U-H-F circuit design is simplified by this miniature ceramic tube.

RONIC ESIGN

OCTOBER 1965

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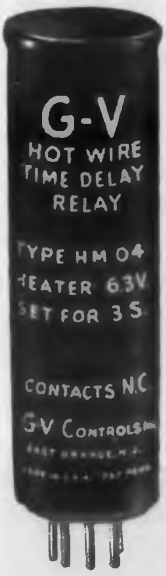

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CIRCLE 2 ON READER-SERVICE CARD FOR MORE INFORMATION

Editorial

How Do You Read?

Cultivating the skill of creative reading can pay great dividends for design engineers. This is an effective method of getting the most from published information—much more than merely the stated facts. It is the kind of reading that can give design engineers direction for their creative talents.

How is creative reading done? By applying imagination to the act of reading. Let us illustrate. On pages 64-71 there appears in this issue a chart called "Components and Building Blocks for Computers". At first glance this is merely a collection of some useful data presented in tabular form. Many readers accept it as such and file it for future reference. This is a "one-dimensional" approach to the information—accepting the facts presented and letting it go at that.

The creative reader uses the information as a stimulant for his imagination or as a springboard for the creation of new ideas. He notes the large number of companies and the wide variety of components listed. He realizes that the chart is really a map of design skills serving the computer industry.

Does the reader have any of these skills? Has his company the required know-how and facilities to make some of the products listed? Can he see the possibility of improving any of the components? Are any new devices suggested? Studying the chart with these and similar questions kept consciously in mind is what we mean by creative reading. It is the act of reading imaginatively—relating the basic information presented to one's own work as well as the present and possible future activities of one's company.

Creative reading can be applied to any article—short or long, theoretical or practical, a broad survey or a product description. Conscientiously applied to technical reading matter, it creates a host of new ideas which are the life blood of industry and the basic foundation of national security.

In these days of rapid electronic industry growth and international crisis no electronic design engineer can afford the luxury of one-dimensional noncreative reading. The stakes are too high.

Engineering Review

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

Russian Translations Praised . . . Reaction to the program of translating Russian technical articles inaugurated in the August, 1955 ELECTRONIC DESIGN (*p. 20*) has been quick and it is generous with congratulations. Our correspondence has also revealed many new sources for such translations. Typical comments from electronic design engineers are: "Electronic Design has taken a singular step . . . Let us hope that the initial interest in these, your first translations of selected articles, persists and gathers substance among our scientists and engineers."

"Your publishing of translations and summaries of Russian articles is a step in the right direction and is to be congratulated! . . ."

"I would like to congratulate you . . . This step is very important as most American engineers are quite ignorant of the stauts of Soviet electronics."

"I have just read your translations from *Radiotechnika* and find them of utmost interest."

These letters confirm our belief that American engineers want to know the status of Russian technology and that this information must continue to be made available on a regular basis. To aid American engineers, we not only intend maintaining our program of publishing Russian translations, but we are assembling a list of qualified technical Russian translators and sources of Russian translations and will publish it in a future issue.

Machine Wires Automatically . . . An experimental machine that can automatically wire electronic chassis has been developed. The "M-4" makes wrapped instead of soldered connections, as illustrated. The electromechanical device was developed by R. F. Mallina, Bell Telephone Laboratories, 463 West St., New York 14, N. Y. It has important advantages over printed circuits for small lots. If the machine is ever used on a wide scale, many components will have to be modified.

Wrapped connections, in which six turns of a single-conductor wire are tightly wrapped around a rectangular terminal, have been in use by the Western Electric Co., Kearny, N. J., for several years. Hand tools are used to make and repair them. Their service life equals that of the components they connect.

The "M-4" does not make all the connections in the chassis. It receives the chassis with all the components connected to special metal terminals with a rectangular or "V" cross-section, or any cross-section with edges. These terminals extend through holes in the plastic board. The device makes the proper wire connections between the ends of the correct terminals according to instructions received from a punched tape. It is roughly analogous to the dip-soldering step in making printed circuits.

No Wasted Wire

A spool of insulated wire is fed into the machine. A spindle removes enough insulation from the end of the wire to make a connection, then pulls the wire to the proper terminal and wraps it around in a helix motion. While the first spindle is in action, a second spindle cuts the wire to the correct length, removes some insulation, and makes the other connection. There is no wasted wire. The machine makes 10,000 connections/hr, or about twice as many as a man using hand-wrapping tools. Since the operation of the spindles is similar to that of textile machinery, the speed of the machine should be greatly increased. Textile machinery works much faster than 10,000 connections/hr.

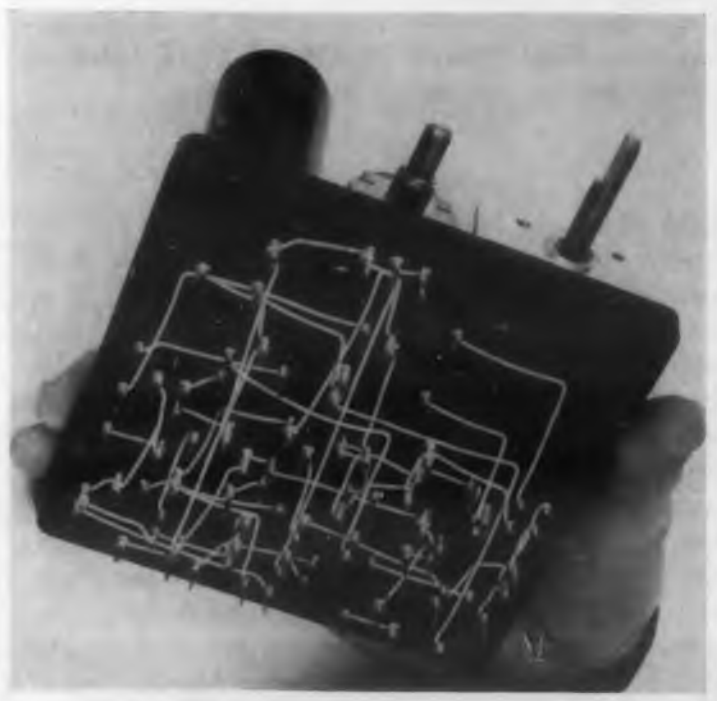
The "M-4" would actually be used with two other machines: a device for attaching the terminals to the components, and a machine for mounting the prepared components in the holes in the plastic board. If the leads on components were furnished with an edged instead of round cross-section, then the first machine could be dispensed with for most components. Components such as electrolytic capacitors and relays could easily be made with the edged terminals, and in this form could also be used with printed circuits. The edged terminals would help to hold the components in the holes in the printed circuit board during production. Mr. Mallina hopes that most components used with his machine can also be used for printed circuits or conventional soldering. Special tube sockets will have to be designed for use with the "M-4", just as new sockets were designed for insertion in printed circuit boards.

The automatic wrapping system would have economic advantages over printed circuitry for small lots, although special effects comparable to printed inductors and capacitors can not, of course, be achieved. Skilled technicians are not required to prepare the instruction tape, in distinction to the trained draftsman needed to prepare the drawings for printed circuit boards.

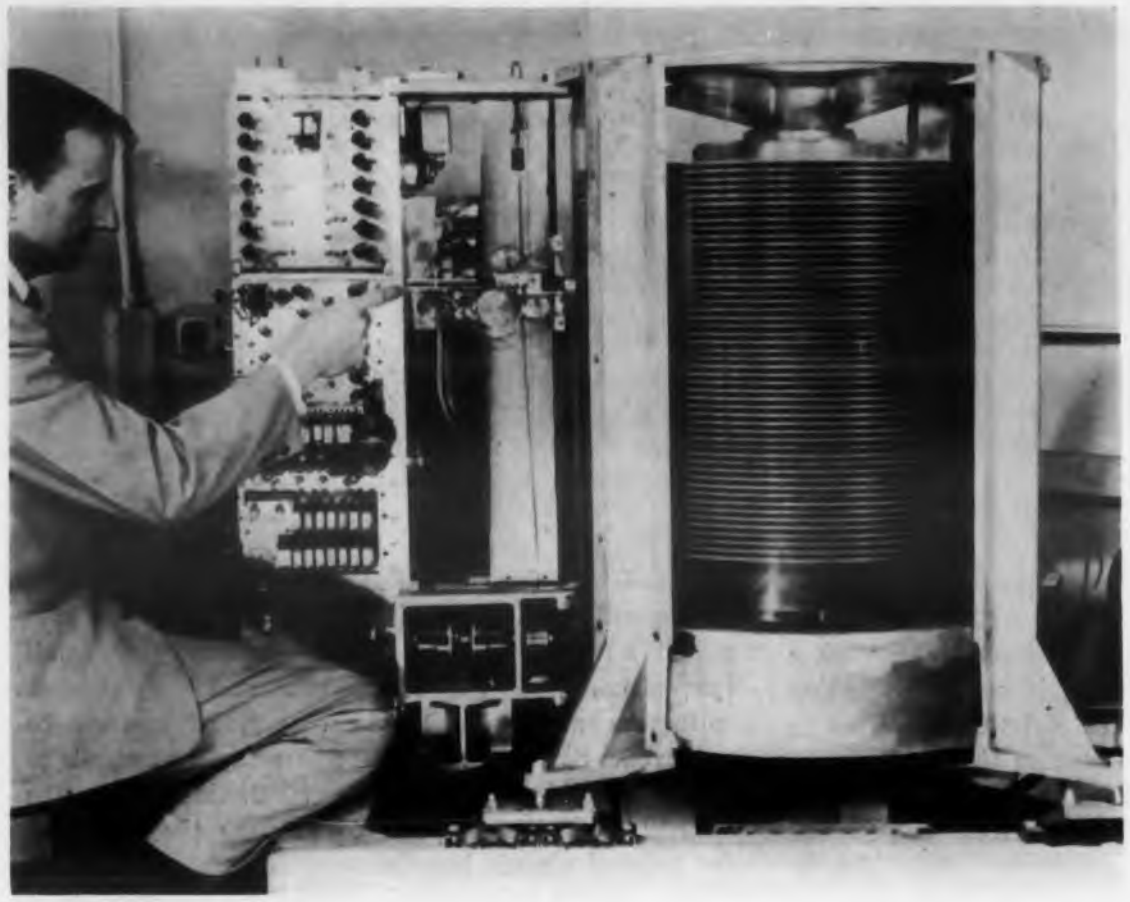
The tape is prepared by punching buttons on a push-button board that simulates the plastic board. One tape can operate up to 10 machines, and the tapes are readily duplicated in a copying machine.

Another advantage of the device over printed circuits is three-dimensional wiring. Up to 10 connections can be made to each of adjacent terminals.

The "M-4" has been licensed for production by the Clevite-Brush Development Co., Cleveland 8, Ohio.



The components are attached to terminals that stick through holes in this plastic board. The connections were wrapped to the terminals by the machine.



This engineer is pointing to the reading and writing arm of this stacked-magnetic-disc memory. The experimental type 305 unit can store 5,000,000 characters.

More Info on "Palace of Progress" . . . Since our first announcement last month on the huge electronic installations planned for the Palace of Progress (ELECTRONIC DESIGN, *Sept. 1955, p 5*), we have received additional technical details. The "Teleprint" system of long-distance TV transmission via magnetic tape and radio broadcasting is under development by Radio Corp. of America, New York, N. Y.

The "remotemobile" will transmit its TV images to the building's main studios via antennas mounted in the ceilings of main rooms, and not by plugging into co-ax cables buried in the walls, as was originally surmised. This arrangement means even greater mobility for the compact TV studio which will move about the building affording spot news coverage. It will carry batteries to supply power to its electronic TV monitoring and transmitting equipment.

High Capacity Memory . . . An experimental random-access memory with a capacity of 5,000,000 characters has been developed. Information is stored as magnetized spots on the illustrated stack of magnetic discs. The units can be combined to constitute a memory of vast capacity for the largest businesses.

The memory, known as the type 305, was developed at the Advanced Engineering Laboratory, San Jose, Calif., of the International Business Machines Corp. A random-access memory process each bit of information on arrival instead of waiting for a batch of information to accumulate for processing.

ECDA Meets in San Francisco . . . At the Summer Meeting of the Electronic Commercial Development Association in San Francisco during the recent Wescon Show, Richard T. Silberman, president and general manager of Kay Lab, San Diego, Calif., discussed the problems involved in cutting down the reliance of his firm on government developmental projects. By following a program of developing new commercial products, notably closed-circuit TV, the firm has reduced the percentage of income from military contracts in its business volume from the greatest portion to less than 50% of dollar volume.

The association is made up of a group of executives of the industry whose function is the development of new commercial products. For further information on coming meetings and other activities of the organization, write to James S. Mulholland, Jr., Secretary, ECDA, 19 East 62d St., New York 21, N.Y.

The back seat of this Cadillac "show car" is equipped with a telephone, TV, and tape recorder. If TV sets ever become a standard auto accessory, transistors would be necessary to lower the amount of heat produced. Including its radio and electronic headlight dimmer, this car must have as many tubes as the average home.

Solar-Power Motor . . . A solar-powered 5-to-10hp engine will be displayed at the Solar Engineering Exhibit in Phoenix, Arizona from October 29 to November 13. In addition, many other devices powered by the sun's rays such as water heaters, stoves, water distilleries, and furnaces will be shown. The exhibit is being held in conjunction with the first World Symposium on Applied Solar Energy.

The solar engine incorporates a flat-plate collector that uses the sun's rays to evaporate sulphur dioxide, which then operates a vapor engine. The gas is condensed by a water cooled condenser and is returned to the collector and a continuous cycle. It was manufactured by the Somor Co., Leeco, Italy.

Another foreign device is a solar water-heating collector and steam generator made by the Meromit, Ashkolon Metal Works, Tel Aviv, Israel. These machines are of particular interest to electronic design engineers because they indicate that sufficient sun power can be converted by compact devices to operate electronic equipment.

Electronic Robot Controls for Reactor . . . A robot system that will electronically control the operation of a nuclear reactor is being constructed for peacetime research. The system will regulate such critical phases of the reactor's operation as "start-up" and the control and maintenance of power (or rate of atom splitting).

The controls are being constructed by Industrial Div., Minneapolis-Honeywell Regulator Co., Philadelphia, Pa., under contract to American Machine and Foundry Co. The reactor is being built by Battelle Memorial Institute, Columbus, Ohio. It is designed to operate at 1000kw on Uranium-235.

Lightweight Gyro Compass . . . Weighing only 22 lb, a newly developed North-seeking gyro compass fills an important need in helicopters, aircraft, and tanks. When released commercially in about a year, it could be utilized by fishing boats, yachts, and for surveying and geographical exploration. It will cost in the neighborhood of $6-7000.

Developed by Arma, Garden City, L. I., N. Y., the Subminiature Gyro Compass has the accuracy of the huge shipboard gyro compasses from which it was evolved. It is about twice as heavy as present magnetic-North-indicating gyro compasses.

One of the features that contributes to the small size of the unit is the elimination of all gyro gimbal bearings and their attendant friction. A fluid suspension system is employed. In addition, transistors are employed in the servo amplifiers. Texas Instruments transistors are employed for amplification and Minneapolis-Honeywell types for power output.

The unit has an accuracy of 1/4° and a drift rate performance of 0.1°/hr. It is made in a heavier 30-lb version for installation in tanks.

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1 KVA

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- ☆ NO MOVING PARTS
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- •Power Factor Range: 0.5 lagging to 0.9 leading
- •Response Time: 0.2 sec.
- •Maximum Load: 1.0 KVA
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- •Dimensions: 19½" wide x 11" high x 11½" deep (cabinet) 19" wide x 10½" high x 11½" deep (rack panel)
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- •Finish: Gray Hammertone
- •Weight: 85 lbs.

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CLE 4 ON READER-SERVICE CARD FOR MORE INFORMATION

High-Density Tape Recording . . . A method of high-density recording on magnetic tape has been developed at the National Bureau of Standards, Washington 25, D. C. In a series of experiments performed by J. R. Sorrells both continuous-current and pulse techniques were investigated to achieve densities in the range of 500 to 700 pulses per inch. Recording and reading circuitry was also developed to provide large-amplitude playback signals with error-free differentiation between binary "ones" and "zeroes".

One variation of the non-return-to-zero (NRZ) system of tape recording was selected for the present investigation. In this system current sufficient to saturate the tape is maintained in the recording head at all times, but the polarity is changed each time a binary "one" is to be recorded.

In this system, the recording rate and the exact location of each recorded digit is determined by timing pulses derived from a "sprocket" channel prepared in advance of the recording operation. The word length can be chosen arbitrarily, depending on the equipment with which the storage system is to be used.

This development is part of a drive throughout the computer industry to develop methods of reading information into and out of the computer at speeds approaching that of the calculations.

Missile Velocity Digitized . . . In order to study the velocity characteristics of various missiles by means of a high-speed digital computer, a device has been developed to place Doppler radar data on magnetic tape in digital form. Known as the Doppler Data Translator, Model 3154, it was developed for the Ballistic Research Laboratories, Aberdeen Proving Grounds, Md., by Potter Instrument Co., 115 Cutter Mill Road, Grtat Neck, L. I., N. Y. It accepts Doppler radar data and associated interpolation and time code signals from a cyclical data magnetic tape and codes this information onto a digital data magnetic tape.

Battery Design Eliminates Hand Labor . . . One of the principal requirements for placing a product on an automatic manufacturing basis, redesign for ease of machine handling, has been achieved for the common dry battery. By substituting a conductive silver wax for welded or soldered connections, the battery is easily made by machine by stacking a group of "wafer" cells. At the same time, the new battery has a 30% increase in power output and life.

The redesign was accomplished by Burgess Battery Co., Freeport, Ill. The individual cells consist of a sandwich of artificial dioxide mix between discs of flat zinc and carbon electrodes. The conventional carbon rod has been replaced by a small piece of conductive carbon. The sandwich is machine wrapped

in an airtight pliofilm envelope and heat sealed. A small amount of the conductive wax is placed on the positive and negative sides of the cell and the cells are then stacked. The entire stack is wrapped in Mylar. Because the wrapping materials are so thin, a maximum amount of the battery space is occupied by energy producing materials. Raw materials are fed directly into the machine that produces the wafers.

Self-Service Tube Tester . . . The self-service tube tester shown on this page may cut vacuum tube sales by servicemen but could lead to greater over-all tube sales. The device, with a stock of replacement tubes, is available for installation in drug stores, filling stations, and groceries throughout the nation. Store owners receive a percentage of the tube sales.

Operating like conventional tube testers, the unit gives a dial indication of tube merit. The indication is matched against a figure on a chart of values for all common receiving tubes. If the tube is defective, the customer then removes a replacement from a stock of 300 tubes contained in the cabinet and pays the store owner. The unit is serviced and inventory is maintained by local distributors. The tester is made by U-Test-M Manufacturing Co., 4325 West Lincoln Ave., Milwaukee, Wis.

Although widespread installation of this free tester would obviously cut into tube sales and service charges by the regular service dealers, over-all tube sales may increase. Many consumers who are reluctant to have their defective radios or TV receivers serviced because they fear the charges will be high, will not hesitate to test their own tubes on this unit. To compensate, servicemen can expect to be called in to service equipment in which tubes have been inserted in the wrong socket.

If these testers are successful, trend towards making more components of the plug-in variety in consumer equipment may develop. Eventually the testers themselves may have transistor testing features added.

Remote TV Control
A separate speaker is included in this remote control for TV receivers. The viewer can listen in at night with the regular speaker turned off and not disturb others. The unit is a product of Sentinel Radio Corp., Evanston, Ill., and retails for $50.

Civilian TACAN . . . The TACAN system of air navigation has been declassified by the Armed Forces and will be made available for installation in commerical and private aircraft. Combining direction-indicating and distance-measuring functions in one device, the radar equipment could replace the present VOR direction indicators and separate distance-measuring equipment now in wide-spread use. The new equipment is about ten times as accurate as VOR in the military version and would be about three times as aceurate as VOR in the proposed model for private planes. Commercial airlines would undoubtedly use some adaptation of the military model.

The system was developed by Federal Telecommunications Laboratories, Nutley, N. J., after World War II for use by the Air Force and on aircraft carriers. The equipment has a range of about 200 miles. Both civilian and military models could use the same ground stations. Since the Air Force has not as yet constructed the necessary network of ground stations, the government would have to authorize such a network before there is any point in producing and installing non-military airborne TACON. Since each ground station will cost about $50,000, the nation-wide network involved an expenditure in the tens of millions of dollars. Each ground station can handle over a thousand aircraft at the same time. The system is now being evaluated by the Civilian Aeronautics Administration.

In operation, the pilot reads his direction from and bearing to a TACAN ground station on two panel dials, respectively. The military model is accurate to 0.2 mile and 1° of bearing. The device operates on radar principles. It queries a ground station by means of a pulse train. That pulse triggers a pulse train from the ground station much as ground radar triggers a transponder in a plane. The airborne unit

then interprets the pulses received from the ground station into bearing distance information.

The distance measuring aspect of TACAN operates in the same manner as present airborne distance measuring devices. The directional feature is similar to present v-h-f omnirange in principle except that the receiver interprets amplitude-modulated pulse trains instead of cw. The pulses are modulated by rotating a parasitic array around a central antenna on the ground.

If a network of TACAN ground stations ever covers the United States, presently available airborne computers could use TACAN signals to fly planes on a specified course by-passing the ground stations. The TACAN system is also being investigated by various foreign governments and NATO officials.

In the civilian version, the pilot does not receive an automatic direction indication. He must manipulate a knob until a null indication is obtained, then read his bearing to the ground station from the dial. By eliminating the automatic direction feature plus other changes, the civilian unit has less than half as many tubes as the 84-tube military model. The manufacturer hopes to sell the private-plane version for less than $2500 and the commercial version for about $5000.

In addition to offering greater accuracy, TACAN suffers fewer side effects from the proximity of buildings to the TACAN ground antenna.

Black Market in Selenium . . . A black market in selenium has developed, according to the *Wall Street Journal*. Prices run as high as $40 per pound, although the open market price is $13.50. In 1947 the price was $1.75. A by-product of copper mining, the shortage of the metal was accentuated by the recent strike in the copper mines.

In addition to its uses in rectifiers, selenium is used to make paint, hair tonic, stainless steel, and acts as a catalyst in making cortisone. The development of silicon rectifiers may help relieve the shortage of selenium in the United States.

Dummy Auto Antenna . . . Dummy antennas for auto owners who can not afford radios for their cars have now been placed on the market. Snyder Mfg. Co., Philadelphia, Pa., developed the phony antenna after a survey by their field men revealed that 12.1% of cars with antennas did not have radios. The same survey showed that 7.3% of homes with TV antennas did not have receivers.

We suggest that the Snyder organization would do well to develop a phony TV receiver cabinet for the homes with phony TV antennas. Then if neighbors drop in the home owner can always claim that it is impolite to watch TV when company calls. The cabinet can be used to store liquor—especially in dry states.

Converted Typewriter

By adding the solenoids contained in the black base, this standard Underwood electric typewriter has been converted into a digital read-out device for business computers. The unit, which sells for $1200, was developed by Fischer & Porter Co., Hatboro, Pa. It can be serviced by regular typewriter servicemen instead of specially trained personnel.

Plastic Replaces Metal . . . The cover for a new telephone unit will be made of reinforced polyester instead of metal. The change affords greater strength with half the weight plus easier assembly and installation costs and lower noise level.

The cover is being made for Western Electric Co., Kearney, N. J., by Winner Mfg. Co., using Paraplex P-49, a polyester resin made by Rohm and Hass Co., Philadelphia, Pa.

New Closed-Circuit TV Uses . . . The first airline use of closed-circuit TV is reported at the Portland, Ore., Airport where United Air Lines is testing TV as a means of disseminating flight information. A TV camera is focused on a large panel in the airline's dispatch office where flight arrival and departure times are posted. Pictures of the information are transmitted to four receivers in the terminal building. The equipment was constructed by Kay Lab, San Diego, Calif.

At the White Barn Theatre, Westport, Conn., a closed-circuit TV system is used to handle overflow audiences and synchronize sound effects. Because of the limited seating of the theatre, those who cannot be seated in the auditorium sit outside on the terrace. A TV camera is trained on the stage and connected to a projector outside on the terrace. Simultaneously the same TV camera relays every moment of the stage performance to a receiver in the sound effects room located below the stage. By watching the monitor, the sound effects man can provide the appropriate sound effects with exactness. The TV system was developed by General Precision Laboratory, Inc., Pleasantville, N. Y.

Electronics in Aviation . . . Heavy investments in electronic equipment are continuing to be made by the commercial airlines. Braniff International Airways, Love Field, Dallas, Texas has joined the growing list of airlines (and railroads) that will use electronic reservation systems developed to Teleregister Corp., Stamford, Conn.

Swissair is installing C-band weather radar in its four new DC-7C airliners. The equipment developed by Radio Corp. of America, New York, N. Y., can detect storms 150 miles away.

United Air Lines, Chicago, Ill., will have selective calling equipment installed on its fleet of planes. The gear, made by Motorola, Inc., Chicago, Ill., should aid in reporting weather conditions to individual pilots.

Phonograph in Cars . . . We have received a report that one line of 1956 automobiles will feature a "high-fidelity" phonograph as optional equipment. Setting aside the question of the need for phonographs in cars, we doubt that high fidelity is required in this phonograph. Can the listener tell the difference between good reproduction and high fidelity against a background of car, air-conditioner, and road noise? Actually we doubt that this phonograph is of highest quality in view of the tendancy today to call any equipment that sounds better than a pocket portable a "hi-fi" set.

Nations Rated in Atomic Research . . . American nuclear research equipment is on a par with that of other countries, according to a report on the technical progress of the participants at the recent "Atoms-for-Peace" conference by Athel Denham of Denham & Co., Detriot, Mich.

According to Mr. Denham, Russia is much farther ahead in nuclear research and knowledge of nuclear physics than in practical applications. England showed a definite commercial outlook with instruments being designed for easy serviceability and replacement of components. The United States commercial exhibit showed that American equipment is on a par with the best produced in other countries. France had the largest number of individual exhibits, but quality was below that of the United States, Great Britain, and even Belgium. The Swiss seem to have developed excellent instruments requiring clockwork types of mechanisms. Holland has been doing a surprising amount of nuclear research, especially in its universities. West German developments appear to still be in their infancy, and Canada is doing an outstanding job in medical research.

The conference showed that development of nuclear power plants will probably come most rapidly in those countries short of fuel, like England, unless there is a form of government subsidy and that industrial uses of by-products of nuclear reactions, like isotopes, are far ahead of development of nuclear reactors themselves, understandable in view of cost.

Radiation Effects on Insulation . . . As the need for electronic devices in the atomic industry rises, electronic design engineers will have to know what effects radiation has on various components according to a paper read at the recent Fall General Meeting of the AIEE in Chicago. Some electrical insulation is affected adversely, some is benefited, and some shows little affect from radiation in the vicinity of nuclear reactors. The paper "The Effects of High Energy Gamma Radiation on Dielectric Solids" was read by P. H. Klein and Clifford Manell, General Electric Co., Schenectady, N. Y.

The following affects of radiation on insulation were noted: For dosages of radiation up to 10^8r, polyethelene tape and Formex wire enamel undergo noticeable decreases in their resistance to short time voltage breakdown. Cellulose acetate shows little change under the same conditions. Polyvinal cloride shows some distinctly favorable alterations after radiation. When levels of radiation exposure up to 10^{10}r are to be expected, mica-and-glass tape impregnated with silicon resin has been demonstrated to be virtually unaffected or slightly improved. Power factor has not been found to be a particularly sensitive index to radiation induced changes. The hardness of most organic resins increased with radiation.

Counterfeit Money Detected Electronically? . . . Inspired by a visit to Great Britain, a reader has proposed an electronic method of detecting counterfeit money. In the United Kingdom all large-denomination bills have a single gold thread running through them to make counterfeiting difficult. This engineer has proposed that one corner of all large American bills be made faintly radioactive. Each bank teller would then be equipped with a scintillation counter. If a large bill does not produce an indication, it would be minutely examined for authenticity.

Since sources of radioactive material could be carefully controlled by the Government, there is little chance of any counterfeiters being able to acquire or operate one. Acceptance of this proposal by the Treasury Department would greatly stimulate sales of radiation-detecting apparatus. Any organization handling large amounts of money would be a potential customer. The only drawback to this system is that people who carry great numbers of large bills in their pockets, such as bookies, are risking sterilization. Of course, engineers will not have to worry about that problem.

Period Misplaced

A period was inadvertently misplaced in the August, 1955, issue of ELECTRONIC DESIGN. In an article on Airborne Instruments Laboratory's "Operational Amplifier" (*pp 28* and *29*) one sentence read: "Output drift with a 0.5μfd storage capacitor is ±0.1v per 150sec." Actually this capacitor is a 0.05μfd unit.

Coffee Made Electronically . . . Large restaurants will welcome a new electronically controlled coffee maker. Once the start button is pushed, the machine automatically brews coffee and keeps adding water to replace that which is drawn off. Coffee already brewed is maintained within five degrees of the proper temperature.

The unit was developed by Best Products Co., 2618 West Addison, Chicago 18, Ill. Up till now only a few electronic aids such as the "Radarange" and intercommunication equipment have been used in the operation of large kitchens. The great need is for an electronic waiter who doesn't forget orders and does not expect a tip.

Bulletin Board

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

Flash Tube: Capable of dissipating 4watt-seconds of energy per flash when flashed at any pulse rate up to 10pps rate. Flash tube must be flashed with ignition coil. Flash duration must not exceed 150microsec when used in proper circuit to dissipate the required energy. The lamp must be capable of being flashed continuously for periods up to 20min. It is used in such a manner that each light flash must be approximately the same intensity. The environmental and space conditions under which this flash tube will be operated make cooling a problem. *Write to:* P. G. Shupe, Project Engineer, Timing and Firing Engineering, RCA Service Co., Inc., Missile Test Project, Patrick Air Force Base, Fla.

Terminology Needed: The Army Ordnance Corps requests all engineers to help suggest proper engineering terminology and nomenclature to be incorporated in a comprehensive "Ordnance Engineering Design Handbook" now under preparation. By establishing a uniform and widely accepted terminology, the editors hope to simplify the task of ordnance designers. They are interested in formal or informal collections of terminologies and glossaries. *Write to:* Alan Kent, Associate Director, Center for Documentation and Communication Research, School of Library Science, Western Reserve University, Cleveland 6, Ohio.

Lenses Evaluated Electronically . . . An experimental electronic instrument that for the first time will enable optical scientists to evaluate and grade the performance quality of lenses in objective mathematical terms has been developed. The electronic lens tester resulted from initial research conducted by Otto H. Schade of the Radio Corp. of America, New York, N. Y. When placed in production, the device will enable users to select lenses by specific grades and with known characteristics for given applications.

Getting on the Bandwagon . . . The "most important economic fact" in modern America according to the President of Bendix Aviation Corp., is the "mass conversion of doubting Thomases throughout industry into believers in the practical value of electronics in their operations, large and small." Malcolm P. Ferguson made these remarks in a speech at the annual meeting of the National Petroleum Association.

Rare Metals Needed . . . Various atomic energy and reactor projects in the nation are requiring the Atomic Energy Commission to stimulate the production of high-purity zirconium and hafnium. The AEC will contract for 2,000,000lb of zirconium and 1,200 000lb of hafnium over a five year period.

Precision Measuring Device . . . An extremely accurate measuring device capable of direct linear measurements to within one-millionth of an inch has been developed. Link Aviation, Inc., Binghampton, N. Y., calls the unit the Fringecount Micrometer. It uses a wave length of light as a basis of measurement.

The device consists of three separate units—the measuring head, a control box, and a bi-directional digital counter. The unit may be used for measuring gage blocks, plug gages, ball and roller bearings, and precision instrument parts.

New Corrosion-Resistant Alloy . . . A new zirconium alloy that resists the very corrosive action of high-temperature, high-pressure water in nuclear reactors has been developed. In a year's time, only 1/10,000″ of corrosion can be measured.

Known as "Zircaloy-2", the alloy was compounded at Westinghouse Electronic Corp., Pittsburgh, Pa. It contains 1.5% tin, 0.12% iron, 0.1% chromium, and 0.05% nickel.

Students Work in Industry . . . Rensselaer Polytechnic Institute and Raytheon Manufacturing Co., Waltham, Mass., have announced the start of a co-operative plan in which electrical engineering students at the Institute receive practical training and experience in the company's laboratories and factories. A similar arrangement exists between the firm and several other universities.

Medal Given for Paper . . . Dr. D. A. Huffman, assistant professor of electrical engineering, Massachusetts Institute of Technology, has been named recipient of the Louis E. Levy Medal of the Franklin Institute in recognition of his outstanding paper, "The Synthesis of Sequential Switching Circuits". Presenting the results of investigations, Dr. Huffman's paper dealt with the problem of developing an orderly procedure for designing computing, control, or switching networks whose outputs are functions of past and present states of inputs. The paper was published in the March and April, '54 issues of *Journal of The Franklin Institute.*

Automatic Iris for TV . . . An automatic iris that compensates for changing light levels has been developed for use on industrial closed-circuit TV cameras. The mechanism automatically masks the lens with the proper filter for any given external light condition. The device was designed by Radio Corp. of America, Camden, N. J.

CIRCLE 13 ON READER-SERVICE CARD ➤

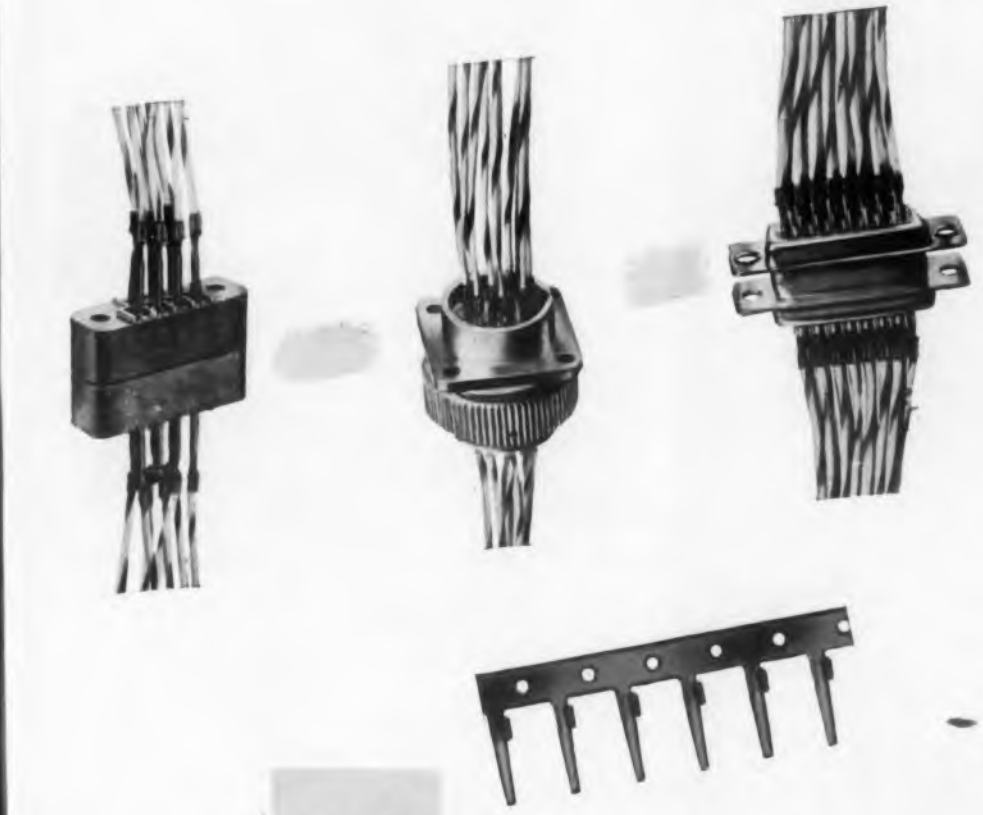
$1000 Reward . . . A $1000 reward is being offered by Sylvania Electric Products, Inc., New York, N. Y., for information leading to the arrest and conviction of any individual or company fraudently branding radio and TV receiving tubes with the firm's name. The firm reports that there are reprocessors who can make the inside electrical element of tubes appear new. By subjecting the tubes cathode to a heating process called "toasting," an old tube can be restored temporarily to usefulness. The burn mark that appears on the inside of a used tubes glass envelope is eliminated by applying a blow torch flame to the outside of the envelope. After washing and polishing and rebranding on the outside surfaces, the tube appears to be new. One sure answer to the menace of counterfeit tubes would be a federal law requiring service men to destroy all defective tubes after removal, as suggested recently. (*ED July 1955, p. 13*).

Growth of X-Ray Analysis . . . During each subsequent 5-year period since 1930, the number of X-ray analysis installations has at least doubled. This information was obtained from questionnaires submitted in a nation-wide survey sponsored by the Educational Dept., North American Philips Co. Inc., 750 S. Fulton Ave., Mount Vernon, N. Y. Only 1.2% of the installations on the 1955 tally existed prior to 1930, 4.8% prior to 1935, 8.5% prior to 1940, 21.9% prior to 1945, and 42.6% prior to 1950.

It is interesting to note that the sixtieth anniversary of the discovery of X-rays by Conrad Roentgen will be commemorated Nov. 8, 1955.

Cabinet Part of Antenna . . . Faced with the old problem of overcoming the shielding action of metal TV cabinets on built-in antennas, one firm's electronic engineers solved the dilemma by making the cabinet part of the antenna system. As developed by engineers of the General Electric Co., Syracuse, N. Y., the antenna system offers superior performance without introducing any radiation problems.

IRE Medal Winners . . . John V. L. Hogan, president of Hogan Laboratories, New York, N. Y., and founder of station WQXR, has been named recipient of the IRE Medal of Honor. The Morris Liebmann Memorial Prize was awarded to Kenneth Bullington, Bell Telephone Laboratories, New York, N. Y. Wilbur S. Hinman, Jr., director of the Diamond Ordnance Fuze Laboratories, Washington, D. C., received the Harry Diamond Memorial Award.



A-MP's new Miniature Taper Pins, shown here actual size, provide the same uniformly reliable wire connections for your miniature components, as the larger, widely used and accepted A-MP Taper Pins. Miniature Taper Pins are applied to wire with A-MP Automatic Machines at speeds up to 4000 per hour. They are then inserted into components quickly and easily with A-MP CERTI-LOK Insertion Tools. Miniature Taper Pins are available for wire sizes #26 to #20.

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CIRCLE 14 ON READER-SERVICE CARD FOR MORE INFORMATION

Big Market for TV . . . There are still about 15 million families in the United States who have not bought their first TV receiver, J. D. Secrest, executive vice-president of RETMA, reported recently. Even among families equipped with TV, he added, there is a growing market for replacement of sets that are antique by present standards. At least 10% of these families have sets of a screen size for which there is no current demand and 30% have sets that only one out of ten new purchasers are willing to buy. This suggests that good promotion techniques could resell 12 to 15 million of the present set owners.

Railroad Safety Device . . . An ultrasonic journal test car which facilitates the detection and replacement of defective freight car axles has been demonstrated. The ultrasonic test car, developed jointly by Sperry Rail Service, Danbury, Conn., and the Chesapeake & Ohio Railway Co., as a railroad safety device, is capable of inspecting as many as 320 freight car journals a day.

The device comprises a midget automobile mounting a Reflectoscope and equipped with a generator. Driven between tracks in railroad yards, it enables the operator to apply an ultrasonic transducer to the journals under each freight car.

Battery Saving Circuit . . . A battery saving circuit that automatically reduces drain as volume is lowered has been incorporated in a new transistor radio. At medium volume the set will operate intermittantly for about 100hr. At reduced volume, the circuit will stretch battery life to about 200hr.

The five-transistor set, made by General Electric Co., Syracuse, N. Y., will retail for about $50. The radio has both a loudspeaker and a jack into which a hearing-aid type earphone may be plugged. Printed circuits are used.

Color TV Changes Package Color . . . The electronic art has forced many changes in our ways of living. Now we can learn than one cigarette manufacturer is adding color to his cigarette packages so that they will have greater appeal to color TV audiences. If only a few thousand color TV receivers can produce this change, imagine the changed appearance of America when the majority of sets can receive color. We predict that there will be a decline of the charcoal-grey suit and a shortage of announcers with red hair.

Meetings

Oct. 17-19: *1955 Radio Fall Meeting,* Hotel Syracuse, Syracuse, N. Y. Sponsored by the Engineering Dept. of RETMA and the Professional Groups Committee of the IRE. Sessions have been planned on reliability and quality control, transistorization, TV, and electron devices. For information, write to RETMA, 777 14th St., N. W., Washington 5, D. C.

Oct. 17-19: *Conference on Electrical Insulation,* Pocono Manor Inn, Pocono Manor, Pa. Sponsored by the National Research Council. The program will include technical papers on dielectrics, and round table discussions on such topics as deterioration of dielectrics, high temperature dielectric materials, high dielectric constant ceramics, and dielectric measurement techniques. For information, write to R. G. Breckenridge, Chairman, Conference on Electrical Insulation, National Research Council, 2101 Constitution Ave., Washington 25, D. C.

Oct. 19: *Fall Meeting, Society of Tecnical Writers and Editors,* New York Academy of Sciences, New York, N. Y. Program is a panel discussion, "How to Interview". For information, write to Helen Cressman, Corresponding Secretary, Society of Technical Writers and Editors, Columbia Research Laboratories, 632 W. 125th St., New York, N. Y.

Oct. 20-22: *Eighth Gaseous Electronics Conference,* General Electric Research Laboratory, Knolls, Schenectady, N Y. Co-sponsored by the Division of Electron Physics of the American Physical Society and the General Electric Research Laboratory. The program will consist of invited and contributed papers pertaining to the fundamental physics of gas discharge phenomena. For information, write to J. D. Cobine, General Electric Research Laboratory, The Knolls, Schenectady, N. Y.

Oct. 20-Nov. 3: *International Atomic Energy Exhibit,* Carnegie Endowment International Center, New York, N. Y. Sponsored by the Atomic Industrial Forum, the Fund for Peaceful Atomic Development, and the Carnegie Endowment for International Peace. The exhibit will be entitled "Man, the Atom, and the Future" and will stress the use of atomic energy for the advancement of human welfare. For information, write to Atomic Industrial Forum, Inc., 260 Madison Ave., New York 16, N. Y.

Oct. 24-25: *First Annual Technical Meeting of the Professional Group on Electron Devices*

of the IRE, Shoreham Hotel, Washington, D. C. Developments and applications of electron tubes and transistors in radio, TV, business machines, and military equipment will be discussed. For information, write to IRE, 1 E. 79th St., New York, N. Y.

Oct. 24-25: *Conference on Computer Applications*, Illinois Institute of Technology, Chicago, Ill. Sponsored by Armour Research Foundation of Illinois Institute of Technology. The first session will be devoted to discussions of business applications of digital computers and the second session will feature talks on engineering and scientific applications of computers. For information, write to Armour Research Foundation, Illinois Institute of Technology, Chicago, Ill.

Oct. 24-26: *Sixth National Conference on Standards*, Sheraton Park Hotel, Washington, D. C. Sponsored jointly by the American Standards Association and the National Bureau of Standards. Co-ordination of Government and industry requirements for manufactured products will be discussed. A series of exhibits will show how standardization programs may be coordinated. For information, write to the American Standards Association, 70 E. 45th St., New York 17, N. Y.

Oct. 31-Nov. 1: *1955 East Coast Conference on Aeronautical and Navigational Electronics*, Lord Baltimore Hotel, Baltimore, Md. Sponsored by the Baltimore Section of the IRE and the IRE Professional Group on Aeronautical and Navigational Electronics. For information, write to IRE, 1 E. 79th St., New York 21, N. Y.

Nov. 1-5: *World Symposium on Applied Solar Energy*, Westward Ho Hotel, Phoenix, Ariz. Sponsored by the Association for Applied Solar Energy, Stanford Research Institute, and the University of Arizona. Conversion techniques and applications of solar energy will be discussed. An exhibit is planned. For information, write to W. C. Estler, Stanford Research Institute, Stanford, Calif.

Nov. 2-4: *Classified Symposium on Guided Missile Reliability*, Wright Air Development Center, Wright-Patterson Air Force Base, Ohio. Topics to be covered include problems in establishing and implementing missile reliability programs; responsibilities for reliability during development and production; establishing requirements for predicting and measuring the reliability of systems and components. For information, contact R. L. Dingle, Directorate of Weapon Systems Operations, Wright Air Development Center, Wright-Patterson Air Force Base, Ohio.

Nov. 3-4: *Eighth Annual Electronics Conference,* Town House, Kansas City, Kans. Sponsored by the Kansas City Section of the IRE. The conference will discuss components, microwave, automation, and audio. For information, write to IRE, P. O. Box 391, Kansas City, Mo.

Nov. 7-9: *Eastern Joint Computer Conference and Exhibition,* Hotel Statler, Boston, Mass. Sponsored by the AIEE, IRE, and the Association for Computing Machinery. Theme of the conference is "Computers in Business and Industrial Systems". Papers will be presented covering the role of computers in business, trends in system design, and communication and compatability among electronic computers in business and industrial use. Exhibits will include data processing systems, process control systems, input-output equipment, conversion devices, sensing devices, and storage devices. For information, write to AIEE, 33 W. 39th St., New York, N. Y.

Nov. 10-11: *Electronic Business Systems Conference,* Statler Hotel, Los Angeles, Calif. Sponsored by the Western Region of the National Machine Accountants Association. The conference will emphasize the application of electronic data processing to business. Exhibits will show electronic equipment for business use and machines for high-speed record keeping and processing. For information, write to Electronic Business Systems Conference, P. O. Box 221, South Gate, Calif.

Nov. 14-15: *Symposium on Communication by Scatter Techniques,* Lisner Hall, George Washington University, Washington, D. C. Jointly sponsored by the IRE Professional Groups on Antennas and Propagation and Communications Systems and George Washington University. The technical program will include four sessions. The first session will be devoted to propagation mechanisms with authorities on auroral, tropospheric, ionospheric, and meteoric ionization propagation discussing the mechanics of each of the methods. The other sessions will include practical and descriptive discussions on communication systems, antennas, and propagation studies. For information, write to C. Goatley, Melpar Inc., 3000 Arlington Blvd., Falls Church, Va.

Nov. 14-17: *Second International Automation Exposition,* Navy Pier, Chicago, Ill. The exhibition will feature automatic controls, materials handling devices, etc. The electronic computer clinic will be repeated. For information, write to Second International Automation Exposition, 845 Ridge Ave., Pittsburgh 12, Pa.

Nov. 17: *Conference on A-Bomb and Industry —a Prescription for Survival*, Illinois Institute of Technology, Chicago, Ill. Sponsored by Armour Research Foundation of Illinois Institute of Technology. Subjects scheduled for discussion include economics of A-bomb and H-bomb protection, protection possibilities, and industry operations under emergency conditions. For information, write to Illinois Institute of Technology, 35 W. 33rd St., Chicago, Ill.

Nov. 21-22: *Symposium on Aeronautical Communications*, Hotel Utica, Utica, N. Y. Sponsored by the IRE Professional Group on Communications Systems. The symposium will stress the communications systems both ground-to-ground and ground-to-air used in aeronautical activities. Both military and civilian aspects of these systems will be discussed and an exhibit will be held. For information, write to R. C. Benoit, Jr., 138 Riverview Parkway North, Rome, N. Y.

Dec. 12-17: *Nuclear Engineering and Science Congress and Atomic Exposition*, Cleveland Municipal Auditorium, Cleveland, Ohio. Fifty technical sessions will cover every phase of peace-time uses of atomic energy and its by-products. Nuclear developments for applications in industry, science, and agriculture will be exhibited. For information, write to Atomic Exposition, 931 Book Bldg., Detroit 26, Mich.

Dec. 28-30: *Conference on Low Temperature Physics and Chemistry*, Louisiana State University, Baton Rouge, La. Sponsored by the National Science Foundation and Louisiana State University. Topics for discussion will include liquid and solid helium, superconductivity, ionic and nuclear paramagnetism and magnetic cooling, electronic and thermal properties of metals at low temperatures. Those wishing to attend should write to Dr. J. M. Reynolds, Dept. of Physics, Louisiana State University, Baton Rouge, La.

Jan. 9-10, 1956: *Second National Symposium on Reliability and Quality Control in Electronics*, Hotel Statler, Washington, D. C. Sponsored by the Professional Group on Reliability and Quality Control of the IRE, American Society for Quality Control, and RETMA. Of particular interest to electronic designers are sessions on "Quality Control and Automation"; "Advances in Tube Reliability"; "Controlling Relay Characteristics"; and "Reliable Capacitors". For information, write to IRE, 1 E. 79th St., New York, N. Y.

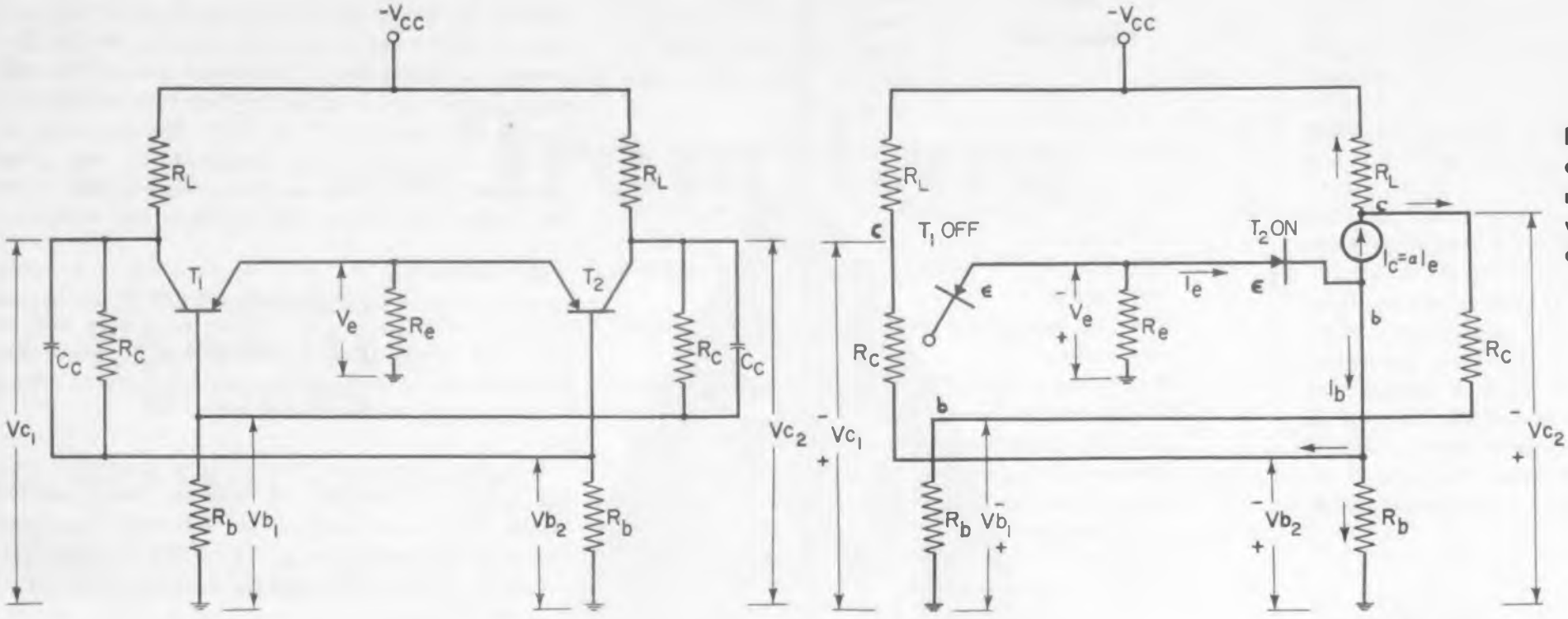


Fig. 1 (left), the symmetrical transistor flip-flop, is redrawn as Fig. 2 (right), which is the basis for the design formulas.

Designing Transistor Flip-Flops

Robert E. McMahon

Lincoln Laboratory, Massachusetts Institute of Technology, Lexington, Mass.

BASED on the illustrated symmetrical junction transistor flip-flop, this article presents a group of formulas and a nomograph that enables the designer to construct a reliable flip-flop with the desired properties. Any resulting designs should be broad enough to overcome the variation of transistor parameters. The derivations of these formulas are also presented.

The circuit shown in Fig. 1 is a symmetrical transistor flip-flop logically similar to the Eccles-Jordan vacuum-tube circuit. Assuming that the circuit has two stable states, and designating T_1 as "off" and T_2 as "on", the circuit can be redrawn as shown in Fig. 2 using the diode equivalent circuit and considering the collector resistance to be infinite. Throughout this article, p-n-p transistors will be considered, but the design holds equally well for n-p-n transistors.

Referring to Fig. 2, the design equations are as follows: for two stable states to exist

$$R_c/R_L < (2\alpha—1)/(1—\alpha) \qquad (1)$$

For non-saturation, the maximum emitter current, I_{emax}, is given below. (Saturation occurs when the base voltage equals the collector voltage and brings about the undesirable effects of minority carrier storage.)

$$I_{e\ max} < \frac{V_{cc}(R_b + R_c)}{R_b + R_c + R_L} \div \left[R_e + \frac{\alpha R_L\ (R_b + R_c)}{R_b + R_c + R_L}\right] \qquad (2)$$

Operating emitter current, $I_{e\ op}$, must be less than $I_{e\ max}$.

$$I_{e\ op} = \frac{V_{cc}\ R_b}{R_b + R_c + R_L} \div \left[R_e + \frac{R_b(R_c + R_L)\ (1\text{-}\alpha)}{R_b + R_c + R_L}\right] \qquad (3)$$

Usually a desired output voltage swing, $\triangle\sqrt{\ }$, is specified.

$$\triangle\sqrt{\ } = I_{emin}\left[\frac{\alpha_{min} R_L\ (R_c + R_b) - (1\text{-}\alpha)\ R_b\ R_L}{R_b + R_c + R_L}\right] \qquad (4)$$

From formulas 2 and 3 we see that the normal operating current increases with an increase in alpha. This situation is illustrated in Fig. 3. Operation is restricted to the left of α_o so that the operating current is less than the maximum current determined by the saturation limitation. We will find it convenient later to allow the cross-over of I_{eop} and I_{emax} to occur at α equals one so that we can be sure of non-saturation for any junction transistor.

To be certain that a particular output is obtained we must specify the output for a minimum alpha and hence, minimum emitter current. For any alpha larger than the α_{min}, the output will be larger since, as we have already noted, the emitter current increases with an increase in alpha.

Let us consider these design equations when $\alpha = 1$. Then $I_{e\,op}$ will be at its highest value while I_{emax} will be at its lowest value. Then, if we require these two currents to be equal, we shall meet the requirements that $I_{e\,op} < I_{emax}$ for all values of alpha less than 1. Furthermore, we must decide on a value for R_c/R_L in accordance with equation. For $\alpha = 0.83$, which is low for currently available transistors, the $(2\alpha-1)/(1-\alpha)$ term equals 4. For alphas larger than 0.83, the $(2\alpha-1)/(1-\alpha)$ term is greater than 4. So if we take $R_c/R_L = 4$ we are assured of stability for any alpha above 0.83. However, to keep the analysis general we

will define R_c/R_L equal to γ. Taking our equations as specified ($\alpha = 1$, $R_c/R_L = \gamma$ we have, from

$$R_e = \frac{V_{cc}}{I_e} \cdot \frac{R_b}{R_b + R_c + R_L} = \frac{A\ R_b}{R_b + R_c + R_L}$$

$$= \frac{A\ R_b}{R_b + (\gamma + 1)\ R_L} \qquad (5)$$

where

$$A = V_{cc}/I_e$$

Substituting equation 5 in equation 2, we obtain

$$R_b = \gamma\ [(V_{cc}/I_e) - R_L] = \gamma\ [\alpha - R_L] \qquad (6)$$

Now, substituting these equations in equation 4, we get,

$$R_L = \frac{A}{(2\ (1-\alpha)\ (\gamma + 1 - \gamma\rho)} \Big(\gamma\rho\ (2\alpha - 1) - 1 - \gamma\ (\gamma + 1)\ (1 - \alpha) - \Big\{ [\gamma\rho\ (2\alpha - 1) - 1 - \gamma\ (\gamma + 1)\ (1 - \alpha)]^2 - \gamma\ (1 - \alpha)\ (\gamma + 1 - \gamma\rho) \Big\}^{1/2} \Big) \qquad (7)$$

where $\rho = V_{cc}/\Delta\sqrt{\ }$

If we take the R_c/R_L ratio as 4 ($\gamma = 4$), which we have noted will more than guarantee stability for α values as low as 0.83, and substitute this value in equation 7, we have R_L equal to the expression below.

$$R_L = \frac{A}{2\ (1 - \alpha_{min})\ (5 - 4\rho)} \Big(4\rho\ (2\alpha_{min} - 1) - 1 - 20\ (1 - \alpha_{min}) - \Big\{ [4\rho\ (2\alpha_{min} - 1) - 1 - 20\ (1 - \alpha_{min})]^2 - 16\ (1 - \alpha_{min})\ (5 - 4\rho) \Big\}^{1/2} \Big) \qquad (8)$$

$$= AB$$

We now have a suitable equation completely defining the resistive elements of the flip-flop. However, it is necessary to discuss some of the restrictions of equation 8. Examination of equations 5 and 6 indicates that ρ must be chosen appropriately for a particular minimum alpha so that the term B multiplying A in equation 8 is less than unity. Otherwise, as indicated by equation 7, the base resistor R_b will be zero if B equals one, or negative if B is greater than one, A value of B between 0.83 and 0.96 gives suitable values for R_b. The graph of Fig. 4 was drawn to show the limits of B and hence the permissible range of ρ versus α_{min}, that will result in useful positive values of R_b. Nothing is gained by taking B much less than 0.83, even though we are extending the range of ρ for α_{min} values, for if ρ is chosen larger than it need be we are requiring a much greater V_{cc} than is actually necessary for a given $\Delta\sqrt{\ }$.

The procedure for using the graph is as follows: An alpha minimum is selected based on what a designer expects to receive from the transistor manufacturer. Then from the graph ρ is selected so that α_{min} and ρ intersect in the shaded area of the graph. From this value of ρ and the value of $\Delta\sqrt{\ }$ (output voltage swing) that is desired we compute V_{cc}. Prior to substituting ρ and α_{min} in equation 8 to obtain R_L we must choose a value for I_e. The transistor manufacturer supplies data giving suggested limits of emitter current, and it is well to stay within these ratings. Having chosen I_e we can find R_L from equation 8. The remaining resistances can be found from equations 5 and 6.

Several facts regarding the design procedure should be considered. The value chosen for ρ is not particularly important provided we remain within the limits indicated, hence ρ may be shifted within this region to give a convenient value of V_{cc}. Furthermore, if possible it is convenient to choose ρ on the $B = 0.83$ or 0.96 line, since an evaluation of B using ρ and α_{min} is not necessary. Also, if α_{min} is chosen above 0.97, the evaluation of B becomes laborious due to the nature of the term. However, the binomial approximation can be used to reduce the term as follows, where $\alpha_{min} > 0.97$

$$R_L = A \left\{ \frac{4}{4\rho\ (2\alpha_{min} - 1) - 1 - 20(1 - \alpha_{min})} \right\} \qquad (9)$$

Sample Problem

An example will be worked out to show how the design might proceed. Let us begin by assuming that the flip-flop must work with a large percentage of transistors. We must expect alpha to vary from around

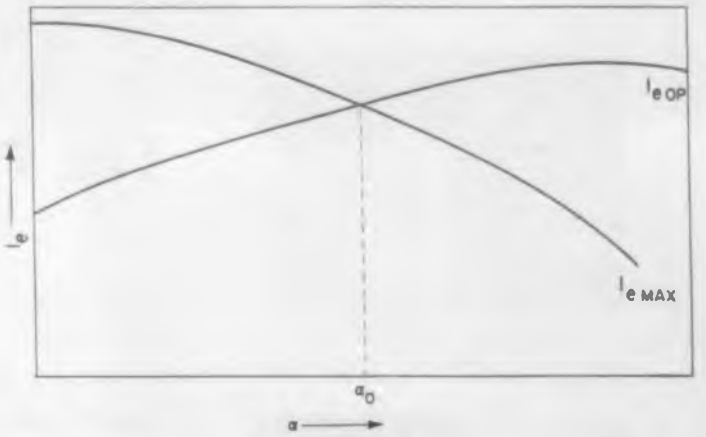


Fig. 3. Operation of the transistor flip-flop is restricted to the left of alpha sub-zero.

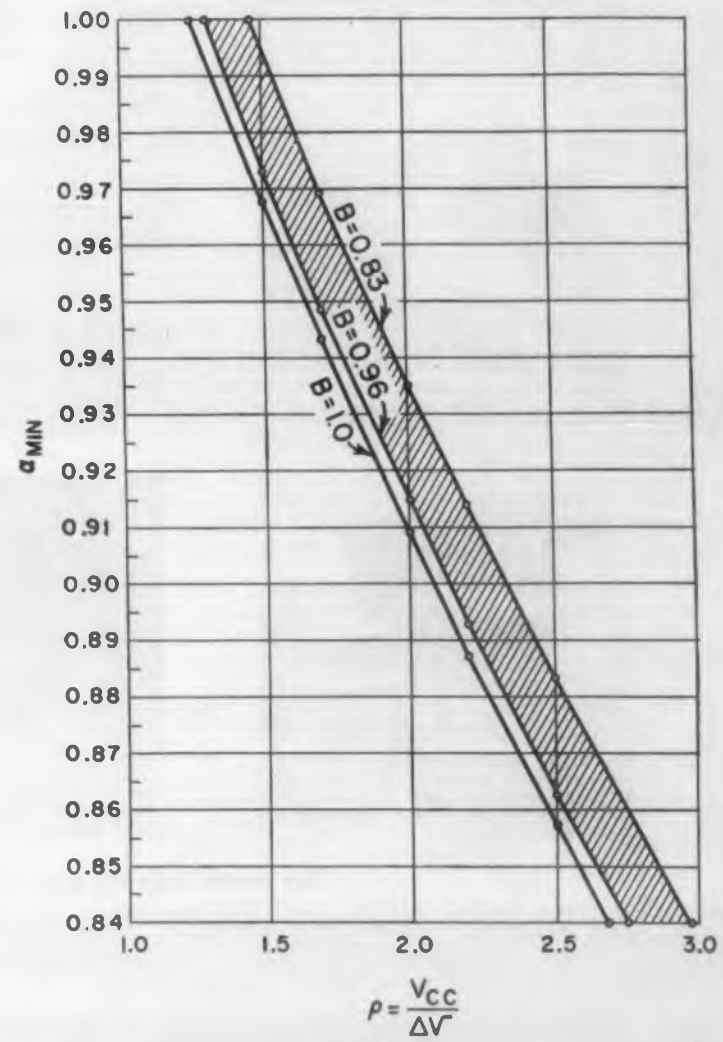


Fig. 4. This nomograph is derived from equation 8. The limits of B give suitable values of R_b.

0.93 to 0.99 or higher. From the nomograph see that a convenient value for ρ is about 2. If a 15v output swing is desired, then V_{cc} is determined as follows.

$$\rho = 2 = V_{cc}/\Delta\sqrt{}$$
$$V_{cc} = 15 \times 2 = 30\text{v}$$

In accordance with transistor current ratings we will choose I_e to be 5ma. Then substituting $\alpha_{min} = 0.93$, $\rho = 2$, and $I_e = 5\text{ma}$ in equation 8, we have

$$R_L = AB = \frac{V_{cc}}{I_e} \times 0.81 = \frac{30}{5. \times 10^{-3}} \times 0.81 = 4860 \text{ ohms}$$

From the appropriate equations we find,

$$R_b = 4\,[A - R_L] = 4\,[6 - 4.86] \times 10^3 = 4560 \text{ ohms}$$

$$R_c = 4\,R_L = 19{,}440 \text{ ohms}$$

$$R_e = \frac{AR_b}{R_b + 5R_L} = \frac{6 \times 4560}{4.56 + 24.3} = 947 \text{ ohms}$$

As a check, one can find $I_{e\,op}$ for α_{min} and compute the desired output voltage swing $\Delta\sqrt{}$. For the above problem it should be 15v as originally specified.

The design is flexible enough so that normally the RETMA standard resistance values closest to the calculated values can be used without affecting the operational characteristics of the flip-flop. Before considering the design completed, a check of the transistor power dissipation should be made to be sure it is within the rated value.

Derivation of formula (1).

In order that T_1 be off, its base voltage (V_{b1}) must be less negative than the emitter voltage (V_e) and for T_2 to be on, its base voltage (V_{b2}) must be more negative than V_e. Then for two stable states,

$$V_{b2} < V_e \quad \text{(a)} \qquad V_{b1} > V_e \quad \text{(b)}$$

We can easily derive the equations for these voltages from Fig. 2. Using the voltage division rule to obtain the effect of the collector supply voltage (V_{cc}) on V_{b2} and the current division rule to find the effect of the base current (I_b) on V_{b2}, we have:

$$V_{b2} = \frac{-V_{cc}\,R_b}{R_b + R_c + R_L} + \frac{I_b R_b (R_c + R_L)}{R_b + R_c + R_L} \quad \text{(c)}$$

Using the relationship between the base and emitter current, $I_b = I_e\,(1-\alpha)$, we may rewrite V_{b2} as,

$$V_{b2} = \frac{-V_{cc}\,R_b}{R_b + R_c + R_L} + \frac{I_e\,(1-\alpha)\,R_b\,(R_c + R_L)}{R_b + R_c + R_L} \quad \text{(d)}$$

In the same way the voltage V_{b1} can be obtained as,

$$V_{b1} = \frac{-V_{cc}\,R_b}{R_b + R_c + R_L} + \frac{I_c\,R_L\,R_b}{R_b + R_c + R_L} \quad \text{(e)}$$

Substituting $\alpha I_e = I_c$ gives,

$$V_{b1} = \frac{-V_{cc}\,R_b}{R_b + R_c + R_L} + \frac{\alpha I_e\,R_L\,R_b}{R_b + R_c + R_L} \quad \text{(f)}$$

We can combine equations 1 and 2 to obtain:

$$V_{b2} < V_{b1} \qquad (g)$$

and substituting the value for V_{b2} and V_{b1}, we have;

$$\frac{-V_{cc}\,R_b}{R_b + R_c + R_L} + \frac{I_e\,(1-\alpha)\,R_b\,(R_c + R_L)}{R_b + R_c + R_L} < \frac{-V_{cc}\,R_b}{R_b + R_c + R_L} + \frac{\alpha I_e\,R_b\,R_L}{R_b + R_e + R_L}$$

Simplifying the above we obtain:

$$R_c/R_L < (2\alpha - 1)/(1 - \alpha) \qquad (1)$$

Derivation of formula (3).

Referring to Fig. 2, we must require for non-satura tion that,

$V_{b2} > V_{c2}$ (V_{b2} must be less negative than V_{c2}) (a)

If we consider the internal emitter resistance of the on transistor, T_2, to be zero, then we can write equa a as:

$$V_e > V_{c2} \qquad (b)$$

then substituting the values for V_e and V_{c2},

$$-I_e\,R_e > \frac{-V_{cc}\,(R_b + R_c)}{R_b + R_c + R_L} + \frac{\alpha I_e\,R_L\,(R_b + R_c)}{R_b + R_c + R_L}$$

or, rewriting,

$$I_{c\,max} < \frac{V_{cc}\,(R_b + R_c)}{R_b + R_c + R_L} \Big/ \left[R_e + \frac{\alpha R_L\,(R_c + R_b)}{R_b + R_c + R_L}\right] \qquad (c)$$

The emitter current must be less than the value given by equation c to avoid saturation. Notice that the current decreases with an increase in alpha. The normal operating emitter current is,

$$I_{e\,op} = \frac{V_{cc}\,R_b}{R_b + R_c + R_L} \Big/ \left[R_e + \frac{R_b\,(R_c + R_L)\,(1-\alpha)}{R_b + R_c + R_L}\right] \qquad (d)$$

Derivation of formula (4).

The output voltage level for the on transistor is,

$$V_{on} = \frac{I_c\,R_L\,(R_c + R_b)}{R_b + R_c + R_L} - V_{cc} \qquad (a)$$

The voltage level, when the transistor is in the off condition, is

$$V_{off} = \frac{I_b\,R_b\,R_L}{R_b + R_c + R_L} - V_{cc} \qquad (b)$$

The output voltage swing then is,

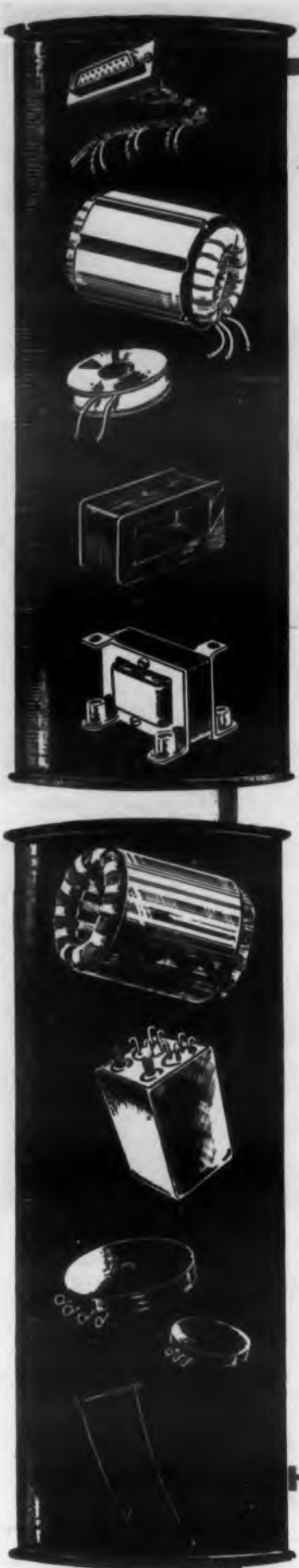
$$\triangle \sqrt{\ } = V_{on} - V_{off} = \frac{I_c\,R_L\,(R_c + R_b)}{R_b + R_c + R_L} - \frac{I_b\,R_b\,R_L}{R_b + R_c + R_L}$$

This may be rewritten in terms of I_e,

$$= \frac{\alpha_{min}\,I_{emin}\,R_L\,(R_c + R_b)}{R_b + R_c + R_L} - \frac{(1-\alpha_{min})\,I_{emin}\,R_b\,R_L}{R_b + R_c + R_L} \qquad (4)$$

Acknowledgment

The design procedure discussed in this article is based on research that was supported jointly by the Army, Navy, and Air Force under contract with the Massachusetts Institute of Technology.



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- "THERMALON", SILICONE MAGNET WIRE

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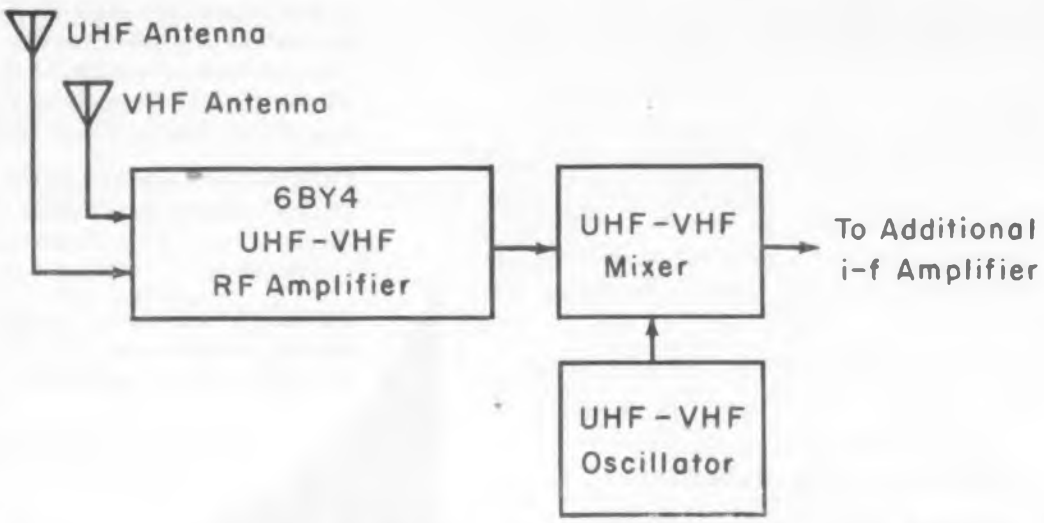
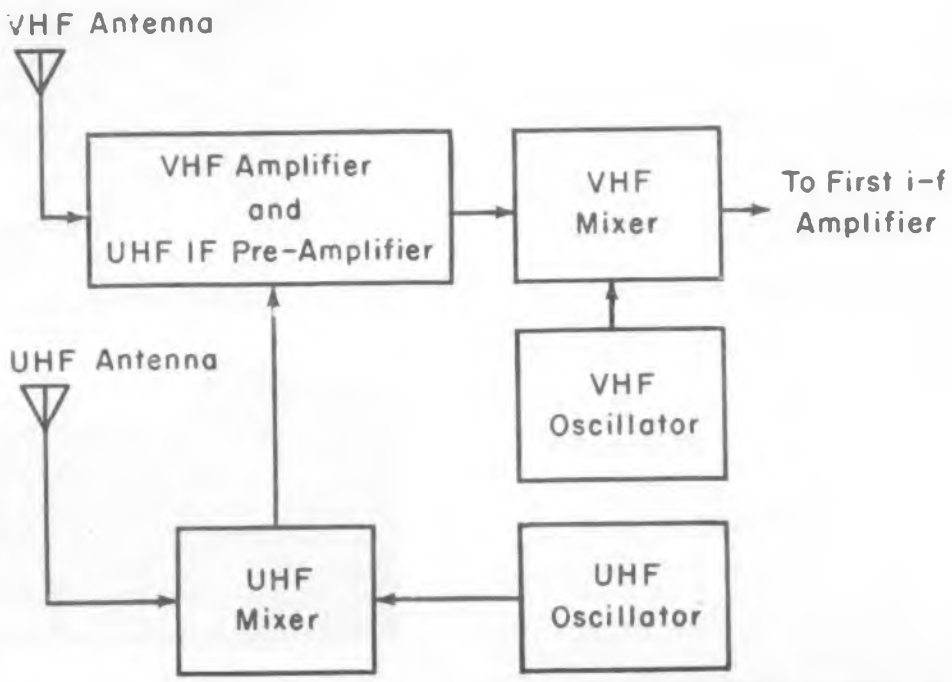
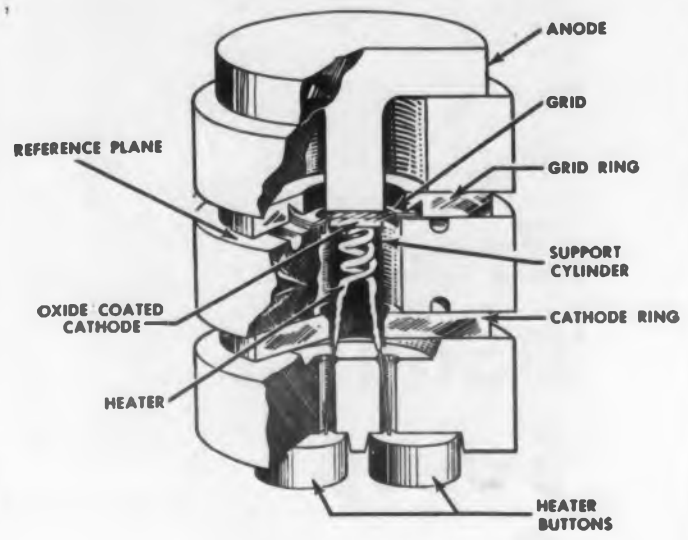
Tiny Ceramic Tube

The tube is actually 3/8" long x 5/16" diam, about the size of a pencil eraser.



By utilizing the new tube, the above v-h-f—u-h-f tuner can be desiged to replace the more complicated circuit below.





