ELECTRONIC INDUSTRIES

A CHILTON PUBLICATION

1961

IRE International Convention and the IRE Show

ELECTRONIC INDUSTRIES

ROBERT E. McKENNA, Publisher • BERNARD F. OSBAHR, Editor

THE I.R.E.

How It Began . .

ALMOST a half century ago, three men—Alfred N. Goldsmith, Robert H. Marriott, and John V. L. Hogan—saw the need for a separate professional society in the radio field. They represented the two societies already in existence—the Society of Wireless Telegraph Engineers (22 members) and the Wireless Institute (25 members). The three men recommended merger; the memberships concurred.

Today, that small group has grown to more than 58,000 professional members; the union, *the* recognized society in the field of electronics. And the organization is, of course—IRE.

IRE members are graded as Member, Senior Member, and Fellow—approximating their industry status. (Incidentally, all editors of EI are Members of IRE). Fellow, the highest grade, "is awarded as an honor of recognition for outstanding contributions to the electronic science." No more than 75 men a year can be so honored. We are fortunate in this issue, page 126, to have most of this year's appointees comment on the future of the electronic industries.

R. G. S.

It's A Big Show . . .

THE more our industry grows and diversifies, the more valuable the annual IRE convention becomes. The convention gives a *total* picture of the industry. It is at the apex of a triangle; whose broad base is composed of hundreds of specialized and regional conventions. The annual convention stimulates co-operation between the engineer, industry, and other professional societies. It fosters the free exchange of information and provides the cohesive force that binds all electronic engineers in the largest technical fraternity in the world.

The encouragement of this unity of purpose—the advancement of the *total* engineering society—is indeed justification enough for the convention—if justification is needed.

This year's IRE International Convention, spurred on by tremendous growth of the electronic industry, promises to be the biggest and best ever. Here, under one roof, will be over $15 million worth of electronic equipment. Over 260 technical papers will be presented. Today's electronic engineer, caught in an ever narrowing field of specialization, can "catch-up" with industry progress, review the accomplishments of his fellow engineers, and catch a glimpse of progress yet to come.

C. M. C.

While You Are There . . .

WE wonder whether the engineer visiting the show realizes the usefulness that can be derived. We see so many just wandering up and down the aisles. The only thing gained from this will be sore feet.

Having gone the sore feet route ourselves, we would like to pass along a few words of wisdom. Plan your tour before your arrive at the show. Beginning on page 124, we have prepared 32 pages of information to assist you in planning the show. You must have specific fields of interest. There must be items that are needed for a project. These are the areas you should cover first. Visit the booths that are specializing in the items of your choice. Talk to the engineers there. They can intelligently assist you and that's what they are there to do.

Should there be two or more of you going from the same company, don't play follow-the-leader . . . . split up and spread the work. If any of your companions are junior engineers or recent graduates, take them along with you and show them what to look for and how to evaluate it.

After you have made all of the booth visits on your list, then go ahead and get sore feet with the time left. When they do get sore, stop at Booth 4202 and relax for a few minutes with our editors. They look forward to meeting their readers . . . . You.

J. E. H.

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ELECTRONIC INDUSTRIES

Vol. 20, No. 3 — March, 1961

COVER: Symbols or initials of many of the organizations serving the electronic industries. How many do you know? They are all identified on page 131 of this issue.

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Highlights

of this issue

Design Trends in Low-K Substrate Modules — page 92

Modules have followed two main avenues of development. The military and industrial groups have concentrated on putting all components on the module; the commercial have experienced an evolution to two basic components. Here's the "why" story on the commercial route.

Silicon Rectifier Design Techniques — page 98

Series or parallel operation of silicon rectifiers requires special treatment. Here are three general methods for series operation in high voltage applications and three general methods for parallel operation where current rectification is needed.

Strip Transmission Line Tuners — page 104

The microwave tuner can be quickly designed with a few simple equations. These equations are given here. Tuner is comprised of a shorted line and a piston capacitor.

Reliability of Precision Potentiometers — page 106

For reliability the questions arise: multiple wipers or single wipers; Wire wound pots or carbon pots? Here is a discussion that helps to answer these questions.

Instrumentation for Radio Interference Measurements — page 110

Interference instrumentation may be divided into two categories—those for field survey use and those used by researchers for studying the detailed properties of the noise. Instruments for both uses are discussed and described along with information about commercially available instruments.

The 1961 IRE International Convention — page 123

Each year attendance at the IRE convention increases. The number of exhibitors and the products they show increases. There are hundreds of papers worth hearing and a host of worthwhile new products to see. Save your time—and your feet—use this handy guide to the convention.

Controlling Burst in Color-B&W TV — page 268

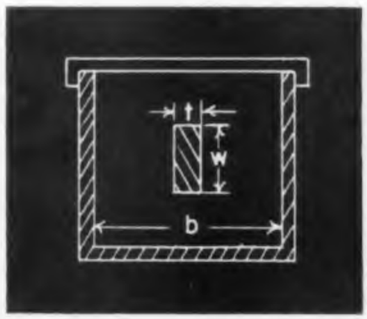
If the same switcher is used for Color and Black and White operations, various problems of handling the color burst arise. Should burst be added before switching? Should burst be added after switching? Are modifications needed?

Writing—Newest Engineering Skill — page 278

Whether trying to sell his ideas to management or passing along his findings to other engineers, a good part of the engineer's success will depend on his ability to express himself. In a word—this is "writing." As a shortcut to the problem this article advises, "Think of yourself as a teacher!"

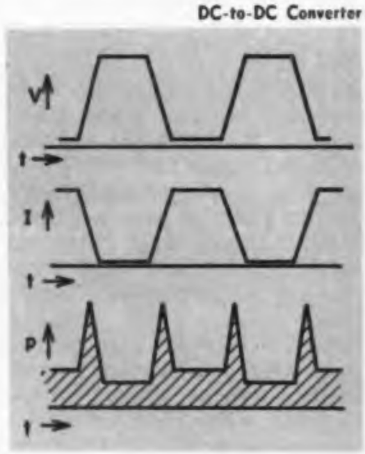
Electronic Hardware

Low-K Modules

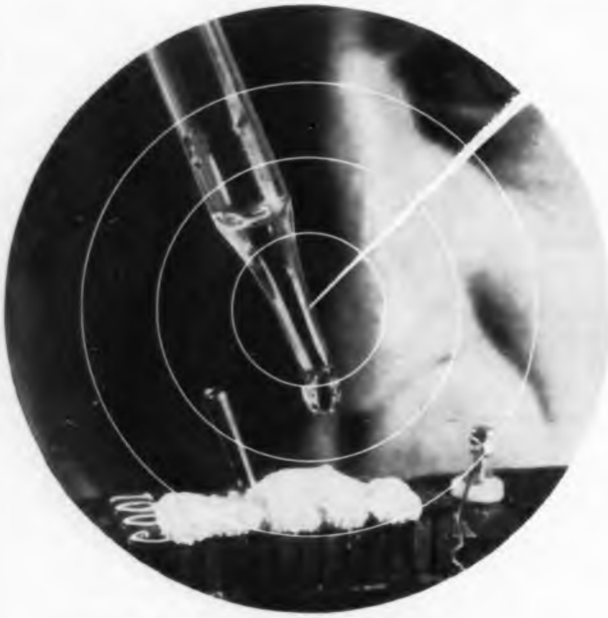


Transmission Line Tuner

DC-to-DC Converter



RADARSCOPE



THERMOELECTRIC HEATER-FREEZER

New thermoelectric cooler can freeze water on the power of two flashlight batteries. Hughes Aircraft Co. device uses a new technique for fabricating the thermoelectric material. Company has built a 3-stage cascaded cooler that brings temperatures down to 100° F below zero.

IT WILL BE INTERESTING TO SEE how the AIEE handles their new Electrical Engineering Exposition. A survey of members showed that 58% wanted commercial exhibits to supplement their technical sessions. First show is planned for Jan. 29-Feb. 2, 1962 at the New York Coliseum.

PRIVATE COMMUNICATIONS SATELLITES are still a long way off. Biggest roadblocks are bureaucratic. Nobody seems to know just which agencies are responsible for regulation. Then there are international roadblocks, e.g., countries without satellites may be unwilling to agree to frequency allcocations.

LABOR'S ACTION on Jap imports will have wide repercussions. The IBEW (Local 1031 in Chicago) move to boycott Japanese electronic imports will probably trigger action by other unions against imports. Move will probably help establish protective tariffs. EIA has been clamoring for similar-type action for some time. But, it will be interesting to see which way the situation develops. Problem is that the balance of electronic trade is still in our favor—we export $450 million and import $130 million. The balance shifts the other way though for consumer-type electronic equipment. The Office of Civil & Defense Mobilization doesn't seem too receptive to EIA's plea that national security is being endangered by transistor imports.

FIRST FIVE YEARS ARE THE HARDEST for small manufacturing firms, reports the Small Business Administration. 70 to 75% of all closing are in that period. The complete study, "The Turnover and Mortality Experience of Manufacturing Firms in the Hartford, Conn., Economic Area, 1953-1958" can be obtained ($2.00) from Dean L. J. Ackerman, School of Business Administration, Univ. of Conn., Storrs, Conn.

SMALL BUSINESS FAILURES by the thousands are predicted by at least one prominent electronic industry exec. He claims failures will be accelerated by a demand for standardized products. But we don't think so. The electronic industry is too complex to be fitted into standardized molds. We feel that there will always be a need—a need that will make up a considerable portion of the industry—for the highly skilled firm making specialized products.

UNSUCCESSFUL BIDDERS on the Dyna-Soar Program subsystems were given a briefing by the Air Force. The AF believed the critique was necessary "in view of the need for improvement in the quality of future proposals as well as consideration of the magnitude of effort expended by the twenty-two companies entered in the subsystem competition for the program."

IMPORTANT STEP has been made in microelectronics program. Armed Services plan a number of development programs in support of several promising techniques. The programs are relatively small. Encouraging is the fact that the Navy, heretofore rather aloof in this respect, is going into a program. Up till now the biggest programs have been at Westinghouse and RCA and have been supported by the Army and Air Force.

NEW SUPERCONDUCTING COMPOUND

Bell Labs scientist, J. Wernick pours liquid nitrogen into a cryostat to super-cool sample of niobium-three-tin alloy. Lab has demonstrated feasibility of superconducting solenoids producing very high magnetic fields with the material. 88,000 gauss fields are possible.

Analyzing current developments and trends throughout the electronic industries that will shape tomorrow's research, manufacturing and operation

NEWEST BILLION DOLLAR INDUSTRY is the computer-data processing industry. Biggest fact to emerge from statistics of the industry is the staggering development costs. This means that only relatively well-heeled manufacturers are likely to remain as complete systems makers. Second fact is that the high costs of owning computers indicates that most computers will be rented by the users.

IT'S JUST A RUMOR but: we have heard that some missile component makers are getting jittery over possible threat of foreign competition. Rumor probably started as a result of recent indications that the Military is being more cost conscious. Fear of competition (foreign) could lead to lower missile component prices.

LIGHTWEIGHT NUCLEAR GENERATOR is being tested by the Air Research & Development Command. The thermoelectric generator, built by Westinghouse, is designed to provide power for such facilities as unmanned surface radio beacons and weather stations. The device, NAP-100, produces about 150 watts.

FAST TAX WRITE-OFFS, proposed by Kennedy administration, could provide real stimulus for electronic firms. Over 2,000 firms (not all electronic) have already indicated that liberalized depreciation allowances would spur capital expenditures for expansion.

COMMUNICATIONS EQUIPMENT SALES will probably drop off a bit in 1961 but the curve will correct itself in the last quarter. This is a pattern generally expected of the entire electronic industry by most leaders. A lot of cash is being invested in the expansion of research laboratories to develop new techniques, create new manufacturing methods, and design new equipment.

CRYSTAL-BALLING THE FUTURE. The Aerospace Industries Assoc. sees these as the significant developments of the 1960's: (1) Increasing emphasis on the 1000 to 10,000 mc range, due to the accelerating need for higher data rates in telemetry and data length. (2) Increased importance of secure and private wireless communication, with attention moving to transmission at very low frequencies, use of the earth as a communication system, and modulation of waves in both visual and infrared ranges. (3) Relationships between time and space will be more widely understood. Space buoys orbiting the sun will contain atomic clocks and transmit time signals to supplement electro-optical observation of planetary positions in the star field for accurate interplanetary navigation.

ENGINEERING EMPLOYMENT

NEW APPROACH TO ENGINEER UNIONIZATION will probably result from the foldup of the Engineers and Scientists of America. Union's attempt to emphasize professionalism made the union rather ineffective. New approach will probably welcome technicians and emphasize new organizing techniques.

WE SEE INCREASED EFFORTS in the missile industry to step-up use of automatic program tooling systems. Successful effort could cut off years in the development of special tools.

YOU HEAR A LOT these days about recession, distressed areas, unemployment, etc. Latest information coming our way indicates that engineers—especially electronic engineers—are virtually unaffected by these problems. Dr. Ingram, chairman of EJC, points out three buffers that work for the engineer: the engineer shortage; the technological complexities of today's living, and demands of the military. EJC's Engineering Manpower Commission points out that the overall median salary is now $9,600. Seven years ago it was $6,500. Engineers do have employment problems though. For example: the way contracts shift from company to company, the engineer (to remain employed) must be somewhat of a nomad. Complaints are also coming in that military contracts are being concentrated in certain areas of the country (West Coast). Senator J. M. Butler (R-Md.) says that California holds 26% of *all* military prime contracts and 31% of military prime contracts for R & D. Standard argument against this trend is the need for dispersal of plant in an atomic age.

SEAGOING RADAR

This 10-ton seagoing radar, built by Raytheon, is for use aboard Navy picket ships and cruisers. The 40-ft. aluminum antenna, an ensemble of 150 horns, can rotate 360°. The AN/SPS-38 will give earlier warning of air attack and is designed to baffle enemy attempts to jam it.

+125°C

NEW ! Etched and Plain Foil Single-Case Tantalex® Capacitors in Both Polar and Non-Polar Designs

When you specify *Sprague*, you pay no penalty in size and weight because of an extra outer shell on 125°C tubular foil tantalum capacitors!

Sprague's new family of foil Tantalex capacitors for 125°C operation uses only a single case. An improved end-seal construction does away with the need for a supplementary second outer case.

Manufactured to exceed the performance requirements of Military Specification MIL-C-3965B, this new series of capacitors sets new standards of reliability for all types of military and industrial applications.

Polarized capacitors are available under the designation Type 120D in plain foil construction and Type 122D in etched foil construction, while non-polarized units are listed as Type 121D in plain foil and Type 123D in etched foil designs.

These outstanding new Tantalex capacitors are available promptly in production quantities. If you need small quantities overnight, key Sprague industrial distributors stock the more popular items in the Type 120D and 121D plain-foil designs. Non-standard ratings are also available for special applications.

For complete technical data on these new Tantalex capacitors, write for Engineering Bulletin 3602A to Technical Literature Section, Sprague Electric Company, 233 Marshall Street, North Adams, Mass.

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See us at the I.R.E. Show—Booths 2416-2424

Circle 2 on Inquiry Card

As We Go To Press . . .

New GE Space Simulator Checks Full-Size Rockets

GE is building a $6,000,000 space simulator that duplicates space conditions for testing full-size space vehicles. A special solar system is included which provides a large size collimated sun source.

The "cold sun" effect will be achieved by a 22-ft. mirror. It will beam energy on a test vehicle but will deflect all energy transmitted toward it to cryogenic walls.

The simulator will be 32 ft. in dia. and 54 ft. high. It will allow testing operation of full-size space vehicles and their equipment in an accessible location and under controlled conditions prior to actual space launchings.

The energy source will transmit up to 140 watts/ft^2 in a uniform beam 20 ft. in dia. The artificial sun will appear to be the same distance away from the earth as the real sun. Max. reduction of pressure inside the vessel will be 10^{-9} mm Hg.

One of the first vehicles to be tested is the Project Advent communication satellite. Among unknowns to be probed in simulator research will be the behavior of metals, operation of electronic equipment and solar collectors, and the thermal balance of vehicles.

ITT Makes Statement on Nuclear Fusion Process

Reports that ITT's Fort Wayne labs are working on a low-cost nuclear fusion process that shows promise have prompted ITT's Dr. Philo T. Farnsworth to make this statement:

"It is true that we have been working for a number of years on a low-cost nuclear fusion process and that our current experiments indeed show encouraging promise. However, the final results of these experiments may not be known for some time, but if the conclusions do confirm the present results, they would be important to the future of the company. It is desirable to point out that even these successful results, if confirmed, would be several years in being reflected in products and earnings of ITT."

SPACE ANTENNAS

E. Blasi, P. Kennedy, Lenny Gutierrez, and R. Hoddle, Lockheed's Missile & Space Division, examine inflatable aluminum foil and plastic bag antennas designed for use with space vehicles. 6 psi is needed to inflate the antennas.

FCC OK's Relay Satellite Study By American T & T

AT&T has FCC permission to operate experimental (research) radio stations for basic earth-satellite communication study. A fixed station at Holmdel, N. J., will transmit to and receive from as many as six satellites.

The Company will investigate space transmissions of voice and TV signals as well as various kinds of data and other communications. No commercial service is intended or permitted.

The cost of the transmitters, antennae, power supplies, and associated equipment will be borne by AT&T. The launching of the satellites will be handled by NASA on an actual cost basis. The cost of launching a single satellite for this purpose has been estimated at approx. $3,000,000.

A fixed station at Holmdel, N. J. will operate on 6325-6425 MC with 3 kw into the antenna. The satellite stations will use 4100-4200 MC at 5 watts.

Join Two Space Vehicles

NASA is studying the possibility of joining two space vehicles together while they are in earth orbit. Vehicles under consideration are the Thor-Agena B and Atlas-Agena B.

U. S., Russia and TE

Richard Petritz of Texas Instruments Incorporated, Dallas, Texas, told the recent Thermoelectric Energy Conversion Symposium in Dallas that the U. S. was far ahead of Russia in thermoelectric fabrication and device work.

NEMA Forms New Section On Unconventional Power

The National Electrical Manufacturers Association has formed a new Unconventional Power Generation Section. Scope will include: magneto - hydrodynamics (MHD); thermoelectrics; thermionics; batteries; photovoltaics; and photochemicals.

Dr. Manfred Altman, GE Consulting Engineer, heads a 5-man Program Committee which will prepare recommendations concerning proposed Section activities. Initial projects will probably deal with government contracts and developing standards for basic terms, definitions, and tests.

Study Manned Space Shots

The possible launching of manned exploratory expeditions into lunar and interplanetary space from earth orbits will be studied under two recently awarded NASA contracts. The two 6-month studies will be made by Douglas Aircraft Co., Santa Monica, Calif., and Vought Astronautics, Dallas, Tex.

The studies will provide NASA with data on costs, research and development programs, requirements for earth-based facilities and earth launchings necessary for initiating and sustaining orbital launch operations.

MISSILE CAR

First missile-firing railroad car for the AF's Minuteman ICBM receives finishing touches at ACF Industries' Berwick, Pa., plant. Boeing Co. will install launching gear.

New Science Advisor

President Kennedy's new Special Assistant for Science and Technology is Dr. Jerome B. Weisner, director of Massachusetts Institute of Technology's research laboratory for electronics.

More News on Page 8

Electronic SHORTS

▶ General Atronics Corp., Bala-Cynwyd, Pa., has presented a mathematical study on "enhanced accuracy radar" to the U.S.A.F. According to the theory, apparatus can be designed for making direct measurements of the speed, acceleration, and spin of targets from their radar echo. Equipment could also determine if the target is single or multiple.

▶ Computer Equipment Corp., Los Angeles, has delivered their first radar quantizer, a missile tracking device, to the Army Ordnance Corps. It will be used in a system capable of three-dimensional tracking of missiles, in flight, with a position plot resolution of ± 2½ ft.

▶ Convair (Astronautics) Div., General Dynamics Corp., San Diego, will build three experimental satellite payloads to investigate deep space conditions. The payloads, to supply supporting data for future military space programs, will be launched into orbits 22,000 mi. above the earth. Results expected: determination of the effects of exposure at very high altitudes—and for a long period of time—on materials, components, and subsystems.

▶ Republic Aviation Corp., Farmingdale, N. Y., has an ultra-high speed electronic data recording and processing system that analyzes in 2 hrs. flight test data that formerly took 2 weeks. The system, designed and built by Epsco, Inc., Cambridge, Mass., is being used in the F-105-D fighter bomber program.

▶ Electronic medical data will give doctors a direct physical report on America's first astronaut as he orbits the globe in the Project Mercury capsule. Bendix Corp.'s Bendix-Pacific Div., is developing equipment to telemeter the spaceman's pulse, temperature, respiration, oxygen consumption, etc., to earth.

▶ General Electric engineers are combining thermoelectric and thermionic converters to get more output from these unconventional power generators. GE's Power Tube Dept. has experimentally operated a thermoelectric generator on the waste heat rejected by a thermionic converter.

▶ An artificial mouth, acoustically similar to a human mouth, is aiding engineers at ITT to design better telephones. It produces the same pattern of sound waves around a telephone as that produced when sound waves bounce back and forth between a telephone and a human face. Measurement techniques are so sensitive that they can tell whether a person is wearing glasses when speaking on the telephone.

▶ Computers which now "talk" to each other in elementary language will be developed in 1961 to the "talk, think, and act" stage, says Kin Tel's E. T. Clare. He sees the development of large technical information storage centers in major U. S. Cities. Technical information will be received, stored, digested, translated, and transmitted for use by universities, engineers, scientists, etc.

▶ F. G. von Saurma of the George C. Marshall Space Flight Center, NASA, has been issued a patent for a device designed to use rocket power for accurate cargo delivery. The "rocopter" combines a rocket booster with a rotary-winged compartment capable of traveling in space and air.

▶ NASA has contracted with Electro-Optical Systems, Inc., Pasadena, Calif., for two R & D studies. One is for advanced condensing techniques for space vehicle heat rejection systems. The other is for the design and development of ultra-lightweight solar concentrators for use with solar power systems.

▶ Hughes Aircraft Co.'s flight test division is developing (for the Air Force) a micro-miniature instrumentation packet to measure man's physiological responses during space flight. It will make 12 measurements, including heart reactions, skin temp. and reaction rate.

▶ General Electric Co.'s Missile & Space Vehicle Dept., Phila., Pa., is looking for new materials that can store heat collected from the sun. The material is needed for producing electrical power in satellites (with thermionic converters) while they pass through dark periods in their orbit. They are also looking for a high temperature material to contain the heat-collecting material. NASA let the $200,000 contract.

As We Go To Press (cont.)

Cockpit Voice Recorder Proved Effective By FAA

The FAA's Bureau of Research and Development has shown the feasibility of recording crew conversations (as an aid to accident investigation) in transport type aircraft amid ambient noise levels. The tests show that recordings can be effectively made with special filters at variable distances.

A report on the experiment concludes that "an area pickup microphone with a cardioid pattern" will serve as a satisfactory device for recording crew conversations. The report states that "sophisticated mounting techniques" are not necessary for mounting the area pick-up type microphone in the cockpit.

MISSILE STAND-IN

Missile monitoring station built into a Convair 240 twin-engine transport, "hears" and "talks" like a missile in flight. The planes have been converted into airborne stations for frequency monitoring and interference control (FMIC). Plane has 49 antennas. Engineer is William Garcia, Convair's project engineer.

Fuel Cells Evaluated

An Air Force research report (PB 161 972) evaluates six types of fuel cells that have proved feasible as electrical energy sources. Tests were conducted on these cells: electrolyte, molten salt electrolyte, consumable electrode, ion-exchange electrolyte, chemical regenerative (redox), and thermal regenerative.

Copies are available ($0.50) from, Office of Technical Services, Business and Defense Services Administration, U. S. Dept. of Commerce, Washington 25, D. C.

Mach 5...Mach 10...and Beyond

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* 6°F is difference between maximum open and minimum close.

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Coming Events in the electronic industry

Mar. 1: Machine Design Conf., Cleveland Eng'g Soc., Machine Design Div.; Cleveland Eng'g & Scientific Center, Cleveland, Ohio.

Mar. 1-2: Annual Tech. Symp., Soc. of Vacuum Coaters; Conrad Hilton Hotel, Chicago, Ill.

Mar. 6-8: 7th Annual Data Processing Conf. & Exh.. American Management Assoc.; Statler-Hilton Hotel, N. Y.

Mar. 8-10: 11th Annual Conf. on Instrumentation for the Iron & Steel Industry, ISA; Roosevelt Hotel, Pittsburgh, Pa.

Mar. 9-10: Symp. on Eng'g Aspects of Magnetohydrodynamics, IRE, AIEE, IAS; Univ. of Penna., Phila., Pa.

Mar. 9-10: Nat'l Flight Propulsion Mtg. (Classified); Cleveland, Ohio.

Mar. 9-14: 3rd Int'l Audio Hi-Fi and Stereo Exh., Federation Nationale des Industries Electroniques, and Syndicat des Industries Electroniques de Reproduction et d'Enregistrement; Palais d'Orsay, Paris, France.

Mar. 12-16: Aviation Conf., ASME; Statler-Hilton Hotel, Los Angeles, Calif.

Mar. 13-15: Testing Conf., ARS; Biltmore Hotel, Los Angeles, Calif.

Mar. 15: Committee & Section Mtg. EIA; Statler-Hilton Hotel, Washington, D. C.

Mar. 15-16: ASTME Plastics Tooling Seminar — Tech. Mtg. and Plant Tour, ASME, SPE; Statler-Hilton Hotel, Detroit, Mich.

Mar. 16: Div. Exec. Comm. Mtgs. (Reception & Government-Industry Dinner); EIA; Statler-Hilton Hotel, Washington, D. C.

Mar. 19-21: Northwest Reg. Conf., Nat'l Assoc. of Music Merchants; Hotel Benson, Portland, Ore.

Mar. 20-23: IRE Int'l Conv., IRE; Coliseum & Waldorf Astoria Hotel, New York, N. Y.

Mar. 20-24: 12th Western Metal Congress & Expos., ASM; Pan-Pacific Audit. & Ambassador Hotel, Los Angeles, Calif.

Mar. 21: 10th Annual SSB Dinner and Hamfest, SSB Amateur Radio Assoc.; Hotel Statler-Hilton, New York, N. Y.

Mar. 21-23: 23rd Annual American Power Conf., Illinois Inst. of Tech., ASME, AIEE, WSE, NAPE, ASCE, ASHR&ACE; Hotel Sherman, Chicago, Ill.

Mar. 21-25: Electrical Engineers Exhib.; Earl's Court, London, S.W. 5, England.

Mar. 24-25: ARRL Michigan State Conv., ARRL; Wanona Hotel, Bay City, Mich.

Mar. 27-28: Conf. on Mathematics and Statistics for Reliability Problems, Electronics Div. of ASQC & Section on Eng'g and Physical Sciences, ASA; New York Univ., New York, N. Y.

Mar. 27-29: 15th Anniv. of Advertising Essentials & National Sales Aids Show, Advertising Trades Inst.; Hotel Biltmore, New York, N. Y.

Mar. 27-31: 4th Symp. on Temp—Its Measurement & Control in Science & Industry, ISA, AIP, NBS; Veterans Memorial Bldg. & Deshler-Hilton Hotel, Columbus, Ohio.

Mar. 29: Annual Conf., Tech. Societies Council of N. J.; Hotel Robert Treat, Newark, N. J.

IRE
International Convention
(Convention
March 20-23)

For complete pre-convention coverage turn to page 123

Apr. 4-6: 10th Annual Mtg. & Conf., Nat'l Microfilm Assoc.; Sherman Hotel, Chicago, Ill.

Apr. 4-6: Int'l Symp. on Electromagnetics and Fluid Dynamics of Gaseous Plasma, Polytechnic Inst. of Brooklyn; Auditorium of Engineering Societies Bldg., 33 W. 39th St., New York, N. Y.

Apr. 4-7: West Coast Spring Conf. & High Fidelity Show, Audio Eng'g Soc., Inst. of High Fidelity Manufacturers; Ambassador Hotel, Los Angeles, Calif.

Apr. 5: Dental TV Teaching Inst., Council on Medical TV; Clinical Center, Nat'l Inst. of Health, Bethesda, Md.

Apr. 5-7: Lifting Reentry Vehicles; Structures, Materials & Design Conf., ARS; El Mirador Hotel, Palm Springs, Calif.

Apr. 5-7: South East District Mtg., AIEE; Jung Hotel, New Orleans, La.

Apr. 5-7: Symp. on Materials and Electron Device Processing, ASTM Committee F-1 on Materials for Electron Tubes and Semiconductor Devices; Benj. Franklin Hotel, Phila., Pa.

Apr. 5-7: Mtg., Radio Tech. Comm. for Marine Services; Sheraton-Palace Hotel, San Francisco, Calif.

Apr. 5-7: Annual Conv., Inst. of Environmental Sciences; Hotel Sheraton Park, Washington, D. C.

Apr. 6-7: Management Eng'g Conf., ASME, SAM; Statler Hilton Hotel, New York, N. Y.

Apr. 8-9: ARRL Southeastern Div. Conv., American Radio Relay League; Cherry Plaza Hotel, Orlando, Fla.

Apr. 10-12: 44th Nat'l Open Hearth Steel Conf. & Blast Furnace, Coke Oven and Raw Material Conf., AIME; Sheraton Hotel, Phila., Pa.

Apr. 10-19: Annual Assembly of Int'l Inst. of Welding, AWS Sheraton-Atlantic Hotel, New York, N. Y.

Apr. 11-13: 33rd Annual Conv., Petroleum Electrical Supply Assoc. & Petroleum Industry Electrical Assoc.; Moody Center, Galveston, Tex.

Apr. 11-13: Conf. on Ultrapurification of Semiconductor Materials, AFRD, AR&DC, USAF; New England Mutual Hall, Boston, Mass.

Apr. 12-13: 15th Annual Spring Tech. Conf., "Electronic Data Processing," IRE (Cincinnati Sec.), ARS (S. Ohio Sect.); Hotel Alms, Cincinnati, Ohio.

"CALL FOR PAPERS"

Radio Tech. Commission for Marine Services Meeting, Apr. 5-7, Sheraton Palace Hotel, San Francisco, Calif. Deadline date for papers: Mar. 15, 1961. Forward to: G. R. McLeod, Exec. Sec'y, RTCM, c/o FCC, Wash. 25, D. C.

9th National Conf. on Electromagnetic Relays, Apr. 25-27, Oklahoma State Univ., Student Union Bldg., Stillwater, Okla. Deadline for all papers: Mar. 1, 1961. Forward to: Prof. Charles F. Cameron, School of Electrical Engineering.

Meeting, Acoustical Society of America, May 11-13, 1961. Deadline date for Abstracts: 10 weeks before meeting date. Contact: Chairman, Mones Hawley, RCA, Moorestown, N. J.

Meeting, Armed Forces Communications & Electronics Assoc., June 6-8, 1961. Sheraton - Park Hotel, Wash., D. C. Deadline for papers: Mar. 2, 1961.

1961 International Conf., The 4th International Conf. on Medical Electronics combined with The 14th Annual Conf. on Electrical Techniques in Medicine and Biology, July 16-21, 1961, The Waldorf-Astoria, N. Y., N. Y. The Joint Executive Committee on Medicine and Biology (IRE-AIEE-ISA) submit Abstracts of 300 words for preliminary review and 50-word Summary for inclusion in an Advance Program before Apr. 1, 1961. Six-hundred to 1000-word Digests to appear in Conference Digest must be received by Program Committee before May

(*Continued on page* 12)

HIGHLIGHTS OF 1961

Mar. 20-23: IRE Int'l Conv., IRE; Coliseum & Waldorf-Astoria Hotel, New York, N. Y.

Apr. 17-19: Annual General Session of JEDEC; Hotel Syracuse, Syracuse, N. Y.

Apr. 19-21: SWIRECO — S.W. IRE Regional Conf. & Elec. Show, IRE (Region 6); Dallas, Tex.

May 8-10: NAECON (Nat'l Aeronautical Electronics Conf., IRE (PGANE) (Dayton Sec.); Miami & Dayton Biltmore Hotels, Dayton, Ohio.

May 9-11: Western Joint Computer Conf., IRE (PGEC), AIEE, ACM; Ambassador Hotel, Los Angeles, Calif.

May 22-24: 5th Nat'l Symp. on Global Communications (GLOBECOM V), IRE (PGCS), AIEE; Sherman Hotel, Chicago, Ill.

May 22-24: Nat'l Telemetering Conf., IAS, IRE, AIEE, ARS, ISA: Sheraton-Towers Hotel, Chicago, Ill.

June 28-30: Joint Automatic Control Conf., IRE, AIEE, ASME, ISA, AIChE; Univ. of Colorado, Boulder, Colo.

Aug. 22-25: WESCON: Western Electronic Show & Convention, WEMA, IRE (L.A. & S.F. Sect.); Cow Palace, San Francisco, Calif.

Oct. 9-11: Nat'l Electronics Conf. (NEC), IRE, AIEE, EIA, SMPTE; Amphitheatre, Sherman Hotel, Chicago, Ill.

Oct. 30-Nov. 1: Radio Fall Meeting, EIA, IRE; Hotel Syracuse, Syracuse, N. Y.

Nov. 14-16: MAECON (Mid-America Elec. Conf., IRE (Kansas City Sect.); Kansas City, Mo.

Nov. 14-16: N. E. Res. & Eng. Mtg. (NEREM), IRE (Region 1); Boston, Mass.

Dec. 3-7: Eastern Joint Computer Conf., IRE (PGEC), AIEE, ACM; Sheraton-Park Hotel, Washington, D. C.

Abbreviations

AIEE—American Institute of Electrical Engineers
AIP—American Institute of Physics
ARRL—American Radio Relay League
ARS—American Rocket Society
ASA—American Statistical Association
ASCE—American Society of Civil Engineers
ASHR&ACE—American Society of Heating, Refrigeration & Air Conditioning Engineers
ASM—American Society for Metals
ASME—American Society for Mechanical Engineers
ASQC—American Society for Quality Control
EIA—Electronic Industries Association
IRE—Institute of Radio Engineers
ISA—Instrument Society of America
NAPE—National Association of Power Engineers
NBS—National Bureau of Standards
SPE—Society of Plastics Engineers
SSB—Single Side Band
WSE—Western Society of Engineers

PULSE-FORMING NETWORKS

FROM WATTS

to MEGAWATTS

... and everything in between!

When it comes to pulse capacitors and pulse-forming networks, many complexities in parameters and design factors must be considered. These specialized units must be designed and manufactured by a specialized organization. And because Sprague maintains a highly-technical special engineering section devoted exclusively to pulse capacitors and networks, it has been, from the very beginning, a major supplier of these complex units for radar equipment (ground, marine, aircraft, missile), tube testing, and similar pulse circuit applications.

This special engineering section performs four important functions: One group *designs* custom units in accordance with required parameters. Another group *builds* pulse capacitors and networks to these precise specifications. In another area, a group of specially-trained field engineers *provides application assistance* wherever needed. And yet another independent group *works toward the future* developing new materials, new design concepts, and new techniques for manufacture.

This concentration on pulse capacitors and pulse-forming networks has enabled Sprague to introduce product improvements such as heliarc sealing of cases, rugged alumina bushing assemblies, Fabmika® dielectric, and improved hermetic sealing of closures.

Save time and money by working with Sprague from the start. Application engineering services are available to you without obligation.

Write for Engineering Bulletin No. 10,001 to Technical Literature Section, Sprague Electric Co., 233 Marshall Street, North Adams, Massachusetts.

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HIGH TEMPERATURE MAGNET WIRE • CERAMIC-BASE PRINTED NETWORKS • PACKAGED COMPONENT ASSEMBLIES • FUNCTIONAL DIGITAL CIRCUITS

See us at the IRE Show—Booths 2416-2424

As We Go To Press . . .

NAB Seeks Change In Automatic Logger Rule

The National Association of Broadcasters is asking the FCC to permit use of electronic recording devices for logging operational measurements of radio and TV stations.

Under present FCC rules, transmitter and antenna parameters such as output current, plate current, plane voltage, frequency deviation, current amplitude ratios between transmitter towers, obstruction lighting, operating hours, and variences in transmitter operation are logged manually.

NAB contends that improperly maintained operating logs constitute the largest number of FCC rules violations. Automatic loggers would eliminate these.

Project Relay Briefing

NASA has outlined specs for a low altitude communication satellite, Project Relay. It's purpose is to demonstrate the feasibility of basic concepts and technological approaches and to evaluate the various systems to be used in communications satellites.

First launch will be about mid-1962. Wideband communications signals will be transmitted between the east coast of the U. S. and western Europe. The payload will carry instruments to detect radiation damage and other environmental effects on critical components such as solar cells as it passes through the Van Allen radiation Belts.

PUSH-BUTTON 'TALKER'

Communications device built by Hughes Aircraft Co. lets jet pilot "talk" to his base by punching indicated panels. Engineer Robert J. Harris demonstrates panel. Communications are twice as fast as normal and can penetrate heavy electrical interference.

EIA Asks For Delay In Safety Standards Rule

The Electronic Industries Association has asked the Secretary of Labor, Arthur J. Goldberg, to delay the effective date of the Labor Department's new minimum standards for health and safety. The delay (three months) would give industry time to comment. No public hearings were held prior to publication of the new regulations.

EIA is concerned that: "regulations might create a 'double standard' requiring plant operators to adhere to safety and health rules of both federal and state governments." Also, "they may overlap collective bargaining contracts . . . many of which contain safety and health measures."

EIA also believes: "there is a real possibility that compliance with these standards may result in increased costs to contractors now performing under contracts with the government with no provision for adjusting prices to compensate for increased costs." The association feels that this might do "serious harm" to the government's small business program.

RCA Makes Speed-of-Light Circuits for Computers

Basic circuitry operating at speeds approaching that of light has been devised by the Radio Corp. of America. Circuitry is for a new ultra swift electronic computer for the Navy.

The designs, using tunnel diodes, were developed through joint efforts of the David Sarnoff Research Center (Princeton, N. J.) and the Semiconductor and Materials Div. (Somerville, N. J.).

ARTRON—Electronic Nerve Cell Planned

An electronic nerve cell (ARTRON for artificial neuron) with the power to simulate elementary thought processes will be built by Melpar, Inc. The cell will "learn" as a result of reward and punishment signals. Project also calls for digital computer simulation of a network of these cells including self-generation of the reward and punish signals.

The contract comes from WADD's Bionics Computer Branch of the Electronics Technology Laboratory.

Work on Soft Landing Lunar Spacecraft

NASA has chosen Hughes Aircraft Co. to build a soft landing lunar spacecraft called "Surveyor." It will land gently on the moon, perform chemical analyses of the lunar surface and subsurface, and relay back to earth TV pictures of lunar features.

Plans call for 7 Surveyors to be launched to the moon in the period 1963 to 1966. Cal Tech's Jet Propulsion Laboratory will provide technical direction for the $50 million program.

GEODETIC SYSTEM

Transit IIIB satellite will carry a 7-lb. transmitter-receiver which will give accurate data on the relative locations of continents, cities, islands, and other landmarks around the globe. Cubic Corp. makes the transponder.

FM Boom to Continue

"Sales of FM radio sets in 1961 will be the greatest in history, exceeding by 30 to 40% the estimated 1,000,000 sold in 1960," says H. Fogel, President of Granco Products, Inc., Kew Gardens, N. Y. "In addition, the industry expects the FCC to permit FM stereophonic broadcasting, which will be one of the most significant advances in the coming year."

Form American-Canadian Data Processing Group

American and Canadian companies in the computer and punched-card service field have formed the Association of Data Processing Service Organizations (ADAPSO).

The members are companies which service clients through data processing centers, as distinct from companies which make, rent, or sell computers. Headquarters is at 1000 Highland Ave., Abington, Pa.

New President of the association is Romuald Slimak, Manager of Remington Rand Univac Service Centers. Vice President is Z. V. Zakarian, New York Electronic Systems Center, RCA. Treasurer is C. G. Green, Statistical Reporting & Tabulating, Ltd., Toronto.

HST* TRANSFORMERS

Type SMH
Ultimate in space and weight saving. Hermetically sealed to meet MIL-T-27A specifications. Frequency range 30-10,000 cps maximum levels to 30 mw. Designed to meet the most stringent applications.

Type TAF
Encased in special material formed into rugged deep drawn cases that afford maximum magnetic shielding. Excellent fidelity for levels to 10 mw. Wide frequency range is consistently achieved. Meet all MIL-T-27A specifications.

Type MH
Designed to meet MIL-T-27A specifications for speech circuit applications including transistorized optimum response from low to high frequency. Maximum power ranges to 100 mw. Hermetically sealed.

Type SMO
SMO open construction affords maximum flexibility in both electrical and mechanical considerations. Though subminiaturized these units exhibit unusually high efficiency and wide frequency response. New design leads to greater dependability and higher performance.

24 Hour Delivery from ARCO

Type SS
Fills need for an economical, compact, quality transformer. Weighs one ounce yet is fully impregnated and sealed in a drawn aluminum case. Ideal for portable broadcast, aircraft, mobile service, etc. High fidelity characteristics are provided uniform within approximately 1 db from 30 to 20,000 cycles.

Type SSM
This popular series is designed to handle higher levels than the SMO units yet retain the high performance characteristics exhibited by that series. Available as a hermetically sealed unit (encasement is identical to the SMH series).

Type TT
Built and tested to meet MIL-T-27A specifications, for altitudes up to 50,000 ft. Ideally suited for transistor circuits. In addition, frequency response ratings are based on military specifications. The exceptional reliability and low distortion characteristics combine for excellent performance.

Complete stocks are available from ALL Arco branches or from any Arco-HST Industrial Distributor for instant shipment upon receipt of order. Required material is prepared minutes after your request is received. Arco's branches in Dallas and Los Angeles eliminate any delay in shipping time from the East to West coast.

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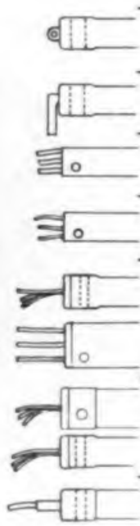
Circle 98 on Inquiry Card →

DALE

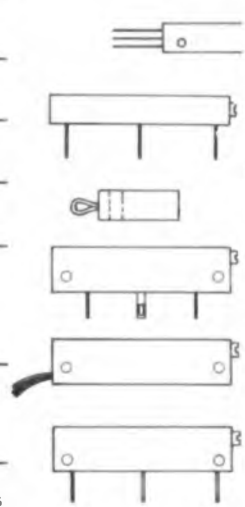
TRIMMER POTENTIOMETER SPECI

PART NUMBER	TOLERANCE	RESISTANCE RANGE	HUMIDITY PROOF	POWER RATING	RESOLUTION DEPENDING ON VALUE
199 and A10W	± 5%	10 Ohms to 50K Ohms	NO	.8 Watt	.12% to 1.2%
198 and A10WPC	± 5%	10 Ohms to 50K Ohms		.8 Watt	.12% to 1.2%
195 and A10WML	± 5%	10 Ohms to 50K Ohms		.8 Watt	.12% to 1.2%
194 and A10WML-1	± 5%	10 Ohms to 50K Ohms		.8 Watt	.12% to 1.2%
193 and A10WL	± 5%	10 Ohms to 50K Ohms		.8 Watt	.12% to 1.2%
299 and B11W	±10%	10 Ohms to 50K Ohms	NO	.5 Watt	.12% to 1.2%
298 and B11WPC	±10%	10 Ohms to 50K Ohms		.5 Watt	.12% to 1.2%
295 and B11WML	±10%	10 Ohms to 50K Ohms		.5 Watt	.12% to 1.2%
294 and B11WML-1	±10%	10 Ohms to 50K Ohms		.5 Watt	.12% to 1.2%
293 and B11WL	±10%	10 Ohms to 50K Ohms		.5 Watt	.12% to 1.2%
399 and C12W	±15%	100 Ohms to 20K Ohms	NO	.25 Watt	.6% to 1.2%
398 and C12WPC	±15%	100 Ohms to 20K Ohms		.25 Watt	.6% to 1.2%
697 and 750WL-1	± 5%	10 Ohms to 30K Ohms	YES	1 Watt	.23% to 1.82%
692 and 750W	± 5%	10 Ohms to 30K Ohms		1 Watt	.23% to 1.82%
691 and 750WP	± 5%	10 Ohms to 30K Ohms		1 Watt	.23% to 1.82%
690 and 750WT	± 5%	10 Ohms to 30K Ohms		1 Watt	.23% to 1.82%
686 and 751WL	± 5%	10 Ohms to 30K Ohms		1 Watt	.23% to 1.82%
685 and 751W	± 5%	10 Ohms to 30K Ohms		1 Watt	.23% to 1.82%
684 and 751 WT	± 5%	10 Ohms to 30K Ohms		1 Watt	.23% to 1.82%
683	± 5%	10 Ohms to 30K Ohms		1 Watt	.23% to 1.82%
997	± 5%	10 Ohms to 30K Ohms	YES	1 Watt	.23% to 1.82%
996	± 5%	10 Ohms to 30K Ohms		1 Watt	.23% to 1.82%
983	± 5%	10 Ohms to 30K Ohms		1 Watt	.23% to 1.82%
1289	± 5%	10 Ohms to 50K Ohms	YES	1 Watt	.12% to 1.13%
1288	± 5%	10 Ohms to 50K Ohms		1 Watt	.12% to 1.13%
1287	± 5%	10 Ohms to 50K Ohms		1 Watt	.12% to 1.13%
1597 and 1000-WL-1	± 5%	10 Ohms to 50K Ohms	YES	1 Watt	.12% to 1.13%
1592 and 1000W	± 5%	10 Ohms to 50K Ohms		1 Watt	.12% to 1.13%
1591 and 1000WP	± 5%	10 Ohms to 50K Ohms		1 Watt	.12% to 1.13%
1590 and 1000WT	± 5%	10 Ohms to 50K Ohms		1 Watt	.12% to 1.13%
1586 and 1001WL	± 5%	10 Ohms to 50K Ohms		1 Watt	.12% to 1.13%
1585 and 1001W	± 5%	10 Ohms to 50K Ohms		1 Watt	.12% to 1.13%
1584 and 1001WT	± 5%	10 Ohms to 50K Ohms		1 Watt	.12% to 1.13%
1583	± 5%	10 Ohms to 50K Ohms		1 Watt	.12% to 1.13%
1580	± 5%	10 Ohms to 50K Ohms		1 Watt	.12% to 1.13%
5050	± 5%	100 Ohms to 50K Ohms	YES	1 Watt	.10% to .72%

TERMINAL CONFIGURATIONS



NUMBER	
99	Solder Lug
98	Printed Circuit Solder Lug
97	28 Awg Stranded Teflon Leads
96	30 Awg Stranded Teflon Leads
95	Molded Cap 28 Awg Stranded Vinyl Leads Emerging Separately
94	Molded Cap 28 Awg Stranded Vinyl Leads Emerging as a Group
93	28 Awg Stranded Vinyl Leads Attached to 99 Style Solder Lugs

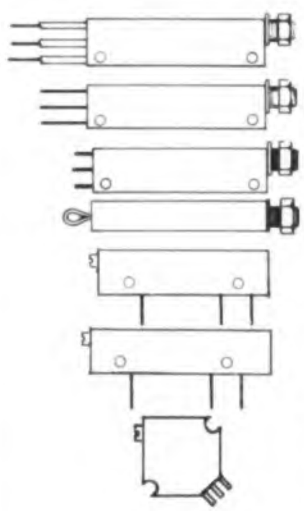


NU
92
91
90
89
88
87

…IFICATION SUMMARY

MAXIMUM OPERATING TEMP (°C.)	CASE DIMENSIONS WIDTH	HEIGHT	LENGTH	MOUNTING HOLE CENTERS	MECHANICAL ADJUST[illegible] turns
135°	.310	.220	1.250	1.000	25
135°	.310	.220	1.250	1.000	25
135°	.310	.220	1.320	1.000	25
135°	.310	.220	1.320	1.000	25
135°	.310	.220	1.250	1.000	25
105°	.310	.220	1.250	1.000	25
105°	.310	.220	1.250	1.000	25
105°	.310	.220	1.320	1.000	25
105°	.310	.220	1.320	1.000	25
105°	.310	.220	1.250	1.000	25
85°	.310	.220	1.250	1.000	25
85°	.310	.220	1.250	1.000	25
175°	.300	.180	1.000	.750	17
175°	.300	.180	1.000	.750	17
175°	.300	.180	1.000	P.C.	17
175°	.300	.180	1.000	.750	17
175°	.300	.180	1.000	Panel	17
175°	.300	.180	1.000	Panel	17
175°	.300	.180	1.000	Panel	17
175°	.300	.180	1.000	P.C.	17
175°	[illegible]	.180	1.000	.750	17
175°	.300	.180	1.000	.750	17
175°	.300	.180	1.000	P.C.	17
150°	.280	.310	1.250	1.000	25
150°	.280	.310	1.250	1.000	25
150°	.280	.310	1.250	P.C.	25
175°	.300	.180	1.250	1.000	25
175°	.300	.180	1.250	1.000	25
175°	.300	.180	1.250	P.C.	25
175°	.300	.180	1.250	1.000	25
175°	.300	.180	1.250	Panel	25
175°	.300	.180	1.250	Panel	25
175°	.300	.180	1.250	Panel	25
175°	.300	.180	1.250	P.C.	25
175°	.300	.180	1.250	P.C.	[illegible]
150°	.500	.190	.500	.520	25

NUMBER	
92	26 Awg Solid Wire Leads
91	Printed Circuit Pins 22 Awg
90	Hook Type Wire Solder Terminal
89	Solder Lug
88	30 Awg Stranded Teflon Leads
87	Printed Circuit Pins 21 Awg



NUMBER	
86	Panel Mounted Style with 28 Awg Stranded Teflon Leads
85	Panel Mounted Style with 26 Awg Solid Wire Leads
84	Panel Mounted Style with Hook Type Wire Solder Terminal
83	Printed Circuit Pins 22 Awg
80	Printed Circuit Pins 22 Awg
50	30 Awg Stranded Teflon Leads

ADVANCED DESIGN Illustrated by HIGH PERFORMANCE

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SERIES 1200 T-POT

ENLARGED CUTAWAY ILLUSTRATION
Four Times Actual Size

1. Welded termination
2. Longer winding mandrel (ceramic) giving better resolution, better heat dissipation, higher values and allows use of larger wire diameter
3. Lightweight precious metal wiper with low weight-pressure ratio provides best performance under vibration and shock
4. "O" ring seal provides protection against humidity, dust and salt spray
5. Thrust spring maintains constant position of lead screw eliminating lead screw backlash
6. Polished stainless steel lead screw is ultrasonically polished for smooth operation and long rotational life
7. Collector provides dual current path for improved reliability and low rotational noise level
8. Wide selection of terminal configurations is available to meet any requirements

A DALE T-POT TO MEET EVERY DEMAND

DALE SERIES 1200 WIRE WOUND
A miniature (.280" x .310" x 1.250"), humidity proof, precision T-Pot with welded construction throughout; three different terminal configurations for standard and printed circuit mounting; 10 to 50K ohms; 5% tolerance; 1 watt up to 85° C, derating to 0 at 150° C.

DALE SERIES 900 WIRE WOUND
A sub-miniature (.300" x .180" x 1"), humidity proof, precision T-Pot with welded construction throughout, three different terminal configurations for standard and printed circuit mounting, 10 to 30K ohms, 5% tolerance; 1 watt up to 70° C, derating to 0 at 175° C.

DALE SERIES 600 WIRE WOUND
A sub-miniature (.300" x .180" x 1"), humidity proof, precision T-Pot with welded construction throughout, eight different terminal configurations for standard, panel and printed circuit mounting, 10 to 30K ohms, 5% tolerance, 1 watt up to 70° C, derating to 0 at 175° C.

DALE SERIES 1500 WIRE WOUND
A miniature (.300" x .180" x 1.250"), humidity proof, precision T-Pot with welded construction throughout; nine different terminal configurations for standard, panel and printed circuit mounting; 10 to 50K ohms; 5% tolerance; 1 watt up to 70° C, derating to 0 at 175° C.

DALE SERIES 5000 WIRE WOUND
A new, humidity proof, precision T-Pot with new space saving square configuration (.500" x .190" x .500") and welded construction throughout; 100 to 50K ohms; 5% tolerance; 1 watt up to 70° C, derating to 0 at 150° C.

DALE SERIES 100 WIRE WOUND
A miniature, precision T-Pot, ideal for computers and laboratory type applications; five different terminal configurations for standard mounting; 10 to 50K ohms; 0.8 watt up to 70° C, derating to 0 at 135° C.

DALE SERIES 200 WIRE WOUND
A miniature T-Pot offering dependable performance in normal circuits where economy is important; five different terminal configurations for standard mounting; 10 to 50K ohms; 10% tolerance, 0.5 watt up to 70° C, derating to 0 at 105° C.

DALE SERIES 300 WIRE WOUND
A miniature T-Pot for commercial applications; two different terminal configurations for standard mounting; 100 to 20K ohms; 15% tolerance, 0.25 watt up to 70° C, derating to 0 at 85° C.

Hathaway Instruments Inc.

DALE ELECTRONICS, INC. PACIFIC DIVISION
P. O. Box 747, Burbank, Calif.
A Subsidiary of **HATHAWAY INSTRUMENTS INC.**

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Probing new dimensions in Electronics through Stackpole Research . . .

A MAJOR NEW FERRITE

FOR TELE-COMMUNICATIONS

Permeability: 1800

Temperature Constant: 1.8×10^{-6} per °C (—20° to 120° C)

Avg. Temperature Coefficient (un-gapped cores): 0.29% per °C (—20° to 85°C)

μQ (merit factor): Greater than 200,000 at 100 kc

. . . these in brief are the salient electrical characteristics of Stackpole *Ceramag 501*—a remarkable new low-loss ferrite grade for the 10 kc to 250 kc range. Already revolutionizing the design of carrier-current communications filters, the material shows considerable promise for electronic switching circuits and others as well.

Cup cores of Ceramag 501 no larger than a quarter enable the design of filters with such narrow pass bands that message-handling capacities of communications systems can be increased from 2 to over 90 messages per channel. The extraordinary high gain of filters using Ceramag 501 combine with other inherent advantages—smaller size, no aging or life problems—for a significant contribution to system reliability.

But equally significant is the extremely close tolerances to which these cores are made. To achieve the exact air gap required, Ceramag 501 cups are supplied in matched pairs. Special Stackpole-designed mounting hardware and tuning slugs can also be supplied to assure easy assembly and maximum electrical performance with your own coil designs.

Almost four years in development, Ceramag 501 represents another basic contribution based on magnetic ceramic research and engineering by the oldest commercial ferrite producer in the United States.

Complete details on Ceramag 501 and the remarkable research facilities that made it possible are available upon request to the *Electronic Components Division,* Stackpole Carbon Company, St. Marys, Pa.

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CERAMAG® FERRITE CORES • VARIABLE COMPOSITION RESISTORS • SLIDE & SNAP SWITCHES • CERAMAGNET® CERAMIC MAGNETS • FIXED COMPOSITION CAPACITORS BRUSHES FOR ALL ROTATING ELECTRICAL EQUIPMENT • ELECTRICAL CONTACTS GRAPHITE BEARINGS, SEAL RINGS, ANODES • HUNDREDS OF RELATED CARBON & GRAPHITE PRODUCTS.

News Briefs

Capsule summaries of important happenings in affairs of equipment and component manufacturers

EAST

DYNISCO INC., Cambridge, Mass., manufacturer of electro-mechanical transducers and ultrasensitive measuring instruments, has been bought by American Brake Shoe Co.

WESTREX CORP., division of Litton Industries, has established a geophysical and oceanographic instrumentation lab at its headquarters, 540 W. 58th St., New York City.

SYLVANIA ELECTRIC PRODUCTS, INC., has formed three new laboratories within the company's Amherst Engineering Laboratory. These are: An Advance Communication Systems Laboratory; a Product Development Laboratory; and a Product Engineering Laboratory.

AMERICAN MACHINE & FOUNDRY CO. is acquiring the Paragon Electric Co., Two Rivers, Wis., manufacturer of electrical timers and controls.

FOTO-VIDEO ELECTRONICS INC., Cedar Grove, N. J., is providing a closed-circuit color TV system for U. S. Air Force Headquarters, Pentagon. It will include color video tape recorders, color TV projectors for large screen observation, multiplexers, and camera heads for color slides and films.

WESTINGHOUSE ELECTRIC CORP., has an $8.3 million contract for additional production of the radar portion of the Air Missile Control System for the Navy's McDonald F4H-1 fighter plane.

SONOTONE CORP., Elmsford, N. Y., has established a special space battery facility to consolidate the design and development of the company's sealed rechargeable battery cells for space travel.

ITT LABORATORIES has joined ITT Federal Div., to form a single operating unit to be known as ITT Federal Laboratories, Div. of International Telephone & Telegraph Corp. This consolidates into one division the research and development activities carried on by the laboratories and the electronic system manufacturing and other related business performed by ITT Federal Div.

CBS ELECTRONICS is launching an expanded research and development program. Emphasis will be on promising types of semiconductors and microelectronic circuits. The company's laboratories in Stamford, Conn., will provide most of the additional R&D requirements.

CRAIG SYSTEMS, INC., Lawrence, Mass., has a subcontract from Raytheon Co. for approximately $1.3 million of ground support equipment for the U. S. Army Hawk Missile.

TENNEY ENGINEERING, INC., Union, N. J., is acquiring Harvick Mfg. Corp. and Harvick Machine Corp., Southgate, Calif. The companies will be combined and operated as one subsidiary under the name of Harvick Mfg. Corp.

LABORATORY FOR ELECTRONICS, INC., Boston, has delivered its first RD-900 random storage and display system to the U. S. Army Corps of Engineers. The system places information necessary for effective decision making during a national emergency at the fingertips of the Nation's executive staff.

WALSON ASSOCIATES, INC., Elizabeth, N. J., has established a High Vacuum Division. Engineering and production facilities of the new division will be in the company's Elizabeth plant.

LORAL ELECTRONICS CORP and **RADIATION APPLICATIONS, INC.** (both of N. Y.), have established a joint venture company, Radiation Materials, Inc. The company will investigate the development of and market for irradiated installation products such as polyolefin wire and cable.

FILTORS, INC., has purchased Seal-A-Metic, Paterson, N. J. The company makes glass to metal seals.

MIDWEST

LaPINE SCIENTIFIC CO., is the new name of Arthur S. LaPine & Co. of Chicago. The new name of the company's Eastern subsidiary, formerly Tenso-Lab, Inc., is also LaPine Scientific Co. (New York).

AMERICAN MISSILE PRODUCTS CO., INC., and **DORSET ELECTRONICS LABORATORY, INC.**, Norman, Okla., have merged.

UNIGHEE CORP., manufacturers of precision gauging equipment, have moved to a new location at 330 Interstate Rd., Addison, Ill.

WELEX, INC., of Ft. Worth and Houston, has been merged into the Haliburton Co., Gunkin, Okla. The Welex organization will be an operating division of Haliburton and will be known as Welex Div. Co.

ELECTRALAB PRINTED ELECTRONIC CORP. has established an Electrolube Div. in Detroit, Mich., to market a new electrical lubricant.

GENERAL ELECTRIC CO.'s Computer Dept., Phoenix, Ariz., has been awarded a contract by Marine Trust Co., Weston, N. Y., for two GE-210 computer systems for completely automating the bank's checking account bookkeeping. The first system is scheduled for delivery in February.

MOTOROLA, INC., is moving the company corporate headquarters to its new administration building in Franklin Park, Ill. The new $7.5 million structure, at 9401 W. Grant Ave., contains all of the company's corporate executive offices in addition to the consumer and automotive products division.

THE ZERO-MAX CO., manufacturer of variable speed drives, has moved from 1900 Lindale Ave., S., Minneapolis 5, Minn., to a new building at 2845 Harriet Ave., So., Minneapolis 8, Minn.

WEST

KIN TEL DIV., COHU ELECTRONICS, INC., San Diego, Calif., will supply closed circuit TV systems at four of the Nation's major missile bases. Initial contracts call for installations at Vandenburg AFB, Calif.; Offutt AFB, Nebr.; Warren AFB, Wyoming, and Fairchild AFB, Washington.

SYSTRON-DONNER CORP., has contracts of $560,000 from Sikorsky Aircraft Div. of United Aircraft Corp., and the Research and Advanced Development Div., Avco Corp. The contracts are for S-D designed stabilizing couplers used in all-weather helicopters.

VIDEO CORP., San Diego, has been awarded a contract by the U. S. Navy Bureau of Aeronautics for an air traffic control center visual signaling system.

MHD RESEARCH, INC., Newport Beach, Calif., is moving its general offices and primary research laboratories into a new 10,000 sq. ft. plant at 1535 Monrovia Ave., Newport Beach.

ALFRED ELECTRONICS has started a new 32,000 sq. ft. factory and administration building on a 4-acre site in Stanford Industrial Park, Palo Alto, Calif.

GENERAL ELECTRIC'S DEFENSE SYSTEMS DEPT. has established a space systems operation in Santa Barbara, Calif. Work will be primarily with systems engineering and technical direction to insure that overall requirements of space programs assigned to the defense systems dept. are recognized, defined and wholly satisfied.

VARIAN ASSOCIATES, Palo Alto, Calif., has created a new department to concentrate on military applications of magnetometry. The new department is designated the Military Magnetics Dept.

PENTA LABORATORIES, INC., Santa Barbara, Calif., has added a new research and development laboratory building. The company will use the new facility for material studies, process technology, and new product development work.

LENKURT ELECTRIC, San Carlos, Calif., has created a new project group to spearhead a stepped-up microwave product development program.

LOCKHEED AIRCRAFT CORP.'S CALIFORNIA DIV. has a new $4,941,573 Navy contract for electronic re-equipment of 69 P2V Neptune anti-submarine aircraft.

UNIVERSAL DATA PROCESSING EQUIPMENT, INC., is now an autonomous subsidiary of Dashew Business Machines, Inc., Los Angeles.

ZERO MFG. CO. and **LION AIRCRAFT SERVICES** have a new reciprocal marketing agreement. Most direct result of the agreement is the sharing of Zero's modular container system and Lion's electro-suspension mounting system.

PENDAR, INC., has a contract with Sonic Fatigue Test Aircraft Laboratory, WADC, Wright-Patterson AFB, Ohio. They will supply illuminated push-button indicators for consoles and panels in the master control room of the $5.6 Air Force installation.

CONSOLIDATED SYSTEMS CORP., Monrovia, Calif., has established a photo-optical vision which will engineer, manufacture and market military cameras and precision instrumentation optics.

TELE-TRONICS CO., Ambler, Pa., has formed a wholly-owned California subsidiary, Pepco, Inc., Costa Mesa, Calif. Pepco will produce rotary and push-pull switches.

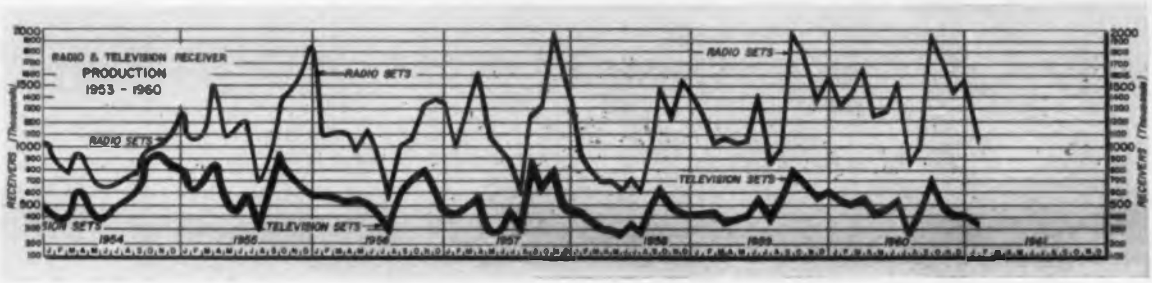
TASKER INSTRUMENTS CORP., Van Nuys, Calif., has completed delivery of terminal area sub-system equipments for use in the FAA's new data processing central for air traffic control. Equipment includes a video tracker programmer, radar aircraft trackers, display-character generators, radar video conditioner, precision approach radar consoles, and support equipment.

CLEVITE CORP., Cleveland, has granted rights under its patents in lead, zirconate-lead, titanate, piezoelectric elements to Acoustica Associates, Inc., Beverly Hills, Calif.

HOFFMAN ELECTRONICS CORP.'s Military Products Div., has a contract from the U. S. Navy Bureau of Ships for modification of the Navy's AN/UPA/24 IFF Aircraft Identification System. Contract value is approx. $150,000.

Facts and figures Round-up
March 1961

ELECTRONIC INDUSTRIES TOTALS



GOVERNMENT ELECTRONIC CONTRACT AWARDS

This list classifies and gives the value of electronic equipment selected from contracts awarded by government agencies in January, 1961.

Amplifiers, af	72,566
Amplifiers, linear/integrating	35,373
Amplifiers, electronic control	69,184
Amplifiers, servo	348,536
Antennas	87,977
Assemblies, cable	315,627
Batteries	1,727,794
Battery boxes	45,870
Bridges, capacitance	28,785
Buffers, large screen display	44,156
Cable, r-f	26,587
Capacitors, variable	37,050
Cells, fuel	57,097
Circuit breakers	28,051
Communications assemblies	42,489
Compensators	3,210,874
Components, radar	169,384
Components, transceivers	1,423,770
Components, computer	40,053
Components, transmitter	39,317
Controls, speaker-amplifier	104,991
Converters, analog-digital	148,000
Converters, telegraph-telephone	1,513,648
Cores, magnetic memory	49,888
Correlators, video	64,000
Digital tape handlers	38,250
Discriminators	36,390
Data processors	55,000
Gages, inspection	37,425
Generators, noise	147,930
Generators, thermal noise	42,843
Generators, pulse	73,805
Headsets	130,607
Indicators, digital display	466,692
Indicators, thermocouple	31,238
Indicators, thrust	110,805
Intercom units	42,300
Inverters	49,867
Inverters, static	40,730
Lie detectors, recording	52,099
Meters, flux	29,160
Meters, frequency	363,300
Meters, galvanometer	43,049
Meters, gauss	25,876
Meters, multi	114,887
Meters, ohm	77,700
Meters, spectra	125,128
Meters, radiac	37,455
Meters, vibration	33,075
Meters, volt	63,440
Microphones	383,771
Microphone assemblies	31,675
Microwave terminal equip.	87,953
Module, digital	61,917
Monitors, maneuver	64,916
Oscillators, r-f	793,129
Oscillographs	26,973
Power supplies	568,159
Radar	18,871,169
Radar towers	837,731
Radiac sets	45,969
Receivers, radio	47,452
Recording equipment	158,159
Recording oscillographs	30,875
References, a-c	43,226
Relays	34,694
Resistors	70,497
Resistors, negative resistance devices	60,500
Resistors, variable	113,188
Resolvers	30,791
Servo motors	27,571
Solenoids	28,155
Sounders, echo	296,700
Standards, capacitance	31,965
Switches	192,728
Switches, thermostatic	192,973
Synchros	57,317
Systems, antenna	262,823
Systems, digital	169,650
Systems, measuring	95,456
Systems, microwave relay	41,195
Systems, processing	180,000
Systems, multiplex receiver	29,100
Systems, radio	10,296,626
Systems, telemetering	90,967
Telephones, field	2,231,319
Test sets	466,362
Trainers, weapons system	1,770,893
Transducers	677,917
Transformers	32,300
Transmitters	366,609
Transmitters, teletype	136,544
Transponders	47,000
Tubes, electron	1,858,860
Tubes, magnetron	985,500
Ultrasonic cleaners	46,402
Wind measuring sets	521,355

EMPLOYMENT IN COMMUNICATION EQUIPMENT AND RELATED PRODUCTS*

(Thousands of employees)

Year	Monthly Average	Year	Monthly Average
1950	350.7	1955	515.7
1951	405.8	1956	557.8
1951	474.2	1957	579.8
1953	558.0	1958	551.4
1954	490.1	1959	627.2

Month	1957	1958	1959	1960
January	566.5	552.0	583.0	674.2
February	565.7	541.0	586.8	671.3
March	565.4	535.3	589.5	666.1
April	563.2	528.3	590.2	657.5
May	569.1	526.7	599.8	658.0
June	580.0	532.3	615.8	665.7
July	582.5	536.6	625.8	664.9
August	598.5	554.6	645.3	680.2
September	608.1	569.4	664.6	690.9
October	602.4	576.0	675.2	684.1
November	587.7	582.6	674.9	—
December	568.6	582.5	674.7	—

*Note: Though this series does not measure levels of electronics employment exactly, it is a reliable indicator of short-term variations in electronics manufacturing activity.

Source: Bureau of Labor Statistics.

THE MOST NEARLY PERFECT SWITCH

(And we don't mean a shell game)

SILICON CHOPPERS

From 1 mV "on" to 80 V "off"

HERE ARE THE FACTS IN A NUTSHELL . . .

- High breakdown ratings — 50 to 80 volts
- Two point control of current/voltage offset parameters
- Matched pairs to standard tolerance of 100 µv
- 10 million-to-1 minimum "off" to "on" resistance ratio
- Typically 30,000 megohms reverse resistance
- Typically 50 ohms forward resistance
- High temperature stability
- Unlimited quantities available
- Available from local Sperry Authorized Distributors

Don't gamble — you put your experience on the line when specifying for analog computers, D.C. amplifiers, electronic commutators and multiplex equipment.

Sperry now offers you a complete series of silicon transistors for single use or matched pairs that have the best combination of chopper characteristics — plus an extra margin of safety which provides true design flexibility.

Type Number	BV_{CEO} (Volts)	BV_{CES} (Volts)	BV_{EBO} (Volts)	V_{FZ} (max) Offset Voltage (mV)	I_{FZ} (max) Offset Current (mµA)	Price 1 — 99	PRICE 100 — 999
2N1917	—8	—25	—25	1.0	1.0	$ 9.75	$7.50
2N1918	—8	—25	—25	3.0	3.0	7.80	6.00
2N1919	—18	—40	—40	2.0	1.0	12.35	9.50
2N1920	—18	—40	—40	3.0	1.5	8.77	6.75
2N1921	—50	—50	—50	4.0	2.0	5.20	4.00
2N1922	—80	—80	—80	4.0	2.0	6.50	5.00

Write for 16 page Technical Application Bulletin #2107 and new Chopper transistor data sheets on types 2N1917 through 2N1922.

SPERRY

SPERRY SEMICONDUCTOR DIVISION

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SEMICONDUCTOR OPPORTUNITIES
AVAILABLE TO QUALIFIED ENGINEERS

*Trade Mark, Sperry Rand Corporation

Is This New Printed Circuit Process For You?

Have you heard about the remarkable new "scribe 'n' peel" technique for making printed circuit layouts? One of the first major companies to adopt this new method reports saving $27,000 on a single project involving 300 precision printed circuits.

"Scribe 'n' peel" is quite simple, actually. With the conventional method, you lay out your printed circuit by putting ink or drafting tape *on* a surface. With "scribe 'n' peel", you scribe your design *into* the surface of a specially coated STABILENE® Film with a sharp steel instrument. After a few simple processing steps, you've got a complete negative master!

In addition to impressive savings, the "scribe 'n' peel" technique allows much more flexibility than is possible with the old ink and tape methods. The scribing tools, which make it a cinch to execute uniform circuit paths, will enable your least experienced draftsmen to produce work almost impossible to tell apart from the work of your most highly skilled veterans. And your best men will be giving you the same top-quality work as they do now . . . only faster and more easily.

Various mechanical advantages are enjoyed with "scribe 'n' peel", too. For one thing, it's the only practical method which allows the preparation of double-sided boards where perfect register is essential. For another, it makes possible ready duplication of sections of the printed circuit master without the slightest risk of damage to the original.

This new "scribe 'n' peel" technique may or may not be for you . . . but the advantages it presents are so significant that we'd like to offer you a practical means of finding out. We've put together a complete "scribe 'n' peel" Evaluation Kit with everything you'll need to test this new technique, including easy-to-follow instructions. Using the kit, you'll be able to render an actual printed circuit master and see first hand what "scribe 'n' peel" can mean to *you* in terms of increased accuracy, flexibility, speed and savings.

We're charging only $5 to cover materials and handling . . . a modest investment which can reap tremendous dividends in terms of up-dating your printed circuit techniques. Simply fill out the coupon below and a K&E representative will deliver it promptly to your door. (see coupon below).

STABILENE "Scribe 'N' Peel" Evaluation Kit*

1. 3 sheets Stabilene Scribe Coat #R 132H • 8½" x 11"
2. Scribe Points
3. Scribe Point Holder
4. Touch Up Crayon
5. 6 sheets Stabilene Photo Sensitized Peel Coat #597H • 8½" x 11"
6. Photographic Developer • Directions under label
7. Reversal Solution • Component "A"
8. Reversal Solution • Component "B"
9. 4 Cloth pads for etching
10. Etching Solution
11. Instruction Sheet

*This kit contains basic scribing tools to acquaint you with the technique. If you decide to adopt the "scribe 'n' peel" method, K&E has a full range of top-quality, precision instruments specially designed for this type of work. They are fully described in the literature which comes with your Evaluation Kit.

K+E

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Company & Address: ____________________

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3077

VISIT K&E BOOTH 4506 AT THE IRE SHOW

CRYSTAL PULLER

Vertical crystal puller is used by Merck & Co., Rahway, N. J., for producing single crystal gallium arsenide. The semiconductor material is available in doped and undoped form.

AUTOMATIC SWITCHBOARD

"Dialmaster" is an automatic telephone switchboard for internal communications. It has 14 links to accommodate conversations between 28 phones. Stromberg-Carlson is maker.

THERMOELECTRIC GENERATOR

Thermoelectric generators made by Westinghouse Electric Corp. are for commercial and industrial applications. Units range from 5 to 100 w and are completely static devices.

Snapshots of the Electronic Industries

BALLOON CARRIED TELESCOPE-CAMERA

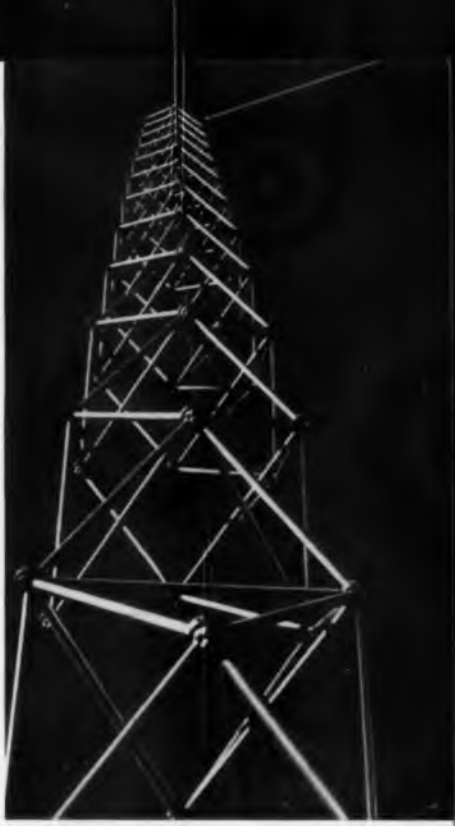
Telescope-camera is being built by Perkin-Elmer Corp. for Project Stratoscope 11. 36-inch aperture, 4500 lb. system will be carried to over 80,000 feet by unmanned balloon, above most of the earth's atmosphere, to photograph planets, nebulae, and other celestial objects. Primary optical system is in 18-ft. tube at right; secondary optical system and camera in 11-ft. tube at left. Total height is over 500 ft.

MIDGET SOLDERING IRONS

Operator uses General Electric Co.'s midget soldering iron on electronic circuit at Hughes Aircraft Co. plant in El Segundo, Calif. Irons can solder joints separated 1/8 in.

FOR PRIVATE SPACE PROBE

Space scientists at ITT Federal Labs, Nutley, N. J., will use this 40-ft antenna to beam signals at outer space. Company has first "earth-space" license granted by FCC to private firm.



OCTAHEDRON TOWER

Tower has greater load capability and torsional rigidity than conventional towers. Built by Up-Right Towers, Berkeley, Calif., it is an assembly of eight-sided sections.

VARACTOR DIODE

New RCA varactor diode is one of seven types that operate within 2,000 to 20,000 MC. Made of gallium arsenide, they were developed by the Advance Development Labs of RCA's Semiconductor and Materials Div., Somerville, N. J.

RADIOACTIVE HYDROGEN

A.E.C. has OK'd license-free sale of luminous paints containing tritium. This bottle of tritium powder contains approx. 50 curies, yet has negligible surface radiation. Luminous Products Corp., Boston, is using the powder in a luminous paint called Lumichron.

BATTLE DATA DISPLAY

Old grease-pencil method of plotting aircraft contrasts with new Navy Display console in foreground. Developed by Hughes Aircraft Co., the consoles display graphically all aspects of sea, air and underwater warfare.

Dual-Beam Versatility

With the Types 551 and 555 Oscilloscopes (and Tektronix dual-trace plug-ins in both channels), you can display four different waveforms at once. You can select from 24 calibrated sweep rates—run all four traces at the same speed on the Type 551, or run each pair of traces at different speeds (or the same if desired) on the Type 555.

In addition, with the Type 555 you can control either or both beams with either time-base generator. Both are designed as plug-in units for easier maintenance. Or, you can operate one time-base unit as a delay generator, hold off the start of any sweep generated by the other for a precise interval—from one-half microsecond to 50 seconds. And you can select from two modes of sweep-delay: either Conventional—when the delayed sweep is started at the end of the delay period by the delayed trigger, or Triggered—when the delayed sweep is started after the delay period by the signal under observation.

Although excelling in waveform-comparison analyses, the Type 550-Series Oscilloscopes are extremely adaptable to many other laboratory applications. Operating in conjunction with any combination of 16 "letter-series" plug-in units, the two dual-beam oscilloscopes offer unique signal-handling versatility with simple, reliable performance.

Type 551 DUAL-BEAM OSCILLOSCOPE

Common X—Independent Y Deflection
Vertical response—DC-to-25 MC,
14-nanosecond risetime
with Types K, L, R, S, Plug-Ins

Type 551 (without preamplifiers) **$1800**
Includes Indicator Unit, Power Supply, 4 Probes, 7 other accessories.

Type 555 DUAL-BEAM OSCILLOSCOPE

Independent X and Y Deflection
Vertical response—DC-to-30 MC,
12-nanosecond risetime
with Types K, L, R, S, Plug-Ins

Type 555 Sweep Delay

Among many specialized applications, the delayed-sweep enables you to make precise incremental measurements along a complex waveform and to obtain high magnification of a selected portion of an undelayed sweep—with jitter-free magnifications up to 10,000 times.

Type 555 (without preamplifiers) . . . **$2600**
Includes Indicator Unit, Power Unit, 2 Time-Base Units, 4 Probes, Time-Base Extension, 7 other accessories.
Prices f.o.b. factory

Characteristics Common to Both Oscilloscopes

Adaptable Vertical System—accepts interchangeable plug-in preamplifiers.

Versatile Sweep Features—wide range from 0.1 μsec/cm to 5 sec/cm in 24 calibrated main sweep rates, continuously variable uncalibrated to 12 sec/cm. 5X magnifier increases calibrated sweep time to 0.02 μsec/cm. Single sweep facilitates recording one-shot phenomena.

Complete Triggering Facilities—amplitude-level (manual) selection or fully automatic control.

High Writing Rate—10-KV accelerating potential provides bright traces at low repetition rates. 4 by 10 centimeter display for each beam, with 2 centimeter overlap.

Precise Amplitude Calibrator—with 18 square-wave voltages (from 0.2 mv to 100 v peak-to-peak) available at the front panel.

Separate Power Supply—electronically regulated.

Call your Tektronix Field Engineer for a demonstration of the Type 555 or Type 551 Oscilloscope in your own dual-beam (or single-beam) applications.

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TEKTRONIX ENGINEERING REPRESENTATIVES: Hawthorne Electronics, Portland, Oregon • Seattle, Washington. Tektronix is represented in twenty overseas countries by qualified engineering organizations.

In Europe please write Tektronix Inc., Victoria Ave., St. Sampsons, Guernsey C.I., for the address of the Tektronix Representative in your country.

VISIT TEKTRONIX AT IRE SHOW BOOTHS 3511-3517

EI's International News

FAR EAST

Trouble with Jap Imports

Washington — EIA says that U.S. radio and TV dealers are having difficulties in handling products imported from Japan. The Japanese practice of requiring cash payments with orders has tied up large amounts of dealer capital, and purchasers have had to carry inventory normally stocked by distributors. Dealers are also having trouble obtaining adjustments for damaged or sub-standard merchandise.

Calling attention to the loss of thousands of jobs in U.S. electronic industries (Japanese imports have climbed to 240 times their 1955 level), EIA suggests that Congress and the Executive branch give serious consideration to developing reasonable and effective import controls. The U.S. should also make a serious effort to effect removal of restrictions against U.S. products now prevailing in foreign countries, notably Japan.

EIA stresses that in the electronics industry, the imports problem is more than economic. Upon a reasonable solution of it depends the capability of the nation both to keep its defenses strong and to compete successfully in the space race. This is because modern weaponry and the technology of space exploration require increasingly large amounts of electronic equipment of many kinds.

See No American Market for Small TV

Tokyo—Sales tests in American and Japanese markets have convinced executives of Tokyo Shibaura Electric Co. that there is not much of a market for their small-screen (8-in.) transistorized TV sets. They have postponed plans to market these sets in the U.S.

"Re-evaluate Trade Policies with Cheap Labor Countries," Urges Admiral's Siragusa

Chicago—"Cheap labor from abroad is undermining many American industries and poses a serious threat to the entire economic system of this country," says Ross D. Siragusa, President of Admiral Corp.

He proposes that the new administration undertake an immediate re-evaluation of American trade policies with certain cheap labor countries. He also suggests that non-discriminatory duties be imposed to raise the cost of foreign goods to a level where American products can at least be competitive.

Supporters of our present international trade policies point out that Japan—one of the cheap labor countries—is our second best customer importing $1.4 billion this year and exporting $1.1 billion. "But," says Siragusa, "The figures do not tell the whole story. American exports to Japan are primarily in coal, cotton, wheat, and other raw materials which require a minimum of labor. On the other hand, Japanese exports to this country are finished products and components with a high labor content. The U.S. has suffered a loss of half a million jobs in its trade with Japan last year."

EUROPE

Italian Transistors to Meet U. S. Specs, Jap Price

Milan—Low cost transistors meeting American specifications will soon be coming from Sicily, says G. Donato, La Centrale S.P.A., Milan, Italy.

Italian firms have several advantages, including a ten year tax exemption for new firms and duty free imports of equipment. The Sicilian government will also pay the salaries of workers who are being trained for highly - specialized manufacturing techniques.

Form European Subsidiary

Chicago — Fansteel Metallurgical Corp. has formed a wholly-owned subsidiary, Fansteel A. G., Inc. in Switzerland. The Company will concentrate on markets outside the U.S. Fansteel makes refractory metals, Selenium and silicon rectifiers, tantalum capacitors, electrical contacts, and carbide tools.

New Belgium Firm

Brussels — COBELDA (Compagnie Belge d'Electronique et d'Automation), a new firm located at Gosselies near Brussels, has been formed by Hughes Aircraft Company and SABCA, a Belgian aircraft corp. It will service electronic equipment deployed in Europe by Hughes.

U. S. S. R.

U.S.S.R. Grants Rights To Scientific Books

Moscow — Mezhdunarodnaya Kniga, the official Soviet book export agency, has signed an agreement with Consultants Bureau, 227 West 17th St., N. Y., N. Y., for translation and English language rights to Soviet scientific journals. Rights include monographs, symposia, conference proceedings, and collections on scientific and technical subjects.

Books chosen for translation into English will be those recommended by both Soviet and American scientists as outstanding contributions to the existing literature on the subject.

Russians Lag U. S. in Orbiting Satellites

Washington — NASA's December 15, 1960 count of operating space vehicles shows the U.S. leading with 17 in orbit. Russia has two satellites. Of the U.S.'s 17, 10 are still transmitting. Neither of Russia's is.

Since Sputnik, a total of 41 satellites and space probes have been launched. Thirty-seven were in earth orbits, three in solar orbits and one (Russian) landed on the moon. The U. S. has launched 32 and the Russians 9. Oldest satellite is Explorer 1, which was launched Jan. 31, 1958. It is still transmitting. Russia's oldest, Lunik 1, is in orbit around the sun, but it is silent.

MOBIDIC GOES OVERSEAS

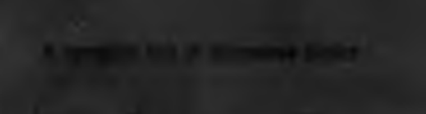
Mobile Digital Computer developed by Sylvania Electric Products, Inc., is loaded aboard ship for shipment to Zweibrucken, West Germany. U. S. Seventh Army will use it for controlling supply requisitions.

ALL-GLASS SUB MINIATURE RF DIODES

FM discriminator circuits
VHF/UHF general purpose
Low-noise balanced mixers through X-band
RF Harmonic Generation
AM clipping in IF amplifiers
RF Power Monitoring (pulsed & CW)
RF Sweep Circuits
RF Cavity Tuning (preselectors)
RF Leveling, Limiting & Switching
VHF/UHF Parametric Circuits
Microwave Computer Subharmonic Oscillators

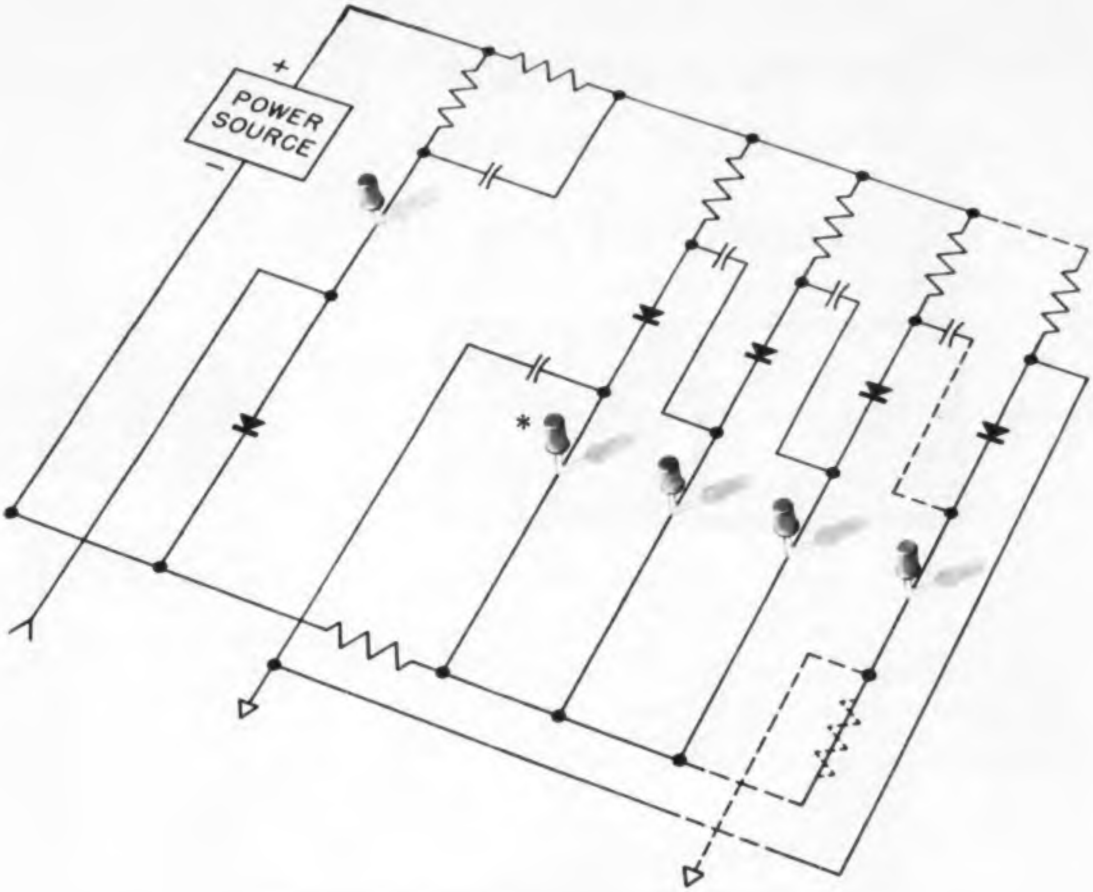
A series of tiny, more adaptable, military-rugged diodes with axial wire leads designed for maximum convenience in all miniature strip-transmission-line or coaxial circuits.

All-glass sealing assures reliable hermetic seal, particularly when diodes are soldered into a circuit. All-glass packaging reduces shunt-capacitance for improved RF bandwidth at microwave frequencies.



MICROWAVE ASSOCIATES, INC.

Circle 15 on Inquiry Card



*SHOCKLEY 4-LAYER DIODES *used in typical multiple-stage ring counter circuit. The circuit may have an odd or even number of stages.*

YOU CAN COUNT ON 4-LAYER DIODES

For counting pulses... for timing... for digital read-out. The diagram shows one of several simplified ring counter circuits using Shockley 4-layer diodes. This silicon semiconductor switch is the key to circuit versatility. Apply appropriate resistors and capacitors, and speeds from less than one pulse per second to several hundred thousand per second may be obtained. At each stage enough power can be handled to operate signal lamps, enough voltage can be supplied to operate Nixie Tubes.

When broad temperature ranges and tough environmental conditions must be met, the MIL-LINE diode is available. Standard commercial 4-layer diodes are suggested for low cost, non-military applications. If your circuits involve ring counters, consider Shockley 4-layer diodes for faster, more dependable operation. For application notes on ring counters, how to make flip-flops, drive relays, convert DC to AC, pulse magnetrons, or for suggestions about the use of 4-layer diodes in the circuit you are developing now... call or write your local Shockley representative or write Dept. 12-2.

Shockley TRANSISTOR

UNIT OF CLEVITE TRANSISTOR

STANFORD INDUSTRIAL PARK, PALO ALTO, CALIF.

CLEVITE CORPORATION

Circle 16 on Inquiry Card

ANTENNA INSULATOR

Seventy-four foot antenna insulator for the Navy's new radio station at Cutler, Maine, is tested on dummy tower at Lapp Insulator Co's. High Voltage Laboratory in LeRoy, N. Y. System will be used with Polaris FMB system.

MHD Conference Set

A second symposium on "Engineering Aspects of Magnetohydrodynamics" has been scheduled for March 9-10 at the University of Pennsylvania, Phila., Pa. The conference is sponsored by the IRE, AIEE, and IAS.

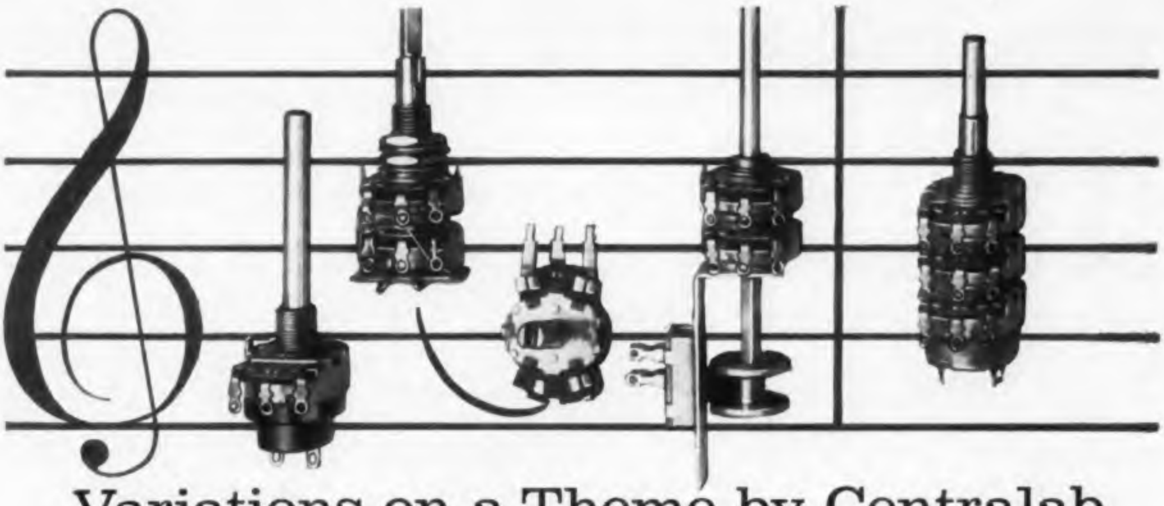
Four major sessions will deal with: Communications and diagnostics; flight applications; fusion; and Power-conversion.

NASA Sets Up New Group For Theoretical Research

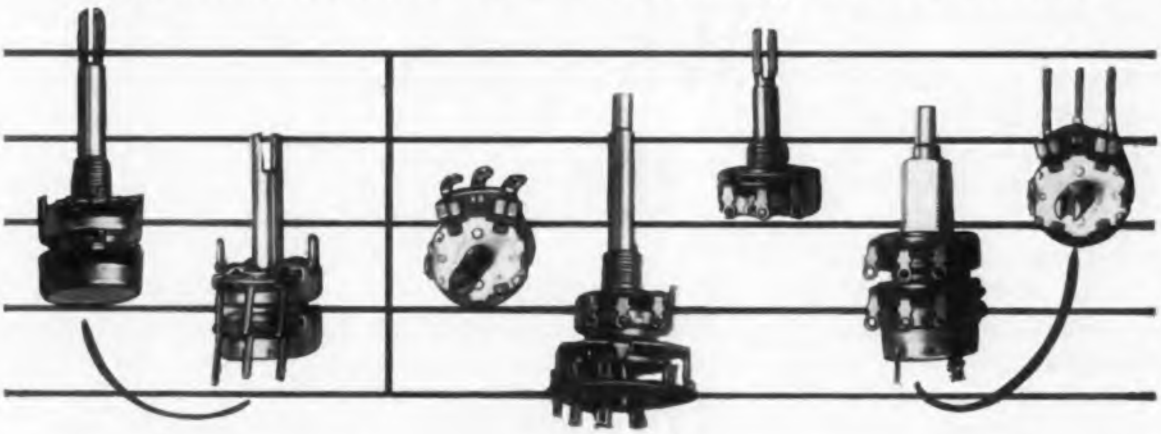
The National Aeronautics and Space Administration is establishing a new theoretical research group in New York City. Called the Goddard Institute for Space Studies, it will serve as an arm of the Theoretical Div. of the Goddard Space Flight Center, Greenbelt, Md.

The regular scientific staff (about 50 people) will be supplemented with part time consultants from neighboring universities. Program will include these major areas: the structures of the earth, moon, and other planetary bodies; the atmospheres of the earth and other planets; the origin and evolutions of solar systems; the properties of the interplanetary plasma; sun-earth relationships; celestial mechanics; and the structure and evolutions of the stars.

More News on Page 40



Variations on a Theme by Centralab



The Conventional Model 2 Composition Variable Resistor has 15 separate identities*... and potentially more!

Versatility is music to the ears of CENTRALAB engineering and production people—which is one of the reasons that our 15/16" composition variable resistor (known as the Model 2) is such a favorite. The basic unit, rated at ½ watt, with resistances from 200 ohms to 10 megohms, in various tapers, is highly adaptable.

It is available as a single, dual or twin control, metal or plastic shaft, with a choice of 5 types of switches (snap action, push-push, push-pull, slide, or rotary), 5 types of mountings (bushing, twist-tab, snap-tite*, "doghouse" bracket or "grasshopper"), 3 types of terminals (solder lug, wire wrap, or printed circuit), with unlimited variations and combinations.

Harmonizing with your requirements is our business. We probably make the type of Model 2 you need—if not, we can develop it for you. We're always interested in an additional variation on our favorite theme.

* **Described in our brand-new Model 2 Brochure, available free by requesting Bulletin #42-1081.**

Centralab®

THE ELECTRONICS DIVISION OF GLOBE-UNION INC.
938C East Keefe Avenue • Milwaukee 1, Wisconsin
Centralab Canada Limited Ajax, Ontario

*Trade Mark B-6113

ELECTRONIC SWITCHES • VARIABLE RESISTORS • CERAMIC CAPACITORS • PACKAGED ELECTRONIC CIRCUITS • ENGINEERED CERAMICS

Tuning breakage, backlash, and accelerated wear are among the problems you encounter in a trimmer capacitor whose core *rotates* during tuning.

What is a direct traverse trimmer and why?

That's why we took the rotation out of our trimmer capacitors. Our core runs up and down its tube without turning.

That's why direct traverse tuning curves are all smooth lines, utterly devoid of capacitance reversals.

That's why direct traverse trimmers tune so smoothly, without a snag to cause breakage just when you think the circuit is complete and ready to go.

That's why tuning cores never work loose and become microphonic.

That's why direct traverse capacitance values never change . . . even when you shock or vibrate the trimmer.

Plus the properties of glass. We've added to this direct traverse design the many values of glass. No other material combines such high reliability with such low TC. Or such precision at such low cost. Let the specs speak for themselves:

TC	±50 to ±100
DC volts	1000
Dielectric strength	1500
Megohms, IR	10^6
Q factor, 50 MC	500

Four models. Where space is no problem, you'll look immediately for our standard direct traverse trimmers. They range from .5-3.0 to 1-12 uuf. Approximately 0.6 uuf change per turn.

When space is tight both in front of and behind your panel, you'll appreciate our petite mini-trimmers. Not only are the over-all dimensions small, but we throw in fixed cavity tuning which keeps the screw enclosed at all times. These range from 1-4.5 to 1-18 uuf with approximately 0.40 uuf change per turn.

For printed circuits you can get trimmers with the same specs as the mini-trimmers, but designed specifically for board mounting.

When you want to really get short *behind* the mounting panel, look at our precision direct traverse trimmers. Hardware in front is slightly longer than with the mini-trimmers, but we more than make up for this with a short back-panel dimension. All the way from .8-4.5 to 1-30 uuf with about 0.50 uuf change per turn.

Try a direct traverse trimmer in your next circuit and see the difference for yourself. You can get complete specifications by writing to us at Corning Glass Works, 546 High Street, Bradford, Pa.

