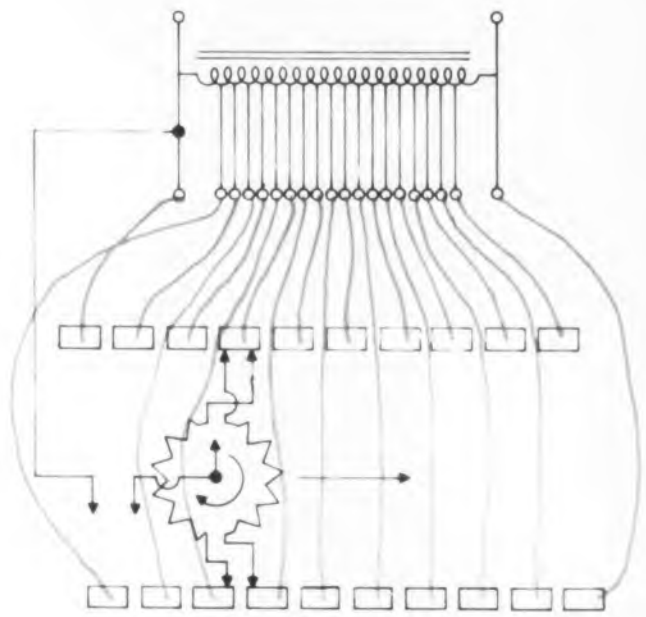
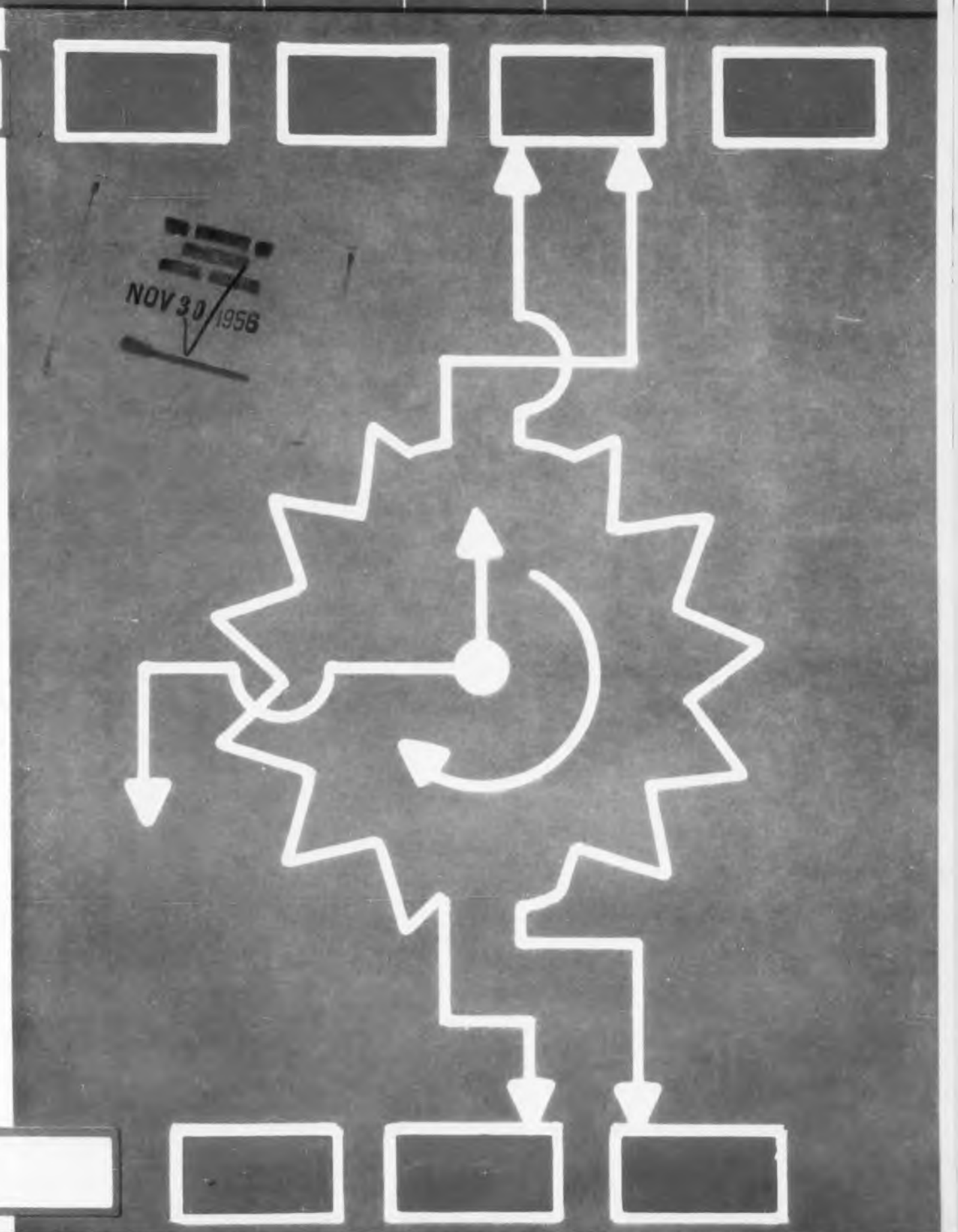
ELECTRONIC DESIGN

NOVEMBER 15, 1956



Rotary Ratio Transformer ..... page 26



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ELECTRONIC DESIGN

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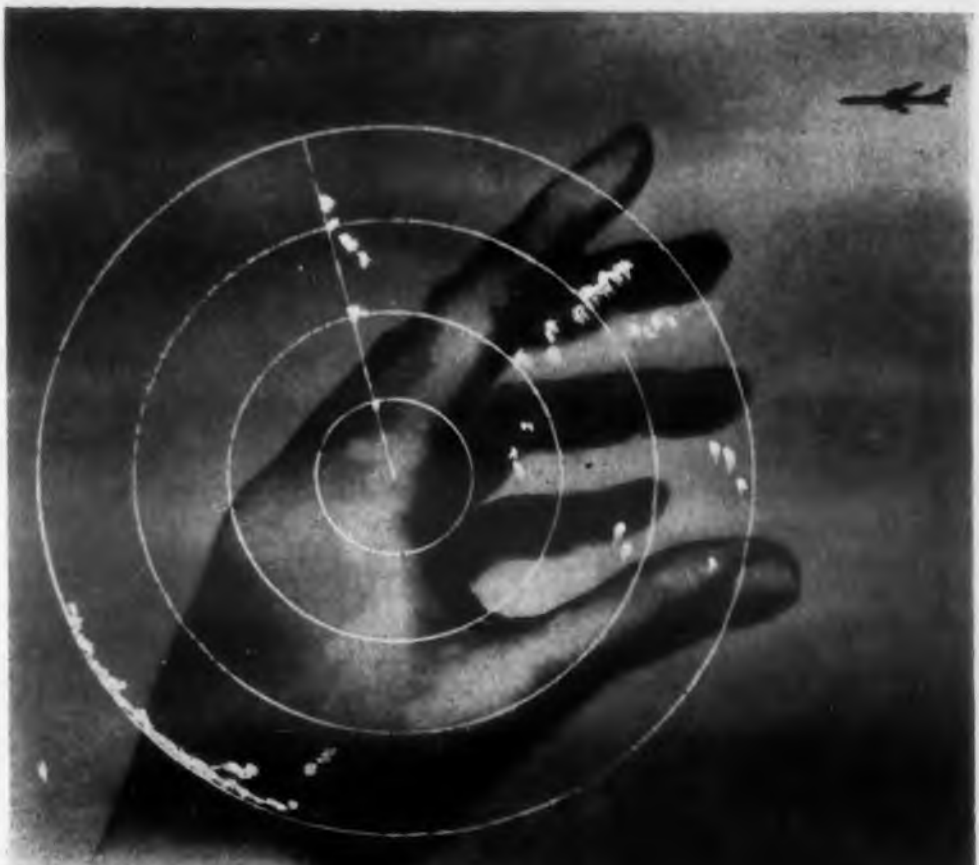

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CIRCLE 2 ON READER-SERVICE CARD FOR MORE INFORMATION

Editorial

Common Sense Is Not the Answer

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

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

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

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

Engineering Review

Post Office To Try Electromechanics

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

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

Britain Opens Atomic Power Plant

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

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

Non-Degaussable Magnet Developed by GE

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

Over-The-Horizon Microwave

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

Airborne Infrared Lab Exported

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

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

Annals of Physics

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

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

The first issue is scheduled for release in April 1957.

AT&T Patents Available

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

Swedes View TV Commercials

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

600 F Plastic Insulation

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

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

IBM Patents Available

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

CIRCLE 5 ON READER-SERVICE CARD ➤

Underwater TV Camera

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

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

Solid State Research

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

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

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

Education for Automation

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

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

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

Submarine Simulator Envy of Capt. Nemo

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

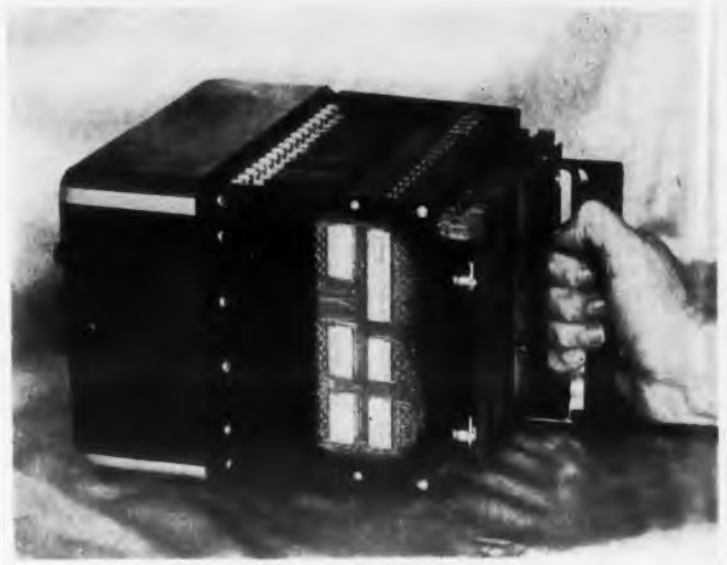
Submarine maneuvers are simulated from a control room mounted on a hydraulically actuated cradle anchored firmly in concrete. Torpedoes can be fired on "enemy" targets. Scoring is determined by computer. Conditions of start up, dive, turn, climb, in fair or foul weather, as well as equipment failure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

U. S. Airmen Studied For Stress

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

Industry Aids Science Students

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



Consolidated Computer for Jet Fighters

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

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

Ultrasonic Fog Disperser

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

Automated Farms

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

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

Ultrasonics And Cold Water Cleans Surgicals

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

Federal Communications Commission

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

Training Aids For Industry

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

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

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DESIGNER'S

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

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

Typical radar transformers, being produced at General Electric's Holyoke plant, are shown in the photo at left. The large unit—73⅞ inches high—weighs 8750 pounds. It is an oil-filled unit, hermetically sealed with an air head and internal cooling coils which carry water as a coolant.

The small unit—an airborne radar transformer—weighs four pounds. Also oil filled and hermetically sealed, it utilizes expansion bellows permitting it to be operated in any position.

But whether it's four pounds or 30,000 pounds, every radar transformer that is custom-built to your particular specifications by General Electric benefits from the same degree of design and engineering skill. For further information, write for GEA-5963.

Rugged motor-alternators help provide reliable railway communications

For power supplies in railway radiotelephone transmitting and receiving equipment, G.E. offers designers both open and totally enclosed motor-alternator sets. Open model is for inside mounting only; totally enclosed model for severe duty inside and outside the cab. Housed to withstand vibration and heavy handling, these power supplies can be furnished for operation with 32, 64, or 115 volts d-c, to meet AAR Specifications 12-10 and 12-22.

Open model is rated at 117 volts a-c, 60 cycle, 3600 rpm, 300 watts continuous at 0.9 power factor. Totally enclosed model, rated 175 watts, is same otherwise. Both sets have built-in automatic-reset thermal overload protection. See Bulletin GEA-6370.

New 1 1/2-inch starting relay operates 1,000,000 times

Dependable, long-life performance has been built into General Electric's new silver-dollar-sized Type ARR-2 accelerating relay designed for more than 1,000,000 operations in such applications as starting single-phase hermetically sealed refrigerator compressor motors. Contact pressure and action are always the same, regardless of line voltage or motor-performance variations, because there are no pivots to wear out, contact tips are independent of solenoid plunger, and relay is enclosed in sturdy plastic case.

Wiring is fast and easy, with readily accessible terminals available in push-on, screw or lead-type. There's no need for special mounting brackets because the relay is easily mounted from any direction.

You can install this relay in many compact applications because unique design combines high horsepower and current ratings with small, space-saving size. Further versatility is provided by its adaptability for use over a wide range of horsepower and current ratings. At 115 volts this relay will make and break 15 amperes; at 230 volts, 7½ amperes. In addition, this new relay is extremely quiet in operation because there is no armature-to-magnet contact. It is especially applicable where adverse atmospheric conditions exist or remote control is needed. G-E control engineers co-operate with you on every application. See Handbook Sheet 3286, page 23 for details.

GENERAL ELECTRIC

CIRCLE 10 ON READER-SERVICE CARD FOR MORE INFORMATION

DIGEST

GENERAL ELECTRIC COMPONENTS
FOR ELECTRONIC MANUFACTURERS

New low-cost double-diode *Vac-u-Sel** selenium rectifier replaces present 6AL5 tube in printed circuits

Longer life, smaller size and lower first cost make the new miniature General Electric Vac-U-Sel selenium rectifier an ideal replacement for the 6AL5 tube-in-socket rectifier now used in TV-horizontal-phase-detector circuits. This new rectifier measures 5/8 x 19/32 inches in profile, 1/4 x 19/32 inches from the top.

Encased in tough, durable, moisture-resistant plastic, the unit offers greater product uniformity, longer life and low cell capacitance. Ratings: 0.5 ma at 2.0 v d-c, 5.0 ma at 20 v d-c, 50 uuf 10% per section. Spacing between terminals is accurately maintained for automatic assembly in printed circuits. Wide range of uses includes its application as low-cost replacement of tube and socket rectifiers, as a voltage doubler, or in conventional wiring applications which require leads up to 1½ inches in length.

Series is also available in common cathode and double circuits with a higher forward current rating of 1.5 ma continuous at 1.5 v d-c. Terminals are plainly oriented for easy indentification. Tough over-all construction of this new General Electric unit practically eliminates breakage from handling. Ratings and mechanical configurations other than those described are also available. Send for descriptive bulletin GEA-6538.

**Trade-mark of General Electric Company.*

Space-saving panel and switchboard instruments are accurate, easy to read

Designers no longer need be limited to large-size instruments to get a high accuracy and readability in panels and switchboards.

General Electric's line of miniature panel instruments combines these features with space-saving design—at low cost. The 2½-, 3½-, and 4½-inch miniatures (above) are accurate within 2 per cent of full scale. Minimum depth behind panel provides economy of space. Alnico V magnets with sintered iron pole pieces, polished steel pivots, and tough low-friction jewels to withstand normal shock, assure extreme reliability.

General Electric's line of long-scale switchboard instruments feature minimum behind-panel depth, operate within 1 per cent accuracy. Shadow-proof covers, anti-parallax scale and pointer permit reading from any reasonable distance or angle. Available in 4¼-inch types (7.1-inch scale); or in 8¾-inch types (14.2-inch scale) for long range reading. Both scales span 250 degrees. See Bulletins GEC-218E and GEC-368H.

Miniature aircraft relay operates 300,197,234 times without a miss!

Unerring performance under severe climatic conditions, stress and shock makes this General Electric hermetically-sealed miniature relay a trustworthy component for electronic applications in aircraft, aboard ship, and on portable units. Designed to meet or better all provisions of MIL-R-6106 (Joint Military Service Specifications for Relays), this miniature relay outperforms its competitors. In tip-pressure tests, its magnetic structure gives 40-55 grams to its competitors' 22-40 grams while its load life proves to be from 220% to 625% longer. Greater pull force, higher dielectric strength and arc resistance, non-annealing contact fingers, and greater leakage resistance, assure a high degree of dependability. This relay is available in 2, 3 or 4-pole double throw and 6-pole normally open forms, in voltage sensitive, current sensitive and standard forms. See Bulletin GEA-6213.

New Permafil capacitors operate at 125 C ambients

Designed for operation in 125 C ambient temperatures at full rated voltage, General Electric's new Permafil capacitors meet the performance requirements of MIL-C-25A characteristic "K." They feature high insulation resistance values, and will not change in capacitance more than ±10 per cent over a temperature range from −55 C to 125 C.

Because Permafil—a solid—is used as the impregnant, these General Electric capacitors cannot leak, and easily withstand the shocks and vibration of missile and airborne electronic systems. They have 100 per cent rating at altitudes up to 50,000 feet, save space because no derating is needed for high-temperature operation.

Permafil capacitors—now available in rectangular case styles—come in ratings .01 uf to 10 uf; 100 v d-c to 1500 v d-c. For more data on how Permafil capacitors meet your application check Bulletin GEC-811.

GENERAL ELECTRIC COMPANY, APPARATUS SALES DIVISION, SECTION A667-35, SCHENECTADY 5, NEW YORK.

Please send me the following:

√ for reference only ×for planning immediate project

☐	GEA-5963	Transformers and Inductors for Radar	☐ GEA-6538	Selenium Rectifiers
☐	GEA-6213	Miniature Relay	☐ GEC-218E	Switchboard Instruments
☐	GEA-6370	Meter-alternators	☐ GEC-368H	Panel Instruments
			☐ GEC-811	Permafil Capacitors
		☐ HB-3286, P. 23 ARR-2 Relay		

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

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CIRCLE 10 ON READER-SERVICE CARD FOR MORE INFORMATION

Two-Stage Hypersonic Rocket

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

Electronic Photo Printer

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

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

11-Million Gauss-Oersted Permanent Magnet

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

◄ CIRCLE 11 ON READER-SERVICE CARD

Mental Telepathy Needs Engineers

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

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

Gas-Filled Transformer

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

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

CIRCLE 12 ON READER-SERVICE CARD ➤

Air-to-Ground Loudspeaker

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

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

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

Study 50 Weeks, Vacation 2 Weeks

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

Electronic Telephone Switching

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

Heart Murmur Analyzed Electronically

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

Washington Report

Herbert H. Rosen

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

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

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

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

Meetings

Nov. 26-30: Third International Automation Exposition.
Trade Show Building, New York, N. Y. Clinic sessions will be offered in electronic computers, process automation, machine tool automation, office automation, automatic materials handling, servomechanisms, electromechanical components, and electronic components. More than a hundred exhibitors will participate in the clinics. A two-day "Senior Officer Conference on Office Automation" directed by Gordon L. Mattson and sponsored by Fordham University School of Business will be held. For information, write to Richard Rimbach Associates, 845 Ridge Ave., Pittsburgh 22, Pa.

Dec. 3-4: Second Midwest Symposium on Circuit Theory.
Michigan State University. Symposium will consist of four sessions: Topology and Circuit Theory, System Analysis and Synthesis, Circuit Theory and Applications, and the Place of Circuit Theory in Education. A talk on "Engineering Education for the Future" will be given by Dr. J. D. Ryder on Monday evening. Papers will also be presented by engineers in the education field. Contact for further information, IRE, 1 West 79th St., N. Y., N. Y.

Dec. 5-7: Second IRE Instrumentation Conference. Biltmore Hotel, Atlanta, Ga. Sponsored by the Professional Group on Instrumentation and the Atlanta Section of the IRE. Sessions will be devoted to industrial applications, missile range instrumentation, and the application of solid state devices. For further information, contact the IRE, 1 E. 79th St., New York, N. Y.

Dec. 10-12: Eastern Joint Computer Conference. Hotel New Yorker, New York, N. Y. Sponsored by the IRE, AIEE, Association for Computing Machinery. "New Developments in Computers" is the theme of the meeting. In addition to an extensive program of technical papers, the meeting will feature exhibits by many manufacturers in the computing field. For information, contact Al Forman, Room 639, 480 Lexington Ave., New York 17, N. Y.

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

Dec. 19-20: RETMA Symposium on Applied Reliability.
Bovard Hall, University of Southern California, Los Angeles, Calif. Sessions on Mechanical Reliability, Information Feedback, Component Evaluation Usage will be presented. "Failure Feedback —Is It Effective" is highlight of the meeting. Registration in advance is $3.00. Further information received from RETMA Engineering Office, Room 650, 11 West 42nd St., New York 36, N. Y.

Dec. 26-27: American Association For the Advancement of Science.
Statler Hotel, New York, N. Y. General theme of program on the Aids for Environmental Control. Various discussions will be held. For further information contact the American Association for the Advancement of Science, 1515 Massachusetts Ave., N.W., Washington 5, D. C.

Jan. 9-11, 1957: Symposium on Communication Theory and Antenna Design.
Boston University, Boston, Mass. Sponsored by the Air Force Cambridge Research Center and Boston University. For information, contact Miss Alice Cahill, Air Force Cambridge Research Center, Air Research and Development Command, Laurence G. Hanscom Field, Bedford, Mass.

Jan. 14-15, 1957: Third National Symposium on Reliability and Quality Control in Electronics.
Hotel Statler, Washington, D. C. Sponsored jointly by the IRE Professional Group on Reliability and Quality Control, the American Society for Quality Control, the American Institute of Electrical Engineers, and RETMA. For information, write to IRE, 1 E. 79th St., New York 21, N. Y.

Jan. 16-18: Society of Plastics Engineers, Inc., Thirteenth Annual Technical Conference.
Sheraton-Jefferson Hotel, St. Louis, Mo. Sixty-eight advanced technical papers will be presented. For further information contact Jas. R. Davidson, Executive Secretary, Society of Plastics Engineers, Inc., Suite 116-18, 34 East Putnam Ave., Greenwich Conn.

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

February 5-7: Twelfth Reinforced Plastics Division Conference.
Edgewater Beach Hotel, Chicago, Ill. Latest developments in both technical and practical aspects of reinforced plastics. Subject matter will range from reports on research and testing to product design to production methods to marketing techniques. A complete program, listing papers and speakers, registration forms for the three day Conference and hotel reservation blanks will be available after December 26. Those interested should write now to The Society of the Plastics Industry, Inc., 250 Park Ave., New York 17, N. Y.

Feb. 7: Annual Symposium of the New York Section of the ISA.
Garden City Hotel, Garden City, N. Y. Short papers on "Practical Accuracy of Measurement" will be presented followed by a discussion. Afternoon session will be on "Data Handling." For further information contact G. Newberg, Publicity Chairman, Fairchild Engine Division, Fairchild Engine & Airplane Corp., Deer Park, L. I., N. Y.

Feb. 7: Operations Research Symposium.
University Museum Lecture Hall, University of Pennsylvania. Sponsored jointly by the Professional Group on Engineering Management of the Philadelphia Section of IRE and the Society of Industrial and Applied Mathematics. Major theme will be Mathematical Models in Management Decision Making. Contact Haydn Ringer, 1303 Highland Ave., Palmyra, N. J.

February 14-15: 1957 Transistor and Solid State Circuits Conference.
University of Pennsylvania, Philadelphia, Pa. Sponsored by the Institute of Radio Engineers, American Institute of Electrical Engineers, and the University of Pennsylvania. For further information contact G. H. Kunstadt, Radio Corporation of America, Defense Electronic Products, Camden 2, N. J.

Feb. 26-28: Western Joint Computer Conference.
Statler Hotel, Los Angeles, Calif. The Conference is under the joint sponsorship of the IRE, AIEE, and ACM. Theme of the meetings will be "Techniques For Reliability." For further information contact S. Dean Wanlass, Aeronutronic Systems, Inc., 13729 Victory Blvd., Van Nuys, Calif.

March 11-15: The 1957 Nuclear Congress
Convention Hall, Philadelphia, Pa. Exhibits and conference sessions covering latest developments relating to the utilization of atomic energy in its various non-military forms for civilian use. For further information contact Atomic Exposition Office, 304 Architects Bldg., Phila. 3, Pa.

March 18-21: The 1957 SPI Annual National Conference and Pacific Coast Plastics Exposition.
Hotel Biltmore, Los Angeles, Calif., sponsored by the Society of the Plastics Industry, Inc. Sessions will cover plastics in the fields of electronics, aircraft and defense, building, and processing. Exposition will be held at the Shrine Exposition Hall. Further information may be obtained from the Society of the Plastics Industry, Inc., 250 Park Ave., New York, N. Y.

April 8-11, 1957: Fourth National Electrical Industries Show.
71st Regiment Armory, New York, N.Y. Sponsored by the Eastern Electrical Wholesalers Association. For more information, contact William S. Orkin, Co-Producer, The American Electrical Industries Expositions, Inc., 19 W. 44th St., New York, N.Y.

April 11-13, 1957: Southwestern IRE Conference and Electronics Show.
Houston, Texas. Sponsored by the Houston Section of the IRE. This conference will be augmented by the National Simulation Conference which will be sponsored by the IRE Professional Group on Electronic Computers. For information, write to Ninth Southwestern IRE Conference and Electronics Show, P. O. Box 1234, Houston 1, Texas.

May 16-18: Eighth Annual Conference and Convention, American Institute of Industrial Engineers.
New York City, Hotel Statler. For information write to AIIE, P.O. Box 8, Substation 135, The Bronx 53, New York.

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

Rectifiers and Circuits for DC Relays

F. W. Parrish

Chief Design Engineer
International Rectifier Corp.

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

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

The largest single use of relay rectifiers is to supply power to the operating coils of relays. Available types of selenium and silicon rectifiers for this purpose are shown in Fig. 1. Where only ac is available as in many applications, ac relays would normally be used if possible. However, the life of an ac relay is much less than that of a dc type. The ratio has been estimated at about 5 to 1. Moreover, dc relays close less violently than ac relays (resulting from the absence of the high current surge in ac relays prior to the closing of the magnetic circuit) and are therefore quieter and maintain accurate adjustment for longer periods of time. Accordingly, there is often considerable advantage gained by using dc relays; in which case, rectifiers must convert the ac line current to dc.

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

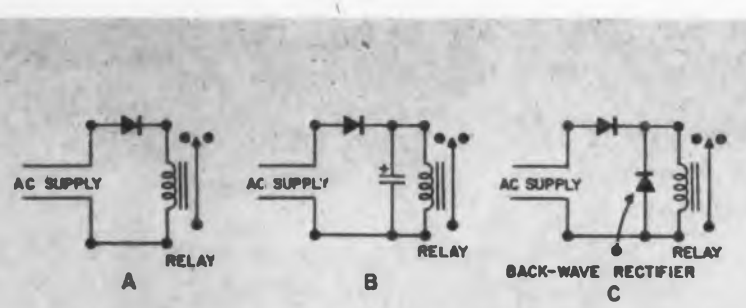


Fig. 2. Three circuits for supplying dc power to relay coils from ac source.

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

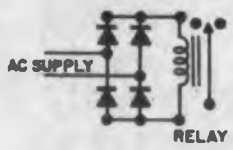


Fig. 4. Single-phase full-wave bridge relay supply.

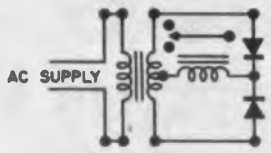


Fig. 5. Single-phase full-wave relay supply.

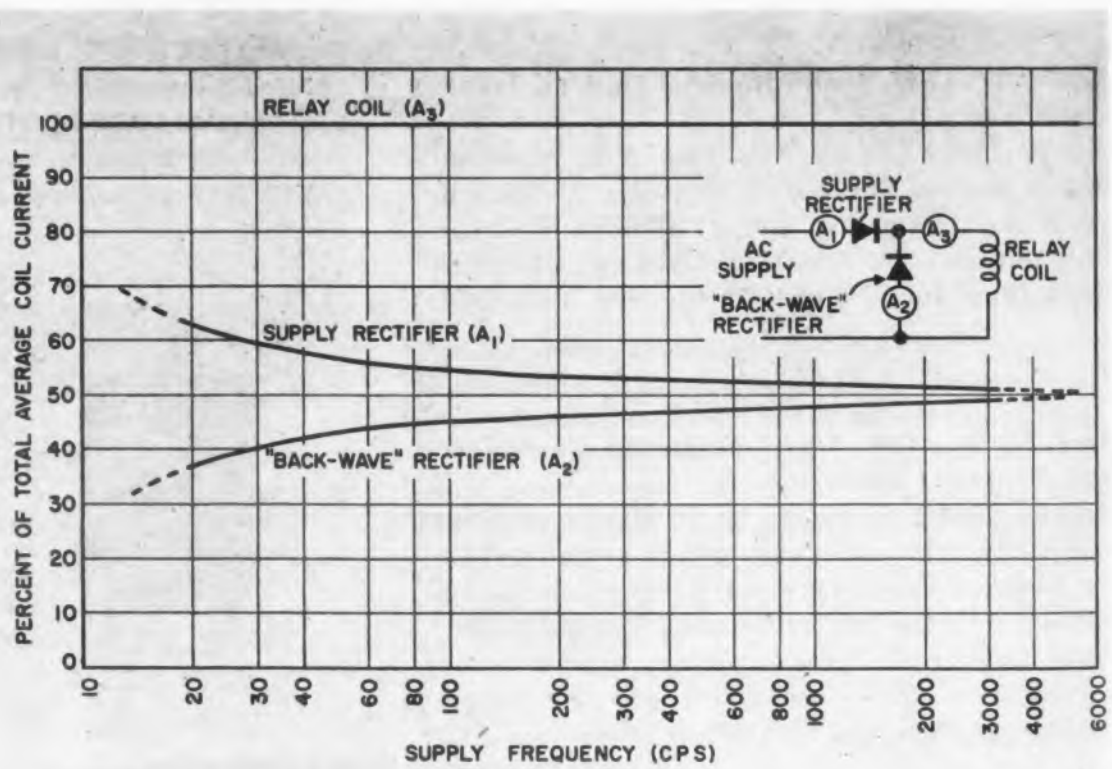


FIG. 3 RECTIFIER AND RELAY COIL CURRENT – FREQUENCY CHARACTERISTICS – "BACK-WAVE" RECTIFIER CONNECTION.

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

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

Preventing Chatter

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

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

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

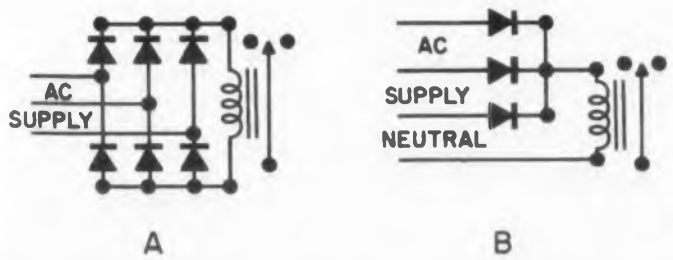


Fig. 6. Polyphase relay supply circuits. (A) Three wire bridge circuit. (B) Four-wire bridge circuit.

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

Coil Voltage

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

Other Circuits

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

A full-wave rectifier (Fig. 5) could also be used; however, a center-tapped ac supply is generally not available. Therefore, the bridge type is more popular. It is to be noted the current smoothing action of the "back-wave" current path is not obtained with the full-wave circuit. Where polyphase ac power is available, polyphase rectifiers similar to those shown in Fig. 6 can be used.

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

Special Rectifier Applications

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

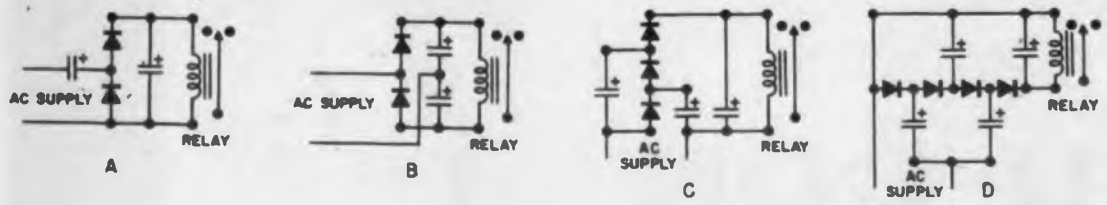


Fig. 7. Voltage-multiplier circuits for relay applications. (A) Half-wave doubler, (B) Full-wave doubler. (C) Tripler (D) Quadrupler.

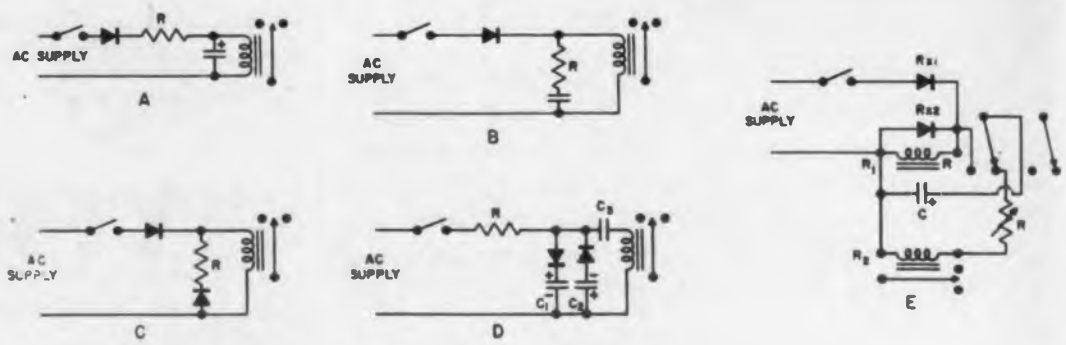


Fig. 9. Circuits for time-delay operation of dc relays.

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

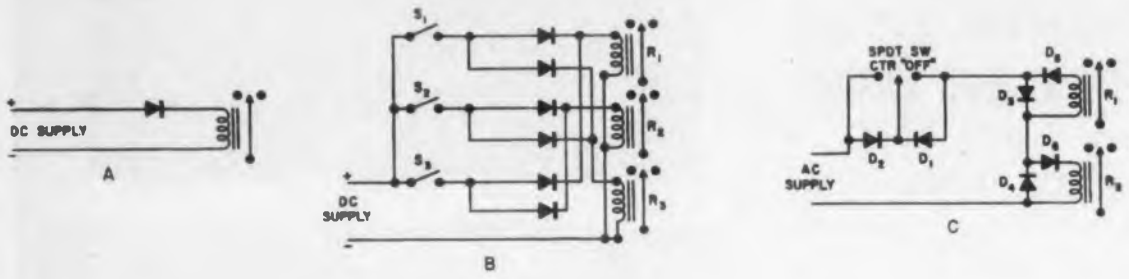


Fig. 8. Selective relay operating circuits.

A. Simple blocking valve to prevent relay operation if polarity is reversed.
B. Selective relaying from dc supply where
  S_1 operates R_1 & R_3 only
  S_2 operates R_2 & R_3 only
  S_3 operates R_1 & R_2 only
C. Selective relaying from an ac supply where
  (1) Shorting diode D_1 permits D_2 to rectify the supply and operate R_2.
  (2) Shorting diode D_2 operates R_1 similarly.
If impedance of relay coils is high compared to forward resistance of D_3 and D_4, D_5 and D_6 may be omitted.

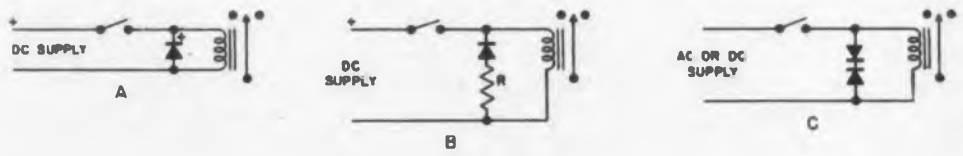


Fig. 10. Relay contact protection circuits for inductive loads. The circuit to use depends upon the load conditions.

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

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

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

Still another use of time delay relays is to provide for the initiation of a new circuit function after a predetermined interval following the completion of a previous function. In Fig. 9e rectifier R_{x1} operates relay R_1 and also charges capacitor *C*. After relay R_1 is deenergized, the stored energy in capacitor *C* closes relay R_2 and holds it closed until the charge on the capacitor decays to the drop-out voltage of the relay.

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

References

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

Rotary Ratio

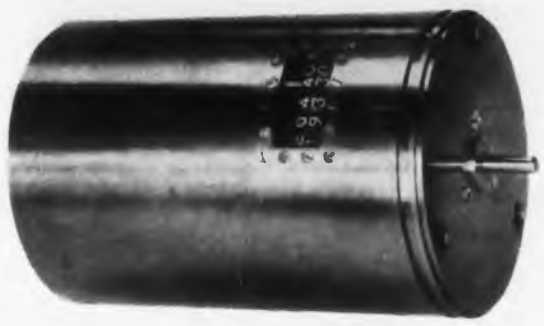
EXTREMELY accurate automatic translation of digital information to mechanical movement can be effected using a new, available transducer. Called the Rotary RatioTran, it is a rotary ratio transformer which closely approaches the characteristics of an ideal precision ac voltage divider. A unique feature is the built-in mechanical counter for simple readout of shaft rotational ratio of the instrument.

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

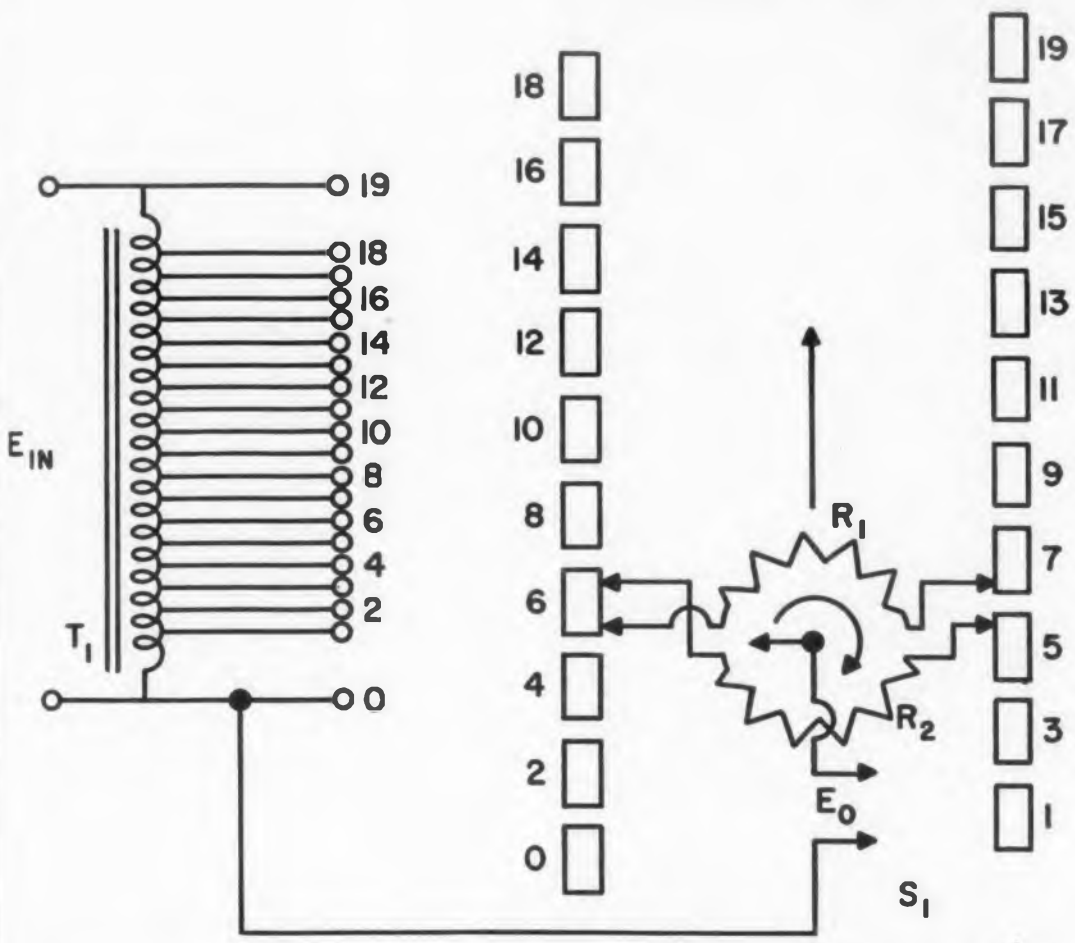
Autotransformer T_1 of Fig. 2 shows how a 10-turn unit is constructed with 20 taps, equally spaced, and connected to the corresponding fixed contacts on switch S_1. R_1 and R_2 are resistance windings on the special potentiometer. Winding ends are insulated so that they are electrically isolated from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

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

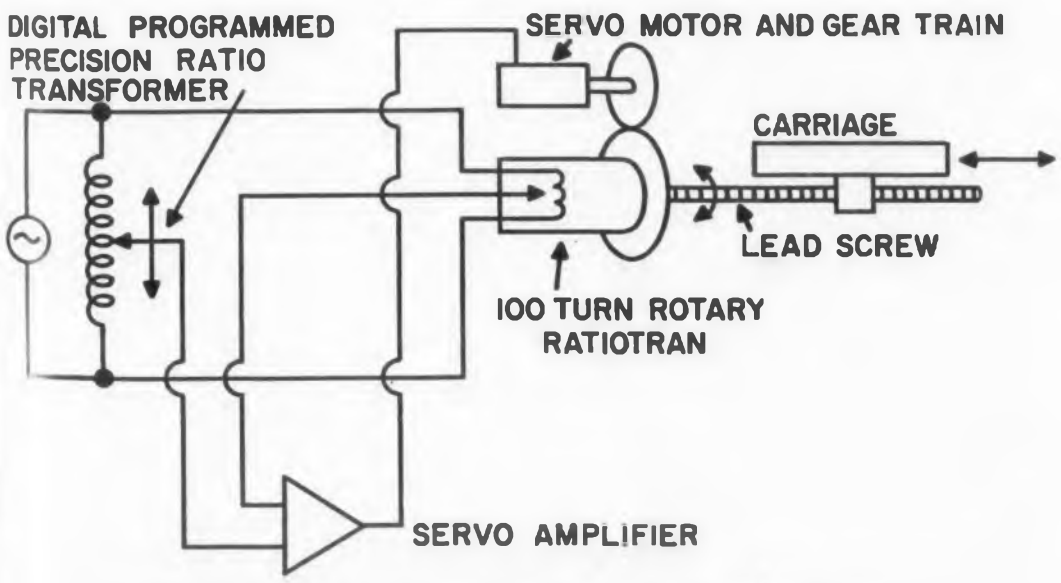
Transformer



Suitable for gear trains and servo systems.