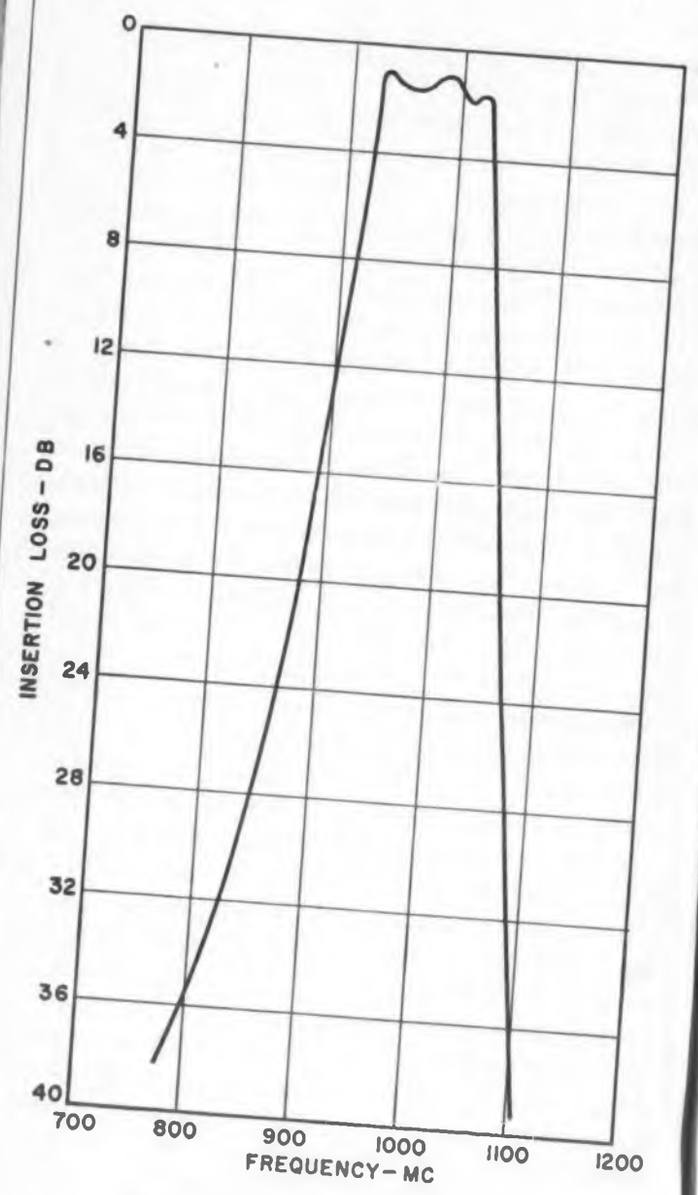
LOW-NOISE and high-gain features of the micro-miniature ceramic *6BY4* make it particularly valuable in the design of u-h-f—v-h-f TV tuners. Its ability to stand shock and vibration and operate at temperatures in excess of 500°C are advantages for guided-missile and other airborne applications. This tube is also shown on the cover.

Interelectrode spacings in this triode are measured in microns. The metal parts in the tube are made of titanium, which has a gettering characteristic that continues throughout the life of the tube. Special ceramic spacers were compounded that have the same thermal coefficient of expansion as titanium. The rigid construction helps eliminate microphonics. This ceramic also has very low r-f losses. The construction techniques evolved in the development of this tube may be applied to other types by the manufacturer, Tube Dept., General Electric Co., One River Rd., Schenectady 5, N. Y.

Measured in a grounded-grid circuit at 900Mc with a 10Mc bandwidth signal, power gain is about 15db with a noise factor of about 8db. Transconductance is 600μmhos. Amplification factor is 100. The heater and plate voltages are 6.3v and 200v, respectively. Lead inductances are very low.

In order to utilize this new tube to full advantage, new tuner and converter circuits must be developed. The new tuner will have improved u-h-f performance, while noise factors comparable to present cascode tuners will be obtained in the v-h-f band. Although the over-all gain of the new simpler tuner will be less than that of present tuners, especially at v-h-f, the extra gain that is needed can easily be obtained by an additional low-cost i-f amplifier stage. For more data on this tube, turn to the Reader's Service Card and circle **22.**

Broad Band Sweep Generator



Typical response of lumped-constant triple tuned bandpass filter. Note broad skirts.

PANORAMIC displays of several hundred megacycles in the 200-2000Mc range can be generated with these new broad-band sweep generators. The response of 100 Mc quadruple-tuned amplifiers, which heretofore has been, for the most part, a mathematical concept, can be presented visually instantly. Alignments of up to 10 cascaded stages have been accomplished. Two models of the unit pictured here are available; Model HFS 1319 simultaneously displays the frequency range of 1350 to 1950Mc, while Model HFS 813 displays the range of 845 to 1375 Mc.

Replacing signal generators and narrow-band sweep generators, which have been almost useless in setting selectivities of multiple tuned-circuits because of the time-consuming factor, these broad band units have a steady output amplitude. The variation of the instrument, developed and manufactured by Applied Research, Inc., 163-07 Depot Road, Flushing, N. Y., is less than ±1db for any 100Mc segment, or ±2.5db for an entire band. The alignment of broad band networks is simple; no correction factors are necessary. To eliminate marker ambiguities that are often associated with active circuits, a calibrated passive frequency marker is used. The front panel dial setting indicates directly exact location of absorption notches.

Because of the broad sweeping frequencies available, the input skirts of a response curve can be shown. See graph. Actually the frequencies swept are about twice the band width encountered in most design problems in the 1000Mc region.

Design studies of spectrum analyzers, transmission lines, traveling wave tube amplifiers and image and spurious responses of receivers are aided with this device.

The impedance is 50 ohms. VSWR ratio of the HFS 813 model is 1.3:1. Sweep frequency for frequency domain readings is 60cy. For more data, turn to the Reader's Service Card and circle **25.**

Components Needed for Digital Computers

Robert C. Kelner, Chief Engineer
Laboratory for Electronics, Inc.,
Boston, Mass.

Kind of Component Part	Function of the Part	Defects in Present Types Available	Desired Characteristics
Computer Semi-Conductor Diode.	Perform logical functions in digital computers.	Germanium back resistance decreases too rapidly with temperature. Silicon diodes are too expensive and have too low conductance.	Back. 1 meg ohm at 70°C at —20v. Forward. 10 ohm. Recovery times. 0.1 microsec. Cost. 25¢
Ferrite material with magnetic properties of 1/8 mil strip 4-79 Mo-Permalloy at least in coercive force and retentivity and approaching the same Curie point, or 4-79 Mo-Permalloy 1/8 mil strip toroid fabrication technique to bring the cost down to that of molded ferrite toroids.	Storage and amplification.	Coercivity too high; temperature-sensitivity too high. Fabrication too expensive.	See left. Same characteristics but less cost for fabricated toroid. Objective 25¢.
Vacuum tube with efficiency, stability and life of filamentory hearing aid tubes; performance of 5965.	Pulse power source for magnetic circuits.	Life and efficiency are poorer than hearing aid tubes.	Life of 50,000 hr.
Computer transistor.	Pulse power source and logical functions.	Cost is three or four times too high in competition with vacuum tubes for commercial work.	Present high-frequency junction type is good except for cost and lack of ruggedness for small area junctions.
All-magnetic frequency multiplier from 60cy to 100kc+.	Pulse power source for magnetic circuits.	Require vacuum tubes or alternators with their inherent lack of reliability.	At least 30% efficiency.
Magnetic recording head material.	Contact recording on tapes.	Ferrite chips—especially at the gap; and metal heads are too lossy and their smooth wear is too great. Metal heads also suffer from cold-working, reducing definition at the gap.	Slow rate of wear with no chipping; magnetic properties stable under cold working.
Accurate, stable resistors at same cost as composition resistors.	General purpose.	Unstable (±20% must be assumed for nominally ±5% composition resistors).	1% accuracy overall with low cost.

FUTURE component needs for digital computers are not so much for new components as for new approaches to cost and performance of familiar components. Therefore, the accompanying table does not consider components such as electroluminescent or ferroelectric or other storage devices that are in laboratory use only at present.

One basic element of a computer system that is perhaps the bottleneck today in most computer applications is the bulk storage device for storing in the order of 10^{10} bits with access times in the order of milliseconds. Desirably, it should be erasable and non-volatile. It will undoubtedly be here at the requisite cost of a tenth to a hundredth of a cent per bit and with the cost proportional to the storage capacity within a few years. However, this need is really too great to be called a component problem.

The computer diode problem has come very near to being solved in the last few years, and further work beyond the objective stated in the table would to some extent yield diminishing returns. In other words, a diode with the back-resistance properties of silicon diodes, and with the forward conductance, physical stability, and recovery time properties of the gold-bonded germanium diodes, all of which properties are separately available today, would be all that the designer could ask for reasonably.

The development of ferrite materials with the low coercivity and high retentivity of 4-79 "Mo-Permalloy" and also with its insensitivity to temperature would greatly extend the possible use of magnetic techniques in computers for both storage and other problems. Alternatively, if the Mo-Permalloy material could be fabricated into fractional thousandth inch thick strip cores at a cost approaching that of molding ferrite cores, the same objective would be achieved.

Vacuum tubes are still more versatile elements than either their magnetic or semiconductor competitors, and there are many special computer problems where they will continue to be used if their life can be extended to that which has been achieved in certain hearing-aid subminiature tubes of recent design.

The computer transistor promises to displace all competitors, even its close relative, the semiconductor diode, in the logical and control sections of digital

computers. The cost must come down by a factor of at least three before this event occurs in many commercial applications. Moreover, it would be advantageous, although it does not appear to be necessary, to improve the temperature dependence of cut-off current to the degree mentioned above for diodes. The computer transistor may also be used as a pulse power source for magnetic circuits. Its current-carrying capacity must be perhaps increased without sacrificing speed for this purpose. The dissipation allowable in these transistors need not be greatly increased for this function because the transistors can be operated as "on-off" switches.

Another power source for magnetic circuits can be made from magnetic elements. An extension of the magnetic frequency converters used by the Westinghouse Electric Corp. for developing higher frequency power for illumination would conceivably permit of a completely passive high-frequency pulse power source for magnetic devices. The principle is a chain of nonlinear magnetic harmonic generators alternating with linear filters.

The requirements specified on magnetic recording head material in the table may be met in part by Alphenol. The requirement is identical with that imposed by color television tape recording or high-density storage techniques for digital devices. This component would implement the magnetic recording approach to developing the bulk storage devices specified above.

The last item in the table is a mundane requirement for a better resistor at lower cost. Availability of such a resistor would result in a great reduction of the design time required for reliable circuits and would permit the advantageous combination of analog techniques with digital techniques to a much greater extent than is now possible.

The availability of more stable components does not necessarily reduce the designer's burden, because stability can only be specified for a certain life period. More stable components may perhaps be thought of as having better stability for the same life, or the same stability over a longer life, so if the designer wishes to design for longer and longer life, he must assume wide tolerances even with more stable components.

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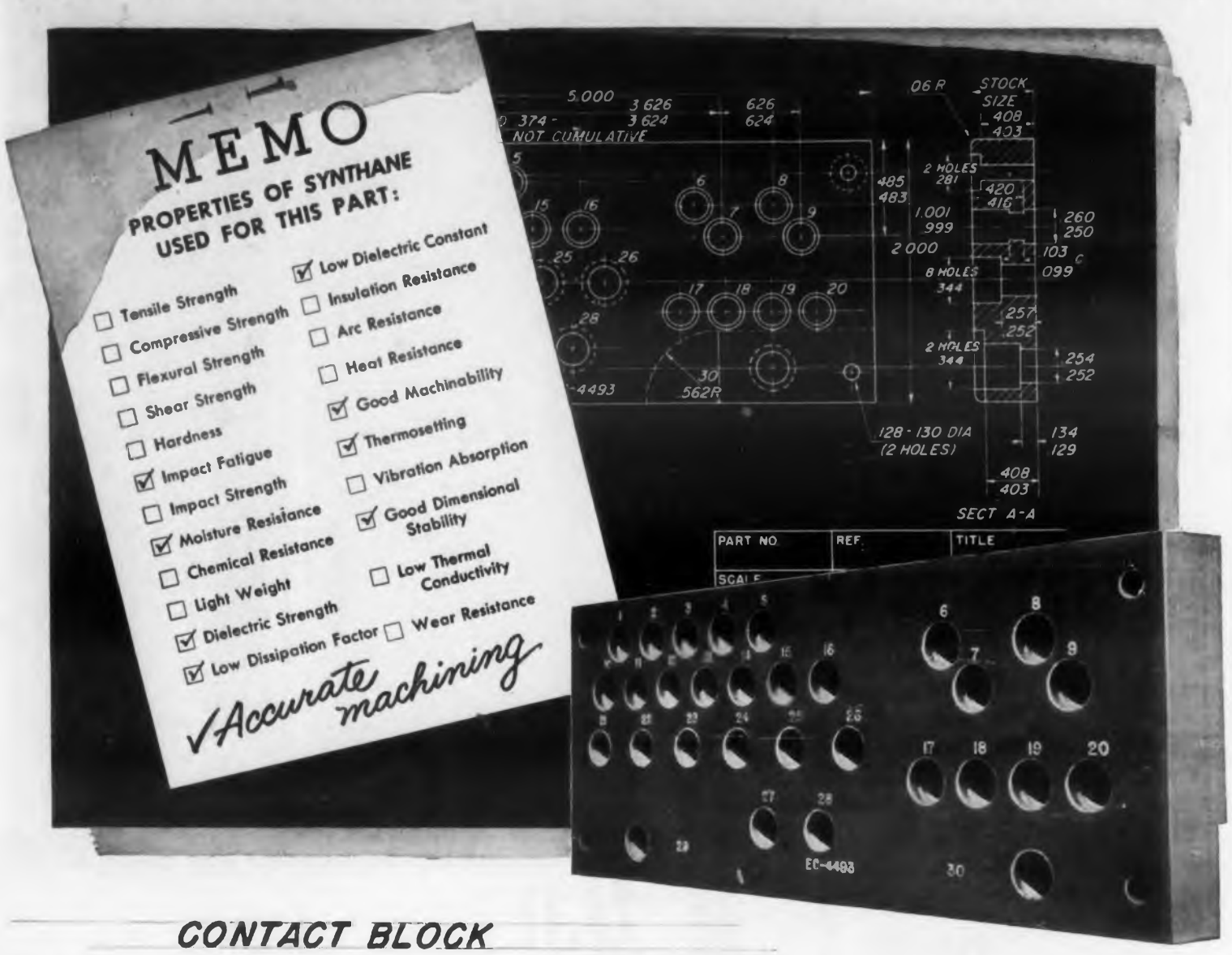

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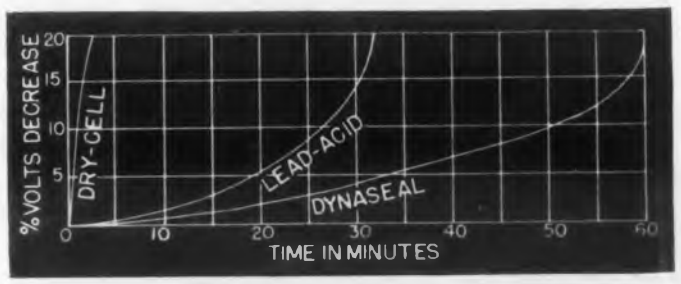

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The batteries are not damaged nor is their useful life shortened by inadvertent short circuits. They occupy half the space and are 6/10 as heavy as comparable lead-acid batteries. Operating efficiently from —20°F to 145°F, they can be stored at temperatures ranging from —40°F to 160°F. These cells have been recycled over 1000 times with only 10 to 20% loss in original stored power capacity. The high capacity of the cells is produced by forming the anodes and cathodes of spongy metal. For more information on these power sources, turn to the Reader's Service Card and circle number **29.**

Needed Analog Computer Components

Frank Klimowski, Jr.
Stavid Engineering Co., Plainfield, N. J.

ANALOG computers are being employed in so many different applications that any one engineer can not speak for the entire field in regard to component needs. The choice of components is generally unique to a particular installation except for the basic computing devices. The below listed component requirements for electromechanical and d-c analogs should be considered as general comments on the needs of the analog computer industry.

D-C Analog

DC analog installations may or may not include servo apparatus. Where such gear is used, it is directed to multiplication, division, and function generation.

Servo multipliers are usually used on low-frequency problems and are characterized by their repeatability and simplicity. Electronic multipliers are capable of a higher frequency input and are more accurate, but must be monitored to insure repeatability. Electronic multipliers are to be desired from a long-range viewpoint. An entirely passive device, not requiring frequent alignment, is the principal component objective.

Function-generators can be of the servo type or the all-electronic type in a d-c analog installation. The requirements of an ideal function generator include simple alignment, reliability, repeatability, and the ability to produce steps as part of the output function. The servo type meets these needs except for the production of sharp steps because of inherent servo response limitations. The present day electronic type is to be preferred from the size viewpoint, but it is difficult to align, require monitoring, and cannot reproduce very large slopes.

A low-cost multi-tap variable increment potentiometer for function generator purposes would find a ready market. Such a potentiometer would be roughly 3″ in diameter about 1″ thick and would contain at least 20 slider taps variable in spacing along a very linear resistance card. Either the voltage tap method or the resistance loading method would be used to generate functions with such a potentiometer, although the former would be simpler.

The variable tap spacing feature would permit the designer to make far fewer compromises in the reproduction of a function. Because of inter-tap wattage limitations of such a potentiometer, the impressed voltages would be restricted to five volts or less. However, an operational amplifier will usually be used to accept the potentiometer output.

Systems synthesis requires a great number of switching operations. In the simulation of a system, operators must always wire in external relay and switching apparatus to work in conjunction with d-c analog equipment. Such operations require much time compared to the set-up time of a d-c analog unit.

It would be a great convenience for such installations if a so-called "universal control cabinet" were available. Such a cabinet would contain a variety of switching devices: toggle switches, various contact combination relays, both a-c and d-c, amperites, stepping relays pulse multi-vibrators, sensitive plate relays, polarized relays, timers, intervalometers, etc. Each switch component would be represented on a patch panel, permitting almost any control operation.

In setting up a problem or system on a d-c analog computer an operational amplifier is often wasted when only isolation is required. To restore the original polarity, the first buffer amplifier must be followed by another operational amplifier for inversion. The situation is more recurrent in systems works than in problem solution. One manufacturer of d-c analog equipment presents a polarity option at the output of each amplifier. If economy dictates against a polarity option at every amplifier, then at least 25% of the total number of operational amplifiers should have this capability.

An analog-to-digital converter is a hybrid component in the computer field. For data recording, the unit should be capable of simultaneously sampling at least 10 information channels of a variable rate from about 10/sec to 1/sec. The converters should be absolutely free of drift and should not permit a static error greater than 0.05%. The system should be acceptable to either electrical or shaft inputs. Either a-c or d-c should be acceptable as inputs without external transducers. The relays of such a system should be capable of more than a million operations.

Mechanical shaft analog-to-digital converters have the disadvantage that a position servo must be used to transfer d-c analog outputs into shaft rotations. Another disadvantage of mechanical types is their low sampling rate; four samples per second being typical of most models currently available.

Present electronic analog-to-digital converters are guilty of drift, are not ideally accurate since any error in measurements is objectionable, and are limited by the velocity of the input data.

Electromechanical Analogs

The introduction of servo breadboard hardware has been a tremendous boon. A prototype system can now be produced in a tenth of the time and cost previously required by conventional fabrication methods. A skilled technician can produce a workable model from a block diagram within two to four hours by using these expedient methods. The concept behind such hardware is that standard parts and components can be assembled into any servo system. Shaft clamps and various couplings permit ready assembly and disassembly. Several companies manufacture their versions of these electromechanical "Tinkertoys".

The use of such equipment has been mainly restricted to organizations with mechanism projects and programs. Almost every laboratory has a requirement for such hardware. A possible compromise between limited demand for precision hardware and high cost may be the production of ordinary workaday hardware at a reduced cost. A considerable number of laboratory servo requirements are those of the work-horse category where mere electromechanical transformation is required.

The experimental mechanism laboratory has a recurrent need for rectangular-to-polar transformation. The conventional approach to the requirement has been to design and develop the system completely from booster amplifiers to resolver to servo with automatic-gain-control. Design, development, and fabrications costs can be cut considerably if such a system is available as an integrated package. The size of such a coordinate conversion package would vary according to the particular shaft load need.

Stabilization networks and quadrature rejection circuits should be made available as plug-in units to help reduce the amount of paper calculations prior to prototype construction. The workaday servos they

are used with should utilize standard amplifiers and standard motors for specified load requirements. When the physical characteristics of a load are not altogether known or cannot be specified, plug-in stabilization options are needed as unitized items.

Analog installations dealing in system synthesis require an auxiliary cabinet containing such associated servo circuitry as amplitude discriminations, linear phase detectors, a-c to d-c and d-c to a-c converters, servo analyzers, synchro systems, servo voltmeters, polarity detectors, and auxiliary position and velocity servos. Servomechanism system manufacturers produce complex machines from these basic units. A laboratory can increase its potential by including such an auxiliary rack as an adjunct to servomechanism and other analog computers. The auxiliary equipment should be as flexible in patching as conventional operational amplifiers.

Phase comparator devices of the diode type are presently available as plug-in units. As a-c to d-c conversion devices they are substantially linear, but suffer from a null voltage that limits their application to some servo systems. A plug-in component of this type with a considerably decreased null voltage is required. The requirement of a minimum null voltage, of course, also applies to two-phase induction motors and generators, transformers, and resolvers.

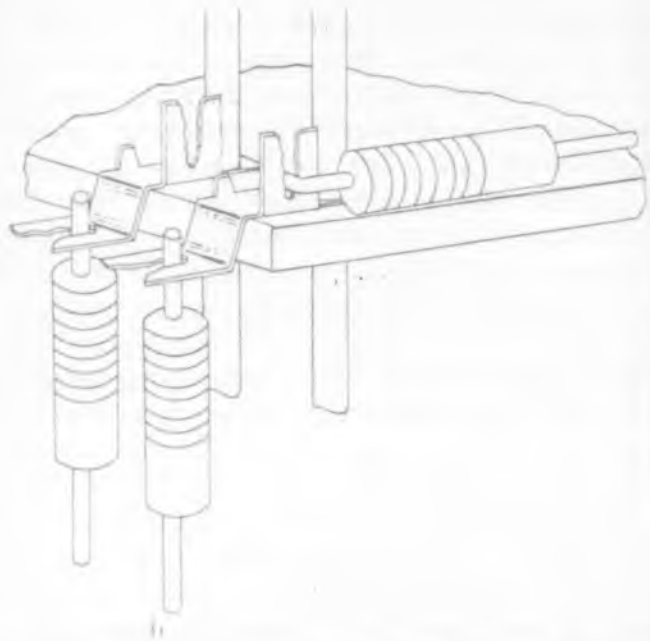
Some progress has been made in the development and production of infinite resolution potentiometers. The elimination of turn-to-turn potential steps and reduction in noise may encourage the use of these devices in some of the differentiation applications previously avoided by computer engineers. These potentiometers have a temperature characteristic that limits their use to high resistance voltage dividers.

Snap-action switches are sometimes required to approach the positiveness of point-to-point commutation. An accompanying requirement with such positiveness is repeatability of contact make or break regardless of the direction of motion. This deficiency does not condemn the accuracy of snap-action switches but there is a need for commutation-type switches.

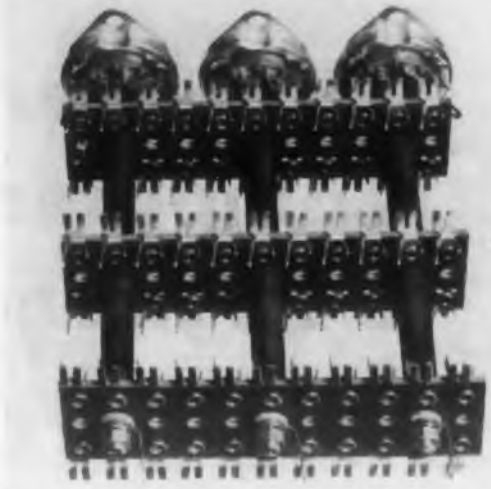
Recorded plots currently permit only two significant figures, at best, to be read. New digital display voltmeters could be used with a time increment selector for numerical display of amplitude.

Multi-Layer Turret Socket

In this type of turret socket, the layers are separated by spacers and long screws.



Components are mounted both between decks and across the surface of the deck with this fork terminal.



The layers are held together by vertical risers in the second version.

PRODUCTION of electronic devices can be speeded by means of the Deck Turret Socket. Groups of connections can be made simultaneously by dip-soldering instead of hand-soldering. The components are firmly held in place by fork-type terminals until soldering takes place. The units are available in two different types with sizes mounting from one to six tubes.

In the first type of Deck, the decks or plates are held together by spacers and long screws that run up into the sockets. The fork terminals extend out from the decks. Components can be mounted between decks or across the decks. In this type only the terminals in the bottom deck can be dip-soldered by holding the unit at a 45° angle and immersing one edge at a time.

A majority of the terminals can be dip-soldered by using the second type of Deck in which the fork terminals are vertical to the plane of the deck. The decks are also wider to enable the components to be mounted across the deck. The components are first plugged into the decks and then the decks are mounted together and held in place by bare copper vertical risers or busses. No spacers and screws are employed. The risers are inserted in holes in the decks. When completely assembled, an entire side of the unit can be dip-soldered at one time. This construction system was developed by Vector Electronic Co., 3352 San Fernando Rd., Los Angeles 65, Calif. The assembled units can be mounted in plug-in enclosures made by this firm.

Connections to the sockets and risers cannot, of course, be made by dip-soldering. The plates or decks are available in either XXXP phenolic, glass silicone, or glass epoxy materials. For more data on this method of construction, turn to the Reader's Service Card and circle **33.**

Label courtesy of Rembert Wurlitzer

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CIRCLE 34 ON READER-SERVICE CARD FOR MORE INFORMATION

Ideas for Computer Designers

THE use of digital computers for a wide variety of applications would be facilitated by sectionalized construction. The basic unit should be a small but high-speed computer with limited internal storage and input and output facilities. Such a unit might find wide use in small labs (and schools) if the price were low enough. It should be possible to expand this system by adding additional units: of internal memory, to allow the solutions of large problems; of external memory to allow the storage of large quantities of data; of a variety of input-output devices, to allow the use of the computer in various applications. It should also be possible to expand the command list by additional appropriate control units.

In constructing digital computers, manufacturers have not taken advantage of the ease with which electronic devices can be expanded, modified, and intercoupled. If advantage were taken of these factors one set of computer components could be made to handle many applications and would allow the expansion of the system as the applications expand.—*Roger L. Sisson, partner, Canning, Sisson and Associates, Los Angeles 35, Calif.*

FOR those digital systems using punched paper tape input it would be desirable to have: a quick method of preparing error-free paper tape with a single punching, a flexowriter modification to permit a typed output from a bi-octal tape, a tape loader which winds tape after loading and rewinds at fast speeds like motion picture projectors, a small cheap device to add or delete holes in paper tape, and a device to splice paper tape. It would be desirable to have a cheaper metallic tape, or a plastic tape with more of the properties of the metallic tape.

A cheap fast access memory of large capacity will always be in demand. In general we hope we can look forward to a means of entering code in standard typed form directly into the computer. Or even better still, let's have a means of putting oral inputs into the computer.—*Donald B. Houghton, Chief, Analysis Section, The Franklin Institute, Philadelphia 3, Pa.*

We asked computer people whose primary concern is offering computing services what they think is needed in the way of equipment to make computers more useful and easier to use. Here are typical replies.

MANY of the requirements of the general-purpose analog computer installation today stem from the necessity of performing real-time simulation. This has led to the search for all-electronic computer components which are capable of approaching the accuracy of the slower electromechanical units.

The one computing component subject to the greatest engineering effort is the electronic multiplier. The most widely used multiplying device is the electromechanical servo. It possesses high accuracy (between 0.02% and 0.1%) but its frequency response is fairly low and prohibits, therefore, the use of analog equipment for the analysis of nonlinear high-frequency systems which must be simulated on a real-time basis. There are available high frequency electronic multipliers with a response in the order of several hundred cps, but their accuracy, 0.2%, is below that of the servo multiplier. Further development is a definite requirement in the computer industry. The most successful techniques used for electronic multipliers are time-division, diodes, and more recently, AM-FM circuits. The search for a simple electronic multiplier which obeys some physical law has produced some results, but unfortunately, these multipliers are not too accurate.

Although some success is being realized in the design of an electronic multiplier, the same cannot be said of the electronic resolver. A fast, accurate resolver for generating sine and cosine functions should constitute one of the primary goals of analog computer development.

The end result of a computational process is the recordings of the solution. Needless to say, the accuracy of the results obtained from a computer cannot exceed the accuracy of the recording equipment. It is often ironic that analog computer solutions which stem from mechanizations containing hundreds of components are generally more accurate than are the means of recording them. Recorders which possess high frequency response are generally incapable of high accuracy, and conversely. The need exists for recorders whose accuracy and frequency response approach those of the computer itself.—*Stanley Fifer, Dian Laboratories, Inc., New York 12, N. Y.*

Field Effect Transistor Circuit Design

II—Applications

Chaang Huang, Melvin Marshall, and B. H. White

Sylvania Electric Products, Inc., Electronics Div., Ipswich, Mass.

CHARACTERISTICS of the field effect transistor essential to designing circuits utilizing this new device were presented in the first part of this article in the July ELECTRONIC DESIGN (*pp. 38-39*). In addition the equivalent circuit of the unit, now in pilot-plant production, and the equivalent circuit reduced to an r-c network were also given. In this concluding portion, the application of the field effect transistor in Colpitts sineware, and relaxation oscillators, bistable, monostable, and multivibrator circuits is extensively treated by means of circuit diagrams.

Colpitts Oscillator

To illustrate the use of the equivalent circuit, the Class A Colpitts oscillator shown in Fig. 1, is designed. Our objective is to design the tank circuit according to a specified frequency of oscillation and to predict the voltage swing and power output from the value of the load resistance. By making use of the equivalent circuit, we can write down the loop equations for the circuit. Setting the determinant of the simultaneous equation to zero and neglecting some terms, we obtain the conditions of oscillations.

$$f = 1/2\pi \sqrt{(C_d + C_g)/(C_d\ C_g\ L)}$$

$$g_{11}\ (C_d/C_g)^2 - (g_{21} + g_{12})\ C_d/C_g + (1/R + g_{22}) = 0$$

From these two conditions, if we choose one of the three tank circuit elements, the other two elements can be calculated. To check the accuracy of these conditions, experimental results have been compared to the calculated results. It is found that for $f =$ 2Mc and $L =$ 140mh, the calculated value of C_d/C_g is 0.63, and C_d equals 74$\mu\mu$f. On the other hand when the oscillator is tuned to 2Mc, the measured value of C_d/C_g is 0.618 while C_d was found to be 60$\mu\mu$f.

Recalling that the equivalent circuit is essentially resistive up to 2Mc, it is plausible that the power output and efficiency of an oscillator with an oscillating frequency less than 2Mc can be directly predicted from the static characteristic curve shown in Fig. 3. With the load resistance given, we can draw a load line on the static characteristic curve. The load line intersects with the curves $V_G = 0$, and $V_G = 33$v (the pinch-off voltage) at two points, giving two voltage swings. The smaller of the two swings is the drain voltage swing V_D. From the voltage swing and load resistance we can calculate the power output. Since the d-c biases are known, we can also find efficiency.

In order to ensure the validity of these calculations, the power output and efficiency of a field-effect-transistor Colpitts oscillator was measured under the following conditions:

(1) At a fixed bias point, $V_D = 60$v. $I_d = 6$ma, with the frequency of oscillation tuned to 2Mc. The load resistance has been varied from 2000 ohms to 12,000 ohms. The measured and calculated results are found to be in good agreement, as shown in Fig. 2. This result shows that for a frequency up to 2Mc, the amplitude of oscillation can be accurately predicted from the static characteristics. Furthermore, corresponding to each bias point there is an optimum load to give maximum amplitude of oscillation. For the operating point of $V_D = 60$v, $I_d = 6$ma, $V_G = 12$v, the optimum load is about 6200 ohms.

(2) The a-c power output and the efficiency of the oscillator are measured when the frequency is varied from 1 to 8Mc. With the operating point kept at $V_G = -12$v, $V_D = 60$v and with a 6200 ohms load resistance, the frequency of oscillation is tuned from 1 to 8Mc. Fig. 5 shows that when the frequency is higher than 2Mc, there is a decrease both in power output and efficiency. In other words, at frequencies higher than 2Mc, the power output and efficiency cannot be directly predicted from the static curves. The maximum frequency of oscillation for this circuit is found to be 11.5Mc.

(3) By maintaining a constant drain bias of 50v and a constant frequency of oscillation of 2Mc the power output and efficiency are measured versus gate bias. (At each gate bias the load resistance is adjusted to the optimum value). The measured results are compared with the calculated values in Fig. 4. As can be readily explained from the static characteristic curves, there is an optimum gate bias that gives more power out. This optimum bias occurs at $V_G = -12$v.

(4) When the transistor is operating at a constant gate bias, with the tank circuit tuned to a fixed frequency, an increase in drain voltage will shift the operating point to allow a larger amplitude of oscillation, as shown in Fig. 6.

Power Rating

Although the highest power output data we have shown here is only 100mw, an output of more than 300mw has been observed. The heat dissipation rating of the field effect transistors is 500mw. If a Class B or C oscillator is designed, larger power output at 2Mc is possible. Furthermore, if the heat sink is improved, the same transistor could be made to dissipate 2w. This would make the device unique in giving large output power at the range of 2Mc.

As shown in the equivalent circuit, (ELECTRONIC

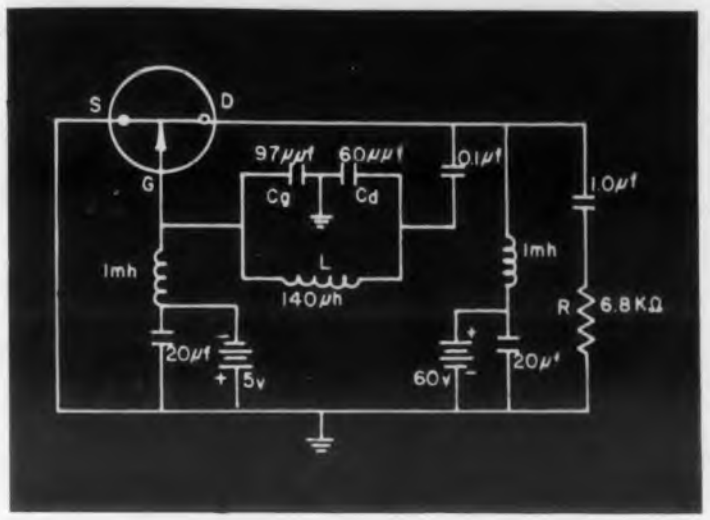


Fig. 1. The characteristics of this Colpitts oscillator are analyzed in the five charts on this page.

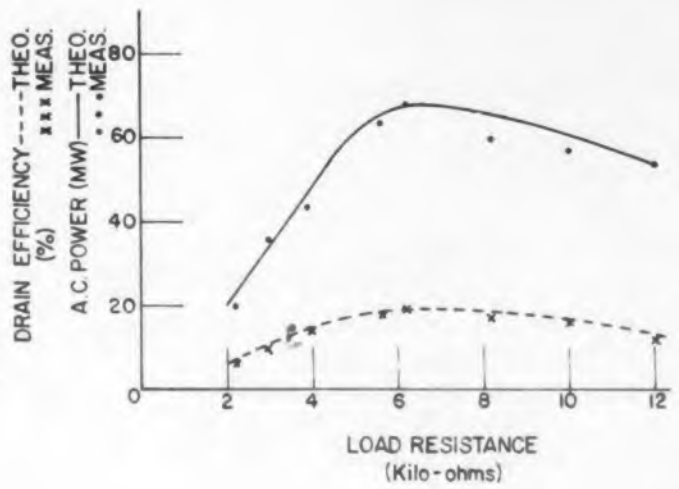


Fig. 2. This graph was plotted at 2Mc with V_D = 60v, and V_G = −12v.

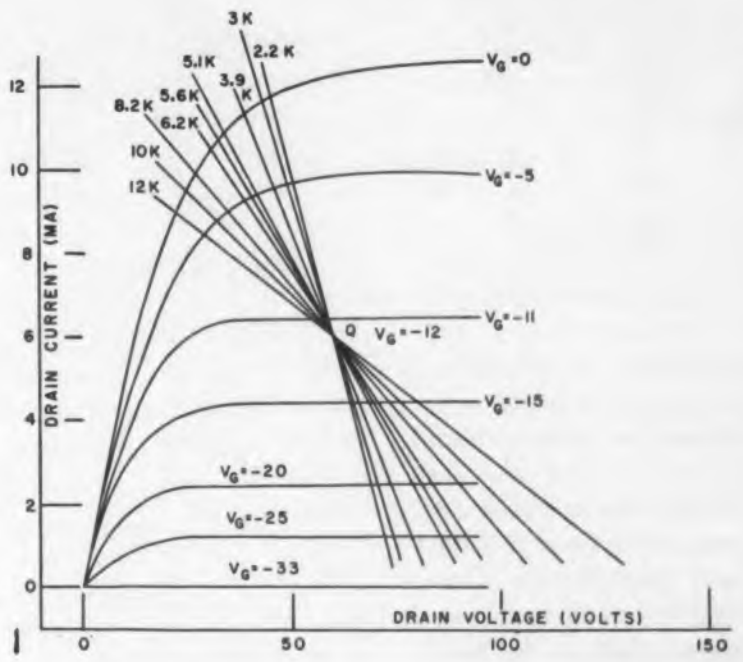


Fig. 3. Static characteristics of the type *N6701* field effect transistor used in the above oscillator.

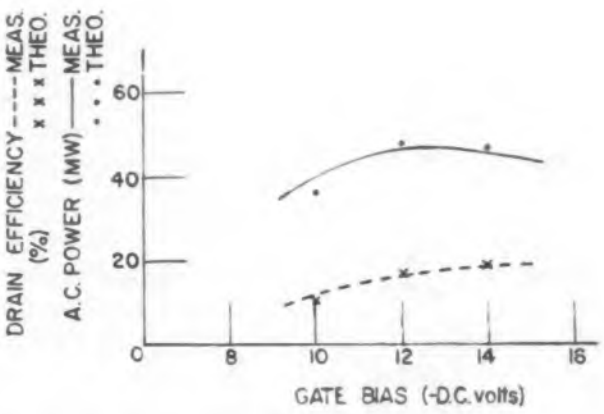


Fig. 4. The drain voltage, V_D, was held at 50v and the oscillation frequency was 2Mc for this plot.

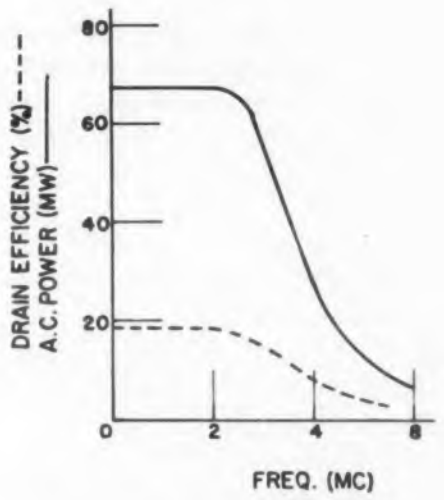


Fig. 5. The load resistance was 6200, V_D = 60v, and V_G = −12v for this analysis.

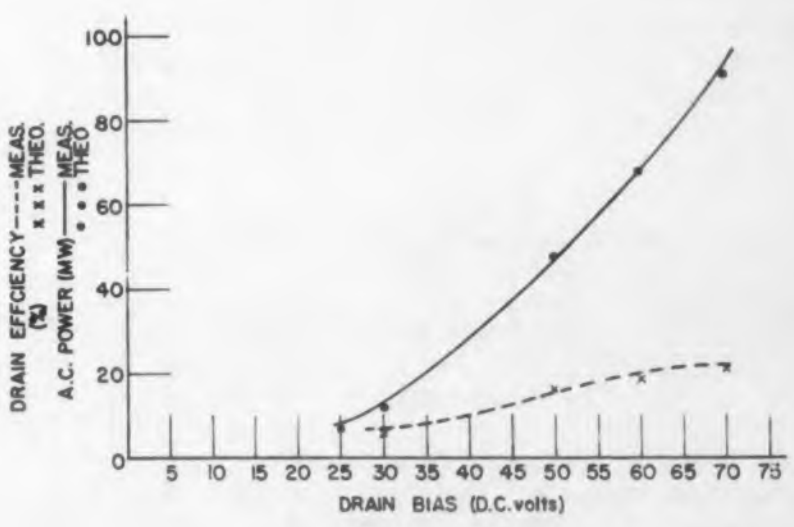


Fig. 6. Optimum load resistance, V_G = −12v, and oscillation frequency of 2Mc were the conditions for this plot.

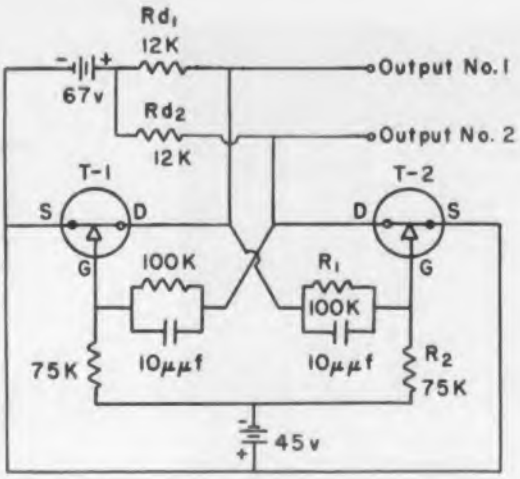
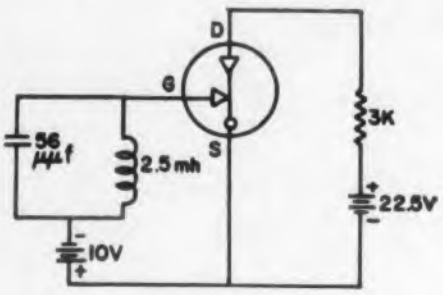
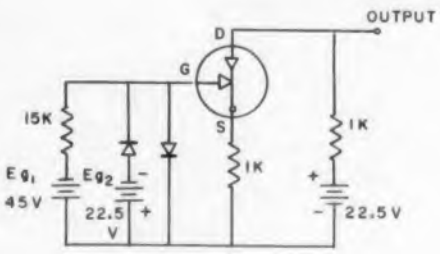


Fig. 7. The pinch-off value, W_o, is 15v, and I_{max} is 5ma for this bistable flip-flop utilizing two field-effect units.





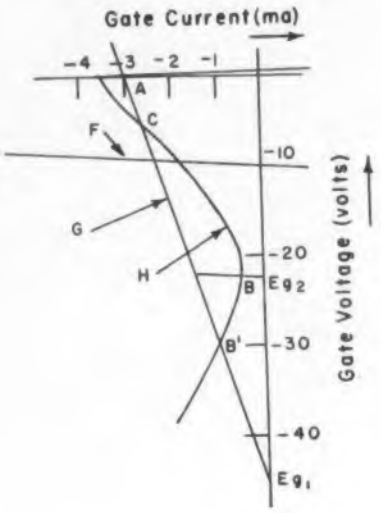
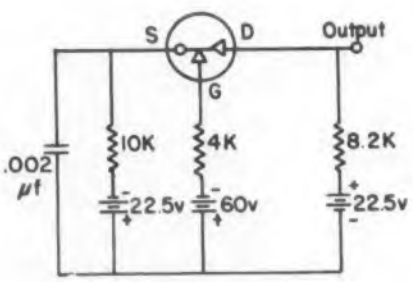


Fig. 9. Bistable (upper right) and sinewave oscillator (upper left) circuits and the characteristics of the field-effect transistor with a carrier injection drain contact. *F* and *G* are the load lines for the oscillator and bistable circuits, respectively, and *H* is the gate-input characteristic. Output from the oscillator is by inductive coupling to the tank.



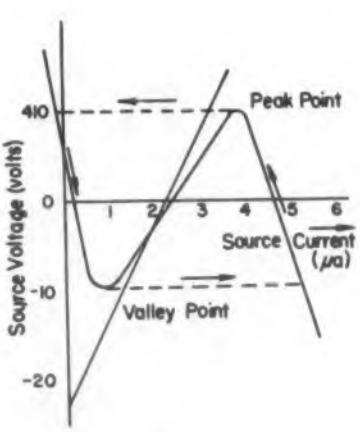


Fig. 11. The chart at the right can be used to design this relaxation oscillator. Diagonal line is the load line.

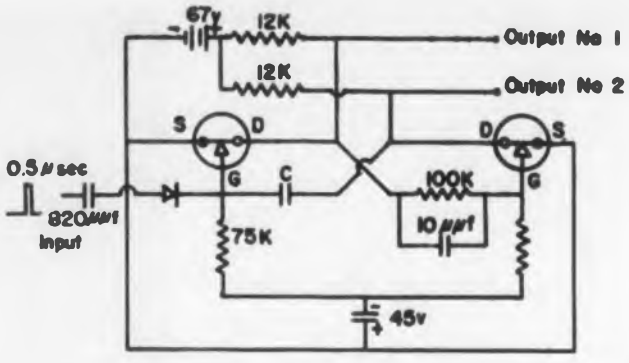
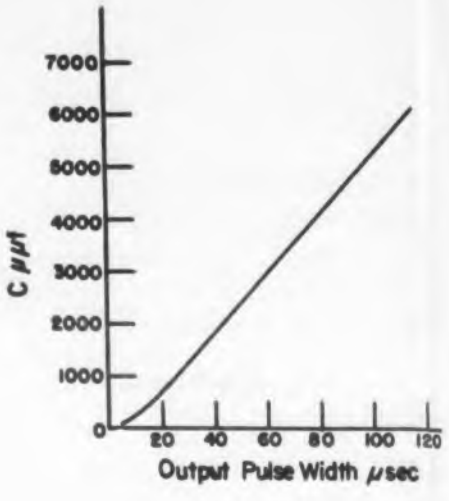


Fig. 8. Replacing one of the feedback circuits of Fig. 7 with capacitor C results in a monostable circuit. The variation of the output pulse with C is shown at right.



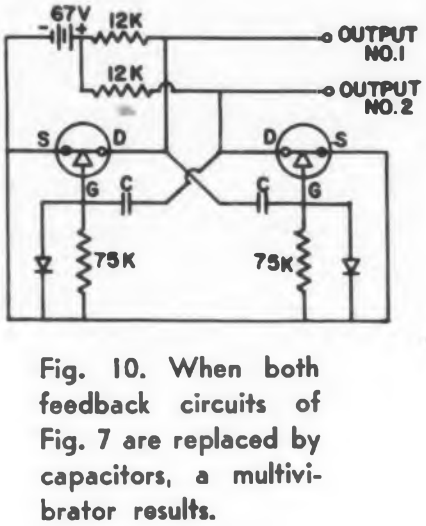
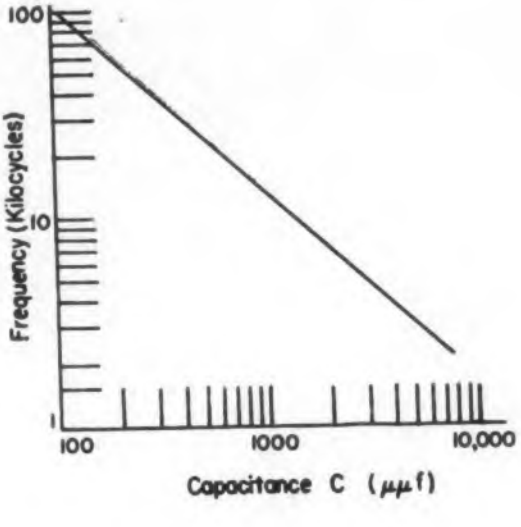


Fig. 10. When both feedback circuits of Fig. 7 are replaced by capacitors, a multivibrator results.



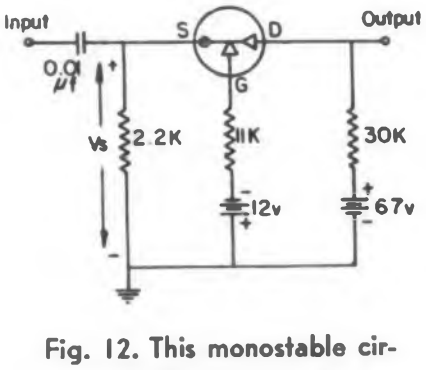
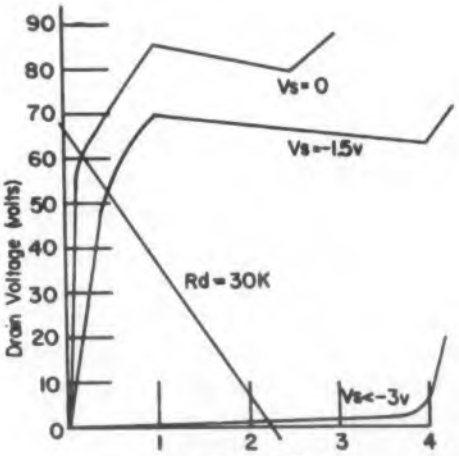


Fig. 12. This monostable circuit is similar to a point-contact transistor monostable arrangement. The diagonal line in the chart is the load line for the drain resistor.



DESIGN, July, 1955, p 39, Fig. 3), the coupling between the gate and the drain is a simple parallel r-c combination. In a narrow frequency band, we can easily neutralize[3] the inherent feedback caused by this r-c combination, thus achieving unilateralized amplifiers.

Additional Applications

The high input impedance of the field effect transistor makes it ideal in some applications, such as a pre-amplifier connecting to a high impedance microphone. However, in order to obtain reasonable efficiency, low pinch-off transistors are preferred. (W_o in the order of 10v). The typical input resistance ranges from 50,000 to 200,000 ohms; the transconductance is about 500micromhos. Thus, if a load resistance of 50,000 to 100,000 ohms is used, the power gain is 20 to 30db.

Field effect transistors of low pinch-off voltages can also be used in flip-flop circuits, such as the one shown in Fig. 7. Due to the similarity of field effect transistors to vacuum tubes, flip-flop circuits can be designed similar to that of vacuum tubes[4]. If the transistor *T-1* is in the conducting state, due to the large voltage drop across R_{d1}, the "drain" of *T-1* is at a low positive voltage and its "gate" voltage will be near to ground. Because of the voltage dividing action of R_1 and R_2, the gate of transistor *T-2* will be at a negative value that is more than sufficient to pinch off transistor *T-2*. The drain of *T-2* will, therefore, rest close to E_d, causing the gate of *T-1* to rest near ground. This state is a stable one since small changes of the drain voltage of *T-1* will not move the gate voltage of *T-2* above pinch-off, and will, therefore, produce no change at the gate of *T-1* and no further change at the drain of *T-1*. If by means of a trigger the gate of *T-2* is moved more positive than the pinch-off gate voltage, the circuit becomes regenerative and a rapid transition to a second stable state occurs, i.e., *T-1* non-conducting, *T-2* conducting. Since the drain voltage is positive while the pinch-off gate voltage is negative, a negative gate bias is required. For transistors of high pinch-off voltage, the gate bias required will be unreasonably high. Hence, it is necessary to use transistors of low pinch-off voltages (10 to 15v) in a flip-flop circuit. One advantage of this flip-flop circuit is the large output voltage swing. For example, the circuit shown in Fig. 7 gives 50v swing at the repetition rate of 100kc. With a higher drain supply voltage, a higher output swing can be obtained. By replacing one of the feedback circuits by a capacitor C in the order of thousands of microfarads, the circuit becomes a monostable circuit. With an input pulse of 0.6μsec, the output pulse width varies with the value of C, as shown in Fig. 8. A variation from 10 to 120μsec in pulse width was observed. The output voltage swing is about 50v.

When both feedback circuits are replaced by C (see Fig. 10), the circuit becomes a multivibrator. Due to capacitive coupling the negative gate bias is not necessary. The two diodes are placed to ensure negative gate voltage and to improve the waveform.

Injecting Drain Transistor Circuits

Field effect transistors with a carrier injection drain contact are characterized by a negative resistance region[2] in the gate input resistance curve. Using this property, bistable circuits, sinewave oscillators, relaxation oscillators, and monostable circuits shown in Figs. 9, 11, and 12 can be designed similar to the point contact transistor switching circuits[4, 5, 6].

The drain D, in the bistable circuit is biased positive. If the gate terminals are taken as the input terminals, a point by point measurement of the gate voltage and current characteristic can be found as shown in Fig. 12*. It has 3 regions of operation: one positive-low-resistance region, one negative-resistance region, and one positive-high-resistance region. It is apparent that if a proper gate load line is chosen as shown (G), three points of operation will be obtained. Among these points A and B are stable points, while C is an unstable point. At point A, the transistor is in the "on" stage, both the drain and gate currents are large; the "off" stage; both the drain and gate currents are small and the gate voltage is close to $-E_{G1}$. The off gate voltage will be dependent on the transistor characteristic. To modify this, a diode is used that clamps the gate voltage to $-E_{G2}$, and the off point is raised to point B. A positive voltage applied to the gate will switch the transistor from the off to the on state. A negative voltage applied to the gate will switch the transistor from the on to the off stage. The source load resistance is included so that the bistable circuit can be triggered at the source to obtain better trigger sensitivity. The maximum switching rate of this circuit is 25kc. The trigger sensitivity is poor due to the large pinch-off voltage of the experimental field effect transistors used.

A sinewave oscillator circuit is shown in Fig. 9. When a parallel resonant circuit was used for the gate load, it presents a low d-c resistance. If the bias was selected properly, the d-c loadline (F) would intersect the gate input characteristic (H) in an unstable region and oscillation takes place. The highest frequency of oscillation was found to be about 300kc. The output can be taken by inductive coupling to the tank circuit.

Relaxation Oscillator

Using the source input characteristic shown in Fig. 11, we can design a relaxation oscillator. First, we chose a load line that intersects with the input characteristic on the upswing. This region is unstable. If a capacitor is placed across the source as in Fig. 11, relaxation oscillations will occur. The frequency of oscillation depends upon the r-c time constant. When the negative charge on the capacitor makes the source voltage more negative than the voltage of the valley point, the transistor will turn on and stay on until the capacitor discharges to a point where the source is more positive than the voltage of the peak point. At this time, the transistor will turn off. Once it is off, the capacitor will be charged up again and the cycle repeats. The maximum frequency of oscillation obtained was 6kc.

The monostable circuit illustrated in Fig. 12 is similar to the monostable circuit of a point contact transistor. The output pulse width is controlled by the input pulse width and amplitude. The transistor is biased in the off region by using a large drain load, as shown in Fig. 12. If no input is applied, the transistor will stay off. When a negative pulse larger than —3v is applied to the source, the transistor will turn on. The transistor will stay on until the voltage on the source drops to a point where the gate diode is biased in the reverse direction, then the transistor will turn off and stay off until the next pulse.

* Mr. Khandki, General Electric Co., has pointed out that in the positive gate voltage and current quadrant, the characteristic would be similar to that of the double base diodes.

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(2) G. C. Dacey and I. M. Ross, "Unipolar 'Field Effect' Transistor", *Proc.I.R.E.*, Vol. 41, Aug. 1953, pp. 970-979.

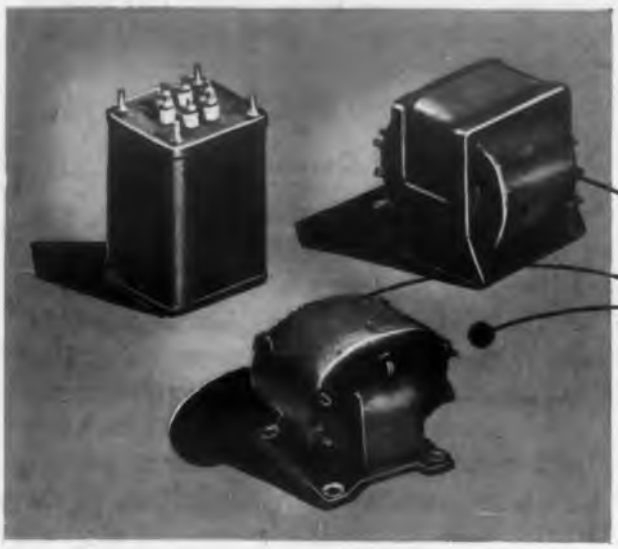
(3) See, for example, Cruft Lab Staff "Electronic Circuits and Tubes", N.Y. and London, McGraw-Hill Book Co., Inc., 1947, pp. 450-451.

(4) See, for example, W. C. Elmore and M. Sands, "Electronics Experimental Techniques", N.Y. and London, McGraw-Hill Book Co., Inc., 1949, pp. 78-123.

(5) A. W. Lo, "Transistor Trigger Circuits", *Proc.I.R.E.*, Vol. 40, Nov. 1952, pp. 1531-1540.

(6) A. E. Anderson "Transistors in Switching Circuits". *Proc.I.R.E.*, Vol. 40, Nov. 1952, pp. 1541-1558

Do you have source spots?



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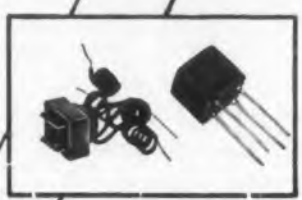

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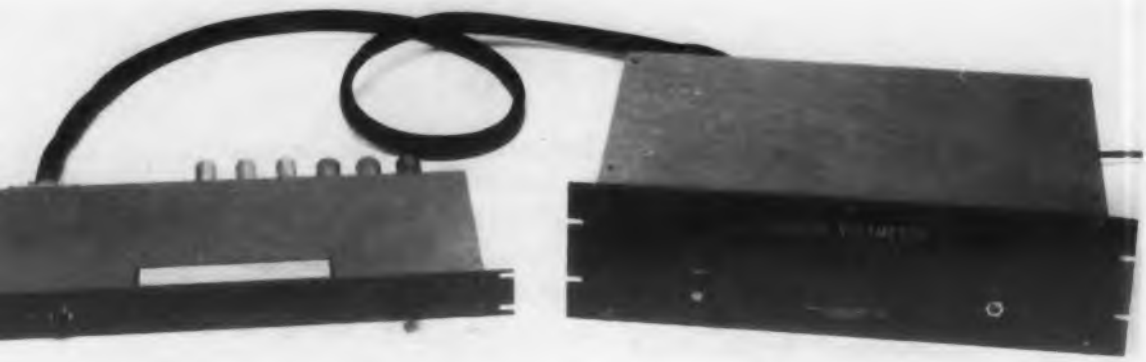


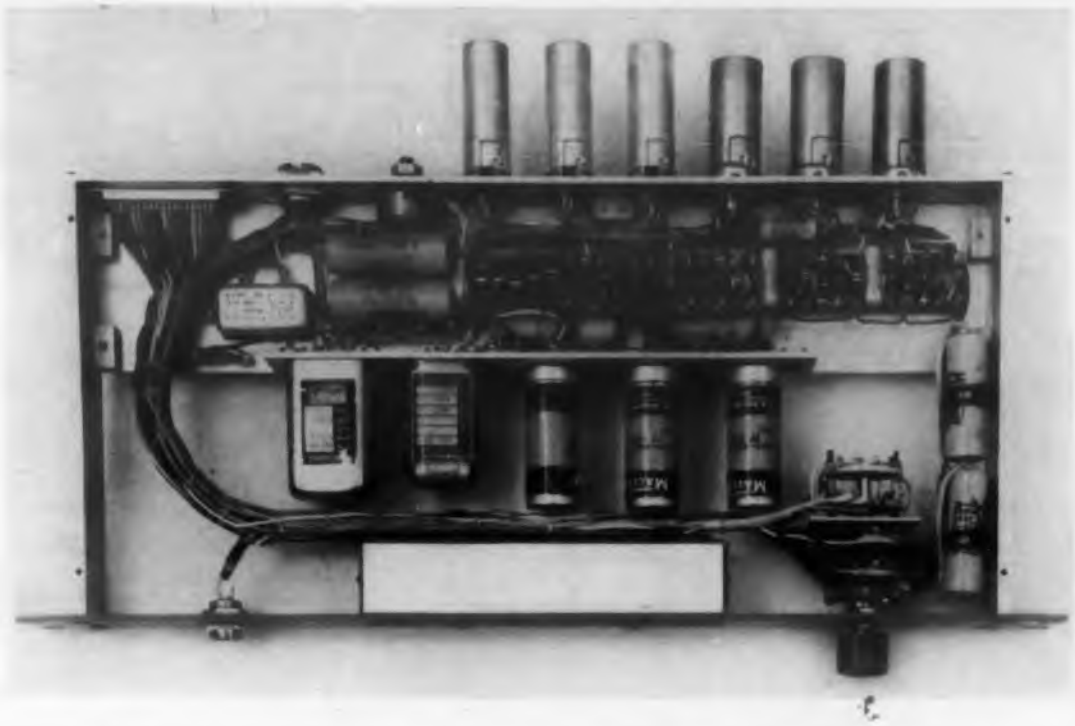
Three-digit indicator panel is 1¾" high. Overall size of instrument is 7" x 19". Input impedance is 11M.

A-C—D-C Digital Voltmeter

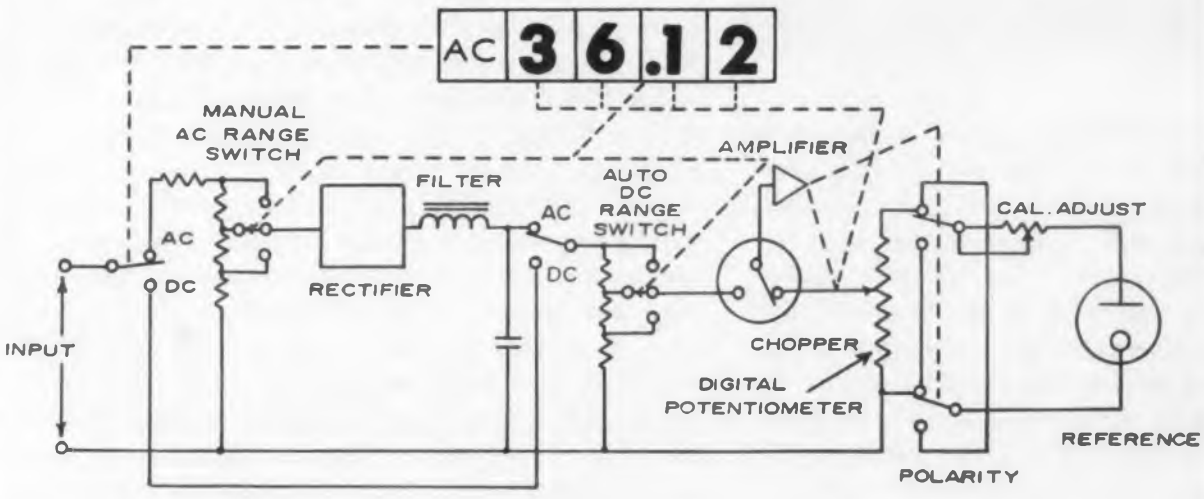
ANALOG computer engineers can use this a-c/d-c digital voltmeter as a converter for digital readout, automatic print out, or card punching. It may be used to set a-c and d-c computer reference voltage. Because of accuracies, 0.1% from 30-10,000cy for the larger model, the device may be used as a laboratory standard for meter calibration. It is desirable as a test device for unskilled operators as readings are practically error-proof.

Two models of the A-C—D-C Digital Voltmeter are available from Electro Instruments, Inc., Old San Diego Station, San Diego 10, Calif. The compact 1-3/4" panel indicator (top illustration) is the less accurate version being rated at 1%. The four-digit lab model, illustrated below, is accurate to ±1 digit rms or d-c. A-c scales are 10, 100, and 1000, selected manually. D-c scale and polarity selection is automatic from 0.001 to 999. For more information turn to the Reader's Service Card and circle **38.**

Four-digit unit has 0.1% accuracy. Switch selects a-c or d-c. Size is 14" x 19".



Selected, aged resistors are used to assure stable reliable life. Flat design aids installation with other equipment.



The a-c/d-c digital voltmeter with illuminated digital readout consists of a self balancing d-c bridge in combination with a feedback rectifier system which converts the average value of an a-c voltage to d-c. Calibration is adjusted to indicate rms voltage of a sine wave. There is virtually no zero phase shift error. Read time on a-c balance averages 2sec; on d-c 1sec.

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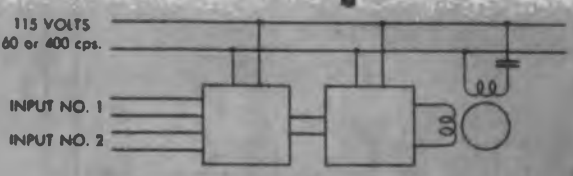

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Supply: 115 volt 400 cps.
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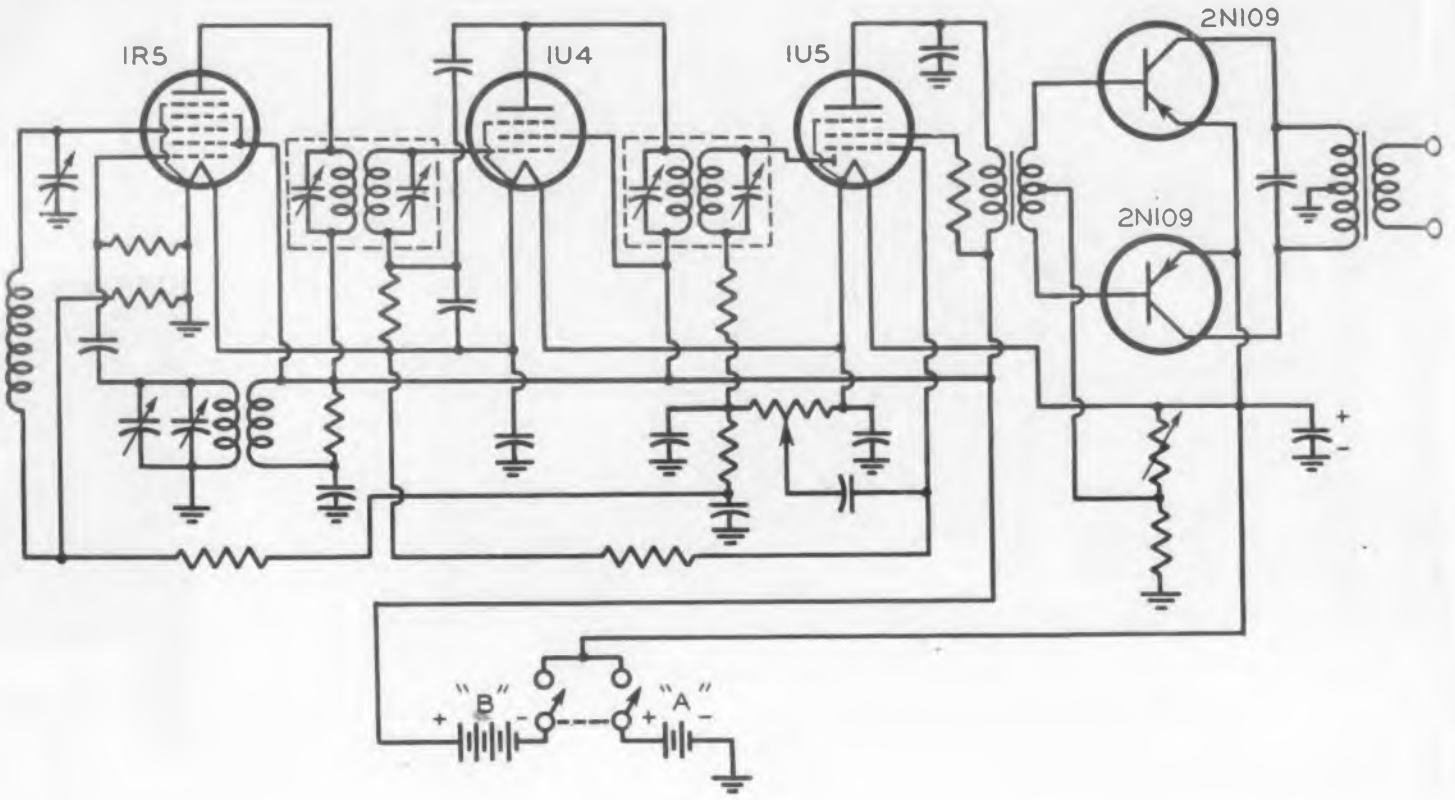
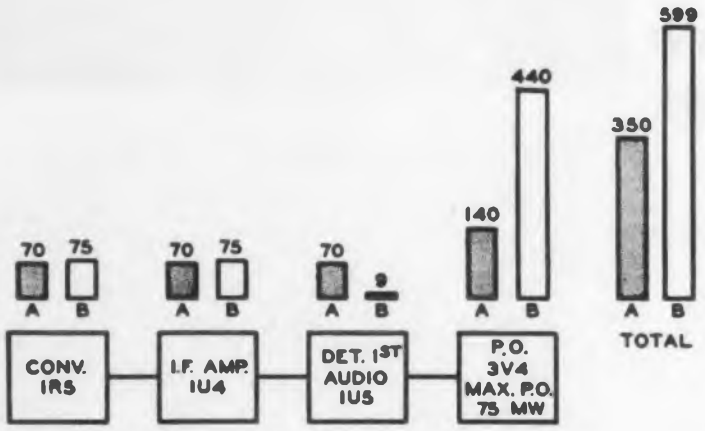
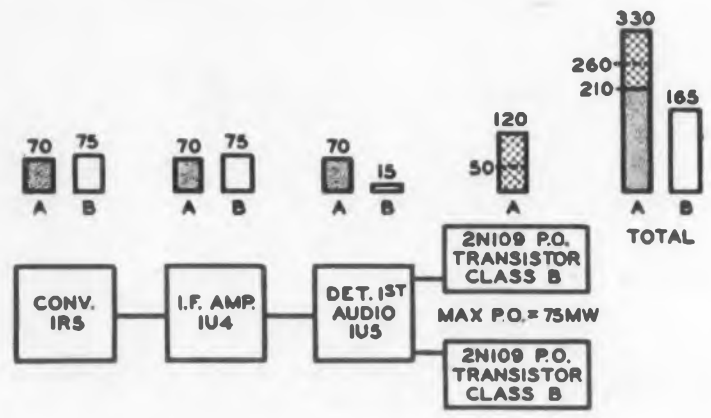
Hybrid Radio

K. E. Loofbourrow
Tube Div., Radio Corp. of America,
Harrison, N. J.





Stage-by-stage battery power needs in milliwatts for an all-tube portable above and a hybrid radio below. Dotted lines indicate normal conditions. "A" and "B" stand for A and B batteries, respectfully.



Editor's Note: Class B operation of transistors at audio frequencies in the power-output stages of portable amplifiers was extensively analyzed in a recent article by Mr. Loofbourrow in ELECTRONIC DESIGN (July, 1955, pp. 28-31; August, pp. 34-37). *A proposed application using transistors in this manner is presented here.*

USING junction transistors in class B in hybrid receivers in place of a power output tube effect an increase in available power output and a substantial reduction in required battery power, as illustrated. Approximately 75% of the relativey expensive B-battery power and 40% of the less expensive A-battery power is consumed by the output stage. When transistors are used in the output stage of the receiver, a considerable saving in battery power can be obtained. It should be noted that the power for the transistor output stage is obtained from the A-battery supply. The battery-drain value given for the receiver using transistors is higher than that which would occur in normal operation because the power consumed by the output stage in class B operation varies with the signal level. The value given represents continuous operation of the receiver at maximum power output under sine-wave conditions. Under conditions of normal speech and music, the average power consumption would be cut as shown.

A circuit diagram of a part-tube, part-transistor battery-operated portable radio receiver is illustrated. The tube filaments, which originally were connected in parallel, are connected in series so that a common supply voltage can be used for the filaments and the transistors. Consideration must be given in this circuit to the normal biasing arrangements required with series-string operation of tubes. The operating conditions of the pentode section of the first audio stage are modified to provide adequate driving power for the transistor output stage and to increase the over-all power sensitivity of the audio system. The sensitivity of the resulting audio system is equivalent to that of receivers using a subminiature output tube and operating from a supply of 45v or less. This sensitivity is about 10db below the audio sensitivity of receivers using a miniature output tube similar to the *3V4* and operating from a supply of 67v. The sensitivity of all-tube receivers, however, generally decreases more rapidly with battery life

Schematic of a hybrid radio with two transistors operating Class B push-pull in the output.

than the sensitivity of the illustrated receiver. Consequently, any difference in performance between the two systems is reduced with battery life. In some existing receiver designs having an r-f stage, the loss in audio sensitivity is automatically compensated for by the r-f sensitivity, which is normally more than adequate. In many other receivers, additional sensitivity may be gained by modification of the i-f stage, or by use of more sensitive antennas and higher efficiency speakers.

As compared to an all-tube receiver, therefore, the part-tube, part-transistor receiver has nearly equivalent audio sensitivity, similar distortion characteristics, equal or greater power output with a maximum value that is more nearly constant with battery life, and considerably higher over-all efficiency. The greater battery efficiency can be used in either of two ways: (1) portable equipment can be designed to have extremely small size and light weight by the use of miniature batteries compatible in size with the low power requirements; or (2) portable equipment can be designed using conventional battery sizes resulting in substantial improvements in battery life and a sizable reduction in operating cost/hr.

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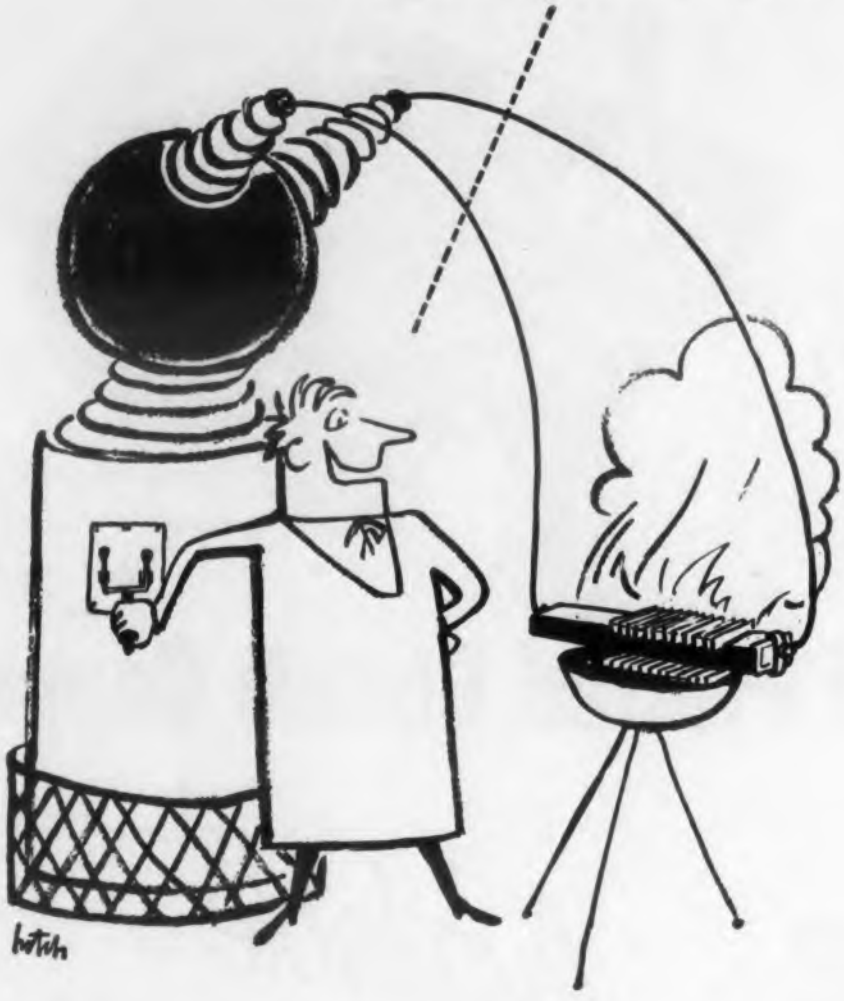

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The large coil uses the self-insulated foil, while the smaller coils use the uninsulated.

Self-Insulating Aluminum Conductor

Microscopic views of the foil edge show it when just slit (above). If anodized, points of possible low-voltage breakdown would be formed (white dots).

Special treatment transforms the rough edge into a semi-circular shape, which is uniformly insulated when anodized (as shown below).

ALUMINUM conductors in the form of thin stripping and coated with an insulating film of aluminum oxide offer an inexpensive and cost-saving material for winding larger transformer, inductor, and solenoid coils. Because the dielectric film is so thin, an aluminum strip-wound coil can be fabricated with the same volume and electrical characteristics as one made with heavier copper magnet wire. Since the coil is much lighter than a copper coil, important weight savings for airborne use can be realized. The coils can also be used at high temperatures.

