ELECTRONIC DESIGN

MARCH 5, 1958

IRE Convention Issue

Preview of new Products at the 1958 National IRE Convention Starting on Page 80

ELECTRONIC DESIGN

COVER STORY

IRE Show Highlights
. . . . . Sessions p 22
. . . . . New Products p 80

Preview new products being shown for the fiirst time at the IRE National Convention by turning to the New Products department. Capsule summary of trends in components precedes this section.

Transistor Simulated Reactances . . . . . p 24

Very large reactances can be replaced by compact transistor circuits with large savings in cost, size, and weight.

How To Measure FM Bandwidth at Microwave Frequencies . . . . . p 36

Mr. Larson provides here a very simple, yet effective technique for measuring fm bandwidth. A few simple components make it possible to measure bandwidths greater than one per cent.

Transistor Voltage Standards . . . . . p 50

A proposal for the standardization of power supply voltages for transistor circuits. Recommended voltages are ±1.5, 3, 6, 12, 25, 50, and 100 v, with voltages above 100 falling in 50 v increments.

Silicon Diode Application Notes, Part II . . . . . p 58

For rapid solution of diode design problems, a nomogram enables quick inspection adjustment of thermal and electrical variables.

CIRCLE 1 ON READER-SERVICE CARD

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Number

5

SUBSCRIPTION POLICY

ELECTRONIC DESIGN is circulated only to qualified electronic design engineers of U. S. manufacturing companies, industrial consultants, and government agencies. If design for manufacturing is your responsibility, you qualify for subscription without charge provided you send us the following information on your company's letter head: Your name and engineering title, your company's main products, and description of your design duties. The letter must be signed by you personally. Any address changes for old subscribers necessitates a restatement of these qualifications. Subscription rate for non-qualified subscribers—$15.00 for 1 year only.

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ENGINEERING REVIEW

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

Airborne TV Gives Pilot Geographical Location

The Horizontal Situation Display is a TV device which permits the pilot to see his exact location in relation to the ground. The 45-pound system automatically correlates navigational computer information and presents a TV picture in the form of a map corresponding to the pilot's exact location over the terrain.

A closed circuit television device that gives an airplane pilot a continuous and automatic pictorial presentation of the aircraft's geographical position and flight track has been developed by Avion Division of ACF Industries Inc.

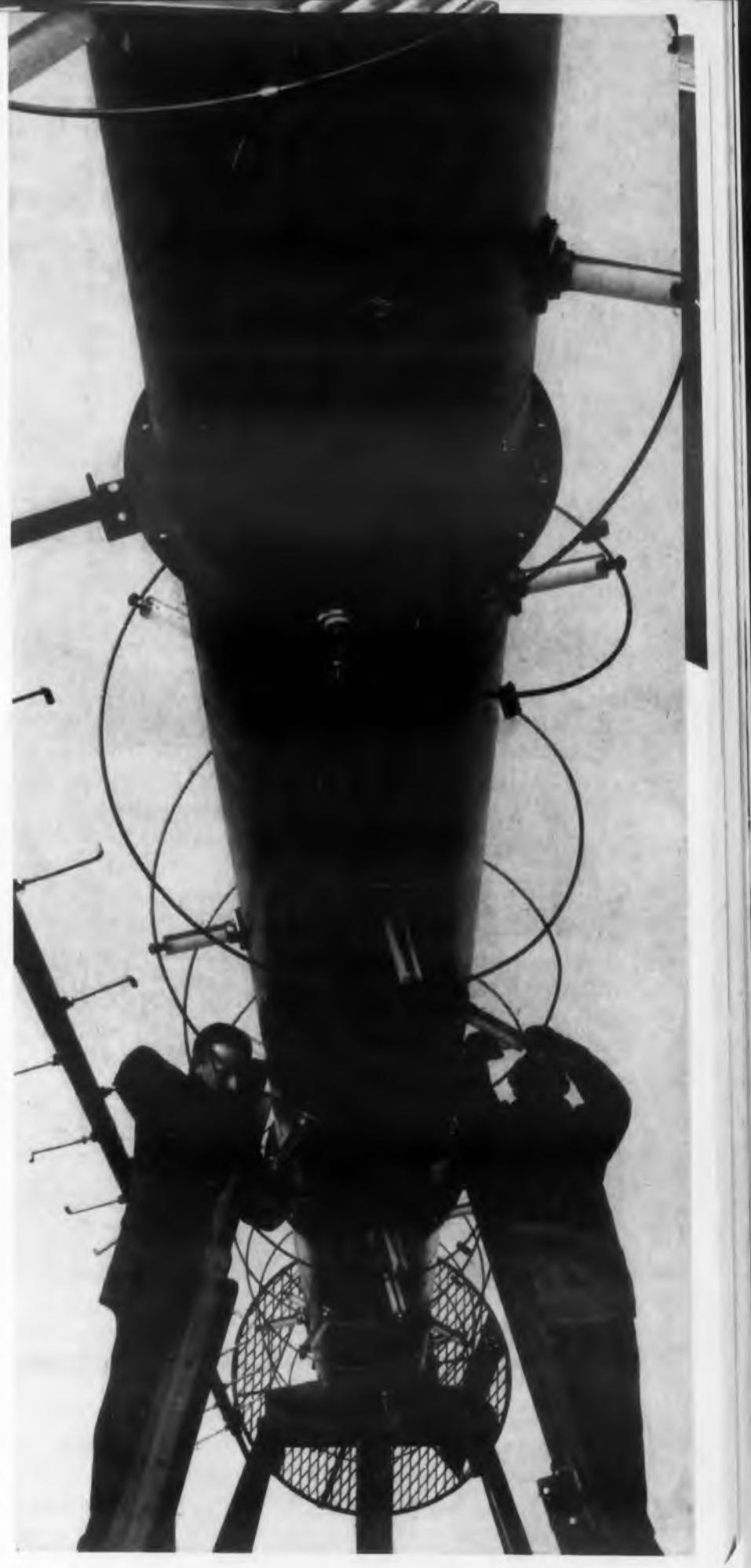
Designated the Horizontal Situation Display (HSD), the device correlates information fed to it by navigational instruments and presents this information in the form of a map of the territory below the plane. The aircraft position is also indicated on the display screen by a silhouette of the aircraft which changes correspondingly with its movement through the air.

When signals from the navigation computer are fed into the HSD, controls governing the position of the map and plane image in relation to each other are actuated. The result is picked up by the TV camera located in a remote part of the plane and transmitted to the 5-inch cathode ray tube on the pilot's instrument panel. The map, approximately 4 x 3 in., is a microfilmed chart mounted on a rigid glass plate with only a small but enlarged portion of the slide projected at a time on the vidicon pickup.

The map slide is located on a carriage which is movable in both X and Y directions by means of precision lead screws.

Latitude and longitude drive information to

(Continued on next page)



TV Titan.—This 57-feet-long, 5,500 pound helical television broadcast antenna will soon be blanketing the Seattle, Wash., area with VHF TV picture and sound signals. Designed by General Electric, Syracuse, N.Y., the antenna is self-deicing and can withstand severe lightning and other weather hazards.

ENGINEERING REVIEW

the lead screws from the computer is transformed into X and Y signals by the coordinate converter.

The image of the aircraft is etched on a glass disk in reticle fashion and is placed directly in the main optical path in close proximity to the map slide. This design feature makes it possible to project both the reticle marker and the map detail on the screen with the same optical system. The reticle marker also is mounted on a carriage which is positioned in X and Y and may be rotated to indicate heading. The reticle lead screws and map lead screws are linked together through the X and Y servos. It is possible to track either by marker or map motion.

Semiconductor Rectifier Use Increasing

Semiconductors as sources of rectified power are achieving increasing popularity, according to statements made at the Winter General Meeting of the American Institute of Electrical Engineers.

"The interest in semiconductor power supplies, which was touched off by early industrial installations in January 1954, continues unabated," R. M. Crenshaw and A. L. Munn of General Electric Co. told a symposium on metallic rectifiers.

According to General Electric, the silicon rectifier's superior characteristics at high voltages and high temperatures is resulting in its broad application for outputs of 100 v dc and up. At lower voltages it is expected that germanium will continue to be used.

High amperage semiconductor rectifiers are replacing mercury arc rectifiers for high current applications, particularly to handle electrochemical loads. The mercury arc rectifier has been the most important source of direct current power in the electrochemical industry, but "semiconductor rectifiers are destined to furnish a much larger proportion of future loads."

New Drafting Aid Developed At Eastman

A new drafting technique has been developed at Eastman Kodak Company, Rochester, N.Y., which uses photographs to convey engineering drawing information in a form easier to visualize.

Photographs are reproduced on a translucent material. To this, engineering detail and additional superimposed sketches can be added. The method saves both time and money, according to Walter C. Foulks of the Kodak Park engineering staff, speaking at a recent meeting of the American Society of Mechanical Engineers in New York City. The easy readability of the prints makes them especially useful for equipment assembly and, because of the small cost of photographic reproductions, they fit in situations where expense prohibits the use of engineering drawings. Shop time can often be reduced because one does not have to visualize the end result from a written specification sheet. One can see the scope of the project at a glance from a photograph of existing equipment or a model.

Additional information on this new photodrawing technique can be obtained from Kodak's pamphlet P-22.

First the Law of Parity and Now . . .

Superatomic energy, a theory which challenges the concept of absolute zero and the speed of light as atomic ultimates, has been proposed by Navy physicist Robert L. Carroll as a possible future rocket power source.

He asserts that as an atom gets colder and becomes less active it gravitates toward the nucleus at an increasing velocity. At a sufficiently cold temperature the atom would collide with and disintegrate the nucleus, releasing its energy.

The Air Force has reportedly agreed to explore the possibility of Dr. Carroll's theory.

CIRCLE 5 ON READER-SERVICE CARD ➤

ENGINEERING REVIEW

Microwaves Produce Human Eye Image

A device which converts microwave radio energy into visible light has been developed. Designated the Eyetron, the unit produces on a screen a picture of scenes which are illuminated by microwaves or which contain sources of microwave radiation. The picture appears on the screen instantaneously and continuously so that it corresponds in all respects to the appearance of the scene to the human eye. The Eyetron consists of a microwave collector which separates incoming waves according to their angle of arrival, channeling all waves from a given direction into a precise location corresponding to that direction, electronic sensing equipment, patent rights pending, to determine the presence or absence of waves arising from a particular direction, and a viewing screen.

Some applications suggested by the designers, Diamond Antenna and Microwave Corp., Wakefield, Mass., are for use in air traffic control, airport surveillance, anti-collision, missile or rocket tracking.

Tape Recorder Stores Photographs

A magnetic tape recorder making it possible to transform a photograph into magnetic impulses that can be retransmitted, stored permanently on tape, or converted back to a picture has been developed by the Ampex Corp., Redwood City, Calif. Upon playback the machine reproduces the original picture with all of its original clarity and detail.

The picture fed into the Faxtape recorder is the output signal from a standard facsimile transmitter. A built-in time standard provides playback with an accuracy of two parts in a million. Complete grey-scale fidelity is achieved.

◄ CIRCLE 6 ON READER-SERVICE CARD

Electronics Volume to Double by 1965

The American electronics industry will almost double its present 12 billion dollar business volume by 1965 according to Frank M. Folsom, Chairman of the Executive Committee of the Board of the Radio Corporation of America. At a meeting of the San Francisco Security Analysts Society, he indicated that the greatest increase would be achieved primarily in industrial equipment, microwave and other forms of radio communication, closed-circuit TV, broadcasting equipment and electronic data processing system areas, a projected growth approaching 300 per cent. The most significant advances will occur in automated sensing and control devices for production, and in data processing. Television spurred by color, should more than double in dollar volume between now and 1965, he estimated, while defense electronics is expected to reach a volume of nearly $6.5 billion by 1965.

Popcorn Returned to the Gourmet

Popcorn, which has been used in some instances in packaging electronic equipment, is not a savory cushioning material. This conclusion, based on tests of the material in comparison with conventional cushioning agents such as bound hair and cellulosic wadding, was noted in a report released by the Office of Technical Services (PB 131162). Results showed popcorn to be relatively stiff and to have very little ability to recover after compression. Its extreme hydroscopicity causes shrinkage in high humidity.

Moviegoers, a word to the wise is sufficient.

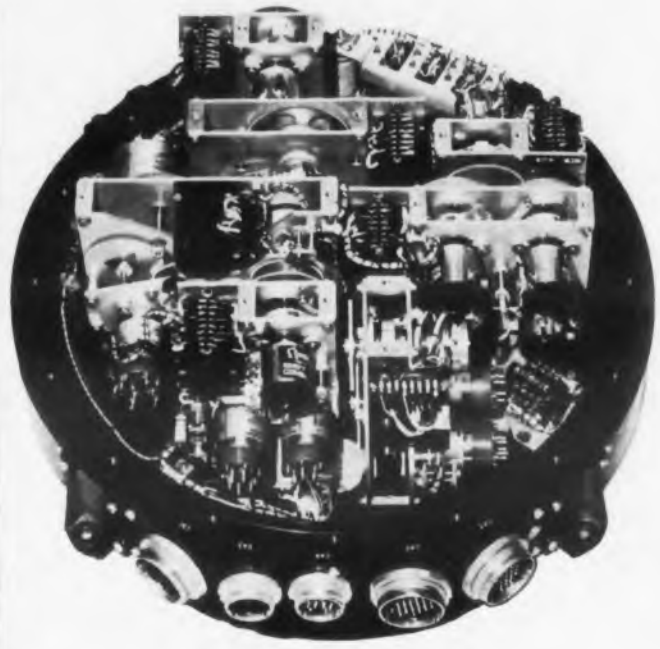
Anticipate Thermonuclear Temperatures Of 40 Million Degrees

A thermonuclear torus is being designed at Associated Electrical Industries, Berkshire, England, which may permit temperatures of thirty to forty million degrees to be reached by the end of the year. The reaction will occur through a mixture of deuterium and tritium.

These higher temperatures may offer further evidence that neutrons produced in this and similar equipment are actually the result of thermonuclear fusion.

At present experiments are being performed with the Sceptre Three, with which temperatures of 12 million deg. will perhaps be achieved. The torus of the Sceptre Three is made of 12-in. diam tubing, the ring diameter being 45 in.

CIRCLE 7 ON READER-SERVICE CARD



The Air Data Computer provides pressure altitude, indicated air speed, Mach number, true air speed, and vertical speed information.

Automatic Computing of Aircraft Data

A fully automatic integrated air data computer system providing a centralized source of aerodynamic data for various services in an aircraft, has been developed in Britain.

The Central Air Reference System, is completely duplicated for safety reasons each half consisting of a transducer unit, a temperature unit, a computer, and first and second pilots' repeaters. The transducer unit, designed for installation close to the pressure head, is a two-capsule, pitot/static type in which deflection of the capsules is first corrected for instrument error, magnified, and then converted to electrical signals by means of a low-friction, low-hysteresis system statically and dynamically balanced. The signals are transmitted to the computer together with signals from the resistance probe temperature unit, and corrections are applied for position, compressibility errors, and temperature.

The corrected static signal gives pressure altitude and is differentiated to obtain rate of climb or descent. Pitot and static signals are also computed to provide indicated air speed, true air speed, and Mach Number, this information being transmitted to the repeater units by means of synchros.

The fully duplicate system necessitates two pressure heads and two resistance probe temperature units. Dimensions of each measuring unit are approximately 7.5 in. x 6.5 in. x 5 in., and its weight 7 lb. Total power consumption for the duplicated system is estimated to be 60 watts. In

rder to provide good legibility on the Altimeter/V.S.I. and the A.S.I./Machmeter within a reasonable panel area, these instruments are of the moving tape type.

The system was developed by Elliott Brothers, London, England, in conjunction with the Bendix Corporation of America.

Luminous Steel

An opaque fabric woven from stainless steel wire can become a flexible light source when coated with phosphors and a transparent conductive material according to researchers in electroluminescent lighting at the Westinghouse Lamp Division, Pittsburgh, Pa. Before it was curled into a cylinder, the steel fabric was twelve in. sq and lay flat upon the lab bench. Light output visible here resulted from the application of 250 v at 4000 cycles. Other light sources have been made with a nylon base.

We Admittance Our IMPEDANCE Error

The following is a letter we recently received. Our apologies to Robertshaw-Fulton.

"I would like to thank you for the publicity we received in your January 8th issue of ELECTRONIC DESIGN concerning our Universal Bridge, Type B-221, which appeared as item 81 under your Products Section.

"Unfortunately, the photograph appeared inverted from the instrument's normal operating position. Perhaps the bridge will operate better in this position, but since it is an impedance bridge this may change its characteristics to one of an admittance bridge." Boyce M. Adams, Mgr., Electronic Instruments Dept.

ENGINEERING REVIEW

NBS Summer Career Program Aids Scientist Recruitment

A program which gives students an opportunity to become acquainted with a Government research laboratory during their summer vacation periods is helping the National Bureau of Standards to meet its increasing demand for high-caliber technical graduates. Having discovered for themselves the advantages of a professional career at the Bureau, of the 236 students employed at the Washington laboratories in the past summer, 44 are still on full- or part-time duty and 130 who plan to return to the Bureau have been granted leave without pay to continue their education. One-half of the 208 students employed in 1956 were included in last summer's program. The program, inaugurated in 1948 was extended to the NBS laboratories in Boulder, Colo., in 1956, where it has resulted in a number of permanent appointments.

The Student Trainee Program, which enables college men and women to apply their education in jobs selected according to their interests, is proving mutually beneficial to NBS and the students. Actual participation in laboratory work has been found to be not only an incentive for continuing scientific studies but also a help to the student in formulating career objectives and in integrating classroom work with actual experience.

During the past summer, students aided in projects ranging from radio propagation studies to developing test methods for acoustic tiles. Programming problems for automatic computers, standardizing isotopes used in medicine, measuring the velocity of free-radical recombination, and designing cryogenic equipment were just a few of the activities.

The Student Trainee Program supplements on-the-job experience with a series of lectures and tours designed to familiarize the summer employees with the research proj-

cts carried on throughout NBS. For example, during the past summer, details of the free-radicals research program were presented to the students. They were given the opportunity to view computer facilities, reactors, the solar furnace, and experiments on purification and high temperature physics.

To gain eligibility on the register from which appointments to the program are made, college men and women must pass a written Civil Service Examination for Student Trainees. At the high-school level a limited number of direct appointments are offered winners in the Westinghouse Science Talent Search and other national science competitions. A student who has taken part in the program and is recommended by his supervisor may return each summer while he is completing his education. Trainee appointments are limited to science majors planning careers in the fields of research carried on at the Bureau. The trainee group ranges from high-school graduates entering at the GS-2 level ($2960 per year) to students who have completed their junior year in college at the GS-4 level ($3415). Graduates who return to the Bureau receive a GS-5 rating ($4480), and those who are employed in a permanent capacity are advanced to a grade 7 ($5335) after three months if they have qualified under a special training agreement during the preceding summer so that their summer work experience can be counted toward promotion. Graduate students are also accepted for summer employment, a master's degree qualifying scientists or engineers for a GS-7 and half the required PH.D work for a GS-9 rating ($6250).

John Ryder Is New Editor of IRE Proceedings

John D. Ryder, Dean of Engineering at Michigan State University, has been appointed Editor of the IRE to succeed Donald G. Fink. President for 1958. Dean Ryder was appointed at the January meeting of the IRE Board of Directors.

Atom-by-atom buildup of the transparent phosphor screens is accomplished with this vapor phase deposition equipment. An evaporation process may be used.

Transparent Phosphor CRT Now Utilized

Transparent phosphor cathode ray tubes are now being designed into classified military systems and air traffic control systems in what is reportedly the first such application.

The product of ten years of research at General Electric, Schenectady, N.Y., the tubes afford higher resolution capabilities, higher ambient light viewing, and increased burn resistance over conventional tubes. In addition, the phosphors are virtually noiseless with practically constant light output.

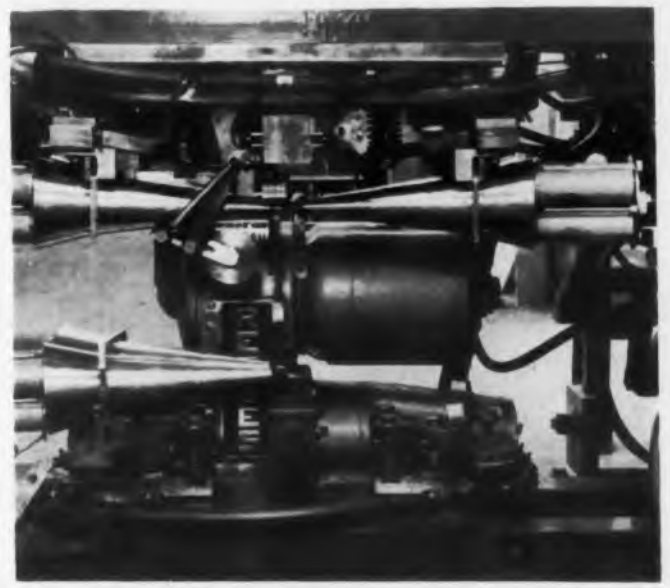
Utilizing low temperature condensation or evaporation processes, non-scattering phosphor screens 1-2 microns thick have been achieved as opposed to the 15-25 micron thickness of standard phosphors.

Theoretically, resolutions of 10,000 lines per inch may be attained with these phosphors although only 1000 lines per inch have been obtained at present. This lag is due to the limitations in the electron optics area and not the state-of-the-art of the phosphors.

The normally diffuse reflecting surface of the standard phosphor has been eliminated so that incident light is not reflected permitting displays under extremely high conditions of ambient lighting. Instead the incident light is trapped inside the transparent phosphor tube resulting in excellent contrast. Light which is specularly reflected may be trapped by a light trap. Up to 97 per cent of the external light has been eliminated in this fashion.

Since the transparent phosphors are in intimate contact with the glass face plate of the tube, the glass may serve as a heat sink allowing greater heat dissipation. In some instances, beam currents in the order of 50-500 times higher than their equivalent standard phosphor tube may be used safely without deteriorating the transparent phosphors.

One unusual development arising from these phosphors is the penetron, a multi-colored device consisting of separate layers of phosphors, with various color emission characteristics. The change of voltage of the cathode ray beam controls the penetration of the beam to the appropriate color emitting layer.



Automated Ultrasonic Welder

An ultrasonic welder, reportedly the first automated, continuous seam welder has been developed by Gulton Industries, Inc., Metuchen, N.J. The unit joins aluminum to aluminum, aluminum to stainless steel, or any two dissimilar or similar metals, as a result of a molecular transference or plastic flow at the interfaces of the two metals below the melting point of either metal. Achieving a rate of speed of 200 in. of welding per min, the welder stands 13 x 12 x 10 ft, and weighs three tons. It is powered by two, 2 kw generators which operate alternately depending on the forward or backward motion of the welding heads, and which supply 500 watts to each welding head. The eight welding heads are driven in the range of 10,000 cps.

Correction

A large error conspicuously occurring in a subtitle is the painful admission we must make about a product written up on page 52 of the February 5 issue. The HD file drum, manufactured by Laboratory for Electronics, Inc., has a storage capacity of 15,000,000 bits, a much more impressive figure than the 15,000 we stated.

Washington Report

Herbert H. Rosen

Quickening of Pace

What's been done? What's going to be done? What are you doing now? These are the three big questions being asked most often in Washington these days. Congress is now in the process of finding out if the President's request for nearly $74 billion in FY '59 will or will not do the job. And that job? The defense of the nation against the threat of Russian technological and military supremacy.

Major interest, naturally, is in the department with the largest share of the budget, Defense. How and where it expects to spend its $40 billions has been of extreme and particular interest since October 1957. Public interest has been at a peak since December, provoked chiefly by the many inquiries being made by Congress.

A preview of general congressional sentiment on the way the Department of Defense conducts itself is reflected in the 17-point program recommended in the interim report of the Johnson Committee. These are the steps the committee feels should be taken immediately by the Administration: 1. Strengthen the Strategic Air Command; 2. Step up dispersal of SAC bases; 3. Step up development of antimissile missiles; 4. Improve the early warning system for manned aircraft and accelerate development of early warning detection of ballistic missiles; 5. Modernize the ground and naval forces; 6. Provide an adequate airlift for troops; 7. Speed up our antisubmarine program; 8. Step up production of the Atlas, Thor, Jupiter and development of the Titan; 9. Reduce lead time in developing weapon systems by cutting down decision times and simplifying procurement procedures; 10. Provide for a freer exchange of technical and scientific information between the nations of the free world; 11. Give serious attention to questions of shelters

and stockpiles for civil defense; 12. Reorganize the Department of Defense; 13. Provide increased incentives for trained persons in the military services; 14. Accelerate and expand the R & D programs. Provide funding on a long-term basis, and improve the administration and control within the Department of Defense or through an independent agency; 15. Step up development of manned missiles; 16. Accelerate the development of the Polaris missile system; 17. Start work now on the development of a rocket motor with one million pounds of thrust.

The Key to Survival—Money

The goal of all these points is to buy time. Time to get our ballistics missiles into production. Time to develop radar, guidance, and data processing systems to cope with enemy manned and unmanned missiles.

This year's spending program—January to June, 1958—has been given a substantial transfusion in the form of a supplemental appropriation. Over $1.4 billion has been allotted to the Defense Department for IR and ICBM production and bases, antimissile research, and atomic-missile launching submarines. Funds have been earmarked for support of the new operational agency in the DOD, the Advanced Research Projects Agency. The Defense Secretary's emergency fund has been augmented to pay for any rapid breakthroughs that may develop.

In all, defense electronics should exceed $4 billion in calendar 1958. More than $1.7 billion should be spent in the missiles field alone. Even at a reduced procurement rate, aircraft electronics should approach $1.1 billion. Ground type electronics and communications should amount to $860 million. And electronics share of the R and D category should go beyond the $40 million level.

This year should also produce some startling developments in electronics because of the emphasis on new techniques. Frequency diversity radar is looked upon as a brand new method for interference-free detection and ranging. The Army's Nike Zeus antimissile program should come up with innovations that will be valuable to the future growth of the industry. More than $721 million will be spent by the Air Force alone in the area of antimissile detection (part of the defunct Wizard program).

Money—and the quick decision to spend it in designated areas—should be adequate for the current defense program. Yet, in testimony before the House Appropriations Committee, Secretary of Defense McElroy forecasted that he expects to be forced to ask for another supplemental appropriation next January. At this point, industry should consider where it is to get the manpower for these accelerated programs.

MEETINGS

Mar. 16-21: 1958 Nuclear Congress

Chicago Amphitheatre and Palmer House, Chicago, Ill. Sponsored by the AICE, AIEE, IRE, and many others. The congress will include five separate conferences: The Fourth Nuclear Engineering and Science Conference (Mar. 17-21); The Fourth International Atomic Exposition (Mar. 16-21); The Sixth Atomic Energy in Industry Conference (Mar. 17-19); The Sixth Hot Laboratories and Equipment Conference (Mar. 19-20); and The American Power Conference (Mar. 17-19). For more information write to the American Institute of Chemical Engineers, 25 West 45th St., New York 36, N. Y.

March 18-19: Conference on Extremely High Temperatures

Air Force Cambridge Research Center, L. G. Hanscom Field, Bedford, Mass. Sponsored by AFCRC. The purpose of the Conference is to further the exchange of information among those interested in research into temperatures above 30,000 Kelvin. Emphasis will be placed upon theoretical and experimental aspects although the Conference will also cover applications. Write Dr. Heinz Fischer, AFCRC, L. G. Hanscom Field, Bedford, Mass. for details.

Mar. 24-27: IRE National Convention

Waldorf-Astoria Hotel and New York Coliseum, New York City. More than 55,000 engineers and scientists from 40 countries are expected to attend this technical convention. Program includes 275 papers, covering the most recent developments in the fields of all 27 IRE Professional Groups, and two special symposia. For information contact E. K. Gannett, IRE, 1 East 79th St., New York, N.Y. (See program on page 22.)

Mar. 27-29: Ninth Biennial Electrical Industry Show and Fifth Electrical Maintenance Conference

Shrine Exposition Hall, Los Angeles, Calif. Some of the topics to be discussed are maintenance to prevent breakdown, maintenance of electrical and electronic equipment and maintenance of lighting to assure peak output. For more details write Paul H. Henrichs, Southern California Edison Co., P.O. Box 351, Los Angeles, Calif.

Mar. 31-Apr. 2: AIEE South West District Meeting

Tulsa, Okla. For information send to the AIEE, 33 West 39th St., New York, N.Y.

Mar. 31-Apr. 2: Instruments and Regulators Conference

University of Delaware, Newark, Del. Sponsored by the IRE, ASME, AIChE, and ISA. For details send to E. M. Grabbe, P.O. Box 45067, Airport Station, Los Angeles 45, Calif.

Apr. 2-4: ASME Conference on Automatic Optimization

University of Delaware, Wilmington, Del. AIEE, IRE, ISA, AIChE with professional groups analogous to the RE will participate in the conference by sponsoring technical papers centered around the theme, "Automatic Optimization." For details write W. E. Vannah, Control Engineering, 330 W. 42nd St., N. Y. 36, N. Y.

Apr. 8-10: Sixth National Conference on Electromagnetic Relays

Oklahoma State University, Stillwater, Okla. Sponsored by the National Association of Relay Manufacturers. More information may be obtained from Charles F. Cameron, Dept. of Electrical Engineering, Oklahoma State University, Stillwater, Okla.

Apr. 8-10: Symposium on Electronic Waveguides

Auditorium of Engineering Societies Bldg., 33 W. 39th St., New York. Sponsored by IRE, PGED and PGMTT, and the Department of Defense Research Agencies. The symposium will deal with the interaction of electromagnetic fields and electron or plasma beams in general waveguide regions. The symposium covers the fields of electron beams, plasmas, and electromagnetics to compare the rather widely disparate theories and techniques employed to describe the wave phenomena encountered in the interaction of such fields. For further information contact the Polytechnic Institute of Brooklyn, 55 Johnson St., Brooklyn 1, New York.

Apr. 10-12: IRE South West Regional Conference and Electronics Show

San Antonio Hotel and Municipal Auditorium, San Antonio, Tex. Write for details to J. O. Parr, Jr., 202 Janis Ave., San Antonio, Tex.

MEETINGS

Apr. 30-May 1-2: 7th Regional Technical Conference & Trade Show

Hobbies Bldg., State Fair Grounds, Sacramento, Calif. Write Ewald W. Berger, 3421 58th St., Sacramento 20, Calif. for information.

May 4-7: 4th National Flight Text Instrumentation

Park-Sheraton Hotel, New York City. Sponsored by the Instrument Society of America. Coverage of all phases of instrumentation for aircraft testing will be offered including sessions on helicopter and power plant instrumentation. Three sessions will be specifically devoted to Missile Instrumentation. Another session will be spent on the instrumentation for ground testing of aircraft and aircraft systems. Theme of the Symposium is "More Data Per Dollar." For details write P.O. Box 113, Bethpage, N. Y.

May 5-7: PGMT&T National Symposium

Stanford University, California. For details, write to Dr. K. Tomiyasu, GE Microwave Lab., 601 California Ave., Palo Alto, Calif.

May 6-9: Western Joint Computer Conference

Ambassador Hotel, Los Angeles, Calif. Cosponsored by IRE, ACM, and AIEE. Theme of the conference will be "Contrasts in Computers," with panel discussions on controversial aspects of modern computers. For more information write David Parry, 6363 Wilshire Blvd., Los Angeles 48, Calif.

May 13-15: Spring Assembly Meeting of the Radio Technical Commission for the Marine Services

Benjamin Franklin Hotel, Philadelphia, Pa. Write R. T. Brown, Radio Technical Commission for Marine Services, c/o Federal Communications Commission, Washington 25, D.C.

May 21-23: AIEE, IRE, RETMA, WCEMA, Joint Electronic Components Conference

Los Angeles, Calif.

June 2-4: National Telemetering Conference

Lord Baltimore Hotel, Baltimore, Md. Sponsored by the AIEE, ARS, ISA, and IAS. The technical program will feature sessions in telemetering in

the IGY program, telemetering overseas, rocket telemetering, industrial telemetering, and data reduction. In addition there will be the annual exhibit staged by manufacturers of telemetering equipment. For further details about the conference write W. J. Mayo-Wells, Program Chairman, 3830 Beecher St., N.W., Washington, D.C.

June 5-6: 2nd National Symposium on Production Techniques

Hotel New Yorker, New York, N.Y. Sponsored by PGPT. For information write John W. Trinkaus, Sperry Gyroscope Co., Great Neck, L.I., N.Y.

June 9-13: 6th Annual Technical Writers' Institute

Rensselaer Polytechnic Institute, Troy, N.Y. For details contact William E. Price, News Bureau, Rensselaer Institute, Troy, N.Y.

June 16-18: 2nd National Convention on Military Electronics

Sheraton Park Hotel, Washington, D.C. Sponsored by PGMIL. Contact Dr. J. McLaughlin, Naval Research Labs, Washington 25, D.C., for information.

June 22-27: AIEE Summer General Meeting

Buffalo, N.Y.

June 23-27: ASTM 61st Annual Meeting

Hotel Statler, Boston, Mass. Highlighting the meeting will be the 12th Technical Photographic Exhibit of the ASTM. Entries will be accepted from members of ASTM, employees of company members, and engineering students. For further information, contact E. W. Walsh, Chairman, ASTM Photographic Exhibit, Narragansett Electric Co., 15 Westminster St., Providence, R.I.

Paper Deadlines

May 1: Deadline for papers to be presented at the **1958 WESCON Show and Convention.** The convention is planned for August 19-22 and is to be held in Los Angeles. Prospective authors should submit 100 word abstracts and either the completed texts or detailed summaries. All material should be mailed to *Dr. Robert C. Hansen, Microwave Lab., Hughes Aircraft Co., Culver City, Calif.*

AHEAD AGAIN...

U. S. Radium's Newest Instrument Dial

A current problem in integral instrument lighting is that of obtaining, at reasonable cost, a dial for a particular unit which will light within the brightness ratio spec of MIL-L-25467A. Since different instruments will have different lighting systems and will require different dial configurations and indicia, the dial contractor must be able to vary the opacity of his dials in order that the finished instrument assemblies will light to MIL spec, regardless of the internal light levels and the number and position of the lights.

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CIRCLE 18 ON READER-SERVICE CARD

IRE National Convention Program

All A.M. sessions begin at 10:00, P.M. sessions at 2:30, Eve. sessions at 8:00 P.M.

Abbreviation Key: Waldorf (W)—Astor Gallery (A), Grand Ballroom (G), Jade Room (J), Sert Room (SE), Starlight Roof (ST). Coliseum (C)—Morse Hall (MO), Marconi Hall (MA), Faraday Hall (F).

Session and Number	Time and Location
Aeronautical Electronics	
Aeronautical and Navigational Electronics (14)	Tues am-C-MO
Aeronautical and Navigational Electronics (26)	Wed am-W-ST
Antennas and Propogation	
Propogation and General Antennas-I (40)	Wed pm-C-F
General Antennas-II (47)	Thur am-C-MA
Microwave Antennas (54)	Thur pm-C-MA
Audio	
Stereophonic Disc Recordings (12)	Tues am-W-SE
Amplifier and Receiver Development (20)	Tues pm-W-SE
Circuit Theory	
Modern Delay Lines—Symposium (29)	Wed am-W-SE
Filter Design (42)	Thur am-W-A
Topological and Group Concepts (50)	Thur pm-W-A
Communications	
Vehicular (2)	Mon pm-W-A
Broadcast Transmission Systems (11)	Tues am-W-J
Broadcast Transmission and Communications Systems (19)	Tues pm-W-J
General Communications Systems (16)	Tues am-C-F
Long Distance Comm. (52)	Thur pm-W-SE
Components	
Papers on Inductors, Ceramics, Miniature Meters (28)	Wed am-W-J
Papers on Capacitors, Filters, Amplifiers and Radiation Effects (36)	Wed pm-W-J
Microwave Components (39)	Wed pm-C-MA
Computers	
Computers and Control (37)	Wed pm-W-SE
Magnetics and Computers (41)	Thur am-W-ST
Data Reduction and Recording (46)	Thur am-C-MO
General Systems (49)	Thur pm-W-ST
Control Systems	
Telemetry and Remote Control (3)	Mon pm-W-J
Automatic Control-General (9)	Tues am-W-ST
Canadian Postal Operations (30)	Wed am-W-G
Detection Theory	
Tutorial Session on Applications (1)	Mon pm-W-ST
Electronic Engineering	
Techniques and Criteria (4)	Mon pm-W-SE
Engineering Writing and Speech (6)	Mon pm-C-MO
Industrial Electronics (44)	Thur am-W-SE
Information Theory	
Code and Detection (35)	Wed pm-W-A

Session and Number	Time and Location
Instrumentation	
Instrumentation Systems (38)	Wed pm-C-MO
High Accuracy Instruments (53)	Thur pm-C-MO
Microwaves	
Measurements (32)	Wed am-C-MA
Components (39)	Wed pm-C-MA
Tubes (48)	Thur am-C-F
Antennas (54)	Thur pm-C-MA
Medical Electronics	
Medical Electronics (15)	Tues am-C-MA
Nuclear Science	
Controlled Thermonuclear Power (10)	Tues am-W-A
Atomic Clocks and Masers (18)	Tues pm-W-A
Panel Discussions	
Educational Needs in Systems Engineering (5)	Mon pm-W-G
Changing Demands on Engineering Education (17)	Tues pm-W-ST
Biological Transducers (22)	Tues pm-C-MA
Electronics in Space (24)	Tues eve-W-ST
Electronics Systems in Industry (25)	Tues eve-C-F
Planning	
Planning Against Time (13)	Tues am-W-G
Production Engineering (8)	Mon pm-C-F
Radar, Military (31)	Wed am-C-MO
Radio Frequency Interference	
R-F Interference (7)	Mon pm-C-MA
R-F Interference in Military Systems (45)	Thur am-W-G
Radio and TV (55)	Thur pm-C-F
Reliability	
Reliability Through Components (23)	Tues pm-C-F
Reliability Through Systems (34)	Wed pm-W-ST
Semiconductors	
Semiconductor Devices (33)	Wed am-C-F
Statistics	
Statistical Applications (27)	Wed am-W-A
Telemetering	
Telemetry and Remote Control (3)	Mon pm-W-J
Tubes	
Beam and Display Tubes (21)	Tues pm-C-MO
Microwave Tubes (48)	Thur am-C-F
Ultrasonics	
Delay Lines—Symposium (29)	Wed am-W-SE
Delay Line Measurements (43)	Thur am-W-J
Radiated Acoustic Power Measurement (51)	Thur pm-W-J

EDITORIAL

'58 IRE National Convention

World's Biggest Ice Breaker

Where else will so many people meet so many other people? Mike Todd's highly publicized extravaganza at Madison Square Garden catered to 10,000. That party will be outdone by the IRE National Convention. Over 15,000 will be present each day. You could have done some limited table hopping at Todd's show to enlarge your acquaintance a bit. At the Coliseum you can booth hop 850 times meeting new faces with common interests every time. You can join in the discussion at any one of 255 sessions.

Todd, of course, had champagne. Most parties count on cocktails to spread congeniality. No forced chemical change is needed at the IRE Convention, however, to break down the engineer's reserve or inhibitions, because the catalyst is simply the interesting new product, the provocative session paper (or the common malady, tired feet).

To persist in this soliloquy, I can't help but think of another markedly similar point between Todd's show and the IRE Show. Prizes could be won at both; for the person who wants to escape it all, suites at nearby hotels are dispensing hospitality à la Todd.

Break the Ice with Your *ED* Editor

In making your rounds, make it a point to stop and meet some of your *ED* editors. We'll have an editorial office for that purpose at Booths 4101-4102 (next to the elevators). We'd like to hear about what you're doing and at the same time twist your arm to do some writing for us. We have a list of articles that we want somebody to do. Maybe you'll be interested.

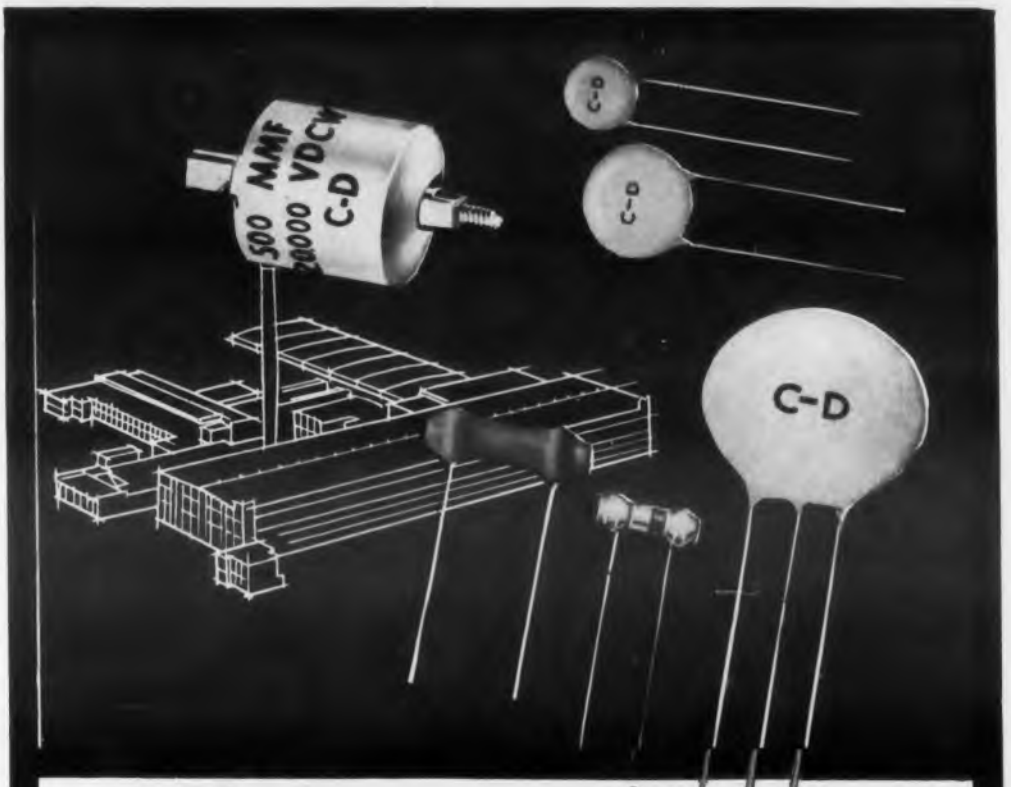
We're especially interested in lining up some engineers to critique U.S.S.R. literature. If you're at all intrigued by something like this, let's chat.

Incidentally, this year's IRE Convention marks the anniversary of associate editor, George Rostky joining our staff. We met George at the Coliseum—we're looking for others like him again this year.

Latest New Product Information

You can preview many of the new products being introduced at the show by scanning the New Products department in this issue. To get the very latest on new products, check our booth. We will post announcements and pictures of new devices unveiled at the show, opening day. As a matter of fact, one of the best things you can do when you get to the Coliseum is to take the elevator to the fourth floor and turn left. You'll see us standing there.

James A. Ryppa



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CIRCLE 19 ON READER-SERVICE CARD

Transistor-Simulated Reactances

Richard H. Stern
Norden Ketay Corp.
Milford, Conn.

Circuit designs using large values of reactance are often limited by the cost, size, or weight of the reactors. The compact transistor circuits described here can substitute for chokes and capacitors wherever cost and size are important. Applications include the suppression of spike and ripple voltages in power supplies, or use in delay networks requiring large lumped-constant reactances.

THE CIRCUIT designer is frequently caught between circuit specifications requiring the use of large values of reactance and limitations of cost, size, or weight which prohibit large reactors. In the past there was no choice but to accept the inferior performance resulting from economic restrictions. The advent of transistors made possible a solution of this problem in certain applications. In power supplies, for example, transistorized regulators can sometimes be substituted for conventional filter circuitry.

This solution is not wholly satisfactory. If batteries are used as regulator reference sources, periodic replacement must be made; on the other hand, alternate reference sources such as diodes are costly. A true voltage regulator will not pass changes in dc level, causing unregulated parts of a system to vary in level with respect to the regulated parts. Changes in dc input level to the regulator due to changes in ac line input voltage impose high collector dissipation upon certain stages of a series regulator.

An alternate approach to the problem is suggested by the vacuum tube operational amplifier developed by Ragazinni *et al* during World War II as a refinement and generalization of the Miller effect. The transistor equivalents of these circuits are compact, light and inexpensive units which simulate large values of reactance within a linear operating region. Although these circuits present an impedance to input signals which is a function of frequency, they depart from ideal reactive behavior in a number of important respects. Because their performance depends upon transistor current gain, they are inoperable above transistor cutoff frequency. The capacitive reactance circuits do not show infinite impedance at dc and the inductive circuits do not show zero impedance at dc. Nevertheless, in well-biased Class-A operation, they furnish extremely large values of reactance in small space at little cost.

The principal applications envisioned for the circuits developed in this article are filtering and decoupling. However the circuits and analytical treatments are equally applicable to phase shift and delay network applications.

Transistor-Simulated Capacitance

The circuit for a transistor-simulated shunt capacitance is shown in Fig. 1. Both pnp and npn transistors are suitable, and the unit may be placed across a positive or negative polarity load. This circuit effectively multiplies the capacitance of the base capacitor by the current gain, h_{fe} of the transistor. Analytically, the current through the transistor may be represented as[2]

$$i_c = h_{oe}\, v_c + h_{fe}\, i_b + I_{CEO} \qquad (1)$$

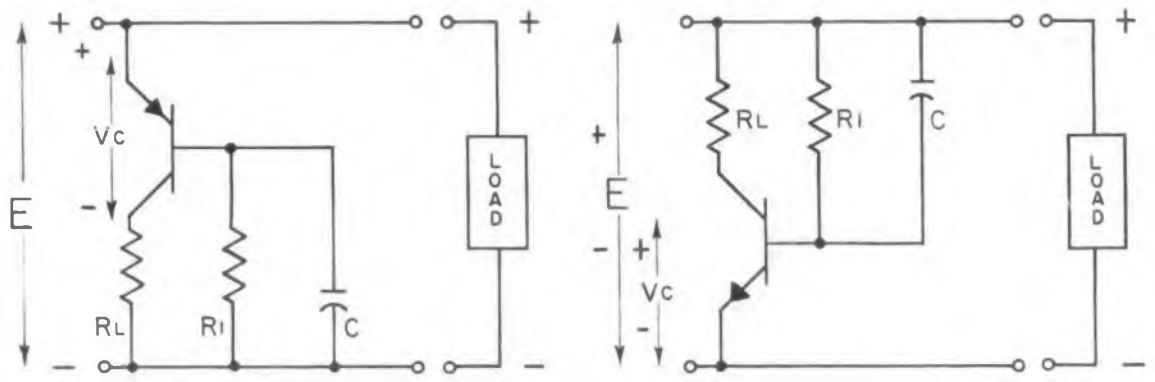

Fig. 1. Circuit for transistor-simulated shunt capacitance. The value of the capacitance used in the base path is multiplied by the transistor gain.

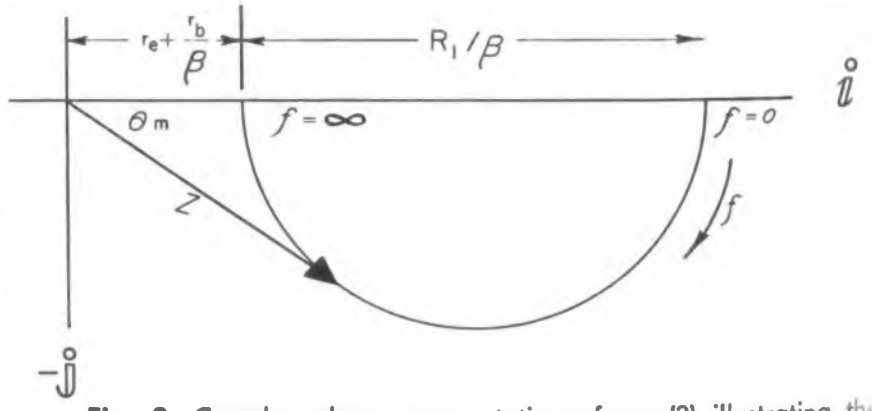

Fig. 2. Complex plane representation of eq. (3) illustrating the variation in impedance with respect to frequency.

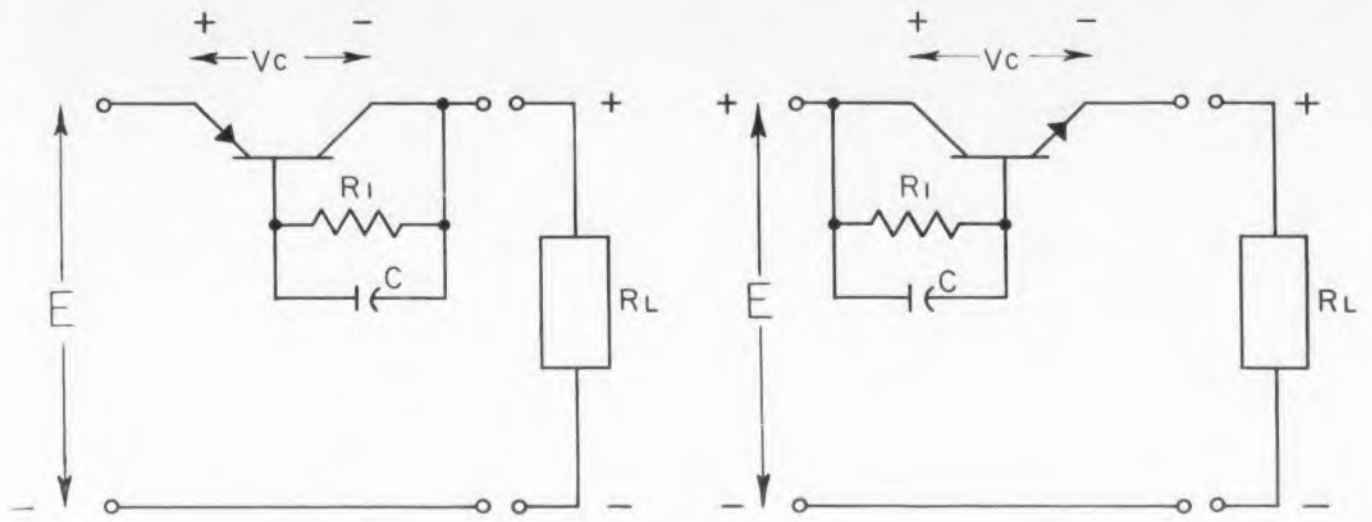

Fig. 3. Transistor simulated series capacitance, modified from the circuit of Fig. 1.

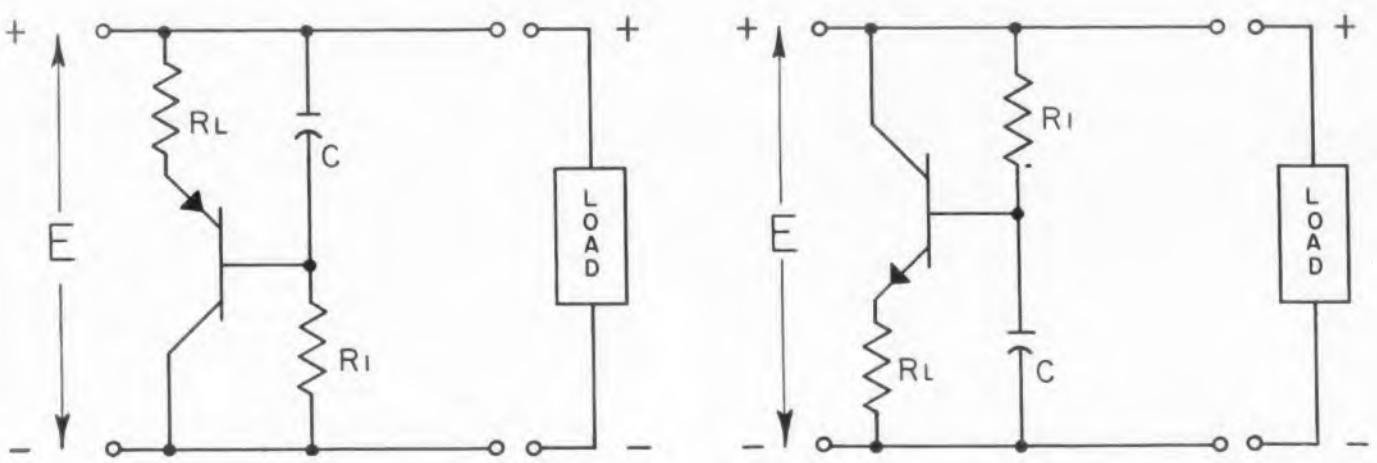

Fig. 4. Shunt inductance circuit, using only capacitance as a reactive parameter.

Substituting into this equation the values of v_c and i_b obtained by replacing the transistor with its z-parameter equivalent and then writing loop equations, the equation may be rewritten as follows:

$$i_c = h_{oe}\,(e - i_c R_L) + h_{fe}\,\frac{e}{h_{ie} + R_1/(1+R_1 Cs)} \qquad (2)$$

If the impedance of the unit is defined as the voltage across it divided by the current through it, then

$$z_{unit} \equiv \frac{e}{i_c} \approx h_{ib} + \frac{1}{h_{fe}/R_1 + h_{fe}\,Cs} \qquad (3)$$

This approximation is correct so long as $i_c \approx h_{fe}\,i_b$

From Equation 3 it can be seen that, essentially, the circuit does multiply the value of capacitance used in the base path by the transistor gain, h_{fe}. The advantage to be obtained by adding stages of gain is apparent. Moreover, while for "real" capacitors the capacitance is roughly proportional to size, for transistor-simulated capacitors the capacitance increases exponentially with size. Each stage of gain (and consequent increment in size, weight, and cost) multiplies capacitance rather than merely adding capacitance.

The complex plane representation of z_{unit} from Equation 3 is shown in Fig. 2, illustrating the variation in impedance with respect to frequency. It may be seen from the figure that maximum phase shift can be set at any desired frequency by choice of a suitable value of C, and that maximum phase angle can be set at any desired value by choice of a suitable value of R_1.

In Fig. 3, the circuit of Fig. 1 is shown as modified for use as a series capacitance. Conversion to negative polarity loads may be effected by reversal of the direction of conduction of the transistor and associated base paths. The analytic approximation of the impedance of this circuit is the same as that given in (3) for the shunt capacitance circuit, and the complex plane representation in Fig. 2 is therefore applicable as well.

Transistor-Simulated Inductance

Transistor-simulated inductances could be developed from the circuits of Figs. 1 and 3 by substitution of small inductors for the capacitors shown. However, it is much more desirable from an engineering standpoint to use no inductors at all. For this reason, alternative circuitry is developed which requires only capacitance as a reactive parameter. Only grounded collector configurations are used. Grounded emitter configurations are unsatisfactory because the effec-

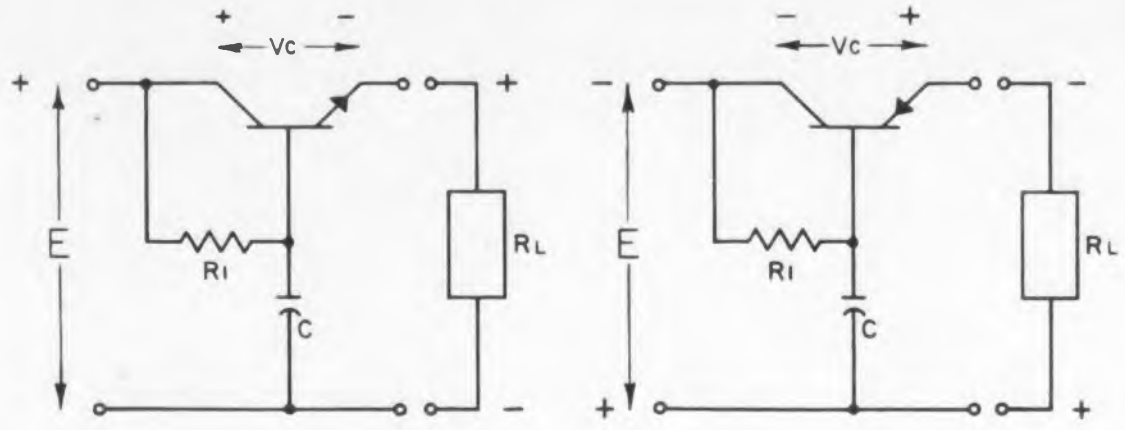

Fig. 5. Transistor simulated series inductance, using only capacitance as the reactive parameter.

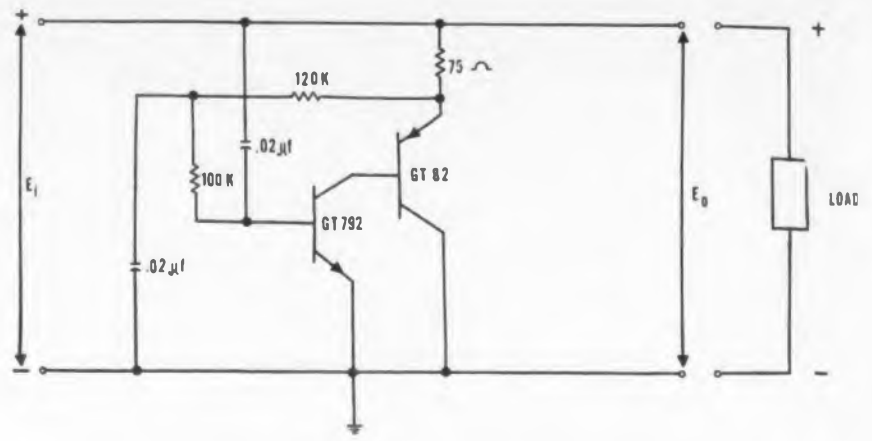

Fig. 6. Practical two-stage transistor-simulated shunt capacitance, designed to replace a 6 v, 150 uf capacitor.

tiveness of the circuit depends on the path through the capacitor being the element which controls magnitude of base current. If no external resistance is used in the emitter circuit, the only resistance shunting the capacitor is h_{ie} or $r_b + h_{fe}\, r_e$. Since this quantity is of the order 2K for common transistors, crossover frequency will be unduly high unless very large capacitances are used. But this, of course, defeats the whole economic advantage to be gained from the circuit. Hence, the load must be placed in the emitter path.

Analytic expressions for the approximate impedances of the transistor-simulated shunt and series inductance circuits may be developed as was done in Equations 1-3. For the shunt inductance circuit of Fig. 4, the expression is

$$z_{unit} \equiv \frac{e}{i_c} \approx \left(R_L + \frac{R_1}{h_{fe}}\right) + R_1\, R_L\, Cs \qquad (4)$$

while for the series inductance circuit of Fig. 5, the expression is

$$z_{unit} \equiv \frac{v_c}{i_c} \approx \frac{R_1}{h_{fe}} + R_1\, R_L\, Cs \qquad (5)$$

Effect of Parameter Variation

When an exact value of effective reactance is required, negative feedback should be employed to lessen the effect of h_{fe} variation with temperature and with manufacturing control.[3] On the other hand, if a variable capacitance is desired, advantage may be taken of the decrease in h_{fe} displayed by transistors as quiescent current increases.[4] A variable resistance or another transistor (the base of which is controlled) may be substituted for the bias resistor R_1 of Figs. 1, 3, 4 and 5 in order to control quiescent current level. Variation in R_1 does not substantially affect the real part of the denominator in Equations 3, 4 and 5—and thereby alter the dc level—since the quantity R_1/h_{fe} will tend to remain constant when both numerator and denominator vary in the same direction. A variable reactance as de-

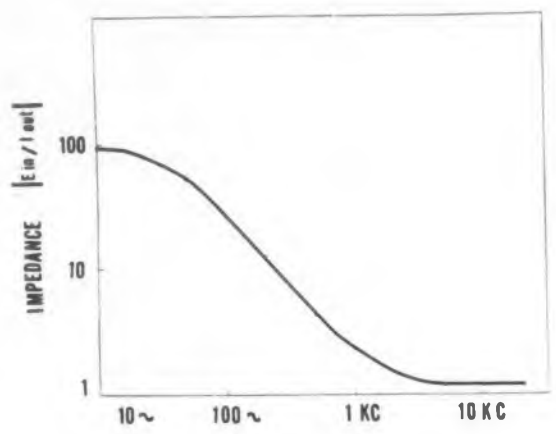

Fig. 7. Effective impedance versus frequency for circuit of Fig. 6.

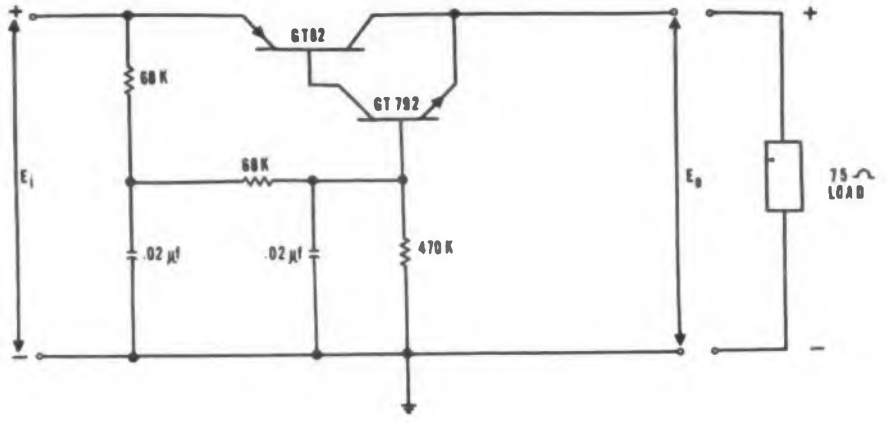

Fig. 8. Emitter follower effect used to match a 75 ohm load to a 470 K terminated filter.

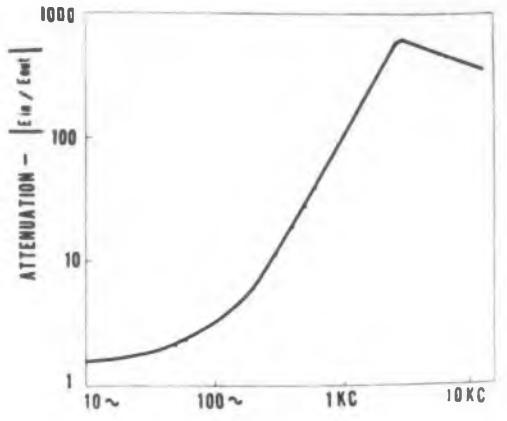

Fig. 9. Attenuation for circuit of Fig. 8. Maximum attenuation of 55 db occurs at 2kc.

scribed here is suitable for use in changing the operating frequency of an oscillator, e.g. as in AFC systems, or for varying the crossover frequency of a filter.

Generalized Transistor-Simulated Impedance

The foregoing analysis may be expanded from the special cases developed to the generalized case of the transistor-simulated impedance. Proceeding according to the methods of Eqs. 1-3 for the generalized grounded emitter case, it may be shown that the admittance of the base circuit is multiplied by the current gain of the transistor. For the generalized grounded collector case, it may be shown that the impedance approximates

$$\frac{Z_C}{h_{fc}} + \frac{Z_L Z_C}{Z_e} \qquad (6)$$

where Z_c is the impedance shunting the collector, Z_l is the load in the emitter path, and Z_e is the impedance from base to ground, shunting the emitter. In the series impedance connection, the transfer function of the circuit approximates Z_c/Z_e; the similarity between this expression and the transfer function of the vacuum tube operational amplifier should be noted. The utility of the generalized transistor-simulated impedance circuit is that band-pass and band-rejection filters may be developed which are not loaded down when used to feed low impedance loads. In general, it may be said that the loading effect is reduced by a factor of $1/h_{fe}$—since in the grounded emitter case the filter admittance is multiplied by h_{fe}, while in the grounded collector case the filter looks into a load of $h_{fe}\ R_L$ (emitter follower effect). [5]

Applications Data

A practical two-stage transistor-simulated shunt capacitance circuit is shown in Fig. 6. Designed to replace a 6 v electrolytic capacitor in an application where specifications permitted only mica, paper, or ceramic capacitors, the unit provides the effect of about 150 μf at intermediate frequencies and a minimum impedance of 1.2 ohms at 5 kc. Beyond 20 kc, impedance rises because of loss of gain due to internal phase shift. If this is undesirable, suitable feedback correction may be employed to extend range. The effective impedance of the circuit, E_{in}/I_{in}, is plotted against frequency in Fig. 7. When developing such a circuit, the designer should avoid a cascaded emitter configuration in order to keep input impedance down. The latter acts as a series resistive component to the simulated capacitance, determining minimum impedance for the unit. Input impedance can be kept down, also, by keeping collector current in the first stage relatively high, since $h_{ib} \approx 26\text{mv}/I_e$.

The circuit shown in Fig. 8 uses emitter follower effect to match a 75 ohm load to a 470 K terminated filter. A maximum attenuation of 55 db is attained at 2 kc, beyond which frequency, attenuation decreases due to phase shift losses. A plot of attenuation—E_{in}/E_{out}—is shown in Fig. 9. When designing such a circuit, quiescent collector voltage should be kept low to permit high dc current, but collector voltage must exceed peak input voltage variation to avoid overdriving.

The designer can adapt a conventional regulator circuit to a filter-simulation circuit by regarding the latter as a regulator which uses a function for its reference rather than a constant. The reference battery or diode of the regulator is then replaced by the output of an RC network.

The circuitry described here will help the electronics designed to avoid a conflict between performance requirements and space, weight and cost limitations. Principal consideration has been given to an effort to develop inexpensive low-pass filters for applications where the suppression of ripple, spike and input voltage fluctuation are more important than the maintenance of an absolute dc level. The circuits presented are equally appropriate for use in delay or phase-shifting networks which require large lumped-constant reactances. The development of variable reactances and of generalized transistor-simulated impedances has also been suggested. The compactness and relatively large current-handling capabilities of these circuits will recommend them as substitutes for chokes and capacitors wherever cost and size are important considerations.

References

1. Ragazinni, Randall, Russell. *Proceedings of the IRE*, Vol. 35, No. 5, 1947, p. 444. See also Electron Tube Circuits, Seely; 1950, pp. 160-161.
2. Transistor Electronics, Lo, Endres, Zawels, Waldhauer, Cheng. Prentice-Hall, New York, N.Y., 1955. P. 84, Fig. 3-2(b).
3. Transistor Bias Stabilization, Penfield. *Audio*, June and July, 1956.
4. Transistor Electronics, Lo, Endres, Zawels, Waldhauer, Cheng. Prentice-Hall, New York, N.Y., 1955. Pp. 205-206.
5. For a more elaborate treatment of the generalized transistor filter, see RC-Transistor Network Design, I. M. Horwitz, ELECTRONIC DESIGN, Aug. 1 and Aug. 15, 1957, pp. 28-31; RC Active Filters, Linvill, *Proceedings of the IRE*, Vol. 42, March 1954, p. 555; Transistor Negative Impedance Converters, Linvill, *Proceedings of the IRE*, Vol. 41, June 1953, p. 725; Theory of the Negative Impedance Converter, Merril, Bell Systems Technical Journal, Vol. 30, 1951, p. 88. However, the use of the negative impedance converter involves more exacting design work than does the relatively simple circuitry described here. For routine regulation applications where the unique negative impedance characteristic of the converter is not required, such effort probably will not be justified.

Simplifying Circuit Design with Floating Power Supplies

John F. Walton
Elcor, Inc.
McLean, Virginia

Floating power supplies have not seen widespread use in circuit design despite the fact that they simplify circuitry and solve many design problems. When a floating supply is resorted to, it is usually conceived of as a bias supply, because appreciable current will limit the life of a bias supply. This is not the case with circuits operated for short periods of time from batteries, or for circuits operating from isolated electronic supplies. With substantial currents available, isolated supplies can be used to furnish plate and screen energy, resulting in new and simple circuits with many advantages.

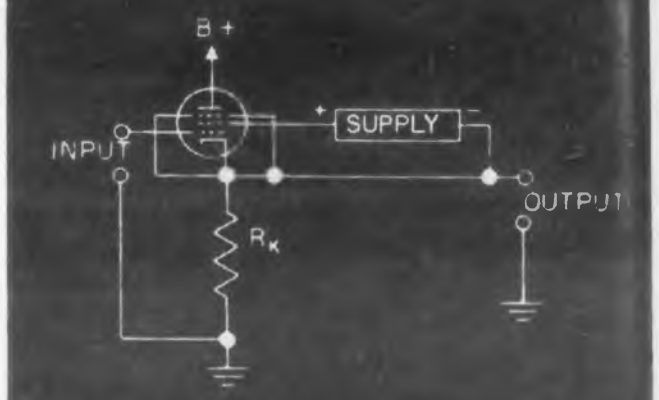

Fig. 1. Pentode cathode follower.

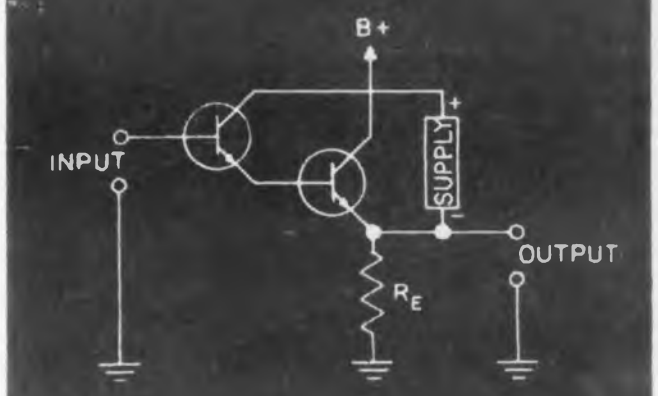

Fig. 2. Bootstrapped emitter-follower.

A SUITABLE power supply needs a carefully isolated secondary and a low shunt capacitance from the dc output to ground. Either batteries may be used or an electronic supply such as the one manufactured by Elcor, Inc., P. O. Box 354, McLean, Virginia. This supply uses special construction to insure capacitive isolation from ground (see ELECTRONIC DESIGN, Jan. 15, 1957). Such supplies permit the addition of two or three extra stages often found necessary in removing the bugs from an instrument, without exceeding the capacity of the original supply.

Cathode Followers

The familiar triode cathode follower can be improved upon in several ways for applications requiring more critical circuit performance. Fig. 1 shows a pentode cathode follower in which the screen grid is direct coupled to the cathode by means of an isolated supply. In this circuit the usual advantages of the pentode cathode follower, namely, higher input impedance, better linearity, and nearer unity gain are obtained without the disadvantages inherent in the conventional capacitance coupling between cathode and screen grid. A bootstrapped triode cathode follower circuit is an alternate solution for obtaining higher input impedance, or a bootstrapped pentode cathode follower operated in its positive grid region. This makes possible relatively high currents at moderate plate voltages and yields a very low output impedance. A close analogue of this is shown in Fig. 2. In transistor circuits bootstrapping is essential in obtaining a high value of input impedance. The circuit of Fig. 2 in addition to high input impedance has a gain very close to unity and good linearity.[1]

Fig. 3 is a transistor analog of a constant-current cathode. The circuit incorporates a constant-current cathode or emitter load impedance. It will handle signals whose peak-to-peak potentials are nearly equal to the sum of the B+ and B— supply voltages.

Where performance requirements are unusually rigid, requiring not only very high input impedance and gain very near unity, but also very low output impedance and the capability of supplying peak charge and discharge currents several times the quiescent tube current to a capacitive load, and, further, requiring the advantages of direct-coupling, the superior cathode follower and driver[2] of Fig. 4 is most satisfactory. The transistor circuit of Fig. 5 is the approximate analogue of the superior cathode follower and driver shown in Fig. 4. This emitter follower and driver would be suitable for sweep and deflection needs.

Sweep Generators

Because of their improved gain and linearity, these cathode and emitter followers lend themselves very appropriately to certain sawtooth, ramp, or sweep voltage generators. It is interesting to note that introductions to sweep voltage generators occasioinally start with a bootstrap sweep circuit. After extolling its merits and simplicity, some authors then dismiss the circuit to make it practical. Actually the circuit is very practical. An improved version shown in Fig. 6 is very simple to design; it requires no linearity adjustments; ramp voltage change with respect to time is quite linear; and the circuit is very independent of tube changes.

Greater ramp voltage excursion and even better linearity may be achieved by replacing R_K (Fig. 6) with a constant-current cathode load impedance. A transistor version with the latter suggestion appears in Fig. 7.

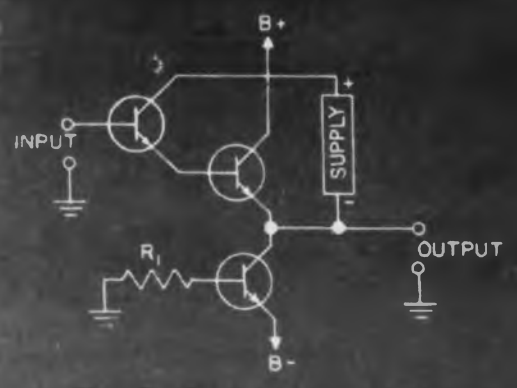

Fig. 3. Constant-current boosting and emitter-follower.

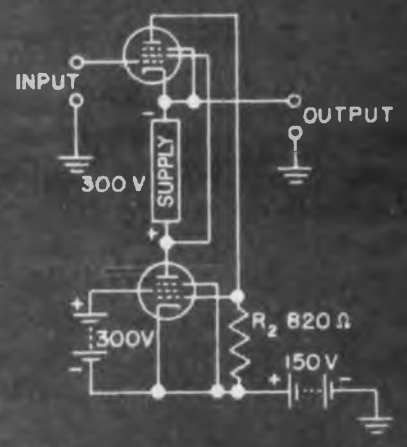

Fig. 4. Superior cathode-follower and driver

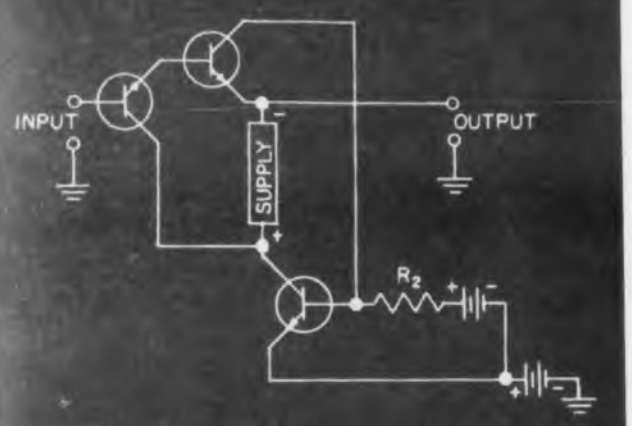

Fig. 5. Emitter-follower and driver

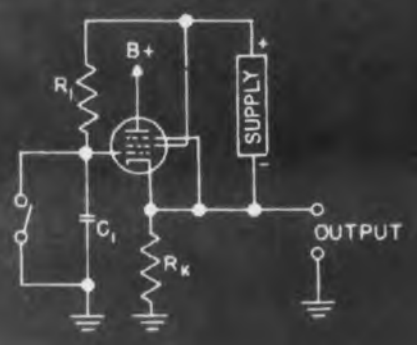

Fig. 6.

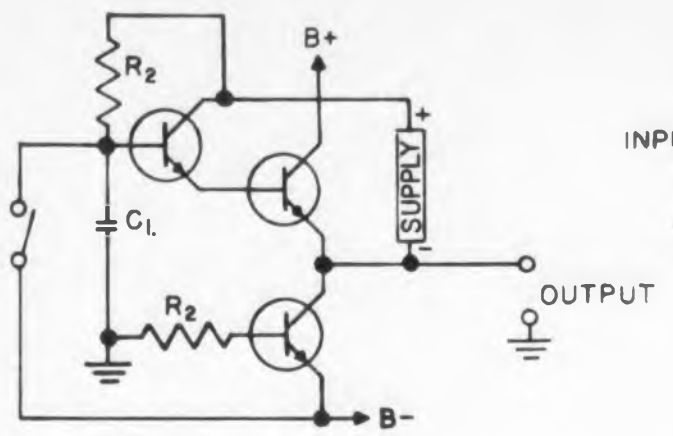

Fig. 7. Bootstrapped transistor ramp-voltage generator.

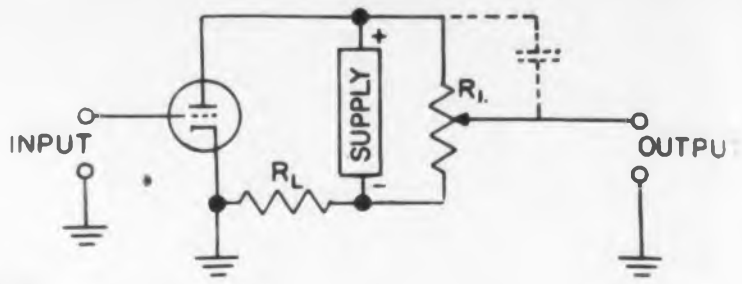

Fig. 8. Basic direct-coupling circuit with adjustable output bias.

Amplifiers

Cathode and emitter followers are but one general application in which isolated supplies are extremely helpful. Other improvements are possible in the performance of amplifiers. The availability of an isolated supply enables the designer to interchange the location of power supply and plate load resistor, achieving a simple method of direct coupling (Fig. 8). The output voltage across R_L is some value between 0 potential and some negative value that depends on the plate current. This is convenient for feeding the following stage directly. In class A amplifiers where R_L may be a moderately high resistance which would result in too negative a bias for the following stage, a voltage divider may be connected across the isolated supply in Fig. 8. The voltage divider acts only to divide the dc voltage and not the signal. The divider may load the supply slightly or as much as desired, but this in no way loads the amplifier. If needed, the output may be taken simultaneously at several dc biases.

Another improvement made possible by the use of a floating supply is increased linearity of amplification. Fig. 9 shows an amplifier with

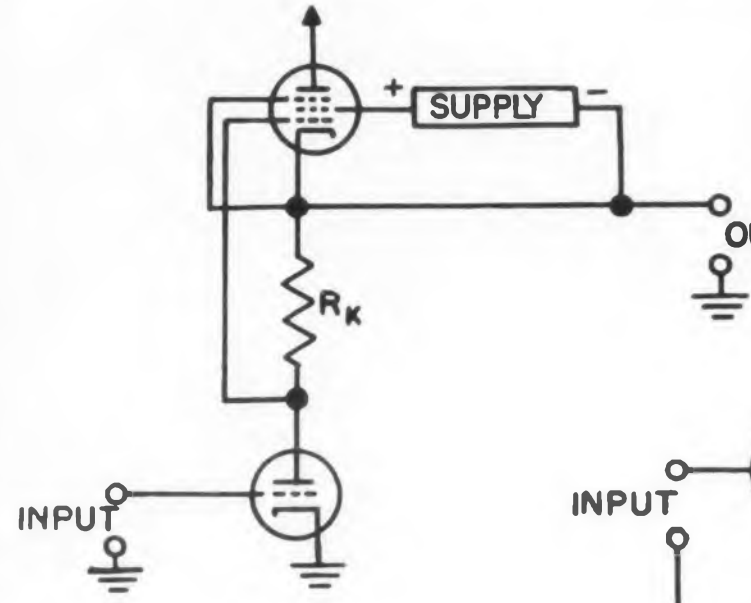

Fig. 9. Linear amplifier with good high-frequency response.

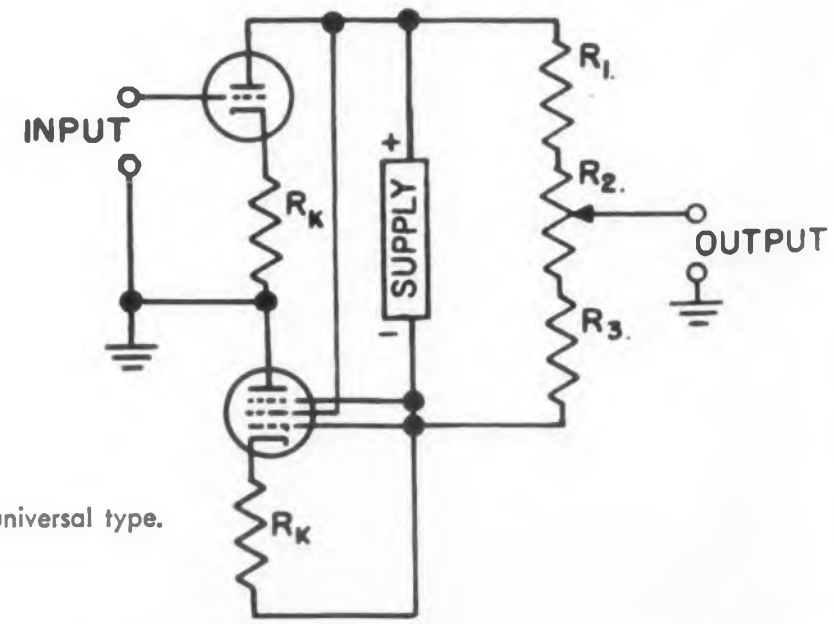

Fig. 10. Linear amplifier, universal type.

od linearity obtained by means of a constant rrent plate load impedance. Along with the provement in linearity over the conventional iode amplifier comes higher gain (very close to e mu of the triode) nearly constant output impedance, and better high frequency response. A mbination of the circuits found in Figs. 8 and produces the circuit of Fig. 10 having a group desirable properties:

Gain equals the mu of the triode.