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



Simplified diagram of servo system for precise carriage movement.

Temperature Compensation Method For Transistor Amplifiers

Albert N. DeSautels
Minneapolis-Honeywell Regulator Company

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

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

Theory of Compensation

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

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

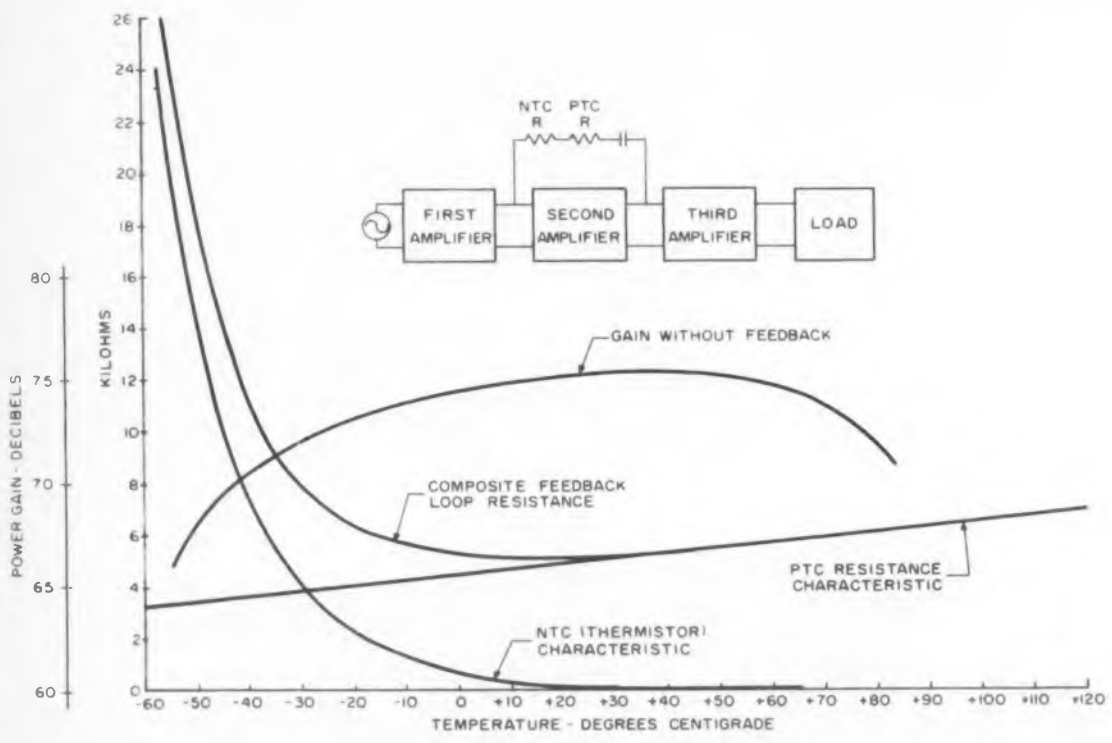


Fig. 2. Temperature characteristics of feedback loop components.

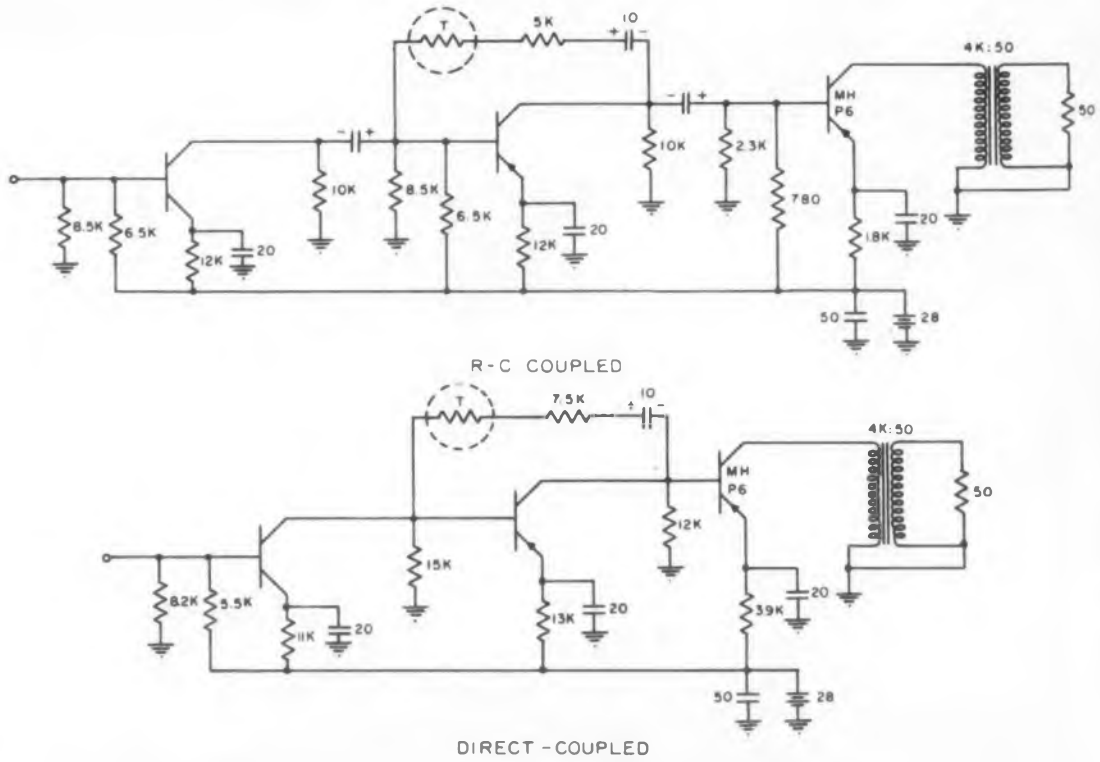


Fig. 3. Schematics of experimental three-stage amplifiers.

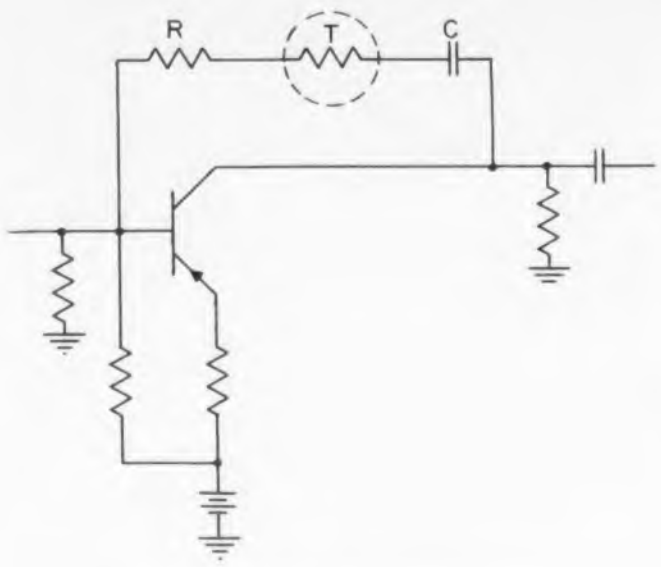


Fig. 1. Simplified schematic showing feedback loop.

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

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

Experimental Results

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

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

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

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

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

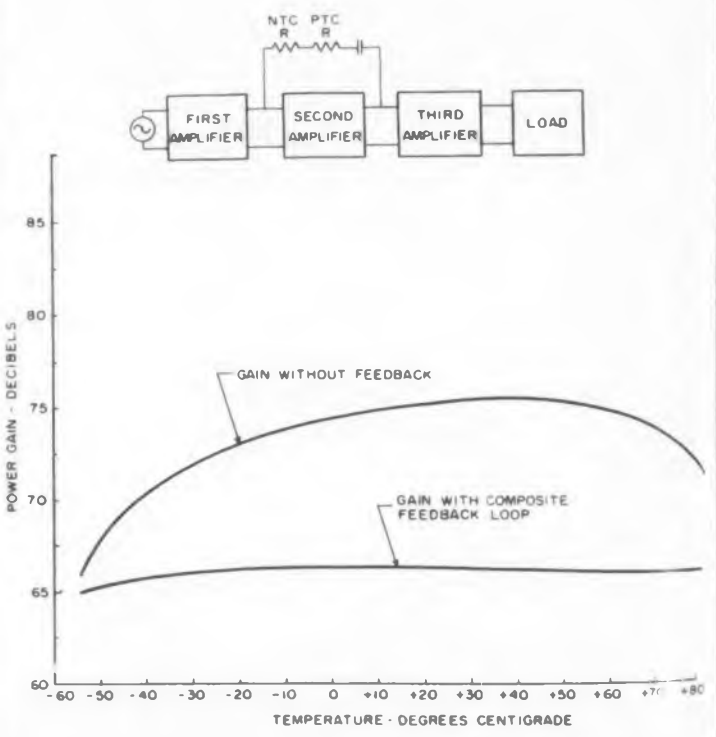


Fig. 5. Temperature characteristics of three-stage, r-c coupled transistor amplifier gain with and without feedback.

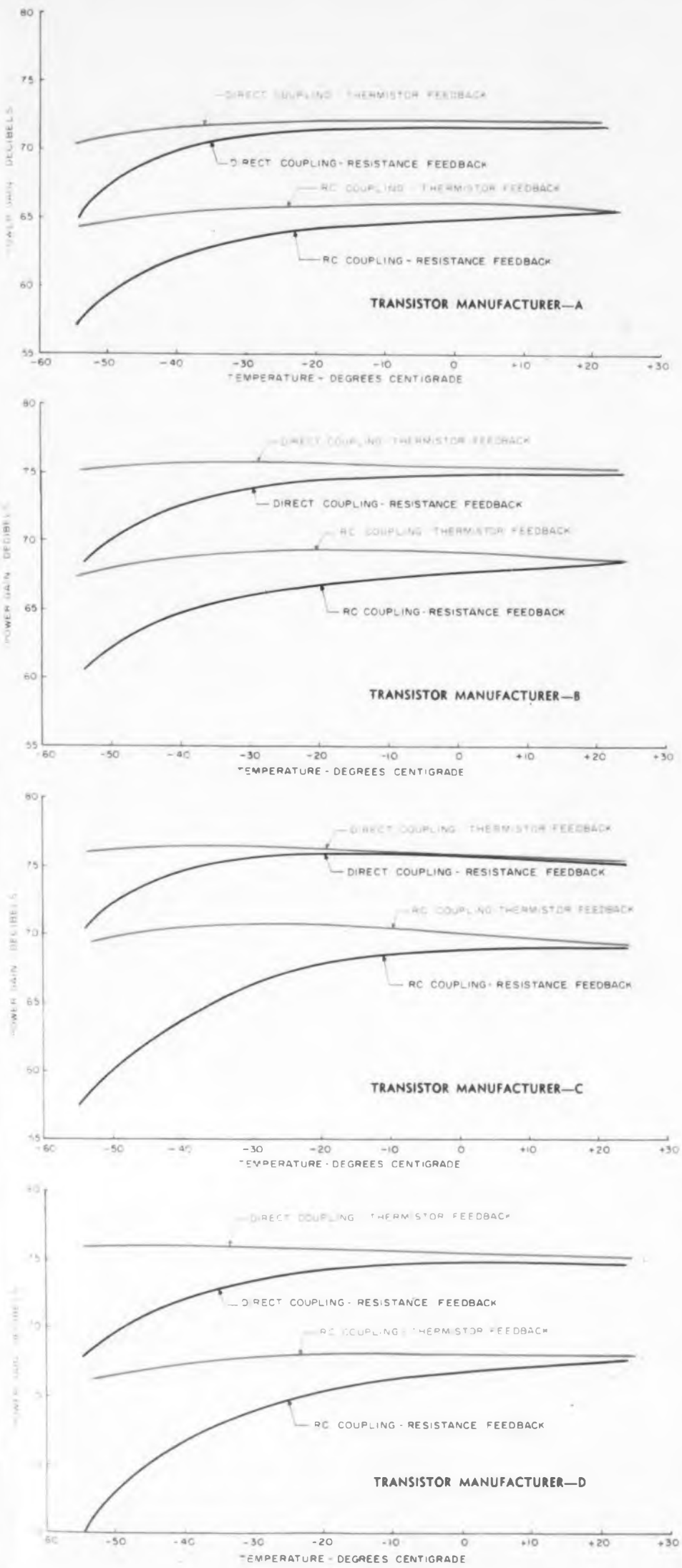


Fig. 4. Low temperature gain characteristics of four different manufacturer's transistors in a three-stage transistor with thermistor feedback and fixed resistance feedback. Legend:

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

42 Microsec

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

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

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

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

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

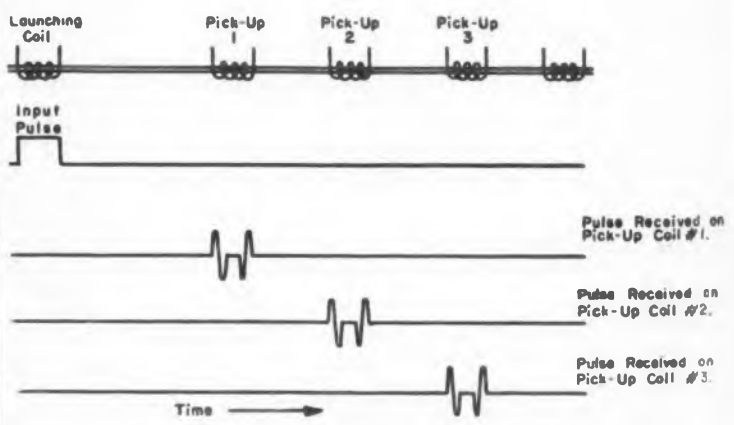


Fig. 2. Typical output pulses, showing how they are spaced in time depending upon physical location of pickup coils.

Delay Line

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

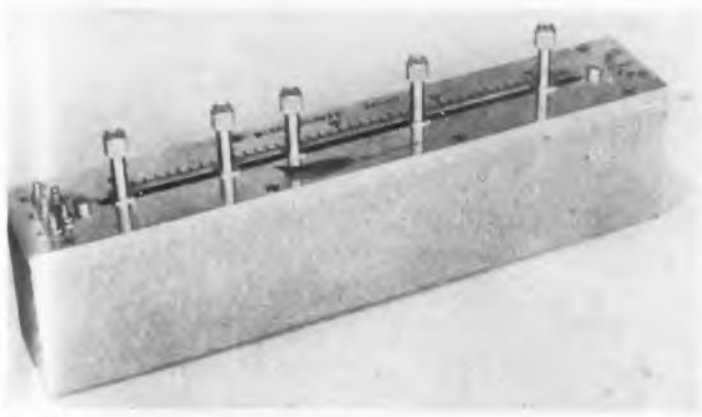


Fig. 3. Deltime Model 103 Delay Line which can be fitted with up to 20 pickup coils with delays up to several milliseconds.

Circuitry For Photodiodes

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

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

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

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

Detection and Counting

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

Position Indicator

Shown in Fig. 3 is a circuit for using photodiodes as a position indicator or position controller. The circuit input uses two photodiodes to control the input voltage. The amplifier output uses a complementary transistor pair to drive a dc control motor. The effect of an increased (or decreased) light intensity on either photodiode will drive the control meter in the direction given by the activated photodiode. The photodiode potentiometers should be adjusted for no motor movement when both diodes are exposed to a light source. This circuit set-up is advantageous, for example, in automatic production operations where obstructions or a complex material shape obviates use of stationary feeders or welders. As the material to be worked interrupts the light beam to the first photodiode, the feeder or welder could start moving toward the object, perform its function on interception and then retract as the second photodiode is cleared by the object worked on. This system also makes it unnecessary to stop the feeder mechanism if the work can be done fast enough or if the feeder programming is set at the proper speed.

Speed Control

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

Circuit Advantages

The advantages of the circuits discussed are as follows:

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

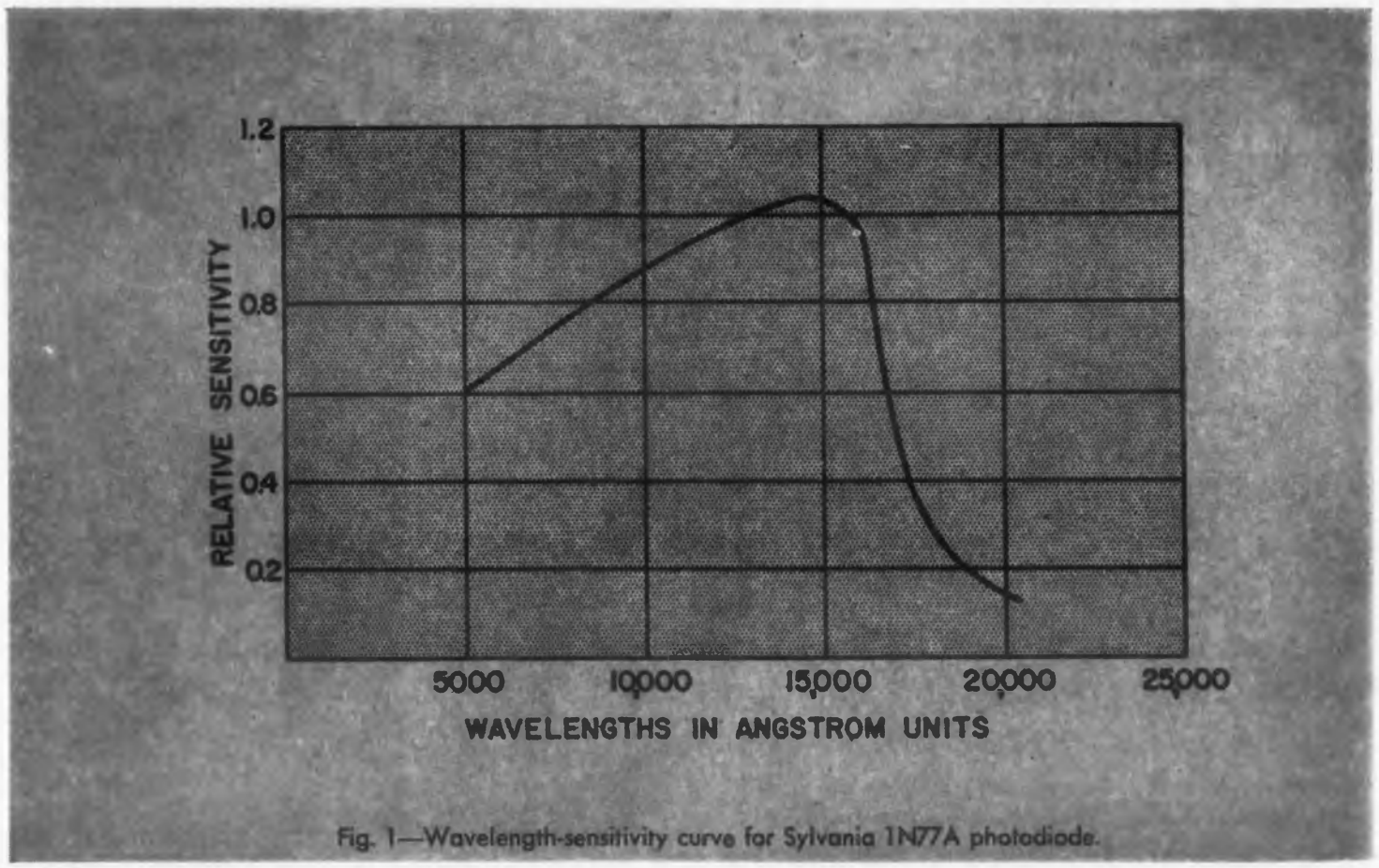


Fig. 1—Wavelength-sensitivity curve for Sylvania 1N77A photodiode.

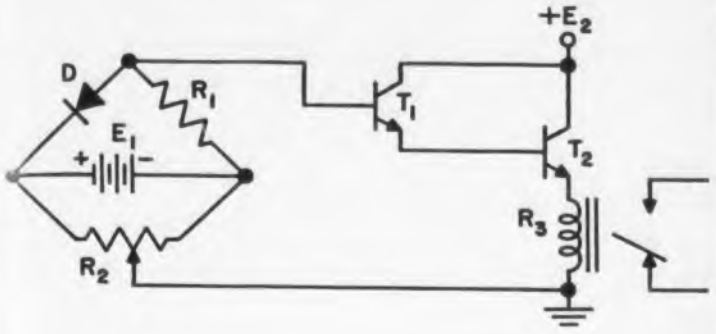


Fig. 2—Photodiode circuit for detection and counting. Components: *D*—1N77A photodiode; E_1—22-45 v; E_2—6-12 v; T_1, T_2—2N35 transistors; R_1—100K; R_2—50K pot.; R_3—Sigma 400G relay.

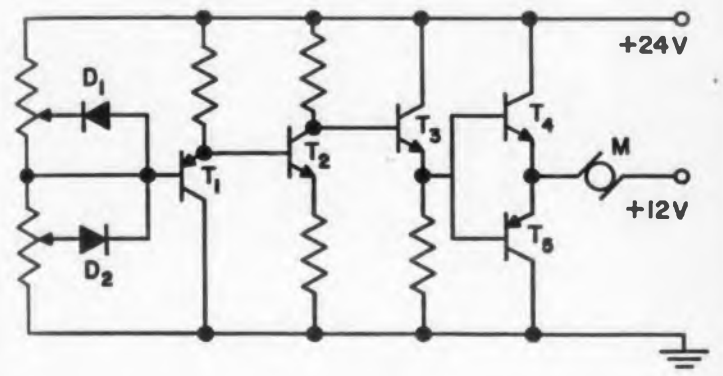


Fig. 3—Position indicator circuit. Components: D_1, D_2—1N77A photodiodes; T_1—2N34; T_2—2N35; T_3, T_4—2N95 power transistors; T_5—2N68 power transistor; *M*—dc control motor (approx. 200-300 ma full speed).

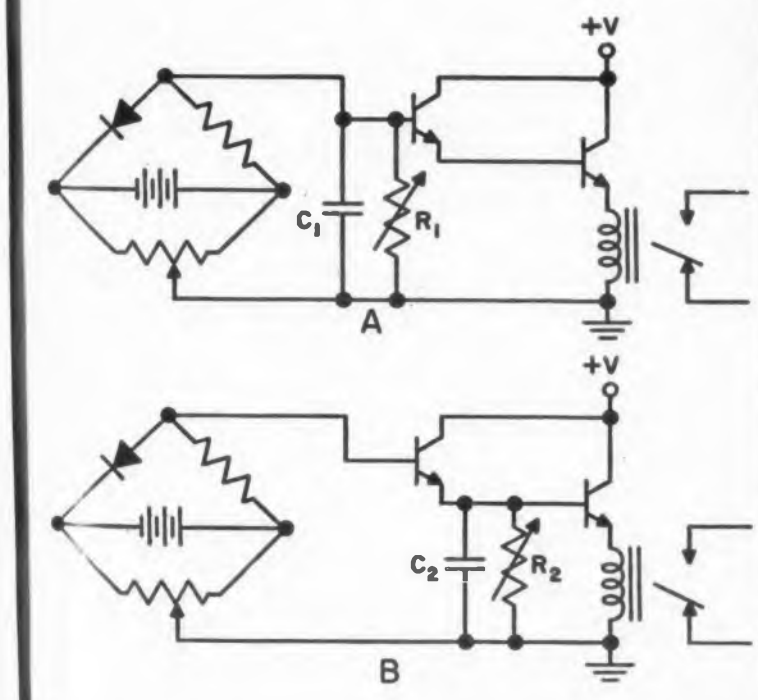


Fig. 4—Speed control circuit. (A)—Delay on relay closing; (B) Delay on relay opening. Components: C_1—4μ; R_1—1 M fine time control; C_2—100 μf; R_2—100K fine time control.

CIRCLE 30 ON READER-SERVICE CARD FOR MORE INFORMATION

UHF Oscillator Stability Tester

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

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

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

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

*Word contraction for stabilized local oscillator.

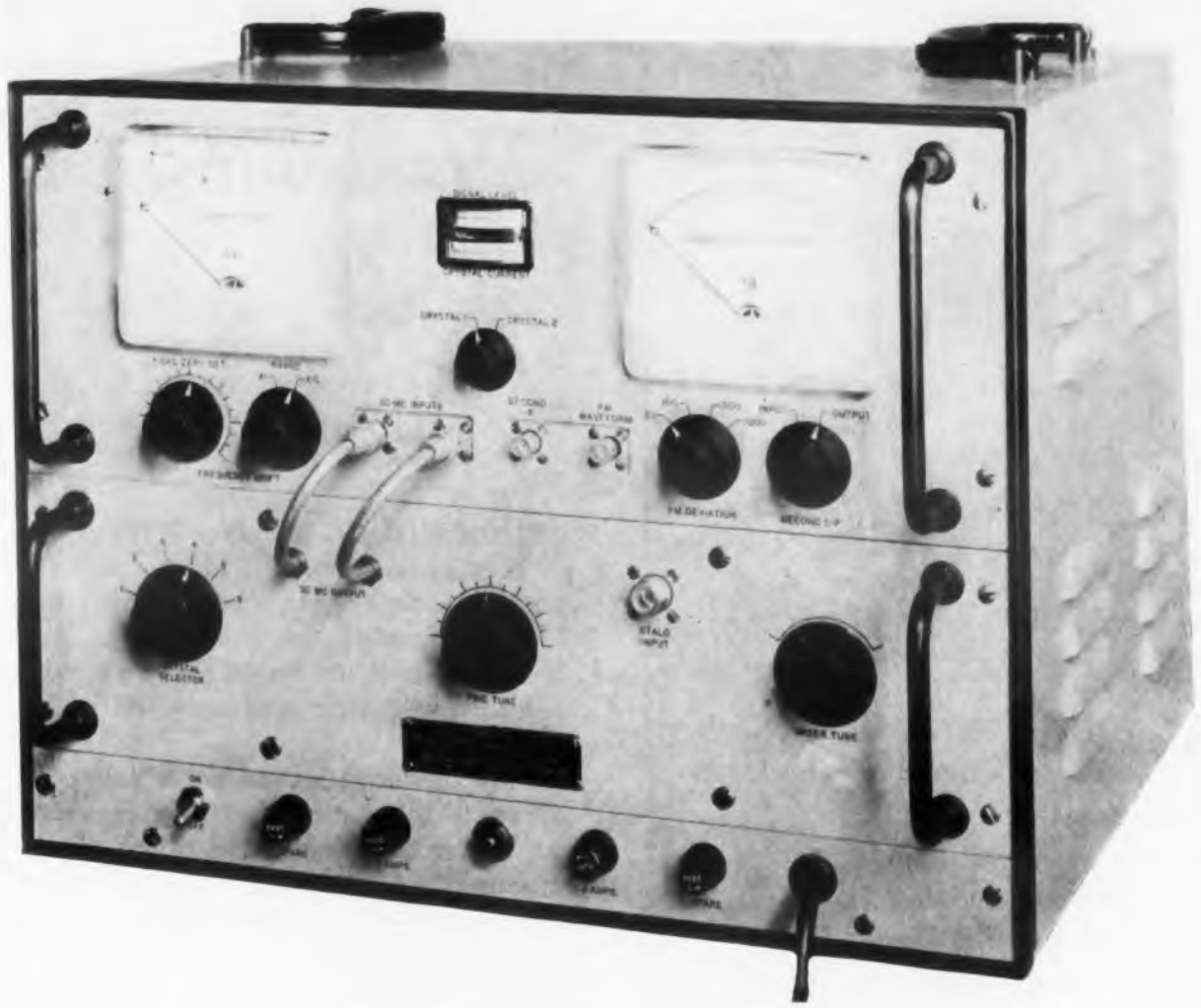
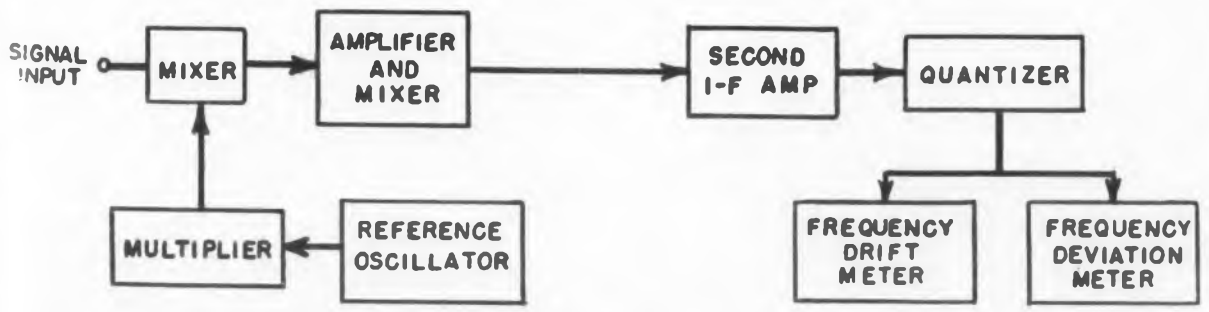


Photo: Front Panel View, Stalo Stability Tester

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

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

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



Line Drawing: Simplified Block Diagram, Stalo Stability Tester

Producing 3D

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

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

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

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

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

Visual Patterns

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

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

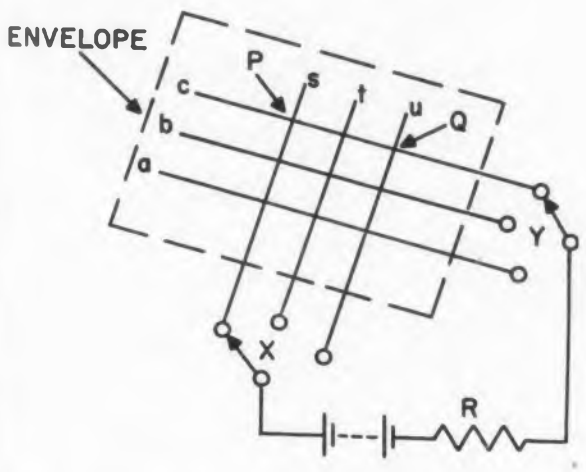


Fig. 1 Planar glow at wire proximity junctions

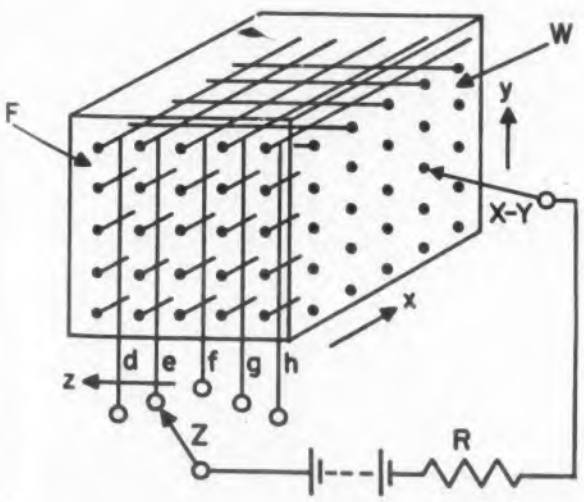


Fig. 2 3D glow at wire proximity junctions

Transistorized Power Sources

For DC to AC and DC to DC Conversion*

Robert R. Smyth and Marvin G. Schorr
Consultants
Power Sources, Inc.
Arlington, Massachusetts

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

Methods of Power Conversion

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

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

A new and improved solution to the problem of converting dc voltage level involves the use of a transistor power oscillator to interrupt the low-level dc source. Fig. 1 shows both internal and external appearance of a typical transistor power converter developed by Power Sources, Inc. of Arlington, Mass. Transistors, driven in push-pull, replace the customary mechanical element, and the power converter circuit can thus withstand the full shock and vibration limits of the transistors themselves. By using transistors, weight and volume of the power converter can usually be reduced, and power efficiency increased to as high as 85%. The most spectacular advantage of the transistor power converter, however, is its increase in operating life. Power converter life is limited only by the basic components themselves and may be 50,000 hours or more under suitable conditions.

Basic Transistor Oscillator

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

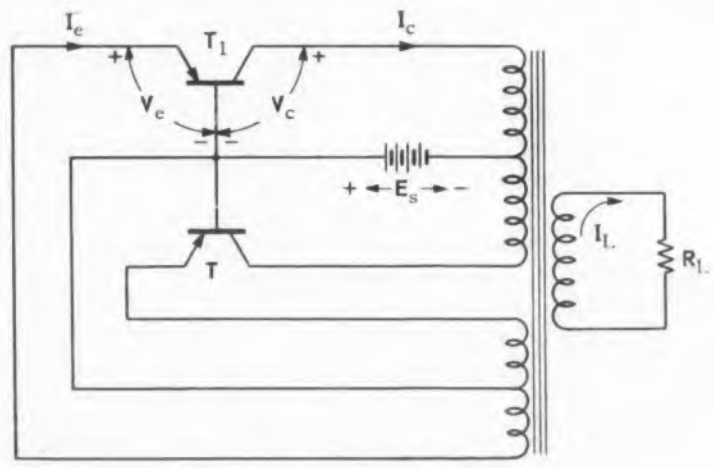


Fig. 2. Basic transistor oscillator circuit

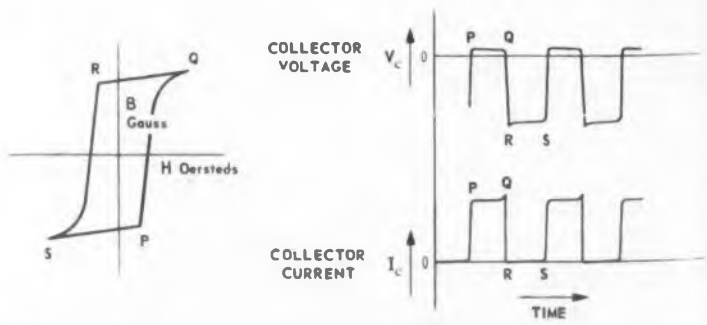


Fig. 3. B-H curve for transformer core and resultant oscillator waveform

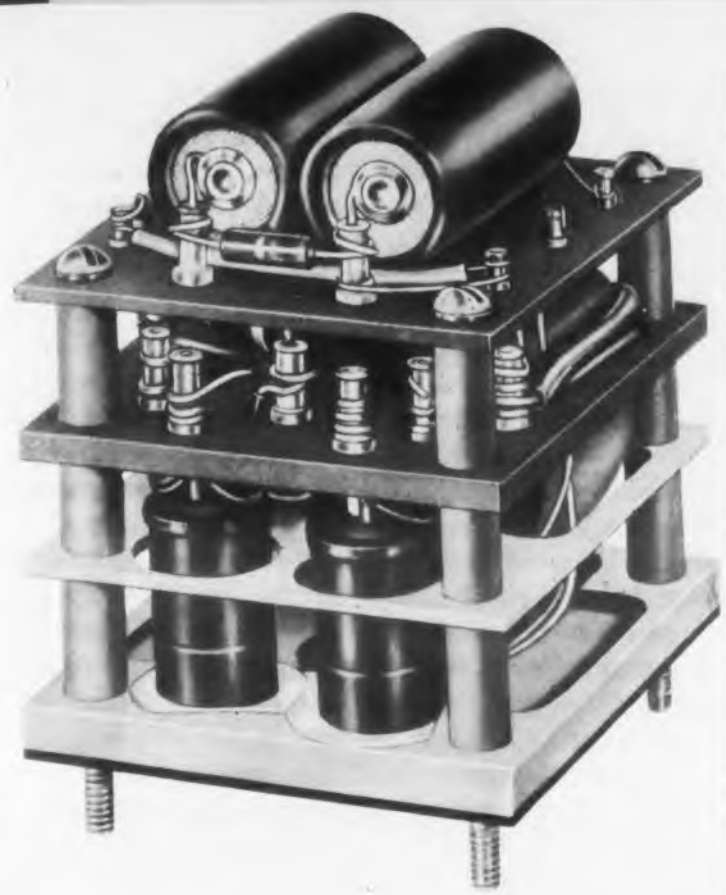


Fig. 1. Typical transistor power converter for 24 v dc input and producing 30 watt output. It fits into a standard MIL-T-27 can measuring only 3-1/16 x 3-3/16 x 2-5/8 in. The entire unit weighs only 14 ounces.

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

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

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

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

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

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

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

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

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

DC to DC Transistor Power Converter

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

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

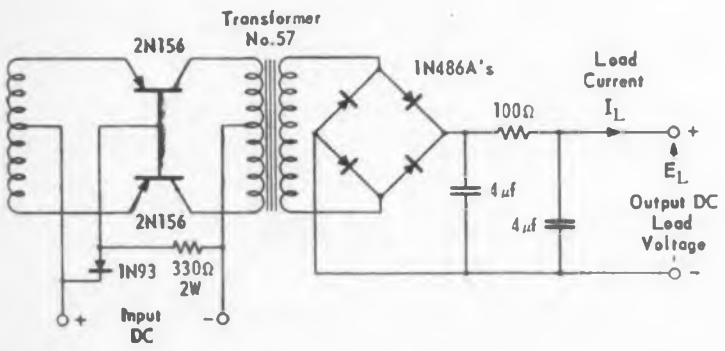


Fig. 4. Circuit of DC to DC transistor power converter

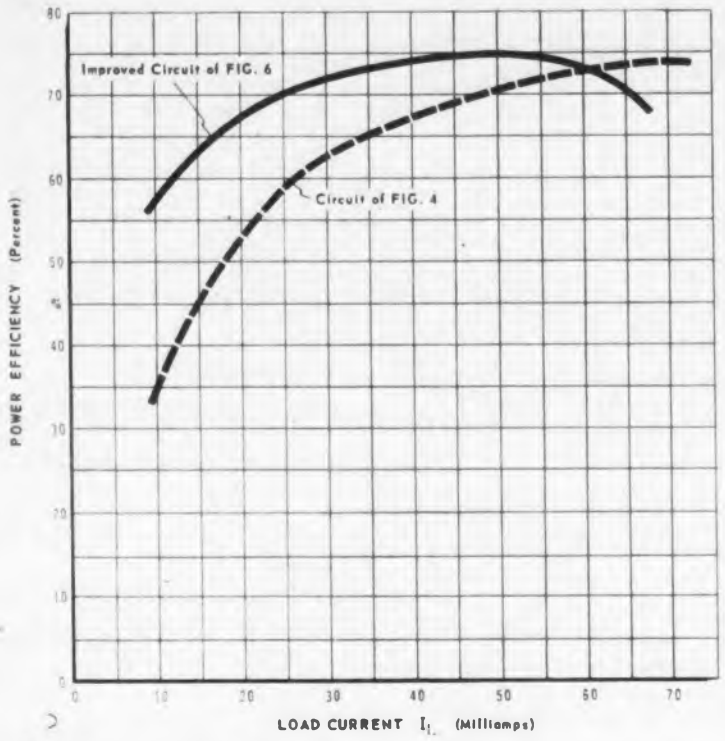


Fig. 5. DC to DC power conversion efficiency vs. load current

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

Conversion Efficiency

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

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

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

Transistor Converter Design

Oscillator Frequency: The frequency of transistor oscillation is, within broad limits, subject to the choice of the designer. The maximum upper limit is set by response of the transistors themselves. To preserve high efficiency, the rise and fall times of the transistor responses must be short compared to the period of oscillation.