Aluminum magnet wire has been in use for some time, and the possibilities of using aluminum oxide as the dielectric have been under investigation for many years, but the metal is still not in wide use as a conductor. By treating the burred edges of the stripping after slitting so that they have a semi-circular shape when seen under a microscope, the fabricator has produced a conductor that can be wound with only its own oxide as dielectric without fear of shorting at the edges. This advance makes the stripping competitive with copper wire. The stripping was developed by Reynolds Metals Co., 2500 Third St., Louisville, Ky.

The thickness of the oxide film is controlled by an anodizing process. The breakdown voltage through the film is about 1000v, while the breakdown voltage across its surface is 400v. Both these voltages are far greater than any inter-turn voltages likely to be encountered. The film is very hard and has a higher melting point than aluminum itself. It is also transparent.

Although the stripping is of primary interest to the electrical industries and utilities, it can be fabricated in forms suitable for the larger types of power transformers for electronic devices. It is available in thicknesses from 0.004″ to 0.04″, and in widths down to one inch. It may eventually be slit to widths of 1/2″ or 1/4″. It is also made without anodizing, and in this form requires some dielectric material between turns. It is less expensive to construct the smaller solenoid coils of the uninsulated variety. This conductor can not be used in motors of the size employed in electronic devices and instruments.

The stripping can be bent down to a 1/2″ radius without crazing the oxide film. Below a 1/2″ bending radius, the film will crack. However, the material is still useable since the air entering the cracks is a suitable inter-turn dielectric. There are no hot-spot problems with these coils. Heat generated in the center of the coil is carried out to the edges by the conductor itself. Transformers made with this material have been successfully operated at 250°C, and could run at even higher temperatures. For more information on this conductor, turn to the Reader's Service Card and circle **42**.

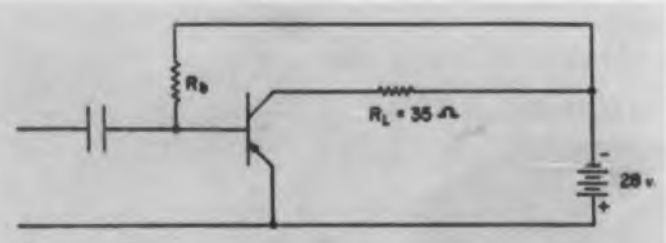


Fig. 1. Class A resistance-load circuit.

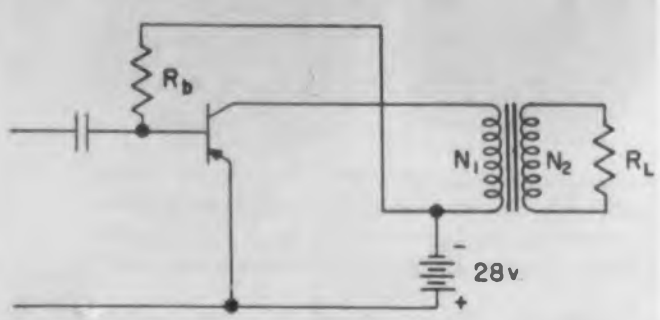


Fig. 2. Class A transformer-coupled circuit.

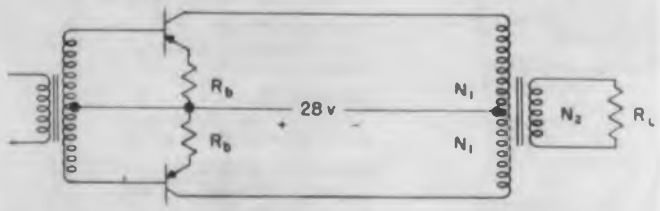


Fig. 3. Push-pull Class B amplifier circuit.

Design Procedures for Power Transistors - III

Howard T. Mooers, Transistor Engineering
Minneapolis-Honeywell Regulator Co.
Minneapolis, Minn.

ALTHOUGH power transistors are capable of high currents, it is often desirable to use them at a high voltage and low current, rather than at low voltage and high current. As explained in Part II of this series (*ED, Sept. 1955, p 42*) to attain the highest power output, the transistor must be mismatched considerably. Table at right shows common emitter circuit is often best choice.

Class A Resistance Load Circuit—Assume the problem is to design a Class A resistance load circuit using the common emitter configuration to deliver 2-1/2w from a 28v supply, Fig. 1. In order to deliver 2-1/2w of Class A power from a 28v supply, the load resistor must be equal to or less than 40 ohms for a perfect amplifier. Because of the leakage current and the saturation resistance, a slightly smaller load resistor is necessary for transistor circuits. If a load resistance of 35 ohms were chosen, its load line would have intercepts of 28v and 0.8amp on the output characteristic chart. The Class A quiescent power dissipation would be about 5.6w, and it is assumed that the temperature of the transistor can be kept at or below the temperature limit for this dissipation.

For a distortionless amplifier, the bias point will be at a collector current of 0.4amp. This will produce a 14v drop in the load resistance and the remaining 14v will be across the transistor. In order to maintain the quiescent current of 0.4amp, a base current of about 25ma is required at a bias voltage of 2.7v. The value of the biasing resistor R_b is then:

$$R_b = \frac{28 - 2.7}{0.025} \cong 1000 \text{ ohms}$$

If this circuit were driven with a low impedance source, a peak voltage of 2.7v would drive the instantaneous operating point to each extremity of the load line. The input impedance of the transistor varies so that the peak value of input signal current is only 25ma to cut off the transistor, but it is about 90ma to drive to the saturation point. Consequently the source impedance must be low to get this output at low distortion.

If a high impedance source were used, distortion would be present due to the non-linear current gain of the common emitter circuit, and the full 2-1/2w output could not be achieved without clipping. By changing the bias point, a high impedance source may be used and clipping can be avoided, but the distortion will be high at full output. For this case the bias point should be I_b = 57-1/2ma at 4v and I_c = 0.58amp, so the value of R_b should be:

$$R_b = \frac{28 - 4}{57\text{-}1/2} \cong 417 \text{ ohms}$$

With this new bias point, a peak signal current of 57-1/2ma will drive to cut-off and saturation, but the positive and negative output peaks will not be equal and will give a second harmonic distortion of:

$$H_2 = \frac{(I_{max} + I_{min}) - 2\,I \text{ quiescent}}{2(I_{max} - I_{min})}$$

$$= \frac{(0.78 + 0) - 2 \times 0.58}{2(0.78 - 0)} = 24\%$$

Intermediate values of source impedance will require intermediate bias points for optimum performance and will have less distortion than for a high impedance current drive source.

The power input to this stage is approximately:

$$P_{in} = \frac{(E_{max} - E_{min})\ (I_{max} - I_{min})}{8}$$

$$= \frac{5.4 \times 0.115}{8} = 77.6\text{mw}$$

so the power gain is about: G_p = 15db

The bias point for this circuit may shift somewhat with temperature. At elevated temperatures the leakage current will increase and tend to cause the collector current to be greater, while the gain will decrease and tend to cause the collector current to be less. At the higher current levels, the gain variation will overpower the change due to leakage current, and the collector current will be reduced at elevated temperatures. The bias point can be controlled by using a negative temperature coefficient resistor for

R_b. The changes in the bias point for this circuit will not tend to cause run-away. As the current increases the voltage impressed on the transistor is reduced so the bias point is always located on the load line which is determined only by the supply voltage and the load resistance.

Class A Transformer Coupled Circuit—The quiescent voltage for the circuit of Fig. 2 is 28v, and to deliver 2-1/2w from a distortion-free amplifier the load resistor should be such that $(N_1/N_2)^2 R_L = 140$ ohms and the quiescent collector current should be 0.2amp. The base bias required for this circuit is 8ma at 1.2v, so the value of R_b will be:

$$R_b = \frac{28 - 1.2}{} \cong 3350 \text{ ohms}$$

At full drive the transistor will operate between 56v and 400ma and will have 23db gain. This is an 8db increase over the previous circuit. The better matching accounts for 6db of this increase, and the higher gain at low currents accounts for 2db.

If a low impedance voltage source is used for driving the transistor, it will take 1.2v to cut off the transistor and 1.5v to drive it to saturation. Consequently the output signal will clip against the leakage characteristic before it delivers full power. This may be remedied by increasing the load resistance slightly which allows the peak voltage to be somewhat higher than 56v. The slight nonlinearity of the transconductance will produce some distortion.

With a high impedance current drive, the nonlinearities are much worse. The current can be cut off by a 8ma peak signal, but it will take about 22ma peak signal to drive the transistor to saturation. Full drive along the load line cannot be achieved by increasing the load resistance or bias current without causing the peak voltage to be in excess of the rating. With transformer coupling, an increase in bias current does not move the bias point down the load line as in the first case. An increase in the bias current simply moves the quiescent operating point to the right and moves the load line along with it.

The best way to realize the full swing along this load line with constant current drive is to reduce the supply voltage to about 15v and increase the bias current to 15ma. This type operation will give the high distortion which is characteristic of power transistors driven from high impedance signal sources, but it will provide operation to the extremeties of the load line.

Push-Pull Class B Circuit, Fig. 3.—In order to deliver 10w push-pull from a 28v supply, the peak collector current must be about 0.8amp. The load line on the characteristic to describe this operation would have intercepts at 28v and 0.8amp. The resistance that each transistor drives must be 35 ohms. Thus $(N_1/N_2)^2 R_L = 35$ ohms.

The collector to collector impedance will be 4 times this, (140 ohms), but neither of the transistors has this for a load. In order to drive to the full 0.8amp, this 35 ohm load resistance must be reduced by the amount of resistance inserted as R_b, emitter stabilizing resistor controlling leakage current.

The necessary value of R_b will depend upon the total thermal resistance, the junction operating temperature, the leakage characteristic of the unit, and the d-c resistance of each half of the secondary winding of the driving transformer. It therefore is quite important to reduce as far as possible the d-c resistance of the driving transformer secondary.

At extremely low temperatures, the transistors exhibit an input threshold characteristic such that the gain for very small signals is low. This characteristic may be offset by using a slight Class A bias, so the transistors will be operating Class A for small signals and Class B for larger signals. This bias may be established by connecting each base through a high resistance to the negative supply, or the transformer could be capacitively coupled to the bases which are connected to a voltage divider.

For audio work where the crossover distortion is

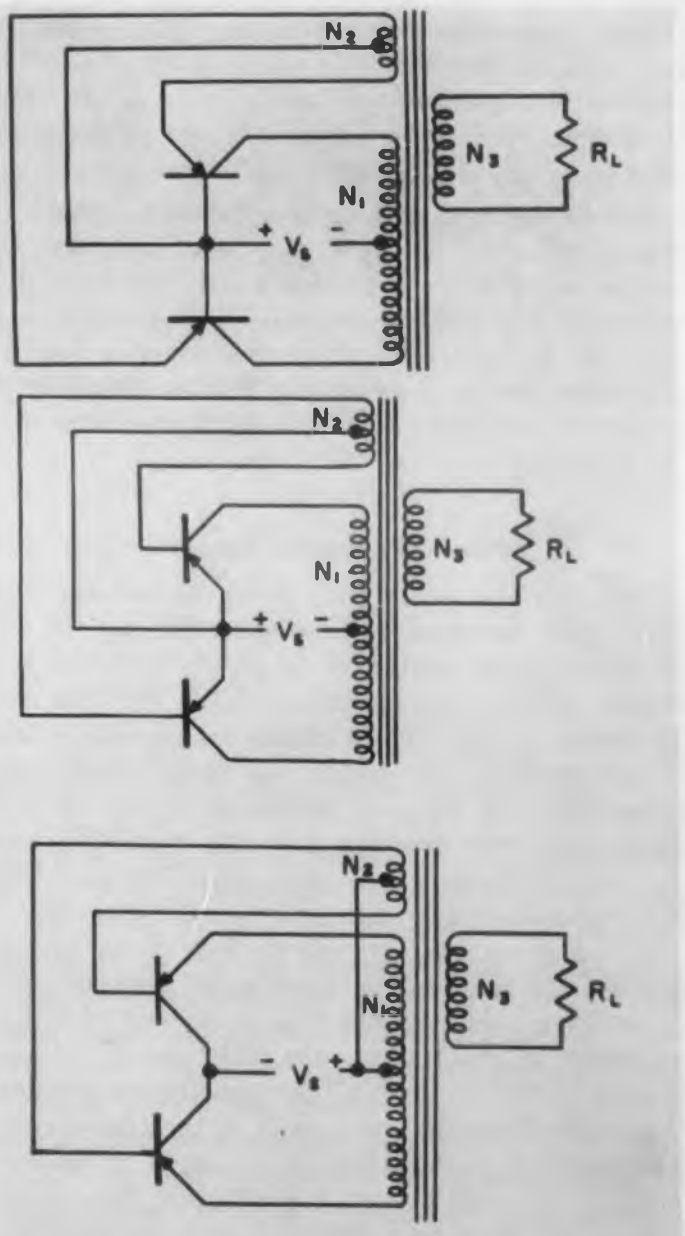
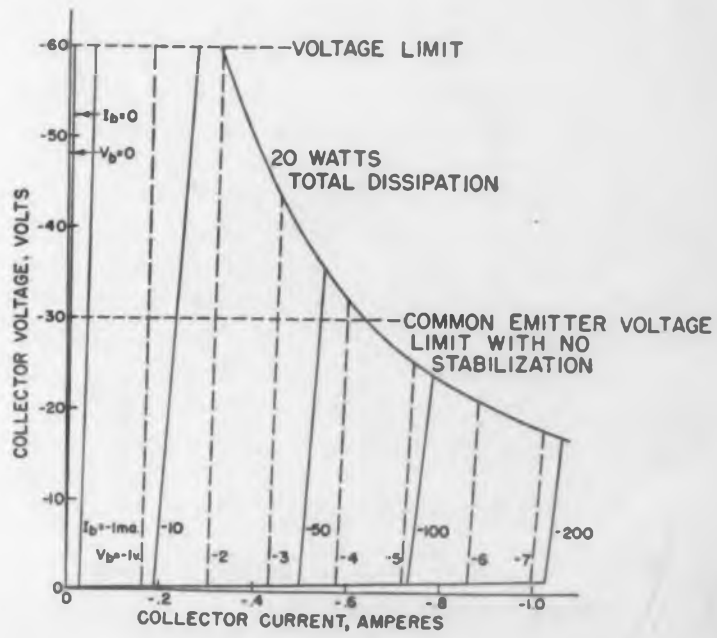


Fig. 4. Suggested power converter oscillator circuits: *a* (top) common base, *b* (middle) common emitter, *c* (lower) common collector.

Quantity	Common Base	Common Emitter	Common Collector
Bias + signal peak driving current	High $I_b + I_c = 1.2$amp	Low $I_b = 0.2$amp	Low $I_b = 0.2$amp
Bias + signal peak driving voltage	Low $V_{eb} = 7$v	Low $V_{be} = 7$v	High $V_{be} + V_{out} = 61$v
Input impedance at full drive	7ohm	35ohm	300ohm
Output impedance middle of characteristic	7,000ohm	700ohm	7ohm
Full power output	6.25w	6.25w	7.5w
Gain at full power	5db	16db	4db
Distortion for voltage drive	Low	Low	Low
Distortion for current drive	Low	High	High

Table shows common emitter is best all-purpose circuit from gain, distortion, and impedance-level factors. *2N57* common emitter characteristics with base at 70°F at right.



of great importance, it may be desirable to connect the emitters together and return them through a common bias resistor equal to R_b. The common resistor attempts to have one and only one of the transistors conduct, thus reducing the crossover distortion.

Due to the push-pull circuit, the even order harmonics will tend to cancel and leave only the odd harmonics, of which the third will be the most predominant. If harmonic distortion is important, it is desirable to drive the transistors from a low a-c impedance source because the transconductance of power transistors is generally much more linear than the current gain.

Power Converter Circuit

The circuit shown in Fig. 3 can be coupled back upon itself to create an oscillator. The output will be square wave and may be easily rectified and filtered at any output voltage level. In this configuration, a pair of *2N57* transistors can deliver 20w of square wave a-c power. All three circuit configurations may be used as shown in Fig. 4. The efficiency of the transistor is better than 95%, and the overall efficiency can vary from 70% to about 90% dependent upon the transformer efficiency.

The oscillator switches mainly due to the saturation characteristic of the transformer core material. Considering each transistor as a switch, when one transistor is conducting, the full supply voltage appears across one half of the transformer winding. Dependent upon the turns ratio of the transformer, a voltage will be developed on the input of the conducting transistor to keep it conducting. The output voltage will also be constant at a level dependent upon the turns ratio and supply voltage. When the core saturates, the driving voltage falls off which restricts the current causing further cut-off. The collapsing field applies a conducting bias to the input of the alternate transistor which immediately turns on and conducts current for the other half cycle. These circuits need no temperature stabilization because the leakage current is cut off as far as possible during the non-conducting part of the cycle. At full conduction the power dissipation is low and the collector voltage is nearly zero, making runaway of no concern.

Because of the voltage doubling effect of transformer coupling, a supply voltage greater than 30v cannot be used in these circuits without exceeding the 60v limit of the transistors. The leakage inductance between the two halves of the primary winding should also be as low as possible or the collapsing field in one half of the winding will not be completely coupled to the other half, and over-voltage spikes may be produced.

In order to deliver 20w output with a 28v supply, a peak current of 0.800amp will be required. The input drive for Fig. 4a and 4b will be about 5.6v. Allowing a little drop in the feedback winding, the turns ratio should be $N_1/N_2 < 28/5.6$.

The feedback winding of Fig. 4a should be capable of a peak current of about 1amp, and for Fig. 4b about 0.12amp.

The turns ratio for Fig. 4c should be $N_1/N_2 < 28/28 + 5.6$ and the current capacity of the feedback winding should be 0.12amp.

For any given transformer, the frequency will vary directly with the input supply voltage. The output voltage will be approximately $V_{out} = N_2/N_1 (V_s)$. Of considerable importance in inverter and other types of switching service is the point of high dissipation (instantaneous peak product of collector voltage and current) as the transistor switches from on to off.

With an ohmic load line connecting the high current low voltage condition with the high voltage low current condition, there is evidence that traversing the high dissipation region quickly in 1 to 10μsec will permit exceeding the standard dissipation rating.

For example, an inverter with a peak dissipation in excess of the published rating can operate without apparent difficulty when the transistor case is as high as 85°C with as much as a 2μsec switching time.

However, in many cases, the load line is far from ohmic, particularly for the cut-off cycle in transformer coupled devices. Voltage swings of many times the supply voltage can occur simultaneously with high peak currents when the load appears as a nearly pure inductance. The only safe design approach is to monitor the V_c vs. I_c trace on an oscilloscope under all anticipated operating conditions.

Interstage Coupling Methods

Transformer coupling is one of the easiest, although the most expensive, methods of coupling between successive stages. It provides d-c electrical isolation between stages, and generally allows increased stage gain because of better impedance control. For driving a power transistor which has a varying input impedance, transformer coupling permits the matching of input characteristics to the region where the greatest gain is desirable. In a Class B null balance servo system, the gain and sensitivity should be greatest in the region near null. This may be accomplished by matching the transformer to the high input impedance that exists at very low currents. The gain of the stage will drop with higher signals, due to both the increasing mismatch and the decrease of transistor gain at high currents. This is not undesirable for null balance systems, and prevents the amplifier from overloading at large signal drives. The only requirement on the system is that, at or above a certain signal level, the output device must be traveling at full speed in the direction of null balance.

For linear applications, the transformer may be designed to cause a good impedance match at high currents and mismatch at lower currents to compensate for the high gain at these low currents. In this manner the transistor may be matched dependent upon the gain characteristic desired.

The transformer design for single ended operation poses a problem in getting the characteristics desired with the current unbalance necessary in the windings. When this becomes too great a problem, it is often convenient to change to push-pull circuitry.

Capacitor coupling also provides d-c electrical isolation but the flexibility of impedance matching is lost. The operating point for each transistor is determined by its d-c load resistor and bias conditions.

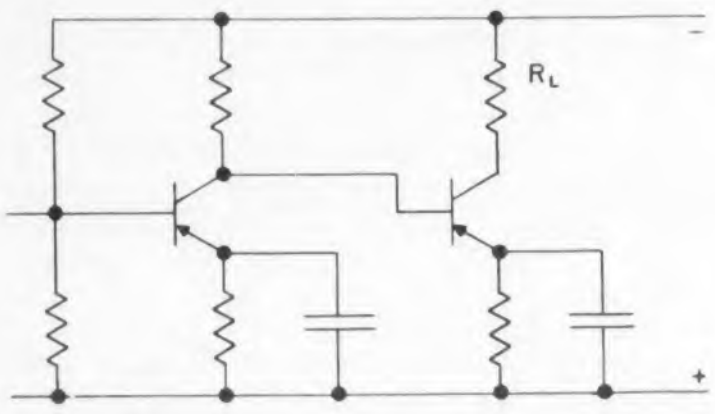


Fig. 5. Two-stage direct-coupled amplifier circuit, diagram using p-n-p type transistors.

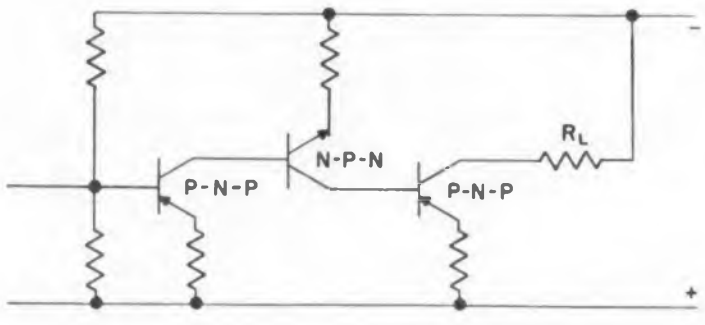


Fig. 6. Three-stage direct coupled complementary symmetry circuit using p-n-p and n-p-n types.

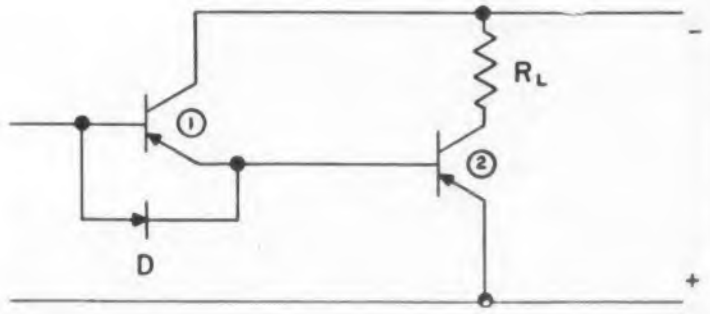


Fig. 7. Composite direct-coupled transistor amplifier circuit using diode for cutoff.

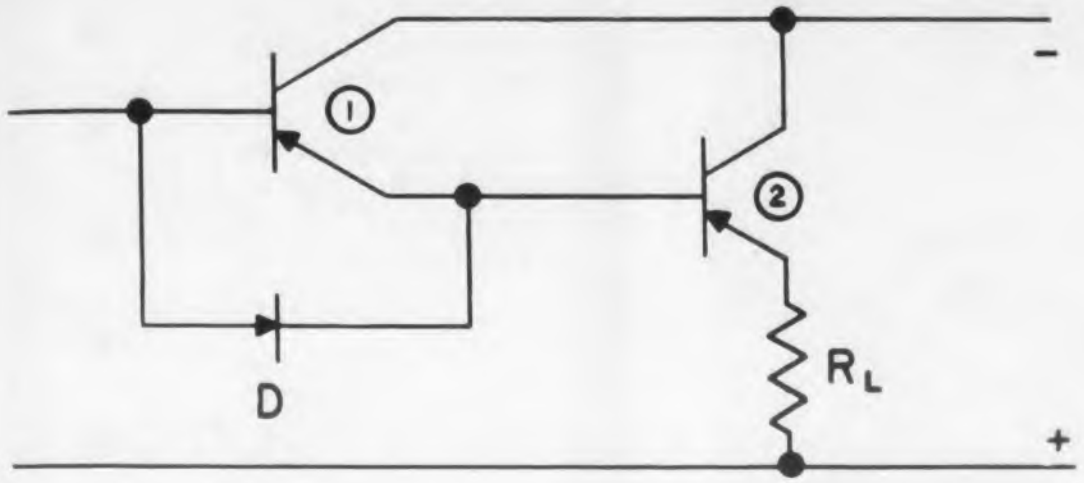


Fig. 8. Composite direct-coupled transistor circuit with high input impedance

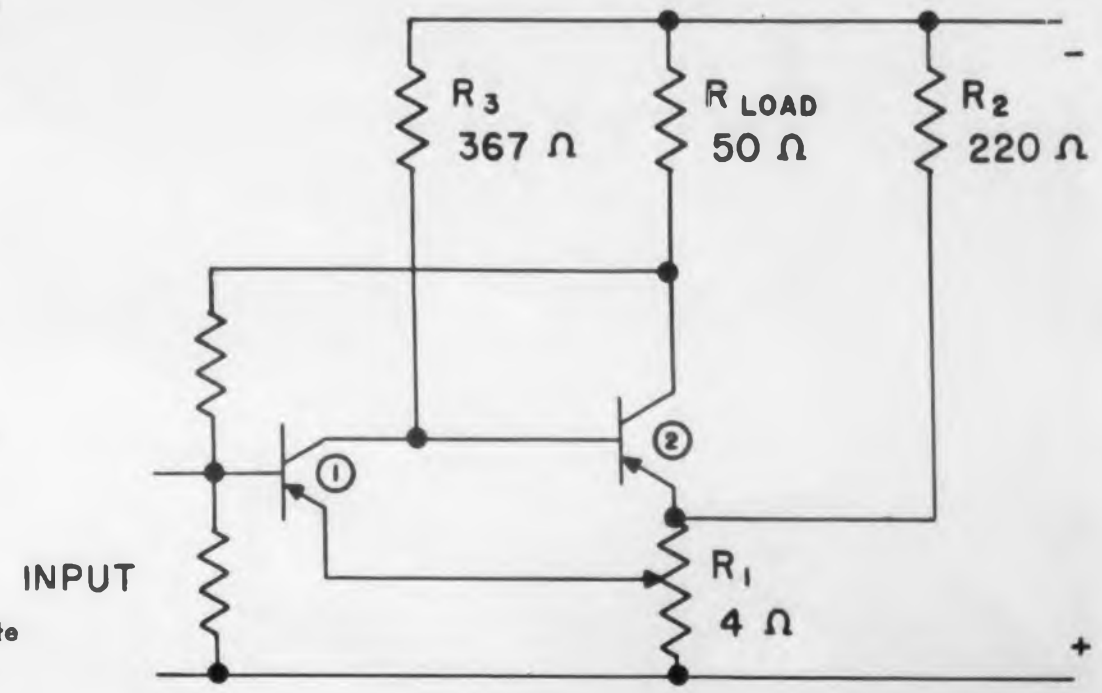


Fig. 9. Two-stage bistable circuit to operate as a switch circuit.

However, this is not the dynamic or a-c load resistance. The low input resistance of the following stage is in parallel with the d-c load resistance to determine the operating load line.

It may be possible to achieve better over all gain for two stages which are capacitor coupled by using a circuit configuration for the second stage which may have lower gain but higher input impedance. This allows the first stage to operate closer to its optimum gain level.

Capacitor coupling uses more components, but with the exception of the capacitor, they are small and inexpensive. The low input impedances of transistors usually require large capacitors to avoid phase shift in the amplifier. These capacitors are neither physically small nor inexpensive.

Direct coupling has the advantage of using the fewest components, but the stages are not electrically isolated for d-c. This allows a d-c input signal to be amplified, but it also allows the leakage current of each stage to be amplified by succeeding stages. Therefore, special attention must be paid to the stability of leakage current in direct coupled circuits. In spite of these disadvantages, direct coupled circuitry is often a desirable choice. The design procedures for the direct coupled circuits shown are the same as for iterated single stages except that the collector current and voltage of the first stage usually becomes the base current and voltage of the second stage etc.

The diode *D* shown in Fig. 7 and 8 will permit both transistors to be cut off by permitting the base of transistor *2* to become positive and thus provide all of its leakage current. Without the diode, the base current of transistor *2* would only approach zero and not reverse, giving amplified leakage current in transistor *2* when transistor *1* is cut off.

With these circuits it is often simpler to design the last stage first and build the circuit backwards until the input stage is reached. Generally it has been desirable to limit direct coupling to just two stages, and then provide isolation to the rest of the circuit which may also be two stages direct coupled. Fig. 8 shows the manner of using a composite transistor circuit to achieve high input impedances. The value of the input impedance will be:

$$r_{in} \cong \frac{R_L}{(1-\alpha_1)\,(1-\alpha_2)}$$

where α_1 and α_2 are the current gains of the two transistors at these operating points.

Switching Circuit

With two stages, a circuit can be made bistable to operate as a switch. The circuit shown in Fig. 9 is such that when the first transistor is conducting, the second is cut off. When the first units is cut off, the second is conducting to its full extent. If the supply is 28v, and 0.5amp are required for the load, the available voltage across the load will be perhaps 25v d-c. The load resistance then must be 50 ohms.

If the second stage is a *2N57* transistor, it will require a base current of 50ma which flows through R_3. When transistor *1* is made to conduct, it supplies this current through R_3 and transistor *2* is forced to cut-off. If the first stage is also a *2N57* transistor, it will require a 2 or 3ma base current to produce the current in R_3 to provide cut-off. In order for transistor *1* to be able to pass current in R_3, its collector must be more positive than the emitter of transistor *2* at cut-off. In fact, this potential difference holds *2* cut off while *1* conducts.

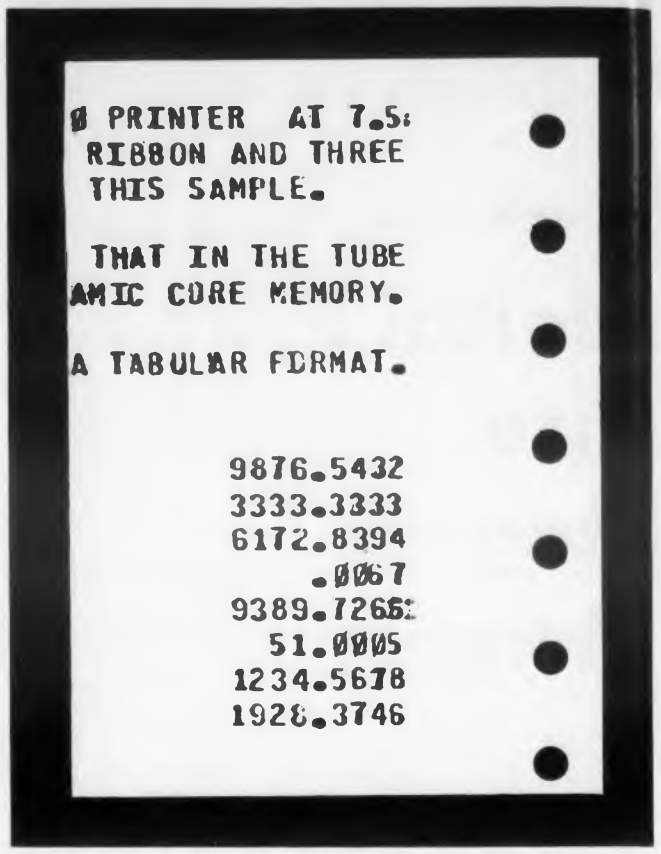
If the "bottoming," or saturation, voltage of the first transistor is 1/4v at its full current of 60ma, the emitter bias of the second transistor when it is non-conducting should be perhaps 1/2v to insure cut off. When the second transistor is fully conducting, there will be 25v across the load, about 1/2v across the transistor, and thus 2-1/2v are allowed across the emitter resistor. To satisfy these conditions the emitter resistance, R_1, must be approximately 4 ohms and the voltage divider resistor, R_2, associated with it, must be about 220 ohms.

When the first transistor is cut-off and the second one conducting, there will be a 2-1/2v drop across R_1 and 3-1/2v from emitter to base of *2*. Thus the value of R_3 is determined by the voltage drop across it (28 — 2-1/2 — 3-1/2 = 22v) and the required base current for full drive (50ma calculated, allow 60ma). The resistance R_3 should be 367 ohms.

The bistable mechanism is accomplished by returning the emitter of transistor *1* to a tap on the emitter resistor of transistor *2*, and feeding a current from the transistor side of the load resistor to the base of the first transistor. If the emitter lead of the first transistor were attached 1 ohm from ground of the 4-ohm resistor, its emitter voltage would be 1/8v while it is conducting full and would be 5/8v while it is cut off. Since it takes about 1/2v to drive the first transistor to 60ma, this mechanism alone has almost enough variation to drive the switch.

By coupling the load voltage variation back to the input base of the first transistor, the remaining power to switch can be achieved at a reasonably high impedance level. This feedback circuit has the disadvantage of prohibiting full cut-off of the current through the load resistor.

If the load voltage feedback is used alone, a bias must be provided to keep the first unit cut off, or if it is not cut off completely, the value of R_3 must be reduced to handle this extra current.



A sample of printing done by the device.

PRINTING speed has been increased 50% and more than 1000 vacuum tubes have been eliminated from the "Flying Typewriter" High Speed Electronic Printer by substituting a magnetic-core for a vacuum-tube memory. The read-out device can be directly connected to some medium-size computers without requiring a magnetic tape buffer in between.

The earlier version printed 24,000 alphanumerical characters per minute compared to 36,000 for the new model. It contained 1500 tubes compared to less than 300 in the latest version. The printer is a product of Potter Instrument Co., Inc., 115 Cutter Mill Rd., Great Neck, L. I., N. Y.

Results are printed on 8-1/2" wide forms. The device is available in two models: an 80 columns and a 120 columns wide type, respectively. The latter prints 43,200 alphanumerical characters per minute. The unit comes in three parts: a 29" x 47" x 55-1/2" high printer; a 20" x 48" x 94" high magnetic storage and power supply; and a tape handler that fits into a 19" relay rack. Only one type wheel is employed. For more data on this high-speed printer, turn to the Reader's Service Card and circle **45.**

Digital Printer with Magnetic-Core Memory

The printer is one of the three parts of the unit.

Servo Analysis with Analog Computers

John D. Strong, Application Engineer

Princeton Computation Center,
Electronic Associates, Inc.

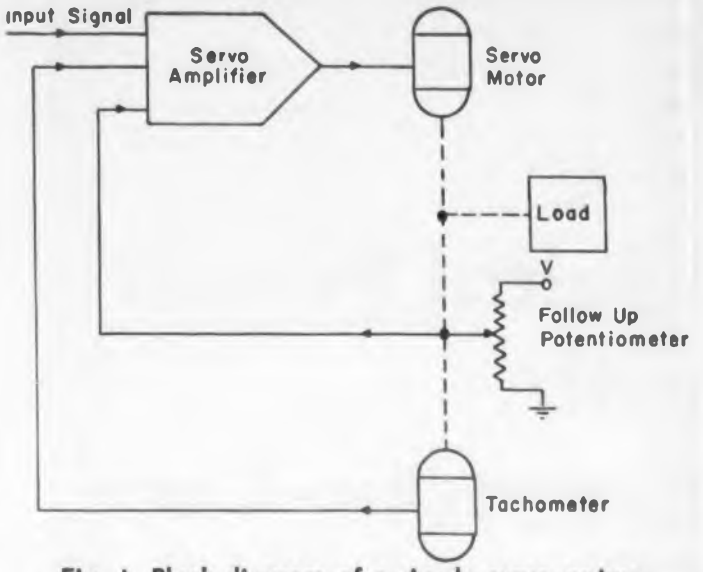


Fig. 1. Block diagram of a simple servo system.

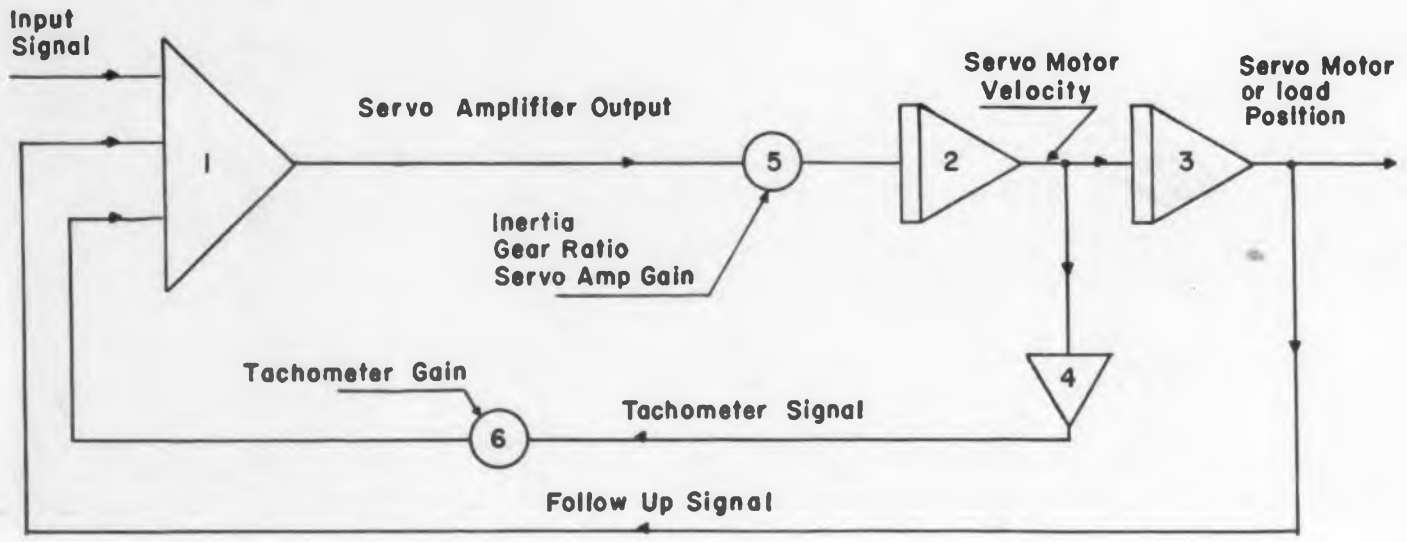


Fig. 2. Computer diagram simulating simple servo system.

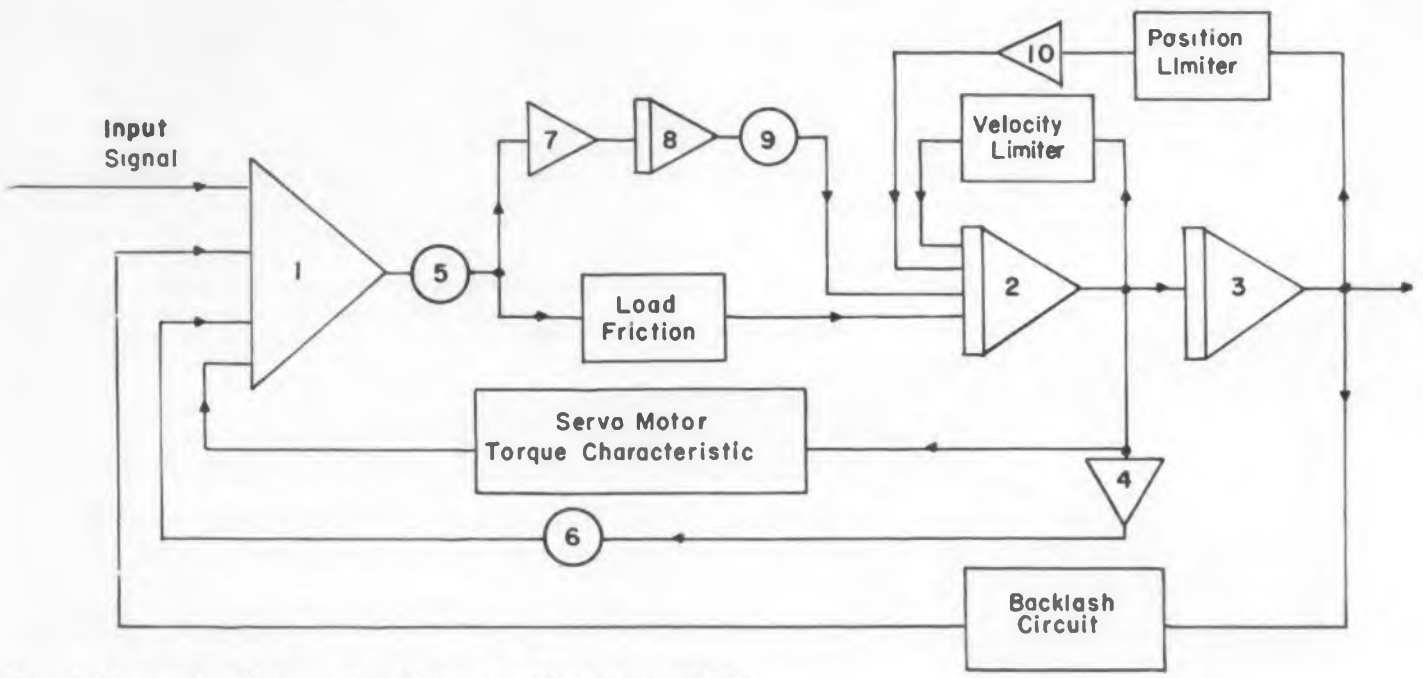


Fig. 3. Computer diagram simulating precision servo system.

ANALYSIS of automatic control systems is one of the most important and promising of the new fields for analog computers. The analog computer has behind it a substantial record of achievement in solving complex guided-missile trajectories and airframe design problems. But because the computer is simple to operate it is suitable for simpler circuit engineering problems. The average electrical engineer, with as little as 8hrs training and a weeks practice, can successfully set up and run routine problems. Computer methods for analyzing servo design, for example, are described in this article.

A typical servo system is diagrammed in Fig. 1. It consists of a servo motor which drives a load, a follow up potentiometer and a tachometer. Signals from the follow up and tachometer together with the servo input signal are added and amplified in the servo amplifier. The output of the amplifier provides electrical control power for the servo motor.

The computer diagram for this problem is shown in Fig. 2. Input signals may consist of steps, ramps, or sine waves, depending on the nature of the particular problem and are usually generated within the computer. Outputs consisting of load position or load velocity are plotted on a strip recorder.

The setting of attenuator *5* depends on several physical parameters such as amplifier gain, motor inertia, load inertia and motor-load gear ratio. The effect of a change in any of these parameters may be studied on the computer by an appropriate change in the setting of attenuator *5*. Changes in tachometer gain or inherent motor damping may be studied by an apporpriate change in attenuator *6*.

Other effects may be easily studied by suitable additions to the computer circuit as shown in Fig. 3. If the effect of large signals is of interest, it may

Mathematical equations or the simulated diagram describing the problem are set up on the computer patch board. The problem boards may be set up or "patched" external to the equipment, or while the patch board is in place in the computer. Numerical values for the constants and parameters in the problem are then inserted by means of the scale-factor, potentiometers, or attenuators. Potentiometers may be dial-set to within +0.5% of the proper value. Accuracy of +0.01% can be set by metering voltage. Since physical variables such as weight, temperature, or area are represented by voltages, arbitrary scale factors are used to relate voltages in the computer to these variables or parameters of the problem. These scale factors may be of the form 5v equals 1"; 100v equals 0.4 sq ft; −100v equals 2 oz, etc. Either positive or negative voltages up to −100v or + 100v can be used to represent physical quantities in the particular problem.

be necessary to simulate the velocity limits of the servo motor or the position limits of the load. The velocity limiter is connected in a straight forward manner around the velocity amplifier, but the position limiter is connected so as to reduce the velocity to zero when the position limit is reached.

Load Friction is simulated by a "dead-space" circuit between attenuator *5* and amplifier *2*. Its effect reduces the torque available from the servo motor by an amount equal to the load friction. In simpler problems, the torque is assumed proportional to the motor control voltage. In practice the motor torque varies with motor speed according to its torque characteristic curve. In general, the torque is maximum at zero velocity (called stall torque) and falls to zero at maximum velocity (called lock speed). This torque curve is roughly linear between these two points so that it may be simulated by an additional damping term and incorporated in the setting of attenuator *6*. In cases where the curvature of the torque characteristic is severe enough to be important, it may be simulated by a non-linear function generator between the output of amplifier *2* and the input of amplifier *1*.

Use of integral control in the servo amplifier may be simulated by amplifiers *7* and *8* with the gain adjusted by attenuator *9*. Other types of stability terms such as velocity rate or load acceleration may be simulated but are not shown in the diagram.

In many cases, effects can be easily studied on the computer which would be prohibitively expensive or time consuming on the physical equipment itself. The ease and economy of performing these studies on an analog computer make it an ideal tool for design of the servo mechanisms and feedback control systems.

Resistance-Pad Design Chart

Milton H. Crothers, Asst. Professor,
Electrical Engineering Dept., Univ. of Illinois, Urbana, Illinois

RESISTANCE matching pads are readily calculated with the chart shown on the right. Such networks are often used in audio frequency circuits and equipment to match source and load impedances. Resistance pads introduce attenuation between the input and output levels; in some cases the network is designed for minimum possible attenuation when the matching itself is important, in other cases the network attenuation itself is of importance in lowering the level. Resistance pads are also found in radio frequency circuits and equipment where matching, isolation, and attenuation are required.

The fundamental relationships that permit the design of resistance pads are given below. The source and load impedance values are given. The value of attenuation may be selected, provided that it is equal to or greater than the minimum attenuation permitted for the ratio of impedances to be matched.

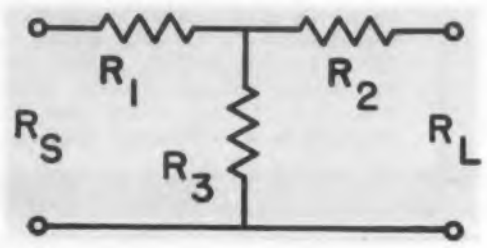
Negative values are not permitted for the element values in these networks. The value of attenuation must be at least equal to the minimum indicated in the nomograph where the minimum possible attenuation is plotted as a function of the ratio of impedances (or admittances) to be matched.

The design chart is operated in a manner much like the "Impedance-Admittance Matching Chart" (ELECTRONIC DESIGN, *March, 1955, pp. 68-69*). The operating instructions are given below.

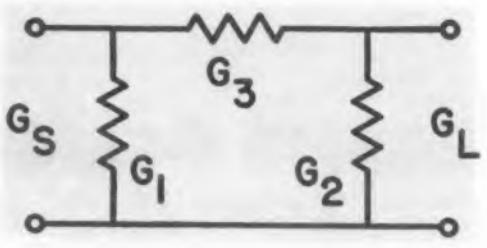
Operating the Chart

1. The scale is kept parallel with the chart and adjusted so that the R_S and R_L values lie on lines *2* and *3*, respectively. The geometric mean value is read from the scale at the "index line" (*1*).
2. The geometric mean value of R_S and R_L as found in step 1 is located on curve A. The scale is adjusted until the larger of the R_S or R_L values is at curve B. The scale must always be kept parallel with the chart. This particular position of the scale is at the minimum attenuation value.
3. The scale is placed at the attenuation selected and is adjusted until the geometric mean value of R_S and R_L lies on the index line. Read the value of R_3 on the scale at curve A.
4. The scale is placed at the attenuation selected with the value of R_S at the index line. The scale value is noted at curve B. The value of R_3 is subtracted from this reading to give the value for R_1 facing the input.
5. The scale is placed at the attenuation selected with the value of R_L at the index line. The scale value is noted at curve B. The value of R_3 is subtracted from this reading to give the value for R_2 facing the output.

If the minimum attenuation value is selected for the attenuation design, the series element of the T network that faces the lower impedance side will be zero in value. The T network has been reduced to a L network at minimum loss attenuation.



$$R_3 = [R_S R_L]^{1/2}/\sinh \alpha \text{ where } \alpha = 0.115(\text{db})$$
$$R_1 = (R_S/\tanh \alpha) - R_3$$
$$R_2 = (R_L/\tanh \alpha) - R_3$$



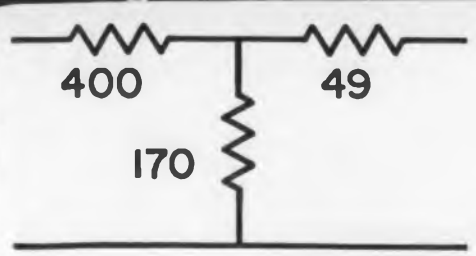
The design relations for the π network are of the same form except that conductance units are used in place of resistance values for the source, load, and network elements.

Sample Problems

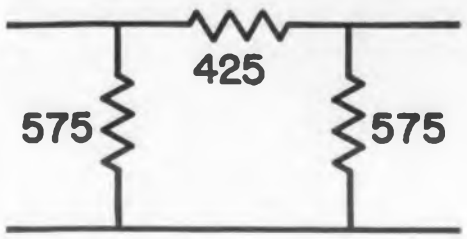
a. Design a resistance pad network of T type which matches a 500-ohm source to 200-ohm load with 12db attenuation. $R_S = 500$, $R_L = 200$ with 12 db attenuation.

1. Read the geometric mean value $[500 \times 200]^{1/2} = 318$ ohms.
2. Find minimum attenuation of 9db. Use the 12db value in the following calculations.
3. Find $R_3 = 170$ ohms.
4. Read from scale, 570 ohms. $R_1 = 570 - 170 = 400$ ohms.
5. Read from scale, 219 ohms. $R_2 = 219 - 170 = 49$ ohms.

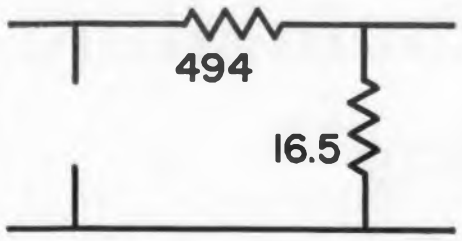
b. Design a π type resistance network with 10 db loss in a 300-ohm line. The values of conductance G_S and G_L are the inverse of the resistance units. If the scale is turned upside down and placed over the base line



Problem A



Problem B



Problem C

normalized scale figures with the ends of the scales in line, the inverse values may be read from one scale to the chart base scale. The decimal point location is not given. The two scales form a simple slide rule in this operation.

$G_S = G_L = 3330$ μmhos. The mean value is also 3330 μmhos in this case.

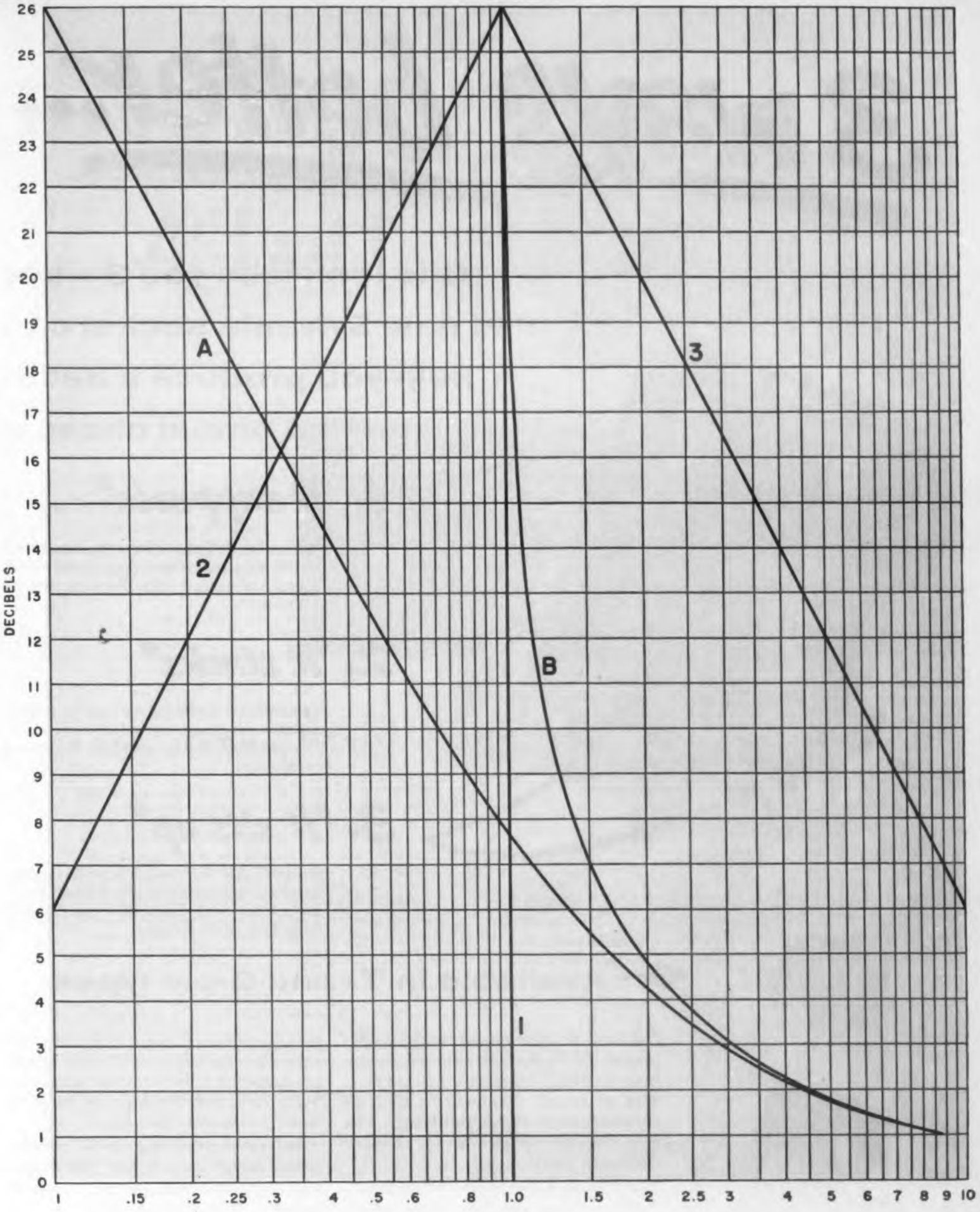
1. Read the mean value = 3330 μmhos.
2. Minimum attenuation in this case if 0db. Use 10db in following.
3. Find $G_3 = 2360$ μmhos.
4. Read from scale 4100 μmhos. $G_1 = (4100 - 2360)$ μmhos = 1740 μmhos.
5. Note the G_2 value is also 1740 μmhos.

The conductance values may be inverted into resistance values after the π network design is completed. Resistance values cannot be used in the design chart itself.

$R_3 = 425$ ohms and $R_1 = R_2 = 575$ ohms

c. Design a minimum loss network to match 500 ohms to 16 ohms.

1. Find geometric mean = 89 ohms.
2. Find minimum loss of 20.9db. and use this minimum value in the following.
3. Find $R_3 = 16.5$ ohms.
4. Read 510 ohms. $R_1 = 510 - 16.5 = 493.5$ ohms.
5. Read 16.5 ohms. $R_2 = 0$ (zero) ohms.



1		1.5	2	2.5	3	4	5	6	7	8	9	10	15	20	25	30	35	40	50	60	70	80	90	100
10		15	20		30	40	50	60	70	80	90	100	150	200	250	300	350	400	500	600		800		1000
100		150	200	250	300	400	500	600		800		1000	1.5K	2K		3K		4K	5K	6K		8K		10K
1K			2K		3K	4K	5K	6K		8K		10K	15K	20K	25K	30K		40K	50K	60K		80K		100K

The scale is cut out and moved across the chart in a horizontal position.

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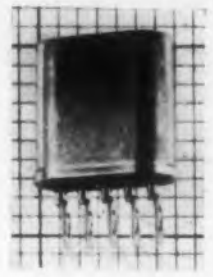
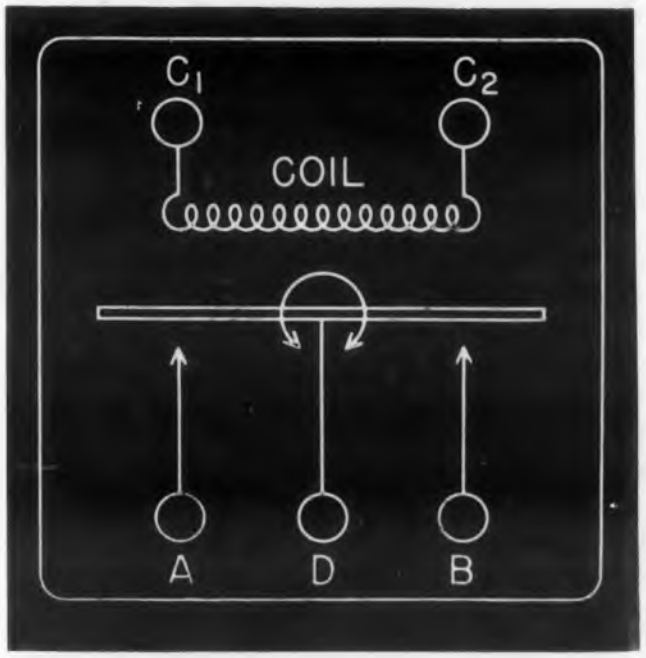


Subminiature Relay with Permanent Magnet



In the polarized type, the armature assumes a neutral position when the coil is unenergized. Current flow from C_1 to C_2 causes *D* to close to *A*. Opposite current flow causes *D* to close to *B*.

The relay is of very compact construction.

HIGH contact ratings are an outstanding feature of Type M-1000 subminiature relays. By incorporating a permanent magnet in the magnetic circuit, the necessary high armature forces have been achieved. The hermetically sealed relay can also stand high shock and vibration forces, making it useful for mobile applications.

The relay is made in two versions. Type M-1000A is a general purpose a-c spdt relay with a standard contact rating of 2amp. Ratings up to 3amp are also available. The overload rating is 8amp. The standard coil for 24v operation has 550 ohms resistance, but coils with resistances to 4000 ohms are available. Standard pull-in power is 500mw, but a sensitivity of 50mw can be achieved by derating the contact currents. Speed of operation is 2millisec, but lesser times are obtainable by derating. The normally closed points will follow up to 500 cy. The normally open points will actuate and follow up to 250cy. These relays are made by Luther Manufacturing Co., 7312 Varna Ave., North Hollywood, Calif.

Type M-1000P is a d-c polarized relay obtainable in sensitivities as low as 8mw. This relay may also be obtained in a two position or magnetic latch arrangement. Applying voltage causes the armature to move to a contact depending on polarity. The armature remains in this position when the current is removed. Biased two-position operation may also be obtained. Detent action can be provided in all the polarized types by the use of auxiliary coils in series with the contact load circuit.

Both types of relays can withstand shocks in excess of 100g. They weigh 0.33 oz each. The units are made with either solder lugs, in plug-in types, or with terminals designed for insertion in printed circuits. For more data, turn to the Reader's Service Card and circle **49**.

Item	Brief Description	Mfg. Code
Capacitors		
Integration	Polystyrene for high stability, uniformity, low leakage. Some slightly adjustable.	54, 122
Choppers		
Mechanical	Converts slowly varying d-c to modified modulated square waves. 400 and 60cy drives. Spdt and dpdt. Sensitivity to 10^{-8}v.	4, 77, 91, 99, 124
Clutch		
Synchronous	Starts and stops several independent shafts in synchronism $\pm 5°$ or ± 1.5millisec at speeds to 2400rpm. Solenoid operated.	56
Magnetic	Transmits torque at high speeds when energized. Some single ended units available.	108, 113, 123
Differentials	As small as 1/8". Backlash down to 0.001".	57, 113, 123
Diodes, Silicon junction	High forward conductance & high inverse resistance ideal for high temperatures, low level magnetic amplifier. E.g. *1N138B*, Min. forward current at 1v is 49ma; inverse current .01μa at 10v (25°C).	
Function Cams		
3-Dimensional	Z=f (x, y). Max slope 30°, Masters have up to 5000 end-milled points for establishing contour.	57
Single input	Grooved flat, external flat, & grooved cylindrical available.	57
Gears Box for Servos	Gear boxes designed especially for servo work, often houses in servomotor cases.	83, 89, 98
Hardware, Parts	Shaft hangers, shafts, precision gears, couplings, stops.	113, 116, 123
Induction Potentiometers	Output proportional to shaft angle. Infinite resolution, high input and low output impedance.	6, 13, 95, 129
Induction Resolvers	Sine and cosine outputs. Generally uncompensated, resistance compensated, or feedback compensated units available. Some companies sell systems for vector rotation.	6, 13, 15, 57, 79, 95, 100, 113, 129
Integrators (mechanical)	2-1/2 & 5" force to move carriage to 1/2oz. Input and output torque 4-5oz-in.	57, 75, 82, 114
Ball & Disc		
Spherical Wheel & Disc	High torque units. 14" by 9-3/4" by 5-1/2".	70
Component type	Spherical unit with three rollers. Gives integrals of components paralleling x and y axis.	57
Phase Shifters (Electromagnetic Type)	Time phase with respect to reference voltage is proportional to shaft angle.	13, 79, 113
Potentiometers—single-turn models		
0.5-0.2%	1-2" dia. Gangable external phasing. Linearity 0.5% or better. Ball bearings available. Continuous rotation. Non-linear functions as log, square and reciprocal usually available.	38, 51, 58, 68, 69, 121, 126, 137, 138
0.15% and better	Independent linearity to 0.05% or better. Non-linear functions.	47, 58, 69, 92, 98, 126
Subminiature sizes	7/8" to 5/8" dia. Linearity to approximately .025%. Resistance approximately 30K.	38, 47, 51, 58, 126, 137, 138
Potentiometer—high resolution, single turn	Wire wound; independent linearity 0.5% or better. High resolution (10K=2120 turns).	38
	Film type; 3/4" dia. 100 to 200K infinite resolution.	51, 117
	Slidewire; single, continuous, slidewire for infinite resolution. Resistance to 100 ohms unless multi-turn device.	23, 63, 83
Potentiometer—Sine-Cosine	Approx 3" dia. 2K to 45K/quadrant. 0.5% linearity.	38, 51, 58, 69, 111, 126
Potentiometer—Rectilinear	Reciprocating shaft motion. Resistance to 4K.	51, 126
Potentiometer—Multiturn models	High resolution units —3 —10 or more turns. Taps easily added.	
0.5-0.1%		17, 23, 69, 133
0.1-0.05%	High precision parts.	17, 23, 51, 69
0.05-0.025%	High precision parts.	69, 98, 126
0.002%	Ten-turn comparison standard.	7
Subminiature sizes	1/2 dia. $\pm 0.5\%$ linearity or better; 1.5 or 10 turns.	23, 42, 69
Potentiometer—Autotransformer	Tapped autotransformer to provide several discrete voltages. Interpolation between voltage level is accomplished by potentiometer.	103

Components and Building Blocks for Computers

Analog Computer Components

Item	Brief Description	Mfg. Code
Reference Generator	P-m generator indicates shaft position as sine of v.	13, 100
Relay Computer types—also consult mfgrs. of telephone-type and stepping relays	Mercury-wetted contacts. Life more than 10^8 operations, speeds to 60/sec. High frequency type will follow 2500cy.	24
Rotary Inductor (See also Resolvers)	Toroidal coil and bar magnet. Inductance function of shaft rotation (continuous).	19
Servomotors		
2ϕ, a-c	Various torque to inertia and power ratings, various sizes, including usually military types. May include damping device.	6, 13, 15, 41, 57 64, 74, 91, 98
d-c	High torque to inertia.	13, 39, 118
P-m & Clutch	Integral package, p-m motor and clutch.	21
Gear Motor	Integral motor and gear reducer to minimize backlash and increase torque ratio.	21, 43, 100
Motor-Generator	2-ϕ motor and tachometer in integral ease. Generator is drag-cup or p-m.	6, 15, 39, 57, 64, 79 98, 100, 129
Synchros		
Torque type	Familiar military standard types. Transmits mechanical data. Most sizes in both 60 & 400cy ratings.	6, 13, 15, 41, 57, 79
Control type	Produces output voltage corresponding to mechanical position of generator.	13, 15, 57, 79, 98
Differential Generator	Output voltage function of input voltages and shaft position.	15, 57, 100
Switches (sampling)		
Mercury stream	High speed commutating switch for monitoring 120 circuits 60 times/sec. Uses mercury jet stream.	40
Special brush	1 to 10 poles, up to 90 channel—30cps.	8, 59
Tachometers		
a-c	Voltage proportional to speed of input shaft. Drag-cup types.	13, 15, 57, 100
d-c	Voltage proportional to speed.	13, 43

COMPONENTS and components assembled into building blocks that go into special or general purpose a-c and d-c computers are tabulated on these two pages. Digital computer items and analog-to-digital, and digital-to-analog converters are described on succeeding pages. Manufacturers' code numbers are identified on pages 70-71.

This tabulation gives a comprehensive picture of commercial items that can be readily purchased and designed into computing equipment. Universally used resistors, capacitors, switches, etc., are not included. Although many precision types of these more common components have been developed to meet computer requirements, space prohibited us from listing them.

Higher accuracies and faster speeds are the main features of new products for analog computers. With the exception of converters, components are not radically different from earlier types. There is however, much emphasis on repackaging items to simplify design. Servo motors, tachometers, and gear trains are packaged in one housing. Compactness and compatability with equipment of other manufacturers is a desirable goal for these building blocks which is being met.

Word of qualification: descriptions do not necessarily represent any one specific item. When more than one manufacturer is listed, descriptions show a range of characteristics of the class. Our listing of manufacturers is not complete; but at least one producer of the various classes is included. Our new products department in a sense is a running supplement. For example this issue has over 40 new items intended specifically for the computer designer.

Analog Computer Subassemblies

Item	Brief Description	Mfg. Code
Amplifier		
Recording	Chopper-stabilized drift less than 25μv per hr. Sensitivity 0.1mv to 10v/mm. Freq. response d-c to 5kc. Carrier types available.	18
Operational	Chopper-stabilized drift average 30μv per hr; gain 100,000. Behaves as 2nd order linear system with natural freq. of 25kc and damping ratio of 1/2. Phase shift 10° at 4kc. Plug-in type.	14
	Chopper-stabilized high gain, broad band, low-noise amplifiers. Type 5691 input tube and 5881 cathode follower output is used. Dual units.	48
	Chopper-stabilized. Gain of 50 x 10^6; 10kc bandwidth. Noise less than 3mv. Long term drift 0.25mv/day. Integrator less than 100mv/15 min.	113
	Output linear ±0.01%. Drift 0.5mv/15 min. Gain exceed 10^5.	101
	Octal base plug-in unit. D-c gain bandwidth over 100kc. Use with stabilizing amplifier in tandem also available are computer components: adding, coefficient multipliers, limiters, integrators.	104
Function Generator	To approximate single-value function such as trig functions, step, reciprocals, dead time, etc. Shifts base uses 24 diodes.	42
	Twenty biased diodes for approximating an arbitrary function with 20 segments. Includes amplifiers and potentiometers for setting slope and break.	48, 104
	Uses phototubes. Produces 80° slope within 0.5v. Noise below 0.1v; drift less than ± 25v/8hr. 3-1/4 by 4-1/2" slide. 7 channels.	90
	Generates functions with two variables. Bias of diode is varied for second function.	113
Integrating Servo	Mechanical shaft output, infinite time scaling, zero drift. 18cy bandwidth, storage linearity 0.5%.	52, 113

Analog Computer Subassemblies

Item	Brief Description	Mfg. Code
Modulator		
Tachometer	Diode type for converting d-c signal from tachometer to modulated 400cy for a-c servos.	116
General	8, 12, 16 diodes, plug-in unit.	44
System	Includes modulator, corrective network, and demodulator.	116, 117
Multipliers		
Electronic	Four quadrants. Operate on sampling-ratio modulation principle. Accuracy 0.5% drift 0.1% in 3 min.	42
	Accuracy to 0.1v. Square-law principle.	48, 113
	AM-FM electronic multiplier. Static accuracy 0.2v. Frequency response flat to 400cy. Noise less than 0.05v mw. Low drift.	90
	Very pulse height and width.	14
	Modulating technique used. Range −50 to +50d-c. Rise time about 10^{-6} sec. Accuracy 1%.	104
Servo	Velocities to 1500v/sec. Max acceleration 60,000v/sec/sec. At 3cy dynamic error 0.5%. Bandwidth to 55/cc.	48, 113
Passive Systems	Transformers, inductors, capacitors and resistors to simulate behavior. Includes amplifiers.	29
Patchcord System	Frame which opens to receive pre-programmed plugboard; taper pins used.	4
Plotters		
Rho-theta	17" diameter circular chart. Accuracy approx. 0.2%. Response speed selectable.	33
x-y	30" by 30" flat bed type. Dynamic accuracy 0.2% to 0.05%.	33, 48
x-y	11" by 16-1/2" or 8-1/2" by 11" graph paper. Synchro motors or servo are x and y drives. Sensitivity to 1/2 mv/in.	48, 70, 94
x-y	Servo operated 11 by 16-1/2 graph paper on concave cylinder. Static accuracy 0.1%; response approx. 1 sec.	82
Recorder		
Strip Chart	16 speeds from 1mm/sec. to 250mm/hr. Ink and electric writing. Sensitivity 1.1mm/v; 18v peak full scale. Freq. response to 100cy.	18
Strip Chart (two variables)	X-axis pen has full balancing speed of 1 sec. Chart travel in Y axis is 10" in 4 sec with reversing motor. 10" by 10" chart. Range 10mv. Sensitivity 0.1% or 5μv. Accuracy ±0.3%.	81
6-Channel	Uniform response to 40cy with peak deflection (20mm). Drift ±0.25mm/hr. Accuracy 1% 6 paper speeds. 1 to 50mm/sec.	90
Strip-Chart (two variables)	Uses continuous balance control. Available for single or multiple record. Pen speeds 1 to 25 sec full span. Accuracy 1/5 to 3/8% of scale span. Chart speed can be function of variable. (Servo available separate, dead zone 0.1μv.)	91
Strip-Chart	Servo controlled. 7" travel, response 1 sec. extreme sensitivity. Servo usable separate.	132
Resolver Servo	Rectangular to polar coordinate converter 18-35cy bandwidth. Agc amplifier or range follow-up servo. Range change ratio 500:1. D-c types use sine-cosine potentiometers.	48, 52, 113
Servo Magnetic Amplifiers. Most types 60cy and 400 cy	Transistor and magnetic amp. Power gain 80db. Output 30w. Signal input 2.8mv for 10v out 50mw for 90v out. Time constant 0.03 sec.	33, 82, 84, 106
	Combination 12AT7WA tube and mag. amp. 100w out; input 3v, response 1cy.	87
	Types having 200mw and 2w available. Control signal 4μw and 200μw respectively. Gains 50,000 and 10,000; response time 1 sec and 1.5 sec respectively.	72
	6w size (215 to 18w available). Output 15v signal 800μa; response 0.06; zero signal out 3v.	78, 116, 120
Servo Reluctance Amplifier	Lightweight, small space unit. Fast response comprises tubes and reluctance amplifier circuit. Include stabilizing networks. 8w ratings.	116
Servo Tube Amplifier	R-C transistor amplifier. Sensitivity 1/4mw; power out approximately 90mw. Very small.	105
	10-18w out. for 115v 400 cy 2-ϕ servo motors. Four inputs can be summed.	14, 116
Servo package	Voltage amplifier, mag. amp., 2-ϕ servomotor, gear train, potentiometers and synchro output or analog to digital converter.	34, 117

Digital Computer Subassemblies

Item	Brief Description	Mfg. Code
Code Stacks	For addition to typewriter to convert the 32 5-channel outputs to bits.	128
Delay-line package	12 1/4-usec delays in 7 combinations. Includes diodes.	1
Delay Systems (Pulse)	Multivibrator, tapped line, lumped constants from 0.1μsec to 80,000μsec.	20, 27
	Cascaded shift registers.	5
Magnetic Storage Drum	Capacity 5 x 10^6 binary digit on 50' tape. Rapid access and large storage capacity at low cost. Tape is endless, 14" wide from 8" to over 600' long.	18
	Oxide-coated, 0-6000rpm, up to 2,000,000 bit capacity. Short access time with reasonable capacity, iron oxide coated drum is 2" rotor of inside-out induction motor. 20 tracks. 1000 digit per track at 12,000rpms.	53
	Drum dia 5". Speed of 6000rpm. Large unit: 250,000 bits capacity. Has 256 heads (imported). Small unit: 32,000 bit, 32 heads.	73
	Drum dia 5". Speed of 3500 to 10,000 rpm. 8 channels, 150 bits per inch.	82
	Drum 22". Bit capacity 2,552,000. 464 tracks. Access time 51 millisec. Other drums from 4-3/8 to 17". 128,400 to 733, 250 bits.	115
Magnetic Storage Matrix (See also memory units in Digital Equipment table.)	Includes system components of matrix, driver transformer, matrix switches various sizes.	131
Memory Block	Fused-quartz delay line recirculating memory loop. Includes r-f amplifiers, detector circuits, gates, delay line.	125
Pulse Units		
Binary Adder	Two state devices, on-off. Two inputs and one output. Act as gating device. 2μsec adding time.	107
Binary Shift registers	Transistors binary data from counters onto magnetic tape in parallel or serial fashion to release counter for continuous data handling.	107
Counters (plug-in)	Octal socket and rectangular plug-in units for logic "and" "or" circuits binary counting, freq. division, switching.	44, 60, 80, 135
Counters (Subminiature)	Subminiature transistorized flip-flop.	122
Counters (Standard)	Small-package decades, binary or decimal counting, computing. Various rates obtainable.	107, 110
Decision Unit	Magnetic-type operates at 100kc. Performs logical function.	92
Detector, Coincidence	Tube or diode gates, "and" circuits.	20
Flip Flops	For switching, counting, storage, 7.5Mc rate.	20, 82
Gate Drive	Plug-in unit to drive 20 gates at 1Mc amplifier and 31 diodes.	1
Gating Package	Accepts 1Mc assertion and negation pulse trains and performs logical functions. Delivers output one pulse later. Handle any function of 3 variables.	27
Mixer	"or" circuits, mixes outputs of several circuits.	20
Systems	Plug-in unit includes 15 gating packages, synchronizing clock generator, plug-in jumper panel. Shift-register adder, multiplier, function generator, code converter, storage.	27
	Four-pulse regeneration amplifiers. "And," "or"; and delay circuits available.	125
Tape Time Delays Audio	Delays of 50 to 180 millisec. 100-8000cy.	11
Supersonic	Delay 5 octaves in 5 to 30,999cy range. Drum-type non-contact recording. 200 sec delay is max.	115

DIGITAL computer components, subassemblies and equipment are tabulated here. As stated in the introduction to analog computer products, these listings show typical characteristics of various categories and do not describe any specific item unless only one manufacturer's code follows the entry. Code numbers are identified on pages 70-71.

Simple pulse handling circuits make up most of a digital computer circuitry and therefore, structurally, such computers are comprised of many identical building blocks. Large-capacity memory devices fall into one of several classifications and can be considered as either subassemblies or equipment. Entries will be found under both headings. Input and output devices for digital computers make up a separate

Digital Computer Components

Item	Brief Description	Item
Beam Switching Tube	One tube, 10 positions, megacycle rate for counting, gating, logic. Magnetic and electrostatic deflection types.	67, 96
Delay Line		
Electromagnetic	Distributed and lumped constant. Various delays, rise times, attenuation, phase shift ratings. Low attenuation wide band pass, good phase response, stable.	2, 22, 31, 49, 50, 65, 69, 102, 122, 125
Acoustic	Fused quartz. Single delays 20 to 1100/sec. Accurate to ±0.1μsec. Input 8v at 1Mc.	27, 80
	Fused silica glass. Delays 50 to 3000μsec. Bandwidth greater than 50% of carrier of 5 to 60Mc.	32
Diodes		
Germanium (High Current)		
PS 201	Inverse max 90v; forward current at 1v=150ma; Inverse current 0.02ma at —10v. After switching from 5ma/μsec. pulse to —40v, the back resistance equals 25K or better in 0.3μsec.	Pacific
CK 713, 742	Latter type has inverse current 0.005ma at —10v.	CBS
1N305-307	For magnetic circuits where low forward resistance and high reverse resistance is needed.	Raytheon
1N308-309	For fast, stable, switching; high forward current and high ratio of back to forward res.	Raytheon
Germanium (Medium Current)		
PS 208, HD 2013, CK 801-802	Inverse 60v, forward current a 1v=40ma. Fast recovery time.	Pacific, CBC, Raytheon
Germanium (Low Current)		
1N191	Inverse 90v, forward current at 1v=5. Back resistance 400K min.	CBS, Pacific, Transitron
1N174	180mw power dissipation.	
1N112-115, 1N119-120	High back resistance.	
Silicon		
PS 500-504	High ratings at 150°C (44 to 60ma av. rect. current). Min. forward current ranges 3 to 60ma at 1v.	Pacific
1N301-303 and 1N432-434	High ratings at 125°C. Forward current range 5ma at 1v.	Raytheon
Display Storage Tube	High speed digital readout device. Speeds of 25,000 characters per second.	71
	One hundred glow spots on matrix for display purposes. Speeds function of switching.	96
Electrostatic Storage	Type 6511 is 3" storage tube for digital computers. Single beam, no cross talk.	109

equipment category. Tape handlers, plotters, etc., are classed as complete equipments. Some input and output equipments are listed under Converters, page 68.

