EDITOR'S PROFILE of this issue

from a historical perspective …

with Paul Wesling, SF Bay Area Council GRID editor (2004-2014)

September, 1963 (mid-month):

Cover: A detached retina is spot-welded with a laser beam at Stanford's Medical Center.

Page 5: The early history of radio in the SF Bay Area is recounted by Douglas Perham and Ralph Heintz, from 1895 to 1915. This was the era of the spark transmitter, and then the Poulsen arc transmitter. A Stanford grad, Cyril Elwell, was a key figure, starting Federal Telegraph and spreading radio coverage across the USA and the Pacific Ocean. A map shows the planned operating stations and links. This history has been preserved and is now at the San Jose History Museum.

Page 8: UC-Berkeley's Lofti Zadeh becomes head of their EE department. An emigrant from Azerbaijan and Iran, he wrote the seminal works on fuzzy sets and fuzzy logic. A Fellow of the IEEE, he was awarded the IEEE Hamming Medal and the IEEE Medal of Honor, and was a member of the National Academy of Engineering.

Page 12: The National Catalogue of Patents (2 volumes, 1,598 pages) can be ordered for US$100.

IEEE Grid

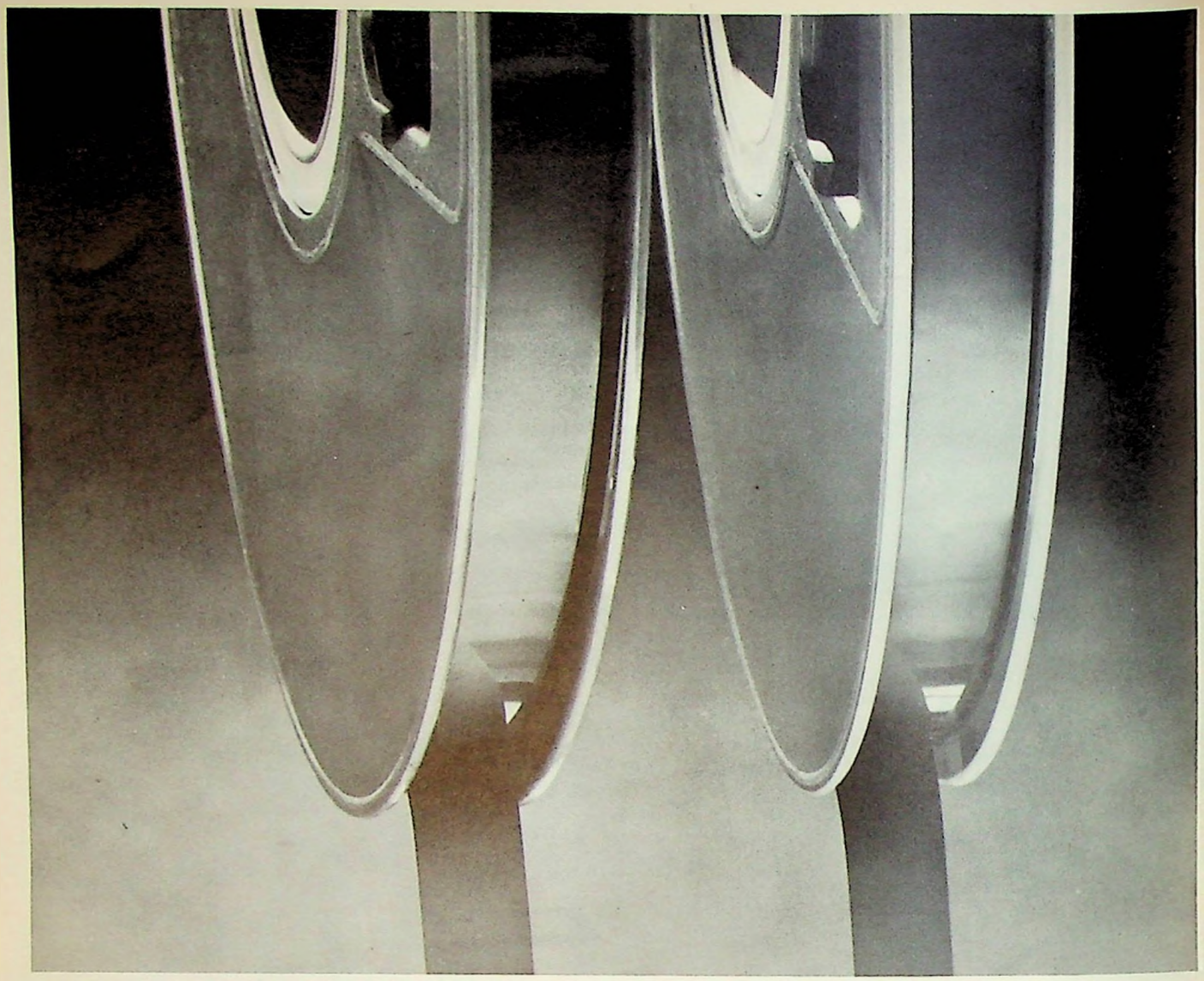
SEPTEMBER 15, 1963

SAN FRANCISCO SECTION

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS

reminder

September 17 (Tuesday) PTGEC/PTGSET
September 24 (Tuesday) PTGPEP
October 23 (Wednesday) PTGMTT



BOTH THESE MAGNETIC TAPES HAVE A POLYESTER BASE ...BUT ONLY ONE IS MYLAR® (8 YEARS PROVEN)

Eight years ago instrumentation tape of Du Pont MYLAR* polyester film appeared on the scene and set new standards of reliability. Naturally enough, people whose needs called for a magnetic tape of highest performance couldn't risk a tape other than MYLAR. ■ Now, other polyester films are beginning to appear. They are not all the same: MYLAR is a polyester film, but other polyester films are not MYLAR. In the past you could safely assume you were getting MYLAR when you specified "polyester base". *Today you cannot.* ■ There's only one way to be sure you're getting the MYLAR you've used and trusted for magnetic tapes of proven reliability: specify **MYLAR** by name. E. I. du Pont de Nemours & Co. (Inc.), 10452 Nemours Bldg., Wilmington 98, Delaware.

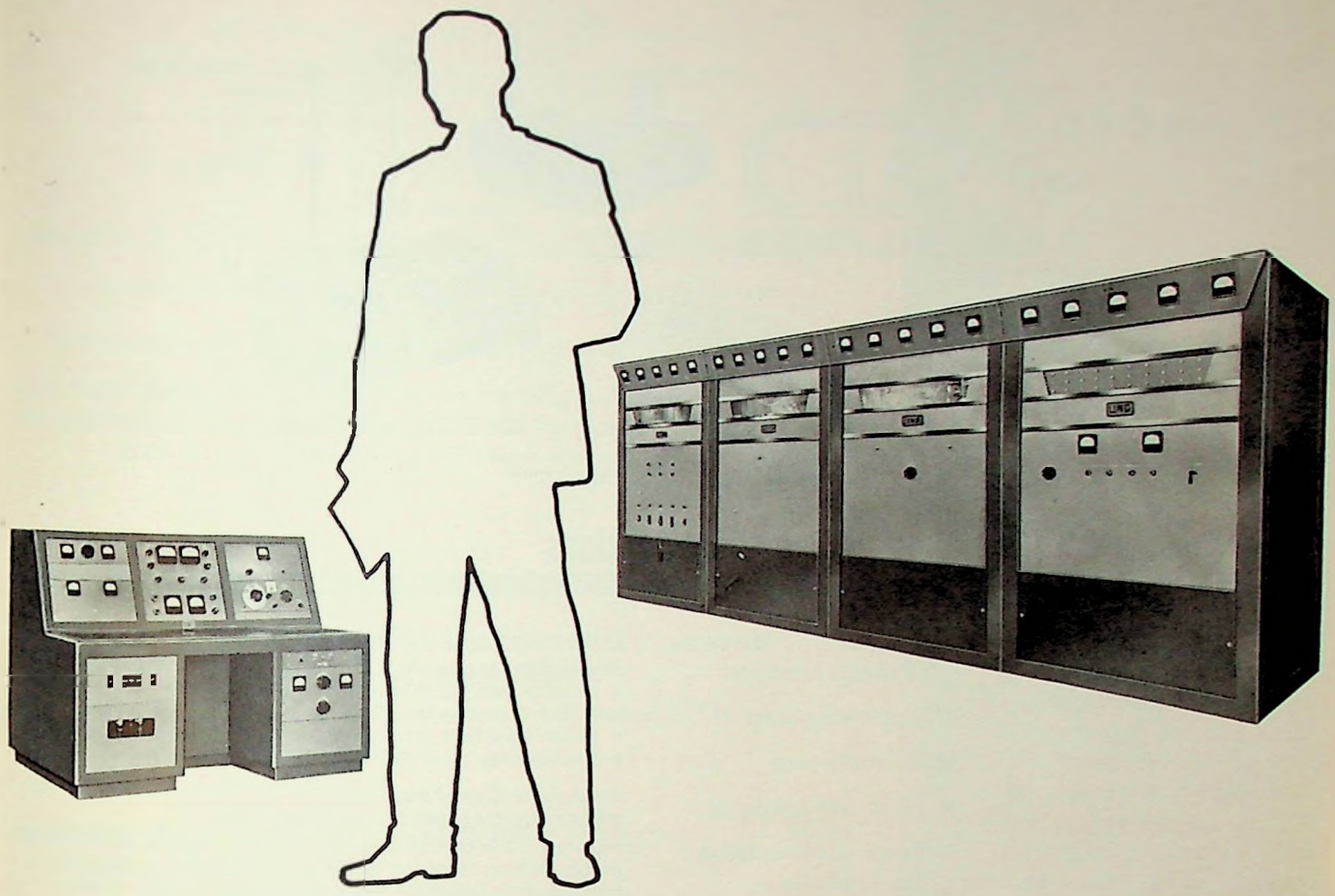
*Du Pont's registered trademark for its polyester film.