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

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

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

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

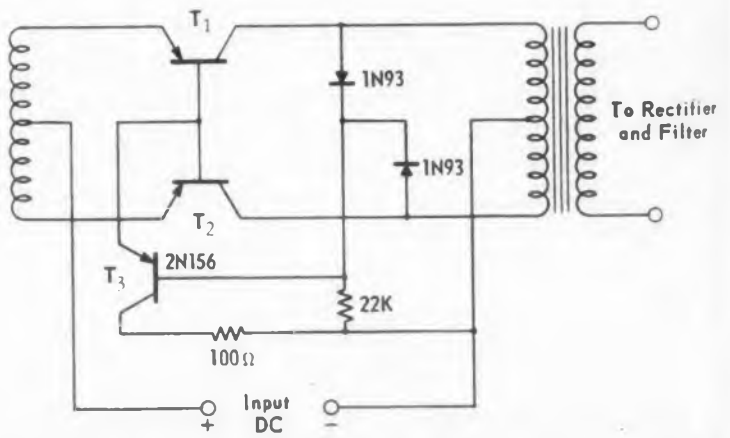


Fig. 6. Modified oscillator circuit for improved regulation

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

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

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

Typical Converter Performance

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

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

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

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

Designing Iron-Core Inductances

With Superimposed Direct Current

J. H. Davis

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

EI Lam.	A_c (cm²)	$R_c \times 10^{-6}$ (microhms)	l_c (cm)	Figure of Merit C_T	C_R
187	0.23	44	4.14	16.6	34.6
375	0.91	45	7.32	130	136
21	1.61	33	8.26	355	280
* 50	1.61	44	7.62	310	243
* 56	2.04	39	8.56	468	327
*625	2.52	35	9.53	680	426
* 68	3.05	32	10.49	940	540
* 75	3.62	26	11.43	1.4x10³	710
* 11	4.94	22.3	13.34	2.3x "	1050
* 12	6.45	19.5	15.25	4.0x "	1460
*112	8.19	15.7	17.15	6 x "	2060
*125	10.07	14.0	19.05	8.5x "	2700
30	12.19	12.4	22.86	12 x "	3460
14	10.07	12.5		9 x "	2850
*138	12.20	10.6	20.96	13 x "	3750
16	13.60	11	23.95	15 x "	4100
* 13	14.50	11.2	22.86	16.5 "	4340
*175	19.80	10.3	26.70	27 "	6200
36	17.03	6.6	27.90	27 "	6600
19	19.74	4.3	33.00	42 "	9540
F14	.23	149	3.18		19
EE24-25	.406	59	5.08	33.8	53
EE26-27	.91	59	6.67	103	118
*EI-212	29.15	7.0	32.39	63 x10³	11000

*Scrapless core of square cross section

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

Four basic assumptions have been made:

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

Starting points are the five basic equations of electricity and magnetism:

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

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

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

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

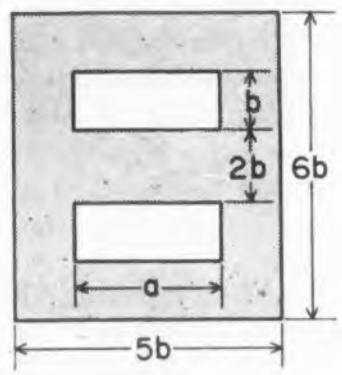
$$R = \frac{1}{A_c \mu} \text{ (all dimensions in cm)}$$

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

$$B_{max} = B_{acm} + B_{dc}$$

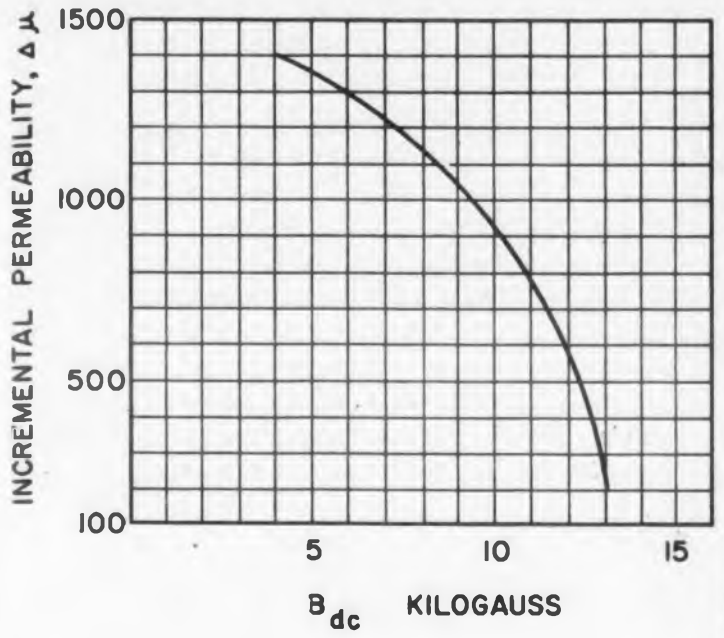
$$= \frac{0.4\,\pi\,NI_{ac}\sqrt{2}}{G} + \frac{0.4\,\pi\,NI_{dc}}{G}$$

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



Typical core lamination showing dimensions a and b.

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



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

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

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

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

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

Solving equations 1 and 2 for B_{dc}

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

For B_{max} use:

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

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

2000 gauss for Mumetal

5000 gauss for 4750 alloy or Carpenter 49

Minimum value of turns is established by:

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

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

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

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

$$R_w = N^2 R_c \tag{5}$$

where

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

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

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

$$A_c = 4\ b^2$$
$$a = 3\ b$$

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

$$N = \frac{1}{1}\sqrt{\frac{A_c}{R_c}} \tag{7}$$

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

$$C_R \geqq \frac{LI_{dc}}{B_{dc}\sqrt{R_w}}\ 10^8$$

$$\geqq \frac{A_c}{\sqrt{R_c}} \tag{8}$$

$$C_T \geqq \frac{LI^2_{dc}}{B_{dc}}\ 10^8$$

$$= \frac{A_c{}^{3/2}}{\sqrt{R_c}} \tag{9}$$

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

Sample Problem

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

Required:

Step 1.

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

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

Step 2.

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

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

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

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

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

Step 3.

$$CT = 2 \times 0.7602 \times 108 = 17.8 \times 103$$

From Table I use $EI = 13$. But since we are liable to end up with a too hot reactor, use the next size, $EI = 175$.

Step 4.

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

Step 5.

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

Dc voltage drop $= 14 \times 0.750 = 10.5$ v

Step 6.

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

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

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

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

Step 7.

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

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

or Cir Mil of Wire

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

where A_w is in inches l_m is in inches.

Solving for $EI = 175$ AWG, No. 21 wire will do. With 0.040-in. spool and 0.15-in. kraft paper over the winding and using 0.005-in. layer insulation, we end up with 1310 turns. Checking: We find $R_w = 1310^2 \times 10.3 \times 1.0^-{}_6 = 17.8$ voltage drop still within limit.

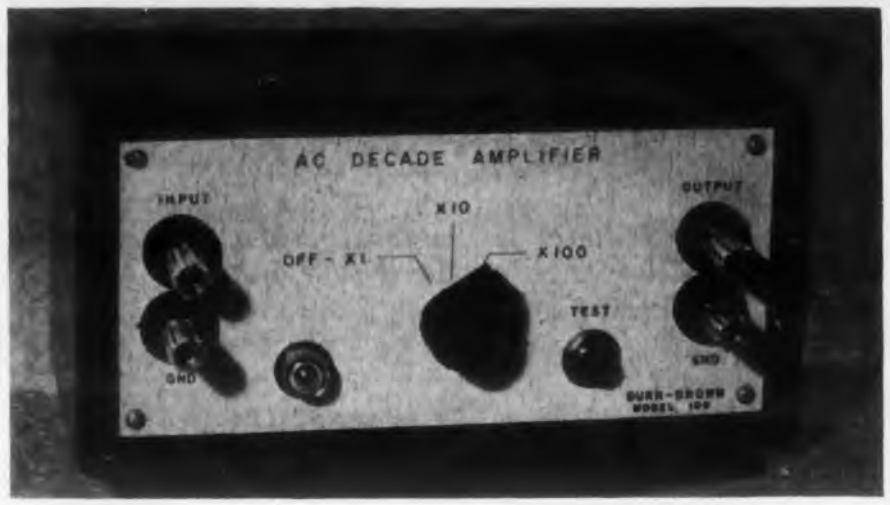
Max. watts dissipated $= 17.8 \times .7602 = 10.2$ watts. A_c in $\text{cm}^2 = 19.76$. Therefore, the temperature rise is within limits.

$$L = 2.46\ \text{henries}$$
$$B_{dc} = 9700\ \text{gauss}$$
$$B_{ac} = 1660\ \text{gauss}$$
$$B_{dc} + B_{ac} = 11360\ \text{gauss}$$

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

Nomenclature

A_c = Core Cross Section, cm^2
A_w = Gross coil winding area of lamination, cm^2
B = Flux density of magnetic path, gauss.
B_{max} = Maximum working flux density of core material gauss.
B_{ac} = Alternating rms value of flux density, gauss.
B_{acm} = Maximum value of ac flux density, gauss.
B_{dc} = Direct current flux density, gauss.
CR, CT = Figures of merit of a stack lamination.
D = Total dissipating area of wound coil and core in in^2.
E_{max} = Maximum volts
E = Volts, rms.
e = Instantaneous volts of a sinusoid wave form.
f = Frequency, cps, or function.
F_w = Winding space factor.
F = Magneto motive force, gilberts.
H = Magnetizing force, oersteds.
I = Current amps.
I_{dc} = Direct current, amps.
I_{ac} = Rms current, amps.
i = Instantaneous current of a sinusoid wave form.
I_{max} = Maximum value of current of a sine wave.
K = Stacking factor of laminations.
l_m = Mean length of winding (one turn) in cm.
l_e = Mean length of uniform magnetic path, cm.
l_g = Mean length of gap in magnetic path, cm.
L = Inductance in henries.
N = Number of turns.
Q = Quality factor
R_c = Resistance of copper bar occupying net available winding space.
R_t = Total equivalent resistance of inductor.
R = Reluctance of magnetic path subscript, R_i = iron, R_a = air.
W_t = Total loss (iron and copper) watts.
R_w = winding resistance in ohms.
w = $2\pi f$
μ = Permeability
μ_a = Permeability in air.
μi = Permeability of iron.
$\Delta\mu$ = Incremental permeability or ac permeability.
ρ = Resistivity of copper.
ϕ = Magnetic flux.
ϕ_{max} = Maximum magnetic flux of a sinusoidal wave shape.
θ = Temperature rise in Centigrade above noted ambient.



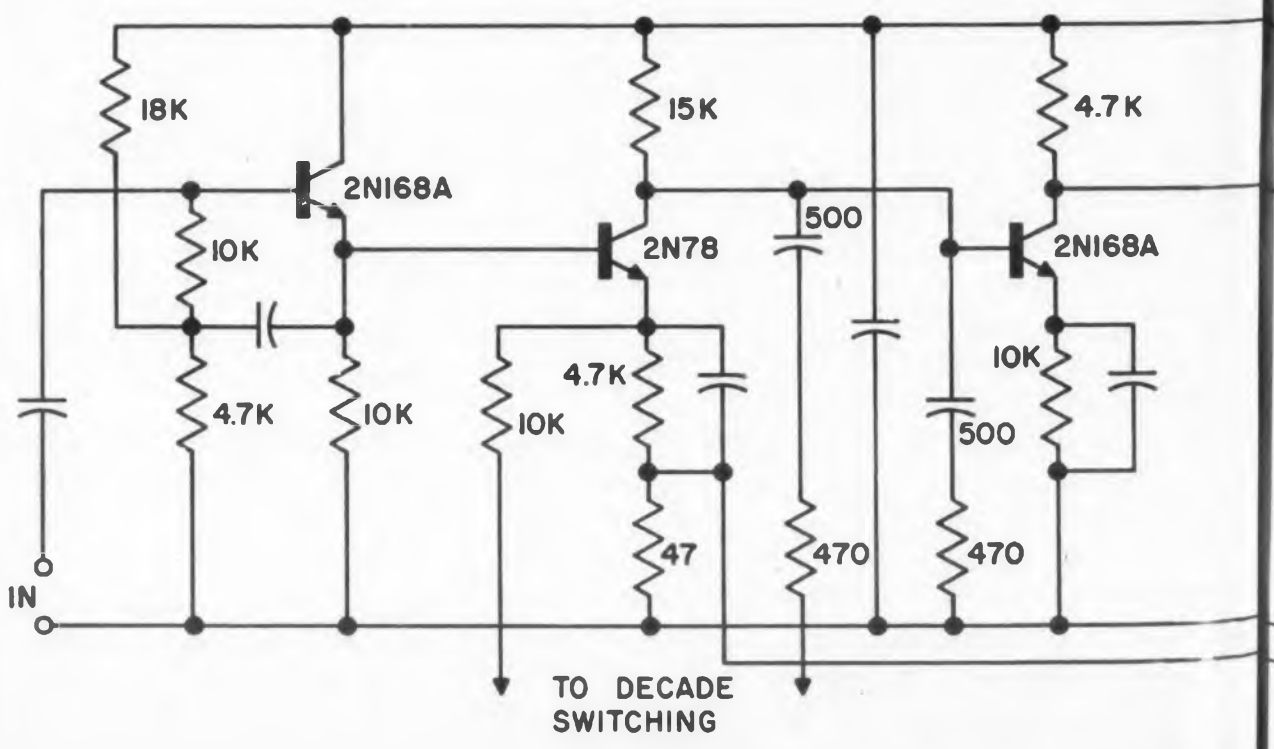
Basically a two-stage resistance-coupled, feed-back amplifier the Model 100 AC Decade Amplifier is designed to achieve maximum temperature stability and minimum low frequency phase shift. Approximately 35 db of feedback is employed for gain stability and frequency characteristics. The high frequency roll-off is designed to display 'maximal flatness' and therefore be free of peaking.

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

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

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

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



AC Decade Amplifier

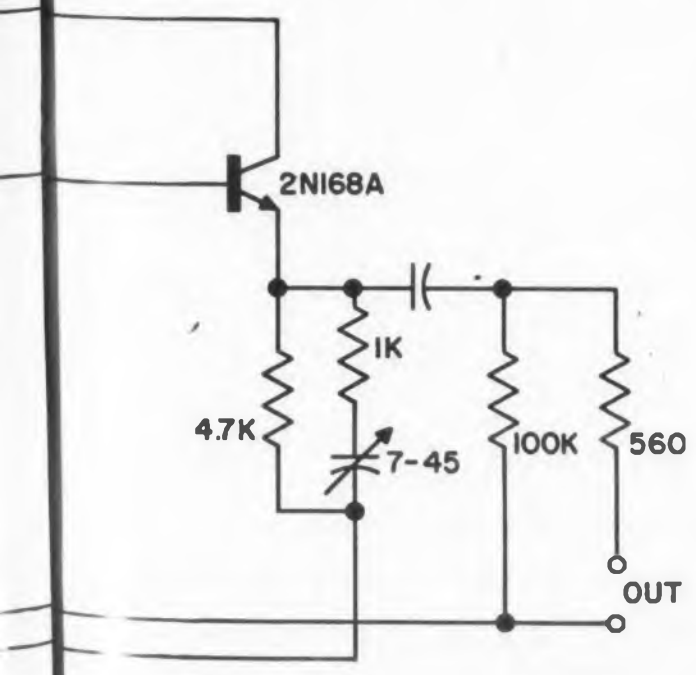
various bandwidths is therefore approximately as follows:

Bandwidth	Noise
20 kc	0.7 μv
200 kc	2.2 μv
800 kc	4.5 μv

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

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

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



Bandwidth Curves for Designing Amplifier Stages

Harold D. Webb
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University of Illinois

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

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

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

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

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

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

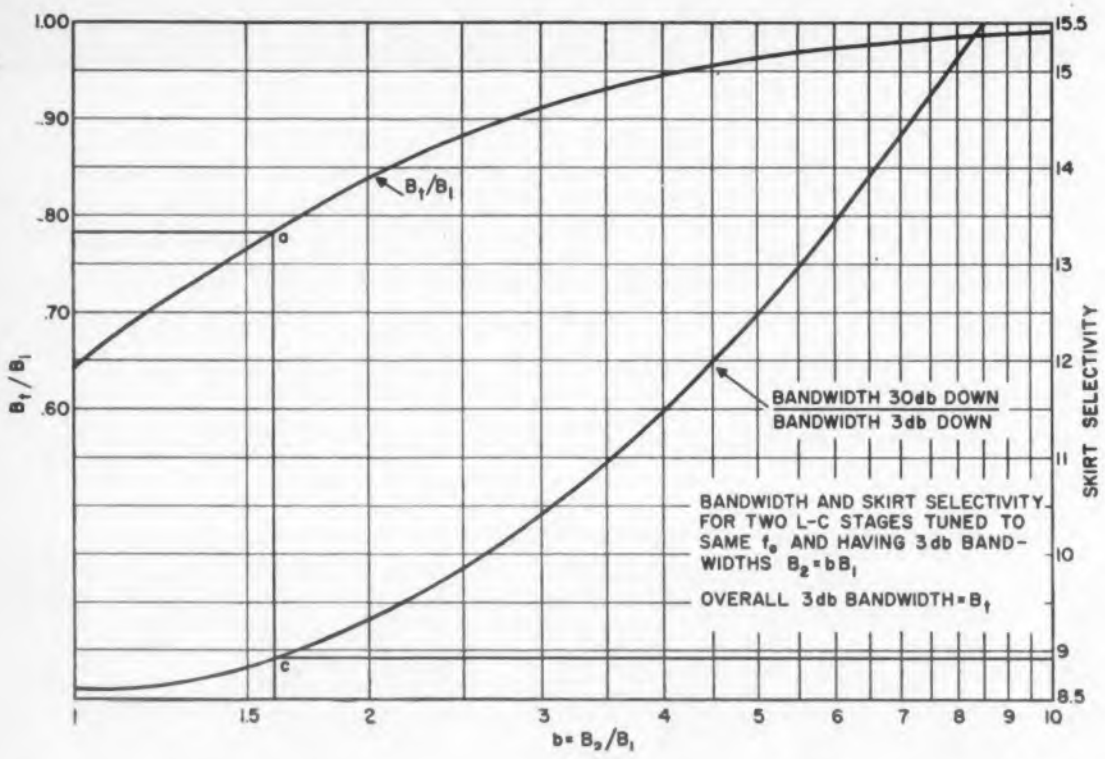


Fig. 1. Design curves for L-C amplifier stages.

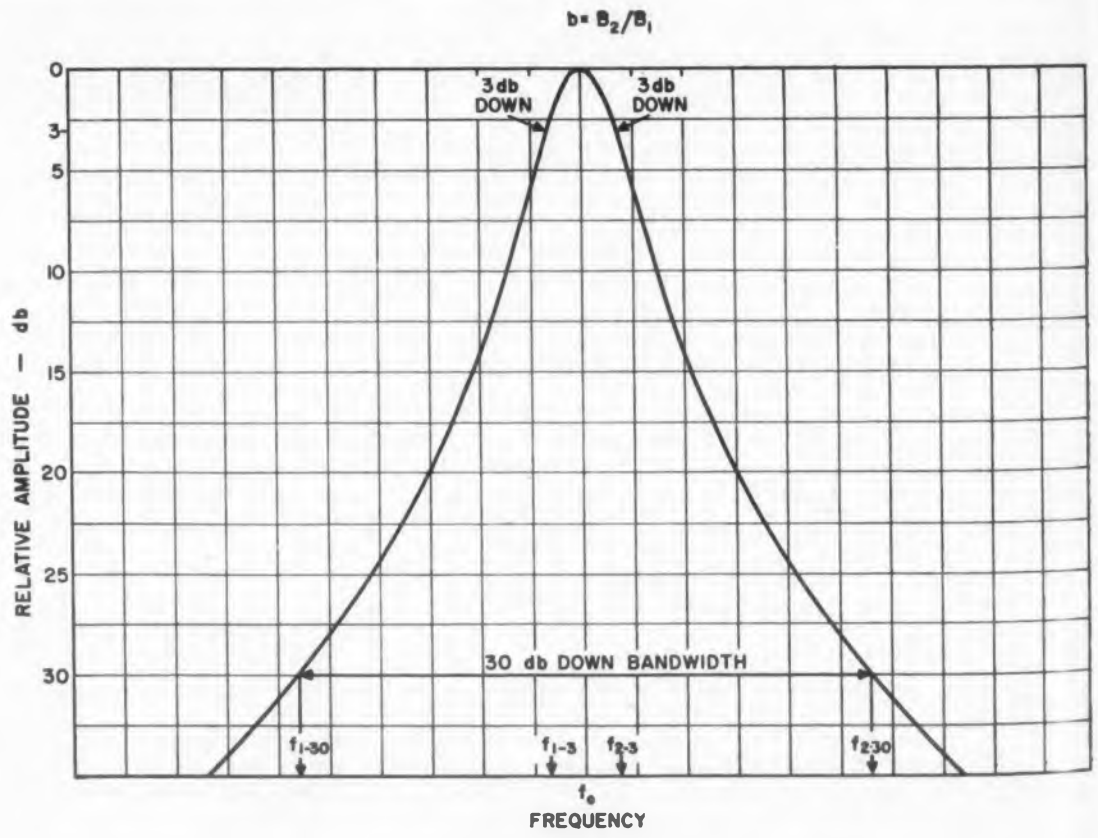


Fig. 2. L-C coupled response for two stages.

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

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

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

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

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

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

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

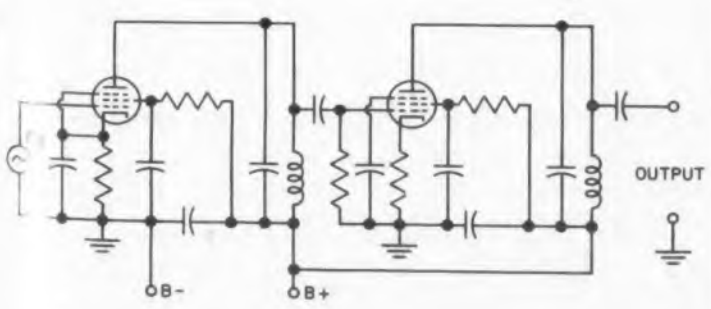


Fig. 3. Circuit diagram for two L-C coupled stages.

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

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

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

Another manner in which the curves of Figs. 1, 4, and 5 may be used is as follows. Suppose that a two stage amplifier has been designed to give a certain bandwidth, but more gain is required and a third stage must be added. Suppose further that a small decrease in overall bandwidth may be tolerated. Fig. 1 may be used to find the bandwidth of the second stage after the overall bandwidth for two stages and the bandwidth for one stage are measured. Then Fig. 4 may be used to find the bandwidth required for the third stage. As an example of this case, suppose the overall bandwidth for the two stages is 1.1 mc, and the bandwidth of one of the stages is 1.4 mc. A third stage must be added such that the overall bandwidth is 1 mc.

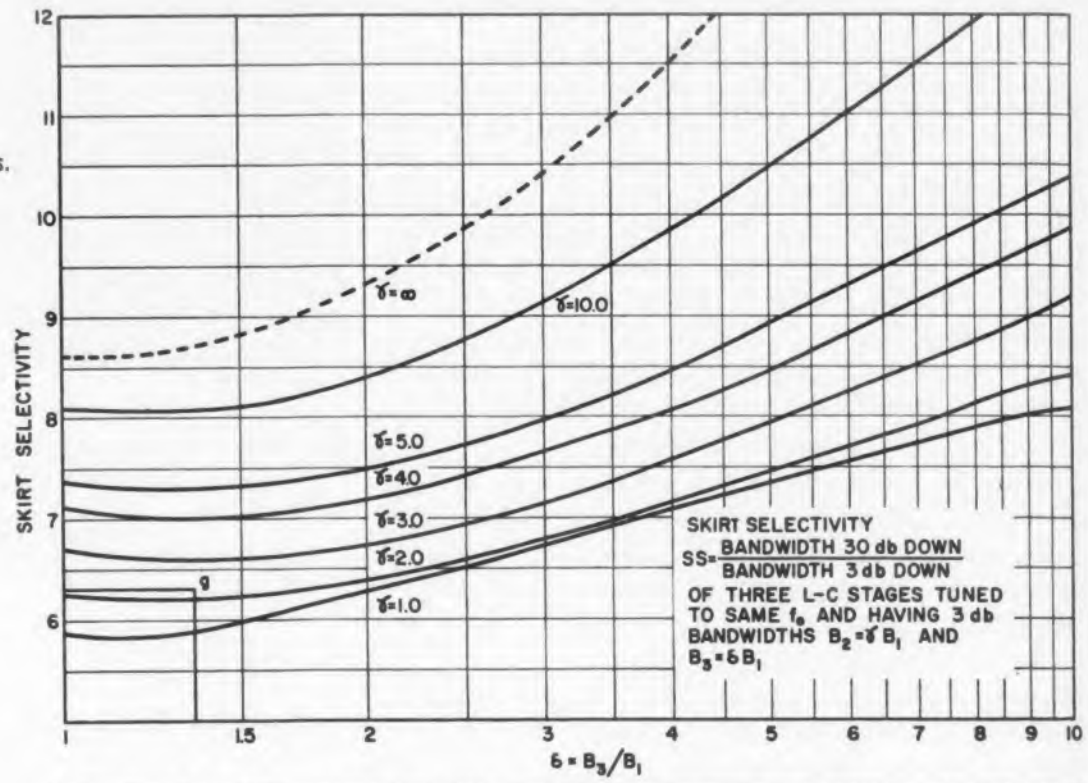
From Fig. 1, using $B_t/B_1 = 1.1/1.4 = 0.786$, $b = 1.63$, or $B_2 = 1.63 \times 1.4 = 2.28$ mc.

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

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

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

Fig. 5. Skirt selectivity curves.



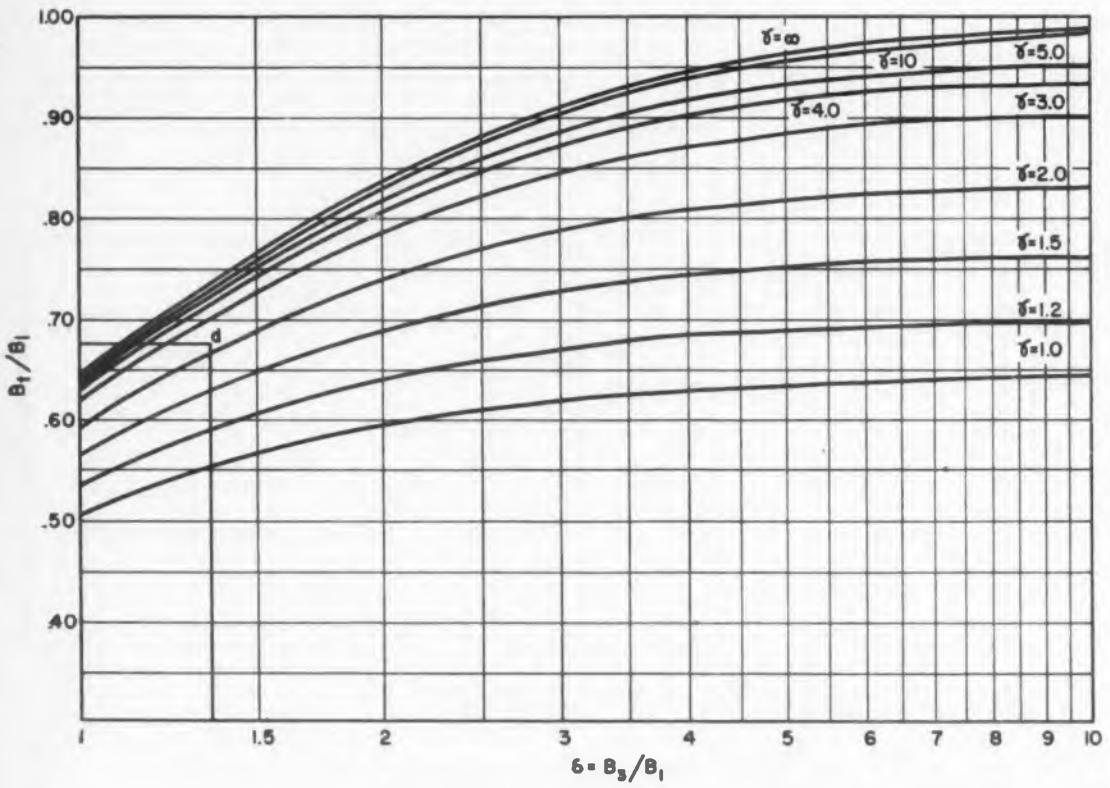


Fig. 4. Design curves for determining bandwidth of three L-C stages tuned to the same center freqency.

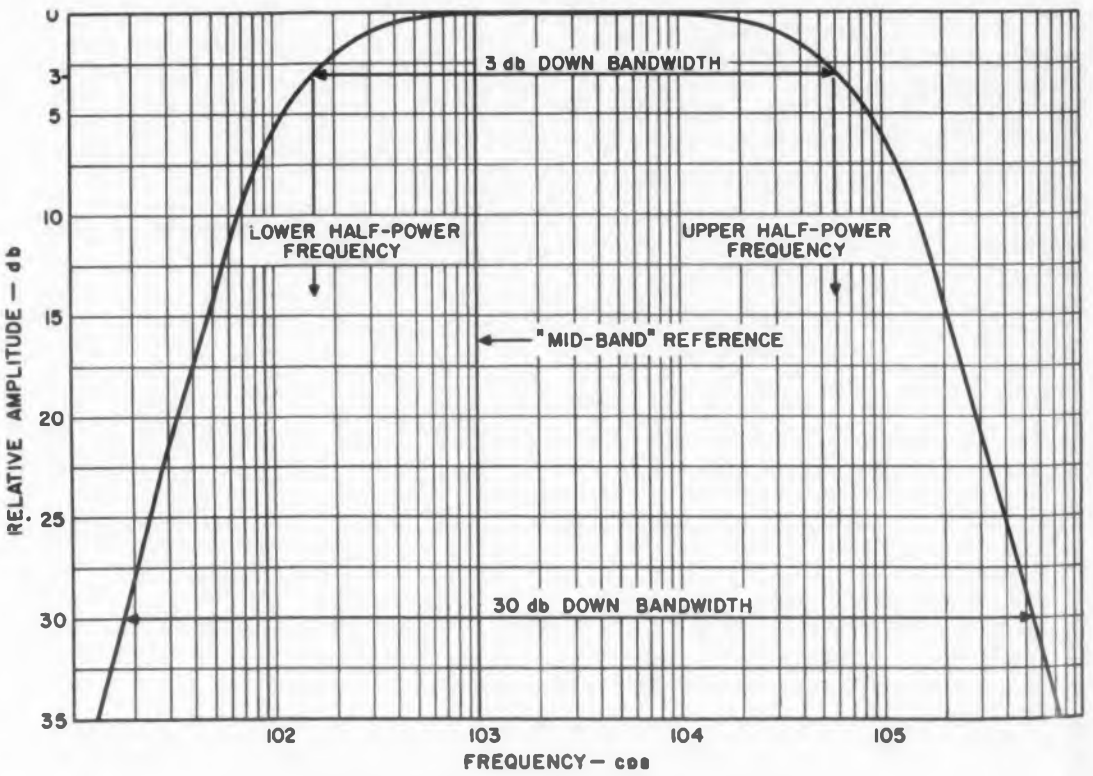


Fig. 6. R-C coupled response for two stages.

CALCULATIONS

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

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

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

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

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

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

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

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

$$\left| A_t \right| = \frac{\left| A_{f_o} \right|}{\sqrt{2}} \quad (3)$$

where A_t is the overall gain and

$$\left| A_{f_o} \right| = \frac{g_{m1}\, g_{m2}}{4\pi^2\, C_1 C_2\, B_1 B_2} \quad (4)$$

This occurs when

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

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

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

where

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

Then

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

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

To get the skirt selectivity, first find $B_{t\text{-}3o}/B_t$ from

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

Then skirt selectivity $= B_{t\text{-}3o}/B_t$ for various values of b. This procedure was used for Fig. 1.

To calculate Fig. 4, the equation for B_t becomes

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

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

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

New Products

Voltage-Reference

Secondary-Standard

A new ultra-stable secondary-standard voltage-reference source combines a dc voltage source with five decade switches as incremental voltage dividers. The continuous dc reference outputs of ±100.00 v have initial accuracy of .01 per cent and maximum drift of .02 per cent *per year.* Output voltage is selectable between +111.112 and −111.112 in discrete steps of 1 mv; minimum resolution steps of 10 μv are obtainable when a precision 100:1 attenuator is used.

Power input is 150 w, 95 to 125 v, 50 to 60 cps, ac.

Epsco, Inc., Dept. ED, 588 Commonwealth Ave., Boston 16, Mass.

CIRCLE 46 ON READER-SERVICE CARD FOR MORE INFORMATION

Transistor Plugboard

For Instant Circuits

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

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

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

CIRCLE 48 ON READER-SERVICE CARD FOR MORE INFORMATION

Direct Frequency Meters

Can Read up to 10 Kc

These frequency meters are direct indicating panel instruments which can be made for any frequency from 40 to 10,000 cycles. The accuracy 0.25 per cent of center scale reading, and they are available for any input between 80 and 500 v. The meters can be made with a maximum frequency range of ±20 per cent from any specified center frequency.

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

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

CIRCLE 50 ON READER-SERVICE CARD FOR MORE INFORMATION

Breadboard Components

For Servo Systems

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

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

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

CIRCLE 47 ON READER-SERVICE CARD FOR MORE INFORMATION

Slotted Lines

Cover VHF-UHF Range

Two slotted lines offered by this firm permit measurements to be made over the entire vhf-uhf range. The Type FT-LMM covers 80-300 mc and has a residual vswr of 1.03:1; probe location can be read to an accuracy of ± 1 mm. The Type FT-LMD covers 300-3000 mc and has a vswr of 1.02:1; its probe location can be read to an accuracy of ±0.1 mm. Both lines have their own built-in detectors and indicators.

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

CIRCLE 49 ON READER-SERVICE CARD FOR MORE INFORMATION

Transistor Oscillator

Crystal-Controlled

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

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

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

CIRCLE 51 ON READER-SERVICE CARD FOR MORE INFORMATION

Ferrite Cores

Are Temperature Stable

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

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

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

CIRCLE 52 ON READER-SERVICE CARD

Television Camera Tube

Has High Sensitivity

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

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

CIRCLE 53 ON READER-SERVICE CARD

Oscillographic Paper

Faster, Thinner

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

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

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

CIRCLE 54 ON READER-SERVICE CARD

CIRCLE 55 ON READER-SERVICE CARD ➤

Logarithmic Converter

For Wide Range Plotting

The logarithmic converter Model 60 is used with the autograf X-Y recorder in applications where dc output voltages proportional to the logarithm of the input voltages are required. Models are available for either ac or dc inputs. The logarithmic output voltage provides the Y function of the curves.

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

CIRCLE 57 ON READER-SERVICE CARD FOR MORE INFORMATION

Indicating Light

Goes Back Only 1-1/16 in.

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

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

CIRCLE 58 ON READER-SERVICE CARD FOR MORE INFORMATION

Aluminum Wire Terminal

Has Inspection Hole

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

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

CIRCLE 59 ON READER-SERVICE CARD FOR MORE INFORMATION

Indium Solder

Soft and Untarnishable

Solders bearing the metal indium, in combination with tin, lead, and silver, yield a metal which is softer than lead, lustrous, and untarnishable. When used as a component of solder, it makes the solder harder and more resistant to corrosion by lye and other alkalis.

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

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

CIRCLE 61 ON READER-SERVICE CARD

Teflon Spaghetti Tubing

Available In Color

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

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

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

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

CIRCLE 62 ON READER-SERVICE CARD

CIRCLE 63 ON READER-SERVICE CARD ➤

DU PONT

ELECTRONIC DESIGN NEWS

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

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

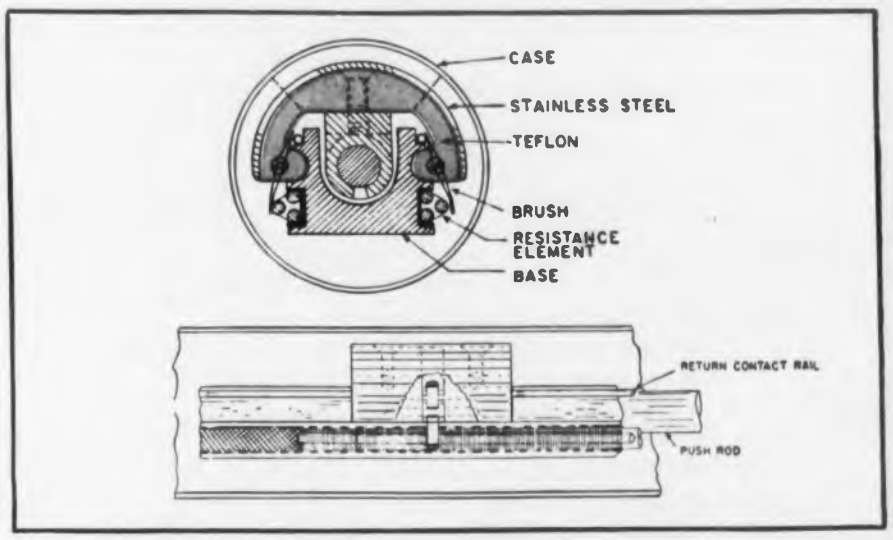
Du Pont ZYTEL® provides needed insulation in strong, lightweight parts

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

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

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

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



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

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

The importance of "Teflon" in this application stems from its high heat resistance and low coefficient of friction. In use, this potentiometer must operate at temperatures as high as 400°F. and intermittently to 550°F. "Teflon" insulates the potentiometer and protects the core. The movement of the sleeve calls for a material with a low coefficient of friction. "Teflon" solves this problem, too.

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

NEED MORE INFORMATION?

CLIP THE COUPON for additional data on the properties and applications of these Du Pont engineering materials.

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

E. I. du Pont de Nemours & Co. (Inc.), Polychemicals Department
Room 4111, 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 and ☐ "Zytel"* nylon resin.

I am interested in evaluating these materials for_____

_____

NAME_____

COMPANY_____ POSITION_____

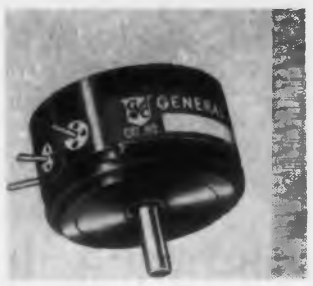
STREET_____

CITY_____ STATE_____

TYPE OF BUSINESS_____

Rotary Potentiometer

±0.3% Linearity



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

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

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

CIRCLE 66 ON READER-SERVICE CARD FOR MORE INFORMATION

Selenium Rectifiers

Line of 45 v Units

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

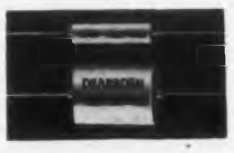
The rectifiers are designed to permit significant savings in cost and space by requiring fewer cells to achieve a desired voltage rating. They are manufactured in both commercial and radio-TV types.

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

CIRCLE 67 ON READER-SERVICE CARD FOR MORE INFORMATION

Metallized Film Capacitor

Self-Healing



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

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

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

CIRCLE 68 ON READER-SERVICE CARD FOR MORE INFORMATION

CIRCLE 69 ON READER-SERVICE CARD

Abrasion Resistant Cables

Have Teflon Jackets

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

The jackets are treated to provide abrasion resistance and also have the normal ability of Teflon to resist solvents and withstand temperatures ranging from minus 300 F to plus 392 F.

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

CIRCLE 71 ON READER-SERVICE CARD FOR MORE INFORMATION

Test Point Connector

For Printed Circuit Board

A female test point receptacle for printed circuit wiring will accept and hold a standard .080 test probe. Molding body is Mineral filled Melamine and is designed for right angle mounting. Six floating type contacts are made of spring temper phosphor bronze, gold plated over silver for low contact resistance and ease of soldering.