Noticeably absent from the list (other than the analog entry) are relays. Our space allocation prohibited describing relay types and differences. There are abounding numbers of counters on the market which can do arithmetic and logical operations but we mention only representative compact plug-in units. Almost every manufacturer making circuits using pulses produces pulse-generators, synchronizers, etc. We do not discuss these units. Every manufacturer who recommended diodes and tubes to us for computer use specified different types. Our final listing seemed representative.

Digital Computer Components

Item	Brief Description	Item
Magnetic Heads		
Single Channel	Read/write heads and cartridges. Example of track widths are 0.014 to 0.245". Erase head separate, tracks 0.090 to 0.257". (Some are non-contact types.)	18, 35, 82, 115
Multichannel	Read/write heads and cartridges. 2-22 channels. Track width 0.0225 to 0.052".	18, 107
Single & multiple ferrite	80 bits/in. 16 track/in.	93, 115
Magnetic Memory (See also Digital Sub-assemblies and Equipment tables)	Three winding storage core can be operated as two cores for storing, transferring, advancing, etc. Includes rectifiers. Various drives from 10kc to 200 kc possible. Power per shipt ratings vary.	5, 49, 85
Cores only	Ferro electric and ferro magnetic type.	5, 36, 86, 93, 107
Magnistors	High speed substitutes for tubes and transistors. Can gate, switch, count, register, amplify, perform logical functions.	107
Panel board	Precise-tolerance phenolic boards.	10
Transistors		
2N91	For switching at I_c of 100ma, as required by magnetic cores.	Transitron
2N92	For switching at I_c of 5ma, such as multivibrators.	Transitron
2N112-113	High frequency applications; Alpha cut-off is 5-10Mc.	Raytheon
2N78	NPN type for switching.	GE
2N123	PNP type for switching.	GE
Tubes (sharp cut-off)	Low perveance, and low cathode interface formation types.	
CK 5755	Twin triode extremely stable.	Raytheon
GL 5844	Med. mu triode for counter or amplifier in moderately high speed computers.	GE
GL 5915A	Dual control heptode as a coincidence gate tube.	GE, RCA
5963-64	Medium-mu twin triodes.	RCA
GL 5965	Twin triode for high speed use as binary counter or amplifier.	GE
GL 6211	Medium-mu twin triode for use as binary counter or amplifier.	GE, RCA
GL 6463	High-power twin triode for extra-fast computers. Suited to frequency-divider circuits.	GE, RCA
CK 6485	Sharp-cut-off pentode.	Raytheon
E 90CC	Twin-triode, matched halves, for switching.	Mullard, Ltd.

Digital Computer Equipment

Item	Brief Description	Mfg. Code
Decimal Keyboard	Designed for binary, binary coded, decimal, or decimal inputs; as a multitap digital potentiometer or as an accessory to X-Y plotter and recorder. Specially designed switch bank.	82
Input and Readout Devices (See also Converter table)	Control chassis fed by coded commutators (see converter table) to operate printers, IBM puncher and tabulator, tape punches and type writer.	63
Memory Unit (See drums in Subassemblies table)	Random Access. Stores 1,000,000 locations (1200 bits per location). Less than 1sec access. For all data storage and access.	107
	4096 40-bit words. Has read-write cycle of 15μsec.	76
Motorized Tape Punch	5 to 8 channel punched tape from modified adding machine. Error key can be added to keyboard. Systems for complete programming.	25, 63
Motorized Tape Reader	Cable for remote connection. 5-, 6-, or 8-channel 1000rpm. Provision for mounting 5 standard relays. Reader unit only is also available. Used in conjunction with Flexowriter for tape verification.	27
	For 5 or 7 unit tape. Reads up to 600 characters/sec. Accelerated from rest to 20"/sec. Stop and next character read within 6 millisec.	53, 107
Plotter	Takes data from keyboard, punched tape. Plots 35 points/min. Accurary 0.15%. Sizes to 30".	16
Printer-Highspeed	"Flying Typewriter" high speed printer. Magnetic core storage. Up to 42,000 characters/min in alphanumerical form. 80 to 120 column fan-folded form. 63 different characters and space. Single typing wheel. Input magnetic tape, perforated tape, punched cards or computer output.	107
	Drum-type typer, 120 column width. 64 characters around perimeter of drum for each column. Type up to 15 lines/sec or 108,000 characters/min.	119
Printer Digital	Visible presentation of 8-digit numbers at rates to 150/sec. Binary coded decimal recording in 1-2-4-8 notation. Electrically sensitized paper or adding machine tape are examples of readout.	14, 107
	Adding or multiplying machines with electrically actuated keep. Prints 20 digits/sec to 9000 four-digit numbers/min.	107, 134
Recorder-Reproducer Flexowriter	Typewriter keyboard combined with tape punch and tape reader. 5-, 6-, or 8-channel models available. Automatic typing speed 572 codes/min. Automatic programming format control in punch selection. Code parity check optional. Used in conjunction with tape reader for tape verification.	27
Tape Transport Mechanism (High Speed)	Multichannel (up to 22) unit with tape speed of 75"/sec, either direction. Start and stop 4 millisec. Tape width 1/4-2". Tape stored in basket. Pinch rolls controlled at panel or by remote pulses.	18
	18-channels, 30, 40, 50, 60, or 75" per sec. Maximum start-stop 6 millisec. 2400' of 1/2 or 3/4" tape. Pinch-roller drives 2" of tape after which vacuum switches in hollow tape guide well and reel drives motors takes control.	45
	Start-stop 5 millisec. 15/30 or 15/60 in/sec. Servo controlled tension arms.	107

Converters

Analog-to-Digital (Shaft position)

Shaft position quantizer. Instantaneous conversion as function of shaft position, accurate to ±1 part in 4000 per rev. 12

"Digitizer" available in decimal, binary or binary coded models. Decimal unit counts 10, 40, or 100 counts per turn, without ambiguity, accumulating 3, 4, 5, and 6 decades. Low torque, brushes can be lifted for slewing. Binary unit produces 64 counts per revolution accumulating 32.767 counts. The binary-coded decimal unit has a total capacity of 1999 without ambiguity. Uses 1-2-4-8 code. 26

Coded commutator: Shaft rotation gives digital output without ambiguity. Output codes are binary, grey or special. Calibrations may be lineal, sine-cosine, etc. Reading of 1000, 2000, 10,000 etc. 63

"Digitometer" transposes rotary mechanical motion to numerical rotation. Output is unambiguous with 8 digits, 256 counts in binary. 1.44" dia. Accuracy ±0.10%. 47

Shaft position converter. Code discs for 7 to 19 digits. By adding discs, more possible. Speed 120rpm. Resolution per shaft rev. 128 to 200. Faster slewing speeds. Various codes. 82

Unambiguous output of 13 digits—no coding or decoding necessary. High speed unit can be read while converter is operating. Complement is available. Small size. Outputs to typewriter, card punch, tapes, etc. 98

Code disc converter. Up to 1000 increments per 360°. Readout speed max 600rpm. Photo cell register picks up output—no contacts. Registers 3 to 6 decades. 136

"Digi-Coder" 4, (and 6, 8 or 10) digits, two drums used, one for units and tons, other for hundreds and thousands. Speed 5000 counts per second. 55

Analog-to-Digital (Electronic-electromechanical)

Analog-to-digital voltmeters. Visual readout and feed to printers connection available on many. 30, 46, 97

Analog-to-digital converter takes 100,000 samples/sec at 0.1% accuracy and 300mv sensitivity. Uses magnetic tape or drum storage. 112

High speed reduction system converting multiple analog data to digital present on punched paper type. Include servo converters, temporary and permanent punched tape storage.

Voltage encoder. Generates voltage and compares it to input. Approximation process. Accuracy is one part in 1024 for rates up to 15,000 codes/sec. 1

Receives analog signal and converts them to 3 digit from 000 to 999. Sensitivity of 1mv gives 0.1% accuracy. Uses servo-controlled stepping switches balanced to pot. One model has 10-position switch to produce 3-digit output. About 0.8sec to balance. 30, 127

Translator—voltage to digital. (See data translator entry below). "Anadige" analog-to-digital integrator. Integral of analog is converted to discrete pulses. Integrates 60,000 counts/sec. Plug-in unit. (See also beam switching tubes in Digital Components table.) 88

There is much activity in the analog-to-digital and digital-to-analog converter field. New products come out each month. A close distinction between converters and regular digital computer input and output devices cannot be made. Therefore, the reader should scan both tables for a more complete picture. For example, digital plotters and printers can be viewed as converters.

On the other hand, some well known card and tape handling equipments long used with small-size office data process machines are not listed.

Analog voltage to digital converters and shaft position digitizers are important for use in recording as well as interconnecting digital computers to analog devices.

Although many new shaft position converters have been announced recently, there will undoubtedly be many new units still to come. In the articles "Needed Analog Computer Components", and "Ideas for Computer Designers", requirements for faster and more flexible converters were outlined.

Some digital voltmeters are equipped with connections to actuate printers. Again referring to the first mentioned article, digital voltmeters could be used to indicate analog plotter positions to greater accuracy than plotters can be read. These voltmeters are, therefore, included in this converter section. Numbers following descriptions refer to manufacturers, whose names and addresses appear on pages 70 and 71.

Digital-to-Analog

Decoder. Uses 10 diode gates for switching and resistor network. Resistor current corresponds to binary digit. Accuracy one part in 1024. Analog current within 5μsec. Takes up to 200,000, 10 bit codes/ sec. 1

Punch card conversion equipment to handle alphabetic information. Current models read 50 cards/min. 45, 82

Data translator gives precise digital-to-voltage and voltage-to-digital conversion. For example, Model E gives two voltage-to-digital conversions/sec or 30 digital-to-voltage conversion/sec to an accuracy of $\pm 0.01\%$. Gives visual read out and output for printers, typewriters, or card punchers. 5 decimal digits provided. Floating decimal point; sensitivity 10mw (10 other models). 49

Data converter and printer. Analog-to-digital and digital-to-analog. Numbers or voltage printed on facsimile paper. Ten wire system for each digit. 1000 conversions/sec. 9

Binary converter translates binary data from a register to analog signal for plotter, etc. Has a speed of 50 pts/min. 82

THE MOSELEY

AUTOGRAF

trade mark

A PRECISION X-Y RECORDER

CURVE DRAWING
CURVE FOLLOWING
POINT PLOTTING

MODEL 1. Drum type, accepts 8½"x11" graph paper; traverses each axis in 1 second; has full scale ranges of 5 millivolts to 100 volts; zero set anywhere on the paper; portable, self-contained; available also as a curve follower for electrical read-out of drawn curves.

AUTOGRAF Recorders, MODELS 1 and 2, provide all the features needed for graphic recording of test data, point plotting, and curve following for readout purposes.

MODEL 2
Flat bed type, accepts 11"x16½" graph paper; same speeds, sensitivities and ranges as MODEL 1; zero set anywhere on paper plus one full scale length of zero-offset; inputs provided for analog recording, point plotting from digital sources, and curve following for computer or data reduction use.

MODEL 20 DC VOLTMETER is a servo-actuated, fast, accurate and sensitive instrument. Has large, easy-to-read scale for general laboratory use where ranges from 3 millivolts to 300 volts are desired. For data handling it is furnished with a built-in Coleman digitizer and delivers digital output for operation of printers, typewriters, tape or card punches, etc.

MODEL 30 CARD TRANSLATOR converts information from punched cards into point form for automatic plotting. Handles up to 50 cards per minute, 10 to 200 counts per inch. Plugs directly into MODEL 2 recorder, controls both card reader and recorder for completely automatic operation.

MODEL 40 KEYBOARD provides a convenient means for plotting large amounts of tabular data in point-curve form. Self-contained voltage source together with full three column keyboard in both X and Y axes; unit plugs directly into MODEL 2 AUTOGRAF.

Bulletins describing these instruments are available and we'll be glad to send them to you. Write . . .

F. L. MOSELEY CO., 409 North Fair Oaks Avenue, Pasadena 3, California

CIRCLE 53 ON READER-SERVICE CARD FOR MORE INFORMATION

Manufacturer's Index for Computer Components

The preceeding pages have tabulated brief descriptions of components, subassemblies and equipments for analog and digital computers. Codes following the various entries refer to manufacturers producing the described equipment.

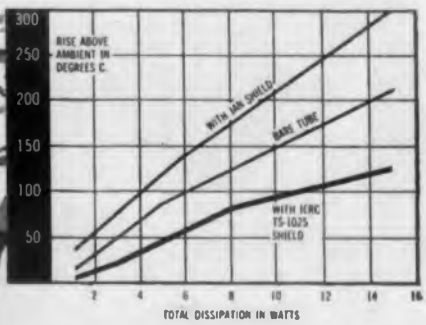
In many cases, manufacturers listed here produce products for both analog and digital equipments. Interested readers seeking additional information about a specific product or a company's entire line should write directly to the manufacturer.

1 ACF Electronics, 800 N. Pitt St., Alexandria, Virginia.
2 Advance Electronics Co., Inc., 451 Highland Ave., Passaic, N. J.
3 Aircraft-Marine Products, Inc., 2100 Paxton St., Harrisburg 10, Pa.
4 Airpax Products Co., Middle River, Baltimore 20, Maryland.
5 Alden Products Co., 117 N. Main St., Brockton 64, Mass.
6 American Electronic Mfg., Inc., 9503 W. Jefferson Blvd., Culver City, Cal.
7 Analogue Controls, Inc., 37 W. 20th St., New York 10, N. Y.
8 Applied Science Corp. of Princeton, P. O. Box 44, Princeton, N. J.
9 Atomic Instrument Co., 84 Massachusetts Ave., Cambridge 39, Mass.
10 Auburn Button Works, Inc., Auburn, N. Y.
11 Audio Instrument Co., Inc., 133 W. 14th St., New York 11, N. Y.
12 Austin Co., Special Devices Div., 76 Ninth Ave., New York 11, N. Y.
13 Beckman Instruments, Inc., Arga Div., 220 Pasadena Ave., S. Pasadena, Cal.
14 Beckman Instruments, Inc., Berkeley Div., 2200 Wright Ave., Richmond, Cal.
15 Bendix Aviation Corp., Eclipse-Pioneer Div., Teterboro, N. J.
16 Benson-Lehner Corp., 2340 E. Sawtelle Blvd., W. Los Angeles 64, Calif.
17 Borg Equipment Div., George W. Borg Corp., 120 S. Main St., Janesville, Wis.
18 Brush Electronics Co., 3405 Perkins Ave., Cleveland 14, Ohio.
19 Burnell & Co., Inc., 45 Warburton Ave., Yonkers 2, N. Y.
20 Burroughs Corp., Electronic Instruments Corp., 2209 Vine St., Philadelphia 7, Pa.
21 Burton Mfg. Co., 11201 W. Pico Blvd., Los Angeles 64, Calif.
22 Carad Corp., 2850 Bay Road, Redwood City, Calif.
23 Circuit Instruments, Inc., 1927 First Ave., S., St. Petersburg, Fla.
24 Clare, C. P. & Co., 3101 Pratt Blvd., Chicago 45, Ill.
25 Clary Multiplier Corp., Electronics Div., San Gabriel, Calif.
26 Coleman Engineering Co., Inc., 6040 W. Jefferson Blvd., Los Angeles 16, Calif.
27 Commercial-Controls Corp., 1 Leighton Ave., Rochester 2, N. Y.
28 Computer Control Co., Inc., 97 Broad St., Wellesley, Mass.
29 Computer Engineering Associates, Inc., 350 N. Halstead St., Pasadena 8, Calif.
30 Consolidated Engineering Corp., 300 N. Sierra Madre Villa, Pasadena 15, Calif.
31 Control Electronics Co., Inc., 1925 New York Ave., Huntington Station, N. Y.
32 Corning Glass Works, Corning, N. Y.
33 Curtiss-Wright Corp., Electronics Div., 631 Central Ave., Carlstadt, N. J.
34 Datran Engineering Corp., 3613 Aviation Blvd., Manhattan Beach Calif.
35 Davies Laboratories, Inc., 4705 Queensbury Rd., Riverdale, Md.
36 Daystrom Instrument, Div. of Daystrom, Inc., Archbald, Pa.
37 Daystrom Pacific Corp., 3030 Nebraska Ave., Santa Monica, Calif.
38 DeJur-Amsco Corp., Northern Blvd., at 45th St., L. I. C. 1, N. Y.
39 Diehl Mfg. Co., Somerville, N. J.
40 Detroit Controls Corp., Research Div., Redwood City, Calif.
41 Doelcam, Div. of Minneapolis-Honeywell, Soldiers Field Rd., Boston 35, Mass.
42 Donner Scientific Co., 2829 Seventh St., Berkeley 10, Calif.
43 Eastern Air Devices, Inc., 385 Central Ave., Dover, N. H.
44 EECO Production Co., 506 East First St., Santa Ana, Calif.
45 Electro Data Corp., 460 Sierra Madre Villa, Pasadena, Calif.
46 Electro Instruments, Box S, Old San Diego Station, San Diego 10, Calif.
47 Electro-Mec Laboratory, Inc., 21-09 43rd Ave., L. I. C. 1, N. Y.
48 Electronic Associates, Inc., Long Branch, N. J.
49 Epsco, Inc., 588 Commonwealth Ave., Boston 15, Mass.
50 ESC Corp., 534 Bergen Blvd., Palisades Park, N. J.
51 Fairchild Controls Corp., Potentiometer Div., 225 Park Ave., Hicksville, L. I., N. Y.
52 Feedback Controls, Inc., Alexandria, Va.
53 Ferranti Electric, Inc., 30 Rockefeller Plaza, New York 20, N. Y.
54 Film Capacitors, Inc., 3400 Park Ave., New York 56, N. Y.
55 Fischer and Porter Co., 476 Court, Line Road, Hatboro, Pa.
56 Flight Research, Inc., P. O. Box I-F, Richmond I, Va.
57 Ford Instrument Co., 31-10 Thomson Ave., L. I. C. 1, N. Y.
58 Gamewell Co., Newton Upper Falls 64, Mass.
59 General Devices, Inc., P. O. Box 253, Princeton, N. J.
60 General Electric, Schenectady 5, N. Y.
61 General Magnetics, Inc., 135 Bloomfield Ave., Bloomfield, N. J.

62. General Scientific Corp., 12027 Vose St., N. Hollywood, Calif.
63 Giannini & Co., Inc., G. M., Datex Div., 1307 S. Myrtle Ave., Monrovia, Calif.
64 G-M Laboratories, Inc., 4300 N. Knox Ave., Chicago 41, Ill.
65 Gudeman Co. of Calif., Inc., 2661 S. Myrtle Ave., Monrovia, Calif.
66 Gulton Industries, Metuchen, N. J.
67 Haydu Bros. of N. J., P. O. Box 1226, Plainfield, N. J.
68 Helco Products Corp., 2041 Colorado Ave., Santa Monica, Calif.
69 Helipot Corp., Div. of Beckman Instruments, 916 Meridian Ave., S. Pasadena, Calif.
70 Hoffman Laboratories, Inc., 3761 S. Hill St., Los Angeles 7, Calif.
71 Hughes Aircraft Co., Culver City, Calif.
72 Hycor Co., Inc., 11423 Vanowen St., N. Hollywood, Calif.
73 Imtra Corp., 58 Charles St., Cambridge 41, Mass.
74 Infra Electronic Corp., 553 Eagle Rock Ave., Roseland, N. J.
75 Instrument Components, Inc., 14-34 112th St., College Point, L. I., N. Y.
76 International Telemeter Corp., 2000 Stoner Ave., Los Angeles 25, Calif.
77 James Vibrapower Co., 4050 N. Rockwell St., Chicago 18, Ill.
78 Keystone Products Co., 904 23rd St., Union City 2, N. J.
79 Kollsman Instrument Corp., 80-08 45th Ave., Elmhurst, L. I., N. Y.
80 Laboratory for Electronics, Inc., 75-4 Pitts St., Boston, Mass.
81 Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia 44, Pa.
82 Librascope, 1607 Flower St., Glendale, Calif.
83 Link Aviation, Binghamton, N. Y.
84 Magnetic Amplifiers, Inc., 632 Tinton Ave., New York 55, N. Y.
85 Magnetic Research Co., 142 King St., Chappaqua, N. Y.
86 Magnetics, Inc., P. O. Box 230-E, Butler, Pa.
87 Maxson Corp., W. L., 460 W. 34th St., New York 1, N. Y.
88 Mega Research, P. O. Box 371, Dover, N. J.
89 Metron Instrument Co., 432 Lincoln St., Denver 3, Colo.
90 Mid-Century Instrumatic Corp., 611 Bdwy, New York 12, N. Y.
91 Minneapolis-Honeywell, Industrial Div., Wayne & Windrim Aves., Philadelphia 44, Pa.
92 Minnesota Electronics Corp., 133 E. Santa Anita Ave., Burbank, Calif.
93 Monrobot Laboratory, Morris Plains, N. J.
94 Moseley Co., 409 N. Fair Oaks Ave., Pasadena 3, Calif.
95 Muirhead & Co., Ltd., Beckenham, Kent, England.
96 National Union Electric Corp., 405 Lexington Ave., New York, N. Y.
97 Non-Linear Systems, Inc., Del Mar Airport, Del Mar, Calif.
98 Norden-Ketay Corp., 555 Bdwy, New York, N. Y.
99 Oak Mfg. Co., 1260 Claybourn Ave., Chicago 10, Ill.
100 Oster Mfg. Co., John, Aviation Div., 1 Main St., Racine, Wis.
101 Parsons, Ralph M. Co., 135 W. Dayton St., Pasadena 7, Calif.
102 PCA Electronics, Inc., 2180 Colorado Ave., Santa Monica, Calif.
103 Perkin-Elmer Corp., Main Ave., Norwalk, Conn.
104 Philbrick Research, Inc., George A., 230 Congress St., Boston 10, Mass.
105 Plastics & Electronics Corp., 272 Northland Ave., Buffalo 8, N. Y.
106 Polytechnic Research & Development Co., Inc., 202 Tillary St., Bklyn. 1, N. Y.
107 Potter Instrument Co., 115 Cutter Mill Road, Great Neck, N. Y.
108 Precision Specialties, 1342 E. 58th St., Kansas City, Mo.
109 Radio Corp. of America, Tube Div., Harrison, N. J.
110 Ransom Research, Box 382, San Pedro, Calif.
111 Rawson Electrical Instrument Co., Inc., 110 Potter St., Cambridge 42, Mass.
112 Rea Co., Inc., J. B., 1723 Cloverfield Blvd., Santa Monica, Calif.
113 Reeves Instrument Corp., 215 E. 91st St., New York 28, N. Y.
114 Reflectone Corp., Stamford, Conn.
115 Remington Rand Engineering Research Associates, 1902 W. Minnehaha Ave., St. Paul, Minn.
116 Servo Corp. of America, 20-20 Jericho Tpke., New Hyde Park, L. I., N. Y.
117 Servomechanisms, Inc., Post & Stewart Aves., Westbury, N. Y.
118 Servo-Tek Products Co., Inc., 1086 Goffle Rd., Hawthorne, N. J.
119 Shepard Laboratories, 480 Morris Ave., Summit, N. J.
120 Specialties, Inc., Skunks Misery Rd., Syosset, N. Y.
121 Spectrol Corp., 2661 Myrtle Ave., Monrovia, Calif.
122 Sprague Electric Co., 125 Marshall St., North Adams, Mass.
123 Sterling Precision Instrument Corp., Instrument Div., 34-17 Lawrence St., Flushing 54, N. Y.
124 Stevens-Arnold, Inc., 22 Elkins St., S. Boston 27, Mass.
125 Technitrol Engineering Co., 2751 N. Fourth St., Philadelphia 33, Pa.
126 Technology Instrument Corp., 555 Main St., Acton, Mass.
127 Telecomputing Corp., 133 E. Santa Anita Ave., Burbank, Calif.
128 Telequipment Corp., Sea Cliff, L. I., N. Y.
129 Transicoil Corp., 107 Grand St., New York 13, N. Y.
130 Underwood Corp., Electronic Computer Div., 35-10 36th Ave., L. I. C. 6, N. Y.
131 Valor Electronic Components Co., 58-08 Maryland Ave., Culver City, Calif.
132 Varian Associates, 611 Hansen Way, Palo Alto, Calif.
133 Vectron, Inc., 400 Main St., Waltham 54, Mass.
134 Victor Adding Machine Co., Electronics Div., Chicago 18, Ill.
135 Walkirt Co., 145 W. Hazel St., Inglewood, Calif.
136 Wang Laboratories, Inc., 37 Hurley St., Cambridge 41, Mass.
137 Waters Mfgs. Co., Inc., 4 Gordon St., Waltham 54, Mass.
138 Wellan Sales Co., 719 W. Bdwy., Glendale, Calif.

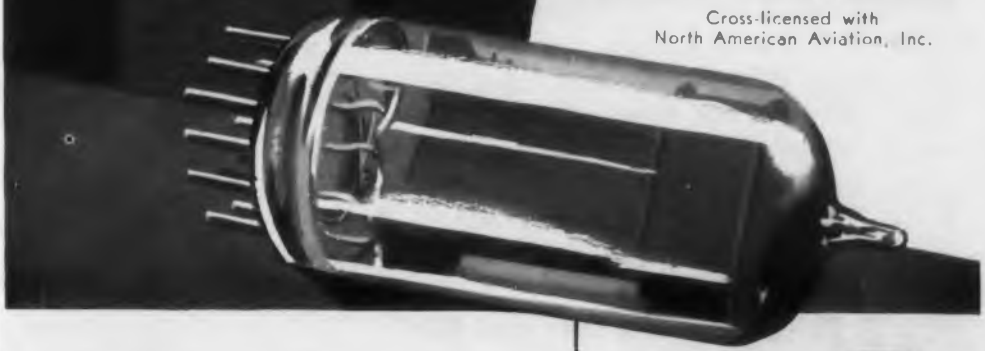
...ever SUSPECT those "normal" tube failures?

You should... because the service life of a tube you now accept as normal can be greatly extended with IERC mounting techniques. With other methods, high operating temperatures deteriorate the tube... causing those premature, so-called "normal" failures!



Graphic evidence of IERC's effective tube cooling is shown in comparison with harmful temperature increases that occur with use of JAN type shields. IERC shields are designed to meet requirements of MIL-S-9372B (USAF).

Cross-licensed with North American Aviation, Inc.



HEAT-REDUCING, VIBRATION-PROOF PERFORMANCE

IERC's complete line of miniature tube shields have proved so efficient in reducing bulb temperatures and prolonging tube life that they have become the first choice of almost every leading manufacturer of aircraft radio, missiles, radar, computers and other types of precision electronic equipment!

Patent pending

There is an IERC shield to choose from for every tube—subminiature, miniature, octal and power!

Write on letterhead for complete illustrated IERC brochures and name of nearest service representative, TODAY!

International electronic research corporation

177 WEST MAGNOLIA BOULEVARD BURBANK, CALIFORNIA

CIRCLE 54 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products

Potentiometer

With Linearities to 0.002%

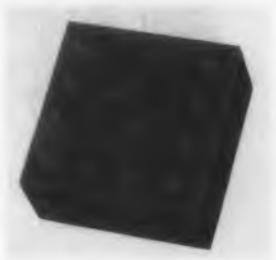
A comparison standard rotation-to-voltage transducer for basic measurement, potentiometer testing and calibration, and analog multiplication, this potentiometer features linearities to 0.002%. The unit is not susceptible to torque overloads (its traveling-nut limit stop is rated at 400 in-lb static torque) or burnout (slider is fused). A teflon shaft seal and high-leakage construction prevent internal loading.

Resistance range is 5K to 200K, resistance tolerance 5% standard. Temperature coefficient of resistance is ±20ppm/°C. Rotation is 10 turns, +90° electrical and mechanical overtravel at each end. OD is 10″; this size facilitates the extremely high resolution (up to more than 100,000 turns of resistance wire). The unit is rustproof and contains no fungus nutrients. Analogue Controls, Inc., Dept. ED, 37 W. 20th St., New York 10, N. Y.

CIRCLE 55 ON READER-SERVICE CARD FOR MORE INFORMATION

Magnetic Storage Element

Subminiature, Low Power Type



This extremely low power, medium frequency, subminiaturized magnetic storage element is suitable for mounting on etched wiring boards. The wide operating limits and encapsulated packaging contributed to ultra-reliable performance.

It may be driven by subminiature tubes. It is adaptable for transistor operation. Many storage elements can be driven by one tube.

Information rate is nominally 10kc. Nominal drive current peak is 70ma and output signal voltage is 11v. Minimum drive current should be 5μsec wide. Size is 3/4″ x 3/4″ x 7/16″ high. Epsco, Inc., Dept. ED, 588 Commonwealth Ave., Boston, Mass.

CIRCLE 56 ON READER-SERVICE CARD FOR MORE INFORMATION

Counter

For High-Speed Impulses

This five-digit electrical counter is designed for reliable high-speed impulse recording. Known as Type E-RSA-200, it measures only 3/4″ x 1-3/16″ x 4-1/6″ overall. Each counter is enclosed in a sturdy metal cover, available either as an individual unit or in strips of 10 with a common cover. A flexible spring clip holds each unit firmly in place on the mounting plate.

Each counter wheel is made of nylon for extra long wear. Final inspection tests are made at a rate of 20 impulses per second. North Electric Co., Dept. ED, Galion, Ohio.

CIRCLE 57 ON READER-SERVICE CARD FOR MORE INFORMATION

Recording Potentiometer

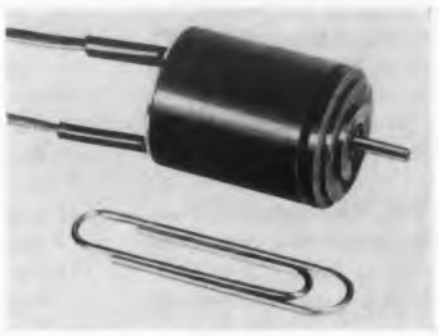
Functions at High Speed

The "Electronic Dynamaster" is a recording wide-strip potentiometer which features full-scale pen travel in only 0.4sec across the 11″ chart scale without overshoot at the end. The "deadband" is less than 0.1% of the full-scale span. The unit is offered with standard ranges as low as 1 mv for full scale, with source resistance up to 10,000 ohms. The recorder has proved highly useful for recording rapidly changing variables such as encountered in rocket and jet-engine testing, wind tunnel investigations, and laboratory tests. Chart speeds up to 4 ips are offered. The Bristol Co., Dept. ED, Waterbury 20, Conn.

CIRCLE 58 ON READER-SERVICE CARD FOR MORE INFORMATION

Size 10 Synchros

Angular Error Is Low



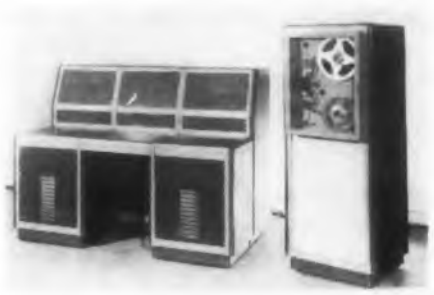
This Size 10 synchro, the Type 3G, has unusually high permeability, and it is highly resistant to corrosion due to the use of a high nickel alloy for laminations. Spread of angular error is from 20 to 30 minutes. The entire device weighs only 1-3/4 oz. Length is 1.278″, and OD is 15/16″.

The Type 3G is furnished with standard synchro mounting dimensions and is designed for use in 26v 400cy systems. For units used as transmitters or receivers, input impedance Z=110/65°. For units used as control transformers, low impedance is 650/65° and high impedance 2200/65°. Input impedance is 150/50° for units used as differentials. When used as resolvers, low impedance is 580/60° and high impedance 2200/65°. A wide variety of shaft lengths is available. John Oster Manufacturing Co., Avionic Div., Dept. ED, 1 Main St., Racine, Wis.

CIRCLE 59 ON READER-SERVICE CARD FOR MORE INFORMATION

Analog-to-Digital Converter

High Speed Electronic Unit



This analog-to-digital converter will take up to 100,000 samples per second at 0.1% accuracy and 30-mv resolution. A digital output count proportional to the input voltage is recorded on either a magnetic drum memory or tape recorder as required. Digital output is later recovered for computation or tabulation using high speed digital computers. The converter requires 115v 60cy power. J. B. Rea Co., Inc., Dept. ED, 1723 Clover Blvd., Santa Monica, Calif.

CIRCLE 60 ON READER-SERVICE CARD FOR MORE INFORMATION

Analog to Digital
Has No Commutators

The "Shaft Position Quantizer", with its control unit, provides a standard shaft-position - to - digital converter system. Together with its suitable standard counter, a complete system is established which will measure shaft positions to the desired accuracy and present an output for recording in any desired digital code.

Essentially a simple induction device, the "Quantizer" has no gears or digitizing commutators. Designed as a standard package, it is adaptable to any shaft. Four standard models of the "Quantizer," functioning with the standard Control Unit, divide one turn of the data shaft into any one of many possible divisions which range from 320 to 4096 parts. The usefulness of the converter may be greatly extended by incorporating an additional standard device that identifies any one of a number of 360° turns of the data shaft.

Total count is accurate to ±1 count for any position of the shaft, and is guaranteed whether the data shaft is stationary or turning at up to 240rpm (16,000 counts/sec). Power required is 6w. Temperature range is −70° to +140°F. Weight is 3 lb. The Austin Co., Special Devices Div., Dept. ED, 76 Ninth Ave., New York 11, N. Y.

CIRCLE 61 ON READER-SERVICE CARD FOR MORE INFORMATION

Sampling Switch
With Speed of 5rps

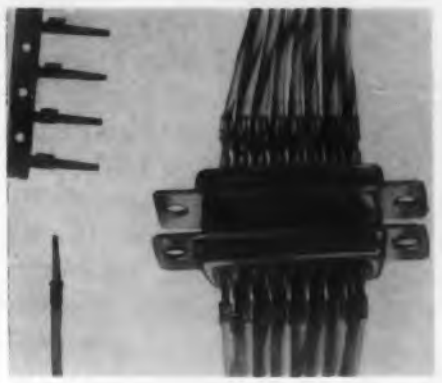
The Model AE-00007 Rotary Sampling Switch, especially designed for commutation with the AN/AKT - 10 FM/FM telemetering system, consists of two poles of 60 contacts each rated at a sampling speed of 5rpm. Its 28v d-c drive motor is furnished with a governor and a primary voltage line filter. There is no contact bounce. Overall dimensions of this switch are 5-11/16" x 3" diam; weight is 19 oz.

Other models are also available for telemetering commutation applications in a series of standard sampling speeds from less than 1rps to 30rps, with a choice of drive motor voltage, number of contacts, number of poles, and percent duty cycle. Applied Science Corp. of Princeton, Dept. ED, P. O. Box 44, Princeton, N. J.

CIRCLE 62 ON READER-SERVICE CARD FOR MORE INFORMATION

Taper Pins and Blocks

Solderless Wiring Devices



This firm's miniature Taper Pins are for miniaturized electronic components. They are installed on wires at high speeds by automatic machines and make use of the self-locking taper principal with mating receptacles.

The pins are inserted into the receptacles with measured force by the firm's "Certi-Lok" Hand Tools. They are available for wire sizes No. 26 to No. 20. All sizes have the same size tapered section to fit universal receptacles.

Also available are Taper Blocks with 10 or 20 sockets and with single or dual contacts. The contacts are available in gold, silver, and tin-plated finishes. Special design features allow them to be rigidly stacked to receive up to 2500 or more connections. This allows the design engineer to utilize a few standard parts for all terminal blocks from 10 connections on up. The 10-connector block is 2-1/8" long x 11/16" wide x 1/4" thick. Aircraft-Marine Products, Inc., Dept. ED, Harrisburg, Pa.

CIRCLE 65 ON READER'S SERVICE CARD FOR MORE DATA

In-Line Read-Outs

Employ Engraved Lucite

This line of miniature digital in-line read-outs is designed for instrumentation applications. The units consist of engraved lucite plates, arranged in depth and held in a precision-milled holder. The numbers are less than 1/2" high, with each number illuminated by a single, miniaturized, aircraft-type bulb.

The construction reduces cross-lighting effects and provides unambiguous readings. Speed of response is limited only by the response of the bulbs. Overall height of the read-out is 1-3/4"; depth 1-1/4". The units are available in any number of decades and with symbols as well as worded displays. Electro Instruments, Inc., Dept. ED, 3794 Rosecrans St., San Diego 10, Calif.

CIRCLE 66 ON READER'S SERVICE CARD FOR MORE DATA

Lumped-Constant Delay Lines

Fore Computer Applications

These hermetically sealed, totally encapsulated, Lumped-Constant Delay Lines, because of design flexibility, can be custom-built for use in the computing circuits of digital computers.

Thermal stability, no aging, and complete encapsulation yield a constant delay to an accuracy of 1% under conditions of extreme temperature, pressure and humidity. Delay lines can be properly terminated to prevent reflections. They simplify assemblies and can be adapted to any type of mounting, including printed circuit boards. They are also available for modular assemblies.

Typical of the new series No. 11-12, it offers the following design advantages: an average delay change of only 0.00005μsec per μsec per degree Centigrade; completely versatile form which enables the delay line to be modified to fit the contour of the available space; extremely low signal attenuation; low cross talk in minimum space; extended bandwith for long delay lines affords fast pulse rise time; essentially linear phase shift. Lumped lines cover the entire practical range of impedance in minimum size and meet environmental tests from —55°C to +125°C. Additional data and catalog can be obtained by writing ESC Corp., Dept. ED, 534 Bergen Blvd., Palisades Park, N. J.

CIRCLE 67 ON READER'S SERVICE CARD FOR MORE DATA

Magnetic Clutch

In Single-Ended Construction

This high-speed, precision, single-end magnetic clutch is for all types of control, computer, and servo systems. Known as the Model T502, it can be mounted on a single hanger like any standard servo motor. Concentric input and output shafts on the mounting end of the unit permit all gearing to be located at this end. Mounting is identical to a Mk 8 Mod 0 servo motor. Sterling Precision Instrument Corp., Instrument Div., Dept. ED, 34-17 Lawrence St., Flushing 54, N. Y.

CIRCLE 68 ON READER'S SERVICE CARD FOR MORE DATA

DU MONT TYPE 331
CATHODE-RAY OSCILLOGRAPH

- Developed in close cooperation with a leading manufacturer of computers
- DC to 4 mc vertical bandwidth (Transient response, 0.08 μsec)
- Precise measurement of time intervals (from 2.5 seconds to 0.08 μsec)
- Accurate voltage calibration over range from 0.4 to 400 volts full scale
- Flat-face, tight-tolerance Du Mont Type 3WP- Cathode-ray Tube provides excellent deflection linearity and freedom from field distortions
- Three-times undistorted sweep expansion of *any* calibrated sweep. Any expanded portion may be positioned on screen

ADDITIONAL FEATURES

Illuminated calibrated scale
High impedance test probe supplied
May be continuously operated horizontally or vertically
Beam-gate output at front panel for triggering external devices
Swing-away chassis construction assures accessibility of all components for convenient maintenance
Probe, instruction manual, and other accessories stored in front panel cover

AND BEST OF ALL, THE PRICE IS ONLY **$585**

Never before has so much high-quality performance been compressed into so small a package. Here, in well under a cubic foot, (7⅞" x 9" x 17½") are *complete* facilities for high-precision observation and measurement of signals from d-c to 4 mc and beyond.

With its wide-band features and excellent pulse response (0.08 μsec) the Type 331 is particularly well suited for maintenance of computers and radar systems, or wherever portability—without sacrifice in performance—is required.

And in this day of cluttered work benches, the compact design of the Type 331 means that for general applications, you have laboratory performance in half to a quarter the surface area occupied by other instruments of comparable function.

For complete details, write to the address below for the technical bulletin.

IMPORTANT SPECIFICATIONS

Cathode-ray Tube: Type 3WP.

Deflection Factor: (full gain) a-c or d-c input, 0.2 p-p volts full scale (1.8").

Frequency Response: (any control setting) flat from d-c to down not more than 30% at 4 mc.

Calibrated Sweeps: 0.5 second to 0.5 μsec per major scale division (0.45"); expansion of 3X available on all ranges.

Amplitude Measurement: 0.4 to 400 volts full scale in 7 ranges.

Size: 7⅞" x 9" x 19½" overall including cover; weight without cover, 17½ lbs.; with cover 19¼ lbs.

DU MONT

TECHNICAL SALES DEPARTMENT • ALLEN B. DUMONT LABORATORIES, INC.
760 BLOOMFIELD AVENUE, CLIFTON, N. J.

Flat Mylar Capacitors
For Automatic Assembling

Designated Type KFM, this new series of flat mylar capacitors are high quality, sub-miniature, components which can readily be used with printed circuits and automatic assembly processes. All sizes are supplied with two sets of parallel leads for convenient mounting.

The Mylar polyester film dielectric capacitors are encapsulated in high quality Kel-F. This construction provides a moisture seal, and stable operating characteristics over a wide temperature range. Lead wires are held rigidly in place by a Kel-F seal to permit varied arrangements of lead connections and reliable attachment to printed circuit baseplates and modular wafers.

Standard sizes are rated at 150 and 250v d-c(w) at 125°C. For use at 85°C and below, these ratings are increased to 250 and 350v d-c(w) respectively. Sanders Associates, Inc., Dept. ED, Nashua, N. H.

CIRCLE 70 ON READER-SERVICE CARD

Vacuum-Tube Curves
For Computer Tubes

Vacuum-tube circuit design is made easier and faster by use of these large-size vacuum-tube characteristic curves. The curves, on 8-1/2" x 11" pads, show plate characteristics, positive-grid characteristics, μ, g_m, and r_p, plus screen characteristics for pentodes.

For ease of reading numerical data, all graph scales have been standardized at 1, 2, or 5 units per scale division. Reliable design is assured by limits of maximum current, voltage, and dissipation being clearly marked on the curves. The reverse side of the sheet gives tabulated electrical and mechanical data for the tube, and for all electrically-equivalent types. After use, the sheet can be torn off the pad and filed for permanent record. Pads are available for computer tubes such as 6211, 6350, 5965, 5687, 5963, 5687, 5751, and 5718. Technical Publishing House, Dept. ED, P. O. Box 61, Waltham 54, Mass.

CIRCLE 71 ON READER-SERVICE CARD

◀ CIRCLE 72 ON READER-SERVICE CARD

Potting Compound

Suited for Electrical Connections

Compounded to withstand thermal shock, this material meets all demands where flexibility combined with high electrical performance is a specific requirement. It is particularly suited to potting electrical connectors.

Catalogued as "Pro Seal #727, this potting compound has the desirable characteristic of being made of elastomeric materials withstanding temperatures from below —60 to 180°F. Another important feature is that the cured Pro-Seal #727 forms a strong, resilient, very low shrinkage rubber, with its base material being approximately 97% solids. Its pourable viscosity allows for escape of entrapped air, resulting in a density core unseen heretofore in this type of compound. Other salient features are its resistance to petroleum products. It is exceptionally resistant to water and weathering. Coast Pro-Seal & Mfg. Co., Dept. ED, 2235 Beverly Blvd., Los Angeles 57, Calif.

CIRCLE 74 ON READER-SERVICE CARD

Plastic Coated Steel Tape

High Tensile Strength, Insulated

Plastic covered metal tape is basically a high tensile steel strap over which is extruded any of these plastics: vinyl, nylon, or polyethylene, the plastic forming a thick coating that protects the metal from corrosion.

Among advantages claimed for MET-L-TAPE is that it combines the strength of steel with the dielectric properties, abrasion resistance, and other service factors of the plastic coating. It can be fastened to bolts or rivets or—by stripping a section of the plastic to expose the metal—it can be spot welded. Plastic can be stripped for fastening. Coatings are available in any color and can be heat sealed at the cut ends. Electronic applications include bundling of wiring in large electrical installations; handles for portable radios, etc. Garrison Co., Dept. ED, 218 Front St., S. Plainfield, N. J.

CIRCLE 75 ON READER-SERVICE CARD

CIRCLE 76 ON READER-SERVICE CARD ➤

Transistor Power Supply

Set to 0.1v Variations

This compact d-c power supply is helpful in designing transistor circuits and in development work on transistors. Designated as the Model T-100A, the unit is a closely regulated, dual-voltage supply, with both outputs contained in a single chassis suitable for rack mounting or bench use. Cabinet size is 5-1/4" high, 19" wide, 14" deep.

Each output supplies 0-100vd-c continuously variable (without switching) and 0-100ma maximum. No derating of output current is necessary. Voltage is adjustable to 1/10thv variations by means of Helipots equipped with Duodials.

Regulation for d-c outputs is 20mv change no load to full load; for line voltage 115va-c ±10% there is a 0.1% change in output voltage. Ripple is below 1.5mv rms for any voltage or load within the ratings. Recovery time, 0 to full load is 0.5 millisec; full load to removal: 0.25 millisec.

Drift, after 1hr stabilization time, is less than 0.1% in an 8hr period. Both outputs are floating, and either positive or negative output may be grounded. Dressen-Barnes Corp., Dept. ED, 250 N. Vinedo Ave., Pasadena 8, Calif.

CIRCLE 78 ON READER-SERVICE CARD

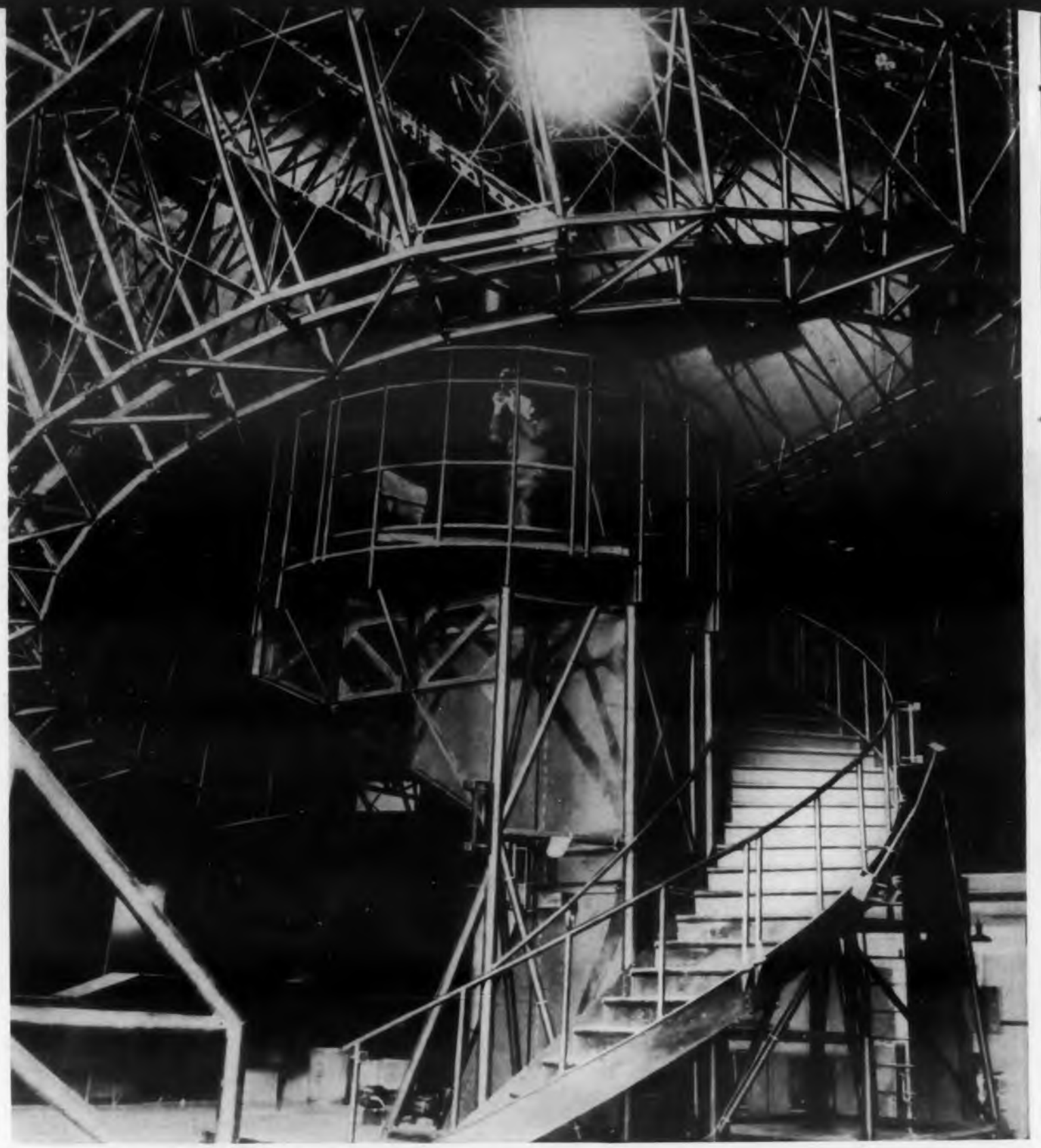
High Temperature Capacitors

Use Alumina Terminals

Alumina terminal insulators have been adopted as standard for all of this company's capacitors designed for operation at elevated temperatures. Terminals made of alumina provide extraordinarily good properties. In cased capacitors operated at temperatures up to 200°C, alumina terminals provide an increase in resistance value up to 100 times over glass terminals. High melting point solders are also used for sealing of case seams and alumina insulators. Hard solder enables capacitor casings to remain hermetic at 200°C. Film Capacitors, Inc., Dept. ED, 3400 Park Ave., New York, N. Y.

CIRCLE 79 ON READER-SERVICE CARD

CIRCLE 80 ON READER-SERVICE CARD ➤



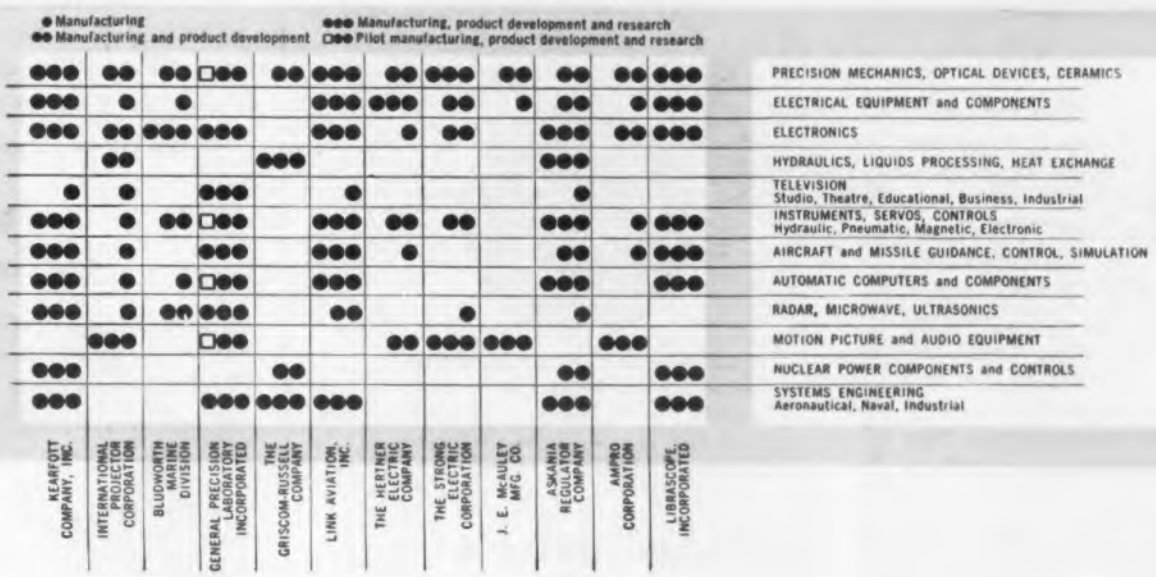
CELESTIAL NAVIGATION—Link Aviation's high-speed, high altitude celestial navigation trainer; only such trainer capable of simulating trans-Polar flight. Trains navigators in techniques of guiding planes by the stars.

PROCESS CONTROL—Askania controls regulate speed of the ten turbines which develop compression to maintain gas suction pressure in Creole Petroleum Corporation's giant, pile-supported oil drilling operation on Lake Maracaibo, Venezuela.

SUBMARINE OPERATION — Controls developed and produced by Askania Regulator Company are utilized to govern operation of U. S. Navy's modern Guppy type submarines.

MISSILE GUIDANCE —One of the many guided missiles equipped with Kearfott basic gyro reference systems, the B-61 Matador—U. S. Air Force's first successful ground-to-ground tactical weapon.

GPE CAPACITIES



themselves, as well as in systems and equipment developed and produced by other manufacturers of advanced technological equipment.

All GPE Producing Companies work in the advanced areas of highly specialized fields and are engaged in the design, development, manufacture and sale of equipment which is closely related from a technical point of view. It is all precision equipment; it derives from similar fields of technical competence; it saves labor, increases productivity or achieves results which cannot be achieved with even limited use of on-the-spot manpower. The chart here shows the specialized fields in which the key GPE Producing Companies work.

In addition to specialization in its particular products and fields of technical competence, each of these companies has at its command, as required, the facilities and specialized techniques of the other GPE Companies in their respective fields. Interrelation of their resources is achieved through GPE's basic operating policy, GPE Coordinated Precision Technology. In all areas in which GPE Companies work, this coordination has been responsible for a wide variety of precision equipment of superior design and performance, embodying new, advanced principles.

A brochure relative to the work of the GPE Companies and GPE Coordinated Precision Technology is available. Address your request, or specific inquiries, to: GENERAL PRECISION EQUIPMENT CORPORATION — 92 Gold Street, New York 38, N. Y.

Germanium Silicon Lenses

For Infrared Applications

Germanian and silicon lenses may now be obtained for use in infrared optics. Because of the high refractive indices, single elements have appreciably less aberration than glass lenses of equal power. Germanium is transparent beyond 1.8 microns with a 50% reflection loss when uncoated. Silicon is transparent beyond 1.1 microns with a 45% reflection loss when uncoated. Silicon has a strong absorption band at 9 microns. These lenses may be anti-reflection coated to provide transmittance of over 90% for the spectral region of interest.

The sharp cut-off filter proerties of these materials together with their excellent lens properties makes them of considerable importance to the infrared designer. Baird Associates, Inc., Dept. ED, 33 University Rd., Cambridge 38, Mass.

CIRCLE 81 ON READER-SERVICE CARD

New TV Tubes

For Deflectors and Oscillators

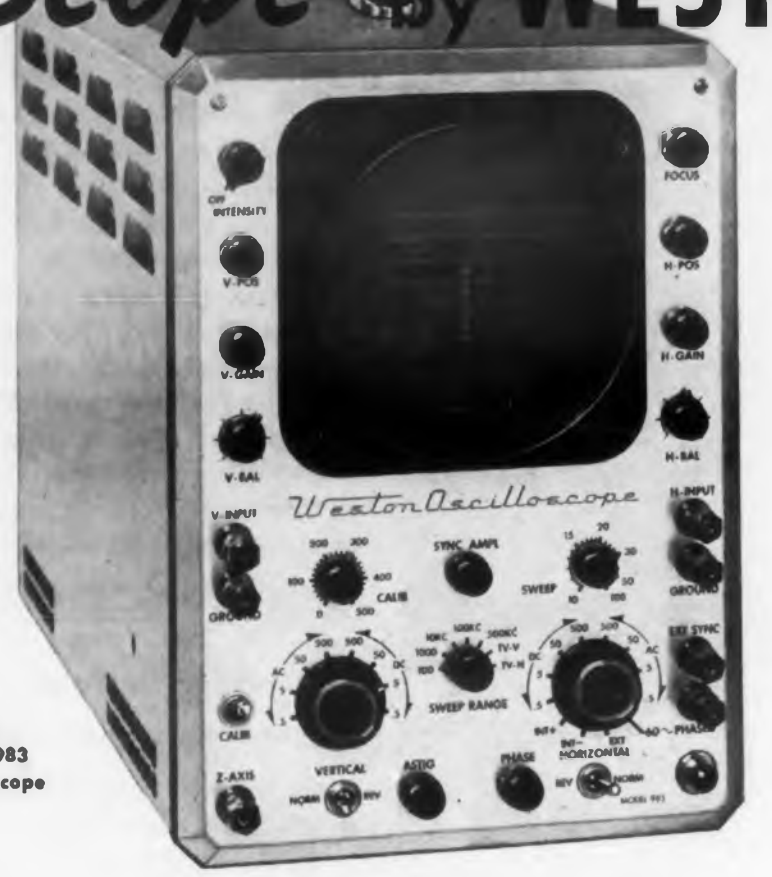
Tube type 6CS7 is a miniature 9-pin, medium mu, dual triode with dissimilar sections and is suitable for vertical deflection and oscillator applications using conventional transformer supply voltages. The output section has the very high plate dissipation rating of 6.5w, high perveance, and an absolute peak positive pulse plate voltage of 2200v. The other triode section of this dual purpose tube is intended for service as an oscillator, detector, or amplifier. The tube is also designed for series string or conventional parallel operation.

The 25DN6 is a beam power pentode rated for TV service as a horizontal deflection amplifier and was designed particularly for use in "off-the-line" series string sets utilizing low B+ voltages. The tube has a very desirable low plate knee characteristic at zero bias. Sylvania Electric Products, Inc., Dept. ED, 1740 Broadway, New York 19, N. Y.

CIRCLE 82 ON READER-SERVICE CARD

◀ CIRCLE 80 ON READER-SERVICE CARD

NOW...the All-purpose 'Scope by WESTON



Weston
Model 983
Oscilloscope

Model 983 is a high gain, wideband Oscilloscope designed to accurately reproduce waveforms comprising a wide band of frequencies. High sensitivity of 15 millivolts per inch RMS makes this "scope ideal for — SETTING RESONANT TRAPS... SIGNAL TRACING IN LOW LEVEL STAGES... AS A GENERAL NULL INDICATOR... for PHASE CHARACTERISTIC MEASUREMENT IN INDUSTRIAL APPLICATIONS...and for SWEEP FREQUENCY VISUAL ANALYSIS.

The 'scope contains identical vertical and horizontal push-pull amplifiers with a choice of AC or DC coupling without affecting either sensitivity or band width. Both amplifiers have compensated step attenuators and cathode follower input. *It has excellent square wave reproduction with overshoot of only 2 to 5%, with a rise time of 0.1 microsecond. The 'scope response is essentially flat throughout the specified range of 4.5 mc and is usable to 6 mc.*

The unit has provisions for internal calibration, internal phased sine wave, and Z-axis intensity modulation. Reversal of polarity of both horizontal and vertical signals is easily accomplished by means of toggle switching. *Tube replacements are non critical, and etched circuitry facilitates quick and rapid maintenance.*

The Model 983 Oscilloscope is now available through local distributors. For complete literature write WESTON Electrical Instrument Corporation, 614 Frelinghuysen Avenue, Newark 5, New Jersey.

WESTON *Instruments*

WAVEFORM ANALYSIS

Response curves accurately displayed. Ideal for use with Weston intensity marker display. A fast, retrace sweep circuit with cathode follower output prevents pattern distortion.

SQUARE WAVE RESPONSE

Overshoot is only 2 to 5%. Rise Time is 0.1 Microsecond. Square wave depicted 250 kc.

PHASE MEASUREMENTS

Phase shift between horizontal-vertical amplifiers, 0-500 kc-0°, to 1 mc within 2°; by internal adjustment with gain controls at max 0° phase shift possible on any specific frequency to 6 mc.

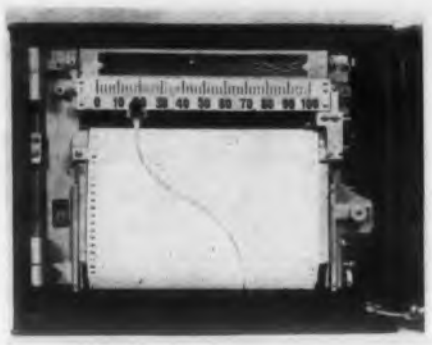
RESPONSE CHARACTERISTIC

Note flatness throughout specified range; to 3.6 mc down 1.5 db, at 4.5 mc down 3 db, at 6 mc down 6 db.

CIRCLE 86 ON READER-SERVICE CARD FOR MORE INFORMATION

High-Speed Recorder

Covers 11" in ¼ Sec



This strip chart instrument requires only a quarter-second for its pen to cover the full 11" chart width. It was designed primarily for research centers, laboratories, and experimental stations where emphasis is on high-speed measurement and charting of changing conditions which can be measured by d-c output transducers. It narrows an important gap in recording between the slower speed, conventional, large chart recorders and oscillographic instruments of the photographic-galvanometer type.

The amplifier of the new recorder has a high input impedance and increased output power. It is of plug-in construction. All components can be replaced as a complete unit to facilitate range changing. A manual pen lifter prevents ink clogging or tearing of chart paper. Continuous standardization is provided.

Accelerated chart speeds, appropriate for the faster pen speed, are available. Basic options are: 2ips or 4ipm. The instrument can also be equipped with a chart drive step-up mechanism. This arrangement gives a speed of 6iph which can be increased in a ratio of 30 to 1 or 60 to 1. Minneapolis-Honeywell Regulator Co., Dept. ED, Wayne & Windrim Aves., Philadelphia, Pa.

CIRCLE 87 ON READER'S SERVICE CARD FOR MORE DATA

Transducers

For Force, Weight, Stresss

New models have been added to the Series 140 Load Transducers, with full scale ranges now available from 5 lb to 100,000 lb. Based on a differential transformer - proving ring combination, these rugged units offer long term stability in continuous use.

Mechanical hysteresis is less than 0.1%. Temperature effect is only 0.025% per °F. Linearity is 1%. Frequency response is uniform from static to 1000cy. Additional features include a standard electrical connector and micrometer zero adjustment for nulling of tare loads. Daytronic Corp., Dept. ED, 216 S. Main St., Dayton 2, Ohio.

CIRCLE 88 ON READER'S SERVICE CARD FOR MORE DATA

Wave Analyzer

Covers Broad Range

The Model 21 Wave Analyzer is a frequency selective vacuum tube voltmeter that accurately measures the amplitude and frequency of electrical signal components within the broad range of 30cy to 50,000cy. Full scale readings are obtainable from input signals ranging from 500v down to 160mv rms. Typical applications of this instrument include harmonic and intermodulation distortion measurements, hum and noise analyses, and carrier telephone line and equipment testing. Donner Scientific Co., Dept. ED, 2829 7th St., Berkeley 10, Calif.

CIRCLE 89 ON READER'S SERVICE CARD FOR MORE DATA

Building Blocks

For Analog Computers

"Servomation" Building Blocks are an array of electro-mechanical general purpose analog computer components. Various component combinations provide means for industrial production control, problem solving for both equations and control system design, experiments, and data processing. These interchangeable modular assemblies match each other in all the important mechanical and electronic specifications. Flexibility is achieved by plug-in units, internally wired cabinets, jack boards, and external patch-cord connections. Units may be rearranged and additional components added with ease at any time.

This equipment features the "Servoscope" for analysis of control system phase and gain shifts; the "Servoboard" for breadboarding electro-mechanical assemblies; and magnetic amplifiers, thyratron drive amplifiers, vacuum tube amplifiers, signal amplifiers, modulators, demodulators, corrective networks, power supplies, jack panels, rack panels, and cabinets. Servo Corp. of America, Dept. ED, 20-20 Jericho Turnpike, New Hyde Park, L. I., N. Y.

CIRCLE 90 ON READER'S SERVICE CARD FOR MORE DATA

Eyelet Kit

61 Types for Fastening

A new eyelet exploration kit, containing small quantities of standardized eyelets is designed especially for engineers and designers. The new eyelet kit aids production and design staffs to explore fully the potentialities of eyelets as fastening devices in their products.

The kit includes quantities of the 61 varying eyelets in the company's standardized series. Eyelets are graduated in 32nds with lengths ranging from 3/32″ to 13/32″, and diameters from 2/32″ to 8/32″. United Shoe Machinery Corp., Dept. ED, 140 Federal Street, Boston, Mass.

CIRCLE 92 ON READER-SERVICE CARD

Pure Mercury

Minimizes Meniscus Effects

This new mercury has a mirror-like surface brilliance, with no observable oxidation apparent. The new mercury is reported to be almost completely free of any meniscus. With the elimination of any observable curvature on interior glass walls, and the reduction of oxidation to a point where it is not detectable, desirable performance of delicate precision instruments is aided. Metalsalts Corp., Dept. ED, 200 Wagaraw Rd., Hawthorne, N. J.

CIRCLE 93 ON READER-SERVICE CARD

Computer Facility

For Mathematical Problems

The computing services of this company are available to government and industry on a rental basis. Geared for round-the-clock operation in the solution of problems, the company is also a consultant to management in the introduction of automation in business and industrial applications. Current facilities consist of 114 operational amplifiers, 10 servos, 6 function generators, and associated, scale-factor pots, diodes, relay amplifiers, recorders and plotters. Dian Laboratories, Inc., Dept ED, 611 Broadway, New York 12, N. Y.

CIRCLE 94 ON READER-SERVICE CARD

◄ CIRCLE 95 ON READER-SERVICE CARD

CIRCLE 599 ON READER-SERVICE CARD ►

DOW CORNING CORPORATION

Silicone Dielectrics

ELECTRICAL AND ELECTRONIC NEWS No. 2

SUNBEAM "FRYPAN": CASE HISTORY OF AN ADVANCED DESIGN MADE PRACTICAL BY SILICONE DIELECTRICS

Ingenious design and resourceful use of materials is reflected in the Sunbeam Automatic Frypan, an attractive and original new household appliance, which combines the appeal of a built-in source of controlled heat with the convenience of easy, thorough washability.

These ideal features were made practical through the use of Dow Corning silicone dielectrics. The completely enclosed lead and thermocouple wiring, for instance, is insulated with Silastic*, the Dow Corning silicone rubber. Silicone-glass sleeving is also slipped over the wires to assure maximum dependability at operating temperatures in the range of 450 F. And the terminal block to which they are connected is a heat resistant silicone-glass laminate.

Although the Frypan may be almost totally immersed in water, the electrical connections at the base remain dry and easily accessible inside a terminal box sealed with molded Silastic. Extensive research and testing, including several thousand actual immersions, have proved that this gasket maintains a watertight seal even after prolonged exposure to temperatures in the range of 450 F. *No. 6*

ELECTRIC RANGE CONTROL SYSTEM INSULATED WITH SILICONE RUBBER

The heart of the Westinghouse "Electronic Eye" heat control system for electric range surface units is a thermistor embedded in Silastic*, Dow Corning silicone rubber. Flexible Silastic insulated cable connects the thermistor to exterior wiring, and the Electronic Eye itself is isolated in the center of a flexible diaphragm of Silastic. The Silastic components have stood up under boiling water, oil, grease, coffee and syrup, as well as accelerated life testing equivalent to 15 years of actual service. *No. 10*

Dow Corning 220 Fluid, a special silicone fluid for sound transducers, has sound transmission characteristics similar to those of water, a freezing point below —65 F, and a flat viscosity temperature slope. Dielectric strength is 200 volts per mil; volume resistivity is 10^{12} ohm cm. *No. 11*

Silicone Molding Compound Qualifies For Guided Missile Service At 750 F

Light weight, high mechanical strength, good dielectric properties and excellent heat resistance motivate the use of a terminal block molded of Dow Corning 301 Molding Compound with brass inserts in an induction potentiometer produced by American Electronics of Culver City, California. Designed for aircraft and guided missile service, the unit is built to operate in ambient temperatures as high as 750 F.

To qualify for the job, the molded parts withstood five room temperature shock tests at 50 "G's" plus constant vibration in the order of 25 "G's" for 4 hours at 600 F. Finally, the potentiometer was subjected to 1050 F for 15 minutes. The terminal blocks molded of Dow Corning 301 Molding Compound were somewhat shrunken and charred, but the brass inserts were still firmly retained. *No. 9*

Silicone dielectrics most widely used are described in the 1955 Reference Guide to Dow Corning Silicone Products. The brief but comprehensive description of each material includes a review of properties and applications. With increasing demands for high temperature operation, such a guide to these remarkably stable dielectrics should be immediately available to every electrical engineer. *No. 7*

"What's a Silicone?" is the title of a 32 page booklet which answers that often asked question in semi-technical terms. Indexed and illustrated, this booklet has earned an international reputation as the most interesting and informative description of silicones ever published. *No. 8*

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Midland, Michigan

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DOW CORNING CORPORATION

Silicone News

FOR DESIGN ENGINEERS

Silicone Fluid Used to Obtain More Uniform Gage Response

While the viscosity of most fluids changes with temperature, Dow Corning 200 Fluids have relatively flat viscosity-temperature slopes. This characteristic plus nonvolatility and excellent resistance to oxidation and mechanical shearing make these silicone fluids ideal for use as damping and hydraulic media in such devices as the dairy homogenizer pressure gage manufactured by Taylor Instrument Company.

Initially, the hydraulic system used to translate volumetric pressures into the pinion-and-sector gear that controls the dial indicator of the gage, contained a glycerine and water solution. But the viscosity of the solution varied with changing temperatures causing the response time of the gage to vary accordingly.

After an adjustable orifice installed in the hydraulic system failed to solve the difficulty, Taylor engineers replaced the troublesome water solution with a Dow Corning 200 Fluid. Showing very little change in viscosity at operating temperatures ranging from 50 to 100 F, the silicone fluid keeps the gages operating uniformly in any dairy without further readjustment.

Taylor also uses two silicone compounds in the gage to assure accurate, dependable service. One of these materials, applied to the pinion-and-sector movement, dampens vibration and greatly lengthens gear life. Dow Corning 11 Compound is coated on the O-ring sealing the faceplate to prevent moisture from entering and fogging the glass. *No. 52*

Silicone Finish Protects and Keeps Die-Cast Range Parts White in Spite of Oven Heat

With properties midway between those of organic paints and vitreous enamels, silicone-based finishes maintain the appearance and prevent the rusting of stacks, space heaters, jet engine parts or kitchen ranges. One of the early users of silicone-based paints on space heaters, Perfection Stove Co. of Cleveland, is now using them on die cast parts and accessories. Here's the story of one of their recent applications.

The oven door of one of Perfection's ranges is left ajar when the broiler is in operation. This is done to keep the temperature in the oven below the point at which the oven thermostat is set to turn off the heat. A deflector bar is fastened above the oven door with two die-cast end-brackets to protect the plastic control knobs against the heat that passes through the slightly opened oven door.

These brackets are painted white to match the rest of the range. When conventional paints showed signs of early failure, Perfection substituted a white Nubelon finish based on modified silicone resins and formulated by Glidden. This silicone finish shows no sign of cracking, peeling or browning even after long exposure to oven heat.

This is the way the finish is applied. The die-cast parts are degreased and given a phosphate surface treatment to improve adhesion. After heating for 15 to 20 minutes at 375 F, the parts are sprayed with the silicone finish, thinned 3 to 1. They are then baked for one hour at 375 F. *No. 51*

44 Silicone Grease Used In Juke Box

The effectiveness of most organic greases is greatly reduced by unusually high or low temperatures. That is why semi-inorganic Dow Corning 44 Grease is the specified lubricant for the popular 80 record juke box produced by AMI Corporation of Grand Rapids.

Applied to the exposed moving parts of the music machine, this silicone lubricant withstands temperatures ranging from —40 to 350 F, assuring proper lubrication and trouble-free operation of installations in any climate.

Dow Corning 44 Silicone Grease has proved to be such an effective lubricant for this particular application that it has now become a standard practice for every AMI repairman to carry a tube in his regular repair kit. *No. 53*

Design Edition 13

DOW CORNING CORPORATION - Dept. 4710-B
Midland, Michigan

Please send me 51 52 53

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COMPANY _____

STREET _____

CITY _____ ZONE ____ STATE _____

ATLANTA • CHICAGO • CLEVELAND • DALLAS • DETROIT • LOS ANGELES • NEW YORK • WASHINGTON, D. C. (Silver Spring, Md.)
Canada: Dow Corning Silicones Ltd., Toronto; **Great Britain:** Midland Silicones Ltd., London; **France:** St. Gobain, Paris

FOR DATA RELATING TO THESE ARTICLES, CIRCLE REFERENCE NUMBERS IN COUPON

Mid-Frequency Oscillograph

For Vectorgraph Work

Type 341 cathode-ray oscillograph for general purpose use in the mid-frequency spectrum has identical, highly stable, linear vertical and horizontal amplifiers.

The high stability has been achieved by the use of a self-regulating power transformer. Because of the instrument's identical amplifiers and excellent stability, the Type 341 is useful in broadcast color television work as a cathode-ray vectorgraph.

The linear X and Y amplifiers of the type 341 offer sinusoidal response from d-c to 600kc at which frequency the response is down less than 30%. Sensitivities are in the order of 100m/inch. Technical Sales Dept, Allen B. DuMont Laboratories, Inc., Dept. ED, 760 Bloomfield Ave., Clifton, N. J.

CIRCLE 96 ON READER-SERVICE CARD

Coating for Metals

Maintains Constant Resistance

Laqua is a new coating for metals that preserves chemically-cleaned surfaces when treated directly after electro-plating or a chemical cleaning operation. It can be sprayed on a clean surface or be applied as a dip after a water rinse without drying.

It is ideally suited for many electronic applications as the deposited film offers the same electrical resistance as an oxide film formed on aluminum after 8hr at room temperature. Resistance remains constant with aging. A film of 0.0001" thickness has an electrical resistance of 0.2 ohms at 1-1/2v and does not interfere with electrical connections, wiring or parts attached to a chassis that must remain in electrical contact.

It offers excellent salt spray resistance. After 210hr of an ASTM salt spray test, no corrosion was found on coated parts. Soldering operations with treated parts take less time. Fidelity Chemical Products Corp., Dept. ED, Frelinghuysen Ave., Newark, N. J.

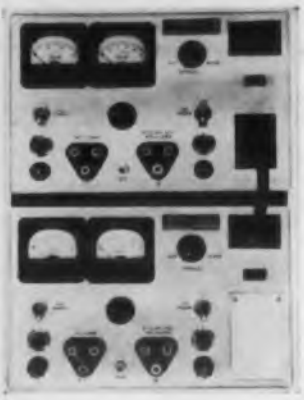
CIRCLE 97 ON READER-SERVICE CARD

CIRCLE 98 ON READER-SERVICE CARD ➤

➤ CIRCLE 599 ON READER-SERVICE CARD

Regulated Power Supply

Can Be Stacked for High Output



This regulated power supply is for use either as an individual supply or may be interconnected to other identical supplies (by means of built-in cables and connectors) to provide extended voltage or current output. It features simplicity of operation, as well as compactness, durability, and lightweight.

The supply is regulated within 0.2% or 0.3v, whichever is larger, at any line voltage from 105v to 130v. Maximum ripple and noise is less than 5mv rms. Output voltage is regulated within 0.3% or 0.7v, whichever is greater.

The supply is available in two models, both the same except that one is equipped with an additional 0 to 150v variable regulated bias supply, 5ma maximum load. These units measure only 10-1/2″ x 10″ x 7″ high and weigh 19 lb. RS Electronics Corp., Dept. ED, 435 Portage Ave., Palo Alto, Calif.

CIRCLE 99 ON READER'S SERVICE CARD FOR MORE DATA

Insulator Terminals

Teflon Stand-Off's and Feed-Thru's

These Stand-Off and Feed-Thru isolator terminals incorporate Teflon and are used in high and ultra-high frequency electronics applications. They are produced in a wide range of sizes.

The toughness, high dielectric strength, and heat resistance of Teflon virtually eliminates service failures of this type of terminal. Resiliency of the Teflon allows permament, 10 lb minimum pull test "press-fit" installation of the one-piece units, reducing assembly costs and eliminating mounting hardware. Miniaturization is easily accomplished, since Teflon's dielectric constant (2.0) and loss factor (0.005) are unaffected in temperatures from 80° to 400°F. Tri-Point Manufacturing & Developing Co., Inc., Dept. ED, 401 Grand St., Brooklyn 11, N. Y.