For orders of less than 1,000, you can get fast service from your local Corning distributor.

CORNING ELECTRONIC COMPONENTS

CORNING GLASS WORKS, BRADFORD, PA.

INLAND d-c torque motors save critical weight in guidance systems

Norden Miniature All-Attitude Inertial Platform uses four Inland torque motors, one for each gimbal axis.

Norden specifies these Inland d-c torque motors because of their compact pancake shape, low-power input and direct torquing. In addition to providing the obvious weight and space reduction, Inland's direct drive positioning eliminates gear train problems such as backlash.

Norden engineers say, "The linearity of the Inland torquers is excellent over a wide range so that precession rates may be accurately established. The torquer fixed field is carefully stabilized so that the torquer gradients will be constant over long periods of time."

Inland d-c pancake torque motors with high torque-to-inertia ratios and linearity of output provide all the advantages of direct gearless servo positioning in a complete line over the full range of 0.1 to 3,000 pound-feet.

PLATFORM SHOWN ½ SIZE

COMPARE THESE TYPICAL INLAND TORQUER RATINGS

	T-1321-A	T-2136-A	T-2108-B
Peak torque, oz. in.	20.0	35.0	60.0
Volts at peak torque, stalled at 250°C	48.0	26.0	25.6
Amps at peak torque	1.21	1.6	1.24
Total friction, oz. in.	0.5	0.8	1.5
Rotor Inertia, oz. in sec²	.001	.007	.011
Weight, oz.	5.0	9.0	14.0
Dimensions (inches):—O.D.	1.937	2.81	2.81
I.D.	.625	1.00	1.00
Thickness	.50	.63	1.00

For complete catalog with engineering data, outline drawings and specifications on these and other Inland d-c pancake torquers, write Inland Motor Corporation of Virginia, Northampton, Massachusetts. Dept. 8-3.

INLAND MOTOR CORPORATION OF VIRGINIA

A SUBSIDIARY OF KOLLMORGEN CORPORATION

NORTHAMPTON, MASS.

Energize High Voltage Project at 460-750 KV

General Electric Co.'s Project EHV (Extra-High-Voltage) transmission line has set a record mark of approximately 750,000 volts. Project EHV is a 4.3-mile prototype transmission system designed to transmit electric power at 460 to 750 KV instead of the 115 KV now used. It is located near Pittsfield, Mass. The project will help solve many problems. Among them are the character and control of corona losses. Over 267 measurements of 47 types are being conducted: 133 electrical of 13 types; 71 mechanical of 11 types; and 63 meteorological of 23 types.

Being measured are radio and television influence, voltage surges and current, axial tension, maximum angle of swing, amplitude and frequency of aeolian vibrations, temperature, wind velocity and direction, and lightning.

Engineering Student Decline Continues

The total number of engineering freshmen enrolling in the fall term of the 1960-61 acadamic year dropped by 100 from the 1959-60 year. Reports from the U. S. Dept. of Health, Education and Welfare show 67,600 students registered in this year compared to 67,700 last year. This is the smallest drop in three years.

Enrollments for master's and doctor's degrees in engineering continues to increase. Enrollments for the master's degree rose 5.1% to 31,200 and for the doctorate 14.3% to 6,400.

FORM NEW COMPANY

W. J. deFremery, International Rectifier Corp. (Right) and Kalwant Rai, Ram Krishan Kulwant Rai of India, discuss new company formed by the two firms to manufacture selenium rectifiers for industrial and commercial use in India.

4-POLE POWER CONTROL RELAYS FROM STOCK

Elgin Advance stocks the only 4-pole power control relay of this type on the market. Specify the PC Series when you require dependable current switching.

The PC Series features heavy load carrying capacity, combined with small size—a variety of contact arrangements—and a wide range of AC and DC coil voltages and resistances.

another example of  reliable relayability

SPECIFICATIONS

Contact arrangements—SPDT, DPDT, 3PDT, 4PDT
Contact rating—15 amps resistive, 5 amps inductive
Contact material—0.25" dia fine silver
Coil voltages & resistances—wide range of AC and DC
AC power—10-12 VA, nominal
DC power—2-3 watts, nominal
Dimensions—1.906" x 3.062" x 2.593", maximum
Weight—8 ounces, maximum

send for  latest data

ELGIN advance RELAYS

ELGIN ADVANCE RELAYS

THE ELECTRONICS DIVISION OF ELGIN NATIONAL WATCH COMPANY
2435 NORTH NAOMI STREET, BURBANK, CALIFORNIA

Circle 58 on Inquiry Card

A NEW SLANT

for TEMPERATURE-COMPENSATED ZENERS

Typical Operating Characteristics Curve

from MOTOROLA

LOWER DYNAMIC IMPEDANCE MINIMIZES VOLTAGE FLUCTUATIONS ...helps reduce circuit complexity...eliminates components

The above curve emphasizes the principal advantage of Motorola's new 1N821A series — 6.2 volt temperature-compensated reference diodes. The slant, or slope, of the curve is due to the extremely low dynamic impedance of these new devices . . . 8 ohms typical, 10 ohms maximum.

Because of this extremely low dynamic impedance (nearly half that of units available elsewhere), reference voltage fluctuations due to current changes are minimized . . . a primary concern in reference applications. This amazing voltage stability allows you to simplify the complex constant-current circuits previously required . . . reducing components and increasing reliability. And, this new 1N821A series costs no more than the higher impedance units.

This dramatic achievement in a single zener device is a typical example of Motorola leadership in zener research and development. Motorola refinements have been responsible for making these versatile devices more useful in an ever widening field of applications.

Another facet in Motorola's zener leadership is an emphasis on reliability second to none. Unique production processes, exhaustive in-process control, continuous life-testing and conservative ratings contribute to a growing preference for Motorola zeners. If you are using zener diodes . . . be sure you have complete information on the design and production advantages to be gained by specifying "Motorola".

SEE THE LATEST MOTOROLA SEMICONDUCTORS AT IRE BOOTH / 1117•1118

VERSATILE MOTOROLA ZENERS . . .
offer you many design advantages

WIDE SELECTION – enabling you to use the precise device for your exact circuit requirements. Over 2,070 different devices are available covering seven wattages . . . and five temperature-compensated series. Three standard tolerances are offered: 5%, 10% and a 20% tolerance for lower-cost, non-critical applications. Matched sets are available in tolerances as low as 1%. Motorola also has a variety of military-qualified zeners.

OUTSTANDING PERFORMANCE – is one of the big advantages you gain when using Motorola zeners. These include lower dynamic impedance, lower temperature coefficients and sharper knees. Units are measured at the 1/4 power level – the point of typical usage. Dynamic impedance is measured at two points and 100% scope-checked.

COMPLETE SPECIFICATIONS – Motorola supplies you with the industry's most comprehensive specifications . . . giving you the complete picture of the diode characteristics. Temperatures are fully specified. Forward current ratings are specified and guaranteed.

RELIABLE OPERATION – exclusive process and quality control procedures assure extreme uniformity, high stability and longer life. Motorola's million-dollar reliability program has resulted in a level of reliability acceptable for the most critical applications.

IMMEDIATE AVAILABILITY – Motorola Zener Diodes are available "off the shelf" from 28 experienced industrial distributors. For fast delivery of any Motorola zener, contact the distributor nearest you.

BIRMINGHAM
Ack Semiconductors, Inc.
3101 Fourth Ave., So.
FAirfax 2-0589

BOSTON
Cramer Electronics, Inc.
811 Boylston St.
COpley 7-4700

Lafayette Radio
110 Federal St.
HUbbard 2-7850

BUFFALO
Summit Distributors, Inc.
916 Main St.
TT 4-3450

CAMDEN
General Radio Supply Co.
600 Penn St.
WOodlawn 4-4500

CEDAR RAPIDS
Deeco Inc.
618 First St., N. W.
EMerson 5-7551

CHICAGO
Allied Radio Corp.
111 N. Campbell Ave.
HAymarket 1-6800

Newark Electronics Corp.
223 W. Madison St.
STate 2-2944

Semiconductor Specialists, Inc.
5706 W. North Ave.
NAtional 2-8860

CINCINNATI
Sheridan Sales Co.
Baselmon Center Bldg.
MElrose 1-2460

CLEVELAND
Pioneer Electronic Supply Co.
2115 Prospect Ave.
SUperior 1-9411

DALLAS
Tobba, Inc.
4308 Maple Ave.
LAkeside 6-8753

DENVER
Inter-State Radio & Supply
1200 Stout Street
TAbor 5-8257

DETROIT
Radio Specialties Co.
12775 Lyndon
BRoadway 2-4200

HOUSTON
Lenert Co.
1420 Hutchins
CApitol 4-2663

JAMAICA, N. Y.
Lafayette Radio
165-08 Liberty Ave.
AXtel 1-7000

LOS ANGELES
Hamilton Electro Sales
11965 Santa Monica Blvd.
EXbrook 3-4441
BRadshaw 2-8453

Kieruiff Electronics
820 W. Olympic Blvd.
Richmond 8-2444

MELBOURNE, FLA.
Electronic Wholesalers
1301 Hibiscus Blvd.
PArkway 3-1441

NEWARK, N. J.
Lafayette Radio
24 Central Ave.
MArket 2-1661

NEW YORK
Lafayette Radio
100 6th Ave.
WOrth 6-5300

Milgray Electronics
136 Liberty St.
REctor 2-4400

OAKLAND
Elmar Electronics
140 11th St.
TEmplebar 4-3311

PHOENIX
Electronic Specialties Co.
917 N. 7th St.
ALpine 8-6121

SAN DIEGO
San Delco
3843 Park Blvd.
CYpress 8-6181

SEATTLE
Almac Electronics Corp.
8301 Maynard Ave.
PArkway 3-7310

WASHINGTON, D. C.
Electronic Wholesalers, Inc.
2345 Sherman Ave., N. W.
HUdson 3-5200

CANADA
Canadian Motorola Electronics Co.
105 Bartley Drive
Toronto 16, Ontario
PL 9-2222

MOTOROLA ZENER DIODES

MOTOROLA 1/4 WATT ZENERS
2.4 - 6.8 volt alloy units
1/4M2.4AZ thru 1/4M6.8AZ
6.8 - 200 volt diffused units
1/4M6.8Z thru 1/4M200Z

MOTOROLA 400 mW ZENERS
6.8 - 200 volt diffused units
1N957 thru 1N992
1N962B thru 1N992B*
*to meet the requirements of MIL-S-19500/117

MOTOROLA 3/4 WATT ZENERS
6.8 - 200 volt diffused units
3/4M6.8Z thru 3/4M200Z

MOTOROLA 1 WATT ZENERS
6.8 to 200 volt diffused units
1M6.8Z thru 1M200Z
1N3016 thru 1N3051
1N3016B* thru 1N3051B*
*to meet the requirements of MIL-S-19500/115

MOTOROLA 50 WATT ZENERS
6.8 to 200 volt diffused units
50M6.8Z thru 50M200Z
1N2804 thru 1N2846
1N2804B thru 1N2846B*
*to meet the requirements of MIL-S-19500/114

MOTOROLA 1.5 WATT ZENERS
6.8 to 200 volt diffused units
1.5M6.8Z thru 1.5M200Z

MOTOROLA 10 WATT ZENERS
6.8 to 200 volt diffused units
10M6.8Z thru 10M200Z
1N1351 thru 1N1375
1N1806 thru 1N1815
1N2970 thru 1N3015
1N2970B thru 1N3015B*
*to meet the requirements of MIL-S-19500/124A

MOTOROLA 400 mW TEMPERATURE-COMPENSATED ZENERS
6.2 volt diffused units coefficients to .001%/°C
1N821 thru 1N827
1N821A thru 1N827A
8.4 volt diffused units coefficients to .001%/°C
1N3154 thru 1N3157
(Replaces 1N430, although only 1/50 the size)
1N3154A thru 1N3156A

MOTOROLA 3/4 WATT TEMPERATURE-COMPENSATED ZENERS
9.3 volt diffused units coefficients to .0005%/°C
1N2620 thru 1N2624

MOTOROLA 1/2 WATT TEMPERATURE-COMPENSATED ZENERS
9.0 and 11.7 volt diffused units coefficients to .0005%/°C
1N935 thru 1N939
1N941 thru 1N945

FOR COMPLETE TECHNICAL INFORMATION on the specific Motorola Zeners most applicable to your circuits, write to Technical Information Department, Motorola Semiconductor Products, Inc., 5005 East McDowell Road, Phoenix 10, Arizona. Or contact your nearest Motorola Semiconductor Distributor.

ZENER-RECTIFIER APPLICATIONS HANDBOOK – Motorola's new Zener Diode-Rectifier Handbook is a valuable reference book for circuit engineers. This 200-page guide to basic theory, design characteristics and applications is available through your Motorola Distributor. Price $2.00.

MOTOROLA
Semiconductor Products Inc.
A SUBSIDIARY OF MOTOROLA, INC.
5005 EAST McDOWELL ROAD • PHOENIX 10, ARIZONA

EIA's Standard Buying System Uses Coupons

The Electronic Industries Association has set up a new system for buying technical standards prepared by its Engineering Dept. The new system uses coupons.

Special coupon books may be bought from the department in N.Y.C. and used as cash in buying the standards. Each $25 book contains 60 coupons. The system features a "built-in" cash discount of 2%.

The system is designed to eliminate purchase orders, small invoices, and minimum charges. Books may be ordered from EIA's Engineering Dept., Room 2260, 11 W. 42nd St., N. Y. 36, N. Y.

COUNTERFEIT DETECTOR

Electronic dollar bill scanner accepts only genuine one dollar bills, face up. Non-genuine bills are returned. Planetronics, Inc., Easton, Pa., makes the device.

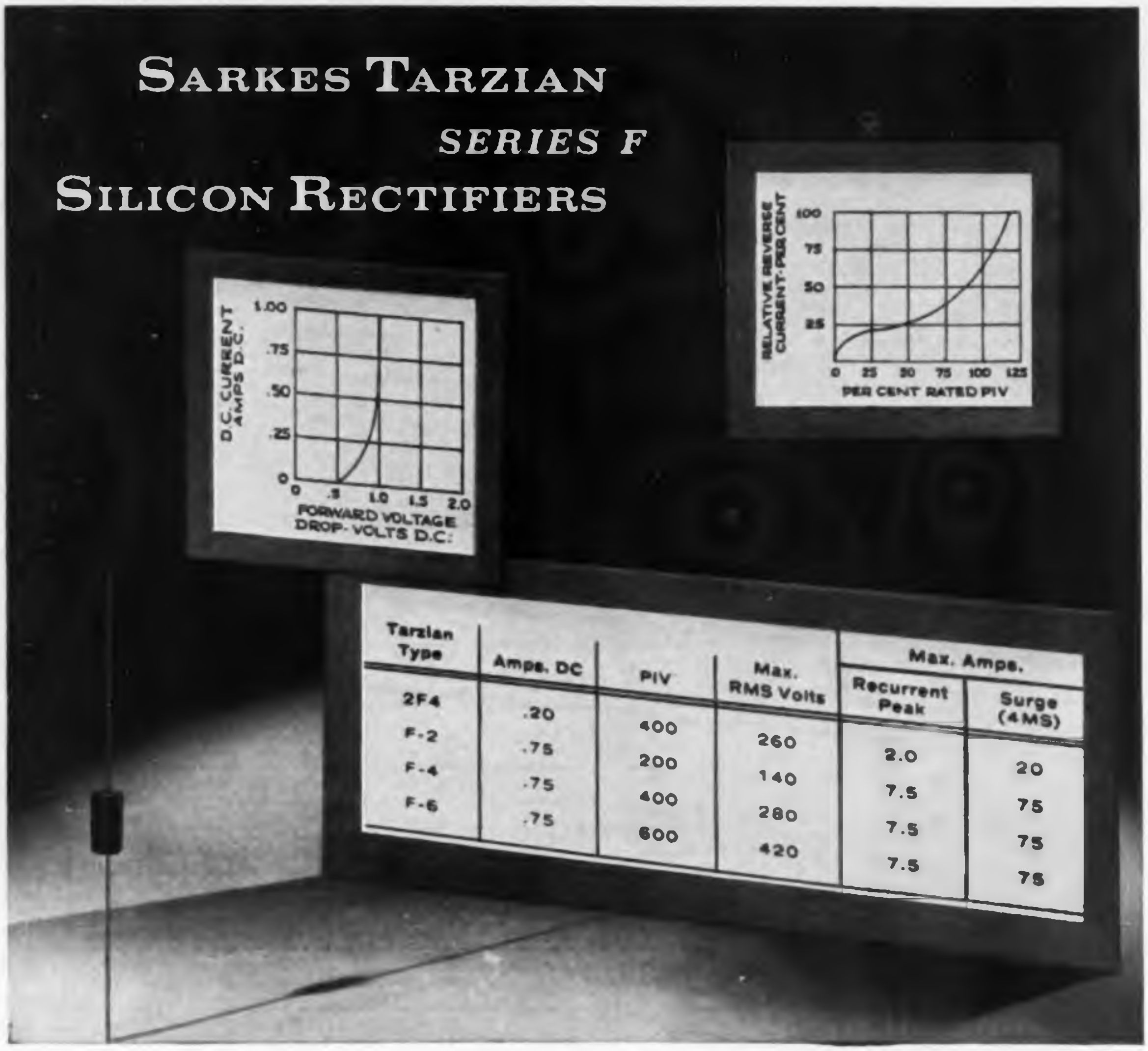
White Light for Pilots

The USAF-Northrop T-38A Talon supersonic trainer will use "white light" illumination for cockpit instruments. The filtered white light system will let pilots distinguish color on instruments and maps.

Present cockpits are illuminated with red lights so that only red and black markings can be seen. It was formerly believed that red light required less time for a pilot's eyes to adapt to night vision. But human factors engineers have learned that there is no appreciable difference in adaptation time between low intensity red light and low intensity white light. The latter also provides the advantage of color detection.

More News on Page 48

Circle 61 on Inquiry Card



Tarzian Type	Amps. DC	PIV	Max. RMS Volts	Max. Amps. Recurrent Peak	Max. Amps. Surge (4MS)
2F4	.20	400	260	2.0	20
F-2	.75	200	140	7.5	75
F-4	.75	400	280	7.5	75
F-6	.75	600	420	7.5	75

THERE'S EVEN MORE TO THIS...

This small "F" unit contains the oversize junction that is characteristic of all Tarzian silicon rectifiers. The result is big performance; specifically, lower temperature rise, longer life, increased reliability, and the capacity to handle inrush currents well above normal circuit requirements.

Furthermore, present production of Series F units is at the rate of tens of thousands per day. Production of these units to date is in the millions. Performance testing and life testing go on continuously, of course. The experience of users is not only favorable, but extremely large. And prices are realistic, to say the least.

In short, we don't know of anybody who makes more of these, or who makes them better, or who makes them at less cost. Do they meet your requirements? Write for the facts you need for decision. Application engineering service is also available without cost or obligation.

Where highest quality
is in volume production

SARKES TARZIAN, INC.

World's Leading Manufacturers of TV and FM Tuners • Closed Circuit TV Systems • Broadcast Equipment • Air Trimmers • FM Radios • Magnetic Recording Tape • Semiconductor Devices

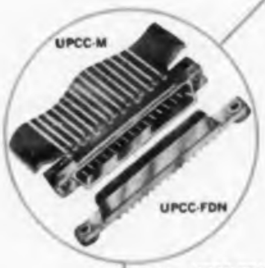
SEMICONDUCTOR DIVISION • BLOOMINGTON, INDIANA

In Canada: 700 Weston Rd., Toronto 9 • Export: Ad Auriema, Inc., New York

Circle 62 on Inquiry Card

Series UPCC-SLK*
(Knob Screw-Lock).
Female chassis connector-wire solder terminals. Knob on male card connector-dip solder terminals.

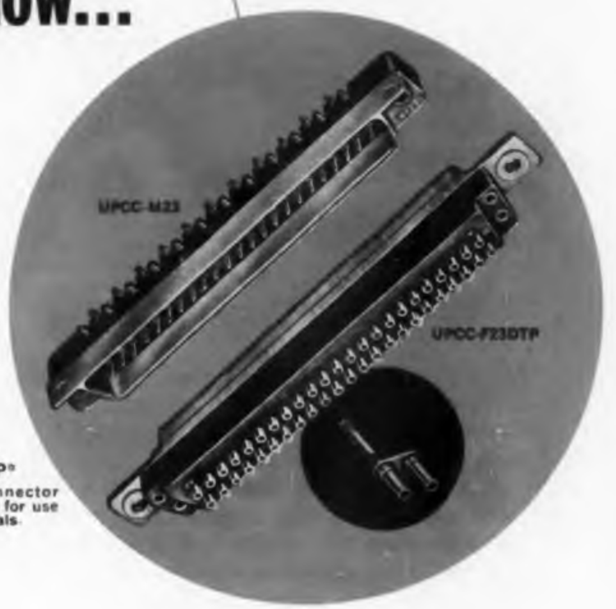
Series UPCC-SLH*
Male chassis connector-dip solder terminals.
Female hooded connector-wire solder terminals.



Series UPCC-FDN
Female chassis connector-dip solder terminals.

and now...

Series UPCC-M & -F
NAS standard.
Male card connector-dip solder terminals.
Female chassis unit with wire-solder terminals.



Series UPCC-FDTP*
Female chassis connector with dual row linked for use with AMP 53 terminals.

Still another ~~another~~ "demand" member has joined U.S.C.

family of Printed Card Connectors . . . the new, dual row taper pin Series UPCC . . . FDTP bringing the total of different available types to over 400.

- Conforms to MIL-C-8384 and NAS specs.
- Molding materials—melamine and diallyl phthalates
- Die cast aluminum shells—aluminum hoods
- Ideal for critical environmental conditions
- Silver plated—gold flash contacts
- Screw lock elements—stainless steel—double lead for double speed

UPCC-M & -F units available with wire solder, turret type, solderless AMP 37, or dip solder terminals (1/16", 1/8", 1/4" boards).

UPCC-FDTP units take AMP 53 taper pins.

Max. Wire Size	#18 AWG
Voltage Breakdown (Min.)	2500v, AC, RMS
Insulation Resistance	over 5000 megohms
No. of contacts	7, 11, 15, 19, 23, 32
Current Ratings	7.5 amps

Also custom configurations to meet your specific application requirements.

*Pat. Pend.

U.S. COMPONENTS, INC. 1320 Zerega Ave., New York 62, N.Y. • TAlmadge 4-1600

Circle 63 on Inquiry Card

Converter For Unconventional Power Generators Developed

A new 50 kva inverter, designed to solve a vexing problem with unconventional power converters, has been announced by GE. The problem with using these new devices—fuel cells, thermoelectric generators, thermionic generators, etc.—is that the power output is dc and the equipment they will operate is ac.

The company's new inverter has no moving parts (except for two fans) and it does the work of a 60-hp motor-generator set. These motor-generator sets are generally too heavy for the new applications and have many maintenance problems.

R. A. Koehler examines silicon controlled rectifier used in GE's new inverter designed for use with unconventional power generators.

The inverters ac power output is provided at frequencies varying from 50 to 500 CPS. The new system uses silicon controlled rectifiers.

New Research Center

The Federal Systems Div., IBM Corp., has established a new Communications Center to develop advanced data transmission technologies for space and military computer information systems. The center will be located near Washington, D. C., at Rockville, Md.

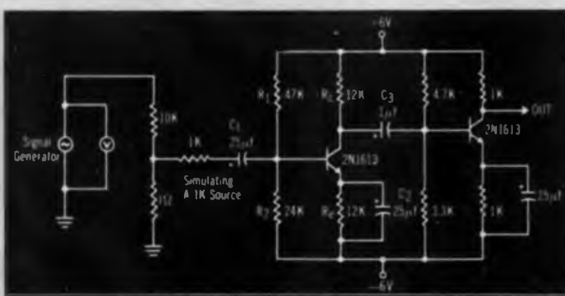
Research will emphasize improvements in systems design and reliability in both radio spectrum and direct wire communications. Major applications in the computer-communication field include: aerospace missions, undersea warfare, real-time command control systems, and complex intelligence and logistics networks. The new Center will also provide systems analysis to apply advanced communications devices to existing and future electronic control systems.

(More News on page 52)

Make sure to visit The Fairchild Exhibit, Booths 2705-2707 on the second floor at the IRE Show

Fairchild's **planar** 2N1613 starts with low leakage (10mµA), high alpha cutoff (120mc) and excellent beta over a wide collector-current range (see specifications). Oxide-protected surfaces and junctions – a unique Fairchild **planar** advantage – keep operating parameters stable throughout transistor life to prevent creeping incremental noise buildup.

LOW-NOISE TRANSISTOR CIRCUITRY



2N1613 SPECIFICATIONS – 25° C EXCEPT AS NOTED	MIN.	TYP.	MAX.	CONDITIONS	
h_{FE} DC pulse current gain	40		120	I_C = 150mA	V_C = 10V
h_{fe} Small-signal current gain	3.0	5		I_C = 50mA, f = 20mc	V_C = 10V
C_{ob} Collector capacitance		18µµf	25µµf	I_E = 0mA	V_C = 10V
I_{CBO} Collector cutoff		0.8mµA	10mµA	V_C = 60	T = 25° C
		1.0µA	10µA	V_C = 60	T = 150° C

LOW-NOISE, LOW-LEAKAGE PLANAR CHARACTERISTICS IN THE FAIRCHILD 2N1613 ARE THE KEY

Low overall noise in this example of a transistor amplifier circuit comes from use of transistors with ideal low-noise characteristics. "Flicker" and "shot" noise — the low- and high-frequency components of transistor noise — are uniquely minimized by the **planar** 2N1613.

Detailed Application Notes disclose complete design and operation considerations for low-noise transistor circuitry. May we send you your copy?

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WHO CAN SHOW YOU A
220 MC FREQUENCY METER
WITH THESE FEATURES?
* All Solid State 10 MC Counter Section
* All Solid State Time Interval Plug-in
* Power Consumption 125 Watts
* Decade Count-down Time Base
* Two Year Warranty Except for Converter Tubes
* Rugged Unitized Construction
0012970
Model 737AN with inline readout.
Move it anywhere you want with ease. Rack Mounting simpler, too.

Only CMC can! **Only CMC's Frequency-Period Meter offers solid state reliability and 48 pound compactness.**

DO ALL THESE JOBS:

- Measure frequency dc to 220 mc
- Measure period to 0.1 microsecond
- Measure time interval 0.1 microsecond to 10^7 seconds
- Count dc to 10 mc

Now · See how the CMC 737A compares with its two closest competitors

	CMC Model 737A	Company A 220 mc unit	Company B 220 mc unit
CIRCUITRY	All solid state counter section	100% vacuum tube	100% vacuum tube
TOTAL NUMBER OF VACUUM TUBES	13	91	75
WEIGHT	Net 48 lbs.	Net 118 lbs.	Net 115 lbs.
SIZE	14" H x 17" W x 13" D (1.8 cu. ft.)	21⅛" H x 20" W x 23½" D (5.8 cu. ft.)	20" H x 20" W x 19" D (4.4 cu. ft.)
POWER	125 watts	600 watts	380 watts
TIME BASE	Decade count-down type; no divider adjustment	Multi-vibrator type; requires frequent adjustment	
WARRANTY PERIOD	2 years	1 year	1 year
PRICE (basic unit with vertical decade display)	$2400	$2150	$2275
(converter plug-ins)	$250 each	$250 each	$250 each
(TIM plug-in)	$300 each	$175 each	Included

WHAT IT IS

CMC's Model 737A Frequency Meter combines an all solid state 10 mc digital counter and a vacuum tube heterodyne converter. Three converter plug-ins are currently available with more on the way. Model 731A plug-in extends the 10 mc range to 100 mc and Model 732A covers 100 mc to 220 mc. The third available plug-in, Model 751A, is an all solid state 0.1 microsecond to 10^7 second time interval section.

LOW POWER—A KEY ADVANTAGE

The complete instrument uses only 125 watts of power which reduces operating temperatures, prolongs component life, and assures long trouble-free operation. Even at 10 mc, transistors are well derated. Because of this inherent reliability, CMC offers a two year free service warranty except for converter tubes—the first manufacturer to offer this extended guarantee.

THESE FEATURES, TOO

Automatic decimal point ✱ Inline readout available as standard option ✱ Stability, 2 parts in 10^7 standard, 5 parts in 10^8 special. ✱ Accuracy, ±1 count ± oscillator stability ✱ Sensitivity, 0.25 v rms ✱ Standardize against WWV ✱ Remote programming without special regard to cable length, type of cable, or impedance matching ✱ Printer output to drive digital recording equipment, punches, inline readout and other data handling gear, $80.00 extra.

AND HERE'S 100% SOLID STATE RELIABILITY

CMC offers a complete line of transistorized digital instrumentation including universal counter-timers, time interval meters, frequency-period counters, printers and preset counter-controllers. Here are two models especially suited for applications where high reliability and flexibility of function are key factors. These units can also be remotely programmed by simply closing contacts.

Model 727A Universal Counter-Timer

Using only 50 watts, Model 727A measures dc to 10 megacycles and 0.1 µsec to 10^7 seconds. Three input channels. Decade count-down time base. Price $2750.

Model 726A Universal Counter-Timer

Only 5¼ inches high and weighing just 25 pounds, Model 726A measures dc to 1.2 mc and 1.0 µsec to 10^6 sec. Three input channels. Decade count-down time base. Power consumption 40 watts; price, $1800.

FOR MORE INFORMATION —contact your CMC representative for a demonstration, or write for new technical bulletins. Please address Dept. 44.

CMC

9 8 7 6 5 4 3 2 1 0

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Circle 66 on Inquiry Card

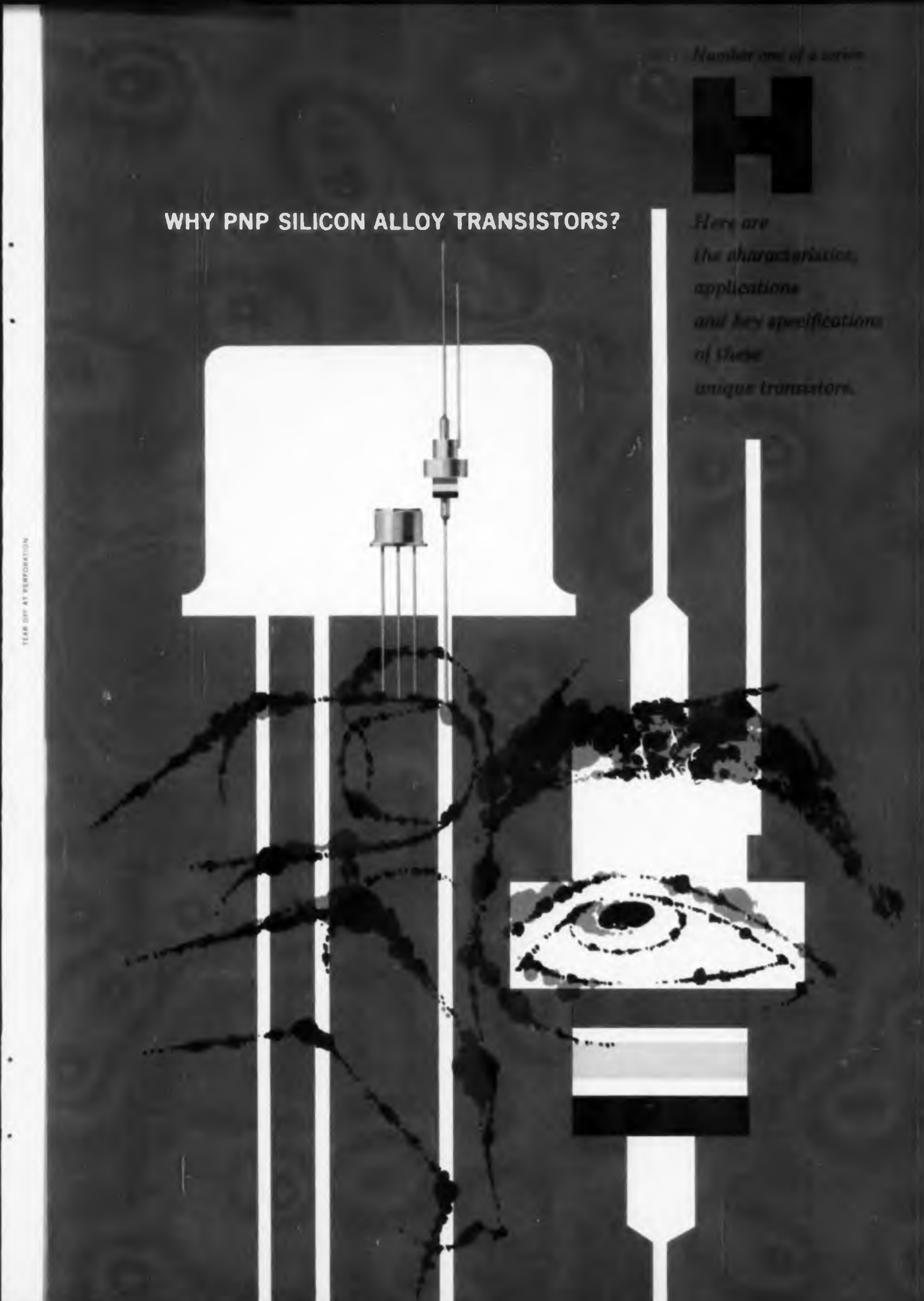
CONTRACT AWARDS IN FISCAL 1960

This list gives (in order by dollar volume) the 100 parent companies which received the largest volume of military prime contract awards in 1960.

1. General Dynamics
2. Lockheed Aircraft Corp.
3. Boeing Airplane Co.
4. General Electric Co.
5. North American Aviation, Inc.
6. Martin Co. (The)
7. United Aircraft Corp.
8. American Telephone & Telegraph Co.
9. Radio Corp. of America
10. Douglas Aircraft Co.
11. Hughes Aircraft Co.
12. Raytheon Co.
13. Sperry Rand Corp.
14. International Business Machines Corp.
15. Republic Aviation Corp.
16. Westinghouse Electric Corp.
17. General Tire & Rubber Co.
18. Bendix Corp.
19. Grumman Aircraft Engineering Corp.
20. General Motors Corp.
21. Newport News Shipbuilding & Dry Dock Co.
22. McDonnell Aircraft Corp.
23. International Telephone & Telegraph Co.
24. Chrysler Corp.
25. Standard Oil Co. (N. J.)
26. Avco Corp.
27. Chance Vought Aircraft Corp.
28. Northrop Corp.
29. Thiokol Chemical Corp.
30. Burroughs Corp.
31. Thompson Ramo Wooldridge, Inc.
32. Standard Oil Co. of California
33. Collins Radio Co.
34. Minneapolis-Honeywell Regulator Co.
35. Pan American World Airways, Inc.
36. Philco Corp.
37. Hercules Powder Co.
38. Merritt-Chapman & Scott Corp.
39. Goodyear Tire & Rubber Co.
40. Texaco, Inc.
41. Kaiser-Raymond-Macco-Puget Sound
42. General Precision Equipment Corp.
43. Garrett Corp.
44. American Bosch Arma Corp.
45. Curtiss-Wright Corp.
46. Ryan Aeronautical Co.
47. Socony Mobil Oil Co.
48. Continental Motors Corp.
49. Bethlehem Steel Corp.
50. Temco Aircraft Corp.
51. Bell Aircraft Corp.
52. Kiewit (Peter) Sons Co.
53. Marquardt Corp.
54. Ogden Corp.
55. Massachusetts Institute of Technology
56. American Machine & Foundry Co.
57. Food Machinery & Chemical Corp.
58. Kaman Aircraft Corp.
59. Morrison-Knudsen Co.
60. Magnavox Co. (The)
61. Hazeltine Corp.
62. Shell Caribbean Petroleum Co.
63. Laboratory for Electronics, Inc.
64. General Telephone & Electronics Corp.
65. Lear, Inc.
66. Sanders Assoc., Inc.
67. Continental Oil Co.
68. Westinghouse Air Brake Co.
69. Olin Mathieson Chemical Corp.
70. Jones (J. A.) Construction Co.
71. Mason & Hanger—Silas Mason Co
72. System Development Corp.
73. Johns Hopkins University
74. DuPont (E. I.) de Nemours & Co.
75. Cities Service Co.
76. Motorola, Inc.
77. Goodrich (B. F.) Co.
78. Hoffman Electronics Corp.
79. MacDonald Scott & Associates
80. States Marine Corp.
81. Ford Motor Co.
82. Hayes Aircraft Corp.
83. Richfield Oil Co.
84. Air Products, Inc.
85. Leavell-Scott & Associates
86. Cook Electric Co.
87. Gulf Oil Corp.
88. Tidewater Oil Co.
89. Overseas National Airways, Inc.
90. ARCO, Inc.
91. Fairchild Engine & Airplane Corp.
92. Firestone Tire & Rubber Co.
93. Standard Kollsman Industries, Inc.
94. Gilfillan Bros., Inc.
95. International Harvester Co.
96. Loral Electronics Corp.
97. Sunray Mid-Continent Oil Co.
98. Eby (Martin K.) Construction Co.
99. U. S. Rubber Co.
100. Utah-Manhattan-Sundt

PRE-LAUNCH ACTIVITIES


Guidance building for the Atlas ICBM. GE test conductors, supervisors, and console operators engage in pre-launch activities.


Number one of a series
H
WHY PNP SILICON ALLOY TRANSISTORS?
Here are
the characteristics,
applications
and key specifications
of these
unique transistors.
TEAR OFF AT PERFORATION

Why PNP Alloy Transistors?

Soon after the introduction of the transistor, many applications which had formerly utilized vacuum tubes were redesigned to take advantage of the favorable characteristics of the new component. Some of these applications were ideally suited to the germanium transistor. But where high operating temperatures or low currents were involved, silicon (with its substantially lower leakage current) gave the circuit designer hope for his critical applications. ■ In designing these silicon transistors, semiconductor manufacturers faced a problem. The alloy process which had proved successful for germanium transistors was found to be extremely difficult with silicon. However, even the earliest silicon alloy transistors indicated a uniformity of desirable characteristics which warranted further research and development. NPN transistors did not lend themselves to the alloy process, so most manufacturers turned to an NPN silicon grown junction process. Circuit designers' needs; however, for a reliable PNP silicon alloy transistor still remained. ■ Some semiconductor manufacturers persisted, and pioneered(1) a PNP silicon alloy transistor. Today it is not only accepted wholeheartedly by the military, but regarded as the "work horse" for high and low level transistor circuitry by electronic design engineers throughout the world. It might be added that PNP silicon alloy transistors are being used in every major missile currently programmed.

Reliability Insurance

In order to insure a stable, reliable product Hughes Semiconductors has established a strenuous test program. Here in detail are two typical environmental tests to which every Hughes silicon alloy transistor is subjected.

Temperature Cycle "Heat-Freeze" Process One hour storage at −65°C, then one hour storage at 200°C alternating the process for 250 continuous hours! All temperature changes take place in less than a minute and are performed automatically in oven-freezers which were designed and built especially for Hughes. Result: Extreme device stability.

Hermetic Seal Test Each transistor is immersed in a liquid detergent with one hundred pounds of pressure applied—and maintained for two hours! Each transistor is then given a thorough leakage current test. Additionally, on a sampling basis, these transistors are subjected to a helium leak rate test. Precautions such as these insure maximum device reliability in your circuits.

Characteristics and Advantages

Dependent upon your specific requirements, some features will obviously be of more importance to you than others. Actually, the proper combination of the following characteristics will produce a high-quality, general purpose PNP silicon alloy transistor. (See Table I for current Hughes family types.)

- High Breakdown Voltages
- Symmetrical Breakdown Voltages
- Uniform Gain Vs. Current Characteristics
- Low Saturation Resistance
- Low Input Impedance
- Low Leakage Current
- High Power Dissipation
- Low Level Operation
- Inverse Gain
- Low Standoff Voltage
- Low Noise Figure

Especially worthy of consideration is the low saturation resistance, which results in small collector to emitter voltage drops permitting low level switching not possible in many of the other types of silicon transistors. Linear operation of silicon alloy transistors is retained even if the collector-base voltage drops to zero – or to a slightly positive value. The breakdown voltages (BV_{EBO}, BV_{CBO} and BV_{CEO}) shown in Table I feature voltages as high as −110V (guaranteed minimum values) on some types. In normal configurations, high collector voltages are possible, making these devices usable in applications such as relays and magnetic core drivers where an "inductive spike" might destroy other transistors. ■ The uniform electrical characteristics and the narrow range of parameter variations also make silicon alloy transistors most desirable. One outstanding example of this is their acceptance in dc differential amplifiers.(2)

Applications and End Products

Some of the more popular applications for this device are ac and dc(2) amplifiers, audio oscillators, low-level circuits(3), switching, dc choppers and modulators, especially those applications operating with elevated or varying ambient temperatures. Typical end products from the above uses are regulated power supplies, computers, missile guidance systems, communication and telemetry equipment, and servo systems.

(1) Hughes Aircraft Company, Semiconductor Division began work on silicon alloy transistors in early 1954 and have continued their research efforts through the present.

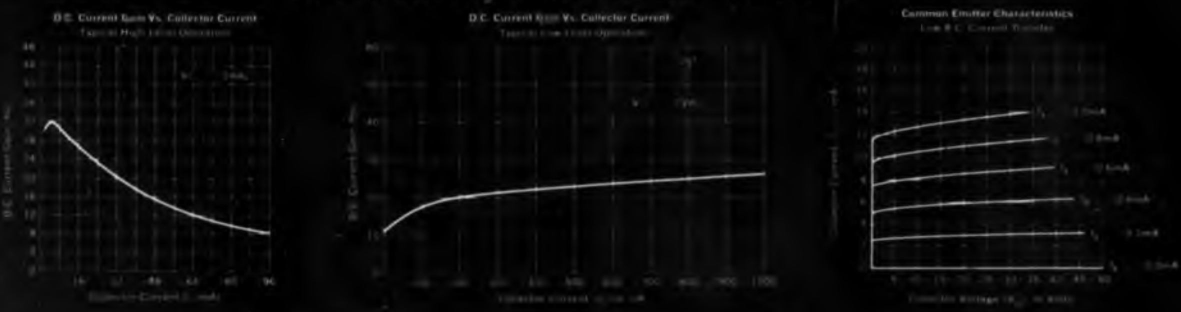
(2) W. Steiger, "A Transistor Temperature Analysis and Its Application to Differential Amplifiers" IRE TRANS. INSTRUMENTATION, Vol. I-8, December 1959.

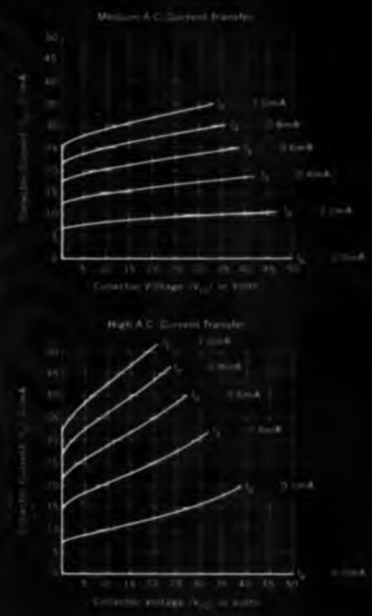
(3) C. D. Todd, "Preamplifier Designed for Minimum Power Consumption" ELECTRONICS, Vol. 33, April 29, 1960.

Hughes Silicon Alloy Transistor Families — Table I

Type	Max. Collector Voltage V_{CE} (V)	Max. Leakage Current I_{CBO} (uAdc)	A.C. Current Transfer h_{fe} (Min)	(Typ)	(Max)	D.C. Current Gain h_{FE} (Min)	(Typ)	(Max)	Write for Descriptive Sheet	Description
2N1238	−15	−0.1	14		[illegible]		[illegible]		[illegible]	[illegible]
2N1239	−15	−0.1	28		[illegible]		[illegible]			
2N1240	[illegible]	−0.1	14		[illegible]		14			
2N1241	[illegible]	[illegible]	28		[illegible]		[illegible]			
2N1242	[illegible]	[illegible]	14		[illegible]		14			
2N1243	[illegible]	−0.1	28		[illegible]		[illegible]			
2N1244	−110	−0.1	14		[illegible]		[illegible]			
2N1228	−15	−0.1	14		[illegible]		14		[illegible]	[illegible]
[illegible]	[illegible]	−0.1	[illegible]		[illegible]		[illegible]			
2N1230	[illegible]	−0.1	14		[illegible]		14			
2N1231	−35	−0.1	28		[illegible]		[illegible]			
2N1232	−60	−0.1	[illegible]		[illegible]		[illegible]			
2N1233	−60	−0.1	28		[illegible]		[illegible]			
2N1234	−110	−0.1	14		[illegible]		14			
2N327A	[illegible]	−0.1		[illegible]		9		[illegible]	[illegible]	[illegible]
2N328A	−35	−0.1		[illegible]		[illegible]		[illegible]		
2N329A	[illegible]	−0.1		[illegible]		[illegible]		[illegible]		
2N1034	−40	[illegible]	[illegible]		[illegible]				[illegible]	[illegible]
2N1035	−35	[illegible]	[illegible]		[illegible]					
2N1036	−30	[illegible]	[illegible]		[illegible]					
2N1037	[illegible]	[illegible]	[illegible]		[illegible]					

TYPICAL CURVES OF SILICON ALLOY TRANSISTORS @ 25 C





Other factors which are used to insure reliability at Hughes are: a. Rigid visual inspection. b. Mechanical vibration under operating conditions. c. Mechanical shock under operating conditions. d. Thermal shock (temperature cycle). e. Moisture resistance (temperature-humidity cycling). f. Operating and storage life tests at specific temperatures. ■ In each case, load levels are equal to or greater than the rated values for any given transistor design. Specific failure mechanisms associated with each type of load are identified and the device is disqualified if it fails to meet required specifications.

NOTE: A truly reliable silicon alloy transistor uses no tin or low melting solders of any kind, but has alloys which melt at temperatures well above the maximum junction temperature of silicon. For complete hermetic sealing at all temperatures, all joints should be welded, including the final seal.

Package Configurations... choice of two package styles

Most [illegible] MIL-S-19500B

Coaxial Package The coaxial package is designed so that junction heat is dissipated through the case allowing a rating of 1 watt in free air. Ratings in excess of 5 watts may be obtained by the use of a properly designed heat radiator (See photograph A). ■ Another advantage of the coaxial package is that it can be attached to circuit boards by familiar resistor-mounting techniques, and can therefore be handled by automatic assembly machinery.

Photo A – shown with heat radiator designed to allow 5 watts dissipation.

TO-5 Package This sturdy package is standard throughout the industry. The TO-5 package is constructed to operate normally at 400mW; however a rating of up to 600mW can be obtained by use of heat radiators such as those shown in photograph B. The major differences between the coaxial package and the TO-5 package, other than power handling capabilities, is that each of the three elements is insulated from the case in the TO-5 design.

Photo B – shown with various types of heat radiators designed to allow 600mW dissipation.

[illegible]

Purchasing Do's and Don'ts

DON'T specify a device that does not exist for your circuits—although this will motivate research and development groups to design better products for the future ... the immediate result is long delay in quantity delivery. Be sure you can wait if your requirement is exotic.

DON'T specify inferior products for economical purposes resulting in unreliable circuit performance. This practice creates a vicious reject and replacement cycle between manufacturer and user.

DON'T buy from manufacturers whose facilities are not adequate for testing to rigid military specifications and production quantity delivery is questionable.

DON'T attempt to buy reliability by specifying breakdown voltages far in excess of those required. There may be some exceptions, however, this is a very expensive practice. DO buy reliability—not reliability by safety factor!

DO make sure that the transistors you buy meet the manufacturer's advertising and registered specifications.

DO make sure your 2N transistor type is "registered" with EIA, not "reserved." When using types with a "reserved" status, the manufacturer may alter his specifications at will.

DO make sure the leakage currents are measured at a reverse voltage as high as your present requirement demands.

DO remember that reliability has to be designed in the transistor; it cannot be tested in. No amount of testing will undo poor design. However, it is important that the manufacturer have a sound quality assurance program to insure that the reliability is actually there.

DO make sure that a transistor that is to be used as a switch meets your speed requirements by actual test in your circuit; this is the only true test. Manufacturers often show values for switch speeds that are optimized.

DO use silicon alloy transistors in applications such as relays and magnetic circuits, where inductive spikes might ruin other transistors.

DO be sure to get the saturation resistance you need. Low V_{CE} (sat) parameter does not guarantee low saturation resistance unless the test conditions are given. (I_C and I_B)

DON'T guess what the parameters will be if your circuit is intended for high temperature application, but DO get the proper data from the manufacturer.

Hughes and the Silicon Alloy Transistor

Silicon alloy transistors are here to stay, but the circuit designer is constantly seeking to improve the device—such is Hughes' goal—to achieve a more perfect transistor. Hughes' research engineers are currently working toward the following ideal goals:

- Saturation resistance approaching zero
- Leakage current approaching micro-micro-amps
- More uniform gain for current variation
- Parameter changes independent of temperature
- Infinite life expectancy and reliability
- Microminiaturization
- High gain at microwatt levels

The foregoing information has been gathered from the Hughes Semiconductor Division's reports and records on the silicon alloy transistor, compiled with the cooperation of Hughes' staff of skilled engineers. ■ Pioneer in the semiconductor field, Hughes has continued as a top developer and producer of the most advanced semiconductor devices. The Newport Beach plant, with its third of a million square feet of floor space, houses all of the facilities necessary for every phase of design, development and production of diodes, transistors, rectifiers, special devices and semiconductor materials. ■ *For further information call or write your nearest Hughes Semiconductor Sales Office. Or write: Hughes Semiconductor Division, Marketing Dept. 500 Superior Ave., Newport Beach, California.*

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Tele-Tips

COMPUTER SPEED COMPARISONS are never-ending. But we like this one: Had the computer that predicted Pres. Eisenhower's election been running continuously since 1952 it would have completed as many calculations as one of today's large computers can make in 24 hours.

COMPETITION, HARD WORK, LONG HOURS. These are the least frequently mentioned aspects of jobs mentioned by 135 college recruiting brochures. The Univ. of Michigan's Bureau of Industrial Relations analyzed the brochures. Another aspect: the brochures seldom mentioned that people expecting promotions could expect an increasing burden of responsibility.

WORK ON THIS ONE for a while. If the temperature is zero and it's going to be twice as cold, how cold will it be?

ENGINEER SHORTAGE has generated another shortage—a shortage of engineering recruiters. One recruiter is applying for engineering jobs, then trying to recruit the recruiter.

MERCURY DRY CELL BATTERY EXPLOSIONS have been reported. The batteries are more apt to explode when subject to excessive heat (400°F) or by a short-circuit. Philco Corp.'s TechRep Bulletin advises these safety rules:

- Never discharge a mercury-cell battery after its voltage falls below 70% of its nominal voltage, or when it fails to operate the equipment in which it is used.
- Never place a direct short across a mercury-cell battery.
- Never leave the battery switch "ON" when the equipment is not in use, or after the battery fails to operate the equipment.
- Never retain exhausted batteries. Discard dead batteries as soon as possible.
- Store spare mercury-cell batteries in a cool, adequately ventilated area.

(Continued on page 62)

10 ADVANTAGES OF DESIGNING WITH SYLVANIA COLD CATHODE DECADE COUNTER TUBES

1 Sylvania Decade Counter Tubes combine actuating and direct visual readout capabilities. (Visual information is obtained by observing a sharply defined ion glow moving around a common anode on a peripheral ring of 30 cathodes.) **2** This significantly reduces circuitry and component requirements, **3** enables compact design, **4** enhances circuit reliability, **5** reduces equipment costs.

Further, Sylvania Counter Tubes feature **6** "add-subtract" capabilities, **7** low power requirements, **8** comparatively low cost. They offer **9** improved performance under standby operation, **10** reliable long life. (As assurance, large samples are tested under standby conditions, thermal and mechanical shock conditions, and cycled life operation.)

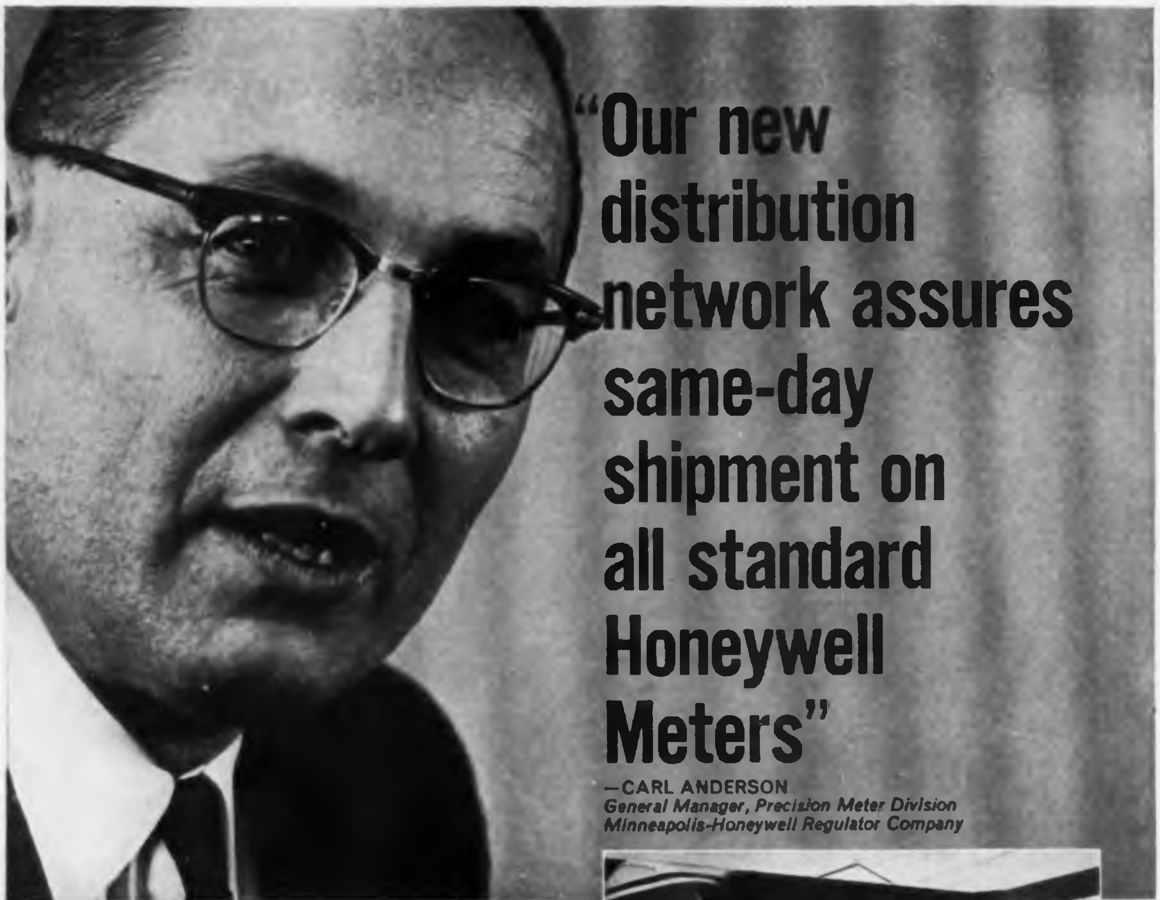
Have a design problem? Count on your Sylvania Sales Engineer for full data and engineering assistance. For the informative Decade Counter Tube Handbook, contact your Sylvania Industrial Tube Distributor or enclose 15¢ to Electronic Tubes Division, Sylvania Electric Products Inc., Dept. 1912, 1100 Main St., Buffalo 9, N. Y.

Sylvania Types	Total Anode Current (mA) Min.	Total Anode Current (mA) Max.	Min. Anode Supply Voltage (Vdc)	Min. Double Pulse Amplitude (V)	Min. Double Pulse Width (μsec)
(0-4KC)					
6476(T-11) 6802(T-9) 6879(T-5½)	0.3	0.6	350	—75	60
(0-100KC)					
6909(T-9) 6910(T-11) 7155(T-5½)	0.6	0.8	400	—85	4

SYLVANIA

Subsidiary of **GENERAL TELEPHONE & ELECTRONICS**

Circle 23 on Inquiry Card



We now have distributors in 20 key cities throughout the nation. For prompt handling of all orders for our top-quality panel instruments, just get in touch with the Honeywell distributor nearest you, our sales representatives, or with us directly: Precision Meter Division, Minneapolis-Honeywell Regulator Co., Manchester, N. H., U.S.A. In Canada, Honeywell Controls Limited, Toronto 17, Ontario; and around the world, Honeywell International Division, Sales and Service Offices in all principal cities.

These are the organizations who can get Honeywell Precision Meters to you in a hurry:

CALIFORNIA: Atlas Electronics, Inc., 4618 Santa Fe St., San Diego 9, BR 4-3131; Bell Electronic Corp., 306 E. Alondra Blvd., Gardena, FL 1-5802; Fisher Switches Inc., 40 Gouch St., San Francisco, UN 1-2569; Elwyn W. Ley Co., 16514 So. Garfield Ave., Paramount, NE 6-8339; Newark Electronics Corp., 4747 W. Century Blvd., Inglewood, OR 8-0441; **CONNECTICUT:** Radio Shack Corp., 230 Crown St., New Haven, ST 7-7121; Radio Shack Corp., 29 High Ridge St., Stamford, DA 5-4371; **WASHINGTON, D.C.:** Electronic Wholesalers Inc., 2345 Sherman Ave., W., Washington 1, HU 3-5200; **ILLINOIS:** Newark Electronics Corp., 223 W. Madison St., Chicago 6, ST 2-2944; **MASSACHUSETTS:** Electrical Supply Corp., 205 Alewife Brook Pky., Cambridge, UN 4-6300; Radio Shack Corp., 730 Commonwealth Ave., Boston 17, RE 4-1000; **MICHIGAN:** Electronic Supply Co., 94 Hamelin Ave., Battle Creek, WO 4-1241; **MINNESOTA:** Stark Electronics Supply Co., 112 Third Ave., No., Minneapolis, FE 6-9220; **NEW JERSEY:** State Electronic Parts Corp., 399 Rte. #10, Whippany, TU 7-2550; **NEW YORK:** A & M Instrument Service Inc., 48-01 31st Ave., L.I. City 3, RA 6-4343; Peerless Radio Distributors Inc., 19 Wilbur St., Lynbrook, L.I., LY 3-2121; **OHIO:** Herrlinger Distributing Co., 112 East Liberty St., Cincinnati 10, GA 1-5285; **PENNSYLVANIA:** Harold H. Powell Co., 2102 Market St., Philadelphia 3, LO 7-5285; **WASHINGTON:** Branom & Leeland Instrument Co., 2137 2nd Avenue, Seattle 1, MA 2-7320.

Honeywell International Sales and Service offices in all principal cities of the world.

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Precision Meters

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Think of every feature, every benefit, you would design into a soldering iron if you could...and you have IMPERIAL! Only UNGAR experience and research could have developed this cool, light-weight, easy-handling iron. From tip to cord...the ultimate in interchangeability. There are so many revolutionary new ideas in IMPERIAL we had to put them all in an 8-page brochure. Send for your free copy now!
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Tele-Tips

(*Continued from page 58*)

RECESSION is hitting the big boys too. The Wall Street Journal reports that some execs are getting hit where it hurts the most—in the expense account. Seems that some companies are unwilling to risk bad public relations by laying-off production workers without cutting back on executive fringe benefits.

WHY DO PH.D.'s, more than any other group, seem to hit the extremes in their writing styles? Either their articles are remarkably clear and concise—written in the simplest language possible—or they are so complicated and abstract that few readers can follow them.

ONE GOOD SECRETARY IS WORTH TWO (OR MORE) SCIENTISTS. according to a formula worked out by a Univ. of Michigan publication. Formula defines scientific productivity as:

$$\text{Productivity} = \frac{\text{Secretaries} \times \text{age typing speed}}{\text{Number of scientists}}$$

How did they arrive at this? They reasoned that when one secretary services several scientists, each scientist wastes a lot of time worrying if she is doing more work for the others than for him. If one scientist has several secretaries, he is kept very busy supplying them with work to do because he is afraid of losing them. Only hitch: as the number of scientists approaches zero, productivity approaches infinity.

CCTV GUARDS AGAINST MASHERS. New York hotel has installed closed-circuit TV in its elevators. A special wide angle lens transmits *all* that goes on to three monitors.

GREEN STAMPS? A leading producer of industrial cleaning equipment and chemicals is offering the familiar retail-store S & H Green Stamps to its industrial customers. Company says key customers are enthusiastic. Probably prodded by their "better halves."

Self-Aligning . . . Even with Commercial Tolerances

Vegetable crate construction is generally frowned upon for complex modular installations. But, with Deutsch self-aligning rack-and-panel connectors, commercial tolerances between mounting hole centers are perfectly okay. When the drawer is slid home, each spring-mounted plug floats into engagement with its receptacle. Spring pressure then maintains an environmental seal. For complete information on this easy-to-mount line of cylindrical and rectangular rack-and-panel connectors contact your local Deutschman today or write for Data File A-3.

DEUTSCH

Electronic Components Division
Municipal Airport
Banning, California

ADVANCED SPECIFICATION MINIATURE ELECTRICAL CONNECTORS

■ *A production reality based on 20 years of crystal engineering experience...*

Miniature Wide Band-Pass Crystal Filters Delivered In Quantity...To Specification

Filters just recently considered as "state of the art" are now a *production* reality. In addition to its many stock narrow band filters, Midland offers prototype and production quantities of practical Miniature Wide Band Filters in the .5 to 30 mc range. These filters are of exceptional quality. They are essentially free from unwanted spurious modes which have previously limited the realization of many types of wide band filters. Small quantities for engineering evaluation are available *immediately* from stock. Consultation is available at any time to potential filter users.

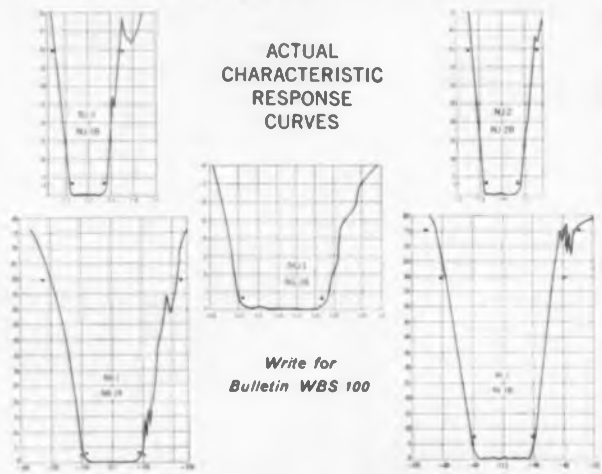
Shown below are specifications for ten of our stock wide band filters, as well as actual characteristic response curves. These filters are actually being delivered to major weapons system manufacturers in quantities — to specification.

THESE ARE NOT LABORATORY CURIOSITIES OR IN PROTOTYPE DEVELOPMENT STAGE

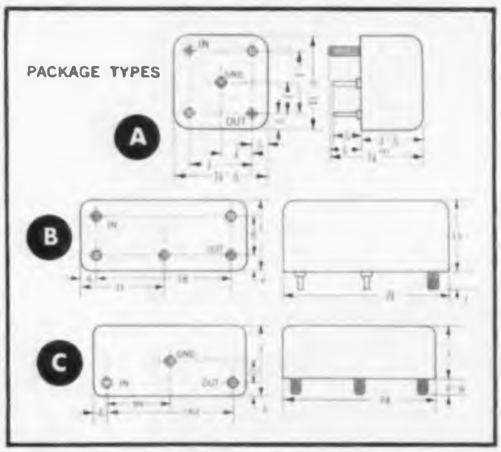
Type	Center Freq.	3db Bandwidth Minimum	40db Bandwidth Max.	60db Bandwidth Max.	75db Bandwidth Max.	Ultimate Discrim. Minimum	Insertion Loss Max.	Impedance ohms	Inband Ripple Max.	Package Type
NJ-1	7.2MC	160KC	300KC			60db	6db	13K	1db	A
NJ-1B	7.2MC	160KC	300KC			60db	6db	13K	.5db	B
NJ-2	7.4MC	160KC	300KC			60db	6db	13K	1db	A
NJ-2B	7.4MC	160KC	300KC			60db	6db	13K	.5db	B
NG-1	5.09MC	160KC	350KC			60db	6db	20K	1db	A
NG-1B	5.09MC	160KC	350KC			60db	6db	20K	1db	B
NB-1	10.7MC	200KC		450KC		75db	12db	50	1db	A
NB-1B	10.7MC	200KC		450KC		85db	8db	50	.5db	B
RL-1	11.5MC	80KC		160KC	200KC	85db	6db	50	.5db	C
RL-1B	11.5MC	80KC		160KC	200KC	90db	5db	50	.5db	B

Operating Temp.: —55°C to +90°C Shock: 100g Vibration: 15g to 2KC Units hermetically sealed

ACTUAL CHARACTERISTIC RESPONSE CURVES



Write for Bulletin WBS 100



A limited number of opportunities for filter and communications engineers and technicians are available. Write Mr. Robert A. Crawford, Chief Engineer, Filter Division.

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MID 1-61

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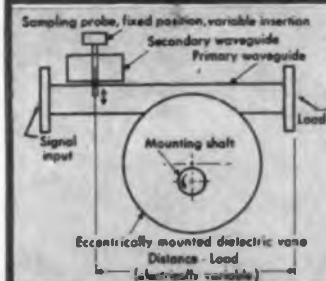
Infinite care in producing all the FXR 2- and 3-mm waveguide components is exemplified by:

- Components machined and milled as needed out of solid blocks.
- All components internally gold plated to preserve their low insertion loss features.
- Precision differential screw micrometer drives (readable to ±0.001 millimeters) used for FXR G band Frequency Meters and Precision Sliding Shorts.

FXR G105A SLOTTED SECTION



- Frequency Range: 140-220 KMC/sec
- Novel technique (see drawing) incorporates a fixed position probe and an adjustable phase shifter to sweep VSWR pattern past the probe.
- Recommended accessories: FXR G208A Detector Mount and Crystal

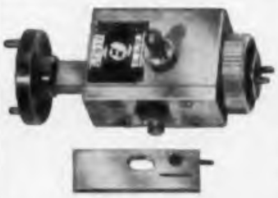
FXR also has available the most complete line of mm waveguide components for use in the 18 KMC to 90 KMC region

FXR G208A DETECTOR MOUNT WITH FXR Z224A CRYSTAL DETECTOR CARTRIDGE

- Frequency Range: 140-220 KMC/sec
- In-guide detector elements for maximum sensitivity
- Series 208 Detector Mount can be used with replaceable crystal, bolometer, or thermistor cartridges
- Recommended accessories:
  FXR Z224A Crystal Detector Cartridge
  FXR Z230S Bolometer Cartridge
  FXR Z235S Thermistor Cartridge

FXR G412A FREQUENCY METER

- Frequency Range: 140-220 KMC/sec
- Micrometer dial, calibration chart supplied provides an accuracy of ±0.5%. Specific point accuracy ±0.2%.
- Self-calibrating by using successive resonances



FXR G781A HARMONIC GENERATOR WITH FXR Z225S HARMONIC GENERATOR CARTRIDGE

- Provides second harmonic output signal in the frequency range 140-220 KMC/sec when supplied with a fundamental frequency input signal
- Required accessory: FXR Z225A Harmonic Cartridge

These components are also available in the FXR F band (90 to 140 KMC)

2 & 3-mm waveguide components

FXR SERIES PREFIX WAVEGUIDE SIZE IN INCHES (I.D.)	F .080 x .040	G .051 x .0255
FREQUENCY RANGE IN KMC/SEC	90.-140.	140.-220.
SLOTTED SECTIONS	F105A $1400	G105A $1400
ATTENUATORS—Precision Calibrated	F163A $ 975	G163A $ 975
CRYSTAL DETECTOR MOUNTS—Tuneable	F208A $ 400	G208A $ 400
CRYSTAL DETECTOR CARTRIDGE	Z224S $ 150	Z224S $ 150
HARMONIC GENERATOR	F781A $ 475	G781A $ 475
HARMONIC GENERATOR CARTRIDGE	Z225S $ 150	Z225S $ 150
BOLOMETER CARTRIDGE	Z230S $ 150	Z230S $ 150
THERMISTOR CARTRIDGE	Z235S $ 150	Z235S $ 150
TUNERS—E/H	F313A $ 775	G313A $ 775
PRECISION PHASE SHIFTERS	F314A $ 950	G314A $ 950
FREQUENCY METERS—Reaction, micrometer	F412A $ 750	G412A $ 750 G413A $ 800
TERMINATIONS—Fixed	F501A $ 150	G501A $ 150
WAVEGUIDE TEES—Series Shunt Hybrid	F620A $ 275 F621A $ 275 F622A $ 325	G620A $ 275 G621A $ 275 G622A $ 325
WAVEGUIDE BENDS—90° E-plane 90° H-plane	F623A $ 275 F624A $ 275	G623A $ 275 G624A $ 275
WAVEGUIDE 90° TWISTS	F625A $ 100	G625A $ 100
PRECISION SLIDING SHORTS	F631A $ 275	G631A $ 275
STRAIGHT WAVEGUIDE SECTIONS (Min. length)	F634A $ 85	G634A $ 85
STANDARD GAIN HORNS	F638A $ 200	G638A $ 200

Characteristics and prices subject to change without notice.

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Typical Output: 75 mW

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Small Signal Gain: 60db
Minimum Power Output: 1 watt

Eimac X-747 Voltage-
Tunable Magnetron
Tuning Range: 400 to 1200 Mc
Nominal Power Output: 100 mW

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New Eimac X- and K-band one watt reflex klystrons with excellent stability and low-noise characteristics.

New Eimac higher powered TWT's to meet the requirements of commercial and military applications.

New Eimac S-band Voltage-Tunable Magnetrons retaining desirable L-band linearity and long life.

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• Maximum Resistance	100,000 ohms
• Indep. Linearity	± .25%, To ± .05%
• Wattage	4.5 watts @ 40° C.
• Taps	Center tap
• Rotations	3600° + 10° − 0
• Maximum Torque	1.0 oz. in.
• Weight	1.0 oz.

WRITE FOR COMPLETE DETAILS

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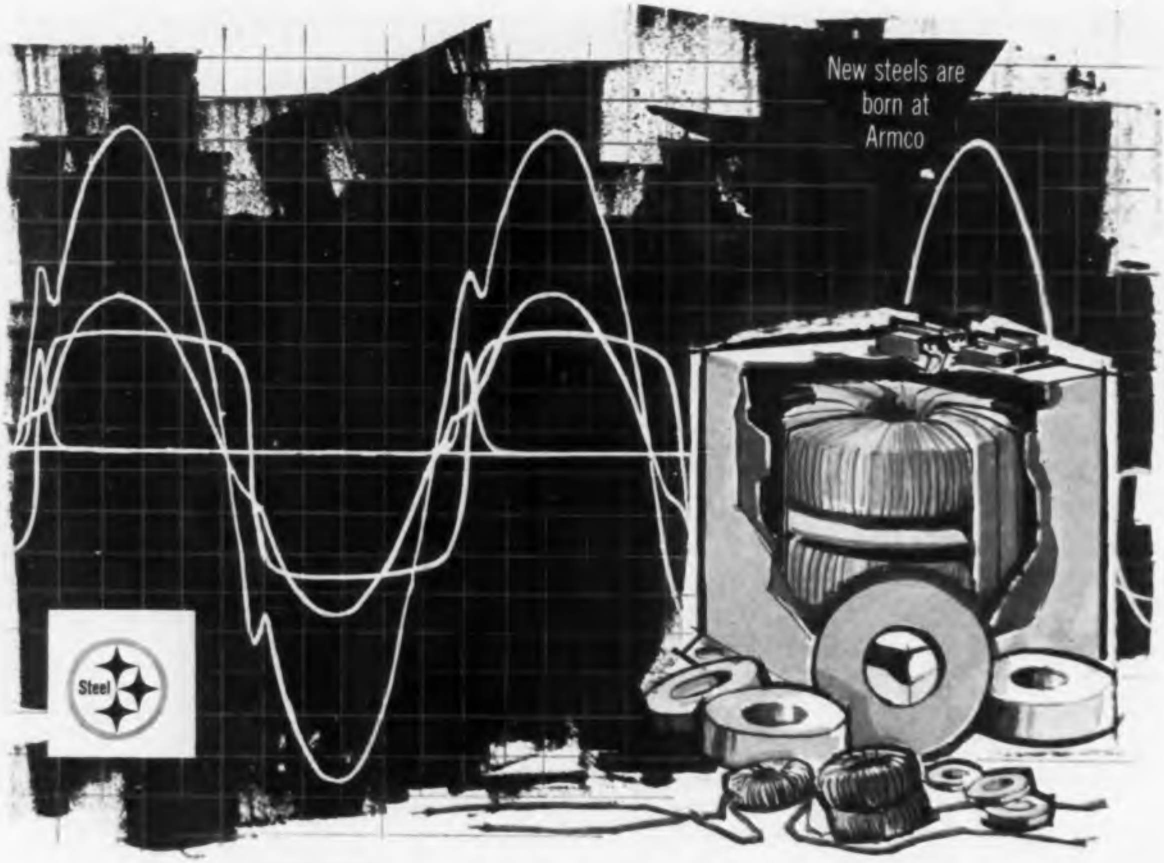
DOVER, NEW HAMPSHIRE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Letters

to the Editor

How Japan Sees EI

Editor, ELECTRONIC INDUSTRIES:

Thank you very much for sending me a copy of "Electron Beam Parametric Amplifiers."

One of my jobs is to make summaries of all theses which appear in your magazine for the Japanese Information Center which publishes "The Technical Abstracts" in Japanese every month. I applied to be the abstractor of your magazine because it is so exciting every month.

Kazuhiko Yazawa
Research Specialist

Electrotechnical Laboratory
Nagata-Cho, Chiyoda-Ku
Tokyo, Japan

"Anyone know where—?"

Some months ago Engineer R. C. Redwood wrote us, asking whether we would be interested in an article on transistors. He included details on what he had in mind.

We would be interested in discussing this further—if we had his return address. He unfortunately neglected to include it on his letter, and we've discarded the envelope.

Can anyone help?

"Minuteman Reliability"

Editor, ELECTRONIC INDUSTRIES:

Please send us a reprint of the article "Component Reliability" which appears in the December 1960 issue of *Electronics Industries*. This reprint will be of value to us in our Measurements Standards Program.

L. R. Wallace
Department 300

IBM Federal Systems Division
Neighborhood Road
Kingston, New York

"New Electronic Markets"

Editor, ELECTRONIC INDUSTRIES:

Please send me three reprints of your very informative article on New Electronic Markets published in the July 1960 issue of *Electronics Industries*.

Austin N. Stanton
Chairman of the Board

Varo Mfg. Co., Inc.
2201 Walnut Street
Garland, Texas

"RFI Series"

Editor, ELECTRONIC INDUSTRIES:

Your series on R.F. Interference should be very helpful and is to be commended. I have missed a part of the series and would like to receive a reprint of those sections of the full series that may be so available.

Lloyd P. Morris

Motorola Inc.
Chicago, Ill.

Editor, ELECTRONIC INDUSTRIES:

I have been following the "RFI" series in your excellent publication and would appreciate reprints of all the articles. My file copies have been either misplaced or have grown legs! Continue the fine work.

W. B. Doan
Range Systems Section

Bell Aerosystems Company
Buffalo 5, New York

Letters to the Editor

Technical Definitions

Editor, ELECTRONIC INDUSTRIES:

With reference to Miss Berman's request on p. 60 in the January 1961 issue of *Electronic Industries* (for a list of technical definitions) you might suggest the Reinhold Publishing Corporation's *Hawley's Technical Speller* for spelling and the Macmillan Company's Chambers's *Technical Dictionary* for definitions.

Melissa Ritter
Engineering Librarian

International Harvester Company
Farm Equipment Research and
Engineering Center
7 South 600 County Line Road
Hinsdale, Illinois

"Boolean Algebra"

Editor, ELECTRONIC INDUSTRIES:

Referencing Volume 19 No. 6 Directory & All Reference Issue; please send me a copy of the reprint on the article titled, AN INTRODUCTION TO BOOLEAN ALGEBRA, written by Theodor H. Levine.

Edward Tangora
Environmental Engineer
Department No. 3930

Kearfott Division
General Precision, Inc.
Little Falls, N. J.

Editor, ELECTRONIC INDUSTRIES:

My attention was directed to the article titled "An Introduction to Boolean Algebra" by Theodor H. Levine which appeared in June 1960 issue of *Electronic Industries.*

This article was well written and contained material that was both interesting and instructive. A notation stated that a reprint of the article was available upon request. If possible, I would like to obtain 25 copies for distribution among the students in our Electronics class. If there is a charge for the additional copies, please bill me accordingly.

J. W. Busman
Superintendent of Training
Sperry Microwave Electronics Company
Division of Sperry Rand Corporation
Clearwater, Fla.

"Oscillator for 450-470 mc"

Editor, ELECTRONIC INDUSTRIES:

I am writing to you to request a reprint of the article appearing in the January '61 edition of *Electronic Industries* entitled "Developing an Oscillator for 450-470 Megacycles," by Nick Goncharoff.

The article was highly interesting and Mr. Goncharoff is to be commended for the great amount of detail covered in the article. For one not engaged in this particular field of electronics the article gave a clear insight into the problems of engineering a piece of equipment to the degree of stability required by both the FCC and the user.

John Miller, Mfg. Engineer
C & A Mfg. Eng.-Electrical
LJED Manufacturing Operation
Building 700, Ext. 1112
General Electric Co.
Cincinnati, O.

Books

Nuclear Forces and the Few-Nucleon Problem

Edited by T. C. Griffith and E. A. Power. Published 1960 by Pergamon Press Inc., 122 East 55th Street, New York 22, N. Y. Two volumes. 712 pages. Price $30.00 per set of two volumes.

Contains the authoritative papers presented by international experts at the London Conference (8-11 July 1959), plus the discussion which followed the presentation of the papers. These important volumes cover the work at present being carried out on few-nucleon processes (3 or more, but less than about 6-12 nucleons).

The work opens with a survey of the present positions of the two-body nucleon - nucleon interaction obtained from consideration both of the "Meson Theory of Nuclear Forces" and of the nucleon-nucleon data below 200 MeV. This is followed by consideration of the few-nucleon processes below 200 MeV both from a theoretical and experimental viewpoint, with emphasis on the extent to which the two-body nucleon-nucleon interaction can be extended to explain the experimental results.

This invaluable report will be of great topical interest to all workers in this extremely important field of research.

Fundamental Physics

By Jay Orear. Published 1961 by John Wiley & Sons, Inc., 440 Fourth Avenue, New York 16, N. Y. 381 pages. Price $6.75.

Especially suited to the non-science student interested in obtaining a truly liberal education, this book gives him an understanding of the physics he reads about in newspapers and magazines — subjects such as space travel, relativity, $E=Mc^2$, the new elementary particles, fallout and the hazards of radiation, anti-matter, and the breakdown of parity. Many applications of the basic principles are presented, including earth satellites, radio, TV, chemistry, astronomy, high energy accelerators, nuclear weapons, nuclear power, and biological effects of radiation.

The understanding of basic principles and their relation to all of physical science is emphasized. The first reasonably accurate picture of what physicists are now doing (not what they have done years ago) is brought to the non-physicist. Reasoning is demanded on every page and very little memorizing is called for.

One of the most valuable features of *Fundamental Physics* is its arresting methods of presentation. Dr. Orear's style is clear and terse. He has included problems which apply to modern, thought provoking situations.

Altogether the book has a *freshness* that simply hasn't been seen before in this field at this level.

(*Continued on page 74*)

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Books

(*Continued from page 72*)

Introduction to the Statistical Dynamics of Automatic Control Systems

By V. V. Solodovnikov. Translation edited by John B. Thomas and Lofti A. Zadeh. Translation published 1960 by Dover Publications, Inc., 180 Varick Street, New York 14, New York. 305 pages, paperbound. Price $2.25.

The author, a leading Soviet engineer, develops a general theory of a highly important class of automatic control systems: those subject to probabilistic or random signals. In developing this theory, Solodovnikov brings together the results of a great deal of research in this field that has until now existed only in scattered American and Russian scientific journals.

An Engineering Approach to Gyroscopic Instruments

By Elliott J. Siff and Claude L. Emmerich. Published 1960 by Robert Speller & Sons Publishers Inc., New York 36. 120 pages. Price $7.50.

This book presents pertinent characteristics of gyroscopes. Starting out from a few special cases which are easily understood, sufficient mathematical formulation is introduced to arrive at quantitative relations that can be applied to new gyroscopic problems. These principles are then applied to the basic gyro configurations that form the foundation of practically all present-day gyroscopic instruments.

Electronic Equipment Reliability

By G. W. A. Dummer and N. Griffin. Published 1960 by John Wiley & Sons, Inc., 440 Fourth Avenue, New York 16. 274 pages. Price $7.50.

While a considerable amount of literature on reliability has been published, the primary aim of this book is to consider the many aspects of the subject of reliability and thus present a summary of present knowledge in order to assist designers and users in obtaining maximum reliability in their equipment.

Electronic Engineering Principles, 3rd Edition.

By John D. Ryder. Published 1961 by Prentice Hall, Inc., Englewood Cliffs, N. J. 428 pages. Price $12.65.

In the 3rd edition, the author has accomplished an especially important innovation: the combination and integration of transistor theory. For the first time, readers learn basic material once only, rather than covering vacuum tube theory, and then redoing the same theory for a transistor. No other book at this level contains this combined treatment of theory that is so much easier for the reader to understand, and save so much time by eliminating duplication of basic material.

(*Continued on page 78*)

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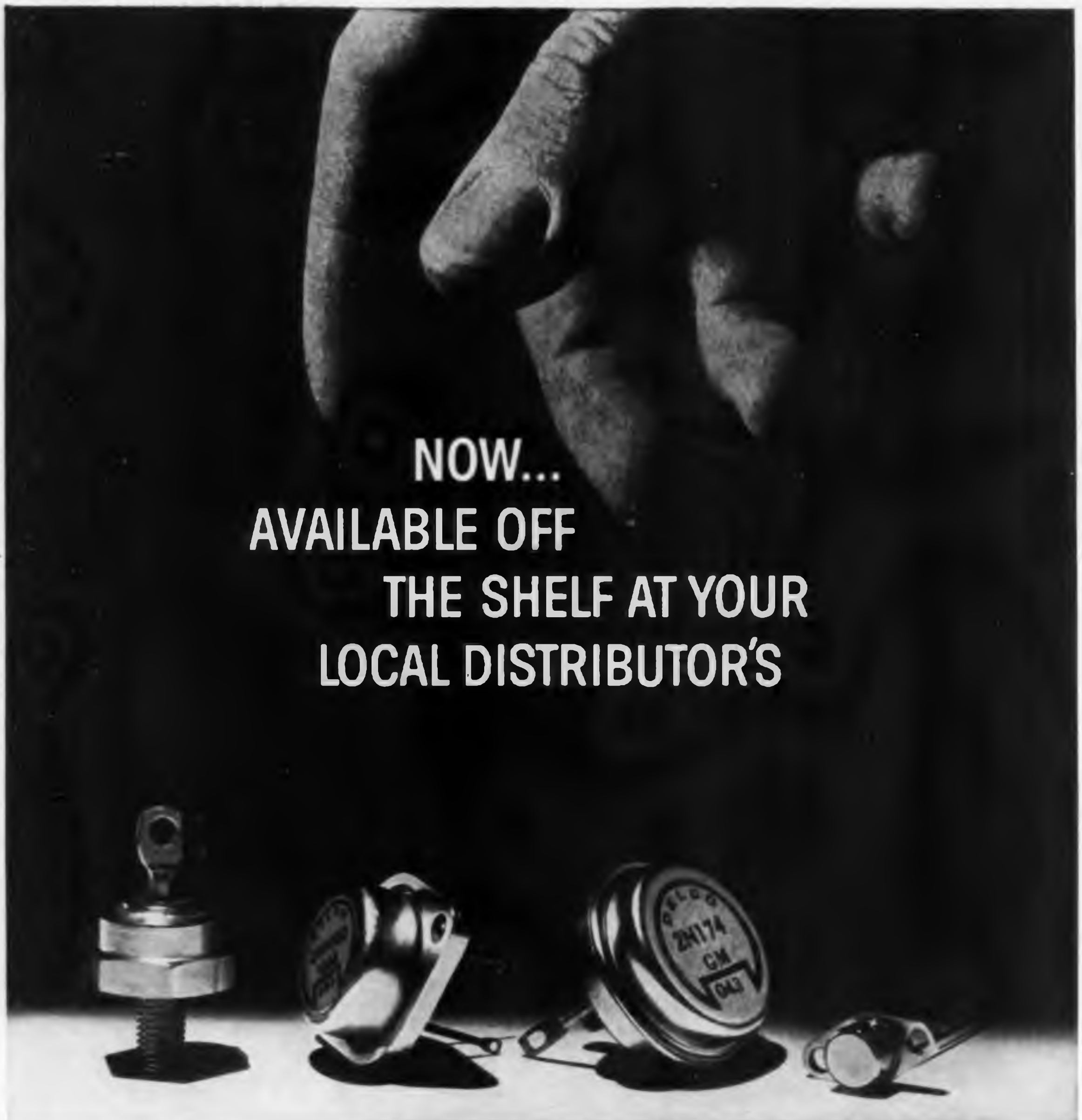

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Just clamp around and read:

- **Tube circuits** . . . . view current on your scope or measure it with a VTVM
- **Transistor circuits** . . . . . measure small signals dynamically, without clipping leads or circuit loading; study diodes at breakdown
- **Logic circuits** . . . . measure ac current in presence of dc current
- **Impedance measuring** . . with a dual-channel scope, measure current, voltage magnitude; phase angle
- **Power measuring** . . . . . with dual-channel scope read current, voltage directly, calculate power
- **Frequency counting** . . . . use 456A with counter for clip-on frequency access
- **And, how about these?** . . phase comparisons of ac carrier waveforms; instrument fuse current ratings; cable identification, response of magnetic cores; magnetic field sensing; silicon rectifier peak currents

SPECIFICATIONS

Sensitivity: 1 mv/ma ±1% at 1 KC
Frequency Response: ±2%, 100 cps to 3 MC
±5%, 60 cps to 4 MC
−3 db at 25 cps and above 20 MC
Maximum Input: 1 amp rms; 1.5 amp peak, 100 ma rms above 5 MC
Maximum dc current: Dc up to 0.5 amp has no appreciable effect
Input Impedance: Probe adds to test circuit only approx. 0.05 ohms in series with 0.05 μh
Equivalent Input Noise: Less than 50 μa rms (100 μa ac powered)
Power: 10 radio mercury cells, approx. 400 hours service normally supplied. Ac supply available
Size: 5" wide, 1½" high, 6" deep, weight 3 lbs.
Price: $190.00; for ac operation $210.00.
hp 456-95A ac supply for field installation $32.00

Data subject to change without notice
Prices F.O.B. Factory

Just clamp the hp 456A probe around a wire under test and view or read ac current directly on an indicating device. Model 456A's 1 mv to 1 ma unity conversion permits direct readings up to 1 ampere rms. The instrument's wide bandwidth permits use with oscilloscopes to view complex current waveforms with rise times to 0.017 μsec. No direct circuit connection is required; there is no loading, no appreciable impedance change in the circuit under test, and the impedance of the test circuit is immaterial.

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hp offers almost 400 precision test instruments

Books

(Continued from page 74)

Laplace Transformation, 2nd Edition

By William T. Thomson. Published 1960 by Prentice-Hall, Inc., Englewood Cliffs, N. J. 255 pages. Price $10.00.

Long a model for its clear and precise description of the Laplace transformation, this new edition expands its coverage to include applications in many engineering fields—electrical, dynamical, structural, and servo-mechanical.

The engineer and technician will gain a clear understanding of Laplace transformation from the first pages of the volume with the idea of functional transformation and its inverse are introduced. This is followed by a graphical discussion of vectors drawn from the zeros and poles of the system. Other chapters cover electrical circuits, dynamical applications, and applications to beam, columns, and structures.

To obtain further insight into the method of Laplace transformation, the theory of complex variables is introduced, along with the arguments necessary for the understanding of the inversion integral and contour integration. This is logically followed by a discussion of closed loop systems. The final section is a clear exposition of the more advanced partial differential equations with emphasis on the procedure of residue evaluation.

This new edition brings the procedure and utility of the Laplace transformation into sharp focus. From the introductory presentation of the basic techniques through the more advanced problems, the reader will gain a working knowledge of its essentials.

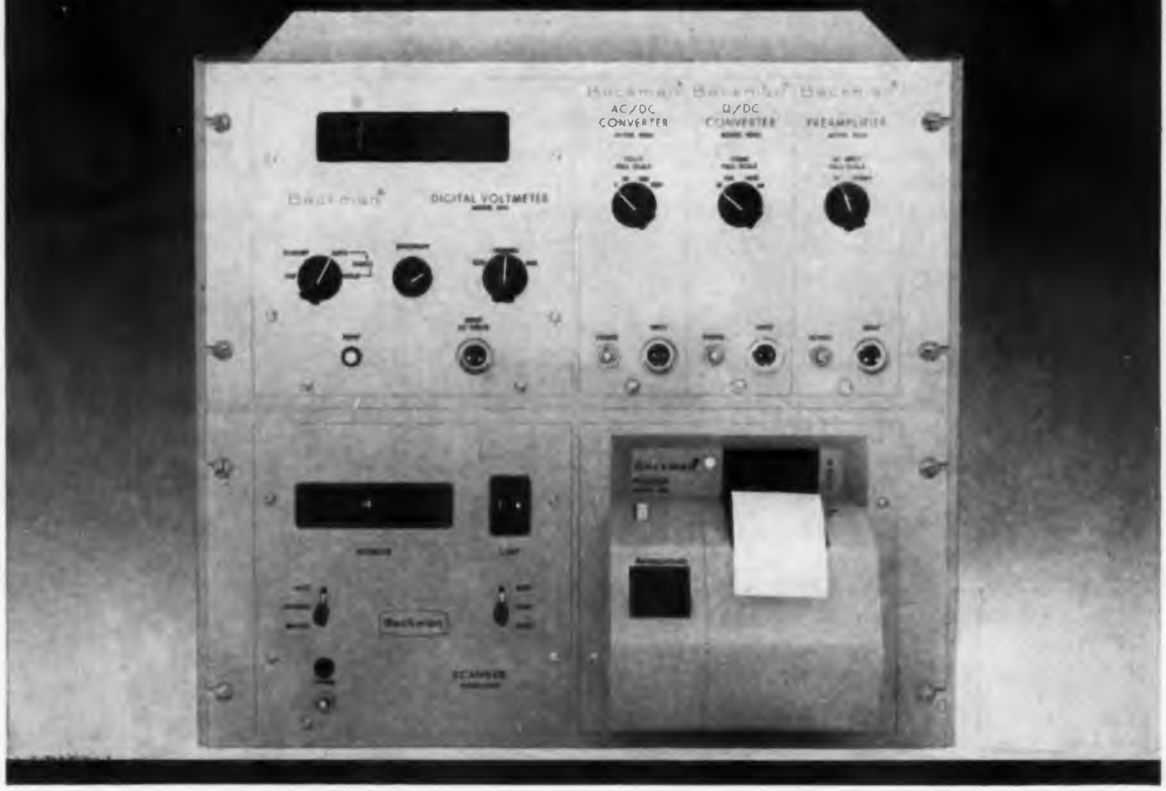
High-Frequency Magnetic Materials, Their Characteristics and Principal Applications.

By W. J. Polydoroff. Published 1960 by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16. 220 pages. Price $9.00.

This book, written by a pioneer in the field, is a comprehensive guide to ferromagnetic materials and their applications at high frequencies. The author first discusses the characteristics of magnetic materials and powders and describes the tests which are used to measure these characteristics. He then considers such important applications as ferroinductors, variable inductors for permeability and incremental permeability tuning, and ferromagnetic antennas. In addition, several special applications are discussed, including microwave ferrites. The book contains a wealth of examples, charts, and figures.

(Continued on page 82)

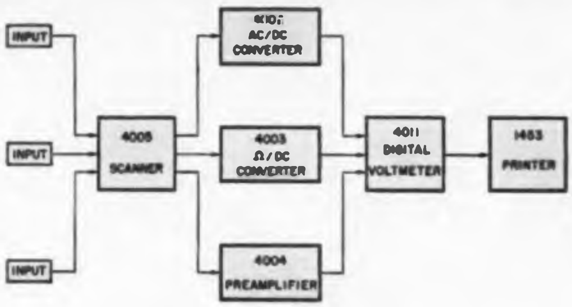
EXPANDABLE MODULAR DIGITAL MULTIMETER



Picture this self contained, automatic system working for you — the compact Beckman 4011 .01% dvm; together with converters for measuring low millivoltage DC, AC and ohms; a scanner which allows automatic readings of 29 sources of information; and finally, the Beckman solid-state, digital printer to make a permanent, indexed record of all the readings.

Price for the complete system about $4800

For detailed specifications on all these instruments and their use together, write for Brochure A4011.



Beckman 4011 a complete portable dvm is available, as are the other modules shown above, as a portable package.

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Books

(*Continued from page 78*)

Books Received

The Million-Dollar Bend

By Charles Eisler, M.E., D.Sc. Published 1960 by The William-Fredrick Press, 391 East 149th Street, New York 55, N. Y. 306 pages. Price $4.75.

Multivibrator Circuits, 2nd Revised Edition

By A. H. Bruinsma. Published 1960 by The Macmillan Company, 60 Fifth Avenue, New York 11, N. Y. 65 pages. Price $2.00.

Practical Robot Circuits, 2nd Revised Edition

By A. H. Bruinsma. Published 1960 by The Macmillan Company, 60 Fifth Avenue, New York 11, N. Y. 125 pages. Price $3.95.

1960 NEREM Record

Copies may be obtained at the Boston Section of the IRE at 313 Washington Street, Newton 58, Mass. 190 pages. Paperbound. Price $7.50.

Instrumentation and High-Speed Photography, Volume I, Series II

Papers reprinted from the Journal of the Society of Motion Picture and Television Engineers. Published 1960 by the SMPTE, 55 West 42nd St., New York 36, N. Y. 187 pages. Paperbound. Price $4.00.

Application and Properties of Materials Used in Aerospace Vehicle Design

Compiled by K. R. Agricola. Published 1960 by The Martin Company, Denver 1, Colorado. 195 pages. Paperbound.

This is a collection of nine of the papers presented at the Martin Company Symposium on materials used in aerospace vehicle design, held 4 through 6 May 1960 in Denver Colorado.

Personal Public Relations and Publicity

By E. Longstreth. Published 1961 by Industries Publishing Co., P.O. Box 621, Culver City 9, Calif. 32 pages. Plasticbound. Price $1.50.

Digest of Military Electronics

Published by RCA Service Company, Government Services (Bldg. 210), Camden 8, N. J. 210 pages. Price $3.95.

Handbook of Noise Measurement

By A. P. G. Peterson and E. E. Gross. Published by the General Radio Company, West Concord, Mass. 100 pages. Price $1.00.

1961 Registry of Industrial Radio Systems

Edited by Ethel V. Sleeper. Published by Communication Engineering Book Co., Monterey, Mass. 243 pages. Price $5.00.

Educational Television Guidebook

By Philip Lewis. Published by the McGraw-Hill Book Co., 330 West 42nd Street, New York 36, N. Y. Price $4.95.

Guide for Reproducing Federal Tax Returns

Copies may be obtained by writing Dept. Li-24, Minnesota Mining and Manufacturing Co., St. Paul 6, Minnesota. Booklet. Free.

Printed Circuit Design Parameters for Data Processing and Communications Equipment

Copies can be ordered from the Institute of Printed Circuits, 27 East Monroe, Chicago 3, Illinois. Price $5.00.

• • •

13 MOVES TO RELIABLE TRIMMING

SPECTROL'S FULL LINE of trimming potentiometers features 10 of the smallest square trimmers ever made, plus the only *transistor-size* units for solid state circuitry. This selection covers almost every conceivable application—a sure way to avoid checkmate when you need reliable trimmers.

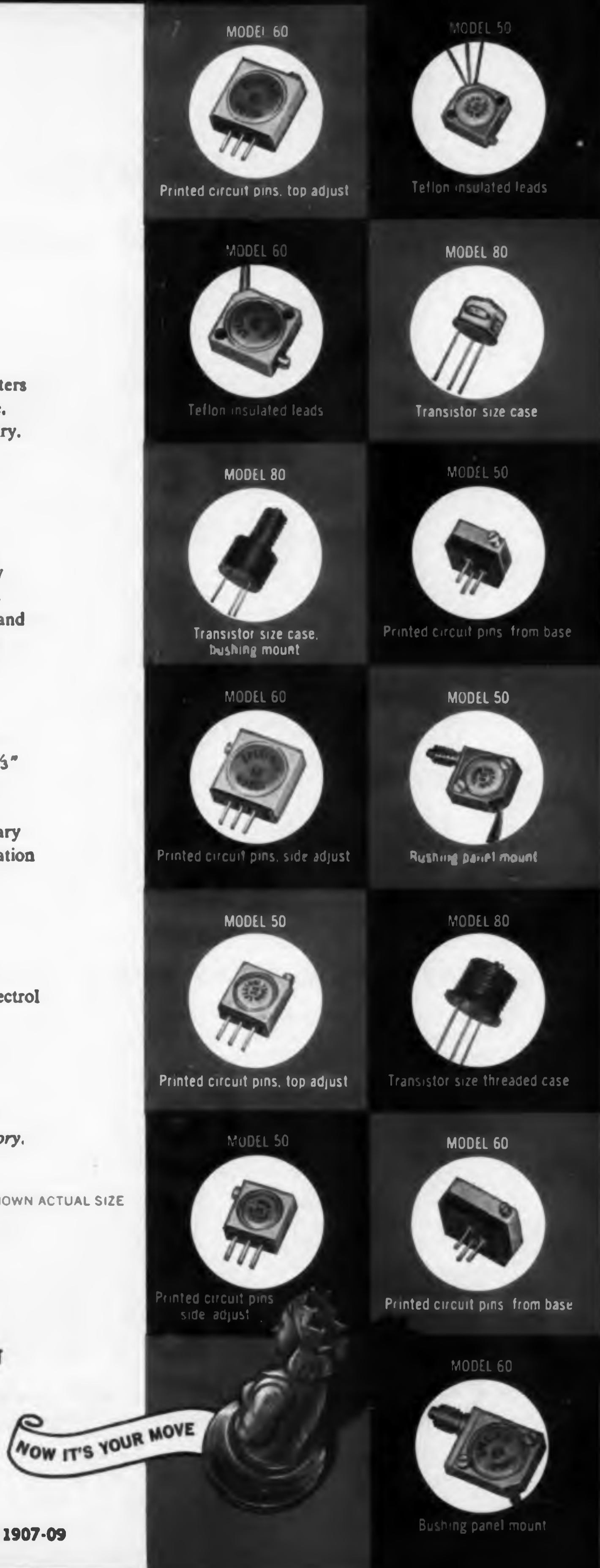
SQUARE TRIMMER DATA. Models 50 and 60 measure ⅜" and ½" square respectively • humidity proofing a standard feature • available in resistances to 100K • greater surface contact between mandrel and aluminum case for better heat dissipation, no external heat sinks needed • dual wiper for positive contact under all conditions of shock and vibration.

