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MAY 1955

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

Back issues of ELECTRONI DESIGN, when available, ma be obtained at a charge o $1.00 per copy.

ELECTRONIC DESIGN

Vol. 3, No. 5
May 1955

Contents

ABPA

ELECTRONIC DESIGN is published monthly by Hayden Publishing Company, Inc. at 19 E. 62nd Street, New York 21, N. Y., T. Richard Gascoigne, President; James S. Mulholland, Jr., Vice-President & Treasurer, and Ralph E. Marson, Secretary. Printed at Publishers Printing Company, New York, N. Y., ELECTRONIC DESIGN is circulated monthly without charge to men in the electronic industries who are responsible for the design and specification of manufactured devices, including development and design men of consulting laboratories and government agencies. Acceptance under section 34.64 P. L. & R. authorized. NBP

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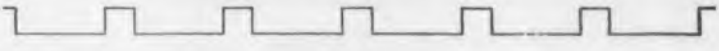

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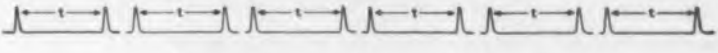

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Despite its small size, this switch is extremely rugged and has been designed to withstand all types of field service. Coin silver contacts, rotors and slip rings are provided for low and uniform contact resistance and excellent electrical characteristics. Ceramic parts are silicone impregnated to function under extreme humidity. Sturdy solder terminals are supplied for wiring.

Single pole style has 18 shorting type contact positions available. 2 or 3 pole types may also be obtained. Several sections may be "ganged" by adding supplementary wafers. Flash-over voltage at 60 cycles is 1000 volts peak . . . current carrying capacity is 2 amperes.

This sturdy, high-quality switch is precision produced . . . will give years of service in fine commercial and military equipment. DAVEN's expert engineering staff is at your service for help with special problems or orders to your specifications. Write today for further information.

Editorial

Stockpiling Security

We hear a lot these days about "stockpiling for security". We have a sizeable stockpile of nuclear bombs. Certain strategic materials are being stockpiled. Recently, the Department of Defense announced that we will stockpile finished machine tool equipment and among other things, vacuum tubes.

We realize the necessity for these actions but they do give rise to a number of important questions. How much material and equipment should we stockpile? How far can we go in this direction without stifling creativeness because we must design equipment around what we have stockpiled? Do we not run into the danger of obsolescence if we rely too much on stockpiling—especially when it comes to finished equipment! There is also the danger of building a kind of "technical Maginot line" which would give us a false sense of security.

Naturally we could err by not stockpiling anything at all. Tubes are an especially critical item, and certain standard test equipment could probably be stockpiled to some advantage.

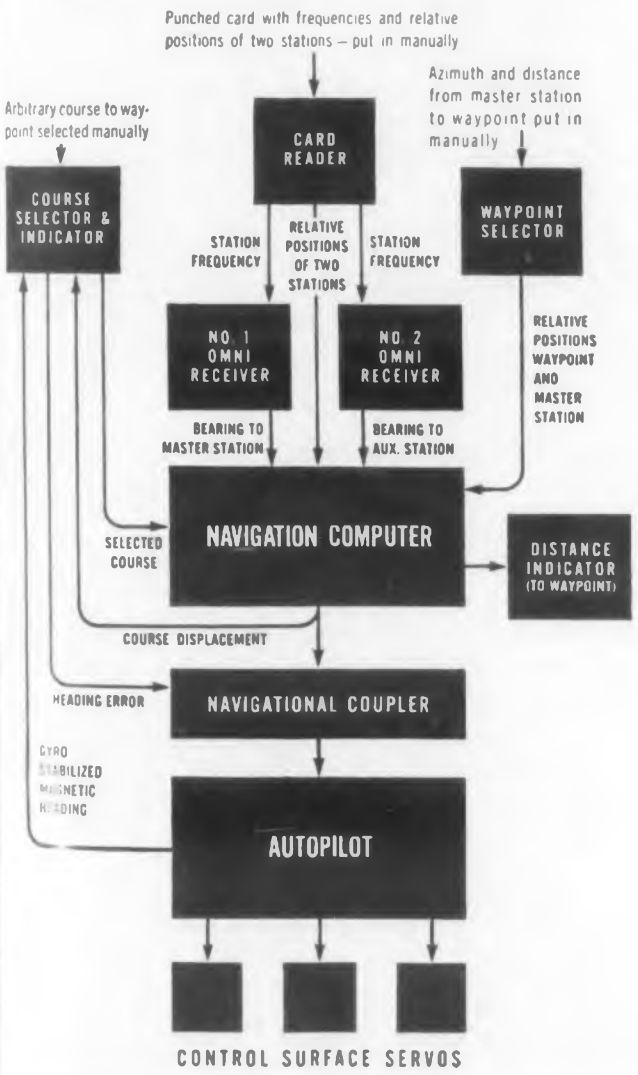
But let's proceed carefully, fully cognizant of the dangers involved. Our best defense insurance lies in having a flexible productive capacity and men who know how to use it to the greatest advantage. Let's do everything we can to "stockpile" that most important and irreplaceable commodity—trained technical manpower.

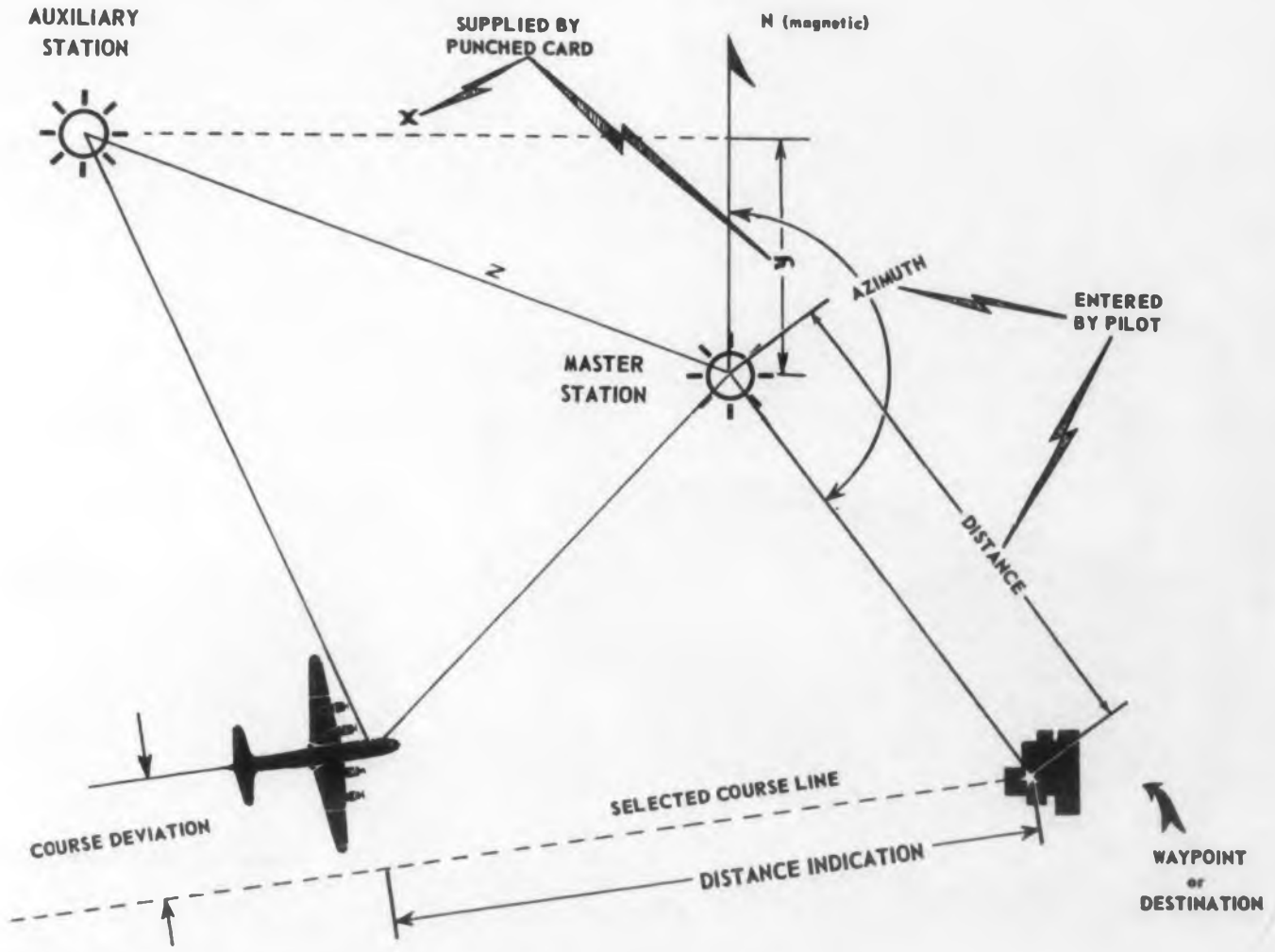
Engineering Review . . .

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

Computer Flies Plane . . . A system for automatically flying a plane to a destination that does not have a radio beacon has been developed. As illustrated, a computer feeds the proper directional signals into a standard autopilot by electronically triangulating two v-h-f omnidirectional range stations. The location of the destinations and the frequencies of the range stations are initially inserted into the computer by a punched-card reader.

The automatic navigation system is being installed in Learstar twin-engine transports, manufactured by Lear, Inc., 3171 S. Bundy Dr., Santa Monica, Calif. The computer is an NC-101 radio-navigation waypoint computer made by Collins Radio Co., Cedar Rapids, Iowa. Any destination can be selected that is within range of radio-navigation ground facilities. There need not be a radio facility of any kind at the destination. The autopilot is a Lear F-5.





The block diagram at the left shows how the computer flies the plane on its course without requiring a radio beacon at the destination.

Dry High-Vacuum Pump . . . A new type of "dry" high-vacuum pump employs evaporating titanium and ion pumping (*ED, June, 1954, pp. 10-11*) to remove gas molecules. Developed to evacuate large-high-voltage particle accelerators, the pump will be made in smaller versions for evacuating power electron tubes, picture tubes, large X-ray tubes, and mass spectrometers.

The pump was invented by Prof. Ray Herb, Univ. of Wisconsin Physics Dept. It will be made by Consolidated Vacuum Corp., 1775 Mt. Read Blvd., Rochester 3, N. Y., under a licensing agreement with Wisconsin Alumni Research Foundation. The pump, which has no moving parts, will be marketed under the name of "Evapor-Ion".

Radar Monitor . . . Operating with any search radar, a newly developed device provides visual and audio alarms whenever a pip appears in a predetermined zone. The device would be especially valuable for merchant vessels that do not have many men on watch or at small airports. It is called "Raytector".

Developed by Miller Associates, Lakeville, Conn., the instrument includes alarms to indicate failure of either the radar or the Raytector. In the event of such a failure, built-in simulated radar signals can be employed to localize trouble in either equipment.

Atomic-Powered Merchantman . . . In his recent nation-wide address the president revealed that an atomic-powered merchant vessel would be constructed as part of a program to develop peace-time uses for atomic energy. If a number of such vessels are constructed, the market for electronic radiation-detecting and reactor control devices would be greatly extended.

Another possible extension of uses for atomic power plants would be in power station barges such as are presently in use in many parts of the world to supply power to disaster areas or where a temporary power shortage exists. Once an atomic power barge is towed to its destination, it would not have to be supplied with fuel.

Phone Capacity Tripled . . . A new military phone system that can handle three times as many conversations over a single wire as comparable Korean and Second World War systems has been developed for the Signal Corps. Recently developed miniaturized parts are credited with reducing the weight and size of the new equipment.

Basic equipment for the new system is contained in units about the size of large suitcases which can be handled by only one or two men. These units are designed to be stacked. The equipment was developed by Bell Telephone Laboratories, 463 West St., New York 14, N. Y., and is being manufactured by Western Electric Co., Kearny, N. J.

The system, providing for 12 simultaneous conversations, can be used for distances up to 200 miles. Another new 4-channel system can be employed up 100 miles. Several of these wire systems linked together can form a communications system of about 1000 miles. They can also be operated in conjunction with a new radio relay system developed at the Laboratories. The cables for these systems can be strung on poles, laid on the ground, or buried.

Complete with its power supply, the new 4-channel unit weighs 178 lb and occupies only 5-1/2 cubic feet. The earlier 4-channel unit weighed 474 lb and occupied 20 cubic feet. Important new features facilitate testing and maintenance while all regular channels are in service. A portable test set provided with the 12-channel system contains a transistor oscillator.

Automatic Production of Printed Circuits . . . An automatic system for producing printed circuits under development for some time *(ED, Sept. 1954, p. 12)*, has now been placed in limited production. The system developed by United Shoe Machinery Corp., Boston, Mass., utilizes components mounted on parallel belts. The components are inserted in previously prepared printed circuit boards by special insertion heads. Since the first announcement of this system last year, insertion heads for tube sockets and transformers and an automatic dip soldering machine have been developed.

Small-Craft Radar

Revealing objects from 20 miles down to 25 yards, this inexpensive radar is designed for use by small craft. Made by Edo Corp., College Point, N. Y., the X-band equipment features a slotted waveguide antenna. On the 2-mile range, two objects on the same bearing may be differentiated if they are as close as 30 yards.

New Magnetic Material . . . A newly developed magnetic material has a coercive force of 3800 oersteds. Known as "Bismanol", the material, which is not available commerically, is made of compacted particles of manganese bismuthide. The material has been used to reduce the weight of a traveling wave tube from over 100 lb to 3-1/2 lb.

Bismanol was developed at the Naval Ordnance Laboratory, Silver Springs, Md., by Edward Adams, William M. Hubbard, and Albert M. Syeles. Magnets made from this material show a field stability of ±5 gauss at temperatures ranging from −67 to +250°F. It has a very high flux density in magnets where the length-to-diameter ratio is one or less. In the traveling-wave tube the Bismanol magnets replaced a heavy copper-wire solenoid whose function is to prevent diffusion of the electron beam moving in the helix.

"So far so good. From here on, it's engineering's baby."

Bacteria Counter . . . An electronic device that can count a variety of objects from bacteria colonies to nuts and bolts has been demonstrated. The counter employs a special cathode-ray tube with a 1000-line raster, about twice the resolution of the standard TV camera tube.

Known as the "Iconumerator", the instrument was developed by Allen B. Du Mont Laboratories, 760 Bloomfield Ave., Clifton, N. J. The count, which can go up to one million, is indicated on an electrical tote board in digits. The instrument can also feed the results to a printing device.

Objects to be counted are placed in a compartment in front of the tube. The tube scans the compartment line by line. The light from the scanning spot is passed through a lens system to a photocell. The electrical signal from the photocell is passed through special circuits that correct deficiencies in the lens and then to a computer. The computer determines the count.

The unit will count irregularly shaped objects correctly. For example, a penny and a doughnut are counted as two objects. If the penny is placed in the hole of the doughnut, the count is still two. Even objects that overlap may be counted as individual units. The Iconumerator was built for the specific purpose of counting bacteria colonies in a Petrie dish.

Weather Map Reproducer

Continuous transmission of weather maps and other pictorial matter is possible with this device. It holds 100' rolls of electrosensitive paper, and it is made by Alden Electronic and Impulse Recording Equipment Co., Westboro, Mass.

Holes Punched in Printed Circuits Automatically . . . A machine that punches holes in a printed circuit board automatically according to instructions from a control tape has been developed. The costs of setting up the machine to punch out a specific board are a small fraction of tooling costs by the punch-and-die or drill methods. Set-up time is only about four hours.

The machine punches any pre-selected combination of holes in a 6″ x 17.6″ board in 45 sec. It will punch 60 boards of this size in one hour, including loading and unloading time. Holes are punched anywhere in 1/16″ or 1/32″ thick boards at 0.10″ grid intersections. Known as the "Programmed Punching Machine", it was developed by Radio Corp. of America, Engineering Products Div., Camden 2, N. J. The machine offers considerable savings on short runs. It only requires one semi-skilled operator. It weighs 1500 lb.

Molten-Salt Semiconductor . . . Recent metallurgical research has discovered that molten copper sulphide conducts electronically like a semiconductor rather than ionically as expected. Althuogh electronic conduction effects have been noted previously in molten ferric sulphide, that salt displays a negative temperature coefficient of conductivity. Like solid semiconductors, the molten Cu_2S has a positive coefficient.

The discovery was made by Drs. Gerhard Derge and G. M. Pound, metallurgists associated with the Metals Research Laboratory, Carnegie Institute of Technology, Pittsburgh 13, Pa. They were examining the electrical character of many melts using a four-terminal cell and an a-c potentiometer circuit to measure liquid conductivity. The conductivity of Cu_2S was more than ten times that expected from ordinary ionic conduction. When they passed direct current through the liquid, they noted virtually no transfer of mass, indicating no appreciable ionic contribution to conductance.

Molten iron sulphide was also tested and found to conduct about ten times better than molten Cu_2S, but it has a negative cofficient, like metals. The conductivities of mattes made by mixing these two salts together approach the rule of mixtures behavior.

Existing theories on the nature of semiconduction cannot account for the new discovery since they apply exclusively to solids such as the transistor and not to liquids where the atoms are in a state of disorder.

The purpose of this research is to discover more about the nature of metal salts and refining and smelting processes and perhaps to improve these processes. Although this research may lead to a greater insight into the nature of semiconductors it is not likely to lead to any practical new semiconductors.

Mobile Laboratory . . . A completely equipped instrumentation laboratory has been constructed in a 28′ trailer van for use on projects where it is impractical to move equipment or material to a fixed laboratory. The laboratory can measure and record 22 simultaneously occurring phenomena.

Constructed for the Armour Research Foundation, Illinois Institute of Technology, Chicago, Ill., and outfitted by the foundation's mechanism and dynamics research engineers, the laboratory is equipped to measure and record pressure, stress, strain, thrust, torque, acceleration, velocity, temperature, and many other mechanical phenomena. It also includes a photographic darkroom.

Since it has its own 5kw gasoline generator, the trailer can be used in locations where commercial power is not available. Fully insulated, it carries an automatic propane gas heater and a 3/4-ton air conditioner.

The laboratory carries a 4-channel cathode-ray oscilloscope in a specially constructed shock mount.

Long Quartz Delay . . . The solid fused quartz delay line illustrated on this page produces a delay of 4100-microsec in a radar. This delay is equivalent to more than 300 nautical miles of radar range.

The unit was developed by Anderson Laboratories, Inc., 39 Talcott Rd., West Hartford, Conn. The carrier frequency is 8Mc, with a bandwidth of 2Mc. Attenuation is 56db when terminated by a tuned 100-ohm load. The spurious response ratio is 40db. The manufacturer reports that units of longer delay and higher carrier frequency are possible.

This fused quartz delay line is mounted in a 18-1/2" diam x 1-1/2" deep enclosure.

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Solar-Atomic Battery . . . Activated interchangeably by either light or radioactivity, a newly developed semiconductor battery produces enough power to operate a special low-drain transistor radio. A previously announced germanium solar battery (*ED, May, 1954, p. 5*) was activated by light only, while various batteries that convert atomic radiation into electric power have been developed (*Sept., 1954, p. 5, and November, 1954, p. 5*).

The new battery was developed at the David Sarnoff Research Center, Radio Corp. of America, Princeton, N. J., by a research team including Dr. Ernest G. Linder, Paul Rappaport, and Dr. J. J. Loferski. Like this firm's previously announced experimental atomic battery (*ED, February, 1954, p. 15*), the battery derives its power from a semiconductor junction exposed to radiation. In both batteries, the beta-particle source is strontium-90. The junction is about 1/4" in diameter and 1/100" thick.

Twelve of the units in parallel provide 10μw to operate a radio consisting of a diode detector and three transistors. The radio picked up a nearby commercial station.

Train Reservations Memorized . . . In another application of electronics to railroading, a magnetic drum memory will be employed to keep track of 100,000 reservations per month. Installed at Stamford, Conn., along with an attendant computer, the reservation control will be tied by telegraph lines to both ends of the New Haven Railroad at New York and Boston as well as to New Haven, Hartford, and Providence. Agents will be able to tell customers within seconds if the space they desire is available. If the space is sold, the computer changes the memory accordingly.

The installation, to be known as the "Magnetronic Reservisor System" will be constructed by Teleregister Corp., Stamford, Conn. The same firm has already constructed similar systems for use in making airline reservations and in warehouse inven-

◀ CIRCLE ED-7 ON READER-SERVICE CARD

tory. A special feature of the system is its ability to determine on demand if adjacent space is available.

In addition to using much electronic communications equipment, the nation's railroads have recently purchased an electronic freight yard master and an electronic device that sends train tickets by facsimile (*ED, February, 1955, p. 5*).

Automatic Warehouse . . . An electromechanically controlled order-filling system has been installed in a warehouse that handles 6 million blouses a year. As cartons of blouses leave the warehouse, they are checked off on an electromagnetic memory that maintains inventory records.

The system was designed by Dasol Corp., 118 E. 28th St., New York City, for the Manhattan warehouse of Judy Bond, Inc., 1375 Broadway, New York 18, N. Y., a blouse manufacturer. The automatic system has increased the warehouse's capacity by 100% while reducing direct labor by 66%. No punched cards are used in the system.

Die-Casting Standards . . . A group of standards for specifying die castings is being prepared by the American Die Casting Institute, Inc., 336 Madison Ave., New York 17, N. Y. It is hoped that these standards for all dimensions of castings will lead to savings by avoiding over-specification. The Institute is the national association of job shop die casters.

Glass Bulbs for Color Picture Tubes . . . A 22" rectangular glass bulb for color TV picture tubes has been developed and is being shipped in sample quantities. Made by Corning Glass Works, Corning, N. Y., the bulb is designed for shadow-mask tubes. It is constructed so that the mask can be mounted by either of the two methods now in use—the flat band or the pin method. The same firm has also developed a 21" round glass tube for color TV.

CIRCLE ED-8 ON READER-SERVICE CARD ➤

Transistor Auto Radio . . . An experimental auto radio incorporating nine transistors has been developed. Operating directly from a 6v car battery, it drains about one-tenth the power required by a conventional radio. More than one-half the power is drawn by the radio's two pilot lights.

The transistor radio was developed at the David Sarnoff Research Center, Radio Corp. of America, Princeton, N. J., by a research group including Larry A. Freedman, Thomas O. Stanley, and David D. Holmes. If ever placed on the market, such a radio would offer the advantages of lowered battery drain, less heat inside the car, and lessen the danger of battery failure due to the driver forgetting to shut his radio when he parks. This radio has performed satisfactorily at temperatures from —90°F to 176°F.

Engine Analyzer . . . By connecting only two leads to an auto engine's ignition system, a recently developed electronic device can be used to detect as many as 65 different engine faults. Faults are rapidly identified by interpretation of the display on a built-in oscilloscope.

Since the analyzer can be powered by the car's battery, the engine's performance can be studied while the car is in motion. It can also be connected to a 110v a-c source. A set of blown-up photographs of typical scope displays are supplied with the instrument to enable a mechanic to utilize it with only a little instruction.

Developed in the research laboratories of Socony-Vacuum Oil Co., Inc., 26 Broadway, New York 4, N. Y., the analyzer will be manufactured and marketed by Allen B. Du Mont Laboratories, Inc., 760 Bloomfield Ave., Clifton, N. J.

In an experiment the analyzer proved that only five out of 25 cars chosen at random were in top running condition. Devices like the analyzer have already been used to study the perofrmance of aircraft engines.

◀ CIRCLE ED-9 ON READER-SERVICE CARD

Crystal Spectrometer . . . In order to overcome the handicap of dealing with a multitude of photon energies with inefficient detectors, the National Bureau of Standards, Washington 25, D. C., has developed a crystal spectrometer having a photon-detection efficiency exceeding 80% and an energy resolution of 11% in the range from 0.5 to 50Mev. The heart of this spectrometer are two large sodium - iodide, thallium - activated crystals 4" long x 5" diam.

The dissipation of the energy of an individual photon in such crystals produces a visible light pulse that is detected and measured by photomultiplier tubes. The total light output is proportional to the total energy absorbed. The development of this spectrometer has provided an approach to many experimental research problems that were formerly considered impossible of attack because of the low detection energy of available instruments.

Computers Aid Plane Design . . . Electronic computers have invaded the aircraft industry on a large scale. Three of the nation's biggest manufacturers of air planes have leased large-size digital computers to aid in the design and evaluation of new types of planes, while a fourth concern has developed its own data-reduction device.

Both Lockheed Aircraft Corp., Marietta, Ga., and Bell Aircraft Corp., Buffalo, N. Y., have leased type 650 Magnetic Drum Data Processing Machines from International Business Machines Corp., 590 Madison Ave., New York 22, N. Y. Convair, San Diego, Calif., has leased a Remington-Rand Univac Scientific ERA-1103. Analog Computers are already in service at Convair's San Diego and Pomona, Calif., installations, and another large digital computer had previously been installed at Convair's Fort Worth, Texas, division.

Chance Vought Aircraft, Dallas, Texas, has constructed its own electronic telemetering and automatic data reduction facility. Data from planes under test is recorded on three magnetic tape recorders.

CIRCLE ED-10 ON READER-SERVICE CARD ➤

Summer Schools

The following courses are being offered during the coming summer. They are all on the advanced or graduate level. Where available, the name of the person to write to for more information and registration and application dates are given.

Columbia Univ., New York, N. Y. Thomas C. Izard. Registration from June 30-July 1.

Engineering s205, Application of the Laplace Transformation to Engineering Problems.
EE s270, Information Theory.

Manhattan College, Riverdale, New York 71, N. Y. Brother A. Leo. Registration July 6.

July 8-August 19: Mathematics 59.5, Higher Mathematics for Engineers.

Polytechnic Institute of Brooklyn, 99 Livingston St., Brooklyn 1, N. Y. Prof. A. B. Giordano. Registration from May 30-June 3.

June 6-July 27: 4600, Techniques in Microwave Measurements.

Massachusetts Institute of Technology, Cambridge 39, Mass. Prof. Ernest H. Huntress.

June 14-24: 2.439, Industrial Applications of Heat Transfer to Electronics.
June 20-July 1: 2.739, Creative Engineering and Product Design.
6.569, Switching Circuits.
M419, Numerical Analysis.
July 18-29: 6.628. Noise in Electron Devices
August 22-September 2: 6.601, Numerical Control of Machine Tools.

Univ. of Illinois, College of Enginering, Urbana Ill. Prof. G. H. Fett. Registration deadline June 1

June 20-August 13:
Servomechanisms and Automatic Control Devices.
Electric and Magnetic Fields.
Electromagnetic Waves and Radiating Systems.
Advanced Communication Networks.
Vacuum Tube Circuit Analysis.

State Univ. of Iowa, Iowa City. Ted H. McCarrel. Applications to June 14. Registration begins June 14

June 15-August 10:
55:100 Elements of Applied Electronics
55:101 Applied Electronics Laboratory.
55:151 Industrial Electronics.
55:213 Advanced Engineering Problems.
55:241 Electrical Research.

Univ. of Texas, Austin 12, Texas. A. W. Straiton

June 7-August 30: EE 392K. Antenna Theory and Practice.

Univ. of Michigan, College of Engineering, Ann Arbor, Mich. S. S. Attwood.

Regular Summer Session: June 17 to August 13.
EE 100, Circuits II.
EE 121, Radio Communications II.
EE 210, Electromagnetic Field Theory.
EE 283, Physical Electronics.
July 5-29: Transistor Application Symposium. Registration July 5. Application deadline June 1.
EE 401, Fundamental Physical Properties of Transistors, and Pulse and Switching Applications.
EE 402 Transistor Circuit Principles, and Applications for Continuous-Operation Service.
Special Short Courses
Digital Computation Dept., Willow Run Research Center, Univ. of Michigan, Ypsilanti, Mich. Dr. John W. Carr III, application deadline June 1.
August 1-12: Digital Computers and Data Processors. At Ann Arbor. Prof. Donald L. Katz, 2028 East Engineering Building, Ann Arbor, Mich.
Automatic Control, Course I: June 13-18. Course II: June 20-22.

Oklahoma Institute of Technology, Oklahoma A & M., Stillwater, Okla. Write to Prof. C. F. Cameron, School of Electrical Engineering.

June 6-August 6. Application deadline June 6.
EE 403, Electrical Transients: Transient behavior of electrical power and communication networks.
EE 510, Seminar: To acquaint students with the literature of electrical engineering, particularly of recent times.
EE 560, Engineering Mathematical Physics, Part II: Basic principles, including switching algebra, governing the intercommunication of two-valued switching elements to form networks and systems for automatic control and digital computers.
EE 570, Advanced Analysis of Electrical Engineering Problems: Study of electromagnetic relays including an introduction to relay design.
(Either EE 560 or EE 570 will be offered, not both. Choice will be governed by demand. A choice of several advanced mathematic courses will also be available).

Pennsylvania State Univ., University Park, Pa. Reed Ferguson, General Extension Building.

June 27-July 2: Creative Engineering.
August 1-12: Technical Report Writing Workshop.

Northwestern Univ., Evanston, Ill. Dr. J. A. M. Lyon, Chairman, Dept. of Electrical Engineering, Application deadline June 4.

June 21-September 3.
EE 550, Nonlinear Electron-Tube Circuits.
EE 612, Operation Circuit Analysis.


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Simulates Houses in All Climates . . . An electronic simulator that can simulate a house's environment anywhere in the world and analyze its reactions to any kind of weather has been developed by Minneapolis-Honeywell Regulator Co., 2954 Fourth Ave., Minneapolis, Minn. The device is expected to shorten by as much as five years the time now required for testing home heating and air conditioning equipment and home building materials.

The simulator not only can duplicate the thermal characteristics of a house—complete to the effects of such factors as storm windows and insulation—but it can surround the house with any type of weather conditions desired. The complete life span of a house can be simulated in a matter of minutes.

The unit will be mainly used in developing improved heating and air conditioning controls. It also will be utilized to learn new things about home construction and in studying the effects of various climatic factors involved in human comfort as well as other research work.

Nuclear Reactor . . . A 10,000kw nuclear materials test reactor will be constructed by the Westinghouse Electric Corp. at Blairsville, Pa. Highly enriched uranium will be the power source and water will be employed as the moderator and coolant. The reactor will be housed inside a vapor-tight steel shell. To be utilized by Westinghouse for experimental purposes, the reactor is to cost $6,500,000. It will be the first element of a "reactor center". A laboratory will be constructed near the reactor.

Nominations Solicited for Award . . . Nominations for 1954's outstanding young electrical engineer are being solicited by Eta Kappa Nu from all accredited colleges, AIEE and IRE sections and employers of electrical engineers.

Candidates do not have to be members of Eta Kappa Nu, but must be

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CIRCLE

under 35 and have baccalaureate degrees in electrical engineering from colleges in the United States and Canada within ten years prior to May 1, 1955. Awards are made on the basis of social and civic accomplishment as well as technical achievements.

Nomination forms may be obtained from A. B. Zerby, executive secretary, Eta Kappa Nu Association, P. O. Drawer C, Dillsburg, Pa. Nominations must be returned to Mr. Zerby not later than May 31, 1955.

TV Receiver Sales Up . . . Retail sales of TV receivers in 1954 increased by nearly one million units from the level of 1953, according to the Radio-Electronics-Television Manufacturers Association, 777 14th St., N. W., Washington 5, D. C. For the year, 7,317,034 receivers were sold at retail compared with 6,370,571 sets sold in 1953.

Retail sales of radios, excluding automobile receivers, totaled 6,430,743 units during the year compared with 7,031,293 sets sold in 1953. In addition to the home, clock, and portable radios sold at retail, an additional 4.1 million auto radios were manufactured during the year.

Methods Improvement Competition . . . Entries are now being accepted for the Fifth Annual Methods Improvement Competition sponsored by the Industrial Management Society. The competition is to be in conjunction with the 19th Annual Time and Motion Study and Management Clinic scheduled for Nov. 9-11, 1955 at the Hotel Sherman, Chicago, Ill.

Industrial plants and companies are invited to submit 16mm motion picture films showing the "before" and "after" phases of methods improvements made in their manufacturing, processing, or office operations. The competition is divided into two sections—for companies over 1000 and those under 1000 employees.

Rules and regulations for the contest may be obtained from the Society, 35 E. Wacker Drive, Chicago 1, Ill.

Automatic Zone Melter . . . An automatic zone melting apparatus has been developed at the National Bureau of Standards, Washington 25, D. C. The zone melting process is widely used to purify semiconductor materials or to produce semiconductor compounds (*ED, March, 1954, p. 5*). In the Bureau's device, the induction heating coils are driven by a motor along the length of the melting tube and returned automatically to the starting position for a new run.

The heating coils are not shut off on the return path because the coils move too fast to melt the semiconductor inside the tube. The Bureau's zone melter is now being used to produce a series of intermetallic compounds formed between the metal antimony and the metals indium, gallium, or aluminum.

Another Work-Study Program . . . Advanced degrees in electronics engineering at Stanford University are available to electrical engineering graduates on a work-study basis through the Honors Cooperative Program of Stanford University in cooperation with Ampex Corp.

Further information and applications may be secured from the Manager, Personnel Dept., Ampex Corp., 934 Charter St., Redwood City, Calif.

Color Wheel Used in Russian Color TV . . . The discarded field sequential color TV system, which requires a rotating mechanical color wheel, is reported to be in use in Russia. According to the *Du Mont Dispatch*, published by Allen B. Du Mont Laboratories, Inc., New York, N. Y., experimental live and film color TV broadcasts are being transmitted from a studio in Southwest Moscow.

Electronic Inventory Control . . . An electronic inventory control system will be installed at the B. F. Goodrich Footwear & Flooring Plant, Watertown, Mass. The "Magnetronic" inventory system was made by Teleregister Corp., Stamford, Conn.

Radio Amateur's Course . . . Sales of communication equipment to amateurs should be stimulated by the availability of a new course for amateurs. The Radio - Electronics - Television Manufacturers Association, 777 14th St., N. W., Washington 5, D. C. is offering a course teaching the international code by records, and explaining how to construct a two-way station.

Electronic Doorman . . . A reader has proposed an electronic doorman for apartment houses incorporating a closed-circuit TV system. The system would consist of a TV camera trained on the entrance way with monitors in each apartment. A person desiring to enter the building could be viewed in the monitor by the tenant whose bell he rings.

If such a system came into widespread use, it might have an adverse effect on the size of broadcast TV audiences. Housewives might spend all their time at the monitors observing the people visiting their neighbors.

Portable X-ray . . . Another use for radioactive materials has been found in the development of a portable X-ray unit. By using thulium-170 as the source of X-rays, no electrical power source is required. The unit weighs 20 lb.

Known as the "Iso-X", the unit is manufactured by Litton Industries, 336 N. Foothill Rd., Beverly Hills, Calif. The radiation from the unit is low enough to permit an operator to remain near it without exceeding the minimum tolerance dose. Since the half-life of thulium-170 is 129 days, the time needed for producing a negative increases as the source decays.

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

Address brief requests to Information Dept., ELECTRONIC DESIGN, 19 E. 62nd St., New York 21, N. Y.

CIRCLE ED-16 ON READER-SERVICE CARD ➤

Single Tube for 3 Colors . . . A new developmental TV camera tube is able to generate red, green, and blue signals simultaneously. The present color camera required a separate tube for each color, with the three signals combined into a single signal. By generating all the colors simultaneously in one tube, the problem of overlapping or fringing of color signals is eliminated. In addition, the color camera can be more compact.

Known as the "Tricolor Vidicon", the tube is under development at the David Sarnoff Research Center, Radio Corp. of America, Princeton, N. J., by a group including Dr. Paul K. Weimer, Dr. Sidney Gray, Dr. Stefan A. Ochs, Harold Borkan, and Harry C. Thompson. It is the same size as present color camera tubes.

The heart of the tube is an intricate color-sensitive target applied to the face of the tube by an evaporation technique. The target is a rectangle whose diagonal measurement is 1-1/2". It consists of nearly 900 fine vertical strips of alternating red, green, and blue color filters, covered by three sets of semi-transparent, closely spaced, conducting signal strips. The signal strips corresponding to a given color are all connected to a common output terminal and insulated at the same time from the strips of the other two colors.

The target is scanned by a single electron beam. The color-sensitive filters permit the signal strips to produce electrical signals corresponding to the arrangement of light and color in the scene before the camera.

Current research on the Tricolor Vidicon is concentrated on the development of more sensitive photoconductive materials that will permit this tube to operate as efficiently under all lighting conditions as present camera tubes.

Eight-Hour Records . . . Recording on endless reels of vinyl tape, a new European recording system offers up to 8 hr of uninterrupted music. Like ordinary records, the tape is grooved and the pickup is a metal stylus similar to a needle. The 1/2" wide reels are housed in plastic boxes called "sound books". A special playback unit, illustrated above, is required.

Although this recording system has been marketed on the Continent for four years by Tefifon, Cologne, Germany, it is being introduced in this country for the first time by Audio-Master Corp., 17 E. 45th St., New York, N. Y. It has been under development for the last 15 years. To play one of the books, it is placed on a spindle projecting from the top of the playback equipment. The spindle mates with grooves in the reel. A little transparent plastic window is then opened in the book and loop vinyl tape is pulled out and slipped over the friction-drive wheels. The drive wheels are turned on and the stylus is

A Tefifon "sound book" is being mounted on the playback unit. Each book contains up to 600' of vinyl tape for eight hours of uninterrupted playing.

moved into position against the tape. The tape moves at two speeds: 7-1/2″/sec and 3-3/4″/sec.

There are about 82 grooves in the tape. In playing a complete record, the stylus slowly moves down the 1/2″ width of the tape. The head mounting the stylus is carefully balanced so that the stylus does not wear hard on the bottom of the groove. The tapes have a long life. They are made in much the same manner as ordinary records.

No rewinding of the tapes is necessary, since they revolve inside the book in a figure-eight manner, automatically rewinding. It is possible to approximately choose the portion of the tape by moving the stylus from one groove to another. The greatest advantage of the Tefifon system is in playing long musical pieces or in providing hours of background music. It is not likely to be used for short popular recordings in this country.

Electronic Ranching

By registering the number of times this cow stretches its neck to chew grass, the electronic device strapped to the animal's back will help determine which grasses cattle like best. The unit was developed by Burgess Products, Ltd., Dukes Way, Team Valley, Gateshead, England.

Meetings

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

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

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

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

May 26-27: *Electronic Components Conference*, Ambassador Hotel, Los Angeles, Calif. For information, write to Dr. Lester M. Field, 8820 Bellanca St., Los Angeles, Calif.

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

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

June 13-18: *International Design Conference*, Aspen, Colo. For information, write to E. W. Fairfield, Libbey-Owens-Ford Glass Co., Toledo 3, Ohio.

June 14-16: *Conference and Exhibit on Magnetism*, William Penn Hotel, Pittsburgh, Pa. Sponsored by the AIEE, American Institute of Mining and Metallurgical Engineers, and American Physical Society. For information, write to A. C. Beiler, c/o Westinghouse Electric Corp., 2-F Materials Engineering Dept., E. Pittsburgh, Pa.

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

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

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

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

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

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

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

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

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

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

Design For Automation

By Robert C. White, Staff Engineer
Automation Engineering Laboratory
Greenwich, Conn.

AUTOMATION in the electronics industry has been achieved to a moderate degree, today, by the component manufacturers. Standardized subassemblies are being produced in large quantities by automation techniques by a number of component and equipment manufacturers. To a large degree this automation has been made possible by top level decisions to redesign components to product characteristics which, without affecting the desired performance factors, facilitate mechanical feeding to automatic manufacturing machinery and assembly stations.

The electronic engineer contemplating design for automation will find his problems greatly reduced if he can place himself in the position of the mechanical engineer who is given the job of producing a machine for automatic production. In a great many cases the feasibility of automation hinges on the adaptability of the component parts to hopper feed methods. It is the purpose of this article to discuss the design factors which result in ease of feeding and those factors which are to be avoided wherever and whenever possible.

Early efforts to mechanize electronic manufacturing were concentrated on the development of special machinery. These machines, although of great importance in reducing manufacturing costs, were often limited by the necessity of resorting to hand feeding assisted by various jigs, fixtures, and transfer mechanisms. It was soon recognized that human dexterity and fatigue were the bottleneck in further improvement. As early as 1930 the development of several practical mechanical parts feeders pointed the way to fully automatic operations. In 1948 the introduction of the vibratory parts feeder opened up the possibility of large scale feeding of glass and ceramic parts which were often damaged in earlier mechanical feed units. The important reductions in cost achieved by fully automatic operation were now given a sharp acceleration and the electronic component design engineer found himself faced to an ever-increasing degree with the question from top management, "Will the product lend itself to automation?"

The basic concepts to follow are applicable to all component design where immediate or future automation is to be considered regardless of whether they are made of metal, ceramic, plastic or fibre.

The most common components encountered in electronic assemblying, testing or manufacturing operations are vacuum tubes, dry rectifiers, resistors, capacitors, coil forms and terminal posts. It is these components and their elemental parts which will form the largest challenge to the design engineer in maintaining and increasing the rate at which automation is finding its rightful place in the vigorous expanding electronic industry.

The direct results which must be expected from a consistent awareness of the importance of the "design for feeding" concept are higher production rates, lower costs, improved quality control and a general up-grading of the workers due to elimination of monotonous manual operations and increased need for a larger percentage of technical operator and maintenance personnel.

Hopper Feed

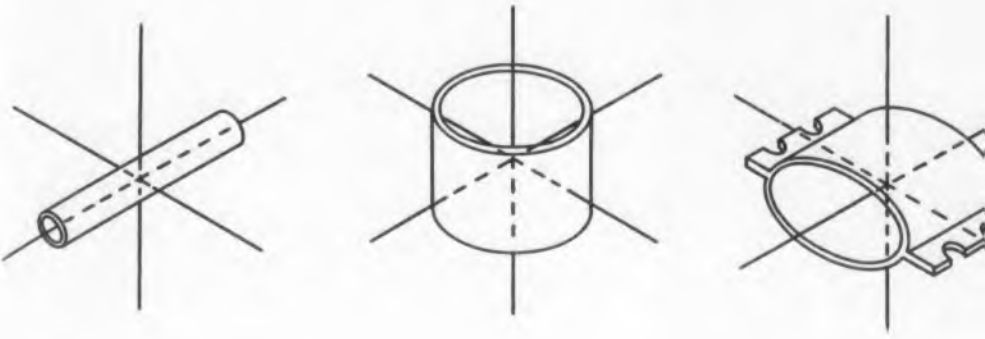
Let us now examine the factors which are of prime importance in designing for automation. The criterion to shoot for is design of parts which can be consistently hopper fed in an oriented position.

Symmetry—In all considerations of symmetrical component design two factors must be emphasized: mass and dimensions.

In most cases it is satisfactory to consider the mass factor simply as the location of the center of gravity of the component. Only in cases where elements of an electronic component are free to change position with respect to one another must a more detailed dynamic study be carried out. The design engineer should establish the location of the center of gravity of each component he develops as a matter of routine if automation methods are to be employed in its application on the production assembly line.

For purposes of this discussion dimensional symmetry shall be defined as symmetry with respect to three axis through the center of gravity. Examples of typical symmetrical components are shown in Fig. 1.

Dissymmetry—If the design of a component requires one or more degrees of dissymmetry it is



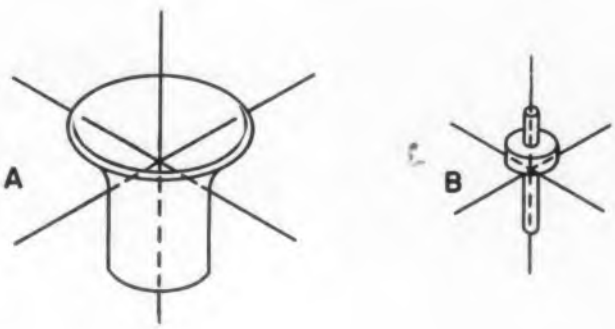


Fig. 2. The parts to the right are externally dissymmetrical in one or more degrees; all can be hopper fed. The extreme right parts, d and e, require special devices for indexing.

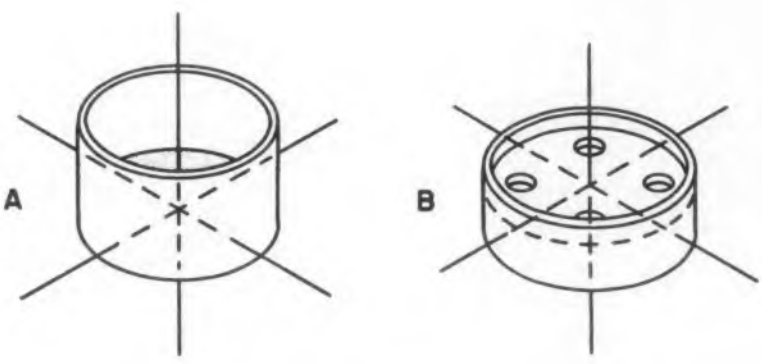


Fig. 4. Parts which are flat and less than 0.020" thick are seldom satisfactory for hopper feed because of difficulty in obtaining single layer feed.

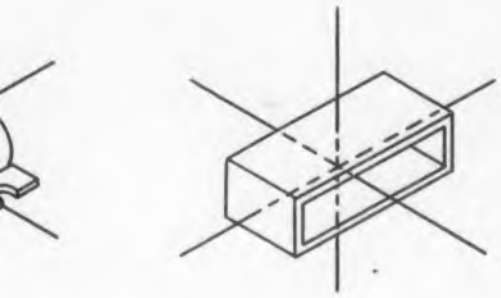
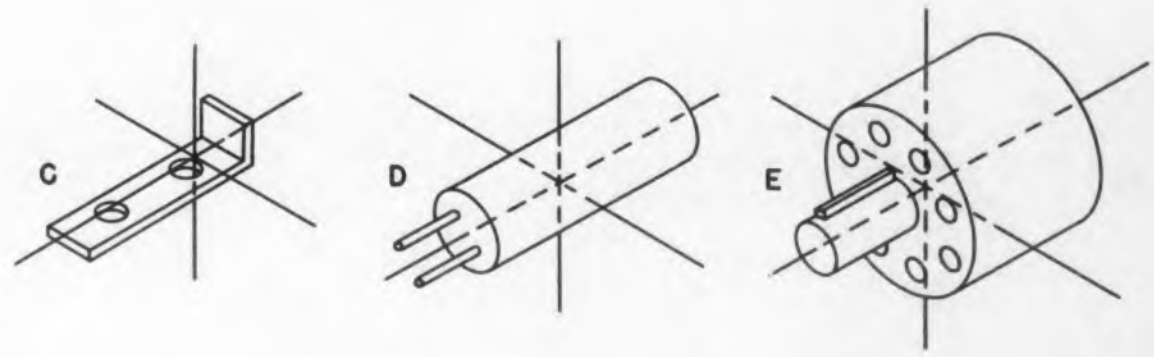


Fig. 1. All of these parts are symmetrical in 3 degrees. They are all simple to hopper feed.



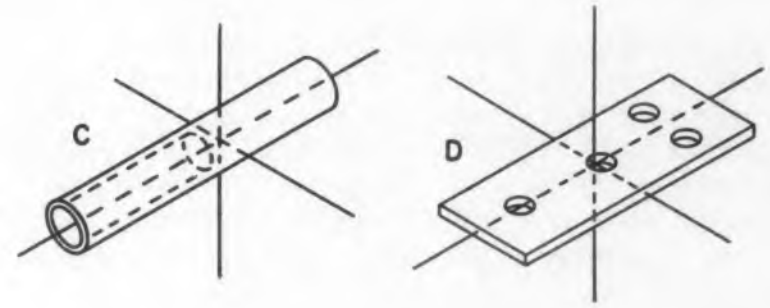
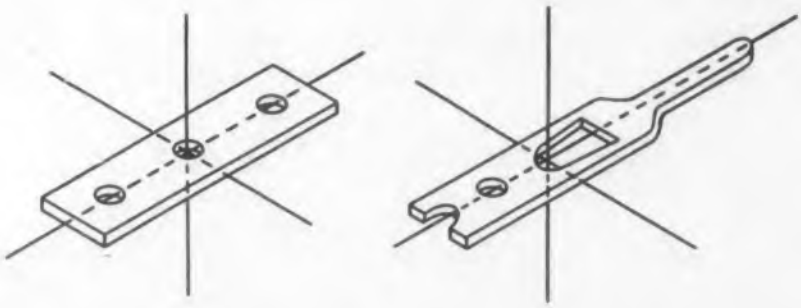


Fig. 3. Internal dissymmetrical parts a and c have a markedly displaced center of gravity and can be readily hopper fed. Parts b and d require mechanical or electric probes or sensing devices.



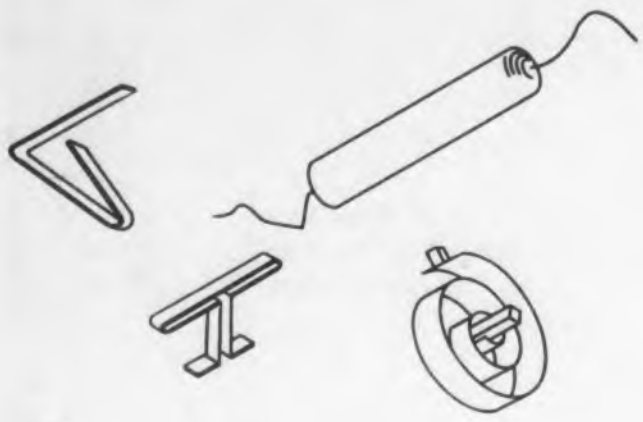


Fig. 5. The parts shown to the left are not adaptable for hopper feed because of interlocking and tangling tendencies.

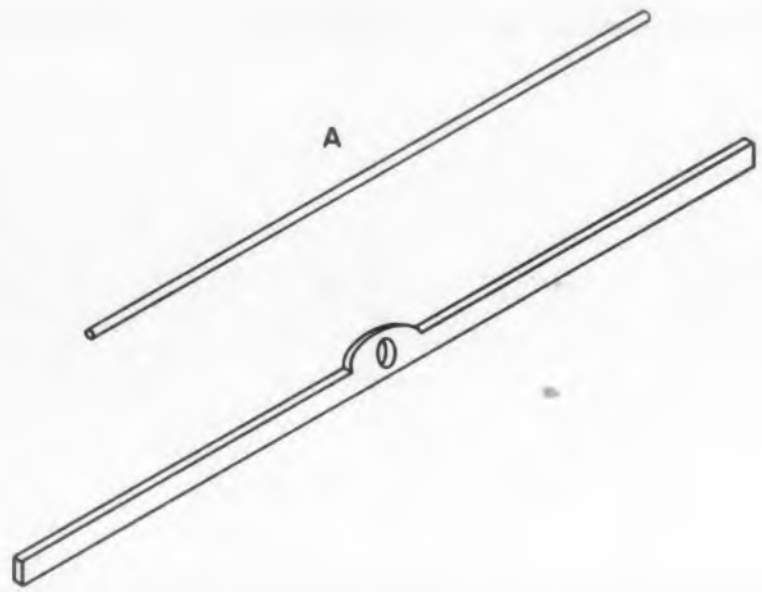


Fig. 6. Long slender parts such as these do not perform well in hopper feeders and should generally be magazine fed.

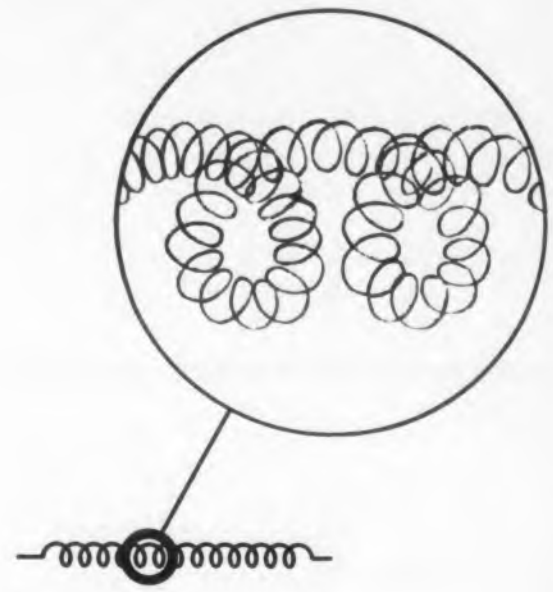


Fig. 7. A coiled filament being extremely flexible is unusually difficult to hopper feed.

important to provide external dissymmetry since automatic feed of such components is generally feasible, Fig. 2.

An electronic component with all degrees of dissymmetry being internal presents a difficult problem for automatic feed. In general mechanical probes or balancing methods of orientation must be employed. Such methods may add tremendously to the complexity and cost of automation. If internal dissymmetry is unavoidable the design engineer should attempt to displace the center of gravity as much as possible from the geometric center. The resulting torque effects may be quite useful in producing oriented feed, Fig. 3.

Shapes to be avoided—The design engineer should constantly be aware of other features which should be avoided whenever possible. For example, do not specify unnecessarily thin cross section of flat pieces. Flat pieces with a thickness of less than 0.020″ are difficult to feed mechanically by standard methods. In cases where thin stock cannot be avoided the engineer should consider incorporation of projections or a rim at right angle to the flat surfaces, Fig. 4.

Parts with shapes that have a strong likelihood of interlocking or tangling into a scrambled mass are Design Enemy No. 1 since more often than not no feasible method of hopper feed can be economically achieved. The standard lead capacitor and resistor falls in this category. It is, however, encouraging that basic redesign of some of these components is now underway, Fig. 5.

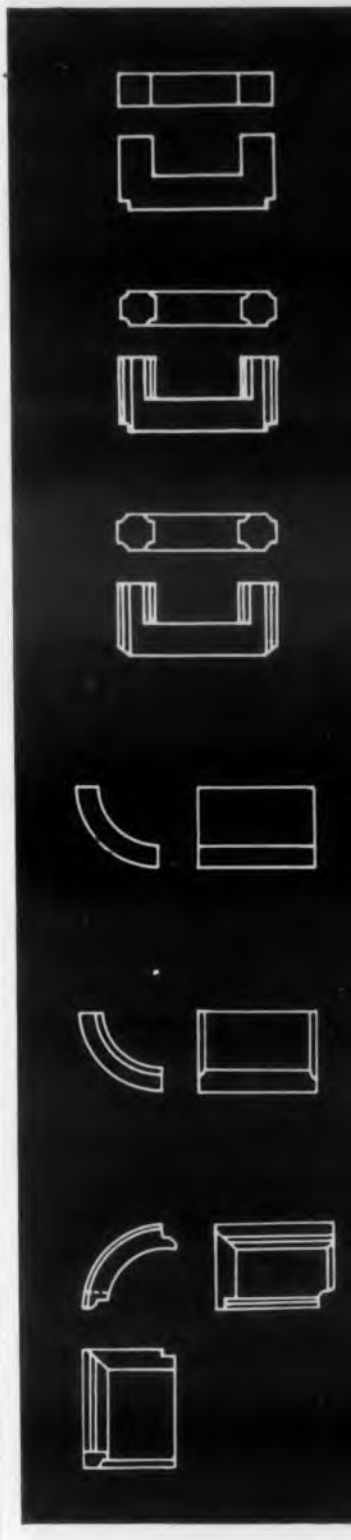
Components or elements of components with slenderness ratios greater than 1:50 are usually very difficult to hopper feed. When this factor cannot be avoided it is necessary to resort to other means than hopper feed, Fig. 6. Alternate types of feed are discussed below.

The most aggravating shapes are those which are highly flexible. An example of this class is the coiled coil tungsten filament, Fig. 7. Although some success has been achieved with vibratory equipment, the feed rate is generally not satisfactory.

Other Types of Feed

Alternate solution if thinness, interlocking, slenderness, and flexibility cannot be avoided are roll, or coil stock, feeding and magazine feeding. In many cases where parts are made from wire or thin flat stock the cut-off or forming operations can be best accomplished by incorporating these operations as an integral part of the assembly operation. Typical cases are the welding of dumet and nickel wire for leads, and the production of terminals in strip form followed by roll feeding the strips to terminal board assembly machines.

In a number of cases it is feasible to magazine parts at the forming operation and use the loaded magazines to feed to subsequent assembly or process operations. This method takes advantage of the oriented position of pieces just prior to discharge



Design To Provide

1. Symmetry of shape and weight distribution with respect to three axis.
2. External dissymmetry in preference to internal dissymmetry.
3. Maximum moment effect around one or more axis where internal dissymmetry is unavoidable.
4. Thickness of .020" or more for flat pieces.
5. Freedom from interlocking or tangling in mass.
6. Slenderness ratio below 1:50.
7. Rigidity of parts in scrambled mass or flow.

Design To Avoid

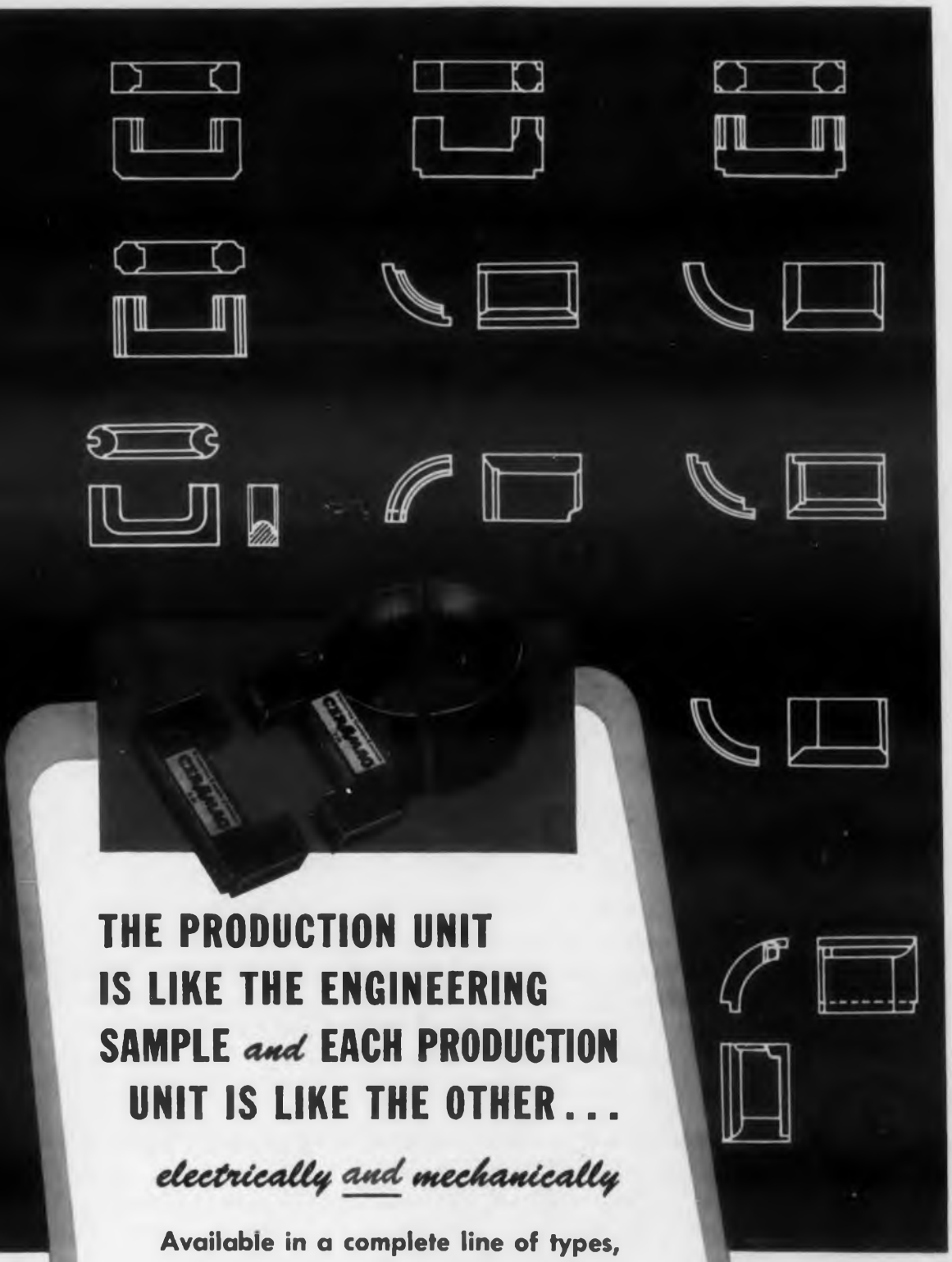
1. Unnecessary dissymmetry of shape and weight distribution.
2. Internal dissymmetry unless resultant movement effect around one or more axis is significant.
3. Thickness less than .020" for flat pieces.
4. Tangling or interlocking characteristics.
5. Slenderness ratio above 1:50.
6. Flexibility of parts in scrambled mass or flow.

from such machines as punch and die presses. The method is particularly applicable to mica parts.