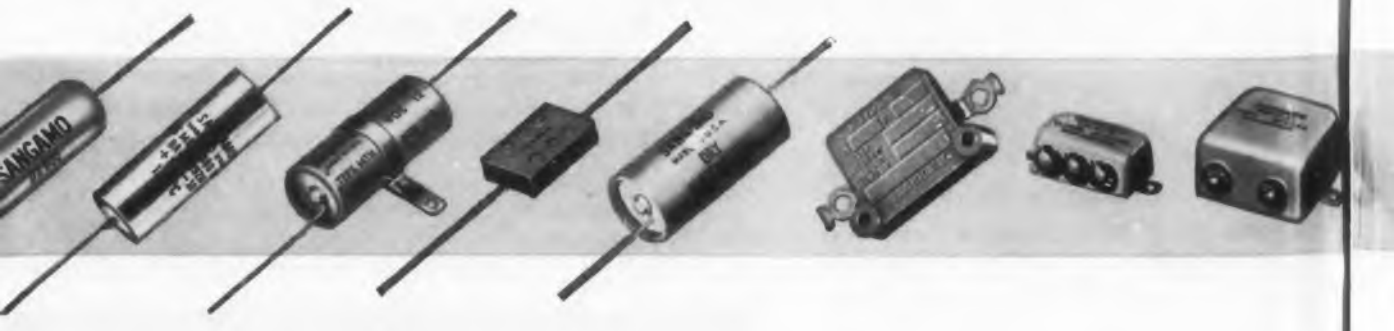
CIRCLE 100 ON READER'S SERVICE CARD FOR MORE DATA

...that's why IBM uses Sangamo

The amazingly complex IBM "702" electronic calculator is hailed as the fastest and most flexible commercial data processing system ever devised. The central Arithmetical and Logical Unit performs calculations and makes decisions at a rate of more than 10,000,000 operations in an hour. Data and instructions for processing are stored in an electrostatic memory bank of cathode ray storage tubes. Output can be in the form of punch cards at the rate of 100 per minute.

A machine like this needs components that assure maximum performance to meet its exacting demands. That's why several different types of Sangamo Capacitors are used in the 702.

If you need capacitors for demanding electronic applications, Sangamo engineers can help you. You can choose from a complete line of paper, mica, electrolytic and button type capacitors for every industrial, electronic, and radio application.



SANGAMO ELECTRIC COMPANY

MARION, ILLINOIS

CIRCLE 101 ON READER-SERVICE CARD FOR MORE INFORMATION

Sound, Vibration Analyzer

For 35-18,000cy Range

The Third Octave Spectrum Analyzer, Model B L-2109, by narrow band analysis, provides physical measurement data that are easily correlated to subjective tests for loudness of sound or the intensity of vibration. It works in the range of frequencies from 35cy to 18,000cy. There are 27 fixed one-third octaves band filters. Manual or automatic switching is possible, with the analysis data being read from a meter or graphically recorded on an oscillograph. Brush Electronics Co., Dept. ED, 3405 Perkins Ave., Cleveland 14, Ohio.

CIRCLE 135 ON READER'S SERVICE CARD FOR MORE DATA

Environmental Test Chamber

Automatically Controlled

The Model W-100 FH test chamber has a temperature range of —100° to +200°F. Extremely accurate automatic temperature control is featured, cycling temperature from —40° to +185°F in 15 minutes.

This same unit can be adjusted to cycle temperatures in conformance with all government specifications. Inside dimensions of test chamber are 12″ x 12″ x 24″. The Webber Manufacturing Co., Inc., Dept. 3a, 2740 Madison Ave., Indianapolis, Ind.

CIRCLE 102 ON READER'S SERVICE CARD FOR MORE DATA

Current Meter

Measures Down to 0.001μamp

The "TAKK Ultra Sensitive Current Meter", Model 63, is suitable for measurement of very small leakage currents through insulation at any voltage level. A rugged unit, it weighs only 8 lb and measures 9″ x 6″ x 5-1/2″. It will measure d-c currents from 0.001 to 1000μamp with an accuracy of ±4%. Hewson Co., Inc., Dept. ED, 443 Broad St., Newark 2, N. J.

CIRCLE 103 ON READER'S SERVICE CARD FOR MORE DATA

Magnetic Amplifier

Linear Over Wide Range

The Type MA-101 "Dynamag" high-stability, low-power, d-c magnetic amplifier is especially suited for driving electro-hydraulic valves, and for mixing signals where low zero drift and zero error are specified. Infinite internal gain together with external current or voltage feedback maintains linearity over a wide load variation. Essentially insensitive to 10% changes in supply voltages and frequency, the amplifier requires a 1.5w, 20v rms, 1000cy power supply.

Nominally less than two ohms, the input impedance may be varied up to 50,000 ohms, making the unit suitable for use with thermocouples, strain gages, photo-electric cells, and demodulators. Power gains up to 5000 are obtainable with either voltage or current output. Potted construction, plug-in connector, and four tie-down studs make this 3" x 2" x 1-1/4", 7oz package ideal for installation design. Dynamics Research Associates, Dept. ED, 414 Times Square Bldg., Seattle 1, Wash.

CIRCLE 105 ON READER-SERVICE CARD FOR MORE INFORMATION

Grounded-Grid Triode

For Use as R-F Amplifier

This transmitting triode, the *PL-6569,* is designed specifically for use as a medium-power grounded-grid r-f amplifier. It combines high perveance with a high amplification factor, to give unusually high power gain in grounded-grid service.

The tube has a maximum plate dissipation rating of 250w. It will give a power gain of more than 10 as a class-C or class-B r-f amplifier; an output of over 800w can be obtained with a driving power of less than 80w.

The inherent input-circuit loading provided by the grounded-grid circuit makes artificial swamping unnecessary when the *PL-6569* is used as a linear class-B amplifier for the amplification of modulated power. Penta Laboratories, Inc., Dept. ED, 312 N. Nopal St., Santa Barbara, Calif.

CIRCLE 106 ON READER-SERVICE CARD FOR MORE INFORMATION

Computer Potentiometers

Individual Linearity Chart Supplied

These precision linear potentiometers are especially designed for computer and control circuits. All resistance measurements are made with a standard accurate to 0.01%. All resistance ratios are accurate to within 0.001%. Pots may be replaced from stock with no retrimming or recalibrating. Single turn pots show no change in characteristics after 1,000,000 complete forward and reverse rotations.

All units are cleaned in an ultrasonic cleaner to insure removal of all dust and foreign matter which might affect wear or noise characteristics. Each pot is supplied with its own individual linearity chart showing its exact characteristics as compared with the reference standard. The Minnesota Electronics Corp., Dept ED, 133 E. Santa Anita Ave., Burbank, Calif.

CIRCLE 107 ON READER-SERVICE CARD

Counter-Converter Unit

Has Digital Output

This unit combines in a low-cost device a basic counting facility and data reduction converter. Accepting regular or random digital information up to 100,000 events per second, the unit has an illuminated electronic scale display and may be used as two independent 3-digit counters, or a single 6-digit counter.

The small device includes a converter assembly providing contact closures to operate IBM type Summary Punches, and readout may progress at the full capacity of the punch. Reset either manually or automatically, the unit has provision for a plug-in time base assembly which permits automatic recycling and e-p-u-t meter operations, when used as either a counting facility or as the combination counter-converter. Harper Engineering Co., Dept ED, 2330 Michigan Ave., Santa Monica, Calif.

CIRCLE 108 ON READER-SERVICE CARD

Triode-Pentode
For TV Applications

The *6BA8*, a miniature, 9-pin medium-mu triode and sharp cutoff pentode, is intended for service in TV receivers employing a series heater string. The pentode section has a plate dissipation rate of 3.25w and is designed to serve as a video amplifier. The triode section has a mu of 18 and is suitable for applications where a low-mu triode is desirable, such as sync amplifiers, etc.

The tube contains in addition a 600ma heater with controlled warmup ratings. Sylvania Electric Products, Inc., Dept. ED, 1740 Broadway, New York 19, N. Y.

CIRCLE 109 ON READER'S SERVICE CARD FOR MORE DATA

Capacitor
For −55° to +100°C Range

The "Tiger Cub" type MGT high-temperature, paper dielectric, tubular capacitors are designed to operate effectively at temperatures from −55°C to +100°C. Capacitance stability varies less than 10% over this entire range. Long service life is assured by "Vikane" impregnation. An external wax dip provides added moisture protection that will withstand 250hr of continuous exposure in 90% relative humidity at 40°C. Cornell-Dubilier Electric Corp., Dept. ED, South Plainfield, N. J.

CIRCLE 110 ON READER'S SERVICE CARD FOR MORE DATA

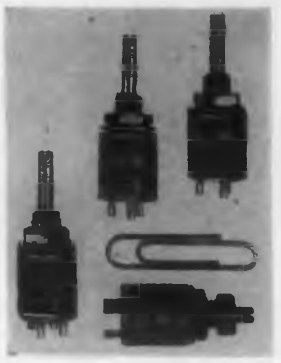
Power Supplies
With 50kv Isolation

For work with klystrons, traveling-wave tubes, and other microwave devices, these supplies have 50kv isolation from ground on both sides of the high-voltage circuit so that several units can be operated in series where desired. Two of the models have continuously-variable outputs from 0-1000v and 0-2000v at 200ma. Levinthal Electronic Products, Inc., Dept. ED, 2758 Fair Oaks Ave., Redwood City, Calif.

CIRCLE 111 ON READER'S SERVICE CARD FOR MORE DATA

Potentiometer Trimmers

With 3% Linearity



The "Acetrim" line of subminiature wirewound precision potentiometer trimmers includes such features as 1/2" diam, standard resistance ranges from 10 ohms to 50k with 3% linearity; ambient temperature range from —55 to 125°C; a new type shaft lock; and a weight of only 1/4 oz. Ace Electronic Associates, Dept. ED, 125 Rogers Ave., Somerville 44, Mass.

CIRCLE 113 ON READER'S SERVICE CARD FOR MORE DATA

Hollow Mill

Cleans Solder from Tube Pins

Designed to shave soft materials, such as solder, from terminal posts or wires, this hollow mill is small enough to be used on closely-spaced transducer pins or on miniature tubes.

The mill may be actuated by hand or inserted in a machine chuck for production work. It is available in sizes to clean terminals from 1/32 to 1/4" diam. Woodruff & Stokes Co., Inc., Dept. ED, 353 Lincoln St., Hingham, Mass.

CIRCLE 114 ON READER'S SERVICE CARD FOR MORE DATA

Pushbutton Switches

For On-Off or Momentary Contact

The Type 1800 units are compact, sturdy pushbutton switches designed for applications requiring on-off spst or dpst throw controls. Rated 20amp 125v, and 10amp 250v a-c/d-c, they are suited to a wide variety of control applications. Large red and black buttons give positive identification. Screw-type terminals are recessed in the sides of a molded phenolic body 15/16" wide x 1-3/4" long, with an overall depth, including buttons of 1-15/16". Arkles Switch Corp., Dept. ED, 51 Water St., Watertown 72, Mass.

CIRCLE 115 ON READER'S SERVICE CARD FOR MORE DATA

Band-Pass Filter

Adjustable over 20cy to 200kc

The Model 310-AB Band-Pass Filter is continuously adjustable with unity pass-band gain and 24db/octave slopes outside the pass band. Peaking is used to reduce the attenuation at the cut-off frequencies. Both the high and low cut-off frequencies are independently adjustable covering 20cy to 200kc. This provides maximum flexibility of adjustment of both the band center frequency and the band width.

Calibration accuracy is ±10%. Accuracy of ±5% is available on special order. The unit is especially useful in the audio and ultrasonic frequency range for noise measurements, harmonic and frequency analysis, and for psycho-acoustics and electro-medical research. By using power supply regulation the internal hum and noise has been reduced to less than 1nw. Krohn-Hite Instrument Co., Dept. ED, 580 Massachusetts Ave., Cambridge 39, Mass.

CIRCLE 117 ON READER-SERVICE CARD FOR MORE INFORMATION

Pressure Switches

Differential and Gage Units

A series of miniaturized, vibration-resistant, differential and gage pressure switches for aircraft and missile systems applications has been developed by this firm. Weighing approximately 1/3 lb, they operate in inert gases and fluids, engine and hydraulic oils, and aromatic fuels, and they are designed to withstand vibration up to 35g. Small and compact, they allow installation in small areas difficult to get at.

Pressure fittings are threaded for bulkhead mounting. Sealed with O-rings to provide protection against moisture, dust, or explosive atmospheres, the units are available with a quick-disconnect plug for easy installation or with lead-wire connections. Operating temperatures range from −65° to 165° F.

Operating pressures of the illustrated unit range from 2psi to 50psi. Weighing 0.32 lb, the unit has a body length of 2″ and has 1-1/2″ diam. Southwestern Industries, Dept. ED, 5880 Centinela Ave., Los Angeles 45, Calif.

CIRCLE 118 ON READER-SERVICE CARD FOR MORE INFORMATION

Mixer Diode

For U-H-F Tuners

Specifically designed for u-h-f tuners, this mixer diode (1N1-73A) is made by a special process which results in uniform characteristics for tuner operation over the entire u-h-f band. The diode is moisture-proof and maintains stability regardless of shock, vibration, and temperature variations. Government and Industrial Div., Philco Corp., Dept. ED, Philadelphia, Pa.

CIRCLE 119 ON READER-SERVICE CARD FOR MORE INFORMATION

Ink Bottle

Is Squeezed for Accurate Flow

The "Squeeze Bottle" is a pinpoint applicator which speeds pen or instrument filling, prevents spilling or drying out, and gives controlled amounts of ink. Ink is electro-polarized so no shaking is necessary. Uniform color obtains throughout the bottle. The ink makes clean-cut lines without doubling back, and it is completely opaque. The Carter's Ink Co., Dept. ED, Kendall Square, Boston, Mass.

CIRCLE 120 ON READER-SERVICE CARD FOR MORE INFORMATION

Signal Generator

With 10kc to 1.5Mc Range

The "Decalator" Model 100, a crystal-controlled signal generator, has decade switching for rapid selection of desired frequency and resettability. Range is 10kc to 1.5Mc, with steps of 1kc in 3 decades. Interpolation is calibrated 0-1kc. Accuracy is 100cy, and short term stability is +25cy. Output is 3v rms. Attenuation provides for 3, 1, 0.3, 0.1, 0.03, and 0.01v full scale. The meter is calibrated 0-1 and 0-3v. Decade Instrument Co., Dept. ED, Box 153, Caldwell, N. J.

CIRCLE 121 ON READER-SERVICE CARD FOR MORE INFORMATION

Magnetic Servo Amplifier

For Airborne Systems

This 6w 115v 400cy magnetic amplifier, Part No. T1616JC, is designed specifically for instrument-type airborne servo systems. It operates directly from a synchro control transformer or potentiometer, without preamplifier or demodulator. A three-stage fast-response half-wave bridge circuit is used which is capable of a 20cy bandwidth when driving a BuOrd Servo Motor Mk 7 in a closed-loop system using simple circuitry.

This hermetically sealed amplifier features less than 0.07v drift with respect to wide changes in line voltage and frequency or temperature. Weight is 1.7 lb. Also available are 60cy models. Specialties, Inc., Dept. ED, Skunks Misery Rd., Syosset, L. I., N. Y.

CIRCLE 124 ON READER'S SERVICE CARD FOR MORE DATA

Cathode Follower

For Crystal Transducers

The Sonic Model S-650 is an impedance-matching cathode follower with unusally high input impedance and resistance to most adverse environmental conditions. Input impedance is over 200 megohms, gain is 0.95 ±1% from 2cy to 20,000cy, and vibration sensitivity is less than 20mv/g. The unit will withstand vibration of ±10g and shock excitation of 30g of 12millisec duration. The case is filled with casting resin to make the unit imperivous to dust, moisture, altitude, or mechanical failure. The S-650 was designed for use with barium titanate accelerometers.

A specially designed six-channel power supply (also shown) with low ripple and d-c heater source is available in both rack and cabinet models for operation of the cathode follower or other devices with similar power requirements. Signal Equipment Co., Inc., Dept. ED, 2706 Third Ave., Seattle 1, Wash.

CIRCLE 125 ON READER'S SERVICE CARD FOR MORE DATA

Potentiometer

400cy Unit with 0.05% Linearity

This 400cy potentiometer is for use in servo systems and analog computers. Known as the Vernistat it combines features of both a potentiometer and a variable transformer. Its low output impedance (less than 130 ohms) eliminates the need for isolation amplifiers in many applications. It also has an extremely low phase shift.

Size and mounting dimensions have been designed to Bureau of Ordnance specifications for a size 18 synchro, and provision has been made for coupling with synchros, resolvers, and other components, as well as ganging. Shaft seals can be supplied when required by environmental conditions.

High linearity (0.05% standard) makes the unit valuable as a precision voltage divider, supplementing its applications as a reference voltage generator or follow-up unit in servo systems. For use in analog computers, it multiplies a shaft angle by a voltage. With suitable modification, the unit can be made to generate a 30 element straight-line approximation to mathematical or empirical curves, including curves with reverse slopes. Dimensions are 1.75″ diam x 2.68″ long. Weight is 10 oz. Vernistat Div., The Perkin-Elmer Corp., Dept. ED, Norwalk, Conn.

CIRCLE 126 ON READER'S SERVICE CARD FOR MORE DATA

Thermostat

Sealed but Adjustable

The electrical rating of this sealed, adjustable thermostat is up to 500w or 5amp. Voltages are 25v to 125v a-c/d-c. Size is 2-1/2″ x 1/2″ diam.

The unit is adjustable to desired temperature by means of an energized magnet. A special locking feature assures dependable service at control point. Temperature ranges are 0 to 80°, 40° to 140°, and 120° to 200°C. Differential is as close as 0.1°C. Atlas Electric Products Co., Dept. ED, P. O. Box 1591, Erie, Pa.

CIRCLE 127 ON READER'S SERVICE CARD FOR MORE DATA

Cabinet Racks

In Variety of Combinations

This company's line of completely assembled racks now includes the universal type, which has provisions for mounting chassis supports, shelves, sliding shelves, and standard sliding devices. These racks, in addition to being available with or without front doors, are also available with or without detachable side panels, and may be used singly, or in rows.

Racks are made in standard units of 19″ and 24″ wide panels, in 18″ and 24″ depths, and in 48-1/8″, 76-1/8″ and 83-1/8″ standard heights.

Intermixing of similar height racks with any combination of 19″ and 24″ wide panels is possible. Panel mounting angles are fully adjustable and may be set anywhere from front to rear of racks. Vertical side supports for attaching chasses, brackets, shelves, and slides may be installed without drilling or fitting. Finishes available are black or grey ripple enamel, primer coat only, grey hammertone, or aluminum grey lacquer. Par-Metal Products Corp., Dept. ED, 32-62 49th St., Long Island City 3, N.Y.

CIRCLE 129 ON READER-SERVICE CARD

Nylon Synthetic Paper

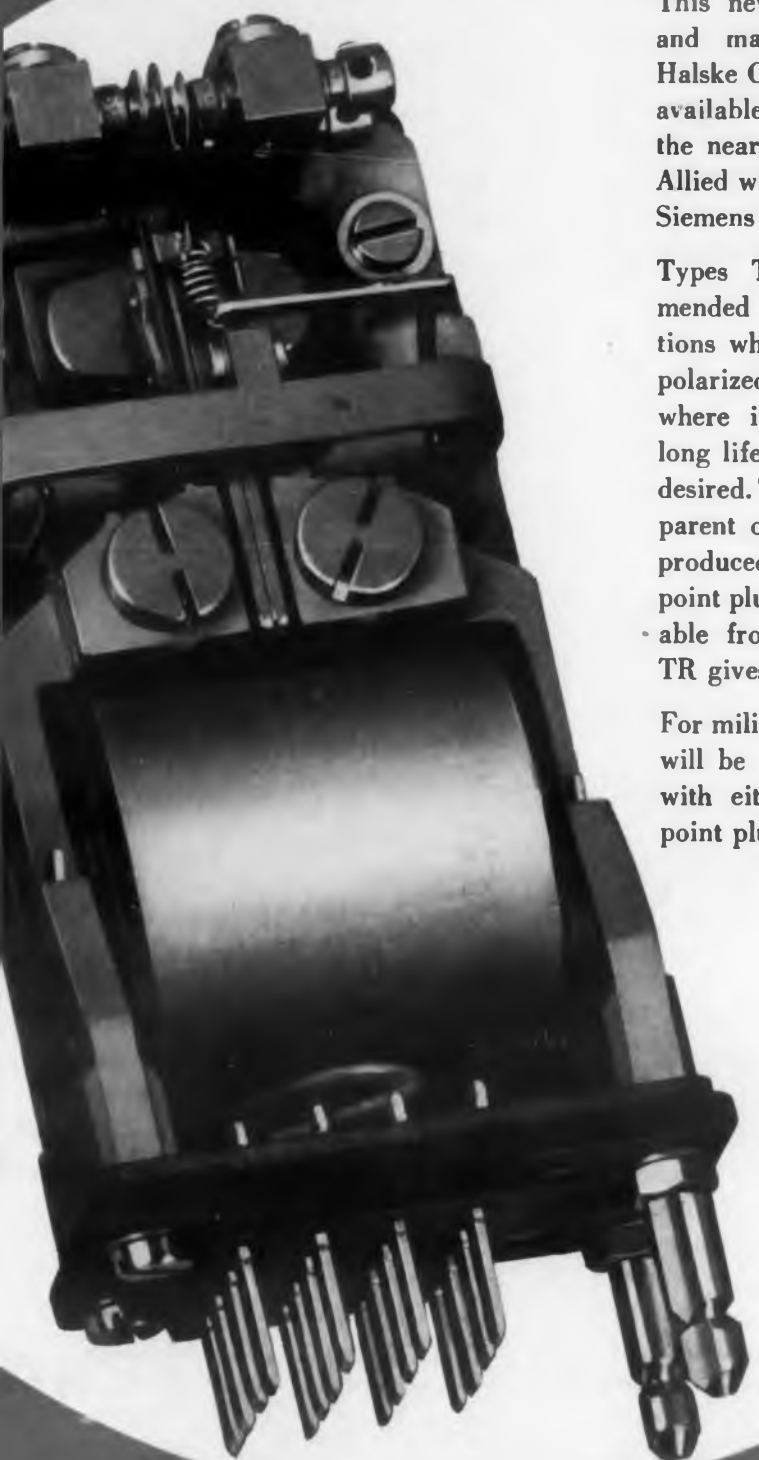
Has Unusual Properties

The synthetic nylon paper is made wholly from nylon fiber. It is almost impossible to tear by hand and is many times stronger than paper made with rags or wood pulp. In addition, it is highly resistant to chemical attack, absorbs very little moisture and resists the action of molds, bacteria, and light. Applications in the electronics industry have not been explored but engineers are encouraged to investigate properties. The stability of paper to moisture indicates possible use in map and tracing papers and for important records and documents where permanence is necessary. Riegel Paper Corp., Dept. ED, 260 Madison Ave., New York 16, N. Y.

CIRCLE 130 ON READER-SERVICE CARD

CIRCLE 131 ON READER-SERVICE CARD ➤

D'S NEW



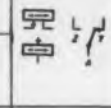
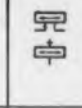
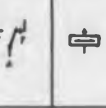
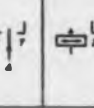
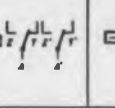
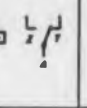
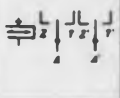
This new polarized relay, designed and manufactured by Siemens & Halske Company of Germany, is now available from Allied Control and in the near future will be produced by Allied with the technical assistance of Siemens & Halske.

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

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

POLARIZED RELAY

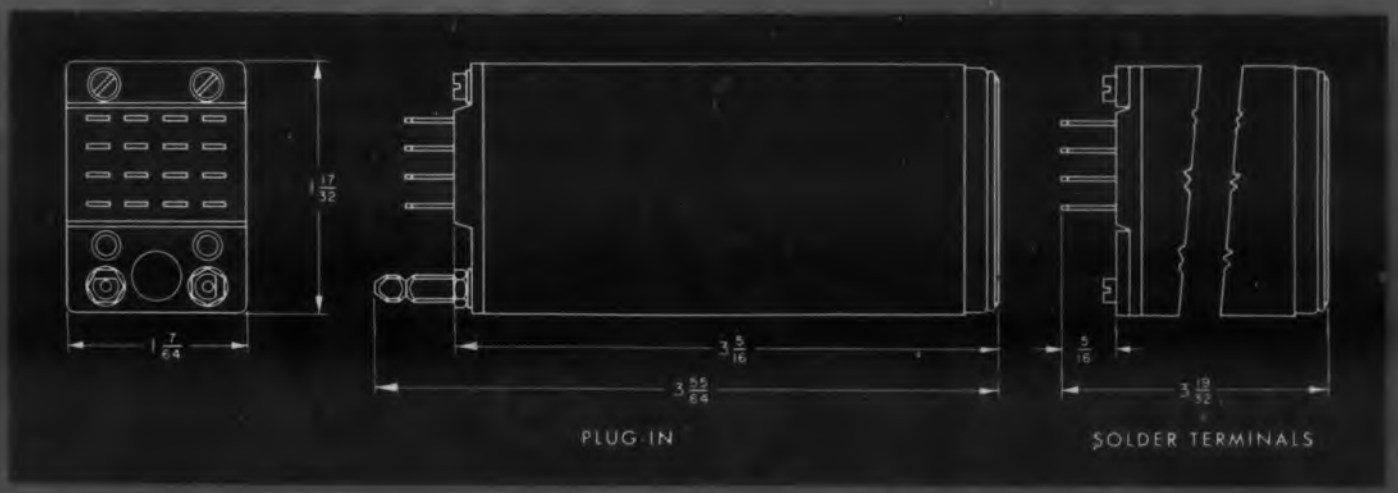
Specifications For Allied's Types Trls 63-69

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

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

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

DIMENSIONS



ALLIED CONTROL

ALLIED CONTROL COMPANY, INC., 2 EAST END AVENUE, NEW YORK 21, N. Y.

Measuring Magnifier

For Various Scales

Four scales are available for this seven-power magnifier to measure radii, line thickness, angles, and metric distance, lineal, and other dimensions.

One general purpose scale provides for all these measurements, while the others are for specialized work. They can check the size of small holes, wires, and fine threads, as well as gages, templates, and layouts. The clear plastic sides permit full illumination of the object being studied. The magnifier barrel is threaded internally, permitting accurate focusing of the eyepiece. Bausch & Lomb Optical Co., Dept. ED, 635 St. Paul St., Rochester, N. Y.

CIRCLE 132 ON READER-SERVICE CARD

Hammer Finish Spray

For Painting Panels

"Hammer-Koat" is a smooth air-drying hammer finish paint. It is designed for use on panels, racks, chasses, and instruments. "Hammer-Koat" is now available in three colors —brown, blue, and silver. It comes in pressurized cans for self-spraying. It is ideal for laboratory use. General Cement Mfg. Co., Dept. ED, 919 Taylor Ave., Rockford, Ill.

CIRCLE 133 ON READER-SERVICE CARD

Test Centrifuge

For Small Components

This test centrifuge is a rotary accelerator which provides controlled variable centrifugal acceleration for testing instruments or electronic assemblies.

The speed of rotation is infinitely variable from 118rpm to 1260rpm to provide, for example, accelerations of 4g to 400g on a 9″ radius of gyration. Unobstructed testing space above rotating table is 23″ in diam and 6″ high. For testing electrical components, a set of 14 slip rings is provided, each engaged by two silver graphite brushes. Coleman Engineering Co., Inc., Dept. ED, 6040 W. Jefferson Blvd., Los Angeles 16, Calif.

CIRCLE 134 ON READER-SERVICE CARD

◀ CIRCLE 131 ON READER-SERVICE CARD

"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
Camden 1, New Jersey

USG

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

CIRCLE 136 ON READER-SERVICE CARD FOR MORE INFORMATION

Automatic Punch

Rapidly Perforates Tape

The Automatic Punch Tape Unit, for integrated data processing, creates a high-speed, versatile five to eight channel punched tape from a modified Clary adding machine. It perforates the tape at the rate of 20 characters/sec. The electrical output adding machine, with commutating mechansim, is available in the 10-key model and in two full keyboards, with eight and 11-column totaling capacities.

Flexibility of the punch's scanning unit permits conversion to other machines with smaller or larger totaling capacities. The tape punch can be operated by remote control with the cable connection to the adding machine. It can be used in a hookup of multiple machines if desired.

The machine performs all its normal calculating functions. An error key which creates a coded signal on the tape can be added to the keyboard. The programming is dictated by the uses desired of the tape. Repeat entries can be coded into the programming. The power supply is self-contained. Electronics Div., Clary Multiplier Corp., Dept. ED, San Gabriel, Calif.

CIRCLE 137 ON READER'S SERVICE CARD FOR MORE DATA

Power Supply

For Strain Gage Systems

This power supply unit is useful in most strain gage systems as a direct replacement of a battery. Drop-off of output voltage is eliminated, as well as battery charging and maintenance. Complete isolation from the input line results in less than 1mv ripple from either output side to ground. It features magnetic circuitry.

Output is 5-15v in two ranges at 0-1amp, continuously adjustable within 0.1%. Ripple is less than 0.05%. Regulation is ±0.1%. Designed for relay rack mounting, the unit has an input of 105-125v 60cy. It is also available with 400cy input and miniaturized hermetically sealed construction for airborne applications. Eagle Instruments, Inc., Dept. ED, 14757 Keswick St., Van Nuys, Calif.

CIRCLE 138 ON READER'S SERVICE CARD FOR MORE DATA

Z-Y Bridge

Can Be Balanced for Any Impedance

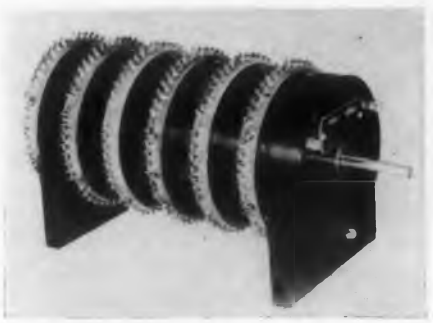
The Type 1603-A Z-Y Bridge posseses the unusual characteristic that it can be balanced for any impedance connected to its terminals. From short circuit to open circuit, real or imaginary, positive or negative, a bridge balance can be obtained with ease.

Nominal accuracy is 1% over the frequency range from 20cy to 20kc. The bridge reads directly the resistive and reactive components, or the conductive and susceptive components, depending on the value of the unknown. In addition to measurement of R, L, and C components, it is useful for measuring the impedance-frequency characteristics of such devices as electro-acoustic transducers, electrolytic and other capacitors, transformers, and filters, batteries, feedback loops, conducting liquids, solids or liquids with glossy polarizations, and many other "blackbox" unknowns. General Radio Co., Dept. ED, 275 Massachusetts Ave., Cambridge 39, Mass.

CIRCLE 140 ON READER'S SERVICE CARD FOR MORE DATA

Sampling Switch

6 Poles, 540 Contacts



This special low-level sampling switch has 6 poles and 540 contacts. Each contact plate has 90 contacts and employs semi-molded construction for dimensional stability and superior performance. Constant-force perma-brushes are utilized. Solder-type terminals or wire leads with plugs are available on request.

The switch features dynamic phasing, and each pole can be individually adjusted in phase relative to the other poles while the switch is operating, with a special adjustment wrench. The switch is available with variations in number of contacts, poles, and wiring arrangements, with or without motor, etc. Dynamic contact resistance is approximately 1 ohm (average), and size is 7-7/16" long × 3-5/8" diam. General Devices, Inc., Dept. ED, Princeton, N. J.

CIRCLE 141 ON READER'S SERVICE CARD FOR MORE DATA

CIRCLE 142 ON READER-SERVICE CARD FOR MORE INFORMATION

Power Supply

Provides 28v D-C

Designed for operating control equipment on unregulated 28v d-c, this power supply is built for continuous duty in laboratory or production testing, and in original equipment. Designated as Model .28-2MX, it employs a selenium rectifier, and it has sufficient filtering to operate relays, solenoids, motors, and many other components. Output voltage can be adjusted for less than full load by means of extra transformer taps, which are brought to a convenient terminal board.

A sub-chassis style unit, it can be readily incorporated in a larger chassis. Input is 115v 60cy; output: 28v d-c 2amp; ripple: 2.2v max. Chassis area is 9-3/8″ x 3-1/2″; height above deck is 4-1/2″; and projection below deck is 1″. Weight is only 6 lb. Dressen-Barnes Corp., Dept. ED, 250 N. Vinedo Ave., Pasadena 8, Calif.

CIRCLE 144 ON READER'S SERVICE CARD FOR MORE DATA

Converter

Gives Binary-Coded Decimals

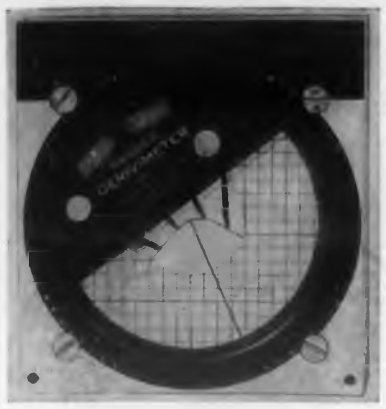
The Binary Coded Decimal Converter is a specialized analog - to - digital converter which uses a pattern design to provide a decimal form readout, but coded in binary notation (the binary bits are grouped, each group describing a decimal unit). This device is especially applicable to data recording systems, control panels, or digit display units; plotting by an automatic coordinated plotter, producing signals for automatic controls of high precision equipment—and may also be used to control the punching of IBM cards, paper tape, or a printer.

The basic element of the converter is a commutator-type disk consisting of concentric rings of alternately conductive or non-conductive segments corresponding to the 1-2-4-8 binary code. The converter is commercially available in single, double, and triple disk models in ranges to 200, 2000, 3600, 20,000, and 36,000 units. Librascope, Inc., Dept. ED, 808 Western Ave., Glendale, Calif.

CIRCLE 145 ON READER'S SERVICE CARD FOR MORE DATA

Slope Reader

For Data Reduction



The "Derivimeter" is designed to obtain the derivative or slope of a plotted curve. The instrument yields the normal as well as the slope directly, without computation. It is not necessary to know the exact equation of the graphical curve to determine derivatives. However, if an equation should be available, a simple plotting of the area of interest on coordinate axes allows the use of the unit to determine the slopes. Unless the function involved differentiates very simply, the use of the "Derivimeter" results in large time savings even when the exact equation is known.

In using the "Derivimeter", the square frame containing a movable indicator mechanism is oriented with the grid lines of the curve being measured. A pivot pin is located on the point of the curve where the derivative is to be taken. After the preliminary adjustment of an unflexed spring to a position approximately tangent to the curve, the spring is adjusted to conform to the shape of the curve. The derivative or slope is read from the circular scale. By orienting the frame at 90° counter-clockwise to the derivative position, the normal to the curve can be read. The Gerber Scientific Instrument Co., Dept. ED, 162 State St., Hartford, Conn.

CIRCLE 146 ON READER'S SERVICE CARD FOR MORE DATA

Potentiometers

Combine Accuracy and Compactness

This series (C-158) of precision ganging potentiometers is for applications requiring a high degree of accuracy in limited space. Diameter is only 1-5/8". Housings are precisely machined from solid aluminum for optimum linearity and ganging dimensions. Multiple ganged units can be electrically phased independently without disassembly. Precious metal contacts are used exclusively. All single and ganged assemblies are completely enclosed by permanent dust covers. Both threaded bushing and servo-mounting types are available. DeJur-Amsco Corp., Dept. ED, 45-01 Northern Blvd., Long Island City 1, N. Y.

CIRCLE 147 ON READER'S SERVICE CARD FOR MORE DATA

LITTON

multi-turn precision potentiometers

a new high in precision!

closer linearities available on special order.

The electrical precision expected of laboratory instruments, with the mechanical ruggedness required for dependable duty under the most severe military and industrial conditions are combined in Litton Potentiometers.

ELECTRICALLY, "ultra-precision" distinguishes Litton "pots". Recently developed high-speed, servo-controlled coil winding techniques make possible consistently high linearities. Linearity data supplied with each unit. Close total resistance tolerances can be held. For some resistance values resolution is several times that of similar models. "Infinite resolution" (stepless) pots are available.

MECHANICALLY, Litton Potentiometers are outstanding examples of precision design and ruggedized construction. All metal case—machined aluminum, anodized—is rust-proof and dust-proof. Shielded stainless steel ball bearings are standard.

DESIGN-WISE, Litton Potentiometers simplify many application and assembly problems. Extremely rugged traveling-nut type stops eliminate need for external stop assemblies for many applications. 3600° of actual electrical rotation with 90° of electrical and mechanical overtravel at each end is a unique feature. Special mountings and shafts are available as well as other electrical angles, extra tap connections, and gang versions.

Litton Potentiometers are refinements of the Series 3500 and Series 1800 ten-turn potentiometers formerly manufactured by the Birklan Corporation.

	CONDENSED SPECIFICATIONS	*series MA-30-10*	*series MA-20-10*
ELECTRICAL	Independent Linearity—Standard Range	±0.5% to ±.01%	±0.5% to ±0.02%
	Special Order	±0.005%	±0.01%
	Standard Total Resistance Range	2K to 300K ohms	1K to 100K ohms
	Resistance Tolerance Standard	±5%	±5%
	Special	±0.5%	±0.5%
	Actual Effective Electrical Angle	3600° $^{+1°}_{-0°}$	3600° $^{+1°}_{-0°}$
MECHANICAL	Case Diameter	3.000 inches	1.820 inches
	Starting Torque maximum at 20°C.	1.0 ±0.5 inch-ounces	0.75 inch-ounces
	Total Mechanical Angle—Nominal	3780°	3780°
	Mechanical Overtravel Each End—Nominal	90°	90°

design details subject to change without notice, certified drawings available on request.

write for complete data **LITTON INDUSTRIES** *(incorporated)*
336 N. Foothill Road · Beverly Hills, California · CRestview 4-7344
215 S. Fulton Avenue · Mount Vernon, New York · Mount Vernon 7-6609
or contact our sales representative nearest you . . .

CHICAGO 13, ILLINOIS, PIVAN ENGINEERING CO., 2871 N. LINCOLN AVE., DIVERSEY 8-6885
NEW YORK CITY, R.B.A., INC. 10 S. MIDDLENECK ROAD, GREAT NECK, LONG ISLAND, HUNTER 2 9320

CIRCLE 149 ON READER-SERVICE CARD FOR MORE INFORMATION

Electronic Relay

Offers Fail-Safe Feature

This electronic relay features high load-handling capacity, low control current, stable d-c circuitry, and a four-way panel selector switch that permits fail-safe operation of the system in any application. It has a capacity of 20amp at 120v a-c for handling high-wattage loads. Its sensitivity enables it to be actuated by low-current sensing elements such as mercury-column thermoregulators or directly by a Type 930 gas phototube.

This relay was designed to eliminate shock hazard when used for water-bath operation. It can be used with such high-wattage loads as incandescent or infrared heaters, refrigerating units, solenoid valves, and motor-driven devices. Arthur S. LaPine & Co., Dept. ED, 6001 S. Knox Ave., Chicago 29, Ill.

CIRCLE 150 ON READER-SERVICE CARD FOR MORE INFORMATION

Sync Generator

Low-Cost Unit For TV

The small, portable, and inexpensive Model 302-AR Drive Generator provides 6-8v (minimum into 75 ohms) blanking, horizontal sync, vertical drive, and color burst flag for driving most color and monochrome signal generating equipment where standard sync is not available. It provides driving pulses for signal generating equipment, such as, Multi-Burst, Window, Stairstep, and Linearity Checkers from remote check points, mobile units, and transmitters where studio sync is not available.

The horizontal signals are timed by a master multivibrator which is variable around 15,750cy. The unit takes 3-1/2" x 19" standard rack mounting. Input is 6.3v, 4.5amp, 285v 100ma. Telechrome, Inc., Dept. ED, 632 Merrick Rd., Amityville, N. Y.

CIRCLE 151 ON READER-SERVICE CARD FOR MORE INFORMATION

Correction: Tone oscillators manufactured by Pacific Div. of Bendix Aviation Corp. (*ED, July 1955, p 76*) are available for frequency ranges from 500 to 6000cy —not 600cy as reported earlier.

Rotary Solenoid

For 60cy Operation

Designed basically for 60cy use, this solenoid can be operated by standard voltages without the use of rectifiers, transformers, etc. The pure rotary movement produced at the shaft simplifies application by eliminating the need for counterbalancing the spiral action of some rotary devices. The solenoid is unaffected by vibration and shock, and it operates in any mounting position.

Eight basic sizes provide a wide range of forms, offering a variety of torque values from fractional in-lb's to 62.5 in-lb at maximum stroke on continuous-duty models. Intermittent-duty models for higher torque values are available. Stock models give 20°, 30°, and 45° rotation. Any other rotation angles up to 60° can be provided. Standard electrical rating is 115v 60cy. Other voltage ratings and d-c types are available. Leetronics, Div. of Lee Spring Co., Inc., Dept. ED, 30 Main St., Brooklyn, N. Y.

CIRCLE 154 ON READER-SERVICE CARD FOR MORE INFORMATION

Microwave Filters

For 100-2000Mc Uses

These compact, low-pass, coaxial filters, Series LS and LF, are for use in the u-h-f and microwave region from 100-Mc to 2000Mc. Featuring insertion loss less than 1db, the attenuation of Series LS rises to 60db within 25%, and that of Series LF within 13% of the cut-off frequency. These filters are useful for suppression of harmonics and spurious radiation from transmitters and receivers, and laboratory measurements.

The filters, rated at 100w, are 3″ to 8″ long, and weigh 5-9 oz, dependent upon cut-off frequency. They are resistant to vibration and shock, and can meet the requirements of MIL-E-5400 and MIL-E-5422C. Type N connectors, one male and one female, are normally furnished; other connectors, including types BNC, C, and U-H-F, can be provided. Standard cut-off frequencies available are 100, 200, 400, 700, 1000, and 2000Mc. Other low-pass, as well as high-pass and band-pass filters, are available with cut-off frequencies from 10Mc to 10,000Mc. Microphase Corp., Dept. ED, Box 1166, West Acton, Mass.

CIRCLE 155 ON READER-SERVICE CARD FOR MORE INFORMATION

ACE SPECIALIZED SERVICE

. . . . . keeps your Ace enclosure on the job!

Put it up . . . take it down . . . air condition it . . . make it larger—or smaller! Whatever the future demands of your Ace shielded enclosure, *you'll be prepared.* Years from now you'll still benefit from the same sound advice and counsel offered by Ace engineers in the original design of your enclosure. Why? Because Ace—and only Ace—*stands behind the service of your enclosure, as well as the performance.*

Little wonder, then, that laboratories, hospitals, manufacturers of every description, and the military prefer Ace. *It's the one enclosure you can buy today for tomorrow's needs.* Whether you're interested in an entirely new enclosure or modification of your present installation, you'll find it pays to call on Ace.

Detailed information on the complete line of Ace enclosures—featuring highest attentuation, full interchangeability*, inside bolting* . . . and exceeding the performance requirements of MIL-S-4957(ASG)—is given in Bulletin 10 available on letterhead request.

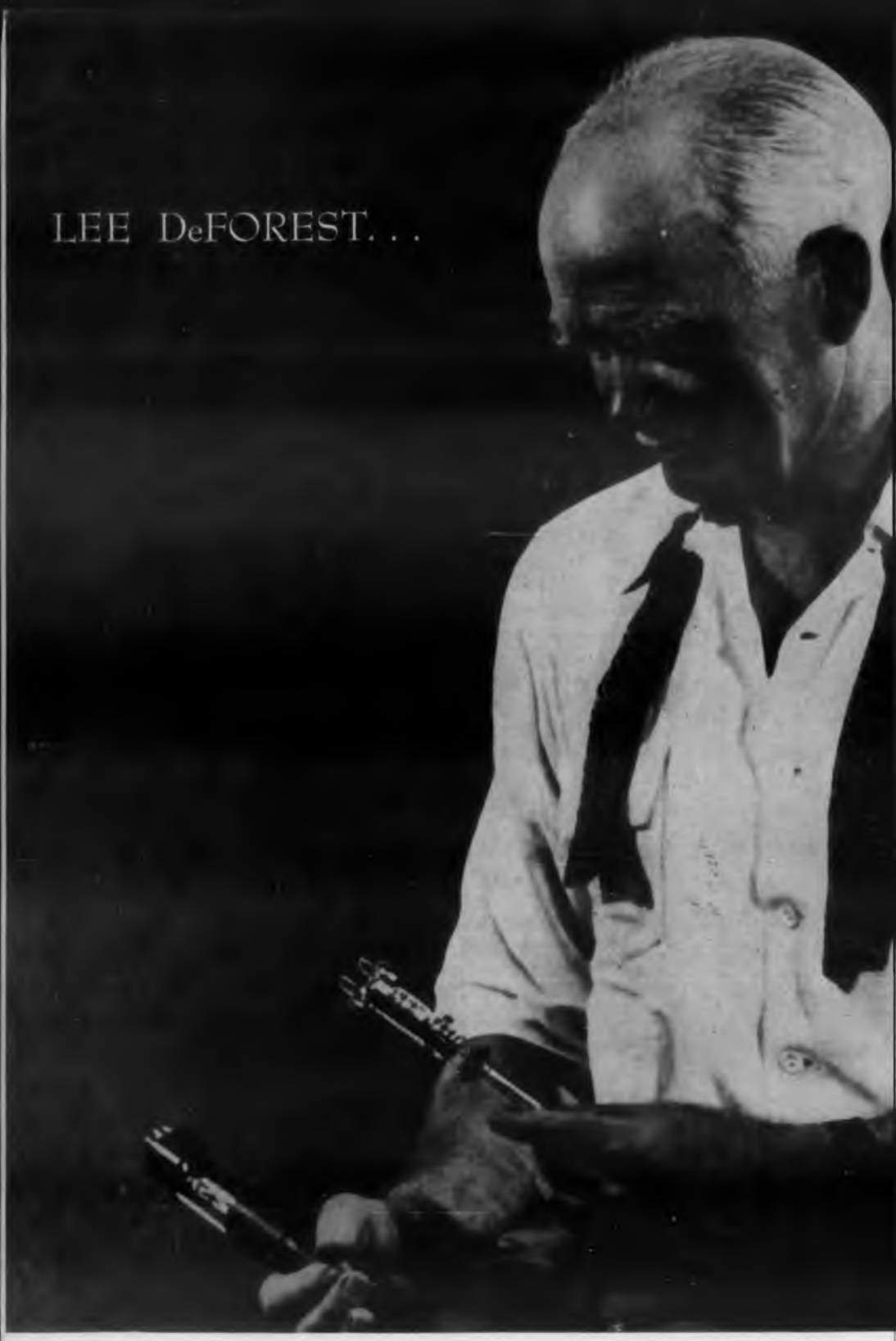
(*Patents Pending)

As an additional feature Ace can now supply shielded enclosures with microwave absorber to simulate free space—or can modify existing installations for microwave testing.

ACE ENGINEERING & MACHINE COMPANY

3644 North Lawrence Street • Philadelphia 40, Pennsylvania

CIRCLE 156 ON READER-SERVICE CARD FOR MORE INFORMATION



. . . . whose electron tube has made possible all modern electronics, has this advice for the electronic design engineer as well as the inventor:

"A wide reading of technical and semi-technical magazines is essential to widen the mental horizon and learn as much as possible of what other inventors and research men are doing...One of these excellent trade magazines which I regularly read is Electronic Design."

Leak Detector

Mass Spectrometer Features

Utilizing the radio-frequency mass spectrometer principle, this new leak detector is a smaller, more compact unit and provides working space on the counter top of the cabinet. Plug-in chassis have been utilized to simplify maintenance and eliminate down time. Incorporating both audible and visible warning, the instrument measures leak rates of 1 part in 700,000. Typical applications are found in the testing of cathode ray tubes, transformer casings, and wherever high-vacuum systems, pressure systems, or hermetic seals are used. Beckman Div., Beckman Instruments, Inc., Dept. ED, Fullerton 1, Calif.

CIRCLE 157 ON READER-SERVICE CARD

Ceramic Capacitors

Small Size, High Capacity

The new line of small size Ceramicons are rectangular, have a phenolic dipped coating, wax impregnated #22 hot tinned copper leads, and are made in three sizes; Style 892—0.34" x 0.34", Style 893—0.58" x 0.43", and Style 896—0.75" x 0.56". Other specifications are: life test—400v d-c; 1000hrs at 85°C; flash test—600v d-c; and power factor 2.5% max at 1v rms 1kc. These Ceramicons are designed especially for use in transistor and other miniaturized circuitry. They have a value range from 0.0022 to 0.1mfd and a 200v rating. Erie Resistor Corp., Dept. ED, 644 W. 12th St., Erie, Pa.

CIRCLE 158 ON READER-SERVICE CARD

Image Orthicon Tube

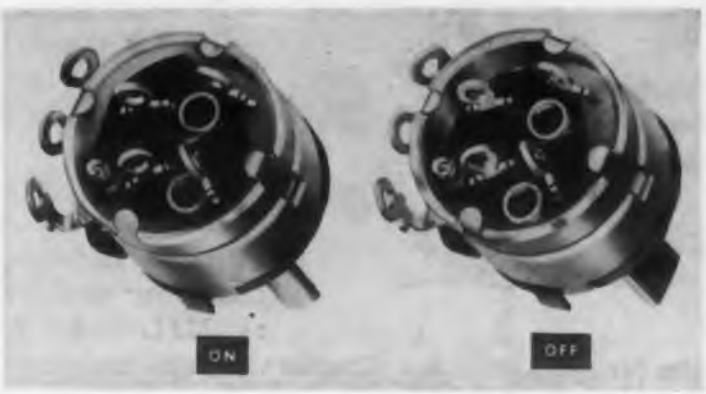
Packaged Carefully

Television broadcasters are no longer dependent upon only one source of supply for this key televising tube. The new image orthicon tube has been completely tested and its efficiency is described as being highly satisfactory. New packaging and shipping techniques are designed to ensure the life of the sensitive tube. Westinghouse Electric Corp., Dept. ED, 401 Liberty Ave., Box 2278, Pittsburgh 30, Pa.

CIRCLE 159 ON READER-SERVICE CARD

Volume Control Switch

With Special Contact Action



A rotary switch using "floating ring" contact action is now available on this firm's volume controls. Make or break of the line circuit is accomplished by spring-snapped, self-aligning motion of rings of special contact alloy. The rings float on pins so they can rotate slightly with each operation, providing a continually changing contact surface. Wear and arc erosion are spread around the whole circumference, make and break action is positive, and switch life is extremely long. The snap spring which moves the contacts carries no current, and will not heat and anneal when overloads occur. Positive snap action "feel" gives definite assurance of switch operation, with minimum torque requirement. Volume controls from 250 ohms to 10 megohms can be supplied with this new switch, at the same cost as conventional attached-switch models. P. R. Mallory & Co., Inc., 3029 E. Washington St., Indianapolis, Ind.

CIRCLE 161 ON READER-SERVICE CARD FOR MORE INFORMATION

Ceramic Capacitor

An U-H-F Subminiature

Offered in a new stand-off design, the Style S-4 u-h-f subminiature ceramic capacitor withstands greater shock and stress and also can be easily installed. It is readily assembled to the chassis with a 1/4" hex socket wrench which fits the tinplated hex brass base. The hot-tin-dipped terminal contains an elongated hole to accommodate more than one wire.

Overall height is approximately 5/8" with 4-40 x 1/8" deep female mounting hole. With extremely low series inductance, the unit has high self-resonant frequency for any particular capacitance value. A range of values from 3mmfd to 3-300mmfd can be obtained, depending on the type of ceramic material required for the use. Mucon Corp., Dept. ED, 9 St. Francis St., Newark 5, N. J. 5, N. J.

CIRCLE 162 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 163 ON READER-SERVICE CARD FOR MORE INFORMATION

PRECISION COMPONENTS in Production

(shown ¼ size)

GYROS—3 Gyro Platforms, Floated Rate Integrating Gyros, Vertical, Free, Directional, Rate Gyros and Gyro operated Rate Switches—compact, lightweight, hermetically sealed.

(shown actual size)

SYNCHROS—Transmitters, Control Transformers, Resolvers, Repeaters, and Differentials in Bu Ord Sizes 15, 11 and 8. High accuracy and environmental resistance.

(shown ½ size)

SERVO MOTORS—High torque, low inertia Servo Motors, Servo Motor-Generators, Inertial and Viscous damped Servo Motors ¾" to 1¾" Diameter.

(shown full size)

MECHANICAL DEVICES

Counters, Electro-Mechanical Computers, Hermetic Rotary Seals, Aircraft Instruments and High Temperature Resistant, Chemically Inert, Machinable Ceramics.

(shown ¼ size)

ELECTRONICS—Miniature and subminiature Servo Amplifiers and Magnetic Amplifiers "potted" for convenience of installation and long life.

SYSTEMS

Aircraft Navigational Systems

Industrial Servo Systems

Servo Analog-to-Digital, Digital-to-Analog Converters

Electro-Hydraulic Servo Systems

Send For Technical Data Sheets

Bulletin giving physical and technical data on the various Kearfott Products will be sent on request. The Kearfott organization is available to assist in the development and manufacture of other precision components you may require.

Kearfott

A SUBSIDIARY OF GENERAL PRECISION EQUIPMENT CORPORATION

KEARFOTT COMPANY, INC., LITTLE FALLS, N. J.

Sales and Engineering Offices: 1378 Main Avenue, Clifton, N. J.

Midwest Office: 188 W. Randolph Street, Chicago, Ill. South Central Office: 6115 Denton Drive, Dallas, Texas

West Coast Office: 253 N. Vinedo Avenue, Pasadena, Calif.

CIRCLE 164 ON READER-SERVICE CARD FOR MORE INFORMATION

D-C Solenoids

In Complete Line

These d-c units, made by Braunson Electronics, include subminiature, high-temperature, and pressurized solenoids, both stock and custom. They qualify to MIL-S-4040 specs for application in hydraulic valve systems, automatic controls, switch mechanisms, communications, aircraft electrical systems, analog and digital computers, or wherever precision actuators are required. They feature pressure balanced armatures, adjustable stroke under operating pressure, maximum efficiency in minimum size, high dielectric strength, Class H insulation, fungus and mildew resistant insulation, explosion-proof switches, anti-rotation plunger lock, hydraulic pressure sealed and high temperature coils.

The units illustrated range in diameter from 0.781″ to 1.875″, and weigh from 1.25 oz to 21 oz. They are capable of providing anywhere from 10 oz to 14 lb of push or pull through a stroke range of 0.025″ to 0.375″. Joe Davidson and Associates, Dept. ED, 2803 Los Flores Blvd., Lynwood, Calif.

CIRCLE 165 ON READER-SERVICE CARD FOR MORE INFORMATION

Accelerometer System

Tape-Records Data to 60g

The "Glennite" Model KAT-1 is a tape-recording accelerometer system which can reliably measure accelerations up to ±60g in guided missiles, air, sea and land vehicles, underwater devices, and ordnance equipment without the use of direct cable or wireless connections. It is comprised of two basic units: a completely self-contained, self-recording accelerometer, and a tape playback unit. It provides for an instantaneous 30sec permanent tape recording of vibration and shock accelerations in moving devices which can be read through any standard recording instrument such as a galvanometer, oscilloscope, meter, or direct-writing recorder.

The accelerometer weighs only 3 lb and is housed in an extremely rugged aluminum cylinder 4-1/2″ in diameter and 3″ high. Gulton Mfg. Corp., Dept. ED, Metuchen, N. J.

CIRCLE 166 ON READER-SERVICE CARD FOR MORE INFORMATION

Portable Toroidal Winder

Handles Wide Size Range

This portable toroidal coil winder is designed for both laboratory and production. It features quick set up and quick wire change. Any of three winding rings can be installed and loaded and winding started, in less than 45sec. It is possible to change wire size and select the required tension in less than 30sec. Operation is simple since there is tension adjustment at only one point. Speeds up to 1500 turns/minute are selected by a choice of hand or foot controls. Multi-layer, bank of scrambled windings can be obtained at will.

The unit's dual counting system comprises a separately-housed electronic impulse counter, and a revolutions counter which counts the turns actually wound onto the core, and also measures the total length of wire loaded. The counting system cross-checks itself for accuracy. The machine handles wire sizes from AWG No. 26 to No. 44. Maximum finished hole size is 0.18″; maximum OD is 4″. The winder occupies only 11″ x 11″ of bench space, and the separately-housed counter base is 2-3/4″ x 5-3/4″. Arnold Magnetics Co., Dept. ED, 5962 Smiley Dr., Culver City, Calif.

CIRCLE 169 ON READER-SERVICE CARD FOR MORE INFORMATION

Electronic Timer

Is Self-Recycling

A repetitive series of circuit closures can be produced automatically by the Model S44 cold-cathode - tube electronic timer. The load circuit remains closed for a fixed time of about 60millisec, and the time between circuit closures can be adjusted to any value from as low as 0.03sec to 24sec. A maximum current rating of 5amp non-inductive at 115v a-c applies to the two spst contactors of this timer.

In addition to its self-cycling feature, the unit has the features of compactness (3-7/8″ x 4-7/8″ x 3″); no warm-up time required; and no power consumption when timer is in its "off" cycle. Farmer Electric Co., Dept. ED, 21 Mossfield Rd., Waban, Mass.

CIRCLE 170 ON READER-SERVICE CARD FOR MORE INFORMATION

Capacitors

Withstand Rough Use

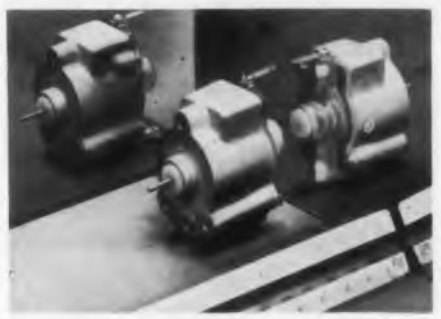
Solid dielectric "Glasseal" capacitors are capable of withstanding vibrational stresses of high acceleration and frequency as well as severe shock conditions. They utilize compression-seal type, glass-to-metal, solder-seal terminals, which will not work loose or rotate. Functional operating range is from —55° to +125°C, and they work normally under conditions of severe humidity.

Capacitance range is 0.001-1.0mfd; and voltage range 100-600v d-c operating. The units can be provided to standard tolerance of ±20%, or closer tolerances, if desired. They are available in both inserted tab and extended foil constructions. Pyramid Electric Co., Dept. ED, 1445 Hudson Blvd., North Bergen, N. J.

CIRCLE 172 ON READER-SERVICE CARD FOR MORE INFORMATION

D-C Motor

Weighs Less than 3 oz



This self-governed, controlled-speed, d-c motor weighs less than 3 oz. Althought it measures only 1-5/8" x 1-3/4" x 1-1/8", it has a self-contained, non-power-wasting governing device, and has a speed of 1800rpm. Speed regulation in a phonograph application for which the motor is currently being mass produced is within 1% from idling to full load and over a range of battery voltages from 6.4v to 5.6v. The Kinder Co., Dept. ED, Box 686, South Milwaukee, Wis.

CIRCLE 173 ON READER-SERVICE CARD FOR MORE INFORMATION

Output Transformers

With Screen Taps

A group of hi-fidelity output transformers with screen taps in the primary has been added to this firm's line. They are designed to provide extended range and increased power for audio amplifier circuits. These items are known as HS-181 and HS-186, and S-142 and S-146. Triad Transformer Corp., Dept. ED, 4055 Redwood Ave., Venice, Calif.

CIRCLE 174 ON READER-SERVICE CARD FOR MORE INFORMATION

CIRCLE 175 ON READER-SERVICE CARD

P-M Motor

Has Governor Attached

The Model PM-OG Miniature Permanent Magnet Motor, with governor attached, can be built in voltages from 3v to 27v d-c. A maximum of 1/400hp, can be developed, and speeds vary from 5,000rpm to 20,000rpm. The unit develops a torque of 0.20 oz-in, and the current draw is only 0.2amp.

The actual size is 3/4″ x 7/8″ x 2″, plus shaft extension, including governor. The shaft diameter is 3/32″, and the motor weighs only 2 oz. It can be made reversible and is quiet running.

Tests have been made at low temperatures (±55°C). The motor starts up quickly. It is used in many small applications which require miniature power, such as business machines, recorders, actuators, blowers, etc. Small Motors, Inc., Dept. ED, 2076 Elston Ave., Chicago 14, Ill.

CIRCLE 177 ON READER-SERVICE CARD FOR MORE INFORMATION

Automatic Data Recorder

For Gyro Rate Tables

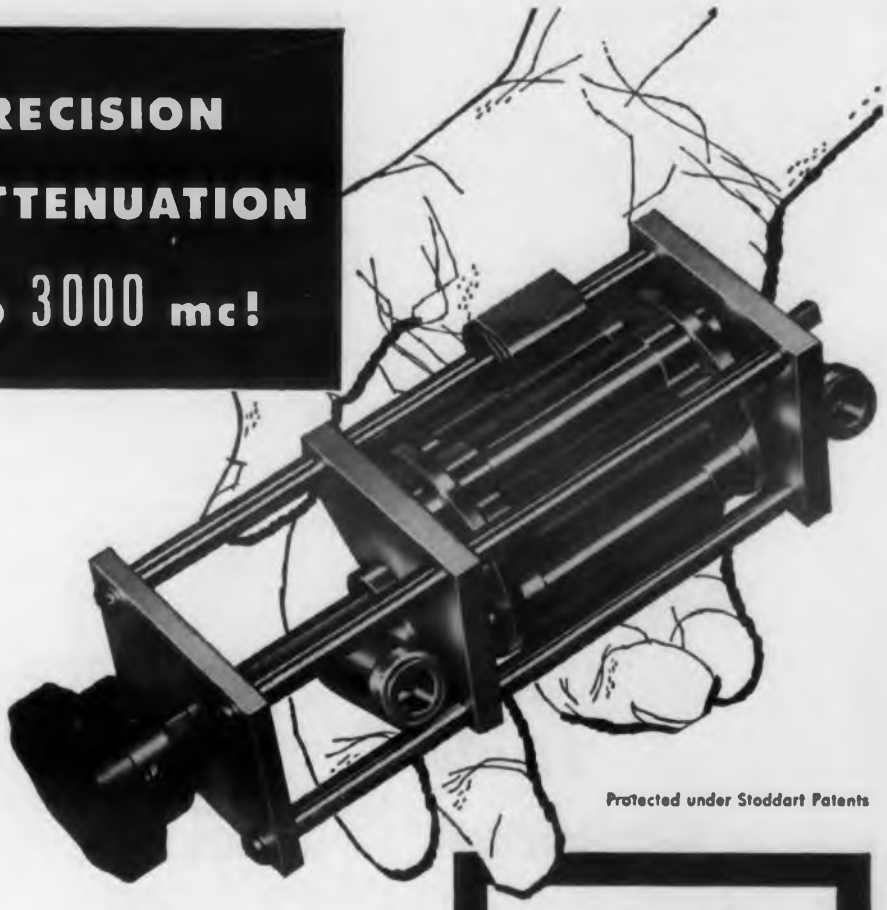
Epsco System No. 177 makes use of magnetic techniques to automatically punch on IBM cards data arriving asynchronously from as many as 10 separate sources. Data consist of time interval measurements to an accuracy of 1/10,000 of a sidereal minute.

In addition, dates, identification numbers, shaft positions, and temperature are automatically recorded on the cards. Special provision is made for measuring the average time interval between pairs of pulses in order to compensate for asymmetry in the rate table. Andor Controls Div., Epsco, Inc., Dept. ED, 588 Commonwealth Ave., Boston 15, Mass.

CIRCLE 178 ON READER-SERVICE CARD FOR MORE INFORMATION

Correction: Ohmic values of resistors made by the Daven Co. (*ED, July 1955, p 101*) will track within ±20ppm/°C of the normal temperature coefficient value—not 200ppm/°C as reported.

PRECISION ATTENUATION to 3000 mc!



Protected under Stoddart Patents

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

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

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

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

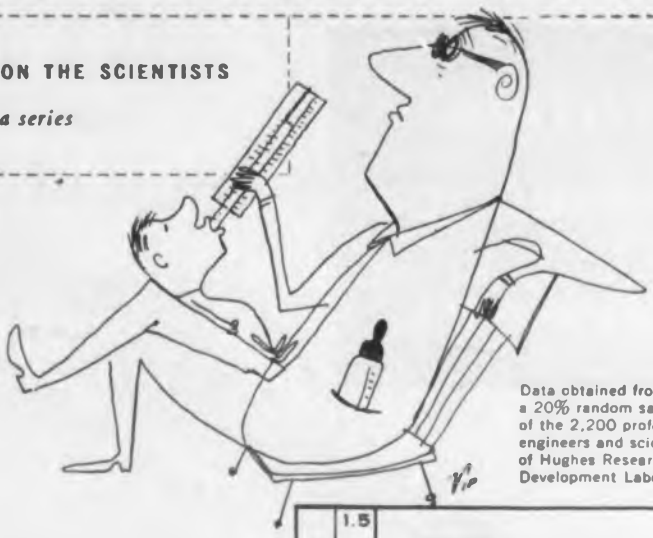
STODDART AIRCRAFT RADIO Co., Inc.

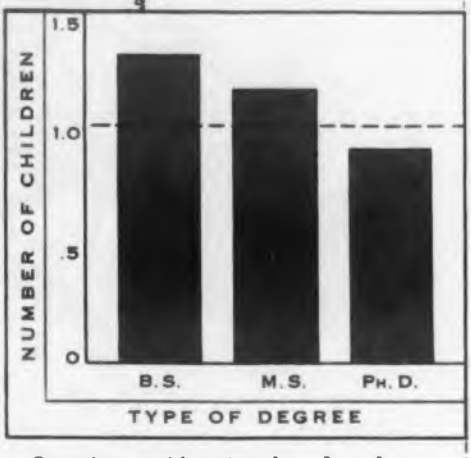
6644-J Santa Monica Blvd., Hollywood 38, California · Hollywood 4-9294

CIRCLE 179 ON READER-SERVICE CARD FOR MORE INFORMATION

SIDELIGHTS ON THE SCIENTISTS

number **1** *of a series*





Data obtained from a 20% random sample of the 2,200 professional engineers and scientists of Hughes Research and Development Laboratories.

Scientists and Their Children

SOME OF THE YOUNG FELLOWS on our staff have been analyzing our files of personal data regarding scientists and engineers here at Hughes. What group characteristics would be found?

With additional facts cheerfully contributed by their colleagues they have come up with a score of relationships—some amusing, some quite surprising. We shall chart the most interesting results for you in this series.

Results may be to some extent atypical due to California locale. Yet we would surmise that they are fairly representative. Some may well lead to soul-searching: "How am *I* doing in my chosen field? In my projected career, am I near the point of optimum advancement, or am I just somewhere along the way?" If the time should come when a move is indicated in your case, we hope you will give serious consideration to joining the exceptional group at Hughes.

* * *

IN OUR LABORATORIES here at Hughes, more than half of the engineers and scientists have had one or more years of graduate work, one in four has his Master's, one in 15 his Doctor's. The professional level is being stepped up continually to insure our future success in commercial as well as military work.

Security considerations have largely obscured Hughes' pre-eminence as a developer and manufacturer of airborne electronic systems. Hughes is now largest in the field. The Hughes research program is of wide variety and scope. It affords exceptional freedom as well as exceptional facilities. Indeed, it would be hard to find a more exciting and rewarding human climate for a career in science.

Our program includes military projects in ground and airborne electronics, guided missiles, automatic control, synthetic intelligence and precision mechanical engineering. Projects of broader commercial and scientific interest include research in semiconductors, electron tubes, digital and analog computation, data handling, navigation, production automation.

RIGHT NOW *we have positions for people familiar with transistor and digital computer techniques. Digital computers similar to the successful Hughes airborne fire control computers are being applied by the Ground Systems Department to the information processing and computing functions of the large ground radar weapons control systems. Engineers and physicists with experience in these fields, or with exceptional ability, are invited to send us their qualifications.*

Scientific Staff Relations

Hughes

RESEARCH AND DEVELOPMENT LABORATORIES

Culver City, Los Angeles County, Calif.

CIRCLE 183 ON READER-SERVICE CARD FOR MORE INFORMATION

Input Scanner

Handles 100 Data Channels

The new Input Scanner IS100 sequentially selects 100 channels of data. When used in conjunction with this firm's digital voltmeters and ohmmeters (and printer), it provides a complete automation system for component and system testing.

The IS100 consists of a series of stepping switches with all necessary controls and power supplies. It is rack mounted (7" x 17" x 16") and operates on 115v power. When used with the voltmeter and printer (as illustrated), 100 channels can be printed out in approximately five minutes. Electro Instruments, Inc., Dept. ED, 3794 Rosecrans St., San Diego 10, Calif.

CIRCLE 184 ON READER'S SERVICE CARD FOR MORE DATA

Lab Kit

For Electromechanical Development

The portable "Mecha-Kit" is for use in laboratories for electromechanical development and control simulation. It consists of a wide assortment of mechanical development apparatus selected through analysis of this firm's own laboratory needs. It is provided in a reinforced plastic carrying case, and is available in three sizes. Servomechanisms, Inc., Components Div., Dept. ED, 625 Main St., Westbury, N. Y.

CIRCLE 185 ON READER'S SERVICE CARD FOR MORE DATA

Relays

With Taper-Pin Terminals

A series of relays, hermetically sealed with taper-pin terminals for solderless connection, is offered in two, three, and four-pole models. These units surpass MIL-R-5757B and MIL-R-6106A. They have been especially designed for use in jet aircraft, guided missiles, and other airborne equipment. Electro-Mechanical Specialties Co., Inc., Dept. ED, 6819 Melrose Ave., Los Angeles 38, Calif.

CIRCLE 186 ON READER'S SERVICE CARD FOR MORE DATA

Counting Tube

With Rates to 4000pps

This "Dekatron" cold cathode counting tube, the GS12D, is designed for industrial and scientific counting applications. It is a 12-cathode tube, with all 12 cathodes brought out to pins on the base. It has a 13-pin base, plus extra flying leads. The counting scale of 12 adds to the value of this device in studies involving dozens, gross, inches, etc., and makes the tube a useful divider in many types of timing units. Count is determined by noting the position of the glow on one of the 12 radially spaced cathodes around the central anode. When the glow is on a cathode, that cathode is positive with respect to the other cathodes; this makes available a positive voltage at any selected count.

The tube has a counting rate from 0-4000pps. It measures 3.49" long x 1.3" bulb diameter. Maximum total anode current is 0.35ma, and maximum voltage between electrodes (other than anode) is 140v. Minimum supply voltage (anode to cathode) is 350v. Atomic Instrument Co., Dept. ED, 84 Massachusetts Ave., Cambridge 39, Mass.

CIRCLE 189 ON READER'S SERVICE CARD FOR MORE DATA

Coaxial Terminations

In Sliding and Fixed Types

This firm's basic coaxial termination consists of a molded "Narda-Iron" terminating element mounted in a coaxial line and having a vswr less than 1.05 over the entire frequency range of the S to X band, 2400Mc to 12,400Mc. "Narda-Iron" consists of powdered iron dispersed in plastic, and is cast to shape.

Both fixed and sliding terminations are available. The fixed units are useful for terminating directional couplers and other devices in actual operation or for test purposes. The sliding units (illustrated) provide an accurate and convenient method for evaluating the residual vswr of coaxial slotted lines and standardizing all types of impedance measuring equipment for coaxial line components. Both types are available with type N or C connectors, either male or female. Power ratings are 5w average, 5kw peak. The Narda Corp., Dept. ED, Mineola, L. I., N. Y.

CIRCLE 190 ON READER'S SERVICE CARD FOR MORE DATA

Save Time, Reduce Errors... Determine and Record Data Automatically with These Two Versatile Berkeley Instruments

Model 5510 Universal Counter and Timer offers direct-reading digital display of count, frequency or microsecond time interval. Time bases from 1 mc. to 1 cps; gate times from .00001 to 10 sec. Accuracy ± 1 count, ± crystal stability (1 part in 10^9). Price $1,100.00 f.e.b. factory.

1. UNIVERSAL COUNTER AND TIMER, Model 5510, combines the functions of four instruments in one single, compact unit. It will:

a. Count at speeds to 1 million per second.
b. Count events occurring during a selectable, precise time interval.
c. Measure time intervals in 1 microsecond increments, from 3 microseconds to 1 million seconds.
d. Determine frequencies or frequency ratios from 0 cps to 1 megacycle.
e. Operate directly the BERKELEY printer (below), BERKELEY digital-to-analog converter, or BERKELEY data processor to drive IBM card punches, typewriters or teletype systems.

2. BERKELEY DIGITAL RECORDER, Model 1452, combines scanner and high speed printer in a single unit; prints up to 10 digits on standard adding machine tape. Can be modified to print "Time" or "Code" information simultaneously with count data on same tape.

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

Please write Dept. D10 for data.

M-43

Berkeley *division*
BECKMAN INSTRUMENTS INC.
2200 WRIGHT AVE., RICHMOND, CALIF.

INDUSTRIAL INSTRUMENTATION AND CONTROL SYSTEMS • COMPUTERS • COUNTERS • TEST INSTRUMENTS • NUCLEAR SCALERS

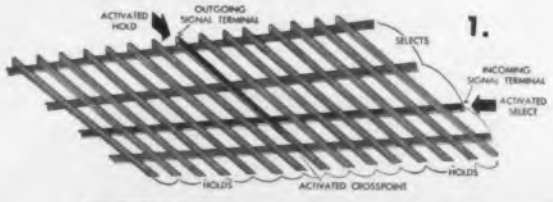
CIRCLE 191 ON READER-SERVICE CARD FOR MORE INFORMATION

CROSS OFF COMPLEX CONTROL PROBLEMS with KELLOGG CROSSBAR SWITCHES

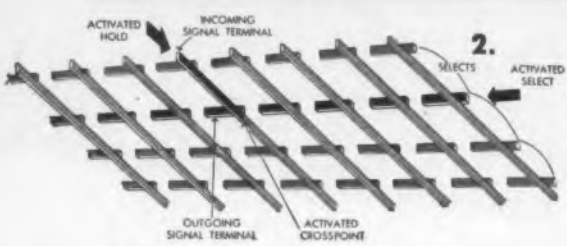
First used and overwhelmingly approved in the telephone industry, the KELLOGG Crossbar is one of the most versatile switch devices yet developed for industrial use. Simple in its operation — durable and dependable — it solves hundreds of multiple or complex switching problems at small cost.

It does away with the limitations inherent in relay trees. It provides connections as low as 25 to 30 milli-seconds for one or many input circuits to one or many output circuits. With Crossbar several switching operations may be done at the same time—any circuit may be held while other circuits are switched. Because Crossbar switch points move only a few thousandths of an inch, wear and maintenance are practically eliminated. Contacts are of paladium metal; gold can be provided.

The entire switch may be drawer mounted for easy inspection without disrupting service. The only wiring normally needed is to connect the input and output circuits. Shown below are the various types of electrical connections possible with KELLOGG Crossbar.



Drawing No. 1 illustrates the basic Crossbar principle which permits any of several incoming circuits to be connected to any of several output circuits. This type of switch can connect any of 60 circuits, 3 at a time, to any of 75.



Drawing No. 2 shows a means of switching one incoming circuit to many possible outgoing circuits—accomplished by removing every other vertical. Thus, instead of having one cable terminal at one end of the switch, each remaining vertical has its own cable connection. This type of switch can easily be adapted to switch one circuit to any of 936.

KELLOGG DIVISION OF IT&T

Write For This Free, Fact-Filled Booklet Today

KELLOGG SWITCHBOARD AND SUPPLY COMPANY
A Division of International Telephone and Telegraph Corporation
SALES OFFICES: 79 West Monroe Street, Chicago 3, Illinois

CIRCLE 192 ON READER-SERVICE CARD FOR MORE INFORMATION

Axial Lead Resistors

Are Thermally Balanced

This line of small, power - type wire-wound resistors has steatite cores and axial leads. A special-formula, vitreous-enamel coating is also employed. The resistance wire and terminal lead are both welded to the end cap, assuring stable electrical connections. All parts are thermally balanced to enable the resistors to stand up under high operating temperatures without loosening of terminals or cracking, and subsequent entrance of moisture.

The resistors are available in an extensive range of sizes and wattage ratings. The smallest resistor is only 1/4" diam x 19/32" long overall and is rated at 3w. Ohmite Manufacturing Co., Dept. ED, 3678 Howard St., Skokie, Ill.