Distortion is substantially lower than the conventional triode or pentode amplifier.

Output impedance is approximately the plate resistance of the triode and is nearly constant over the entire output voltage range.

Output bias is adjustable plus or minus with respect to ground, which is very suitable for direct coupling to other circuits.

No signal degeneration occurs across the cathode bias resistor of the triode, since the plate current is nearly constant.

One isoply furnishes all plate circuit and screen grid energy and output bias voltage.

Decoupling from other circuits is essentially complete.

The signal output voltage is high compared to conventional amplifiers with the same supply voltage.

These amplifiers are the starting points for a host of more specialized circuits. There are several types of difference amplifiers utilizing isolated supplies to obtain superior operating performance along with direct coupled output. Also, the design of direct coupled feedback circuits is accomplished with uncommon facility. In the design of direct-coupled logical networks, isolated supplies produce a considerable simplification. The use of isolated supplies combines the means of direct-coupling and plate circuit energy source into one unit which is simpler than designing a circuit and then a suitable common power supply. They afford essentially complete decoupling, often a trouble spot in conventional design. Appropriate bias voltages are obtained very simply.

Considering the cost of isolated supplies separately, its use may be found a more costly method in some systems. In other cases the overall cost would be comparable to conventional methods, or less costly. Considering the savings in design time and effort, the often superior circuit functioning, increased reliability, ease of servicing and breadboarding, and elimination of many normally required components, there are many cases where the use of floating supplies is the most economical one.

Footnotes:
. Philip J. Anzalone. Electronic Design, Vol. 5, No. 11 (June 1, 1957) p. 39.
. John H. Reaves. Electronics, Vol. 27, No. 8. (Aug. 1954) p. 172.

Accuracy Requirements in Sine, Cosine Transmission

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Baltimore 3, Md.

USE OF angular position information has application in such devices as analog computers and radar displays. The transmission of such information is often accomplished by resolving the direction at the transmitter into sine and cosine signals. These are then amplified before reconstituting them into the original direction information at the receiver.

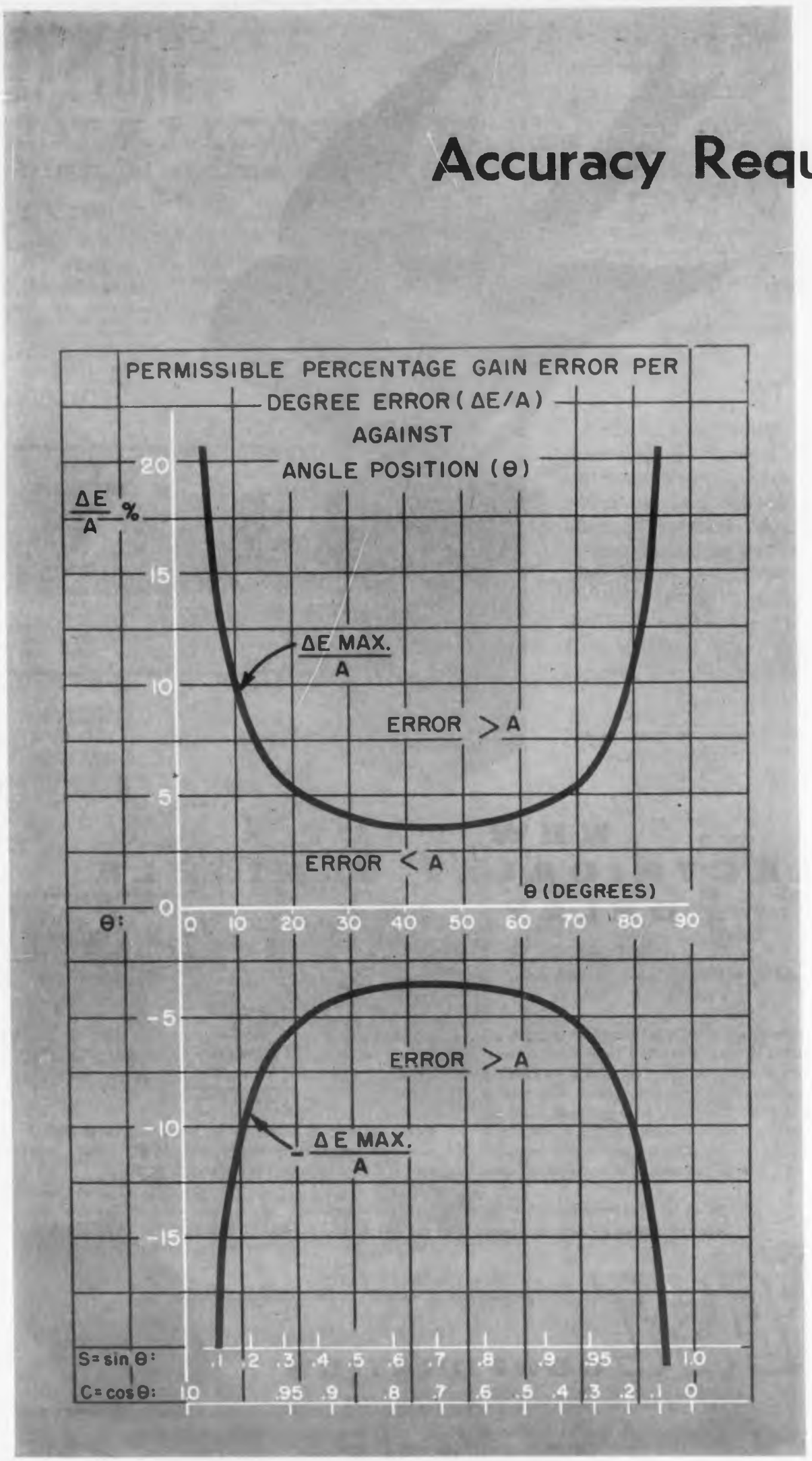
Accuracy is specified in terms of angle, but is determined by the linearity in the sine and cosine channels. The sine and cosine amplifiers are so designed that their combined deviations from linearity are some function of amplitude (and hence angle), which keeps the angle error within a fixed upper bound. It is the purpose here to derive this function and present graphs, so that the angular accuracy can readily be expressed in terms of amplifier performance, and vice versa.

Problem Formulation

An angular position of θ deg of arc at the transmitter is reproduced to an accuracy of $\pm A$ deg at the receiver, due to amplifier distortion. The components, $s = \sin\theta$, and $c = \cos\theta$, are resolved and amplified and finally recombined to give the direction θ. The two amplifier's (for s and c) have a voltage gain G, defined by

$$G = \frac{\textit{Output voltage at carrier frequency}}{\textit{Input voltage at carrier frequency}} \quad (1)$$

This gain will generally not be constant over the selected operating range, but will have some average value G_o. The percentage deviation of G from G_o at any point will be defined as the percentage



distortion at that point. The exact choice of G_o is arbitrary, but its precise value is unimportant for small distortions. Let the percentage error or distortion be

$$E = \frac{100\,(G\text{-}G_o)}{G} \tag{2}$$

Let E_s and E_c be the percentage errors of the sine and cosine amplifiers, respectively. They are functions of the normalized inputs s and c, and are therefore both functions of θ.

Problem Analysis

At the input to the amplifier the two voltages s and c are related by

$$\tan\theta = \frac{c}{s} \tag{3}$$

Owing to distortion, the output angle differs from θ by a small amount $d\,\theta$. Taking logs and differentiating eq. 3 yields

$$d\,\theta = sc\left(\frac{ds}{s}\right) - sc\left(\frac{dc}{c}\right) \tag{4}$$

where θ is in radians. Converting to degrees and introducing A and E gives

$$\frac{\pi A}{180} = \frac{sc}{100}\,(E_s - E_c) \tag{5}$$

or,

$$\triangle E = \frac{1.745\,A}{\sin\theta\,\cos\theta} \tag{6}$$

where

$$\triangle E = E_s - E_c$$

Eq. (5) gives angular error when E_s and E_c are known; and eq. (6) shows how E_s and E_c must be limited when A is specified as the maximum permissible angle error.

Notice that E_s and E_c are not constant, but are functions of θ. Also note that A depends on E_s and E_c only through their difference.

Explanation and Use of Graph

If the maximum permissible angle error is specified and denoted by A, then eq. (6) determines the maximum distortion, $\triangle E\ max$. $\triangle E\ max/A$ is plotted against θ on the graph, using eq. (6). To determine whether a given pair of sine, cosine amplifiers is sufficiently linear, their distortions E_s and E_c are measured for each as a function of their inputs. E_s/A and E_c/A are then plotted on the graph as functions of the normalized inputs, s and c, respectively. The curves are finally subtracted, and a plot of $\triangle E/A$ against θ is thus obtained. If it falls between the two curves, $\pm\ \triangle E\ max/A$, then the two amplifiers reproduce the original direction θ everywhere to an accuracy of $\pm A$ degrees or better.

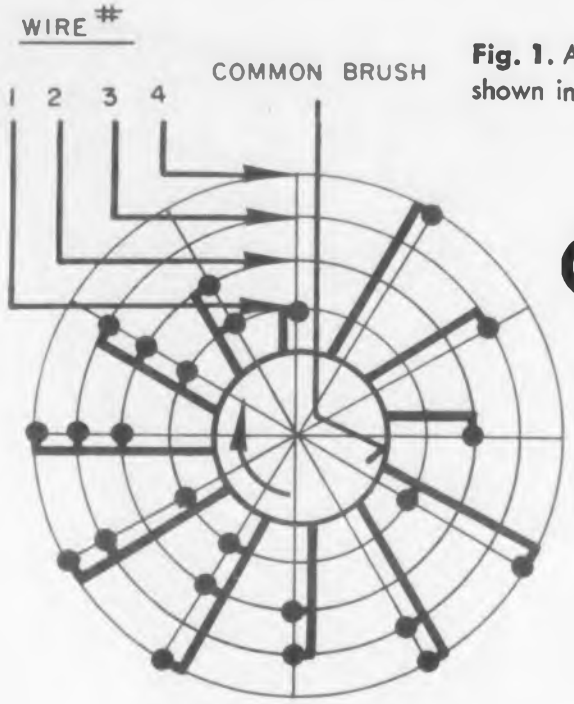


Fig. 1. A code wheel for radial brushes, shown in position 1.

Code Matrices for Indexing

Walter C. Tooker
Hughes Aircraft Company
Culver City, California

IN SERVO mechanisms of the type that index to discrete positions, the number of wires between the transmitter and receiver can be reduced to a minimum by a code matrix. The maximum number of positions which can be defined by the interconnecting wiring is

$$\text{Positions}_{\max} = 2^n - 1$$

where n represents the number of wires. Table 1 shows a definite number of possible positions with a definite number of wires.

In setting up the matrices, there are two general approaches.

a. A possible configuration for concentric rings of contacts on the rotor with a radial arrangement of the stationary brushes is the first approach, and is shown in Fig. 1.

b. Fig. 2 shows a single ring of contacts on the rotor (code wheel) with the stationary brushes arranged circumferentially.

The selection of the proper approach depends on three factors:

- The uniformity of position spacing
- Number of positions required
- Space available

In approach *b*, the brush spacing is equal to 360 degrees divided by the number of positions and the space available will determine whether it can be used. If the spacing is non-uniform, approach *a* is mandatory.

Matrices for the single ring of contacts on the code wheel are set up as shown in Table 2, Part a, shows the contact positions possible with four wires. b is a matrix for checking for ambiguity in the results of part a. It should be noted that the contacts and spaces are arranged with a 45 deg slope in the matrix.

This matrix may also be used for concentric rings of contacts on the code wheel. However, as the number of positions is increased, the difficulty of creating a 45 deg matrix increases. If the number of positions is large, a binary matrix is easier to set up. Such a matrix is exemplified in Tab. 3 but it is suitable only for a concentric arrangement.

Number of Wires	Max. No. of Positions	Number of Wires	Max. No. of Positions
2	3	9	511
3	7	10	1023
4	15	11	2047
5	31	12	4095
6	63	13	8191
7	127	14	16383
8	255	15	32767

Table 1. A table of possible positions with a definite number of wires.

Single	(A) 1 (B) 2 (C) 3 (D) 4
Double	(E) 1, 2 (F) 1, 3 (G) 1, 4 (H) 2, 3 (I) 2, 4 (J) 3, 4
Triple	(K) 1, 2, 3 (L) 1, 2, 4 (M) 1, 3, 4 (N) 2, 3, 4
Quadruple	(O) 1, 2, 3, 4

Wire No.	Position														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	•	•	•	•		•			•		•	•			
2		•	•	•	•		•			•		•	•		
3			•	•	•	•		•			•		•	•	
4				•	•	•	•		•			•		•	•
Check	A	E	K	O	N	M	I	C	G	B	F	L	H	J	D

Table 2. Matrices for a code wheel with a single ring of contacts.

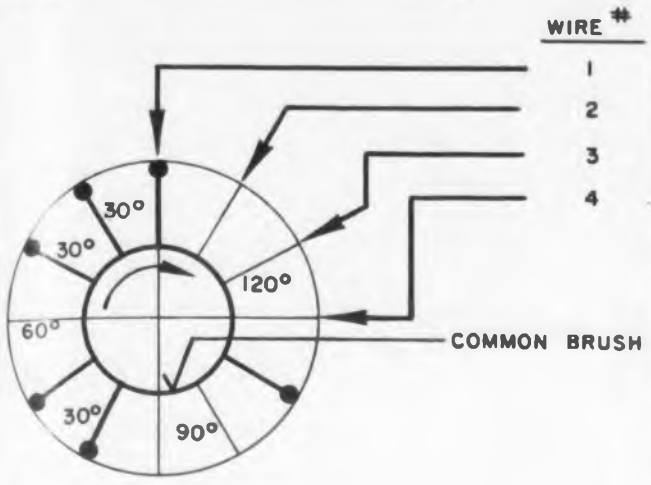
a. Contacts possible with four wires.

b. Matrix to check for ambiguity.

Wire No.	Position														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	•		•		•		•		•		•		•		•
2	•	•			•	•			•	•			•	•	
3	•	•	•	•					•	•	•	•			
4	•	•	•	•	•	•	•	•							
Check	O	N	M	J	L	I	G	D	K	H	F	C	E	B	A

Table 3. A four wire matrix for determinational of concentric contact arrangements.

Fig. 2. A code wheel for circumferential brushes, shown in position 1.



Sample Problem

To illustrate both types of code wheels, one may consider the problem of indexing 12 equally spaced positions.

With 12 positions required, 4 wires are necessary. (See Tab. 1).

For circumferential brushes, the brush spacing will be 360/12 = 30 deg. Examination of the matrix in Tab. 2 for 15 positions shows that it is not suitable for this arrangement. The matrix shown in Tab. 4 is arranged for 12 positions.

Using the matrix for 12 positions, the two types of brush arrangements are shown in Figs. 1 and 2.

In Fig. 1, the connection between the contacts and the common slip ring would be made on the reverse side of the code wheel. If photoetched code wheels are used in this arrangement of brushes, the matrix would have to be of the binary type. The binary matrix lends itself to interconnections on one side of the code wheel.

For a reprint of this article circle 26 on the Reader-Service Card.

Wire No.	Position											
	1	2	3	4	5	6	7	8	9	10	11	12
1	•	•	•		•	•			•			
2		•	•	•		•	•			•		
3			•	•	•		•	•			•	
4				•	•	•		•	•			•
Check	A	E	K	N	M	L	H	J	G	B	C	D

Table 4. A 12 position, four wire matrix for radial or circumferential brush arrangement.

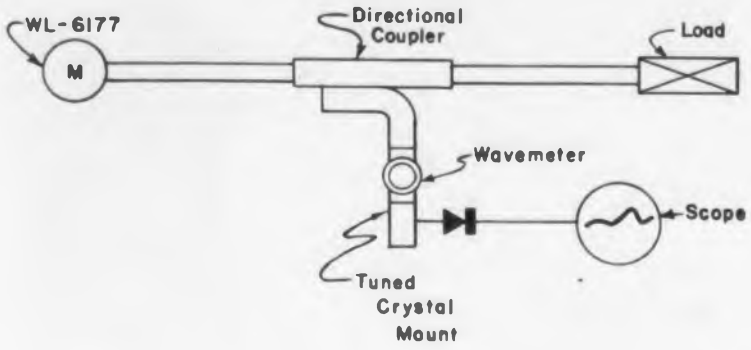


Fig. 1. The components employed for the simple measurements are a directional coupler to sample the energy, a wavemeter, a tuned probe crystal mount, and an oscilloscope.

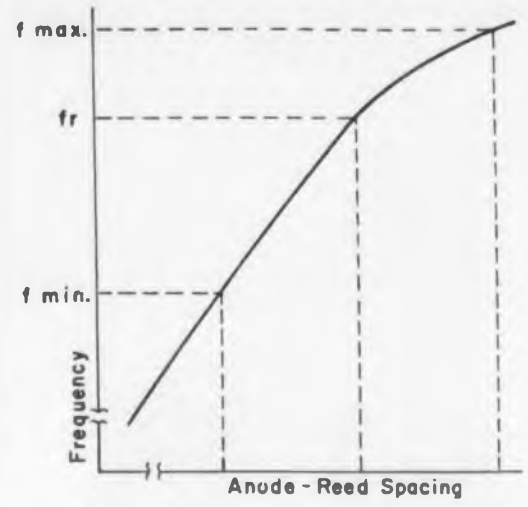


Fig. 2. The magnetron's tuning rate curve.

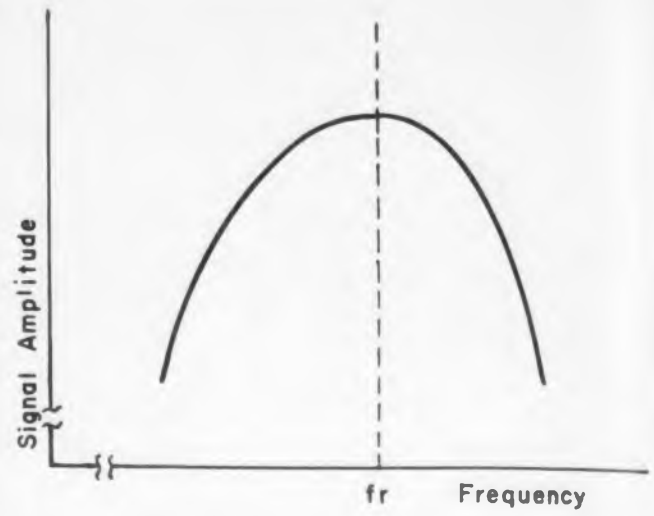


Fig. 3. Response curve of the tuned probe crystal mount.

Physical measurements on a typical magnetron.

How To Measure FM Bandwidth at Microwave Frequencies

R. G. Larson
Electronic Tube Division,
Westinghouse Electric Corporation
Elmira, New York

A very simple method has been found to measure fm bandwidth at microwave frequencies. This method is especially effective when the bandwidth is greater than can be easily observed on a spectrum analyzer. The method can be used with any kind of signal source. With proper attenuation to protect the crystal, it can be used for any power level from a few milliwatts up. The method can be used for any frequency band for which the few simple components are available. The technique is most useful for fm amplitudes of one per cent or greater. It is not precise enough for amplitudes less than 0.1 per cent.

A NEED for a technique to measure large bandwidths arose during investigation of the properties of the WL-6177 magnetron. This tube provides a cw signal at about 4300 mc with an fm amplitude of ±1 per cent. The fm rate is approximately 100 cps. To measure this bandwidth, a simple combination of standard components is effective and easy to use. (See Fig. 1.) The cost is relatively low.

A series of graphs shows how this simple system works. A tuning rate curve, shown in Fig. 2, shows the change of frequency produced by changing the position of a driven reed inside the vacuum envelope of the magnetron. With the reed at rest, a rest frequency, f_r, is generated. As the reed is driven, it oscillates between a maximum and minimum displacement position. This gives rise to a maximum frequency, f_{max}, and a minimum frequency, f_{min}.

A tuned probe crystal mount, with a response as shown in Fig. 3, detects the energy. When the probe is tuned accurately to the rest frequency, any shift in frequency will give a lower amplitude response on the scope. This is easily done when the scope's dc amplifier is used with zero drive voltage, V_d.

An absorption cavity wavemeter is used to measure the frequency. When the wavemeter is set at a frequency within the range of the magnetron, an absorption of energy causes a reduction of signal amplitude at that frequency.

A crystal rectifies the signal, and the resultant dc output is displayed on a cro. The negative characteristic of the crystal causes positive power output to deflect the oscilloscope trace downward.

The drive voltage, shown in Fig. 4, is sinusoidal. The anode-reed spacing is proportional to the drive voltage by nature of the reed construction. The frequency, however, does not vary sinusoidally because of the non-linearity of

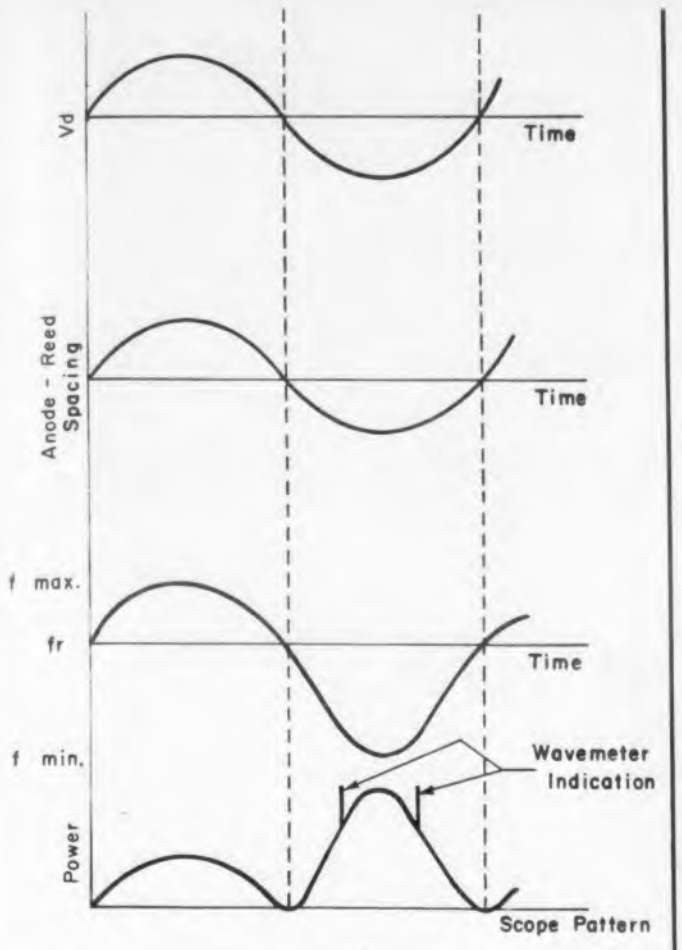


Fig. 4. Time relationship of the drive voltage, anode reed spacing, frequency variation, and power output.

the tuning rate curve. With the probe tuned to rest frequency, the scope trace is deflected downward a maximum amount. With drive voltage applied, the pattern appears on the screen.

When the wavemeter is tuned from a value above maximum frequency toward the range of the output frequency, the first indication is a spike on top of the smaller "hump" on the trace at maximum frequency. The frequency at which this indication appears is noted in the bottom curve of Fig. 4.

As the wavemeter tunes through the fm range of the magnetron, this spike splits into two spikes. They move down the smaller "hump," climb the larger "hump," then disappear at the top at minimum frequency. The difference between maximum and minimum frequency is then directly measured to the accuracy of the wavemeter, 0.05 per cent.

This method of bandwidth measurement is speedy, precise, and easy.

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This transformer has a 10,000 Ampere secondary with a maximum of 5 volts. The primary taps are extended to reduce secondary to 0.75 volts. The secondary copper is ⅜" thick and 16" long, over which is connected and built-in a 5 Ampere current transformer. This special transformer is made for air-blast cooling as the physical size had to be kept extremely small.

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The dynamometer instrument, developed by Trio Laboratories Inc., 4025 Merrick Road, Seaford, N.Y., gives a true rms reading with an accuracy of 1/4 per cent of full scale. This is somewhat better than electronic wave-squaring instruments and overcomes the disadvantages of thermocouple detectors. A multi-stage high-gain amplifier converts the signal voltage into a current sufficient to drive the dynamometer movement. A large amount of current feedback assures that the overall gain remains constant and eliminates line voltage effects. A laboratory standard mirror-scale meter with hand-drawn markings provides readability and accuracy.

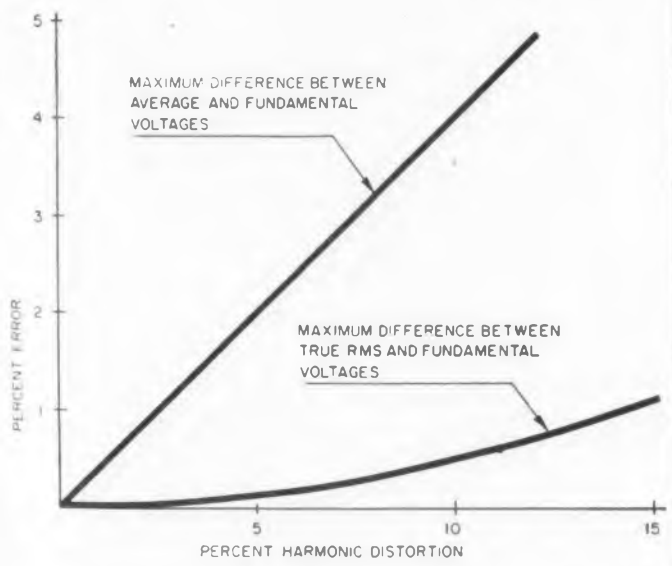
The meter will find application in the measurement of ripple and noise in audio circuits where the true rms value is significant. Measuring the value of the fundamental with high accuracy is important in data type synchros, carrier systems, and control systems. The instrument overcomes the errors inherent in peak-reading instruments in the presence of thin spikes, and the harmonic distortion errors of averaging meters. The accuracy of true rms measurement is shown in the curves of the figure. In computing the value of the fundamental

Precision vtvm reads true rms (opposite page)

from the true rms of a complex wave, the accuracy is much less for a given harmonic distortion.

Ranges up to 500 rms full scale are available with a frequency response of 50-2000 cps. A military version of the instrument is in development for field test and ground support equipment applications.

For more information about this product turn to Reader-Service Card and circle **30.**



Computed errors between true rms voltage of a complex wave and value of the fundamental, and between average voltage and value of the fundamental.

The packaged dc transformer.

DC Transformer Has Continuous Adjustable Ratio

Horace E. Darling
The Foxboro Company
Foxboro, Massachusetts

A precision amplifier-attenuator is an important building block in electronic control systems. In use, this device accepts a direct current from a measuring system and delivers a direct current, accurately related to the input by a manually adjustable ratio.

The output current must be independent of moderate changes in temperature, load resistance, and power supply voltage. What is required, in effect, is a direct current transformer with continuously adjustable transformation ratio.

A TYPICAL industrial application of the "ratio amplifier" is in flow ratio control with all electronic control systems. This device is especially handy for accurately adjusting the blending proportions of two components of a process.

Amplifier Specifications

In one application, this ratio amplifier is to operate from a 60 cycle line regulated to within two per cent. It must meet rather exacting requirements.

- Its 9:1 continuously adjustable ratio must provide, at one extreme, a 10 to 50 ma output for a 10 to 23.33 ma input, and at the other extreme, a 10 to 23.33 ma output for a 10 to 50 ma input.
- It must supply a 600 $\pm$ 60 ohm load with a current constant to within 1/2 per cent of full scale.
- An ambient temperature rise of 100 F must not change the output current more than one per cent.
- The "zero" of the system is such that a 10 ma input must always deliver a 10 ma output regardless of ratio setting.
- The system must maintain 1/2 per cent linearity and stability.

Variable Feedback or Constant Gain?

A high current gain magnetic amplifier with lots of degenerative current feedback tends to be immune to changes in temperature, load resistance, supply voltage, and other factors which affect internal gain.

This particular application calls for an amplifier whose zero and span are to be stable to 1/4 per cent. This requires an open loop current gain 400 times the net gain of the system. Thus, a gain of 1200 and a gain of 133 are required at the extremes.

The desired current ratio could be achieved by varying the amount of feedback. However, it was decided that a constant gain magnetic amplifier would be most suitable. The input is attenuated through the desired range by a precision variable resistor.

Amplifier Design Details

A 10 ma input must look like a zero to the amplifier. Hence, 10 ma are balanced out by a reference current from a Zener diode system. Fig. 1 shows the amplifier in block form.

Resistance values for the input circuit elements are shown in Fig. 2. For maximum sensitivity, a measurement change of 10 to 23.33 ma must produce a 10 to 50 ma output change. This represents minimum control resistance.

Maximum control current will be about 3 ma. To achieve a current gain of 1200 with a high degree of stability, a current feedback factor of .995 was chosen. Thus, the maximum net error signal that the amplifier sees is $(1 - .995) \times 3$ma or 15 μa. Accordingly the magnetic amplifier was designed to deliver a 10 to 50 ma change as an open loop amplifier, for a 15 μa control signal change. This calls for an open loop current gain of 3300.

The complete amplifier, with its two stages of amplification is shown in Fig. 3. Winding specifications are given in the Appendix.

Input Stage

The input stage uses two toroidal cores of 3 mil "Hymu 80" tape. This magnetic material is sensitive to very small magnetizing forces, yet has the moderately square hysteresis loop required for good current gain.

The 90 turn feedback winding, in series with the load, produces the desired current feedback. Since all the output current flows through the feedback winding, copper resistance changes with temperature cannot appreciably alter the feedback ratio. A highly stable amplifier results, approximating a constant current source. The feedback is actually accomplished as a flux balance in the input stage cores.

The 500 turn winding biases the first stage for linear operation and, with the control circuit open, adjusts the output current to 10 ma. The Zener source provides this bias current.

The control signal, applied to the 1000 turn winding, is derived from a voltage developed across a fixed resistor. Its magnitude is directly related to the total control circuit resistance. This fact is used to provide the required ratio adjustment. A 50 ohm negative temperature coefficient resistor in series with the control winding neutralizes resistance changes due to temperature. This is essential to eliminate span error.

The 5 turn shorted winding provides a low impedance path for second harmonic signals and decouples the input stage from the measuring system. A scope, across the open circuited 1000 turn winding with the 5 turn winding also open would show a large second harmonic signal. With the 5 turn winding shorted, most of this induced voltage disappears. In fact, the 1000 turn winding itself can now be shorted with only a small effect on the amplifier's zero. This provides higher power gain than can be obtained with conventional circuitry, since the usual decoupling resistor in the control circuit is no longer required.

Output Stage

The second stage uses two cores of 4 mil "Orthonol" tape. This material has a high saturating flux density and a nearly square hysteresis loop, allowing high power and current gains.

The output of the first stage flows into the 200 turn winding of the second stage through a 10 ohm resistor. This adjusts the interstage circulating current to the bias level required for the output stage. This 10 ohm resistor can be eliminated by using a smaller wire size for the 200 turn winding.

The 1000 turn winding of the output stage provides derivative feedback to stabilize the amplifier when the overall feedback loop is closed. Since this type of high gain amplifier has an appreciable transport lag and time constant, hunting will occur when the feedback loop is closed. Derivative feedback is obtained by a resistor and capacitor in series with the feedback winding, all across the load. Adjusting this resistor changes the gain vs phase shift characteristics of the amplifier over wide limits, and by properly polarizing the feedback winding for positive feedback, counteracts the amplifier's tendency to hunt. The amount of derivative feedback required is related to the time constant of the output filter.

A 50 μf filter in the output leaves a 20 per cent ripple. This may not be sufficiently smooth dc for many purposes. A pi network, comprising two 50 μf capacitors and a 1.5 henry choke can reduce the ripple to 1/2 per cent. This would require a dehunting resistor of approximately half the value of that used with a single capacitor.

A Zener diode system, corrected for a small inherent temperature error, supplies a constant current for the reference resistor. With the use of high quality wire wound resistors, the Zener system's output current can be made constant to .05 per cent for a 100 F temperature rise. This system is used also to provide bias current to the first stage of the magnetic amplifier. All units operate from a common power transformer.

Silicon junction diodes are used throughout to minimize temperature effects on the front-to-back ratio as well as to keep forward resistance of the rectifiers constant.

(Continued on following page)

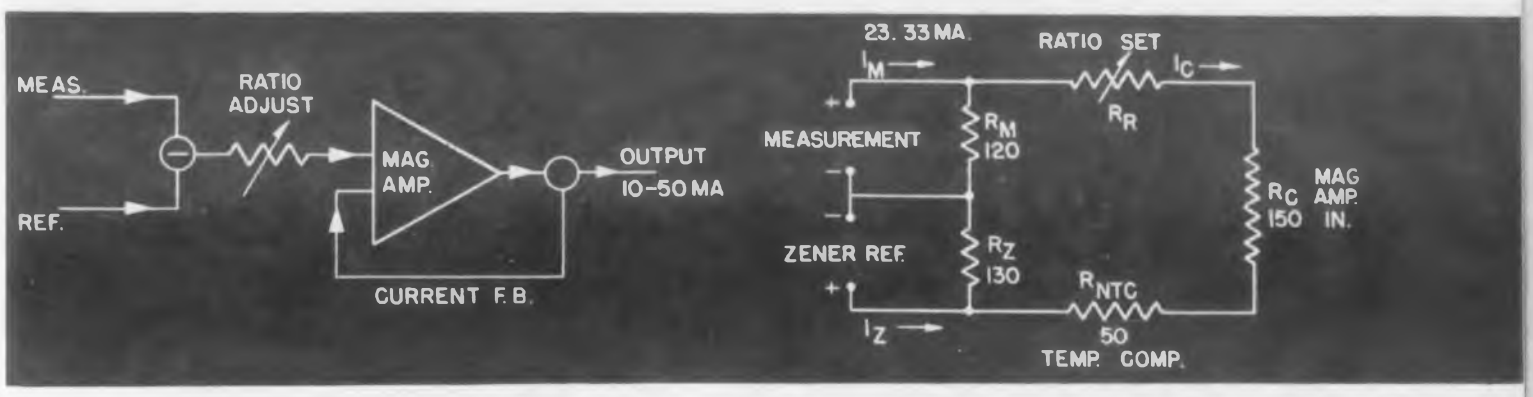


Fig. 1. Block diagram of ratio amplifier.

Fig. 2. Amplifier input circuit. The voltage developed across the 150 ohm resistor is the input to the magnetic amplifier.

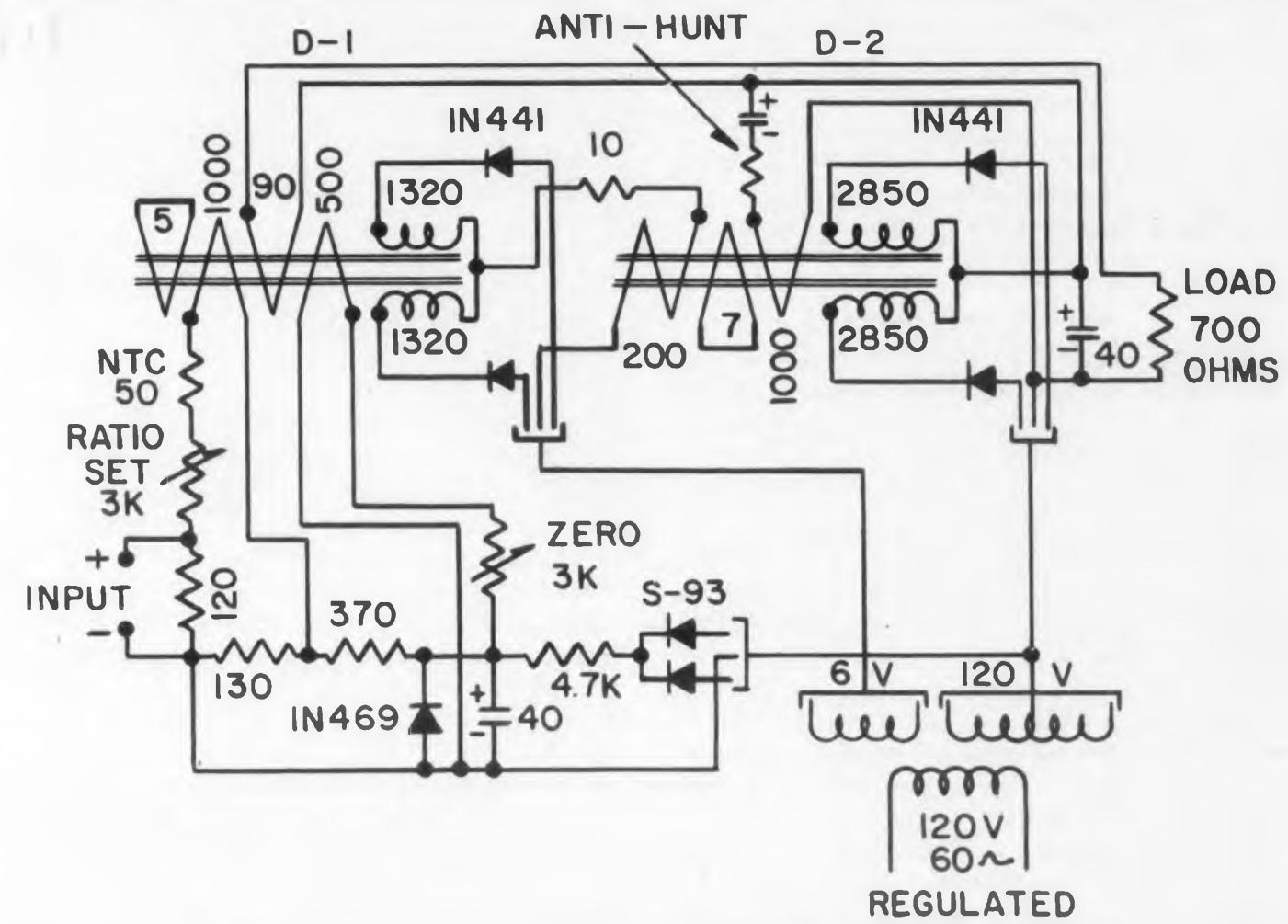


Fig. 3. Ratio amplifier schematic. The system uses two stages of magnetic amplification.

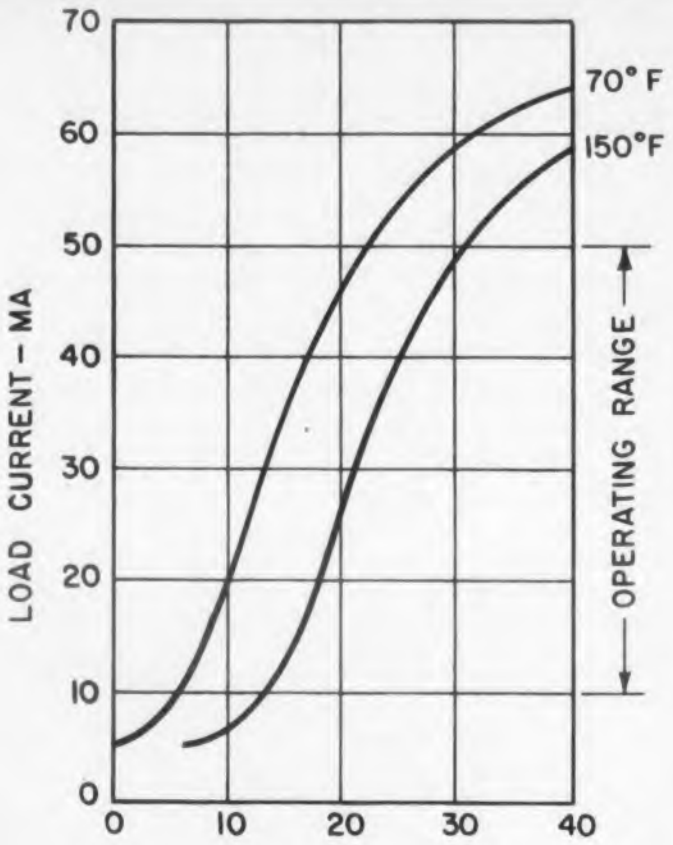


Fig. 4. Open loop transfer characteristic of ratio amplifier.

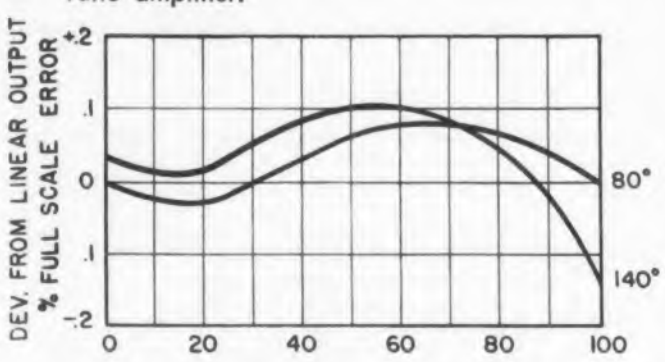


Fig. 5. Linearity and temperature response.

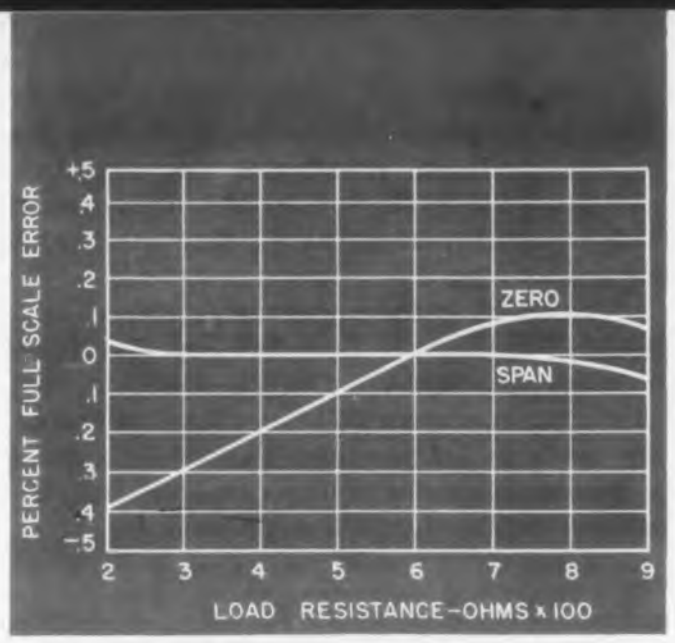


Fig. 6. Ratio amplifier constant current properties.

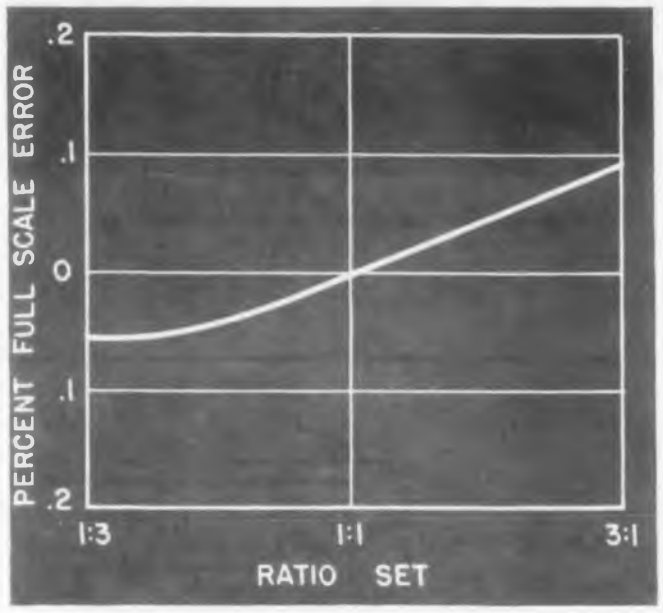


Fig. 7. Effect of ratio setting on "zero."

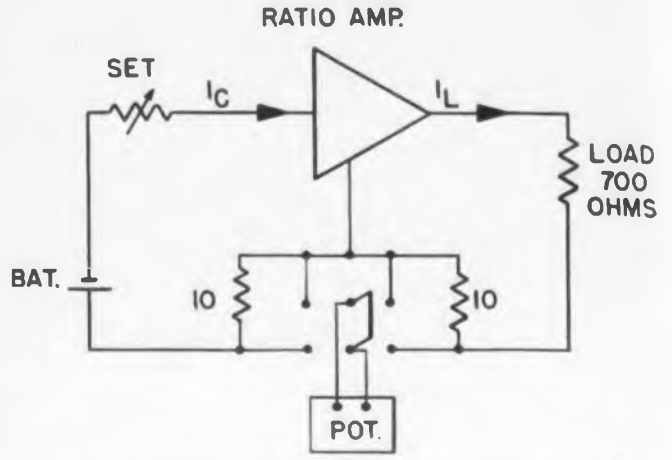


Fig. 8. Circuit for precision testing of ratio amplifier.

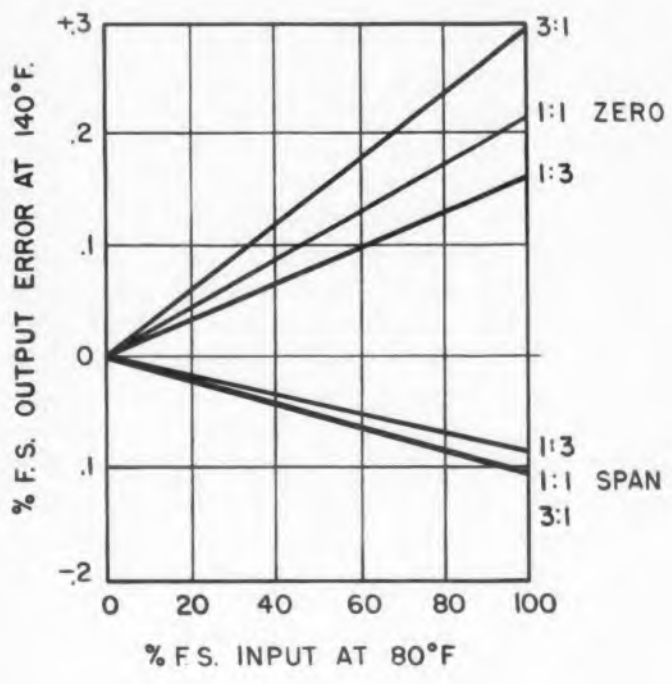


Fig. 9. Effect of ratio setting on temperature response.

Amplifier Performance

With the derivative circuits disconnected, and the current feedback winding shorted, the open loop transfer characteristic of the amplifier is determined by measuring input vs output current into a 700 ohm load. The results for two ambient temperatures are shown in Fig. 4. The effect of temperature on the open loop gain of the amplifier is to produce a slight zero shift, amounting to 0.2 per cent of full scale in terms of the closed loop operation.

With the dehunting and feedback circuits connected, the amplifier performance is measured using input current from a battery through an adjustable resistor. This insures that the input signal remains sufficiently constant to allow accurate measurements of both input and output currents. Both currents were sent through precision ten ohm resistors. The voltage drop across these resistors was measured with a Rubicon potentiometer, as shown in Fig. 8. With this calibration, the currents are read directly in milliamperes to four figures.

Load Resistance Variation

Fig. 6 shows the effect of load resistance change on the output current of the amplifier. The specifications call for an output current change of no more than 1/2 per cent for a load resistance change of 10 per cent. Actual measurement showed a span error of .01 per cent full scale and a zero error of .06 per cent. Extending the load resistance variation from 200 to 900 ohm gave maximum errors relative to the 600 ohm load of .38 to .1 per cent zero shift and .04 to —.04 for span change. This is a striking illustration of the constant current properties of the amplifier.

Ratio Set

The system requires that the output remain at 10 ma when the input is 10 ma regardless of the position of the ratio set resistor. If the voltage drop produced by the 10 ma input is equal and opposite to that produced by the Zener reference, then, theoretically, no current should flow in the control circuit. However, in spite of the use of the shorted decoupling winding, a small residual voltage is induced with its magnitude affected by the total control circuit resistance. Fig. 7 shows that a .1 per cent net error results as the ratio resistor is changed through its limits. A high quality variable resistor is essential since changes in contact resistance have the same effect as changes in ratio setting.

Linearity and Temperature Response

With a 1:1 ratio setting for several tests, the amplifier had a zero shift of +.47 per cent per 100 F rise and a span change of —.28 per cent per 100 F rise. The repeatability was .1 per cent. Results for a typical run are shown in Fig. 5.

Temperature Effect

The effect of temperature is somewhat affected by the ratio setting as shown in Fig. 9.

Zero Stability

The system's zero stability depends on the Zener reference, which, in turn, depends on the type of power supply regulation. In ac regulators having high distortion (20 per cent), a flat top waveform is produced whose peak value remains constant while the wave form varies with supply voltage. Such a wave form, rectified and filtered, produces a different average direct current output than a true sine wave of the same peak value. Hence, different regulators would supply different voltages to the Zener diode, causing it to operate at a different region of its characteristic. This introduces a small zero error. Wave form also affects the gain and zero of magnetic amplifiers, since these devices are frequency sensitive.

A Constant Current Source

This amplifier constitutes a true variable transformation ratio dc transformer. If the measurement signal is replaced by the Zener reference, a highly stable constant current generator is formed. The output current can readily be adjusted over a 5:1 range.

Appendix

First Stage Construction Details

Core: .938 in. od x .75 in. id, x .25 in., 3 mil Hymu 80 tape in protective box. (Magnetics Inc. No. 50003-3D). Core area = .135 cm^2; core length = 6.74 *cm*. Two carefully matched cores are required.

Gate Winding: 1320 turns of no. 34 copper wire over each core. Cover with one layer of 1 mil Mylar tape.

Feedback Winding: 90 turns of no. 34 copper wire wound over gate winding. Place cores together with paper separating washer and bind with one layer Mylar tape.

Control Winding: 1000 turns of no. 40 copper wire wound over two core assembly. Cover with one layer Mylar tape.

Bias Winding: 500 turns of no. 38 copper wound over control winding. Cover with one layer of Mylar tape.

Decoupling Winding: 5 turns of no. 22 copper with shorted terminals.

Second Stage Construction Details

Core: 1.5 in. od x 1 in. id x .375 in., 4 mil Orthonol tape in protective box. (Magnetics Inc. No. 50026-4A). Core area = .544 cm^2; core length = 9.84 *cm*. Two matched cores required.

Gate Winding: 2850 turns of no. 32 copper wire over each core. Place cores together with paper separating washer. Bind with one layer of 1 mil Mylar tape.

Control Winding: 200 turns of no. 36 copper over both cores. Cover with one layer Mylar tape.

Anti-hunt Winding: 1000 turns of no. 38 copper wire. Cover with one layer Mylar tape.

Decoupling Winding: 7 turns of no. 22 copper with terminals shorted.

(All copper wire is triple Formvar covered.)

From a paper presented at the IRE-AIEE Special Technical Conference on Magnetic Amplifiers, September, 1957 at Pittsburgh, Pa.

Read and Write Transistor Circuits for Magnetic Drums

A general approach to the design of transistorized magnetic drum read-write circuits for high reliability is presented in this article.

Part I, which appeared in a previous issue of ELECTRONIC DESIGN, outlined considerations for writer circuits. Part II, presented here, concludes the article with consideration of the read preamplifier.

B. A. Mangan

International Business Machines Corp.
Kingston, N. Y.

Part II

THE FUNCTION of the read preamplifier is to accept an input signal of approximately 30-50 mv and faithfully amplify it to a useful amplitude. In addition, the read preamplifier must reject a 10 mv signal and any pickup noise. Fig. 1 shows a preamplifier ideally suited to fulfill the above specifications. Operation of this circuit is in the megacycle range. This is obtained by the use of a drift transistor.

Essentially, the circuit consists of a push-pull emitter-coupled input stage feeding both sides of an emitter-coupled output stage.

- The advantages of this configuration are:
- Overall gain is increased.

A conversion from double-ended input to single-ended output is obtained without the use of a transformer.

Operation

A positive signal at the base of *Q5* (as shown in Fig. 1) produces an increase of current through the load resistor. A negative signal at the base of *Q6* also increases the current through the load. In the case of pickup noise, both signals are of the same polarity, hence they tend to cancel. However, since *Q2* and *Q4* look into different impedances, complete cancellation does not occur. This latter condition is of little consequence, however, since the small noise output can subsequently be amplitude-discriminated. It can also be seen in Fig. 1 that the circuit presents a high impedance to the read signal. The number of voltage sources have been kept down and are so chosen that the loss of any source will not result in the destruction of any component.

The emitter-coupled stage is a highly linear amplifier for small signals. Fig. 2 (a) indicates the gain stability as a function of the biases on the two transistors. It can be seen that in the useful operating range, the gain is fairly independent of bias. However, the operating point will shift as the difference between the two biases varies. This effect can be minimized by returning both bases to the same source. Variations in beta will displace the curves as shown in Fig 2 (b). However, the ac gain is fairly independent of this parameter. As a result, the circuit configuration is inherently stable. Since both transistors are always in the active region, the effects of I_{co} can be swamped out. For the emitter coupled stage in Fig. 3 we have:

$$I_e = I_{c_1}\left(1+\frac{1}{B_1}\right)+I_{c_2}\left(1+\frac{1}{B_2}\right)-I_{co_1}-I_{co_2}$$

$$I_{c_2}=\frac{I_e-I_{c_1}\left(1+\frac{1}{B_1}\right)}{1+\frac{1}{B_2}}+\frac{I_{co_1}+I_{co_2}}{1+\frac{1}{B_2}}$$

$$\text{Let } \gamma = 1+\frac{1}{B_2} \text{ and } \phi = 1+\frac{1}{B_1}$$

$$I_{c_2}=\frac{I_e-\phi I_{c_1}}{\gamma}+\frac{I_{co_T}}{\gamma}$$

$$I_{c_2}-\frac{I_{co_T}}{\gamma}=\frac{I_e-\phi I_{c_1}}{\gamma}$$

Where: $I_{co_T} = I_{co_1} + I_{co_2}$, each being the maximum I_{co} at the highest allowable temperature.

Using this arrangement, I_e must be kept small to satisfy the high frequency requirements ($f_{co} = 1/I_e$). Knowing I_{co_T}, and that it must be swamped out, fixes the value of I_{c_2}. This will determine a suitable value for I_{c_1}. Therefore, the values of R_e and R_c are also determined.

Discrimination against small signals is accomplished by shifting the operating point of the second stage. Fig. 2 (a) shows that cutoff occurs for equal base voltages. To reject a small input signal, e_{s1} (as shown in Fig. 1), the relation between the bases should be $E_{bQ5} = E_{bQ6}$ minus the voltage gain times the input signal. These base voltages are taken from a common divider so chosen that the current through it will swamp out the base currents. This minimizes variations in the operating point as *Q6* turns on and off.

Conclusion

To the extent that the circuits described are concerned with the application of transistors to magnetic drum requirements, the circuits are therefore typical of some of the problems encountered in reliable design. It must be remembered, however, that reliability and a good basic design are not necessarily one and the same. It is the responsibility of the circuit designer to settle for nothing but the optimum design, and then to build further reliability into it.

Whereas much has been written on the many facets of reliability, it is nevertheless true that there is still a need for a set of rules (or a general procedure) to cover the design of high-reliability circuits. To have a true value, however, each set of rules must be identified with a particular field of endeavor. The design of faster, more reliable circuits for drum applications is continuing.

As the state of the art of transistors improves and better techniques are developed for their utilization. reliability far in excess of that of present-day systems will be realized.

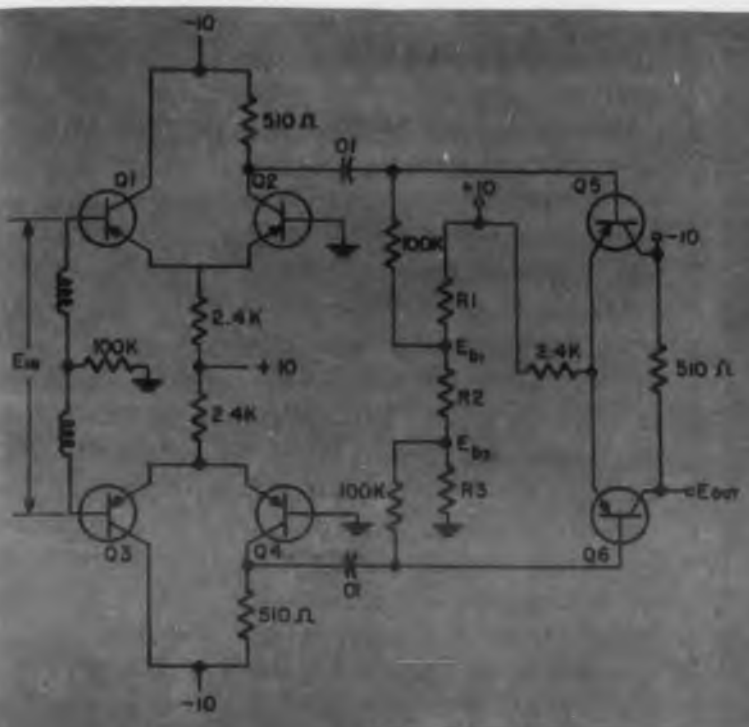


Fig. 1. Read preamplifier circuit.

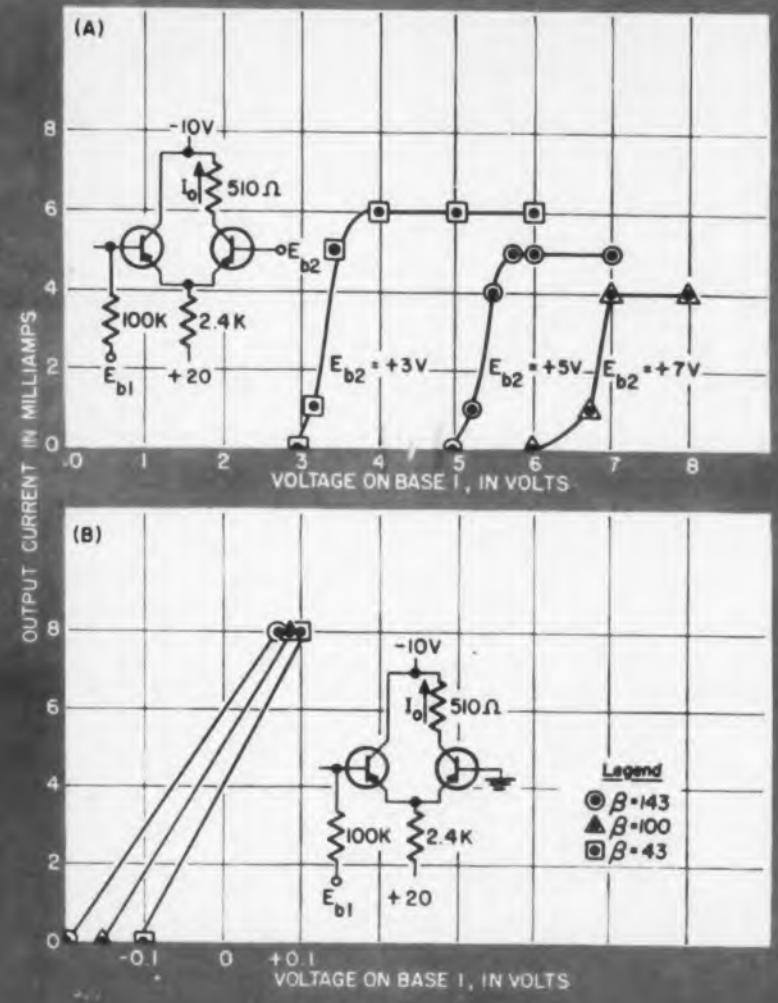


Fig. 2. Output current vs base 1 voltage. a—as a function of base 2 voltage. b—as a function of beta.

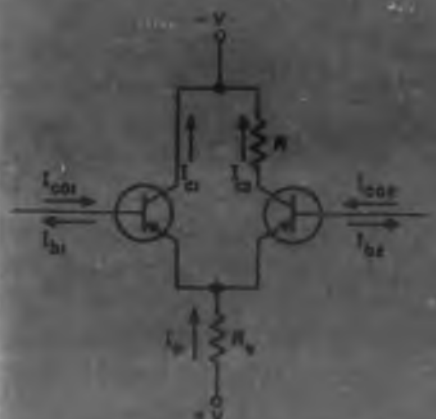


Fig. 3. Simplified emitter-coupled amplifier.

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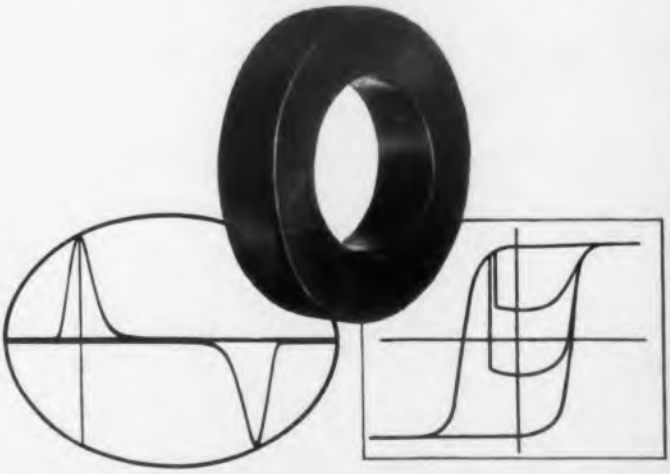

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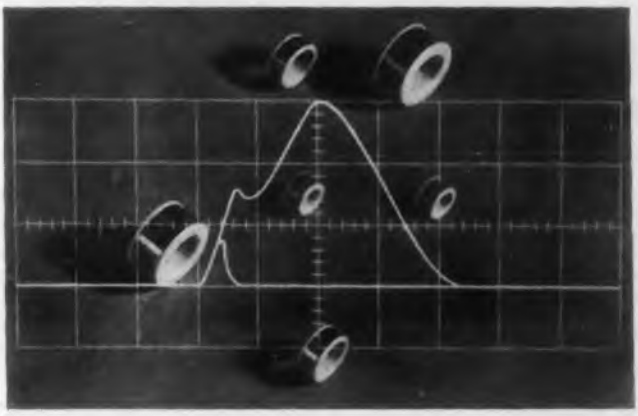

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This article describes a simple high speed fault-protection circuit which provides both dump tube and rectifier-blocking protection. The circuit was designed for use with a 10 kw, 10 kv plate voltage supply used in tests of medium power transmitting tubes, but is easily adaptable to other applications involving high, medium or low power equipment.

Improved Power Fault Protection

John T. Mark

Electron Tube Division
Radio Corporation of America

ELECTRONIC equipment operating at high voltages and powered by rectifier-filter-type supplies capable of storing large amounts of energy can be seriously damaged or destroyed by arcovers or other faults. Although such equipment is usually provided with electro-mechanical overload relays and circuit breakers which remove primary power in the event of a fault, these devices do not protect the equipment against damage by the *energy stored in the power supply filter*, and may not remove primary power rapidly enough to prevent damage to the power supply itself.

For adequate protection against fault damage it should be possible to shunt the faulted tube or circuit in a few microseconds. The shunting device should be capable of dissipating the energy stored in the filter or delivered by the power supply during the interval required for the removal of primary power. *Dump tube* or *electronic crowbar* circuits designed to provide such high speed protection have been described[1,2] and are now in use in commercial and military high power electronic equipment. Increased protection can be obtained if the power supply rectifier is blocked at the same time. In this way no energy is delivered to the filter in the interval required for the electromechanical protective devices to operate.

Operation of Dump Tube Circuit

The essential elements of the fault-protection circuit is shown in Fig. 1. The dump tube is an RCA 5563-A mercury vapor thyratron connected across the 10 kv dc supply leads to the equipment load.

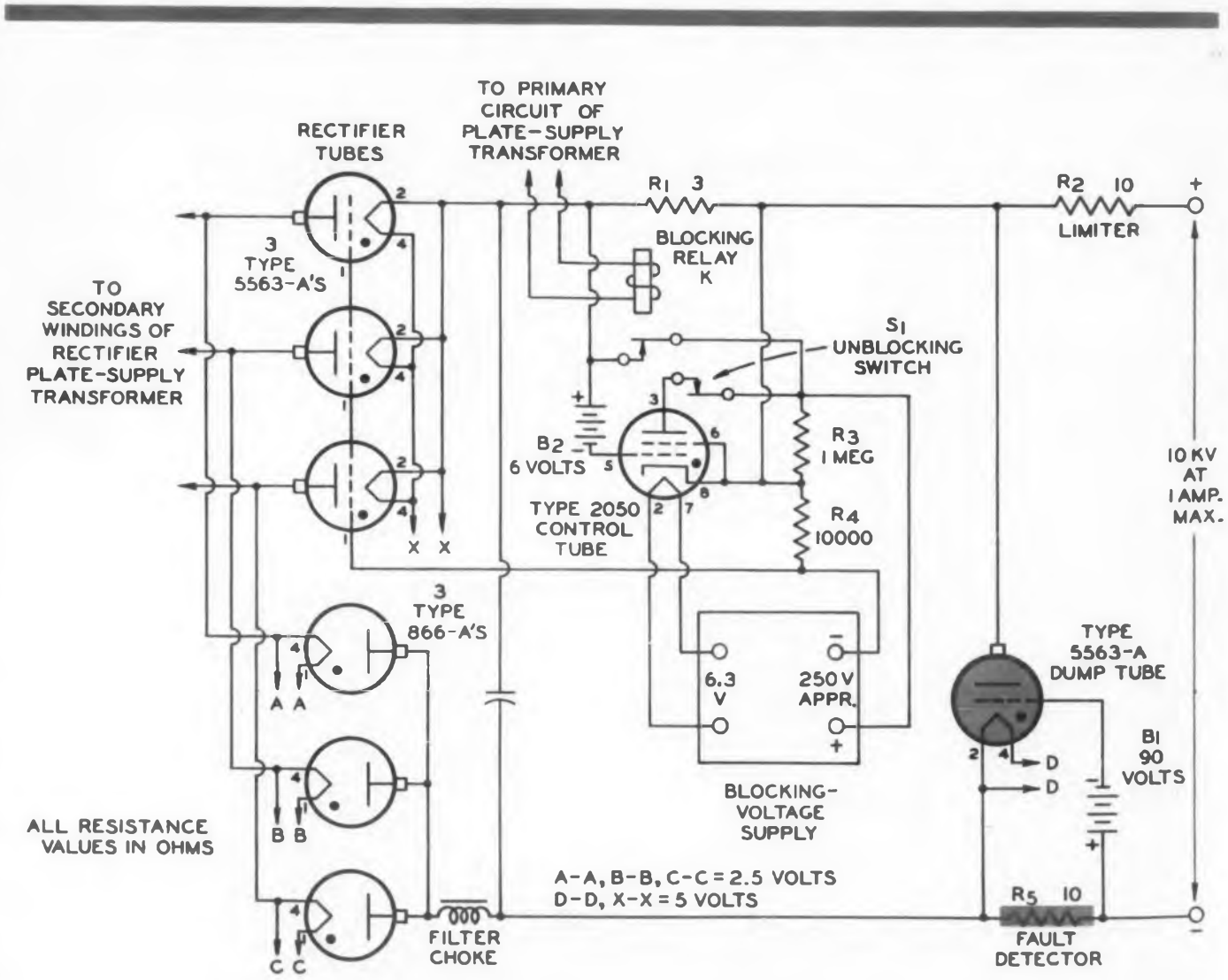

Fig. 1. High-speed fault-protection circuit showing dump tube.

Under normal load conditions the dump tube is prevented from conducting by the 90 v grid bias supplied by B_1. When a fault occurs in the load circuit the resulting surge voltage—developed across the fault-detector resistor R_s—overcomes the battery bias and fires the dump tube. Because the impedance of the ionized dump tube is substantially lower than that of the load and the limiting resistor R_2, the dump tube diverts the current delivered by the power supply. When the overload relay or circuit breaker operates, the energy stored in the filter circuit is dissipated.

The time required for a dump tube circuit to divert the current is determined by the tube ionization time and by the reactance of the firing circuit. A mercury vapor thyratron such as the RCA 5563-A has a rated ionization time of approximately 10 μsec, but can be ionized in a considerably shorter time if its grid is triggered by a suitably steep waveform. Although the rated ionization time of a hydrogen thyratron such as the 5C22 is only 0.1 to 0.2 μsec, such extremely rapid ionization can only be achieved if the fault detection circuit has extremely good high-frequency characteristics. In general, adequate protection can be obtained with an ionization time of 10 μsec. The amount of energy that can be delivered by a low frequency rectifier-filter system during this interval is not great enough to cause damage.

Operation of Rectifier-Blocking Circuit

Additional protection for the faulted circuit is obtained by the use of grid-control rectifier tubes which can be blocked simultaneously with the firing of the dump tube.

The rectifier shown in Fig. 1 is a 3φ half wave type using an RCA 866-A and an RCA 5563-A in each phase. The use of the 5563-A's permits the rectifier to be turned off by a relatively small blocking voltage to the grids. The blocking voltage is obtained from a simple low voltage dc supply; its application to the rectifier tube is controlled by the 2050 hydrogen thyratron.

The unblocking switch S_1, and the contacts of the blocking relay K are normally closed. When filament power is applied to the rectifier tubes and the dump tube, the blocking-voltage supply circuit is energized and applies +250 v to both plate and grid *1* of the 2050. This is more than enough to overcome the –6 v grid bias supplied by battery B_2, and fires the 2050. The resulting drop across R_4 — –250 v — blocks the 5563-A rectifier tubes.

Application of plate-supply power to the rectifier tubes opens the contacts of relay K, removing the positive dc supply from grid *1* of the 2050. The 2050, however, continues to conduct because it cannot be deionized except by removal of plate voltage. It therefore keeps the rectifier tubes blocked.

The unblocking switch S_1 is a spring-return type

which, when pressed, removes plate voltage from the 2050. The resulting deionization of the control tube removes the short across R_3, reduces the drop across R_4 to a negligible value and unblocks the 5563-A rectifiers. When S_1 is released the 2050 control tube is held in the deionized state by the −6 v bias supplied by B_2. During these starting-up operations the 5563-A dump tube is, of course, cut off by the −90 v grid bias supplied by B_1.

Fault-Protection Action

Under normal load the maximum drops across R_1 (3 v) and R_3 (10 v) are too small to overcome the battery bias voltages on the grids of the 2050 control tube and 5563-A dump tube, so that these tubes remain deionized. Under fault conditions, however, the voltages across R_1 and R_3 very rapidly become large enough to trigger the control tube and dump tube. The rectifier is then blocked and the faulted circuit shunted in microseconds. The control tube will continue to conduct and keep the rectifier blocked after primary plate power is removed. It will maintain the rectifier tubes in the blocked condition after the fault has been cleared and plate power reapplied. The rectifier cannot be unblocked except by means of the switch.

In many cases, a fault is present or develops at the instant the power supply is turned on, with the result that the dc output voltage of the supply does not rise to the normal value. In such cases, an ac-coupled or voltage-sensitive fault-detection circuit might not respond to the fault, and would not provide the desired protection. The fault-detection circuit shown in Fig. 1 is free from these disadvantages because it is direct coupled, current sensitive, and substantially independent of the dc operating voltage. In addition, the rectifier-blocking feature automatically prevents application of power to a faulted circuit.

Although this fault-protection circuit is not "fail safe," it is conservatively designed and extremely reliable. Similar circuits have been used for several years in the RCA Electron Tube Division laboratories, and have given very little trouble.

Complete Protection Circuit

A schematic of the complete fault-protection circuit is shown in Fig. 2. The unblocking switch S_1, is a spring-return type equipped with make-before-break contacts. When pressed, the lower (make) contact closes first, maintaining a large current flow through R_1. In this way the rectifier tubes are not without blocking protection during the unblocking operation. The upper (break) contact then opens, and removes plate voltage from the 2050. The rectifier, therefore, is not unblocked until S_1 is released. N_1 and N_2 are neon indicator lamps which show whether or not the rectifier is blocked. S_2, which was not shown in the simplified circuit diagram of Fig. 1, is a normally-open spring-return switch which provides a convenient means for checking the operation of the rectifier-blocking

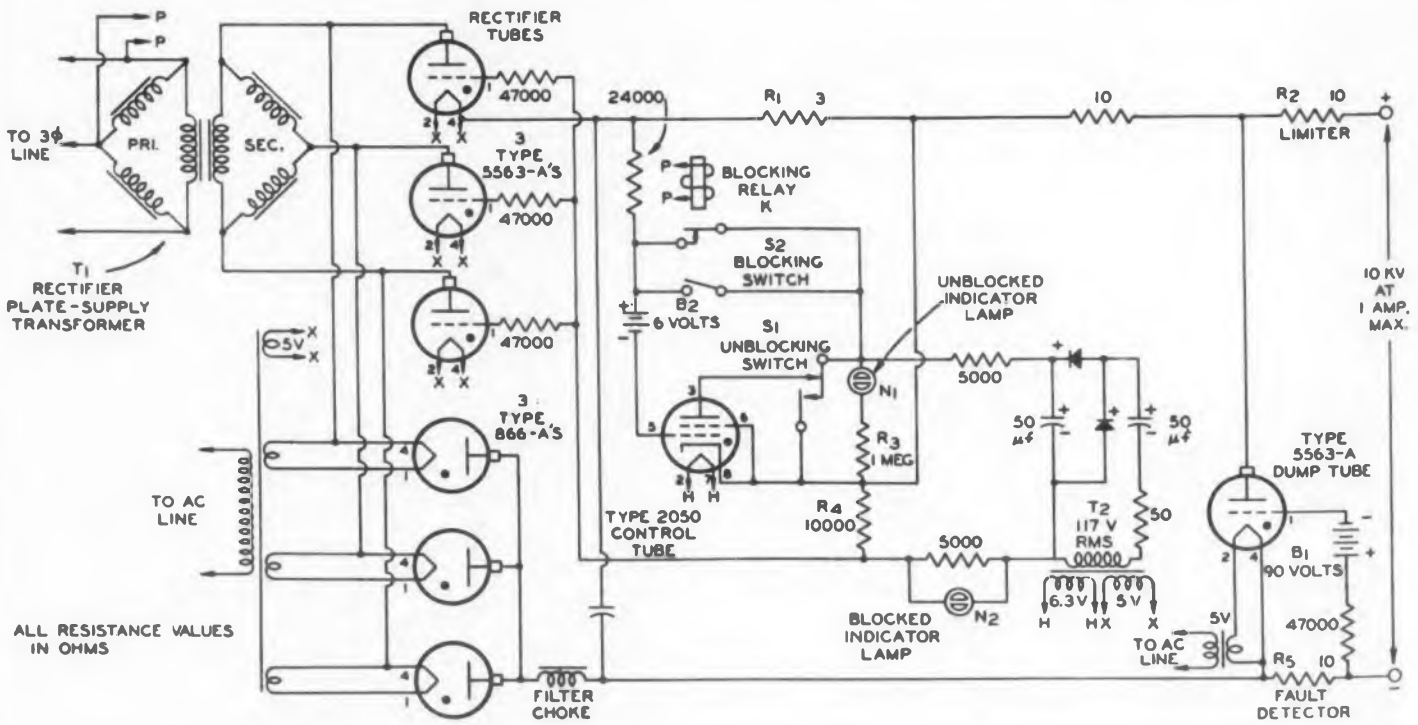

Fig. 2. Complete fault-protection circuit.

circuit. It is connected in parallel with the contacts of relay K, open when the rectifier is operating under normal load conditions. Momentary pressure on S_2, therefore, triggers the 2050 control tube, and blocks the rectifier.

Design and Construction

In the design of the power-supply circuit, consideration was given to the fact that the supply would have to be capable of operation under short-circuit conditions during the interval required for the dump tube and control tube to ionize. No special components were required, because experience showed that standard components were fully capable of standing the anticipated short-time overloads without damage. The inductance of the filter choke was the minimum critical value[3]. Excessive choke inductance can cause the development of a negative voltage kick after the rectifier has blocked. This kick may be of sufficient magnitude to exceed the piv rating of the rectifier tubes, causing arc back.

Considerable care was taken in layout and lead dress to minimize reactance, because excessive reactance may be responsible for transients which can cause the blocking and dump tube circuits to misfire.

Note that S_1, S_2, and the entire blocking-voltage supply circuit, including the heater supply for the 2050 control tube, are at high potential. The expense of a supply transformer having adequate primary insulation for T_2, may be avoided, as shown, by the use of a conventional 6.3/5 v filament transformer with its 117 v primary used as the high voltage secondary and its 5 v winding as the primary. The entire transformer, as well as all components and wiring of the blocking-voltage supply circuit, and the blocking and unblocking switches must be insulated from ground for the peak output voltage of the rectifier.

The effectiveness of this protection circuit is demonstrated by the fact that when a small piece of soft solder wire is placed across the output terminals of the supply, only a small spit and flash results. The solder is not marred and shows no evidence of an arc even when examined through a 10-power magnifier. In operating tests, the supply was repeatedly turned on into a short circuit, and short-circuited while delivering 10 kv, without damage.

Acknowledgements for valuable assistance in the development of this circuit are due to A. C. Grimm, S. E. Pennypacker, and F. S. Keith of the RCA Electron Tube Division, Lancaster, Pa.

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3. RCA Transmitting Tube Manual TT-4, pp. 74-77.

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A proposal for the standardization of power supply voltages for transistor circuits. Recommended voltages are ±1.5, 3, 3, 12, 25, 50 and 100 v, with voltages above 100 falling in 50 v increments. The method used to select these voltage standards, akin to that originally used to select standard resistor values, is described.

Transistor Voltage Standards

W. W. Wells
Autonetics Division
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TRANSISTOR supply voltage requirements have placed greater demands on power supplies. While the majority of the vacuum-tube voltage requirements fall within a 2:1 range between 150 and 300 v, most transistor requirements are spread over a 100:1 range between 1.5 and 150 v.

A method for arriving at standard voltages is to select a series of voltages that are equally spaced by a constant multiplying factor. In this way the percentage difference between an ideal power supply voltage and the closest standard voltage would always be less than a certain fixed amount no matter what part of the voltage spectrum was needed. Fig. 1 shows a fairly uniform spread of transistor power supply voltages used by a number of aircraft companies.

The homogeneity of transistor circuit voltage requirements over the voltage spectrum from 1.5 to 150 makes it desirable to use a system of power

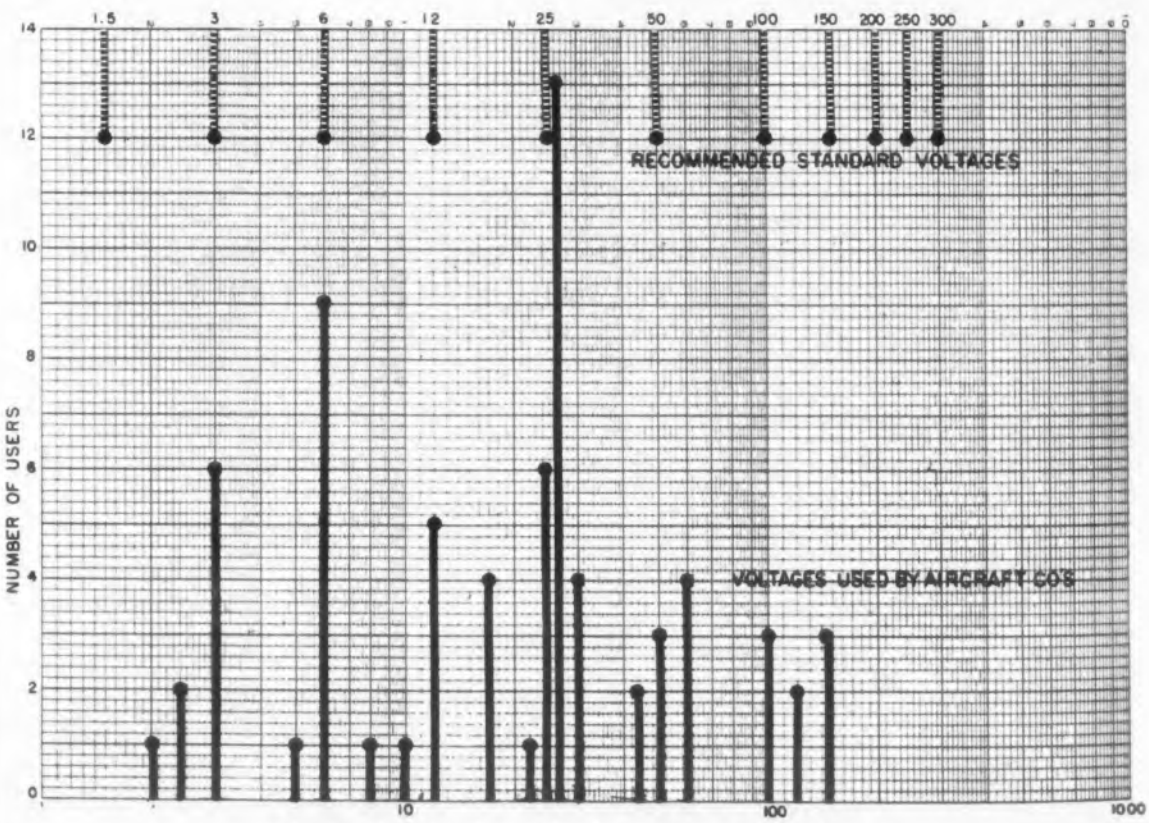


Fig. 1. Proposed standard power supply voltages.

upply voltages separated a given percentage from ach other. In this manner the engineer selecting a tandard voltage near 2 v or 80 v would not be enalized more for one requirement than the other. n illustration might clarify this position further.