Another example of magazine feeding is the stacking of large plastic terminal boards for slide feed to automatic machines which rivet or stake the terminals in place. In this operation an operator can usually stack the boards in a magazine at 4-5 times the production rate of the terminal staking machine. Hence only 1/4 to 1/5 of the operator's time need be chargeable to the assembly cost. Conversely one operator may service 4 to 5 assembly machines.

Summary

In summary, it is essential to realize that although mechanical design must not subordinate function design, awareness of the points which produce 'automatable' parts may well be the determining factor in the economic success or failure of any electronic component.



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Using Glass in Electronic Designs

I—Properties of Glass

William H. McKnight

Corning Glass Works, Corning, N. Y.

GLASS has had a crucial role in electronic devices since the first vacuum tube was enclosed in a glass bulb. Since designing and working with glass is a highly specialized art, the electronic designer who wishes to utilize glass is simply required to prepare careful specifications for the glass fabricator. The properties of glass of significance to the electronic designer are discussed here. The procedures for specifying glass, including all newer forms of glass such as conductive, photosensitive, metallized, ribbon, and fused silica glass, and parts made by the "Multiform" process are to be given in Part 2.

Properties of Glass

Glasses are fundamentally strong materials. In compression they surpass brick, cast iron, or concrete. (Glasses will withstand pressures that cause most metals to flow.) They never fail in shear, and tensile strengths as high as 2,000,000psi have been recorded.

The absolute strength of a glass is directly related to surface conditions. Thus glasses with extremely high strengths are not usually useable in glass products where the surfaces are scratched or abraded. However, by the proper choice of composition, good design and added finishing treatments, glass products can be made with excellent mechanical strength. A working stress of 4000psi with adequate safety factors can be attained with tempered commercial glasses. Since glass does not flow before failure, the full working stress up to fracture can be realized.

The elastic modulus of glass varies from a value lower than most metals to a value higher than aluminum. Many glasses now being melted have an elastic modulus approximately one third that of steel.

The hardness of glass is usually measured by scratch tests. Glass has a hardness, depending on its composition, of about 6 on Mohs' scale. In general, the high silica and borosilicate glasses are harder than lime or lead glass.

In thermal properties glasses have a broad range of characteristics. The heat shock endurance of a glass is a function of its thermal expansion coefficient. These coefficients vary from 5.6 x 10^{-7} per degree centigrade to twenty times that value. For good hermetic seals, it is possible to match the most commonly used metals with one or more glasses with the same temperature coefficient of expansion, as shown in Table 1 on the opposite page.

Glasses are classed as electrical insulators, but here again there is a broad range of characteristics. The best glass has an electrical resistance one hundred million times that of the lowest resistance glass. The dielectric strengths of the glasses are so high, the thickness of the glass necessary for mechanical strength is usually far in excess of that necessary to prevent dielectric breakdown.

The dielectric breakdown voltage of glass usually decreases as frequency and temperature increase. For example, at about 200°C, the dielectric strength of a glass is lowered about 5%. For some glasses, such as the 96%-silica group, the dielectric constant is essentially independent of temperature, while for others there is a marked rise above 200°C. Most of the glasses commonly used for electronic components are essentially independent of frequency, however there is a considerable variation of power factor with frequency which must be considered when designing tuning circuits to cover a large frequency range. The variation of power factor is constant and reproducible. Slightly more expensive glasses are available which are comparatively independent of frequency and can be used when necessary.

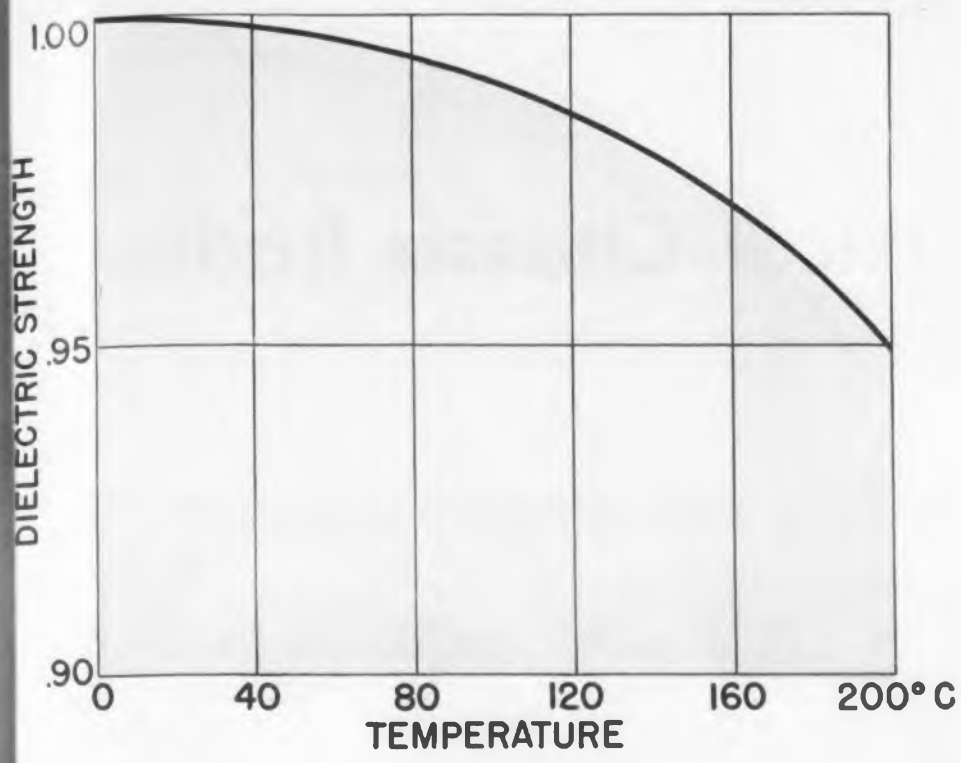


Fig. 1. The dielectric strength of most glasses decreases with temperature, although for some there is a marked rise above 200°C.

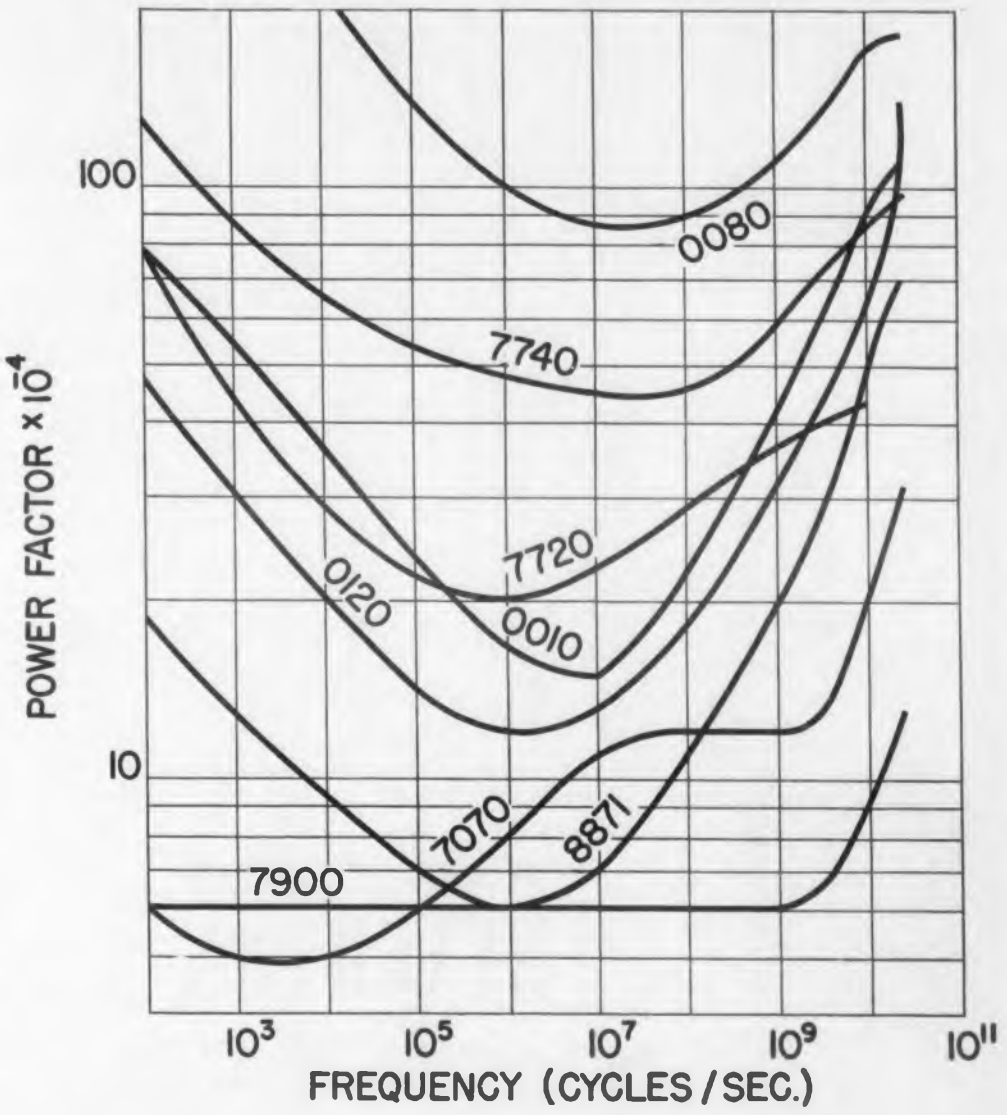


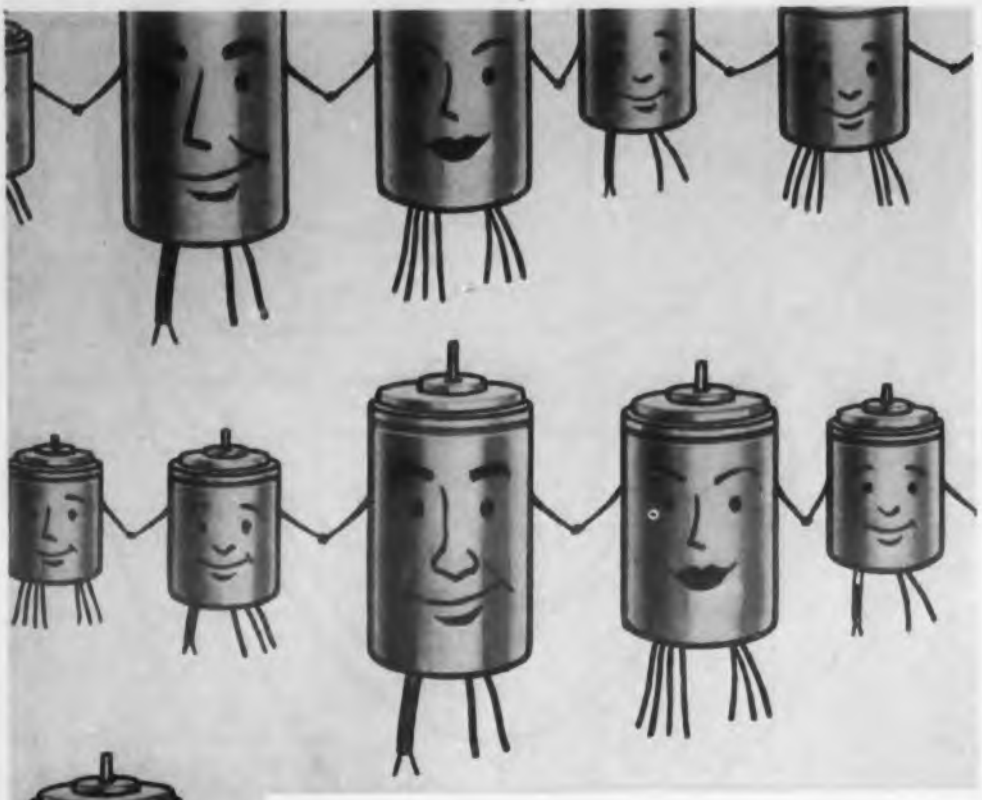
Fig. 2. Additional properties of the glasses charted here are given below.

Table 1. When making glass-to-metal seals, these glasses are commonly sealed to the indicated metal because their thermal coefficient of expansion is the same as that of the metal.

Metal	Glass
Platinum	Potash Soda Lead; Soda Lime, Borosilicate
Tungsten	Borosilicate; 96% Silica; Special sealing glasses
Copper	Any soft glass by special technique
Mica	Special soldering glass
Quartz	96% Silica
Molybdenum	Borosilicate
Dumet	Potash Soda Lead; Soda Lime

Table 2. Selected properties of a representative group of glasses.

Glass Code	Type	Color	Thermal Expansion Coeff.—/°C	Upper Working Temperatures (Mechanical Considerations Only)				Log₁₀ of Volume Resistivity 25°C	Dielectric Properties at 1Mc and 20°C		
				Annealed		Tempered					
				Normal Service (°C)	Extreme Limit (°C)	Normal Service (°C)	Extreme Limit (°C)		Power Factor	Dielectric Const.	Loss Factor
0010	Potash Soda Lead	Clear	91 x 10⁻⁷	110	380	—	—	17+	0.16%	6.6	1.1%
0041	Potash Soda Lead	Clear	84 x 10⁻⁷	110	400	—	—	—	—	—	—
0080	Soda Lime	Clear	92 x 10⁻⁷	110	460	220	250	12.4	0.9	7.2	6.5
0120	Potash Soda Lead	Clear	89 x 10⁻⁷	110	380	—	—	17+	0.16	6.6	1.1
7050	Borosilicate	Clear	46 x 10⁻⁷	200	440	235	235	16	0.33	4.9	1.6
7052	Borosilicate	Clear	46 x 10⁻⁷	200	420	210	210	17	0.26	5.1	1.3
7070	Borosilicate	Clear	32 x 10⁻⁷	230	430	230	230	17+	0.06	4.0	0.24
7250	Borosilicate	Clear	36 x 10⁻⁷	230	460	260	260	15	0.28	4.8	1.3
7340	Borosilicate	Clear	67 x 10⁻⁷	120	510	240	310	16	—	—	—
7720	Borosilicate	Clear	36 x 10⁻⁷	230	460	260	260	16	0.27	4.7	1.3
7740	Borosilicate	Clear	32 x 10⁻⁷	230	490	260	290	15	0.46	4.6	2.1
7760	Borosilicate	Clear	34 x 10⁻⁷	230	450	250	250	17	0.18	4.5	0.79
7900	96% Silica	Clear	8 x 10⁻⁷	800	1090	—	—	17	0.05	3.8	0.19
7900	96% Silica (Multiform)	White Opaque	8 x 10⁻⁷	800	1090	—	—	17	0.05	3.8	0.19
7910	96% Silica	Clear	8 x 10⁻⁷	800	1090	—	—	17+	0.024	3.8	0.091
7911	96% Silica	Clear	8 x 10⁻⁷	800	1090	—	—	17+	0.019	3.8	0.072
8871		Clear	103 x 10⁻⁷	—	—	—	—	18	0.05	8.4	0.42



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

Vertical-Chassis Radio

Notice the neat appearance gained by the use of printed circuits. This cabinet is 9-1/8" wide x 4-3/4" deep x 6-1/16" high.

The printed-circuit board with sockets added.

Design Forum

VERTICAL-chassis construction, which has already reached the consumer market in TV receivers (*ED, Jan., '55, pp. 34-35, and May, '54, p. 18*) and audio amplifiers (*ED, Jan., '55, pp. 24-27*), has now been adopted for the most common electronic product for the consumer—the inexpensive table-model radio. The vertical chassis means that tubes can be removed from the back of the enclosure without unscrewing the chassis. The vertical-chassis radio shown on these pages also features printed circuits.

Manufactured by General Electric Co., Syracuse, N. Y., this Model 455 radio has a printed circuit with copper-foil conductors on both sides of the base laminate. Connection between the two sides of the circuit is achieved by plated-through holes (*ED, Sept., '54, p. 17*) rather than eyelets. The tube complement of the set is as follows: converter—*12AU6;* i-f amplifier—*12BA;* detector and automatic volume control—*12AV6;* audio output—*50C5;* and rectifier—*35W4.* The antenna is mounted on the inside of the perforated back cover of the enclosure in the form of a large loop.

The feet on which the cabinet stands are an integral part of the plastic cabinet and make for good cooling. There are cooling holes in the bottom of the cabinet. The "Conelrad" stations are indicated on the easily-read tuning dial.

The growing use of the vertical-chassis arrangement means that servicing is made easier. At the same time the concurrent use of printed circuits means that the nation's servicemen must be rapidly trained in the method of repairing printed circuits if this gain in ease of servicing is not to be lost.

These potted units are made in many standard circuits, facilitating maintenance.

Encapsulated Plug-In Circuits

After the encapsulated body is inserted into the socket, the screw is turned into the threaded metal insert in the socket, holding the Encapsor securely.

MODERNIZATION and maintenance costs of industrial control, computer, communications, testing, and telemetering equipment can be greatly reduced by designing with the encapsulated plug-in circuits shown on these pages. Known as "Encapsors", these rugged units are available in more than 20 different standard circuits, or they can be made to order with a specified circuit. Some space-saving can also be achieved in many devices by constructing them with a number of these units linked together.

The modular units consist of three main parts: the potted body, the tube, and a center screw that secures the unit to its socket. Generally, Encapsors are furnished with either a conventional or a printed-circuit-type socket modified with a threaded metal insert to receive the center screw. Either conventional or miniature tube types are used. In addition they can be made to receive tube shields or clamps. Units are also made without tubes or with encapsulated semiconductor diodes or transistors.

To install a unit, the tube is removed, the body is plugged into its socket, the center screw is turned into the mating thread in the socket, and the tube is replaced. When the unit is removed, the screw does not fall out of its hole. The screw also functions as a heat sink. The screw runs in a threaded metal insert in the center of the body.

The units are constructed around a base form similar to a turret socket. After the components, which are conventional types, are mounted, the body is encapsulated in a modified epoxy resin known as "Alcorite". This opaque resin contains an aluminum oxide filler. The alumina filler improves heat transmission without lowering the insulation quality of the epoxy. It also makes the epoxy mechanically stronger, less brittle, raises softening temperature, affords greater dimensional stability, and reduces exotherm heat produced during curing. The curing temperature is low enough to prevent damage to components. In addition, the metal stud placed inside the body during the molding process carries away exotherm heat. The potting compound is available in different colors and the plug-in base and the top tube socket are made in a number of different colors for color coding purposes.

Among the standard circuits are a flip-flop, six-to-one and ten-to-one dividers, a transfer gate, a pulse-length adjuster, wave shapers, oscillators, power amplifiers, a keyer-modulator, and a differential amplifier. Other standard circuits are clamping, storage,

Components are mounted on a turret socket prior to the encapsulation process.

A number of Encapsors are used in this device to greatly simplify manufacture and testing.

memory, resolving, integrating, impedance matching, isolation, coupling, and rectifying circuits. These units are manufactured by Alcor Electronics Corp., 180 Lafayette St., New York 13, N. Y.

These plug-in circuits are of particular interest to designers of equipment for the military. Field maintenance problems are solved by substitution of units, with the only tool required being a screwdriver. Military equipment can be readily modernized by substituting improved circuits. When combined with printed circuits, all components are mounted in the potted body, and the printed-circuit board contains only foil connectors and tube sockets. For more information on these plug-in circuits, turn to the Reader's Service Card and circle **ED-24.**

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have solved many specific relay problems with no development or tooling cost to the customer. RBM has produced hundreds of thousands of magnetic relays from standard parts—designed and initially produced over seven years ago—to fulfill the need for dependable relays at low cost.

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●

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Controls for Electronic, Refrigeration, Industrial, Appliance, Communication and Automotive Industries

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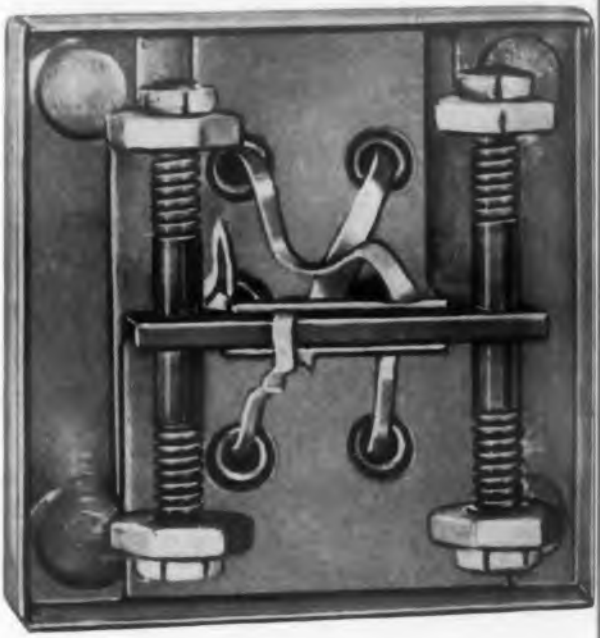
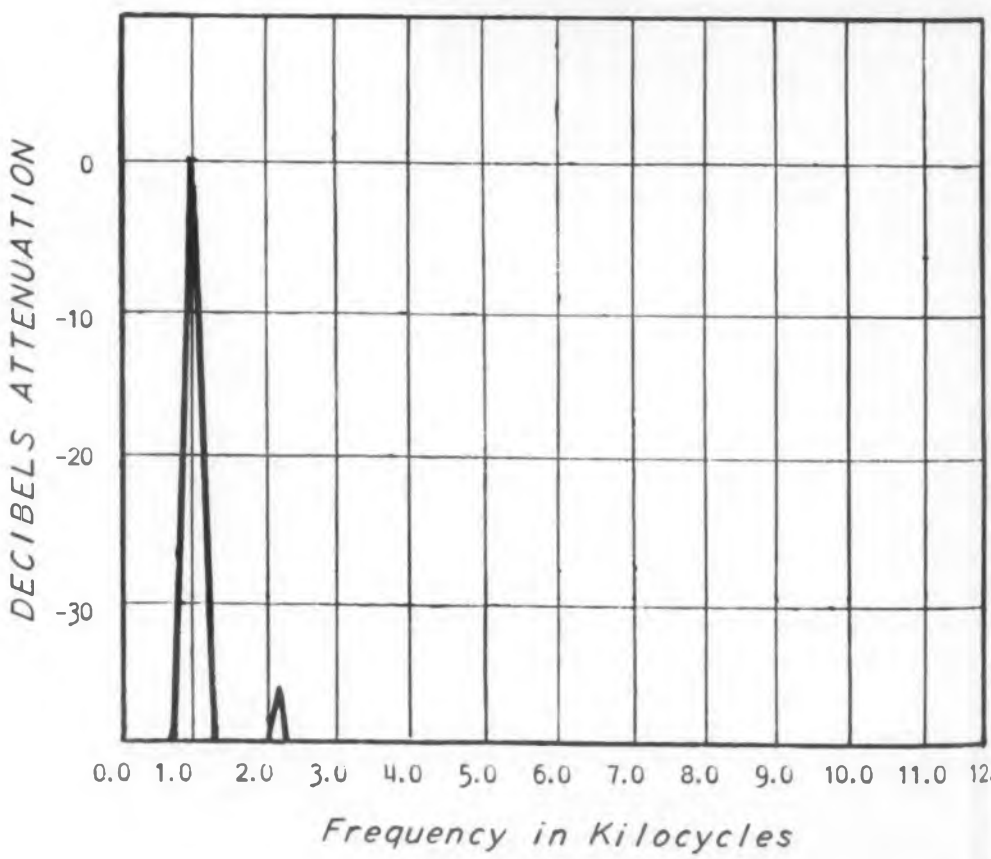
CIRCLE ED-26 ON READER-SERVICE CARD FOR MORE INFORMATION

Electro-Mechanical Circuit Elements



Inertia bars are supported in a symmetrical relationship and are insensitive to vibration. Input and output circuits are isolated.

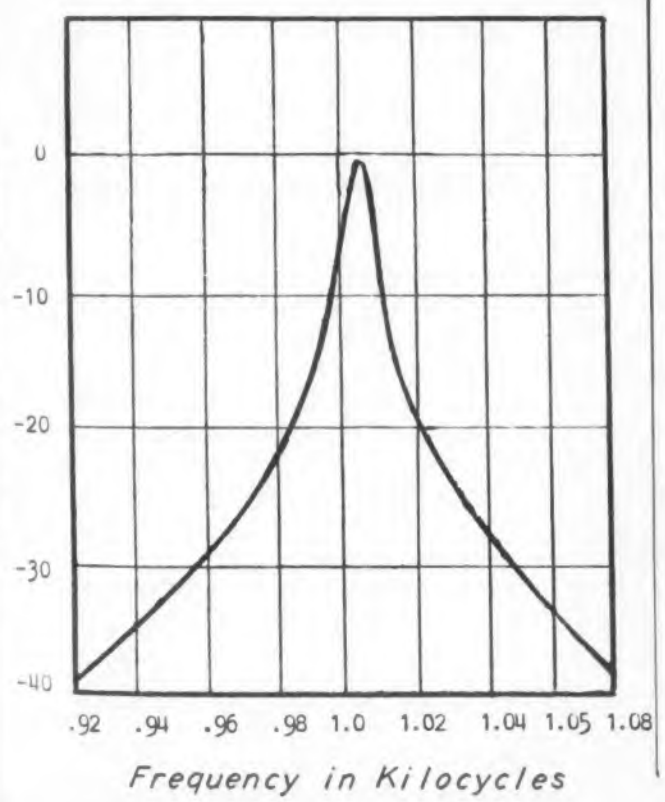
Selectivity curve, right, and spurious response, below.

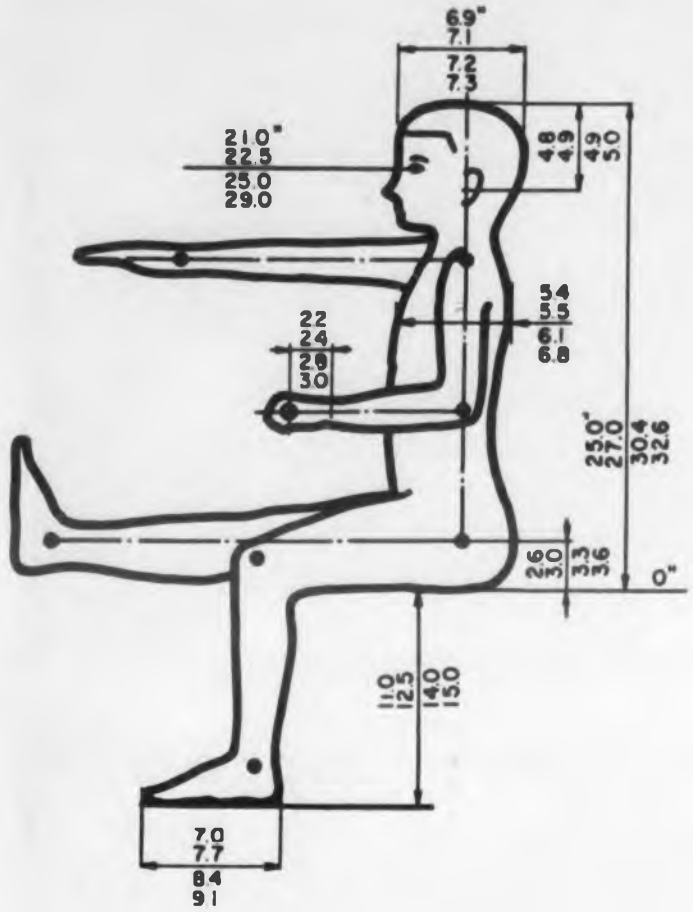


RESONANCE occurs in two parallel inertia bars instead of the conventional L-C circuit in these transducers. Their small size makes them useful as high-impedance, narrow-band, interstage coupling filter elements, or as low-level oscillator circuits. Standard Q's are as high as 250. In groups these units provide comb filtering, band pass filtering or spectrum analysis. They offer possibilities for simple frequency coding and multiplexing applications in communication and data transmission work. They are convenient to use in analyzing doppler shift, and other signals carrying intelligence.

The construction of these Circuit Element Transducers, manufactured by The Harris Transducer Corp., Woodbury, Conn., is unique. Two stiff parallel inertia bars are connected at the center by a flat flexible cross spring. A driver crystal affixed to the cross spring causes it to expand and contract thereby exciting the interia bars into oscillations. A second take-off crystal is also attached to the cross spring. A-c signal voltage applied to the driver crystal excites motion at resonance but has little effect off-resonance.

The transducers are now available in a range of frequencies from 100cy to 7kc. Q's of 100 or 250 can be specified. Matched sets with resonant frequencies matched to 0.01% and Q's as high as 500 can be obtained on special order. The transducers are temperature compensated to .001% per degree F. They are operable to 130°F. Input voltages up to 5v rms and d-c voltages up to 100v may be used. Input and output nominal capacitance is .0016μfd. Transmission loss at the pass frequency is about 2db; off frequency loss is from 40 to 60db as accompanying graphs show. For more data, turn to the Reader's Service Card and circle **ED-27.**

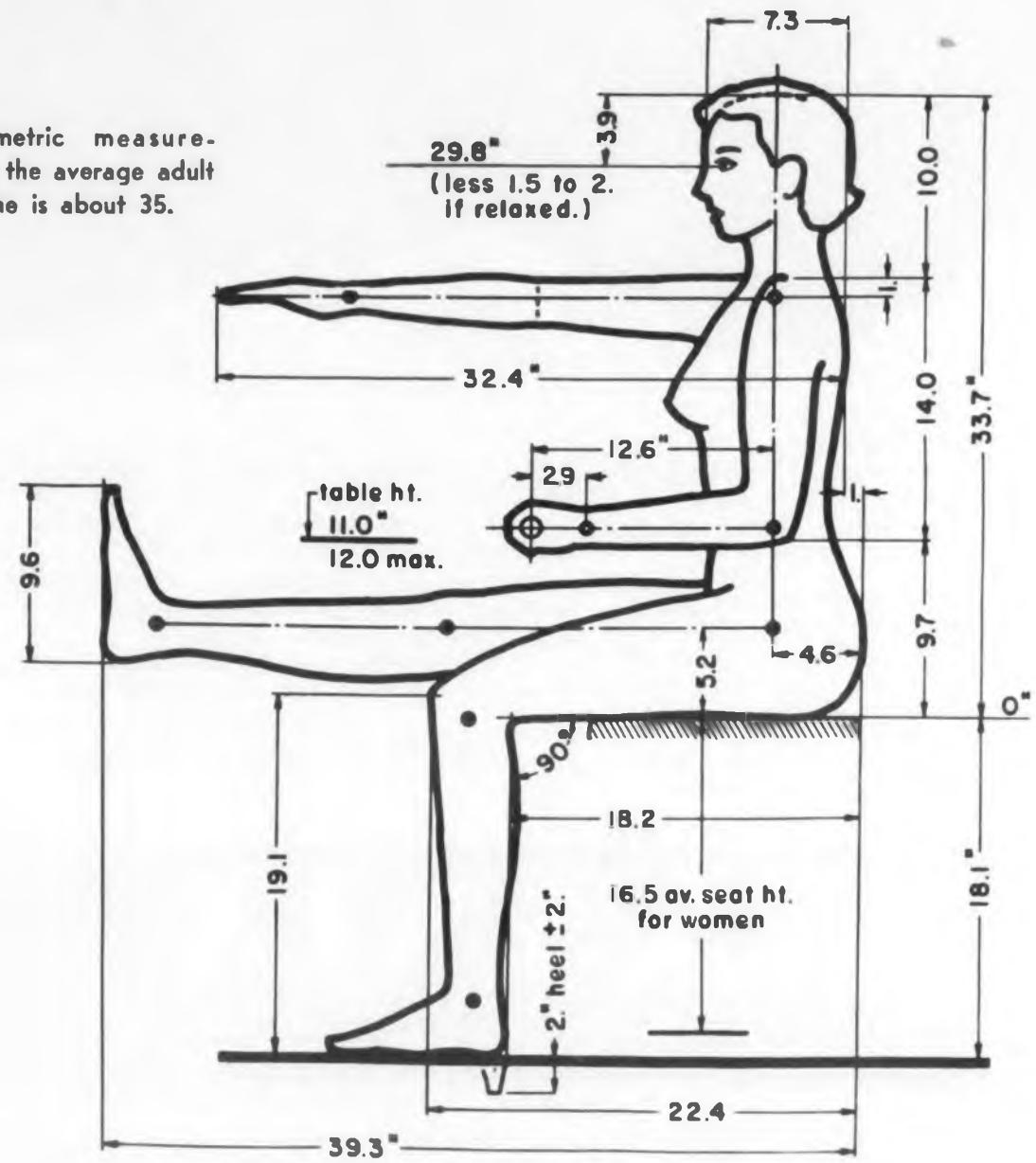




The four values given for each dimension of this child are for average children of 6, 8, 11, and 14 years, respectively.

Background for Designers

Human Measurements



Anthropometric measurements for the average adult female. She is about 35.

DESIGNING equipment to fit the human operate is being emphasized so much these days that i should soon become standard operating procedur Since all electronic equipment, except for a compar tively small number of unattended radio relay an TV booster stations, is meant to be manipulated b humans in some manner, the electronic designer mu have accurate data on human measurements an characteristics readily available.

The anthropometric charts, tables, and source given on these pages contain valuable informatio for all designers. They were compiled by the Henr Dreyfuss organization, 4 West 58th St., New Yor 19, N. Y. and are reprinted from Mr. Dreyfuss' r cently published book, *Designing For People**.

Sources for Charts and Table

Adult Male

1. "Human Body Size in Military Aircraft and Perso Equipment", by F. E. Randal, et al. AAF Tech. Report 55 Air Material Command, Wright Field, Dayton, Ohio, 19 (several thousand cadets tested).

2. *A Survey in Seating*, by E. A. Hooten, Haywood-Wak field Co., Gardner, Mass., 1945 (1959 males tested).

3. "Leg and Strength Endurance in Relation to Heig Weight and Other Body Measurements", by E. R. Elb Report 1, Proj. 318, School of Aviation Medicine, U. S. A Force, Randolph Field, Texas, 1945.

4. "Distance Between Pivot Points", from report by Dr. Ja G. Travell, 9 West 19th Street, New York, N. Y. (1952).

5. "Anthropometric Measurements", Bell Telephone Labo tories Report, 1943.

6. "Dimensions of the Human Figure", *Architectural Grap Standards*, Charles G. Ramsey & Harold R. Sleeper, Jo

*Simon and Schuster, New York, 1955.

Human characteristics. The weight of the average man was determined within the range of 202 and 118 lb for the 97.5 and 2.5 percentiles.

	Average Child				Average	Average
	6	8	11	14	Man	Woman
Weight (lb)	44.5	55	75.5	98.7	153.1	133.5
Left-handed					6.6%	3.8%
Color blind					3.5%	0.2%
Hard of hearing					4.5%	4.5%
Wear glasses					43.6%	56.4%

Wiley & Sons, Inc., 440 Fourth Ave., New York, 1951.

Anatomy for Interior Designers, by F. de N. Schroeder, Whitney Publications, New York, 1951.

An Introduction to Physical Anthropology, M. F. A. Montague, Thomas Publishing Co., Springfield, Illinois, 1951.

"Faces and Heads" by J. A. Consentino—Report by U. S. Chemical Warfare Service Development Laboratory, Massachusetts Institute of Technology, Cambridge, Mass.—1945.

Adult Female

U. S. Department of Agriculture Misc. Pub. No. 454, "Women Measurements for Garment & Pattern Construction," 1941 (10,042 females measured).

"Handbook of Human Engineering Data for Design Engineers," Tech. Rep. No. SDC 199-1-1 Part II, Tufts College, Institute for Applied Experimental Psychology, Medford, Mass. 1949.

"Anthropometric Nomograph of Army Women" prepared by the Quartermaster, Climatic Research Laboratory (6237 females tested).

"Survey in Seating" conducted by Dr. Ernest Hooton & Staff. Harvard Univ. Dept. of Anthropology, 1945 (4908 females tested).

"Survey of Body Size of Army Personnel Male and Female," Phase 4, Report 1, Office Technical Services (4302 females tested).

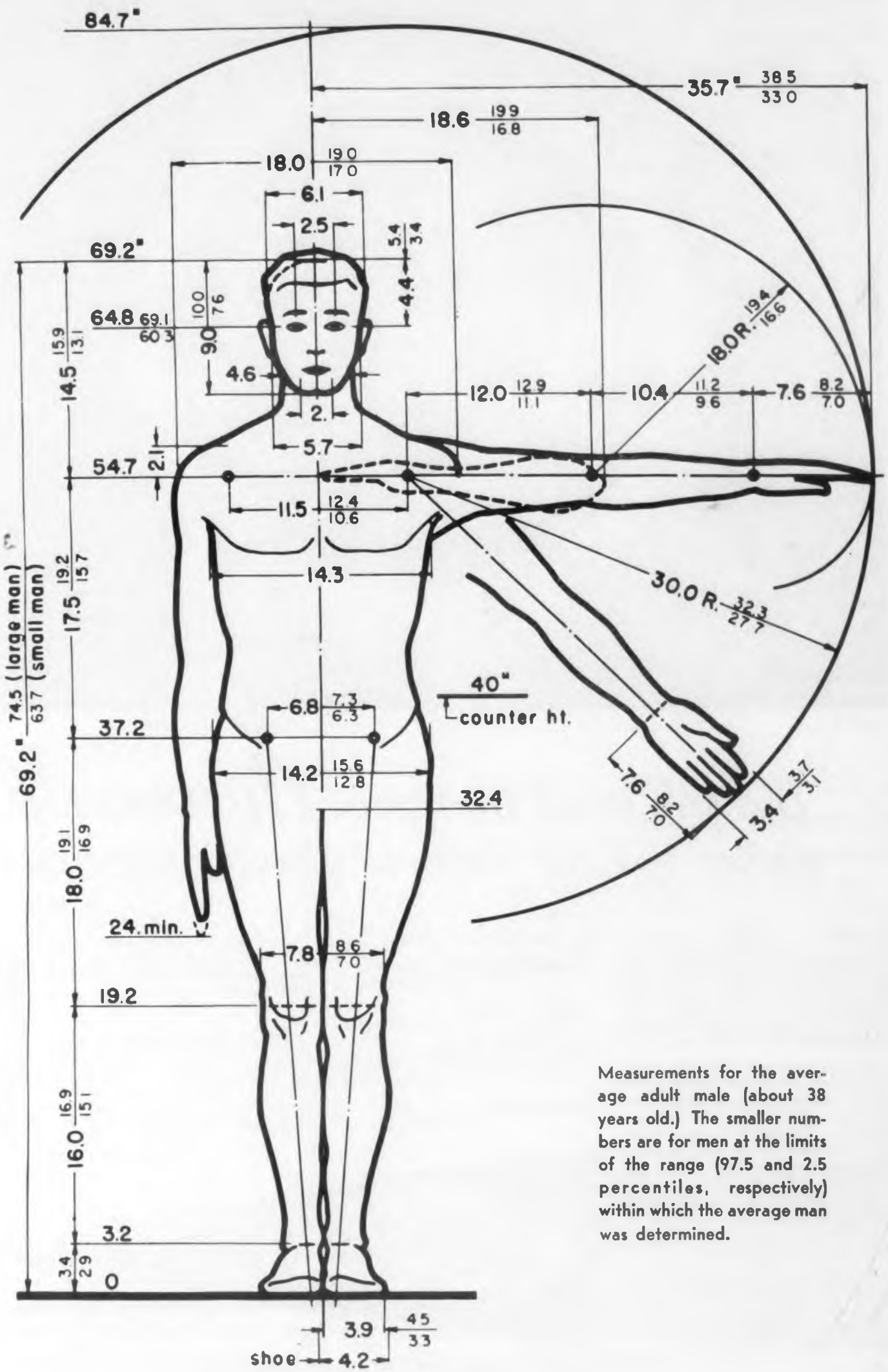
"Body Measurements of Female Flying Personnel" by A. Brues, Report ENG-49-695-32A, USAF-Air Material Command, Wright-Patterson AF Base, 1943.

Children

"Pivot Points", Report by Dr. Travell.

"Children's Body Measurements", U. S. Department of Agriculture Misc. Publication No. 365, 1939 (133,807 American boys and girls tested).

"Basic Body Measurements of School Age Children", U. S Department of Health Education and Welfare, Office of Education, 1953 (152,191 boys and 144,307 girls tested).



Measurements for the average adult male (about 38 years old.) The smaller numbers are for men at the limits of the range (97.5 and 2.5 percentiles, respectively) within which the average man was determined.

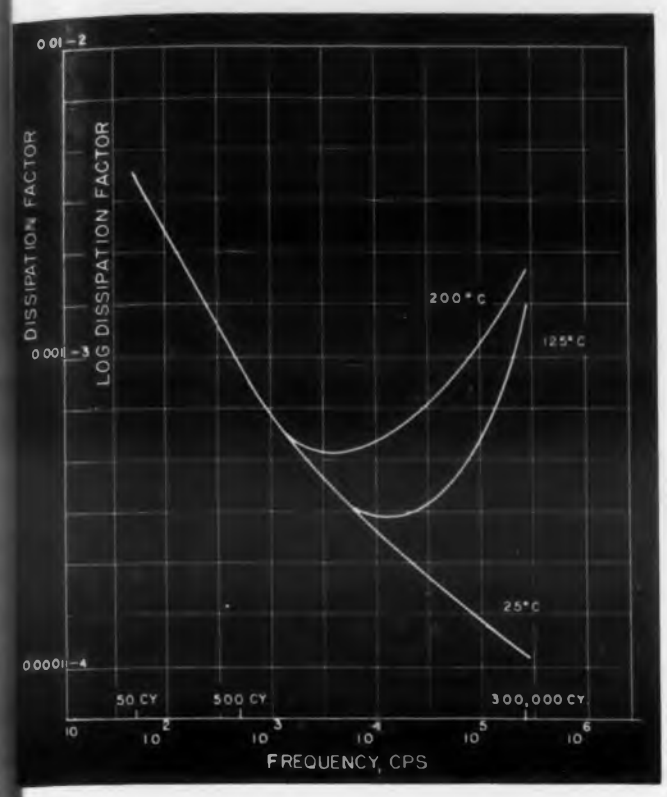
Glass-Teflon Dielectric

EASILY handled and non-stretchable, this stiff thin film, known as Fiberfilm, has all of the excellent electrical properties of Teflon. The non-porous type is especially useful as a dielectric for high-temperature, low-loss capacitors of both the dry and wet type; for interlayer insulation of coils; and for high-temperature rated wire leads and cables. Having desirable adhesive properties coil wire can be wound to the edge of this insulation without spilling off.

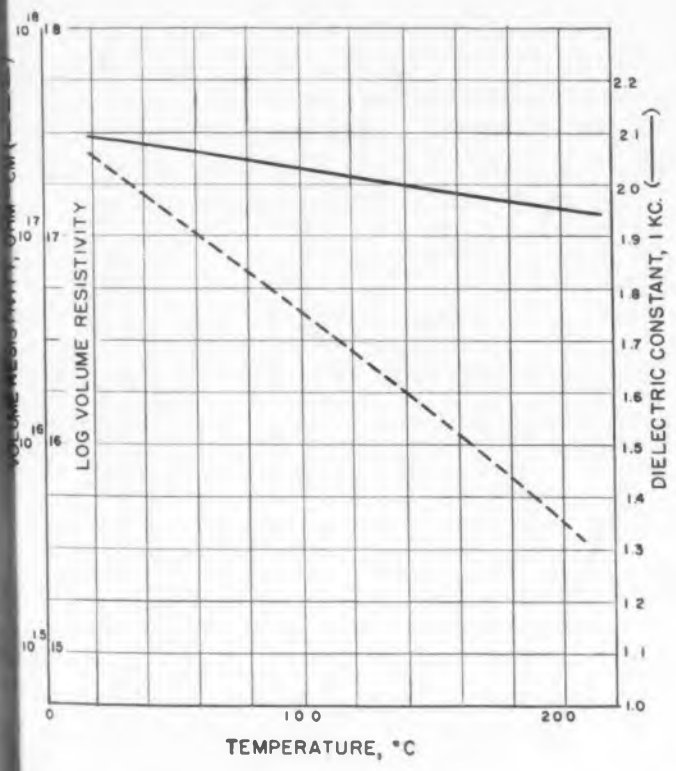
Fiberfilm, manufactured by the New Products Div. of American Machine and Foundry Co., 261 Madison Ave., New York 16, N. Y., is made from glass microfibers and polytetrafluoroethylene. It is available in long continuous rolls up to 40" in width. The non-porous type is currently made in thicknesses ranging from 1 to 1.7 mils. Laminations of greater thicknesses are available. The insulator has a dielectric breakdown strength in the range of 1400 to 4000v/mil, depending on its form and treating. It performs satisfactorily at temperatures of 200 to 250°C. The dissipation factor at 1kc is less than 0.001. Volume resistivity at 25° is 10^{15} ohm-cm. Dielectric constant at 25°C and 1kc is 2.1. Because the dielectric does not stretch under tension it is well suited for use on winding machines. Dielectric-strength uniformity is, therefore, assured and rejection rate of capacitors, for example, is low.

A porous variety of Fiberfilm is available in different thicknesses and Teflon-to-glass ratios. The porous sheet is useful in high-temperature coils and transformers as interlayer insulation where the entire assembly is impregnated with silicone resin. The material also serves as spacers in tantalum electrolytic capacitors. The sheet also acts as a filter and is especially suitable for corrosive high-temperature applications. The porosity can be closely controlled.

Silicone resin can be used in place of Teflon. The porous vinyl Fiberfilm is moisture repellent, yet breathes. For more information on this dielectric turn to Reader's Service Card and circle **ED-30**

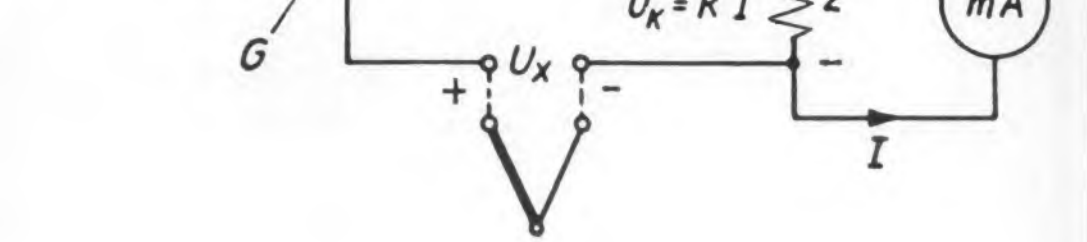


Dissipation factor vs. frequency for non-porous Fiberfilm sheets.



Dielectric constant and resistivity vs. temperature for non-porous type.

Swing-Coil Compensator



Swing-coil zero system; amplifier tube only part subject to wear. Swing coil exerts no reaction torque on moving coil.

D—moving coil
S—swing coil connected to *D*
E—a-c energized exciter
G—gold tape leads
R—compensating resistor
V—electron-tube amplifier

RECORDING instruments that might ordinarily load such low-voltage devices as thermocouples, measuring bridges and p_h-electrodes can be readily operated from the non-dissipative Swing-Coil Compensator. The Swing-Coil Compensator produces a high current output which can drive, also, large easy-to-read milliammeters. Input voltage is compensated in the device by an automatically regulated opposing voltage thus exhibiting closed-loop control. The several milliamperes of current that flows through the resistor in the compensating circuit is proportional to the voltage being measured.

The Swing-Coil Compensator, manufactured by AEG (Allgemeine Elecktricitats Gesellschaft) of Germany, and distributed by D. C. Seibert, Box 31, Wilmington, Del., consists of a moving coil, a swing coil and E-magnet, an electron-tube amplifier, and a compensating resistor. Unknown voltages are connected to the moving coil. As the moving coil deflects, the unique rigidly-connected swing coil moves out of the zero-field center of its exciter E-magnet into a strong magnetic field. Voltage induced in the swing coil drives the amplifier-tube grid and plate current flows. Plate current causes an IR drop in the compensating resistor. If there is a difference between the measured voltage and the compensating voltage, the swing coil picks up exciter voltage and tube current adjusts until it is proportional to the input voltage.

The swing-coil system operates with practically no time lag and is critically damped. Swing-coil movement of less than one degree produces proper action. For a standardized output current of 5ma and a typical input of 10mv, the calculated accuracy is 0.24%.

Supply voltage variations are automatically balanced by the compensator action. The tube is well operated and life expectation is at least 5000 hours. For more information about this instrument, turn to the Reader's Service Card, and circle **ED-33.**

Selecting Miniature Bearings

H. M. Dardani, Chief Process Engineer,

Miniature Precision Bearings, Inc., Keene, N. H.

SELECTION of miniature bearings for electronic devices is greatly implemented by the tables and nomographs given in this article. The types of miniature bearings considered are illustrated above and their relative uses are discussed in the table.

Obviously, radial bearings are designed primarily for radial loads. Nevertheless, they can also sustain a moderate amount of axial or thrust load. Where there is any doubt in this matter, it is best to check with the manufacturer.

Various methods of mounting shafts in bearings are shown in Figs. 1 and 2. In small devices, radial load is often limited by shaft strength rather than by bearing strength. The four most common troubles that designers encounter in mounting miniature shafts involve the following: (1) radial play; (2) axial play; (3) starting torque; and (4) running torque.

A miniature motor with excessive radial play, for example, will not allow the rotor to maintain a uniform air gap. Excessive axial play may cause undue wear or improper functioning of associated equipment. In airborne equipment, starting and running torque characteristics of ball bearings remain almost constant regardless of shaft position.

Sample Problem

A typical problem might concern a tape printer mechanism that records data from an electronic computer. For such an installation the design may require high speed, low torque, and a very small amount of inertia. Since the printer is not intended for mobile use, the loadings are fixed. Thus, it is merely necessary to know whether load is radial, axial (thrust) or a combination of both.

Assume that the printer has a miniature shaft that must sustain 5 lb of radial load at a speed of 8000-rpm. Referring to Table 1, it is clear that out of 13 available bearing designs, several can be considered for this application. Since the load is only 5 lb (light) and the speed 8000rpm (medium), the radial retainer series (No. 3 in the table) may be selected tentatively because of its low starting torque.

Fig. 3 is a set of curves showing the relationship between radial load (lbs) to speed (rpm) for eight sizes of radial retainer bearings. The curves were developed from the equation:

$$P = C/\sqrt[3]{L_H \times rpm \times 60 \times 10^{-6}}$$

where P is the radial load that can be handled in pounds, L_H is the average life in hours, rpm is the speed of the shaft, and C is an empirical factor that depends on bearing design. Actual values of C are found by tests and are listed in makers' catalogs.

The formula gives bearing load rating in pounds for SAE 52100 steel. For stainless steel, the formula result must be multiplied by 0.85 and in the case of beryllium copper by 0.25. An additional factor (0.7) must be applied when the outer bearing race rotates while the inner race is stationary.

Let us assume that the value of P is calculated by means of the equation, to be 10 lb for a bearing of SAE 52100 steel. If the bearing is made of beryllium copper, outer race rotates, inner race stationary, then 10 x 0.25 x 0.7 equals 1.75 lb. Under the changed conditions, the radial load for the bearing is reduced from 10 to 1.75 lb.

Again referring to Fig. 3 and the specific bearing design problem, it is now necessary merely to choose the proper size. Since the intersection of the 5-lb radial load line and the 8000rpm line falls below the three top curves, bearings C, D, F, G, or H will meet the requirements for load and speed. If the designer must hold OD to a minimum, he probably would select bearing C since it has an OD of 0.2500″ as compared to 0.3125″ for the other sizes.

In case bearing C has too small a bore (0.0781″) to accommodate a shaft of sufficient strength for the job, it then may be necessary to consider super-light bearings, which are covered by Fig. 6. Super-light bearing A has an OD of 0.2500″, but its bore is 0.1250″, which is appreciably larger than the bore of radial bearing C.

In a mechanism having a shaft that is subjected to high axial loads, a thrust bearing is recommended. To select the proper thrust bearing for a specific case, the curves of Fig. 4 are used. The broken lines indicate conditions where thrust load requirement is 15 lb and speed is 6000rpm. It is easy to see that thrust bearings C, D, or E would be satisfactory for this situation. Of the three, bearing C has the smallest OD and bearing D accommodates the largest shaft.

Combined Loads

If the electronic engineer is concerned with a mechanism that must withstand sizable radial and thrust loads, which often occur in airborne units, there are several solutions to the problem. He can use two sets of bearings on the shaft, one pair for thrust, the other for radial load. Angular contact bearings may be employed as shown in Fig. 2. Then again, pivot bearings can be used on one or both ends of the shaft as shown in Fig. 1.

If separate radial and thrust bearings are employed, the correct size for each pair can be determined from Figs. 3, 4, and 6 by the method explained previously. The procedure for selecting angular contact and pivot bearings is somewhat different from the above but equally simple.

For example, the case may involve a radial load of 6 lb, an axial load of 3 lb and a speed of 4000rpm. Fig. 5 deals with angular contact bearings. The equivalent radial load from the expected thrust load of 3 lb equals thrust load times tan 60° (cone angle):

$$3 \times 1.732 = 5.20 \text{ lb.}$$

A bearing selected to carry a radial load of 6 lb (bearings C, D or E, Fig. 5) can then support the specified thrust load of 3 lb. If, however, the equivalent radial load produced by the thrust component had exceeded 6 lb, the bearing would have had to be selected on the basis of the higher equivalent radial load.

In a similar manner, Fig. 7 is used to select the proper pivot bearing for a specific design. Here, bearings D, E, or F meet the requirements for the last problem. It should be noted that the smallest angular contact bearing (C) that can be used for the problem has a larger OD (0.2500″) than the comparable pivot bearing (D) which has an OD of 0.1968″. However, the width (W) of the angular-contact bearing (0.0938″) is less than that of the pivot bearing (0.1181″).

Table I. This compilation of information for the bearings illustrated above should help the designer to select the proper type of bearing for a particular application.

No.	Bearing Type Name	Load Conditions	Size Range OD	Size Range Bore	Size Range Width	Weight Range (grams)	Balls	"C" Factor Range
1	Radial	High radial loads, moderate speeds, moderate thrust loads.	1/10" - 5/16"	1/32" - 3/32"	1/32" - 7/64"	0.02 - 0.69	7 - 10	15 - 106
2	Super Light Radial	Same as radial—for larger shafts with small OD of bearing.	1/4" - 3/8"	1/8" - 1/4"	3/32" - 1/8"	0.28 - 0.62	11 - 25	61 - 118
3	Radial Retainer	Moderate or medium speeds, moderate radial and thrust loads, low starting torque.	5/32" - 5/16"	3/64" - 3/16"	1/16" - 7/64"	0.08 - 0.64	5 - 7	24 - 97
4	Spring Separator	Low starting torque, oscillating motion, low speeds (up to 5000rpm).	5/16"	3/32" - 3/16"	7/64"	0.39 - 0.62	5 - 7	68 - 87
5	Flanged Radial	Convenience in mounting eliminates need for seat in housing or special retaining devices. Aids squareness in mounting. Saves axial space in gear trains.	5/32" - 5/16"	3/64" - 3/16"	1/16" - 7/64"	0.12 - 0.78	8 - 16	32 - 118
6	Flanged Radial Retainer	Combines advantages of flanged design with radial retainer bearing.	5/32" - 5/16"	3/64" - 3/16"	1/16" - 7/64"	0.10 - 0.78	5 - 7	24 - 97
7	Separable	Well adapted to very high speeds, combined radial and thrust loads. Mounted in opposition, bearings permit axial adjustment of internal bearing clearances.	3/16" - 5/16"	3/64" - 1/8"	5/64" - 7/64"	0.15 - 0.69	5 - 8	48 - 113
8	Flanged Separable	Combines advantages of flanged and separable types.	3/16" - 5/16"	3/64" - 1/8"	5/64" - 7/64"	0.20 - 0.83	5 - 8	48 - 113
9	Angular Contact Pivot	Receives combined loads on conical 60° pivot point; self-contained.	1/8" - 3/8"		3/64" - 9/64"	0.05 - 1.49	6 - 7	18 - 170
10	Pivot (spherical seat or race types)	Designed for high loads, severe shock. Used with 60° pivot points. Shaft misalignment: 4° for spherical types, 2° for race type.	1/16" - 25/64"		3/64" - 15/64"	0.02 - 2.56	4	3.4 - 205
11	Thrust	Heavy thrust loads, medium speed, minimum space.	1/8" - 7/16"	3/64" - 1/8"	1/16" - 3/16"	0.06 - 3.1	6 - 8	52 - 406
12	Shielded	Protects bearing against foreign matter—retains lubricant—no increase in width.	1/4" - 3/8"	5/64" - 1/4"	1/32" - 7/64"	0.022 - 0.759	7 - 10	15 - 106
13	Shielded Retainer	Same as shielded bearing plus advantages of radial retainer —minimum width.	5/32" - 3/8"	3/64" - 1/4"	1/16" - 7/64"	0.088 - 0.704	5 - 7	24 - 97

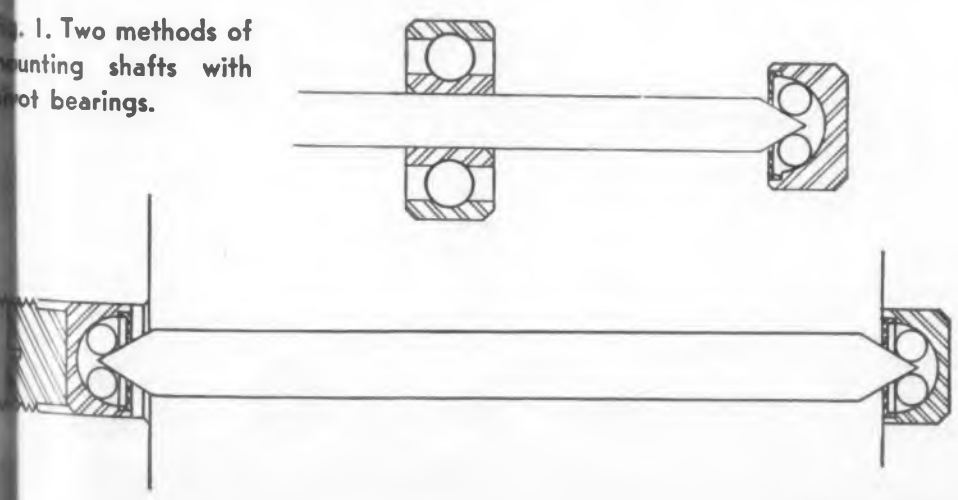


Fig. 1. Two methods of mounting shafts with pivot bearings.

