EDITOR'S PROFILE of this issue

from a historical perspective …

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

October, 1970:

Cover: Different views of the Bay Area Rapid Transit (BART) system as we prepare for a tour. More on page 6.

Page 7: Alan Waterman, my undergraduate advisor at Stanford, is talking about experiments with 35GHz transmissions.

Page 16: Chuck Weaver gives a talk about modeling of heart rate control. He got his EE PhD at Stanford, and is at Stanford Research Institute (SRI) and working with the Medical School. He becomes quite active in local IEEE leadership, and many of us have known Chuck over the years.

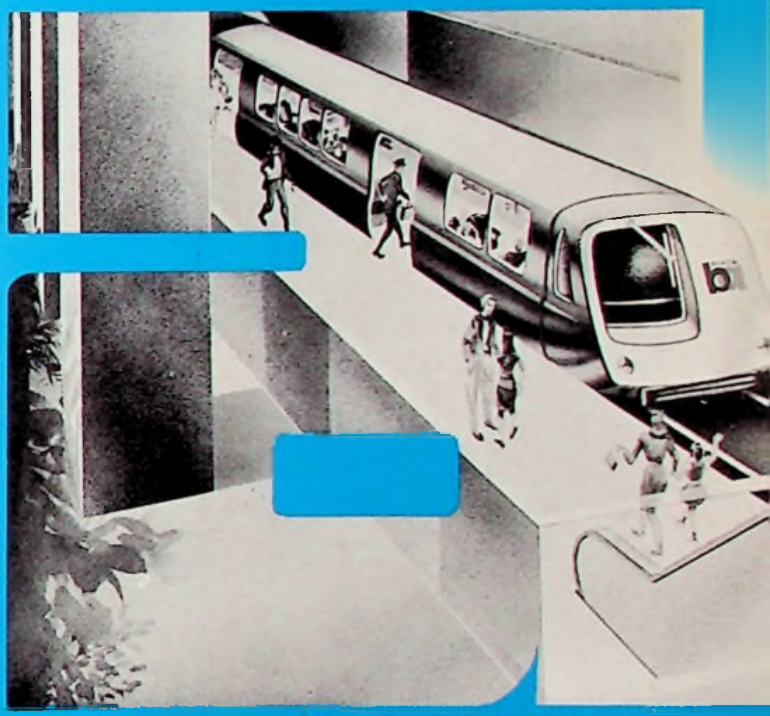
Archive of available SF Bay Area GRID Magazines is at this location:
https://ethw.org/IEEE_San_Francisco_Bay_Area_Council_History

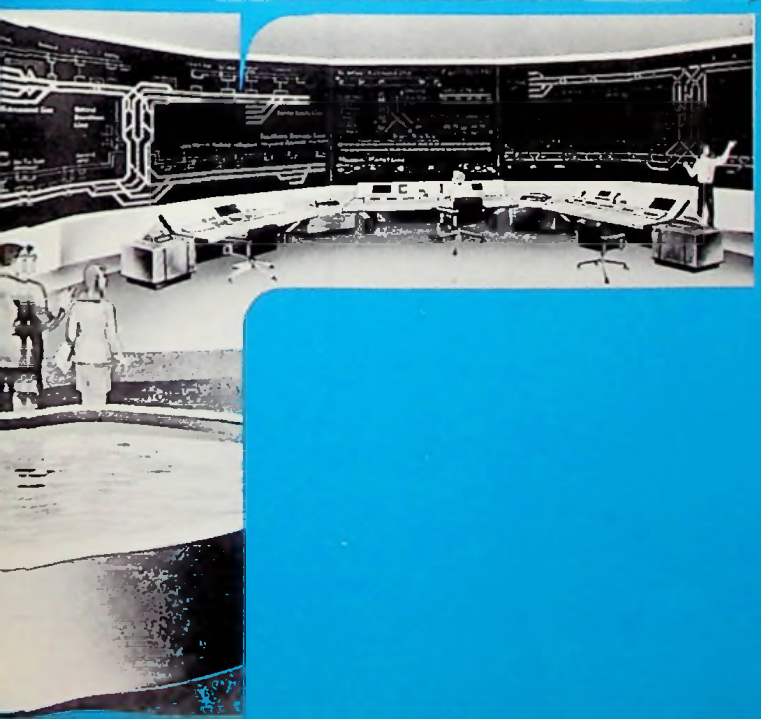
At time of scanning, the bound volumes are held by Paul Wesling. April, 2025 Contact p.wesling@ieee.org

Grid

OCTOBER 1970

SAN FRANCISCO SECTION • THE INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS, INC.





ON THE COVER

This month's cover depicts different working aspects of The Bay Area Rapid Transit. The Golden Gate Subsection is sponsoring a tour of BART's Montgomery Street Station on October 21. Story on Page 6.

Grid

volume 17
number 2

OCTOBER 1970

Published monthly except July and August
by San Francisco Section
Institute of Electrical and Electronics Engineers

EDITORIAL BOARD

Donald O. Pederson, U.C. Berkeley
Larry G. FitzSimmons, PTT Co.
Charles A. Eldon, Ness Pacific, Inc.
Dalton W. Martin, Vidar Corp.

EDITOR

Ernesto Montano

Address all mail except address changes to
San Francisco Section Office, IEEE
Suite 2210, 701 Welch Road
Palo Alto, California 94304
Telephone: (415) 327-6622

Jean Helmke, Office Manager
Bonnie Sorensen, Editorial & Office Assistant

1970-71 San Francisco Section Officers
Chairman: Donald O. Pederson
Vice Chairman: Larry G. FitzSimmons
Secretary: Charles A. Eldon
Treasurer: Dalton W. Martin

Members send address changes promptly to
IEEE, 345 East 47th St., New York, N.Y. 10017
Telephone: (212) PL 2-6800

Advertising

E. A. Montano, IEEE
701 Welch Rd., Palo Alto, Calif. (415) 327-6622

Second Class postage paid at Palo Alto, Calif.
and at additional mailing offices

Subscriptions:

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

Art & Production

O'Neal Advertising, San Francisco

MEETING

AEROSPACE & ELECTRONIC SYSTEMS
OCT. 22

Story on page 14

TOUR OF UNITED AIRLINES MAINTENANCE CENTER. Limited to 60 persons. William Hecht, Mgr., UAL Maintenance Ctr., tour conductor.

OCT. 22, Thursday, 7:30 PM, UAL Maintenance Center, SF Airport. (Take "Airport Shops" exit). Dinner at the Center: 6:15 PM. Reservations: Pat Hoppe, 326-4350, ext. 6143 by Oct. 13th. (Price of dinner $2.00).

ANTENNAS & PROPAGATION
OCT. 21

Story on page 7

FEATURING FOUR SPEAKERS AND SUBJECTS: 1. NEW APPROACH TO REDUCING SIZE OF LOG-PERIODIC DIPOLE ARRAYS, Sam Kuo of Sylvania. **2. ANTENNA ARRAYS OVER LOSSY GROUND,** Dr. E. K. Miller, MB Assoc. **3. FREQUENCY SELECTIVE SURFACES,** Gary Schennum, Philco Ford. **4. LINE OF SIGHT MEASUREMENT AT 34.89 GHz USING TWO SPACED TRANSMITTERS AND AN 8-ELEMENT RECEIVING ARRAY,** Dr. Alan T. Waterman, Stanford University.

OCT. 21, Wednesday, 8:00 PM, Lockheed Auditorium, Bldg. 202, 3251 Hanover St., Palo Alto. Cocktails: 5:30 PM; Dinner: 6:15 PM, Rick's Swiss Chalet, 4085 El Camino Way, Palo Alto. No reservations.

AUTOMATIC CONTROL
OCT. 20

Story on page 6

ASSESSING THE CAPACITY OF A LARGE MULTI-FUNCTIONAL SYSTEM — THE AIR CONTROL PROCESS, Dr. Robert Ratner, SRI.

OCT. 20, Tuesday, 8:00 PM, Lockheed Auditorium, 3251 Hanover St., Palo Alto. Dinner: 6:15 PM, Rick's Swiss Chalet, 4085 El Camino Way, Palo Alto. No reservations.

CIRCUIT THEORY
OCT. 10

FIRST ONE-DAY COURSE ON LINEAR INTEGRATED CIRCUITS.

OCT. 10, Saturday, 9:00 AM to noon; 1:00 PM to 5:00 PM, SLAC Auditorium, 2575 Sand Hill Road, Menlo Park. For registration information see Sept. Grid.

COMMUNICATION TECHNOLOGY
OCT. 20

Story on page 14

COMMUNICATIONS FOR PROTECTIVE RELAYING ON THE PG&E SYSTEM. G. E. Gilcrest and D. G. Gregory of PG&E.

OCT. 20, Tuesday, 8:00 PM, PH104 Stanford University, dinner at Rick's Swiss Chalet, 4085 El Camino Way, Palo Alto. No-host cocktails and dinner at 6:00 PM. Reservations: D. Kidder, 591-8461, ext. 525 or L. Best, (408) 354-6267 by Oct. 19th.

COMPUTER
OCT. 27

Story on page 11

PERFORMANCE EVALUATION OF STORAGE HIERARCHIES. Dr. R. L. Mattson, IBM Research Lab., San Jose.

OCT. 27, Tuesday, 8:00 PM, Skilling Auditorium, Stanford (near Durand Bldg.) Dinner: 6:15 PM, Rick's Swiss Chalet, 4085 El Camino Way, Palo Alto. Reservations: Cathy Morton, 321-3300, ext. 258 by Oct. 26th.

EAST BAY SUBSECTION
OCT. 26

Story on page 8

NEW METHODS IN MEDICAL CARE. Dr. Joseph Terdiman, Medical Methods Research Dept. of Permanente Medical Group.

OCT. 26, Monday, 7:30 PM, Diamond Jim's Restaurant, 245 W. MacArthur Blvd., Oakland. Cocktails: 5:45; dinner 6:30 PM. Reservations: Ruth Clark, 569-2012 by Oct. 26th.

ELECTROMAGNETIC COMPATIBILITY
OCT. 19

Story on page 17

THE DESIGN AND SELECTION OF GROUND CONDUCTORS, Chris M. Kendall, Mgr., Field Engineering Services, Genisco Technology Corp., Compton.

OCT. 19, Monday, 8:00 PM, Hewlett-Packard, Santa Clara, Stevens Creek Blvd., near Lawrence Exp. Dinner: 6:15 PM, Custom House Restaurant, 20060 Stevens Creek Blvd., Cupertino. Reservations: Ray Magnuson, 246-4300, ext. 2241 by Oct. 19th.

ENGINEERING MANAGEMENT
OCT. 14

Story on page 13

THE ENGINEER'S INCOMPETENCE IN PLANNING HIS OWN CAREER. Joseph A. Robinson, Joseph A. Robinson Associates, San Francisco.

OCT. 14, Wednesday, 8:00 PM, Rick's Swiss Chalet, 4085 El Camino Way, Palo Alto. Dinner: 6:30 PM. Reservations: Sue Mendell, 321-2300 ext. 3619 by Oct. 13th.

ENGINEERING IN MEDICINE & BIOLOGY
OCT. 13

Story on page 12

INTERRACTION OF THE AUTOMATED LABORATORY AND THE COMMUNITY HOSPITAL — TOUR AND DISCUSSION, Claude O. Burdick, M.D., Director of Laboratories, Valley Memorial Hospital, Livermore.

