

# EDITOR'S PROFILE of this issue

*from a historical perspective ...*

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

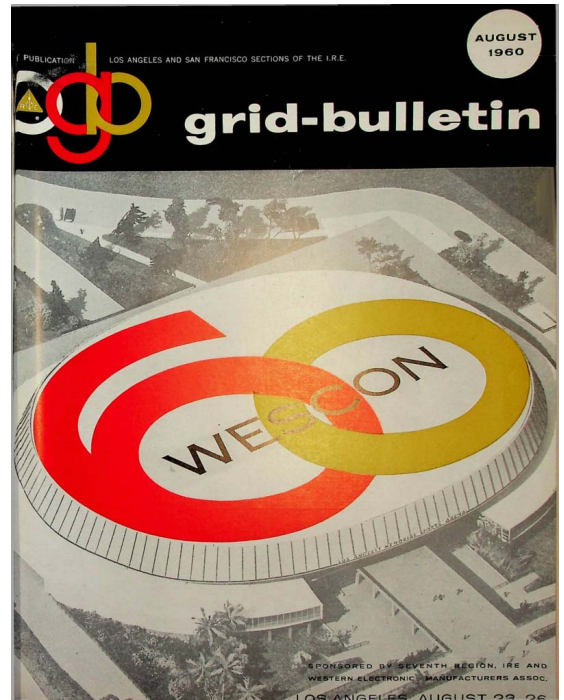
August, 1960:

Cover: The focus of the cover is to remind engineers to drive to L.A. to attend this year's WESCON.

Page 22: A paper by Bernie Widrow and Ted Hoff is in Session 11, "Computer System Theory", and is entitled "Adaptive Switching Circuits". It outlines how an adaptive pattern classification machine (called Adaline, for adaptive linear) might be trained to give certain outputs when it receives certain inputs. Sounds a bit like what we do today with deep neural networks and machine learning.

Page 52: Jack Kilby of Texas Instruments (and a Nobel prize winner, for co-inventing the IC) is a panelist in Session 30, discussing micro-miniaturization. He gives a talk on "Semiconductor Networks", proposing that all the network components can be fabricated on one semiconductor wafer.

Page 64: In a session entitled "Engineering: The Woman's Role", Rose Mary (Decker) Bernstein presents "A Woman Engineer?" to answer questions such as: What kind of women want to do engineering? Can they engineer? Are they accepted by their "fellow" engineers?



Archive of available SF Bay Area GRID Magazines is at this location:

[https://ethw.org/IEEE\\_San\\_Francisco\\_Bay\\_Area\\_Council\\_History](https://ethw.org/IEEE_San_Francisco_Bay_Area_Council_History)

At time of scanning, the bound volumes are held by Paul Wesling.

July, 2021

Contact p.wesling@ieee.org

AUGUST  
1960

PUBLICATION

LOS ANGELES AND SAN FRANCISCO SECTIONS OF THE I.R.E.



# grid-bulletin



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LOS ANGELES, AUGUST 23, 26

# *Gertsch* frequency measuring equipment

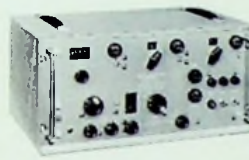
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FM-6

#### VHF FREQUENCY METER

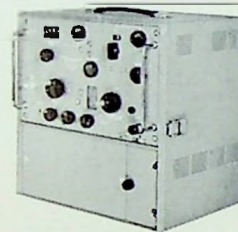
Minimum accuracy and stability is .0001%. Direct reading. Measures or generates frequencies of 20 - 1,000 Mcs. May be used with external 100 kc counter to obtain accuracies approaching .00001%. Supplied case or rack mounted.



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FM-5

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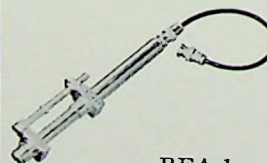


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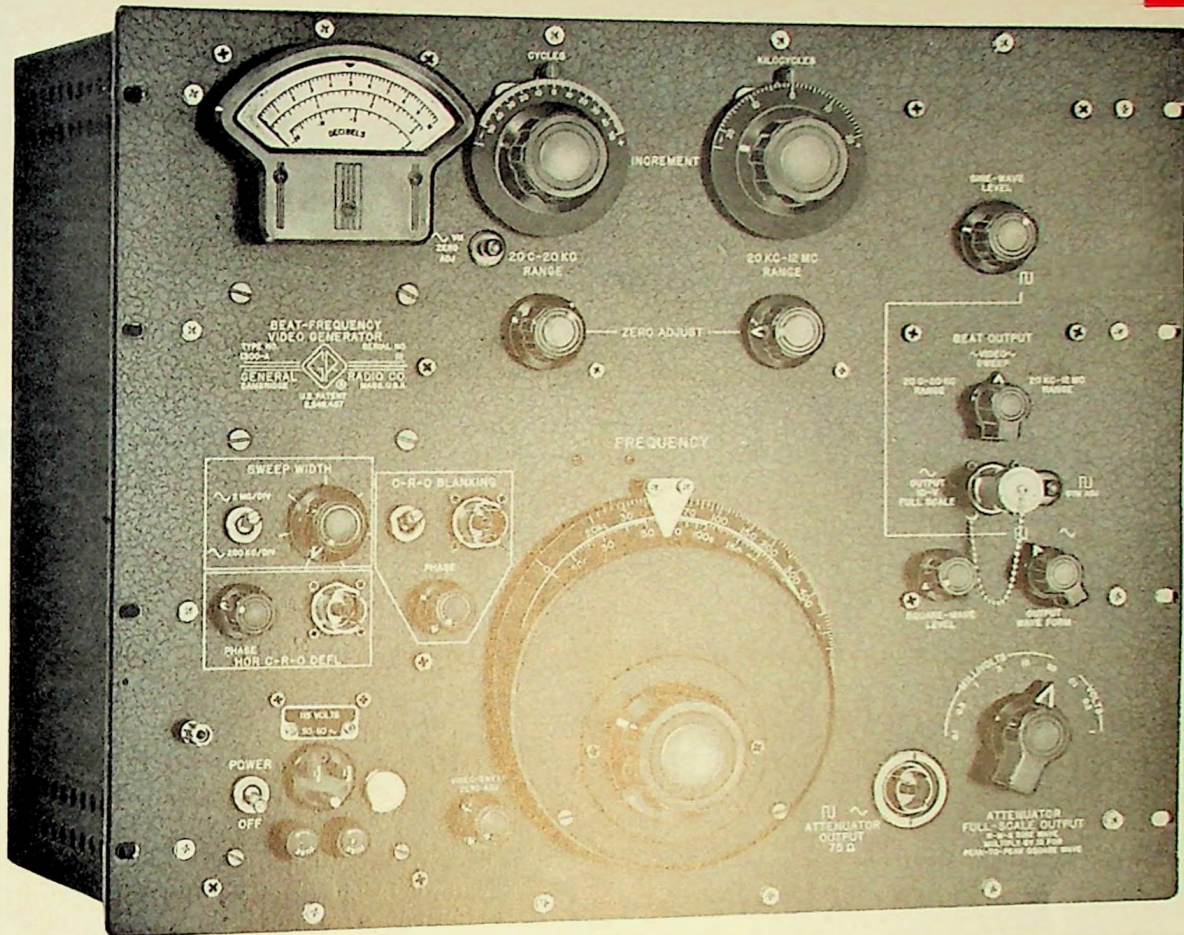
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- As Sweep Generator (60c sweep rate):**  
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20 kc to 500 kc,  $\pm (2\% + 1 kc)$   
500 kc to 12 Mc,  $\pm (1\% + 1 kc)$

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**Square Wave**  
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Hum: less than 0.1% of output

	Voltage Range Sine-Wave (rms)	Voltage Range Square-Wave (peak-to-peak)	Accuracy	Frequency Characteristic	Output Impedance
Attenuator output	0.1, 0.3, 1, 3, 10, and 30 mv; 0.1, 0.3, and 1v full scale, open circuit	1, 3, 10, 30, 100, and 300 mv; 1, 3, and 10v full scale, open circuit	$\pm 3\%$ of full scale; attenuator db increments $\pm 1\%$	flat within $\pm 0.25$ db from 40c to 20 kc ( $\pm 0.75$ db at 20c); $\pm 1$ db from 20 kc to 12 Mc	$75\Omega \pm 2\%$
High output	0 to 10v	0 to 10v	$\pm 3\%$ of full scale	flat within $\pm 0.25$ db from 20c to 20 kc; $\pm 1$ db from 20 kc to 12 Mc (open circuit)	$820\Omega \pm 2\%$

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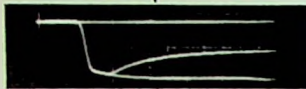
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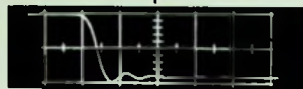
**for clear display of:**

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- Recovery time of fast diodes • High-speed circuit response • Transistor switching waveforms • Radio frequency waveform



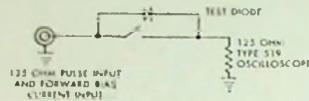
2 nsec/cm

Switching and storage times in fast transistors and diodes can be measured using the outstanding characteristics of the Type 519. In this typical diode-recovery-time waveform, the upper trace is +45 ma reference, the middle trace shows the diode turn-off, and the lower trace shows the diode shorted.



5 nsec/cm

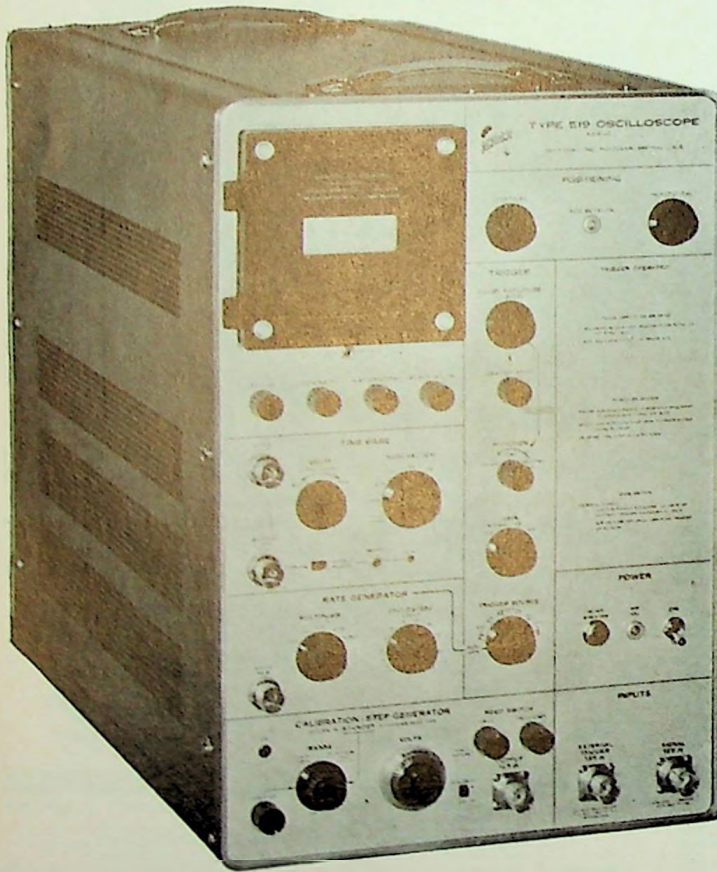
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INDEX

Official Greetings .....	Page 5
WESCON Officials .....	Page 8
WESCON Report .....	Page 11
WESCON Technical Program .....	Page 11
Seventh Region Roundup .....	Page 48
Field Trips .....	Page 74
Future Engineers .....	Page 76
Business Activity .....	Page 84

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1960 WESCON, August 23-24-25-26

Los Angeles Memorial Sports Arena

## Provocative Papers . . .

### . . . Air-Conditioned Safaris

Once again the Seventh Region of the IRE, as co-sponsor, is happy to welcome the visitors to WESCON 1960.

The principal Regional activity during WESCON is the presentation of the Electronic Achievement Award. This is awarded annually, at the All-Industry Luncheon, to an IRE member residing in the Seventh Region who has not yet received national recognition for his contribution to the art.

There have been so many words written already about the outstanding attractions to be found at WES-  
(Continued on Page 6)



C. Wesley Carnahan  
Seventh Region Director



Walter Hausz  
Los Angeles Section Chairman



Donald A. Dunn  
San Francisco Section Chairman

## TECHNICAL TREASURES DISPLAYED

*Bien venido! Aloha! Welcome,* in all the languages of the old west, to the 1960 WESCON. As host and co-sponsor to this gala event, the Los Angeles Section invites you to participate to the fullest possible extent.

The growth of the Seventh Region and the Los Angeles Section of the IRE have both been spectac-  
(Continued on Page 6)

## MAKING NEW CONTACTS

As one of the co-sponsors of WESCON, the San Francisco Section of the IRE extends to all visitors a welcome to WESCON. May your visit to WESCON be enjoyable and worthwhile.

In a show and convention as large as WESCON, any attendee must, of course, be selective in what sessions and activities he attends. I believe one of the important and  
(Continued on Page 6)



S. H. Bellue  
President, WEMA

## WEMA's President Speaks

### Maximum Idea Exchange

We've grown in the past year to more than 300 industrial and research members and it is our privilege, as a co-sponsoring host of WESCON, to welcome you to the 1960 WESCON.

We feel, that, together with IRE, it is our responsibility to you, our guests and to the electronic exhibitors from throughout the nation, to provide the maximum opportunity for the exchange of ideas, close examination of the creative of genius and machines on display.

Events have been scheduled to allow for the renewal of old acquaintances, attending technical sessions, participating in field trips, and relaxing at social events.

We of WEMA are grateful to you for your attendance at the balanced show and technical presentations; to the volunteer staff of member companies, and the IRE, for their time and effort in creating and presenting WESCON to you.

Our reward, WEMA and IRE's, is your happy and productive memories of the creative advances of products and theory that is the trademark of WESCON.

We will see you at the Los Angeles Sports Arena; at exhibitors booths, in technical sessions and on the field trips.

We will meet at the 1960 WESCON.

S. H. Bellue,  
President, WEMA

## Radio Station Previews 1960 WESCON

Backstage preparations for WESCON will be covered via "live" radio on station KRKD Sunday, August 21, it has been announced.

Les Gideon, Hughes engineer and entrepreneur of technical broadcasts in southern California, has scheduled a direct broadcast from the Sports Arena from 1 p.m. to 1:45 that day. The show will feature interviews with WESCON and IRE executives and present a preview of the four-day show and convention.

### Region Director Cont. from page 5

CON, that it would be presumptuous of the Seventh Regional Director, who comes mostly as a guest, to add more. As a prospective guest, however, I can mention a couple of items that interest me greatly. I am going to try to attend the special "Women's Session", another WESCON first, since the paper on "Debugging the Engineer", sounds extremely provocative. I am also intrigued by the paper on "The Anesthetized Individual in a Normal Environment". Will the speaker be talking about an IRE member at the WESCON Cocktail Party?

As usual, I will be torn by the conflict between the field trips and the technical sessions. The field trips are so attractive this year, however, that I suspect I will spend most of my time with the air-conditioned safaris into the wilds of the West San Fernando Valley. Where else but at WESCON 1960 can you visit so many of our new space-oriented facilities in so short a time, so comfortably and so reasonably?

—C. Wesley Carnahan,  
Director, Seventh Region

### Hausz Cont. from page 5

ular over the past decade, more than doubling each five years. The growth in attendance at WESCON has closely paralleled this. Each one at San Francisco has exceeded the preceding one there; each one at Los Angeles has exceeded the preceding one there. With the greatly increased capacity provided by the shift to the new and air-conditioned Sports Arena, we all believe that 1960 WESCON will exceed them all, both in attendance

and in the less tangible but more important aspects, the technical treasures displayed in the technical sessions and at the show, the pleasures of mingling briefly with one's industry associates.

A large crew of dedicated individuals started on this year's show and convention early last fall and have been working at an ever increasing pace to provide a trade show now second largest in the electronics industry and forty plus sessions and workshops of even better technical calibre than in the past. Restriction of the number of sessions, careful selection of papers, solicited and invited papers for well rounded coverage, and such innovations as a series of four workshop sessions on Manned Machine Systems promise a convention to which we of the west can point with pride.