Suppose standard voltages were set up as 3, 50, nd 100 v. Now let two circuits be designed which must use one of these standard voltages but which will be optimized when using 12 and 75 v, respectively. The engineer who needs 12 v is penalized by a factor of 4:1 by going to either 3 or 50 v. On the other extreme the circuit that works best at 75 v is only penalized 1.4:1 by going to 50 or 100 v.

If only three voltages were permissible they would be 1.5, 15, and 150, separated by a factor of 10:1. If thirteen were permissible the 20 per cent tolerance series used for resistors would suffice. The desirable series falls in between these two; one does not include enough and the other has too many.

Standard Voltages

A series spaced by a factor of 2:1 is recommended as shown here with voltages about 100 v spaced in 50 v increments: ±1.5, 3, 6, 12, 25, 50, 100, 150, 200, 250, and 300 v. This series retains the 2:1 spacing between values for transistor voltages below 100 v and retains the most popular vacuum-tube voltages above 100 v. It also seems as though a ratio of less than 2:1 would yield more power supply voltages than desirable and a ratio of over 2:1 would not include enough voltages.

Several of the voltages in this recommended series are standards now in popular usage. The 1.5 and 3.0 v voltages could be supplied from dry cells or electronic supplies. The 6 and 12 v storage batteries are in common use. In the 20 to 30 v range, 22-1/2, 23, 24, 25, 27-1/2, 28, and 30 are all used extensively. For reasons already stated, the 25 v supply, which is consistent in the 2:1 spread for 25, 50, and 100 v, was picked. In the region of 50 c, 45, 50, 55, and 60 are used; 50 was chosen.

Transistor Specs Influenced

A transistor rated by the manufacturer for a maximum collector voltage of 30 v must not be operated above 30 v: the collector might break down and damage could result if the collector current were not limited.

If a circuit engineer were to design a circuit around the type 2N118 transistor (rated at 30 v) using the recommended power supply voltages, it is doubtful that he would want to choose the 50 v supply, because it exceeds the transistor ratings by a large margin. Because the next lower standard supply voltage is 25 v, he would prefer to use this one for a resistive load and 12 v for an inductive load. If a transistor rated for a maximum of 20 v were selected, it is possible that the 25 v supply might still be used, and most transistors would work satisfactorily. This is because manufacturers

cannot produce a production run of transistors with a single value of breakdown voltage (due to process control) but rather a spread of values which range above and below the rated value. Reliable manufacturers choose transistors from their distribution so that most, if not all, of those shipped fall above the value in question.

The manufacturer has little control over the way a product is used in research and development. It is only after a product has gone into production and trouble arises that the component supplier is called in. One good way to decrease the possibility of the misuse of a component is to establish standards in such a way that it will be more difficult to go wrong.

Transistor Ratings

As shown above, a transistor rated for a maximum of 30 v will probably be used with a 25 v supply for a resistive load; this is a 20 per cent safety factor when the transistor is operated in a cut-off condition. On the other hand, a transistor rated for a maximum of 20 v could be operated from a resistive load and a 25 v supply, as stated above, with a good probability that many units would work satisfactorily. As frequently seems to happen, these transistors might all have a collector breakdown above 25 v and work satisfactorily. But in production, when large quantities are used, a certain percentage of the transistors will inevitably have a breakdown just above 20 v and would not be suitable for the application.

If the standard supply voltages are adopted and used by a majority of users, the transistor manufacturer will have gained the tremendous advantage of knowing the universal market requirements for collector voltage. By adding 20 per cent to these standard supply voltages, a new series of voltages is obtained, which are ideal ratings for transistor collector voltage. This new series will be ±2, 4, 8, 15, 30, 60, and 120 v. Circuit designers will then be in a position to use the recommended power supply voltage and to operate transistors out to their maximum ratings with a 20 per cent safety factor. This will certainly tend to discourage the use of the next higher standard voltage because of the very obvious overrating of transistor collector voltage.

Other Advantages

The above series of voltages (2, 4, 8, etc.) would be ideal voltage ratings for capacitors when used in circuits using the standard voltages recommended here. Component manufacturers will be able to produce parts to be used in systems already designed as standard voltages will be available.

Checkout equipment for testing components will be simplified if only standard voltages are needed to power the components. Standard power supplies can be designed and used in many systems without redesigning for new voltages in each new system.

Nonstandard Voltages

No matter how much one wants to standardize, there will be some justifiable exceptions. The hearing aid industry, for instance, will continue to use 1.34 and 2.68 v because the mercury cell was not informed about the proposed standard of 1.5 and 3.0 v. No justification is needed for these voltages. One point three four and 2.68 v will be standards in the hearing aid industry.

In those companies that produce portable transistor radios 9 v will be a standard. It might complicate the proposed standard to use this voltage but the engineer desiring to use 9 v will have no trouble. Nine volts is accepted in the entertainment field. The time may come when transistor, capacitor, and battery ratings will be such that 6 or 12 v might be more economically desirable.

Another group of users desires 18 v for a comparatively large system since this voltage is being used on present equipment. If a survey were made of all equipment in the country, there would be strong justification for certain voltages not recommended here. But if each new voltage were to be put on the standard voltage list to satisfy the needs for certain users, standardization would be doomed to failure. It is probably safe to say that a majority of circuits in use today could have been designed around this recommended series of standard voltages with no consequent deterioration in performance if standard voltages had been available. Many circuits will work just as well over quite a range of collector voltages; when a standard is announced a majority will use it. For those who cannot conscientiously use a standard voltage because of reduced performance, a nonstandard voltage is desirable and should be used. But if the users of nonstandard voltages influence the voltages listed in the standard list, the result will be an overall reduction in the benefits that accrue from voltage standards.

Standard Tolerances

The voltage values suggested here are nominal. The 25 v supply could be 25 v ±0.1 per cent for a precise computer reference voltage or it could be 25 ±5 v when taken from an aircraft dc supply. The current capacity, per cent ripple, regulation, and other power supply characteristics are not considered in this standard. They are dictated by the requirements of the system.

Conclusion

A standard acceptable to industry must offer advantages to a large majority of users. The series of voltages recommended here is realistic and a large number of circuits can be modified easily. In those specialized cases where standard voltages cannot be used, the engineer should have no trouble in justifying his special needs.

Feedback Controlled

Microwave Attenuator

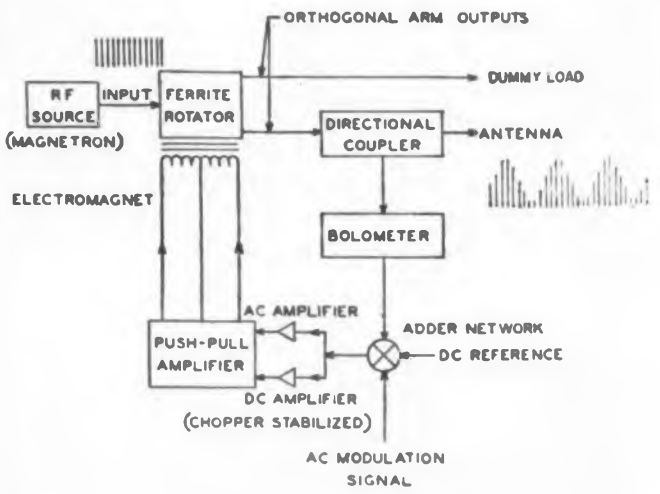
WITHOUT bulky mechanical equipment, this device accurately splits, attenuates, or modulates microwave power. With the advantage of a closed loop system, it automatically regulates output waveform and amplitude, and can handle frequencies from 3 to 10 kmc.

Airtron, Inc., of Linden, N.J., designed reserve gain into this 5 tube system at a total cost of only 25 watts of power consumption.

One can feed power from a klystron or magnetron into this unit and electronically stabilize the amplitude, modulate the power with sine or square waves, split the power and direct it into two discrete outputs, and attenuate or simply monitor the output.

The unit features a voltage standing wave ratio of no more than 1.2, insertion loss from 1 to 20 db, and 2 per cent stability. Sine wave modulation frequency can be as high as 150 cps and square wave modulation can go to 50 cps. The harmonic distortion for 10 db sine wave modulation does not exceed 5 per cent.

The block diagram illustrates the operation. A klystron or magnetron microwave source feeds



This block diagram (discussed in the text) shows how the plumbing and electronic components work together.

This is the compact control box for the programmed microwave attenuator.

a ferrite rotator. A magnetic field applied to a ferrite rod in the rotator, rotates the plane of polarization of the rf wave traveling along the guide. Two coupling windows, 90 degrees apart in a section of circular waveguide, sense this rotation of the rf wave.

As the electric field rotates, the power ratio between the two windows changes. A bolometer detector couples the rotator to an operational amplifier's feedback circuit. The bolometer's output, which represents the actual power in the waveguide, is compared with reference signals to provide an error signal which is fed to the amplifier. The amplifier, in turn, drives the electromagnet which applies the magnetic field to the waveguide ferrite.

Though the ferrite is sensitive enough to find laboratory applications, it can also handle quite high power levels. In the X band, it can accept 100 watts of average power and 100 kw peak. In the C and S bands, it can handle three times these levels.

For further information, turn to the Reader-Service Card and circle **42**.

Here is the plumbing associated with the attenuator. At the upper left is the directional coupler and attenuator. To its right are the orthogonal junction, the ferrite rotator, and a 45 degree twist. The dummy load is shown at the lower right and the bolometer mount at the lower left.

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Transistor Heat Sinks

POWER transistors using these new heat sinks no longer require large surface mounting areas for heat dissipation. Combining convection and radiation cooling, these new heat dissipators can solve many power transistor application problems where conduction cooling is not feasible.

Designed by International Electronic Research Corporation, 145 West Magnolia Boulevard, Burbank, Calif., they allow efficient and compact form factors in equipment where it is now necessary to allow large surface areas for heat dissipation.

By keeping transistors cooler, they improve their operation and extend their life. In addition, they reduce the heat transferred into printed circuit boards.

The heat dissipators are made of aluminum with a black anodize finish. They have holes for convective cooling, and slots, which provide a tight spring friction fit on the transistor.

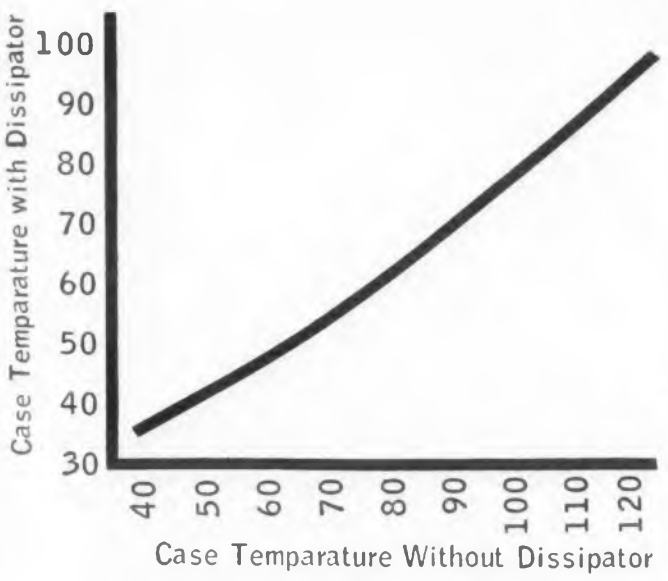
Tests were made to compare the cooling efficiency of these units with other designs. The guinea pig was a power transistor screwed into a small soldering iron. A thermocouple attached to the top center surface of the transistor monitored the temperature.

The new heat dissipator was compared with bare aluminum samples, with and without convective holes, and with a black anodized sample without the holes. It was found superior to all the others. The graph, shown below, illustrates how effectively it reduces case temperature.

Models are available to fit various transistor case sizes.

For more information, simply turn to the Reader-Service Card and circle **45.**

See these dissipators at the Radio Engineering Show at Booth 3704.



This **graph** compares transistor case temperatures with and without the heat sink. Temperatures are in degrees Centigrade.

Part II

Silicon Diode Application Notes

Arnold Bergson
Raytheon Mfg. Co.
Newton, Mass.

Medium power silicon diodes can be applied where small size, high efficiency, high temperature operation, high reverse resistance and medium forward current are required. Equations and criteria for use in designing silicon diodes into practical circuits are given here, together with problem examples.

THE BASIC equations described in the previous article ELECTRONIC DESIGN, March 1, 1957, require separate solution for a trial set or electrical and thermal conditions of limiting diode operation. In many cases repetitive solution will be required for optimum design. For rapid solution, and to permit simple inspection of the results of adjusting independent variables, it is convenient to adapt the main functions to nomograph form.

Electrical Functions

The general equation for forward power dissipation (P_{fd}) is:

$$P_{fd} = I_a E_o + K_f^2 I_a^2 R_d \quad \text{watts} \qquad (1)$$

where, P_{fd} = forward power dissipation
E_o = approximate diode threshold voltage
K_f = theoretical forward current form factor
R_d = diode dynamic forward resistance
I_a = diode forward average current

Equation (1) lends itself readily to three scale nomograph presentation using the following scales (*a*) $K_f^2 R_d$, (*b*) I_a, and (*c*) P_{fd}. E will normally range from 0.7 to 1.0 volt at 25 C, with a temperature coefficient of $-1mv/°C$. R_d will vary over many orders of magnitude with diode size and type. Both parameters are normally given in manufacturer's literature.

Thermal Functions

There has been a recent industry wide tendency to simplify the form of limiting thermal curve (Fig. 2, Part I) to the form:

$$P_{fda} = \frac{T_s - T_c}{K_d R_{ti}} \quad \text{watts} \qquad (6)$$

where T_s = maximum (inoperative) storage temperature

(*continued on page 60*)

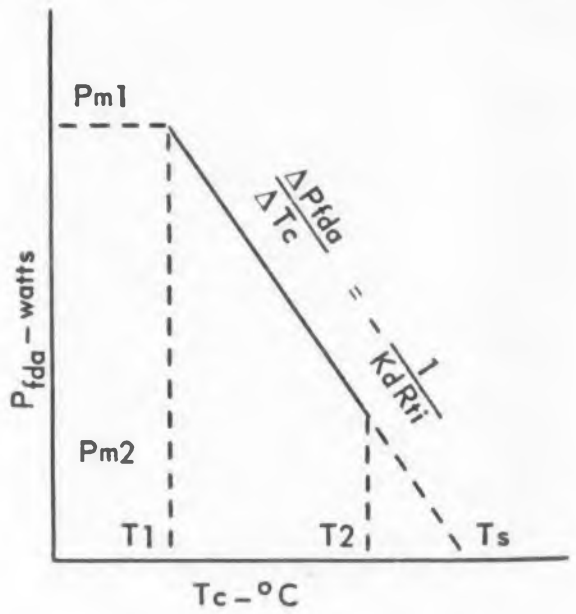
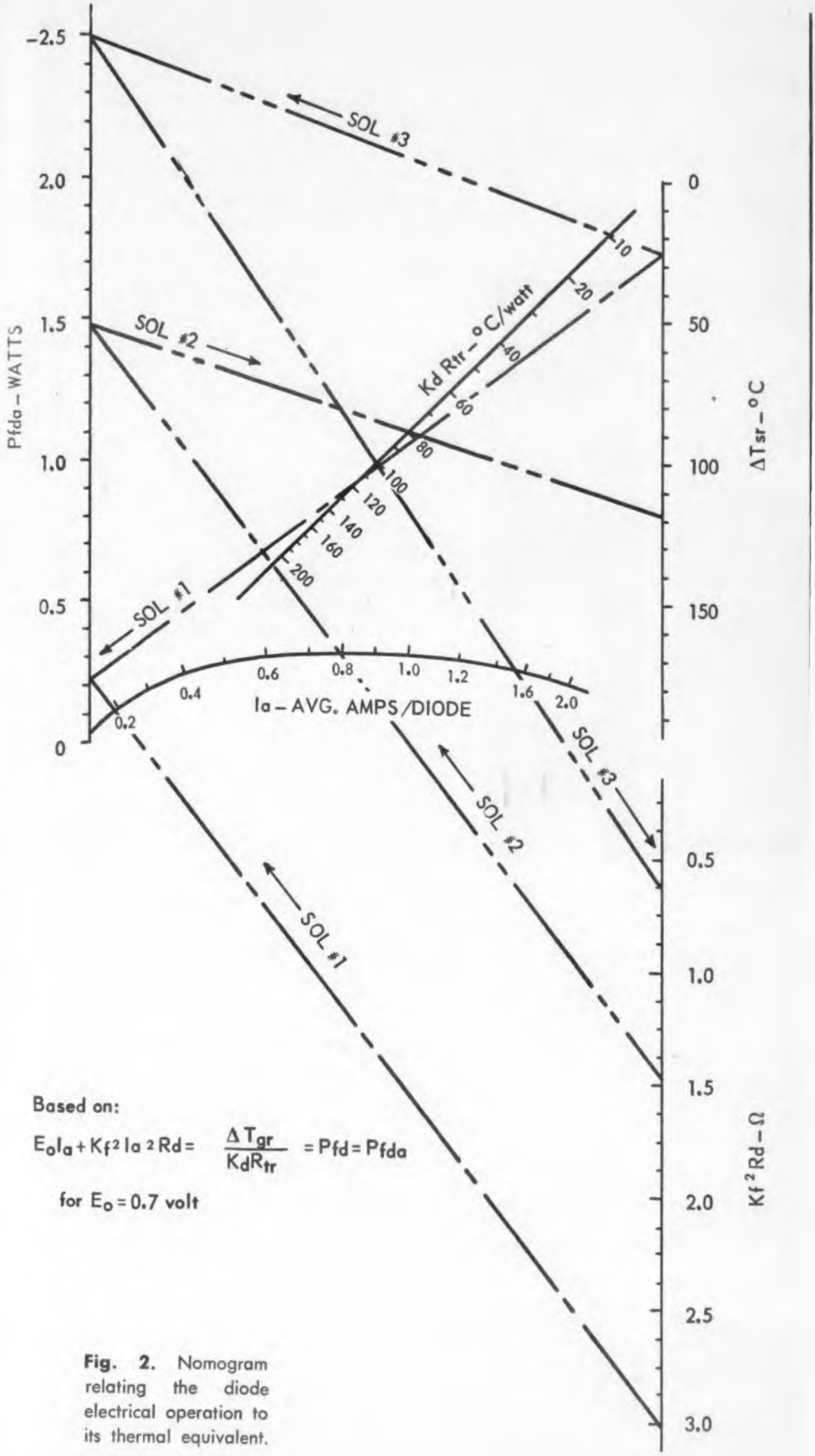


Fig. 1. Modified thermal limit curve. The range covered is usually limited to some extreme temperatures, T_1 and T_2.



Based on:

$$E_o I_a + K_f^2 I_a^2 R_d = \frac{\Delta T_{gr}}{K_d R_{tr}} = P_{fd} = P_{fda}$$

for $E_o = 0.7$ volt

Fig. 2. Nomogram relating the diode electrical operation to its thermal equivalent.

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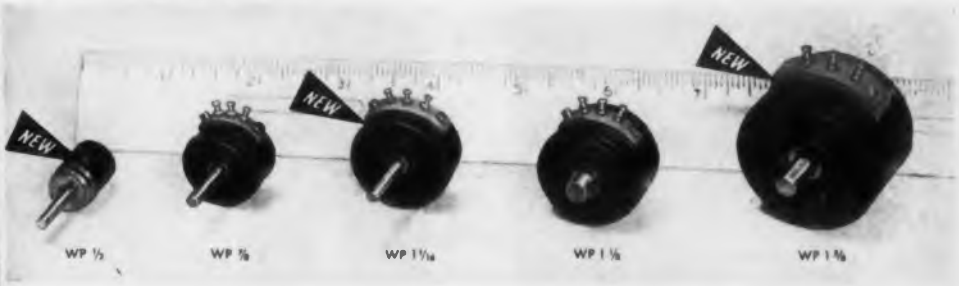

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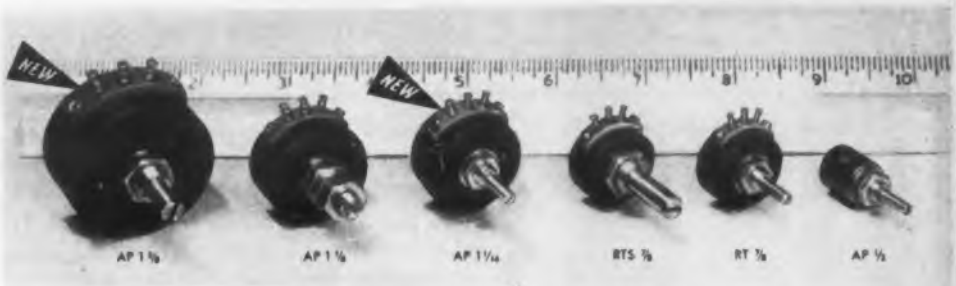

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T_c = case temperature
R_{tt} = maximum effective, diode internal termal resistance
K_d = a derating factor
P_{fda} = maximum allowable forward power dissipation

The modified thermal limit curve is plotted in Fig. 1. The range covered by this curve is normally limited to some extreme temperatures, T_1 and T_2, where:
when $T_c \leqq T_1$, $P_{fda} = P_{ml}$ (7) (*and*) when $T_2 < T_c \leqq T_s$, P_{fda} may be derated to zero, but T_2 may equal T_s for a given diode.

The choice of the test measurement point is purely arbitrary. Equation (6), covering case temperature measurement, can be generalized to include any reference point from ambient (ground) to junction as follows:

$$P_{fda} = \frac{\Delta T_{sr}}{K_d R_{tr}} \text{ watts} \qquad (8)$$

where T_{sr} = the temperature difference between the junction and the reference point
R_{tr} is the effective thermal resistance between the junction and the reference point
K_d = is a derating factor.

Equation (8) can be conveniently adapted to a three scale nomograph for using the following scales: (a) ΔT_{sr}, (b) P_{fda}, and (c) $K_d R_{tr}$.

Combined Electro-thermal Functions

By equating the actual forward power dissipation (P_{fd}, eq. 1) to the maximum allowable forward power dissipation (P_{fda}, eq. 8), a single equation is produced relating the diode electrical operation to its thermal environment:

$$E_0 I_a + K_f^2 I_a^2 R_d = \frac{\Delta T_{sr}}{K_d R_{tr}} = P_{fd} = P_{fda} \qquad (9)$$

Since the power scales are common, the resulting nomograph will have five scales, of which three are linear, and two exponential. In order to provide maximum legability and accuracy, it is necessary to limit use of each nomograph to a single diode type.

The nomograph shown in Fig. 2 covers a family of silicon diodes having a nominal power dissipation rating of approximately 0.5 w at 150 C case temperature. This family is a large one, covered by many manufacturers, in several types of junctions (bonded, fused, and diffused) in different mechanical packages (coaxial lead, stud). Temperature reference points used by the various manufacturer's range from ambient and case, to junction.

Nomogram Problems

The problems selected for nomogram solution illustrate the range and flexibility of this method.

Problem 1: A bonded silicon diode has a forward limit of $I_f = 0.3$ ampere at 1.0 v dc. The derated internal thermal resistance can be found from a published curve to be: $K_d R_{tr} = 120$ degrees C/w from junction to ambient. Storage temperature is given as 150 C. From the above data, determine the maximum output current which can be used from a three phase bridge in an ambient temperature of 125 C:

Solution: Assume $E_o = 0.7$ v, and calculate $R_d = \frac{E_f - 0.7}{I_f} = 1$ ohm. K_f (from the Table, Part I) is 1.74, and $K_f^2 R_d$ is 3.03 ΔT_{sr} is 150 — 125 or 25 degrees. Draw a line on the nomograph connecting 25 degrees on the ΔT_{sr} scale and 120 C/w on the $K_d R_{tr}$ scale. Extrapolate to the P_{fda} scale, and read the maximum allowable forward power dissipation as 0.22 watts. Find 3.03 on the $K_f^2 R_d$ scale, and draw a line connecting this point with the previously determined point on the P_{fda} scale. This line passes through the I_a scale at an average, per diode current of 0.18 ampere. The total bridge output current will then be triple this value or 0.54 ampere.

Problem 2: A fused silicon diode has a forward specification of 0.5 ampere at 1.0 v, dc, for an R_d of 0.6 ohm. Given a storage temperature of 175 C, and a $K_d R_{tr}$ of 80 C/w from junction to ambient, determine the maximum ambient temperature at which an output current of 1.6 amperes can be supplied from a single phase center tap supply:

Solution: Since each diode will supply half the load current, find point 0.80 on the I_a/diode scale, and $K_f^2 R_d$ ($1.57^2 \times 0.6 = 1.47$) on its scale. Connect these points and extrapolate to the P_{fda} scale, reading 1.48 watts. Connecting this point to 80 C/w on the $K_d D_{tr}$ scale, and extrapolation to the ΔT_{sr} scale, read 118 degrees. The ambient temperature (max.) is then 175 —118 or 57 C.

Problem 3: A stud mounted, diffused junction, silicon diode has a forward of 2.0 amperes at 1.0 v, dc. Δt_{sr} and $K_d R_{tr}$ are 175 C, and 10 C/w (junction to case), respectively. It is required to supply 3.0 amperes to a resistive load through a capacitor input filter. The supply will be a single phase bridge, and diodes will be operated at a maximum case temperature of 150 C. The capacitor will cause a poorer current from factor than that indicated by the Table (1.57). Find the maximum value of K_f which can be used:

Solution: From the above data, $\Delta T_{sr} = 175 - 150 = 25$ C. From the nomograph find $P_{fda} = 2.5$ w. Each diode will carry an average current of 1.5 amperes. Therefore, the nomograph gives a maximum permissible value of $K_f^2 R_d$ as 0.625. The dynamic resistance, R_d is (1.0 — 0.7) / 2.0 or 0.15 ohm. Therefore K_f is the square root of 0.625/0.15 or 2.02. Since the resistive load value of K_f is 1.57, an increase of about 30 per cent up to 2.02 is permissible.

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For full details, refer to Bulletin T-5002. A copy will be sent on request.

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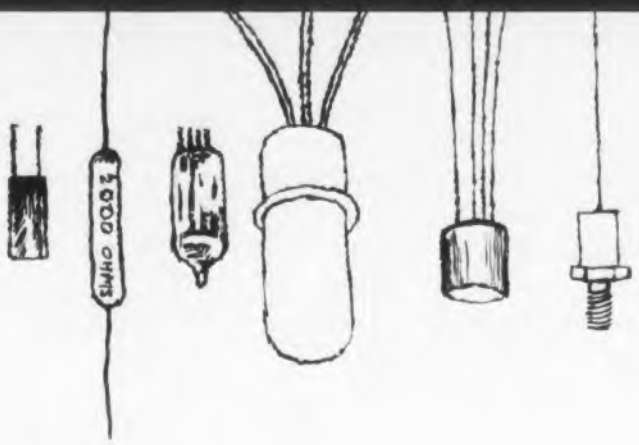


Designing Components for New Applications

PRESENTED here is a method for accomplishing the design and development of a given component to meet the requirements of a future electronic system. A specific example is given—the design and development of a miniature, environment-free, electrical connector for airborne equipment.

Preliminary Thinking

Once the requirements of a future electronic system are known, it should be determined whether existing components will meet the advanced system requirements. Where new components are needed, it is necessary to list the design and performance requirements necessary to make the component function properly in the advanced electronic system, and bring these requirements to the attention of component manufacturers.

Prototype Development

Two approaches may be pursued in order to obtain the prototype design and development of a given component based upon the performance requirements of the advanced electronic system. The usual method is to write a design specification and prepare outline drawings, which are then released to the component manufacturers for bid. An alternate approach is to induce direct development by a component manufacturer if there appears to be a wide application for a non-existing product. If a large market is anticipated, it would be financially beneficial and a credit to the manufacturer's reputation to design and develop a component to meet these requirements.

Example

In one case—because of the universal need for miniature electrical connectors—Douglas selected the latter approach and submitted a list of requirements to all known connector manufacturers in June, 1955. All of the connector manufacturers commented favorably on the re-

The prevailing philosophy prior to World War II was to design and build electronic systems from available components and then test them to determine their capabilities. Depending upon their performance, the systems were then applied to the installations for which they were suitable.

With the rapid advance in the state of the art during the past fifteen years, this former philosophy has, of necessity, yielded to that of designing and developing components to meet the requirements of future electronic systems.

The philosophy presented here is based on a paper presented by Ted. A. Thompson of Douglas Aircraft Co., Inc. at the 1957 National Conference on Aeronautical Electronics.

quirements and expressed a desire to develop a connector for the DC-8. Only one, however, was willing and in a position to undertake the development and tooling program on their own capital.

Coordinating closely with Douglas engineering, this one company completed the development of an acceptable prototype connector in August, 1955. By October of the same year they were tooled on a basic insert arrangement and by November were prepared to submit specimens for test.

Seeing the progress which had been made and being impressed by the Douglas emphasis on dual sources a second company submitted hand made prototype connectors for Douglas evaluation in November, 1955. Many detailed comments on their design were submitted by Douglas, but connectors modified accordingly have not yet been presented.

A third company, working completely independent of Douglas engineering, showed a prototype miniature connector in December, 1955, but stated that much development work remained and did not leave the sample for comment. Samples for the evaluation were not received until April, 1956. Detailed comments were immediately submitted by Douglas and connectors ordered for test. The connectors for test were not received, however, until September, 1956, and then still with reservations.

Tests

When prototype components, which have been designed to meet the performance requirements of the advanced electronic system, are received, testing is necessary to evaluate their operational capabilities and to determine their reliability under various environmental conditions. Tests are usually selected to simulate the worst conditions under which the component is expected to function in service. Tests may also be performed to discover how the component will operate under unrealistically severe circumstances in order to reveal its application limitations.

When test results establish the suitability of a given component for the advanced electronic system, its application to other future or presently existing systems should be considered. Since it was designed to meet future performance requirements, it may contribute favorably to the reliability of other systems.

Synchronization of a Computer

Gerald Smoliar Manager
Jacob Keilsohn Senior Engineer
Magnetic Computers Dept.
Remington Rand Univac
Division of Sperry Rand Corp.
Philadelphia, Pa.

Fig. 1. Ferractor magnetic cores shown in the packaging stage. Note small size of the cores.

IN ELECTRONIC computing systems, the central computer operates at high speed. The pulses in the central computer circulate essentially at uniform speed. In contrast, the speeds of auxiliary units such as input and output devices are slower and irregular. Their pulses occur at random in respect to the central computer speed.

The slower, irregular speeds of auxiliary units must be synchronized with the higher, uniform speed of the central computer. This especially is important in the case of input devices which transmit the information to the central computer where the problem will be solved.

A shift register is used for synchronization. A register holds information, in the form of numbers, before it is fed into the central computer. A shift register can hold information or keep it moving so the information is released to the central computer at the right time.

This paper describes how a new type of shift register was used to solve the synchronization problem in the Cambridge Computer, built by Remington Rand Univac for the Air Force Cambridge Research Center, Cambridge, Mass. The new register used Ferractor® magnetic amplifiers developed by Remington Rand Univac. The Cambridge Computer was the first to use the Ferractor amplifier and its related circuitry.

The Cambridge Computer

Because all normal amplifying functions in the Cambridge Computer are performed with Ferractor cores, the computer is considered a magnetic device. Germanium diodes are used for the logical operations of gating* and buffing†. Magnetic amplifiers perform the functions of pulse shaping and delay. Separate components aren't needed for these functions.

The Cambridge Computer is relatively restricted in input-output function, because it lacks the array of auxiliary equipment found in more diversified computing systems. Despite its specialization, the Cambridge Computer still has many external communication paths.

There are data links for real-time operation, an in-and-out paper-tape punch and reader, and a modified typewriter for input and output. Consideration of the typewriter only will involve all fundamental principles of the operation of the synchronizer.

Data is transferred from the typewriter through a shift register. The 10 characters of a computer word (sign digit and space between words not counted) are assembled in the register.

The digits coming from the typewriter occur at random in relation to the central computer speed. The order in which the digits are typed is reversed in the computer. The operator types the most significant digit first while the word is carried in the computer with the least significant digit first.

For example, in the number 357, the operator types the most significant digit 3 first. The computer carries the least significant digit 7 first. This is done so the result of a carry may be recorded after the carry. In this respect, the computer functions like a person adding numbers. When adding digits, a person begins at the right (the least significant) and works to the left (toward the most significant).

During computing, the sign of a word is stored separately. Even though the sign is part of the word-pulse sequence within the computer memory, it presents no special synchronizing problem.

The Magnetic Amplifier

The Ferractor amplifier consists of two windings on a toroid of square hysteresis loop magnetic material. The core is made from a metal

* A gate is a device whose output is energized when all inputs are energized.
† A buffer is a device whose output is energized when one or more inputs are energized.

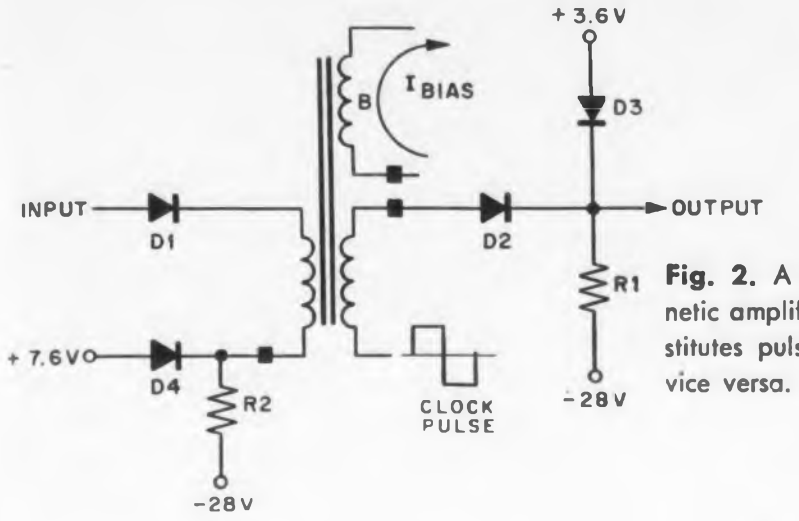
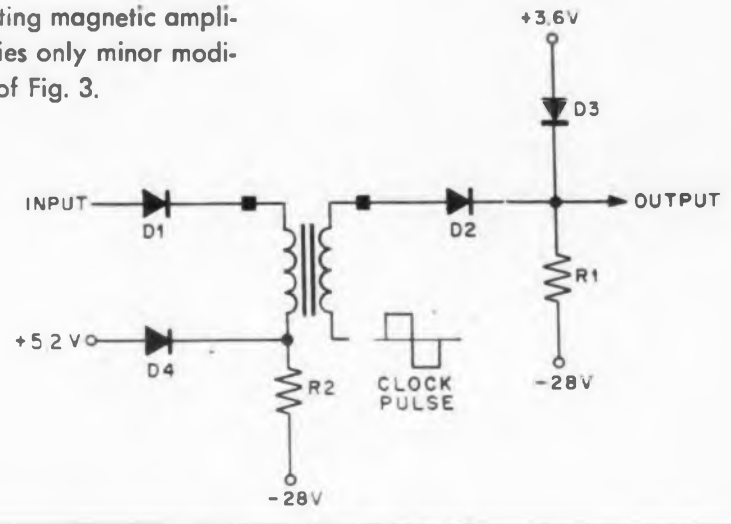


Fig. 2. A complementing magnetic amplifier. The amplifier substitutes pulses for no pulses and vice versa.

Fig. 3. A non-complementing magnetic amplifier. This amplifier embodies only minor modifications of the amplifier of Fig. 3.



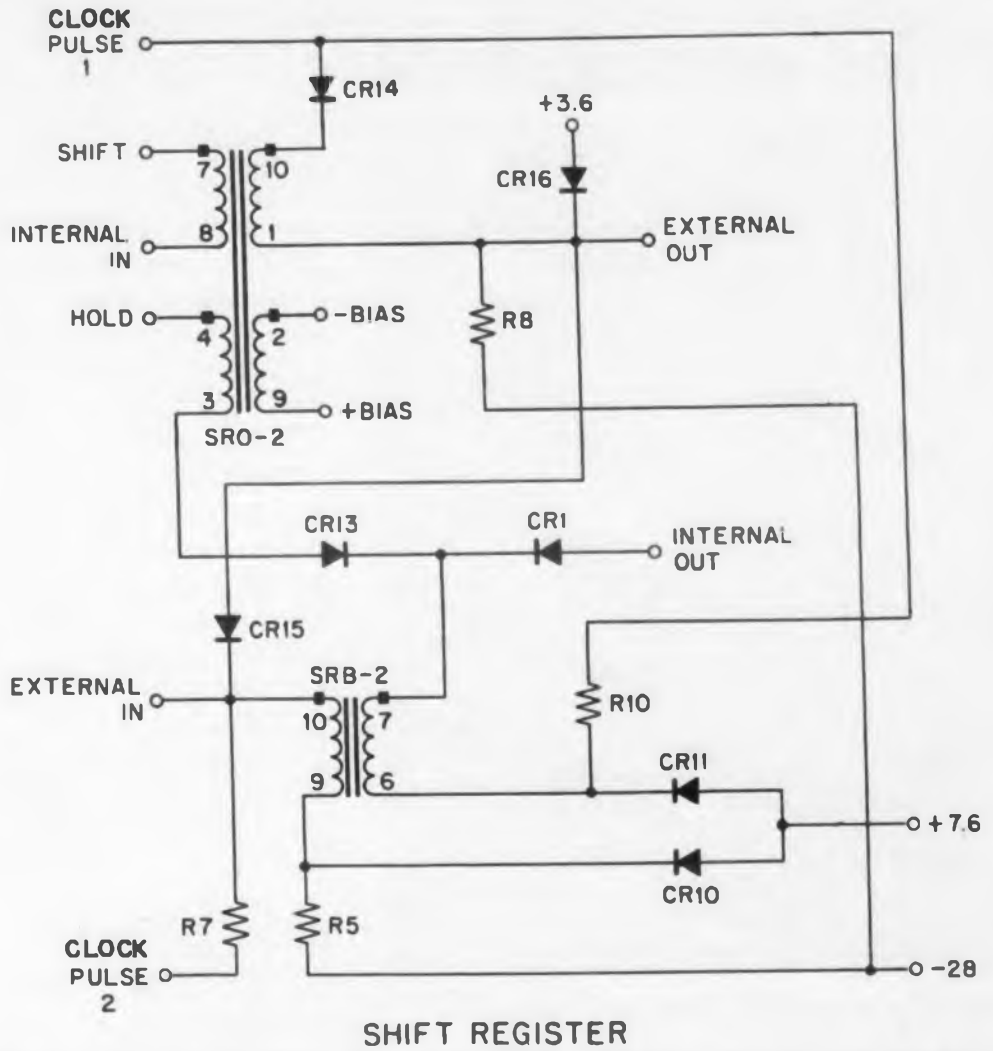


Fig. 4. A typical shift register. There is an additional input winding for each amplifier. In addition, there is a second core with two windings for each bit of information.

bobbin which is first wound with a metallic tape and then wound with wire. The finished amplifier is about one-tenth of an inch in diameter (See Fig. 1). The Ferractor cores have proven more reliable, require less power, last longer and are smaller than vacuum tubes.

A pulse applied to the amplifier input will bring the core from the normal flux state of $+B_r$ to $-B_r$ on the opposite point of the hysteresis loop. The core then presents a high impedance to a clock pulse which will return the core to $+B_r$ without producing appreciable output. If there is no input pulse, the core stays at $+B_r$ for the entire input period. The clock pulse then encounters a low impedance and produces an output pulse.

The device shown in Fig. 2 is an amplifier since the power required to change the polarity of the core is much less than the power which can be sent through the output winding. The core also reshapes and delays the pulses.

With minor modifications, this circuit is the one most frequently used in the Cambridge Computer. The circuit complements the information. It substitutes pulses for no pulses and vice versa.

The circuit is modified to make a true amplifier by adding a bias winding carrying direct current and phased opposite to the input winding, as shown in Fig. 3. In this type of amplifier, an input pulse brings the core from $-B_r$ to $+B_r$, so the clock pulse finds it in the low impedance state. The input pulse thus produces an output. When there is no input pulse, the bias current returns the core to $-B_r$. The succeeding clock pulse produces no output. This is a non-complementing amplifier type.

Recirculating registers may be made by cascading strings of these amplifiers and connecting the output of the string back to the input. However, a true shift register is preferred for the assembly and transfer of asynchronous information. This register is a component which can hold the information in essentially static form or circulate it, either at computer rate or one pulse at a time.

The shift register is more versatile than a static register which holds numbers until they are ready to be used, or a dynamic register where the numbers are circulated constantly.

Shift Register

The shift register is based on the non-complementing amplifier. It has two input circuit differences and one difference in operating timing. Fig. 4 shows the shift register circuitry.

The shift register operates with the same timing as the rest of the computer. But the action is in three steps instead of two. These steps are: *1*—input to the lower core, *2*—interrogate the lower core, setting or not setting the upper core, and 3—clock pulse to the upper core.

Information enters the shift register through the lower Ferractor core which is called the blocking core. A pulse applied at the external input makes the blocking core a low impedance. One half cycle later an interrogating pulse in the hold winding tries to send current through both cores. If the blocking core has been brought to low impedance, the hold pulse brings the amplifying or output core to $+B_r$. On the third half cycle, the clock pulse produces an output.

When the shift register is used for static information storage, a series of hold pulses causes the information to circulate back and forth between the output and blocking cores. The output of the upper core is connected through a diode to the input of the lower core in Fig. 4. If no shift or hold pulses are applied for one cycle, the register is cleared. This results since the bias resets the output core and the negative excursion of the second clock pulse resets the blocking core.

Shifting is done by reading into an output core from the preceding blocking core, rather than from the one shown directly below the output core in Fig. 4. In this way, a series of shift pulses

will move the information through the register at computer rate.

Intercommunication of shift register stages is accomplished by joining the *INT OUT* to the *INT IN* terminal of the stage immediately to the right. In these circumstances, information would move from left to right.

Either direction could have been chosen. If both were needed, one more winding on each output core and one more diode at the *CR13-CR1* junction would suffice. In operation, both left and right shifts are needed. Since plenty of time is available for these operations the left shift is done by moving the information 10 places to the right in the 11-bit loop.

Information can enter the computer in parallel through all external input terminals, or serially, through any terminal with a series of shifts. It can be read out in either form as well.

The operator register, one of the shift registers, is used for most input-output operations. It consists of four loops of 11 bits each, with each loop containing one of the four bits of a character.

All entries in the register are made at the most significant digit position. Information from input devices is presented to the computer in the form of five bits (the fifth being a parity bit for checking purposes) and a sprocket.

The sprocket must be shaped to a computer-sized pulse and properly timed, because it appears at an arbitrary time and must trigger logical operations in the computer. The sprocket pulse is shaped through an R-C network. It is longer than three computer pulse times, but shorter than two word times or 24 computer pulse times.

This pulse then sets flip-flop *A*, Fig. 5, and shapes the sprocket to computer pulse-size. To time the pulse is the function of flip-flop *B*, Fig. 5. At the proper time, the state of flip-flop *A* is sampled. The flip-flop may be set, partly set, or reset. The result of this sampling is placed in flip-flop *B*.

If flip-flop *A* is fully set, flip-flop *B* will be fully set. If flip-flop *A* is being set, a partial set will be passed to flip-flop *B*. The possibility of a partial set in flip-flop *A* makes flip-flop *B* necessary. The partial set is allowed to recirculate in flip-flop *B* for time enough to cause the partial set to either disappear or build up to full size. The result then is sampled. Either a full-sized sprocket or no pulse is obtained.

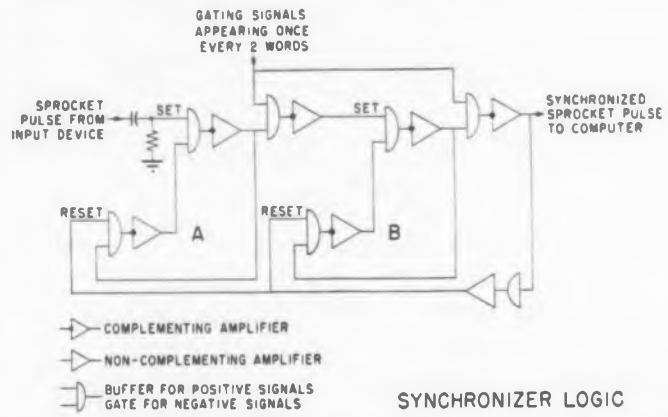


Fig. 5. Synchronizer logic. Two flip-flops (A and B) are used in a set, partial set, or reset condition.

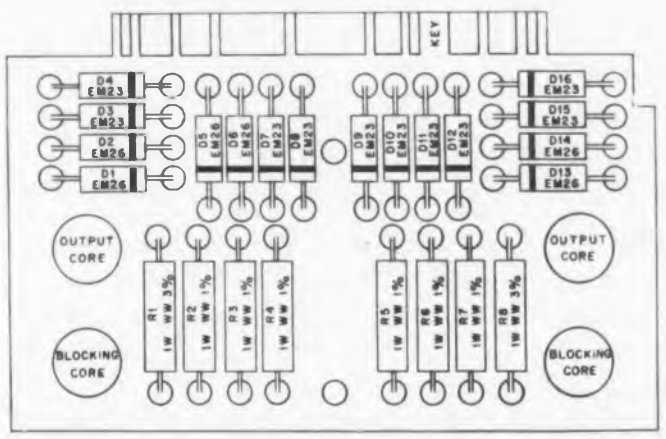


Fig. 6. A shift register package on a single card.

If no pulse is received, a second sampling of flip-flop *A* is made. This always results in a full set of flip-flop *B*, and a full-sized sprocket at the end of the waiting time. Generation of the sprocket clears flip-flop *A* and *B*, allows the four information bits of the input data to be placed in the most significant digit position of the shelf register, and starts the register shifting to the right 10 places. Since the register is 11 digits long, the information now is in the least significant digit position. This arrangement ensures that the computer will operate on the least significant digit first. The computer now is ready to accept another input character.

This operation can be stopped either by a special fill character or by a counter which keeps track of the number of characters in a word. The information, now in computer sequence, goes out of the register at computer rate by means of a full word of shift pulses. The transfer operation is complete.

Construction

Like most of the computer components, the shift registers are made of standard printed-wiring cards. These cards are interconnected by using backboard wiring of the machine. Fig. 6 shows the shift register on a single card which holds four cores and associated circuitry—two bits of shift register storage. The card circuits as they appear in the computer are shown in the photo on the facing page.

Testing

The shift register's versatility makes testing it in the computer a simple operation. In normal sequence of testing, typewriter operation is checked out and then used to generate the characters to fill the shift register. Operation of the register is observed when it is holding information in static form and when it is shifting continuously. A check is made to determine that the characters are correct and that they can be cleared out by dropping the hold and shift lines.

Conclusions

Maintenance experience on these components has been very satisfactory to date. The Ferractor cores perform normal amplifying functions, prove more reliable, require less power, last longer and are smaller than vacuum tubes. This usage provides another example of the excellent reliability of magnetic amplifiers using Ferractor cores.

The new shift register, using Ferractor amplifiers, is able to effectively synchronize the relatively high speed of the central computer with the input-output devices.

The work reported here was sponsored by the Air Force Cambridge Research Center under contract AF30 (602)-1055.

* *Quotation from "Designing Electronic Equipment for Maintainability"; Machine Design, July 12, 1956.*

Precision

THE INFINITE resolution properties of a precision carbon film resistive element are used in this pressure transducer to permit the direct coupling of pressure capsule to potentiometer wiper. The elimination of intermediate linkages minimizes sensitivity to vibration, shock, and temperature change, and insures maximum sensitivity, repeatability, and long life.

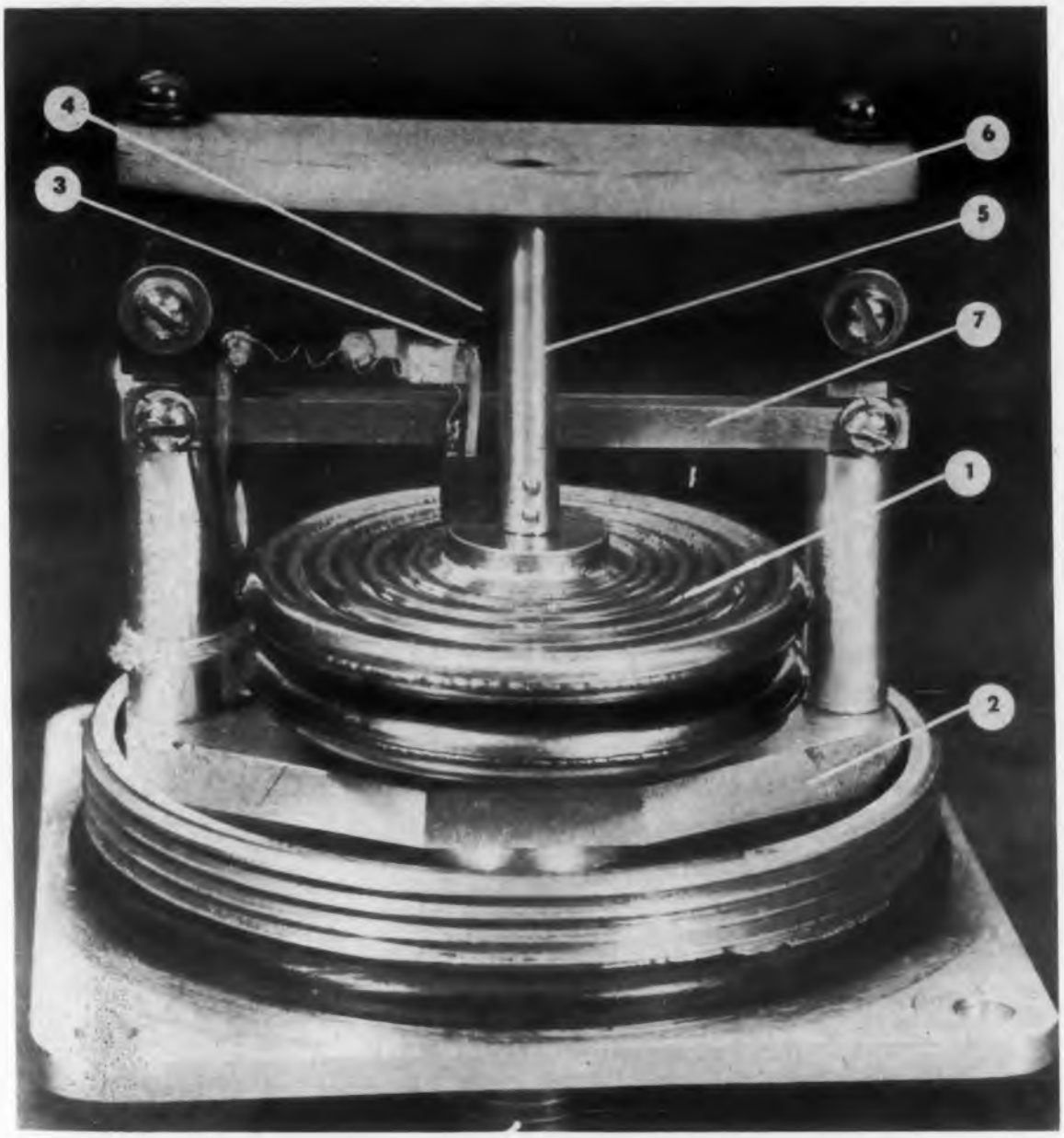
Excellent frequency response is obtained by the minimization of inertial components and intermediate linkages in the Series 6000 unit manufactured by the Computer Instruments Corp., Hempstead, N.Y. Linearity is insured by the use of a carbon film resistive element developed by the company, and by the elimination of linkages. Accuracy of output is thus determined by the linearity of the pressure capsule. A special manufacturing technique trims the resistance element to compensate for this error. A mechanical milling process applied to the resistive element brings the overall linearity to within 0.2 per cent of full scale. This adjustment in the pressure-voltage relationship also fixes the scale factor of the unit, eliminating individual calibration and temperature correction.

While shown with only one potentiometer element, the unit is also available with dual or multiple elements, with separate functional or linear outputs. A Bourdon Tube pressure unit is used for pressures in excess of 100 psi, so that the units have ranges from 0-5 psi to 0-5000 psi. Direct application to control functions is permitted by a maximum full-scale output of 60 v. The transducer has a life in excess of 500,000 cycles and will operate over a temperature range of −55 C to +85 C. Overall length is 3 in.

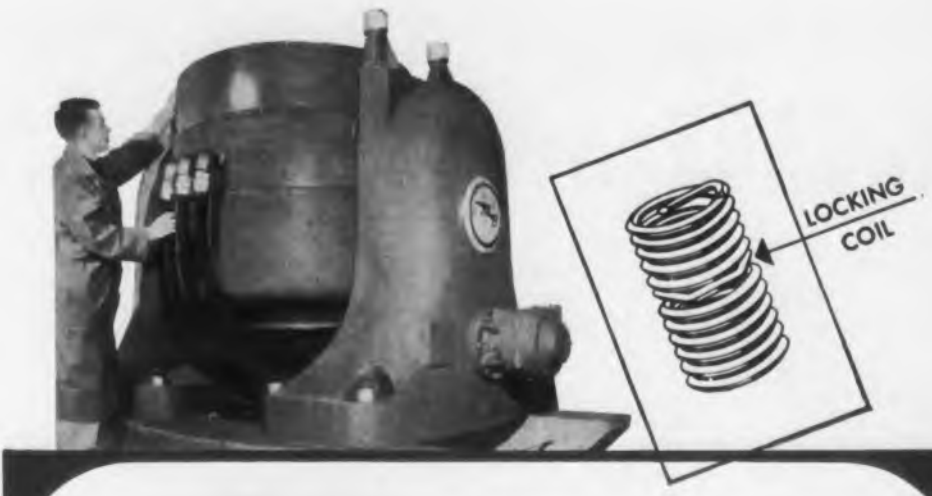
For more information about this product turn to Reader-Service Card and circle **57.**

Pressure Transducer

uses carbon film element



Pressure transducer with cover removed. The pressure capsule (1) and resistance element (4) are both mounted on a common yoke (2). A precious metal wiper (3) welded to the free end of the capsule rides the surface of the resistance element, which is fastened to the yoke arms. Thermal expansion of parts has been kept down to 0.001 per cent per degree C. A guide rod (5) rides freely in a Teflon guide (6) and becomes effective only under severe shock and vibration. A stop bar (7) prevents overload damage.



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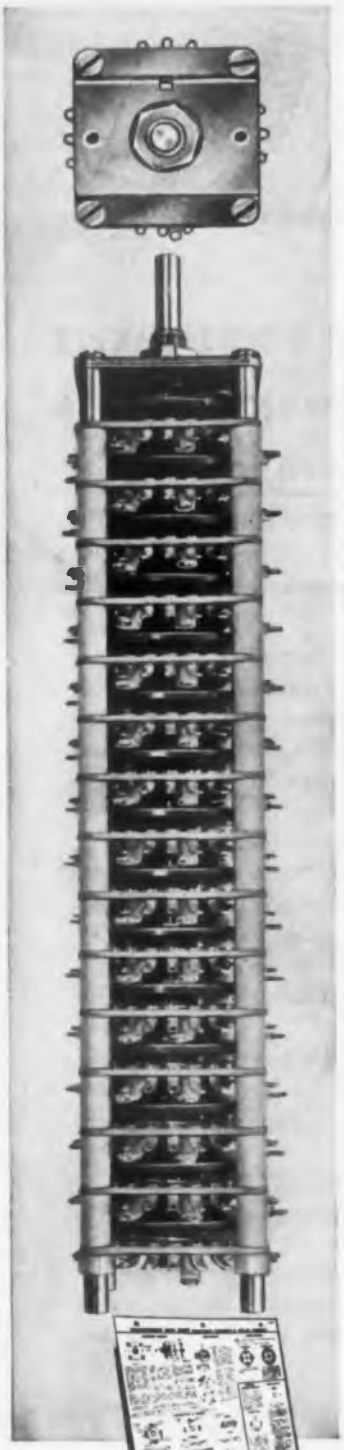
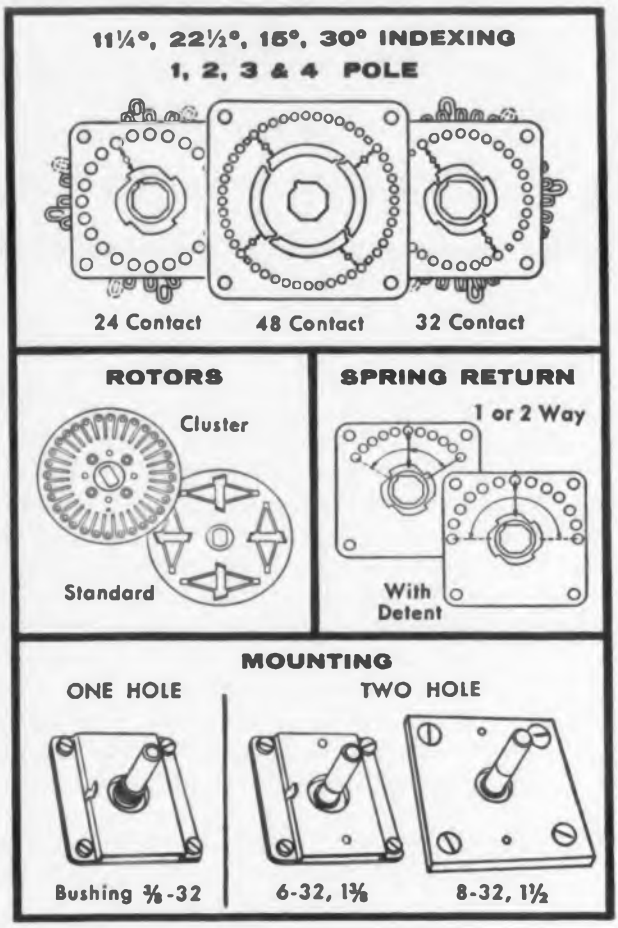


SHALLCROSS *Miniature* ROTARY SELECTOR SWITCHES give the long-lasting dependability of multi-leaf wiper, button-contact design . . . *and* the added advantages of compactness and new versatility. The sketches below detail some of the many unusual features of this new switch series . . .



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Magnetic commutation offers very high reliability, low cost, high speed and high accuracy. New basic techniques are here presented which embody the use of magnetic null detectors in a digital feedback loop so that the function of commutation and conversion from analog to digital form is combined. The absence of linear amplification minimizes drift.

Low Level Magnetic Commutators

D. C. Kalbfell
Kalbfell Electronix
San Diego, Calif.

MECHANICAL commutators and diode switching matrices are widely used today for sampling the outputs of a number of transducers, but each has some disadvantages. The mechanical commutator is short lived and unreliable at the higher speeds, while the diode switching matrix requires a good dc preamplifier for each transducer. The magnetic commutator differs fundamentally from these in that the signal circuit is not interrupted directly, and linear amplification is not required. An additional advantage is that the system can be constructed almost entirely from solid state components.

Fig. 1 shows an elementary form of magnetic commutator. Each magnetic amplifier has a dc signal input winding, a carrier winding, and output terminals. The gates allow carrier current to flow into only one magnetic amplifier at a time, effectively interrupting the other circuits. The outputs are mixed in some suitable circuit. The gates are opened sequentially upon command from a ring counter.

Fig. 2 illustrates a common type of magnetic amplifier which might be used in such a commutation system. It is constructed from two toroidal cores. The carrier windings *C1* and *C2* and the bias windings *B1* and *B2* are applied to the two cores separately. The cores are stacked, and feedback and input windings applied. If there were no bias current, the first cycle of carrier current would saturate the cores, and thereafter windings *C1* and *C2* would offer little impedance to the carrier.

However, bias current flowing during the half cycle when the carrier current is blocked by the diodes will reset the magnetic flux to about point *P* on the *B-H* curve of Fig. 3. On the next conducting cycle, carrier current will flow for ap-

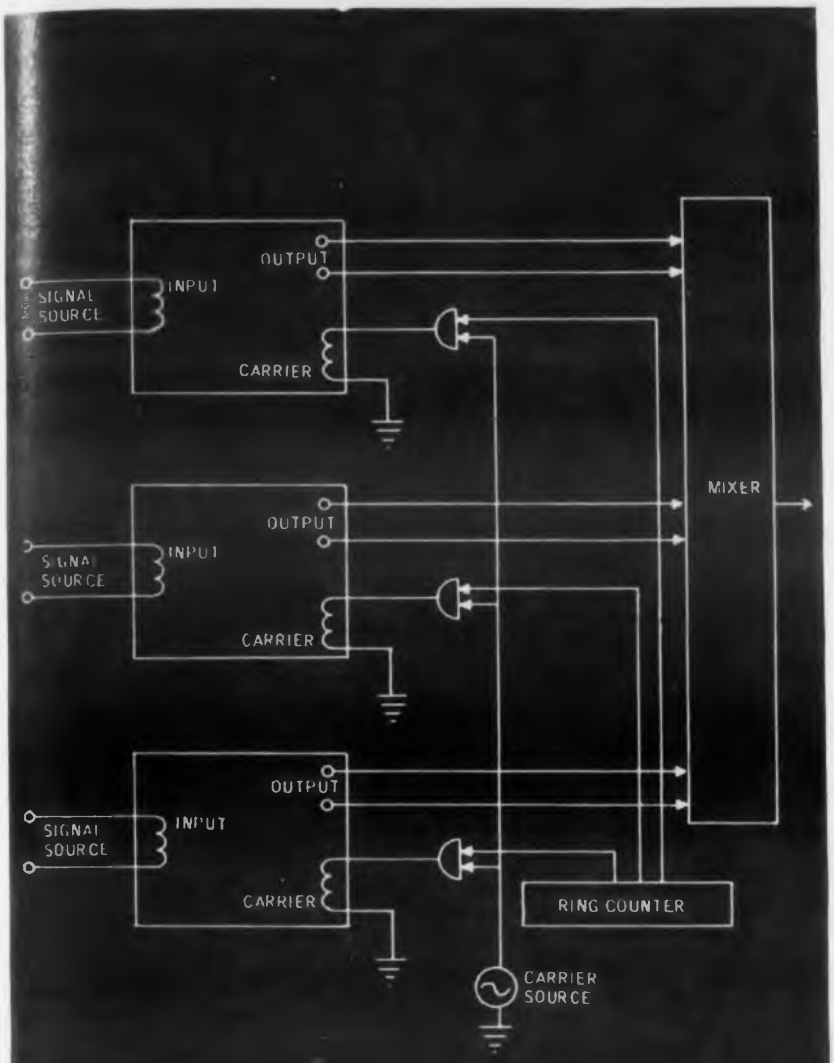

Fig. 1. An elementary form of magnetic commutator. Each amplifier has a signal input winding, a carrier winding and output terminals. Gates allow carrier current into only one magnetic amplifier at a time.

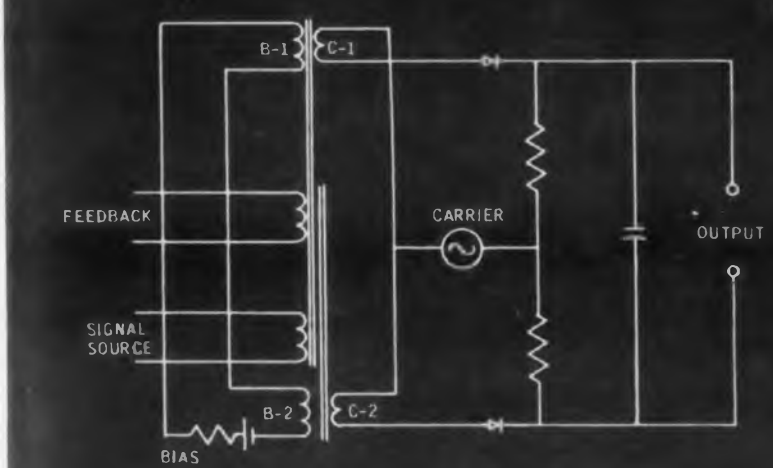

Fig. 2. An analog type magnetic amplifier which can be used in commutation systems. The signal winding and feedback windings act oppositely with respect to the carrier flux, making the average currents in the load resistors differ in accordance with the net dc input signal.

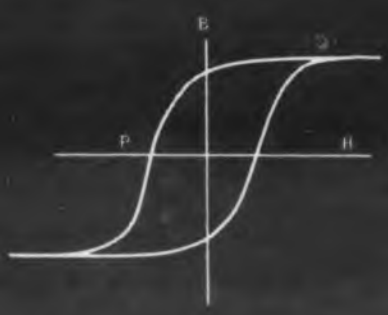

Fig. 3. When the carrier in Fig. 2 is blocked by the diodes, the bias resets the flux to about point *P* on the *B-H* curve.

from

Magnet Charger

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A medium power Magnet Charger capable of developing peak magnetizing force of 40,000 ampere-turns. Designed for production, research and instrument repair work. The Model 1500 easily saturates the new high coercive materials such as Cobalt Platinum and Barium Ferrite. Portable table model operates on 115-volt, 60-cycle line; size 11" wide x 15" high x 20" deep; weight 125 lbs. Price $945.

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proximately 90 deg. The exact amount of current flow depends upon the total flux resetting the cores, including the flux due to signal source and feedback windings. The two latter windings act oppositely on the two cores with respect to the carrier flux. Hence, the average currents flowing through the two load resistors will differ in accordance with the net dc input signal to the magnetic amplifier. A capacitor across the output terminals smooths the output voltage. This magnetic amplifier can be commutated by simply interrupting the carrier.

A more accurate system, in which the output tends to be independent of the linearity of the amplifiers, is illustrated in Fig. 4. Here, the magnetic amplifiers function simply as null detectors. In the case of an analog system, the converter might be eliminated. The output is available as the feedback current, or as the voltage drop across a resistor in series with the feedback loop.

The null detecting amplifier must provide a "yes" or "no" answer to the question of whether

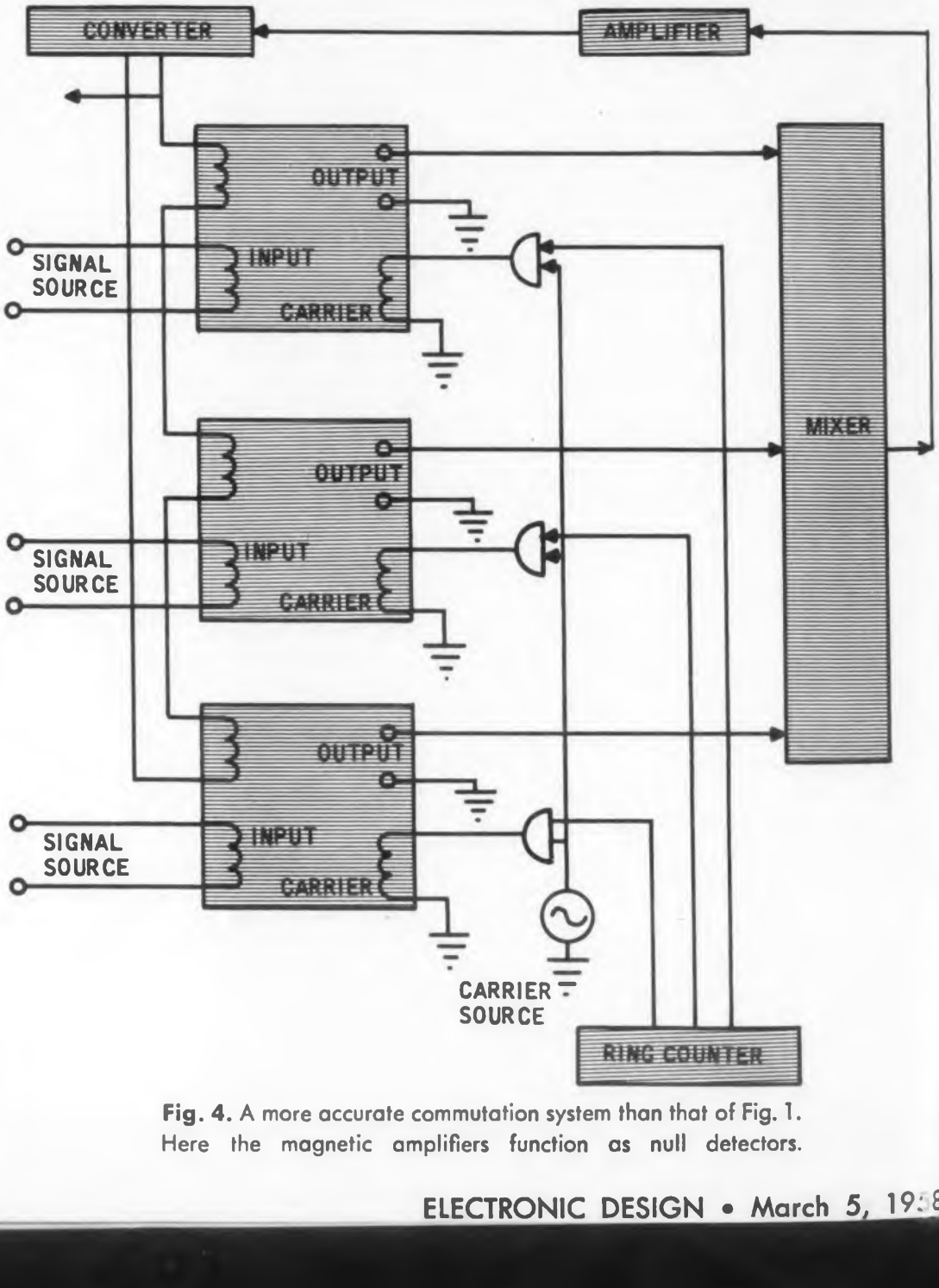

Fig. 4. A more accurate commutation system than that of Fig. 1. Here the magnetic amplifiers function as null detectors.

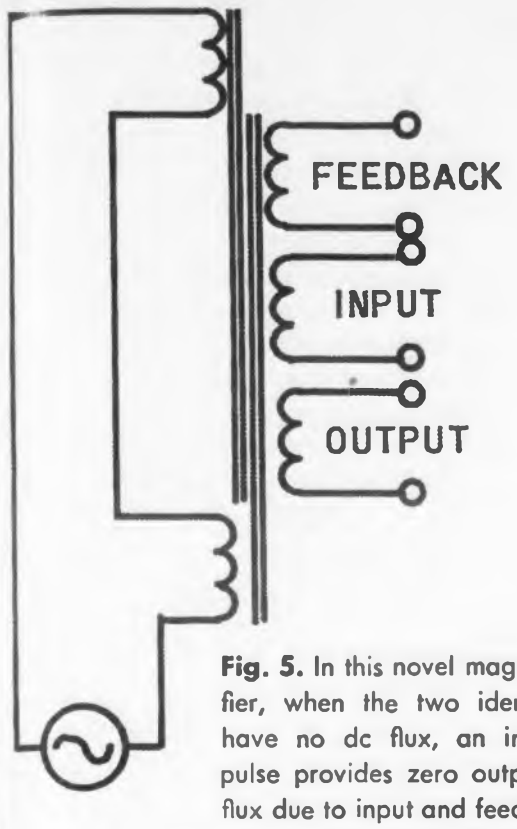

Fig. 5. In this novel magnetic amplifier, when the two identical cores have no dc flux, an interrogation pulse provides zero output. Any dc flux due to input and feedback windings causes an unbalance which provides an output pulse with a polarity dependent on the relative magnitudes of the input and feedback flux.

the feedback current is too great. It may hence be operated as a digital device, considering each cycle of the carrier current to be an interrogation pulse. The corresponding output pulse will be positive or negative depending on the magnitude of the feedback current.

The converter becomes a digital-analog device whose output constitutes the feedback current. The converter register is set up iteratively, by first trying 1/2, then 1/4, 1/8, and so on. After each trial, the appropriate flip flop is reset or not as determined by the polarity of output pulse. After ten cycles, the feedback current would be within 0.1 per cent of the correct value, and the shift register would move on to the next channel. The digital output is available serially at the converter input, or in parallel from the converter register.

A novel magnetic amplifier, particularly suited to digital operation is shown in Fig. 5. If the two cores are identical and have no dc flux, then an interrogation pulse should provide zero output. Any dc flux due to input and feedback windings will cause an unbalance and an output pulse will be produced whose sign depends upon the relative magnitudes of the input and feedback fluxes.

From a paper presented at the Western Electronic Show and Convention, San Francisco, Calif., August 1957.

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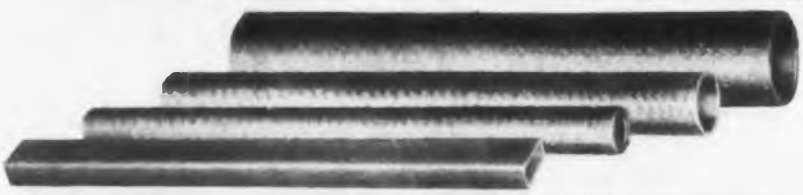
SPECIFICATIONS COMPARISON

	Lamtex TUFF-TUBE	Typical Glass-Melamine
INSULATION RESISTANCE megohms	100,000	75
DIELECTRIC STRENGTH volts per mil, short time	500	225
WATER ABSORPTION %, 24 hr. immersion	.20	3.9
AXIAL COMPRESSIVE STRENGTH psi	20,000	13,000



Electronic design engineers are using TUFF-TUBE for waveguides, coil forms, spacers, component jackets, antenna housings, brush holders, tuning coils, motor insulation, commutator and printed circuit forms, and many other applications that require any or all of these characteristics:

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DIELECTRIC STRENGTH
HUMIDITY-PROOF
HIGH TEMPERATURES
LIGHT WEIGHT
HIGH STRENGTH
THIN WALLS, FROM .008"
SMALL DIAMETERS, FROM .062"
DIMENSIONAL STABILITY

AVAILABLE IN ALMOST ANY CROSS-SECTION SHAPE

Write for complete info — design features, tech data, application notes.

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CIRCLE 63 ON READER-SERVICE CARD

Mechanical sorter in operation. Cores are fed into the tube at the top and delivered to the three cups in front—the acceptable cores in the right cup, the intermediate cores in center cup, and reject cores in the left cup.

Automatic Classifier Speeds Selection of Magnetic Memory Cores

AUTOMATIC checking of "squareness ratio" and switching time of magnetic memory cores can be performed with the instrument shown. Quality decisions are made by an electronic circuit which evaluates both the switching rate and total flux change produced by a switching current of controlled rise time and duration. Unique electronic circuitry is employed for producing the controlled switching pulse and evaluating the resultant voltage generated in a single-turn secondary winding. Mechanical selector gates are automatically energized in accordance with pre-set quality limits to segregate the cores into one of five grades. The instrument is manufactured by Rixon Electronics, Inc., 2414 Reedie Drive, Silver Springs, Md.

Operation

Core handling and sorting is automatically accomplished by a mechanical system with a single input chute and three to five output chutes. This unit automatically places the ungraded core in a sequential carrier, passes the core through the electronic evaluation system where a mechanical stop is positioned to represent classification, and carries the core to the output chute appropriate for its class. It handles approximately 1000 cores an hour.

Electronic Circuitry

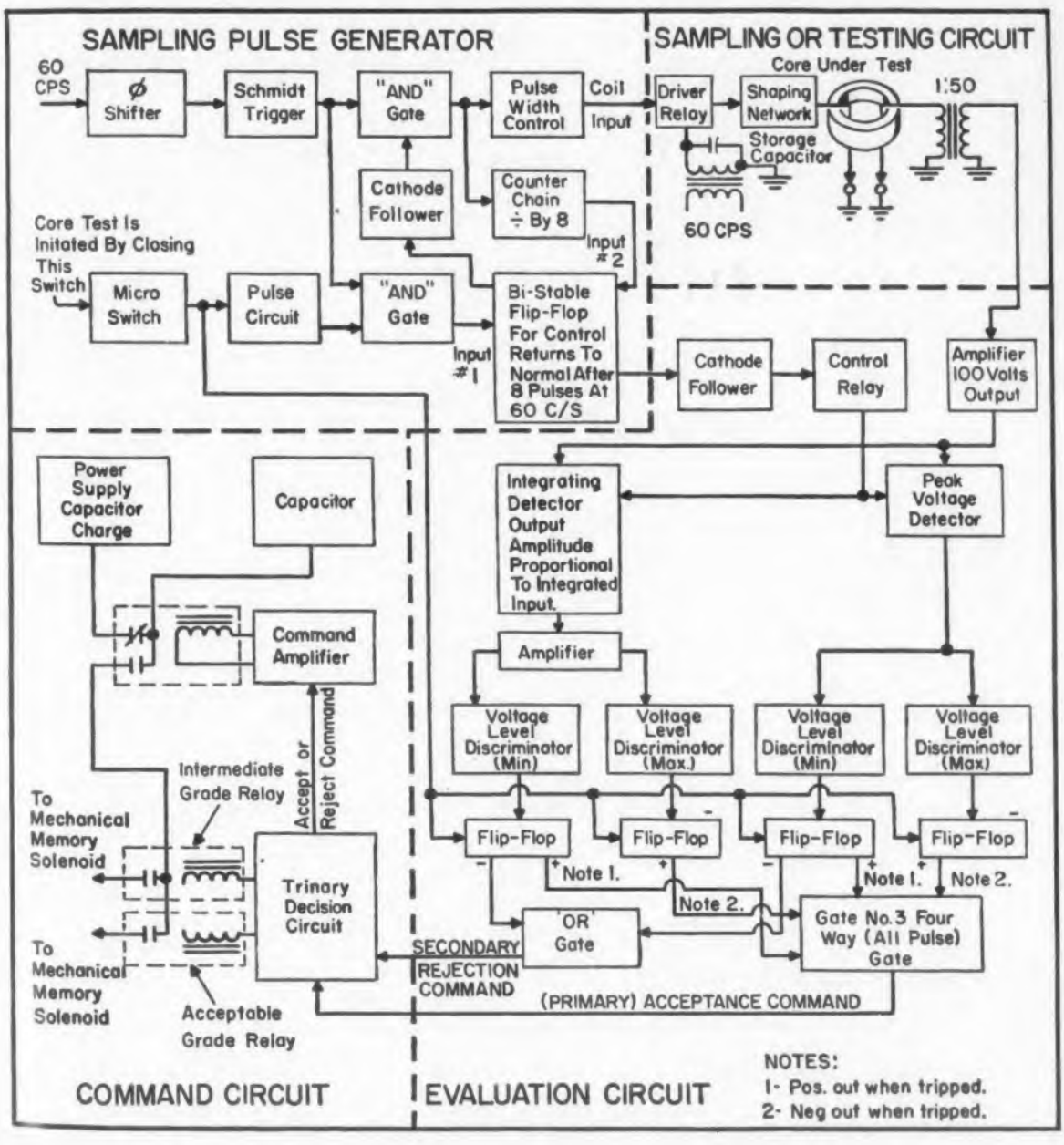
The electronic circuitry has four major divisions—sampling pulse generator, core sampling circuit, evaluation circuit, and command circuits. Evaluation of the core consists of measuring the

peak voltage and total energy induced in a circuit linked by the resultant core flux. The sampling circuit is designed to balance out any voltage induced directly by the driving circuit and develop voltages proportional only to the rate of change of flux in the core under test.

Eight successive and identical driving pulses are applied to the core under test by means of the Sampling Pulse Generator. Evaluation as performed by the Evaluation Circuit, is based on two measurements—the peak amplitude of the voltage pulse to determine the maximum rate of change to flux, and the time-voltage integral to determine the total flux change.

The Command Circuit accepts the quality information from the evaluation circuit and delivers current pulses to the appropriate relay within the mechanical unit to deliver the core to the proper output chute.