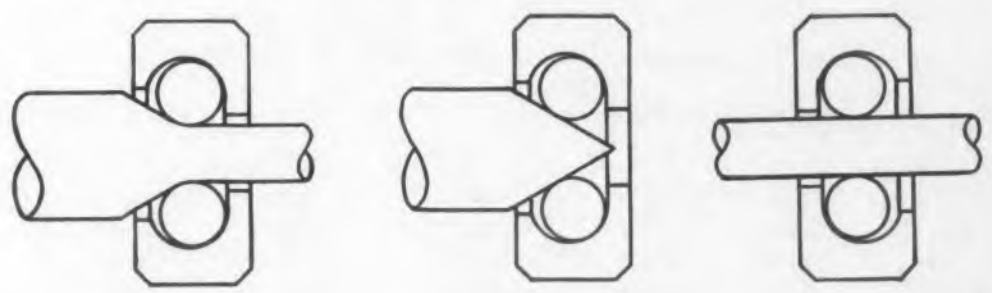
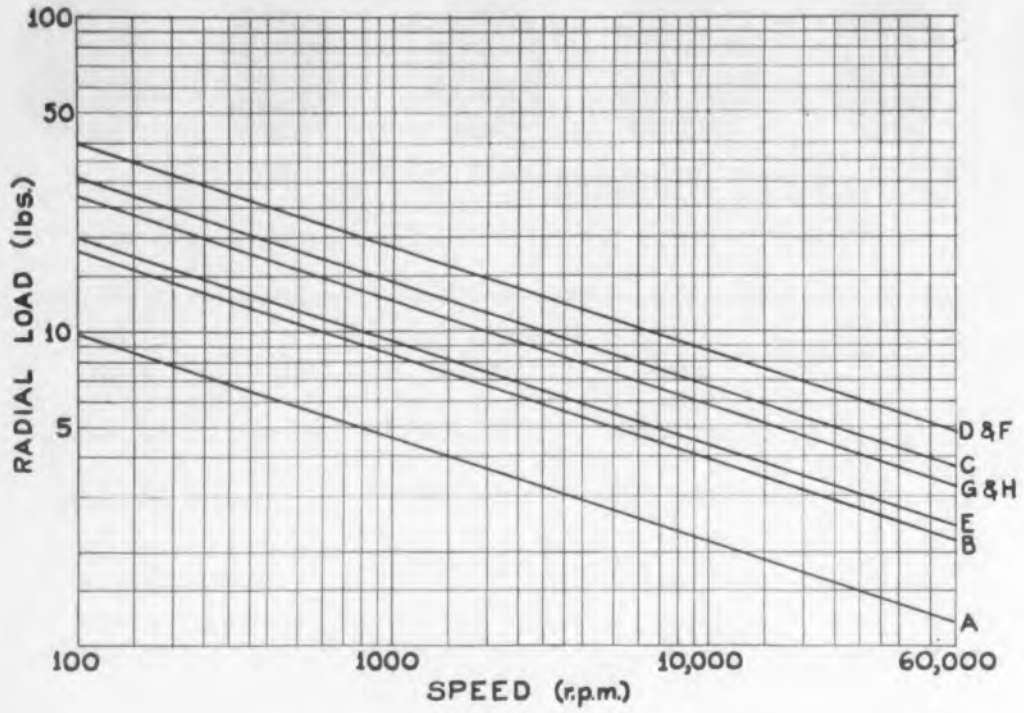
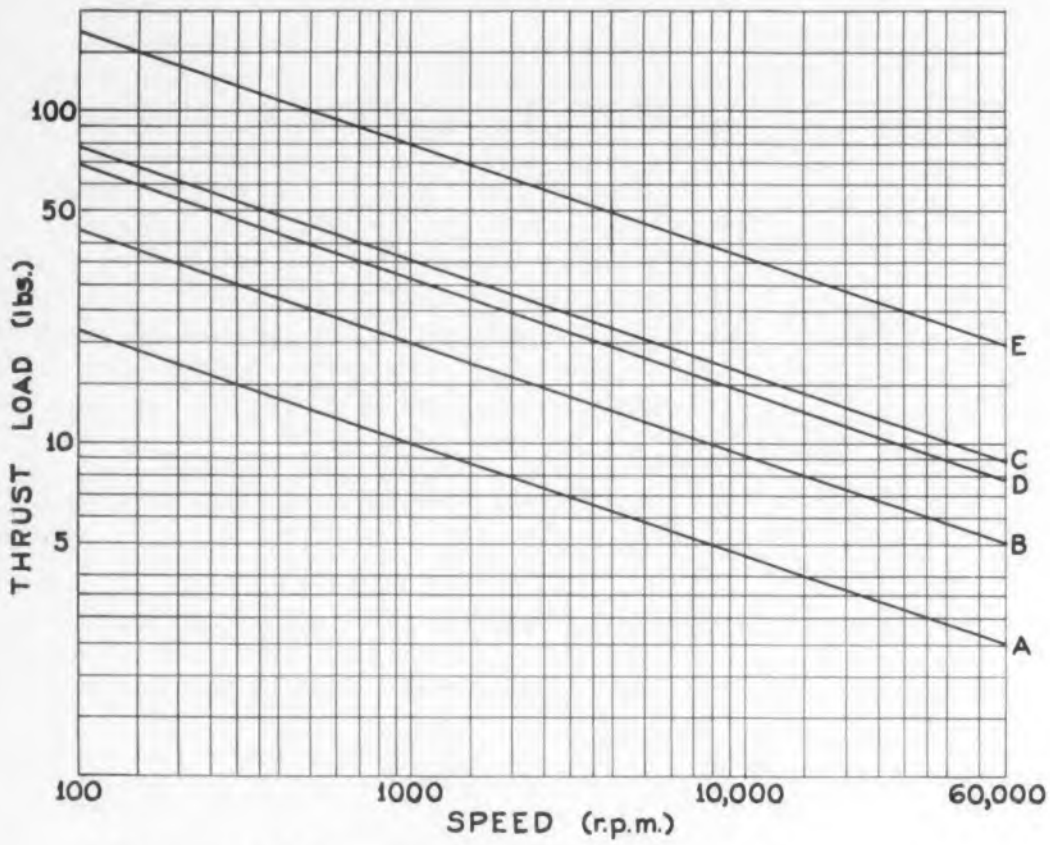


Fig. 2. Three types of shafts that can be mounted with angular-contact bearings.





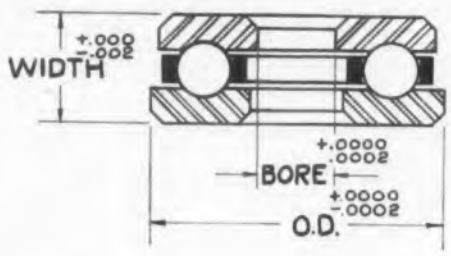


Fig. 4. Thrust bearing selection chart above. All bearing dimensions are in inches.

	A	B	C	D	E
Bore	0.0400	0.0938	0.1250	0.1875	0.1250
OD	0.1250	0.2500	0.3125	0.3750	0.4375
Width	0.0625	0.0938	0.1250	0.1500	0.1875

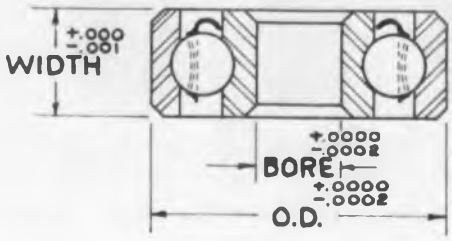
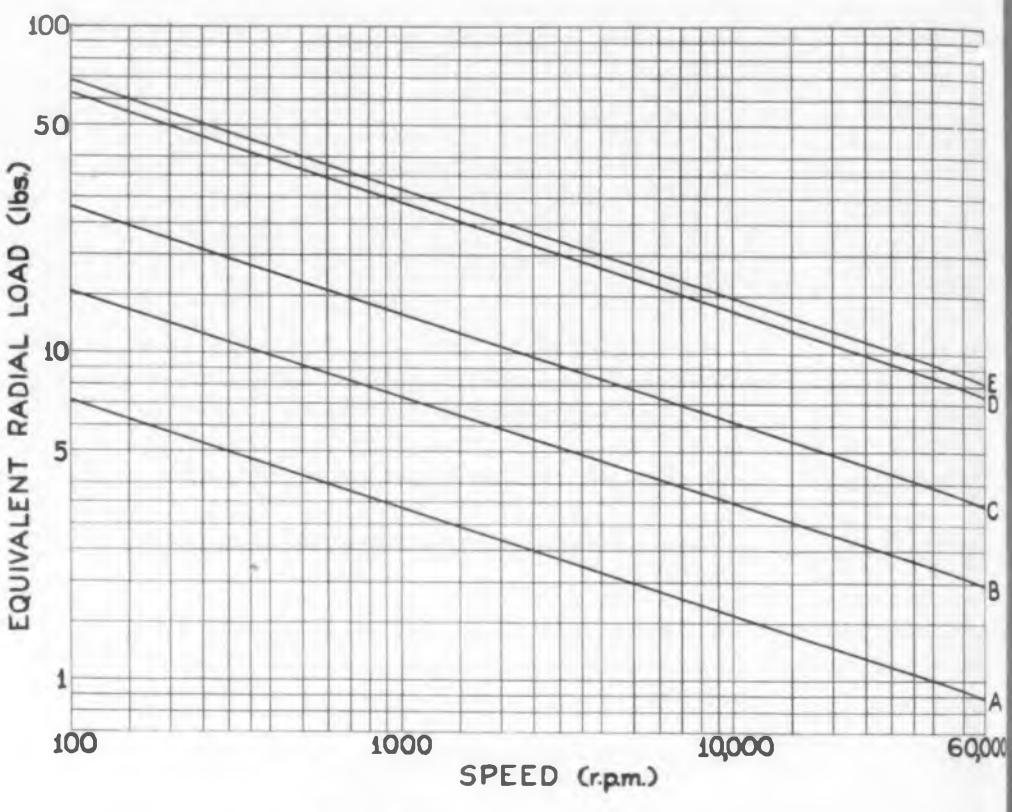


Fig. 3. Radial retainer type bearing selection chart at the left. All bearing dimensions below are in inches.

	A	B	C	D	E	F	G	H
Bore	0.0469	0.0550	0.0781	0.09375	0.1250	0.1250	0.15625	0.1875
OD	0.15625	0.1875	0.2500	0.3125	0.2500	0.3125	0.3125	0.3125
Width	0.0625	0.0781	0.0938	0.1094	0.0938	0.1094	0.1094	0.1094



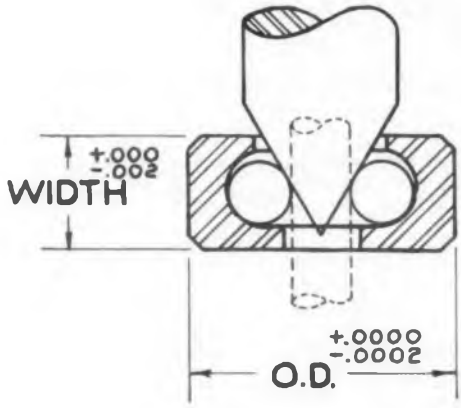


Fig. 5. Angular contact bearing selection chart, above. All bearing dimensions in inches. S stands for shaft diameter, and *SE* is the diameter of the shaft extension (broken lines).

	A	B	C	D	E
OD	0.1250	0.1875	0.2500	0.3750	0.3750
Width	0.0469	0.0700	0.0938	0.1406	0.1406
min S	0.042	0.062	0.085	0.124	0.150
max SE	0.032	0.048	0.063	0.094	0.125

RESULTANT LOAD (lbs.)

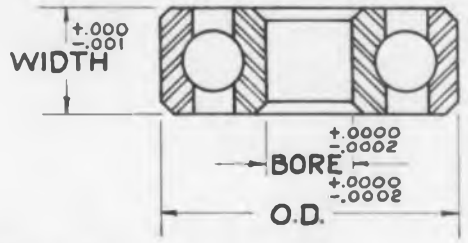
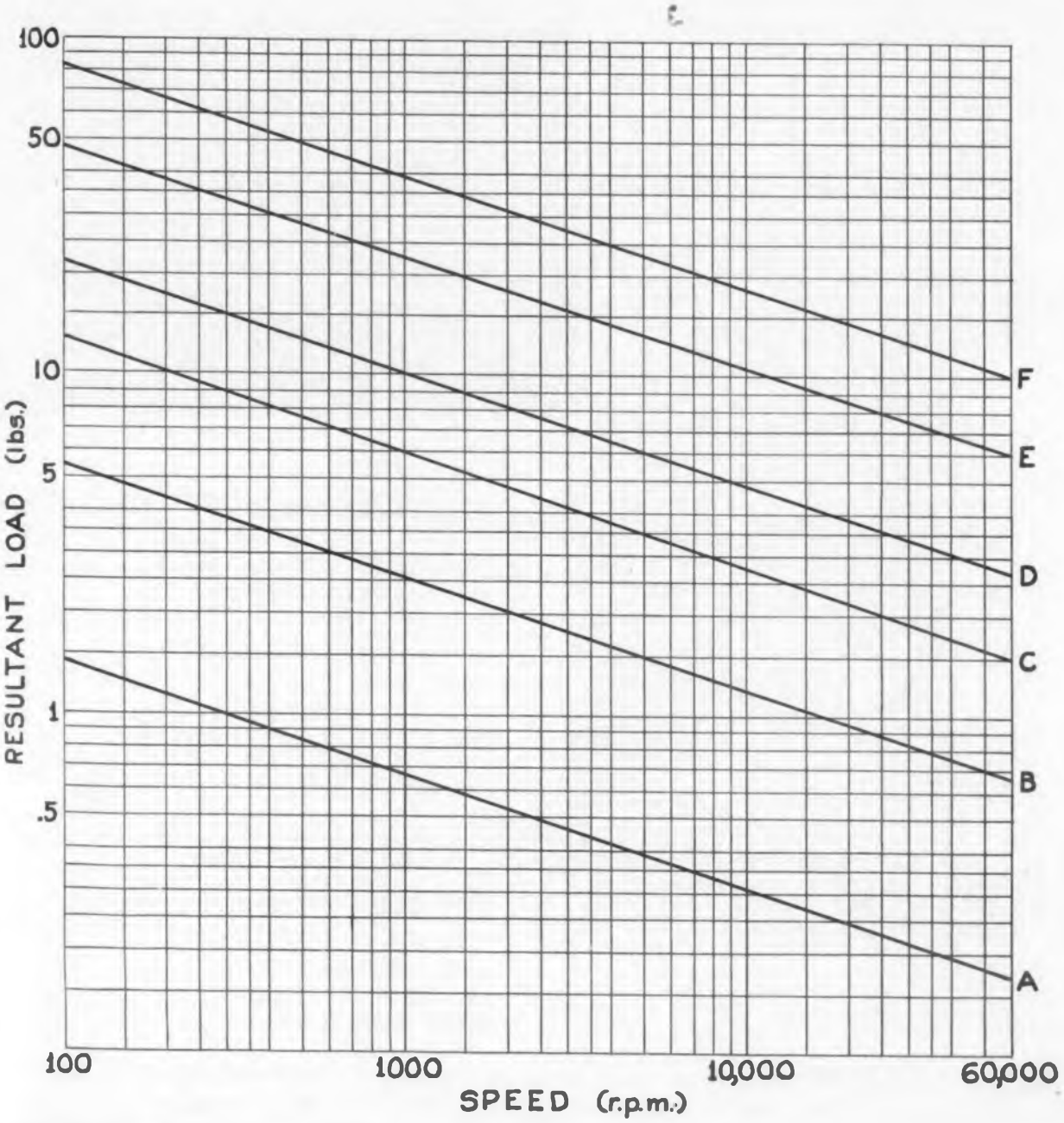
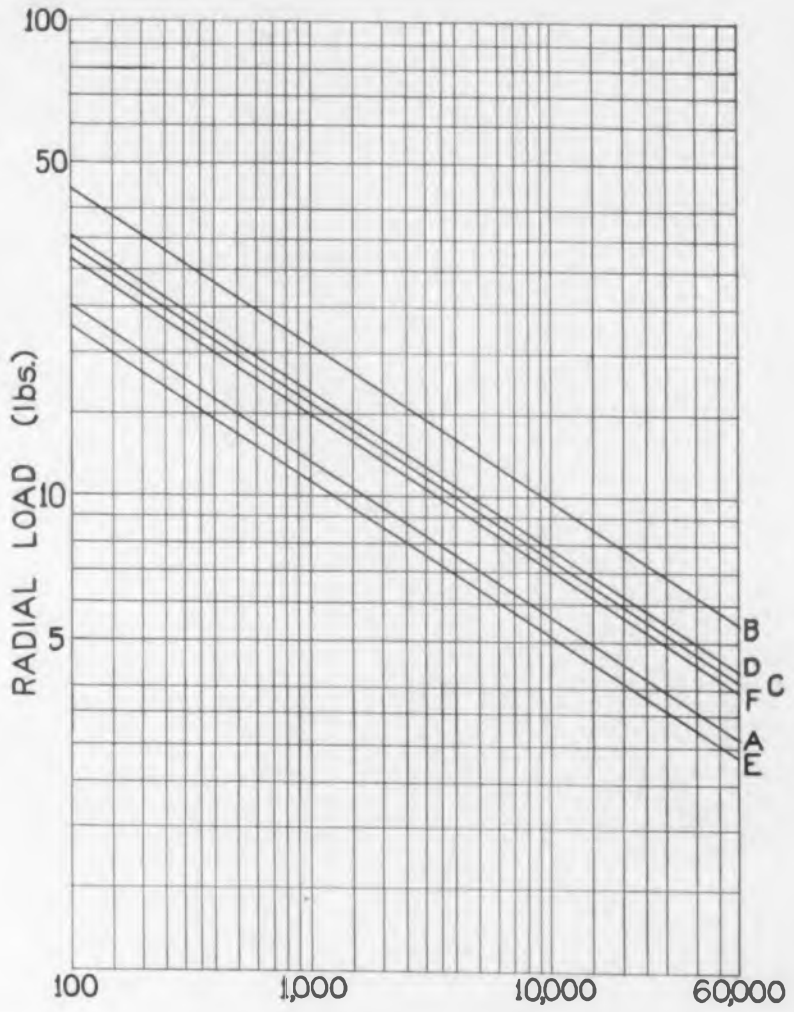


Fig. 6. Super-light radial bearing selection chart.

(All bearing dimensions in inches.)

	A	B	C	D	E	F
Bore	0.1250	0.1250	0.15625	0.1875	0.21875	0.2500
OD	0.2500	0.3125	0.3125	0.3125	0.3125	0.3750
Width	0.0938	0.1094	0.1094	0.1094	0.1094	0.1250





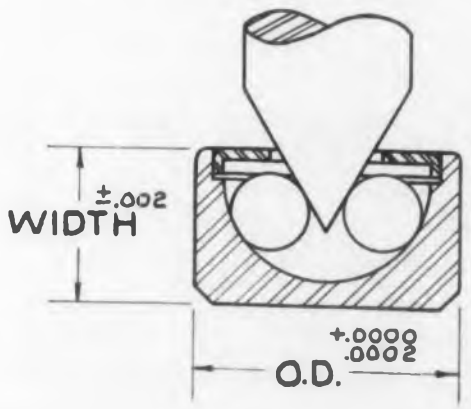
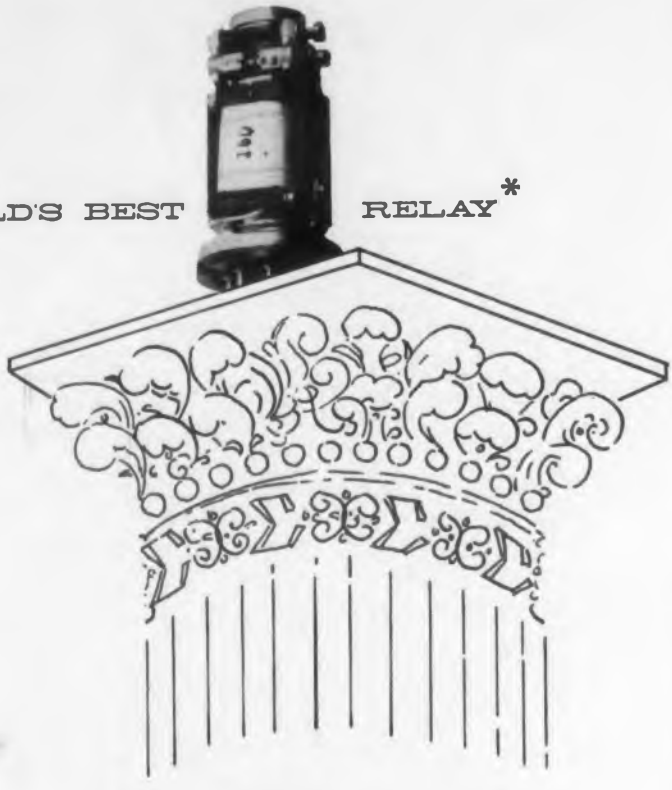


Fig. 7. Pivot bearing selection chart. S stands for shaft diameter.

(All bearing dimensions in inches.)

	A	B	C	D	E	F
OD	0.0590	0.1181	0.1575	0.1968	0.2953	0.3937
Width	0.0472	0.0709	0.0945	0.1181	0.1772	0.2362
min S	0.020	0.030	0.040	0.050	0.075	0.100

WORLD'S BEST RELAY*



That thing up there is one of our Series 72 High Speed Relays. It is basking in the warmth of that glorious moment which only comes to the most fortunate products — the moment when the designer still feels his dreams are realized, just before the murmurings start coming in from the field to shatter it all.

With most products it never happens because the complaints arrive soon after shipment of the first samples. Such was the case with its precursor, our Type 7, which was to be an improvement over all the old line telegraph relays (American relays, that is). Though it was less than half their size, as a telegraph relay it was disappointing, finding principal application in other work. The 72 has been "out" nearly two years and we cautiously permit ourselves to think the objective in hand. One or two Very Important Customers seem to agree.

While hair is down it may be admitted that this little wonder* is Sigma's first serious challenge to European relays. In fact, it is alleged by certain "independent laboratories" to excel them, particularly for high speed transmission. If so, we're in, because in addition the 72 has provision for maintenance and adjustment that combines features of the old fashioned phonograph needle and the timeless water faucet. Bias and sensitivity are "micrometer" adjustable; contact screws and armature are easily replaceable.

We are now in a position to sell these paragons in fair quantity. If you buy them for the type of application for which they are designed, we won't even cross our fingers — hardly.

FEATURES OF THE SIGMA SERIES 72 RELAY

Operating characteristics	Polarized
Contact arrangement	SPDT
Contact life and load rating	5×10^8 @ 60 ma DC (contacts easily replaced)
Contact separation	.004"
Max. aperiodic pulse rate	400 cps
Max. following pulse rate	1200 cps
Vibration immunity	15 g to 500 cps even at highest sensitivity
Height and diameter above octal plug	2 1/2" x 1 5/16"

**We can't prove this, but it is the opinion of the man who designed it.*

SIGMA

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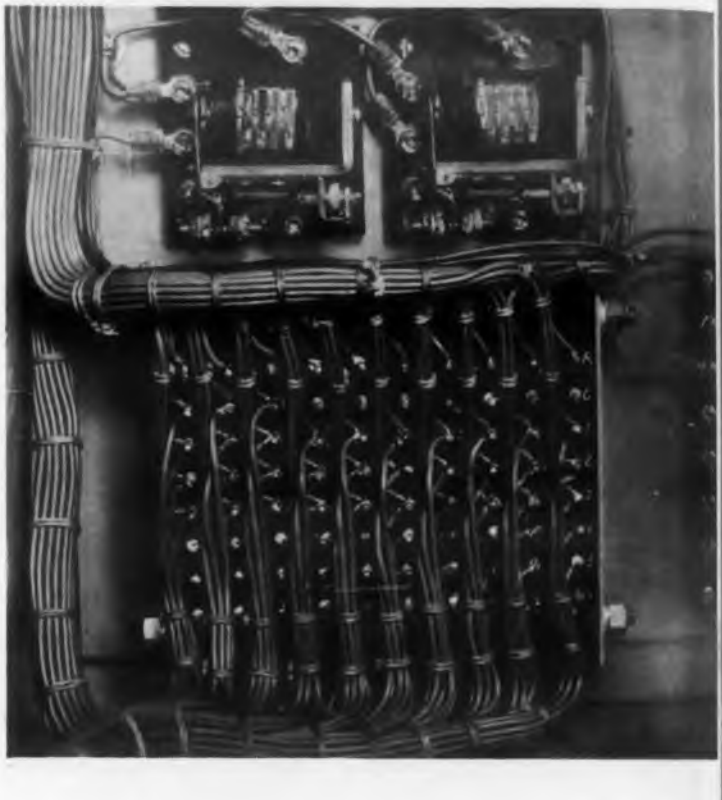
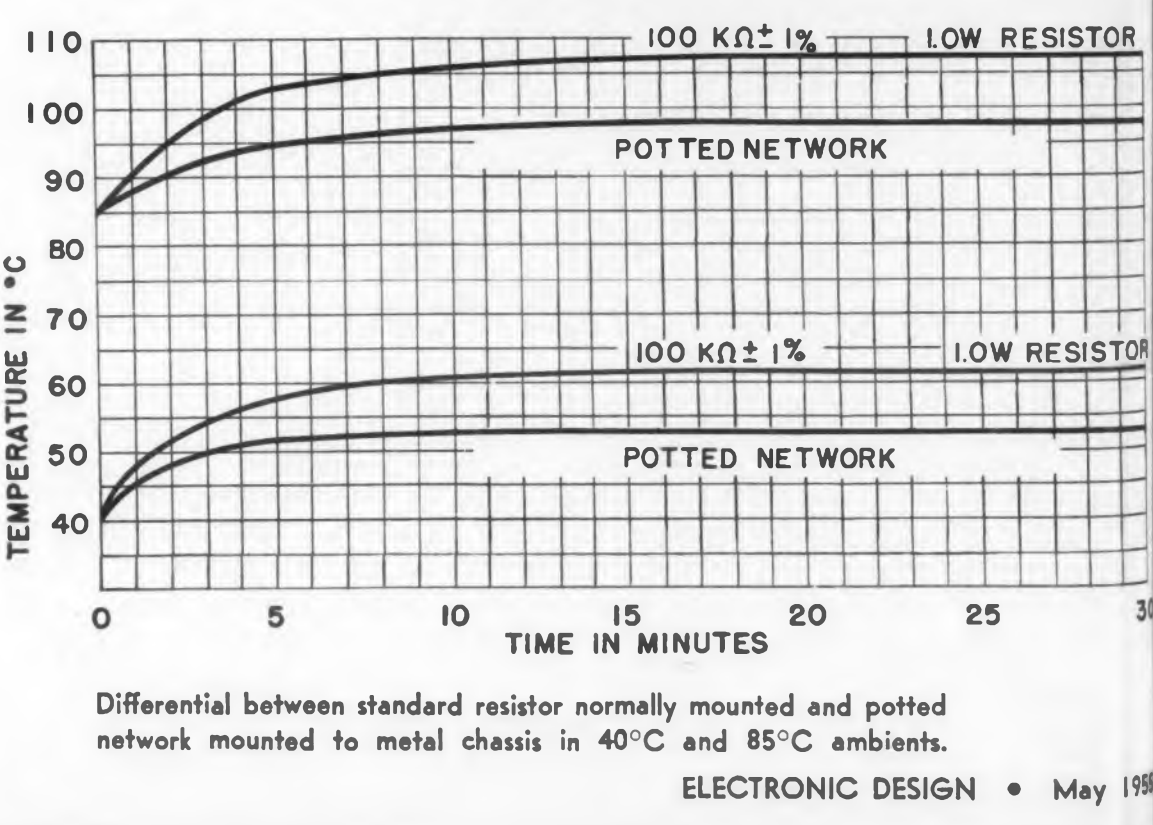
CIRCLE ED-35 ON READER-SERVICE CARD FOR MORE INFORMATION

Potted Resistor Networks



Rear view of console showing ten potted resistor networks. Each network contains seven, 1w resistors.



Differential between standard resistor normally mounted and potted network mounted to metal chassis in 40°C and 85°C ambients.

Five precision resistors attached to octal tube socket.

ENCAPSULATION of precision wire wound resistors in one compact space-saving unit not only offers the advantage of miniaturization and hermetic sealing but cuts assembly time. Resistors can be potted in almost any size or shape providing maximum efficiency and ambient operating temperatures up to 150°C. Sealed units are, of course, fungus proof, non-inductive, and non-corrosive.

Networks are available from the Resistor Div., of ITE Circuit Breaker Co., 19th and Hamilton Streets, Philadelphia 30, Pa., that can be plugged-in or stacked or bolted to the chassis. In the latter case there is maximum heat transfer and units operate at higher wattage ratings. In all units, temperature coefficients of expansion are the same, identical epoxy resin is used for terminal boards, bobbins, and final encapsulation. Network resistance tolerances to 0.01% are possible.

Styles for almost any method of mounting are available: plug-in, wire lead, screw-type or special. Components other than resistors can be included in the network. Units are put through five aging cycles. For more information about these units, turn to Reader's Service Card and circle **ED-36.**

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The automatic range feature does not make the meter larger than comparable VTVM's.

Range-Finding VTVM

WHEN the probe of the VTVM shown at the left is applied to a potential, the range switch in this instrument automatically turns to the proper range and the reading appears on the meter. The range-finding feature on the unit, which is known as the "Volt-Ohmatic" Automatic Range Switching Vacuum Tube Voltmeter, is a discrete position servomechanism. It is available as a packaged component for incorporation in other equipment such as oscilloscopes, automatic parts sorters, comparison bridges, and automatic controls.

The automatic switching feature means that the meter is always reading on the lowest possible scale for greater accuracy. During the switching action, the meter movement is disconnected from the circuit, thus protecting the instrument. The range switch can also be operated manually. When automatic switching is desired, the "automatic" button in the probe is depressed. Only one probe is employed for a-c, d-c, and resistance measurements. The instrument is manufactured by Bergen Laboratories, 11 Godwin Ave., Fair Lawn, N. J.

When used as a d-c meter, the VTVM has an accuracy within ±3% full scale. Voltage ranges are from 1.5v to 1500v full scale. Frequency response is 30cy to 3Mc. The circuit is a twin-triode meter bridge. The dimensions of the unit are 5-1/4" x 5" x 4-1/2", and it weighs 5 lb. The dimensions of the packaged switching feature alone are about 5" x 3" x 4". For more information on this instrument or the packaged servo switching device, turn to the Reader's Service Card and circle **ED-39.**

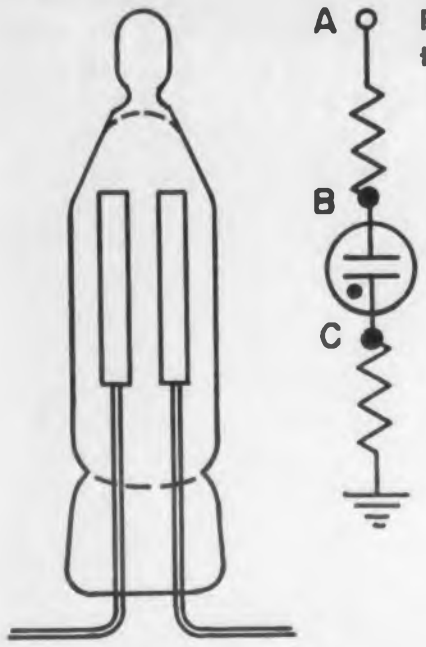

Fig. 1. The basic single-tube gas-diode circuit.

Gas-Diode Memories

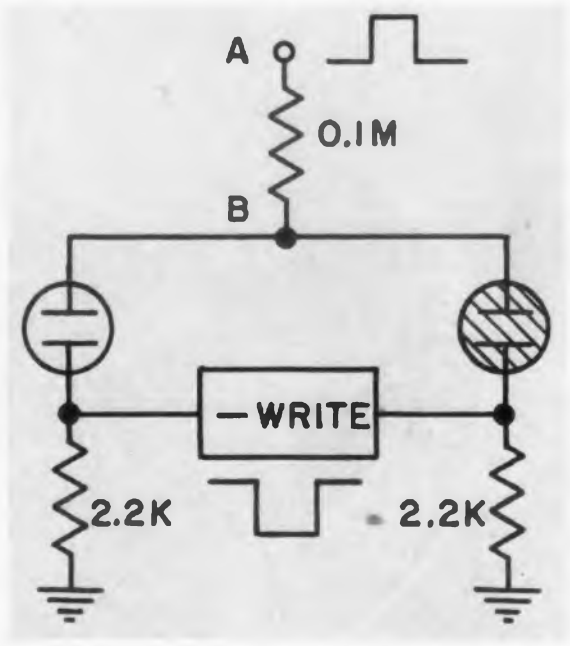

Fig. 2. This double-diode circuit affords high writing speed.

COLD-CATHODE gas diodes such as the simple neon glow lamp offer possibilities for low-cost high-speed memories, once the inherent disadvantages of the tubes are overcome. A study of these tubes for memory and indicator purposes has resulted in a number of circuits that provide an approach to reducing the cost of digital computer memories from the present dollar per bit to about 10 cents. Indication is also possible since in most of the circuits the lamp will flash in only one of the two stored states. This study was made by A. W. Holt and D. C. Friedman of the data processing systems laboratories, National Bureau of Standards, Washington 25, D. C.

Cold-cathode gas diodes as computer elements have a number of advantages: smallness of size, ruggedness, cheapness, cool operation, low power requirements, high possible pulse power, visual indication and several types of possible binary states of electrical operation. However, they also have a number of disadvantages that tend to limit their use. Among these are: a wide range of characteristic potentials; variability of these potentials with use, ambient light, and temperature; long deionization time; and difficulty in obtaining access to a single bit when used in a matrix. Recent efforts at the Bureau have been directed toward developing circuits to overcome the latter two difficulties to obtain indicator memories.

The basic memory circuit consists simply of a gas diode connected in series between two resistors as shown in Fig. 1. Power is applied to one resistor at point *A*. This resistor is connected to the diode at point *B*. The other terminal of the diode is tied, at point *C*, to the second resistor which is returned to ground. This circuit may be a pilot lamp, an oscillator, a flip-flop, an or-gate, an and-gate, a memory bit, or even a photo-flash. How it is used depends upon the voltages applied to points *A*, *B*, and *C*, the values of the resistors, and whether the output is electrical, photoelectrical, or optical.

When used as a d-c indicator memory bit, the total resistance exclusive of the diode is of the order of 0.1 megohm. A potential somewhere between the firing voltage and the holding voltage is applied at point *A*. If the tube is unfired, this potential is not enough to cause conduction, and the bulb will be dark. This condition may be taken as the binary "zero". *B* is at the supply voltage; *C* is at ground. If now a positive potential is applied momentarily at *A* or *B*, or a negative potential is applied at *C*, the tube may be caused to conduct. This conduction makes it glow. Point *B* drops in potential while point *C* rises. The new levels will be maintained as long as the potential at *A* is above the minimum holding potential for the tube. This condition may be considered as the binary "one". To return to the binary zero state, it is necessary to interrupt the holding potential until the tube deionizes fully. This interruption is one disadvantage of the circuit; another is that a continuous path is necessary to maintain the tube in the binary-one state, making it difficult to obtain access to one bit without disturbing others.

Memory Access Circuits

The first innovation was an attempt to overcome the access difficulties. It consisted of turning from the static bit just described to a dynamic type of storage. In this system, a binary one is stored if a tube has "recently" been fired. "Recently," in this sense, means within the last 100μsec. A binary zero is stored if the tube has not been fired in this time. Since a continuous path need not be maintained for storage, any scheme of matrix access circuitry may be employed. In the experiments with gas diodes the diode-transformer and-gate developed for the NBS diode-capacitor memory was used.

In using such an access matrix, the d-c holding potential at *A* is replaced by a 5μsec 100v pulse occurring every 100μsec (called a "hold" pulse) on all word buses simultaneously. This pulse will not fire a tube storing a zero, but will reionize a tube storing a one. In order to write a binary one, a positive pulse is applied to the proper word bus, and a negative pulse is applied to the proper bit bus. Neither pulse alone is sufficient to fire the tube; the simultaneous presence of both is required. Since this condition occurs only at the intersection of the selected buses only the desired bits are written as ones.

In order to examine the stored words, a positive "read" pulse is applied to the proper word bus. If the tube has been ionized recently, this pulse is sufficient to cause conduction, and a signal will be sensed at the "read repeater". During the holding pulse, the logical sum of the memory appears at the read repeaters if this information is desired.

This is a one-way memory: that is, information that has been read into the memory must be completely erased before new information can be read in. In order to write a zero, it is necessary to inhibit the "hold" pulse until the tube will no longer reionize when it is applied, and no provision has been made to make this occur on a single bit. However, because it is a high-speed one-way member, it has several possible applications. For example, it may be used as a buffer between the internal memory of a computer and a high-speed printer. In it would be stored all the information for a long print-out. While the printing operation is going on, the computer may be calculating the next set of data. An erasing time of about one millisecond may be economically allowed at the end of a printing cycle in this application. The memory may also be used as a visual tally board for a high-speed computer. In this case, erasure will

controlled by the operator at any suitable intervals.

Double-Diode Memory Circuits

The second innovation was made to provide high writing speed in both directions, using a double-diode bit (Fig. 2). In this circuit, two gas diodes, three resistors, and a negative "write" source are employed. Both tubes are fed from the power source through a common resistor. The power source is at the *A* end of the common resistor, and the anodes of both diodes are tied to the *B* end of the resistor. The cathodes of the diodes are returned to ground through separate resistors. The cathodes are also connected to the outputs of the negative "write" source.

In the operation of this circuit, a d-c potential above the firing potential is applied to *A*. One of the bulbs will thus always be on. To write-in the opposite digit, the cathode of the "off" tube is pulled down with a negative "write" pulse, which causes it to fire. Firing causes the common point *B* to drop to near ground potential, so that the "on" bulb now has less than holding voltage across it. It goes out and starts to deionize. At the end of the "write" pulse the point *B* rises again to holding potential, but all the current goes through the newly "on" bulb while the other continues toward its fully deionized state. Since the system is symmetrical, fast writing is possible in either direction.

Laboratory studies show that changing from a one to a zero, or vice versa, may be accomplished in 5μsec or less. However, it takes some time to reach steady-state conditions; so that as the repetition rate of changing from a one to a zero and back again increases, it becomes more difficult to determine whether switching has taken place. At the limiting rate, the "off" and "on" tubes have the same conduction state.

This type of memory may be used generally as a high-speed memory, provided the rapidity of change of any one datum is limited to the speed of changing from one binary state to the other. It is an indicating type of memory which may be read out visually by hiding one bulb of each pair or read-out by photo cells with either push-pull or on-off input to them.

Gas Diode-Capacitor Memory

Another memory which operates more slowly in one direction than the other has been the subject of limited study. Here, a gas diode is connected in series with a capacitor. Bipolar pulses are applied to the other side of the diode, and "read-write" pulses are applied to the other end of the capacitor. Suppose that the capacitor has been charged to —15v. When the first half of a bipolar pulse is applied to the top terminal of the diode, there is sufficient voltage across the diode to fire it. Conduction takes place and the capacitor tries to charge toward +15v. Whether it reaches this potential is immaterial, since during the second portion of the bipolar pulse the tube conducts in the opposite direction and charging is toward —15v. At the end of charging, the capacitor is left with the original charge. Thus a binary "one" (since the tube flashed) has been read and restored. If, however, the capacitor had been uncharged, the bipolar pulse would not have fired the bulb, the tube would have remained dark, and the capacitor charge would have remained unchanged. Since in this case all leakage would be toward ground, there is no chance of losing a zero. However, a binary one would tend to leak toward zero and therefore must be regenerated by the process of reading.

In order to write a binary one, it is necessary only to fire the tube during the bipolar pulse. This may be done by a negative bottom "write" pulse applied during the first half of the bipolar operating pulse. The regular regeneration cycle then holds this new information. To write a binary zero, the tube is fired during the first portion of the bipolar pulse; then, when the pulse starts down to charge the capacitor in the opposite direction, a bottom pulse is applied which holds the lower plate of the capacitor at —15v. This does not prevent the normal cycle of charging the upper plate to —15v, since this potential is set by the operating pulse amplitude and the drop across the diode. The bottom pulse is maintained until the upper pulse is over. At this time the upper plate of the capacitor is disconnected so that when the bottom is returned to ground, the top also rises to ground potential. Deionization must have progressed sufficiently before the next operating pulse to prevent refiring.

Other Memory Circuits

A variation of the NBS diode-capacitor memory can be achieved by replacing the semiconductor diodes with gas diodes. Here the diodes are used only to clamp one side of the storage capacitor or to disconnect it. This arrangement makes the requirements concerning the characteristics of the diodes much less stringent. In the operation of this circuit, the capacitor is charged a few volts positive for a binary one and a few volts negative for a binary zero. To write a one, the diodes are fired, clamping the top of the capacitor to approximately ground, and the bottom is pulled downward to —25v. When the clamping pulses are terminated, the diodes deionize, disconnecting the top of the capacitor. The bottom pulse is then released, raising the top of the capacitor to +25v. Similarly, to write a zero, a positive bottom write pulse is used. This circuit is shown in Fig. 3.

Reading is accomplished by clamping the top of the capacitor and noting the polarity of the pulse at the input to the read amplifier. To restore the information, the bottom pulse is applied in the same polarity as the pulse obtained upon clamping. Regeneration is necessary because of the destructive reading operation as well as leakage. Since the bit amplifiers are used in common, regeneration must be done word by word.

Although this is not primarily an indicator type of memory, it is possible to make it one. When operated in the mode just described, one diode carries more current than the other during rewriting, depending upon the polarity of rewriting, and this may be noted photoelectrically. In another mode of operation, regeneration is accomplished by releasing one clamping diode immediately after sensing. This action probably would be noticeable even visually. Writing may be accomplished in 10 to 50μsec.

High firing voltages across the diode may be dispensed with by supplying only low voltage to the diodes for charging purposes and a radio-frequency voltage to a shield about the tube to fire it.

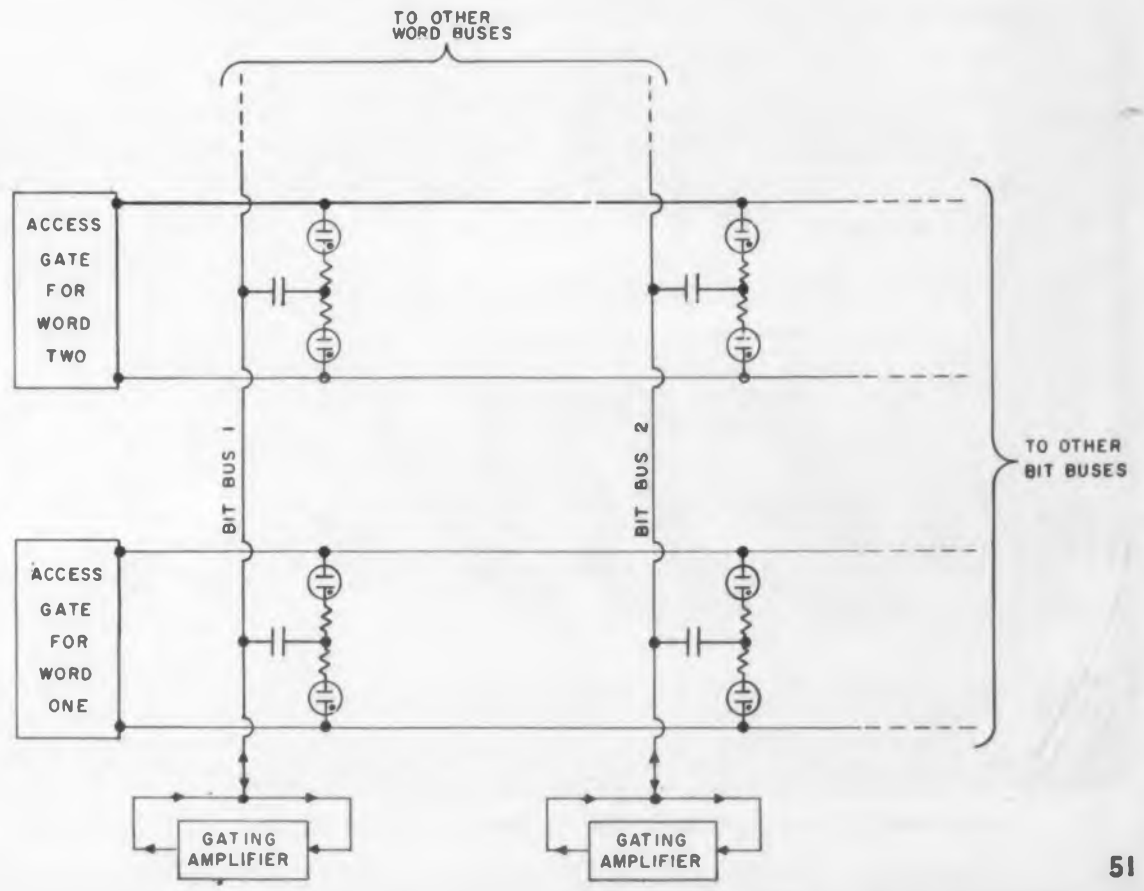

Fig. 3. The organization of a double-diode-capacitor memory.

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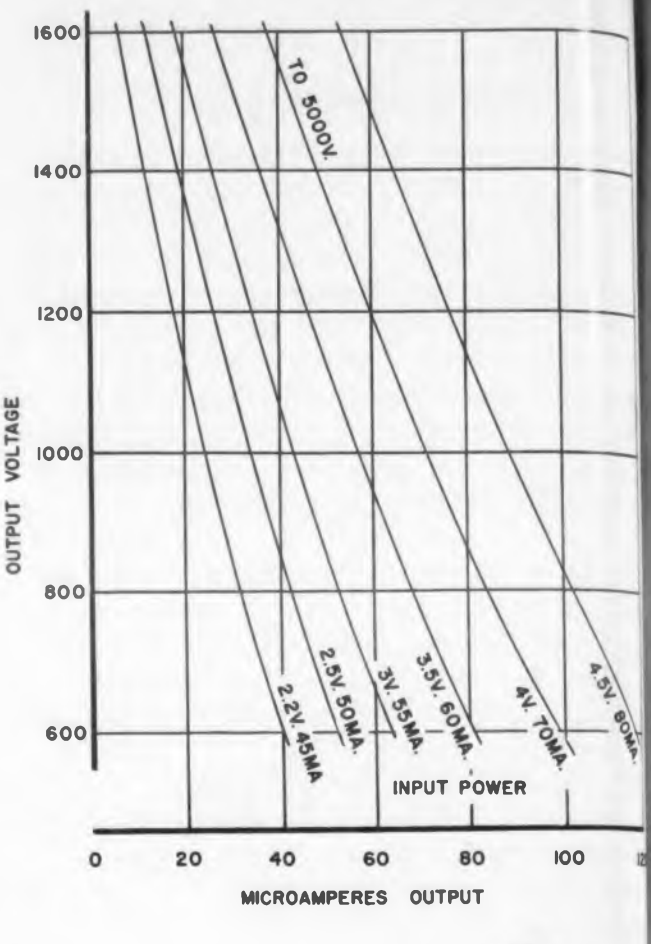
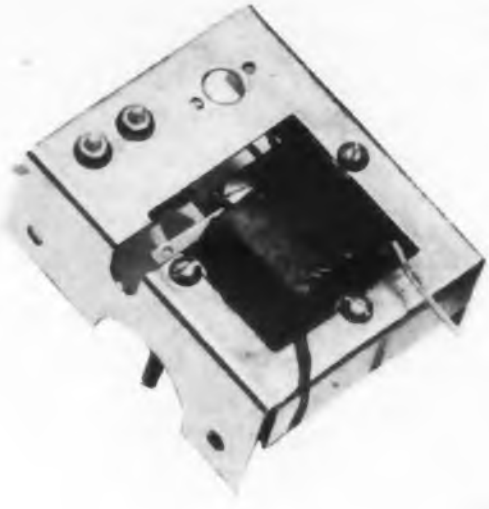
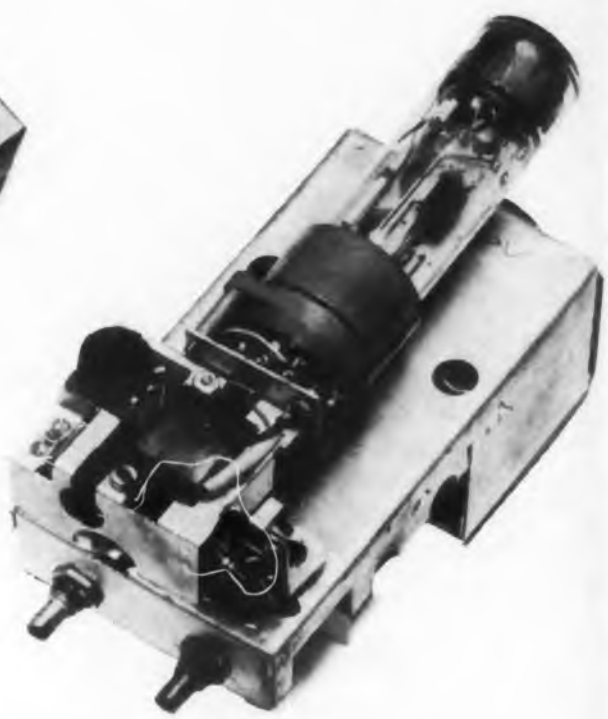
CIRCLE ED-41 ON READER-SERVICE CARD FOR MORE INFORMATION

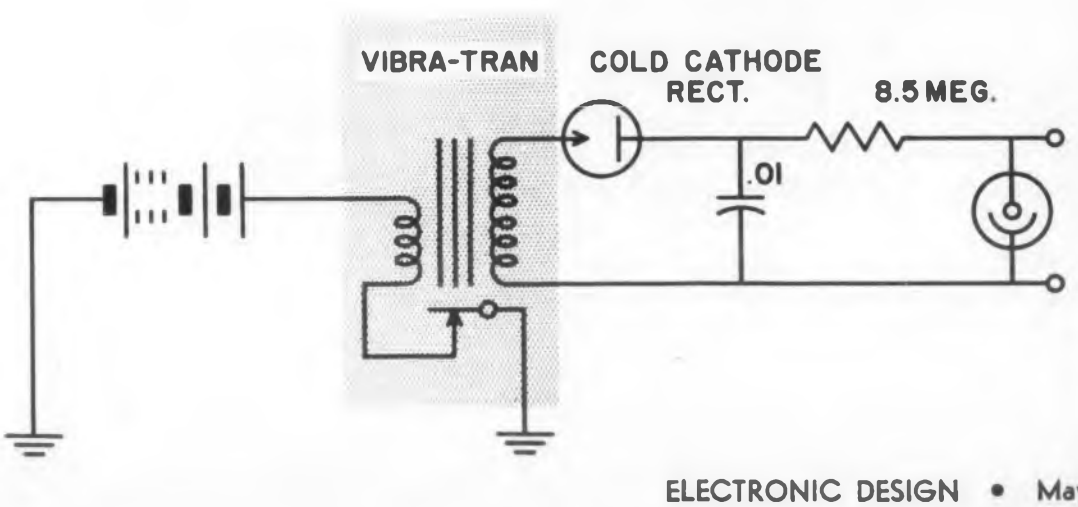
Miniature Step-Up Vibrator







Transformer and reed are mounted in the chassis above. Photomultiplier device using a Vibra-Tran is shown at right. Circuit for producing graph data shown below.



COMBINING the functions of a vibrator and transformer, this flashlight-cell operated component is ideal for miniature portable high-voltage power supplies. Known as the Vibra-Tran, the device was initially developed by the AEC for miniaturizing a Geiger Counter. It is now available commercially for supplying high voltage to photomultiplier tubes, ionization chambers, proportional counters, electrostatic precipitators, and photoflash equipment. Since low-power drain transistor circuits are feasible and practical, this device conceivably aids test-equipment manufacturers produce simple, battery-operated portable equipment such as oscilloscopes and megohmmeters.

The output voltage of the Vibra-Tran, manufactured by Edko Electronics Engineering Co., 202 Grand St., Brooklyn 11, N. Y., is governed by the secondary turns and the rate of change of flux. As the reed breaks contact, the magnetic flux in the core suddenly collapses generating a large, sharp, voltage spike in the secondary. The flux rate at break is much greater than at the reed contact instant, because the primary circuit has a larger LR factor.

A cold cathode rectifier can be used for rectification. Because of the very high harmonics in the secondary voltage, the filter is extremely simple. Coupled with simple electro static shielding normally used for h-f radiation, a 0.01mfd capacitor, and a 1 megohm resistor, the ripple for a 700v d-c regulated output is less than 1mv. The unit's core and reed are mounted on a shielding chassis which also readily accommodates the rectifier, filter, and regulator circuit elements. The platinum ruthenum reed is adjustable by a set screw. The reed has a minimum life of 500 hours. The high efficiency of the circuit permits a battery life as long as 50 hours (two D cells in series).

The unit starts over a wide range of temperature, and battery voltage. No orientation is necessary. Because windings are not grounded, a tapped bleeder may be used to get bias voltage. The unit is not affected by moisture. A typical unit weighs 6-1/2 oz. For more information, turn to the Reader's Service Card and circle **ED-42.**

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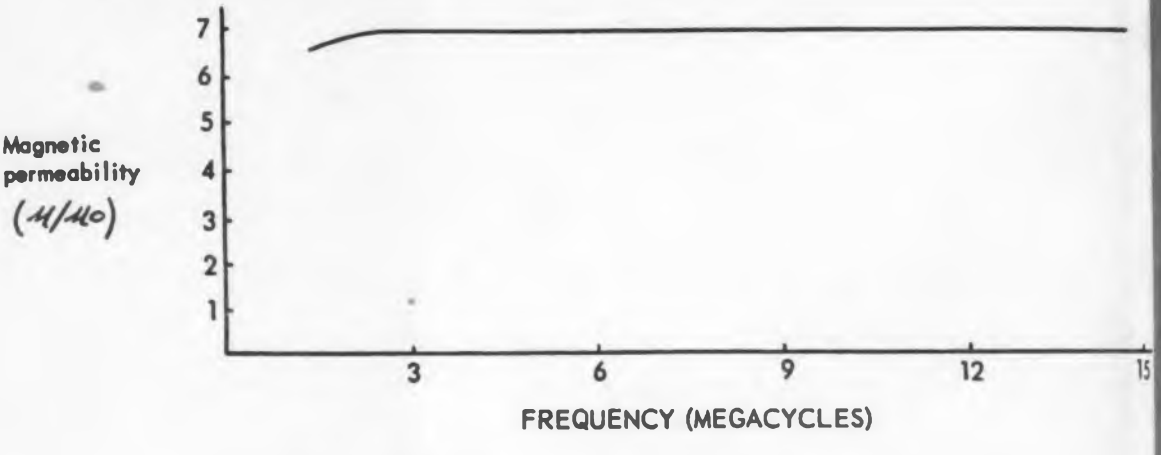
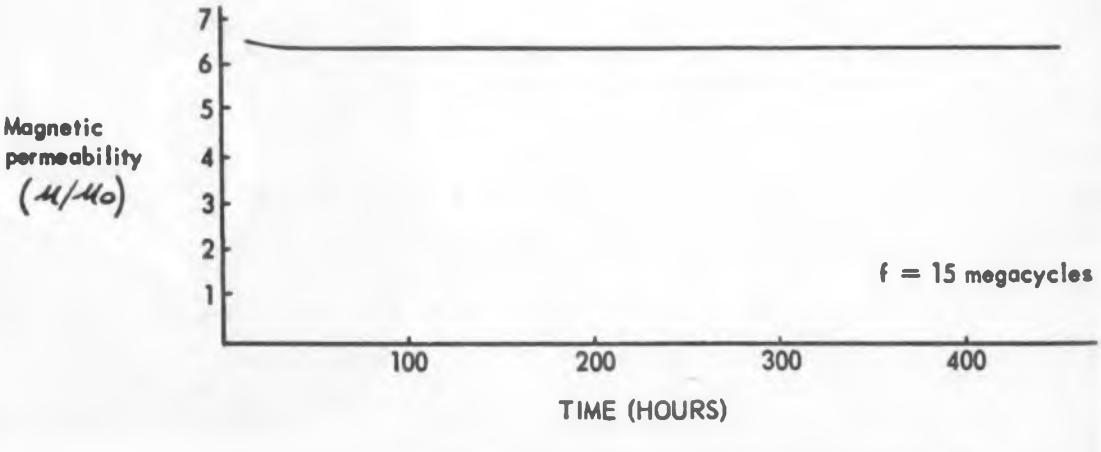
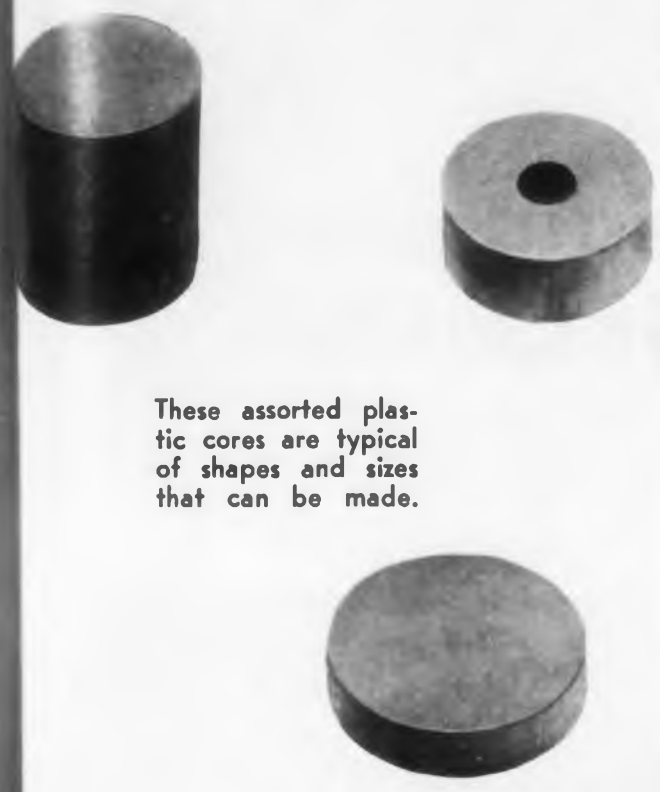
Magnetic Plastic Core



Magnetic permeability versus frequency at room temperature.



Magnetic permeability versus time after heat aging at 200° C.



These assorted plastic cores are typical of shapes and sizes that can be made.

UNUSUALLY high temperature stability, imperviousness to humidity, and low magnetic losses at 20Mc and higher frequencies, make this magnetic plastic core eminently suited for high-frequency coils, filters, and attenuators. Employing a binding resin that has outstanding properties at high frequency and high temperatures, this core offers coil designers new performance standards. Additionally, the core has an impact strength up to 40 times greater than other commercially available high frequency core materials. The material maintains a high impact strength at temperatures as low as —100°C. It is easily machined.

Known as Ferrotron, the core is manufactured by the Polymer Corp., Reading, Pa. It is heat resistant up to 200°C. Permeability is constant over wide ranges of frequency and temperature. It has an extremely low magnetic loss tangent. The material does not change properties due to humidity; it does not require a sealer.

An outstanding property of a coil wound on a Ferrotron slug is a positive coefficient of Q with temperature. Expressed as a percentage, the coefficient is $+0.10\%\Delta Q/°C$. This means that the power loss at elevated temperatures is less than that at ambient temperatures. It also suggests that sharper tuning of resonant circuits is possible. The temperature coefficient of permeability is $+0.002\%\Delta\mu/°C$.

Graph data was obtained for toroidal specimens measured with a Radio Frequency Permeameter (*ED, p. 44, March, 1955*). Uniformity of values from batch to batch is within the accuracy of the test equipment. Slugs are now available in sizes ranging from 1/2″ to 2″ OD by 1″ lg. For more data, turn to the Reader's Service Card and circle **ED-45.**

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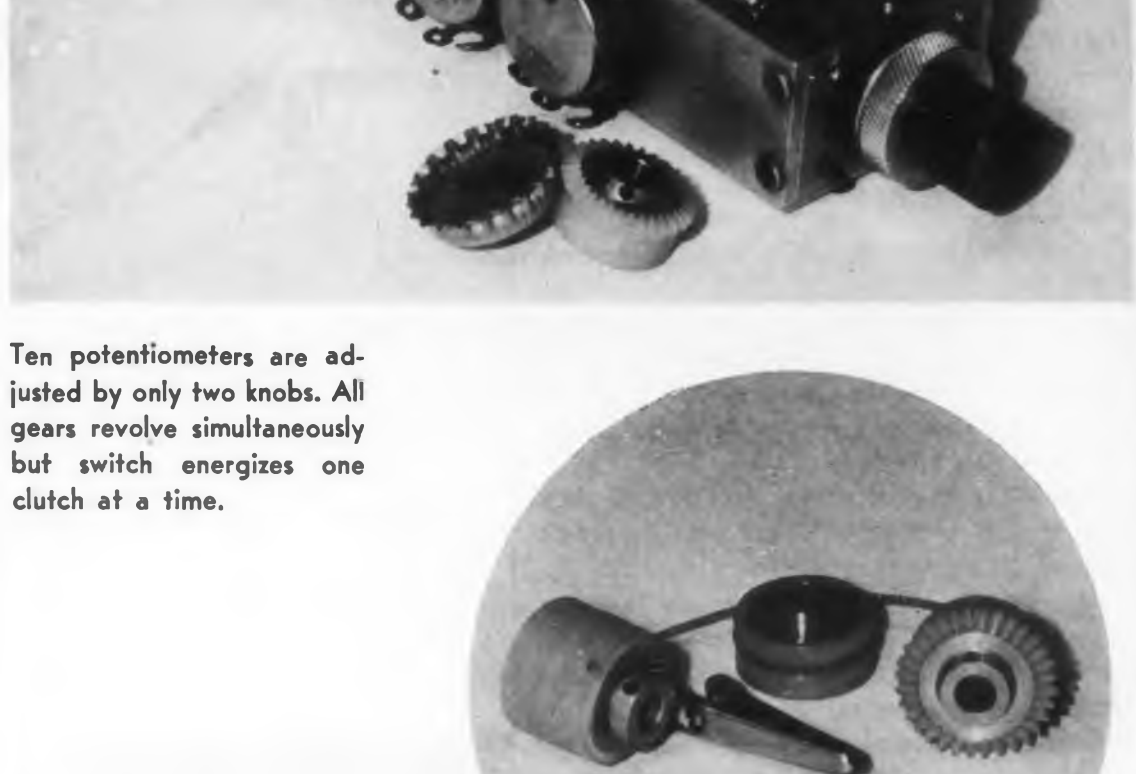
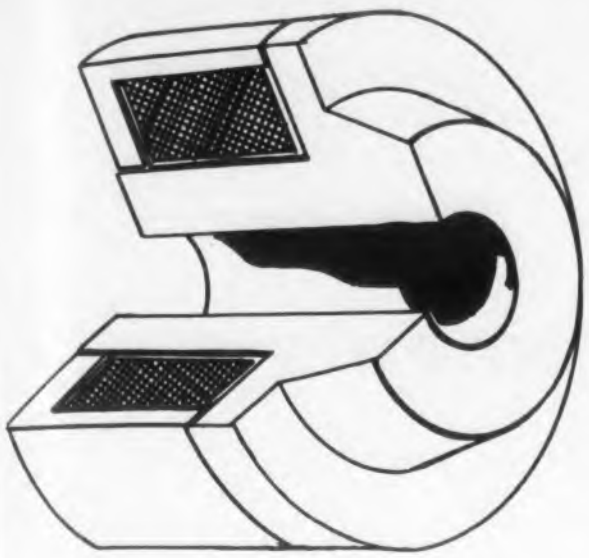
Miniature Magnetic Clutches



Ten potentiometers are adjusted by only two knobs. All gears revolve simultaneously but switch energizes one clutch at a time.