Again, a hearty welcome to all of you, from all over the country. Come early and stay late!

Walter Hausz,  
Chairman Los Angeles Section

### Dunn Cont. from page 5

special values of a general electronics meeting of this sort is the opportunity to make contact with fields of activity different from one's own. An unusual series of survey papers and special sessions provide an up-to-date summary of the state-of-the-art in various specialized areas and I would particularly like to invite your attendance at these tutorial sessions.

Another unusual feature of WESCON is the future engineers' show. I think you will be surprised at the level of technical competence demonstrated by the participants in this show. Their exhibits are the prize-winning exhibits from dozens of high school science fairs throughout the western U.S. If you haven't been to such an exhibit for a while, I can strongly recommend a visit to this part of the WESCON show.

The San Francisco Section of the IRE congratulates the Los Angeles Section of the IRE, WEMA, and the WESCON staff and board on another strong and imaginative WESCON show and convention.

—Donald A. Dunn,  
Chairman, San Francisco Section



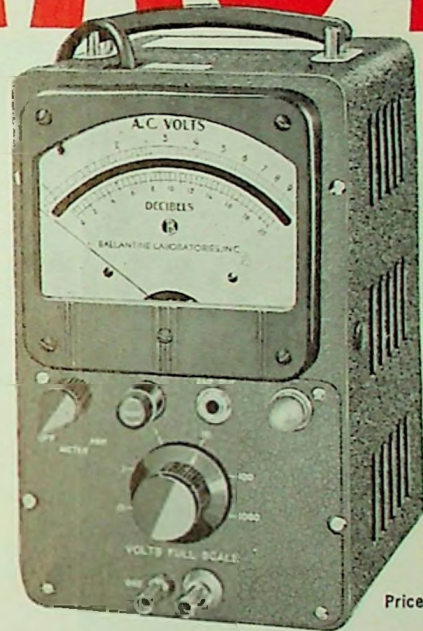
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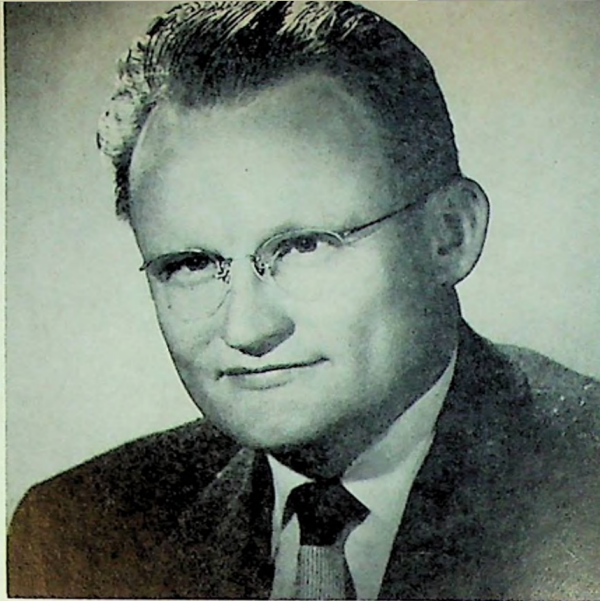
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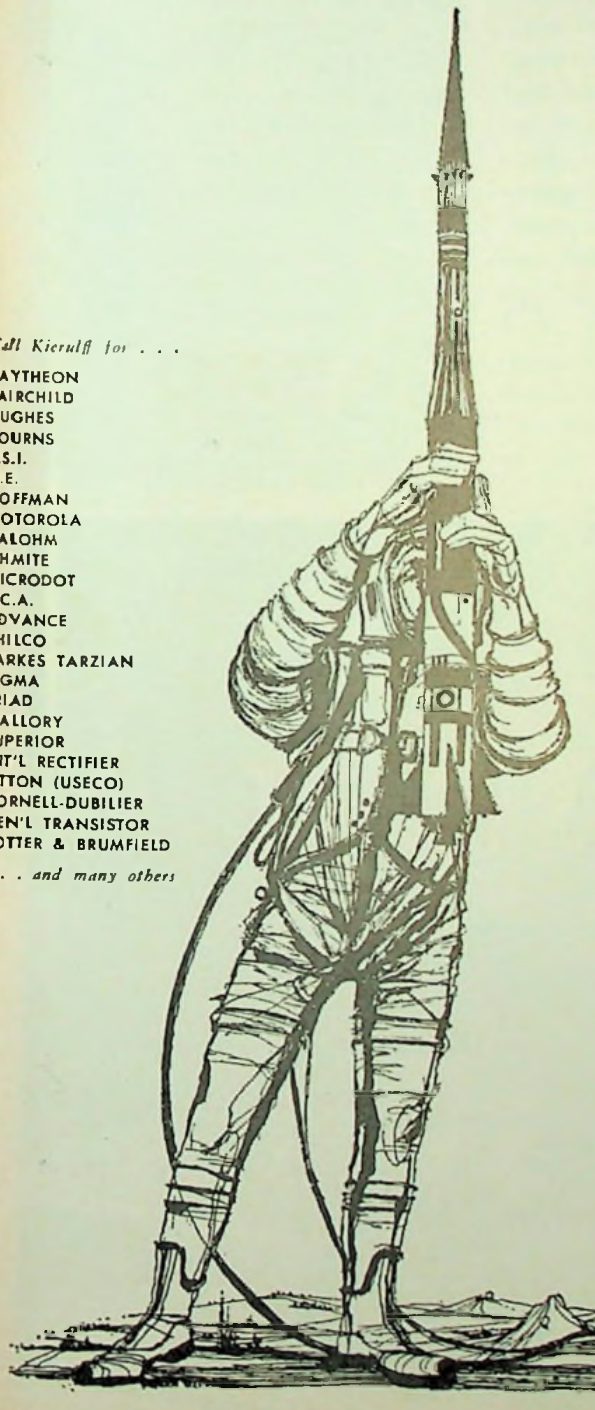
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# Wescon Explores Men-Machines Even the Engineer's Wife in 1960 Version

Human relationships — man-to-machine, man-to-instrument, man-to-man, any yes, even man-to-woman — will form major topics of technical interest in Los Angeles starting August 23, when WESCON-1960 gets underway.

WESCON's technical program, nucleus of the four-day activity in



Richard G. Leitner  
Chairman, Technical Program

which 35,000 persons or more will participate, will investigate various aspects of man-machine systems in four regular sessions and an equal number of workshops, bioinstrumentation systems in another, "working with engineers" in still another, and the woman's role in engineering, as seen by a panel of feminine authors.

## New Format

There will be 40 sessions in all, plus the workshops, with a new variety in format intended to discourage the note-reading of papers in favor of freer and more spontaneous discussions. The program outline includes debates, panels, related papers, tutorial papers, and combinations of the four.

While up to 3000 persons at a time may be involved (in air-conditioned comfort) in concurrent technical sessions, thousands of others will be touring 987 exhibit booths, branching out to 12 Southland field-trip sites, or inspecting such special displays as the second annual Industrial Design Exhibit on the Future Engineers Show.

## Traditional Events

Such traditional events as the All-Industry, Cocktail Party and the All-Industry Luncheon will be staged, and women-at-WESCON (as many as 4000 of them) will be enjoying a four-day "Polynesian Holiday" while the men are involved with business and technical matters at the luxurious Sports Arena.

Included as a part of WESCON is the annual Distributor-Representative Conference, which will engage about 600 industry sales executives in an all-day program of business meetings at the Ambassador hotel on August 22, and both IRE and the Western Electronic Manufacturers Association will use WESCON as a background for executive meetings of various kinds. WEMA will hold its annual meeting and luncheon on August 24 in the Statler-Hilton.

## Goal Achieved

Throughout all this activity, the work of 200 volunteers who have staffed 14 working committees will



Harper Q. North  
Vice-chairman, Technical Program

be in evidence. Their goal — to make WESCON-1960 an unequalled forum for the exchange of technical information — has been pursued for more than six months.

The technical activities of WESCON-1960 have been supervised by Bruce S. Angwin, General Electric, who serves as convention director. His responsibilities have included guidance of seven committees, including the technical pro-

(Continued on Page 12)

# WESCON TECHNICAL PROGRAM

(Note: This is the complete program as it existed at press-time. Check your official WESCON Program for last minute changes.)

## SESSION 1

### RELIABILITY

Tuesday, August 23

10:30 AM to 12:30 PM

Sports Arena - Room A

Type of Session: Contributed Papers

Chairman: Irvin R. Whiteman

Project Director,

General Analysis Corp.

Los Angeles, California

### 1. Economy Models for System Design Engineers

By E. S. Winluad, Consultant

Computer Department

General Electric Company

Phoenix, Arizona

In order to design systems satisfactory to industrial and military customers, with economy of design effort and production cost, it is desirable or necessary to determine achievable system reliability, as well as performance and price, and balance system performance and reliability indices with long-term users cost, to achieve optimal system design. From these aspects a design effort allocation technique is developed for situations requiring reliability improvement in the most economical manner. It utilizes theoretically-achievable reliability gains to project resultant annual savings, investment, and amortization time. Illustrative examples are provided.

### 2. The Engineering Contribution to Product Quality

By William C. Kraft, Manager

Component Test Equipment Development

Department

Sandia Corporation

Albuquerque, N. Mex.

This paper outlines responsibilities of the engineering profession to production of high quality, thoroughly reliable material. Included are identification and explanation of several areas in which the engineer can help assure that his product will conform with expected quality standards. Some of the areas discussed are altitude, change evaluation, optimization vs standardization, inspection controls, and study of defects.

### 3. A Systematic Approach to Complex Electronic Equipment Maintenance Requirements

By J. J. Brown, J. H. S. Chin, G. W. Jacob

Surface Armament Division

Sperry Gyroscope Company

Division of Sperry Rand Corporation

Great Neck, L. I., New York

A complex shipboard electronic equipment utilizing modular packaging is analyzed for maintenance considerations. Test facilities are determined by calculation of predicted failure rates, spares and maintenance philosophy. A demand factor is calculated based upon failure rates, system population and operating or mission periods. Cost factors of module replacement versus module repair in relation to down time and complexity of repair facilities is discussed. Modifications of the latter approach, are presented to yield an acceptable solution when a test facility and selected spare modules are used.

### 4. Precision Film Potentiometers

By Herbert H. Adise

Computer Instruments Corporation

(Continued on Page 12)

gram organizers.

### Technical Program

This activity, in which 210 authors, session chairmen, panelists, and debaters are taking part, will consist of 10 sessions daily (five each morning and afternoon), all but one to be presented in specially built rooms in the audience seating area of the Sports Arena. The session on the woman's role in engineering will be staged at the Stauer-hotel, so that women attending WESCON can more conveniently join the men for this program.

Richard G. Leitner, System Development Corp., and Harper Q. North, Pacific Semiconductors, who set their sites on a new method of presenting technical information, are chairman and vice chairman of the technical program.

### No Reading

In setting up session topics and "inviting" special papers, they designed the program to discourage reading, encourage debate and controversy, and stimulate audience participation. In the matter of paper presentation, they called on the national Professional Group on Engineering Writing and Speech, which is offering special assistance to WESCON authors across the nation in preparation of visual material, speech techniques, and the like.

Technical committeemen, working under Leitner and North, are Dr. Lawrence T. Alexander, System Development Corp.; Edward E. Benham, KTTV, Inc.; V. J. Braun, System Development; Robert H. Brunner, Neely Enterprises; Alan F. Culbertson, Lenkurt Electric Co.; Dr. Malcolm R. Currie, Hughes Research Labs; Malcolm R. Davis, the RAND Corp.; George W. Downs, Applied Physics Corp.; Meyer Fishbein, System Development; Dudley E. Foster, Hazeltine Research Inc. of Calif.; Howard A. Gates; Dr. Richard A. Gudmundsen, Hughes Products; John N. Hawkins, System Development; Jack Higgins, Consolidated Electro Dynamics; John K. Hilliard, Altec Lansing Corp.; Lt. Col. Raymond S. Isenson, Pacific Missile Range; Prof. Ellis F. King, UCLA; Louis A. Kurtz, Rantec; Walter Kuzmin, Packard-Bell Electronics; Frank W. Lehan, Space Electronics Corp.;

(Continued on Page 14)

Hempstead, L. I., New York

An analysis is made of the theory of operation of the precision film voltage-dividing resistor or potentiometer as used widely in servos and analog computers. Certain concepts of potential field theory are shown to be applicable to film potentiometers and comparison is made with the lumped-constant concepts applicable to the older wire-wound potentiometer types. Reliability factors and modes of failure are discussed and it is shown that certain failsafe properties of the film potentiometer permitted the isolation of causes of system failure which were hidden previously by the catastrophic failure of the wire-wound potentiometers. The isolation of failure modes led naturally to their analysis and elimination through design of a unique precision film potentiometer.

## SESSION 2 PULSE-HANDLING TECHNIQUES

Tuesday, August 23  
10:30 AM to 12:30 PM

Sports Arena - Room B  
Type of Session: Contributed Papers

Chairman: Nicholas Begovich,  
Hughes Aircraft Co.,  
Fullerton, California

### 1. Pulsed RF Storage in Long Delay, Broadband Closed Loop Systems

By O. A. Huellner  
ITT Laboratories  
Nutley, N. J.

This paper deals with the design and adjustment of broadband, closed loop, pulsed RF storage systems employing fused silica delay lines. The operating bandwidth of this storage device is in the order of 40 megacycles; the storage time is in the order of several milliseconds. Of particular interest should be the potential application of this technique to RF pulse analyzer, frequency monitor, or RF repeater design.

A quantitative analysis of the storage time, in terms of delay attenuation, media delay, regeneration-enhanced loop noise, and broadband amplifier noise figure and saturation characteristics is developed. Specific design requirements of the broadband amplifiers, pulse injection and extraction networks, equalization networks and automatic gain control circuitry are also discussed. Some peculiarities associated with operation of broadband fused silica delay lines in this application are detailed, and practical design solutions to these peculiarities is indicated.

### 2. Problems and Solutions in the Navy Program for Video Processing Standardization

By L. T. Rhodes  
Naval Research Labs.  
Washington, D.C.

The first of two related papers on video processing, this paper traces the development of pulse standardization program in the U. S. Navy. Problems due to the diversity of video signals in Radar and IFF are discussed, together with early NRL work in the field. Extensions of this work to its present are covered, with specific examples.

The factors involved in the choice of standard levels and impedances are related to the operational environment aboard ship. The dynamic range of level and noise must be accommodated and a standard signal evolved. Other factors such as spurious signals, ease of service, equipment standardization, and availability of devices are explored.

The specific levels and parameters for conformity to MIL-T-17209 are presented in suitable form for equipment designers. Video problems and design approaches are described, pointing out the dangers inherent in pulse work and performance data on standard pulse marks given.

The concept of a new method of video processing is explored as an introduction to the details presented in the following paper.

### 3. A Solid-State Video Processor with Pulse-for-Pulse AGC

By R. Segal  
Packard-Bell Electronics Corp.

Los Angeles, Calif.

In answer to some of the problems posed in the previous papers, this paper describes the details of a new method of video processing.

The Video Processor is a wide band video amplifier designed to receive an IF amplifier output, ranging in amplitude from signals barely discernible in the noise to at least 30 db above that level. The Video Processor produces output pulses which have a limited 2v output and a width equal to the 50% width of the input.

The input pulses have poor rise and fall times and therefore large inputs would be stretched considerably if a system of pulse-for-pulse AGC was not used. The Video Processor preserves the delay and width information over a large dynamic range by effectively slicing out the center portion of each pulse and producing this signal into a standard amplitude and shape. This action is performed on both the leading and trailing edges of each pulse, utilizing direct coupled circuitry.

This paper will also discuss the enhancing of the rise and fall times; zener diode limiting, and the driving of long coaxial cables, as part of the general techniques of video pulse processing and handling.

### 4. On a Theory of Enhancement Filters

By Allen Norris  
Varian Associates  
Palo Alto, Calif.