CIRCLE 193 ON READER'S SERVICE CARD FOR MORE DATA

Rotary Switch

Operates at 10rps with 7w

This high-speed rotary synchronous multiple - pole switch commutator is for missile and aircraft applications such as telemetering, switching radar data presentation, and commutating thermocouple signals. A 12,000rpm 115v, 400cy, single-phase motor drives the brush assembly at 10rps with only 7w of power. Three sets of carbon type brushes bear on precious metal segments to provide BBM operation without riding on filler material, yielding very low noise and long life. The case is hermetically sealed and provided with radiating fins for motor cooling.

The switch can carry 0.1mv to 100v from 3μamp to 50ma current. Life is in excess of 500 hours, meeting MIL-STD-202 requirements. Size is 2-1/2" diam x 5-1/4" long. This switch weighs only 2-1/2 lbs. Other combinations of brushes and speeds are available on special order. Instrument Development Laboratories, Inc., Dept. ED, 163 Highland Ave., Needham Heights 94, Mass.

CIRCLE 194 ON READER'S SERVICE CARD FOR MORE DATA

Gearless Differential

Uses Balls and Plate

Designed specifically for applications where minimum backlash is required, the Model T751 makes use of precision balls instead of conventional planetary gears. The balls and plate upon which they ride are made of tungsten carbide and are lapped to insure accuracy. The unit is simple to mount because it is installed in a servo-type case. Both input gears are accessible through slots in the side of the case. Instrument Div., Sterling Precision Instrument Corp., Dept. ED, 34-17 Lawrence St., Flushing 54, N. Y.

CIRCLE 197 ON READER'S SERVICE CARD FOR MORE DATA

Magnetic Controllers

Amplifier and Voltage Control

This magnetic amplifier unit has a time constant of 1/2cy. It is available in 60 and 400c cy models. It will accept inputs from thermocouples, photovoltaic cells, strain gauges, etc. A voltage control unit is available for use with a dry type battery charger to provide a reliable cutoff point. Preset cutoff in steps of 2v from 2 to 100v can be selected by a switch. Accuracy is ±1%. Stator Electric Corp., Dept. ED, 46-25 58th St., Woodside, N. Y.

CIRCLE 198 ON READER'S SERVICE CARD FOR MORE DATA

Bench Center

Checks Small Part Concentricity

Developed to facilitate testing of this firm's own servo components, this portable bench center has many uses for checking and machining tiny parts. Only 3-1/2" high, 9" long, and weighing 16-1/2 lb, the unit holds pieces up to 5-3/8" long x 3-1/4" diam within 0.0005" accuracy. It is readily carried to the machine tool table or surface plate. Transicoil Corp., Dept. ED, Worcester, Montgomery County, Pa.

CIRCLE 199 ON READER'S SERVICE CARD FOR MORE DATA

TO THE FINE ENGINEERING MIND SEEKING THE CHALLENGING PROJECTS IN

TELEMETERING

TELEMETERING ENGINEERS experienced in research, design and development of all types of static and airborne telemetering systems are offered challenging career opportunities on advanced projects in the rapidly expanding Engineering Department at Convair in beautiful San Diego, California. These responsible positions call for experience in telemetering systems, planning and study; transducer design, selection and application; airborne and ground-based telemetering equipment design and development; and instrumentation systems installation design.

CONVAIR offers you an imaginative, explorative, energetic engineering department to challenge your mind, your skills, and your abilities in solving the complex problems of vital, new, immediate and long-range programs. You will find salaries, facilities, engineering policies, educational opportunities and personal advantages excellent.

SMOG-FREE SAN DIEGO, lovely, cool city on the coast of Southern California, offers you and your family a wonderful new way of life . . . a way of life judged by most as the Nation's finest for climate, natural beauty, and easy (indoor-outdoor) living.

Generous travel allowances to engineers who are accepted. Write at once enclosing full resume to:

H. T. Brooks, Engineering Personnel, Dept. 1010

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DEPEND ON

Bendix Red Bank

RELIABLE ELECTRON TUBES

With electronic controls taking over more and more operational functions in military and industrial applications, it is becoming increasingly important that the electron tubes used be dependable under extremely severe conditions. This applies particularly to installations in aircraft where tubes must operate reliably at high altitudes, while subjected to continuous vibration, varying voltages and frequent shock. Because of their advanced design and construction . . . born of never-ceasing research and special production skills . . . Bendix Red Bank Reliable Electron Tubes have the dependability necessary to meet these severe operating conditions. You can depend on our long, specialized experience to give you the right answer . . . for all types of regular as well as special-purpose tube applications. Tubes can be supplied to both commercial and military specifications. Call on us for full details.

Manufacturers of Special-Purpose Electron Tubes, Inverters, Dynamotors, AC-DC Generators, Voltage Regulators and Fractional H.P. DC Motors.

DESIGNATION AND TYPE					TYPICAL OPERATING CONDITIONS		
Type	Proto-type	Bendix No.	Description	Base And Bulb	Heater Voltage	Plate Voltage Per Plate	M.A. Load
5838	6X5	TE-3	Full Wave Rectifier	Octal T-9	12.6	350.	70.
5839	6X5	TE-2	Full Wave Rectifier	Octal T-9	26.5	350.	70.
5852	6X5	TE-5	Full Wave Rectifier	Octal T-9	6.3	350.	70.
5993	6X4	TE-10	Full Wave Rectifier	9-Pin Miniature	6.3	350.	70.
6106	5Y3	TE-22	Full Wave Rectifier	Octal T-9	5.0	350.	100.

Type	Proto-type	Bendix No.	Description	Base And Bulb	Heater Voltage	Plate Voltage	Screen Voltage	Grid Voltage	Gm	Plate Current	Power Output
5992	6V6	TE-8	Beam Power Amplifier	Octal T-9	6.3	250.	250.	12.5	4000	45. MA	3.5 W
*6094	6AQ5 6005	TE-18	Beam Power Amplifier	9-Pin Miniature	6.3	250.	250.	12.5	4500	45. MA	3.5 W
6385	2C51 5670	TE-21	Double Triode	9-Pin Miniature	6.3	150.	—	−2.0	5000	8. MA	—

*Tube Manufactured with Hard (Nonex) Glass for High Temperature Operation (Max. Bulb Temp. 300°C.)

Bendix Red Bank

DIVISION OF

THE MARK OF Bendix AVIATION CORPORATION SYMBOLIZES INTEGRITY

EATONTOWN, N. J.

West Coast Sales and Service:
117 E. Providencia Ave., Burbank, Calif.

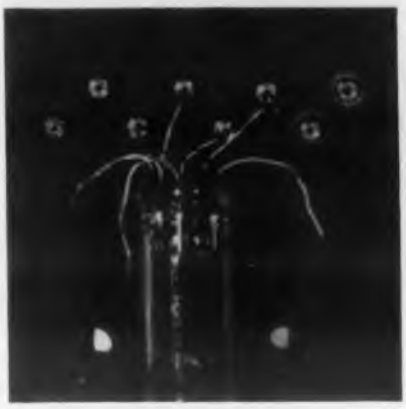
Export Sales: Bendix International Division,
205 East 42nd St., New York 17, N. Y.

Canadian Distributor: Aviation Electric Ltd., P.O. Box 6102, Montreal, P. Q.

CIRCLE 200 ON READER-SERVICE CARD FOR MORE INFORMATION

Slip Sockets

Are Spring Actuated



The "Micro-Pin Socket" makes possible solderless connecting of diodes, transistors, and other components into a circuit, particularly a printed circuit. The spring-backed, plug-in socket is made of copper alloy. Its outer shell is approximately 0.2" long x 0.08" diam. It is press-fitted and dip-soldered into the circuit board, making an excellent electrical contact for leads from any component which requires checking or replacement.

The spring inside the socket is flexible enough to withstand highly repetitive plug-in-and-out operations, yet strong enough to hold the lead with a retaining force of several ounces; it can be designed to cover military specifications on shock and vibration. Sockets are currently available from stock to fit leads of 0.016" diam and will soon be available for 0.175" and 0.002". Techron, Inc., Dept. ED, 254 Friend St., Boston, Mass.

CIRCLE 201 ON READER'S SERVICE CARD FOR MORE DATA

Switching Commutator

Highly Compact Drum Type

This drum-type switching commutator is designed to occupy the smallest possible space. All switching combinations are attainable. Other applications are frequency multiplication and division. The drums are particularly well suited to cascade operation.

Solid, precision-made, precious-metal or alloy segments and a wide choice of plastics allow extensive ranges of operating temperature, insure long shelf life, and give stable operation. Simple registration techniques make possible highly accurate angular resolution as well as exceptionally small segments. Size and weight for airborne and military applications are minimal. Electro Miniatures Corp., Dept. ED, 205 Lafayette St., New York 12, N. Y.

CIRCLE 202 ON READER'S SERVICE CARD FOR MORE DATA

Servo Amplifiers

Transistor-Magnetic Units

This standard line of transistor-magnetic servo amplifiers, "Transi-Mags", feature the use of only static components, absence of filaments, high sensitivity, high input impedance, and flexibility in application to servo systems. They are available for practically all of the standard servo motors for operation on 400cy or 60cy. An ambient temperature range of −50° to +71°C is standard, although higher temperature units are available. Small size and lightweight make these units especially suitable for airborne applications. Magnetic Amplifiers, Inc., Dept. ED, 632 Tinton Ave., New York 55, N. Y.

CIRCLE 205 ON READER'S SERVICE CARD FOR MORE DATA

Graphic Recoder

With Widespread Uses

The Model G-10 is a portable, modestly-priced graphic recorder, capable of widespread applications in the recording of data. Dimensions are 10″ x 7-1/8″ x 8″, and it weighs 15 lb. It may be used directly as a recording millivoltmeter or, with appropriate transducers, as a means for recording pressure, light intensity, temperature, and many other physical quantities.

The instrument is of the self-balancing potentiometer type, and features a standard full-scale response time of 2.5sec and a standard sensitivity of 100mv full-scale. Accuracy is 1%, and maximum allowable signal source resistance is 0.5 megohms. Special Products Div., Varian Associates, Dept. ED, 611 Hansen Way, Palo Alto, Calif.

CIRCLE 206 ON READER'S SERVICE CARD FOR MORE DATA

If you need a special component, send a brief statement of your specifications addressed to Bulletin Board, Electronic Design, 199 E. 62nd St., New York 21, N. Y. Include your complete address.

CIRCLE 207 ON READER-SERVICE CARD ➤

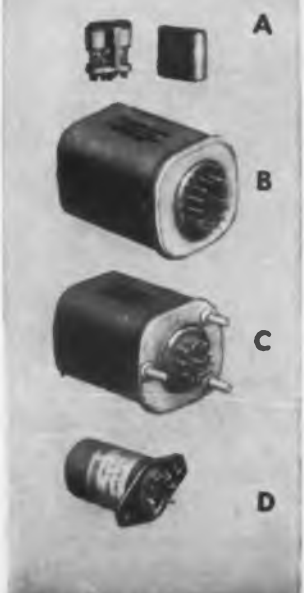
GENERAL ELECTRIC ANNOUNCES . . .

NEW, faster, smaller micro-miniature relay

LIGHT WEIGHT, SMALL SIZE: Weighs only .35 ounces and measures .34" x .781" x .84". This tiny relay utilizes balanced armature and simple design, giving you quality and more reliable operation at a consistently high level.
HIGH CONTACT RATING: For low contact resistance and long life, fine silver is used . . . contact rating is 2 amps resistive load at 30 V d-c or 115 V a-c . . . contact arrangement is 2PDT.
FAST OPERATION: With rated voltage on coil, operating time is 1.5 milliseconds. By adding series resistance in coil circuit or by applying high voltage pulse to coil . . . pickup time will be less than 1 millisecond!
LOW OPERATING POWER: 300 milliwatts for standard model . . . 150 milliwatts for current sensitive model.
HIGH SHOCK; VIBRATION RESISTANT: G.E.'s balanced armature and high tip forces withstand shock of over 50 g's and vibration of 10-55 cp's at .12" maximum excursion and 55–500 cp's at 20 g's acceleration.
HIGH TEMP OPERATION: This new micro-miniature relay gives you continuous and efficient operation at ambient temperatures of 125° C.

G.E.'s line of aircraft-type relays will help solve your space-weight problems. Contact your G-E Apparatus Sales office for more application information. General Electric Company, Schenectady 5, New York.

MAIL THIS COUPON FOR G-E RELAY DATA . . .



- ☐ A: Micro-miniature Relay—Bulletin GEA-6346
- ☐ B: High Speed Relay—Bulletin GEA-6212
- ☐ C: Miniature Relay—Bulletin GEA-6213
- ☐ D: Subminiature Relay—Bulletin GEA-6211
- ☐ E: Have Sales Engineer contact me.

Section KE792-2, General Electric Company, Schenectady 5, New York

NAME..... TITLE.....

COMPANY.....

ADDRESS.....

CITY..... STATE.....

GENERAL ELECTRIC

High-Speed Whiteprinter

Low-Cost Unit Runs at 70'/min.

Designed for high speed production, this unit will actually print and fully develop whiteprints at speeds up to 70 feet per minute. The price of this machine is low. It is compact in design, constructed of heavy gauge steel throughout.

Extremely fast printing speed is obtained by the use of a new inexpensive 5000w printing lamp. Fast and thorough development is accomplished through the unique design of the multiple interlocking roller developer which permits the use of full strength 26 degree aqueous ammonia. It is made in 42″ and 54″ sizes. C. F. Pease Co., Dept. ED, 3939 N. Rockwell Ave., Chicago 18, Ill.

CIRCLE 208 ON READER-SERVICE CARD

Reference Diodes

Two New Types

These silixon junction diodes, known as the Zener reference diodes, type 1N429 and type 1N430, are designed for use in reference voltage sources wherever the absolute value of an electrically sensed variable is important.

Voltage reference units employing types 1N429 and 1N430 silicon junction diodes have been temperature cycled for more than 1000hrs and show a stability of better than 1%. National Fabricated Products, Inc., Dept. ED, 2650 W. Belden Ave., Chicago 47, Ill.

CIRCLE 209 ON READER-SERVICE CARD

Paper Capacitors

Assure Vibration-Proof Mounting

These "Vitamin Q" subminiature paper capacitators are offered in styles that simplify vibration-proof mounting and make harness wiring faster.

Both inserted tab and extended foil designs are obtainable at working voltage ratings up to 1000v d-c. Sprague Electric Co., Dept. ED, 347 Marshall St., North Adams, Mass.

CIRCLE 210 ON READER-SERVICE CARD

◀ CIRCLE 211 ON READER-SERVICE CARD

Vinyl Tubing

Both Fungus and Heat Resistant

Temflex 105, a vinyl plastic tubing, is the first tubing to meet both the stringent heat and fungus requirements of specification MIL-I-631B and is listed as being both self-extinguishing and fungusproof. Temflex 105 has high dielectric strength, good heat aging, and fungus resistance. It has greater resistance to "cut-through" and is rated for continuous operation at 105°C. The improved formulation provides additional enhanced color stability and reduced shrinkage under conditions of sustained operation at elevated temperatures. Samples are available. Irvington Div., Minnesota Mining and Manufacturing Co., Dept. ED, 6 Argyle Terrace, Irvington 11, N. J.

CIRCLE 212 ON READER-SERVICE CARD

Thin Recording Tape

50% More on Reed

With Mylar polyester film as a base, this tape is so thin that a mile of it can be wound on a single 10-1/2″ reel. The Mylar base is only half a mil thick, but because of its stability it can be stored indefinitely without deterioration or loss of sound fidelity. Over a 50% saving in storage space, as well as a 45% saving in weight is gained. Reeves Soundcraft Corp., Dept. ED, 10 E. 52nd St., New York, N. Y.

CIRCLE 213 ON READER-SERVICE CARD

Deposited Carbon Resistors

With New Coating

This company's deposited carbon resistors are now being supplied with an improved coating material. The material incorporates such features as extreme toughness for rough handling; low temperature cycling (to −85°C); resistance to humidity, and high temperature characteristics.

Identified as types DC (per Spec MIL-R-10509A) and CC (commercial grade), the resistors are available in eight standard sizes from 1/8 to 5w, and resistance range to 500meg. Standard tolerance is 1%. Dale Products, Inc., Dept. ED, Columbus, Neb.

CIRCLE 214 ON READER-SERVICE CARD

CIRCLE 215 ON READER-SERVICE CARD ➤

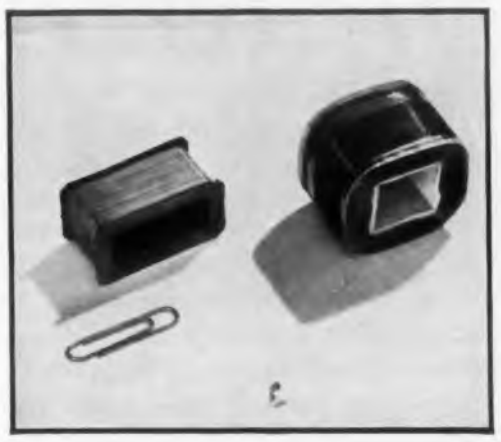
DU PONT
REG. U.S. PAT. OFF.

ELECTRONIC DESIGN NEWS

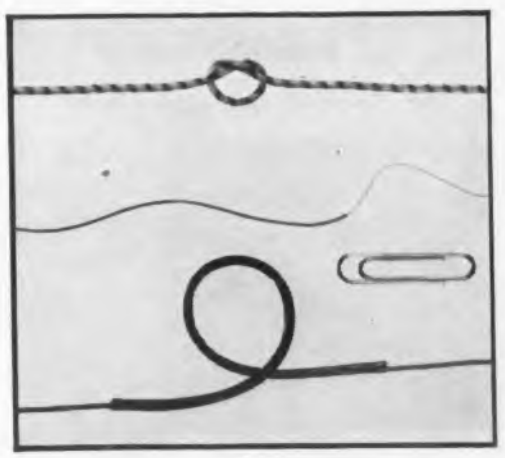
PROPERTY AND APPLICATION DATA ON THESE VERSATILE ENGINEERING MATERIALS: "ZYTEL," "ALATHON," "TEFLON," "LUCITE."

NO. 4 — 1955

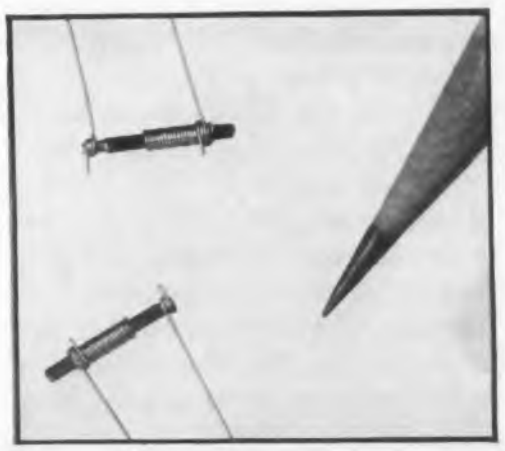
Miniaturized Components Utilize Unique Insulating Properties of TEFLON®



The paper clip indicates the small size of these coils. The insulation of "Teflon" is one important reason why they can be miniaturized.



Here are shown (top) a striped, wrapped lead wire and (bottom) two samples of miniaturized flexible sleevings—all insulated with "Teflon."



These small capacitors use "Teflon" as the dielectric. Their degree of miniaturization is shown by comparison with end of lead pencil.

Working temperature range of Du Pont "Teflon": —450°F. to +500°F.

Miniaturization of electronic components is possible with a unique engineering material: Du Pont "Teflon" tetrafluoroethylene resin.

"Teflon" has a low loss factor, low dielectric constant, and high volume resistivity. It is nonflammable, and unaffected by moisture. "Teflon" is the only insulating material available today that is inert to every commercially used solvent and chemical, excepting only molten alkali metals and fluorine at high temperatures and pressures.

Use of "Teflon" helps cut production costs, too. In soldering operations, the iron will not burn or melt insulation of "Teflon." This important fact can save time, labor, and materials.

The three photographs on this page show some current uses for insulation of "Teflon." The wire is manufactured by Hitemp Wires, Inc., Mineola, New York. Other typical applications by Hitemp which utilize Du Pont "Teflon" are listed below.

The six products listed, insulated with "Teflon" and used in a wide variety of applications, illustrate the application of this material in current electronic designs:

MAGNET WIRE. Such wire, coated with "Teflon," is widely used on high-temperature components for aircraft and guided missiles: transformers, relays and various types of motors.

HOOKUP WIRE AND LEAD WIRE. Insulation of "Teflon" on hookup and lead wire proves advantageous on transformers, motors, and harness assemblies for high-temperature applications. The chemical resistance of "Teflon" is particularly valuable in gyros and other hermetically sealed components.

COAXIAL CABLE. Used as the dielectric medium of coaxial cable, "Teflon" permits the design of miniature constructions which are the equivalent of coaxial cables using much thicker insulation of other materials.

TUBING. Insulation of "Teflon" provides excellent protection for tubing used as bus wire and jumpers.

RESISTANCE WIRE. Insulation of "Teflon" on small resistance wire facilitates miniaturization of heating equipment.

FIBER-GLASS PRODUCTS. Insulation of "Teflon" is being applied currently to such fiber-glass products as lacing, tape and sewing thread. "Teflon" provides excellent temperature resistance, and withstands cutting action of glass fibers.

NEED MORE INFORMATION?

CLIP THE COUPON . . . If you would like further information about the properties and uses of "Teflon" as an electronic design material, fill out and mail the coupon.

E. I. du Pont de Nemours & Co. (Inc.), Polychemicals Department
Room 4110, Du Pont Building, Wilmington 98, Delaware
In Canada: Du Pont Company of Canada Limited,
P. O. Box 660, Montreal, Quebec

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

NAME _____

POSITION _____

COMPANY _____

STREET _____

CITY _____ STATE _____

TYPE OF BUSINESS _____

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

SIGMA SENSITIVE RELAYS

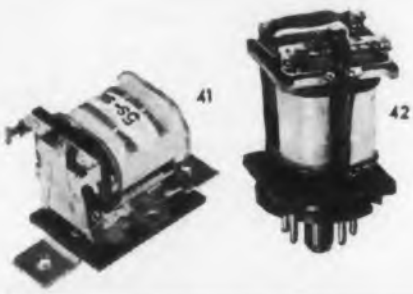
HIGH SPEED RELAYS

LOW COST POLAR RELAY

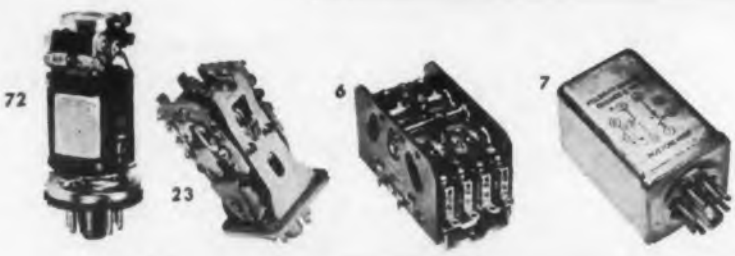
25 AMPERE SENSITIVE CONTACTORS

MISSILE RELAYS

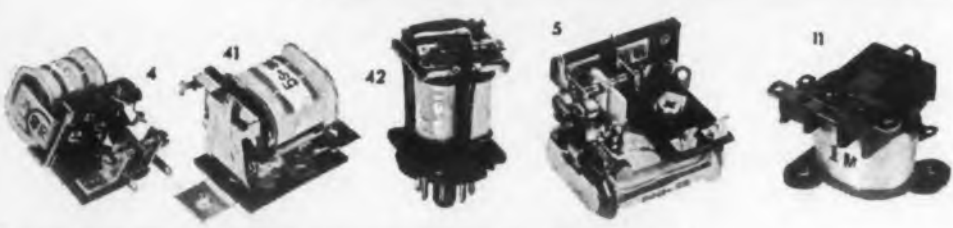
MINIATURE SENSITIVE,
GENERAL PURPOSE DC RELAYS



SENSITIVE, LOW COST AC RELAYS



NULL-SEEKING RELAYS



GENERAL PURPOSE SENSITIVE DC RELAYS

complete catalog on request

Numbers indicate Sigma Relay Series

SIGMA INSTRUMENTS, Inc.

91 Pearl Street, So. Braintree, Boston 85, Mass.

CIRCLE 216 ON READER-SERVICE CARD FOR MORE INFORMATION

DPDT Switch

Hermetically Sealed

The Model J4 is a dpdt switch hermetically-sealed for dependable operation in any environment. It has eight separate contacts and terminals which permit it to be wired externally for a wide variety of circuit combinations, such as simultaneously switching four separate circuits with one snap. Weight is only 2-1/2 oz, and envelope size is 2" x 1-3/4" x 7/8".

Hermetic sealing in a dry, inert gas allows the switch to be rated for operation at temperatures from —100° to +250°F. Temperature cycling cannot cause moisture condensation inside the case. Electrical capacity is 10amp, 125/250v a-c, 30v d-c inductive. A toggle actuator is available which adapts the switch for AN type panel mounting. Electro-Snap Switch & Mfg. Co., Dept. ED, 4220 Lake St., Chicago 24, Ill.

CIRCLE 217 ON READER'S SERVICE CARD FOR MORE DATA

½" Potentiometer

In Special Ganged Units

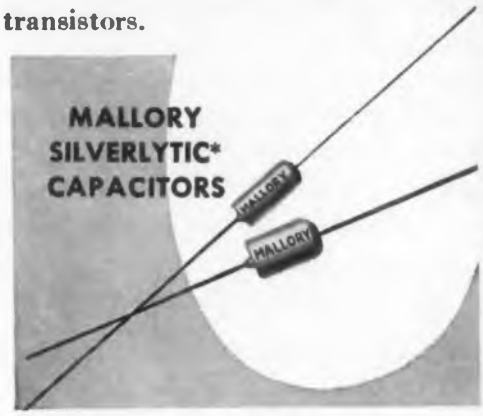
The No. 500 "Acepot", a wire-wound precision potentiometer of only 1/2" diam, is now being made in special ganged control units of high precision and accuracy. These ganged units have the accuracy required by many computer and servo control applications, plus extremely small size. They are available in the range from 200 ohms to 100,000 ohms.

Standard accuracy of linear units is ±0.3% independent linearity. Standard torque requirement is 0.035 oz-in at 20°C. Even lower torque is available on special order. These ganged potentiometers can be supplied sealed (except for the shaft) permitting potting along with their associated circuitry. They meet applicable portions of MIL Standards. Ace Electronics Associates, Dept. ED, 125 Rogers Ave., Somerville 44, Mass.

CIRCLE 218 ON READER'S SERVICE CARD FOR MORE DATA

Miniature Components for Transistor Circuits

The pioneer miniature dry battery with exceptional life on the shelf and in service. Constant voltage discharge characteristic is ideal for use with transistors.



Compress capacitances up to 30 mfd. at 6 volts into a subminiature case only 7/32" in diameter by 3/8" long . . . rated for temperatures from —55° C. to +85° C. Ultra-miniature Type TAW, rated 4 and 6 mfd. at 4 volts, is only 0.145" in diameter by 3/8" long.

Both of these lines of components are available in production quantities. For technical details, write today to P. R. MALLORY & CO. INC., Indianapolis 6, Indiana.

*Trade Mark

P.R. MALLORY & CO. Inc.
MALLORY

CIRCLE 219 ON READER-SERVICE CARD

Torque Motor

Gives 9 lb for 40ma

The Model 41 Torque Motor is designed to drive hydraulic servovalves or other mechanisms which demand fast response and high output force proportional to input current. It is conservatively rated at 9 lb of force for 40ma differential current. It may be driven from two miniature output tubes in push-pull, or from magnetic amplifiers.

Stroke ($\pm 0.15''$) is proportional to input differential current. The displacement sensitivity is 3/4"/amp, or 20ma for full stroke. This small, 18 oz motor is assembled with steel dowels and will withstand severe vibration without damage. It is designed to operate from $-65°$ to $+400°$F. Raymond Atchley, Inc., Dept. ED, 2340 Sawtelle Blvd., Los Angeles 64, Calif.

CIRCLE 221 ON READER'S SERVICE CARD FOR MORE DATA

Analog-Digital Converter

Has 256 Segments

This special shaft - position converter translates the position of an input shaft into the Gray binary-digital code for use in computers and automatic control equipment. A commutator-type code disk, connected to the input shaft, consists of eight rings of alternately conductive and non-conductive segments, arranged to reproduce the Gray code. The eight rings contain a total of 256 segments, producing a resolution of 2^8 (or one part in 256) and provide a range of coded numbers from 1 to 255.

The converter is small in size (3-1/16" OD x 1-5/8" long) and lightweight (8 oz). It withstands shock to 20G or vibration to 10G at 5cy to 5000cy. It functions dependably at temperatures of $-50°$ to $+85°$C. Librascope, Inc., Dept. ED, 808 Western Ave., Glendale, Calif.

CIRCLE 222 ON READER'S SERVICE CARD FOR MORE DATA

NEW ½ watt-type DCM½

MOLDED

deposited carbon resistor

a growing name

Electra

in the electronics industry

Doubly insulated to give you . . .

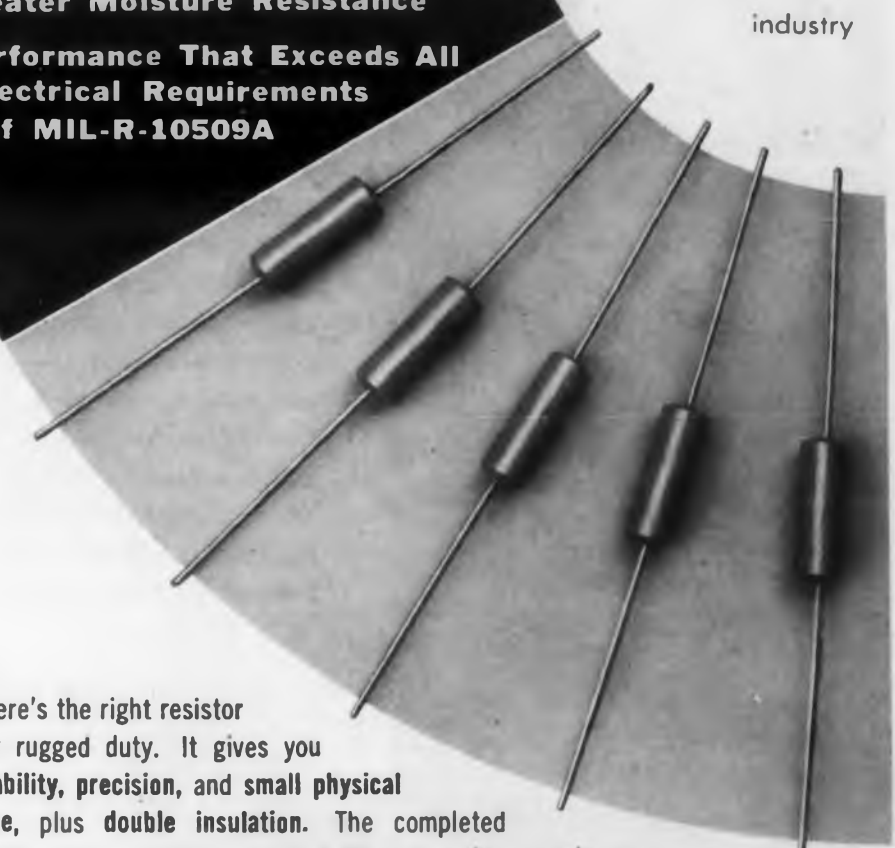
Complete Mechanical Protection

Longer Load Life

Better Electrical Insulation

Greater Moisture Resistance

Performance That Exceeds All Electrical Requirements of MIL-R-10509A



Here's the right resistor for rugged duty. It gives you **stability, precision,** and **small physical size,** plus **double insulation.** The completed resistor has several layers of baked-on, moisture-resistant insulating coatings and, in addition, is encapsulated in a molded plastic case. The result is complete mechanical protection and better operating characteristics. Electra also manufactures a complete line of standard and hermetically-sealed deposited carbon resistors.

FILL OUT AND MAIL THIS COUPON TODAY FOR FULL DETAILS

I am interested in the following type of deposited carbon resistor:

- ○ Molded
- ○ Hermetically-sealed
- ○ Standard

Name _____

Company _____

Street _____

City _____ State _____

Electra carbon-coat PRECISION RESISTORS

ELECTRA MFG. CO.
4051 Broadway
Kansas City, Mo.
WEstport 6864

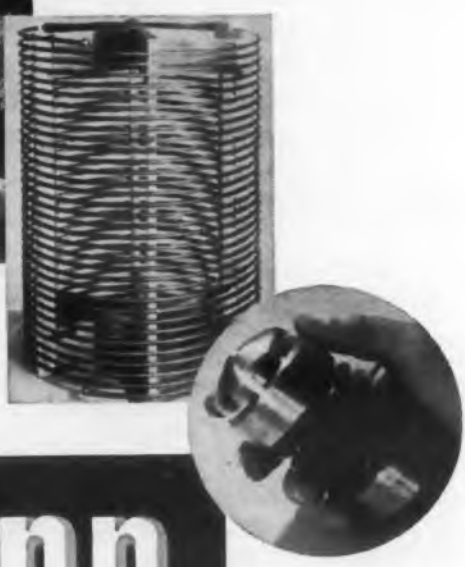
CIRCLE 223 ON READER-SERVICE CARD FOR MORE INFORMATION

LAPP...

FOR 38 YEARS

—SPECIALISTS IN

ELECTRICAL PORCELAIN



From the earliest day of radio and radio-frequency circuits, Lapp has pioneered the application of electrical porcelain and steatite to the special requirements of this industry. Today, "Radio Specialties" identifies a large and efficient department at Lapp where hundreds of parts for hundreds of specialized requirements have been designed and built. We welcome the opportunity to help you—in design and production—with your requirements for insulating parts and associated sub-assemblies. Write Lapp Insulator Co., Inc., Radio Specialties Division, 277 Sumner Street, Le Roy, N. Y.

Lapp

CIRCLE 224 ON READER-SERVICE CARD FOR MORE INFORMATION

Portable Spectrometer

Weighs Only 14 lb

The Model 98 Portable Spectrometer consists of a DuMont 6292 phototube, 1-1/2" x 2" thallium activated sodium iodide crystal, amplifier, single-channel pulse height analyzer, count rate meter, necessary high voltage supply, and low voltage supply. Weight is only 14 lb.

A major feature is almost complete elimination of cosmic ray background count, making it possible to accurately measure very low level radiation. It is also possible to identify the type of material. The energy level on the spectrometer can be set and locked in position so that only material with the given energy will be detected. Alpha, beta, and neutron crystals are available as well as larger thallium activated sodium iodide crystals (up to 5" diam); thus the instrument may be used to make alpha, beta, gamma, and neutron measurements. Radiation Instrument Development Laboratory, Dept. ED, 2337 W. 67th St., Chicago 36, Ill.

CIRCLE 225 ON READER'S SERVICE CARD FOR MORE DATA

Motor-Alternator

Gives r-f Power from 400cy

This series of three high-frequency motor-alternators converts the nominal 400cy 3-phase line to single-phase power at 1150-cy, 2350cy, or 4700cy. In each case of the motor portion of the unit operates from a standard 400cy 3-phase 208v line. The three alternators are characterized by good regulation with low internal reactance, low harmonic content, and the complete absence of sliding contacts in the electrical circuit.

The units are especially suited for laboratory and field use in the design, development, and maintenance of magnetic amplifiers, power supplies, and other components and systems for missile work. Weight is 5-3/4 lb, and overall dimensions are 5-1/2" x 3-1/8" diam. D & R Ltd., Dept. ED, 402 East Gutierrez St., P. O. Box 1500, Santa Barbara, Calif.

CIRCLE 226 ON READER'S SERVICE CARD FOR MORE DATA

Size 15 Servomotor

Operates to 150°C

This new high - temperature size 15, 500-cy, servomotor meets Mark 7 specifications. Continuous operation in temperatures up to an unprecedented 150°C have been attained. Extremely small air gap results in top performance for a high torque-to-inertia ratio. Humidity protection is given by encapsulating the entire stator in a thermosetting resin. Series 2287 has stainless steel ball bearings and meets MIL-S-17087 specs. Dimensions are 1.437″ OD x 1.640″ 1. Weight is 8 oz, minimum stall torque 1.45 in oz, no load speed 4800rpm minimum and power input at stall is 12.2w total. The fixed phase operates on 115v; the control phase may be connected for 115 or 57.5v. Series 2287 may also be wound for 60cy operation in which case no load speed minimum is 3200rpm. John Oster Mfg. Co., Dept. ED, 1 Main St., Racine, Wis.

CIRCLE 229 ON READER'S SERVICE CARD FOR MORE DATA

Snap Switches

With Small Movement Differential

This precise, sensitive, snap switch is for applications requiring extremely small movement differential with high resistance to shock and vibration. A unique sine-curved switching element accounts for excellent performance under shock and vibration (withstands 0-500cy at 10g while continuously loaded to within 0.0002″ of the actuation point). Movement differential, as well as operating and release forces, can be adjusted and set to meet a wide variety of application requirements.

Movement differential is 0.0005″ minimum; shock: 200g; temperature: −65° to +350°F; life: 100,000cy minimum; rating: 10amp at 115v a-c 1.0pf or 30v d-c resistive; size: 1-1/8″ x 7/8″ x 11/16″. Spencer Thermostat Div., Metals & Controls Corp., Dept. ED, Attleboro, Mass.

CIRCLE 230 ON READER'S SERVICE CARD FOR MORE DATA

PANELOC announces a new rotary latch

Saves Cost • Saves Time
Saves Space • Saves Weight

This new Paneloc Rotary Latch is a simple and economical, strong and durable fastener for access panels, electrical control panels, inspection doors, machinery doors, and other hinged or removable covers. It permits a larger access opening, operates quickly with a quarter-turn. Entire assembly on access panel itself, eliminating many installation steps; no special tools required. Only four simple parts; made of steel, cadmium plated. Three standard sizes now available, more to be added. Special sizes and finishes available on order. Cost very low, performance unsurpassed. Write for a catalog and price list for your file.

PANELOC...America's most versatile line of aircraft fasteners . . . Rotary Latches, Styles 1, 2, and 3 Panel Fasteners, High Performance Fasteners, Snap Fasteners.

PANELOC—A product of Scovill

Scovill Manufacturing Company, Aircraft Fastener Div.
47 Mill Street, Waterbury 20, Connecticut

Please send me fastener catalogs checked:

( ) Rotary Latch ( ) Style 3 (MIL-F-5591A)
( ) Styles 1 & 2 (MIL-F-5591A) ( ) High Performance (NAS-547)
( ) Snap Fasteners (AN 227)

Send to:

Name_____ Title_____

Company_____

Address_____

CIRCLE 231 ON READER-SERVICE CARD FOR MORE INFORMATION

Permanent-Magnet Motor

Weighs Less than 3oz

A line of d-c motors incorporating a permanent-magnet field assembly is offered by this firm. The overall body length of the unit is less than 1-1/2", with weight less than 3 oz. A rotatable brush holder can be adjusted for best commutation and power output. Other mechanical features include a flat wafer-type commutator with brushes removable from the rear of the motor.

Various electrical characteristics are available with a range of operating voltages from 6v to 80v, no-load speeds from 3000rpm to 20,000rpm, and power output up to 11w, or approximately 1/70hp. The units are for incorporation into precision servo devices, gear trains, and similar applications. Servo-Tek Products Co., Inc., Dept. ED, 1086 Goffle Rd., Hawthorne, N. J.

CIRCLE 233 ON READER'S SERVICE CARD FOR MORE DATA

Tachometer Takeoff Heads

Cover Ranges from 100-5000rpm

Tachometer Takeoff Heads (Series 32) are versatile general-purpose units for continuous-duty industrial uses requiring ruggedness. They cover speed ranges between 100rpm and 5000rpm for full-scale readings on any stationary Metron Tachometer Indicator.

A dpdt switch, together with a capacitor, acts as a speed-sensing element when the take-off shaft rotates in either direction. It transmits a current (exactly linear with respect to speed) that is measured on any centrally located Metron Indicator either nearby or up to 1000 feet away. Four different stainless-steel shafts are available: 5/16" round, 1/4" square, or one of two keyed shafts. Metron Instrument Co., Dept. ED, 432 Lincoln St., Denver 3, Colo.

CIRCLE 234 ON READER'S SERVICE CARD FOR MORE DATA

WRITE FOR . . .

Magnet Design—Bulletin 151. Specific information for the design engineer. Covers applications, properties, design problems and testing of permanent magnets.

Stock Standard Magnets—Catalog SM-1252. Complete data, with dimensional drawings of standard magnets offered from stock for pilot working models, or for small requirements, without special tooling.

Specialists in Magnetic Materials

Thomas & Skinner, Inc.

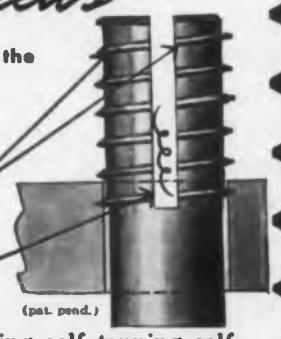
1157 East 23rd Street, Indianapolis 7, Indiana

CIRCLE 237 ON READER-SERVICE CARD FOR MORE INFORMATION

For PLASTIC Parts and Products

SETKO *Self Tapping Set Screws*

—in full range, including the smaller sizes
Save taps, save time, save on production cost!
2 Cutting Edges



Cutting thread extends only around top or slotted section; cuts on both sides of hole, chips are gathered in slot instead of accumulating below. Self-aligning, self-tapping, self-locking! "Pulls itself in." Can be supplied with any type set screw point. Sizes as small as #2 x 3/32.

Write for new illustrated, descriptive bulletin.

823RR

Set Screw & Mfg. Co.

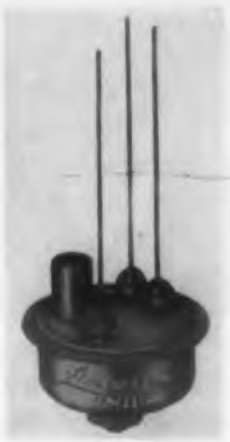
265 Main St., Bartlett, Ill. (Chicago Suburb)

We Specialize in Solving Puzzling Set Screw Problems

CIRCLE 238 ON READER-SERVICE CARD FOR MORE INFORMATION

Power Transistor

Delivers 5w from 6v Input



The Type 2N115, P-N-P, Junction Power Transistor delivers 5w push-pull output with a 6v supply. The unit has a very high current rating at a low drop across the transistor itself. The relationship between the base current and collector current is extremely linear, and the gain is exceptionally high for the power level. The output impedance is low enough for a popular 5 ohm speaker voice coil to be used directly as the collector load in the audio output stage, so that expensive output transformers are not needed.

This transistor is ideal for use in the output stage of automobile radios, either single-ended or push-pull. In push-pull, the gain would be 27db. It can also be used as an oscillator, running from a 6v or 12v supply, to deliver high voltages to vacuum-tube amplifiers. Amperex Electronic Corp., Dept. ED, 230 Duffy Ave., Hicksville, L. I., N. Y.

CIRCLE 239 ON READER'S SERVICE CARD FOR MORE DATA

Read and Record Head

For Magnetic Drums

The Model MH 10-A is designed for low-cost recording or reading on magnetic drums in memory systems of digital computers. It features high readback signal, low noise, and high voltage insulation. It is potted, dimensionally stable, without shrink or swell.

The mounting lends itself to the general-purpose type drum where many heads are stacked, on drums having as few as 30 channels, or as many as several hundred. The writing or record current is less than 20ma, while the readback voltage obtained is greater than 0.5v peak-to-peak across 500 turns. Resonant frequency is over 500kc. With standard head mounting, the unit has a radial adjustment of 0.030". It is completely encapsulated in a die-cast aluminum case. Librascope, Inc., Dept. ED, 808 Western Ave., Glendale, Calif.

CIRCLE 240 ON READER'S SERVICE CARD FOR MORE DATA

For long life under extreme conditions of shock, vibration, corrosion, humidity and temperature

Bendix W type HEAVY-DUTY ELECTRICAL CONNECTOR

Here is the electrical connector designed and built for maximum performance under rugged operating conditions.

Intended for use with jacketed cable and not requiring ground return through mating surfaces, this connector incorporates sealing gaskets at all mating joints.

W-Type Bendix* Connectors also incorporate standard Scinflex resilient inserts in established AN contact arrangements. Shell components are thick-sectioned high-grade aluminum for maximum strength. All aluminum surfaces are grey anodized for protection against corrosion.

For the real tough jobs, be sure to specify the W-Type Electrical Connector.

Our Sales Department will gladly furnish complete specifications and details on request.

*REG. TRADE-MARK

SCINTILLA DIVISION

SIDNEY, NEW YORK Bendix AVIATION CORPORATION

Bendix

Export Sales: Bendix International Division, 205 East 42nd St., New York 17, N. Y.

FACTORY BRANCH OFFICES: 117 E. Providencia Ave., Burbank, Calif. • Stephenson Bldg., 6560 Cass Ave., Detroit 2, Mich. • 512 West Ave., Jenkintown, Pa. • Brouwer Bldg., 176 W. Wisconsin Ave., Milwaukee, Wisc. • American Bldg., 4 S. Main St., Dayton 2, Ohio • 8401 Cedar Springs Rd., Dallas 19, Texas

CIRCLE 241 ON READER-SERVICE CARD FOR MORE INFORMATION

NOW! ULTRA-HIGH PRECISION POLYSTYRENE CAPACITORS

as low as 0.1% tolerance in most values!

Check these outstanding features:

- Capacitance Available - 0.05 to 10.0 MFD
- Voltage Available - 100 to 400 VDC
- Insulation Resistance - 10^6 MEG./MFD
- Temp. Coeff. - 100 P.P.M. per °C (−20° to 140° F)
- Dielectric Absorption — .015%
- Dissipation — .0002

Special values to close tolerances — our specialty

Join these other leading firms in specifying Southern Electronics' precision polystyrene capacitors for your most exacting requirements: Reeves Instrument Corp., Electronic Associates, Inc., Convair, Berkeley Scientific, M.I.T., Calif. Inst. of Tech., and many others.

Write for complete catalog -

POLYCON S&C MYCON

SOUTHERN ELECTRONICS *Corporation*

239 West Orange Grove Ave., Burbank, Calif.

CIRCLE 242 ON READER-SERVICE CARD FOR MORE INFORMATION

Tetrode

With Doubled Power

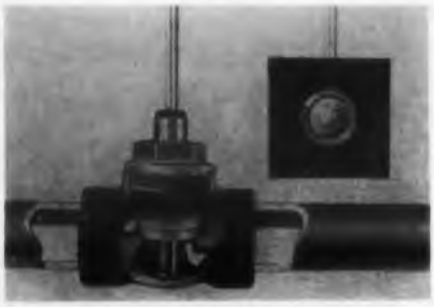
The "Eimac" 4X250B, a radial-beam power tetrode, is unilaterally interchangeable with the 4X150A in nearly all cases. Cooled by convection and forced air, it is intended for modulator, oscillator, amplifier, and frequency multiplier application at all frequencies into uhf. An integral-finned anode, plus other design improvements, make the unit considerably easier to cool than the 4X150A. Seal temperatures are lower, the anode temperature tolerance is higher, and the cooler is more efficient.

Electrical advancements permit an increased plate dissipation rating of 250w, plate voltages to 2000v, and doubled plate power of 500w. A single unit in a coaxial-cavity amplifier circuit will deliver up to 300w of power output at 400Mc. Eitel-McCullough, Inc., Dept. ED, San Bruno, Calif.

CIRCLE 243 ON READER-SERVICE CARD FOR MORE INFORMATION

Flow Indicator

Valuable for Cooling Lines



The Model FI-200 Flow Indicator indicates flow (or lack of flow) of a liquid through a pipe line. Flow actuates a switch that can be used to operate a pilot light, horn, or other warning signal. With suitable relays, it can also be used to operate preventive interlocks. When incorporated in cooling lines, it will signal flow stoppages and can easily be arranged to provide automatic shut-down.

Units now in production accommodate standard pipe sizes from 1/4" to 3". Normally, any flow over 1.5 gpm causes the indicator to function, but other higher or lower points can be provided on special order. Gems Co., Dept. ED, 64 Welles Dr., Newington, Conn.

CIRCLE 244 ON READER-SERVICE CARD FOR MORE INFORMATION

If you need a special component, send a brief statement of your specifications addressed to Bulletin Board, Electronic Design, 19 E. 62nd St., New York 21, N. Y. Include your complete address.

Ceramic Capacitors

For 125°C Operation

These hermetically sealed, "Vitamin Q Pacer" impregnated ceramic case capacitors are for operation at temperatures up to 125°C. Use of a ceramic shell keeps capacitance between the capacitor section and ground at an absolute minimum. The shell, with glass-to-metal solder seals, provides excellent resistance to the effects of humidity and temperature, and extreme stability under all operating conditions.

No voltage derating is necessary for continuous operation at temperatures up to 125°C. Small-sized capacitors with stabilized wax impregnation are available for 85°C operation. Sprague Electric Co., Dept. ED, 347 Marshall St., N. Adams, Mass.

CIRCLE 247 ON READER-SERVICE CARD FOR MORE INFORMATION

Sampling Switch

Has Integral Motor, Gears

This high-speed precision sampling switch with integral motor and planetary gear reduction is available with 1, 2, or 3 concentric poles, 60 contacts per pole, utilizing a semi-molded contact plate construction for long life and dimensional stability. Connections to each pole are made by wire leads molded into the plate and attached to compact multi-pin connectors; this provides plug-in connection and ease of inspection.

These switches are equipped with 60cy or 400cy a-c, 6v to 115v d-c motors, and gear reduction assemblies, with special designs on request. Size is 3-3/8″ diam x 2″ long, with 3/4″ diam x 1″ long hub. General Devices, Inc., Dept. ED, P. O. Box 253, Princeton, N. J.

CIRCLE 248 ON READER-SERVICE CARD FOR MORE INFORMATION

Correction: In the article "Magnistor Circuits" by R. L. Snyder (*ED Aug. 1955, p24*), it was incorrectly stated on page 27 that a 0.07mmfd capacitor was needed. This capacitor should be 0.7mfd instead. In the time equation describing proper buildup of current in the control coil (p24) it was implied but not stated that the control inductance equals 4mh. Author's name is spelled Snyder, not Synder.

FERRANTI

HIGH SPEED TAPE READER

...handles punched tape data at electronic speeds

The Ferranti High Speed Tape Reader accelerates to full speed within 5 milliseconds and stops within 3 milliseconds. It has been in use at leading computer installations for over two years and has achieved a sound reputation for simplicity and reliability in regular operation.

FAST (1) Mark II model reads at speeds up to 200 characters per second, and stops the tape from full speed within a character position – within .03 inch. The tape is accelerated to full speed again in 5 milliseconds and the following character is ready for reading within 6 milliseconds of rest position.

(2) Mark IIA model reads at speeds up to 400 characters per second, and stops within .1 inch.

VERSATILE Both models read either 5 level, 6 level or 7 level tape by simple adjustment of an external lever.

SIMPLE The tape is easily inserted without complicated threading. Lap or butt splices are taken without any difficulty. The same tape may be passed thousands of times without appreciable tape wear. The optical system has no lenses or mirrors to get out of alignment. Friction drive is independent of sprocket hole spacing.

LARGE OUTPUT Amplifiers are included for each channel, including a special squaring circuit for the sprocket hole signal. Output swing between hole and blank is greater than 20 volts.

Dimensions: 9" x 11½" x 11¼" **Weight: 37 lbs.**

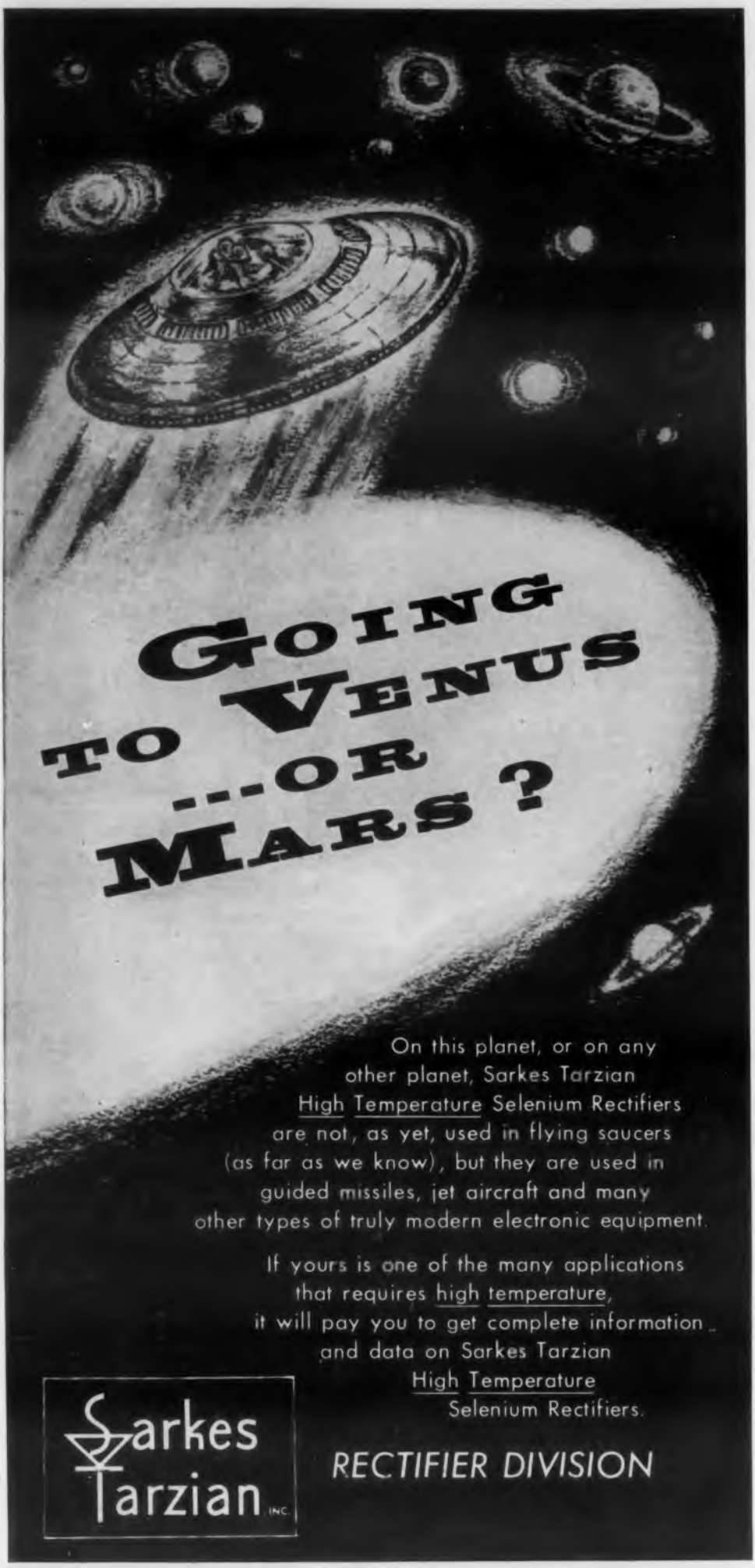
For use with long lengths of tape up to 1000 feet, spooling equipment operating up to 40 inches per second for take-up or supply is available separately.

FERRANTI

FERRANTI ELECTRIC, INC.

30 Rockefeller Plaza New York 20, N. Y.

CIRCLE 249 ON READER-SERVICE CARD FOR MORE INFORMATION



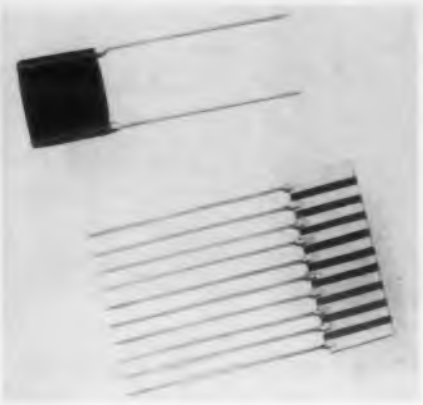
DEPT. C-5, 415 N. COLLEGE AVE., BLOOMINGTON, INDIANA

In Canada: 700 Weston Rd., Toronto 9, Tel. Murray 7535 • Export: Ad Auriema, Inc., New York City

CIRCLE 250 ON READER-SERVICE CARD FOR MORE INFORMATION

Precision Resistor

Single-Section Card Type



This single-section, card - type, precision resistor, "Davohm Series 1300," is wafer-thin and is specifically designed for applications where there is a lack of space for the ordinary round precision wire-wound resistor. It is completely encapsulated for protection against humidity, saltwater immersion, and extremes of temperature, and it is especially adaptable for circuits using transistors, in guided missiles, and airborne communication and navigation equipment.

On values up to 100,000 ohms, the resistor is 1/2" x 1/2" x 3/32" thick. On values from 100,000 ohms to 1 megohm, it is 5/8" x 5/8" x 5/32" thick. Operating characteristics feature precise operation from −55° to +125°C. Wattage rating on each section is 0.6w, and standard tolerance is ±1.0%; accuracies can be obtained to ±0.1%.

In addition, multi-section, card-type resistors are available. The Daven Electronic Sales Corp., Dept. ED, 191 Central Ave., Newark 4, N. J.

CIRCLE 251 ON READER-SERVICE CARD FOR MORE INFORMATION

Magnetic Testing Set

For ASTM Tests

The "Universal Magnetic Testing Set" is a complete unit designed to make measurements that conform to the methods and specifications of the ASTM as described in their specifications on "Standard Methods of Testing Magnetic Materials." It includes d-c and a-c ammeters, rms and flux voltmeters, a low power factor wattmeter, a multirange fluxmeter, and a 25cm Epstein frame as specified by ASTM.

All instruments have 4" hand-drawn mirrored scales and are temperature compensated. Accuracy of the individual instruments is 0.5%, and 0.75% on the thermocouple types. Frequency limit is up to 1000cy. Research Instrument Corp., Dept. ED, 9 Elm Ave., Mount Vernon, N. Y.

CIRCLE 252 ON READER-SERVICE CARD FOR MORE INFORMATION

Inductor Motors

Low-Speed Synchronous Units

Two synchronous inductor motors, self-starting and reversible without gears, are available in 20 and 54-frame sizes from this firm. They accelerate to synchronous speed in 1/2cy or less, and the permanent magnet rotor stops within 7° with moderate external inertia.

The 54-frame motor has a torque rating of 75 oz-in, and the 20-frame unit is rated at 2 oz-in (at 100rpm). The motors start, stop, and reverse very rapidly and will withstand stalling without overheating. The 20-frame motor is available at 100rpm in 60cy, 115v rating and at correspondingly reduced speeds on 50cy and 25cy. The 54-frame is available at 75rpm for 60cy, 50cy, and 25cy at both 115v and 230v. Specialty Component Motor Dept. ED, General Electric Co., Schenectady 5, N. Y.

CIRCLE 255 ON READER-SERVICE CARD FOR MORE INFORMATION

Circuit Breaker

Trip-Free Aircraft Type

The miniature, trip-free, "Klixon" D6761 Aircraft Circuit Breaker is small in size for its rating. Two units fit into the same mounting space as one MS Type Breaker. It has conventional button action (button pops out and indicates on tripping, with manual push to reset). A disk-type thermal element with double break and wiping contacts assures permanent precision calibration.

The D6761 has high rupture capacity and has successfully handled over 2000amp 120v 400cy, and 6000amp 30v d-c. It meets the operational requirements of MIL-C-5809, and is available in ratings from 5amp through 35amp.

Also available is a new "Klixon" thermal-type polyphase Circuit Breaker D6760. It embodies three electrically separate, high-rupture mechanisms that simultaneously trip should any one of the phases become overloaded. Spencer Thermostat Div., Metals & Controls Corp., Dept. ED, Attleboro, Mass.

CIRCLE 256 ON READER-SERVICE CARD FOR MORE INFORMATION

Now...immediate delivery on

NEW TUBELESS

magnetic amplifier

AC LINE VOLTAGE REGULATOR

STABLVOLT® 3 KVA

MODEL MX 3000

- No tubes—no filaments
- Magnetic amplifier regulated
- Maintenance-free
- Adjustable output voltage
- Output held within ±0.25% RMS
- Frequency insensitive
- Excellent wave form
- Fast response
- No dangerous overvoltages
- Quiet operation
- Wide input range
- No jumbled toroids — layer wound

PERFORMANCE SPECIFICATIONS

Input Voltage:	100-130V RMS*, 55-66 cps, single phase
Output Voltage:	110-120V RMS, continuously adjustable
Output Current:	3KVA; 34 Amperes at 110 Volts 31.5 Amperes at 120 Volts
Output Voltage Regulation:	Within a band of ±0.25V RMS for line voltage variations from 100 to 130 V*; Line frequency variations from 55-66 cps, and load variations from 0.3 to 3KVA
Load Power Factor Range:	0.6 to unity
Response Time:	Less than 0.5 seconds
Harmonic Distortion:	5% RMS maximum
Overload Protection:	Automatic magnetic switch in AC line
Size:	19" x 10½" x 13⅜" deep
Weight:	Approximately 130 pounds

** At 3KVA load. Wider input range at lower loads.*

Also available: Model MX 1000 1KVA

For complete technical data request Engineering Bulletin EB-205.

MAGNETIC RESEARCH CORP.

200 CENTER STREET • EL SEGUNDO, CALIFORNIA

Phone OREgon 8-8921

Mfrs. of Magnetic Amplifiers and Converters, Magnetically Regulated DC Power Supplies, Magnetic Pulse Generators.

MRC

CIRCLE 257 ON READER-SERVICE CARD FOR MORE INFORMATION

TUNG-SOL "Magic Mirror" ALUMINIZED PICTURE TUBE

BRIGHTER-SHARPER
MORE DETAIL
MORE CONTRAST

The "Magic Mirror" Aluminized Picture Tube creates the brightest, most realistic TV picture ever seen in the American home. The "Magic Mirror" Tube effectively utilizes *all* the light generated by the phosphor screen.

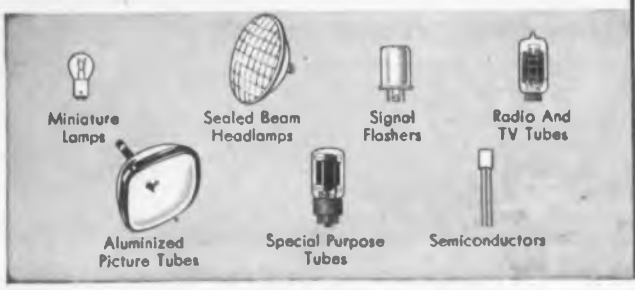
Tung-Sol has developed a unique method of backing the phosphor screen with a mirror-like aluminum reflector: Light is prevented from radiating uselessly back into the Tube. All of the intense detail of which the receiver is capable is brought out by the full light.

Tung-Sol's exacting standards of quality control, manufacture and testing further guarantee the high uniformity and maximum performance of the "Magic-Mirror" TV Picture Tube.

Let the superior qualities of "Magic-Mirror" Picture Tubes add selling advantages to your set.

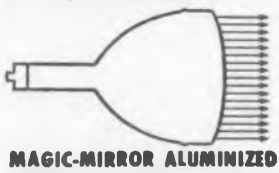
TUNG-SOL ELECTRIC INC., Newark 4, N. J.

Sales Offices: Atlanta, Chicago, Columbus, Culver City (Los Angeles), Dallas, Denver, Detroit, Montreal (Canada), Newark, Seattle.



ORDINARY TUBE—Only *half* the light produced by the phosphor screen is utilized in the picture. Other half radiates wastefully back into tube.

RESULT—A light background within the tube which reduces picture contrast.



MAGIC-MIRROR ALUMINIZED TUBE—Aluminized reflector allows electron beam through. Blocks wasted light from backing up into tube. Reflects *all* the light into picture.

RESULT—Pronounced increase in contrast to make a bright, clear, more realistic picture.

CIRCLE 258 ON READER-SERVICE CARD FOR MORE INFORMATION

Automatic Keyer

Monitors Two Circuits

The Model T-198A "Pulsitometer" is a vibration-resistant keyer originally designed to be used in the overheat warning circuit of all aircraft gas turbine engines, whether jet or turboprop. It utilizes a single warning light to indicate two different conditions of overheat, or two pickup points. When one detector is wired through the keyer, it is possible to differentiate between sources. Flashing is accomplished by alternate charging and discharging a tantalytic capacitor through relays.

The unit will operate over the voltage range of 14v to 30v d-c and under all standard Air Force environmental conditions. Size is 3-1/6" x 2-1/8" x 2-1/8" high, including terminals and mounting base. Weight is 6-1/2 oz. It has a flashing rate of 140cy per minute at 28v. Other flashing rates are available on order. Electronic Specialty Co., Dept. ED, 3456 Glendale Blvd., Los Angeles 39, Calif.

CIRCLE 259 ON READER-SERVICE CARD FOR MORE INFORMATION

Rotary Accelerator

Tests Small Assemblies

The Model CK-9X is a compact acceleration testing machine that tests and calibrates small assemblies while at the same time subjecting them to multiples of the acceleration of gravity. It is capable of subjecting objects as large as a 5" cube weighing a maximum of 3 lb to accelerations up to 250G. The rotating table is tapped with groups of holes to permit mounting, testing, and calibrating four objects simultaneously. The electronic controller furnishes a speed range to 1000rpm with precise speed control. Eight instrument slip rings are provided for electrical connection between rotating test objects, stationary instruments, and power sources. All rings have shielded leads and are rated 5amp at 220v and 10amp at 110v. Schaevitz Machine Works, Dept. ED, Camden 1, N. J.

CIRCLE 260 ON READER-SERVICE CARD FOR MORE INFORMATION

Photoconductive Cell

With Variety of Applications

This tiny, cadmium-sulfide photoconductive cell of the head-on type features high luminous sensitivity, very low dark current, extremely low background noise, and signal output which is directly proportional to the incident light intensity. The characteristics of the cell are not substantially affected by wide change in its operating temperature.

The cell known as the Type 6694, is especially useful in light applications where a single tiny photosensitive device is desired, in light-controlled relay applications, in computer applications, and in light meters for measuring the brightness of small luminous spots. It also finds application in X-ray intensity measurements. The spectral response covers the visible range from about 3500 to 5500 angstroms. Maximum seated length is only 0.190". Tube Div., Radio Corp. of America, Dept. ED, Harrison, N. J.

CIRCLE 263 ON READER-SERVICE CARD FOR MORE INFORMATION

Coil Forms

With Permanent Locking Device

A permanent locking device, the "Perma-Torq", has been developed for this firm's coil forms. The device is a compression spring made of heat-treated beryllium copper which has very high fatigue resistance, thus providing a permanent and constant torque. It comes completely factory assembled to the mounting studs, eliminating the trouble formerly required by separate locking springs.

The new forms are designated PLST, PLS6, PLS5, PLS7, and are completely interchangeable with the LST's, LS6's, LS5's and LS7's. Both types will mount through the same chassis holes, no changes of any kind being required. These "Perma-Torq" forms should find wide application where r-f inductors are preset and pre-tuned before assembly to a chassis. Cambridge Thermionic Corp., Dept. ED, 445 Concord Ave., Cambridge 38, Mass.

CIRCLE 264 ON READER-SERVICE CARD FOR MORE INFORMATION

for COLOR TV

Distributed-Constant Type T 30036. Phase characteristics linear within 5% to 4 mc.

for GUIDED MISSILES

Encapsulated multiple-tap Type 384. Stabilized for rugged environments.

for COMPUTERS

Miniature encapsulated plug-in Type T 30009. Only 1¼" wide by 1½" high.

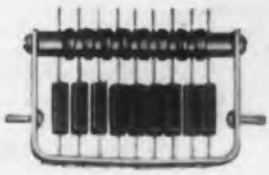
Shallcross DELAY LINES

for LABORATORY DEVELOPMENT

Variable step Type 382. Total delay, 1.1 μs in 0.02 μs steps. Reflections less than 10%.

for RADAR

Multiple-section, open Type 380. Total delay, 0.33 μs with 0.04 μs taps.



for COMMERCIAL INSTRUMENTATION

Enclosed Type T 30030. Total delay, 1.5 μs with 0.05 μs taps.

These six Shallcross lumped-constant and distributed-parameter delay lines cover a wide variety of pulse, video, and timing circuit requirements.

Typical specifications are shown above. Modifications of total delay, tap delay, rise time, attenuation, impedance, bandwidth, dimensions, and mounting are readily possible to match individual requirements exactly.

For detailed specifications and dimensions of basic types, send for Bulletin L-38. A copy of Specification Sheet SS-7 will also be enclosed so you may fully outline your delay line requirements for a prompt recommendation by Shallcross Engineers.

Shallcross

MANUFACTURING COMPANY
526 Pusey Avenue, Collingdale, Pa.

CIRCLE 265 ON READER-SERVICE CARD FOR MORE INFORMATION

PRESET COUNTERS

Automatically count and control to 1,000,000 events.

Dual and multi-sequence models available to provide output signals and relay contact closure at any two or more preset totals

FEATURES

Absolute Accuracy
High Speed
Reliable
Automatic
Rugged
Economical
Small Size

Model DS-8600 Series (5 Models)

Designed to control any operation after a preselected total count has been reached. Used to count pills, bottles, cans, machine parts, etc. for automatic packaging. If an event can be converted to an electrical impulse, it can be counted and controlled with a Detectron Preset Counter.

Count Capacity: 100 to 1,000,000 (depending on model); **Counts per second:** 0-100,000 (as a straight counter); **Recycling rate:** 35,000 per sec. (as a preset counter); **Input Sensitivity:** 0.1 V RMS. **Output Signal:** 50 volt positive pulse; **Relay Contacts:** 5 amps., 115 v. 60 cycle, non-inductive load.

WRITE FOR COMPLETE DETAILS

Representatives in all major areas.

CMC

COMPUTER-MEASUREMENTS CORP.

Formerly Detectron Corporation
5457 Cleon Avenue Dept. 76-K
North Hollywood, California

D-115

CIRCLE 266 ON READER-SERVICE CARD FOR MORE INFORMATION

REGULATED DC POWER SUPPLIES

For varying or heavy "pulse" loads

Complete design and assembly service on dc power supplies is now available from Sola Electric Co. One unusual type of power pack combines Sola Constant Voltage Transformers, high capacitance (no choke) filters and germanium rectifiers for high output voltage stability in the face of varying and/or heavy "pulse" loads.

Typical Sola germanium dc power supplies provide:

- ±1% or less output voltage change with ±15% line voltage variations.
- Minimum output voltage change with wide, rapid load changes.
- High, short-time overload capacity without damage to components.
- Ripple within approximately ±1%.

Other power supplies available to order using electronic and selenimum as well as germanium rectifiers, and conventional filter sections.

For further information on Sola dc power supplies, write for Bulletin 31JCV-223.

SOLA ELECTRIC CO. • **4633 WEST 16TH STREET Chicago 50, Illinois**

CIRCLE 267 ON READER-SERVICE CARD FOR MORE INFORMATION

Power Supply

A Compact, Regulated Unit

This power supply is designed for general laboratory use or for inclusion in new or existant equipment. The entire compact assembly, including five tubes and rectifier, is mounted on a chassis 7-1/4" x 5-1/2" x 1-3/4" deep. It may be incorporated readily into complete-equipment by removing the bottom plate and fastening the assembly directly to equipment chassis.

Lino regulation is less than 5mv/v a-c. Internal impedance is less than 0.5 ohms in series with an inductance less than 1μh. Recovery time is less than 25μsec. Ripple and noise are less than 500μv rms no-load, 1500μv rms full load. Voltage range is 225-325v, continuously adjustable. Current range is 0-175ma, continuous duty. Filament output is 6.3v a-c at 8amp unregulated. Input is 105-125v, 60cy. Other ranges are also available. Trans Electronics Co., Dept. ED, 7243 Eton Ave., Canoga Park, Calif.

CIRCLE 268 ON READER-SERVICE CARD FOR MORE INFORMATION

Micro-Miker

Has Wide Variety of Uses

This dynamic micro-miker, Model 402B, is for measuring capacitances and inductances in operating circuits, as well as for the static measurement of small components. Earlier models have been widely used in such operations as designing video amplifiers and transistors, testing parameters, measuring wiring capacities, and checking components.

A special circuit, employing quartz crystal reference, assures accurate operation over long periods of time. The instrument measures at a frequency of 1Mc where the characteristics of the components can be measured with greater accuracy in terms of the actual operating conditions. Kay Lab, Dept. ED, 5725 Kearney Villa Rd., San Diego 12, Calif.

CIRCLE 269 ON READER-SERVICE CARD FOR MORE INFORMATION

THIS SITE WILL ATTRACT TOP-FLIGHT PERSONNEL

NOW AVAILABLE TO ELECTRONIC AND RELATED INDUSTRIES!

- 4,000 acres for planned industrial development . . . adjacent to double track, main line railroad and spur track, U. S. Highway 1 and airport (inactive).
- 5 miles to the "World's Most Famous Beach" and recreational area.
- More than a location . . . a way of life.
- Natural gas 1957.

Write for 58 page factual economic survey.

TRAFFIC AND INDUSTRIAL DEPT.
CHAMBER OF COMMERCE
DAYTONA BEACH, FLORIDA

Ormond Beach • Holly Hill • South Daytona

CIRCLE 270 ON READER-SERVICE CARD FOR MORE INFORMATION

new! FLEXIBLE VARNISH coating for PRINTED CIRCUITS

Schenectady #642 Insulating Varnish* provides the first practical solution to problems of arc-over and humidity in modular and printed circuit assemblies.

Far more flexible than conventional coatings, #642 Varnish can be baked or air-dried to a tough, resilient coating that completely seals the laminate and component leads against arc-producing moisture. A 2½ mil coating of this water-light varnish withstands 1250 volts—even after 72 hours exposure at 100% relative humidity—without arc tracking or charring.

Write or wire today for complete details on this unusually flexible and durable insulation—the first varnish designed especially for printed circuits.

insl-x SCHENECTADY

* One of the complete line of insulating compounds made by the Schenectady Varnish Co., and the Insl-X Co., now available to electronic equipment manufacturers through:

Insl-x Sales Company 26 Rittenhouse Place, Ardmore, Pa.

CIRCLE 271 ON READER-SERVICE CARD FOR MORE INFORMATION

Insulated Connectors

In 11 Colors

These three miniature nylon-insulated connectors are available in eleven colors each for coding applications. Shockproof and rugged, the nylon insulating handles are unaffected by most chemicals and will withstand extremes of temperature and humidity without loss of mechanical or electrical efficiency. The tip and banana plugs are designed for solderless connection of up to 16 gage stranded wire. The tip plug has a standard 0.081" diam pin to fit all standard tip jacks, while the banana spring tip is 0.175"diam to accommodate nominal 0.166" ID jacks.

The nylon tip jack and insulating sleeve assembly is designed for patch cord use, and will also serve as a panel-mounted jack where the rear connection must be insulated. E. F. Johnson Co., Dept. ED, Waseca, Minn.

CIRCLE 273 ON READER-SERVICE CARD FOR MORE INFORMATION

Ratiometer

Gives 3-Digit Readings

Useful in telemetering, gaging, and quality-control applications, the Model 625 "Digital Ratiometer" provides a rapid three-digit indication of the ratio between two related d-c voltages, accurate to ±5 parts in 1000 (±0.5% of full scale). The complete indication is automatic, and the average reading consumes only 1 to 2sec. Inputs may vary slowly, because internal balancing is continuous.

Voltage ratios range from 000 to 1.000, with four input channels available through a selector switch. The resistance of the input channels may be read up to 10,000 ohms at the same accuracy as ratio readings. Using the basic principle of a self-balancing bridge, the instrument operates on a nominal bridge voltage of 5v. Loading of the test circuit is less than 0.01ma under worst condition and zero when the bridge is balanced. Maximum external current when measuring resistance values is 0.54ma. Hycon Mfg. Co., Dept. ED, 365 Arroyo Pkway, Pasadena, Calif.

CIRCLE 274 ON READER-SERVICE CARD FOR MORE INFORMATION

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.

Driven by Rotron's new **"L"** Frame Induction Motors
1/6 H P to 5 H P
1 Ø—3 Ø 50-60-400 CPS
EXTREME RELIABILITY

ROTRON

ROTRON

MANUFACTURING CO., INC.