Direct in-line, cable, and gear types use identical clutch bodies. Size is indicated by alligator clip.



VARIOUS clutching and drive combinations can be assembled from a single clutch body common to all units described on these pages. By using a standard common body, costs have been reduced so that designers can specify clutches whenever such features are desirable. Two knobs can be used to control ten shafts as shown by the typical potentiometer drive assembly illustrated on the opposite page. This design conserves front panel space and eliminates the confusion of numerous knobs. Gear, cable, or direct in-line drive shells can be mated with the standard clutch body.

Some of the applications for the miniature clutches made by Electronic Manufacturing Engineers Co., 2410 Beacon Ave., Seattle 44, Wash., include controlling remote positioning devices, differential drives, and groups of devices as mentioned earlier. Their small size permits them to be built into speed changer gear boxes for selecting alternate gear ratios. The cable drive type not only allows a large degree of flexibility in hand-drive positioning but is a simple, low cost, anti-backlash servo drive. The direct in-line drives also have servomotor positioning applications.

The clutch assembly weighs less than an ounce and units may be ordered to operate from 6 to 30v dc; power consumption is less than one watt. The various drive shells run approximately 1″ in diameter. The depth of the units depends on whether it is a continuous rotation or single turn model; the maximum depth is 1″. The clutch is a positive on-off type. The drag torque is 0.5oz-in and engaged torque is 15oz-in. There is zero clutch slip when operated within rated conditions. For maximum clutch life, it is not advisable to operate the clutch when speeds exceed 200rpm.

There are a variety of clutch accessories available permitting the clutches to be adapted to many applications. For more application data, turn to the Reader's Service Card and circle **ED-48.**

Precision Phase Shift Measurements

By Raymond Rothschild

Industrial Test Equipment Co., New York 3, N. Y.

ACCURACY of equipment used for computing or control purposes is often determined by the phase shift occurring in transformer components. Small phase angles are exceptionally important in computer transformers, current transformers, potential transformers, computing amplifiers, resolver systems and the like. Hence, it is necessary to be able to make precise phase shift measurements.

Despite the need there are few instruments that can perform the measurements accurately. Some instruments employ the principle of measuring phase by noting the respective zero axis crossings of the reference signal and the signal of unknown phase. Considerable error can be introduced by this method if one of the signals contains noise and harmonic components and this is especially true if the noise or harmonic peak occurs in the vicinity of a zero axis crossing. Ambiguities that can arise are illustrated by the accompanying oscilloscope-type displays.

In order to measure phase, two voltages are required: a reference voltage and a voltage whose phase is to be measured with respect to this reference. The voltage of unknown phase can be resolved into two basic components at right angles to each other. For convenience we may think of these components as an in-phase component (in-phase with the reference) and a quadrature component (90 degrees with respect to the reference). Any instrument that could separate these components in this manner could then be effectively used to measure phase.

The principle of operation of the Phazor Phase Meter Model 200A is based on a precision multiplying device and can be used to measure these components. At the same time it eliminates the effect of noise and harmonics. The multiplier output is proportional to the time average of the instantaneous product of the input signal and the reference signal. The multiplier output is fed to a d-c meter and the deflection of the meter is:

$D_m = kAB\cos\theta$—the in-phase component

$$D_m = \frac{k}{T}\int_0^T V_s \cdot V_r \, dt$$

where

D_m = meter deflection
V_s = input signal
V_r = reference signal
k = a constant

if

$V_s = A \sin(\omega t + \theta)$
$V_r = B \sin \omega t$

then

$$D_m = k\frac{\omega}{2\pi}\int_0^{2\pi/\omega} A \sin(\omega t + \theta) \cdot B \sin \omega t \, dt$$

and

$D_m = k'AB \cos\theta$ (in-phase component)

where

k' = new constant

Employing the built-in phase shifter, the input signal may be shifted 90 degrees or

$D'_m = k'AB \cos(\theta - 90)$
$= k'AB \sin\theta$ (quadrature component)

This then is similar in operation to an ordinary electrodynamometer type wattmeter for which there is a current coil and a potential coil. In the wattmeter the meter deflection is proportional to the product of the voltage and the current and the cosine of the phase angle between them. Also in the wattmeter if the current coil were excited with one frequency and the potential coil with a different frequency there would be instantaneous power but no average power so that the meter reading would indicate zero. It can be shown from the multiplier equations that there will be no meter deflection if V_s and V_r are not of the same frequency. Consequently the instrument eliminates errors due to noise or harmonics of the signal voltage if the voltage applied to the reference channel is a distortionless sine wave.

By using a built-in phase shifter which is capable of shifting the input signal 90° the phase between two signals can be measured irrespective of the magnitude of the signal. With an input phase shift of 90° the meter deflection would be proportional to the sine of the phase angle between the reference and the input voltage (the quadrature component).

Hence

$$\frac{D'_m}{D_m} = \frac{k'AB\sin\theta}{k'AB\cos\theta} = \tan\theta$$

Measurement of Small Phase Shifts

To measure small phase shifts accurately a different method may be employed. That is, a voltage of unknown phase is bucked against the reference voltage. If both voltages are equal in magnitude, then the quadrature component of the difference voltage is proportional to the phase shift.

Let us consider a transformer with a 1:1 ratio transformation. For this condition the circuit connections shown in the diagram to the right would

oplicable. The symbols of the diagram represent spe-
ific voltages as indicated in the legend below:

$\dot{V}_r$ = transformer primary voltage (as vector)
= reference voltage

$\dot{V}_s$ = transformer secondary voltage (as vector)

$\dot{V}_{pm}$ = voltage across Phase Meter (as vector)

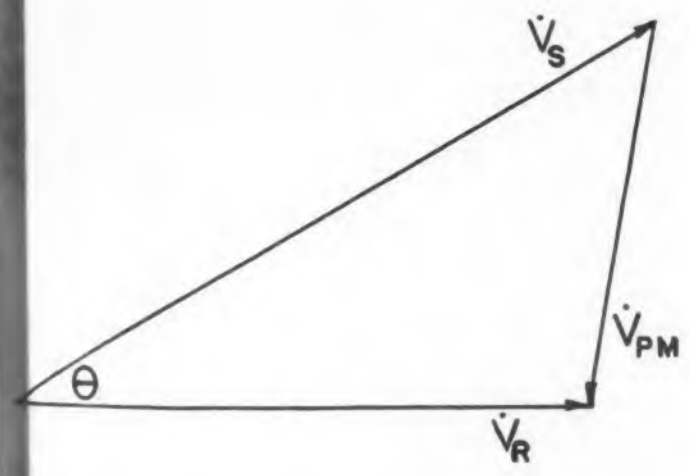
V_r = magnitude of $\dot{V}_r$

V_s = magnitude of $\dot{V}_s$

The voltage across the input terminals of the phase
eter would be

$$\dot{V}_{pm} = \dot{V}_r - \dot{V}_s \qquad (1)$$

A vector representation of each of the voltages is shown
elow.



hen

$$\dot{V}_{pm} = \dot{V}_r - (V_s \cos\theta + jV_s \sin\theta) \qquad (2)$$

$\dot{V}_{pm}$ can be broken up into two components V_o (an
-phase component) and V_{90} (a quadrature component)
follows:

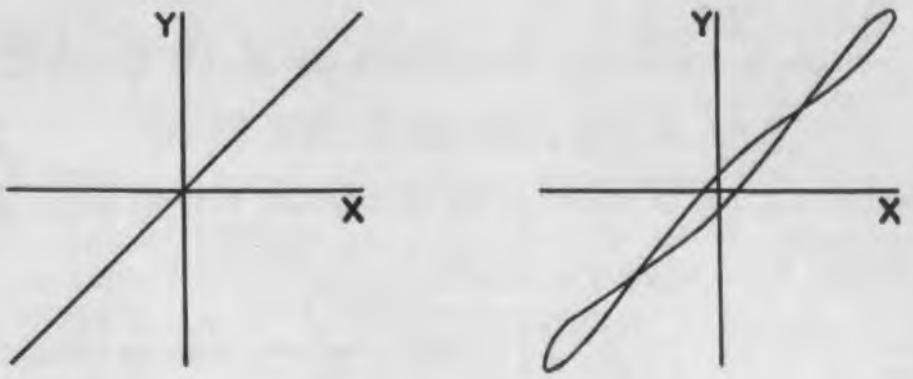
$$V_o = (V_r + V_s \cos\theta) \qquad (3)$$

d

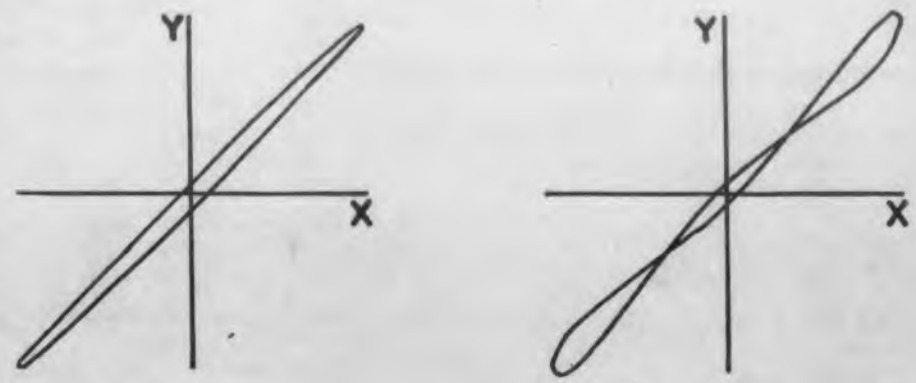
$$V_{90} = V_s \sin\theta \qquad (4)$$

ECTRONIC DESIGN • May 1955

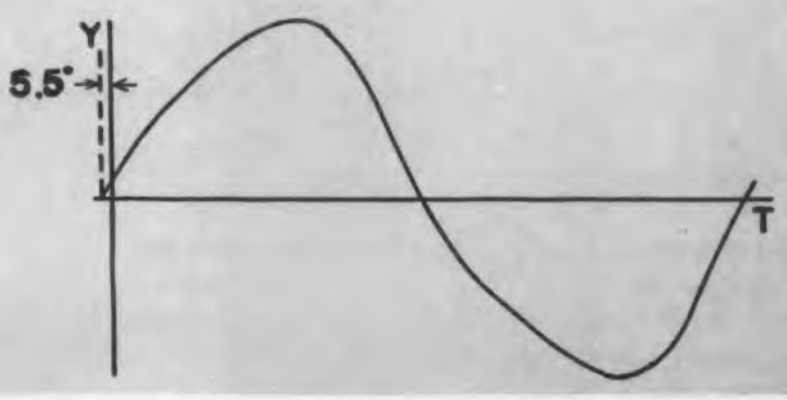
Two voltages at zero phase shift, left, y=sinwt and x=sinwt. At the right, third harmonic has been added and y=sinwt + 0.1cos3wt.



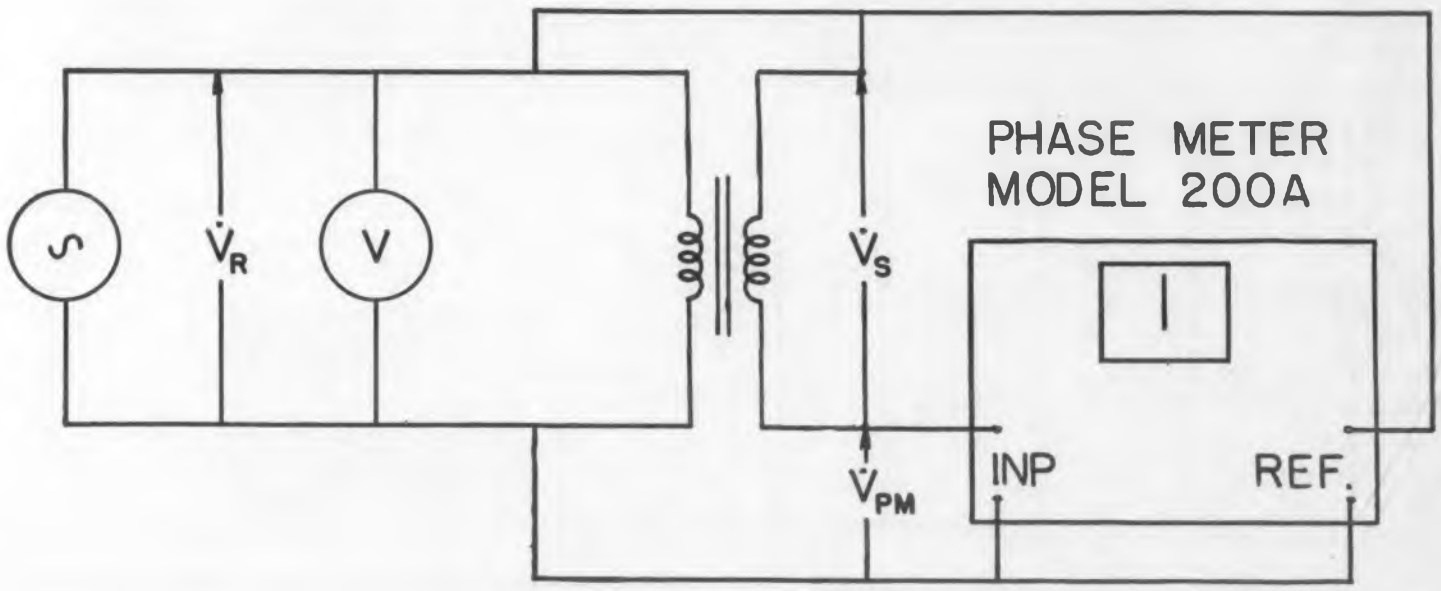
Three degrees phase shift has been added to y signal, left, making y=sin(wt-3°). At the right, y signal contains both 3° phase shift and 10% 3rd harmonic distortion. Note phase shift for this distorted signal is ambiguous.



Plotting y=sinwt + 0.1cos-3wt, note that the fundamental has zero phase shift but does not pass through zero at zero degrees.



Connections for measuring small phase shifts with Phase Meter.



When θ is small, which, of course, is the case in this procedure for measuring small phase shifts that might occur in a transformer

$$\text{Cos } \theta \simeq 1$$

$$\text{and Sin } \theta \simeq \theta \text{ in radians}$$

In accordance with these approximations, equations (3) and (4) can be rewritten as follows:

$$V_o \simeq V_r - V_s \tag{5}$$

$$V_{90} \simeq V_s\,\theta \tag{6}$$

But for a nominal 1:1 ratio of transformation V_r (primary voltage) is approximately equal to V_s (secondary voltage) therefore

$$V_{90} \simeq \theta V_r \tag{7}$$

and dividing thru equation (5) by V_r

$$V_o/V_r \simeq (V_r - V_s)/V_r = 1 - V_s/V_r = e_t \tag{8}$$

which represents the error in the nominal ratio of transformation

or

$$V_o \simeq e_t\,V_r \tag{9}$$

Phase Meter Model 200A produces a deflection proportional to the in-phase component of $\dot{V}_{pm}$ (or V_0) when its phase shift switch is in the "0" position and a deflection proportional to the quadrature component of $\dot{V}_{pm}$ (or V_{90}) when in the "90" position. Therefore, by utilizing equation (7) it is possible to calibrate this Phase Meter to read phase angle directly when the instrument is set to read quadrature voltage. Furthermore, by utilizing equation (9) it is possible to read error in ratio of transformation when the instrument is set to read in-phase voltage.

Let us consider a specific example. Suppose we had a transformer with a transformation ratio of 1.000 $\pm$.001 and an allowable phase shift of $\pm$1 milliradian at a primary voltage of 10.0 volts. Collecting this data in a form to be substituted in our equations

$$V_r = 10 \text{ volts}$$

For the worst condition, the respective maximum phase shift and error in transformation ratio would be

$$\theta = 0.001 \text{ radians}$$

$$e_t = 0.001$$

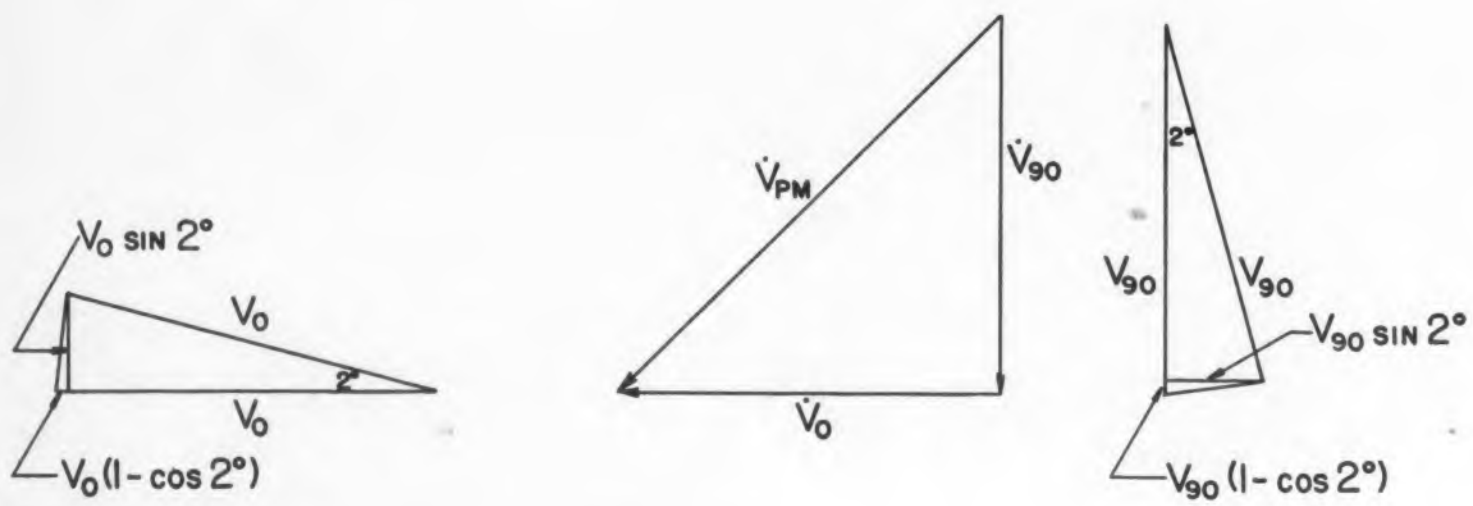
From equation (9)

$$V_o \simeq e_t\,V_r = 0.001\ (10) = 10 \text{ millivolts}$$

and using equation (7)

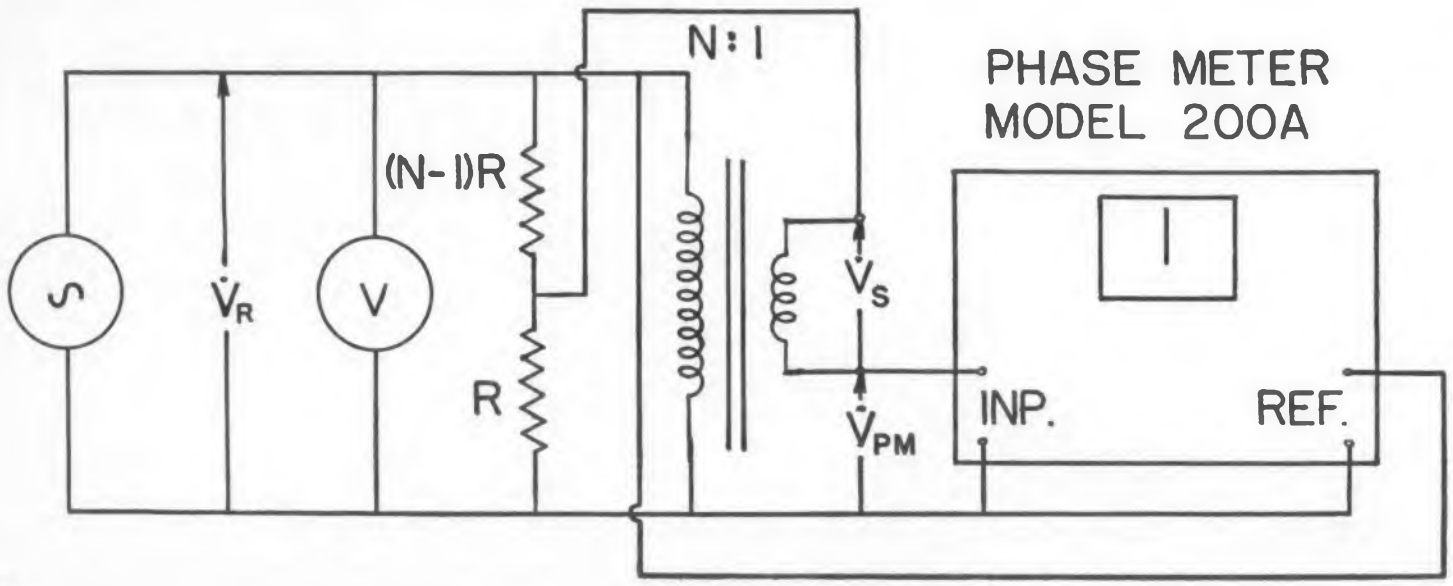
$$V_{90} \simeq (0.001)\ (10) = 10 \text{ millivolts}$$

Hence, when using the foregoing method, a quadrature voltage of 10 millivolts represents 1 milliradian and an in-phase voltage of 10 millivolts represents an error ratio of transformation of 0.1%. It would now be necessary to set the input gain control of the Phase Meter so that a signal of 10 millivolts would produce a full scale deflection.



Effect of a 2° error on the in-phase, V_0, and quadrature, V_{90}, components, left and right respectively, of the phase meter vector voltage, V_{pm}, center. See extreme right-hand column text for numerical results.

Connections for measuring small phase shift in transformers not having 1:1 ratio.



Sources of Error

The major sources of error will originate from the following factors:

a Error in approximations of equations (7) and (9)

b Error in calibration of Phase Meter.

c Possible errors in Phase Meter.

For the example under consideration

$$V_r = 10 \text{ volts}$$

$$\theta = 1 \text{ milliradian}$$

$$e_t = \pm.001$$

$$\sin \theta = 0.00100$$

$$\cos \theta = .99999$$

This means that the error of assuming sin $\theta = \theta$ is negligible and the error of assuming cos $\theta = 1$ is also negligible.

There is another approximation that was made in equation (7); that is, the assumption that V_r is approximately equal to V_s. For this case, the worst condition will occur when the error in transformation ratio is maximum

or

$$e_t = 0.001$$

then

$$e_t = 1 - V_s/V_r = 0.001$$

or

$$V_s/V_r = 0.999$$

But according to equation (6), θ is inversely proportional to V_s. This means that in the worst case this approximation in equation (7) will introduce an error of 0.1% full scale in the measurement of θ.

Assume that the instruments which are employed in the calibration of the Phazor Phase Meter could possibly be in total error by $\pm$3%. This would introduce a maximum error in the reading of the Phase Meter of $\pm$3% of full scale.

The specified accuracy of Phase Meter Model 200A is $\pm$2 degrees. Assume then that either the in-phase or quadrature component of the difference voltage (V_s) might be shifted $\pm$2 degrees due to internal errors in the Phase Meter. To examine the effect of this type

error, consider the vector V_{pm} and its component parts V_o and V_{90} as shown on the opposite page.

If V_o were shifted 2 degrees, it would introduce an error of

$$V_o\,(1-\cos 2^\circ) = V_o\,(0.00061)$$

in the reading of the in-phase component and an error of

$$V_o \sin 2^\circ = 0.0349\ V_o$$

in the reading of the quadrature component.

Similarly, if V_{90} were shifted 2 degrees it would introduce an error of

$$V_{90} \sin 2^\circ = 0.0349\ V_{90}$$

in the reading of the in-phase component.

This would then introduce a maximum error in the reading of the in-phase component of

$$(0.00061)\ (10) = 0.006 \text{ mv.}$$
$$+\ (0.0349)\ \ (10) = 0.349 \text{ mv.}$$
$$\text{Total} \quad\ 0.355 \text{ mv.}$$

But full scale equals 10 mv., hence this contribution will yield a maximum error of 3.55% of full scale in the reading of the error in ratio of transformation.

For the quadrature component, the maximum error would be

$$(0.00061)\ (10) = 0.006$$
$$+\ (0.0349)\ \ (10) = 0.349$$
$$\text{Total} \quad\ 0.355$$

But full scale equals 10 mv hence this contribution will yield a maximum error of 3.55% of full scale in the reading of the phase shift.

To summarize, the total maximum error in the reading of ratio of transformation due to sources a, b, and c is

$$0.0 + 3.0 + 3.55 = 6.6\% \text{ of full scale.}$$

Since full scale represents ±.1%, the actual maximum total error is only

$$0.0066\%$$

The total maximum error in the reading of phase shift due to sources a, b, and c is

$$0.1\% + 3.0 + 3.55 = 6.7\%$$

Since full scale represents ±1 milliradian, the actual maximum total error is only

$$0.067 \text{ milliradians}$$

It should be stated that Phase Meter Model 200A may be employed with equal effectiveness on transformers with other than 1:1 ratio. For a transformer with ratio "n", the circuit shown on having a compensating voltage divider as illustrated may be employed. The corresponding solutions for this condition are

$$V_{90} \simeq (\theta V_r)/n \qquad (10)$$

and

$$V_o \simeq (e_t V_r)/n \qquad (11)$$

Thus we see equations (10) and (11) are similar to equations (7) and (9) except for the additional factor

$$1/n.$$

Calibration procedure and sources of error can be readily deduced by referring to the previous discussion of the transformer with a ratio of 1:1.

New Products...

Potentiometer

Variable and Fixed Sections

The "Esipot" offers the equivalent of a 10-turn potentiometer, although any setting can be made within less than two revolutions of the single control shaft. It consists of a high-resolution single-turn potentiometer which actuates a 10-position attenuator switch as the potentiometer reaches the end of its travel in either direction. This switch transfers the single-turn potentiometer to any one of the 10 voltage positions provided on a 10-step attenuator switch.

Because the "Esipot" uses precision fixed resistors in the initial attenuator section, a wide range of resistance values can be made available, having excellent frequency response and power dissipation characteristics. The unit can often replace a pair of controls where both "course" and "fine" adjustment steps are desired. Its high resolution makes it valuable as a "zero adjust" or precision gain control.

The assembly is only 1-3/4" diam x 1-3/4" long behind panel, and mounts in a single 7/16" panel hole. A standard 1/4" diam operating shaft is provided. Electro-Measurements, Inc., Dept. ED, 4312 S. E. Stark St., Portland 15, Ore.

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

Silicon Power Rectifiers

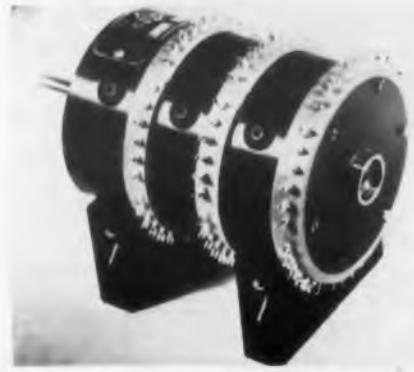
Up to 15amp

Silicon power rectifiers, Types CK775 and CK-776, are capable of handling up to 15amp and 200v peak. Operation at 5amp and 170° is permissible. The ratio of reverse to forward resistance is over 100,000. The rectifiers are small (about 0.6 cu in), hermetically sealed, and usable to over 100,000cy. Raytheon Manufacturing Co., Dept. ED, 55 Chapel St., Newton 58, Mass.

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

Sampling Switch

Has Three Synchronized Poles



The Model 6300 is a high-speed sampling switch with three synchronized poles. This compact, precision unit is available with from one to six poles, each pole being capable of sampling up to 30 non-shorting channels. The switches feature this firm's new "Perma-Brush" to provide longer service life and more predictable, uniform performance.

Standard features include semi-molded contact plate construction and individual phasing provisions. The unit is available in a wide range of variations of number of contacts and terminals. Length, including shaft, is 3", and diameter, minus base, is 2-5/8". General Devices, Inc., Dept. SPED, P. O. Box 253, Princeton, N. J.

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

Silicon Crystal Diode

Covers 10,000-20,000Mc Band

The 1N286, a broad-band, coaxial, point-contact type crystal diode, is designed for use as a crystal mixer. Its unique internal geometry makes it possible to cover the band of frequencies from 10,000Mc to 20,000Mc.

With the crystal holder made in WR-75 waveguide the 10,000-15,000Mc band can be covered, and with the holder made in WR-51 waveguide the 15,000-20,000Mc band can be covered. Because of its broad-band characteristics, the diode is particularly useful in such applications as tunable frequency radar systems and counter-measure devices. Sylvania Electric Products, Inc., Dept. ED, 1740 Broadway, New York 19, N. Y.

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

Spectrum Selector

For Gating Pulses

The Model SD[illegible] Multi-pulse Spectrum Selector displays and selects for spectrum analysis, a specific train of microwave pulses, as well as any one pulse in a train. Designed to work with spectrum analyzers, it will select and gate a group of pulses up to 100μsec in length. It will work with fast, narrow pulses, and can be adjusted to gate any pulse including the first, at zero time. Special circuitry discriminates automatically once pulses have been selected.

The unit operates at all microwave frequencies that can be accepted by Polarad spectrum analyzers. Polarad Electronics Corp., 43-20 34th St., Long Island City 1, N. Y.

CIRCLE ED-56 ON READER-SERVICE CARD FOR MORE INFORMATION

Slip Ring Assemblies

Low Friction, High Precision Units

Miniature slip ring and brush assemblies matched to specific project requirements are now being manufactured by this firm. The units are designed to transmit electrical energy to and from rotating elements in various kinds of electromechanical devices. Many uses are found in computers, telemeters, and other types of control and indicating systems. They are particularly suitable for applications such as gyroscopes, where low friction and high precision are required.

Prototype samples can be supplied within a short time and at low cost. Iron Fireman Electronics Div., Dept. ED, 2839 S. E. 9th Ave., Portland, Ore.

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

Transducer
For Underwater Work

The Model PS-23 transducer is designed for use in the 22 to 28kc band or at lower frequencies, where pressures and temperatures are severe. It is serviceable at static pressures up to 2,000lb square inch and at temperatures up to 300°F.

This model has an impedance of 16 + j56 ohms at 24kc, and a receiving sensitivity of −102 to −104db vs 1v per microbar in the 22 to 28kc band. Its electroacoustic efficiency is approximately 20% for transmitting or receiving in water.

The transducer measures 3-1/2" in length and 3-1/4" in diam. It may be supplied with nonfloodable cable, or with leads and provisions for sealing on to an instrument case or cable header. The Harris Transducer Corp., Dept. ED, Southbury, Conn.

CIRCLE ED-58 ON READER-SERVICE CARD

Potentiometer
Low Operating Torque

Extremely compact and sturdy 4-section precision potentiometers made in Switzerland are available in the United States. The microfriction units have a starting torque of 0.003 to 0.006oz-in per section. Resistance range is 100 to 100,000 ohms. Maximum resistance tolerance is ±0.2%. Special linearity tolerance is ±0.15%. Electrical rotation is 355°±2°; maximum operating speed is 700 rpm. Power rating is 1/2w. Diameter of case is 1.18"; length of 4 sections is 1.86". F. H. Paul & Stein Bros. Inc., Dept. ED, 235 Fifth Ave., New York 16, N. Y.

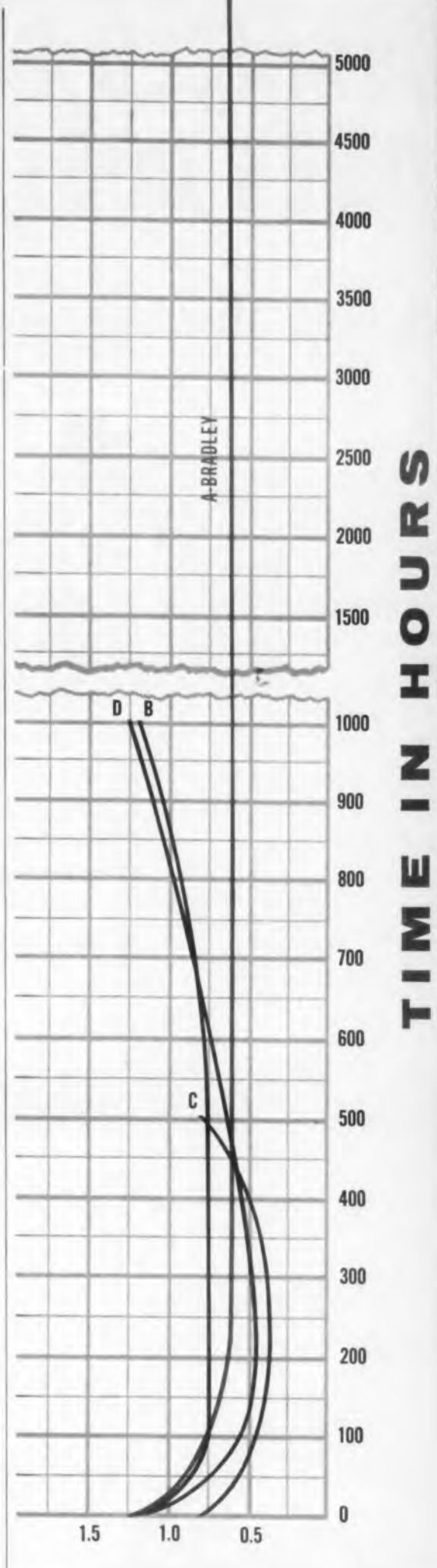
CIRCLE ED-59 ON READER-SERVICE CARD

Fast Etching Solution
For Printed Circuits

A new etching solution for making etched printed circuits is trade named Hunt RCE Solution. It gives controlled rapid etching speed, permitting standardization of a high production etching schedule; and instant and uniform etching over the entire circuit. Philip A. Hunt Co., Dept. ED, Palisades Park, N. J.

CIRCLE ED-60 ON READER-SERVICE CARD

CIRCLE ED-61 ON READER-SERVICE CARD ➤



Life test curves comparing reverse leakage of Bradley vacuum processed selenium rectifiers with units produced by different processes by other manufacturers.

THE LONGER LIFE TEST PROVES

the greater superiority of

Bradley RECTIFIERS

What happens when you test a rectifier? You get an indication of forward and reverse current and power characteristics. But, the ultimate value of a selenium rectifier must be determined as a function of time plotted against electrical characteristics and environmental conditions.

Adequate, long-lasting circuit control should be accomplished in the design stage, not by replacement every few hundred hours.

On extended life tests Bradley vacuum processed selenium rectifiers consistently outperform and outlast similarly rated rectifiers produced by other manufacturers using other processes.

Write for a set of life test curves. They prove the superiority of Bradley Laboratories' vacuum processed selenium rectifiers.

THE BRADLEY METALLIC RECTIFIER MANUAL is today's most comprehensive treatment of selenium and copper oxide rectifiers. Circuitry, applications, testing, construction, design considerations. $2.00

VACUUM PROCESSED FOR PERFORMANCE AS RATED

BRADLEY LABORATORIES, INC.

174 Columbus Avenue, New Haven 11, Connecticut

Bradley

Oscillographic Systems

In Six and Eight Record Channels

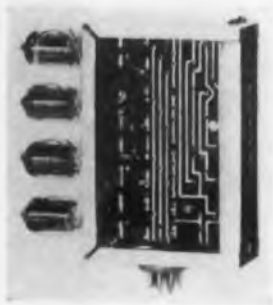
Six and eight-channel models have been added to this firm's line of oscillographic recording systems. The complete "150" line now includes single, two, four, six, and eight-channel systems, adaptable to numerous recording requirements by means of interchangeable, plug-in preamplifiers or "front ends."

The eight-channel system is comprised of two units: a mobile cabinet containing an eight-channel recorder, control panel, and four driver amplifiers with power supplies; and a second mobile cabinet containing four additional driver amplifiers with power supplies, a sliding shelf, and cabinet space. The six-channel system is similar to the eight, but with fewer galvanometers, driver amplifiers, and power supplies. Sanborn Co., Industrial Div., Dept. ED, 195 Massachusetts Ave., Cambridge, Mass.

CIRCLE ED-62 ON READER'S SERVICE CARD FOR MORE DATA

120kc Decade Counter

For Indication and Recording



Model AC-4A Decade Counters provide a 120-kc counting rate and have an output voltage suitable for recorder operation. They feature etched circuits in which every circuit segment is fully visible, clearly labeled, and arranged diagrammatically for simple servicing. The mechanical layout improves ventilation, making possible lower operating temperatures and longer service life. Illuminated numerals have reflectors for maximum brilliance and easy readability under all light conditions.

The counters are engineered to fit all standard electronic counters, regardless of make, and also may be used separately in experimental or special setups. Resistors are premium quality 5% tolerance units, coupling capacitors are silver mica. Four electronic tubes are employed. Hewlett-Packard Co., Dept. ED, 395 Page Mill Rd., Palo Alto, Calif.

CIRCLE ED-63 ON READER'S SERVICE CARD FOR MORE DATA

Coaxial Triodes

For 20-25kw Equipments

The ML-6424 and ML-6425 coaxial-terminal triodes, employing thoriated-tungsten filaments, are for industrial and broadcast equipments of 20-25kw power output. As replacements for types 5619 and 5604, the new triodes provide improved performance ratings, safety margins, and strength. New thoriated-tungsten filaments greatly reduce power requirements while offering life increases to 100%. Plate current ratings are increased by over 15%, grid current ratings by over 10%. Terminal inductances are very low. High transconductance characteristics, up to 25%, assure stable operation, low grid drive, and high plate efficiency.

ML-6424 uses the company's standard water jacket and is rated for 40kw input, 20kw anode dissipation. ML-6425 employs an aluminum radiator to reduce weight to 16 lb as compared with 45 lb for conventional type; it is rated for 40kw input, 12.5kw anode dissipation. Full ratings on both tubes obtain to 30Mc; reduced ratings to 90Mc. Machlett Laboratories, Inc., Dept. ED, Springdale, Conn.

CIRCLE ED-65 ON READER'S SERVICE CARD FOR MORE DATA

Sleeve Bearing Motor

Has 2-9/16" diam

A vertically-mounted sleeve bearing motor, Model RCS-65, built in this firm's RWC-2514 frame, is primarily intended for tape recorder duty. It is a permanent, split-capacitor type motor with a 2-9/16" diam. It has relatively high output torque when provided with a small fan for cooling opposite the drive end.

Torque rating is 4 oz-in at approximately 165-rpm on 115v 60cy, continuous duty. The stray magnetic leakage field is low. Holtzer-Cabot Motor Div., National Pneumatic Co., Inc., Dept. ED, 125 Armory St., Boston 19, Mass.

CIRCLE ED-66 ON READER'S SERVICE CARD FOR MORE DATA

Epoxide Resin

For Casting Purposes

A flexible, high impact strengt epoxide casting resin which is ver simple to use is known as Styca 2340M. It has excellent electrical an physical properties. It is supplie with two components which are mix together and cured readily to a tac free, opaque material. Adhesion metals, plastics, glass, etc., is exce tional. Styeast 2340M is easily m chined and is usable over a temper ture range from —100°F to —400° Emerson & Cuming, Inc., Dept. E 869 Washington St., Canton, Mass.

CIRCLE ED-67 ON READER-SERVICE CARD

Silicone Polymer

Improves Rubber

Rubbery parts with properties i termediate between those of silico rubber and organic rubbers can b produced by compounding a new si cone polymer with sulfur vulcanize and organic rubbers.

Identified as 410 Gum, this m polymer can be blended with or a plied as a protective coating to e tend the serviceable temperature li its and the weather resistance organic rubbers. Brittle points in t range of —70°F and usefulness temperatures up to 400°F can be alized by proper blending. Expe mental samples are available to signers. Dow Corning Corp., De ED, Midland, Mich.

CIRCLE ED-68 ON READER-SERVICE CARD

Vibration Platform

25cy Harmonic Motion

The type 25 Vibration Platfo provides simple harmonic vibrat of 25cy for loads as large as 25 Maximum and minimum amplitu adjustment corresponding to load readily made by an adjustable ecc tric weight. Power requirement 1.1amp at 115v, 60cy. Servo Devel ment Corp., Dept. ED, 1440 Bro way, New York 18, N. Y.

CIRCLE ED-69 ON READER-SERVICE CARD

◀ CIRCLE ED-70 ON READER-SERVICE CARD

Set Screw

For Double-Screw Applications

The "Pivot-Lok" Set Screw, with a pivot shaft point, is for use as a locking or adjusting screw in double-screw installations. It provides the advantages of elimination of damage to the second screw, and prevention of loosening due to the turning of the clamped screws as one.

The pivot screw has a shaft protruding from the end. This shaft is pointed and fits into the socket of the screw ahead of it which is to be locked or held in adjustment. Thus, the point on which the top screws turns provides the only contact between the two screws. In spite of the positive holding action, both screws can be easily removed when desired. Set Screw & Mfg. Co., Dept. ED, 265 Main St., Bartlett, Ill.

CIRCLE ED-71 ON READER-SERVICE CARD

Frequency Meters

Nominal 25 to 400cy Types

"Standco" 3-1/2" vibrating reed panel frequency meters are available in 3 styles of cases: molded bakelite case, metal case, and hermetically sealed case. They come with 5, 7, 9, 11, 21, 36, or 41 reeds for normal frequencies of 25, 50, 60, and 400cy. Other ranges from 15-1500cy per second can be supplied. Accuracy of calibration is ±0.5%. Herman H. Sticht Co., Inc., Dept. ED, 27 Park Place, New York, N. Y.

CIRCLE ED-72 ON READER-SERVICE CARD

Antenna Cores

Offer Maximum Economy

New components are available offering maximum economy, and great uniformity of quality.

Made of Ferramic "Q" they are available in 1/4, 1/3, 3/4" lengths and in rods and plates from 4 to 7-1/2" lengths. Ferramic "Q" provides complete stability in respect to time, shock, vibration, and temperature. Additional advantages are high "Q" and lower losses at all frequencies up to 30Mc. General Ceramics Corp., Dept. ED, Keasbey, N. J.

CIRCLE ED-73 ON READER-SERVICE CARD

CIRCLE ED-74 ON READER-SERVICE CARD ➤

Photo Courtesy American Gyro

How to keep a missile on target

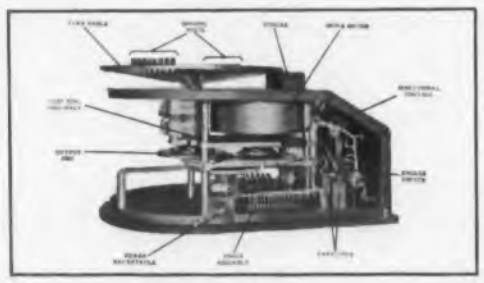
Genisco Rate-of-Turn Tables provide a fast, precise means of calibrating and evaluating rate gyros

It is imperative that components used in missile guidance systems perform to precise specifications. The Genisco Rate-of-Turn Table is a precision test machine used to calibrate and evaluate rate gyroscopes, vital components in missile guidance systems. Almost all major gyro manufacturers are now using these precision turntables in their test programs.

SMOOTH, CONSTANT ROTATION—Rotation of the table is infinitely-variable from 0.01° to 1200° per second. Constancy of angular velocity is within 0.1%, including drift and wow errors. This accuracy is due in large measure to a unique 60-cycle, 180 r.p.m. synchronous motor and a ball-disc integrator drive system. Absence of gears, belts, pulleys, etc., eliminates rotational irregularities inherent in gear-driven machines.

SPECIALLY SUITED FOR TESTING LARGE QUANTITIES—Operation of the machine is extremely simple. Precise rates can be set quickly and easily, using only a single hand-wheel, and without "hunting" or having to read complicated scales. These features enable inexperienced personnel to become proficient in the operation of the machine after a few minutes' instruction.

The machine is unusually rugged and operates for long periods with a minimum amount of maintenance.



Interior view of the Genisco Rate-of-Turn Table, Model C181, shows the neat, compact design. More than 100 of these precision machines are now in use.

Several instruments (total weight 100 lbs.) can be tested simultaneously without affecting accuracy.

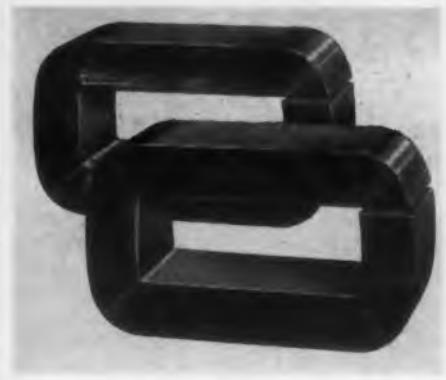
LOW ELECTRICAL NOISE LEVEL—Sixteen slip rings in the machine provide electrical connections from the rotating objects to the control panel. Copper graphite brushes and coin silver slip rings reduce electrical and AC pickup noise below two millivolts per slip ring.

If your problem is development of a single laboratory prototype or production-line calibration and evaluation of rate gyros, write for complete technical data. Address your inquiry to: Contracts Manager, Genisco, Incorporated, 2233 Federal Avenue, Los Angeles 64, Calif.

Genisco
INCORPORATED

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

One-Piece Cores
For Large Transformers



Designed to h
cores for larg
transformers
these one-piec
magnetic cores fe
ture improve
magnetic perfor
ance because the
have only one ai
gap. The coils a
slipped on the co
by pulling the flexible core apart at the gap. The
cores are produced in the same manner as "C" cor
that is, a strip of metal is wound around a form a
then annealed. Instead of being cut into two "C
parts, only one cut is made.

The single air gap also means that the problem
keeping the two halves of a "C" core together
eliminated. The new cores are available in sizes ran
ing in weight from 11.75 to 51 lb. Other sizes can b
ordered.

The cores are made of high-quality, grain-orient
silicon steel. Since these cores are treated only wi
varnish on the sides, there is no loss in electric
properties due to vacuum impregnating with a pla
tic. Indiana Steel Products Co., Inc., Dept. ED, Va
paraiso, Ind.

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

Variable Attenuator
For Use in Coaxial Lines

This "Tri-Plat
Variable Attenu
tor is for use
coaxial lines. T
"Tri - Plate" co
struction mak
use of a moval
resistive card sa
wiched within
new type of pri
ed circuit tra
mission line.

The attenuat
is designed for use as an uncalibrated pad in t
frequency range of 1000Mc to 6000Mc. For conve
ence, the dial carries an approximate calibrati
reading directly in db at 3, 4, and 5kMc, with
accuracy within ±2db.

The unit is extremely light in weight and compa
It offers broadband performance, is direct readi
and low-priced. It may be used at the bench or pa
mounted, and is equipped with two female type
connectors mounted on the upper rear. Sand
Assoc., Inc., Dept. ED, Nashua, N. H.

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

Plastic Coating
Temperature Resistant

Plastic Dispersions—chemically inert, high temperature - resistant (400°F) materials may be applied by spraying, dipping, or spreading to a broad variety of metallic and non-metallic surfaces providing maximum protection under high temperature and corrosive service conditions.

The Dispersions consist of finely divided particles, 1-20microns, of KEL-F Plastic suspended in volatile organic liquids, similar to those employed in normal paint and lacquer systems. The organic media has been carefully selected for proper viscosity and volatility characteristics to permit the rapid spray application of non-sagging, non-running, smooth, wet films which fuse to a film thickness of approximately 2-2.5 mils. They have a shelf-life of at least 3 years. M. W. Kellogg Co., P. O. Box 469, Jersey City, N. J.

CIRCLE ED-78 ON READER-SERVICE CARD

Micaceous Insulator
Bonded with Epoxy Resins

This micaceous insulating material bonded with epoxy resins makes possible extensive improvements in the performance of insulation in generators, motors, transformers, and many other types of electrical equipment. In application, Isomica has outperformed other presently available types of insulation and, because of superior thermal, chemical, and mechanical properties, is giving longer service life.

The new materials come in both flexible and rigid forms—flexible plate, molding plate, segment plate, tapes and tubes. The insulation in homogeneous, with extremely low volatile content—only 1% to 2%.

The material can be thermoset on the coils and does not crack or break down because of different coefficients of expansion between copper and the insulation. Isomica has good adhesive properties toward copper and other metals. Mica Insulator Co., Dept. ED, Schenectady, N. Y.

CIRCLE ED-79 ON READER-SERVICE CARD

CIRCLE ED-80 ON READER-SERVICE CARD ➤

Dual Power Supply

With Four Modes of Operation

This low-cost unit, the Model S-2300, consists of two heavy-duty power supplies, each capable of 200v to 300v at 0-300ma. A new switching principle permits front panel selection of four modes of operation: Series Aiding, 400-1000v, 0-300ma, grounded either polarity or anywhere between the two ends; Parallel, 200-500v, 0-600ma, grounded either polarity with a special internal connection automatically made to control all pass-tube grids from one of the two error amplifiers, ensuring accurate load division up to full rating; Series Bucking, 0-300v at 0-300ma, grounded either polarity, with a factory-adjusted load resistor drawing full rating from one supply, to permit full pump-back and efficient hum cancellation; Isolated, two, completely independent, identical, 200-500v supplies which may be operated in any polarity, up to 1500v apart.

The instrument is available in rack or cabinet style, with or without four 4-1/2" rectangular 2% meters to indicate output voltage and current from each supply. New Jersey Electronics Corp., Dept. ED, 34[illegible] Carnegie Ave., Kenilworth, N. J.

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

Sealing Boot

Replaces Cable Clamp Adapters

This sealing boot is designed to replace AN 3057 cable clamp adapters. It is used on jacketed cables and on wires covered by sleeving to furnish support at the plug or connector and to relieve strain on the connections.

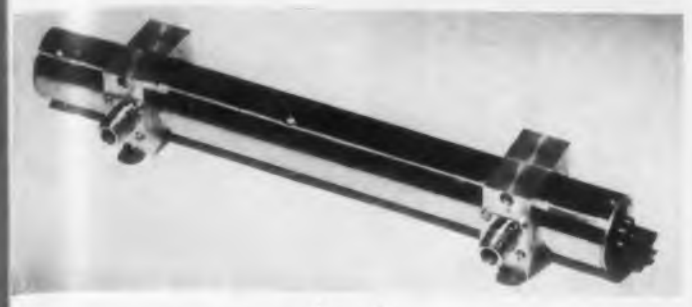
Made of oil-resistant Neoprene with a threaded ring of aluminum, the boot is self-centering. An aircraft-type hose clamp supplies positive sealing action. It is light in weight and has fewer pieces than the conventional-type cable clamp adapter. There are no loose washers or screws.

Boots are now available for Army-Navy connector sizes 10SL, 12S, 12, 14S, 14, 18, 20, 22, and 36. Other sizes will be available. The boot is available without the hose clamp if desired. Electronics Div., Whitney Blake Co., Dept. ED, New Haven 14, Conn.

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

Traveling-Wave Tube

Weighs only 4 lb



Based on several design innovations, the Model SL-24-10M S-Band Traveling-Wave Tube is housed in a reduced-size package of 1-1/2″ diam x 13″ long, including the solenoid, and weighing approximately 4 lb. Both dispersive and non-dispersive low-level tubes are currently being produced for S-band operation, 2-4kMc.

Features also include five-point suspension of the tube stem to provide improved capabilities for rugged-service applications; coaxial input and output terminals conveniently positioned on solid rectangular mounting and heat-dissipation blocks; supply-voltage terminations brought to a convenient end-mounted plug; and an attractive corrosion-resistant chromium finish. Gain is 35db; and output is 19mw. Stanford Laboratories Co., Dept. ED, 1617 Broadway, Redwood City, Calif.

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

Motor-Tachometers

Compact D-C Units

A line of d-c motor and d-c tachometer combinations is available, featuring high performance with unusual compactness. Units measure only 2-3/8″ diam and up to 5-1/2″ long. All combinations are supplied with auto-reset thermal overload protectors built into the motors, with capacitor filters for both motor and generator optionally available.

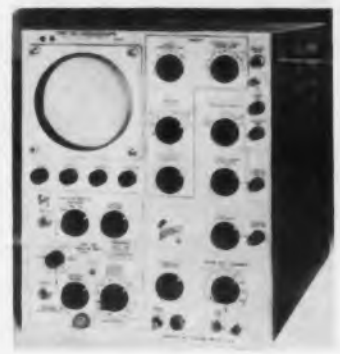
The new line includes units with standard motor outputs of 5w to 100w for speeds to 10,000rpm, with an operating voltage range of 6v to 220v. Both permanent-magnet and wound-field types are available, and units for any combination of field and armature voltages can be supplied.

Standard tachometer output is 6v per 1000rpm, ±10%. Units with other voltage gradients can also be specified. Linearity of all units is guaranteed within ±1%, and maximum ripple, 4% or less, without filtering. Electric Indicator Co., Inc., Dept. ED, Springdale, Conn.

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

Oscilloscope

Incorporated Plug-In Units



The Type 532 Oscillo scope offers the advantag of all of this firm's Ty 53 and Type 53/54 plug-i units, except that the wid band units are limited a passband of d-c to 5M and rise time of 0.07μs by the characteristics of i main amplifier. The Ty 532 is designed for use who do not need the high-speed sweeps, high writi rate, and wide passband of the Type 531.

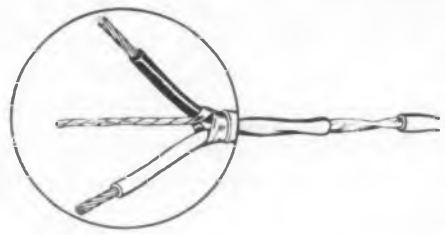
Simplified circuitry eases vacuum-tube loading; a lower accelerating potential reduces possibility screen damage at very slow speeds and makes possib greater linear vertical deflection. Sweep rang 1μsec/cm to 12sec/cm, continuously variable, wi 21 calibrated steps from 1μsec/cm to 5sec/cm, a curate within 3%. An accurate 5x magnifier exten calibrated range to 0.2μsec/cm.

The trigger circuitry includes automatic triggeri The unit has a 4kv accelerating potential. A n precision CRT provides 8cm vertical deflection. Ho zontal input amplifier sensitivity is 0.2v/cm 20v/cm; the square-wave amplitude calibrator (approx) 1kc, 0.2mv to 100v in18 steps, accura within 3%. D-c-coupled unblanking, electronicall regulated power supply, and vertical beam-positi indicators are provided. Weight is 52 lb. Tektron Inc., Dept. ED, P. O. Box 831, Portland 7, Ore.

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

Sound System Cable

Features Spiral Copper Shield



The No. 8 P. A. and Sou System Cable, balanced twist pair, features a n spiral-wrapp tinned copp shield. The wrap offers greater coverage than average braided shield, and also eliminates time-c suming terminations. It is easily unwrapped, twist or soldered.

The color-coded twisted pair is accurately produc to provide line balance and eliminate cross-talk. tough waterproof overall chrome vinyl plastic jac offers full protection for the shield and inner c ductors. Due to its smooth surface and small (0.225" OD), it is easily pulled through conduit. B den Manufacturing Co., Dept. ED, Chicago, Ill.

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

Delay Line

Has 0.4db for 36μsec Delay

The Model No. D L 0600 - 03/120 Attenuation Delay Line has a d-c attenuation of 0.4db for a delay of 36-μsec and rise time of 0.36μsec. It is a general-purpose line which has found wide application in pulse communication systems.

The unit is a 120-section lumped-constant line which can be supplied with taps every 0.3μsec. Delay tolerance is $\pm 3\%$, characteristics impedance 600 ohms, tap capacity 400mmfd, and spurious reflections less than 3%. Size is 13-1/4" x 3" x 1-1/2".

The line is designed for use over a temperature range of $-55°$ to $+125°$C and can withstand severe environmental conditions. Delay lines with the same electrical characteristics can also be supplied with a delay drift of less than 20ppm/°C, working over a temperature range of $-65°$ to $+150°$C. Epsco, Inc., Dept. ED, 588 Commonwealth Ave., Boston 15, Mass.

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

Pre-Fab Rooms

Provide Microwave-Free Areas

These self - contained "free space" rooms for microwave antenna testing are prefabricated units which can be easily assembled for either indoor or outdoor installation. They can be used as boresight tunnels or test ranges as well as for pattern or other measurements where microwave energy absorption is required. Each unit is completely self-supporting and needs no other structural members. It consists of a metal framework and plywood panels with microwave absorbing material permanently attached. Standard panel sizes are 4′ x 6′ x 8′ but any size panel can be built for a particular installation. The microwave absorbing material can be of any type, including plastic foam, hairflex, or thin flexible material. To prevent disturbance from outside r-f sources, the absorber material is backed with a copper screen. An ordinary room can be easily assembled by two men in one day, with the use of a minimum of standard tools. McMillan Industrial Corp., Dept. ED, Brownsville Ave., Ipswich, Mass.

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

Crystal Converters

Employ Modular Construction

These converte[rs] are constructed o[n] the modular pri[n]ciple of employi[ng] plug-in r-f sectio[ns] to cover the v-h[-f] spectrum from 2[0] Mc to 300Mc. No[ise] figure at 150Mc [is] 3db and only 4db at 390Mc. Overall sensitivity is [in] excess of 0.1db. An unusual feature is the univers[al] input which permits matching the unit to any a[n]tenna feed line within the impedance range of [50] ohms to 300 ohms.

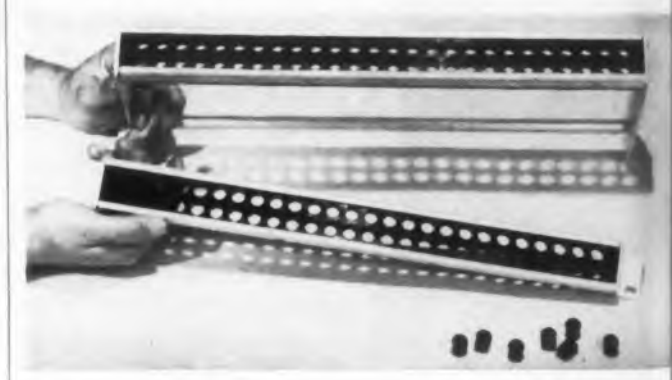
The base unit incorporates a built-in power supp[ly] and a stage of i-f amplification. Plug-in r-f sectio[ns] in 6Mc segments, are available for any of the co[m]mercial or amateur services in the v-h-f range. [Two] output ranges are available to match any existi[ng] receiver installation.

The modified modular construction permits lo[w] cost coverage of the entire v-h-f spectrum with o[ne] basic unit. Overall dimensions are only 5" x 5" x 9[".] Mohawk Electronic Research Laboratories, Inc., De[pt.] ED, R.D. 4, Box 126-A, Amsterdam, N. Y.

CIRCLE ED-94 ON READER-SERVICE CARD FOR MORE INFORMATI[ON]

Jack Strips

Of Molded Phenolic



Molded rather than machined construction is [the] outstanding feature of this improved telephone-t[ype] phenolic jack strip. The construction reduces c[ost] and has a neater appearance.