OCT. 13, Tuesday, 8:00 PM, Western Laboratories, 353-30th Ave., Oakland; dinner: 6:00 PM, Diamond Jim's, 245 W. MacArthur Blvd., Oakland. Reservations: (Restaurant) 653-5985 before 5:30 PM Oct. 13th.

CALENDAR

GOLDEN GATE SUBSECTION
OCT. 21

Story on page 6

TOUR OF BART'S MONTGOMERY STREET STATION. Meet at the corner of Market & Montgomery Sts., – at Crocker Plaza – at 6:00 PM. Ladies invited.

OCT. 21, Wednesday, 6:00 PM, Crocker Plaza. Cocktails and dinner will follow the tour, and will be held at the Engineers' Club, 160 Sansome St., San Francisco. Reservations must be made for both dinner and tour: J. A. Michelsen, 764-6378 or M. W. McLaren, 764-5456 by Oct. 19th.

INFORMATION THEORY
OCT. 15

Story on page 16

MATHEMATICAL MODELLING OF HEART RATE CONTROL, Dr. C. S. Weaver, Sr. Research Engineer, SRI/ Stanford University.

OCT. 15, Thursday, 8:30 PM, SRI Bldg. 1, 333 Ravenswood Ave., Menlo Park. Dinner: 6:00 PM, Ming's of Palo Alto, Embarcadero Road, East Palo Alto. Reservations: D. T. Magill, 326-6200, ext. 6162 by Oct. 14th.

MAGNETICS
OCT. 14

Story on page 10

SPINS, BUBBLES AND WAVES, Jan Smit, Professor at USC, Materials Science Dept.

OCT. 14, Wednesday, 8:30 PM, Ampex Cafeteria, 401 Broadway, Redwood City. Cocktails: 6:30 PM; dinner 7:00 PM, Dinah's Shack, 4269 El Camino, Palo Alto. Reservations: Iris Strassner, 367-3112 by Oct. 13th.

MICROWAVE THEORY & TECHNIQUES/ ELECTRON DEVICES
OCT. 5

MICROWAVE INTEGRATED CIRCUITS. Dr. Harold Sobol, Mgr., Microwave Microelectronics, RCA Components Div., Somerville, N.J. JOINT MEETING.

OCT. 5, Monday, 8:00 PM, Hewlett-Packard Co., 5301 Stevens Creek Blvd., Santa Clara. Dinner: 6:00 PM, Hojo, Intersection 280 and Stevens Creek Blvd. Reservations: Section Office, 327-6622 by Oct. 1st. (See September Grid for story).

PARTS, MATERIALS & PACKAGING
OCT. 20 and 27 and NOV. 3

Story on page 14

FIRST THREE OF SIX SESSIONS. SESSION 1: Oct. 20: GENERAL TERMINOLOGY AND FUNDAMENTALS OF THE PHYSICS OF PACKAGING, (speaker to be announced). SESSION 2: Oct. 27: RELIABILITY STANDARDS AND STATISTICS, C. E. Leake, Asst. Mgr., S.S.D. Reliability and Safety, LMSC. SESSION 3: Nov. 3: BIPOLAR AND MOS FAILURE MECHANISMS, Dr. Don McWilliams, Research Director, Calif. State College, Los Angeles.

OCT. 20 and 27 and NOV. 3, Tuesdays, 7:30 PM, Varian Associates Research Lecture Hall (Bldg. 8), 611 Hansen Way, Palo Alto. See story for registration form and details.

POWER
OCT. 13

Story on page 17

A NEW AND UNIQUE CONCEPT IN UNDERGROUND DISTRIBUTION SYSTEM DESIGN. C. D. McAtee and P. L. Capra, PG&E distribution Engineering Dept.

OCT. 13, Tuesday, 7:30 PM, Engineers Club of S.F., 160 Sansome St., San Francisco. Cocktails, 5:30; dinner, 6:30. Reservations: Engineers Club, 421-3184 by Oct. 13th.

RELIABILITY
OCT. 8

Story on page 10

SYSTEM RELIABILITY ANALYSIS USING THE FLOW GRAPH. K. E. Farrier, Research Asst., Portland State University.

OCT. 8, Thursday, 8:00 PM, Stanford Physics Lecture Hall, PH 104, Stanford University. Happy hour at 6:00 PM. Dinner: 6:30 PM, Stanford View Restaurant, 1921 El Camino, Palo Alto. Reservations: Phil Guillot, 742-7026 or Chuck Leake, 742-0824 by Oct. 7th.

SYSTEMS SCIENCE & CYBERNETICS
OCT. 19

Story on page 18

PRIVACY IN A COMPUTERIZED WORLD. Arthur A. Bushkin, Computer Consultant.

OCT. 19, Monday, 8:00 PM, Physics Lecture Hall, PH 104, Lomita Mall of Serra St., Stanford University. Dinner: 6:00 PM, Coach 'N Six, 1906 El Camino, Menlo Park. Reservations: Section office, 327-6622 by noon, Oct. 16th.

VEHICULAR TECHNOLOGY
OCT. 19

Story on page 12

MOBILE DIGITAL COMMUNICATIONS. Ronald Adams, Sylvania

OCT. 19, Monday, 8:00 PM, International Inn, South San Francisco Airport Blvd. Cocktails: 6:00 PM, Dinner: 7:00 PM, Internation Inn, $4.50 per person. Reservations: Section Office, 327–6622 by noon, Oct. 19th.

ULTRASONICS SYMPOSIUM will be held Oct. 21, 1970 at 9:00 AM at the Jack Tar Hotel. For details contact Dr. Alfred J. Bahr, SRI, 333 Ravenswood Ave., Menlo Park, 326-6200, ext. 4631. Also, see story on page 9.

RJP...

. . . offering a personnel consulting service dedicated towards augmenting the success of young, technically oriented San Francisco Peninsula growth firms.

Executive Search

Identifying technical, managerial and executive talent. Many ground floor opportunities offering stock options and a chance to contribute to state-of-the-art development.

Search West

A service of RJP providing a communication program to keep professional talent apprised of opportunities with Bay area clients. Our monthly bulletin is sent free upon request.

Enhance your career and financial objectives. Confide your interests. We are employer retained.

RJP & Associates
505 W. Olive, Suite 165
Sunnyvale, Calif. 94086
(408) 739-0700

Economics of multiplexing

time division vs frequency division multiplexing: a basic explanation of each and a cost comparison

The purpose of this paper is to discuss the two common methods of multiplexing used for industrial remote control and telemetering, and to develop the criteria for their application. Multiplexing is simply the simultaneous transmission of multiple messages over a single communication link. It is employed solely for the purpose of minimizing the cost of the communication system.

The Communication System

Let us examine a communication system used for transmitting binary (two-state) control or status information to and from remote unattended industrial installations and a central control center. The simplest of all systems, one way transmission of one message, (Figure 1a) does not require multiplexing. Instead, the communications link is a direct connection between the remote and central points. The only cost is that of the link.

Suppose we add the requirement for transmission of another message (Figure 1b). We must either procure another communications link, or adopt a form of multiplexing. Multiplexing requires the use of electronic equipment at both ends of the link. *It is economically feasible if the cost of the multiplexing equipment is less than the projected cost of additional communication links.*

Nature of Communications Link

A great variety of communications links are available for transmitting control and telemetering information. They must be classified in two major groups: DC circuits and AC circuits.

A DC circuit may be thought of as a direct loop. When voltage is supplied by a battery, current flows through the loop. Information is transferred by opening and closing the loop and thus causing current to flow or not to flow. The opening and closing (or sending) and sensing (or receiving) are done with relays.

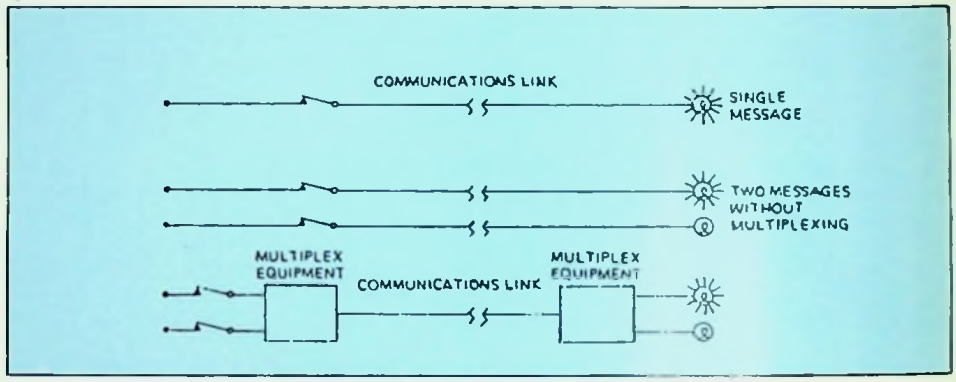


Figure 1

Three general types of DC circuits are available: The DC telemetering circuit, the low speed teletype circuit and the highspeed teletype circuit. From the user's point of view these are differentiated primarily by cost and the date transfer speed which they permit. Figure 2 compares the various data rates and costs using different links and transmission methods. An AC circuit is essentially a pair of wires capable of passing signals containing a specified spectrum of frequencies. For industrial telemetering and control use, the only AC circuit is the voice grade circuit. This is equivalent to the standard telephone line, and is capable of passing those frequencies contained in human speech in which most of the voice energy is concentrated. It is often defined as having a passband of 300-3000 Hz but, depending upon the quality of the circuit, is usually about 300-2800 Hz. Different date rates may be accomplished using the circuit, depending upon the type of transmission equipment used and the portion of the circuit employed. Figure represents the maximum under the best case conditions.

There are many methods of providing these circuits. While a direct metallic wire circuit is sometimes used, the vast majority of circuits are non-metallic and are created by equipment such as telephone carrier, UHF or VHF radio or microwave.

Frequency Division Multiplex

Frequency Division Multiplexing (FDM) is the technique of dividing a voice circuit passband into a number of frequency bands or channels. Each channel can then be used for simultaneously transmitting separate information either in the same or opposite direction. These channels are analogous to the traffic lanes on a highway. Each is capable of transferring simultaneously and each uses a specific assigned portion of the total available bandwidth (or highway). Thus each channel uses a part of the circuit all of the time.

Standard channel allocations have been established for dividing the voice circuit. International standards call for

Figure 2

Type of Circuit	Group	Maximum Transmission Rate (bps)	Typical* Circuit Cost($/Mi./Mo.)
DC Telemetering	DC	30	0.75
Low Speed Teletype	DC	60/80	2.25
High Speed Teletype	DC	110	2.48
Voice Grade Schedule 4	AC	2400/4800	3.65

*California Intrastate Rates

spacings of 120 Hz and 170 Hz. Thus 115-22 channels are available depending upon the spacing used and the quality of the communications link.

Transmission of information is achieved by the use of audio frequency tone transmitters and receivers. The transmitter sends a signal within their channel either by (AM) amplitude modulation or (FM) frequency modulation (Figure 3). The receiver is equipped with a filter which allows it to accept only the signal whose frequencies are within its channels.

Time Division Multiplex

Time Division Multiplexing (TDM) involves parallel to serial conversion—taking information from a group of conditions which exist simultaneously and transmitting the status of each condition in sequence. The transmission, in the form of a digital code, is often sent over one of the audio channels mentioned above. At the receiving end, the serial code is converted back to the parallel state, and the status of the original conditions is represented by relays, lamps or electronic voltage level outputs.