7 SCHOONMAKER LANE • WOODSTOCK • N. Y.

CIRCLE 275 ON READER-SERVICE CARD FOR MORE INFORMATION

Power Meter

Reads Direct in Mw or Dbm

The Model 430C Microwave Power Meter gives power readings direct in decibels or milliwatts and eliminates computation and adjustment during measuring. Either pulsed or CW power may be measured on either waveguide or coaxial systems. Operation of the instrument is entirely automatic, and it may be used with a wide variety of bolometer mounts having either positive or negative temperature coefficients. The broad power range may be extended by directional couplers or attenuators.

Frequency range depends on the bolometer mount employed, and either an instrument fuse, barretter, or thermistor may be employed. Operation may be at 100 ohms or 200 ohms, and power is read direct in milliwatts from 0.02mw to 10mw, or in dbm from −20 to +10dbm. Accuracy is ±5% of full scale readings. Hewlett-Packard Co., Dept. ED, 275 Page Mill Rd., Palo Alto, Calif.

CIRCLE 277 ON READER-SERVICE CARD FOR MORE INFORMATION

Speed Reducers

With Less than 1/2° Backlash

This series of precision miniature speed reducers is for general laboratory and product design use. Two basic units, 1062 and 1687, measure 1.062 and 1.687" diam respectively, and 1.656 and 1.859" long, exclusive of shaft length, which can be specified. Ratios range from 12.5:1 to 10,000:1.

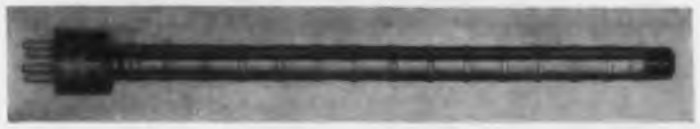
Specifications include backlash of less than 1/2°. Series 1062 is designed for output torque loads up to 25 in-oz; 1687 is up to 100 in-oz. Both units feature ABEC Class 5 ball bearings throughout. Gears are cut to AGMA Precision 2 tolerances from stainless steel, or from aluminum bronze where very quiet operation is necessary. Bowmar Intrument Corp., Dept. ED, 2415 Pennsylvania St., Fort Wayne, Ind.

CIRCLE 278 ON READER-SERVICE CARD FOR MORE INFORMATION

Name Omitted: The capacitors described on page 126, September 1955, ELECTRONIC DESIGN, are manufactured by Corson Electric Mfg. Corp., 540 39th St., Union City, N. J.

Geiger Tube

Has 7" Cathode



The Type 912NB is an unlimited life, halogen Geiger tube with a 7" cathode. Due to the increased cathode length, it provides much higher sensitivity and greater pulse height than earlier units.

The tube itself is a 12" version of the standard Amperex, thin-metal-wall Type 90NB, used for the detection of beta and gamma radiation in monitoring equipment and survey instruments. The new tube has a stainless-steel cathode, 39/64"ID, and a wall thickness of 30mg/cm². Minimum plateau length is 200v; operating voltage is 900v. Amperex Electronic Corp., Dept. ED, 230 Duffy Ave., Hicksville, L. I., N. Y.

CIRCLE 283 ON READER-SERVICE CARD FOR MORE INFORMATION

Vacuum Rectifier

For Use as Damper Diode

The half-wave vacuum rectifier tube *6BL4* is of the glass-octal type and is particularly suited for use as a damper diode in color TV receivers. Rated to withstand a maximum peak inverse plate voltage of 4500v (absolute), the *6BL4* can supply a maximum peak plate current of 1200ma, and a maximum d-c plate current of 200ma. In addition, negative peak pulses between heater and cathode of as much as 4500v including a d-c component of as much as 900v may be used when the heater is operated negative with respect to cathode. Radio Corp. of America, Dept. ED, Harrison, N. J.

CIRCLE 284 ON READER-SERVICE CARD FOR MORE INFORMATION

Hot Tube Puller

For Miniature Tubes

This hot tube puller is built in two models, one straight and one bent at a 90° angle (illustrated). It is easy to operate: it is clamped over the desired tube and pulled up and out, eliminating burned fingers. Hunter Tool Co., Dept. ED, 6608 S. Gretna Ave., Whittier, Calif.

CIRCLE 285 ON READER-SERVICE CARD FOR MORE INFORMATION

Resistance Meter

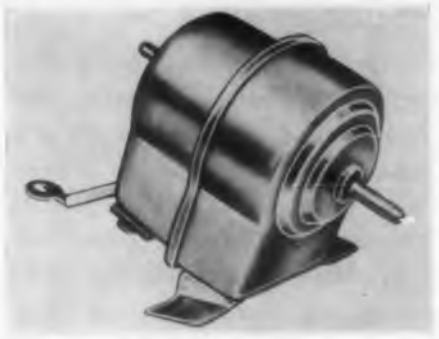
High Accuracy with Wide Range

The Type RGV Resistance Precision Meter has a range of 0.01 ohm to 100 megohms. Accuracy is ±0.1% ±1 milliohm in the 0.01 ohm to 10 megohm range and ±0.5% in the 10-100 megohm range. Completely self-contained, the unit has no batteries or sensitive galvanometer. Low power (less than 10mv) is applied to the sample. Instrument Div., Federal Telephone and Radio Co., Dept. ED, 100 Kingsland Rd., Clifton, N. J.

CIRCLE 288 ON READER-SERVICE CARD FOR MORE INFORMATION

Electric Motor

Very Low Cost



This low-cost "All-Purpose Electric Motor" can be used to run models, toys, and rotating display equipment, as well as industrial devices. Power is furnished by attaching to one, two, or three ordinary flashlight batteries. When three batteries are employed, the motor provides speeds up to 10,000rpm. It is water resistant and will give long trouble-free performance. Moed Trading Co., Dept. ED, 225 W. 34th St., New York, N. Y.

CIRCLE 289 ON READER-SERVICE CARD FOR MORE INFORMATION

Powder Cores

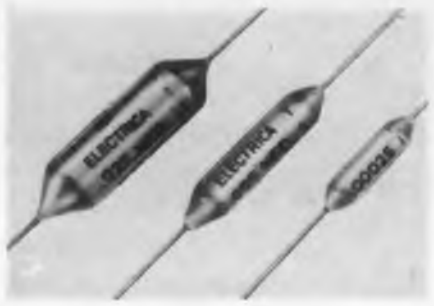
Color Coded for Easy Use

This firm's "Performance-Guaranteed" Molybdenum Permalloy Powder Cores are now graded at no extra cost according to inductance for 1000-turn winding. Cores are color coded in 2% bands from −5% to +15% of the published nominal inductance. This coding provides a guide for assembly operations, allowing the proper number of turns to be put on individual cores without special testing. Magnetics, Inc., Dept. ED, Butler, Pa.

CIRCLE 290 ON READER-SERVICE CARD FOR MORE INFORMATION

Capacitors

In Immersion-Proof Shells

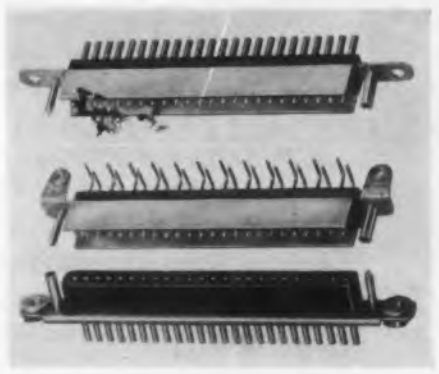


These "Electrica" molded plastic tubular metallized paper capacitors function at temperatures from −20° to +110°C and meet the demands of broadcast, TV, and measurements fields for lightweight and minimum size. Thermoplastic protective covering makes them air tight and moisture and fungus proof. The coating remains stable at all normal operating temperatures and insures high mechanical strength. Arnhold Ceramics Inc., Dept. ED, 1 E. 57th St., New York 22, N. Y.

CIRCLE 295 ON READER-SERVICE CARD FOR MORE INFORMATION

Special Design Connectors

Molds in Stock



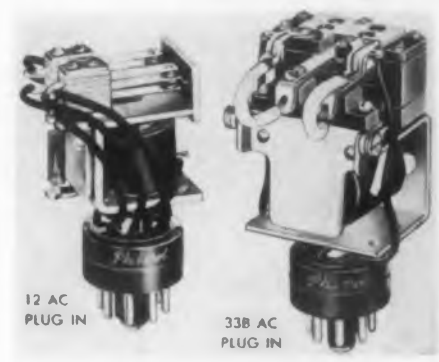
Complex, special-design, "Continental" connectors are now available from this firm on a mass production basis. A completely equipped tool room produces single cavity molds for prototype samples, or multi-cavity molds for high production quantities.

The illustration shows a connector mostly used in digital computer application. It has 24 contacts and is for 90° printed circuit mounting. DeJur-Amsco Corp., Dept. ED, 40-01 Northern Blvd., Long Island City 1, N. Y.

CIRCLE 296 ON READER-SERVICE CARD FOR MORE INFORMATION

Relays

In Two Plug-In Types



To meet the growing demand for convenient plug-in type relays, this firm has added two new models to its line. One is the "Phil-trol" 33 B general-purpose power relay available in either a-c or d-c, 2-pole, 3-pole, or 5-pole models. The other is the smaller Type 12, available in a-c or d-c for operation to 230v. Phillips Control Corp., Dept. ED, Joliet, Ill.

CIRCLE 297 ON READER-SERVICE CARD FOR MORE INFORMATION

Toroidal Coils

In Sizes Down to 0.110"

"Microtoroids" are available in No. 50 wire in sizes as small as 0.110" ID. The manufacturer has developed a new winding technique which permits production in small or large quantities of toroidal inductors and transformers from the smallest sizes up to as large as 2" diam. Offered are continuous uniform windings for single-circuit coils with no gaps, sector-winding, or superimposed winding of multicircuit coils, and simultaneous winding of two, three, or four circuits in different sizes of wire. Mectronics, Dept. ED, Box 807, Ridgecrest, Calif.

CIRCLE 300 ON READER-SERVICE CARD FOR MORE INFORMATION

Disk Capacitor

With High Temperature Stability

The "Iso-Kap" Capacitor provides 9.8% average of nominal capacitance value from −55 to +85°C. In addition, it is made with a completely molded polyethylene case, has a case breakdown voltage rating of 3000v d-c, and an insulation resistance of 10,000 ohms, minimum. Because of the molded case, size is exact and lead spacing is constant which is of value in automatic assembly operations.

The capacitors are smaller than 1/2" x 11/16" diam. They are rated at 500vdcw, flash tested at 1500v d-c, and available in values from 5mmfd to 0.0022mfd. Centralab, 900 E. Keefe Ave., Dept. D-60, Milwaukee 1, Wis.

CIRCLE 301 ON READER-SERVICE CARD FOR MORE INFORMATION

Portable Oscillographs

In 4 and 6 Channels

These portable oscillographs are designed for either four or six channel recording and have weights of 36 lb and 48 lb, respectively. Each unit offers a range of 16 chart speeds with travel variation from 10" per day to 10ips. They are equipped for either ink or electric writing. A control selector permits either local or remote control. Event markers are available. Brush Electronics Co., Dept. ED, 3054 Perkins Ave., Cleveland 14, Ohio.

CIRCLE 302 ON READER-SERVICE CARD FOR MORE INFORMATION

Traveling Wave Tube

X-Band Backward Wave Oscillator

This traveling wave tube features broadband electronically tuned oscillations from 7 to 14kMc, accomplished by the adjustment of a single voltage without any complementary mechanical adjustments. This type of oscillator should find its greatest field of use in swept-signal generators for automatic testing, swept local oscillators, and wide-band transmitter-receiver applications.

The tube is capable of being swept across its band in less than 1μsec. Approximate operating characteristics over the band are 300 to 3000v, 12ma, and 10mw output. X-band voltage requirements are 450 to 2000v. Huggins Laboratories, Inc., Dept. ED, 711 Hamilton Ave., Menlo Park, Calif.

CIRCLE 307 ON READER-SERVICE CARD FOR MORE INFORMATION

Sweep Calibrator

For Time Base Calibration

The Model SC-2 Sweep Calibrator, for oscilloscope time base calibration, has many applications including: sweep time calibration, frequency measurement, frequency response analysis, and use as a marker generator, counter and computer calibrator, and a rectangular pulse shaper.

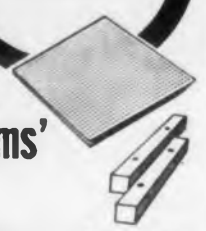
The unit produces narrow marker pulses 0.1μsec wide, spaced at crystal-controlled intervals of 1, 10, 100, 1000, and 10,000μsec. Facility for increasing the pulse widths is provided by a "Stretch" switch. Rectangular output pulses are simultaneously available at crystal-controlled frequencies of 1Mc, 100kc, 10kc, and 100cy. Loral Electronics Corp., Dept. ED, 794 E. 140th St., New York 54, N Y.

CIRCLE 308 ON READER-SERVICE CARD FOR MORE INFORMATION

If you need a special component, send a brief statement of your specifications addressed to Bulletin Board, Electronic Design, 19 East 62nd St., New York 21, N. Y. Include your complete address.

SOLVE

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



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

SERVOmechaNISMS INC.

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

CIRCLE 310 ON READER-SERVICE CARD FOR MORE INFORMATION

Amplifier Klystron

Delivers 2kw at 760-980Mc

This high-power; ultra-high-frequency amplifier klystron, the 3K3000LQ, delivers 2kw power output with a power gain of 1000x and 40% efficiency in CW operations at 760-980Mc. The forced-air-cooled tube has a long-life oxide cathode and rugged ceramic and metal construction. Resonant cavities are completed external to the vacuum system, which is left free of r-f circuitry, enabling wide range tuning, uncomplicated input and output coupling adjustment, and ease of installation and maintenance. The tube is available with circuit components comprising the essential elements of a complete amplifier package. Eitel-McCullough, Inc., Dept. ED, San Bruno, Calif.

CIRCLE 311 ON READER-SERVICE CARD FOR MORE INFORMATION

Mercury Relay

In Improved Versions

The two-pole, single-throw EM-4 and HD-4 relays are offered in improved versions. The EM-4, illustrated, is rated at 35amp or 2hp at 115v a-c. The heavy-duty version, HD-4, is 60amp at 115v a-c. The d-c ratings of both models are 12amp at 120v and 7amp at 220v. Both units are UL approved for inductive and non-inductive control applications.

One improvement is a redesigned collar that supports the relay tube; connection is easier. Ebert Electronics Corp., Dept. ED, 212-21T Jamaica Ave., Queens Village 28, N. Y.

CIRCLE 312 ON READER-SERVICE CARD FOR MORE INFORMATION

Direct-Coupled Amplifier

With ±1% Linearity

This direct-coupled amplifier is for driving galvanometer oscillograph elements and other low impedance loads. Known as the Model CA-401 current amplifier, it features a full scale output of ±40ma into a 35 ohm load with ±600mv input; output impedance loads from 0 to 1000 ohms; flat frequency response from 0 to 50,000-cy; linearity within ±1%; and excellent stability. Photocon Research Products, Dept. ED, 421 N. Foothill Blvd., Pasadena, Calif.

CIRCLE 313 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 wirewound 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
© B. L. PATENTS PENDING *Technical Bulletin On Request, Dept.*

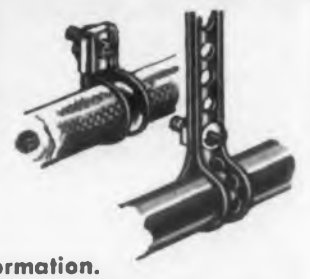
CIRCLE 314 ON READER-SERVICE CARD FOR MORE INFORMATION

HOLD everything!

Yes, our complete line of plastic cable clips and perforated Nylon strapping will "Hold Everything"... wiring, tubing, fragile objects, safely and economically.

MANY STYLES AND TYPES— ETHYL CELLULOSE AND NYLON

Special
Non-corrosive Nylon screws and nuts now available.

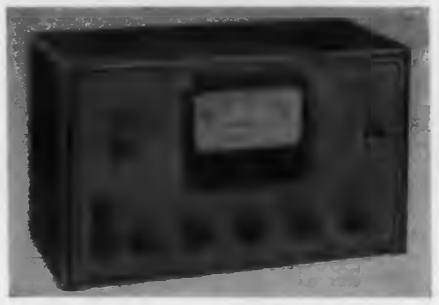


WRITE TODAY For samples and complete information.

WECKESSER CO.
5253 N. Avondale Avenue • Chicago 30, Illinois

CIRCLE 315 ON READER-SERVICE CARD FOR MORE INFORMATION

Bridge
Measures Flutter and Wow



The "Flutter Bridge" measures flutter and wow in turntables, tape recorders, wire recorders, and motion picture equipment. Measurements in either the 0-0.5% or 0-2% ranges are easily taken and indicated on a 4" square meter. An accurate band-pass filter eliminates noise and hum. No external power source is needed, and the unit is housed in a 13" x 8" x 6" metal case. It is presently available for testing equipment with either 4, 8, 16, or 500 ohm impedances. Telectro Industries Corp., Dept. ED, 35-18 37th St., Long Island City 1, N. Y.

CIRCLE 318 ON READER-SERVICE CARD FOR MORE INFORMATION

A-C Capacitors
In Three Terminal Types

These A-C Drawn Oval Capacitors are designed to save space, weight, and cost for compact motor installations. They are available for 236v, 330v, and 440v 60cy. All sizes are made in seamless cases. These capacitors feature three types of terminals to fit specific needs: quick-connect, eyelet, and fork types; each is available for conventional or barrier type terminal mounting. Two types of mounting brackets are offered: footed and wrap-around. The Potter Co., Dept. ED, 1950 Sheridan Rd., North Chicago, Ill.

CIRCLE 319 ON READER-SERVICE CARD FOR MORE INFORMATION

Drawing Instrument
With Seven Uses

The "Triangle-Draft Meter" can be used in seven different ways; 1) as a large 10" —45°/90° triangle; 2) as combined 30° and 60° angles; 3) as a 10", fully-graduated protractor; 4) as an accurate half scale in 32nds; 5) an accurate full scale in 16th; 6) a lettering guide; 7) and as a complete circle template with 33 circle guides from 3/32" to 1½". It is made of acrylic vinyl plastic, 0.075" thick. Alvin & Co., Dept. ED, Windsor, Conn.

CIRCLE 320 ON READER-SERVICE CARD FOR MORE INFORMATION

Motor Overload Switch

For Fractional-Hp Motors

This fractional motor thermal overload switch is designed for positive protection against overload current as well as frame overheating. It is all metal; when mounted on the motor frame it picks up heat by conduction. The metal case at the same time provides complete shielding against r-f interference. Voltage drop is slight because the heating element has low resistance. The heater is bi-metallic and operates contacts by snap action. Thermal cutout is factory set for 225° to 325°F, depending on user requirements, and operates independently of heater current. Units are self-resetting.

Maximum rating is 30v d-c, 10amp; 115v a-c, 5amp. Minimum opening time is 15sec. Case dimensions are 1-5/32" x 17/32" x 11/32" high. An uncased switch can be mounted inside the motor by means of special brackets. Nader Mfg. Co., Dept. ED, 2661 Myrtle Ave., Monrovia, Calif.

CIRCLE 323 ON READER-SERVICE CARD FOR MORE INFORMATION

Delay System

Contains Two 10μsec Lines

The Model V-124 Delay System provides two separate 0 to 10μsec infinitely variable delay lines in one (5-1/4" x 19") rack mounting panel assembly, for a total of 20μsec per assembly. The delay of each line is selected by means of two decade switches having 1μsec and 0.1μsec steps respectively and an infinitely variable fine control of 0 to 0.1μsec. The switching circuit is such that delay line sections are switched into the circuit as needed, thereby avoiding the use of taps and providing at each delay setting a complete delay line properly terminated.

The delay is obtained with a lumped-constant circuit consisting of M-derived coils and capacitors. The overall accuracy is 5%. The rise time varies with delay and increases to approximately 0.4μsec at full delay. Control Electronics Co., Inc., Dept. ED, 1925 New York Ave., Huntington Station, N. Y.

CIRCLE 324 ON READER-SERVICE CARD FOR MORE INFORMATION

Variable Transformer

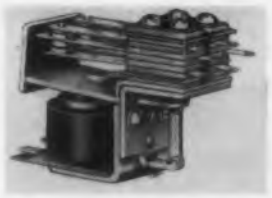
In Cased and Uncased Models

This "Adjust-A-Volt" variable transformer is offered in cased and uncased models. The cased version is for laboratory and industrial use and has a streamlined case, extractor type fuse, jeweled pilot light, output receptacle cord, plug, and on-off switch. Output voltage is 0-115v and 0-135v; maximum output of 7.5amp. Standard Electrical Products Co., Dept. ED, 2240 E. 3rd St., Dayton, O.

CIRCLE 330 ON READER-SERVICE CARD FOR MORE INFORMATION

Motor-Control Relay

An Economical Unit



The magnetic motor controller relay, Series 210-UM, is a sturdy unit available in any standard arrangement of contact combinations from spst normally open, to dpdt. Coil voltage is 115v 60cy. Contacts are rated at 115v, 60cy, single-phase, 1/4hp. Standard coil and contact terminals are lug type, tinned for easy soldering. Bakelite insulation of the contacts is tested at 1500v 60cy.

A comparatively economical unit, the relay combines heavy-duty contact construction and spacing with compact coil and field piece design. It is UL approved. The standard dpdt unit weighs 4.3 oz. Guardian Electric Manufacturing Co., Dept. ED, 1621 W. Walnut St., Chicago 12, Ill.

CIRCLE 331 ON READER-SERVICE CARD FOR MORE INFORMATION

Tube Socket

For Septar Bases

This compact new 7-pin steatite insulated tube socket is designed especially for septar based tubes such as the RCA 5894 and 6524, and the Amperex 5894 and 6252. Requiring 1/2" less chassis mounting space than previously available types, the socket has an integral ventilated aluminum shield base which submounts the tube for optimum input and output shielding. The socket permits compact equipment design in mobile, aircraft, and other types of transmitting equipment. E. F. Johnson Co., Dept. ED, Waseca, Minn.

CIRCLE 332 ON READER-SERVICE CARD FOR MORE INFORMATION

STANDARD

BASIC SWITCH

Gives You More Than Just Long Life!

● You get long life *plus* tolerance stability which gives positive snap-action and accurate repeatability throughout the entire life of the switch . . . even at 1,500,000 cycles and over.

Silver Contacts minimize arcing, assuring precision control and long electrical operation. Patented, self-aligning springs provide contact wiping action seldom found in a switch of this size.

CUT SWITCH COSTS

Long life lowers switch costs . . . minimizes "down-time" and increases efficiency of operation. Durable, compact plastic case permits great flexibility of application. Available in a wide selection of models, including "reset." Rated at 10 amps 125/250 v. AC; 30 v. DC inductive.

Write for details in DATA SHEET STS-10

A few of the standard actuators available.

CIRCLE 334 ON READER-SERVICE CARD FOR MORE INFORMATION

Cooling Fan

For Electronic Cabinets

The Model 2E-408 Cabinet Cooling Fan is specially designed to fit the standard 19" electronic rack. It pressurizes the cabinet with filtered air, preventing dust from entering through cracks and joints of the cabinet. The assembly is rack-mounted the same as other chasses. It contains a hidden replacable filter which is replaced from the front by merely removing the stainless steel grill. The assembly is complete in one unit, ready for use. Standard RETMA notching allows mounting on the rack without cutting and fitting.

Air delivery is 300cfm. The motor is a fan-cooled, rubber-mounted, 1500rpm 50w, shaded-pole type with life-lubricated sleeve bearings. A 115v 60cy rating is supplied as standard; other motors are available to order. With this fan, air is discharged diagonally up, setting up a revolving air current in the rack. It can also be inverted. McLean Engineering, Dept. ED, Box 228, Princeton, N. J.

CIRCLE 335 ON READER-SERVICE CARD FOR MORE INFORMATION

Portable Stroboflash

With Reading Accuracy of ±1%

This instrument is specifically designed for the rapid measurement of speed and the study of rotating and vibrating or reciprocating mechanisms in slow motion. The objects to be viewed are illuminated intermittently to produce the optical effect of slowing down or stopping the motion. Direct reading range is 250rpm to 18,000rpm in three overlapping ranges, with an accuracy of ±1%. Speeds outside the scale range can be measured by using multiples of the flashing speed. The practical upper limit is around 100,000rpm. Flash duration is between 10μsec and 15μsec. The case is 9-1/2" x 9-1/2" x 9-1/2". A number of special accessories are available. Hickok Electrical Instrument Co., Dept. ED, 10525 Dupont Ave., Cleveland 8, Ohio.

CIRCLE 336 ON READER-SERVICE CARD FOR MORE INFORMATION

HIGH TEMPERATURE TERMINALS

100% leak tested, can be soldered, brazed, or welded

Now you can obtain electrical terminals made by a patented process utilizing a silver solder alloy to produce a molecular bond between metal and ceramic parts. They are hermetic, as proved by a mass spectrometer, and every terminal is leak tested before shipment. These high alumina-ceramic terminals operate at temperatures in excess of 350 deg. C, have unexcelled thermal and physical shock resistance, excellent electrical characteristics at high and low temperatures. Now used by leading electronic manufacturers in transformers, capacitors. Stocks on hand, 3/8" to 8" long, specials on request, engineering assistance provided for all your terminal needs. Call:

THE CERAMASEAL COMPANY
NEW LEBANON CENTER, N. Y.

CIRCLE 337 ON READER-SERVICE CARD FOR MORE INFORMATION

Versatrol Indicating Controller

For any variable that can be measured electrically. Adjustable control points. . . . automatic operation.

Catalog No. 3561 Versatrol (High Limit Automatic) with Single Contact 451-C Meter-Relay (0-20 Microamperes DC) Approx. 10 x 6 x 7 inches. Price $154.25.

The meter-relay "heart" of a Versatrol detects and indicates minute changes of current or voltage. It trips self-contained control relays (5 Ampere) as a result of these changes. The trip point or points are adjustable. This control action can be initiated by changes in linear or rotary speed, radiation, moisture content, heat, flow, level, electrical resistance—or variations in pressure, quantity, stress or strain, load, deflection, thickness, weight, color, or light, etc.

Some of the present applications are: Monitoring milling cutters (a dull tool pulls more load); automatic pH alarm; photocell light detectors; battery charger control; control of vacuum in TV tube manufacturing; conveyor belt speed control; moisture content control or warning.

Ranges of Versatrol Meter-Relays: 0/20 Ua to 0/50 A, 0/5 Mv to 0/500 V. Dials can be calibrated in any units—rpm, foot candles, feet-per-minute, counts per minute, deflection, deviation, etc. Signal input may be either AC or DC. Control sensitivity may range from 0.2 microamps to 1000 amps, or 0.1 mv. to over 500 volts. Shunts, series resistors and current transformers can be used in input to extend sensitivity range. Control can be high limit (on an increase in signal), low limit (on a decrease in signal) or double (control action on rise or fall of signal). Versatrol can be used for continuous on-off control (automatic) or for shut-down or alarm (requiring manual reset). No vacuum tubes are used. Write for Bulletin G-7. Assembly Products, Inc., Chesterland 17, O. Or phone our Versatrol Department: (Cleveland, O.) HAmilton 3-4436.

Booths 425-426, Automation Show, Nov. 14-17, Chicago.

CIRCLE 338 ON READER-SERVICE CARD FOR MORE INFORMATION

Is CONTROL your problem? If it's an electrical system, REGOHM can help you. For full details about this finger-type voltage regulator, write:

ELECTRIC REGULATOR CORPORATION
140 Pearl Street, Norwalk, Conn.

REGOHM

CIRCLE 340 ON READER-SERVICE CARD FOR MORE INFORMATION

SEE the complete Shakeproof line!

SPRING WASHERS

by SHAKEPROOF

Free! Write today for this catalog . . . contains full description and specifications on a wide variety of types and sizes of spring washers.

SHAKEPROOF®
"Fastening Headquarters"
DIVISION OF ILLINOIS TOOL WORKS
St. Charles Road, Elgin, Illinois

CIRCLE 341 ON READER-SERVICE CARD FOR MORE INFORMATION

Knob

With Collet-Type Lock

This "Kollet" Knob, with a special locking device for 1/4" shafts, is offered in two types: with and without a skirt. The knobs eliminate the use of set-screws by utilizing a collet-type locking device which permits tightening with screwdriver, coin or socket wrench, from the front. The knob's metal faceplate snaps in to complete the design and cover the locking device. Cambridge Thermionic Corp., Dept. ED, 445 Concord Ave., Cambridge 38, Mass.

CIRCLE 342 ON READER-SERVICE CARD FOR MORE INFORMATION

Resistance-Capacity Box

Provides 54 Standard Valves

The "Resistance-Capacity Substitution Box", Model 900, is produced in two forms: wired and tested, and in an easy-to-assemble kit. It provides, within 10% accuracy, 36 standard RETMA resistor values from 15 ohms to 10 megohms, and 18 standard RETMA capacitance values from 0.001 to 0.22mfd. Electronic Measurements Corp., Dept. ED, 280 Lafayette St., New York 12, N. Y.

CIRCLE 343 ON READER-SERVICE CARD FOR MORE INFORMATION

Work Solenoid

For Severe Conditions

The Model 9300 single-coil work solenoid provides consistently high force under severe operating conditions to meet applicable requirements of MIL-S-4040A.

The solenoid is a single-coil push-type, rated at 18-30v d-c for continuous duty. Minimum pull available at the beginning of the stroke is 1.85 lb at 0.125-amp, 78°F, and 24v d-c. Stroke is 0.1". Weighing 0.42 oz, the unit is 2-1/32" in overall length and has a 1-1/4" diam. Carruthers & Fernandez, Inc., Dept. ED, 1501 Colorado Ave., Santa Monica, Calif.

CIRCLE 344 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRICAL CONTACTS

ADJUSTING SCREWS

NOTE: LEFT-HAND THREADS

SPECIAL SHAPES

ELCO

COLD-HEADED PRODUCTS

One interesting feature of several of the items above is that they are roll-threaded on the *short* end — a neat trick that called out some ingenuity on the part of ELCO shop people. ELCO facilities also include an Engineering Service that will help you design — or re-design — your special screws and similar pieces for *lowest-cost* manufacture. *Always consult your ELCO representative.*

COMPLETE LINE OF ELCO PRODUCTS

WOOD SCREWS
MACHINE SCREWS
MACHINE SCREW NUTS
TAPPING SCREWS
SPECIAL SCREWS
THREAD-CUTTING SCREWS
PHILLIPS AND SEMS SCREWS
COLD HEADED PRODUCTS
PIPE PLUGS
STOVE BOLTS
CAP SCREWS
LAG SCREWS
DRIVE SCREWS

"ELCO SCREWS ARE GOOD SCREWS...
ASK A MAN WHO HAS USED THEM"

ELCO TOOL AND SCREW CORPORATION
1948 BROADWAY, ROCKFORD, ILLINOIS

CIRCLE 345 ON READER-SERVICE CARD FOR MORE INFORMATION

EAD's subminiature CENTRIFUGAL BLOWER

Here is the most compact centrifugal blower unit made . . . EAD's high-velocity subminiature centrifugal blower is only 2⅛" long, weighs only 6 ounces, yet it can move 13 cfm of air at a velocity of 3,000 feet per minute—and the volume holds up at high static pressures. It is driven by EAD's new one-inch diameter motor. The metal blower housing can be rotated to any position desired for maximum efficiency in cooling radar equipment, amplifier units, transmitter equipment, oscillators, and in other applications where high temperatures in confined areas demand miniaturized blowers with the highest possible performance characteristics. EAD's subminiature blower units meet all applicable MIL specification, and low temperature rise makes them suitable for high altitude and high ambient temperature operation.

CFM	13 @ 0" SP 10 @ 1.0" SP	7 @ 0" SP 5 @ 2" SP
MAX. SP.	2.5	0.6
RPM	20,000	11,000
AMPS	0.1	0.06
WATTS	10.0	6.0
CAPACITOR Mfd/Volts	0.25/220	0.1/220
WEIGHT (OUNCES)	6	6
MODEL NO.	B2GOU-C	B2HOU-C

Modifications of standard models or completely new designs can be engineered to meet your special cooling needs. Write for complete information.

EASTERN AIR DEVICES, INC.

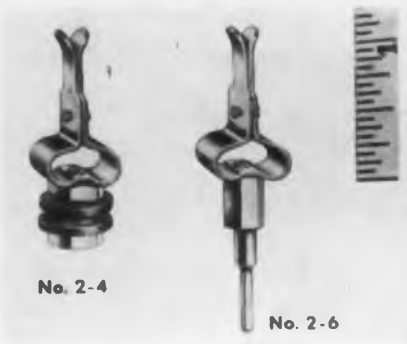
SOLVING SPECIAL PROBLEMS IS ROUTINE AT EAD

391 CENTRAL AVENUE • DOVER, NEW HAMPSHIRE

CIRCLE 346 ON READER-SERVICE CARD FOR MORE INFORMATION

Test Clips

In Four Different Mountings



Two new items have been added to this firm's Series 2 line of Test Clips, which now provides four different methods of mounting the basic clip itself. The No. 2-4 clip, which is affixed to a threaded stud, incorporates two molded phenolic washers between two hex nuts on the stud; this provides insulation between the clip itself and the metal panel on which it is mounted. The No. 2-0, a similar type without the washers, is for use on laminated panels.

Another version, the No. 2-6, uses the basic clip affixed to a pin plug. It is considered by the factory to be a counterpart of the No. 2-1 banana plug clip. There is now one available for either a banana jack of a pin jack. Grayhill, Dept. ED, 561 Hillgrove Ave., LaGrange, Ill.

CIRCLE 347 ON READER-SERVICE CARD FOR MORE INFORMATION

4-Digit Counter

Weighs 6 oz

The "Tab Electric Counter" contains a one-piece cog-action actuator that insures positive stepping for each impulse up to 300cpm. This counter is a rugged, 6 oz unit of the non-reset type, with a cadmium-plated case. The four-digit model is 1-7/8" x 1-3/8" x 2-5/8" high. Numerals are black on white and 3/16" high for easy reading. Standard counters are available for 50v and 100v. Counters for special voltage requirements are also available. Como Manufacturing Corp., Dept. ED, 5013 N. Kedzie Ave., Chicago 25, Ill.

CIRCLE 348 ON READER-SERVICE CARD FOR MORE INFORMATION

If you need a special component, send a brief statement of your specifications addressed to Bulletin Board, Electronic Design, 19 East 62nd St., New York 21, N. Y. Include your complete address.

PUT DAGE TV TO WORK FOR YOU

Write directly to Dage Television Division of Thompson Products, Inc., Michigan City, Indiana. An experienced industrial TV engineer will be glad to help you . . with no obligation on your part. For complete details on Dage installations write us for Booklet ED2.

As an efficient, modern "tool", Dage closed-circuit TV is saving time and money today for almost every type of business, industry and institution . . . keeping materials flowing . . . transmitting records accurately and swiftly . . . training personnel . . . safeguarding property . . . and doing literally hundreds of other vital jobs.

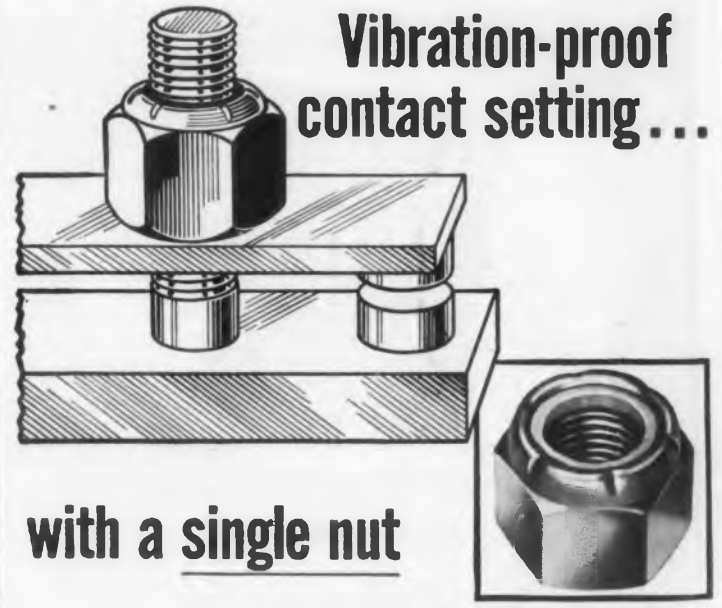
Its applications are endless—Let our engineers suggest an answer for your problems.

In Canada Distributed by Rogers Majestic Electronics, Limited, Toronto, Canada

DAGE TELEVISION
Division of Thompson Products, Inc. Michigan City, Indiana

CIRCLE 349 ON READER-SERVICE CARD FOR MORE INFORMATION

Vibration-proof contact setting...



with a single nut

Easily wrenched on to an exact setting, the one-piece, self-locking Elastic Stop® nut won't shake loose. The red elastic locking collar grips the stud threads tightly . . . maintains a precision adjustment without any secondary locking devices. Usable over and over again. Many types available in miniature sizes for electronic and instrument assemblies—hex nuts as small as .109 across flats!

For information and help with electronic fastener problems, write Dept. N70-1057.

ESNA ELASTIC STOP NUT CORPORATION OF AMERICA
2330 Vauxhall Road, Union, N. J.

DESIGN HEADQUARTERS FOR SELF-LOCKING FASTENERS

CIRCLE 350 ON READER-SERVICE CARD FOR MORE INFORMATION

Rate Meter

Makes 5-10,000 Counts/sec

This precision count rate meter, the Model CRM-560, has an unusually wide range of 5 to 10,000 counts per second full scale. It incorporates a sensitive linear amplifier and discriminator with 2mv sensitivity. Statistical error may be chosen as 1%, 2%, 5%, 10%, or 20%. There is no needle kick when switching ranges or error settings. NRD Instrument Co., Dept. ED, 6425 Etzel Ave., St. Louis 14, Mo.

CRCLE 354 ON READER-SERVICE CARD FOR MORE INFORMATION

Potentiometers

In Low-Cost Bakelite

The "P Series" Potentiometers are low-cost molded-Bakelite units for automation and industrial applications. These units retain all of the precision features developed for stringent military requirements that are applicable to commercial requirements. They are available in single or ganged assemblies in three sizes, P3, P1-5/8, and P1-1/4. A precision pilot is optional for all three units. Technology Instrument Corp., Dept. ED, Acton, Mass.

CIRCLE 355 ON READER-SERVICE CARD FOR MORE INFORMATION

Wing Nuts

For Special Applications

"Low Wing" and "High Wing" Nuts are for applications where lack of sufficient overhead or side space prohibits using standard wing nuts. Both items feature "Finger-Grip" recessed wings, and clean threads. They are die-cast of a non-ferrous, corrosion-resistant zinc alloy. The plain bright finish withstands normal usage, or parts may be obtained in all commercial finishes when desired. Gries Reproducer Corp., Dept. ED, 400 Beechwood Ave., New Rochelle, N. Y.

CIRCLE 356 ON READER-SERVICE CARD FOR MORE INFORMATION

Capacitor

Vertical Paper Unit

Available in MIL-C-25 CP11 types with axial wire leads, this vertical mounting type capacitor is designed with critical requirements in high vibration and weight. Utilizing deep drawn cases, the unit eliminates a weakness common to capacitors of this style where the solder joint between the threaded bushing and the case is used as a mechanical connection. San Fernando Electric Mfg. Co., Dept. ED, 1509 First St., San Fernando, Calif.

CIRCLE 359 ON READER-SERVICE CARD FOR MORE INFORMATION

Oscillographs

Will Do Rectilinear Recording

Rectangular - coordinate recording in ink is featured in oscillographs available from this firm in two, four, six, and eight channels. A six-channel unit is illustrated. The oscillographs are designed for ink or electric curvilinear recording and will accommodate attachment for ink rectilinear recording. Various chart speeds are available. Photron Instrument Co., Dept. ED, 6516 Detroit Ave., Cleveland 2, Ohio.

CIRCLE 360 ON READER-SERVICE CARD FOR MORE INFORMATION

Power Meter

Measures D-C to 11,000Mc

The Model P-2 Power Meter operates over the entire frequency range of d-c to 11,000Mc. Power is measured in three ranges: 0-1mw, 0-10mw, and 0-100mw. This unit is a true rms milliwatt indicating meter that measures CW pulse power in milliwatts and db with a minimum of ±1.0db accuracy over the entire band. Polarad Electronics Corp. Dept. ED, 43-20 34th St., Long Island City 1, N. Y.

CIRCLE 361 ON READER-SERVICE CARD FOR MORE INFORMATION

PANEL HARDWARE

C.T.C.'s high quality panel hardware is precision made, of exceptionally fine finish, and meets applicable military specifications.

PANEL SCREWS. (X1786). Brass, with polished nickel plated head or black oxide finish. Panel sizes: ⅛″; 3/16″; ¼″.

THUMB SCREWS. (1120). Brass, with polished nickel plated head or black oxide finish. Thread sizes: 6-32; 8-32; 10-32.

DIAL LOCKS. (X1552). Brass, with nickel plate or black oxide finish. Captive assembly, no loose parts, positive locking.

SHAFT LOCKS. (X1774). Brass, with nickel plate or black oxide finish. Fit standard ¼″ shafts.

HANDLES. Brass, with nickel plate or black oxide finish, in sizes: 6¾″ x 1¾″; 4⅞″ x 1½″; 3-5/16″ x 1-5/16″. *Aluminum* (X1884) black aluminite or special colors in lacquer or enamel. One size: 4⅜″ x 1⅞″.

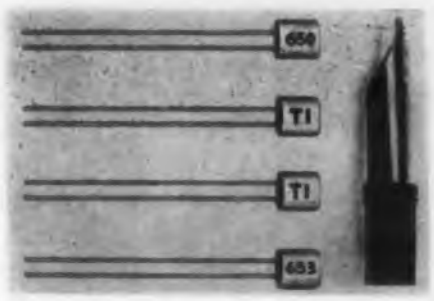
Order parts by number in bracket adding suffix BO for black oxide finish. Send for catalog 400 containing details of C.T.C.'s complete line of electrical and electronic hardware and ask for prices.

CAMBRIDGE THERMIONIC CORPORATION
457 Concord Ave., Cambridge 38, Mass.

CIRCLE 364 ON READER-SERVICE CARD FOR MORE INFORMATION

Voltage Reference Diodes

Four New Units Offered



For extremely accurate voltage reference, four new types have been added to this firm's line of silicon diodes, bringing the total up to 19. With reverse breakdown voltage (measured at 5ma) ranging from 3.7v to 8.0v, the new diodes feature extremely small breakdown voltage temperature coefficients from −55° to +150°C. This temperature coefficient, which can be positive or negative, is combined with low dynamic resistance in the breakdown region. Texas Instruments, Inc., Dept. ED, 6000 Lemmon Ave., Dallas, Tex.

CIRCLE 366 ON READER-SERVICE CARD FOR MORE INFORMATION

Circuit Breaker

With High Rupture Capacity

The miniature, trip-free D6761 Aircraft Circuit Breaker is very small for its rating. Two breakers fit into the same mounting space as one MS Type unit. It is designed to meet operational requirements of MIL-C-5809. It is available in ratings from 5 through 35amp. Spencer Thermostat Div., Metals & Controls Corp., Dept. ED, 34 Forest St., Attleboro, Mass.

CIRCLE 367 ON READER-SERVICE CARD FOR MORE INFORMATION

Resistor

Up to 10 Million Megohms

This miniature high megohm resistor, Type HSD, is hermetically sealed in a glazed steatite jacket and is unaffected by adverse climates and high humidity. Measuring only 7/8″ long x 11/32″diam and being light in weight, it can be soldered directly into the circuit with no support other than the wire leads.

Because of the long path length and use of resistance materials of low specific resistance, the noise level is extremely low. Maximum voltage is 2500v. Voltage and temperature coefficients are low. Resistance Products Co., Dept. ED, 914 S. 13th St., Harrisburg, Pa.

CIRCLE 368 ON READER-SERVICE CARD FOR MORE INFORMATION

Differential

With Concentric Shafts

This high precision differential, the Model T750, does not have the usual two input shafts at opposite ends of the spider. The output and both input shafts extend concentrically from one end of a servo-mounted case. This provides the design engineer with a dustproof unit for mounting on a single hanger. Sterling Precision Instrument Corp., Dept. ED, 34-17 Lawrence St., Flushing 54, N. Y.

CIRCLE 371 ON READER-SERVICE CARD FOR MORE INFORMATION

Twin Triode

For Digital Computers

The Type *6350*, a miniature T-6-1/2 twin triode, is for use in high-speed digital computers. Featuring long life, high perveance, and good power handling, it has a plate dissipation rating of 3.5w per section. Each section features a high zero bias plate current, sharp cutoff, and a separate cathode connection.

The cathode is designed to operate at very low temperature, and special alloys used in its composition control sublimation and cathode interface formation to a slow rate. Sylvania Electric Products, Inc., Dept. ED, Emporium, Pa.

CIRCLE 372 ON READER-SERVICE CARD FOR MORE INFORMATION

Switch

Puts Two Patterns on Slopes

Switch Type 650 is a portable instrument which makes possible simultaneous observation of two recurrent patterns on the screen of a single cathode-ray oscilloscope. The instrument also chops a d-c signal, making it suitable for a-c cathode-ray oscilloscopes. Switching rate is continuously variable, 10 to 20,000 times/sec. Size is 6″ x 7″ x 8″; weight is 10 lb. Chatham Electronics, Div. of Gera Corp., Dept. ED, Livingston, N. J.

CIRCLE 373 ON READER-SERVICE CARD FOR MORE INFORMATION

MORE THAN 50,000,000 IMPULSES COUNTED WITHOUT A MISS

We've been testing a SODECO Electric Impulse Counter out of a recent production run to find out how long it would last. The count has now reached the fifty million mark without the slightest indication of trouble. This is pretty good proof of rugged long-lasting quality built into all SODECO Counters.

Apart from long dependable service, you get many other plus values when you specify SODECO for your counting problems. For instance:

- SPEED—up to 25 impulses /sec.
- COMPACTNESS — The model illustrated measures only 1⅜" x 2⅜" x 4⅜" and is suitable for flush mounting
- ELECTRIC RESET—Permitting simultaneous remote resetting of an entire bank.
- LOW POWER REQUIREMENT—These counters have been operated in electronic circuits.

A SODECO Counter may be the answer to your counting problem. Write for full information.

LANDIS & GYR, Inc.

45 WEST 45TH STREET, NEW YORK 36, N. Y.

CIRCLE 376 ON READER-SERVICE CARD FOR MORE INFORMATION

HERE'S KLIPZON The *Smallest* CLIP CONNECTOR made!

MINIATURIZED FOR MODERN ELECTRONICS

LOOK - HOW EASY TO USE!

WHY USE OLD STYLE CLIPS WHEN MODERN SELF HOLDING KLIPZONS ARE AVAILABLE

For QUICK, EASY-TO-MAKE TEMPORARY CONNECTIONS

PLUS - - - these EXTRA *Features:*

- ★ FITS INTO PIN JACKS, TUBE SOCKETS, BINDING POSTS AND SMALLEST SPACES IN CIRCUITRY.
- ★ FITS ONTO WIRES UP TO #12 B&S Ga.
- ★ STAINLESS STEEL NEEDLE POINT TO PIERCE INSULATION.
- ★ REMOVABLE INSULATING SLEEVE ON SHANK PREVENTS ACCIDENTAL SHORTS.
- ★ SOLDERLESS CONNECTION FOR LEAD WIRE IN RED OR BLACK TENITE HANDLE.

At your LOCAL DISTRIBUTOR —or write on your letterhead for FREE SAMPLE

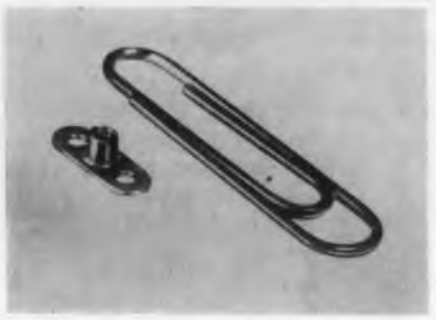
UNITED TECHNICAL LABORATORIES

BOX 425 C • MORRISTOWN, N. J.

CIRCLE 377 ON READER-SERVICE CARD FOR MORE INFORMATION

Anchor Nut

A Full-Floating Miniature



This precision all-metal full-floating miniature "Kaylock" anchor nut is designed to be less than one-half the size and one-third the weight of conventional floating anchor nuts. A new receptacle design allows it to be interchanged with fixed miniature anchor nuts. It has the same rivet size and the same rivet hole spacing. Torque-out and push-out strengths are far in excess of Air Force-Navy specifications requirements. The Kaynar Co., Kaylock Div., Dept. ED, 820 E. 16th St., Los Angeles, Calif.

CIRCLE 378 ON READER-SERVICE CARD FOR MORE INFORMATION

Impulse Relay

Can be Mechanically Locked

The Series 22L sensitive impulse latching, mechanical locking, and electrical impulse reset relay is for applications where it is not practical to have the holding coil in constant service. It consists of two sensitive relays mounted on a phenolic base. Both relays are available in either a-c or d-c, or in any combination of these. The contacts, rated at 2amp 110v a-c, are supplied as spdt or dpdt. Kurman Electric Co., Dept. ED, 35-18 37th St., Long Island City, N. Y.

CIRCLE 379 ON READER-SERVICE CARD FOR MORE INFORMATION

Miniature Power Transformers

For 400cy and Higher

A new line of miniature power transformers for 400cy and high frequencies is available with output power ratings up to 15va with multiple windings from 1 to 500v. The units are offered in metal cases or in plastic encapsulated form to satisfy MIL-T-27 requirements. Hycor Co., Inc., Dept. ED, 11423 Vanowen St., North Hollywood, Calif.

CIRCLE 380 ON READER-SERVICE CARD FOR MORE INFORMATION

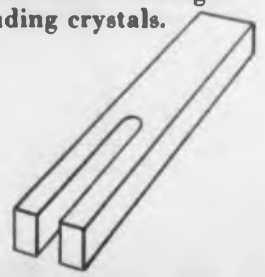
Will these Components Solve a Problem?

FORK OSCILLATORS

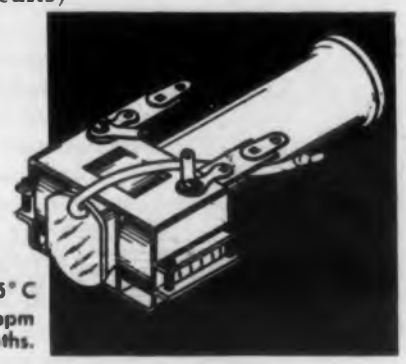
for the most precise timing and frequency control

FEATURES

In Audio Frequency systems, the fork has advantages over other types of oscillators including crystals.



- *INTRINSIC STABILITY*— superior at audio frequencies.
- *TEMPERATURE COMPENSATED*
- *RUGGED MECHANICAL DESIGN*
- *STABILITY NOT DEPENDENT ON AMPLIFIER COMPONENTS* (in recommended circuits)
- *STABLE OPERATION WITHIN 5 MINUTES*
- *LOW AGING RATE*



SPECIFICATIONS
frequency stability

a. ± 3ppm room ambient (no oven)
b. ± 1ppm after temperature equilibrium is attained ± 5° C
c. Long term drift less than 5ppm per annum after first 3 months.

SYNCHRONOUS MOTORS

Wherever highly constant angular velocity at approximately 1/100 H.P. is desired, these motors, in combination with a suitable control frequency source, will give excellent performance. Motors will operate on control frequencies from 200-2500 CPS.

FEATURES

The model KBA is a self-contained synchronous motor with integral start motor and reduction gear box permitting a choice of 30:1 or 20:1 reduction: Provision is made for a fast acting clutch and phasing (indexing) magnet as accessories. The model MS motor is similar but requires an external start motor.

KBA integral start motor

The motor speed range is 400 RPM to 5000 RPM.

MS
external start motor required

Information and prices will be mailed on request.

TIMES FACSIMILE Corporation

540 West 58th St., New York 19, N. Y. • 1523 L St. N.W., Washington 6, D. C.

CIRCLE 381 ON READER-SERVICE CARD FOR MORE INFORMATION

35w Servo Motor

With Tachometer Generator

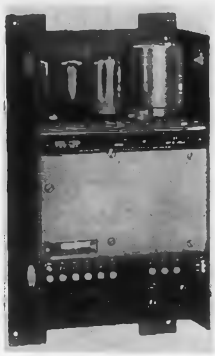
This 35w, 2-phase, a-c servo motor-tachometer generator unit operates on 115v 60cy. It can be used to regulate the speed of a motor or to stabilize closed-loop circuits. Because the motor and tachometer are mounted on a single shaft, backlash is zero. The motor component is rated for continuous duty at rated output. It can be stalled continuously with one phase of the motor excited at rated voltage and frequency. Minimum locked torque is 45 oz-in. Free acceleration is 10,600rad/sec^2.

Tachometer output is 6v per 1000rpm. Linearity (% of output voltage at 3000-rpm) is 1.0%. Servomotor Dept. ED, Diehl Manufacturing Co., Finderne Plant, Somerville, N. J.

CIRCLE 384 ON READER-SERVICE CARD

Amplifier-Converter

For T/C and Other Low Voltages



This amplifier-converter enables the "Autronic System" of all-electronic control to be used with thermocouples or other low-voltage d-c inputs. Designated as the Type T2C "Autronic" Thermocouple Converter, it is a high-impedance, null-balance unit which does not draw current from the thermocouple. It takes d-c millivolt signals and converts them to a 0.000-0.500mv 60cy a-c signal. This signal, directly proportional to the variable being measured, is then transmitted to the "Autronic" Controller. The converter uses no batteries, slide wires, solenoids, or motors.

Span accuracy is 0.5%, reproducibility 0.25% of span, and ultimate sensitivity better than 0.1% of span. Power consumption is 12w. The unit can be easily mounted on any vertical surface. Overall dimensions are 7" x 12" x 4" deep. The Swartwout Co., Dept. ED, 18511 Euclid Ave., Cleveland 12, Ohio.

CIRCLE 386 ON READER-SERVICE CARD

Patchcord System

For Computer Programming

This patchboard system is designed to program computers, business machines, and testing operations. It consists of a frame which opens to receive a pre-programmed plug board, the boards, and patchcords terminated with taper pins. When the board is placed in the frame and the frame closed, the board makes contact with stationary male contacts.

The construction of the frame is such that a wiping contact is made, assuring good electrical contact. The patchboard systems are available on special order. Aircraft-Marine Products, Inc., Dept. ED, Harrisburg, Pa.

CIRCLE 385 ON READER-SERVICE CARD

TV Tubes

Need No External Ion Traps

Large size TV picture tubes which require no external ion traps are now available from this firm. They have been made possible by a newly-designed straight electron gun and a special aluminization control process. The new gun is being built into four new 21" tubes and a new 24" tube.

Elimination of the external magnet not only provides production simplification for the equipment manufacturer, but also simplifies installing and servicing the receiver in the home. The new gun (at left in illustration) replaces the ordinary "bent" gun (shown at right). General Electric Co., Tube Dept. ED, Schenectady 5, N. Y.

CIRCLE 387 ON READER-SERVICE CARD

Power Rectifier

Silicon Unit Weighs 7/100 oz

This silicon power rectifier is first product to emerge from newly-established Semi-Conductor Department of this firm. It is designed for use in equipment where miniaturization and high temperature reliability are of utmost importance. Rectifiers take up only 3/100 cu in. and weigh only 7/100 oz (body diam. is 0.270″). They operate at temperatures as high as 200°C, and in many instances are directly interchangeable with vacuum tubes, selenium rectifiers, or germanium junction rectifiers. Automatic Manufacturing Corp., Dept. ED, 829 Newark Ave., Elizabeth, N. J.

CIRCLE 389 ON READER-SERVICE CARD

Servo Actuator

Has High Torque-Inertia Ratio

The Series 171 consists basically of a continuous-duty motor driving two counter-rotating magnetic power clutches and gear reduction from the clutches to the output shaft. Its low-inertia factor is due to the magnetic powder clutches. Since the motor runs continuously, it is necessary to overcome only the inertia of the clutch and gearing during acceleration. The clutch has a torque-to-inertia ratio of 440,000-rad/sec^2 and requires less than 1w to produce full output torque.

Torque-speed ratings available in the series range from 500 in-lb at 4rpm to 6 in-lb at 500rpm. The unit weighs as little as 3.5 lb. It comes equipped with a radio-noise filter and, for closed-loop servo systems, an optional velocity generator. Clutch windings are designed for 26v d-c, but variations are available. Lear, Inc., Dept. ED, Grand Rapids, Mich.

CIRCLE 390 ON READER-SERVICE CARD

Perforated Tape Recorder

Speeds to 600 Characters/sec

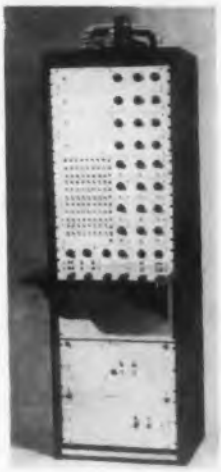
With start and stop times of 5millisec and tape speeds up to 60ips, the Model 903 Perforated Tape Handler offers character readout of 150, 300, or 600 per sec. It will actually stop on the stop character at speeds of 150 and 300 characters/sec and on the character following the stop character at rates of 600 per/sec.

Various models handle tape widths from 11/16″ to 1″ and 5 to 8-channel tape for nearly every conceivable tape handling operation. Readout head is of simple photodiode construction. Potter Instrument Co., Dept. ED, 115 Cutter Mill Rd., Great Neck, N. Y.

CIRCLE 391 ON READER-SERVICE CARD

Pulse Code Generator

Provides Wide Variety of Shapes



The Model 5000A Pulse Code Generator features a four-channel constant current output which is controllable in 100Mc steps with a fill-in in between from 100ma to 1.1amp per channel. Two of the output channels are positive current and two are negative current with the base line at ground potential. Constant current is assured by a sampling and feedback technique, with each channel entirely independent of the other. An independent rise-time control is placed on each output channel. Each channel can be used independently of the other, or can be mixed to obtain a wide variety of pulse shapes. This unit can be used to set up almost any sequence of pulses for core testing, data handling, counter-measures, beacon testing, and transistor testing. Electro-Pulse, Inc., Dept. ED, 11811 Major St., Culver City, Calif.

CIRCLE 392 ON READER-SERVICE CARD

New Literature

Magnetic Null Indicator 397

A 2-page bulletin describes the Magnetik Null Indicator, a portable temperature measuring instrument. The bulletin provides complete engineering data on the low-level, linear-deflection d-c null indicator. Included is a technical description of the engineering concept of the division's second harmonic magnetic converter covering such features as isolated input, immunity to 60cy pick-up, and rugged design. Doelcam, Div. of Minneapolis-Honeywell Regulator Co., 1400 Soldiers Field Road, Boston 35, Mass.

Connectors 398

A 4-page folder entitled "A New Approach to Connector Problems" is available. The illustrated folder shows the company's new electrical connectors and explains how many types of AN connectors can be built up from a few basic components. The folder also illustrates new types of termination provided and describes the new enclosed type socket contact developed for these connectors to provide protection against test prods and abnormal abuse. Whitney Blake Co., Electronics Div., New Haven, Conn.

Germanium Power Rectifiers 399

Bulletin No. GPR-1 lists ratings and specifications on germanium power rectifiers. The bulletin describes two styles of this firm's line: Style C, natural convection cooled and Style F, fan cooled. Included are the complete operating instructions and the typical dynamic characteristic curves for these two styles. International Rectifier Corp., 1521 E. Grand Ave., El Segundo, Calif.

Signal Generator 400

A multiple signal generator with various signal outputs for directly comparing the gain and phase shifts of a serva system is described in a 6-page folder. The folder also contains industrial applications, outstanding features, and specifications. Servo Corp. of America, 20-20 Jericho Turnpike, New Hyde Park, L. I., N. Y.

Magnetic Components 401

A 16-page booklet describes in detail a wide variety of specialized magnetic components for use in all types of electrical and electronic equipment. Illustrated with photographs, circuit diagrams, and output curves, the booklet covers equipment designed for transformers, magnetic amplifiers, filters, delay lines, etc. A section on interesting design features is also included. Equipment Marketing Div., Raytheon Manufacturing Co., 100 River St., Waltham 54, Mass.

Consulting Service 402

A 4-page brochure describes the facilities and services of this consulting organization. Some of the fields in which this firm does work are tube materials, tube processing and applications; circuit research and packaging; servomechanisms; mechanical and electromechanical equipment. Thomas H. Briggs & Associates, Box 185, Norristown, Pa.

Resolution Test Patterns 403

Resolution test patterns on glass are reproduced in Bulletin No. 8000. The precision resolution targets consist of progressions of line spacings and are used as a method for determining the resolving power of photographic lenses and other equipment. W. & L. E. Gurley, Troy, N. Y.

Ball Bearings 404

Over 500 different standard radial ball bearings are described and tabulated by bore size in a 24-page catalog. The catalog describes 16 types of radial bearings in detail, including two new series of bearings, and presents summary information on six other standard series of ball bearings. Torque, speeds, and tolerances are discussed. Radial and axial play and load-life characteristics are explained and graphically illustrated, as are specific bearing C-factors. Instructions for mounting, handling, and lubricating miniature ball bearings are given. Engineering Dept., Miniature Precision Bearings, Inc., Keene, N. H.

Insulation 409

A 20-page catalog contains revised and added technical data, descriptions, applications, and photos on treated and coated fabric and paper for electrical insulation users. Electrical insulating materials covered in this catalog are "Silastic R" tape or cloth; "Varsil" silicone resin or rubber coated glass cloth and tape; varnished cotton cloth and tape; varnished glass cloth and tape; straight cut varnished silk; varnished asbestos cloth; varnished papers; and "Teflon" coated glass cloth. Publications Dept., Insulation Manufacturers Corp., 565 W. Washington Blvd., Chicago 6, Ill.

Linear Transducers 410

Bulletin No. KCE-491 describes and illustrates a simple method of evaluating transducers for absolute linearity, sensitivity phase, and frequency characteristics. Accuracies to 0.1% are possible with an inexpensive VTVM, oscillator, and 10-turn potentiometer. The circuitry described operates independent of line voltage fluctuations. A test of a linear transducer is reproduced with linearity and sensitivity computations. Crescent Engineering & Research Co., 11632 McBean St., El Monte, Calif.

Polyethylene Waxes 411

The typical properties, applications, and compatibility characteristics of polyethylene waxes, Epolene "E" and Epolene "N" are described in an 8-page booklet. These waxes can be used in the manufacture of electronic components such as capacitors. Technical data includes compatibility charts, cloud points, properties, and emulsion procedures. Eastman Chemical Products, Inc., Kingsport, Tenn.

Base Diagram Book

The 1955 edition of this firm's Base Diagram Book contains blueprints of more than 350 base connections for over 1300 electron tubes. Each page is devoted to a single base diagram to provide full detail and easy reading. $0.75. Sung-Sol Electric, Inc., 95 Eighth Ave., Newark, N. J.

Pulse Height Analyzers 412

Cross reference sheets, No. 114-5, list features of all existing single channel pulse height analyzers. These sheets should assist the designer in selecting the proper pulse height analyzer to fill individual requirements. Radiation Instrument Development Laboratory, 2337 W. 67th St., Chicago 36, Ill.

Needle Bearings 420

A new catalog presents design, application, and use data for five types of needle bearings. Descriptive material on each type of bearing covers design considerations, construction, materials and finishing, lubricating, housing and shaft requirements, fits, load capacities, and recommended installation methods. Text, tables, and cross-sections show bearing identification numbers, dimensions, recommended shaft diameters, and housing bores, and rated load capacities. The Torrington Co., Torrington, Conn.

Tantalytic Capacitors 421

Four new bulletins on tantalytic capacitors are available. "Specifications for Tantalytic Capacitors", GET-2333G, is a complete revised spec on tantalum foil capacitors. Specifications for 125°C tantalytic capacitors are given in two bulletins. One, GET-2502, describes rectangular case units and the other, GET-2513, describes cylindrical, double-case units. General information on the company's lines of tantalum foil capacitors for high temperature applications is given in GEA-6258. General Electric Co., 1 River Road, Schenectady 5, N. Y.

Airborne Electrical Equipment 422

A new engineering design catalog lists voltage sensing devices, timers and time delay relays, flashers, and special aircraft devices, test equipment, and miniature components. Forty-eight installation drawings are provided, plus specifications for each item. Electronic Specialty Co., Contract Div., 5121 San Fernando Road, Los Angeles 39, Calif.

Metallic Oxides 423

Booklet No. A-7 describes the properties of sintered metallic oxides. Charts give physical, electrical, and mechanical properties and show tensile strength and resistivity. Electrical, mechanical, and chemical applications are discussed. Alite Div., U. S. Stoneware Co., Akron 9, Ohio.

Toroidal Coil Winding Machine 424

A 4-page folder describes a portable toroidal coil winding machine used for both laboratory and production requirements. The literature explains how the machine sets up quickly, is easy to operate, accommodates a range of wire sizes from AWG 26 to 44, and winds at speeds up to 1500 turns per minute. Arnold Magnetics Co., 5962 Smiley Drive, Culver City, Calif.

High Voltage Resistors 427

This 8-page bulletin, No. G-1, provides information on composition-film type high voltage resistors. Charts and graphs are used to show construction, specifications, installation, tolerance, voltage coefficient, temperature coefficient, ratings, insulation, and terminations. International Resistance Co., 401 N. Broad St., Philadelphia 8, Pa.

Ceramic Capacitors 428

This new catalog gives application data, capacity-per-size designations, specifications and curves for a complete line of ceramic capacitors. An extensive line of printed networks is cataloged together with data on piezoelectric elements. Solar Manufacturing Corp., East 46th St. and Seville Ave., Los Angeles, Calif.

Plastic Products 429

Plastic indicating knobs, dials, and windows, as well as printed and molded plastic products are illustrated in this brochure. Also described is a transmission line calculator of heavy vinyl plastic. Emeloid Co., Inc., 1239 Central Ave., Hillside, N. J.

Micro-Miniature Relay 430

A micro-miniature relay for electronic applications that demand minimum size and weight is the subject of a new bulletin. The bulletin, No. GEA-6346, describes the relay and lists specifications for both the standard and the current sensitive models. Specialty Control Dept., General Electric Co., Waynesboro, Va.

High Vacuum Pumps 431

A 52-page catalog of this firm's line of high vacuum pumps features an engineering section of formulas and data of practical value to engineers. The catalog contains cutaway drawings, diagrams, graphs, performance curves, installation pictures, tabulations of data, conversion tables, charts, and formulas. Kinney Manufacturing Div., The New York Air Brake Co., 3640 Washington St., Boston 30, Mass.

Vibration Isolators 432

Two types of mountings which provide isolation of vibration over a wide frequency range are described in a new bulletin. The mountings are either a square plate type or a circular cup type and are available in three sizes. Dimensional drawings, overall dimensions, deflection curve, and transmissibility chart are included. Ucinite Co., Div. of United-Carr Fastener Corp., 459 Watertown St., Newtonville 60, Mass.

Ceramic Magnets 439

The characteristics, design, and application of Indox I, a light-weight, low-cost, non-metallic ceramic permanent magnet, are described in a 4-page catalog. This magnet is suitable for indicating gauges, magnetic couplings and filters, and special instrumentation. Indiana Steel Products Co., Valparaiso, Ind.

Crystal Diode Manual 440

The second edition of this company's Crystal Diode Manual includes germanium and silicon diodes, glass-encased and plastic-encased. The illustrated manual is in three parts: construction and advantages, electrical and mechanical data, and selection and application. CBS-Hytron, Danvers, Mass.

Transformers 441

A 16-page catalog lists various transformers and other magnetic components manufactured by this company. Case dimensions and ratings are given and illustrated. Milwaukee Transformer Co., 5231 N. Hopkins St., Milwaukee 9, Wis.

Elapsed Time Indicators 442

An engineering bulletin describes the 60 and 400cy total hour indicators manufactured for military applications. The bulletin lists complete specifications applying to the meter. Dimensional and mounting diagrams are shown. Haydon Manufacturing Co., Inc., Torrington, Conn.

Heat Transfer Surface 443

A brochure contains engineering data and general application information on Inner-Fin, this company's heat transfer surface. Charts show size and typical performance data. Bush Manufacturing Co., 179 South St., West Hartford 10, Conn.

Explosive-Driven Cutters 444

Three designs of guillotine-type explosive-actuated cable cutters are described in a new leaflet. The three types vary primarily in the diameter of the cables they are able to cut. The units are detailed with scaled dimensional drawings and specifications. Beckman & Whitley, Inc., 1085 E. San Carlos Ave., San Carlos, Calif.

Inspection Service 446

A descriptive price list on this firm's thread gage inspection service and indicator repair service is now available. Quality Control Corp., 401 Broadway, New York 13, N. Y.

Pyrometers 447

A new 4-page brochure describes two infrared radiation pyrometers. By the remote detection of infrared radiation, these instruments measure temperature variations without direct contact or interruption of the process under control. Servo Corp. of America, 20-20 Jericho Turnpike, New Hyde Park, L. I., N. Y.

Dual-Sensitivity Voltmeter 448

A technical data sheet describes the Model 610 dual-sensitivity voltmeter specially designed for measurement of galvanic d-c potentials in corrosion control and cathodic protection work. Specifications and operating principles are given. Associated Research, Inc., 3758 Belmont Ave., Chicago 18, Ill.

Drafting Room Furniture 449

A 16-page illustrated catalog features a wide selection of furniture for the drafting room. This literature provides a reference to selection and purchasing of tracing storage files, drafting tables, draftsman's stools and chairs. Frederick Post Co., 3650 N. Avondale Ave., Chicago 18, Ill.

Thermocouples 450

Specification Sheet No. 57 describes new two-wire thermocouples with outside diameters of 1/8" and 3/16". These are for use where sensitivity and accuracy are important and where space is limited. Industrial Div., Minneapolis-Honeywell Regulator Co., Wayne & Windrim Aves., Philadelphia 44, Pa.

Plug-In Units 451

A new 40-page illustrated catalog, No. 827, presents circuit drawings and specifications on 36 different plug-in units. A number of typical applications are described to show their use. Eeco Production Co., 506 E. First St., Santa Ana, Calif.

Rubber Engineering Data Book 459

A new Rubber Engineering Data Book contains illustrations and descriptions of this company's line of molded and extruded rubber products. A special section is devoted to the technical specifications and relative properties of natural rubber, Buna S, Buna N, neoprene, butyl, thiokil, and silicone. Typical parts include seals, boots, gaskets, rolls, covers, sleeves, shields, and shock mounts. Tyer Rubber Co., Industrial Div., Dept. P, Andover, Mass.

Magnets 460

A 4-page bulletin describes this company's Super Magnetomotive rectangular separation magnets. The bulletin gives full details including performance data and is illustrated with line drawings and schematic and dimensional diagrams. The Ohio Electric Manufacturing Co., 5400 Dunham Road, Maple Heights, Cleveland, Ohio.

Proximity Meter 461

The proximity meter, a precision electronic instrument that measures without touching the specimen, is described in a 28-page booklet. Also described in the booklet are applications of the proximity meter as a non-contacting micrometer; concentricity gage; surface finish gage; strain gage; torque meter; vibration meter; automatic weighing; breaking strain gage; micro thermometer; pressure gage; and moisture content or product composition by means of dielectric measurement. Fielden Instrument Div., Robertshaw-Fulton Controls Co., 2920 N. Fourth St., Philadelphia 33, Pa.

Recording Mechanisms 462

Project Digest No. PD-18 illustrates and describes the various magnetic tape recording mechanisms developed by this company. These devices meet environmental specifications and size and weight limitations for the various recording and playback applications in collecting data aboard aircraft and missile vehicles under test. Cook Research Laboratories Div., Cook Electric Co., 2700 N. Southport Terminal, Chicago 14, Ill.

Laboratory Heater 463

Bulletin No. 626 describes this company's "Ful-Kontrol" Heater, a wide-range laboratory heater with a built-in auto-transformer. The bulletin describes applications, features of construction, range, control, and temperature reproducibility. Precision Scientific Co., 3737 W. Cortland St., Chicago 47, Ill.

Power Supply 469

Bulletin No. MR2432-100X describes this company's 28v, 100amp regulated and filtered power supply. The bulletin lists the unit's specifications and also contains operating curves showing the response time, load and line regulation characteristics. A circuit block diagram and the theory of operation of the power supply are given. Perkin Engineering Corp., 345 Kansas St., El Segundo, Calif.

Power and Gas Tubes

This 24-page booklet (No. PG-101B) contains technical data on 178 vacuum power tubes including forced-air-cooled and water-cooled types; gas, mercury-vapor, and vacuum rectifier tubes; gas and mercury-vapor thyratrons; ignitrons; magnetrons; and vacuum-gauge tubes. Each tube type is covered by a text description, tabular data, and a base or envelope connection diagram. $0.20. Commercial Engineering, Tube Div., Radio Corp. of America, Harrison, N. J.

Investment Casting 470

A new brochure, "Design—With Microcast in Mind", outlines in pictures and text the steps involved in investment casting and the wide range of intricate parts that may be mass produced by the method. The booklet also includes the most recent table of the properties of investment cast alloys. Austenal Laboratories, Microcast, Div., 224 E. 39th St., New York, N. Y.

Hydraulic Die Handling Trucks 471

A 4-page folder describes this firm's line of hydraulic die handling trucks with capacities from 10,000 to 80,000 lbs. The literature contains both operating photographs and illustrations of major components. In addition, engineering drawings and accompanying text cover both design and operating information. Complete specifications are included. Elwell-Parker Electric Co., 4205 St. Clair Ave., Cleveland 3, Ohio.

Glass Sealing Alloys 472

Glass sealing tubing made from constant or uniform expansion alloys is described in Data Memorandum No. 15. The data covers six glass sealing alloys in standard production. Included in the data are production limits, nominal chemical analysis, temper ranges, mechanical properties, thermal properties, and tolerances. Superior Tube Co., 7521 Germantown Ave., Norristown, Pa.

Analog-to-Digital Converter 479

An 8-page illustrated brochure describes this firm's analog-to-digital converter and systems in which the converter operates. Illustrated with photographs and block diagrams, the brochure describes operation of the converter and also describes a typical converter system using a high-speed input commutation switch, digital output magnetic recorders, and programming circuits. J. B. Rea Co., Inc., 1723 Cloverfield Blvd., Santa Monica Blvd., Santa Monica, Calif.

Relays 480

This new relay catalog includes short and long form telephone-type relays for a-c and d-c, subminiature d-c relays, latch-in relays, relays with bifurcated contacts, miniature relays with heavy current contacts, relays with time delay, plug-in relays, relays with snap action contacts, and 400cy relays. The catalog also illustrates and gives dimensions of hermetically sealed and dust proof enclosures. Magnecraft Electric Co., 3350D W. Grand Ave., Chicago 51, Ill.

Encapsulated Resistors 481

A 20-page catalog covers this company's encapsulated resistor line. Illustrated are types for axial wire, radial wire, and radial lug terminals and for printed circuitry. Dimensional detail, wattage ratings, maximum resistance, and military equivalents are stated. Cinema Engineering Co., Div. of Aerovox Corp., 1100 Chestnut, Burbank, Calif.

Pulse Transformers 482

This data sheet describes high-power pulse transformers, which are available in both standard and special designs. The literature supplies technical information on distortion minimization, data on high temperature capability, windings, and construction as well as a specification list and outline drawings of typical transformers. Equipment Marketing Div., Raytheon Manufacturing Co., 100 River St., Waltham 54, Mass.

Resistors 483

A new bulletin describes glass sealed carbon film resistors for use in circuits requiring exceedingly high stability, small size and rugged construction. Technical information on stability characteristics, resistance values, matched networks, tolerances, temperature and voltage limits is included. Pyrofilm Resistor Co., 8 Whipany St., Morristown, N. J.

Computer Directory

This 164-page book is divided into three parts to give complete information about the computer field. Part 1: Who's Who in the Computer Field contains about 7500 entries, of which 2700 are full entries and 4800 brief entries on persons in the field. About 300 entries comprise Part 2, a roster of organizations in the computer field. Products and Services for Sale in the field make up Part 3. About 600 entries are classified under 62 headings in this section. $4.00. Berkeley Enterprises, Inc., 36 W. 11th St., New York 11, N. Y.