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

CIRCLE 72 ON READER-SERVICE CARD FOR MORE INFORMATION

Power Resistor

For Printed Circuits

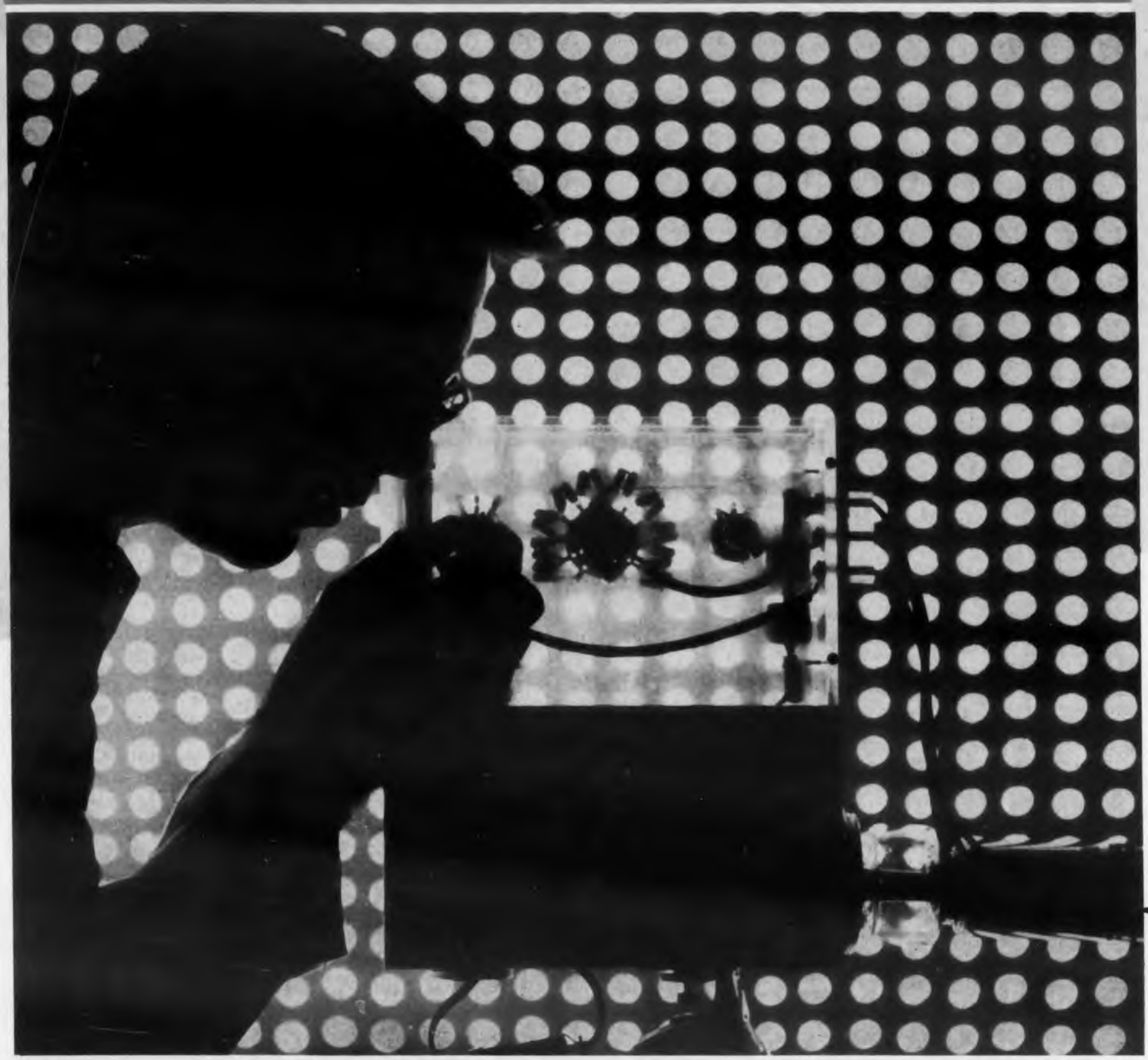
A new type of flexible power resistor is specially designed for printed circuits. The element is wound on a flexible fiberglass core. The sleeving, also of fiberglass, is heavily saturated with silicone to pass requirements for above chassis mounting.

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

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

CIRCLE 73 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC WEEK



A HAYDEN PUBLICATION October 8, 1956

Complete Electronic News Coverage—Every Week—From All Over The World

ELECTRONIC WEEK is reporting America's fastest-growing industry—clearly—concisely in a single publication. Here is *all* the electronic news brought to you from world-wide electronic centers by correspondents experienced in the electronic field. *The Week in Electronics . . . Washington Report . . . Electronics and the Law . . . Broadcasting . . . Labor . . . Finance . . . Inside Wall Street . . . Taxwise Tips . . . Marketing . . . Contract Awards . . . Foreign News . . . People . . . Plants.* This is information of value to management of all levels.

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CURTISS-WRIGHT
DYNAMIC CAPACITOR ELECTROMETER

FOR STABLE AMPLIFICATION OF LOW-LEVEL DC SIGNALS

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

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

ELECTRONICS DIVISION
CURTISS-WRIGHT
CORPORATION • CARLSTADT, N. J.

CIRCLE 75 ON READER-SERVICE CARD FOR MORE INFORMATION

Capacitor Kit
For Transistor Circuits

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

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

CIRCLE 76 ON READER-SERVICE CARD FOR MORE INFORMATION

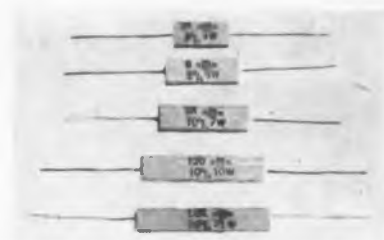
Delay Line
Continuously Variable

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

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

CIRCLE 77 ON READER-SERVICE CARD FOR MORE INFORMATION

Resistor Line
From 4 to 15 Watts

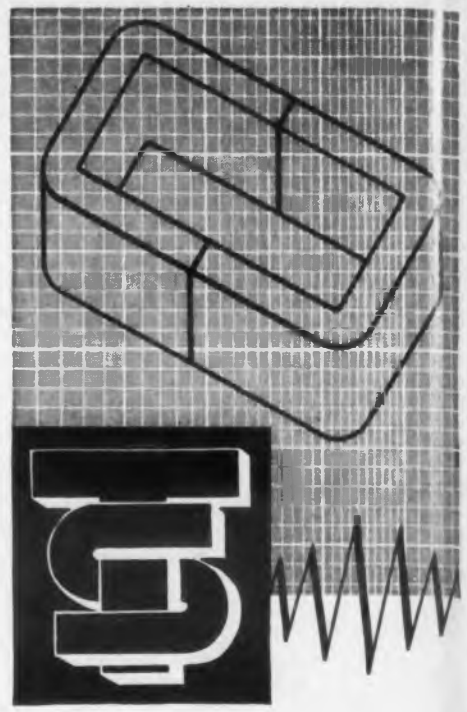


The Square Ohm or bath-tube type of unit is made in five sizes as shown by the photographs. These range from 7/8 in. through 1 1/8 in, 1 3/8 in., 1 5/8 in. and 2 1/16 in., covering the ranges from 4 w to 15 w.

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

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

CIRCLE 78 ON READER-SERVICE CARD FOR MORE INFORMATION



wound cores

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

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

Besides complete assurance of quality and specification conformity, T&S offers its highly qualified engineering assistance—based on more than 50 years experience in the magnetic materials industry—to help you select the core best suited for your application.

Write today for Bulletin WC-356.

Specialists in magnetic materials

THOMAS & SKINNER, INC.
INDIANAPOLIS, INDIANA
1157 EAST 23rd STREET

CIRCLE 79 ON READER-SERVICE CARD

Trimming Potentiometer

High Resistance

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

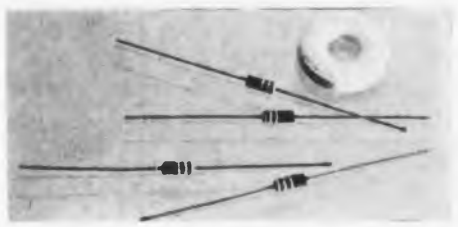
Subminiature in size, these units can be stacked seven deep in less than 2 sq in. of front panel space. Provided is a screwdriver adjustment over 25 turns, with a self-locking shaft for stable settings.

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

CIRCLE 81 ON READER-SERVICE CARD FOR MORE INFORMATION

Silicon Junction Diodes

Feature Quick Recovery



Quick recovery subminiature silicon junction diodes, 1N625, 1N626, 1N627, 1N628 and 1N629, afford a combination of high speed, high voltage and high temperature.

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

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

CIRCLE 82 ON READER-SERVICE CARD FOR MORE INFORMATION

Hermetically Sealed Relays

Has No Contact Contamination

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

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

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

CIRCLE 83 ON READER-SERVICE CARD FOR MORE INFORMATION

MicroMatch

directional couplers monitor ANTRAC *right . . . here!*

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

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

WRITE FOR OUR 50-page catalog.

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

M.C. Jones

M. C. JONES ELECTRONICS CO., Inc.

BRISTOL, CONNECTICUT

CIRCLE 85 ON READER-SERVICE CARD FOR MORE INFORMATION

400 Cps Motors

Induction and Hysteresis Types

Type FC motors are compact 400 cps units for applications where size, weight, and high performance are the governing factors. Protection for military environmental specifications has been considered in the design. They can be wound as follows: three phase, two pole or four pole; and two phase, two pole or six pole. Both three phase and two phase units can be operated single phase with a suitable phasing capacitor (not furnished). Overload protection can be supplied.

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

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

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

CIRCLE 86 ON READER-SERVICE CARD FOR MORE INFORMATION

Transistorized Scalers

With Decade Counters

The transcaler series is a line of completely transistorized scalers and counters for laboratory or field use. These instruments range from a basic scale of 128 to 1 mc decade units. Use of transistors throughout yields light weight, small size, and low power drain. Automatic count-up and count-down circuitry is included in some models.

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

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

CIRCLE 87 ON READER-SERVICE CARD FOR MORE INFORMATION

High-Power Power Supply

Regulated Multiple Output

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

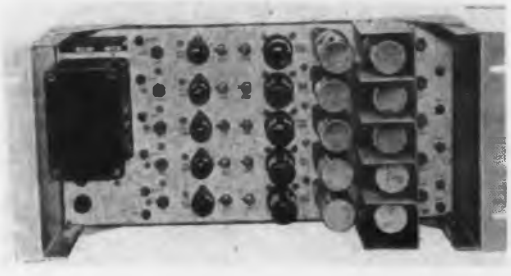
The second output is 0 to 1500 v dc negative with respect to output No. 1 at ±50 ma dc. The third output is rated 0 to 2000 v dc positive with respect to output No. 1 at 10 ma dc.

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

CIRCLE 90 ON READER-SERVICE CARD FOR MORE INFORMATION

Video Distribution Amplifier

Designed For Color Signals



Type 1316, an extremely compact video distribution amplifier for color signals, packs 5 identical amplifiers on a single 8 3/4 in. chassis of standard RETMA 19 in. width, and weighs 17 lbs. The channels feature low differential gain and phase characteristics, and low crosstalk. Differential gain is less than 2 percent (0.17 db) at 50 percent duty cycle. Differential phase is less than 0.3 degree at 50 per cent duty cycle. Crosstalk between channels is less than −60 db from 60 cps to 3.6 mc. The output is source terminated by 75 ohms.

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

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

CIRCLE 91 ON READER-SERVICE CARD FOR MORE INFORMATION

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

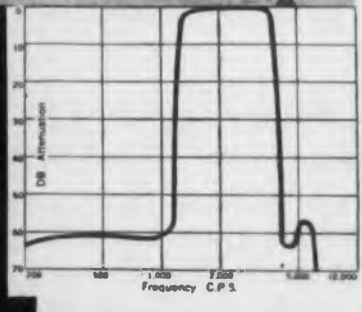
BUILT TO YOUR SPECIFICATIONS or available as stock units.

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

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

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

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



FREQUENCY RESPONSE
Typical
Band-Pass Filter

CHICAGO STANDARD TRANSFORMER CORPORATION

3501 Addison Street, Chicago 18, Illinois
EXPORT SALES: Roburn Agencies, Inc.
431 Greenwich Street, New York 13, New York

Write Today

outlining your filter requirements and for information on stock units.

CIRCLE 92 ON READER-SERVICE CARD FOR MORE INFORMATION

Insulating Bonding Tape

Highly Chemical Resistant

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

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

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

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

CIRCLE 95 ON READER-SERVICE CARD

Battery-Operated Motor

Used in Unattended Recorders

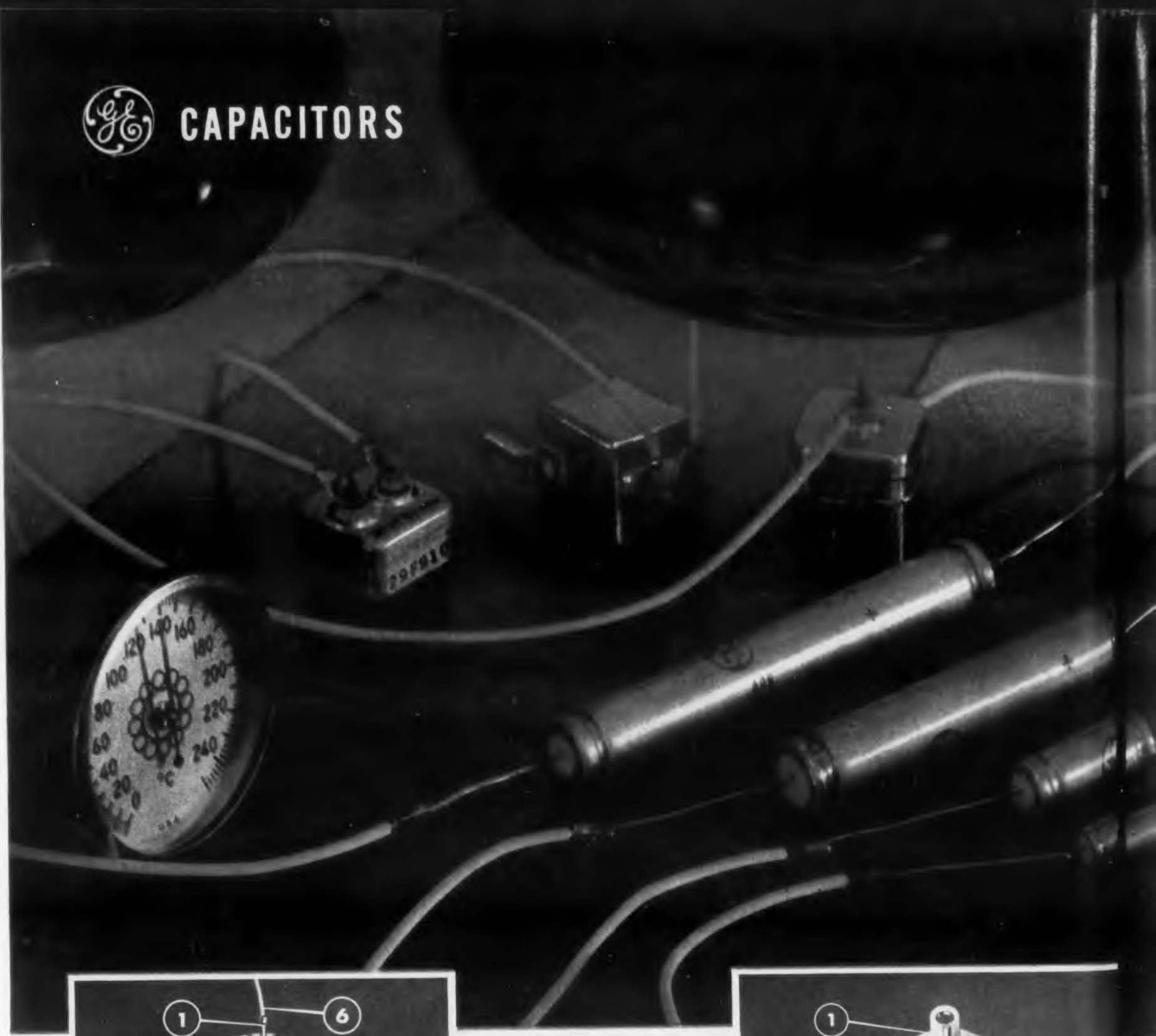
This "Elix" motor has small size (1-1/2 x 1-1/4 x 2-3/8 in. high) and negligible current demands. Utilizing the power of a flashlight battery, it requires no outside source of current. It is used on many recording instruments and chart drives and left unattended for months. For example, a large number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

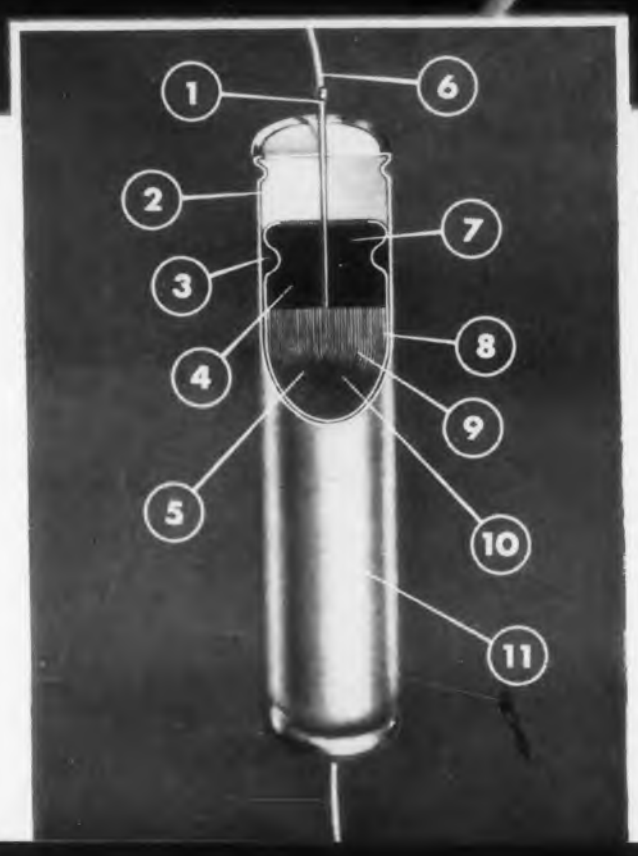
Motion of the motor is controlled by a four jewel balance and a rust-proof hair spring which can be regulated to very close timing requirements. Motor voltages are available for 1-1/2, 4-1/2, 6, and 12 v dc. Output speeds range from 1 rev/hr to 1 and 2 rev/day. Torque varies from 0.5 in. oz to 9 in.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

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

CIRCLE 96 ON READER-SERVICE CARD

CIRCLE 98 ON READER-SERVICE CARD ➤

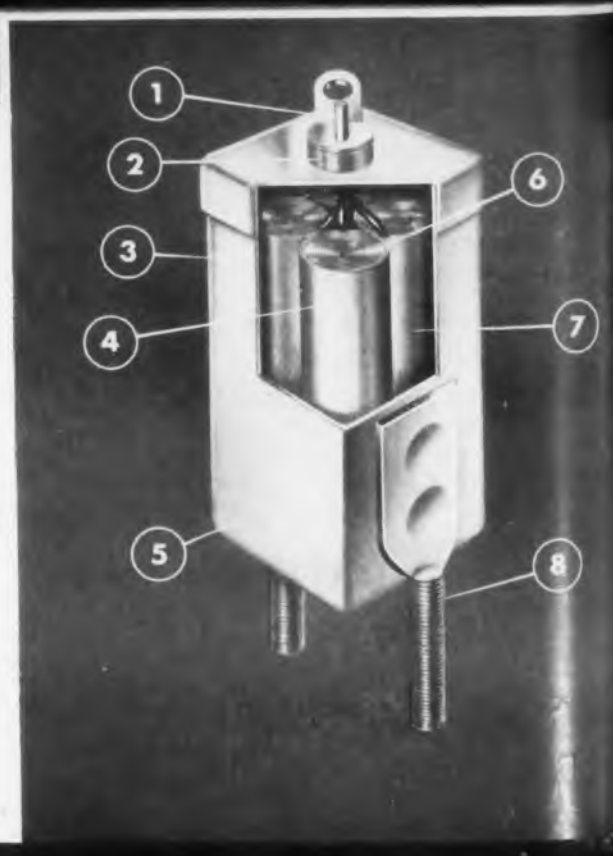




HIGH TEMPERATURE TANTALYTIC CAPACITOR — TUBULAR — features: 1 —Tantalum lead, 2 — Teflon* bushing, 3 — Mylar* insulating sleeving, 4 — Insulation, 5 — Paper and tantalum foil roll, 6 — Solderable nickel lead, 7 — Rubber bushing, 8 — Double metal case construction, 9 — Non-acid electrolyte, 10 — Plain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

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

*DuPont Co. Trade Mark



Insulating Resin

Of Flexible Epoxy

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

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

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

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

CIRCLE 99 ON READER-SERVICE CARD

Bonding Label

Oil Resistant

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

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

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

CIRCLE 100 ON READER-SERVICE CARD

← CIRCLE 98 ON READER-SERVICE CARD

Longitudinal Counter

Accurate to Tenths of a Minute

The Model 2216 counter provides longitudinal readings in tenths of a minute divisions. Beginning at 0 degrees West, the counter increases in West readings to 179 deg. 59.9′, where it transfers to the equivalent of 180 deg. East, declining in East readings back to 0 deg. The counter is reversible at any point in the complete cycle. Clockwise rotation of the input shaft increases West readings from the 0 degree starting reference.

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

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

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

CIRCLE 103 ON READER-SERVICE CARD FOR MORE INFORMATION

Enlarger-Projector-Plotter

For Film and Microfilm

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

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

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

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

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

CIRCLE 104 ON READER-SERVICE CARD FOR MORE INFORMATION

Servo-Amplifiers
Subminiatures

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

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

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

Vacuum tube models include a 5 w rugged amplifier and precision summing amplifier that handles up to seven inputs at an accuracy of ±.05 per cent, and provides a 90 degree phase shift if desired.

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

CIRCLE 108 ON READER-SERVICE CARD FOR MORE INFORMATION

Accelerometer
Used in Flight Control

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

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

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

CIRCLE 109 ON READER-SERVICE CARD FOR MORE INFORMATION

SIZE 8 (R1000 Series)

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

SIZE 11 STANDARD (R900 Series)

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

SYNCHROS

STANDARD AND SPECIAL

SIZE 11 SPECIAL (R500 Series)

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

PRECISION RESOLVER (R587)

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

"PANCAKE" SYNCHROS

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

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

ALL PHOTOS 3/4 SIZE

KEARFOTT COMPONENTS INCLUDE:

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

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

KEARFOTT COMPANY, INC., Little Falls, N. J.

Sales and Engineering Offices:
1378 Main Avenue, Clifton, N. J.
Midwest Office:
188 W. Randolph Street, Chicago, Ill.
South Central Office:
6115 Denton Drive, Dallas, Texas
West Coast Office:
253 N. Vinedo Avenue, Pasadena, Calif.

Kearfott — A SUBSIDIARY OF GPE

CIRCLE 112 ON READER-SERVICE CARD FOR MORE INFORMATION

Tape Transport Mechanism

Has Precise Speed Settings

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

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

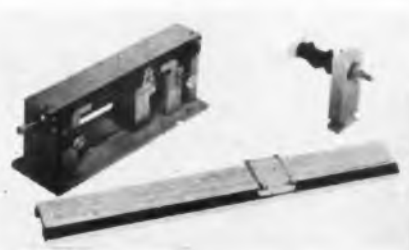
The mechanisms are available in any combination of channels up to 28.

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

CIRCLE 113 ON READER-SERVICE CARD FOR MORE INFORMATION

Limit Stops

Offered in Three Types



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

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

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

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

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

CIRCLE 114 ON READER-SERVICE CARD FOR MORE INFORMATION

CHICAGO MAGNETIC solves problems in

TRANSFORMERS TUNED FILTERS

creative engineering

such as this*

Paired Filters

Matched

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

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

CHICAGO MAGNETIC CONTROL
1616 NORTH DAMEN AVENUE
CHICAGO 47, ILLINOIS

CIRCLE 115 ON READER-SERVICE CARD

Sealed Switch

Glass Insulated

This hermetically sealed switch is designed to meet demands for reliability in electronic equipment. It features rigid mechanical design making use of low-loss glass insulation, solid molybdenum contact points, solid coined-silver contact arm, hardened shafts and wear surfaces.

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

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

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

CIRCLE 118 ON READER-SERVICE CARD FOR MORE INFORMATION

Transistor Power Supply

With Efficiencies to 90%

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

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

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

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

CIRCLE 119 ON READER-SERVICE CARD FOR MORE INFORMATION

Precision Phasemeter

Has 0.1% Accuracy

The Model 901 Phasemeter permits direct reading of phase differences between sinusoidal voltages from 0 to 360 degrees, with provision for sense indication to avoid 180 degree ambiguity.

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

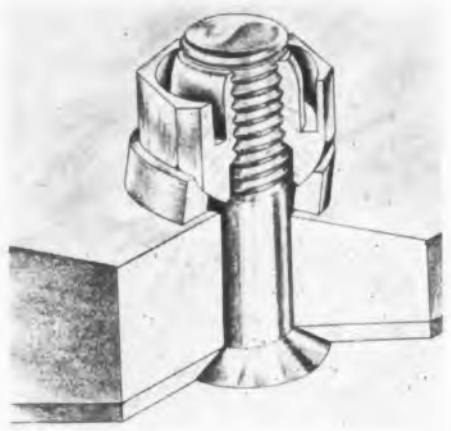
W. L. Maxson Corp., Dept ED, 47-37 Austell Pl., Long Island City 1, N. Y.

CIRCLE 123 ON READER-SERVICE CARD FOR MORE INFORMATION

Hex Locknut

Fastens Non-Parallel Surfaces

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



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

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

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

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

CIRCLE 124 ON READER-SERVICE CARD FOR MORE INFORMATION

Glass Trimmer Capacitor

Has Linear Curve

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

Measuring only 3/4 in. deep behind the chassis, the capacitor, No. 682014, features lack of negative increments in the tuning curve making it ideal for critically tuned rf circuits and high Q tuned circuits. Minimum Q is 500 at 50 mc. Temperature coefficient of capacitance in 50 ppm per degree C.

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

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

CIRCLE 128 ON READER-SERVICE CARD FOR MORE INFORMATION

Arithmetic Control Unit

For Computer Use

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

It operates on a 3 v potential and employs direct-coupled circuitry. The unit contains nearly 1000 transistors, 300 resistors, and 12 capacitors permanently dip-soldered into plug-in printed circuit cards. Each card provides all the necessary functions for one binary digit including add, subtract, multiply, divide, square root, shift right, shift left, sign magnitude and absolute magnitude.

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

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

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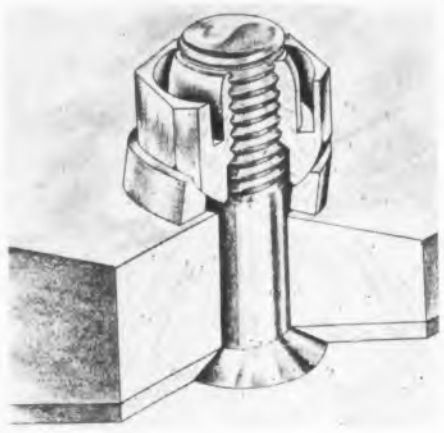

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Adjustment tongue is .029 in wide; the mounting has a standard bushing 8-32 thread. Constructed of glass tubing with a coating of metal bonded to it, the trimmer has a silver-pleated Invar core and wire terminal.

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

CIRCLE 129 ON READER-SERVICE CARD FOR MORE INFORMATION

Press-Fit Connectors

Simplify Breakaway Connections

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

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

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

CIRCLE 132 ON READER-SERVICE CARD

Telemetering System

For Computer Use

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

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

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

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

CIRCLE 133 ON READER-SERVICE CARD

CIRCLE 135 ON READER-SERVICE CARD ➤

Epoxy Resin Preforms

Joins Metals, Non-Metals

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

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

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

CIRCLE 136 ON READER-SERVICE CARD

Tin Clad Nickel Strip

For Germanium Cradles

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

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

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

CIRCLE 137 ON READER-SERVICE CARD

COMING JANUARY 1st

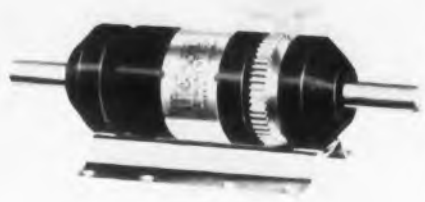
DESIGN '57

Yearly Feature Issue of ED

◄ CIRCLE 135 ON READER-SERVICE CARD

Miniature Differential

With Anti-Backlash



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

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

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

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

CIRCLE 140 ON READER-SERVICE CARD FOR MORE INFORMATION

PNP Germanium Transistor

A Low Noise Unit

The 2N23M is a low noise transistor for use at audio and ultrasonic frequencies. Available in commercial quantities, it is a pnp germanium diffused alloy junction unit, hermetically sealed in a resistance welded metal case with glass-to-metal seals to secure the 1-1 2 in. leads. The unit is designed for high gain (B = 70) low-to-medium power applications (150 mw).

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

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

CIRCLE 141 ON READER-SERVICE CARD FOR MORE INFORMATION

Designed for Dependability in Transistor Circuits

NEW MALLORY MERCURY BATTERIES

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

MALLORY SUBMINIATURE CAPACITORS

Newly developed Type TNT tantalum capacitors . . . another Mallory "first" . . . offer ratings never before possible in a case only 0.145" in diameter by ⅜" long. Five different values: 80 mfd. at 3 volts; 50 mfd. at 6 volts; 25 mfd. at 15 volts; 15 mfd. at 30 volts; and 8 mfd. at 50 volts.

For technical facts, write to

P. R. MALLORY & CO. INC.
Indianapolis 6, Indiana

Trade Mark
Patent applied for

P.R.MALLORY & CO. Inc.
MALLORY

CIRCLE 144 ON READER-SERVICE CARD

Klystron Power Supply

Internal Pulse Modulation

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

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

CIRCLE 145 ON READER-SERVICE CARD FOR MORE INFORMATION

Lamination Shapes

Standard Units Offered

Four nickel-iron laminations are offered for immediate delivery by this firm. The shapes are UI-312, F-21, DU-1, and DU-37.

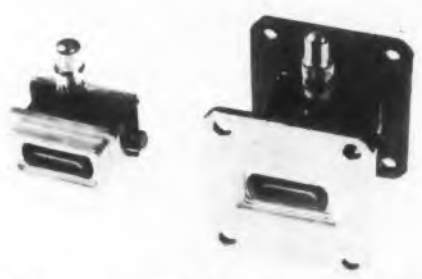
These laminations are made substantially burr free and flat for precision stacking. They are "Performance-Guaranteed," meeting high magnetic standards. They are especially valuable for applications requiring high initial or high maximum permeabilities.

Magnetics, Inc., Dept. ED, Butler, Pa.

CIRCLE 146 ON READER-SERVICE CARD FOR MORE INFORMATION

TR Tube

Saves 50% in Size



The tube type 6795, a Bantam TR tube (left), is nearly 50 per cent smaller than a comparable component (right). The tube is for radar sets, serving as an electronic switch permitting the equipment alternately to send and receive signals with one antenna.

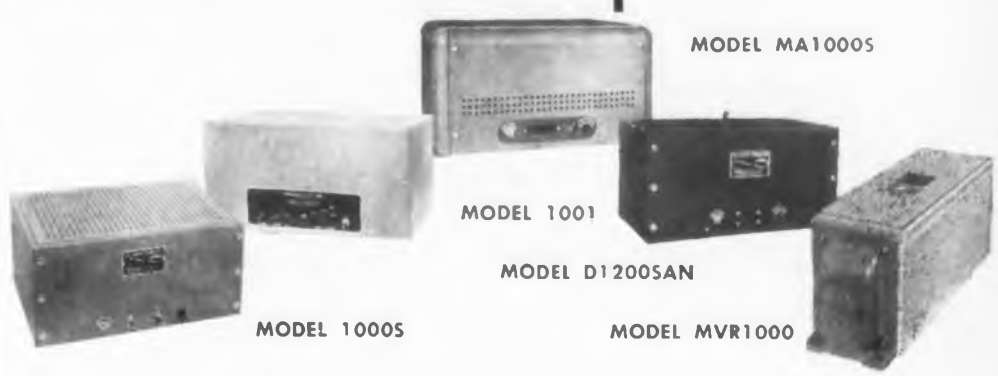
Sylvania Electric Products, Inc., Dept. ED, 1740 Broadway, New York 19, N.Y.

CIRCLE 147 ON READER-SERVICE CARD FOR MORE INFORMATION

NOW FIVE 1000 VA REGULATORS

. . . ONE FOR EVERY APPLICATION

MODEL 1000S — Automatic wide-range electronic regulation with the original Sorensen frequency insensitive circuit incorporating the safety diode Regulation ±0.1%.



If you want 1000 VA capacity in a low-cost magnetic voltage regulator with 0.5% regulation, choose the new, economical and compact MVR1000. If you need 1000 VA but with 0.01% regulation, choose Model 1001. For *any* requirement, *any* application, Sorensen has exactly the right 1000 VA unit . . . standard models meeting *special* requirements.

Sorensen offers you the widest possible range of characteristics—and a complete line which includes AC regulators, DC supplies, frequency changers, tubeless regulators and supplies, high voltage supplies, and meter calibrators. For research and industry, call on Sorensen —*the* authority on controlled power.

SEND FOR CONDENSED CATALOG

New and more complete—gives condensed specifications on a wide range of units for a variety of applications. Be sure you have all available information when you specify—send for *your* copy today.

MODEL MA1000S — For unattended installations requiring extremely dependable automatic line regulation. This tubeless unit offers stable long-life performance with minimum maintenance. Regulation ±0.5% over wide frequency range.

MODEL 1001 — Developed from unique, dependable Sorensen regulating circuit, refined for ultra-precision ±0.01% regulation.

MODEL D1200SAN — ±0.25% regulation for 400 cycle industrial and aircraft requirements up to 1200VA.

MODEL MVR1000 — New low cost compact magnetic voltage regulator for less exacting applications. Fully automatic ±0.5% regulation with fast response time.

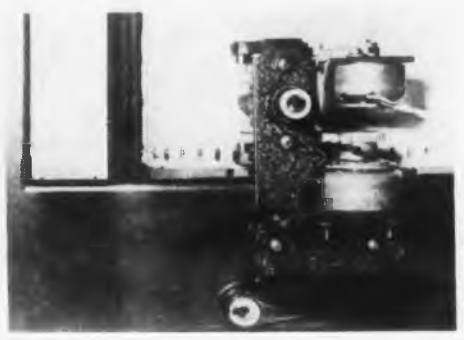
Sorensen

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

CIRCLE 148 ON READER-SERVICE CARD FOR MORE INFORMATION

Automatic Counter

Also Prints Results



This compact device automatically counts and then at some particular time prints the count. Known as the Model RI-4 "Identichart," it can be caused to print at regular intervals so that it is possible when reviewing the chart to determine the number of counts in any particular time period. The unit is ideally suited as a print-out device for integrators, and mounting can be provided for all popular makes of recorders. It can also be supplied as an independent unit for printing on a card or adding machine tape.

The RI-4 can be supplied with as many as 8 digits so that a maximum count of 100 million is possible. The counting circuit and printing circuit are independent of each other, so that counting can continue. Both the counting solenoid and the printing solenoid can be supplied for any dc voltage from 24 v to 220 v, and rectifiers can be supplied for use on ac, if desired.

To simplify installation, the RI-4 is supplied in kit form, including a plexiglass window for the recorder and a plexiglass cover for the printer.

Royson Engineering, Dept. ED, Hatboro, Pa.

CIRCLE 150 ON READER-SERVICE CARD FOR MORE INFORMATION

Sine Wave Oscillator

From 9 Cps to 100 Kc

Waveforms, Inc. announces the addition of a new general purpose sine wave oscillator to its instrument line.

The Model 401 sine wave oscillator features wide tuning range, 9 cps to 100 kc, an accuracy of 2 per cent with 1/2 per cent stability, a flat response of 1/2 db, and distortion of 1/2 per cent.

At full output the instrument delivers 20 v open circuit or 1/2 into 600 ohms. Output level is controlled by a logarithmic calibrated potentiometer in tandem with a 100:1 attenuator.

Waveforms, Inc., Dept ED, 333 Sixth Ave., N.Y., N.Y.

CIRCLE 151 ON READER-SERVICE CARD FOR MORE INFORMATION

Automatic Program Controller

Fatigue Tests

An automatic program controller for Baldwin-Sonntag fatigue testing machines can be preset: (a) To 10 static load levels in either tension or compression and/or (b) 10 dynamic load levels, each of which can be set (c) For any number of load cycles up to 999,999, (d) Sequenced in any desired preset order of load levels for (e) any preset number of sequences.

Load levels can be set on any values up to machine capacity.

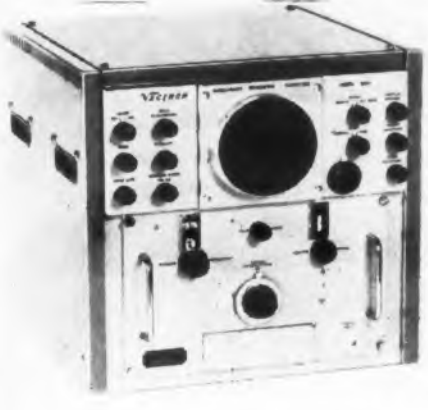
Baldwin-Lima-Hamilton Corp., Dept. ED, Philadelphia 42, Pa.

CIRCLE 155 ON READER-SERVICE CARD FOR MORE INFORMATION

THE ELECTRONICS INDUSTRY LOOKS AHEAD
SEE DESIGN '57—JAN. 1 ISSUE ED

Microwave Spectrum Analyzer

Range in X-Band



This complete instrument provides precision coverage of the 8500 mc to 9660 mc portion of the X band. A direct reading klystron tuning dial and a wavemeter is calibrated in actual signal frequency. It includes a special if amplifier with modified cascode input stages, tracked repeller voltage and a precision calibrated 80 db input attenuator.

The unit has separate brightness and intensity controls for signal and baseline, plus a two- position if gain switch. The "frequency difference" control permits direct incremental frequency measurements from 100 kc to 5.0 mc on the displayed signal against either an electrical or mechanical index.

Model SA30X5 is available for standard rack mounting or as a portable package weighing less than 80 pounds.

Vectron, Inc., Dept. ED, 1583 Trapelo Rd., Waltham 54, Mass.

CIRCLE 156 ON READER-SERVICE CARD FOR MORE INFORMATION

Precision Regulated Power for

- METER CALIBRATION
- MULTI-STAGE AMPLIFIERS
- COMPUTERS

Oregon Electronics

MODEL PR 300

A dependable voltage reference! Long and short term stability is excellent, internal noise and ripple is extremely low. Low internal impedance. The PR 300 adapts itself perfectly where a medium power source is required.

SPECIFICATIONS

Voltage Outputs:
No. 1, Regulated:
10 to 310 volts variable in 1 volt steps. Potentiometer to vary voltage between any 1 volt step.
150 milliamperes maximum at any voltage setting.
No. 2, Stabilized:
0 to —150 volts continuously variable.
5 milliampere maximum.
0 to 50 kilohms impedance.
Ripple and noise less than 2 millivolts peak to peak.
No. 3, Unregulated:
6.3 volts, 3 amperes CT.

Stability of regulated output:
Long term: ± 100 parts per million.
Short term: ± 50 parts per million per hour.

Regulation:
Output voltage variation no load to full ± .01%
Output voltage variation for 10% line voltage change, ± .002% or 5 millivolts.

Recovery time: 0.2 milliseconds

Output impedance:
At DC, less than .5 milliohms.
At 10 KC, less than .1 ohm.
At 200 KC, less than .5 ohm.

Write or wire at once for complete technical details.

Oregon Electronics

2232 EAST BURNSIDE STREET
PORTLAND 15, OREGON
BEImont 6-9292

MANUFACTURERS OF SPECIAL ELECTRONIC EQUIPMENT

CIRCLE 157 ON READER-SERVICE CARD FOR MORE INFORMATION

Type F Crossbar Switch

High Speed Selection

This new switch offers a simplified high speed logic, and is available in a number of matrix arrangements. The Type F switch offers a flexible high-speed means of selecting information remotely from a large number of sources (up to 1200 per switch) without the necessity of scanning intermediate points.

Closely-held timing tolerances make it possible to operate the switch at high speeds with little lost time for commutation.

Due to the balanced nature of connections within the Crossbar, the thermoelectric potentials generated by the switch are held to a very low value. In the range of 25 C to 50 C, the thermoelectric potential is less than .01 mv per degree C.

James Cunningham, Son & Co., Inc., Dept. ED Rochester 8, N.Y.

CIRCLE 160 ON READER-SERVICE CARD FOR MORE INFORMATION

1/3 Octave Filter Set

Has Many Uses

The 1/3 octave filter set, Model BL-1609, made by Bruel & Kjaer, is designed for sound and vibration analysis, measurement of sound transmission and reverberation time, and, in general, any audio signal analysis or telemetry data reduction. It consists of 27 flat-topped filters of 1/3 octave bandpass width with seven additional filters available as optional equipment to cover the frequency spectrum of 14 cps to 36,000 cps. Besides the bandpass filters, the instrument contains standardized weighting networks for overall loudness measurements in phons and a linear bandpass. The filter response is within ±2 db of the linear level.

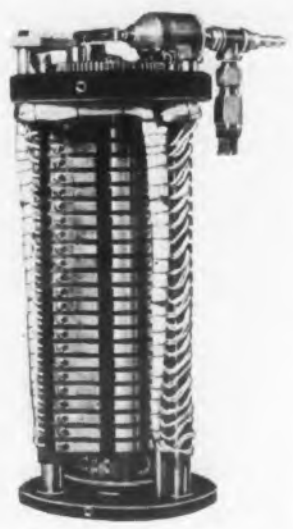
The filters can be manually selected by means of a 50 position switch or automatically scanned by an external drive motor. The stepping switch is a non-shorting type, and, accordingly, the output of all filters can be simultaneously transmitted to readout equipment.

Brush Electronics Co., Dept. ED, 3405 Perkins Ave., Cleveland 14, Ohio.

CIRCLE 161 ON READER-SERVICE CARD FOR MORE INFORMATION

Variable Pressure Brush

Air-Operated



A new type of slip ring assembly has a unique construction which provides continuously variable remote control of brush pressure by means of a miniature air cylinder built into the brush house assembly.

This system gives continuous compensations which permits low wear on both brush and ring surfaces to attain minimum noise levels. It is adaptable to applications requiring either high or low brush pressure, and has extended life at all speeds.

This variable brush pressure can be incorporated into strain gage and thermocouple slip ring assemblies and power slip ring units.

Electro-Miniatures Corp., Dept. ED, 1060 Elm Ave., Ridgefield, N. J.