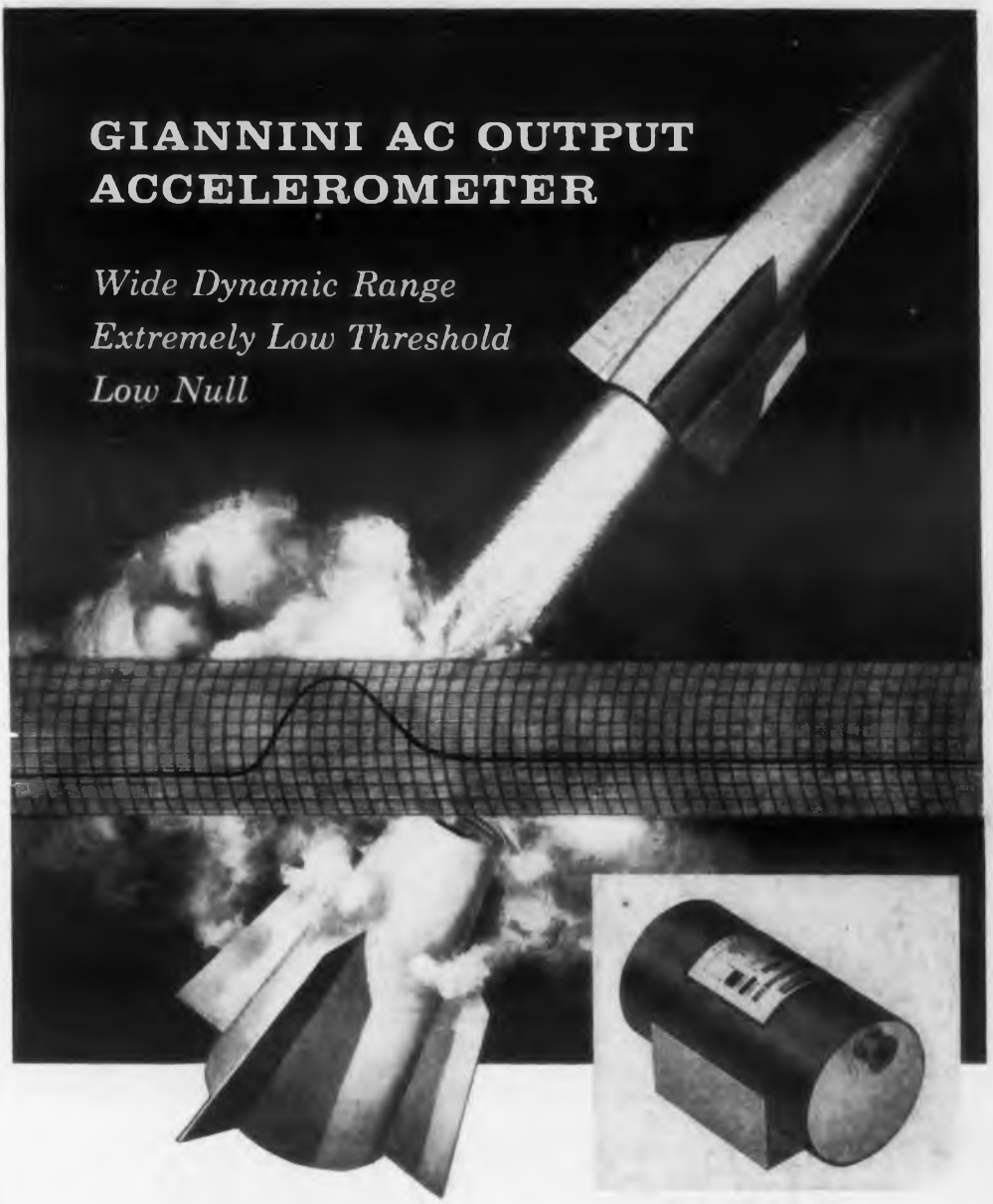
For additional information on this product, turn to the Reader-Service Card and circle **64.**



How the various circuits are inter-related in the Automatic Memory Core Classifier.

GIANNINI AC OUTPUT ACCELEROMETER

Wide Dynamic Range
Extremely Low Threshold
Low Null



ACCURATE, CONSISTENTLY RELIABLE AC output, proportional to linear acceleration, is provided by this new Giannini accelerometer. Available in ranges from ±1 g to ±20 g, the instrument has a full scale output of 6 volts which may be fed directly into a relatively low impedance with little or no phase shift.

NULL VOLTAGE IS 0.015 VOLTS, of which at least 90% is harmonic, assuring a wide dynamic range for the instrument. With a basic threshold sensitivity as low as 0.0001 g/g, input accelerations on the order of 0.0017 g's will provide a 10 millivolt change in output.

NO COULOMB FRICTION IS EXHIBITED in this design, bearings are eliminated by suspending the mass between two disc springs. Acceleration inputs move the magnetically damped mass, causing a proportionate change in the output voltage of a differential transformer. Cross-talk effect is minimum (0.003 g/g at 10 g cross acceleration on a 1g instrument); repeatability and hysteresis are below thresholds of measuring equipment.

IDEAL SECOND ORDER SYSTEM RESPONSE is achieved in the Model 24614 by magnetic eddy-current damping. The hermetically sealed instrument is oil-filled for stability of output under vibration. Specially designed and constructed for use in critical airborne control, stabilization, and flight test applications, the instrument is readily adapted to telemetering.

Giannini measures & controls:

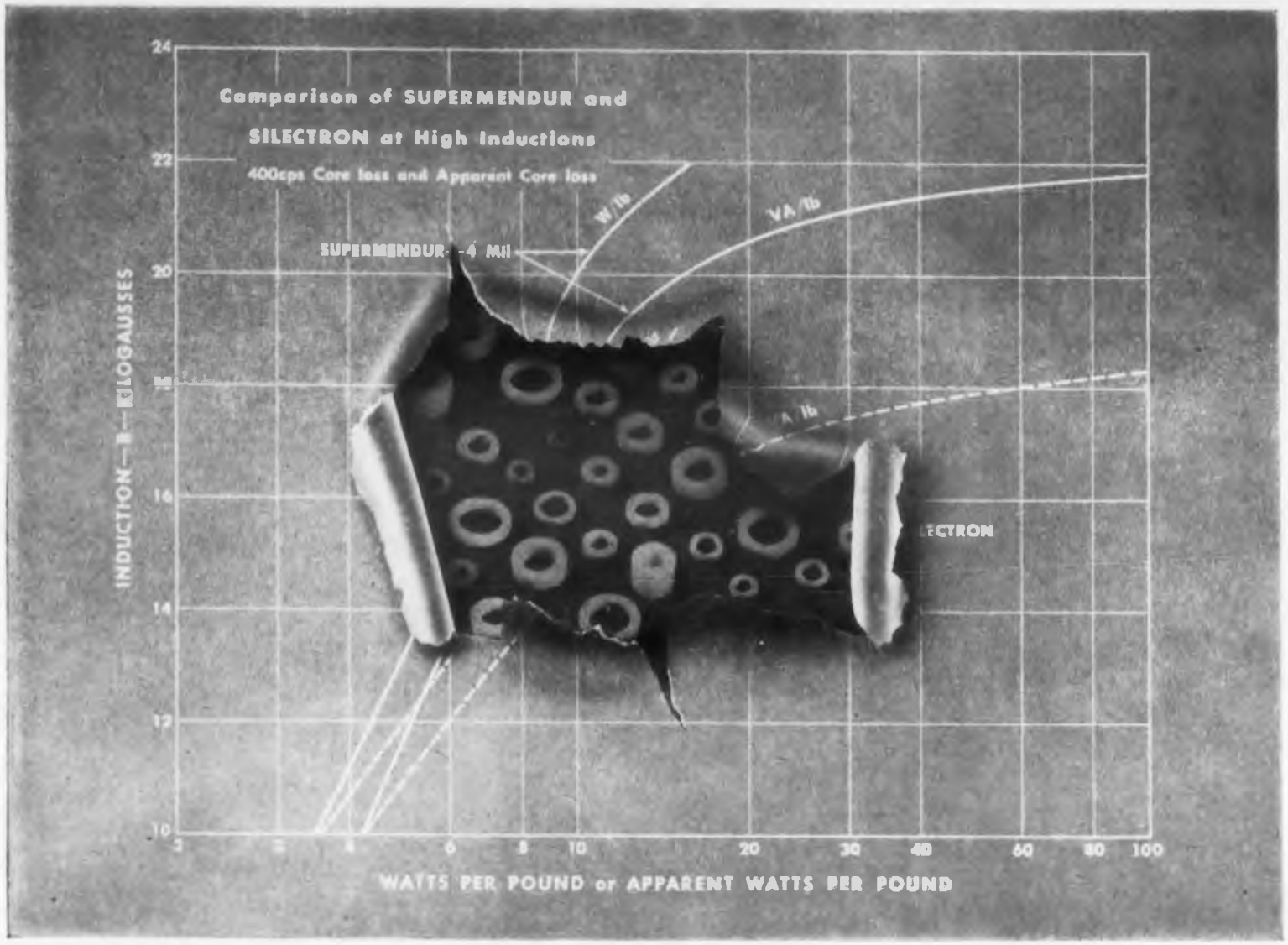
ω	β	θ	ψ	τ	v	ϕ
δ	Ω_x	a_x	h	P	ΔP	T
T_S	P_S	Qc	M	T_0	P_T	TAS

PRECISION INSTRUMENTS AND CONTROLS

Giannini

G. M. GIANNINI & CO., INC., 918 EAST GREEN STREET, PASADENA, CALIF.

CIRCLE 65 ON READER-SERVICE CARD



SUPERMENDUR TAPE WOUND CORES
. . . A Real Breakthrough in Miniaturization

The successful development of tape wound cores of Supermendur represents a giant step in the field of circuit miniaturization and simplification. The unique characteristics of this new rectangular-loop core material in the range of induction from 16 to 22 kilogausses permit significant weight and size reduction of toroidal transformers and magnetic amplifiers.

Supermendur, an oriented cobalt-iron-vanadium alloy, combines the high saturation flux density of the cobalt-iron alloys with the desired hysteresis loop rectangularity of the oriented 50% nickel-irons.

Coercive forces substantially lower than those of previously available cobalt-iron alloys are obtained. The lower core losses and excitation properties of Supermendur show a decided improvement in high density characteristics compared with oriented silicon steel, as illustrated by the curves partially shown above. ***Complete curves are available in a new Supermendur Bulletin TC-113, available on request.***

Specific advantages of Supermendur cores in toroidal transformers are: high operating induction, low core loss, low exciting current and high permeability at high induction. In magnetic amplifiers or saturable reactors, they include: rectangular hysteresis loop, high saturation induction and moderate excitation at high induction. Advantages in all uses are: thin tape, small size and low weight.

Supermendur is an ideal material for high temperature core components, because of its high Curie temperature.

● Supermendur is manufactured by Arnold under license arrangement with the Western Electric Company. We'll be glad to send you additional information or furnish you engineering assistance on any of your tape core applications if you'll just drop us a line.

WSW 7026

Visit us at the
IRE SHOW
NEW YORK
March 24 through 27
BOOTH 2201-2205

THE ARNOLD ENGINEERING COMPANY

Main Office & Plant: Marengo, Illinois
Repath Pacific Division Plant: 641 East 61st Street, Los Angeles, Calif.
District Sales Offices:
Boston: 49 Waltham St., Lexington Los Angeles: 3450 Wilshire Blvd.
New York: 350 Fifth Ave. Washington, D.C.: 1001-15th St., N.W.

CIRCLE 66 ON READER-SERVICE CARD

Shield Insert Keeps Tubes Cool

FULL CONTACT between tube and shield, and therefore better heat dissipation, is made possible by the triangular configuration of this insert. The insert is made of black cadmium-plated beryllium copper, measuring 0.0015 in. thick. Besides providing heat-dissipating qualities, the insert's succession of oppositely oriented triangles acts as a cushion for tubes under environmental stress.

The Full-Contact inserts, made by Atlas E-E Corp. of Woburn, Mass. represents the end result of a train of thought originating at the Navy Electronics Laboratory. In October, 1956 the NEL issued a supplement to their Reliability Design handbook describing a corrugated insert which had been designed at the laboratory for use in TS Shields. This liner, although of a square-wave configuration contacting only about one-half of the tube surface, served to reduce bulb temperatures by 50 C or more. Reports were received of spectacular results in prolonging tube life through its use. The present insert, by increasing the contact area to between 95 and 98 per cent, provides even better results.

The insert however lowers only one of the three thermal barriers existing in a tube and shield assembly. The remaining two barriers exist between shield and shield base, and between shield base and chassis. Work had also been done in these areas by the Navy, and re-

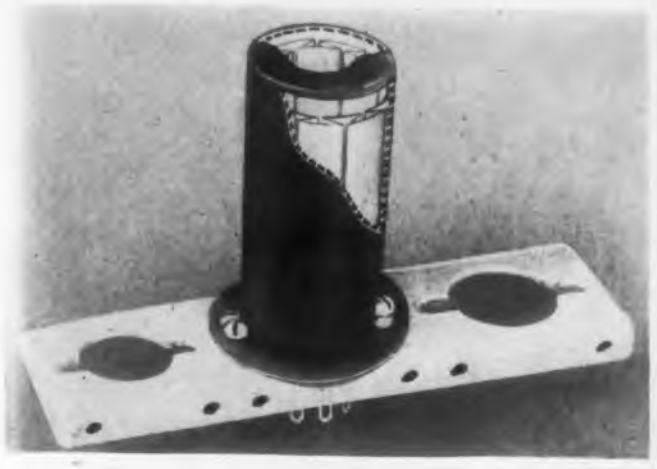


Fig. 1. The one piece shield assembly, showing the Full-Contact insert in place. The surfaces of the insert plus the one-piece construction of the shield lower the usual barriers to heat conduction.

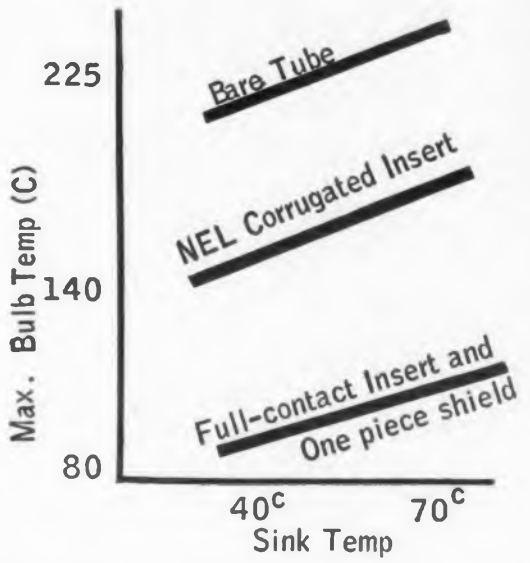


Fig. 2. Bottom curve approximates the cooling performance of the insert in a one-piece shield, using a type 5687 tube.

cently Atlas E-E Corp. has developed the one-piece assembly as shown in Fig. 1. The comparative performance of the different types of assemblies is shown in the graph, Fig. 2. As compared to a bare tube (type 5687), the NEL corrugated insert provides a substantial improvement. The one-piece shield and base assembly, along with the Full-Contact insert, afford even cooler operation, in fact in many cases it is below the curve as shown.

The Full-Contact inserts are available in widths to 1-1/2 in. either in strips or cut to fit a particular shield. The one-piece shield assembly is furnished with double-head screws which, when installed in place of the usual tube base screws, allow the unit to be twist-locked in place.

For more information on the insert and one-piece shield, turn to the Reader-Service Card and circle 69, or stop by at Booth 4235 at the IRE Show.

Do It Yourself

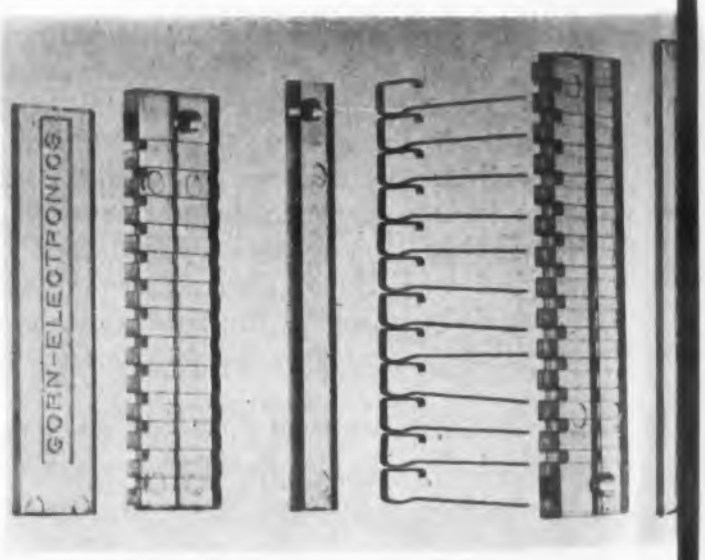
Printed Circuit Assemblies

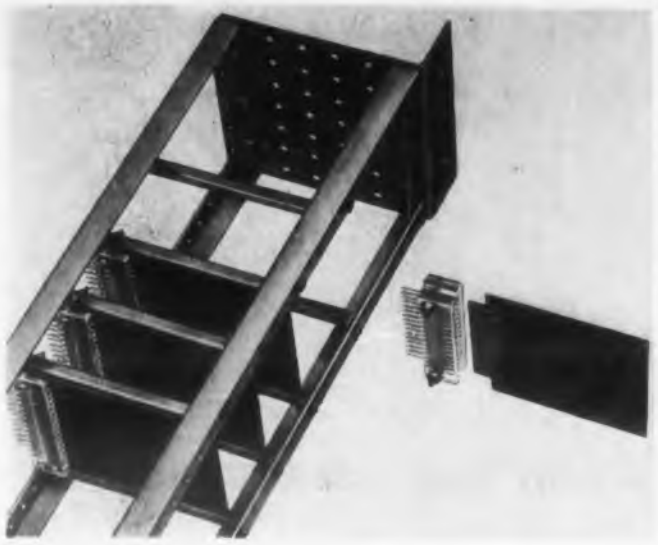
PRINTED circuit board assemblies can now be put together quickly with off-the-shelf stock parts. The parts include a channel framework, strips of appropriately cut plastic for the bodies of receptacles, contacts, and printed circuit board guide rails.

Gorn Electric Co., Inc., of Stamford, Conn., conceived the idea of these structural parts and connectors to eliminate the delays in ordering special connectors and hardware.

The receptacles, made of nylon, polystyrene, or diallyl phthalate are quickly and easily assembled. The contacts are slipped into notches on the edge of plastic strips, and their crimped ends are held in grooves by outside strips of plastic. The strips are available in long lengths which may be cut to size.

The receptacle assembly can be held together with screws and nuts, as shown in the photograph, or they can be cemented together with





a special cement which is provided.

A large variety of contact types is available. The contacts may be made of phosphor bronze, spring temper brass, or beryllium copper; and may be terminated in solder eyes, turrets, taper tabs, wire wrap forms, or dip solder lugs. Two facing contacts may be joined or kept separate. The resistance at the spring action contacts is no greater than five milliohms.

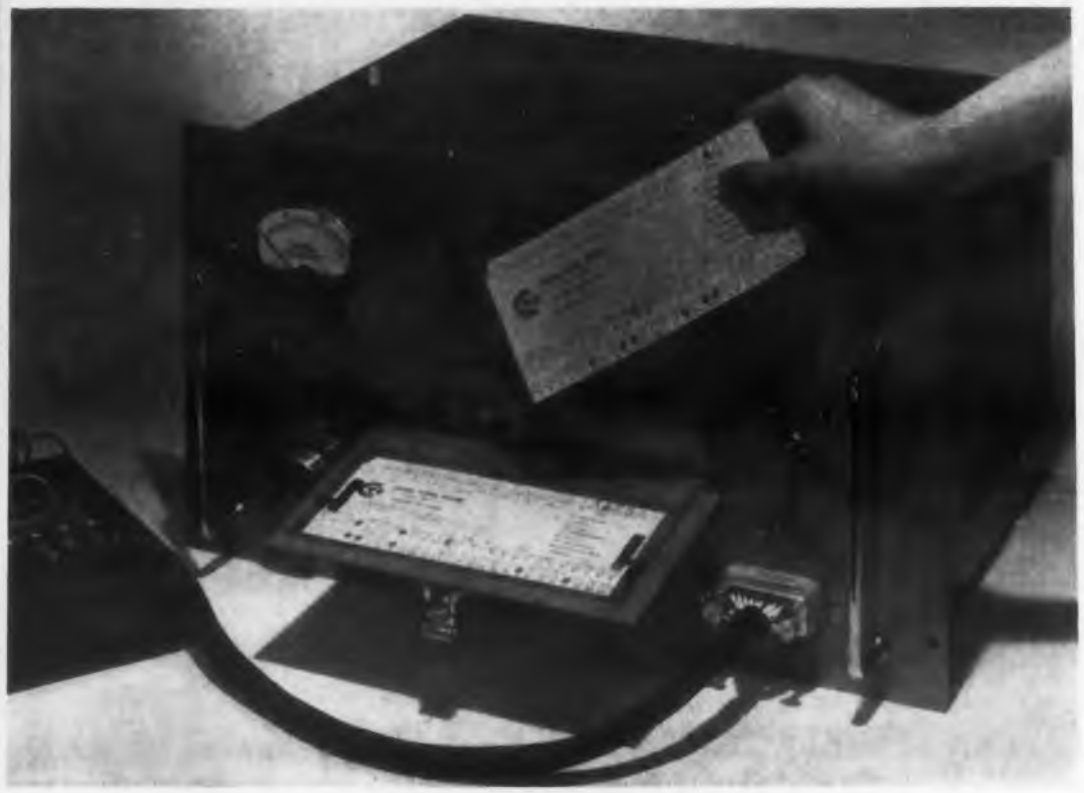
The channels supplied for the framework can be cut and spaced to suit individual requirements. The guide rails are available to take printed circuit boards from 1/16 to 1/4 in. thick.

Receptacles are secured to the channels with cotter pins, allowing just enough play to ease the insertion of the printed circuit boards when there isn't perfect alignment.

For more information and specifications on a prototype kit for experimental use, turn to the Reader-Service Card and circle **72.**

The parts on the left can be quickly assembled to make the complete printed wiring receptacle.

NEW PRODUCTS PREVIEW OF THE 1958 IRE SHOW . . .



COMPONENT TESTER

Punched Cards allow simplified programming for the incoming inspection of transformers, relays, resistors, transistors, diodes, capacitors, and similar items. The component tester is able to make a complete series of tests according to values indicated by a punched card, thus enabling it to make complex tests and yet permitting instant change-over to the next type of component.

California Technical Industries, Division of Textron, Inc., Dept. ED, 1444 Old County Rd., Belmont, Calif.

IRE Booth No. 1111, 1112

CIRCLE 74 ON READER-SERVICE CARD

DC-AC CHOPPERS

Twin-Contacts in these choppers serve to increase their over-all reliability. The units have two independently adjustable, parallel connected contacts, making a total of four for spdt and eight for dpdt. Case size is 1-1/4 x 1 x 2-11/16 in. Electrical noise and thermal emf's are nearly eliminated through the use of a Mu-metal case, internal shielding, and a noval plug-in low loss base with gold plated pins. Eleven different models are available for use either on 50, 60, 94 or 120 cps.

Stevens-Arnold, Inc., Dept. ED, 22 Elkins St., South Boston, Mass.

IRE Booth No. 2937

CIRCLE 75 ON READER-SERVICE CARD

SILICON CONTROLLED RECTIFIER

Control of the Volume of Power fed into a load is the featured characteristic of this semiconductor device. Six models of the silicon rectifier will be available in sample form at the show. These devices are all rated at an average forward current of 5 amp at 125 C stud temperature and variously at 25, 40, 75, 100, 150 and 200 pivw. All models have a typical gate current to fire of 10 ma at 25 C and a typical minimum holding current of 10 ma.

General Electric Co., Semiconductor Products Dept., Dept. ED, Syracuse, N.Y.

IRE Booth No. 2906

CIRCLE 76 ON READER-SERVICE CARD

See us at our booth (4101-02) for the latest information on products announced at the show.

ELECTRONIC DESIGN, together with ELECTRONIC WEEK-ELECTRONIC DAILY, will maintain a running coverage of products announced just prior to or during the IRE show. Information and photographs of these items will be displayed at our booth.

In this issue, you will find a preview of the majority of products to be exhibited. In collecting this information, we have taken note of a few components, described more fully on the following pages, which you may find of interest:

In the semiconductor field, there have been more significant developments in devices related to the transistor than in refinement of the conventional transistor itself. Described on the opposite page, for instance, is a heavy duty silicon rectifier which is controlled by a minute voltage. Zener diodes will be displayed in an interesting fashion by International Rectifier Corp. An X-Y graph of each diode will be plotted on the spot; a look at one of these shows a very sharp breakdown curve. Thermistors are being supplied in accurately matched pairs for gas analysis by Fenwal Electronics. Other devices of interest include Transitron's silicon transistors which, with a R_{CS} of 1.5 ohm, permit 80 w ratings.

Capacitors being exhibited include a British electrolytic type with an interesting end seal; the Daly Ltd. electrolytic employs a compressed plastic plug to provide hermetic sealing. Pyramid Engineering will display a low-leakage series of electrolytics. Vitramon's standard line of thin design axial radial capacitors will be expanded by the addition of a few new types.

Some of the more rugged relays exhibited include a 200 C unit, manufactured by Union Switch and Signal, that will withstand 55 g shock, 25 g vibration, and have a contact bounce of less than 250 μsec. An impulse latching relay, utilizing only one coil instead of the usual two, will be exhibited by Comar Electric. Other electromechanical devices of interest include a chopper from Airpax Products exhibiting very low noise over a 40 kc bandwidth.

NEW PRODUCTS
at the IRE Show

Power Supply
Cannot be short circuited

Overcoming the limitations of previously available types, these Transpac power supplies may be completely short circuited without damage to the semiconductors or other components. The units are available in 150 and 300 v dc ratings, 0-100 ma. Input is 105-125 v ac, 60 or 400 cps. Regulation is better than 0.1 per cent. Size of the 150 v model is 3-1/16 x 3-9/16 x 4-7/8 in.

Electronic Research Associates, Inc., Dept. ED, 67 Factory Place, Cedar Grove, N.J.
IRE Booth No. 2705

CIRCLE 79 ON READER-SERVICE CARD

Cooling Motor
Changes speed according to altitude

The E2123-200 is a high-speed, 3-phase, 400 cps motor. It automatically changes speed with varying altitudes and air densities to provide constant cooling efficiency from sea level (high density) to 70,000 ft. Used in conjunction with a 4-in. impeller the motor delivers 145 cfm at O" SP at sea level and

◀ CIRCLE 78 ON READER-SERVICE CARD

changes speed to deliver 440 cfm at O″ SP at 70,000 ft. This motor is rated at a minimum life of 1000 hrs at a 125 C ambient. This 1.4 lb motor meets the requirements of MIL-M-7969A, MIL-E-5272A, Air Force spec #32590 and MIL-P-721B. This motor type can also be produced in 1-phase, 400 cps or variable (320 to 1000 cps.)

Air-Marine Motors, Inc., Dept. ED, Amityville, N.Y.

IRE Booth No 2315

CIRCLE 81 ON READER-SERVICE CARD

Zener Diodes

Temperature range of —65 to +200 C

A line of miniature glass Zener diodes has been designed for clipping, limiting, regulating, and similar applications. They are made with gold alloyed ohmic contacts in order to withstand high operating temperatures.

Low voltage types GZ1 through GZ6 cover the Zener voltage range from 2 v through 8 v in approximately ±10 per cent stops. Special selections from types GZ1 through GZ6 and available with tolerances of ±5 per cent. Units with Zener voltages from 8 v through 51 v are available with similar tolerances. These diodes are designed to function at an extended operating and storage temperature range of from —65 to +200 C. They are rated at 250 mw at 25 C and derated at 1 mw per deg C above 25 C.

Hoffman Electronics Corp., Semiconductor Div., Dept. ED, 930 Pitner Ave., Evanston, Ill.

IRE Booth No. 3830

CIRCLE 82 ON READER-SERVICE CARD

CIRCLE 83 ON READER-SERVICE CARD ➤

NEW PRODUCTS at the IRE Show

Phase Meter

Direct measure regardless of peak values

The 410 panel mounted phase meter is suitable for measuring phase angle between two periodic potentials of any shape, sinusoidal or nonsinusoidal, regardless of the relations between the peak values. It requires no adjustment, including zeroing, for obtaining a phase reading. The instrument consists of two clipping circuits, one for each channel, a rectifier and a panel meter. Accuracy is ± 2.5 per cent of full scale on all ranges for input voltages of 110 ± 10 v and ± 3.5 per cent on all ranges for input voltages of 110 ± 20 v. The operating frequency is 20 to 1000 cps, with no effect on accuracy. The impedance is 5500 ohms per phase on standard model.

Advance Electronics Lab., Inc., Dept. ED, 249-259 Terhune Ave., Passaic, N.J.
IRE Booth No. 3606

CIRCLE 84 ON READER-SERVICE CARD

Decade Counter

Resets in one microsecond

Designed as a companion unit to the decade counters types 101 and 102 whose counting rate is 10 kc and 100 kc respectively, this 1 mc Nixie readout unit resets to zero in less than 1 μsec. All outputs are available for print-out or other applications. The power requirements are 300 v—30 ma dc, and 6.3 v—0.9 amp ac.

Burroughs Corp., Electronic Tube Div., Dept. ED, P.O. Box 1226, N. Plainfield, N.J.
IRE Booth No. 1718, 1724

CIRCLE 85 ON READER-SERVICE CARD

AMP-lok eliminates the necessity for supplementary mounting devices in through panel multiple connector applications.

multiple connector design

. . . IT'S SELF-ANCHORING

AMP-lok obsoletes all it replaces because of the following design features:

- contacts are identical . . . self-cleaning . . . recessed for safety
- finger grip engagement and disengagement
- polarized to eliminate circuit error
- wide panel thickness accommodation — one simple mounting hole required
- color-coding available

AMP-lok can be used as a safe, free-hanging multiple connector, also.

Additional literature and samples available on request.

We will feature the AMP Automated Shielded Wire Ferrule at the IRE Show. Visit our Booth #2427-29.

AMP INCORPORATED

GENERAL OFFICES:
3539 Eisenhower Blvd., Harrisburg, Pa.

Wholly Owned Subsidiaries: Aircraft-Marine Products of Canada, Ltd., Toronto, Canada • Aircraft-Marine Products (Great Britain) Ltd., London, England • Societe AMP de France, Le Pre St. Gervais, Seine, France • AMP — Holland N. V. 's-Hertogenbosch, Holland
Distributor in Japan: Oriental Terminal Products Co., Ltd., Tokyo, Japan

AMP®

CIRCLE 86 ON READER-SERVICE CARD

Servo Cam Assembly

Adjustable limits for switching purposes

For use in servo mechanisms where it is desired to actuate switches and similar devices at predetermined angular limits, the T-159 cam assembly can be adjusted through 180 deg. A balanced clamp secures the assembly to the shaft as well as locking the cams for the desired setting. Maximum diameter is 1-1/8 in. and hubs are available for 1/8, 3/16, and 1/4 in. shafts.

Sterling Precision Corp., Dept. ED, 54-17 Lawrence St., Flushing 54, N.Y.
IRE Booth No. 1621

CIRCLE 87 ON READER-SERVICE CARD

Silicon Rectifiers

Ratings up to 16,000 piv

Designed for forced-air or liquid cooling, these rectifiers utilize metallized ceramic housings with ferrule-type terminals for insertion into standard 30-amp fuse clips. Available in peak inverse voltage ratings of from 1500 to 16,000 v at rectified dc output currents ranging from 210 to 360 ma. For short durations, load current several times the rated values can be withstood.

Primarily designed for airborne power supplies, these units can also be used for dc over-potential testing damping out oscillation in electric welding circuits, pulsing of magnatrons, or as power supplies in electrostatic precipitators due to their ability to withstand surge currents.

International Rectifier Corp., Dept. ED, 1521 E. Grand Ave., El Segundo, Calif.
IRE Booth No. 3915, 3917

CIRCLE 88 ON READER-SERVICE CARD

NEW PRODUCTS
at the IRE Show

Delay Line
Delays of 5 to 100 μsec

This delay box offers standard impedances of 50, 73, or 93 ohms and delays of 5, 15, 10, 25, 50, and 100 mμsec. A jumper for connecting and two delays in series is provided, as well as two adaptors from BNC to uhf or type N connectors.

Electrical & Physical Instrument Corp., Engineering Div., Dept. ED, 42-19 27th St., Long Island City 1, N.Y.

IRE Booth No. 3240

CIRCLE 89 ON READER-SERVICE CARD

SSB Generator
For X-band use

The 3036 side band generator covers the frequency range of 8.5 to 9.6 kmc. A 20 db suppression of the undesired side band frequency and 15 db suppression of the carrier has been obtained. No tuning of the microwave assembly needed.

Microwave Development Labs., Inc., Dept. ED, 92 Broad St., Babson Park, Mass.

IRE Booth No. 3415

CIRCLE 90 ON READER-SERVICE CARD

CIRCLE 91 ON READER-SERVICE CARD ➤

Wire Clamp

Can be permanently mounted

This clamp can be permanently mounted by means of a rivet or bolt and is opened or locked in a quarter turn. Designed primarily for wire bundles, the unit is available from 1/4 to 1-1/4 in. diam types.

Camloc Fastener Corp., Dept. ED, 22 Spring Valley Rd., Paramus, N.J.

IRE Booth No. 4306, 4308

CIRCLE 92 ON READER-SERVICE CARD

Switch

Miniature 10 amp model

The type 16 10-amp miniature switch measuring 1/4 x 7/16 x 25/32 is available with screw end terminals, and bottom taper tab and solder terminals. The switch provides over 20,000,000 life cycles. Double break contact arrangement is employed. A broad field of application is possible by combining the switch with an assortment of miniature actuators. Actuator designs include panel mounted toggles, oil-tight push-buttons, and spring pivoted lever, roller, levers.

Illinois Tool Works, Licon Switch & Control Div., Dept. ED, 2501 N. Keeler Ave., Chicago 39, Ill.

IRE Booth No. 3842

CIRCLE 93 ON READER-SERVICE CARD

◄ **CIRCLE 91 ON READER-SERVICE CARD**

NEW PRODUCTS **at the IRE Show**

Transistors

Computer, r-f and audio types

Part of the component line available from the manufacturer are 13 germanium and fusion alloy transistors in a case measuring 0.002 cu. in. There are four computer, four general purpose rf and 5 general purpose audio types. Four types of glass silicon rectifiers all rated at 400 ma forward current, having piv ratings from 225 to 500 v, and the CK1053 low power, subminiature time indicator for determining electronic component and equipment life are also included in the line.

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

IRE Booth No. 2611-2614

CIRCLE 80 ON READER-SERVICE CARD

Ultrasonic Cleaners

Wide range of mass-produced sizes

Series 600 ultrasonic cleaners cover two types of submersible transducers and seven different process tanks. Thirteen ultrasonic systems in all are available. Powered by the model G-601 generator, the stainless steel tanks in this series range from 1/2 gallon to one gallon capacity with single or double tank compartments. Some use external recirculating systems and others have self-contained recirculating pumps, filters and temperature controls. Models NT-604 and NT-605 transducers are hermetically sealed in heli-arc-welded stainless steel cases for use in installed process tanks, metal-finishing and heavy duty cleaning tanks.

The Narda Ultrasonics Corp., Dept. ED, 160 Herricks Rd., Mineola, N.Y.

IRE Booth No. 4053, 3021, 3607, 3609

CIRCLE 218 ON READER-SERVICE CARD

High Voltage Resistors

For high temperature ambients

These pyrolytic carbon alloy film resistors, type PVX can operate in high ambient temperatures with improved stability under high voltage loads.

International Resistance Co., Dept. ED, 401 N. Broad St., Philadelphia, Pa.

IRE Booth No. 2821, 2825

CIRCLE 219 ON READER-SERVICE CARD

Switches

A lighted panel type includes nameplate in one unit

Among the switch and control products which will be displayed are these lighted push-button panel switches (shown), a long life miniature snap-action switch, and an adjustable sealed limit switch. The lighted push-button panel switches (series C6) are of modular design. Most of the models combine a nameplate, pilot light and switching unit into a single assembly. Two or more switch units may be stacked side-by-side in one panel slot. Through variation of circuit arrangements, colored lights for color monitoring, and colored push buttons for color coding, a large number of operating and indicating conditions can be provided for sequencing, movement limit, start-and-stop, and similar applications. Models are available with push-push alternate action, momentary contact, momentary contact with over-centering, and an assembly for pilot light duty only which includes no switching mechanism.

The miniature snap-action switch (model E4-134) measures 25/32 in. long and has a mechanical life rating of 1,000,000 operations at 0.005 over travel. It is electrically rated at 0.5 amp 125/250 v ac.

The adjustable sealed limit switch (model H11-2), is designed for control or indicating applications at any exposed locations on machines or aircraft. All exposed metal parts are stainless steel or Monel, and the entire switch is corrosion resistant.

Electro-Snap Switch & Mfg. Co., Dept. ED, 4218 W. Lake St., Chicago 24, Ill.

IRE Booth No. 2225

CIRCLE 220 ON READER-SERVICE CARD

NEW PRODUCTS
at the IRE Show

Diode Tester
Provides rapid, accurate testing

Model DT-257 diode tester is designed to measure the characteristics of medium and low-power semiconductor diodes. A lever switch is provided which automatically selects the desired test voltage and meter ranges for both forward and reverse tests. The reverse voltage supply is regulated to 0.5 per cent. Either one of three preset voltages or a continuously variable voltage covering the range from 0 to 150 v may be selected. The forward voltage supply is continuously variable from 0 to 2 v. Accuracy of the voltage and current meters is ±2 per cent. The instrument is housed in the company's CA-846 modular case (11-1/2 x 8-3/8 x 6-1/8 in.).

Teletronics Lab., Inc., Dept. ED, 54 Kinkel St., Westbury, N.Y.
IRE Booth No. 3417

CIRCLE 100 ON READER-SERVICE CARD

VSWR Monitor
Handles up to 500 w

Type 1273 vswr monitor satisfies requirements for a lightweight, rugged unit to monitor r-f power, vswr, and side-tone. Built into a

section of transmission line, it furnishes two dc voltages representing incident and reflected power.

Power handling capacity ranges up to 500 w depending on reflected power. Output to indicator is one volt (nominal) from 500 ohms. The unit may be used to modulate a sub-carrier oscillator for telemetry. Frequency range is 100 to 400 mc.

Hycon Eastern, Inc., Dept. ED, 75 Cambridge Pkwy., Cambridge 42, Mass.

IRE Booth No. 3038, 3039

CIRCLE 101 ON READER-SERVICE CARD

Frequency Converters

Supply 330 to 3700 cps power

Models 411, 421, and 431 frequency converters are used in conjunction with equipment requiring 330 to 3700 cps power. Power output is 250 va for model 411, 500 va for model 421 and 1000 va for model 431. All three units are useable with loads having power factors ranging from 0.7 leading to 0.7 lagging. The converters provide full power output over the entire output voltage range of 90 to 130 v through the use of an impedance matching circuit. A Wein bridge oscillator covers the entire range of 330 to 3700 cps in seven bands.

Specifications include less than 2 per cent harmonic distortion; voltage regulation of ±2 per cent from no load to full load; frequency stability of better than 0.25 per cent after 15-min warm-up; and frequency accuracy within 3 per cent of dial calibration.

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

IRE Booth No. 3406, 3408

CIRCLE 102 ON READER-SERVICE CARD

CIRCLE 103 ON READER-SERVICE CARD ➤

ARMA relies on Photocircuits plated-thru holes

Heart of TITAN ICBM Inertial Guidance System

When the Titan's electronic umbilical cords are severed, the giant missile begins life. With no ground contact, its unjammable inertial guidance system must work... there's no second chance.

Arma Division of American Bosch Arma Corporation, maker of the Titan's computer brain, demands printed circuit boards that must function the first time... every time. A defect, at any assembly point, means discarding the board and the costly components mounted on it.

That's why Arma relies on PHOTOCIRCUITS printed circuit boards with *plated-thru holes* to do the job.

PHOTOCIRCUITS pioneered *plated-thru holes*... manufactures them with built-in reliability for military and industrial applications.

Plated-thru hole reliability is based on PHOTOCIRCUITS' unequalled experience in every phase of printed circuitry. Consistent dependability is the result of proper design, precision production and advanced quality control techniques.

Check the advantages of *plated-thru holes* by PHOTOCIRCUITS ...the largest and most experienced manufacturer in printed circuitry. For complete information, write our Engineering Department PS-2 today.

PHONES
GLEN COVE 4-8000
FLUSHING 7-8100
CABLE
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PC Photocircuits
CORPORATION
GLEN COVE, NEW YORK

SEE US AT THE IRE SHOW, BOOTH #s 2302-2304

CIRCLE 104 ON READER-SERVICE CARD

NEW PRODUCTS at the IRE Show

Ferrite Isolators

L-band types for low to high power

The L-band, WR-650 waveguide-size absorption ferrite isolators provide constant isolation for low, medium and high power microwave applications. All these units operate over the range from 1250 to 1350 mc. Isolation is 10 db min, insertion loss 0.5, input vswr 1.15, and average power handling capacities are 100, 2000 and 5000 w respectively. While the low and medium power versions do not require cooling, the high power unit requires either forced air or a liquid cooling agent. Recommended liquid flow is one gallon per minute with the cooling liquid at a maximum temperature of 65 C.

Airtron, Inc., Dept. ED, 1096 W. Elizabeth Ave., Linden, N.J.
IRE Booth No. 3318

CIRCLE 105 ON READER-SERVICE CARD

Epoxy Resin

For dipping applications

Specifically designed for dipping applications, No. 253 Scotchcast resin is a flexible, all solids material which can be applied in a controlled thickness with no run-off during the cure.

Since the new resin can be applied by dipping, brushing, or spraying, as well as extrusion, costs of molds are eliminated.

Pot life is from two to four days at room temperature. The cured specific gravity is 1.44; water absorption is 0.52 per cent; heat aging weight loss is 0.02 per cent after 168 hours at 105 C; and the dielectric strength is 450 volts per mil. The resin meets all Mil-T-27A requirements.

Minnesota Mining and Manufacturing Co., Dept. ED, 900 Bush St., St. Paul 6, Minn.
IRE Booth No. 3901, 3903

CIRCLE 106 ON READER-SERVICE CARD

Transistorized Inverters

Ratings up to several kva

These inverters transform low voltage dc to either 60 or 400 cps. An addition to the Transpac line, the inverters are available in stock models with ratings up to 250 va, 15 v ac, or on order with ratings up to 5 kva. Input is 24 v dc nominal. The inverters are self-starting, with diode stabilized design, which use type E core magnetic circuits. Efficiencies of these units exceed 90 per cent.

Electronic Research Associates, Inc., Dept. ED, 67 Factory Place, Cedar Grove, N.J.
IRE Booth No. 2705

CIRCLE 108 ON READER-SERVICE CARD

Microwave Absorbent

Lightweight film type

A lightweight, space-saving microwave absorbent, this material is designed for frequency coverage ranging from 9317 to 9434 mc. It is also available for coverage at other frequencies upon request. It measures 22 x 22 x 0.03 in., and weighs 2.5 to 3 oz per sq ft. Maximum reflection is rated at 4 per cent.

B.F. Goodrich Sponge Products, Dept. ED, Shelton, Conn.
IRE Booth No. 3232

CIRCLE 109 ON READER-SERVICE CARD

CIRCLE 110 ON READER-SERVICE CARD ➤

NEW PRODUCTS
at the IRE Show

Laminated Plastics

High temperature and flame retardent

Phenolite grade G-11 is a glass base epoxy material which retains 70 per cent fluxural strength at 150 C for one hour, and is stated to be superior to other glass base grades in insulation resistance and dielectric strength. It has high impact strength, low in water absorption and dissipation factor measurements, and meets MIL-P-18177-A. Type G-11 is also available as a copper clad material. Another material, grade XXXP-467, is a flame retardent hot punching type also being announced.

National Vulcanized Fibre Co., Dept. ED, Box 311, Wilmington, Del.

IRE Booth No. 4419, 4421

CIRCLE 111 ON READER-SERVICE CARD

Static Inverter Supplies

Provide 400 cps ±0.01 per cent

This line of static inverter supplies has been developed from similar items which the company has been building for some time. Covering a range of power ratings, the units are particularly suitable for gyro wheel supplies or where 400 cps accurate to ±0.01 per cent is required. Waveform, simplicity of circuitry, fast starting time, and good voltage regulation are featured.

Magnetic Amplifiers, Inc., Dept. ED, 632 Tinton Ave., New York 55, N.Y.

IRE Booth No. 1518 and 1520

CIRCLE 112 ON READER-SERVICE CARD

CIRCLE 113 ON READER-SERVICE CARD ➤

Modules never become obsolete—As needs change simply regroup present modules or add new ones. Your system is always up-to-date at minimum cost and engineering. Internal construction is also modularized for maintenance ease.

Fully transistorized circuitry—All transistor circuits on encapsulated plug-in cards

- gives increased reliability
- reduces power consumption
- lowers heat dissipation
- permits miniaturized packages
- eliminates radio noise and line transients

Many new advanced application features and specifications—The result of thousands of applications and field experience from more than 2,500 digital instruments and systems.

- Now you can "read through" superimposed ripple on DC—and know its magnitude—by using the calibrated digits gain control located on the front panel. Steps by 1, 2, 3, 4, 5, 10, 50 and 100 digits.
- Controlled ranging by switch position—"automatic," "hold," "manual"—enables operator to manually control range position but still select automatic ranging in the same instrument.
- Power control for "on," "off," and "stand by" positions.
- Wider dynamic range covering all voltages from 100 microvolts to 1,000 volts, resistance range from 10 milliohms to 10 megohms—in single instruments.
- Input power frequencies from 50 to 400 cycles.
- New balance logic for faster down ranging.
- Automatic AC ranging from 30 to 10,000 cycles.
- Controlled stepping switch drive increases switch life by a factor of five—proved by actual tests.
- Meets many MIL specifications.

MAXIMUM FLEXIBILITY

1. Universal 3½"x19"x12" chassis with mounting hardware for any rack.
2. Digital outputs may also drive storage matrices, go-no go comparators, and other auxiliary modules.
3. All contacts readily accessible at rear panel on connectors.
4. With auxiliary plug-in modules, digitized data is provided in printed form, punched cards or tape with no modification to basic measuring instruments.

DIGITAL OHMMETERS

Specifications	Model DOA-400	Model DOA-500
Display	4 digits	5 digits
Range	00.01 ohms to 10 megohms	000.01 ohms to 10 megohms
Automatic Features	Ranging	Ranging
Controls	Digits gain, manual and automatic ranging, power on-off-standby	Digits gain, manual and automatic ranging, power on-off-standby

For accuracy specifications see Bulletin 180.3

Write for Bulletins 180.1, 180.3

AC RATIOMETERS

Specifications	Model DRA-480	Model DRA-490
Display	5 digits	5 digits
Ratio Range	0.0000-1.0999	0.0000-1.0999
Accuracy*	±2 digits	±2 digits
Controls	Digits gain, power on-off-standby	Digits gain, power on-off-standby, reference selector
External Reference	1 volt rms	Choice of 3

*Calibration at 400 cycles; 60 cycle models also available.

Write for Bulletin 180.9

DC RATIOMETERS

Specifications	Model DRC-400	Model DRC-500	Model DVC-400†
Display	4 digits	5 digits	4 digits, polarity
Ratio Range*	.0000-.9999	.00000-.99999	00.01-99.99 volts
Accuracy	±1 digit	±(0.01% and 1 digit)	±1 digit
Controls	Digits gain, power on-off-standby	Digits gain, power on-off-standby	Digits gain, power on-off-standby
External Reference**	1 to 10 volts	10 to 100 volts	±100 volts

*Models DRA-400L and DRA-500L, 10% overscale read out. For higher ratio ranges, see Bulletin 180.7.

†Recommended for computer applications.

**Internal reference supply optional; specify DRA in place of DRC.

Write for Bulletins 180.1 and 180.7

Complete specifications are available on all basic and auxiliary modules. Write for your set of catalog sheets today.

ELECTRO INSTRUMENTS INC.

3794 Rosecrans Avenue
San Diego, California

Transistor Socket

Compression mounted Teflon unit

A low-loss transistor socket, Teflon-insulated for environmental extremes, has been announced. The sockets are of compression-mounted design to cut assembly time. They are also suitable for subminiature tubes with in-line leads, and are applicable to printed circuits.

Fluorocarbon Products, Inc., Div. of United States Gasket Co., Dept. ED, 602 N. 10th St., Camden, N.J.
IRE Booth No. 4036, 4037

CIRCLE 114 ON READER-SERVICE CARD

Shock Testing Machine

Portable unit for testing units up to 60 lb

Simulating shocks with closely controllable and repeatable waveforms, the type 15575 shock machine is a portable completely integrated instrument occupying 22 x 39 in. of floor space. Assemblies weighing up to 60 lb may be tested.

Utilizing the vertical-drop design, the unit requires no auxiliary reservoir of power, since impact on various materials of different configuration generate the desired wave shapes. The range of shock pulses provided is from 2 msec at up to 700 g peak acceleration to 60 msec at up to 25 g peak acceleration. Precision and uniformity of the pulse shape is preserved by structural rigidity in design.

Barry Controls, Inc., Dept. ED, 700 Pleasant St., Watertown 72, Mass.
IRE Booth No. 2534

CIRCLE 115 ON READER-SERVICE CARD

◀ CIRCLE 113 ON READER-SERVICE CARD

NEW PRODUCTS
at the IRE Show

Binary Timer
Generates 128 binary counts

This binary timer provides 128 binary counts at a rate of one per second. The unit is comprised of a recently designed commutator and brush assembly plus low inertia gold plated code drums driven by a 28 v dc chronometric type motor. Each data frame, or second of time, contains a synchronizing commutor pulse, followed by an identifying 8 bit train of pulses.

Instrument Development Labs., Inc., Dept. ED, 67 Mechanic St., Attleboro, Mass.
IRE Booth No. 3925

CIRCLE 117 ON READER-SERVICE CARD

Choppers
Noise level below 10 μv

Type 2300 and 2400 choppers feature noise levels below 10 μv in low-impedance circuits. These noise levels are for band widths extending from a few cps up to 40 kc, and are measured by a thermocouple voltmeter for a true rms reading. These few microvolts of chopper noise can be further reduced by restricting the band width.

The contacts are rated for operation in dry and nearly dry circuits, yet will withstand surges as high as 2 ma at 100 v into resistive loads. Drive is rated at either 400 ±20 cps (type 2300) or 60 ±6 cps (type 2400) at 6.3 ±0.6 volts rms. Normal operating temperature range is −65 to +100 C. In usual applications the choppers can be expected to remain within ratings for over 5000 hours.

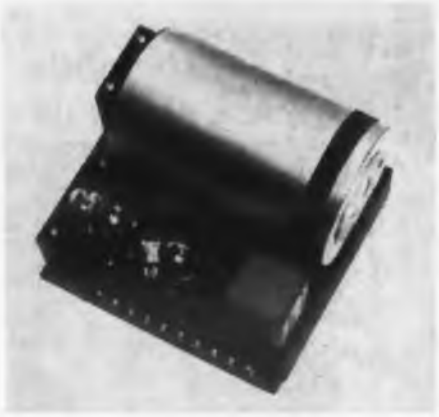
Airpax Products Co., Cambridge Div., Dept. ED, Cambridge, Md.
IRE Booth No. 3502, 3504

CIRCLE 118 ON READER-SERVICE CARD

◀ CIRCLE 116 ON READER-SERVICE CARD

Fork Amplifier

Frequency accurate to 1 part in 10^7



The fork amplifier, model FK5, is designed for maximum frequency stability. An oven is added for applications requiring a frequency source accurate to 1 part in 10^7. The FK5 chassis is 6-5/8 x 6-1/2 x 4 in. high, and the FK5A (with oven) is 5-1/6 in. high. The amplifier may be mounted in any position. Power requirement is 200-300 v dc and 6.3 v ac. No regulated B+ supply is required. Temperature stability of the oven is well within 0.1 C at the fork assembly.

Time Facsimile Corp., Dept. ED, 540 W. 58th St., New York 19, N.Y.

IRE Booth No. 1824

CIRCLE 119 ON READER-SERVICE CARD

Impulse Latching Relay

One coil provides efficient operation

Type W impulse latching relay features an insulated rocker arm activated by a single coil, instead of the two coils usually used. In this one-coil design, the contacts are set up in one position when the coil is energized or pulsed and return to the first position on the next pulse.

Designed for both ac or dc operation, the relay has a coil rated from 2 to 7 w dc, or from 15 va to 115 va ac. The larger values are for a 4 pdt combination. The relay measures about 2 in. high.

Comar Electric Co., Dept. ED, 3349 W. Addison St., Chicago 18, Ill.

IRE Booth No. 3821

CIRCLE 120 ON READER-SERVICE CARD

CIRCLE 121 ON READER-SERVICE CARD ➤

SEE HOW BRAND ELECTRICAL INSULATING TUBINGS

assure product performance for major manufacturers

At United Transformer New York, New York

To assure long service life, U.T.C. covers the leads of their high temperature transformers with Turbo 117® silicone rubber coated glass tubing. A Class H material with outstanding heat resistance and low temperature flexibility, the five available grades meet NEMA VS1-1957 and the performance requirements of MIL-I-3190A.

At Allis-Chalmers Norwood, Ohio

For stator connections in their semi-enclosed slot motors, Allis-Chalmers uses Turbotuf®, a highly flexible, heat resistant, vinyl coated glass tubing. This Class B material is supplied in two grades meeting all requirements of the NEMA VS1-1957 and the MIL-I-3190A specifications.

At American Bosch Springfield, Mass.

Miniature electric windshield wiper motors require moisture resistant insulation, so American Bosch chooses Turbo® varnished tubing, a cotton or rayon braid coated with a tough, organic varnish. Manufactured in five grades it meets the Class A requirements of MIL-I-3190A, ASTM D-372, and NEMA VS1-1957.

At Lockheed Marietta, Georgia

To provide low temperature abrasion protection for wiring assemblies, Lockheed uses Turbozone® 40 extruded plastic tubing for use in the C-130 Hercules. This tubing meets the requirements of MIL-I-7444A(2) and is available in three size ranges — from .022" to 2.500" inside diameter.

At Avco's Crosley Div. Cincinnati, Ohio

For applications ranging from test and fire control equipment to navigational and radar units, Crosley selects Turbolex® 76 general purpose plastic tubing, a flame and fungus resistant material operable from —40°C to +80°C. This tubing meets MIL-I-631C, Grade a, Class 1, Category 1 and ASTM D-922.

High dielectric strength; flame, fungus, moisture, solvent or abrasion resistance; low temperature flexibility; high temperature operation; chemical inertness . . . whatever your requirement in a coated textile or an extruded plastic tubing, there is a Brand product to meet your specifications. Turbo tubings are manufactured in all standard colors and a range of sizes #24 (.022") to 2½" I.D. Produced with engineer-supervised techniques, subjected to continuous in-process inspection testing, Turbo tubings meet and exceed all applicable military and commercial specifications. Samples are available, your inquiry is invited.

THE WILLIAM BRAND & CO., INCORPORATED

WILLIMANTIC 2, CONNECTICUT

electrical and electronic wires and cables • harnesses and cable assemblies • plastic and coated insulating tubings identification markers

BRAND SUITE AT THE BARBIZON-PLAZA HOTEL DURING THE I.R.E. SHOW

NEW PRODUCTS
at the IRE Show

Rheostats
Ring types rated at 100 and 150 w

These 100 and 150 w ring rheostats have twin-shoe self-lubricating contacts; molded ceramic base and core featuring high density, low porosity, and high dielectric strength. Ratings of 100 and 150 w rings are based on a 300 C rise in 40 C ambient. Both sizes are available in resistance values to 10,000 ohms. Tapered windings, tandem mountings, dial plates, and other accessories are available.

Ward Leonard Electric Co., Dept. ED, Mt. Vernon, N.Y.
IRE Booth No. 2231

CIRCLE 123 ON READER-SERVICE CARD

Chopper
Thermal stability low noise

Having low thermal construction, this chopper is useful in dc amplifiers requiring thermal stability and low noise. Contact ratings and reliability are identical with the company's standard external coil units. As in the standard

◀ CIRCLE 122 ON READER-SERVICE CARD

CIRCLE 506 ON READER-SERVICE CARD ▶

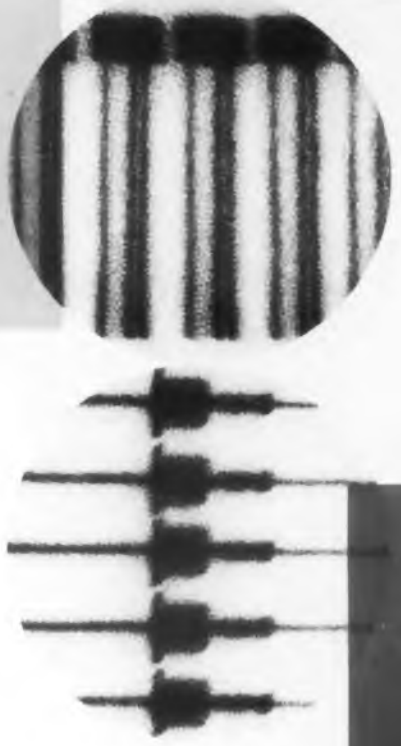
YOUR
REFERENCE
GUIDE TO....

Semiconductors

GERMANIUM • SILICON

BY GENERAL ELECTRIC

A WIDE
SELECTION OF
Transistors
COVERING ALL
MARKETS IN
THE ELECTRONIC
INDUSTRY



A
COMPLETE
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OF
Rectifiers
WITH
BROAD
APPLICATION
POSSIBILITIES

GE

w 4PDT relay to all requirements MIL-R-25018!

se with the Class C, Type II, Grade 3 re-
IS 24114-9, MIL-R-25018. You don't have
ow Union Switch & Signal has a 4PDT,
relay designed to meet these specifications
the first of its type to do so. In fact, it
the rugged requirements.
nd of performance you can expect from this

mperature. Even at an ambient temperature
lay gives optimum performance. The use of
l provides consistently high insulation re-
esult, you can install this relay closer to
ten can use it *without* temperature con-
lways, you will find it supremely rugged

esistance. This new UNION Relay with-
ater than 55 g for 11 milliseconds—and con-
te. In vibration tests, it shows no contact
00 cycles at an acceleration of 25 g.

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s that of comparable devices because of its
furcated contacts. Bifurcation also increases
g capacity (each button easily handles a
ad) . . . and makes gold alloy contacts prac-
w- and high-level loads.
ility is enhanced, too, by the ceramic insula-
tains no volatile material to contaminate
separate hermetic sealing of the magnet coil.

e rotary-armature suspension improves re-
nal shock . . . increases reliability over the
ure range . . . and greatly extends the op-
is new 4PDT relay. Call or send the coupon
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COMPLETE FACTS

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-25018, MIL-R-6106C, and MIL-R-5757C requirements. ☐ De-
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oth #2122-2124 at IRE Show—New York City

SIGNAL

APANY

8, PENNSYLVANIA

NEW PRODUCTS
at the IRE Show

Rheostats

Ring types rated at 100 and 150 w

These 100 and 150 w ring rheostats have twin-shoe self-lubricating contacts; molded ceramic base and core featuring high density, low porosity, and high dielectric strength. Ratings of 100 and 150 w rings are based on a 300 C rise in 40 C ambient. Both sizes are available in resistance values to 10,000 ohms. Tapered windings, tandem mountings, dial plates, and other accessories are available.

Ward Leonard Electric Co., Dept. ED, Mt. Vernon, N.Y.
IRE Booth No. 2231

CIRCLE 123 ON READER-SERVICE CARD

Chopper

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CIRCLE 506 ON READER-SERVICE CARD ▶

YOUR
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Semiconductors

GERMANIUM • SILICON

BY GENERAL ELECTRIC

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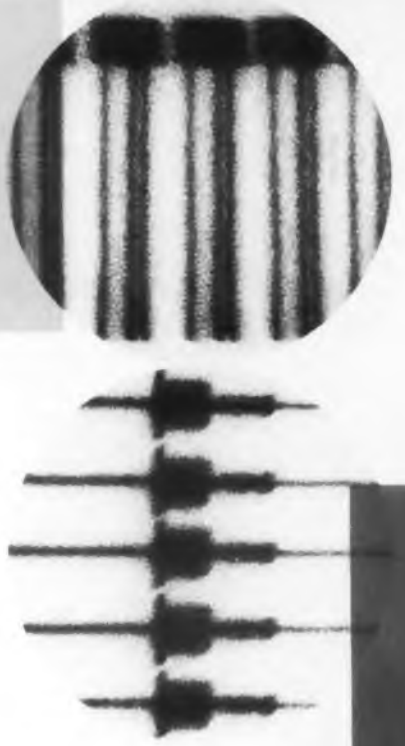


A
COMPLETE
RANGE
OF
Rectifiers
WITH
BROAD
APPLICATION
POSSIBILITIES

GE

Specify G-E TRANSISTORS

INDUSTRIAL • COMPUTER • MILITARY

ENTERTAINMENT





		INLINE LEAD PNP	TRIANGULAR LEAD PNP	INLINE LEAD NPN	TRIANGULAR LEAD NPN	POWER NPN
SILICON	AMPLIFIER & COMPUTER				2N332 2N333 2N335	
	UNIJUNCTION				2N489* 2N490* 2N491* 2N492* 2N493* 2N494* *A PN Device	
	POWER					2N451 2N452 2N453 2N454
GERMANIUM	AUDIO PNP	2N43 2N43A 2N44 2N44A	2N525			
	COMPUTER PNP	2N123	2N394 2N395 2N396 2N397 2N450 2N518			
	COMPUTER NPN			2N78 2N167		
	HIGH FREQ. AMPLIFIER NPN			2N78		
	TETRODE NPN				4JD3B1	
GERMANIUM	IF NPN			2N168A 2N169 2N169A 2N292 2N293		
	AUDIO PNP	2N186 2N186A 2N187 2N187A 2N188 2N188A 2N189 2N190 2N191 2N192 2N241 2N241A 2N265	2N319 2N320 2N321 2N322 2N323 2N324 2N508			

FOLD OUT PAGE FOR G-E RECTIFIERS

RECTIFIERS for your every need!

SILICON / GERMANIUM

GREATER POWER – HIGHER TEMPERATURE RATINGS

G-E Semiconductor Rectifiers are the largest selling in the industry!

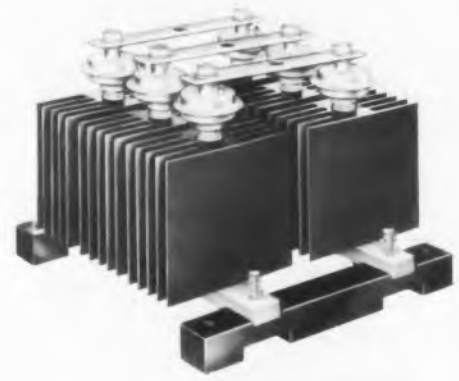
1N1115 Series: For direct chassis mtd., or on fins, permitting forward currents up to 1.5 amps, temperature up to 170° C with derating. Extremely low reverse current at max. junction temperature. **1N253 Series** offers specifications designed for applications requiring forward current up to 1.0 amp. temperature up to 150° C, such as power supplies and magnetic amplifiers.

SILICON LOW CURRENT

1N536 Series; 1N1095-96: Designed for maximum forward conductance at high operating temperatures. The **1N440-440B Series** is similar to the 1N536 Series but with extremely low reverse current. The **1N1487 Series** provides less expensive units for lower temperature requirements. No heat sink required. Ratings up to 160° C ambient.

4JA411 Stacks: Combine high temperature operation (up to 150° C) with increased ratings (up to 18 amps d-c). Hundreds of stack combinations to meet a variety of circuit conditions. High efficiency plus excellent regulation.

SILICON HIGH CURRENT



Large area junction type. Operating temperature to 200° C. D-C outputs as high as 85 amps per rectifying element. Lower cost 4JA62 and 6211 units are for applications which do not require the full current ratings of 4JA60 line. Reverse polarities provided in 4JA61 and 4JA63 units. Stack combinations offer d-c outputs up to 915 amps.

Designed for individual cell applications in the 2 to 20 amp. range. High junction temperature ratings, extremely low forward voltage drop and thermal resistance. May be mounted directly or electrically insulated from heat sink with mica-washer mounting kit provided with each unit.

SILICON MEDIUM CURRENT

Stacks provide a broad range of power applications with d-c outputs up to 100 amps.

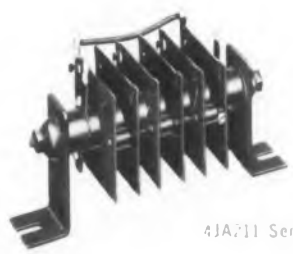
Mounted in standard eight-pin tube base (**4JA220 and 4JA420 Series**) or rectangular design with solder lug connections (**4JA221 and 4JA421 Series**). Available in a large number of circuit configurations. One to six cells may be potted in a single circuit. Individual cell specifications determine ratings. Derating from free air ratings is not necessary. **4JA220-21 Series** utilize **1N91-93 cells**; **4JA420-21 Series** utilizes **1N536-540, 1N1095-96 cells.** (See BASIC RATING CHART)

4JA221 Series (Germanium)
4JA421 Series (Silicon)

POTTED RECTIFIER CIRCUITS

USAF1N315, 1N315, 1N368
1N91 Series

GERMANIUM LOW CURRENT



4JA211 Series

USAF1N315; 1N315: Designed for high operating temp. (up to 85° C) and low reverse current. **USAF1N315** meets Air Force Specification MIL-E-1/1088. The **1N368** type features a very low reverse current at a high d-c reverse voltage.

1N91 Series: Alloyed junction type combining very low forward resistance with high back resistance to give almost 100% efficiency. **1N93** is the commercial version of the G-E U.S. Navy approved USN 1N93 rectifier. **1N151 Series** and **1N158** are single and double-fin units, respectively.

4JA211 Stacks: The industry's most widely used semiconductor rectifier. Hundreds of of thousands in use. May be arranged in stacks up to 12 fins to produce over 160 different circuit configurations. Small size, light weight, excellent regulation.

Single Fin Mount

GERMANIUM MEDIUM CURRENT

4JA3011 Series

For general purpose power supplies, control devices, blocking circuits, and many other applications. Extremely low power dissipation and forward voltage drop provide excellent regulation and efficiency. Available in stacks up to 12 fins providing ratings in thousands of watts, depending on circuit design, with operation to 85° C. Transient PIV's up to 600 volts per cell.

G-E rectifiers are designed to meet rigid military mechanical and environmental specifications

BASIC RATING CHART

Choose the performance range required for your particular needs from one of the most comprehensive line of rectifiers in the industry. Complete specifications are available through your distributor or G-E Semiconductor Products Dept. District Sales Office. Order by JETEC or G-E Type No.

RECTIFIER CELLS

JETEC or G-E Type No.	PIV	Max. I_{DC} at T°C	Max. 1 Cycle (60 cps) Surge	Max. Storage Temp. °C
1N91	100	150ma at 55° amb.	25A	85°
1N92	200	100ma at 55° amb.	25A	85°
1N93	300	75ma at 55° amb.	25A	85°
USN1N93	300	75ma at 55° amb.	25A	85°
1N151	100	500ma at 55° amb.	25A	85°
1N152	200	500ma at 55° amb.	25A	85°
1N153	300	500ma at 55° amb.	25A	85°
1N158	380	500ma at 55° amb.	25A	85°
1N253	95	1000ma at 135° stud	4A	150°
1N254	190	400ma at 135° stud	1.5A	150°
1N255	380	400ma at 135° stud	1.5A	150°
1N256	570	200ma at 135° stud	1.5A	150°
1N315	100	100ma at 85° amb.	5A	95°
USAF1N315	100	100ma at 85° amb.	5A	100°
1N368	200	100ma at 85° amb.	10A	85°
1N440	100	300ma at 100° amb.	15A	175°
1N440B	100	500ma at 100° amb.	15A	175°
1N441	200	300ma at 100° amb.	15A	175°
1N441B	200	500ma at 100° amb.	15A	175°
1N442	300	300ma at 100° amb.	15A	175°
1N442B	300	500ma at 100° amb.	15A	175°
1N443	400	300ma at 100° amb.	15A	175°
1N443B	400	500ma at 100° amb.	15A	175°
1N444	500	300ma at 100° amb.	15A	175°
1N444B	500	425ma at 100° amb.	15A	175°
1N445	600	300ma at 100° amb.	15A	175°
1N445B	600	350ma at 100° amb.	15A	175°
1N536	50	500ma at 100° amb.	15A	175°
1N537	100	500ma at 100° amb.	15A	175°
1N538	200	500ma at 100° amb.	15A	175°
1N539	300	500ma at 100° amb.	15A	175°
1N540	400	500ma at 100° amb.	15A	175°
1N1095	500	425ma at 100° amb.	15A	175°
1N1096	600	350ma at 100° amb.	15A	175°
1N1115	100	1.5A at 85° stud	15A	175°
1N1116	200	1.5A at 85° stud	15A	175°
1N1117	300	1.5A at 85° stud	15A	175°
1N1118	400	1.5A at 85° stud	15A	175°
1N1119	500	1.5A at 85° stud	15A	175°
1N1120	600	1.5A at 85° stud	15A	175°
1N1301	50	1.5A at 85° stud	300A	200°
1N1302	100	15A at 160° stud	300A	200°
1N1304	200	15A at 160° stud	300A	200°
1N1306	300	15A at 160° stud	300A	200°
1N1487	100	250ma at 125° amb.	15A	175°
1N1488	200	250ma at 125° amb.	15A	175°
1N1489	300	250ma at 125° amb.	15A	175°
1N1490	400	250ma at 125° amb.	15A	175°
1N1491	500	250ma at 110° amb.	15A	175°
1N1492	600	250ma at 95° amb.	15A	175°
4JA60A	100	70A at 120° stud	900A	200°
4JA60B	200	70A at 120° stud	900A	200°
4JA60C	300	70A at 120° stud	900A	200°
4JA60F	50	70A at 120° stud	900A	200°
4JA60G	150	70A at 120° stud	900A	200°
4JA60H	250	70A at 120° stud	900A	200°
4JA61A	same as 4JA60A, except reverse polarity			
4JA61B	same as 4JA60B, except reverse polarity			
4JA61C	same as 4JA60C, except reverse polarity			
4JA61F	same as 4JA60F, except reverse polarity			
4JA61G	same as 4JA60G, except reverse polarity			
4JA61H	same as 4JA60H, except reverse polarity			
4JA62A	100	40A at 120° stud	900A	200°
4JA62B	200	40A at 120° stud	900A	200°
4JA62C	300	40A at 120° stud	900A	200°
4JA62D	400	40A at 120° stud	900A	200°
4JA62F	50	40A at 120° stud	900A	200°
4JA62G	150	40A at 120° stud	900A	200°
4JA62H	250	40A at 120° stud	900A	200°
4JA62J	350	40A at 120° stud	900A	200°
4JA63A	same as 4JA62A, except reverse polarity			
4JA63B	same as 4JA62B, except reverse polarity			
4JA63C	same as 4JA62C, except reverse polarity			
4JA63D	same as 4JA62D, except reverse polarity			
4JA63F	same as 4JA62F, except reverse polarity			
4JA63G	same as 4JA62G, except reverse polarity			
4JA63H	same as 4JA62H, except reverse polarity			
4JA63J	same as 4JA62J, except reverse polarity			

RECTIFIER STACKS

G-E Type	PIV (up to)	Max. I_{DC} at T°C (up to)
4JA211	630 V	6 amps. at 55° amb.
4JA411	3360 V	18 amps. at 25° amb.
4JA3011	630 V	48 amps. at 55° amb.
4JA3511	630 V	100 amps. at 55° amb.
4JA6011	840 V	573 amps. at 35° amb.
4JA6211	840 V	430 amps. at 35° amb.

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General Electric's new streamlined line of transistors offers you both standard reliable transistors that you have used successfully for years, and exciting new devices that are extending the range of applications suitable for transistorization.

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For servo amplifiers, switches, DC to DC (or AC) converters, etc., G.E.'s Silicon Power Transistor's power handling ability allows you to design equipment never before practical.

For high frequency switching applications, the 2N394-2N397's extreme stability of h_{FE} and I_{CO}-I_{EO} simplify your design problems and contribute to high equipment reliability.

Whatever your application is, be sure to check your G-E Semiconductor Products District Sales Manager first.

MAXIMUM COLLECTOR DISSIPATION (@ 25° C (mw) P_C	BREAKDOWN VOLTAGE (VOLTS) BV_{CB}	COLLECTOR CURRENT (ma) I_C	MAXIMUM STORAGE TEMP. (° C) T_{STG}	D-C CURRENT GAIN h_{FE}	ALPHA CUTOFF FREQ. (mc) f_{ab}	POWER GAIN (db) G_e	SATURATION VOLTAGE (VOLTS) V_{CE} (SAT)	COLLECTOR CAPACITY ($\mu\mu$f) C_{ob}	COLLECTOR TO BASE CURRENT (μa) MAX I_{CO} @ V_{CB}	
150	45	25	200	15	30.0	35	.4	7	4	30
150	45	25	200	35	33.0	39	.4	7	4	30
150	45	25	200	50	38.0	42	.4	7	4	30
P_{AV}	BV_{IOB}	I_E		η	f_{MAX}	R_{BBO}	V_E (SAT)	I_{B2} (MOD)	I_{EO} @ V_{EB}	
350	45	50	200	0.56	0.9	5.6	2.2	12	1	60
350	55	50	200	0.56	0.7	7.5	2.4	12	1	60
350	45	50	200	0.62	0.8	5.6	2.6	12	1	60
350	55	50	200	0.62	0.7	7.5	2.8	12	1	60
350	45	50	200	0.68	0.7	5.6	3.0	12	1	60
350	55	50	200	0.68	0.65	7.5	3.2	12	1	60
P_C	BV_{CE}	I_C		h_{FE}	f_{ab}	R_{BE} (MAX) Ohms			I_{CO} (ma) @ V_{CB}	
85w	65	5A	150	16	400kc	4			20	65
85w	65	5A	150	12	400kc	2.5			50	65
85w	30	2A	150	30	400kc	6			20	30
85w	65	2A	150	15	400kc	10			20	65
					f_{ab}	G_e	Freq of G_e	C_{ob}	($\mu\mu$f)	
240	−30	−300	100	53	1.3			40	−16	−45
155*	−25*		100	53	1.3			40	−16	−45
240	−30	−300	100	31	1.0			40	−16	−45
155*	−25*		100	31	1.0			40	−16	−45
240	−30	−300	100	52	2.5			25	−10	−45
*Ratings based on military test requirements										
150	−15	−125	85	30 Min.	8.0			15	−6	−20
150	−10	−200	100	20 Min.	5.5			12	−6	−10
150	−15	−200	100	25 Min.	7.0			12	−6	−15
150	−20	−200	100	30 Min.	7.0			12	−6	−20
150	−10	−250	100	30 Min.	10.0			12	−6	−10
150	−12	−125	85	30 Min.	6.0			12	−6	− 6
150	−12	−125	85	60 Min.	11.0			12	−6	−12
65	15	20	85	70	9.0			3	5	15
75	30	75	85	30	9.0			2.5	1.5	15
65	15	20	85	70	9.0	28	500kc	3	5	15
50	10	20	85		100.0	14	60mc	1.8	25	7
65	15	20	85	40	8.0	30	455kc	2.4	5	15
65	15	20	85	72	9.0	24	455kc	2.4	5	15
65	25	20	85	72	9.0	24	455kc	2.4	5	15
65	15	20	85	25	6.0	24	455kc	2.4	5	15
65	15	20	85	25	7.0	30	455kc	2.4	5	15
							Po			
100	−25	−200	85	24	0.8	28	300	40	−16	−25
200	−25	−200	85	24	0.8	30	750	40	−16	−25
100	−25	−200	85	36	1.0	30	300	40	−16	−25
200	−25	−200	85	36	1.0	30	750	40	−16	−25
100	−25	−200	85	54	1.2	32	300	40	−16	−25
200	−25	−200	85	54	1.2	32	750	40	−16	−25
75	−25	− 50	85	24	0.8	37		40	−16	−25
75	−25	− 50	85	36	1.0	39		40	−16	−25
75	−25	− 50	85	54	1.2	41		40	−16	−25
75	−25	− 50	85	75	1.5	43		40	−16	−25
100	−25	−200	85	73	1.3	35	300	40	−16	−25
200	−25	−200	85	73	1.3	35	750	40	−16	−25
75	−25	− 50	85	110	1.5	45		40	−16	−25
240	−20	−200	85	33	2.0	30	750	25	−16	−25
240	−20	−200	85	48	2.5	32	750	25	−16	−25
240	−20	−200	85	48	3.0	35	750	25	−16	−25
140	−16	−100	85	70	2.0	39		25	−16	−16
140	−16	−100	85	90	2.5	41		25	−16	−16
140	−16	−100	85	80	3.0	43		25	−16	−16
140	−16	−100	85	125	3.5	45		25	−16	−16

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The foregoing specifications and data are presented to give you a general and compact guide to General Electric's broad line of Semiconductor Products. You may obtain detailed information concerning any of the devices listed by contacting your nearest G-E Semiconductor district representative, your local G-E Tube Distributor, or by writing to:

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- Tabulation of JETEC Registered Types
- Application and Design Information
- Circuit Diagrams

and other information frequently needed.

This 112 page manual is available at your local G-E Tube Distributor, or enclose 50 cents (no stamps, please).

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GENERAL ELECTRIC

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units, this chopper has complete electrostatic shielding of the coil from the contact assembly. Modular construction permits use of interchangeable coils in the operating frequency range of 0-700 cps. Thermal stability under general laboratory conditions is less than ± 2 μv.

The Bristol Company, Dept. ED, Waterbury 20, Conn.
IRE Booth No. 3932

CIRCLE 124 ON READER-SERVICE CARD

Sweep and CW Signal Generator

Separate units providing sweep-marker

Model M5-X/L5-X is a combination of two separate instruments which work together to provide a sweep-marker system. This instrument covers a range of 20 to 40 mc with other ranges from 1 mc to 100 mc available.

The top unit contains two identical variable oscillator and attenuator systems. Each oscillator provides 1 v rms into 50 ohms (metered). Frequency calibration is made in 0.25 mc increments, with accuracy of better than 0.25 per cent. The bottom unit is the sweep generator which provides 1 v rms into 50 ohms. Output is flat to better than 5 per cent, with sweep width variable from 0 to 40 per cent of center frequency. Included in this section is a crystal-controlled 1 mc harmonic generator marker system and output attenuator.

Telonic Industries, Inc., Dept. ED, 73 N. 2nd Ave., Beech Grove, Ind.
IRE Booth No. 3826

CIRCLE 125 ON READER-SERVICE CARD
CIRCLE 506 ON READER-SERVICE CARD
CIRCLE 126 ON READER-SERVICE CARD

NEW PRODUCTS at the IRE Show

Coaxial Termination

Terminates pulses with 1 μsec time

A one per cent terminating resistor mounted in a BNC male connector provides resistance values of 50, 73, and 93 ohms. The units can be used as satisfactory terminations in wide band pulse line systems from dc to pulses of one mμsec rise time (approximately 400 mc). Maximum rated pulse voltage is 200 v and average rated power dissipation is 1/2 w.

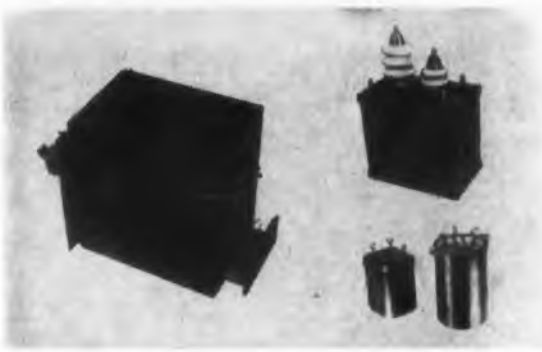
Electrical & Physical Instrument Corp., Engineering Div., Dept. ED, 42-19 27th St., Long Island City 1, N.Y.

IRE Booth No. 3240

CIRCLE 128 ON READER-SERVICE CARD

Transformer Line

High power pulse types plus others



This microwave manufacturer is offering a variety of magnetic components and assemblies, including high and low power pulse transformers, specialized audio transformers, current limiting filament transformers for high power magnetrons, and hermetically sealed power supplies. Radar modulators in sealed packages of minimum size and weight are also available including soft tube conventional types and magnetic types.

Specifications on one of these, the high power pulse transformer package, are as follows: 1600 kw peak pulse power, 1050 w average, 0.5 to 4 μsec pulse width, duty cycle of .00066, 8.7 kv peak input, impedance ratio 503:48 ohms. Self contained dc filament supply uses silicon diodes.

Airtron Inc., Dept. ED, 1096 W. Elizabeth Ave., Linden, N.J.

IRE Booth No. 3318

CIRCLE 129 ON READER-SERVICE CARD

Servo Package

Used in radar scanning systems

Model T-950 which is a compact servo-package combining a servo motor, a geared reducer, a magnetic clutch-brake and a potentiometer. In this particular unit, the motor drives the potentiometer arm at a speed corresponding to a radar scan rate of approximately 40 rpm. Upon a given signal the motor can be uncoupled and the potentiometer braked within 2 msec.

Sterling Precision Corp., Dept. ED, 34-17 Lawrence St., Flushing 54, N.Y.

IRE Booth No. 1621

CIRCLE 130 ON READER-SERVICE CARD

Crystal Filters

Feature High Selectivity

These crystal filters permit single conversion with high selectivity in the early stages of the receiver close to the antenna. Specifications include a center frequency of 10.7 mc; shape factor of 2:1; insertion loss of approximately 1 db, and size of 2-3/8 x 1 x 1-1/32 in. Model 10MA has a 6 db bandwidth of 30 kc and model 10MF has a bandwidth of 3.5 kc.

