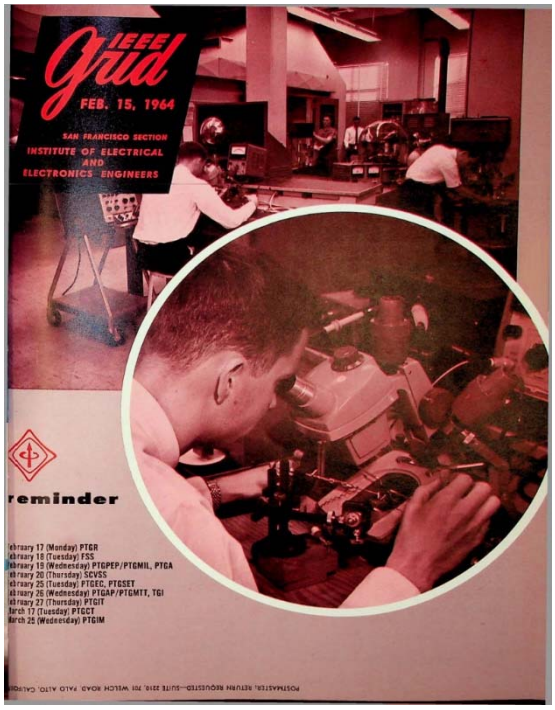
EDITOR'S PROFILE of this issue

from a historical perspective …

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



February, 1964 (mid-month):

Cover: Shown are several photos at UC-Berkeley's new semiconductor laboratory, with high-temperature furnaces for epitaxial and diffusion work; a chemistry section for etching, polishing, and plating; darkrooms for masking and lithography; and vacuum evaporators, bonders, probers and more. Members in the Center are from various UC departments. More on page i.

Page 2: The Perham Foundation signs an agreement with Foothill College, in Los Altos, to build a permanent home for Doug Perham's vast collection of Valley memorabilia dating back to 1900. When funding gets raised, the displays move in 1973 into new on-campus buildings for a number of years. I remember bringing my sons to the planetarium to see some of the displays (including a very large animatronic Chucky Cheese). However, after the passage of Proposition 13 and the resultant cuts in funding, the college decided in 1988 to evict the museum to use the space for classes, and settled on a $775,000 payment to the Foundation as compensation, which was used through 1991 to pack up and put the collection in storage. The collection is now at History San Jose (as the Perham Collection of Early Electronics). I've used photos of some of the historical pieces in my talk on "The Origins of Silicon Valley: Why and How It Happened Here".

Page 5: San Jose State College (later, University) dedicates a new 230,000 square foot engineering building, at Seventh and San Fernando streets, as part of Engineers Week ceremonies of the Santa Clara Valley Subsection; speaker is John Haanstra of IBM, one of the developers of the RAMAC disk drive designed in San Jose. The GRID announces an open house at the new facility. Many of Silicon Valley's engineers graduated from SJSU's strong engineering school. I've spoken on campus a number of times to the gathered EE seniors about what a career is like as a practicing engineer.

Archive of available SF Bay Area GRID Magazines is at this location:
https://ethw.org/IEEE_San_Francisco_Bay_Area_Council_History

IEEE Grid
FEB. 15, 1964
SAN FRANCISCO SECTION
INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS

reminder

February 17 (Monday) PTGR
February 18 (Tuesday) FSS
February 19 (Wednesday) PTGPEP/PTGMIL, PTGA
February 20 (Thursday) SCVSS
February 25 (Tuesday) PTGEC, PTGSET
February 26 (Wednesday) PTGAP/PTGMTT, TGI
February 27 (Thursday) PTGIT
March 17 (Tuesday) PTGCT
March 25 (Wednesday) PTGIM

POSTMASTER: RETURN REQUESTED—SUITE 2210, 701 WELCH ROAD, PALO ALTO, CALIFOR

cover story

NEW LAB AT UC

The new semiconductor laboratory in operation in the Department of Electrical Engineering at the University of California at Berkeley will aid in research projects ranging from the fabrication of experimental integrated circuits to the detailed study of a wide variety of semiconductor processes.

The laboratory occupies about 1,800 square feet in the electronics research laboratory in Cory Hall and is divided into several areas of activity. Two hydrogen rooms allow a maximum degree of freedom in the choice of atmospheres for diffusion and epitaxial work. One of these rooms contains four diffusion furnaces used for diffusion, oxidation, and other high-temperature processes. The other hydrogen room contains a high-power radio - frequency induction heater, hoods, and other facilities for epitaxial growth.

A chemistry room provides facilities for various kinds of surface treatments including cleaning, plating, etching, and polishing of devices. Two darkrooms are available for experimental work that requires light control. Portions of the darkrooms house the necessary equipment to do photoresist masking, i.e., photoreduction, step and repeat, and mask-making facilities.

Three vacuum evaporators are available for a variety of applications, including vacuum deposition of various materials and the observation of surface properties of materials that may be affected by an atmospheric environment. Devices and circuits may be mounted and leads attached by use of the die-attach and thermocompression bonding equipment.