CIRCLE 165 ON READER-SERVICE CARD FOR MORE INFORMATION

Stroboscope Synchronizer

For Vibration Testing

Slip-Sync, an instrument which permits watching of shake tests in slow motion, or stopped in any selected cyclic position, is used in vibration testing of electronic equipment.

The unit automatically synchronizes stroboscopic lights with vibration exciters. This is accomplished by controlling the time-position of the flash with respect to the shake frequency signal. Both phase and amplitude of the vibration are observable.

Slow motion rate is continuously adjustable from 1/3 to 3 cps by front panel control. Range is from 5 to 10,000 cps with instantaneous response. Input amplitude range is 100 to 1 (40 db). A lightweight unit, it features printed wiring and ready access.

Chadwick-Helmuth Co., Dept. ED, 472 East Duarte Rd., Monrovia, Calif.

CIRCLE 166 ON READER-SERVICE CARD FOR MORE INFORMATION

DOES THE COMPUTER INDUSTRY Need More Specialized Equipment?

READ DESIGN '57—JAN. 1ST ED

High Current DC Supply

Fast Response

This regulated dc power supply is designed for high-current applications requiring fast recovery time. A 1-1/2 amp unit, its response is 0.4 ms NL to FL, 0.25 ms FL to NL, enabling use with computers, and quick-response laboratory applications.

The Model 3-1.5 MB unit supplies 0 to 300 v dc at 1-1/2 amp, continuously variable without switching. It supplies a variable bias voltage of 0.145/155 v dc at 5 ma, and an external 6.3 v ac output at 10 amp. High-voltage output is floating, and may be used as either a positive or negative source.

Regulation for 300 v 1500 ma output is 100 mv change NL to FL. For line voltage of 105 to 125 v ac, the regulation is 0.15 per cent change of output voltage. Ripple for 300 v 1500 ma output is below 3 mv rms.

Dressen-Barnes Corp., Dept. ED, 250 N. Vinedo Ave., Pasadena, Calif.

CIRCLE 170 ON READER-SERVICE CARD FOR MORE INFORMATION

Ignitron Tube

With Thermostat Control

An improved ignitron tube, the type WL-5822-A is offered for control applications, such as control of frequency-changer resistance welders. It directly replaces the WL-5822 and is a sealed, stainless steel jacketed, water cooled, mercury pool tube capable of intermittent ignitor service. It has a 1200 v or 1500 v max anode voltage rating with 1500 amp or 1200 amp max anode current.

The tube features a provision for thermostatic control which, when equipped with suitable thermostatic switches, conserves cooling water consumption and simultaneously protects the tube and associated equipment from overloads and overheating. Overall size, including leads, is 25 in. x 4-1/4 in. diam. The unit weighs only 8-1/4 lb.

Westinghouse Electronic Tube Div., Dept. ED, Box 284, Elmira, New York.

CIRCLE 171 ON READER-SERVICE CARD FOR MORE INFORMATION

WHAT IS THE TREND in Printed Circuits?
Transistors?
WATCH FOR DESIGN '57—JAN. 1ST ED

Microwave and UHF Components

Immediate Field Operation

A custom-line of microwave and uhf components, including standard as well as job-engineered complex units, is now available. Typical examples are cavities, mixers, duplexers, multipliers, rotary joints, twists, bends and others.

Ranging from dc to over 40,000 mc, components can be furnished to specifications.

J-V-M Engineering Co., Dept. ED, 4633 South Lawndale, Lyons, Ill.

CIRCLE 175 ON READER-SERVICE CARD FOR MORE INFORMATION

Mercury Switch Pulser

Has Adjustable Rise Time

Designed for calibration and stability measurements involving scintillation spectrometry circuits, the N-101 mercury switch pulser has a continuously adjustable rise time of .03 - 0.5 μsec.

Output delivers up to 10 ma, max 22 v, at either polarity and is continuously variable with 0.1 per cent linearity. It has a battery pulse source and a stability of 0.1 per cent per day after initial warm-up.

Hanmer Electronics Co., Inc., Dept. ED, Princeton, N.J.

CIRCLE 176 ON READER-SERVICE CARD FOR MORE INFORMATION

Blower

Weighs 5-1/4 Oz

The Model BC910B-1 is a subminiature blower utilizing a 1 in. diam motor. It is designed especially for cooling airborne electronic equipment where space requirements are critical, and it weighs just 5-1/4 oz. It operates at 115 v 400 cps at 20,000 rpm. The 1/250 hp single phase motor, with a 0.22 mfd capacitor, delivers 8 cfm at 1 in. back pressure.

Induction Motors Corp., Dept. ED, 570 Main St., Westbury, L.I., N.Y.

CIRCLE 177 ON READER-SERVICE CARD FOR MORE INFORMATION

Regulated Inverter

Lightweight Unit

This small, light, closely regulated inverter produces high wattage per weight and volume. Input is 24 to 30 v dc at 4.5 amp max. at −55 C. Ambient temperature range is −55 C to +71 C. Output is 115 v 400 cy 1, 2, or 3 phase, 20 to 40 watts.

The complete unit weighs 3 3/4 lbs and measures 6.69 in. L x 2.87 in. W x 3.89 in. H.

John Oster Manufacturing Co., Dept. ED, Avionic Div., Racine, Wis.

CIRCLE 180 ON READER-SERVICE CARD FOR MORE INFORMATION

Digital Indicator

In Miniature

A new digital indicator features high readability while requiring a minimum of panel space.

Permitting direct reading of signals from a variety of transducers, the Model 756 incorporates an electronic null balance servo system driving a precision set of geared number wheels. Numbers are 7/16 in. high.

Performance Measurements Co., Dept. ED, 15301 W. Mc. Nichols Rd., Detroit 35, Mich.

CIRCLE 181 ON READER-SERVICE CARD FOR MORE INFORMATION

Crystal Oven

Weighs Less than 1 Oz

The JK0-10 miniature crystal oven, designed for an HC-6U holder, weighs less than 1 oz. It has a temperature stability of ±0.25 C at constant ambient temperature, and ±0.5 C over an ambient range of —55 to 75 C.

The unit features a noval base, an easily detachable cover, new heater binding tape, and low inductance winding. It is made in a choice of heater voltages from 6.3 v to 48 v, ac or dc for greater flexibility.

James Knights Co., Dept. ED, Sandwich, Ill.

CIRCLE 182 ON READER-SERVICE CARD FOR MORE INFORMATION

Strain Gages

For Four-Arm Systems

A new instrument for the universal calibration of wire strain gages, their transducers, and thermocouples has been designated the Type C calibrator.

It will calibrate 1, 2, or 4-arm systems without complicated hookups. Employing the electrical equivalent method of calibration makes dead-weight testing necessary only once for each transducer.

Allegany Instrument Co., Dept ED, 212 Durham Ave., Metuchen, N. J.

CIRCLE 185 ON READER-SERVICE CARD FOR MORE INFORMATION

Magnetic Friction Clutch

Has Fast Response Time

A magnetic clutch for applications in low power servo mechanisms meets military specifications. Standard models are designed to operate on 24 v dc delivering a minimum torque of 50 oz in. Response time is within 3 milliseconds. Endurance tests reveal no reduction in performance when tested at rated load and high speed for one million cycles.

Dynamic Instrument Corp., 59 York Ave., Westbury, L.I., N.Y.

CIRCLE 186 ON READER-SERVICE CARD FOR MORE INFORMATION

Miniature Differential

Has Planetary Gears

This planetary gear reducer has been adapted as a mechanical differential device. By mounting the internal gear freely, it may be driven independent of the input shaft and the resultant speed at the output shaft will be the difference between the speed of the input shaft and the speed of the internal gear.

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

CIRCLE 187 ON READER-SERVICE CARD FOR MORE INFORMATION

Proportional Voltage Bridge

Checks Synchros, Servos

The SB-10 proportional voltage bridge measures the electrical error of CX, TX, CDX, and CT synchros in accordance with MIL-S-16892 and SAE-APP-461. It is also used to measure the positional accuracy of a servo loop containing synchros without introducing loading errors and without attaching to any shaft in the servo.

The device is a passive comparison bridge of high accuracy. Its elements are carefully aged, sealed in oil, and matched against NBS primary standards. Each of its three arms have resistances of 50 K. Angular accuracy is given as 10 sec of arc max. Rotation is in steps of 5 deg, continuous throughout 360 deg. The bridge is hand set to each angle by a detent switch.

Theta Instrument Corp., Dept. ED, 204 Market St., E. Patterson, N.J.

CIRCLE 190 ON READER-SERVICE CARD FOR MORE INFORMATION

Ultrasonic Cleaner

For Printed Circuits

A low frequency ultrasonic cleaner is suitable for small parts cleaning, removal of radioactive contamination and printed circuit cleaning. The standard unit consists of an electronic generator delivering up to 100 watts of energy to crystal transducers mounted on a one gallon stainless steel tank.

Two cleaning tanks may be used alternately without disconnecting either one so that one tank may be used for removing large amounts of soil and the other may be used for final cleaning, or two different solutions may be used. The controls are on off-on switch, a frequency adjusting knob and a toggle switch to operate either transducer.

Alcar Instruments, Inc., Dept ED, 17 Industrial Ave., Little Ferry, N. J.

CIRCLE 191 ON READER-SERVICE CARD FOR MORE INFORMATION

HOW FAR WILL COMPUTERS Penetrate Industrial Applications in '57?

READ DESIGN '57—JAN. 1ST ED

Spectrum Analyzer

Has Broadband RF Heads

A broadband spectrum analyzer, Model L701A, with broadband rf heads, combines superior specifications with simplicity of design.

The broadband heads permit operation with one head in the range from 950 to 16,000 mc. This microwave receiver affords great sweep width, good display, and all controls are convenient.

Electronics and X-Ray Division, Dept. ED, F-R Machine Works, Woodside, N.Y.

CIRCLE 196 ON READER-SERVICE CARD FOR MORE INFORMATION

Rack Cooling Fan

Only 5-1/4 in. High

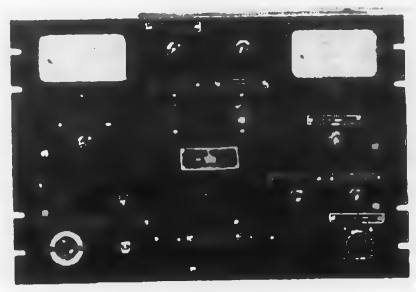
The Model 3E40 Rack Cooling Fan Unit, for electronic cabinets, fits standard 19 in. racks but occupies a space only 5-1/4 in. high. It has RETMA notching for ready installation and is complete with filter and 5-1/4 x 19 in. stainless steel grill. No color matching is required. Air delivery is 140 cmf.

McLean Engineering Laboratories, Dept. ED, Princeton, N.J.

CIRCLE 197 ON READER-SERVICE CARD FOR MORE INFORMATION

30 Kv Power Supply

Laboratory Instrument



Model 922 is a 30 kv regulated power supply designed specifically as a laboratory instrument. It is supplied on a single chassis 19-1/4 x 18 x 14-1/4 in. high, with provision for remote control operation and for external interlock.

The supply requires 105-125 v 60 cps, consumes 300 va and delivers from 0 to 30 kv dc at 0 to 0.5 ma.

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

CIRCLE 198 ON READER-SERVICE CARD FOR MORE INFORMATION

Barometric Switch

With Altitude Accuracy of 100 Ft

With this barometric switch, the user presets the altitude and the switch will operate within 100 ft of that height. Greater accuracy can be supplied on special order. The switch is temperature compensated, ruggedly built to resist shock and vibration, and has hermetically sealed contacts. It is valuable for air ordnance application and for material drops by parachute.

Clifford Manufacturing Co., Dept. ED. 152 Grove St., Waltham 54, Mass.

CIRCLE 202 ON READER-SERVICE CARD FOR MORE INFORMATION

Sealed Switch Series

Variety of Actuations

This precision snap-acting switch is sealed against moisture, dust, oil, and corrosive gases. Known as the 2HB series switch, it has a silicone boot that seals the clearance space around the operating pin, and the cover is sealed to the base with a thermosetting resin.

The switch is available with a variety of actuators, permitting a wide range of actuating devices.

Unimax Switch Div. of The W. L. Maxson Corp., Dept. ED, Ives Rd., Wallingford, Conn.

CIRCLE 203 ON READER-SERVICE CARD FOR MORE INFORMATION

Free Gyro

Unusually Rugged

Model 3416 free gyro features a cast steel frame mounted solidly inside a structural outer shell having an integral CG mounting flange and offering insensibility to mounting and dynamic loads. Shock specification is 50 g in all axes. Drift rate is less than 18 minutes of arc per min. The potentiometer pickoffs, which supply outputs of up to 70 v for telemetering and control operations, have a linearity of ±0.5 per cent and resolution of .09 degree.

G. M. Giannini & Co., Inc., Dept. ED, 918 East Green St., Pasadena 1, Calif.

CIRCLE 204 ON READER-SERVICE CARD FOR MORE INFORMATION

Tape Rule
Is Read from Dial

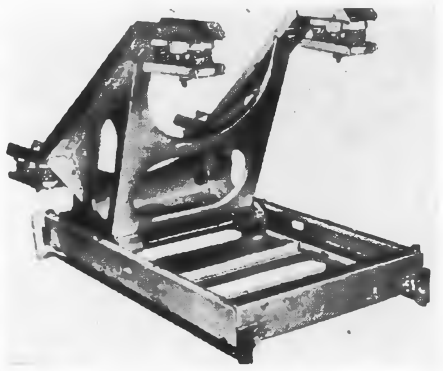
The "Rulo-Matic" shows complete measurements to fractions of an inch on a vernier dial. Upper graduations on the dial shown 1/16 in. fractions, with main fractions on the lower side.

The triple coated white-face tape is counterbalanced with an inner return spring for smooth operation. Oiling and cleaning pads are built in to clean and oil the blade each time it is used. A small serrated steel wheel scriber is contained in the case for marking measurements. A movable end-clip on the tape compensates for "butt' or "hook" measurements. The "Rulo-Matic" is furnished in a die cast, highly polished, chrome plated case.

Frederick Post Co., Dept. ED, 3650 N. Avondale Ave., Chicago 18, Ill.

CIRCLE 209 ON READER-SERVICE CARD FOR MORE INFORMATION

Vibration Mounting
Has Movable Suspension



Electronic equipment and delicate mechanical components are easily mounted in this rack with minor modifications. Vibrations isolation is over 90 per cent at frequencies of 30 cy per second and higher.

The resilient members and the equipment center of gravity are in the same diagonal plane. This eliminates rocking and tipping modes.

Model 1374-3 is designed to support radar indicator and scope weighing 37 lbs, but may be modified for other loads. The rack and pinion device with locking handles facilitates alignment of equipment by the operator while in flight.

Robinson Aviation, Inc., Dept ED, Airborne Division, Teterboro, N.J.

CIRCLE 210 ON READER-SERVICE CARD FOR MORE INFORMATION

Miniature Clutch & Brake

Dry Powdered Iron Unit

Model #10 clutch is a lightweight unit with a torque rating of 80 in.-oz at 5000 rpm, and an output inertia of 1.85 gm. cm². Speed of response is in the order of 2 msecs.

Since the excitation coil is fixed, slip rings and external bearings are not required. This unit has only two moving parts. Precision ball bearings are used throughout. The clutch offers either on-off or proportional control up to 100 per cent slip. Ratings apply for either direction of rotation.

Electomic Mechanisms, Inc., Dept ED, P.O. Box 1156, Greenwich, Conn.

CIRCLE 214 ON READER-SERVICE CARD FOR MORE INFORMATION

Amplitude Modulator

Range 9.15 to 9.65 K Mc

A new X band Gyraline, Model X-234, affords a ten-time increase in operating power level compared to most previous models.

This microwave amplitude modulator operates over a frequency range of 9.15 to 9.65 k mc, has a continuous power dissipation rating of 10 w and a maximum attenuation of 30 db.

Cascade Research Corp., Dept ED, 53 Victory La., Los Gatos, Calif.

CIRCLE 215 ON READER-SERVICE CARD FOR MORE INFORMATION

Differential Transformer

Four Channel System

The Model 52 four channel linear variable differential transformer system is a standard 19 in. rack mounted chassis which can excite up to four LVDT transducers from zero to 10 v rms. The internal oscillator is a unitized plug-in unit which can operate at any frequency between 9 kc and 22 kc.

Micro Gee Products, Inc., Dept. ED, 6100 W. Slauson Ave., Culver City, Calif.

CIRCLE 216 ON READER-SERVICE CARD FOR MORE INFORMATION

Preset Decade Counter

Has High Acceptance

Direct reading Model 101A Preset Decade Counting Unit is designed to provide an output pulse at a selected number at rates in excess of 40,000 counts per sec. If reset is not required, they are capable of counting at a 100,000 cps rate. These units are readily cascaded and Model 101A is of the coincident type with an 11 pin base, pulse output and O reset.

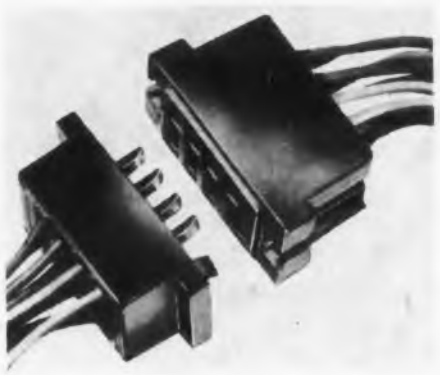
The input requirements are a negative pulse, 75 to 100 v peak. The rise time is 1 μsec max. with a duration of at least 2 μsec. Input impedance is 100 μμf in series with 16,000 ohms. The preset coincidence output positive pulse is approx. 50 v peak. Reset to O is instantaneous by opening grid circuit or by application of 70 v pulse at least 15 μsec wide.

Computer-Measurements Corp., Dept. ED, 5528 Vineland Ave., North Hollywood, Calif.

CIRCLE 221 ON READER-SERVICE CARD FOR MORE INFORMATION

Plug and Receptacle

Feature Fast Assembly



These low-cost units feature fast, simple assembly for use in appliances, electronics, machinery, or any application requiring multiple circuit hook-ups. Crimped terminals for snap-in assembly eliminate time-consuming soldering and cut assembly costs. Terminals are available individually or in reels for automatic mechine assembly to wires; rating is up to 15 amp per terminal.

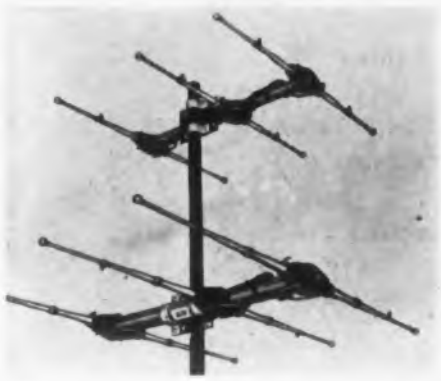
The units are molded from a Molex compound, UL approved, which provides good electrical and physical properties, plus dimensional stability and low moisture absorption.

Molex Products Co., Dept. ED, 9515 Southview Ave., Brookfield, Ill.

CIRCLE 222 ON READER-SERVICE CARD FOR MORE INFORMATION

Communication Arrays

Precision Tuned



These communication arrays are designed to specific requirements and employ standard or modified components. Standard arrays are fully integrated, hair-pin resonated, precision-tuned, matched and calibrated; and provide 75 per cent reduction in precipitation static.

Telrex Labs., Dept. ED, Asbury Park, N.J.

CIRCLE 226 ON READER-SERVICE CARD FOR MORE INFORMATION

Portable Frequency Changer

60 to 320-1000 Cps

A new frequency changer converts 50 or 60 cycle line power to any desired frequency between 320 and 1000 cps.

The unit is portable and is designed to replace rotating equipment.

The Model FCR 250 provides frequency regulation within ±1 per cent. Regulation of ±.01 per cent is available with auxiliary frequency standard fixed at 400 cycles. Voltage regulation is within ±1 per cent.

Sorensen and Co., Dept. ED, 375 Fairfield Ave., Stamford, Conn.

CIRCLE 227 ON READER-SERVICE CARD FOR MORE INFORMATION

Frequency Deviation Meter

Measures AM or FM

Type FT-FMV frequency deviation meter, which measures fm or am characteristics over a range of 20 to 600 mc carrier frequencies, has the capability of simultaneously indicating the incidental am in an fm signal being measured and, conversely, the incidental fm in an am signal.

CIRCLE 228 ON READER-SERVICE CARD FOR MORE INFORMATION

HOW WILL INNOVATIONS in Air Navigational Systems Affect The Component Picture in '57? FIND THE ANSWERS IN DESIGN '57— JAN. 1ST ED

Accurate Relay

Has High Repeatability

A new type 3-pole double throw relay, Model RL-503-ES has been developed for aircraft power control systems and applications requiring accuracy of pull-in and drop-out, high repeatability, resistance to vibration and small size.

The relay can be adjusted for 20 v pull-in and between 9 and 19 v drop-out.

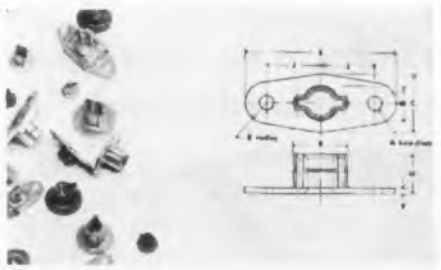
The maximum variation is 1 v in pull-in and drop-out voltage over the ambient temperature range of −60 C to +125 C. Contact ratings are 2.5 amps inductive and 4 amps resistive at 30 v. Coils range from 1/10 ohm to 6400 ohms. It has an electrical life of 100,000 operations at 5 amps 120 v ac.

Joseph Pollak Corp., Dept. ED, Freeport St., Boston 22, Mass.

CIRCLE 233 ON READER-SERVICE CARD FOR MORE INFORMATION

Self-Locking Nuts

In Complete Line



These self-locking metal nuts can be reused repeatedly without impairing their locking ability, and they are easily installed with standard tools, such as pliers and hex wrenches.

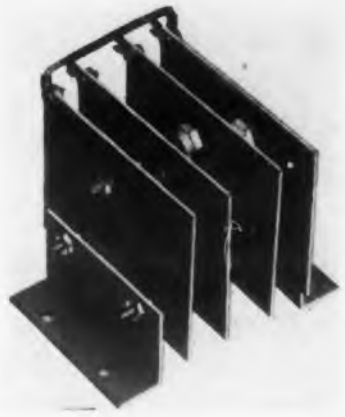
The nuts are now available for screw sizes ranging from No. 4 through 5/16 in. They are precision-threaded and have crimped ribs on two sides. As a screw is inserted, the nut is spread apart slightly, exerting a concentrated torque which grips the screw but cannot harm the threads. The nuts are usually made of cadmium-plated spring steel, although other materials can be used. Applications include automotive, electronic, machine tool, and appliance uses.

Con-Torq, Inc., North & Judd Mfg. Co., Dept. ED, New Britain, Conn.

CIRCLE 234 ON READER-SERVICE CARD FOR MORE INFORMATION

Silicon Power Rectifier

High Operating Voltage



This type of silicon power rectifier has advantages over other metallic rectifiers. It features 99 per cent efficiency, compared to 75 per cent for selenium, and 4 per cent regulation compared to 15 per cent for selenium. It has a high forward current with a low voltage drop, and a low reverse current which gives it magnetic amplifier quality. It has high operating temperature, 190 C and up to 120 C ambient, and operating voltage up to 600 piv. Small in size and easy to fan-cool, the unit is hermetically sealed and exhibits no aging effects.

Sanford Miller Co., Dept. ED, 691 Bedford Ave., Brooklyn 6, N.Y.

CIRCLE 239 ON READER-SERVICE CARD FOR MORE INFORMATION

WHAT NEW PLANS Will Directly Affect the Component Parts Manufacturer in '57
SEE DESIGN '57—JAN. 1ST ED

Broadband Microwave Signal

In Single Package

A broad-band microwave signal source, Type No. S771A, features a direct reading frequency dial that offers one knob control from 950 to 2000 and 1900 to 4000 mc.

The unit combines a power supply, klystron, klystron cavity, modulator, variable rf attenuator and an automatic reflector voltage tracking system for efficient, versatile operation. Output power across the band is high enough for most attenuation measurements.

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

CIRCLE 240 ON READER-SERVICE CARD FOR MORE INFORMATION

Silicon Rectifiers

Low Current Types

Expansion of the GE line of low current silicon rectifiers includes three new types, 1N536, 1N539 and 1N540 which meet military requirements. Respectively rated at max. peak inverse voltages of 50, 300 and 400 v. maximum allowable rms voltages are 35, 210 and 280 v respectively.

Ambient operating temperature for the series is from −65 to 165C, with storage temperature rated at −65 to 175 C. Maximum rated output current is 750 ma, at 50 C ambient. Full forward voltage drop is a max. of 0.5 v at 150 C.

General Electric, Dept ED, Syracuse, N. Y.

CIRCLE 246 ON READER-SERVICE CARD FOR MORE INFORMATION

Portable Scaler

Features Reliable Economy

Compact in 24 lbs, exceptional in reliability, this portable scaler Model 2101 fills the need for a general purpose instrument. The scaler has a built-in timer to collect counting rate data without auxiliary equipment.

The instrument operates with a detector even where the slope of the high voltage against the counting rate curve fails to form a true plateau, permitting lower energy gamma rays to be screened out. It also measures anything giving out pulses, depending upon the detector used.

Berkeley Div., Beckman Instruments, Dept. ED, 2200 Wright Ave., Richmond, Calif.

CIRCLE 247 ON READER-SERVICE CARD FOR MORE INFORMATION

TV Tubes

90 Deg Deflection

Type 14NP4 and 14NP4A are directly-viewed picture tubes of rectangular glass construction for portable TV sets.

A new bulb design permits 90 deg deflection which increases picture area and decreases tube length by 2 in. The over-all length of each tube is 14-1/4 in. The spherical faceplates are made of neutral gray glass, minimizing reflections and improving picture contrast. Both types have an external conductive coating that provides a filter capacitor when grounded. The 14NP4A has a metal-backed screen for increased picture brightness.

The tubes employ low-voltage electrostatic focus and magnetic deflection; anode voltage is 12,000 v. Both tubes are 10-9/16 in. high, and 13-1/16 in. wide.

Westinghouse Electric Co., Tube Div., Dept. T-070-ED, Box 284, Elmira, N. Y.

CIRCLE 252 ON READER-SERVICE CARD

Vinyl Tubing

Fungus Resistant

Modifications of Hyflex and Transflex electrical tubings provide a line of tubing meeting all requirements of the MIL-I-631C specification. The new vinyl tubings have fungus resistance while retaining flame resistance and clarity.

They are approved for both Class I and Class II (fungus resistance) in both Grade A and Grade B (general and low temperature) as well as for Categories 1 and 2 (self-extinguishing) for both temperature grades.

The tubings are available in both clear and colored vinyl. Colors include black, white, red, blue, green and yellow.

Lengths of 500 and 1000 ft are wound on spools and 50 and 100 ft lengths are coiled. Tubing sizes range from number 24 to 2 in.

Minnesota Mining & Mfg. Co., Irvington Div., Dept. ED, 6 Argyle Pl., Irvington 11, N. J.

CIRCLE 253 ON READER-SERVICE CARD

◄ CIRCLE 251 ON READER-SERVICE CARD

Precision Power Supplies

Transistor Regulation

Transistor regulated dc power supplies, manufactured to the customer's specifications offer an unusually high degree of stability.

Sizes and weights of the units are about 1/5 to 1/3 those of comparable vacuum tube regulated supplies.

Equipment can be supplied to meet any requirement within the following range of characteristics: power output: up to 2.5 kva; dc voltage: 1 v to 2.5 kv; Current: 0-20 amp; regulation: 0.05 per cent; stability: 0.01 per cent for 24 hours; ripple: 0.002 per cent; ambient temperature: —55 +85 C Storage, —55 to 71 C operating; ambient temperatures to 150 deg can be accommodated where the output power requirement permits the use of silicon transistors.

Transval Engineering Corp., Dept. ED, 10401 Jefferson Blvd. Culver City, Calif.

CIRCLE 255 ON READER-SERVICE CARD

Remote Positioning Control

With Plug-In Modules

This system enables both positioning and proportioning control, plus monitoring of remote equipment over one circuit.

Bi-directional positioning is effected by polarized dc signals transmitted from a supervisory control panel to a remote slave receiver. Quantitative data on the control function is transmitted from the slave unit back to a meter on the supervisory panel. Visible and audible alarm, as well as fail-safe, lock-out, and hold-out features, can be added.

The systems are available with or without transducers for telemetering, and with pilot operators up to several horsepower rating. Overall accuracy of the metering system is guaranteed better than 2 per cent.

Sparks-Withington Co., Sparton Control Systems Div., Dept. ED, Jackson, Mich.

CIRCLE 256 ON READER-SERVICE CARD

THIS MAN CAN HELP YOU

Eliminate cost of incoming magnet wire inspection!

This inspector acts as customers' agent in the Anaconda magnet wire mill.

Result: Anaconda Magnet Wire complies with such exactness to specifications that many customers have felt it possible to *eliminate incoming inspection* . . . at considerable savings in money, time and manpower.

More than this, customers say Anaconda quality control pays off in smoother winding room performance . . . and helps them produce a consistently high quality product at lowest cost.

Talk to the Man from Anaconda about a trial run of Anaconda Wire to prove it to yourself. Call or write: Anaconda Wire & Cable Company, 25 Broadway, New York 4, New York. 56322B

ASK THE MAN FROM ANACONDA® FOR MAGNET WIRE

◀ **Inspector** checks finished enameled wire to insure customers' requirements are met.

CIRCLE 260 ON READER-SERVICE CARD FOR MORE INFORMATION

STABLE DC POWER SUPPLY + **PRECISION DIFFERENTIAL VOLTMETER** = **.05% INSTRUMENT CALIBRATOR**

MODEL 406
Range—0 to 530 volts at 0 to 100 ma.
Stability—.01% short term; .05% per day.
Regulation—.01% for 20% line voltage change or 100 ma load change; ripple less than 1 mv.
Resolution—2 mv. over entire range via Coarse, Fine, Vernier controls.
Meter—Selectively reads output voltage or current or bias voltage.
Auxiliary Outputs—0 to —225 volts bias supply with .02% line regulation; 6.3 voc @ 3 amp. **$245**

MODEL 800
Accuracy—now increased to .05% of actual reading from 500 to 10 v; .1% below 10 v. Calibrated against standard cell. 5-dial precision decade attenuator.
500 volt search range—(10 megohm VTVM) establishes value of unknown voltage to within 3%.
2 calibrated null ranges—10-0-10 and 1-0-1 volt. Input impedance infinite at null.
High resolution—500 volts spread out over 80 ft. of effective scale length.
Printed circuits—light, strong, aluminum construction; illuminated meter **$315**

These two new jf tools do three basic jobs faster, more accurately, at less cost

"This is terrific!" is the engineer's instant reaction when they see this new 3-way system work. Each instrument performs at laboratory levels of precision on its own job... the Model 800 as a voltmeter, and the Model 406 as a high resolution dc power supply. *Used together* they are all you need to calibrate your dc instruments to .05% accuracy. They're portable so it's easy to check fixed installations or at instrument issuing points. Low cost and broad application make this pair a sound investment for single department or total plant use. Fast, simple operation and Fluke's exclusive "direct read-out" saves time and eliminates reading error, thus allowing use by semi-skilled personnel.

Write for full details on 3-way use of these two new instruments from John Fluke. Arrange for an early demonstration in your own shops.

Electronic tools jf *for Industry*

JOHN FLUKE MANUFACTURING CO., INC. jf **1111 W. Nickerson St., Seattle 99, Washington**

CIRCLE 261 ON READER-SERVICE CARD FOR MORE INFORMATION

Oldham Couplings

For Controls and Computers

Though made for precision instrument, computer, and control applications, oldham couplings can compensate for shaft parallel misalignment, .03 in. max, or for expansion. They permit components to be removed from equipment without the necessity of removing shafts.

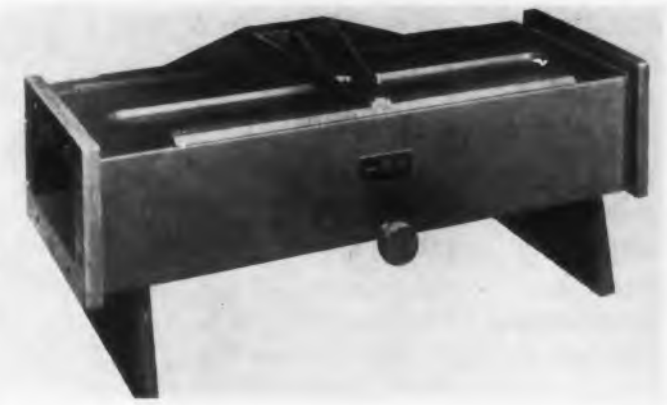
Features include no loose parts, a maximum backlash of 10 minutes of arc, and all-stainless-steel construction. The couplings are available in five models to take 3/16, 1/4 and 5/16 shaft diameters, and 3/16-1/4 and 1/4-5/16 in. shaft combinations.

Ford Instrument Co., Dept. ED, 31-10 Thomson Ave., Long Island City 1, N.Y.

CIRCLE 262 ON READER-SERVICE CARD FOR MORE INFORMATION

L Band Waveguides

Range From 1120 to 1700 Mc



A line of L band equipment, containing large precision waveguide components is now being manufactured in production quantities. It uses 6.660 in. x 3.410 in. waveguides for optimum performance over the frequency range from 1120 to 1700 mc.

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

CIRCLE 263 ON READER-SERVICE CARD FOR MORE INFORMATION

WHAT ARE THE LATEST TRENDS in Instrumentation?

BE SURE TO READ DESIGN '57—JAN. 1ST ED

Pulse Oscillator

From 100 Cps to 3.3 Mc

The Model 3420B pulse oscillator is a wide range trigger generator producing pulses at repetition rates from 100 cps to 3.3 mc. The instrument is particularly useful as a clock pulse generator, for flip-flop resolving time studies.

Two separate blocking oscillator output pulses, each available positive or negative, are provided in a half-period relationship enabling, by mixing, such waveforms as alternate positive and negative pulses.

Output pulses are approximately 0.1 μsec wide from an impedance level of less than 250 ohms, and with amplitude variable to 25 v open circuit.

Electro-Pulse, Inc., Dept ED, 11861 Teale St., Culver City, Calif.

CIRCLE 265 ON READER-SERVICE CARD FOR MORE INFORMATION

Transformer Line

For Selenium Rectifiers

These power supply transformers, designed for ac operation or for dc use for selenium rectifiers, are ideal for heavy current, low voltage operation. Eight transformers are available for applications where special filament transformers were contemplated. The variable tap arrangement with the proper rectifier gives a wide range of applications for voltages between 3.3 dc v output to 43.5 dc output and a maximum of 22.5 adc, depending upon the transformer.

Chicago Standard Transformer Corp., Dept. ED, 3001 W. Addison St., Chicago 18, Ill.

CIRCLE 266 ON READER-SERVICE CARD FOR MORE INFORMATION

New Literature

VHF Receiver 272

R-9903 is a 4-page folder which illustrates and describes the Servoflight R 5200 VHF communications receiver. The receiver combines qualities needed for both communications and laboratory use—wide frequency range, high accuracy, maximum sensitivity, high frequency stability—and provides automatic noise limiter, squelch, continuous tuning without switching and continuous operation. Servo Corporation of America, 20-20 Jericho Tpke., New Hyde Park, N.Y.

Standard Reflections; Coaxial Lines 273

Two data sheets, one on standard reflections and a second on coaxial slotted lines are now offered. The first sheet covers standard reflections for calibrating slotted line impedance meters and standardizing reflectometers in the frequency range of 2600 to 18,000 mc. The second sheet describes Model 230 Type N and Model 230B 7/8 in. coaxial slotted lines of the parallel plane type for the frequency range of 300 to 4000 mc. Both data sheets contain specification tables and prices. Narda Corp., 160 Herricks Rd., Mineola, N.Y.

Resistor Catalog 274

A 20-page catalog, No. LC-1030BX, for the line of wire wound, fixed, accurate encapsulated resistors. The catalog includes a Military Specification tabulation. Information includes line drawings of the products, as well as descriptive tabulations. Aerovox Corp., Cinema Engineering Div., 1100 Chestnut St., Burbank, Calif.

Brush Springs 275

Data for the design of constant-pressure brush springs for rotating electrical machinery is described in Bulletin 310P. The 20-page illustrated booklet discusses physical and operational characteristics, design principles and application limitations of the spring. Actual brush holder applications are described and illustrated, and complete design procedures and charts are presented. Hunter Spring Co., Neg'ator Div., Lansdale, Penn.

Pulse Transformer 276

Application to a variety of circuit applications is assured design and production engineers in this bulletin on pulse transformers. Different core materials and variations in windings and sizes allow the rapid production of a number of series and types within each series, all encapsulated, to fit many standard circuits. Also offered are custom-wound pulse transformers to fit special circuits such as transistor, printed and military types. Technitrol Engineering Co., 2751 N. 4th St., Philadelphia 33, Penn.

Technical Data 277

Recently released are technical bulletins describing the Model 5692 Digital Flow Meter and Series 5910 Inline Readout. Included in the bulletins are description, basic design, features and specifications. Beckman Instruments, Inc., Berkeley Div., 2200 Wright Ave., Richmond 3, Calif.

Instrument Counters 282

Illustrations, descriptions and dimensional data on the "Y" instrument counters are given in Bulletin 400. The instruments can be used as read-out indicators on navigation instruments, missile tracking instruments, radar controls, computers, and for other instrument and electronic applications. The 6-page brochure contains detailed diagrams of 5 counter models and a number of "Y" instrument wheels. Several design considerations are suggested. Durant Mfg. Co., 1993 No. Buffum St., Milwaukee 1, Wisc.

Power and Gas Tubes 283

A revised 24-page booklet on power and gas tubes contains technical data on 175 types. Listed are vacuum power tubes, rectifier tubes, thyratrons, ignitrons, magnetrons, and vacuum-gauge tubes. Each type is covered by a thumb-nail text description, charted dimensions, ratings, operating values, and a base or terminal-connection diagram. Photographs of representative tube types in each family are shown. The price of this booklet, PG101C, is 20 cents. RCA Tube Div., Harrison, N.J.

Subminiature Electrolytics 284

The maximum rated operating temperatures of a line of subminiature electrolytic capacitors has been increased to 85 C. Bulletin 320A gives a complete list of the expanded capacitance ratings in these subminiature transistor capacitors at voltages of from 1 to 50 v dc. Sprague Electric Co., 347 Marshall St., No. Adams, Mass.

Resistors 285

A 4-page brochure on precision wire wound resistors has been issued. The brochure tabulates resistance sizes, wattage ratings and mounting dimensions (length and diameter, terminal thickness and center hole clearance). Tables also show whether resistor style is inductive or non-inductive, and the number of sections of the bobbin. Other information such as resistance wire and operating characteristics is included. DMeter Mfg. Co., Inc., 22024 Larkin Plaza, Yonkers 2, N.Y.

Freeze-Drying Equipment 292

Freeze-drying equipment for laboratories is the subject of a 36-page catalog. Freeze-drying units, vacuum gauges and pumps, bath coolers, refrigerated centrifuges, and related equipment are listed and described. Many of the items are illustrated and all are priced. Arthur S. LaPine & Co., 6001 S. Knox Ave., Chicago 29, Ill.

ESI Short Form Catalog 293

A variety of precision impedance and comparison bridges, decade resistance and capacitance standards, and high linearity decade voltage dividers are described in a recent short form catalog. Included in the 8 pages are illustrations, prices and brief specifications. Electro-Measurements, Inc., 7524 S.W. Macadam Ave., Portland 1, Ore.

Contacts and Metals 294

Complete assemblies, contacts, contact materials and a variety of precious metals are described in a recent catalog. The booklet contains details on solid and clad precious and base metals, industrial metals, electrical contacts, contact parts and assemblies, thermostat metal, thin gauge metals, gold filled, rolled gold plate and others. Metals & Controls Corp., General Plate Div., Attleboro, Mass.

Precision Potentiometers 295

Technical Bulletin 63 covers a number of single and multi-turn wire-wound precision potentiometers in 6 pages. Applications are stated and specifications are set forth in tables. Clearly labeled photographs and diagrams show dimensions and construction. Electromath Corp., 190 Henry St., Stamford, Conn.

Basic Modular Hole Patterns 296

A system for assembling chassis cabinets from mechanically marked, prefabricated forms is outlined in 8-page Catalog A. Modular hole patterns and standard stock items are listed. Illustrations show forms and parts and how they are assembled. Circle Dot Mfg. Corp., P.O. Box 364 Shalvoys Lane, Danbury, Conn.

Terminal Blocks 302

An entire line of terminal blocks and terminal block kits is set down in Catalog 556. Complete as to technical description, specifications and current prices, the catalog is accompanied by a new selectro chart designed to pinpoint quickly the best block for each application. Suggestions are made for combinations of various types of terminals within the same block for most convenient terminating of high current, control and power circuits. The 8-page booklet includes high pressure solderless connectors, screw type, solder lug, and feed-thru terminals. Curtis Development & Mfg. Co., 3250 N. 33rd St., Milwaukee 16, Wisc.