SINGLE TURN TRIMMER DATA. Model 80 built into TO-9 transistor type case • measures less than ⅓" in diameter, weighs 1 gram—smallest trimmer on the market • completely sealed against moisture and humidity • resistance element twice as long as ordinary trimmers • designed for complete package encapsulation with other printed circuit components • available in 3 case styles with resistance range to 20K.

IMMEDIATE DELIVERY. Your nearby Spectrol distributor stocks standard models of trimmers and miniature potentiometers as well as other standard Spectrol precision potentiometers and turns indicating dials. Prices are $6 to $8 in quantities of 1-9 for most styles and resistances.

MORE DATA AVAILABLE. Contact your Spectrol engineering representative or drop us a line at the factory. Please address Dept. 44.

ALL TRIMMERS SHOWN ACTUAL SIZE



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Phone: ATlantic 7-9761

Adams Court • Plainview, L. I., New York
Phone: WElls 8-4000

Circle 47 on Inquiry Card

See the complete Spectrol line at I.R.E. Show—Booth 1907-09

Personals

Walter Boiko has joined Eitel-McCullough, Inc. as Senior Sales Engineer.

Joseph L. Sturdevant has been named Manager of Commercial Sales for the Remington Rand Univac Div., Sperry Rand Corp.

George Capsis has been named as Manager of Presentations and Exhibits for Radio Corp. of America.

Walter S. Bopp has been appointed to the new post of Vice-President and General Manager of Philco International Div. of Philco Corp.

Robert E. Carr has been named Manager of Rectifier Operations for Hughes Aircraft Co., Semiconductor Div.


Dr. G. Caryotakis


Robert E. Carr

Dr. George Caryotakis has been appointed Manager of the newly formed High-Power Laboratory of Eitel-McCullough, Inc.

O. F. Janssen, Jr. has been elected National Chairman of the Spare Parts Committee of the Aerospace Industries Assoc.; **Herschel S. Nelson**, elected as National Vice-Chairman of the Committee for 1961; **T. Morris Barrett** and **T. B. Nichols**, elected as Vice-Chairmen of the Committee for the Eastern and Western regions respectively.

H. C. Christen, Director, Quality Control, California Div., Lockheed Aircraft Corp., Burbank, Calif., has been elected 1961 Chairman of the Quality Control Committee of the Aerospace Industries Assoc.; **Frank McGinnis**, Director, Reliability & Quality Control, Sperry Gyroscope Co., Div. of Sperry Rand Corp., was elected Vice-Chairman.

Robert W. Whitfield and **Robert J. Dunlavey** have joined the staff of Stromberg-Carlson's Washington, D. C. Commercial Sales Office as Sales Engineers. Whitfield will be in the Washington office and Dunlavey will be in the Boston area.

(Continued on page 88)

Circle 49 on Inquiry Card

Shallcross

precision circuit news

50:1 Delay-to-Rise-Time Ratio in Only 6 in^3

Total Delay	1.5 μsec
Rise Time	0.03 μsec
Impedance	500 ohms
PRF	2.5 mc
Attenuation	1 db
Distortion	5%
TC	+150 ppm, ±15 ppm (−10°C to +50°C)

Some of the toughest performance specs we've seen in 12 years of delay line engineering are crammed into the ½" x 2" x 6" case of this lumped constant line. Used by a data processing equipment manufacturer, the unit requires uncommon care in component selection and in circuit layout to achieve the desired 50 to 1 delay-to-rise-time ratio in the space allowed.

Special cores and toroidal winding techniques promote maximum Q, and, when coupled with custom miniature capacitors, desired LC characteristics are obtained within the specified space. An ingenious termination further reduces distortion at tapped outputs and appreciably enhances the pulse time characteristic.

Even if your delay line requirements are not so critical, this same Shallcross ingenuity may pay big dividends in reducing size, cost, or circuit complexity for you. Why not outline your needs to us?

DELAY LINES

VARIABLE DELAY

Continuously adjustable delays from 0 to 0.5 μsec with 0.005 μsec resolution are attainable in this typical Shallcross unit. Maximum rise time is 0.06 μsec at maximum delay.

DISTRIBUTED CONSTANT

LUMPED CONSTANT

Shallcross' family of distributed constant and lumped constant lines utilize the latest refinements in inductors, capacitors, winding, trimming and packaging techniques.

STEPPING ACCURATELY

Typical of longer Shallcross delay lines, this variable lumped constant unit provides a total delay of 24.65 μsec in 15 steps calibrated to 0.05 μsec accuracy. Delay-to-rise-time is 100:1—and in a hermetically-sealed package measuring only 2" x 4" x 7¼".

Of course variations can be made for your requirements — in impedance, taps, rise time, attenuation and so forth. These are regular occurrences with the many hundred designs produced by Shallcross delay line specialists.

Shallcross Manufacturing Co. Selma, North Carolina

Precision wirewound resistors, Switches, Instruments, Delay lines, Resistance networks, Audio attenuators

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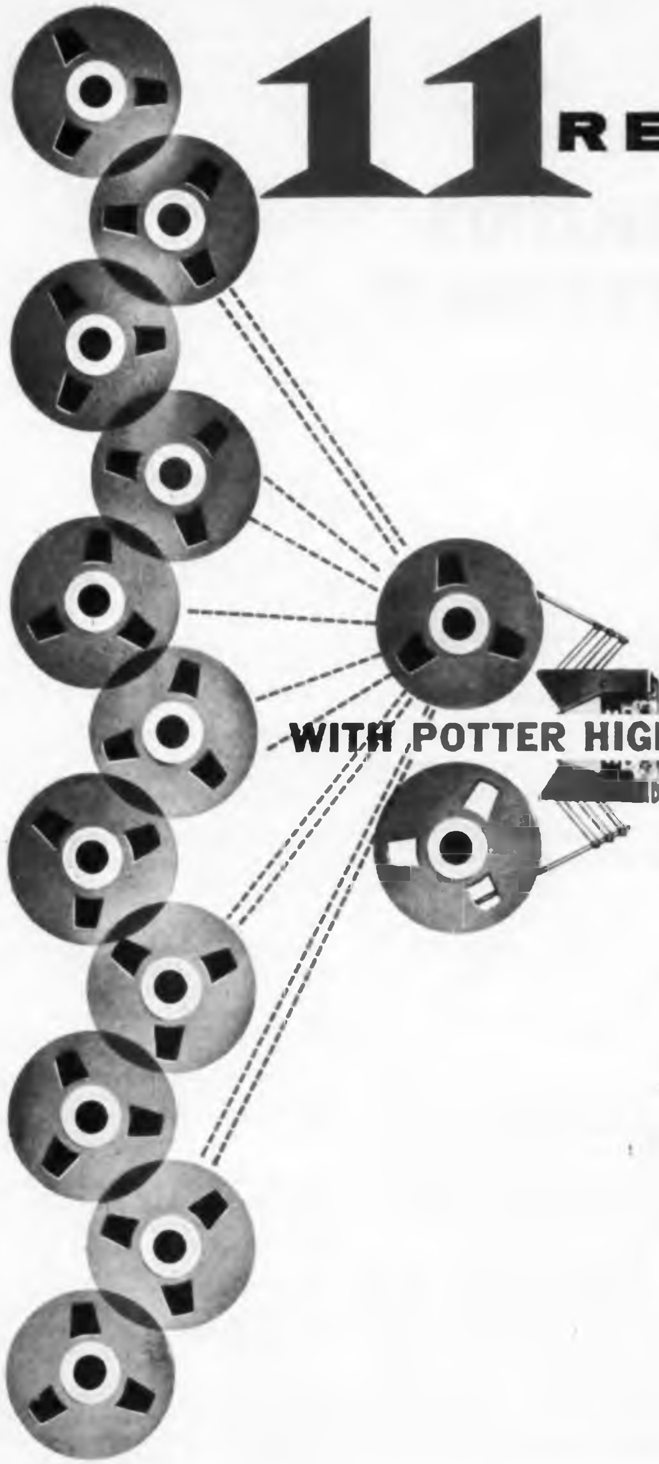
11 REELS IN 1



With the revolutionary new Potter High Density Recording System, each reel of 1-inch tape holds as much data as 11 reels recorded by the most widely used computer tape system.

For highly reliable computer applications, Potter High Density recording can give you data transfer rates of 360,000 alphanumeric characters per second or more, at densities to 1500 bits per inch on 1-inch tape. Sixteen parallel channels can be accommodated on one-inch tape. Because Potter has made the information channels self-clocking, no separate clock channel is needed, and multichannel data can be read out in true parallel form, despite interchannel time displacement.

WITH POTTER HIGH DENSITY RECORDING

In production units delivered by Potter, this dramatic new technique makes recording so reliable that in 40 hours of continuous operation, less than 2 seconds re-read time are required to recover information lost through transient error. Dropouts are fewer than 1 in 10^7 at densities up to 1500 bits per inch. More than 20,000 passes of the tape can be made without losing information or significantly increasing the dropout rate.

Tested and proven in computer systems, Potter High Density Recording is presently available in the Potter 906II High Speed Digital Magnetic Tape Handler, and will be available in other Potter Tape Systems.

Write today for details on how High Density Recording can be applied to your data handling problem.

See us at the IRE — Booths 3405-3407

POTTER INSTRUMENT COMPANY, INC. • SUNNYSIDE BOULEVARD, PLAINVIEW, NEW YORK

Personals

(*Continued from page* 84)

John H. Haughawout has been appointed Manager of the Computer Laboratory's Advanced Development Dept. at Hughes Aircraft Co., Ground Systems Group.

Charles K. Titus has joined the staff of the Communication and Data Processing Div. of the Collins Radio Co.

Solomon Hudes has joined Telechrome Mfg. Corp., Amityville, N. Y., as Vice-President in Charge of Engineering.

Harold B. Law and **Alfred H. Sommer** have been named Fellows of the Technical Staff, RCA Laboratories.

Perry W. House, appointed Works Manager of the Delco-Remy Div. of General Motors.

Carl J. Kunz has become Chief Engineer of the Ferroxcube Corp. of America.

Robert C. Johnson is now Assistant to the Vice-President and General Manager of Spectrol Electronics Corp.

Robert A. DeWitt has been named Assistant to the Director of Marketing; **Robert W. Blucke** has been appointed Manager of Sales Administra-

David D. Bulkley has been appointed Product Manager for Intercommunication Systems in Stromberg-Carlson's Commercial Products Div.

Arthur R. J. Johnson has been appointed to the new post of Customer Services Manager for The Systems Div. of Beckman Instruments, Inc., Anaheim, Calif.

Warren D. Hulbert has been named Manufacturing Manager for trimming potentiometers by Spectrol Electronics Corp.

Arling Woolaver, named Manager of the Southeastern Sales Region for General Electric Co., Semiconductor Products Dept.

C. F. Pizac is the new Director of Marketing, Electronics and Avionics Div., The Emerson Electric Mfg. Co., St. Louis, Mo.

Melpar, Inc., has announced the following executive organizational changes: **Thomas Melroy**, formerly President and Chief Executive Officer, elected Chairman of the Board; **Edward M. Bostick**, formerly Executive Vice-President and General Manager, elected President and Chief Executive Officer; and **Arthur C. Weid**, formerly Vice-President for Operations, elected Executive Vice-President.

RELAY NEWS from Union Switch & Signal

VISIT US AT THE
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Contact Redundancy in New UNION Crystal Case Relays

The UNION 2-pole double throw General Purpose Crystal Case Relay is designed to consistently meet the requirements of Mil-R-5757D and Mil-R-5757/10. Its essential features . . . from minimum size to optimum reliability . . . permit it to be used in aircraft, guided missiles, shipboard and ground control electronic equipment.

A unique torsion-wire armature suspension system and a rugged all-welded frame construction provide a high level of vibration and shock immunity. Contact redundancy, which assures reliability in dry circuit and higher level contact loads, is provided through the use of bifurcated contacts.

Available with 0.2" grid-spaced header or "S" type header, with various mountings, terminals, and operating voltages. Write for Bulletin 1064.

Why UNION Relays Are So Dependable

There's a good reason why our relays are the standard for reliability. For years, we've been building tough, reliable relays for use in airborne and guided missile electronic equipment and similar vital applications where perfect operation under severe environmental conditions is mandatory.

Our engineers created a compact 6-PDT miniature relay with just three major assemblies . . . instead of a fistful of small parts. This was accomplished by using a balanced rotary-type armature that provided a maximum resistance to the severe shock and vibration environment of aircraft and guided missiles. The rotary principle of operation is utilized in all our relays.

We have a reputation for building reliable electronic components and we intend to maintain our tradition for building reliable relays. And we supply these quality relays in quantity. Stocks are now available for prototype requirements in New York, Pittsburgh, Dallas and Los Angeles.

New 4-PDT-10-amp Relay Most Compact Rotary Type Available

This new durable relay is designed to meet the requirements of Mil-R-6106. It's a rugged relay featuring exceptionally sturdy terminals and husky contacts for high current applications. Glass-coated cylindrical contact actuators attached to the rotary armature provide square mating of contact surfaces, thereby assuring longer relay life. The balanced rotary armature provides maximum resistance to severe shock and vibration.

This small 4-PDT-10-Ampere relay is currently available with 115VAC and various DC operating voltages. Various mounting styles are provided. Write for bulletin 1069.

For additional information, write for Bulletin 1017 or call Churchill 2-5000 in Pittsburgh.

MEMBER OF THE NATIONAL ASSOCIATION OF RELAY MANUFACTURERS

UNION SWITCH & SIGNAL
DIVISION OF WESTINGHOUSE AIR BRAKE COMPANY
PITTSBURGH 18, PENNSYLVANIA

Next month

THE EFFECTS OF THE VAN ALLEN BELT RADIATION ON MATERIALS

Since more and more space vehicles will be entering and passing through the radioactive Van Allen belt in the near future, it is very important that we know the effects to be expected on electronic equipment. This article describes the results of studies using nuclear fission fragment bombardment, and several specific components and materials.

ANTENNA SYSTEMS FOR RECONNAISSANCE SATELLITES

The value of an airborne reconnaissance system depends upon its ability to detect and locate the source of signals on the earth's surface. The antenna and associated system is the critical portion of such an operation. Design of the antenna is limited by the physical size of the satellite, the large number of signals to contend with and the height at which the satellite must travel.

FUNDAMENTALS OF SPACE VEHICLE ARITHMETIC

The common denominator governing the performance of all space vehicles—satellites, space ships and ICBM's—is "gravity." The problem differs, depending on whether the vehicle is to orbit, escape the gravitational pull of Earth, or reach another planet. The "arithmetic" of the problem is spelled out in a number of charts covering the various conditions.

THE PROBLEM OF SPACE COMMUNICATIONS

A full treatment of the space communication problem involves studying the frequency range of megacycles to gamma rays, and distances of meters to light years. Included here are discussions of linear-receiver sensitivity, enhancement, and degradation factors; antenna gain and atmospheric propagation and absorption factors.

MEASURING RECOVERY TIME OF ULTRA-FAST DIODES

Direct measurement of recovery time of diodes below approximately 3 nanoseconds has not been practical. An indirect method has been devised that gives accurate results below 1 nanosecond.

Plus all our other regular departments

Our regular editorial departments are designed to provide readers with an up-to-the-minute summary of world wide important electronic events. Don't miss Radarscope, As We Go To Press, Electronic Shorts, Coming Events, El Totals, Snapshots of the Electronic Industries, El International, News, Briefs, Tele-Tips, Books, Representatives News, International Electronic Sources, Personals, etc.

COMING SOON—

THE 1961 ANNUAL ALL-REFERENCE ISSUE

The fourth consecutive annual edition containing year-round technical reference information for electronic engineers. The editorial staff is already at work compiling and selecting data for this issue. Suggestions from user-readers for new topics and compilations to be included will be given careful consideration.

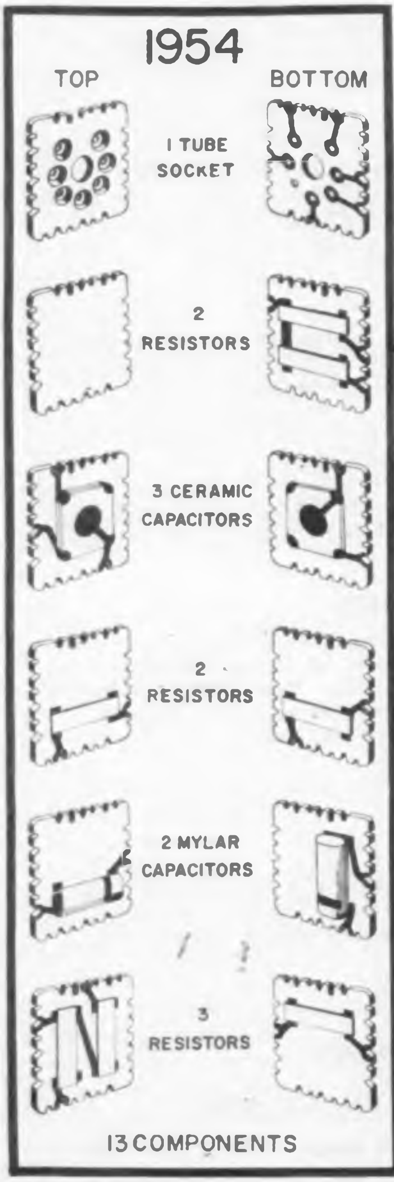
Watch for these coming issues:

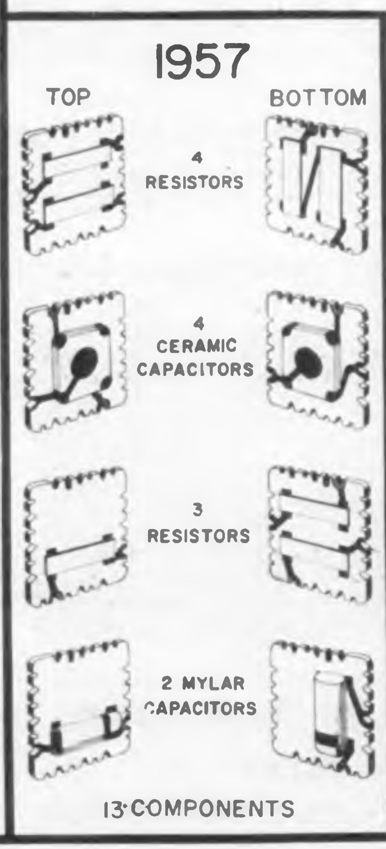
***JUNE**
Annual All-Reference & Directory Issue

***AUGUST**
Annual WESCON Issue

***NOVEMBER**
Annual Microwave Issue

Design Trends in





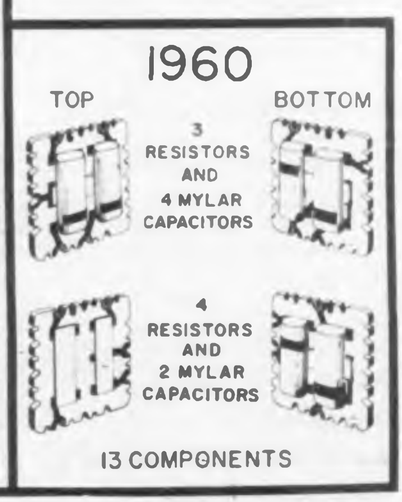


Fig. 1: Design progress which may be attributed directly to printed leads under Mylar capacitors, impossible with ceramic.

THERE are 2 basic materials on which we construct multi-component assemblies. One of these materials has a high dielectric constant (K); the other, a low dielectric constant. Each has its own unique uses.

For minimum coupling between components, we use low-K material. For other uses, the high-K substrate forms the circuit capacitances. In both cases, two-dimensional resistors are bonded to the substrate which provides the leads and acts as a heat sink. Other components are mounted and connected together on the surface of either material.

Actually, the module developed in *Project Tinkertoy*[1] has changed very little. Despite the chance to alter it during re-tooling, it has remained the same in plan, wafer thickness, and stacking pitch. One change was made in 1954. The

Modules have followed two main avenues of development. The military and industrial groups have concentrated on putting all components on the module; the commercial have experienced an evolution to two basic components. Here's the "why" story on the commercial route.

Low-K Substrate Modules

By CHARLES C. RAYBURN

Engineering Manager
Paktron, Div. of Illinois Tool Works
1321 Leslie Avenue
Alexandria, Virginia

notch depth was reduced. This increased the component mounting area.

Although distinct in component design, type, and application, the RCA Micro-Module[2] is structurally a scale-down of the basic stacking wafer concept.

The larger module has been applied broadly in military, industrial, and commercial fields during the past 6 years. Its production has been highly mechanized. Commercial economic pressures have determined the design changes for high quantity production. Meanwhile, military and industrial markets have contributed to component type diversification. Unless noted, the various design and component trends in this article relate only to the commercial market in television, radio, hi-fi, stereo, etc.

Tube sockets, inductors, diodes and other special components have undergone continued development and expansion in military and industrial applications. Meantime, commercial requirements have narrowed to resistor-capacitor packages almost exclusively. Resistors and capacitors use the module structure as an integral part of the component. Other components, e. g., tube sockets, have been adapted to the wafer surface without receiving economic help from the module structure. These components must be priced above individual components and are generally found unpopular among commercial buyers.

Influencing Factors

Table 1 shows this evolution to 2 component types. Table 2 shows the wafer component loading change. Equally significant is the trend away from ceramic capacitors and toward plastic film. This appears in contradiction to highly mechanized printed circuit processing and deserves further analysis. The major factors of influence have been:

1—Economy of component preparation favored Mylar dielectric over ceramic. The wound Mylar section was produced in a single, versatile, mechanical process on equipment of relatively low investment. Problems of thermal shock and breakage were eliminated. Although the purchased raw mate-

Fig. 2: This demonstration of component independence displays a loading rate of 16 components per wafer

Table 1

Average Commercial Module Component Composition

	1954	1957	1960
Tube Socket	1.0	0.5	0
Resistor, Carbon Composition	5.0	6.0	6
Capacitor, Ceramic	4.0	4.0	0
Capacitor, Glass or Mica	0.0	0.1	0
Capacitor, Plastic Film	0.0	2.0	6
Inductor, Osc. Coil, R.F. Choke	0.25	0.1	0

Table 2

Components per Wafer

	1954		1957		1960	
	Avg	Max	Avg	Max	Avg	Max
Tube Socket	1	1	1	1	--	1
Resistor, Carbon Composition	2	4	3	4	3	10
Capacitor, Ceramic	2	4	3	4	--	4
Capacitor, Glass or Mica	1	4	1	4	--	4
Capacitor, Plastic Film	--	--	2	4	3	6
Resistors and Capacitors in Combinations	--	--	4	4	6	16
Inductor, Osc. Coil, R.F. Choke	1	1	1	1	--	--

(-- not in design).

Modules *(Continued)*

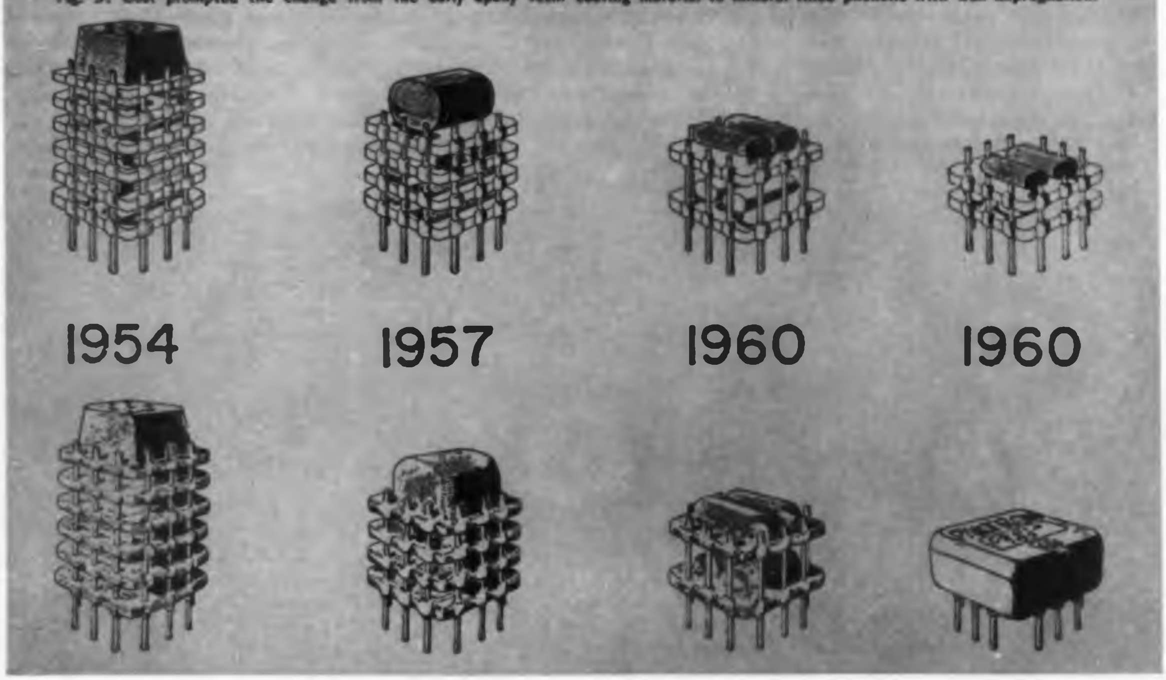
rials would direct the use of ceramic, the material, labor and overhead composite gave a sizeable economic margin to Mylar dielectric.

2—Component range considerations indicated that Mylar could replace ceramics whereas, ceramics could not replace Mylar with a value range to 0.5 µf. Winding equipment was developed to produce any low value covered in the ceramic range. Ceramic capacitors were retained as an available component only in applications where temperature compensation was required. Inventory stocks were reduced in type, reducing the associated costs.

3—High power dissipation of up to 2 watts per wafer naturally elevate module temperatures, causing high dielectric constant ceramics with high temperature coefficients to produce circuit problems if applied in sensitive positions. The relatively flat Mylar temperature coefficient allowed capacitors in the 1000 µµf range and above to be more broadly applied, even to replacing Class C mica capacitors.

4—Design versatility is preeminent. Fig. 1 shows the design progress which may be attributed directly to printed leads under Mylar capacitors. Ceramic capacitors not only required a large metalized area, under which no circuits could run, but further required a common electrode for mounting two stacked capacitors per wafer surface.

Fig. 3: Cost prompted the change from the early epoxy resin coating material to mineral-filled phenolic with wax impregnation.



Reduced Structure Cost

The design trend shown in Fig. 2 obviously reduces the inert structure cost compared to earlier designs, but the principal advantage of high wafer loading results from improved manufacturing yield. The resistor wafer assemblies are pretested; then, capacitors are added and the entire wafer circuit is tested for value, breakdown and connection correctitude.

If 2 wafers with 7 components each are accordingly tested and assembled into a module, 24 solder joints are made. If 7 wafers with 2 components each were tested and assembled into a module, 84 solder joints are made. Since the units are lost if one circuit path is open, high final yields have guided designs toward high wafer loading. Interconnections on the surface of one wafer are more reliable since they are printed and do not depend on the variables of soldering.

The coating material, Fig. 3, of 1954 was an epoxy resin, applied by dipping. The material cost soon directed development toward a lower cost mineral-filled phenolic with wax impregnation, as was used in 1957, continuing in use in 1960.

Also appearing in 1960, is molded encapsulation. Both epoxy and phenolic resins are used by a transfer molding process. Epoxy coating is economically usable once again, not due to its cost reduction since 1954, but mainly through high component density which consequently requires less resin per component.

Module Mounting

The module mounting methods in Fig. 4 show the popularity of hand wiring in the entertainment industry and also shows the stress being placed on serviceability, as evidenced by the socket. Sockets are used both in printed circuits and hand-wired chassis and bracket the module both in cost and function. The module must be sufficiently broad in componentry and densely designed to be of sufficient value to justify the additional cost of a socket, while being functionally distinct for ease of service analysis.

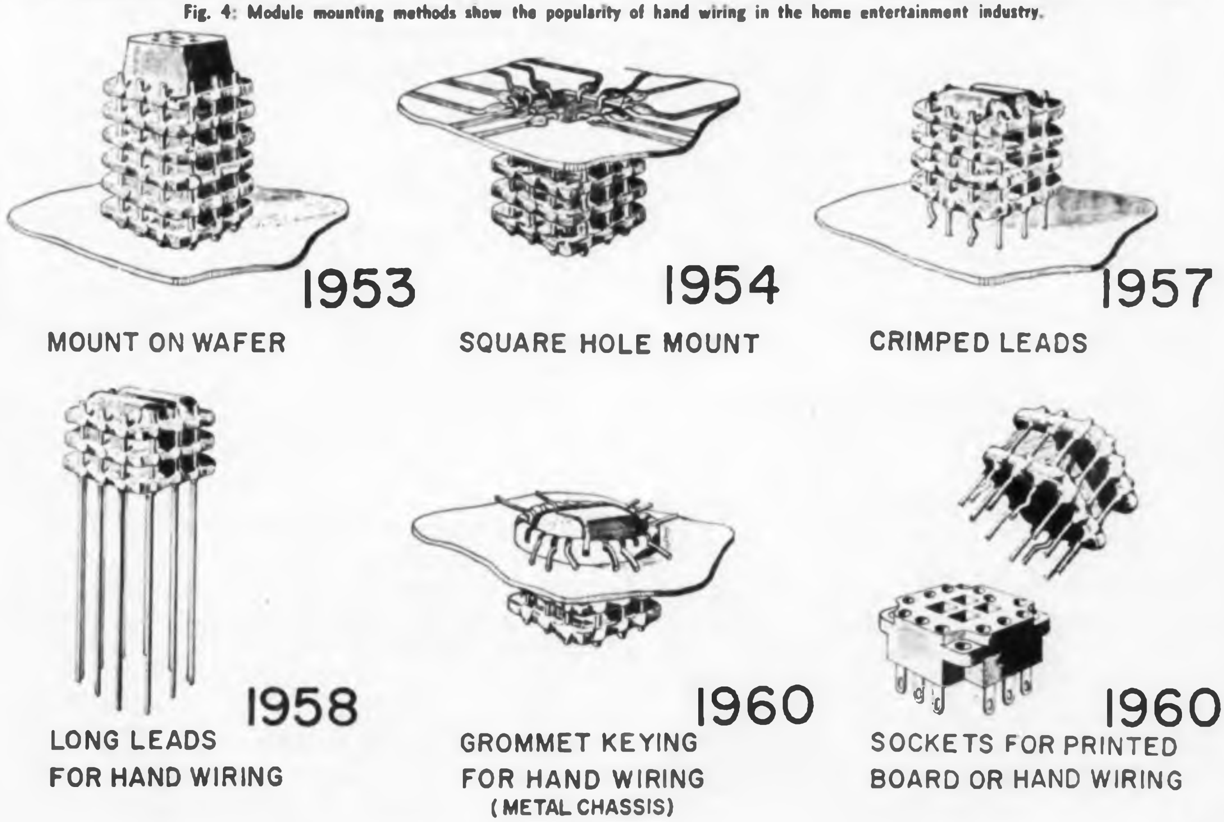
The grommet mount is used with long leads for hand wiring. The plastic grommet is inexpensive and locks in a hole in the metal chassis. This mounting system reduces the time and cost of product tooling while retaining the assembly labor advantage inherent in integrated components.

Many of the components illustrated and referred to are patented articles of Paktron, as are the machines and methods used to produce them.

References

1. "Project Tinkertoy: It Changes the Electronic Design Concept," *Product Engineering*, Dec. 1953.
2. Mackey, D., "The Micro-Module Program," 1960 Electronic Components Conference, Washington, D. C., May 10-12, 1960.

Fig. 4: Module mounting methods show the popularity of hand wiring in the home entertainment industry.



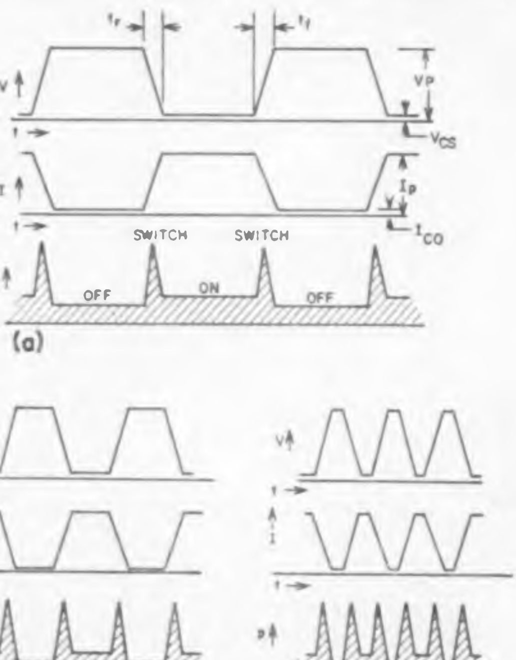
Opened or closed . . . transistor switches lose very little power. That's why they are being used more and more in d-c to d-c converters. But there is one problem—the switch is not instantaneous. Here's how switching time and peak voltage affect the power transistor's efficiency.

Power Loss vs. Frequency ...In D-C to D-C Converters

A POWER transistor is an almost perfect switch. Very little power is lost when it is closed. And very little power is lost when it is open. However, the device cannot switch instantaneously from ON to OFF, nor vice-versa.

During the switching interval, a high pulse of power is generated in the collector junction. As operating frequency increases, these power pulses occupy a larger portion of the period—and, average power dissipation increases. Power transistor efficiency in switching circuits is a function of operating frequency and transistor response time.

Fig. 1: Collector voltage, collector current, and collector power dissipation plotted against (a) low, (b) mid, and (c) high frequency.



The operating frequency effect upon transistor power loss can be simply shown. Fig. 1a is a plot of the wave shapes of collector voltage, collector current, and collector power dissipation at a low frequency. In Fig. 1b, a much higher operating frequency is shown; finally in Fig. 1c, an extreme case.

The "on time" power loss is the product of collector saturation voltage times the peak collector current. The peak power dissipated while switching from ON to OFF, and vice versa, is one-half the peak collector current times one-half the peak collector voltage. During the OFF state, the peak voltage multiplied by I_{co} represents the power loss.

The total average power loss then is the sum of losses during each operating state. The power loss equations are:

$$\text{"ON Loss"}\ P_{ON} = FI_p V_{cs} \left(\frac{T}{2} - t_r\right) \tag{1}$$

$$\text{"Switching Loss"}\ P_s = FI_p \frac{(V_p + 2 V_{cs})(t_f + t_r)}{6} \tag{2}$$

$$\text{"OFF Loss,"}\ P_{OFF} = FI_{co} V_p \left(\frac{T}{2} - t_f\right) \tag{3}$$

$$\text{Total Loss, } P_T = P_{ON} + P_s + P_{OFF} \tag{4}$$

where, F = Frequency (cps)
T = Period (μ sec)
V_{cs} = Collector saturation voltage (volts)
V_p = Peak collector voltage (generally 2 × supply voltage)
I_p = Peak collector current (amps)
I_{co} = Collector cutoff current (amps)
t_r = Transistor rise time (μ sec)
t_f = Transistor fall time (μ sec)

Assuming that I_{co} is negligible and $V_{cs} \ll V_p$, the low frequency power loss will be:

$$P_{LF} = \frac{I_p V_{cs}}{2}. \tag{5}$$

And high frequency loss will be:

$$P_{HF} = \frac{I_p V_p F (t_r + t_f)}{6} \tag{6}$$

By RALPH GREENBURG

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Table 2

Heat Sink Temperature In D-C To D-C Converter

D.C. supply voltage	12v
Peak voltage (V_p)	24v
Low load current	5a
Full load current	13a
Frequency	2 KC

The average power in each case is the area of the power-time curve divided by a given length of time. Obviously, the case of Fig. 1c will have the greatest average power loss of the three frequency ranges.

Fig. 2 is a plot of power loss *versus* frequency for two typical power transistors. The conditions for this plot are listed in Table 1. Note that transistor Type 2N630 has higher loss at low frequency than Type 2N1167. But the opposite is true beyond a cross-over frequency near 600 cps. This is generally true since a correlation exists between collector saturation voltage (V_{cs}) and switching time. Transistors with high V_{cs} tend to have fast response times. When comparing a set of transistors which have this inverse relation of V_{cs} to response time, the cross-over frequencies are dependent on peak voltage. As voltage increases the cross-over frequency decreases.

Heating Effects

Since power is lost as heat, the junction temperature will rise with operating frequency. Heat sink temperature also follows frequency. If several different transistors are operated in identical circuits, at the same frequency, the heat sink, and junction, temperature will be affected by transistor characteristics detailed in Eqs. (1) through (3).

Fig. 3 shows actual test results of heat sink temperatures *versus* operating time, using three different transistors. In this test, peak current was set at 5 amps for 30 sec and 13 amps for 30 sec; the cycle was then repeated by use of a timer. This was a 50% duty cycle. Thermal stability was achieved after 15 minutes at which time the 13 amp interval was increased to 36 sec and the 5 amp interval decreased to 24 sec. This was called a 60% duty cycle. This sequential operation was continued until the heat sink temperature began to stabilize at its final value. Table 2 lists the test conditions. The 2N1167 which was chosen for this test had high response time which accounts for the high temperatures.

Table 1

Typical D-C To D-C Converter

	2N630	2N1167
D.C. Supply voltage	30v	15v
Peak voltage (V_p)	60v	30v
Peak current (I_p)	10a	10a
Base Drive on (I_{BON})	1a	1a
Base Drive off (I_{BOFF})	0.16a	0.16a
Rise time (t_r)	4.5 μ sec	5.0 μ sec
Fall time (t_f)	10.5 μ sec	24.0 μ sec
Coll. Sat. voltage (V_{cs})	0.35v	0.12v
Coll. Cutoff current (I_{co})	5 ma	5 ma

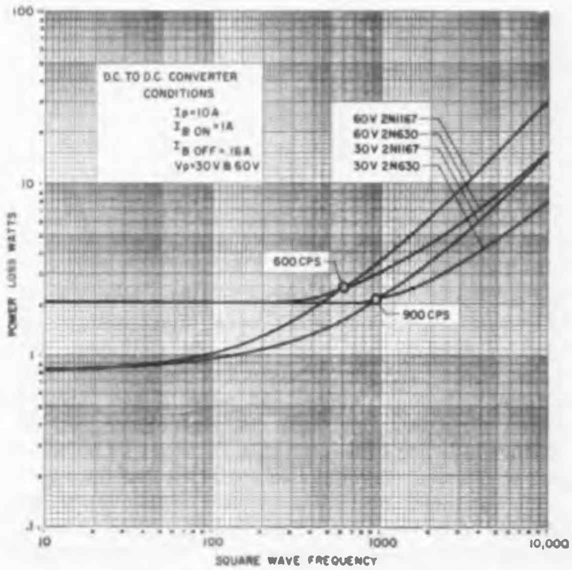
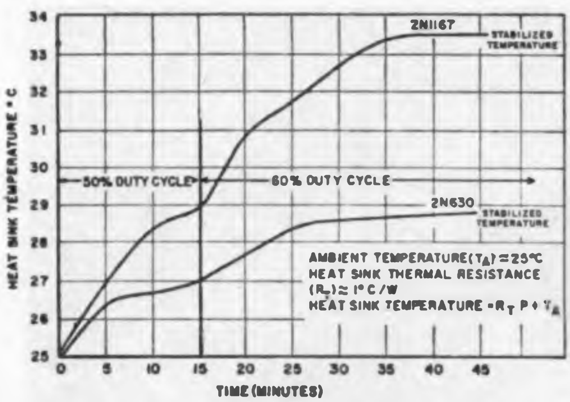


Fig. 2: Cross-over frequency increases with decrease in voltage.

Fig. 3: Actual test results of heat sink temperature against time.



Series or parallel operation of silicon rectifiers requires special treatment. Here are three general methods for series operation in high voltage applications and three general methods for parallel operation where high current rectification is needed.

Silicon Rectifier Design Techniques

By DR. ROBERT LYNCH

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MANY applications of silicon rectifiers need special design considerations, since they cannot be specified simply. For example, if the equipment designer wishes to mount the rectifier cells on his own heat sink, he must understand some of the thermal design problems which will be encountered. Or, if rectifier cells are to be connected in series or parallel, proper division of voltage and current is important.

The overload protection devices which must be specified in any application will differ, depending upon particular customer requirements. The advantages and disadvantages of various types of voltage surge suppression and the many sources of voltage surges must be considered.

It is the purpose of this article to summarize design problems and to suggest various techniques which have been used quite successfully in properly building rectifier equipment.

Bridge assembly is an example of seriesing silicon rectifiers. Here 50 rectifiers are used in a precipitator power supply.

Thermal Design

Standard rectifier assemblies manufactured by Westinghouse have been designed to provide effective heat dissipation with either natural convection or forced air ventilation. They may be mounted easily; cells may readily be changed, and connections are simple. However, the standard assemblies may not always meet the particular requirements of a customer. Limited space requirements or the need of special mounting features may result in the equipment manufacturer designing his own heat dissipator.

Silicon cells permit the equipment designer an extensive choice of designs. They have been mounted on air-cooled bus bars, on water-cooled bus bars, on plates immersed in oil, and on a variety of plates and fins cooled by natural convection or forced air ventilation.

Curves showing the maximum power dissipated by a particular silicon rectifying cell will aid the designer in specifying his heat sink requirements. It is important that the junction temperature does not exceed 190° C during continuous load operation. The maximum power which can be dissipated, up to a maximum power determined by thermal stresses and natural design limitations, is then expressed in Eq. 1.

$$190^\circ C - T_a = P_{max} (\theta_1 + \theta_2 + \theta_3) \qquad (1)$$

where:

T_a = Ambient temperature — °C.

P_{max} = Maximum power dissipated by the rectifying cell—watts.

θ_1 = Thermal resistance, junction to case—°C/watt.

θ_2 = Thermal resistance, case to heat sink—°C/watt.

θ_3 = Thermal resistance, heat sink to ambient—°C/watt.

θ_3 is the most difficult to specify. It varies with ambient temperatures, operating temperatures, air density and air velocity, and it depends upon other factors such as the material in the heat sink, the external finish and proximity to other heat sinks. In Table 1, typical values of thermal resistance are given for some of the more popular cells and heat sinks. Values of θ_2 and θ_3 depend upon the point on the heat sink where the temperature is measured. However, the sum of θ_2 and θ_3 would be the same. Values in Table 1 were obtained by measuring the temperature on the plate at one side of the cell. Values of θ_3, listed under natural convection cooling, are given for unpainted plate surfaces with the plates mounted in bridge assemblies. All values of θ_3 are based upon sea level conditions and an ambient temperature of 35°C.

It is desirable, in most thermal designs, to verify the temperature rise of the components. If thermocouples are attached to the rectifying cells, it is important that care is taken to avoid erroneous readings. A small hole, large enough for the end of the thermocouple, may be drilled 1/32 inch deep into the case on the flat of the hex. The thermocouple should then be cemented into the hole with a high temperature cement. The leads close to the thermocouple should be shielded from any forced air ventilation. Direct contact surface reading pyrometers may be used on some of the larger cells. Since a wide variation of thermal contacts and other factors influencing the temperature rise is possible, it is advisable to make temperature measurements on a number of cells in any new design.

Series Operation

The operating voltage of many applications will require that more than one cell in series be used. If this is necessary, it is important to assure that the proper division of voltage is obtained.

Three methods of operating silicon rectifying cells in series are currently being used in high-voltage applications:

1. The addition of resistive voltage dividers.
2. The addition of capacitive voltage dividers.
3. Special designs.

A fourth method of matching reverse characteristics has been used but is generally not recommended.

Matching Reverse Characteristics

If it is desired to series cells without the addition of a voltage divider, the reverse characteristics must be matched. The cells should have similar breakdown characteristics and reverse temperature coefficients.

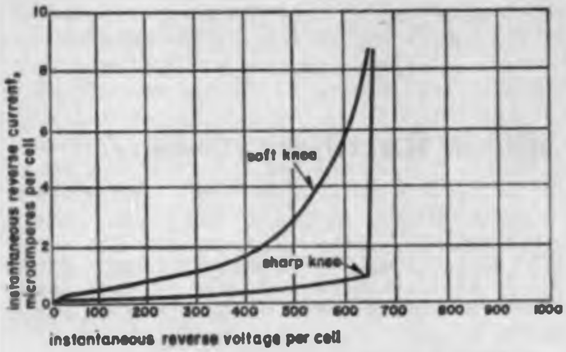


Fig. 1: Graph shows the sharp and soft knee characteristics.

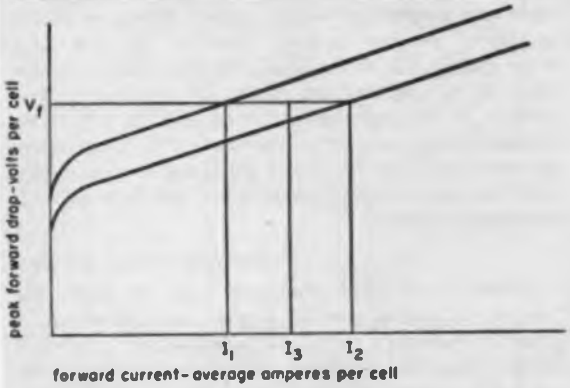


Fig. 2: Unmatched load characteristics of 2 rectifying cells.

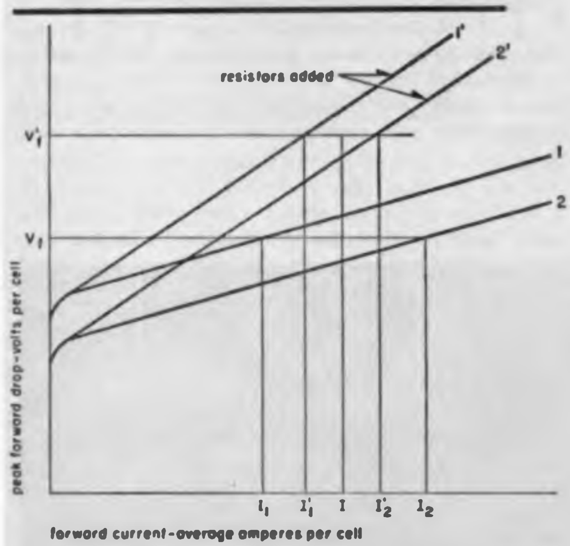


Fig. 3: Unmatched rectifying cell load characteristic of two medium power cells with and without resistance in series.

TABLE I

Cell Type No.	θ_1	Heat Sink Size	Natural Convection θ_2	Natural Convection θ_3	Forced Air 1000 LFM θ_2	Forced Air 1000 LFM θ_3
304	2.0	3 x 3 x 0.047 in.	1.70	8.00	1.50	1.00
302	1.0	5 x 5 x 0.047 in.	1.30	4.00	1.20	0.80
319	0.3	5 x 5 x 1/8 in.	0.20	1.88	0.21	0.41
339	0.2	7 x 7 x 1/4 in.	0.12	1.30	0.10	0.21

Silicon Rectifiers *(Continued)*

Cells with sharp avalanche-breakdown knees should not be placed in series with cells with soft knees. These two types of reverse characteristics are shown in Fig. 1.

Matched cells have operated successfully with no voltage dividers. However, there is some question regarding proper division of voltage during transient switching. Reverse recovery times of the cells in a series string may differ and cause extreme unbalance when a reverse voltage is suddenly applied. The problem of unequal recovery times and the difficulties encountered in matching breakdown and temperature characteristics results in the general recommendation that voltage dividers be used with two or more cells connected in series.

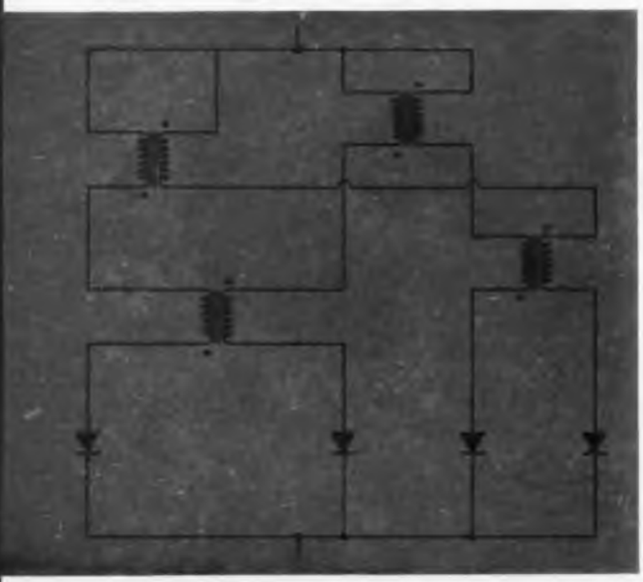
Resistive Voltage Dividers

Resistors are most commonly used to divide the reverse voltage of a small number cells in series. A value of resistance across each cell equal to one-half to one times the minimum reverse resistance of the cell has worked satisfactorily for up to 6 cells in series. The minimum resistance is determined by the ratio of the PIV and maximum peak reverse current. A value of resistance equal to the minimum reverse resistance is adequate if the cells are selected within a particular voltage class. Cells chosen from the higher advertised voltage class may include much higher voltage cells which do not exhibit breakdown characteristics. If the reverse voltage is not limited by avalanche-breakdown, an internal dielectric breakdown may occur.

Capacitive Voltage Dividers

Capacitive voltage dividers are quite important in very high-voltage applications where distributed capacitances may result in uneven voltage distribution during transient operation. To be effective, the capacitance across any cell must be larger than the junction capacitance, but the actual value will depend upon the particular assembly. Capacitance dividers may be combined with resistive dividers in some applications. The capacitance will have the additional effect of reducing uneven voltage distribution resulting from the differences in recovery times. If neither matching nor resistor dividers are used, the capacitance required may be too large to be practical.

Fig. 4: Closed "chain" arrangement of balancing transformers.



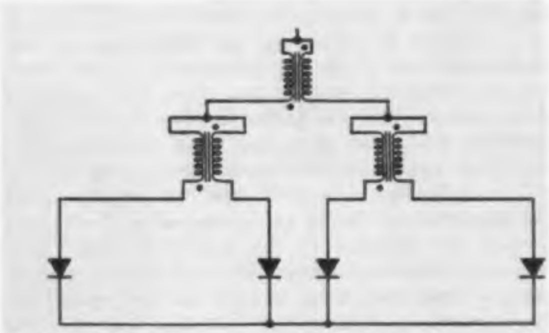


Fig. 5: Cascade arrangement of balancing transformers.

Special Transformer Designs

Multiple windings may be used on transformers if only a few cells must be placed in series. Each winding would supply an assembly with one series cell. Then the output of the assemblies must be connected in series. An effective method of seriesing has been used in which specially designed low-power transformers are interconnected in the circuit to force division of voltage.

Parallel Operation

The characteristics of silicon rectifying cells which contribute to low regulation result in difficulties if cells are to be connected in parallel. The load characteristics of two cells are shown in Fig. 2. If the forward voltage across the two cells is the same, the current will differ by $I_2 - I_1$. The slope of the characteristics is quite important and is greater where forced air ventilation is used. In natural convection cooled application, the slope may be close to zero or negative, depending upon the heat sink. The proper division of current may be obtained among cells connected in parallel by the following techniques:

1. Matching of the forward characteristics.
2. The addition of resistance or reactance in series with each cell.
3. Balancing transformers or separate transformer windings.

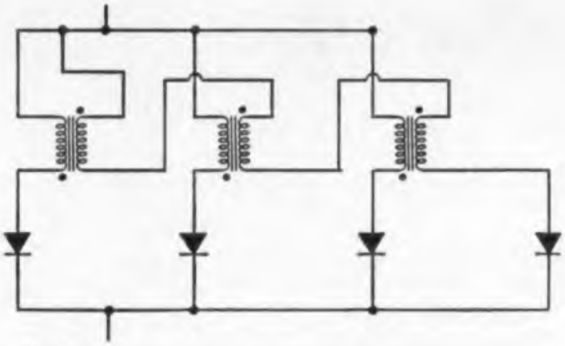


Fig. 6: Reference cell arrangement of balancing transformers.

Matching Forward Characteristics

The most obvious procedure of paralleling cells is to match the forward characteristics. However, cells, matched at one point, may have different slopes and therefore may not divide current properly during overload or fault conditions. An additional disadvantage of matched cells is the larger stock of replacements required by the equipment manufacturer. Cell manufacturers will usually furnish cells matched within 0.05 volts of each other. A practical limit exists on the number of matched cells which can be paralleled. It is difficult to balance bus reactance and resistance sufficiently to place more than 6 to 10 matched cells in parallel. With matched cells, the unbalance may be 25% of the average current per cell, and therefore cells should be operated at only 80% of their rating.

Resistance or Reactance with Cell

The simplest method of forcing proper current division among cells in parallel is to effectively increase the slope of a cell by the addition of series resistance. In Fig. 3, there is an example of this effect. The current unbalance between two cells is reduced from $I_2 - I_1$ to $I'_2 - I'_1$. If a value of resistance is chosen to add approximately 0.40 volts to the peak forward drop of the cells, the unbalance may be limited to about 20% of the average current per cell. The cells should then be operated at 83% of their rated value. The same effect may be obtained by the addition of individual reactors in series with each cell.

The resistors have the obvious disadvantage of introducing more regulation and more power losses into the equipment. This is undesirable in many applications. However, the resistors do have the advantage of assuring a better balance during overload or fault conditions.

Balancing Transformers

Balancing transformers, as a means of forcing proper current balance, have been the subject of several technical papers and articles. Their effectiveness has been well established. These balancing transformers, or reactors as they are sometimes called, consist of laminated iron cores, usually with single turn primary and secondary windings. The currents from two cells in parallel pass through a core in opposite directions, and an unbalance between the two currents will induce a voltage which tends to correct the unbalance.

Several arrangements of reactors and cells are possible if two or more cells are to be connected in parallel. A "chain" arrangement similar to Fig. 4 is the most commonly used circuit. It is important that the "chain" be closed as shown. Discrepancies in current balance may be additive and may result in widely different currents in the first and last cell of a simple "chain." If a cell which fails is cleared from the circuit by a fuse, a simple "chain" would be broken into two sections.

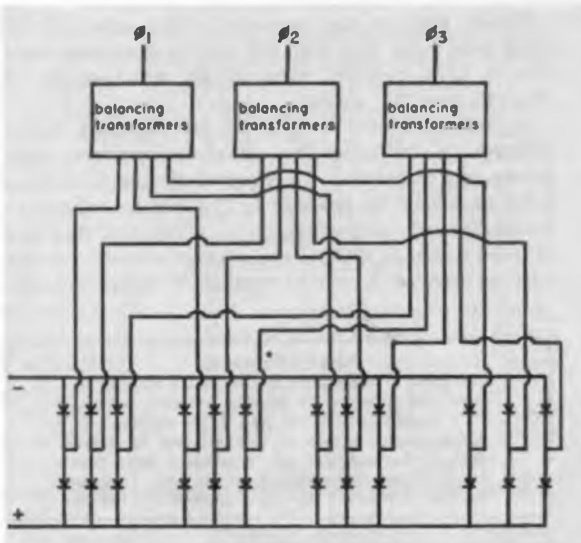


Fig. 7: Three phase bridge of four cells in parallel with the balancing transformers located in the ac leads.

A cascade arrangement similar to Fig. 5 will result in satisfactory division of current between cells, but will result in extreme unbalance if any one cell is cleared from the circuit by a fuse.

Another circuit which will work satisfactorily is shown in Fig. 6.

Each cell is balanced against a reference cell which

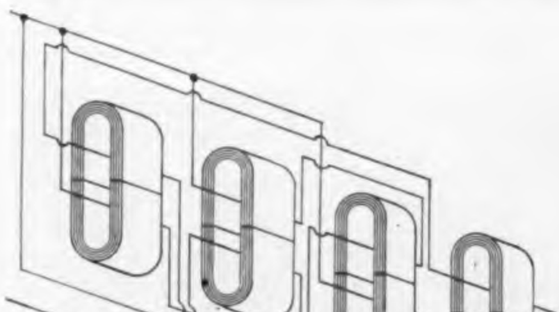


Fig. 8: Hipersil iron "C" connected in a "chain" arrangement with 4 cells in parallel.

Silicon Rectifiers *(Concluded)*

may be designed to operate at a reduced rating to insure reliability. If a large number of cells are to be parallelled, it may be economically feasible to use two separately fused cells in parallel to carry the reference current.

Instead of placing the balancing transformers in the leads of the individual cells, they may be placed in the a-c leads of a bridge. Fig. 7 is a sample of an arrangement of this type.

Varied designs and mechanical arrangements of cores have been used but will not be discussed here. Fig. 8 is a pictorial view of an arrangement of Hipersil iron "C" cores.

A core area of 1 to 1½ sq. in. has been found effective in reducing the unbalance between high power cells in parallel. An effective air gap of at least 0.001 in. should be retained in the core to reduce the possibility of saturation. The unbalance may be reduced to about 10% of the average current per cell with as many as 6 cells in parallel. With up to 6 cells in parallel, the cells should be operated at 90% of their rating; with 7 to 10 cells in parallel, 85% of their rating; and with 11 to 20 cells in parallel, 80% of their rating.

In any design, current division among the cells should be measured to assure proper balancing. This may be done quite simply by inserting a shunt in place of the fuse. If the fuses are calibrated and checked for uniformity the voltage drop across the fuses will be an indication of the current division. It may not be desirable to place more than 20 cells in parallel, unless a separate transformer is used for each group of 20 cells.

Separate transformers or transformer windings may be used to supply a number of assemblies each with only one cell in parallel. Then the output of these assemblies may be connected in parallel. If separate transformer windings are used, care must be taken in the transformer design. Multiple windings on any one transformer core will not necessarily have the identical leakage reactances required to force division of current between assemblies.

If a series parallel arrangement of rectifying cells is necessary, no set rule exists which will determine whether the seriesing or the paralleling should be done first. Each has its advantages and disadvantages depending upon the heat sink design, required fusing, necessary reliability, etc. Individual applications will determine which is most economical or practical.

REFERENCE PAGES
The pages in this section are perforated for easy removal and retention as valuable reference material.
SOMETHING NEW HAS BEEN ADDED
An extra-wide margin is now provided to permit them to be punched with a standard three-hole-punch without obliterating any of the text. They can be filed in standard three-hole notebooks or folders.

What's New

Optical Maser

A CONTINUOUSLY operating optical maser has been demonstrated by Bell Telephone lab. The new system, in contrast to intermittent or "pulsed" optical masers, uses a gaseous discharge to get continuous operation.

The maser gets its energy from an electrical discharge of very low power. The coherent beam of radiation is in the infrared region. It is invisible except through a "sniperscope" or similar converter.

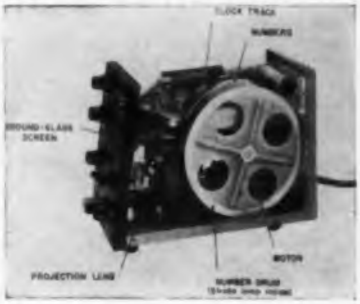
The spectral line width of the output beam is a hundred thousand times narrower than that from other coherent light sources. It allows observing difference-signals at radio frequencies between two optical lines.

The gas maser uses a mixture of helium and neon. An electrical discharge flows through it in the same way as in a conventional neon tube. The energy from the internal discharge excites the helium atoms to a very high upper "metastable" energy level, from which they normally would not radiate energy.

The neon atoms collide with the excited helium atoms and the energy is transferred to them through the collision process. The neon atoms then can be stimulated to radiate their energy on demand in a continuous stream. The beam is reflected back and forth through the length of the gas-filled tube by semi-reflecting end plates, growing in intensity with each trip. Some of the beam is transmitted through the plates and forms a very narrow output beam of coherent infrared light.

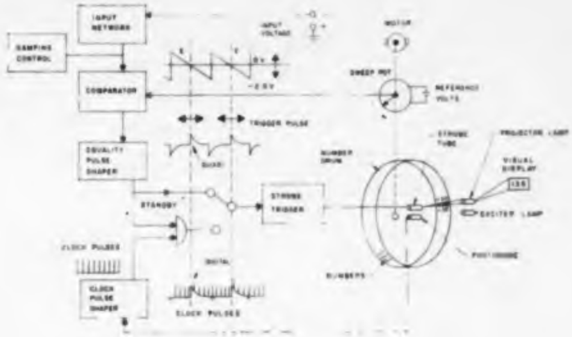
Power to excite the maser action is in the tens-of-watts range. Output power is in the 1/100 watt range.

Dr. A. Javan, proposer of Bell's optical gas maser, inspects 40-in. tube filled with helium and neon. Interactions between gases produce coherent beam of infrared light that can carry vast information.



Functional Block diagram of digital voltmeter.

Stroboscopic Drum-side view of digital volt meter (right)



Digital Voltmeter

NEW digital voltmeter combines stroboscopic readout techniques with the long life and high accuracy of a conductive plastic potentiometer.

Heart of the instrument is a number drum — rotating continuously at high speed—which is coupled directly to a rotary linear potentiometer that generates a sawtooth sweep voltage.

A film strip having a row of small holes is on the surface of the drum. Each hole is aligned with one of a series of 250 numbers. Holes and numbers are placed at equal intervals of 320° on the drum periphery. The potentiometer, with electrical angle of 320°, is mounted on the same shaft. Both potentiometer and drum rotate at a nominal speed of 24 rps.

A light shines through the holes in the film onto a photodiode. This feeds a series of clock pulses to a flip-flop. The pulses are timed so that a strobe lamp inside the drum fires only when a number and a projection lens are properly aligned.

A standard voltage impressed across the potentiometer generates a sawtooth voltage for each revolution of the potentiometer.

The unknown voltage is continually compared to this sweep voltage, and at the instant the two voltages —potentiometer sweep and the unknown—are equal, the flip-flop is triggered so that the next hole coming into alignment causes the strobe lamp to flash. A film strip number is thereby projected through an enlarging lens onto a ground-glass viewing screen. Since this comparison is made once for each revolution, the strobe lamp "fixes" or stops the number which

(*Continued on page* 231)

The level of operation can be increased by using larger diameter tubes.

The neon atoms can radiate energy from almost any one of four upper energy levels to one of ten intermediate levels. Thus up to thirty discrete frequencies can be emitted by the maser. Range of possible wavelengths lies between 11,000 A and 12,000 A. The output line width is far sharper than that of ruby masers.

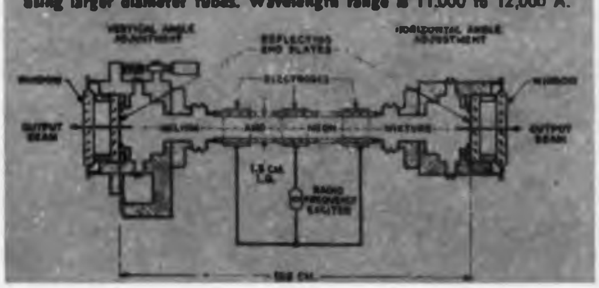
The gaseous optical maser should provide physicists with a very useful tool. The narrowness of the line will afford an accuracy hitherto unattainable in spectroscopic work at these frequencies.

Another possible application is in the measurement of distances of many miles with extreme accuracy.

Tube, vital element of new optical gas maser, is source of continuous stream of coherent light which may one day carry simultaneous telephone conversations and television programs.

D. Herriott demonstrates technique for impressing telephone conversation on coherent beam of light generated by optical maser. Information handling capacity is millions of times greater than radio waves.

Gaseous Optical Maser. Input is in the tens-of-watts range. Output is in the 1/100 watt range. Level of operation can be increased by using larger diameter tubes. Wavelength range is 11,000 to 12,000 A.



The microwave tuner can be quickly designed with a few simple equations given here. Tuner is comprised of a shorted line and a piston capacitor.

Design Notes for

Strip Transmission Line Tuners

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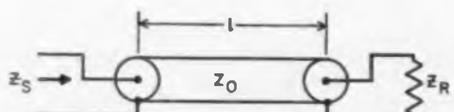
THE impedance at the input of a transmission line is given by:

$$Z_s = Z_o \frac{(Z_R + j\,Z_o \tan\beta\, l)}{(Z_o + j\,Z_R \tan\beta\, l)}$$

where:

Z_o = the characteristic impedance of the line
Z_R = the terminating impedance of the line
$\beta = 2\,\pi/\lambda$
λ = wavelength in meters
l = length of the line in meters

Note: l and λ can be expressed in the same units, i.e., centimeters, meters, feet, inches.

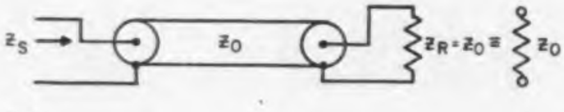


TRANSMISSION LINE

If $Z_o = Z_R$

then $$Z_s = Z_o \frac{(Z_o + j\,Z_o \tan\beta\, l)}{(Z_o + j\,Z_o \tan\beta\, l)} = Z_o\,[1] = Z_o$$

therefore, $Z_s = Z_o$ hence the line becomes independent of the operating frequency and physical length.



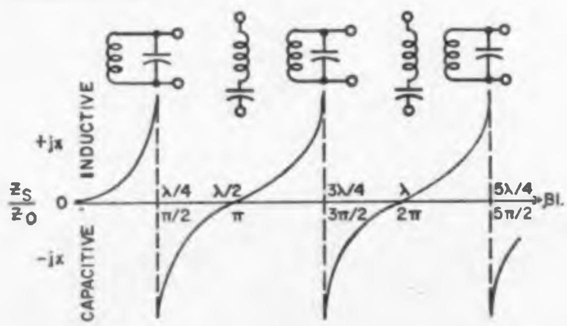
If $Z_R = 0$, then

$$Z_s = Z_o\left[\frac{0 + j\,Z_o \tan\beta\, l}{Z_o + j\,0}\right] = j\,Z_o \tan\beta$$

so that $Z_s = j\,Z_o \tan\beta\, l$ (a pure reactive quantity).

Note: The sign of the reactance, plus or minus, depends upon λ or l or both since the tangent function is negative between 90°-180°, 270°-360°.

The response of the function $Z_s/Z_o = j\tan\beta l$ is plotted below.



RESPONSE OF $Z_S/Z_O = j\,\mathrm{TAN}\,\beta l$ FOR A SHORTED LINE, $Z_R = 0$
NOTE: $l = \lambda/4$, $\frac{2\pi}{\lambda} \times \frac{\lambda}{4} = \pi/2$, TAN $\pi/2 = \infty$

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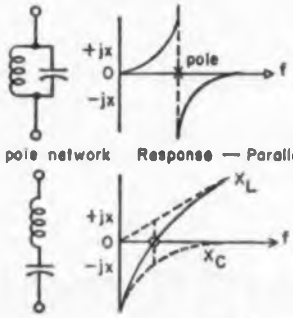
The plot for the $\lambda/4$ shorted line shows parallel and series resonances every $\lambda/4$ which alternate one another, i.e., poles and zeros according to Foster's Reactance Theorem. Single-tuned circuits displaying parallel and series resonance are shown below with their reactance-frequency curves.



Single pole network   Response — Parallel resonance

Single zero network   Response — Series resonance

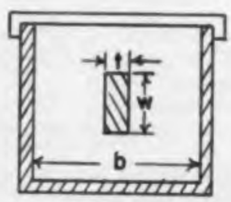
Thus a shorted line having a length $\lambda/4$ at some frequency F_x behaves as a parallel resonant circuit. For frequencies below F_x, the line behaves as an inductance whose reactance is a function of frequency.

Hence $Z_s/Z_o = j\,x$ for $F_s > F$.

In the frequency range where the shorted line is inductive, parallel resonance is obtained by tuning the line with a variable capacitor. In contrast to the lumped-constant type of resonant circuit, this configuration is known as a distributed-constant resonator.

Example of Tuner Design

A resonator is to be designed to operate from 500 MCS to 1000 MCS using a strip transmission line element. The design data for the line is obtained from "Reference Data for Radio Engineers," 4th edition, pages 598-599.



Cross-Section of Strip Line

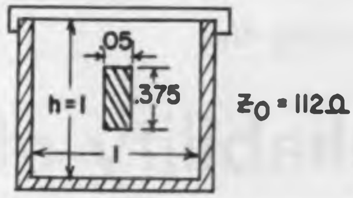
As a first approach:

Let t be equal to 0.05, a practical thickness for a small rigid brass strip. The width b is assumed one inch, thus giving ample work space inside the line. Further, assume, Z_o, the characteristic impedance to be equal to 100 ohms. Note that the value of Z_o will be largely determined by the final dimensions used for the line. Then from page 599 of the handbook, the calculations are as follows:

$$t/b = \frac{0.05}{1} = 0.05$$

$$w/b = 0.4,\ w = 0.4 \times 1 = 0.4$$

If w is made $\frac{3}{8}$ inch wide (0.375) while keeping the other dimensions the same, the characteristic impedance, Z_o, changes slightly as seen from Fig. 13, page 599. The calculated values for the strip line appear below in the sketch. The height, h, is independent of Z_o and can approximate b.



To tune the line, assume a variable capacitor having a minimum capacity of 1 pf.

At 1000 MCS:

$$X_c = \frac{1}{2\pi f c}$$

$$= \frac{1}{6.28 \times 1000 \times 10^6 \times 1 \times 10^{-12}} = \frac{10^3}{6.28} = 159\ \Omega$$

To obtain parallel resonance, the shorted strip line must have an equal inductive reactance.

Thus $X/Z_o = 159/112 = 1.42 = \tan\beta l = \tan\theta_2$

Therefore

$$\theta_2 = \beta l = 55^\circ = 55/57.3 = 0.96 \text{ radians}$$

$\beta = 2\pi/\lambda, \quad \lambda = c/f$

$= 3 \times 10^8/1000 \times 10^6 = 0.3$ meters $= 11.8$ inches

Hence $l = \theta_2/\beta = 0.96\ \lambda/2\pi = 0.96 \times 11.8/6.28 = 1.8$ inches

At 500 MCS: the reactance of the line is

$X = Z_o \tan\beta l = Z_o \tan\theta_1$

$\lambda = c/f = 3 \times 10^8/500 \times 10^6 = 0.6$ meters $= 23.6$ inches

$\theta_1 = \beta l = 2\pi l/\lambda = 6.28 \times 1.8/23.6 = 0.48$ radians

$\theta_1 = 0.48 \times 57.3 = 27.5^\circ$

$\tan 27.5^\circ = 0.522$

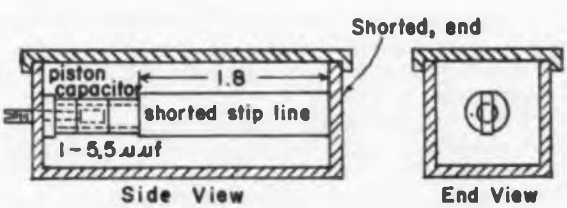
Therefore

$X = Z_o \tan\theta_1 = 112 \times 0.522 = 58.5$ ohms.

At 500 MCS, the variable capacitor must have a reactance of 58.5 ohms. The required c is

$$C = \frac{1}{\omega x} = \frac{1}{6.28 \times 500 \times 10^6 \times 58.5} = \frac{10^3}{184} \cong 5.5 \text{ pf}$$

The final resonator requires a tuning capacitor with a capacitance range of 1 to 5.5 pf. A rough sketch of the tuner is shown below.



Side View   End View

A similar analysis can be made for an open-ended line.

★ ★ ★

By HERBERT ADISE

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Estimating the

Reliability of Precision Potentiometers

For reliability the questions arise—
multiple wipers or single wipers?
wire wound pots or carbon pots?
Here is an easy way to answer these questions.

A SYSTEM is considered only as reliable as its individual components. Here we discuss the reliability of one system component—the potentiometer.

A component's measure of *reliability* is said to be *the inverse of the probability of its failure.* The greatest possible component reliability is limited by the greatest failure probability among its constituents.

Let's first make this definition: "A component is considered to have failed when it is unable to perform its intended function satisfactorily."

For a potentiometer the prime function is to give a *continuous* voltage output in proportion to its shaft position. To be useful, a specified degree of proportionality must be met.[1]

Unless the precision potentiometer's wiper makes continuous contact, and hence provide continuous output, it has failed. Thus, its reliability factor begins with our finding the probability of continuity failure.

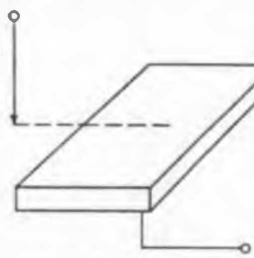
Basic Probability Concepts

1. The probability that an event will happen is the ratio of the number of favorable cases to the entire number of possible cases, provided all cases are equally likely to occur.
2. The probability of simultaneous occurrence of two independent events whose respective probabilities are a and b is $a \times b$.
3. The probability of occurrence of one or the other of two mutually exclusive events whose respective probabilities are a and b is $a + b$.

[1] See "One Solution to Servomechanism Hunting," *Electronic Industries*, January 1961.

Slider Contacts

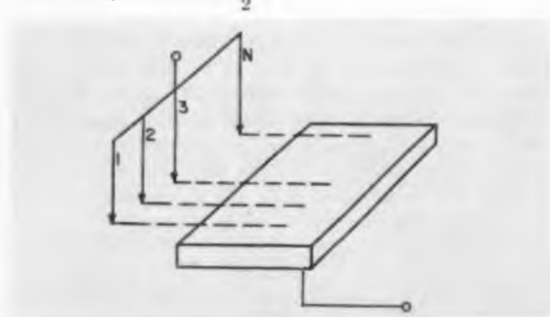
Let us consider the relative probabilities of continuity failure of a single sliding contact versus multiple sliding contacts:



Possible cases: 2 $\begin{cases}\text{(won't make contact)}\\ \text{(will make contact)}\end{cases}$

Failure cases: 1 (won't make contact)

Probability of failure $= \frac{1}{2}$



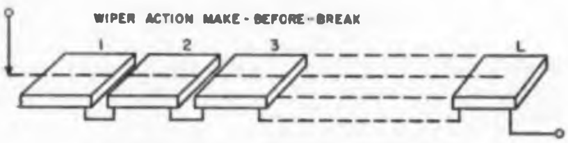
From Concept (2) above:
Probability of Simultaneous Failure

$$= \left(\frac{1}{2}\right)_1 \left(\frac{1}{2}\right)_2 \left(\frac{1}{2}\right)_3 -- \left(\frac{1}{2}\right)_n = \left(\frac{1}{2}\right)^n$$

Failure Probability Ratio—
Multiple Wipers vs. Single Wipers $= \dfrac{\left(\frac{1}{2}\right)^n}{\frac{1}{2}} = \left(\frac{1}{2}\right)^{n-1}$

Conclusion: Multiple wipers (n) are $\left(\frac{1}{2}\right)^{1-n}$ times as reliable as a single wiper.
A four wiper contact is eight times as reliable as a single wiper.

The probability of continuity failure of a single wiper traversing a series of contacts is:
From Concept (3) above:



Probability of Failure =

$$\left(\frac{1}{2}\right)_1 + \left(\frac{1}{2}\right)_2 + \left(\frac{1}{2}\right)_3 -- \left(\frac{1}{2}\right)_L = \frac{1}{2} L$$

Failure Probability Ratio—
Single Contact vs. Series Contacts $= \dfrac{\frac{1}{2}}{\frac{1}{2} L} = \dfrac{1}{L}$

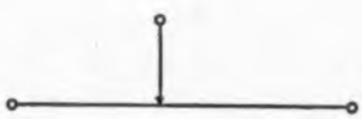
Failure Probability Ratio—
Multiple Wipers, Single Contact
vs.
Single Wiper, Series Contacts

$$= \frac{\left(\frac{1}{2}\right)^{n-1}}{L}$$

Conclusion: (a) A single long contact is L times as reliable as L series contacts of equal total length. (b) A single long contact with multiple wipers (n) is $L \frac{1}{2}^{1-n}$ times as reliable as L series contacts of equal total length traversed by a single wiper.

Resistance Element

The relative probabilities of continuity failure between ends of a single long stationary contact versus paralleled stationary contacts, are:



Possible Cases: 2
Failure Cases: 1
Probability of Failure between B and C $= \dfrac{1}{2}$

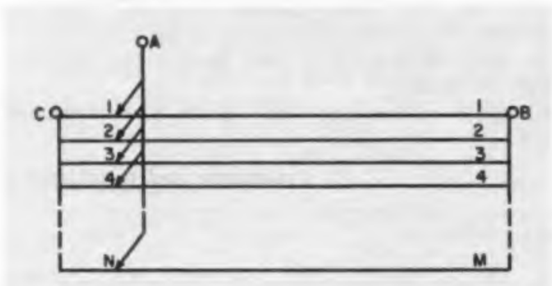
Possible Cases: 2 M
Failure Cases: 1
Probability of Failure $= \dfrac{1}{2\,M}$

Failure Probability Ratio—

Multiple Parallel Paths vs. Single Path $= \dfrac{\frac{1}{2\,M}}{\frac{1}{2}} = \dfrac{1}{M}$

Conclusion: A resistance element having multiple wiper (or current) paths M is M times as reliable as a resistance element having one wiper path.

The probability of simultaneous continuity failure of paralleled wipers combined with paralleled resistance elements is:



From Concept (2) above:
Probability of Failure between A and C or A and B

$$= \frac{\left(\frac{1}{2}\right)^n}{2\,M}$$

Failure Probability Ratio—
Multiple Wipers, Multiple Paths vs.
Single Wiper, Single Path

$$= \frac{\frac{\left(\frac{1}{2}\right)^n}{2\,M}}{\frac{1}{2}} = \frac{\left(\frac{1}{2}\right)^n}{M}$$

Failure Probability Ratio—
Multiple Wipers, Multiple Paths vs.
Single Wiper, Series Contacts

$$= \frac{\frac{\left(\frac{1}{2}\right)^n}{2\,M}}{\frac{1}{2} \cdot \frac{1}{2} L} = \frac{\left(\frac{1}{2}\right)^{n-1}}{M\,L}$$

Film vs. W. W. Pots

The current in the typical wire-wound potentiom-
(*Continued on page* 260)

A procedure for using a slotted line to measure resistance and reactance components of an unknown impedance is described. After a few simple readings, the components can be found from an included table.

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An Easy Method for

Analyzing Impedance

THE following is a step by step procedure for measuring impedances with a slotted line:

The unknown impedance Z_L is connected to a slotted line of known characteristic impedance Z_o, and the value of the unknown impedance is determined by measuring the voltage-standing-wave-ratio and the position of the voltage minimum on the line. A voltage minimum position is used since it may be more precisely located.

The nature and magnitude of the load impedance as seen along the slotted line when using a voltage minimum as reference, is shown in the diagram of Fig. 1.

A Smith Calculator may be used to obtain the components of the complex load impedance from the VSWR and line angle measurements, but for low standing-wave-ratios (less than 1.2 to 1) Table 1 may be used for greater ease and accuracy. The table has been calculated to five significant figures and it represents particular solutions of the equation

Resistance and reactance from slotted line measurements. Multiply values given

CAPACITIVE REACTANCE | INDUCTIVE REACTANCE

Deg.	VSWR 1.07		VSWR 1.08		VSWR 1.09		VSWR 1.10		VSWR 1.11		VSWR 1.12		Deg.
	Res.	Reactance	Res.	Reactance	Res.	Reactance	Res.	Reactance	Res.	Reactance	Res.	Reactance	
0	.93458	.000	.92593	.000	.91743	.00	.90909	.00	.90090	.00	.89286	.00	180
5	.93536	.010999	.92692	.012325	.91846	.013763	.91024	.015088	.90223	.016378	.89422	.017635	175
10	.93818	.021726	.92994	.024502	.92183	.027227	.91387	.029836	.90603	.032399	.89833	.034895	170
15	.94255	.031911	.93482	.036010	.92738	.040004	.91980	.043899	.91242	.047696	.90514	.051399	165
20	.94865	.040690	.94164	.046628	.93473	.051803	.92728	.056892	.92122	.061906	.91456	.066763	160
25	.95625	.049598	.95021	.056703	.94422	.062407	.93835	.068604	.93232	.074667	.92648	.080609	155
30	.96516	.056802	.96019	.064060	.95524	.071388	.95037	.078565	.94545	.085608	.94054	.092517	150
35	.97517	.062047	.97151	.070327	.96783	.078474	.96412	.086479	.96040	.094357	.95667	.10210	145
40	.98615	.065760	.98391	.074638	.98166	.083400	.97931	.092059	.97697	.10059	.97452	.10900	140
45	.99772	.067556	.99695	.076802	.99630	.085965	.99548	.095023	.99458	.10403	.99361	.11285	135
50	1.0096	.067298	1.0105	.076666	1.0114	.085942	1.0123	.095529	1.0129	.10466	1.0135	.11372	130
55	1.0213	.064982	1.0240	.074126	1.0265	.083260	1.0289	.092322	1.0312	.10134	1.0335	.11053	125
60	1.0326	.060527	1.0369	.069149	1.0411	.077763	1.0452	.086364	1.0492	.094955	1.0531	.10353	120
65	1.0430	.054098	1.0488	.061894	1.0546	.069705	1.0602	.077526	1.0658	.085361	1.0713	.093206	115
70	1.0522	.039062	1.0594	.052458	1.0665	.059152	1.0736	.065874	1.0807	.072622	1.0876	.079398	110
75	1.0597	.036538	1.0681	.041802	1.0764	.046438	1.0848	.051770	1.0930	.057135	1.1012	.062532	105
80	1.0654	.025062	1.0746	.028762	1.0839	.031983	1.0931	.035683	1.1023	.039412	1.1115	.043001	100
85	1.0689	.012536	1.0787	.014343	1.0885	.016385	1.0990	.018280	1.1081	.020193	1.1179	.022122	95
90	1.07	.000	1.08	.000	1.09	.00	1.10	.00	1.11	.00	1.12	.00	90

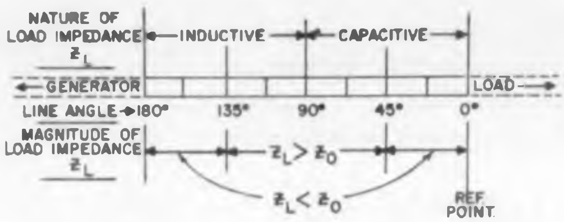

Fig. 1: The nature and magnitude of load impedance is illustrated.

With the Slotted Line

$$\frac{Z_L}{Z_o} = \frac{1 - j\rho \tan \beta d}{\rho - j \tan \beta d}$$

where:

ρ = voltage-standing-wave-ratio

βd = line angle measured to the voltage minimum position from the voltage minimum reference.

Z_L = unknown load impedance.

Z_o = slotted line impedance.

1. Short circuit the load end of the slotted line with a suitable shorting plug.

Note: The design of the short circuiting plug is very important. The impedance measured will be that existing in a normal plane through the load connector and located at the same position, with reference to the slotted line, as had been the inside surface of the short circuiting plug.

2. Establish the reference point on the slotted line at any voltage *minimum*. The one nearest the load is usually most convenient.

(*Continued on page* 289)

by Z_o of slotted line. Angles are electrical distance from load to E_{min}.

Deg.	VSWR 1.01		VSWR 1.02		VSWR 1.03		VSWR 1.04		VSWR 1.05		VSWR 1.06		Deg.
	Res.	Reactance	Res.	Reactance	Res.	Reactance	Res.	Reactance	Res.	Reactance	Res.	Reactance	
0	.99010	.00	.98039	.00	.97087	.00	.96154	.000	.95238	.000	.94340	.000	180
5	.99027	.0017109	.98063	.0031724	.97127	.0049861	.96209	.0065539	.95298	.0080776	.94414	.0095589	175
10	.99068	.0033716	.98152	.0066483	.97253	.0098333	.96369	.012932	.95501	.015944	.94657	.018874	170
15	.99139	.0049325	.98380	.0087417	.97462	.014406	.96645	.018957	.95836	.023388	.95039	.027705	165
20	.99237	.0063472	.98491	.012536	.97595	.018574	.97010	.024463	.96283	.030208	.95574	.039700	160
25	.99370	.0075740	.98728	.014978	.98099	.022179	.97475	.028293	.96856	.036213	.96242	.042987	155
30	.99498	.0085747	.99003	.016980	.98501	.025219	.98007	.033297	.97507	.041216	.97007	.048981	150
35	.99662	.0093187	.99307	.018480	.98956	.027490	.98600	.036349	.98242	.045060	.97881	.053625	145
40	.99820	.0097819	.99633	.019433	.99388	.028952	.99250	.038344	.99042	.047608	.98835	.056743	140
45	.99995	.0099500	.99980	.019800	.99956	.029550	.99923	.039201	.99881	.048751	.99830	.058203	135
50	1.0017	.0098160	1.0033	.019566	1.0047	.029251	1.0061	.038869	1.0073	.048420	1.0085	.057905	130
55	1.0034	.0093819	1.0066	.018733	1.0098	.028052	1.0128	.037336	1.0158	.046588	1.0186	.055803	125
60	1.0049	.0086568	1.0098	.017312	1.0146	.025964	1.0192	.034612	1.0238	.043258	1.0282	.051897	120
65	1.0064	.0076848	1.0127	.015363	1.0189	.023075	1.0251	.030805	1.0311	.038554	1.0371	.046319	115
70	1.0076	.0064448	1.0152	.012923	1.0227	.019434	1.0302	.025978	1.0376	.032552	1.0449	.039158	110
75	1.0086	.0050180	1.0172	.010072	1.0257	.015830	1.0337	.020955	1.0428	.026115	1.0513	.031310	105
80	1.0094	.0034351	1.0188	.0076118	1.0281	.010560	1.0375	.014140	1.0468	.017751	1.0561	.021392	100
85	1.0099	.0017449	1.0196	.0035066	1.0295	.0052852	1.0394	.0070803	1.0493	.0088926	1.0590	.010721	95
90	1.01	.000	1.02	.000	1.03	.000	1.04	.000	1.05	.000	1.06	.000	90

CAPACITIVE REACTANCE

INDUCTIVE REACTANCE

Interference instrumentation is divided, generally, into two categories— those for field survey use and those used by researchers for studying the detailed properties of the noise. Instruments for both uses are discussed and described along with information about commercially available instruments.

Instrumentation for Radio Interference Measurements

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This is the tenth in a planned series of editorial features on Radio Frequency Interference arranged for by the editors of ELECTRONIC INDUSTRIES

INTEREST in the field of Radio Interference Measurement began almost imperceptibly about 30 years ago. Since then, a considerable development of devices and techniques covering the entire communication spectrum has taken place. However, in respect to the development of standardized procedures and universally acceptable measures of interference, progress has been unsteady, and many problems introduced by early contributors to the field show a relentless persistance to remain problems.

The difficulty here is one of lack of bounds. "Radio interference" is the opposite of "desired radio signal" and can be any electrical disturbance. It may be periodic or it may be random; it may be generated by natural sources or by man-made sources. Typical of the variety of radio noises which must be measured are, noise generating rotating and vibrating machinery, discharges in switching systems, corona discharges, ignition noise, noise generated in ionized gas devices, atmospheric noise, cosmic noise, and unwanted signals from radio communication systems. Each of these sources has its own set of characteristics, and while one quantity will establish the amplitude of a sine wave, an infinite number of quantities are required to completely specify a general random process. Acceptable methods of measurement for use in establishing the noisiness of a source will necessarily involve compromise. It is interesting to note the remarks of C. M. Burrill[1] in a paper surveying the field of measurement in 1941. He writes, ". . . the most difficult problem in radio noise measurement is to select, from the many types of measurements which might be made, the ones which are most significant for the purposes desired. It is easy to obtain numerical measures of radio noise; the problem is the interpretation of the values after they are obtained."

Even today, the questions "what shall we measure," and "what use can be made of the measurement" cause a bit of bewilderment, even among experts.

With this doleful opening completed, let us, however, see what has thus far been accomplished.

We should, at the outset, distinguish between instruments and techniques developed for field survey use and those developed or adapted by researchers for the purpose of studying the detailed properties of the noise. The former, which we shall call field instruments, are usually employed by equipment manufacturers to determine if the radio interference generated by the equipment meets a certain stated limit. Military specifications MIL-I-6181B and MIL-I-16910A, typically, require the use of such instruments for tests on new equipment. Most of the field instruments available today are also equipped to measure the carrier level of radio signals, and are often used to measure harmonic output of radio transmitting stations. It has become virtually standard to refer to such devices as Radio Interference-Field Intensity Meters, abbreviated RIFI meters.

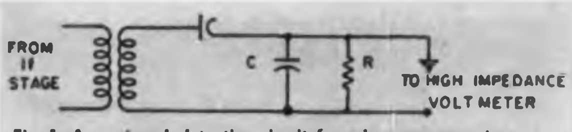


Fig. 1: A quasi-peak detection circuit for noise measurements

The second kind of instrument referred to above is properly not an instrument, in general, but a laboratory setup. Special arrangements have been developed at the Bureau of Standards, the University of Pennsylvania, the University of Florida, and many others, for measuring various statistical parameters of noise. Among these are the probability distribution of the amplitudes of random waveforms, the probability distribution of the number of peaks in such a waveform above a chosen level, the average power spectral density, etc.

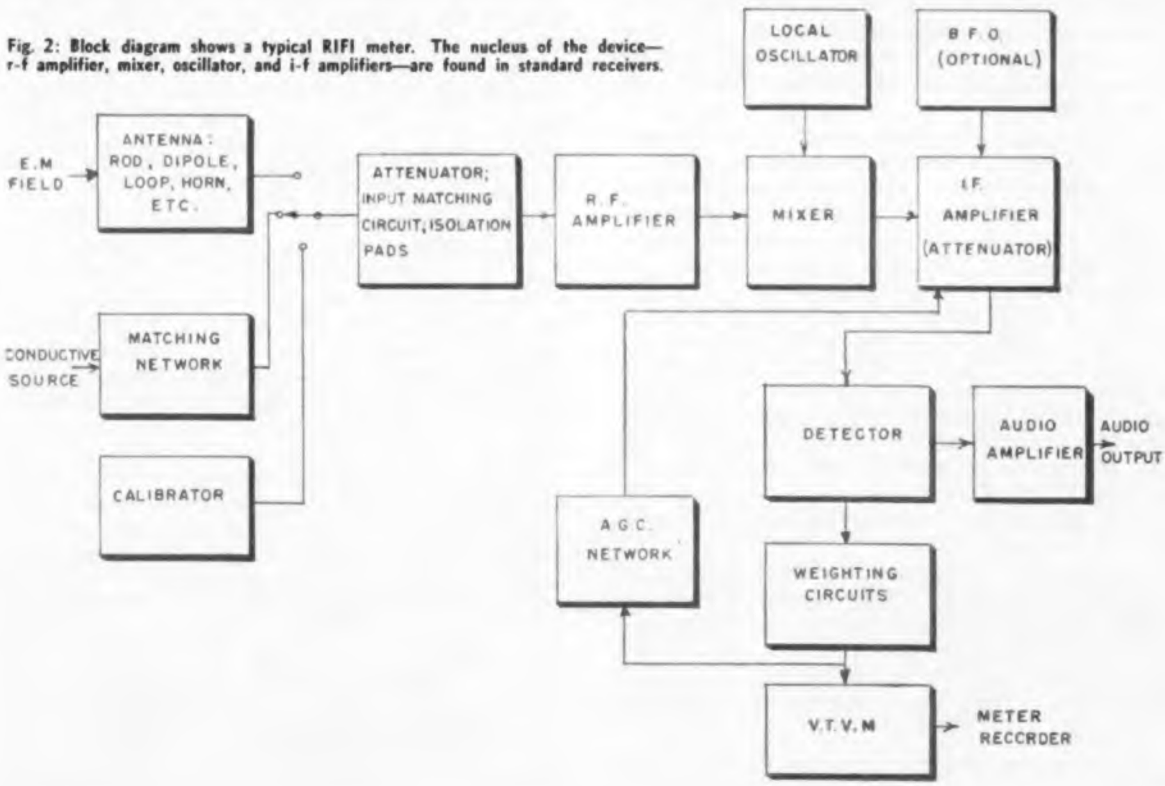
We shall discuss these in order; let us look, first, at the field instrument.

Field Instruments

Early attempts at measurement of interference were largely adaptations of field strength measuring techniques and "ad hoc" procedures. Often, a standard radio receiver equipped with an audio output meter was used to get a quantitative measurement. In 1933, Barhydt[2] described a device which appears to be the first one specifically made and publicized for interference measurement. His instrument was a tuned r-f receiver with a full wave copper oxide rectifier as a detector, followed by a meter indicator. Measurements were to be made by matching the indicator reading obtained with the interference source, to the reading obtained with an internal 120 CPS reference multivibrator which was fed to the receiver input through a calibrated attenuator. The dial calibration of the attenuator was the measure of the interference. It is interesting to note that this technique—that is, the substitution method—is in use today, although the reference source is a generator of extremely narrow pulses. More will be said about this later. The procedure described is predicated on the assumption that the reference source is similar in its essential characteristics to the noise under measurement. The effect on the receiver would then be the same in both cases and substitution is valid.

The radio communication art was progressing quickly during this period, particularly in the use of higher frequencies and in the refinement of communication circuits, and the specification of radio interference measuring instruments changed, too. In 1940, the essential characteristics of a measuring instrument and measuring techniques were described in a paper by Aggers, Foster, and Young[3] which indicated a different attitude toward this problem. The authors explicitly stated that "the most practical type of noise meter is one which is essentially similar to a radio receiver, with indicating means at the output." Their measurement was not necessarily to be compared with that obtained with some standard source. Their instrument was designed to give readings which, in effect, represent what the ultimate listener hears. Their detector, as shown in Fig. 1, was a conventional diode detector whose time constants were selected to give specified rates of charging and discharging of capacitor C. Because the dc output voltage is close to

Fig. 2: Block diagram shows a typical RIFI meter. The nucleus of the device—r-f amplifier, mixer, oscillator, and i-f amplifiers—are found in standard receivers.



RFI Measurements *(Continued)*

the peak value of the input, at least for pulse inputs of high repetition rates, the circuit is known as a quasi-peak detector. Their calibrating source was a broadband random noise generator whose function was simply to aid in setting the gain of the overall device to a standard level. The indicating meter was to give a quantitative reading of the actual interference, or nuisance effect of the noise, after being filtered in an i-f amplifier.

In 1942, a paper was, in fact, published by C. M. Burrill[4] wherein the judgment of 30 listeners was compared with the signal to noise ratio (S/N) as indicated on three different radio noise meters, each built to correspond to a 1940 proposal of a joint industry committee[5] and which was similar to the proposal of Ref. 3. The noises used were electric razor (vibrator) noise, dc commutator machine noise, and relay click noise. The signal was standard broadcast program material. The meters were of different manufacture; one had quasi-peak detector charge and discharge time constants[a] of 1 msec and 160 msec, respectively, and each of the other two had charge and discharge time constants of 10 msec and 600 msec, respectively. The 10/600 devices appeared to give readings less dependent on the type of noise used, but all of them gave S/N readings in decibels which were nearly linearly related to the interference effect in the judgment of the listeners.

Though "natural selection" might be expected to result in the ascendancy of one method over all others, particularly after 20 years, this has not been the case in the field of interference measurement. And this is so in spite of the efforts of various groups, both national and international, to effect some satisfactory compromise.

The International Special Committee on Radio Interference (CISPR), a group operating under the International Electrotechnical Commission, and Committee C 63 of the American Standards Association, are occupied with attempts to specify standard meters for field measurement. The aim of these groups is to establish values for the parameters of the instruments and to set measuring procedures which are generally agreeable. While no one measurement can furnish all the information required to predict the severity of a given noise, at least readings taken with different meters will be comparable. While there is a considerable area of agreement between the international and the ASA standards, there are differences particularly in regard to detector time constants. It is, however, usually possible to relate readings made according to the two standards.

Another international body, the International Radio Consultative Committee (CCIR), operating under the International Telecommunication Union, is concerned with the more basic questions of what to measure, how to measure it, and how to use such data in interference analysis. Liaison exists between this group and those mentioned in the preceding paragraph. A typical publication of the CCIR is Ref. 6.

Modern Field Instruments

A block diagram of a typical RIFI meter is shown in Fig. 2. The nucleus of the device—the r-f amplifier, mixer, oscillator, and i-f amplifiers—will, to a large extent, be similar to what is found in standard receivers. The significant differences are in the input circuits, which must accommodate a number of different pick-up devices and must include attenuators and calibrators, and the output circuits, which contain the special detectors and metering devices.

Instruments are available today to cover the range from 30 CPS to 10 KMC, and the development of instruments up to 100 KMC is now underway. A list of several commercially available devices and some of their properties is shown in Table 1. Only those instruments which are specifically designed for noise measurement, rather than for field intensity measurement exclusively, are listed. The characteristics are those supplied by the manufacturer. Meters made in Germany by Siemens, to the specifications of the CISPR, are also known.

These devices are often used simply as two terminal voltmeters with either a known, or constant, input impedance. Most instruments are designed with 50 ohm input impedance and the lower frequency instruments are often equipped with several values ranging from 20 ohms up to the input impedance of the basic tuned coupling circuit existing between the antenna and the r-f amplifier.