The following staff members participate: Prof. A. C. English (investigation of basic electronic phenomena that exist in solid-state devices), Prof. T. E. Everhart (application of high-density, well-resolved electron beams to the study and fabrication of semiconductor devices), Profs. D. O. Pederson and R. S. Pepper (creation of optimum semiconductor integrated circuits to perform specific circuit functions), Prof. R. S. Muller (characteristics and properties of thin-film devices), Prof. Shyh Wang (study of the detailed physical basis of tunneling in semiconductor and thin-film junctions), and Prof. R. M. White (studies of the interactions of elastic waves in solids).

S. R. Pedersen, research specialist, is in charge of the laboratory, and G. A. Becker, research engineer in charge of the microwave tube laboratory, supplies support.

WIDE RANGE CALIBRATED TEST SIGNALS

5 cps to 560 kc, 5 μv to 2.5 v into 600 ohms

SPECIFICATIONS

Frequency range:	5 cps to 560 kc, 5 ranges
Dial:	logarithmic calibration, ± 3% accuracy
Frequency response:	± 3% into rated load
Output:	10 mw (nominal 2.5 v rms into 600 ohms)
Output impedance:	600 ohms
Output attenuator:	6 position, 10:1 steps from 0.01 mv to 1 v; times 2.5 multiplier gives 10:1 steps from 0.025 mv to 2.5 v
Output monitor:	transistor voltmeter monitors level at input to attenuator and after set level
Set level:	continuously variable attenuator with 10:1 (20 db) minimum range
Distortion:	less than 1%
Hum and noise:	less than 0.05%
Power:	four rechargeable batteries (furnished), recharge during ac operation; 30 hours per charge, more than 500 recharges
Size:	6½" high, 7¾" wide, 8" deep, 8¼ lbs.
Price:	hp 208A, $525

Data subject to change without notice. Prices f.o.b. factory.

Also available: Model 208A-DB for audio, communication system testing. Model 208A-DB, same as 208A except that output is calibrated in dbm, has a 110 db attenuator calibrated in 1 and 10 db steps. Price: $535.

New hp 208A Test Oscillator

Solid state and operated from a rechargeable battery pack or ac line, the 208A can be used anywhere to provide stable, accurate signals that are calibrated with a built-in attenuator and voltmeter. The precision attenuator adjusts the output in 20 db steps from 0.01 mv to 1 v or from 0.025 mv to 2.5 v. A metered set level control provides continuous adjustment between 20 db steps. Output is calibrated into 600 ohms, single ended.

While operation on rechargeable battery pack makes the 208A ideal for field use, battery operation is also useful in general lab work, providing isolation from power line ground to avoid hum and ground loop problems. The long-life nickel-cadmium batteries recharge automatically while the oscillator is operated from the ac line so that the 208A is always ready for portable use. Output is flat within ± 3%; frequency stability is typically better than 5 parts in 10^4.

HEWLETT-PACKARD COMPANY

CONTACT OUR FIELD SALES OFFICES, NEELY ENTERPRISES—Los Angeles, 3939 Lankershim Blvd., North Hollywood, TR 7-1282 and PO 6-3811; San Francisco, 501 Laurel St., San Carlos, 591-7661; Sacramento, 2591 Carlsbad Ave., 482-1463; San Diego, 1055 Shafter St., AC 3-8103; Scottsdale, 3009 N. Scottsdale Rd., 945-7601; Tucson, 232 So. Tucson Blvd., MA 3-2564; Albuquerque, 6501 Lomas Blvd., N.E., 255-5586; Las Cruces, 114 S. Water St., 526-2486. • LAHANA & CO.—Denver, 1886 S. Broadway, PE 3-3791; Salt Lake, 1482 Major St., HU 6-8166 • ARVA, Inc.—Seattle, 1320 Prospect St., MA 2-0177; Portland, 2035 S.W. 58th Ave., CA 2-7337 • EARL LIPSCOMB ASSOCIATES—Dallas, 3605 Inwood Rd., FL 7-1881 and ED 2-6667; Houston, 3825 Richmond Ave., MO 7-2407.

Earl Goddard, chairman of the board of the Perham Foundation, looks on as Dr. Calvin Flint, president of Foothill College, signs an agreement of intent, thus paving the way for a fund drive by the foundation to finance an electronics museum on the Foothill campus.

historical notes

ELECTRONICS MUSEUM FUND DRIVE

A $100,000 fund solicitation campaign—the proceeds of which will be used to finance the initial construction phase of a national electronics museum —will be launched soon by the Perham Foundation of California, Earl G. Goddard of Palo Alto, chairman of the foundation, has reported. The museum will be located on the campus of Foothill College in Los Altos Hills, in the heart of the area where, in the first half of the twentieth century, many internationally significant electronics discoveries and inventions have been made.

Goddard announced the signing of an "agreement of intent" between the foundation and the Foothill College district which will pave the way for the fund campaign and establishment of the museum.