Twist-Mount Capacitors 303

A comprehensive booklet, Form TMR-1, lists all of the firm's twist-mount electrolytic capacitors in 18 pages. The capacitors described are designed for 85 C operation and are available in single, dual, triple and quadruple units. Pyramid Electric Co., 1445 Hudson Blvd., N. Bergen, N.J.

Electronic Equipment 304

A 16-page short form catalog, SF 9901 describes various electronic systems, equipment and components. Included are building blocks, amplifiers, electro-mechanical assembly kits, a spectrum signal generator, infrared radiation standard, dead reckoning tracer, high frequency direction finder, VHF communications receiver, and other instruments. Servo Corporation of America, 20-20 Jericho Tpke., New Hyde Park, N.Y.

Vibration Pickups and Preamplifiers 305

Vibration pickup preamplifier BL-1606 and its vibration pickups BL-4305 are illustrated and described in a 4-page folder. The literature gives detailed specifications and complete data on product design, operation and application. Brush Electronics Co., 3405 Perkins Ave., Cleveland 14, Ohio.

Plastic-Enclosed Thermostats 306

Two thermoswitch unit types are presented in MC-137, a 4-page illustrated brochure. The units, a standard cartridge-type thermoswitch and a rectangular model, are encased in plastic for use in highly humid or corrosive environments. Complete specifications for units with current ratings up to 5 amp, 230 v ac are given. Fenwal Inc., Ashland, Mass.

Filter Set 312

A single-page catalog sheet illustrates and describes the 1/3 octave filter set BL-1609. The set consists of 27 flat-topped filters of 1/3 octave band pass width with seven additional filters available as optional equipment. The literature lists specifications and design, and operating and installation information which suggests various applications. Brush Electronics Co., 3405 Perkins Ave., Cleveland 14, Ohio.

Tantalum Electrolytics 313

Aided by graphs and illustrations, Bulletin GEC-808C describes Tantalytic capacitors for low-voltage, ac and dc applications. The 6-page folder gives typical test data and ample application information. A table lists standard ratings. General Electric Co., Schenectady 5, N.Y.

Carrier Amplifier 314

Applications and features of the 1-127 carrier amplifier are set forth in a 4-page bulletin, 1550B. Illustrations and specification tables are included. Consolidated Electrodynamics Corp., 300 N. Sierra Madre Villa, Pasadena, Calif.

Tape Converters 315

Two tape recorders—perforated to magnetic and magnetic to perforated—are the topic of an illustrated folder. Each device is discussed with reference to characteristics, applications and performance. Remington Rand Univac, Div. of Sperry Rand Corp., 315 Fourth Ave., New York 10, N.Y.

Precision Potentiometers 316

The single-turn 1-7/16 in. diameter series 5400 precision potentiometer is the subject of Data Sheet 54-44. The sheet is illustrated and lists specifications, construction, coil characteristics and available modifications. Helipot Corp., Newport Beach, Calif.

Ferramic Magnetic Cores 317

Ferramic magnetic cores S-1 and S-3 are treated in Bulletins MT-103 and MT-104 respectively. Graphs and tables are used to show magnetic properties and specifications. General Ceramics Corp., Keasbey, N.J.

Spring Manufacturing Facilities 322

Special facilities, spring products and the "cross-curving" process used in manufacturing springs are described in a booklet. Illustrated are several steps in spring manufacture, such as tool and die making, precision bench work, strip steel cutting, induction heat treatment for shaping spring ends, laboratory testing and inspection. Sandvik Steel, Inc., Sandsteel Spring Div., Fair Lawn, N.J.

Plastic Injection Molding 323

Facilities for custom plastic injection molding are set forth with text and illustration in a 12-page brochure. Described is equipment for molding polystryene, acetate, butyrate, polyethylene and other thermo-plastic materials into small precision or very large forms. The Morningstar Corp., 156 Sixth St., Cambridge 42, Mass.

American Standards 324

A booklet tells in 19 pages how standards are made. The history, membership, work, and aims of an organization for this purpose are clearly outlined. The brochure contains diagrams to show the many boards and offices which cooperate in national standardization. A glossary at the back of the booklet defines terms common to standards personnel. American Standards Association, 70 E. 45th St., New York 17, N.Y.

Power Supply and Bridge Control 325

Price, specification and other information on the model 9293-B power supply and bridge control is available in a data sheet. The unit is designed to operate cells for gas chromatography or gas analysis. A photograph and schematic diagram provide illustrations. Gow-Mac Instrument Co., 100 Kings Rd., Madison, N.J.

Gas Chromatography 326

Bulletin 831 describes the model K-3 Kromo-Tog chromatographer. The 4-page brochure offers recommendations for building up the basic unit to suit specialized needs. Illustrated, listed and priced are all needed accessories including fractionating columns designed and coiled for the K-3 and both activated solid and partition type adsorbents for all chromatographic analysis. Burrell Corp., 2223 Fifth Ave., Pittsburgh 19, Penna.

Portable Vibration Meter 332

The type 1-128 vibration meter is featured in Bulletin 1566. Illustrated, the 4-page pamphlet describes the instrument's construction, features, operation and uses and lists specifications in a table. Brief coverage is given to several vibration pickups. Consolidated Electrodynamics Corp., 300 N. Sierra Madre Villa, Pasadena, Calif.

Mercury Plunger Relays 333

An engineers' file folder contains complete information on a line of mercury plunger relays and related products. It includes load ratings and contach data, coil characteristics, diagrams and illustrations, and general information. Ebert Electronics Corp., 212-26 Jamaica Ave., Queens Village 28, N.Y.

Tubing Metals 334

Data Memorandum 1 lists 121 metals and alloys used in small diameter tubing. The analyses are grouped into carbon, alloy and stainless steels, nickel and nickel alloys, copper and copper base alloys, glass sealing alloys, reactive metals and nickel cathode materials. Superior Tube Co., 1521 Germantown Ave., Norristown, Penna.

Control Devices for JIC Standards 335

A 12-page publication describes application features of control devices built to meet standards. The illustrated bulletin gives product data on the machine tool relay, oil-tight push button, solenoid, limit switch, magnetic starter, plugging switch, and pneumatic time-delay relay. General Electric Co., Schenectady 5, N.Y.

Performance Testing Facilities 336

A brochure points to a military approved environmental testing facility. Readiness to run functional and qualification tests on electronic, fuel, hydraulic and mechanical components and systems is announced. Parameters, Inc., 195 Herricks Rd., Garden City Park, P.O. New Hyde Park, N.Y.

Electronic Counters 341

Two frequency meters, a preset counter and a time interval meter receive full-page treatment in a recent folder. In addition to a complete description, there is an illustration, price, and list of specifications given for each instrument. Westport Electric, 149 Lomita St., El Segundo, Calif.

Socket Screws 342

An illustrated folder describes a complete socket screw line in 4 pages. Socket head cap screws, button head socket screws and shoulder screws are listed. Also in the folder are a line of N.P.T.F. pressure plugs available in standard sizes from 1/16 to 1 1/4 in. The Cleveland Cap Screw Co., Box 202, 2917 E. 79th St., Cleveland 4, Ohio.

Attenuator Pads 343

Bulletin 56 is a 2-page list of specifications for the 502 and 503 attenuator pads. These pads cover the frequency range of 1000-10,000 mc and are designed for high power. The bulletin lists prices. Weinschel Engineering, 10503 Metropolitan Ave., Kensington, Md.

Instrument Cases 344

A line of drawn aluminum instrument cases complying with Spec Mil-T-945A and Mil-Std-108C is announced in a 4-page brochure. Illustrations, specifications and tables of sizes combine to describe a variety of types. Instrument Cases, Inc., 510 Garfield St., Glendale 4, Calif.

Recording Oscillograph 345

Text, photographs, diagrams, and specification tables give extensive coverage to recording oscillograph 5-114 in a 16-page booklet. The bulletin, 1500D, also describes the series 7-300 galvanometers, related equipment, and repair services. Consolidated Electrodynamics Corp., 300 N. Sierra Madre Villa, Pasadena, Calif.

Capacitors 351

A 4-page bulletin GEC-1346A, has been issued describing high-frequency Pyranol capacitors, generally designed for power-factor improvement in circuits operating at frequencies from 500 to 12,000 cy per sec. The majority of applications of the high-frequency capacitors are with induction heating equipment for melting, forging and hardening operations. These capacitors are also used for series applications on the load side of a high-frequency generator, where they supply a reactive component to the generator windings and tend to neutralize its reactance. General Electric Co., Schenectady 5, N. Y.

Potentiometers 352

A 20-page 1956 precision potentiometer catalog has been released and prepared as a complete technical digest of the company's line of precision potentiometers. There is an introductory section giving details on engineering, laboratory and production facilities and five separate product sections. Detailed description, technical data, dimensional drawings, specifications alternates and power rating curves are included.
The Gamewell Co., Precision Potentiometer Div., Newton Upper Falls, Mass.

Flexible Plastic Tubing 353

A 28-page manual T-97 gives formulations on Tygon flexible tubings and cites the applications and limitations of each. The illustrated booklet has charts and tables giving physical properties and chemical resistance, 63 bore and wall size combinations, available lengths and packaging data. The U.S. Stoneware Co., Plastics & Synthetics Div., Akron 9, Ohio.

Chart of Epoxy Resins 354

A complete chart has been published giving physical and electrical data of formulated epoxy resins which include 27 systems. Included in the chart are room temperature set, heat cured, filled, unfilled, resilient and rigid resins. Noteworthy is the multiple choice of hardener for several epoxy resin systems, offering fast or moderate cure, with and without safety hardeners. Furane Plastics, 4516 Brazil St., Los Angeles 39, Calif.

Ball Bearings 35

A 30-page reference catalog has been published describing small precision instrument ball bearings. The manual, written by Ralph S. Blanchard, Jr., Professor of Mechanical Engineering, Northwestern University, stresses such considerations as types of bearings available, materials, components, engineering standards, tolerances and the computation of dynamic and static loads. An outstanding feature is a series of Engineering Bulletins bound into the back which give detailed information normally obtainable only by factory correspondence. Shattuck, Clifford & McMillan, Inc., 143 Newbury St., Boston 16, Mass.

DC Power Supplies 356

A booklet has been published describing fixed-output constant voltage dc power supplies. The illustrated booklet gives technical data for six, standard-design, regulated dc power supplies for intermittent, variable, and pulse loads, or high-amperage loads. These dc power supplies combine a constant voltage transformer, a germanium power rectifier and high-capacitance filter without choke. Sola Electric Co., 4633 W. 16th St., Chicago 50, Ill.

Metrology 357

Three papers presented at the Symposium on Engineering Dimensional Metrology in England have been reprinted. The subjects discussed are large scale metrology, working on engineering dimensional metrology at the National Physical Laboratory, and a new precision internal measuring machine. Engis Equipment Co., 431 S. Dearborn St., Chicago 5, Ill.

Caloric-Flowmeter 358

A 4-page brochure describing function, construction, and operation of the electrocaloric flowmeter listing the advantages of this instrument has been issued.

A cut-away view illustrates the construction of the smooth-bore flow cell while a simple diagram shows the principles of operation. Standard sizes and materials are listed and complete mechanical and electrical specifications are furnished.
Industrial Development Labs., Inc., 17 Pollock Ave., Jersey City 5, N. J.

Plug-In Components 359

A 4-page quick index guide covering basic components for plug-in unit construction. This illustrated booklet contains a complete series of hardware components necessary to mount, house, fasten, connect and monitor electronic or electrical circuitry, and gives complete prices and specs on each component. Alden Prods. Co., 117 N Main St., Brockton 64, Mass.

Process Instruments 360

Process instruments for precision analysis, measurement and control are covered in bulletin 491. An electrolytic hygrometer, infrared analyzer, leak detector, flow colorimeter, micro-microammeter, gas analyzer and the pH control systems and 111 data system are illustrated and described in 4 pages. Beckman Instruments, Inc., 2500 Fullerton Rd., Fullerton, Calif.

Molded Plastics 361

An 8-page booklet has been published on the properties, applications and manufacture of molded plastics. Included in the booklet are a comparison table of characteristics and applications, specification tables, and illustrated descriptions of a variety of appliances and molding facilities. General Electric, 1 Plastics Ave., Pittsfield, Mass.

Magnetic Memories 362

Technical bulletin MM-1 is the first of a series of articles on ferramic square hysteresis loop materials for design, development and production personnel. The bulletin covers basic operation of magnetic cores, operation of coincident current memory, and operation with reference to a particular core. Diagrams are included. General Ceramics Corp., Keasbey, N.J.

Precision Potentiometers 363

Recently published is a pictorial bulletin which traces the growth of electroplating techniques. The bulletin gives the metal finishing requirements of the electronics, electrical, aircraft, and bearing industries and contains a list of Federal specifications for which the company is approved. The Summit Finishing Co., Thomaston, Conn.

Standard Alternators 364

Designed for fiield maintenance personnel, a 6-page folder has been released describing the simplified step-by-step maintenance and repair procedures of standard alternators. The illustrated booklet also offers design, operating and application information on the alternator. 14 steps are pictured, with detailed text supplementing each photograph. Other illustrations show alternators installed. Leece-Neville Co., 1374 E. 51st St., Cleveland 3, Ohio.

Non-Activated Liquid Rosin Flux 365

A 2-page technical bulletin gives a complete description of the No. 100 non-activated rosin flux, its uses and properties, and methods of application. Included is a graph showing the concentration-density relationship of the 100 and 400 flux thinners. Alpha Metals, Inc., 56 Water St., Jersey City, N.J.

Metal Fasteners 366

Purchasing data for a variety of bolts, nuts, screws, washers and other metal fasteners is listed in a revised catalog. Also included are extensive listings of standards, weights, design and other information of interest to the metal fastener buyer. Sterling Bolt Co., Chicago, Ill.

Balanced Mixers 367

Catalog No. C-756 describing microwave components and balanced mixers. The 12-page catalog included diagrams and a simplified method of ordering standard balanced mixers and mixer elements. Microwave Development Labs., Inc., 92 Broad St., Babson Park, Wellesley 57, Mass.

Glass 368

"Primitive Art To Improve Today's Products," a 4-page bulletin recently issued illustrates the application of decorative glass. It discusses the four major points designers should know when considering decorative glass for product restyling-dramatic 3-D decoration, deluxe decoration, colorful cold colors and tempered glass for all applications. Croname Glass Studios, 3701 N. Ravenswood Ave., Chicago 13, Ill.

Molybdenum Compounds 371

Bulletin Cbd-9 has been published summarizing all available information on the formation, formula, chemical properties, and uses of organic complexes and organometallic compounds of molybdenum. The bulletin lists 30 poly-basic organic acids and polyhydroxyl compounds which form complexes with molybdate salts or oxides. Thirty-two references to sources of more complete information. Climax Molybdenum Co., Dept. 1, 500 Fifth Ave., New York 36, N. Y.

Fluxes And Solders 372

A 4-page folder has been issued which simplifies the proper selection of corrosive and non-corrosive fluxes for all metal joining from alnico to zinc. Included in the folder are a flux selection chart that pinpoints the right flux for the specific metal, plus detailed tables of ASTM Standard Solders and Fed. Specifications for soft solders. Anchor Metal Company, Inc., 244 Boerum St., Brooklyn 6, N. Y.

Mass Spectrometer for Gases 37

Bulletin 488 has been published containing information on RF Gas Analyzer. The unit is described as a compact mass spectrometer which combines analytical versatility, and simplicity with ease of operation, portability and performance. Important basic information in exploratory work such as oil well mud logging and pilot plants are just a few of the many uses of interest to engineers. Beckman Instruments, Inc., Scientific Instruments Div., Fullerton, Calif.

Standards 374

A 56-page booklet recently published describes wiring, power switchgear, radio, electrical measuring instruments, rotating machinery, transformers, regulators and reactors, electron tubes, conduit components for electronic equipment and preferred voltage ratings. American Standards Association, 70 E. 45th St., New York, N. Y.

Resistors 380

Bulletin B-4 has been published describing deposited carbon resistors. The 4-page catalog includes data on construction, applications, types, dimensions, performance and tolerance. Also included are charts and graphs. International Resistance Co., 401 N. Broad St., Philadelphia 8, Pa.

Timers 381

An 8-page brochure has been issued with current information and specifications describing the company's standard line of electronic timers. Included in this line are delay, and repeat cycle, and interval timers. G. C. Wilson & Co., 1915 Eighth Ave., Huntington, W. Va.

Relays 382

A 20-page relay sales catalog, C-7, has been issued showing a broad range of relay types of most manufacturers. Types include telephone, keying, midget, hermetically sealed, steppers, motor starters, timers, and sensitive relays in practically all popular contact arrangements and coil ratings. Relay Sales, Inc., Box 186, W. Chicago, Ill.

Germanium Diodes 383

Bulletin No. G-60 has been issued describing subminiature gold bonded germanium glass diodes. The units are hermetically sealed and resist contamination of moisture and have welded junctions to insure stagle characteristics. Radio Receptor Co., 240 Wythe Ave., Brooklyn 11, N. Y.

Technical Language Glossary 384

A glossary of technical terms which describes the technology of coating blueprint and diazotype reproduction papers has been published by the Association's Research and Standardization Committee. National Association of Blueprint & Diazotype Coaters, 1001 Connecticut Ave., N. W., Washington 6, D. C.

Precision Metal Finishing 385

Recently published is a pictorial bulletin which traces the growth of electroplating techniques. The bulletin gives the metal finishing requirements of the elctronics, electrical, aircraft, and bearing industries and contains a list of Federal specifications for which the company is approved. The Summit Finishing Co., Thomaston, Conn.

X-Ray Diffraction 391

A 4-page brochure has been released discussing the basic theory (Bragg's Law), definitions, analytical advantages and applications in metallurgy, chemistry, mineralogy, physiology, pathology and biology. Included are typical patterns of fundamental methods of crystal study—Laue, rotating crystal, and powder method. Two x-ray diffraction units are illustrated to describe the "building block" principle for acquiring the unit. General Electric, X-Ray Dept., Milwaukee 1, Wisc.

Aluminum Alloys 392

A 176-page booklet, "Alcoa Aluminum Handbook," has been issued which presents data on aluminum alloys and mill products in an easy-to-read tabular form. The reference handbook contains information essential to a manufacturer on aluminum and alloy standards as well as properties, sizes, and tolerance of mill products usually produced for them. Aluminum Co. of America, 1501 Alcoa Buliding, Pittsburgh 19, Pa.

Optical Supplies 393

A catalog has been published describing a line of miniature taps, dies, screws, drills, and tools. The catalog contains dimensional data on all popular sizes from the range of 56 to 160 threads per in. as well as prices of stock items and an outline of their special order facilities. Engineers working with small threads will find this information interesting. J. I. Morris Co., 394 Elm St., Southbridge, Mass.

Nameplates 394

A 4-page brochure has been published describing a new method of manufacturing nameplates. The process etches markings through enameled surfaces. The process was designed and engineered to comply with military standards and will withstand 300 cycles on the taber abraser with a CS-17 Calibrase wheel carrying a 1000 gram load. Photo Chemical Products, 4790 Walton Ave., New York 51, N. Y.

Bobbins and Washers 400

A 4-page technical bulletin has been issued containing maximum and minimum wall thicknesses, core lengths and sizes, and flange sizes on nylon bobbins; and maximum and minimum thicknesses, outer and inner diameters, and tolerances on nylon washers for a wide range of electrical uses. Sample bobbins and washers will be sent with each catalog. Cosmo Plastics Co., 3239 W. 14th St., Cleveland 9, Ohio.

Diodes 402

Catalog 56S, an 8-page brochure contains information useful to the standards engineer, designer and purchasing agent for silicon diodes. In addition to 56S, two new sheets describing the new IN53A broadband, high burnout millimeter detector and MA-571 barreter for accurate millimeter power measurements are inclosed. Microwave Associates Inc., 22 Cummington St., Boston 15, Mass.

Wire Wound Resistors 401

Catalog data bulletin B-5 has been offered giving comprehensive data on types, construction, tolerance, dimensions, temperature coefficient, derating, etc., of the series BW insulated wire wound resistors. Included in the description are detailed charts and graphs. International Resistance Co., 401 N. Broad St., Philadelphia, Pa.

Microwave Tubes 403

A new brochure has been offered describing a line of microwave tubes and equipment. Included are specifications for various microwave gas control tubes, together with a description of each and its application. Illustrations of the test equipment are also included, plus a description and uses for each piece of equipment. Roger White Electron Devices, Inc., 4th Ave., Haskell, N.J.

Transistor Hearing Aids 411

Technical Bulletin No. 7 provides designers of transistor hearing aids with specifications and other vital information.

The energizers for transistor hearing aids are depolarized with mercuric oxide. This permits the energizers to deliver an unusually high output per unit volume. Physical and chemical properties are discussed. National Carbon Co., 30 E. 42nd St., New York 17, N. Y.

Grooving Machines 41

Illustrated Bulletin 76-C, has been published, presenting the modernized Model No. 48-U universal power grooving machine. Full details and specifications for this machine as well as for the hand operated and giant power groovers are included along with step-by-step illustrations of single and lock seaming. Niagara Machine & Tool Works, 683 Northland Ave., Buffalo 11, N. Y.

Self-Clinching Fasteners 412

Bulletin CL-356 has been made available describing a line of load-carrying threads which can be obtained in thin steel, brass, copper or aluminum sheets, with self-clinching nuts. Installed in drilled or punched holes with standard tools, the nuts are available in a wide range of thread sizes and types. Penn Engineering & Mfg. Co., Doylestown, Pa.

Products For Research 415

A new Catalog Digest has been offered describing the company's products for research, development, and production. Described are the instruments designed for applications requiring accurate high speed spectrum or waveform analysis. Each instrument is illustrated. Panoramic Radio Products, Inc., 9 So. Second Ave., Mount Vernon, N.Y.

Ceramic Capacitors 420

A 6-page catalog describing the line of ceramic capacitors has been announced. Rigidly inspected, to ensure that electrical properties are maintained, ceramics are intended for use in circuits where capacitance must not change with changes in temperature such as in critical rf tuning and resonant circuit applications. Skottie Electronics, Inc., Peckville, Pa.

Wire Wound Resistors 422

A catalog has been made available describing the super Davohm encapsulated precision wire wound resistors. Included are charts on resistance change vs temperature change of various alloys, wattage derating curves, and illustrations of the various resistors (miniature, military, lug and axial types) in the line. The Daven Co., Livingston, N.J.

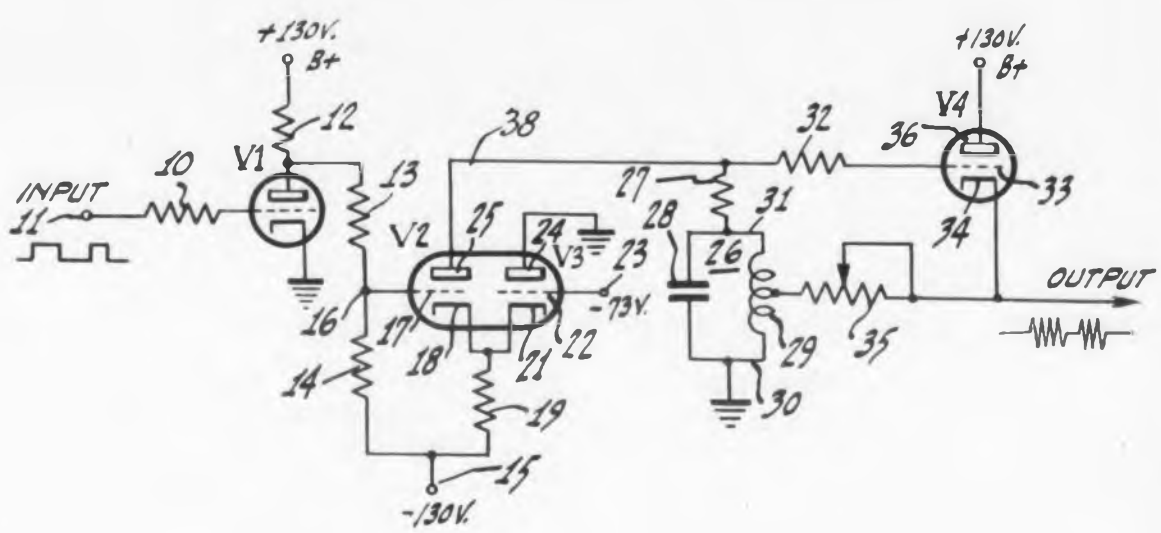
Electrolytic Grinding 421

Engineering Bulletin No. 300 has been released for electrolytic grinding. Titled "Suggestions for Modification of Standard Grinding Machinery To Anocut Electrolytic Grinding Equipment," it outlines the procedures in adapting any standard grinder. It is complete with cutaways, views and parts recommendations. Anocut Engineering Co., 631 W. Washington Blvd., Chicago 6, Ill.

Embossed Metals 423

A 4-page bulletin, "CroRoto Embossed Pattern Metals For Contemporary Design," has recently been issued. This bulletin discusses the use of stock embossed patterns for decorative trim and functional metal parts illustrating some of the many patterns available. It describes production facilities and finishes recommended. CroRoto Division, Croname, Inc., 3701 N. Ravenswood Ave., Chicago 13, Ill.

Patents



Pulsed Oscillators

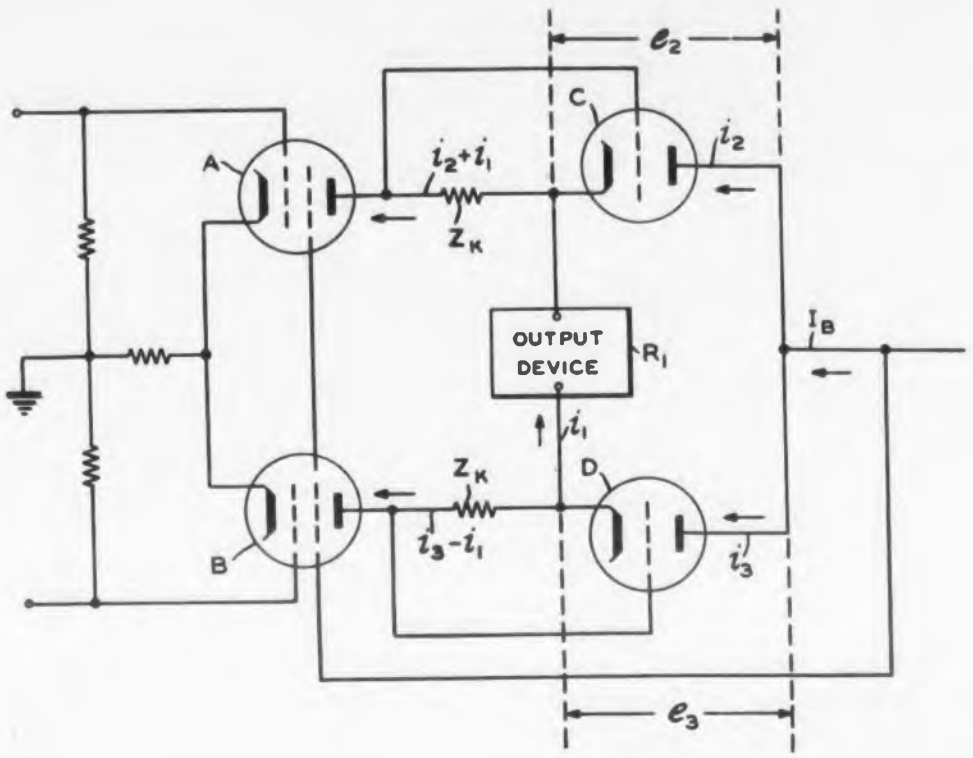
Patent No. 2,741,701 J. S. Harris (Assigned to Radio Corp. of America)

Pulsed oscillators are used in radar, loran, printing telegraph and many other devices and circuits. These pulsed oscillators should start without generation of a transient and should be able to terminate their oscillation without a transient. Another desirable feature in such oscillators is that the oscillations be sustained and that the amplitude of oscillation remain constant. The circuit illustrated in the figure provides a pulsed oscillator free of the undesirable characteristics enumerated.

The circuit components of the pulsed oscillator are apparent from the figure. The tube *V3* is normally biased for conduction for example, by a grid bias of —71 v. The tube *V2* is biased to non-conduction by a grid potential of about —85 v provided at the terminal *16* by a voltage divider formed by the resistors *12*, *13* and *14*. Under this condition the oscillation circuit *26* generates its oscillations. The amplifier tube *V4* feeds back energy to the oscillation circuit, to maintain sustained oscillations of fixed magnitude. When the tube *V2* becomes conductive, the cathode potential increases on tube *V2* and *V3*, which automatically bias the latter tube to non-conductive condition. With the tube *V2* conducting, the dc through the tube and the inductor *29* of the oscillation circuit *26* in the plate circuit of the tube is such that oscillation ceases. The tube *V3* is a stabilizing element to limit the potential of its cathode to above —73 v and hence prevent the cathode of tube *V2* from falling below this potential. Increase in potential of about *20* v on the grid of tube *V2* renders this tube conducting.

With the tube *V1* biased for conduction, the current through this tube maintains the potential at terminal *16* and hence on the grid of tube *V2* at about —86 v so that the latter tube is non-conductive and oscillations are generated. A negative input pulse on the grid of the tube *V1* renders this tube non-conducting, with the result that the potential at the tap *16* and grid *17* of tube *V2* is raised to about —65 v or above cut off, and tube *V2* becomes conductive and oscillations are terminated.

In order that the oscillator generate oscillations without the formation of transients when oscillations cease, it is necessary that the amplitude of the current through the inductor *29* drawn by the tube *V2* must have a value which is equal and opposite to the instantaneous current in the inductor *29*, as a consequence of the oscillations in the oscillation circuit *26*. In addition a feedback timing element is used (not shown in the figure) or it may be accomplished by a modified circuit shown and described in the patent. The circuit described provides an oscillator which is free of transients even though the input signal is of random occurrence and of variable duration.



Direct Coupled Amplifier Circuit

Patent No. 2,740,849 W. D. Cannon (Assigned to The Western Union Telegraph Company)

A well known direct coupled amplifying circuit uses a pair of discharge tubes having their plates connected to a potential supply through coupling resistors, with the output or load being connected between the plates of the tubes. A resistance coupled amplifier retains its linearity at low frequencies. The patent points out that the efficiency of such a circuit is a little over 7% with considerable energy being dissipated in the plate resistors. A circuit is described in the patent and shown in the figure which increases the efficiency of this type of amplifier by about three times.

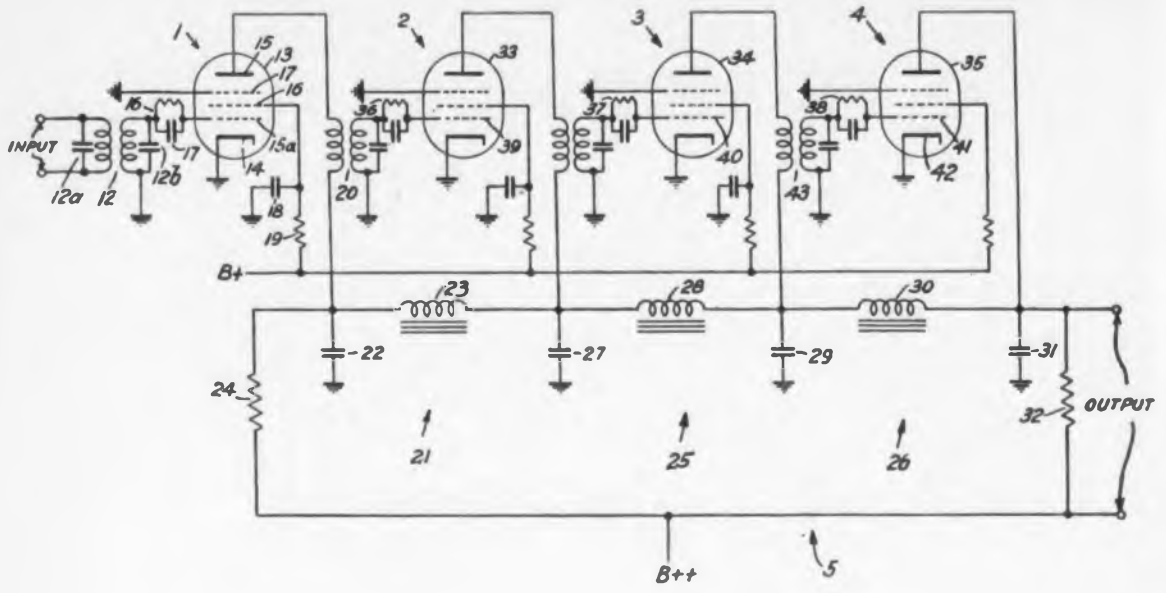
The circuit is shown in the figure using balanced screen grid tubes *A* and *B* and having their cathodes connected together. A common cathode resistor is used. Instead of supplying a plate resistor, the circuit uses a coupling triode *C* and *D* in each plate circuit of the tubes *A* and *B*. A resistor Z_k is provided between the cathode of each triode, and the plate of the screen grid tube with the grid of each triode being connected with the plate of the former tube. The output or load R_1 is provided between the cathodes of the two triodes. With this circuit, the efficiency is increased by about three times or to about 20% without any increase in the energy supplied by the power supply. The resistor component Z_k is selected in accordance with the dynamic impedance of the coupling tube *C* and *D*. If the dynamic impedance of these tubes is in the neighborhood of 2500 ohms, then the resistor Z_k should have a value between 5 and 20% of the dynamic impedance. If the coupling tube has a low dynamic impedance of about 750 ohms, then the resistive component Z_k should be between 40 and 60% of the dynamic impedance of the coupling tube.

The resistive component Z_k may be a resistance, as shown in the figure, or it may be an impedance network including an inductance having a resistor in parallel therewith and a second resistor in series with the parallel elements. The network also may be an inductor, resistor and capacitor connected in parallel with a second resistor in series with the parallel elements. These networks improve the efficiency of the circuit at higher frequencies. Various other networks may be substituted for the resistor Z_k for securing different frequency responses from the circuit.

Voltage Reference Network

Patent No. 2,743,152. James T. Carleton. (Assigned to Westinghouse Electric Corp., East Pittsburgh, Pa.)

A voltage regulator circuit utilizing a magnetic amplifier in conjunction with a diode operating in the region of Townsend discharge. The magnetic amplifier is arranged to present a high impedance to the reference diode and the non-linear characteristics of the diode provide the voltage regulation.



Logarithmic Amplifier Detector

Patent No. 2,729,743. J. S. LeGrand. (Assigned to International Telephone and Telegraph Corp.)

The circuit shown is an amplifier which provides a dc output signal which is proportional to the logarithmic value of the ac input signal. In circuits previously designed, the response time has been of an appreciable value with the result that inaccuracies result. Such circuits also would be more useful if the band width could be increased.

The circuit illustrated is a cascade amplifier having four stages with a tube for each stage. The circuit may have additional stages. The output of each stage is coupled by a transformer to the control grid of the next succeeding stage. In addition, the output of each tube is connected with a delay line comprising a series of capacitors and inductors *22*, *23*, *27*, *28*, *29*, *30*, and *31*, with terminal resistors *24* and *32*. Each section of the delay circuit provides a time delay comparable to the transit time through each stage of the amplifier.

With this circuit, when there is no input signal each tube passes maximum plate current, since there is essentially no grid bias. Upon application of input signal, the grid and cathode function as a detector of the input signal and increase the bias on the grid. The average value of current through the last tube will decrease. Increasing the input signal results in decreasing plate current through this tube until a point is reached when the last stage is saturated so that its output signal remains substantially constant.

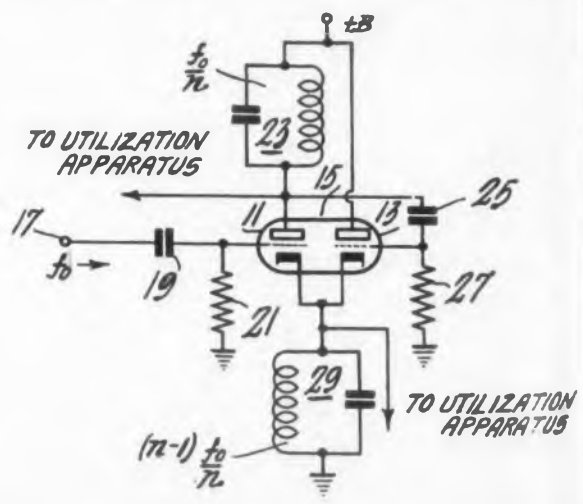
With further increases in the amplitude of the input signal, the third stage and thereafter the second stage each pass through the same cycle as the last stage until they also reach their saturation points and their output signals remain constant. The resultant output signal across terminal resistor 32 of the delay line has an amplitude which is proportional to the logarithm of the input signal.

Regenerative Frequency Dividers

Patent No. 2,738,423. G. C. Sziklai (Assigned to Radio Corp. of America)

Frequency dividers find particular usefulness with a colored television circuit. In such a circuit, a frequency divider takes a sample of the high frequency and from it reproduces the line frequency and the vertical deflection frequency so that the sampling frequency is synchronized with the line and field frequency of the television circuit. Such a divider circuit should be able to maintain a stable frequency and use simple components. The circuit of the patent has these advantages as well as providing a circuit which will operate at a much higher frequency than multivibrators which are commonly used for this purpose.

The circuit uses a dual triode *11*, *13* with the high frequency of the sample being



pplied to the control grid of the first triode. A tuned circuit *23* is in the plate circuit of the first triode section and it is coupled through a condenser 25 to the control grid of the second triode section *13*. A tuned circuit 29, in the cathode circuit of the two triode sections, is tuned to a different frequency. The two frequencies are heterodyned together to produce the desired frequency at the anode and output terminal of the first triode section. As an example, if the input frequency f_o is 10,000 cycles, and circuit *23* is tuned to 2000 cycles, this frequency, which is a noise component, is applied to the control grid of the second triode section. The second section multiplies this frequency to 8000 cycles, which is heterodyned with the input 10,000 cycles to result in the desired 2000 cycle frequency.

The patent also describes a modification of the basic circuit of the figure, in providing a third tuned circuit in the anode circuit of the second triode. This tuned circuit is tuned to a multiple of the frequency of the tuned circuit *23*. This particular frequency may be a second output frequency as well as the heterodyned frequency at the anode of the first triode section of the triode *11*.

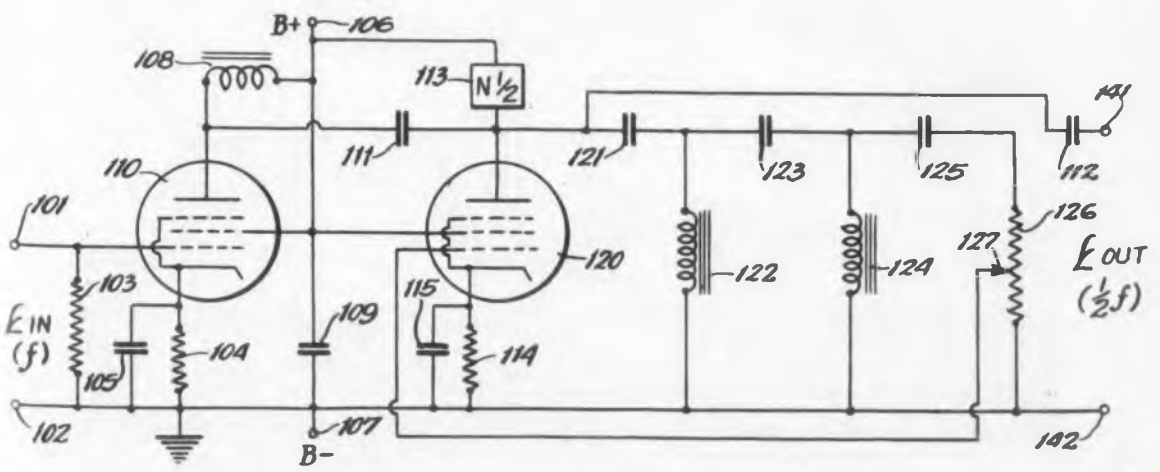
Frequency-Dividing Circuit

Patent No. 2,739,240. W. L. Hughes. (Assigned to Iowa State College Research Foundation, Inc.)

Multi-vibrators have been used for frequency dividing; however, their output wave form is not sinusoidal. There are uses for a frequency divider with a sinusoidal or approximately sinusoidal output. Frequency dividers have been devised which give this form of output wave but they have been unstable circuits. Variation in supply voltage, input potential or input frequency will "unlock" the circuit and fail to give the desired output.

The circuit shown in the figure is a stable frequency divider circuit which gives a sinusoidal output wave at a fractional frequency with respect to the input frequency. The input frequency is applied to the terminals *101* and *102* and to the control grid of the tube *110*. The output is taken from the anode of the second tube *120* at the output terminals *141, 142*. A reactive net work is provided in the output of the second tube *120*, the last element of which is a voltage divider *126*. A feedback connection from this voltage divider to the control grid of the tube *120* is provided by the sliding contact *127*. A non-linear resistor *113* is inserted in the anode circuit of the second tube *120*. For an output frequency of 1/2 of the input frequency, the resistor has a potential drop which is proportional to the square root of the current through the resistor. Three thyrite disks in series have been used to provide this characteristic.