The application of the RIFI meter to the measurement of electromagnetic fields is of particular importance. The low frequency devices—that is, those operating below 30 MC, are generally supplied with non-resonant rod and/or loop antennas for the measurement of the electric and magnetic field, respectively. For interference search, requiring physically small antennas, loop probes, ranging from about the size of an acorn to about 4 in. in diameter, and small dipole probes, about 8 in. overall, are used.

At frequencies beyond 30 MC, up to, say, 1000 MC tuned antennas, either dipole or rod, are generally used. Since the need for tuning both the antennas and the noise meter complicates the process of interference search, broadband antennas are often provided for this purpose. Once found, the field is more accurately measured using a tuned dipole. In the microwave range, that is beyond 1 KMC, calibrated horns are common as well as broadband conical antennas.

An important application of the RIFI meter is in the measurement of r-f noise conducted along power lines. Direct connection to the power line may be made through a coupling network which isolates the

REFERENCE PAGES
The pages in this section are perforated for easy removal and retention as valuable reference material.
SOMETHING NEW HAS BEEN ADDED
An extra-wide margin is now provided to permit them to be punched with a standard three-hole-punch without obliterating any of the text. They can be filed in standard three-hole notebooks or folders.

a. The accepted definitions of the time constants will be given later.

meter from the power frequencies and which presents a suitable impedance to the power line. For this purpose, r-f probes are supplied with some instruments. Clamp-on transformers (for example, Stoddart Model 91550-1 Current Probe) which obviate the need for a physical connection to the line are also available.

The attenuators, at frequencies up to about 30 MC are often networks comprised of either lumped resistors, or capacitors. At higher frequencies, coaxial resistive attenuators, where the inner conductor is a metalized resistor, and waveguide devices are found. The range of input voltages often accommodated in these instruments is 1 μv to 1 volt. The range of input voltages without attenuation varies; in some devices it is 1 μv to 10 μv, in others 1 μv to 100 μv. Thus. attenuators with maximum input-output ratios of 10^4 or 10^5 are required; that is, 4 or 5 steps of 10:1 attenuation. The first step of attenuation is virtually always connected beyond the r-f stage, either in the i-f amplifier or the detector. This is done to depress the internally generated noise at the same time that the input signal is reduced.

impulse, in volt-seconds. We are in the habit of defining the strength of a rectangular impulse by

$$S = 2A\tau$$

where S is the impulse strength,

A is the height of the impulse in volts, and

τ is its duration in seconds.

As is well known, the frequency spectrum of such a pulse can be written

$$F(f) = 2A\tau \frac{\sin \pi f\tau}{\pi f\tau}, \ f \gg o$$

where $F(f)$ is the spectral intensity in volts per cycle per second, and f is the frequency in CPS.

At low frequencies $\sin\pi f\tau/\pi f\tau \cong 1$ and the spectral intensity and impulse strength are nearly equal in this case. The impulse calibrators are, in fact, used at frequencies such that the approximation above is applicable. Separate calibrator units are also available in addition to the ones built into the RIFI meters of Table 1. Units are made which are nominally flat from about 10 KC to 1000 MC (e.g. Stoddart type 91263-1 and Empire Devices type IG-102 and IG-115);

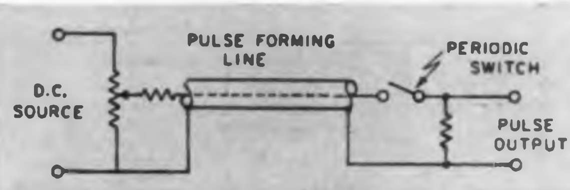


Fig. 3: Simplified schematic of an impulse generator which is used to generate periodic impulses. Line length determines pulse width.

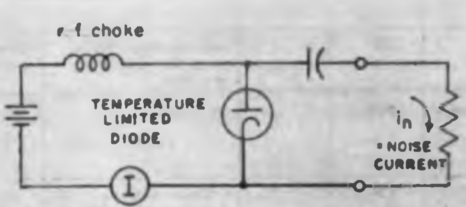


Fig. 4: A simple random noise broadband device.

Internal calibrating devices differ considerably among RIFI meters. As Table 1 indicates, sine wave oscillators—tuned or fixed frequency, random gaussian noise generators, or impulse generators are used in different instruments. The two latter sources, which are broadband, have an advantage over the sine wave source in that their output is available immediately anywhere in the band without tuning. However, internal sine wave signal generators, which are tuned by the same knob as are the receiver circuits, are also being used.

One method of generating periodic impulses is shown in a simplified diagram in Fig. 3. This device uses a periodically discharging transmisson line whose length determines the width of the pulse. Pulse widths of the order of 10^{-9} seconds are in common use, with corresponding frequency spectra which exceed 1000 MC. Under ideal conditions, with the line perfectly matched to the discharging load and instantaneous closing of the switch contacts, the output is a rectangular pulse whose height is ½ the voltage to which the line was charged by the dc source and whose width is the time required for a disturbance to travel twice the length of the line.

It is customary to speak of the output of an impulse generator in terms of the impulse strength, or in terms of the spectral intensity. The former is defined in a number of ways by different people, but it is always proportional to the area under the individual

at least one is available which covers up to 10 KMC (Empire Devices IG-118). Repetition rates on some are fixed at 60 CPS or 1000 CPS; on others, the rates are variable.

Random noise broadband devices are generally temperature limited noise diodes connected in a circuit schematically shown in Fig. 4. The noise output of such a device is given by:

$$\overline{i_n^2} = 2\,eIB_p$$

where $\overline{i_n^2}$ = mean-square noise current in bandwidth B_p

e = charge of the electron in coulombs

I = dc flowing between anode and cathode in amperes

B_p = effective bandwidth of the measuring circuit in CPS[b]

Random noise calibrators using gas filled devices (thyratrons, neon bulbs, fluorescent tubes) are also occasionally used. Although temperature limited devices, which are generally quite reliable, have been built to several thousand MC, they are used as internal calibrators in RIFI meters only up to about 30 MC. However, calibrated noise generators as separate devices are available from a number of manufacturers (e.g. Polarad Model N-1, flat to several hundred MC).

The broadband calibrators are used largely as transfer devices. The basic calibration is done in the laboratory using a sine wave signal generator. The calibrator output required to give the same deflection as the signal generator is noted on charts and is then

b. A precise definition of B_p will be given near the end of this section.

RFI Measurements *(Continued)*

Table One

CHARACTERISTICS OF SEVERAL COMMERCIALLY AVAILABLE RIFI METERS

Manufacturer	Type Designation		Frequency Range	Bandwidth 6db(5)	Sensitivity limit(6)	Detector Function(7)	Calibrator Source	Pick-up Devices
	Commercial	Military						
Empire Devices	NF-105		0.014-1000mc/s with 5 tuning units as follows T-X/NF-105 14kc-150kc	600-1000cps(3)			variable prf impulse generator;	
			TA/NF-105 150kc/s-30mc/s	5-15kc/s(4)	1μv			loop, 12"; rod, 1/2 meter
			T-1/NF-105 20mc/s-200mc/s	100kc/s(3)	10μv			
			T-2/NF-105 200-400mc/s	200kc/s(3)	10μv	A P SBP	fixed frequency sine wave generator	tuned dipole, Broadband conical
			T-3/NF-105 400-100mc/s	300kc/s	10μv			
Empire Devices	NF-112		1-10kmc/s with 4 tuning units as follows T-1/NF-112, 1-2kmc/s		10μv	A P SBP	impulse generator 1000pps	Horns
			T-2/NF-112, 2-4kmc/s	1mc/s and 5mc/s(3)				
			T-3/NF-112, 4-7kmc/s					
			T-4/NF-112, 7-10kmc/s					
Ferris	32B		150kc/s-350kc/s, 550kc/s-20mc/s	10kc/s(3)	1/2μv	QP2	random noise generator	1/2 meter rod, inductive probe
Ferris	32D		550kc/s-25mc/s	6.4-9.6kc/s(2)	1μv	QP1 SBP	multi-vibrator	1/2 meter rod; loops: one per band 5"-6 1/2" "Square"; loop probe 2" dia; Dummy antenna.
Ferris	32J		any 40kc/s interval in range 500-1600kc/s is available	10kc/s (estimate)	1μv	QP1 QP2 QP3	multi-vibrator	1/2 meter rod
Measurements	58AS		15-150mc/s	140kc/s(3)	1μv	A QP1 SBP	random noise source	loop 9" dia., Tuned dipole, loop probe. 3" dia, capacitive probe. RF probe
Polarad	FIM		1-10kmc/s with 4 tuning units as follows FIM-L, 1-2.4kmc/s FIM-S, 2.14-4.34kmc/s FIM-M, 4.2-7.74kmc/s FIM-X, 7.36-10.0kmc/s	5mc/s(3)	20μv	A SBP QP1	internal sine wave signal generator	Broadband Conical, Horns
Stoddart	NM-40A	AN/URM-41	a. Selective: 30cps-15kc/s	13-90cps(1) variable	1μv	A	400cps tuning fork oscillator	loop: 30" dia; capacitive probe with dipole
			b. Wideband: 30cps-15kc/s ± 0.5db		15μv	A SBP QP1		
Stoddart	NM-10A	AN/URM-6B	14kc/s-250kc/s	100cps-600cps (2)	1μv	A SBP QP1	neon bulb random noise source	rods: 1 meter and 1/2 meter; loops: 30" and 5 3/8" dia; RF Probe.
Stoddart	NM-20B	AN/PRM-1A	150kc/s-25mc/s	2-6kc/s(2)	3μv	A SBP QP1	random noise source	rod: 1/2 meter; loops: 30" dia, and 7" x 8" rect. loop probe; RF Probe
Stoddart	NM-30A	AN/URM-17	20mc/s-400mc/s	138kc/s-(2) 175kc/s	1μv to 145mc 2μv to 240mc 6μv to 400mc	A SBP QP1	Impulse generator 60pps	tuned dipole, tuned vertical rod, loop probe 3" dia.
Stoddart	NM-52A	AN/URM-17	375mc/s-1000mc/s	510kc/s(3)	1.6μv to 610mc 2.0μv to 1000mc	A SBP QP1	Impulse generator 60pps	tuned dipole, Broadband "Bowtie"
Stoddart	NM-60A	AN/URM-42	1000mc/s-10.7kmc/s	1.5mc/s(3)	15μv	A SBP QP1	Impulse generator 60pps	Broadband conical, Horns

1. *The bandwidth of this instrument is continuously variable over the range shown.*

2. *The bandwidth of this instrument depends upon the frequency to which the device is tuned.*

3. *The bandwidth of this instrument is virtually constant over the tuning range.*

4. *This unit is tuned in 6 bands, within any one band the bandwidth is said to be virtually constant.*

5. *The bandwidth quoted in this column is either the 6db bandwidth or the "effective impulse bandwidth" defined as the peak output voltage at the dector to an impulse divided by the impulse strength. The latter is for most usual circuits nearly equal to the 6db bandwidth.*

6. *The sensitivity limit is not defined rigorously in most manufacturing bulletins. It may be viewed as the rms amplitude of a sine wave input signal required to equal the detector output obtained from the internal receiver noise.*

7. *Dector functions are designated by the following*

   A = Average of envelope

   SBP = Slide Back Peak

   P = Peak

   QP1 = Quasi-Peak, 1msec charge - 600msec discharge

   QP2 = Quasi-Peak, 10msec charge - 600msec discharge

   QP3 = Quasi-Peak, 1msec charge - 160msec discharge

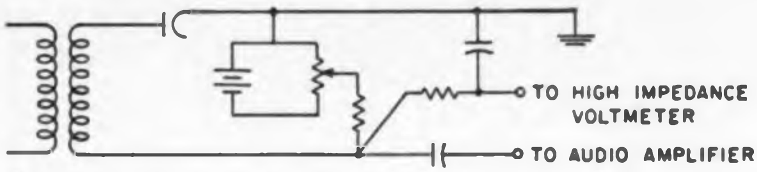


Fig. 5: Cut-off in the Slide-Back-Peak detector circuit can be monitored visually or aurally.

used to reset the gain of the instrument in the field. However, if the bandwidth of the instrument were to change, the process of calibration, which involves setting only the center frequency gain, would result in changing the gain from its earlier value. The measurement of narrow band signals will thus be in error.

However, increasing use is being made of the calibrator as a comparison device for measurement by substitution. The meter then operates as a sensitive detector. This procedure is more often used with devices which incorporate an impulse calibrator. The strength of the impulse, which is set to give an output peak reading equal to that obtained with the noise, is taken as a measure of the noise. For certain impulsive noises, the measurement so obtained is not affected by moderate variations in the bandwidth.

The substitution technique can, of course, be used with a random noise calibrator. Here, too, results unaffected by instrument bandwidth would require that the noise being measured be similar in nature to the calibrator output. We shall return briefly to the question of calibration later.

Although the response of the RIFI meter is also a function of the bandpass characteristics of the r-f and i-f amplifier these are usually not too different from what is found in commercial receiving equipment. Two points are worth noting about the i-f amplifier: over coupling of tuned circuits is generally to be avoided (to simplify interpretation of the measurements), and. to obtain the required dynamic range, the last i-f amplifier in an RIFI meter is usually capable of much wider amplitude swings than the corresponding stage in a conventional receiver.

While all other parts of the RIFI meter affect the measurement in some degree, the detector is, in this respect, the most significant element of the system. The noise to be measured is not, in general, determined by any single measurement, and each detector will only provide a single—hopefully significant—parameter of the noise. Most instruments, it will be noted from Table 1, are provided with more than one detector function. By making measurements with more than one detector, it is sometimes possible to further identify the noise.

The average function, labeled A in Table 1, gives the average of the envelope of the waveform at the output of the i-f amplifier. To obtain this result in the instrument, a standard envelope detector is followed by a long time-constant resistance-capacitance averaging circuit.

The Slide-Back-Peak circuit, labeled SBP in Table 1 and shown schematically in Fig. 5, involves applying a dc bias voltage to the diode detector which is just sufficient to cut it off. The bias voltage, which is measured in the metering circuits, is, for this condition, equal to the peak of the noise at the i-f output. Cut-off is detected either aurally, by listening to the audio output, or visually, by allowing the audio output to turn an indicating lamp on and off.

The quasi-peak circuit, labeled QP1-3 in Table 1, was shown in Fig. 1. The designations QP1-3 imply the following time constants:

QP1: 1msec charge, 600 msec discharge.
QP2: 10msec charge, 600 msec discharge.
QP3: 1msec charge, 160 msec discharge.

The charge and discharge time constants are defined as follows:

The charge time constant is the time needed, after the instantaneous application of a constant sine-wave voltage to the stage immediately preceding the input of the quasi-peak voltmeter, for the output voltage of the voltmeter to reach 63% of its final value.

The discharge time constant is the time needed, after the instantaneous removal of a constant sine-wave voltage applied to the input of the apparatus, for the output voltage of the voltmeter to fall to 37% of its initial value.

Both 1 ms-600 ms and 1 ms - 160 ms time constants are proposed for adoption by the American Standards Association for instruments in the frequency range 15 KC to 30 MC. (Higher frequency instruments are currently under study by the ASA.) The 1 ms-160 ms time constants have been adopted by the CISPR group mentioned earlier, for instruments in the frequency range 150 KC to 30 MC; 1 ms-550 ms time constants have been adopted by this group for instruments in the frequency range 25 MC to 300 MC. The 10 ms-600 ms time constant may be found in early meters and is furnished in some meters today as an added facility.

The peak circuit, labeled P in Table 1, is essentially a quasi-peak circuit wherein the charge time is made very small, in the order of 1 μsec, and the discharge time is made extremely long, in the order of 1 second. The detector output in this case is virtually equal to the peak value of the i-f amplifier output even for inputs of very low repetition frequency. Since it does not require a nulling operation, it is more convenient than the slide-back circuit.

The response of a given meter with various detectors, when certain standard inputs are applied, has been calculated in Ref. 7[c]. Table 2 shows the results of this work giving the response of a slide-back-peak detector, an average of the envelope detector, a quasi-peak detector with 1 ms-600 ms time constants, and a true RMS detector. The latter is not currently built into any meter. The inputs are sine waves with RMS

c. This work is to be published by D. B. Geselowitz of the Moore School of Electrical Engineering.

d. In order for the above definition to apply, the width of the impulse must be small compared to the reciprocal of the center frequency of the instrument. If this is not true, S must be replaced by $F(f)$.

RFI Measurements

value equal to E, impulses with strength S as defined above[d], and gaussian random noise which is specified by E' where

$$(E')^2 \Delta f$$

is the average energy in a one ohm resistor and in a frequency band Δf CPS. The impulses are at a repetition frequency f_p, which is assumed small enough so that no overlapping of the pulses at the i-f output occurs (f_p much smaller than the bandwidth of the instrument insures this). The device is assumed to have been calibrated to read the RMS value of a sine wave correctly on each function.

The quantities B_e and B_p are equivalent bandwidths defined as follows:

$$B_e = \frac{\int_0^\infty |G(f)|\, df}{|G(f_o)|}$$

$$B_p = \frac{\int_0^\infty |G(f)|^2 df}{|G(f_o)|2}$$

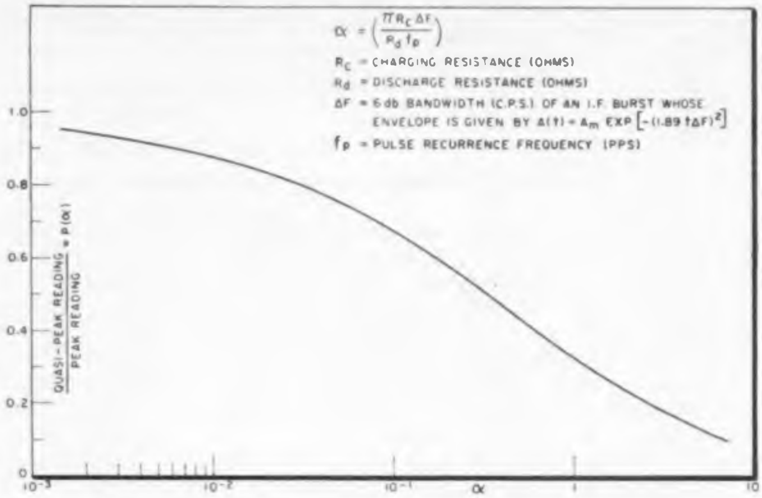


Fig. 6: A ratio of quasi-peak to peak readings as a function of RIFI meter parameters.

Table 2

Response of RIFI Meter

Input	Detector Function: Peak	Average	Q.P. (1 ms–600 ms)	RMS
Sine Wave	E	E	E	E
Impulse	$S B_e/\sqrt{2}$	$Sf_p/\sqrt{2}$	$SP(\alpha) B_e/\sqrt{2}$	$S \sqrt{f_p B_p}/\sqrt{2}$
Random Noise	—	$0.884 E' \sqrt{B_p}$	$1.820 E' \sqrt{B_p}$	$E' \sqrt{B_p}$

$|G(f)|$ is the amplitude vs. frequency response curve of the receiver, and $|G(f_o)|$ is the magnitude of the gain at the tuned frequency, f_o. These bandwidths have been found to approximate the usual 6db and 3db bandwidths, respectively.

The function $P(\alpha)$ required to find the quasi-peak response to an impulse is shown in Fig. 6 (abstracted from Ref. 8, facing p. 90). This curve applies only when the i-f selectivity curve resembles the bell shaped normal error curve; it is, however, an adequate approximation for most amplifiers, particularly if they are comprised of a large number of single-tuned circuits. The quantity α is a function of the bandwidth, the pulse recurrence frequency, and the charge (R_c) and discharge (R_d) resistances. The ratio R_c/R_d is not equal to ratio of time constants but may be taken approximately as

$$\frac{R_c}{R_d} = \frac{1}{4}\frac{T_c}{T_d}$$

The use of a number of detectors for identifying noise is suggested by Table 2. For example, we note that if the input were random gaussian noise, the quasi-peak reading should be very nearly twice the average reading. It is also interesting to note that advocates of the quasi-peak circuit argue that the decreasing reading, as the pulse recurrence frequency of pulse noise is reduced, suggests the smaller interference effect experienced by a listener.

Laboratory Instruments

Although we have made a distinction between field instruments and laboratory instruments, it is well to point out that the former are often used in the laboratory to measure basic noise properties. Being general purpose devices, the field instruments are often inadequate in a detailed study of the characteristics of noise, and additional special instruments must be used.

In particular, the determination of the effect of noise on a communications system often requires more information than can be obtained using the field instruments. At most, the commercially available RIFI meters give three parameters of the noise after filtering. This isn't enough for most needs, except when certain advance information is available about the noise, for instance the knowledge that it is gaussian. What kind of statistical information—we assume that our interest is with noise of a random nature—should be determined in the course of studying noise, depends on how the data will be used. For example, in a National Bureau of Standards report (Ref. 9), Watt, et al, describe the use of the amplitude probability distribution of the noise to determine the error probability in a teletype system. In other applications "higher order" statistical information may be required.

The choice of the quantity to be measured and also the technique of measurement are, hence, functions

(*Continued on page* 252)

ELECTRONIC INDUSTRIES
SPECIAL REPORT

This is the fifth in a series which describes hardware for the electronic industry. Part V presents in tabular form, additional tube sockets, transistor sockets, CRT sockets and sockets for the new tube types recently introduced. Each item is clearly described and illustrated along with uses, types of material and known suppliers.

Electronic Hardware

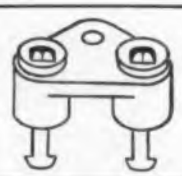
Tube and Transistor Sockets, Part 2

By V. S. GITTENS
Component Applications Section
Engineering Dept.
Philco Corp.
Tioga & "C" Sts.
Philadelphia 4, Pa.

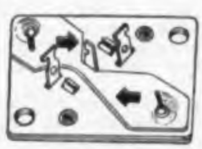
TRANSISTOR SOCKETS

Transistor sockets have insulating bodies of low-loss mica-filled phenolic. Contacts are phosphor bronze, 0.0002 inch gold plated. Mounting ring is cadmium plated steel. Available from Cinch Mfg. Corp.

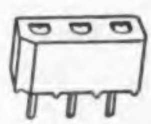
Transistor socket has an insulating body of low-loss mica-filled phenolic. Contacts are of silver plated brass. Available from Cinch Mfg. Co.



This power transistor socket is designed for mobile communication receivers. It has an insulating body of general purpose phenolic. Contacts are phosphor bronze, cadmium plated. Available from Cinch Mfg. Corp.



The top and bottom plates of this power transistor socket are made of grade XP natural colored laminated phenolic and are wax impregnated. This socket can be used under the most severe vibration conditions because of its high initial withdrawal force. The metal collector plate is completely insulated from the chassis. The transistor can be grounded to the collector plate and at the same time it will be insulated from the chassis. Available from Cinch Mfg. Corp. and Industrial Electronic Hardware Mfg. Co.

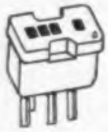


Double Diode Socket is for mounting a diode. It is used in horizontal phase detector and for printed circuit applications. The body is made of general purpose phenolic and the contacts are of hot solder coated brass. Available from Cinch Mfg. Corp.

SUBMINIATURE SOCKETS

In-Line Sockets

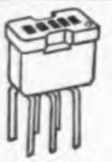
These sub-miniature sockets can be swaged or cemented into the chassis or mounted with rings. The insulating bodies are either low-loss mica filled phenolic, general purpose phenolic, glass-filled silicone resin, or high dielectric black phenolic. Contacts are heat-treated beryllium copper silver-plated and have twisted tails. The sockets with the glass-filled silicone resin are for use in equipment subject to high temperature and humidity conditions. Available from Cinch Mfg. Corp.



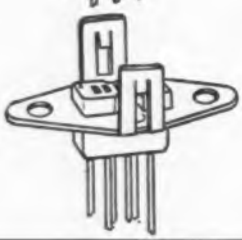
These 4 contact in-line sockets are similar to the ones described above (5 contacts) but the contact and the contact cavity in the positions shown are omitted. Contacts are heat-treated beryllium copper and have twisted tails. Available from Cinch Mfg. Corp.

These sockets are swaged to a cadmium plated brass flat mounting plate. Contacts have twisted tails and are beryllium copper, silver plated. Available from Cinch Mfg. Corp.

Long Tail Contact Sockets



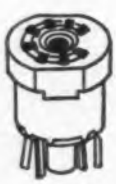
Long tail in-line sockets eliminate wiring to contact tails where short leads are required. Maximum length of tails is 1 7/16 inches. Contacts are spring brass with tuning-fork type grip. Sockets can be swaged or cemented into chassis or mounted with rings. The bodies are low-loss mica-filled phenolic, or general purpose phenolic. Contacts are available silver plated or silver plated with gold flash. Available from Cinch Mfg. Corp.



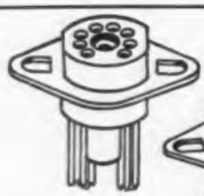
These sockets are similar to the previously described types except that they are swaged into nickel-plated brass mounting plates. The ears in the vertical sides of the plate are for retaining shields or wire-type tube retaining devices. Available with low-loss mica filled bodies from Cinch Mfg. Corp.

Flat nickel plated brass mounting plate type sockets for top or bottom mounting are available in low-loss mica-filled castings from Cinch Mfg. Corp. They have gold flash over silver plated contacts.

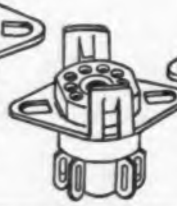
T-3 Sockets

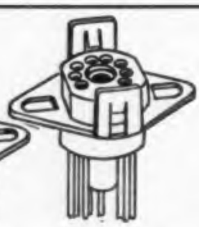


This type socket can be swaged or cemented into chassis; mounting rings are available for types A and B. The cartings of low-loss mica filled phenolic or silicone resin are for use in equipment subject to high temperature and humidity conditions. Center shields are cadmium plated brass. The contacts-up type A are beryllium copper with twisted tails. Type B contacts have "tuning fork" contact grip and are retained by a laminated washer. Type C is a special round sub-miniature socket with center keyway; beryllium copper contacts have twisted tails. All types are available from Cinch Mfg. Corp. with silver plated or gold flash over silver plated contacts.

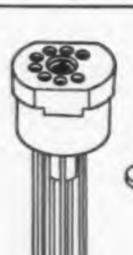


These are type A sockets swaged into a flat nickel plated brass mounting plate. Center shields are cadmium plated brass. Available from Cinch Mfg. Corp.

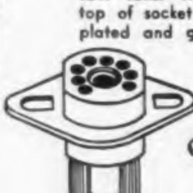




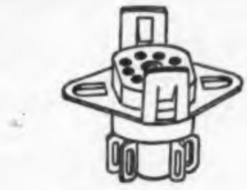
Same as type A sockets swaged into nickel plated brass mounting plates with ears for the retention of tube shields or tube hold-down devices. Available from Cinch Mfg. Corp.



When short leads are required, these long-tail sockets eliminate the necessity of wiring to contact tails. The maximum length of tails from top of socket is 1 47/64 in. Contacts are silver plated and gold flash over silver plated beryllium copper or silver plated brass and are of the "tuning fork" type. To prevent moisture trap, Sylastic Sealer is applied inside the laminated phenolic washer which holds the contacts in place. These sockets are available with or without center shield from Cinch Mfg. Corp.



This type is the same as the preceding socket except that the socket is fastened to a nickel plated brass plate. Type D has spring brass contacts with "tuning fork" type contact grip. Tails have slots for conventional wiring. Center shield is nickel plated brass. Long tail contacts or slotted contacts may be used in same sockets as required. Available from Cinch Mfg. Corp.



These sockets are similar to type C except that the mounting plates include ears to accommodate tube shields or wire-type tube hold-down devices. Available from Cinch Mfg. Corp.

High Temperature Sockets

These sockets are for use in equipments subject to high temperature, humidity or vibration conditions. Shield bases are nickel plated brass. Contacts are heat treated beryllium copper, silver plated and give added retention over an extremely wide temperature range. Available with either twisted contact tails or "looped" tails for conventional "feed-thru" wiring. Center shields are hot solder coated brass. Castings are either glass filled silicone resin or low-loss mica filled phenolic. Available from Cinch Mfg. Corp.

These in-line high temperature sockets are available with or without nickel plated brass mounting bases. Tails are available either twisted or with "looped" ends. Castings are of glass filled silcone resin or mica filled low-loss phenolic. Available from Cinch Mfg. Corp.

Pencil Tube Sockets

These sockets have insulating bodies of mica filled low-loss phenolic. Contacts are silver plated beryllium copper with twisted tails. Available from Cinch Mfg. Corp.

These sockets are used with pencil tubes 5675, 5676, 5893, 6173, 6263 and 6264. Insulating bodies are of general purpose pheolic or mica filled low loss phenolic. Contacts are silver plated beryllium copper with twisted tails. The clip connects to cathode of tube and is made of silver plated beryllium copper. Available from Cinch Mfg. Corp.

Nuvistor Socket

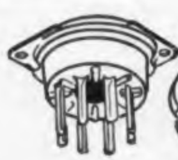
This tube socket is fastened by two tails, which are an integral part of the metal saddle retaining the tube socket body. These tabs are rolled against the underside of the chassis. The body of the socket is of mica-filled low-loss phenolic. The contacts have feed through tails. Available from Cinch Mfg. Corp.

Octal Tube Sockets

Top and bottom mounted molded octal tube sockets are available with bodies of general purpose phenolic, mica-filled low-loss phenolic and ceramic. The contacts may be of beryllium copper phosphor bronze or brass, hot-solder coated, silver-plated or silver-plated with tabs but solder coated. The mounting saddles are available in steel, nickel-plated, cadmium plated or hot solder coated. Top mounted sockets do not have grounds and the bottom mount have two or four ground lugs as required.

Bottom mounting molded octal sockets for 1 inch chassis hole, with ground lugs adjacent to #2 and #6 positions or numbers 2, 4, 6 and 8 mounting holes are 1 5/16 in. apart. These sockets are available with bodies of general purpose phenolic or mica-filled low-loss phenolic from Hugh H. Eby Inc., Cinch Mfg. Corp., Sylvania Electric Products Industrial Electronic Hardware Mfg. Co. Inc., Alcon Metal Products Inc., Elco Corp. and several others. By reversing the saddle and removing the ground lugs these sockets may be top-mounted.

Bottom mounting molded octal sockets for 1 1/8 in. chassis hole with ground lugs and mounting holes 1 1/2 in. apart. Available with bodies of general purpose phenolic, mica-filled low-loss phenolic or ceramic from Cinch Mfg. Corp., Hugh H. Eby Inc. and others.

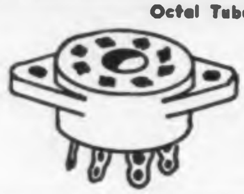


Bottom mounting molded octal sockets for one inch chassis holes and mounting holes 1 5/16 in. apart. This socket has the wire-wrap type tails and is available from Elco Corp.

Two types of molded octal tube sockets are for printed wiring applications. One is the flash mounting type and the other is the standoff type. The former is available from Elco Corp. and the latter from Cinch Mfg. Corp.

CRT SOCKETS

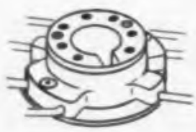
Octal Tube Sockets (Continued)

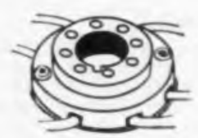


All plastic type molded octal tube sockets are available in general purpose phenolic and low loss phenolic from Cinch Mfg. Co., Industrial Electronic Hardware Mfg. Co. Inc., Hugh H. Eby Inc. and several others.

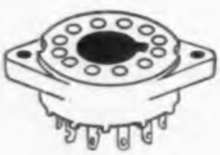
Molded octal sockets for military use, meet the requirements of JAN-S-28. They are available in mica-filled low-loss phenolic or ceramic from Cinch Mfg. Corp., and many others.

CRT SOCKETS





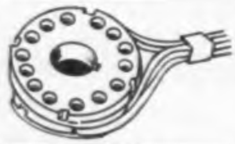
Cathode ray tube mold sockets for use on the 110° picture tube are available in two styles one with 0.040 diameter contacts and the other with 0.093 diameter contacts. The body material is of general purpose phenolic. The contacts are of hot solder coated brass and are retained to the body by a phenolic plate, which is eyeletted in place. They are available from Industrial Electronic Hardware Co., Syvania Electric Products, Hugh H. Eby Inc.



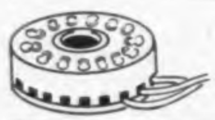
Duodecal C.R. tube sockets for chassis mounting have bodies of either general purpose phenolic or mica-filled low-loss phenolic with hot solder coated brass contacts or silver plated phosphor bronze contacts. The body has two ears as an integral part to provide for mounting screws. They are available from Hugh H. Eby Inc.

Duodecal C.R. tube sockets with twelve contacts for use on television sets have bodies of general purpose phenolic or mica-filled low-loss phenolic. These sockets fit on the neck of the tube and have no other means of fastening except by its contacts to the pins of the tube. The contacts are of hot solder coated brass and are available from Hugh H. Eby Inc., Cinch Mfg. Corp., and several others.

This is an abbreviated duodecal C.R. molded tube socket, developed as a cost reduced type where only five contacts are used. The body is of general purpose phenolic or mica-filled low-loss phenolic; the contacts are of hot solder coated brass. They are available from Hugh H. Eby Inc., Alden Mfg. Co., and Sylvania Electric Products.

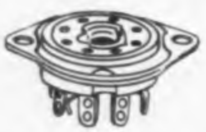


This is a diheptal C.R. molded tube socket and is similar in all respects to the twelve contact duodecal except that it has fourteen contacts. The bodies are of general purpose phenolic or mica-filled low-loss phenolic and is available from Cinch Mfg. Corp. and Hugh H. Eby Inc.



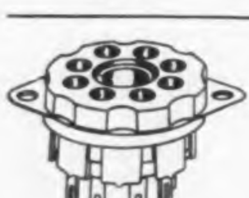
Neo-Diheptal sockets for use on 21-inch color picture tubes have bodies made of mica-filled low-loss phenolic with depressions to match the boss of the tube base, the contacts are of solder-coated brass. Available with axial wiring or side-entry leads from Alden Products Co. and with side-entry from Ucinte Co.

LOCTAL or LOCK-IN

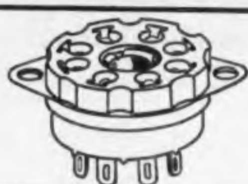


Molded loctal or lock-in sockets have bodies of general purpose or mica-filled low-loss phenolic. Saddles are of solder-coated steel and are available with or without ground lugs. Center guide clip is available in brass or spring steel. The guide clip has a tension locking spring which locks the tube in the socket. They are available from Cinch Mfg. Corp. and Hugh H. Eby Inc.

Chassis clinch type loctal or lock-in type molded sockets are available with all the compactness and simplicity of design of the actual chassis clinch type.



Octal and Loctal Type Electron Tube Sockets, with built-in capacitors, provide the shortest possible path to ground in by-passing any tube element. They are available with any tube element connected directly to ground. The Loctal can also be made with built-in coupling capacitors. The physical dimensions of these sockets are identical to those of standard receiver tube sockets. The body is held in a metal saddle used to fasten the socket to the chassis by means of screws, rivets, or eyelets. Tubular ceramic capacitors completely surround the socket, the socket-terminals and are directly connected to the metal saddle which is the ground terminal. These sockets are designed for under chassis mounting. The bodies are of mica-filled low-loss phenolic. Contacts are of spring brass or heat treated beryllium copper, silver plated. The metal saddles are of solder coated steel or nickel plated brass; all other metal parts are available in solder coated steel or nickel plated brass. The capacitors available are: Hi-K, and temper-



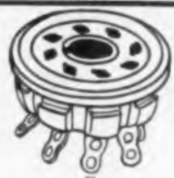
ature compensating types with insulation resistance of 750 megohms at 25°C, measured at 100 vdc in series with a protecting one megohm resistor. The dielectric strength is three times the voltage rating of 350 vdc or 1050 vdc for one record at sea level. The charging current is limited to 50 ma. maximum. Available from Cinch Mfg. Corp.

12 Pin Molded Sockets

Molded twelve pin bottom mounting tube sockets have bodies of general purpose phenolic. The hot solder coated saddles are securely crimped to the casting. Sockets may be obtained for top-mounting by reversing the saddle on the casting. The contacts are of hot-solder coated brass with feed-through tails. Sockets are available from Cinch Mfg. Corp., Connector Corp., and Alcon Metal Prods., Inc.

This is the printed wiring version of the above socket. The casting is of general purpose phenolic and contacts are made of hot solder coated brass with tails shaped for insertion and soldering in printed wiring panels. They are available from Connector Corp., and Alcon Metal Prods., Inc.

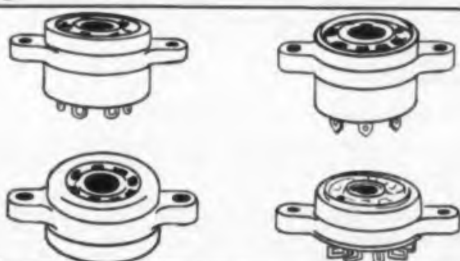
Another version of the 12 pin (compactron) sockets for use on printed wiring boards, available in general purpose or mica-filled low-loss phenolic with hot solder coated contacts from Industrial Electronic Hardware Mfg. Co.



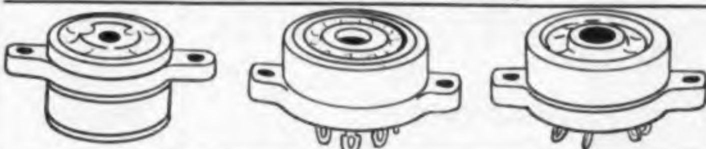
Special Sockets

Ring mounted type octal molded tube sockets are used extensively in test equipment, public address amplifiers and other apparatus where sockets are top mounted. They are mounted by spring steel retainer rings requiring no screws nor rivets. A molded keyway inside allows socket to be mounted in any one of eight positions while the key in the chassis prevents the socket from turning. An adapter plate may be used with this socket. The bodies are of general phenolic or mica-filled low-loss phenolic and the contacts of hot solder coated brass or silver plated bronze. They are available from American Phenolic Co. and Cinch Mfg. Corp.

Chassis clinch type octal molded sockets are mounted in specially punched chassis holes and rigidly fastened by lugs sheared from the chassis. Simplicity of design and elimination of screws or rivets make it extremely compact and saves valuable chassis space and assembly time. Bodies are of general purpose phenolic or mica-filled low-loss phenolic. Contacts are hot-solder coated brass. Available from Cinch Mfg. Co.

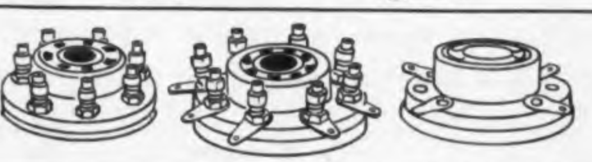


Panel mounted molded sockets are for tube testers, aging and life testing racks and other uses. The sockets are available for 4, 5, 6, 7, small 7, octal and loctal tubes. Contacts are free floating and designed to give a minimum of flexing so as to avoid crystallization; excellent tube insertion life is expected of these contacts as they are of the tuning fork type, silver plated, and tempered for long life. Bodies are of general purpose phenolic or mica-filled low-loss phenolic. Available from Alden Products Co., Inc.



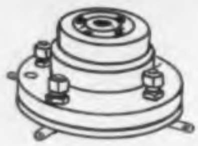
These composite sockets will accommodate 4, 5 or 6 prong bases, or double seven; they are of the same rugged construction as the panel mounted types described above. Available from Alden Products Co., Inc.

Button type sockets are for making adapters and other uses, such as mounting for under panel connections. They have spring contacts of solder coated phosphor bronze and insulated by molded dividers. For use with 4, 5, 6, 7 prong and octal base tubes, also available in composite arrangements from Alden Products Co., Inc.



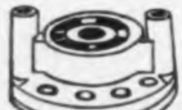
Breadboard sockets for fastening directly to "breadboards" for experimental work in laboratories etc. These sockets have contact extensions to facilitate soldered connections, to attach clips to terminals or to check from point to point. Extensions are either solder lugs or screw binding parts. Available from Alden Products Co., Inc.

Special Sockets (continued)




Special vibration resisting socket for four prong tubes. Available from Alden Prod. Co., Inc.

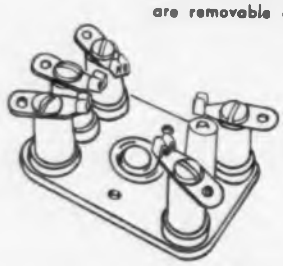
Vibration resisting adapter for standard tube bases. This one is for the four prong base. Available from Alden Products, Inc.




Special socket for extremely long leakage path to ground when mounted below panel. For H-F work in transmitters. Available from Alden Products Co., Inc.

Tuning eye sockets supplied with leads to order. Basic design has three parts—body, contacts and disc. They are available for the 6-prong or octal based tubes. Available from Alden Products Co., Inc.

Acorn tube sockets, type shown is the breadboard type, the tube prongs being inserted into exposed clips. Long leakage paths are obtained with the pillar type construction. Molded from mica-filled low-loss phenolic. The clips are removable as they are fastened by machine screws. A post between the pillars prevents inserting a tube the wrong way. Contacts are of silver plated phosphor bronze. Available from Alden Products Co., Inc.

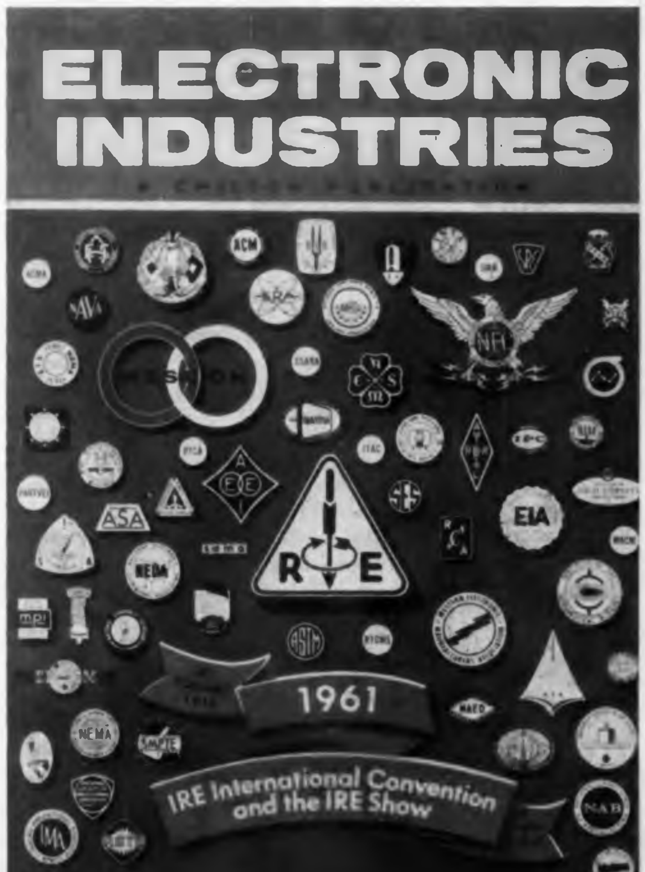



This type acorn tube socket is for use in tube test equipment, but has characteristics which make them useful in experimental work and permanent equipment. Sockets are molded from mica-filled low-loss phenolic and contacts are silver plated. The contacts are recessed in insulation providing long leakage paths. Contacts are isolated from each other and are securely riveted to the molding. The wiring tabs of the contacts come out below the molding. The socket mounts under a 1¼ in. hole with 3 #6 machine screws and requires 2⅛ in. below the chassis. Available in 5 and 7 contacts from Alden Products Co., Inc.

Your Guide to the

1961 IRE International Convention

- IRE Fellows Predict the Future
- Complete Technical Papers Program
- Technical Papers That Point-up Industry Progress
- A Cross-referenced Guide to Exhibitors and Products
- See These New Products at the Show



Over $15,000,000 worth of the latest electronic equipment will be displayed, most of it for the first time. 850 exhibitors will fill all four floors of the Coliseum.

Lloyd V. Berkner
President
Inst. of Radio Engineers

The IRE

A HEART beat, bounced off the moon, will signal the opening of the world's biggest engineering event —the 1960 IRE International Convention and Show. Over 70,000 engineers and scientists from 40 countries are expected to attend the four-day event at the New York Coliseum and Waldorf-Astoria Hotel.

Technical Papers

There will be 54 sessions at the Waldorf-Astoria Hotel and at the Coliseum where a comprehensive program of 275 technical papers will be presented. The papers will cover the most recent developments in science and industry as represented by the 28 professional groups of the IRE.

Papers presented will be of interest to all electronic engineers—from Digital Computer Techniques to Graduate Education in Electrical Engineering, and from Mathematical Approach to Reliability Prediction to Engineering Writing and Speech.

High point of the technical papers program will be Tuesday evening when a special symposium on new energy sources will be held. The panel will be chaired by Gordon S. Brown (M.I.T.). Panel members will be: P. H. Egli (Naval Res. Leb.—Thermoelectricity); A. R. Kantrowitz (Avco Res. Labs.—Magnetohydrodynamics); V. Wilson (GE Res. Labs.—Thermionic Converters); A. M. Moos (Leesona Corp.—Fuel Cells); J. I. Yellott (Yellott Solar Energy Labs.—Solar Energy). R. L. Petritz (Texas Instruments Incorporated) will present a report on the Russian thermoelectric program, and P. R. Aigrain (Univ. of Paris) will discuss the status of new energy in Western Europe.

The complete papers program and highlights of the program selected by the Editors of EI begins on page 132.

Exhibits

The exhibition of electronic materials, products and processes at the Coliseum, formerly called the Radio Engineering Show, has been changed to the "IRE Show." The Show will completely fill all four floors of the Coliseum. Some 850 exhibitors will display over $15,000,000 in the latest electronic equipment—much of it for the first time.

ELECTRONIC INDUSTRIES has prepared several aids to help you preplan your convention activities—and to avoid foot-killing, random trudging past the 2¼ miles of exhibits at the Coliseum. These include: A locator guide (page 146) which lists all the booths featuring each type of equipment, a cross-referenced (alphabetically and by booth number) guide to the manufacturers exhibiting at the show (pages 139 and 142), and a series of maps showing booth locations, floor by floor. (*Be sure to stop by Booth 4202 and visit with EI's Editors and Regional Managers.*) A special section featuring some of the more important new products being exhibited for the first time begins on page 147.

Annual Awards

IRE's annual awards will be presented at the banquet, March 22, at the Waldorf. Ralph Bown, former Bell Labs scientist, will receive the Founders Award for "outstanding service to the IRE and for outstanding contributions to the radio engineering profession through wise and courageous leadership in the planning and administration of technical developments

If you walk by each booth once, you will travel over 2¼ miles.

At 10:00 A.M., Monday, March 20, the doors of New York's Coliseum will swing open and the world's most spectacular engineering event—the 1960 IRE International Convention—will be under way.

International Convention

which have greatly increased the impact of electronics on the public welfare." Ernst A. Guillemin will receive the Medal of Honor for "outstanding scientific and engineering achievements."

Five other awards will be given. These are: The Memorial Prize Award in Memory of Morris N. Liebmann to Leo Esaki, Consultant at IBM; Memorial Prize Award in Memory of Browder J. Thompson to Eiichi Goto, Univ. of Tokyo; Memorial Prize Award in Memory of Harry Diamond to Helmut L. Brueckmann, U. S. Army Signal R&D Labs.; W. R. G. Baker Award to Manfred Clynes, Rockland State Hospital; Vladimir K. Zworykin Award to Peter C. Goldmark, CBS Labs.; and the Professional Group on Bio-Medial Electronics Award (in memory of William J. Morlock) to Britton Chance, Johnson Research Foundation, Univ. of Penna.

Pictures of the award winners and their citations are in Technical Papers section beginning on page 135.

At the Annual Banquet on Wed. March 22nd, Patrick E. Haggerty, President of Texas Instruments Incorporated will talk on "Where Are the Uncommon Men."

Social Events

There will be a get-together cocktail party (Monday evening) and the annual IRE banquet, Wednesday evening, both in the Grand Ballroom of the Waldorf. The banquet will feature the presentation of IRE awards for 1961 (see above).

Guest speaker at the banquet will be Patrick E. Haggerty, President of Texas Instruments Incorporated. He will talk on "Where are the Uncommon Men." Daniel E. Noble of Motorola will be toastmaster. IRE President, Lloyd V. Berkner will present the awards.

Fellows

Seventy members of the IRE will be elevated to "Fellow" the highest grade of membership in the Institute. These men will be honored at the annual banquet. Carl Wischmeyer, Rice Institute, will be spokesman for the group. *As a special feature,* ELECTRONIC INDUSTRIES *presents "IRE Fellows Predict Your Future," beginning on page 126.*

Ladies Activities

A special program has been prepared for the ladies including a trip to the United Nations, social "get-togethers," etc. The complete ladies' program is on page 145.

An *ELECTRONIC INDUSTRIES'* Exclusive—

1961 IRE 'Fellows' Look

Statements from the nation's leading electronic engineers summarize

Antennas and Propagation

Thomas E. Tice, The Ohio State University—"The solution to many communications problems of the future lies in the implementation of novel radiating systems employing unified antenna-radome designs. These must withstand extreme temperatures, thermal shock, and stresses associated with the environment of hypersonic space vehicles while at the same time maintaining the accuracy of a precision sighting instrument. They must be capable of operating over broader bands of frequencies. Higher resolution is needed; hence larger physical apertures and higher frequencies will be utilized. In most applications the weight of the antenna and radome must be minimized."


T. E. Tice


R. N. Bracewell

R. N. Bracewell, Stanford University—"Application of radio techniques to astronomy will clarify the structure and evolution of the galaxy, and the origin of the galatie cosmic rays. Cosmology will be stimulated by observations already reaching beyond 0.5 of the theoretical radius of the universe. In the next decade, radio astronomical antenna technique will contribute the giant antennas now under way that will have collecting areas approaching a million square meters . . . The merger of antenna design and signal analysis will lead to novel automatic techniques for the extraction of information from a radiation field."

G. S. Wickizer, RCA Laboratories — "In the last decade, developments in the field of propagation have been brought about largely through higher transmitter power and antenna gains. Corresponding advances can be expected in the future through general application of more complex detection systems to reduce the threshold of measurable signal voltages. In addition, the space age brings with it a number of opportunities to study propagation from a different viewpoint, thereby revealing new phenomena and clarifying present knowledge."


G. S. Wickizer


A. H. LaGrone

Alfred H. LaGrone, The University of Texas — "The demands for service in the VHF and UHF bands are increasing daily making efficient use of these frequencies of utmost importance to all concerned. It is expected that continued research of both theoretical and field natures into the propagation characteristics of these frequencies in the troposphere and over irregular terrain will yield optimum criteria for their most effective application."

S. S. Attwood, University of Michigan—"The effectiveness of communication systems and radar, particularly for long ranges, depends upon the manner in which electromagnetic waves can be propagated through the "atmosphere" at all altitudes . . . Well known are the bending effects of the ionosphere (mostly below 30 Mc) and of the tropospheric radio ducts for higher frequencies caused by temperature and water-vapor gradients. To these must now be added the bending of the waves in regions where the earth's magnetic field reacts with electron concentrations such as the Van Allen belts. This can lead to a new type of long range communication and radar."


S. S. Attwood


R. S. Elliott

Robert S. Elliott, University of California—"The next decade should see a significant shift in antenna practice toward an awareness of the information content of the radiated signal and toward techniques of exploiting this content through the use of complex circuitry attached to the antenna. Non-linear problems due to the environment of a plasma should receive much attention, and antennas which include solid-state elements might begin to emerge as practical devices."

Broadcast and Television

Paul Adorian, Associated-Rediffusion, Limited, London, England — "The greatest technical improvements in television broadcasting I expect to come from bandwidth compression. The television systems used throughout the world are basically almost identical with the first system developed in Britain over 30 years ago. The system depends on the establishment of a complete picture 25 or 30 times per second and is, therefore, highly wasteful due to its repetitive nature. An improvement of only 2:1 in bandwidth utilization would have immense effect on the future of television development mainly because of the additional channels that would become available in the VHF band."

Joseph F. Fisher, Philco Corp. — "Recent developments and the successful installation of many closed circuit television systems during the

At The Future . . .

"what's ahead" for the electronic industries . . .

R. D. O'Neal

R. F. J. Filipowsky

P. Adorian

J. F. Fisher

past years should result in a greatly increased use of closed circuit television and special video systems in the fields of teaching, monitoring of industrial processes, surveillance, medical electronics, non-destructive testing, and photography . . . There should be a more widespread use, when required, of systems including such features as extremely high resolution, slow scan, digital transmission of picture video information, color, and stereoscopic viewing . . . Developments during the next decade will most likely result in television camera tubes having greater sensitivity and better resolution."

Charles L. Jeffers, WOAI & WOAI-TV—". . . The recent presidential election clearly demonstrated the role of broadcasting, and in particular, television, in educating and informing the American electorate in a manner not possible by other means of communication. The initial success of educational television and the critical foreign relations brought on by the Communist aggression clearly indicate that broadcasting must assume even greater responsibility, and our domestic, as well as our international broadcast facilities, must be expanded greatly to meet the challenge of the future."

Communications

Delmer C. Ports, Jansky & Bailey Radio & Electronic Engineers—"The coming decade will forge ahead with revolutionary improvements in spectrum utilization and in concepts of communications system design . . . It is entirely conceivable that complex functions making use of the most minute corners of the time domain will come to the forefront as primary tools. The expansion of communication services would be subject to the same arbitrary system of definition and control as now applied to frequencies. Furthermore, concepts of communications systems will break away from the present day building block image now prevalent, (e.g., power amplifier, modulator, antenna, etc.). They will find new expression in terms of integrated, carefully articulated, dynamic functions . . ."

C. L. Jeffers

D. C. Ports

R. D. O'Neal, The Bendix Corporation—". . . Active communication satellites, in particular synchronous orbit satellites, will be especially important. Booster systems under development will make possible the orbiting of communication payloads having high traffic handling capacity. Advanced techniques will permit successful operation of these systems in the presence of countermeasures and other interference. Through selective redundancy, combined with component improvements and quality control techniques, operational life well in excess of one year will be achieved. This will result in economical military and commercal systems."

Dr. R. F. Filipowsky, I.B.M. Corporation—". . . Computer controlled communications will permit large networks and individual links to adapt themselves automatically to the ever changing operating conditions, such as traffic load, traffic distribution, propagation conditions, the nature of disturbances, and the types of messages. New communication media can be expected . . . Long distance waveguide transmission is not far off. Optical rays, earth currents, shortest microwaves, earth-magnetism, microseismics, neutrino radiation, cosmic rays, X-rays, gravitational fields, and ESP (Extra Sensory Perception) are further applications in their order of priority."

Warren B. Bruene, Collins Radio Company—". . . The tremendous inertia of starting the change to SSB is overcome, and we can expect to see SSB adopted and installed in practically every high frequency communication facility including mobile and transportable as well as fixed stations during the coming decade. SSB can be expected to make an increasing penetration into the LF and the VHF portions of the spectrum also."

W. B. Bruene

D. E. Maxwell

D. E. Maxwell, General Electric Company — "Radio communication systems, particularly those intended for military applications, will become ever more sophisticated, reflecting the insatiable demand for more channels, increased reliability, greater security and higher data rates . . . Where reliability is paramount there will be a trend toward radio communication systems which utilize very high ratios of transmitted - signal - bandwidth to data rate, and which include means for efficiently adjusting the data rate to the existing interference (or jamming) level."

T. A. Smith, R.C.A.—"In the decade now beginning . . . We can look forward to new and exciting developments in the art of communications. Automated devices, growing out of these advances, will take over an increasing number of routine, monotonous tasks in factories, offices, government and perhaps even in the home. Electronics will play a stronger role in serving the nation as a shield of defense, and as a powerful influence in shaping the course of its future growth."


T. A. Smith D. D. Grieg

Components

Donald D. Grieg, Electronic Research Associates, Inc.—"We should continue to see the substitution of solid state devices for the more cumbersome and conventional components, particularly in the higher frequency areas and for higher power applications. In addition, not only will there be more extensive circuit application of recently available solid state components such as controlled rectifiers, tunnel diodes and ultra-high frequency transistors, but these and related components will be teamed in circuits with other elements such as magnetics, ferrites, electroluminescent and transducer materials to provide new combinations for the control, transformation or generation of electrical phenomena."

A. C. Keller, Bell Telephone Labs., Inc.—"Electromechanical devices such as relays and similar devices can be expected to be further developed for telephone switching, computers, military systems and automatic control systems that will be compatible, combinational, and competitive with solid state switching devices. Compatibility is illustrated by many types of miniature relays. Combinational devices are illustrated by the *ferreed* which is a combination of ferrites and glass sealed contacts . . . The rapidly expanding needs for all kinds of switching will require more of all types of switching devices, including many kinds of relays and solid state devices."


A. C. Keller P. Rosenberg

Paul Rosenberg, Paul Rosenberg Associates — "Extreme miniaturization of components and circuitry will characterize electronics in the next decade. Compact high performance computers with fast access storage will become available at relatively low cost, using new solid-state elements, perhaps cryogenic. Automatic recognition of "gestalt" will be developed, carrying the art of automatic recognition far beyond its present state which is limited to automatic reading of characters. Further development of the optical maser, improvements in electroluminescence, advances in the theory of color vision, and better fiber optics will open new fields and applications in electro-optics."

Gustave Shapiro, National Bureau of Standards—"Look for a renaissance in the application of discrete component parts to micro-miniature assemblies . . . Potentially high set-up costs should limit the application of exotic miniaturization methods to assemblies having large production runs. However, recent successes in the application of discrete component parts to micro-miniature assemblies indicate the probability that discrete component assembly and inter-connection methods will be developed making possible practical reliable economically feasible micro-miniature assemblies for short as well as long production runs."


G. Shapiro F. B. Bramhall

F. B. Bramhall, Lenkurt Electric Co., Inc.—"Within the present decade we can expect tremendous strides in dependability and compactness of all electronic and communication gear. We should not be satisfied until it will, without attention, outlive its present amortization schedule. Nor should we rest until, immersed in liquid, half its over-all volume is displaced. Right now an enterprising mouse would consider our most compact assemblies as spacious apartment houses."

P. S. Darnell, Bell Telephone Laboratories—"In the next decade, incremental improvements in our present electronic components and devices will be made as new materials become available. There will be continued emphasis on higher reliability. Integrated and solid state functional devices will play an increasingly important role and major advancements in devices performing complex functions may be expected. The problem of the environment of outer space will occupy growing attention and will probably lead to the development of parts and devices capable of long life in such environments . . ."


P. S. Darnell S. Lubkin

Computers

Samuel Lubkin, Ph.D.—". . . I believe that the time is ripe for small, very reliable, and maintenance-free digital computers to replace mechanical and electro-mechanical devices used in accounting, sales, inventory, etc. Such computers would be used singly or in multiples, according to size of the operation, by companies who cannot justify present-day large computers. In the technical field, analog computation will be replaced by digital more and more until only "sensors" and "muscles" remain analog. Reliability of digital computers will steadily improve, although size, weight, power, and maintenance effort decrease."

Control and Instrumentation

Y. H. Ku, Moore School, University of Pennsylvania — "In the control field, interest continues to grow in the use of nonlinear elements and the study of nonlinear systems. Electronic tubes, transistors, and tunnel diodes are all nonlinear devices. The technique of linear control systems has been well developed. Is it logical to look forward to the development of the technique of nonlinear control systems? It is said that all adaptive control systems are nonlinear. Systems with varying parameters are also very important. Parametric amplifiers are recent examples. Systems with random inputs are to be studied intensively."

Dr. E. H. Greibach, Greibach Instruments Corporation—"Advances of the atomic, space, and semiconductor fields demand evermore sensitive and


Y. H. Ku E. H. Greibach

accurate electrical measuring instruments, accuracy of .01% being the goal. At the same time, the emphasis is on reliability, sturdiness, and quick action of direct reading meters. In A. C. measurements, the development trend is toward greater sensitivity and accuracy, at least ⅛% over ever wider frequency ranges, regardless of wave shape. Reliable A. C. Voltage standards are most urgently needed."

Education and Management

Carl R. Wischmeyer, Rice University—"Significant progress on the part of the colleges and universities in identifying high aptitude and, more particularly, motivation among potential students will characterize the next decade. Further, instructional methods which challenge the capabilities and captivate the enthusiasm of the individual student must be found. The intensity of scientific and technological competition today demands the development of the incisive, creative technical abilities to reach beyond the present frontiers of knowledge. It redoubles the urgency of complete and mature development of responsible personalities in these same individuals."


C. R. Wischmeyer


H. M. O'Bryan

Henry M. O'Bryan, General Telephone & Electronics Labs. — "Advances in management will lead to increased profitability and effectiveness of engineering-based organizations in the current decade. Improvement in the recognition of needs, in planning, in progress evaluation, and in control will multiply the contributions to world progress and security. The Engineering Management sessions of the national convention, other conventions, and local chapter meetings offer IRE members and their associates opportunities to participate in these advances."

R. M. Somers, Bendix Aviation Corporation — "The increasing need for greater specialization in technical areas is creating a problem in the development of future engineering managers who can solve the difficulties of intraproject communication. Better ways must be found through organizational structures, on the job training and new communication methods to develop technically capable men who can understand, correlate and manage these diverse specialists groups to achieve an efficient and reliable end product . . ."


R. M. Somers


H. A. Leedy

H. A. Leedy, Armour Research Foundation—". . . greater research effort will yield more new products and processes providing the basis for a continued rapid growth of the electronics industry. However, as the research budget becomes an even greater percentage of the cost of electronic goods and services, management will take a far more critical look at the efficiency of its research programs. More emphasis will be placed on obtaining qualified research management capable of obtaining greater research output per dollar of expenditure. As a result, the market for top flight management personnel in electronics will be tighter in the decade ahead than ever before."

Microwaves

Sloan D. Robertson, Goodyear Aircraft Corporation—"In space exploration, microwave technology can contribute greatly to meet the need for wide band communications and to provide means for detection and mapping. Recent advances in the techniques of high resolution radar offer an approach to the exploration and mapping of the darkened surfaces of planets and to the problem of penetrating permanent cloud cover such as that encountered on Venus . . . Microwave instruments can be used to increase our knowledge about the physics of the universe itself."


S. D. Robertson


F. B. Berger

France B. Berger, General Precision, Inc.—". . . Doppler radar has moved from the Research and Development laboratory into operational use in manned aircraft on a large scale. In the period ahead, aircraft use will continue to expand as the equipment proves its value in more and more ways for both military and civil applications. New techniques under development will lead to equipment with greater capabilities for a variety of applications, including use in satellites and space vehicles."

Wellesley J. Dodds, Bomac Laboratories, Inc.—"The microwave business as such is approximately twenty years old. During that period it has continuously responded to powerful growth factors. During the next decade this growth will continue. Operations will become increasingly competitive, both in terms of economics and technology. As in pharmaceuticals and chemicals, most rewards will go to companies who successfully correlate advanced business practice with large R and D risks to combat rapid product obsolescence."


W. J. Dodds


E. K. Stodola

E. K. Stodola, Reeves Instrument Co.—"There is a continuing trend toward improved methods of signal processing . . . there will be continued intensive antenna work to produce more accurate beam shaping and pointing. It can be expected that the problems of radar data interpretation and utilization will continue to grow and further encourage automation in this field. More and more one will find radar elements closely integrated in overall systems rather than as separate entities."

Navigation

Charles E. Hastings, Hastings-Raydist Inc.—"The tremendous need for new and improved electronic instrumentation for navigation and control of today's ships and aircraft in order to assure maximum efficiency and public safety makes it imperative that this industry make great strides as rapidly as possible. This decade should be one of definite action and major accomplishment in this field. I believe it will be."


C. E. Hastings


E. A. Post

E. A. Post, Radio and Weather Sciences Lab.—"In air navigation, communications and traffic control, civil aviation today faces the most crucial problems of its existence . . . There is no doubt that the solutions lie in the unlimited capabilities of modern electronic aids. Somehow, the vigor and capacity of electronics engineers for generating ideas and systems must be applied more effectively, in combination with aircraft operators and government assistance, to the solution of these momentous problems. This is the task before us."

Research and Development

Dr. Hans K. Ziegler, U. S. Army Signal Research and Development Laboratory—"Military electronics in the fields of communications and combat surveillance undoubtedly will make great advances through the further pursuit of previously conceived and the introduction of new concepts. With the ever increasing multitude and multiformity of information provided by these electronics, the practical military usefulness will more and more depend on concurrent progress in the art of electronic data processing and evaluation . . ."

H. K. Ziegler

A. S. Jensen

A. S. Jensen, Westinghouse Electric Corporation—"Space and terrestrial activities have been demanding ever more rapid data gathering and handling means. To meet these demands image systems will be developed using ultraviolet, visible and infrared camera tubes of increased resolution and detectivity, and electrical signal storage tubes with higher writing speeds. The development of recently discovered techniques will make these new electron devices possible. These special electron tubes . . . are only now beginning to be appreciated for their real value in high data rate systems."

Dr. A. M. Zarem, Electro-Optical Systems, Inc.—"I should like to confine my comments principally to the field of research and development as it affects all areas of electronics—materials, instrumentation, etc. During the next decade, emphasis upon this vital, creative force must increase tenfold if we are to retain the type of dynamic technology necessary to provide sufficient economic and military foundations to support the American way of life as we presently know it . . . American government and industry must recognize the crucial need for "patient money". By this term, I mean the type of dollars that can be channeled into the search for basic scientific truth that may have no immediate application, but whose existence makes possible vastly advanced technologies . . ."

A. M. Zarem

R. C. Sanders, Jr.

Royden C. Sanders, Jr., Sanders Associates, Inc.—". . . We need a more conscious effort in learning what is the proper atmosphere of creativity. Many of our present ideas of a climate for creativity do not correlate with the conditions under which most creative ideas have been produced. We are learning this. And, also we will learn how to direct these creative ideas better toward useful areas in an atmosphere and in organizations that will quickly and economically reduce them to a practical and useful form."

Paul R. Adams, International Tel. & Tel. Corp. Research on thin films should open up much cheaper ways to make devices equivalent to transistors, solar cells, and thermionic generators of electricity. Research on controlled release of fusion energy and direct conversion to electricity should revolutionize small, medium and large power sources. The exploitation of coherent light will be important for outer space and satellite communications and should revolutionize transmission here on earth (making possible very wide-band services such as phono-vision at reasonable cost). Research in the use of electronics in biology and medicine will produce a near-revolution in these sciences. Commercial use of space satellites for communication relaying will be a reality well within the decade and the consequent development of international TV will have an incalculable impact on international relations.

P. R. Adams

S. M. Bagno

Theory

Samuel M. Bagno, Kidde Ultrasonic & Detection Alarms, Inc. — "I see communication theory extrapolated until we can begin to engineer all our channels for carrying organization with the same facility we engineer our power cables. I see network theory extrapolated until we can start to measure, understand and predict the transient or inertial behavior of human organizations. With these tools, extended by the electronic computer, I see the fanatical struggle of ideologies start to evolve into uninterrupted human progress based on real understanding so that our democratic hopes can become our realities."

L. S. Schwartz

Leonard S. Schwartz, New York University—"Until recently most optimization studies on coding and receiving systems were confined to the case in which the interference was assumed to be thermal noise. This limitation seemed reasonable for physical and analytical reasons. With the advent of high speed data-link systems, some of which employ tropospheric scatter links, it has become clear that multiplicative, impulsive, and burst forms of interference must also be considered. Future developments in information and decision theory can be expected to include studies of coding and receiving systems which are optimum for these forms of noise."

★ ★ ★

The editors of ELECTRONIC INDUSTRIES would like to draw your attention to the IRE's new procedure for nominating Fellows. Deadline for 1962 award is March 31, 1961.

John F. Byrne
Vice-President, I.R.E.

Franz Ollendorf
Vice-President, I.R.E.

Geo. W. Bailey
Exec. Secretary, I.R.E.

Front Cover...

Symbols of organizations serving the electronic industries. How many do you know?

1. Acoustical Society of America
2. Aerospace Industries Association of America, Inc.
3. Alumina Ceramic Manufacturers Association
4. American Electroplaters Society, Inc.
5. American Institute of Electrical Engineers
6. American Institute of Physics
7. American Radio Relay League, Inc.
8. American Society of Tool and Manufacturing Engineers
9. American Society for Quality Control, Inc.
10. American Society for Testing Materials
11. American Standards Association, Inc.
12. American Women in Radio and Television, Inc.
13. Armed Forces Communications & Electronics Association
14. Associated Police Communications Officers, Inc.
15. Association for Applied Solar Energy
16. Association for Computing Machinery
17. Association of Electronic Parts & Equipment Manufacturers, Inc.
18. Audio Engineering Society, Inc.
19. Broadcast Pioneers
20. Electronic Industries Association
21. Electronic Representatives Association
22. Forestry Conservation Communications Association
23. Institute of the Aeronautical Sciences, Inc.
24. Institute of High Fidelity Manufacturers, Inc.
25. Institute of Printed Circuits
26. The Institute of Radio Engineers, Inc.
27. The Instrument Society of America
28. International Municipal Signal Association
29. Joint Technical Advisory Committee
30. Long Island Electronics Manufacturers Council
31. Metal Powder Core Association
32. National Alliance of TV & Electronic Service Associations
33. National Appliance & Radio-TV Dealers Association
34. National Association of Broadcasters
35. National Association of Electrical Distributors
36. National Association of Music Merchants, Inc.
37. National Association of Relay Manufacturers
38. National Audio-Visual Association
39. National Community Television Association, Inc.
40. National Electrical Manufacturers Association
41. National Electronic Distributors Association
42. National Society of Professional Engineers
43. Phonograph Manufacturers Association, Inc.
44. Purchasing Agents of the Radio, TV and Electronics Industry
45. Radio and Television Executives Society, Inc.
46. Radio Technical Commission for Aeronautics
47. Radio Technical Commission for Marine Services
48. Record Industry Association of America, Inc.
49. Scientific Apparatus Makers Association
50. Single Sideband Amateur Radio Association
51. Society of Motion Picture and Television Engineers
52. Society of Plastic Engineers, Inc.
53. Standards Engineers Society
54. Steatite Manufacturers Association
55. Ultrasonic Manufacturers Association
56. Western Association of Circuit Manufacturers
57. Western Electronic Manufacturers Association
58. The Radio Club of America
59. Joint Electron Device Engineering Council
60. The Electro-Chemical Society
61. Assoc. Federal Communications Consulting Engineers
62. American Society of Mechanical Engineers

The Editors Select . . .

Highlights of the Technical Program

These papers and symposia have been selected by the editors of EI as meriting your special attention. We have selected representative papers from a wide area— there are 54 technical sessions at which 275 papers will be presented.

For the complete technical papers program see page 134.

REACTOR INSTRUMENTATION

2.5. Transient Effects of Pulsed Nuclear Radiation on Electronic Parts and Materials

H. J. Degenhart and W. Schlosser, U. S. Army Signal Res., & Dev. Lab.

Transient effects in electronic parts and materials obtained by the most recent experiments conducted at Godica II pulse reactor will be described and discussed.

The electronic parts exposed to, investigated and monitored under such an environment include: 1) resistors of all types of make and in the range from 100 dhms up to 1 megohm; 2) thermistors; 3) capacitors (ceramic and tantalum); 4) Si- and Se- rectifiers; 5) magnetic cores (ferrites); and 6) coaxial cables.

Typical results obtained on the above parts will be shown and interpreted as to the possible mechanism involved. The instrumentation and setup used in the above experiments will be described briefly.

2.6. Problems of Testing Military Computers and Computer Components in Nuclear Radiation Environments

P. E. Brown and A. L. Long, Jr., Burroughs Corp.

Military computers are exposed to the threat of nuclear radiation from natural and artificial sources. Definition of these environments is difficult. Simulation problems exist because of the difference in reactor characteristics. Omissions of pertinent material limit the value of published data.

The testing program is designed to subject all critical components in the active and passive condition to accurately measured irradiation in reactors and accelerators selected as test machines for optimum simulation of environments. There are major problems in making dynamic nuclear measurements and in instrumentation. Data will be collected automatically for machine computation and correlation.

ENGINEERING MANAGEMENT

5.3 Steps in the Transitions from Engineer to Entrepreneur

James L. Hollis, Rixon Electronics.

Many good engineers are absolutely certain that if they had a little money, or an angel, they could develop the better mousetrap that would make customers beat a path to their door. Some do just that. *Fortune Magazine* frequently publishes short stories of their success. What they don't publish are stories about the many engineers who lost the fruits of their effort to the so-called angel or went broke before their mousetrap was accepted.

This paper discusses the transition of a working engineer into the manager of a small independent company and highlights some of the open doors he must successfully select or avoid.

ADVANCES IN NAVIGATION FLIGHT SAFETY SYSTEMS

7.4. Gross Errors in Height Indications from Radar Altimeters Operating Over Thick Ice or Snow

A. H. Waite and S. J. Schmidt, U. S Army Signal Res. and Dev. Lab.

Operation of 400-Mc pulsed altimeters over thick ice in the Antarctic and Greenland, throughout the International Geophysical Year and afterwards, have revealed the occurrence of many, sometimes fatal, errors. Studies of the controlling electrical characteristics of thick ice and snow and the behavior of both vertically and horizontally polarized radio waves in this medium are described. Results are analyzed and compared with actual field observations in both areas. Measurements at several frequencies between 200 and 4000 Mc are discussed and the article concludes with a series of specific limits for over-ice pilots that cannot be exceeded safely.

PRODUCTION ENGINEERING

6.6. The Application of Thermoelectric Spot Cooling to Electronic Equipment

William Stubstad, Collins Radio Co.

The results of an investigation on the evaluation and application of thermoelectric spot cooling to electronic equipment are presented. The evaluation of a designed spot cooler included mechanical and thermal tests which indicated that spot coolers can perform satisfactorily under operational conditions as predicted by theory. Based on the results of the evaluation, spot coolers were analytically applied to forced-convection cooled equipment and equipment cooled by natural means. The analysis indicates that spot cooling can reduce the forced convection cooling requirements and allow natural cooled equipment to operate in higher-temperature environments.

ENGINEERING WRITING AND SPEECH

3.2. Readability or Common Sense?

Cyril A. Dostal, General Electric Co.

Engineering writers have recently shown interest in formulas that purport to measure readability by word and syllable count. Attractive as this idea may seem, it does not stand up under critical scrutiny. Common sense tells us not to use a long word or sentence where a short one will do. But common sense should also tell us that we cannot substitute counting skills for writing skills. The professional writer, especially the engineering writer, must concern himself with words and sentences only as they convey the true product of his labor: *ideas* clearly, logically, appropriately presented.

W. R. G. BAKER AWARD

To: Manfred Clynes, Rockland State Hospital, Orangeburg, N. Y. "best paper published in the IRE TRANSACTIONS of the Professional Groups." His paper was, "Respiratory Control of Heart Rate: Laws Derived from Analog Computer Simulation," Transactions on Medical Electronics, Jan., 1960.

PANEL: NEW ENERGY SOURCES

Chairman: Gordon S. Brown, M.I.T.

Developments in the field of new energy sources have come so fast that few people have had the opportunity to assess their significance. We are privileged to bring you a panel discussion by outstanding individuals who have pioneered in their respective areas of new energy sources. Dr. Gordon S. Brown, Dean of Engineering at M.I.T., will lead the panel in a review of current and future demands which will be made upon electronics as our knowledge and the use of new energy sources advance.

24.1. Thermoelectricity

Paul H. Ekli, Naval Res. Lab.

24.2. Magnetohydrodynamics

Arthur R. Kantrowitz, Everett Avco Res. Labs.

24.3 Thermionic Converters

Volney Wilson, GE Res. Lab.

24.4. Fuel Cells

Anthony M. Moos, Leesona Corp.

24.5. Solar Energy

John I. Yellott, Yellot Solar Energy Labs.

24.6. Report of Russian Thermoelectricity Program

R. L. Petritz, Advanced Energy Conversion Projects, Texas Instruments, Inc.

24.7. Status of New Energy Sources in Western Europe

Pierre R. Aigrain, Univ. of Paris.

TELEMETRY

36.1. The Use of Magnetic Fields in the Elimination of Re-Entry Radio Blackout

H. Hodara, The Hallicrafters Co.

This paper analyzes the propagation characteristics of electromagnetic waves in ionized media with a view towards the elimination of the communication blackout which occurs when a missile re-enters the earth's atmosphere.

The results of the analysis reveal several major features in the transmission characteristics of the plasma which surrounds the missile. It is found that wave propagation is possible below plasma resonance when collisions between electrons and neutral molecules or atoms are present. This mode of propagation becomes practical when the collision frequency exceeds the plasma resonant frequency. The presence of windows in the electromagnetic spectrum below the plasma resonant frequency is also investigated in great detail in this paper. Several windows are found to exist when longitudinal and transverse constant magnetic fields are applied. Of particular interest is the existence of a window in the megacycle range when a longitudinal magnetic field of intensity comparable to the earth's magnetic field is applied. The feasibility of eliminating the communication blackout through this window by means of applied static magnetic fields is discussed.

PROPAGATION

38.1. The Plasmas of Rocket Flight

W. W. Balwanz, Naval Res. Lab.

A rocket in flight is attended by plasmas from a number of sources; these include the existing plasmas of the ionosphere and outer space, as well as plasmas induced by the propulsion system, by component eroson due to excitation of molecules outgassed from the rockets. Such plasmas interact with radio waves to produce a variety of effects, some of which are undesirable. A combination of experimental and theroretical studies provide the knowledge required for operational systems. Further investigations are required to optimize communications links for the space vehicle of the future.

BANQUET SPEAKER

Patrick E. Haggerty, Director, IRE

DIGITAL COMPUTER TECHNIQUES

48.6. Tunnel Diode Threshold Logic

G. P. Sarrafian, Texas Instruments Inc.

Some advantages of tunnel diodes as computer elements are discussed, along with their applicability to systems of threshold logic. Specific circuits are given which perform complex logic functions. Logic applications which are discussed include 1) novel circuits performing conventional computer functions, 2) techniques for achieving reliability through redundancy, and 3) simulation of neuron-like elements and nerve nets.

ULTRASONICS ENGINEERING

505.5. A Review of Some Russian Papers in Ultrasonics Engineering

R. N. Thurston, Bell Telephone Labs.

Several Russian papers of interest to the PGUE will be reviewed. While it is hoped to include more recent papers, topics available in November include ultrasonic machining, effect of transducer seal on delay line characteristics, high-intensity ultrasound, and the properties of magnetostrictive ferrite transducers.

MEDICAL ELECTRONICS

14.5. The Measurement of Internal Physiological Phenomena Using Passive-Type Telemetering Capsules

V. K. Zworykin, Rockefeller Inst. for Medical Res.; J. T. Farrar, N. Y. Veterans Admin. Hospital; R. C. Bostrom, Airborne Instrument Lab.; and F. L. Hatke, RCA.

A passive-type telemetering capsule has been developed for measuring internal physiological phenomena, particularly the measurement of pressure in the gastrointestinal tract. Because early systems were extremely sensitive to orientation and position of the capsule, their use in obtaining long-term data for motility studies was severely limited. A cylindrical antenna has been developed that greatly increases the coupling to the capsule coil. In addition, an antenna switching system selects automatically from three mutually perpendicular antennas the antenna that provides a signal adequate for limiting in the external receiver. Clinical tests show that with the present system, continuous measurements can be obtained for all possible positions of the capsule as it passes through the intestine. Other applications of the capsule for the study of the functioning of the bladder and uterus will be briefly discussed.

ENGINEERING MANAGEMENT

13.3. The Professional Engineer as a Manager

Robert E. Lewis, Sylvania Electric Products.

There is a tendency in the engineering profession to look upon the employment of good technical men as engineers as a waste of technical talent. Far from being the case, the application of technical talents to managerial work provides great opportunity to multiply the effectiveness of engineering because it involves the broad responsibility of organizing, directing, and stimulating others toward effective group effort. Group effort has become more and more the key to scientific and engineering achievement. There is a vital and increasing need for men who can effectively direct these groups.

GRADUATE EDUCATION IN ELECTRICAL ENGINEERING

Chairman: Ronald L. McFarlan, 20 Circuit Road, Chestnut Hill, Mass.

This session will concern itself with a critical examination of the objectives and future direction of graduate electrical engineering education in the United States. It will endeavor to establish and analyze appropriate criteria with respect to faculty, admissions, programs of study, resident requirements, etc.

Panel Members: ERNEST WEBER, *Polytechnic Inst. of Brooklyn;* J. R. WHINNERY, *Univ. of California;* R. L. MCFARLAN, *Consultant, 20 Circuit Road, Chestnut Hill, Mass.;* AND S. W. HERWALD, *Westinghouse Elec. Corp.*

Papers Highlights

(Continued)

MICROWAVE SOLID STATE

32.1. Recent Advances in Solid-State Microwave Devices

M. E. Hines, A. Uhlir, and R. Damon, Microwave Associates

The paper reviews the present state of the art in new semiconductor and ferrite devices for microwave signals. Emphasis will be on applications of low-loss ferrites and diodes of Varactor, Pin, and Esaki or Tunnel types. Applications include parametric amplification harmonic generation, RF power control, signal limiting, crystal protection, oscillation, mixing, negative resistance amplification and tunable filtering.

In certain cases the new devices offer advantages such as improved sensitivity, lower power supply requirements, reduced size and weight and increased ruggedness and reliability compared with previous methods of accomplishing the equivalent circuit functions.

DATA RECORDING AND STORAGE

33.3. Analog Recording of Thermoplastic Film

William C. Hughes, GE Co.

Thermoplastic recording is a new method for the permanent storage of information in the form of deformations in the surface of a thin thermoplastic film. The method has great potential application in the field of analog recording. It makes possible the recording of frequencies in excess of 10 Mc and because of the high density obtainable, several hundred hours of audio-frequency information can be stored on a single reel. Other advantages are dc response, immediate playback and long tape life.

An electron beam is used to record on the plastic and a light beam is used or readout. The recording is developed by heating the tape electronically and it can be erased for re-use.

CIRCUIT THEORY

34.2. On the Rate of Parameter Variations in Feedback Systems

I. M. Horwitz, Hughes Res. Labs.

It is shown that the effect of parameter variations in a feedback system is identical to the effect of an external disturbance on the time-varying feedback system. The value of equivalent disturbance is readily obtained. The usual design technique for attenuating disturbances is used to insure that the system response is always within the desired tolerances, whatever the rate of parameter variation. This method gives an upper bound on the required loop-gain bandwidth of the loop transmission. The same method is used to find a similar upper bound in order that a feedback system with nonlinearities may respond linearly within desired tolerances to a class of input signals.

SPACE COMMUNICATION SYSTEMS OF THE FUTURE

44.5. The Dwindling High-Frequency Spectrum

G. Jacobs and E. T. Martin, Broadcasting Service, U. S. Information Agency

This paper discusses the trend of the solar cycle and its probable impact on high-frequency radio communications during the next five years, and in a more general way, during the remainder of the century. It is shown that the present cycle (which reached an unprecedented peak during early 1958) is now declining, and that the next three cycles may have exceptionally low maxima. Such a drastic reduction in solar activity would be accompanied by a corresponding reduction in the amount of high-frequency spectrum propagationally useful for long-distance communications. This reduction, coupled with the ever increasing worldwide demands for additional high-frequency communication circuits, leads to the conclusion that the high-frequency spectrum will become progressively less useful for communications in the years ahead.

44.3. Pseudo-Redundancy in Communication Systems

R. N. Close, M. Schwartz, M. Chomet, H. Keen, and L. Fogel, Airborne Instruments Lab.

Reliability is of the utmost importance in many modern multichannel communications systems, and particularly in unattended systems. One approach to improving reliability has been to use redundant components that are switched in when original components fail. Complex monitoring and decision-making equipments are required in systems of this type. This paper shows how in a multichannel communications system a pseudo-redundant mode of operation can be established that does not require the complex decision-making circuitry or the additional redundant components.

HUMAN FACTORS IN ELECTRONICS

45.5. Why Design for Maintainability?

Joseph G. Wohl, Dunlap and Associates.

The relationships among down time (a system maintainability measure), time between failures (a system reliability measure), equipment availability, number of equipments, number of on-call technicians, and system readiness reliability are developed under the assumption of constant failure and repair rates. Design trade-off between reliability and maintainability is shown to be feasible with resulting reduction in both design and operating costs. A technique for specifying combined reliability, maintainability, and availability constraints to manufacturers is reported which allows the latter a great deal of design flexibility in meeting operational requirements at least cost. Finally, the need for research to establish the quantitative effects of maintainability design practice upon down time is explored.

(*Continued on page* 154)

The 1961

MONDAY AFTERNOON—MARCH 20

Discrete and Adaptive Control Systems

Starlight Roof, Waldorf-Astoria

Chairman: Louis B. Wadell

"On 'Bang-Bang' Adaptive Control Systems," R. E. Kopp.

"A Statistical Measurement of the Effectiveness of Adaptation in Control Systems," R. A. Nesbit.

"An Adaptive System Using Periodic Estimation of the Pulse Transfer Function," S. C. Bigelow, and Hermon Ruge.

"Digital Computers for Stabilizing Control Systems," William Zdan.

"Computer Optimization of Nonlinear Control Systems by Means of Digitized Maximum Principle," S. S. L. Chang.

Reactor Instrumentation

Astor Gallery, Waldorf-Astoria

Chairman: Harold E. DeBolt

"The Log Count Rate Period Meter Used with Safety Circuits," Helge Christensen, and R. B. Stanfield.

"A Nuclear Reactor Regulating Rod Position Indicator," R. I. Little.

"A Digital Start-up Control Unit for Nuclear Reactors," J. D. Schmidt, B. K. Eriksen and W. Peil.

"Proportional Control of Pressurized Water Reactors," Donald E. Rathbone.

"Transient Effects of Pulsed Nuclear Radiation on Electronic Parts and Materials," Hans J. Degenhart and W. Schlosser.

"Problems of Testing Military Computers and Computer Components in Nuclear Radiation Environments," Paul E. Brown and Alton L. Long, Jr.

Engineering Writing and Speech

Jade Room, Waldorf-Astoria

Chairman: Keith Henney

FOUNDERS AWARD

To: Ralph Brown, former Bell Telephone Laboratories scientist. For: "outstanding service to the IRE and for outstanding contributions to the radio engineering profession through wise and courageous leadership in the planning and administration of technical developments which have greatly increased the impact of electronics on the public welfare."

Technical Papers Program

"Creative Aspects of Engineering Writing," H. B. Michaelson.
"Readability or Common Sense?" C. A. Dostal.
"Literature on the Linguistic Problem for the Engineer," J. D. Chapline.
"On the Engineering of Self-Expression," D. M. Krigbaum.
"The Engineer — Engineering Writer Relationship," H. P. McCartney.

Radio Frequency Interference

Sert Room, Waldorf-Astoria

Chairman: Dr. Joseph H. Vogelman
"Radiation Characteristics of Antenna at Other Than Design Frequencies," J. C. Pullara and J. P. Jones.
"The Relationship Between Broadband Interference Measurements (DBMC) and Pulsed-CW Signals," L. R. Pangburn.
"Shielding Enclosure Performance Utilizing New Techniques," R. B. Schulz, and D. P. Kanellakos.
"Graphical-Numerical Prediction of Tuned R F Amplifier Output Spectrum," W. G. Duff.
"Radar Mutual Interference Problem," C. Gager, A. Ruvin, and C. Fowler.

Engineering Management

Empire Room, Waldorf-Astoria

Chairman: Dr. John E. Keto
"Pert—An Empirical Approach to Resources Planning," Jerome Pearlman.
"Designing the Corporate Structure to Combine Small-Company Vitality with Large-Company Strength," A. W. Tyler and A. D. Ehrenfried.
"Steps in the Transition from Engineer to Entrepreneur," J. L. Hollis.
"Research Administration in an Explosive Technology," Royal Weller and N. A. Finkelstein.

Product Engineering and Production

Faraday Hall, New York Coliseum

Chairman: J. Maurice Lee
"Microminiature Components and Packaging Techniques," S. M. Stuhlbarg and L. P. Sweany.
"A Dot Component Packaging System for Electronics," A. E. Hawley, E. A. Klein and Sheldon Rubin.
"New Developments in Multilayered Etched Circuitry," N. Schuster and W. Reimann.
"The Application of Thermoelectric Spot Cooling to Electronic Equipment," William Stubstad.
"Picture-Tube Improvement Through Controlled Environment and Ultrasonic Techniques," J. C. Holbrook.

Advances in Navigation and Flight Safety Systems

Marconi Hall, New York Coliseum

Chairman: Ludlow B. Hallman, Jr.
"Star Tracking and Scanning Systems—Their Performance and Parametric Design," J. E. Abate.
"Semi-Automatic Flight Inspection of Navigation-Aid Stations," J. S. Prichard, J. Lovell and E. Drogin.
"An Active Radar Surveillance Beacon," A. R. Almond and D. F. Gumb.
"Gross Errors in Height Indications From Radar Altimeters Operating Over Thick Ice or Snow," A. H. Waite and S. J. Schmidt.
"Performance in Clutter of Airborne Pulse MTI, CW Doppler, and Pulse Doppler Radar," D. Mooney and G. Ralston.

Electron Devices

Morse Hall, New York Coliseum

Chairman: C. G. Thornton
"Fundamental Limiting Noise of Depletion Layer Capacitance," L. J. Giacoletto.
"Block-Diagram Representation of Junction Diodes and Transistors," Georg Bruun.
"Recent Advances in Gallium Arsenide Transistors," M. E. Jones and E. C. Wurst, Jr.
"Uniform Turn-On in Four-Layer Diodes," K. Hubner, M. Melehy and R. L. Biesele, Jr.
"A New High Gain Ultraviolet Detector Tube of High Output Power," D. H. Howling and R. C. Roxberry.
"Solid State Display Device," S. Yando.

TUESDAY MORNING—MARCH 21

Control Theory and Practice

Starlight Roof, Waldorf-Astoria

Chairman: John E. Ward
"An Extension of Wiener Theory to Multivariable Controls," L. G. McCracken.
"Analysis of Linear Control Systems Containing Distributed and Lumped Parameters—A Comparative Study," O. I. Elgerd.
"Harmonic Analysis and Describing Function of Non-Linear Systems," D. M. Makow.
"Considerations in the Optimum Design of a Precision Radar Track Loop," Stephen Adelman.
"Short Time Stability in Linear Time-Varying Systems," Peter Dorato.

Nuclear Instrumentation

Astor Gallery, Waldorf-Astoria

Chairman: Dr. H. E. Banta
"Four Channel Magnetic Tape System for Medical Studies," R. Hindel.
"A Digital Data Handler for Use with Pulsed Particle Accelerators," W. A. Higinbotham and D. W. Potter.
"Automatic Sample Handling and Processing of Nuclear Data," G. M. Kerrigan, L. E. Babcock and O. Forrant.
"The Design of Regulated, Miniature High Voltage D. C. Power Supplies for Satellite and Deep Space Probe Applications," J. B. Minter.
"A New Instrument for Differential DME Polarography," S. Rankowitz and W. A. Higinbotham.
"Use of Entrance Hodoscope for Particle Identification in Very-High Energy Bubble Chamber Experiments," W. Selove, H. Brody, E. Leboy and R. Fullwood.
"A Double-Delay-Line Clipped Linear Amplifier," R. L. Chase and V. Svelto.

Broadcasting

Jade Room, Waldorf-Astoria

Chairman: Adolph B. Chamberlain
"ABC Scan Converter," A. W. Malang.
"Minimizing the Effects of Vidicon Lag with a Broad Band Delay Line," W. L. Hughes.
"Improved Video Recording System," Frank Gillette.
"Recent Advances in Vidicons," Martin Rome.

Electroacoustics

Sert Room—Waldorf-Astoria

Chairman: Philip B. Williams
"The Concept of Linear Interpolation in Spectral Compensation," C. E. Maki and Joseph Chirnitch.
"Adjustable Shelf-Type Treble Equalizer with Separate Control of Frequency and Limiting Loss or Gain," R. H. Rose.
"A Low Noise Microphone Preamplifier," A. B. Bereskin.
"Transient Distortion in Loudspeakers," R. J. Larson and A. J. Adducci.
"Apparent Bass" and Non-Linear Distortion," J. D. Griffiths.
"Artificial Reverberation Facilities for Auditoriums and Audio Systems," G. A. Brookes and R. L. Fisher.

Engineering Management

Grand Ballroom, Waldorf-Astoria

Chairman: Dr. Ernest Weber, President
"Changing Personality of Today's Engineer," I. N. Polley.
"The Current Technological Revolution in Business and Management Methods," H. W. Robinson.
"The Professional Engineer as a Manager," R. E. Lewis.

Medical Electronics

Faraday Hall, New York Coliseum

Chairman: George N. Webb
"Real-Time Spectrum Analyzer and Digital Correlator for Brain Potentials," W. K. Hagan and G. C. Manning, Jr.
"High-Level Electromagnetic Energy Transfer Through a Closed Chest Wall," J. C. Schuder, H. E. Stephenson, Jr. and J. F. Townsend.
"A Current Distribution Electrode System for Defibrillation," D. G. Kilpatrick, E. D. Banta, D. K. Detweiler and D. E. Sunstein.
"Electronic Obstacle and Curb Detector for the Blind," J. M. Benjamin, Jr.
"The Measurement of Internal Physiological Phenomena Using Passive-Type Telemetering Capsuls," V. K. Zworykin, J. T. Farrar, R. C. Bostrom and F. L. Hatke.
"Representation of Electrocardiograph by Orthogonalized Exponentials," T. Y. Young and W. H. Huggins.

This World and the Adjacent One

Marconi Hall, New York Coliseum

A. Lunar Exploration

Chairman: Dr. K. C. Black
"Velocity Sensing for Soft Lunar Landing by Correlation Between Spaced Microwave Receivers," F. R. Dickey, Jr.
"Surveying and Mapping of the Moon from an Orbiter," B. C. Aschenbrenner.
"Summary of Methods and Results of Estimation of the Physical Constants of the Lunar Surface," K. M. Siegel.

B. Meteorological Electronics Panel

"The 433L Weather Data System," G. A. Guy.
"A Ka-Band Radar for Cloud Base and Top

MEDAL OF HONOR

To: Ernst A. Guillemin, Webster Prof. of Electrical Engineering—M. I. T. For: "outstanding scientific and engineering achievements."

Papers Program

"Measurements," Irwin Marson and Henry Katzenstein.
"The AN/FMQ-5 Automatic Meteorological Station," J. Beck.

Broadening Device Horizons

Morse Hall, New York Coliseum
Chairman: John G. Linvill
"Electron Devices for Millimeter-Infrared Gap," P. D. Coleman.
"Optical Masers," G. C. Dacey.
"Solid State Devices," E. O. Johnson.

TUESDAY AFTERNOON—MARCH 21

Coding Theory

Starlight Roof, Waldorf-Astoria
Chairman: Norman M. Abramson
"Improvement of Two Way Communication by Means of Feedback," S. S. L. Chang.
"Sequential Transmission Using Feedback," Michael Horstein.
"Capacity of 2-3 and 3-3 Channels," Sze-Hou Chang and Eric Reid.
"Low Density Parity Check Codes," R. G. Gallager.

Industrial Electronics Applications

Astor Gallery, Waldorf-Astoria
Chairman: I. E. Munson, Manager
"Transistorizing the Industrial Image Orthicon Camera," Richard W. Cook.
"Computers for Industrial Control," R. W. Sonnenfeldt.
"The Infrared Radiometric Method and its Application to Remote Temperature Measurement," Herbert L. Berman.
"A Phase-Shift Data-Transmission System for Analog to Digital or Digital to Aanalog Conversion," H. P. Kilroy.

Broadcasting

Jade Room, Waldorf-Astoria
Chairman: Clure Owen
"An Improved Loudness Indicator," J. L. Hathaway.
"The International Broadcasting System of the Voice of America," E. T. Martin and George Jacobs.
"FCC Laboratory Observations of Precision Frequency Control of TV Stations," E. W. Chapin.
"The CBS NetALERT—A System for Network Signaling," A. A. Goldberg, A. Kaiser, G. D. Pollack and D. M. Vorhes.

Studies in Magnetic Recording

Sert Room, Waldorf-Astoria
Chairman: Dr. S. J. Begun
"Analysis of Sine Wave Magnetic Recording," Irving Stein.
"A New Model for Magnetic Recording," B. E. Bauer and C. D. Mee.
"The Mechanism of A. C. Biased Magnetic Recording," D. F. Eldridge.

VLADIMIR K. ZWORYKIN AWARD

To: Peter C. Goldmark, CBS Labs., Stanford, Conn. For: "important technical contributions to electronic television in military reconnaissance and in medical education."

"Magnetic Recording of Short Wavelengths," Marvin Camras.
"Flutter in Magnetic Recording of Data," C. B. Pear, Jr.

Symposium: The Changing Role of Bio-Medical Electronics in Science and Technology

Faraday Hall, New York Coliseum
Chairman: Dr. Otto H. Schmitt
Otto H. Schmitt, Dr. Herman P. Schwan, Dr. Joseph Almasi, Dr. Albert H. Schwichtenberg, Lovelace Clinic and Dr. Jerome B. Wiesner.

Implementation of Reliability Predictions

Marconi Hall, New York Coliseum
Chairman: Leon Podolsky
"Reliability Trade-Off Analysis," A. Sternberg and J. S. Youtcheff.

WILLIAM J. MORLOCK AWARD

To: Britton Chance, Prof. and Director, Johnson Research Foundation, Univ. of Penna., Phila., Penna. For: "the application of a variety of advanced electronic techniques in a long-term program of fundamental biological research."

"A Study for Determining an Optimum Burn-In of Fixed Glass Dielectric Capacitors," L. D. Hines.
"Significance of Nuclear Radiation for Military Computer Reliability," P. E. Brown and A. L. Long, Jr.
"Transistor Reliability Estimated with the Poisson Distribution," C. H. Li.
"Does Derating Improve Reliability-Longevity?" W. C. Drone and H. L. Benjamin.