The foundation is sole owner of the famed Perham electronics collection of documents and artifacts dating back to the turn of the century. It was begun by Douglas Perham, a pioneer electronics engineer, who has maintained the collection in the New Almaden Museum for many years.

The artifacts and documents illustrate discoveries and works of such giants in early-day electronics as Guglielmo Marconi, Lee DeForest, Charles D. Herrold, Ralph Heintz, Sr., Cyril Elwell, Herbert Van Etten, C. V. Logwood, Leonard Fuller, Valdemar Poulsen, H. J. Ryan, Russell and Sigurd Varian, W. W. Eitel, J. A. McCullough, F. A. Kolster, C. B. Kennedy, W. R. Hewlett, D. Packard, and many others.

Company names represented in the early-day collection include Wireless Telegraph and Signal Company Ltd. (Marconi), Pacific Wireless Telegraph Company, American DeForest Wireless Telegraph Company, Occidental and Oriental Wireless Company (DeForest), Poulsen Wireless Telephone and Telegraph Company (Elwell), Federal Telegraph Company, Magnovox, Heintz and Kaufman, and Eimac.

The foundation was incorporated as a non-profit body to establish a museum and educational facility for the collection, development, and preservation of historical radio and electronic materials. It has been encouraged and assisted by the historical committee of the San Francisco Section and has also received wide endorsement by firms and individuals in the local electronics industries. The foundation is an independent organization and has no formal connection with the IEEE; however, since both are interested in the history of electronics, a mutual interest has developed and a beneficial exchange has grown up between the two groups.

Goddard said that information regarding the activities of the foundation may be obtained by writing to: Perham Foundation, Foothill College, 12345 El Monte Road, Los Altos Hills, Calif.

IEEE Grid

volume 10, number 12 • february 15, 1964

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: 363 Sixth Street, San Francisco 94103. Second class postage paid at San Francisco, Calif.

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

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cover

A UC graduate student probes an integrated circuit with a micromanipulator in the new semiconductor integrated circuits laboratory of the electronics research laboratory on the Berkeley campus. The facility is being used by more than 20 graduate students working on semiconductor problems, as well as by an increasing number of others working in related areas. Photos by Vern Tarr, UC College of Engineering.

san francisco section officers

advertising

meeting ahead

DIGIMUX

A fresh approach to supervisory and control equipment—Digimux—will be presented to the February 26 meeting of the Industrial Technical Group by John L. Haynes, chief engineer of Pacific Communications & Electronics, Redwood City.

His talk will be concerned with the interface at the input and output of the supervisory and control equipment, including considerations of external interference, transient conditions, and interface of electromechanical and solid-state circuitry.

Also discussed will be security considerations in transmission of data over a communications channel with emphasis on error detection, reliability in transmission, and accuracy of output information from the receiver.

Mr. Haynes has successfully incorporated a broad background in computer techniques and data handling and processing methods.

Haynes

White

meeting ahead

HF ULTRASONICS

A talk by Dr. Richard White of the University of California on recent developments in high-frequency ultrasonics is planned for the February 26 meeting of the PTG chapter on Microwave Theory and Techniques.

During the past five years, techniques have been developed for the generation, detection, and utilization of elastic waves well into the microwave frequency range. Some of the devices of potential significance which have resulted from this development include the ultrasonic amplifier and microwave frequency elastic wave delay lines. Related to this work has been the discovery or development of media suitable for high-frequency elastic wave propagation or interaction. For example, materials have been found which exhibit low loss for room temperature elastic wave propagation at microwave frequencies.

At somewhat lower frequencies it has been observed that elastic waves can be generated by the transient heating of the surfaces of solids and liquids. This latter effect has possible application to the measurement of electromagnetic power density (for example, at radio or optical frequencies) and to the detection of electron impact in totally enclosed vacuum devices.

MEETING CALENDAR

FRESNO SUBSECTION

8:00 P.M. • Tuesday, February 18

Open meeting—all interested persons welcome
Wide band data transmission
Herbert C. Jessen, engineer, PT&T Co., Sacramento
Place: 10th floor, PG&E Bldg., Fresno
Dinner: (Speaker and officers)

SANTA CLARA VALLEY SUBSECTION

Thursday, February 20

Santa Clara Engineers' Council banquet for Engineers' Week
John Haanstra, president, general products division, IBM
Place: Lou's Village, 1465 W. San Carlos, San Jose
Dinner: 7:30 P.M. ($4.75); Cocktails: 6:30
Reservations: Robert R. Shepperd, 297-3000, Ext. 2424 or 266-7214

TECHNICAL GROUP

Industrial

7:30 P.M. • Wednesday, February 26

Digimux—a fresh approach to supervisory and control equipment
John Haynes, chief engineer, Pacific Communications and Electronics
Place: Physics lecture hall, Room 101, Stanford University
No dinner

PROFESSIONAL TECHNICAL GROUP CHAPTERS

Antennas and Propagation

8:00 P.M. • Wednesday, February 26

(Joint with PTGMTT. See below)