Hycon Eastern, Inc., Dept. ED, 75 Cambridge Pkwy., Cambridge 42, Mass.

IRE Booth No. 3038, 3039

CIRCLE 131 ON READER-SERVICE CARD

CIRCLE 132 ON READER-SERVICE CARD ▶

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Extreme high-temperature operation is just one of the many "plus" features—such as high-shock resistance, high-vibration resistance, low-temperature operation, and rugged construction—you get with all Miniature, Sub-miniature, and Micro-miniature G-E sealed relays. Today, General Electric sealed relays are proving their reliability on a wide variety of military and industrial electronics applications.

What's more, you get all of General Electric's complete line of standard-listed relays on only ***3-week shipment from receipt of order***—plus—rapid service on samples and prototypes.

For further information, contact your G-E Apparatus Sales Office—or—write to General Electric Co., Section 792-9, Schenectady 5, N. Y., for your copy of the brand new G-E sealed relay catalog. *Specialty Control Dept., Waynesboro, Va.*

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NEW PRODUCTS
at the IRE Show

Punched Tape Reader

Provides strip and reel feed

The Dykor paper tape reader offers the advantages of strip and reel feed by combining both in one unit. The unit stops within one character at a reading rate of 600 characters per sec and within two characters at 750. The tape is set in motion when a solenoid squeezes the tape against a continuously-rotating capstan. To stop tape motion, the driving solenoid is released, and stop solenoids engage the tape against non-rotating capstans. Fast reading is made possible through photoelectric sensing using silicon photocells. All standard 5, 6, 7, or 8 level tapes (plus sprocket hole) are handled and 11/16, 7/8, or 1 in. wide tape can be used interchangeably.

Digitronics Corp., Dept. ED, Albertson Ave., Albertson, Long Island, N.Y.

IRE Booth No. 1730

CIRCLE 133 ON READER-SERVICE CARD

Decade Counter

Maximum frequency of 1 mc

Model M6744 transistorized decade counter occupies 3.75 cu in. and has a maximum operational frequency of 1 mc. The decade

consists of four binary circuits separately constructed in an individual cartridge assembly, each of which is independently usable as a flip-flop or binary stage. Each binary module is replaceable in the decade and packaged with a hermetically sealed header, and additionally protected by complete encapsulation in epoxy resin.

In addition to the 1 mc model, the decade is available in 800 kc and 400 kc models. Silicon transistor models are available for operation at temperatures in excess of 100 C. The decade output is 6 v with 0.1 μsec rise time.

The Walkirt Co., Dept. ED, 141 W. Hazel St., Inglewood 3, Calif.
IRE Booth No. 3923

CIRCLE 135 ON READER-SERVICE CARD

Temperature Test Chambers

Standard line of 30 cu ft units

The series 30 group of temperature test chambers provide 30 cu ft of work space and have outer dimensions of 4-1/2 x 5 x 7-1/4 ft high. The units have low temperature ranges of −40 F, −100 F, −120 F, and high temperature ranges of +240 F, or +350 F optional. The units can provide for relative humidities of 20 to 98 per cent (limited by +35 F dewpoint) and 5 per cent at +160 F. The chambers are heliarc welded, with stainless steel interior and a positive seal dual door gasket.

Tenney Engineering, Inc. Dept. ED, 1090 Springfield Rd., Union, N.J.
IRE Booth No. 1516

CIRCLE 136 ON READER-SERVICE CARD

CIRCLE 134 ON READER-SERVICE CARD

ns Speed Design of Super-Power Radar

When tube designers and equipment manufacturers work together on advanced projects early in the planning stages, vital time is saved. Also, future availability of new tubes in desired quantities is assured.

The three developmental General Electric hydrogen thyratrons shown above are examples. New design and manufacturing techniques—and new applications of materials—were conceived by G-E designers to meet the specific needs of advanced super-power radar equipments now being developed. The result, months saved in the development of both new tubes and the equipment in which they will be used.

Call any of the General Electric Power Tube offices listed at the bottom of this page now if you are planning or developing advanced electronic equipment—and take advantage of General Electric's comprehensive facilities and experience. *Power Tube Department, General Electric Company, Schenectady, New York.*

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Inspect these three new hydrogen thyratrons in the General Electric exhibit at the IRE Show.

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MODEL 72
Actual Size

This unusual instrument development meets all the requirements of MIL-M-10304A as applicable, and is available in all standard DC ranges.

The completely self-shielded 180 degree arc-angle movement features a new type pivot with a new reinforced jewel holder and other construction advantages designed to withstand exceptionally high impact and vibration without impairing the accuracy or functioning qualities of the meter.

ALSO AVAILABLE

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CIRCLE 213 ON READER-SERVICE CARD

NEW PRODUCTS **at the IRE Show**

Multiturn Dial

Eliminates ambiguity

The Colvern multi-turn dial has a quick change indicator to avoid ambiguity. Ten and 15 turn dials are available with accuracies of 1 part in 1000 and 1 part in 1500 respectively.

British Radio Electronics Ltd., Dept. ED, 1833 Jefferson Pl., N.W., Washington 6, D.C.
IRE Booth No. 2815

CIRCLE 94 ON READER-SERVICE CARD

Oscilloscope

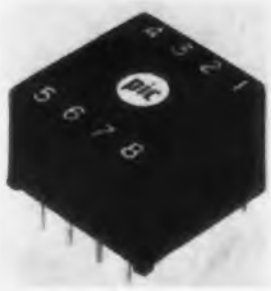
Highly linear sweep in low frequency range

The model 85-A oscilloscope is designed particularly for the teletype communications field and allied operational systems. Emphasis has been placed on providing superior low frequency sweep linearization and balanced input dc amplifiers of high gain. The oscilloscope generally fulfills the technical specifications outlined in MIL-O-15525D, with greatly improved capabilities in the low frequency spectrum.

Specifications for the horizontal sweep include range of 3 cps to 40 kc in 4 bands with a minimum of 5 per cent frequency overlap on each end of each band; linearity of ± 1 per cent on all frequencies up to 5 kc, and ± 2 per cent on frequencies above 5 kc; recovery time of less than 1 part in 100 frequencies up to 5 kc, and less than 1 part in 70 above 5 kc. The vertical and horizontal amplifiers have identical characteristics. Input impedance is single ended, 1 meg, shunted by 25 $\mu\mu$f on all attenuator positions. Input sensitivity is 5 mv/cm to 500 v/cm. Band pass is 0 to 250 kc.

James S. Spivey, Inc., Dept. ED, 4908 Hampden Lane, Washington 14, D.C.

CIRCLE 95 ON READER-SERVICE CARD



Printed Circuit Module

Pulse transformer measuring 1 in. sq

Type BA transformer has been designed to include all qualities required for printed circuit applications keeping low cost in mind. Plug in terminals are arranged on the accepted 0.1 in. grid. The units are keyed for easy insertion with automatic machinery. Four spacers provide board clearance to eliminate condensation problems. Epoxy encapsulated pulse transformers and toroids in the plastic BA case meet applicable sections of MIL-T-27A and 21038. Dimensions: 15/16 in. sq, 1/2 in. high, 1/4 in. pins.

Polyphase Instrument Co., Dept. ED, Bridgeport, Pa.

IRE Booth No. 2235

CIRCLE 97 ON READER-SERVICE CARD

Servo Amplifier

Provides 15 w of controlled power

Requiring 115 v 60 cps power, this amplifier is capable of supplying up to 15 w controlled power for the operation of standard 60 cps servo motors. The amplifier has a nominal 30 k input impedance, voltage gain of 400, 90 deg phase shift and as a plug-in unit, it sits on a miniaturized 28 v dc regulated power supply as required.

Also being shown is a hermetically-sealed, high gain (30,000) servo amplifier designed to meet MIL-E-5400A and MIL-E-5272A. The unit, measures 1-15/32 x 1-29/32 x 4-3/32 in. has an input impedance of 200 ohms, 90 deg phase shift, can drive a 60 cps 6 w servo motor from a 0.1 mv, 60 cps input and requires only 28 v dc at 350 ma power.

M. Ten Bosch, Inc., Dept. ED, Pleasantville, N.Y.

IRE Booth No. 1316

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CIRCLE 216 ON READER-SERVICE CARD

Where's the motor?

Inside-Out Motor Makes Shallow "Saucer" Fan

YOU WONDER where the motor is, when you see this fan with a "new look." Saucer-shaped, with its driving motor built into the propeller hub, it embodies an entirely new concept in fan design.

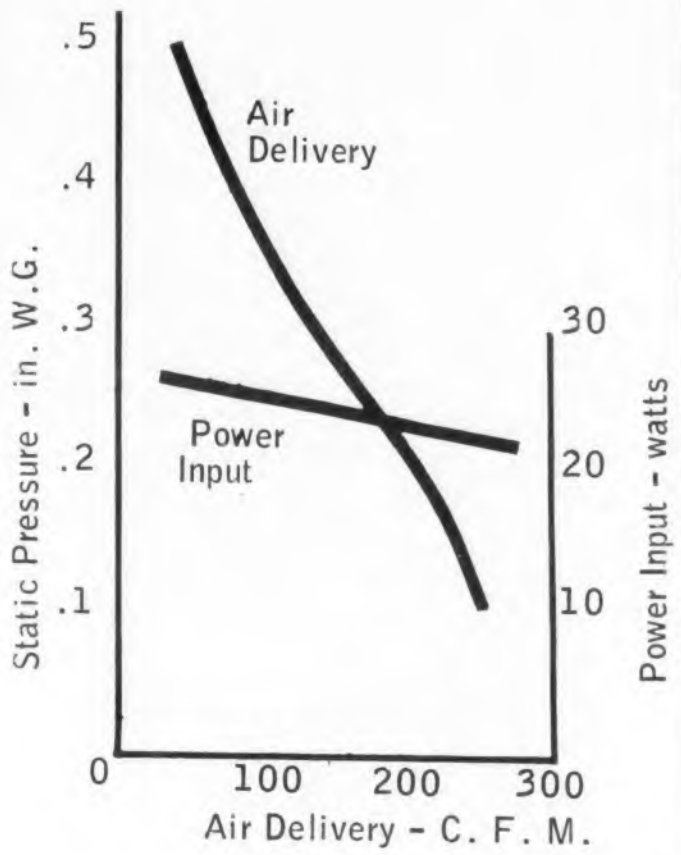
The rotor, which is part of the propeller hub, surrounds the stator. It rides on high quality ball bearings. The stator is secured to spokes on the rear of the fan, which, in turn, are secured to the rim. A terminal block on the rim connects a single phase, 115 v line (50-60 cps) to the fan's 2-pole

induction motor. Wiring enters the stationary winding through one of the spokes.

Developed by Rotron Manufacturing Company of Woodstock, N.Y., for cooling electronic consoles, the new design constitutes a step forward in space conservation. The fan's axial length is down to no more than the depth of the propeller, about 2-1/2 in. With a diameter of about 7 in., the fan weighs but a trifle more than a pound and a half.

In free air, the fan delivers 280 cfm to keep temperature rise down to only 25 deg F for 2 kw heat dissipation inside a cabinet. It maintains a 35 C winding temperature rise.

The "saucer" fan is designed for use with the modern washable dust filters. Its pressure buildup is adequate to overcome the loss of head introduced by the filter in addition to the back pressure in the equipment. The airflow can be directed in either direction, simply by reversing the fan end-to-end.



Static pressure and power input curves for 60 cycle operation.

Three servo-motor clamps secure the fan to a panel or filter box at either end of the venturi. Both ends of the venturi have "servo" type clamping rims.

The fan meets all government specifications for humidity, fungus, and altitude.

For further information on this unusual fan, turn to the Reader's Service Card and Circle 142.
IRE Booth No. 2334-6

New trends and developments in designing electrical products . . .

"Work backward"—a new design approach that's bringing the advantages of General Electric permanent magnets to fields traditionally reserved for electromagnets

A new approach to the design of motors, generators, relays, and similar products is making it possible to produce smaller, more efficient and economical units by using permanent magnets, instead of electromagnets.

The new approach is simply to "work backward." That is, design the most efficient magnet assembly first, and then the rest of the component.

In the past, where designers tried to replace electromagnets in these products, permanent magnets often proved uneconomical. Here's why:

The traditional approach was to work the permanent magnet into an *existing* design for a wire-wound field, to save the cost of new dies and other major manufacturing changes.

Under these conditions, permanent magnets will seldom show to best advantage. But, by using the "work backward" approach, many outstanding results can be obtained.

FIGURE 1 — G-E Alnico 5 magnet helps 2-pole motor develop 1/150 hp at 10,000 to 15,000 rpm.

For example, permanent magnets had been limited to fractional-hp applications, such as the 1/150-hp toy-locomotive motor in Figure 1.

But today, through imaginative design and more efficient alloys, permanent magnets are now used for rotors and stators in much larger equipment.

The DC tachometer generator in Figure 2, for example, uses a 2-lb. G-E Alnico 6 stator.

The permanent magnet provides greater reliability and accuracy than copper windings, over wide ambient temperatures. It eliminates an external power source and field regulating equipment. And, there is no replacement problem since the magnet — unlike wire — never burns out.

These are some of the advantages that can be realized from early consideration of the permanent magnet in design.

FIGURE 2 — 46-frame DC tachometer generator with Alnico 6 stator.

Alone, these can more than justify the cost of redesigning equipment to eliminate wound fields. Yet, there are other advantages that result from the magnet's ability to supply a constant field without external excitation, including:

- Elimination of field interruptions due to power failure.
- Elimination of heat and need for costly cooling equipment and insulation — thus conserving valuable weight and space.
- Elimination of danger from faulty wiring or damaged insulation.

These are important advantages where equipment must be reliable despite severe environmental conditions. But equally important to the designer is the permanent magnet's superior volumetric efficiency. A G-E Alnico magnet can usually supply a given magnetic field in a fraction of the space needed by even the best designed electromagnet.

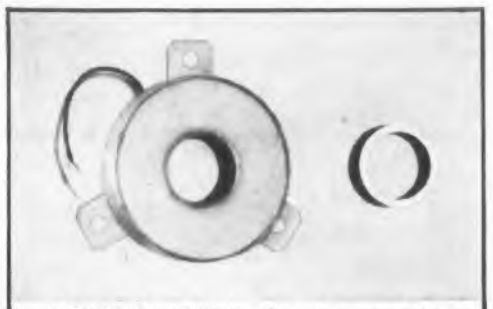


FIGURE 3 — TV-tube focusing magnets.

The TV-tube focusing magnets in Figure 3 gives some idea of the savings in space and weight a designer can effect.

The electromagnet weighs 2 lbs., and takes up 16.35 cubic inches. The G-E Alnico 5 permanent magnet weighs just 15 ounces, and requires only 1.30 cubic inches — a space-saving of 87%.

In addition to the problem of economics, two other traditional objections to permanent magnets have also been largely eliminated:

First, early permanent magnets were relatively unstable. But modern permanent magnet materials from improved manufacturing techniques are really "permanent" . . . even under temperature and humidity conditions ruinous to electromagnets.

Second, applications requiring "on-off" field action seemed outside the capabilities of permanent magnets. But modern design techniques have developed practical ways to handle this by shunting flux around the air gap.

With the new high-energy alloys and the development of more scientific design methods, the future for permanent magnets—and the opportunity for designers — is virtually unlimited.

For example, a recent use of the "work backward" approach has, for the first time, made it possible to use powerful Alnico magnets to supply uniform fields in equipment like traveling wave tubes.

General Electric Magnet Engineers have accumulated a wealth of information on the problems of redesigning for permanent magnets. They will share their knowledge with you at any stage of the magnet design project.

For more information, or the services of a G-E Magnet Engineer, write: *Magnetic Materials Section of General Electric Company, 7820 N. Neff Road, Edmore, Michigan.*

Progress Is Our Most Important Product

GENERAL ELECTRIC

CIRCLE 144 ON READER-SERVICE CARD

NEW PRODUCTS at the IRE Show

Silicon Transistors

Ratings up to 80 W

Low R_{cs}, typically 1.5 ohm, enables the ST400 and 2N389 60-v transistors to operate at currents to 5 amp. The units are useful in servo-amplifiers, relay drivers, and power switching applications. Other applications include audio amplifiers, dc to ac power converters and voltage regulators.

Transitron Electronic Corp., Dept. ED, Wakefield, Mass.

IRE Booths No. 3912, 3914

CIRCLE 145 ON READER-SERVICE CARD

Electrolytic Capacitors

Feature low leakage current

Series ML electrolytic capacitors is designed for use in miniature devices such as transistorized radio receivers, portable tape recorders, and hearing aids. The low leakage current of type ML capacitor prevents excessive current drain and permits proper functioning in coupling capacitor applications.

The maximum permissible leakage current is determined from the expression .03VC + 2, where V is the rated dc working voltage, and C is the rated capacitance in microfarads. The units are designed to operate from —20 to +65 C. The capacitors withstand the rated working voltage (from 3 to 100 v) for 500 hours at the rated ambient temperature.

Type ML can be supplied with an insulating paper sleeve (designated as type MLS) or without one (type ML). A plastic sleeve capacitor is also available (type MLV). For mounting on printed circuit boards, both leads are brought out at one end and the metal case covered with an insulating paper tube. This type is referred to as AMLS.

Pyramid Electric Co., Dept. ED, 1445 Hudson Blvd., North Bergen, N.J.

IRE Booth No. 2832

CIRCLE 146 ON READER-SERVICE CARD

Relay

Operates at +200 C

This 4pdt relay has the following characteristics: Operates in an ambient temperature of +200 C, withstands 55 g shock for 11 msec, withstands 25 g vibration up to 2000 cps, and has a contact bounce of less than 250 μsec. Insulation consists of all ceramic material in order to maintain high resistance at maximum operating temperature. The coil is hermetically sealed from the contact structure. The relay retains the rotary principle of operation standard in the Company's line of relays.

Westinghouse Air Brake Co., Union Switch & Signal Div., Swissvale, Pa.
IRE Booth No. 2122, 2124

CIRCLE 147 ON READER-SERVICE CARD

Coil Winder

Produces cross-wound coils

The No. 111 coil winder is equipped with a precision traverse system to produce accurate cross-wound coils. The machine is also equipped with an electronic drive and other attachments to speed up production and reduce handling operations. A programming attachment automatically stops the winder for the removal of taps. A pie-winding attachment automatically indexes coils. Gears are located on fixed centers so that a machine operator can change from one coil specification to another by dropping the new gears into place without using tools.

Universal Winding Co., Dept. ED, P.O. Box 1605, Providence, R.I.
IRE Booth No. 4313, 4315

CIRCLE 148 ON READER-SERVICE CARD

NEW PRODUCTS at the IRE Show

Potentiometer

Dissipates 2 W at 60 C

Offering high stability under temperature cycling in a small size, these Aceset potentiometers will dissipate 2 w at 60 C. They are available in nine resistance ranges between 100 and 25,000 ohms. Temperature cycling stability is made possible through the use of 20 ppm temperature co-efficient wire.

Mechanical specifications include a rotation of 330 deg nominal and size of 1/2 in. diam by 5/16 in. body length. Electrical specifications feature voltage breakdown of 1000 v dc, electrical angle of 325. deg nominal, resistance tolerance of ± 10% and linearity of ±5%.

Ace Electronics Associates, Inc., Dept. ED, 99 Dover St., Somerville, Mass.
IRE Booth No. 1807

CIRCLE 151 ON READER-SERVICE CARD

DC Power Supply

0 to 60 v, 7.5 amp

A rack-mounted, continuously variable power supply, model 810-A delivers from 0 to 60 v at 0 to 7.5. Regulation at any output voltage is less than 0.05 v output change from no load to the full 7.5 amp. The dc internal impedance is less than 0.007 ohms. Ripple is 7 mv rms. Overload and short circuit protection are provided by magnetically-operated circuit breakers.

Harris Labs., Inc., Dept. ED, 45 Industrial Rd., Berkeley Heights, N.J.
IRE Booth No. 1910

CIRCLE 152 ON READER-SERVICE CARD

60-V Power Supply

Regulation of 0.05 v, for 0 to 7.5 amp

Model 810A is a transistorized unit providing regulation at any output voltage of 0.05 v output change from no load to the full 7.5 amp. Internal impedance (dc) is less than 0.007 ohms. Ripple is 7 mv rms. Overload and short circuit protection are provided by magnetically-operated circuit breakers.

Harrison Labs., Inc., Dept. ED, 45 Industrial Rd., Berkeley Heights, N.J.
IRE Booth No. 1910

CIRCLE 153 ON READER-SERVICE CARD

Power Supplies

Two precision rack mounted units

The first of two power supplies being featured is MTR060-5 shown. This unit is a transistorized magnetic amplifier regulated dc supply having an output voltage of 0-60 v at 5 amp and an ac input of 95-135 v single phase, 60 cps. The ripple supplied is 2 mv rms maximum; line regulation (static) is less than ±5 mv; and dynamic line regulation is less than 10 mv. Static load regulation is less than 25 mv for no load to full load changes. All of these regulation accuracies are applicable for any output setting between 0 and 60 v dc.

The second supply, model MTB300-200, is a B+ type with circuitry similar to the above. The ac input on this unit is 105-125 v, single phase, 50-400 cps. Ripple is 6 mv peak to peak, and regulation is ±0.1 per cent for line and load. Dynamic impedance is 1 ohm from 20 to 20,000 cps. Unit is supplied in rack panel construction, and has dimensions of 5-1/2 in. high x 19 in. wide. The dc output rating is 300 v ±10 per cent at 200 ma.

Perkin Engineering Corp., Dept. ED, 345 Kansas St., El Segundo, Calif.
IRE Booth No. 3711, 3713

CIRCLE 154 ON READER-SERVICE CARD

NEW PRODUCTS at the IRE Show

Trimming Capacitor Kits

Seven types for various mounting needs

Each of these seven kits includes from four to nine piston capacitors designed for a particular mounting application. The PK11 kit contains 5 glass and invar miniature trimming capacitors for panel mount uses. The PK12 kit contains similar trimmers designed especially for printed circuit applications. The PK13 kit features 4 lead mountings for shock resistance, and polarization for wiring board plug in. The PK14 kit houses 5 glass dielectric split stator trimmers for standard panel mount. The PK15 kit includes 4 quartz split stator trimmers for panel mount. The PK16 kit offers 9 glass and invar and glass and brass trimmers for panel mount. The PK17 kit includes 4 quartz dielectric trimmers.

JFD Electronics Corp., Dept. ED, 6101 16th Ave., Brooklyn 4, N.Y.

IRE Booth No. 2333

CIRCLE 157 ON READER-SERVICE CARD

S-Band Ferrite Isolator

With standard coaxial connectors

These S-band ferrite isolators are equipped with female type N connectors to meet particular coaxial requirements. Frequency range is 2670 to 2930 mc. The unit's characteristics are as follows: frequency range, 2670 to 2930 mc; isolation, 20 db min; insertion loss, 0.8 db max; input vswr, 1.2 max, and power handling capacity of 10 w average with a 2:1 load vswr.

Airtron, Inc., Dept. ED, 1096 W. Elizabeth Ave., Linden, N.J.

IRE Booth No. 3318

CIRCLE 158 ON READER-SERVICE CARD

Zener Diodes

Full line of 65 will be exhibited

A complete line of silicon Zener voltage regulator and reference diodes comprised of a series of types in each of seven styles will be displayed. The 64 types includes: miniature types rated at 500 mw, standard top-hat style with pigtail leads rated at 1 w; 3.5 and 10 w types featuring stud construction; double-anode types rated at 350 mw; 5 w multiple junction high voltage types; and the 1N430, 1N430A, and 1N430B reference element types. All diodes in this group are designed for temperatures of −65 to +150 C and high load current capacity. An x-y plot of the reverse breakdown characteristics is supplied with each of the diodes.

International Rectifier Corp., Dept. ED. 1521 E. Grand Ave., El Segundo, Calif.
IRE Booth No. 3915, 3917

CIRCLE 159 ON READER-SERVICE CARD

Circuit Breaker

Miniature unit with ratings up to 10 amp

The model SM3 circuit breaker is a series-overload type designed for operation at 110 v at either 60 or 400 cps, or for 50 v dc. It is available in ratings from 50 ma to 10 amp. A choice of two time delay curves is offered, for fast or slow overload response. The breaker is also available for instantaneous-trip response.

Since the SM3 combines magnetic actuation with hydraulic time delay, its current capacity and trip points are free from ambient temperature effects. The breaker will maintain its 125 per cent trip point from −65 to +125 C.

Heinemann Electric Co., Dept. ED, 449 Plum St., Trenton 2, N.J.
IRE Booth No. 3811, 3818

CIRCLE 160 ON READER-SERVICE CARD

NEW PRODUCTS at the IRE Show

Microsecond Indicator

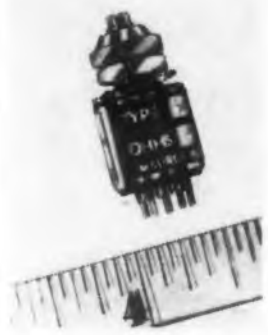
Measures time between two points of a pulse

The fundamental application of the type 206 microsecond indicator is to measure the time interval between any two points of one or two pulse waveforms with a high degree of accuracy. Operation using an oscilloscope is as follows: first, balance the time delay between two channels by using an identical signal for both inputs and record the reading of the delay dial as T_1; then apply two input signals under test separately to both channels E_1 and E_2; adjust the delay lines again until the pulse of E_2 is aligned with the pulse of E_1 channel; record the dial reading as T_2. The difference between T_1 and T_2 is the time delay between the two input signals.

Advance Electronics Lab., Inc., Dept. ED, 249-259 Terhune Ave., Passaic, N.J.

IRE Booth No. 3606

CIRCLE 163 ON READER-SERVICE CARD



Trimming Potentiometer

Dissipates 1/2 w at 150 C

Type 50-M14 trimming potentiometer will dissipate 1/2 w at an ambient temperature of 150 C, and derate at 250 C. It is housed in a 1/2 in. diam by 1/2 in. long stainless steel case. Mechanical stops are built to withstand 60 oz-in torque, and the housing has been rolled over the ceramic terminal board. The unit can withstand a 1500 v rms dielectric breakdown test at room temperature.

Maurey Instrument Corp., Dept. ED, 7924 So. Exchange Ave., Chicago 17, Ill.

IRE Booth No. 3825

CIRCLE 164 ON READER-SERVICE CARD

Electrolytic Capacitors

Hermetically sealed types, up to 150 wvdc

The positive connection of the Daly electrolytic capacitors is hermetically sealed by a compressed plastic plug. The foil, rivet, and internal connections are high purity aluminum. Availability range is 5 μf to 150 μf covering voltages from 6 to 150 wvdc. Tube diameter varies from 1/4 to 1/2 in. Lengths vary from 3/4 to 1-1/8 in., including the seal. Leads are at right angles to the axis of the capacitor and are suitable for printed circuit or tag board mounting. Positive lead cannot make accidental contact with the can.

British Radio Electronics Ltd., 1833 Jefferson Pl., N.W. Washington 6, D.C.

IRE Booth No. 2815

CIRCLE 185 ON READER-SERVICE CARD

Relay

Rugged unit for low level switching

Frame and header assembly or bridge-type construction affords high resistance to shock, vibration, and temperature in this relay. Oversize instrument type bearings at both ends minimize hinge friction. The unit is hermetically sealed and filled with inert gas.

Contacts are dpdt, rated at 100,000 operations minimum at 2 amp, 28 v dc or 115 v ac, noninductive. Available for low level and dry current switching. Resistance range, 22 to 500 ohms and up. Power requirement, 500 mw, dc. Insulation to ground, 500 v ac rms minimum. Insulation resistance, 100 meg minimum at 500 v oc, 25 C. Vibration, 10-55 cps at 10 g acceleration; 55-500 cps at 20 g. Shock, 40 g for 11 msec. Weight, 0.35 to 0.55 oz. Dimensions 0.797 x 0.875 x 0.359 (maximum).

Magnecraft Electric Co., Dept. ED, #3350D W. Grand Ave., Chicago 51, Ill.

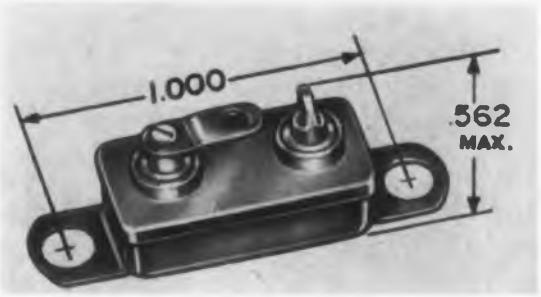
IRE Booth No. 2342

CIRCLE 186 ON READER-SERVICE CARD

NEW PRODUCTS at the IRE Show

Thermostat

Sensitivity of ±1 F



Featuring good sensitivity in a small size, the Thermoswitch measures 1.25 in. long x 0.562 in. high x 0.401 in. deep and has a sensitivity of one deg F. Temperature changes act to expand or contract the stainless steel outer shell which actuates the inner assembly to make or break totally enclosed contacts. Operating temperature limits are −65 to +220 F. No resonant frequencies occur between 5 and 500 cps vibration. Testing at 500 cps vibration with 10 g acceleration, the temperature set point will not shift over ±3 F.

Fenwal, Inc., Dept. ED, Pleasant St., Ashland, Mass.

IRE Booth No. 3001

CIRCLE 189 ON READER-SERVICE CARD

Analog-Digital Converter

Speeds of up to 200,000 conversions per sec

An addition to the company's Datrac line of high-speed analog-digital converters, the Transicon Datrac is designed primarily for industrial usage. Applications include scaling of data into engineering units, linearizing transducer nonlinearities, and arithmetic operations for function generation. As a digital-to-voltage converter the unit has speeds of up to 200,000 conversions per sec. As a voltage-to-digital converter, the speed is 5 μsec per binary bit maximum. Up to 100,000 alarm tests can be performed per second. Accuracy is ±0.05 per cent, ±1/2 least significant digit, regardless of code. Available output control current is 25 ma.

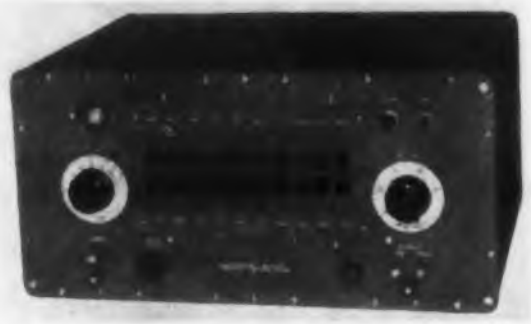
Epsco, Inc., Dept. ED, 588 Commonwealth Ave., Boston 15, Mass.

IRE Booth No. 3823

CIRCLE 190 ON READER-SERVICE CARD

Test Oscillator

Calibrates fm/fm sub-carrier units



Push-button selection of frequency is featured in the model TO-258 telemetering test oscillator. The unit is designed to provide convenient calibration for sub-carrier units of fm/fm telemetering systems. Standard fm/fm frequencies from 400 cps to 70 kc are supplied with calibrated deviation control of ±15 per cent of center frequency. Distortion is less than 1 per cent to 21 ma rms, frequency error is less than 1 per cent and output voltage is constant to 1 db from 1 to 25 v.

Teletronics Lab., Inc., Dept. ED, 54 Kinkel St., Westbury, L.I., N.Y

IRE Booth No 3417

CIRCLE 191 ON READER-SERVICE CARD

Video Sweep Generator

For use with wide band circuitry

Intended for the observation of frequency versus amplitude characteristics of wide band circuitry, such as radar and video amplifiers, type 1105 radar-video generator features high output and low harmonic distortion. It provides a sweep from 50 kc to 10 mc and has an r-f output adjustable from 1 mv to 2 v peak-to-peak into a 75 ohm load from 75 ohm source. The r-f output signal may be attenuated from 0 to 63 db by means of a pushbutton attenuator. The swept oscillator, of the varible-permeability type, has an extremely linear incremental frequency characteristic, and is keyed at a 60 cps rate to provide a return trace baseline. Ten crystal-controlled frequency markers are provided to indicate 1, 2, 3, 4, 5, 6, 7, 8, 9, and 10 mc points.

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

IRE Booth No. 3406, 3408

CIRCLE 192 ON READER-SERVICE CARD

NEW PRODUCTS at the IRE Show

Sine-Cosine Potentiometer

±0.05 per cent peak to peak accuracy

The Colvern precision sine cosine potentiometer, type 9600, makes possible a law accuracy of ±0.05 per cent peak to peak. The machined light alloy case if fitted with resistance elements wound on shaped cards, each card covering 180 deg. These pairs of cards are joined with metal bridges giving 360 deg of track. Center taps are on a single turn of wire. One or two pairs of concentric cards can be fitted, each carrying two brushes to give either one sine and cosine or two separate sine and cosine outputs.

British Radio Electronics Ltd , Dept. ED, 1833 Jefferson Pl., N.W., Washington 6. D.C.
IRE Booth No. 2815

CIRCLE 195 ON READER-SERVICE CARD

Frequency Meter

Five heads cover 170 kc to 700 mc range

The 90680 series consists of self-indicating, absorption frequency meters covering the range of 170 kc to 700 mc. This frequency range is covered by five basic heads. Each head has three or four plug-in inductor probes and the same number of individual frequency calibrations. A single 500 μamp, end-indicating, plug-in circuit is used with each of the heads. The indicating circuit is partially self-limiting so that a high power signal will not damage it.

James Millen Mfg. Co., Inc. Dept. ED, 150 Exchange St., Malden, Mass.
IRE Booth No. 2523

CIRCLE 196 ON READER-SERVICE CARD

Magnet Wire

Thermal life of 30,000 hr at 180 C

A polyester film coated magnet wire, Beldtherm provides good resistance to heat aging, solvents, and abrasion. At temperature of 130 C, the magnet wire possesses the desirable qualities which Formvar has at 105 C. Thermal life is rated at 30,000 hr at 180 C. However, this test measures limiting temperature only, and does not take into consideration the other properties, such as cut through values at elevated temperatures. Therefore a Class B rating has been assigned. Under favorable conditions the wire may be used where Class F insulations are indicated.

Belden Mfg. Co., Dept. ED, 4647 W. Van Buren, Chicago, Ill.
IRE Booth No. 1630

CIRCLE 197 ON READER-SERVICE CARD

Phase Meter

Direct reading unaffected by input amplitude

Series 405 precision phase meters measure the phase angle between two alternating voltages without either amplitude or frequency adjustment. The phase angle is presented directly in degrees on an 8 in. rectangular panel meter with mirror scale. No ambiguity exists at zero degree, and the instrument is perfectly stable for measuring a small fraction on the degree on all eight ranges including the 0-12 deg range. The circuitry consists of a coincident slicer and cathode-c coupled limiter stages with plate-to-grid degeneration providing equal accuracy for symmetrical waveforms of any shape.

Specifications are as follows: Type 405L has a frequency range from 1 cps to 20 kc; Type 405H has a range from 8 cps to 500 kc. The relative accuracy is $\pm 1/4$ deg and the absolute accuracy is $\pm$ 1 deg or 2 per cent at any range. Input voltage is 0.3 v to 70 v for type 405L, and 2 v to 40 v for type 405H. Input impedance is 3 meg shunted with 20 $\mu\mu$f on both input channels for type 405H, and 6.8 meg for type 405L.

Advance Electronics Lab., Inc., Dept. ED, 249-259 Terhune Ave., Passaic, N.J.
IRE Booth No. 3606

CIRCLE 198 ON READER-SERVICE CARD

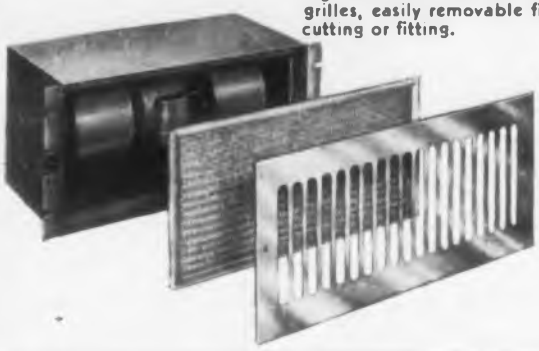
McLEAN FANS & BLOWERS*

*Patented

FOR ELECTRONIC APPLICATIONS

RACK MOUNTED FOR EASY ASSEMBLY ● FIT STANDARD 19" RACKS
STANDARD MODELS FOR OTHER RACK WIDTHS AND ANY ANGLE OF AIR DISCHARGE

Save sensitive components in computers, control units, etc. McLean's ready-to-use packaged units pressurize cabinet with cool, filtered air keeping dust out. All rack fans feature smart, heavy gauge, stainless steel grilles, easily removable filters, and standard RETMA notching to eliminate cutting or fitting.

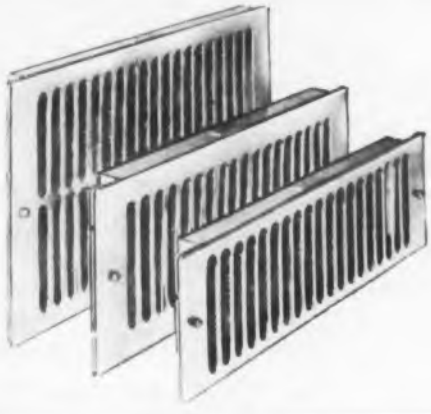


STANDARD RACK MOUNTED FANS & BLOWERS

Over 15 models available in panel heights of 3½" to 12¼" in increments of 1¾". Range, 80 to 1200 cfm. All units feature quiet operation, no electrical noise and maximum air delivery. Blower units provide better air delivery against pressure and higher velocity for faster cooling. Highly reliable, rubber mounted, 115 volts, 60 cycle motors. Also Mil. Spec. and DC motors available. Permanent filters.

RECESSED MODELS

Provide higher performance with minimum panel height. Filter and blower are recessed into the unused portion of the open base commercial type rack. Fit 3½", 5¼", 7", 8¾" and 10½" panel heights and deliver 150 cfm to 800 cfm. Highly reliable, rubber mounted, 115 volts, 60 cycle motors. Mil. Spec. and DC motors available. Permanent filters.



FILTER GRILLE ASSEMBLIES

Developed as air outlets for racks without louvres. Prevent back flushing of dust when blower is not on. Use also as inlet for filtered air with exhaust fan. Permanent filter acts as R-F shield. Mount on upper part of cabinet . . . top, front or rear. Fit standard 19" racks (or other widths), in 3½", 5¼", 7", 8¾" and 10¼" heights. Filter may be removed without removing assembly from rack. Disposable filters available.

HALF PANEL WIDTHS

For narrow racks or where space is a problem. Fit half the width of standard 19" racks leaving balance of space for other components. Blower model (5¼" high) delivers 100 cfm. Fan model (7" high) delivers 225 cfm. Powered by highly reliable, rubber mounted, 115 volts, 60 cycle motors. Mil. Spec. and DC motors available. Permanent type filter.

HALF PANEL WIDTH FILTER-GRILLE ASSEMBLIES ALSO AVAILABLE

MIL. SPEC. BLOWERS

Meet most rigid specifications. Mount in any position. Deliver 10 cfm. Fit 3¾" cube. Continuous duty, totally enclosed motor, 1/300 hp. 115 volts, 60 cycle, 3400 rpm.

RING TYPE FANS

175 to 395 cfm. Fan diameters, 6½" and 8". Motors totally enclosed, highly reliable, 115 volts, 60 cycle, 3000 rpm. Mil. Spec. and DC motors available. Other sizes available.

Most Models Available For Rapid Delivery

FREE! *12 Page Cooling Article*
16 Page Catalog • Individual Spec. Sheets

McLean Engineering Laboratories

Princeton, New Jersey • Walnut 4-4440

Agents in Principal Electronic Manufacturing Areas

mcLean

CIRCLE 200 ON READER-SERVICE CARD

NEW PRODUCTS at the IRE Show

Capacitors

300 v, 100 μμf, featuring thin design

This radial series of capacitors has ratings of 300 v up to 100 μμf. An extension of the company's axial radial series, the units feature a thin design of 5/64 to 7/64 in.

The capacitors are produced by the company's standard process: silver electrode fused to porcelain enamel bonded into a homogenous unit that requires no hermetic seal. The process results in humidity immunity, Q in excess of 2500 dissipation factor less than 0.0003, insulation resistance greater than 50,000 ohm farads, capacitance drift less than 0.05 per cent, and temperature coefficient of 115 ±25 ppm/deg C through the range from —55 to 125C.

Vitramon, Inc., Dept. ED, Box 544, Bridgeport, Conn.

IRE Booth No. 2401, 2403

CIRCLE 201 ON READER-SERVICE CARD

Differential DC Amplifier

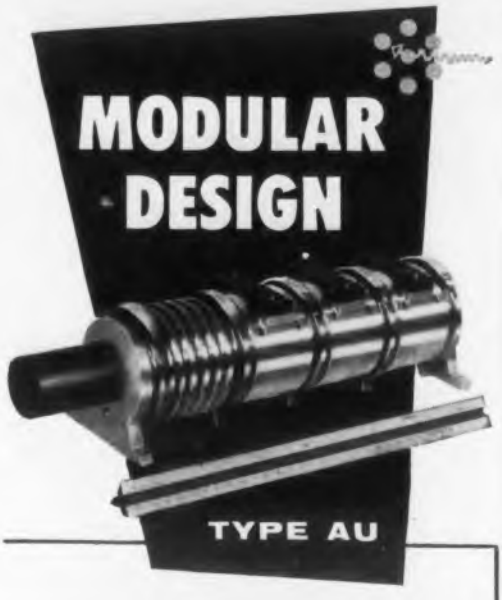
Completely isolated input and output

Model 114A differential dc amplifier features floating input and output both of which are completely isolated from each other. Specifications include 120 db common-mode rejection from dc to 60 cps, gain of 10 to 1000 in 5 steps with continuous variation in between, gain accuracy of 1 per cent from dc to 10 cps, 3 per cent to 30 cps, 3 db down at 120 cps. Dc gain stability and linearity is 0.1 per cent. There is less than 5 μv noise, and less than 5 μv drift at gain of 100 or above. Maximum output capability is 10 v at 10 ma.

Cohu Electronics, Inc., Kin Tel Div., Dept. ED, 5725 Kearny Villa Rd., San Diego 11, Calif.

IRE Booth No. 3401, 3403, 3405

CIRCLE 202 ON READER-SERVICE CARD



SCANNING SWITCH

BY

ASCOP

Maximum flexibility and ease of servicing have been achieved in the design of this Type AU multiplexer by ASCOP. Building block construction enables easy adaptation of the switch to a wide variety of requirements in systems using electrical time sharing techniques. Switch sections, gear reduction modules, and drive units can be changed rapidly in the field for system alterations and servicing. Reduction units can be installed between switch sections for various speed combinations. Only minutes are needed for replacing or changing any module. Brushes and contact surfaces are readily accessible for inspection. Each contact plate is externally phaseable with respect to shaft position while in operation.

DESIGN DATA

Contact plates per section: 2
Poles per plate: 1, 2 or 3
Contacts per pole: To a maximum of 240
Phase error between poles: ± 5%
Leakage resistance: 100 megohms nominal
1000 megohms with more frequent service
Scanning rate: Up to 30 rps
Motors: 60 cps, 400 cps, or D.C.
Duty: Continuous

For Further Information, Write:

ASCOP

Electro-Mechanical Division
Applied Science Corporation of Princeton
P.O. Box 44, Princeton, N. J.

CIRCLE 204 ON READER-SERVICE CARD

Spectrum Analyzer

Uses triodes in place of klystrons

Full frequency range covered in one r-f head and use of triodes in all local oscillators are featured in this spectrum analyzer. Frequency range is from 10 mc to 16 kmc by interpolation. Sensitivity from 10 mc to 1000 mc is 85 dbm or better, ranging down to a figure of 50 dbm at 16,000 mc. Spectrum resolution is 10 kc measured at 3 db bandwidth points. Regulated plate supplies are employed to provide maximum stability. A panel mounted meter and selector switch is available to monitor line voltage and power supply voltages.

Lavoie Labs., Inc., Dept. ED, Morganville, N.J.
IRE Booth No. 3242-43-44

CIRCLE 205 ON READER-SERVICE CARD

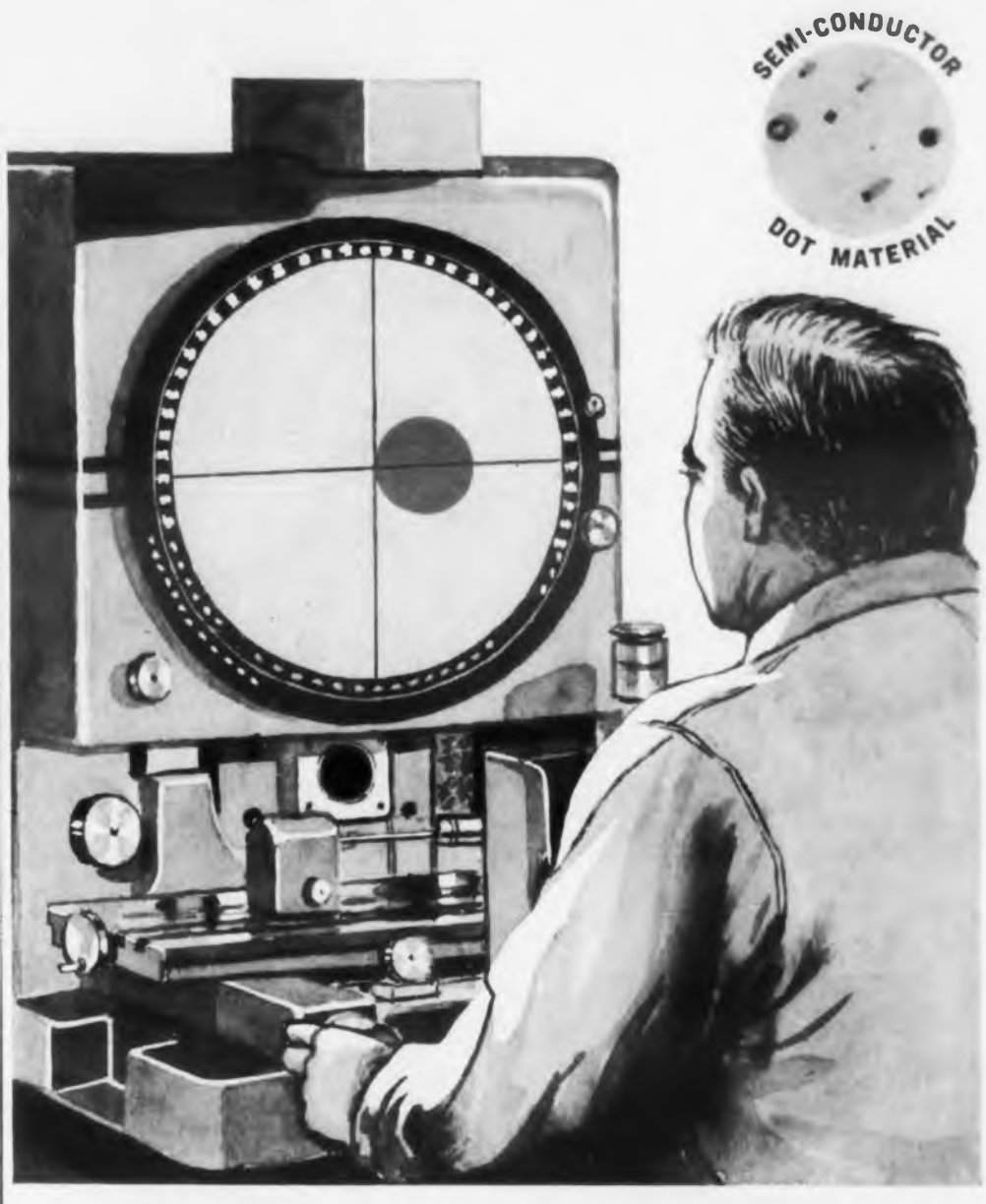
Phase Meter

Measures down to 0.01 deg

Model 200AB phase meter features high sensitivity, and high input impedance for the reference input as well as for the signal input. As with other of the Company's instruments, model 200AB measures phase angles by the multiplying principle which permits measurements to be made accurately in the presence of noise and harmonic voltages. The instrument can be used to measure in-phase and quadrature components of voltage and may be used to measure phase angles in the order of 0.01 deg. The unit, measures from 0 to 360 deg without ambiguity.

The Industrial Test Equipment Co., Dept. ED, 55 E. 11th St., New York 3, N.Y.
IRE Booth No. 3229

CIRCLE 206 ON READER-SERVICE CARD



WITH **ALPHA UHP*** Ultra High Purity **DOT MATERIAL**

ONLY THE BEST ARE CHOSEN

ULTRA HIGH PURITY METALS – *continuous spectrographic analyses assure purity of elements to 99.999+.*

METALLURGICAL RESEARCH – *facilities, trained personnel, and skills available for your development problems.*

EXTENSIVE SPECIALIZED EQUIPMENT & FACILITIES – *for production of specific alloy requirements.*

ALLOYING – *atmospheric control, basic melts, and other techniques guarantee complete uniformity.*

INSPECTION – *precise control and measurement of physical dimensions and alloy compositions.*

PACKAGING – *scientifically cleaned, counted, and packaged.*

BREAK THROUGH *the quality barrier on Dot Material SPECIFY ALPHA UHP**

*trademark

ALPHA METALS, INC.

69 WATER ST., JERSEY CITY 4, N. J.– HEnderson 4-6778
midwest division ALPHA-LOY CORP.
2248 S. Lumber St., Chicago, Illinois – MOnroe 6-5280

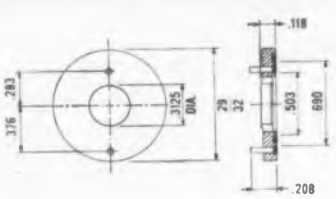
ALPHA

AT IRE SHOW Booth **4323** . . . CHEMISTS, METALLURGISTS, AND ENGINEERS PRESENT TO DISCUSS YOUR CURRENT PROBLEMS.

CIRCLE 207 ON READER-SERVICE CARD

high precision? low cost?

Electro Tec Flat Pancake Slip Rings May Answer This Double Question



If wide temperature range, low torque, high current density and inexpensive design are prime considerations in your circuits, Electro Tec round pancake slip rings mounted radially will serve your purpose.

Miniature pancake units are yet another product of Electro Tec's superior manufacturing techniques and facilities for producing precision quality miniature units, at low cost.

If your design involves a problem in commutation, or if your present units are capable of improvement *at no extra cost*, call or write Electro Tec. There is an Electro Tec engineer near you. He will be glad to visit you and help on your design problems.

Write for illustrated literature.

ELECTRO TEC CORP.

Products of Precision Craftsmanship

P. O. Box 37B, SOUTH HACKENSACK, N. J.

Pat. No. 2,696,570

Visit our booth 1216-1220 at the IRE show.

CIRCLE 208 ON READER-SERVICE CARD

NEW PRODUCTS **at the IRE Show**

Phase Shifter

Accuracy of 0.1 deg

Type 208 consists of resistant-capacitance phase shifter networks, and electron-tube phase inverter, and an output cathode follower. Phase angle lag can be read directly at 400 cps. Phase range is 360 deg with a maximum error of less than 0.1 deg at 400 cps. Maximum input signal is 25 v rms. Impedance looking into the output is 300 ohms shunting resistance, and 2 μf series for dc blocking. Input impedance is about 100 K in series with 2000 μμf to ground.

Advance Electronics Lab., Inc., Dept. ED, 249-259 Terhune Ave., Passaic, N.J.

IRE Booth No. 3606

CIRCLE 209 ON READER-SERVICE CARD

Audio Spectograph

Three visual analyses in 85-12,000 cps range

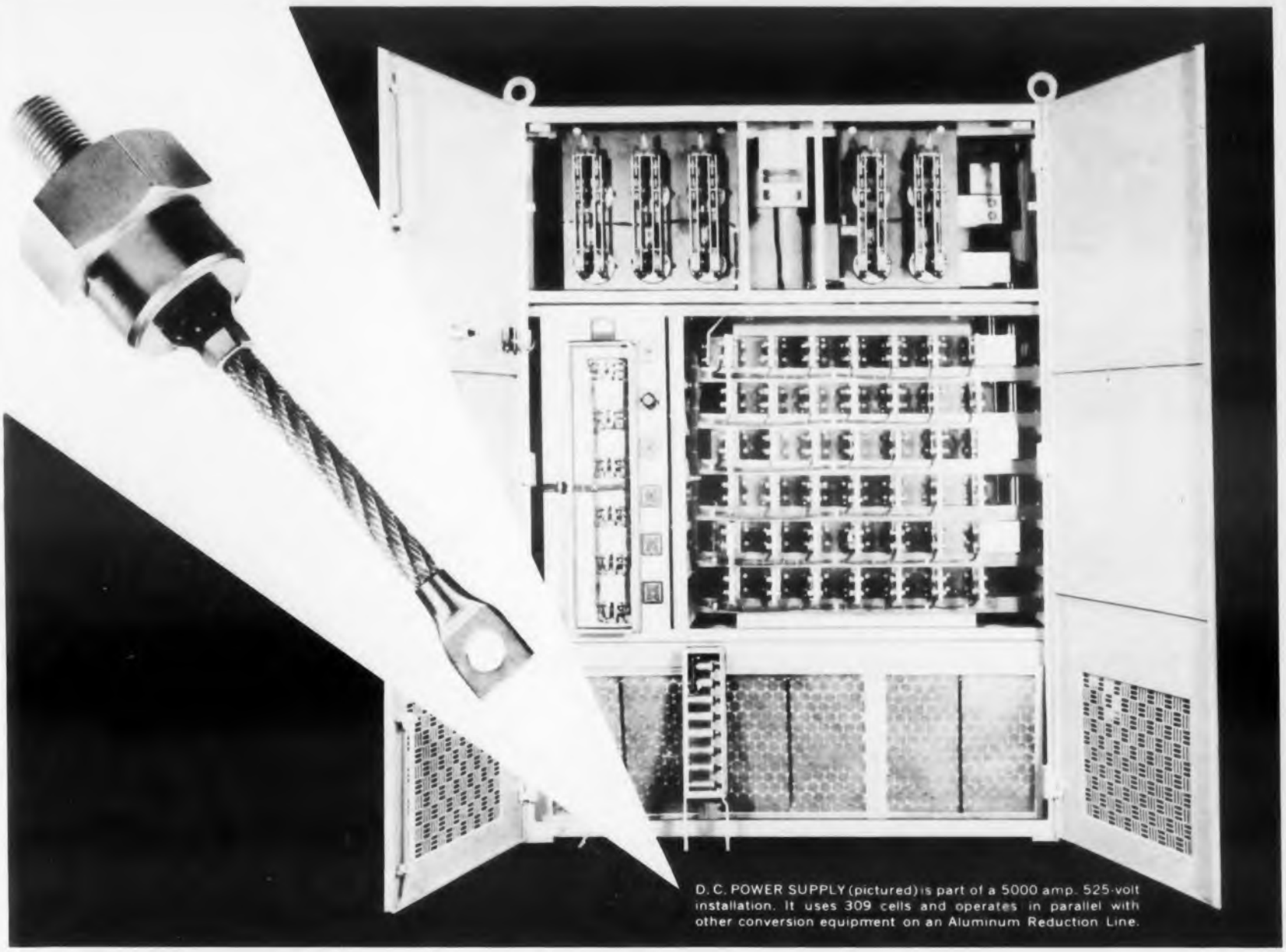
The Sona-Graph recorder is a sound spectrograph that makes a permanent, storable, aural record in addition to three visual analyses. The display graphs are made in two switched bands, the first from 85 cps to 6 kc, and the second from 6 kc to 12 kc. A characteristic of the recorder is that with slight loss in output amplitude it can be adapted to study subsonic vibrations.

The first of these displays, the Sonagram, relates frequency and intensity to time; the second, the Section, relates intensity (over a wider dynamic range than the first) to frequency at any selected time. The third displays amplitude.

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

IRE Booth No. 2608, 2610

CIRCLE 210 ON READER-SERVICE CARD



D. C. POWER SUPPLY (pictured) is part of a 5000 amp. 525-volt installation. It uses 309 cells and operates in parallel with other conversion equipment on an Aluminum Reduction Line.

WESTINGHOUSE, LEADER IN ELECTRONICS, BRINGS YOU

MORE EFFICIENT DC POWER

WHEREVER YOU NEED IT!

ELECTRO-CHEMICAL PROCESSING

INDUSTRIAL POWER SUPPLIES

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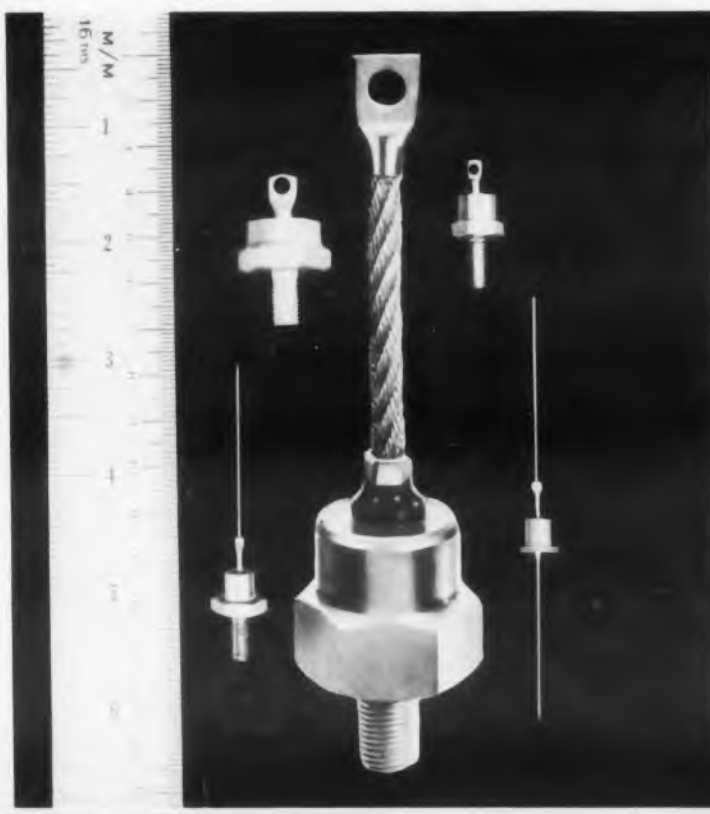
WESTINGHOUSE

"BEEF UP" DC POWER AT LOWER COST!

Now, greater power output at lower cost is obtainable for countless applications—from smallest to heaviest industrial jobs (such as arc welding, electroplating, electro-chemical processing, etc.). Westinghouse silicon and germanium rectifiers give more efficient rectification, making possible important reductions in space, weight, and cost. Ruggedly designed to meet a wide range of operating conditions, they are hermetically sealed and are characterized by their long life, no detectable aging, excellent reliability and mechanical stability. For full information on Westinghouse Semiconductors, mail coupon on the page after next.



SILICON POWER RECTIFIERS

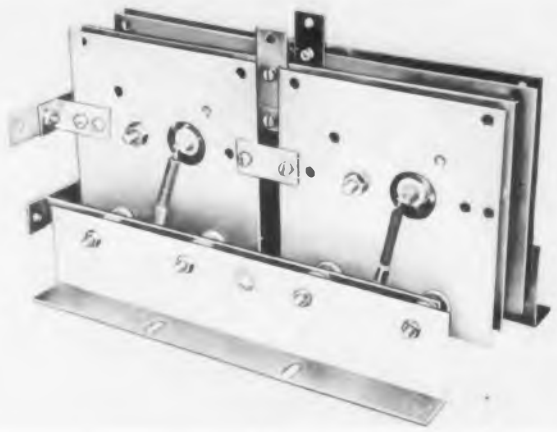
The d.c. forward currents for single cells range from 50 milliamperes to 150 amperes with maximum peak inverse voltages up to 1000 volts. Bridge configurations are assembled to give any desired combinations of d.c. forward current and output voltages.

Type	P.I.V. (max)	Peak Reverse Current Max.	Maximum Current at 150°C case	Thermal Drop Junction to Case
Low Power				
305	50-1000	1.5 ma	1.6 amps	5°C per watt
307	50-600	.5 ma	1.6 amps	5°C per watt
308	50-600	.5 ma	1.6 amps	5°C per watt
320	50-1000	1.5 ma	1.6 amps	5°C per watt
Medium Power				
302	50-600	20 ma	35 amps	1°C per watt
303	50-600	10 ma	18 amps	1.5°C per watt
304	50-600	10 ma	12 amps	2°C per watt
341	50-600	10 ma	6 amps	2°C per watt
High Power				
319	50-500	40 ma	110 amps	.3°C per watt
322	50-500	40 ma	110 amps	.3°C per watt
326	50-500	40 ma	110 amps	.3°C per watt
327	50-500	50 ma	140 amps	.2°C per watt
328	50-500	50 ma	140 amps	.2°C per watt

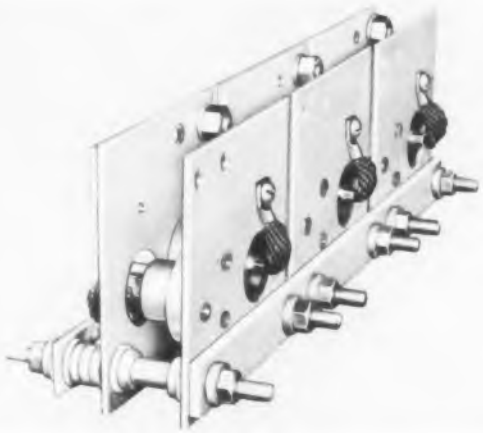
SEMICONDUCTORS

BRIDGES

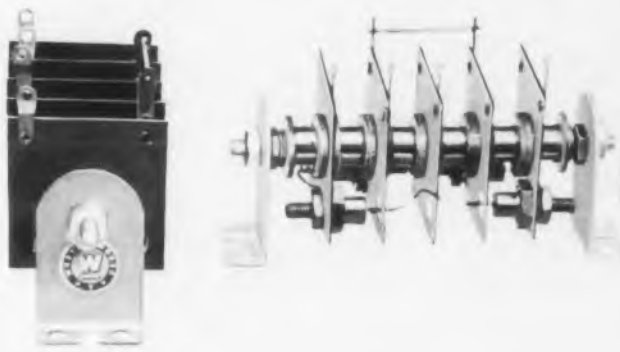
This is a 4-1-1 single-phase full-wave bridge using 303 cells on 5" x 5" copper plates. At an ambient temperature of 30° C, it will deliver up to 27 amperes d.c. with convection cooling, or 53 amperes d.c. with forced air cooling at 1000 l.f.m. The primary applications are d.c. power supplies, vibrator and magnet coil supplies, motor control, etc.



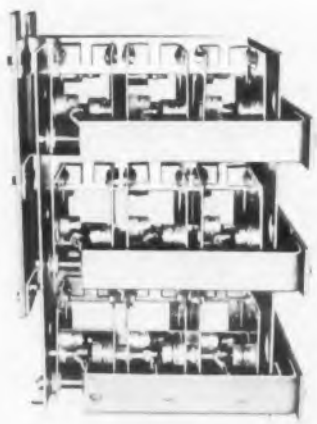
This is a 4-1-2 single-phase full-wave bridge using 302 cells on 5" x 5" copper plates. At an ambient temperature of 30° C, it will deliver up to 94 amperes d.c. with convection cooling, or 178 amperes d.c. with forced air cooling at 1000 l.f.m. The primary applications are d.c. power supplies, vibrator and magnet coil supplies, motor control, etc.



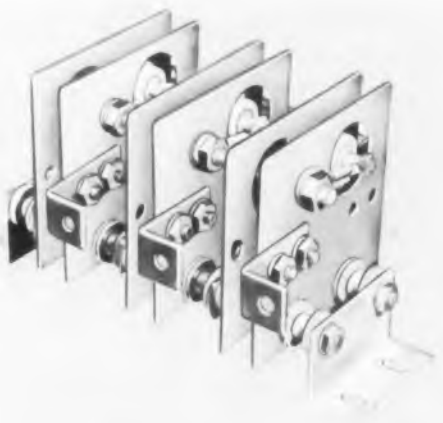
This is a 6-1-1 three-phase full-wave bridge using 322 cells on 5" x 5" copper plates. At an ambient temperature of 30° C it will deliver up to 132 amperes d.c. convection cooled, or 330 amperes d.c. with forced air cooling at 1000 l.f.m. The primary applications are welding, electro-plating, chemical reduction, arc furnaces, motor drive, battery chargers, etc.



This is a 4-1-1 single-phase full-wave bridge using 305 cells on $1\frac{1}{2}$" x $1\frac{1}{2}$" copper plates. At an ambient temperature of 30° C, it will deliver up to 3.2 amperes d.c. with convection cooling. The primary applications are power supplies, relays, solenoids, mag amps, etc.

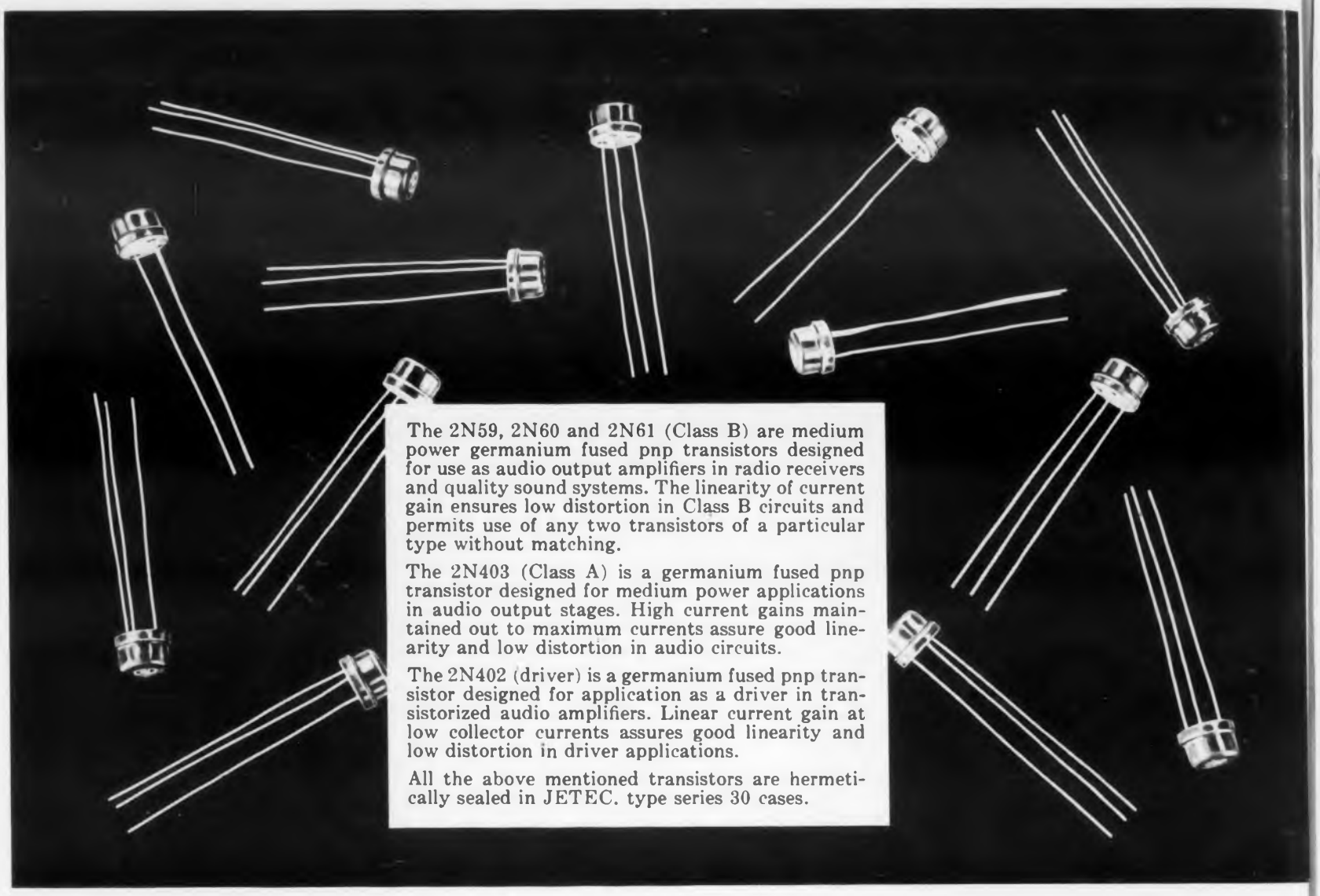


This is a 6-1-6 three-phase full-wave bridge using 322 cells on 5" x 5" copper plates. At an ambient temperature of 30° C, it will deliver up to 780 amperes d.c. with convection cooling, or 1980 amperes d.c. with forced air cooling at 1000 l.f.m. The primary applications are electro-plating, battery forming, arc furnaces, chemical reduction, motor drive, etc.



This is a 6-1-1 three-phase full-wave bridge using 302 cells on 3" x 3" copper plates. At an ambient temperature of 30° C, it will deliver up to 61 amperes d.c. with convection cooling, or 132 amperes d.c. with forced air cooling at 1000 l.f.m. The primary applications are d.c. power supplies, vibrator and magnet coil supplies, motor control, etc.

WESTINGHOUSE GERMANIUM TRANSISTORS



The 2N59, 2N60 and 2N61 (Class B) are medium power germanium fused pnp transistors designed for use as audio output amplifiers in radio receivers and quality sound systems. The linearity of current gain ensures low distortion in Class B circuits and permits use of any two transistors of a particular type without matching.

The 2N403 (Class A) is a germanium fused pnp transistor designed for medium power applications in audio output stages. High current gains maintained out to maximum currents assure good linearity and low distortion in audio circuits.

The 2N402 (driver) is a germanium fused pnp transistor designed for application as a driver in transistorized audio amplifiers. Linear current gain at low collector currents assures good linearity and low distortion in driver applications.

All the above mentioned transistors are hermetically sealed in JETEC. type series 30 cases.

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Westinghouse Electric Corporation
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Please send me full information on the following Semiconductors:

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TITLE _____

COMPANY _____

ADDRESS _____

Type	Collector Supply Voltage Volts	Power Output Milliwatts	Maximum Collector Dissipation @ 25°C Milliwatts	Collector Load Impedance Ohms	Power Gain Decibels	Collector-to-Base Cutoff Current Micro-amps	Junction Temperature Centigrade
Class B Applications							
2N59	−9	300	180	250*	30	−15†	+85°C
2N60	−9	300	180	250*	28	−15†	+85°C
2N61	−9	300	180	250*	26	−15†	+85°C
Class A Applications							
2N403	−9	30	180	500	34	−15†	+85°C
Driver Applications							
2N402	−9	2	180	10.000	39	−15†	+85°C

*Collector to Collector Load Impedance

†VCB = minus 20V

YOU CAN BE SURE...IF IT'S Westinghouse

Waveguide Rotary Joints

Broad band operation at high speeds

Series DIC-6500 waveguide rotary joints is of the in-line type and features ranges from 2600 mc to 18 kmc and operation at speeds up to 100 rpm. The joints employ special transducers from rectangular to loaded circular waveguide, producing a pure circularly symmetric TM mode. Because of the purity of the mode, no dissipative mode suppressors are required so that insertion loss is held to a minimum, and there is no phase shift with mechanical rotation.

Vswr is less than 1.5, insertion loss is less than 0.1 db, and the variation of insertion loss with rotation is less than 0.05 db.

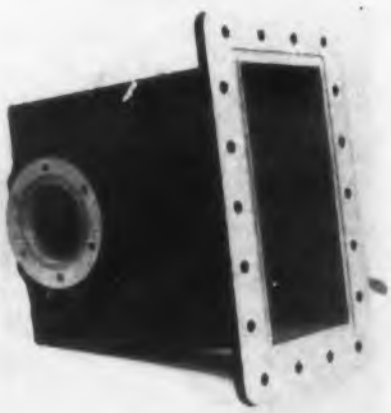
Diamond Antenna & Microwave Corp., Dept. ED, 7 North Ave., Wakefield, Mass.

IRE Booth No. 3237, 3239

CIRCLE 221 ON READER-SERVICE CARD

Microwave Transition Member

Offers high heat dissipation



Featuring a high heat dissipation rate, this transition member of a microwave transmission line is a high-power waveguide component with a wide bandwidth. In conventional transition construction, the probe has a minimum opportunity to dissipate the heat generated by high power conduction, and the coax insulator tends in time to break down. In place of the round bar customarily placed at the quarter wave point, between the probe and transition sides to aid in heat dissipation, this transition member uses a flat bar at this point. The flat shape allows greater freedom of positioning for a given area. Better impedance matching with minimum loss results, and wider bandwidth becomes possible. Bandwidths up to 40 per cent of center frequency with a standing wave ratio of 1.1:1 have been achieved.

D. S. Kennedy & Co., Dept. ED, Cohasset, Mass.

IRE Booth No. 2344

CIRCLE 222 ON READER-SERVICE CARD

ACTUAL SIZE

SERIES 341 TEN-TURN *PRECISION* POTENTIOMETER

Smaller in diameter than a fountain pen — no longer than a shriveled up Gryllidae Gryllus*, this tiny "pot" offers ultimate precision in the smallest package on the market.

Check some of the standard specifications of this precision-built, wire-wound, ten-turn potentiometer:

SIZE:	**0.55"x 1.02"**
WEIGHT:	**10 gms. max.**
BACKLASH:	**Essentially zero**
PHASE SHIFT:	**Less than 0.1° at 400 cps**
VIBRATION:	**20gs to 2000 cps (3 attitudes)**
POWER:	**2.5 watts at 40°C, 0 watts at 140°C**

* also known as a cricket

STANDARD MODELS AVAILABLE IN PRODUCTION QUANTITIES NOW . . . SPECIAL REQUIREMENTS CAN USUALLY BE MET. WRITE TODAY FOR COMPLETE INFORMATION CONCERNING THIS AND OTHER MINIATURE WIRE-WOUND, PRECISION POTENTIOMETERS.

Openings exist for highly qualified engineers

WRITE TODAY FOR DETAILS

ACTUAL SIZE

One-turn, Wire-wound, Precision Potentiometer.
LOW COST HIGH PERFORMANCE

DAYSTROM PACIFIC

A division of DAYSTROM INC.

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Toronto 10, Ontario

Export: Daystrom International
100 Empire Street
Newark 12, New Jersey

CIRCLE 223 ON READER-SERVICE CARD

NEW PRODUCTS

at the IRE Show

Synchronous Motor

Rotation accurate to ±0.1 deg

Model GS synchronous motor features a constant angular rotation (±0.1 deg) no load to full load. The motor is provided with an integral start motor, and is capable of operating from a vacuum tube amplifier on signal frequencies from 60 to 3600 cps. The unit will operate single phase in the plate circuit of a single-ended amplifier or as a two-phase motor when driven by a push-pull amplifier, providing up to 1/100 hp output. The motor current is about 75 ma per phase. The power input may be as high as 20 w.

Times Facsimile Corp., Dept. ED, 540 W. 58th St., New York 19, N.Y.

IRE Booth No. 1824

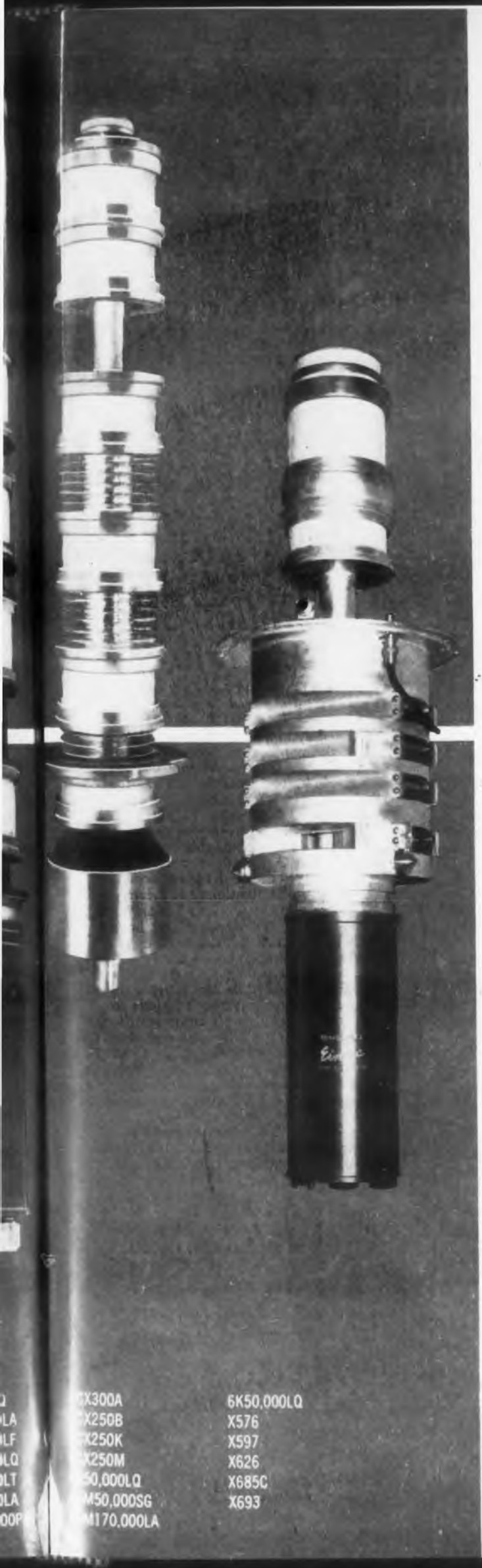
CIRCLE 137 ON READER-SERVICE CARD

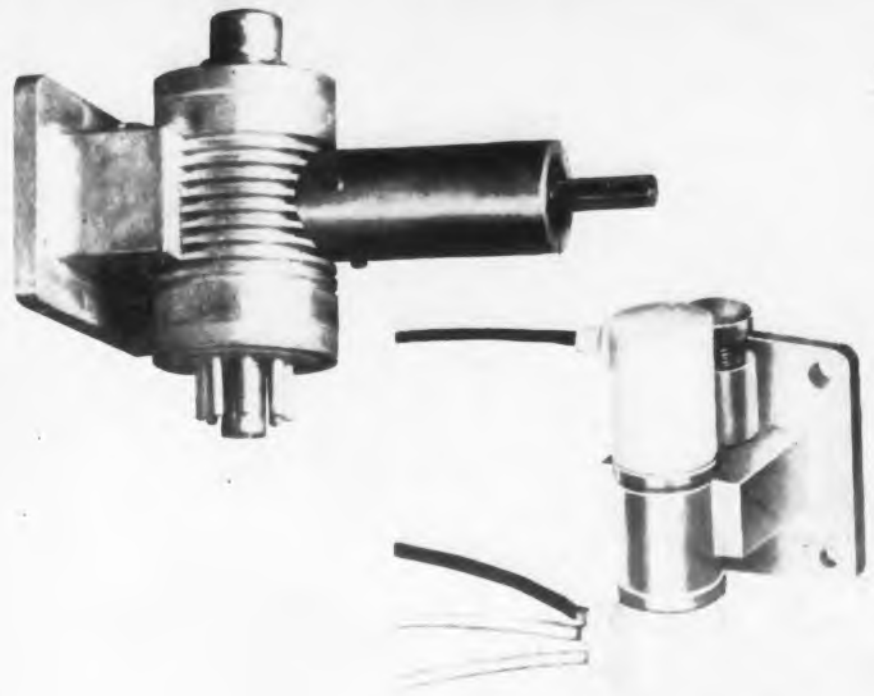
Magnetic Recording Test Unit

A modular read-write test system

This read-write system for magnetic tape or drum memories measures 11 in. high x 11 in. wide x 9 in. deep. Individual units are entirely transistorized and printed

CIRCLE 138 ON READER-SERVICE CARD ➤





From audio into super high frequencies, Eimac covers the RF spectrum with modern ceramic tubes. This incomparable ceramic electron tube family — more than one-third of the Eimac line — includes reflex and amplifier klystrons, negative grid tubes, rectifiers, pulse modulators, and receiving tubes. The tubes illustrated are typical of more than 40 Eimac ceramic tube types that are being selected by leading equipment manufacturers for use in all types of applications — from tropo-scatter to industrial heating, from single sideband to pulse.

The advantages of reliable Eimac ceramic tubes include: resistance to damage by impact, vibration, and heat; smaller size; and better processing techniques.

Do it yourself — subject an operating Eimac ceramic tube to impact at our unique display, booths 2409-2412, during the New York IRE Show, March 24-27.

Eimac®

EITEL-McCULLOUGH, INC.
SAN BRUNO CALIFORNIA

Eimac First with ceramic tubes that can take it

SHF Ceramic Tubes

1K125CA
1K125CB
1K20XS
1K20XK
1K20XD
1K20KA
X563
X639
X686

circuit techniques are utilized throughout. The modular units pictured above are, from top to bottom, a 10 bit shift register for parallel-to-serial conversion of incoming data or serial-to-parallel conversion of outgoing data, a ten channel NRZ write-amplifier, a ten channel NRZ read-amplifier, and a regulated power supply. The units are compatible with all other units in the company's line of transistorized pulse programming equipment.