DU PONT
REG. U.S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING . . . *THROUGH CHEMISTRY*

only **DU PONT** makes
MYLAR®
POLYESTER FILM

Can you fit yourself into this LING picture?



LING ELECTRONICS NEEDS CHIEF ENGINEER, experienced in high power vibration test equipment.

Basic Prerequisites:

(a) BSEE from a recognized school or college.

(b) Strong academic background and recent experience in application of electrical engineering fundamentals.

(c) Minimum of 8 years experience since obtaining BSEE, including some supervisory experience.

(d) Experience in the field of audio amplifiers, preferably in high power (10 KW and up).

(e) Some experience with a proprietary product line.

Job Responsibilities:

(a) Supervision & direction of 15 Engineers, 5 Draftsmen.

(b) Supervision and participation in applied research leading to the development of new products.

(c) Scheduling, budgeting and following-up of all engineering development programs in the product section.

(d) Acting as a member of Engineering-Sales Planning Committee to provide guidance in the future of the Division's product line.

THIS INTERESTING, WELL-PAYING JOB is located in the residential community of Anaheim, California—close to beaches and outdoor recreation. Send your résumé to Mr. Bill Mueller, Personnel Dept., Ling Electronics, Inc., 1515 South Manchester Ave., Anaheim, California.

We are an equal opportunity employer

LTV

LING ELECTRONICS
A division of LING-TEMCO-VOUGHT, INC.
1515 SO. MANCHESTER AVENUE, ANAHEIM, CALIFORNIA • PR 4-2900 AREA CODE 714

DESIGNERS AND MANUFACTURERS OF SUPERPOWER VLF, SONAR TRANSMITTERS, AND PULSE MODULATORS

IEEE Grid

volume 10, number 2 • september 15, 1963

Published twice a month except July and August by San Francisco Section, Institute of Electrical and Electronics Engineers

JAMES D. WARNOCK, Executive Editor

Address all mail to:
IEEE OFFICE, SUITE 2210, 701 WELCH ROAD, PALO ALTO, CALIF.

Mailing office of publication: 394 Pacific Ave., Fifth Floor. Second class postage paid at San Francisco, Calif.

Subscription: $4.00 (members); $6.00 (others); overseas, $7.00 per annum.

SECTION MEMBERS! To stay on mailing list when you move, send address change promptly to IEEE National Headquarters, Box A, Lenox Hill Station, New York 21, N.Y.

contents

cover

Broad new horizons in medical electronics are being explored at such facilities throughout the West as the Palo Alto–Stanford Medical Center, where the spot welding of a detached retina with a laser beam was pioneered in one of the most dramatic and beneficial applications of this new development. Cover drawing courtesy of the Western Electronic Manufacturers Association.

san francisco section officers

advertising

IEEE Grid reporters

EAST BAY SUBSECTION
N. K. (GENE) LITTLE, LAWRENCE RADIATION LABORATORY
FRESNO SUBSECTION
J. M. SWALL, P.G.&E., FRESNO
SANTA CLARA VALLEY SUBSECTION
ROBERT W. SUMNER, WESTINGHOUSE ELECTRIC CORP.

TECHNICAL DIVISIONS:
COMMUNICATIONS: ALFRED R. DOLE, PAC. TEL. & TEL. CO.
INDUSTRIAL: J. ARTHUR WELLS, ARTWELL ELEC., INC.
INSTRUMENTATION & CONTROLS: RONALD K. CHURCH, HEWLETT-PACKARD CO.
POWER: JAMES J. McCANN, PACIFIC GAS & ELECTRIC CO.
SCIENCE & ELECTRONICS: JAMES J. HALLORAN, ELECTRO ENGINEERING WORKS

PROFESSIONAL TECHNICAL GROUPS:
AUDIO: HERB RAGLE, MEMOREX
AUTOMATIC CONTROL: A. S. McALLISTER, SAN JOSE STATE
ANTENNAS AND PROPAGATION: ROLF B. DYCE, SRI
BROADCASTING: BEN WOLFE, KPIX
BIO-MEDICAL ELECTRONICS: CON RADER, BECKMAN/SPINCO DIV.
COMMUNICATIONS SYSTEMS: MAURICE H. KEBBY, LENKURT
CIRCUIT THEORY: R. E. KIESSLING, ITT LABORATORIES
ELECTRON DEVICES: MAHLON FISHER, SYLVANIA
ELECTRONIC COMPUTERS: WILLIAM DAVIDOW, GENERAL ELECTRIC
ENGINEERING MANAGEMENT: LEONARD M. JEFFERS, SYLVANIA
ENGINEERING WRITING AND SPEECH: DOUGLAS WM. DUPEN, TECHDATA DIV., L. C. COLE
INFORMATION THEORY: CHARLES H. DAWSON, SRI
INSTRUMENTATION & MEASUREMENT: JAMES HUSSEY, GENERAL RADIO CO.
MICROWAVE THEORY AND TECHNIQUES: ROBERT J. PRICKETT, HEWLETT-PACKARD CO.
MILITARY ELECTRONICS: VICTOR A. CONRAD, VARIAN
PRODUCT ENGINEERING AND PRODUCTION: W. DALE FULLER, LOCKHEED
RADIO FREQUENCY INTERFERENCE: JOHN W. WATTENBARGER, SIERRA ELECTRONICS CORPORATION
RELIABILITY: W. WAHRHAFTIG, PHILCO
SPACE ELECTRONICS AND TELEMETRY: TOM LINDERS, LOCKHEED

HISTORIAN: EARL G. GODDARD, VARIAN ASSOCIATES

production staff

ADVERTISING ASSISTANT:
RITA EARNSHAW

MEETING CALENDAR

PROFESSIONAL TECHNICAL GROUPS

Electronic Computers

8:15 P.M. • Tuesday, September 17

(Joint meeting with PTGSET, see below)

Space Electronics & Telemetry

8:15 P.M. • Tuesday, September 17

(Joint meeting with PTGEC)

Vehicle-Borne Telemetry Data Compression
Speakers: Richard Schomburg and Harvey Massey
Lockheed Missiles & Space Company, Sunnyvale
Place: Lockheed Auditorium, Bldg. 202, 3251 Hanover St., Palo Alto
Dinner: 6:15 P.M., El Camino Bowl, 2025 El Camino Real, Mountain View
Reservations: Robert Light, 968-6211, Ext. 2024

PRODUCT ENGINEERING & PRODUCTION

8:00 P.M. • Tuesday, September 24

Discussion and Demonstration of a Printed-Circuit-Board-Making Machine, Including Plant Tour

Place: Friden, Inc., 2350 Washington Avenue, San Leandro
For further information contact: Thomas E. Scatchard, Berkeley Division/Beckman, LA 6-7730

MICROWAVE THEORY & TECHNIQUE

8:00 P.M. • Wednesday, October 23

(Joint with PTGCT, PTGRFI, PTGAP, PTGCS)

Some Microwave Filter Design Concepts and Their Application to the Design of Microwave Devices

Place: P.H. 100, Stanford University
For further information contact: Leo Young, Stanford Research Institute, DA 6-6200

---

remarks from the chairs

INDUSTRIAL DIVISION

The Industrial Division was an important integral division of the AIEE program structure prior to the merger.

There is now strong feeling that it should be continued as a program division and eventually become a Professional Technical Group.

It is my opinion that the division can be made into a very active and interesting program presentation group, and that this can best be done by soliciting support from the memberships of both former organizations, particularly from former IRE members to whom the division is new, to insure programs of interest to all IEEE members.

I am therefore requesting volunteers to serve on the program committee and asking for suggestions from the general membership for programs and speakers.

Please contact me if you are interested in this activity.

J. Arthur Wells
Chairman
Industrial Division

ptg notes

THE STATUS OF RELIABILITY

The field of reliability engineering has grown in the past decade from a limited study of electron tube failure to an engineering discipline of considerable stature. What was formerly a highly specialized area of consideration is today a formal and systematic branch of technology. This tremendous growth of the reliability field stems, in a large measure, from the recognition of reliability as a vital factor in the production, maintenance, and operation of complex military systems. A major objective of future reliability effort will continue to be reduction of unreliability in military equipments, while preserving a proper perspective on costs. Achievement of this objective demands programs which apply scientific analysis and techniques to understand the causes and effects of unreliability, rather than just improving product quality.