Audio

8:15 P.M. • Wednesday, February 19

Some problems in obtaining broadband performance in magnetic recording
Eric D. Daniel, director of research, Memorex Corp.
Place: Stanford Research Institute, Conference Room B
Dinner: 6:30 P.M., Atherton Club, 3391 El Camino Real, Atherton
Reservations: Herb Ragle, 248-3344, Ext. 60

Circuit Theory

8:00 P.M. • Tuesday, March 17

Recent developments in applications of the computer to network theory
Prof. D. Calahan, visiting assistant professor, University of California, Berkeley
Place to be announced

Electronic Computers

8:00 P.M. • Tuesday, February 25

The Burroughs B 5000 as an operating system
Dr. Gene Thompson, head of computing center, United Technology Center, Sunnyvale
Place: General Electric Computer Laboratory, 310 De Guigne Dr., Sunnyvale
Dinner: 6:30 P.M., Old Plantation, El Camino & Bernardo, Sunnyvale
Reservations: none required

Information Theory

8:00 P.M. • Thursday, February 27

FM reception and the zeros of a narrow-band gaussian process
Dr. Nelson M. Blachman, senior scientist, Sylvania Electronic Defense Labs., Mountain View
Place: Stanford Research Institute, Bldg. 1, 333 Ravenswood Ave., Menlo Park
Dinner: 6:00 P.M., Villa d'Este, 3401 El Camino, Atherton
Reservations: Mrs. Kelly, 326-6200, Ext. 2945, by February 26

Instrumentation and Measurement

8:15 P.M. • Wednesday, March 25

Instrumentation for nuclear measurements—a detailed discussion of the instrumentation for measurements relating to nuclear explosives
Marcus McCraven and Gordon Longerbeam, Lawrence Radiation Laboratory, Livermore
Place: Hewlett-Packard auditorium, 1501 Page Mill Road, Palo Alto
Dinner: 6:00 P.M., Dinah's Shack
Reservations and information: Mrs. Renda Blackler, 948-0571

MEETING CALENDAR

Microwave Theory and Techniques

8:00 P.M. • Wednesday, February 26

(Joint with PTGAP)

Recent developments in high frequency ultrasonics

Dr. Richard M. White, University of California

Place: Physics lecture hall, Room 100, Stanford University

No dinner

Military Electronics

8:00 P.M. • Wednesday, February 19

(Joint with Product Engineering and Production)

Fiber optics in photoelectronics, medicine, and infrared

H. L. Sowers, N. Silbertrust, and R. J. Simms, Research Dept. of Optics Technology, Inc., Belmont

Place: Lockheed Auditorium, Bldg. 202, Palo Alto

Dinner: 6:30 P.M., Rick's Swiss Chalet, 4085 El Camino Way, Palo Alto

Reservations: DA 6-4000, Ext. 2212 by 4:30 P.M., February 18

Product Engineering and Production

8:00 P.M. • Wednesday, February 19

(Joint with Military Electronics, see above)

Reliability

8:00 P.M. • Monday, February 17

(Joint with Maintainability Society)

Reliability—maintainability interface

Panel meeting—R. Owen Holbrook, moderator

Place: Physics lecture hall, Room 100, Stanford University

Dinner: 6:30 P.M., Ed's Chuck Wagon, El Camino Real, Mountain View

Reservations: Tom King, 639-4321, Ext. 24211 by February 17

Space Electronics and Telemetry

8:15 P.M. • Tuesday, February 25

Understanding of PGM frame synchronization coding

Robert G. Masching, research specialist, LMSC, 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 H. Light, 968-6211, Ext. 2748, 2755 by noon, February 25

meeting ahead

FM & ZERO CROSSINGS

Dr. Nelson M. Blachman, senior scientist at the Sylvania electronic defense laboratories, Mountain View, will discuss FM reception and the zeros of a narrow-band gaussian process at the February 27 meeting of the PTG chapter on Information Theory.

The mean number of zeros of a gaussian process in a given time interval takes a simple, well-known form; the variance of this number, however, takes a very complicated, known form in the wide-band case which cannot readily be applied to narrow-band noise. Blachman will present a new approach by which a relatively simple expression is obtained for this case, and he will extend it to the case of narrow-band noise plus a sinusoid when the interval under consideration is long. This result will be used to determine the output signal-to-noise ratio of a wide-band FM receiver near and below its threshold.

meeting ahead

BURROUGHS B 5000

The PTG chapter on Electronic Computers will meet February 25 at the General Electric computer laboratory, Sunnyvale. The topic will be the Burroughs B 5000 as an operating system.