A circuit for obtaining an output frequency of 1/3 of the input frequency is essentially similar to that shown in the figure excepting that resistors may be used in the network in place of the inductors *122, 124* of the figure illustrated. The non-linear resistor in this circuit has a characteristic such that the potential drop across the resistor is the cube root of the current through the resistor. This circuit differs from that of the figure in another respect namely, the non-linear resistor is connected between the anode of the second tube and ground. A circuit is also illustrated for obtaining a frequency of 1/5 or 1/7 of the input frequency. For an even integer of the input frequency, the non-linear resistor is connected so that it not only carries the alternating component of the current but also carries a dc component. It is for this reason that in the circuit of the figure the non-linear resistor *113* is connected in the anode circuit of the second tube.



Horizontal Deflection System For Television Receiver

Patent No. 2,74,070 W. A. Ogletree (Assigned to Philco Corporation)

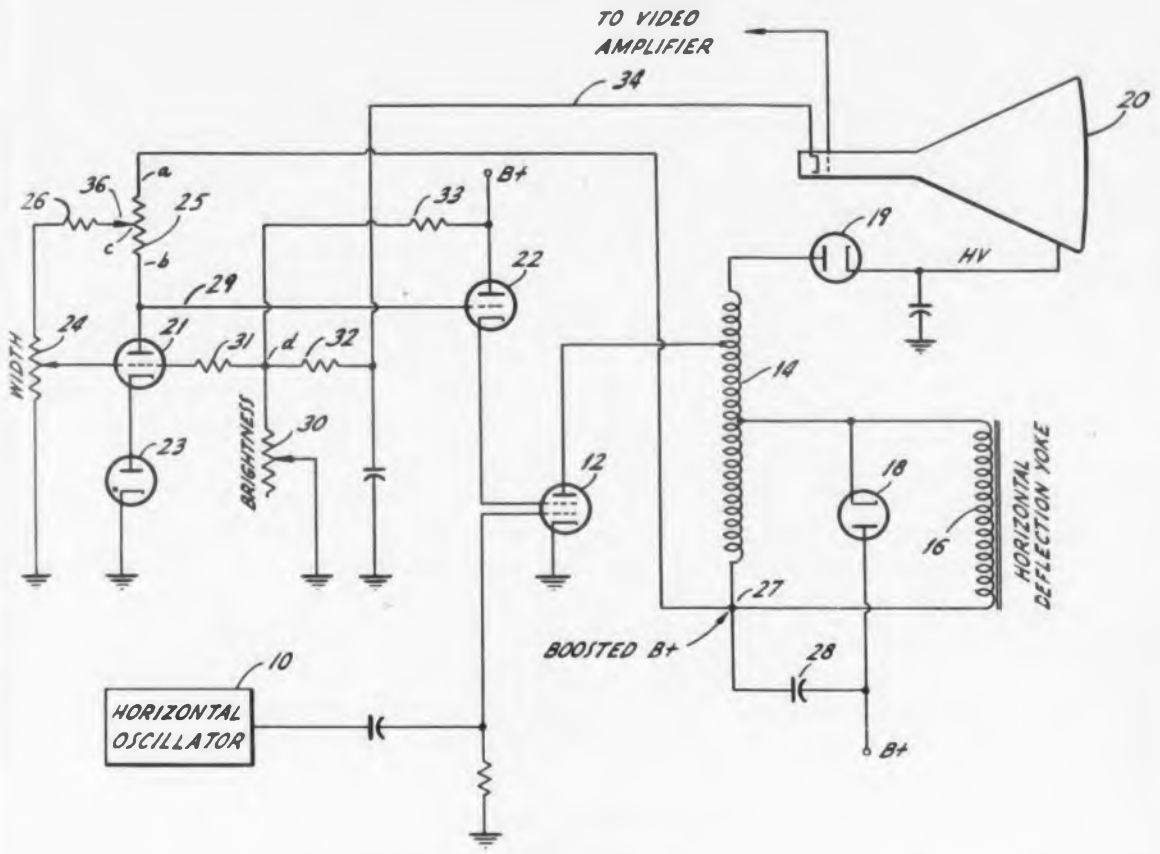
The width of the picture of a television receiver is affected by the supply potential, by the adjustment of the brightness of the picture or any variation in the brightness of the picture from the received signal. Some television receivers derive their second anode potential for the cathode ray tube from the deflection yoke current which also is affected by the supply voltage. It is desirable, therefore, that a receiver be stabilized so that the variations enumerated will not affect the width of the received picture.

In the circuit illustrated, the horizontal output transformer *14* has a condenser *28* connected between junction *27* and the B+ supply so that the boost B+ potential is developed at this point. Tube *18* is a damping tube and tube *19* provides a high voltage rectification for the second anode potential. The horizontal sweep oscillator *10* applies its frequency to the horizontal deflection yoke *16* through an amplifier tube *12*. The amplifier tube has a screen grid, the potential of which is controlled by a variable resistance tube *22* connected with the cathode of the latter tube.

If the voltage supply potential should vary it would also vary the boosted B+ potential at the junction *27*. This potential is applied to the control grid of a control tube *21* through resistors *25*, *26* and *24*. A change in the boosted B+ voltage controls the current through the control tube and changes the potential on the conductor *29*. The potential of this conductor is applied to the control grid of the regulator tube *22* thereby varying the plate resistance of this tube. This in turn varies the potential on the screen grid of the amplifier *12* to maintain constant current which stabilizes the picture width and the second anode potential.

If the beam current through the picture tube *20* should vary, the current through the resistors *32* and *30* will vary and change the potential at the junction point d. The change in potential of point d is applied to the control grid of the control tube *21* through resistor *31* and changes the potential of the connection *29*. This results in a change in the potential on the grid of the variable resistance tube *22* and a change in plate resistance of the tube *22*. The potential of the screen grid of the amplifier tube

is varied accordingly, as previously described. The picture width is therefore stabilized, irrespective of the change in the brightness value of the received signal. Likewise adjustment of the contact on the resistor 30, to change the brightness of the picture, also changes the potential of the point d, and in like manner stabilizes the picture width upon any variation of the brightness control.



Books

Vacuum Deposition of Thin Films
L. Holland, John Wiley & Sons Inc., 440 4th Ave., New York, N.Y., 541 pages; Price: $10.00

A comprehensive treatment is given of both deposition procedures and the physical properties of thin films.

In chapters 1 and 3 design features are discussed of vacuum evaporation apparatus which includes basic plant layouts, the effects of back streaming oil vapor on the quality of the deposited film, and high tension power supplies and electrode arrangements for ionic bombardment cleaning.

Two new applications of the cathodic sputtering technique, that is, metal oxide deposition and the cathodic etching of metallurgical specimens, are treated fully.

Handbook of Semiconductor Electronics
Lloyd P. Hunter, McGraw Hill Book Co., 330 W. 42nd St., New York 36, N.Y. Price: $12.00

A comprehensive guide for all concerned with the design and application of semiconductor devices. The book gives authoritative coverage of the entire field by thirteen specialists. A physical explanation of the principles of operation of transistors, diodes and photocells is provided. The circuit applications of semiconductor devices, primarily those of transistors, are discussed. A reference section is given on methods of mathematical analysis and semiconductor parameter measurements. The 68-page bibliography of the material published since 1940 on transistors, semiconductors, and rectifiers is a valuable index of information.

Circuit Theory and Design
John L. Stewart. J. Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. 480 pages, $9.50.

Avoiding abstract mathematics, the modern network theory presented is an aid to an understanding of vacuum tubes and feedback systems. A large amount of material is assembled which previously was scattered throughout the literature of electronics in a relatively incomplete form.

Pole-zero design methods, founded on an easily grasped pictorial representation, are employed extensively. Design methods are developed for a variety of circuits, with and without vacuum tubes, and for systems with and without feedback.

Chapter headings include: Circuit Analysis; The Poles and Zeros of Functions; The Poles and Zeros of Networks; Elementary Synthesis and Numerical Procedures; Some Important Gain Functions; An Introduction to Modern Synthesis; Image Parameters; Conventional Filters; The Circuit Representation of Vacuum Tubes; Low-Pass Amplifiers; Band-Pass Amplifiers; Feedback Amplifiers and Stability; Oscillators; Servomechanism Functions.

Television Eengineering, Principles and Practice, Vol. II, "Video Frequency Amplification."
S. W. Amos and D. C. Birkinshaw. Philosophical Library, 15 East 40 Street, New York 16, N.Y., 270 pages, $15.00.

This volume describes the fundamental principles of video-frequency amplifiers, and examines factors which limit their performance at the extreme of the passbands. A variety of circuits is described; particular attention is paid to the use of feedback. A section deals with the special problems of camera-head amplifiers. Mathematical derivations are included where necessary.

Smoley's Four Combined Tables
C. K. Smoley & Sons, Inc., Chautauqua, N. Y. 424 pages; Price $12.00.

This is a revised and enlarged edition of Smoley's Four Combined Tables, which contains tables of Logarithms and Squares, Slopes and Rises, Logarithmic Trignometric Tables, and Segmental Functions. Designed as a reference book, the electronics design engineer may find the use of the tables a time-saver in mathematical calculations.

What The Russians Are Writing

J. George Adashko

Operating Features of Power Amplifiers with AC Plate Supply, O. M. Minina, D. E. Polonnikov (6 pp, 9 figs).

Such amplifiers are frequently used in servo work because of their simplicity and phase-sensitive properties. Experiments at the Institute of Automation and Telemechanics of the USSR Academy of Sciences have shown that at heavy plate loads the plate and screen-grid circuits carry inverse currents which reduce the efficiency and output power of the amplifier and increase its time constant. The authors propose five practical remedies to minimize this effect—keep the plate current low, increase the control-grid resistance, employ rectifier elements (without filters) in the plate circuit of the tube, use rectifier elements in the screen-grid circuit, and use special tubes having high inverse resistance.

General Condition of Minimum Mean Squared Error in Dynamic Systems, V. S. Pugachev (7 pp).

Derivation of a necessary general condition under which one random function can be approximated by another in a manner producing a minimum mean-squared error. This general condition leads to equations that define optimum dynamic systems of various classes. Many similar equations, derived by Wiener, Zadeh, Booton, Davis, Preston, and others are shown to be particular cases of the general equation derived in this article.

Graphic-Analytic Method of Plotting the Current-Voltage Characteristic of a Two-Terminal Network Containing a Transistor, N. I. Brodovich, (5 pp, 8 figs).

This method employs the static characteristics of the transistor to plot the characteristic of transistor switching circuits and of transistor dc amplifiers. Reference is made to an article by C. A. Krause, "Transistor Negative Resistance Characteristics," *Radio-Electronic Engineering*, May 1954.

Balanced-Bridge Electronic DC Amplifier Stages, A. A. Sokolov (9 pp, 8 tables).

Extensive tables of design equations for most widely used "standard" balanced-bridge two-tube dc amplifier stages employing triodes. These equations agree quite well with experimental data.

Electronic Analogue Computer for Investigations of Prolonged Automatic Regulation Processes (2 pp, 1 fig).

News Item: Latest analogue computer produced by the Institute of Automation and Telemechanics of the USSR Academy of Science is the EMU-6. It

Delay Unit Employing Magnetic Recording, V. A. Ivanov (5 pp, 6 figs).

Delay units are frequently used in the simulation of automatic-regulation systems to reduce the order of a differential equation, thereby reducing in turn the number of simulator elements. Automatic-regulation processes usually have very low frequencies, from .001 to 5 or 10 cycles, and the time delays required range from .05 seconds to 20 minutes. One way of doing it is to store the signal in a capacitor, which is discharged after a set interval with a rotary switch. However, to produce the wide range of time delay indicated above, a large number of capacitors would be required and this would result in a very bulky device.

Another method is to record the signal on tape and reproduce it after a specified time delay, varied by changing the speed of the tape. This is shown in Fig. 1, in which is produced a magnetic recording of a carrier (500-2000 cycles) amplitude-modulated by the input signal. Frequency modulation can also be employed.

Figs 2 and 3 show the recorded signal (left) and reproduced signal. In Fig. 2 the reproduction error reached 5 per cent, in Fig. 3 it is reduced to 1.5 per cent. The delay time is stable within 0.1 per cent.

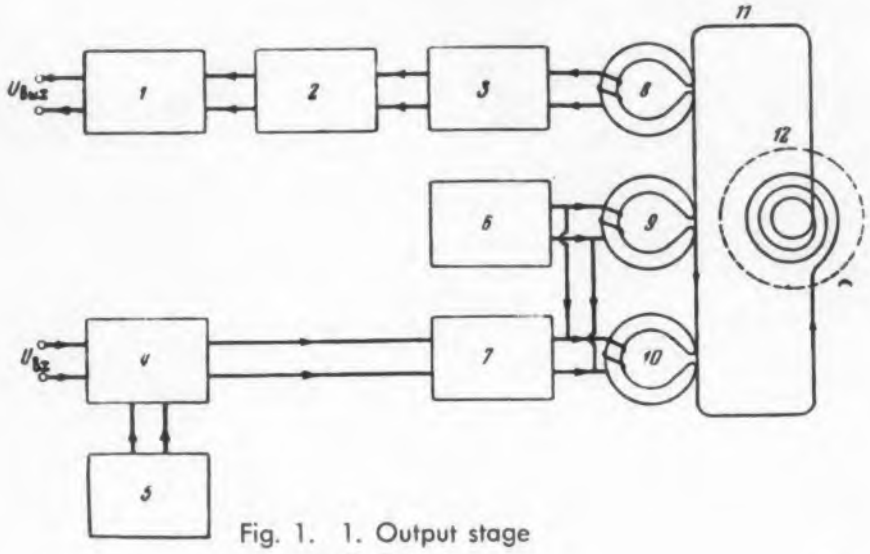


Fig. 1. 1. Output stage
2. Detector
3. Amplifier
4. Modulator
5. Carrier-frequency oscillator
6. Bias-frequency oscillator
7. Power amplifier
8. Playback Head
9. Erase Head
10. Recording Head
11. Magnetic tape
12. Endless tape magazine

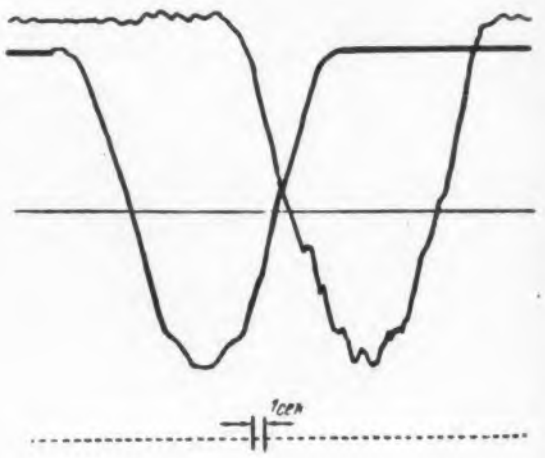


Fig. 2

Fig. 3

iffers from the earlier model (EMU-5, see ELECTRONIC DESIGN July 15, 1956) in that it can investigate processes lasting up to 1.5 hours. This is accomplished by reducing the leakage between the summing point and the output of the solution amplifier and by reducing the grid current of the first tube of the dc amplifiers.

Design of Circuits within Directly-Heated Semi-Conductor Thermistors. N. P. Udalov (3 pp, 7 figs).

Investigation of the current-voltage characteristics of such thermistors leads to the suggestion that increasing the heater current is equivalent to increasing the ambient temperature. This means that a set of characteristics plotted at one value of heater current can be used to plot characteristics at other values of current.

Connection between the Equivalent Amplification Factor of a Non-Linear Element and its Characteristic Curve, Ya. Z. Tsypkin (4 pp, 2 figs, 1 table).

This brief communication gives equations with which the amplification factor can be determined approximately, in explicit form, from the characteristic curve of the non-linear element.

Device for Integration of Slowly-Varying Functions of Time, Specified in the Form of an Angle of Rotation, I. P. Pal'tov (14 pp, 8 figs, 2 tables).

A dc motor used alone, or in conjunction with a tachometer generator in a feedback loop, is one of the most widely used devices with which a time function, given in the form of an angle can be integrated. The author developed a more accurate device, employing a servo system with "on-off" control and an eddy current motor in the feedback loop. The relative error produced by such a device is on the order of several tenths of one percent, and fluctuations in supply voltage and load do not affect the results.

Any type motor can be employed in the integrator, and the motor can be controlled with either sliding contacts, or vibrating contacts. Analysis shows the latter to be more accurate since it produces more readily the high-frequency low-amplitude pulse-width modulation on which the operation of the scheme is based.

Other Articles in this Issue:

"Magnetic Alloys for Cores of Magnetic Amplifiers and their Behavior under Simultaneous Magnetization with DC and AC Fields," O. N. Aven (6 pp, 7 figs, 4 tables); "Simulation of Water Hammer in Header Pipes of Hydroelectric Stations," A.A. Pervozvanskii, R.A. Poluetkov (14 pp, 10 figs); Bibliography on Mathematical Computation with Analogue Computers, 1947-1954 (conclusion); Book review.

What the Russians are Writing

—Continued

Radiotechnika I Electronika No. 2 1956

Effect of Large Fluctuations on Electronic Relays, V. I. Tikhonov, (12 pp, 9 figs).

Probability-distribution density functions are calculated for the lengths of relay pulses and for the intervals between pulses in the case of a stationary fluctuating voltage applied to a relay. The average number of relay operations and of coincidence counts is obtained for the combined action of periodic pulses and random fluctuations.

Analysis of Toroidal Tuned Cavities using Curvilinear Coordinates, V. L. Patrushev, (9 pp, 2 figs).

Summarizes the theoretical calculations that result from the application of the method of curvilinear coordinates to a toroidal tuned cavity with a tuning rod of arbitrary thickness.

The Schwarz-Christoffel transformation is used to map the outlines of the toroid in the (z, r) plane, Fig. 1, left, onto the (ξ, η) plane as shown in the right side of the figure. Analytical expressions are derived for the transformations, and a graph is given with which the parameters of the curvilinear system η_1 and η_2 can be readily obtained from the known values of r_1/z_o and h/z_o.

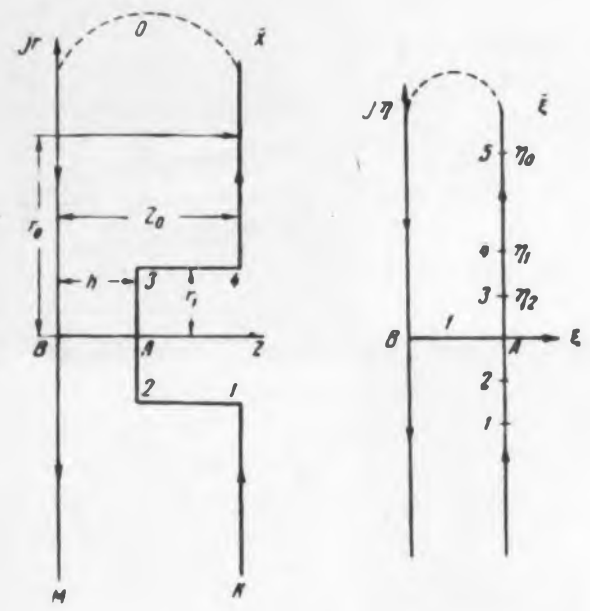


Fig. 1

On the Theory of Periscopic Antenna Systems, L. B. Tartakovski, A. M. Pokras, (11 pp, 15 figs).

Analysis of a periscopic antenna with a parabolic radiator. The analysis is based on introducing phase and amplitude corrections to previously known equations and on the reduction of the quadratures involved to simple Bessel-function series. The gain of the antenna system is expressed in terms of the field distribution on the radiator. The role of the effective dimension of the radiator and of several other details is also discussed. Refers to articles by V. C. Jakes, *Proc. IRE*, 1953, 272-274; Greenquist and Orlando, *Proc. IRE*, 1954, 1173-1178; Drexler, *Proc. IRE*, 1954, 1022; and Crosby, *Convention Record IRE*, 1954, 71.

Bent Waveguides of Constant Cross Section, B. Z. Katsenelenbaum, (15 pp, 3 figs, 1 table).

A waveguide of constant but arbitrary transverse cross section with ideally-conducting walls is bent about a circular arc and an arbitrary electromagnetic wave is propagated from the straight portion into the curved one. The field in the waveguide can be represented in the form of a superposition of the waves propagated in the straight portion. The coefficients of this superposition satisfy a system of first-order ordinary differential equations. An explicit expression can be derived for the amplitudes of all the parasitic waves that occur in the straight-line portions of a waveguide having a slight bend or break. Reference is made to papers by S. E. Miller, "Waveguide as a Communication Medium," *BSTJ*, 1954, p 1209; and W. J. Albersheim, "Propagation of TE_{01} Waves in Curved Waveguides," *BSTJ*, 1949, p 1.

Fluctuations of Space Charge Cloud in Cylindrical Magnetrons, Part I. (Theoretical) V. P. Tychinski & Iu. T. Derkach, (12 pp, 5 figs).

The power-balance method is used to prove the instability of the static state of the cloud during the formation of synchronous layer. A diagram, based on the Hartree equation, is obtained for the frequency spectrum of the oscillations. The effect of wave dispersion in the electron stream on the oscillation spectrum is qualitatively discussed.

The second part of the article will be devoted to a description of experiments that are in agreement with the theory developed. Numerous references are made to American articles on magnetrons.

Action of Amplitude Limiter, M. E. Zhabotinski, Iu. L. Sverdlov, (8 pp, 7 figs).

A limiter, as shown in Figs. 1 and 4, can be considered as consisting of a non-linear element (1) followed by a narrow-band filter (2). The plate-to-cathode capacitances C_{ak} usually restrict the effectiveness of the limiter and result in parasitic phase modulation of the output signal. An LC network is proposed to neutralize this parasitic capacitance, and calculations are given to show the extent of its effectiveness.

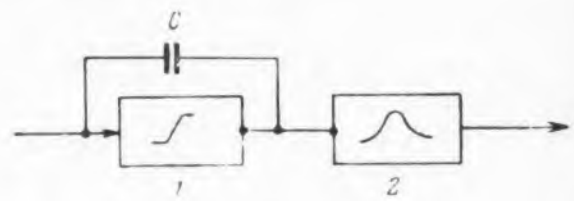


Fig. 2

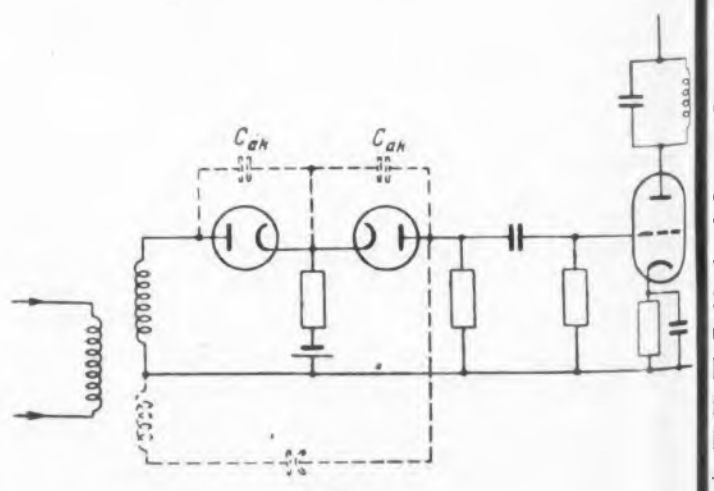


Fig. 3

Use of Chebyshev Polynomials in the Analysis of Stepped Transmission-Line Discontinuities. Ia. M. Tuover, N. I. Strutinski, (19 pp, 8 figs).

Two transmission lines with unequal characteristic impedances can be matched with transformers in which the characteristic impedance changes in several steps from one terminal value to the other. Usually such a transformer consists of several electrically-equal lengths of transmission line, and the characteristic impedance values of each step are so chosen that the local reflection coefficients between steps are proportional to the Newton binomial-expansion coefficients, 1-2-1, 1-3-3-1, 1-4-6-4-1, etc.

An analogy exists between the calculations used to obtain the total field radiated by an array of linear antenna elements (where Chebyshev polynomials are extensively used) and the effect produced by successive reflections at transmission-line discontinuities. The author shows that the use of Chebyshev polynomials (of the first kind) to approximate the transition between the two lines results in greater gain and smoother distribution of the values of the local reflection coefficients than obtained with a binomial distribution.

Noise Stability of Systems with Correcting Codes, V. I. Siforov, (12 pp, 5 figs, 4 tables).

Statistical study aimed at obtaining the relationship between the noise stability of a communication system that employs a correcting code and the parameters of this code. (A "correcting code" is one containing supplementary symbols which detect and correct noise-produced errors.) Refers to work by Shannon, Hamming, Laemmel, Reed, Silverman-Balser, and G. A. Barnard.

Radiation of Electromagnetic Waves by Uniform Motion of Electric Charges in the Vicinity of Obstacles or Inhomogeneities, V. B. Braginski, (8 pp, 4 figs).

When electric charges move at uniform speed past inhomogeneities in waveguides or vacuum tubes, the accelerated motion of the induced charges produces electromagnetic radiation. Perturbation methods are used in the analysis of the resultant waves. Refers to Slater's Microwave Transmission (Russian Translation, 1947).

Other Articles in This Issue:

Transmitting Television Tube Employing Photoconductance. I. L. Artem'ev, V. K. Sokolov, S. K. Temiriazeva (8 pp, 9 figs), a summary of this article will appear in a future issue of ELECTRONIC DESIGN); The Cold-Electrode Ionic Pump and its Characteristics, E. M. Reikhrudel', G. V. Smirnitskaia, O. I. Borisenko (7 pp, 9 figs); Secondary Emission from Antimony-Cesium Cathode at Low Primary Electron Energies, E. S. Mashkova, (2 pp, 4 figs).

Russian Translation

What the Russians

Radiotekhnika No. 4

Certain Generalizations of the Kotel'nikov Theorem, I. T. Turbovkch (10 pp).

The Kotel'nikov theorem makes possible representation of any time function with a limited spectrum in terms of discrete values of this function at certain values of time. The article extends this theorem to time functions having an unlimited frequency spectrum and determines the error that results from approximately expanding such a time function into a Kotel'nikov series.

New Hybrid Junctions for High Frequencies, A. A. Lvovich (8 pp, 7 figs).

Hybrid junctions of the type shown in Fig. 1 are widely used to parallel two hf oscillators without producing mutual coupling between them. Figs. 2 and 3 show similar circuits developed by the author to enable four generators to supply a single load (Z_H). These circuits are analyzed and it is shown that their efficiency is quite high.

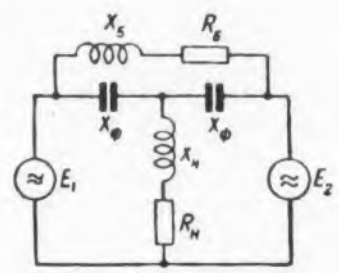


Fig. 1

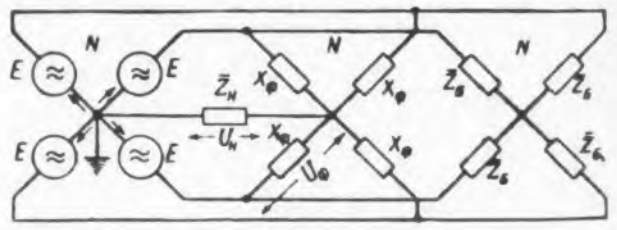


Fig. 2

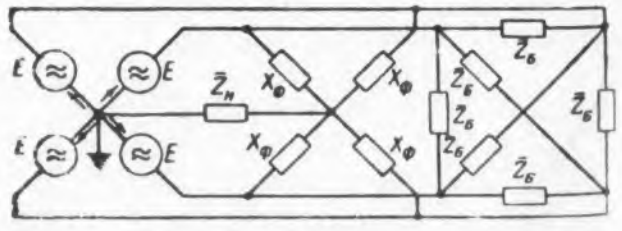


Fig. 3

Are Writing

Continued

Calculation of Principal Parameters of Electron Tubes Used to Measure Acceleration, L. A. Goncharskii (8 pp, 3 figs).

Vacuum tubes are used as acceleration transducers for various purposes, for example in mechanical-vibration testing. One of the electrodes of such a tube is usually a high-inertia mass that can be displaced relative to the remaining electrodes. The author discusses the differential equations and the structural features of several variants of such tubes.

Noise Stability of a Filtering Auto-Correlation Receiver for Pulse Signals, V. I. Chaikovskii (7 pp, 2 figs).

Discussion of methods of obtaining optimum signal-to-noise ratio at the output of a filtering auto-correlation receiver, such as discussed by Lee, Chatham and Wiesner in *Proc. IRE*, 38, Oct. 1950, "Application of Correlation Analysis to the Detection of Periodic Signals in Noise."

Low-Pass Piezoelectric Filter, Ia. I. Velikin, Z. Ia. Gel'mont, E. V. Zeliakh (8 pp, 5 figs).

The technical literature contains adequate treatment of piezoelectric bandpass and rejection filters, but not of high-pass and low-pass filters. This is the second of a series of articles (the first, covering high-pass filters, was published in the March 1955 "Radiotekhnika") covering analysis and design procedures for filters of a modified m-derived type.

On the Theory of a Spiral Line Covered by a Cylindrical Semiconducting Coating, E. G. Solov'ev, L. V. Belous (5 pp, 3 figs).

Such a structure is used as a delay line in traveling-wave tubes to prevent parasitic oscillations. The author employs straightforward transmission-line equations to obtain the variation of line attenuation with the thickness of the semi-conducting layer and with the values of the conductivity, delay time, and frequency. The theoretical results were experimentally confirmed.

A possible Method of Improving the Definition of Television Images, V. F. Samoilov, V. M. Rodionov (5 pp, 5 figs).

The device shown in Fig. 4 increases the contrast of the weaker details of the image without affecting the stronger video signals. This is done by differentiating the television signal, delaying the derivative signal by a time approximately equal to the transmission time of a single image element, comparing the delayed and undelayed derivative signals, and amplifying the television signal only if the delayed and undelayed derivatives differ in sign. This procedure is illustrated in Figs. 5a and 5b, respectively, for a weak detail and a strong signal front.

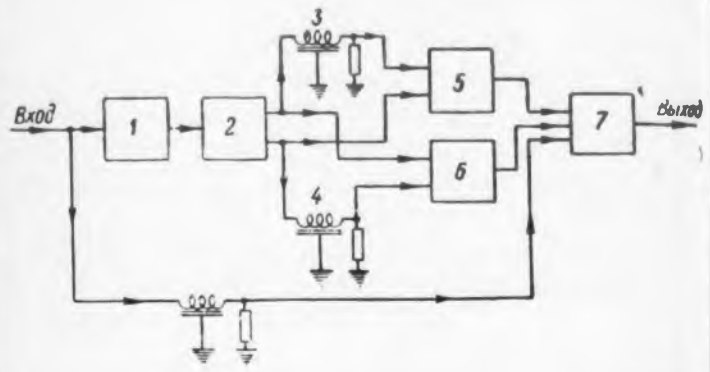


Fig. 4—1. Differentiating circuit for TV signal. 2. Amplifier. 3, 4. Identical delay lines. 5, 6. Combined multiplication and limiting circuits. 7. Mixer.

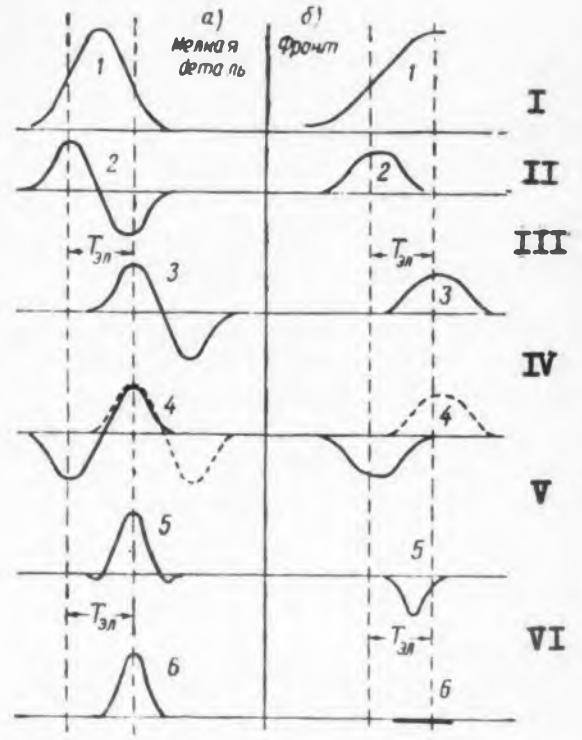


Fig. 5. a—weak detail, b—rising front of stronger signal. I—original signal, II—derivatives of signals, III—delayed derivatives, IV—comparison of original and delayed derivatives, V—multiplication of delayed and undelayed derivatives, VI—limiter passes only positive pulses, which correspond to a signal whose derivative changes sign. This positive pulse is added to the original signal to increase the definition.

Analysis and Design Procedure for Oscillators employing Triodes, Tetrodes, and Pentodes. M. S. Neiman (9 pp, 7 figs).

Conventional oscillator design begins with specified values of the ac power, plate voltage, and cutoff angle (or maximum value of plate current); the properties of the plate tank circuits are not taken into consideration. It would be more correct to specify not the ac power, but the useful power. Furthermore, the plate voltage and cutoff angle should be chosen so as to prevent excessive losses in the anode tank circuit from reducing the overall efficiency of the oscillator. This loss may occur in low-power, short-wave, or pulse oscillators. The equations given here lead to several optimum procedures, depending on the design objectives specified (maximum efficiency, definite plate-to-grid voltage ratio, etc.).

Cancellation Method for Reducing Non-Linear Distortion, A. A. Gorbachev (8 pp, 2 figs, 1 table).

Fig. 6 shows a novel method of reducing nonlinear distortion from the output stage of an amplifier. Essentially, a voltage proportional to the distortion is separated from the output, reversed in phase, and applied to the load circuit, thereby cancelling the distortion component of the load voltage.

This method has several advantages over the use of negative feedback in that there is no need for applying an amplified useful-signal voltage to the input of the non-linear stage, and that it is easy to make the output impedance of the amplifier quite low. The cancellation method can therefore be used in those cases where excessive phase shift makes negative feedback inapplicable. A shortcoming of the method is increased complexity, which makes its use practical only in high-power amplifiers.

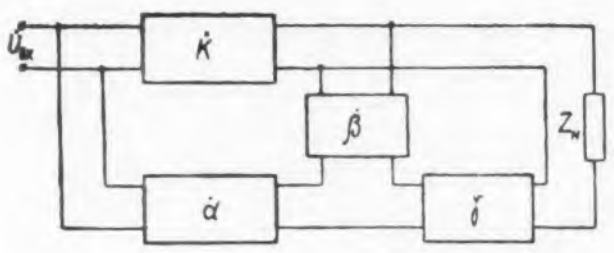


Fig. 6. Block diagram of cancellation circuit for nonlinear distortion. U—input voltage, Z—load impedance, K—non-linear amplification, α, β, γ—cancellation circuit.

Grid Current Components in Power Amplifiers

In the design of power amplifiers operating in the grid current region, accurate knowledge of the direct current, fundamental and harmonic components of the grid current is essential in determining input power, grid dissipation and overall efficiency.

In order to compute the general expressions for the various grid current components, a simple power law has been assumed for the grid voltage versus grid current characteristic:

$$i_g = C\, e_g^{\,n} \qquad (1)$$

By replotting the actual i_g vs e_g tube characteristic using logarithmic scales for both voltage and current, (1) becomes a straight line, if the simple power law holds, and n can be read off as the slope of the line.

The grid operating conditions are depicted in Fig. 1. Table 1 shows all quantities expressed as functions of the peak grid current I_{gm} and half the grid current flow angle φ_o. The cosine of this angle equals the ratio of grid bias to maximum grid voltage E_{gm}. This is based on the assumption that grid current begins to flow when the instantaneous grid voltage is zero.

Only integral values of n are considered up to n equal to 3. By plotting the desired grid current component as a function of n with the use of Table 1, it is possible to interpolate for any intermediate value of the exponent. The formulae for n equalling 1, 2, and 3 were obtained by development of the sine and cosine functions into powers of half the grid flow angle. *Abstracted from an article by W. Knappe, "Grid Current Analysis," Frequenz, vol 10, pp 44-50; February 1956.*

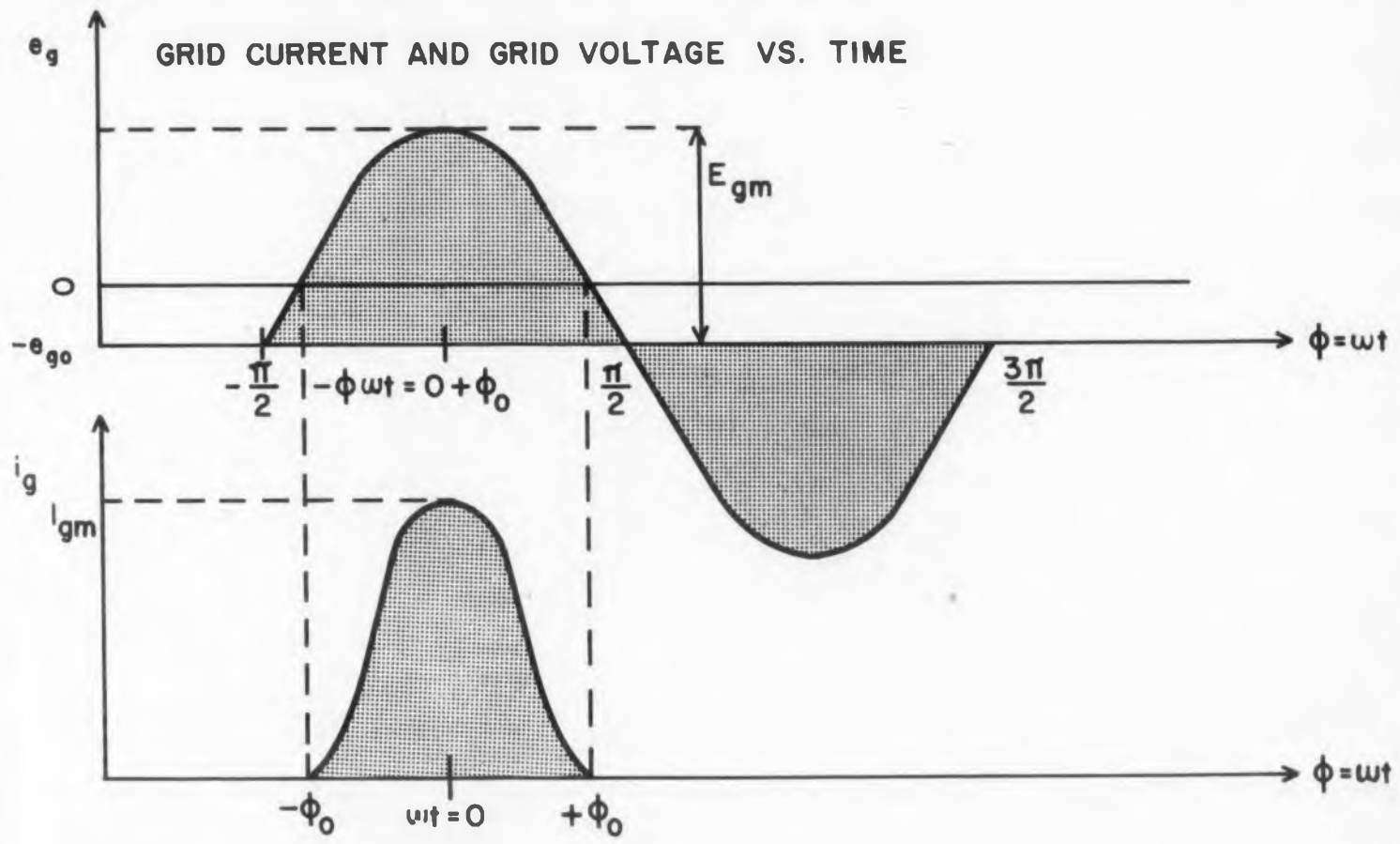
Table 1

	n = n	n = 0	n = 1	n = 2	n = 3
DC Component	$\frac{I_{gm}}{2\pi a^n}\int_{-\phi_o}^{+\phi_o} b^n\, d\phi$	$I_{gm}\frac{1}{\pi}\phi_o$	$I_{gm}\frac{1}{\pi}\left(\frac{2}{3}\phi_o-\frac{1}{90}\phi_o^3-\frac{1}{5040}\phi_o^5\ldots\right)$	$I_{gm}\frac{4}{315\pi}(42\phi_o-\phi_o^3\ldots)$	$I_{gm}\frac{16}{35\pi}\phi_o\ldots$
Amplitude of Fundamental	$\frac{I_{gm}}{\pi a^n}\int_{-\phi_o}^{+\phi_o} b^n\cos\phi\, d\phi$	$I_{gm}\frac{2}{\pi}\sin\phi_o$	$I_{gm}\frac{1}{\pi}\left(\frac{4}{3}\phi_o-\frac{7}{45}\phi_o^3+\frac{11}{1260}\phi_o^5\ldots\right)$	$I_{gm}\frac{8}{315\pi}(42\phi_o-4\phi_o^3\ldots)$	$I_{gm}\frac{32}{35\pi}\phi_o\ldots$
Amplitude of Second Harmonic	$\frac{I_{gm}}{\pi a^n}\int_{-\phi_o}^{\phi_o} b^n\cos 2\phi\, d\phi$	$I_{gm}\frac{1}{\pi}\sin 2\phi_o$	$I_{gm}\frac{1}{\pi}\left(\frac{4}{3}\phi_o-\frac{5}{9}\phi_o^3+\frac{17}{180}\phi_o^5\ldots\right)$	$I_{gm}\frac{8}{315\pi}(42\phi_o-13\phi_o^3\ldots)$	$I_{gm}\frac{32}{35\pi}\phi_o\ldots$
Amplitude of Third Harmonic	$\frac{I_{gm}}{\pi a^n}\int_{-\phi_o}^{+\phi_o} b^n\cos 3\phi\, d\phi$	$I_{gm}\frac{2}{3\pi}\sin 3\phi_o$	$I_{gm}\frac{1}{\pi}\left(\frac{4}{3}\phi_o-\frac{11}{9}\phi_o^3+\frac{77}{180}\phi_o^5\ldots\right)$	$I_{gm}\frac{8}{315\pi}(42\phi_o-26\phi_o^3\ldots)$	$I_{gm}\frac{32}{35\pi}\phi_o\ldots$
Square of RMS Grid Current	$\frac{I_{gm}^2}{2\pi a^{2n}}\int_{-\phi_o}^{+\phi_o} b^{2n}\, d\phi$	$I_{gm}^2\frac{1}{\pi}\phi_o$	$I_{gm}^2\frac{4}{315}(42\phi_o-\phi_o^3\ldots)$	$I_{gm}^2\frac{3}{8\pi}\phi_o\ldots$	

$a = (1-\cos\phi_o)$

$b = (\cos\phi-\cos\phi_o)$

$\cos\phi_o = \frac{e_{go}}{E_{gm}}$



e_{go} — BIAS

I_{gm} — PEAK VALUE OF GRID CURRENT

Abstract

Design With Ferristors

VACUUM tubes may be effectively replaced by magnetic amplifiers[1] in many high frequency circuit applications. The Ferristor, a type of saturable reactor, consists of two windings of fine wire on a tiny iron core, all encased in resin. The small core can be saturated by minute currents in either winding. Circuits employing the Ferristor, as a vacuum tube substitute, have the characteristic of long-life reliability despite exposure to shock, vibration, or moisture effects.