The causes of unreliability have been generalized through the years and appear to be as pertinent to future systems as they are to present and past military systems and equipments. Major factors causing equipment failure include:

- Insufficient consideration in the original design, of the variation of part characteristics with time. (Unfortunately, some drift in characteristics has become almost an accepted happening for many equipments.)
- Interaction of various conditions of equipment operation that were not visualized in the design. Such conditions may include temperature, interactions with other equipments, grounding problems, or vibration.
- Dependence of equipment performance on part characteristics which are not controlled by specifications. This problem requires action at the design stage—it cannot be corrected solely by good quality control.
- Failure to consider the influence of operator and maintenance personnel on reliability. This factor is a dominant cause of unreliability in many military equipments.

Future reliability work must emphasize programs which will reduce major causes of failure. These programs must determine how to achieve:

- More careful effort in design stages.
- Better coordination between designers and parts manufacturers to insure that proper part characteristics are incorporated in specification requirements.
- Better laboratory and field testing of products before full production.

R. O. Holbrook

- Prompt feed-back of test information to designers and manufacturers.
- Adequate consideration of ease of operation and maintenance in design and production of equipments.
- Better training of equipment users.

Projected future changes in electronic equipment alone are sufficient to show the need for giving ever increasing attention to assurance of product reliability. From 1960 to 1970, an over-all growth in equipment complexity (number of elemental parts) of about 70 percent is predicted. Also, by 1970, high-density complex components are expected to find predominant use in electronic assemblies. Thus, many more—and different—types of electronic equipments will become available for military use.

To realize desired performance, including measurable reliability gains, from future military electronic (and other) systems, maximum effort must be exerted in well-planned, government-sponsored reliability research programs. These programs should not only consider the six areas listed above, but also have the added and essential factor of cost consciousness.

R. O. HOLBROOK
CHAIRMAN
SAN FRANCISCO CHAPTER, PTGR

grid inputs

NEW CLASSIFIED SECTION

In response to many requests, and primarily as a service to the membership, the Grid will offer a classified advertising section beginning with the November issues. Every appropriate category of ad will be carried, including business and professional cards, consulting services, positions available, positions wanted, and products. Rates for members will be $15 for the first column-inch, $10 for the second inch, and $5 for each additional inch, not to exceed a total of 4 inches. Special type or logos will not be carried. Nonmembers will be charged $20 for the first inch, $15 for the second inch, and $10 for each additional inch.

historical notes

SF—EE HISTORICAL CENTER

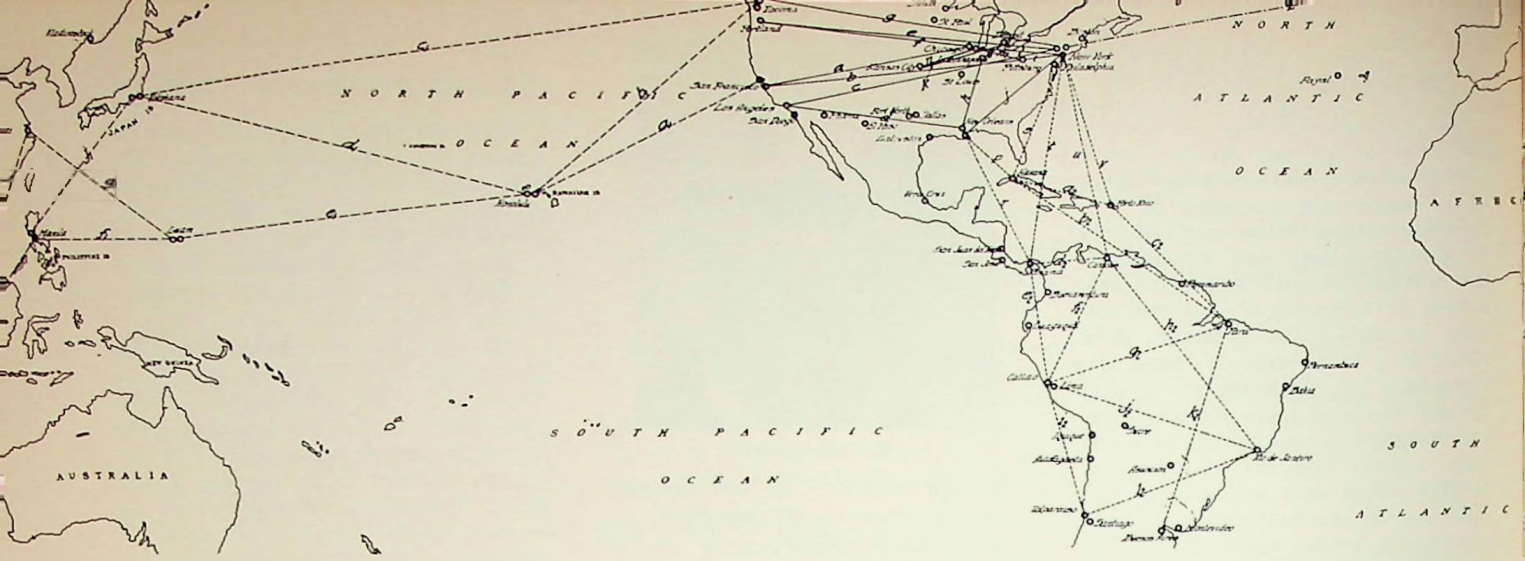
The early history of radio and electronics was truly global in extent. The era, begun by Marconi's 1895 experiments in Italy and his 1897 founding of the Wireless Telegraph and Signal Company, Ltd., in England, was quick to find its way to all the important centers of the world.

The reception of wireless telegraph signals from the "USS Thomas" on her return from the Philippines at the Cliff House in San Francisco in 1898 began the development of one of the most important single centers of the world that has since contributed so much to the rapid growth of communications and electronics as we know it today.

In the year 1901 the Marconi Company of England erected wireless stations on practically all the islands of the Hawaiian group for inter-island commercial traffic. The first commercial radio stations on the Pacific Coast were located at San Pedro, California, and Avalon, Catalina Island, and were owned and operated by a Los Angeles newspaper. The primary purpose of these stations was the furnishing of news to a paper printed on Catalina Island called "The Wireless." This circuit also handled commercial traffic. A few years later the stations were taken over by the Pacific Wireless Telegraph Company, which established a network of stations in other cities. Commercial traffic was sent between San Francisco and Oakland, and other stations were also located in the Northwest at Queen Anne's Hill, Seattle, Port Townsend, and Victoria.

During this period Marconi succeeded in spanning the Atlantic in December 1901, and commercial service was established in October 1907 between Clifden, Ireland, and Glace Bay, Newfoundland. The transmitters of this period employed spark gaps of one variety or another. One used a synchronous rotating gap. The gap was adjustable, which made it possible to control the arc discharge relative to the peak of the alternator output wave and thus vary the tone of the spark note. In 1905 the Pacific Wireless Telegraph Company erected 300-foot antenna masts on top of Mount Tamalpais in an attempt to span the Pacific. The spark transformer or induction coil, as it was called, that was used in the transmitter was a large open-cored unit intended to produce a spark several feet in length. In 1906 the towers were destroyed by a severe windstorm, and the station was discontinued.