The B 5000 has been of interest to computer designers because of some of its unique hardware functional implementation. The potential user has keen interest in the machine because, among other reasons, of its possible multiprocessing capability. Several B 5000 machines have been installed, with a total of about 60 expected to find their way into use. One of the first was installed at the United Technology Center almost a year ago. The speaker for the evening, Dr. Gene Thompson, is head of UTC's computing center, and will give an evaluation of the B 5000 from the user's point of view based on UTC's experience.

meeting ahead

FIBER OPTICS

Dr. Narinder S. Kapany, president of Optics Technology, Inc., Belmont, has arranged a presentation by members of his research staff for a joint meeting of the PTG chapters on Military Electronics and Product Engineering and Production on three aspects of this evolutionary technology on February 19.

Fiber optics may be defined as the science concerned with the transmission of light and images through optical waveguides. The basic fiber optic device consists of a bundle of fibers which have been drawn from thick glass rods and coated with a glass of lower refractory index. Such devices with fibers of two micron diameter can resolve images with a resolution of 250 lines per millimeter. Such device may have as many as 50,000 fibers with a packing density as high as 6×10^6 per square inch. Fiber optic devices have present applications in light and image transmitting systems, but potential applications in computers, pattern recognition, and instrumentation have been shown in the laboratory.

At this joint meeting, Drs. H. L. Sowers, N. Silbertrust, and R. J. Simms will detail the application of fiber optic technology in photoelectronic systems, medicine, and infrared systems.

Kapany

Haanstra

meeting ahead

ENGINEERS' WEEK SPEAKER

Electronic engineers take center stage this year at the Santa Clara Valley's celebration of National Engineers' Week, February 16 through 22.

Principal speaker at the two civic events on the schedule of the Santa Clara Valley Engineers' Council will be John W. Haanstra, who played a major role in development of IBM's random access memory machine, the RAMAC.

Haanstra, who was in San Jose from 1952 to 1957 for IBM, now is president of IBM's general products division in White Plains, New York.

On the afternoon of February 20, Haanstra will speak at dedication of San Jose State College's new $10-million, 230,000-square-foot engineer-

(Continued on page 7)

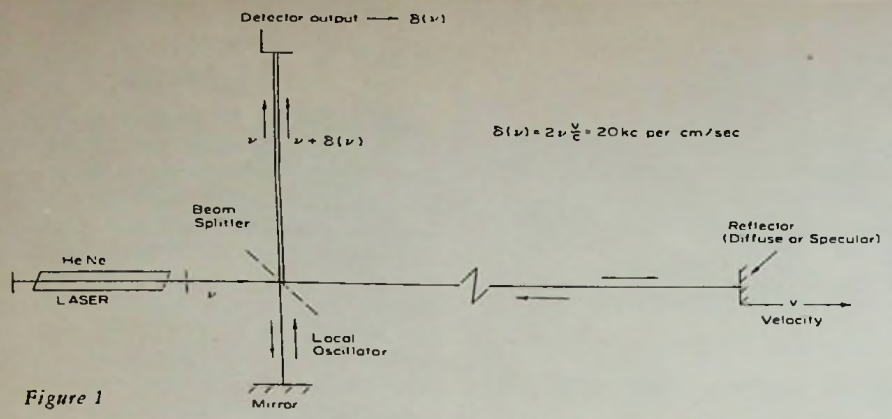
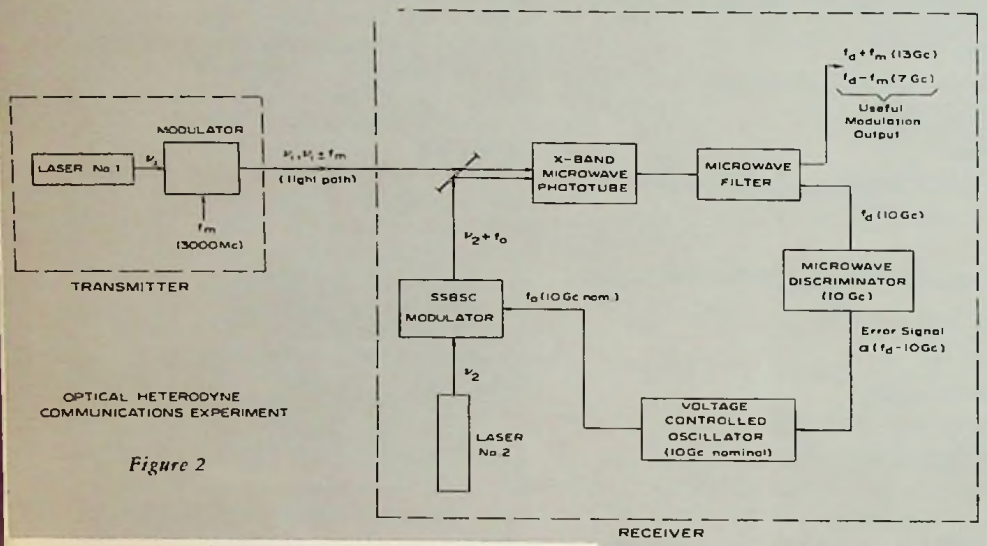


Figure 1

DOPPLER HOMODYNE SYSTEM



OPTICAL HETERODYNE COMMUNICATIONS EXPERIMENT

Figure 2

meeting review

LASER TECHNOLOGY

Russell Targ, in the absence of Dr. B. J. McMurtry, delivered an excellent lecture on December 17 to the PTG chapter on Space Electronics and Telemetry, covering current applications of laser technology being developed at Sylvania electronic defense laboratories optics department.