Microwave Devices

Morse Hall, New York Coliseum
Chairman: Paul W. Crapuchettes
"A Tunable L-Band Tunnel-Diode Amplifier," H. M. Wachowski.
"The Maser Amplifier as a Practical Microwave Component," F. E. Goodwin, J. E. Kiefer and G. E. Moss.
"A Voltage-Tunable Magnetron with a Matrix Cathode and Improved R-F Structure," J. W. McLaughlin.
"A New Method of Magnetron Tuning and Frequency Stabilization," R. M. Salzer and Reynold Steinhoff.
"A Survey of the Elements of Power Transmission by Microwave Beam," W. C. Brown.

TUESDAY NIGHT—MARCH 21

New Energy Sources

Grand Ballroom, Waldorf-Astoria
Chairman: Dr. Gordon S. Brown
"Thermoelectricity," Paul H. Egli.
"Magnetohydrodynamics," Arthur R. Kantrowitz.
"Thermionic Converters," Volney Wilson.
"Fuel Cells," Anthony M. Moos.
"Solar Energy," John I. Yellott.
"Report of Russian Thermoelectricity Program," R. L. Petritz.
"Status of New Energy Sources in Western Europe," Pierre R. Aigrain.

WEDNESDAY MORNING—MARCH 22

Detection Theory and Signal Analysis

Starlight Roof, Waldorf-Astoria
Chairman: George Turin
"Applications of Stochastic Approximation Methods to Optimum Filter Design," D. J. Sakrison.
"Radar System Performance in a Dense-Target Environment," E. N. Fowle, E. J. Kelly and J. A. Sheehan.
"A Method of Designing Signals of Large Time-Bandwidth Product," E. L. Key, E. N. Fowle and R. D. Haggarty.
"On the Recognition of Signal Patterns in Noise," J. K. Wolf and J. B. Thomas.

Broadcast and Television Receivers

Astor Gallery, Waldorf-Astoria
Chairman: John F. Bell
"A Report on the Midwest Program of Airborne Television Instruction," T. F. Jones.
"TV is Feasible for Regular Graduate Courses," Prof. Wayne B. Swift.
"Subminiature Tubes for TV Tuners," T. E. Gausman.
"Horizontal Scan Non-Linearity in Television Receivers and the Saturable Reactor," H. W. Claypool.

Application of Solid State Devices as Components

Jade Room, Waldorf-Astoria
Chairman: Dr. Rudolfo M. Soria
"Semiconductor Bandpass Filters," S. N. Levine and J. J. Sein.
"Limitations of Film-Type Microsystem Circuits Consisting of Resistive and Capacitive Layers," W. W. Happ and Grant C. Riddle.
"Silicon Oxide Capacitor," Olin B. Cecil.
"New Concepts in Thermoelectric Device Design," William H. Clingman.
"Ceramic-Metallizing-Tape for Reliable Metal-Ceramic Sealing," H. D. Doolittle, K. Ettre, R. F. Spurck and P. F. Varadi.
"A Ceramic Band-Pass Transformer and Filter Element," A. Lungo and F. Sauerland.

Space Electronics

Sert Room, Waldorf-Astoria
Chairman: Philip D. Doersam
"The Effects of Van Allen Belt Radiation on Material," R. S. Shane.
"The Existence of Periodic Variations in the Observations of Jovian Eclipses," Martin Ruderfer.
"Atlas Missile Flight Safety System for Project Mercury," J. W. Schaelchlin, R. D. Gadbois and T. F. Heinsheimer.
"Diagnostic Instrumentation for an Electric Propulsion Plasma Engine," L. Aronowitz and A. Steinberg.
"Inherent Errors in Locating Electrical Storms with a Surveillance Satellite," R. A. Whiteman and D. Fryberger.
"Logarithmic Navigation for Precise Guidance of Space Vehicles," W. G. Green.

Graduate Education in Electrical Engineering

Grand Ballroom, Waldorf-Astoria
Chairman: Dr. Ronald L. McFarlan
Ernst Weber, J. R. Whinnery, R. L. McFarlan and S. W. Herwald.

Communications Systems—Techniques

Faraday Hall, New York Coliseum
Chairman: Christopher Buff
"A Queuing Problem of Mixed Type Traffic," Kurt Ikrath and Horst Ulfers.
"Wideband Channel for Emergency Communications," Henry Magnuski.
"Voice Modulated SSB and DSB Peak-to-Average Envelope Power Ratios," J. D. Griffiths.
"Improvement of Unbalance Distortion in a Baseband Combiner," Masahisa Miyagi.
"Telephone Lines, Their Simulation and Equalization," Allen Gatfield.
"Frequency Division Multiplexing on Transoceanic Cables," Walter Lyons.

Mathematical Approach to Reliability Prediction

Marconi Hall, New York Coliseum
Chairman: Seymour Nozick
"Reliability of System Components Under Stationary Random Perturbations," D. W. C. Shen.
"Utilization of Reliability Factors for Prediction of Spare Parts Requirements," Jerome Klion.
"Generalized Mathematical Model for Reliability

Studies of Electronic Equipment Complexes," F. P. Randazzo and W. J. Stahl.
"On the Reliability of Sequentially Operated Networks," G. H. Weiss and M. M. Kleinerman.
"A Markovian Model for Predicting the Reliability of an Electronic Circuit from Data on Component Drift and Failure," D. M. Brender and M. Tainiter.

Microwave Solid State

Morse Hall, New York Coliseum

Chairman: Harold Seidel
"Recent Advances in Solid State Microwave Devices," M. E. Hines, A. Uhlir and R. Damon.
"Microwave Ferrite Stripline Filter and Power Limiter," John Carter, Irving Reingold and R. A. Moore.
"Ferrite Post Microwave Resonant Structure," W. J. Parris and R. A. Moore.

BROWDER J. THOMPSON AWARD

To: Eiichi Goto, University of Tokyo, Japan. For: "an IRE paper combining the best technical contribution and presentation which has been written by an author under thirty." His winning paper was: "The Parametron, a Digital Computing Element which Utilizes Parametric Oscillation," Proceedings of the IRE, Aug., 1959.

"X-Band Parametric Amplification—An Integrated Approach to the Diode and Circuit Problem," S. M. Ku, R. I. Harrison and S. W. Harrison.
"Recent Advances in Microwave Mixers," Robert Tenenholtz.

WEDNESDAY AFTERNOON —MARCH 22

Data Recording and Storage

Starlight Roof, Waldorf-Astoria

Chairman: Otto Kornei
"The Design of a High Performance 14-Channel Magnetic Record/Playback System for Use as a Precise Frequency Multiplier," S. Himmelstein.
"A Unique Variable Time Delay Network with Application to Linearizing Magnetic Recording Systems," R. A. Wainwright.
"Analog Recording on Thermoplastic Film," W. C. Hughes.
"A Harmonic Analysis of Saturation Recording in a Magnetic Medium," Bohdan Kostyshyn.
"Design and Operation of a Hgh Speed Increased Capacity Magnetic Drum," R. B. Schaffer and D. W. Gill.

Circuit Theory I

Astor Gallery, Waldorf-Astoria

Chairman: S. J. Mason
"Synthesis of Passive Networks for Networks Active at pa I," R. W. Newcomb.
"On the Rate of Parameter Variations in Feedback Systems," I. M. Horowitz.
"Analysis of Circuits Containing Variable Capacitance Diodes," D. R. Anderson and B. J. Leon.
"A New Gain and Power Concept with Circuits Extending the Frequency Spectrum in Transistors into the Microwave Region," R. Zuleeg and V. W. Vodicka.
"Noise in Oscillators with General Tank Circuits," Raffaele Esposito and J. A. Mullen.

Advances in Component Designs

Jade Room, Waldorf-Astoria

Chairman: Paul S. Darnell
"General Theory of a Class of UHF Resonators," J. L. Ekstrom.
"Materials and Form Factors for Micromodule Inductors," G. G. Hauser.
"Micro-Module Reliability Status Report," D. T. Levy.
"Application Characteristics of Solid Tantalum Capacitors," Raymond Rhodes.
"The Design of Bowl Magnets Using the Electrolytic Tank," J. C. Wurr.
"The Sealed Silver-Cadmium Battery," P. L. Howard.

Telemetry

Sert Room, Waldorf-Astoria

Chairman: Robert V. Werner
"The Use of Magnetic Fields in Elimination of Re-entry Radio Blackout," H. Hodara.
"Data Transmission for the NRL Space Surveillance System," M. G. Kaufman and F. X. Downey.
"A Predetection Recording Telemetry System," W. R. Johnson and G. N. Johnson.
"PCM Telemetry Recording at High Densities," G. E. Comstock III.
"Globetrotter—An Air Transportable Satellite Tracking Station," R. L. Scrafford.
"The Courier Recorder-Reproducers," J. P. Buffington and S. L. Wiig.

Communications Systems—Basic Theory

Faraday Hall, New York Coliseum

Chairman: Prof. Mischa Schwartz
"An Orthogonal Coding Technique for Communications," G. A. Franco and G. Lachs.
"Analysis of Multiple Tone Clipping," C. J. Styers.
"Control of Over-Modulation with Multiplexed Coherent Or Non-Coherent Frequencies," D. R. Anderson, S. G. Lutz and J. H. Zeilenga.
"Statistics of Hyperbolic Error Distribution in Data Transmission," Pierre Mertz.
"An Evaluation of the Effects of Delay Distortion in FM Data Transmission," R. A. Gibby.

Propagation

Marconi Hall, New York Coliseum

Chairman: Dr. Sidney A. Bowhill
"The Plasmas of Rocket Flight," W. W. Balwanz.
"Enhancement of Radar Returns Through Double Bounce Circular Polarization," Sheldon Isaacson.
"VHF and UHF Signal Characteristics Observed on a Long Knife-Edge Diffraction Path," A. P. Barsis and R. S. Kirby.
"An Ionospheric Scatter Mode Associated with the Earth's Magnetic Field," Byron Bailin and J. L. Heritage.
"Wave Propagation in Magneto-Ionic Media," H. Hodara.

Microwave Measurements

Morse Hall, New York Coliseum

Chairman: Dr. Helmut M. Altschuler
"A Precision Microwave Phase-Measurement System with Sweep Presentation," S. B. Cohn and H. G. Altman.
"A Precise Method for Measuring the Incremental Phase and Gain Variations of a Traveling Wave Tube," A. Zacharias.
"A Transient Analysis of the Traveling-Wave Resonator with Application to High-Power Microwave Testing," Henry Berger.
"Gas Discharge Noise Sources in Pulsed Operation," N. J. Kuhn and M. R. Negrete.
"A Sequential Detection System for the Processing of Radar Returns," A. A. Galvin.

THURSDAY MORNING—MARCH 23

Analog and Hybrid Techniques

Starlight Roof, Waldorf-Astoria

Chairman: W. W. Seifert
"A Simulator for the Evaluation of Electromagnetic Systems," L. G. Fischer, Gabriel Frenkel and F. S. Barbeck.
"Theory and Practice of Hall Effect Multipliers," G. S. Glinski and J. P. Londolt.
"A Tunnel-Diode Function Generator," Philip Spiegel.
"Stabilized Synchro to Digital Converter," Marvin Masel and David Blauvelt.
"Real-Time Analog-Digital Computation," M. E. Connelly.
"Obtaining the Frequency Response of Physical Systems by Analog Computer Techniques," G. W. Ogar.

Circuit Theory II

Astor Galler, Waldorf-Astoria

Chairman: C. A. Desoer
"The Central Limit Theorem in Circuit Theory," A. Papoulis.
"The Tchebysheff Approximation of a Prescribed Impulse Response with RC Network Realization," D. T. Tang.
"Synthesis of an Arbitrary Bank of Filters by Means of a Time—Variable Network," Eli Brookner.
"Synthesis of Input and Output Networks for a Resonant Transfer Gate," G. B. Thomas, Jr.
"A Limit Theorem on Passive Reactance Two-Ports with Constraints," H. G. Baerwald.

Ultrasonics Engineering I

Jade Room, Waldorf-Astoria

Chairman: Dr. Rudolph Bechmann
"The Ultrasonically Coupled Oscillator," Yujiro Yamamoto.
"The Bandwidth, Insertion Loss and Reflection Coefficient of Ultrasonic Delay Lines for Backing Materials and Finite Thickness Bonds," W. F. Konig, L. B. Lambert and D. L. Schilling.
"Techniques for the Determination of Ultrasonic Attenuation in Fused Silica," R. F. Weeks.
"Depletion Layer Ultrasonic Transducer—A New High Frequency Transducer," D. L. White.
"Ultrasonic Instrumentation for Research on Bats," J. J. G. McCue.

Radar

Sert Room, Waldorf-Astoria

Chairman: Salvatore E. Petrillo
"The Exploration of a Given Volume with a High Accuracy Radar: Considerations of Power, Data Rate and Accuracy," P. R. Dax.
"Correlation Radar Using Pseudo-Random Modulation," W. Fishbein and O. E. Rittenbach.
"Single Pulse AFC System," J. G. Isabeau.
"An Experimental Laser Radar," D. A. Buddenhagen, B. A. Lengyel, F. J. McClung, Jr. and G. F. Smith.
"Application of Molded Wiring Boards to Low Quantity Production," J. C. Gioia.

Space Communications Systems of the Future

Empire Room, Waldorf-Astoria

Chairman: Prof. Walter Lyons
"Decision Feedback Under Adverse Noise Conditions," H. A. Lindgren.
"A Solid State Crystal Controlled FM Transmitter for 150 m/c Band," R. H. Taplin.
"Pseudoredundancy in Communication Systems," P. N. Close, M. Schwartz, M. Chomet, H. Keen and L. Fogel.
"The Courier Communications Satellite Electrical Design," J. M. Rosenberg, J. T. Nawrocki and H. A. Kelley.
"The Dwindling High Frequency Spectrum," George Jacobs and E. T. Martin.
"The First Commercial Comprehensive Microwave and Tropospheric Communication System in South America," F. B. Woodworth.

HARRY DIAMOND AWARD

To: Helmut L. Brueckmann, U. S. Army Signal Research and Development Labs., Fort Monmouth, N. J. For: "outstanding contributions to the theory and technology of antennas."

Human Factors in Electronics

Faraday Hall, New York Coliseum

Chairman: Alexander E. Javitz
"Radar Target Identification by Aural Display," R. W. Pew and J. I. Elkind.
"Acoustic Iso-Preference Contours and TPU's," W. A. Munson and J. E. Karlin.
"A Judgmental Method for Voice Communication System Evaluation," W. R. Roberts.
"The Application of Feedback Techniques to the Measurement of Maximum Human Operator Bandwidth in Closed Loop Control," J. S.

Papers Program

MORRIS N. LIEBMANN AWARD

To: Leo Esaki, consultant at IBM. For: "important contributions to the theory and technology of solid state devices, particularly as embodied in the tunnel diode.

Sweeney and H. P. Birmingham.
"Why Design for Maintainability?" J. G. Wohl.

Antennas

Marconi Hall, New York Coliseum

Chairman: Dr. Robert J. Adams
"A Monopulse Antenna Having Independent Optimization of the Sum and Difference Modes," P. W. Hannan and P. A. Loth.
"Calculation of Radiation Patterns from Apertures with Arbitrary Field Distributions by the Fourier Integral Method," J. S. Hollis and R. E. Moseley.
"The Design of Log-Periodic Dipole Antennas," R. L. Carrel.
"Log-Periodic Monopole Array," D. G. Berry and F. R. Ore.
"Helical Top-Loading of Electrically Small Monopole Antennas," R. O. Schildknecht.

Advances in Instrument Calibration and Precision

Morse Hall, New York Coliseum

Chairman: Harvey W. Lance
"Calibration of Electromagnetic Flowmeters," W. D. Jackson.
"Calibration of a UHF Q Meter," C. G. Gorss.
"A Frequency Standard of Exceptional Spectral Purity and Long-Term Stability," Leonard Cutler.
"Short Term Frequency Stability Measurements," H. D. Tanzman.
"Analysis of Drifts in a Transistor Chopper," R. H. Okada.
"An Implementation of the Correlation Process in the Manner of a Parallel Digital Computer," R. L. Boyell.

Digital Computer Techniques

Starlight Roof, Waldorf-Astoria

Chairman: L. W. VonTersch
"On a Random Walk Related to a Nonlinear Learning Model," Laveen Kanal.
"A Systematic Method for Computer Simplification of Logic Diagrams," F. A. Rocket.
"Design of Computer Circuits Using Linear Programming Techniques," G. H. Goldstick.
"Systematically Introduced Redundancy in Logical Systems," W. C. Mann.
"Majority Gate Logic for Improved Digital Reliability," Gerry Buzzell, William Nutting and Reuben Wasserman.
"Tunnel Diode Threshold Logic," G. P. Sarrafian.

Symposium on Time-Varying Networks

Astor Gallery, Waldorf-Astoria

Chairman: S. Darlington
"Time-Varying Networks—Past and Present," L. A. Zadeh.
"Analysis of Time-Varying Networks," B. K. Kinariwala.
"Some Techniques for the Analysis and Synthesis of Nonstationary Networks," J. B. Cruz, Jr.
"Some Models for Linear Time-Variant Filters and Their Use in Communications Problems," T. Kailath.

Ultrasonics Engineering II

Jade Room, Waldorf-Astoria

Chairman: Robert L. Rod
"Automatic Ultrasonic Examination of Large Rotor Forgings," M. E. Auger and R. G. Goldman.
"Application of Theory of Elastic Waves in Plates to the Design of Ultrasonic Dispersive Delay Lines," T. R. Meeker.
"Transmission Characteristics of Longitudinal-Mode, Strip Delay Lines Having Asymmetrically Tapered Widths," A. H. Meitzler.
"Discussion of Time Delay in Reference to Electrical Waves," E. H. Young, Jr.
"A Review of Some Russian Papers in Ultrasonics Engineering," R. N. Thurston.

Military Electronics

Sert Room, Waldorf-Astoria

Chairman: R. L. Clark
"The Photoscan Reconnaissance System," R. H. McMann, Jr.
"Micromodules in Avionics—Applicable, Practical," G. Sievers.
"A Static Electronic Frequency Changer," D. C. Griffith and R. M. Ulmer.
"Improved Flight Deck Communications System," T. H. Yaffe.
"A Missile-Borne Sun-Position Indicator," N. K. Marshall.

Vehicular Communications

Faraday Hall, New York Coliseum

Chairman: Donald S. Dewire
"Tone Signaling Increases Mobile Radio Efficiency," T. G. Humphreys, Jr.
"A New Approach To Transistorization of Mobile Radiotelephone Equipment," I. Tease.
"A 150 MC Personal Radio Signaling System," Doren Mitchell and Kenneth Van Wynen.
"15 kc Split Channel for the 150 Mc Land Mobile Service," R. T. Myers.
"Splitting the 450 MC Channels," C. J. Schultz.

Antennas

Marconi Hall, New York Coliseum

Chairman: Delmer C. Ports
"Optimizing the Performance of Very High Gain Low Noise Antenna Systems," R. Caldecott, J. W. Eberle and T. G. Home.
"Far Field Properties of Wide Band Planar Arrays with Nonlinear Processing," E. D. Banta.
"Frequency Scanning Antennas," Akira Ishimaru and Hang-Sheng Tuan.
"A Critical Study of Linear Arrays with Equal Side Lobes," M. T. Ma and D. K. Cheng.
"Maintaining Fixed Phase Differences Between Microwave Signals Generated at Remote Sites," S. B. Boor and R. J. Wohlers.

Advances in Instrumentation Techniques and Systems

Morse Hall, New York Coliseum

Chairman: Dr. P. S. Christoldi
"A Ferrite Piezomagnetic Stress Transducer," C. E. Land.
"Metastable Helium Sensitive Magnetometer," J. A. Rice, Jr.
"Hysteresis Curve Tracer for Thin Magnetic Films," T. F. Bryzinski and D. R. Sahba.
"A New Method for Automatic Measurement and Display of Amplitude/Frequency Characteristics in the VHF-UHF Range," H. Lucius.
"Precision Measurement System for Large Antennas," W. C. Espenlaub.

	WALDORF-ASTORIA HOTEL						NEW YORK COLISEUM		
	Starlight Roof	Astor Gallery	Jade Room	Sert Room	Empire Room	Grand Ballroom	Faraday Hall	Marconi Hall	Morse Hall
MONDAY, MARCH 20 2:30–5:00 p.m.	SESSION 1 Discrete and Adaptive Control Systems	SESSION 2 Reactor Instrumentation	SESSION 3 Engineering Writing and Speech	SESSION 4 Radio Frequency Interference	SESSION 5 Engineering Management		SESSION 6 Product Engineering and Production	SESSION 7 Advances in Navigation and Flight Safety Systems	SESSION 8 Electron Devices
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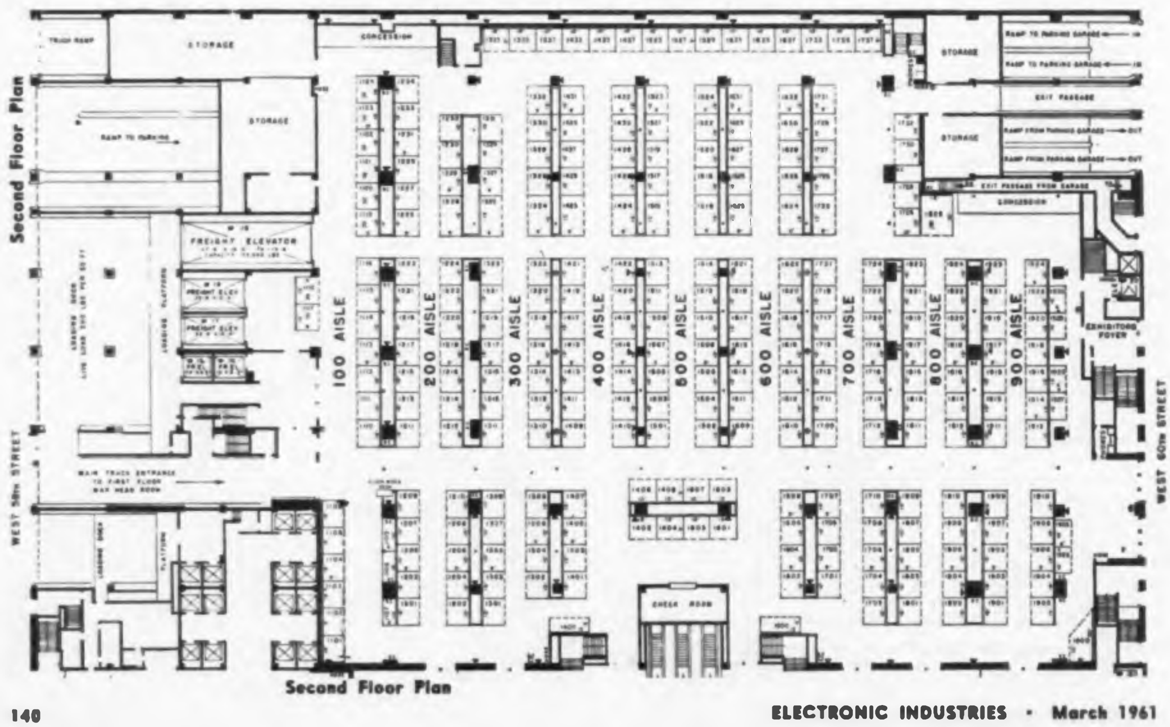

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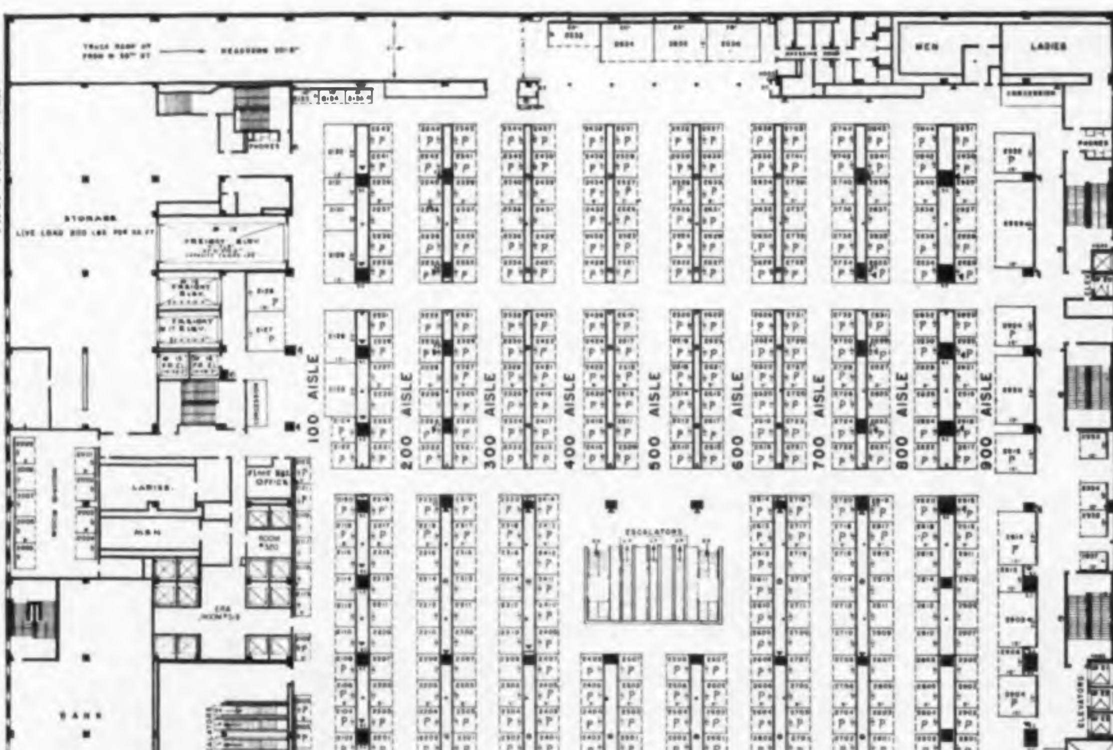


First Floor Plan

IRE Exhibitors . . .

. . . By Booth Numbers

1101 General Transistor
1103 General Instrument, Micamold Electronics Mfg., Radio Receptor Co.
1107 The Constanta Co. of Canada
1108 The Sibley Co.
1109 Consolidated Resistance Co. of America
1110 Engineered Electronics Co.
1111 Autotronics
1112 Avnet Electronics
1113 Twin Lock
1114 Consolidated Avionics
1115 Reon Resistor
1116 Tru-Connector
1117-18 Motorola Semiconductor Products
1119 Universal Electronics Co.
1120 Gould-National Batteries
1121 Aircom
1122 Columbus Electric Mfg. Co.
1123 Gordos
1124 Three Point One Four

1201-03 Beckman Instruments
1202 Reeves Instrument, Dynamics Corp. of America
1204 Fenwal Electronics
1205 Airflyte Electronics Co.
1206 Collins Electronics Mfg.
1207 Technical Appliance
1208 The W. L. Maxon
1209 Minnesota Mining & Mfg. Co.
1211 Burroughs
1212 Pyramid Electric Co.
1214 Chicago Standard Transformer
1216 Epsco
1217 Isotronics
1218 Electronic Specialty Co.
1220 Transitron Electronic Corp.
1221 Axel Electronics
1223 Tower Construction Co.
1225 Sage Laboratories
1226 ACF Industries
1227 Augat Bros.
1228 The National Cash Register Co.
1229 A.P.M. Corp.
1230 Travco Associates
1231 Electro Mechanical Instrument Co.
1233 Waters Manufacturing
1234 Rotating Components

1301 Radio Engineering Labs.
1302 Philco
1305 Reeves Instrument
1309 Dynamics Corp. of America
1310 Indiana General
1311 C W S Waveguide
1315 M. Ten Bosch
1317 Telrex Labs.
1318 Bliley Electric Co.
1319 Industrial Timer
1320 Good-All Electric Mfg. Co.
1322 The Bristol Co.
1324 The Korfund Co.
1325 Delco Radio, General Motors
1326 Silicon Transistor
1327 American Electronics
1328 Arthur Ansley Manufacturing Co.
1329 Columbia Technical
1330 John Oster Mfg. Co.
1331 Reeves Soundcraft
1333 Condenser Products Co.
1335 PCA Electronics
1337 Sinclair Radio Labs.
1400 CTS Corp.

1401 CBS Electronics
1402 Westinghouse Electric
1405 National Co.
1409 Texas Instruments Incorporated
1410 P. R. Mallory & Co.
1414 Radio Materials Co.
1416 Perkin Engineering
1420 Elco
1423 Victory Engineering
1424 Instruments for Industry
1425 The Deutsch Co.
1426 Sterling Precision
1427 Telerad Mfg.
1428 Phaostron Instrument & Electronic Co.
1429 The Siegler Corp.
1432 Automatic Metal Products
1433 Valpey Crystal
1435 Thompson-Ramo-Wooldridge

1501 General Precision
1502 Andrew Corp.
1505 General Precision
1506 Illinois Tool Works
1507 Link, Gen. Prec.
1509 Kearfott, Gen. Prec.
1510 Electro Voice
1512 The A. W. Haydon Co.
1513 Vector Electronic Co.
1515 Precision Apparatus Co.
1517 PIC Design Corp.
1518 U.S. Semiconductor Products
1519 Glasseal Products Co.
1521 Curtiss-Wright
1522 Int'l Electronic Research
1524 Haydon Switch

1600 Land Air
1602 Radio Corp. of America
1609 Alfax Paper and Engineering
1610 Litton Industries
1611 Alden Elect. & Impulse Recording
1613 Alden Products
1617 Crucible Steel Co. of America
1619 Maurey Instrument
1620 Electro Tec
1621 Hermetic Seal
1622 JFD Electronics
1623 ADC Inc.
1624 McLean Engineering Labs.
1625 Magnetic Metals Co.
1626 Orth Filter
1627 Industro Transistor
1628 Hoffman Electronics
1629 C & K Components
1631 United Mineral & Chemical
1637 The Hart Manufacturing Co.

1702 Heath Co.
1704 Daystrom Pacific
1708 Weston Instrument
1712 Wind Turbine Co.
1716 Dyna-Empire
1718 Alford Manufacturing Co.
1719 Power Sources
1721 Telex Inc.
1722 Bowmar Instrument
1723 Sanders Associates
1724 Ceranaseal
1725 Deltime, Inc.
1726 General Time
1728 Schutter Microwave
1730 Sarkes Tarzian
1732 Sony Corp. of America
1733 Varo Mfg. Co.
1735 Burndy

1802 Jennings Radio
1805 Daystrom Transicoil
1806 Filmohm
1807 Daystrom
1808 The Zell Products
1810 Budd-Stanley Co.
1811 Hughes Aircraft
1812 Filtron Co.
1816 Bourns
1819 Ainslie
1821 Bulova Watch Co
1822 British Radio Electronics
1824 The Walkirt Co.
1825 Harrison Laboratories
1900 Telemeter Magnetics

1901 Sonotone
1902 Mitronics
1903 Applied Research
1904 General Magnetic
1905 Glass-Tite Industries
1907 Spectrol Electronics
1908 Automatic Electric Sales
1911 Control Electronics Co.
1912 Ace Electronics Associates
1913 Diehl Manufacturing
1916 G-L Electronics Co.
1917 The Singer Mfg. Co.
1918 Aladdin Industries
1919 Del Electronics
1920 Solid State Products
1921 The Thomas & Betts Co.
1922 Delta Coils
1923 Dempa Shinbun
1923 Japan Electric Industry
1924 The Torrington Mfg. Co.
1925 Chicago Dynamic Industries
1926 Walter Kidde & Co.
1927 The Pyle-National Co.
1928 Syntron Co.
1930 Shepherd Industries

M-2 Guidance Controls
M-4 Methode Manufacturing
M-5 Slip Ring Co. of America
M-6 Renbrandt
M-12 Antenna & Radome Research Assoc.
M-13 Hoyt Electrical Instrument Works
M-15 Babcock Relays
M-17 Master Specialties Co.
M-18 ECCO Electronic Components
M-20 Borg-Warner
M-21 Pittman Elec. Dev. Co.
M-22 Security Devices Lab.
M-24 D & R Ltd.

2001 National Semiconductor
2002 Microwave Electronic Tube Co.
2006 Camblock
2008 Murata Mfg. Co.
2009 North American Electronics

2100 James Electronics
2101 Microdot
2102 Power Designs
2104 Pyrfilm Resistor Co.
2105 G-M Laboratories
2106 LEL
2109 Carter Parts Co.
2110 Belling & Lee
2112 Donald P. Mossman
2113 LaPointe Industries
2114 Tempo Instrument
2115 Bogue Electric
2116 Vemaline Products
2118 Shockley Transistor
2119 George Ulanet Co.
2120 Tech Laboratories
2122 Union Switch & Signal
2125 North Electric Co.
2126 Telecomputing
2127 Yardney Electric
2128 New Departure, General Motors
2129 D. S. Kennedy & Co.
2130 Electralab Printed Electronics
2131 Rowan Controller
2132 Coors Porcelain Co.
2133 Eastern Industries
2135 Kurman Electric Co.

2201 Photocircuits
2202 Minneapolis-Honeywell Regulator
2205 Sangamo Electric
2209 Vari-L Co.
2211 Allen-Bradley Co.
2215 McCoy Electronics
2216 Walthan Precision Instrument Co.
2217 Southern Electronics
2218 C. P. Clare & Co.
2219 Cambridge Thermionic
2221 Kings Electronics Co.
2222 Bendix
2225 Herman H. Smith
2227 Electronic Measurements Co.
2231 Ward-Leonard Electronic Co.
2233 Elgin National Watch Co.
2234 Dale Electronics
2235 Sage Electronics
2237 James Cunningham Son & Co
2238 The U. S. Stoneware Co
2239 Epco Products
2241 Douglas Microwave Co.
2242 Barber-Colman Co.
2301 Victoreen Instrument Co.
2302 Microwave Assoc.
2305 Model Engineering & Mfg.
2306 Airpax Electronics
2307 DeJur-Amsco
2309 Continental Connector
2310 Illinois Condenser Co.
2311 Microtron Co.
2312 Bogart Manufacturing
2313 Industrial Electronic Hardware
2314 The Arnold Engineering Co.
2315 Curtis Development & Mfg.
2317 Technology Instrument
2321 Simpson Electric Co.
2322 Sylvania Electric Products
2327 Stevens Mfg. Co.
2331 M. C. Jones Electronics Co.
2333 Ohmite Electronics
2334 Tung-Sol Electric
2337 G.C. Electronics Co.
2338 RS Electronics
2339 Ericsson
2340 Phillips Control
2341 Buchanan Electronical Prods.
2342 Pacific Semiconductors
2343 AGASTAT Timing Instruments

2401 Union Carbide Consumer Products
2402 Amphenol-Borg Electronics
2407 Microwave Development Labs.
2409 Price Electric
2410 Eitel-McCullough
2413 United Transformer
2416 Sprague Electric Co.
2426 The Triplett Electrical Instrument Co.
2428 International Resistance Co.
2431 Balco Research Laboratories
2433 LIECO
2434 Branson
2435 Dage Electric Co.
2436 Rheem Semiconductor
2437 Magnetics

2502 Guardian Electric Mfg. Co.
2506 Robinson Tech. Prod.
2509 Freed Transformer Co.
2510 International Tel. & Tel.
2515 James Millen Mfg. Co.
2517 Mycalex Corp. of America
2521 Audio Devices
2522 Amperex Electronic
2523 San Fernando Electric Mfg. Co.
2525 Magnecraft Electric Co.
2526 Electrical Industries
2527 AMP
2530 Ferroxcube Corp. of America
2532 Capitol Machine Co.
2534 Barry Controls
2535 United Car Fastener
2536 Cinch Mfg.

2601 Air-Marine Motors
2602 Astron
2604 Sorensen & Co.
2605 Vitramon
2608 Machlett Labs.
2616 Clevite Transistor Products
2618 Brush Instruments, Clevite Corp.
2620 Clevite Electronic Components
2627 Corning Glass Works
2628 Sigma Instruments
2632 Gorham Electronics
2634 Shallcross Mfg.
2635 The Gabriel Co.
2636 Kepco

2701 Fairchild
2702 Potter & Brumfield
2706 The James Knights Co.
2708 Varian Assoc.
2709 Burgess Battery Co.
2710 Bomac Labs.
2711 Syntronic Instruments
2713 Drake Manufacturing Co.
2715 Servomechanisms
2717 The Daven Co.
2721 Cornell-Dubilier Electronics
2722 Superior Electric Co.
2725 Federal Pacific Electric
2731 Cannon Electric Co.

2733 Sperry Gyroscope Co
2734 J-B-T Instruments
2736 Penta Laboratories
2738 Plastic Capacitors
2740 Bussmann Mfg.
2741 Standard Electrical Prod.
2742 Thomas A. Edison Industries

2801 Grayhill
2802 Mepco
2803 Behlman Engineering Co.
2805 U. S. Components
2806 Bergen Labs.
2807 Mucon Corp.
2808 Filtors
2809 Communications Accessories Co.
2810 Perkin-Elmer Corp.
2811 Gremar Manufacturing Co.
2812 Hi-G
2813 International Instruments
2814 Garlock
2815 Sola Electric Co.
2818 John Gombos Co.
2821 American Television & Radio
2822 Rotron Mfg. Co.
2825 Switchcraft
2826 The Gudeman Co.
2827 Globe Industries
2828 Kemtron Electron Products
2829 Dialight
2830 Electronic Research Assoc.
2833 The Electro Motive Mfg. Co.
2834 Electra Manufacturing Co.
2835 All Products Co.
2837 The Gamewell Co.
2838 Lord Manufacturing Co.
2839 Polyphase Instrument Co.
2841 Heinemann Electric Co.
2842 Hardwick, Hindle
2844 Northeast Scientific

2900 Kulka Electric
2901 International Rectifier
2904 General Electric Co.
2905 Allied Control Co.
2906 General Electric Co.
2909 Burnell & Co.
2911 Christie Electric
2912 General Electric Co.
2913 Thomas Electronics
2914 General Electric Co.
2915 ESC Corp.
2916 General Electric Co.
2917 Lambda Electronics
2919 Sealectro
2920 General Electric Co.
2921 Thomas & Skinner
2922 Bradley Semiconductor
2923 Littelfuse
2925 Huggins Laboratories
2927 Comar Electric Co.
2929 Rye Sound
2930 The Carborundum Co.
2933 Deluxe Coils
2934 Stevens-Arnold
2935 Columbus Electronics
2937 Faradyne Electronics

3001 Radiation Inc.
3003 Dytronics Co.
3004 Aetna Electronics
3005 Radar Measurements
3006 Wallson Associates
3007 Strand Labs
3008 BLUE M Electric Co.
3009 Mid-Eastern Electronics
3010 Republic Aviation
3011 General Dynamics
3012 Landis & Gyr
3013 Foto-Video Electronics
3014 Dynatran Electronics
3016 Di/An Controls
3018 Int'l Electronic Res.
3019 Hewlett-Packard Co.
3021 San Diego Scientific
3022 North Hills Electronics
3023 Pitometer Log
3024 Sierra Research
3025 EH Research Labs.
3026 General Resistance
3027 Freeport Engineering Co.
3027 Ebauches S.A.
3028 Electro Scientific Ind.
3031 Sierra Electronic
3033 Trio Labs.
3034 Quan-Tech Labs.
3035 Precision Instrument Co.
3036 Barnes Engineering Co.
3037 General Thermodynamics
3038 Hermes Electronic Co.
3041 Non-Linear Systems
3043 Instron Engineering
3044 Molectronics Corp.
3051 Offner Electronics
3052 Burr-Brown Research
3053 American Electronic Labs
3056 Cook Electric Co.
3059 Lumatron Electronics
3060 Optimized Devices
3061 Shielding
3063 Pickard & Burns
3064 Rizon Electronics
3065 CBS Labs.

3101 Boonton Radio
3103 Waterman Products Co.
3105 James G. Biddle Co.
3106 Precise Electronics & Development
3107 MB Electronics
3108 California Technical Industries
3111 Philamon Labs.
3112 Electronic Tube
3114 Boonton Electronics
3115 Radio Frequency Labs.
3116 Avco
3118 Tenney Engineering
3121 Larson Instrument Co.
3122 B & F Instruments
3123 Cubic

3201 General Radio Co.
3205 Hewlett-Packard Co.
3210 Erie Registor
3216 Baird-Atomic
3217 Bird Electronic
3220 Waveforms
3221 Wang Labs.
3222 DeMornay-Bonardi
3223 McMillan Lab.
3225 Industrial Instruments
3226 Computer-Measurements
3229 Northeastern Engineering
3230 Muirhead & Co.
3231 Wayne-George
3232 Navigation Computer
3233 ANTLAB
3234 Probescope Company
3236 Herman H. Sticht Co.
3237 John Fluke Mfg. Co.
3238 Julie Research Labs.
3239 The Geotechnical
3240 Harvey-Wells Electronics
3241 Manson Labs.
3242 Transistor Specialties
3244 Edgerton Germeshausen & Grier

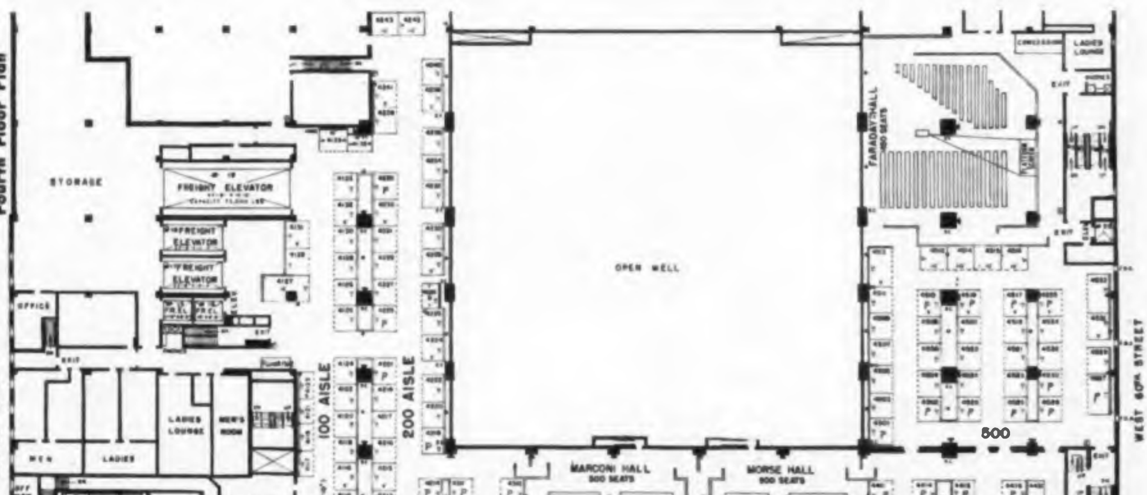
3301 Polarad Electronics
3302 Collins Radio Co.
3309 Hastings-Raydist
3310 F. L. Moseley Co.
3311 Rawson Electrical Instr. Co.
3313 Vesco Vacuum
3311 Airborne Instruments Lab.
3317 Rutherford Electronics Co.
3401 Ballentine Labs.
3402 Panoramic Radio Products
3405 Potter Instrument Co.
3406 British Industries
3409 Sensitive Research Instrument
3410 FXR
3416 Beckman Instruments

3501 Allen B. Du Mont Labs.
3502 McGraw-Edison
3509 Electronic Instrument Co.
3510 Northern Radio Co.
3511 Tektronix
3512 Kay Electric Co.

3601 Millivac Instruments
3602 PRD Electronics
3603 Messa Labs.
3607 KIN TEL
3608 Gates Radio Co.
3612 Century Electronics & Instruments
3613 Industrial Test Equipment Co.
3615 Crosby-Teletronics
3616 Hickok Electrical Instrument Co.

3701 Sanborn Co.
3702 Marconi Instruments
3707 Servo Corp. of America
3708 Krohn-Hite
3709 Electro-Pulse
3712 Electronic Associates
3713 MacLeod & Hanopol
3715 Gertsch Products

3801 Ferris Instrument Co.
3802 Ling-Temco Electronics
3803 Trak Electronics Co.
3807 E.M.I.-Cossor Electronics
3808 International Business Machines
3809 Narda Microwave
3815 Lavoie Labs.
3814 Burlingame Assoc.
3818 Empire Devices Prod.
3819 Laboratory for Electronics
3822 Beattie-Coleman
3823 Emerson & Cuming
3824 Precision Scientific Co.
3825 Technology Instrument
3826 Telonic Industries
3828 Greibach Instruments
3829 Victor Adding Machine Co.
3830 General Mills



Fourth Floor Plan

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3831 Knight Electronics
3834 Wayne Kerr
3835 Franklin Electronics
3839 Telectro Industries
3840 Digital Equipment
3841 Garrett Corp.
3842 Micro Gee Products
3843 Menlo Park Engineering
3844 Harvard Industries
3845 Hoover Electronics Co.
3846 Electric Hotpack Co.

3901 Technical Materiel
3904 Jerrold Electronics
3905 Computer Control Co.
3908 Specific Products
3909 Ad-Yu Electronics Lab.
3910 Veeder-Root
3911 Packard-Bell Electronics
3912 Electro Instruments
3914 Electronic Measurements
3916 Assembly Products
3917 Vitro Electronics
3920 Keithley Instruments
3921 American Bosch Arma
3922 The Martin Co.
3925 Systron
3926 Scientific-Atlanta
3927 Page Communications Engrs.
3928 Ace Engineering & Machine Co.
3931 Associated Testing Labs.
3932 Avco Corp.
3934 Alfred Electronics
3935 Datex Corp.
3936 Minnesota Mining & Mfg. Co.
3937 General Computers
3938 Unholtz-Dickie
3939 North Atlantic Industries
3940 Yokogawa Electric Works
3944 Thermo Electron Engineering

4001 Chassis-Trak
4002 Hexacon Electric Co.
4003 Weckesser Co.
4004 Universal Mfg. Co.
4006 Utica Drop Forge & Tool
4007 Circo Ultrasonic Corp.
4008 Edwin B. Stimpson Co.
4010 Wales-Strippit
4011 MM Enclosures
4012 Weller Electric
4013 Cable Designs
4014 American Aluminum Co.
4015 Little Falls Alloys
4016 Rosan, Inc.
4017 Boston Insulated Wire & Cable Co.
4018 Gorman Machine
4019 Universal Instruments
4021 Fansteel Metallurgical
4023 Allegheny Electronic Chemicals Co.
4024 International Eastern Co.
4025 Gudebrod Bros. Silk Co.
4026 Monsanto Chemical Co.
4028 Phelps Dodge Copper Products
4030 Gries Reproducer
4033 American Electrical Heater Co.
4034 Swiss Jewel Co.
4035 Uniform Tubes
4036 Eubanks Engineering Co.
4037 Optical Coating Lab.
4038 Micromach Mfg.
4039 Stewart Stamping Co.
4040 Adolpf Meller Co.
4042 Anchor Metal Co.
4043 Lindberg Engineering Co.
4044 The Zippertubing Co.
4045 Raytheon Co.
4046 Norrich Plastics
4047 Dynacor
4047 Sprague Electric Co.
4048 Howard W. Sams & Co.
4049 Wright Metalcoaters
4050 Furane Plastics
4051 Leach & Garner
4052 Secon Metals
4053 GOE Engineering Co.
4054 Inso Electronic Products
4056 Technical Wire Products

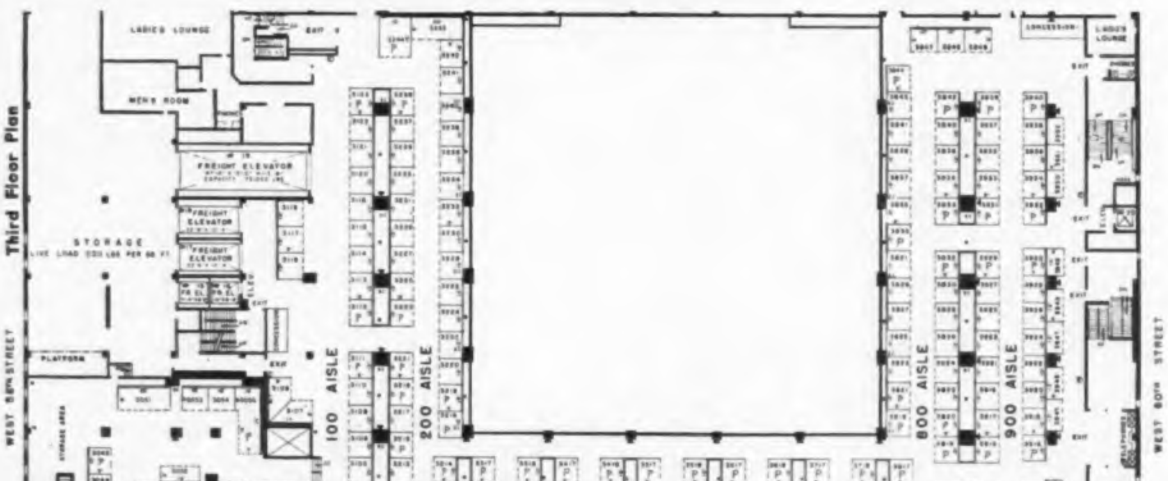
4101 W. H. Brady Co.
4103 Alpha Wire
4104 Bodner Products
4105 Diamonite Products Mfg. Co.
4106 General Aniline & Film Corp.
4107 Electro Devices
4108 Artos Engineering Co.
4109 Oryx Co.
4110 Perfection Mica Co.
4112 Design Tool Co.
4113 Derivation & Tabulation Associates
4114 Hull Corp.
4115 Great Eastern Metal Products Co.
4116 Belden Manufacturing Co.
4121 W. L. Gore & Assoc.
4123 The Combined Book Exhibit, Inc.
4124 New Hermes Engraving Machine Corp.
4125 Popper & Sons
4128 Plastoid
4129 Acoustica Associates
4130 McDowell Electronics
4131 Affiliated Manufacturers
4132 Zero Manufacturing Co.
4135 Ungar Electric Tools
4139 Temperature Engineering

4201 Electronic Mechanics
4203 Wilbur B. Driver Co.
4204 Premier Metal Products Co.
4207 Tinnerman Products
4208 H. Braun Tool & Instrument Co.
4210 Garkem Machine Co.
4213 Lepel High Frequency Labs.
4214 W. M. Welch Manufacturing
4215 Hitemp Wires
4216 Spaulding Fibre Co.
4218 George Stevens Mfg. Co.
4219 International Pump & Machine Works
4221 Kester Solder Co.
4222 The Kanthal Corp.
4224 Associated American Winding Machinery
4225 Borg-Warner
4226 Signal AFGEA
4228 American Silver Co.
4231 Krengel Manufacturing Co.
4232 Hysol
4233 American Molded Products Co.
4234 Technical Devices Co.
4235 Aeroprojects
4236 Kingsley Machine Co.
4239 York Metal Products
4242 Molecu-Wire
4243 Parker Seal Co.
4244 Parker-Hannifin

4300 Boesch Mfg. Co.
4301 P. Wall Manufacturing Co.
4302 Par-Metal Products
4305 Allied Chemical Corp.
4308 American Enka
4309 The New York Air Brake Co.
4310 Dow Corning
4313 Instrument Specialties Co.
4315 Falstrom Co.
4318 Kupfrian Mfg.
4319 E. I. du Pont de Nemours & Co.
4322 Sigmund Cohn
4323 Leesona
4327 REF Manufacturing
4328 Alpha Metals
4329 E. I. du Pont de Nemours & Co.
4330 Tensolite Insulated Wire Co.
4332 Green Instrument Co.

4401 American Lava
4402 Western Lithograph Co.
4404 Grant Pulley & Hardware
4406 Engelhard Industries
4407 South Chester Corp.
4409 Hudson Tool & Die Co.
4416 Birnbach Radio Co.
4417 Driver-Harris Co.
4418 F. J. Stokes
4421 Synthane
4422 Buckbee Mears Co.
4425 NRC Equipment
4426 Coil Winding Equipment Co.
4428 Federal Tool Engineering Co.
4429 Mathias Klein & Sons

4501 Amco Engineering Co.
4502 Jonathan Mfg. Co.
4504 Raychem
4507 Consolidated Mining & Smelting Co.
4508 Halliburton
4512 HPL Manufacturing Co.
4513 Merck & Co.
4514 Skydyne
4519 Penn Engineering & Mfg.
4521 American Sealants Co.
4523 Beemer Engineering Co.
4524 Gardner-Denver Co.
4525 Eugene Engineering Co.
4527 Unitek
4528 Standard Pressed Steel Co.
4529 Barnstead Still & Sterilizer Co.
4531 Knapic Electro-Physics
4533 C. I. Hayes



Third Floor Plan

Where to Find It . . .

A quick, handy guide for locating products and equipment at the IRE Show

Amplifiers

1103, 1110, 1208, 1424, 1429, 1515, 1903, 2106, 2306, 3401, 2616, 2925, 3802, 3843, 3845

Attenuators & Insolators

2120, 2302, 2838, 2937, 3223, 3512, M-12

Batteries & Power Supplies

1114, 1119, 1124, 1230, 1416, 1719, 1825, 1901, 1919, 2102, 2127, 2227, 2338, 2401, 2604, 2636, 2709, 2717, 2803, 2815, 2830, 2844, 2911, 2917, 2933, 3009, 3013, 3034, 3237, 3708, 3908, 3934, 4318, M-24

Bridges & Decades

1109, 1702, 3028, 3114, 3201, 3225, 3226, 3406, 3509, 3713

Cabinets & Enclosures

1902, 3824, 4011, 4115, 4315, 4204, 4239, 4327, 4409, 4501, 4508

Cameras & Optical Equipment

1233, 1435, 2510, 2701, 3031, 3036, 3401, 3509, 3815, 3822, 3932

Capacitors

1103, 1212, 1221, 1320, 1333, 1410, 1802, 2008, 2310, 2333, 2416, 2431, 2523, 2602, 2605, 2721, 2738, 2807, 2826, 2833, 2834, 4021, 4401

Chemicals & Metal Parts

2132, 2916, 2937, 4014, 4023, 4037, 4105, 4222, 4228, 4305, 4319, 4328, 4507, 4528, 4531

Choppers

1206, 2100, 2306, 2934, 3601

Coils

1103, 1202, 1233, 1301, 1309, 1733, 1918, 1934, 2209, 2312, 2509, 2711, 2927, 3302, 4018

Communications Equipment

1301, 1405, 3510, 3608, 3615, 3901

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1327, 1335, 1517, 1626, 1821, 2205, 2211, 2219, 2517, 2711, 3022, 4034, 4313, 4523

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1116, 1311, 1425, 2805, 2814, 1420, 1432, 1735, 1808, 1921, 1927, 2006, 2101, 2110, 2121, 2221, 2307, 2402, 2435, 2919, 4416, M-4, M-18

Cooling Devices

1234, 1624, 1924, 2302, 2601, 2822, 3841

Cathode-Ray Tubes

1302, 1401, 1402, 1602, 1610, 1701, 1709, 1811, 2322, 2334, 2415, 2427, 2522, 2534, 2608, 3065, 3103, 3112, 3244, 3501, 5045

Crystal Equipment

1202, 1227, 1309, 1318, 1433, 1621, 1820, 1821, 1905, 2215, 2219, 2302, 2407, 2627, 2706, 4513

Data Processors—Computers

1110, 1124, 1202, 1208, 1211, 1216, 1230, 1301, 1305, 1309, 1310, 1322, 1401, 1409, 1435, 1505, 1507, 1509, 1513, 1600, 1602, 1610, 1722, 1900, 2114, 2126, 2201, 2510, 2527, 2906, 3001, 3016, 3122, 3123, 3310, 3316, 3232, 3238, 3240, 3712, 3829, 3830, 3835, 3840, 3841, 3905, 3917, 4047, M-2

I.R.E. TREASURER

Stuart L. Bailey

Delay Lines

1121, 1201, 1329, 1335, 1521, 1622, 1725, 1911, 2515, 2527, 2721, 2915, 2919, 3112, 4406

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1226, 1501, 1509, 1512, 1608, 1610, 1635, 2222, 2332, 2920, 3231, 3905, 3935

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Indicators—Counters

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Klystrons & Magnetrons

1402, 1602, 1610, 2002, 2222, 2301, 2322, 2410, 2710, 2733, 2913, 2925, 3807, 4045

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4101, 4125, 4231, 4236, 4402

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1510, 1602, 1901, 2929, 3603, 3839

Microwave Components & Equipment

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1234, 1327, 2115, 2242, 2601, 2715, 2722, 2822, 3921, M-20

Oscilloscopes

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3008, 4043, 4219, 4418, 4533

Panel Lamps & Accessories

1207, 1302, 1614, 2713, 2829

Plastics & Encapsulants

4026, 4046, 4050, 4051, 4216, 4232, 4310, 4421, 4521, 4525

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1115, 1201, 1233, 1619, 1816, 1822, 1907, 1912, 2216, 2235, 2307, 2317, 2810, 2837

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Booth Locator

Recording-Reproducing Equipment

1609, 1611, 1930, 3051, 3056, 3310, 3405, 3603, 3701, 3839, 3926, 3936, 4233

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1103, 1226, 1327, 1518, 1730, 1928, 2115, 2222, 2636, 2717, 2806, 2901, 2922, 2935, 3302, 4045

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1322, 1521, 1637, 1733, 1908, 2122, 2125, 2135, 2218, 2233, 2340, 2343, 2409, 2443, 2502, 2525, 2628, 2702, 2742, 2808, 2812, 2905, 2927, 3064, 3105, K-17, M-15, M-22

Resistors

1107, 1109, 1115, 1631, 1806, 2104, 2205, 2231, 2234, 2301, 2305, 2333, 2428, 2634, 2802, 2842, 2910, 2930, 3026, 3406

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1621, 1905, 2238, 2402, 2526, 2570, 2627, 3823, 4401

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1327, 1330, 1405, 1509, 1805, 2115, 2222, 2715, 2742, 2827, 3053, 3202, 3230

Signal Generators

1309, 1515, 3007, 3019, 3025, 3201, 3221, 3317, 3502, 3709, 3801, 3826, 3904
1205, 1620, 4406, M-5

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Switches

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1113, 1724, 2341, 2900, 4016, 4053

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1112, 1627, 1708, 1716, 2222, 2241, 2321, 2426, 2534, 2913, 3004, 3006, 3011, 3014, 3031, 3043, 3044, 3053, 3060, 3101, 3107, 3108, 3216, 3222, 3230, 3234, 3236, 3301, 3416, 3509, 3616, 3707, 3809, 3814, 3815, 3819, 3845, 3931, 3938, 3940, 4425

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1204, 1423, 1926, 2920, 2930

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1319, 1322, 3003, 3239

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1123, 1222, 1302, 1401, 1402, 1602, 1610, 1701, 1709, 1811, 1901, 2002, 2222, 2301, 2302, 2329, 2334, 2339, 2410, 2427, 2510, 2522, 2534, 2608, 2615, 2627, 2708, 2710, 2714, 2733, 2736, 2906, 2912, 2925, 3065, 3216, 3244, 3301, 3316, 3406, 3413, 3501, 4051, 4105, 4401

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1402, 1602, 1610, 1701, 1709, 2222, 2301, 2322, 2329, 2410, 2415, 2522, 2616, 2708, 2714, 2733, 2912, 2925, 3244, 3301, 4045

Ultrasonic Equipment

1402, 1926, 2222, 2314, 2616, 2920, 3819, 3839, 4007, 4045, 4129, 4235

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4013, 4015, 4017, 4025, 4052, 4054, 4103, 4116, 4121, 4128, 4201, 4203, 4215, 4242, 4308, 4322, 4330, 4417

I.R.E. EDITOR

Ferdinand Hamburger Jr.

I.R.E. SECRETARY

Haraden Pratt

NOT AT THE COLISEUM . . .

Each year there are more manufacturers desiring exhibit space than there are booths available. Many of those unable to exhibit in the show set up their displays in hotel suites near the show. This year the following companies have reported their IRE location as:

COMPANY	PRODUCT SUMMARY	LOCATION IN NEW YORK CITY	PERSONNEL IN ATTENDANCE
Clifton Precision Products, Marple at Broadway, Clifton Heights, Pa.	Gear trains, servo motors, etc.	Barbizon-Plaza Hotel, Studio K (6 to 10 pm)	T. W. Shoop, V. P. G. Galvin H. T. Larkin A. Mohan J. Cliggett W. Runiewicz
DIT-M-CO Electronics Div., 911 Broadway, Kansas City 5, Mo.	Automatic logic circuit tester, automatic ac-dc circuit analyzer, electro-mechanical system analyzers	Henry Hudson Hotel, Rooms 608, 610, 612	
Analab Instrument Corp., 30 Canfield Road, Cedar Grove, N. J.		Mayflower Hotel, 61st Street and Central Park West	
Clarostat Mfg. Co., Dover, N. H.	Potentiometers, resistors	Essex House, Central Park South	F. J. Chamberlain, V. P. J. Dillon J. F. Smith W. Mucher
Jettron 56 Route 10, Hanover, N. J.	Sockets, connectors, cable assemblies, micromodular and special components, transistor sockets	Savoy Hilton Hotel, 5th Ave. & 58th St.	K. Johnson, Pres. E. A. Dietz W. P. Hemmel H. Curran J. M. Schill
Princeton Electronics Corp., P. O. Box 127, 178 Alexander St., Princeton, N. J.	Silicon glass diodes, computer diodes, high voltage diodes	St. Moritz Hotel, Central Park South	Dr. W. P. Lynas, Pres. R. C. Lancaster, V. P. S. Diaz
NJE Corp., Kenilworth, N. J.	Power supplies	Park Sheraton	R. Forbes H. J. Lutz S. Glassman M. Coben M. Valmberg M. Kaufman
Nuclear Corp. of America, Denville ,N. J.	Instrumentation	Henry Hudson Hotel	W. H. Bailey D. Silverstein L. Eisenstein

Circulating Ball Slide

The heavy-duty circulating ball slide will support 1000 lb. and allow ease of sliding action. Two circulating ball channels extend around the top and bottom of the slide. Chassis-Trak, Inc. BOOTH 4001

Circle 305 on Inquiry Card

Magnetic Tape

This magnetic recording tape is designed for audio, video and instrumentation uses. It features high freq. response, low noise level, and high sensitivity. Burgess Battery Co. BOOTH 2709.

Circle 308 on Inquiry Card

DC Amplifiers

Models 3A and 3AM are high gain dc operational amplifiers for analog computing systems. The 3AM provides a 5 times reduction in quiescent current requirements. General Computers, Inc. BOOTH 3937.

Circle 310 on Inquiry Card

See these Products at IRE

Frequency Calibrator

The simultaneous 11 point telemetering frequency calibrator, Model TMC-411E, features all-electronic operation and 0.002% frequency accuracy. Panoramic Radio Products, Inc. BOOTH 3402.

Circle 306 on Inquiry Card

DC Power Supply

Rated 0-36 v. at 5 a, this regulated dc power supply eliminates transistor-ruining transients. Model MTRO36-5A is designed for laboratory testing of transistorized loads. Perkin Electronics Corp. BOOTH 1416.

Circle 311 on Inquiry Card

Band-Pass Filter

The new Band-Pass Filter is capable of handling a peak transmitted power of 3 to 5 megawatts with an average power of 15 kw. Insertion loss is 0.15 db max. Frequency Standards. BOOTH 3844.

Circle 307 on Inquiry Card

Micro-Module Circuitry

A series of digital and logic circuits is available, including binary counters, triggers, multivibrators, gates, inverters and flip-flops. Size is 7/16 x 8/16 x 9/16 in. Walkirt Co. BOOTH 1824.

Circle 309 on Inquiry Card

Flame Retardant Plastic

Flame retardant laminated plastic, Grade FR-2, has all of the electrical properties of paper-base XXXP, but may be punched at room temperature and is self-extinguishing. Synthane Corp. BOOTH 4421.

Circle 312 on Inquiry Card

High Megohm Bridge

Model 801 Bridge is self-contained with a built-in battery power supply, electrometer amplifier galvanometer and 9 plug-in ratio arms. Range covers 1000 to 1.1 x 10^{14} ohms. Mid-Eastern Electronics, Inc. BOOTH 3009.

Circle 194 on Inquiry Card

Transistor Tester

The semiconductor reliability test system provides repetitive test data from lots of transistors and/or diodes. It automatically programs, tests, evaluates and records test data. Optimized Devices, Inc. BOOTH 3060.

Circle 197 on Inquiry Card

Ceramic Capacitors

Named "Wee Con," this series of dipped phenolic coated, subminiature, plate ceramic capacitors are well suited for printed circuit boards. Capacity is from 10pf to 0.036μf, at 200 wvdc. Erie Resistor Corp. BOOTH 3210.

Circle 199 on Inquiry Card

See these Products at IRE

Digital Phase Meter

Type 524 gives direct reading of phase angle between two alternating voltages. Fluctuation of signal amplitude or continuous variation of signal frequency does not affect the accuracy. AD-YU Electronics Lab., Inc. BOOTH 3909.

Circle 195 on Inquiry Card

Mil-Spec Blowers

A complete line of Mil-Spec rack-mounted centrifugal blowers is available. Airflow ranges from 150 to 800 cfm. Motors are 50/60 CPS and 400 CPS, 1 and 3ϕ, 115-230 v. and 440 v. McLean Engineering Labs. BOOTH 1624.

Circle 200 on Inquiry Card

Bonded Shield CRT

The 5 in. industrial "Bonded Shield" cathode ray tube, Type SC-3076, features a permanent built-in reference scale on an integral reflection-free safety panel. Sylvania Electric Products, Inc. BOOTH 2322.

Circle 196 on Inquiry Card

Automatic Wire Stripper

Quick-change devices reduce set-up time in the new Model 810A Automatic Wire Stripper. Designed principally for single conductor wire, it will also strip coaxial cable. Eubanks Engineering Co. BOOTH 4036.

Circle 198 on Inquiry Card

Coil Winding Machine

The Model S Toroidal Coil Winding Machine has completely transistorized "in-line digital readout" counter. It features many interchangeable sized heads making it versatile. Universal Mfg. Co., Inc. BOOTH 4004.

Circle 201 on Inquiry Card

Multistage Blower

This blower has been designed for high back pressure applications. Specs are: 3.3 in. dia.; 200 vac. 400 CPS, 3 phase. Minimum speed in free air is 20,500 RPM. Globe Industries, Inc. BOOTH 2827.

Circle 202 on Inquiry Card

Battery Service Unit

Model RAC-60CDT services the high performance silver zinc type battery. Unit's capabilities are precision charging, discharging and testing. Republic Aviation Corp. BOOTH 3010.

Circle 203 on Inquiry Card

Audio Oscillator

An a-f sweeping oscillator and frequency marker covers from 20 CPS to 200 KC. It provides a swept freq. display of detected envelope and sharp pulse markers. Kay Electric Co. BOOTH 3512.

Circle 204 on Inquiry Card

Pancake Resolver

Precision pancake resolver has a functional accuracy of 10 sec. of arc. It is designed for stable platform applications and permits direct mounting to gimbal structure. Reeves Instrument Corp. BOOTH 1305.

Circle 205 on Inquiry Card

Solid State Alarm

The solid state alarm unit is for monitoring over-limit conditions from low level inputs such as thermocouples, strain gages, resistance thermometers and thermistors. San Diego Scientific Corp. BOOTH 3021.

Circle 206 on Inquiry Card

Compensating Capacitor

The T-C Trim provides compensation for variations caused by temp. changes. Model VCJ463 can be tuned by an invar piston. Capacity is fixed. JFD Electronics Corp. BOOTH 1622.

Circle 207 on Inquiry Card

Heat Sink

Power transistor junction temp. is controlled by this heat sink. It is 1 55/64 in. sq. x 1 13/64 in. high. Sink is anodized cast aluminum alloy with insulated aluminum base plate. Augat Bros., Inc. BOOTH 1227.

Circle 208 on Inquiry Card

Connectors

Plug and socket connectors are available in a variety of contact sizes from 4 to 38. All dip solder to a printed circuit board at right angle to the plug and receptacle contacts. DeJur-Amsco Corp. BOOTH 2307.

Circle 209 on Inquiry Card

Speed Reducers

A new line of precision speed reducers, in ⅛, 3/16 and ¼ in. shaft sizes is designed for torques up to 350 oz.-in., in ratios from 1:1 to 360:1. PIC Design Corp. BOOTH 1517.

Circle 210 on Inquiry Card

Impedance Plotter

The AMCI Type 14 Automatic Impedance Plotter covers the 0.1-1700 MC range. Self-contained except for an external oscillator, it presents continuous impedance information. Alford Mfg. Co. BOOTH 1718.

Circle 271 on Inquiry Card

Voltage Tunable BWO

Backward wave oscillator QKB924 is for applications where frequency stability is essential. It has permanent magnet beam focusing and range is 2700 to 3200 MC. Raytheon Co. BOOTH 4045.

Circle 274 on Inquiry Card

Precision Pots

The 7800 series of precision potentiometers is for ac excited circuits. These units have high input impedance and low output impedance. Helipot Div., Beckman Instruments, Inc. BOOTH 1201.

Circle 276 on Inquiry Card

Encoder

A 12 tone, 4 pulse transistorized encoder, Model ET 12-4, enables operator to select up to 11,000 possible

4 letter code groups. Security Devices Lab., Electronics Div. BOOTH 1508.

Circle 272 on Inquiry Card

See these Products at IRE

Compact Power Supplies

Model 170, 3 x 4 x 5 in., has an output current of 0.25 a. The unit has a voltage output variable from

10 to 32 v. with regulation of 3 mv. Ripple is less than 250 μv, RMS. Quan-Tech Labs., Inc. BOOTH 3034.

Circle 277 on Inquiry Card

Recorder/Reproducer

The CM-100 series of video band recorder/reproducers can handle freq. to 1.2 MC when the magnetic tape is run at 120 ips. The 7-track CM-100 can be converted to 14 tracks. Mincom Div., Minnesota Mining & Mfg. Co. BOOTH 3243.

Circle 273 on Inquiry Card

Microwave Absorber

The NEO-T absorber for airborne and missile use is available for standard radar and special frequencies. It features temp. range of −70° to 270°F, easier handling and greater strength. McMillan Industrial Corp. BOOTH 3223.

Circle 275 on Inquiry Card

Printed Board Connector

The POS-E-KON connects flat conductor cable to printed circuit boards or to flexible etched circuitry. It produces a direct conductor-to-conductor contact without solder. Thomas & Betts Co., Inc. BOOTH 1921.

Circle 278 on Inquiry Card

Film and Paper Processor

The whiteprinter processes sensitive films and office paper work. The Junior Ozamatic is a table-top copier with a 13 in. throat. Ozalid Div., General Aniline and Film Corp. BOOTH 4106.

Circle 279 on Inquiry Card

Indicator Lights

"Data Cap" Series 250 assemblies offer removable cap (with legend) and replaceable cartridge. They use T-1¾ incandescent lamps ranging from 1.35 v. to 28 v. Dialight Corp. BOOTH 2829.

Circle 282 on Inquiry Card

Resistors

A new line of reliable high resistance resistors known as the HR 1000 series use the PyroSeal technique and a new type of coating to assure long term stability. Pyrofilm Resistor Co., Inc. BOOTH 2104.

Circle 285 on Inquiry Card

Tantalum Capacitors

Type TAD is a miniature dry electrolyte tantalum capacitor that meets Mil-C-26655A. Operating temp. range

is from −80°C to +125°C, with low leakage current and dissipation factor. Pyramid Electric Co. BOOTH 1212.

Circle 280 on Inquiry Card

AC Power Supply

Precision 25 va ac power supply meets all military specs for ground support equipment. Unit features

circuit breaker overload protection. Output voltage is variable. Industrial Test Equipment Co. BOOTH 3613.

Circle 283 on Inquiry Card

Synchros

Improved synchro design permits operation of size 8, 10 and 11 synchros and resolvers in the extreme

environments encountered in missiles and high performance aircraft. Kearfott Div., General Precision, Inc. BOOTH 1509.

Circle 286 on Inquiry Card

Klystron Power Supply

The 809-A Klystron Power Supply is designed to operate low power klystrons. It contains a regulated 250 to 600 v. beam voltage, and 0 to 900 v. reflector voltage. PRD Electronics, Inc. BOOTH 3602.

Circle 281 on Inquiry Card

Mobile Data System

A mobile low-cost data handling system will eliminate the need for complex installations. RADAC I. was developed for the processing, defense and manufacturing industries. Radiation Inc. BOOTH 3001.

Circle 284 on Inquiry Card

Recorder/Reproducer

The 460 Series recorder/reproducer can be changed from reel to loop operation without rehandling the tape or making any changes other than operation of the controls. Sangamo Electric Co. BOOTH 2205.

Circle 287 on Inquiry Card

Wide Band AM Generator

AM Generator Model 144H tunes from 10 KC to 72 MC. Features include a precisely calibrated fine freq. control, automatic level control and output voltage accuracy to 0.5 db. Marconi Instruments. BOOTH 3702.

Circle 288 on Inquiry Card

DC Operational Amplifier

The Model 505A operates directly from a 115 v. 60 CPS, and features response to 5 KC and open loop gain of 5000. It fits a standard 19 in. rack. Micro Gee Products, Inc. BOOTH 3842.

Circle 291 on Inquiry Card

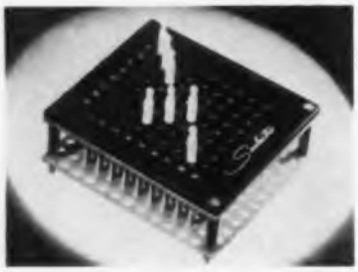
Probe Thermistor

Mating of the plain bead and glass probe thermistors has produced a hybrid thermistor only 0.060 in. in dia. by ¼ in. long. Dissipation constant is 0.6 mw./°. Victory Engineering Corp. BOOTH 1423.

Circle 293 on Inquiry Card

Circuit Board

The Sealectoboard provides a means of switching and component interposi-



tioning at a simple push of a pin at the desired point in the circuit. Sealectro Corp. BOOTH 2919.

Circle 289 on Inquiry Card

See these Products at IRE

Molded Screws

Delrin screws possess high electrical insulation properties and tensile

strength, and rigidity and resistance to deformation and creep. Gries Reproducer Corp. BOOTH 4030.

Circle 294 on Inquiry Card

Crimp-Type Contact

Varilok is a crimp-type contact which will accept all wire sizes from 18 ga. to 30 ga. It offers positive locking of contacts when inserted into connector castings. Elco Corp. BOOTH 1420.

Circle 290 on Inquiry Card

Floating Zone Unit

The Model HCP floating zone unit and its associated controls, including power control for operation of generator, is designed for production and lab. purposes. Lepel High Frequency Labs., Inc. BOOTH 4213.

Circle 292 on Inquiry Card

Coil Turns Analyzer

The instrument checks the number of turns on a variety of coils. Model 165 Coil Turns Analyzer compares an internal universal standard against a production coil product. DeLuxe Coils, Inc. BOOTH 2933.

Circle 295 on Inquiry Card

Terminal Boards

The military terminal board line offers every type designation according to MIL-T-16784B, made according to BUSHIPS 9000-S6505-73214 drawings with their latest revisions, BUORD S64101. Kulka Electric Corp. BOOTH 2900.

Circle 296 on Inquiry Card

Flat Attenuator

Model 4664-20A is an S-band flat, continuously variable, attenuator for the 2.5-4 KMC band. It can be remotely controlled and is suited for missile, airborne, and lab applications. Antenna & Radome Research Assoc. BOOTH 3015.

Circle 299 on Inquiry Card

Alumina Ceramics

These subminiature ceramic forms of alumina oxide, possess high dielectric strength at high freqs. and elevated temps. They are for use in semiconductor assemblies. Diamonite Products Mfg. Co. BOOTH 4105.

Circle 302 on Inquiry Card

Semiconductor Mounts

Mounts are made by cold forming the bases, which double as heat-sink and electrically conducting mounts,

from either oxygen-free copper or from a zirconium copper alloy. Standard Pressed Steel Co. BOOTH 4528.

Circle 297 on Inquiry Card

Metal-to-Metal Adhesive

A new "dry" adhesive, Metlbond 408, is for metal-to-metal bonding applications. It meets Mil-A-005090D

and Type I. Class II under Mil-A-25463. Narmco Materials Div., Telecomputing Corp. BOOTH 2126.

Circle 300 on Inquiry Card

Switch Circuit Tester

Navcor Experimenter, Model 1320, is an all-semiconductor general purpose laboratory instrument for de-

signing, testing, and demonstrating pnp transistor switching. Navigation Computer Corp. BOOTH 3232.

Circle 303 on Inquiry Card

Microwave Antennas

The TACO microwave antenna line includes freq. ranges from 806 MC to 12.7 KMC. Reflector sizes range from 2 to 12 ft. Line offers a choice of spun or mesh reflectors. Technical Appliance Corp. BOOTH 1207.

Circle 298 on Inquiry Card

Stroboscope

The Model 510-AL Stroboscope provides a direct and accurate measurement of speeds from 60 to 15,000 RPM. With harmonics, speed over 15,000 RPM can be measured. Herman H. Sticht Co., Inc. BOOTH 3236.

Circle 301 on Inquiry Card

Vacuum Coating Unit

This 6 in. vacuum coating unit is designed for laboratory and production uses. Model HVS 1006 consists of 18 x 30 in. bell jar, base plate with feed throughs and a 6 in. high vacuum system. International Pump & Machine Works. BOOTH 4219.

Circle 304 on Inquiry Card

ADVANCES IN COMPONENT DESIGNS

35.1. General Theory of a Glass of UHF Resonators

Joel L. Ekstrom, Westinghouse Electronics Div.

A general theory of UHF resonators composed of a cascade connection of a shorted, high-impedance line and an open-circuited low-impedance line is presented from the point of view of the poles and zeroes of the driving point immittances at the shorted end and the junction point. It is shown that the configuration studied is a general one from which re-entrant and quarter-wave resonators may be derived as special cases. The Q factor of such resonators is considered, and it is shown that conventional resonators do not have as large a Q per unit volume merit factor as is possible with proper capacitive loading. The coupling problem is considered, and practical experimental results at 450 Mc are given.

SPACE ELECTRONS

28.1. The Effects of Van Allen Belt Radiation on Material

Robert S. Shane,, Light Military Electronics Dept., GE Co.

The paper is a discussion of the interaction of the Van Allen Belt with certain components and materials. This radiation belt, located between latitudes 50°N and 50°S (auroral zones) and roughly between 1000 statute miles and 3500 statute miles above the equator, has a radiation intensity which is about one order of magnitude more than the area above or below it.

An estimate of the effects of Van Allen radiation on various materials and components is included as an extrapolation of data secured from nuclear fission fragment bombardment and gamma irradiation. The estimated effects of high-energy radiation on several specific components and materials are discussed, and recommendations are made for an additional testing and evaluation program.

ANALOG AND HYBRID TECHNIQUES

40.2. Theory and Practice of Hall Effect Multipliers

G. S. Glinski and J. P. Landolt, Univ. of Ottawa.

The theoretical part of the paper is concerned with the systematic analysis of errors arising when the physical principles of Hall effect are translated into engineering design of a Hall multiplier suitable for electronic analog computer applications.

The practical part of the paper describes the development prototype of a completely transistorized self-contained multiplier, based on Hall effect and utilizing the commercially available components.

SHUTTLE SERVICE

International Rectifier Corp. is again providing free shuttle bus service between the Coliseum area and convention headquarters.

ELECTRON DEVICES

8.3. Recent Advances in Gallium Arsenide Transistors

M. E. Jones and E. C. Wurst, Jr., Texas Instruments, Inc.

Techniques for constructing an *n-p-n* alloy diffused mesa gallium arsenide transistor will be presented. The parameters achieved to date will be discussed, with the emphasis on the application of this device as a high-speed switching transistor. These parameters will include the output characteristics, power gain, current gain and other h parameters, static characteristics, HF characteristics, and switching characteristics.

MICROWAVE DEVICES

23.2. The Maser Amplifier as a Practical Components Microwave

F. E. Goodwin, J. E. Kiefer and G. E. Moss, Hughes Res. Labs.

Microwave master amplifiers, with typical noise temperatures near 10°K, can offer substantially improved performance in a variety of systems, *e.g.*, satellite communications, long-range radar. Until recently, the complexity and bulkiness of maser amplifiers has seriously restricted their usefulness. This paper describes the results of a program to develop the maser as a rugged practical component. Through unconventional packaging, single-port and traveling-wave X-band masers, together with their magnets, circulators and isolators, have been developed to fit within a miniature dewar less than 14 inches long, weighing less than 12 pounds. These masers will operate 20 hours in any position on one charge of helium. The cryogenic technology is being further refined to allow the use of a self-contained miniature helium refrigerator weighing 14 pounds.

INDUSTRIAL ELECTRONIC APPLICATIONS

18.2. Computers for Industrial Control

R. W. Sonnenfeldt, RCA

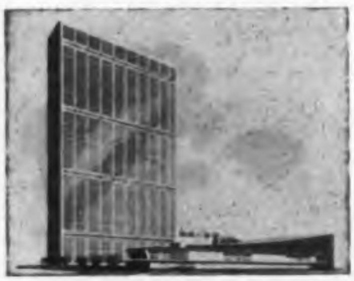
General-purpose digital computers are now making their appearance in industrial plants. For the most part, they do not merely mechanize tasks previously handled by humans, but make possible an entirely new era in control of complicated processes. Industrial control computers are now being designed for such application. This paper discusses in basic terms the characteristics and performance features of industrial computers and how they can increase process profitability.

Computer speed, memory capacity, kind of memory, mechanical design, programming features, reliability and other specifications are related to requirements of industrial control. A typical application analysis is explained through use of high-speed tin plate line as an illustrative example. Several suggestions are offered as an aim in the writing of better purchase specifications.

Something For the Ladies

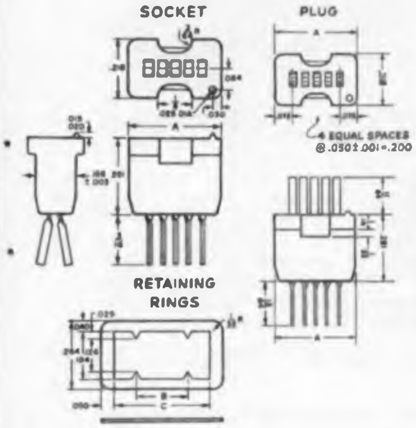
Ladies may register free in the Ladies Headquarters at the Waldorf Astoria Hotel (Regency Suite). The registration badge is also good for admission to the Show at the Coliseum.

Monday 9:30 am 1:30-4:30 pm	Registration and "Get Together" Coffee Hour. Bus tour through Lower New York and Old Chinatown; Visit to the National Design Center.
Tuesday 8:45 am to 3:30 pm	Fashion Show Breakfast at Altman's Dept. Store; A guided tour of the United Nations; Luncheon at "Luau's 400."
Wednesday 11:30 am to 1:30 pm	Luncheon Fashion Show — Empire Room, the Waldorf-Astoria.
2:00 pm	Matinee—"Irma La Douce."



Among the field trips will be a guided tour of the United Nations

NEW FROM CINCH.



Low-Cost
SUBMINIATURE PLUGS and SOCKETS
for low-current circuits

ACTUAL
SIZE

Booth #2535
IRE Show

for interconnecting low current circuits where miniaturization is important . . . electrical ratings conform to EIA standards

DIMENSIONS

No. of Contacts	A	B	C
3	.350 ± .003	.194	.360
4	.350 ± .003	.194	.360
5	.350 ± .003	.194	.360
6	.400 ± .003	.244	.410
7	.450 ± .003	.294	.460

NOMENCLATURE

PLUG	RECEPTACLE	RETAINING RINGS
3 contacts 204-92-03-047	131-13-12-095	441-00-11-082(105)
4 contacts 204-92-04-048	131-14-12-096	441-00-11-082(105)
5 contacts 204-92-05-049	131-15-12-097	441-00-11-082(105)
6 contacts 204-92-06-050	131-16-12-098	441-00-11-083(105)
7 contacts 204-92-07-046	131-17-12-099	441-00-11-084(105)

Molded of low-loss, mica filled phenolic insulation (type MFE per MIL-4-14E) with beryllium copper contacts, .00003 Min. Sel-rex gold plated. Available also, with glass-filled Diallyl Phthalate insulation (type SDG per MIL-M-18794).

May be swaged into metal chassis, cemented into Bakelite chassis, mounted with retaining ring or potted.

ELECTRICAL RATINGS

Maximum Rated Voltage AC-RMS
Contact to contact .... 300 volts
Contact to ground .... 500 volts
Capacitance
Measured from one contact to all other conducting parts ... 1.5 m.m.f. (Max.)

Insulation loss factor
Maximum .... 0.50 Dry
Insulation Resistance
Measured from one contact to all other conducting parts .... 50,000 Megohms (Min.)
Contact Resistance 0.50 Ohms (Max.)
Safe Operating Temperature
Maximum .... 80 C

Initial Insertion and Extraction Force
3 contact (Max.) .... 6 lbs.
4 contact (Max.) .... 7 lbs.
5 contact (Max.) .... 8 lbs.
6 contact (Max.) .... 9 lbs.
7 contact (Max.) .... 10 lbs.
Individual Contact Retension Force
Minimum Gauge Weight .... ½ ounce

WRITE FOR FULL INFORMATION TODAY! Complete engineering data and detailed specifications on this line of low cost plugs and sockets is available. Yours for the asking, or phone NE 2-2000.

Circle 67 on Inquiry Card

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Division of United-Carr Fastener Corporation, Boston, Massachusetts

ELECTRONIC DOT ASSEMBLIES

Centrally located plants at Chicago, Illinois; Shelbyville, Indiana; City of Industry, California, and St. Louis, Missouri

UHF Oscillator

The Model 400 UHF electronically swept oscillator covers the frequency range of 500 to 1100 MC. It is capable of amplitude, pulse or frequency modulation. Menlo Park Engineering. BOOTH 3843.

Circle 169 on Inquiry Card

Interval Counter

Model 5275A Time Interval Counter provides precise digital measurements of very short time intervals between events. Range is 10 nanoseconds to 0.1 sec. Hewlett-Packard Co. BOOTH 3205.

Circle 172 on Inquiry Card

Twin Fans

The Twinpax offers large air delivery, directed air flow, low noise level, min. vertical space requirements, and high efficiency filtering. It uses 2 saucer fans in parallel. Rotron Mfg. Co., Inc. BOOTH 2822.

Circle 175 on Inquiry Card

Illuminated Switch

A Multi-Switch, Series 21000, is for use in computers, telephone apparatus, data systems and ground to

air support equipment. Buttons are side and front illuminated. Switchcraft, Inc. BOOTH 2825.

Circle 170 on Inquiry Card

See these Products at IRE

Decade Voltmeter

The D-930-A precision RMS voltmeter has a range of 1 mv. to 300 v. and a frequency range of 5 CPS to 100

KC. Reading accuracy over the whole range is 0.025%. Muirhead Instruments Inc. BOOTH 3230.

Circle 176 on Inquiry Card

Flexible Encapsulant

Silicon resin material permits visual inspection of circuits and components. Sylgard 182 possesses high dielectric properties, good moisture resistance, flexibility and toughness. Dow Corning Corp. BOOTH 4310.

Circle 171 on Inquiry Card

Soldering Machine

Semi-automated or completely automated soldering is featured in the Universal Soldering Machine, SD-4 Model 1. It can accommodate a variety of units using "Solderforms." Kester Solder Co. BOOTH 4221.

Circle 174 on Inquiry Card

Oscilloscope

The Model IO-30 laboratory 5 in. oscilloscope features: wide band amplifiers; push-pull output; positive trace position controls; good linearity and lock-in characteristics. Heath Co. BOOTH 1801.

Circle 177 on Inquiry Card

PROGRESS IN MICROWAVES

NEW X-BAND TUBES IMPROVE MICROWAVE RECEIVER PERFORMANCE

for Radar, Communications, ECM, Radiometry, Radio Astronomy Systems

The latest advances in G.E.'s continuing program for providing complete microwave coverage in a wide variety of tubes from L to K band are the traveling-wave tubes and voltage-tunable magnetron shown on the right.

OUTSTANDING LOW-NOISE, HIGH-GAIN PERFORMANCE

TWT types Z-3103 and Z-5259 are particularly suited for use in X-band receiver systems as broad-band amplifiers. The low-noise characteristics, ranging from 7 to 10 db max., coupled with a uniform high minimum gain of 25 db, make possible new levels of performance in detection and amplification of weak signals.

The low saturation power of both tubes protects mixers and other components from overload damage. Permanent magnet focusing eliminates need for additional power supply equipment in the circuit, including weighty, space-consuming solenoids.

Because of their inherent broad-band operation, the tubes require no tuning over their respective ranges, thereby permitting a significant degree of flexibility in frequency selection.

Compact and rugged, these metal-ceramic tubes are completely packaged with r-f and d-c connectors. The tubes illustrated withstand stringent specifications for shock (50 G's) and vibration (15 G's) in critical military applications.

VTM'S PROVIDE LINEAR TUNING

Newest addition to a growing line of G-E Voltage-tunable Magnetrons is the Z-5429. This tube's broad-band frequency range suits its use as a local oscillator in radar receiver circuits. A complete r-f power package, the tube gives a minimum of one milliwatt of linearly voltage-tuned power over the entire X-band range, without mechanical adjustment.

FREQUENCY RANGES AVAILABLE* TO DATE

Band	VTM (Kmc)	TWT (Kmc)
K	—	35.0–40.0 14.0–18.0
X	8.5–11.0	7.0–12.0
C	—	4.0–8.0
S	2.2–3.85	—
L	1.0–2.3	—

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Circle 68 on Inquiry Card

NEW TRAVELING-WAVE TUBES

Z-3103 7.0-11.0 Kmc, 5 mw Output, 10 db Max. Noise Figure

Z-5259 8.0-12.0 Kmc, 5 mw Output, 10 db Max. Noise Figure

NEW VOLTAGE-TUNABLE MAGNETRON

Z-5429 8.5-11.0 Kmc, 1 mw Output (min.), 9.0 mc v Tuning Rate

G-E POWER TUBE DEPARTMENT PRODUCTS ALSO INCLUDE:

- Ignitrons
- Hydrogen thyratrons
- Magnetrons
- Metal-ceramic tetrodes
- High-power duplexers
- High-power waveguide filters
- Klystrons
- Thermionic converters

General Instrument Silicon Rectifiers

UP TO 25 AMPS...

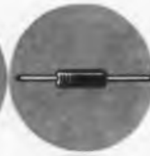
...PIV's—50v to 30,000v

225
Top Hats
from 50 to
1,500 PIV

1619

129
$\frac{3}{8}$" Medium
Power Studs
... from 50 to
1,000 PIV

7 JAN
Top Hats
& $\frac{3}{8}$" Studs
... from 100 to
600 PIV



52
Diode/Rectifiers
... from 50 to
600 PIV

GI SILICON

110
$\frac{3}{8}$" Hi Power
Studs
... from 50 to
600 PIV*

RECTIFIER TYPES

47
Hi Power
Studs
from 50 to
600 PIV*

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Insulated
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600 PIV

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Hi Voltage
Cartridges
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600 to
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New 25-Amp
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600 PIV

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Electronic Tachometer

The self-contained, sensitive unit accurately measures the speed of any rotating, reciprocating or oscillating shaft or mechanism. It employs a magnetic pickup. Airpax Electronics Inc. BOOTH 2306.

Circle 185 on Inquiry Card

RF Shielding Compound

Highly conductive caulking paste Eccoshield VX properly applied to conduit pipe threads or enclosure seams, gives insertion loss of 100 db from 200 KC thru 10 KMC. Emerson & Cuming, Inc. BOOTH 3828.

Circle 188 on Inquiry Card

Torque Calibrator

The Model 6500-T2 Torque Calibrator has three scales which provide a measuring range of 0.5 to 40.0 oz.-in. at an accuracy of $\pm 0.2\%$ of indicated reading. Waters Mfg. Co., Inc. BOOTH 1233.

Circle 191 on Inquiry Card

See these Products at IRE

Command Receiver

For missile flight guidance and safety operations, the Model 2621 tunes to a fixed freq. in the 406-549

MC range. Sensitivity is 7 μv. A matching decoder is available. RS Electronics Corp. BOOTH 2338.

Circle 186 on Inquiry Card

Wide-Screen Film Viewer

The 16mm Film Viewer features a motorized film drive, a remote operator control, and data magnified

20 times on a large viewscreen. Distortion is not more than $\pm 1\%$. Geotech, Inc. BOOTH 3239.

Circle 192 on Inquiry Card

Building Block Kit

Electronic test, measurement, control or communications equipment can be designed with kit #40. It can be moved intact and set up anywhere for operation and easy maintenance. Alden Products Co. BOOTH 1613.

Circle 187 on Inquiry Card

Conductivity Controller

Model RGC-11 is for on-off control action based on a change of solution conductivity. It uses magnetic amplification, avoiding tube aging, tube replacement, and sensitive relays. Industrial Instruments, Inc. BOOTH 3225.

Circle 190 on Inquiry Card

Calibration Standard

Calibration of dc voltmeters and ammeters to $\pm 0.05\%$ accuracy can be accomplished quickly using the Model 1900 dc semiautomatic instrument calibration standard. Radio Frequency Labs., Inc. BOOTH 3115.

Circle 193 on Inquiry Card

Meter Relay

Model 1073 Mag-Trak relay provides positive reliable contact even when contact points have become contaminated in use. Magnet "pull-in" action closes contact points. Daystrom Inc., Weston Instruments Div. BOOTH 1708.

Circle 313 on Inquiry Card

Traveling-Wave Tubes

Eight new TWTs are available in the 0.5 to 20 KMC range. Depending on tube type, focusing is accomplished by one of 3 methods: solenoid, electrostatically or periodic permanent magnet. Huggins Labs., Inc. BOOTH 2925.

Circle 316 on Inquiry Card

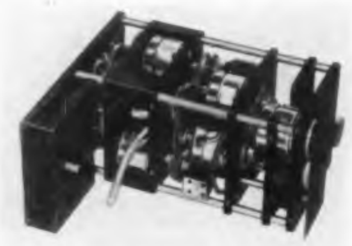
TWT Amplifier

The Model T601 covers a range of 2-15 KMC. It features: TWT tubes using permanent magnets, and metered internal power supplies with meters for beam current, beam voltage and grid voltage. AEL, Inc. BOOTH 3053.

Circle 318 on Inquiry Card

Speed Transmissions

Multiple speed transmissions feature instantaneous changes between predetermined speed ratios, manual



or automatic selection of speed ratios, and remote control of speed changes. Autotronics Inc. BOOTH 1111.

Circle 314 on Inquiry Card

See these Products at IRE

Panel Meter

The YEW Prince has increased readability with a 40% longer scale. The coremagnet self-shielded meter

requires no adjustment when mounted on magnetic or nonmagnetic panels. Yokogawa Electric Works, Inc. BOOTH 3940.

Circle 319 on Inquiry Card

Transistor Aging Oven

High temp. oven is for aging transistors and other electronic components at 350°C under inert gas atmospheres. The 1290 oven series has capacities to 30 cu. ft. The Electric Hotpack Co., Inc. BOOTH 3846.

Circle 315 on Inquiry Card

Logic Circuit Device

With on-off control at a single base input, binary functions can be accomplished with only one active element per stage. The 2N892 Trigistor Series combines ratings to 200 v. with high sensitivity. Solid State Products, Inc. BOOTH 1920.

Circle 317 on Inquiry Card

Electrometers

Model 620 battery-operated electrometer offers 31 ranges full scale current covering from 10^{-11} to 10^{-6} a. It can be used for a dc preamplifier. Keithley Instruments, Inc. BOOTH 3920.

Circle 320 on Inquiry Card

ENGINEERING NEWS - #14

FULL LINE OF MINIATURE SNAP-ACTION SWITCHES

CHECKED *Gun*	ENGR. *Dut*	CONTROL SWITCH DIVISION


B7001


B7021


T2106


T2108


T2150


T2151


T3103


T3106


T4203


T4205


T-3

SPECIFICATIONS

Model No.	Amps @ 28 VDC or 120 VAC Resist	Induc.	Circuitry	Approx. Weight Lbs.
B7001	7	4	S.P.N.O.	.005
B7021	7	4	S.P.N.O.	.010
T2106	10	5	2 Cir.	.010
T2108	10	5	2 Cir.	.016
T2150	3	1	D.P.D.T.	.010
T2151	3	1	D.P.D.T.	.016
T3103	5	3	S.P.D.T.	.009
T3106	5	3	S.P.D.T.	.013
T4203	1	—	S.P.D.T.	.004
T4205	1	—	S.P.D.T.	.013
T-3	7.5	2.5	S.P.D.T.	1.6 Grams

NOTE: All models above (except T-3) are available with maintained or momentary action. Self-sealing boot available for any bushing mounted model, as shown on T2150. All models available with flange or bushing type mounting. Basic switch Model T-3 is available with a wide variety of standard and special actuators.

These miniature pushbutton and toggle switches are typical examples of our complete line of miniaturized switches. Whatever your requirements for miniature hand-operated or mechanically-operated switches, we can meet your needs from our hundreds of standard and custom units. We offer an almost unlimited range of variations in configuration, actuation, ratings, operating characteristics, etc.

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Manufacturers of a full line of switches, controls and indicators for all military and commercial applications. All standard units stocked for immediate delivery by leading electronic parts Distributors.

SUBMINIATURE INDICATOR LIGHTS

Moisture-proof. Only 35/64 inch overall. 60,000 hour life with 5V lamp. Translucent lens colors. Available with MS or commercial type lamp. Three lens styles.