The remote conditions share the use of the channel by taking turns transmitting their information. They divide sequentially among them the channel time —hence, the name *Time Division Multiplex*. Transmission takes place in a fixed sequence and synchronizing elements are added to the code to maintain the sequence.

Time division multiplexing requires a parallel to serial converter or encoder at the transmitting end of the channel and a serial to parallel converter or decoder at the receiving end. In addition, transmission equipment such as audio frequency tone equipment (above) or line relay transmitters and receivers must be furnished.

Application Considerations

There are several important application factors to consider when choosing a multiplex method. In general, cost will be the primary factor. However, performance in each of the following characteristics must be adequate in reference to system requirements.

Security

Message security requires the ability to transfer information from one end of the link to the other without distortion or change. This is accomplished chiefly by rejecting, at the receiving end, data found to be erroneous.

Practical TDM Systems are more secure than FDM Systems, because they employ some sort of fixed code format and perform checks at the receiving end to insure that the received code conforms to the format. TDM security is affected substantially by the choice of a specific code format, and by the number and types of checks performed upon the code.

FDM is much more susceptible to noise bursts on the communication link. Because there is no format to the message which the receiver expects to see, it has no way of recognizing a false output. Time delay relays can be used to reduce false outputs. The relay is connected to the output of the audio tone receiver and requires the presence of a signal for a predetermined period of time before it operates. This helps to eliminate false operation caused by short noise spikes, but does not achieve the security obtainable by using TDM.

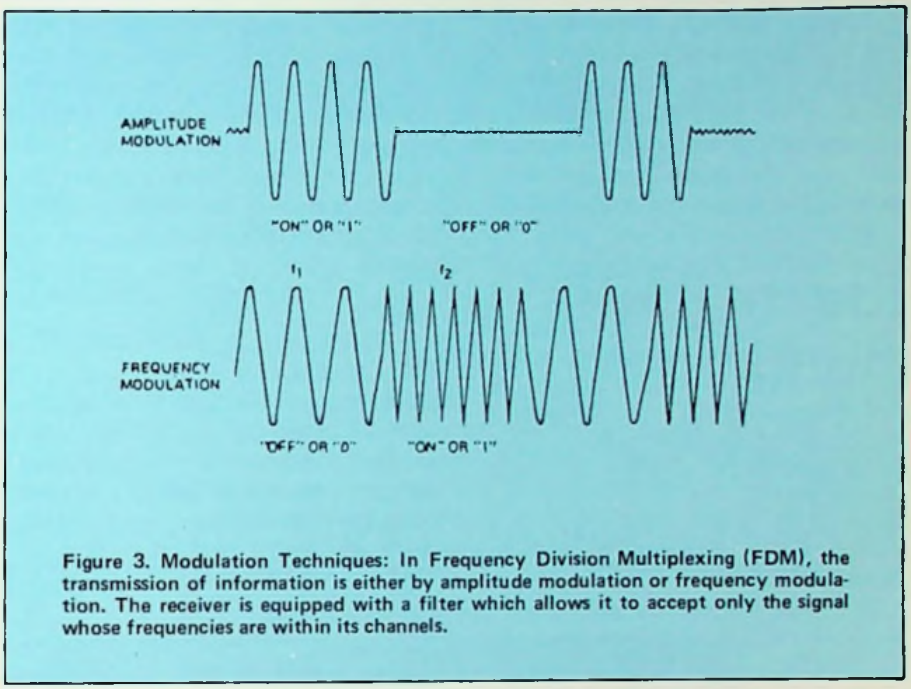


Figure 3. Modulation Techniques: In Frequency Division Multiplexing (FDM), the transmission of information is either by amplitude modulation or frequency modulation. The receiver is equipped with a filter which allows it to accept only the signal whose frequencies are within its channels.

Speed

FDM Tone Transmitters provide rapid response. The transmitter and receiver are directly connected at all times. The only delay between input change and output recognition involves signal processing time and line delay. A typical response time using a narrow band channel is about one tenth of a second.

TDM response is somewhat lower. Each input must "wait its turn" until it can report its status. Depending on the number of points and the method of transmission the delay may be from 25 milliseconds to several seconds. Response can be substantially improved by using high-speed transmission equipment.

A key consideration in selecting a mode of multiplexing is the system's potential expansion requirements.

The next point added to FDM system requires another transmitter and receiver, and another portion of available bandwidth. The next point added to a TDM System at a present location requires nothing until the initial capacity of the coding equipment is reached. Most TDM equipment is designed so that further expansion requires only the addition of a plug-in module. No additional bandwidth is required.

When using Either TDM or FDM, one must consider the cost and availability of the communication link, whether a DC telemetering circuit or a microwave channel. This item of cost is almost always substantial.

TDM can be performed over a DC telemetering circuit (0-30) bps) the cheapest of all communication links, or low and high speed teletype circuits (80-160 bps respectively), as well as over all voice grade links. FDM can be utilized only over voice grade circuits because of the passband requirements. TDM's greater flexibility can save considerable operation expense if the lower speed can be tolerated. A typical DC telemeter circuit generally can be leased for about 75 cents per mile per month, while a typical voice circuit is about $3.65 per mile per month. For a 20-mile link, the yearly difference in cost would be $696.00. The above rates vary widely in different parts of the country, but will serve as a general guideline.

Comparative Equipment Cost

Usually the primary factor in choosing any system component is cost. Multiplexing equipment is no exception. Occasionally system requirements will override cost. The proposed multiplexing mode must perform adequately with reference to the above application considerations. However, within this framework, economies play a major part in dictating specific system designs.

Moore Systems Div., The Rucker Co.

ATC mathematical model developed

The Automatic Control Group will sponsor a talk by Dr. Robert Ratner on Tuesday, October 20th at Lockheed Auditorium. This talk, "Assessing The Capacity of a Large Multifunctional System – The Air Traffic Control Process," is a "case study" account of a mathematical modeling effort directed to developing capacity evaluation techniques for air traffic control systems. The work is still in progress, and the object of the talk is to describe the approach taken, the problems encountered, and the model concepts developed, rather than final computational results.

The Air Traffic Control Process operating in the U.S. is a large one in the sense that any credible model of its complete function must have tens of thousands of state variables, or equivalently, degrees of freedom. It is a multifunctional process in the sense that its component subprocesses have different and often conflicting goals and constraints. For example, one part of the process works to keep aircraft far apart, for safety and control flexibility, while another part strives to group them closely and precisely for efficient traffic flow.

We have developed the basis of a method of simulating the capacity-limiting behavior of a large and geographically extensive ATC system under heavy load.

Whereas other simulation techniques are computationally infeasible for such a large problem, by use of a two-level hierarchy of models we can conveniently analyze in a rough way the capacity-limiting behavior of the whole system, and "zoom" in on selected geographical areas for more detailed evaluation where the whole-system analysis indicates a potential capacity constraint. Alternatively, the local-area models can be used by themselves for capacity analysis of a selected part of a system.

The simulation is a system of evaluation methods, each with a different mathematical basis, and each designed to measure a different class of capacity limitation.

The talk characterizes the ATC process and the measures and limitations that suitably define capacity. With this basis, the way in which the characterization has led to a system concept of evaluation models is described.

Dr. Ratner

Robert Ratner received his Ph.D. in Electrical Engineering at Stanford University in 1968. Since then he has been a research engineer with the Stanford Research Institute, where he has been responsible for work in air traffic control system analysis and evaluation, as well as for applications of control, estimation, and optimization techniques. His experience in aviation includes work in flight instrumentation integration, area navigation airways structure design, and participation in a technical session of the most recent National Air Meeting of the Institution of Navigation. Dr. Ratner is a member of the IEEE, Sigma Xi, and the Institute of Navigation.

There will be a dinner at Rick's Swiss Chalet preceding the talk, see Calendar for reservations and details.

Tour of BART's montgomery street station

The Bay Area Rapid Transit District will host a tour for the Golden Gate Subsection of their Montgomery Street Station for members and guests on October 21, 1970. The Assistant Manager of the Market Street area office, Mr. William Maher of PBTB will meet the group at the Crocker Plaza entrance to the station located at the corners of Market, Montgomery and Post Streets at 6:00 p.m., October 21, 1970.

The tour will take approximately one hour. Hard hats and handouts will be provided and low-heeled shoes for the ladies are suggested. Following the tour of the BART facilities, the evening meeting will continue with cocktails and dinner at the Engineers Club, corner of Sansome and Pine.

For safety and control reasons, it will be necessary that the number of members and guests able to take this tour be limited. Please make reservations by October 19. Call J. A. Michelsen, 764-6378, or M. W. McLaren, 764-6464.

A special plaza and entrance to the Bay Area Rapid Transit District's Montgomery Street Station has been designed for the Crocker Building in San Francisco. This artist's rendering shows the sunken plaza entrance with walkways leading to the Crocker Building, a restaurant and the BART facility.

A & P chapter features four speakers

The October 21st meeting of the Antennas and Propagation Group will feature speakers from four different Bay Area Organizations.

Mr. Sam Kuo of Sylvania Electric Products, Mountain View, will discuss a new approach to reducing the size of log-periodic dipole arrays. Mr. Kuo received his BA in Economics from Soochow University in Taiwan, and his BS and MS degrees from the University of Illinois. Prior to joining Sylvania he was employed by Granger Associates in Palo Alto and Texas Instruments in Dallas.

Dr. E. K. Miller of MB Associates, San Ramon, will present a paper entitled "Antenna Arrays over Lossy Ground." An antenna operated in proximity to a lossy ground may experience significant modification of its free-space properties due to the ground reflected fields. A rigorous analysis of this problem may be taken via the Sommerfeld integrals, which are for the general case unfortunately expensive to compute. As an alternative to the Sommerfeld integrals, the utility and accuracy of using an approximate quasi-image derived from plane-wave reflection coefficients will be demonstrated.

Dr. Miller attended the Michigan Technological University and the University of Michigan where he received his Ph.D. (EE) in 1965. After 2½ years with the University of Michigan High Altitude Laboratory he joined MB Associates, where his activities involve the development and application of computer-oriented solution techniques to problems in EM, acoustics, and related areas.

Mr. Gary Schennum of Philco-Ford, Palo Alto, will discuss "Frequency Selective Surfaces." The need in microwave tracking and radar systems for antennas with a dual-frequency capability has necessitated the development of Frequency Selective Surfaces (FSS). An FSS reflector is an array of passive resonant elements, such as crossed dipoles, which will ideally behave as a solid metal reflective surface over its resonant frequency band but allow RF energy to pass through at other frequencies.

One application of such a surface is as a Cassegrain subreflector in a large parabolic antenna. The surface is made resonant or reflective in the normal Cassegrain mode. It is, however, essentially transparent to radiation at another frequency radiated from the prime focus.

Sam Kuo

Dr. E. K. Miller

Gary Schennum

The presentation is concerned with the design of such FSS subreflectors for high-power radar and communication operations.

Mr. Schennum received his BS and MS degrees from the University of Illinois in 1967 and 1968, respectively. Since that time he has been with Philco-Ford where he has been engaged in development of satellite and ground antennas. He is a member of Tau Beta Pi.

The final paper will be presented by Dr. Alan T. Waterman, Jr. of Stanford University. His talk is titled, "Line of Sight Measurements at 34.89 GHz using Two Spaced Transmitters and an 8-Element Receiving Array."