A doppler homodyne system was described (Figure 1) in which the velocity of a moving object produces a frequency change of 20 kc per cm/sec. This system uses an HeNe gas laser at a center frequency of 6328 angstroms. The divergence of the 6-inch ranging beam results in a 1-foot diameter beam at a distance of five miles.

Troublesome sources of noise in these experiments have been direct mechanical vibrations and airborne acoustical vibrations. Movement of the mirrors does not prevent the operation of the homodyne detector, but serves to add a source of low-frequency noise. Airborne acoustical vibrations cause density modulation of the air in the interferometer, perturbing the index of refraction of the air in one arm with respect to that in the other.

$P_{out} = \frac{1}{2} i^2 R_{equivalent}$

i = peak dc photocurrent

$i = mI_o$

I_o = average photocurrent

$I_o = P_{light} \frac{\eta e}{h\nu}$

m = modulation index

$P_{out} = \frac{1}{2} i^2 R_{equivalent}$ Figure of Merit

η = quantum efficiency = $\frac{\text{electrons out}}{\text{photons in}}$

Figure 3

In Figure 2 is an illustration of an optical heterodyne communications experiment. One of the problems encountered here is that a ¼-micron movement of the reflecting cavity mirrors results in a 150-megacycle variation in the laser oscillation frequency. For optimum results, lasers 1 and 2 should be at exactly the same frequency. One solution to this problem is in shorter length resonating cavities. A 2-inch laser which oscillates in one mode has been reported by workers at Bell Telephone laboratories.

In this experiment, laser No. 2 in the receiver is controlled by the output of a 10 Gc microwave discriminator (at right). The error signal is an amount more than zero but always different from the input by 10 Gc. When applied through the voltage controlled oscillator to the single side band suppressed carrier modulator, the local oscillator (laser No. 2) is driven into synchronism with the transmitter. Therefore, even though the frequency does shift, it does not affect the output of the system, and useful modulation output is obtained of f_d+f_m (13 Gc) and f_d-f_m (7 Gc).

Of considerable interest in all phases of the program have been the relative merits of the different types of detectors. In order to simplify this evaluation the equations shown in Figure 3 have been developed. The resultant figures of merit offer ready comparison between detection systems.

TOM LINDERS

meeting review

EM COMPATIBILITY

Ben Weinbaum, electronics group engineer, General Dynamics Astronautics, presented a talk at the January meeting of the PTGEMC chapter. His topic was large weapon and space system electromagnetic compatibility.

The place of interference control as a functional part of systems engineering technology was discussed. The typical present-day interpretation of compatibility requirements consists of recognition of the specifications and the requirement for meeting them. More compatible system designs would result if, instead, the technological accomplishments necessary to meet the specifications were recognized as a necessary part of the system design. Most EMC problems develop as the system comes into being. Many of them could have been prevented at the "block-diagram" stage by preparing a description of all of the outputs from and inputs to the system, and applying the information thus obtained to separate the desired from the undesired signals.

The second portion of Mr. Weinbaum's talk concerned measurement techniques. The example described was a technique for using the analog computer to perform a Fourier analysis of transient signals. The first step in the technique consists of photographing a transient waveform on an oscilloscope camera. The photographic record is then sampled optically to provide an input to the computer converted from real time to computer time. The Fourier analysis is limited only by the response of the oscilloscope, and has shown good agreement with field intensity meter measurements. Once the computer is set up, the time required to obtain the information is considerably shorter than the time required to make point-by-point measurements on a field intensity meter.

FLOYD LEWIS

MEMBERSHIP

Following are the names of IEEE members who have recently entered our area, thereby becoming members of the San Francisco Section:

J. E. Armstrong
L. B. Day, Jr.
H. M. Kohlstadt
J. N. Lind
R. B. Martin
E. A. Meyers, Jr.
W. H. Nail
R. A. Pearson
C. R. Perkins
T. A. Puorro
O. E. Selenius
H. L. Shoemaker
D. R. Steenhausen
J. W. Stugart

MORE ENGINEERS' WEEK

ing building. Following the dedication, the building at Seventh and San Fernando streets will be opened for the first time to public inspection. The open house will continue Friday and Saturday afternoons.

Thursday night, February 20, Haanstra will speak at the Engineers' Council's eighth annual dinner. Tickets are available at most Santa Clara Valley plants employing engineers.

William E. Chamberlin of General Electric, president of the Engineers' Council, will preside. The meeting is jointly sponsored by the Santa Clara Valley Subsection of IEEE.

IEEE

April 21-23 — **Residential Underground Distribution Conference,** Chase-Park Plaza Hotel, St. Louis, Mo. IEEE. Program: R. C. Graham, Rome Cable Div., ALCOA, Rome, N.Y.