Electrical Contacts 489

A new magnetic force spotwelding method which reduces costs is described in a 4-page bulletin. Also described and illustrated are the cold heading method, properties and contact applications of silver and other precious metals, and this firm's facilities for manufacturing electrical contacts and cold headed specialties. Deringer Metallurgical Corp., 8131 Monticello Ave., Skokie, Ill.

Teflon Stock Catalog 490

A new catalog on Teflon stock and custom fabricating service includes tables and descriptions on chemical, electrical, thermal, and mechanical properties, and applications. Standard dimensions, weights and tolerances are tabulated, covering sheets, tape, molded cylinders and bars, extruded tubing and rods, electrical spaghetti, beading, and extruded shapes. United States Gasket Co., Camden, N. J.

Tape Resistors 491

"Tape Resistors and Their Application to Miniaturization" is the title of a new 4-page bulletin. This bulletin describes tape resistors, gives their characteristics and discusses design considerations affecting printed circuitry and miniaturization. Hansen Electronics Co., 7117 Santa Monica Blvd., Los Angeles 46, Calif.

Capacitor Networks 492

"Capacitator Pulse Forming Networks" is an explanatory bulletin on the functions of networks and methods of determining the suitable unit for each application. A capacitor network application data sheet, essential for all radar and missile applications, is included. General Electric Co., 1 River Road, Schenectady 5, N. Y.

Electron Microscopes 499

An 8-page booklet, "Questions and Answers on Electron Microscopes", is available. The booklet explains such things as shadow casting, use of the same instrument for electron diffraction, resolution, visual and camera work, specimen preparation, negative and positive replicas, as well as electron and lens theory. Research and Control Instruments Div., North American Philips Co., Inc., 750 S. Fulton Ave., Mount Vernon, N. Y.

Automatic Control 500

Automation in the petroleum and chemical industries is the subject of a new booklet. Diagrams are used throughout to illustrate the basic functions of instruments used in automatic control. One section describes the use of radio-isotopes in level measuring devices. Another section discusses data reduction systems, with diagrams to show how automation depends on complete data reduction systems. Other subjects are electronic instrumentation, stream analyzers, and high pressure instruments. M. W. Kellogg Co., 225 Broadway, New York 7, N. Y.

Vacuum Melted Metals and Alloys 501

A new technical bulletin on vacuum melted metals and alloys includes both general information and technical data. The 23-page publication, No. VM-101, covers the effects of vacuum melting on properties of various metallic materials, benefits of the process to the user of such metals, and fabricating and machining recommendations. It also includes detailed engineering data on two new vacuum melted high temperature alloys. Carboloy Dept., General Electric Co., Detroit, Mich.

Rubber Phenolics 502

The 6th edition of this "Design File" has been expanded to include the latest applications of this company's rubber phenolics in electrical equipment, electronics, appliances, and machinery. The illustrated publication contains 25 case histories and stresses the design advantages offered by rubber phenolics. General Electric Co., Chemical Materials Dept., Pittsfield, Mass.

Motor Speed Controller 503

A speed control for shaded pole motors 1/50 to 1/8hp is described and illustrated in a 4-page brochure. The device is a low cost retractor which may be used to reduce or vary voltage. Killeen & Son Production Engineering Co., 340 W. Compton Blvd., Gardena, Calif.

Testing Facilities 507

A 40-page brochure describes the qualifications, personnel, equipment, and facilities available at this firm for a wide range of products and systems testing and evaluation and other testing services available to industry and government agencies. Inland Testing Laboratories, 1457 W. Diversey Parkway, Chicago, Ill.

Code Converter 508

A computer which converts International Morse code into standard teleprinter page copy ready for reading is described in a 4-page brochure. A block diagram illustrates the layout and operational sequence of the converter. CGS Laboratories, Inc., 391 Ludlow St., Stamford, Conn.

Humidity Cabinets 509

A 4-page, 2-color brochure illustrates a low-cost Annual Mechanical Convection Controlled Relative Humidity Chamber. The chamber automatically controls relative humidity to ±1%. The bulletin contains complete construction specifications and prices. Blue M Electric Co., 138th & Chatham St., Blue Island, Ill.

Electron Tubes 510

Special purpose electron tubes, including CRT's, magnetrons, thyratrons, chonotrons, and phototubes, etc. are listed in a 24-page catalog. A brief description, price and type number are given. Industro, Inc., 649 Broadway, New York 12, N. Y.

Parabolic Antennas 511

A 2-color, 14-page bulletin describes parabolic antennas used for radio and TV microwave relay. Antennas described are of the mesh-reflector, dipole-feed type in 4, 6, and 10′ sizes. Data on applications, features, descriptions, specifications, radiation patterns is included. Prodelin, Inc., 307 Bergen Ave., Kearny, N. J.

Electronic Catalog 512

This firm's 1956 catalog on electronic parts, tubes, equipment, and accessories is now available. The 260-page catalog features 64 pages on high fidelity and complete listings of electronic items of various manufacturers. Newark Electric Co., 223 W. Madison St., Chicago, Ill.

CIRCLE 513 ON READER-SERVICE CARD ➤

Tape Recording Equipment 519

A new 16 page brochure describes and illustrates 9 basic "building block" components and a series of accessories designed to make up magnetic tape recording systems of from 2 to 14 channels for instrumentation data. Block diagrams show methods of planning desired systems by interconnecting the various plug-in units and components. A-V Manufacturing Corp., 730 Fifth Ave., New York 19, N. Y.

Electric Tool Catalog 520

A new 25-page 1956 catalog describes 52 portable electric tools and kits with over 400 accessories. This book includes 150 pictures of tools and their uses with complete specifications and prices for electric saws, sanders, drills, planes, routers, shapers, combination tools, and grinders. Porter-Cable Machine Co., 58 Exchange St., Syracuse 8, N. Y.

Relays 521

Three new sensitive relays incorporating sensitivity with a thorough wiping effect are described in this new literature. The relays are designed particularly for chassis with space limitations, where there is ample height but little width. Resistance, capacity, dimensions, speed, etc. are given. Hedin Tele-Technical Corp., 87 Dorsa Ave., Livingston, N. J.

Film Directory 529

A 2-color folder lists all free movie and strip films available through members of this association. Film information is outlined for each picture according to title, film size, color or black-and-white, running time, description of picture, and source. Subjects range from optical instruments to basic electronics. Public Information Committee, Scientific Apparatus Makers Association, 20 N. Wacker Drive, Chicago 6, Ill.

Thermocouple Connectors 530

Specification Sheet No. 56 describes AN thermocouple connectors. They consist of mating plug and receptacle assemblies, keyed to prevent incorrect assemblies. Their particular usefulness is in test assemblies and for panelboards which are set up for semi-permanent use. Industrial Div., Minneapolis-Honeywell Regulator Co., Wayne & Windrim Aves., Philadelphia 44, Pa.

Precision Resistors 531

Data on ½, 1, and 2w boron carbon precision resistors is given in Bulletin No. B-6a. Information on types, construction, applications, performance, temperature coefficient, tolerance, insulation, terminations are shown in charts and graphs. International Resistance Co., 401 N. Broad St., Philadelphia 8, Pa.

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Patents

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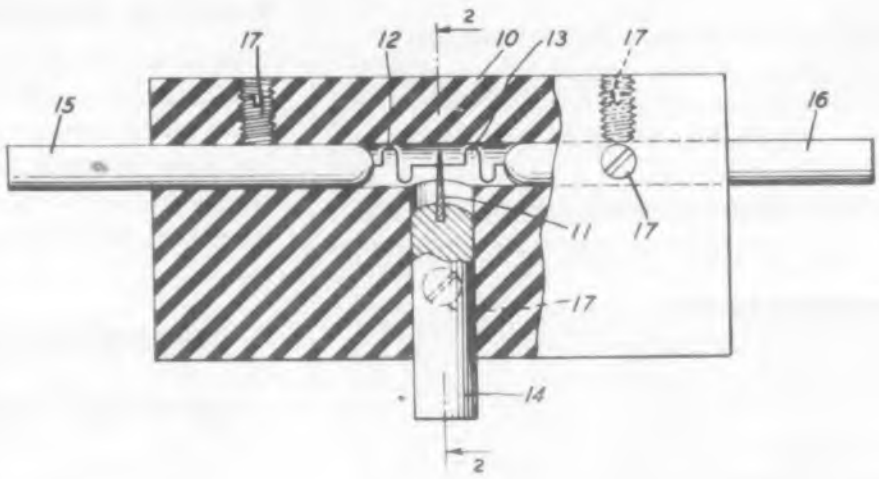


Semiconductor Amplifier . . . *Patent No. 2,691,750. J. N. Shive (Assigned to Bell Telephone Laboratories, Inc. New York, N. Y.)*

One of the major obstacles to greater use of transistors is their comparatively high cost. The transistor described in this patent can be made cheaply. It also has improved mechanical and operating stability.

In making the amplifier, a block of insulating material (*10*) is provided with a longitudinal hole or bore extending therethrough from opposite ends. A second hole comes in from the side until it meets the longitudinally extending hole. The semiconductor (*11*) is mounted in any way upon the end of a holder (*14*) which serves as a base electrode. This holder is projected into the side hole until the semiconductor is located or projects within the longitudinal hole. The semiconductor is relatively thin, and as illustrated, is tapered, although the taper form is not essential. The semiconductor is about 3 mils in thickness between the emitter and collector electrodes. It may have a height and width of about 0.04". Base thickness may be 0.01".

A resilient emitter wire (*12*) is mounted upon a holder (*15*) and the holder is projected into one end of the longitudinal hole in the insulating block until it contacts the semiconductor. A similar resilient electrode forming a collector, is carried upon a holder (*16*) which is projected into the other end of the longitudinal hole until it engages the semiconductor. The two electrodes engage opposite sides of the crystal. Contact of the electrode with the crystal can be determined by connecting the electrode to an oscilloscope. When contact is indicated, the holder is inserted about another 3/1000" in order to assure contact

with the semiconductor under all conditions. A set screw (*17*) is used to lock each holder in assembled position.

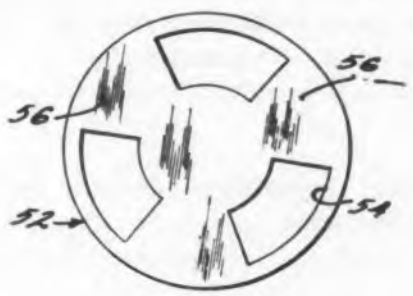
With the amplifier described power gains as much as one hundred times have been secured at frequencies as high as 10Mc. It has been found, too, that the amplifier may be used as an oscillator when the resistance between the base and a region between the electrodes is of the order of a 100 to a 1000 ohms. No other intercoupling means is necessary. Should a non-oscillating condition be desired, this can be accomplished by reducing the resistance through increasing the thickness of the semiconductor or by reducing the resistance at the point of contact of the base with the semiconductor crystal.

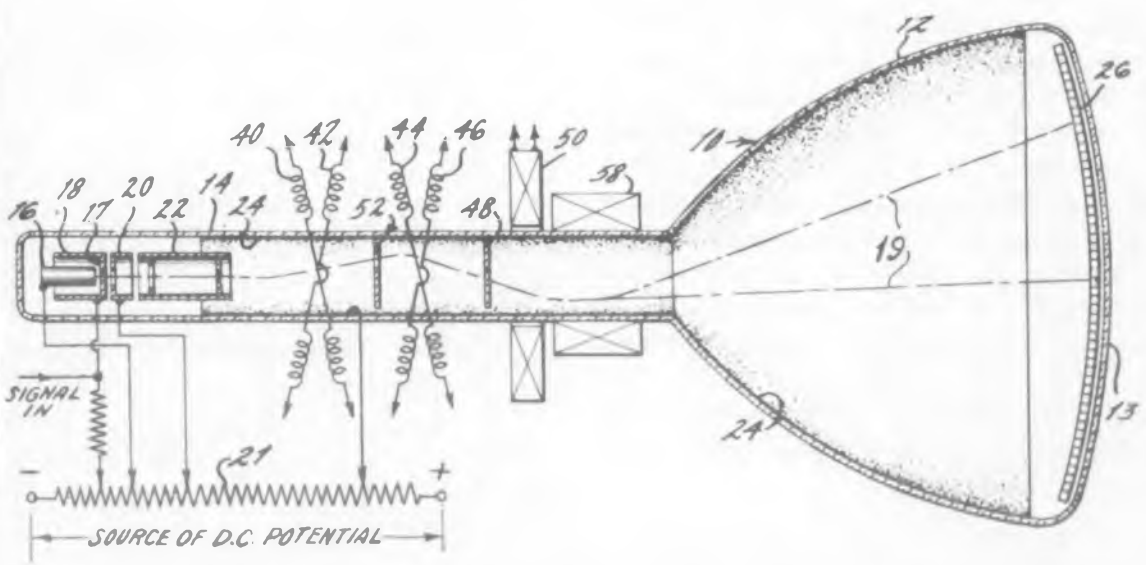
Color Kinescope . . . *Patent No. 2,696,571. R. R. Law (Assigned to Radio Corporation of America, New York, N. Y.)*

The color TV picture tube described in this patent does not utilize a shadow mask in order to prevent improper impingement of the electron beam on the phosphors. The circular plate (*56*) at right mounted in the neck of the tube (*52*), performs much the same function as the shadow mask in other types of color picture tubes. This new tube also requires only one electron gun.

This simplified tube has a screen on its inner face having holes through it similar to a honeycomb. Another type of screen that can be used has elemental areas of pyramidal form. A screen having elemental holes of hexagonal form has two adjacent surfaces of the hexagon in the hole coated with a phosphor of one primary color, two other adjacent surfaces are coated with a phosphor of a second primary color, and the remaining two adjacent surfaces are coated with a phosphor of a third primary color. If a beam of electrons is directed at an angle so that it will impinge on one pair of surfaces, the phosphor on them will give the desired color. By changing the angle of the beam, any one of the primary color phosphors may be made to luminesce. The phosphors on the other surfaces are shielded from the beam because of the angle of the beam with respect to the hole. The same result is secured with a triangular form of perforation or hole in the screen. A pyramid having three surfaces, likewise will present a single face to the angularly directed beam.

The cathode ray tube (*12*) with the above screen has the usual electron gun which supplies the electron beam. Coils (*40, 42*) are provided at the neck of the tube and carry current pulses of sine wave form, the pulse in one coil being 90° out





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of phase with the other. This current provides a field which rotates the beam. A second set of coils (*44, 46*) similarly carries sine wave current pulses which are 90° out of phase. The latter developes a field that restores the beam to a normal path but at an angle to the axis of the tube, so that it crosses the tube axis at a point corresponding with the position of an electrode (*48*). The beam passes through an aperture in its center. The beam then passes through the focussing field of coil *50*. The beam follows an angular path (*19*) so that it approaches the screen (*26*) at an angle of about 1° and impinges upon one of the series of three color phosphors in the holes of the screen. Coil *58* provides a conventional deflecting field.

In order to assure impingement of the beam on only one of the color phosphors, a portion of the beam is blanked out as it rotates in the field of coils *40, 42, 44* and *46*. The electrode (*52*) in the neck of the tube has three apertures spaced 120° apart and have a circular extent of approximately 60° to blank out the beam at angles where the beam may impinge upon adjacent surfaces of different colors. This action avoids blurring of the picture. The patent points out that this blanking-out function may be accomplished by suitable control of the control grid of the tube.

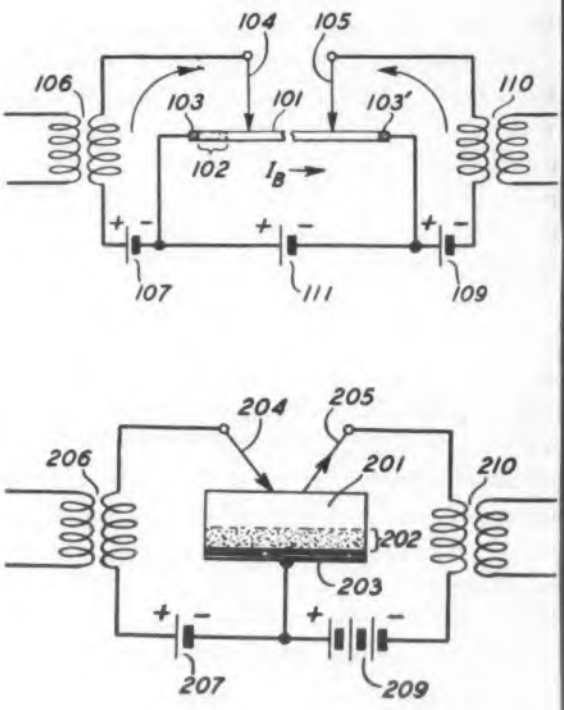
Electrical Translation Device, Including Semiconductor . . . *Patent No. 2,691,736. J. R. Haynes. (Assigned to Bell Telephone Laboratories, Inc., New York, N. Y.)*

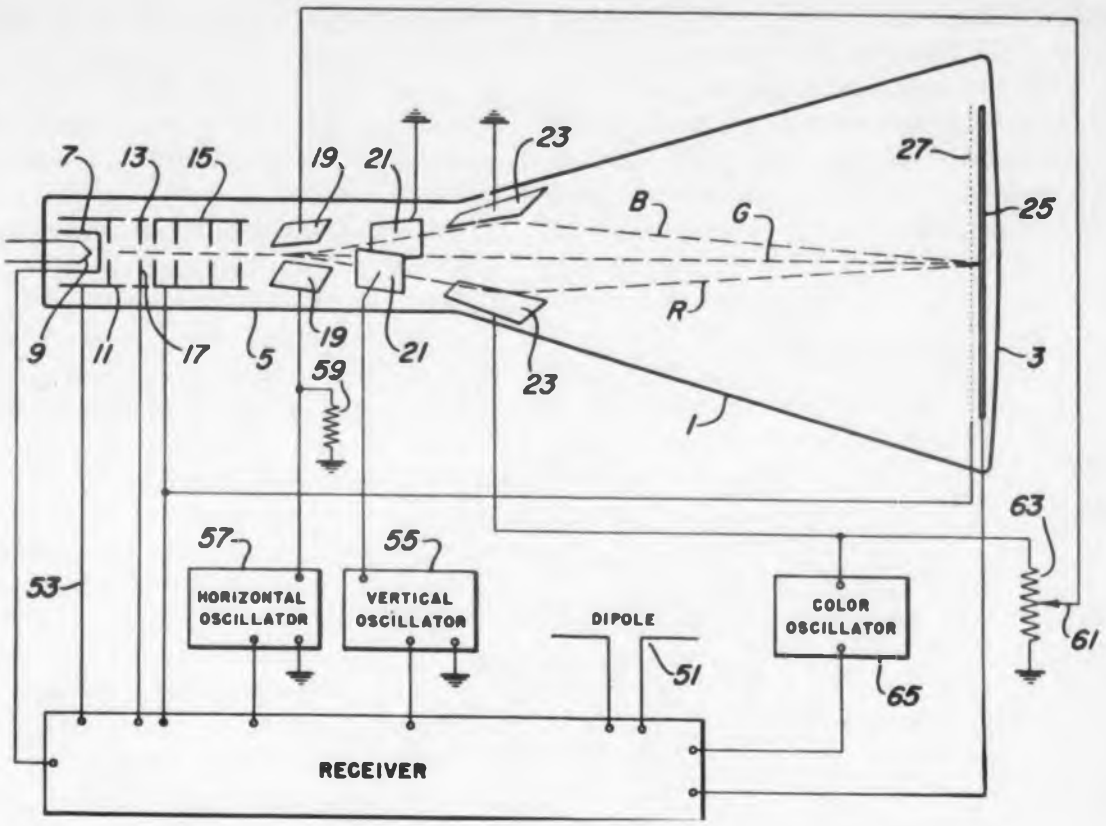
This patent deals with various techniques in the manufacture of transistors to achieve desirable electrical effects.

When the base electrode of the left-hand circuit is at a potential greater than that of the semiconductor, it serves as a secondary source of carriers which flow toward the collector. Since they are unmodulated by the signal, a distortion is introduced into the signal output of the collector circuit. The patentee secures substantial reduction in the effect of such undesired carriers by giving the semiconductor a high decay constant and, thereby decreases the lifetime of such unwanted carriers by an amount which is at least ten times that of the decay rate in a region adjacent to the other electrodes.

In a semiconductor of such small dimension, the larger proportion of carrier decay occurs in the surface. An increased rate of decay of unwanted carriers can be secured by sand-blasting the surface of the semiconductor in the region adjacent to the base electrode. This region may be of the order of 0.15 centimeters around the base electrode. An increased carrier decay rate at the surface can be secured chemically as well by the above methods.

In a block type of semiconductor, as shown in the lower circuit, the greater part of any carrier decay occurs within the semiconductor. A substantial increase in the rate of this form of carrier decay can be accomplished by rapid heating of the desired part of the semiconductor to 500°C and then quenching. Bombarding of the desired area with high-energy particles will also secure this result. In the bombardment, the process must not be carried so far as to cause conversion of the treated section from an n to a p type. This section may be of the order of a few tenths of a millimeter. A bombardment of about 15sec to a beam of specified strength will secure sufficient penetration to change the character of the semiconductor to give a high decay rate to the unwanted carriers. (*Editors' Note*: The use of high-energy particles to produce semiconductor materials for transistors has also been reported in Great Britain in recent months.)



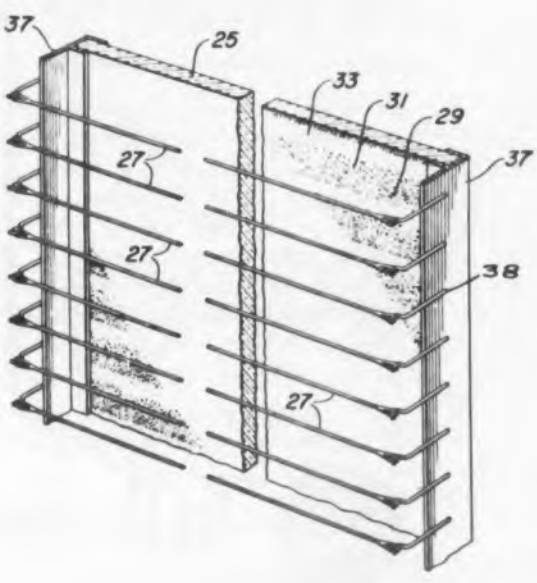


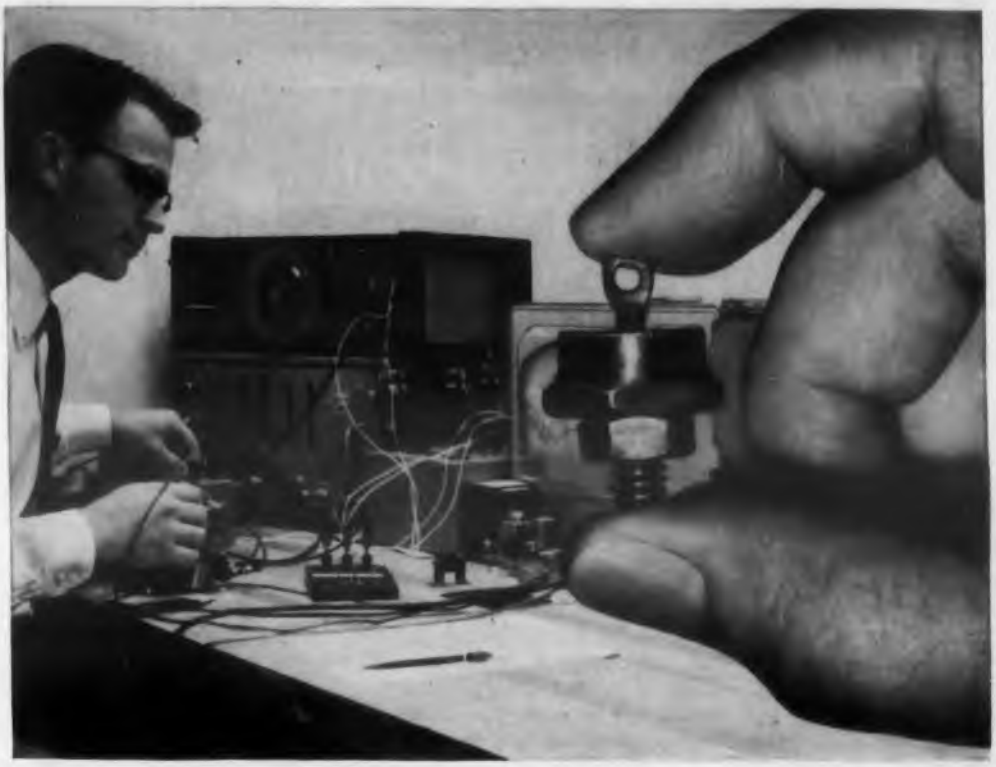
Direct-View Color Tube . . . *Patent No. 2,711,493. E. O. Lawrence. (Assigned to Chromatic Television Laboratories, Inc., San Francisco, Calif.)*

Dr. Lawrence, famous for his discoveries in atomic research, has developed another color TV picture tube. This tube calls for a focusing element made up of parallel wires near the phosphor screen. Dr. Lawrence also holds another patent (No. 2,692,532, ELECTRONIC DESIGN, *January, 1955, pp 118 to 121*) on a similar tube in which a grid of crossed wires near the screen focuses the electron beam.

A lens grid is used adjacent to the screen made up of spaced parallel wires (*27*) which focuses the beam to the narrow dimension of sets of strips of color phosphors (*29, 31,* and *33*) extending across the viewing screen. The wires are spaced apart a distance corresponding to each set of color phosphors. The wires of the lens grid are spaced from the target a distance of about ten times the width of the set of color strips. If each color strip is 0.01" wide or 0.03" for the three colors then a suitable distance of the wires from the screen is 0.30". The wires are placed under tension by the posts (*38*) so that they will not sag. The lens grid intercepts less than 10% of the beam.

The lens grid carries a potential which is the same as that applied to the second anode (*15*). The target has a conducting electron permeable layer over the phosphors that carries a potential about four times that of the lens grid. For example, if the lens grid has 3000v applied to it, then the voltage applied to the target is 12,000v. The voltage applied is dependent upon the construction of the tube. The tube includes the usual vertical deflection electrodes (*19*) and the usual horizontal deflection electrodes (*21*). A third set of electrodes (*23*) is used between the horizontal deflection electrodes and the lens grid to give the electron beam the deflection for color selection as shown above.





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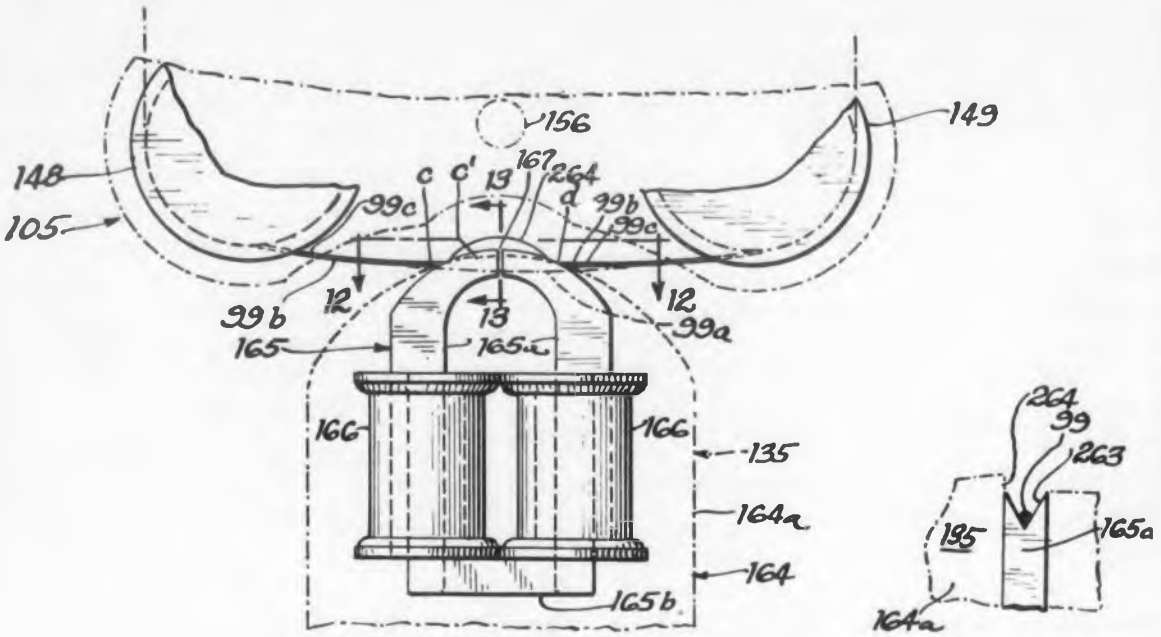
Pocket Recorder . . . *Patent No. 2,713,618. L. A. McNabb, Davenport, Iowa.*

Three pocket-size (overcoat not vest pocket) recorders have been placed on the market recently. The first, which records on magnetic wire, is a German import, while the other two, of American design, employ magnetic tape. The miniature recorder discussed in this patent uses wire. In all of these devices the drive motor is battery driven. One of the units employs a spring drive for playback purposes to save the battery.

In designing a miniature sound recorder



Cross-section view *13* of the head above is shown at the lower right

nd reproducer, one of the problems has been to so construct it that the unit is unaffected by different positions in which it may be placed. A miniature unit not properly designed will not operate at all in certain positions. Another difficulty is that operation in different positions may be sufficient to make recording erratic so that other undesirable effects such as "wow" result. A further source of difficulty is that the transmission rolls from the motor to the wire spools may eventually wear flat, which also has the effect of producing "wow" in the recording and reproducing.

The patentee avoids these difficulties by designing a mounting for the motor and the transmission such that they are pivoted with respect to each other and each is pivoted upon its center of gravity. In this way, the unit is free from pressures that may interfere with satisfactory operation in the various positions in which the unit may be placed. It also helps avoid the development of flats on the transmission rolls.

With respect to the illustrated recording and reproducing head at left, it conforms generally with practices known in this art. Coils *166* through which armature arms *165* pass energizes a small gap (*167*) between them. The armature arms have a V-shaped groove (*263*) through which the recording wire (*99*) passes. One interesting feature of the construction is that the wire has a tendency to curve outwardly—as indicated by the dot-dash line (*99A*). This action assures a relatively long contact of the wire within the groove of the armature arms. The pulley head with pulleys *148* and *149* for the wire, is mounted on a pivot (*156*) so that any variation in the speed of the wire tends to pivot the head and thereby feeds the wire through the recording and reproducing head at a uniform speed. The long contact of the wire in the groove of the armature arms, assures that such pivoting of the pulley head will not cause the wire to move away from the bottom of the groove and reduce the efficiency of the recording and reproducing head.

Copies of the patents reviewed in this department may be obtained from the U. S. Commissioner of Patents, Washington 25, D. C., at 25¢ each.

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Machlett Laboratories offers the designer the ML-6424 and ML-6425 coaxial-terminal triodes, employing thoriated-tungsten filaments, 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 trans-conductance characteristics, up 25%, assure stable operation, low grid drive and high plate efficiency.

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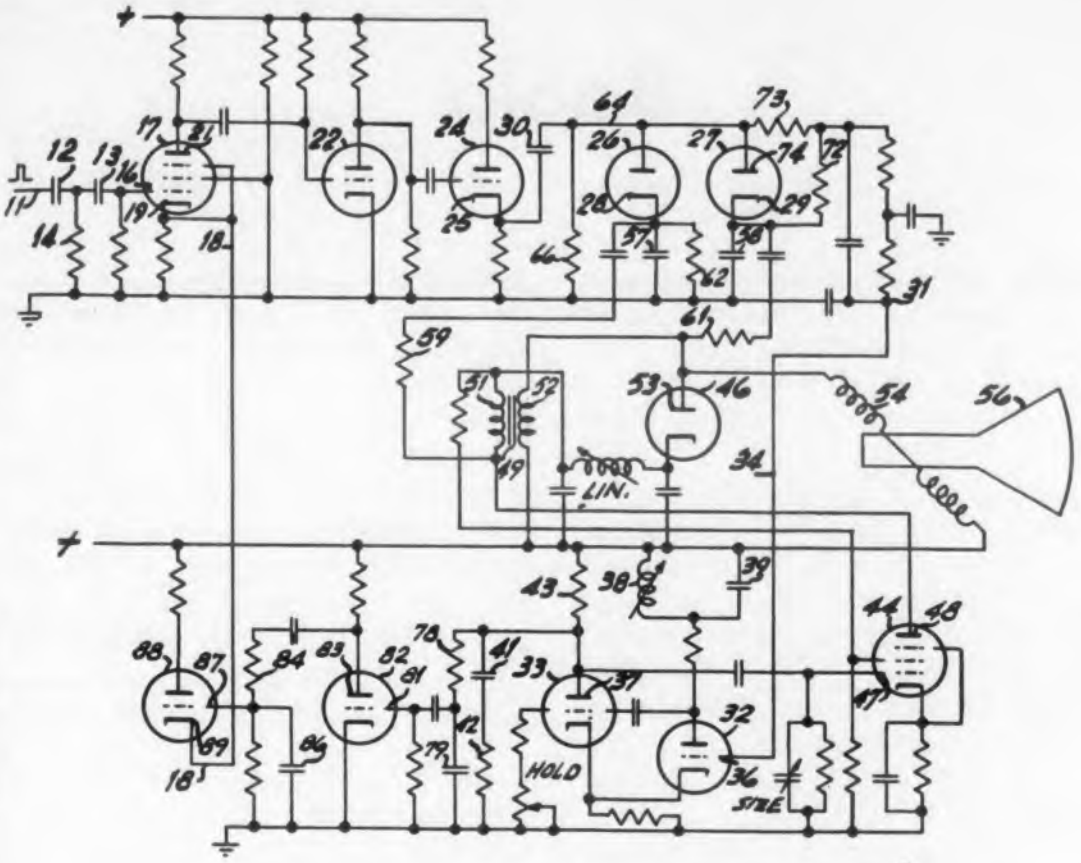
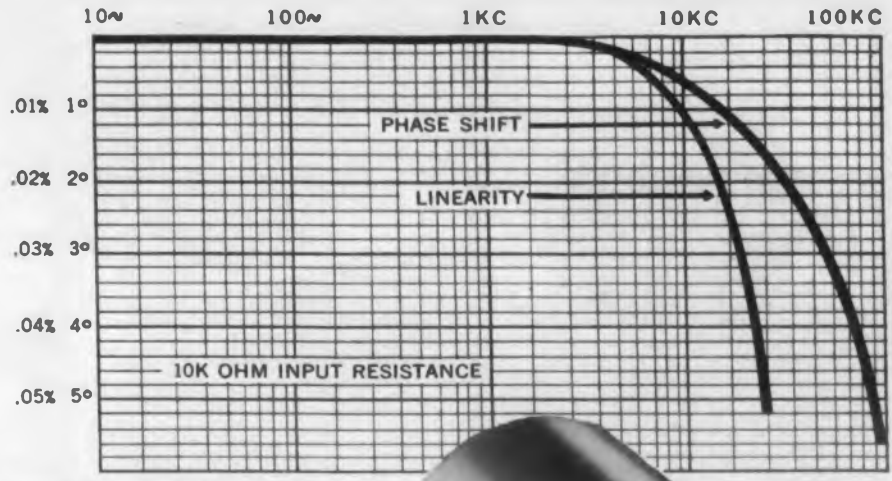
Television Synchronizing Pulse Circuit . . . *Patent No. 2,692,912. F. N. Gillette et al. (Assigned to General Precision Laboratory, Inc., Pleasantville, N. Y.)*

Difficulties in TV reception are eliminated by the accompanying circuit, which reshapes the horizontal synchronizing signal. A common difficulty in the horizontal synchronizing pulses are that the double frequency pulses are often times not received with the proper width and amplitude. Also the double frequency pulses sometimes have erroneous information.

(The patentees have devised a circuit which eliminates the difficulties in reception by reshaping the horizontal signal. The circuit for accomplishing this is shown at right.) That portion of the circuit is shown which receives the horizontal synchronizing pulse after it has been separated from the rest of the television signal. This synchronizing pulse is applied to a differentiating circuit (*12*, *13* and *14*) to give sharp peaked, positive and negative pulses which are applied to the grid of tube *17*. A gating pulse is applied to the cathode of the tube through the conductor *18* which clips the signal and removes alternating ones of the double frequency pulses. The resultant is a peaked signal which is applied to a clipper amplifier tube (*22*). This tube clips the peaked signal and inverts the pulses so that a rectangular pulse is applied to the cathode follower tube (*24*). All disturbing variations are, therefore, removed from the horizontal synchronizing signal.

The reshaped pulses are compared in a comparison detector with the signal at the picture tube yoke by means of diodes *26* and *27*. An error voltage is derived from them which is proportional to any phase difference between the signals. This error voltage is fed to the multivibrator (*22*, *33*) and controls its period of oscillation. The output of the multivibrator is applied to a sawtooth generator (*41*, *42* and *43*), which produces a wave shape having a sharp peak at the beginning of a linear inclined wave form. This signal is applied to the amplifier tube (*44*) which removes the sharp peak. This action produces a saw-tooth current wave form at the plate of this tube. A transformer (*49*) applies the signal to the yoke (*54*) of the picture tube (*56*) and a damper diode.





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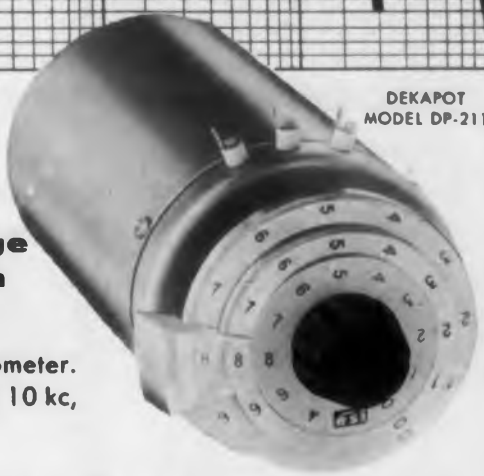

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Books

Formulas for Computing Capacitance and Inductance . . . *by Chester Snow. 69 pages, paper-bound. NBS Circular 544. For sale by the Superintendent of Documents, Government Printing Office, Washington 25, D. C., $0.40.*

This compilation includes formulas for determining capacitance between conductors having a great variety of geometrical arrangements; the inductance, both self and mutual, of circuits of various shapes; and the electrodynamic forces acting between coils carrying current. Formulas for skin effect and proximity effect in concentric cables and parallel wires are also given. One section is devoted to a discussion of the relation between the Legendre and the elliptical functions.

Switching Relay Design . . . *R. L. Peek, Jr., and H. N. Wagar. D. Van Nostrand Co., Inc., 250 Fourth Ave., New York 3, N. Y. $8.00*

The highly specialized field of switching relay design is thoroughly discussed in this comprehensive work. Beginning with the fundamental relations that apply to relay design, such as magnetic field theory, the authors develop all the formulas and relationships that are necessary to the design of this type of relay.

A number of valuable tables are given in the last chapter. These include "Properties of Typical Wires for Magnet Coils", "Winding Tables for Spool Wound Cores" and "Winding Tables for Filled Coils—Thin Enameled Copper Wire".

Electronic Data Processing in Industry . . . *256 pages, American Management Association, 330 W. 42nd St., New York 36, N. Y. $7.75.*

In order to design complete equipments properly, the electronic design engineer must know how the consumer will use them. This slim volume will help computer designers to learn how industry is using computers, what it thinks of them, and how various size computers have been evaluated.

The book, subtitled "A Case Book of Management Experience", is divided into three sections: "The Evolution of Data Processing", "The Planning Stage", and "The Equipment and Its Use". A special chapter at the end on future developments is of particular interest to design engineers.

Linear Feedback Analysis . . . *J. G. Thomason, 355 pages, McGraw-Hill Book Co., Inc., 330 West 42nd St., New York 36, N. Y. $8.50.*

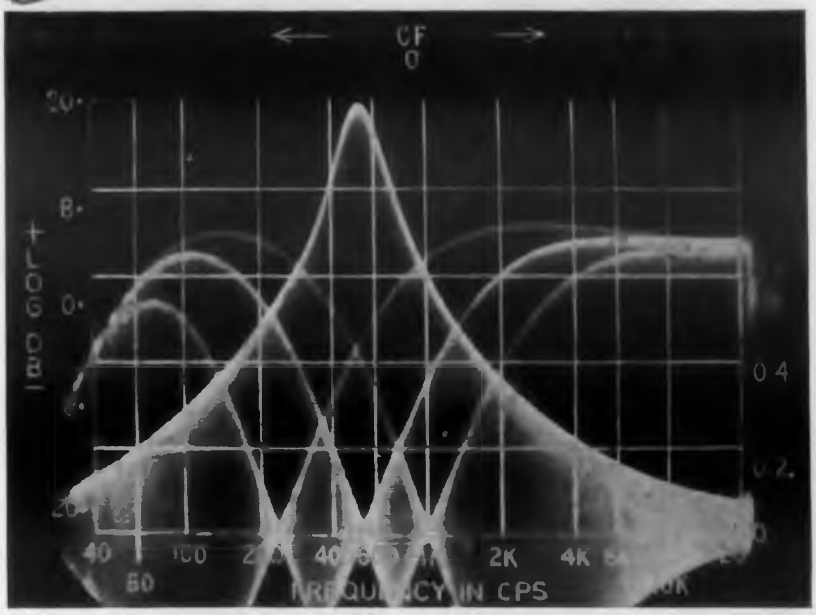
Written by a member of the British Radar Research Establishment, this volume on Linear Feedback Analysis is intended for the specialists in servomechanism development. Although mathematical derivations are presented as simply as possible, a practical example follows each derivation.

Among the interesting circuitry considered is the "Velodyne," a motor-generator combination for very low frequency applications. The author has drawn heavily from H. W. Bode's *Network Analysis and Feedback Amplifier Design* (D. Van Nostrand, 1945).

Technical Dictionary . . . *160 pages. Coyne Electrical School, Chicago, Ill. Distributed by Howard W. Sams & Co., Inc., 2201 E. 46th St., Indianapolis 5, Ind. $2.00.*

This reference handbook contains over 4000 terms, abbreviations, symbols, expressions used in the television, radio, electrical, and electronics fields. In addition to the dictionary, the book has a data section which includes formulas, tables, tube characteristic charts, symbols, wiring diagrams, and other reference data. The volume should be a valuable reference aid to technicians, students, and others interested in the subject.

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.

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Abstracts

Pertinent condensations from foreign journals, house organs, reports, and periodicals of related technologies that frequently miss the attention of electronic designers.

Twelve Guides to Reliable Electronic Design

Class Features of Capacitors

Type	Advantages	Disadvantages
Tantalum (electrolytic)	High capacity for size (as compared with other electrolytics) Good shelf life Excellent stability Can be used from —60° C to +200° C (derate 25% at 200° C) Low leakage current Self-healing properties	Limited to low-voltage DC or intermittent AC uses Temperature sensitive at high frequencies
Aluminum (electrolytic)	Lower cost than tantalum	Limited temperature range Large size for capacity as compared with tantalum Limited shelf life except under optimum conditions
Metallized-paper	High capacity for size as compared with paper capacitor Self-healing Can be used from —30° C to +100° C without derating	High cost
Paper	Low cost Compact	Limited range of operating temperatures (although some operate at 125° C without derating) Limited life unless sealed against moisture
Ceramic disk	High capacity for size	Temperature sensitive Moisture sensitive (not hermetically sealed).
Ceramic temperature compensating	Good for high-temperature use	Available only in small capacities
Plastic	Higher dielectric strength than paper Lower temperature coefficient than paper type Lower loss than mica Smaller physical size than mica Can be made with either positive or negative temperature coefficient High insulation resistance Low dielectric absorption	Unknown
Mica	Low Losses High leakage resistance High voltage strength Good stability	Expensive in moderate and large capacity values Silver migration

TWELVE guides to reliable electronic design is the subject and title of a recent NAVORD report, 3461, prepared by Gordon G. Johnson of the U. S. Naval Ordnance Station, China Lake, Calif. Highlights are condensed here.

In his introduction the author stresses the need for reliable components in complex equipment. For example, if a system has two components each with a 90% reliability, the over-all system reliability is 81%. As another measure, failure rate increased exponentially with number of tubes used.

Since tubes account for about 67% of all failures, they should be carefully selected; reliable types are mentioned. (Other components account for about 10% of all failures; engineering 13%; field use 7%; and manufacturing 3%.)

An appendix includes two general tables comparing various types of resistors and capacitors (see example, left), and a comprehensive table analyzing characteristics of vender's specific resistors. The twelve guides are summarized below.

Simplify system function and design—Eliminate unnecessary functions. Use minimum number of components. Design to reduce down time for maintenance.

Replace tubes with more practical substitutes—Selinium rectifiers are more reliable, occupy less space, generate less heat, consume less power. Use magnetic amplifiers if response liminations permit. Investigate use of transistors.

Design for reliability first, maximum performance second—For example, a high grid resistor gives maximum gain but may cause tube failure if primary grid emission results from overheated tubes. Use as small a grid resistor as practical.

Design circuit with broad tolerances—Allow for change in contact potential, in primary and secondary grid emission, decrease in emission density and decrease in transconductance. Allow for manufacturers' range of transconductance. To minimize grid to cathode contact potential, use large cathode resis-

or. Use self bias to offset reduction in plate current due to reduced transconductance.

Design equipment to withstand its environment—Often the main environmental condition to overcome is heat. Use proper component arrangements, fastening methods, and sufficient cooling. Most tube shields cause tubes to operate 50°C higher. Unshielded tubes can be cooled by blowers 40°C, shielded tubes 10°C.

Observe component limitations specified by the manufacturer—Faulty engineering is the cause of 13% of equipment failures as determined in a wartime study. Manufacturers' ratings are for fixed conditions only; ratings do not apply to all conditions.

Provide failure predictions systems in complex equipment—Marginal checking methods currently used include any one of the following: varying plate voltage, screen grid voltage, bias voltage, and filament voltage. A signal insertion method has also been used.

Reduce filament current surges—Thermo-shock and mechanical shock are two factors affecting tube filament life most. It appears that gradual or step application of filament voltage should be used to reduce filament current surges and thus reduce failures. Methods include thermistors, stepping switches, etc.

Avoid unnecessory use of unstandard items—New types of components for which all data is not known often cause failures. Other items include long storage time, lack of uniformity in small quantity production.

Use "computer-type" tubes in prolonged cut-off applications—Electrical characteristic changes are often caused by cathode interface formation. The effect of this semiconductor layer is the same as a parallel R-C combination in series with the cathode—it causes degeneration and lowers transconductance. The 6SN7, 6AG7, 3E29, 7AD7, and 5687 are among the offenders. Use new "computer" tubes having nickel cathodes as: 5915, 5963, 5964, 5965, 6197, 6211 and 6463.

Use long life, stable, rigidly-constructed and uniform special tubes—10,000 hour RCA "special red" or equivalent tubes should be used if circuit requires it. Included in this series are 5691 (similar to the 6SL7) and, the 5692 (similar to the 6SN1), the 5693 (similar to the 6SJ7), and the 5690 full-wave rectifier.

Use ARNIC tubes or equivalent where feasible—GE "Five Star" high reliable tubes or equivalent have heavier heater wire, short and sturdy elements supports, and gold or silver plated grids (to reduce grid emission). The diameter insulation thickness, and bend sharpness of the heater wires are closely controlled. Double mica spacers are used. Construction and assemblying is under strict quality control. There are some 36 tubes available. See General Electric bulletin, GE-ETD-548B. See also *Armed Services Reliable Electron Tubes, ED, Feb. 1955, p. 31.*

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Abstracts

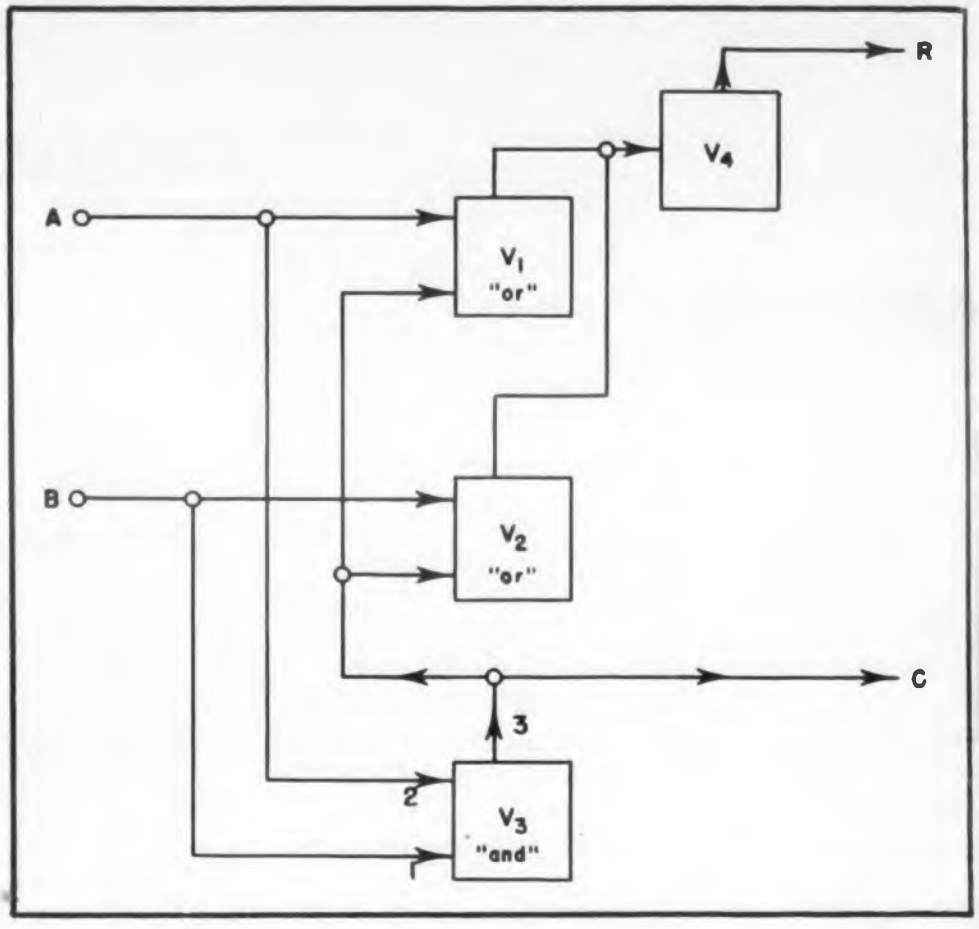

Fig. 1. Serial half adder for two digits with sum at R and carry at C.

SERIAL adders can be made from combinations of binary logical elements, usually called "and" and "or" circuits. An "and" circuit may have two inputs and one output. If pulses appear simultaneously at both inputs, an output pulse occurs. Otherwise, there is no output. In an "or" circuit, there is a pulse out if a pulse appears at either input (or both).

The serial adder circuit, Fig. 1, is called a half adder because it does not provide for taking care of the carry, which requires an additional half adder as shown in Fig. 2.

In the first of these two diagrams, the vacuum tubes V_1, V_2, and V_3 can be tetrodes and V_4 can be a triode. Arrows pointing in as at points *1* and *2* represent connections to grids, and lines at the top as at point *3* represent connections to plates. V_1, V_2, and V_3 are biased below cutoff and are not conducting in the absence of inputs, where as V_4 is normally conducting. V_1 and V_2 are "or" gates; that is, they conduct if a pulse arrives at either grid. But V_3 is an "and" gate and is biased to conduct only if pulses arrive simultaneously at both grids.

Suppose that at a given time a pulse (representing a *1*) arrives at A and no pulse (representing a *0*) arrives at B. A pulse arrives at a grid of V_1 and of V_3 from A, and no pulse arrives from B. Hence, only V_1 conducts sending a negative pulse to V_4 which inverts it, causing a positive pulse output (representing a *1*) at R which represents the sum of $1 + 0 = 1$. No carry arrives at C since V_3 does not conduct unless pulses arrive at both grids. No pulse at A and a pulse at B $(0 + 1)$ would cause V_2 to conduct, sending a pulse to V_4 and getting an output pulse (a *1*) at R with no carry. If pulses arrive at A and B simultaneously $(1 + 1)$, there is a sum output at R of *0* and a carry at C since $1 + 1 = 10$, which is 0 and 1 to carry.

Analysis shows why this occurs. A pulse arrives at V_1 from A and at V_2 from B and it woud be expected that they would both conduct. But this is not the case because a negative pulse from the plate of the new conducting tube V_3 is applied to grids of V_1 and V_2, which overrides the pulses from A to B and keeps V_1 and V_2 from conducting. Since neither of these con-

Adding with Logical Elements

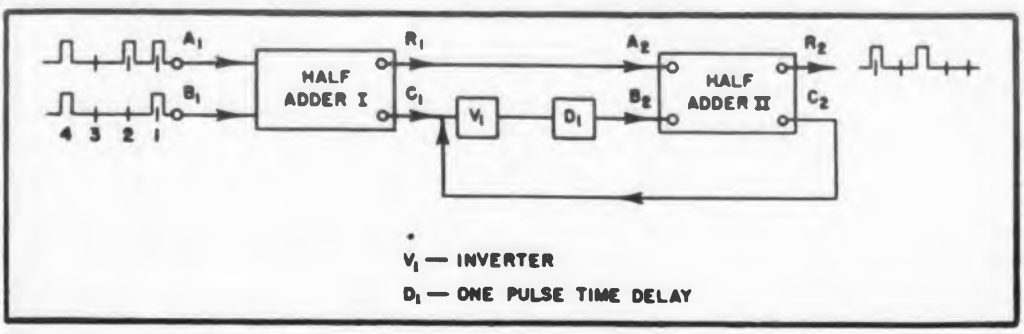

Fig. 2. Two half adders with inverter and delay for any number of digits.

ducts, no pulse goes through V_4 to arrive at R.

The next question to answer is, "Why does V_3 conduct and send the inhibit pulse to V_1 and V_2?" Note that a pulse arrives at V_3 from A and also from B. Since two pulses arrive at V_3, it conducts sending out the inhibit pulse mentioned above to V_1 and V_2. This negative pulse also goes to C to represent the carry.

To add the carry from a previous column, to the next column, the two half adders are connected as indicated in Fig. 2. V_1 is an inverter to change negative pulses to positive pulses, since the carry explained above was negative. D_1 is a circuit which delays a pulse by 1 pulse time. The addition of A_1 (1011) and B_1 (1001) as shown is:

$$1011 = 11$$
$$1001 = 9$$
$$\overline{10100} = \overline{20}$$

The pulses at the right of each number enter half adder I first; that is, a pulse appears at both A_1 and B_1. Hence a *0* (no pulse) appears at R_1 and A_2 and a carry of *1* (a negative pulse) appears at C_1. Since there is *0* at A_2 and B_2, the sum at R_2 is *0*. This carry at C_1 is inverted in V_1 and is delayed at D_1, arriving at B_2 1 pulse time later. By now, the next two pulses have arrived at half adder I. The pulses second from the right end are a *1* in the top and a *0* in the bottom series of pulses. A pulse arrives at A_1 and no pulse arrives at B_1, so a sum of *1* appears immediately at R_1 and A_2 and no carry is emitted from half adder I.

However, the carry from the previous sum (delayed 1 pulse time) arrives at B_2 at the same time this sum of *1* arrives from R_1 and A_2. Since there is a *1* at A_2 from the second sum and a *1* at B_2 from the first carry, $1 + 1 = 10$ is in the second adder, so that there is *0* and *1* to carry as the output of half adder II. This carry goes back through the inverter V_1 and is delayed 1 pulse time and arrives at B_2 at the time the third pulses are ready to be added. Since these are both *0*'s, there is no output to A_2 and the carry from the second addition arriving at B_2 is added to *0*, putting out a *1* and no carry from half adder II.—*"Binary Numbers and Electronic Digital Computers", A. E. Smith. Bureau of Ships Journal, pp 29-32, August 1955. Bureau of Ships, Dept. of the Navy, Washington 25, D. C.*

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USSR Beam Switching Tubes

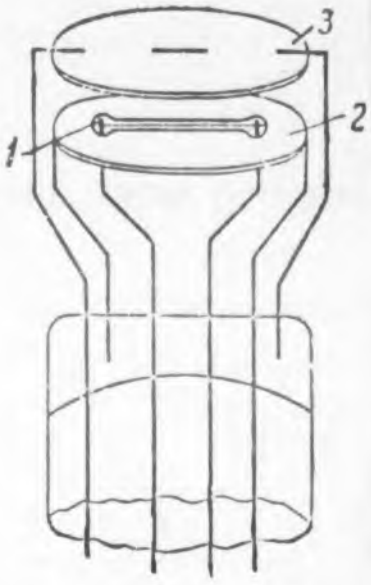

Fig. 1. Flat-beam switching tube with threadlike directly heated cathode.

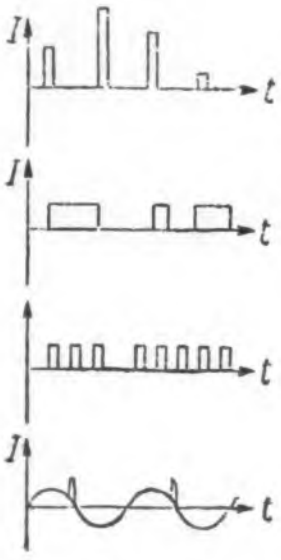

Fig. 2. Signal types. Top to bottom is a, b, c, d.

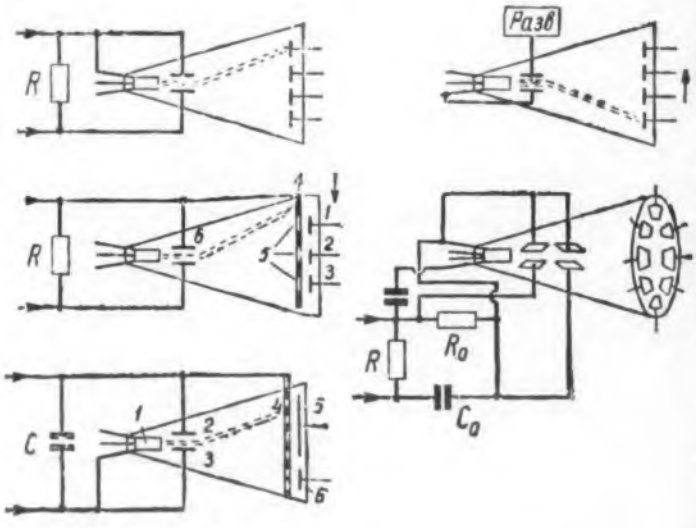

Fig. 3. Switching circuits. Reading left to right, top row is a and b; middle row, c and d. Bottom circuit is e.

BEAM switching tubes as a means of multiple communication were first proposed by I. G. Freeman (1919, Patent 787). The author of this article in 1932-1935 helped develop a similar system for purposes of remote control. A flat beam of electrons is used in switches with the target electrode arranged linearly. Flat beams instead of round ones permit considerable rise of switch current with the same beam cross section in the direction of its scanning. The heightened intensity results from replacement of the point cathode with a threadlike type, Fig. 1.

The directly heated threadlike cathode *1* is placed in a slot-like opening of the flat controlling electrode *2*. In the flat anode *3*, placed in parallel to the controlling electrode, is another slot aligned with the slot of the controlling electrode. Such switches approximate in size the usual receiver tube types. The best known signal forms for cathode-selection switching include amplitude, impulse, time, time-impulse, and phase-impulse types.

Impulses of rectangular form that differ in amplitude are shown in Fig. 2b. They cause a voltage that deflects the beam to a corresponding target. Fig. 3a. The electron beam is blanked below specified signal amplitude levels. Such a selector can analyze energy spectrums of fast particles.

In time selection, the choice of circuit contact is determined by the duration of the current pulse or voltage, Fig. 2b. The incoming signal commences a scanning process, Fig. 3b. When the signal drops the beam stops on the target which it reached by that time, closes it and then returns to the initial position.

The phase impulse selector for signal of Fig. 2d illustrated in Fig. 3d. Circular sweep is used. The short impulses unblank the beam of electrons. The beam briefly contacts the target of the switch during each period of sinusoidal current. The phase of the impulse relative to the sweep signal determines which target is contacted.

In impulse selection the selected contact depends on the number impulses Fig. 2c. In this scheme Fig. 3c, the targets (*1, 2,* and *3*) which are behind slot *5* of the target *4*, are connected with one of the deflection electrodes. Electrons falling on the target charge the capacity of the deflection electrodes *6*. Changes of voltage on these electrodes move the beam downward until the charging of the electrodes stops, and the beam remains steady until an incoming pulse throws it across the slot. Only after the last impulse of the signal does the beam come to final rest.

The action of beam computer tubes is based on impulse selection, Fig. 3e. Often the luminous spot takes the form of a numeral that corresponds to the number of impulses—"*Beam Switching Tubes,*" *by L. Gonscharsky,* Radio, *No. 7, 1955.*

What the Russians are writing

Listed to the right are titles and brief abstracts of articles appearing in the two leading periodicals, excepting several physics journals that publish theoretical studies in electronics. Below is a letter to the editor and a news report.

Letter to the Editor . . .

"The radio industry this year can supply resistors, capacitors, and radio tubes in unlimited quantity for sale to the public," the letter says, "but the stores that sell radio equipment don't have them yet."

The reasons given are that (1) store managers think sale of radio parts "unprofitable" and take no steps to expand the assortment, (2) wholesalers that draw up orders on industry are unfamiliar with the diversified radio parts and, being unable to formulate an adequate list of parts in demand, they limit stock to "arbitrary assortments that often fail to meet consumer demands", and (3) the stores "don't exercise their right to sell without cash payment to radio clubs, schools and laboratories" with the result that these groups send "petty orders" direct to factories unable to fill them.

The society of radio amateurs has repeatedly raised this question to the Trade Ministry, but without satisfactory result, the letter says. It recommends that "specialized radio stores, that would always have a full stock list of all radio goods" be opened by the Ministry in cities for improvement of the trade in radio parts. Not less than one such store should be opened in every city, with two or three in bigger cities, and up to five in Moscow, Leningrad and Kiev. Credit sales should be encouraged. "Consumers must not be limited to a fixed sum per order," by the mail order houses which should expand their assortment.

Conference Report . . .

Engineer V. V. Gurov spoke on the low-cost "Electronic Linear Analog, Type EMU-5", at a meeting of the Institute of Automation and Telemechanics. (About 210 from 32 organizations attended.) He discussed new features embodied in this small-sized device built around operational amplifiers with efficient output stages that reduced power requirements from 400 to 60w. The linear portion of the computer, designed for solution of 6th order differential equations, measures 25" x 24" x 20". The 8-diode function generator and dual multiplication-division device measures 25" x 20" x 13".

Radiotekhnika, May 1955, 80p, 11,850 copies

Fundamental Equations of a Steady Oscillator with Grid Current Present, by M. I. Kontorovich. Develops equations taking into account the influence of grid currents. An oscillator with automatic bias is taken as an example.

General Theory of Signals and the General Theory of Automatic Processes, by M. S. Neiman, These theories are defined. Emphasis is put on the connection between them and on their importance for modern radio engineering and electronics.

Calculation of Phase and Group Velocity of Surface Waves, by V. Y. Smorgonsky. Examines a method of plotting the frequency characteristics of phasevelocity of surface waves by approximated step functions.

Other articles treated mathematical calculations of: cathode detectors, cathode follower action with trapezodial signals, and phase distortion in opening of a 3-dimensional antenna. Temperature-frequency characteristics of electrolytic capacitors were condensed on p 164 of *ED,* September, 1955.

Avtomatika I Telemekhanika, January-February, 1955 No. 1, 112 p., 6,250 copies.

Certain Problems of Design of Correcting Elements of AC Servo Systems, by L. S. Goldfarb, N. M. Aleksandrovskii. Introduces the concept of the equivalent complex transfer function of a linear system working on a-c. Expressions are obtained that determine the value of the equivalent complex transfer function for "working" and "non-working" components, from a given transfer function of the linear system Includes parallel T networks.

On the Question about Evaluation of Integral Criteria of Quality of Control of Non-Linear Systems, by Y. M. Plishkin. Lyapunov's function for non-linear systems of automatic control is used for evaluation of integral criteria of control quality.

Generalization of the Amplitude-Phase Stability Criteria on Systems with Undamped Resonant Elements by N. T. Kuzovkov. The Amplitude-phase stability criterion is generalized for systems which contain undamped resonant elements, that is, elements whose transfer functions have complex conjugate poles on an imaginary axis. The possibility of applying the method of logarithmic frequency characteristics to such systems is shown.

Design of Magnetic Amplifier for Complex Load, by N. P. Vasileva, O. A. Sedykh. Suggests a method for calculating impedance of magnetic amplifiers yielding all amplifier parameters required for minimum amplifier size or weight. The starting data in the calculation are the maximum power and load power factor, ratio of full load to no load current, and coefficient of amplification of maximum signal.

Decoder Remote-Control Devices Using Magnetic Elements with Rectangular Hysteresis Loops, by V. A. Zhozhikashvili. A method is suggested for construction of contactless decodes using magnetic elements with rectangular hysteresis loops. Symbolic diagrams for decoder circuits are used, similar to diagrams of primary circuits of relay-contact decoder. The protective properties of the developed decoders are investigated.

Theory of a Bridge Detector Feeding a Resistive Load Shunted by Capacitance, by I. A. Popov. Article presents an analysis of the work of a bridge detector, and investigates the operating conditions and parameters of bridge detector circuits.

Additional articles (3) cover pneumatic and hydraulic control. Also included: general news and report on "Seminar on Mathematical Problems on the Theory of Automatic Control".

Standards and Specs

Sherman H. Hubelbank

This department surveys new issues, revisions, and amendments, covering military and industry standards and specifications. Our sources of information include the Armed Services Electro-Standards Agency (ASESA), the cumulative indexes to Military Specifications, Vols. II, IV, American Standards Association (ASA) and other standards societies.

Standards

STANDARDIZTION MANUAL—A BOOK OF PRINCIPLES AND PRACTICES FOR PURCHASING PERSONNEL, 1955 . . . Although this manual was written for those actively engaged in the procurement field, its scope extends beyond this field. This manual should prove to be handy to anyone engaged in the field of standards. The book is divided into the following eight sections: (1) Basic Facts and Definitions, (2) Starting a Standardization Program in a Company, (3) The Purchasing Agent and Standardization, (4) Putting Standardization to Work in the Company, (5) The Status of the National Association of Purchasing Agents in National Standards, (6) The American Standards Association, (7) Sources of Nationally Recognized Standards and Standardization Information, and (8) The PA's List of Talks and Articles on Standardization. Single copies of this forty page manual may be obtained from the National Association of Purchasing Agents, 11 Park Place, New York 7, N. Y., without charge.

The Sixth National Conference on Standards, sponsored jointly by the American Standards Association and the National Bureau of Standards, will be held at the Sheraton Park Hotel, Washington, D. C. on October 24 to 26. The theme of the conference will be "Government-Industry Cooperation on Standardization" and subjects will range from the legal implications of standardization to the coordination of Defense Department and industry requirements for manufactured products.

Vice Admiral George F. Hussey, Jr., USN (ret), Managing Director of ASA, will open the Monday session with a report on the year's progress in the development of American Standards. The legal implications of standardization will be discussed at the Monday evening session. Federal Trade Commissioner Lowell B. Mason will preside. Government and industry standardization from the level of the Office of the Secretary of Defense in the morning and from the level of the Army, Navy, and Air Force in the afternoon will be the feature of the second day. The Wednesday session will be devoted to the relationship of industry standards and specifications to those of government and government-industry cooperation in standardization at the international level.

A number of exhibits will show how both government and industry are coordinating their standards programs.

RETMA Standard Tr-139, Audio Transmitter Input Impedances, June 1955 . . . The transmitter input impedance is defined, as is the minimum standard input impedence of audio transmitters for radio broadcasting. This standard also recommends that a six decibel resistive pad be inserted between the transmitter audio input terminals and the external audio equipment to provide suitable impedance isolation between them. Copies of this standard are available from RETMA at 25 cents per copy.

RETMA Standard Rec-145, Packing Tests for Television Receivers, June 1955 . . . This standard describes a recommended technique for testing table model TV receivers and three classifications, by gross weight, of console TV sets after they have been packaged in accordance with the manufacturer's specs. Copies of this spec are available from RETMA, 777 14th St., N.W., Washington 5, D. C. at 25 cents per copy.

ASTM Standards on Glass and Glass Products, April 1955 . . . A 136 page compilation of ASTM standards on glass and glass products was published by ASTM. This publication supersedes the previous edition published in 1950. Of particular interest to the electronic industry are the specs for glass insulators and the methods for testing glass insulators. Copies of this standard may be purchased from the American Society for Testing Materials, 1916 Race Street, Philadelphia 3, Pa., at $1.50 per copy.

Application Design Notes

ASESA 51-4, Application Design Notes . . . A new index for this publication was issued May 31, 1955. ADN-92, covering Capacitors, Air-Dielectric Variable (Trimmers), JAN-C-92 was revised May 31, 1955. A new edition of ADN-11015, covering Capacitors, Fixed, Ceramic-Dielectric, General Purpose, MIL-C-11015A was issued April 30, 1955.

Testing Methods

MIL-STD-202A, Test Methods for Electronic and Electric Component Parts (Proposed), 1 June 1955 . . . The proposed test methods 304, 305, 306 and 307 of MIL-STD-202A are being circulated to all interested personnel by ASESA. Method 304 describes how to measure the change in ohmic resistance of any resistor or resistance material with a change in temperature. Method 305 describes how to measure capacitance. Method 306 covers the measurement of the Q of component parts, such as capacitors and inductors. Method 307 explains how to test for contact resistance between such items as switches, relays, plugs, sockets, and other electrical mating contacts. Upon approval of the various test methods of MIL-STD-202 they will be referred to, if applicable, in all future specs for electrical and electronic parts.

Capacitors

MIL-C-5A Capacitators, Fixed Mica-Dielectric, 5 July 1955 . . . The methods of packing and packaging have been simplified by the establishment of three groups: immediate use, short time storage, and overseas shipment. Wire-lead capacitators are now tested for temperature coefficient and capacitance drift at —55°C during qualification approval tests. All other types are still tested at —40°C. Seventeen spec sheets were amended by the issuing of Supplement 1B which added tolerance values and changed some minor dimensions. The requirement making it mandatory to test assorted sizes of similar types in each inspection lot has been changed to make this requirement optional.

MIL-C-3871 Capacitors, Fixed, Electrolytic (AC, Dry Polarized) Amendment 2, 7 July 1955 . . . A requirement has been added to the life test that there shall be no leakage of electrolyte. In addition, the position of the test samples being life tested is now specified as being six in the vertical and six in the horizontal.

ASESA has issued a revision of Application Design Note 81, which covers variable ceramic-dielectric capacitors.

MIL-C-62A, Capacitors, Fixed, Electrolytic (DC Aluminum, Dry Electrolytic, Polarized), 15 August 1955 . . . A 250-hour life test has been added to the acceptance tests. The maximum dc leakage current requirements for the different dc working voltages has been changed. Working-temperature range characteristics A, B, D, and E have been deleted. The vibration test requirements have been modified. Requirements were added concerning corrosion and mechanical damage after performance of the moisture-resistance test. The list of referenced specs and publications has been revised. JAN-C-62 has been superseded by this revision.

Insulation Tape

MIL-I-18622 (Ships), Insulation Tape, Electrical, Pressure Sensitive Adhesive, Silicone Rubber Treated Glass, Electrical Cable Splicing, 16 May 1955 . . . This spec covers various sizes of roll tape consisting of a woven glass cloth backing, the weave of which is filled on both sides with silicone rubber, and coated on one side with a pressure sensitive silicone base adhesive.

Specifications listed on these pages are for information only and government contractors should be guided by their contracts. Copies of military specs should be obtained from sources recommended by procuring officers. ASESA bulletins may be obtained from Fort Monmouth, N. J. ASA standards may be obtained from American Standards Agency, 70 E. 45th St., New York 17, N. Y., unless otherwise noted.

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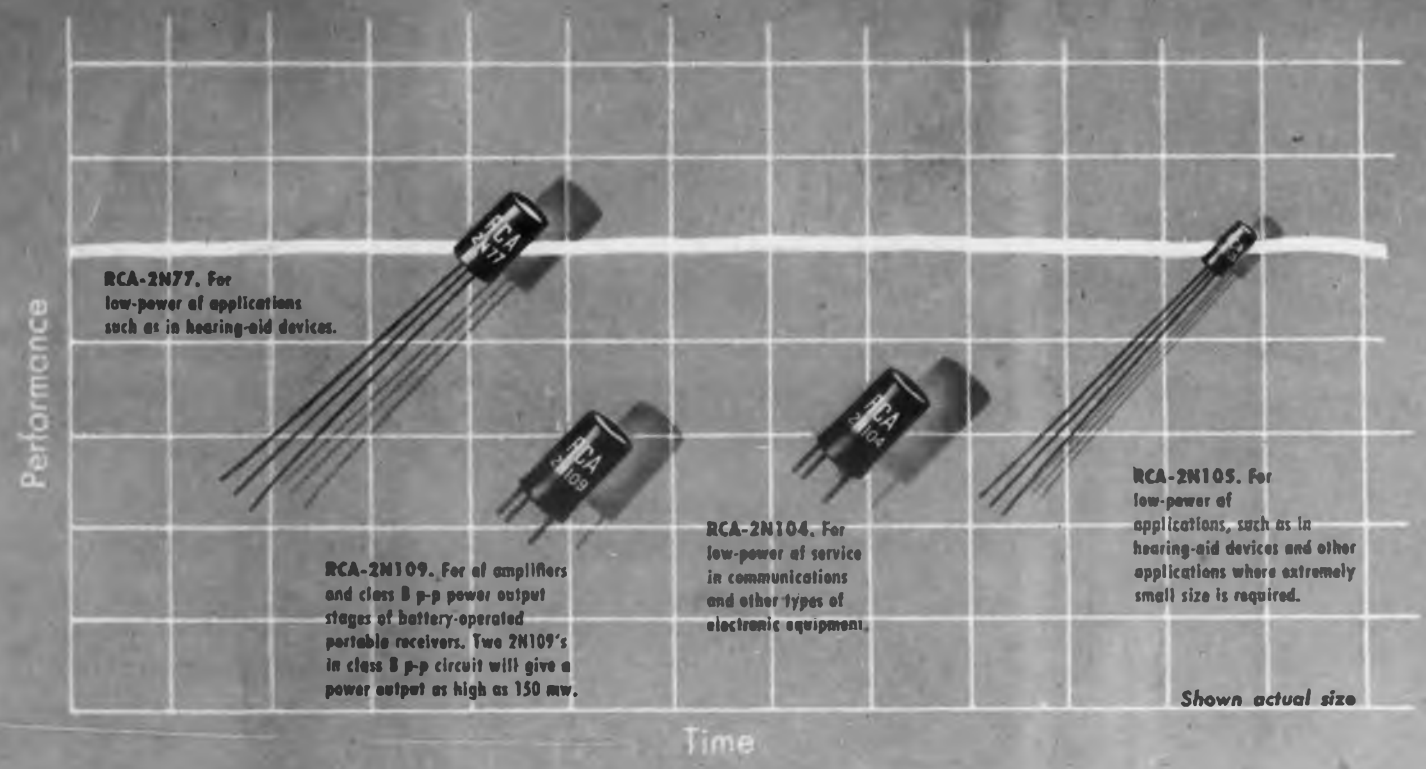

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MAX. RATINGS (Absolute Values):				
Collector Volts	−25	−30	−25	−20
Collector Ma.	−15	−50	−15	−50
Collector Dissip. (mw)	35	up to 150*	35	50
Operating Temperature (°C)	50	70	50	50
TYPICAL OPERATION:†				
Collector Volts.	−1	−6	−1	−4.5
Collector Ma.	−0.7	−1	−0.7	−13
Alpha (Collector-to-base connection)	55	44	55	70††
Power Gain (db)	41	41	42	30**
Power Output (mw) approx.	—	—	—	75**
Source Imped. (ohms)	2450	1400	2300	375 per base connection
Load Imped. (ohms)	20,000	20,000	20,000	100 per collector
Noise Factor (db)	6.5 av.	12 max.	4.5 av.	—
Cutoff Freq. (kc)	700	700	750	—
Figure of Merit for High Frequency Performance (Mc)	1.7	1.6	2.6	—

* Depends on temperature and circuit parameters
†† Large-Signal
† In common-emitter circuit at 25°C, ambient temp.
** For 2 transistors in class B af circuit, and maximum distortion at 10 percent