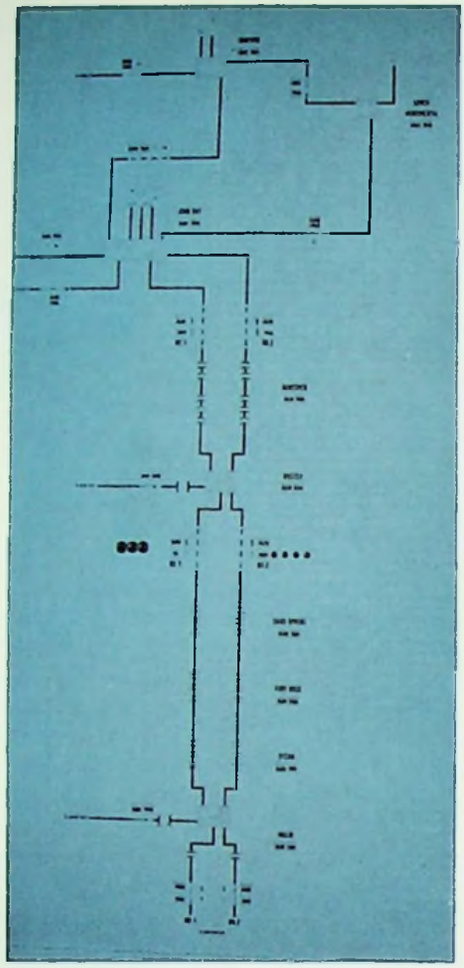
The meeting will be held at the Lockheed Research Laboratories Auditorium in Bldg. 202, at 3251 Hanover St., Palo Alto, at 8 P.M. Wednesday, October 21. Meet the Speakers Dinner at Rick's Swiss Chalet, 4085 El Camino Way, Palo Alto. Cocktail Hour 5:30, Dinner 6:15 P.M. No reservations required.

Mosaics in display systems–new approach

The requirement for visual representation of information has existed throughout various industries for decades and intensified with the advent of automated equipment. Status boards, large or small, mechanically activated or computerized assist operators in their task of supervising for instance, the operation of a communications center, refinery, utility, railroad, airport etc. The ultimate display system would be one that would lend itself to numerous custom-made applications and offer the user flexibility for modifications and/or expansions, aesthetic appearance, and competitive pricing. Such a system, having no overall size limitations, has been developed on the mosaic concept.

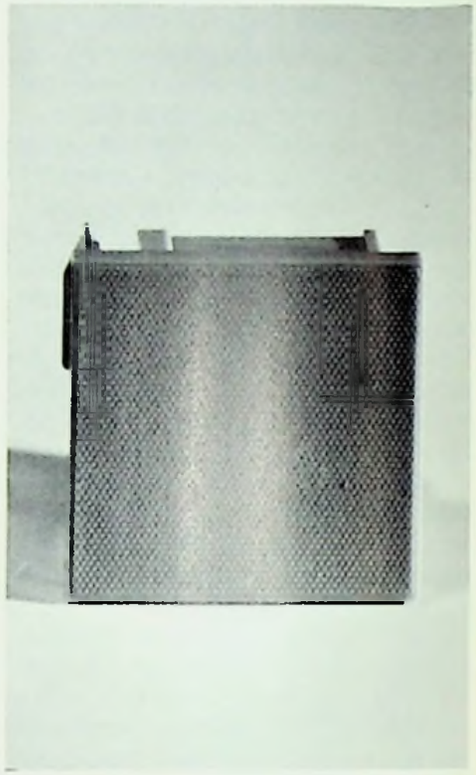
The basic components consist of one-inch-square plastic tiles which mount into a rigid steel cross-bar grid. The tile surfaces have been designed so as to diffuse reflected light and sound waves, eliminating glare and sound spots. The tiles may be either silk-screened or engraved and painted with symbols appropriate for the particular application. They may also be transparent or fitted with light transmitting symbols illuminated from the rear.

To further facilitate modifications and extensions to existing display systems without the need of costly tradesmen all lampholders are prewired with 7-ft. cables terminated by a plug. These are then easily corrected to terminal blocks conveniently located for accessibility. The lampholders, housing one to four lamps, are inserted into transparent symbol tiles from the rear.

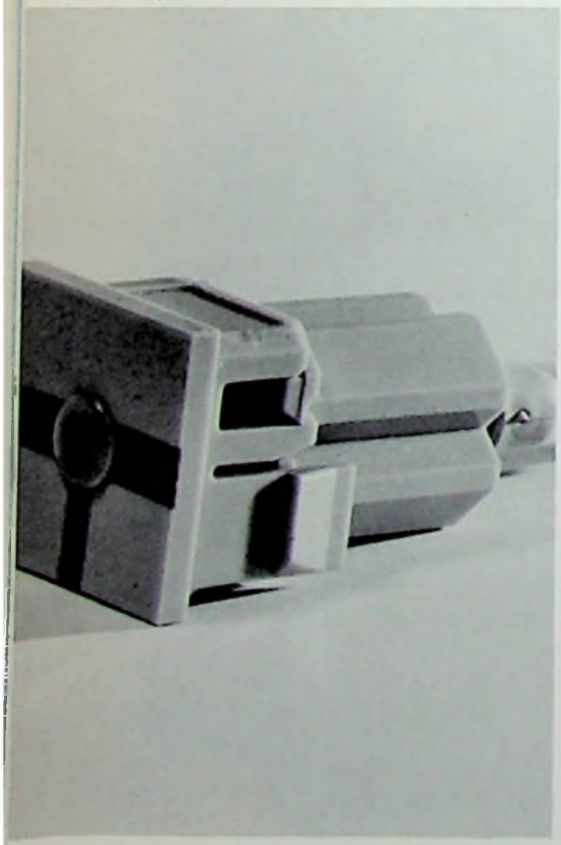


Dynamic Display Board indicates power flow, switching, alarms, etc., against a detailed system diagram.

Close-up view of basic plain tile.



Close-up view of silk-screened lens tile with lampholder.



A mosaic display for a West Coast Utility is shown. Since the utility is expanding at an average rate of approx. 9 per cent per year the display must expand likewise. Addition of a substation involves merely the removal of plain tiles and replacement with those having the appropriate silk-screened symbols.

A firm in California has awarded a contract to a mosaic display manufacturer for a communications display system. This system will monitor cable and satellite transmissions in the Pacific Ocean area. The display board is 10 x 22 ft., curved at a radius of 34 ft., with two full-color maps, one showing satellites to ground station routes, the other transpacific cable routes. The communications network is monitored by a computer which controls the display board.

Mosaic display systems offer many significant advantages over the conventional types and have already been adopted by major industries nationwide. As the demand for systems offering flexibility and long-term cost savings increases the mosaic types will become increasingly attractive.

by Gerhard Herbst
of Siemens Corporation, Burlingame, Cal.

Spectra-Mat increases staff

Noted microwave tube designer, Mr. George Washburn, will head the Research and Development functions, it was announced here today by Mr. Leo J. Cronin, President.

Mr. Washburn recently headed the Traveling Wave Tube Development for the Stewart Division of Watkins-Johnson Co. Prior to that position, he was in design, research, development, prototype, production and customer applications. After obtaining a BSEE from Clarkson College in New York he spent 15 years with the Westinghouse Electronic Tube Division, Elmira, New York, in various phases of microwave tubes.

IE & CI names Chope

R. E. Chope, Chairman of the Group on Industrial Electronics & Control Instrumentation was not pictured in the Directory of the September Issue of the GRID.

Abraham Armoni, Vice-Chairman of the newly-reactivated Group on Industrial Electronics & Control Instrumentation.

1970 IEEE ultrasonics symposium

Medical ultrasonics, surface waves, acousto-optics and ultrasonic testing will be the featured topics of the more than 1120 papers already accepted for presentation at the three-day 1970 IEEE Ultrasonics Symposium, which opens 9:00 a.m., October 21, 1970, at the Jack Tar Hotel, San Francisco. Of special interest will be a series of invited tutorial papers on surface waves, industrial applications and physical acoustics. At a Wednesday evening session, thin film, photolithography, and other technology for constructing acoustic devices will be discussed.

The Symposium, the first of which was held at Stanford University in 1959, is arranged by the IEEE Group on Sonics and Ultrasonics. Registration, starting Tuesday evening, is $20.00 for IEEE members, $25.00 for non-members. For a single day the fee is $15.00; students are $5.00. A cocktail party for full-time registrants will be held on Thursday after conclusion of the technical sessions.

For further details, contact Dr. Alfred J. Bahr, Stanford Research Institute, (415) 326-6200, Ext. 4631.

IMMEDIATELY AVAILABLE

NEW

HIGH POWER

dc Series Voltage Regulators

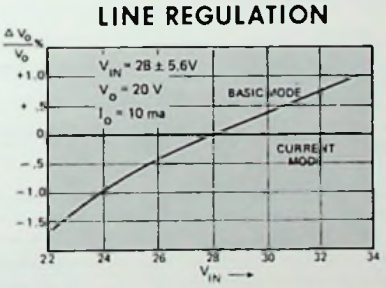
TO-3
(8 LEAD)

Solitron has expanded its high power dc voltage regulator line with three circuits each for positive (+) and negative (—) applications. The HCCA 103 (+) and 104 (—) have current limiter; the HCAA 105 (+) and 106 (—) provide current limiter with a FET constant current source; the HCAA 100 (+) and 102 (—) are the same circuits without limiting and internal current source.

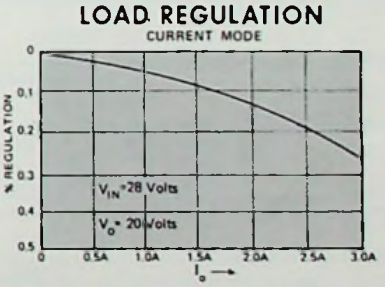
The regulators offer a wide variety of applications from distributed power systems to D.C. motor supplies. Features include:

- Regulation of .5% max., .05% typical, no load to 1.0 Amp
- Temperature coefficient less than .005%/°C
- Line Regulation: Output voltage variations less than .001% @1.0 Amp, ± 20% input voltage
- 40 Watts dissipation with heat sink
- Hermetically sealed low profile case (.240 max. ht.) for high density packaging

LINE REGULATION



LOAD REGULATION



Dial 1-800-327-3243 for a "No Charge" telephone call and further information.

Solitron DEVICES, INC.

1177 BLUE HERON BLVD. / RIVIERA BEACH, FLORIDA

(305) 848-4311 / TWX: (510) 952-6676

Second of series for CACD

The second of the series "Computer Aided Circuit Design" (CACD) is to familiarize the practicing electronics engineer with the state-of-the-art circuit design techniques and some of the commercially available computer design routines. The topics to be covered include: topological techniques, dc analysis, linear frequency domain analysis, nonlinear circuit analysis, transient analysis, s-plane analysis, stability, two-port techniques, microwave circuits, scattering parameter applications, computer graphics, and computer search routines.

Lecturers for the seminar are: Dr. Shu-Park Chan, Chairman, Department of Electrical Engineering, University of Santa Clara, Edward T. Johnson, CACD Project Leader, IBM Systems Development Division Laboratory, Les Besser, Project Manager, Fairchild Microwave and Optoelectronics Division, Dr. Swanko Fazarinc, Development Engineer, Hewlett Packard Laboratories, and Robert Hall, President, Dean Hall Associates.