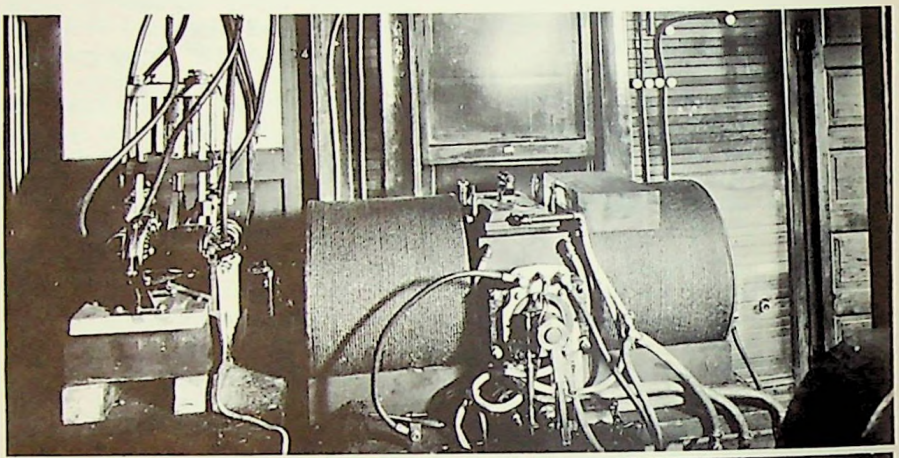
Also in 1905 the American de For-

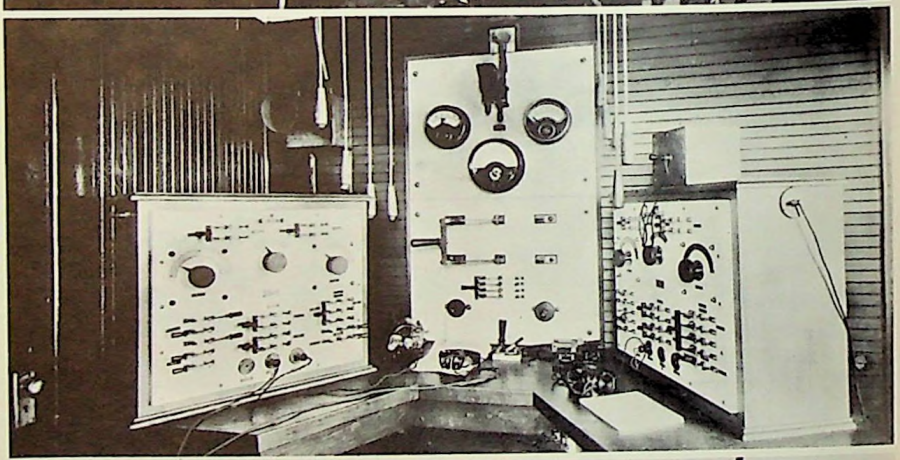


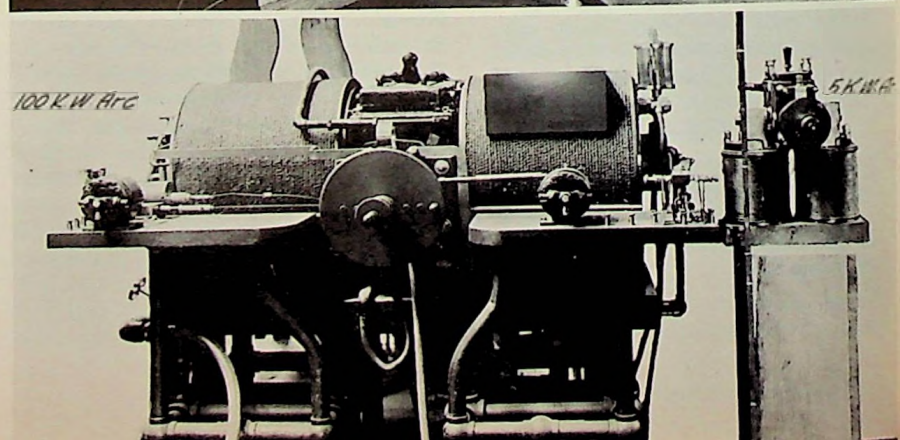
Transpacific, transatlantic, South American, and domestic systems of the Federal Telegraph Co., San Francisco, planned by the company in 1914 with a 100-kw transmitter and operating room in South San Francisco.

est Wireless Telegraph Company established an office in the old Palace Hotel. Their call was "PH," which stood for Palace Hotel. In 1906 the Navy erected its first Pacific Coast radio station on the Farallon Islands, and soon afterwards built others at Mare Island, Yerba Buena, North Head, Tatoosh, and Bremerton. During the 1906 fire both the "de Forest" and the Pacific Wireless Companies' San Francisco stations were destroyed. The Pacific Company started immediately to rebuild, and the "de Forest" Company reincorporated under the name of the Occidental and Oriental Wireless Company and rebuilt its transmitter on Russian Hill. When the station was completed it was sold to the United Wireless Telegraph Company, which operated it under the original call "PH." Later the station was moved to South San Francisco and from there, when the Marconi Company took over the interests of the company, to Bolinas, where it was operated as "KPH." In 1919 it became part of the Radio Corporation of America network when RCA took over the Marconi Wireless Telegraph Company.

In 1908, while the United Wireless Telegraph Company's station was located atop Russian Hill in San Francisco, the first radio communication was established between the Hawaiian Islands and the mainland. The Hawaiian end was operated by the Mutual Telephone Company of Hawaii. A 10-kw spark transmitter at Kahuku was



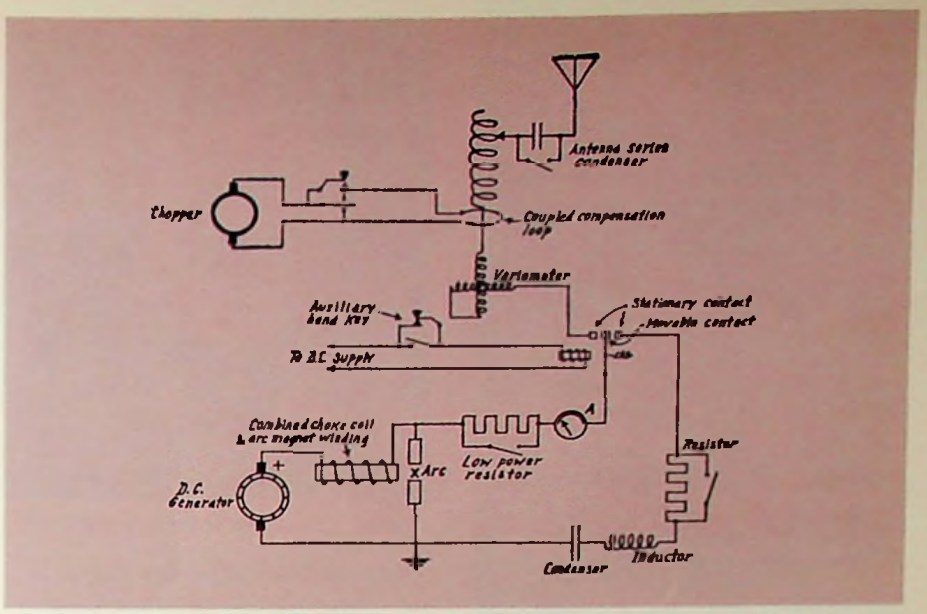




Period photos show (top to bottom) 100-kw arc key and helix, the operating room for the set, and a comparison of the original 5-kw arc and the 100-kw arc.

employed. The United Wireless Telegraph Company had embarked upon an ambitious program to erect stations all over the Pacific Coast and, in fact, all over the United States. The company eventually took over the Pacific Wireless Telegraph Company's stations and operated them.

In 1909 Cyril Elwell obtained the patent rights to the Poulsen arc for the United States and its dependencies. He founded the Poulsen Wireless Telephone and Telegraph Company in October of that year to exploit its use. The Poulsen arc was the first practical device for the generation of high-power CW energy, having been invented by Poulsen in 1904. By 1912 the Poulsen Wireless Corporation had established commercial stations in the principal cities of the West, in the Midwest, and across the Pacific. By 1914 the company had established a manufacturing facility at Palo Alto to build Poulsen arcs for their own commercial business and the U.S. government. The Poulsen Wireless Corporation was incorporated in Arizona in October 1910 and took over the interests of the Poulsen Wireless Telephone and Telegraph Company in February 1911. The Wireless Development Company was established to operate the Poulsen Wireless Corporation stations. The name of the Wireless



Federal arc transmitter, showing circuits for models "K" and "Q" 2-kw "back shunt" method of signaling.

Development Company was changed to the Federal Telegraph Company in July 1911. The first commercial business between Stockton, Sacramento, San Francisco, Los Angeles, and San Diego took place in June of 1911. Phoenix, El Paso, Fort Worth, Kansas City, Chicago, Medford, Central Point, and Portland accepted commercial traffic in February and March of 1912.

Pacific, Atlantic, South American, and domestic systems were planned by the Federal Telegraph Company in 1914. The stations that had been built and placed in service at that time were indicated on a company map by the date and the transmitter's power. A

100-kw transmitter and operating room of the station were located in South San Francisco.

These interesting facts of radio history are only a brief summary of what occurred in the two decades between 1895 and 1915 and have been compiled with the aid of Douglas M. Perham of New Almaden, California, who has been active in radio and electronics since the early 1900's. His interest in saving items that today are priceless historical artifacts stemmed from a remark by George Westinghouse at the Chicago World's Fair in 1893.

As a boy, Doug was interested in the electrical exhibits at the fair. Mr. Westinghouse noted this and told the lad, "Young man, get a hold of some of these things and save them. They will have valuable historical significance one day." Since that time Perham has saved many of the items and documents that he has had a part in creating. More recently he has devoted his entire time to the collection and preservation of what is now an outstanding collection of radio and electronics history. Many pieces of equipment that were used in the episodes recounted above may be seen in the electronic collection of the Perham Foundation.

The Perham Foundation was incorporated in 1960 with the objective of establishing a museum and educational facility for the collection, development, and preservation of educational and historical radio and electronic materials and for the dissemination of the same. The foundation is greatly indebted to Doug Perham for his cooperation and assistance in carrying out its objectives.

Current plans of the foundation include the relocation of the exhibits, obtaining a staff to care for and exhibit the collection, and prepare displays and educational materials based upon the collection. The foundation, in cooperation with the Santa Clara County Office of Education, has recently completed photographs and written inventory of its electronic collection and is currently engaged in taping documentary accounts of each major item in the collection. To aid in carrying out these programs the foundation will soon embark upon a sustaining membership drive to enlist the support of all who are interested in helping to preserve and make available this part of the West's history to as many as possible. Inquiries may be addressed to Ralph Heintz, Jr., president, Perham Foundation, Stanford Research Institute, 333 Ravenswood Ave., Menlo Park.

EARL G. GODDARD

Pert-o-graph II

computer notes

SON OF PERT-O-GRAPH

The "much talked about but little understood" PERT technique can now become useful to any company doing business below the "huge systems level" through the use of the new "Pert-o-graph II" critical path computer, according to James Halcomb, designer and producer.