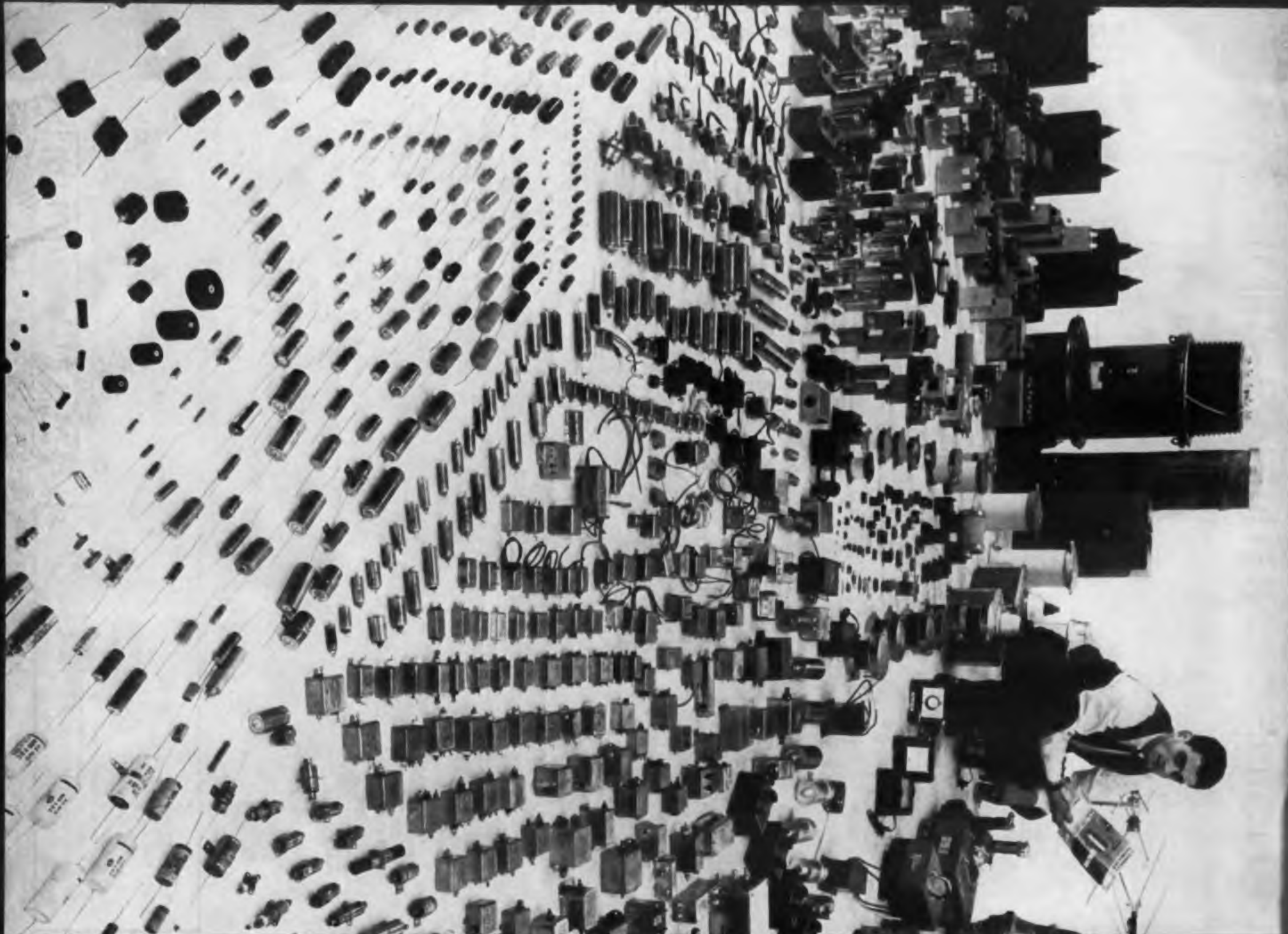

L10.000

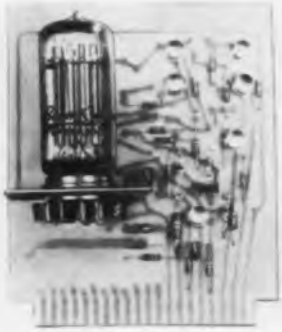

L10,100


L10,200

Circle 70 on Inquiry Card

VISIT I.R.E. SHOW March 20-23 - BOOTH 1727-1731

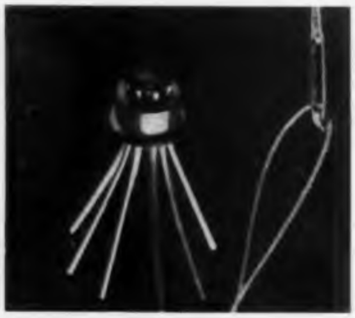




Binary Decoder

Module DC-115 uses the Beam-X switch's ability to function as a binary decoder. One Beam-X switch and 4 transistors are used to convert coded information to decimal form. Burroughs Corp., Electronic Tube Div. BOOTH 1211

Circle 321 on Inquiry Card



Flip-Flop Circuit

This solid state, integrated micrologic flip-flop circuit is designed for the logic section of a digital computer. The circuit has an operating temp. of −55° to 125°C. Fairchild Semiconductor Corp. BOOTH 2701.

Circle 324 on Inquiry Card

Microminiature Relay

These SPDT ½ x ½ x ½ in. relays are for printed circuit applications. They are rated from dry circuit to 1a. resistive; temp. −65° to +125°C; insulation resistance 1000 meg. at 125°C. Hi-G, Inc. BOOTH 2812.

Circle 326 on Inquiry Card

Readout Instrument

The new sealed case 64 character Readall readout instrument is designed to meet the environmental re-

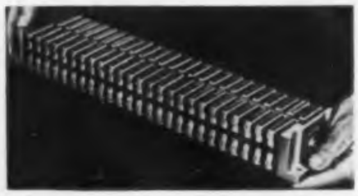
quirements of MIL-E-5422D and other specs. Union Switch & Signal. BOOTH 2122.

Circle 322 on Inquiry Card

See these Products at IRE

H. V. Rectifier Columns

These modular silicon high voltage rectifier columns can deliver up to 1000w. of power/cu. in. They are



available from 10 to 120 kv, with current capacities of 1 to 50 a. International Rectifier Corp. BOOTH 2901.

Circle 327 on Inquiry Card

Wide Band VTVM

The Model 317 voltmeter accurately measures 300 μv to 300 v. at frequencies from 10 CPS to 11 MC, and is usable from 5 CPS to 30 MC as a null detector. It has a 0-10 db scale. Ballantine Labs., Inc. BOOTH 3401. **Circle 323 on Inquiry Card**

Training Simulator

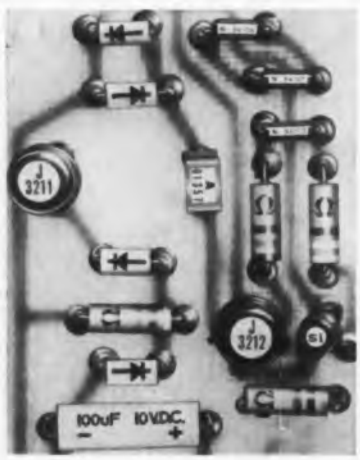
Model PS-250-L, continuous tape loop simulator, provides 50 or more channels for repetitive playback of data in training, computer, and control applications. Precision Instrument Co. BOOTH 3035.

Circle 325 on Inquiry Card

Miniature Markers

Information is accurately and legibly printed on the markers. Special materials developed for the markers stick-at-a-touch. They stay stuck at temp. up to 300°C. W. H. Brady Co. BOOTH 4101.

Circle 328 on Inquiry Card



Sign up for the Magnetics self-improvement course:

Here's free help to enable you to improve yourself—and your position as a magnetic circuit designer. You need it if:

> You don't know how to work with $E = n\frac{d\phi}{dt}$ to reduce the size of magnetic amplifier circuits. Most men who design amplifiers for cramped operation in missiles have found it invaluable.
>
> What's more, you may only vaguely remember $H = .4\pi\frac{NI}{\ell_m}$, so how can you use it to cut circuit size by two to ten times, and shorten response time proportionately?

It's quite possible that you, like many engineers, may have bypassed or been bypassed by magnetic circuit theory *as a working tool* while you were in school. Yet this science has opened frontiers of static control which makes an understanding imperative if you are to do your job—and further your career. For your sake (and for ours, too, because we manufacture and sell high permeability tape wound cores and bobbin cores which are used in amplifier circuits), we have started this course. Lesson 1, "How to Reduce Magnetic Circuit Size and Response Time," will be on its way to you immediately if you use the coupon below.

MAGNETICS inc. ®

MAGNETICS INC., DEPT. EI-86, BUTLER, PA.

Please enroll me in your free self-improvement course, and send me "How To Reduce Magnetic Circuit Size and Response Time."

name____________________

title____________________

company____________________

address____________________

VISIT OUR BOOTH 2533 AT THE IRE SHOW

IRE New Products

DC Power Supply

Model 890A is a general purpose lab type dc power supply. It is used as a highly regulated supply for vacuum tube type voltages. At 0-320 v., 0-0.6 a. load regulation is 0.007%. Harrison Labs., Inc. BOOTH 1825.

Circle 329 on Inquiry Card

Power Resistors

Four new additions to their Axiohm® power resistor line are the 2, 4, 7 and 12.5 w. resistors. With

the former 3, 5 and 10 w. units, 6 sizes are now available. Ward Leonard Electric Co. BOOTH 2231.

Circle 330 on Inquiry Card

UHF Antenna

Model 302-A Corner Reflector Antenna is designed to operate in the UHF range from 400 to 470 MC. Communication antennas for other freq. ranges are available. Sinclair Radio Labs., Inc. BOOTH 1337.

Circle 331 on Inquiry Card

Transitron

SILICON CONTROLLED RECTIFIERS

augmenting the industry's broadest line

With the addition of the 50-Amp Silicon Controlled Rectifier, Transitron now offers the industry the broadest line of Controlled Rectifiers available on the market today.

Research and development efforts during the past year have already produced an impressive array of types which include the following series:

TSW31S SERIES (TO-18 package).......operating current range to 200mA
TCR251 SERIES (TO-5 package)........operating current range to 1 amp
2N1595 SERIES (TO-5 package).........operating current range to 1 amp
2N1600 SERIES (7/16" hex package)...operating current range to 3 amps
TCR505 SERIES (7/16" hex package)...operating current range to 5 amps
TCR510 SERIES (11/16" hex package) operating current range to 10 amps
TQR520 SERIES (11/16" hex package) operating current range to 20 amps

NOW AVAILABLE — NEW 50-AMP CONTROLLED RECTIFIER

The latest addition to the Transitron line — the 50 Amp Silicon Controlled Rectifier — is a three-terminal, four-layer device designed to control very large load currents with small gate current signals. A mechanically rugged and electrically stable device, the new Controlled Rectifier is provided in the 1 1/16" hex base stud-mounted package and is hermetically sealed. Wherever high power handling ability is required, the 50-Amp Silicon Controlled Rectifier will find wide application ranging from frequency changing to welding control.

TCR550 SERIES (1 1/16" hex package)
operating current range to 50 amps

Type	Min. Peak Reverse Volt. and Min. Forward Breakover Volt. (volts)	Max. Average Forward Current at 90°C case (amps)	Package Configuration
TCR4050	400	50	1 1/16" hex
TCR3050	300	50	1 1/16" hex
TCR2050	200	50	1 1/16" hex
TCR1050	100	50	1 1/16" hex
TCR550	50	50	1 1/16" hex

Requires 50mA to turn on 50 Amp

For information on any or all of Transitron's line of Controlled Rectifiers, call or write today for Bulletin TE-1356.

WHY BIAS CONTROLLED RECTIFIERS?

Pioneering in new application techniques, Transitron application engineers have assembled information which demonstrates how "gate biasing" will improve the circuit reliability of the SCR. This informative booklet, entitled "The Biasing of Silicon Controlled Rectifiers and Switches," deals individually with *each* of Transitron's Controlled Rectifiers and Switches. It is an indispensable aid to the design engineer seeking *longer life* and *greater stability* in higher temperature applications . . . It's yours for the asking.

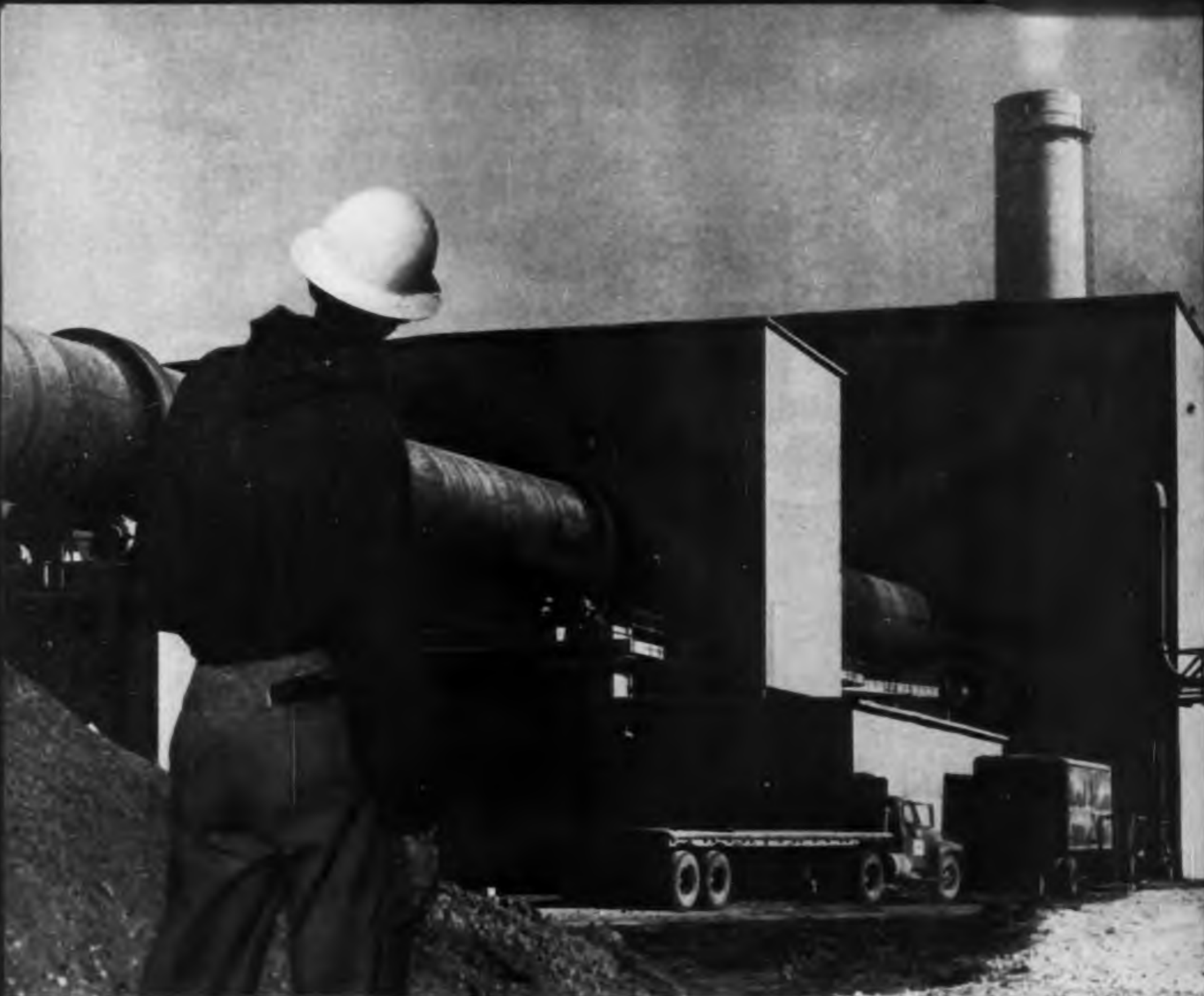
Circle 73 on Inquiry Card

MEET US AT IRE — BOOTH NOS. 1220-1224

Transitron

electronic corporation
wakefield, melrose, boston, mass.

SALES OFFICES IN PRINCIPAL CITIES THROUGHOUT THE U.S.A. AND EUROPE • CABLE ADDRESS TRELCO



AIR POLLUTION PROBLEM SOLVED. Lehigh Portland Cement plant at Mitchell, Indiana, removes more than 99% of dust and impurities from kiln exhaust gases with four Buell Electrostatic Precipitators. Westinghouse Silicon Rectifier Stacks in the precipitators have operated without a single failure since installation in February, 1960. Rectifier units (in building above) do not require maintenance, temperature control, or ozone ventilation.

COMPACT HIGH VOLTAGE INSTALLATION. Westinghouse Silicon Rectifier Stacks are housed in Buell Transformer Rectification Unit (left rear). Tank (center foreground) is the separate Immersed Distribution High Voltage Switch Unit. An alternate Buell model encloses both units in a single tank.

SPECIAL TRUCKS DISPOSE OF WASTE. Dust that is not recirculated is transferred from precipitators to special dust-tight trucks. Hoppers and other related precipitator equipment are also designed and manufactured by Buell Engineering Company, New York, N.Y.

Progress in high voltage with semiconductors:

WESTINGHOUSE SILICON RECTIFIER STACKS PROVIDE UNLIMITED FAILURE-FREE LIFE... HELP PRECIPITATORS COLLECT OVER 99% OF CEMENT DUST

Westinghouse Silicon Rectifier Stacks provide the 50 kilovolts required by Buell Electrostatic Precipitators in this Lehigh Portland Cement plant installation. In 12 months of round-the-clock operation these Westinghouse stacks have provided continuous failure-free output—with no parts replacements, no maintenance! Electrical efficiency is 95% plus! For Lehigh Portland Cement Company this means no production downtime, no maintenance costs, and lower power costs. For Buell Engineering Company, it means no service calls, complete customer satisfaction, and a product that is superior to precipitators based on mechanical, vacuum tube or selenium rectifiers.

Electrostatic precipitators impose severe current demands on their power supply. Sparking between electrodes and varying dust deposits cause momentary current surges of large magnitudes. Westinghouse research engineers have developed exclusive fail-safe circuits—the first to provide ideal voltage division under all load conditions. As a result, in electrostatic precipitators and other industrial applications, including radio broadcasting transmitters, pulse generators and radar transmitters, Westinghouse stacks have achieved an unprecedented record of more than 20,000,000 hours of failure-free operation.

For more information on electrostatic precipitators—or how Westinghouse Silicon Rectifier Stacks may provide a more reliable, low-cost source of rectified power for your needs—you are invited to call or write: **Westinghouse Electric Corp., Semiconductor Dept., Youngwood, Penna.** SC-1014

Westinghouse

20,000,000 FAILURE-FREE STACK HOURS! There is no record of a single stack failure since these devices first became available to industry. In Buell Transformer Rectification units, 16 stacks are used to provide power in the 50 kilovolt range.

Circle 74 on Inquiry Card

CO-ORDINATED ENGINEERING AT WORK. Westinghouse Sales Engineer, James Corson (left), discusses design requirements with Buell's Chief Electrical Engineer, L. L. Nagel, and V. P. of Engineering, H. C. Dohrmann. Co-ordinated engineering enables Semiconductor engineers at Youngwood to work closely with equipment manufacturers to develop new products according to parameters specified by customer engineering departments.

IRE New Products

Impulse Relay

Series 670 is designed to insure trouble free operation in excess of 1 million steps. Each momentary impulse (up to 10 steps/sec.) causes relay to reverse its cam actuated contacts. Guardian Electric Mfg. Co. BOOTH 2502.

Circle 332 on Inquiry Card

Vibration Meter

The Dial-A-Gain Double Integrating Meter reads displacement and velocity directly from an accelerom-

eter. Pre-calibrated sensitivity dial keeps instrument and output signal in calibration. Unholtz-Dickie Corp. BOOTH 3926.

Circle 333 on Inquiry Card

Soldering Tip

Durotherm is a long-life soldering tip which cannot freeze or stick in the tip hole. Tip is wear-resistant and comes in a variety of lengths, shapes and points. Hexacon Electric Co. BOOTH 4002.

Circle 334 on Inquiry Card

Circle 87 on Inquiry Card

ELECTRON TUBE NEWS
...from SYLVANIA

See them all on display—
Sylvania I.R.E. Exhibit!
Booth #
2322-2332, 2415-2425

7
significant developments create

NEW DIMENSIONS FOR DESIGNERS!

- Sarong Cathode
- Strap Frame Grid
- 9-T9 Outline
- 10-Pin Tubes
- 12-Pin Tubes
- "Bonded Shield" CRT's
- Compact TWT's

Among the notable accomplishments in recent tube technology are important Sylvania refinements in the state of the art. Impressive advances are being made in tube *reliability*, tube *versatility* at Sylvania. Performance parameters are undergoing marked improvement while electrical uniformity is rigidly maintained. Some results of this vigorous new approach to the tube art can be seen in the following Sylvania tube developments.

SYLVANIA ...*new dimensions for designers*

SYLVANIA STRAP FRAME GRID

Delivers high Gm, low noise

Sylvania *Strap Frame Grid* improves tube reliability, provides high Gm per mA of Ib, enables uniform grid-cathode spacing and resultant narrow dispersion of characteristics. It affords much improved control of cutoff characteristics. *Strap Frame* design significantly improves stability, resistance to vibration and shock. Extensive Sylvania development brings *Strap Frame* advantages to: 6ER5, *semi-remote cutoff triode;* 6DJ8, *sharp cutoff double triode;* 6FQ5A and 6GK5, *semi-remote cutoff triodes;* 6EH7, *semi-remote cutoff pentode;* 6EJ7, *sharp cutoff pentode.* Another example, Sylvania-6ES8, *semi-remote cutoff double triode,* combines *Strap Frame Grids* and *Sarong Cathodes* for greater accuracy in grid-cathode spacing for improved cutoff characteristics, high stability, exceptional uniformity.

SYLVANIA-DEVELOPED SARONG CATHODE

Improves tube stability, uniformity

The extraordinary *Sarong Cathode* is a major tube refinement designed to stabilize cathode performance, add life to tube service. The Sarong Cathode uses a thin film of cathode material precisely controlled for uniform density and surface smoothness, and *wrapped* on an ultrasonically cleaned cathode sleeve. As a result, possibility of plate-to-cathode arcing or cathode "hot spots" is drastically reduced.

SYLVANIA TYPES UTILIZING SARONG CATHODE

5V4GA	6BC5	6DE4	6W4GT
6AL5	6BQ7/A	6ES8	7F7
6AU4	6BY5GA	6FQ5A	12AU7/A
6AU6	6BZ7	6K6GT	12AX7/A
6AX4	6CY5	6U8	35Z5
6BA6	6DA4	6V6GT	

SYLVANIA 9-T9 TUBE OUTLINE

Brings new efficiency to chassis layout

Utilizing the straight-sided bantam envelope and a miniature 9-pin circle, Sylvania-developed 9-T9 increases volumetric efficiency by eliminating the T9 octal base. 9-T9 enables the use of large tube assemblies in those stages where higher power dissipation capabilities are a design requirement. First new 9-T9 types are – *6/10EW7* . . . double-triodes intended for service as a vertical deflection oscillator and amplifier • *6/17HC8* . . . triode-pentodes designed for use as vertical deflection oscillator and amplifier in 110° deflection circuits of TV receivers *7695* . . . beam power pentode features unusually high power sensitivity as an AF amplifier. In Class A1 operation, self-biased, it delivers 4.5W power output with a B+ voltage of only 140 volts • *7754* . . . 6-volt version of 7695 • *6GM5* . . . beam pentode features improved sensitivity and output characteristics for AF power amplifier use • *6GC5* . . . beam power pentode features high power sensitivity as an audio power amplifier.

NEW SYLVANIA 10-PIN TUBES!

Double tetrodes in T-6½ bulb!

Sylvania adds a new dimension to circuit design with the addition of a 10th pin to the center of the 9-pin miniature circle. Sylvania 10-Pin design provides improved tube performance, makes possible new multiunit combinations . . . offers unusual design advantages with a minimum of chassis redesign. Case in point: *Sylvania-6C9* and *-17C9*, sharp cutoff double tetrodes, offer two high-performance units in the compact T-6½ envelope . . . providing potential savings in circuitry, reducing space requirements. With the addition of the 10th pin, heat dissipation capabilities are increased, cathodes have separate connections, shielding is introduced to effectively reduce undesirable oscillator signal radiation. Sylvania-6C9 and -17C9 are designed for VHF service as RF amplifiers and autodyne mixers.

SYLVANIA "BONDED SHIELD" CRT's

Measurably improve image display

Sylvania pioneered the dramatic improvements made in image viewing by *"Bonded Shield"* design. First to demonstrate the feasibility of quantity-producing *"Bonded Shield"* TV picture tubes, Sylvania applied its knowledge to the specialized requirements of industrial-military CRT's for virtually any application.

"Bonded Shield" eliminates the need for conventional safety glass, reduces the number of reflecting surfaces by 50%. Here's what it does for the viewer: apparent light transmission and contrast are increased; mirror-like reflections are eliminated. Image display is brought "out front" for wide-angle viewing, mounting and styling are simplified, tube face is made accessible for easy cleaning. Other unique advantages: *"Bonded Shield"* caps are available with special anti-reflection treatment that can diffuse up to 70% of reflected light; several *"Bonded Shield"* CRT's are available with calibrated reference scales permanently etched on the safety cap, thereby reducing viewing errors caused by parallax.

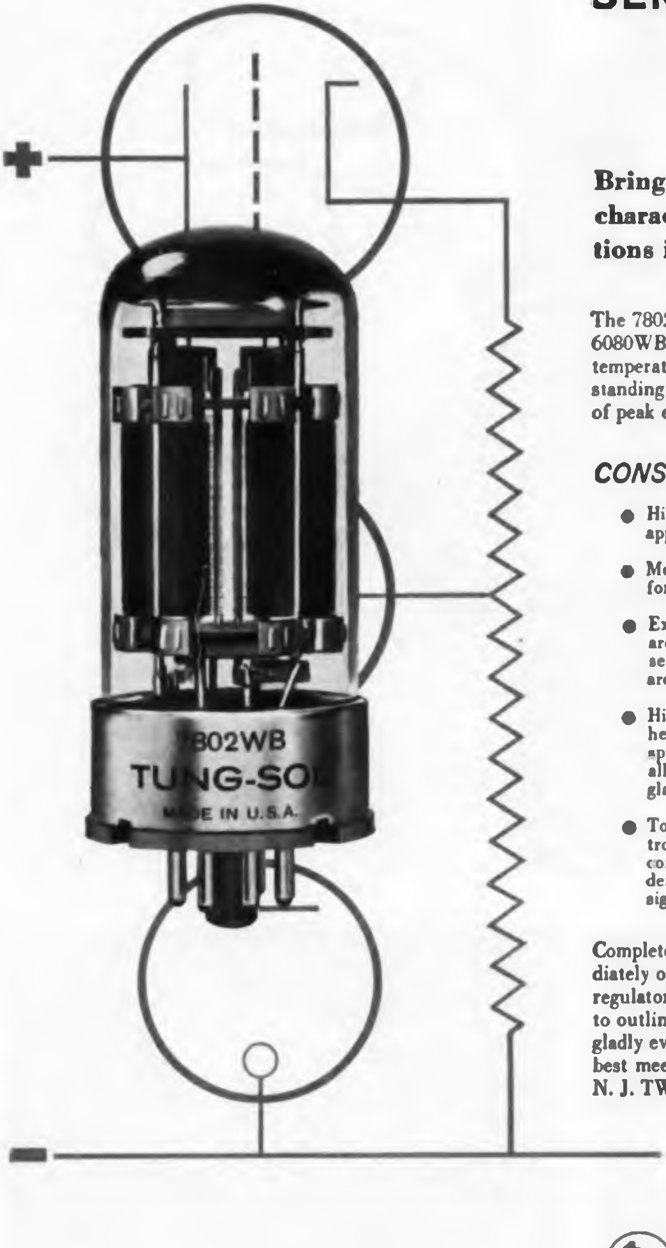
NEW 12-PIN MULTIFUNCTION TUBES

Sylvania 12-T9, 12-T12 types!

Presently under development at Sylvania are five new 12-pin tube types for TV receiver applications. A natural advance in the evolution of small-size, multifunction tubes, Sylvania 12-pin tubes utilize dome-shaped bulbs evacuated from the bottom providing reduced seated height. First types to be announced soon will be commercial versions of these prototypes: two 12-T9 types using the T-9 bulb—SR-3202, damper tube; SR-3203, double diode-double triode, horizontal phase comparator and oscillator; and three 12-T12 types in the T-12 bulb—SR-3201, double-diode, low voltage rectifier; SR-3204, double-pentode, sound discriminator, sound output; SR-3205, beam power pentode, horizontal deflection tube.

Contact your nearest Sylvania Sales Engineering Office for further information on these and other exciting tube developments under way at Sylvania. For data on specific types, write Electronic Tubes Division, Sylvania Electric Products Inc., Dept. C, 1100 Main Street, Buffalo 9, N. Y.

TUNG-SOL ANNOUNCES:



NEW MEDIUM-MU

SERIES REGULATOR TUBE

7802WB

Brings together an optimum combination of characteristics that makes it ideal for applications in tough environmental extremes.

The 7802WB twin-triode, medium MU companion to the popular 6080WB, is the newest in the broad Tung-Sol line of rugged, high temperature, long-life series regulators. It combines many outstanding operational and design features in an optimum package of peak efficiency and dependability.

CONSIDER JUST THESE FEATURES:

- High perveance . . . Makes the 7802WB an excellent choice for applications requiring high plate current at low plate voltage.
- Medium-mu . . . Makes only very small signal voltages necessary for precise 7802WB control.
- Extra-tight tolerances . . . Plate current and transconductance are held to rigid limits to provide greater balance between tube sections. This is of particular significance where many sections are operated in parallel.
- High temperature operation . . . Extensive use of ceramics for heater-cathode insulators, anode standoff insulators and element spacers. The graphite anodes used are warp-free and dimensionally stable regardless of operating temperatures. Non-char, glass-bonded mica material is employed in the tube base.
- Top-performance in environmental extremes . . . Where electronically regulated power supplies must perform under severe conditions of shock vibration and high altitude, the 7802WB demonstrates long, trouble-free life, assured by both tube design and specifications.

Complete technical details on the 7802WB will be furnished immediately on request. A description of the full-line of Tung-Sol series regulator tubes is also readily available. Tung-Sol also invites you to outline your design needs to us. Our application engineers will gladly evaluate your circuit and outline the component which will best meet your requirements. Tung-Sol Electric Inc., Newark 4, N. J. TWX:NK193

TUNG-SOL®

Technical assistance is available through: Atlanta, Ga.; Columbus, Ohio; Culver City, Calif.; Dallas, Texas; Denver, Colo.; Detroit, Mich.; Irvington, N. J.; Melrose Park, Ill.; Newark, N. J.; Philadelphia, Pa.; Seattle, Wash. In Canada: Abbey Electronics, Toronto, Ont.

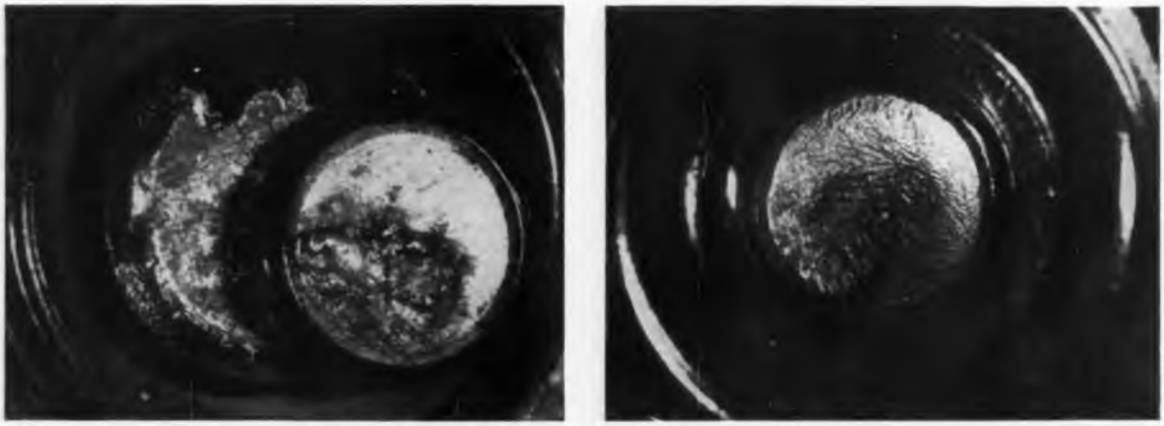
Circle 147 on Inquiry Card

Free from Thermal Fatigue – the

Thermal fatigue of internal soft solder joints has long been a major pitfall in rectifier design. Now, General Electric medium current silicon rectifiers beat the heat and highly cyclical loads with high melting point, hard solder joints that make thermal fatigue failures a thing of the past.

The test units shown (minus housing and top lead) were set up to reach 180°C and drop to 40°C during 3-minute "on" and 1-minute "off" cycles. After 900 thermal cycles the soft solder junction temperature rose to 191°C while the hard solder junction temperature peak remained at 180°C. At 1150 cycles the soft solder junction temperature reached 201°C, and by 1155 cycles it had skyrocketed to 240°C where the soft solder melted and the junction sandwich separated from the copper stud.

In contrast, the hard solder junction temperature peaks remained constant, unaffected by the highly cyclical load. In fact, General Electric hard solder junction silicon rectifiers have been tested to 70,000 temperature cycles from 35°C to 200°C *with absolutely no trace of thermal resistance deterioration.* And hard solder joints are only one part of the inside story of G-E medium current silicon rectifiers.



The two test units are shown here. Before the test they were identical in every respect, except that the unit on the left uses conventional tin-lead soft solder, while the unit on the right uses exclusive G-E hard solder joints.

Inside Story of General Electric Medium Current Silicon Rectifiers

DESIGNED FOR THE 2 TO 30 AMPERE RANGE...
General Electric medium current silicon rectifiers offer important extra advantages for your circuit designs:

- high current operation with minimum space requirements
- high junction temperature rating and extremely low voltage drop and thermal impedance
- available with negative polarity (stud is anode)
- transient PRV ratings mean safer application
- may be mounted directly to chassis or fin, or may be electrically insulated from heat sink using mica washer insulating kit provided
- conservative ratings for maximum reliability under all operating conditions
- all of these same rectifiers are available in a wide range of rugged stack assemblies complete with cooling fins, connection terminals and mounting brackets.

Medium Current Silicon Rectifier Cells

JEDEC & GE Type Number	Repetitive PRV	Transient PRV	Max Idc @ 145°C Stud Single Phase	Max. Rev. Cur. (Full Cycle Av. @ Full Load)	Max. Full Load Voltage Drop	Max. Oper. °C
				@ 150°C Stud	@ 150°C Stud	
1N1341A	50	100	6A	3.0 ma	.64V	200°
1N1342A	100	200	6A	2.5 ma	.64V	200°
1N1343A	150	300	6A	2.25 ma	.64V	200°
1N1344A	200	350	6A	2.0 ma	.64V	200°
1N1345A	300	450	6A	1.75 ma	.64V	200°
1N1346A	400	600	6A	1.5 ma	.64V	200°
1N1347A	500	700	6A	1.25 ma	.64V	200°
1N1348A	600	800	6A	1.0 ma	.64V	200°
1N1199A	50	100	12A	3.0 ma	.55V	200°
1N1200A	100	200	12A	2.5 ma	.55V	200°
1N1201A	150	300	12A	2.25 ma	.55V	200°
1N1202A	200	350	12A	2.0 ma	.55V	200°
1N1203A	300	450	12A	1.75 ma	.55V	200°
1N1204A	400	600	12A	1.5 ma	.55V	200°
1N1205A	500	700	12A	1.25 ma	.55V	200°
1N1206A	600	800	12A	1.0 ma	.55V	200°
					25°C T_J	
1N248	50		10A	5.0 ma	1.5V*	175°
1N249	100		10A	5.0 ma	1.5V*	175°
1N250	200		10A	5.0 ma	1.5V*	175°
1N248A	50		20A	5.0 ma	1.5V**	175°
1N249A†	100		20A	5.0 ma	1.5V**	175°
1N250A†	200		20A	5.0 ma	1.5V**	175°
				@ 145°C Stud		
1N2154	50	100	25A	5.0 ma	0.6V	200°
1N2155	100	200	25A	4.5 ma	0.6V	200°
1N2156	200	350	25A	4.0 ma	0.6V	200°
1N2157	300	450	25A	3.5 ma	0.6V	200°
1N2158††	400	600	25A	3.0 ma	0.6V	200°
1N2159	500	700	25A	2.5 ma	0.6V	200°
1N2160	600	800	25A	2.0 ma	0.6V	200°

*@25A — †B types available as SIGNAL CORPS approved units.
**@50A — ††Signal Corps approved units available as USA 1N2135A.

For complete information on General Electric thermal-fatigue free medium and high current silicon rectifiers, see your G-E Semiconductor District Sales Manager. For additional technical data, write Section 24C2, Rectifier Components Department, General Electric Company, Auburn, New York. In Canada: Canadian General Electric Company, 189 Dufferin St., Toronto, Ontario. Export: International General Electric Company, 150 East 42nd Street, New York, N. Y.

For fast delivery at factory-low prices in quantities up to 999, see your local G-E Distributor

Progress Is Our Most Important Product

GENERAL ELECTRIC

Circle 77 on Inquiry Card

IRE New Products

Analog-Digital Converter

Unit features 128-count/rev. true binary readout. Non-ambiguity is obtained through the use of V-scan brushes. Also available as sine-cosine, Gray Code, BCD and special readouts. Airflyte Electronics Co. BOOTH 1205.

Circle 354 on Inquiry Card

Vacuum Coaxial Relays

The vacuum coaxial relay is for use at higher frequencies and high power levels. They handle up to 15

kw peak power at 600 MC. Relays available with 24 or 115 vdc solenoids. Jennings Radio Mfg. Corp. BOOTH 1802.

Circle 355 on Inquiry Card

WW II Scientific Reports

An index to the recently declassified reports of the World War II Office of Scientific Research and Development has been printed for sale by the Office of Technical Services, U. S. Dept. of Commerce, Washington 25, D. C. Index is PB 161976. Price is $8.00.

Young Scientist Award

Dr. Malcolm R. Currie, Hughes Aircraft Company scientist, has been named one of five "outstanding young men" of 1960 by the California Junior Chamber of Commerce for his "contributions in the space propulsion and microwave electronics."

ARNOLD 6T CORES: PROTECTED AGAINST SHOCK, VIBRATION, MOISTURE, HEAT... AVAILABLE FROM STOCK

The hermetically-sealed aluminum casing method developed exclusively for Arnold 6T tape cores is packed full of advantages for you . . . *performance-improving and cost-saving advantages.*

It is compact: you can design for minimum space/weight requirements. It's extra-rigid to protect against strains. And it gives you maximum protection against environmental hazards. Arnold 6T tape cores are guaranteed against 1000-volt breakdown . . . guaranteed to meet military test specs for resistance to shock and vibration . . . guaranteed also to meet military specs for operating temperatures. They require no additional insulation before winding, and can be vacuum-impregnated afterward.

And now a NEW Arnold service: immediate delivery on your prototype or production requirements for Deltamax 1, 2 and 4-mil Type 6T cores in the proposed EIA standard sizes (see AIEE Publication 430). A revolving stock of approximately 20,000 Deltamax cores in these sizes is ready for you on warehouse shelves. Subject to prior sale, of course, they're available for shipment *the same day your order is received.*

Use Arnold 6T cores in *your* designs. Technical data is available; ask for Bulletin TC-101A and Supplement 2A (dated June '60). ●Write *The Arnold Engineering Company, Main Office and Plant, Marengo, Ill.*

ADDRESS DEPT. EI-3

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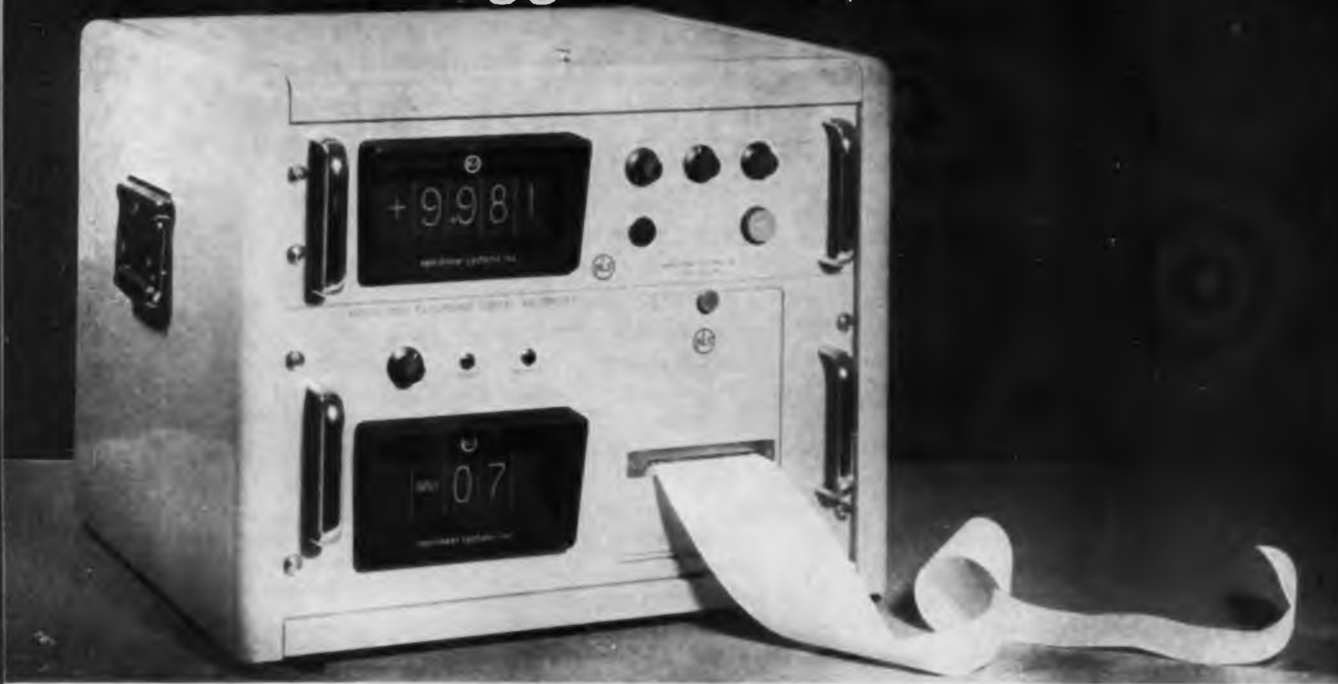
SPECIALISTS in MAGNETIC MATERIALS

BRANCH OFFICES and REPRESENTATIVES in PRINCIPAL CITIES • Find them FAST in the YELLOW PAGES

1936

High Precision Data Logger for $3,600



The RS2 Recording Digital Voltmeter – now in volume production at Non-Linear Systems, Inc. – scans up to 20 double-pole input channels . . . measures DC voltage from ±0.001 to ±999.9 with ±0.01% accuracy . . . and records input channel number and the 4-digit voltage measurement. Uses include research and development, quality control, environmental and reliability testing.

Plug-in stepping switches in the digital voltmeter section of the RS2 permit replacement of all switches and decade resistors in minutes instead of days. The plug-in feature allows almost instant trouble-shooting by the substitution method.

Volume production and simplified controls of the RS2 account for its low cost – half to a third less than custom-built units.

Note the compact, plug-in modular design of the scanner-printer section of the RS2.

Circle 80 on Inquiry Card

New Products

COMPUTER POWER SUPPLY

This computer power supply will accurately regulate 400 CPS ac voltage for rectifying to various dc voltages needed in transistorized, modern computers. The 3-unit, 2-bearing motor-alternator will permit the use of

smaller transformer-rectifiers and filter network components. The power supply is made up of 3 basic units: A 60 CPS induction drive motor, a wound-field synchronous generator and a rotating exciter-rectifier combination. Continuous output ratings from 1 to 5KVA are available. General Electric Co., Schenectady 5, N. Y.

Circle 342 on Inquiry Card

GANGED ATTENUATORS

A series of new ganged attenuators provides a wide selection of ranges and stepping increments. They use 2 or more standard Telonic turret attenuators ganged in tandem with a common dial-control and shaft.

The complete units can be used to operate 2 separate r-f circuits or can be wired in series to double or triple the range of a single attenuator. The Model TAA 50 consists of two 0-50 db attenuators with 10 db steps. It can provide up to 50 db attenuator to each of 12 circuits or 100 db in 20 db steps to a single circuit. Telonic Industries, Inc., Beech Grove, Ind.

Circle 344 on Inquiry Card

HIGH VOLTAGE DIODE

The 1N645B is a new CSP high voltage silicon diode featuring low leakage. The reverse current is typically 25 na @ 225 v. This leakage provides increased safety margins for high reliability designs. It provides 400 ma. av. rectified current, 225 v. piv, and 600 mw power dis-

sipation. This diode is recommended for such applications as magnetic amplifiers, modulators, demodulators, networks and power supplies. Rheem Semiconductor Corp., 350 Ellis St., Mountain View, Calif.

Circle 343 on Inquiry Card

FLEXIBLE ABSORBER

Metal film Mylar is a thin and completely flexible microwave absorbing material. The resistance material is a thin film of pure metals, approximately 50 millionths of an in. thick, uniformly deposited on the surface of the Mylar. This flexible absorber can be used to line the inside of a

cavity as a mode suppressor, or to wrap around the shorting plunger in a cavity to suppress leakage. Values are 50, 100, 150, 200, 300, and 377 ohms/sq. Filmohm Corp., 48 W. 25th St., New York 10, N. Y.

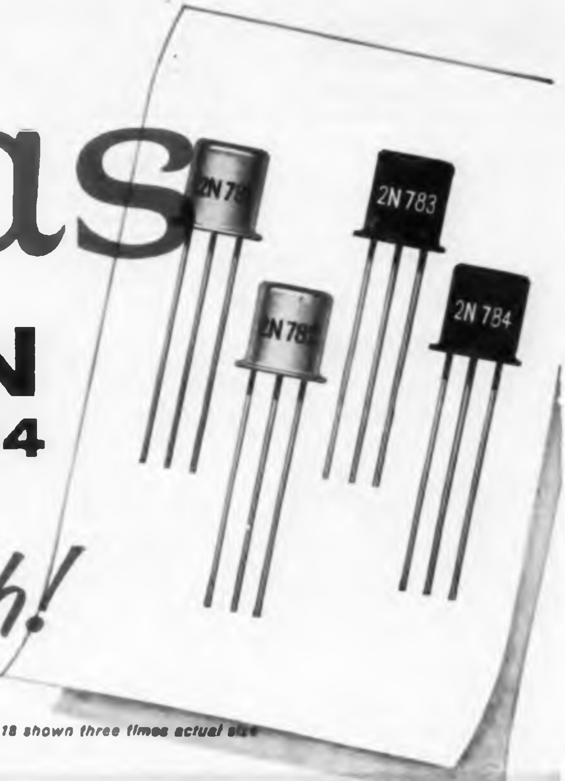
Circle 345 on Inquiry Card

mesas

· SILICON

2N783 2N784

Sylvania offers both!



TO-18 shown three times actual size

SYLVANIA 2N783 — WORLD'S FASTEST NPN SILICON SWITCHING TRANSISTOR

. . . is designed specifically for circuits with high speed as a prime performance feature. Sylvania 2N784 delivers low saturation voltage combined with exceptional high-speed capabilities.

ABSOLUTE MAX. RATINGS (AT 25°C)

	2N783	2N784	UNIT
Collector to Base Voltage	40	30	V
Collector to Emitter Voltage	20	15	V
Emitter to Base Voltage	5	5	V
Collector Current	50	50	mA
Power Dissipation (free air)	300	300	mW
Power Dissipation (case at 25°C)	1	1	W
Storage Temperature	−65 to +300	−65 to +300	°C
Junction Temperature	+175	+175	°C

ELECTRICAL CHARACTERISTICS (AT 25°C)

Symbol	Conditions	2N783 Min.	2N783 Max.	2N784 Min.	2N784 Max.	UNIT
BV_{CBO}	$I_C = 100\ \mu A$, $I_E = 0$	40	—	30	—	V
BV_{EBO}	$I_C = 100\ \mu A$, $I_C = 0$	5	—	5	—	V
BV_{CER}	$I_C = 1$ mA, $V_{BE} = 0$, $R_{BE} = 10$ ohms	20	—	15	—	V
I_{CBO}	$V_{CB} = 25$ V	—	250	—	250	mμA
	$V_{CB} = 25$ V, $T = 150°C$	—	30	—	30	μA
h_{FE}	$I_C = 10$ mA, $V_{CE} = 1$ V	20	60	25	—	
V_{BE}	$I_C = 10$ mA, $I_B = 1$ mA	0.7	0.9	0.7	0.9	V
V_{CES}	$I_C = 10$ mA, $I_B = 1$ mA	—	.25	—	.16	V
C_{ob}	$V_{CB} = 10$ V, $I_E = 0$, $F = 1$ MC	—	3.0	—	3.5	μμf
h_{fe}	$V_{CB} = 15$ V, $I_c = 10$ mA, $F = 100$ MC	2.0	—	2.0	—	
t_{on}	$I_{B(1)} = 3$ mA, $I_{B(2)} = 1$ mA $V_{CC} = 3$ V, $R_L = 270\ \Omega$	—	16	—	20	mμsec
t_s	$I_{B(1)} = 10$ mA, $I_{B(2)} = 10$ mA $V_{CC} = 10$ V, $I_C = 10$ mA, $R_L = 1000\ \Omega$	—	10	—	15	mμsec
t_{off}	$I_{B(1)} = 3$ mA, $I_{B(2)} = 1$ mA $V_{CE} = 3$ V, $R_L = 270\ \Omega$	—	30	—	40	mμsec

SYLVANIA

SUBSIDIARY OF

GENERAL TELEPHONE & ELECTRONICS

GENERAL SYSTEM

Circle 81 on Inquiry Card

New Products ... for the Electronic Industries

POWER SUPPLY

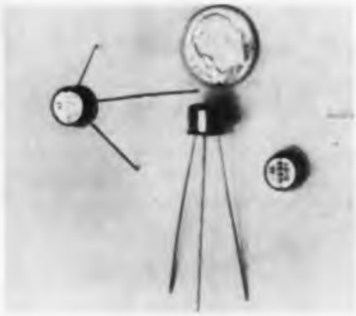
This transistorized power supply develops a square wave ac voltage from a 24 to 30 vdc source, to drive inductive loads, as well as loads that vary widely in power factor. Model 591AC can withstand a 2 sec. over-

load of up to 80 va. and will tolerate a line transient of up to 60 v. where adequate heat sink is provided. Output voltage is 115 v. at 400 cps. It uses a minimum number of semiconductor elements and toroidal transformers, to minimize transistor failures due to leakage reactance. Arnold Magnetics Corp., 6050 W. Jefferson Blvd., Los Angeles 16, Calif.

Circle 336 on Inquiry Card

AUDIO TRANSISTOR

A high-voltage germanium pnp transistor, type 2N398A, features 100°C junction operation and 150 mw power dissipation. The unit has a 105 v. collector-base rating and is intended as a driver transistor



for Nixie tubes, indicator and neon bulb applications. The device is also rated for 200 ma. collector current. Housed in a standard TO-5 package, it has a 4-point mounting internal substructure with 2 connections for the base tab rather than the customary single connection. Motorola Semiconductor Products Inc., 5005 E. McDowell Rd., Phoenix, Ariz.

Circle 338 on Inquiry Card

POWER PENTODE

This tube incorporates 2 frame grids, one a control grid, the other a screen grid. The type 7534 is an output pentode and is designed for 10,000 hrs. It is intended for use as a wideband amplifier, cathode fol-

lower, and as an output tube in Class B push-pull circuits. The tube features high transconductance of 25,000 micromhos, low screen grid current (4 ma), and a peak voltage of 6 kv. The cathode current is 300 ma. It has a low distortion for 60w. output in push-pull class B circuits. Amperex Electronic Corp., 230 Duffy Ave., Hicksville, L. I., N. Y.

Circle 340 on Inquiry Card

TEMPERATURE CONTROLS

A series of small automatic temperature controls designed 1/5 as large as former units is capable of maintaining heat within ±1°F. The new "Temp-Tendor" controls, Model 450, are intended for panel mounting with visual signal indication. Built

around locking contact meter-relays for simplicity and reliability, controls are available in 8 standard ranges between 300°F and 2500°F. They measure 4¼ x 5½ x 4 in. Assembly Products, Inc., Chesterland, Ohio.

Circle 337 on Inquiry Card

HIGH GAIN TRANSISTORS

A new series of pnp germanium alloy transistors is designed for applications requiring high gain and low noise characteristics. They have min. collector to base voltage ratings of 10 v. The 2N1175 and 2N1175A have a typical collector cutoff cur-

rent of 6μa with a collector to base voltage of 30 v. The devices are rated for operation in the −65°C to +85°C range. General Electric Co., Semiconductor Products Dept., Kelley Bldg., Liverpool, N. Y.

Circle 339 on Inquiry Card

GLASS CAPACITORS

A new capacitor, the CYF-20 has a range of 560 to 5100 pf. The capacitor exceeds Mil-Std-202A and Mil-C-11272B. These capacitors are used in missiles, nuclear equipment, aircraft and computers. Temperature coefficient is 140 ±25 ppm/°C over

the range of -55°C to 125°C. They are available at 500 wvdc at capacitances between 560 and 3600 pf and at 300 wvdc between 3600 and 5100 pf. Corning Glass Works, Corning, N. Y.

Circle 341 on Inquiry Card


A shining example of Ampex leadership!

New Products

MICROWAVE TESTER

This compact X-band gas discharge noise source is designed to measure the noise figure of receivers. The termination is included within the waveguide. The entire unit, exclusive of waveguide, is epoxy-resin

potted to secure tube, leads, and other parts within the housing. High voltage BNC receptacles are used to connect a readily available limited current transformer to a 115 v., 400 CPS power source. A dc power supply is not required. It is also available in Ku band. Bomac Labs., Inc., Salem Rd., Beverly, Mass.

Circle 346 on Inquiry Card

REGULATED POWER SUPPLY

Model TC200-5 current-regulated power supply is completely transistorized. It converts 110 v., 60 CPS, 1 ø ac to 200 vdc with max. current of 5, 10 or 15 amp. Controls give continuous coarse and fine adjustment from zero current to max., with regu-

lation of 0.1%. Meters included indicate output current and regulating range. Cabinet dimensions are 24 x 19⅛ x 30 in. Weight is 200 lbs. Spectromagnetic Industries, P. O. Box 3306, Hayward, Calif.

Circle 347 on Inquiry Card

New Tech Data for Engineers

Pulse Generator

E-H Research Laboratories, Inc., 163 Adeline St., Oakland 20, Calif., offers a 3-color data sheet on their Model 121 pulse generator. Included are complete technical specs.

Circle 211 on Inquiry Card

Epoxy Resins

A technical bulletin from Marblette, 37-31 30th St., Long Island City 1, N. Y., gives specifications, applications and working instructions for their crystal clear, thermosetting Maraglas resin.

Circle 212 on Inquiry Card

Grid Wire

General Electric Co.'s Lamp Metals & Components Dept. ED-011, 21800 Tungsten Rd., Cleveland 17, Ohio, has issued a technical data sheet describing their line of gold or silver plated molybdenum or Tungsten wire. Characteristics are included.

Circle 213 on Inquiry Card

Control and Pointer Knobs

Catalog No. 8 describing a wide choice of control knobs, pointer knobs, instrument cases and covers is offered by Harry Davies Molding Co., 1428 N. Wells St., Chicago 10, Ill.

Circle 214 on Inquiry Card

Microwave Tube Facilities

A 2-color, 6-page brochure describes in detail the facilities and capabilities of the Stewart Engineering Corp., Santa Cruz, Calif., services in the microwave tube areas.

Circle 215 on Inquiry Card

Digital Voltmeters

A line of electronic digital voltmeters and their accessories is described in a 4-page, 2-color technical brochure issued by Systron-Donner Corp., 950 Galindo St., Concord, Calif. Complete information is given.

Circle 216 on Inquiry Card

Parametric Amplifiers

"Parametric Amplifier Progress Report" reviews the state-of-the-art in commercially available parametric amplifiers. Specs. are included for L-band, S-band, C-band and X-band parametric amplifiers. Photographs of available units and current system installations are included. Components Div., Hughes Aircraft Co., Bldg. 20, Room 1372, Culver City, Calif.

Circle 217 on Inquiry Card

Component Markers

A technical data sheet describing subminiature components identification markers and E-Z-Code wire markers has been released by Westline Products, Div. of Western Lithograph Co., 600 E. 2nd St., Los Angeles, Calif. Specifications and uses for these markers are included.

Circle 218 on Inquiry Card

Diodes

Microwave Associates, Inc., Semiconductor Div., Burlington, Mass., offers 4 technical data sheets covering their line of varactor diodes. Covered are reversible base and fixed base silicon. reversible cartridge 30 v., and subminiature "pill" varactor diodes.

Circle 219 on Inquiry Card

Component Tester

A 4-page, 2-color technical brochure has been issued by Statham Instruments, Inc., 12401 W. Olympic Blvd., Los Angeles 64, Calif., dealing with their MC temperature test chamber. Information on various models and specifications is included.

Circle 220 on Inquiry Card

Electronic Ignition System

A 2-color technical data sheet complete with graphs and drawings describes a transistorized electronic ignition system. Autronics, Inc., 5801 East Calle Del Norte, Phoenix, Ariz.

Circle 221 on Inquiry Card

Internal Timer Booklet

Ten page application notes and specifications booklet includes full range of electronic Interval Timers, both solid-state and relay actuated. Designed for use in computer circuits, missile systems, sequencing circuits, counter control, event signal and many others. Electronic Products Corp., 4642 Belair Rd., Baltimore 6, Md.

Circle 222 on Inquiry Card

Metal-Cased Switches

Unimax Catalog No. 30-1 gives details on the new hp-rated KL series of heavy-duty-metal-cased switches. Pictorial index shows location of dimension drawings, descriptions, force and movement specs. electrical ratings, and photographs for each switch listed. Unimax Switch Div., The W. L. Maxson Corp., Ives Rd., Wallingford, Conn.

Circle 223 on Inquiry Card

Electronic Timing Modules

A 5-page product data bulletin PD-1016 describes small and light microminiature timing modules. The bulletin contains dimensional drawings, tables of characteristics and complete specs. for Types 406-1, 406-2 and 406-3. G-V Controls Inc., 101 Okner Pkwy., Livingston, N. J.

Circle 224 on Inquiry Card

Toroidal Components

Johnson Electronics, Inc., P. O. Box 1675, Casselberry, Fla., has issued an 8-page, 3-color technical brochure covering subminiature toroids, toroidal coils and specially designed components. Photographs, tables, graphs and specs. are included.

Circle 225 on Inquiry Card

Tape Instrumentation

A 7-page, 4-color technical bulletin No. 3400 entitled "A New Concept in Magnetic Tape Instrumentation" has been issued by the Sangamo Electric Co., Springfield, Ill. Included in the bulletin are photographs, block diagrams, graphs and complete specs. on their 460 series recorder/reproducer.

Circle 226 on Inquiry Card

Controlled Rectifiers

Texas Instruments Incorporated, Semiconductor-Components Div., P. O. Box 312, Dallas, Tex., has issued an 8-page technical data brochure complete with schematics, nomograms and graphs describing dynamic switching using pnpn silicon controlled rectifiers.

Circle 227 on Inquiry Card

Accelerometer Calibration

A 28-page technical review complete with photographs, diagrams, schematics, and drawings describes the electrical and mechanical performance characteristics of the high frequency calibration Exciter Model 4290. B & K Instruments, Inc., 3044 W. 106th St., Cleveland 11, Ohio.

Circle 228 on Inquiry Card

Miniature Capacitors

A technical data booklet, ED-L101, describes polystyrene miniature capacitors. Types PH and PC. Information includes temperature effects on capacitance, power factor, insulation resistance, voltage ratings and tolerances according to types and sizes. Efcon, Inc., Patterson Place, Roosevelt Field, Garden City, L. I., N. Y.

Circle 229 on Inquiry Card

Dependability PROVED!

...in tests at 5 Times mil specs for shock, vibration and acceleration

Potentiometers Type J and Type K | Potentiometers Type G and Type L | Adjustable Fixed Resistors Type R | Hermetically Sealed Ceramic Encased Resistors Type TS Type CS Type ES

About the test

At the United States Testing Co., Inc.* the above Allen-Bradley resistors and potentiometers were subjected to a constant acceleration of 300g, impact shock of 150g and vibration of 50g from 55 to 2,000 cps. All tests were conducted in accordance with procedures outlined in the latest Mil Specs.

*Test Report #71801, Sept. 1960.

In these severe tests, Allen-Bradley resistors and potentiometers have demonstrated their complete dependability in environmental extremes.

The ruggedness of A-B fixed resistors is obtained through an *exclusive* process in which the resistance element and the insulating jacket are hot molded into an integral unit of unusual mechanical strength. This unit is then hermetically sealed in a ceramic tube. Also, please remember, A-B fixed resistors are *completely free from catastrophic failures.*

A-B potentiometers have the resistance elements molded into, and are an integral part of, the base; therefore, they are virtually indestructible. In addition, operation is quiet and smooth when the potentiometer is new, and these characteristics improve with use.

For maximum reliability under severe operating conditions, insist on Allen-Bradley *quality* electronic components.

Allen-Bradley Co., 222 W. Greenfield Ave., Milwaukee 4, Wis.
In Canada: Allen-Bradley Canada Ltd., Galt, Ont.

ALLEN-BRADLEY | QUALITY ELECTRONIC COMPONENTS

ALLEN-BRADLEY QUALITY

FERRITES

HAVE SOLVED THESE DESIGN PROBLEMS

...they can also be the Answer to Yours!

From the broad line of Allen-Bradley *quality* ferrites, more and more designers are finding they can obtain the exact characteristics to meet their specific needs. Allen-Bradley's precise quality control methods insure continuously uniform electrical and mechanical properties—and A-B has the facilities for supplying ferrites in quantity. Listed below are a number of areas in which A-B ferrites have helped the manufacturer to reduce the product size or weight, or cost, and frequently the performance has been improved. If you have problems along this line, please let our engineers work with you in solving them.

APPLICATION	A-B FERRITE	PREFERRED CHARACTERISTICS
TELEVISION, RADIO Deflection Yokes	W-03 W-01	High permeability High resistivity
Flyback Transformers	W-04	Low losses, high B_{max}, high permeability, high Curie temp
Convergence Cores	W-01	Low residual with large gap
I. F. Transformers	R-02	Low losses at low amplitudes. Good temperature stability of permeability
R. F. Tuning Coil (fixed or permeability tuned)	R-02	Low losses. Temperature stable permeability, minimum hysteresis for permeability tuning
TELEPHONE SYSTEMS Interstage and Matching Transformers	W-03	High permeability, low losses
H. F. FLUORESCENT LIGHTS Loading Reactors	W-07	High flux density
Transformers	W-04	High permeability, low losses, high B_{max}
ELECTRIC ORGANS AND HI-FI STEREO Oscillator Inductors	W-03	High permeability, temperature stable, linear B vs. H
Output Transformers	W-04	High permeability, high B_{max}, low losses
AUTOMATIC MACHINE TOOLS Magnetic Amplifiers	R-03	Rectangular hysteresis loop, high B_{max}
Logic elements for high-power levels	R-03	Rectangular hysteresis loop, high B_{max}
Matching Transformers	W-04	High permeability, low losses, high B_{max}
MOBILE POWER SUPPLIES Static Inverters	R-03	Rectangular hysteresis loop, high B_{max}.
RADAR, MISSILES Pulse Transformers	W-04 R-02 (for short pulses)	High pulse permeability, high B_{max}, low losses
PERMANENT MAGNETS	M-01	High energy factor Good mechanical strength

ALLEN-BRADLEY | Quality Electronic Components

ALLEN-BRADLEY CO., 222 W. GREENFIELD AVE., MILWAUKEE 4, WISCONSIN • IN CANADA: ALLEN-BRADLEY CANADA LTD., GALT, ONTARIO

THE

Blue Chip

OF THE MINIATURE

GYRO FIELD

Reeves proudly presents its latest achievement in precision gyro miniaturization . . . an extremely compact and rugged unit designed and produced to meet the most exacting requirements of service in advanced inertial reference packages and stable platforms.

Reeves 121G Gyros are 1.25 inches in diameter, 2.5 inches in length overall, and weigh only 6 ounces. Trimmed drift rate is very low . . . 0.1° hr.— Mass unbalance, 1.0°/hr/g. Angular momentum, 30,000 c.g.s. units. Gyros can be supplied with or without case heaters. For more complete information, write for data file 303.

SEE this NEW Reeves Gyro on display at the I.R.E. Show — Booths 1305 and 1307

THE ULTIMATE

IN MINIATURE

FLOATED

INTEGRATING GYROS

Qualified engineers who are seeking rewarding opportunities for their talents in this and related fields are invited to get in touch with us.

REEVES INSTRUMENT CORPORATION

A Subsidiary of Dynamics Corporation of America

Roosevelt Field, Garden City, New York

3RV61

New Tech Data for Engineers

Resistors

Physical and electrical characteristics for a complete range of wire-wound and carbon-film resistors, manufactured to Mil Specs. and to commercial requirements are described in a new 24-page catalog issued by Mepco., Inc., 35 Abbett Ave., Morristown, N. J.

Circle 230 on Inquiry Card

Converters

Vidar Corp., 2296 Mora Drive, Mountain View, Calif., has issued a technical data sheet describing their analog-to-frequency converters. Specs. and photographs are included.

Circle 231 on Inquiry Card

DC Voltage & Resistance Meter

Bell Inc., 1356 Norton Ave., Columbus 12, Ohio, has just issued a technical data sheet on their Digimeter, digital readout voltage and resistance meter. Complete technical specifications are included.

Circle 232 on Inquiry Card

Rectifier Wall Charts

General Electric Co., W. Genesee St., Auburn, N. Y., has announced the availability of 2 wall charts. The "Rectifier Selection Chart" (ECG-545) "Characteristics of Common Rectifier Circuits" (ECG-546) may be used independently or to complement one another, as a means of selecting optimum silicon and germanium rectifiers for basic circuits.

Circle 233 on Inquiry Card

Coaxial Connectors

Illustrated 8-page brochure describes new connectors for aluminum sheathed, high frequency Styroflex and Foamflex Coaxial Cables. Full mechanical and electrical specifications along with typical installation instructions are given. Phelps Dodge Copper Products Corp., 300 Park Ave., New York 22, N. Y.

Circle 234 on Inquiry Card

Digital Instrumentation

A 17-page, 3-color catalog describing their digital instrumentation for measurement, counting and control has been issued by Beckman/Berkeley Div., 2200 Wright Ave., Richmond, Calif. Block diagrams, photographs, modifications and specs. cover their line from digital voltmeters to pre-set counter controllers.

Circle 235 on Inquiry Card

Solid State Alarm

San Diego Scientific Corp., 3434 Midway Dr., San Diego 10, Calif., has issued a 2-color, 4-page brochure describing a new solid state alarm unit for use with temperature monitoring equipment. Block diagrams and specifications are included.

Circle 236 on Inquiry Card

Microwave Components

Aircom, Inc., 48 Cummington St., Boston 15, Mass., announces its new catalog of microwave components, antennas and instruments. It contains specs., photos and diagrams.

Circle 237 on Inquiry Card

Microminiature Tools

New microminiature hand-tools for electronics and instrument uses have been announced by the Circon Component Corp., Santa Barbara/Goleta, Calif. Drawings, specs. and kit information are included.

Circle 238 on Inquiry Card

Facilities Brochure

An 18-page, 3-color, facilities brochure describing their various capabilities and facilities in the area of combining electronics, optics and photography has been issued by Photomechanisms, Inc., 6 W. 18th St., Huntington Station, L. I., N. Y. Some of their equipment is shown.

Circle 239 on Inquiry Card

SCR Commutation Capacitors

Schematics, graphs, photographs and tables are included in a 4-page bulletin from General Electric Co., Schenectady 5, N. Y., describing capacitors for silicon controlled rectifier applications.

Circle 240 on Inquiry Card

Thermostats

A 4-page technical data bulletin covering their line of type G commercial thermostats is issued by Stevens Mfg. Co., Inc., P. O. Box 1007, Mansfield, Ohio., included are drawings, specs. and dimensions.

Circle 241 on Inquiry Card

Stock Relays

Magnecraft Electric Co., 3350 H West Grand Ave., Chicago 51, Ill., has issued a 4-page, technical catalog on the relays carried in stock. Specs., wiring diagrams and photographs are included.

Circle 242 on Inquiry Card

Welding Equipment

Hughes Aircraft Co., Vacuum Tube Products Div., 2020 Short St., Oceanside, Calif., has issued a 6-page, 3-color brochure on thin metal welding equipment. This short form catalog comes with photographs, specs., and complete information on their welding equipment and accessories.

Circle 243 on Inquiry Card

Logic Module

A technical specification bulletin describing a dual output variable delay logic module is available from Harvey-Wells Electronics, Inc., 14 Huron Dr., Natick, Mass. Specs., applications information, and photograph are included.

Circle 244 on Inquiry Card

Dual-Trace Indicators

Analab Instrument Corp., 30 Canfield Rd., Cedar Grove, N. J., offers a technical data sheet on Types 1120 and 1120-R Dual Trace Main Frames. Specifications and photograph of this oscilloscope are included.

Circle 245 on Inquiry Card

Relays

A new 16-page, 2-color catalog showing the complete P&B line of electro-magnetic relays is now available with specs, photographs, and application notes. Potter & Brumfield, Div. of American Machine & Foundry Co., Princeton, Ind.

Circle 246 on Inquiry Card

Power Supply Unit

Stabilized power supply unit, Catalog No. 8440, is described in a 4-page technical data sheet by W. G. Pye & Co. Ltd., Granta Works, Cambridge, England. Photograph and specs. are included.

Circle 247 on Inquiry Card

Recording Paper

A number of different brochures are available from Alfax Paper & Engineering Co., P. O. Box 125, Westboro, Mass., describing their various recording papers. Specs., drawings, and descriptions are included.

Circle 248 on Inquiry Card

Thyratron Care

Technical Data Bulletin PA-503, "The Care and Control of Thyratrons," is offered by CBS Electronics, Danvers, Mass. Included in the technical bulletin are schematics and graphs.

Circle 249 on Inquiry Card

Precision Ball Bearings

A 40-page catalog contains dimensional information as well as practical engineering and applications data for the selection and specification of ball bearings for instruments. It features actual size photos of the bearings. The Fafnir Bearing Co., 37 Booth St., New Britain, Conn.

Circle 250 on Inquiry Card

Silicone Rubber Chart

A 4-color, 4-page specifications chart contains complete data on applications, typical properties, primary classes and standard industry and military specs for silicone rubber. The chart is designated CDS-145C. General Electric Co., Silicone Products Dept., Waterford, N. Y.

Circle 251 on Inquiry Card

Timing Motors

An 8-page condensed illustrated catalog on timing motors, and time and torque controls has been issued by the Haydon Div. of General Time Corp., Torrington, Conn. The 3-color catalog contains specs., drawings, photographs and applications information.

Circle 252 on Inquiry Card

Mechanical Filters

Collins Radio Co., 2700 W. Olive Ave., Burbank, Calif., has issued a comprehensive 4 piece package on mechanical filters. Included in the package are: general catalog; short form catalog; specification sheet; and a data sheet on do's and don'ts of filter installation.

Circle 253 on Inquiry Card

Microwave Handbook

Issued in monthly installments, by Radar Design Corp., P. O. Box 38, Syracuse 11, N. Y., "Microwave Designer's Handbook" details procedures for designing waveguide, coaxial components and instruments.

Circle 254 on Inquiry Card

Memory Plan

A new 4-page bulletin on Microstack, a miniaturized memory plan for use with coincident current memory systems. is available from General Ceramics, Keasbey, N. J. Illustrations, photos, charts and diagrams are included.

Circle 255 on Inquiry Card

Electronic Hook-Up Wire

A 12-page, 4-color brochure contains condensed data on a complete line of electronic hook-up wire manufactured by Sequoia Wire & Cable Co., Sub. of Anaconda Wire & Cable Co., 2201 Bay Rd., Redwood City, Calif. Applicable military specifications for the wire are also listed.

Circle 256 on Inquiry Card

Circle 91 on Inquiry Card

Tech Data

for Engineers

Magnetic Amplifiers

Technical data bulletin 1316-3 describes Vickers Mega-Power high-capacity magnetic amplifiers. Photograph, specs., graph and schematic are included. Vickers Inc., Electric Products Div., 1815 Locust St., St. Louis 3, Mo.

Circle 257 on Inquiry Card

Voltage Reference Tube

Graphs, specs. schematics and photographs are included in a technical data sheet from Bendix Corp., Red Bank Div., Eatontown, N. J., describing their subminiature voltage-reference tube 5783 WA.

Circle 258 on Inquiry Card

X-Band TWT

Sperry Electronic Tube Div., Sperry Rand Corp., Gainesville, Fla., has issued a technical data sheet describing its PPM-focused, X-band traveling wave tube. Dimensions and specs. for the STX-264 are given.

Circle 259 on Inquiry Card

Potentiometers

A 28-page technical catalog on their complete line of potentiometers has been announced by the Electronic Sales Div., DeJur-Amsco Corp., 45-01 Northern Blvd., Long Island City 1, N. Y. Specs. outline drawings, general information and pictures cover their complete line of components.

Circle 260 on Inquiry Card

Facilities and Components

An 8-page brochure describing their facilities and components has been released by the Trak Microwave Corp., 5006 N. Coolidge Ave., Tampa 3, Fla. Included are photographs, specs. and capability information. Their line of low, medium and high power cavities from 500 MC up is also featured.

Circle 261 on Inquiry Card

Facilities Brochure

An 8-page, colored brochure has just been issued by Elgin Laboratories, Inc., Sub. of Erie Resistor Corp, Waterford, Pa., describing their facilities and production capabilities. Proprietary packaging concepts are featured.

Circle 262 on Inquiry Card

Oscilloscopes

A 15-page short-form presentation describes all currently manufactured Tektronix oscilloscopes and associated electronic equipment. Pictures and specs. are included. Tektronix, Inc., P. O. Box 500, Beaverton, Ore.

Circle 263 on Inquiry Card

This Top Team of Application Engineers Represents You at Bourns!

NUMBER 12—APPLICATION SERIES

See us March 20-23 at the IRE Show/Booths 1816-1818

Consider this crack Trimpot® engineering group an extension of your own staff... because that's exactly what it is. Each of these men is a graduate engineer; each has extensive experience in potentiometer applications; and each is responsible for technical subjects within a specific geographic area. The Bourns specialist assigned to your region therefore becomes well acquainted with your requirements—to help you solve today's problems today!

Because Bourns offers the widest selection of adjustment potentiometers in the nation, these men are in the best possible position to steer you to fast answers for your potentiometer needs. If modifications or specials are in order, they'll come up with sound, low-cost solutions. If your problems require direct engineer-to-engineer contact on problems involving design, quality control, or testing, they'll provide it... on the phone or in your office.

Here, in short, is a group of engineers devoted to giving you personal service and personal follow-through on your projects. The phone is right there on your desk—call anytime!

Exclusive designers and manufacturers of Trimpot® potentiometers. Pioneers in transducers for position, pressure, acceleration.

Circle 96 on Inquiry Card

Tech Data
for Engineers

Traveling-Wave Tubes

Huggins Laboratories, Inc., 999 E. Arques Ave., Sunnyvale, Calif., has issued an 8-page, 2-color brochure on traveling wave tubes. BWAs, FWAs, BWOs and special purpose microwave tubes are described with complete specs.

Circle 264 on Inquiry Card

Negative-Ion Generators

Booklet CE 860 tells how to build negative-ion generators and how to measure their ion output. The 8-page booklet includes specs., drawings, schematics and tables. Westinghouse Lamp Div. MacArthur Ave., Bloomfield. N. J.

Circle 265 on Inquiry Card

Flame-Retardant Plastic

A technical data sheet giving detailed information on Grade FR-2, flame-retardant industrial thermosetting laminated plastics, has been issued by Synthane Corp., Oaks, Pa. Property values, specs. and make-up are included.

Circle 266 on Inquiry Card

Switch Catalog

Specifications, drawings, photographs and diagrams are included in the new 48-page, 3-color switch selection catalog entitled "Daven Switches" which describes the selection and ordering of their complete switch line. The Daven Co., Livingston, N. J.

Circle 267 on Inquiry Card

Silicon Devices

Sperry Semiconductor Div. of Sperry Rand Corp., Norwalk, Conn., has just published a 6-page specification brochure Bulletin SS-100, covering silicon transistors and silicon diodes. Diagrams, specifications, drawings and photographs are included.

Circle 268 on Inquiry Card

Semiconductor Facilities

An 8-page, 3-color, facilities and capabilities brochure is offered by Kearfott Semiconductor Corp., West Newton, Mass. Photographs and pertinent information are included. Their quality control methods are featured.

Circle 269 on Inquiry Card

Slide Switches

Continental-Wirt Electronics Corp., 5221 Greene St., Philadelphia 44, Pa., offers a 4-page, 3-color technical information on their line of slide switches. Charts, specifications, diagrams, and photographs are included.

Circle 270 on Inquiry Card

Computer Brochure

A 6-page, 4-color illustrated brochure describing Donner Scientific Co.'s new Model 3500 analog computer is now available. Photographs, block diagrams, areas of application and specs. are included. Donner Scientific Co., Concord, Calif.

Circle 163 on Inquiry Card

Multi-Switches

An 8-page, 3-color catalog S-305 lists engineering data, considerations, design features and special assemblies as a guide for engineers on standard and special multi-switches. Switchcraft, Inc., 5555 N. Elston Ave., Chicago 30, Ill.

Circle 164 on Inquiry Card

Microwave Filters

John Gombos Co., Inc., Webro Rd., Clifton, N. J. is making available a 6-page, 3-color, brochure entitled "Microwave Tunable Band-Pass Filters." Included are photographs, graphs, specifications and drawings on their complete line from 500 MC to 18,000 MC.

Circle 165 on Inquiry Card

System Facilities Brochure

A 12-page, 4-color, brochure describes the capabilities, facilities and equipment of Wickes Engineering and Construction Co., 12th St. & Ferry Ave., Camden 4, N. J. Their line of ground support equipment for missile systems is included.

Circle 166 on Inquiry Card

Transformers

A 4-page, illustrated brochure describes the new form of wound cut cores, as well as including a chart showing max. power handling of circular transformers at 400 cps. Gulow Transformer Co., Rt. 17 & Broad St., Carlstadt, N. J.

Circle 167 on Inquiry Card

New Foundation

Texas Instruments Incorporated, Dallas, Texas, has established the "Walter F. Joyce Foundation," a non-profit activity for the study of geophysical and geochemical phenomena. The initial grant is to M. I. T. for the study of radon gas by Prof. Robley D. Evans of the Physics Dept.

Radon is the only naturally occurring, long-lived, chemically inert, radioactive gas which is continuously generated and is always present in all rocks and soils. Prof. Evans will study the mechanisms which govern the escape of radon into the atmosphere.

Circle 83 on Inquiry Card →

New Products

P-C CONTACTS

The 400 series printed circuit "Fork" contacts feature full radiused contacting surfaces for smoother mating. These contacts are fabricated from spring tempered phosphor bronze and are finished with gold

plating. They are available in 3 different styles: for mounting upright to printed circuit panel, parallel to printed circuit panel or for 45° angular mating. These contacts are interchangeable with types now available. Methode Mfg. Corp., 7447 W. Wilson Ave., Chicago 3 Ill.

Circle 350 on Inquiry Card

COMPACT MERCURY RELAY

The Type HGSS mercury-wetted relay which provides the same sensitivity, high speed and long life of the HGS relay, is now available in a more compact size. The new relay is 25/32 in. shorter than the Type HGS. As in the HGS, the coil is fitted with side plates supporting 2 permanent magnets. Operating characteristics are established by adjusting the strength of these magnets

after assembly. A broad range of single-side-stable, bi-stable or chopper adjustments is available. It is suited for use as a high-speed chopper relay. C. P. Clare & Co., 3101 Pratt Blvd., Chicago 45, Ill.

Circle 351 on Inquiry Card

TRANSISTOR POWER SUPPLY

An all solid state dual power supply is designed for energizing transistorized electronic equipment. The Model 6033 operates from 115 vac. and provides 2 fixed voltage outputs; ± 15 vdc, each at 200 ma. Regulation

against line and load of the unit is under 0.01%. Ripple is under 0.5 mv. The power supply is available in 3 package types. George A. Philbrick Researches, Inc., 127 Clarendon St., Boston 16, Mass.

Circle 352 on Inquiry Card

WIRE TESTER

The WU-10024 is designed for testing wire and cable under temperature conditions from +80° to −100° F ±2°F. The pulldown is accomplished in 60 min. The chamber, measuring 24 x 26 x 72 in. is penetrated by a self-supporting cone-step mandrell which provides for testing on 2, 3, 4½ and 6 in. dia. The pillow-block construction will accommodate a test load of ½ ton. Two 2 in. ports, 12 x 12 in., frost-free multipane window

and interior illumination are incorporated in the unit. The power pack operates on current requirements of 230 v., 60 cps, 1 ø. Cincinnati Sub Zero Products, 3932 Reading Rd., Cincinnati 28, Ohio.

Circle 353 on Inquiry Card

This 3 lbs. of transistorized new AC amplifier gives you 20 or 40 db gain, increases scope or VTVM sensitivity 10 or 100!

This new hp 466A AC Amplifier is just 4" high, 6" wide and 6" deep. Yet it can become one of the most helpful instruments on your bench, or in the field. It is ac or battery powered; battery operation gives you hum-free performance and easy portability. Response is flat within approximately ½ db over the broad range of 10 cps to 1 MC, distortion is less than 1%, and gain is stabilized by substantial negative feedback to virtually eliminate effects of transistor characteristics and environment.

For a demonstration on your laboratory or field application, call your hp representative or write direct.

Specifications

Gain:	20 and 40 db, $\pm$0.2 db at 1000 cps.	**Distortion:**	Less than 1%, 10 to 100,000 cps.
Frequency Response:	$\pm$0.5 db, 10 cps to 1 MC; $\pm$3 db, 5 cps to 2 MC.	**Power:**	Ac line power normally supplied, but battery operation available. (12 radio type mercury cells, battery life about 160 hours.) Specify battery operation if desired.
Output Voltage:	1.5 v rms across 1500 ohms.	**Dimensions:**	6¼" wide, 4" high, 6¼" deep. Weight: approx. 3 lbs.
Noise:	75 μv rms referred to input, 100,000 ohm source.	**Price:**	$150.00 f.o.b. factory. (Either ac or battery operation.)
Input Impedance:	1 megohm shunted by 25 $\mu\mu$f.		
Output Impedance:	Approximately 50 ohms.		

Data subject to change without notice.

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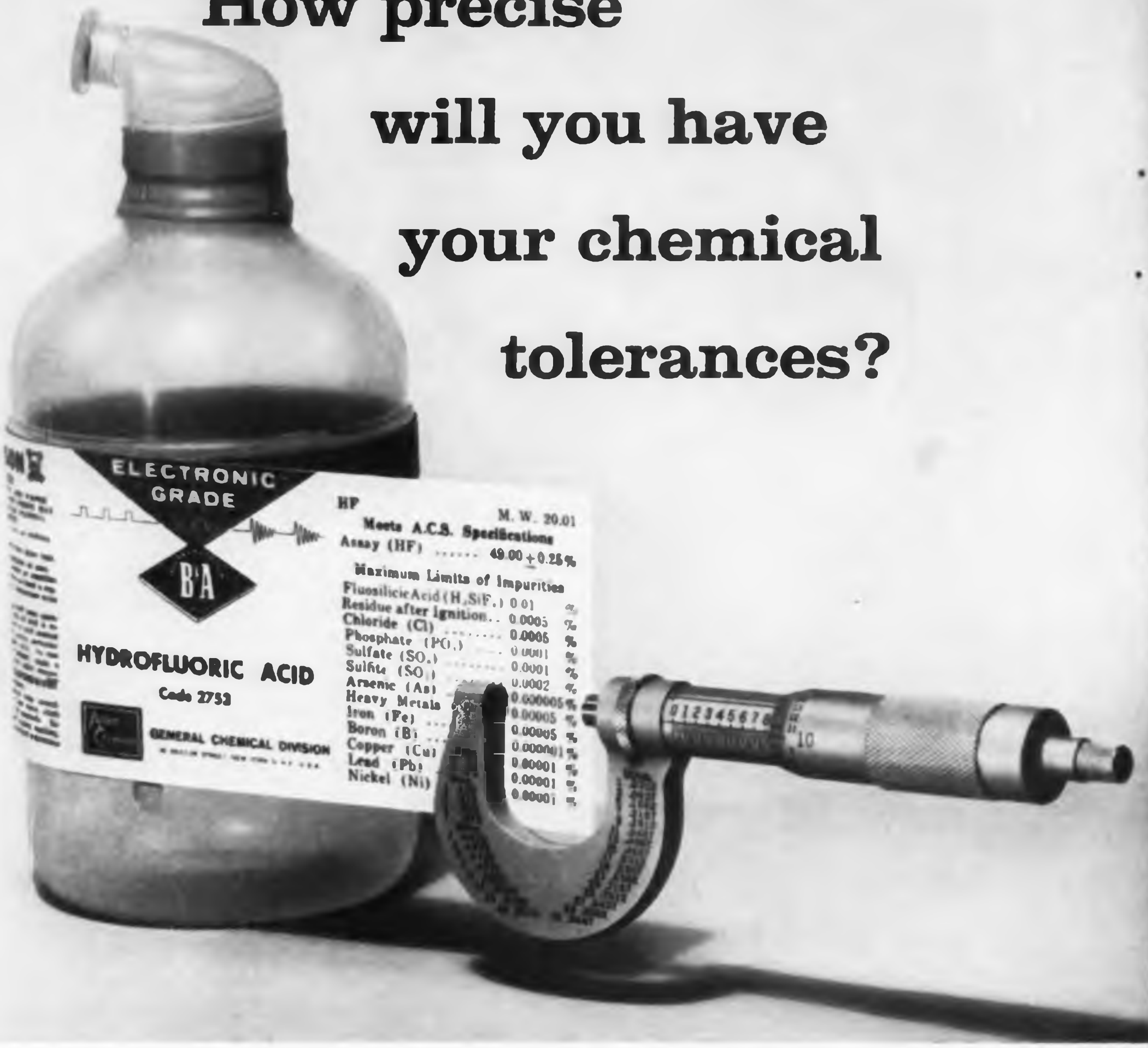

Maximum precision in a fine micrometer means measurement down to the ten-thousandth of an inch. With Baker & Adamson® "Electronic-Grade" Hydrofluoric Acid, impurities are held to the lowest levels ever attained... measured in ten-thousandths—even millionths of a *percent*.

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These new ultra-pure specifications for "Electronic-Grade" Hydrofluoric Acid are still another example of Baker & Adamson's continued leadership in supplying high purity production chemicals for the electronic industry. For the finest in electronic chemicals—always specify B&A!

Circle 97 on Inquiry Card

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Allied Chemical

GENERAL CHEMICAL DIVISION
40 Rector Street, New York 6, N. Y.

New Products

TANTALUM CAPACITORS

Tantalum, wet-electrolytic capacitors, Series TW (wire type) and Series TS (slug type) can be supplied with single-ended lead termination. Both the cathode and anode leads extend from the same end of

the capacitor. Leads are properly coded for easy identification. Single-ended lead termination finds use in fast assembly operations on modules and printed circuit terminal boards. Ohmite Mfg. Co., 3650 Howard St., Skokie, Ill.

Circle 348 on Inquiry Card

TRANSISTOR TESTER

The Model 890 transistor tester is capable of measuring ac Beta with an accuracy of 5%. Using an ac bridge principle, with the transistor input elements as one arm of the bridge, the total impedance is nulled. The all-transistorized tester measures the following in-circuit parameters: ac Beta, I_c, transistor input resistance and base-emitter circuit imped-

ance. It will also measure ac Beta, I_c and I_{cbo} out of circuit. It is self-contained and in a steel portable carrying case, 10¾ x 9 x 6⅛ in. and weighs 7¼ lbs. The Hickok Electrical Instrument Co., 10514 Dupont Ave., Cleveland 8, Ohio.

Circle 349 on Inquiry Card

New Products

INTERLOCK SWITCH

A 4 station interlock switch for use in military aircraft features an interlock or anti-defeat function where one button in the multi-station system is always down. Actuating any other button causes depressed

button to return to normal or "at rest" position. Circuitry is dpdt; electrical ratings 5 a @ 125/250 vdc; 5 a (res.) @ 30 vdc; 2.5 a (ind.) @ 30 vdc. Overall length is 3¾ in. WC 1730 is designed to meet Mil-S-6743, Mil-S-6744 and Mil-E-5272 as applicable. Control Switch Div., Controls Co. of America, Folcroft, Pa.

Circle 356 on Inquiry Card

TRANSISTOR TEST SOCKET

Socket for production testing of 3 or 4 lead transistors occupies 11/16 in. square x 1 7/16 in. long. Designed for ⅛ in. panel mounting in keyed hole and retained by a snap ring, sockets may be mounted on 0.812 in. centers. Double fingered spring contacts grip leads close to base of transistor with frictional force in excess of 50 gm on 0.017 in. dia. lead wires. Generous entry funnels assure ease of lead insertion. Contacts are beryllium copper, silver plated,

and terminate in rigid solder terminals on each face of body. Body is molded of glass filled Diall FS-5. Socket weighs less than 9 gms. (Cat. No. 72-101.) Jettron Products Inc., 56 Route 10, Hanover, N. J.

Circle 357 on Inquiry Card

Circle 101 on Inquiry Card →

NIKE-ZEUS TRACKING

Pilot model of the latest tracking and guidance system for the Nike-Zeus is moved from Bell Labs, Whippany, N. J., to the White Sands Proving grounds.

Webb Named NASA Head

James E. Webb, a President of Educational Services, Inc., a director of McDonnell Aircraft Corp. and former budget director under President Truman, has been named Chief of the National Aeronautics and Space Administration.

The new NASA chief is not a scientist or engineer, but has had wide administrative experience.

Epitaxial Transistors

Texas Instruments Incorporated has announced the availability of two ultra-fast silicon switching transistors made by the new epitaxial process. Switching function is performed in 24 x 10^{-9} secs. Initial use area is in electronic computers and as small-signal general purpose transistors.

Check-out Equipment

Automatic check-out equipment is being studied by PRD Electronics, Inc., Brooklyn. It will enable Navy technicians, without advanced avionics training, to detect and identify trouble in complex computers and other equipment.

The project has been named NAVSEA (Naval Avionics Support Equipment Appraisal). Project is supported by the Bureau of Naval Weapons.

Radio Station Ready

The Navy's 2-megawatt communication station (Cutler, Maine) is one year ahead of schedule. The station—for communications with operational Polaris submarines — has passed pre-operational tests. Continental Electronics Mfg. Co. is prime contractor for the $50 million project.

FREQ. STDS.

AND TUNING FORK OSCILLATORS

TYPE 10, ACTUAL SIZE

SIZE, 1-3/8" x 1-3/8" x 3/8"

This frequency standard (360 or 400 cy.) is accurate to ± 25 parts per million at 10° to 35°C. The tuning fork is made from Iso-elastic alloy and is approximately 1 inch long. Fork aging has been greatly minimized. Compensation in the circuit provides a minimum rate change throughout the useful life of the power cell (over a year). External power of 1.4 volts at approximately 6 microamperes can also power the unit. An hermetically sealed model, Type 15, is also available.

TYPE 2007

TYPE 15

For more than 20 years, this company has made frequency standards and fork oscillators within the range of 30 to 30,000 cycles for applications where consistent accuracy and rugged dependability are demanded. A few examples are shown and described here.

Some users integrate these units into instruments of their own manufacture. Others rely on our experience and facilities to develop complete operating assemblies to meet their special needs.

You are invited to submit any problems within the area of our activities for study by our engineering staff.

TYPE K-5A FREQUENCY STANDARD

Size, 3½" x 3" x 1¾"
Weight, 1½ lbs.
Frequency: 400 cycles
Accuracy: .03%, —55° to + 71°C
Input: 28V DC ±10%
Output: 400 cy. approx. sq. wave at 115V into 4000 ohm load (approx. 4W)

TYPE 2007-6 FREQUENCY STANDARD

Transistorized, Silicon type
Size, 1½" dia., x 3½" H., Wt., 7 oz.
Frequencies: 360 to 1000 cy.
Accuracies:
2007-6 ± .02% (—50° to +85°C)
R2007-6 ± .002% (+15° to +35°C)
W2007-6 ± .005% (—65° to +85°C)
Input: 10 to 30V DC at 6 ma.
Output: Multitap, 75 to 100,000 ohms

TYPE 25 PRECISION FORK

Size, ⅝" dia. x 2⁵⁄₁₆"
Weight: 2 ounces
Frequencies: 200 to 1000 cy. (specify)
Accuracies:
R-25T and R-25V ± .002% (15° to 35°C)
25T and 25V ± .02% (—65° to 85°C)
For use with tubes or transistors.

TYPE 15 FREQUENCY STANDARD

Similar to Type 10 (illustrated) except with silicon transistor, hermetically sealed and vibration resistant.
Size, 1" x 2" x 2" high
Tolerance, ± .01% from —40°C to + 71°C
Output: .1V at 50,000 ohms source impedance.

ATP

AMERICAN TIME PRODUCTS, INC.
61-20 Woodside Ave., Woodside 77, L.I., N. Y.

Circle 103 on Inquiry Card

PRD *previews / reviews / design notes*

Measuring Microwave Frequencies

Of the four basic microwave measurements, i.e., (1) VSWR (2) Power (3) Attenuation and (4) Frequency, the latter is probably the easiest to determine. There are available, of course, many frequency meters with varying degrees of accuracy. These are generally either tunable cavity-type resonators or devices which utilize a harmonic of a low frequency standard.

Cavity Frequency Meters

Cavity-type frequency meters, both coaxial and waveguide, make use of the absorption (reaction) or transmission properties of selectively tuned resonators. In use, the meter is inserted between the signal source and the r-f detector indicator. The reaction or absorption type instrument is tuned to obtain a decrease in power level at the detector and, consequently, is particularly useful as a search frequency meter. The transmission type unit passes only those frequencies within the pass band of the resonant cavity and so is most convenient for monitoring or filtering purposes.

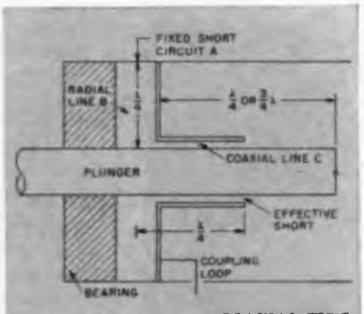
Of the dozens of frequency meters available from PRD, among the most popular and simplest to use are the

PRD 555

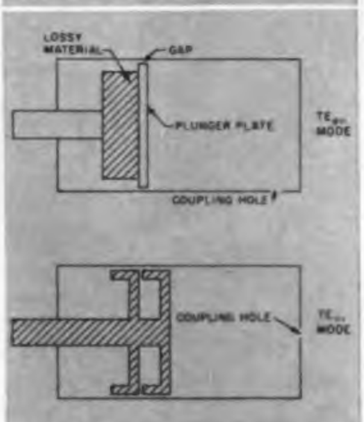
PRD 555-579 Series. They are high precision, direct reading, hermetically sealed, temperature compensated instruments and are particularly useful for laboratory and production line testing or as secondary standards.

At X band frequencies the PRD 559-A or B, which are available in both reaction and transmission types, are accurate to 0.015% with readout directly in megacycles.

Typical cross sectional views are shown for both coaxial and waveguide resonating cavities in this series of precision meters.



COAXIAL TYPE



WAVEGUIDE TYPE

UHF Frequency Meter

Another popular and useful meter in the UHF television band is the PRD 587-A, which is accurate to ±0.2%. It can be used for alignment of tuned circuits and oscillators in the frequency range of 250 to 1000 megacycles. The direct reading dial has a scale length of 60 inches for easy and accurate readout. For convenience and protection the meter is housed in a metal carrying case with a handle.

PRD 587-A

Precision Heterodyne Frequency Meter

An instrument that uses the heterodyne principle with a crystal oscillator as its standard is the PRD 504 Precision

PRD 504

Heterodyne Frequency Meter. It has an extended range of 100 to 10,000 megacycles and is accurate to 0.002%. This versatile and portable instrument is used for laboratory and field testing of transmitters, receivers, and signal generators. A cathode ray tube is provided for zero-beat indication on the front panel.

If you would like some assistance with your frequency measuring problems, please contact our Applications Engineering Department.

We have many interesting openings for engineers...contact Mr. John R. Zabka

PRD ELECTRONICS, INC.

A Subsidiary of Harris-Intertype Corporation
Formerly Polytechnic Research & Development Co., Inc.

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Please send me further information on the items I have circled above.

ALPHABETICAL LISTING OF

CIRCLE THE NUMBERS OPPOSITE THE NAMES OF THE

110 Adams & Westlake Company, The—Mercury-wetted relays.
119 ADC Incorporated — Ultrasonic output transformers.
122 Aerovox Corporation—Electrolytic capacitors.
46 Air Marine Motors, Inc.—Motors.
22 Airpax Electronics, Incorporated — Circuit breakers.
88 Allen-Bradley Company — Resistors and potentiometers.
89 Allen-Bradley Company—Ferrites.
97 Allied Chemical, General Chemical Div. —Electronic-grade hydrofluoric acid
149 Alpha Metals, Inc. — Solder and flux R&D kit.
21 American Airlines, Inc.—Air transportation.
124 American Electrical Heater Company—Transformer type electric soldering iron
108 American Time Products, Inc. — Frequency standards.
107 AMP Incorporated — Plug-in circuit units.
85 Ampex Corporation—Computer and analog tapes.
80 Amphenol-Borg Electronics Corporation, Amphenol Connector Div.—MIL connectors.
34 Amphenol-Borg Electronics Corporation, Borg Equipment Div.—Miniature trimmer potentiometers.
92 Antenna Systems, Inc.—Antennas.
7 Arco Electronics, Inc.—Transformer distribution.
32 Armco Steel Corporation, Armco Div.—Thin electrical steels.
79 Arnold Engineering Company, The—Tape cores.
168 Arnold Magnetics Corporation — Solid state power supplies.
144 Artos Engineering Company—Automatic wire finishing machine.
86 Avnet—Connector distribution.