The last part of the seminar will be a practical design session using an IBM 360/67 time shared computer through interactive terminals. Various circuit types will be analyzed and optimized. Attendees are encouraged to supply design problems in advance (check box provided on registration form). Depending on the length of time available, some of their circuits may actually be discussed and optimized.

The seminar will be held on Saturday, November 14, 1970, at the main auditorium of Stanford Linear Accelerator (SLAC), 2575 Sand Hill Road, Menlo Palo. Time is 9 a.m. to 4:30 p.m. The fee for the course is $10.00 for IEEE regular members, $5.00 for student members and $20.00 for non-members. The fee also includes the lecture notes to be handed out and A HOT LUNCH SERVED AT SLAC. The enrollment for this course is limited. Therefore, persons interested in taking this course are urged to enroll early by completing and mailing the registration form below.

Deadline for the registration is November 1. For additional information write Les Besser, Fairchild Microwave and Optoelectronics, 2513 Charleston Road, Mountain View, California 95111, or phone (415) 962-2872.

REGISTRATION FORM

(Should be mailed before November 1, 1970)

Mail to: Mr. Dale Nielsen
c/o IEEE San Francisco Section Office
Suite 2210, 701 Welch Road
Palo Alto, California 94304

Enclosed is check (payable to San Francisco Circuit Theory Group) in the amount of $..... to cover the enrollment fee.

Name: .....
(please print full name)

Home Address: .....
(Street)

.....
(City and State) (Zip)

Business Address: .....
(Street)

.....
(City and State) (Zip)

Position or Title: .....

Business Phone: .....

IEEE Affiliation (Check One) [ ] Member; [ ] Student Member;
[ ] Non-Member

IEEE Membership No. .....

I HAVE A CIRCUIT PROBLEM THAT I WOULD LIKE TO HAVE OPTIMIZED AT THE SEMINAR [ ]

System reliability uses 'flow graph'

The Reliability Group opens its Fall Meeting Series with Kenneth Farrier's presentation of "System Reliability Analysis Using the Flow Graph" on Thursday, October 8th. The 8 p.m. meeting will be held at the Stanford Physics Lecture Hall (PH104), and will be preceded by a 6:30 dinner at the Stanford View Restaurant.

Mr. Farrier will outline the methodology whereby the problem of calculating the reliability of a complex system of interacting elements can be reduced to comparison with a linear system. A precise definition can then be developed to specify the reliability of the linear system, a single path at a time, directly from the reliability flow graph of the system.

The models that are obtained by this analysis, such as the interactions between the elements of a computer system itself, can be programmed through a computer using the BASIC language.

Mr. Farrier received his BS degree in Applied Science from the Portland State University, Oregon, in 1968, and has recently completed the requirements for a Master's degree in Applied Science majoring in Electronic Systems Analysis at the same school.

At present, Mr. Farrier has been doing System consultation and is planning to rejoin the staff of PSU as a Research Assistant which would enable him to obtain his Doctorate in Systems Sciences.

See calendar for details and reservations.

Spins, bubbles and waves for magnetics

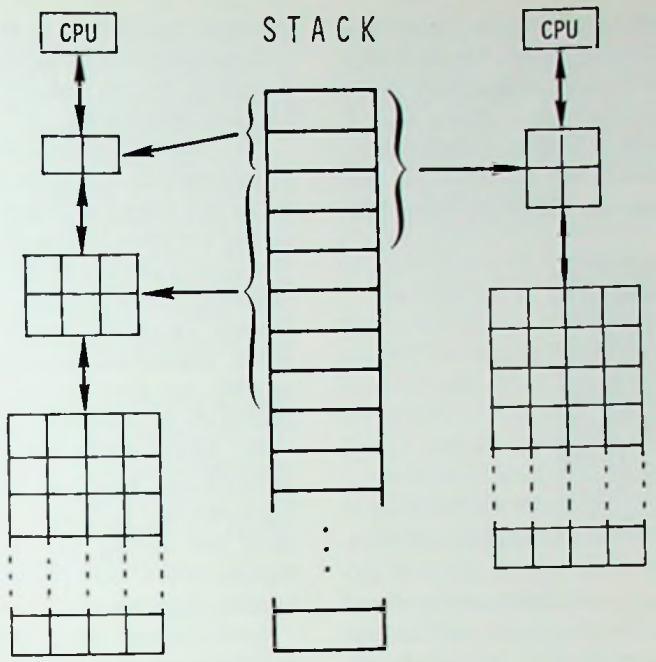
Professor Smit received his Ph.D. in Physics from the University of Leiden, Holland, in 1956. Before joining the faculty as a professor in the Materials Science Department of the University of Southern California, he was on the staff of the Phillips Research Laboratories in Eindhoven. Professor Smit has published widely on a variety of topics in magnetism. He is perhaps best known for his classic book "Ferrites" which he co-authored with H. P. J. Wijn. His talk will combine three topics of much current interest.

The Magnetics Chapter meeting will be preceded by cocktails at 6:30 and a 7:00 dinner at Dinah's Shack. The meeting itself will begin at 8:30 p.m. at the Ampex Cafeteria, 401. See calendar for reservations and details.

Storage hierarchies performance evaluated

Increasing speed and capacity demands on computer systems have resulted in corresponding demands on the memory and storage systems. Since it has been generally recognized that the speed and capacity requirements of storage systems cannot be fulfilled at an acceptable cost-performance level within any single technology, storage hierarchies that use a variety of technologies have been investigated. One of the key problems is how to manage the flow of information in the hierarchy. Either one leaves the hierarchy management to the user, or the hierarchy becomes transparent to the user and the system takes over the management. System management is preferred since it eases the programming burden, but it is the most difficult to implement since it requires knowledge of program behavior to efficiently allocate resources and move data.

Typical methods of automatic hierarchy management involve partitioning programs into segments or pages and adopting some technique for moving these blocks of information in the hierarchy. The design of efficient system management techniques generally involves the repeated running of "typical" programs through a simulated storage system while various hierarchy design parameters are adjusted. A new and efficient method of evaluating the performance of a large class of multi-level, demand-paged or segmented storage systems utilizing a variety of replacement algorithms and address mapping schemes has been developed by utilizing the properties of a class of management algorithms called stack algorithms. Commonly known replacement algorithms such as least recently used, least frequently used, random, and a non-realizable algorithm called MIN or optimal



A SINGLE STACK REPRESENTS BUFFER CONTENTS
FOR MANY HIERARCHY CONFIGURATIONS

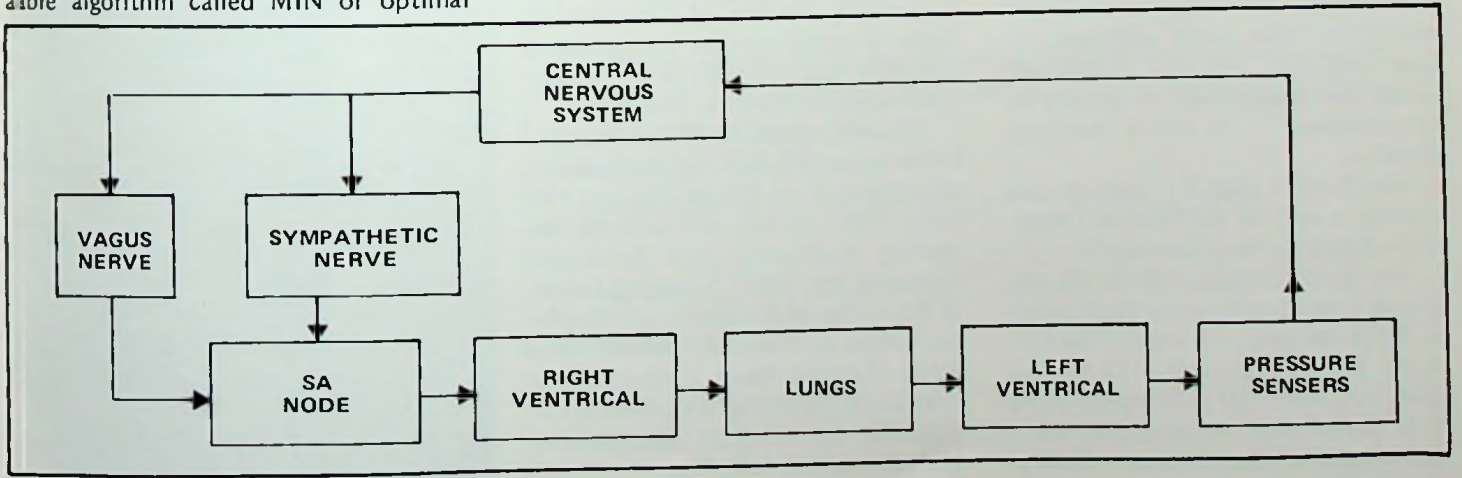
can be easily evaluated by this technique. This technique allows one to readily compare various approaches to the automatic management of storage hierarchies.

Dr. Richard L. Mattson is currently a research staff member at IBM San Jose where he is conducting research in storage system design. He received his Ph.D. in electrical engineering at Stanford in 1962. He was an Associate Professor of Electrical Engineering at Stanford University before joining IBM in 1965. He has conducted research projects in the areas of switching theory, logical design, communication theory, pattern recognition, and computer system modeling and analysis.

Dr. R. L. Mattson

The Computer Chapter meeting, scheduled for October 27, will begin at 8:00 p.m. in Skilling Auditorium, Stanford (near the Durand Building). The dinner preceding at 6:15 will be at Rick's Swiss Chalet. For dinner reservations contact Cathy Morton, 321-3300, ext. 258, by October 26.

Block diagram of The Heart Rate Control Loop



Mobile digital communications reviewed

The Group on Vehicular Technology will sponsor a talk by Mr. Ronald Adams on "Mobile Digital Communications" on Monday, October 19. A dinner at 7:00 with cocktails at 6:00 at the International Inn in South San Francisco will precede the meeting which is scheduled for 8:00.

Ronald Adams

Since 1968 Mr. Adams has been heavily involved in the development of Sylvania's computer-assisted command and control system for police and fire services. As part of this program he developed the BEATFINDER computer program to assist police departments in rapidly processing incoming complaints and dispatching investigating officers more quickly and effectively. He was the principal contributor to studies of the communications-dispatching-field force systems in the San Jose and San Francisco police departments.

Mr. Adams managed the Sylvania/digicom project—a program implemented in the San Francisco Police Department to test the effectiveness of digital communications devices in police cars. Significantly, the system has reduced radio channel congestion, relieved overburdened dispatchers, provided increased security for field personnel, and increased the recovery rate on stolen autos.

Mr. Adams will be reviewing the Sylvania/digicom system presently operating in the San Francisco Police Department and discuss the new Sylvania/digicom 300 system presently available to police departments.

In the system, information is transferred from the patrol vehicle to central communications via the radio link. Briefly, the officer in the vehicle enters a digital message via a keyboard cathode ray tube terminal and transmits it as a tone coded burst over the voice channel to the base station. At the base station the digital information is decoded and entered into a "minicomputer." The minicomputer transfers the digital message to the dispatcher, central computer facility, or sends it via a telephone line to a remote computer facility. Digital information from the dispatcher is entered into the minicomputer via a keyboard which outputs it to the encoder for transmission to the patrol units. Information from other computer systems is transferred directly to the minicomputer for output to the field units.