Frequently, in designing a detection system when a copy of the incoming waveform is given by a matching enhancement filter, it is desirable to have the filter optimized for a larger class of incoming waves. This broadening of the design criteria may not be met if the waveforms differ significantly in their shape. The purpose of this paper is to present the criteria for linear enhancement and the modifications necessary to extend the design to the more general case. The linear model chosen is the one of constant rms noise output. With this constraint on the coefficients of the linear sum to be maximized, the coefficients occurring in the maximization are explicitly given and hence differences between system parameters for differently shaped waveforms measured. If these differences are too great, a multiple element detection model must be chosen. This implies that the detection system be operative for greater variations in waveforms than simple amplitude translation. A discussion of such a model is presented with its relevance to other correlation processes.

## SESSION 3

### COMMUNICATIONS:

### NEW SOLUTIONS TO SOME OLD PROBLEMS

Tuesday, August 23  
10:30 AM to 12:30 PM

Sports Arena - Room C

Type of Session: Contributed Papers

Chairman: Carroll Lindholm,  
Rand Corporation,  
Santa Monica, California

### 1. Effect of Link Elimination in Data Transmission Systems

By A. Machi and J. Hoffman  
System Development Corp.  
Paramus, New Jersey

Data Transmission systems are normally designed to function along specific links between points. The elimination (by accident, sabotage, war, etc.) of one link leads to a need for reorganization of the remaining network to enable the information to still be handled. An analytical tool is developed for treating such problems in an orderly way.

### 2. Determination of the Optimum Antenna Pattern for a Signal Burst Communication System

By P. A. Lux  
Sandia Corp., Livermore, Calif.

(Continued on Page 14)

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A. N. Curtiss  
Chairman, Field Trips



Eugene M. Knight  
Vice-chairman, Field Trips

Michael Waldner, Semiconductor Div.; Hughes Products; and Bernard Walley, RCA.

**8 Field Trips**

Eight field trips to 12 Southland locations have been booked by a committee headed by Chairman Arthur Curtiss, RCA, and Gene Knight, STL. Plans include enroute briefing and distribution of trip descriptions in advance, and

(Continued on Page 16)

H. M. Swarm and D. D. McNelis  
University of Washington, Seattle

The propagation path between stations communicating by scattering mechanisms is found to be oriented in various (stochastic) directions about a nominal (mean) path. Thus a highly directional antenna pointed in one direction may not serve the system as well as a broader antenna properly designed to these statistics. This paper considers the designs of such antenna patterns as a function of various parameters.

**3. Linear Cancellation Techniques for Suppressing Impulse Noise**

By E. J. Baghdady  
Massachusetts Institute of Technology  
Cambridge, Mass.

The time-honored techniques for eliminating impulse noise are clipping and blanking. Under many circumstances these are entirely adequate, but the resulting non-linearity also introduces distortion, cross talk, loss of information, etc. Linear techniques also can be effective against impulse noise and often do not suffer the same disadvantages. This paper describes linear techniques in general and a new specific technique in particular.

**SESSION 4  
MANAGEMENT OF  
MAN-MACHINE SYSTEMS**

Tuesday, August 23  
10:30 AM to 12:30 PM

Sports Arena - Room D

Type of Session: Symposium

Chairman: Arnold Small,  
Hughes Aircraft Company,  
Fullerton, California

**1. A Systems Management Appraisal of the Functions of Human Engineering**

By T. Eason  
Stromberg Carlson Co.  
Rochester, N. Y.

If Hollywood would elect to do a scenario about the large electronic systems job of today, the chances are that the villain would be the Systems Manager himself. The heroes obviously are the technical specialists—the Human Engineers, the Reliability Engineers, and the Training Specialists.

The object of this paper is to explore the roles of the Systems Manager and of the technical specialists with whom he works. It is hoped that this exploration of objectives can help to establish a unity of purpose among these people.

**2. Human Factors Contribution to Management Control Procedures**

By Dr. Stanley Deutsch  
Douglas Aircraft Company  
Santa Monica, Calif.

The design of a system control program requires the identification and listing of areas requiring control, variables involved in control, and relationships among elements within the control system.

By virtue of the academic training and general work experience, the Human Factor Specialist is uniquely qualified to assist management in the design and development of system control program procedures.

The discussion in this paper is intended to highlight the levels at which the Human Factors Specialists can most effectively apply his competence.

**SESSION 5  
SEMICONDUCTOR DEVICES  
AND TUBES**

Tuesday, August 23

10:30 AM to 12:30 PM

Sports Arena - Room E

Type of Session: Contributed Papers

Chairman: Norman J. Golden  
Hoffman Semiconductors, Inc.  
El Monte, California

**1. Power Output and Efficiency of Thermionic Converters**

By Ideal T. Saldi  
General Electric Co.  
Schenectady, N. Y.

The Power Tube Department of the General Electric Company has been actively engaged in developing and manufacturing thermionic converters. Much effort has been expended in producing close-spaced vacuum converters. The knowledge and experience gained in the development, design and manufacture of vacuum converters has been applied to the design of vapor converters.

The purpose of this paper is to present the results of efforts to increase the power output and efficiency of the close-spaced vacuum converter. Some preliminary data from a vapor converter will also be presented.

Theoretical and experimental results will be outlined which show converter output dependence on cathode temperature, anode work function, electrode spacing, anode temperature, and cesium bath temperature.

Converter efficiency dependence on cathode temperature, cathode diameter and electrode spacing mechanism will also be described.

**2. High Power at 1,000 MC Using Semiconductor Devices**

By G. Luetgenau and M. V. Duffin  
Pacific Semiconductors, Inc.  
Culver City, Calif.

An optimized set of transistors and variable capacitor diodes delivering 0.75 watts at 1 KMC is described. A series of optimized device-circuit combinations are described, consisting of a 100 mw transistor crystal oscillator driving a transistor delivering 1 watt at 125 mc, in turn driving another transistor delivering 3.2 watts at 125 mc. This output drives three successive semi-conductor variable capacitor frequency doublers, with an output of 0.75 watts at 1,000 mc. Device optimization and circuit innovations necessary for the above results are considered in appropriate detail.

**3. Glass Ambient Diodes**

By Jack Carmen  
Unitrode Transistor Products, Inc.  
Calabasas, Calif.

Silicon junctions are inherently capable of withstanding thousands of volts. Present-day devices do not realize these voltages principally because of shortcomings in the ambient medium surrounding the silicon. This paper discusses silicon diodes operating in an ambient of hard glass where the surface condition and ambient cease to limit either reliability or voltage breakdown. Drift and instability caused by surface migration are not observed.

By choosing the glass and the electrode metal with the same expansivity as silicon, an unstressed structure can be fabricated. Since this common coefficient of an expansion is low, the device can withstand severe thermal shocks. The high-melting materials used made the device capable of unusually large overloads and of storage temperatures as high as 500°C. By eliminating expansion differences the need for a cavity housing a spring or flexible conductor has disappeared, making possible rugged unitrode construction.

**4. Quality Assurance Procedures for Power Transistors**

By J. S. Schaffner  
Delco Radio Division  
Kokomo, Indiana

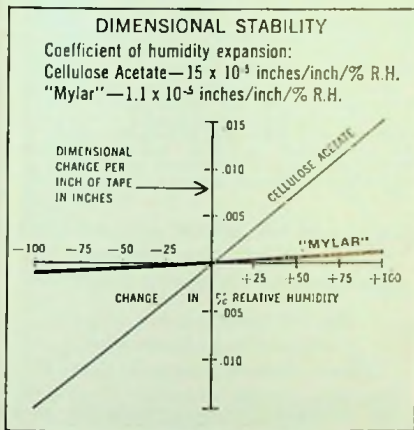
Power transistors used in military and industrial applications require a high degree of reliability. Quality control procedures for the testing of such power transistors will be discussed. These procedures involve the electrical and environmental tests set

(Continued on Page 16)

# Magnetic tapes of "Mylar"<sup>®</sup> insure reliability of recording and playback

Much information recorded on magnetic tapes can never be replaced because of the tremendous cost of duplicating test conditions. You can protect your investment in such valuable data with tapes of "Mylar"<sup>\*</sup> polyester film. Their small additional cost is negligible compared to the cost of the data they contain. Here's why they provide higher reliability than any other tapes:

CHART NO. 1

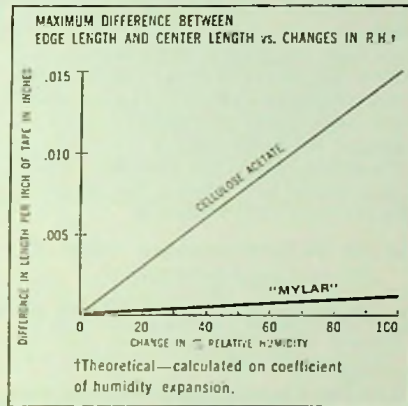


## Less signal dropout.

Chart 1 shows that dimensional change in "Mylar" with humidity change is negligible compared to acetate. This exceptional stability prevents tape shrinking, swelling or cupping that could result in shifting of

tracks or loss of contact with the recording or playback head. Possibility of signal dropout or garbled or weak signals are minimized and reliability of recorded data is assured.

CHART NO. 2



## Fewer garbled signals.

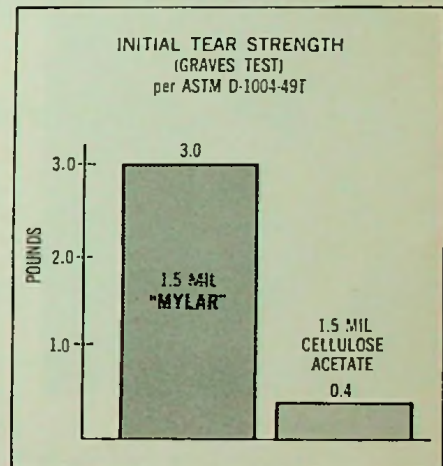
If magnetic tape picks up or loses moisture unequally across the tape width there will be a difference in length between the edges and center. Chart 2 compares this effect for "Mylar" and cellulose acetate tapes. Because "Mylar" is virtually non-hygroscopic there is no dimensional difference between edges and center to cause poor registration of timing across adjacent tracks on the tape.

## Less tape breakage.

Since most breaks start as edge nicks,

the high initial tear strength of "Mylar" reduces chance of breakage and subsequent failure to record critical information. Chart 3 compares initial tear strength of "Mylar" and acetate. In addition, "Mylar" has the highest tensile strength of any instrumentation tape base. And "Mylar" does not lose its toughness with age, repeated playbacks or storage because it has no plasticizer to dry out.

CHART NO. 3



The superiority of "Mylar" can make an important contribution to reliability of your magnetic tape system. Ask your magnetic tape supplier to recommend the specific tape of "Mylar" for your needs.



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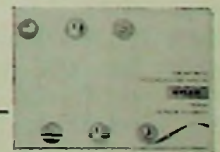
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trippoers will have the advantage of air-conditioned busses on several of the trips.

Sites to be visited include Cal-Tech (accelerators, synchrotron, electron microscopes) and JPL (telemetry, microminiaturization, information theory) on Tuesday, August 23; STL (data reduction and satellite tracking center) on Wednesday morning; Packard-Bell (consumer products) and Telemeter Magnetics (memory cores), Wednesday afternoon.

Wednesday evening, a trip is planned to System Development Corp. (SAGE computer); on Thursday morning, there will be a journey to Rocketdyne's rocket-engine test facility; Thursday afternoon, RCA's new Valley facilities (ground-support electronics) and Thompson Ramo Wooldridge (systems) will receive attention. A second trip on Thursday afternoon will go



Ernest Clover  
Chairman, Exhibits

to the ITT Labs (communications) and to Librascope (computer production).

On WESCON's final day, Friday, a trip will go to Hughes' new Malibu research labs (electronics, infrared, solid-state physics).

#### Committeemen Named

Working with Curtiss and Knight in planning the big program of field trips are W. M. Anderson Sr., CBS Electronics; Donald L. Segel, Fenske-Fedrick & Miller; Dave Traitel, Electro-Optical Systems; R. G. Molokie, Westinghouse; George A. Strawn, General Mills; Joseph Chernof Sr., ITT; George Saturensky, Packard-Bell; and Charles Wacker, Ramo-Wooldridge.

(Continued on Page 18)

forth in the specifications as well as a number of additional tests necessary to insure reliability. A potent tool in this program is a quality index that will indicate the quality of each transistor type at any given time. This index takes into account approximately twelve mechanical and electrical factors, including both operating and non-operating accelerated life tests. Computers are used for the evaluation of raw quality control data, particularly for the evaluation of parameter changes during accelerated life tests.

## SESSION 6

### WHAT ARE THE COMMUNICATION VALUES OF THE TECHNICAL SYMPOSIUM?

Tuesday, August 23  
2:00 PM to 5:00 PM

Sport Arena - Room A

Type of Session: Panel Discussion

Chairman and Moderator:

Lorimer F. McConnell,  
System Development Corporation,  
Santa Monica, California

Panelists:

Irving J. Fong, Remington Rand Corporation,  
UNIVAC Div., St. Paul, Minn.: THE SPEAKER

E. R. Hagemann, Space Technology Laboratories,  
Los Angeles, Calif.: THE WRITER

Neil Horgan, The RAND Corp.,  
Santa Monica, Calif.: THE EDITOR

Walker G. Stone, John Wiley & Sons, Inc.,  
New York, N.Y.: THE PUBLISHER

#### What Are the Communication Values of the Technical Symposium?

The four members of the panel will address the subject: "What are the Communication Values of the Technical Symposium?" from the points of view of the speaker, the writer, the editor, and the publisher.

The number of technical symposia held each year appears to be rising at a rapid rate, and attendance at such meetings represents a considerable effort. It therefore seems appropriate to take a long, hard look at the values of technical meetings and attempt to define requirements for effective communication. Presumably, a symposium is conducted for the purpose of exchanging information and with the hope that, by means of such exchange, old ideas will be modified and perhaps some new ones will emerge. If this is so, then it is really enough for people to simply assemble and address one another and provide a printed record of what transpires?

The speaker at the symposium must employ the best oral communication techniques. Simply reading to the audience has proved in most cases to be entirely inadequate. The writer must recognize the particular communication values of the printed word and use them effectively. His paper might be better written after attending a symposium—after his ideas have been tried out on and modified by his colleagues. The editor is traditionally considered to be the man who polishes a piece of writing in order that it may be more palatable to a reader. It is perhaps appropriate to consider the need for an editor who can pull together the various written contributions to a symposium, draw conclusions from the various pieces of information presented, and point up the significance of any particular sessions after the papers have been presented and the discussion completed. The publisher makes the final comment. His obligation is to assure that the printed record of the symposium is not simply a souvenir piece, but that it makes a real contribution to science and technology.

## SESSION 7

### VARACTORS AND TUNNEL DIODE APPLICATIONS

Tuesday, August 23  
2:00 PM to 5:00 PM

Sports Arena - Room B

Type of Session: Contributed Papers

Chairman: George C. Messenger,  
Hughes Semiconductor Division  
Newport Beach, California

#### 1. A Nonlinear Capacitor Harmonic Generator Suitable for Space Vehicle Applications

By P. M. Fitzgerald, T. H. Lee, M. S. Moy,  
E. J. Powers and J. J. Younger  
Lockheed Aircraft Corp.  
Missile Systems Div.  
Sunnyvale, Calif.

This paper describes a harmonic generator device which was designed to be incorporated into a frequency modulated communication system capable of operating under severe environmental conditions. An extension of the theory associated with frequency multiplication using nonlinear capacitance as well as a comparison with experimental results is described. The measurement techniques, results, and the procedures followed in the environmental testing of the harmonic generating system are presented.

#### 2. Parametric Radio Frequency Amplifier

By Alexander Szerlip  
Packard-Bell Electronic Corp.  
Los Angeles, Calif.

The parametric amplifier using the varactor diode is shown to consist of four frequencies that are the signal, the pump, the sum, and the difference. The stability of this type of amplifier depends on many parameters. It is mathematically shown that an amplifier in which the sum frequency is suppressed can become unstable under certain conditions while the amplifier in which the difference frequency is suppressed is unconditionally stable.