The new computer contains scales necessary to determine earliest times, latest times—either in accumulated elapsed time or by actual calendar dates—slack analysis, and identification of the critical path in any network. It also contains all basic PERT computation scales to determine standard deviation, variance, accumulated variances, and probability of meeting scheduled completion dates of any project.

Prior to the new version, no other method was available to determine the critical path of a network or to solve the majority of all basic PERT or CPM calculations without tedious hand calculations or complex electronic computerization, according to the former Varian engineer who designed an earlier version now in use by thousands of firms.

section notes

REGULAR TUESDAY LUNCHEON

A special luncheon table is reserved every Tuesday at the San Francisco Engineers Club for members of IEEE. Club membership is not required and a cash ticket may be purchased from the cashier for $2.00, including tax. No reservations are required.

IEEE members are invited to drop in for lunch whenever they are in the San Francisco area on Tuesdays. The club occupies the 15th floor at 206 Sansome St., San Francisco.

grid swings

IT IS REPORTED:

Lofti A. Zadeh, professor of electrical engineering at the University of California in Berkeley since 1959, has been appointed chairman of the dept. of electrical engineering. Professor Zadeh takes over the position from Professor Robert M. Saunders, who is returning to his full-time academic work, after having held the chairmanship for four years.

Roy A. Hundley has been appointed manager, mechanical and servo engineering dept. of Dalmo Victor Co., Belmont, Calif., division of Textron, Inc.

Daniel A. Worsham has been appointed manufacturing manager of Siliconix Inc., Sunnyvale, having been formerly associated with Fairchild Semiconductor Corp. as manager of the glass-to-metal seals dept.

Jefferson R. Wilkerson has been appointed to a new top-level staff position at Melabs, Palo Alto electronics firm. As system design specialist, he reports directly to Dr. Wesley P. Ayres, vice president in charge of engineering. He is responsible for analysis and planning on systems designed and built by Melabs.

R. Patrick McKeever has been added to the research and development staff of Ultek Corp., Palo Alto, to carry on basic research studies in the field of vacuum physics, his previous experimental work having resulted in a reliable, intense, and aberration-free proton beam for linear accelerator application.

Spectra-Physics, Inc. of Mountain View, Calif., has been awarded a $585,000 contract by NASA for the development, fabrication, and installation of a magnetic field test facility at NASA's Goddard Space Flight Center in Greenbelt, Md. The facility will be used to simulate accurately the magnetic environment encountered by space vehicles. Project manager is Kenneth A. Ruddock, one of the five scientists and engineers who in September of 1961 founded Spectra-Physics, a company engaged in research and development in the fields of quantum-electronics, geophysics, and space instrumentation. Spectra-Physics has grown to 40 employees, and is the leading commercial manufacturer of gas-phase lasers.

Dr. Donald Wahl has been named vice president of engineering and manufacturing at Optics Technology, Inc., Belmont. He was formerly manager of engineering at General Dynamics/Electronics, San Diego.

Robert N. Palmer has been appointed to the newly created position of applications engineering manager, research and development, of the tube division of Varian Associates, Palo Alto, after serving as senior engineering manager in the firm's megawatt-range twt product engineering program.

Eitel-McCullough, Inc., San Carlos, has expanded personnel in its microwave tube division 50 percent this year because of new business, the increase being almost equal in research and development and manufacturing.

Philco Corporation has been awarded a design study contract for a satellite control center for the U.S. Navy Astronautics Group located at Point Mugu, Calif. The work will be done at Philco's WDL division in Palo Alto under the direction of WDL's operations analysis dept. Project manager will be G. A. Barnard, who has previously participated in WDL satellite control center programs for the Air Force, NASA, and the Army Signal Corps. Assisting him will be W. E. Feroglia and Ralph A. Seitle, both widely experienced in control center design.

MANUFACTURER / REPRESENTATIVE INDEX

Accutronics, Inc. ..... G. S. Marshall Co.
Ace Engineering & Machine Co. ..... R. W. Thompson Assoc.
Adcom Corporation ..... W. K. Geist Co.
Adirondack Wire & Cable Co. ..... Schwarzschild Assoc.
AD-YU Electronics Labs, Inc. ..... Carl A. Stone Assoc.
Aertech ..... Jay Stone & Assoc.
Airborne Instruments Lab. ..... Wright Engineering
Alfred Electronics ..... Moxon Electronics
Ameray Corporation ..... White & Co.
American Nuclear Corp. ..... McCarthy Assoc.
Ammon Instruments, Inc. ..... Tech-Ser, Inc.
Antlab, Inc. ..... Jay Stone & Assoc.
Applied Magnetics Corp. ..... The Thorson Co.
Applied Microwave Lab., Inc. ..... Moxon Electronics
Applied Research, Inc. ..... Jay Stone & Assoc.
Applied Systems Corp. ..... Jay Stone & Assoc.
Applied Technology, Inc. ..... Moxon Electronics
Arizona Instruments ..... West Eleven
Arnold Magnetics Corp. ..... Walter Assoc.
Arra ..... West Eleven
Astrodata, Inc. ..... Moxon Electronics
Astron (Skottie Electronics) Corp. ..... Long
Autronics Corp. ..... The Thorson Co.

Ballantine Labs, Inc. ..... Carl A. Stone Assoc.
Barnes Engineering Co. ..... Costello & Co.
Bausch & Lomb, Inc. ..... Perlmuth Electronics
Bay State Electronics Corp. ..... Perlmuth Electronics
Beckman/Berkeley Division ..... V. T. Rupp Co.
Beckman/Stevens-Evans, Inc. ..... V. T. Rupp Co.
Behlman/Invar Electronics Corp. ..... Snitzer
Biocom, Inc. ..... Schwarzschild Assoc.
Blaw-Knox ..... The Thorson Co.
Block Associates, Inc. ..... W. K. Geist Co.
Bogart Mfg. Corp. ..... Jay Stone & Assoc.
Boonshaft & Fuchs, Inc. ..... W. K. Geist Co.
Boonton Electronics Corp. ..... O'Halloran Assoc.
Boonton Radio Co., Div. of H-P ..... Neely Enterprises
Borg Equipment ..... Recht Assoc.
Bryant Computer Products ..... Costello & Co.
Burr-Brown Research Corp. ..... W. K. Geist Co.
Burroughs Corp., ECD ..... Tech-Ser, Inc.
Burton, Trans Electronics, Div. ..... Jay Stone & Assoc.

California Instruments Corp. ..... V. T. Rupp Co.
California Technical Indus. ..... Perlmuth Electronics
Century Electronics & Instruments ..... V. T. Rupp Co.
Chrono-Log Corp. ..... West Eleven
Cimron Corporation ..... Ault Assoc.
CircuitDyne Corp. ..... T. Louis Snitzer Co.
Clairex Corp. ..... Moxon Electronics
Comcor, Inc. ..... Moxon Electronics
Communication Electronics ..... Costello & Co.
Components Engineering & Mfg. Co. ..... Premmco
Components for Research ..... White & Co.
Computer Instruments Corp. ..... Components Sales
Computer Measurements Co. ..... Moxon Electronics
Continental Connector Co. ..... J. Logan & Assoc.
Continental Sensing, Inc. ..... Birnbaum Sales Co.
CTS Corp. ..... J. Logan & Assoc.

Dana Laboratories, Inc. ..... McCarthy Assoc.
Datamec Corporation ..... Moxon Electronics
Datapulse, Inc. ..... O'Halloran Assoc.
Decker Corporation ..... Costello & Co.
DeMornay-Bonardi Corporation ..... J. T. Hill Co.
Diamond Antenna & Microwave Corp. ..... Wright
Di/An Controls, Inc. ..... Wright Engineering
Digital Electronics, Inc. ..... Peninsula Assoc.
Digitronics Corp. ..... Components Sales Calif.
Duncan Electronics, Inc. ..... Birnbaum Sales Co.
Dymec, Division of H-P ..... Neely Enterprises
Dynatran Electronics Corp. ..... G. H. Vaughan

Eckel Corporation ..... White & Co.
E-H Research Laboratories, Inc. ..... V. T. Rupp Co.
Elcor, Inc. ..... T. Whychell Co.
Electra Manufacturing Co. ..... Birnbaum Sales Co.
Electro Assemblies, Inc. ..... Birnbaum Sales Co.
Electron Products ..... G. S. Marshall Co.
Electronic Modules Corp. ..... Walter Assoc.
Electronic Products Corp. ..... West Eleven
Electronic Research Assoc., Inc. ..... Tech-Ser, Inc.
Emcor, Ingersoll Products Div. ..... T. Louis Snitzer Co.
E M I ..... O'Halloran Assoc.
Empire Devices, Inc. ..... Carl A. Stone Assoc.
Eppley Laboratory, Inc. ..... W. K. Geist Co.
Eubanks Engineering Company ..... Tech-Ser, Inc.