Navigation Computer Corp., Dept. ED, 1621 Snyder Ave., Philadelphia 45, Pa.
IRE Booth No. 1311

CIRCLE 139 ON READER-SERVICE CARD

Duplexer Tube

Two megawatt unit for L-band use

The MA-336/7166, first in a series of L-band high power duplexer tubes, is conservatively rated at 2 megawatts peak power and 4 kw average power for continuous operation over a minimum life span of 500 hr.

Features of the tube include a ruggedized window construction for high reliability under thermal shock or mechanical strain during high power operation. The keep-alive structure of the tube makes possible controlled TR leakage energy over 500 hr operation. This is evidenced by a negligible change in the overall noise figure of crystals mounted behind the tube. Overall length of the MA-336 is 7-1/4 in.

Microwave Associates, Inc., Dept. ED, Burlington, Mass.
IRE Booth No. 3508, 3510

CIRCLE 140 ON READER-SERVICE CARD

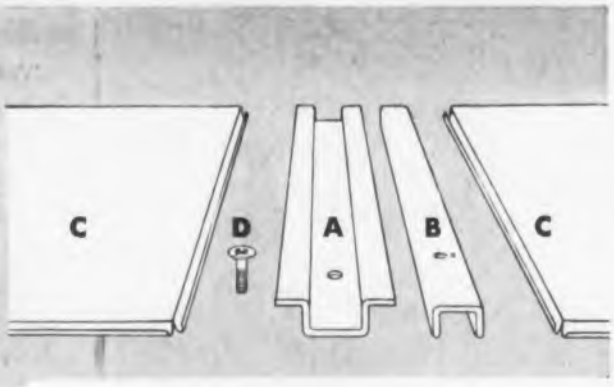
◄ CIRCLE 138 ON READER-SERVICE CARD

LINDSAY STRUCTURE

application requires only

4 BASIC PARTS

yet installations are unlimited



A—FLANGED FRAME
B—TENSIONER
C—PANEL SHEETS
D—LOCK SCREWS

Lindsay Structure makes possible the prefabrication of enclosures for instruments, testing machines, radio and radar equipment; housings for processing, shielding, large towers and industrial equipment; truck and trailer bodies; and buildings. All shapes and sizes are possible to any desired dimension within ½ inch. Lindsay Structure has demonstrated its efficiency in hundreds of different applications, and in all workable metals.

With Lindsay Structure you save the cost of expensive dies and "tooling" up. Production can be started almost immediately . . . and assembly handled by workers without special training . . . and uniformity of finished structures is assured with die-drawn, die-cut Lindsay components to exact size requirements.

And there need be no delay in changing models, sizes, or other details that would normally slow down production — even in the largest Lindsay Structure units.

Make use of Lindsay Structure's 78,085 panel sizes for your housing, enclosure, building or equipment requirements. Write for descriptive folder, or send a single-line drawing for prompt cost estimate.

LINDSAY STRUCTURE DIVISION

INTERNATIONAL STEEL COMPANY

1427 Edgar Street Evansville 7, Indiana

Canadian Affiliate: Lindsay-International, Ltd., Port Credit, Ontario

CIRCLE 224 ON READER-SERVICE CARD

NEW PRODUCTS at the IRE Show

I-F Transformers

For transistor circuits

This line of i-f transformers, series 35, is designed for transistor circuits. The unit pictured is a typical 455 kc i-f unit. Other transistor i-f's designed for frequencies up to 10.9 mc are similar in appearance but taller.

Aladdin Electronics, Dept. ED, 703 Murfreesboro Rd., Nashville, Tenn.
IRE Booth No. 1816

CIRCLE 225 ON READER-SERVICE CARD

Relay

Stands 500 cps 10 g vibration

Type BHSM-HT relay is rated at 500 cps at 10 g vibration. The unit uses cross-bar palladium contacts, silicone-glass pile up insulators, a welded bracket assembly and frame, Teflon magnet wire, and a Kel-F-Coil bobbin. The relay is designed to operate at a temperature range of −65 to +125 C and will withstand 30 g operating shock or 70 g non-destructive shock.

Available in contact form up to 4pdt rated 3 amp at 32 v dc or 115 v ac non-inductive. Coils can be furnished up to 130 v dc with a minimum sensitivity of 0.2 w per pole and a maximum coil dissipation of 3.75 w. Approximate weight is 3.25 oz. Approximate dimensions are 1.332 x 0.960 x 1.643 in.

Essex Wire Corp., RBM Div., Dept. ED, 1601 Wall St., Ft. Wayne 6, Ind.
IRE Booth No. 2525

CIRCLE 226 ON READER-SERVICE CARD

Electronic Measuring Equipment

Twenty-two models will be exhibited

Heading the list of 22 instruments being introduced by this manufacturer at the show are the 120 A and 120 AR oscilloscopes. With a range from dc to 200 kc, the 120 A (cabinet mount) and 120 AR (rack mount) have a sweep speed range of 1 μsec/cm to 0.5 sec/cm. They include a X5 sweep expansion on all ranges, with vernier for continuous control. Fifteen calibrated sweeps are provided, in 1-2-5 sequence. Automatic synchronizing is provided on any internal or external voltage; scopes may also be triggered by line voltage. Calibrated identical bandwidth vertical and horizontal amplifiers provide convenient phase measurement.

Other instruments that will be featured are: four microwave sweep oscillators, covering the G, J, X and P bands engineered to speed measurements between 3.95 and 18.0 kmc; the 721A transistor power supply having a 150 ma maximum output, with output resistance less than 0.2 ohm; the 218A digital delay generator, producing two exact time intervals or pulse delays independently adjustable from 1 to 10,000 μsec in 1 μsec steps; the 606A signal generator, covering the broad frequency range of 50 kc to 65 mc; the 340A noise figure meter; enabling a semi-skilled worker to do receiver and component optimizing jobs in a few minutes; the 345A i-f noise source, designed specifically for i-f amplifier noise measurement, includes temperature-limited diode sources operating at either 30 or 60 mc; the 425A microvolt meter, a high stability voltmeter which reads voltages of 10 μv to 1 v in 18 ranges and currents of 10 μamp to 3 ma.

Some of the other instruments are: the 434A calorimetric wattmeter; the 355A and 355B 50 ohm attenuators; the P532A waveguide frequency meter; and the 152B oscilloscope differential amplifier.

Hewlett-Packard Co., Dept. ED, 275 Page Mill Rd., Palo Alto, Calif.

IRE Booth No. 2509, 2511, 2513, 2515

CIRCLE 229 ON READER-SERVICE CARD

ELIN POWER OSCILLATORS...

to "System-mate" Your Equipment Requirements!

CABINET MODEL
DK-102 (2 watts)
DK-106 (6 watts)

RACK MODEL
DK-102R (2 watts)
DK-106R (6 watts)

Pat. Pending.

In applications concerning strain gauges, bridge-type transducers, time correlation, precision 400 cycle gyro testing, process control and preflight missile checkout, ELIN Precision Power Oscillators prove compatible and, in combination with other equipments, readily yield superior systems!

The desirable features of ultra-precise frequency and amplitude stability, low distortion and high output power capacities, make ELIN Precision Power Oscillators the ideal "System-mate" in these applications, and are derived from an exclusive High-Q LC tuned circuit and a special voltage-sensitive bridge combined in a circuit employing a large amount of negative feedback.

FREQUENCY (FIXED)—250 cps. to 15,000 cps. **VOLTAGE (OUTPUT)**—10, 30 & 100 volts RMS, all with floating center-tapped output. **DISTORTION**—0.1% maximum harmonic content, 0.05% maximum AC hum, 0.01% maximum noise. **CALIBRATION ACCURACY**—±0.02% under usual lab ambient conditions*, checked against station WWV as a primary standard. **FREQUENCY STABILITY**—±0.5% maximum, under usual lab ambient conditions*, ±0.02% maximum per ±10 volts variation in line voltage, ±0.05% maximum, zero to full load. **AMPLITUDE STABILITY**—±0.1% maximum under usual lab ambient conditions*, ±0.02% maximum, per ±10 volts variation in line voltage, ±0.2% maximum, zero to full load.

Special models operating from other prime power sources, with higher power capacities and at other frequencies supplied to your specs in cabinet or rack styles. Write today!

*Lab ambient, 10°C to 40°C.

Reg. U.S. Pat. Off.

elin® / Precision Power Oscillators

ELECTRONICS INTERNATIONAL CO.

145 West Magnolia Boulevard, Burbank, California

Special Products Division of International Electronic Research Corporation, Burbank, California

CIRCLE 230 ON READER-SERVICE CARD

NEW PRODUCTS at the IRE Show

Cord Mounted Switch

Rated at 250 ma

Designed for numerous remote control applications, this push button switch, enclosed in a handle, provides a cord mounted or pendant switch. Housing is nickel plated brass or black phenolic. The red or black push buttons are non-locking. The switch is rated at 250 ma, non-inductive load, ac 30 w maximum.

Switchcraft, Inc., Dept. ED, 1328 N. Halsted St., Chicago 22, Ill.

IRE Booth No. 2228

CIRCLE 232 ON READER-SERVICE CARD

Tape Recorder

Three motor drive, 7.5 and 15 ips speeds

This tape recorder, Type 800, has a 10-1/2 in. reel capacity with speeds of 7.5 and 15 ips. Equalization automatically switched with speed change. Signal-to-noise ratio is 60 db at 1 per cent distortion. Frequency response is 30 to 20,000 cps ±2 db at 15 ips. The recorder can accommodate up to four full or 1/2 track. With a 3 motor drive, the unit features individually and functionally illuminated push button relay controls, provision for remote control, and a tape edit button which allows easy run-off of unwanted tape.

Presto Recording Corp., Dept. ED, P.O. Box 500, Paramus, N.J.

IRE Booth No. 1211

CIRCLE 233 ON READER-SERVICE CARD

Mixer Crystal

Improved noise figure in C and X band

The MA-423A is a point contact silicon mixer diode which requires no dc bias. It is mechanically interchangeable with other diodes of the 1N23 series, but provides improved receiver noise figures of 7 db or better when used with a 1.5 db i-f strip at 30 mc. For radar receivers which employ image termination techniques and which are designed to use 1N23C or 1N23E diodes, circuit adjustment of i-f impedance match, local oscillator drive, and r-f match may be necessary to derive maximum receiver noise figure improvement with the MA-423A.

Microwave Associates, Inc., Dept. ED, Burlington, Mass.

IRE Booth No. 3508, 3510

CIRCLE 234 ON READER-SERVICE CARD

Sweep Generator

Checks response to 0.01 db

Model 1099 sweep generator, covering the 100 kc to 20 mc range with crystal markers throughout this range, enables response measurements to be made with a discrimination of at least 0.01 db. A stabilized output level of 3 v max is provided, and the instrument is supplied with detector probes on both input and output. With these probes a greatly amplified indication can be obtained of the deviation of an amplifier frequency response from level. Measurements are largely independent of input level changes.

Marconi Instruments, Dept. ED, 111 Cedar Lane, Englewood, N.J.

IRE Booth No. 3315, 3317

CIRCLE 235 ON READER-SERVICE CARD

NEW PRODUCTS at the IRE Show

Copper Clad Laminates

Epoxy paper and epoxy glass bases

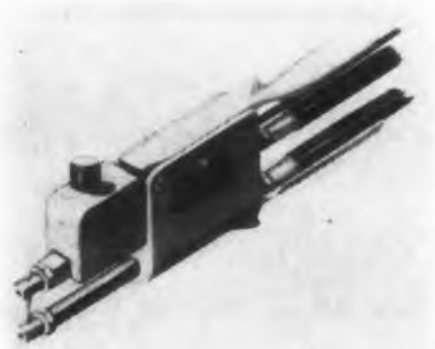
Two copper clad laminates, types 11574 and 11558, will be featured. Type 11574 self-extinguishing epoxy paper laminate has: flame retardency; outstanding cold punching; high mechanical strength; and high insulation resistance. Type 11558 cyanide proof copper clad epoxy glass laminate features: resistance to cyanide plating solutions; resists cleaning solvents such as MEK; and it withstands thirty seconds plus in 500 F solder pot. A high mechanical strength allows use of minimum thickness in fabricated parts.

General Electric Co., Chemical and Metallurgical Div., Dept. ED, Coshocton, Ohio.
IRE Booth No. 2914

CIRCLE 238 ON READER-SERVICE CARD

Welding Attachment

Welds wires of 8 or 10 gage



A heavy-duty handpiece accessory for precision welders, the UT-865 is capable of welding wires of 8 or 10 gage and smaller. The accessory is adaptable to existing weldmatic precision welder models and handles up to 500 watt seconds of energy. It is especially useful in heavy-gage thermocouple welding, and in performing general heavy-duty precision welding in hard-to-reach locations.

The handpiece provides adjustable pressure ranging from 1 to 25 lb and has a 3 to 1 mechanical advantage. The electrodes are pressure sensitive, firing only when a pre-set pressure is reached, regardless of electrode spacing or configuration.

Unitek Corp., Weldmatic Div., Dept. ED, 380 N. Halstead Ave., Pasadena, Calif.
IRE Booth No. 4417

CIRCLE 239 ON READER-SERVICE CARD

Oscilloscope

Small 6 x 8 x 13 in. unit

A portable, relatively inexpensive unit, the Serviscope features balanced dc coupled amplifiers giving flat response to 6 mc (—3db) and having a rise time of better than 0.06 μsec for less than 2 per cent overshoot. Both automatic sync and precision trigger level are provided as well as TV field and frame sync selectors. Voltage and time calibrating signals facilitate quantitative measurements and X- expansion, about the center, gives a 50 cm effective trace length. Eighteen sweep speeds and an attenuator permit time and voltage measurement over the ranges 0.1 μsec/cm to 0.5 sec/cm and from 20 mv to 250 v, ac or dc respectively. The unit weighs 16 lb and measures 6-1/2 x 8-1/2 x 13-1/2 in. overall.

Scopes Co., Inc., Dept. ED, 22-02 Raphael St., Fairlawn, N.J.
IRE Booth No. 2815

CIRCLE 241 ON READER-SERVICE CARD

Testing Chamber

Accurately tests capacitor coefficients

The FB-411 capacitor coefficient testing chamber features adjustable indicating temperature control for the range of +150 to —70 C, with proportioning action for heating or cooling demand, whichever is being controlled. A stainless steel inner chamber is furnished for encasing capacitors being tested. Movable dampers are provided to permit rapidly circulating air through this inner chamber for rapid cooling or heating effect. At stabilized conditions, the movable dampers are kept closed, and a very small circulator within the member circulates the air to prevent stratification. This equipment permits stability of items on test to as close as ±1/10 F, as measured with static load conditions. The refrigeration equipment employs Freon-13 and Freon-22 coolants in a patented arrangement.

Conrad, Inc., Sub. Crampton Mfg. Co., Dept. ED, 141 Jefferson St., Holland, Mich.
IRE Booth No. 3834

CIRCLE 242 ON READER-SERVICE CARD

®REGATRON *Programmable Power Packs*

FRONT PANEL CONTROL RESISTANCE

E_o & I_o expressed in terms of % of rated voltage and current.

Curves for extended-voltage operation vary between models. Request Specification Sheet 3022 for additional curves.

Model 212AM shown above has less than .0005 volt hum; regulation is within 0.1% or 0.02 from no load to full load; output impedance is less than 1.0 ohm at 40 KC, dropping off to less than 0.01 ohm at low audio frequencies. A modulation input is provided.

RELIABLE, DEPENDABLE...

this power pack will furnish almost three times its rated maximum voltage

The extra margin of safety built into every E/M Power Pack is no idle boast. E/M's smallest Power Pack, Model 212A, is rated at 0—100V dc and 0—100 ma . . . yet it can and will deliver almost three times its rated maximum voltage at reduced current. What's more, operation beyond its rated voltage is a *practical, safe performance feature.*

Notice too, that within normal operating limits, 100% rated current is always available . . . even at a fraction of a volt.

But that's not all . . . for automatic test facilities, Regatron Programmable Power Packs have provisions for the simplest remote control system known—a variable resistor.

Constant current models, transistorized models . . . see them at the IRE show—Booths 3837 & 3839.

For a detailed account of how Regatron Programmable Power Packs can be used for automatic control and automation, send for your copy of Bulletin 765.

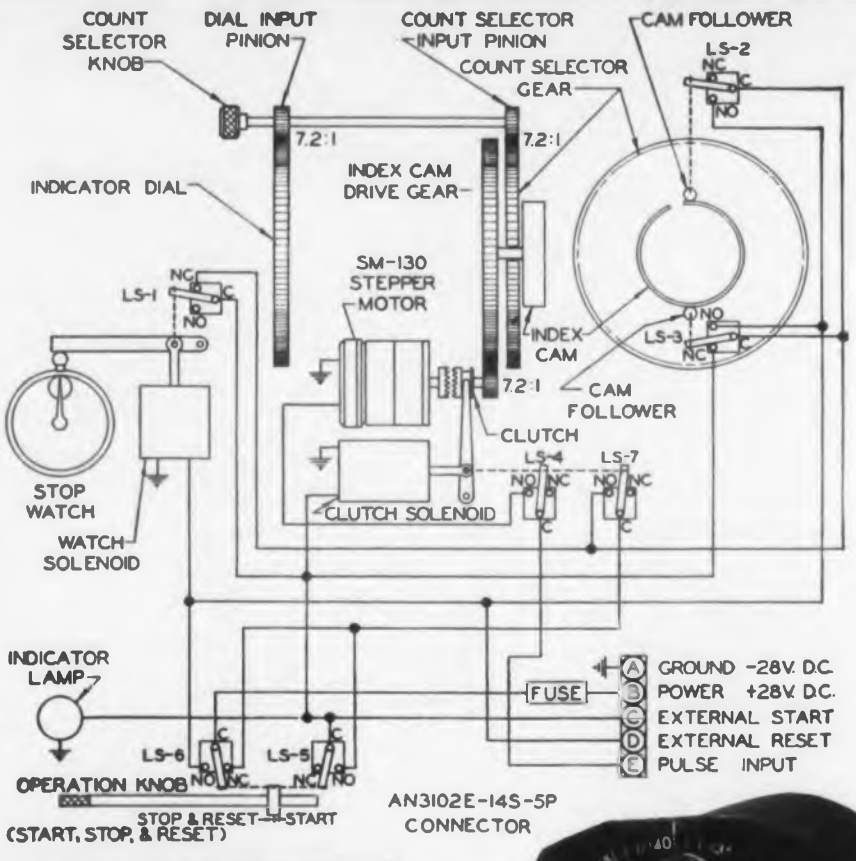
® Registered U. S. Patent Office. Patents pending.

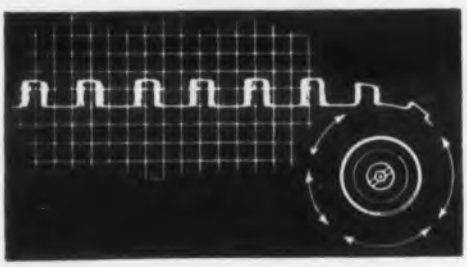
ELECTRONIC MEASUREMENTS CO., Inc.

Eatontown • New Jersey

CIRCLE 243 ON READER-SERVICE CARD

STEPPER AUTOMATIC PULSE TIMER





Model K-165

This Automatic Pulse Timer mounts in a standard 3 1/8" mounting. The initial usage of the Automatic Pulse Timer was for a difficult instrumentation problem encountered on test aircraft—timing the pulses from a fuel flow transducer and thus determining specific fuel consumption. It successfully replaced a complex and unreliable method.

The Automatic Pulse Timer incorporates an uni-directional Stepper Motor along with complimentary gears, cams, solenoids, switches, an indicator light and—for an accurate independent time base—a stop watch. It is designed to visually record the lapsed time of an occurance of a specific number of electrical impulses. The Pulse Timer can count pre-selected quantity of 2 to 60 pulses, having a uniform or variable rate up to 25 pulses per second.

In this application the combined accuracy of the fuel flow transmitter and the automatic pulse timer is better than 1%, and of this the timer contributes essentially no error. When the broad input requirements are available, the unit can be used for timing pulses regardless of the source from which they may originate.

DETAILED OPERATIONAL SEQUENCE IS AVAILABLE UPON REQUEST.

STEPPER MOTORS CORPORATION

Subsidiary of California Eastern Aviation, Inc.

7445 West Wilson Avenue • Chicago 31, Illinois

• WEST COAST FACILITY . . . 11879 W. FLORENCE AVE. . . . CULVER CITY, CALIF.

CIRCLE 244 ON READER-SERVICE CARD

NEW PRODUCTS at the IRE Show

Computing Transfer Oscillator

Measures cw and pulsed frequencies

A computing transfer oscillator, model 7580, which measures cw and pulsed frequencies using the harmonic multiplying factor, will be introduced. The instrument extends the range of the companion 10 mc Eput meters to beyond 12 kmc. Accuracies are in the order of 3 parts in 10^7.

A nomograph mechanism determines and displays the harmonic number of the fundamental at zero-beat against the unknown. The harmonic number is preset into two built-in decimal counting units which scale the fundamental so that the associated counter presentation is a direct-digital reading of the unknown. The transfer oscillator has a built-in crystal detector, harmonic generator, and tuning stubs for maintaining input sensitivity.

Beckman Instruments, Inc., Berkeley Div., Dept. ED, 2200 Wright Ave., Richmond 3, Calif.
IRE Booth No. 3416, 3418

CIRCLE 245 ON READER-SERVICE CARD

Cabinets and Racks

Of magnesium alloys

Utilization of corner castings and extrusions in the fabrication of control and instrument cabinets, racks, and chassis are featured. Emphasis is placed on late developments in fabricating light-weight metals such as aluminum and thorium based magnesium alloys.

Falstrom Co., Dept. ED, Falstrom Court, Passaic, N.J.
IRE Booth No. 1116

CIRCLE 246 ON READER-SERVICE CARD

Backward Wave TWT

Narrow band, voltage tunable types

Available for S and X bands, the BA-1 and BA-2 backward wave traveling wave tube amplifiers find use as voltage tunable filters, possessing between 10 and 25 db gain. The narrow band characteristic makes possible their use as pre-selectors in wide-band receivers. Specifications for the BA-1 include: frequency range, 2.4-3.6 kmc; bandwidth, 0.1-1.0 per cent; magnetic field, 600 gauss; capsule length, 15 in. and a net weight of 1 lb. The BA-2, available for 8.2 to 12.4 kmc use, has similar characteristics.

Huggins Labs., Inc., Dept. ED, 711 Hamilton Ave., Menlo Park, Calif.

IRE Booth No. 3927, 3929

CIRCLE 249 ON READER-SERVICE CARD

True RMS VTVM

3 per cent accuracy for 5 cps to 500 kc

Model 900 true rms vacuum tube voltmeter reads either true rms or average value of input voltage as selected by front panel switch. Frequency range is 5 cps to 500 kc. Seventeen ranges cover 0.0015 to 300 v full scale. Input resistance is 10 meg for all ranges. Input capacitance is approximately 20 μμf. The peak voltage rating in 5 times peak value of sine wave required for full scale meter deflection. Accuracy is 3 per cent for any signal whose frequency components are between 5 cps and 500 kc. The voltage at output terminals is proportional to instantaneous square of input voltage. Output voltage at full scale meter deflection is approximately 75 mv.

John Fluke Mfg. Co., Inc., Dept. ED, 1111 W. Nickerson St., Seattle 99, Wash.

IRE Booth No. 3413

CIRCLE 250 ON READER-SERVICE CARD

BULOVA

FAMED FOR PRECISION SINCE 1875

NEW ST-73X

"SHOCK MOUNTED" QUARTZ CRYSTAL

The Bulova ST-73X need never be babied. Effective new shock mounting and traditional Bulova manufacturing precision result in a rugged, extremely stable, frequency determining element for missiles, aircraft and other applications involving extreme environmental problems.

Where frequencies must be maintained with ultra-reliable stability under high shock and temperature conditions, you'll find no adequate substitute for Bulova quality.

THE ST-73X FEATURES: Frequency Range from 16 KC through 350 KC, with lower frequencies possible in holders of different configuration; Shock Tests of 100 G; Dynamic vibration tests met per MIL-T-5422, MIL-E-5272 and MIL-E-5400 without adverse results; Storage Temperatures over a range of −65°C. to +135°C. can be coupled with an operation temperature range of −55°C. to +100°C.; Low excursions of frequency (±.015%) over this range.

Precision Bulova Quartz Crystals are now available in quantity for frequencies from 16 KC and lower to 100 MC and above.

BULOVA
watch company

Electronics Division
Woodside 77, N.Y.

Write Dept. A-738 For Full Information and Prices on Quartz Crystals

SEE US AT THE IRE SHOW BOOTH NOS. 1811-1813
CIRCLE 251 ON READER-SERVICE CARD

NEW PRODUCTS at the IRE Show

VHF Receivers

35 to 150 mc range

Two VHF panoramic receivers designed to provide coverage from 35 to 150 mc have been added to the Trak line of receivers. All models feature three inductor-tuned rf stages in a double-superheterodyne circuit providing greater than 60 db attenuation of spurious responses and noise figures down to 4.5 db.

Models PAN-1D and PAN-1E, which cover the upper part of the band, have a 5 in. crt to display received signals logarithmically, with a dynamic range of 60 db as an 8 to 1 variation in observed amplitude. A precision marker circuit permits frequency measurements of signals to within 1 per cent accuracy. Model PAN-2, sweeping the lower part of the range, offers both an externally operated step marker and calibrated adjustable band edges which control upper and lower sweep limits individually. Any 5 mc segment of the band can be displayed across the full width of the crt.

CGS Labs., Inc., Dept. ED, 391 Ludlow St., Stamford, Conn.
IRE Booth No. 1310, 1312

CIRCLE 252 ON READER-SERVICE CARD

Servopot

Furnished completely aligned

This servopot is an integral combination of a two-phase instrument servomotor, gear reduction, slip clutch, and precision potentiometer. The instrument eliminates the need for mounting, testing and aligning separate units. The slip clutch is factory adjusted to permit servo operation into potentiometer stops without damage. Standard pots feature 0.5 per cent linearity and are available with resistances from 35 to 80,000 ohms. Single, multi-turn, and non-linear models are available.

Diehl Mfg. Co., Dept. ED, Finderne Plant, Somerville, N.J.
IRE Booth No. 2237

CIRCLE 253 ON READER-SERVICE CARD

Motion Testing System

Complete system for wide variety of needs

A complete sine-wave and complex motion testing system will be exhibited which will include a model T888 high output wide-band amplifier, model TEMC control console (shown), and a model C10 vibration exciter featuring the Unimode suspension of the moving element assembly. Designed for high g acceleration tests on relatively light specimens, the system is capable of vibrating sinusoidally 102 lb to 10 g; 42 lb to 20 g and 22 lb to 30 g. Random motion testing is attained by the simple addition of a T67 or T88 compensation console. Capable of 850 lb rms force, the C10 will vibrate 67 lb to 10 g rms with 30 g peaks; 25 lb to 20 g rms, 60 g peaks; and 11 lb to 30 g rms, 90 g peaks.

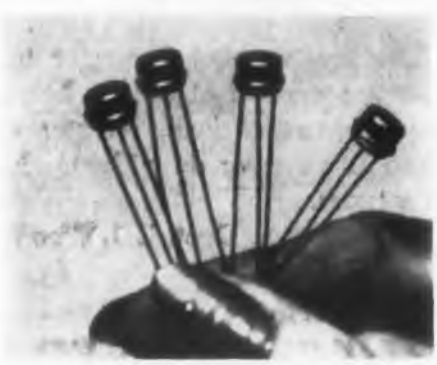
Textron Inc., MB Mfg. Co. Div., Dept. ED, 781 Whalley Ave., New Haven, Conn.

IRE Booth No. 1723, 1725

CIRCLE 256 ON READER-SERVICE CARD

Transistors

For computer applications



Four germanium alloy transistors designed for computer applications will be among the semiconductor devices exhibited by this company. Designated types 2N312, 2N356, 2N357, and 2N358, the units feature rapid switching, high constant beta characteristics, and excellent leakage stability. The transistors have base-off-the-can construction for applications where it is necessary to isolate all elements.

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

IRE Booth No. 2402, 2408, 2501, 2507

CIRCLE 257 ON READER-SERVICE CARD

LOOK TO TOBE FOR PROGRESS

electronic interference filters

TOBE brings unequalled experience to the solving of your filtering problems. TOBE'S advanced design-techniques, and the technical data accumulated by TOBE filter specialists over the years, meet your problems with solutions that are quicker, more efficient, and more reliable. For all your filtering needs, look to TOBE DEUTSCHMANN, the oldest name in interference filters.

TOBE FILTERETTES, available in wide range of ratings, sizes and mounting styles, are engineered to operate under the most severe environmental conditions.

Tobe Exclusives:

Feed-thru capacitor construction in filterettes.

Miniaturization with maximum quality.

Guaranteed attenuation characteristics—under full-load operating conditions.

We invite inquiries on specific applications. The services of our engineers are always available. Write TOBE-DEUTSCHMANN Corporation, Norwood, Mass., the acknowledged authority on electronic interference—manufacturers of "FILTERETTES".

specify TOBE FILTERETTES

TOBE DEUTSCHMANN • CAPACITOR PIONEERS SINCE 1922

CIRCLE 258 ON READER-SERVICE CARD

"THINK SMALL—
THINK MICRODOT"

Reliability and high performance with a minimum of size and weight. Proven by applications in military and commercial fields, one million combinations of Microdot micro-miniature coaxial cables and connectors are available from stock. Assemblies made by the exclusive Microdot technic to assure prompt delivery on standard and custom designs. Detailed 36 page catalog on request.

microdot

For micro-miniaturization, "Think Small—Think Microdot." Our sales engineers are located in all major cities to readily assist you in special design and standard applications.

MICRODOT, INC. 220 PASADENA AVE. SO. PASADENA, CALIF.

Visit Our Exhibit at the I. R. E. Show • Booths 2101-2103

Prepared by Guerin, Johnstone, Jeffries, Inc.
for **MICRODOT, INC.**

CIRCLE 259 ON READER-SERVICE CARD

NEW PRODUCTS at the IRE Show

Attenuators

Feature low noise level

The resistive elements and contacts in these attenuators are embedded in a special tough, glass-fiber plastic compound which provides protection against extreme humidity, mechanical shock, and wide temperature variations. Brushes are secure, so they cannot trip. The switching noise level is kept extremely low.

International Resistance Co., Dept. ED, 401 N. Broad St., Phila., Pa.

IRE Booth No. 2821, 2825

CIRCLE 260 ON READER-SERVICE CARD

Thermal Time Delay

For airborne applications

The H series of thermal time delay relays are designed for airborne or other military applications. They will operate under vibration to 500 cps at 10 g and shock up to 50 g. Factory preset from 3 sec to 3 min, the hermetically sealed relay will operate at altitudes to 70,000 ft. They are ambient temperature compensated from —65 to +125 C. The spst normally open or normally closed contacts are rated at 3 amp 120 v ac or 2 amp 32 v dc resistive loads. Heater voltages are from 5 to 125 v ac or dc with standard 6.3, 26.5 or 117 v types.

Curtiss-Wright Corp., Dept. ED, Wood-Ridge, N.J.

IRE Booth No. 1327

CIRCLE 261 ON READER-SERVICE CARD

Standoff Terminal

Operates at 1000 C temperatures

This insulated standoff terminal can operate in the high temperature region of 1000 C and still maintain its electrical function. The terminal will also operate in an environment exposed to nuclear bombardment. High strength alumina is used as the insulator, permitting the terminal to withstand greater than 0.05 lb-ft impact on the

IZOD type test, and 400,000 psi compression.

Final terminal assembly test results show a resistivity at 25 C of greater than 10^{14} ohms per cm cube. At 800 C, the figure is 10^{6}, and at 900 C, it is 4×10^{5}. The material is impervious to water absorption, and is unaffected by fungus growth.

Litton Industries, Components Div., Dept. ED, 5873 Rodeo Rd., Los Angeles 16, Calif.
IRE Booth No. 1618

CIRCLE 264 ON READER-SERVICE CARD

Wave Analyzer System

Provides power spectral density analysis

A basic wave analyzer system, consisting of oscillator and analyzer, is equipped with the TP-633 power integrator that accepts intermediate frequency output from the analyzer, producing a direct current analog proportional to power spectral density.

Front panel controls allow output analog to be made proportional to peak level, to average value, to mean square value, and to continuous time integral—linear or square—of the voltages in the narrow frequency band input. The averaging time is continuously adjustable in three decades. Provision is made for dividing by the bandwidth to make output directly proportional to power spectral density. Scale factors are provided by a calibrated input potentiometer. Circuitry is provided for remote operation.

Technical Products Co., Dept. ED, 6670 Lexington Ave., Los Angeles 38, Calif.
IRE Booth No. 3032

CIRCLE 265 ON READER-SERVICE CARD

Transducers

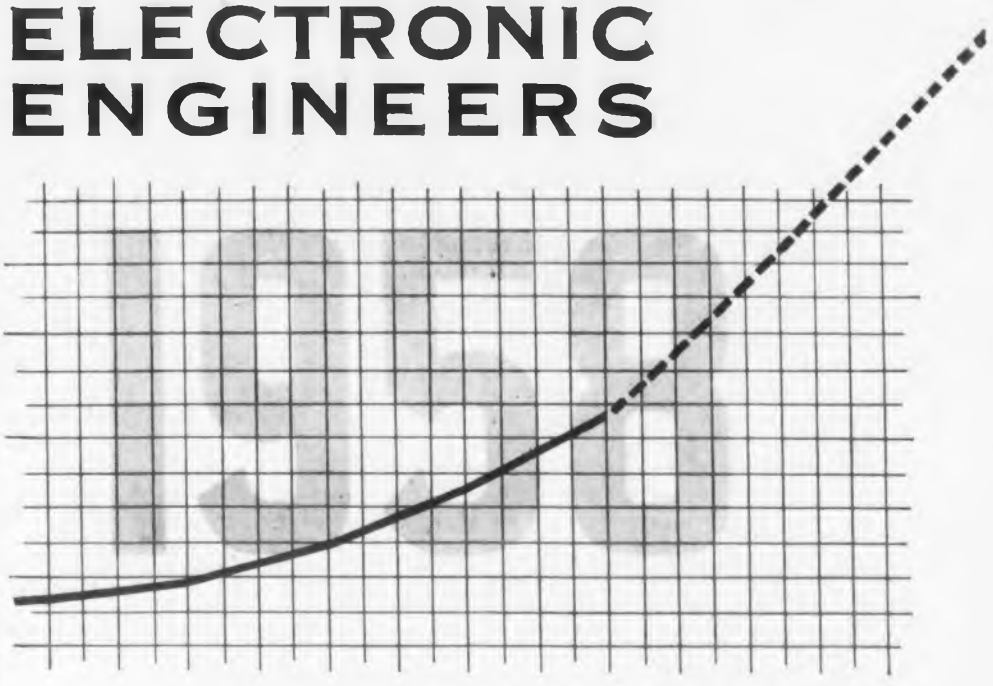
Displacement and pressure

The "Compu-Tran" displacement transducer features higher sensitivity and a longer linear range for equivalent cost. The pressure transmitter is a low cost item useful in ground environment testing, multiple pressure scanning and alarm systems.

International Resistance Co., Dept. ED, 401 N. Broad St., Phila., Pa.
IRE Booth No. 2821, 2825

CIRCLE 266 ON READER-SERVICE CARD

ELECTRONIC ENGINEERS



1958 definitely promises to exceed the record-setting volume of our Electronics and Avionics Division last year. And we are not overly optimistic at all in our plans to double these figures during the next few years.

Emerson Electric, a leading medium-size manufacturer of missiles and electronic equipment, has a firmly outlined, long-range expansion program. Our plans require broadening our organizational structure immediately. This has opened unusual career opportunities with complex challenges.

We emphasize research, design and development, and maintain a strong balance in production work. Current projects include the B-58 fire control system, mortar locators, radar components and assemblies, servomechanisms, missiles and rockets, ground support equipment, microwave antennas, F-101 Voodoo subsystems, plus many other classified electronic devices for the supersonic era.

These positions require an E.E. degree plus 1-6 years' experience in electronics. Experience must include electronic design work in any of the following: servomechanisms, radar systems, analog or digital computers, fire control systems or ground support equipment. Missile guidance and/or infra-red experience will be helpful but is not essential.

Emerson Electric is a well-established dynamic organization with 900 engineers and 5000 employees. Salaries and benefits, including advanced education, are top level. Our suburban location is ideal in every way. All moving expenses are fully paid.

Be sure to send your complete resume NOW, including business experience, education and salary requirements, to A. L. Depke.

Your Future Is Our Business!

EMERSON ELECTRIC

Electronics and Avionics Division

8100 W. Florissant • St. Louis 21, Mo.

CIRCLE 267 ON READER-SERVICE CARD

NEW PRODUCTS at the IRE Show

Fan Assemblies

Easily mounted

These square-mounted packaged assemblies eliminate the inconvenience of mounting ring fans and their accessory components. The same fan may be used to either suck or blow air, and may be mounted inside or outside a cabinet. The filter can be either permanent or disposable. Fan orifice is recessed for maximum air delivery. Three sizes are currently in stock.

McLean Engineering Labs., Dept. ED, P.O. Box 228, Princeton, N.J.
IRE Booth No. 3825

CIRCLE 268 ON READER-SERVICE CARD

Servo Motor Tach

Linearity of 0.2 per cent to 5400 rpm

Type 18-MTG-6302 servo motor tach has an operating temperature range from —54 to +125 C and a starting voltage as low as 1-1/2 v. The unit consists of 115 v 400 cps 2 phase size 18 servo motor with a size 15 tachometer integrally mounted on the motor shaft. The servo motor has a high torque to inertia ratio, a no load speed of 4700 rpm, a rotor moment of inertia of 5.73 gm-cm², develops a stall torque of 2.4 oz-in. with a power input of 9.2 w per phase. The unit is rated for continuous duty at stall.

The tach's output is 3.1 v per 1000 rpm, null voltage of 13 mv max, and has a linearity within 0.2 per cent up to 5400 rpm. Entire unit weighs 20 oz.

John Oster Mfg. Co., Avionic Div., Dept. ED, 1 Main St., Racine, Wis.
IRE Booth No. 2129

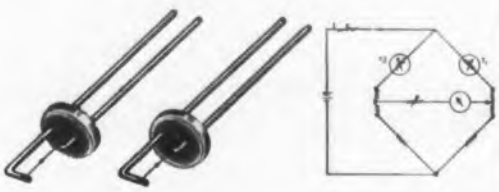
CIRCLE 269 ON READER-SERVICE CARD

Using Thermistors

Edited by
FENWAL ELECTRONICS

MATCHED THERMISTORS FOR GAS ANALYSIS

Now Fenwal Electronics offers resistance and voltage-current matched thermistor assemblies which are particularly useful for gas chromatography and other gas analyses.



The matched thermistor assemblies above are used in a balanced bridge circuit. One assembly is in each arm of the bridge and equal current is applied to each. The thermistors, self-heated by the passage of current, will dissipate heat at equal rates if the medium surrounding each thermistor is identical. The meter will show an equilibrium reading.

If the thermal conductivity of the gas surrounding either one of the thermistors should change, the rate of heat dissipation will also change, altering the resistance of the thermistor and unbalancing the bridge, thus causing a reading on the meter. The meter can, therefore, be calibrated to give an accurate indication of the percentage of a foreign element in the gas being analyzed, as related to a known reference gas.

It's all based on the unique characteristic of thermistors — when temperature rises, resistance falls. This relationship occurs whether the thermistor is self-heated, as in the example above, or externally heated through a liquid, gas or solid.

Write FENWAL ELECTRONICS, INC., 32 Mellen Street, Framingham, Mass., for complete information on matched thermistors (Bulletin EM-14), and for many other thermistor applications (Catalog EMC-1).

Fenwal Electronics

Design — Engineering — Production
of Precision Thermistors

CIRCLE 271 ON READER-SERVICE CARD

Vacuum Storage Cart

For tube components

A vacuum storage cart for storing certain components of electronic tubes while awaiting the completion of other components has been developed. Storage of these parts under vacuum assures that they will be clean and more easily degassed when they are finally assembled in the completed tube.

F. J. Stokes Corp., Dept. ED, 5500 Tabor Rd., Philadelphia 20, Pa.
IRE Booth No. 4415

CIRCLE 272 ON READER-SERVICE CARD

Printed Circuit Connectors

Bifurcation provides larger contact surface

The Bellows Action contact for printed circuit connectors provides a redundant circuit with two independent spring leaf contact actions for greater reliability. Coil spring action grip of the bifurcated contact clasps printed circuit board over its entire contact area. A gold plated phosphor bronze spring retains tension when used with either undersized or oversized tolerance boards. The contact resistance is rated at less than 20 mv at 5 amp.

Wiring styles include eyelet lug for soldering, solderless wire wrap lug, taper tab solderless wiring, and contacts for dip soldering.

Dejur-Amsco Corp., Electronic Sales Div., Dept. ED, 45-01 Northern Blvd., Long Island City 1, N.Y.
IRE Booth No. 3911, 3913

CIRCLE 273 ON READER-SERVICE CARD

AC Battery Unit

Delivers 110 v, 300 w

Incorporating a 15 v Silvercel battery and transistorized converter, with 80 to 90 per cent efficiency, this unit delivers 300 w of 110 v ac 60 cps power continuously for several hours and can be recharged from a 110 v ac outlet. The ac battery assembly weighs less than 20 lb and is the size of a 9 in. cube.

Yardney Electric Corp., Dept. ED, 40-50 Leonard St., New York, N.Y.
IRE Booth No. 2127

CIRCLE 274 ON READER-SERVICE CARD

He's minding YOUR business

YOUR HEART IS *HIS* BUSINESS. He's a research scientist—one of thousands supported by the Heart Fund. His life is dedicated to finding the unknown causes of the heart diseases, and new methods of treating and preventing them. He and your Heart Association have made *your* heart their business.

YOUR HEART IS *YOUR* BUSINESS. Whatever your way of life, your future depends on your heart. Heart disease causes personal suffering and undermines the happiness and economic welfare of the family. No one—no child or adult—is immune.

THE HEART FUND IS *EVERYBODY'S* BUSINESS. When you support the Heart Fund, you help all hearts. You support heart research—and you make it possible for your Heart Association to bring the latest advances in heart research to you and your family through your doctor.

Give Generously for Every Heart You Love

HELP YOUR HEART FUND HELP YOUR HEART

NEW PRODUCTS at the IRE Show

Relay

Size of a postage stamp

This miniature relay meets and exceeds military specifications MIL-R-25018 and MIL-R-5757C. Vibration resistance characteristics are in excess of 20 g to 2000 cps and shock in excess of 50 g. Contact form is dpdt, with dry circuit or 2-amp contact capacity. Available models include conventional terminals 0.1 in. grid spacing for printed circuits. Temperature range is —65 to +125 C.

Telecomputing Corp., Dept. ED, 915 N. Citrus Ave., Los Angeles 38, Calif.
IRE Booth No. 2128

CIRCLE 278 ON READER-SERVICE CARD

Film Resistors

Feature stability

A line of high stability molded film resistors have been developed to provide improved moisture resistance and insulation properties. The resistors fulfill requirements of MIL-R-10509B. These units are available in 1/2 w style in ±1 per cent and 5 per cent tolerances for standard ranges of 10 ohm to 2 meg.

Wirt Co., Continental-Carbon Div., Dept. ED, 5221 Greene St., Philadelphia 44, Pa.
IRE Booth No. 2209

CIRCLE 279 ON READER-SERVICE CARD

Rate Gyro

Tough, subminiature unit

This subminiature floated rate gyro the RG-100 can take 100 g's of shock and 15 g's at 2000 cps vibration in any axis. Damping is held to within 15 per cent for any required percentage of critical. The dynamically balanced hysteresis motor reaches full 24,000 rpm operating speed in less than 20 seconds. It is wound for two or three phase operation and is rated at three watts. The temperature range is from —40 to +200 F.

Fairchild Controls Corp., Dept. ED, 225 Park Ave., Hicksville, N.Y. or 6111 E. Washington Blvd., Los Angeles 22, Calif.
IRE Booth No. 2702, 2704

CIRCLE 280 ON READER-SERVICE CARD

Sampling Switch

Used with surveillance radar

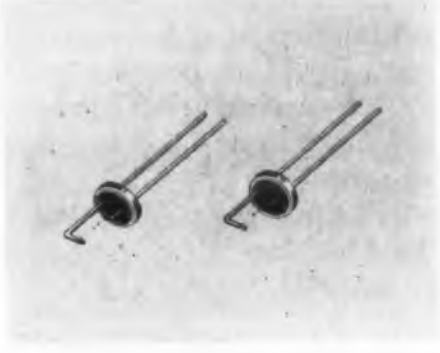
This rotary switch has such applications as from surveillance type radars, sonars, and magnetometers. This unit has 3 poles, 16 non-shorting contacts per pole, operating at 30 rps. Of the 16 positions, one carries a reference frame voltage, and each of the other fifteen samples the returned response of a 25 deg cone. Noise levels considerably less than 0.1 mv are available for 1 mv signal levels in a 50 ohm circuit. The unit is hermetically sealed and withstands MIL-E-8189 environmental conditions.

Instrument Development Labs., Inc., Dept. ED, 67 Mechanic St., Attleboro, Mass.
IRE Booth No. 3925

CIRCLE 283 ON READER-SERVICE CARD

Matched Thermistors

For gas analysis

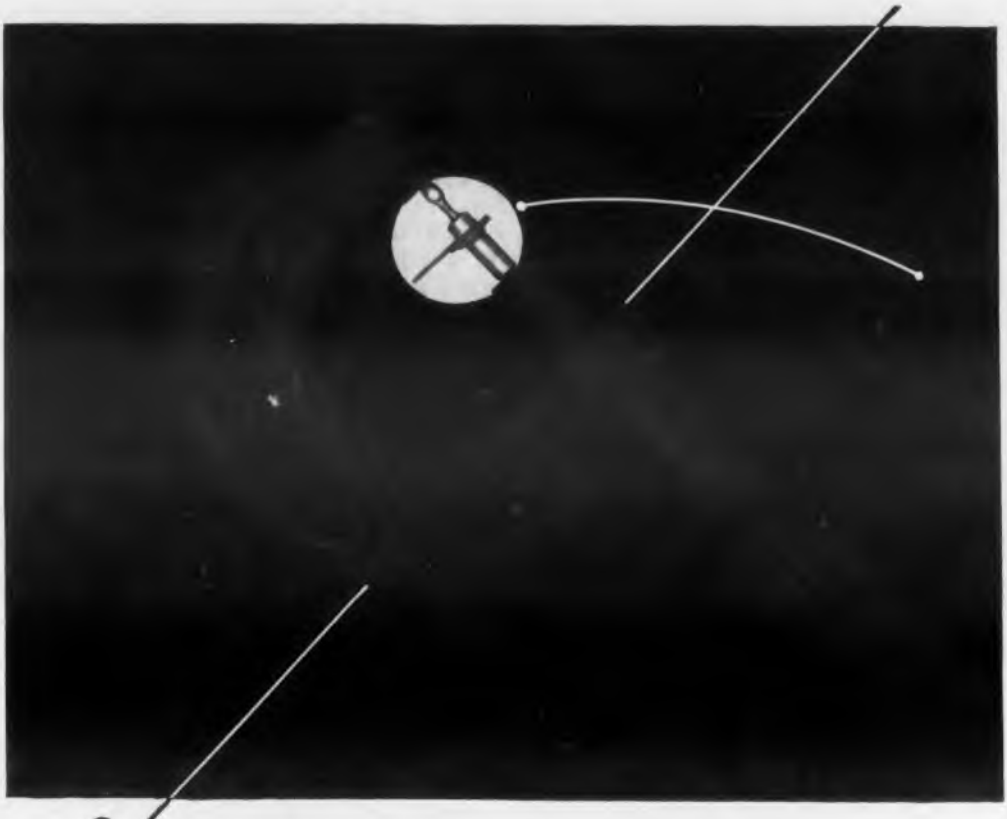


Voltages are matched at four points to within 0.03 v in these thermistors. Matching measurements are made while the unit is suspended in helium at 25 C. The thermistor beads used are also matched to within 5 per cent resistance at 25 C. Matched assemblies of this type are useful in gas chromotography where the thermistor assemblies are used in a balanced bridge circuit. The thermistors, self-heated by the passage of current, will dissipate that heat according to the thermal conductivity of the surrounding medium.

Fenwal Electronics, Inc., Dept. ED, Mellen St., Framingham, Mass.
IRE Booth No. 3001

CIRCLE 284 ON READER-SERVICE CARD

VICTOREEN *Announces*



NEW COLD CATHODE GAS TRIGGER DIODE

This reliable, rugged, micro-miniature tube has an extremely high input resistance before a critical voltage is reached, at which time the tube breaks down and becomes a very low resistance.

MODEL TAA-113	
Nominal Firing Voltage	113 V
Leakage Resistance (95V)	5×10^{10} ohms
Acceleration	20,000 G
Vibration	10 - 55 cycles at .06 D.A.
Operating Temperature	−65° to 160°F
Energy Transfer	3000 ergs

Victoreen's new cold cathode gas trigger diode is ideal for use where weight, space and high G considerations are involved. It can be used for isolation purposes, electronic switching, RC timing circuits, or relaxation oscillators.

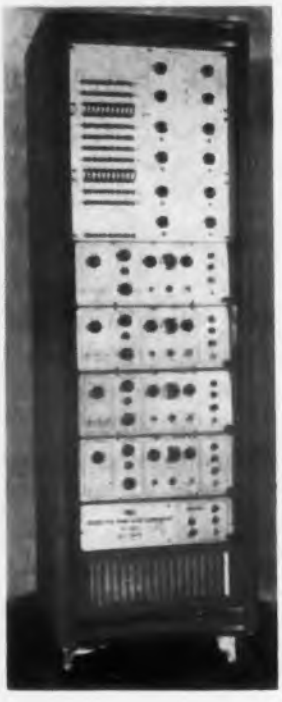
Victoreen micro-miniature diodes are available now and can be supplied with a variety of different characteristics. Full details are available on request. AA-7080

See Victoreen's new micro-miniature cold cathode gas trigger diode on display for the first time at the
IRE SHOW BOOTH 2232

The Victoreen Instrument Company
Components Division
5806 Hough Avenue • Cleveland 3, Ohio

CIRCLE 287 ON READER-SERVICE CARD

NEW PRODUCTS at the IRE Show



Pulse Code Generators

Ten bit codes provided at 1 mc rates

Designed for study and test of memory components, the 5100A series of pulse code generators provide high speed pulse programs at high impedance and high power output. Single and multiple channel 10 bit pulse codes are provided at clock rates to mc, with controllable repeat of selected intervals. Output from each channel is variable from 50 ma to 5 amp peak current, with rise and fall time control provided. Multiple channel outputs, positive and negative around ground, may be paralleled for high pulse current or the formation of complex codes.

Instruments are comprised of various combinations of coding units and output amplifiers. Amplifiers are self-contained, with integral power supply, and may be driven by any general purpose pulse generator.

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

IRE Booth No. 3611, 3613

CIRCLE 288 ON READER-SERVICE CARD

Klystron Test Facility

Produces up to 50 kv pulses

Model 42M modulator is a complete laboratory test facility for high-power pulsed klystrons. The modulator produces 0 to 50 kv pulses at currents from 0 to 15 amps with repetition rates from 10 cps to 10 kc.

With an external pulse-group generator, the 50 kv pulser will recover and respond to pulses of varying widths occurring less than 1 μsec apart, producing pulses with rise and fall times of approximately 0.25 and 0.5 μsec respectively.

Arbitrary arrangements of pulses can be achieved with the following limitations. The maximum allowable pps under pulse-group operation is 15,000 and the effective duty cycle must be less than 0.01. An internal trigger generator is provided for single-pulse operation with pulse widths of either 0.5 or 5 μsec and repetition rates from 10-5000 pps.

Levinthal Electronic Products, Inc., Dept. ED, Stanford Industrial Park, Palo Alto, Calif.
IRE Booth No. 1205

CIRCLE 291 ON READER-SERVICE CARD

Clutch-Brakes

Miniature 4 oz-in. units

These units are available in a number of configurations, consisting of clutches, brakes, clutch-brakes, and a special dual clutch-brake. Other models are available for fail-safe or reverse energization applications. The method of mounting is with a standard 1/2 in. diameter servo mount, on either or both ends, with concentric output and input members. Shown is the model FB-59 Microbrake.

All units feature fast response time with low coil wattage. A typical clutch will reach the first time constant of maximum torque in less than 2.5 μsec, using a 1.6 w, 25 v coil. The coil wattage is low enough that extreme reduction in performance is not encountered under conditions of continuous energization. A non-rotating coil is used, which eliminates the drag and objectionable limitations of slip-rings.

The minimum torque of standard clutches and brakes is 4 oz-in., while the de-clutched drag will be less than 0.06 oz-in. Class 5 instrument bearings are used throughout. The rotor design features no radial or axial displacement when engaging or dis-engaging, and gives zero backlash when engaged.

Magtrol, Inc., Dept. ED, 240 Seneca St., Buffalo, N.Y.
IRE Booth No. 1230, 1232

CIRCLE 292 ON READER-SERVICE CARD

now

you can wind your filter coils
WITHOUT CORE ADJUSTMENTS

on

pre-adjusted filter cores

- guaranteed effective permeabilities within ±3%, ±2% or ±1% of specifications, instead of the usual 10% to 50% spread
- measured, adjusted and grouped for magnetic characteristics at the factory
- a complete line of pot-type ferrite cores from ⅜" to 1¾" diameter, with bobbins and hardware for each size
- available in quantity to manufacturers of communications, telemetering and computer equipment

There's Nothing Else
Even Remotely Like These
Pre-Adjusted Potcores

by **FXC**

Write for literature describing standard sizes available from stock, exact permeability values, and number of turns required for any given inductance.

FERROXCUBE CORPORATION OF AMERICA
50 East Bridge Street, Saugerties, New York

Manufacturers of ferrite cores for recording heads, magnetic memories, TV flyback transformers, pulse transformers, filters, inductors, high frequency shields and power transformers.

CIRCLE 293 ON READER-SERVICE CARD

NEW PRODUCTS at the IRE Show

DC Motor

Multiple output provided by 3 shafts

Three output shafts are provided on this permanent magnet dc motor to satisfy multiple use applications. The motor, used with this gearhead, incorporates the manufacturer's symmetrical, progressive lap type armature winding to provide electrical balance, superior commutation, and low radio noise output. Magnets are stabilized to eliminate demagnetizing effects due to sudden reversals. Elementary control circuits provide dynamic braking.

Barber-Colman Co., Electrical Components Div., Dept. ED, 1800 Rock St., Rockford, Ill.
IRE Booth No. 3833

CIRCLE 297 ON READER-SERVICE CARD

Shielded Wire Ferrule

Permite automated pigtailing

Designed expressly for grounding the shield braid of coaxial conductors, a machine is featured which feeds and attaches these ferrules and pigtails simultaneously to shielded wire leads. The machine's dual applicator permits attachment of ferrule and pigtail wire to a double ended shielded wire jumper or to two shielded wire leads at the same time, with pigtail wire whose length can be adjusted in the applicator. The firm reports that the process can reduce the cost of pigtailing by 75 per cent by eliminating the wire preparations formerly required.

AMP Incorporated, Dept. ED, Harrisburg, Pa.
IRE Booth No. 2427, 2429

CIRCLE 298 ON READER-SERVICE CARD

Two-Phase Servo Motor

For high ambient temperatures

This 115 v, 400 cps servo motor can operate in air at 600 deg F or in a stream of 550 F jet fuel. It weighs only 2-1/2 lb and can withstand vibration of 15 g's to 2000 cps. At 600 deg F it can accelerate at 4500 radians per second from stall, and maintain a positional accuracy of 1/2 degree.

Electronics Division, Thompson Products, Inc., Dept. ED, 2196 Clarkwood Road, Cleveland, Ohio.

IRE Booth No. 2527, 2529, 2531

CIRCLE 299 ON READER-SERVICE CARD

Video Amplifier

200 cps to 50 *mc*

The model 600 is a super video wide band amplifier which can be used singly or as a component unit in an electronic system. The specifications include: bandpass of 200 cps to 50 mc; gain of 40 db +1-1/2 db (into matched load); input impedance of 90 ohms, vswr less than 1.5:1; and an output impedance of 90 ohms, vswr less than 2.1. Pulse rise time is 10 mμsec, and noise figure is approximately 9 db. The unit may be used as an external preamplifier; a post amplifier in noise figure measurement and a pulse amplifier in nuclear work. The M-600 is a metal unit 12 in. long x 2-1/2 in. wide x 4 in. high including the tubes. The tube complement consists of one 6CB4, two 6AK5, one 6CY5, one 6CC6, and one 12A4.

Instruments for Industry, Inc., Dept. ED, 150 Glen Cove Rd., Mineola, N.Y.

IRE Booth No. 2830

CIRCLE 300 ON READER-SERVICE CARD

NEW PRODUCTS

Telemetering System

Operates over single pair of wires

Multiplexed transmission permits incoming data signals and outgoing supervisory commands to be carried over a single pair of wires by synchronous time-division sampling devices. This telemetering station has a capacity of 165 on-off type supervisory controls or 17 telemetered analog signals, or a combination of both The system checks itself once each second and, if necessary, makes automatic calibration and synchronization adjustments. It is compatible with available dc transducers at input and with all types of dc meters and recorders at output.

Applied Science Corp. of Princeton, Dept. ED, Post Office Box 44, Princeton, N. J.

CIRCLE 460 ON READER-SERVICE CARD

Decade Amplifier

High sensitivity at low frequencies

A low noise, general purpose instrument, model 40-A transistorized decade amplifier has selectable bandwidth for improved sensitivity during measurements at the lower frequencies. The amplifier noise figure is made independent of the magnitude of the driving impedance through the use of a vacuum tube at the input stage. The input impedance is in excess of 10 meg. A constant 600 ohm output impedance is useful for driving passive networks. A gain of 10 or 100 is available over the frequency range of 2 cps to 1 mc with an accuracy of ±0.2 db from 10 cps to 300 kc and ±1 db from 5 cps to 500 kc. Gain is down 3 db at 2 cps and 1 mc. Noise with shorted input terminals is 4 to 7 μv. Maximum output is 3 v rms or 1 mw.

Zacharias Electronics Corp., Dept. ED, P.O. Box 172, Livingston, N.J.

CIRCLE 461 ON READER-SERVICE CARD

TYPICAL TEST VALUES ON COPPER CLAD PHENOLITE

GRADE	PROPERTIES OF BASE MATERIAL					COPPER CLAD PROPERTIES				RELATIVE COST
	Dielectric Constant	Dissipation Factor	Moisture Absorption	Flexural Strength	Maximum Operating Temperature	Copper Bond Strength		Hot Solder Resistance	Surface Resistance	Based on XXXP as Arbitrary Scale of 1
						Pounds to Pull 1" Strip				
	10^6 Cycles	10^6 Cycles	1/16", % 24 Hrs	Psi	Degree F	1 Oz	2 Oz	Secs to Blister 1" Square > Greater Than	Megohms, Etched Retma Comb Pattern, 96 Hrs/35°C/90% RH	1/16" Thk. 1 Oz. Copper 1 Side
P-214-B-1	5.3	.040	2.20	18,000	250	8	11	>10 @ 475°F	100,000	.81
XXP-209-G-1	4.6	.037	1.30	17,000	250	8	11	>10 @ 475°F	200,000	.92
XXP-239-1 PHENOCLAD	4.2	.035	0.67	15,500	250	8	11	>10 @ 475°F	200,000	.92
XXXP-219-C-1	4.5	.030	0.70	15,500	250	8	11	>10 @ 475°F	500,000-1,000,000	1.00
XXXP-455-1	4.0	.026	0.55	23,500	250	8	11	>10 @ 475°F	1,000,000-1,500,000	1.00
XXXP-470-1	3.7	.027	0.48	14,000	250	8	11	>10 @ 475°F	300,000-500,000	1.00
N-1-852-1	3.3	.030	0.20	16,000	165	8	11	>10 @ 450°F	2,000,000	2.69
G-5-813-1	6.8	.018	1.00	55,000	300	8	11	—	—	2.98
G-10-865-1	5.2	.012	0.13	60,000	250	10	15	>30 @ 500°F	1,500,000-2,000,000	3.49
G-11-861-1	4.9	.015	0.17	60,000	300	10	15	>30 @ 500°F	2,000,000	3.55

NEW PRODUCTS

Telemetering System

Operates over single pair of wires

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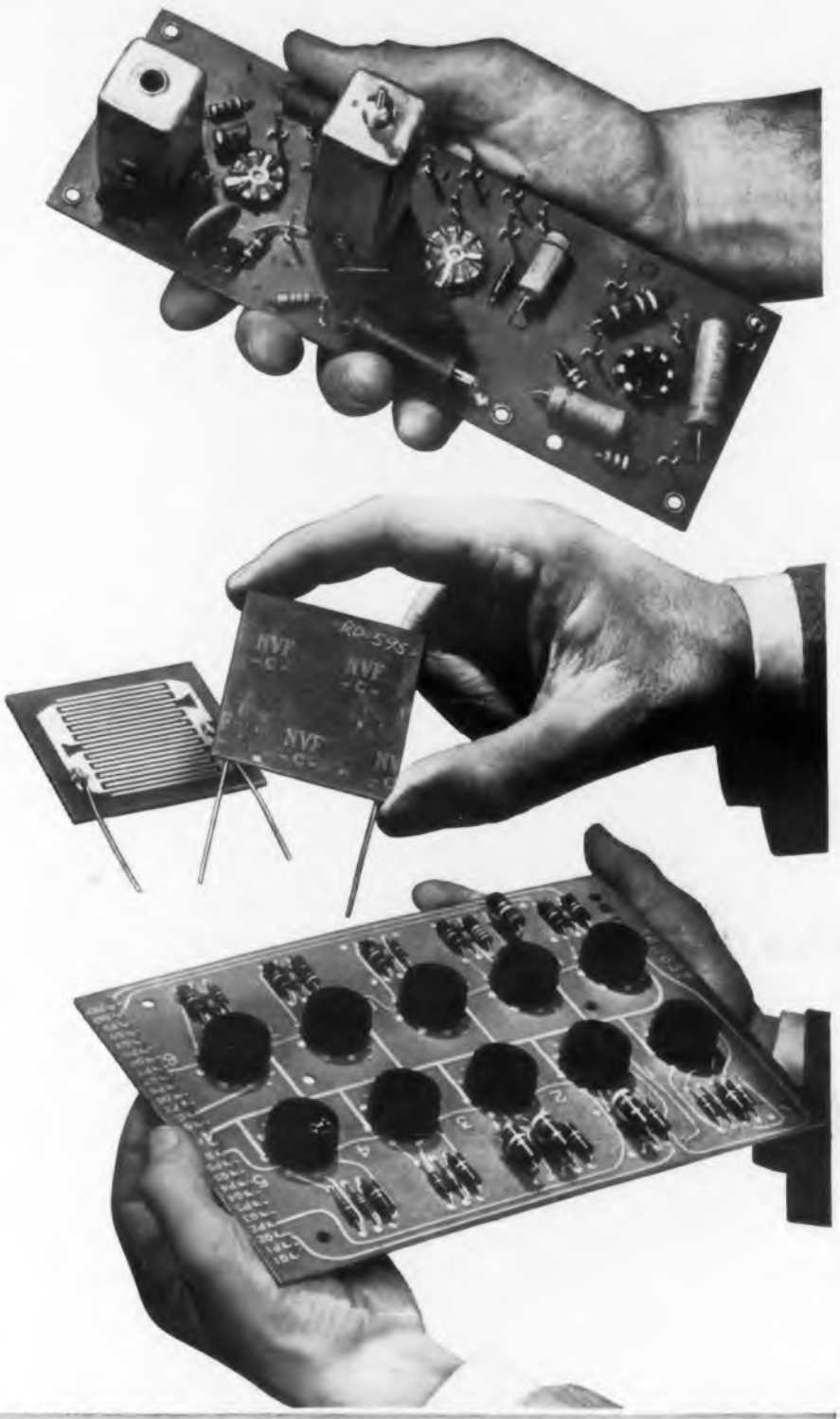
Zacharias Electronics Corp., Dept. ED, P.O. Box 172, Livingston, N.J.

CIRCLE 461 ON READER-SERVICE CARD



TYPICAL TEST VALUES ON COPPER CLAD PHENOLITE

GRADE	PROPERTIES OF BASE MATERIAL					COPPER CLAD PROPERTIES				RELATIVE COST
	Dielectric Constant	Dissipation Factor	Moisture Absorption	Flexural Strength	Maximum Operating Temperature	Copper Bond Strength		Hot Solder Resistance	Surface Resistance	Based on XXXP on Arbitrary Scale of 1
	10⁶ Cycles	10⁶ Cycles	⅛", % 24 Hrs	Psi	Degree F	Pounds to Pull 1" Strip		Secs to Blister 1" Square > Greater Than	Megohms, Etched Retma Comb Pattern, 96 Hrs/35°C/90% RH	⅛" Thk. 1 Oz. Copper 1 Side
						1 Oz	2 Oz			
P-214-B-1	5.3	.040	2.20	18,000	250	8	11	> 10 @ 475°F	100,000	.81
XXP-209-G-1	4.6	.037	1.30	17,000	250	8	11	> 10 @ 475°F	200,000	.92
XXP-239-1 PHENOCLAD	4.2	.035	0.67	15,500	250	8	11	> 10 @ 475°F	200,000	.92
XXXP-219-C-1	4.5	.030	0.70	15,500	250	8	11	> 10 @ 475°F	500,000-1,000,000	1.00
XXXP-455-1	4.0	.026	0.55	23,500	250	8	11	> 10 @ 475°F	1,000,000-1,500,000	1.00
XXXP-470-1	3.7	.027	0.48	14,000	250	8	11	> 10 @ 475°F	300,000-500,000	1.00
N-1-852-1	3.3	.030	0.20	16,000	165	8	11	> 10 @ 450°F	2,000,000	2.69
G-5-813-1	6.8	.018	1.00	55,000	300	8	11	—	—	2.98
G-10-865-1	5.2	.012	0.13	60,000	250	10	15	> 30 @ 500°F	1,500,000-2,000,000	3.49
G-11-861-1	4.9	.015	0.17	60,000	300	10	15	> 30 @ 500°F	2,000,000	3.55


Alu

umalytic*

bring General Electric

Twist-tab capacitors in 1" and 1.375" diameter sizes feature G-E etched foil to increase effective anode area. They come supplied with printed circuit board mountings or regular solder eyelet terminals and twist-tab lugs. (Unit at left is actual size. Units above are shown ½ actual size.)

* ALUMALYTIC

Alumalytic is General Electric's trademark for its electrolytic capacitors made with 99.99% pure aluminum foil.
Alumalytic capacitors give you:

- **Longer shelf life because of less oxide deterioration**
- **Longer operating life because of lower leakage currents**
- **Higher reliability because the foil contains fewer impurities**

Capa

quality to the el

Alumalytic capacitors for very high microfarad applications, such as found in computer power supplies, come in 1⅜", 2", 2½" and 3" case diameters. Ratings up to 35,000 mfd; 350 vdc are available. Units are made to exacting specifications under closely controlled conditions. (Capacitor above is shown ½ actual size.)

Insulated metal tubular capacitors are available in all popular ratings, with choice of insulated or uninsulated wire leads or solder eyelet terminals at either or both ends. Uninsulated metal tubular units are also available. (Unit above is shown actual size.)

acitors

ectrolytic field

Competitively priced units made with 99.99% pure aluminum foil

Now you can get electrolytic capacitors that are backed by General Electric's long experience in making capacitors for the most critical electronic applications. New DC Alumalytic capacitors are especially designed to meet the growing need for higher quality and more reliable electrolytic capacitors.

Production quantities of Alumalytic capacitors are now available for immediate shipment. They are offered in a broad range of popular types and ratings for radio and television applications, as well as for phonographs, tape recorders, sound systems, computers and similar equipment.

Although the recently developed Alumalytic capacitors are competitively priced, they are made with extremely high quality (99.99% pure) aluminum foil, a feature normally found only in more expensive, specialized types. This high purity foil makes possible a superior dielectric film. With it, units operate at lower leakage currents, and offer superior shelf life at both normal and elevated temperatures. Other materials used in the G-E Alumalytic capacitors are of similar high quality.

Alumalytic capacitors are manufactured by scientifically controlled methods at General Electric's new Irmo, South Carolina plant. Laboratory tests, built right into the production lines, constantly check quality. Millions of capacitors already delivered have passed the most exacting specifications.

For more information and for complete service assistance on your specific problems, contact your nearest General Electric Apparatus Sales Office. Or write to General Electric Company, Section 449-2. Schenectady, N. Y.

Progress Is Our Most Important Product

GENERAL ELECTRIC

Visit booth #2928 at New York I.R.E. Show, March 24–27.

AND THEY ARE RUGGED!

NEW DONNER TEST INSTRUMENTS

New Donner design integrates the most wanted mechanical and electrical features to create test and measuring instruments of high durability. These instruments will stand up in the field and in the lab. New circuitry provides improved specifications.

Mechanically and electrically these features add up to

RELIABILITY

The NEW Donner instrument line includes sine wave generators, low frequency generators, wave analyzers and wow and flutter meters. Shown are models 1202 Sine Wave Generator and 2102 Wave Analyzer.

Donner's new mechanical configuration combines functional styling with sturdy construction. Strong one-piece aluminum castings support ⅛" plate aluminum panels. In turn, reinforced shaft brackets are firmly anchored to these heavy plate panels, so binding, shifting and dial discrepancies are eliminated.

◀ MODEL 1202 SINE WAVE GENERATOR

- 1 cps to 1 mc, plus overlap, in 6 decades
- Less than 0.1% distortion
- 600 ohms constant output impedance, no dc
- 6 volts rms maximum. 2% calibration accuracy
- 0.5% stability. Regulated power supply
- Price (f.o.b. factory) $265.00

MODEL 2102 WAVE ANALYZER

- 30 cps to 50 kc coverage, 3% calibration accuracy
- 160μv to 500 volts rms full-scale sensitivity
- Broad and narrow crystal filter selectivities
- VTVM reads harmonic components directly in percent and db
- Simple operation, portability, reliability
- Price (f.o.b. factory) $495.00

For complete technical information on Donner's rugged new line of test equipment, please address Dept. 193

See the whole Donner line at the IRE, Booth #3616. Console styled analog computers, transistorized accelerometers and rugged new test instruments

DONNER SCIENTIFIC COMPANY

CONCORD, CALIFORNIA

CIRCLE 508 ON READER-SERVICE CARD

Transducer

Provides precise voltages and frequencies

Designed for flight test instrumentation where 115 v 400 cps power is available, the Gepod provides controlled excitation of information transducers. The unit will energize three transducers and demodulate their output signals to a form suitable for in-flight recording and/or energizing an air-to-ground telemetering link. When gyros are used Gepod will supply adequate power of precisely controlled frequency to operate 3 gyro spin motors. Measuring 6 x 7 x 13 in. (including shock mount), the instrument weighs 15 lb.

Bloc Corp., Dept. ED, Maple Ave., Atkinson, N.H.

CIRCLE 464 ON READER-SERVICE CARD

32-V Power Supply

0.03 per cent regulation

Model SC-32-1 power supply delivers 0-32 v, 0-1 amp. Regulation for line or load is less than 0.03 per cent or 0.003 v, whichever is greater. Ripple is 3 mv rms. Recovery time is 50 μsec. Stability for eight hours is 0.03 per cent or 0.003 v. Output impedance is 0.01 ohms. Additional features include 0.005 per cent resolution by means of a 10-turn voltage control.

Kepco Labs., Inc., Dept. ED, 131-38 Sanford Ave., Flushing 55, N.Y.

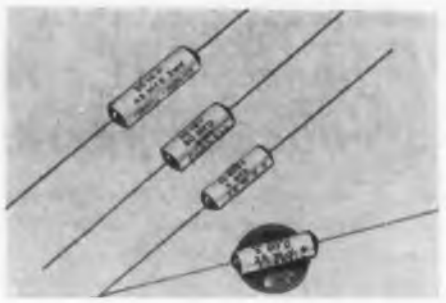
CIRCLE 465 ON READER-SERVICE CARD

◀ CIRCLE 507 FOR G.E. SPREAD

NEW PRODUCTS

Electrolytic Capacitors

Miniature sizes for low voltage use



Type EC electrolytic capacitors are available in ratings from 3 to 75 v dc working, and in capacitances from 1 to 250 μf, depending on voltage ratings. Operating temperature range is —20 to +65 C. The smallest case size is 0.187 in. diam and 1/2 in. long, and the largest is 0.375 in. by 1-1/2 in. The capacitors are housed in tubular ceramic cases. Capacitor sections are sealed with cast resin making them moisture-tight and heat resistant.

Cornell-Dubilier Electric Corp., Dept. ED, S. Plainfield, N.J.

CIRCLE 480 ON READER-SERVICE CARD

Transformers and Chokes

Can design provides good thermal quality

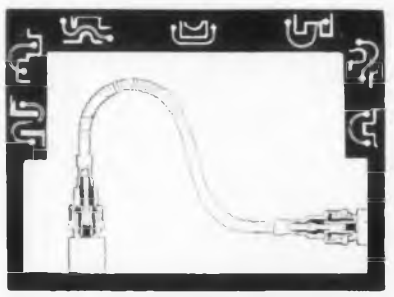
This line of standard 400 cps transformers and chokes features a can design only slightly larger than the actual magnetic core. Power range up to 200 w at 400 cps is available in case sizes ranging from 1-1/4 x 1 x 1 up to 2-1/2 x 2 x 2-1/8 in. The proximity of the double-ended can to the coil and core provides minimum thermal distances, while contact with the core allows the base to dissipate heat in a heat-sink mounting. Reduction of case size also decreases the weight and volume of epoxy required for potting.

Magnetic Circuit Elements, Inc., Dept. ED, 3722 Park Pl., Montrose, Calif.

CIRCLE 481 ON READER-SERVICE CARD

FLEXIBLE SHAFTS

Handle wide variety of control applications.



The Flexible Shaft today, although not complicated, is a specific component designed for specific applications. Industry in many fields, i.e., automotive, automation, aircraft, electronics, radio and television, machinery, and marine (to name but a few) have found flexible shafting to be more economical and yet more productive than whatever means they were employing to control motion from one unit to another where obstacles in the path of installation were impossible to do away with.

There are two types of flexible shafts. One is the power drive flexible shaft which utilizes a cable wound to rotate in one direction only. The outer layer of wire of the cable determines the direction rotation, and is wound so that the slack is taken up when the shaft is in operation, making it practically impossible for the cable to spring from its original shape. The other type is the remote control flexible shaft in which the cable is wound so that the slack is taken up no matter which direction the shaft is turned. The remote control shaft provides for both rotation and reciprocation, such as the opening and closing of a valve.

• • • For complete information as to how flexible shafting may help you solve your specific control problem, write F. W. Stewart Corporation, 4311-13 Ravenswood Ave., Chicago 13, Illinois.

CIRCLE 483 ON READER-SERVICE CARD

Teflon Hook-Up Wire

For aircraft and missiles

Teflon insulated hook-up wire was developed for use in aircraft, rocket and missile wiring, distribution and power transformers, integral and traction motors. Extruded Teflon coating on the silver-plated copper wire conductor makes the wire capable of continuous service over a temperature range of −90 to +260 C. It is easily stripped.

Haveg Industries, Inc., Halocarbon Div., Dept. ED, 900 Greenbank Rd., Wilmington 8, Del.
IRE Booth No. 4216

CIRCLE 486 ON READER-SERVICE CARD

Clutch-Brake Assembly

Operates on less than 5 w

Model FD electromagnetic clutch-brake is designed to couple and uncouple a mechanical load upon receipt of a signal. A braking torque is automatically applied to the load shaft when decoupled. The operating coil requires less than 5 w power and may be wound for any specified dc voltage rating. Hermetically sealed power units packs measuring 2 x 2 x 1/2 in. are available for operation from 115 v 60 cps.

General Technology Corp., Dept. ED, 44 N. Dean St., Englewood, N.J.

CIRCLE 487 ON READER-SERVICE CARD

Radar Pulse Systems

Packaged units save space

Savings in space and weight are made possible by the incorporation of several matched radar transmitter components in one package, called a Pulsepak. For instance, a typical space-saving situation occurs when high voltage components are at virtually the same potential. If packaged separately, each would need insulation from its own enclosure, but they may all be placed close together in the same container. The units furnish outputs meeting reasonable performance requirements of any specific radar system employing a hydrogen thyratron tube.

Filtron Co., Inc., Dept. ED, Flushing, N.Y.
IRE Booth No. 1502, 1504

CIRCLE 488 ON READER-SERVICE CARD

NEW PRODUCTS

Cables and Connectors

50 and 160 ohm low capacitance types

Two miniature cable and connector assemblies have been developed. The Twinax component is a 160 ohm, low capacitance connector with two shielded and jacketed conductors. This connector is a slide-on type, keyed for polarity. The Triax is a screw-type, 50 ohm connector with double shielded coax insulated between the shields.

Microdot, Inc., Dept. ED, 220 Pasadena Ave., South Pasadena, Calif.

CIRCLE 492 ON READER-SERVICE CARD

Audio Voltage Standard

Stable supply with 30 cps to 20 kc range

The model AVS-320 audio voltage standard has output voltages of 1, 10, 100, and 300 rms. Frequency range is 30 cps to 20 kc; input voltage 1 v rms; output regulation of plus 0.1 per cent for a period of 30 days, with distortion of less than 0.025 per cent. Power source is 105 to 125 v ac 60 cps, 150 w.

Holt Instrument Labs., Dept. ED, Oconto, Wis.

CIRCLE 493 ON READER-SERVICE CARD

High Temperature Connector

A push-pull type for 500 F operation

A 500 F push-pull connector will be featured in this company's display of miniature connectors. Included in the exhibit will be miniature electrical connector applications for black box packag-

Shielded room, 10' x 20' x 8', designed and manufactured by SHIELDING, INC., Riverton, N. J., for Magnavox Corporation, Ft. Wayne, Ind.

Sectional shielded room of metal-faced Weldwood Plywood gives positive RF seal, needs no maintenance

"Our Armorply shielded room, manufactured by Shielding, Inc., does a first-class job of isolating electrical equipment undergoing radio interference tests," reports Jack Ford, Magnavox standards engineer. "The ¾-inch plywood core separating the zinc-coated steel faces eliminates any possibility of short circuits. Also neither periodic repair nor painting is needed."

An Armorply room can be installed, expanded, altered, or dismantled and moved easily because special compression joints eliminate any need for soldering the modular panels. "We intend to order another Armorply enclosure shortly," says Mr. Ford. "We're perfectly satisfied with Armorply's performance." Armorply panels can be specified in a variety of faces and cores. For full details and a free Armorply sample, write: United States Plywood Co., Dept. ED 3-5-58, 55 W. 44th St., N. Y. 36, N. Y.

Weldwood® ARMORPLY®

CIRCLE 496 ON READER-SERVICE CARD

Push Button Switches Designed for your Miniaturization Program

These Grayhill Switches are designed and built for long dependable service. They are silent action momentary contact with an exceptionally long life. Series 2000 Snap Action Switch also available.

All Switches Actual Size

Series 4000 SPST ½ Amp.— 115 V. AC Normally Open or Normally Closed

Series 35 DPST .50 Amp.— 115 V. AC Normally Open

Series 23 SPST ¼ Amp.— 115 V. AC Normally Open

Series 30 .10 Amp.— 115 V. AC Normally Open or Normally Closed

Series 39 SPST ¼ Amp.— 115 V. AC Normally Open

Request Catalog No. M-202

Grayhill INC.

Telephone Fleetwood 4-1040
565 Hillgrove Avenue • La Grange, Illinois

See Us in Booth No. 2317 at the I.R.E. Show
CIRCLE 497 ON READER SERVICE CARD

ing and special rack and panel installation. In addition to rack and panel units, the line is made up of edgelite panel, hermetic and miniature connectors of all types, including push-pull, positive locking and sealing units.

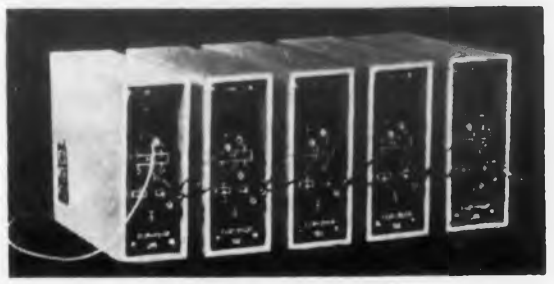
The Deutsch Co., Dept. ED, 7000 Avalon Blvd., Los Angeles 3, Calif.

IRE Booth No. 3921

CIRCLE 498 ON READER-SERVICE CARD

Digital Test Equipment

A transistorized building block line



Designed for use by engineers involved in the development and production of computer systems, this equipment features ease of application, high speed, and compactness. The transistors used make possible pulse speeds of 5 mc.