Low noise, large dynamic range, and low inter-modulation distortion are essential characteristics of an RF amplifier for a communication receiver. These are shown to exist in the parametric amplifier. To investigate some of these characteristics more thoroughly, various low frequency versions, based on the microwave balanced modulator, were constructed and tested.

#### 3. Gain and Bandwidth Inconsistencies in Low Frequency Reactance Up-Converter Parametric Amplifiers

By A. K. Kamal and A. J. Holub  
Millimeter Wave Research Lab.  
Purdue University, Lafayette, Indiana

Parametric amplifiers achieve the maximum theoretical performance predicted by Rowe only when a matching parameter,  $a_0$ , is unity, a condition unlikely to exist in low frequency operation.

The parameter  $a_0$  is dealt with for the case of a quasi-optimum amplifier and an experimental amplifier. Effects of the non-unity value of  $a_0$  are shown on various performance characteristics. Methods of measurement are shown, allowing a determination of  $a_0$ , and accordingly, more accurate prediction of amplifier performance.

Methods of overcoming the non-unity value of  $a_0$  are suggested.

#### 4. A Compact Tunnel Diode Amplifier for Ultra High Frequencies

By Dr. Gerald Schaffner  
Motorola, Inc.  
Scottsdale, Arizona

Describes a compact tunnel diode amplifier for operation between 405 and 460 megacycles. Used in conjunction with an equally compact UHF isolator, an unusually small, low noise and stable amplifier system is achieved.

The design of the amplifier is described, including the effect of coupling on noise figure and stability. It is shown that special attention to the biasing circuit prevents low frequency oscillation in the bias leads.

The amplifier described has 15db gain, a 12 mc bandwidth and a noise figure of 5.5 db across the band. With the isolator, system gain changes less

(Continued on Page 18)

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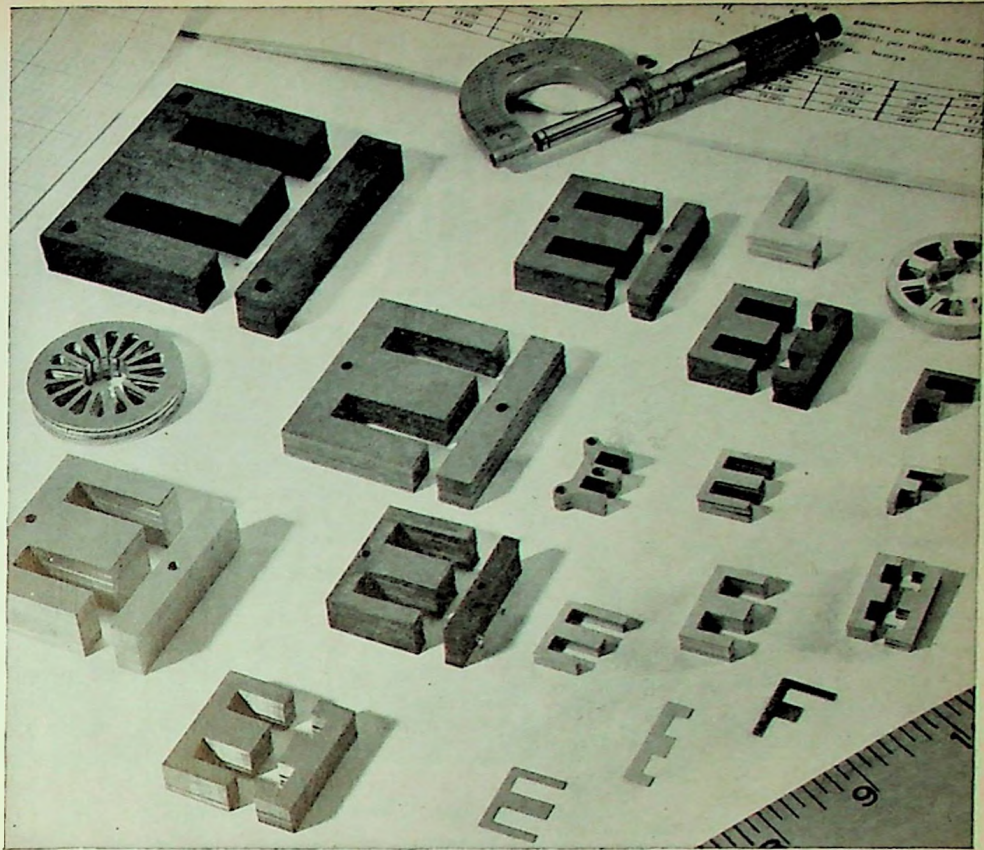
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Herb Becker  
Vice-chairman, Exhibits

WESCON Report Cont. from Page 16

**A Thousand Exhibitors**

Making sure that exhibitors—1000 strong—receive all necessary on-the-spot services during WESCON is an Exhibits committee headed by Ernest Clover, Triad Transformer, chairman; Herb Becker, Herb Becker Co., vice chairman; and committeemen Bob Andrews, Raytheon Waltham; Dale Harr, Hughes; George Dunbar, Westinghouse; and Richard Hastings, Elpac. Their work will start with the arrival of exhibits at the Sports Arena starting August 21, and will be the heaviest during installation days.

**Signs to Buses**

All the WESCON committees turn to their own "G-4" for their equipment, personnel, and material needs. The Facilities committee, headed by Don Montgomery, Aeronutronic, chairman and Duano Wood, Lockheed, vice chairman, is supplying everything from air-con-



Donald N. Montgomery  
Chairman, Facilities

Technical Program Cont. from Page 16

chan 3 db with antenna VSWR variations of from 1.0 to 1.8.

Possible applications for the amplifier are discussed.

**5. Analysis and Design of the Twin-Tunnel-Diode Logic Circuit**

By C. H. Alford

Lockheed Aircraft Corp.

Missile Systems Div.

Sunnyvale, Calif.

A pair of series tunnel diodes, supplied by a balanced source containing a sinusoid rather than a pulsed component, is used as the basis of analysis. Graphic analysis, using load line techniques, permits simultaneous solutions of the loop equations. The analysis then proceeds through the derivation of output characteristics, and the use of "Shmoo" diagrams to develop optimum and extreme case combinations of circuit parameters and component variations. Indices of performance are obtained which can be used to determine the applicability of the circuit as a high speed digital computer element.

**SESSION 8**

**INSTRUMENTATION**

Tuesday, August 23

2:00 PM to 5:00 PM

Sports Arena - Room C

Type of Session: Contributed Papers

Chairman: Alvin Kaufman,

Litton Industries,

Beverly Hills, California

**1. Widely Separated Clocks with Microsecond Synchronization and Independent Distribution Systems**

By Thomas L. Davis and Robert H. Doherty

U.S. Dept. of Commerce

Nat'l Bureau of Standards

Boulder, Colorado

In a majority of timing applications, a problem exists in setting two or more clocks to agree with one another. Present techniques using WWV allow clocks to be synchronized within one millisecond. This paper describes a system which offers an improvement in synchronization of three orders of magnitude.

Microsecond synchronization is obtained by use of the Loran C navigation system as the link between a master clock at Boulder, Colorado, and any slaved clock anywhere in the Loran C service area.

The system also includes a unique method for distribution of several time code formats on a single UHF channel.

**2. The Synthesis of Instrument Compensating Networks**

By Robert Kearns

Wayne State University

Detroit, Mich.

Compensating computing networks, termed instrument functions, have been developed which, when placed in series with an instrument signal-generating system, result in total dynamic characteristics of unity. While application to accelerometers for inertial navigation is specifically discussed, use of an instrument function is general and can be applied whenever the dynamic characteristics of the system are known.

Other topics of discussion will be noise amplification control to alleviate limitations due to the increased high frequency noise sensitivity of the computing circuitry; obtaining acceleration, velocity and displacement response ratios with one instrument function for a square pulse of acceleration, a second for a triangular pulse of velocity and a third for a half sine wave pulse of displacement; graphical proof that usage of any of the three instrument functions results in more faithful measurement reproduction.

**3. An Automatic Plotter of Bode, Nichols or Nyquist Responses**

By David Rice

Republic Aviation

Farmingdale, L. I., N.Y.

This paper describes an automatic AC-DC servomechanism response plotter. Its characteristics include a frequency range of 0.3 to 30 cps, amplitude range of 40 db, continuous phase range of 338 degrees and delivery of reproducible x-y plots within 12 minutes.

The plotter consists of five basic units: a generator to supply suppressed carrier information to the system under test; cross-correlation detectors to extract phase and amplitude data; analog computer to convert the data into DC functions for plotting; an x-y plotter using 11 x 17 inch graph paper; a digital programmer which determines the type of plot (Bode, Nichols or Nyquist), regulates plotting time, calibrates the instrument, selects the logarithmic frequency for the generator and provides for manual control, reset to zero and automatic shutoff.

**4. Touch Detector**

By G. T. Kemp

Texas Research Associates Corporation

Austin, Texas

Touch detector is the name given to a solenoid (electrochemical) pressure detector constructed in a unique manner to make it suitable for sensing very small momentary forces and displacements and yet be insensitive to vibrations.

The device employs the principle of constricted flow of electrolyte through an orifice cathode in response to pressure on either of the enclosing diaphragms. This flow of electrolyte causes a change in electrical current in an external biasing circuit. The current can be fed into an electronic circuit to operate counters or to trip relays for various control purposes.

The design of a particular unit controls the frequency response and thereby the unit may be made selective to different types of stimuli.

Applications of the touch detector will be discussed with primary emphasis on its use as a very sensitive limit switch.

**5. An Improved Method of Determining and Presenting Instantaneous Speed Error (Flutter) Data**

By Abner Updike

Ampex Data Products Co.

The present method of reading flutter on a calibrated oscilloscope is subject to individual operator interpretation and consequent errors. The method to be discussed eliminates human error, and displays the desired information on an electronic counter in numerical form accurate to within  $\pm 5\%$ . The information so produced is in a convenient form for statistical evaluation.

The equipment is calibrated by inserting known sinusoidal signal levels and calibrating a gain control to represent various percentages of flutter. In use the gain control is consecutively set to predetermined points and the counter readings tabulated for each setting. A set of numbers is then available which represent the amount of time the flutter signal was less than various percentages.

**SESSION 9**

**CIRCUIT THEORY**

Tuesday, August 23

2:00 PM to 5:00 PM

Sports Arena - Room D

Type of Session: Tutorial Papers with Panel

Chairman: Louis Weinberg  
Hughes Research Laboratories,  
Malibu, California

Panelists:

Isaac M. Horowitz, Hughes Research Laboratories, Malibu, California

J. R. Burnett, Space Technology Laboratories, Los Angeles, California

**1. Analysis and Design of Feedback Systems with Gain and Time Constant Variations**

(Continued on Page 20)

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- **OUTPUT POWER:** 0 to 20mw minimum cw into matched load, continuously adjustable. With AGC-detected output flat to  $\pm 0.5$ db (when used with matched bolometers and directional couplers).
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 $\pm 2\%$  — sweep frequency operation.
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ditioned busses to counter signs, and inculding thousands of dollars worth of projecting, recording, lighting, and other equipment for technical program use.

Just the transportation program for WESCON alone, calling for continuous shuttle bus service to and from the arena and hotels, and fleets of busses for field trips, the



Duane Wood  
Vice-Chairman, Facilities

women's program, and the future engineers' activities, has been a major enterprise in the planning.

Working with Montgomery and Wood are Tom Endo, Magnavox; R. W. Lacy, General Electric; Todd D. Cochran, Aeronutronic, Arnold T. Lloyd, Lockheed; David A. Young, Electronic Systems; Leo Arndt, Hoffman Labs; Harry Mayer, General Electric; Patrick H. Packard, Lockheed, and E. A. Randolph, also of Lockheed.

#### Students at WESCON

The fourth annual Future Engineers show at WESCON will be, more than ever, a "show within a show," with 36 junior engineers exhibiting their experiments, delivering papers about them, journeying forth on field trips, and attending an awards luncheon.

Electronics experiments were selected in local science fairs throughout the West and Hawaii, and outstanding students and their instructors will be the guests of WESCON and the local sections throughout WESCON in Los Angeles. This is the first year in which future engineers have had their own technical session or a field trip program. They'll visit Space Technology Laboratories for business—

(Continued on Page 22)

By Kan Chen  
Westinghouse Electric Corporation  
Pittsburgh, Pa.

This paper presents a method for analyzing the transient response of systems containing elements with proportional variation of gain and time constant. This problem includes the stabilization of systems, which are open loop unstable, where both the gain and the time constant of an element are negative. Several practical examples are discussed, including the open-loop instability in reactor controlled ac motor drives. The method of analysis is based mainly on the relationship between a Bode plot and the corresponding transient response. Bode plots and actual transient response measurements are given for several examples. Practical design methods are presented.

#### 2. Measures of Sensitivity for Linear Systems with Large Multiple Parameter Variations

By S. L. Hakimi and J. B. Cruz  
University of Illinois  
Urbana, Ill.

Two methods are discussed for characterizing the system function deviation from the design function due to large element variations. The first method involves the use of Myers' theorems on an extension of a Nyquist stability criterion. By this method, bounds on the deviation of the system function are obtained. These bounds are calculated while allowing the element values to deviate from the designed values less than the corresponding element tolerances. The second method makes use of the statistical properties of element values. Assuming all of the elements of the system have certain statistical properties, the changes of the system function are studied. Numerical techniques are presented for computation of the "standard deviation" of the system function for a given distribution of the random variables.

#### 3. Sampled Data Technique for Realizing Network Transfer Functions

By L. E. Franks and I. W. Sandberg  
Bell Telephone Laboratories, Inc.  
Murray Hill, New Jersey

A sampled-data network is described which consists of a parallel combination of  $N$  paths, each path containing a linear, time-invariant network and input and output sampling devices. This network can be characterized by a transfer function which is essentially periodic over a bandwidth proportional to  $N$ , the number of parallel paths. The sample-data filter provides an attractive alternate realization technique for network functions which would normally require delay line elements. Another feature of practical significance is that the transfer function consists of a sequence of frequency-translated versions of the transfer function of the linear, time-invariant networks in the individual paths. This property has been used for the realization of highly selective bandpass filtering characteristics without the use of inductors.

#### 4. Delay Distortion Correction for Networks and Filters

By T. R. O'Meara  
Hughes Research Laboratories  
Malibu, Calif.

This paper discusses the group time delay functions for low-pass Butterworth filters of orders two through six. These functions then provide examples for a number of delay correction techniques. A number of unusual realization techniques for the first degree network are discussed. The first order all-pass networks are relatively difficult to realize in unbalanced passive networks.

The second order networks are realizable as convenient bridged T's, and design techniques are presented which are based on mixed analytical and graphical techniques.

For problems which require a large number of correction networks, a trial and error process is outlined. The process converges very rapidly and the computational effort is eased by including a set of group time delay tables and curves for the all-pass network.

### SESSION 10 SEMICONDUCTOR DEVICES

Tuesday, August 23  
2:00 PM to 5:00 PM

#### Sports Arena - Room E

Type of Session: Contributed Papers

Chairman: T. W. Grinstead,  
Continental Device Corporation,  
Hawthorne, California

#### 1. A New Semiconductor Memory Element with Non-Destructive Read-Out and Electrostatic Storage

By V. H. Grinich and D. Hilbiber  
Fairchild Semiconductor Corporation  
Mountain View, Calif.

A method of information storage is described which utilizes the stored charge in the depletion layers of a PNP structure. Presence of a large space charge indicates a "zero," and a smaller charge a "one." In the determination of the existing state of the device, advantage is taken of the fact that the point at which breakdown occurs in a PNP device is a function of the rate of rise of the applied voltage,  $\frac{dV}{dt}$ . If one assumes a device with all junctions initially discharged, a voltage pulse having an amplitude less than  $V_S$ , the switching voltage, and a sufficiently short rise time will cause the device to switch. If, however, the middle junction were previously charged to some level less than  $V_S$  at a sufficiently slow rate, the application of the first pulse would not result in a breakdown. Therefore, by selection of a proper "interrogation" pulse, and monitoring the current through the device, one may readily determine the storage state.