April 22-24 — **Southwestern IEEE Conference and Elec. Show (SWIEEECO),** Dallas Memorial Auditorium, Dallas, Tex. Region 5. Exhibits: Edward F. Sutherland, General Radio Co., Dallas, Tex. Program: Dr. F. E. Brooks, Ling-Temco Vought, Inc., Dallas 22, Tex. No proceedings.

April 29-30, May 1—**IEEE Region 6 Annual Conference,** Salt Lake City, Utah. Region 6/ISA. Exhibits.

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Aertech ..... Jay Stone & Assoc.
Airborne Instruments Lab. ..... Wright Engineering
Alfred Electronics ..... Moxon Electronics
Ameray Corporation ..... White & Co.
American Electronics Labs ..... Perlmuth Electronics
Antlab, Inc. ..... Jay Stone & Assoc.
Applied Magnetics Corp. ..... The Thorson Co.
Applied Research, Inc. ..... Jay Stone & Assoc.
Arizona Instruments ..... West Eleven
Arra ..... West Eleven
Astrodata, Inc. ..... Moxon Electronics
Astromarine Products Corporation ... W. K. Geist Co.
Autronics Corp. ..... The Thorson Co.

Ballantine Labs, Inc. ..... Carl A. Stone Assoc.
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Blaw-Knox ..... The Thorson Co.
Bryant Computer Products ..... Costello & Co.
Burmac Electronics ..... McCarthy Assoc.
Burr-Brown Research Corp. ..... W. K. Geist Co.

Century Electronics & Instruments .... V. T. Rupp Co.
Chrono-Log Corp. ..... West Eleven
Clairex Corp. ..... Moxon Electronics
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(formerly Speidel Corp.) ..... Perlmuth Electronics
Comcor, Inc. ..... Moxon Electronics
Communication Electronics ..... Costello & Co.
Computer Instruments Corp. ..... Components Sales
Computer Measurements Co. ..... Moxon Electronics
Control Science Corp. ..... W. K. Geist Co.
Custom Materials, Inc. ..... Jay Stone & Assoc.

Dana Laboratories, Inc. ..... V. T. Rupp Co.
Data Equipment Co. ..... Moxon Electronics
Datamec Corporation ..... Moxon Electronics
Decker Corporation ..... Costello & Co.
Diamond Antenna & Microwave Corp. ..... Wright
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REPRESENTATIVE DIRECTORY

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

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

Geist Co., W. K.
Box 746, Cupertino;
968-1608, 253-5433

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

Peninsula Associates
1345 Hancock Street,
Redwood City; 344-2521

Components Sales California, Inc.
Palo Alto; 326-5317

Dynamic Associates
1011-D Industrial Way,
Burlingame; 344-2521

Marshall Company, G. S.
890 Warrington Road,
Redwood City; 365-2000

O'Halloran Associates
3921 E. Bayshore,
Palo Alto; 326-1493

Perlmuth Electronics
1285 Terra Bella Ave.,
Mt. View; 961-2070

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1011-E Industrial Way,
Burlingame; 342-8901