The Sylvania/digicom 300 system significantly reduces the acute channel congestion being experienced by large and small police departments. Routine dispatcher operations associated with status changes, tow requests, and on-view investigations are completely automated. Manpower requirements are reduced, message turn-around time is decreased, and direct access from the patrol car to large data bases is possible.

See calendar for details and reservations for this meeting.

In-depth look and tour of clinical lab

E-MB members, guests and interested individuals are invited to attend a most interesting presentation and tour of a clinical laboratory at Western Laboratories in Oakland.

Dr. Claude O. Burdick will speak on "The Interraction of the Automated Laboratory and the Community Hospital." In his presentation, Dr. Burdick will discuss the practical limits of automation in a community hospital; describe the skills and training of medical technologists as related to electronic equipment, offer several approaches to cost reduction and will outline the needs and inadequacies of present instrumentation in the clinical laboratory situation.

Dr. Burdick and his associate will provide a tour of the Western Laboratories following his presentation.

Dr. Burdick received his BS and MD degree from the University of Wisconsin in 1958. He spent 11 years in the U.S. Army and holds the rank of Lt. Colonel (Res.). He was Chief of Pathology in the U.S. Army while in Japan and was a pathologist at Wm. Beaumont General

Dr. Claude Burdick

Hospital in El Paso, Texas. Dr. Burdick is presently Director of Laboratories, Valley Memorial Hospital in Livermore, California, and is employed by Western Laboratories in Oakland, California.

The meeting will be held at Western Laboratories, 353 30th Ave. in Oakland, promptly at 8:00 PM on Tuesday, October 13th. Dinner will precede the meeting at Diamond Jim's Restaurant located in the "MB"' Shopping Center at the corner of Broadway and MacArthur Blvd. in Oakland. (Across from Kaiser Hospital) Please confirm dinner reservations by calling the restaurant at 653-5985 before 5:00 PM October 13th. Dinner is at 6:00 PM.

Is the average engineer incompetent?

"Why are engineers who are supposed to be at the forefront of technology preparing new products and improving the old being laid off?"

This question is asked — and answered — in an article appearing in a recent Engineering Management Group Newsletter. The author, Editor Irwin Gray, contends that engineers and engineering managers are, in the main, incapable of determining the direction of their own careers. Some excerpts:

"The average engineer is incompetent in planning his own career, he is incompetent in acting as a good businessman in a business world, and he is incompetent in even learning how to become competent." "The average engineer who spends four grueling years in earning his degree spends less than a week in short, unconnected, non-integrated, incoherent thinking sessions about what he is going to do with that degree. He falls into his line of work largely by default."

Copies of the article will be available to attendees at the Engineering Management Group chapter meeting on October 14. Joseph A. Robinson of Joseph A. Robinson Associates, management

Joseph Robinson

consultants, will lead a discussion devoted to the problems of career planning for the engineer and possible solutions proposed by Mr. Gray. Come prepared to air your personal views, opinions, questions, and gripes.

Mr. Robinson is a consultant in management development and management communication. In addition to counseling individual and corporate clients, he designs and conducts workshops for general management and for professionals in organizational development and training. He received a BSEE and MBA from UC Berkeley and expects to complete work for the Ph.D. in Business Administration in 1971. He is a licensed Professional Engineer and a Member of IEEE and other organizations.

A dinner will precede the meeting at Rick's Swiss Chalet. Chef's special steak, $4.65, includes tax and tip. See calendar for details and reservation information.

Quality aspects of microelectronics

The PMP Group of the IEEE and the San Francisco and Santa Clara sections of ASQC are jointly sponsoring the coming course titled "Quality Aspects of Microelectronics." The sessions will be held each Tuesday evening at 7:30 starting October 20 and continuing for six weeks through November 24. Classes will be held at Varian Associates Research Lecture Hall (Bldg. 8), 611 Hansen Way, Palo Alto. There is a registration fee of $10 per person.

The course is designed for career engineers and engineering managers who are using or thinking of using microelectronic components in system applications and want to know more about the quality aspects of integrated circuits.

Session 1: October 20
Speaker to be announced

The first session will discuss general terminology and the fundamentals of the physics of packaging. The failure mechanisms of packages and package selection will be dealt with in detail. Thermal considerations will be reviewed.

Session 2: October 27
C. E. Leake, Assistant Manager SSD Reliability and Safety, Lockheed. Chairman Reliability Group, San Francisco Chapter of IEEE.

The second session will cover reliability standards and statistics. In sampling of life characteristics and screening of solid state devices, certain risks must be accepted that the test results will give an erroneous answer. It is to the mutual interest of buyer and seller to be able to access the extent of these risks.

Session 3: November 3
Dr. Don McWilliams, Research Director, Cal. State College, Los Angeles.

The third session will emphasize bipolar and MOS failure mechanisms. Bipolar and MOS processing and terminology will be presented. MOS device performance and reliability will be compared to that of bipolar devices. Finally the impact of Large Scale Integration (LSI) on reliability will be brought out.

Future sessions, to be discussed more fully in the November GRID, will be:

Session 4: November 10
Bill Littell, Supervising Engineer in charge of Thick Film Processing, Fairchild. Weldon Jackson, Hewlett Packard. Thick and Thin Film Reliability.

Session 5: November 17
Charlie Trimble, Engineering Section Manager, Hewlett Packard. L. G. Reis, Jr., Research Specialist for SSD Reliability and Safety, Lockheed. Reliability Testing.

Session 6: November 24
Dr. W. Cox, Hugle Industries

Potential Impact of the Beam Lead and Flip Chip Technologies on Packaging.

ADVANCED REGISTRATION FORM
Six Sessions Microelectronics Course

To: Jeff Schlageter, Secretary-Treasurer
PMP Microelectronics Course
Fairchild Semiconductor, M. D. 20-2811
464 Ellis Street
Mt. View, California 94040
(415) 962-3393

Please register me in the six-session microelectronics course starting October 20. Enclosed is my check for ..... Please make checks payable to PMP Chapter of IEEE.
Course Registration $10 each.
[ ] IEEE Member; [ ] PMP Member; [ ] ASQC Member; [ ] Other

Name: .....

Company and Address: .....

.....(Zip).....

Telephone: .....

PG&E protective relaying communications

"Communications for Protective Relaying on the PG&E System" will be the subject for the October 20th meeting for the Group on Communication Technology. At 6:00 p.m. there will be a "No Host" cocktails and dinner at Rick's Swiss Chalet, and at 8:00 at Stanford, PH101, the meeting will begin.

This meeting will be devoted to covering the communications system used by PG&E for protective relaying of their power distribution plant. The type of equipment used including facilities will be discussed by Mr. G. B. Gilcrest and Mr. D. G. Gregory of PG&E. The performance requirements and design considerations will be covered. The speakers will also point out the future requirements for the system. Also included will be some comments on the IEEE Guide for protective systems that was recently published.

Mr. Gregory served in the Army Signal Corps from 1951 to 1953. After his tour he attended U.C. Berkeley where he received his B.S. degree in Electrical Engineering in 1958. He joined PG&E after his graduation and has worked in the Company's Station Construction, System Protection Departments and the

D. G. Gregory

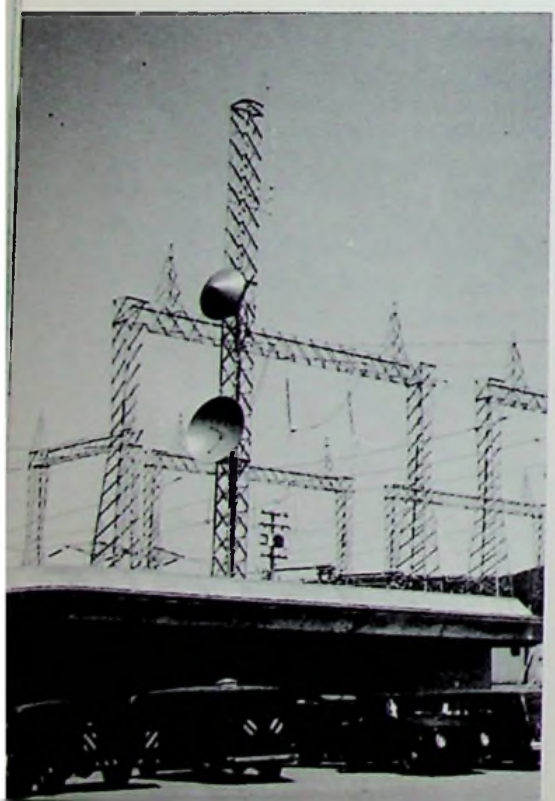
office of the Vice-President—Electric Operations. His present assignment is as a Senior Engineer in the Communications Department involved in the design of PG&E's private communication facilities. He is a member of IEEE and Registered Professional Engineer, State of California.

G. B. Gilcrest

Mr. Gilcrest is the Protection Engineer with PG&E. He graduated from U.C. Berkeley with a B.S. degree in Electrical Engineering. Prior to joining PG&E three years ago, he worked for General Electric for twenty-five years in San Francisco in their field service and application engineering. He is now in PG&E's System Protection Department. Mr. Gilcrest is a member of the IEEE and a Registered Professional Engineer in California.

See calendar for details and reservations.

Round Mountain Substation Control Building in foreground. 500 KV Bus Structure in background with microwave antenna tower in front which is part of the system to be discussed in the Com Tech meeting on October 20, 1970. Two systems are utilized here; one a 2GHz system and the other 6GHz.



NEW MEMBERS

The Section Welcomes These New Members:

R. F. Arnold
S. S. Demian
R. L. Knight
K. Nagai
M. L. Neubauer
J. W. Parker
P. M. Swenson

Sacramento hosts region 6 Conference

PLAN now and budget to attend the IEEE Region 6 Conference to be held in Sacramento May 11-13, 1971. The conference theme, "ENGINEERING FOR CONSERVATION OF MANKIND," should satisfy the interest of all Electrical Engineers in the Region 6 Area. Detailed information on location, program, etc., will appear in future releases.

Authors are requested to submit 500-word abstracts on any of the following: managing, marketing, and engineering; noise pollution standards, and measurement; computer hardware and software; computer applications and computer-aided designs; power generation; power systems; recent advances in solid-state circuits; electron and solid-state devices; space instrumentation systems; spinoffs from space technology; communications and microwaves; circuits, systems, controls, and telemetry; biomedical electronics.

These abstracts should be submitted by December 1, 1970 to: Dr. D. H. GILLOT, Program Co-Chairman, IEEE Region 6 Conference, Sacramento State College, Dept. of Electrical Engineering, 6000 Jay Street, Sacramento, Calif. 95819.

Plan to attend, — Mark your Calendar NOW!

AES tours UAL maintenance base

The group on Aerospace and Electronics Systems will feature a tour of the United Airlines Maintenance Center. Mr. William Hecht, Manager of the Maintenance Center, San Francisco Airport, will conduct the tour of this major airline center on Thursday, October 22 at 7:30 p.m. Preceding the tour, dinner will be hosted by United Airlines at 6:15 p.m., the charge will be $2.00.

At San Francisco, United Airlines has one of the largest maintenance centers in America. The engineering personnel have developed unique diagnostic and statistical approaches toward high maintenance cost effectiveness.