Fabri-Tek, Inc. ..... Costello & Co.
Fabricast Inc. ..... Costello & Co.
Fairchild/Dumont Labs ..... R. W. Thompson Assoc.
Fairchild Semiconductor ..... G. S. Marshall Co.
Fil-Shield Div. of Filtron, Inc. ..... Carl A. Stone Assoc.
Filtors, Inc. ..... Compar San Francisco
Flow Corporation ..... G. H. Vaughan Co.
Fluke Mfg. Co., John ..... McCarthy Assoc.
Franklin Systems, Inc. ..... Carl A. Stone Assoc.
Frenchtown Porcelain Co. ..... Compar San Francisco
Frequency Engineering Lab. ..... West Eleven

General Instrument, Capacitor Div. ..... J. Logan
General Instrument, Semiconductor Div. ..... J. Logan
General Ultrasonics Div. (Acoustica) ..... Tech-Ser, Inc.
Globe Industries ..... Long & Assoc.
Gruenberg Electric Co. ..... Peninsula Assoc.

Hammarlund Mfg. Co. ..... R. W. Thompson Assoc.
Hamner Electronics ..... McCarthy Assoc.
Hardwick, Hindle, Inc. ..... Long & Assoc.
Harrison Labs., Div., H-P ..... Neely Enterprises
Heli-Coil Corp. ..... Premmco, Inc.
Heller Industries, Inc. ..... Tech-Ser, Inc.
Hewlett-Packard Company ..... Neely Enterprises
Holt Instruments Laboratories ..... W. K. Geist Co.
Hughes Aircraft Co., Instruments ..... Walter Assoc.

Impact-O-Graph Corp. ..... White & Co.
Industrial Instruments, Inc. ..... G. H. Vaughan
Inland Motor Corp. ..... Costello & Co.
International Resistance Co. ..... J. Logan & Assoc.
ISO/Serve, Inc. ..... McCarthy Assoc.

James Knights Co. ..... G. S. Marshall Co.
Jetronics Labs. ..... Goodrich & Assoc.
J-Omega Company ..... Moxon Electronics

Keithley Instruments ..... T. Louis Snitzer Co.
Kewaunee Scientific Equipment ..... White & Co.
Kemet Co. ..... G. S. Marshall Co.
Kepco, Inc. ..... V. T. Rupp Co.
Kinetics Corporation ..... The Thorson Co.
KRS Electronics ..... V. T. Rupp Co.

REPRESENTATIVE DIRECTORY

Artwel Electric, Inc.
1485 Bayshore Blvd.,
San Francisco; 586-4074

Ault Associates
120 Santa Margarita,
Menlo Park; DA 6-1760

Birnbaum Sales Company, Inc.
626 Jefferson Ave.,
Redwood City; EM 8-7757

Compar San Francisco
1817 Bayshore Highway
Burlingame; 697-6244

Components Sales California, Inc.
Palo Alto; DA 6-5317

Costello & Company
535 Middlefield Road,
Palo Alto; DA 1-3745

Dynamic Associates
1011-D Industrial Way,
Burlingame; 344-1246

Geist Co., W. K.
Box 746, Cupertino;
YO 8-1608, AL 3-5433

Goodrich & Assoc., James L.
68 Allston Way,
San Francisco; OV 1-3874

Hill Company, J. T
4117 El Camino Way,
Palo Alto; 327-0311

Logan & Associates, Jack
801 Mahler Road,
Burlingame; OX 7-6100

Long & Associates, Inc.
505 Middlefield,
Redwood City; EM 9-3324

Marshall Company, G. S.
708 Warrington Road,
Redwood City; 364-9023

McCarthy Associates
1011-E Industrial Way,
Burlingame; 342-8901

McDonald Associates
716 Wilshire Blvd.,
Santa Monica; 394-6610

Moxon Electronics
15 - 41st Avenue,
San Mateo; 345-7961

Neely Enterprises
501 Laurel St.,
San Carlos; 591-7661
1317 Fifteenth St.,
Sacramento; GL 2-8901

MANUFACTURER / REPRESENTATIVE INDEX

Landis & Gyr, Inc. ..... Recht Assoc.
Laser Systems/Lear Siegler, Inc. (Trion) ..... Walter
Lavoie Laboratories, Inc. ..... McCarthy Assoc.
LFE ..... O'Halloran Assoc.
Lind Instruments, Inc. ..... The Thorson Co.
Lindgren & Associates, Erik A. ..... White & Co.
Lion Research Corp. ..... Schwarzschild Assoc.
Liquid Heat Co., Inc. ..... Schwarzschild Assoc.
Lockheed Electronics ..... Ault Assoc.
Lowell Instrument Laboratories ..... W. K. Geist Co.
Lumatron Electronics, Inc. ..... Ault Assoc.

Magnetic Metals, Inc. ..... Compar San Francisco
Marconi Instruments ..... Moxon Electronics
Maser Optics, Inc., Trident Div. ..... Peninsula Assoc.
McLean Engineering Labs ..... T. Louis Snitzer Co.
McLean Syntorque Corporation T. Louis Snitzer Co.
Melabs ..... Perlmuth Electronics
Melcor Electronics Corp. ..... Components Sales Calif.
Metrix, Inc. ..... White & Co.
Metron Instrument Co. ..... Components Sales Calif.
Micro-Power, Inc. ..... Walter Assoc.
Micro-Tel Corp. ..... Walter Assoc.
Microwave Associates ..... Elliott Recht Assoc.
Microwave Electronics Corp. ..... Jay Stone & Assoc.
Mid Eastern Electronics, Inc. ..... Perlmuth Electronics
Millitest Corp. ..... Components Sales Calif.
Moseley Co., F. L. ..... Neely Enterprises
Motorola, Inc. ..... Perlmuth Electronics
MSI Electronics, Inc. ..... Walter Assoc.

Narda Microwave Corp. ..... O'Halloran Assoc.
Navigation Computer Corporation ..... Snitzer
Neff Instrument Company ..... Ault Assoc.
Nesco Instruments (Div. of Datapulse) Schwarzschild
NJE Corporation ..... Ault Assoc.
North Atlantic Industries, Inc. ..... Tech-Ser, Inc.
Northeast Scientific Corporation ..... White & Co.
North Hills Electronics, Inc. ..... G. H. Vaughan

Omni Spectra, Inc. ..... Walter Assoc.
Optimation, Inc. ..... McCarthy Assoc.
Oread Electronics Laboratory, Inc. ..... V. T. Rupp Co.
Oregon Electronics Mfg. Co. ..... White & Co.

Pacific Data Systems ..... Moxon Electronics
Paradynamics, Inc. ..... O'Halloran Assoc.
Peerless Electrical Products ..... Birnbaum Sales Co.
Philbrick Researches, Inc. ..... Tech-Ser, Inc.
Philco (Microwave Div.) ..... Compar San Francisco
Phillips Control Relays ..... Long & Assoc.
Physics Research Laboratories, Inc. ..... W. K. Geist Co.
Polarad Electronics ..... T. Louis Snitzer Co.
Potter and Brumfield ..... Elliott Recht Assoc.
Power Designs, Inc. ..... Long & Assoc.
Precision Mechanisms Corp. ..... Components Sales
Probescope Company, Inc. ..... T. Louis Snitzer Co.
Pyrofilm Resistor Company, Inc. ..... Tech-Ser, Inc.

Quality Transformer & Coil Co., Inc. ..... Schwarzschild
Quan-Tech Labs ..... Jay Stone & Assoc.

Radiation at Stanford ..... O'Halloran Assoc.
Radiation Counter Laboratories, Inc. ..... White & Co.
Radiation Instr. Devel. Labs, Inc. ..... R. W. Thompson
Raytheon - Distributor Products ..... Perlmuth Electronics
Raytheon (Industrial Division) ..... McCarthy Assoc.
RCL Electronics, Inc. ..... G. S. Marshall Co.
RdF Corporation ..... Tech-Ser, Inc.
Renco Dry Box Glove Company ..... White & Co.
Rixon Electronics, Inc. ..... Costello & Co.
RHG Electronics Laboratory ..... Walter Assoc.
Rohde & Schwarz Sales Co. ..... W. K. Geist Co.
Rowan Controller Co. ..... Artwel Electric
Rutherford Electronics ..... Moxon Electronics

Sage Laboratories ..... The Thorson Co.
Sanborn Company ..... Neely Enterprises
Sandefur Engineering ..... Tech-Ser, Inc.
Sangamo Electronics Div. ..... Perlmuth Electronics
Scientific Data Systems ..... West Eleven
Scott, Inc., H. H. ..... W. K. Geist Co.
Sensitive Research Instrument ..... O'Halloran Assoc.
Shielding Division, Shieldtron, Inc. McDonald Assoc.
Sierra Electronic Div. of Philco Corp. ..... T. Louis Snitzer Co.
Singer Metrics (Panoramic Products) Carl A. Stone
Somerset Radiation Labs. ..... Peninsula Assoc.
Sorensen ..... O'Halloran Assoc.
Spectra-Physics, Inc. ..... O'Halloran Assoc.
Sperry Microwave Company ..... McCarthy Assoc.
Stevens Manufacturing Co. ..... Artwel Electric
Syracuse Electronics, Inc. ..... Artwel Electric
Systems Research Corp. ..... Moxon Electronics
Systron-Donner Corporation ..... Ault Assoc.