64 Ballantine Laboratories, Inc. — Digital readout RMS voltmeter.
153 Bead Chain Mfg. Co., The—Contact pins, terminals, jacks, bead chains.
43 Beckman Instruments, Inc., Berkeley Div.—Modular digital multimeter.
891 Beckman Instruments, Inc., Helipot Div. —Trimming potentiometers.
112 Bell, Inc., F. W.—Digital voltmeter.
127 Boehme, Inc., H. O.—Precision design & manufacture of component parts.
418 Boonton Electronics Corporation — R.F. power meter.
67 Borg-Warner Corporation, Ingersoll Products—Metal cabinets.
96 Bourns, Inc., Trimpot Div.—Potentiometer engineering.
156 Brady Company, W. H.—Wire markers.
409 Braun Tool & Instrument Company, Inc.—Contact strips and rings.
106 Breeze Corporations, Inc.—Custom and standard slip ring assemblies.
414 Bruno-New York Industries Corporation —Pig-tailoring machine.
58 Brush Instruments, Div. of Clevite — Chart paper.
76 Burnell & Co., Inc.—Toroids, filters and related networks.
154 Burroughs Corporation, Electronic Tube Div.—Digital readout tubes.
395 Bussmann Mfg. Division McGraw-Edison Co.—Fuses, clips, blocks & holders.

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18 Centralab, The Electronics Div. of Globe-Union, Inc.—Variable resistor.
67 Cinch Manufacturing Company — Subminiature plugs and sockets.
101 Clare & Company, C. P.—Sealed contact relays.
31 Clarostat Manufacturing Company, Inc. —10-turn potentiometers.
892 Clevite Transistor Products—Transistors.
16 Clevite Corporation, Shockley Transistor —4-layer diodes.
148 Columbian Carbon Company—Iron oxides for ferrites.
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100 Consolidated Vacuum Corporation — 10-port vacuum manifold system.
45 Continental Electronics Manufacturing Company—Acquisition radar transmitters.
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71 Cornell-Dubilier Electronics Div.—Capacitors.
19 Corning Glass Works—Trimmer capacitor.
129 Curtiss-Wright Corporation—Time delay relays.
131 Curtiss-Wright Corporation — Thermal time delay relays.
405 Custom Components, Inc. — Permeable dielectric.

98 Dale Electronics, Inc.—Trimmer potentiometers.
182 Daven Company, The—Headset amplifier.
27 Deutsch Company — Self-aligning rack-and-panel connectors.
117 Dialight Corporation — Multiple indicators.
29 Dow Corning Corporation—Single crystal silicon.
64 DuMont Laboratories, Allen B.—Storage oscilloscope.

133 EICO, Electronic Instruments Co., Inc. —Electronics catalog.
30 Eimac Company—Microwave tubes.
135 Electra Manufacturing Company—Space-saving hermetically sealed and matched resistors.
43 Electro Scientific Industries — Universal impedance bridge.
58 Elgin National Watch Company—4-pole power control relays.
146 ESC Electronics Corp.—Miniaturized low pass and high pass filters.

38 Fairchild Controls Corporation — Strain gage pressure transducer.
66 Fairchild Semiconductor Corporation—Planar transistors.
120 Fansteel Metallurgical Corporation—Capacitors and rectifiers.
55 Fluke Manufacturing Company, Inc., John—Universal impedance bridge.
49 FXR, Inc.—Precision waveguide components.

108 General Electric Company, Cathode Ray Tube Dept. — Advanced-design camera tubes.
68 General Electric Company, Power Tube Department—X-band microwave tubes.
77 General Electric Company, Rectifier Components Dept. — Medium current silicon rectifiers.
33 General Electric Company, Semiconductor Products Dept. — Tunnel diode manual.
115 General Electrodynamics Corporation — Electrostatic focus & deflection vidicon tube.
69 General Instrument Corporation, Semiconductor Div.—Silicon rectifiers.
40 General Motors Corporation, Delco Radio Div.—Semiconductor distribution.

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PROFESSIONAL ENGINEERING OPPORTUNITIES

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504 Philco Techrep Div.

41 Hewlett-Packard Company—AC current probe.
424 Hewlett-Packard Company—Transistorized AC amplifier.
87 Hill Electronics, Inc.—Crystal controlled frequency sources and filters.
152 Howard Industries, Inc.—Universal motors.
20 Hughes Aircraft Company, Semiconductor Div.—Silicon alloy transistors.
37 Hughes Aircraft Company, Industrial Systems Div.—Memory-type oscilloscope.

95 IERC, International Electronic Research Corporation—Heat-dissipating electron tube shields.
139 Illinois Condenser Company—Miniature electrolytic capacitors.
400 Industrial Electronic Engineers, Inc.—In-line digital readout devices.
56 Inland Motor Corporation of Virginia—D-C torque motors.
159 Interelectronics Corp.—Solid-state power inverters.
72 IRC, International Resistance Company Trimmer potentiometers.
118 Institute of Radio Engineers—IRE Show.
399 Institute of Radio Engineers—IRE Show.
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417 Institute of Radio Engineers—IRE Show.

102 Jennings Radio Mfg. Corporation—Vacuum coaxial relays.
415 Jerrold Electronics Corporation—Sweep signal generator.
136 Jettron Products, Inc.—Magnetron connectors.
188 Jettron Products, Inc.—Special sockets and connectors.
105 JFD Electronics Corporation—Trimmer capacitor.
151 Johnson Company, E. F.—Variable capacitors.
143 Jones Division, Howard B.—Plugs & sockets.
26 Jones Electronics Company, Inc., M. C., Subsidiary of Bendix Corp.—Directional DC and RF output couplers.

126 Kay Electric Company—Sweep generator.
12 Keuffel & Esser Company—Printed circuit drafting materials.
111 Lel, Inc.—Octave RF amplifiers.
99 Lenz Electric Manufacturing Company—Double channel audio cable.

140 Marconi Instruments—Capacity bridge.
15 Microwave Associates, Inc.—Semiconductor Div.—Subminiature RF diodes.
410 Mid-Eastern Electronics, Inc.—Transistorized power supplies.
28 Midland Manufacturing Company—Miniature wide band-pass crystal filters.
24 Minneapolis-Honeywell Regulator Company—Meter distribution.
134 Minnesota, Dept. of Business Development—Industrial Horizons Minnesota.

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80 Non-linear Systems, Inc.—Recording digital voltmeter.
114 Nothelfer Winding Laboratories, Inc.—Portable AC power supply.
402 Ogilvie Press, Inc.—Tracing paper.
14 Ohmite Manufacturing Company—Resistors.
116 Perfection Mica Company, Magnetic Shield Div. — Thin shielding foils shielded containers.
130 Philbrick Researches, Inc., George A — Octal plug-in amplifiers.
10 Philco Corporation, Lansdale Div.—Switching transistors.
422 Polarad Electronics Corp. — Microwave Generators.
423 Polarad Electronics Corp. — Microwave Generators.
88 Potter & Brumfield, Div. of AMF Canada Ltd.—Miniature 4-pole relay.
51 Potter Instrument Company, Inc.—High density recording system.
411 Power Designs, Inc. — Voltage current regulator.
418 Powertron Ultrasonics Corp. — Ultrasonic cleaning equipment.
104 PRD Electronics, Inc.—Frequency meters.

394 Radio Cores, Inc. — Powdered iron toroids.
1 Radio Materials Company—Ceramic disc capacitors.
9 Rayclad Tubes Incorporated — Heat shrinkable molded parts.
398 Reeves-Hoffman, Div. of Dynamics Corp. of America—1-MC precision crystal oscillator.
90 Reeves Instrument Corporation, Subsidiary of Dynamics Corp. of America —Miniature floated integrating gyros.

62 Sarkes Tarzian, Inc., Semiconductor Div. —Silicon rectifiers.
121 Scientific-Atlanta, Inc.—Antenna pattern analyzer.
398 Sekonic Inc.—Precision meters.
80 Shallcross Manufacturing Company—Delay lines.
86 Sonotone Corp.—Ceramic stereo cartridge.
47 Spectrol Electronics Corporation—Trimming potentiometers.
11 Sperry Rand Corporation, Semiconductor Div.—Silicon choppers.
2 Sprague Electric Company — Tantalum capacitors.
6 Sprague Electric Company—Pulse-forming networks.
390 Sprague Electric Company—RF interference locator.
8 Stackpole Carbon Company — Ferrite cores.
397 Stainless, Inc.—Tower tips.
421 Stanpat Company—Drafting symbols.
5 Stevens Manufacturing Company, Inc.—Thermostats.
406 Stromberg-Carlson, Div. of General Dynamics—Telephone-type relays.
28 Sylvania Electric Products, Inc., Electronic Tubes Div.—Cold cathode decade counter tubes.
81 Sylvania Electric Products, Inc., Semiconductor Div.—Silicon & germanium transistors.
3 Syntronic Instruments, Inc.—Deflection yoke coils.

42 Taylor Fibre Company—Glass-base laminated plastics.
18 Tektronix, Inc.—Dual-beam oscilloscope.
419 Templet Industries, Inc.—Die tooling system.
4 Texas Instruments Incorporated—Germanium mesa transistor.
407 Thomas & Betts Ltd.—Printed board connectors.
408 Thomas & Betts Ltd.—Solderless connectors.
166 Times Wire & Cable Division, The International Silver Company—Custom cable assemblies.
137 Tinsley Laboratories, Inc.—Corning glass filters.
403 Trak Microwave Corporation—Oscillator cavity.
73 Transitron Electronic Corporation—50-AMP controlled rectifier.
147 Tung-Sol Electric Inc.—Series regulator tube.

26 Ungar Electric Tools — Light-weight, easy-handling soldering iron.
76 Union Switch & Signal, Div. of Westinghouse Air Brake Co.—Relays.
92 United Van Lines—Home or industrial transportation.
68 U. S. Components, Inc.—Printed card connectors.

404 Vector Electronic Company—Structures for circuitry.
61 Victoreen—High voltage regulator or amplifier tube.
126 Vitro Electronics — Modular telemetry receiver.

91 Waveline, Inc.—Waveguide switches.
150 Weckesser Company — Molded nylon screws and nuts.
416 Western Rubber Company—One piece seal rings.
401 Western-Sky Industries—One piece nylon grommets.
74 Westinghouse Electric Corp., Semiconductor Dept.—Silicon rectifier stacks.
82 White, S. S.—Air abrasive units.

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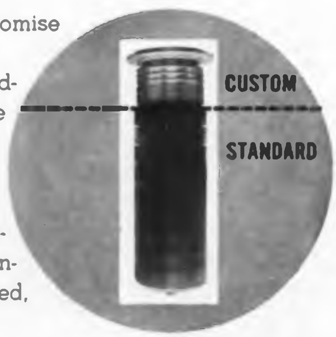

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AUDIO

Considerations Concerning Receivers VHF FM and VHF FM Stereo, E. Paulsen. "El. Rund." Dec. 1960. 4 pp. The RF signal-noise ratio for good VHF reception, monaural and stereo, is calculated on the basis of theoretical requirements. The result for monaural operation is compared with experimental values. The generally employed limiter is critically reviewed. (Germany.)

What do we Perceive as Uniform Noise?, L. Schreiber. "Freq." Dec. 1960. 5 pp. Noise can be presented as the output of a fourpole, whose input is a sequence of narrow pulses. Whether the human ear perceives such a process in the audio range as noise, depends on the median number of pulses per unit time and on the transfer function of the fourpole. Some simplifying assumptions are made, after which an experiment is described that determines the impulse density needed for the ear to perceive the pulses as uniform noise. In this experiment, randomly distributed pulses of equal amplitude were passed through a low-pass filter before the above determination was made. (Germany.)

An Acoustic Spectrum Analyzer with Electronic Scanning, D. J. H. Admiral. "Phil. Tech." #12, 1960. 8 pp. Beljer's acoustic spectrum analyzer contains 79 filters whose pass bands, each a semitone in width, consecutively cover a frequency range from 86.5 to 7440 c/s. (Netherlands, in English.)

CIRCUITS

A Low Frequency RC Sweep Generator with an Incorporated Varicap. L. S. Berman. "Radiotek" 15, No. 12, 1960. 2 pp. A low-frequency RC sweep generator is described in which frequency sweeping is achieved by changing the capacitance of a non-linear condenser with a varying bias. The frequency of the sweep generator changes linearly with time. The ratio of the maximum frequency to the minimum frequency is 1.6. This circuit was used for an oscilloscope display of a low-frequency amplifier frequency response. (U.S.S.R.)

Frequency Multiplication by Large Factors Using Start-up Oscillators, G. Becker. "Freq." Dec. 1960. 3 pp. A start-up oscillator controlled by a pulse generator circuit allows frequency multiplication by factors of some thousands. (Germany.)

Transistorised DC Amplifiers, A. C. Piulipov. "El. et Auto." Nov.-Dec. 1960. 5 pp. It is not too easy to design a good dc amplifier using tubes, because of zero drift. Difficulties pile up when transistors are used, because their parameters vary rapidly with temperature. Several methods are presented to reduce the effect of the variation of base current. (France.)

CONTROLS

Dual Control Theory, II, A. A. Feldbaum. "Avto. i Tel." Nov. 1960. 12 pp. Basic formulae are deduced and an optimum control algorithm is determined in the general form firstly for an open-loop system and then for a closed-loop one which is nonlinear in the general case at the dual control (1). Signs of likeness and difference of solutions for an open-loop and closed-loop systems are indicated. (U.S.S.R.)

Optimization of Destillation Columns Using Feed-Forward Computer Control, J. G. Dobson. "rt." Nov. 1960. 7 pp. Conventional-type methods of feed-back control use measurements obtained at intermediate or final stages to compensate for disturbances occurring at the beginning of the process to be controlled. Instead of this, fed-forward control measures the conditions before entering the process, computes the expected disturbance quantity, and compensates for it immediately, effecting the necessary changes. Therefore time-lags can be avoided to a high degree. This main advantage of feed-forward computer control is demonstrated. (Germany.)

Effect of Electrical Control Element on Choice of Hydraulic Amplifier Parameters. I. M. Krassov, et al. "Avto. i Tel." Dec. 1960. 4 pp. There is a well-grounded calculation of the initial pressure in the chamber between throttles of the hydraulic amplifier of the nozzle-flapper type which is controlled by an electromagnetic element, the characteristics of the element being taken into consideration. (U.S.S.R.)

GENERAL

Modern High Vacuum Techniques, N. W. Robinson. "Brit. C&E." Nov. 1960. 4 pp. Modern improvements in high vacuum techniques have enabled pressures of 10^{-10} torr or less to be obtained in closed systems such as thermionic tubes without the use of chemical getters. At these pressures some metallic surfaces can be maintained clean for periods of several hours during which time accurate investigations may be made on reactions at clean gas-solid interfaces hitherto impossible because of contamination. (England.)

Electronics and Communications in Argentina, Compiled by Jose I. Caicoya. "Brit. C&E." Nov. 1960. 8 pp. A system combining both State control and private enterprise has been established in Argentina for the telecommunications and electronics industries following the fall of the Peron regime in 1955. This article reviews the present position. (England.)

Induced Power from Grid Lines, A. Wright. "Brit. C.&E." Nov. 1960. 3 pp. One of the difficulties of sending r-f signals between the ends of electrical power lines in the grid system is the provision of power supplies for the repeater amplifiers. This article describes a method of inducing power into an aerial from the lines. (England.)

REGULARLY REVIEWED

AUSTRALIA

AWA Tech. Rev. AWA Technical Review
Proc. AIRE. Proceedings of the Institution of Radio Engineers

CANADA

Can. Elec. Eng. Canadian Electronics Engineering
El. & Comm. Electronics and Communications

ENGLAND

ATE J. ATE Journal
BBC Mono. BBC Engineering Monographs
Brit. C.&E. British Communications & Electronics
El Tech. Electronic Technology
GEC J. General Electrical Co. Journal
J. BIRE. Journal of the British Institution of Radio Engineers
Proc. BIEE. Proceedings of Institution of Electrical Engineers
Tech. Comm. Technical Communications

FRANCE

Bull. Fr. El Bulletin de la Societe Francaise des Electriciens
Cab. & Trans. Cables & Transmission
Comp. Rend. Comptes Rendus Hebdomadaires des Seances
Onde. L'Onde Electrique
El. et Auto. Electronique et Automatisme
Rev. Tech. Revue Technique
Telonde. Telonde
Toute R. Toute la Radio
Vide. Le Vide

GERMANY

AEG Prog. AEG Progress
Arc. El Uber. Archiv der Elektrischen Ubertragung
El Rund. Electronische Rundschau
Freq. Frequenz
Hochfreq. Hochfrequenz-technik und Electro-akustik
Nach. Z. Nachrichtentechnische Zeitschrift
Rt. Regelungstechnik
Rundfunk. Rundfunktechnische Mitteilungen
Vak. Tech. Vakuum-Technik

POLAND

Prace ITR. Prace Instytutu Tele-I Radiotechnicznego
Roz. Elek. Rozprawy Electrotechniczne

USSR

Avto. i Tel. Avtomatika i Telemekhanika
Radio. Radio
Radiotek. Radiotekhnika
Rad. i Elek. Radiotekhnika i Elektronika
Iz. Acad. Bulletin of Academy of Sciences USSR.

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Procurement Decisions Must be Based on Sound Economic Studies, Ian R. Dutton. "Can. El. Eng." Dec. 1960. 8 pp. The financial relationship between electronic equipment and industrial processes can become very complex. This article, based on studies of actual installations in uranium mines and mills, describes the careful analysis needed to determine the economic advantages of an electronic ore sorter. It considers two typical operating and marketing conditions to show how the ore sorter can reduce cost. (Canada.)

The New Electronics, Magnetism 3—Materials and Microwave Applications, Phonon. "El. Tech." Nov. 1960. 6 pp. (England.)

Interference Suppression in Household Appliances, F. A. Thebridge. "Proc. AIRE." Sept. 1960. 4 pp. The problem of interference suppression in household appliances is discussed, together with the paths by which interference arrives at radio and television receivers. A portion of the paper describes the design and application of interference suppression capacitors, covering star, delta and series, single winding types. The combination of capacitors and inductors into a line filter and the proper use of it is explained. (Australia.)

The Theory of Magnetic Modulators with Transverse Fields and Main Frequency Output, F. I. Kerbnikov. "Avto. i Tel." Nov. 1960. 6 pp. The theory of magnetic modulator with transverse fields, provided the induction of the modulator control winding changes periodically is expounded. Basic results obtained in the paper are confirmed by the experimental data. (U.S.S.R.)

Investigations of Metal Oil Diffusion Pumps in the Ultra High Vacuum Range, R. A. Haefer and J. Hengevoss. "Vak. Tech." Dec. 1960. 5 pp. In a vacuum system characterized by two metal oil diffusion pumps in Series Diff 170 and Diff 60, and gold metal joints on the high vacuum side, the lgp—1/T dependence was measured in a temperature range of −40 to +100°C after heating the test dome at 400°C for some time. A high speed gage arrangement is used. The characteristic differences of the four oils used, i.e., mineral oils Apiezon C and Diffoil 71 and silicones as PD 75 and DC 704—especially at the lower kink of the lgp—1/T—curve are discussed. (Germany.)

The Scientific Work of Balthasar van der Pol, H. Bremmer. "Phil. Tech." #2, 1961. 7 pp. The review given deals principally with the work done by Van der Pol in the years from 1922 to 1949, when he was with the Philips Research Laboratories at Eindhoven. (Netherlands, in English.)

The Influence of Back-Diffusion on the Sensitivity of Photoelectric Counters, K. M. Vahibruch. "Vak. Tech." Dec. 1960. 4 pp. The probability for an electron which is emitted from a photoelectric cathode to reach the anode and so to contribute to the measurement is, in a gas filled tube, smaller than in vacuo. The electrons collide with the gas molecules and are partly being scattered back to the emitting electrode. The influence of the gas atmosphere on counters made of aluminum has been investigated. (Germany.)

Are we Selling our Defense Industry Short?, W. S. Kendall. "El. & Comm." Nov. 1960. 3 pp. Canada's electronic defense industry is fighting for survival. In the absence of adequate government funding for research and development, leading to the production of advanced design technical equipment, this important segment of our technology will disappear leaving behind it nothing but the ghosts of achievements passed. (Canada.)

A Shaft Position Indicator, A. Etaniforth and P. G. Hodgson. "El. & Comm." Nov. 1960. 4 pp. A shaft position indicator using a synchro-resolver as an analog to digital transducer is described in the following article. The overall error of the system is ±0.3°. Some advantages of the synchro-resolver are discussed. (Canada.)

Electronic Cardiology, F. Juster. "El. et Auto." Nov.-Dec. 1960. 4 pp. Electronic techniques find interesting applications in the field of cardiology, be it for amplification, recording or analysis of noises. These applications have even been extended to the case of the foetus, and this article describes a foetoscope which reproduces aurally the foetal heartbeats and presents the corresponding curve on the screen of an oscilloscope. (France.)

A Bakable Ultra-High-Vacuum Valve of Large Cross-Section, Hans-Werner Drawin. "Vak. Tech." Oct. 1960. 8 pp. A bakable ultra-high-vacuum valve is described whereby sealing is obtained by means of a golden or silver plate. The valve, either in its open or closed position, can be baked up to 500°C. (Germany.)

Poor Reliability of Electronic Equipment and its Causes, H. J. Frundt. "Nach. Z." Nov. 1960. 5 pp. The general failure characteristic of maintained equipment shows that the failure rate is constant during normal operational periods. The law of failure in a series circuit and in a parallel circuit is quoted and the effect of the quality of the components on the reliability of the equipment is outlined. (Germany.)

Determination of Transfer Functions of Certain Variable Parameter Systems, B. E. Rudnitsky. "Avto. i Tel." Dec. 1960. 11 pp. A method of determination of transfer functions of systems described by common high-order differential equations with variable coefficients when these coefficients are polynomials is explained. (U.S.S.R.)

Tunable Molecular Oscillator and Amplifier for Millimetric Wave Range, H. Awender. "El. Rund." Dec. 1960. 2 pp. J. R. Singer suggested the utilization of atomic or molecular rays in an oscillator or amplifier for the millimetric range tunable through a wide frequency range. An atomic ray is employed where the atoms are in two energy levels. After separation, the higher-level atoms are excited into an equiphase transition to the lower energy level by a homogeneous magnetic field. (Germany.)

Reservation by Means of Spare Parts Substitution, M. A. Sinitza. "Radiotek" 15, No. 12, 1960. 10 pp. A method to calculate the reliability of complex systems is discussed. The systems consist of a number of operating and reserve elements. The method considers the fact that damage to reserve elements constitutes an event statistically dependent on the damage to basic elements or reserve elements put previously in operation. The effectiveness of reserved replacement is analyzed as a function of various values of reservation multiplicity. (U.S.S.R.)

INDUSTRIAL ELECTRONICS

Data on Leading Executives in U. S. Electronics Industry, G. Meyer. "El. Rund." Nov. 1960. 1 p. The average leading expert in electronics in the U. S. is 56 years of age and has an annual income of $82,700. This is the result of an investigation involving 1700 top-flight people of the U. S. industry, their education, income and working conditions. In accordance with the many chances offered by electronics, the leaders in this field are the most versatile. One out of three had previously worked for three or more other employers before assuming his present position. Another typical feature is that one out of four holds a position that did not exist before in that organization. (Germany.)

Problems Facing Industrial Electronics Manufacturers in Canada, Eric W. Leaver. "Can. El. Eng." Dec. 1960. 8 pp. The author examines some of the problems of Canadian manufacturers of industrial electronic equipment. These are classified as problems generated by the manufacturers, by their customers, by government, and by Canada's geography. He concludes that the development and aggressive marketing of unique products will provide the main solution to many of these problems. (Canada.)

Self-Adapting Controls Will Extend Range of Industrial Automation, Arthur Porter. "Can. El. Eng." Dec. 1960. 4 pp. Considerable attention is being devoted in many laboratories to the study of self-adapting control systems, spurred by parallel developments and industry's needs. This article indicates how self-adapting systems differ from conventional controls, discusses the inclusion of learning capability, and shows why their development is so important. (Canada.)

Industrial Applications of Zener Diodes, M. Lelong. "El. et Auto." Nov.-Dec. 1960. 8 pp. The voltage stabilizing properties of Zener diodes are useful in a number of circuits. The article describes typical applications for measuring instruments overload protection, low-voltage regulation, and square-wave generation. (France.)

Approximate Determination of Jet Reaction in Hydraulic Amplifier of Nozzle-Flapper-Type, I. M. Krassov, et al. "Avto. i Tel." Nov. 1960. 3 pp. The calculation of an approximate value of a power with which an operational liquid jet affects a flapper is expounded. The obtained results are compared with the experimental data. (U.S.S.R.)

Problems Facing Users of Industrial Electronic Equipment, Harold Price. "Can. El. Eng." Dec. 1960. 2 pp. This article attempts to show the users' side of the picture, based on interviews by CEE's editors. (Canada.)

Electronics in the Coal Mine, G. M. Wells. "Brit. C.&E." Nov. 1960. 5 pp. This is the first of a series of four articles from members of the staff of the Mining Research Establishment of the National Coal Board, which are put forward in support of the thesis that electronic instrumentation and control gear have an important contribution to make to the efficiency of the industry and the well-being of its workers. (England.)

MEASURE & TESTING

Spectrum of Pulse Sequences with Time Modulation, V. S. Fein. "Radiotek" 15, No. 11, 1960. 3 pp. At the expense of several considerable simplifications, a useful formula is obtained for engineering design and calculations of complex amplitudes of pulse spectral components with time modulation. This design formula is presented and applied to a concrete example. (U.S.S.R.)

Development of a Highly Stable Decadic Short-wave Exiter for the 1.5-30 Mc/s Range, H. Valdorf and R. Klinger. "Freq." Oct. 1960. 9 pp. The principle of frequency generation is described and the stability problems of the automatic frequency control system are discussed. (Germany.)

Measurement of Receiver Noise, F. F. Gardner. "Proc. AIRE." Oct. 1960. 6 pp. Methods for measuring radio receiver noise, either in terms of "noise factor" or "noise temperature" are reviewed. The various types of noise generator are described and their limitation discussed. The factors affecting the overall accuracy of noise measurement are considered in detail. (Australia.)

Sources

The Quantitative Measurement of Molecular Beams of Small Intensities by Partial Neutralization of Electron Space Charge in a Diode, D. Fuchs. "Vak. Tech." Oct. 1960. 7 pp. (Germany.)

Foundation of Application of Describing Function Method to Analysis of Periodic Oscillations of Time Lag Systems, V. S. Kisljakov. "Avto. i Tel." Nov. 1960. 9 pp. Problems connected with foundation of application of the describing function method by N. M. Krylov and N. N. Bogolubov (1, 2) to the analysis of periodic oscillations of time lag systems which are described by the n-th order linear differential equations with lag, are considered. (U.S.S.R.)

A Simple Method of Determining the Thermal Conductivity of Solids, J. Schroder. "Phil. Tech." #12, 1960. 4 pp. The two ends of a cylindrical sample, about 18 mm in diameter and 0.5-30 mm in length, are kept at constant temperatures, by contact with two boiling liquids of suitable boiling points, viz. differing by about 10°C. The time is measured in which a quantity of heat flows, in the steady state, through the sample. (Netherlands, in English.)

RADAR, NAVIGATION

Development of Fire Control Radars, J. E. Engledew. "Brit. C.&E." Nov. 1960. 5 pp. A major military threat today is attack by supersonic tactical strike aircraft capable of high speeds at low altitudes. The inability of line-of-sight radars to give sufficient early warning for long-range weapon launching, and the problems of background clutter at effectively zero elevation, makes successful engagement difficult. Early warning is obviated by dealing with the low-level target by means of a short-range weapon system with a rapid time into action. (England.)

The Principles of 3-Dimensional Radiolocation (3D-radar). "Nach. Z." Dec. 1960. 9 pp. The object of 3D-radar is the continuous measurement of azimuth, elevation and distance of targets. After a discussion on the propagation conditions in the microwave region, the limits of 3-dimensional radio location are outlined with due consideration of the operational requirements in respect of vertical resolution, range and height coverage. (Germany.)

Generation of High Voltage Pulses, K. D. Moser. "El. Rund." Dec. 1960. 2 pp. To monitor the magnetron, special test points for pulse current and voltage are required which should be stable against high-voltage breakdown. Moreover, the delay-line pulse generator should be designed to protect the magnetron and high-voltage parts from overvoltages occurring whenever the magnetron, due to a wrong mode of oscillation, does not form the proper termination of the delay line. (Germany.)

The Effect of the Radar Wave-Length on the Hourly Rate of Detected Meteorites, E. I. Fialko. "Radiotek" 15, No. 12, 1960. 3 pp. An investigation of the possibility to approximate the relationship between the number of detected meteorites and the wave-length by a parabola $N - \lambda^n$ is presented. The index n essentially depends on the T min factor of the radar. In the case, where T min = 0.035 sec. (which is true for a type TPI station), linear and cubic approximations are possible. (U.S.S.R.)

Correlation Functions and Spectra of FM Radar Signals, S. E. Falkovitch. "Radiotek" 15, No. 12, 1960. 5 pp. The author presents an approximated derivation of correlation functions and energy spectra of frequency-modulated radar signals. These expressions can be used to determine the correlation func-

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GL-7538 (Z-5294)	Low-light-level Surveillance Space Navigation Electro-optical Telescope Systems	High Sensitivity Magnesium Oxide Target Non-burn-in Storage Capabilities	3200-6950 4500-Peak (S-10)	500 TV Lines at 10^{-6} f/c
ZL-5395*	Aerial Mapping Passive Detection Systems Spectrographic Detectors	Near-Infrared High Sensitivity Magnesium Oxide Target Storage Capabilities	3200-10,800 8000-Peak (S-1)	200 TV Lines at 10^{-6} f/c (No filter)
GL-7967* (Z-5396)	Extreme Low-light-level Surveillance Orthicon Intensifier Applications Underwater Observation	Supersensitive Magnesium Oxide Target Storage Capabilities	3200-7400 4250-Peak (S-20)	300 TV Lines at 10^{-6} f/c
GL-7969* (Z-5453)	Missile Detection Spectrographic Detectors Underwater Observation	Ultraviolet High Sensitivity Magnesium Oxide Target	2500-7000 3800-Peak	500 TV Lines at 10^{-5} f/c
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GL-7629	Closed Circuit Training Applications Special Monochrome and Color Broadcast	Supersensitive at Low Light Levels Magnesium Oxide Target Non-burn-in Storage Capabilities	3200-6950 4500-Peak (S-10)	Scene Illumination: Color—as low as 5 f/c Monochrome—as low as 1 f/c

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tion and energy spectrum of a signal, according to its desired frequency-modulation, and, visa-versa, to determine the corresponding mode of frequency modulation for a given correlation function or a desired wave form of signal pulses at the output of an optimal linear system. (U.S.S.R.)

SEMICONDUCTORS

Temperature Compensation of Crystal Oscillator Frequencies Using the p-n Junction Capacitance of Semiconductor Devices. G. B. Altshuller, V. A. Prokhorov. "Radiotek" 15, No. 11, 1960. 6 pp. A method is described to compensate for the frequency variations of crystal oscillators, caused by temperature variations, by using the properties of the p-n junction capacitance of semiconductor devices. An evaluation is given of the limits of such compensation and of the selection of suitable similar devices. Given experimental data permit the judgment of the effectiveness of the described method. (U.S.S.R.)

Stability Evaluation of Single Circuit Semi-Conductor Triode Amplifiers. Y. L. Simonov. "Radiotek" 15, No. 11, 1960. 9 pp. The author presents basic results of a stability analysis of semi-conductor triode amplifiers. Stability conditions are derived for the limiting stable amplification with a varying number of stages. The analysis employs the method of imput conductance applied to a common-emitter circuit. (U.S.S.R.)

Measurement and Testing of Transistors. H. S. Blanks. "Proc. AIRE." Oct. 1960. 9 pp. The parameters which determine functional quality depend on the specific field of application for which the transistor is intended and for large signal applications include a composite assessment of thermal stability. The philosophy of transistor testing and measurement is discussed in the light of the above requirements, and simple means of measurement are described. (Australia.)

Ultra Pure Water for Semiconductor Manufacture. K. L. Livett. "Brit. C.&E." Dec. 1960. 4 pp. It has been widely observed that the electrical properties of transistors and semiconductor devices are improved and made more stable by rinsing in ultra pure water. The effect is to remove all traces of ionic, chemically combined and gaseous contaminants. (England.)

The Use of Transistors for Power Conversion. Part II High Power Equipment. John E. Pinnell. "El. & Comm." Nov. 1960. 4 pp. Much of the pioneering work on the commercial use of static power conversion equipment has been done in Canada and the problems of design and development of equipment to meet Canadian requirements are discussed in the following article. (Canada.)

Transistors in Vibration Voltage Regulator. A. G. Zdrok. "Avto i Tel." November 1960. 11 pp. Electrical circuits for control of dc generator voltage using transistors and 2-position electromagnetic vibration regulator are analyzed. Circuits providing increase of vibration frequency of the regulator anchor are given. (U.S.S.R.)

Cross Modulation Performance of Alloyed and Drift Type Transistors in a Frequency Range up to About 1 Mc. H. Lotsch. "El. Rund." Dec. 1960. 4 pp. Since the base resistance of an alloyed RF transistor is by a power of ten greater than that of a drift type, their cross-modulation performance differs. It can be shown that this difference decreases with increasing values of resistors in the base circuit. The investigation covers low frequencies, briefly referring to high-frequency performance. A circuit is indicated where the cross-modulation is reduced by counter-modulation. (Germany.)

Certain Aspects of Frequency Response of Common Emitter Cascades. V. F. Rachmanoff. "Radiotek" 15, No. 12, 1960. 8 pp. The author analyzes the indirect effect of negative current feedback on the frequency characteristics of a common emitter stage. On the basis of the formulae and graphs presented in this article, it is possible to conclude whether it is reasonable to account for the above-mentioned effect, depending on the precision of the desired frequency response. (U.S.S.R.)

Matrix Tables for Four-Pole Networks Containing Transistors. E. N. Garmash. "Radiotek" 15, No. 12, 1960. 8 pp. Four-pole network theory is applied to networks containing transistors. Matrices of these networks are presented in tables containing twenty-four different basic configurations. A method is also presented to obtain matrices of other network configurations, using the given basic matrices. (U.S.S.R.)

Transistor Relay Circuits. A. P. Suponitsky, V. D. Urin. "Avto. i Tel." Dec. 1960. 6 pp. Transistor relay circuits are considered. Operation of the said circuits with a diode inverter at the imput is analyzed. The peculiarities of thermal stabilization of these circuits are studied. Main results are confirmed by an experiment. (U.S.S.R.)

Rational Approximations of Semi-Conductor Diode Characteristics. L. A. Sinitzky, Y. M. Shumkov. "Radiotek" 15, No. 12, 1960. 8 pp. Given are results of calculations of rectifying circuits using two types of approximation of the straight line rectifier characteristic-piece-linear and linear. It is shown, that in many cases it is allowable to use the linear approximation with a succeeding correction of the calculated results. Graphs are constructed which permit calculations for circuits with one rectifier and one reactive element. (U.S.S.R.)

TELEVISION

Measurement of TV Field Strength. G. de V. Gipps. "Proc. AIRE." Oct. 1960. 7 pp. The equipment and procedure used in establishing the service area of a proposed television station are described. As subjective judgment is largely involved in definitions an accuracy of ± 4 db is considered adequate. (Australia.)

A Magnetic Wheel Store for Recording Television Signals. J. H. Wessels. "Phil. Tech." #1, 1961. 10 pp. Description of a magnetic wheel store for recording single television frames. Good results are achieved by frequency-modulating a carrier with the video signal. The frequency range of the recording is approximately from 0.5 Mc/s to 8 Mc/s. (Netherlands, in English.)

Television Noise Limiting in A.M. Sound Channels. H. D. Kitchin. "El. Tech." Nov. 1960. 9 pp. (England.)

Color-Television Transmission with Simultaneous Frequency and Amplitude Modulation of the Color Carrier (FAM Method). Norbert Mayer. "Rundfunk." Dec. 1960. 15 pp. By modulating the color carrier simultaneously in frequency and amplitude, a color transmission system which is considerably simpler in comparison with other systems may be obtained. The article examines the properties of such a system. (Germany.)

Analysis of Amplitude Selection Circuits. A. Y. Kornienko. "Radiotek" 15, No. 12, 1960. 10 pp. Given is a classification of amplitude selector circuits of a television receiver. Relationships are derived for the selection of basic parameters of all three groups of amplitude selectors with large and small time constants of the automatic bias. The operation of amplitude selectors with television signals and noise is analyzed. New amplitude selector circuits are given which comply most fully with present-day requirements. (U.S.S.R.)

A Transposer - Modulator - Demodulator Using VHF/FM Technique for Television Tape-Recording Equipment. H. Fix and W. Habermann. "Rundfunk." Dec. 1960. 10 pp. This article begins with a discussion of the possible methods of modulation and demodulation and goes on to regard more closely the sources of distortion. It then describes the circuit and functioning of a double-frequency-changer and gives the results of measurements made. (Germany.)

Some Comparative Investigations into the Modified NTSC Color-Television System with Pre- or Post-Correction of the Gradation. Konrad Gernath. "Rundfunk." Dec. 1960. 6 pp. The article compares for a modified NTSC color-television system two alternative methods of gradation correction (at the transmitting end, pre-correction and at the receiving end, post-correction, of the three basic color signals, red, green, and blue) as regards sensitivity to interference and picture sharpness. (Germany.)

Multiple Interlacing of a Television Picture. Y. M. Brook. "Radiotek" 15, No. 12, 1960. 6 pp. Considered is the fundamental and technical possibility of obtaining a relationship between the field frequency and the frames of considerable multiplicity. Various possibilities are examined for practical applications of the offered methods in commercial and broadcast television. (U.S.S.R.)

TRANSMISSION

Circular Waveguides for Wideband Radio Relay Systems. E. Gillitzer and R. Herz. "Freq." Oct. 1960. 11 pp. This article reports about the properties of circular waveguides, in particular their reflection coefficient, the attenuation, and the polarization decoupling ratio. (Germany.)

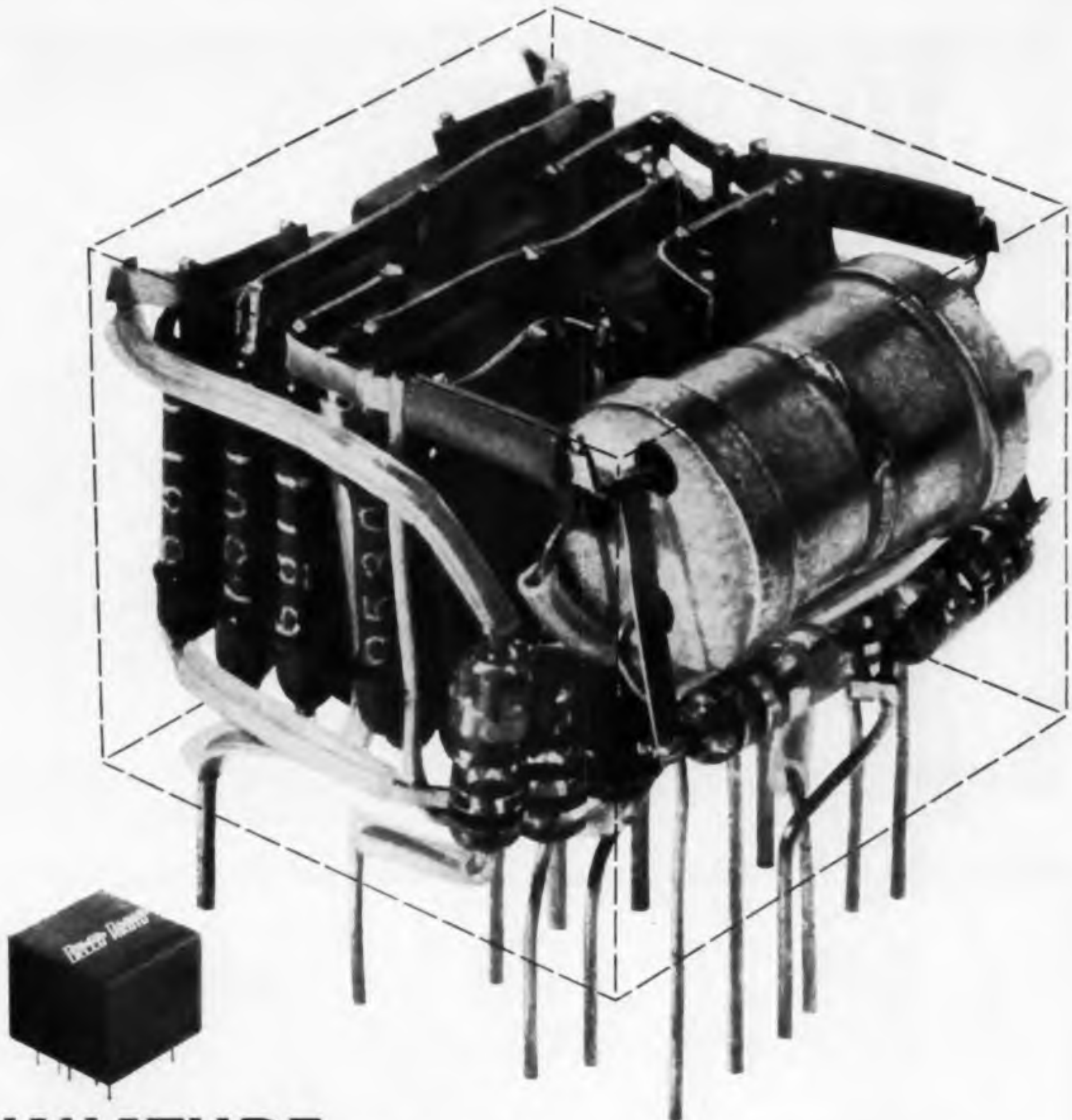
Mechanical Vibrating Systems as Simple Building Components for Signal Transmissions. W. Rauch and A. Ueberschuss. "Freq." Nov. 1960. 6 pp. This paper explains the four basic building blocks of such systems, their connection and function, and some possible applications. (Germany.)

Measurement of Voltage Reflection Coefficients Produced by Inhomogeneous Transmission Lines. J. R. Pyle. "Proc. AIRE." Oct. 1960. 2 pp. The technique, based on the Smith chart, of measuring small voltage reflection coefficients produced by inhomogeneous lines is described. (Australia.)

Reciprocal and Non-reciprocal Phaseshifters in Rectangular Waveguides. E. Pivit. "Freq." Nov. 1960. 10 pp. This paper investigates theoretically and experimentally the dielectrically loaded waveguide and waveguides of different widths as reciprocal phase shifters. (Germany.)

Two-Path Transmission-Line Network. C. S. Gledhill. "El. Tech." Jan. 1961. 5 pp. The objects of this paper are to present an analysis of the network in terms of its normalized terminating impedance, to derive design criteria for the network in its two modes of working and to show any limitations in performance. (England.)

Transmission of White and Frequency-Dependent Noise Through a Low-Q Amplifier. G. V. Voishvyllo, V. C. Davydoff, N. V. Solovyoff. "Radiotek" 15, No. 12, 1960. 4 pp. Results are given for the calculation of the RMS noise at the output of a low-Q amplifier, consisting of one to three stages. The input is noise of constant or changing density, according to the 1/f law. The obtained results are used to determine the relationship between the instantaneous maximum value of a pulse signal and the RMS noise at the output of the amplifier. (U.S.S.R.)



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Carrying Capacity of Channels with General and Selective Fading. I. A. Ovseyevitch, M. S. Pinsker. "Radiotek" 16, No. 12, 1960. 7 pp. Approximate methods are given to find the carrying capacity of radio channels with strong and weak fading. These methods also apply to the case of selective fading. The carrying capacity of a channel is calculated in the presence of feedback. (U.S.S.R.)

TUBES

Peak, Mean and RMS Currents and Voltages in CW Magnetron VALVO 7091, W. Golombek. "El. Rund." Dec. 1960. 5 pp. CW magnetrons may be operated with filtered or unfiltered DC or AC voltage. When no filtered DC voltage is used, the mean-value and rms meters indicate different plate voltages. In the case of unfiltered feeding from a single-phase bridge (recommended for Valvo 7091 magnetron) with peak-current limiting by resistors, these readings can be computed from the mean and peak plate current and the plate voltage for filtered DC voltage. Results of calculation and measurements are compared on the background of an example. The last section shows to what degree the equations are satisfactory when the peak current is limited by an air-gap choke. (Germany.)

Numeral Display Using Glow Discharge Technique, V. S. Perelmuter, F. M. Yablonsky, G. M. Yankin. "Radiotek" 15, No. 12, 1960. 3 pp. The authors analyze the construction and basic parameters of a glow discharge tube to be used for display of numerical symbols. These tubes are distinguished for their low power consumption and high efficiency in the conversion of electrical energy to light energy. (U.S.S.R.)

Selecting Tubes for Single Sideband Transmitters, R. Hubner. "El. Rund." Dec. 1960. 3 pp. The increasing strain on available frequency bands not only calls for shifting to higher frequencies, but also for better utilization of existing bands. One of the methods used is bandwidth reduction in communication channels by single-sideband (SSB) operation. Dimensions and price of a transmitter may be considerably reduced by SSB operation. Additional advantages are elimination of heterodyne whistle, interference noise, selective fading and other disturbances, as well as savings in transmitter power. (Germany.)

Applications of Microwave Triodes, J. P. M. Gieles. "Phil. Tech." #1, 1961. 18 pp. Because of such features as simplicity, favorable phase characteristics and large produce of gain and bandwidth, disc-seal triodes for centimeter waves are suitable and attractive for many and various applications, especially in microwave radio links. (Netherlands, in English.)

Reflection of Objects by Curved and Plane TV Tube Fronts, R. Suhrmann. "El. Rund." Nov. 1960. 2 pp. Illuminated objects are reflected by the curved front plate of a TV picture tube. They are scaled down when reflected, but at an increased light density. The paper shows the disturbance caused by these reflected images and indicates that plane picture screens or panes have much less of such disturbing reflections. (Germany.)

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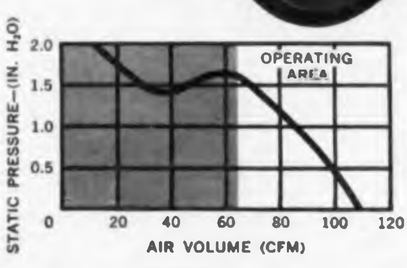

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Rugged mechanical protection is provided by the black anodized aluminum housing and propeller. Mount by clamping to servo ring at either end. Nominal life exceeds 1000 hours. Max. current is 0.47 amps at free air delivery. Request Bulletin GNB from Globe Industries, Inc., 1784 Stanley Avenue, Dayton 4, Ohio.

GLOBE

GLOBE INDUSTRIES, INC.

Circle 113 on Inquiry Card

GE Establishes New Ground Support Group

General Electric Co. has established a Ground Support Organization within its Aviation and Defense Equipment Sales Operation to market ground support systems for aircraft and missiles, and communications.

The new organization will make available technical design information and assistance in engineering integrated electrical systems for ground power applications in the aerospace industry.

OUTSTANDING EE OF '60

Kenneth H. Olsen. Pres., Digital Equipment Corp., Maynard, Mass., has been named the winner of the "Outstanding Young Electrical Engineer Award for 1960." Award is given by Eta Kappa Nu, national electrical engineering honor society.

Traffic Control Center

The FAA is building a new Air Route Traffic Control Center at Leesburg, Va. It will have electronic equipment for direct communications between pilot and controller, an electronic computer especially adapted for traffic control, bright display radarscopes, and radar beacons for identifying individual aircraft.

For protection from radiological effects, it will have an 18-in. wall of reinforced concrete, lead-lined doors, and a roof washdown system.

Test Blue Water

Blue Water, the English Electric ground-to-ground solid-fuel missile, will soon be tested at Woomera in Australia. The missile is a second generation Army weapon designed to succeed existing liquid-fueled missiles such as this country's Corporal.

NEW

ELECTROSTATIC FOCUS & DEFLECTION VIDICON

Provides new degree of freedom in TV camera design

GEC's new 7522 electrostatic focus and deflection vidicon was developed to fill the need for smaller, lighter, more versatile image pickup tubes.

External components for magnetic focus and deflection have been eliminated and total power requirements for beam focusing and deflection have been reduced to less than 100 milliwatts.

The GEC 7522 is capable of any type scan . . . sawtooth to spiral, over a wide and variable range of frequencies.

The ruggedized version, the GEC 1343, was developed for aircraft and missile environments. Electrical characteristics are identical to the 7522.

features:

- ★ **Resolution 500 Lines**
- ★ **Accelerating Voltage 300v**
- ★ **Deflection Voltage 30v per plate**
- ★ **Sensitivity .090 microamps/microwatts radiant energy at 4800A**
- ★ **Operates with completely transistorized circuits**
- ★ **Size 7522 1"x6-1/4"**
  1343 1"x5-5/8"
- ★ **Availability From Stock**

For further information on this revolutionary new GEC Vidicon development, as well as our complete line of pickup, scan conversion, and image conversion tubes, write today for information.

. . . . where tube research begins

G E C

GENERAL ELECTRODYNAMICS CORPORATION

4430 FOREST LANE • GARLAND, TEXAS

Circle 115 on Inquiry Card

Inventions Wanted

A list of technical problems affecting the defense of the U. S. has been prepared by the National Inventors Council with the cooperation of the Army, Navy, Air Force and other government agencies.

The inventions wanted include: A low energy, reliable switching device (5000 ergs maximum) that is capable of at least 100 reliable operations. A semi-flexible wave guide in one-half wave size for missile fuzing applications; a line of reliable thermistors; low voltage vacuum tubes or other devices that will operate on transistorized low-voltage power supplies, etc.

The booklet which lists the problems also answers such questions as: What steps to take if you have ideas which contribute to the solution of these problems? Can you obtain a research and development contract to perfect a problem solution? Will you be paid for acceptable ideas or inventions? Where can you get a patent? etc.

For copies of the booklet "Inventions Wanted by the Armed Forces and Other Government Agencies," write to National Inventors Council, U. S. Dept. of Commerce, Washington 25, D. C.

RCA Awards Fellowships

RCA has awarded Fellowships to 12 graduate students for advanced studies in engineering, physics, dramatic arts, journalism, and science teaching. The Fellowships, valued at approximately $4,000 each, are part of RCA's program of providing financial assistance to students at more than 50 American colleges and universities.

Missile Microwave

Microwave will be used as the primary communications link in the new $15.5 million MISTRAM missile-tracking system being developed by GE for the AF. System is scheduled for operational use by 1962.

Radiation Suit

The Air Research and Development Command, Andrews AFB, is testing a radiation-resistant suit designed to protect radar technicians from radiation during emergency maintenance of radar equipment. The suit was designed primarily for use at BMEWS stations.

CW MAGNETRONS

attuned to new applications

This Litton continuous wave magnetron is one of a family of ten that gives coverage from P to X bands at minimum power outputs from 250-500 watts.

The dependability and versatility of Litton CW magnetrons has been time-proved by the many thousands in field service. There are undoubtedly long years of operation ahead in new military and commercial applications.

These Litton CW magnetrons are mechanically-tuned and liquid-cooled. We also manufacture CW magnetrons with versatile hydraulic tuning and, at lower powers, can supply them with forced air cooling.

Litton CW magnetrons are being applied in a pulse width modulated navigation system. Pulse rate, amplitude and frequency modulation techniques make possible other communication applications. This family also offers many advantages in such CW applications as RF drivers, industrial processing and component testing. They can be pulsed to approximately 2 KW peak power at a .25 duty cycle, a desirable attribute in component testing.

Investigation of these magnetrons and Litton pulse magnetrons, the international standards of excellence, may lead you to new applications. If we have stimulated your thinking a little, we *would* like to hear from you. Write to: 960 Industrial Road, San Carlos, California.

CW MAGNETRONS

Type Number	Frequency Range Megacycles	Minimum Power Watts
L-3456	350-590	500
L-3459	590-975	500
L-3465	975-1500	400
L-3464	1500-2350	400
L-3460	2350-3575	500
L-3461	3575-4975	400
L-3467	4975-6175	400
L-3468	6175-7275	300
L-3462	7275-8775	300
L-3463	8775-10,475	250

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MICROWAVE TUBES AND DISPLAY DEVICES

"Capability that can change your planning"

Stock Market Computer

The American Stock Exchange has a new $3 million communications facility and data processor. The system will provide instantaneous, automatic reports on open-high-low-last-bid-asked-volume-to-the-moment and size (number of shares bid and number of shares offered) figures.

System will permit sub-system additions to operate the ticker system, permit same-day comparisons of trades, and do most of the Exchange's clearing functions. Ultimately it will relieve member firms of much of their back office billing work and other clerical procedures.

Saturn Recovery Study

Ryan Aeronautical Co. is studying ways to recover the expensive first stage of the Saturn research space vehicle. It will be a flexible wing glide recovery system.

Periscope Simulator

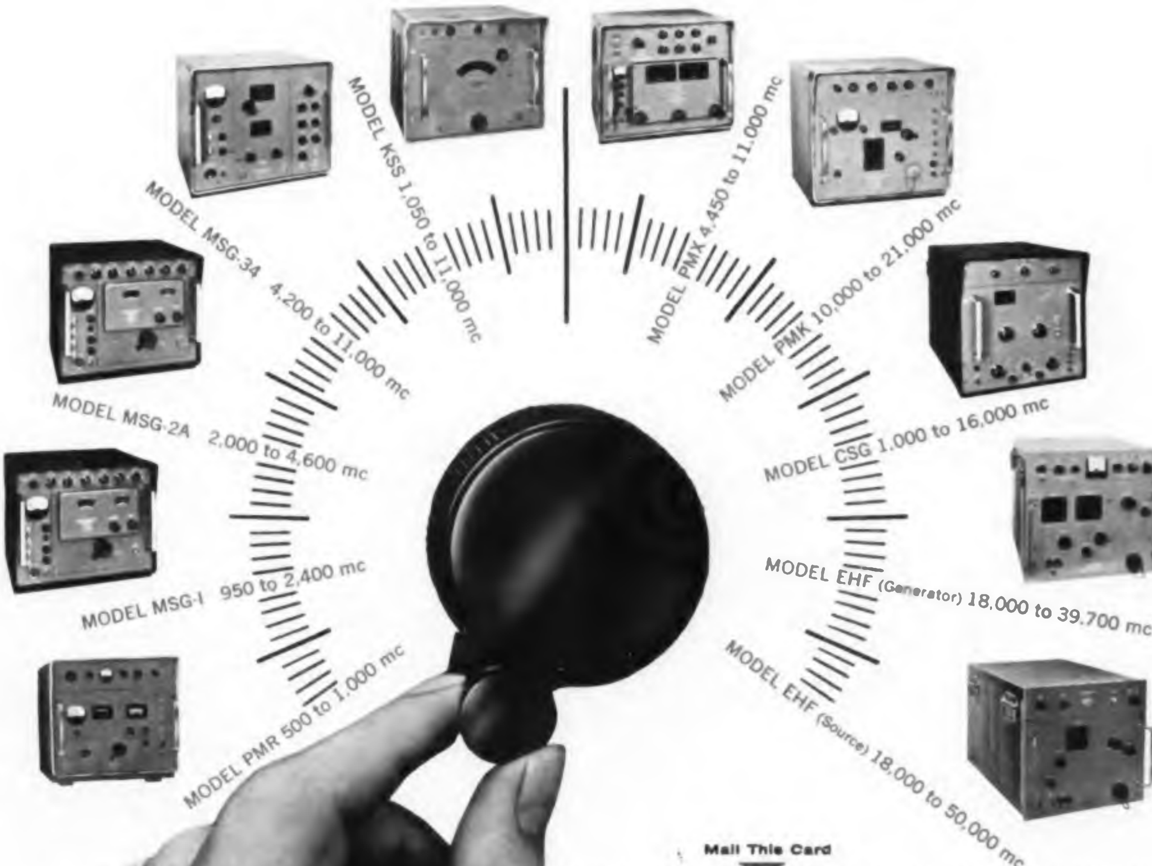
Photronics Corp., Flushing, N. Y., is designing and building a periscope simulator. The device will be used in the Polaris program. The contract, $150,000, came from Minneapolis-Honeywell Corp.

Circle 422 on Inquiry Card →

POLARAD

MICROWAVE GENERATORS

500 mc to 50,000 mc



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43-20 34th St., Long Island City 1, N.Y.

Please send me information and specifications on

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- ☐ Model PMR
- ☐ Model MSG-1
- ☐ Model MSG-2A
- ☐ Model MSG-34
- ☐ Model KSS
- ☐ Model PMX
- ☐ Model CSG
- ☐ Model PMK
- ☐ Model EHF (generator)
- ☐ Model EHF (source)
- ☐ A copy of "Notes on Microwave Measurements."

My application is__________

Name__________

Title__________ Dept.__________

Company__________

Address__________

City__________ Zone_____ State__________

Digital Voltmeter

(*Continued from page* 103)

corresponds to the unknown voltage.

By projecting 24 images per second, the apparatus creates a virtually steady image since the phenomenon of persistence of human vision enables the eye to see an essentially continuous image, provided that the flashing frequency is more than approximately 16 images per second.

The instrument, made by Electro-Logic Corp., Venice, Calif., affords an accuracy of 0.4%. Markite Corp., N.Y.C., made the conductive plastic sweep potentiometer.

THERMOCOUPLE CALIBRATION

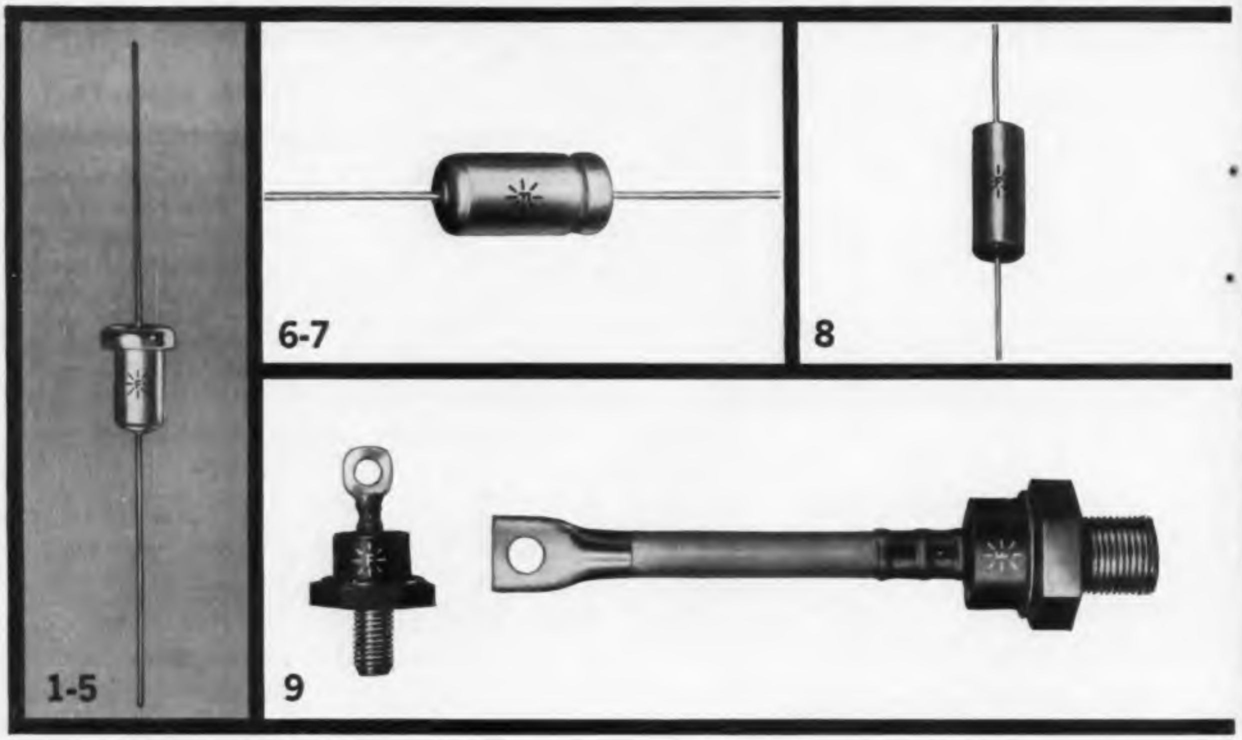
Thermocouples are calibrated by NBS over the temp. range of −190 to +1100°C.[1] This service, is important in providing accurate temperature determinations on all levels. The Bureau, by maintaining the standards against which temperature measuring devices are calibrated, insures a common basis for temperature measurement.

The Bureau also provides other allied services in the area of thermocouple calibration. Thermocouple wires are calibrated to determine the voltages they produce when fused to a standard platinum wire. Occasionally, the accuracy of a potentiometer used in thermoelectric measurements will be determined. Samples of freezing point standards—aluminum, copper, lead, zinc, and tin—are available on a fee basis.

A thermocouple consists of a pair of wires of dissimilar metals joined together at one end to form a measuring junction. The other ends are connected to lead wires connected to a sensitive voltage measuring device. The electromotive force produced depends upon the composition of the wires and the difference in temperature between the junctions. By determining the emf-temperature relationship of a particular thermocouple at several known points, temperature measurements of considerable accuracy can be made within the bounds of the calibra-

(*Continued on page* 234)

FANSTEEL HIGH RELIABILITY



FANSTEEL TANTALUM CAPACITORS

In 1949, Fansteel introduced the first commercially available miniature, porous tantalum electrolytic capacitor. This capacitor was the result of more than 25 years of research into the film forming properties of tantalum and techniques for refining and fabricating the metal. Today, Fansteel's complete line of tantalum capacitors includes, in addition to the original PP type (with improved shock and vibration resistant properties), high temperature tantalum capacitors, pre-tested capacitors with certified reliability and solid tantalum types. From this broad line, it is possible to select a capacitor to meet virtually every requirement.

1. **GOLD-CAP® TANTALUM CAPACITORS**

Pre-tested for reliability with test results certified in writing. Gold-Cap Tantalum Capacitors are available in a wide range of ratings—2 μf to 330 μf—6V to 100V (−55° up to + 125 °C) and are supplied with a standard tolerance rating of ±10%.

2. **PP TANTALUM CAPACITORS**

Most widely used of all tantalum electrolytic capacitors. Meets MIL-C-3965B for vibration Grade 3 capacitors. Excellent low temperature characteristics—operating range −55° to +85°C at full rated voltage. Fansteel PP Tantalum Capacitors have outstanding frequency stability, negligible electrical leakage and are shock and vibration resistant. Capacity tolerance of ±10% is standard for Grade 1 PP capacitors.

3. **HP TANTALUM CAPACITORS**

For high temperature applications. Fansteel HP Tantalum Capacitors offer reliability and unexcelled stability over a −55° to +125°C ambient temperature range. In addition, HP types are able to withstand severe vibration and impact shock. Grade 1 HP capacitors have a standard capacity tolerance of ±10%.

4. All types of CL-44 and CL-45, conforming to MIL-C-3965B, are also available.

5. **BLU-CAP® TANTALUM CAPACITORS**

These economical units are designed to bring the benefits of tantalum capacitors to any commercial or military application where wider capacity tolerances (−15%, +75%) are permissible.

6. **SP TANTALUM CAPACITORS**

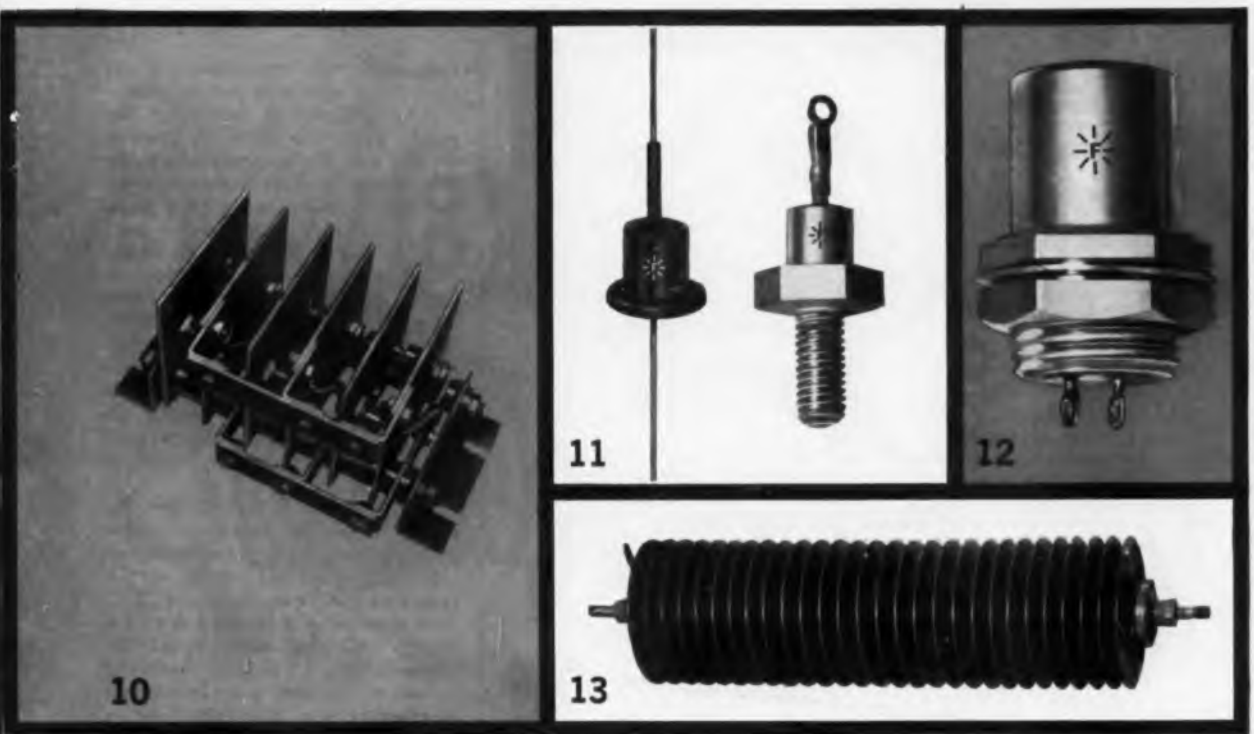
Fansteel SP Tantalum Electrolytic Capacitors offer same capacity ratings as the PP with the advantage of cylindrical cases.

7. All types of CL-64 and CL-65, conforming to MIL-C-3965B, are also available.

8. **STA SOLID TANTALUM CAPACITORS**

Unsurpassed performance reliability at operating temperatures up to 125°C. Hermetically sealed case affords full protection against the various environments encountered in use. A wide variety of ratings, consolidated

ELECTRONIC COMPONENTS



into four convenient sizes, cover the most complete line of solid tantalum capacitors available. Built to meet requirements of MIL-C-26655A.

FANSTEEL RECTIFIERS

Fansteel has been actively engaged in the development, engineering and production of dependable rectifiers since 1924, when Balkite Tantalum Rectifiers were introduced. As early as 1932, Fansteel conducted exploratory research work in selenium, as well as other types of metallic rectifiers. This extensive background has enabled Fansteel to continually broaden its line of rectifiers, offering designers and industrial users a full line of highly reliable components.

9. **SILICON POWER RECTIFIER CELLS**

Available in 20, 35, 50, 70, 160 and 240 Ampere Ratings.

10. **SILICON RECTIFIER STACKS**

These units provide a highly reliable d-c source for a wide range of power applications. Normally supplied in a single phase center tap, single phase bridge or three phase bridge configurations. Special assemblies can be built to specifications. (Unit illustrated has output rating of 700 volts at 147 kw.).

11. **NEW! FANSTEEL SILICON ZENER VOLTAGE REGULATOR CELLS**

- 1- and 10-watt power dissipation ratings
- Designed and process-selected to give sharp Zener characteristics and low dynamic resistance over entire operating current range
- Hermetically sealed
- All-welded, shock-proof cell

12. **NEW! SILICON ZENER VOLTAGE REFERENCE ELEMENTS**

- For applications from −55°C to +165°C
- High voltage stability
- Rugged construction

13. **SELENIUM RECTIFIER STACKS**

Practically unlimited life with no maintenance—instantaneous power with negligible leakage. Over 400,000 different stack combinations readily available in a broad range of power ratings. Selenium is still a practical semiconductor used by many designers where peak reverse voltages are troublesome.

Get more information on these new Fansteel Zener Diodes and other Fansteel components at the IRE Show. Visit us in Booth 4021-4022.

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FANSTEEL

Fansteel Metallurgical Corporation, North Chicago, Illinois, U.S.A.

WHERE RELIABILITY DICTATES STANDARDS

Circle 120 on Inquiry Card

Thermocouple Calibration

(*Continued from page* 231)

tion and, with some loss of accuracy, in extrapolated regions.

The calibration procedure depends upon the type of thermocouple, and the accuracy-and-range requirements. Base metal thermocouples are compared with a platinum resistance thermometer over –190 to 538°C. They are also compared with a standard platinum versus platinum - 10 - percent - rhodium thermocouple, up to 1100°C. Platinum thermocouples are compared with the standard thermocouple, or, if greater accuracy is required, the emf developed at fixed points on the International Practical Temperature Scale is determined.

Because the emf developed depends upon the temp difference between the two junctions, all calibrations are performed with a reference-junction temp of 0°C. This eliminates correcting for constantly changing room temp. The thermocouple wires are connected to lead wires, usually by immersion in mercury, and the connection is maintained at 0°C in a Dewar filled with ice and water.

Annealing

The calibration of any platinum thermocouple or test wire is preceded by annealing at 1450°C for one hr. Mechanical strains are relieved, and the effect of surface impurities may be minimized. Base metal thermocouples are not annealed, as they are less stable at high temps, nor are they calibrated against fixed points.

Fixed Point Calibration

When a calibration of max accuracy is required, the temp-emf relationship of platinum versus platinum-rhodium thermocouples is determined at 4 fixed points on the International Practical Temperature Scale. The points used by the Bureau in the thermocouple calibrations are the freezing points of gold (1063°C), silver (960.8°C), antimony (630.5°C), and zinc (419.5°C).

Extremely pure gold and silver must be used in freezing point determinations, for as little as 0.05% impurity may lower the freezing temp by 0.1°C.

As the International Practical Temperature Scale is defined up to

(*Continued on page* 236)

Thermocouple Calibration

(*Continued from page 234*)

630.5°C with a platinum resistance thermometer, thermocouples are calibrated against a resistance thermometer at the zinc and antimony points.

Comparison Calibration

The comparison of base metal and platinum thermocouples with the standard platinum versus platinum-10-percent-rhodium thermocouple is performed from 50 to 1100°C. When individual thermocouple wires are being tested, one or more of the test wires are fused to a length of the standard platinum wire, and a standard platinum thermocouple is fused to this junction to provide a basis for comparison. When complete thermocouples are being tested, a common junction is made between one or more test thermocouples and the standard thermocouple. The bundle of thermocouples, each insulated by a length of 2-hole porcelain tubing, is inserted into a closed-end porcelain protection tube which is placed in an electrically heated tube furnace. The emf of the standard and each test wire or thermocouple is determined usually, at intervals of 100°C.

When more than four thermocouples are run concurrently, the respective emf's are determined manually with two potentiometers, one which measures the emf of the standard and one which measures each test thermocouple individually. If no more than 4 thermocouples are run at one time, a semi-automatic thermocouple comparator is used.

Accuracy

The accuracy depends upon the material being tested, the type of calibration made (fixed point or comparison), and the range over which a temp-emf relationship is established. Accuracies range from 0.05°C for a copper-constantan thermocouple compared with a standard resistance thermometer to 0.5°C for a Chromel-Alumel thermocouple compared against a standard thermocouple. Of course, the uncertainty of interpolated values is greater than that at fixed points, and this uncertainty increases as the difference from the nearest known point increases.

* * *

a new UHF OSCILLATOR

Type 1361-A Oscillator.........$285.

- Butterfly Tuning Circuit — no sliding contacts
- Frequency Scale Calibration Accuracy ±1%; constant 0.1% frequency change for each vernier division. Warm-up frequency drift is 0.2%, maximum.
- Modulation Capabilities — sine wave, square wave, or pulse from external source; 40v required to produce 30% sine-wave modulation.
- High Output — 100 mw minimum into 50-Ω load, adjustable at panel by calibrated 80-db attenuator.
- Complete Shielding, including use of ferrite-loaded filters and ceramic shaft, reduces stray fields to very low values.
- Sweep Drive Capability using G-R sweep and dial drives.
- Small Size: 8″ x 7″ x 8¼″; only 7 lbs.
- Power Supply Recommended: 1201-A Regulated Power Supply $85, for cw; 1263-B Amplitude Regulating Power Supply $355, for constant output level; 1264-A Modulating Power Supply (below).

Type 1361-A Oscillator and Type 1264-A Modulating Power Supply conveniently mount in a relay rack with Adaptor Plates, Type 480-P-416, $6.

NEW MODULATING POWER SUPPLY

. . . for high-level pulse and square-wave modulation of Vhf-Uhf Unit Oscillators.

OUTPUTS: Square Waves — adjustable from 160v to 210v; internally generated 850 to 1150 cps, with high stability; externally generated 20 to 50,000 cps from sine or square-wave source.

Pulses (externally generated) — 160v to 210v at rates up to 100 kc, pulse durations from 1.5 μsec to square wave (determined by external generator), less than 1.5 μsec rise and decay times for typical oscillator load, overshoot less than 5%.

Regulated DC — adjustable from 200v to 300v, 50 ma (max)

Unregulated AC — 6.3v; 2.1a (max)

INPUT: 115v or 230v, 50-1000 cps, 85 watts
Small Size: 7″ x 8″ x 8″; 12 lbs. **Price: $285.**

12 Other Unit Oscillators Cover the Range from 20 cps to 7,425 Mc

See 21 NEW Instruments at the IRE Show including a Counter with a Memory and a new 1000-Mc Frequency Standard.

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GENERAL RADIO COMPANY

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Circle 123 on Inquiry Card

Where high accuracy frequency references are maintained as a necessity to a company's business, it is important that they are regularly re-calibrated to compensate for component aging. This manufacturer has developed a method using common lab equipment. It provides accuracies to 5 and 10 parts in 10^{-9}.

Using WWV for

Calibrating Precision Oscillators

VERIFYING the performance of high stability oscillators is becoming more difficult as customer requirements increase. To measure precision oscillators and provide our Reliability and Quality Control Group with adequate permanent records, a new method of production acceptance testing was required.

The method described here will calibrate oscillators to an accuracy of 5 and 10 parts in 10^{-9}. The accuracy is limited only by the short term propagation errors of the received signal. When that signal is at its best it is in the order of one part in 10^{-9}. The complexities of explaining the propagation errors are beyond the scope of this article. However, it may be pointed out that the method described here will minimize these effects when regarding the order of accuracy discussed.

The advantages of this system are low equipment expense and the ability to measure short term stability. For long term stability the usual chronometer method is required.

A brief description of the procedures that may be used in the measurements utilizes equipments ordinarily found in the laboratory. The equipment used is as follows: Hammarlund SP 600 JX-10; Brush Dual Channel Amplifier; and a Brush Dual Channel Recorder.

In using a recorder to record the difference in frequency between WWV and some other oscillator involves many parameters. Among these, the most important are the following:

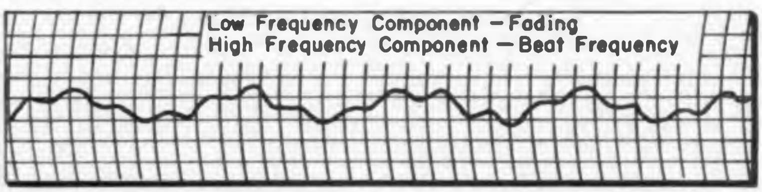
- Signal strength of WWV
- Signal strength stability of WWV
- Signal strength of the oscillator to be calibrated
- Stability of the signal strength of the oscillator to be calibrated

WWV Stability

Of prime importance in using this procedure is the signal strength stability of WWV. Because of the propagation characteristics of the frequencies involved, the WWV signal will fade and become strong and fade and come in strong again. If the WWV signal and the frequency to be calibrated are beat together at the antenna of the receiver, the fading mentioned will appear as a beat that is to be discerned from the beat of the two frequencies. (Fig. 1)

Should the signal from WWV stay stable, then the beat frequency will be that of the WWV signal and the oscillator to be calibrated. (Fig. 2.) The Oscillator to be calibrated may then be adjusted for a slower and slower beat until there is essentially no beat. At this time the oscillator may be said to approach the accuracy of WWV or a few parts in 10^{-9}. (Fig. 3.)

FIG. 1



By **MARTIN J. KIOUSIS**

Designers for Industry, Inc.
4241 Fulton Pkwy.
Cleveland 9, Ohio

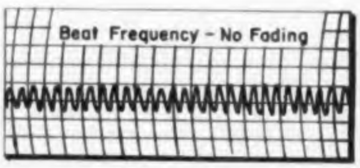


FIG. 2

Receiver Coupling

The most critical adjustment to be made in setting up the calibration procedure presented here, is the coupling of the unknown source to the receiver. The techniques involved are not unlike the injection of the local oscillator of a receiver into the mixer. The balance of the input signal from WWV and the frequency to be calibrated must be of exacting magnitude. This is required for the mixer of the receiver to accept both signals, and beat them

(*Continued on page* 240)

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The Editor
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Accurate Calibration

(*Continued from page* 239)

to the i-f frequency, and thus realize an output at the AVC terminals of the SP-600 receiver. It may be pointed out that the R-F gain control is used to control the r-f signals rather than have the AVC operative at the input of the receiver. This is accomplished by having the AVC-MANUAL switch in the MANUAL position. The varying AVC voltage that then appears at the AVC terminals is the difference in frequency between WWV and the oscillator being calibrated. If the signal to be calibrated is too strong, then it will block the local oscillator of the receiver and you will not have an output that can be recorded.

The technique initially used for coupling of the unknown signal to the antenna of the receiver was to have a one turn loop energized by the frequency source to be calibrated. The distance of this loop was then varied to get the right amount of injection of signal into the antenna. This was indicated by the recording pen starting to record a consistent cycling. (Fig. 4.) This coupling may then be increased until an optimum signal is realized. This optimum is indicated by the recording of the largest amplitude of beat frequency signal which does not start blocking of the receiver.

Several approaches were considered for the most efficient method of coupling the signal to be calibrated to the antenna of the receiver. It was first thought that two loops could be used, one connected to the antenna terminals and the other connected to the unknown source to be calibrated. The loop from the unknown source would then be varied physically with respect to the receiver loop, consequently varying the coupling. Investigation showed that there would be considerable loading of the input circuit of the receiver. This would decrease the sensitivity of the receiver and was a major detriment in considering the basic requirements of this method of calibration.

An alternate approach still using the mutual coupling technique, yet minimizing the loading of the antenna circuit, would be to loosely couple to the antenna coil of the receiver and then vary the coupling to this coil by adjusting the coil of the unknown source. This approach, although technically realizable, involves more detail than is warranted when considering the third approach which follows.

Injection Approach

Since the injection of the unknown signal is much like the injection of the local oscillator into the mixer of a receiver, a small capacitor was used to couple the unknown signal into the antenna of the receiver. Where frequencies in the order of 100 KC were used, a direct contact to an antenna terminal was necessary. The reason for this is that the magnitude of the harmonic content that is present at the order required to beat with 5 MC or 10 MC is extremely weak. For the 100 KC signal used for this calibration procedure, the initial frequency source had to be greatly amplified in order to get the harmonic content up to a point where a beat frequency was possible.

As mentioned previously, the beat signal recorded is the difference of the WWV signal and the unknown signal to be calibrated or adjusted. The accuracy of this recording will, of course, then effect the absolute calibration of the unknown signal. Several methods of calibrating the chart speed may be readily recognized. Depending on the speed of the chart paper, a low frequency saw tooth wave may be connected into the amplifier which drives the pen. By examining the recording then, one may be able to determine if there is any grabbing or hanging-up of the paper or inconsistencies in the chart drive. This is of little importance if your recorder is in good shape. Of relatively major importance is the consistency of the paper speed when recording.

Chart Speed Calibration

Because of the order of magnitude that this measuring technique involves, a highly accurate calibrating source is required. In the case of the procedure here, the source used for the measurement of the speed of the chart drive was the one second time ticks transmitted by WWV. These time ticks were used to drive one channel of the dual channel Brush Amplifier, while the beat frequency was used to drive the other channel. The outputs of the amplifiers then drove the pens on the Brush dual recorder. Use of this technique then yielded calibration of chart speed as well as calibration of the unknown signal against the accuracy and stability of WWV. (Fig. 5.)

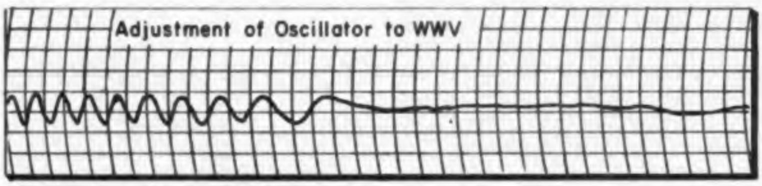
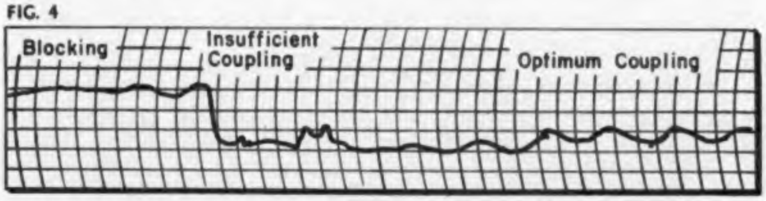


FIG. 3

FIG. 4



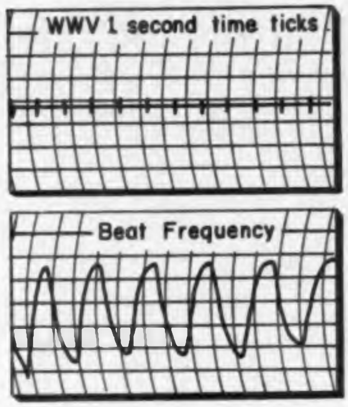


FIG. 5

The chart speed used for all of the represented chart recordings was 5 MM/sec. It was found though that by calibrating the chart speed against WWV one second time ticks, that the chart speed was 6 MM/sec. But it may be pointed out that this calibrated speed was consistent, and that variation was less than 1%.

Calculation of the accuracy of the unknown signal is as follows:

Beat Period (Avg.)	10 seconds
Beat Frequency	0.1 CPS.
Receiver Frequency	10 MC.

If the beat frequency is 0.1 CPS in 10 MC, then it is 0.01 CPS in 1 MC. The accuracy then is 0.01 PPM or 1 part in 10^{-8}, plus the chart speed accuracy of 2 parts in 10^{-9}, or an absolute calibration of the signal of 1.2 parts in 10^{-8}.

Another example using 5 MC as the receiver frequency.

Beat Period (Avg.)	20 seconds
Beat Frequency	0.05 CPS.
Receiver Frequency	5 MC.

If the beat frequency is 0.05 CPS in 5 MC, then it is 0.01 CPS in 1 MC. The accuracy then is as stated above, or 1.2 parts in 10^{-8}, including the chart speed error.

In conclusion it may be pointed out that by using this method over other recognized procedures for measuring higher order stabilities and accuracies, the maximum realizable accuracy is achieved in a shorter period of time.

Cutting Germanium Discs

INTERNATIONAL Business Machines Corp. has developed an ultrasonic cone tool for cutting germanium discs for transistors. It is made of a cluster of seamless type 304 stainless tubes of very thin wall (0.008 in.) drawn to close tolerances and with a smooth finish on the inside dia. Superior Tube Co., Norristown, Pa., produces the tubing.

Formerly, solid metal blocks were used both with small, close-spaced holes machined in. It was difficult to drill and ream all the holes straight so that fractures would not develop in the narrow walls between the holes. Another problem was drilling and reaming the holes to the close tolerance ID.

Some advantages of the nested steel tubing: The tubes are precision drawn by Superior Tube so that IBM need only assemble the cone tool; each of the 114 tubes can be individually inspected before assembly; the time required to build a nested tubing cone tool is much less than that required to drill and ream solid metal.

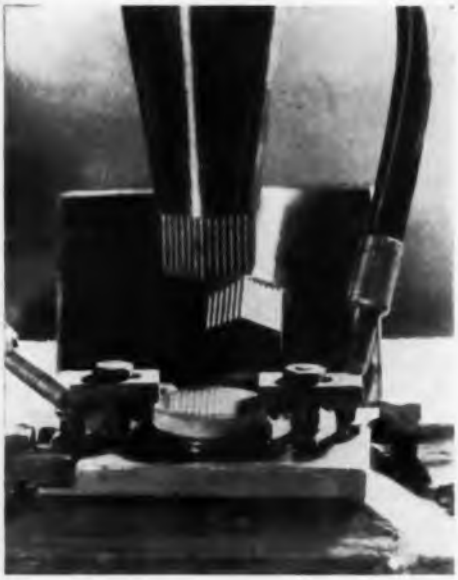
The ultrasonic equipment, a Sheffield Cavitron impact grinder, operates at 20,000 CPS. It takes about 3 minutes to cut the 114 discs from one germanium wafer.

Germanium discs for transistor components are ultrasonically cut from wafers by cone tool made from nested tubes.

Finished cone tool has 114 each 0.624 in. long.

To assemble tool cone, the tubes are confined in a holding fixture and silver soldered.

Cutting surface of nested tubing cone.



Computer Protection

A REINFORCED plastic cover made of a special formula of polyester resin reinforced with fibre glass is being used to protect a new electronic computer.

The reinforced plastic was selected because it eliminates many assembling difficulties usually found in metal castings. The computer it is protecting is the Monrobot Mark XI—built by Monroe Calculating Machine Co.

The reinforced plastic covers have an advantage over aluminum covers in that they will spring or bend slightly and cen be drawn into shape very easily.

Cost is also important. The selection of this material represents a cost saving of over 50%.

Another advantage is the plastic's high impact resistant characteristics. Although lighter in weight than aluminum, it protects the instrument much better than metals. Aluminum castings, for example, will dent and break. Anything dropped on the reinforced plastic will actually bounce off.

Finishing problems are minimized. The premix pieces are pigmented in order to make painting easier. The surface requires less preparation in order to get a good bond and there is less tendency for paint to chip or flake.

Finally, the mold is easier to produce. Tooling for the aluminum mold is difficult and costlier to make. Tolerances can be more closely held in the forming operation and odd shapes can be built into tooling at lower costs.

Moldable Ceramoplastic

A NEW, ultra-high temperature, precision moldable insulation material has been announced by Mycalex Corp. of America. The dielectric, Supramica 620 "BB," operates at 1200°F. It can be molded to most complex geometries with gauge-like tolerances. It also provides a very tight hermetic seal.

The thermal expansion factor of the new material matches that of many metals. This means that it can be precision-molded with metal inserts including titanium for the most perfect seals even under widely and quickly varying temperatures. Loss factor is 0.020 at 1 MC, and it is completely impervious to oil, water, humidity and organic solvents. Arc resistance is 300 sec and dielectric strength is 270 volts/mil.

Hermetically sealed transducer pick-up head uses new ceramoplastic.

Circle 132 on Inquiry Card

STRIP-CHART RECORDER

New strip-chart integrating recorder features high speed and operational flexibility. Accurate quantitative analysis of any variable that depends on the precise measurement and integration of the curve may be obtained. Five different max. count rates are obtained through an

adjustable gear system up to a max. of 40,000 area counts/min. Counting rate linearity is ± 0.5% of full scale. The integrating signal utilizes the full chart scale for faster, easier reading. Integrator pen may be reset to either margin between each peak or at the start of each integration for easier interpretation. Integrating circuit may be set to any assumed 0 point in the span of the recorder signal. Texas Instruments Incorporated, 3609 Buffalo Speedway, Houston 6, Tex.

Circle 359 on Inquiry Card

Evaporation Sources

Tech. Bulletin No. 102, gives a complete list of the more commonly used metals for the deposition of thin or thick film in high vacuum. Includes the metal's melting temperature (C°), recommended evaporation source and general configuration. Allen-Jones, Inc., 1345 Gaylord Ave., Long Beach 13, Calif.

Circle 360 on Inquiry Card

Transistor Circuits

"Transistor Guide for Switching Circuit Designers" from Philco Corp., Tioga and "C" Sts., Philadelphia 34, Pa., is an aid in selecting transistors for saturated DCTL, SCTL, RTL, RCTL, and DTL low-level logic circuits. Also discussed are nonsaturated logic such as current switching, medium level switching up to 400 ma, and high level switching including dc to dc converters and static relays. Schematic diagrams, curves, charts show design and usage of inverters and flip-flops as basic building blocks for switching circuitry. Relationships of switching circuitry to overall systems—such as computers—are graphically presented.

Circle 361 on Inquiry Card

See EICO at IRE BOOTH 3509
Circle 133 on Inquiry Card

Circle 134 on Inquiry Card

The "RIQAP" award pennant is presented to Reeves-Hoffman. Holding flag are H. Potter, President, Reeves-Hoffman and C. S. Hays, Comm. Gen., U. S. Army Signal Supply Agency.

Signal Corps "RIQAP" To Reeves-Hoffman

The U. S. Army Signal Corps "RIQAP" award has been presented to the Reeves-Hoffman Division of Dynamics Corp. of America. The award is for "consistent production of high - quality quartz crystals over a long-term period."

"RIQAP," which stands for "Reduced Inspection Quality Assurance Plan," is the highest quality-recognition and honor the Army Signal Corps can bestow upon a manufacturer.

RIQAP is an approach to product evaluation and acceptance. Designed to assure the highest quality standards, the plan reduces the amount of end product inspection by the Federal Government. This is done through increased reliance on the manufacturer's own control policies and practices. It requires, however, "the most advanced quality control methods and test procedures" from the manufacturer.

Participation in RIQAP must be by mutual agreement between the contracting manufacturer and the Army Signal Corps. Through

(Continued on opposite page)

To insure maximum reliability each quartz crystal is tested over a temperature range of —55°C to 105°C. Each crystal must hold its frequency to a tolerance of ±0.002%.

RIQAP, the government and the contractor realize mutual benefits in reduced costs and improved relationships. In addition, the manufacturer achieves smoother production flow, maximum use of testing equipment, simplified record keeping and inventory control, increased storage space and improved employee morale through the recognition.

Reeves-Hoffman quartz crystals and network assemblies are used in electronic circuitry in controlling radio frequency. Besides quartz crystals, crystal filters, frequency sources and networks, the Carlisle plant also supplies fractional horsepower motors.

Appoint Italian Rep

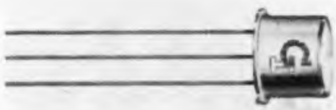
Lindenhurst, Long Island — CWS Waveguide Corp. manufacturer of microwave components for the radar and communications industries has appointed Metroelettronica Co. of Milano as sales representative for all of Italy. Company's products include: waveguide assemblies, attenuators, adaptors, reducers, transmission line and co-axial instruments of special design.

New Japanese Rep

Tokyo—Packard Bell Elctronics, Los Angeles, Calif., has retained Kyokuto Boeki Kaisha, Ltd., Tokyo, Japan, as sales and engineering representatives in Japan for their computers, analog-digital converters, data handling components, and digital systems. Bell's analysis of the Japanese market indicates a substantial sales potential in this field as a result of increasing technological progress there. They already have orders for three pb250 computers.

Mesa Transistors

Through better junction contacting, permanent surface passivation, 96 hr. baking 300°C and automatic testing



of all parameters, a highly reliable line of silicon mesa transistors is assumed. General Instrument Corp. BOOTH 1103

Circle 358 on Inquiry Card

Synthetic crystals emerge from the growing vessel three weeks after being sealed inside.

A perfect synthetic quartz crystal. Pieces of natural quartz are in the foreground.

What's New

Artificial Quartz

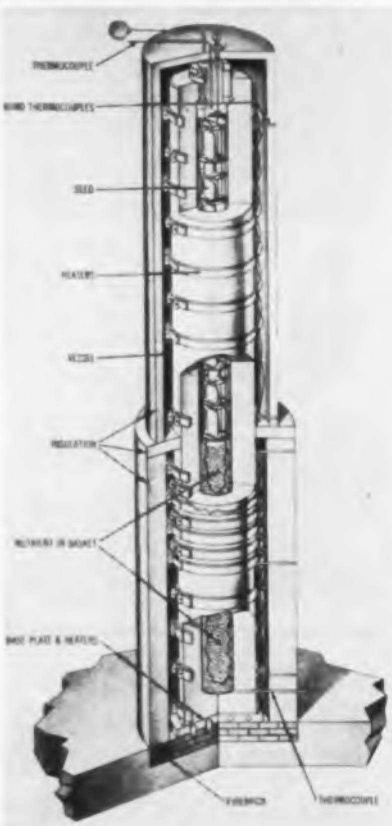
THE Western Electric Co. is now mass producing synthetic quartz crystals. The only source of natural crystals—used in radio and TV transmitters, radar, sonar, etc.—has been the interior of Brazil.

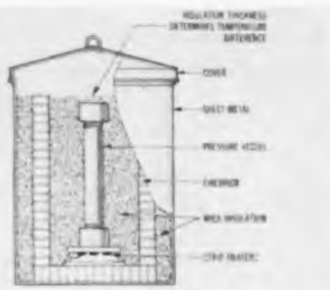
The synthetic crystals have a number of advantages over natural quartz crystals. They may be grown in configurations that allow more efficient sawing and shaping; the natural crystal faces of synthetic quartz allow easier orientation of the stock for cutting into crystal units; it has none of the foreign inclusions usually found in natural quartz, and it can be produced without either optical or electrical twinning.

The Bell Telephone Laboratories' hydrothermal process for growing the crystals is used. Seed crystals are suspended in tiers at the top of a basket within a cylindrical vessel. The lower half of the basket is filled with small, inexpensive pieces of natural quartz. A weak alkali solution is poured into the vessel.

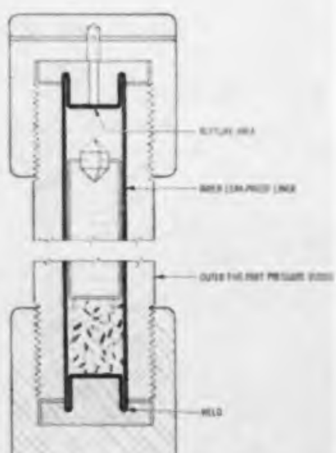
The contents of the vessel are then heated to 700°F under about 25,000 psi. The process depends on maintaining a critical temperature differential between the lower zone (nutrient area) and the upper zone (seed plate area). The low grade quartz dissolves into the alkali solution, and is carried by convection to the cooler upper region. The lower temperature here supersaturates the nutrient solution causing the dissolved quartz to redeposit onto the seed plates in single crys-

Construction details of crystal growing vessel





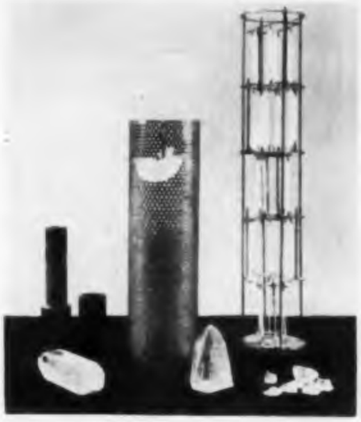
Research oven with a vessel and hot plate.



Research pressure vessel with inner liner.

Inspecting synthetic quartz plate for imperfections under high intensity light.

Heavy steel shield is lowered in place over growing vessel. Shields are needed because of high temperatures (700°F) and high pressures (25,000 psi) involved in process.



Model of nutrient basket seed plate holder. In foreground (l to r): synthetic quartz crystal, natural quartz crystal, and nutrient.

tal form. The entire process from loading to unloading completed crystals takes about 21 days.

Riveting Subminiature Parts

ENGINEERS at the Centralab Div., Globe Union, Inc., are assembling the parts of their subminiature, multiple contact switch (Series 100) by riveting. They use small tubular rivets which can be set in high speed automatic rivet setting machines.[1]

At the start of each production run, riveting machine operators are given a prototype subassembly to follow. From this they determine how many clips must be riveted to a stator section and where they are located.

(*Continued on page* 251)

1: Article abstracted from information supplied by the Tubular and Soll Split Rivet Council.

In-line riveting of miniature switch assemblies. Rivets are fed to the work automatically from rotary hopper feeds.

Riveting a contact, rotor and phenolic disc in a stator section.

(Continued from page 249)

To rivet the rotor, the contact, and the phenolic disc together, the operator first hangs the contact on the anvil guide pin, then adds the rotor which is temporarily held in the stator core by finger. The phenolic disc is then placed over the guide pin and the machine cycled. Holes are aligned by pivoting the contact.

Once rotor and contact are joined and located in the stator section, the assembly goes to a line of four setting machines where clips are riveted, one at a time, to the outer edge of the stator. At least one terminal clip, and usually more, is slightly longer than the others. The operator rivets it in place first using it as a reference point. Then, feeding slips to the anvil with one hand and rotating the stator under the spindle with the other, she sets the remainder as indicated on the sample.

The series 100 switch is used in guided missiles, transistor circuitry, aircraft instrumentation, and in band switching in ultra small electronic equipment.

Adjustable spring compensator on the anvil assembly reduces impact, alleviates breakage of ceramic parts. It provides needed control for clinch tightness.

RFI Measurements

(*Continued from page* 110)

of the need and inclination of the group doing the work. It is thus impractical to attempt to be complete in any general description of this sort. We shall describe in brief, several measurements which have found wide application and enumerate some references where additional information can be obtained.