Each jack strip provides mounting spaces for [a] single (26 double) jacks. Horizontal and vertical [pin] spacings are arranged so that either single or dou[ble] plugs can be used. Two types of mounting brack[ets] are available: flush mounting or standoff. Jack str[ips] are also available without brackets.

In addition to the basic jack strip, four styles [of] telephone-type jacks are offered for assembling [com]plete jack panels. Lenkurt Sales Co., Dept. E[D,] County Rd., San Carlos, Calif.

CIRCLE ED-95 ON READER-SERVICE CARD FOR MORE INFORMATI[ON]

Meter Multipliers

Hermetically Sealed

Generally used with 1ma instruments, as well as other measuring equipment, Type MFA Resistors will withstand indefinite exposure to high humidity, salt spray conditions, or immersion in salt water. They are hermetically sealed, precision wire-wound, high-voltage resistors.

Each unit consists of a number of multiple-pie non-inductively-wound resistors, electrically connected in series. Total voltage is divided into a large number of individual resistor sections with a very low gradient between adjacent sections. The resistor assembly is hermetically solder-sealed within a glazed steatite tube with metal and ferrules.

Units fully comply with JAN-R-29. Standard tolerance is ±0.5%. Special tolerances of 1%, 0.25% and 0.1% are also available. Resistance Products Co., Dept. ED, Harrisburg, Pa.

CIRCLE ED-96 ON READER-SERVICE CARD FOR MORE INFORMATION

Time Delay Relay

Can Handle Motor Loads Directly

With this Time Delay Relay any delay from 1/2-sec to 6sec may be obtained for all standard a-c voltages (120, 240, 460, 600v, 60cy). The relay is also available for other frequencies, and for d-c. An important feature is its capacity for handling motor loads directly: it contains both a time delay relay and a contactor.

The unit has proved especially adaptable for use in conjunction with motors with brake windings. With this brake motor-relay combination, dynamic braking for a-c motors without a separate d-c source being necessary is economically practical.

The relay may also be used as a "single pulse" time relay. Each momentary closing of the pushbutton causes the relay to close, connecting the line to the controlled equipment. The relay automatically disconnects the circuit 1/2sec to 6sec later, depending upon the setting. For repeated cycling, with external contact closed, the relay repeatedly closes and drops out at intervals of 1/2sec to 6sec as required. Automatic Switch Co., Dept. ED, 391 Lakeside Ave., Orange, N. J.

CIRCLE ED-97 ON READER-SERVICE CARD FOR MORE INFORMATION

Temperature Sensitive Resistor

For —100° to +500°F Thermometers

The "RdF Stikon" line of resistance-thermometer elements has been broadened by the addition of the SN-1, a new type for higher temperature applications. In common with other "RdF Stikons", a temperature-sensitive grid of very fine nickel wire is bonded between two paper-thin wafers of insulating material. Silicone-impregnated glass-fiber fabric permits continuous operation at 500°F and short term use at 600°F.

"RdF Stikons" can be attached by means of appropriate cements to almost any surface anywhere. Unaffected by shock or vibration, the element will indicate temperature and temperature changes with high sensitivity and speed. The change in resistance with temperature may be used to actuate direct-reading indicators, recorders, or controllers of various types. In laboratories, temperature may be determined by direct measurement of the element resistance by means of a Wheatstone bridge.

Only 0.0001" thick and 9/16" x 1-7/16" in width and length, the Type SN-1, excluding external leads, weighs about 2 grains, a little less than 1/200th of an ounce. At 70°F, resistance is 100 ohms. Manufacturing tolerance is ±2.0 ohms, and each element is marked to the nearest 0.5 ohm. Ruge-De Forest, Inc., Dept. ED, 50 Moulton St., Cambridge 38, Mass.

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

Digital Read-Out Unit

Eight or Ten Column Printers

This 10-key Digital Read-Out Machine is designed as a practical, inexpensive and flexible device for printing data in electrical pulse form. Eight and 10-column printers are available.

Pulses may be entered into the amount solenoids at speeds up to 40millisec total pulse resolution with 20millisec on time. Solenoids are available for operation on 24v d-c, 40v d-c, 110v a-c/d-c. The unit will accept serial information without switching from column to column. Clary Multiplier Corp., Dept. ED, San Gabirel, Calif.

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

Delay Cable

For Color TV

The Type HII-4000 Delay Cable is an ultra-high impedance, compact, delay element which offers new design possibilities in amplifier circuits because of the higher possible gain and higher available voltage output from a given tube. Its use in advanced color TV receiver models made it possible to eliminate one stage in the conventional two-stage video amplifier.

The cable has a nominal characteristic impedance of 4000 ohms, and a time delay of 1.0μsec/ft. The attenuation for a delay of 1μsec is 0.2db at 1Mc, 1.2db at 4Mc, and 3.0db at 6Mc, resulting in a bandwidth (3db down) of 6.2Mc. The pulse rise time is 0.06μsec for a delay of 1μsec, and correspondingly faster for shorter time delays. The phase characteristic of the cable is designed in such a manner as to compensate for any delay errors.

A strong polyvinyl-chloride jacket protects the cable against moisture and abrasion. OD is 0.32", and the cable can be bent around a minimum radius of 3". It can be supplied in bulk (100' lengths) or in precalibrated sections terminated with molded vinyl endcaps. Columbia Technical Corp., Dept. ED, 5 E. 57th St., New York 22, N. Y.

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

Size 11 Resolvers

In High and Low Impedances

These Size 11 Resolvers are especially suitable for precision reduction systems, industrial process control, radar positioning, guided missile control, fire control systems, automatic plotters and computer systems. They feature an ambient range of −55° to +85°C. Weighing 4.7oz the resolvers have a 1.065" OD x 1.85" BuOrd type case and are available with various shafts, including spline, pinion, or plain termination, per customer reqirements. They meet the environmental qualifications of MIL-E-5272A.

Units are available with input impedances of 3500 ohms/78° ±10% or 800 ohms /76° ±10%, with input voltage at 400cy of 0-100v or 0-60v, respectively. Maximum functional error (% of sine function at max coupling) is 0.1%. American Electronic Mfg., Inc., Dept. ED, 9503 West Jefferson Blvd., Culver City, Calif.

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

Measuring Magnifier

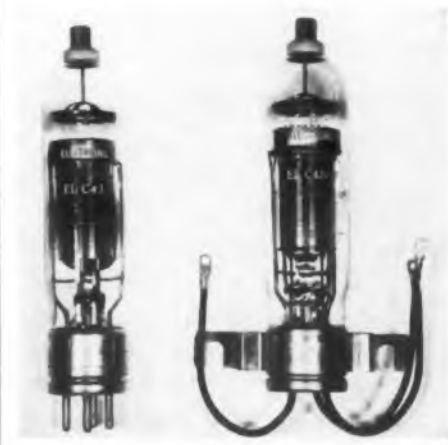
Uses Real Glass Reticle

A "vest-pocket" size version of this firm's pocket comparator, this tiny device is about half the size of the larger unit. Its major feature is a real non-warpable etched-glass reticle instead of the film reticle found on other low-price miniature comparators. The reticle pattern compares hole diameters as well as takes linear measurements. A special feature of the reticle is the thickness comparison scale, a series of parallel lines 0.002" to 0.007" apart. This makes it possible to measure directly the thicknesses of sheet material such as paper or plastic. The linear scale is given both in millimeters and decimal inches. The decimal inch scale is 0.5" long, subdivided into units of 0.005". Hole diameters are given in fractions from 1/64" to 1/16"; in decimals from 0.005" to 0.050". Both the reticle and the object to be measured are magnified six times. The complete unit measures only 2" long and 1" diam. Edmund Scientific Corp., Dept. ED, Barrington 3, N. J.

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

Thyrations

For Motor Control; Ignitor Firing



Two xenon-filled thyratrons, available from this firm in identical electrical characteristics, are designed for application in motor control and ignitor firing circuits. The EL C4 is designed for socket mounting and the EL C4J/ for panel mounting wherever conventional socket might not be desirable.

Ratings of both units are 4amp d-c continuous average anode current; 30amp oscillograph peak current with maximum peak forward and peak inverse of 900v. The average arc drop is 12v, and heating time is 60sec. Stable grid characteristics are maintained throughout life, and the critical grid current is less than 10amp. Electrons, Inc., Dept. ED, 127 Sussex Ave., Newark 3, N. J.

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

Telemetering Oscillator

For Many Measuring Uses

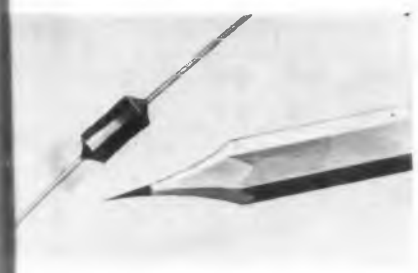
Series 0200 Inductance Controlled Telemetering Oscillators can be supplied to work with most variable inductance (variable reluctance) type end instruments, on any center frequency from 1kc to 100kc. The circuit used in this device employs a highly stable fm oscillator followed by an isolating voltage amplifier. Inductance variations of an end-instrument connected across the oscillator tank circuit produces proportional deviation in oscillator frequency; and a cathode-follower amplifier meets isolation and matching requirements to low impedance loads. A wide variety of measuring applications is possible with these units, including many airborne uses.

Output signal amplitude is 2v rms across 10,000 ohm load (min). Total harmonic distortion is less than 3%. Useful temperature range is —65° to +250°F. Plate voltage requirement is 150v d-c at 3ma or 108v d-c at 6ma. Filament voltage requirement is 6.3v at 600ma or 12.6v at 300ma. Size is 3" x 1-1 2", and weight is 3 oz. Datran Engineering Corp., Dept. ED, 6312 West 92nd St., Los Angeles 45, Calif.

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

Wire-Wound Resistor

In Tolerances to ±0.02%



The "Davohm" Type 1274 precision wire-wound resistor, only 3/16" in diameter x 7/16" long, is completely encapsulated and meets all requirements of MIL-R-93A Characteristics A.

The resistor can be subjected to salt water immersion, humidity, and extremes of temperature without effect to characteristics. It is especially suitable for applications where space is at a premium, as in airborne communications and radar systems. Such applications require the mounting flexibility provided by the unit's narrow diameter and axial leads.

A maximum resistance of 180,000 ohms can be wound on the unit. It can dissipate 1/4w at 125°C without derating. Tolerances as close as ±0.02% can be obtained. The Daven Co., Dept. ED, 191 Central Ave., Newark 4, N. J.

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

Beam Triode

Sharp Cutoff for Color TV

The *6BK4* is a low-current beam triode of the sharp-cutoff type designed specifically for voltage regulation of high-voltage, low-current, d-c power supplies in color TV receivers. It has a maximum d-c plate-voltage rating of 25,000v, a maximum d-c plate-current rating of 1.5ma, and a maximum plate dissipation rating of 25w.

High-voltage insulation is obtained by the use of a double-ended structure utilizing a suitably designed electron gun which consists of a thermionic cathode and one grid. The plate connection is made to a small cap at the end of the bulb. Tube Div., Radio Corp. of America, Dept. ED, Harrison, N. J.

CIRCLE ED-111 ON READER'S SERVICE CARD FOR MORE DATA

Audio Frequency Filter

With Cut-Off Down to 15cy

The Model 2-A Filter Set is engineered for extreme low frequency applications ranging from 15cy to 10,000cy. The new passive network unit, which eliminates vacuum tubes and power supply, is designed to fulfill a need for a continuously variable high-pass and low-pass audio frequency filter for laboratory and production applications in many fields.

The equipment has only two controls for each group of filters. One control is a switch in octave steps, while the second control is a multiplier, making the filter continuously variable between the octave steps on the switch. High attenuation outside of the pass band of 30db per octave is adequate for most uses. The filter will handle 5w in a 600 ohm circuit, which makes its use possible where a vacuum tube type would not handle the power. Loss in the pass band is approximately 1db, making amplification to compensate for loss unnecessary. Calibrated vernier control allows the use of bands either wider or narrower than an octave.

Also available is the Model 2-B Filter, which covers a frequency range of 60cy to 20,000cy. Allison Laboratories, Dept. ED, 14185 Skyline Dr., Puente, Calif.

CIRCLE ED-112 ON READER'S SERVICE CARD FOR MORE DATA

Single Deck Switch

Miniature Tap Type

The 24YY2100 Single Deck Switch, incorporating a positive detent section, has been added to the Series No. 24 family of miniature tap switches. Its construction reduces back-of-panel depth of a single deck unit to a minimum of only 0.562″, with an overall diameter across the terminals of 1.032″.

The unit is designed to provide positive detent action as the switch is indexed. Rated to break 1amp 115v a-c resistive load, it will carry 5amp if not required to make or break the circuit. A maximum of 10 positions are available within its compact area. Stops are built in for nine positions or less, while the 10-position switch permits continuous rotation in either direction. Grayhill, Dept. ED, 561 Hillgrove Ave., LaGrange, Ill.

CIRCLE ED-114 ON READER'S SERVICE CARD FOR MORE DATA

Clinch Nut

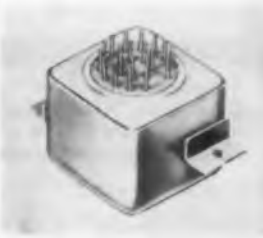
Low-Cost Unit

Automation of production makes this clinch nut available at low cost. At the same time, it is made to close tolerances to satisfy the requirements of the automotive industry and other industries that require precise clinch nut applications. It is available in all machine screw sizes from No. 6 to 3/8″. Jacobson Nut Mfg. Corp., Dept. ED, Kenilworth, N. J.

CIRCLE ED-115 ON READER'S SERVICE CARD FOR MORE DATA

Power Transformer

1.65 cu in Unit for Airborne Uses



With a volume less than 1.65 cu in, this power transformer has a range from 400cy to 6000cy with efficiency up to 95%. Wattage is 6mw to 200w. Operating temperatures are −55° to +155°C. A plug-in type unit, it is in a hermetically sealed case. Communication Accessories Co., Dept. ED, Hickman Mills, Mo.

CIRCLE ED-116 ON READER'S SERVICE CARD FOR MORE DATA

Rotary Joint

For K_u, X, and S Band Waveguides

This compact ro tary joint, f waveguides in K_u, X, and S ban is available f both 90° and 18 orientation of put and outp waveguide se tions, and provi 360° continuo rotations at high speeds with broadband operati and very high power handling capabilities. At t same time, vswr is extremely low (less than 1.10 f the entire frequency range of $f_o \pm 0.06\ f_o$).

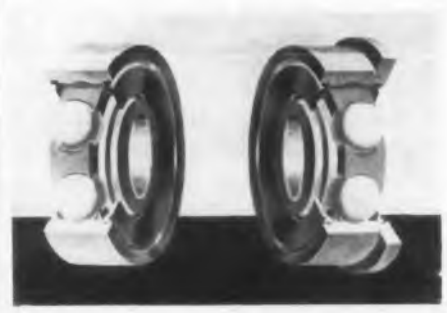
Construction is such that operation may be un fully pressurized waveguide conditions if desired raise the power handling capabilities and to en ideal environmental conditions. Peak power wit pressurization is 80kw for the K_u band, 175kw the X band, and 1500kw for S band. Pressurizat will increase these values proportionally to the solute pressure.

The coupling loop is supported rigidly in an o bearing, and the main housing is supported on bearings. R-f chokes have been incorporated in design to prevent leakage of r-f power from the jo Finish and constructional details are in accorda with MIL specifications, and the complete unit weatherproofed for outdoor use. Reeves Instrum Corp., Dept. ED, 215 E. 91st St., New York 28, N.

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

Radial Bearings

With Single or Double Shields



"Micro" Reta er Radial Beari are now avail with single or d ble side shields added protect against contami tion during inst lation and u Metallic type shields may be removed for clean the bearing. Oil or grease lubrication can be specifi

Types include straight and flanged outer ri Most sizes are being scheduled in stainless steel (t 440) at no increase in price over chrome steel (S .52100). Tolerances are ABEC 5 or better. Sizes ra from 3/64" bore, 1/2" overall diameter. New Ha shire Ball Bearings, Inc., Dept. ED, Peterboro N. H.

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

Logarithmic-Linear Amplifier

Valuable for Recording Uses

Logarithmic functions, such as gain and attenuation expressed in decibels, are rapidly plotted on linear paper using a standard recording milliammeter in conjunction with the Logarithmic-Linear Amplifier, Model 120A. Complete antenna radiation patterns have been obtained in less than 2 minutes using the unit in automatic antenna pattern recording systems.

Designed primarily for use with an r-f source modulated at 1000cy, the input provides a metered, variable 0 to 10ma d-c supply for bolometer operation. Alternatively, the instrument can be supplied with a crystal input.

The output is presented on a 4" meter and is also available at a meter jack for driving either a 1ma d-c recording milliammeter or a high-impedance recorder. The logarithmic channel has a dynamic voltage range of 100db, equivalent to a 50db power range in a square-law detector. The corresponding meter scale reads attenuation from 0 to 50db in equally spaced 1db graduations. When the linear channel is used, the output is read on a typical db scale with 3db at approximately midscale so that antenna half-power points can be accurately determined. Color Television Inc., Dept. ED, 932 E. San Carlos Ave., San Carlos, Calif.

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

Rotary Shear

Precision Trims 16ga Steel

The "Toolmaster" is a hand-operated low-cost rotary shear which provides sufficient mechanical advantage to cut steel (other than stainless) as heavy as 16 gage without undue effort. It will handle even heavier gages of aluminum or brass.

The unit provides a clean, straight cut, plus positive adjustment for width of cut, from 2" max down to a trim as fine as 0.005". It can be bolted to a bench or truck to prevent loss. Cutting wheels can be replaced for about one-fifth the cost of a new pair of snips. Fidelity Tool Supply, Inc., Dept. ED, 309 Pine St., Camden 2, N. J.

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

CHICAGO HERMETICALLY SEALED TRANSFORMERS

that meet the full requirements of

MIL-T-27

A complete range of MIL-T-27 units is available for quick delivery from your Chicago Standard distributor.

- **POWER**
- **FILAMENT**
- **BIAS**
- **CHOKES**
- **AUDIO INPUT**
  3 frequency ranges
- **AUDIO OUTPUT**
  3 frequency ranges
- **PULSE**
- **400 CYCLE**
  Power
  Filament
  Chokes
- **MS (Military Standard)**
  Power,
  Filament

Ask for the free CHICAGO catalog, listing detailed electrical and physical specifications on all these transformers. Available from your electronic parts distributor or from Chicago Standard Transformer Corporation.

CHICAGO STANDARD TRANSFORMER CORPORATION

ADDISON AND ELSTON • CHICAGO 18, ILLINOIS

Export Sales: Roburn Agencies, Inc., 431 Greenwich Street, New York 13, N.Y.

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

Audiosweep Generator

For Displaying Response Curves

The Audiosweep Generator is an instrument designed to eliminate time-consuming point-by-point plotting of frequency response curves. It presents a frequency response curve at a glance by automatic visual plotting of the curve as a display on a cathode-ray tube.

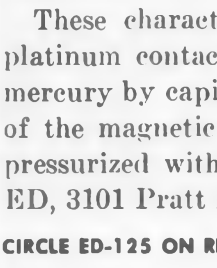
The instrument can accurately analyze the audio and supersonic spectrum. The frequency sweep is achieved by a continuous variation of the sinusoidal output frequency between any two frequency limits in the range from 20cy to 200,000cy. The frequency swing is achieved entirely by electronic means. A variable marker makes possible accurate frequency readings at any point along the curve. A selection of sweep types and sweep rates is available.

The instrument may also be used as a f-m signal generator with modulating frequencies from d-c to 10,000cy. As a beat frequency oscillator it covers the entire spectrum from 20cy to 200,000cy in one continuous range, and as a sweeping harmonic wave analyzer over all or any part of the spectrum from 100cy to 200,000cy. The unit is made in three models: for 20-200,000cy, 2-20,000cy, and 0.2-2000cy. Technomatic Instrument Co., Dept. ED, 11368 W. Olympic Blvd., West Los Angeles 64, Calif.

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

Contact Relays

For High-Speed Switching



Two mercury-wetter contact relays, the Type HG and HGP, are capable of over a billion operations without maintenance, and are designed for use in high-speed switching machines and devices. These relays will operate at up to 60 operations/sec; have high current-carrying capacity (up to 5amp) and high voltage-handling capacity (up to 500v); are bounce-and-chatter-free; and keep a uniformity of operation to within 1.5millisec under constant drive conditions.

These characteristics are achieved by the use of platinum contact surfaces, continuously wetted with mercury by capillary action, and the hermetic sealing of the magnetic switch in a protected glass capsule, pressurized with hydrogen. C. P. Clare & Co., Dept. ED, 3101 Pratt Blvd., Chicago 45, Ill.

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

Automatic Printer

Identifies Recording Charts

The "Identi-chart" is a compact device that automatically prints a number, date, or time on "Brown" strip chart or similar recorder charts at any instant when a voltage is ap-ed to the device during process, test, or control rk. The unit makes it easy to identify individual tions of charts in relation to particular conditions ing place at a remote point. It mounts on the out-e of the door of the recorder, regardless of type instrument, and does not interfere with or obscure recording procedure.

The device is made for 28v d-c operation, but can adapted to other electrical requirements. It is sup-ed in kit form for easy installation. The kit con-s of a strip of rubber for the chart platten, mount-screws, plexiglass window to replace the original in the door, plastic transparent cover for the ice itself, and instructions for installing. Wires the unit go to the power supply and switch which connected to the process. Royson Engineering, pt. ED, Hatboro, Pa.

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

Dual Triode

Serves as Cascode Amplifier

The *6BC8*, a miniature 9-pin, medium-mu dual triode with semi-remote cutoff characteristics, lends itself readily to applications as a cascode amplifier in v-h-f TV tuners. It also gives more satisfactory performance in AGC systems under both strong and weak signal conditions.

In addition, the tube provides relief from objectionable cross modulation effects when reception of a weak signal is degraded because of strong adjacent channel station interferences. This effect is minimized because the transfer curve of the tube aches the desirable square law characteristic, ch is the optimum shape for minimizing cross dulation. Sylvania Electric Products, Inc., Dept. , 1740 Broadway, New York 19, N. Y.

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

for high voltage, airborne service

Compact, fast action Eimac vacuum switches are custom designed for high voltage application. Single pole, double throw action contacts are precision spaced in high vacuum, permitting reliable performance regardless of ambient atmospheric conditions. In antenna switching service, RF peak potentials as high as 20kv may be applied between the switch terminals. Eimac vacuum switches are not limited to this service, however, as they will handle 1.5 amps at 5kv in DC switching. Efficient operation in severe airborne conditions, small size and instant response give these switches a distinct advantage over conventional relays. Now available are four Eimac switch types, including one for pulse service.

For further information contact our Application Engineering department

Eimac

EITEL-McCULLOUGH, INC.
SAN BRUNO, CALIFORNIA
The World's Largest Manufacturer of Transmitting Tubes

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

Ovens

Compact Units for Crystals

The Type VCO-2 temperature - controlled oven is for use with JAN type HC-6/U and HC-13/U crystals. The unit comprises a heavy anodized-aluminum housing arranged to accept two, two-prong mounted crystal units. The base of the housing fits a standard octal socket. The housing cover is threaded onto the base for simplified removal when changing crystals.

The connections to both crystals are brought out independently to allow the greatest flexibility of oscillator circuit adaptation, and are kept isolated from heater and thermostat leads. A connection is brought out for operation of an external pilot lamp to indicate heater operation.

Heater power is 4w available for use with 6.3v, 12.5v, or 28v operation, either a-c or d-c. Temperature of the crystals is maintained at 75°C ±1°. Oven cases are optionally available with height of 1-9/16" or 2-1/16", to fit specific crystal sizes. Case diameter is 1-9/16"; weight, 57.5gr, exclusive of crystals. Valpey Crystal Corp., Dept. ED, 1244 High land St., Holliston, Mass.

CIRCLE ED-131 ON READER-SERVICE CARD FOR MORE INFORMATION

Oscilloscope

Versatile Midget Unit

This D-C "Midgetscope", Model No. 534, combines linear sweep with a d-c amplifier for color TV restorer circuits and for complex waveforms. Other features include provisions for a-c coupling; full vertical and horizontal expansion of trace; automatic astigmatism control circuit; linear time base and sweep; returned trace automatically blanked, and vertical or horizontal operation. Frequency range is d-c to 500kc. Sensitivity is better than 50mv. The unit has push-pull deflection throughout. Radio City Products, Inc., Dept. ED, Easton, Pa.

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

Digital Decade Counters

For Rates to 100,000/sec

Two Digital Decade Counters, each available in three variations, are for use wherever high-speed electronic counting is required. Both types employ the printed circuit principle, thereby permitting maximum ventilation, low operating temperature and longer life.

The Type "A" group has decades with a staircase output of voltage proportional to the count. This enables the output of the decades to be recorded on a direct-writing oscillograph. The type "B" group has decades with a four-line coded output which can be used to operate mechanical printers.

Both types are applied to Models 100, N-100, and N-101 high-speed electronic counters, each of which will accept input pulses at rates varying from 0 to 100,000cps. For each ten impulses received at the input, one pulse is generated at the output.

Model N-100 is a low-power (150v plate supply) neon version similar in design to Model 100, which is the standard decade using a drum or meter type display. Model N-101 is designed as a direct replacement for neon-type counting decades operating at plate potentials of 350v. Brush Electronics Co., Dept. ED, 3405 Perkins Ave., Cleveland 14, Ohio.

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

Generator Noise Filter

For Mobile Applications

For amateur, marine, aviation, police, utility, civil defense, military, and similar uses, the Model 1080 is a completely shielded generator filter designed to materially reduce commutation "hash" and "whine" throughout the high-frequency amateur bands. These filters are supplied complete with a 4-way mounting bracket for quick, easy installation on one end of the vehicle generator.

The units may be quickly adjusted after installation for highest efficiency and maximum noise reduction. Model 1080 is for 10-11-15-20-40 meters; Model 10 0A is for 2-6-10-11 meters.

Also available is the Model 1081 Regulator Noise filter, a companion unit to the Model 1080 designed for the popular amateur bands. Rex Bassett, Inc., Dept. ED, Bassett Bldg., Fort Lauderdale, Fla.

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

Engineer using BURROUGHS PULSE UNITS loses no time designing test equipment

1. **FAST SET-UP.** Engineer draws pulse sequence, then determines by block diagram how to connect his Burroughs Pulse Units. Usually this can be done in a matter of minutes.

2. **JOB COMPLETED.** No time lost. Because engineer spends no time designing test equipment, he can spend his full time on the real problem. This means he can do more, accomplish more.

3. **NEXT ASSIGNMENT.** Without losing time, engineer simply determines the block diagram needed to produce the next pulse sequence and sets up his Burroughs Pulse Units. He shifts quickly from one assignment to the next—saving considerable time otherwise needed to design and build special test equipment.

GET THE FACTS

Learn how you can make your time worth more. Burroughs Pulse Units save weeks of engineering, uncertainty, and considerable equipment cost. Can be used over and over again on different future projects. Immediate delivery from stock. Write for detailed brochure. *Burroughs Corporation, Electronic Instruments Division, Dept. 4-E, 1209 Vine St., Phila. 7, Pa.*

ELECTRONIC INSTRUMENTS DIVISION

Burroughs

FIRST IN PULSE HANDLING EQUIPMENT

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

Meter Calibrator

With 0.05% Accuracy

Meter Calibrato Model M100A-2 is a standard d reference that pro vides both volta and current cal bration rang from 0 to 1000v 200ma max, a from 0 to 100 at 1000v max. T unit maintai long time stabili of 0.01%, accuracy of 0.05%, and regulation f ±10% line voltage charge of 0.01%.

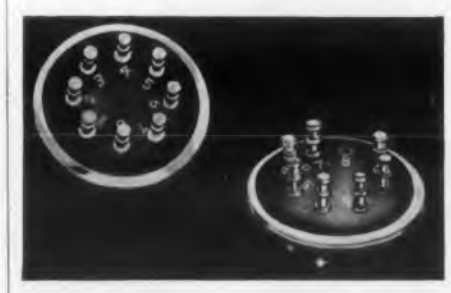
The voltage output is variable in 0.1v steps, a the current output is adjusted in four ranges. On t lowest range of 0 to 0.1ma, the output varies 0.01μamp steps. Other full-scale current ranges a 1ma, 10ma, and 100ma.

The instrument employs absolute d-c power supp circuitry which constantly compares the output vo age against a standard cell and maintains the lo time stability and accuracy of a standard cell. Th unit is for use in analog computer facilities, te metering, instrumentation groups, automatic f quency control calibration, and as a secondary sta ard voltage source, Kalbfell Laboratories, Inc., De ED, P. O. Box 1578, 1090 Morena Blvd., San Die 10, Calif.

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

Terminal Headers

In Variety of Styles, Materials



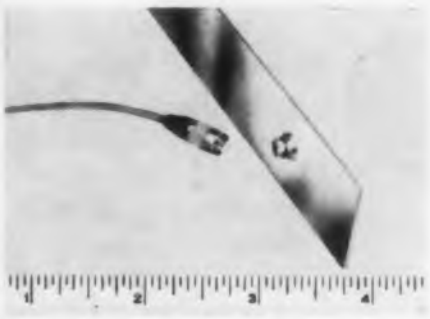
These Single a Multiple Termin Headers are ava able in a wide v riety of styles a insulating mate als, and plated suit specificatio They are used e tensively in the manufacture of hermetically seal components, including transformers, condensers, co relays, and other components.

Body materials are designed to meet requireme of MIL-P-14 and MIL-T-27. In addition, vari other insulating compounds are available to meet erating temperatures of 550°F. Terminals are ma in turret head, hollow tube, straight wire, or to c tom specifications, and are plated in tin zinc, sil plate, gold plate, gold flash, palladium, rhodi and other materials. Garde Manufacturing Co., De ED, 588 Eddy St., Providence 3, R. I.

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

Quick-Connect Plugs

For Miniature Coaxial Uses



Offered in "microminiature" size for coaxial circuitry, the QC Series of connectors is available in a complete series of 50 ohm, 70 ohm, and 93 ohm types, offering over two million coaxial circuitry design possibilities. The line is particularly well suited for blind and hard-to-reach applications.

Mating is accomplished by simply pushing the units together with a "snap-on action" over a spring-loaded locking design. A constant pressure is maintained, holding the mating connectors tightly together. The company's 1/2 oz hand tools permit these parts to be readily assembled to all types of "Microdot" cable. The series includes jacks, feed-thrus, bulkhead receptacles, adapters for BNC, Ell, Tee, Cross Adapters, and many specials.

All connectors are 100% "Teflonx" dielectric. The finish is silverplate with pins, gold-plated. Life is guaranteed for over 100,000 engagements. The standard type QC-50 (50 ohms) has a length of 0.73", with nut OD of 0.225". Weight is 0.8 oz. Insulation resistance is over 100,000 megohms, capacitance is 2mmfd, and voltage rating is 600v rms. Microdot, Dept. ED, 1826 Fremont Ave., South Pasadena, Calif.

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

Shields

For T-12 Tube Sizes

Originally developed for special missile requirements, these T-12 shields are now mass-produced for use under similar environmental conditions. The shields are for use with tubes of the T-12 envelope size similar to the 6080, 6146, and 6293. The base fits the following JAN approved submounted sockets: TS 101P 01, TS 101P 02, TS 101C 01, and TS 101C 02.

A handle has been made an integral part of the shield to aid in its removal from tight places. For greater stability under vibration and shock, two additional counter-sunk holes have been added to the base, the use of which is optional. International Electronic Research Corp., Dept. ED, 177 W. Magnolia Blvd., Burbank, Calif.

CIRCLE ED-143 ON READER-SERVICE CARD FOR MORE INFORMATION

NEW DEVELOPMENTS

NEW Bandpass Filters

FROM 200-2000 Mcs.

To meet the rapidly growing need for accurately defined bandpass networks, A R I introduces its new line of BANDPASS FILTERS, covering the frequency range of 200 Mcs. to 2000 Mcs., with bandwidths of from 1% and up of center frequency.

These NEW Bandpass Filters incorporate multiple tuned resonant circuits with an insertion loss of less than 1 db., and will display the typical Tschebycheff response.

These space-saving filters have been kept to the absolute minimum size, consistent with the number of resonant circuits. These filters may be readily incorporated as external adjuncts to any existing equipment.

Although the A R I Bandpass Filters are available at standard frequencies and bandwidths, they may be obtained at any frequency and bandwidth desired.

TYPE HFF
For bandwidths of 5% and greater of center frequency.

TYPE HFF-T
For bandwidths from 1% and up of center frequency.

TYPE HFF
QUADRUPLE TUNED

CHARACTERISTICS
TYPE HFF & HFF-T BANDPASS FILTERS

Center Frequency:	200-2000 Mcs.
Bandwidth:	From 1% and up of center frequency; Maximum 100 Mcs.
Impedance:	52 ohms (Input and Output)
Connectors:	BNC to 1000 Mcs. Type N 1000-2000 Mcs.
Insertion Loss:	Less than 1 db.
Peak to valley ratio:	Less than 1 db.
Selectivity:	Defined by resonant elements. Doublets to Sextuplets available.
Standard Frequencies:	400 Mcs.; 1000 Mcs.; 1680 Mcs.

ALSO AVAILABLE
- Filters up to 3000 Mcs., to meet your specifications.
- Filter applications with R.F. amplifiers, up to 3000 Mcs.
- Band Rejection filters.
- Bandwidths greater than 100 Mcs.

TYPE HFF-T

Applied Research INC.

163-07 DEPOT ROAD, FLUSHING, N. Y.

WRITE TODAY for full information, and latest prices

MANUFACTURERS OF: BNC Attenuators and Coaxial Terminations, Bandpass and Bandreject Filters, Broadband Sweep Generators, Community TV Components, Crystal Mode Indicators

CIRCLE ED-144 ON READER-SERVICE CARD FOR MORE INFORMATION

Why has G-V in 3 Years Become the Preferred Supplier of

Thermal Time Delay Relays?

Because G-V OCTAL & MINIATURE RELAYS have been...

adopted as production components by hundreds of principal producers of electronic, electrical and aviation equipment.

Delivered for use on over 250 Government contracts.

Only G-V offers complete technical data and helpful engineering cooperation on THERMAL TIME DELAY RELAYS.

G-V ENGINEERING OFFERS A NEW APPROACH TO THERMAL RELAY DESIGN

- Stainless steel mechanism welded into a single integral structure and supported at both ends for unequalled resistance to vibration and shock
- Heater built inside expanding member for maximum efficiency and protection
- Rolling contact action for positive operation
- Easy adjustability where desired
- Precise operation never before available in thermal relays
- Time ranges: 3 seconds to 5 minutes
- Hermetically sealed in metal shell
- Heater voltages up to 230 volts
- Fully temperature compensated
- Suitable for military and industrial use
- Unequalled for ruggedness and precision

U. S. and Foreign Patents Pending

Write for bulletin and help with your particular problems.

G-V CONTROLS INC.

18 Hollywood Plaza
East Orange, New Jersey

Greatly expanded production facilities assure prompt deliveries.

CIRCLE ED-145 ON READER-SERVICE CARD FOR MORE INFORMATION

Accelerometer

Highly Sensitive and Stable

Model 602A Accelerometers are engineered to meet the requirements of jet aircraft and missile applications. They are extremely sensitive to linear movement applied along the sensitive axis, and feature an air-damped spring-mass system which travels on precision bearings, thereby eliminating, for all practical purposes, side acceleration effects.

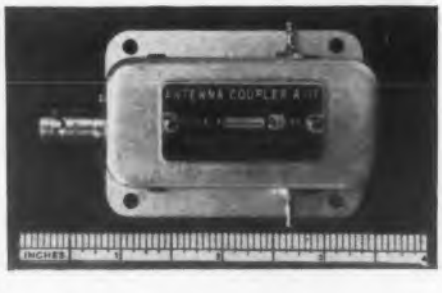
Stable damping characteristics from −65° to +200° F are maintained by the use of a unique damping orifice. To meet individual customer ranges and specifications, the damping ratio can be adjusted to any value between 0.1 and 1.0 critical, within a tolerance of ±0.05 critical. The operating mechanism is pressure-sealed within an anodized aluminum case and meets Government specs covering protection against salt spray, humidity, and fungus.

Performance characteristics include resolution of 0.25% to 0.45% for resistances from 5000 ohms to 1000 ohms. Linearity is ±0.5 to ±1.0%. Life expectancy is 1,000,000 cycles. The accelerometer is recommended for use where total ranges are less than 20G. Weight is 8 oz, and size is 1-1/4″ diam x 4-1/8″ long. Power rating is 1/2w at 160°F. Bourns Laboratories, Dept. ED, 6135 Magnolia Ave., Riverside, Calif.

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

Airborne Antenna Coupler

Weighs Less Than 0.1 lb



The A-17 Antenna Coupler is designed to couple an airborne dipole antenna into a 52-ohm coaxial cable over a band of 108Mc to 125Mc. The weight of the coupling unit is under 0.1 lb.

The dipole antenna usually consists of two rods in the shape of a "V" fastened on the inside of the canopy of jet aircraft. Due to the height of the plastic canopy above the surrounding metal of the fuselage, the resulting 'submerged' antenna is entirely satisfactory. Placing the omnilocalizer antenna inside the canopy helps to further streamline the plane. Aircraft Radio Corp., Dept. ED, Boonton, N. J.

CIRCLE ED-147 ON READER-SERVICE CARD FOR MORE INFORMATION

Vertical Attenuator

Permits 10 Mixers on 19" Panel

This low-cost vertical attenuator covers the audio range. It has straight-line, fingertip operation, accomplished without any guide rods, through the use of a new linkage system that completely eliminates any backlash or stickiness, minimizing wear and extending the life of the unit. It is possible to tie a number of units together for simultaneous operation, with narrow construction permitting use of as many as 10 mixers on one 19" panel.

Both plug-in and fixed-panel designs are available. Standard units are furnished in two sizes of 30 and 20 steps. The 30-step units are at 1.5db, and 20-step units at 2db. Ladder "T" or potentiometer circuits are standard, with impedance values for ladders ranging from 30 ohms to 600 ohms, and 250,000 ohms for potentiometers. Additional features include a completely shielded and dust-proof construction and new floating switch blades with better adjustment of spring tension. Tech Laboratories, Inc., Dept. ED, 50 E. Edsall, Palisades Park, N. J.

CIRCLE ED-150 ON READER-SERVICE CARD FOR MORE INFORMATION

Metal Panel Enclosures

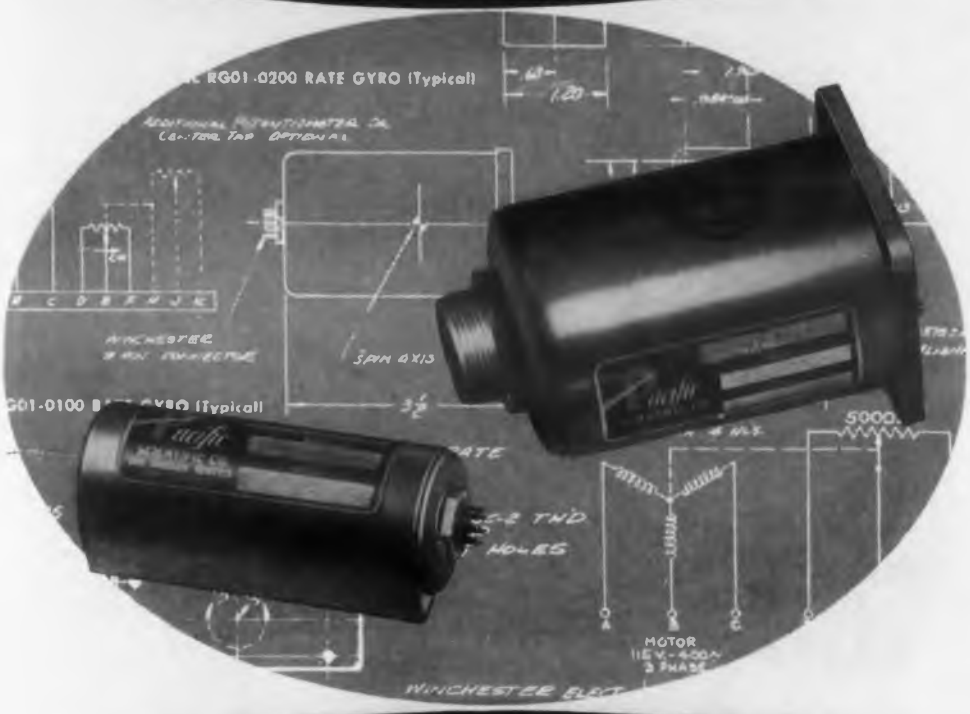
In 15 NEMA "12" Sizes

Fifteen standard sizes of NEMA "12" sheet metal panel enclosures (16" x 12" x 6" to 60" x 36" x 8") are available from this firm to supplement its line of oil-tight "JC" electrical pull boxes and troughs. These enclosures are constructed to be completely liquid tight. All seams are welded, and there are no holes. The cover is gasketed with neoprene sponge.

The enclosures have external mounting feet. The cover is hinged on one side with a continuous type hinge; it is fastened to the box by means of external clamps. A print holder is provided on the inside of the cover. There is a removable mounting panel for mounting electrical equipment. The interior is finished with a baked white enamel and the outside with a prime coat. Hoffman Engineering Corp., Dept. ED, Anoka, Minn.

CIRCLE ED-151 ON READER-SERVICE CARD FOR MORE INFORMATION

Pacific rate gyros



. . . advanced wheel design gives **higher natural frequency** over any rate range!

Now in production, an entirely new concept in wheel design provides Pacific Rate Gyros with unusually accurate and dependable performance. Combined with a special precision potentiometer, this advanced design Rate Gyro gives greater resolution and shock resistance...lower power consumption...light weight...and a higher natural frequency with any rate range!

A wide variety of Pacific Rate Gyros are built for any application. Production models from sub-miniature designs for use in stabilization or damper systems, to gyros for precision computer applications. Special models can be custom designed to your own specifications by Pacific's large staff of experienced gyro engineers.

For any Rate Gyro, Pacific's creative designs, complete manufacturing facilities and experience are backed by fully approved quality control. You're assured precision performance and rugged dependability in every unit.

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CIRCLE ED-152 ON READER-SERVICE CARD FOR MORE INFORMATION

EXPANDED SCALE, THREE BANDWIDTHS ENABLE FASTER, MORE ACCURATE VSWR MEASUREMENTS

Speed up production of microwave components through faster, more accurate reading of low VSWR. An expanded meter scale is provided on the PRD Type 277 Standing Wave Indicator for readings up to 1.3. Choice of not one, nor two, but *three* bandwidths allows greater flexibility in the choice of modulation. The narrow and broad band positions are useful when the modulator is less stable or accurate and for convenience in making preliminary adjustments in the test setup. The very narrow bandwidth, on the other hand, permits operation with minimum noise and interference. These features, coupled with high gain and wide range of input levels, make this instrument extremely versatile. Only $235.00 f.o.b. New York. Write for complete new catalog of precision microwave and VHF-UHF test instruments and components.

SPECIFICATIONS

	Very Narrow Band	Narrow Band	Broadband
Center Frequency (cps)	1000 ±2%	1000 ±2%	350-2500
Bandwidth (cps)	15	50	
Sensitivity for Full Scale Deflection (μv)	0.3	1	4
Noise Level (μv)	0.03	0.06	0.4
Range of Input Level (db)	70	70	70
Meter Scales	Db	0 to 10	
	Expanded	VSWR 1.0 to 1.3	
	Normal No. 1	VSWR 1.0 to 4.0, 10 to 40, etc.	
	Normal No. 2	VSWR 3.2 to 10.0, 32 to 100, etc.	
Input Selection	(1) Crystal; (2) Bolometer, 4.5 ma bias; (3) Bolometer, 8.75 ma bias; (4) 75,000 ohm impedance.		

Polytechnic RESEARCH & DEVELOPMENT CO. INC

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Western Sales Office:
741½ NO. SEWARD ST., HOLLYWOOD 38, CAL.—HO 5-5287

CIRCLE ED-155 ON READER-SERVICE CARD

Instrument Receptacles

Seal Against Temperature, Humidity

These sealed instrument receptacles are designed for use on delicate precision instruments where the greatest reliability is required. They will perform all functions of Army-Navy 3102A, 3102C, E, F, L, and M receptacles and will mate with standard Army-Navy 3106 and 3108 plugs. They meet all requirements of Specification MIL-C-5015B.

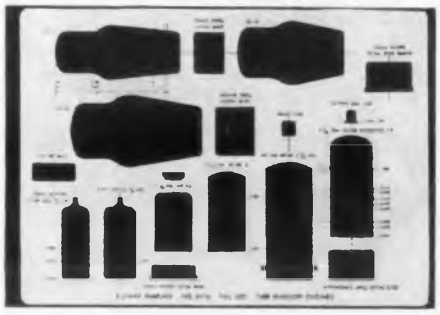
Simple in design and easy to assemble, the receptacles have only two pieces, an aluminum shell and a neoprene or silicone rubber insert with permanently bonded pin or socket contacts. All materials are non-magnetic. A silicone rubber insert is available for temperatures up to 450°F. Rubber O-rings molded as a part of the flange both front and rear form automatic seals when the insert is mounted in the shell, making additional gasketing unnecessary. The sealing remains permanent over a wide temperature range and under high humidity conditions.

Pin or socket contacts are available. They are permanently bonded into the insert dielectric material. Contacts are turned from solid-bar copper-alloy stock, silver plated and gold flashed. Electronics Div., Whitney Blake Co., Dept. ED, New Haven 14, Conn.

CIRCLE ED-153 ON READER-SERVICE CARD FOR MORE INFORMATION

Drafting Templates

Tube Envelopes, Sockets



For electronic engineers, draftsmen, and designers, the No. 6116 Template contains cutouts of standard vacuum tube envelopes, and is useful in three-dimensional layout problems. It is made of 0.030" rigid vinyl plastic.

Authentic standard dimensions are used throughout, with pencil tolerance allowed. Horizontal, vertical, and centerline indexes, plus nomenclature and sizes, are clearly shown.

Also available are two other templates. No. 6110 contains cutouts for top and bottom views of tube sockets, and No. 6120 contains cutouts of electrolytic capacitor twistlock bases and a rotary selector switch. E-Z-Way Templates, 2242 S. Colby Ave., Los Angeles 64, Calif.

CIRCLE ED-154 ON READER-SERVICE CARD FOR MORE INFORMATION

Shift Registers
With 19 Bit Capacities

Four Magnetic Shift Registers are being offered by this firm for radar, computer, and business machine system applications. Each package contains storage capacity for 10 bits and is so designed that the output of one package provides the input for a second. The package is extremely compact, measuring 4" x 1-3/4" x 1-1/4". For ease of interchangeability, the units plug into standard octal sockets.

The four different models are offered to provide various combinations of serial or parallel read-in and read-out. At 100kc, four 10-bit units may be driven from a pair of 5881 receiver tubes. At 10kc, 10 units may be driven from a pair of miniature tubes. For customer convenience, a compatible timing and driving unit is also available.

Ruggedly constructed for military applications, the units have a life expectancy greatly in excess of 15,000 hours. Magnetics Research Co., Dept. ED, 142 King St., Chappaqua, N. Y.

CIRCLE ED-158 ON READER-SERVICE CARD FOR MORE INFORMATION

Pulse Generator
Features Accurate Control

The Model B-2A Pulse Generator is a general-purpose instrument giving repetition rates from 10cy to 100-kc, widths from 0.1μsec and delays from 0 to 10,000-μsec, with an output pulse of 40v into 93 ohms. It is an improved version of this company's previous unit.

An input trigger circuit has been added to permit the selection of external triggering levels and operation from slowly rising trigger wave forms. The cooling fan has been relocated on the rear of the cabinet, increasing the area of the dust filter by a factor of five times, giving vastly improved cooling. The output circuit has been changed to eliminate starting and switching transients. Rutherford Electronics Co., Dept. ED, 3707 S. Robertson Blvd., Culver City, Calif.

CIRCLE ED-159 ON READER-SERVICE CARD FOR MORE INFORMATION

precision instruments by DeJUR

SERIES BC-200-E
(Extended Terminal Board)

BC-200
(Typical Cross-Section)

Linear and non-linear function

Ball Bearing Potentiometers

- External phasing
- Starting torque: 0.5 oz. in. max.
- Backlash: 0.05° max.
- Logarithmic, sine-cosine and other functions
- Multiple, adjustable taps
- Unitized design for universal coupling
- Precision machined aluminum housing
- Servo or single hole mounting

Our engineering department can supply prototypes quickly to meet unusual design specifications for tests and approval. Write for complete technical literature. No obligation.

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Electronic Sales Division
DeJUR-Amsco Corporation
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- *Fully enclosed precision ganging types*
- *Standard and power types*
- *High resolution precision types*

"You're always sure with DeJUR potentiometers"

CIRCLE ED-160 ON READER-SERVICE CARD FOR MORE INFORMATION

Electronic Pressure Gage

With Size, Weight Reduced 75%

The Model D
400 "Dynagage"
measures static a
dynamic pressur
and displacemen
under the most a
verse temperatur
and vibrations. T
new model with i
integral power s
ply, retains all t
features of the original "Dynagage", with size a
weight reduced over 75%.

Housed in a rigid aluminum casting, the unit m
be used with a complete new series of pressure pi
ups for measuring pressures up to 75,000psi. Featu
include: a stable output of ±15v into a high im
dance load; frequency response from 0 to over 20,0
cy; cable lengths up to 1000' for remote applicatio
and simplified tuning controls. The unit is suita
for pressure studies in rocket and jet motors, a
and aircraft reciprocating engines, hydraulic syste
compressors, pumps, and explosive systems. Photo
Research Products, Dept. ED, 421 N. Foothill Bl
Pasadena 8, Calif.

CIRCLE ED-162 ON READER-SERVICE CARD FOR MORE INFORMA

5" Oscilloscope

Has Wide Range, High Sensitivity

The Model 7
a 5" wide-ran
high-sensitivity
cilloscope, has b
engineered f
maximum depe
ability. The un
vertical ampli
provides a f
quency range
d-c to 2.5Mc,
down, with b
width switch in narrow position; and d-c to 5Mc,
down, with band width switch in wide position.
horizontal amplifier is d-c to 500kc, 3db down.
sweep circuit oscillator is 2cy to 30kc. Fixed sw
frequencies are 30cy and 7875cy.

Vertical amplifier input impedance is 2.2 megoh
50$\mu\mu$f and the horizontal amplifier is 2.2 megoh
50$\mu\mu$f. Vertical amplifier deflection sensitivity
0.010v/in rms (narrow position) and 0.035v/in
(wide position). The horizontal amplifier is 0.075
rms. Hickok Electrical Instrument Co., Dept.
10525 Dupont Ave., Cleveland 8, Ohio.

CIRCLE ED-163 ON READER-SERVICE CARD FOR MORE INFORMA

Power Supply

For 28v Aircraft Equipment

Model KM88 Aircraft Battery Eliminator is for testing and operating aircraft electrical and communication equipment. It operates on 115v a-c 60cy single phase and provides a continuously variable output from 0 to 28v d-c. The maximum continuous load current rating is 20amp. Overload capacity is 400% for 1/2 minute and 200% for 2 minutes. Ripple does not exceed 1% at maximum ratings.

Large 4" panel meters indicate output voltage and current, and an ammeter protection circuit automatically disconnects the instrument during periods of high inrush current. This feature permits starting of motors, converters, and other types of rotating machinery without injury to the ammeter.

All controls are on the front panel. The unit mounts in a standard 19" rack cabinet and occupies 15-1/4" of panel height. Opad Electric Co., Dept. ED, 69 Murray St., New York 7, N. Y.

CIRCLE ED-164 ON READER-SERVICE CARD FOR MORE INFORMATION

Capacitors

For High-Humidity Applications

Series 337 and 338 miniature flat "Mylar" polyester film dielectric capacitors are sealed in non-metallic cases and are designed to meet MIL-G-91A moisture resistance requirements. They are recommended for high-humidity applications requiring reliable operation from −55° to +85°C, and up to +125°C when proper voltage derating is applied.

The capacitors withstand a d-c voltage equal to 150% of the rated voltage for 1 minute at 25°C. They withstand a 250hr accelerated life test with 140% or rated voltage at 85°C and with 140% of the specified derated voltage at 125°C. Power factor is less than 1% at a frequency of 1000cy at 25°C.

Minimum insulation resistance is 50,000 megohm-mfd at 25°C, but need not exceed 150,000 megohms; at 85°C it is 1000 megohm-mfd minimum, but need not exceed 6000 megohms; at 125°C it is 50 megohm-mfd minimum, but need not exceed 300 megohms. Gudeman Co., Dept. ED, 340 W. Huron St., Chicago 10, Ill.

CIRCLE ED-165 ON READER-SERVICE CARD FOR MORE INFORMATION

PRESSURIZE ELECTRONIC EQUIPMENT

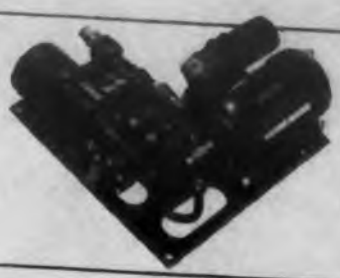
with **Eastern** UNITS

The extensive line of Eastern Pressurization Units for airborne electronic equipment accommodates a broad range of requirements, and meets appropriate government standards.

Units can be modified to meet your specific requirements. These modifications usually consist of: 1) Different compressors; 2) Motor change to meet your requirement; 3) Change in pressure switch settings; 4) Different mounting provisions. Eastern welcomes the opportunity to discuss and quote on your particular application problem.

MODEL E AP-100 TYPE 202

- Maintains a system pressure of 25 P.S.I.A. minimum.
- Motor is .03 H.P.—10,000 R.P.M., 208 V., 3 ph., 400 cy.
- Current draw is .7 amperes/phase maximum under normal operating conditions
- Unit operates continuously
- Weight is 4¾ lbs. maximum



MODEL E AP-150 TYPE 205

- Operating pressure switch maintains a system pressure of 17 P.S.I.A.
- Motor is 1/25 H.P. 7,500 R.P.M., 27 volts D.C. — T.E.B.B.
- Current draw is 2.0 amperes maximum under normal operating conditions
- Life is 500 operating hours
- Weight is 8 lbs. maximum

MODEL E AP-1500 TYPE 203

- Operating pressure switch maintains a system pressure of 30 P.S.I.A.
- Motor is 1/15 H.P. nominal 24-28 volts D.C., 5,000 R.P.M., continuous duty, shunt wound
- Current draw is 3.4 amperes maximum under normal operating conditions
- Life is 500 operating hours
- Weight is 12 lbs. maximum

MODEL E AP-2400 TYPE 201B

- Maintains system pressure of 31 P.S.I.A.
- Motor is 1/10 H.P., 24-28 volts D.C., 5,000 R.P.M. continuous duty
- Current draw is 5.5 amperes maximum
- Life is 500 operating hours
- Weight is 10-3/4 lbs. maximum

MODEL E AP-3600 TYPE 200

- Maintains system pressure of 31 P.S.I.A.
- Motor is 1/7 H.P., 10,000 R.P.M. { 208 V., 400 cy., 3 ph. / 24-28 V.D.C. } continuous operation
- Current draw is { 1.3 amp./phase / 7.1 on D.C. } amperes maximum under normal operating conditions
- Life is 1,000 operating hours
- Weight is 8-1/2 lb. maximum

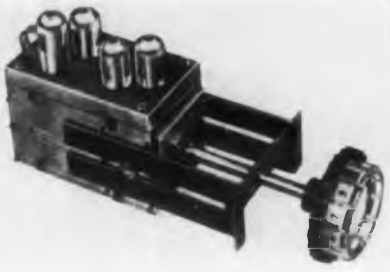
Eastern INDUSTRIES, INC.
100 SKIFF STREET
HAMDEN 14, CONN.

COMPLETE AVIATION CATALOG #330-P ON REQUEST.

CIRCLE ED-167 ON READER-SERVICE CARD FOR MORE INFORMATION

12-Channel Tuner

Takes Any Channels from 2 to 83



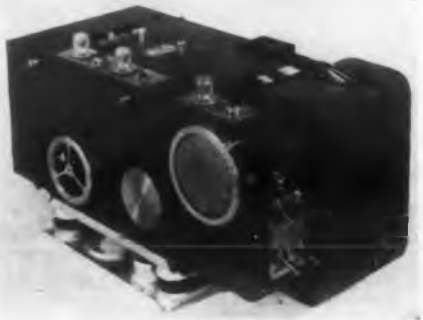
This tuner is a single unit no larger than the average v-h-f tuner and is operated without complicated drives or knobs. Channel segments (not converter strips) to suit local TV station requirements are snapped into the easily accessible turret and they may be arranged in any desired order. The segments consist of simple circuits which are factory tuned and need no further adjustment in the field. All channels, 2 to 83, are available at the same low price, and as many as 12 channels may be inserted.

One single conversion circuit is used throughout. Channel segments from 2 to 83 are all alike, except for values of inductance and capacity. Also new is the use of a 6AN4 r-f amplifier operating in both v-h-f and u-h-f. Better sensitivity, improved bandwidth control for black-and-white or color, and suppression of oscillator radiation are claimed for this circuit. Four tubes are used. Anchor Radio Corp., Dept. ED, 2215 S. St. Louis Ave., Chicago 23, Ill.

CIRCLE ED-168 ON READER-SERVICE CARD FOR MORE INFORMATION

Oscillograph

A Rugged Flight-Test Instrument



The Model 581 Oscillograph has been designed to fill the need for an extremely small flight-test instrument where automatic features are needed. Dimensions have been held to a minimum without affecting abiltiy to obtain highly accurate recordings. It measures stresses, strains, vibrations, and other physical phenomena under extreme acceleration, shock, and temperature conditions.

Some of the features are: automatic record-numbering, automatic length-control (resettable by remote control), no-record warning, lamp burn-out indicators, full-width timing lines at 0.01sec and 0.1sec, trace identification, footage indicator, and a wide selection of paper speeds from 1/2ips to 44-3/4ips. The instrument's capacity of 14 separate channels of information on 3-5/8" paper also makes it usable as a small laboratory oscillograph. Midwestern Instruments, Dept. ED, 3401 S. Harvard, Tulsa, Okla.

CIRCLE ED-169 ON READER-SERVICE CARD FOR MORE INFORMATION

Relay

Gives Full Wiping of Contacts

Engineered for d-c applications, the 100-C Relay is available either hermetically sealed or with dust cover in contact combinations from spst to dpdt. It incorporates the unique feature of thorough wiping action yet with a sensitivity of 10mw. This wiping effect has the advantage of eliminating the bounce and chatter at normal operating voltage.

Coil resistance is up to 30,000 ohms and contact capacity up to 1 amp inductive and 3 amp resistive. Non-ferrous metals and hyydrogen annealing of magnetic components eliminate the iron-aging and residual magnetism. Silver contacts are used; headers are available in any specification. The armature is securely locked without hinge pins.

Hermetic sealing is done exclusively by welding. Accessible spring-screw adjustment is provided for dust-cover type. Size standardized with other Diameter of the relay is 1-1/4" x 3-5/8" above mounting line. Hedin-Tele-Technical Corp., Dept. ED, 640 W. Mt. Pleasant Ave., Livingston, N. J.

CIRCLE ED-172 ON READER-SERVICE CARD FOR MORE INFORMATION

Bridge

Measures Resistance, Capacitance

This "R.C." low-cost, completely self-contained, portable resistance - capacitance bridge is designed to increase the speed and accuracy of making measurements on capacitors from 10mmfd to 50mmfd, and resistors from 10 ohms to 50 megohms. It can also be used for making continuity measurements on circuits, coils, and transformers.

The bridge is constructed with 1% precision resistors and 2% precision capacitors and highest components throughout. It detects paper, mica, electrolytic, and air capacitor faults, including open and short circuits, high and low capacity, and high power factor. It has a simplified direct-reading scale, and the power factor of electrolytic capacitors is indicated by means of a visual eye detector tube. Deltron, Inc., Dept. ED, 2905 N. Leithgow St., Philadelphia, Pa.

CIRCLE ED-173 ON READER-SERVICE CARD FOR MORE INFORMATION

To Wind Coils of "INVISIBLE WIRE"

(or other minute precision operations)

At the Hathaway Instrument Company, tiny galvamometer coils are wound with wire so fine that it is almost invisible to the unaided eye. Ingenious tooling and use of an AO Stereoscopic Microscope assure fast, precise workmanship.