Tally Registor Corp. ..... Moxon Electronics
Tamar Electronics, Inc. ..... Premmco, Inc.
Tech-Stok, Inc. ..... Tech-Ser, Inc.
Telewave Laboratories, Inc. ..... T. Louis Snitzer Co.
Telonic Industries and Engineering ..... Snitzer
Tenney Engineering, Inc. ..... The Thorson Co.
Test Equipment Corp. ..... V. T. Rupp Co.
Thermal Systems, Inc. ..... Costello & Co.
Trak Microwave Corp. ..... Wright Engineering
Transistor Specialties, Inc. ..... O'Halloran Assoc.
Transnuclear Corporation ..... White & Co.
Triconix Inc. ..... Peninsula Assoc.
Tri-Ex Tower Company ..... R. W. Thompson Assoc.
Trimm Inc. ..... R. W. Thompson Assoc.
Trygon Electronics, Inc. ..... Moxon Electronics
Tucor Company ..... Wright Engineering

United Shoe Machinery Corp. ..... Premmco, Inc.
United States Dynamics ..... White & Co.
Unitrode Transistor Corp. ..... Compar San Francisco
Utah Research & Development Co. The Thorson Co.

Varian Associates, Recorder Div. ..... McCarthy Assoc.
Velonex ..... Ault Assoc.
Vernistat Div. Perkin-Elmer Corp. ..... Artwel Electric
Vidar Corporation ..... Moxon Electronics
Vitramon, Inc. ..... G. S. Marshall Co.
Volumetrics ..... Schwarzschild Assoc.

Waters Corporation, The ..... G. H. Vaughan
Waters Manufacturing, Inc. ..... Goodrich & Assoc.
Watkins-Johnson Co. ..... Perlmuth Electronics
Wavetek ..... McCarthy Assoc.
Wayne-George Corp. ..... Wright Engineering
Weinschel Engineering, Inc. ..... Jay Stone & Assoc.
Weldmatic Div. of Unitek Corp. ..... Tech-Ser, Inc.
Welwyn ..... Compar San Francisco
WEMS, Inc. ..... Tech-Ser, Inc.
Wesco Electrical Co., Inc. ..... Schwarzschild Assoc.
Wilk Instruments ..... V. T. Rupp Co.
Wiltron Co. ..... O'Halloran Assoc.
Wincharger Corp. (Zenith Radio Corp.) ..... Premmco
Winchester Electronics, Inc. ..... Long & Assoc.
Winslow Electronics, Inc. ..... Peninsula Assoc.
Wyle Labs/Mfg. Div. ..... West Eleven

REPRESENTATIVE DIRECTORY

O'Halloran Associates
3921 E. Bayshore
Palo Alto; DA 6-1493

Peninsula Associates
1345 Hancock Street,
Redwood City; EM 9-1226

Perlmuth Electronics
941 Charleston Road,
Palo Alto; DA 1-5064

Premmco, Inc.
2406 Lincoln Ave.,
Alameda; LA 3-9495

Recht Associates, Elliott
175 S. San Antonio Road,
Los Altos; 941-0336

Rupp Co., V. T.
1182 Los Altos Avenue,
Los Altos; WH 8-1483

Schwarzschild Associates
1405 - 4th Avenue,
San Francisco; SE 1-8282

Snitzer Co., T. Louis
1020 Corporation Way
Palo Alto; 968-8304

Stone Associates, Carl A.
800 N. San Antonio Road,
Palo Alto; DA 1-2724

Stone & Assoc., Jay
349 First Street,
Los Altos; 948-4563

Tech-Ser, Inc.
800 San Antonio Rd.,
Palo Alto; DA 6-9800

Thompson Associates, R. W.
4135 El Camino Way,
Palo Alto; DA 1-6383

The Thorson Company
2443 Ash Street
Palo Alto; DA 1-2414

Vaughan Co., G. H.
Box 1253, Palo Alto;
DA 1-1347

Walter Associates
Box 790, Menlo Park;
323-4606

West Eleven, Inc.
210 California Ave., Suite K,
Palo Alto; 321-3370

White & Company
788 Mayview Ave.,
Palo Alto; 321-3350

Whychell Company, T.
580 Spargur Drive,
Los Altos; 948-0355

Wright Engineering
126 - 25th Ave.,
San Mateo; 345-3157

new literature

CURRENTLY AVAILABLE

(At no charge unless indicated)

Directory of membership, Northern California Chapter, Electronics Representatives Assn. ERA Directory, 2316 El Camino Real, Mountain View, Calif. DA 6-1272.

Photoelectric and automation components. 32 pp. catalog. John M. Farmer, Farmer Electric Products Co., Tech Circle, Natick, Mass.

The National Catalogue of Patents (from 1798 to the present). First 2 electrical vols. (1,598 pp.) Rowman and Littlefield, Inc., 84 Fifth Ave., New York. $100 for 2 vols.

Services, capabilities, and experience in the telecommunications systems engineering environment. 12 pp. brochure. Microwave Services International, Inc., U.S. Route 46 and Cisco Road, Denville, New Jersey.

Advanced family of lithium drift, solid state nuclear detectors and use in instruments and probe assemblies. 4 pp. brochure. Dr. J. C. Lee, Electro-Nuclear Laboratories, Inc., 2443 Leghorn St., Mountain View, Calif.

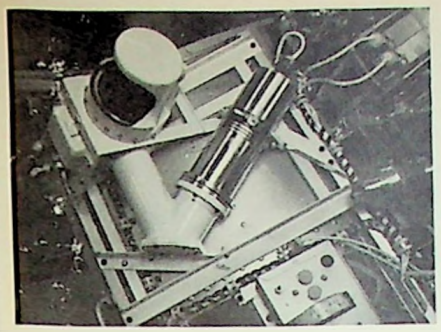
National Electrical Code Handbook (11th Ed.) including complete text of 1962 National Electrical Code. McGraw-Hill Book Information Service, 327 W. 41st St., New York. $12.50.

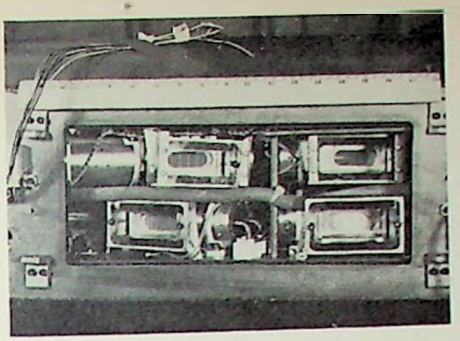
Basic switches and actuators with dimensional drawings and specifications. 16 pp. catalog. H. J. Roeser, Advertising Manager, Licon, 6615 W. Irving Park Rd., Chicago 34.

Digital voltmeter with 1 microvolt/digit sensitivity and five digit readout. Bulletin. Robert Dabbs, Advertising Manager, Houston Instrument Corp., 4950 Terminal Ave., Bellaire 101, Texas.

Capability in antenna systems. Brochure. WDL Division, Philco Corp., 3825 Fabian Way, Palo Alto.

Advertisers & Agencies





Here, in Lockheed Missiles & Space Company's Physical Sciences Laboratories, scientists are engaged in a comprehensive space physics research program embracing experimental and theoretical work in space radiation, aurora, atmospheric structure, geomagnetic micropulsations, x-ray astronomy, and the propagation of electromagnetic waves in space. Experimental programs include the measurements of geophysical and space properites, both in space and in the laboratory.

Currently, measurements of variations on the earth's magnetic field are being made at remote islands in the Pacific Ocean, providing clues to the effect of solar activity on its shape and stability. The influence of solar wind on the geomagnetic field is also being investigated in laboratory experiments, by bombarding magnetic fields with clouds of highly ionized gases.

Scientists at Lockheed are engaged in a continuing program of designing and placing density gages, mass spectrometers, ion traps, and similar instruments on space vehicles to measure the density, composition, and temperature of matter in space. These experiments lead to a better understanding of the chemical reactions occurring in the atmosphere high above the earth.

Important investigations of the low energy x-rays emitted by stars are being carried out and interpreted to give information on the structure of stellar coronas.

LOOK AT LOCKHEED...AS A CAREER Consider Lockheed's leadership in space technology. Evaluate its accomplishments —such as the Polaris missile, the Agena vehicle's superb record of space missions. Examine its outstanding advantages —location, advancement policies, creative climate, opportunity for recognition.

Then write for a brochure that gives you a more complete Look at Lockheed. Address: Research & Development Staff, Dept. M-44H, P.O. Box 504, Sunnyvale, California. Lockheed is an equal opportunity employer.