In another NBS report (Ref. 10), Watt and Maxwell describe an arrangement they have used, and which has become virtually standard, for obtaining cumulative probability distribution of the amplitudes of the envelope of atmospheric radio noise. The cumulative probability distribution of the amplitudes is defined as the percent of time that the amplitude of the waveform exceeds any selected threshold level. The procedure is then, as shown in Fig. 7, to allow the noise waveform in some relatively large interval, T, to turn on a gate only when it is higher than the preselected threshold. The gate, while it is on, admits the signal generator output to the counter input. The ratio of the counter reading, which records the number of cycles during gate on intervals, to the number of cycles generated by the signal generator in the large interval T ($= fT$, where f is the frequency of the signal generator) is the cumulative probability corresponding to that threshold. The same publication describes a method for measuring the distribution of the pulse widths of the noise envelope waveform above a given level, and the distribution of spacing between such pulses.

A recent paper by Clarke (Ref. 11) describes another laboratory setup for measuring some characteristics of atmospheric noise. The apparatus described will measure the functions listed in the last paragraph and also the rate of arrival of such pulses, the mean square, and the average value of the noise envelope. The NBS has, in recent years, developed a system for measuring three statistical moments of atmospheric noise in each of eight frequencies in the range of 13 KC to 20 MC and in a bandwidth of 200 CPS (Ref. 13). This equipment, designated ARN-2, was employed during the International Geophysical Year at a number of locations throughout the world. The quantities measured are the RMS value, the mean value, and the mean of the logarithm, of the noise envelope in the 200 CPS band. In a recent paper (Ref. 13) Crichlow, et al, show methods for graphically converting these moments into probability distributions.

In work done recently at the University of Pennsylvania (Ref. 12), measurements, similar to those made by Clarke, were made on corona noise utilizing methods developed locally. One particular matter of interest in both this work and the work of Clarke, is the use of a device for measuring mean square or root

(*Continued on page* 254)

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RFI Measurements *(Continued)*

mean square values. Clarke describes an RMS detector which uses a thermistor element. The University of Pennsylvania tests utilized a Ballantine Model 320 RMS voltmeter which employs a collection of biased diodes to obtain the square law non-linearity. The latter device was connected to the i-f amplifier output of one of the RIFI meters described above.

It is of interest to note that this last arrangement, with suitable calibration, results in an "Average Power Spectral Density" meter. This quantity, which we shall define as the average power of the noise in a 1 ohm resistor per unit of bandwidth, is much used in statistical studies (the quantity $(E')^2$ introduced above is an average power spectral density). Such a meter can be conveniently calibrated, using an impulse source, and, in fact, the impulse device can be used for measurement by substitution. It will be noted from Table 2 that the RMS output of a RIFI meter (or any filter) to an impulse input is proportional to $\sqrt{B_p}$. The RMS output of any wideband noise is also proportional to $\sqrt{B_p}$. For instance, if we measured gaussian random noise in such a meter by making the deflection to the noise input and the deflection to the calibrating impulse equal, then

$$\sqrt{B_p}\,E' = S\sqrt{f_p B_p}/\sqrt{2}$$

or

$$(E')^2 = S^2 f_p/2.$$

Thus, the average power spectral density is determined by the impulse strength and its repetition frequency, both of which are known, and is not dependent on the filter bandwidth. For accurate work, it will be necessary for the spectrum of the noise to be substantially constant over the bandwidth of the filter.

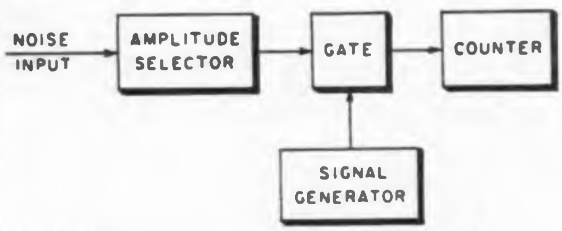

Fig. 7: Diagram of a probability distribution measuring device.

The quantity described above is a function of the center frequency of the filter. A complete Power Spectral Density curve is obtained by tuning the filter over the frequency range over which the noise is significant and recording the mean square output at a sufficient number of points. The curve so obtained can be shown to be the Fourier Transform of the autocorrelation function (Ref. 15), which is another useful measure for which apparatus has been devised in recent years. (Many research laboratories employ correlators constructed to suit local needs. Commercial units are also available, e.g., Flow Corporation Model MNC-11). A block diagram of an autocorrelator is shown in Fig. 8. The measurement obtained in this manner is the average value of the product of the

(*Continued on page* 256)

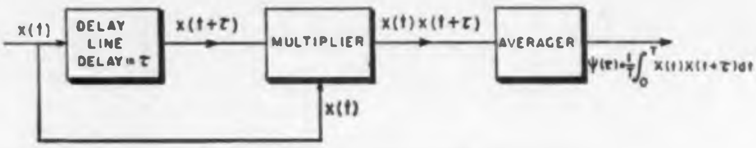

Fig. 8: Simplified block diagram of an autocorrelator for RFI investigations.

input time function, $x(t)$, and the same function delayed by a time, τ. By making the delay time, τ, equal to zero, the instrument will measure the mean square value of the function. τ is varied from zero up to a value sufficiently high so that $\psi(\tau)$ is zero, or becomes repetitive. For processes which are pure random functions of time, $\psi(\tau)$ ultimately becomes zero. If there is a periodic component in $x(t)$, then $\psi(\tau)$ ultimately becomes periodic. This technique is, in fact, used to find hidden periodicities in otherwise random phenomena. It may be well to point out that the periodicity is observed in the autocorrelation function by making the delay time, τ, very large. Alternatively, a periodicity can be found using the Power Spectral Density technique by making the filter bandwidth extremely small.

Conclusions

We have described, in some detail, the background and present status of the field survey type of radio noise measuring instrument. We have seen that these devices are designed for the measurement of all kinds of noise either in terms of some comparison standards, for example, an impulse source, or in terms of a standard circuit, such as the quasi-peak circuit. In some instruments, more than one measure of the noise is provided and these often provide a basis for distinguishing between classes of noise. To a large extent, measurements using such instruments are made to compare the strengths of similar sources of radio noise, and to a lesser extent, to determine the relative interference effect of different radio noises. In many cases, however, such instruments do not provide adequate data for establishing the loss of information in a communication system. More detailed study of the noise, using specially devised equipment, is required. We have described, although briefly, several such measuring systems.

The field of radio noise measurement has, quite obviously, not reached its limit. The area of laboratory and analytical methods of handling radio noise has only recently begun to receive much attention and can be expected to flourish in the future. The area of field survey instruments, too, can be expected to develop further. While most instruments in the latter category are vacuum tube operated today, a number of groups are at work redesigning them with semiconductor devices. Furthermore, as the communication frequencies are extended, RIFI meters covering

(*Continued on page* 258)

RFI Measurements *(Concluded)*

the new regions will be developed. It should be noted that instruments below 15 KC and above 1000 MC have been introduced commercially only recently.

Finally, the establishment of universal standards of noise measurement, which will be generally acceptable, and which suggest the resulting severity of interference (note that the quasi-peak circuits originally specified were based on tests with early quality audio broadcasting and the applicability to high fidelity audio broadcasting, television broadcasting, etc., is not known), is still a goal to be achieved.

Acknowledgment

This paper is based on work done with the support of the Bureau of Ships of the United States Navy under Contract Obsr 72505.

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CLOSED CIRCUIT TV gets a boost with the development of high voltage amplifiers capable of serving thousands of outlets at maintenance costs that are about 50% less than previous techniques. The new distribution equipment, which reduces the number of amplifier positions by a ratio of about 14 to 1 was initially developed by International Telemeter Company. Production models, developed and designed by Jerrold Electronics, are being installed as part of ITC's telemeter wired system in West Toronto, Canada.

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Output Voltage:	115 VRMS
Output Frequency:	400 cps (other frequencies available)
Output Power:	50 volt-amps
Frequency Regulation:	0.3% for 6 V line variations
Harmonic Distortion (Total):	2% at specified load (4% max.)
Size and Weight:	2½"x4"x2½" high; 26 oz.

DC TO DC *Model 591HC*

Input Voltage	24-30 VDC
Output Voltage Range	from 6 VDC to 3500 VDC
Output Power	60 watts (max.) regulated
Regulation	±1.0% for 6 V line variations; ±1.5% for 50% load variations
Ripple	0.3% RMS
Size and Weight	3" OD x 3¾" high; 22 oz.

DC TO SQUARE WAVE *Model 591ACB*

Input Voltage	24-30 VDC
Output Voltage Range	1.0 to 3500 VRMS, square wave, 400 cps (other frequencies available)
Output Power	50 V. A.
Regulation	Frequency and Voltage: ±1.0% for 6 V line variations; ±1.0% for 50% load variations
Size and Weight	3" OD x 3" high; 19 oz.

Constant frequency, voltage and output as battery discharges. Units withstand short circuit, reversed polarity and input voltage transients of 60 volts. Load power factors as low as 0.2 (lead or lag) may be applied.

Literature with performance curves sent on request. Literature includes "easy to order" information—no need to write complicated specifications.

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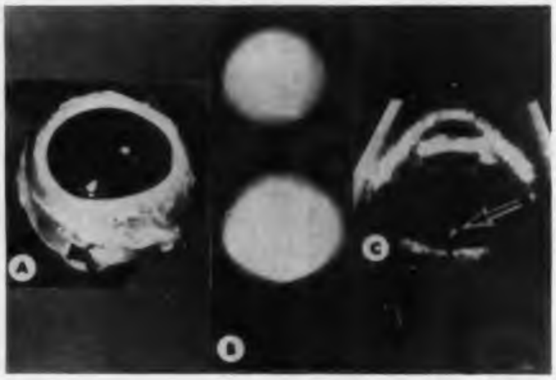
MEDICAL ULTRASONICS

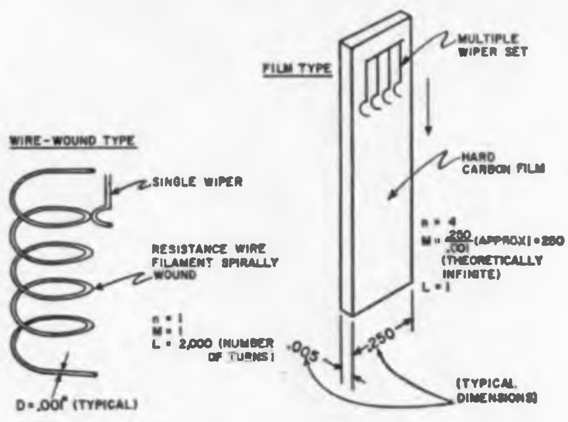


A new instrument, Ultrasonoscope by General Precision, Inc., can visualize soft tissues of the eye. Pix shows (L to R) comparisons of Gross, X-ray, and ultrasonic appearance of a piece of wood (arrow) in the eye.

Potentiometer Reliability

(*Continued from page* 107)

eter is carried by the single hair-like wire which is spirally wound about an insulated core; the single wiper in travelling along the length of the winding makes contact successively to each turn in a make-before-break action. From the point of view of reliability, wire-wound potentiometers can be likened to the single wiper, series contact situation analyzed. above. The current in the carbon film of potentiometer is carried by the entire film, offering virtually an infinite number of paths to the multiple wipers. The reliability of film potentiometers can be analyzed similarly to the multiple wiper, multiple path situation.



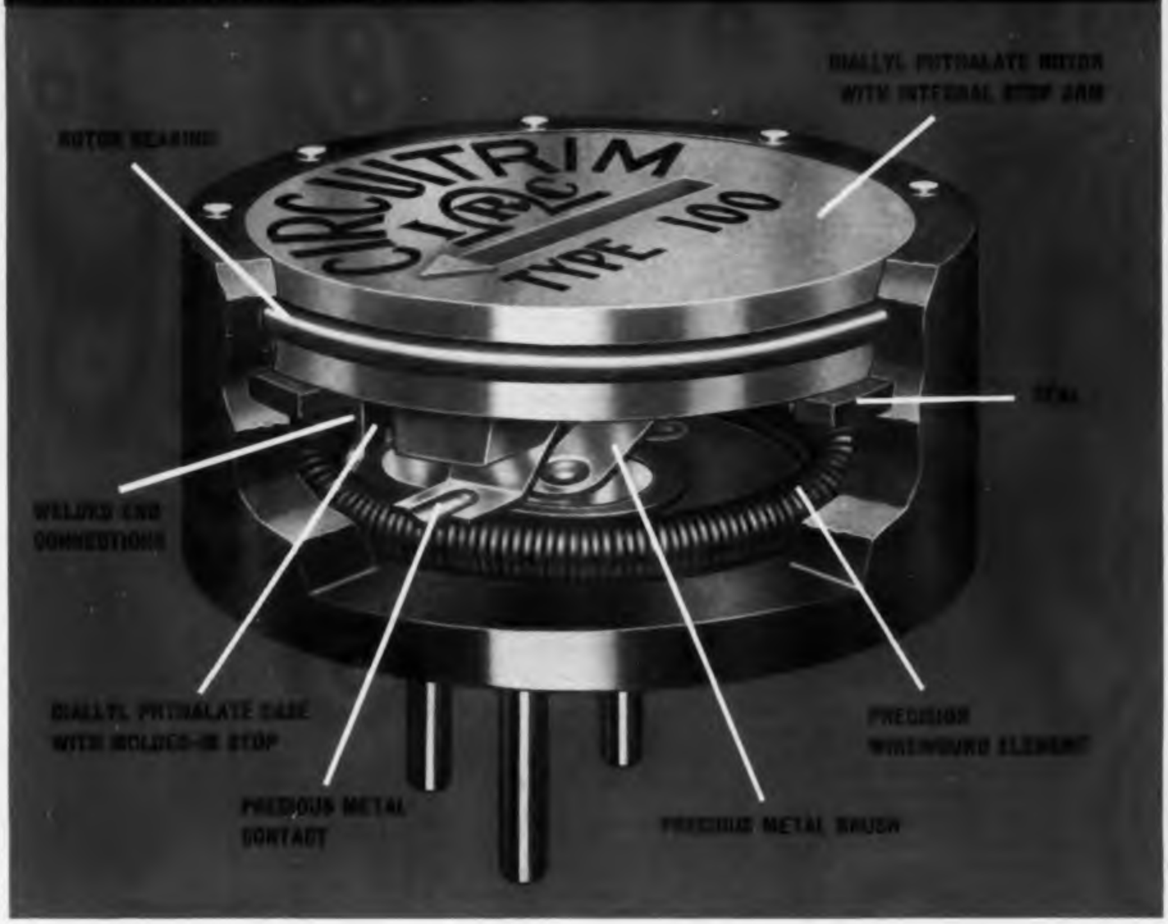
Failure Probability Ratio of Film Pots vs. Wire-Wound

$$= \frac{\left(\frac{1}{2}\right)^{n-1}}{M\,L} = \frac{\left(\frac{1}{2}\right)^{3}}{250 \times 2000} = \frac{1}{4 \times 10^{6}}$$

Conclusion: Film pots are at least 4×10^6 times inherently more reliable than wire-wound pots.

* * *

IN PRECISION POTENTIOMETERS : if it's news, expect it first from IRC



EXPOSED...a new simplified trimmer design
increased reliability...added economy

The new IRC Circuitrim 100 with its unique mechanical design (shown above) simplifies the complex mechanical linkage used for adjustment in most trimmers making it more reliable and less costly.

The Circuitrim 100 is available from 10 ohms to 50K ohms. Standard power rating is 1 watt at 25°C and derated to "0" at 150°C. Higher power rating is available. Printed circuit terminals are standard.

IRC also offers the conventional square trimmer design, the CT-200 with full interchangeability and superior moisture, shock and vibration characteristics. Choice of p-c pin terminals or Teflon-coated leads.

The Circuitrim 200 is available from 10 ohms to 50K ohms. Standard power rating is 1 watt. Write for Bulletins AE-19 and AE-20. International Resistance Company, 401 N. Broad St., Philadelphia 8, Pa.

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Industry News

Stewart Pfannstiehl—elected Vice President, Marketing, Oak Mfg. Co., Crystal Lake, Ill.

Edward L. Fitzgerald — appointed Computer Marketing Manager, Data Systems Operations, Sylvania Electric Products, Inc., Needham, Mass.

E. Willard Gentz—appointed Manager, Central Office Equipment Mfg., ITT Kellogg, Div. of International Telephone & Telegraph Corp., Chicago, Ill.

Robert T. Cahill—appointed Manager of Sales Service for the Technical Products Div., Corning Glass Works, Corning, N. Y.

Charles S. Hazard—joins American Machine & Foundry Co., New York, N. Y., in the newly created position of Manufacturing Specialist.

Donald Christiansen—named to the new post of Manager of Publications, CBS Electronics Div., of Columbia Broadcasting System, Inc., Danvers, Mass.

Ernest D. Hams — appointed Assistant Manager, Contract Administration, Remington Rand Univac Military Dept., St. Paul, Minn.

J. C. Pitts—promoted to Chief Project Engineer, **D. A. Spencer**—promoted to Engineering Staff Assistant, **P. J. Sprouse**—promoted to Chief Test Engineer; at Bendix Corp. Mishawaka Div., Mishawaka, Ind.

Edson D. Strong—appointed Senior Applications Engineer, Advanced Devices Laboratory, Airtron, Div., Litton Industries, Morris Plains, N. J.

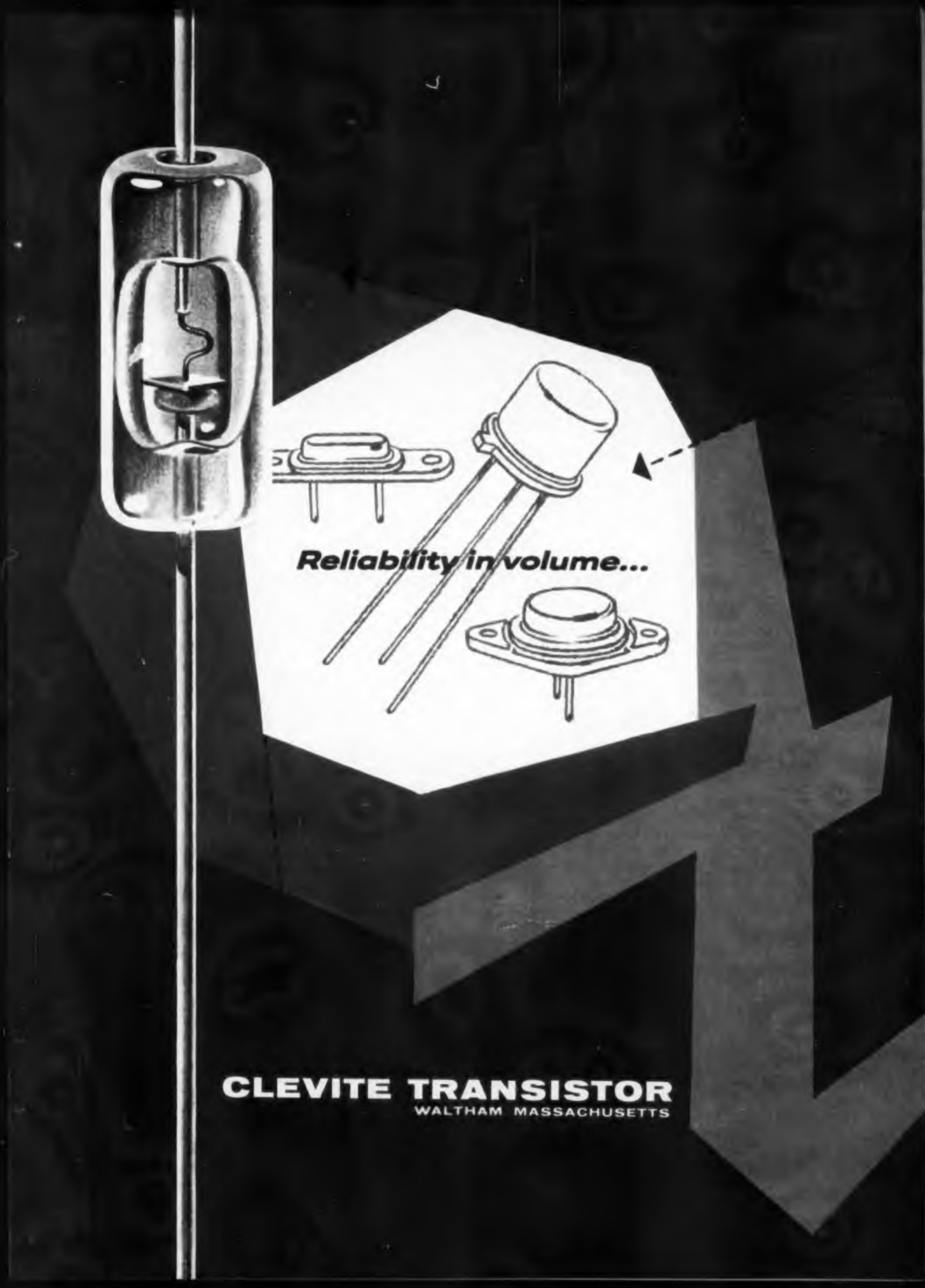
Arthur D. Coleman—joins International Resistance Co., Phila., Pa., as Senior Quality Assurance Engineer.

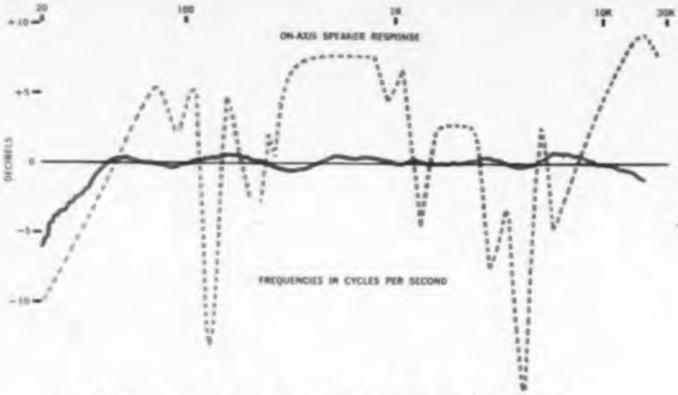
John P. Jacobic—appointed Quality Control Manager, ESC Electronics Corp., Palisades Park, N. J.

Jack W. McCarthy—appointed Vice President in Charge of Manufacturing, Electronic Transistors Corp., North Bergen, N. J.

Harry Turkington—named Director of Engineering; **Hal Moore** — advanced to Chief Meter Engineer of the Meter and Controls Div., The Hickok Electrical Engineering Co., Cleveland, Ohio.

(*Continued on page* 265)


Reliability in volume...
CLEVITE TRANSISTOR
WALTHAM MASSACHUSETTS



New transistorized speaker-amplifier system sets high standards in fidelity

A significant new design advance by Intergrand uses a unique servo-feedback between speaker and amplifier. Result: an amazing reduction in acoustic distortion.

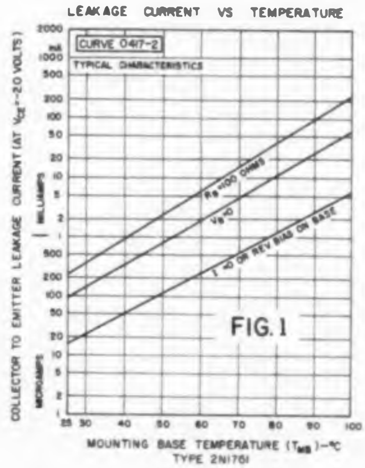


FIG. 1

By ROBERT CHASE — Applications Engineer Clevite Transistor

Utilizing servo feedback techniques, this new integrated sound reproducing unit treats the amplifiers loud speaker and enclosure as one electromechanical-acoustic network. The frequency requirements of this feedback system would have required prohibitively expensive output transformers had tubes been used. Inherent properties of power transistors that makes them suitable for output transformerless design made a reality of what was formerly considered an uneconomical but ideal acoustic theory.

The degree of success in this design is clearly shown by the curves that compare the pressure response of this system with a high quality, low efficiency speaker driven by a quality tube amplifier. The total technical specifications of this achievement are too detailed to be presented here. Crosby Telectronics of Syossett, Long Island, New York, has become exclusive sales and manufacturing agent for this system. This firm can supply all details.

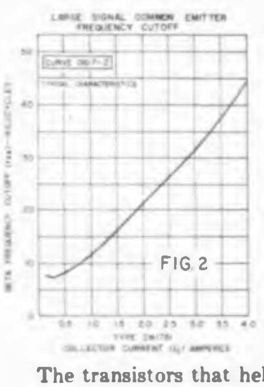


FIG. 2

Key elements in this design were power transistors incorporating precise electrical characteristics and extreme reliability. These were found in the Clevite 2N1761 units.

The three transistor amplifiers used to cover the entire audio spectrum must meet stringent requirements as to gain, stability, frequency response and power output.

The transistors that help meet these requirements are Clevite type 2N1761 (see chart). These are relatively new, fully specified at high temperatures to allow stable, predictable operation in DC coupled circuits. Figure 1 shows leakage current versus temperature for various common emitter operating conditions. The Clevite Spacesaver transistor exhibits low phase shift at high audio frequencies, allowing its use in systems having large amounts of negative feedback. Frequency response of the 2N1761 versus collector current is shown in figure 2.

A pair easily provides 10 watts output at 20 Kc with low distortion. Designers of high fidelity amplifiers, series regulated power supplies, DC to DC converters, servo motors and computor equipment requiring fast switching at high current will find the Clevite Spacesaver series of interest. Send for Bulletin TB226-2.

[illegible] Characteristics	Symbol	Measurement Conditions	2N1761 Min	2N1761 [illegible]	2N1761 Max	Units
D C Current Gain	h_{FE}	IC = 0.5 A, VCE = −2.0V	[illegible]	100	150	
Base Input Voltage	V_{EB}	IC = 3 [illegible], IB = [illegible]		0.5	1.0	Vdc
Collector to Emitter Saturation Voltage	$V_{CE(SAT)}$	IC = [illegible], IB = [illegible]		0.3	0.7	Vdc
Large Signal Cutoff Frequency	[illegible]	IC = 1 [illegible], [illegible], VCE = −2.0V	10	15		[illegible]
Thermal Resistance	R_t			1.4	2.5	°C/W
Collector to Base Breakdown Voltage	BV_{CBO}	ICBO = 3.0mA	[illegible]			Vdc
Emitter to Base Breakdown Voltage	BV_{EBO}	IEBO = 3.0mA	[illegible]			Vdc
Collector to Emitter Sustain Voltage	$V_{CES(SUS)}$	IC = [illegible], Shorted Base, VEB = 0	65			V
Collector to Emitter Sustain Voltage	$V_{CEO(SUS)}$	IC = [illegible], Open Base, IB = 0	[illegible]			V
Collector Cutoff Current	I_{CBO}	85°C, [illegible] Vdc / [illegible] Vdc / 70 Vdc / [illegible] Vdc		4.0	7.0	mAdc
Collector Cutoff Current	I_{CBO}	25°C, VCB = −2V		25		[illegible]

CT **CLEVITE TRANSISTOR** Waltham, Massachusetts

Industry News

(*Continued from page* 262)

Irving Silberg appointed General Sales Manager, Kay Electric Co., Pine Brook, N. J.

Richard A. Stonesifer appointed Product Sales Manager, Special Tube Operations, Sylvania Electronic Tubes, Div. of Sylvania Electric Products Inc., Mountain View, Calif.

Ted Westfall appointed Area General Manager-Latin America and Vice President, ITT, N. Y.

Stanley W. Cochran appointed Division Vice President and General Manager, Surface Communications Div. and **Irving K. Kessler** appointed Division Vice President and General Manager, Airborne Systems Div., both in RCA Defense Electronic Products, N. Y., N. Y.

P. P. Hoppe—appointed General Engineering Manager, and **C. D. Stephenson**, Advanced Project Engineering Manager, of the Amphenol Connector Div., Amphenol-Borg Electronics Corp., Broadview, Illinois.

Charles Camillo—named Div. Vice President, Engineering of Amphenol-Borg Electronics Corp., Danbury, Connecticut.

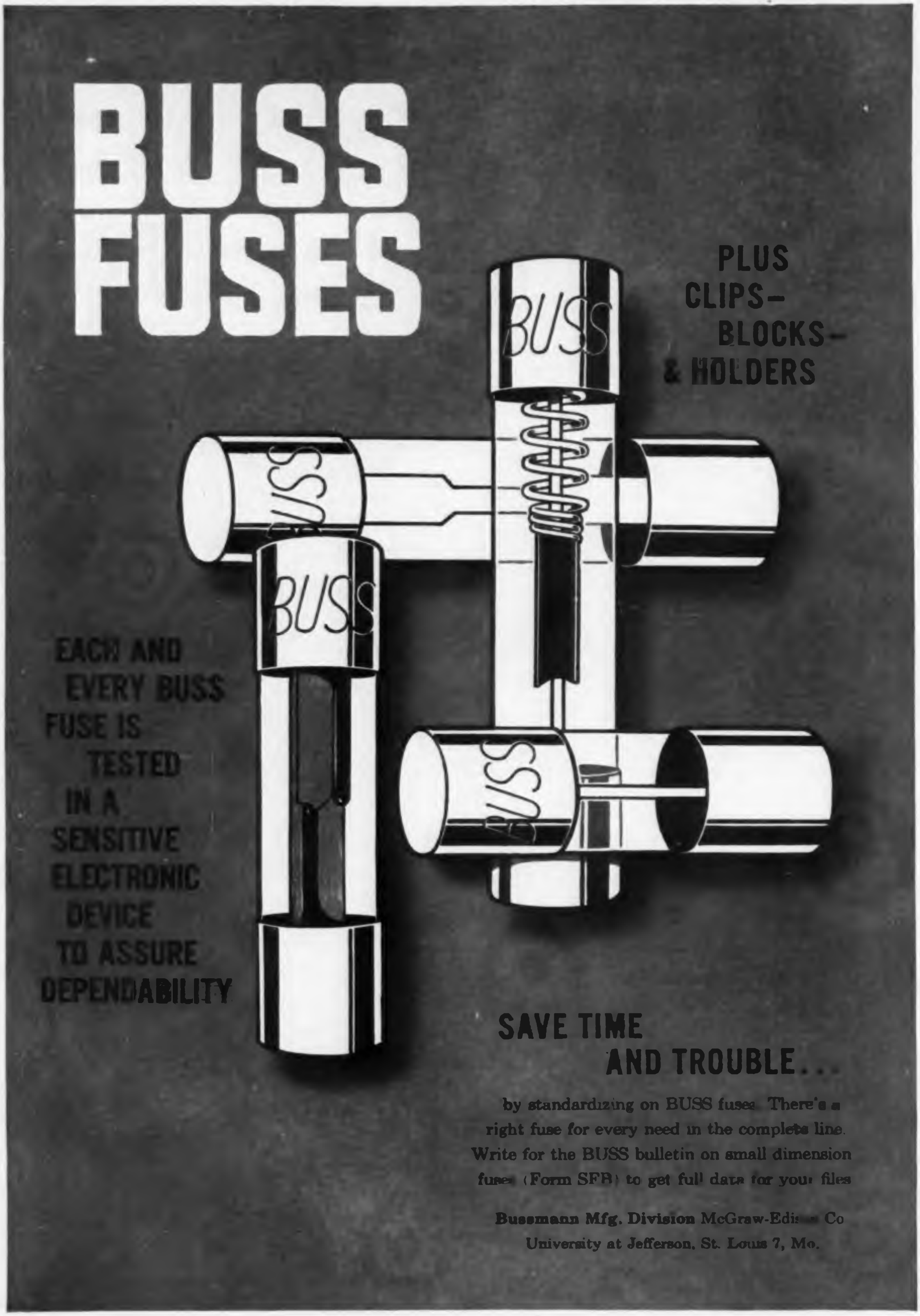
Roy H. Olson—joins Hughes Aircraft Co.'s Communications Div. as Director of Engineering Laboratories, Culver City, California.

Jack Glaser and **John B. Coontz** named to new positions in the Computer Labs at Hughes Aircraft Co.'s Ground Systems Group. Glaser appointed Manager, Army Missile Monitor Air Defense Command Post Project Dept. and Coontz named Senior Staff Engineer in the Computer Lab's Field Service and Support Dept.

David R. Heebner — Manager of Hughes Aircraft Co.'s Undersea Warfare Dept., appointed to serve on a National Research Council Panel, sponsored by the National Academy of Sciences, Washington, D. C.

H. Kenneth Payne — promoted to newly created position of Vice President, Operations will correlate functions of Engineering, Manufacturing, Quality Control, and Marketing; **Donald L. Welborn**—promoted from Director to Vice President, Manufacturing; **James Q. Kohler**—promoted from Director to Vice President, Purchasing; **Max Keith**, Director of Accounting—elected Treasurer of the company; Wilcox Electric Co., Inc., Kansas City, Missouri.

(*Continued on page* 271)



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Tele-Tech's ELECTRONIC OPERATIONS

The System Engineering Section of ELECTRONIC INDUSTRIES • MARCH 1961

SYSTEMS—WISE . . .

▶ A solar optical communications system (SOCOM) has been successfully tested by Electro-Optical Systems, Inc. Test was to establish feasibility and to check prototype equipment for a space communications system. Communications were carried out over simulated distances as great as 10 million miles.

▶ By 1961, a complete facsimile of a newspaper may be transmitted from the U. S. to Paris within 6 minutes, says E. T. Clare, of Cohu Electronics, Inc. A satellite communications system would be used—he predicted the systems would be a reality within a matter of months.

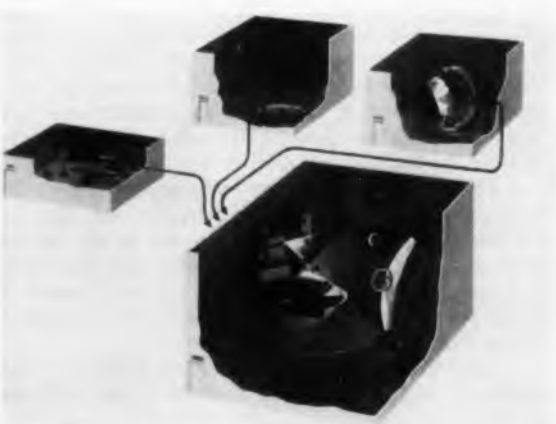
▶ New color TV system, designed by Dr. W. L. Hughes at Iowa State Univ. claims advantages in simplicity. TV stations could record color TV more economically and would need less complicated and more compact equipment. Three years ago Dr. Hughes demonstrated methods for recording color TV signals on ordinary black-and-white film. New system shows promise for point-to-point color TV.

▶ A new process has been developed for joining copper to copper and certain alloys to copper. A special coating on the metal surface diffuses into the parts to be joined and, under proper conditions, produces a bond without an interface. Joints retain the high electrical and thermal conductivity of copper. Chase Brass & Copper Co., Waterbury, Conn., developed the process.

▶ Thermal problems in the Saturn, Skybolt, and Nike Zeus programs will be studied with a new thermal analog computer being built for Douglas by Computer Engineering Assoc., Pasadena. Both re-entry problems and payloads-in-space problems will be studied.

VISUAL SIMULATOR

Visual simulator is for space flight training. Theater (lower right) houses mock-up. Directional screens, which receive images from separate projectors, are in the view field of each space vehicle window. Image generation studios supply high-resolution TV pictures to the projectors.



RADAR SHADOW

Tracking radar antenna creates "bat-like" shadow on covering during night operations at GE's Defense Systems test facility at Hancock Field, Syracuse, N. Y. Radar is part of AF's Atlas radio-command guidance system.

▶ BMEWS operational readiness is being evaluated by a Digital Data Processor developed by RCA and Auerbach Electronics Corp. The Processor controls the insertion of realistic patterns of radio frequency into BMEWS to simulate radar echoes in a sequence of events involving detection of an object in space. It then evaluates the operability of BMEWS based on its reaction to these simulated radar signals.

▶ "Old-fashioned communications systems prevent key executives in large complex organizations from speeding up decision-making," says Dr. John Manglesdorf, Lockheed Missiles Space Div., Sunnyvale, Calif. Paperwork should be eliminated entirely and information fed into a Computer "Central" Memory System on a continuing basis. Appropriate data could be "dialed out" of the computer in this vast pool of knowledge, without disturbing the originator. A direct, immediate flow of information between key people with no time lag between request and delivery of data is vital.

▶ Completely automated coal-fired steam electric power plant presently being engineered, constructed and automated for the Carolina Power and Light Company, Goldsboro, N. C., will be ready for operation early in 1962. Power plant's capacity will be 250 megw. Daystrom's SPARC (steam, power, automation, results, computer) system will start up and shut down the plant with analog sub-loop controls at 99.9% guaranteed reliability of information and 99% availability during any six month period.

▶ The instrumentation and process-control equipment manufacturers are looking for 1961 to be a good year. Potential users—utilities, metals production and processing, chemicals and food processing, etc.—are beginning to buy. For example: an automatic control system for ice cream production has been installed in Boston, and the meat packing industry is studying the possibilities of computer control systems.

If the same switcher is used for Color and B&W operations various problems of handling the color burst arise. Should burst be added before switching? Should burst be added after switching? Are modifications needed?

Controlling Burst in

TWO general methods are used to add color cameras to black & white (B & W) cameras in TV operations. One method is to install the color camera controls in a separate control room which has its own switcher. Color productions then become a separate function not directly associated with the B & W operations.

The other method is to add one or more color camera chains to the same switcher as that used for the B & W cameras. But problems arise with this method, and we will discuss them here.

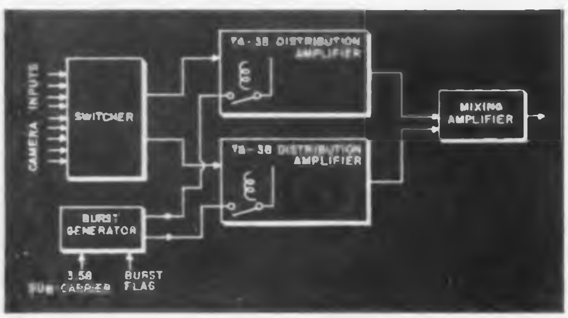
Functions

The color burst has two important functions, aside from providing a reference phase for demodulation of the chroma information. One burst function is to disable the "kill" circuit which turns off the chroma channel when the receiver is used for B & W reception. This stops noise from passing through the chroma channel and appearing on the screen in color. The "kill" circuit is disabled when a burst of sufficient amplitude appears on the incoming signal, thus allowing the chroma channel to operate.

The amplitude of the burst signal, in a receiver with automatic chroma gain, controls the gain of the chroma channel in an inverse ratio, i.e., when burst is low gain is increased.

It is desirable, therefore, that a full burst be transmitted on color signals, even if color and B & W pictures are mixed. Also, receivers tend to lose color sync on low amplitude burst if the color AFC circuits are on the "ragged" edge due to slight maladjustment or aging.

Fig 1. System used to add an in-phase burst on the B&W channel whenever a color camera is punched into one channel of the switcher and a B&W camera on the other.



Switching

When B & W and color cameras are mixed in a switching operation the burst has to be reduced. As the color video is lowered to permit the B & W video to come in, the burst is lowered also. Switching situations where this occurs are:

1. Dissolving from B & W camera to color camera and vice versa.
2. Super-imposing B & W and color cameras.
3. Fading color camera to black and vice versa.

For example a color title slide may be superimposed over a B & W live camera.

A solution to this problem is to add the burst after the switching operations have taken place. However, this poses two problems when dealing with color. First, it is desirable to have burst present on the color signal before it is switched in order to drive monitors. Second, it is difficult to maintain accurate phase relationships between the color signal and the burst if the burst is added later.

A better solution is to have burst added temporarily to the B & W cameras as they are punched into the switcher. With this method burst can be left on the color signals for monitor operations and the phase problem is not important because the added burst is never the main burst in the resultant signal and minor phase drifting is not important.

To do this, it is desirable that whenever a color camera is punched into one channel of the switcher and a B & W camera (or black) is on the other chan-

By E. W. LAMBOURNE

Chief Engineer
Columbia Pictures
130 Social Hall Avenue
Salt Lake City 11, Utah

Color-B & W TV

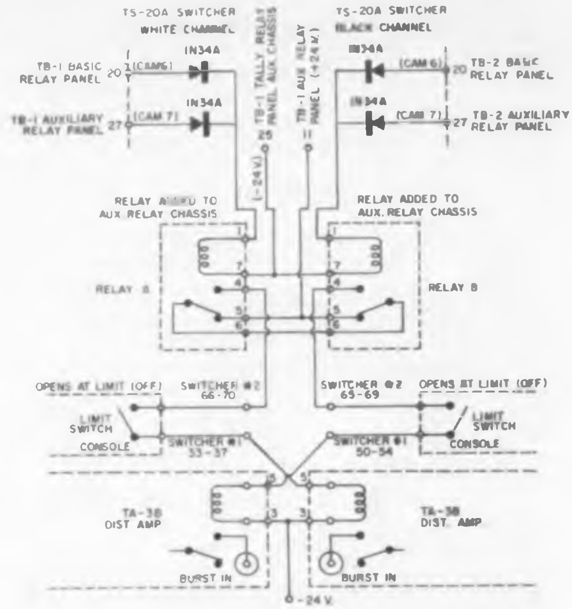


Fig. 2. Shows the connections for controlling burst insertion in the TA-3B Distribution Amplifiers.

nel, an in-phase color burst must be added to the B & W channel as dissolve action starts. The new burst will always be adding just enough to make up for the loss in the color camera burst as the dissolve action proceeds.

Relay Switcher

Fig. 1 shows a method of doing this with an RCA TS-20A relay switcher. Two TA-3B distribution amplifiers are inserted into the output channels of the

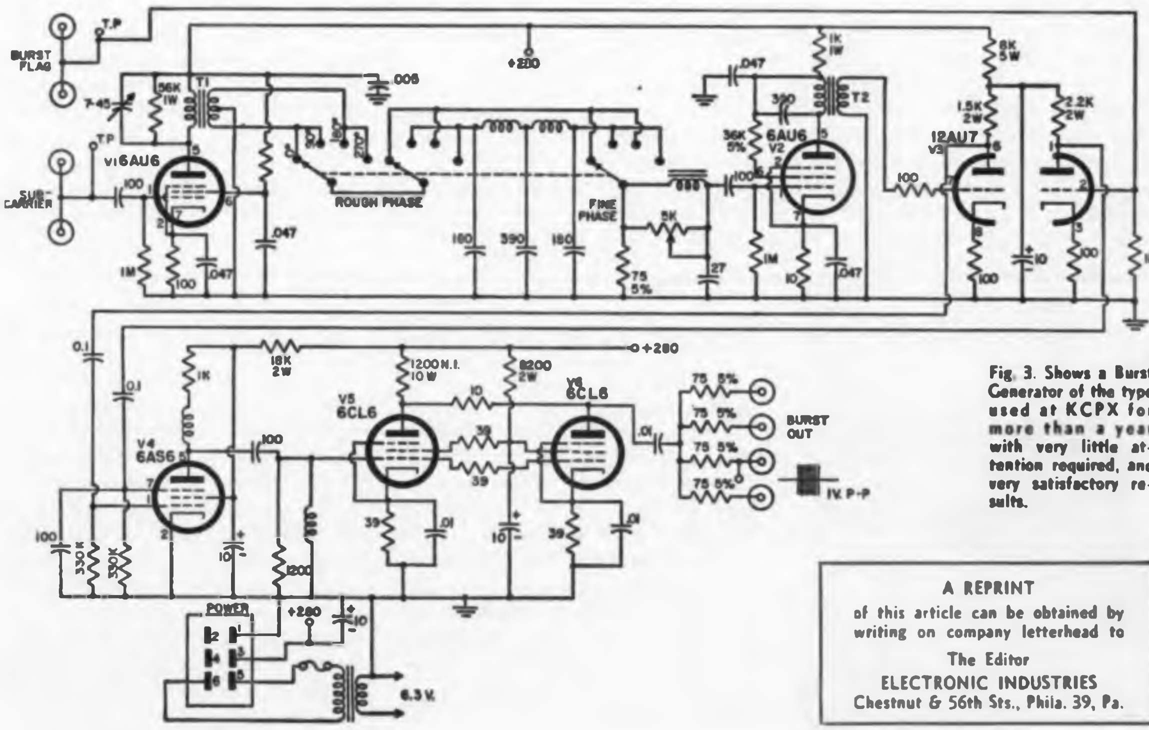


Fig. 3. Shows a Burst Generator of the type used at KCPX for more than a year with very little attention required, and very satisfactory results.

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The Editor
ELECTRONIC INDUSTRIES
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Controlling Burst *(Concluded)*

switcher. The amplifiers have burst added at the normal sync input connection. This burst is turned on and off with the TA-3B sync relay. The sync relay is controlled by relay contacts in the switcher so that the burst is turned on when the proper events are punched into the switcher.

When a color camera is entered into the white channel and a B & W camera into the black channel, the relay in the black channel TA-3B amplifier will add a burst to the B & W camera video as soon as dissolve action starts and the limit switches are released.

Interconnections for accomplishing this in the TS-20A switcher are shown in Fig. 2. It is necessary to add two relays to the switcher. Cameras 6 and 7 in the figure are color cameras, all others (not shown) are B & W.

Operation

Relay "A" is energized when camera 6 is punched up in the white channel. This in turn applies +24 volts through relay "B" and "A" contacts, and through the white channel limit switch to the burst-adding relay in the black channel distribution amplifier. If a B & W camera (or no camera) is punched up in the black channel, a burst will be added to the signal, and will remain until the white channel "off" limit switch opens the circuit and removes the connection. This would, of course, happen if a dissolve were taking place from the color camera into the B & W camera.

If color cameras are punched up in both channels no burst can be added because of the connections on relays "A" and "B". No burst will be added unless a color camera is punched up in one of the channels because neither relay would be activated.

The 1N34A diodes prevent interaction in the switcher between the two camera inputs.

If the color camera is up full and it is desired to dissolve to the B & W camera, the burst added to the black channel distribution amplifier will be added in the correct proportion to the burst of the color camera. As the dissolve action is completed and the B & W camera comes up full, the burst is removed due to the action of the white camera "off" limit switch.

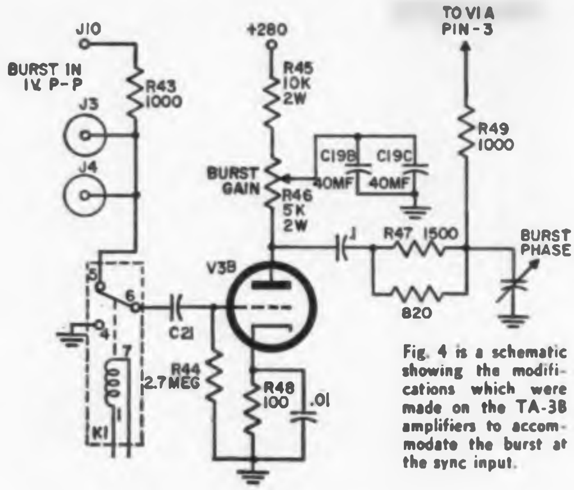


Fig. 4 is a schematic showing the modifications which were made on the TA-3B amplifiers to accommodate the burst at the sync input.

Modifications

Modifications were made on the TA-3B amplifiers to accommodate the burst at the sync input. These were centered about the sync amplifier (Fig. 4). The cathode was bypassed and the isolation resistor reduced in value to increase the gain. A small trimmer was added to allow small burst phase adjustments. This circuit will produce ¼ volt of burst on a non-composite input signal of ¾ volt when one volt of burst is present at the input jack J-3.

Circuit Functions

In Fig. 3 the first two stages constitute a phase shifter similar to that used in the RCA TX-1C colorplexer. This allows the burst to be phased with the burst produced by the color camera chains. The third tube acts as a driver to supply subcarrier and burst-flag to the gating stage. The coil, and coupling capacitor in the mixer output serve as a filter to remove the low frequency burst flag pedestal from the gated burst. Four outputs are used to feed burst to two switchers.

This installation has been in use at KCPX for more than a year with very little attention and very satisfactory results.

Tiny Transmitter

A MICROMINIATURE transmitter so compact that the entire unit including its battery is mounted in a dental bridge is being used by the U.S.A.F. Aerospace Medical Center at Brooks AFB. Transmitter is also small enough to be swallowed.

Air Force scientists are monitoring the number of closures, grinding, and tooth pressures as a measure of the amount of stress being experienced. The transmitter goes on when the teeth are closed and goes off when they separate.

Tooth transmitter can be mounted in a dental bridge.

The transmitter's signal can be received at a range of 2 to 3 ft. It was built by Varo, Inc., Garland, Texas using micro-circuitry techniques. This involves circuit fabrication in a vacuum chamber by vapor depositing several basic materials in the proper pattern on a ceramic wafer.

Industry News

(*Continued from page* 265)

Henry Reinecke, Jr. and **Richard W. Hofheimer**—join Non-Linear Systems, Inc., Del Mar, California, as Project Managers in the field of analog to Digital Converters.

Eugene Kleiner — appointed Manager of Administration and Research Services for Fairchild Semiconductor Corp.'s Research and Development Center, Palo Alto, Calif.

James Bagnall—named Director of newly established Applied Research Div., National Co., Inc., Malden, Mass. **James George**—named Manager of newly established Tube Engineering Dept.

K. L. Curtis and **A. A. McGowan**—appointed to the Instrument Engineering Staff, Instrument Div., Bourns, Inc., Riverside, Calif. Mr. Curtis will concentrate on AC Instrumentation while Mr. McGowan will work in the field of Pressure Transducers.

Harry L. Hildebrand—named Manager of Process and Design Engineering and **John G. Musselman, Jr.**—appointed new Manager of the Fabricating Division, Taylor Fibre Co., Norristown, Pa.

P. H. Neville—elected Director, The Hickok Electrical Instrument Company, Cleveland, Ohio.

Edwin S. Davis—appointed Device Design Engineer by Industro Transistor Corp., Long Island City, N. Y.

Harry A. Pearl—appointed Supervising Engineer, Materials Laboratory, Republic Aviation Corp.'s new Research and Development Center, N. Y., N. Y.

Jerome G. Friedman—named Sales Manager, Systems; **James A. Pitrelli** named Sales Manager, Industrial; and **Frank R. Meshowski**, as Sales Manager, Components, Gulton Industries, Metuchen, N. J.

John B. Tuthill—elected Vice President, Finance, and **W. W. Roodhouse** elected Vice President, Administration, Collins Radio Co., Dallas, Tex.

Noel E. Porter—appointed to new post of Vice President of Operations, and **Ralph E. Lee** named Vice President of Manufacturing, Hewlett-Packard Co., Palo Alto, Calif.

Hector D. Petri—appointed General Sales Manager, Ucinite Co., Div. of United-Carr Fastener Corp., Framingham, Mass.

CUES for Broadcasters

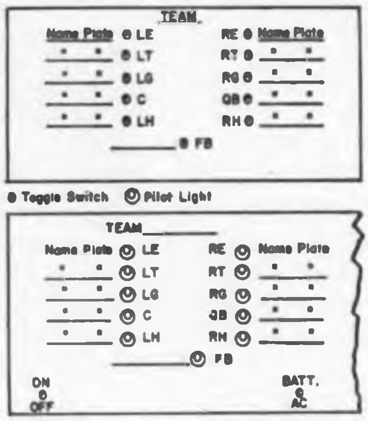
Football Spotter's Board

EARL N. HODGES, Ch. Eng.

KFFA, Helena, Ark.

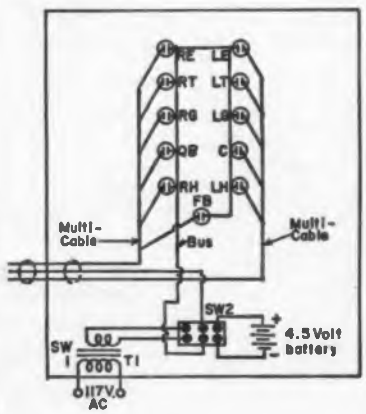
A football announcer has a difficult time keeping up with the game unless he has good spotters. And spotters are often handicapped because they do not have a good means of communicating players' names to the announcer.

The board described in this article should be a great help to spotters and announcers alike. The spotter merely throws a toggle switch, indicating the players involved in a given play, and a light flashes on the announcer's board. The player's name and position are there before the announcer's eyes.

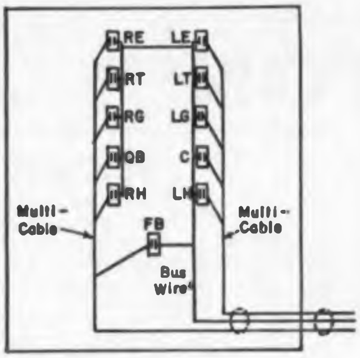


Front view of spotters' and announcer's panels are shown. There are two spotters panels—one for each spotter. Only one-half of the announcer's panel is shown. The other half is identical.

This setup consists of two control or switch panels—one for each spotter—and the board for the announcer. The announcer's board has two rows of lights on the left side and two rows on the right side. There are five lamps in each row, and below the two rows and between them—as shown in the diagram—is a single lamp. That makes eleven lights on each half. Each lamp indicates a player. The single, and lower, lamp can be used to indicate either Center, Fullback, or Quarterback, depending on the choice of the announcer.



Pictorial hook-up diagram of the announcer's board is seen from the underside. T1 is a 6.3 v., 0.7 a. transformers. Battery is actually three flashlight cells in series.



Underside of the spotter's board is shown with the wiring. Multi-cable has 14 conductors. Cable connects to the announcer's board. Plugs may be used on both panels instead of through wiring for the interconnecting cables.

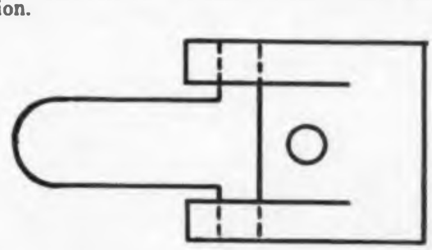
The boards or panels, should be thin plywood or Masonite. The announcer's board should be about 12 x 30 inches, and each spotter's switch panel should be made to fit inside the bottom of the announcer's board. That way you will have a compact, easy-to-carry job. The lamps can be any kind you choose, but I use #47's. Side rails should be 1 x 2 in. pine or other softwood. The backs of the switch boards should be enclosed with plywood or Masonite to protect the wiring. The wiring of the announcer's board will be protected by inserting the other two boards into the bottom of the announcer's board.

A fourteen (14) wire cable should be used to connect each switch panel to the lamp panel. Lamp assemblies can be Dialco or any other kind that will do the job. Any kind of SPST toggle switch will be okay. SW 2 is a DPDT switch. As shown in the diagram it chooses between the batteries and the ac filament power. The battery assembly is ordinary battery clips screwed to the inside of the announcer's board. Three flashlight batteries will supply sufficient voltage to illuminate the #47 bulbs. They should last through a couple of games before needing replacing. The nameplates should be the slide-in type, and the player's names can be typed on thin, smooth pasteboard and slipped into the slot when substitutions are made.

Gates Interlocks

DONALD M. WHEATLEY, Ch. Eng.
WJOY, S. Burlington, Vt.

After the speed locks on the back of our Gates "Hi-watter" transmitter got worn, they repeatedly let go, tripping the interlocks and throwing us off the air. The problem was solved by obtaining, from a local hardware store, a couple of spring clips of the type used to hold in window screens and storm windows. These are mounted with a small block on the back of the cabinet so the spring holds the panel and interlock in place. This proved to be a quick and easy solution.



WASHINGTON

News Letter

INDUSTRY PROPOSALS—Forty-one companies interested in participating in the development of a low-altitude active communications satellite will submit proposals to the National Aeronautics & Space Administration's Goddard Space Flight Center by March 6. Proposals are for Project Relay. Project Relay, NASA stated, will "demonstrate the feasibility of basic concepts and technological approaches and to evaluate the various systems to be employed in communications satellites." NASA sponsored the 1960 successful Echo passive satellite in conjunction with the Bell Telephone Laboratories and the Jet Propulsion Laboratory at Goldstone, Cal.

"RELAY" SPECIFICATIONS—NASA has asked the companies to conduct experiments on the transmission of wide-band communications using a low altitude active artificial earth satellite. The tests will include communications between the east coast of the U. S. and the west coast of Europe. They will cover the range of television signals, multi-channel telegraphy and data handling. It is planned to have the satellite orbit the earth once every three hours. The frequencies favored at present are in the 400-500 MC band from ground-to-satellite and in the 2200-2300 MC band from satellite-to-ground.

AT&T SPACE PLAN—The FCC has approved American Telephone & Telegraph Co.'s plans to conduct extensive research into earth-satellite communications. But the Commission refused, for the present, AT&T's request for changes in rules to permit the company to go ahead with initial stages of commercial service following satisfactory tests. The AT&T proposed tests will include experimental communication with earth stations operated by the United Kingdom, French, and German Republic governments.

NEW APPROACH—Plans for a new approach to satellite communications, involving the establishment of a "common carrier's common carrier," were presented by the Lockheed Aircraft Corp. to the FCC, NASA, Office of Civil & Defense Mobilization, and Congressional committees. This was at a session in the FCC's headquarters which received virutally no publicity. The Lockheed program emphasized that the FCC was the only existing government entity with statutory power to get the satellite project off the ground before additional problems develop. The legal representatives of Lockheed stressed to the government officials that "the satellite operation could be best carried on through a joint venture of manufacturers of satellite hardware and the major United States communications common carrier activities in both the voice and record fields."

ECONOMIC FEASIBILITY — In its presentation, described as "very impressive" by a number of participating government officials to **ELECTRONICS INDUSTRIES'** Washington news bureau, Lockheed concluded that an international satellite communications link for telephone, telegraph and telex operated by private enterprise "will be economically feasible by 1968-1970 and technically feasible even sooner." The satellite communications system would cost an estimated $260,000,000 over a six-year initial phase period. There would be two "stationary" active satellites in orbit about 22,300 miles above the earth on a 24-hour basis of operation and 20 ground stations, four of which would be in the United States.

NEW FCC CHIEFTAIN—New FCC Chairman, Newton N. Minow, promises to be the strongest helmsman in the Commission's 26-year history. He takes over early this month (March). He was confirmed unanimously by the Senate during mid-February to serve until June 30, 1968, but had to wind up his responsibilities with his Chicago law firm before coming to Washington. Chairman Minow terminated all relationships with his law firm upon assuming the Commission post.

EXHIBITED CAPABILITY—FCC Chairman Minow demonstrated to the Senate Interstate & Foreign Commerce Committee (in a 2-hour confirmation hearing Feb. 8) his intelligent and fair approach to the problems facing the FCC. He stressed that he would do everything possible to aid the expansion of educational TV and improve TV programs—within the limits of the FCC's legislative powers. Likewise, he regarded the furtherance of space communications as a matter of highest priority. He also gave full recognition to the question of bringing about greater coordination of the federal government agencies in regard to frequency allocations.

National Press Building *ROLAND C. DAVIES*
Washington 4

LOOK FOR EMPHASIS on advertised procurements in Government contracts. The Small Business Administration has complained that small business firms are losing out on Government contracts. In fiscal 1960 only 14% of the dollar volume value of procurements was accomplished through formal advertising. The Senate Small Business Committee has introduced a bill to authorize the Comptroller General to review certain negotiated Government contracts. Senator Sparkman (D., Ala.) believes this would encourage the advertisement of contracts and thus aid small business firms.

Industry News

Non-Linear Systems, Inc., has appointed new Sales Managers in each of four new regional sales offices. They are: **James F. Helfrick,** Northeastern Marketing Region, Garden City, N. J.; **Thomas Kurtzer,** Central Marketing Region, Chicago, Ill.; **W. E. Bradbury,** Eastern Marketing Region, Washington, D. C.; and **William Olbrick,** Western Marketing Region, South Pasadena, Calif.

George N. Krassner — appointed Product Manager for Astronautics Equipment in the Electronics Div. of Stromberg-Carlson, a Div of General Dynamics Corp., Rochester, N. Y.

James L. Lahey has been appointed to the newly created post of Manager, Advance Technical Products for the Commercial Electronics Group, Thompson-Ramo-Wooldridge, Inc.


James L. Lahey


Lester P. Creaser

Lester P. Creaser has been appointed as Semiconductor Sales Engineer at the Lansdale Div. of Philco Corp., Lansdale, Pa.

Joseph R. Conroy—named Regional Manager, Field Marketing, Rocky Mountain Region for Sylvania Electronic Systems, a Div. of Sylvania Electric Products Inc. Sylvania is a subsidiary of General Telephone & Electronics Corp.

W. V. Warner — appointed Vice President-Sales for Ford Instrument Co., Div of Sperry Rand Corp., Long Island City, N. Y.

Frederick H. Norton—named as Regional Sales Manager of the East Central Sales Region of the Baldwin-Lima-Hamilton Corp., Phila., Pa.

John L. Herre—appointed Government Sales Manager of General Instrument Corp.'s Semiconductor Div., New York, N. Y.

Thomas H. O'Brien—promoted to Director of Operations; and **Harry C. Nelson**—promoted to Director of Marketing; at PRD Electronics, Inc., Brooklyn, N. Y.

(F101, AIR FORCE PHOTO)

National has had many years' experience making significant contributions to the defense effort, including airborne components.

COMPARE THIS OPPORTUNITY

WITH WHAT YOU ARE NOW DOING!

HERE'S WHAT *National's* NEW MILITARY RESEARCH AND DEVELOPMENT PROGRAM OFFERS.

This operation will interest any engineer or scientist possessing enough self-confidence—ability and experience—to develop projects initially and carry them through to completion.

WHO WE'RE LOOKING FOR

National is looking for military-oriented scientists and engineers who hold a B.S. degree or advanced degrees. You should be working in electronic, electro-mechanical, mechanical, physics, optics, mathematics, or other related areas. Preference will be given to those who have had several years' experience dealing with prime contractors and government agencies.

As a member of National's New Military Development Team—you will be working initially with our Military Proposal Group. As proposals become specific projects, your responsibility will continue through the contractual stage for technical liaison, fulfillment of contractual obligations including hardware development, meanwhile retaining sufficient flexibility to continue your proposal efforts.

WHY YOU SHOULD INVESTIGATE

National's new Military Research and Development Program offers you unusual latitude in responsibility. It offers you the chance to participate in military projects from start to finish. Furthermore, you now have the opportunity to join an operation still in its formative stage with one of the world's most successful . . . most reputable corporations.

COMPLETE INFORMATION is yours by sending your résumé to Mr. T. F. Wade, Technical Placement Section G9-1, The National Cash Register Company, Dayton 9, Ohio. All correspondence will be kept strictly confidential.

National

THE NATIONAL CASH REGISTER COMPANY, *DAYTON 9, OHIO*

ONE OF THE WORLD'S MOST SUCCESSFUL CORPORATIONS

77 YEARS OF HELPING BUSINESS SAVE MONEY

PROFESSIONAL OPPORTUNITIES

Reporting late developments affecting the employment picture in the Electronic Industries

Design Engineers · Development Engineers · Administrative Engineers · Engineering Writers Physicists · Mathematicians · Electronic Instructors · Field Engineers · Production Engineers

Pay-Fringe Benefit Cuts Anti-Recession Measures

The impact of the current recession, until now limited to layoffs and short time for production workers, is beginning to hit the executive level.

Some execs are being fired but the squeeze is mostly taking the form of pay-cuts, bonus cuts, fringe benefit cuts—expense accounts, travel allowances, country-club memberships, etc.

The situation is by no means universal. Some companies feel that these actions could make extremely valuable execs move (to competitors) or that it is unjust to penalize the execs for a general business slump.

Other companies feel that they are encouraging bad public and employee relations when production people are required to bear more of the recession losses than the execs.

Some execs are being asked to take pay cuts but most reductions are the result of declining bonuses which are tied to company sales or profits. The companies are also cutting expenses in such areas as stockholder and community relations where there is less direct connection with sales and profits. The companies also are putting more of a load on individuals: when an exec leaves, the workload is transferred or distributed among remaining execs instead of hiring another man.

Most layoffs and pay-cuts are in middle-management—the $15,-000 to $30,000 a year group—but this is because this group is numerically the largest in management. The top-level management men are feeling the pinch mostly in bonus cuts.

FOR MORE INFORMATION . . . on positions described in this section fill out the convenient inquiry card, page 211.

NEW AWARD

Trophy will be awarded annually by Lear, Incorporated, to the person, persons, or organization in the U. S. or foreign countries making the most lasting contributions to air safety. An independent award committee is being formed.

IBM Institutes Invention Awards for Employees

International Business Machines Corp. has a new Invention Award Plan to give special recognition to individual IBM inventors who contribute significantly to the Company's technical position, as well as to IBM's efforts to advance the scientific and technical community.

The first presentation will award over $275,000 to 250 employees. An invention rated "outstanding" by a laboratory board earns an award of $1,000. The invention is also eligible for a corporate award of $5,000 or more. The program also offers a five-stage achievement plan that rewards inventors according to the number of their inventions.

Five inventions must be filed to qualify for the first stage award which pays $1,000. A cumulative total of 13 filed inventions is required to win the next stage award which pays $1,500. A total of 25 inventions filed is required to win the $2,500 award at the third stage, and 40 filed for an additional $3,000.

Consumer Demand Boom Not In Sight—Kelly

"Manufacturers of electronic equipment will be under 'increasing pressure' this year to conserve working capital and to trim unnecessary overhead and payroll costs," says Walter M. Kelly, President of Commercial Factors Corp. "Pent-up consumer demand, the vital force that propelled the post-war boom, is now behind us, and we probably won't see another boom of anywhere near such massive proportions until the mid-1960's."

Despite an expected increase in sales volume, competition will be intense and rising costs will eat into profits. Companies that hope to prosper in this climate will have to ride herd on costs and get maximum mileage out of their working funds.

First NASA Award To Johns Hopkins' McClure

NASA's first award under the invention award authority of the Space Act of 1958 goes to Dr. Frank T. McClure, Chairman of the Research Center at the Johns Hopkins University Applied Physics Laboratory, Silver Springs, Md. The award is for his invention of a Satellite Doppler Novigation System.

Under terms of the Space Act the award ($3,000) is for "contributions used to further space and aeronautical activities of the U. S."

Mathematician Shortage

Industry reports a shortage of mathematicians. They are needed to design computers, break down complex formulas so computers can handle them, plot trajectories of missiles, etc.

Mathematicians can now demand higher salaries. A Ph.D., for example, can get $11,000 to $12,-000 a year from industry compared to $6,000 to $7,000 in teaching.

An effective talk is the product of a well-written paper

By HARRY BAUM

Engineer
Radio Corporation of America
Electron Tube Division
Harrison, New Jersey

Writing—

MORE and more, the engineer is called upon to put his thoughts on paper. Progress reports to clients, reports to management, papers for publication in the technical journals—all take a sizable portion of the engineer's time. So much time is taken that the engineer can no longer consider writing an unpleasant task that isn't really part of his job. Writing must be considered an engineering skill—and an important one.

Each person has his own writing problems. You may find it difficult to organize your material or to verbalize your thoughts. You may tend to be too wordy, or imprecise. You may be unable to impart a feeling of smooth flow to your writing. There is no cure-all for these writing ills, but there are methods of writing that will help most people. The technical paper is used here as a frame of reference, but most of the ideas are applicable to any kind of technical writing.

Get into a Teaching Mood

Don't try to be a writer. Think of yourself as a teacher. You want to get ideas across, but you don't want to call attention, either favorable or unfavorable, to the medium you're using to do it. Such attention can only detract from your message. Try to get into the reader's frame of mind before you reach for a pencil.

Let Your Thoughts Flow

Pick up a pencil and jot down your thoughts just as quickly as they come. Jot down sentences that seem particularly good to you. Don't attempt to organize your thoughts. Trying to organize at this point would just tend to dry up the flow.

Organize Your Thoughts

When your random thoughts stop flowing, it's time to really get down to business. Look at the notes you've written and organize them into some logical order. This procedure should take care of the main topics of your outline. Now fill in the subtopics needed to explain these major topics to the reader. The result is the body of your outline.

Stop and look it over carefully. Has the reader been given the material he needs to understand each point in the outline? If not, start juggling until that condition is satisfied.

Don't rewrite the outline six times during this phase. Get a pair of scissors and a paste pot and literally cut and paste the outline until you're satisfied with it.

Think About Illustrations

You're still not ready to start writing. Try to think of illustrations that will help the reader visualize what you're writing about. Make rough sketches of them. If you have large masses of data to present, try to present them graphically. When you get to the actual writing, you'll find that it's easier to refer to illustrations.

Start Writing

Inexperienced writers try to start at the beginning of a paper and work straight through to the end. There is no good reason for this procedure, but there is a good reason against it.

The first part of the paper is the introduction. It should sum up the whole purpose of the paper and give the salient points in which the casual reader might be interested. This summing up is much more easily done after the rest of the paper is completed.

Look at your outline, pick a section that appeals to you, and start writing there. Repeat this process until you've covered all the topics in the body of the paper.

When you've "roughed out" the body of the article, give your attention to the introduction and the sum-

Whether trying to sell his ideas to management, or passing along his findings to other engineers a good part of the engineer's success will depend on his ability to express himself. In a word—this is "writing." As a shortcut to the problem this article advises, "Think of yourself as a teacher!"

Newest Engineering Skill

mary. If you want your article to be read and remembered, these are the parts that must be well written.

The Introduction

You have something to say and, in the body of your paper, you say it. The introduction is your chance to tell the reader why he should be interested in what you have to say. If you convince him, he'll read further; if you don't, he won't.

Pick out the most important points in the body of your paper. Tell the reader what they are and why they're important. Don't use technical jargon, unless it's absolutely necessary.

Make your introduction as easy to understand as possible. While the body of your paper is written for the specialist, the introduction should be written for the general reader.

The Summary

In the introduction, you tried to capture your reader's interest. If you were successful, he read on into the body of the paper about what was done, and how. He read it complete with supporting evidence, background information, and all the rest of the detail that goes into a good technical paper. But too often in presenting all of this detail, you have found it difficult to keep the emphasis on your most important points. He may no longer be able to see "the forest for the trees." The summary is your chance to make him see "the forest" again. Try to draw everything together. Tell the reader what you want him to remember, and nothing more. If you succeed in getting him to remember those points, you have a successful paper.

Polish Your Work

You now have all the parts of your paper "roughed out." It's time to put them together and make sure they fit well. Polishing is the most difficult task for any writer—and the most important. Polishing spells the difference between a readable, coherent paper and a paper that the reader will have to struggle through. It's also the process that most improves your own ability to write. Polishing is essentially a process of self-criticism.

At this point, you've completed your first draft and you've put your best effort into it. You think it's good. This is not the time to try to polish it. If time permits, put your paper into a drawer and leave it there for at least a week. At the end of that week, take it out and look at it again. It will look quite different. Fix the things you don't like, and your paper is done. Here are a few pointers that will help you develop a critical eye.

Check For Flow

If you prepared your outline properly, the paper will have continuity and organization, but it may still lack the appearance of continuity. Read it carefully to be sure that the transitions from section to section are smooth. Be sure that at every point in the paper, the reader knows how he got there and where he's going.

Use Short Simple Sentences

The average sentence length in today's technical writing is about twenty words. Try not to exceed that average. Long, complex sentences are difficult to follow. Use them only when they're necessary, or you run the risk of having your reader forget what the beginning of a sentence was about before he reaches the end.

A REPRINT
of this article can be obtained by writing on company letterhead to
The Editor
ELECTRONIC INDUSTRIES, Chestnut & 56th Sts., Phila. 39, Pa.


LUNAR PROBE
Lockheed's capability in satellites and spacecraft, manifested by such an achievement as the AGENA, encompasses the entire field. It includes current and long-range programs such as interplanetary probes, global and space communication systems, and manned space travel
Engineers and Scientists: The accomplishment of such programs offers challenging opportunities to engineers and scientists in the research, design, development, test and operation phases of these programs. If you are experienced in work related to any of the above areas, you are invited to write: Research and Development Staff, Dept. M-29 , W. El Camino Real, Sunnyvale, California. U.S. citizenship or existing Department of Defense industrial security clearance required.
Lockheed
MISSILES AND SPACE DIVISION
Manager for the Navy POLARIS FBM and the
Air Force AGENA Satellite in the DISCOVERER and MIDAS Programs
SUNNYVALE, PALO ALTO, VAN NUYS, SANTA CRUZ, SANTA MARIA, CALIFORNIA
CAPE CANAVERAL, FLORIDA • HAWAII

Writing *(Concluded)*

Don't Use Big Words Just for Effect

Engineering is a field that uses many polysyllabic words. You can't get away from these specialized terms, but you can make up for their difficulty by keeping your non-engineering words as short and simple as possible. Don't say "utilize" when "use" will do as well; don't say "practicable" when what you really want to say is "practical"; don't say "prior to" when "before" can be used.

Use Active Voice

Sentences are more interesting when you let their verbs do the work. Compare these two:

"Louis tags Carnera with a right cross."

"Carnera is tagged by a right cross by Louis."

The first sentence is short and crisp. It carries the action. The second is slow and lagging. Here are two examples from engineering papers:

Original: "An increase in the yield was caused by addition of 25% excess reactant."

Rewrite: "Addition of 25% excess reactant increased the yield."

Original: "This fuel cell is characterized by an operating temperature above 500°C."

Rewrite: "An operating temperature above 500°C characterizes this fuel cell."

Get Rid of Excess Words

Excess words dilute the text without adding anything to its potency. Most writers of technical papers love excess words, as you can see by looking at many of the professional journals. Here are two examples of wordy sentences, and suggestions on how they could have been written:

Original: "It is evident from a study of the data that . . ."

Rewrite: "Study of the data shows that . . ."

Original: "Maximum life of 18 hours from cast-iron, wire-aluminizing sinker rolls has led to substitution of nitride-bonded silicon-carbide rolls which give highly satisfactory 3 to 6-week service."

Rewrite: "Cast-iron, wire-aluminizing sinker rolls, which last 18 hours or less, have been replaced by nitride-bonded silicon-carbide rolls, which last 3 to 6 weeks."

In Summation

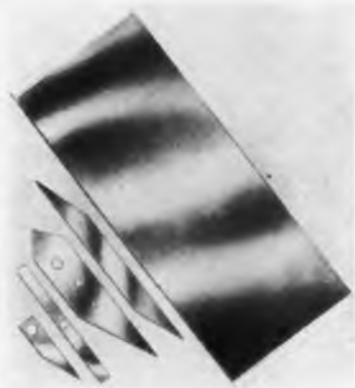
There you have one proven method of writing. It may not work for everyone, but it has been successful with many people. Here are the points to remember:

- Get into a teaching mood.
- Let your thoughts flow.
- Organize your thoughts.
- Think about illustrations.
- Start writing.
- Put your best efforts into the introduction and the summary.
- Polish, polish, polish.

New Products

RESISTANCE CARDS

Metal Film Resistance Card is a new highly stable microwave attenuator material. Base is a fine weave glass cloth impregnated with high temp. thermosetting resin meeting MIL-P-18177. Resistance material is a thin film of pure metal approx. 50



millionths of an inch thick, uniformly deposited on one surface. Protective coating over film is provided. No special machining techniques required. Cards can be punched, drilled, sheared, machined, and sanded. Max. surface temp. should be limited to 130°C. Cards are 5 x 12 in.; and 0.025, 0.032, or 0.062 thick. Resistivity range is 25 to 750 ohms/sq. Filmohm Corp., 48 W. 25th St., New York 10, N. Y.

Circle 362 on Inquiry Card

XY Plotting Boards

New 5-page technical data sheet from Computer Systems, Inc., Culver Rd., Monmouth Junction, N. J., describes transistorized XY plotting boards, both single and dual arm, with electroluminescent panels for backlighting. Detailed features and specs are given for the 30 x 30 in. units designed for plotting data from digital and analog computers and for plotting tracking data from missile-range instrumentation systems.

Circle 363 on Inquiry Card

Digital Voltmeters

A 6-page, 2-color folder describes important differences in digital voltmeters. It points out features that add to efficiency and usefulness in digital instrument use. Descriptive examples include: snap-out readout, plug-in oil-bath stepping switches, "no-needless-nines" logic, and 99% plug-in modular construction. Non-Linear Systems, Inc., Del Mar, Calif.

Circle 364 on Inquiry Card

News of Mfrs'

Representatives

REPRESENTATIVES WANTED

Manufacturer of **miniature power supplies** desires representatives for the New England, Metropolitan New York and greater Philadelphia areas. (Box 3-2, Editor, ELECTRONIC INDUSTRIES.

Oak Mfg. Co. has appointed **Morris, Cunningham & Assoc.** of Indianapolis, Ind., as manufacturing representatives in Indiana and Kentucky.

Servomechanisms, Inc., has been appointed the repair, overhaul and certification agency in the 11 Western states for the Hass Instrument Corp., Washington, D. C.

John C. Soult has been assigned to the Chicago District Sales Office as a sales representative for the Continental-Diamond Fibre Corp., Newark, Del.

The Vernistat Div. of the Perkin-Elmer Corp. has appointed two new sales representatives: **The Peterson Co.**, Denver, Colo., will cover Colorado, Idaho, Montana, Utah and Wyoming; and **Fryco**, Scottsdale, Ariz., covering Arizona, New Mexico, and El Paso County in Texas.

PIC has appointed **Belchamber & French**, San Francisco, Calif., as representatives for Northern California and Nevada.

Quan-Tech Laboratories, Inc., Boonton, N. J., has appointed three new sales representative firms. They are: **Associated Industries**, Seattle, Wash., for Washington and Oregon; **Associated Industries, Inc.**, Wichita, Kans., for Kansas and Missouri; and **Mid-west Electronic Sales**, Chicago, Ill., for Illinois, Indiana, Iowa and Eastern Wisconsin.

Markite Corp. of New York City has named **Tower Engineering Co.** as sales representative covering Mich., Ohio (except Gentile and Wright-Patterson Air Force Stations) and Western Pennsylvania.

Federal Tool and Mfg. Co., St. Louis Park, Minn., has appointed two sales representatives: **Robert Christopher**, Farmington, Conn., in Western New England, and **Stanley J. Woods**, Pawtucket, R. I., in Eastern New England.

HARCO Laboratories, Inc., New Haven, Conn., has appointed three new sales representatives. They are: **Anger Associates**, Dearborn, Mich., for Michigan; **Harry Gee Associates, Inc.**, Culver City, Calif., for California; and **The Technicraft Co.**, Philadelphia, Pa., for Southern New Jersey, Eastern Pennsylvania, and all of Maryland and Delaware.

News of Mfrs' Representatives

The Washington Aluminum Co., Inc.'s, Baltimore, Md., Special Products Div. has appointed 4 additional firms as sales representatives for its electronic products. They are: **Eastern Instrumentation, Inc.**, will cover metropolitan New York City, Long Island, northern New Jersey, and parts of Pennsylvania; **D & B Assoc.**, DeWitt, N. Y., allocated the territory of upstate New York State. **The Tiby Co.** will be representative in the states of Ohio, Michigan and western Pennsylvania; **Kenneth F. Ferris** has been assigned to cover the Southeastern part of the United States.

Electramics Corp., Solana Beach, Calif. has appointed the following manufacturers' representatives: **Richard Legg Co.**, Portland, Ore., to cover the Pacific Northwest, Alaska and British Columbia; **L. A. Nott Co.**, San Francisco, to cover Northern California and Hawaii; **Wes Alderson Co.**, Los Angeles, to cover the Los Angeles area; **Fred W. Falck**, La Jolla, to cover San Diego County; **Gramer & Co.**, Phoenix, Ariz. for Arizona; **Hal F. Corry Co.**, Dallas, for Texas, Oklahoma, Arkansas and Louisiana; **E. C. Raymund Co.**, St. Petersburg, to cover Florida, Alabama, Tennessee, North and South Carolina and Georgia. **Arnold Assoc.**, Cheltenham, Pa., to cover eastern Pennsylvania, southern New Jersey, Maryland, District of Columbia (OEM local only), and northern Virginia; **Ellis-Haber Corp.**, Great Neck, L. I., to cover metropolitan New York City and Long Island; **Sales Engineering Co.**, Newton, Mass. for the six New England states; **Lee Sales Co.**, Dayton, to cover Ohio, western Pennsylvania and West Virginia; **G. McL. Cole Co.**, Chicago, to cover northern Illinois and eastern Wisconsin; **F. C. Somers & Co.**, Kansas City, Mo. to cover Kansas, Nebraska, Iowa and Missouri.

Baird-Atomic, Inc., has named the **G. S. Marshall Co.**, San Marino, Calif., as its sales representative and distributor for California and Nevada.

The American Marietta Co., has selected 5 manufacturers' representatives to service sales for EMC, epoxy molding compounds, **TESTCO**, Seattle for Washington, Oregon, Montana, and northwestern Idaho; **EVRA, Inc.**, Los Angeles, will cover California and Nevada; **Shefler-Kahn Co.**, Phoenix, Ariz. for Arizona and New Mexico; **M. F. Klicpera Co.** of Houston and Dallas, will cover Texas and **R. G. Bowen Co., Inc.**, will be representative in Colorado, Utah, Wyoming, and southeastern Idaho. The remainder of the U. S. will be served by **American-Marietta's** own eastern offices in Newark, Ohio.

News of Mfrs'
Representatives

R. P. Kennedy Co., Inc., Rochester, N. Y.—named sales representative in Upper New York State, **Engineered Components Co.**—appointed sales representative in the Syracuse and Binghamton Tri-Cities area of New York by Burnell & Co., Pelham Manor, N. Y.

Norbatrol Electronics Corp., Pittsburgh, Pa. has appointed **J. F. Wulfetange**, DeWitt, N. Y., as sales representatives in the upstate New York area.

Waldom Electronics, Inc., Chicago, Ill., announced the recent appointment of **Robert Milsk Co.**, Detroit, Mich., as sales representative in Michigan.

Engineering Enrollments Drop For Second Year

For the second consecutive year, enrollment in America's accredited engineering colleges has dropped. This fall 240,063 students registered in engineering; last year there were 249,950, and in the fall of 1957 there were 257,777, according to the American Soc. for Engineering Education, Univ. of Illinois, Urbana, Ill.

The figures were compiled by the U. S. Office of Education. They come from 154 engineering schools in the U. S. The engineering enrollment decreases come at a time when total college enrollments are rising—in all by 10.9% during the two-year period. In 1959 engineering students accounted for only 7.1% of all college students, compared with the high of 8.4% in 1957.

Engineering enrollments for advanced degrees continued to show increases in the fall of 1959, but the rate of growth is decreasing. Of 34,731 graduate students this fall, 28,734 were registered for the master's degree, 357 for professional degrees, and 5,640 for doctor's degrees. This represents an increase of 6% in master's and 18.4% in doctor's registrants over the previous year.

TIROS II Still Going

The infrared equipment aboard TIROS II has been in continuous operation since launching last November, and is still functioning. Over 6,000,000 measurements are being received each day.

Continuation of table from pages 108-109.

3. Remove the short circuit and connect the unknown load to the slotted line.
4. Measure the Voltage Standing Wave Ratio.

$$\text{VSWR} = \frac{\text{Max. Voltage}}{\text{Min. Voltage}}$$

5. Determine the slotted line angle. This is the electrical angle between the reference point and the first voltage minimum toward the generator. Spacing between successive adjacent minima equals 180 electrical degrees.
6. Find the resistance and reactance components of the unknown impedance in the Table.

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of this article can be obtained by writing on company letterhead to
The Editor
ELECTRONIC INDUSTRIES, Chestnut & 56th Sts., Phila. 39, Pa.

CAPACITIVE REACTANCE / INDUCTIVE REACTANCE

Deg.	VSWR 1.13		VSWR 1.14		VSWR 1.15		Deg.
	Res.	Reactance	Res.	Reactance	Res.	Reactance	
0	.88496	.00	.87719	.00	.86957	.00	180
5	.88635	.018859	.87868	.020050	.87115	.021869	175
10	.89075	.037329	.88337	.039699	.87603	.043314	170
15	.89798	.055012	.89099	.058537	.88403	.063898	165
20	.90798	.071506	.90154	.076217	.89491	.083175	160
25	.92070	.086408	.91490	.092096	.90928	.10068	155
30	.93498	.098932	.91092	.10559	.92602	.11560	150
35	.95292	.10972	.94916	.11720	.94539	.12843	145
40	.97203	.11729	.96956	.12546	.96699	.13767	140
45	.97258	.12161	.98713	.13028	.99031	.14316	135
50	1.0140	.12272	1.0144	.13164	1.0148	.14479	130
55	1.0356	.11927	1.0380	.12817	1.0397	.14127	125
60	1.0569	.11210	1.0606	.12065	1.0642	.13319	120
65	1.0768	.10106	1.0821	.10894	1.0874	.12042	115
70	1.0945	.086201	1.0140	.093028	1.1082	.10298	110
75	1.0947	.067962	1.1103	.072945	1.1258	.081365	105
80	1.1207	.046787	1.1298	.050605	1.1390	.057170	100
85	1.1277	.024068	1.1369	.026030	1.1473	.028875	95
90	1.13	.00	1.14	.00	1.15	.00	90

Industry News

Charles R. Coleman has been appointed to the newly-established post of Manager, Administration-Marketing for the Electronics and Avionics Div. of the Emerson Electric Mfg. Co., St. Louis, Mo.

Charles F. Erlandsen has been appointed manager of Quality Control at the General Electric Co.'s Semiconductor Products Dept. plant, Buffalo, N. Y.

Warren R. Baughman has been named Sales Manager - Permanent Magnets, Indiana Steel Products Div. of Indiana General Corp., Valparaiso, Ind.

Harry L. Benjamin has been appointed Assistant to the President of United Aircraft Products, Inc.

Harry L. Benjamin

William H. Rous

William H. Rous has been appointed Vice President, International Operations, Amphenol-Borg Electronics Corp., Broadview, Ill.

Kendell Oulie has been appointed Director of Planning for The Garrett Corp.

Dr. John J. Bohrer, Director of Research for International Resistance Co., has been elected a Fellow of the New York Academy of Sciences.

J. A. Brustman has been appointed Manager, Electronic Systems Engineering of the Advanced Systems Development Engineering Activity, RCA Electronic Data Processing Div.

Michael J. Marino has been appointed Marketing Manager of International Resistance Co.'s Major Industrial Distributor program.

Elby Martin has been appointed as Marketing Manager, Advanced Technologies, in Central Staff Marketing of Texas Instruments Incorporated.

Stanley R. Sulis has been named Manager, Instrument Product Planning at General Electric's Instrument Dept., West Lynn, Mass.

Industry News

Stanley T. Olafson—joins Hoffman Electronics Corp., Los Angeles, Calif., as an Advisor on International Trade. He was formerly associated (31 years) with the World Trade Dept. of the Los Angeles Chamber of Commerce.

Thomas E. Nawalinski — named Manager of Sales Promotion and Advertising, Non-Linear Systems, Inc., Del Mar, Calif.

Milton C. Jordan—appointed Plant Manager of International Resistance Co.'s operation in Vega Baja, Puerto Rico.

Jerome Berger — appointed Sales Manager of the Contract and Special Products Div. of JFD Electronics Corp., Brooklyn, N. Y.

Edward J. Verity—appointed Manager, Marketing Research Dept., Garlock, Inc., Palmyra, N. Y.

Daniel P. Geeding—appointed Overall Director of Marketing, Hathaway Instruments, Inc., Columbus, Neb., to coordinate sales and advertising for all Hathaway interests.

Joseph W. Yuhas—appointed Manager of the Distributor Div., Pyramid Electric Co., Darlington, South Carolina.

Joe P. Schindler—appointed Director of Marketing, Polarad Electronics Corp., Long Island City, N. Y.

Harry H. Bauer—appointed Midwestern Regional Sales Manager, Scientific and Process Instruments Div., Beckman Instruments, Inc.

C. Edward Bold—appointed Manager-Marketing Operation, G. E. Co.'s Special Programs Section, Radnor, Pa.

Robert R. Wylie — elected Vice President, Sangamo Electric Co., Springfield, Ill.

William E. Wilson — named Vice President and General Manager; Jack D. Hall assumes Vice President, Sales and Marketing duties and Karl F. Crease appointed Vice President in charge of Manufacturing, Chicago Standard Transformer, Div. of the Essex Wire Corp., Chicago, Ill.

William J. Henderson—joins FXR, Inc., Woodside, N. Y., as Assistant General Manager.

G. J. Hunt — appointed General Sales Manager, Cinch Mfg. Co., Chicago, Ill.

Industry News

Gerald M. Anderson—elected Director, Taylor Fibre Co., Norristown, Pa.

Michael J. Balen — appointed to newly created position as International Controller, Cannon Electric Co., Los Angeles, Calif.

Merle C. Sherman—appointed Financial Vice President, Antenna Systems, Inc., Hingham, Mass.

John A. McKenna—appointed Manager of Control Systems Marketing, Missile Electronics and Controls Div., Radio Corp. of America, Burlington, Mass.

Fred A. Speaks—named Director of Marketing Div., Eitel-McCullough, Inc., San Carlos, Calif.

W. C. "Red" Schultz—promoted to National Distributor Sales Manager, Semiconductor Div., Hoffman Electronics Corp., El Monte, Calif.

Jack Dubin—appointed to newly created post as Eastern Contracts Manager, Beckman Instruments, Inc., Washington, D. C.

Alexander J. Groves—named Vice President, Manufacturing; **William Osowski**—named Treasurer; and **Clifford H. Tuttle, Jr.**—named Vice President, Sales by Vitramon, Incorporated, Bridgeport, Conn.

Jon Doolittle—appointed District Sales Manager, District Sales Engineering Office in Branford, Conn., by Cannon Electric Co., Los Angeles, Calif.

Robert J. Barrett, Jr.—appointed to new position, Director of Administration of Thompson-Ramo-Wooldridge Products Co., Beverly Hills, Calif.

M. A. Soldinger—promoted to Manager of Production Control Dept., Receiving, Shipping and Stores by Shure Brothers, Inc., Evanston, Ill.

Edward S. Quilter—appointed to newly created position, Special Representative in Military Sales Dept., Librascope Div., General Precision, Inc., Glendale, Calif.

John A. West — appointed Field Specialist by Superior Tube Co., Norristown, Pa.

Edward V. Z. Lane—appointed Director of Market Research and Development, American Super-Temperature Wires, Inc., Winooski, Vt., a subsidiary of Haveg Industries, Inc.

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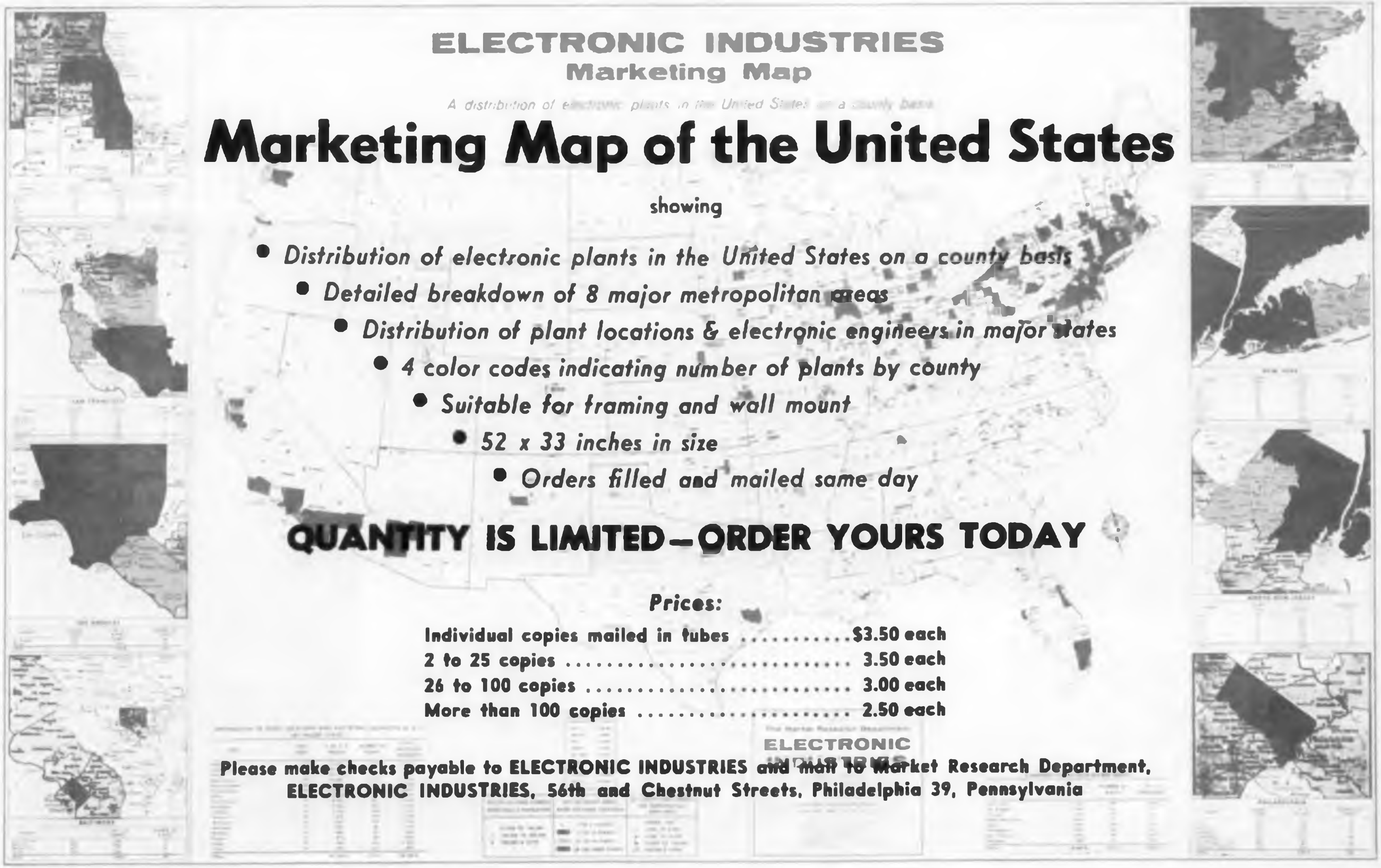

Industry News

Donald J. Harrington is now Manager of Marketing for General Electric Capacitor Dept., Hudson Falls, N. Y.

Joseph Toyzer has been named Manager of Manufacturing Engineering for a new computer production center being completed by RCA at Palm Beach Gardens, Fla.

Frank A. Saikley has been appointed Controller of Indiana General Corp., Valparaiso, Ind., and **Richard S. Laney** named Div. Controller of Indiana Steel Products Div. of Indiana General Corp.

Thomas J. March has been appointed Manager, Sales Operation, Internal Automation Operation of G-E's Industrial Electronics Div., Schenectady, N. Y.

Wilbur L. Pritchard has been named Director of Engineering for Selenia SPA in Europe.

Gilbert B. Devey, named as General Manager of VecTrol Engineering, Inc., of Stamford, Conn., a subsidiary of Sprague Electric Co.

Louis E. Risner has been appointed Sales Engineer, Semiconductors, West Coast area for CBS Electronics, the manufacturing div. of Columbia Broadcasting Systems, Inc.

Albert E. Brownrigg, Quality Control Engineer, has been named Manager of the newly created Quality Assurance Dept. of Dunn Engineering Associates, Inc.

Gino E. DePaola of New Shrewsbury, N. J., has been appointed Senior Staff Engineer of the John Gombos Co., Inc.

Raymond G. Loughlin—appointed Manager, Weapons Systems Div., PRD Electronics, Inc., Brooklyn, N. Y.

Ted Hayes—appointed Manager of Distributor Sales for Semiconductor Products—Delco Radio Div., General Motors Corp., Kokomo, Ind.

E. C. Spevak—appointed Engineering Manager, Elgin National Watch Co.'s Electronics Div., Burbank, Calif.

Joseph V. Malek—appointed Engineering Manager, Amphenol-Midwestern Connector Div., Amphenol-Borg Electronics Corp., Broadview, Ill.

Kenneth C. Hayes—appointed Manager, Technical Service Dept., American Machine & Foundry Co.'s R&D Div., N. Y., N. Y.

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Industry News

Denham Scott, Asst. to the President of The Garrett Corp., has been appointed an Associate Member of the Military Procurement Advisory Committee to the U.S. Senate.

L. S. Thees has been appointed to the new post of Division Vice President, General Sales, RCA Electron Tube Div.

Minneapolis-Honeywell's Electronic Data Processing Div. has appointed 5 Managers of Systems Service. They are: **Gordon P. Brunow**, Boston Branch office; **John D. Bragg**, Detroit; **Arnold A. Shupack**, Los Angeles; **Daniel Sitomer**, New York, and **Leo A. O'Keefe**, Washington.

Robert C. Bennett, Jr., President of Wheatland Electric Products Co., Carnegie, Pa., has been elected a Director of Barker & Williamson, Inc., Bristol, Pa.

R. C. Bennett, Jr.

John H. Boyle

John H. Boyle has been named General Manager of the Collins Radio Co.'s Communication and Data Processing Div.

Louis R. Farin has been appointed to the new post of Programs and Contracts Manager of Bulova Research & Development Laboratories, Inc., Woodside, N. Y.

Vernon G. Price has been appointed Manager, Filter and R-F Component Engineering at the General Electric Power Tube Dept. plant, Palo Alto, Calif.

The Garrett Corp. has appointed **G. C. "Gad" Pearce** as Assistant to the Vice President in Charge of Sales.

The appointments of **John R. Fox** as Pacific Coast Regional Manager and **William E. Cohan** as Manager of Industrial Distributor Sales, have been announced by the Westinghouse Electronic Tube Div.

Ned W. Buoymaster has been appointed Sales Manager of Ferroxcube Corp. of America.

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...from the leader in thermal relay design!

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And the PT's **sturdiness** is unequalled in thermal relays. It withstands missile vibration and shock far better than any other thermal relay.

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Time Delay: 3 to 60 seconds (Factory Set)

Setting Tolerance: ±5% (±¼ sec. min.)

Temperature Compensation: Within ±5% over −65°C. to +125°C. range (±¼ sec. min.)

Heater Voltages: 6.3 to 115 v. for delays up to 12 sec.; 6.3 to 230 v. for longer delays.

Power Input: 4 watts. Rated for continuous energization al 125°C.

Contacts: SPST, normally open or normally closed. Rated 2 amps. resistive at 115 v. AC or 28 v. DC.

Write for Product Data Bulletin #PD-1015

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Dielectric Strength: 1000 v. RMS at sea level. 500 v. RMS at 70,000 ft.

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Shock: Operating or non-operating, 50 g for 11 milliseconds

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