Since this method is electrostatic, the only input power to the device is that which supplies the charge lost due to stray leakages. "Interrogation" does not alter the existing state, hence a non-destructive read-out is obtained. Specific device characteristics are discussed.

#### 2. Some Device Aspects of Multiple Microwave Reflections in Semiconductors

By H. Jacobs, F. A. Brand, J. Meindl,  
M. Benanti  
U.S. Army Signal Research & Development Lab.  
Fort Monmouth, N.J.  
and  
R. Benjamin  
Monmouth College, West Long Branch, N.J.

In considering the transmission of microwave energy through a semi-conductor medium such as high resistivity germanium, an analysis has been made of the effects of absorption and multiple reflections within the medium. The dependence of these properties on frequency, sample length and conductivity has been determined analytically and experimentally verified. Variation of the conductivity by injected carriers results in changes in power transmitted. New device possibilities appear feasible such as amplitude modulator with little or no change in phase, a phase shifter with no change in amplitude and other optical-electrical devices.

#### 3. Base Turn-off of PNP Switches

By R. H. Van Ligten and D. Navon  
Transitron Electronic Corp.  
Wakefield, Mass.

Three-terminal, four layer semi-conductor devices have found use in switching applications. Switching on is done by supplying base current. The device may be turned off by withdrawing base current, provided that the load current does not exceed a critical value.

A study of switchoff by base current will be presented. The switchoff current gain  $\frac{I_{load}}{I_{base}}$  will be derived in terms of composite transistor current gains. To attain high switchoff current gains without sacrificing other desirable device properties such as forward voltage drop, switching speed and stability, design compromises involving base layer width, lifetimes and doping levels must be reached.

The load current that can be switched off by withdrawing base current is limited. This is due to potential differences in the control base layer causing the emitter junction to avalanche. Geometry designs to minimize this effect will be discussed.

Switching off times are compared for base or collector turnoff. Their dependence on base layer width, lifetimes and injection levels will be indicated.

#### 4. Novel Adder-Subtractor Circuit Utilizing Tunnel Diodes

(Continued on Page 22)

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**MICROWAVE ENGINEER**—Ph.D. or M.S. in E.E. You should have five years' experience in design of microwave systems. Familiarity with parametric amplifier design, klystron and traveling wave circuits is desirable. Your work will be in the area of data transmission. Transmitter and receiver design will be involved.

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WESCON Report Cont. from Page 20  
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Committeemen, working under Joel Axe, Ramo-Wooldridge, chairman; and Col. Frank J. Shannon Sr., Packard-Bell, vice chairman, are Chester Jur, Packard Bell; Eric Burgess, Telecomputing Corp.; John W. Herrick, STL; Mrs. Avonale Stephenson, TAPCO; and Joe Cryden, Litton Industries.

Very special treatment for very important guests of WESCON is being planned this year by a Hospitality committee headed by Burgess Dempster, chairman, and John J. Guarrera, Guide Manufacturing Co.

**Hospitality Planned**

Their task includes pre-arrangement of badges, transportation, and other services for IRE and WEMA executives, leaders in technology and in the industry, and other persons of special note.

The Hospitality committee will maintain headquarters at the Stat-  
(Continued on Page 24)



Col. Frank Shannon, Sr. (Ret.)  
Vice-chairman, Future Engineers

By R. A. Koelen  
Bell Telephone Labs.  
Murray Hill, N.J.

Two binary counter configurations have been devised which fully exploit the properties of a modified tunnel (Esaki) diode flip-flop. A bipolar regenerative gate and a conventional flip-flop utilizing tunnel diodes are described and partially analyzed to complete the understanding of the new counters. Experimental results are given which demonstrate the feasibility and reliability of the circuit.

The counter stages described combine memory, gate, and amplifier without impairing reliability. The economy inherent in this arrangement gives the designer latitude in adding regenerative amplifiers to improve reliability.

**5. Transistor Scaling Theory**

Sports Arena - Room A

By W. E. Roach  
Pacific Semiconductors, Inc.  
Culver City, Calif.

Basic principles are given for the application of scaling theory to the problem of increasing the power capability of a certain class of high-frequency transistors. Effects of the scaling process on transistor characteristics and performance are predicted on a theoretical basis. Measured values for a range of sizes over a 5000 to 1 range are compared with the theoretical values.

It is concluded that the application of scaling principles represents a valid and useful approach to the problem of extending the power capability of high-frequency transistors.

**SESSION 11**

**COMPUTER SYSTEM THEORY**

Wednesday, August 24  
10:00 AM to 12:30 PM

Sports Arena - Room A

Type of Session: Contributed Papers

Chairman: L. J. Craig,  
The RAND Corporation  
Santa Monica, California

**1. Digital Control Techniques for Space**

By L. F. Jones and P. Margolin  
Westinghouse Elec. Corporation  
Baltimore, Md.

The considerations affecting the use of digital computer controllers in space vehicles (manned or unmanned) are explored in the light of our expanding space programs. The projected augmentation of system control capability is contrasted with the penalties (of size, weight and power) incurred, to determine under what conditions a digital computer controller can be employed to advantage. The desirability of planning for the use of a digital controller is stressed.

System control functions are analyzed to determine the corresponding digital computer requirements. The role of a digital computer as a means for upgrading the probability of mission success and of overall equipment reliability in a space environment is discussed.

Digital computer hardware techniques are surveyed in terms of size, weight and power both as regards electronic circuit techniques and packaging.

A combination of a magnetic disc memory, transistor-diode circuitry, code disc input devices, permanent magnet stepping motor output devices, flexible multiple layer printed circuitry and molecular electronic blocks are deemed desirable and feasible.

**2. The Polymorphic Principle in Data Processing**

By Harold A. Keit  
Thompson Ramo Wooldridge, Inc.  
Canoga Park, Calif.

Discusses the "Polymorphic" concept of data processing; a special organization of computer elements in which control, arithmetic, and other functions

are allocated to separate, self-contained modules instead of being centralized in one element-modules are connected to each other through a passive switching network operating at electronic speeds; explains three main advantages of this system: adaptability, expandability and dependability (figures are given for mean-time-between failure rates and total failure probabilities); describes the functions and capacities of individual modules; various sophisticated input-output devices; and the Central Exchange-the switching network that is the passive, central element of the system.

**3. An Adaptive Character Reader**

By Paul Baran and Gerald Estrin  
U.C.L.A., Los Angeles, Calif.

A pattern recognition system utilizing information derived from a machine learning operation is described. Samples of a set of characters are first identified by a human operator. From such inputs, a probability matrix is computed, and used to derive a set of weighted filters or stencils which distinguish each character relative to the set of possible characters. When unknown characters are read, the proposed pattern recognition machine produces estimates of the confidence of the identification.

A digital simulation of the proposed technique was performed on an IBM 709 computer. A possible implementation having a raw character reading rate of up to 500 characters per second appears feasible. When low confidence estimates are encountered for certain unknown characters, it is possible to call upon more complex processes to aid recognition. Thus, a recognition system can be built having greater accuracy than the basic reading machine. This technique is particularly useful in dealing with distorted characters encountered in language text.

**4. Adaptive Switching Circuits**

By Bernard Widrow and Marcian E. Hoff  
Stanford University  
Palo Alto, Calif.

Adaptive or "learning" systems can automatically modify their own structures to optimize performance based on past experiences. The system designer "teaches" by showing the system examples of input signals or patterns and simultaneously what he would like the output to be for each input. The system in turn organizes itself to comply as well as possible with the wishes of the designer.

An adaptive pattern classification machine (called Adaline, for adaptive linear) has been devised to illustrate adaptive behavior and artificial learning. A statistical theory has been developed which relates the competence of the classifier to the amount of experience had (number of patterns "seen" in adapting). This theory leads to a basic rule of thumb: the number of patterns required to train an adaptive classifier is equal to several times the number of bits per pattern.

Solid adaptive logical elements (miniaturized Adalines) would be very effective in pattern recognition systems, information storage and retrieval-by-classification systems, and self-repairing logical and computing systems.

**SESSION 12**

**STEREO MULTIPLEX BROADCASTING**

Wednesday, August 24  
10:00 AM to 12:30 PM

Sports Arena - Room B

Type of Session: Papers and Panel Discussion

Chairman: I. J. Kaar,  
Hoffman Electronics Corporation,  
Los Angeles, California

**Panelists:**

Carl Eilers, Zenith Radio Corporation,  
Chicago, Illinois

William H. Beaubien, General Electric Co.,  
Utica, N.Y.

Murray G. Crosby, Crosby-Teletronics Corp.,  
Syosset, N. Y.

Harold Parker, Calbest Engineering and  
Electronics, Los Angeles, Calif.

William S. Hasteed, Multiplex Development  
Corporation, New York, N.Y.

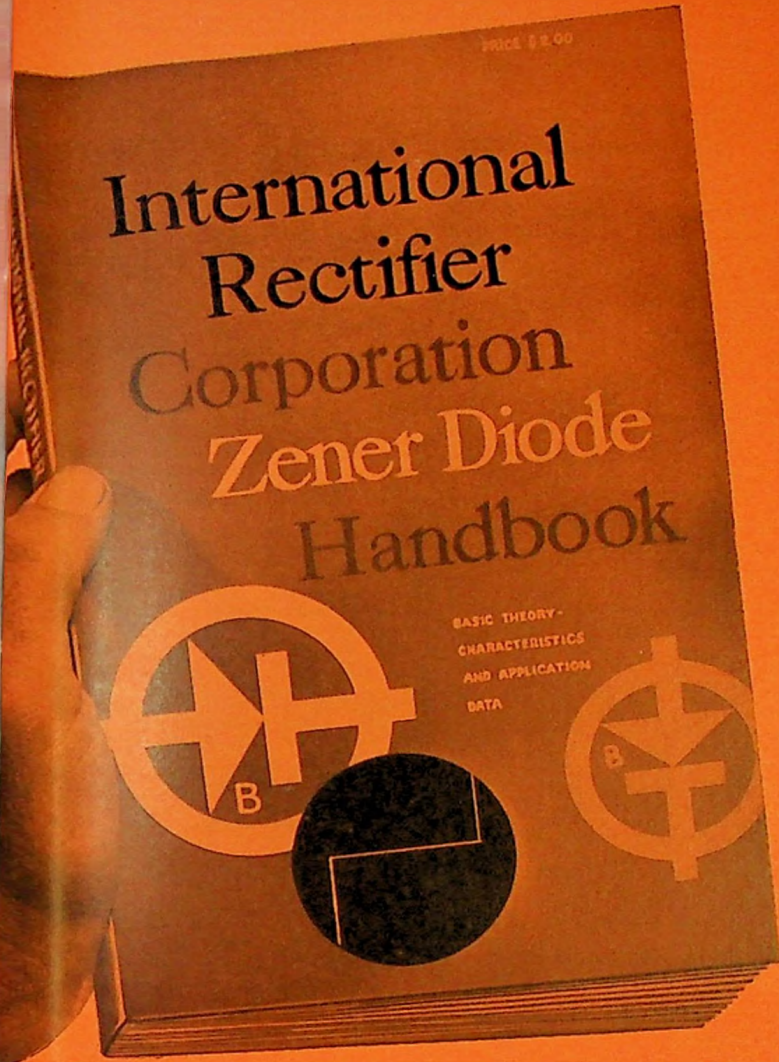
(Continued on Page 24)

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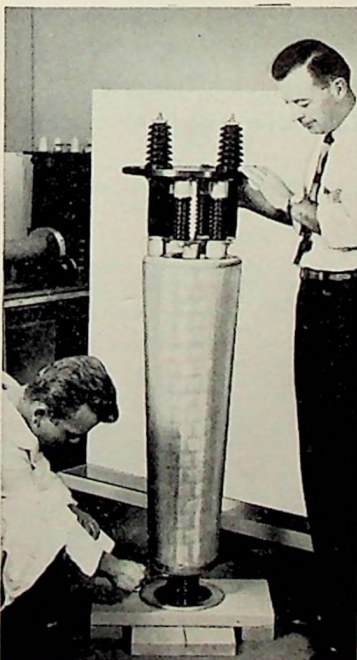
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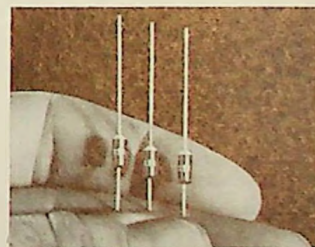


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WESCON Report Cont. from Page 22

ler-Hilton, with hosts and hostesses on hand to greet these guests on arrival, and to help make their stay in Los Angeles pleasant and rewarding.

Committeemen include J. M. Loge, Sound Engineers; Ralph Wenters, Giannini Co.; Mark Biedebach; Col. James H. Rothrock, RCA; Jack Moseley; Marge and Einar Ingebretsen, Summers Gyroscope; Earl Haag, Hughes; John C. McAdam, International Electronic Research; William X. Lamb Jr., Bendix-Pacific; Leo W. Geary, Hughes Aircraft Co.

Others include: H. J. Werst, Electro Space Labs, Russell Strom, North American Aviation, Alan Abel, and Mr. and Mrs. Ernest Nesbit, Bendix Aviation. From the San Fernando Valley IRE Sub-

(Continued on Page 26)

Technical Program Cont. from Page 22

Speakers:

R. J. Farber, Hazeltine Research Corp., Plainview, N.Y.: REQUIREMENTS FOR FM STEREO-PHONIC RADIO TRANSMISSION.

A. Prose Walker, National Association of Broadcasters, Washington, D.C.: PROGRESS OF FIELD TESTS FOR FM STEREO-PHONIC BROADCAST SYSTEMS.

1. Technical Requirements for FM Stereo Multiplex Broadcast

By R. J. Farber  
Associate Director of Research  
Hazeltine Research Corp.  
Secretary Panel 1, NSRC

Based on the premise that the reproduction of individual left and right original microphone signals will produce a satisfactory stereophonic effect, this paper discusses some of the technical considerations involved in FM multiplex broadcast transmission of stereophonic programs. The general considerations of FM and AM subcarrier transmissions are reviewed. Some comments are also made relating to audio bandwidth relationships, stereophonic crosstalk, and to the precedence effect.

2. The Zenith System of FM Stereophonic Broadcasting

By Carl Eilers  
Zenith Radio Corporation  
Chicago, Illinois

The system for FM Stereophonic Broadcasting proposed by Zenith is basically a sum and difference system. The sum (left + right) audio is used to directly frequency-modulate the main carrier, while the difference audio signal (left - right) is used to amplitude modulate a sub-carrier (39.5 Kc) using suppressed carrier techniques. The sub-carrier, along with a pilot carrier (19.5 Kc), is also used to modulate the main carrier. The pilot sub-carrier uses 10% of the allowable deviation leaving 90% for either the sum or difference amplitude modulated sub-carrier.

At the FM receiver a beam deflection tube is used to demodulate the difference sub-carrier and simultaneously matrix it with the sum audio to directly recover the left and right stereophonic channels.

3. The General Electric Stereophonic Multiplex System

By William H. Beaubien  
General Electric Co.  
Utica, N.Y.

The FM stereophonic broadcasting system developed by General Electric features stereophonic separation over the entire audio band and yet provides for simultaneous transmission of stereocast music. Only a simple one tube adapter is required with an FM tuner to convert to this system for the monophonic listener. The change in signal to noise ratio is less than one db. The system employs sum and difference matrixing with the sum transmitted as the main carrier frequency modulation and the difference signal transmitted as suppressed carrier amplitude modulation of an ultrasonic subcarrier. Provision for recovery of the carrier at the receiver is made by transmission of a unique pilot signal at half frequency.

4. Sum-and-Difference FM - FM Multiplex Stereo

By Murray G. Crosby  
Crosby-Teletronics Corporation  
Syosset, Long Island, N.Y.

In the system to be described, it is recommended that the full multiplex baseband be devoted to the second channel for stereo. Sum-and-difference mixing of the two stereo channels is applied with the sum combination fed to the main channel for compatible monaural reception, and the difference combination to the subcarrier channel. This arrangement results in improvements in signal-to-noise ratio, and stability of separation adjustment. The problems involved when a second subcarrier channel is added, will be discussed.

5. The Calbest Stereo Multiplex System

By Harold N. Parker  
Calbest Engineering & Electronics  
Los Angeles, Calif.