These unique AO Microscopes provide *two* complete optical systems (one for each eye) to enhance the perception of depth and to provide *three-dimensional* reality plus an exceptionally wide field of view. Unlike ordinary microscopes, objects and movements are *not* inverted. Instead they appear in their natural directions. Because AO Stereoscopic Microscopes are unequalled for fabrication, assembly, inspection of minute precision parts, they are widely used in electronics, metal working, food and many other industries.

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Buffalo 15, New York

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Please send me further information on AO Stereoscopic Microscopes.

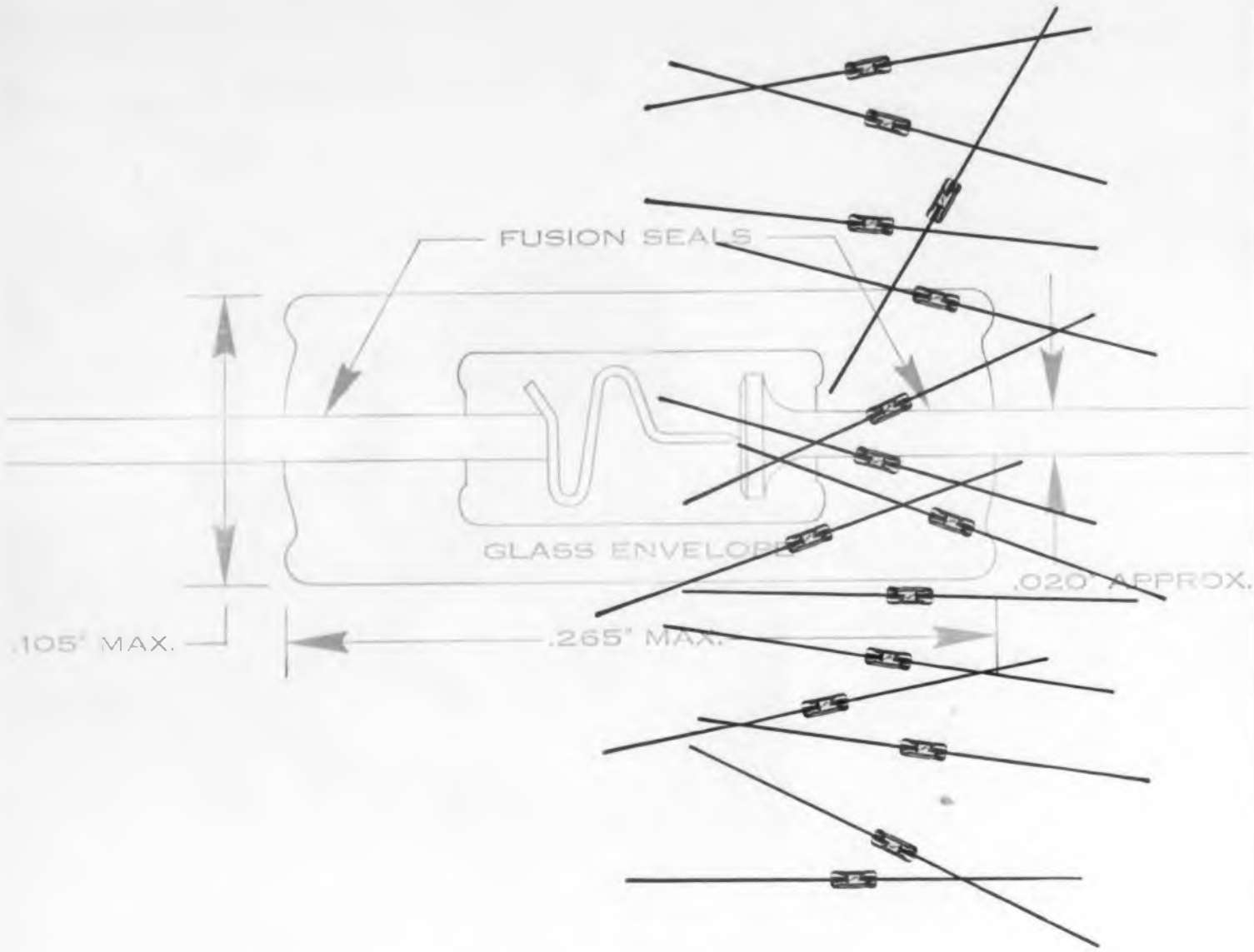
Signed .....

Organization .....

Address .....

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

CIRCLE ED-174 ON READER-SERVICE CARD FOR MORE INFORMATION



FIRST OF ALL FOR **RELIABILITY**

HUGHES SEMICONDUCTOR PRODUCTS

Why should YOU use Hughes semiconductors? First of all—for reliability. You can depend on these devices to stay within published ratings and specifications under varied and severe operating conditions.

All diodes made by Hughes are:

MOISTURE-PROOF—Fusion-sealed in a one-piece glass envelope. This construction eliminates a major cause of diode failure.

RUGGED—Small volume and mass enable them to withstand physical shock and vibration.

STABLE—Internal elements are isolated from damage or contamination. Mechanical and electrical characteristics remain stable throughout a long operating life.

THOROUGHLY TESTED—All diodes are tested for electrical and mechanical characteristics. They operate faithfully over wide ambient temperature ranges.

SUBMINIATURE*—In miniaturized circuitry, the high component density possible with these diodes promotes greater volumetric efficiency.

For instance, Hughes subminiature diodes have now been used by many major manufacturers of electronic equipment. Without exception, available performance reports indicate that, in military and commercial installations alike, the Hughes components have maintained an extraordinary record of failure-free service. Today, these same diodes are continuing to add to the reputation for superior reliability synonymous with Hughes Semiconductor Products.

The Hughes line of semiconductor devices is being steadily expanded. It now comprises a wide selection of Germanium Point-Contact and Silicon Junction Diodes, and Photocells. New products, now under development, are being readied for commercial production. Watch for their release. They, too, will embody the same Hughes quality in design and manufacture that spell out unsurpassed stability and reliability. Specify Hughes—with confidence.

HUGHES SEMICONDUCTOR SALES DEPARTMENT

Aircraft Company, Culver City, California

New York Syracuse Philadelphia Chicago

**Maximum dimensions, standard germanium diode glass envelope: 0.265 inch by 0.105 inch.*

CIRCLE ED-175 ON READER-SERVICE CARD FOR MORE INFORMATION

Sealed Panel Meters

1" Units for Electronics, Aircraft

For aircraft and electronic applications, the Model 100, 1" Panel Meter uses a miniaturized version of the highly accurate external pivot D'Arsonval movement. Scale windows and terminals are gasketed sealed watertight. An O-ring pressure gasket and locknut are provided for sturdy, shock-proof mounting. Watertight qualities meet MIL-3823 specifications.

This sealed meter (the round unit in the illustration) can be ordered with white, black, or luminous markings on white or black scale background, and a choice of colors for the pointer. The round mounting flange measures 1-1/4". The square unit shown (Model 102) is available on special order. Delivery: Amsco Corp., Dept. ED, 45-01 Northern Blvd., Long Island City 1, N. Y.

CIRCLE ED-176 ON READER-SERVICE CARD FOR MORE INFORMATION

Ultrasonic Equipment

For Wide Ranges of Applications

Utilizing highly efficient low-frequency ultrasonic vibrations, the Model DR-40C Ultrasonic Generating Equipment is primarily intended for cleaning and degreasing precision metal, glass, and plastic products such as bearings, potentiometers, lenses, printed circuits, microwave components and intricately machined pieces. The equipment also descales heat-treated parts, accelerates the dyeing of fabrics, and has numerous other uses.

In operation, the glass detergent or solvent-filled tank containing the parts to be cleaned is seated on top of a rugged magnetostriction-type transducer developing intense vibrations at an optimum cleaning frequency just beyond hearing range. Groups of these transducers energizing larger tanks can be driven by economical motor-generator sets for cleaning applications involving huge assemblies. Acoustica Associates, Inc., Dept. ED, 421 Seventh Ave., New York 1, N. Y.

CIRCLE ED-177 ON READER-SERVICE CARD FOR MORE INFORMATION

Solenoid

Small, Lightweight and Rugged

This solenoid is available in quantity for small equipment and components. Incorporating a new type positioning of a double wading coil for high seat-pull, it is a lightweight, powerful unit especially adapted to rugged duty. The solenoid will operate in any position and is regularly furnished for both constant and intermittent duty. 115v 60cy a-c. Blade terminals are standard, with flexible leads optional. Dormeyer Industries, Dept. EDN, 3418 N. Milwaukee Ave., Chicago 41, Ill.

CIRCLE ED-178 ON READER-SERVICE CARD FOR MORE INFORMATION

Right-Angle Drive

Valuable for Ganging Applications

This right-angle drive, Model RAD, features unusually sturdy construction with a die cast zinc housing and gears. It is especially valuable for ganging condensers, potentiometers, or other parts located in hard-to-reach locations on a chassis. Total length, including shaft, is 4-1/2". The shaft is standard 1/4" diam. Action is smooth and free from backlash. The National Co., Dept. ED, 61 Sherman St., Malden 48, Mass.

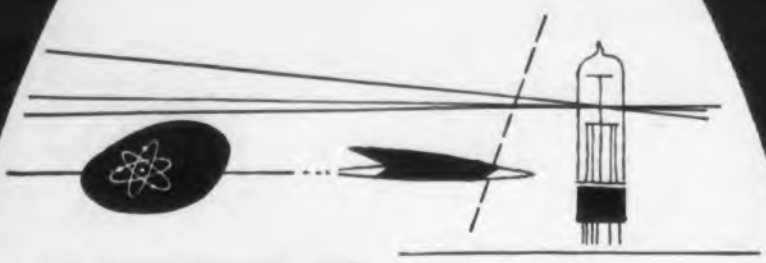
CIRCLE ED-179 ON READER-SERVICE CARD FOR MORE INFORMATION

Electrical Tachometers

In Single and Multi-Range Units

A redesigned circuit is now put in all of this firm's single-range and triple-range tachometers. Under normal conditions, this new circuit lengthens the life of the instruments about five times. It is linear, making available easy-to-read single and multiple range indicators. The indicators can be calibrated in any units desired at the time. Metron Instrument Co., Dept. ED, 432 Lincoln St., Denver 3, Colo.

CIRCLE ED-180 ON READER-SERVICE CARD FOR MORE INFORMATION



ELECTRONIC ENGINEERS:

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Long-range expansion programs in two Westinghouse divisions have created excellent ground-floor openings in *career* positions.

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World-leader in the field of aviation - electronics. Work involves computer, autopilot, radar and other advanced projects.

ELECTRONICS DIVISION:

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BALTIMORE DIVISIONS

Ceramic Capacitors

For Color TV

The "Cartwheel" heavy-duty ribbed-case Ceramic Capacitor has been made available to meet the higher operating voltages of color TV receivers. Of particular interest in high-voltage applications is a special ribbed construction which provides extra-long "creepage path" in a relatively small size.

Rated at a working voltage of 30v d-c, or a test voltage of 50kv d-c for 1 minute, the unit is encased in a cast insulating material, completely permanently sealed in one operation. The potting compound provides an insulation resistance greater than 50,000 megohms. Power factor is 1.5" max at 1000cy.

Units withstand 37.5kv after exposure to 200 hours of 90-95% relative humidity at 40°C. Standard capacitance is 500mmfd, with tolerance of +50% minus zero. Hi-Q Division, Aerovox Corp., Dept. ED, Olean, N. Y.

CIRCLE ED-185 ON READER-SERVICE CARD FOR MORE INFORMATION

Miniature Terminals

Stand-Offs for H-F Use

These miniature and subminiature insulated stand-off terminals for high-frequency applications and miniaturized equipment are supplied with taper pin connectors to accommodate "Amp" taper pins for solderless connections. These taper pins are also available on "Garde" feed-thru terminals, headers, connectors, terminal boards, and other components.

The terminals are manufactured in a wide variety of styles and insulating materials, plated to suit the application. Body materials are designed to meet requirements of MIL-P-14D. Terminals are plated in tin zinc, silver plate, gold plate, gold flash, palladium, and other materials. The studs in all insulated stand-off terminals are cadmium plated to QQ-P-416 specifications. Garde Manufacturing Co., Dept. ED, 588 Eddy St., Providence 3, R. I.

CIRCLE ED-186 ON READER-SERVICE CARD FOR MORE INFORMATION

Logic Building Blocks

For Digital Systems

A basic building block for doing complicated switching operations at speeds up to 200kc, the "Logiblock" contains four cores, three diodes, and a buffer amplifier tube. A maximum of eight input signals can be accepted and combined to give output signals in accordance with the built-in logic.

The "Logiblock" is split into two output sections. One output occurs when there is coincidence between two pairs of input signals (Or-And). The other output occurs in accordance with the presence of either of two input signals (Or-Inhibit). Provision is made for mixing the two outputs at the option of the user.

Each output is capable of providing inputs to four other "Logiblocks". In this way very complicated switching operations can be performed. The units are ruggedly packaged, have low power drain, and the inherent reliability and life associated with magnetic core switching devices. Magnetics Research Co., Dept. ED, 142 King St., Chappaqua, N. Y.

CIRCLE ED-189 ON READER-SERVICE CARD FOR MORE INFORMATION

Plugs and Jacks

One-Half Former Size

To meet the demand of small-size radios, tape recorders, and musical instruments, this firm has made available miniature plugs and jacks, approximately one-half the size of the former standard. The illustration indicates comparative size. The new items are called "Tini-Plugs" and "Tini-Jax".

The plugs feature high-grade insulation throughout; a one-piece tip rod staked into the tip terminal to insure tightness; terminals and body which interlock, eliminating any shifting; black and red Tenite, shielded handles. The jacks feature notched insulating washers which mechanically interlock the springs and solder lugs, eliminating the probability of shifting resulting in "electrical shorts" or change in adjustment; a contact area (of the tip spring) which firmly holds the mating plug; and springs of special alloy of nickel silver produced in special dies, for maximum spring life. Switchcraft, Inc., Dept. ED, 1328 N. Halstead St., Chicago 22, Ill.

CIRCLE ED-190 ON READER-SERVICE CARD FOR MORE INFORMATION

"powder to part"

Quality Controlled Fluorocarbon Plastics

U.S.G. quality control extends through every operation in the fabrication and custom molding of parts from duPont TEFLON, Kellogg KEL-F and BAKELITE fluorothene.

This quality control insures uniform electrical, chemical and physical characteristics of the highest quality. It also assures uniform density and dimensional stability permitting superior accuracy and dependability in the finished part.

Get the advantages of these fluorocarbon plastics at their best. Whether your requirements are for sheets, rods, tubing, tape, bars, cylinders, beading, electrical spaghetti, or parts extruded, molded or machined to your specifications . . . see U.S.G.

Write for Bulletin No. 300.

UNITED STATES GASKET COMPANY
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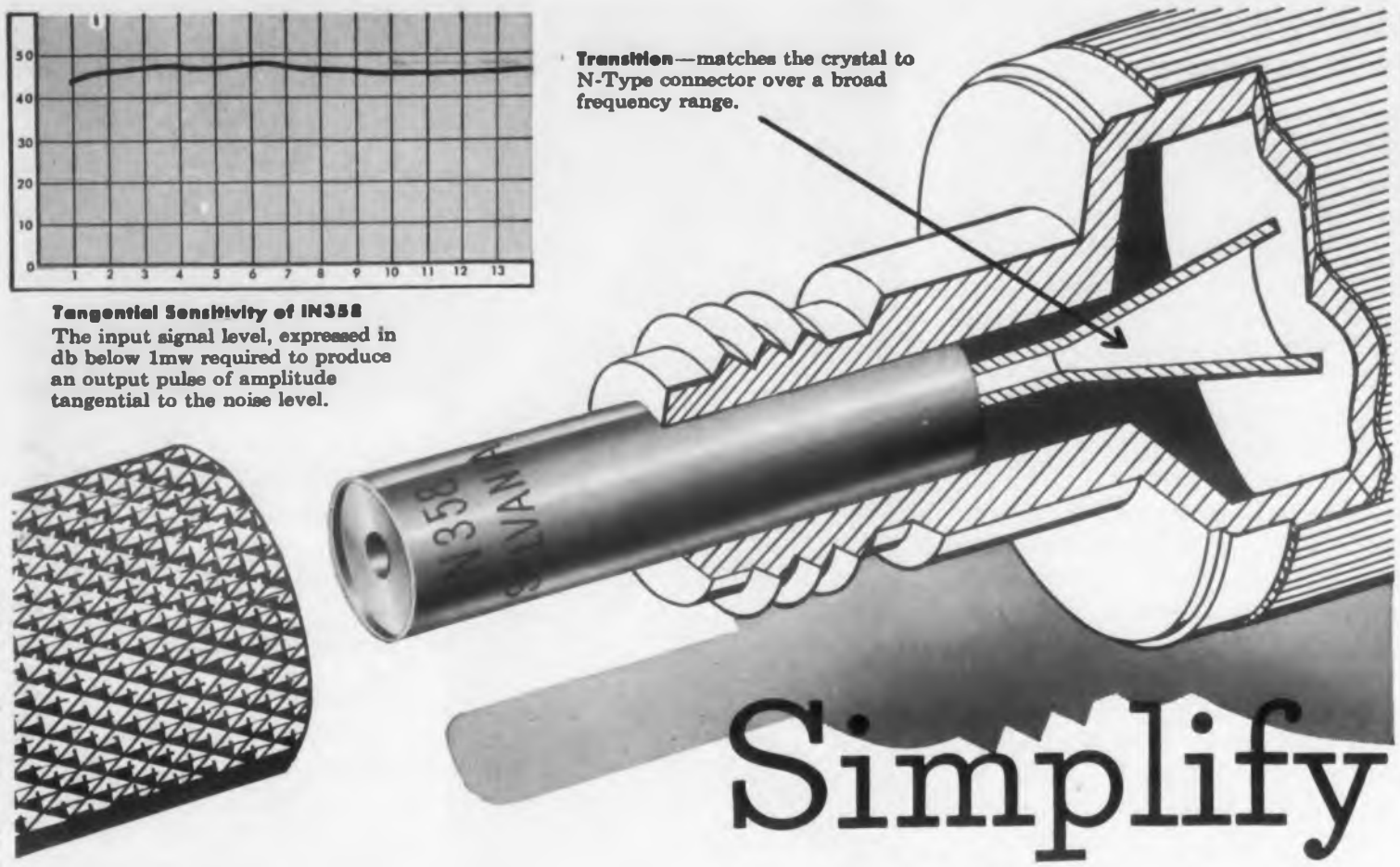
USG

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

CIRCLE ED-191 ON READER-SERVICE CARD FOR MORE INFORMATION

Tangential Sensitivity of IN358
The input signal level, expressed in db below 1mw required to produce an output pulse of amplitude tangential to the noise level.



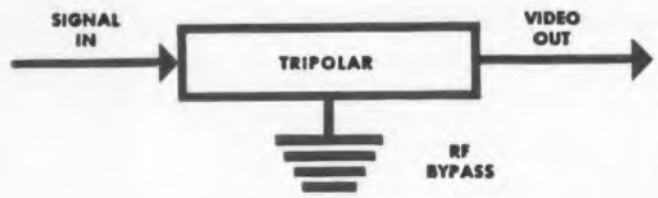
Simplify front-end design

over a BROADBAND microwave frequency range

NEW TRIPOLAR CRYSTAL DIODE

offers these five advantages

- Simpler, broadband crystal mount
- Signal goes in one end—is taken off the other
- No extra plumbing is required
- Built-in rf bypass capacitor
- Available with or without built-in dc return



By matching the inherent broadband characteristics of coaxial cable, the Tripolar crystal diode introduces an entirely new concept in broadband microwave circuitry and opens a fresh, simplified approach to front-end design.

The IN358 video detector is the first of these new broadband crystal diodes. In a simple holder, it covers the frequency range from 1 to over 12 kmc. The IN358 is connected in series with standard coaxial cable between the signal source and amplifier.

Other broadband video types are available now and broadband mixer types will be ready soon.

SPECIFICATIONS

Frequency Range:	1,000—12,400 Mc
Figure of Merit: (1)	10 min. at 6750±10 Mc
Tangential Sensitivity:	—40 DBM over frequency range @ 25°C
Video Resistance:	450 ohms—18000 ohms @ 25°C
Ambient Temperature:	—40—70°C

Note 1. Measured in untuned broadband holder

ANOTHER REASON WHY IT PAYS TO SPECIFY SYLVANIA

SYLVANIA

Sylvania Electric Products Inc.
1740 Broadway, New York 19, N. Y.
In Canada: Sylvania Electric (Canada) Ltd., University Tower Bldg., Montreal, P. Q.

LIGHTING • RADIO • ELECTRONICS • TELEVISION • ATOMIC ENERGY

CIRCLE ED-192 ON READER-SERVICE CARD FOR MORE INFORMATION

Subcarrier Discriminator

For Telemetering and Recording

The Model 67 Precision Subcarrier Discrimina is for use in f-m telemetering and data record systems. The discriminator contains its band input filter, frequency determining network, and interchangeable output filter in a single front-pa plug-in unit. Three outputs are provided, one which will drive most pen motors to full deflecti Each discriminator contains its own electronic regulated power supply.

The unit provides ±0.1% linearity, slope cons to ±0.25%, and zero drift of ±0.5% of full b width in a 15 hour period. Wide-range base-li limiting of the subcarrier eliminates amplitude mo lation effects and reduces to a minimum the effect step function changes normally encountered in m netic-tape drop outs.

This discriminator provides constant time de of intelligence through a subcarrier channel, perm ting reduction of recorded or transmitted multiple data, occuring at maximum intelligence frequenc with errors of less than 1% of bandwidth. As int gence approaches d-c, error is reduced to 0.1% bandwidth. Complete compensation for speed cha error in tape-recorded data can be provided. Elec Mechanical Research, Inc., Dept. ED, Ridgefi Conn.

CIRCLE ED-193 ON READER-SERVICE CARD FOR MORE INFORMAT

Precision Cam Assembly

For Adjustable Timing

The Type P1 precision assembly is signed to be u where a phys displacement any microswi or similar act ing device is quired. The stainless-steel cams can be rotated with respect each other and locked at any desired timing posit The assembly's stainless-steel shaft adapters are signed for three basic shaft sizes: 1/8", 3/16", 1/4"; they have setscrews for holding and sub-d holes for fixed pinning as desired. PIC Design Co Dept. ED, 160 Atlantic Ave., Lynbrook, L. I., N

CIRCLE ED-194 ON READER-SERVICE CARD FOR MORE INFORMAT

Phase Detector

Accuracy of 0.1° from 10kc to 15Mc

This instrument will measure time delay, phase delay, or envelope delay with error less than 1% or 0.1° between two alternating voltages from 10kc up to 15Mc. Known as Type 205a Precision Phase Detector, it consists of two input amplifiers, a continuously variable delay line, a step variable delay line, a differential tuned amplifier, a balanced phase detector, and a sensitive output indicator.

Applications include measuring phase characteristics of video amplifiers and envelope delay of television networks. Because constant time delay for all frequency components is important for faithful reproduction of TV pictures or pulse waveforms, the unit is valuable for measuring performance characteristics of TV and pulse equipments.

The smallest time delay that can be read on the dial is 5×10^{-10} sec; the smallest phase angle in degrees that can be read is equal to $5 \times 10^{-10} \times 360 \times$ frequency in cycles. The time delay of the step variable delay line is 5μsec in steps of 0.05μsec. Three plug-in units of continuously variable delay lines are supplied with the instrument, 0 to 0.4μsec, 0 to 0.25μsec, and 0 to 0.05μsec. Indicator sensitivity is approximately 0.01v full scale maximum without probe, and 0.1v with probe. Two low-capacity probes are supplied. Advance Electronics Co., Inc., Dept. ED, 451 Highland Ave., Passaic, N. J.

CIRCLE ED-196 ON READER-SERVICE CARD FOR MORE INFORMATION

Data Recorder

For Ground and Airborne Applications

The R-1021-D Recorder is a 210-channel fixed-stylus recorder, writing on a 5" width electrosensitive chart. It is a light, compact unit, designed for use on airborne as well as ground applications. It operates from either 115v, 400cy or 60cy power. A direct-writing unit adaptable to analog, digital, or sequential data recording, it is a ruggedized package whose accuracy is unaffected by temperature, humidity, or vibration. Radiation, Inc., Dept. ED, Melbourne, Fla.

CIRCLE ED-197 ON READER-SERVICE CARD FOR MORE INFORMATION

extruded TEMPREX teflon* HOOK-UP WIRE

for reliability

Temprex Extruded Striped Teflon Wire

Temprex Extruded Teflon Wire-Shielded (Metal)

Temprex Extruded Teflon Wire-Fiberglas Braid, Teflon Saturated

50-70-90 Ohm Coaxial Cable also available

● Insulated with a smooth sheath of extruded Teflon, Hitemp's new TEMPREX hook-up wire is unaffected by commercial solvents, temperatures from −90° to +260°C (Class H or better), fungus growth, moisture, or weathering. Retains its excellent electrical properties over a wide range of frequencies, conforms to MIL-W-16878A (Navy) E and EE constructions, and to MIL Standard 104.

Furnished in 14 solid colors extruded over silver-plated, stranded copper wire, or a solid conductor. Sizes 26—10 AWG in production lengths. Delivery within 10—14 days . . . Write for complete engineering information and price list.

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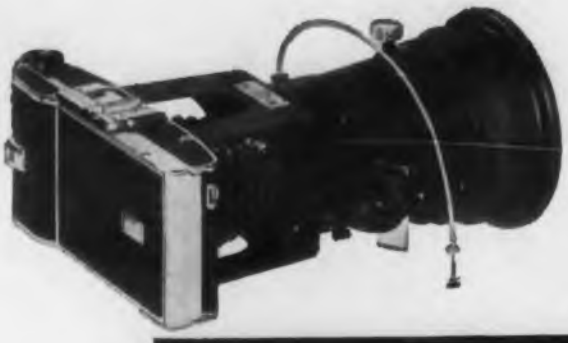
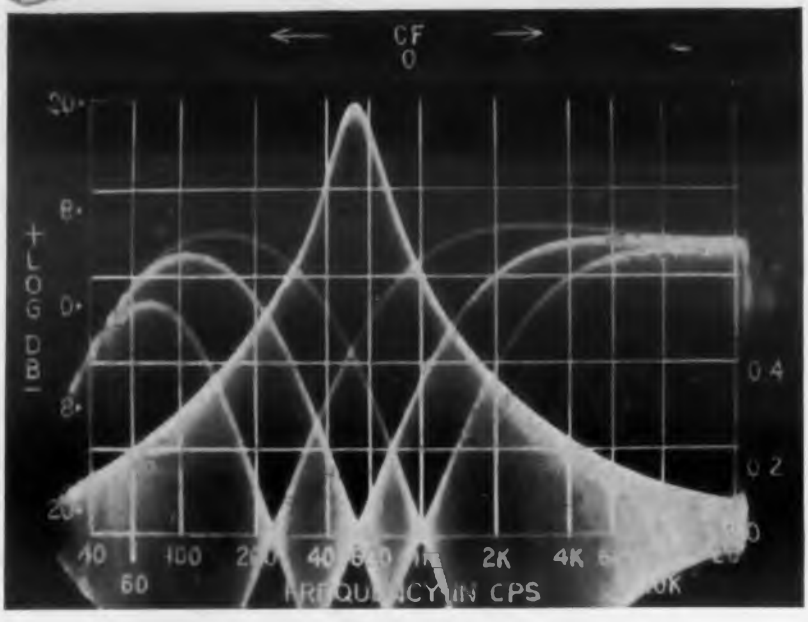
TEMPREX TEFLON EXTRUDED HOOK UP WIRE
TEMPCLAD TEFLON FIBERGLAS LEAD WIRE
RETEP TEFLON SATURATED GLASS BRAID LEAD WIRE
NEBROC TEFLON-FIBERGLAS LACING CORD
TEMPTUBE TEFLON FIBERGLAS TUBING

*Du Pont's Trade Name for Polytetrafluoroethylene

CIRCLE ED-198 ON READER-SERVICE CARD FOR MORE INFORMATION



in sixty seconds...



Performance evaluation of a Fischer electronic (low frequency—high frequency) filter; wave forms signify the following: Variable null marker to check points on response curve at 1 Kc, 2.2 Kc and 5.5 Kc. This is a log amplitude presentation where the frequency is multiplied by a factor of 10. Instrument used is SGI Sweep Generator; courtesy Panoramic Radio Products Corporation.

a full-size photo of any scope pattern for evaluation of transient phenomena!

This special Fairchild adaptation of the Polaroid-Land principle delivers a permanent, photographically accurate, full-size record of single transients or identical repetitive phenomena in 60 seconds after they appear on the C-R Tube. It is the only practical method to obtain a quick, permanent record of scope patterns like the one above. Because this photographic method is so fast, laboratory work can proceed continuously without interruptions or delays so usual where conventional film is used. The life size 3¼ x 4¼ in. image makes evaluation easy and accurate. Camera is automatically in focus when attached to the oscilloscope. Also provides for critical focusing adjustment where thick grids or filters are interposed between the tube face and camera hood.

For accurate records of continuously varying phenomena or single transients and stationary patterns on 35 mm. film, the Fairchild Oscillo-Record Camera is available. For more information, write Fairchild Camera and Instrument Corporation, 88-06 Van Wyck Expressway, Jamaica, New York, Department 120-23N.

FAIRCHILD

OSCILLOSCOPE RECORDING CAMERAS

CIRCLE ED-199 ON READER-SERVICE CARD FOR MORE INFORMATION

Internal Timers

For Automation Uses

"I.T." Electronic Interval Timers have been added to the "Decitron" counter line. Normal 60cy current is converted to 120cy and each impulse is registered by the "I.T." Timed operations, in seconds, are automatically controlled.

There are two rows of selector switches on Model "I.T.2," shown, and a dual timing circuit is possible. In a filling operation of liquid and gas, for example, the top row can be set to a desired time-fill interval, such as 4sec or 480 on the dials: 4 on the left control, 8 in center, 0 on the right control (120cy x 4 = 480). The lower row can be set for any desired time up to 8-1/3sec by the same method. By connecting the "I.T." to each operation with rear solenoid connections, the liquid will flow 4sec, shut off, and then gas will be drawn for 6sec. At this point, the timer automatically shuts off and repositions itself to liquid station again. A coincidental solenoid at the instant of stop on the second operation can signal a conveyor line to start again (bringing the next unit to filling station).

Single, dual, triple or quadruple "I.T." models are available, and various combinations to permit lengthy timed sequences are possible. Electronic Products Div., Post Machinery Co., Dept. ED, Beverly 11, Mass.

CIRCLE ED-200 ON READER-SERVICE CARD FOR MORE INFORMATION

Bandpass Filters

Displaces 0.55 cu in

The dimensions of this standard series of subminiature bandpass filters are 23/32" x 23/32" x 1-1/16" high. The units have a 0.55 cu in displacement and exhibit excellent characteristics for telemetering and airborne applications. They are designed to meet MIL specifications with 6% bandwidth at 3db, 40db/octave.

The units are hermetically sealed with a compression glass header and drawn metal can. The 2/56 studs afford a positive mounting arrangement. Custom designs can be produced. Communication Accessories Co., Dept. ED, Hickman Mills, Mo.

CIRCLE ED-201 ON READER-SERVICE CARD FOR MORE INFORMATION

Coaxial Triodes

For 10-15kw Equipment

The ML-6422 and ML-6423 Coaxial-Terminal Triodes, employing thoriated-tungsten filaments, are for industrial and broadcast equipment having 10-15kw power outputs. As replacements for types 892 and 892R as well as 5668 and 5669, the new triodes provide improved performance ratings, safety margins, and strength.

The thoriated-tungsten filaments greatly reduce power requirements while offering life increases to 100%. Plate current ratings are increased by 25%, grid current ratings by 20%, terminal inductances are very low; and high transconductance characteristics, up 70%, assure stable operation, low grid drive, and high plate efficiency. ML-6422 uses the company's standard water jacket and is rated for 30kw input, 20kw anode dissipation. ML-6423 employs an aluminum radiator to reduce weight to 16 lb as compared with 52 lb for a conventional type; this unit is rated for 30kw input, 12.5kw anode dissipation. Full ratings on both tubes are to 30Mc; reduced ratings to 90Mc. Machlett Laboratories Inc., Dept. ED, Springdale, Conn.

CIRCLE ED-203 ON READER-SERVICE CARD FOR MORE INFORMATION

Self-Locking Nut

Provides 80% Weight Saving

This all-metal self-locking miniature nut is designed to use only one-half the space of comparable standard anchor nuts and to be only one-fifth the weight, thus effecting weight savings of 80%. It retains the full tensile strength of the original "Kaylock" self-locking standard anchor nut.

The nut utilizes a simple positive locking principle wherein the upper threads are made elliptical and highly resilient, allowing all threads to carry the actual load, thus eliminating the necessity for an auxiliary locking device. It can be used in temperature ranges up to 550°F, and is fungus-proof. The company's "Kaylock" miniature nuts are now produced in a complete range of sizes from 4-40 to and including 1/4"-28 in three basic configurations: two lug, one lug, and corner types. The Kaynar Co., Kaylock Div., Dept. ED, 820 E. 16th St., Los Angeles, Calif.

CIRCLE ED-204 ON READER-SERVICE CARD FOR MORE INFORMATION

Save valuable laboratory time, avoid production delays and unnecessary overhead. Put your coil problem in the hands of experts with the experience and facilities to design and produce your coil quickly and in volume.

Send details to COTO-COIL COMPANY, INC.
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New York: 10 East 43rd Street, New York 17, N. Y.

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Coto Coils
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CIRCLE ED-205 ON READER-SERVICE CARD FOR MORE INFORMATION

Electrometers

With Terminals for Recording Uses

Models 200 and 200A Electrometers, battery-operated d-c vacuum-tube voltmeters with input impedances exceeding 10^{14} ohms, are available in an improved version. These are now fitted with output terminals, providing a convenient means for recording a very broad range of voltage, current, and resistance measurements. In addition, amplifier-recorder systems can be given an inexpensive ultra-high input. The electrometer tube is used as a cathode follower, providing an output voltage gain of 0.65, a zero drift within 0.1% of full-scale per hour on each range, and response of d-c to about 100cy.

When used with accessories, the instruments measure full-scale voltages of 2v to 20,000v, currents down to 2 x 10^{-12}amp full scale, and resistances to 16^{14} ohms full scale. Applications include indicating and recording potentials of charged capacitors and vacuum-tube grids; measuring currents in photocells, ion chambers, and semi-conductors; making insulation leakage resistance and volume resistivity tests; and detecting static charges. Keithley Instruments, Dept. ED, 3868 Carnegie Ave., Cleveland 15, Ohio.

CIRCLE ED-208 ON READER-SERVICE CARD FOR MORE INFORMATION

Toroid Transformers

In Four Ranges to 50-200 kc

The Series ST and ST4 Transformers are for use in applications requiring a compact, efficient multiwinding transformer, operating at low impedance circuits over a wide frequency range.

Transformers are toroidally wound on molybdenum permalloy cores. Four different types of cores are utilized, each the most efficient in the range to be covered. Ranges available are: up to 15kc; 10-50kc, 30-75kc and 50-200kc. Each core type is available with either two, three, or four identical windings.

Transformers occupy less than 0.85 cu in, including terminals. Convenient single-hole mounting with anti-rotation pin is provided. Voltage rating between windings is 100v. Mico Instrument Co., Dept. ED, 77 Trowbridge St., Cambridge 38, Mass.

CIRCLE ED-209 ON READER-SERVICE CARD FOR MORE INFORMATION

Coaxial Tuner

For Broad-Band Use

The Model G50-A Broad-Band Coaxial Tuner, for use in the microwave region, makes possible impedance matching over a wide frequency range with a single instrument. Utilizing the line-stretcher and single-stub principal for matching to 50-ohm lines, the unit reduces vswr's in excess of 30:1 to less than 1.2 over the frequency range 750Mc to 10,000Mc.

Ruggedly built, the tuner is constructed largely of coin silver, rhodium plated for tarnish resistance. Settings are retained by simple, finger-tightened locking nuts. The tuner is intended for use with systems employing Type N fittings and is furnished with male or female Type N connectors in combinations specified by the customer. Dunn Engineering Associates, Inc., Dept. ED, 11 Windsor St., Cambridge, Mass.

CIRCLE ED-212 ON READER-SERVICE CARD FOR MORE INFORMATION

Vector Analyzer

Can Measure Fractional Degrees

The Type 202 "Vectorlyzer" can be used to measure very small phase angles, such as 1° or a fraction of a degree with maximum error less than 2.5%. The instrument is based on a circuit which permits unusual speed and accuracy to measure vectorrelations of alternating voltages.

Applications include measuring vector sum or difference of two voltages; imaginary and real components of an unknown voltage in terms of a reference voltage; phase angle between two alternating voltages; voltage across two points which are both above a-c ground potential; and magnitude and phase angle of an unknown impedance.

The frequency of this instrument is 8cy to 2Mc with amplifier. The upper limit decreases to 200kc without amplifier. The probe has a frequency range from 100kc to 500Mc. The voltage range is 0.04v, 0.4v, 4v, and 40v rms full scale with amplifier. All ranges increase fifty times without amplifier. Advance Electronics Co., Inc., Dept. ED, 451 Highland Ave., Passaic, N. J.

CIRCLE ED-213 ON READER-SERVICE CARD FOR MORE INFORMATION

Frequency Divider

Extends Meter Ranges

The FM-5 Frequency Divider is designed specifically to extend the frequency measuring range of either the Gertsch FM-3 or AM-1 down to 500kc and the frequency generating range down to 200kc with no loss of accuracy. It both measures and generates up to 20Mc with continuous coverage. The FM-3, shown at left, is direct-reading v-h-f frequency meter (20-640Mc) rated at 0.001%.

The FM-5 consists basically of two tuned frequency dividers in cascade, each dividing by ten. These dividers are used to divide the fundamental output frequency (20-40Mc) of either the FM-3 or the AM-1 by exactly ten or one hundred, depending on whether one or both dividers are being used. This gives a source of 2-4Mc and harmonics, or 200-400kc and harmonics, as accurate and stable as the 20-40Mc input. Included is a detector-audio system for heterodyne type measurements.

The FM-5 is available in both rack panel and portable models. The portable model is available for either battery or a-c operation. Gertsch Products, Inc., Dept. ED, 11846 Mississippi Ave., Los Angeles, Calif.

CIRCLE ED-217 ON READER-SERVICE CARD FOR MORE INFORMATION

Hermetic Seal Terminal

Takes −60° to +500°F Temperatures

This terminal is composed of Steatite insulators which compress a silicone rubber grommet against an extruded hole in the header, forming a leak-proof oil seal capable of withstanding extremely high internal pressure. D-c metallic migration is prevented, and operating temperatures range from −60° to +500°F. Standard voltage rating is 2000v to 7000v.

The terminal is approved under MIL-T-27 for transformers and MIL-C-25 for capacitors, and is used extensively in relay lines and as feed-throughs on metal panels. The minimum size is 0.187"diam, and the terminal can be mounted on 1/4" centers.

This company also announces a service to fabricate complete headers. Robco Manufacturing Div., Pilot International Corp., Dept. ED, 27-01 Bridge Plaza North, Long Island City 1, N. Y.

CIRCLE ED-218 ON READER-SERVICE CARD FOR MORE INFORMATION

DURABLE, ACCURATE Decade Resistance Boxes

36 types . . . . 1 to 6 dials

ACCURACY:
10Ω & above ± 0.1% 0.1 Ω–± 1%
1.0 Ω–± 0.25% 0.01 Ω–±5%
Closer tolerance on request.

TEMPERATURE COEFFICIENT: 0.002%/°C.
MAXIMUM LOAD: ½ watt per step
FREQUENCY LIMIT: Non-inductive to 20 Kc.

TYPE	DIALS	OHM STEPS	TOTAL RESISTANCE OHMS	PRICE
550	1	1,000,000	10,000,000	$ 66.00
023	3	1,000	1,110,000	77.00
024	3	10,000	11,100,000	120.00
017-A	4	0.01	111.1	75.00
019	4	0.1	1,111	71.00
025	4	1	11,110	77.00
026	4	10	111,100	79.00
027	4	100	1,111,000	92.00
028	4	1,000	11,110,000	139.00
017-B	5	0.01	1,111.1	94.00
0285	5	0.1	11,111	94.00
029	5	1	111,110	101.00
030	5	10	1,111,100	113.00
032	6	1	1,111,110	121.00
033	6	10	11,111,100	169.00

Write for Bulletin L-17A for a complete listing of Shallcross Decade Resistance Boxes.

Shallcross MANUFACTURING COMPANY
526 PUSEY AVE., COLLINGDALE, PA.

CIRCLE ED-221 ON READER-SERVICE CARD FOR MORE INFORMATION

VALPEY *Quartz Crystals*

symbol of craftsmanship for over 23 years

Temperature-controlled oven

An essential and critical part of Valpey's quality-control process is X-raying blanks to accurately determine the angle of cut. This inspection occurs after slices have been sawed from large natural quartz bars prior to lapping to fine surface flatness.

Quartz blanks not cut to the exact angle are rejected. The X-ray pictured here, accurate to within two minutes, is used in this vital inspection.

Valpey precision produces the finest crystals available for every application in ranges from 40 Kc. to 100 Mc. Bulletin FE-1 describes all conventional units. Available on request.

VALPEY *Crystal* CORPORATION
242 Highland Street
Holliston, Mass.
Craftsmanship in Crystals since 1931

CIRCLE ED-222 ON READER-SERVICE CARD FOR MORE INFORMATION

Power Supply

With Two High-Voltage Outputs

The Model D3-300D Power Supply provides two high-voltage output ranges, each independent of the other, on one compact chassis. It delivers 0-300v d-c at 300ma max load; 0-300v d-c at 150ma max; d-c variable bias 0-150v at 5ma max load (regulated by VR tube); and 0-10v a-c unregulated, at 10amp max load which is variable with powerstat control.

For line voltage of 115v a-c ±10%, the output voltage change is 0.15%. For d-c regulated high voltage, the change from no-load to full-load is less than 30mv. Ripple for both high-voltage outputs is less than 500μv rms. Both positive or negative of either high-voltage outputs may be grounded.

All components in the unit are derated for long service life. Tapped screw holes, readily removable tops and bottoms, and easy-to-trace wiring are features included to simplify maintenance. Dressen-Barnes Corp., Dept. ED, 250 N. Vinedo Ave., Pasadena 8, Calif.

CIRCLE ED-223 ON READER-SERVICE CARD FOR MORE INFORMATION

Breadboard Kit

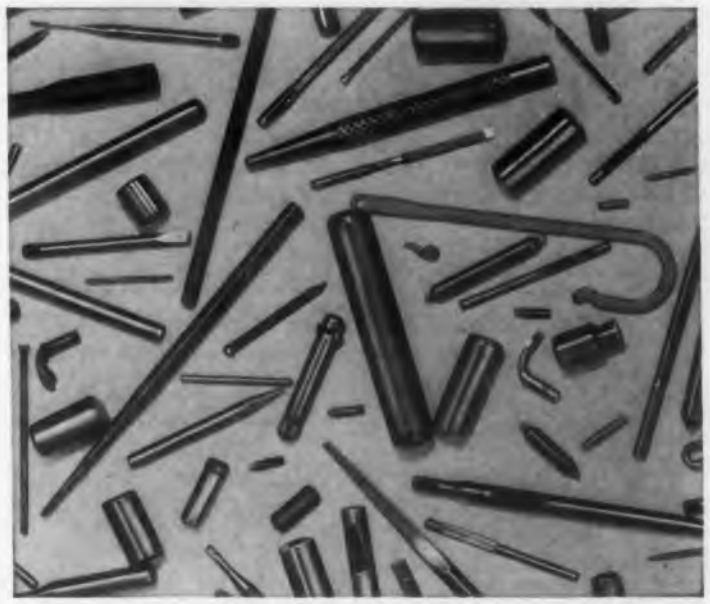
Contains 630 Different Parts

Breadboard Kit "P" consists of 630 different parts, such as gears, shafts, differentials, breadboard plates, hangers, bearings, etc. It is designed to include all parts necessary to solve any mechanical or electronic problem. Material is designed for reuse.

The kit can be used for military engineering or development contracts, laboratories, and for all electronic applications. It is contained in an attractive leather carrying case 5″ x 12″ x 18″, felt lined to protect the precision instrument parts. It is complete with tools to assemble and disassemble parts as desired. Two other smaller kits are also available as standard. Pic Design Corp., Dept. ED, 160 Atlantic Ave., Lynbrook, L. I., N. Y.

CIRCLE ED-224 ON READER-SERVICE CARD FOR MORE INFORMATION

TORRINGTON *delivers small precision parts promptly*



"On time" shipments of Torrington small precision metal parts will keep your production lines moving.

Special automatic machinery of our own design, plus almost 90 years of precision metalworking experience, enables us to produce your small precision parts *faster, better and for less* than you can make them yourself. And we follow your specifications *exactly* on tolerances, temper, hardness and finish.

Send a sample part or blueprint for our quotation. Our Condensed Catalog illustrates many of the parts we can produce for less. Ask for it.

THE TORRINGTON COMPANY
Specialties Division
37 Field Street, Torrington, Conn.

TORRINGTON SPECIAL METAL PARTS

Makers of Torrington Needle Bearings

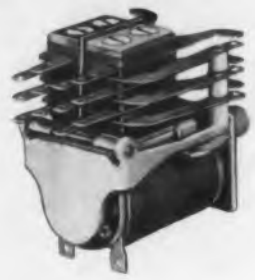
CIRCLE ED-225 ON READER-SERVICE CARD FOR MORE INFORMATION

OHMITE AMRECON® RELAYS

High quality, general purpose relays featuring compactness, dependability and long life!

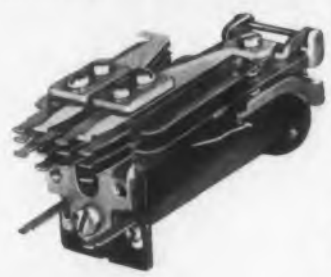
MODEL DO
Ideal for mobile equipment and aircraft. Contact Rating: 10 amp at 115 VAC or 32 VDC noninductive load.

MODEL DOS
Meets rigorous aircraft standards. Contact Rating: 15 amp at 115 VAC or 32 VDC noninductive load.



MODEL TKL
Miniature of long telephone type relay. Contact Rating: 1 amp at 115 VAC or 32 VDC noninductive.

MODEL DOSY
Twin coils provide extra sensitivity. Contact Rating: 15 amp at 115 VAC or 32 VDC noninductive load.



MODEL TG
Use where fine adjustment is needed. Contact Rating: 1 amp at 115 VAC or 32 VDC noninductive.

30 TYPES AVAILABLE FROM STOCK

Write for Catalog R-10

American Relay & Controls, Inc.
3643 Howard St.
Skokie, Ill.
(Suburb of Chicago)

a subsidiary of

OHMITE® MANUFACTURING COMPANY

CIRCLE ED-226 ON READER-SERVICE CARD FOR MORE INFORMATION

Miniature Transformers

200w Pulse and Broadband Types

A full line of miniature broadband and pulse transformers for universal applications is offered by this firm for applications requiring up to 200w peak power. The line consists of two basic styles. One type is encapsulated in epoxy resin, and the other hermetically sealed in a metal can. A choice of silicon ribbon or ferrite as core material is available.

Type 19 is an epoxy-encapsulated unit employing a toroidal core of oriented-grain silicon steel. Type 50 is a similar transformer hermetically sealed in a metal container. Both are useful to 200w peak power in coupling and blocking oscillators requiring pulse widths from 0.5μsec to 10μsec and rise times to 0.02μsec.

Type 60 is a ferrite-core transformer of high efficiency in coupling circuits. It is also useful for fast pulses of 0.05μsec to 0.5μsec widths, and rise times to 0.01μsec. The three types are made to pass MIL-T-27 requirements. Carad Corporation, Dept. ED, 2850 Bay Rd., Redwood City, Calif.

CIRCLE ED-227 ON READER-SERVICE CARD FOR MORE INFORMATION

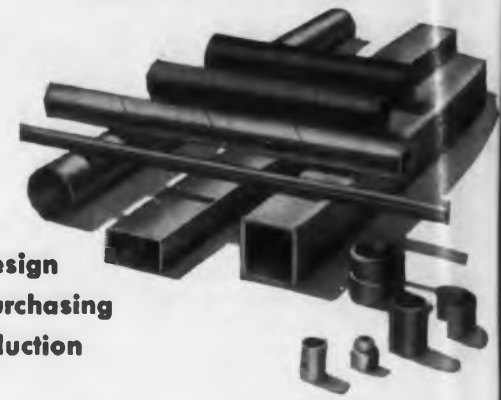
D-C Power Supply

125v 25amp Germanium Unit

This 125v 25-amp Germanium Rectifier D-C Power Supply contains no moving parts, is compact, lightweight, and has an inherent regulation of 4% from no-load to full-load. It is identified as Model No. G 125-25.

Specifications include: d-c output, 125v at 25amp (continuous); a-c input, 230v, 60cy, 3 phases; regulation, 4% no-load to full-load, 1-1/2% from 1/2 load to full-load; ripple, 5% rms; efficiency, 94%; power factor, 98%; weight, 125 lb (approx); and dimensions, 22" x 15" x 19". A tap switch will give output voltage adjustment over the range of 115-125v for normal line and load variations. Metering is on a 4-1/2" ammeter and a 4-1/2" voltmeter, with 2% accuracy. Perkin Engineering Corp., Dept. ED, 345 Kansas St., El Segundo, Calif.

CIRCLE ED-228 ON READER-SERVICE CARD FOR MORE INFORMATION



improve design
simplify purchasing
speed production
with

C-D-F SPIRAL TUBING

Looking for low-cost tubing to reduce unit costs and improve product performance? Consider the use of C-D-F Spiral Tubing, a high strength plastic made from paper or fibre that is spirally wound and cured at high temperatures. In many cases it can replace rolled or molded laminated plastics . . . at a good cost saving. Small sizes, thin walls are not a problem. For many applications, dimensional stability and moisture resistance is excellent. Coil forms, insulating tubes, paint roller tubes, shipping containers, bushings are just a few applications. Write today for 8-page Technical Folder ST-53, giving properties, sizes, tolerances on impregnated and unimpregnated round, square and rectangular C-D-F Spiral Tubing. Well illustrated. Call your C-D-F sales engineer (offices in principal cities) — he's a good man to know!

Continental-Diamond Fibre
CONTINENTAL-DIAMOND FIBRE COMPANY, NEWARK 107, DELAWARE

CIRCLE ED-229 ON READER-SERVICE CARD FOR MORE INFORMATION

STABILITY ± 1°C

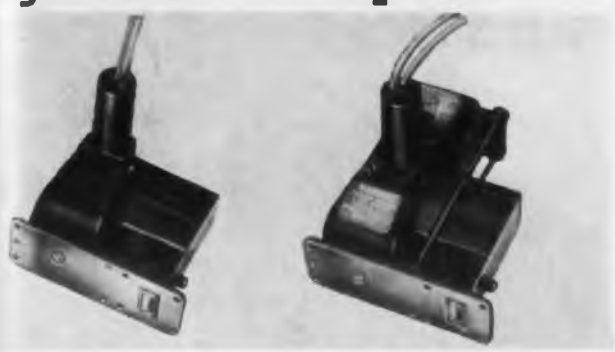
NEW TCO-22 SERIES CRYSTAL OVEN

A *new concept* of frequency stability, with compact design, is introduced by the TCO-22 series oven. Features include provision for mounting two BH6A crystal holders (MIL type HC-6/U), quick heating, easy access for frequency change, in addition to a *stability* of ± 1°C. Standard units are rated 7.75 Watts supplied for either 6.3 V or 26.5 V operation. Nominal temperature +75°C or +85°C.

BLILEY ELECTRIC COMPANY
UNION STATION BUILDING
ERIE, PENNSYLVANIA

CIRCLE ED-230 ON READER-SERVICE CARD FOR MORE INFORMATION

Magnetrons for High Altitude Operation



MICROWAVE ASSOCIATES, INC. has developed two new magnetrons for high altitude unpressurized operation. The 2J42H is a modification of the popular 2J42 and the MA-201 of the higher power 6027 (2J42A). The 2J42H and MA-201 are capable of delivering 14 and 20 watts (min) average power at altitudes used by modern intercept planes. Both tubes are provided with glass pressure windows to prevent RF breakdown and heavily insulated pigtails embedded in plastic at the filament end to prevent corona. Although normally produced at a center frequency of 9375, tubes are available on special order from 9000-9600 mcs.

For further information, contact D. W. Atchley, Jr., Sales Department, Microwave Associates, Inc., 22 Cummington St., Boston, Mass. Phone, COpley 7-7577.

MICROWAVE Associates INCORPORATED

CIRCLE ED-231 ON READER-SERVICE CARD FOR MORE INFORMATION

...ready for YOU

WRITE TODAY for your copy of the new Thomas & Skinner Bulletin No. L-355 on electrical laminations. Complete data with sketches, dimensions, and characteristics charts. Also, complete details on new T&S Test Procedure for Standard EI Laminations.

Call on your Thomas & Skinner engineering staff for expert assistance on your lamination problems.

Specialists in Magnetic Materials

THOMAS & SKINNER
Steel Products Company, Inc.

1157 EAST 23RD STREET, INDIANAPOLIS 7, INDIANA

CIRCLE ED-232 ON READER-SERVICE CARD FOR MORE INFORMATION

Scaler

For Binary and Decimal Counting

The Model 200 Scaler utilizes decimal or binary units which are directly interchangeable; it may be changed from one to the other in a matter of seconds. A direct-coupled non-overload linear amplifier is followed by a discriminator that drives the decimal or binary scaling stages. The output of the counting units drives a register driver circuit which in turn operates a mechanical register. A pulse generator is incorporated to furnish an accurate check of calibration and operation.

The discriminator utilizes a flutter-free reference tube permitting use of the scaler as an integral type pulse-height analyzer or to discriminate between pulses in the 0 to 87-1/2v range. The high-voltage supply of this unit utilizes a voltage doubler which keeps the high-voltage transfer noise down to an absolute minimum. Provisions are made for this firm's Automatic Sample Changer, utilizing glow transfer tubes as a six digit register, permitting any number from 10 to one billion to be selected as a preset count. Radiation Instrument Development Laboratory, Dept. ED, 2337 W. 67th St., Chicago 36, Ill.

CIRCLE ED-233 ON READER-SERVICE CARD FOR MORE INFORMATION

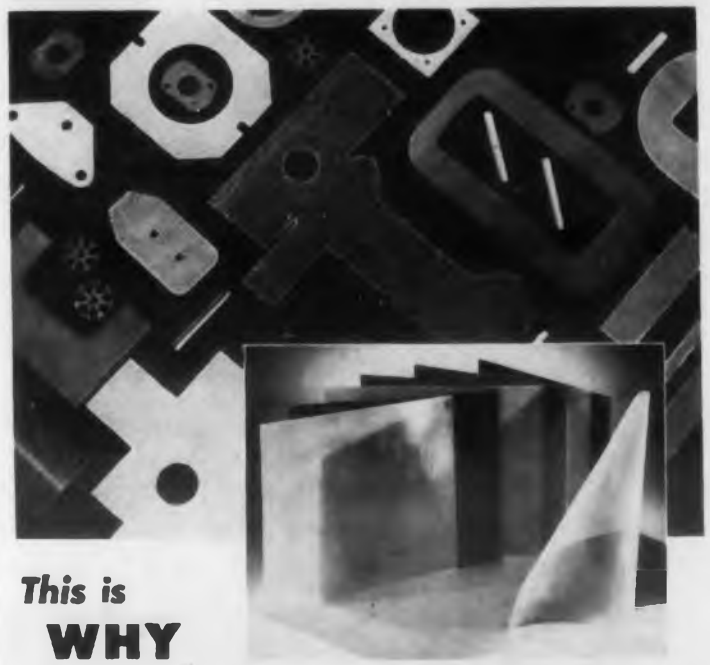
Glass Trimmer Capacitor

Has Low Minimum Capacitance

Only 3/4" in overall length, this midget glass rotary trimmer capacitor features a very low minimum capacitance and smooth trimmer adjustment. It is suitable for application in any commerical circuit requiring an economical trimmer.

The unit is available in two sizes: 0.5-3.0mmfd and 1.0-4.5mmf. Q is 500 at 50Mc. The temperature coefficient of the body of the trimmer is 200ppm. Constructed of glass tubing with a coating of metal bonded to it, the capacitor has a self-lubricating nylon bushing threaded to take a 6-32, Class 2 type screw. Corning Glass Works, Dept. ED, Corning, N. Y.

CIRCLE ED-234 ON READER-SERVICE CARD FOR MORE INFORMATION



This is WHY CONOLITE *POLYESTER* LAMINATES

may surpass your specifications

Specifications for laminates that give your electrically operated equipment a competitive edge may be more than met by Conolite *polyester* laminates. This is possible because Conolite is made of thermosetting *polyester* resins reinforced with filler materials in combinations or individually, and built up in layers.

Here is why. Three basic laminates: 1) extremely flexible, cold-forming glass cloth, and glass cloth-asbestos paper, 2) flexible glass base, postformable under heat, 3) rigid paper base, postformable under heat. Excellent room or low-temperature punching quality. Low specific gravity—more area per unit weight. Dielectric strength 20-100% better than phenolic laminates. Excellent arc resistance—106 seconds for a .062" thickness in a paper grade. Extreme uniformity of thickness within close tolerances. Chemically inert, noncorrosive *polyester* resins. Outstanding impact strength—10 times better than phenolic laminates. Excellent power loss factor. Unlimited color range. Complete line in thicknesses from .005" to .062" for class A and B requirements.

Conolite *polyester* laminates are available in continuous coils for sustained automatic fabricating operations, and also in sheets. Conolite laminates in coils are packaged in fibre drums that reduce storage 2 to 3 times compared to other laminates. The fibre drums also cut handling and shipping costs.

Investigate Conolite *polyester* laminates and you'll learn why they may more than meet your specifications. Call in an IMC sales engineer today or write the nearest IMC office for more information. Also ask about IMC's Chicago Fabricating Division that can supply you with fabricated Conolite parts to meet your requirements.

INSULATION MANUFACTURERS CORPORATION

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*LOCAL STOCKS AVAILABLE AT THESE LOCATIONS

CIRCLE ED-235 ON READER-SERVICE CARD FOR MORE INFORMATION

Induction Motor

Sub-Fractional Low-Slip Unit

Combining good speed regulation with low slip, the AC-93 Miniature Sub-Fractional Induction Motor offers favorable application characteristics for magnetic tape recorder operation; servo or actuator motors; and geophysical equipment uses. Although the standard unit is an induction motor, its design is such that it can be supplied, with minor changes, as a synchronous unit with reduced power output.

Operating at 115v, 400cy single-phase, the unit has a speed of 11,800rpm with a 15w output. Locked rotor torque is 1.8 oz-in minimum. Maximum power input is 45w, and rotation is reversible. Driving shaft design and arrangement of input terminals or leads can be adapted to user requirements. Weight is 14 oz. Dalmotor Co., Dept. ED, 1326 Clay St., Santa Clara, Calif.

CIRCLE ED-237 ON READER-SERVICE CARD FOR MORE INFORMATION

Oscillograph

Measures Extremely High-Speed Pulses

Precise measurements and analyses of phenomena which take place at extremely high rates of speed may be made with the Type 336 Cathode-ray Oscillograph. The instrument is expected to have applications in nuclear studies, development and maintenance of high-speed electronic computers, design of radar systems, and similar applications requiring high-frequency measurements.

The Y-amplifier of this unit has a rise time of 0.02μsec with less than 2% overshoot, and a useful response from d-c to beyond 30Mc. There is no degradation of high-frequency bandwidth or sensitivity with either conductive or capacitive coupling. The d-c amplifier is extremely stable, exhibiting very low drift for long time measurements. There is no d-c shift or slump. Operating voltages are electronically regulated to increase stability. Full scale ranges extend from 1v to 500v. Instrument Div., Allen B. Du Mont Laboratories, Inc., Dept. ED, 760 Bloomfield Ave., Clifton, N. J.

CIRCLE ED-238 ON READER-SERVICE CARD FOR MORE INFORMATION

SIMPLYTROL AUTOMATIC PYROMETER

10 temperature ranges cover from -75° to 3000°F.

Several special ranges to -400°F.