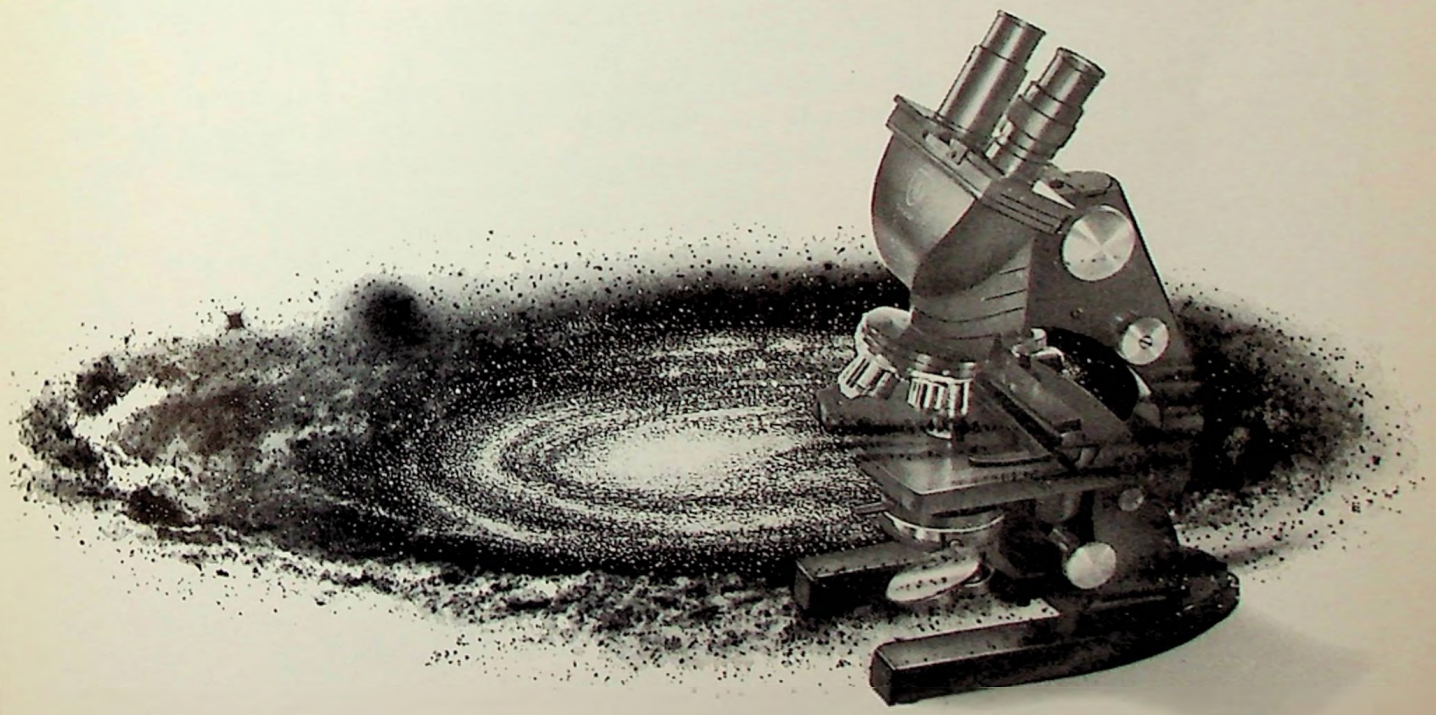
SCIENTISTS & ENGINEERS: In addition to positions in the physical sciences, other important openings exist for specialists in: Trajectory analysis • Gas dynamics • Orbit thermodynamics • Electromagnetics • Chemical & nuclear propulsion • Systems engineering • Electronic engineering • Communications & optics research

LOCKHEED
MISSILES & SPACE COMPANY
A GROUP DIVISION OF LOCKHEED AIRCRAFT CORPORATION

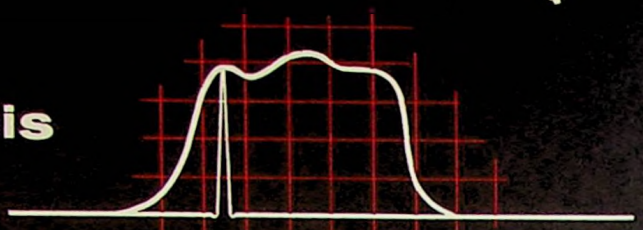
Sunnyvale, Palo Alto, Van Nuys, Santa Cruz, Santa Maria, California · Cape Canaveral, Florida · Huntsville, Alabama · Hawaii

LOOK AT LOCKHEED IN SPACE PHYSICS:

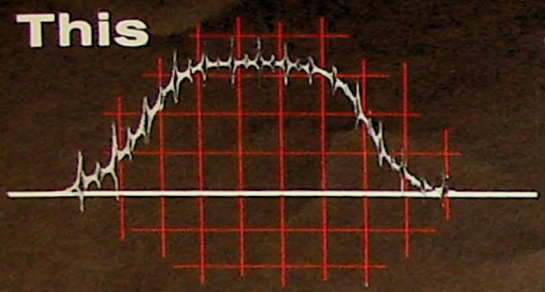
Continuing investigation of matter and forces in space



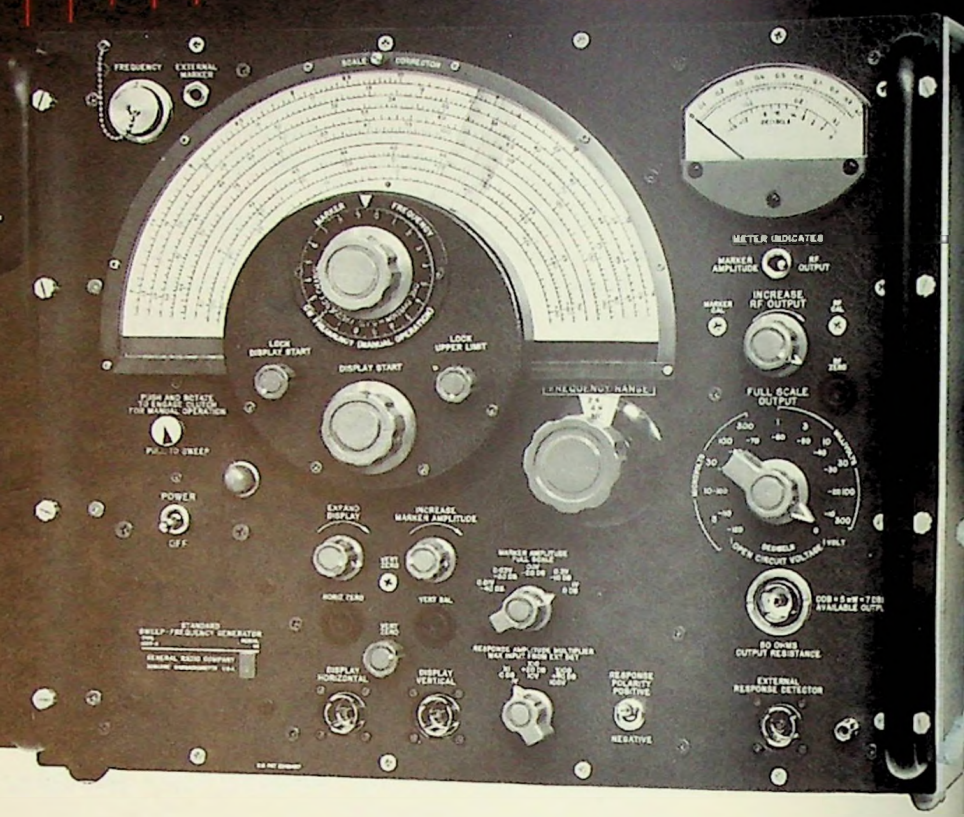
This



Not This



with the 1025-A Standard Sweep-Frequency Generator



"The Sweep Generator with the perfect marker"

. . . a marker that's continuously adjustable in frequency and amplitude . . . accurately calibrated in frequency and amplitude . . . that lets you take your data directly from the display . . . a marker that does not interfere with the response display . . . a single marker, not an ambiguous, confusing string of pips.

The 1025-A has all you need for QUANTITATIVE frequency-response measurements . . . a sweep generator, cw generator, marker generator, precision attenuator, and output meter. This instrument can be instantly switched from sweep to cw operation without changing adjustments or connections. A unique motor-driven capacitor produces a swept signal free of harmonic distortion and spurious responses. Low residual fm permits ready investigations of steep response slopes. Its meter measures both rf input and detected output. A high-impedance detector probe is supplied to minimize loading during response measurements.

In short, the 1025-A is the most complete sweep-frequency generator you can buy.

SPECIFICATIONS

Range: 0.7 to 230 Mc in ten overlapping octave ranges plus two bandspread ranges of 400-500 kc and 10.4-11 Mc. Other bandspread ranges available on special order.

Sweep Width: Entire selected range is swept. Portions of range as small as 10% can be expanded to full oscilloscope width for detailed visual display. Selected range is swept in 22.2 msec twenty times a second. Output is blanked off during return sweep.

Stability: Drift is less than ±0.1% over 5-hour period after warmup. Frequency dial accuracy is within ±0.5%.

Marker: Adjustable from 3 mv to 1v; multiplier extends range to 100v. Resolution is better than ±0.1% of indicated frequency.

RF Output: 0.3μv to 1v behind 50 ohms. Output flat to within ±1% up to 100 Mc and within ±3% up to 230 Mc.

Price: $3250 in U. S. A.

Write for complete information

GENERAL RADIO COMPANY

WEST CONCORD, MASSACHUSETTS

Sales Engineering Office in SAN FRANCISCO: 1186 Los Altos Avenue, Los Altos, California
James G. Hussey • Donald M. Vogelaar
Tel: 415 948-8233 • TWX: 415 949-7964