The Calbest Stereo Multiplex System employs a narrow band subcarrier located at 29.5 KC. Investiga-

tion, both at Calbest, and by Panel 6 of the National Stereo Radio Committee has shown that separation of audio frequencies higher than approximately 8 KC is unnecessary for reproduction of high fidelity stereo. The Calbest system makes use of this fact to occupy a narrow spectrum with improved signal-noise ratio. It is thus possible to utilize one and possibly two additional subcarriers for background music and other non-broadcast applications. In contrast with other systems which have been designed with intention of providing space for background music, the Calbest system makes it possible for the broadcaster engaged in such operations to continue with no change in receiving equipment when stereo programming begins.

6. High-Fidelity Stereo and Simultaneous Subscriber Services by FM/FM Multiplex Method

By William S. Halstead  
Multiplex Development Corporation  
New York, N.Y.

The paper outlines the importance, to broadcasters and the public, of compatibility of proposed multiplex stereocast systems with respect to: (1) simultaneous non-interfering transmission of high-fidelity stereo programs and revenue-producing subscriber services under SCA, now granted to more than 250 FM stations and of economic value to broadcasters, (2) satisfactory stereo reception of FM/AM simulcasts, now widely used in commercial public service, and stereo reception of the same program by FM multiplex method thus providing the large audience needed to attract sponsors, and (3) satisfactory reproduction at monophonic radio receiving points during stereo broadcasts.

Techniques employed, as described, permit signal-to-noise ratios of 50db or better on FM main and subchannels, crosstalk and stereo separation of 50db or better, and overall harmonic distortion of both main and stereo subchannel conforming to existing rules and regulations of the FCC for high-fidelity broadcast service. A mixed-highs technique to improve S/N performance under high ambient-noise conditions, and to provide two 30-15000 cycle channels at receiving points without exceeding multiplex spectrum limitations, also is described.

SESSION 13

MICROWAVE THEORY AND TECHNIQUES — 1: PASSIVE ELEMENTS

Wednesday, August 24  
10:00 AM to 12:30 PM

Sports Arena - Room C

Type of Session: Contributed Papers

Chairman: Harold Saltzman,  
Kearfott Company, Inc.,  
Van Nuys, California

1. Misconceptions About Equivalent Circuits for Periodic Microwave Structures

By Robert M. Bevensee  
Varian Associates  
Palo Alto, Calif.

This discussion will establish a scientific procedure for deriving equivalent circuits for periodic microwave structures. Several instances will be discussed of the arbitrariness of an "equivalent" circuit chosen by intuition for a structure and the different results obtainable by selection of different circuits of apparently equal worth.

Further discussion will include expansion of the excitations in a periodic structure in a set of modes, each of which has an equivalent interpretation; use of variational or coupled-mode techniques to obtain equations for mode amplitudes; use of the variational-coupling techniques which obviate the need for equivalent circuits at all.

2. A Fast Switching X-Band Circulator Utilizing Ferrite Toroids

By L. Levey and L. M. Silber  
Microwave Research Institute  
Polytechnic Institute of Brooklyn

(Continued on Page 26)



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Mr. John D. Cupp and Mr. Donald R. Bocast complete the committee as appointed at press-time.

#### Registration

Electronic methods of making the electronics convention registration procedure easier will be employed this year, according to Gerry Goldenstern, Hoffman, chairman.

Electronic counters donated by Non-Linear Systems, Inc. at the registration desks will provide a



G. Goldenstern  
Chairman, Registration

running and a cumulative tally of registration on display readouts, and since WESCON registration cards are IBM cards, quick breakdown of totals by professional category will also be made possible. An innovation this year is a system devised by the committee whereby exhibitor companies can order guest registration in bulk in advance, then pay for only those that are actually used. Computing techniques will provide each exhibitor with a list (by name) of all guests who have attended the show.

Goldenstern and his vice chairman, Harry Delaney, U.S. Science Corp., erroneously credited as being at Hughes in the July GRID-BULLETIN have directed activities of a committee that includes Ted Golmis, Hughes; Arthur Chippendale, Convaire; Walt Nicholls, Hughes; Ray

(Continued on Page 28)

Non-reciprocal waveguide devices have been constructed utilizing permanently magnetized ferrite tubes. The use of ferrite elements of this geometry makes possible the realization of ferrite assemblies without the need of a magnet. For switching purposes the remanent state of the ferrite material may be reversed by the application of current pulses to a wire inserted through the tube.

Utilizing this arrangement, a differential phase shift circulator has been developed which operates over the frequency range of 8.2 to 9.2 KMC. The loss between coupled ports is 0.6 db or less and the isolation between uncoupled ports is 25 db or greater. The circulator can be switched in less than 0.5 micro second.

Permanently magnetized ferrite toroids have also been employed in waveguide T and coaxial geometries. Preliminary results are presented.

### 3. Broadband Electronically-Tuned Microwave Filters

Brooklyn, N.Y.

By K. K. Kotzebue

Watkins-Johnson Company

Palo Alto, Calif.

It has been suggested recently that single crystals of yttrium iron garnet (YIG) can be used in the construction of low-loss microwave bandpass filters which can be tuned by means of an applied dc magnetic field. This paper will discuss practical broadband circuits in coaxial line and waveguide for both single-tuned and multiple-tuned bandpass filters using such YIG crystals. One version has operated with electronic tuning from 2000 mc to 6500 mc. The insertion loss was 3 db at 2000 mc, 1 db at 4000 mc, and 0.7 db at 6500 mc, with bandwidths ranging from 18 mc to 40 mc. A packaged version of this filter will be described which utilizes a combination of permanent magnets and solenoids for tuning. The complete filter weighs less than 2½ lbs. and can be tuned  $\pm 1000$  mc from 3000 mc with a power consumption of 5 watts.

### 4. The Observed 50-90 KMC Attenuation of Two Inch Improved Waveguide

By A. P. King

Bell Telephone Laboratories

Red Bank, N.J.

A new measuring technique which is particularly suited to the measurement of low loss waveguide lines is described. The beam circuit of a single backward wave oscillator is modulated with a short pulse to provide both the signal and beating oscillator frequencies.

Some measured results which employ this new technique are given for the TE<sub>10</sub> transmission loss with 2 inch improved waveguide lines. Both the average loss and the random fluctuations in loss over the 50-90 kmc frequency band are significantly lower. Some observed data obtained with lines about 400 feet long, one of solid copper and an all helix line, is presented.

### 5. A Non-Contacting, Broadband Rotary Joint, and Four-Way Switch

By D. Alstadter and N. A. Dawson

Melpar, Inc.

Falls Church, Virginia

Recent advances in the development of very wide band antenna types have dictated the need for correspondingly broadband rf rotary joints and rotary switches capable of high speed continuous rotation with long life characteristics. This paper describes the design and development of a novel non-contacting coaxial rotary joint covering a 12.5 to 1 bandwidth with VSWR less than 1.5:1 over the band.

A second component described is a new four way rf rotary switch covering an octave band in the VHF to S band spectrum.

Both components are capable of continuous rotation at speeds in excess of 3000 rpm for nearly indefinite time periods. The long standing need for such devices in many applications indicates that these designs should find numerous immediate applications for broad band rf systems.

## SESSION 14 ANALYSIS OF MAN-MACHINE SYSTEMS

Wednesday, August 24  
10:00 AM to 12:30 PM

### Sports Arena - Room D

Type of Session: Symposium

Chairman: G. F. Rabideau,

Norair Division of Northrop Corporation,  
Hawthorne, California

### 1. The Vocal Adaptive Controller— Human Pilot Dynamics and Opinion

By D. T. McRuer and I. L. Ashkenas

Systems Technology, Inc.

Inglewood, California

The human pilot, currently the ultimate in adaptive controllers, is not as uncomplicated as his mechanical counterpart. Pilot's opinions of vehicle dynamic response stability and control are surprisingly uniform and have, in the past been instrumental in specifying certain airplane dynamic requirements. It is a reasonable certainty that they will be equally important in specifying future vehicles and missions.

This paper undertakes to examine the roots of pilot opinion from the standpoint of the dynamical system involved. By considering data which contain both pilot opinion and pilot performance in the dynamic output/input sense, it is shown that opinion is closely correlated with certain factors.

On the basis of the demonstrated relationships, certain vehicle dynamics are analyzed and shown to be probably unacceptable. Test data from other sources confirm these predictions.

### 2. An Analysis of the Decision-Making Functions of a Simulated Air Defense Center

By Anders Sweetland and William Haythorn

The RAND Corp.

Santa Monica, Calif.

The crews of two simulated air defense centers were charged with the responsibility of defending a geographical area against enemy attack. The effects of the following six independent variables were recorded and analyzed: (1) Classes of tracks (penetrating, local and outbound), (2) Density of air traffic, (3) Crew differences, (4) Time differences, (5) Crew experience, and (6) Load pattern distribution. The effects of each of the independent variables (and their interactions) are discussed. Two models were suggested by the data: (1) A generalized three-element model of how man-machine systems make decisions, and (2) A simple, dichotomous model that describes the discrete decision-making actions of the laboratory participants.

### 3. Optimizing Linear Dynamics for Human Operated Systems by Minimizing the Mean Square Tracking Error

By T. E. Leonard

Aeronutronic Systems, Inc.

Newport Beach, Calif.

This paper describes the *minimum mean square tracking error* criterion used to establish linear machine dynamics that are best suited for human control.

The problem is to optimize the dynamics of a closed loop tracking system in which a human is used as a "component." The usual system is one in which a human must visually observe an error and use arm extension or force to correct that error.

The approach taken in this study is a "brute force" method, made easy by the use of a digital computer. The inherent physical system dynamics and the human's limitations (reaction time delay and neuromuscular time lag) are considered to be fixed transfer functions. Then the mean square tracking error for a representative statistical input is calculated as a function of conceivable compensation dynamics and amplification. These calculations are done on a digital computer. The computations use the statistical scheme of integrating (vs. frequency) the product of the error transfer function and the input frequency power spectrum.

### 4. Methodology for Man-Machine Systems Analysis

By Ralph Queal

Boeing Airplane Co.

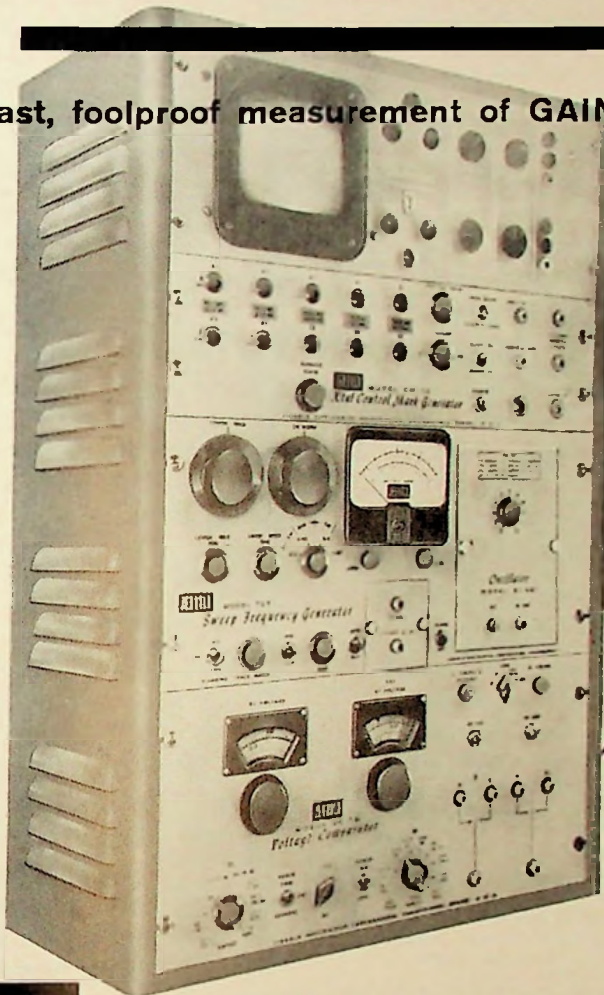
Seattle, Wash.

This paper discusses a variety of techniques which

(Continued on Page 28)

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Churchill, Hoffman Electronics; R. H. Dahlin, Beckman Instruments; Bill Donee, Hughes; Jack Osborne, Aerojet-General; Jim Thomas, Hughes, and William Olhwick, Non-Linear Systems.

### Ladies Go Polynesian

While their menfolk are busy with technical sessions and touring exhibits, WESCON's women guests will be "getting away from it all" via a Polynesian Holiday, a series of unusual social events planned for their leisurely enjoyment.

The island theme embellishes each of the activities, starting with the first get-together for coffee-and-conversation in the "island retreat" headquarters in the Statler-Hilton.



Harry J. Delaney  
Vice-chairman, Registration

There's a festive punch-party on WESCON's opening day; the choice of a scenic homes tour or a trip to Disneyland on Wednesday; and the glamorous and authentic Tamara Luncheon and the famed Polynesian on Thursday. Friday's activity will include a swim party at the Statler, and the first all-industry luncheon of feminine guests, complete with featured speaker.

Women guests will also attend the special session on "Engineering; The Woman's Role" on Wednesday at the hotel. **Island Magic**

Creating the island magic especially for WESCON has been an active committee working under chairmanship of Mrs. Lois Montgomery, with Mrs. Bea Larson as vice chairman. Members include Mesdames A. N. Curtiss, Gerry

(Continued on Page 30)

a specific group of human factors specialists have used to analyze certain man-machine systems and major subsystems. Currently it is necessary to rely on techniques selected or developed for the specific job at hand. The general theme of this paper is therefore to point up the need for the development of a body of methodology which has general applicability to man-machine system analysis and design problems.

### 5. Encoding Techniques for Visual Displays in Computer-Aided Systems

By Klaus M. Neuman, PhD  
U.S. Navy Electronics Laboratory  
San Diego, Calif.

Since the function of a visual display in a man-machine system is to present the operator with signs and since the signs may have the functions of command, designation and computation, any evaluation of a display must be in terms of its success in presenting signs which perform these functions. The word "success" applies ultimately, of course, to the ability of the man using the display to interpret these signs and take the appropriate action.

In modern tactical computer-aided data systems, the quantity and complexity of information which must be visually displayed, has grown to such an extent that systems of symbolic encoding had to be devised. However, another factor which has led to symbolic encoding is the desirability—and often the necessity—for displaying a complex tactical situation in the most compact and successful manner possible.

This paper will examine three techniques for visual symbolic encoding tactical information, which have been or are presently being studied by the author and his associates at the Navy Electronics Laboratory.

## SESSION 15

### MICROWAVE TUBES

Wednesday, August 24  
10:00 AM to 12:30 PM

Sports Arena - Room E

Type of Session: Tutorial Papers

Chairman: W. H. Christoffers,  
Microwave Tube Division,  
Hughes Aircraft Corporation,  
Los Angeles, California

#### 1. An Octave-Band Ultra-Low-Noise Traveling Wave Amplifier

By E. W. Kinaman and G. E. St. John  
Watkins-Johnson Company  
Palo Alto, Calif.

Important achievements have recently been made in reducing the noise figure of longitudinal beam traveling-wave amplifiers. At S-band, the WJ-211 has been developed with noise figure below 4.8 db over octave bandwidth with all voltages fixed. Spot noise figures as low as 2.7 db have been achieved. Noise figure and gain variations over the full octave are low, being typically 1.5 and 5.0 respectively. Comparable results at L-band will be outlined.

The tube design features a multi-anode gun proposed originally by D. A. Watkins and a dispersion-free RF structure. The discussion will feature the design, construction, and performance of the S-band tube with an attempt to assess possible future improvements.

#### 2. Very High Convergence Guns for Traveling-Wave Tubes

By Donovan V. Geppert  
Sylvania Electronic Systems  
Mountain View, Calif.

The discussion will concern general principles and design procedures for a gun capable of producing a solid Brillouin-focused beam of small diameter from a large cathode. Specifically, a new concept allows virtually an unlimited convergence ratio to be obtained.