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REPRESENTATIVE DIRECTORY

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

Rupp Co., V. T.
1182 Los Altos Avenue,
Los Altos; 948-1483

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

Stone Associates, Carl A.
800 N. San Antonio Road,
Palo Alto; 321-2724

Stone & Assoc., Jay
140 Main Street,
Los Altos; 948-4563

The Thorson Company
2443 Ash Street,
Palo Alto; 321-2414

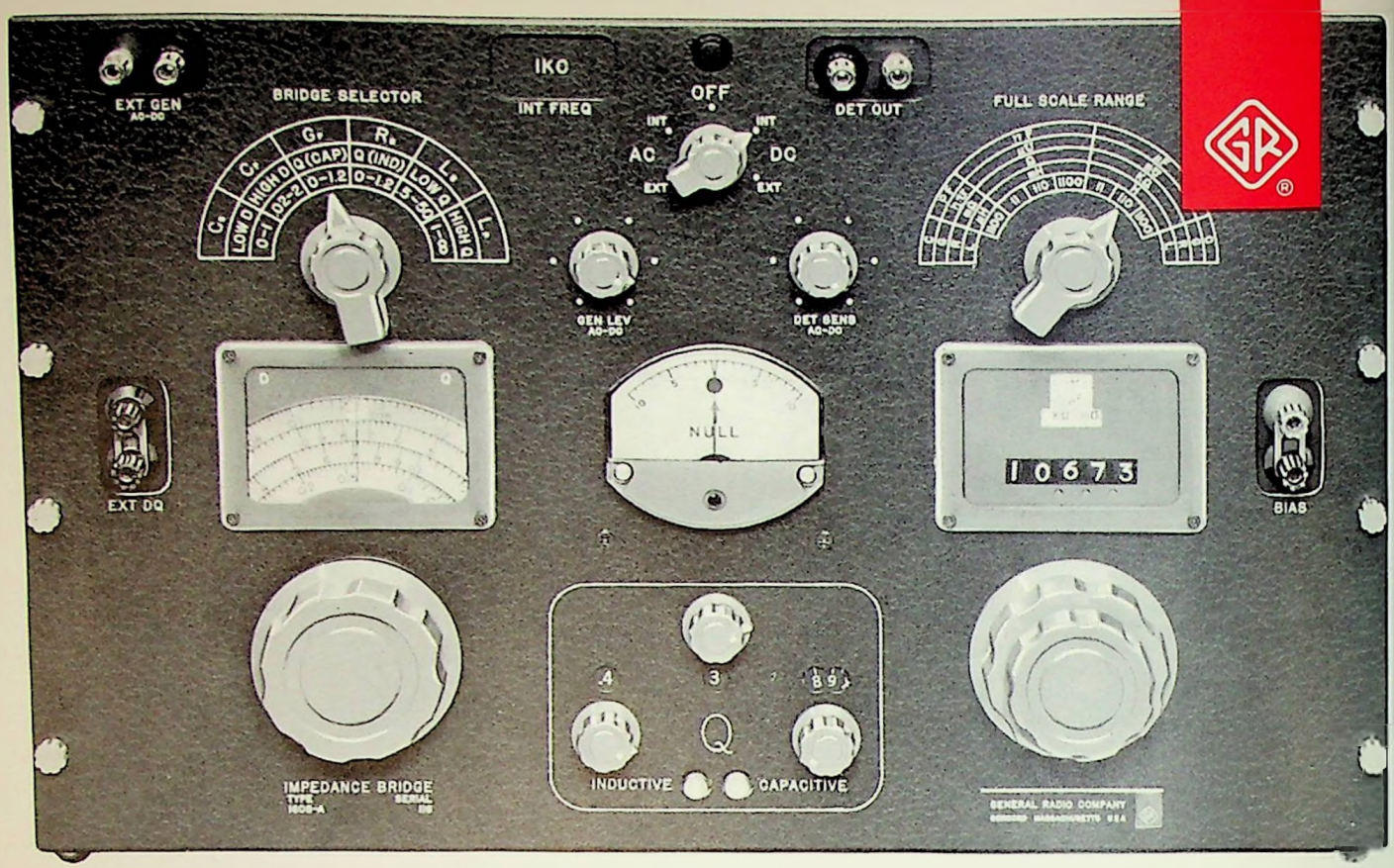
Walter Associates
Box 790, Menlo Park;
323-4606

Welco, Inc.
502 Waverley St.,
Palo Alto; 321-8500

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

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

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



It's Easy To Make 0.1% Measurements

with the Type 1608-A Impedance Bridge

Outstanding features are plentiful in this instrument. Basic impedance accuracy is 0.1%. High phase accuracy permits measurement of D down to 0.0005 or Q to 2000. C, R, L, and G parameters are indicated by an in-line digital presentation that includes automatic decimal-point location and display of unit of measurement — there are no multiplying factors to remember. Appropriate D and Q scales are indicated automatically. A concentric coarse- and fine-balance control makes possible rapid bridge balancing. Provision is also made for external biasing of components under test as well as for use of external generators and detectors at frequencies to 20 kc. In short, the 1608-A is the bridge that makes 0.1% impedance measurements easy.

Six bridge circuits provide complete phase coverage of the passive half of the impedance plane so that components, transducers, filters, equalizers, or other networks can be measured regardless of phase angle. A 1-kc oscillator and selective detector are built into the instrument as well as three power supplies which provide standard EIA test voltages for dc resistance and conductance measurements over a wide range.

SPECIFICATIONS

Ranges:
Resistance: 0.05 mΩ to 1.1 MΩ in 7 ranges (ac or dc)
Conductance: 0.05 nʊ to 1ʊ in 7 ranges (ac or dc)
Capacitance: 0.05 pf to 1100μf in 7 ranges (series or parallel)
Inductance: 0.05 μh to 1100h in 7 ranges (series or parallel)
at 1 kc: D (series C): 0.0005 to 1 — D (parallel C): 0.02 to 2
Q (series L): 0.5 to 50 — Q (parallel L): 1 to 2000
Q (series R): 0.0005 to 1.2 Inductive — Q (parallel G): 0.0005 to 1.2 Capacitive

Accuracy (at 1 kc): ±0.1% of reading ±0.005% of full scale except on lowest R and L ranges and highest G and C ranges where it is ±0.2% of reading ±0.005% of full scale. D and 1/Q accuracy are ±0.0005 ± 5% at 1 kc for L and C; Q accuracy ±0.0005 ± 2% for R and G. At 10 kc, R, L, C accuracy is ±0.2%.
Residual Terminal Impedance: R 1 mΩ, C 0.25 pf, L 0.15 μh.
Power Requirements: 105-125 or 210-250 volts, 50-60 cycles.
Type 1608-A Impedance Bridge, $1300 in U.S.A.

Write for Complete Information.

GENERAL RADIO COMPANY
WEST CONCORD, MASSACHUSETTS

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