Counters, shift registers, and pattern generators as well as other test set ups can be assembled from the units. Only three voltages are used, +10, −3, and −15.

Digital Equipment Corp., Dept. ED, Maynard, Mass.

CIRCLE 499 ON READER-SERVICE CARD

Frequency Meter and Counter

10 cps to 100 kc range with high stability

Model WE-120 five-decade frequency or events per unit of time meter and counter uses decade glow transfer tubes for both digital presentation and digital division of the time base frequency. Frequency range is 10 to 100,000 cps, and stability is 0.001 per cent ±1 count. Sensitivity is 75 mw to 120 v rms, with 105-125 v, 75 w power input.

Westport Electric, Dept. ED, 149 Lomita St., El Segundo, Calif.

CIRCLE 500 ON READER-SERVICE CARD

SPIROL - the spring pin made with Low-Cost Non-Heat-Treated Metals

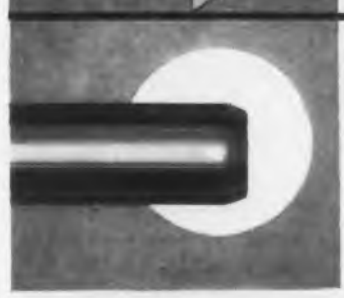
Nickel stainless steel SPIROL pins are used as corrosion-proof fastenings on "Moen" one-handle mixing faucets. SPIROL pins can be made with *lower-cost*, non-heat-treated metals — stainless steel, brass, and ordinary copper — because stress is evenly distributed throughout the spiral coils, giving *full radial spring action*, with no flexing concentrated along a "hinge" line.

SHOCK RESISTANCE

High resistance to shock and vibration permits use of "medium duty" SPIROL pins in the majority of applications. Heavy and light duty SPIROL pins also available in stock.

WIDER HOLE TOLERANCES

Both plus *and* minus hole tolerances are allowed because spiral construction permits greater flexibility in expansion and compression. The wider hole tolerances eliminate precision reaming requirements, reduce drilling rejects, cut costs.



PERFECT CHAMFER

A. Smoothly rounded radius where chamfer meets shank eases insertion into hole. No sharp break to "bite" and resist insertion. *B.* Chamfer angle is precisely designed to offer minimum thrust resistance and maximum compression leverage.

MINIATURE PINS — SPIROL is the only spring type pin available in these miniature diameters: 1/32" — .039" — 3/64" — .052". Unique spiral cross-section retains flexibility and strength in smallest sizes. Other standard sizes up to ½" diameter.

FREE! *Write for literature on Spirol Pins.*

® SPIROL *the true spring* **PIN**

C. E. M. COMPANY • SCHOOL ST. • DANIELSON, CONN.

CIRCLE 510 ON READER-SERVICE CARD

NEW PRODUCTS

Magnetic Amplifier

Linear dc output controlled by dc signal

Model 420 magnetic amplifier has a trans-impedance of 50,000 ohms and delivers a linear dc output from 10 μw of dc control signal. Frequency response extends from dc to 25 cps, depending on circuits used. Model 420 contains a push-pull, full-wave, reversible-polarity magnetic amplifier, and uses negative feedback for stabilization and linearity. Performance is not impaired by distorted supply waveforms, 10 per cent voltage and frequency variations, or temperatures from −55 to +85 C. Unit measures 1-1/2 in. diam by 3 in. high.

Acromag, Inc., Dept. ED, 22519 Telegraph Rd., Detroit 41, Mich.

CIRCLE 513 ON READER-SERVICE CARD

Memory Cores

Less than 1 μsec switching time

One of four products being announced are these memory cores, available in S-4 material, with switching time of less than one μsec with 550 ma full drive. At recommended operating conditions the "one" output voltage is greater than 60 mv and "zero" output voltage less than 6 mv.

A zinc ferrite material is also available. Expected to gain wide acceptance in transformer applications, this material has a loss of less than 85 mw per cubic centimeter at 15 kc. Initial permeability is rated at 2000 and maximum at 3600. Ballast for high frequency lighting systems is another application presently being explored.

Two other products consist of a line of high temperature solid pin headers for use in tubes where uniformity and ability to withstand severe environmental conditions are required, and a line of vacuum tight high-temperature ceramic-to-metal cable end seals designed for use as terminations with mineral insulated cable.

General Ceramics Corp., Dept. ED, Crows Mill Rd., Keasbey, N.J.

CIRCLE 514 ON READER-SERVICE CARD

Digital Clock

Output accurate to nearest second

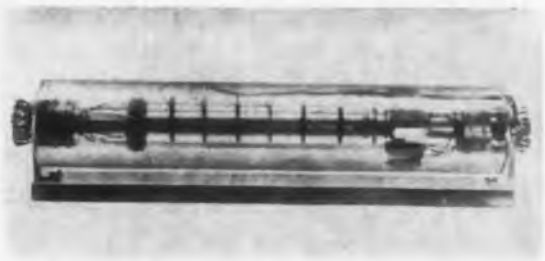
Suitable for providing time data to logging systems or data handling systems, model 2600 digital clock produces multiple digital representations of time to the nearest second. Up to three independent, parallel, decimal outputs are available in one unit, with time resolutions of seconds or minutes.

Chrono-log Corp., Dept. ED, Box 4587, Philadelphia 31, Pa.

CIRCLE 519 ON READER-SERVICE CARD

Magnetostrictive Storage Unit

Making possible a 3 μsec access rate



Having a rate of access of 3 μsec as against 10 μsec or more for usual delay lines this magnetostrictive storage unit consists of eleven 120-μsec delay lines. Ten of these lines are storage units capable of storing 60 bits of information at a 1 mc prf for a total of 600 for the 10 lines. The eleventh line is intended as a clock and/or synchronization line for purposes of controlling the time slots in a computer.

Read coils can be installed every 3 μsec along the length of the line. Using the write coil and the first read coil of the clock line as the basic timing unit, maximum timing stability is achieved while temperature changes are immaterial and will not cause the storage lines to drift. Each line may be driven by a single tube or transistor.

The storage unit is constructed around a central supporting rod or shaft for purposes of ready accessibility and servicing. Input and output coils of the delay lines can be wound for any desired impedance, tube, or transistor. The inherent temperature coefficient of the line is 0.005 per cent per deg C, but may be improved by temperature-compensating techniques.

The unit measures 40 in. long and 7 in. diameter. Weight is 25-1/2 lb.

Deltime, Inc., Dept. ED, 608 Fayette Ave., Mamaroneck, N.Y.

CIRCLE 520 ON READER-SERVICE CARD

NEW PRODUCTS

Preset Counters

Feature reliability, count rate above 5000 cps

Since cold cathode glow counters and transistors are the only critical components, this counter provides substantial reliability. Available with single and dual presets, 2 to 6 digits, and optional Nixie-in-line readout, tentative specifications include a count rate above 5000 cps, sensitivity of 50 mv at 20,000 ohms, and a pulse output of 30 v. Output relay is mercury wetted, hermetically sealed, spdt.

Dynapar Corp., Dept. ED, 5150 Church St., Skokie, Ill.

CIRCLE 524 ON READER-SERVICE CARD

Temperature Measuring System

An adiabatic type for remote indication

Application of this system can be made to any situation requiring direct reading remote temperature indication. System accuracy and range are essentially that of the total temperature probe, and can be supplied for any span from −60 to +1000 F. A typical system, the FT-104, consists of a resistance thermometer, control unit with a temperature-controlled silicon diode reference bridge circuits, and a chopper type servo millivoltmeter for display purposes.

North Atlantic Industries, Inc., Dept. ED, 603 Main St., Westbury, N.Y.

CIRCLE 525 ON READER-SERVICE CARD

Glass-Base Epoxy Laminates

Easily machinable

An epoxy-impregnated plastic laminate, designated as Grade G-11, with a continuous-filament woven glass fabric base has been developed. It is anticipated that Grade G-11 will be eventually

attention authors

Because an electronic design engineer must have hundreds of ideas to draw upon for each individual design decision, the editorial staff of *ELECTRONIC DESIGN* is continually trying to add to this storehouse of ideas. We are, therefore always interested in material based on your own experience which would be of immediate practical use to electronic design, development and research engineers. It is not difficult to write an article for *ELECTRONIC DESIGN* if you know what to write about and how we like to have our stories written. To simplify the preparation of an article, we have drawn up a brief guide for authors. Send for your copy today.

Edward E. Grazda, Editor.

ELECTRONIC DESIGN
19 East 62nd Street
New York 21, New York

covered by a future military specification of its own; it does conform to Military Specifications MIL-P-18177 at present. Grade G-11 possesses low moisture absorption, and low dissipation factor properties, maintaining these characteristics over a wide range of humidities and temperatures. It can be easily machined because of its high bond strength, and is fungi-resistant.

Synthane Corp., Dept. ED, 12 River Rd., Oaks, Pa.

CIRCLE 530 ON READER-SERVICE CARD

Transformer Kit

For blocking oscillator design

The Pulsite transformers in this kit are specifically designed for use in preferred blocking oscillator circuits. For example, in NBS preferred circuit no. 46, cathode output is 60 to 85 peak volts with pulse durations of 0.1 to 10 μsec, depending on transformer used. The kit consists of eight oscillator units with turns ratios of 1:1:1 and open-circuit primary inductances from 0.08 to 150 mh and two interstage units with turns ratios of 5:1:1.

Airpax Products Co., Transformer Div., Dept. ED, Middle River, Baltimore 20, Md.

CIRCLE 531 ON READER-SERVICE CARD

300 Deg Panel Meter

Available in sensitivities to 100 μamp

Featuring 8-1/2 in. of useable linear scale in a 4-1/2 in. diam meter, these units cover 15 per cent more scale than the 250 deg instruments previously manufactured by this company. Response time and dampening of these meters surpass MIL 10304A. The instruments are hermetically sealed and ruggedized. Meters can be furnished in standard ranges from 100 μamp and up, with accuracies from 0.5 to 2 per cent. They are available in 2-1/2, 3-1/2, and 4-1/2 in. sizes, round or square. Other sizes and meters more sensitive than 100 μamp can be built.

Miller Instrument Co., Dept. ED, 165 E. Lincoln St., Escondido, Calif.

CIRCLE 532 ON READER-SERVICE CARD

APPLICATIONS

Electrical and Acoustical Measurements
Electrical Communication Systems (Selective Calling)
Remote Operation and Supervisory Control of Machinery and Apparatus
Electrical Computers and Telemetering Systems
Electro-Mechanical Bandpass Filters

Frahm Oscillator Controls, Type ROC, make possible the design and construction of inexpensive, precision tone generators that are small and light weight. These generators will have accurate output frequency and output voltage with very nearly sinusoidal wave shape.

They can be made with any one nominal control frequency between 20 and 1100 cps. They will control the output frequency of circuits, under specified conditions, constant within $\pm 0.15\%$ of the nominal control frequency.

We particularly encourage your inquiries and correspondence on special applications and problems. If you haven't explored these Frahm Oscillator Controls we'll be glad to send you complete specifications, characteristics, etc. Write for Bulletin **34-ED**.

B-706

JAMES G. BIDDLE CO.
ELECTRICAL TESTING INSTRUMENTS • SPEED MEASURING INSTRUMENTS
LABORATORY & SCIENTIFIC EQUIPMENT
1316 ARCH STREET, PHILADELPHIA 7, PA.

CIRCLE 301 ON READER-SERVICE CARD

NEW LITERATURE

Silicone Sponge Sheets 302

The properties of Cohrlastic R-104070 silicone sponge rubber sheets for —100 to 480 F applications are detailed in this 2 page data sheet. These silicone sponge rubber sheets meet AMS 3195 and 3196 and many commercial specifications. Data sheet, as well as a sample of the silicone sponge rubber are available. Connecticut Hard Rubber Co., 407 East St., New Haven 9, Conn.

Visual Analysis Techniques 303

A bulletin series covering technical notes on applications of panoramic techniques in the solution of measurement problems has been released. The series covers actual case histories, the function and use of various types of instruments, results achieved with combination instrumentation systems, technical explanations and solutions of both common and unusual problems. Panoramic Radio Products, Inc., Mount Vernon, N.Y.

Reflex Klystron 304

Describing a low voltage, reflex klystron for the frequency range of 8.5 to 10.5 kmc, the bulletin includes special features and applications. The oscillator produces a minimum output power of 20 mw at a beam potential of 300 v when operating into a load having a measured vswr of less than 1.1.

The oscillator features broad band; low cost; small size; waveguide output; base shield flange; integral cavity and tuner with a single-screw tuning covering the full frequency range; free convection cooling; compensated for ambient temperature changes; all electrical connections through standard small-wafer octal base. Sperry Gyroscope, Electronic Tube Div., Great Neck, New York.

Metal Film Resistors 305

This four page brochure describes and gives specifications of metal film resistors especially designed for use from dc to

90,000 mc. Described are waveguide metallized glass attenuator elements, coaxial load resistors, metal film resistance card, metallized mica elements 0.001 in. thick and miniature metal film rod and disc type resistors. Applications of the resistors are microwave attenuators, coaxial low and high power loads, Tee pads, precision low vswr terminations, strip line resistors, directional couplers, and coaxial attenuators. Filmohm Corp., 48 W. 25th St., New York 10, N.Y.

Special Cams 307

This illustrated booklet, No. SC-1, describes a service for providing industry with special cams of every type, whether the need is for a single piece or for production lots. Many of the modern manufacturing and testing facilities utilized in the precision operations are illustrated. Included among the facilities described in detail are cam millers, cam grinders, turret lathes, visual comparators, air gages and an optical rotary table reengineered to the comany's specifications. The American Cam Co., Inc., P. O. Box 2106, Hartford, Conn.

Pulse Transformers 308

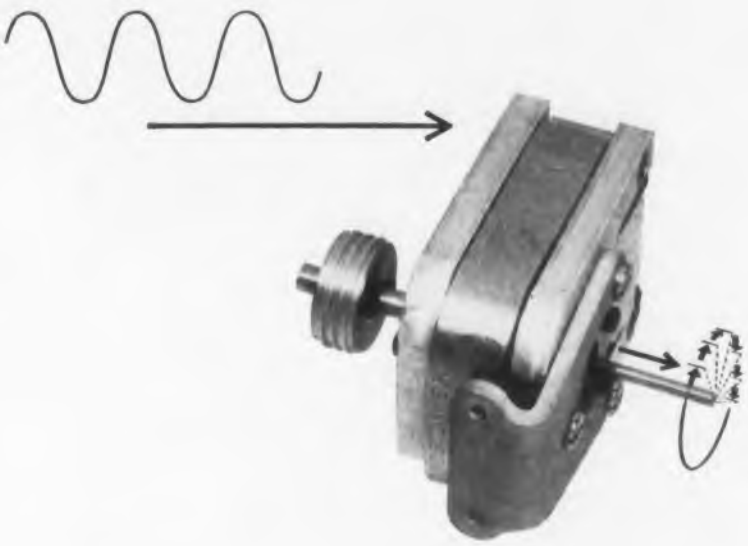
A 12-page catalog, C 201, describes pulse transformers, toroids, and filters. With schematics showing typical uses, it provides detailed circuit applications and design hints. Pulse Engineering, 2657 Spring St., Redwood City, Calif.

Facilities Brochure 309

Facilities which span the full spectrum of engineering and design services are described in a 6-page folder. A data processing and electronic digital computer service are among those mentioned. Photographs illustrate the text. Allstates Design & Development Co., Inc., 25-27 N. Warren St., Trenton, N.J.

Relays 310

A 20-page catalog shows a full line of relays for electronic, electrical, and industrial use. It contains technical data on relays of all types. Kurman Electric Co., Div. of Norbute Corp., 191 Newel St., Brooklyn, N.Y.



99% *magnetic* stepping motor—

1% moving part (TOUCHES ONLY BALL BEARINGS)

. . . 8000 STEPS PER MINUTE

. . . INSTANT START, NO SLIP, NO CLATTER

. . . IT WORKS

THE SIGMA CYCLONOME® STEPPING MOTOR* behaves like a 10-pole synchronous motor, but because of small inertia and high torque it comes to a dead stop between *each half cycle* up to rated maximum of 130 cps. It continues to run synchronously at frequencies well above this maximum, but eventually fails to stop on command on a selected pole.

Since stopping and starting torques are roughly equal, it makes a good counter of cycles or pulses. It accepts sine waves or square pulses, but requires reversals. These reversals may be provided by straight AC signals, DC pulses supplied alternately to separate windings, or DC pulses to one winding with a reference or bias DC in the other.

As proof that this dandy little motor works and can do some useful jobs, three "for instances" that we've built are shown. In (1), some rather elaborate switching is done by a commutating switch driven by the motor. At (2), it functions as a self-checking digital readout switch. In the third example (3), the motor is housed with and drives a 6-digit Veeder-Root register at rates up to 8000 CPM (sold for some time as the Sigma Cyclonome Counter).

*Pat. app. for

TYPE 12D CYCLONOME STEPPING MOTOR SPECS INCLUDE:

TORQUE OUTPUT: approximately 100 gram-cm. for every 18° of rotation (optimum input signal)

INERTIA: 0.6 gram-cm².

INPUT POWER: ½ to 12 watts depending on speed requirements

SIZE: 2⅜" x 2⅞" x 1⅞"

Why you would want to get shaft positions out of electrical cycles is, of course, your business, but there is a thinly disguised feeling around here that (maybe?) one of these gadgets might be just what you've been looking for. If you can withstand the Tumult and get past the Lions, you can see a Cyclonome Motor stepping at BOOTH 2628-2630, at the athletic contest in March. If not, write for Bulletin.

SIGMA INSTRUMENTS, INC.

91 Pearl Street, So. Braintree 85, Massachusetts

CIRCLE 312 ON READER-SERVICE CARD

ACTUAL SIZE

Overall dimensions: 4″ x 8″ x 7½″ deep, wt. 14 lbs.

ADJUSTABLE
POWER SUPPLY
0-300 V, 200 ma

$89.50
f.o.b. factory
Immediate delivery

Send for complete literature

SPECIFIC PRODUCTS

Box 425; 21051 Costanso, Woodland Hills 2, California

CIRCLE 313 ON READER-SERVICE CARD

NEW LITERATURE

Economical Packaging 314

Packaging cost reduction from original package design to final product shipment is the subject of this pocket-size booklet, titled "How to Ship More Economically in Corrugated Boxes." The 24-page publication includes information on the designing, testing and storing of product packages. Illustrated with photographs and drawings, the booklet also offers information on the planning of the shipping department and on economy considerations in the packing, sealing, warehousing and shipment of corrugated boxes. Hinde & Dauch, Sandusky, Ohio.

Transistor Manufacture 315

A brochure to show the reader exactly how the germanium alloyed junction transistor is manufactured is now available. Included in this eight-page brochure are photographs and a flow chart which shows the step-by-step operations in the production of the transistor from raw material to finished product. General Transistor Corp., 91-27 138th Place, Jamaica, New York.

Potted RF Chokes 316

Potted Chokes are fully described in a four page, two color bulletin, number 125. These units, available from stock, are epoxy encapsulated and meet performance requirements of MIL-C-15305A, Grade 1, Class B. The bulletin includes a section covering theory of typical application in rf circuits. NYT Electronics, Inc., 2979 Ontario St., Burbank, Calif.

Panel Lamp Chart 317

A chart on panel and flashlight lamps has been compiled, and is now available. The chart is a composite listing, arranged numerically, of all panel and flashlight lamps manufactured by Chicago Miniature, General Electric, National Carbon (Eveready), Radio Corporation of America, Raytheon, Tung-Sol and Westinghouse. Simply by checking the lamp number the user can determine at a glance the respective manufacturers, bulb type, base, volts, amps and bead color. All bulb types are illustrated with physical dimensions. The Radio-Electronic Master, 60 Madison Ave., Hempstead, N.Y.

Powdered Metal Processes 319

This 16-page, pocket-size booklet, in color, shows how to cut precision parts costs with a powdered metal process. The booklet tells what the powdered metal process is and does. It states advantages and limitations, illustrates good and bad parts-design factors, and charts material specifications. Reese Metal Products Corp., Lancaster, Pa.

Electronic Master Catalog

The 1958 Radio-Electronic Master Catalog is ready. The largest yet, it has 1584 pages, 11,500 pictures, and over 150,000 items from 350 manufacturers. It gives detailed descriptions, specifications, and prices for standard stock items. An index pinpoints all products. Some of those listed are: tubes, test equipment, capacitors, resistors, relays, coils, antennas and accessories, transformers, recording and public address systems, high fidelity equipment, hardware, tools, transmitters, communications receivers, wire and cable, speakers, microphones, rectifiers, converters, amateur gear, switches, and volume controls. *The catalog may be obtained from electronic parts distributors. Names will be furnished on request by United Catalog Publishers, Inc., 60 Madison Ave., Hempstead, N.Y.*

Crystal Diodes 320

A crystal diode replacement guide is now available. The guide contains special data on miniature diodes plus complete listings for all general purpose diodes. Sylvania Electric Products, Inc., 100 Sylvan Road, Woburn, Mass.

Chassis Latches 321

Bulletin 27L introduces two electronic chassis latches with interchangeable handles and forks. The 4-page folder lists specifications and tells, step by step, how to install and remove the latches. Labeled dimensional drawings show handle and fork assemblies. Weight, material, and finish are given for all catalog part numbers; and panel thickness and adjustment ranges are given for fork assemblies. Camloc Fastener Corp., 22 Spring Valley Rd., Paramus, N.J.

New PRECISION FREQUENCY

STATIC INVERTER SUPPLY

INPUT 28V D.C. ± 10%

OUTPUT Nom. 115V ± 2% 400 CPS ± 0.01%
1 ø (2- or 3-phase output available)

RATINGS: 30VA 50VA 100VA
Higher ratings available.

APPLICATION:

For gyro wheel supplies and where precise 400 cycle voltages are required in aircraft, radar and missile computers.

FEATURES:

PRECISION OUTPUT FREQUENCY
RUGGED
EXCELLENT WAVEFORM
SIMPLICITY OF CIRCUITRY
FAST STARTING TIME
GOOD VOLTAGE REGULATION
throughout an adjustable range
ISOLATED CASE DESIGN
HIGH RELIABILITY
VIBRATION ISOLATED
COMPACT
LIGHTWEIGHT
MILITARY SPECIFICATIONS

(Send for Bulletin S-864)

PERFORMANCE SPECIFICATIONS

MODEL NUMBERS				
	± .01% CPS	SIS 40311	SIS 40511	SIS 410011
	± .05% CPS	SIS 40315	SIS 40515	SIS 410015
INPUT VOLTAGE		28V DC ± 10%		
MAX. OUTPUT POWER		30VA	50VA	100VA
OUTPUT VOLTAGE		115V AC (Adjustable ± 10%)		
OUTPUT FREQUENCY		400 CPS ± .01% 400 CPS ± .05%		
VOLTAGE REGULATION		±1% For Line Variations ±2% For Load Variations		
FREQUENCY DISTORTION		3% Maximum At Full Load		
LOAD POWER FACTOR		+0.5 to −0.5 Maximum		
MILITARY SPECS.		MIL-E-5400A & MIL-E-5272A		
AMBIENT TEMPERATURE		−55°C to +71°C when mounted to heat sink		
VIBRATION		20G 10 to 2000 CPS		
UNIT DIMENSIONS		L5" D 2 7/8" H 2 13/16"	L8" D 2 7/8" H 2 13/16"	L10" D 4 1/2" H 2 13/16"
WEIGHT (Approx.)		2 lbs.	3.5 lbs.	5 lbs.

MAGNETIC AMPLIFIERS INC.
632 TINTON AVENUE • NEW YORK 55, N. Y. • CYPRESS 2-6610
West Coast Division
136 WASHINGTON ST. • EL SEGUNDO, CAL. • OREGON 8-2665

CIRCLE 323 ON READER-SERVICE CARD

Kearfott's creative engineering and production experience assures the precision and reliability of their inertial guidance systems for the successful performance of all airborne equipment.

Kearfott

GENERAL PRECISION EQUIPMENT CORPORATION
GPE

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

Sales and Engineering Offices: 1378 Main Ave., Clifton, N. J.
Midwest Office: 23 W. Calendar Ave., La Grange, Illinois
South Central Office: 6211 Denton Drive, Dallas, Texas
West Coast Office: 253 N. Vinedo Avenue, Pasadena, Calif.

CIRCLE 324 ON READER-SERVICE CARD

NEW LITERATURE

Germanium Rectifiers 325

Bulletin GEA-5773C is a 6-page write-up on germanium component rectifiers. It describes fan and blower cooled types, telling when and how each is best used. It also discusses series and parallel operation, and voltage and current ratings. A brief section tells how to order by model number. The folder has graphs, tables, dimensional drawings, and cutaways. General Electric Co., Schenectady, N.Y.

Conversion Factors 326

A wall chart of conversion factors may be had free. On it are common conversions, and many not so common. The usual changes include: inches to centimeters, watts to horsepower, and cubic feet to liters. Among the rare ones are: atmospheres to kilograms per square centimeter, centimeters per second to miles per hour, microns to meters, and quintal to pounds. Precision equipment Co., 4401 N. Ravenswood Ave., Chicago 40, Ill.

Magnetic Flowmeter 327

This catalog discusses principle and operation of magnetic flowmeters. It gives advantages and specifications of the units. Fischer & Porter Co., 461 Jacksonville Rd., Hatboro, Pa.

Copper Foil 328

Publication D-8 is an 8-page booklet about copper foil and its uses. The text covers three grades of electro-deposited sheet copper. One is for printed circuits, another is for insulating and electrostatic shielding, and the third is for metal laminating. Properties and thicknesses are given for each grade. Photographs illustrate the booklet. The American Brass Co., Copper Foil Dept., Waterbury, Conn.

Potentiometer Catalog 329

This 26-page booklet describes ten potentiometers, both single and multiturn, with various linearities and dissipations. Specifications and sizes of potentiometers are given. Hardwick, Hindle, Inc., George Rattray & Co. Div., 116-08 Myrtle Ave., Richmond Hill, N.Y.

Strain Gage Calibrator 331

A 4-page folder describes a universal calibrator for wire strain gages, their transducers and thermocouples. The text covers the features, uses, operation, and specifications of the instrument. Prices are also given. A keyed drawing locates the unit's controls, and captions tell what they are for. Photographs and a schematic provide further illustration. Allegany Instrument Co., Inc., 1091 Wills Mountain, Cumberland, Md.

Technology of Materials 332

Technical information on materials to meet unusual conditions in processing or operation is featured in an 8-page booklet "Advanced Materials Technology." The first issue gives data on a self-bonded KT silicon carbide which provides "high strength" and other outstanding properties up to 4000 F. Thermal shock problems are treated; an improved heating element is discussed and some uses of zirconium are explained. Another feature is a question and answer treatment on ceramic to metal bonds. Carborundum Co., Research & Development Div., Niagara Falls, N.Y.

NPNP Silicon Diode 333

A 4-layer npnp silicon diode is discussed in this four-page folder which is now available. Including a brief discussion of the theory and function of the device, the publication shows a series of application diagrams described as indicative of a few of the immediately apparent potentialities. Also included is the characteristic curve of the device in its standard test circuit used at the laboratory, as well as a tabulation of the characteristics displayed under these conditions. Beckman Instruments, Inc., Shockley Semiconductor Lab., Mountain View, Calif.

FHP Geared Motors 334

Form 6 announces ready-made fractional gear reducer motors which rotate clockwise and come in 16 output speeds. The 2-page sheet explains the unit's make-up and features and outlines its specifications. A table lists idling speeds and starting torques next to catalog numbers. Photographs illustrate the motor, and drawings show its dimensions. Merkle-Korff Gear Co., 213 N. Morgan St., Chicago 7, Ill.

This typical application of the Hupp "Data-Tab", lighted by 2,300 G-E 2-pin lamps, posts wheat prices. It can easily be adapted to deliver practically any message—instantly.

WHEAT PRICES, TEAM SCORES OR TRAIN SCHEDULES, G-E 2-PIN LAMPS CAN ANNOUNCE THEM ALL!

Actual size

By arranging more than 2,300 tiny G-E 2-pin lamps in rectangular patterns, or modules, and then flashing combinations of the lamps, Hupp Electronics Company's* new data tabulator can spell out any message—instantly! Designed for push-pull sockets, G-E 2-pin lamps are used because they're so easy to install and maintain. Simplified construction of lamps and socket takes less space.

For many applications, the G-E 2-pin lamp offers special advantages. It weighs about half as much as conventional lamps with the metal base. You get positive electrical contact, and because there's no solder to soften, G-E 2-pin lamps give good performance up to 600°F.

Two-pin lamps "live" longer because there's no glass bead needed to hold the heavy-duty lead-in wires. (This means no resonant frequency differential that helps break filaments in other lamps.) Discover how they can give your products improved design and operation—and more sales appeal. For further information on G-E 2-pin lamps write: General Electric Co., Miniature Lamp Dept. ED-38, Nela Park, Cleveland 12, Ohio.

**713 Circle Avenue, Forest Park, Illinois.*

Progress Is Our Most Important Product

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CIRCLE 336 ON READER-SERVICE CARD

NEW LITERATURE

Instrumentation Cables 339

Multiconductor instrumentation cables are the topic of Bulletin RCD-400. Described with pictures are cables for telemetering, data recording, circuit control testing, and electronic computers. The 8-page booklet discusses insulating and jacketing materials, color coding, and military specifications. Data on stock types are listed in tables. The pamphlet is punched to fit a notebook. Rome Cable Corp., Rome, N.Y.

Spring Materials 340

This 8-page bulletin explains the mechanical and metallurgical changes which take place in materials at elevated temperatures, the setting or relaxation of the spring, and loss of spring rate. The bulletin also presents some available solutions to these problems by proper selection of materials, choice of design stresses, and the use of certain manufacturing processes. Associated Spring Corp., Bristol, Conn.

Interval, Frequency Meter 341

Detailed specifications for a time interval and frequency meter are compiled in a 1-page leaflet. Performance and construction data are also given. A photograph illustrates the unit. Electro-Pulse, Inc., 11861 Teale St., Culver City, Calif.

Mobile Radio Equipment 342

Catalog 457 covers two-way mobile radio antennas, accessories, and towers. It gives a full page to the description, specifications, and illustration of each unit. Both base station and vehicular antennas are shown. Among other accessories, the 40-page booklet lists clamps, cable connectors, and sundry mounts. Communication Products Co., Inc., 2-Way Mobile Radio Div., Marlboro, N.J.

Transducer Calibrating 343

A unitized sub-miniature system is illustrated and described in Bulletin BBU. Complete specifications and additional information are given on both Models 6-104 and 50-B. B & F Instruments, Inc., 4732 North Broad St., Philadelphia 41, Pa.

Footswitch 345

The "Nautilus" waterproof footswitch is described in a 2-page bulletin. The bulletin indicates it has a rugged aluminum casting for long life and a piston type actuator sealed with an "O" ring. Linemaster Switch Corp., 130 Putnam Rd., Woodstock, Conn.

Precision Gears 346

A 64-page supplement lists over 2,000 additional precision instrument components. It includes such items as 24 to 200 pitch spur gears, Precision II stock gears, anti-backlash gears and couplings. PIC Design Corp., Sub. Benrus Watch Co., Inc., 477 Atlantic Ave., E. Rockaway, N.Y.

Transistor Data Chart 347

Complete, up-to-date technical information is included in the four-page transistor data chart, just released. The brochure features specifications and application data for almost 500 transistors and shows over 170 types introduced during recent months. Kahle Engineering Co., 1313 Seventh St., N. Bergen, N.J.

Mobile Radio 348

Two-way mobile radio equipment is described in a 38-page brochure. The booklet shows the wide range of equipment designed to fit individual needs based on present FCC rulings. It also tells how today's units are being engineered, taking into consideration such factors as FCC policies.

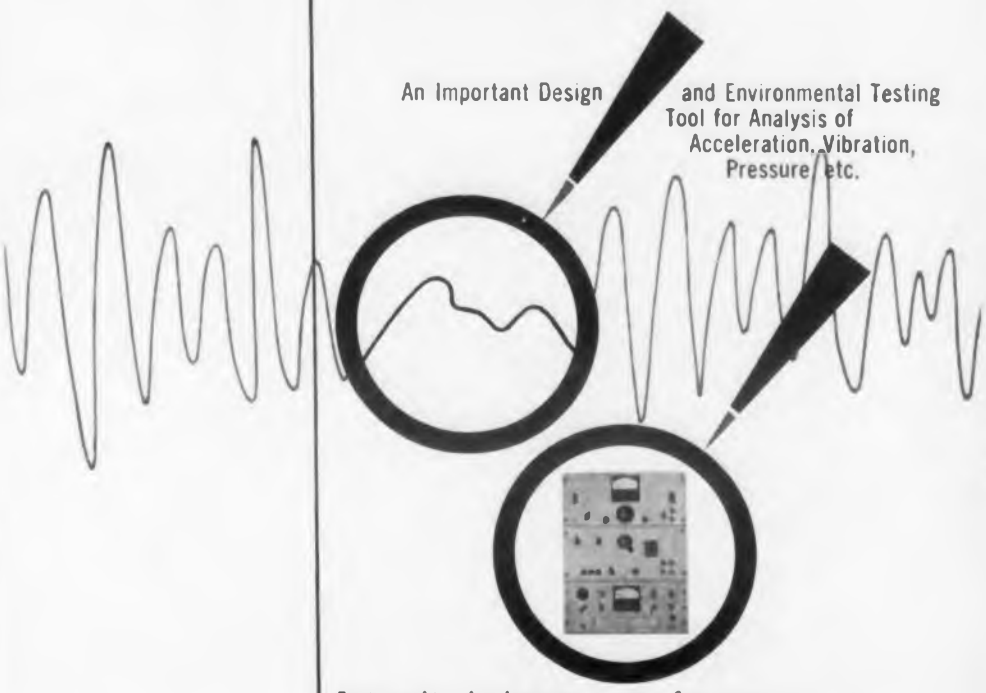
Included in the booklet are sections on "What's inside the case," frequency, bandwidth, voltage, and descriptions of cases, cabinets and mountings. General Electric Co., Communications Products Dept., Electronics Park, Syracuse, N.Y.

Etched Parts 349

Photo-formed parts and two ways to etch them are the topics of Bulletin 90. Step by step, the 8-page booklet explains chemical and electrolytic etching, and cites the advantages of each process. It tells what materials can be etched, and to what extent the etching process limits raw material, pattern, and tolerance. The booklet also lists diverse uses for etched parts. Superior Tube Co., Photo-Forming Dept., Norristown, Pa.

POWER SPECTRAL DENSITY ANALYSIS OF RANDOM WAVES

PROVIDED BY TP-625 WAVE ANALYZER SYSTEM WITH POWER INTEGRATOR



Integrity in instruments for over a quarter-century assures reliability of the TP-625 Wave Analyzer System. It provides accurate, practical, economical solutions to problems in a wide range of applications. It determines frequency and amplitude of components in a complex wave ranging from 2 to 25,000 cycles. And, with the TP-633 Power Integrator, it produces a direct current analog output proportional to power spectral density. Analog can be made proportional to peak level, average value, mean square value, as well as continuous time integral—linear or square—of the voltages in a narrow frequency band.

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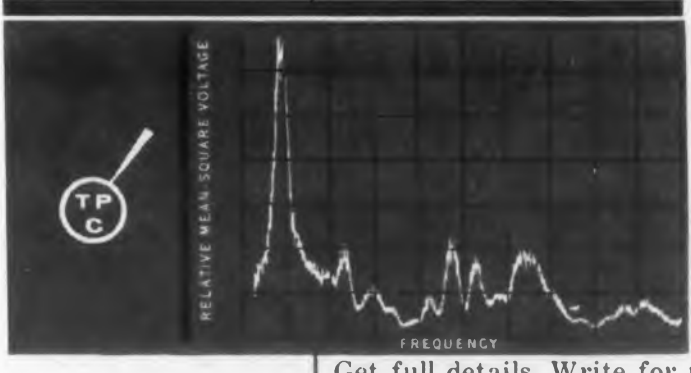

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CIRCLE 351 ON READER-SERVICE CARD

6000 cps

—a new high in frequency from a high force vibration exciter system

With new 6000 cps rating, the MB Model C10VB electrodynamic exciter further extends the complex motion testing range . . . yet delivers 1750 pounds force for sinusoidal testing with an MB Model T666 15 KVA amplifier (36,000 watt plate dissipation).

This is versatile equipment. With an MB T666 amplifier and TEMC control cabinet, it has the "muscle" to subject electronic products and other critical components to accelerations up to 58 "g". Adding an MB T88 Complex Motion Console equips it for duplicating the actual "noise" or random motion of the environment. This system is designed with an eye to future needs.

What's more, the exciter works in environmental test chambers, so that vibration can be combined with heat, cold, altitude. This not only saves test time, but gives more realistic data on performance as well.

MB C10VB Exciters have UNIMODE rocker suspension (pat. pend.) which assures linear motion and a uniform spring rate over the total stroke of 1-inch (double amplitude).

Users of MB test equipment have at their call a nationwide field service organization of vibration specialists to help on application problems. Send for full data on the complete line MB Shakers.

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HEADQUARTERS FOR PRODUCTS TO ISOLATE . . . EXCITE . . . AND MEASURE VIBRATION

CIRCLE 352 ON READER-SERVICE CARD

NEW LITERATURE

Terms for Switches 353

Standard definitions for snap-acting switches are fully-illustrated in a folder now available. An exploded view of a typical switch on the cover clearly identifies the basic parts and general construction of snap-action switches. The inside pages show the snap-action mechanism to illustrate definitions. Four carefully-executed drawings, show an entire operating cycle and visually point-up the definitions given in the text. Hetherington, Inc., Delmar Drive, Folcroft, Pa.

High Temperature Switch 354

This data sheet describes a switch which has a very high electrical rating for its size and is designed for use at 600 F. The case, cover, and plunger are molded of a special type of glass-bonded synthetic mica. A photograph and dimension drawing of the switch are included and operating characteristics, electrical data, and prices are covered. Minneapolis-Honeywell Regulator Co., Micro-Switch Div., Freeport, Ill.

P C Design Guide 355

Technical Bulletin P-9b on standard printed circuit tolerances is now available. The Bulletin contains clearly defined guides for design engineers and layout draftsmen in the preparation of original circuit designs. Photocircuits Corp., Glen Cove, N.Y.

Laminated Plastics 356

A 20-page bulletin provides a full description of the manufacture, application, and various forms of Lamicoid laminated plastics. Fold-outs list the various grades of the material and include specifications, physical and electrical characteristics, and sizes. Mica Insulator Co., Schenectady 1, N.Y.

Wire Processing 357

A four-page bulletin is available describing this company's facilities for wire processing. The processed wires described include plated, etched, or enameled types, as well as anodized aluminum. Sigmund Cohn Corp., 121 S. Columbus Ave., Mt. Vernon, N. Y.

Synchronous Motors 359

Complete technical, operational, and design data on the permanent magnet synchronous motor are given in Bulletin No. PB117. Detailed specifications on all five types are included in addition to material and construction information. Cramer Controls Corp., Centerbrook, Conn.

1958 TV Manual 360

A four-page brochure describing and explaining the advantages of using manuals in service work is now available. Description is also given of earlier television volumes as well as seventeen radio service manuals. Supreme Publications, 1760 Balsam Rd., Highland Park, Ill.

Relays and Contactors 361

DC contactors and relays are described in a 32 page catalog, GEA-6621. Extensive selection and application data are provided, including ordering instructions, full product descriptions, photographs of representative units, and pertinent technical data. General Electric Co., Schenectady 5, N.Y.

Microwave Components 362

Available is a catalog of waveguide and coaxial components. Featured are wideband coaxial terminations for all standard lines in current use. Radar Design Corp., 2360 James St., Syracuse, N.Y.

Color-Matching Plastics 363

A 20-page brochure tells about a service for color-matching plastics to other materials. Liberally illustrated with 4-color photographs, the text shows how matches are made from existing samples or new formulations. It discusses research work being done to improve the life and weather resistance of color in plastics. Concentrates for coloring polyethylene are described. Eastman Chemical Products, Inc., Kingsport, Tenn.

How to Ruin Transistors 364

Information on how NOT to use transistors is contained in a new type of "how to do it" booklet. A dozen ridiculous cartoons can help rush you through the coffee break. General Transistor Corp., 91-27 138th Place, Jamaica, N.Y.

Ultra-Miniature
Low Cost Capacitors
for Transistor Circuits

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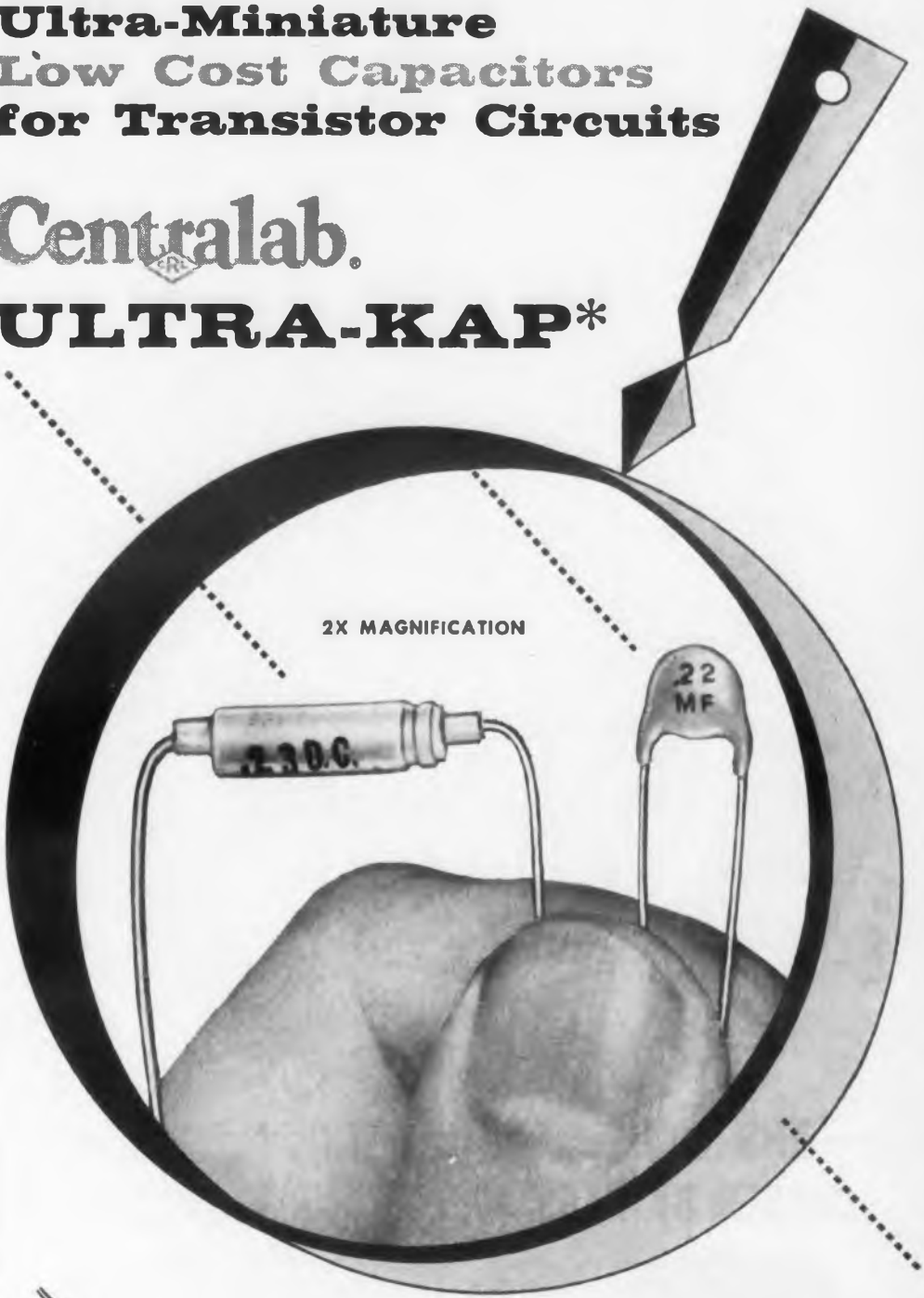
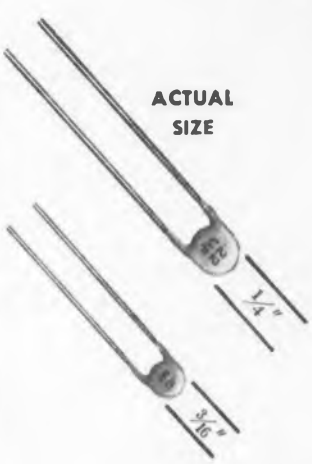
ULTRA-KAP*





. . . with performance characteristics that equal or exceed much larger or more costly components. Excellent temperature stability: plus or minus 25% from 10° to 85° C. Extremely low power factor. Working voltage, 3 VDC. GMV tolerances. Maximum thickness, 0.156".

TYPICAL SIZES

.10 mfd	3/16" diameter
.22 mfd	1/4" diameter
.47 mfd	3/8" diameter
1.0 mfd	9/16" diameter
2.2 mfd	3/4" diameter

For detailed information write for Engineering Bulletin EP-87 or contact your local Centralab sales representative.

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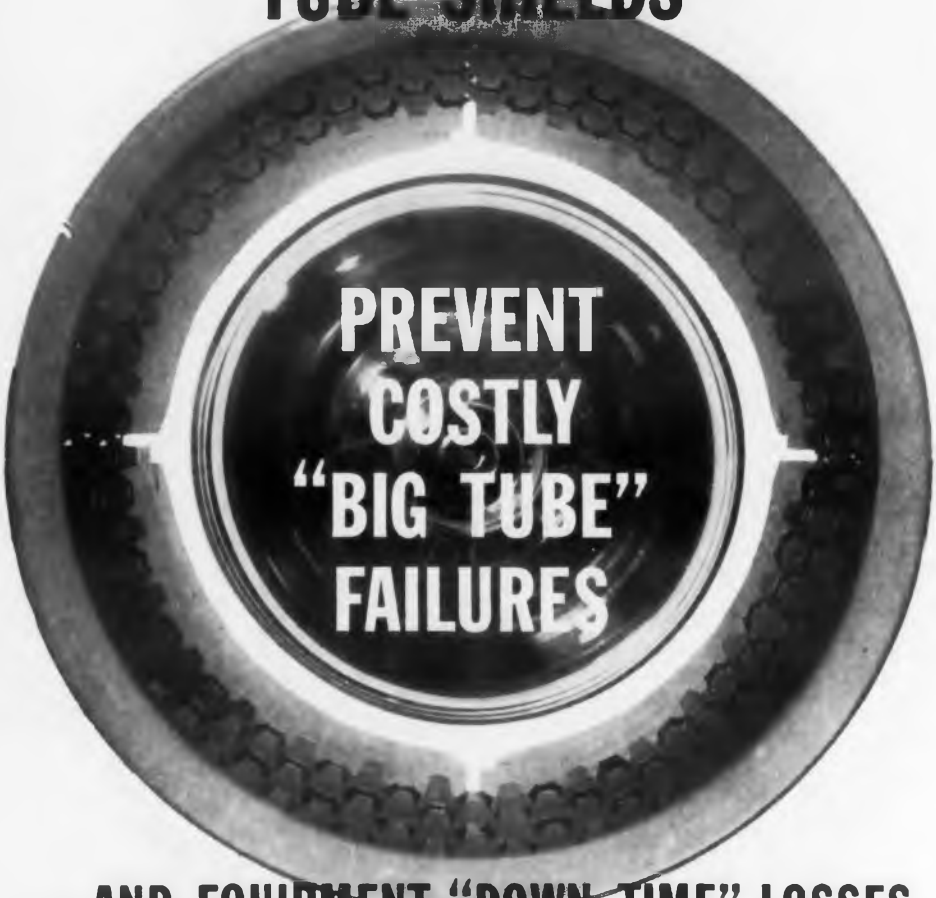
VARIABLE RESISTORS • PACKAGED ELECTRONIC CIRCUITS • ELECTRONIC SWITCHES
CERAMIC CAPACITORS • ENGINEERED CERAMICS • SEMI-CONDUCTOR PRODUCTS

CIRCLE 366 ON READER-SERVICE CARD

IERC HEAT-DISSIPATING ELECTRON TUBE SHIELDS



— AND EQUIPMENT "DOWN TIME" LOSSES CAUSED BY HEAT, SHOCK AND VIBRATION!

Investigate the extraordinary tube-saving, cost-saving potentials of IERC Heat-dissipating Tube Shields — the only complete, commercially-available line of effective heat-dissipating electron tube shields for **miniature, subminiature and octal/power** size tubes. IERC's expanded line of heat-dissipating tube shields for the larger size power tubes offer, for the first time, **a practical method to retain these tubes** in severe shock and vibration environments!

The most complete electron tube heat-dissipation information is yours for the asking! Technical data comprised of IERC and independent laboratory test reports will be sent upon request on your company letterhead.

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electronic research corporation

145 West Magnolia Boulevard, Burbank, California

LATEST addition to IERC's product line is the IERC HEAT DISSIPATOR for POWER TRANSISTORS. Effective reduction of temperatures, elimination of heavy, large or finned surfaces plus adaptability for use in confined spaces are prime features. Technical Bulletin PP112 is included with general IERC information sent on request.

Heat-dissipating electron tube shields for miniature, subminiature octal and power tubes

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Fiberglas Laminates 372

A selection guide to Fiberglas reinforced laminates is offered. Briefly, the 8-page pamphlet tells what can be expected of laminates prepared from different resins. It also tells where the laminates are used, and what tools are best for fabricating them. A chart shows comparative properties and prices. Owens-Corning Fiberglas Corp., Electrical Div., 598 Madison Ave., New York 22, N.Y.

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Bulletin 151 describes in detail the VT1R5 variable transformer (1.5 amp), which features a new design in the industry. Pertinent performance data is presented such as voltage regulation and derating curves. Ohmite Mfg. Co., 3668 Howard St., Skokie, Ill.

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2 NEW INSTRUMENTS by TECHNITROL

THE DYNAMIC DIODE TESTER

An invaluable means for the rapid, accurate checking of semiconductor diodes for irregularities. The dynamic curve, more revealing than static testing, is quickly apparent on the screen, and is readily adapted to volume testing. And the easy portability of this 16-pound instrument makes it ideal for field work as well as for bench or rack installation.

Designed for use with the Cathode Ray Indicator, this moderate-price instrument provides for a variety of back and forward voltages, as well as independently-controlled ranges for back and forward currents.

THE CATHODE RAY INDICATOR

Send for Bulletin 1002

Provides a visual indicating device for the dynamic display of electrical signals and is intended primarily as an output indicating device for such instruments as the Dynamic Diode Tester and transistor curve tracers.

Also makes an ideal display unit for analogue computer and other applications where the repetitive cycle rate of display is consistent with screen persistences of available five-inch cathode ray tubes.

High-quality components assure a stable instrument which provides a very sharp focused beam on the face of the tube.

Designed for standard 19″ relay rack mounting or with separate mounting legs at additional cost.

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Manufacturers of Pulse Transformers, Delay Lines and Electronic Test Equipment.

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IERC HEAT-DISSIPATING ELECTRON TUBE SHIELDS

— AND EQUIPMENT "DOWN TIME" LOSSES CAUSED BY HEAT, SHOCK AND VIBRATION!

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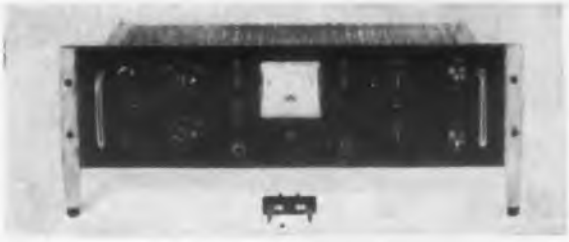

An invaluable means for the rapid, accurate checking of semiconductor diodes for irregularities. The dynamic curve, more revealing than static testing, is quickly apparent on the screen, and is readily adapted to volume testing. And the easy portability of this 16-pound instrument makes it ideal for field work as well as for bench or rack installation.

Designed for use with the Cathode Ray Indicator, this moderate-price instrument provides for a variety of back and forward voltages, as well as independently-controlled ranges for back and forward currents.

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Send for Bulletin 1002

Provides a visual indicating device for the dynamic display of electrical signals and is intended primarily as an output indicating device for such instruments as the Dynamic Diode Tester and transistor curve tracers.

Also makes an ideal display unit for analogue computer and other applications where the repetitive cycle rate of display is consistent with screen persistences of available five-inch cathode ray tubes.

High-quality components assure a stable instrument which provides a very sharp focused beam on the face of the tube.

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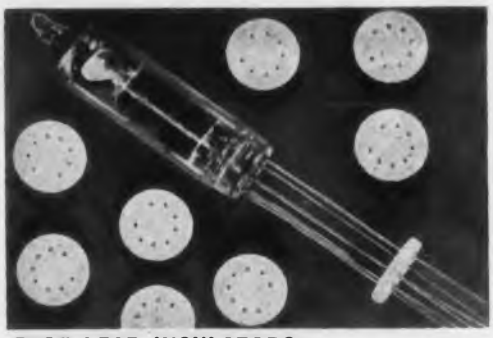
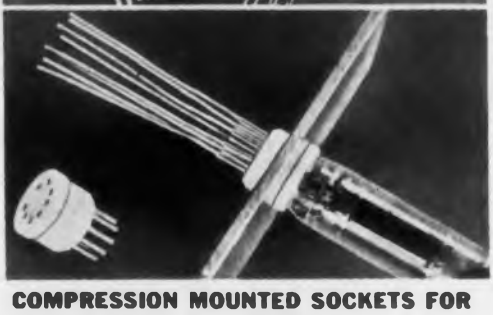


TUBE LEAD INSULATORS



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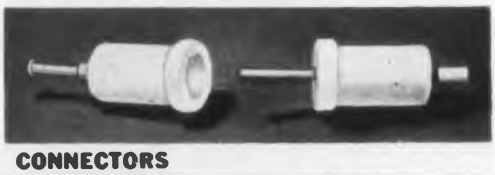

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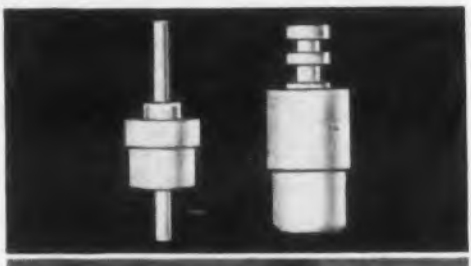

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CIRCLE 384 ON READER-SERVICE CARD

NEW LITERATURE

Circuit Analyzer 385

This 22 page, two color catalog describes, in detail, the operation of circuit analyzers, designed to expedite the testing of complex, multiple circuitry in the aircraft, missile, electronic and related fields. The text includes instructions, applications and specifications for each circuit analyzer. Comprehensive illustrations, diagrams and charts highlight important operational features. One section is devoted to a description of test consulting services. Dit-Mco, Inc., 911 Broadway, Kansas City, Mo.

RF Suppression Filters 386

Specifically designed for shielded enclosures and individual applications, this catalog presents a listing of the rf suppression filters. It includes both high power and low power suppression filters for use in single, dual and 3 wire circuits. The catalog gives the complete physical and electrical characteristics. Axel Bros., Inc., Electronics Div., 134-20 Jamaica Ave., Jamaica 18, N.Y.

Electric Brakes 387

A technical report of over 40 pages with numerous illustrations describes the advantages and construction of the company's power-safe electric brakes. The brakes have replaceable facings and are of the released-when-energized type. Warner Electric Brake & Clutch Co., Beloit, Wisconsin.

Compressed Air Dryers 388

The 12-page bulletin describes models of heatless, self-activating, zero-dew-point dryers designed to prevent moisture fouling. Containing graphs and drawings, the bulletin gives operating capacities, dimensional data, standard specifications and installation information on the dryers. Van Products Co., 5825 Swanville Rd., Erie, Pa.

Facilities Brochure 389

Detailed facts and figures on "Engineering and Production Capabilities" are provided in this 12-page, 40 photograph brochure. Lear Inc., 3171 So. Bundy, Santa Monica, Calif.

Titanium Strip 391

The physical and chemical characteristics of Titanium strip are covered in a data sheet, now available. It was prepared to meet the increasing demand for information on this subject. The data sheet gives details on ultra-thin and the extremely close tolerance Titanium in the aircraft, instrumentation, and chemical industries. American Silver Co., 36-07 Prince St., Flushing 54, N.Y.

Modular Enclosure System 392

A line of vertical cabinets which provide up to 200 per cent more load carrying capacity, is featured in this 36-page catalog. Also included are a number of other basic products and component parts produced by the company. Elgin Metalformers Corp., 630 Congdon Ave., Elgin, Ill.

Copper Plating Process 393

An acid copper plating process is described in a 3-page technical paper. In addition to the various features and advantages of the process, the literature also covers such topics as preparation and maintenance of copper sulphate and copper fluoroborate baths, recommended temperatures, current densities and agitation. Sel-Rex Corp., Nutley, N.J.

Current Governors 394

Current governors for constant current from 1 ma to 30 amps are described in Bulletin No. 957. It indicates that each of them is a two terminal current stabilizer, modulator and dynamic electronic load. The bulletin shows primary uses in production testing and laboratory operation of various current sensitive devices. North Hills Electric Co., Inc., 402 Sagamore Ave., Mineola, N.Y.

Project Summaries 395

An 8-page booklet, entitled "Technical Project Summaries" describes twenty-four military and industrial electronics projects. The booklet is intended to highlight the development capabilities of Pickard and Burns, Inc., 240 Highland Ave., Needham 94, Mass.

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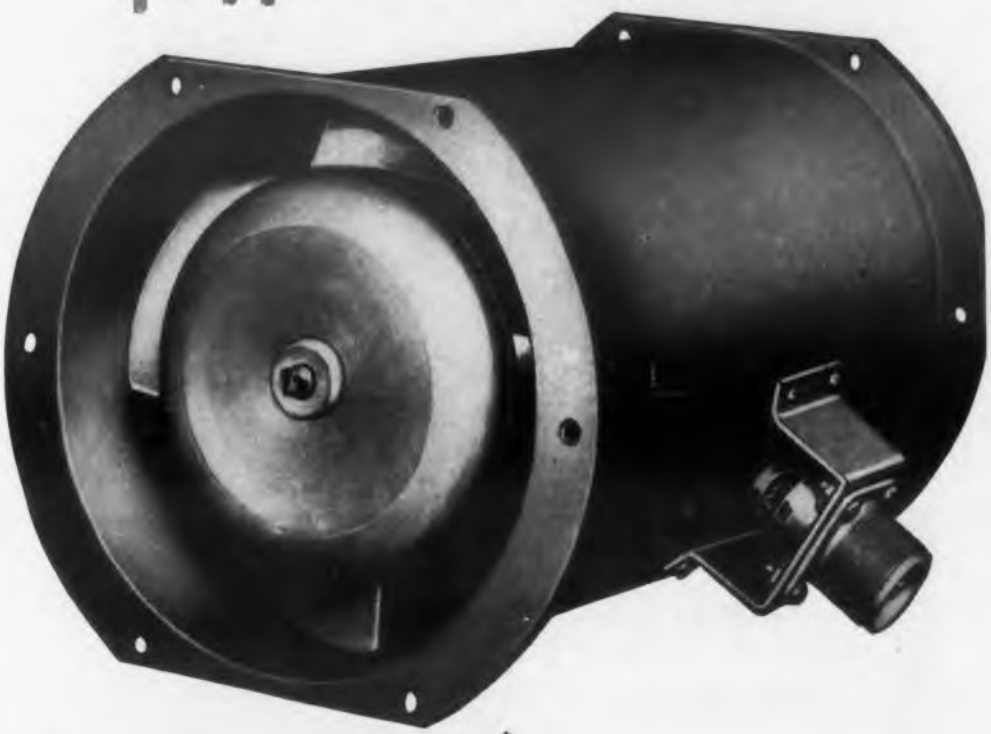

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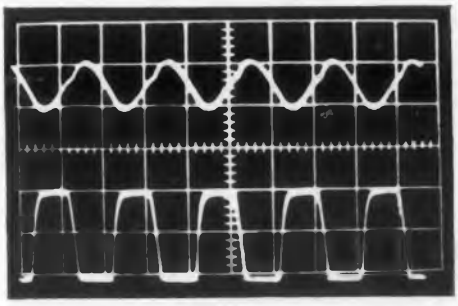
Square-Wave Adapter for Sine-Wave Oscillator

A SQUARE wave with a sharp rise time and a somewhat greater voltage output than obtainable with standard laboratory oscillators (such as the H.P. 200 C), is often needed to drive a low impedance load.

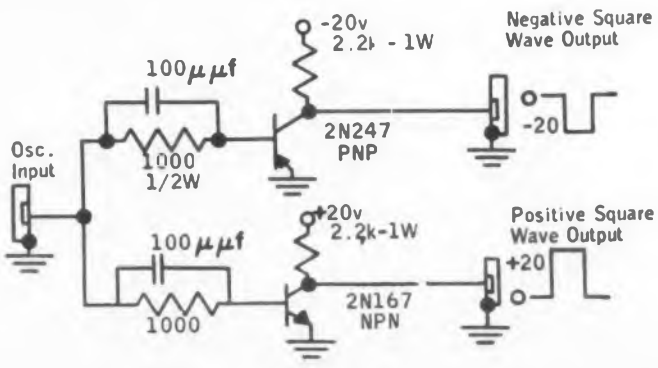
A transistor emitter follower of the design shown can be used after the standard oscillator. It has the characteristics of high input impedance and is capable of driving a low output impedance. Since a low input signal will drive it from cut-off to saturation, this device makes an excellent clipper. By using a pnp and a npn transistor, either positive or negative square waves of amplitude equal to the supply voltage may be obtained. Transistors with high alpha cutoffs should be used. A GE 2N167 npn and an RCA 2N247 pnp drift transistor work very well. The photographs show the 100 kc 6v pp sine wave into the clipper and the 20 v output negative-going square wave. The rise time of the square wave is about 0.5 msec. The fall time is about 1 msec at 100 kc.

The circuit was built in a small box, and batteries were used to power the transistor. The box was plugged onto the oscillator output terminals, and the circuit was energized when square waves were needed.

Thomas F. Prosser, Senior Electronics Engineer, Marchant Calculators, Inc., Dept. ED, Oakland, Calif.



Input shown above, **output** below.



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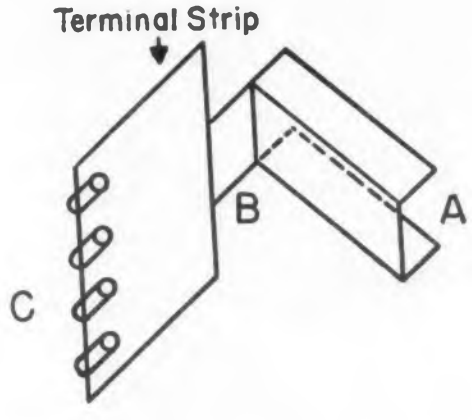
New Terminal Strip Design for Toroids Reduces Scrap

IN WINDING magnetic cores for servo systems it becomes necessary to wrap many thousands of turns of small mil wire around small cores. This increases the possibility of breaking leads when soldering and unsoldering connections. The wire is very brittle from #AWG 30 on up and is apt to waste manufacturing time spent in the winding of a core.

The solution to the problem is to use a simple type of terminal strip which is held on by the wire wrapped around the core itself. All connections made within the core are made at this terminal strip; and all connections made outside of the core are made on this strip also. Thus, once a core has been wound, there is no stress or strain on the internal wiring with subsequent broken leads.

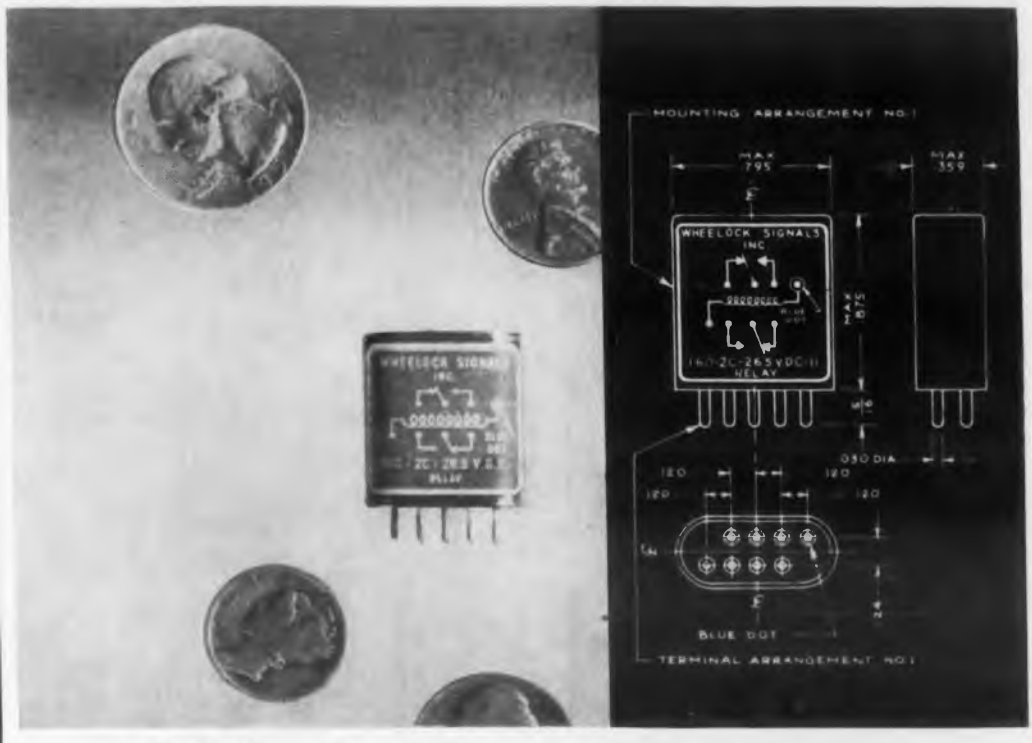
Ralph S. Gootner, System Field Engineer, International Business Machines, Lexington, Mass.



A. This part of the terminal strip is fitted over the core prior to the winding. The windings will act as mechanical security for the strip.

B. When a core is completed, the fold is made at this point leaving the darkened portion for the thickness of the windings. The lugs are folded back over the windings, with the overall result of permanent terminals for use and very little additional space required. The fold can be held down by a strip of tape running across the board and then through the core center.

C. As many lugs as needed to accommodate the core.



Wheelock SIGNALS CRYSTAL CASE RELAYS resist high temperatures . . . up to 125° C and excessive vibrations . . . 2000 cps at 20 g

These new Wheelock Crystal Case relays will solve all your space problems! Wheelock engineers designed these precision-made relays smaller than small . . . about the size of a quarter . . . lighter than lightweight . . . approximately .35 oz. . . . and sensitive enough for milli-second operation, yet so rugged to withstand rigid military environmental specifications.

For consistent reliability, extended life and never-failing performance, specify Wheelock Crystal Case relays for your electronic applications. Wheelock will help you solve your relay problems . . . they will gladly recommend the relay to suit your needs.

Write for additional details and literature.

consistently high reliability inherent in design and performance

SPECIFICATIONS

TEMPERATURE	—65° to 125° C
DIELECTRIC	1000 VRMS; 750 VRMS across contact gaps
INSULATION RESISTANCE	10,000 megohms at 25° C; 100 megohms at 125° C
CONTACT ARRANGEMENT	SPDT—2PDT
CONTACT RATING	2 amps resistive at 28 VDC or 115 VAC
CONTACT LIFE	100,000 operations
CONTACT RESISTANCE	.05 ohms
SHOCK	JAN-S-44 Test in excess of 100 g all planes — no opening
VIBRATION	10-55 cps at ⅛" excursion and 0-2000 cps at 20 g acceleration
ENCLOSURE	Hermetically sealed dry nitrogen filled
TERMINAL & MOUNTING	Mounting arrangements to your specs
PICKUP TIME	5 milliseconds approx.
DROP-OUT TIME	1.45 milliseconds approx.
WEIGHT	.35 oz.
COIL POWER	350 milliwatts
COIL RESISTANCE	up to 6000 ohms
SIZE	.359 in. x .797 in. x .875 in.

Wheelock SIGNALS

CIRCLE 370 ON READER-SERVICE CARD

IDEAS FOR DESIGN

These Parts Were Cold Headed

These cold-headed members of the nail family include items having both "heads" and "collars." Among the items having heads are standard nails, identification nails having letters formed in their heads, hobby-size railroad spike (top left), nails made from square and rectangular wire stock, nails having special points (needle point, top right for example), and nails having special purpose heads (cupped head, for example). Among the items having collars is a stud-gun nail (center—flat piece above collar bends over), electronic wiring post which is driven into harness board up to collar (long item near bottom), peg for toy top (top left), and nails to which components are secured by riveting the section of shank above the collar. Also included are several items made on nail machines and given secondary operations. Threaded nails and ski-pole point (right) are in this category. Parts shown are made from steel, copper and copper alloys, and aluminum. Note also the wide range of sizes represented.

Process Described

In making parts on nail machines, reel-mounted wire stock feeds into a cylindrical opening formed by semi-cylindrical grooves in mating die blocks. The wire comes to rest with the leading end projecting beyond the ends of these gripping dies. The dies close, clamping the wire, and a heading punch strikes the protruding end, forcing the metal into the desired head shape. The punch retracks, the gripping dies open, and the wire moves forward and is pinched off. The dies close again, the forming punch strikes, and the cycle repeats. The point of the nail is formed in the cut-off operation. The

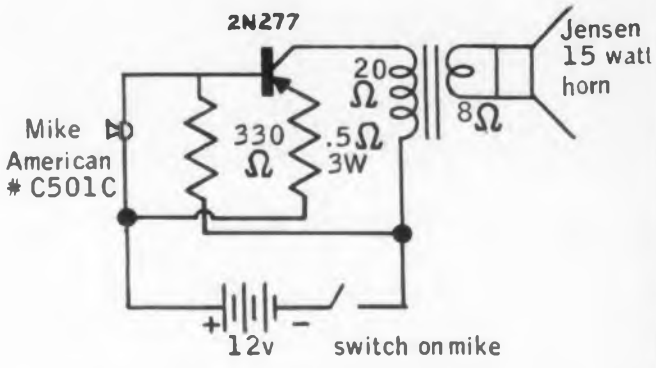
process takes place very rapidly and hundreds of parts can be produced per minute.

In this manner heads and collars of thousands of sizes and shapes can be formed on a wide variety of metals to close commercial tolerances. Secondary operations, such as roll threading, machining and plating can adapt the nail-machine product for many made-to-order applications.

The ingenuity of the designer is required in recognizing parts which should be specified for cold heading. The manufacturer will work out the details of production and will often make helpful suggestions which will lower costs and/or improve the product.

John Hassall, Inc., Westbury, N.Y.

Simplified Public Address System



During the course of designing a portable public address system various circuits were tried and discarded because of relative complexity. What was needed was a battery operated, transistorized, 3 to 5 w unit. The circuit shown indicates how this unit was simplified without sacrificing performance.

A single 2N277 pnp power transistor is driven directly by a single-button carbon microphone which has a nominal dc resistance of 100 ohms. The microphone is used as a part of the base bias voltage divider as well as the source of audio voltage to drive the power transistor. A small resistor is used in series with the emitter to prevent runaway. The output transformer is wound on 3/8 x 3/8 stack, 20 ohms Z to 8 ohms Z, with a primary dc resistance of approximately 1 ohm. Were a speaker available with an impedance of 16 ohms and a dc resistance of less than 1-1/2 ohms, the output transformer would not be needed. The circuit is self-contained and is powered by a pair of 6 v lantern batteries in series, but could easily be used in an automobile with the storage battery as a source of power. Power output is 5 w maximum with dry battery power supply.

J. Frank Brumbaugh, Marine Project Engineer, Heath Co., Benton Harbor, Mich.

Readin',

Synthane plastic laminated bushings and breaker arms for automotive ignition.

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Dependable operation of a school bus, a truck, or your own car involves the functioning of many parts. One breakdown can wipe out the memory of ten thousand trouble-free miles.

Some of these parts are made of laminated plastics. They're usually unseen, unsung, small in size yet efficiently performing their job.

Their cost is relatively insignificant when compared with the cost of equipment in which they work, but it should be sufficient to insure dependability.

Actually, what you pay for Synthane laminated plastics is little or no more than you'd pay for any other plastic laminate. But the Synthane price includes top quality materials, product control, excellent facilities and workmanship, an assurance of continuous supply, and a long reputation for fair dealing.

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SYNTHANE

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CIRCLE 168 ON READER-SERVICE CARD

IDEAS FOR DESIGN

Plastic Microphone Diaphragm Solves Moisture Problem

A new transistorized dynamic microphone, developed by Motorola, Inc., Communications & Industrial Electronics Div., 4501 W. Augusta Blvd., Chicago 51, Ill., utilizes a plastic diaphragm in place of the usual paper cone. It is used to impart greater moisture resistant characteristics.

The enclosed transistor amplifier reduces noise pickup by boosting output to approximately carbon microphone level. This also eliminates need for a preamplifier at the transmitter. The transistor amplifier draws its power from the usual carbon microphone source.

Printed Wiring Technique Makes Control Panel

We had the problem of a serviceable, yet inexpensive control panel for a single piece of test equipment. A panel with decals to designate the controls proved unsatisfactory because the decals were easily scratched off. An engraved panel was considered too expensive since there would be only one instrument of a kind.

The solution turned out as follows: A "positive" layout of the desired panel was made and

Test set using etched printed-wiring board, for panel. It is attractive, yet unexpensive.

then exposed on a piece of epoxy resin copper-clad board with a black base color. The panel was then etched. The procedure for exposing and etching was the same as that used in making printed circuits except that the solder plating process was eliminated. The panel was sprayed with clear lacquer to preserve the copper luster and prevent tarnishing. The resulting panel was inexpensive and serviceable as well as attractive.

James E. Rogers, Electronic Technician, National Cash Register, Hawthorne, Calif.

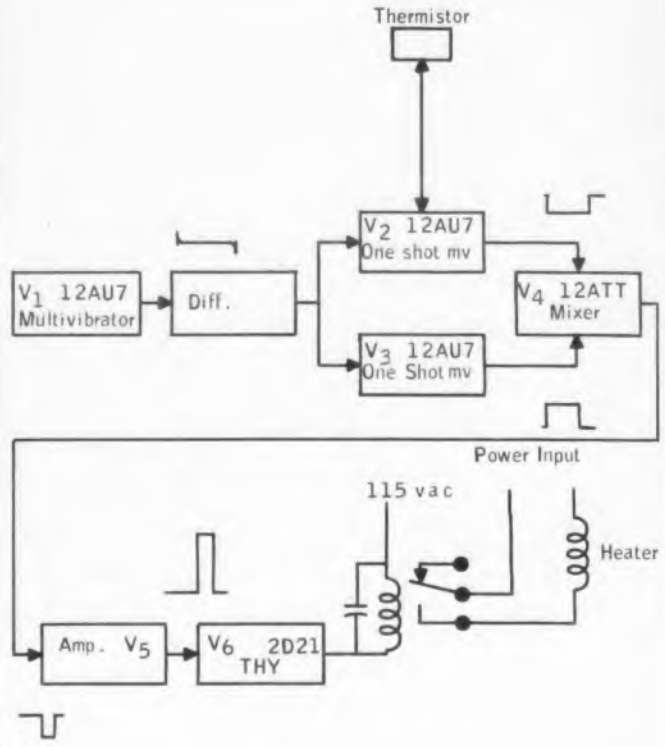
Magnetic Parts Holder

Small permanent magnet is worn as a ring to simplify assembly of tiny parts in precision manufacturing at Owensboro, Ky. tube plant of General Electric Co. Motion studies reveal that U-shaped Alnico 5 magnets step up this "tweezer" operation by 12 per cent. Formerly, time was lost through extra motions in picking up tiny parts individually from bins.

General Electric Co., Metallurgical Products Dept., Detroit, Mich.

IDEAS FOR DESIGN

Precision Electronic Temperature Controller



The precision electronic temperature controller shown in block diagram form, works on the principle of comparing two pulses. The first temperature pulse is generated by V_2. The width of this pulse is controlled by the resistance change of a temperature sensitive element—thermistor. The second reference pulse is generated by V_3, having the same phase and amplitude, but different polarity than the temperature pulse. The width of this pulse can be preset to any desired value, and its width is unaffected by temperature change. These two pulses are fed into a mixer stage, V_4, where they are compared algebraically.

Two possible conditions should be considered:

a. If the temperature is lower than desired, the temperature pulse will be wider than the reference pulse. A positive peaked voltage will result. This difference in positive voltage will fire a thyratron V_6, and energize a heating element;

b. If the temperature is higher than desired, the temperature pulse will be narrower than the reference pulse. The resulting difference will be a negative peaked voltage. This voltage will not be able to keep thyratron V_6 fired and it will recycle automatically. The relay contacts of the heating element will interrupt, which will cause lowering in temperature.

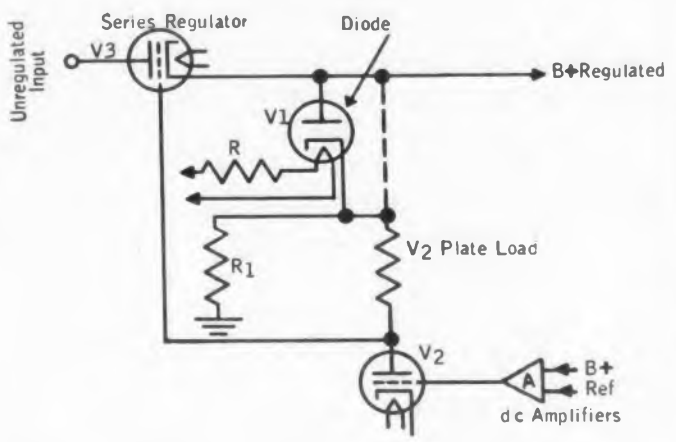
Gleb Denijanenko, Design Engineer, Bell Aircraft Corp., Buffalo, N.Y.

Series Regulator Warm-Up

In regulated-power supplies the tubes in the rectifier and amplifier circuits warm-up faster than the series regulator tube (V_3). This causes the series tube to conduct high currents when the cathode is not up to proper operating temperature; thus, tube life is shortened. The usual, costly solution is to use a time-delay relay somewhere in the circuit.

An inexpensive, yet simple and effective answer to this problem is to use a diode as shown in the accompanying circuit. The dotted line indicates the connection used in most regulators.

In the modified circuit, regulating action cannot occur until diode V_1 conducts, thereby connecting the plate load resistor of V_2 (the last



Modified Voltage Regulator Circuit. Diode prevents V_3 from being overloaded until heater reaches normal operating temperature.

amplifier tube) to $B+$. If warm-up of V_1 is delayed by inserting a resistor (R) in series with its filament, a large bias is maintained on the series regulator until its filament is at the proper operating temperature.

The value of R can be between 4.7 and 5.6 ohms or can be determined experimentally. R_1 is added to insure that the circuit "fails safe" under all conditions.

With this circuit, not only are series regulator tubes protected, but the output voltage of the regulator rises smoothly to its pre-adjusted value without overshoots; thus is gives added protection to the load circuit.

S. Bernstein-Bervery, 205 So. Broadway, Tarrytown, N.Y.

Get $10.00 plus a by-line for the time it takes you to jot down your clever design idea. Payment is made when the idea is accepted for publication. Full information and an "entry blank" can be obtained by circling #166 on the Reader's Service Card.