Cat. No. 4531 0 2500° F.
Price $132.00

Thermocouple type Automatic Pyrometer for controlling temperature in furnaces, ovens, and processes. The Simplytrol is economical and reliable with few moving parts. There are no vacuum tubes. The regular load relay is S.P.D.T. 5 Amps. Optional heavy duty relays to 40 Amps.

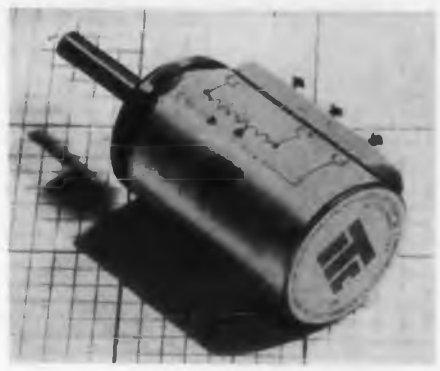
10 temperature ranges cover from —75° to 3000° F. Several special ranges to —400° F. "On & Off" control for holding the desired temperature works on gas, oil or electric heat. Indicating meter-relay is medium high resistance and has bimetal cold junction compensation. For use with all standard thermocouples. Accuracy 2%.

"Auto-Limit" switch changes Simplytrol from automatic controller to limit pyrometer for safety shut down or warning. Cabinet: 6½x6½x9½ inches. Also flush panel mount models. Send for new Bulletin G-7 for more data. Assembly Products, Inc., Chesterland 17, Ohio.

CIRCLE ED-242 ON READER-SERVICE CARD FOR MORE INFORMATION

Potentiometer

Miniature with 0.05% Linearity



The L10S miniature 10-turn potentiometer features linearity of 0.05% standard and 0.025% as a special tolerance where required. Overall length is 1-3/8″ from front mounting surface. Diameter of the pilot is 3/4″. The red anodized aluminum housing is fully shielded. High resolution, low torque, long life, and stability under environmental conditions meeting military specifications are features of the unit. The synchro-type mounting provides precision positioning.

Resistance range is 1000 ohms to 100,000 ohms, with a tolerance of ±5% standard, ±0.05% special. Ambient temperature range is —55° to +125°C. Power rating is 5w at 40°C, derated to zero at 130°C. Maximum starting torque is 0.75 in-oz at 20°C, and running torque 0.60 in-oz. Taps may be provided to within ±1° std. Multiple taps are available on special order. Technology Instrument Corp., Dept. ED, 531 Main St., Acton, Mass.

CIRCLE ED-243 ON READER-SERVICE CARD FOR MORE INFORMATION

Toggle Switch

Miniature Long-Life Type

In addition to precision electrical control and extreme life span, the miniature toggle switch Model A3-8 features a new patented spring mechanism which provides smooth operation and a positive snap-action in either direction. The switch is designed for testing equipment, electronic apparatus, business machines, aircraft, and other types of panel-mounting applications.

The actuator shell is made of stainless steel, and the spring mechanism is of durable berylium copper. Two miniature basic switches, encased in the actuator, provide a dpdt circuit arrangement. The switch is also available in a momentary contact model.

Electrical life is 100,000 cycles minimum. Size is 7/8″ long x 1/2″ thick (approx). Electrical rating is 125/250v a-c, 5amp; 30v d-c, 4amp resistive; 30v d-c, 2.5amp inductive. Electro-Snap Switch & Mfg. Co., Dept. ED, 4218 W. Lake St., Chicago 24, Ill.

CIRCLE ED-244 ON READER-SERVICE CARD FOR MORE INFORMATION

VSWR Measuring System

For 8500-9600Mc Range

The Model 110B X-Band VSWR Measuring System has an added attenuation scale and new vswr scales reading from 1.02 to 1.20 and 1.1 to 2.50. The system includes a tunable oscillator, permitting complete and continuous coverage from 8500Mc to 9600Mc, an accurate wavemeter to supplement the direct-reading dial of the oscillator, a bi-directional coupler with bolometer detectors for incident and reflected power, and a direct-reading vswr indicator.

Overall accuracy is better than 2%. Simple operation makes the system easy to use. Other specifications are: r-f power source, V-260 klystron; wavemeter accuracy ±0.08%; directivity of couplers, greater than 45db; output waveguide fitting, UG-39/U; indicator cabinet, 8-3/4" front panel for bench use or standard 19" rack; overall length of waveguide assembly, 31-3/4"; primary power, 115v 60cy. Color Television, Inc., Dept. ED, 932 E. San Carlos Ave., San Carlos, Calif.

CIRCLE ED-247 ON READER-SERVICE CARD FOR MORE INFORMATION

Klystron

For Airborne Radar Applications

flex klystron, the VA-203 is for airborne X-band radar receiver and beacon local oscillator service. It has a brazed-on external tuning cavity to assure exceptional frequency stability. This klystron can withstand shocks of 50G to 100G without malfunction or damage.

Among the unit's characteristics are negligible microphonics, slow tuning rate, long tuning life, and a single-shaft tuner which adapts easily to motor tuning. Weighing only 8 oz, it mates directly to standard waveguide flanges.

A companion klystron, the VA-201 is equipped with silastic leads, and resists shocks as high as 250G while performing with the same dependability as the VA-203. Varian Associates, Dept. ED, 711 Hansen Way, Palo Alto 2, Calif.

CIRCLE ED-248 ON READER-SERVICE CARD FOR MORE INFORMATION

Trimmer Potentiometer

In Wide Ranges of Values

This 3/4" diam wire-wound potentiometer is available in standard values of 25, 500, 1000, 5000, 10,000, 50,000, and 100,000 ohms. A 5% resistance tolerance is standard with a temperature coefficient of 0.00002 and a resolution of 0.1% available in the higher resistance values. The trimmer was especially designed for use in military aircraft instruments. The case is made of an unusually high-tensile-strength aluminum, terminals are gold plated, contacts are of precious metals, and the shaft and locating pins are of 303 stainless steel.

A standard locking device firmly holds the resistance setting under rugged vibration and shock conditions. The unit is moisture resistant with a Teflon gasket sealing the shaft. The pot is designed to operate at a temperature range of −55° to +125°C with a dielectric breakdown exceeding 1000v rms at 25°C. Maurey Instrument Co., Dept. ED, M-16, 2450 E. 72nd St., Chicago 49, Ill.

CIRCLE ED-253 ON READER-SERVICE CARD FOR MORE INFORMATION

Motor-Gear Train

In a Single Case

The Type 3094 Power Motor-Gear Train combines motor and gear train in a single homogeneous unit. This homogeneous compactness reduces space and weight substantially. A typical example is 10-1/2 oz weight, 1-1/2" diam, and 3-1/2" length for the entire unit at a ratio of 523:1.

The motor-gear train has an extremely versatile range covering any ratio from 3:1 to 10,500:1. It is capable of withstanding an exceptionally high torque in relation to its size and weight. Typical examples are 100 lb-in of torque at a ratio of 523:1, and 1600 lb-in at 10,500:1. This versatile unit is designed for a wide variety of applications requiring a precision speed reducer with low backlash and low composite error at a moderate price. John Oster Manufacturing Co., Avionic Div., Dept. ED, 1 Main St., Racine, Wis.

CIRCLE ED-254 ON READER-SERVICE CARD FOR MORE INFORMATION

Color Picture Tube

Uses Phosphor-Dot Screen

RCA-*21AXP22* is a directly viewed picture tube of the metal-shell type for use in color TV receivers. It is capable of producing either a full-color or a black-and-white picture measuring 19-5/16″ x 15-1/4″ with rounded sides and having a projected area of 260 sq in.

The tube utilizes three electrostatic-focus guns spaced 120° apart with axes tilted toward the tube axis to facilitate convergence of the three beams at the shadow mask; individual convergence control of each beam radially by internal magnetic poles and supplemental control of the blue beam tangentially by internal magnetic poles; and an assembly consisting of a spherical metal shadow mask with uniform holes and a metallized, tricolor, phosphor-dot screen on the inner surface of the spherical Filterglass faceplate. The screen is composed of an orderly array of small, closely spaced, phosphor dots arranged in triangular groups. Each group consists of a green-emitting dot, a red-emitting dot, and blue-emitting dot, and is aligned with a corresponding hole in the shadow mask. Tube Div., Radio Corp. of America, Dept. ED, Harrison, N. J.

CIRCLE ED-258 ON READER-SERVICE CARD FOR MORE INFORMATION

Electronic Generator

Covers Wide Frequency Range

The Model 1420-B Variable Frequency Electronic Generator is a versatile power source for use in the development or testing of equipment operating over a range of power supply frequencies. The frequency range of its internal oscillator is 50-6000cy with an external oscillator of 25cy-20kc.

Power output is 300va. Distortion is under 2%. Regulation is less than 2%, no-load to full-load. Nominal output voltages of 80, 120, 135, 215, 255, and 270v are available. The unit's 12db inverse feedback insures low dynamic output impedance. Communication Measurements Laboratory, Inc., Dept. ED, 350 Leland Ave., Plainfield, N. J.

CIRCLE ED-259 ON READER-SERVICE CARD FOR MORE INFORMATION

GUIDE TO
VOLTAGE
SPEED
CURRENT
SERVO
CONTROL

ON REQUEST

This new 12-page illustrated bulletin describes the wide variety of control situations to which the REGOHM electro-mechanical controller is adaptable.

Learn how REGOHM will provide sensitivity, speed of response and system stabilization under severe operating conditions in your control system.

Circuit diagrams illustrating the many applications of this versatile, automatic controller, are given.

Text and illustrations describe the functions, design advantages, operation and control characteristics of this small size, lightweight, plug-in device.

Write for Bulletin 505.00. Address Dept. G, Electric Regulator Corporation, Norwalk, Conn.

REGOHM

CIRCLE ED-262 ON READER-SERVICE CARD FOR MORE INFORMATION

SIMPLIFY CIRCUIT TRIMMING *with*

BOURNS sub-miniature

TRIMPOTS

TRADE MARK

- **Resolution: As low as 0.25%**
- **Power Rating: 0.25 watt at 100° F.**
- **Weight: Only 0.1 oz.**

BOURNS ***TRIMPOT*** is a 25 turn, fully adjustable wire-wound potentiometer, designed and manufactured exclusively by BOURNS LABORATORIES. This rugged, precision instrument, developed expressly for trimming or balancing electrical circuits in miniaturized equipment, is accepted as a standard component by aircraft and missile manufacturers and major industrial organizations.

Accurate electrical adjustments are easily made by turning the exposed slotted shaft with a screw driver. Self-locking feature of the shaft eliminates awkward lock-nuts. Electrical settings are securely maintained during vibration of 20 G's up to 2,000 cps or sustained acceleration of 100 G's. BOURNS ***TRIMPOTS*** may be mounted individually or in stacked assemblies with two standard screws through the body eyelets. Immediate delivery is available in standard resistance values from 10 ohms to 20,000 ohms. BOURNS ***TRIMPOTS*** can also be furnished with various modifications including dual outputs, special resistances and extended shafts.

BOURNS *also manufactures precision potentiometers to measure Linear Motion; Gage, Absolute, and Differential Pressure and Acceleration.*

BOURNS LABORATORIES

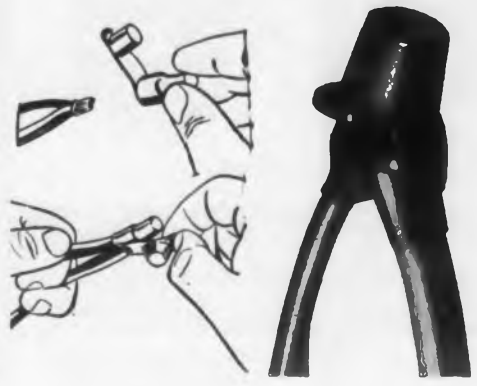
6135 MAGNOLIA AVENUE, RIVERSIDE, CALIFORNIA

U. S. PATENTS PENDING — Technical Bulletin on Request, Dept. 232

CIRCLE ED-263 ON READER-SERVICE CARD FOR MORE INFORMATION

Crimp Connector

For Diaper-Wrap Insulators



This crimp-type wire connector with a diaper-wrap insulator provides a connection of extremely high mechanical strength and insulating qualities. The connector has only two parts, the sleeve and the patented insulating "Wrap-Cap". Both parts are listed by Underwriters' Laboratories, Inc., for general use for branch circuits and fixture wiring.

The insulator is applied by pushing it down over the crimped sleeve and wires and then drawing the tabbed cap and connecting strip through the wires and over the end of the joint in a diaper-wrap. The insulator provides a prefabricated insulating job; without the use of tape, it insulates all around the joint and between wires, and provides double thick, puncture-proof insulation over the sleeve and wire ends.

The insulator is made of the same type of flexible vinyl material used for TW wire and is practically impervious to aging, corrosive atmospheres, sunlight, gasoline, etc. It is listed for maximum temperature of 165°F and works easily at —10°F. The crimp sleeve is made of cadmium-plated steel to insure greater holding power. It is open at both ends to allow visual observation of the joint. Ideal Industries, Inc., Dept. ED, Sycamore, Ill.

CIRCLE ED-264 ON READER-SERVICE CARD FOR MORE INFORMATION

Elapsed Time Meters

Available in Sealed Cases

This Elapsed Time Meter is available in 2-1/2" and 3-1/2" sealed and Bakelite cases conforming dimensionally to MIL specifications. Standard ratings include commercial voltages and frequencies, with five-digit registers reading total hours or tenths of hours. Standard ratings are stocked. Special ratings to customer requirements are available. All sizes are styled to match other panel meters in this firm's line. Instrument Div., Roller-Smith Corp., Dept. ED, Bethlehem, Pa.

CIRCLE ED-265 ON READER-SERVICE CARD FOR MORE INFORMATION

Corning Type N Precision Resistors. Rugged. Stable. And Economical.

For critical accuracy, extreme stability...

Rugged Corning Type N Film-Type Resistors

When you need a precision resistor for really hard work, our Type N accurate grade is a likely job candidate.

We make it to a standard tolerance of 1%, but we can tighten up if you wish. You can operate Type N's at ambient temperatures up to 140°C. with derating. Their noise level is so low, you'll have difficulty measuring it.

They have a negligible voltage coefficient averaging less than .001% per volt. You needn't worry about moisture because both core and film are absolutely impervious.

Stability means that the average change of resistance after 500 hours at maximum dissipation is less than 0.5%. A standard 5-second overload of 6.25 times rated power causes a permanent resistance change of less than .75%. Type N resistors are non-inductive.

These accurate grade resistors overcome the inadequacies of conventional resistors in many advanced circuits. We recommend them to you for use in circuits where other resistors aren't up to the task or cost too much.

Specifically, you'll find these resistors most useful for radio and TV equipment, HF circuits, test equipment, and low-signal, hi-gain amplifier stages. Their stability and ruggedness make special handling unnecessary. Made to MIL-R-10509A Specifications.

Fine as they are, Corning Type N Resistors cost remarkably little. For complete technical information and price lists, use the coupon.

Corning Type R High-Power Resistors—Range from 25 to 1,000,000 ohms, ratings from 7 to 115W, are non-inductive. Exceptionally good noise and frequency characteristics. Excellent moisture resistance and overload capacity recommend them for stable long-life service under adverse conditions. Meet MIL-R-11804A Specifications.

Corning means research in Glass

CORNING GLASS WORKS, 39-5 Crystal St., Corning, N. Y.

New Products Division

Please send me descriptive catalog sheet on Corning Type N Film-Type Resistors.

Name.....

Title.....

Company.....

Address.....

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

CIRCLE ED-266 ON READER-SERVICE CARD FOR MORE INFORMATION

vernistat... *The Revolutionary*

New Precision Variable-Ratio Transformer

Analog Computers? Servos? Control Systems? The Vernistat is a completely new type of voltage divider that combines **low output impedance with an inherently high resolution and linearity** not ordinarily attainable by precision potentiometers.

The Vernistat consists of a tapped auto-transformer which provides the basic division of voltage into several discrete levels. These levels are selected and further sub-divided by a continuous interpolating potentiometer that moves between 31 transformer taps.

Because of its unique operating principles, electrical rotation is held to close tolerances eliminating the need for trim resistors. In many applications there is no need for impedance matching amplifiers.

Specifications of the standard model Vernistat are shown below. Other versions are under development to meet specific end uses.

What are your requirements for this unique precision voltage divider?

SPECIFICATIONS

Linearity Tolerance better than ±.05%	Frequency ..... 50-3000 cps
Output Impedance ..... 130 ohms (max.)	Max. Output Current ..... 50 ma
Minimum Voltage Increment	better than .01%

Other models including a miniaturized 400 cps version will soon be available.

vernistat division Perkin-Elmer Corporation, Norwalk, Conn.

CIRCLE ED-267 ON READER-SERVICE CARD FOR MORE INFORMATION

High speed, direct reading. Indicates increment of measurement in radar navigation instruments.

"Y" Rotary Counter used in navigating instruments.

DURANT Specials

For RADAR • ELECTRONIC • INSTRUMENT Applications

Special counter for Tape Recorder to indicate position of tape passing through recorder.

Special high speed Y-type for Goniometer application.

Send for Literature

DURANT MANUFACTURING CO.

1993 N. Buffum St. Milwaukee 1, Wis.

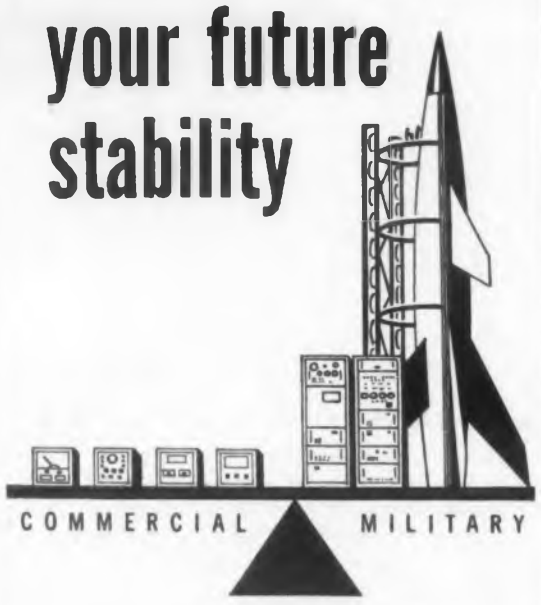
193 S. Water St. Providence 3, R. I.

Representatives in Principal Cities

PRODUCTIMETERS SINCE 1879 *Count Everything*

CIRCLE ED-268 ON READER-SERVICE CARD FOR MORE INFORMATION

In Hycon's balance.... your future stability



Hycon activities are part military, part commercial... a balanced blend of electronics, ordnance, photography. Qualified men with the following specialized electronic training or experience can find in this atmosphere **long-term** careers both satisfying and stimulating:

CIRCUIT DESIGN... D. C. and audio amplifiers, VTVM and CR 'scope deflection circuitry, military packaging and miniaturization.

MICROWAVE CIRCUIT AND COMPONENT DESIGN... in radar, microwave, traveling wave tubes, etc.

PULSE CIRCUITRY DESIGN... radar and allied applications, microwave circuitry.

SERVOMECHANISM AND ANALOG COMPUTER DESIGN... control systems, magnetic amplifiers, and similar fields.

ELECTRONICS SYSTEMS ENGINEERING... instrumentation, microwave, and control system design, particularly in guided missiles.

INTERVIEWS ARRANGED IN YOUR LOCALITY

If your professional background parallels our requirements, we'd like to hear from you. Send a resume to:

Hycon Mfg. Company

P.O. Box "N" Pasadena 15, California — "Where accuracy counts"

CIRCLE ED-269 ON READER-SERVICE CARD FOR MORE INFORMATION

Vertical Gyro

Stabilizes Free Drift Rate

This new-type vertical gyro, Series 2153, is designed to reduce and stabilize free drift error. It is a vertical reference for such gyro-stabilized equipment as remote attitude indicators, autopilots, and bombing systems. It eliminates variations in free drift with changes in operating temperature, heretofore a major deficiency in operational gyros. The success in meeting this problem is attributable largely to techniques which permit the use of steel parts throughout, removing the factor of differential expansion. Steel construction should also reduce cost.

Friction-reducing features, combined with the increased momentum of a large wheel, results in a three-to-one improvement in the vital friction-to-momentum ratio.

Power requirements are 115v, three-phase, 400cy and 27.5v d-c. Spin axis erection is accomplished by 400cy, single-phase 55v for initial erection, and less to 20v during normal erection. The gyro has a minimum angular momentum of 8.0 x 10^6 gm-cm²/sec. Rotor speed is approximately 23,500rpm. It has 360° of freedom in roll and ±82° in pitch. The erection system is capable of maintaining the spin axis within 1/10° of vertical when free of external acceleration. Free drift error is less than 0.25° per minute. Let... Inc., Dept. ED, 80, 110 Ionia, N.W., Grand Rapids 2, Mich.

CIRCLE ED-270 ON READER-SERVICE CARD FOR MORE INFORMATION

Resistors

In Ratings from 5-18,000 ohms

The units shown are the latest additions to this firm's line of resistors. Employing a unique method for attaching the leads to the body of the resistor, the construction is designed to provide desirable in mechanical and electrical connections. Wound on ceramic cores and covered with an extremely hard ceramic based coating, they are available in 4w to 25w, 5 ohms to 18,000 ohms resistance. Wirt Co., Dept. ED, 5221-27 Greene St., Philadelphia 44, Pa.

CIRCLE ED-271 ON READER-SERVICE CARD FOR MORE INFORMATION

Indicating Controller

For Automation Applications

The basic purpose of the "Versatrol" is to detect minute changes of current or voltage while indicating their magnitude. It trips relays for control as a result of these changes. ...me of the present applications include: milling ...ter monitors (a dull tool pulls more load), auto... ...tic pH alarm, photocell light detectors, battery ...argers, control of vacuum in TV tubes, moisture ...ntent, and gas alarm devices.

Contact is made directly in the sensitive meter-...ay. There is a signal input section and a section ...t controls the power. Signal input may be micro-...ps or millivolts, a-c or d-c. Control sensitivity may ...ge from 0.2μamp to 1000amp or more, voltage ...sitivities from 0.1mv to over 500v.

Contact setting is adjustable, from front, to any ...nt on the scale. Or, contacts may be preset and ...-adjustable. The power relay is rated 5amp, 115v, ... non-inductive, spdt. Built-in heavy-duty relays ...40amp are available and can be supplied in the ...e cabinet. There are "Panelmount" and U-Mount-... styles for custom installations. Assembly Prod-..., Inc., Dept. ED, Chesterland, Ohio.

...LE ED-272 ON READER-SERVICE CARD FOR MORE INFORMATION

Crystal Mounts

Serve as Mixers, Detectors

The Model 497C and 497K Microwave Mixer Crystal Mounts operate without tuning over the 5.4-5.9-kMc and 15.75-17.-25kMc ranges, respectively. The sep-...e mounts are useful in the laboratory as mixers ... also as video detectors. They have single-ended ...ut for operation into 400 ohms, nominally. Out-... capacitance is about 13mmfd.

...igh detection efficiency is afforded because the ...tal effectively terminates the waveguide to pre-... a low vswr over the operating range. Thus, ...her an attenuator nor an absorption termination ...ecessary to maintain the low vswr. Commercial ...ducts, Div. of Aircraft Armanents, Inc., Dept. ... 4003 Seven Mile Lane., Baltimore 8, Md.

...LE ED-273 ON READER-SERVICE CARD FOR MORE INFORMATION

NEW TRANSFORMER CORE!

Valparaiso, Indiana, April, 1955 —The Indiana Steel Products Company has developed a new product...a wound core, consisting of just ONE PIECE, not two pieces as in conventional C-type cores.

ADVANTAGES: One air gap, instead of two gives better performance ...exciting current normally lower, often by significant amount. Vacuum impregnating unnecessary...resulting electrical losses eliminated. No "halves" to mix up. Slight "tilt," sometimes present on ground pole faces of C-cores, completely eliminated.

Manufacturing economies reflected in low price. For descriptive literature, write Indiana Steel Products Co., Dept. M-5, Valparaiso, Indiana.

CIRCLE ED-275 ON READER-SERVICE CARD FOR MORE INFORMATION

Capacitors

Withstands Severe Environments

In these "Steacaps", steatite encased tubular paper capacitors, the capacitor section is assembled in a dense steatite tube that is a practically perfect moisture barrier. The ends are sealed with a thermo-setting plastic compound that forms a moisture-proof bond to the wire terminals and the steatite tube. This construction makes a capacitor capable of withstanding the most severe tests and operating conditions, including the temperature of soldering and body contact with a soldering iron.

The capacitors are conservatively rated for continuous operation in the temperature range of −40° to +85°C. They are made in all the preferred standard capacitance values for ±20% and ±10% tolerances in the ranges of from 0.01-1mfd at 200v d-c, 0.005-0.04mfd at 400v d-c w, 0.001-0.27mfd at 600v d-c, and 0.001-0.1mfd at 1000v d-c. Micamold Radio Corp., Dept. ED, 1087 Flushing Ave., Brooklyn 37, N. Y.

CIRCLE ED-277 ON READER-SERVICE CARD FOR MORE INFORMATION

Electronic Counter

Uses Multiple Decades

Making use of quickly interchangeable plug-in miniature decade counters, the direct-reading Model C-101 multiple decade counter employs one 30kc and four 10kc decade counters. The 30kc counter is provided with an input shaper circuit and is operable with inputs ranging from 6v to 50v.

The entire decade counter is only 10" long x 3-1/4" high x 3-1/2" deep. It is provided with a self-contained power supply for direct operation from a 117v single-phase source. It can be used for counting operations, objects, and other electrical and physical phenomena. It can be used directly as a measuring instrument in laboratories and in industrial applications, or can be integrated into other apparatus used in automation or computation. Ransom Research, Dept. ED, P. O. Box 382, San Pedro, Calif.

CIRCLE ED-278 ON READER-SERVICE CARD FOR MORE INFORMATION

Digital Cycling Counter

Gives Speeds to 100,000cps

This five-bank Digital Cycling Counter, Model N-655, is suitable for counting events, measuring frequencies, determining rpm, and other similar basic measurement applications. It consists of an amplifier at the input, together with a shaping circuit for converting the input information into trigger pulses suitable for driving high-speed electronic counters. A gating circuit is inserted between the trigger and the counter for controlling the flow of information; this permits counting over a precise time interval which is supplied from an internal time base generator controlled by a temperature compensated crystal. Dividers reduce the intervals to 0.01, 0.10, and 1.00-sec, or, on special order, to 10.0sec.

By proper choice of time intervals, the number of events per second, frequency in cycles per second, or speed in rpm can be obtained. Speeds as high as 100,000 counts per second are possible. When using this instrument, it is possible to utilize an accessory device which permits the presetting of one or more counts. It is thus possible to use the cycling counter as a control device in which frequency or speed may be controlled to very close limits by presetting an upper and lower limit. The output of the decade counter may also be recorded on a Brush Direct-Writing Oscillograph. Brush Electronics Co., Dept. ED, 3405 Perkins Ave., Cleveland 14, Ohio.

CIRCLE ED-283 ON READER-SERVICE CARD FOR MORE INFORMATION

Pulse Transformers

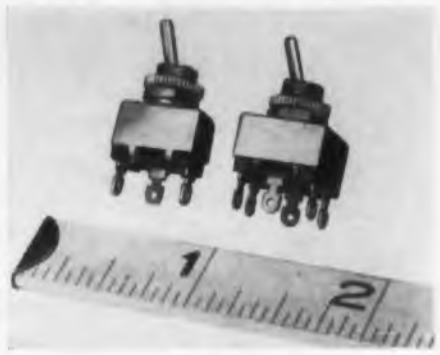
0.07μsec Rise Time

The GFZ 10-1, a 7-pin impedance-matching ferrite-core pulse transformer, has an impedance ratio of 10:1 for matching 1000 ohms to 100 ohms. The unit is epoxy-resin impregnated and cast. It is designed to surpass MIL-T-27, Grade 1, Class A test specifications, and is useful for coupling a 2μsec pulse with less than 5% tilt and overshoot. Rise time is less than 0.07μsec. Size is 23/32" diam x 1-1/16". The Gudeman Company of California, Inc., Dept. ED, 9200 Exposition Blvd., Los Angeles 34, Calif.

CIRCLE ED-284 ON READER-SERVICE CARD FOR MORE INFORMATION

Toggle Switches

Offered in 50% Smaller Designs



These subminiature "TorBal" toggle switches reduce by a half standard size and weight. Available in spdt and dpdt, they are contact rated for 10amp at 50v d-c and weigh 0.15 oz and 0.22 oz, respectively. They are available for commercial as well as aircraft and other military electrical-electronic circuit applications where savings in space and weight are important.

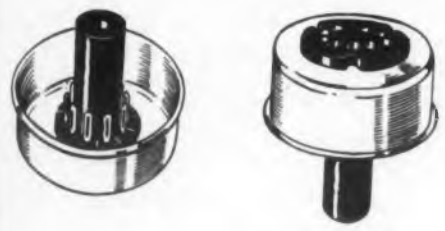
Dimensions, including terminals and handle, are 0.25″ x 0.5″ x 1.047″ for the spdt and 0.5″ x 0.5″ x 1.047″ for the dpdt. Both switches conform to electrical and environmental requirements of JAN S-23 Amendment 3. They are corrosion proof, will operate in the temperature range of −55° to +85° C, and have a contact resistance of less than 0.003 ohms and insulation resistance of over 100,000 megohms at 100v d-c and 70°F.

The switches are single-hole mounted, and the one-piece housings are of aluminum bronze alloy. A silicone boot is available to cover the handle for panel-sealing. The mounting bushing length and threads can be varied for special applications. The Torsion Balance Co., Dept. ED, Clifton, N. J.

CIRCLE ED-289 ON READER-SERVICE CARD FOR MORE INFORMATION

High Voltage Sockets

Eliminate Corona Problems



These "Hi-Voltage and Anti-Corona" sockets for 1 x 2 type tubes meet UL requirements and are guaranteed against tracking or carbonizing from corona. The sockets are designed to eliminate arcing when subjected to voltage between socket pins and the screw extending 3/8″ in the hole at bottom of post. Extremely compact in design, they are easily mounted to the chassis with a self tapping screw.

Available in general-purpose phenolic or mica-filled phenolic, the units have a cup diameter of 1-1/2″ or 1-5/16″. Depth of cup is 1/2″ or 11/16″. Height of post under socket is 1-1/8″ or 1-3/8″, or any combination required. National Fabricated Products Inc., Dept. ED, 2650 W. Belden Ave., Chicago 47, Ill.

CIRCLE ED-290 ON READER-SERVICE CARD FOR MORE INFORMATION

High-Slope Pentode

For Wide Band Amplifiers

The Mullard *E180F* is a new miniature pentode with a high mutual conductance of 16.5ma. This, together with its low interelectrode capacitances, makes the tube ideal for all wide-band amplifier applications, such as radar i-f amplifiers, high definition television cameras and transmission equipment, and carrier telephone equipment, especially that used with coaxial telephone cables.

Control grid wires are spaced only 60 microns. The construction employs unusually fine grid wire and enables variations from valve to valve to be kept small, resulting in close tolerances on certain electrical characteristics, notably interelectrode capacitances.

The cold input and output capacitances are 7.9$\mu\mu$f and 2.9$\mu\mu$f respectively, giving a slope to capacitance ratio of about 1.7:1. The anode current under normal operating conditions is 13ma, at an anode voltage of 180v. Under these conditions the working input capacitance is 11.2pF. The heater rating is 6.3v, 0.3amp, and the base is B9G (noval). The equivalent noise resistance is only 460 ohms. Where even lower noise is called for, the valve may be triode connected; the equivalent noise resistance is then 150 ohms. Mullard, Ltd., Dept. ED, Century House, Shaftesbury Ave., London, W. C. 2, England.

CIRCLE ED-295 ON READER-SERVICE CARD FOR MORE INFORMATION

Decade Delay Line

Only 1 μsec Overall

The Model GD-D2-1000-1 Decade Delay Line has an overall delay of 1μsec. Dial-selected taps are at 0.1μsec intervals. Impedance is 1000 ohms, and overall rise time is 0.1μsec.

The delay element is hermetically sealed in epoxy resin, and the selectors for delay and termination are equipped with ceramic wafer switches which have solid silver contacts. Size of the unit is 7-5/8" x 4-3/8" x 4-3/8". The Gudeman Co. of California, Inc., 9200 Exposition Blvd, Los Angeles 34, Calif.

CIRCLE ED-296 ON READER-SERVICE CARD FOR MORE INFORMATION

NEW REGULATED POWER SUPPLY

0.001% Regulation at ½ Amp.

MODEL UHR-240

- 0-500 volts 0-500 ma
- 0.001% Regulation
- 0.005 ohms Impedance
- 0.1 Millivolts Ripple
- 0.003% Stabilization
- Bias and 3 Heater Supplies

The Krohn-Hite Model UHR-240 Power Supply provides up to ½ amp. at 0-500 volts with 0.001% regulation and less than 100 microvolts of ripple.

The internal impedance is less than 0.005 ohms for low frequencies and d-c and less than 0.1 ohms for frequencies as high as 100 kc.

A 0-150 volt, 0-5 ma bias supply is available with 0.05% stabilization and less than 2 mv of ripple. A 2.5 amp. d-c heater supply adjustable from 5 to 13 volts with less than 20 mv ripple is included in addition to two independent 6.3 volt a-c heater supplies of 10 amp. capacity.

The ultra-high regulation applies over the entire operating range. Full maximum current can be drawn continuously at any output voltage, from 105 to 125 volt line.

For further details write **Price $550.00**

KROHN-HITE INSTRUMENT COMPANY

Dept. ED, 580 Massachusetts Avenue, Cambridge 39, Mass.

CIRCLE ED-299 ON READER-SERVICE CARD FOR MORE INFORMATION

Miniature Toggle Switch

Sealed and Tested to 75psi

The miniaturized, panel-sealed, "K-W" toggle switch, tested to more than 300,000 cycles, reduces behind-panel space by 50%, and can withstand acceleration, impact, and vibration to 200G. Because of special, patented features, the switch eliminates contact bouncing. Advantages include corrosion-proof and explosion-proof construction. Construction eliminates the need for a bulky boot to keep out moisture and dust.

The miniaturized device has a switch case 1.15″ x 0.625″ x 0.415″. Silicone rubber bonded to its stainless-steel bushing gives the switch its panel-sealed feature. Screw-type terminals emerging from the rear are also offered.

The switch now makes possible the control of hermetically sealed assemblies by toggle action. Each sealed bushing is tested to 75psi. Official underwater tests have been successful beyond 150 feet. Contact rating is 10amp at 125v a-c; 10amp at 30v d-c; and 1.5amp at 125v d-c. Opening force is 95gr; closing force is 85gr. Insulation resistance is better than 1000 megohms at 70°F. Dielectric strength is checked at 1000v rms.

The switch has military authorization for replacement of JAN S-23: ST 42, and ST 52 types. Hermetronic Controls Div., General Hermetic Sealing Corp., Dept. ED, 99 E. Hawthorne Ave., Valley Stream, N. Y.

CIRCLE ED-301 ON READER-SERVICE CARD FOR MORE INFORMATION

Mechanical Differential

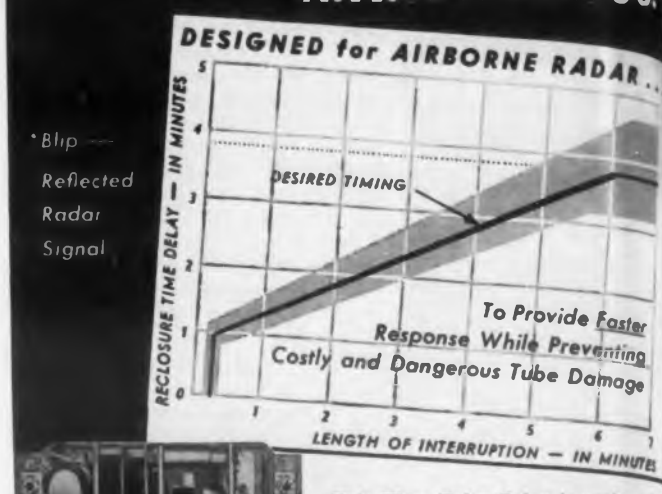
In Four Hollow-Shaft Sizes

This precision, hollow-shaft differential provides high speed rotation, minimum backlash, and low breakaway torque. A simple shaft lock provides for easy removal of the differential from a gear train without disassembly of the end plates.

Differentials are available for shaft sizes of 0.062″, 0.125″, 0.187″, and 0.250″. All differentials have precision ball bearings throughout and are constructed of stainless steel. Sterling Precision Instrument Corp., Instrument Division, Dept. ED, 34-17 Lawrence St., Flushing 54, N. Y.

CIRCLE ED-302 ON READER-SERVICE CARD FOR MORE INFORMATION

There'd be no "blip" without power control by the* **A.W. HAYDON CO.**



This Time Delay Relay is used to delay application of plate power to vacuum tubes until filaments reach operating temperature. It provides maximum reset rate with minimum "time-out". — Eliminates danger of costly tube damage. — Provides *faster* response. Send for information about this Time Delay Relay and other special cost-saving timing devices.

double delayed reset time delay relay

WHEN TIMING POSES A PROBLEM CONSULT

The A.W. HAYDON COMPANY
227 NORTH ELM STREET
Waterbury 20, Connecticut

Design and Manufacture of Electro-Mechanical Timing Devices

CIRCLE ED-303 ON READER-SERVICE CARD FOR MORE INFORMATION

161 control steps!

That's what you get in Ward Leonard's 13″ Multi-step plate rheostat — what's more, you get 161 steps whether it's a 2 ohm or a 1000 ohm plate.

You get smoother operation and longer life in any W/L rheostat and you take your pick from the most complete line of power rheostats ever offered for industrial and commercial applications.

Write for free data-packed Bulletin 60A. Ward Leonard Electric Co. 77 South St., Mount Vernon, N.Y. 4.12

WARD LEONARD ELECTRIC CO.

Result-Engineered Controls Since 1892

RESISTORS • RELAYS • MOTOR CONTROLS • CHROMASTER

CIRCLE ED-300 ON READER-SERVICE CARD FOR MORE INFORMATION

FREE

SAMPLES AND BOOKLET!

NEW SHAKEPROOF® **Plasti-Rings*** CUT SHAFT RETAINING COSTS

Slash costs of shaft retention and provide a more powerful, efficient retainer! Made of elastic vinyl that's oil, chemical and corrosion resistant, SHAKEPROOF Plasti-Rings roll into prepared grooves on shaft . . . provide a shoulder that withstands up to 250 lbs. direct shear. 16 sizes: ⅛″—1″ shaft size. Send for free Sample Kit and Booklet today!

SHAKEPROOF

"Fastening Headquarters"®

DIVISION OF ILLINOIS TOOL WORKS

St. Charles Road, Elgin, Illinois • Offices in principal cities

CIRCLE ED-304 ON READER-SERVICE CARD FOR MORE INFORMATION

Polarized Relay

Has Anti-Chatter Contacts

The P255A Polarized Relay utilizes a reed-type, Permaloy armature with anti-chatter contacts. The armature is equipped with extra-heavy (3/32" diam) palladium-copper contacts. The contact screws have 1/16" diam tungsten contacts rated at 2amp 110v d-c.

The relay is especially valuable for use in teletypewriter applications. It consists of a coil with two parallel windings of 136 ohms each. It is mounted through a Western Electric No. 18B connecting block and is insulated from the mounting. Kurman Electric Co., Inc., Dept. ED, 35-18 37th St., Long Island City, N. Y.

CIRCLE ED-307 ON READER-SERVICE CARD FOR MORE INFORMATION

Commutator-Generator

Provides High-Speed Switching

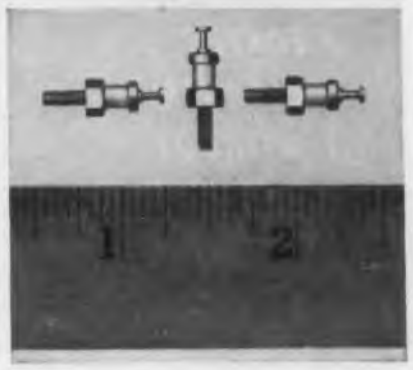
The Precision Commutator and Impulse Generator has been added as a standard component to this firm's line of miniature precision potentiometers. The unit is intended for use as a high-speed switching device, for counting, digital indication of shaft rotation, pulse shaping, pulse gating, sequenc ecircuit control, and similar applications.

The commutator-generator consists of a series of conducting segments, bonded to a high-temperature plastic base, insulated from one another, and interconnected to form a wide variety of coded commutation or pulse sequences. The use of multiple isolated wipers permits commutation in several circuits simultaneously, and increases total pulse count per revolution. The commutator element can be nested with the firm's standard potentiometer elements for various analog-to-digital conversions, potentiometer excitation control, pulse shaping, etc.

The element is approximately 1" in diameter and weighs 2/10 oz. Precious-metal contacts are employed throughout. Operational speeds up to 1000rpm are permissible, with a life in excess of 1,000,000 revolutions. The commutator element is available either unmounted or in a precision end-bell assembly with ball-bearing supported shaft for extremely low-torque operation. Computer Instruments Corp., Dept. ED, 1964 Utica Ave., Brooklyn 34, N. Y.

CIRCLE ED-308 ON READER-SERVICE CARD FOR MORE INFORMATION

New, Tougher Miniature Insulated Terminal . . . for tight spots



C. T. C.'s X2128 is the first of a family of *quality-controlled* miniature standoff terminals for wide production line application. X2128 supplements C.T.C.'s standard line providing engineers and technicians with rugged units of exceptional mechanical features.

Of *solid* ceramic rod, grade L-5, X2128 is silicone impregnated to resist moisture. Nickel-plated mounting stud is securely bonded to the ceramic insulator. Solder terminal of copper plated brass with 24K gold flash is rolled over shoulder at top of insulator and provides excellent solder-ability during extended shelf life. Long soldering operations will not loosen this insulator.

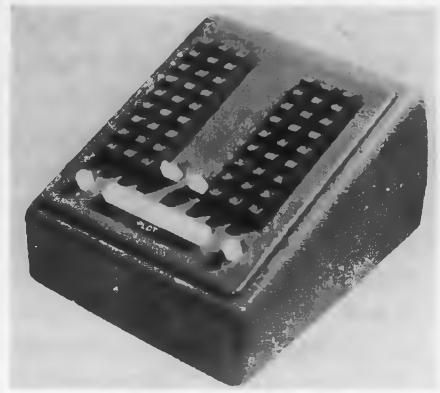
X2128 has 1/4" long screw stud, 3/48 THD, base diameter 3/16", lugs are available in a variety of mounting studs. O.A. height when mounted .447".

Write for full data and prices NOW to Sales Engineering Dept., Cambridge Thermionic Corporation, 457 Concord Ave., Cambridge, Mass.

CIRCLE ED-310 ON READER-SERVICE CARD FOR MORE INFORMATION

Decimal Keyboard

Activates X-Y Plotter



This manually operated decimal keyboard activates a plotter by supplying excitation for the X and Y input transducers. It simulates resistance potentiometers by means of two voltage dividers (one each for the X and Y axes), each consisting of three banks of series-connected precision resistors which are switches into the input circuit by pressing the front panel keys.

The quadrant in which an input signal is plotted is controlled by the position of two selector switches on the front panel. Pressing the plot bar drives the pen to the correct position on the chart, where it will not mark until its drive motors have positioned it in exact correspondence to the numerical value of the depressed switch keys.

All keys are released automatically. A switching arrangement halts the release of depressed keys until the point has been plotted. A hold switch button and a clear switch button override these automatic arrangements and enable the operator to clear all keys manually or to prevent automatic clearing of depressed keys.

The keyboard is energized by voltage from the recorder. No external power sources are required. It is enclosed in a casting 6" x 11" x 8-1/2" and weighs only 12 lb. Models are available for use with the Librascope Type "A" X-Y Plotter, Type "B" X-Y Plotter, and Punched Card Converter System. A variety of contact configurations are available which make possible the manual feeding of decimal or binary coded decimal inputs to computer and other system. Librascope, Inc., 808 Western Ave., Glendale, Calif.

CIRCLE ED-313 ON READER-SERVICE CARD FOR MORE INFORMATION

Resistors

Made to MIL-R-10509A Specs

Type "DCM" deposited carbon resistors are made to specification MIL - R - 10509A, Type RN20. These precision units are manufactured in resistance values from 10 ohms to 2 megohms with tolerances of 1%. Higher or lower values are available on request. Dale Products, Inc., Dept. ED, Columbus, Nebr.

CIRCLE ED-314 ON READER-SERVICE CARD FOR MORE INFORMATION

Plug-In Circuits

Supplies, Relays, Interrupters

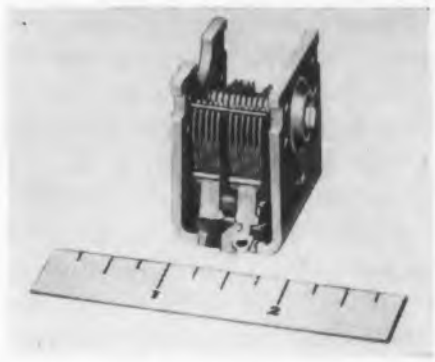
These plug-in power supplies, load relays, and automatic interrupters simplify the assembly of meter-relay controls. A typical unit, the 1817-2 Load Relay (illustrated), contains a 5ma relay, 200-mfd timing condenser, and limiting resistor. Connections are brought out to a 9-pin octal-type plug. There are four hold-down screws for mounting. The relay has a 12,000 ohm coil. It pulls in at 5ma and releases at 1.5ma. Snap-action contacts are conservatively rated at 5amp, 115v a-c resistive, spdt. The condenser, when connected across the coil, gives 5sec delay on release. Dimensions are 1-3/4" x 4" x 5".

There are several load relays in the series with coils for 6, 12, 24, and 75v. Other plug-in units include power supplies, both single and double. These have a transformer, for isolation, with tapped primary for 115v or 230v line; rectifier; and filter condenser. Output is 130v d-c at no load, 80v at 50ma (the maximum). Another plug-in unit is a complete automatic interrupter with a period of about 5sec. This can be speeded up by changing the timing condenser which is brought out to separate terminals for that purpose. There is also a motor-driven interrupter, with notched cam, that gives periods as long as 1 minute. Assembly Products, Inc., Dept. ED, Chesterland, Ohio.

CIRCLE ED-319 ON READER-SERVICE CARD FOR MORE INFORMATION

Variable Capacitor

For Pocket Radios



This miniature two-gang variable capacitor, Model 2851, is designed especially for miniaturized portable and "pocket" radios using transistors and printed circuits. Only 15/16" high, and weighing approximately 1 oz, it uses a cradle made of aluminum instead of steel, as in other models. It is so designed as to fit into printed circuit panels, if desired. General Instrument Corp., Dept. ED, Elizabeth, N. J.

CIRCLE ED-320 ON READER-SERVICE CARD FOR MORE INFORMATION

Aircraft Relays

For Switching High Currents

These 200amp d-c relays are designed to meet the problems of switching high currents encountered in aircraft 28v d-c systems. They meet all requirements of Specification MIL-R-6061, are spdt, and are identical except for mounting. The JH28007-1 relay illustrated, conforms to an AN-3370-1 mounting while relay JH28007-2 meets an AN3370-2 mounting.

Rated at 200amp, the relays operate on a nominal coil voltage of 24-28v, with 29v maximum. They pick up at 18v and drop out at 7v (+0, —5.5v). Designed for continuous duty (50,000 cycles minimum), they will function efficiently at altitudes to 50,000′ within an ambient range of —55° to +71°C, and under acceleration forces to 10G. They have been specially designed to withstand extreme conditions of vibration, shock, sand and dust, humidity, and salt spray.

The relays weigh only 1.25 lb and measure (approx) 4.5″ x 3.75″ x 2.0″ overall. Jack & Heintz, Inc., Dept. ED, 17600 Broadway, Cleveland 1, Ohio.

CIRCLE ED-324 ON READER-SERVICE CARD FOR MORE INFORMATION

A-C Vacuum-Tube Voltmeter

Measures 0.001-300v

The Model 202A voltmeter is designed for the accurate measurement of a-c voltages from 0.001v to 300v full scale in the frequency ranges from 20cy to 2Mc. The input impedance of 10 megohms and 25-mmfd minimizes errors due to loading of the circuit under test. Separate terminals are brought out from the input and output of the amplifier section of the instrument, permitting its use as a separate amplifier with maximum gain of 50db for input voltages of 0.001v or less, and lesser gains with higher input voltages.

This instrument incorporates features to simplify operation and prevent misreading. This is accomplished by utilizing a large easy-to-read 6″ meter with color matched voltage and db scales, and a simplified front-panel layout. Shasta Div., Beckman Instruments, Inc., Dept. ED, P. O. Box 296, Station A, Richmond, Calif.

CIRCLE ED-325 ON READER-SERVICE CARD FOR MORE INFORMATION

A-C INDUCTION TYPE

New Series 15 and 18

SERVO MOTORS

Two new G-M Miniature Servo Motors are now avail for use in electronic control circuits. The motors are stand frame sizes 15 and 18 which are 1.437″ and 1.750″ in diam respectively, and are designed for use in a wide variet equipment such as computers, gun sights, navigation eq ment, guided missiles, radar and similar applications. T light weight, high torque, low inertia, two-phase induction motors are available in 2, 4 and 8-pole models for 400 or 60 cycle supply, and can be supplied to meet performance specifications for military servo motors, Mark 7 and Mark 8. The control phase can be wound for connection *by the user* for either series or parallel operation. The stators of the motors, as in all G-M Servo Motors, are embedded in an insulating compound of high dielectric strength and high temper stability. This material has a low mechanical coefficie expansion and great stability at high temperatures. dielectric strength is maintained between windings and ing when at high altitudes. Write for information on Size 15 and/or Size 18 Servo Motors to

G-M LABORATORIES, INC.
4284 N. Knox Ave., Chicago 41, Ill.

CIRCLE ED-327 ON READER-SERVICE CARD FOR MORE INFORM

NEW BARRY

ALL-ANGL VIBRATION MOUNT

Works in Any Position — Has High Damping

Satisfying the need for a vibration isolator that protects the mounted equipment regardless of the position in which it is supported, the new Barry ALL-ANGL mount permits equipment to be mounted upside down, vertically on firewall or bulkhead, or at any odd angle. Damping is exceptionally high in all directions; transmissibility at resonance is less than 3.

The ALL-ANGL mount above has a standard one-inch cup to mount on 1-13/32" centers, and is interchangeable with other miniature BARRYMOUNT® isolators. Weighing less than one ounce, it handles loads up to 3 pounds.

This isolator answers the tough vibration-protection problems — permits design for easiest installation and best utilization. Let us show you what it will do for you at the New York I. R. E. Show.

The Barry Corporation, 775 Pleasant Street, Watertown 72, Massachusetts

CIRCLE ED-328 ON READER-SERVICE CARD FOR MORE INFORMATION

INSURE *Proven Quality* with JONES PLUGS AND SOCKETS

Plug, Cable Clamp P-306-CC1 in Cap.

Jones Series 300 illustrated. Small Plugs & Sockets for 1001 Uses. Cap or panel mounting.

S-306-AB Socket with Angle Brackets.

- Knife-switch socket contacts phosphor bronze, cadmium plated.
- Bar type Plug contacts brass, cadmium plated, with cross section of 5/32" by 3/64".
- Insulation molded bakelite.
- All Plugs and Sockets polarized.
- Metal Caps, with formed fibre linings.
- Made in two to 33 contacts.
- For 45 volts, 5 amperes. Efficient at much higher ratings where circuit characteristics permit.

Ask for Jones Catalog No. 20 showing complete line of Electrical Connecting Devices, Plugs, Sockets, Terminal Strips. Write or wire today.

Jones

HOWARD B. JONES DIVISION
CINCH MANUFACTURING CORPORATION
CHICAGO 24, ILLINOIS
SUBSIDIARY OF UNITED-CARR FASTENER CORP.

CIRCLE ED-329 ON READER-SERVICE CARD FOR MORE INFORMATION

Mercury Battery

Weighs Only 4.5gr

This miniature mercury battery, with an unusually high rating for constant current, power, and service life, is for use in electronic equipment. Called the "General 625", it measures 0.225" high x 0.605" diam, and weighs 4.5gr.

Applications include electronic testing devices, such as meters, transistor oscillators, and sound-measuring instruments; circuits, including audio, bias voltage, voltage reference, relay, and switching; communications, including transistor radios and hearing aids; and other equipment like digital computers and radiation detection instruments.

When the battery is operating at a drain of 2.0ma with an initial terminal voltage of 1.30v and cutoff voltage of 0.90v, it delivers 200 hrs of service with a 12 hr day test cycle. Tests show that the battery has a low internal impedance throughout its useful service life. It has a very low noise level, and keeps static and background noise to a minimum. General Dry Batteries, Inc., Dept. ED, 13000 Athens Ave., Cleveland 7, Ohio.

CIRCLE ED-330 ON READER-SERVICE CARD FOR MORE INFORMATION

Crystal Multiplier

For Ultramicrowave Research

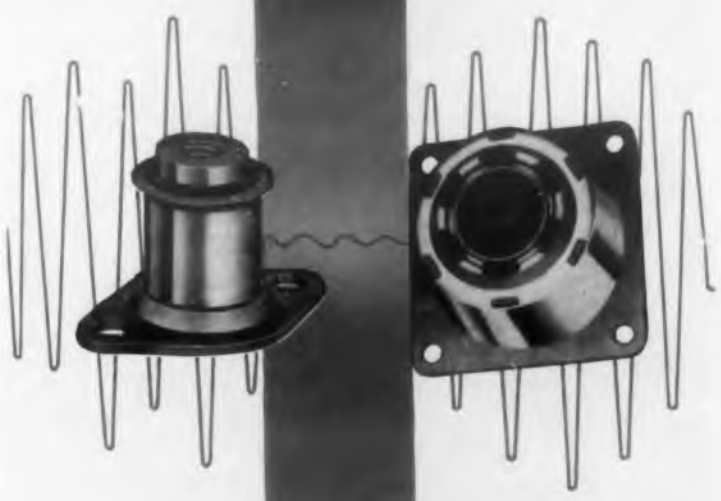
The DB-350 Crystal Multiplier enables experimentation in the "Ultramicrowave" region up to 90,000 Mc. It is designed to operate with this company's new ultramicrowave waveguide equipment.

The multiplier is especially for harmonic power generation at the second, third, fourth, or fifth harmonic. It consists of an input waveguide of a size appropriate to the input frequency, an output waveguide, and a tunable crystal holder. A BNC connector permits the introduction of low frequency modulation, or the biasing of the crystal to obtain optimum multiplication at the desired frequency.

Micrometer-driven plungers permit accurate tuning-in of the desired harmonic, and minimization of the other, unwanted, higher harmonics simultaneously present in the output. DeMornay-Bonardi, Dept. ED, 780 S. Arroyo Pkwy., Pasadena, Calif.

CIRCLE ED-331 ON READER-SERVICE CARD FOR MORE INFORMATION

SILENTBLOC simply smothers VIBRATION



Silentbloc rubber-in-metal mounts soak up sound and vibration through a unique deflection principal. It works equally well in shielding delicate equipment or protecting larger apparatus from the damaging effects of vibration.

There is practically no limit to the working life of Silentbloc. Units will stand unbelievable stresses for many years with no measurable fatigue.

For complete information on Silentbloc motion control products write to The General Tire & Rubber Company, Industrial Products Division, Dept. I-2, Wabash, Indiana.

"From Plans to Products in Plastics and Rubber"

These are General Tire Industrial Products now serving Industry

Silentbloc vibration and shock mountings • Silentbloc bushings • Silentbloc bearings • Oil & hydraulic seals • Bonded to metal rubber parts • Hydraulic brake parts • Metal stampings • Extruded & molded rubber • Extruded plastic • Polyester glass laminates • Sponge rubber • Glass run channel • Vibrex® fastners

THE GENERAL TIRE *Industrial Products Division* WABASH INDIANA

CIRCLE ED-332 ON READER-SERVICE CARD FOR MORE INFORMATION

New Literature . . .

R-F Interference Filters 334

A new 22-page catalog reviews this company's complete standard line of type FSR r-f interference suppression filters. Detailed information on each filter is given by means of cut-away views, dimension drawings, and descriptive text. Graphs of attenuation characteristics and complete engineering data on every unit permit the user to select and specify the right filter for a particular application. Filtron Co., Inc., 131-05 Fowler Ave., Flushing, L. I., N. Y.

Polyethylene 335

"Polyethylene's Potential in Large Plastic Structures", reprinted from *Product Engineering,* discusses the new application of the plastic in welded units where lightness in weight and corrosion resistance are decisive factors. Tables give physical and chemical properties of polyethylene and applications are illustrated. American Agile Corp., P. O. Box 168. Bedford, Ohio.

Peelable Plastic Packaging 336

A 15-minute, sound, 16mm motion picture has been produced describing the use and application of butyrate peelable plastic for packaging. The film is available to technical groups, societies, and members of industry who are concerned with protection of unit parts and assemblies either in storage or during shipment. Eastman Chemical Products, Inc., 260 Madison Ave., New York 16, N. Y.

Alloy Steels 337

A new 200-page handbook entitled "Alloy Steels Pay Off" discusses the economic advantages of fabricating with alloy steels for improved weight-to-strength ratios, longer life, and less maintenance, and lower operating costs. Advantages of high impact strength and shock-load resistance are explained. The economics resulting from alloy steel are documented by more than 60 case histories. Climax Molybdenum Co., 500 Fifth Ave., New York 36, N. Y.

Industrial Fasteners 33

A new bulletin describes and illustrates this firm line of die cast zinc alloy in industrial fasteners. T bulletin contains illustrations of each type of faste diagrams with complete specifications, and lists stock sizes to facilitate selection of the right size a type of fastener. Gries Reproducer Corp., 400 Bea wood Ave., New Rochelle, N. Y.

Electrical Instruments 33

This 8-page catalog gives descriptions and sp fications for this firm's line of precision electri instruments. Among those featured are impeda bridges, accessory null bridge amplifiers, and labo tory instruments. Circuit diagrams and sketches provided. Electro-Measurements, Inc., 4312 S. Stark St., Portland 15, Oreg.

Glass-Reinforced Plastics 3

Technical data on custom-molded parts of gl reinforced plastics are given in Bulletin No. GRP New high-pressure molding techniques, which per economical production of complicated shapes w metal inserts if required, are described. Data a are provided on matched-die metal molding for production of relatively simple shapes with unifo cross-sections. American Hard Rubber Co., 93 Wo St., New York 13, N. Y.

Dielectric Capacitors 3

A 6-page, 2-color bulletin (No. 337-8) illustr and gives complete technical information on minia flat "Mylar" dielectric capacitors. Included are ta of capacitance values and voltage ratings, dimensi drawings, and data on voltage derating for h temperature operation, dielectric material, end s capacitance change, lead specifications, test volt life test, power factor, and typical curves. Gude Co., 340 W. Huron St., Chicago 10, Ill.

Aircraft Battery Eliminator 344

This 2-page catalog sheet illustrates and describes this firm's model KM88 aircraft battery eliminator. The unit supplies from 0 to 28v d-c at 20amp with only 1% ripple. The bulletin includes detailed electrical and physical specifications and an outline drawing of the rack mounting type enclosure. Opad Electric Co., 69 Murray St., New York 7, N. Y.

Germanium Diodes 345

Bulletin No. GD-2 lists ratings and specifications for this company's complete germanium point contact diode line. It offers specifications on high temperature diodes computer diodes, uhf mixer diodes, meter protection diodes, and general purpose diodes. A complete interchangeability and replacement chart is included. Semi-Conductor Div., International Rectifier Corp., 1521 E. Grand Ave., El Segundo, Calif.

Automatic Counters 346

A 4-page bulletin describes and illustrates this firm's line of electrically and mechanically actuated counters for indicating, recording, and automatic regulation of industrial machinery. Besides a photograph of each counter, the reference shows two typical installations. It also gives information on the enclosures, housings, and wirings of the impulsing switch and motor drive unit. Richardson Scale Co., Van Houten Ave., Clifton, N. J.

Weight Selection System 347

A proportioning system that permits remote dialing of individual ingredient weights is pictured and described in a 28-page, 2-color bulletin. Forty-seven photographs and engineering drawings illustrate actual installations of the system in varied operations. Design and operating characteristics are explained. Richardson Scale Co., Van Houten Ave., Clifton, N. J.