To reach the area, turn off Freeway 101 at the "Airport Shops" exit (1 mile north of the San Francisco Airport passenger terminal exit), proceed east for a quarter of a mile and enter the visitors parking area of United Airlines.

For dinner and tour reservations call Pat Hoppe, 326-4350, ext. 6143.

Why is modern control theory not widely used in process industries?

The term 'modern control theory' generally refers to those concepts and techniques that use the 'state-space' point of view. Towards the late 1950's, the notion of 'state' was found to be a very powerful tool for the analysis of control systems, and during the last decade there has been tremendous growth in this field. In reviewing the IEEE Transaction of Automatic Control, one finds that most of the papers are concerned with theoretical development of modern control concepts. There are very few application papers, and among these the largest share is concerned with applications in the aerospace industry. Only a small percentage, about 5%, describes industrial process applications. One obvious question is: 'Why is modern control theory not widely used in process industries?'; this article attempts to find some of the reasons.

(a) **Assumptions in Modern Control Theory.** Most of modern control is developed under the following two assumptions: (1) the model or the dynamical equation that describes the system is known and (2) the control objective is to either minimize or maximize a scalar cost function. These assumptions are frequently satisfied in aerospace applications. One simple example would be to find the optimal trajectory of a missile going from one point to another in minimum time, subject to some constraint on the maximum power available. The dynamical equations that govern the motion of the missile are known from aerodynamic studies. Occasionally if the model of the system under consideration is not known, a fair amount of resource and manpower can be committed by the aerospace industry to solve the problem.

In an industrial environment, the process is often so complex that accurate modelling seems to be hopeless. For example, in certain industries, like paper and cement, the fundamental physical and chemical reactions that occur in the process have not been fully understood since the products were made hundreds of years ago; yet engineers are able to design systems which produce good quality paper and cement. To build a reasonable model of an industrial process that is based on the physical and the chemical equations is extremely time consuming and often an expense the industry is not willing to pay for. Furthermore, such an approach often requires one to know certain difficult parameters in the process, e.g. radiation factor of the wall of a cement kiln, etc. Linear regression analysis of operating data has had some success, but the model is only accurate over a small region of operation. Those industrial processes that remain open to research with modern control techniques are generally highly non-linear and/or distributed parameter systems; otherwise, they could have been controlled by conventional control methods. In short, we are hung up at the very first assumption of modern control theory – a good model.

It is seldom that a control system for industrial processes can be designed based on a single criterion. Very often constraints are imposed by the physical size of the process variables, such as maximum amount of power in the manipulated variables. At other times, there are constraints set by the plant operation people who believe that certain process limits cannot be violated. Increase in yield in one section of the process may degrade the quality of the final output, or impose additional control problems on other parts of the plant. This means that the design of the entire control system is based on trade-offs. The emphasis in modern control theory is to obtain an exact optimal solution to the problem. Since there is little hope that a scalar criterion will satisfy a designer, he has to find the best solution by adjusting the parameters in the cost function, if he chooses to go through with modern control theory techniques. Sometimes he is justified in doing this, because there are fewer parameters to manipulate.

(b) **Limited number of people with modern control background working in the process industries.** Graduates from universities with higher degrees in control often either remain at the universities or join organizations which are not related to process industries. The application of modern control theory to industrial systems is still at its infancy, and well documented cases of success in terms of economical return are few. Because of this, process industries have not hired many people with modern control theory background to work on their control problems. On the other hand, new graduates with advanced degrees sometimes prefer to join organizations where they have large number of professionals of the same field. The plant locations of industrial processes are sometimes very remote from city areas, due to pollution or raw material supply problems, and this may discourage some people from joining the process industries. Consequently we have only a limited number of people with modern control background working in the field of process control.

(c) **Instrumentation.** The problem of instrumentation in process industries, such as drifts, break-downs, maintenance, etc. have long been nightmares to control engineers. Very often more programming effort has to be made to check the 'integrity' of data received from an instrument than to program the control calculations. There is little incentive to spend the manpower to apply advanced control technique to a system whose instrumentations are not capable of providing the expected accuracy and reliability. If nothing can be measured in a system, the control solution is very obvious—nothing can be done. If an instrument is available to measure the variable to be controlled, even indirectly, an interesting control problem can be formulated, such as a feed-forward control in this case. Instrumentation is part of the control system. Advances in instrumentation in the process industries certainly will promote more use of sophisticated modern control techniques.

We do not wish to imply that modern control theory cannot be or will not be applied to process industries. What is needed is more feedback from the process application areas to the theoretical control research area, so that certain stringent assumptions in modern control theory can be removed or modified to suit industrial applications. Instrumentation is a vital part of the control system. Improvements in instrumentation will promote the use of more advanced control concepts.

K. Y. Wong,
IBM Corp., San Jose, Calif.

Computer aided medical diagnosis

Dr. Joseph Terdiman

Innovations in medical care resulting from applied computer and engineering technology will be the subject of the October 26th meeting of the East Bay Subsection. The guest speaker will be Dr. Joseph Terdiman of the Medical Methods Research Department of Permanente Medical Group. Dr. Terdiman will review the "Multiphasic screening" program such as presently utilized in physical examinations conducted within the Kaiser Foundation Health Plan. This computer-aided diagnostic method was developed in 1963 and is only one of the programs to broaden the effectiveness of services to the approximate 1 million members and 10 hospitals in the Bay Area associated with the Health Plan. Other projects under study by the Medical Methods Research group include Medical Information Systems related to computerized patient records; automatic pharmaceutical records, and on-line information for use by doctors and nurses.

Dr. Terdiman graduated from Cornell University with a BS in Physics and following this he attended medical school and received his MD degree, then did graduate work at the University of Illinois in Neurophysiology, and is presently completing his doctoral thesis.

Meeting time will be October 26th at 7:30 PM at Diamond Jim's, Oakland. No-host cocktails will be at 5:45 and dinner will commence at 6:30. Please call Ruth Clark at 569-2012 for dinner and meeting reservations.

Heart rate control system

The group on Information Theory will present "The Mathematical Modelling of Heart Rate Control," a talk by Dr. C. S. Weaver, at their 8:30 p.m. meeting on Thursday, October 15 at SRI Building 1. A dinner at Ming's of Palo Alto will precede the talk at 6:00.

This talk presents a basic description of the heart rate control system. A mathematical model of the basic oscillation mechanism is developed. The significance of this oscillator in the heart rate control system is established. Finally, experimental and theoretical results on the phase-locking mechanism are presented. These results are of particular interest to information theorists who have long been involved with the theory and application of phase-lock loops.

Dr. Weaver is a Research Engineer in the Information Sciences Laboratory of the Stanford Electronics Laboratories, has an appointment as Research Associate in the Department of Anesthesia, at the Stanford Medical School, and is employed as a Senior Research Engineer at the Stanford Research Institute.

He attended the College of Idaho, from which he received a BA degree in mathematics in 1951. Continuing his studies, he received an MS degree in electrical engineering from the University of California in 1958, and the degree of Engineer and Ph.D. in electrical engineering from Stanford University in 1962 and 1965 respectively. In 1951 he went to work for the Philco Corporation as an engineer in their Research Department working on microwave receivers. From 1953 to 1956 he served as an Electronics Officer and Naval Gunfire Officer in the Navy. He returned to Philco in 1958 and in 1964 he joined the staff of the Stanford Electronics Laboratories. In 1969 he became a part-time member of the SRI Staff. At Stanford and SRI he has conducted research in the areas of pattern recognition, optical data processing, the processing and classification of electrocardiograms on digital computers, digital filtering, the application of pattern recognition to electronic warfare, the mathematical modeling of the cardiovascular system of a dog, blood flow instrumentation, and the computer monitoring of patients in the operating room.

Dr. C. S. Weaver

Dr. Weaver is a member of the IEEE and of Sigma Xi.

See calendar for details of this meeting, and reservations for dinner.

- 5 minutes from LOS ANGELES Int'l Airport
- 3 blocks to fabulous Forum
- 30 minutes to Disneyland
- 30 minutes to Marineland
- across from Hollywood Park
- full kitchens • completely furn.
- garage parking • heated pool
- daily, weekly, monthly rates

Park Hillcrest
APARTMENT MOTEL
919 SOUTH PRARIE AVENUE,
INGLEWOOD, CAL. 90301
TELE: (213) 674–1841

Distribution system undergrounding increases

Underground electric distribution has almoost completely taken over for new residcdential areas, a situation that was hard to fooresee a few short years ago. The fresh thinnking that is making it possible to go underground will be the subject of the firstt Power Group meeting October 13, 1970 at the San Francisco Engineers Clubb. The meeting starts at 7:30 p.m. with a cocktail hour at 5:30 and dinner at 6:300. Two speakers, Mr. C. D. McAtee and Mr. R. L. Capra from PG & E's Distribution Engineering Department will share the program.

The rate of distribution system undergrounding has mushroomed in the past few years. Since 1968, PG & E has committed $25,000,000 to convert overhead to underground. In addition, more than 95% of the new subdivisions are being supplied underground. As a result of the increased application and an extensive program to improve the economics of undergrounding, a new system has evolved. This system is based on the application of surface-operable equipment, designed to be installed in low-cost enclosures and operable by one man from the surface.

The speakers will point out how the distribution system has been designed to take advantage of this new equipment and how, through cooperative effort between manufacturers and utilities, the equipment has been designed to meet utility requirements. They will also emphasize the areas in which further development is necessary.

C. D. McAtee

Mr. McAtee is a member of the Department of Electric Distribution Engineering, Pacific Gas & Electric Company. He joined PG & E in 1951, shortly after receiving his B.S. degree in electrical engineering from the University of California. Prior to joining his present department, he was employed in the Company's North Bay Division.

R. L. Capra

Mr. Capra is a graduate of California State Polytechnic College and a member of IEEE. He joined PG & E in 1964. One of his major assignments has involved studies aimed at developing preferred designs for underground distribution systems. He recently completed General Electric Company's 30-week Power Systems Engineering Course in Schenectady, New York.

The design and selection of ground conductors

"The Design and Selection of Ground Conductors" will be the subject oof the October19th meeting of the Electromagnetic Compatibility Chapter. Mr. Chris Kendall, Manager of Field Engineers Services at Genisco Technology Corp. in Compton will discuss the theoretical and practical aspects of electrical bbond paths commonly used in ground sschemes. The theoretical portion of his ppresentation will describe mathematically the characteristic impedance of two ccommon electrical ground conductors, wwires and solid straps. Using these expressions, the effects of resonance on gground conductors and the effects of ddissimilar metals on ground connections wwill be evaluated in relation to the total iimpedance of a given ground path.

The practical presentation will include examples of common electrical gground schemes which are reviewed in rrelation to the theoretical discussions. This review results in the recommendation by Mr. Kendall of preferred steps to follow in designing and selecting ground conductors within a given ground scheme.

Chris Kendall received his BSEE in Physics from San Fernando Valley State College in 1962. He has had experience in many areas of EMI engineering beginning with the Sprague Electric Co. where he eventually became manager of their Los Angeles EMI testing labs. Later he held EMC engineering positions with Electronic Specialties in Glendale and with Litton Guidance and Central Systems in Woodland Hills. Besides bonding and grounding, Chris is especially interested in methods of transient analysis and recording and in the practical applications of Fourier Analysis and similar mathematical tools to EMI emission and susceptibility level predictions in general electronic equipment.