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- 0-101 db in 1 db Steps from Single Unit
- Proved Reliability—Ruggedized High-Frequency Teflon Switches
- Long Term Stability—Carbon Film Resistors
- Choice of 50, 70, or 90 Ohm Impedance

SPECIFICATIONS

Model	20	21	22	20-0	21-0	22-0	30-0	31-0	32-0
Cat. No.	430-A	440-A	450-A	431-A	441-A	451-A	432-B	442-B	452-B
Z_{in} Z_{out}	50 ohms. nom.	70 ohms. nom.	90 ohms. nom.	50 ohms. nom.	70 ohms. nom.	90 ohms. nom.	50 ohms. nom.	70 ohms. nom.	90 ohms. nom.
Max. Power	½ watt								
Insertion Loss	10 db			zero db at low freq. approx. 0.3 db at 200 mc			zero db at low freq. approx. 0.5 db at 200 mc		
DB Switched	41 db in 6 steps						101 db in 9 steps		
Steps	20 db, 10 db, 5 db, 3 db, 2 db, 1 db						20 db, 20 db, 20 db, 20 db, 10 db, 5 db, 3 db, 2 db, 1 db		
Frequency Range	DC to 500 mc								
Accuracy of Attenuation	Within 0.1 db db to 500 mc Better accuracy at lower frequencies								
Connectors	BNC type UG-185/U								
Dimensions	2¼" x 8¾" x 2⅛"						2¼" x 11½" x 2⅛"		
Weight	2½ lb.						4 lb.		
Price	$65			$60			$100		

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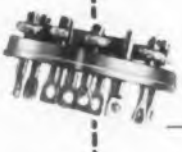

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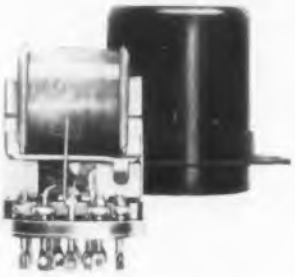

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PATENTS

Radio Frequency Amplifier

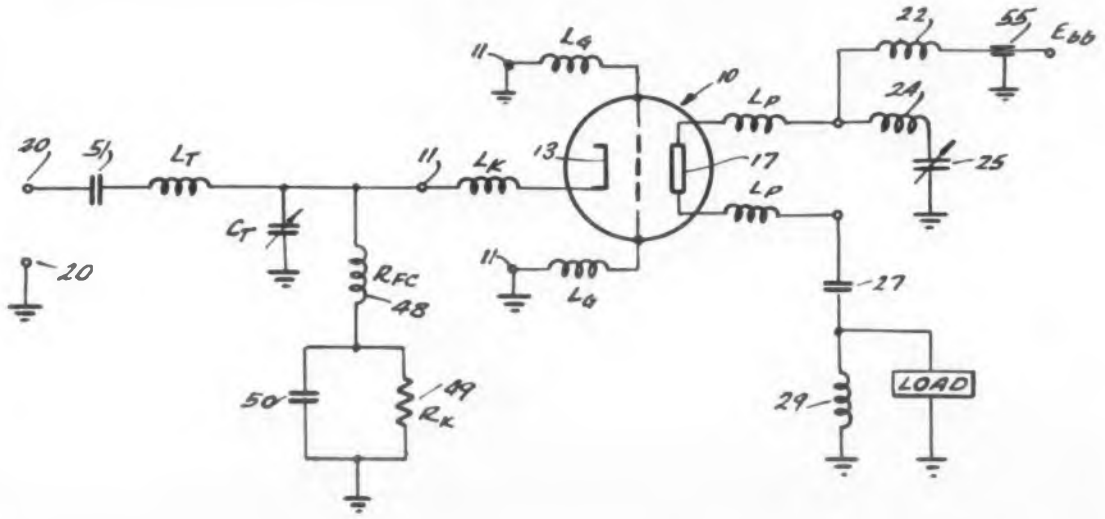
Patent No. 2,799,736. R. J. Hannon. (Assigned to Standard Coil Products Co., Inc.)

Considerable research has been done seeking to extend the upper frequency range of tubes for use in amplifier circuits. This has been dictated by ultra-high frequency TV broadcasting. One tube which has been developed has two terminal leads to the grid and plate and the electrodes are positioned in such manner that the capacity between electrodes is greatly reduced. Even with this improved construction the tubes could not operate in a range of frequency above the self-resonant frequency of itself.

The amplifier of the patent is designed to enable the type of tube described to operate above the resonant frequency of the tube One manner in which this is partly accomplished is by making the structure of the plate and the lead inductances a part of the output resonator. Another problem with these tubes has been the noise factor which was unsatisfactory. This is because the distributed inductance of the leads to the cathode and grid with the shunt capacitance and resistance from the control electrodes to ground, constitutes an L attenuator with the result that the input signal is decreased whereas the noise energy which is applied directly across the grid and cathode is unaffected and hence the noise factor is poor. This has been overcome in the amplifier herein by inserting the input signal directly at the point where the noise energy is applied to the amplifier as in a T network.

In the circuit illustrated, the grid of the tube is connected to ground through two leads with the inductance of the leads represented by LG. and the inductance of the lead to the cathode is represented by L_k. The signal is applied to the input terminals 20 which are connected with the cathode through a coupling capacitor 51 and a T network consisting of inductors L_t and L_k and shunt capacitor C_r. The signal appears across the shunt network formed by an r.f. choke 48 which is in series with a bias resistor 49 and shunt capacitor 50. The inductance of the two leads to the plate 17 are represented by L_p with the plate potential applied to one lead through a choke 22. This same lead is connected to ground through an inductor 24 and trimmer capacitor 25. The other lead for the plate is connected with the load through a coupling capacitor 27 with an inductance 29 in parallel with the load. In the amplifier circuit shown, the input circuit provides an analog transformer in which the primary is the T network and the output termination is the capacity between cathode and grid and the input resistance so that a non-attenuated signal is applied across the inherent resistance and capacitance of the tube. The noise factor at uhf is substantially reduced. The noise factor has been reduced from 18 db to 10.5 db at 887 megacycles.

The self biasing resistor 49 and bypass condenser 50 determines the operating bias for the grid. The rf choke 48 isolates the high frequency from the bias elements. Examples of the values of the various circuit components is given in the patent. A variation in the plate circuit of the amplifier is also illustrated and described.



Receiver Circuit

Patent No. 2,808,507. Frank L. Pawlowski. (Assigned to Motorola, Inc.)

The frequency modulated radio receiving system of the patent includes carrier wave selecting and converting apparatus, amplitude limiting apparatus, frequency discriminating apparatus and signal reproducing apparatus which are serially connected to form a receiving channel. The system limits the amplitude of the received signal modulated carrier wave and detects and reproduces the modulation components of the signal. These circuit parts are operative to transmit noise which appears in the channel. A noise squelch system is provided which functions as will now be described. The higher frequencies are accentuated for applying modulation signals and noise from the frequency discriminating apparatus to a limiter. The limiter is coupled to a high pass filter which selects noise at frequencies above the modulation signal frequencies at the output of the limiter. Coupled to the amplitude limiting apparatus is means for deriving a first control voltage therefrom. A rectifier is coupled to this means and to the high pass filter which rectifies the noise selected by the filter and produces a second control voltage of opposite polarity to the first control voltage. The rectifier also differentially combines the first and second control voltage to produce a third control voltage. A squelch circuit controls the signal reproducing apparatus to prevent the latter from responding to noise or signals appearing in the channel so long as the third control voltage exceeds a predetermined value.

Efficient And Stabilized Semiconductor Amplifier Circuit

Patent No. 2,810,024. Thomas O. Stanley. (Assigned to Radio Corporation of America)

The circuit disclosed is a class B push-pull signal amplifying circuit using a first and a second semiconductor of opposite conductivity types. An input circuit applies signals to the base electrodes of the pair of devices which are in parallel. The input circuit includes a low impedance biasing network such as a third semiconductor and including a resistive element between the base electrodes. The emitter electrode of the first device is connected with the emitter electrode of the second device. An output circuit is provided between the emitter electrodes of the devices and a point of fixed reference potential for deriving an output signal therefrom. A signal feedback circuit connects a point between the output circuit and the emitter electrode with the input circuit. This feedback circuit has a low impedance at signal frequencies to provide a relatively high dynamic input impedance for the semiconductor devices whereby efficient signal transfer is accomplished.

Electronic Relay Control

Patent No. 2,807,757. Robert W. Callinan. (Assigned to the United States of America)

A remotely-controlled relay system is described which is adapted to respond to signal-modulated radio carrier waves. A receiver receives the waves and detects the modulation component. A rectifier converts this modulation component to a direct-current potential. The output circuit of the rectifier comprises a resistor and capacitor in parallel whereby upon cessation of reception of the carrier waves, the direct-current potential is maintained for a time determined by the time constant of the resistor and condenser. A relaxation oscillator circuit comprises a thyratron tube and an electromagnetic relay having a coil and a movable armature. A battery applies a positive potential to the anode of the tube through the coil. A portion of the battery supplies the heater circuit and the negative terminal is connected to the grid in series with the resistor and an additional current limiting resistance. The potential of the cathode heating battery maintains the tube nonconducting. A condenser is provided between the anode and cathode of the tube. The tube coil, and the last mentioned condenser forms the relaxation oscillator so that when a direct-current potential appears across the output circuit of the rectifier, the tube is rendered conducting and the oscillator circuit begins oscillating. The resultant current in the coil actuates the armature of the relay and a circuit controlled by the armature.

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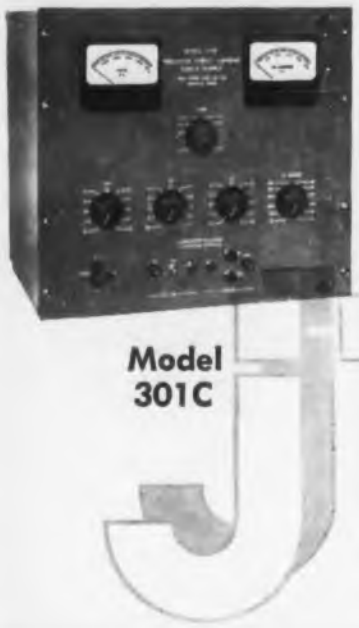

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OUTPUT POLARITY	pos. or neg.	pos., neg., or floating	pos. or neg.	pos., neg., or floating
REGULATION VS. LINE	.01% max. for 20% line change	.01% for line change from 105 to 130 volts	.03% max. from 100 to 130 volts	.01% for line change from 105 to 130 volts
REGULATION VS. LOAD	.01% max. for 10ma change	.01% from 0 to 300ma	.03% no load to full load	.01% for load change from 0 to 100ma
STABILITY	.005% per hour	.01% per hour	.02% per hour	.01% per hour
RESOLUTION	10mv at any output voltage	2mv over entire range	100mv at any output voltage	2mv over entire range
CALIBRATION ACCURACY	Better than .5%	Better than .5%	2%	
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OUTPUT VOLTAGE	500 to 5100 volts DC	500 to 1600 volts	500 to 2000 volts DC	500 to 1600 volts
OUTPUT CURRENT	0 to 1ma	0 to 1ma	0 to 5ma at 500 to 1500 volts; 0 to 2ma at 1500 to 2000 volts	0 to 1 ma
OUTPUT POLARITY	pos. or neg.	pos. or neg.	pos. or neg.	pos. or neg.
REGULATION VS. LINE	.01% max. from 100 to 130 volts	.03% max. from 100 to 130 volts	.01% max from 100 to 130 volts	.01% max. from 100 to 130 volts
REGULATION VS. LOAD	.01% max. no load to full load	.03% no load to full load	.03% no load to full load	.01% max. no load to full load
STABILITY	.005% per hour	.01% per hour	.005% per hour	.005% per hour
RESOLUTION	100 mv at any output voltage	100 mv at any output voltage	100mv at any output voltage	100mv at any output voltage
CALIBRATION ACCURACY	1%	1%	Better than 1%	Better than 1%
RIPPLE	5mv max.	5mv max.	Less than 5mv RMS	Less than 5mv RMS
SIZE AND WEIGHT	19"W x 10½"H x 14"D—42 lbs.	19"W x 7"H x 13"D—22 lbs.	19"W Rack x 7"H x 13"D—27 lbs.	19"W Rack x 7"H x 13"D—27 lbs.
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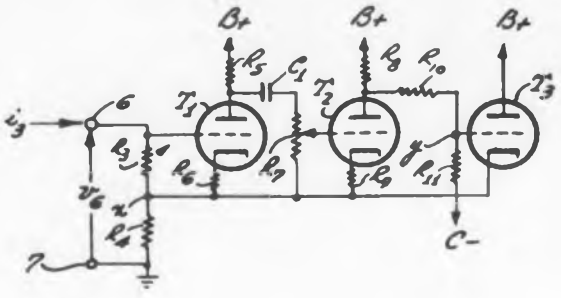
PATENTS



Artificial Inductor

Patent No. 2,800,586. G. H. Towner. (Assigned to Northrop Aircraft, Inc.)

An inductor which has a large value of inductance but is of relatively small size has many advantages. The patentee has devised an artificial inductor which does not use coils and occupies relatively small space. This inductor also has application in an oscillator and in a resonance circuit having a high Q. Other applications of the inductor are for a remotely variable inductor using simple control means and a tone control circuit.

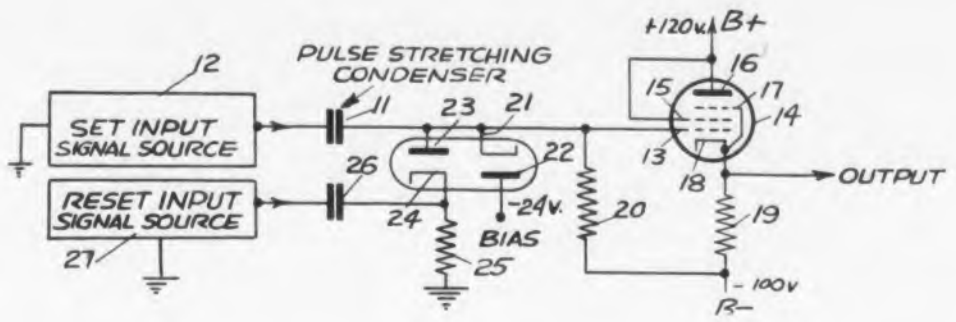
The artificial inductor is shown in the figure and comprises a resistor R_3 which may be variable over a range from 0-10 kilohms. Across this resistor is connected an amplifier of three tubes in which the last tube T_3 is a cathode follower tube with its cathode resistor R_4 of say 27 kilohms in series with the resistor R_3. The condenser C_1 and resistor R_7 form an R-C differentiator. The mathematical analysis of the circuit is given in the patent and the circuit has been tested for conformance with inductor characteristics. For example a square wave input applied to the terminals 6, 7 produces an output of spiked or peaked wave form across the output resistor R_4. A triangular wave input will result in a square wave output and a sine wave input will result in a sine wave output which is 90° out of phase with the input wave. The value of inductance can be varied by varying the resistor R_3 or R_7. The equivalent inductor resistance is essentially the value of resistor R_3.

The artificial inductor may have a capacitor connected across the terminals 6 and 7 which results in a resonant circuit. As a consequence the inductor may also be modified to provide an oscillator. The oscillator circuit is the same as that of the figure with the capacitor across terminals 6, 7 and a feed-back loop consisting of a blocking capacitor and resistor between the plate of the tube T_2 and the grid of the tube T_1. A blocking capacitor is also provided between the plate of the tube T_2 and the grid of the tube T_3. In another modification the capacitor may be removed whereupon the circuit becomes essentially a "perfect" inductor with practically no resistance. A proper amount of feed-back voltage in effect cancels the applied voltage across the resistor R_3. In addition the circuit may be modified to provide a tone control which is also illustrated and described in the patent. The oscillator output is secured across the resistor R_4.

Grounded Grid Power Amplifier

Patent No. 2,810,793. Warren B. Bruene. (Assigned to Collins Radio Company)

The amplifier uses a tube having a first tuned impedance circuit between the cathode of the tube and ground. The signal source is applied across this impedance circuit. A signal current detector is in series with the signal source and has a direct voltage output which is proportional to the signal current. A voltage detector is in parallel with the first cathode impedance circuit and has a direct voltage output which is proportional to the signal voltage and further has a polarity which is opposite to that of the current detector output. A potentiometer consisting of resistor with a variable tap has one end of the resistor connected to the output of the signal current detector and the other end of the resistor connected to the output of the voltage detector. A grid current detector is in series with the grounded-grid of the tube and has a direct voltage output which is proportional to the grid current. A second tuned impedance circuit has a variable resistive component connected in series between the plate of the tube and the load. A servo system has its error input connected between the tap on the potentiometer and the output of the grid current detector. The output of the servo system is coupled to the second impedance circuit so that its resistive component is varied in a manner to equalize the voltage on the tap with the voltage output of the grid current detector.



Pulse Stretchers

Patent No. 2,802,101. C. F. West et al. (Assigned to Raytheon Manufacturing Company)

The pulse stretcher circuit finds particular application in computers for generating a gating pulse. This application requires a gating pulse which is precisely instituted and terminated. A control signal sets the beginning of the pulse and a second control signal resets the circuit or the ending of the pulse. For this service bistable multivibrators or so-called flip-flop circuits have been extensively used as well as a one pulse multivibrator having a circulating delay line or the so-called dynamic flip-flop circuit. Both of these types of circuit use dc coupling which requires components which are critical in nature and for this reason such circuits are generally unstable in operation.

The circuit shown in the figure initiates a gating pulse by a negative triangular control signal generated at the source *12*. The leading edge of this negative control signal drives the cathode *21* of a diode more negative than the cathode *22* so that a current flows through this diode and resistor *20* to a source of negative potential B—. This flow of current charges the capacitor *11* so that the trailing edge of the control pulse raises the potential on the control grid *13* of the cathode follower amplifier tube *14*. As a consequence, the cathode follows the grid potential and produces an output pulse across the cathode resistor *19* or at the output terminal. The charge on the capacitor *11* leaks off slowly through the resistor *20* and therefore maintains the control grid *13* positive and maintains the potential of the pulse at the output terminal although at a somewhat decreasing level. The pulse is terminated by a negative reset control signal generated at the source *27* which is applied through the capacitor *26* to the cathode *24* of the second diode. This negative pulse renders this diode conducting and discharges the charge on the capacitor *11* which terminates the pulse. This circuit is not critical in operation so that changes in circuit values which may arise from aging of the tubes or variations in supply voltage does not affect operation of the circuit. In addition the switching time from pulse off to pulse may be less than one tenth of a microsecond.

There is also illustrated and described, a modification of the circuit of the figure whereby the input control signal may be a positive triangular pulse. This circuit requires relocation of the diode which charges the condenser into the connection from the control signal source *12* to the grid *13* of the amplifier tube and relocation of the capacitor *11* between this diode and the grid *13* with one plate being grounded. There is also shown three other circuits which develop regenerative pulses for extending the duration of the gating pulse or maintaining its potential amplitude over a long period.

Time Delay Control

Patent No. 2,809,297. Edward C. Hartwig and Francis T. Bailey. (Assigned to Westinghouse Electric Corporation)

The control circuit consists of an amplifier having a first input terminal, a second input terminal, a first output terminal and a second output terminal. A photo-sensitive device has a third output terminal and a fourth output terminal. The third output terminal is connected to the first input terminal and the fourth output terminal is connected to the second input terminal. Circuit means connects the first output terminal to the control grid of a discharge tube. Other circuit means connects the second output terminal to the cathode. A time constant network is provided in series with the anode and cathode of the tube. A second discharge tube has this network connected between its control electrode and cathode. A current responsive means is provided between the anode and cathode of the second tube.

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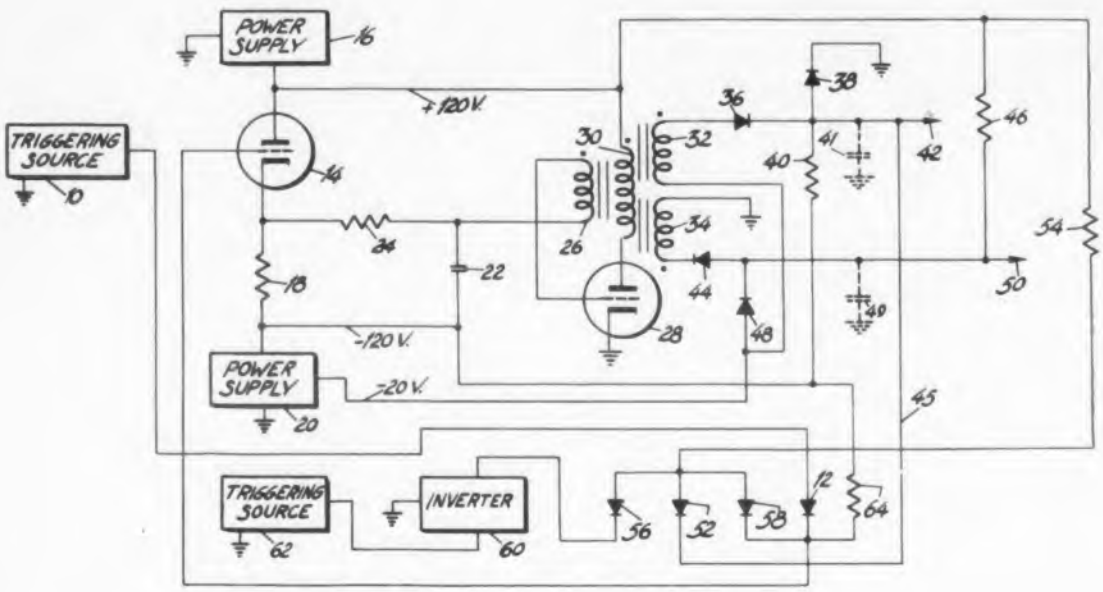

Flip-Flop Circuit

Patent No. 2,795,696. D. C. Evans. (Assigned to Bendix Aviation Corporation)

Many improvements have been made in flip-flop circuits seeking to improve their performance. Many of these circuits are of the Eccles-Jordan type which use a pair of tubes with interconnections between plate and grid of resistances and capacitances. By the application of a triggering pulse, one tube becomes conducting and the other becomes non-conducting. Such circuits, however, require resistances and capacitances of precise values for securing desirable operating characteristics and this necessarily results in increasing the cost of the circuit. Such circuits also require input and output stages requiring additional tubes which further increases the cost and complexity of the circuit. In the field of electronic computers large numbers of flip-flop circuits are used and for such uses a flip-flop circuit of lower cost and greater dependability is very desirable.

The circuit disclosed in the figure overcomes the disadvantages discussed above and makes use of an oscillator stage. This stage is normally non-oscillating but upon being triggered is set into oscillation. By the use of a pair of rectifier circuits, low and high voltages are produced in the outputs when the oscillation circuit is non-oscillating and produces high and low voltages when the oscillations begin. The circuit components are well illustrated in the circuit diagram of the figure. The oscillator makes use of a tube 28 and the inductors 30 and 26. Assume that the oscillator is non-oscillating, a trigger pulse generated from the source 10 supplies a positive pulse through the diode 12 to the control grid of the tube 14. This tube becomes conducting and the potential increase across the cathode resistor 18 is applied to the control grid of the oscillator tube 28 through the winding 26. Increasing conduction through the oscillator tube 28 is fed back to the control grid through the windings 30 and 26 which regenerative action sets the tube into oscillation.

When the oscillator is non-oscillating a potential of —20 volts appears at the output 42 from the negative power supply 20, winding 32 and diode 36. During the non-oscillating condition of the oscillator, a zero potential appears at the output 50 because of the low potential drop through the diode 44 and winding even though this output terminal is connected with the power supply 16 through a resistor 46. When the triggering pulse from the source 10 sets the oscillator circuit into oscillation the potential at the output 42 becomes zero through the coupling between the winding 30 and 32. Similarly the potential on the output 50 becomes —20 through the coupling between the windings 30 and 34. This potential relationship continues until a triggering signal is generated by the source 62. This triggering

signal is inverted in 60 into a negative potential applied to the cathode of the diode 56 which appears on the anode as a result of current flow through a circuit from power supply 16, resistor 54 diode 56 and inverter 60. This negative signal appears also on the anode of diode 58 as well as the cathode resulting from current flow from supply 60, through resistor 64, diode 58, resistor 64 and the negative power supply 20. The negative potential on the cathode of diode 58 biases the grid of tube 14 to cut off. With cessation of conduction through the control tube, the grid of the oscillator tube 28 is biased below oscillating level and the oscillation cease to restore the initial potential on the outputs 42 and 50.

In the Eccles-Jordan type of flip-flop circuit, one of the two tubes is always cut off with the result that the tubes of this circuit present different impedances at different times because of the "cathode interface impedance" which is relatively large at cut off. This fact tends to produce undesirable transients when a tube is triggered. In the circuit of the figure this difficulty is overcome by having some current at all times flowing through the oscillator tube 28 but it is at such a low level that it is below the condition of oscillation of the oscillator circuit. This flow of current avoids any "cathode interface impedance" and provides a flip-flop circuit of stability.

Color Television Image Reproducing System

Patent No. 2,806,899. Vladimir K. Zworykin. (Assigned to Radio Corporation of America)

The reproducing system of the patent uses a cathode-ray tube with a luminescent screen having a plurality of groups of subelemental size areas. Each area of of the groups has fluorescent material to produce light of a different color when it is excited by the beam of the cathode-ray tube. The primary electron beam is controlled to effect scanning of successive elemental areas of the screen and to determine intensity of the light produced in accordance with the received signals. The system provides means which is responsive to the primary electron beam for developing at each of the elemental screen areas, a single secondary electron beam for each of the groups of subelemental screen areas. Each of the secondary electron beams are controlled to selectively excite any one of the color screen areas of its group of the screen.

Radio Receiver

Patent No. 2,810,071. Richard T. Race. (Assigned to Motorola, Inc.)

The radio receiver is of the superheterodyne type to be used in a vehicle so that it is energized from the battery of the vehicle which provides a direct current potential having a nominal value of 12 volts. The receiver includes a voltage amplifier for the received radio frequency signals which uses a first vacuum tube. The received radio frequency signals are converted to intermediate frequency signals which converter uses a second vacuum tube. The intermediate frequency signals are amplified which i-f amplifier includes a third vacuum tube. A demodulator demodulates the intermediate frequency signals to provide audio frequency signals. A control voltage is derived representing the average value of the amplified intermediate frequency signals which applies the control voltage to the first and third vacuum tubes for controlling their gain. The audio signals are amplified by a fourth vacuum tube and at least one power transistor device which provides the audio output signals. A loudspeaker is coupled to the power transistor device for reproducing the audio output signals. The fourth vacuum tube and the power transistor device are coupled to means which produce audio frequency current sufficient to drive the loudspeaker so as to produce sound at a level which can be conveniently heard in the vehicle. A form of power supply provides operating potential for the receiver circuit from the battery power supply and includes a filter and direct current connections to each of the vacuum tubes and to the power transistor device. This power supply derives a single direct current voltage from the battery and applies only this single voltage to all of the circuits of the entire receiver so that all of such circuits are energized by a voltage no greater than that of the battery.

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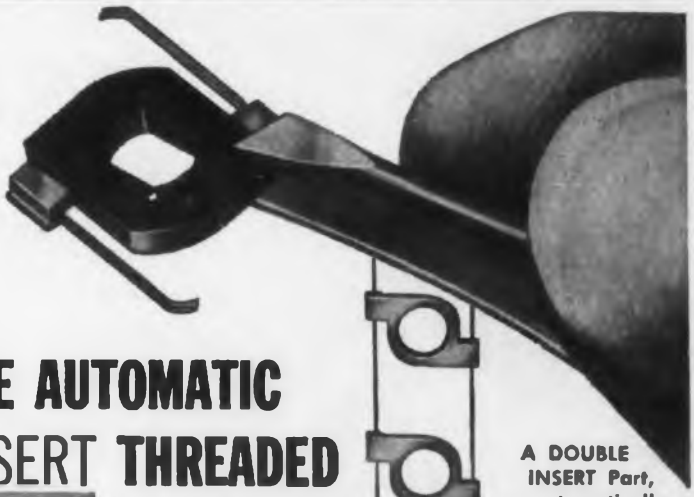

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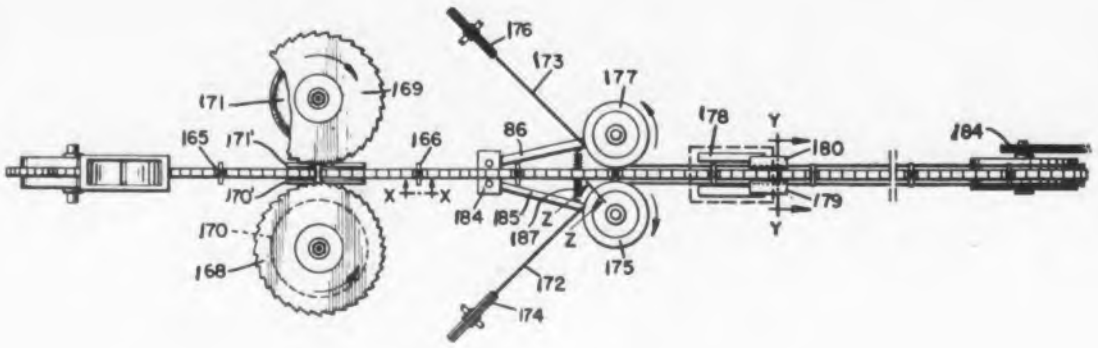
PATENTS



Processes For The Manufacture Of Multiple Strand Electrical Conductor Leads

Patent No. 2,810,670. Faust R. Gonsett. (Assigned to L. A. Young Spring & Wire Corporation (1/2) and Fretco, Inc. (1/2))

The patent is directed to a method of making that type of conductor commonly used as the leads between a television antenna and the receiving set. This type of conductor consists of spaced bars to which the two conductors are secured in spaced relation so that the conductor is air insulated.

In the broader aspect of the process the insulating cross bars are of plastic material. The ends of bars and the two conductor wires are heated in a suitable oven. Each conductor wire is pressed into the opposite ends of the plastic bars so that they are embedded in the plastic. Upon cooling, the conductors are securely fastened to each end of the bar. An automatic machine is used which feeds the spaced insulating bars into spaced clips on an endless chain and at the same time a conductor wire is fed to each side of the cross bars from spools. The bars and conductors are heated in an oven and each conductor wire is then pressed into the ends of the bar where they are secured upon cooling.

In the more detailed method of making this conductor, the plastic bars are loaded into spaced clips on the endless chain or conveyor. While the plastic bars are held on the conveyor they come into contact with a saw on each side which cuts a kerf into each end of the plastic bar. Wire is then fed from each side of the conveyor and into the kerf. The bars and conductors then pass through an oven and pressure is applied to the ends of the plastic bars to close the kerf onto the conductors. In this manner each wire is firmly embedded and attached to an end of the plastic bar.

Magnetic Amplifier and Flip-Flop Circuit Embodying the Same

Patent No. 2,798,168. Theodore H. Bonn, John Presper Eckert, Jr., and Robert P. Talambiras. (Assigned to Sperry Rand Corporation)

The circuit uses a core having a substantially rectangular hysteresis loop on which core there are a plurality of windings. A first source of spaced power pulses feed current through a first winding, and output means receives this current. A second winding has a bias arrangement for normally applying magnetizing forces to the core during the spaces between power pulses. These magnetizing forces are in the opposite direction to the magnetizing forces set up by the power pulses. The power pulses and bias have such amplitudes that during the spaces between pulses the bias will drive the magnetization of the core so far in one direction that the next power pulse cannot saturate the core when it drives the magnetization of the core in the other direction. A second source of spaced input pulses is coupled to one of windings on the core which pulses have a polarity as to oppose the magnetizing effect of the bias so that during the presence of an input pulse, the power pulses will repeatedly drive the core to saturation. The duration of the input pulses are long enough so that a plurality of power pulses occur between the beginning and end of each input pulse. A filter between the second source and the windings blocks current at the frequency of the power pulses so that currents at the frequency of the power pulse will not flow through the second source.

Pulse Modulation Circuit

Patent No. 2,804,595. Robert O. Soffel. (Assigned to Bell Telephone Labs.)

The circuit modulates a carrier wave under the control of direct current signal pulses. The circuit includes, therefore, a carrier source and a source of direct current signal pulses. One or more modulator output circuits are provided having a predetermined impedance. A dummy output circuit is also provided having substantially the same impedance as the modulator output circuit. A first diode is used between the carrier source and the modulator output circuit. A second diode is used between the carrier source and the dummy output circuit. The first diode is biased in the forward direction and the second diode is biased in the reverse direction in the presence of a signal pulse. This bias arrangement permits the carrier to pass through the first diode to the modulator output circuit. The first diode is biased in the reverse direction, the second, in the forward in the absence of a signal pulse thereby blocking the carrier from the modulator output circuit and presenting a terminating impedance to the carrier source which is much the same as presented thereto by the modulator output circuit.

Semi-Conductor Squelch Circuit

Patent No. 2,809,240. Larry A. Freedman. (Assigned to Radio Corp. of America)

The circuit is a semi-conductor signal amplifier device in which the signal input circuit is between the base and emitter electrodes and the signal output is from the collector electrode. A bias voltage is provided between the base and emitter electrodes in the forward direction. An energizing means is connected with the collector electrode through resistive means connected so as to establish a substantially zero potential between the base and collector electrodes at static operating conditions. A direct current automatic gain control is used with the input circuit which is responsive to an increase in signal strength to decrease the bias voltage between the base and emitter electrodes on signals exceeding a predetermined value and to increase the gain as the amplitude of the applied signals begins to exceed the predetermined value. The agc thereafter decreases the gain of the amplifier for further increase in the amplitude of the applied signal.

Differencer Circuit

Patent No. 2,807,730. Henry W. Kaufmann. (Assigned to Sperry Rand Corp.)

A signal generator is provided having an input and an output which generator produces regularly spaced output signals at the output during predetermined spaced output time periods. The generator also includes means which is responsive to an input signal occurring during one of the spaced output time periods for inhibiting an output signal during a next subsequent output time period. A gating device has first and second gating control inputs which device is responsive to coincident signals at the first and second gating control inputs for effecting a predetermined gating output state. The output of the pulse generator is coupled to one of the gating control inputs. A control signal is applied simultaneously to the generator input and to the other of the gating control inputs during a selected one of the output time periods.

Two Stage Magnetic Amplifier

Patent No. 2,809,241. Seymour Weissman. (Assigned to The W. L. Maxson Corp.)

The magnetic amplifier comprises several stages, the first stage including a magnetic core, a first output winding and a first control winding on the magnetic core. A control voltage is applied to the latter winding. The second stage includes a magnetic core having a second control winding and a second output winding on the core. A first rectifier and a load are in series with the second output winding. An interstage coupling circuit includes a second rectifier in series with the first output winding and the second control winding to which a voltage is applied of the same frequency as above. The rectifiers are poled to pass current during alternate half cycles of the alternating current. The cores and windings have dimensions and are so arranged that the first stage remains saturated and the second stage remains unsaturated throughout the entire ac cycle when no control voltage is applied. To the second stage there is connected means for altering its magnetization so as to substantially eliminate a dead space in the amplifier characteristic in which the amplifier produces no appreciable output in response to a control voltage.

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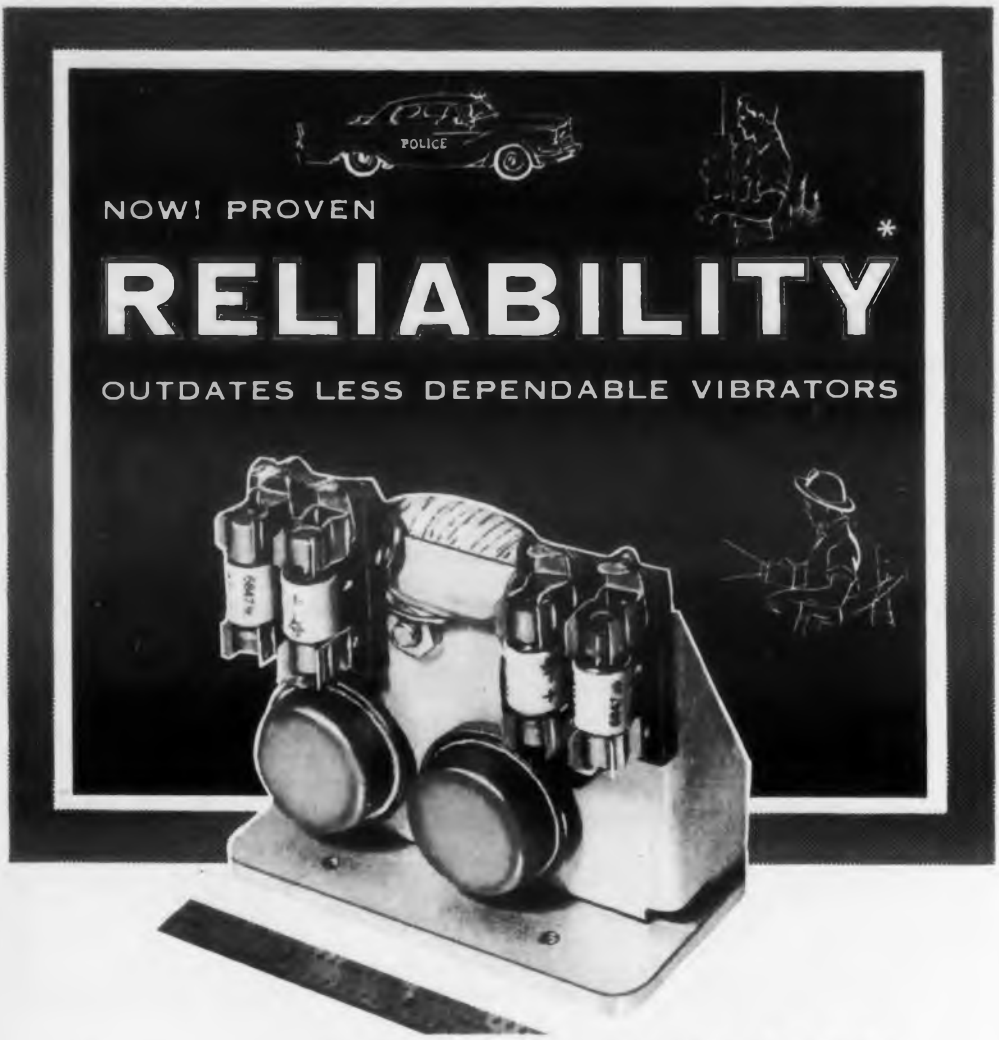

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Books

Soviet Education for Science and Technology

Alexander G. Korol, The Technology Press of Massachusetts Institute of Technology and John Wiley & Sons, Inc., New York, N.Y., 513 Pages, $8.50.

Perhaps the most comprehensive study to date, this book examines the organization and effectiveness of Soviet formal training in science and technology in an effort to evaluate the overall quality of Soviet-trained scientists and engineers. It concentrates the investigation on the two representative fields of physics and mechanical engineering.

Though not intended as a comparative study, the book refers to American educational data as a frame of reference by which the scale of Soviet education could be concretely appreciated.

The book deals with education through the graduate level. The investigation probes organization, curricula, instruction, textbooks, student selection, any many other aspects of Soviet education. It is well documented with 56 tables. An extensive annotated bibliography and 15 appendices round out this excellently organized study.

Atomic Energy Facts

Prepared by the U.S. Atomic Energy Commission. Available from the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C. 216 Pages, Paper bound, $2.00.

This up-to-date compilation of information on atomic energy, though intended primarily for industrial management, is also of interest to the layman.

Well illustrated, with 86 drawings, photographs, and flow charts, it combines and organizes material from many Atomic Energy Commission sources.

Devoted entirely to peaceful uses of atomic energy, the volume describes the organization, functions, and technical information services of the AEC. Sources of technical information and services are presented in addition to information on how to obtain licenses and patents.

Five of the nine chapters are technical, dealing with the production of uranium and thorium, power reactors, fuel cycles, reactor materials, research reactors, and the characteristics and production of radioisotopes.

The volume does not report on weapons programs or basic research in universities.

Industrial Electronics Handbook

R. Kretzmann, Philosophical Library, 15 East 40th Street, New York 16, N.Y. 298 Pages, $12.00.

This second edition is an enlarged version of an earlier work which was very valuable to those engaged in the supervision or maintenance of industrial equipment. The book was printed in the Netherlands. Perhaps its greatest weakness for American readers is that it was translated into English rather than American. Nevertheless, the American reader should not have too much trouble translating *main voltage* to *line voltage* and *earth* to *ground*. Most of the tubes referred to are Dutch types—a small inconvenience.

Perhaps most disappointing about this book and its sequel, "Industrial Electronics Circuits" is the absence of discussion of magnetic amplifiers and transistors, with their growing role in industrial electronics.

In spite of these shortcomings, the book is an excellent practical handbook on electronic relays, counters, timers, rectifiers, control, and other devices. It describes the principles and properties of the various classes of hard and soft electron tubes with typical applications and circuits.

Industrial Electronics Circuits

R. Kretzmann, Philosophical Library, 15 East 40th Street, New York 16, N.Y. 194 Pages, $10.00.

A sequel to "Industrial Electronics Handbook," this book concentrates on the circuitry most often employed with industrial electronic applications. There are nearly 200 circuits together with parts lists and descriptions of the functions of component parts.

American readers will have to acclimatize to *picafarads* for *micromicrofarads* and to the use of Dutch tube types. A convenient adjunct to the book would have been a translation of Dutch tube types to American equivalents.

The circuitry is presented under six categories: photoelectrically controlled apparatus; counting circuits; stabilizing circuits; contact and control devices; oscillator- and amplifier circuits; and rectifier and motor control circuits.

Despite the shortcomings which this book shares with the "Industrial Electronics Handbook," both books can be invaluable to the designer of industrial electronic apparatus.

Closed Circuit TV System Planning

M. A. Mayers and R. D. Chipp, John F. Rider Publisher, Inc., 116 West 14th Street, New York 11, N.Y. 250 Pages, $10.00

This book is not intended for the electronic design engineer. For those thinking of using closed circuit TV, it is a complete advisory source. An excellent guide for those who must plan and evaluate these systems, it answers questions related to the organization of such systems such as space requirements, cost of equipment and installation, types of equipment available and manpower required to operate and maintain the equipment.

Principles of Properties of Materials

Jacob Porter Frankel, McGraw-Hill Book Co., 330 West 42nd St., New York 36, N.Y. 228 pp, $6.00.

An outgrowth of a series of lectures delivered to an undergraduate class at Northwestern Technological Institute, this volume takes a new approach to the subject by emphasizing principles and properties of materials rather than the materials themselves. The author has explicitly written a very basic text and not a reference book. Since it is intended as an introduction to all fields of engineering, discussions of such matters as magnetic properties and some of the properties of liquids have been omitted.

Digital Computer Components and Circuits

R. K. Richards, Van Nostrand Co., Inc., 120 Alexander St., Princeton, N.J., 511 pp, $10.75.

In this clear delineation, emphasis is laid on the presentation of information to reduce ideas about arithmetic and logic to a working machine. Many of the topics included represent components and circuits of an experimental nature which have never been utilized in working computers but which offer proven or potential advantages. Logical functions and digital storage, basic operations to be performed by a digital computer, are discussed at length. The various advantages and disadvantages of the several approaches to design are thoroughly explored. Intended as a companion book to the author's *"Arithmetic Operations in Digital Computers,"* this present volume is nevertheless an entirely separate work intended as a reference source for the practicing engineer and as an aid in introducing the newcomer to the field. Brief discussions of Boolean notation, counters, and adders are repeated here.

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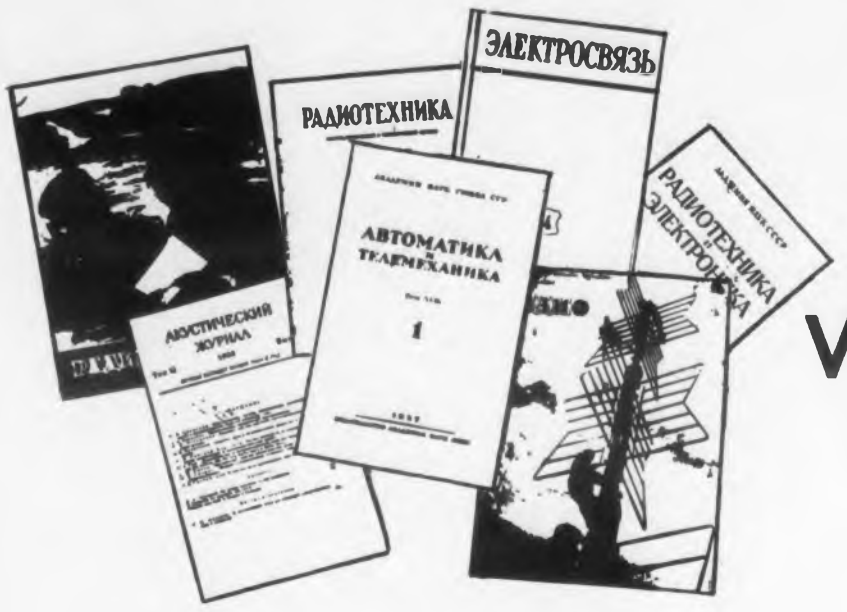


What The Russians Are Writing

J. George Adashko

RADIO ENGINEERING AND ELECTRONICS

(Contents of Radiotekhnika i Elektronika No. 6, 1957)

TUBES AND THERMIONICS

Trends in the Development of Thermionic Cathodes, B. M. Tsarev (pp 675-687, 6 figs).

Modern types of thermionic cathodes are classified with respect to the principal requirements that they must satisfy in modern electron tubes, primarily those employed for the amplification and generation of uhf waves up to the millimeter range. Possible new types of cathodes of the future are described.

Electron Waves in Decelerating Systems. Nonlinear Equations of Traveling Wave Tubes, L. A. Vaynshteyn (pp 688-695, 1 fig).

The equations of the nonlinear theory of traveling wave tubes are derived, analyzed, and solved by successive approximation. The forces acting on the electron beam in the nonlinear operating mode and certain other problems in the nonlinear theory of traveling wave tubes are discussed. Reference is made to an article by A. Nordsieck in *Proc. IRE*, vol. 41, p. 630 (1953).

Theory of Electron Beam Shaping, V. T. Ovcharov (pp 696-704).

The author develops a method for finding the electrical field within an electron beam, when the trajectories and the magnetic field (if used) are given, with allowance for the intrinsic charge of the beam.

The method proposed and developed in this article can be used to solve many beam problems so far unsolved. It leads, for example, to a demonstration of the practical realizability of the so-called Brillouin beam—a cylindrical beam with constant axial velocity in the homogeneous magnetic field. Configurations such as a converging axially-symmetrical beam for a plane cathode, a ribbon-like beam for a cathode having an area greater than that of the ribbon in a homogeneous transverse magnetic field, and others, can also be treated.

"Phasochron" Backward Wave Oscillator, S. I. Tetel'baum (pp 705-713, 6 figs).

This oscillator uses distributed interaction between the electron beam and the traveling wave field. The phase velocity of the electron bunches is opposed to their forward velocity, so that an internal feedback is produced if the waveguide system employed has a positive normal dispersion. The author develops an approximate theory for such a generator, constructed of a nonretarding two-conductor waveguide system, and gives test results.

Concerning the Electron Energy Distribution of Electrons From Antimony-Caesium Cathodes, A. I. Pyatnitsky (pp 714-725, 14 figs).

Discusses the experimentally established difference in the current-voltage characteristics of the photocurrent between a Sb-Cs cathode and a Ag-Cs layer. Refers to work by Apker, Taft and Dickey (*Physical Review*, 1948, vol. 74, 1462), Bardeen (*Physical Review*, 1947, vol. 71, 717), Apker, Taft, and Dickey (*Physical Review*, 1949, vol. 76, 270), and Taft and Apker (*Physical Review*, 1949, vol. 75, 1181).

Interdepartmental Seminar on Cathode Electronics, N. L. Yasnopol'skiy and A. E. Dyklop (pp 814-816).

This is the fifth session sponsored by the Institute of Radio Engineering and Electronics of the Academy of Sciences, U.S.S.R. It was held on April 8, 1957 and was devoted to secondary electron emission. The contents of about 15 papers are briefly reported.

Quantum Effects in the Interaction Between Electrons and High Frequency Fields in Resonators, V. L. Ginzburg and V. M. Fayn (pp 780-789).

In the analysis of the quantum effects that take place when electrons pass through a cavity resonator, it is shown that the only quantum effect is essentially the interaction between the electrons and the zero-order oscillations of the field in the resonator. Accordingly, the calculations do not require the use of quantum-mechanical methods and reduce to a simple utilization of the Nyquist quantum formula.

CIRCUITS

Operating Modes of a Symmetrical Multivibrator, N. A. Zheleztsov, M. I. Feygin (pp 751-761, 12 figs).

An approximate method is used to break down the multi-dimensional phase space into the subspaces of the motions of the individual orders, in which the symmetrical multi-vibrator circuit is analyzed. The parasitic capacitances and grid currents are taken into account. The self-oscillation frequency is calculated for positive grid bias. Nonlinear theory of considerable complexity is used in the discussion. A brief reference is made to an experimental verification of the theoretical results, for which good agreement is claimed.

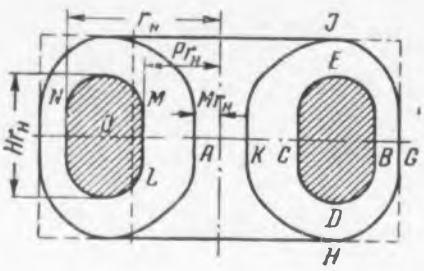
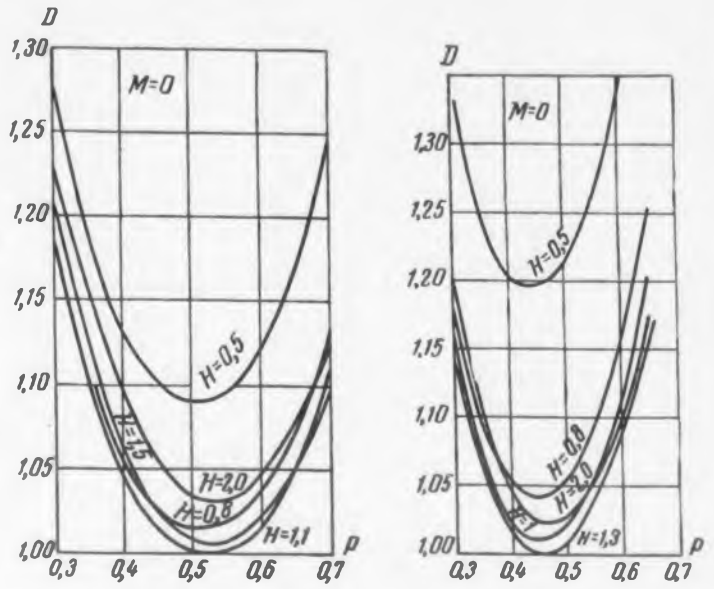


Fig. 1. Transverse section of toroidal core of the (oval) form investigated by Rabkin and Novikova.



Figs. 2 and 3. Dependence of loss angle (D) on the dimensional ratios H and P (which are defined on Fig. 1) for cores in which the magnetization losses predominate (Fig. 2) (left) and for those in which hysteresis losses predominate (Fig. 3).

RECEPTION

Concerning an Optimum Detector for Weak Signals in the Presence of Noise, B. S. Fleyshman (pp 726-734, 1 fig).

The author proposes a more accurate analysis of the problem than Peterson, Birdshall, and Fox, "The Theory of Signal Detectability." *Transactions IRE*, Information Theory, 1954, vol. 4, 171-212, or D. Middleton "Statistical Criteria for the Detection of Pulse Carriers in Noise," *Journal of Applied Physics*, 1953, vol. 24, 371-391, because the latter include only the quadratic term of the expansion of log $I_0(x)$. The results obtained are in agreement with those quoted by Bussgang and Middleton "Optimum Sequential Detection of Signals in Noise," *Transactions IRE*, Information Theory, 1955, vol. 1, 518, without employing so many simplifying assumptions.

Passage of Fluctuation Signals Through a Detector, with Account of the Effect of Bias and Limitation, E. G. Logachev (pp 735-750, 3 figs).

A general expression for the correlation function of the current at the detector output is used to derive an expression for the correlation function of the noise current at the output of a fluctuation-signal detector at low frequencies, making due allowances for bias and limiting. Cites articles by Middleton on the subject (*Quarterly of Applied Mathematics*, 1948, page 445, and *Journal of Applied Physics*, 1946, vol. 17, 778).

CIRCUIT ELEMENTS

Calculation of Toroidal Coils with Ferrite Cores, Operating at Audio Frequencies, L. I. Rabkin and Z. I. Novikova (pp 762-768, 3 figs).

The article contains a method for determining the optimum ratio of the dimensions of a toroidal magnetic core, so as to guarantee minimum coil volume for a specified Q or a maximum Q for a specified volume. The calculations are based on the assumption that the ratio of the outside diameter of the coil to its internal diameter is constant. See Figs. 1, 2, and 3.

PHYSICS

Grapho-Analytical Method of Plotting Trajectories of Charged Particles in Magnetic Fields, N. I. Shtepa, (pp 790-795, 4 figs, 1 table).

Unlike all other approaches to the problem, this article proposes methods with which it is possible to determine trajectories other than those in axially-symmetrical fields (principally paraxial rays), and treating only nonrelativistic particles. This article treats relativistic particles in magnetic fields, provided that the field distribution is known.

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MEASUREMENTS

Calculation of Resolving Power of Automatic Frequency Analyzers, N. V. Terpugov (pp 796-806, 10 figs).

A method is given for the calculation of the dynamic frequency characteristics of filtering systems. The results of an experimental test on several filtering systems are cited, and generalizations are made concerning their selection and concerning the procedure used to calculate such systems. See Fig. 4.

WAVE PROPAGATION

Allowance for Multiple Scattering in Diffusion UHF Propagation in the Troposphere, D. M. Vysokovskiy (pp 807-809, 2 figs).

Techniques usually employed in multiple X-ray scattering are generalized to include the calculations of the effect mentioned in the title.

ELECTRICAL COMMUNICATIONS

(Contents of Elektrosvyaz No. 7, 1957)

TELEVISION

Power Spectrum and Correlation Function of Television Signal, N. G. Deriugin (pp 3-14, 10 figs).

It is shown that the best analytic representation of both the power spectrum and the correlation function of a television signal is in the form of a product of three simple functions, which are determined experimentally for the power spectrum and which can be approximated by experimental curves from which the correlation function of the television signal can be calculated.

CIRCUITS

Concerning the Design of Cathode Followers Operating in the Pulse-Amplification Mode, E. N. Mokhov (pp 15-25, 11 figs).

Analysis of the cathode follower circuit with allowance for the duration and character of the rise of the applied pulses applied to it. Design curves are plotted to facilitate the choice of optimum parameters of a stage so as to prevent tube overload by rapid pulse buildup. A method is given for calculating the influence of nonlinearity of the tube characteristics on the overload of the stage. An illustrative example is given.

Construction of Modulation-Signal Feedback Loops in Radio Transmitting Apparatus, V. A. Khatskelevich, L. M. Shur (pp 26-33, 6 figs).

Continuation of an article published by the authors in the November 1956 issue of Elektrosviaz' (*ED* July 15, 1957), attention being now devoted to the choice of the feedback-loop elements. Some ideas are presented concerning a procedure for correcting the frequency characteristics of the loop so as to obtain effective modulation-signal feedback.

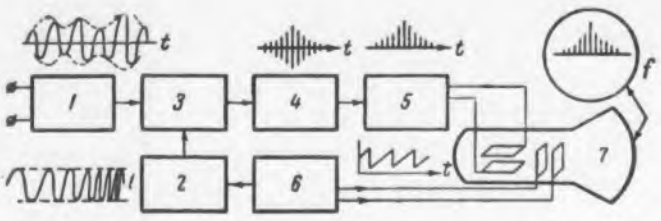


Fig. 4. Block diagram of frequency analyzer: 1—hf amplifier; 2—fm generator; 3—mixer; 4—if amplifier; 5—detector; 6—sweep generator; 7—CRT.

Other Articles

Thyratron Circuit for Disconnecting High-Voltage DC Circuits, A. D. Artym (pp 34-41, 9 figs).

Induction Between All-Copper Lines and Steel Lines Through a Third Line, P. K. Akul'shin (pp 42-48, 4 figs).

Method for Calculating Losses in Circuits of Step-by-Step Automatic Telephone Stations with Single Step Preselection, R. A. Avakov (pp 49-56, 6 figs, 1 table).

Analysis of Five-Digit Codes for Letter-Printing Telegraph Apparatus, Yu. I. Savitski and V. M. Timofeev (pp 57-62, 2 tables).

Procedure for Measuring Telegraph Distortions, K. P. Lishai (pp 63-67, 5 figs).

Corrosive Action of Current in a DC Wire-to-Ground Loop of a Communication Cable, M. I. Mikhailov and K. K. Nikol'ski (pp 68-72, 4 figs).

ELECTRICAL COMMUNICATIONS

(Contents of Elektrosvyaz No. 6, 1957)

CIRCUITS

Production of High Harmonics with the Aid of a Magnetic Harmonic Generator, L. T. Kim (pp 58-60, 5 figs).

Several circuits are given for obtaining high harmonics with the aid of a magnetic generator, loaded by a complex load. The circuits make it possible to obtain readily one or two harmonics of the fundamental frequency with a considerable suppression of the remaining harmonics. Reference is made to an article by Peterson, Manley & Wrathall "Magnetic Generation of a Group of Harmonics," *Bell System Technical Journal*, vol. 16, no. 4, 1937.

Analysis of the Operation of a Reactive Trigger Circuit and a Procedure for its Design, A. S. Vladimirov (pp 15-27, 5 figs).

Theoretical analysis of the reactive trigger circuit with anode coupling. Recommendations are made on the choice of parameters to insure the most stable operating condition for the circuit. Methods for engineering design are also given. An example of a circuit design based on the analysis is shown.

Contribution to the Design of Multistage Amplifiers with Junction Transistors, I. N. Migulin (pp 34-41, 8 figs).

The generalized theory of transistor and vacuum tube amplifiers, developed by Kulikovskii in the November 1955 issue of Radiotekhnika (*ED*, April 15, 1956) and by Migulin in the September 1956 issue of Elektrosviaz is used to present an analysis and a design procedure for junction transistor amplifiers.

Design of Spark Quenching Circuits, F. F. Zhdanov (pp 47-51, 1 fig, 1 table).

Equations are derived for a variety of spark quenching circuits to operate under various conditions. The results are tabulated, and the limits of the validity of all these equations are indicated in the table.

CIRCUIT ELEMENTS

On the Design of Broadband Grid Transformers for a Specified Input Impedance Characteristic, Y'a L. A'lterman (pp 42-46, 7 figs).

A method is given for the calculation of the optimum parameters of a broadband grid transformer based on the analysis of the specified input impedance characteristic. It is proposed that the required input impedance of the transformer be obtained by means of a shunt, consisting of an active resistance, connected in the secondary winding and equal to the internal impedance of the generator. Using the resultant simple equations, it is possible to determine the maximum transformation coefficient for a specified value of the reflection coefficient.

COMMUNICATIONS

Concerning Certain Geometric Properties of the

Optimum Code, N. K. Ignat'ev (pp 3-9, 1 fig).

Discussion of the choice of the best configuration of signal space to contain the dots of an optimum-code signal (i.e., a code, insuring maximum signal entropy, other conditions being equal). Cases are investigated, in which the dots of the signal are placed in a volume of an n-dimensional sphere, on the surface of an n-dimensional sphere, and in the volume of an n-dimensional cube.

Electronic Telegraph Apparatus, B. P. Terent'yev (pp 52-57, 6 figs).

Description of a telegraphic letter-printing apparatus in which all the basic operations (formation of code transmission, synchronization, decoding at the receiver, etc.) are performed with the aid of vacuum tubes. The circuit of the electronic portion of the apparatus is given and the mechanical parts of a model of the apparatus are briefly described.

Loading of Channels by Service Conversations between Telephone Operators, V. M. Belous (pp 61-63, 5 figs).

It is indicated that the group systems are not satisfactorily operated from the point of view of protecting them against overloads. A method for protecting group channels against high voltages, occurring during service conversation between telephone operators, is given.

RECEPTION

Overshoots of Fluctuations and their Correlation Characteristics, B. I. Tikhonov (pp 10-14, 5 figs, 1 table).

The author reports on an experimental investigation of the distribution of overshoots of normal and Rayleigh fluctuations with respect to duration, and estimates their correlating ability.

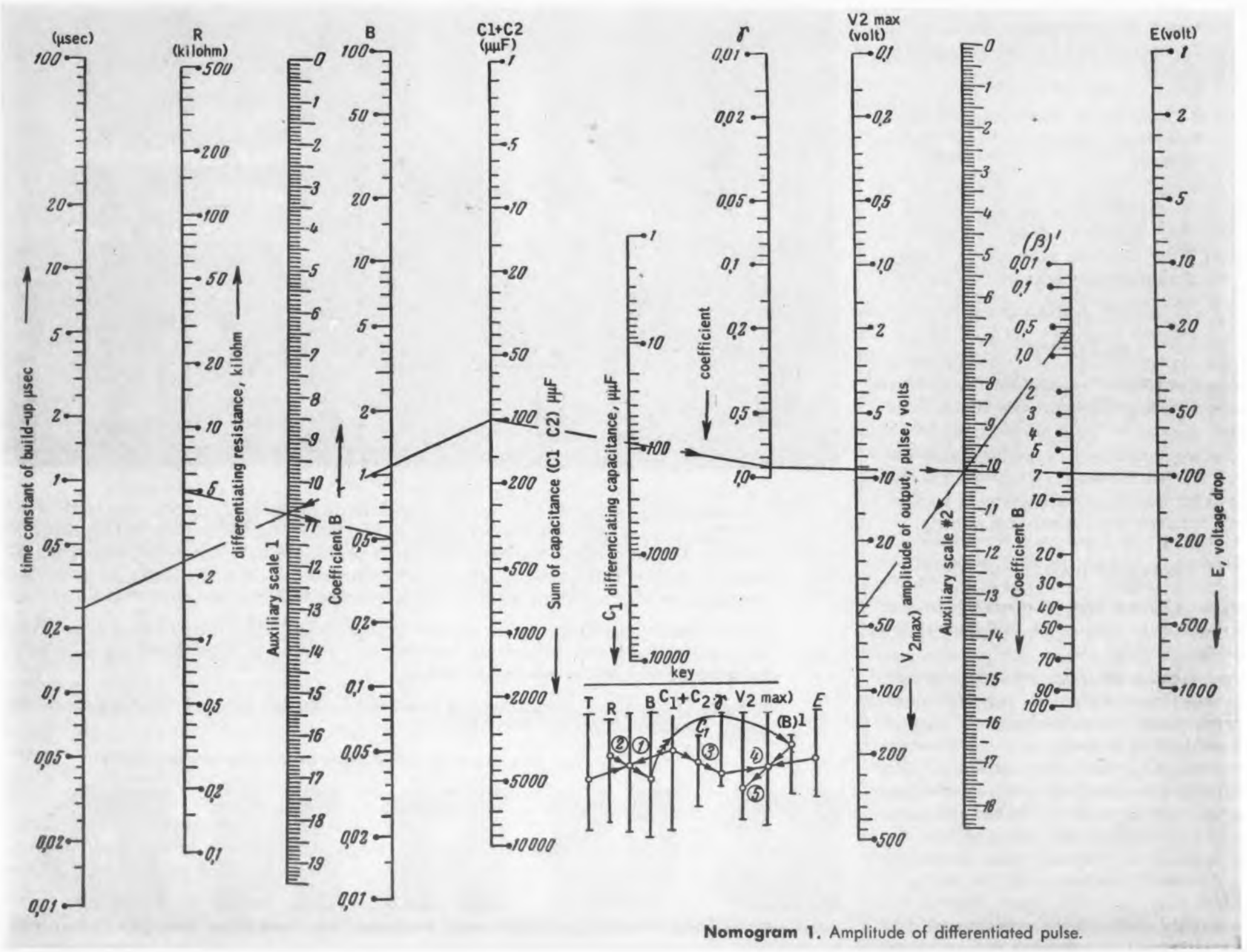
WAVE PROPAGATION

Propagation of Meter and Decimeter Waves over the Earth's Uneven Surface, N. D. Dymovich (pp 28-33, 4 figs, 1 table).

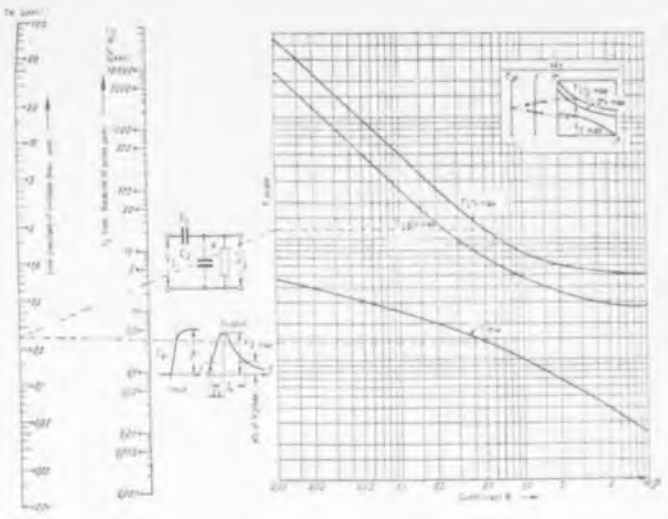
The propagation of radio waves over an uneven surface (in particular, one varying sinusoidally in one plane) is examined from the point of view of the laws of geometric optics. A transcendental equation is derived, the graphical solution of which gives the coordinates of the reflection points. An equation is given for the difference in the paths of the direct and reflected rays. The validity limits of the proposed calculation methods are discussed. Comparison of the results of the method given here with a more rigorous diffraction method and with the experimental data shows good agreement with both.

R-C Differentiator Nomograms

J. George Adashko



Nomogram 1. Amplitude of differentiated pulse.



Nomogram 2. See next page.

THESE nomograms yield the amplitude and duration of pulses obtained by differentiation of rising and falling voltages. The differentiation is effected by the circuit shown in nomogram 2. Here R is the differentiating resistance, C_1 the differentiating capacitance, and C_2 the parasitic capacitance parallel to resistance R. If the input signal is of the form.

$V_1 = E(1 - e^{-t/\tau_\phi})$

the equation for the output pulse is

$$V_2 = \frac{E\,C_1}{\tau_\phi\,(C_1+C_2)} \frac{[e^{-t/\tau_\phi} - e^{-t/R(C_1+C_2)}]}{\frac{1}{R(C_1+C_2)} - \frac{1}{\tau_\phi}}$$

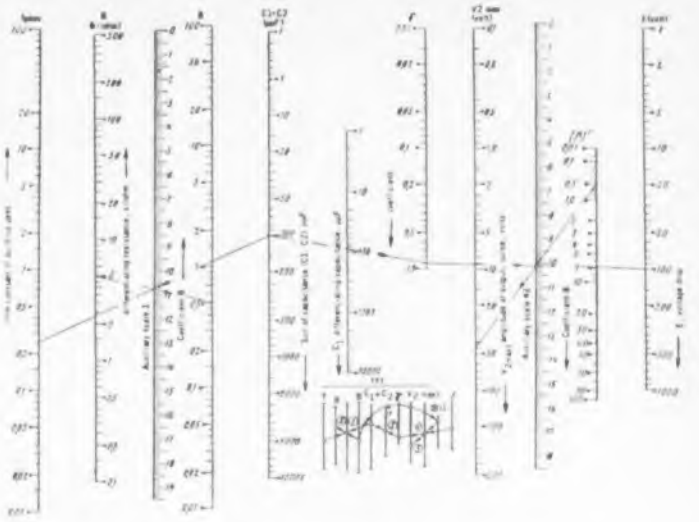
where τ_ϕ is the time constant of the voltage drop. The maximum amplitude of the differentiated voltage is

$$V_{2max} = \frac{E\,C_1}{C_1+C_2}\left[\frac{1}{\beta}\right]^{\frac{\beta}{\beta-1}} = \frac{E\,C_1}{C_1+C_2}\,e^{\frac{-t_3}{R(C_1+C_2)}}$$

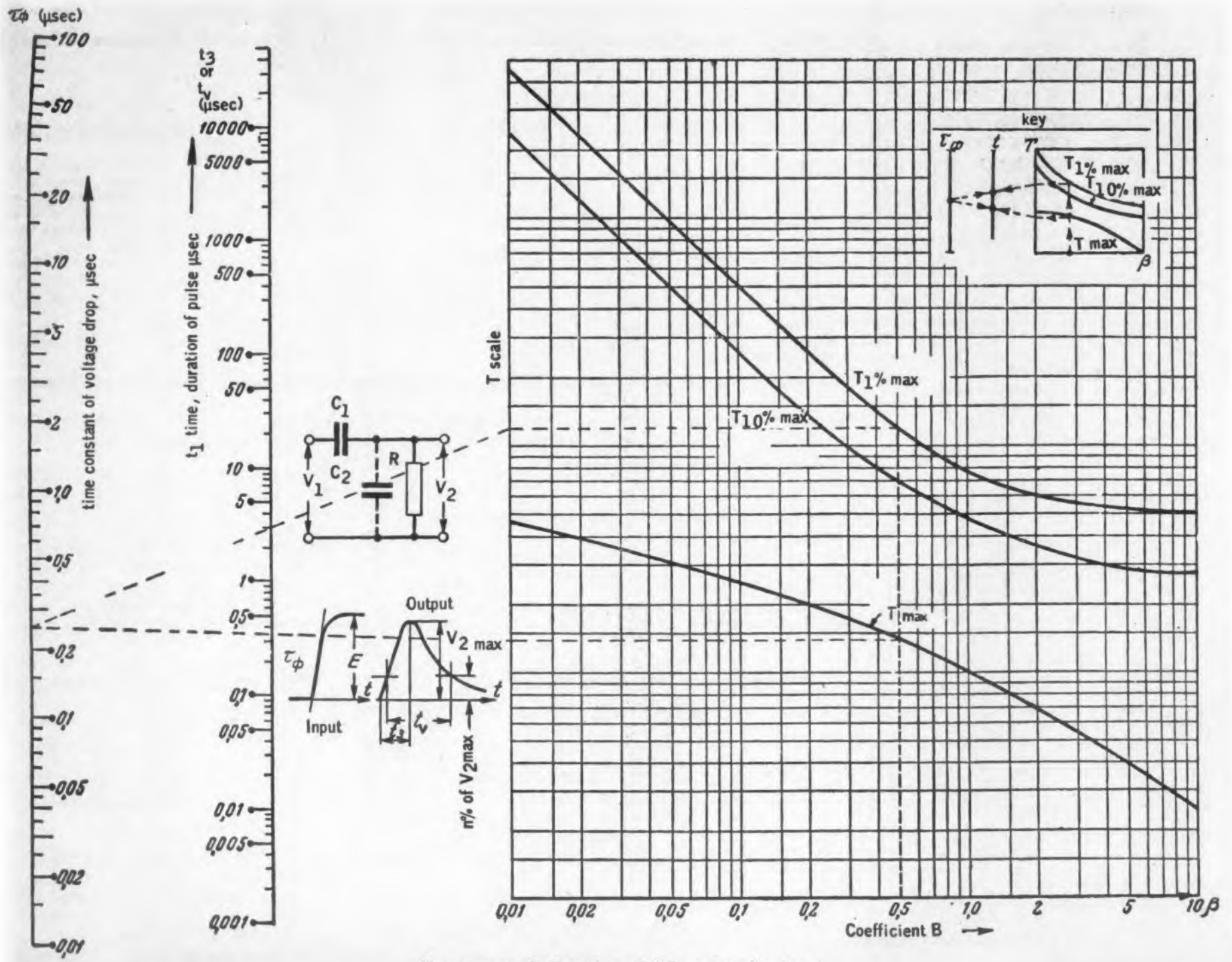
where $\beta = \tau_\phi/R(C_1+C_2)$. By determining V_{2max}, we find the delay of the peak of the differentiated pulse relative to the start of the voltage applied to the differentiator. This time is $t_3 = 1/\beta - 1\ \tau_\phi\ ln\ \beta$ In the same manner, it is possible to determine the time delay of any part of the differentiated pulse, expressed as a fraction of the maximum value, that is, the duration of the pulse at a given voltage level. If one defines $\gamma = C_1/(C_1 + C_2)$ and $T = t/\tau_\phi$ one may write $t_n = \tau_\phi\ T_n$ where n is the percentage of V_{2max} at which the duration of the pulse is measured. From this one obtains

$V_{2max} = E\ \gamma\ e^{-\beta T max}$ and $t_3 = \tau_\phi\ T_{max}$

(Continued on following page)



Nomogram 1. See previous page.



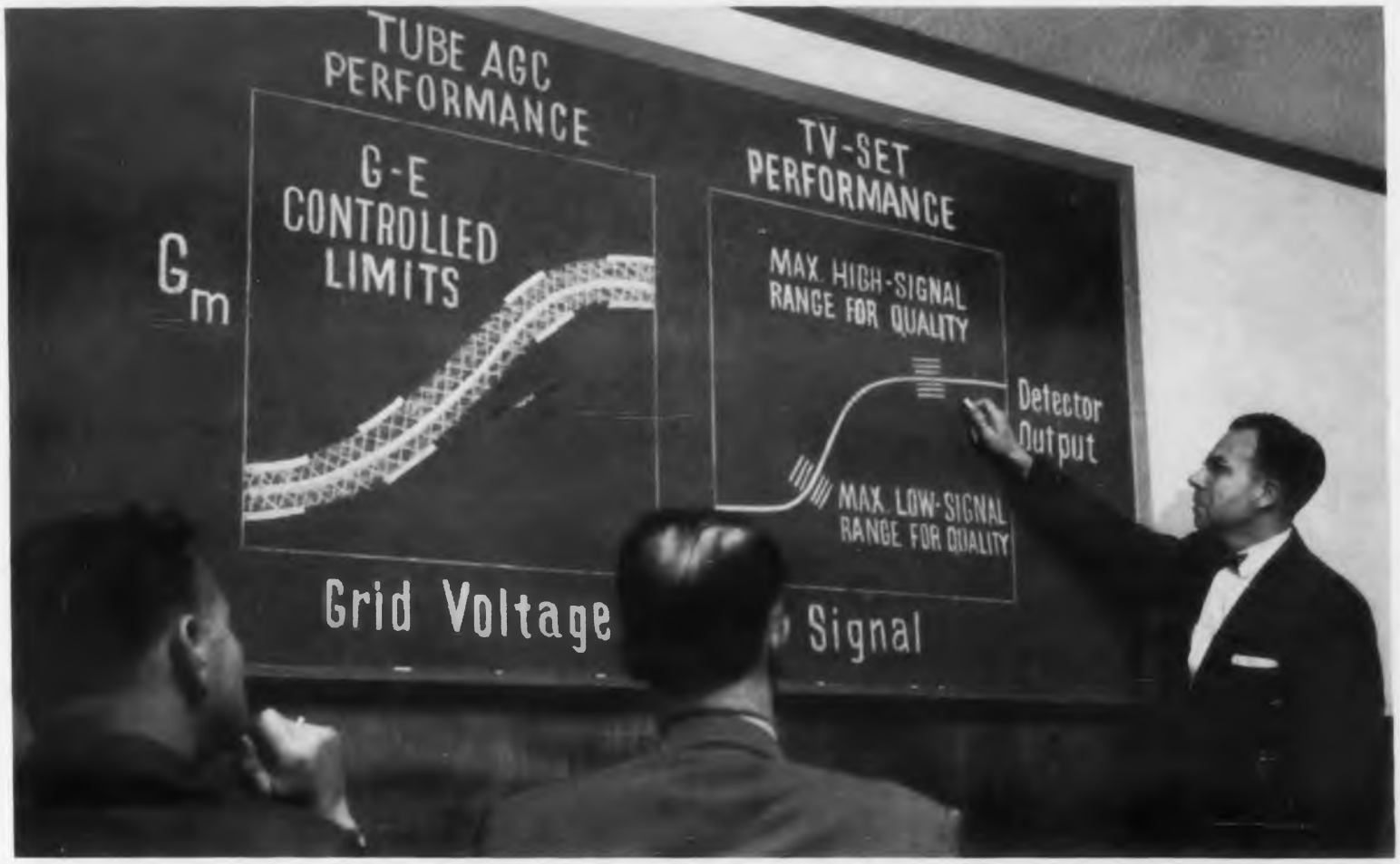
Nomogram 2. Duration of differentiated pulse.

GENERAL ELECTRIC

TUBE DESIGN NEWS

FROM THE RECEIVING TUBE DEPARTMENT OF GENERAL ELECTRIC COMPANY

General Electric Improves TV Reception Through New, Close Controls of Tube AGC Performance!



How General Electric's close control of tube AGC characteristics stabilizes TV-set performance! R. E. Moe, Manager of Engineering, General Electric Receiving Tube Department, shows the relationship that exists between tightly-controlled characteristics of an IF-amplifier type, and television-receiver performance that is held to quality levels at important points such as the high-signal and low-signal reception areas.

More and tighter controls than the industry has used before, are being applied by General Electric to critical IF-amplifier tubes for sockets with AGC. Television manufacturers and owners benefit in improved reception, whether in low, intermediate, or strong-signal areas.

In the past, the practice has been to hold quality controls to the high and low ends of the AGC voltage range, which led to variations—often wide—in the shape of the actual tube performance curve. Now, by doubling the number of control points, General Electric helps stabilize the performance of IF-amplifier types at all signal levels.

In addition: through median, or "lot-center" control methods, a heavy preponderance of General Electric tubes manufactured and shipped follow the center line of the optimum performance curve (see chart at left, above). The percentage of tubes which approach the outside control limits is exceedingly small.

Because tubes for fringe-area TV must amplify extremely weak signals, high tube gain is fundamental—and, from the standpoint of a receiver manufacturer, must be uniform and predictable in every lot of tubes he installs. Strong-signal reception, on the other hand, calls for equally uniform and predictable grid cut-off characteristics.

By promoting consistent tube AGC performance at all voltages, General Electric's new, close control methods help make it possible for television builders to offer the public sets that are economical in circuitry and transform signals of any strength into pictures with superior quality.

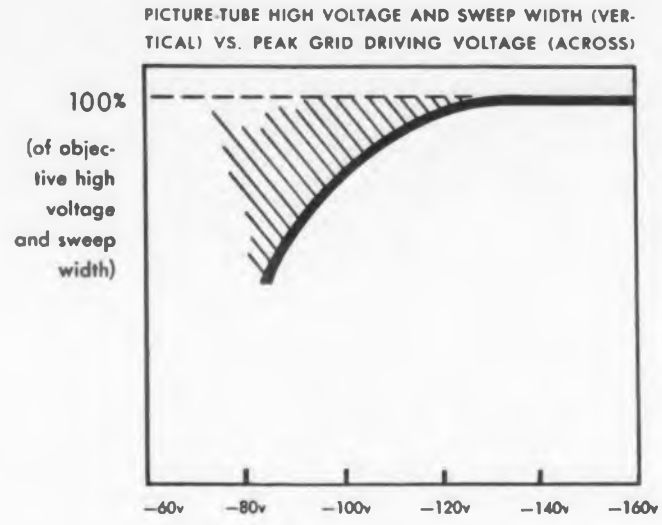
Tear off and keep this sheet for reference. It contains useful tube-application data.

WITH TV SWEEP TUBES, INADEQUATE GRID DRIVE CAN CAUSE . . .

. . . Loss of sweep width—giving a narrowed and distorted picture.

. . . Reduction in the picture-tube voltage —less brightness and contrast.

RIGHT: curve shows how sweep width and high voltage both are reduced by grid voltage that is insufficient. The shaded area indicates less-than-desired picture performance. Designers, by providing for ample grid drive in the sweep circuit, can contribute importantly to superior TV.

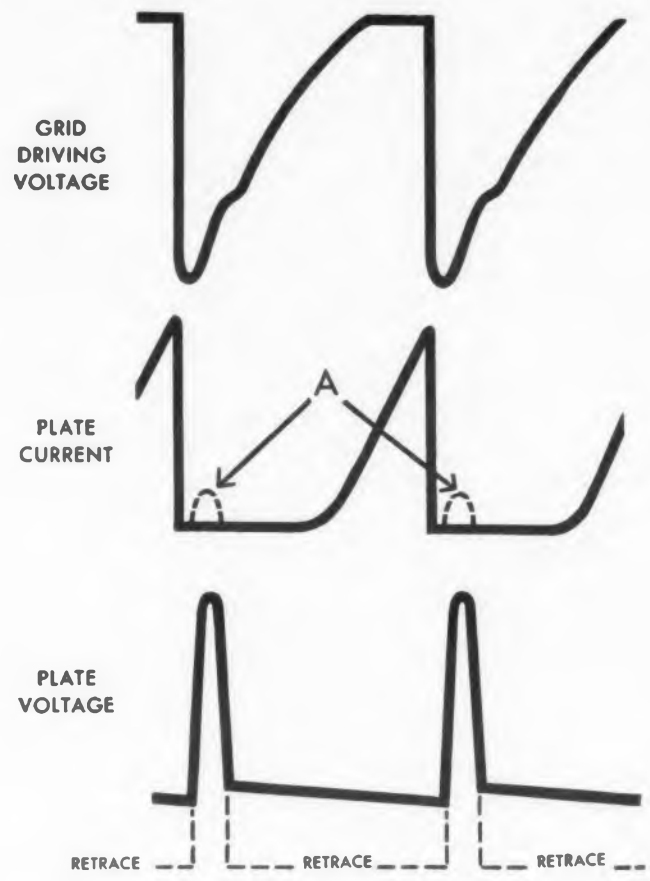


Low Grid Drive Will Fail to Hold Tubes at Cut-Off. Circuit Energy Suffers.

In the center curve at right, "A" indicates the undesirable plate-current flow that can occur when grid drive is insufficient to hold a horizontal-amplifier tube at cut-off. This flow acts as a shunt on the stored energy of the circuit. The result is a loss of high voltage and sweep width of as high as 50%.

TV designers must guard against two contingencies. One is insufficient grid voltage provided for in the sweep circuit itself. After the circuit has been checked with this in mind, the designer should assure himself that the sweep tubes he selects will meet those standards of performance required for high picture-tube voltage and full sweep width at all times.

Here General Electric assists by carefully controlling, through high-voltage testing, the cut-off and other characteristics of 6DQ6-A's and other sweep tubes *before* they reach the set manufacturer's hands. More dependable TV quality results.



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