Electrical Steels 348

"Armco Hot Rolled Electrical Steels" is a new design data book on nine grades of silicon steel. A large part of the 88-page book is devoted to curves showing various magnetic properties for a wide range of flux densities. The curves present data on the core loss, exciting rms voltamperes, reactive voltamperes, exciting ampere turns, d-c magnetization data, hysteresis loops, a-c and d-c normal permeability, and incremental permeability. Armco Steel Corp., Middletown, Ohio.

Directory of Testing Laboratories

The Directory of Commerical and College Testing Laboratories gives information regarding the location of testing laboratories together with the types of commodities and the nature of the investigations the laboratories are prepared to undertake. It is designed to be of assistance to purchasers who are not equipped to make their own acceptance tests and to manufacturers seeking testing laboratory services in the evaluation of raw materials and finished products. $1.00. American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa.

Receiver 352

A 2-color, 4-page folder describes the new amateur and professional communications receiver, the Pro-310. The bulletin gives specifications, design and performance characteristics. Hammarlund Manufacturing Co., Inc., 460 W. 34th St., New York 1, N. Y.

Variable Auto-transformers 353

Banked-winding for variable auto-transformers is discused in a technical data sheet. A description of the method and cut-away drawings are given. Rex Rheostat Co., 3 Foxhurst Road, Baldwin, L. I., N. Y.

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

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

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

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

59-7

CIRCLE ED-354 ON READER-SERVICE CARD FOR MORE INFORMATION

Long Life Tips 359

"Hexclad" plug tips and screw tips for soldering irons have a coating of iron alloy over copper base on all exposed surfaces for long wearing qualities. Dimensions and scale drawings of the tips are given in this data sheet as well as uses and a price list. Hexacon Electric Co., 161 W. Clay Ave., Roselle Park, N. J.

Rotating Equipment 360

A technical data sheet describes this company's line of rotating equipment. Facts and illustrations are given on synchros, servo torque units, a-c drive motors, d-c motors, a-c servo motors, tachometer generators, actuators, and motor driven blowers and fan assemblies. John Oster Manufacturing Co., Avionic Div., 1 Main St., Racine St., Racine, Wis.

Engineering Bulletins 361

A series of four engineering bulletins describe this company's line of miniature panel-mounting vacuum tube voltmeters, auxiliary power supplies, and the technique of obtaining automatic scale selection in test equipment design. Specifications and dimensional drawings are included. Trio Laboratories, Inc., 3293 Seaford Ave., Wantagh, N. Y.

6 Instruments in 1

without plug-ins!

BERKELEY Model 5571 Frequency Meter

Another BERKELEY first! Model 5571 offers for the first time the combined functions of six instruments in one compact, light weight unit—without plug-ins. Additional features include:

1. **0-42 mc frequency meter (extendable to 515 mc)**
2. **Frequency ratio meter**
3. **0-1 mc period meter**
4. **1 μ sec to 10,000,000 sec time interval meter.**
5. **0-2 mc events-per-unit time meter.**
6. **1 mc counter**

features

- Frequency range extendable to 515 mc
- Direct-coupled input amplifiers
- Direct connections to digital printer, digital-to-analog converter, or data converters for IBM card punches, electric typewriters or telemetering systems
- Provision for external frequency standard input
- Coupling to WWV receiver
- Relay rack mounting if desired

CONDENSED SPECIFICATIONS

Frequency Meas. Range:	0 cycles to 42 mc
Time Interval Meas. Range:	1 μ sec. to 10^7 seconds
Period Meas. Range:	0 to 1 mc (Period x 10, 0 to 100 kc)
Input Requirements:	0.1 v. peak to peak
Time Bases:	Frequency: 0.000002 to 20 seconds, decade steps. Time Interval and Period Meas: 1 mc to 1 cps, decade steps
Accuracy:	± 1 count of unknown (or time base) ± crystal stability
Crystal Stability:	Temperature stabilized to 1 part in 10^7 (short term)
Display Time:	0.2 to 5 seconds
Power Requirements:	117 v. ± 10%, 50-60 cycles, 260 watts
Dimensions:	20¾" W x 19" H x 16" D. Weight, 100 lbs.
Price:	$1,650.00 (f.o.b. factory)

Available Now!

Write today for complete technical data and application information; please address Dept. D-5

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INDUSTRIAL INSTRUMENTATION AND
CONTROL SYSTEMS • COMPUTERS • COUNTERS • TEST INSTRUMENTS • NUCLEAR SCALERS

CIRCLE ED-365 ON READER-SERVICE CARD FOR MORE INFORMATION

Preheating Chart 366

The Tempil° Preheating Chart lists the recommended preheat temperatures for 79 commonly used metals and alloys. Plain carbon steels, high tensile steels, medium chrome moly steels, and plain chrome steels are some of the metal groups for which approximate compositions and recommended preheat temperatures are shown. Factors influencing temperatures and the desirable effects of correct preheating on metal properties are enumerated. Tempil Corp., 132 W. 22nd St., New York 11, N. Y.

Photocells 367

This company's complete line of photoelectric cells and apparatus is described and illustrated in this brochure. Specifications and dimensional drawings are provided. Scientific Specialties Corp., Snow and Union Sts., Brighton, Mass.

Industrial Facilities 368

This 16-page booklet describes the Upper Kanawha Valley of West Virginia pointing out its industrial advantages and facilities available to industry. The booklet contains statistics as to employment, transportation, and resources. The Upper Kanawha Valley Development Assoc., Montgomery, W. Va.

Instrument Catalog 369

A "Quick Reference Instrument Catalogue" lists the salient points of this firm's cathode-ray oscillographs and accessory instruments. The 8-page catalog is divided into three sections devoted to low frequeny instruments, high frequency instruments, and accessory instruments. A picture of each instrument is provided together with a brief description of its features and some of the fields of application. Additional technical information is provided in tabular form. Technical Sales Dept., Allen B. Du Mont Laboratories, Inc., 760 Bloomfield Ave., Clifton, N. J.

Magnetic Test Limits 370

Technical Bulletin No. DMF-1 covers "Magnetic Test Limits for Standard El Laminations". This bulletin describes the test methods used, methods of determination of maximum limits, and shows schematic drawings of test equipment and complete tables covering maximum core loss at 10,000 gauss and maximum volt-amperes per pound values at 10,000 and 1000 gauss. Thomas & Skinner Steel Products Co., Inc., 1157 E. 23rd St., Indianapolis, Ind.

Resistance Strips 374

Comprehensive data on resistance strips and concentric disc resistors is given in this 4-page bulletin. Included is information on construction, dimensions, machining technique, tolerances, resistance values, power and voltage ratings, temperature coefficient, voltage coefficient, etc. Charts and graphs illustrate characteristics. International Resistance Co., 401 N. Broad St., Philadelphia 8, Pa.

TV Picture Tubes 375

The "Quick Selection Guide for Television Picture Tubes" can help designers select a particular tube from the large number of tubes now available. It lists 205 tube types and for each of these the following information is listed: whether it is aluminized or not, external conductive coating capacitance, type of iron-trap magnet, face, dimensions, and style of anode terminal. Tube Dept., General Electric Co., 1 River Road, Schenectady 5, N. Y.

Tubing and Sleeving Chart 376

"Engineer's Cross-Reference Tubing and Sleeving Chart" enables the engineer to find the specific tubing and sleeving needed for any particular application. Full technical specifications such as dielectric strength, temperature rating, etc., are included. Alpha Wire Corp., 430 Broadway, New York 13, N. Y.

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Lighter, more compact Servo Systems

Kearfott developed components to fill the need today, for tomorrow's Servo Systems.

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  10 minute maximum error,
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Straight thru bore and potted stator construction provide environmental resistance and high order of performance to these Motors and Synchros. Technical data sheets sent on request.

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CIRCLE ED-380 ON READER-SERVICE CARD FOR MORE INFORMATION

Self-Synchronous Motors 381

Folder No. EI-5A describes the various commercial types of self-synchronous motors made by this firm. The folder covers theory of operation and lists the design characteristics of over 30 different models. Characteristic curves, dimensional drawings, and electrical data are included for standard transmitters and receivers, differential units, phase shifters and resolvers, as well as for control and rotary transformer units. Electric Indicator Co., Inc., Springdale, Conn.

Engineering Service 382

The experience, facilities, and ability of a complete single-source engineering service are described in this brochure. Such services as product design and development, manufacturing cost studies, and production engineering are discussed in their application to engineering requirements. Pioneer Engineering & Mfg. Co., Inc., 19669 John R St., Detroit 3, Mich.

Aviation Products 383

This aviation products catalog covers aircraft pumps, electronic tube cooling units, refrigeration-type cooling units, pressurization units, and dehydrators. Complete engineering data gives performance and operation temperature range, weights and sizes of all models, and performance curves. Eastern Industries, Inc., 100 Skiff St., Hamden 14, Conn.

Opportunities for Industry 384

This report describes the opportunities offered to industries engaged in the manufacturing and assembly of electronic and scientific equipment by Michigan's upper peninsula. Among the location advantages cited are research facilities, quantities of raw materials, and good marketing area. Michigan Economic Development Dept., 110 Stevens T. Mason Bldg., Lansing, Mich.

Varistors 385

Comprehensive data in varistor applications, characteristics, current ratings, enclosures, terminations, is given in this 6-page bulletin. International Resistance Co., 401 N. Broad St., Philadelphia 8, Pa.

Connectors 386

A 4-page brochure gives actual size illustrations, outline drawings, and specifications on AN-type connectors. DeJUR-Amsco Corp., 45-01 Northern Blvd., Long Island City 1, N. Y.

Resistors 388

Bulletin No. B-9 describes and illustrates 1/2w molded deposited carbon resistors. Data is given on characteristics, applications, tolerance, wattage rating, terminations, dimensions, insulation, etc. International Resistance Co., 401 N. Broad St., Philadelphia 8, Pa.

Panel Meters 389

An engineering data sheet describes and gives complete performance information on a new series of large size indicator panel meters. Information includes standard ranges and approximate resistances available, special variations, specifications, physical dimensions, and mountings. International Instruments, Inc., P. O. Box 2954, New Haven, Conn.

Copper-Clad Phenolite 390

Methods of producing printed circuits from copper-clad phenolite are described in this booklet. Materials and properties as well as design details for printed circuits are given. Grades of copper-clad phenolite are described and applications described. National Vulcanized Fibre Co., Wilmington 99, Del.

Magnetic Cores 391

Specifications and data on standard grades of Ferramic S-1 magnetic cores are given in a 4-page booklet. Performance curves are included. General Ceramics Corp., Keasbey, N. J.

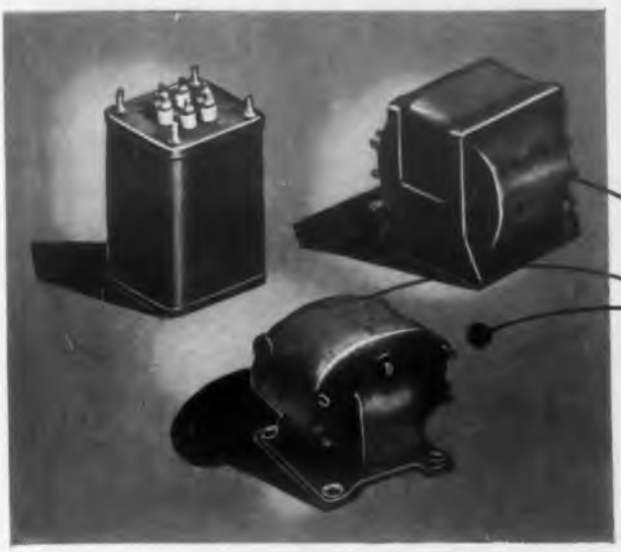
Electrical Tapes 392

A 4-page brochure "Permacel 2 in 1 Electrical Tapes," discusses the application of one tape doing the work of two. The brochure supplies a complete table of technical data, illustrating the curing cycle, tensile strength, and seven other pertinent factors relating to the backing of these tapes. Permacel Tape Corp., New Brunswick, N. J.

Lathe Operation

Revised edition 53 of "How to Run a Lathe" covers new material on the use of toolmaker's buttons for locating work on the lathe face plate, the use of the steady rest, follower rest, internal grinding attachment, and precision gage blocks. This edition has 128 pages and over 365 illustrations. Paper binding, $0.50, imitation leather fabrikoid binding, $1.50. South Bend Lathe Works, South Bend 22, Ind.

Do you have source spots?



Every design engineer or production man we ever met makes mental notes of good places to get quick aid on needs out of the ordinary.

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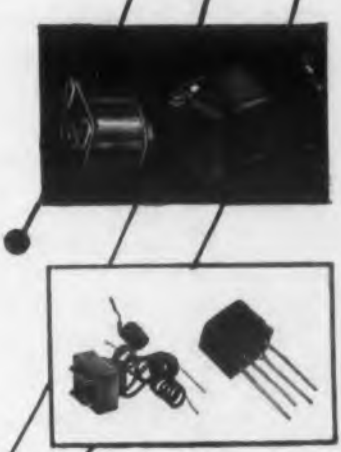

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Special Air Performance curves to suit electronic tube applications

Model A simplex-duplex

"communication" quality blowers

New Catalog section #40101-1 describes **60 DIFFERENT TYPES** covering almost any conceivable requirement in TV-Broadcasting and Radio Communication.

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1/6 H P to 5 H P
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EXTREME RELIABILITY

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CIRCLE ED-394 ON READER-SERVICE CARD FOR MORE INFORMATION

Regulator 395

Complete details and instructions for the use of Size 4 Regohm are given in this 8-page bulletin. This unit is a direct-action, finger-type electric circuit control regulator. Electric Regulator Corp., 604 Pearl St., Norwalk, Conn.

Height Gages 396

A fully illustrated 6-page folder describes a new and differently designed height gage. The gage is particularly suitable for layout and checking of large jigs, fixtures, and machine parts. George Scherr Co., Inc., 200 Lafayette St., New York 12, N. Y.

Potentiometers 397

Two types of broadband dielectric potentiometers are described in this 4-page 2-color brochure. Type PD-1 is used in closed-loop self-regulating systems or remote contorl of servo systems. The PD-2 is useful in control and measurement applications. Technology Instrument Corp., 531 Main St., Acton, Mass.

Lens Data Book 39

A photographic lens data book lists pe tinent dimensions of 43 lenses. Listed the data book are lenses covering 8m 16mm, and 35mm film, and lenses for fi sizes to 9" x 9". Bausch & Lomb Optic Co., 635 St. Paul St., Rochester, N. Y.

Subminiature Toroids 39

A 4-page, 2-color folder describes thr core type subminiature toroids in six di ferent package styles. The brochure su plies Q curves, dimensional drawings, a application suggestions for the vari types. Also described are components i special networks for use in airborne a telemetering equipment. Communicati Accessories Co., Hickman Hills, Mo.

Tube Catalog 40

Various types of tubes made by this fi are illustrated and described in a 4-pa bulletin. Electrical and mechanical da are provided. Chatham Electroni Livingston, N. J.

Composite Catalog 402

Catalog No. 5002 is a new issue of the composite catalog which briefly describes this company's industrial instruments and equipment. Industrial Div., Minneapolis-Honeywell Regulator Co., Wayne and Windrim Aves., Philadelphia 44, Pa.

Hermetic Seals 403

Hermetic seals which can withstand high temperatures and severe thermal shock are described in a 4-page catalog. Dimensional drawings and ratings are given. Advanced Vacuum Products, Inc., 18 Liberty St., Stamford, Conn.

Fiberglas Sheets 404

A 4-page folder lists comparative properties of Fiberglas-polyester general purpose electrical flat sheets with Phenolic grade GE. Recent developments in combining Fiberglas reinforcements with polyester resins are discussed. Electrical Div., Dept. 7, Owens-Corning Fiberglas Corp., 598 Madison Ave., New York 22, N. Y.

Platinum Clad Tungsten 405

A 4-page catalog describes platinum clad tungsten wire for high power vacuum tube grids. Applications and requirements are given. Baker & Co., 113 Astor St., Newark 5, N. J.

Accident Prevention Signs 406

A 16-page full color bulletin describes and illustrates self-sticking accident prevention signs. The signs come in three standard sizes. W. H. Brady Co., 727 W. Glendale Ave., Milwaukee 12, Wis.

Capacitors 407

A 2-color, 32-page catalog describes this company's line of paper and Mylar dielectric capacitors for civilian, military, and specialty applications. This catalog, No. 551, includes line drawings and photographs of all case style mountings. Graphs and charts describe electrical and mechanical characteristics of each capacitor series. Good-All Electric Manufacturing Co., Ogallala, Nebr.

CIRCLE ED-408 ON READER-SERVICE CARD ➤

CIRCLE ED-409 ON READER-SERVICE CARD FOR MORE INFORMATION

300,197,234 operations without a miss! G-E miniature relays are service-proved

Ideal for radar, aircraft computers, guided missiles and other defense and industrial applications, General Electric Hermetically Sealed Miniature Relays are designed for top reliability of operation.

Over 300,000,000 operations without a miss is the record of several G-E Miniature Relays in an actual application. One relay was checked after its 200 millionth operation—revealing only a 2 to 3 mil wear between armature tail piece and contact lifter. The G-E Miniature Relay met all factory tests at that point and could have been shipped as a new unit.

Successful results from this and other applications, plus results of extensive load-life tests assure you that G-E will aid in the selection of the relay best suited for your own application.

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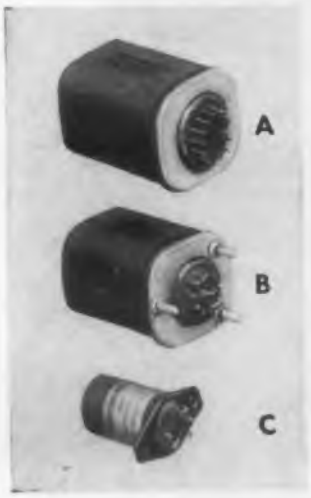

- ☐ **A: High Speed Relay—Bulletin GEA-6212**
- ☐ **B: Miniature Relay—Bulletin GEA-6213**
- ☐ **C: Subminiature Relay—Bulletin GEA-6211**

Section D-792-1, General Electric Company, Schenectady 5, New York.

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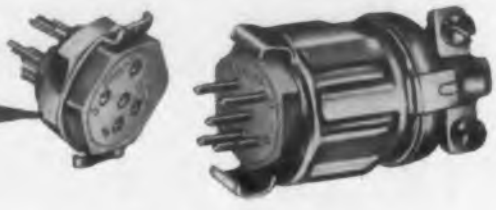
OF RACK & PANEL CONNECTORS

Interconnection of vital electronic equipment demands a wide variety of connector designs. At AMPHENOL this demand has resulted in the most comprehensive connector line available to the electronics industry—AN connectors, RF connectors, *Blue* RIBBONS, and hundreds of special components. In the latter category are the 26 series of Rack & Panel connectors, which includes three distinctly different designs, each offering excellent design and mechanical characteristics.



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Designed to cover a wide range of miniaturized applications by the use of interchangeable hardware and contacts. Hex nut type has threaded body for panel mounting without the use of external shells. Locking Clip type permits positive mating with Hood & Cable Clamp type. All with male or female contacts. Bodies molded of AMPHENOL 1-501 blue: gold plated contacts.

14, 15, 18, 21 & 34 Contact Miniature Connectors

Extremely small pin and socket type connectors available in numerous contact arrangements. Have guide pins and bushings for positive alignment. Contacts are brass, gold over silver plated. Bodies are melamine.

11, 15 & 20 Contact Connectors

Available with protective aluminum housings with top or side cable outlets. Connectors have eyelets inserted in the mounting holes for extra strength. Interlocking barriers prevent accidental shorting. Bodies are mica-filled phenolic; contacts are brass, gold over silver plated, and are molded into the insert.

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Color Concentrates 411

Three technical data sheets give properties, description, applications, and prices on color paste concentrates for coloring epoxy, thiokol, polyurethane, and isocyanate resins. Claremont Pigment Dispersion Corp., 110 Wallabout St., Brooklyn, N. Y.

Plastic Cabinets 412

This new catalog features transparent plastic drawer cabinets for storing small parts. Also included in the catalog are material handling equipment, lockers, storage cabinets, safety ladders, and other items for industrial use. General Industrial Co., 5737 N. Elston, Chicago 30, Ill.

Voltmeter Multipliers 413

Sealed precision voltmeter multipliers are the subject on this data sheet. Charts and graphs show data on construction, wiring, voltage rating, and dielectric strength. International Resistance Co., 401 N. Broad St., Philadelphia 8, Pa.

Tubes and Coil Forms 414

A 4-page brochure contains technical data on square and round tubes, coil forms, bobbins, and mandrel services for electrical/electronic applications. Precision Paper Tube Co., Dept. EDN, 2035 W. Charleston St., Chicago 47, Ill.

Fuel Gage Test Unit 415

A direct-reading test for use in the installation and maintenance of capacitor-type fuel quantity gaging systems is described in this bulletin. Liquidometer Corp., Skillman Ave., 36th & 37th St., Long Island City 1, N. Y.

Vulcanized Fibre 416

The properties and applications of vulcanized fibre are described and illustrated in a 20-page, 2-color brochure. National Vulcanized Fibre Co., Wilmington 99, Del.

Auxiliary Relays 417

This technical data sheet describes auxiliary relays for all demands. A chart gives technical and performance data. Allgemeine Elektricitats Gesellschaft; U. S. sales representative, Donald C. Seibert, Box 281, Wilmington, Del.

◀ CIRCLE ED-410 ON READER-SERVICE CARD FOR MORE DATA

Tubes 420

"What's New with the Electron", a discussion of developments during the past year, covers this company's electron-power tubes. The booklet discusses new and improved tubes in the triode, tetrode, klystron, and rectifier fields. Technical Services Dept., Eitel-McCullough, Inc., San Bruno, Calif.

Carrier Equipment 421

The complete line of this company's power-line carrier equipment for voice communications is described in this 24-page booklet. Some features of the equipment are improved receiver selectivity, operation from station batteries, filament current regulation, and accessibility of assemblies. Westinghouse Electric Corp., P. O. Box 2099, Pittsubrgh 30, Pa.

Tool Design Facilities 422

This 24-page brochure describes tool design facilities for the electronics, aircraft, and appliance industries. Illustrations show how tool design, tool and die-making, stamping, and assembly are handled by this firm. August W. Holmberg & Co., Inc., 133-31 39th Ave., Flushing, N. Y.

Multi-Headers 423

A new catalog furnishes complete technical data on Vac-Tite compression multi-headers of all-glass and all-metal construction. Solid pin terminals, tubular terminals, and unit headers are available in the plain, flanged, and skirted multi-header body types. Hermetic Seal Products Co., 29-37 S. Sixth St., Newark 7, N. J.

Temperature Tester 424

This data sheet describes a portable temperature tester with readings from −50°F through 1000°F. A special internal temperature compensation circuit automatically corrects room temperature effects. Simpson Electric Co., 5200 W. Kinzie St., Chicago 44, Ill.

Equalizers and Filters 425

This 16-page catalog, completely illustrated with response charts, covers, equalizers and wave filters. The catalog includes all applications of this type of equipment in sound and sound recording with case histories. Cinema Engineering Co., Div. of Aerovox Corp., 1100 Chestnut St., Burbank, Calif.

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Model REL-12

SPECIFICATIONS

Size	7/8" x 2-5/16" x 4-3/8"
Weight	7 ounces
Frequency Response	5 to 20,000 cps with less than ±1% deviation
Voltage Gain	Adjustable 5 to 500
Linearity	Within ±1%
Output	5 v rms maximum
Input Impedance	Over 100 megohms
Output Impedance	Less than 100 ohms
Load	33,000 ohms minimum

Will maintain a constant output with B+ and filament variations of ±15%.

Different models available with variations of frequency response and recovery time. Recovery time as low as 30 milliseconds.

RHEEM R. F. POWER MINIATURE AMPLIFIER

Model REL-09

SPECIFICATIONS

Size	4.90 x 3.37 x 2"
Weight	16 ounces
Controls	Plate tuning Grid tuning
Filter	85-db attenuation filter on all power leads
Tuning Range	215 to 235 megacycles
Power Output	12 watts nominal
Required Drive	1.4 watts minimum
Plate	250 V dc @ 90 ma
Filaments	12.6 V @ 0.41 amp or 6.3 V @ 0.82 amp
Bias	None Required

RHEEM SUBMINIATURE VOLTAGE REGULATOR

Model REL-11

SPECIFICATIONS

Size	1-3/4" x 2-5/16" x 4-3/8"
Weight	14 ounces
Output Voltage	Any nominal voltage from 130 to 235 volts, adjustable range ±10% of the nominal voltage
Current	Up to 200 milliamperes
Ripple Reduction Factor	5×10^{-4}
Output Impedance	Will not exceed 2 ohms from 1 cps to 200,000 cps
Regulation	Within .05% for load variations of ±25% and input variations of ±20%
Minimum DC Input Voltage	Equal to 100 volts greater than the regulated output voltage

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

RHEEM Manufacturing Company

Government Products Division

9236 East Hall Road, Downey, California

YOU CAN RELY ON... Rheem

CIRCLE ED-426 ON READER-SERVICE CARD FOR MORE INFORMATION

Winding Alloy Chart 428

To help the engineer in the determination and selection of platinum metals winding alloy wires for specific potentiometer applications, this firm has prepared a special cross-reference chart which plots bare diameter vs. resistance values of several platinum metals potentiometer winding alloy wire. Secon Metals Corp., 7 Intervale St., White Plains, N. Y.

Radar and Radio Controls 429

This 8-page catalog describes and illustrates control knobs, pointer-lever control knobs, and other electronic instrument knobs. A chart shows dimensions and types of set screws used in the knobs. Harry Davies Molding Co., 1428 N. Wells St., Chicago 10, Ill.

Transistor Packaged Circuits 430

A catalog sheet covers this firm's line of Transamp transistor packaged circuits. It covers transistor audio amplifiers, transistor controlled magnetic amplifiers, and other packaged circuits such as transistor oscillators and transistor photo-sensitive amplifiers. Electronic Research Associates, Inc., 67 E. Centre St., Nutley, N. J.

Automatic Electrolytic Grinding 436

How electronic control makes possible automatic electrolytic grinding of cemented carbide tools and other hard-to-work materials is the subject of a 12-page manual. The process and equipment is described in detail. Anocut Engineering Co., 631 W. Washington Blvd., Chicago 6, Ill.

Relay Catalog 437

A 72-page catalog covers this company's complete line of basic type relays. Each relay is fully described as to physical and electrical characteristics, complete operating data, and suggested applications. The book devotes two pages to definitions of engineering and electrical terms and laws. Guardian Electric Manufacturing Co., 1621 W. Walnut St., Chicago 12, Ill.

Temperature Indicators 438

A revised brochure covers this company's line of temperature indicating products. The brochure contains concise directions for use; indicates the choice of temperature indicating product for the intended application; and lists the various temperature ratings available in each of the product types. Tempil Corp., 132 W. 22nd St., New York 11, N. Y.

RADAR i.f. amplifiers

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LINEAR EQUIPMENT LABORATORIES will design and build to your electrical and mechanical specifications I.F. strips of ANY type. We are currently producing our standard wide-band postamplifier strips incorporating built-in attenuator networks.

Our staff has designed and built minimal noise I.F. strips using stagger-tuned, M derived, double-tuned, bridged T, and feedback types of coupling. We are also experienced in the construction of rugged, reliable, subminiature amplifiers.

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- UHF TRANSFORMERS
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- TERMINATIONS
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- VIDEO LINE AMPLIFIER

WRITE FOR CATALOG ED-55

CIRCLE ED-441 ON READER-SERVICE CARD FOR MORE INFORMATION

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ENCAPSULATION*

. . . for the most exacting requirements of the electronic industry.

Impervious to climatic destruction—greater mechanical strength—improved appearance—reduction in size and weight—tamper proof—are but a few of the advantages of this LESS COSTLY, modern method of HERMETIC SEALING, adaptable to the smallest component or the largest assembly.

Our engineers will be pleased to discuss applications with you—and embed or encapsulate samples to your requirements. Write, wire or phone today.

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HERMETIC SEALING OF ELECTRONIC COMPONENTS

221 LAKE STREET, OAK PARK, ILLINOIS

CIRCLE ED-442 ON READER-SERVICE CARD FOR MORE INFORMATION

Tube Plate Characteristics

The second edition of Vacuum Tube Characteristics and Design Sheets in tablet form contains 48 different commonly used octal, miniature, and subminiature tube types. Each sheet features precision drawn plate characteristic curves 8-1/2" x 11" in size; circuit design information including filament voltage and current, tube schematic, absolute maximum ratings per MIL-E-1B, and the plate dissipation hyperbola. Single sheets of 52 different tube types are also available. $0.85, plus mailing. Vacuum Tube Research, P. O. Box 4023, St. Louis 20, Mo., or P. O. Box 25892, Los Angeles 25, Calif.

Precision Tool Facilities 443

A working-hour tour of this company's plant, showing examples of fine die and gage making work is given in a 24-page brochure. Attention is called to the complete facilities and highly skilled personnel of the firm. Ehrhardt Tool and Machine Co., 914 Monroe St., St. Louis 6, Mo.

Tube Guide 4

This 24-page 2-color booklet conta sections on fundamentals of voltage re ence and stabilizer tubes; the interpr tion of published characteristics; and plications, including design formulas associated components. The booklet is ti "A Guide to the Application of Volt Reference and Stabiliser Tubes." C munications and Industrial Valve De Mullard Ltd., Century House, Shaftesb Avenue, London, W. C. 2, England.

Engineering Sound Catalog 4

This engineering catalog contains c plete technical data on all this fi engineering sound products. The 36-p catalog covers AM-FM tuners, transc tion reproduction arms, twelve diffe broadcast, public address, and scient microphones, more than twenty amplif and preamplifiers, power supplies, con consoles, speakers, horns, cabinets, matching transformers. Altec Lans Corp., 161 Sixth Ave., New York 13, N.

...mpression Terminals 447

...new line of color-coded compression ferrules, ...ed Hyrings, for grounding shielded wire and co... ...al cable, terminating rod-type heating element ...ds. and splicing solid and stranded wire is de... ...ibed in Bulletin No. 55Y1. Burndy Engineering ..., Inc., Norwalk, Conn.

...oling Devices 448

...An 8-page brochure describes the complete line of ...ling devices for the electronics industry made by ...s company and indicates applications for these de... ...es. Rotron Manufacturing Co., Schoonmaker Lane, ...oodstock, N. Y.

...ttern Recording Systems 449

...Complete details on an antenna pattern recording ...tem, including equipment, principles of operation, ...l descriptive specifications, are given in a new ...chure. Airborne Instruments Laboratory, Inc., ...0 Old Country Road, Mineola, N. Y.

...otentiometers 450

...The single-turn, high precision Helipot series G po... ...tiometer is the subject of data sheet 54-36. Specifi... ...ions and linear coil characteristics are described in ...tail. Technical Information Service, Helipot Corp., ... Pasadena, Calif.

...ap Computations

...Experiments in the Computation of Conformal Maps ...ntains descriptions and evaluations of three com... ...tation experiments in the general field of conformal ...pping. The publication contains six papers on ...e three experiments. Conformal mapping is of ...incipal importance in electromagnetic theory, air... ...ft wing design, and hydrodynamics. $0.25. Govern... ...ent Printing Office, Washington 25, D. C.

...otors 451

...An 8-page brochure describes and illustrates this ...mpany's line of motors. Among the types included ...e fractional hp, sub-fractional hp, miniature, and ...rvo motors. National Pneumatic Co., Inc., and ...oltzer-Cabot Divs., 125 Armory St., Boston 19, Mass.

...anel Meters 452

...A 2-page brochure gives general specifications, table ... standard ranges and approximate resistances, out... ...e drawings, and ordering information for round ...d square watertight panel meters. Electronic Sales ...iv., DeJUR-Amsco Corp., 45-01 Northern Blvd., ...ong Island City 1, N. Y.

Patents . . .

By John Montstream

Frequency Controllable Oscillating System . . . *Patent No. 2,684,404. Robert Adler. (Assigned to Zenith Radio Corp., Chicago, Ill.)*

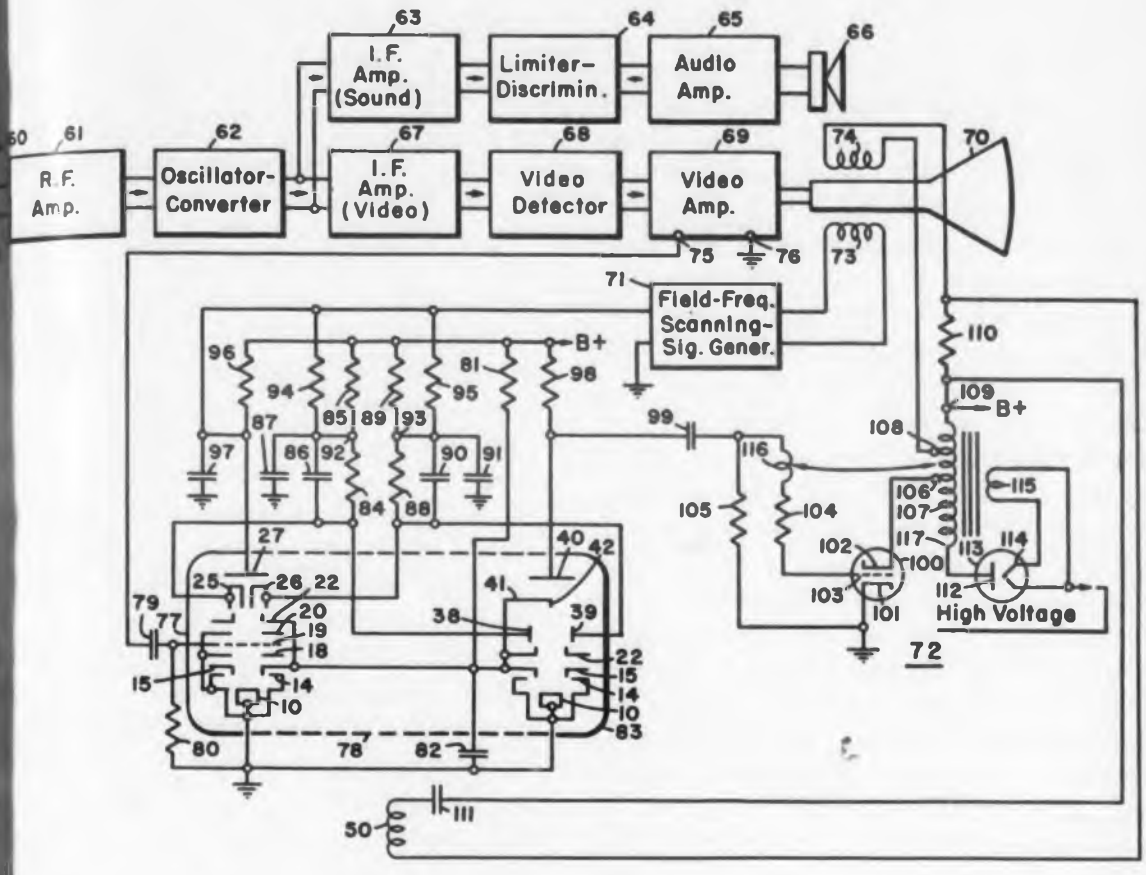
Television receivers usually secure synchronization of the field frequency generator and of the line frequency generator by circuits of some complexity using a minimum of three tubes. With a special tube described in the patent, the synchronizing operation is accomplished with this one tube and a relatively simple circuit arrangement shown at the right.

The sound and video circuit as well as the field synchronizing generator (*71*) is conventional. The synchronizing signals of the received program are applied to the control grid (*19*) of the specially designed tube (*78*) through an input circuit consisting of a condenser (*79*) and resistor (*80*). This input circuit has a time constant at least as long as the field frequency period. The tube in effect is a double or two section tube, but having a single cathode (*10*) that produces an elongated or rectangular form of electron beam. Electrodes *14, 18,* and *20,* are focusing elements, and electrodes *15* and *22* are accelerating elements connected through a resistor (*81*) with a source of potential. A pair of spaced anodes (*25* and *26*) normally divide the electron beam equally during line synchronizing signals so that the output voltages in each output circuit are the same. With equal output voltages, the field between electrodes *38* and *39* is uniform and the electron beam in the second section of t tube is unaffected.

A coil (*50*) supplies a magnetic fie that controls deflection of the electr beam in the second section of tube *78* fr an interceptor anode (*41*) to the outp anode (*40*). Current flow in the outp circuit of anode *40* produces a pulse whi controls line synchronization generator 7

The magnetic field of coil *50* also dete mines whether or not the beam of the fir section of the tube is deflected to anode or *26*. If the field of the coil pass through zero when the tube is conductin the beam is not deflected. If, howeve line synchronization generator *72* is n in step with the received synchronizati signal, the field of coil *50* deflects the ele tron beam to one or the other of t anodes, *25* or *26*, depending upon whethe it leads or lags the received signal. Th action in turn creates a field between de flection electrodes *38* and *39* of the secon section of the tube which retards or ad vances the deflection of the beam from th left to the right. The triggering pulse delayed or advanced thereby to bring lin synchronization generator *72* into step wit the line synchronization signal receive from the transmitter.

The description given here is necessaril brief and many details of the operation of the circuit have not been given. I addition patent discloses other circuit arrangements that may be used. The tub construction is described in greater detai in this inventor's patent No. 2,606,300.



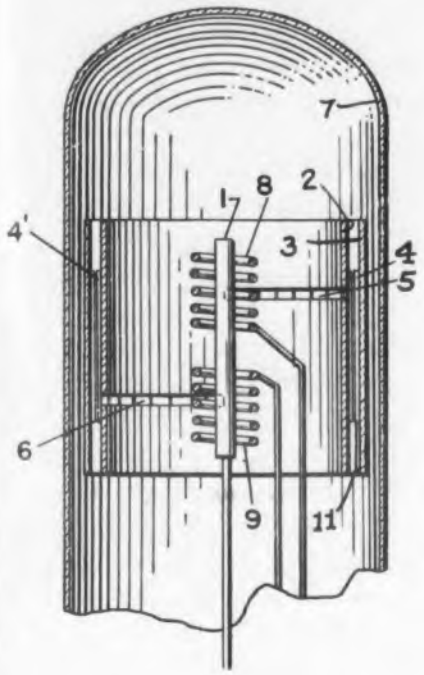
Commutator Tube . . . *Patent No.2,684,-449. S. R. Rich and E. E. Turner, Jr. (Assigned to Raytheon Manufacturing Co., Waltham, Mass.)*

The tube shown opposite provides smooth commutation between two or more circuits without switching noises. It may be used in circuits for the determination of distance and direction of an object. The tube will operate with very low signal levels.

The tube has a cathode (*1*) and a cylindrical anode (*2*). The anode is provided with one or more circumferential slots through the anode, two slots (*5* and *6*) being illustrated. The slots are shown extending over about 180° of circumference so that two spaced slots extend over the entire circumference of the cylindrical anode. A series of vertical segments are spaced a short distance from the anode at the slot or slots. They may be provided on the surface of a carrier cylinder (*3*) of glass that surrounds the anode. Each segment constitutes a commutator element and is connected by a lead (*11*) to its respective circuit.

The cathode produces a beam of electrons that is rotated by a magnetic f which may be produced in several w such as by two coils 180° apart. As beam rotates it passes through the from one segment to another and as electron beam engages a segment a cur is set up in its circuit which may con another circuit. The low switching n is secured because the electron beam p tically loses its velocity at the slot in anode. It is for this reason, too, that segments are placed close to the an This construction also assures little re tion of the beam from the segments. addition smooth commutator effect secured by placing the segments c together, that is, spaced from each o on the order of a few thousandths of inch. Preferably the beam of electrons a width approximately the width segment or even less.

When two or more slots are provi in the anode, a control grid (*8* and *9*) be provided for each slot. The beam be controlled by the control grid to pre the beam from being projected throug slot and hence prevent commutation any slot or slots. A common load resi



be employed in the cathode circuit. Smooth and rapid commutation from segment and its circuit to another is ured by the tube. It is also a tube that be manufactured economically.

Means for Delaying Electrical Signals . . .
Patent No. 2,685,067. H. N. Beveridge and J. J. Staller. (Assigned to Raytheon Manufacturing Co., Newton, Mass.)

One of the difficulties of the mercury pool type of delay line has been spurious signals caused by divergence of a portion of a signal beam. The path of this portion of the signal between the input transducer and the output transducer is reduced or increased from the desired path and in this manner produces a spurious signal. The delay means secures a delay from 25 to 10,000 microseconds.

The delay device shown on p. 151 includes a mercury tank of rectangular form having an input opening (*15*), marked *IN*, in the wall in which an input transducer is mounted. It is mounted at a slight angle such as by inclining the outer surface so that when the transducer is mounted on this inclined surface it is at the desired angle to provide a series of reflections of the signal from the walls of the tank. In the delay tank illustrated one corner may be provided with an inclined reflecting member (*11a*) so that with this particular type of tank, the signal is re-

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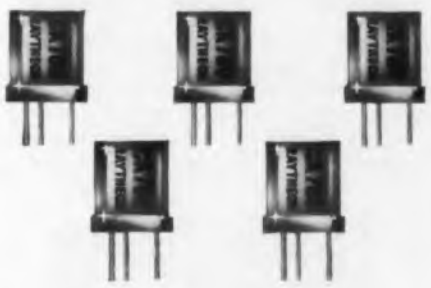

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	Volts	Cutoff μA	MA						
CK760	−6	1	−1.0	75	40	5	85	0.62	14
CK761	−6	1	−1.0	75	45	10	85	0.62	14
CK762	−6	1	−1.0	75	65	20	85	0.62	14

Note: above characteristics are average except where noted.

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CIRCLE ED-479 ON READER-SERVICE CARD FOR MORE INFORMATION

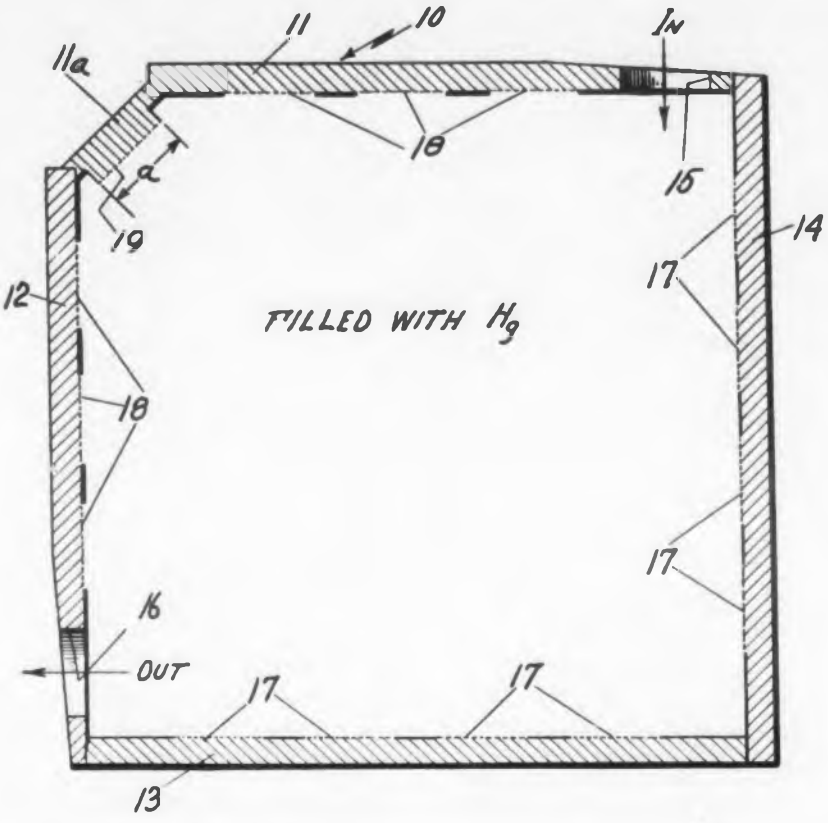
flected from the first or right hand reflecting pad (*17*) on wall *13* to the pad (*18*) adjacent the input transducer. The signal is reflected from wall to wall until the last pad is reached in wall *13*. At this point the signal impinges angular surface *19* and is multi-reflected in a similar manner between walls *14* and *12* until the reflected signal impinges on the output transducer in opening *16*. With this type of delay tank, maximum utilization of reflection within the tank is secured. Reflections may use but two walls. In this type of construction the output transducer is mounted at the left hand end of wall *13*.

It has been discovered that a smooth or polished wall surface absorbs about 9/10 of the signal. It has also been found that by roughening the surface such as by a sand blast, signal reflection of about 100% is secured. If, therefore, roughened reflector pads *17* and *18* in a smooth wall surface have a size the same as or approximating that of the transducer, then any divergence of the beam that would produce spurious paths or signals are practically clipped and are not reflected.

The inventors present a suggested theory as to why a roughened surface would g better reflection of ultrasonic signals th a smooth surface. It is pointed out too t the patentees do not bind themselves the theory presented. This points up principle of Patent Law that an inven does not have to know the theory by wh he secures improved results but only ne to know the structure by which such proved results are secured.

To further augment clipping of a vergent portion of a signal, a ring-l trough or recess surrounds each reflect pad. The bottom of the trough is smo so that it will absorb 9/10 of the sig which impinges thereon. In addition plane of the bottom of the trough is clined so that any portion of the sig that diverges beyond that of the reflect pad is deflected to the bottom or top the delay tank so that very little of such signal reaches the output transdu

The delay device finds usefulness moving target indicator radar systems cancel out any reflected signal from a s tionary object. The system therefore means a give a signal only upon receiving an e gnal from a moving object or target. The de stem.



eans also may be used as a memory or gnal storage channel of a computing stem. Circuits for both of these types of applications are illustrated. The delay means described in the patent is an inexpensive and easily made mechanism.

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SILICON POWER RECTIFIERS

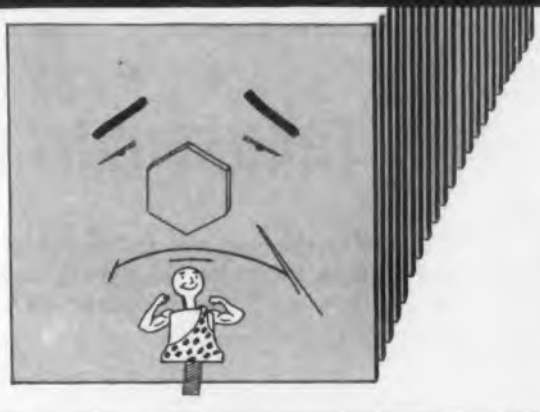
to 175°C to 15 amps. to 200 volts

ACTUAL SIZE

$\frac{R_{REVERSE}}{R_{FORWARD}} > 100{,}000$

Circuit	Number of CK776	Watts Output at Case Temperature† of 30°C	70°C	170°C
One Phase				
Half Wave	1	700	530	265
Full Wave	2	1600	1070	530
Bridge	4	3050	2040	1020
Three Phase				
Half Wave	3	3200	2150	1070
Bridge	6	6800	4550	2270

† Maintained with heat radiator



At maximum power handling capability of CK776, an equivalent selenium rectifier could occupy as much as 100 times the volume.

RAYTHEON SILICON POWER RECTIFIER CHARACTERISTICS

	MAXIMUM VOLTAGE RMS VOLTS	MAXIMUM VOLTAGE PEAK VOLTS	MAXIMUM CURRENT PEAK AMPERES	MAXIMUM CURRENT AVERAGE AMPERES	TYPICAL DISSIPATION WATTS
TYPE CK775					
CASE TEMP. 30°C*	40	60	50	15	40
CASE TEMP. 170°C*	40	60	15	5	10
NO HEAT RADIATOR					
AMBIENT TEMP. 25°C	40	60	6	2.0	3.0
AMBIENT TEMP. 170°C	40	60	2.0	0.5	2.0
TYPE CK776					
CASE TEMP. 30°C*	125	200	50	15	40
CASE TEMP. 170°C*	125	200	15	5	10
NO HEAT RADIATOR					
AMBIENT TEMP. 25°C	125	200	6	2.0	3.0
AMBIENT TEMP. 170°C	125	200	2.0	0.5	2.0

*maintained by external heat radiator

At 25°C both CK775 and CK776 have maximum drop at 5 amperes of 1.5 volts. Maximum reverse current is 25mA for CK775 at −60 volts, CK776 at −200 volts.

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CIRCLE ED-482 ON READER-SERVICE CARD FOR MORE INFORMATION

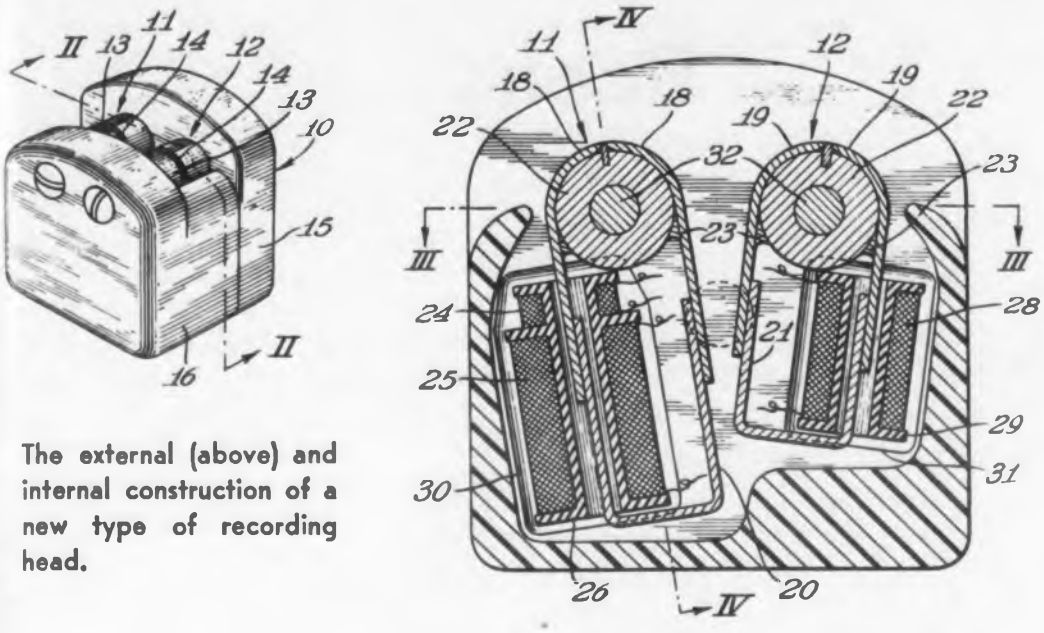
Electromagnetic Transducer Head . . . *Patent No. 2,683,774. Marvin Camras. (Assigned to Armour Research Foundation of Illinois Institute of Technology, Chicago, Ill.)*

A transducer head for magnetic recording and reproducing requires that the magnetic circuit must be small in dimension in order to secure fidelity and efficiency in the operation of the head. The small dimensions of the head also tend to make for high cost in manufacture of this piece of equipment. The head shown opposite is so designed that it can be manufactured to close tolerances and with maintenance of efficiency and high fidelity in operation.

The operational parts of the head are mounted in a two-part plastic housing (*10*) in which part *15* serves as a mounting base and part *16* forms a cover over the coils. The base carries two spaced screws (*32*) upon one of which is mounted a recording head (*11*) and on the other an erase head (*12*). Each head utilizes a cylindrical nonmagnetic collar or spacer (*22*) which is received upon its screw (*32*). A pole tip member (*18* and *19*) of U-shaped form encircles the upper part of the periphe of each collar *22* and provides downward extending legs. Each pole tip member secured to its collar. The gap may be air gap. The gap shown, however, formed by an insert strip secured to t ends of each pole tip member. This g strip may be recessed into collar *22* aid in maintaining the part in positi An audio frequency coil (*25*) surrou one leg of U-shaped member *18*. A sm high frequency coil (*24*) is also associat with the audio coil. Improved response obtained if a second U-shaped yoke me ber (*20* and *21*) frictionally engage t ends of its tip member and hence has leg extending through its respective coil.

The erasing head is essentially identi in construction with the recording he although the gap may be larger and t coil smaller. Coil *28*, however, has hi frequency applied to it for erasing t recording tape before it reaches the reco ing head as the tape passes through t erasing head.

Although the transducer head shown the right has a single coil around the l



The external (above) and internal construction of a new type of recording head.

U-shaped tip members *18* and *19*, the tentee also contemplates a coil around ch leg. A transducer head so constructed uld be somewhat bulkier than the form strated above. Recording head *11* is o used as a play back head; however, when so used, high frequency winding *24* is not energized and of course the erasing head coil *28* is similarly not energized. The head described is inexpensive to manufacture and assemble, yet the device is very efficient in actual operation.

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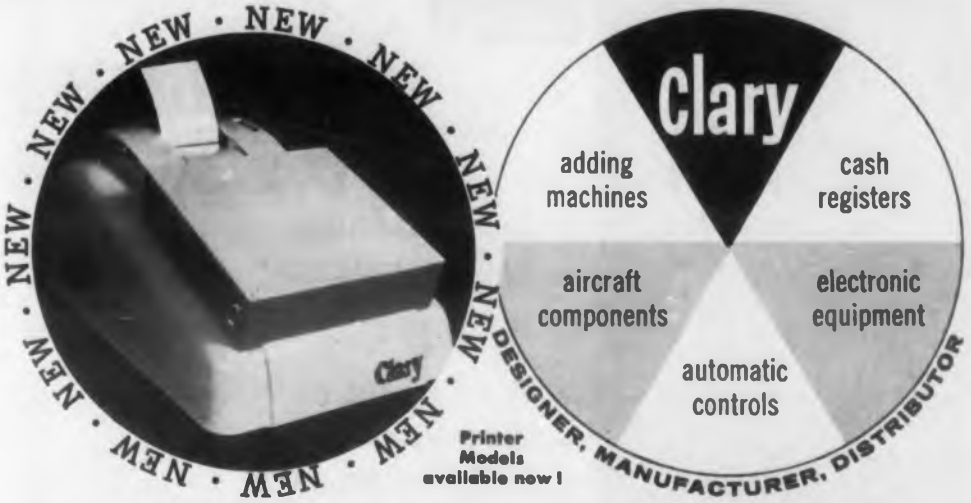

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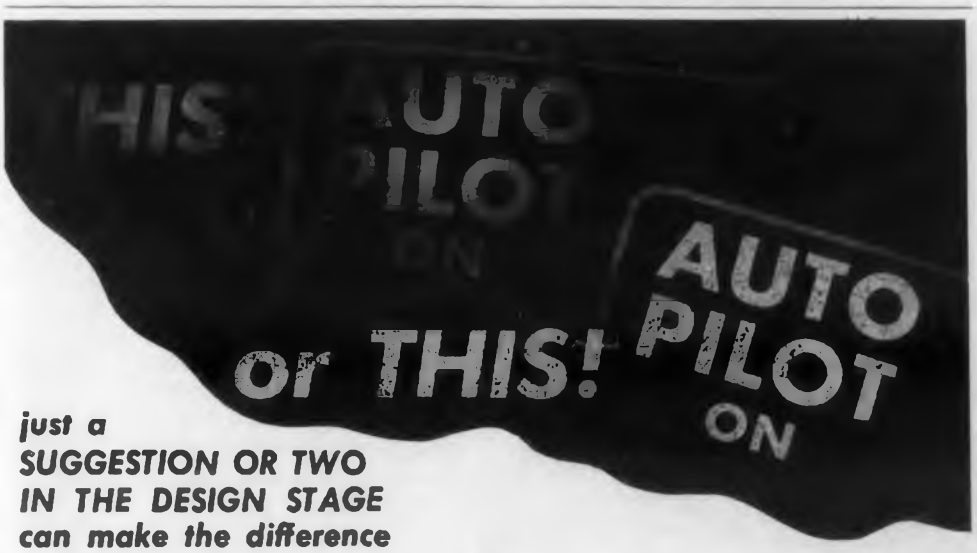

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Books . . .

Noise . . . *Aldert van der Ziel. 450 pages. Prentice-Hall, Inc., 70 Fifth Ave., New York, N. Y. $10.35.*

Designers of television, communications, radar, and measuring equipment will welcome this work. The problem of noise is becoming increasingly important in these types of equipment as their designers strive for greater sensitivity. The object of the first ten chapters is to reduce noise problems to network considerations that can be solved by standard methods. Noise in tubes at both high and low frequencies, in semiconductors, and in mixer and feedback circuits is discussed.

The noise problem from the theoretical aspect is treated in chapters 11 through 15. Chapter titles in this section are: "S "mini tistical Methods", "Fourier Analysis esider Fluctuating Quantities", "Noise in De tor Circuits", "The Laws of Vacuum T Electronics", and "Space-Charge Wave Electron Beams". Mathematics have b kept to a minimum in this section. T author follows the IRE recommendati on noise nomenclature and measurem

Servomechanism Practice . . . *Willia Ahrendt. 349 pages. McGraw-Hill B Co., Inc., 330 W. 42nd St., New York N. Y. $7.00.*

Written as a textbook, this work valuable to the electronic engineer

shes to review his knowledge of servo-echanisms after specializing in some other ld of electronic design. The theory of rvomechanisms is treated briefly, followed detailed discussions of the actual com-nents making up servo systems.

A method of designing a servomechanism treated in one chapter, followed by apters on the manufacture, maintenance, d testing of servomechanisms. A number valuable appendices are given, including "minimum phase graph". The author is esident of the Ahrendt Instrument Co.

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. *William w-Hill B ew York*

his work ngineer

Who's Who in Electronic Distribution, 955 edition . . . *Radio & Electronic ber News, Inc. 848 Leader Building, eveland 14, Ohio. $7.50.*

The problem of finding a source for a ally needed component is simplified by ference to this comprehensive listing of ousands of electronic parts distributors d manufacturers' representatives. The ok is divided into the following sections: d salesmen for each of more than 2000 nufacturers, listed alphabetically; an dex of trade names; product listing; rosters of manufacturers' representatives arranged alphabetically and by states and cities, respectively; and a wholesale distributors roster. The sturdily bound book is thumb-indexed.

Guides to Meeting Tomorrow's Production Needs . . . *Manufacturing Series No. 209, 64 pages, paper cover, American Management Association, 330 W. 42nd St., New York 36, N. Y. $1.25 ($1.00 to AMA members).*

Although written primarily for management, this volume includes a section on automation that should be of interest to designers of electronic automatic controls. Officials of several companies that are using automation in various manufacturing operations discuss their needs and problems. This section, "Automation to Date: Progress Toward the Push-Button Factory", covers the applicability of automation, automation in the chemical industry, and automatic materials handling.

The book also includes articles on cost reduction problems, production control, and methods engineering.

Advances in Electronics and Electron Physi volume VI . . . *Edited by L. Marton, 538 pa Academic Press Inc., 125 East 23rd St., New York N. Y. $11.80.*

The latest volume in this series of critical rev essays of advances in electronics has a new and ferent title from previous volumes, but it serves same worthwhile function. Contributors from United States, England, and the Netherlands h written chapters on the following: "Metallic Cond tion at High Frequencies and Low Temperatur "Relaxation Processes in Ferromagnetism"; "Physi Properties of Ferrites"; "Space Charge Limited rents"; "A Comparison of Analagous Semicondu And Gaseous Electronics Devices"; "The Elect Microscope"; "Traveling-Wave Tubes"; and fina "Paramagnetism".

This compilation is recommended to electr engineers who wish to keep track of developm in fields other than the one in which they are spec izing. The editor is associated with the Nati Bureau of Standards.

Basic Electronics . . . *Prepared by Van Valkenbu Nooger & Neville, Inc., in five volumes. 560 pa paper-bound, John F. Rider Publisher, Inc., Canal St., New York 13, N. Y. $2.00 per volume, $ for set of five volumes.*

Electronic Engineers faced with the problem training technicians to assist them in their w should be able to recommend some basic textbo These five volumes fill the bill admirably. Origin prepared for the U. S. Navy for use in Naval sch they are full of illustrations and diagrams. Writ in simple language and eschewing all mathemat derivations, they should help to build up the ne sary force of electronic technicians.

Advanced Mathematics for Engineers, third tion . . . *by H. W. Reddick and F. H. Miller. pages. John Wiley & Sons, Inc., 440 Fourth New York 16, N. Y. $6.50.*

More than other other types of engineers, design engineer must depend on mathematics as a of his trade. All the familiar mathematical meth and theorems are treated extensively in this w known textbook with problems based on actual ph cal situations. This revision has resulted in the a tion of about 20% more problems. Many of theorems are applied to more than one branch engineering, reminding us that electrical ana can often be set up for problems in heat and liq flow. Answers to all the problems are given. volume is recommended for the personal librarie all electronic design engineers and for design dep ment libraries.

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