The 8 PM meeting will be held at Hewlett-Packard's Santa Clara Station, preceded by dinner at Custom House restaurant. See calendar for details.

tooling, machine, e/m, design in our facilities or yours

A job shop providing technical personnel.

Services Division of
General Devices, inc
1765 Scott Blvd., Santa Clara, Cal.
Tel: (408) 296-4052

Privacy in a computerized world

As the availability of large computerized data bases becomes more widespread in both government and industry, security of information and invasion of privacy are becoming of increasing concern to the public. In the October meeting of the Systems Science and Cybernetics group, Mr. Arthur Bushkin will discuss such questions as:

- How serious is the danger to our society posed by data banks?
- What legal efforts are being taken to combat these dangers?
- What technical efforts can be taken to maintain privacy of computer files?
- What are common pitfalls to avoid in system security?
- What are the advantages and disadvantages of today's privacy products?

Mr. Bushkin is a computer consultant, and has been a Senior Scientist at the Lockheed Research Laboratories, Palo Alto, during which time he worked with the Defense Science Board on problems of computer privacy. While still a graduate student at MIT, he served as consultant to the General Electric Computer Equipment Division, and in 1967 he was with the Advanced Research Products Agency, Office of the Secretary of Defense, where his interests included data management and multilevel security in on-line, multi-access computer systems. He later joined the staff of Bolt, Beranek and Newman, Cambridge, Massachusetts, where he participated in work on information systems, and privacy and security of information. He has also acted as consultant to various government agencies on these issues. In his present capacity, he conducts general and applied research in information retrieval, computers and privacy, and technology and policy.

Grid Special Issues

As announced in last month's Directory the Grid is offering its readers "Special Issues." This month we have three special editorial articles on pages 4, 8 and 15.

Next month the features will be a look at Computer Equipment and the field of Information Technology.

Each issue of the GRID this year, November through June, will feature one or more of the disciplines pertinent to local Group Chapters within electrical and electronic engineering. This new plan will encourage Chapters dealing with a particular field to delve into it more deeply in the GRID with stories on latest developments, significant changes, human aspects of the area, all of the facets that make each topic stimulating and relevant. We are very hopeful that this new approach will offer engineers and scientists an opportunity to enlarge their scope of interest.

GRID's concentrated readership includes engineers in 31 electrical/electronics related disciplines, many of whom are Senior Members or Fellows holding key assignments in Bay Area industry or research and development laboratories. In addition to these established professionals, GRID is also read by more than 1,000 members of IEEE student branches in colleges and universities in the Bay Area. Advertisers and companies dealing with products or services in each particular field will have an opportunity to take advantage of these "Special Issues" in their advertising plans, zeroing in on the heart of the important northern California electrical/electronics and management community.

ISSUE	DISCIPLINE	CONTRIBUTING CHAPTERS
November	Computer and Information Technology	Computer, IT
December	Power	Power, Magnetics, EMC
January	Communications, COORDINATE WITH: COMTEC Seminar	A&P, A&E, MTT, CT, COMTEC, IT, VT
February	Solid-State Devices and Circuits	PMP, Reliability
	Micro-Electronics	ED
March	Aerospace and Electronic Systems	A, ES
April	Medicine and Biology	EMB
May	Nuclear Science	NS
June	Systems Science and Cybernetics	SSC

Nerem expands tech program

The IEEE Northeast Electronics Research and Engineering Meeting (NEREM-'70), which will be held on November 4, 5, and 6 at the Sheraton-Boston Hotel and the John B. Hynes Civic Auditorium (formerly, the Boston War Memorial Auditorium) will feature an expanded technical program that emphasizes engineering and socio-economic problems as well as new developments in electronic systems and devices. For information about this important meeting, contact Mr. Val Laughner of Val Laughner Associates, Inc., 30 Boston Post Road, Wayland, Massachusetts 01778.

Classified Advertising

Dr. Floyd M. Gardner
Consulting Engineer

"TRACKING SYSTEMS"

18040 Calvert St., Reseda, Calif. 91335
(213) 881-1193

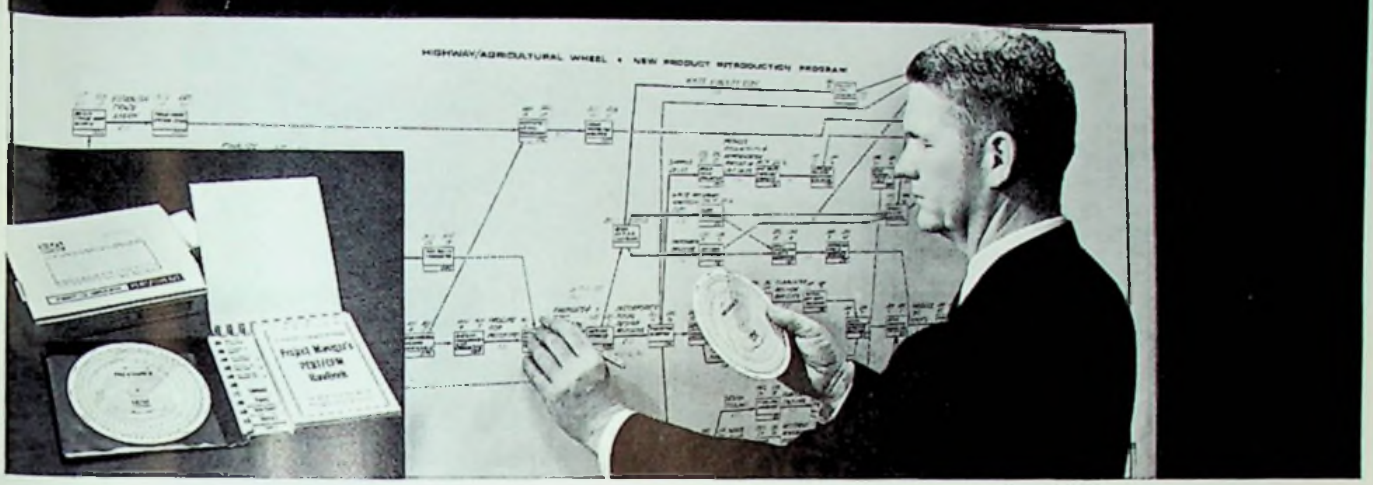
COMMUNICATIONS ENGINEERING

As project engineer, design, plan, coordinate installation of complex public safety radio and industrial communications systems in the frequency range from audio to 12GHv. Requires BSEE from accredited college with major in communications or equivalent major and minimum three years experience in industrial or public safety radio services.

Experience should include various types of modulation, radio propagation, base mobile and relay stations, multiplex, selective callings, antenna systems, multiple high power transmitters located in close proximity with many receivers. Supervisory experience very desirable. Stable, non-defense employment. Excellent working conditions and benefits. Salary range Electronics Engineers $1,271 - $1,343 - $1,419, Senior Electronics Engineers $1,271 - $1,343 - $1,419 - $1,499 - $1,583. These are exceptional career opportunities.

Submit resume in confidence to Mr. Toshio Adachi, Chief Electronics Engineer, Dept. of Communications, County of Los Angeles, 500 West Temple Street, Los Angeles, 90012; Telephone (213) 625-3611 Ext. 64210.

This remarkable PERT/CPM Kit will make you an expert in management planning in less than one day!



The PERT-O-GRAPH Kit is complete in a handsome vinyl binder. It contains the slide-rule computer, handbook with 92 illustrated panels, and quick reference section.

The extraordinary PERT-O-GRAPH Kit puts you in command of two of the most sophisticated management techniques developed over the past decade. This unusual aid to decision-making fits into your pocket or briefcase. It is already used by 25,000 alert executives to employ the principles of PERT (Program Evaluation and Review Technique) and CPM (Critical Path Method)

Where The Kit Is Used

The PERT-O-GRAPH Kit is effectively used to plan, schedule and control new product introductions; for short term or long range planning. It simplifies production scheduling and control, programming mergers and acquisitions, managing engineering projects, and planning and executing construction projects. It facilitates monitoring procurement cycles, fund raising programs, charting R&D breakthroughs, marketing programs, activating manufacturing facilities, launching new businesses and more – *much more.*

Take It Along

PERT-O-GRAPH is an ideal portable slide rule computer for management conferences. The kit will help planning committees to develop accurate time plans and enumerate steps for pin-pointing responsibilities and implementing decisive action.

Save Time

PERT-O-GRAPH accurately computes critical paths in less than half the time required to program and activate computers! Answers and solutions become readily apparent without the need for programmers, translators or extensive readout equipment.

Eliminate Errors

Keypunch and programmer errors are eliminated because PERT-O-GRAPH is a precision instrument with direct readout. Calibrations are so accurate that it is characteristically incapable of making mistakes. The instruction handbook clearly explains how you simply set the hairline, slide the circular rule and read the answer.

Why PERT?

PERT was created by Admiral Raborn in 1958 for the Polaris Program. At about the same time, DuPont developed CPM. Both systems have since been adapted as an integral part of modern operations research and systems analysis. PERT/CPM provides management with visual time and event control of nearly any project, plan, system, forecast or commercial activity.

Why PERT-O-GRAPH?

PERT-O-GRAPH was developed by James Halcomb, who was a Lockheed executive at the time Admiral Raborn instituted PERT for systems analysis. Because of the success of PERT and PERT-O-GRAPH, Mr. Halcomb is recognized as a world famous authority on PERT techniques and their application to management problems.

What $24.50 Buys

The basic package of the PERT-O-GRAPH system consists of the Project Manager's Handbook with complete instruction, chart examples, User Reference Guide and Critical Path Computer.

PERT-O-GRAPH Users

Within the past few months, orders have been filled for executives employed at Xerox, Lockheed, 3-M, IBM, RCA, G.E., Kaiser Engineers, Stewart-Warner, Polaroid, General Foods, Motorola, United Air Lines, Texas Instruments, Stanford University, and Sears.

Barrons:

"(The $4 million Pay Less Drug Store) was completed in just eight-and-a-half months instead of the projected 15, with the help of the PERT-O-GRAPH Computer, using space-age technology from the Polaris program, which enables management to act on specific problems before they halt or disrupt an entire project."

Business Week:

"Tiny computer helps PERT jobs."

House & Home:

"This computer Kit makes any builder a scheduling expert."

HALCOMB ASSOCIATES
149 San Lazaro Avenue
Sunnyvale
California 94086

Now is always the best time to improve your position or business. Mail this coupon today for literature, or complete PERT-O-GRAPH Kit. **No risk 10 day trial.**

*name*_____

*address*_____

☐ *Send literature* ☐ *$24.50 enclosed*

"Thank you for calling Hewlett-Packard."

Computer software . . . Yes sir, I'll connect you with our Data Products Staff Engineer.

Microwave applications . . . Yes sir, I'll connect you with an Instrumentation Staff Engineer.

Intensive care patient monitoring equipment . . . I'll connect you with a Medical Staff Engineer.

Chromatography . . . Yes sir, I'll connect you with our Analytical Staff Engineer.

Calculator programming assistance . . . I'll connect you with our Calculator Staff Engineer.

Voltmeters . . . Yes sir, I'll connect you with an Instrumentation Staff Engineer.

Whatever your requirements for scientific or medical electronic instrumentation, Neely is your source of immediate, responsive, and competent service. Just pick up the phone; dial; and listen for the *Thank you for calling Hewlett-Packard.*

HEWLETT hp PACKARD

NEELY SALES REGION