A convergence ratio of 130:1 is now being used in a pulsed high-power X band TWT utilizing this concept. Other advantages realizable through this new concept include reduced cathode emission with

longer life, gun reproducibility and reduced possibility of leakage and arcing due to increased physical gun size, possibility of using the same gun to produce beams of different diameters with constant perveance; less critical beam magnetic field entrance, and convergence reduction given a more laminar beam due to reduced lens aberration at the anode.

#### 3. Cooling of the Slow Space-Charge Wave of an Electron Beam with Application to the Traveling-Wave Tube

By D. C. Forster  
Hughes Research Laboratories  
Malibu, Calif.

Using a Lagrangian formulation, Sturrock has shown that cooling of the slow space-charge wave of an electron beam is possible by parametric pumping. In this paper, numerical solutions of a general set of coupled-mode equations are presented which include the effects of the generation of higher-order mixing products in the nonlinear beam on the cooling process.

Implicit in the cooling process is the generation of moderately strong pump modulation on the beam. Coupled-mode theory again is employed to predict the noise temperature of a traveling-wave tube utilizing the "cooled" beam with the pump modulation present. Effects of higher order mixing products are included. Sufficient data is presented to allow formulation of an optimum design philosophy when practical physical limitations are imposed.

#### 4. ARC Discharge, Microwave Switch Tube

By S. J. Tetenbaum, R. R. Moats,  
and D. Campbell  
Sylvania Electronic Systems  
Mountain View, Calif.

A new type of gas discharge switch tube is described. This tube consists of a section of rectangular waveguide enclosed at each end by microwave windows and filled with hydrogen or a noble gas at low pressure. A hot cathode is mounted on one side of the waveguide and an anode on the opposite side. Two grids are located on opposite walls of the waveguide, one grid adjacent to the cathode and the other adjacent to the anode. The grids initiate an arc discharge in the same manner as the grid in a thyatron. The arc, flowing across the waveguide, acts like a short circuit to the incident microwave power. The tube is suitable for switching over a wide range of power levels and operates over essentially a full waveguide band. It exhibits very low insertion loss and high isolation. The electrical characteristics of typical X-band and C-band switch tubes are discussed and compared with those of TR tubes and other microwave switches.

#### 5. A Periodically-Focused Backward-Wave Oscillator

By C. C. Johnson  
Hughes Research Laboratories  
Malibu, Calif.

The application of some new periodic-focusing techniques to the backward-wave oscillator will be discussed. An oscillator utilizing a hollow electron beam with an inner focusing rod was constructed at S-band. A periodic-electrostatic focusing method was used with considerable success, and an octave tuning range was obtained. A periodic-magnetostatic-focusing method was attempted with less encouraging results. Some interesting focusing and r-f effects were observed when the periodic focusing techniques were applied to the backward-wave oscillator, and some of these will be described.

The experimental results obtained here will be coupled with known focusing techniques to predict the compactness, weight and power output obtained from an oscillator package.

#### 6. A Four-Cavity Electrostatically Focused, $K_{11}$ Band Klystron Amplifier

By Robert G. Rockwell  
Varian Associates  
Palo Alto, Calif.

AKU-band (13.3 kMc) air-cooled klystron amplifier of extremely light weight has been developed. Through the use of punched parts and electrostatic focusing, the tube, which weighs 8 ounces, has been reduced to near minimum weight.

An electron gun of perveance  $5 \times 10^{-4}$  and four equally-spaced doubly re-entrant cavities with gridded gaps are employed. The resulting beam interception

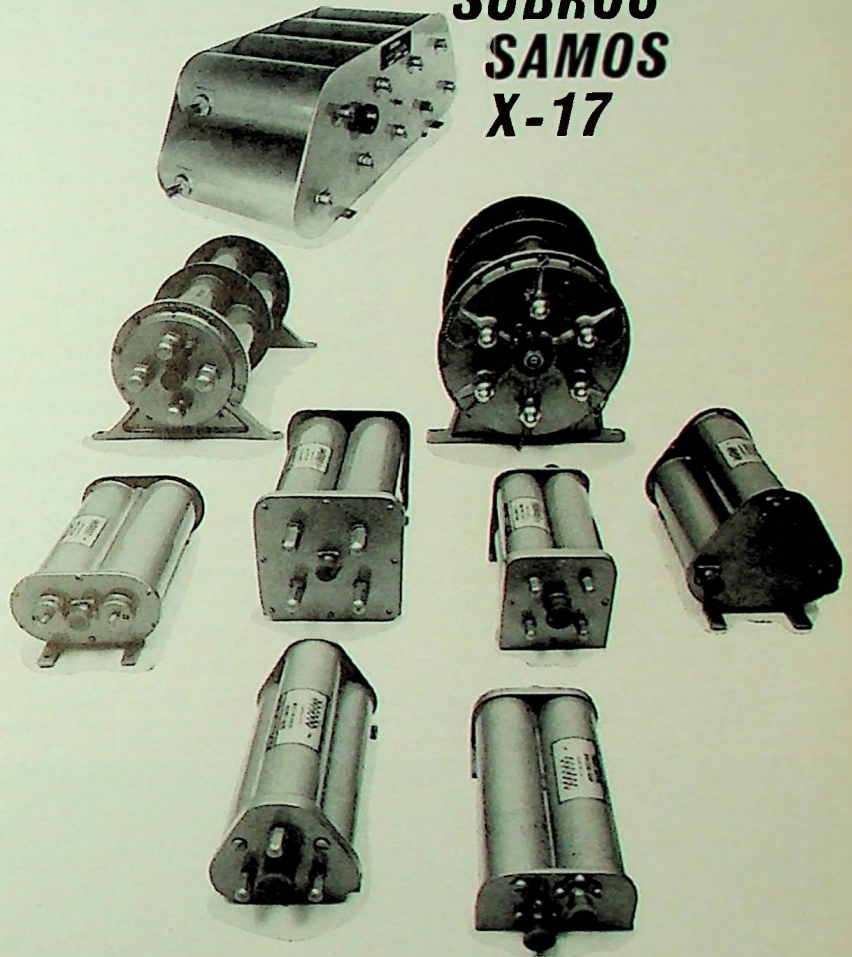
(Continued on Page 30)

**W**e hate stereotypes, generic statements and even veiled illusions. Therefore, we cannot say that all engineers love sports cars. We can say, however, (with some degree of safety) that some do. As a matter of fact, we have one at Rantec that's a nut, with wire wheels and knock off hubs yet. Much has been claimed for this seeming predilection on the part of the engineer. That there is a definite comparison with his own professional art and the whine of an engine at 6000 rpm is, to us, a rather weak argument. This engineer and/or nut is a pleasant enough fellow, quiet, talented (in the extreme, we might add), and a family man with a large second mortgage. At first glance, his demeanor is in, well, the Pontiac class. But if one is possessed of a little insight, one sees deep within this gentleman's eyes a romance — cornering at 65 mph, Weber carbs and overhead cams.

**A**lthough we like this man and respect him, we think all of this is a trifle sad. The modern sports car is truly fine technical machinery, but its popularity in Southern California and Westport, Connecticut, makes them suspect. A love affair between an engineer and a Stutz Bearcat, Mercer Raceabout (with T-head) or a Hispano-Suiza Boulogne we could understand. These cars were great not because of their purities (one gentleman installed a cigarette lighter in his Porsche Super 90 and was drummed out of the Altoona Sports Car Club), but, essentially, because of their impurities. Take the Auburn 13 Boat-Tail, for instance. Now there was a car. Twelve cylinders in line, six miles to the gallon and a lacquered planked wood body that bore a greater resemblance to Columbus' Santa Maria than anything automotive. Yet, at the mere mention of a Deussenberg SJ, our engineer grits his teeth and says, "Can it go from zero to 60 and back to full stop in 20 seconds" We are puzzled. This so-called advantage might be quite good for kangarooing about in downtown traffic or for burping the baby, but for going down to the grocery store for a can of salmon it seems to leave a little something lacking.

**D**espite it all, we are big-hearted, even though this engineer mumbles disrespectfully every time we pass him in the lunchroom, "Detroit iron!". And with such vehemence. We tell you, if it weren't for the fact that he's one of the smartest guys around, we'd... Any engineer with experience in ferrite devices, waveguide components, rf-telemetry devices, microwave subsystems and De Sotos, please call Rantec, Calabasas, California. No Volkswagens, please. They're the worst.

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Frank Gianninoto, George Walker and George Jergenson, are among outstanding designers who will judge this year's Industrial Design awards for WESCON.

WESCON Report Cont. from Page 28

Goldenstern, Donald Montgomery, Dana Johnson, Bruce Angwin, Harry Mayer, S. H. Bellue, Willard Fenn, Hugh Moore, James Reece and Walter E. Peterson.

Additional ladies in committee roles include: Mrs. Robert Gingrich, Mrs. William J. Miller, Mrs. Nathan I. Hall, Mrs. Phyllis Huggins, Mrs. Einar Ingebretsen, Mrs. Herman Ross, Jr., Mrs. Burgess Dempster, Mrs. Harry J. Delaney, Mrs. Donald C. Duncan, Mrs. Edward C. Bertolet, Mrs. Richard B. Leng, Mrs. John C. McAdam, Mrs. Charles Kierulff, Mrs. Thomas Friedman, Mrs. Andrew V. Haeff. An

Checking out Polynesian Restaurant for one of the Ladies Field trips: Left to right: Mrs. Jeff Montgomery, Ladies Program Chairman, Mrs. S. H. Bellue, Mrs. Don Larson, Ladies Program Vice-Chairman, Mrs. Walter E. Peterson (seated) and Convention Director Bruce Angwin.



additional 40 ladies will serve as hostesses for the Women's program.

**Industrial Design**

Twenty-five outstanding examples of electronic package design have been selected for inclusion in the second annual WESCON Industrial Design Awards, to be presented as a part of the big Sports Arena show.

Judges for this year's event include George Walker, vice president for styling, Ford Motor Co.; Bert Gasteneau, Aerojet General; Wilson Bradley, Endevco, and such outstanding designers and design instructors as George Jergenson, Frank Gianninoto, Henry Keck, Storother MacMin, and Harry Greene.

On display will be winning designs in components, instruments, products, and systems, and five of these will be awarded certificates of excellence at the show.

Kenneth J. Slec, Librascope has been chairman, and Robert Saunders, Benson-Lehner, vice chairman of a design committee that includes Dean Johnson, Librascope; Bob Emerson, Gordon MacKay and Alan Johnson, Emerson-Johnson-MacKay; Bob Mason Industrial Design; Howard Assel, Robert Wilson, Wilson-Assel Industrial Design; Jim Craig, Beckman Instruments; Hal Zierhut, Moto Shimano and Pete Klepa, Zierhut/Vedder/Shimano; John Power, industrial designer; Melvin Best, Melvin Best & Asso-

(Continued on Page 32)

reduces the efficiency to 2-4%.

C-W saturated power outputs of from 2-20 watts have been obtained with the four cavities synchronously tuned. The low level, synchronously tuned gain ranges from 25-35 db over the beam voltage range of 500-1500 volts with bandwidths of 10-15 Mc. Synchronously tuned, saturated gains are about 3 db less with bandwidths of 15-20 Mc. If the tube is over-driven and stagger tuned, bandwidths of 20-25 Mc at increased saturated power output and reduced gain may be obtained.

A novel type of differential screw allows easy tunability without backlash over a tuning range of almost 100 Mc.

**SESSION 16**

**COMPUTER CIRCUITS AND DEVICES**

Wednesday, August 24

2:00 PM to 5:00 PM

Sports Arena - Room A

Type of Session: Contributed Papers

Chairman: George Eisler,  
Eisler Associates,  
Los Angeles, California

**1. Diodeless Core Logic Circuits**

By S. B. Yochelson  
Goodyear Aircraft Corp.  
Akron, Ohio

A new logic mechanization system, suitable for digital computers, is described. This system is based on the use of conventional square loop ferrite magnetic cores for all operations. It differs from the common core-diode or core-transistor logic systems in that no semi-conductors or other active coupling elements are needed. It differs from other diodeless core logic systems in that there are no inherent limits on speed, logic capabilities, or branching (fan out) capabilities.

A detailed description of the basic concept of the operation of the circuit is contained in the paper and also, descriptions of the theoretical and practical problems resulting from the non-ideal characteristics of the cores encountered in reducing the basic circuit to successful operation. An analysis is presented relating the core parameters to the limits of operation of the circuit as well as analyses of the requirements of digital logic circuits.

Circuits and photographs of a few simple working examples are included.

**2. A Multi-Addressable Random Access File System**

By E. A. Coil  
Librascope Div., General Precision, Inc.  
Glendale, Calif.

This paper describes the file system developed by Librascope for the Air Traffic Control Data Processor.

This system is unique in that it allows information to be stored in randomly distributed, available locations as identified by the file itself. The data can then be retrieved from the file by addressing the information content directly. The paper's title stems from the fact that many different criteria may be used, either singly or in combination, for the retrieval of any given record.

Program bookkeeping is thus effectively eliminated. No increase in access time is involved over a conventional, fixed address system.

**3. 25-MC Clock-Rate Computer Circuits for Operation from -20°C to +100°C**

By Charles R. Cook, Jr.  
Texas Instruments, Inc.  
Dallas, Texas

Computer circuits have been designed and built for operation at clock-rates up to 25 mc and over a temperature range from -20°C to +100°C. Current-mode, inhibit and complementary circuit techniques have been used to obtain maximum speed with two types of presently available silicon transistors. Conventional high-frequency circuit packaging techniques were used.

(Continued on Page 32)



## WHY A MANUFACTURERS' REPRESENTATIVE

More and more engineers in the electronic industry rely on manufacturers' representatives for *objective advice* in the choice of electronic equipment and components. The "rep" unlike a factory salesman, is not an employee of the manufacturer he represents; his reputation depends on his independence and freedom to make the best recommendations to customers.

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Kenneth J. Slee  
Chairman, Industrial Design

WESCON Report Cont. from Page 30

ciates; Henry Keck, Henry Keck & Associates; W. E. Balla, Salvatore Merendino, and Harry Green, Merendino, Greene & Associates; Huck Dadian, Wayne Takeuchi and Ed Asadoorian, Chaix & Johnson; Bill Hannaford, Displaymasters Inc.; Bill Ward, Aerojet General; Tom Tweedie, Lewis & Tweedie; Charles Cruze, industrial designer; Ted Youngkin, Art Center; John Maguire, U.C.L.A. instructor; George Akin, Consolidated Electrodynamics; Jim Powell, industrial designer; Lincoln Rosay, U.C.L.A. student; and Channing Gilson, Channing Wallace Gilson Industrial Design.

**Socializing**

One of WESCON's most popular events — the all-industry cocktail party — will again provide a prime opportunity for engineers and executives to put aside business and technology long enough to meet and talk with old friends who will be in Los Angeles for the convention.

(Continued on Page 34)



Robert C. Saunders, Jr.  
Vice-chairman, Industrial Design

A full adder circuit has been built (to operate at 100°C) that will give a SUM or CARRY with less than 20 micro sec. delay, when used in a serial application. With parallel organization the CARRY propagation time is less than 15 micro sec. per stage at 100°C.

The shift register and pulse generator used as a clock pulse generator are designed to realize the full adder speed. The pulse generator consists of a complementary delay-line oscillator and amplifier which has only 4 percent change in frequency over the temperature range.

**4. A Dynamic Logic Technique for Sixteen Megacycle Clock Rate**

By T. P. Bothwell, J. Declue, H. H. Hill,  
and J. R. Longland  
Computer Control Company, Inc.  
Framingham, Massachusetts

This paper describes a Family of very high speed dynamic logic packages that perform logic functions at a 16 MC clock rate. Functional equivalence to SEAC logic is achieved with a clocked, symmetrical static logic element, active and passive delay lines.

The paper reviews briefly the background of dynamic logic and discusses the "marriage" of static and dynamic techniques as exhibited in the basic logic element. Discussions include performance, packaging, and typical logical structures.

Generation and distribution of clock signals are considered, as are the problems and solutions of signal transmission associated with 16 MC synchronous logic.