An amplifying circuit may be converted into a current discriminator by adding positive resistive feedback, shown in Fig. 1. The output voltage E_o draws current through the control winding and feedback resistor in a direction that re-enforces the input current. As the input current rises from zero to the point where saturation begins, the output voltage remains almost constant. When the Ferristor begins to saturate, the gain from input to output rises sharply, shown in Fig. 2. At a certain point, the feedback loop gain becomes greater than one and the control current and output voltage increase rapidly in a regenerative circuit until the Ferristor is fully saturated. At this point, the gain from input to output decreases again to nearly zero and further increases in input current have no effect. When the input current decreases to a value slightly lower than that at which sudden saturation occurred, the total current in the control winding becomes too low to maintain saturation. At this point, the output voltage begins to drop, and a reverse regenerative action returns the circuit to the original unsaturated state. Owing to this action, the circuit switches rapidly back and forth from one to another of two comparatively constant states as the input current rises and falls. Since the state it assumes depends upon whether the input current is above or below a certain value, the circuit is called a "current discriminator."

Other circuits, representative of Ferristor applications, are: the one-shot multivibrator, the ring counter, the two-stage amplifier, the balanced amplifier, the free-running multivibrator, and the crystal-controlled oscillator. Some of these circuits are shown here. *Abstracted from Electronic Design With Ferristors, Data File 110, Berkeley Div., Beckman Instruments, Inc., 2200 Wright Ave., Richmond 3, Cal.*

1. Fast Magnetic Amplifier, *Electronic Design*, Jan. 1, 1956, pp 46-47.

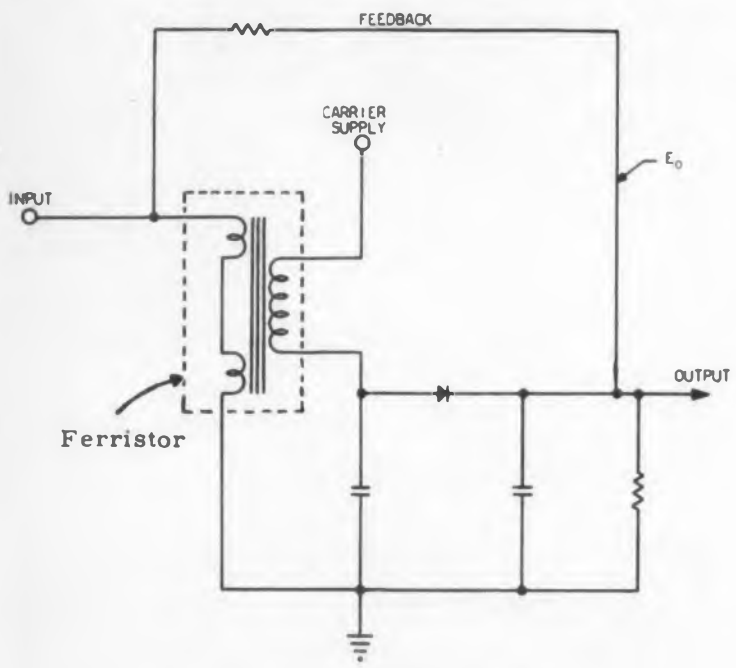


Fig. 1. Current Discriminator Circuit

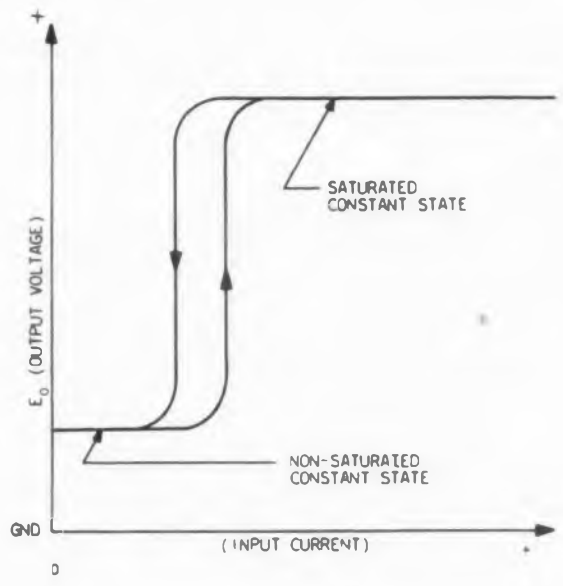


Fig. 2. Current Discriminator Saturation Curve

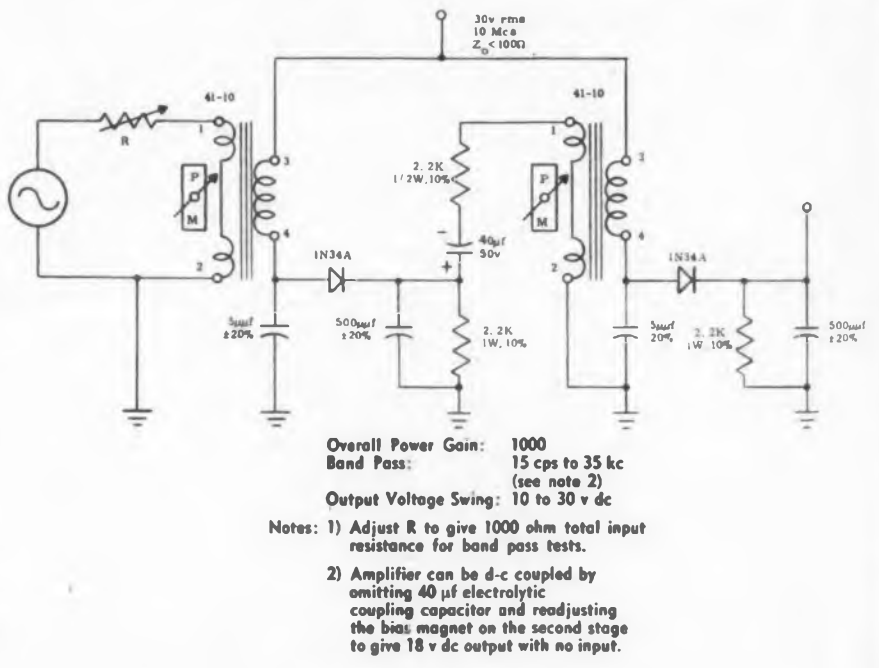
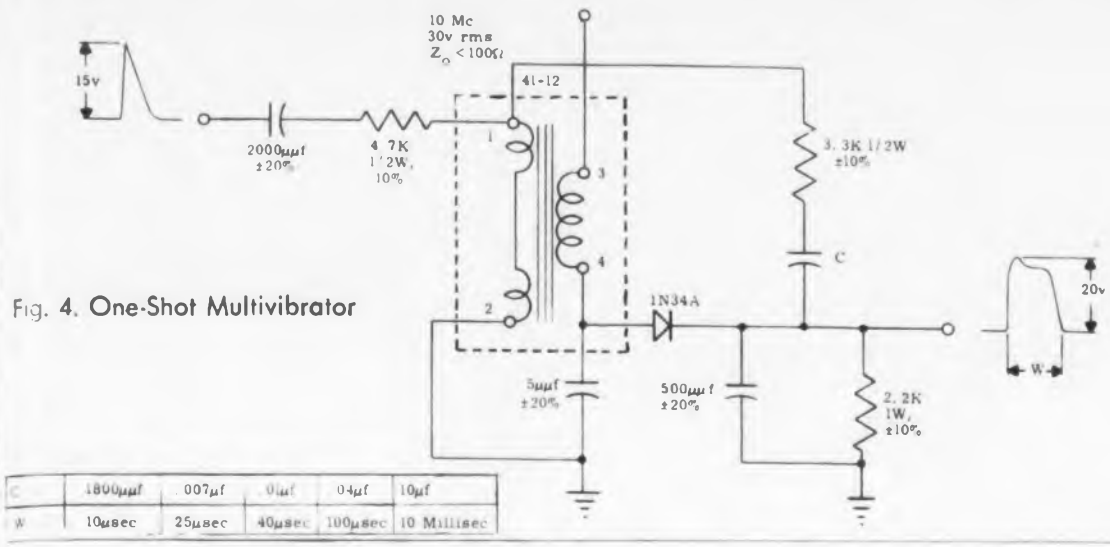


Fig. 3. Two-Stage Amplifier



C	1800μμf	.007μf	.01μf	.04μf	.1μf
W	10μsec	25μsec	40μsec	100μsec	10 Millisec

Fig. 4. One-Shot Multivibrator

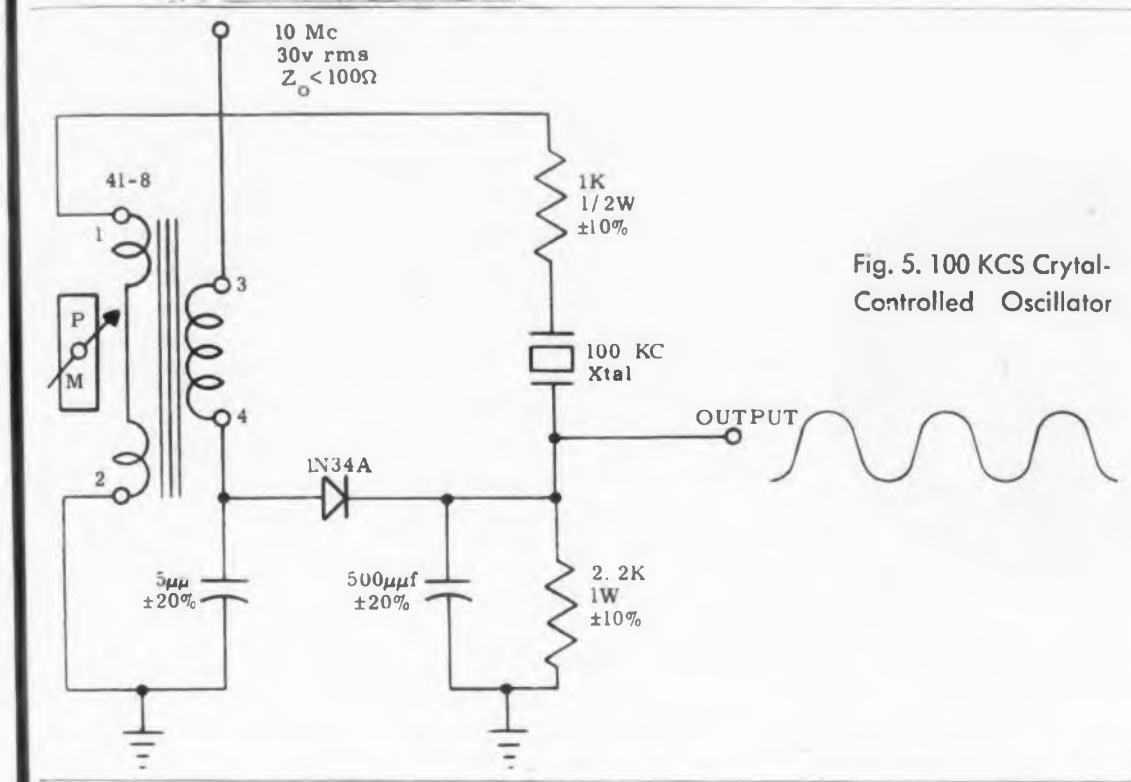
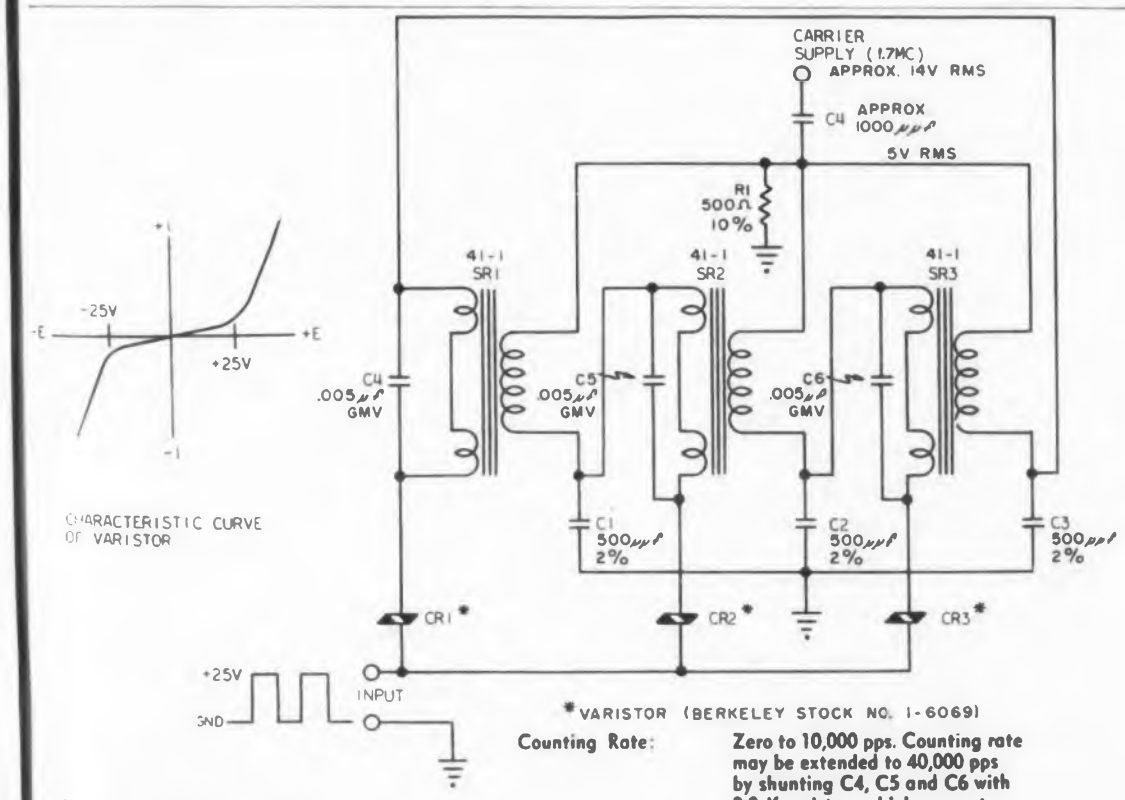


Fig. 5. 100 KCS Crytal-Controlled Oscillator



Counting Rate: Zero to 10,000 pps. Counting rate may be extended to 40,000 pps by shunting C4, C5 and C6 with 2.2 K resistors which prevent ringing at high frequencies.

Input Pulse Duration: 10 to 30 μs.

Fig. 6. Ring Counter

MEMO

TO: OUR MOST HELPFUL SUBSCRIBERS

FROM: HAYDEN PUBLISHING STAFF

RE: THIRD ANNUAL AUDIT OF BRAND RECOGNITION

Thanks to you, our subscribers, Hayden Publishing has once again published its annual Brand Recognition Study. From the 3027 questionnaires sent out to a cross section of the men in the electronic industries, 979 answers were received. This is an extraordinary response on such a long and intricate questionnaire, and we appreciate your co-operation in taking the time to fill it out.

This Study showing the percentage of responses of brand names to the 36 categories of component parts shows the changes that have occurred in marketing patterns over the last three years. And the percentage of electronic design engineers responding to each product is an indication of the interest shown by the original equipment market in the products mentioned.

Hayden Publishing is happy to be able to serve the electronic industries with this report, and appreciates such a responsive audience. Thank you for your cooperation.

Abstract

Reliability

IN many instances, resistor elements heretofore available have been unsuitable for the highest degree of reliability required today in critical applications. A resistor must be considered unreliable if its resistance value goes outside arbitrarily specified limits under anticipated operating conditions, even when its life may not be unduly shortened thereby or when open-circuit does not occur. High humidity over extended periods has been a factor in resistor unreliability, and Allen-Bradley set about to improve resistor characteristics under such operation conditions.

Unpredictable failures have occurred with film-type resistors but composition resistors have been generally reliable as long as they are not subjected to extreme humidity over extended periods. The approach taken by Allen-Bradley to improve reliability under such conditions was to develop an improved hermetically-sealed composition resistor. The results of their efforts are shown in the table for the new types, ES and TS.

The Type ES resistor element is centrally disposed in a ceramic tube whose inner wall ends are metallized. The solder seal to the lead wire is recessed below the edge of the tube. This recessed seal serves a practical function in that it becomes more difficult for an assembly operator to melt the solder around the seal than if the seal were flush with the end of the tube. Outside body dimensions are 0.560 in. long by 0.225 in. diam.

With the Allen-Bradley Type TS resistor, which has its resistive element centrally disposed in a metallized ceramic tube, the solder seal is made on the tube ends rather than inside the tube itself. Body dimensions for the TS resistor are 0.210 in. long by 0.107 in. diam.

# of Resistors

The performance limits established for the Type ES resistor are shown in the table, as compared to the requirements of MIL-R-11A and MIL-R-10509A. Note, particularly, the improvement gained in the humidity characteristic and the moisture resistance test. The prime purpose, of course, was to initially isolate the resistor from deleterious humid environmental conditions. The data shown is the result of a test for 1000 hours at 100% relative humidity at 55 C, as contrasted to MIL-R-11A, of only 250 hours at 90 to 95% relative humidity at +40 C. All resistors in this test, which comprise resistance values in the entire range of 10 ohms to 22 megohms, changed less than 1%. Changes of less than 1% compared to an allowable 5% were obtained with the moisture resistance test of MIL-R-10509A. Besides these small resistance changes under high humidity, the sealed resistor has been stabilized in many of its other characteristics, as shown.

The performance limits on the Type TS resistor are also listed in the table as compared to the minimum requirements for higher powered resistors under the military specifications. Although the maximum operating temperature is limited to +110 C, this is not a serious handicap in the use of such a resistor if it is borne in mind that for those applications of miniaturization where such small size is required, high electric loads and ambients are not usually encountered for extended periods of time.

These new resistors described are not a "cure-all" in regard to the problem of reliability of resistors, of course, since there can exist conditions under which almost any component will fail if improperly applied.

From a paper entitled "Hermetically Sealed Composition Resistors," *presented by A.C. Pfister, Research Engineer, Allen-Bradley Co., at The National Conference On Aeronautical Electronics in Dayton, May 14-16, 1956.*

Table of Performance Data, Allen-Bradley Resistors, Types ES and TS

Test Procedure As Per MIL-R-11A or MIL-R-10509A Where Applicable	Maximum Changes Allen-Bradley Type ES	Allen-Bradley Type TS	MIL-R-11A	MIL-R-10509A
Humidity Test	1%	1%	10%	
Moisture Resistance Test	1%	1%		5%
Temperature Cycling	1%	1%	3%	1%
Short-time Overload	1%	1%	2.5%	0.75%
Effect of Soldering	1%	1%	3%	0.5%
Load Life	6%	6%	6%	
1 watt at 70 C Derate to Zero at 165 C				
Vibration	1%	1%	1%	

Missile Electronics Reliability

IN ANALYZING a recently manufactured group of missiles, knowledge became available on individual components sustaining failures during routine missile checkout, with all components being exposed to approximately the same extent of test time of about 19 hours per missile. Since a study indicated that failures appeared to be random in nature and distribution during these tests, the random failure law can be used to define the expected reliability for each family of components.

Thus: Component Reliability $= P_x = e^{-t/T} = e^{-tf/h}$

where:

P_x = Probability of no failure in a component group

t = Time at which reliability is measured

T = Mean-time-to-failure

f = Average component failures per missile

h = Average hours per missile (19 hours)

And: Missile Reliability

$$(P) = P_1 . P_2 . P_3 . P_4 . P_5 \ldots\ldots\ldots\ldots P_x$$

From the above probability expression, Table 1 has been prepared to show the relative rates of component failures sustained in this group of missiles, giving percent contribution to total failures, the reliability per hour and the reliability expression (P_x) for each major group of components. Electronic system failures account for 76 percent of all missile failures, and that solder joints and wiring, subminiature tubes, and relays are responsible for about 50 percent of all electronic failures. Resistors, potentiometers and capacitors together represent only 12 percent of all electronic failures in these particular missiles.

Figure 1 shows the respective contribution of individual component reliabilities to overall missile reliability, as a function of cumulative hours of missile operation. Data in both Table 1 and Figure 1 are independent of the component part population per missile, and merely define the relative rates of failure expected during checkout of these missiles.

Abstracted from Reliability Indices For Missile Electronic Component Parts, T.S. Bills, Applied Physics Lab., The Johns Hopkins University, Electronic Applications Reliability Review, RETMA, 11 West 42 Street, New York 36, N.Y., Sept. 1956.

Abstract

TABLE I

Component Failure Proportions in a Guided Missile Program
Cumulative Testing Time (h) = 19 Hours Per Missile

Component Part	Failures Per Missile (f)	% of All Failures	Reliability Per Hour	Reliability $P_x = e^{-tf/h}$
Unresolved	.453	6.7	.9764	$e^{-t/42}$
Transformers	.071	1.1	.9962	$e^{-t/266}$
Rotating Equipment	.119	1.8	.9938	$e^{-t/160}$
Connectors & Plugs	.143	2.1	.9925	$e^{-t/133}$
Miniature Tubes	.143	2.1	.9925	$e^{-t/133}$
Potentiometers	.167	2.5	.9913	$e^{-t/114}$
Capacitors	.214	3.2	.9888	$e^{-t/89}$
Resistors	.238	3.5	.9875	$e^{-t/80}$
Crystal Diodes	.428	6.3	.9778	$e^{-t/44.5}$
* Special Devices	.525	7.8	.9728	$e^{-t/36.3}$
Relays & Switches	.548	8.1	.9716	$e^{-t/34.8}$
Subminiature Tubes	.715	10.5	.9632	$e^{-t/26.7}$
Solder Joints & Wires	1.380	20.4	.9302	$e^{-t/13.8}$
Propulsion Comps.	.477	7.0	.9753	$e^{-t/40}$
Hydraulic Comps.	1.142	16.9	.9420	$e^{-t/16.7}$
Total Electronic	5.144	76.1	.763	$e^{-t/3.7}$
Total Mechanical	1.619	23.9	.918	$e^{-t/11.8}$
Each Missile	6.763	100.0	.700	$e^{-t/2.82}$

* *Note:* Special devices include klystrons, magnetrons, accelerometers, inverter governors, and multiplexing switches

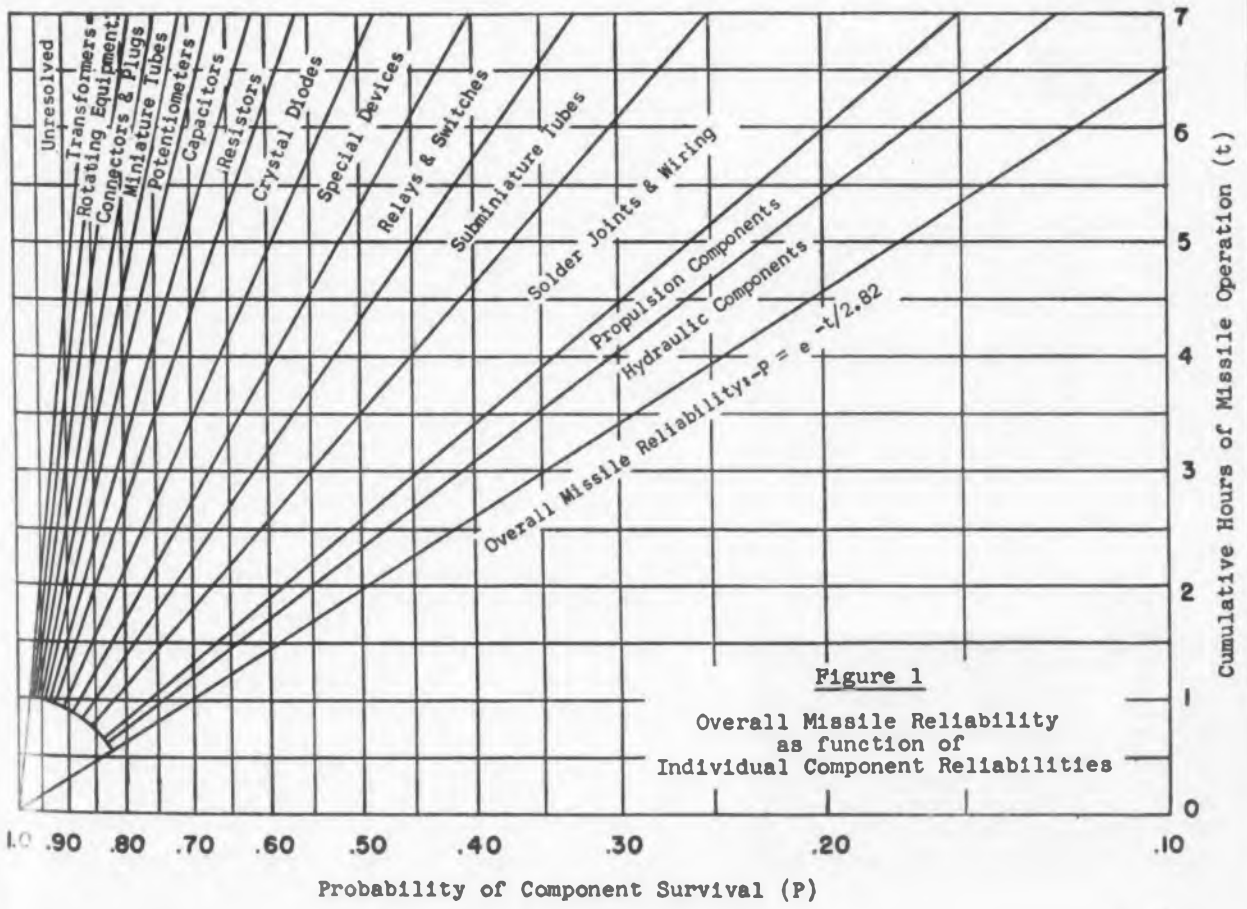


Figure 1

Overall Missile Reliability
as function of
Individual Component Reliabilities

Abstracts

Report Briefs

Transistor At High Current Densities

At high current densities the simple theory of the junction transistor is no longer valid, in view of the fact that in the transistor base the minority concentration ceases to be everywhere negligible with respect to the majority concentration. One consequence of this is that the base loss drops fairly quickly to half its initial value as the current density is raised; another consequence is that the emitter loss gradually increases. The increase in emitter loss continues long after the base loss has become constant, the net result being that the total losses go on increasing and that the current amplification factor falls off. The higher the equilibrium concentration of majority charge carriers in the emitter the slower the rise of emitter losses with current density; as a result of this, excessive losses are not incurred until higher current densities. Where p-n-p alloy transistors are concerned, this higher concentration can be obtained by the use of gallium-indium alloy as acceptor material for the emitter instead of the usual pure indium. *Abstract summary, Transistor At High Current Densities, Stieltjes and Tummers, Philips Technical Review, North American Philips Co., Inc., 750 South Fulton Ave., Mt. Vernon, N.Y., July 1956, pp 61-68.*

Diode Mixer Analysis

Discussed is a method for calculating the mixer admittance matrix Y′ which results when the ohmic impedance is connected in series with a diode mixer described by an admittance matrix Y. There are no restrictions on the frequency dependence of the ohmic impedance nor on the number of harmonic sidebands considered. The equations are worked out in detail for the "low Q" case in which signal, image, and intermediate frequencies are considered, and it is shown that Y′ in this case is "nearly low Q." Explicit formulas have been derived for calculating the elements of Y′ when Y represents the parallel combination of a nonlinear conductance and capacitance. In general, these formulas are cumbersome, but three special cases have been considered in detail. *PB 111786 An Analysis of the Diode Mixing Consisting of Nonlinear Capacitance and Conductance and Ohmic Spreading Resistance, A.C. Macpherson, NRL Report 4607, OTS, US Dept. of Commerce, Washington 25, D.C., Feb. 1956, 16 pp.*

/OR Ground Discontinuity Effect

Tests were conducted atop a high bluff along the Lake Michigan shore to determine the effect of an abrupt ground discontinuity on the course accuracy of a vhf omnirange. Satisfactory operation is obtained when the antenna is located 4 ft above the terrain and not less than 63 ft from a ground discontinuity. Distance from antenna to ground discontinuity must be increased to 125 ft if the antenna is raised to 14 ft above the terrain. Equations describe some phenomena observed. *PB 121228 Effect of a Ground Discontinuity On a VOR, Anderson and Frederick, CAA TDC, Bulletin 278, OTS, US Dept. of Commerce, Washington 25, D.C., May 1956, 20 pp. 50 Cents.*

Vernier Timer Measures Millisecs

Developed at NRL, a vernier timer uses magnetic disc recording and is capable of measuring in true time the position of a shaft when its position is proportional to time. A prototype of the timer has been built, using two magnetic discs. The timer measures intervals from 10 to 20,000 msecs, with an accuracy of ±1 msec., and largely dependent on the constancy of the frequency supply to the disc drive motor, *PB 121099 A Vernier Timer, J. P. O'Connor, NRS Report 4741, OTS, US Dept. of Commerce, Washington 25, D.C., April 1956, 16 pp, 50 Cents.*

Substitute For Hi-Nickel Alloy

Sendust powder cores exhibit excellent magnetic properties (low eddy current, hysteresis, and residual losses, coupled with high permeability) indicate their usefulness as a future substitute for high nickel alloys used in loading and filter coils, such as 2-81 molybdenum-permalloy. *PB 121166 Sendust Powder Magnetic Cores: A Non-Strategic Substitute For Powdered High Nickel Alloys, E. Adams, NOL, OTS, US Dept. of Commerce, Washington 25, D.C., June 1953, 19 pp. 50 Cents.*

AF Materials Research

Two hundred and five abstracts of USAF research in adhesives, metallurgy, analysis and measurement, biochemistry, textiles, petroleum products, plastics, packaging, protective treatments and rubber are contained. This research was conducted during the period from July 1954 to June 1955. *PB 111648S A Review of the Air Force Materials Research and Development Program, Mary M. Sokol, USAF Wright Air Development Center, OTS, US Dept. of Commerce, Washington 25, D. C. Feb. 1956, pp. 137, $3.50.*

Standards and Specs

Sherman H. Hubelbank

This department surveys new issues, revisions, and amendments, covering military and industry standards and specifications. Our sources of information include the Armed Services Electro-Standards Agency (ASESA), the cumulative indexes to Military Specifications, Vols. II, IV, American Standards Association (ASA) and other standards societies.

Connectors

MIL-C-8384A (USAF), CONNECTORS, ELECTRICAL, (MOLDED BODY) AND ACCESSORIES, 7 JUNE 1956.

Electrical, molded-body, multicontact connectors and their accessories as used in electronic equipment are covered in this spec. This spec has been prepared to assure that the connector made by one manufacturer will be interchangeable with the connectors of the same design and size made by any other manufacturer.

Solenoids

MIL-S-004040B (USAF), GENERAL SPECIFICATION FOR SOLENOID, 3 MAY 1956.

The general requirements for solenoids used in aircraft to actuate various devices for electric power are covered by this spec. Solenoids are either Type I, continuous duty, or Type II, intermittent duty, and either Class A, in which the mechanical force is presented as direct movement in a plane parallel to the longitudinal axis of the coil, or Class B, which impart a mechanical force perpendicular to the longitudinal axis of the coil. This limited coordination spec has been prepared by the Air Force, based upon currently available technical information, but the spec is not approved for promulgation as a revision of MIL-S-4040A.

Transistors

MIL-T-25380A (USAF), TRANSISTORS, PHOTOTRANSISTORS, SEMICONDUCTOR DIODES, AND PHOTODIODES, 17 MAY 1956.

Semiconductors for use in Air Force electronic equipment are covered by this spec. The class into which each semiconductor falls is indicated on the individual specs. Terms and symbols used in this spec and related semiconductor specs, concerning semiconductors, are defined.

Resistors

The Air Force has issued the following specs covering variable wirewound resistors of the low operating type. These specs are to be used for the procurement of replacement parts and not for new design.

MIL-R-26979, RESISTOR TYPE RA-15
MIL-R-26980, RESISTOR TYPE RA-24
MIL-R-26981, RESISTOR TYPE RA-40
MIL-R-26982, RESISTOR TYPE RA-50
MIL-R-26983, RESISTOR TYPE RA-60
MIL-R-26984, RESISTOR TYPE RA-75

Capacitors

MIL-C-18312 (Navy), Amendment 1, Capacitors, Fixed, Paper Dielectric, Metallized Paper Construction, Direct Current, Hermetically Sealed Metallic Case, 28 May 1956

The tab type of construction has been deleted from the spec. The tables showing the characteristics of styles CH04, CH05, CH10, CH53, and CH54 capacitors have been revised.

RETMA RS-164, Fixed Paper Dielectric Capacitors In Tubular Non-Metallic Cases, August 1956

The dimensional and electrical characteristics of fixed capacitors in tubular non-metallic cases whose performance characteristics can be met with paper and/or film dielectric or equivalent are described by this standard. A typical RETMA type designation for capacitors meeting this standard is RCP10W6504K. Copies of this standard may be obtained from Engineering Department, RETMA, 11 West 42nd Street, New York 36, N.Y. for 50 cents each.

RETMA RS-165, Ceramic Dielectric Capacitors, Classes 1 and 2, 1000 Through 7500 Volts Rating, August 1956

Class 1 capacitors are a type specifically suited for resonant circuit application or any other application where high Q and stability of capacitance characteristics are essential. A typical RETMA type of designation for Class 1 capacitors is R1CC20U2J470G15. Class 2 capacitors are specifically suited for by-pass and coupling or where Q and stability of characteristics are not of major importance. R2CC20Y5Y221M15 is a typical designation for Class 2 capacitors. Copies of this standard may be obtained from RETMA for 80 cents.

Standards Book

Standards are linked with the achievements of scientific research and technological innovation and with high production efficiency in the age of automation in a 370-page book, entitled "National Standards in a Modern Economy." Edited by the late Dickson Reck, professor, School of Business Administration, University of California, the book is the work of 34 noted authorities in the field of standards. Publishers are Harper and Brothers, New York. Copies may be obtained from ASA at $5 each.

Procurement

MIL-E-17189B, Special Provisions For Offshore Procurement of Electronic Equipment, 3 May 1956

Supplementary requirements to basic specs covering equipments for offshore procurement are established by this spec. A procedure is outlined for the selection of parts. Instruction books are to follow MIL-M-16616, with exceptions as indicated in the spec.

Coils, Transformers

MIL-C-15305A, Coils, Radio Frequency; and Transformers, Intermediate and Radio Frequency, Amendment 1, 17 July 1956

Procurement of coils and transformers of a specific design require additional data to give detailed electrical and mechanical requirements, tolerances, and applicable additions and exceptions to the general requirements and tests specified in this spec. A paragraph has been added indicating the information to be furnished with preproduction samples.

Standard Samples of Nickel Oxide

Two new standard samples of nickel oxide powder are now available from the National Bureau of Standards, Washington 25, D. C. Although designed primarily as spectographic standards, they are also useful as chemical standards. Analyzed and certified for nine minor and trace elements, the standards are intended for checking and calibrating spectrochemical and chemical methods employed in the analysis of nickel, particularly cathode-grade material.

Signal Corp Equipment

MIL-P-11268C (Sig C), Amendment 2, Parts, Materials, and Processes Used In Signal Corps Equipment, 16 August 1956

Seven specs have been added to the list of applicable specs. These specs cover cable, resistors, and rectifiers. Three tables have been added to specify various styles of capacitors for specs MIL-C-62, MIL-C-5, and MIL-C-25. The requirements for lamps, selenium rectifiers, resistors, electron tubes, and shock isolators have been revised.

Transistors

MIL-T-19500 (Ships), Transistors, 7 May 1956

This is a general-purpose spec covering transistors for use in electronic equipment. The individual transistor specs govern in cases of conflicts. A color code for designating types of transistors is established. Transistor terms are defined as are transistor symbols.

Capacitors

MIL-C-25102A (USAF), Capacitor, Fixed Electrolytic, Tantalum, 20 April 1956.

Tantalum, electrolytic capacitors suitable for use in filter and by-pass circuits where large excesses of capacitance over the nominal capacitance can be tolerated are covered in this spec. This spec is a graded spec having characteristics and grades covering ranges in temperature and vibration respectively. The characteristic, capacitance, working voltage, and grade of capacitor used should be based upon the application in which the capacitor is to be used. A typical type designation of a capacitor meeting this spec is CW12B101A1.

ADVERTISING INDEX

November 15, 1956

Ceramic bushings—important design feature of

NEW UHF BEAM POWER TUBES

RCA-6816 and RCA-6884

lightweight...small size...high efficiency

80 watts cw output at 400 Mc! • 40 watts cw output at 1200 Mc!

Only 1⅞" high, 1¼" diameter, and 2-ounces in weight, RCA-6816 and RCA-6884 are exceptionally well suited for oscillator, multiplier, and amplifier applications in communications equipment where *light weight, physical compactness, and rugged construction* are important design considerations.

These versatile RCA-designed tubes are the result of unusual precision-production techniques and processes. For example, simultaneous cutting of both control grid and screen grid is effected by an electrical-discharge method which assures exceptionally uniform and accurate alignment of these structures. All welding of tube elements to their individual supports and internal leads is eliminated through use of one-piece construction which combines each electrode, its support, and its external contact surface. This feature provides low-inductance paths, high electrical and thermal conductivity, and rugged construction. Coaxial electrode structure, and low-inductance large-area rf electrode terminals *insulated from each other by low-loss ceramic bushings* facilitate the use of these tubes in circuits of the coaxial-cylinder cavity type. Both types have integral radiator and gold-plated contact surfaces.

Because of their high power sensitivity and high efficiency, these new RCA tubes can be operated with relatively low plate voltage to give large power output with small driving power. RCA-6816 has 6.3-volt, 2.1-ampere heater and RCA-6884 has 26.5-volt, 0.52-ampere heater.

Typical CCS Values for RCA-6816 and RCA-6884 in CW Service

	400 Mc	1200 Mc
DC Plate Volts	900	900
DC Plate Amperes	0.170	0.170
Useful Power Output (watts)	80	40
Power Gain	28	9

Investigate these two new types for your uhf equipment designs. For sales information, contact the RCA District Office nearest you:

EAST: HUmboldt 5-3900
744 Broad Street
Newark 2, N. J.

MIDWEST: WHitehall 4-2900
Suite 1181,
Merchandise Mart Plaza
Chicago 54, Ill.

WEST: RAymond 3-8361
6355 East Washington Blvd.
Los Angeles 22, Calif.

For technical bulletin now in production, write RCA Commercial Engineering, Section K18-Q2, Harrison, N.J.

Actual size exploded view of these new UHF Beam Power Tubes. Seen are the coaxial structure, the one-piece construction of elements and the unique control and screen grids.

◀ CIRCLE 468 ON READER-SERVICE CARD