**SESSION 17  
MAGNETIC DATA  
RECORDING**

Wednesday, August 24  
2:00 PM to 5:00 PM

Sports Arena - Room B

Type of Session: Tutorial

Chairman: Warren R. Isom,  
Radio Corporation of America,  
Camden, New Jersey

**1. Extending the Bandwidth of a Conventional Instrumentation Recording System**

By Al M. Wilson  
Precision Instrument Co.  
San Carlos, Calif.

A development program is described in which an investigation was made of two recording systems which differed only in regard to bandwidth capabilities. The paper is divided into two major sections: (1) the results of extended bandwidth in conventional instrumentation tape recording systems; and (2) the technical design improvements necessary to make extended bandwidth practical for use in such systems. The first section discusses the increase in FM noise and the increase (or decrease) in direct noise. The second section discusses many aspects of required technical design improvements: (1) head requirements; (2) amplifier response; (3) bias frequency; (4) dynamic range; (5) tape selection.

**2. The Sensitivity of Reproducing Heads in High-Frequency Magnetic Recording Systems**

By W. T. Frost  
Ampex Data Products Co.  
Redwood City, Calif.

The sensitivity of a reproducing head in high-frequency magnetic recording systems is defined in terms of the frequency losses in the head core. A calculation is made of the variation in sensitivity with frequency in a high frequency reproducing head and a method of measuring the sensitivity is presented with experimental results. This analysis and method of measurement has led to the development of reproducing heads with increased sensitivity.

**3. Comparison of Wideband FM and Carrier Erase Techniques for Recording Data from DC to 10 KC**

By George Work and David Lewis  
Leach Corp.  
Compton, Calif.

Instrumentation engineers responsible for recording data are often concerned with a wide range of frequencies from dc to several thousand cycles, with a variety of input instruments. This paper compares two types of recording systems, one employing wideband FM and the other a carrier erase technique. Design problems and performance characteristics are discussed for both systems together with an analysis of typical experiences in data acquisition by users of these techniques.

**4. A Wideband Magnetic Recording System**

By M. E. Anderson and J. A. Granath  
Armour Research Foundation  
Chicago, Ill.

This paper describes a video magnetic recording and reproducing technique suitable for airborne and mobile use, and particularly suitable for satellite applications. The principle features of the system are: the use of a multichannel common-pole head for non-mechanical scanning, high frequency recording capability with low tape speed, low power drain through use of all solid-state circuitry, area density of information stored on tape, and potential for very compact size and low weight. Essentially, the entire video spectrum is recorded on a number of low-definition tracks whose outputs can be recombined on playback to produce the original signal.

**5. Mechanical Design of the CM-100 Instrumentation Tape Recorder**

By John T. Mullin  
Mincom Div.  
Minnesota Mining & Manufacturing Co.  
Los Angeles, Calif.

A new series of ground-based instrumentation tape recorders has been developed for seven-track, 14-inch reel operation with each track capable of one megacycle performance at a speed of 120 inches per second. The tape transport is designed for mechanical simplicity with a high degree of reliability, compactness, and light weight. Principle design features include modular construction wherever possible, shunt type d-c drive motors independent of power line frequency, dynamic braking, and differential capstans to provide tension in the tape scanning area where the tape passes over the record and playback heads.

**6. Electrical Design and Performance of the CM-100 Instrumentation Tape Recorder**

By George Nels Johnson  
Mincom Div.  
Minnesota Mining & Manufacturing Co.  
Los Angeles, Calif.

This paper describes the electrical characteristics of the instrumentation recorder discussed in the previous paper. In the electronic design, transistorized circuits have been introduced wherever feasible and a new packaging approach has been employed. Two frequency response characteristics for playback are provided: one for flat response from 400 cycles to 1.0 megacycle and another for optimum reproduction of pulse waveforms. Equalizers are provided for each of the 6 tape speeds from 7-1/2 ips to 120 ips.

**SESSION 18**

**MICROWAVE THEORY AND TECHNIQUES: — II: ACTIVE ELEMENTS**

Wednesday, August 24  
2:00 PM to 5:00 PM

(Continued on Page 34)

# ESAKI DIODE

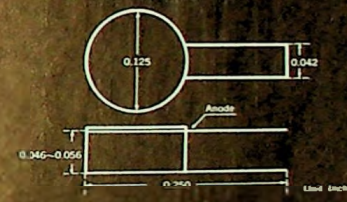
## (TUNNEL DIODE)

INVENTED BY  
Dr. ESAKI  
OF

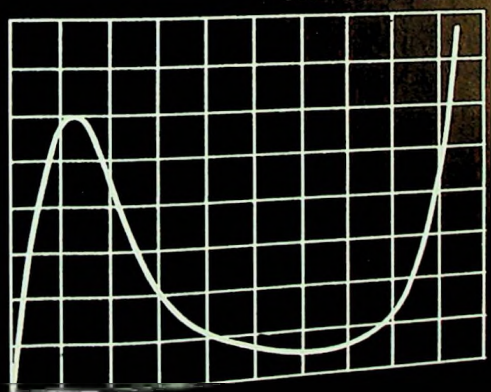
# SONY

Now Available

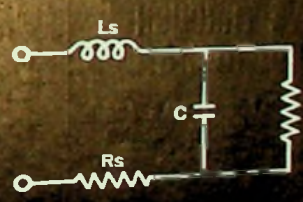
- Construction** Germanium Alloy Junction Type Diode.
- Use** Low level high speed switching,  
Digital pulse circuits, memory matrices,  
Negative resistance Amplifiers.
- Features** Frequency capability is a few Gigacycles.  
Good temperature stability.  
Rugged construction.



### Characteristics.



- $I_p$  2mA  $\pm$  10%
- $I_v$  0.44 mA max
- $V_p$  65 mV mean V
- $V_v$  350 mV mean V
- $I_p/I_v$  5 min
- $V_s$  450~500 mV



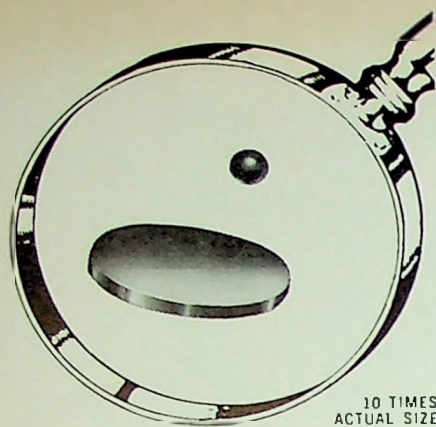
### Equivalent circuit

- R 70  $\Omega$  mean
- C 7  $\mu$ F mean
- Rs 2  $\Omega$  max
- Ls  $\approx$  0.4  $\mu$ H mean

TYPICAL SELF-RESONANT FREQUENCY  $\approx$  3 GC  
SWITCHING SPEED a few  $\mu$ s.

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# MICROWAVE

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## Sports Arena - Room C

Type of Session: Contributed Papers

Chairman: Richard Jamison,  
Hughes Aircraft Company  
Culver City, California

### 1. Masers for System Applications

By H. R. Senf  
Hughes Research Laboratories  
Malibu, Calif.

This paper presents a survey of results of applied research on masers. It is intended to provide general information pertinent to the application of maser amplifiers to advanced system problems.

Noise temperatures of 10° Kelvin or less are available between about 300 MC and 12 KMC with gains between 20 and 30 db. Typical bandwidths for reflection-cavity masers are about 0.7% of the center frequency. Travel-wave masers show promise for achieving bandwidths of up to about 5%. The development of maser materials suitable for use in the frequency range between 10 KMC and 100 KMC is progressing. The results of a preliminary study for the design of a wide band traveling-wave maser at 35 KMC are presented.

### 2. Design and Operation of an S-Band Traveling-Wave Diode Parametric Amplifier

By Clinton G. Shafer  
Raytheon Co.  
Waltham, Mass.

The first part of this design program was to ascertain the necessary conditions for successfully operating a traveling-wave amplifier which utilizes diodes. The theoretical approach used "coupled-mode" theory rather than the more complex filter theory. The device was treated in terms of differential equations rather than difference equations and quantitative answers were obtained without laborious numerical calculations. The same approach has been used successfully in traveling-wave beam-tube work. It not only gave design criteria for obtaining the desired gain and bandwidth but also led to the theoretical expression of the noise figure.

### 3. The Noise Figure of Iterative Traveling-Wave Parametric Amplifiers

By C. V. Bell  
Walla Walla College  
Walla Walla, Wash.  
and  
Glen Wade  
Raytheon Co., Burlington, Mass.

The main reason for interest in parametric amplifiers is their inherent low-noise behavior. The gain mechanism involves a reactive element and hence does not produce noise at the output. However, when semiconductor diodes are used to provide the reactive element, spreading conductances in the diodes and other losses in the circuit constitute sources of thermal noise. By far the most important source of noise within the amplifiers is the thermal noise from the spreading conductances. This paper reports on a theoretical treatment of the noise figure and gives experimental data from noise-figure measurements.

Experimental data were obtained from an iterative traveling-wave parametric amplifier operating at 1.7 KMC. The measured noise figure was 1.2 db. The theoretical calculated noise figure was 1.3 db.

### 4. Theory of Tem Diode Switching

By R. V. Garver  
Diamond Ordnance Fuse Laboratories  
Washington, D.C.

Recently experimental work has been performed in diode switching in TEM-wave transmission lines with a measure of success but with a minimum of theoretical investigation. In this paper theory is presented which explains the three basic modes of diode switching, one of which is heretofore unreported; the isolation and insertion loss bandwidths; the spacing for and isolation from multiple diode switching elements; the bandwidth of the biasing lead; and the peak and average incident power that a diode can switch. It is concluded that

(Continued on Page 36)

Chairman Bill Miller of Burton Manufacturing has declared a western theme for this year's event, which will attract about 2500 to the Ambassador Ballroom and adjoining rooms.

Wild westerners who are helping Chief Wrangler Miller plan the roundup include Robert L. Boniface, Neely Enterprises, vice chairman, and Charles E. Ault, Ault Associates; William H. Burgess, Electronic Specialty Co.; Elvin Feige, Elmar Electronics; Stanley W. Horrocks, Autonetics; Cortlandt Van Rennselaer, Hewlett-Packard Co.; Byron Bromes, Textronix; Wendell Fales, California Electronics Supply; R. E. Honer, Convair, and David N. Marshank, Marshank Sales Co.

### Publicity Workers

Each of WESCON's 14 working committees has had its own built-in public relations counsel during the planning stages, assigned by (Continued on Page 36)



William J. Miller  
Chairman, Cocktail Party

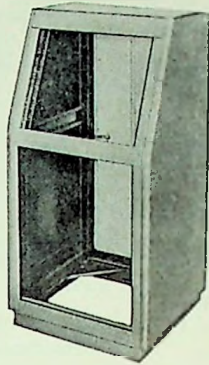
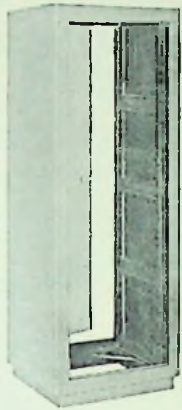


Robert L. Boniface  
Vice-Chairman, Cocktail Party



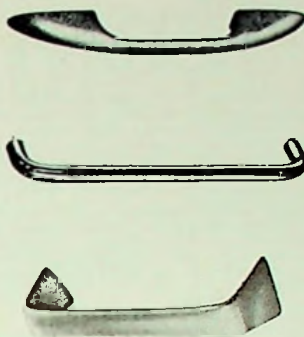
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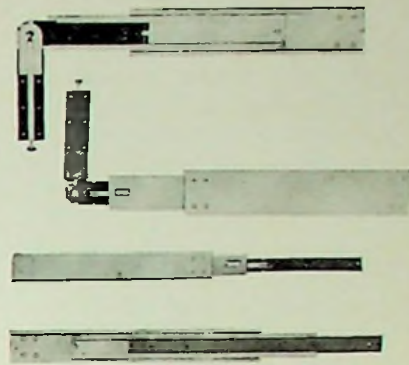
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Polar Electronic Supply  
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Radio Specialties & Appliance Corp.
- TUCSON**  
Standard Radio Parts

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Newark Electronics
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Kierulff Electronics, Inc.  
Federated Purchaser
- OAKLAND**  
Elmar Electronics, Inc.
- PALO ALTO**  
Zack Electronics
- PARAMOUNT**  
Elwyn W. Ley Co.
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Electronic Supply Corp.
- SACRAMENTO**  
Sacramento Electronic Supply
- SAN DIEGO**  
Radio Parts Co.
- SAN FRANCISCO**  
Zack Electronics

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- Peninsula Electronic Supply

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the overall Public Relations committee to oversee publicity plans and help out in other areas where public relations considerations were important.

Each of the other committees has at least one public relations representative to provide liaison. In addition, the Public Relations committee also planned WESCON's opening ceremonies, press coverage of the big show, the annual tour by security analysts, and similar events.

Willard B. Gregory, Beckman, is public relations chairman, and his vice chairman is Richard L. Paulus, Electronics Investment Management Corp. Committeemen include Don Flamm, Ford Aeronutronic; Eugene A. Mathews, Jet Propulsion Lab; David B. Browne, American Electronics; Charles Francis, IBM; Leon Levitt; A. G. New-

(Continued on Page 38)



Willard B. Gregory  
Chairman, Public Relations



Richard L. Paulus  
Vice-Chairman, Public Relations

a switch can be made having a 100-to-1 bandwidth and giving isolation greater than 20 db with insertion loss less than 1 db from 40 mc to 4 gc.

**5. Tunnel Diode Microwave Oscillators with Milliwatt Power Outputs**

By D. E. Nelson and F. Sterzer  
Radio Corporation of America  
Princeton, N.J.

In tunnel diodes, the motion of the electric charges takes place at essentially the speed of light in contrast to the relatively slow motion of the minority carriers in transistors. As a consequence, tunnel diodes are unlike transistors, not limited by transit time effects, and can operate at high microwave frequencies.

This paper describes several microwave oscillators using germanium and gallium arsenide tunnel diodes. Problems connected with stability, oscillation build up, hysteresis effects, etc., have been solved by using Laplace transforms. An outline of design procedures is given.

**SESSION 19**

**INTERACTION OF ENGINEERING AND BUSINESS OPERATIONS**

Wednesday, August 24  
2:00 PM to 5:00 PM

Sports Arena - Room D

Type of Session: Invited Speakers

Chairman: Dr. Norman H. Moore,  
Litton Industries,  
San Carlos, California

Panelists:

Glen P. Biegling, Packard-Bell Electronic Corp.,  
West Los Angeles, Calif.: **MARKETING**

W. R. Lane, North American Aviation,  
Los Angeles, Calif.: **PATENT LAW**

R. T. Silberman, Electronics Capital Corp., San  
Diego, Calif.: **ACCOUNTING AND FINANCE**

**Panel Discussion—  
Interaction of Engineering and  
Business Operations**

How versatile is the engineer? Can he formulate, promote and adhere to the non-engineering aspects of a corporate posture, or is he lost without a slide rule? Three authorities in the fields of marketing, patent law, and management, will discuss the varied roles of engineers in the electronics industry, and the day-to-day non-engineering problems which must be faced.

Customer orientation is the essence of the marketing concept, and Mr. Biegling will stress the technical requirements of marketing people to assure coordination between engineer and customer.

Mr. Lane will discuss the function of patent law in our economy, and the present corporate and government attitudes towards patents.

Mr. Silberman will compare the present and past states of the electronics industry, and advance the thesis that engineering management is essential to the development and application of new technologies for the growth of the industry. He will offer some management tools for determining products, company worth, and short and long term cash flow forecasting.

**SESSION 20**

**VEHICULAR COMMUNICATIONS:— I: RADIATING SYSTEMS**

Wednesday, August 24  
2:00 PM to 5:00 PM

Sports Arena - Room E

Type of Session: Contributed Papers

Chairman: D. L. MacDonald,

Pacific Telephone and Telegraph Company,  
Los Angeles, California

**1. Theory and Performance of Vehicular Center Fed Whip Antenna**

By Helmut Brueckmann  
U.S. Army Signal Research & Development  
Laboratory  
Ft. Monmouth, N.J.

Theoretical design considerations and the results of extensive performance tests of a novel antenna for vehicular communications in the 30 to 76 mc frequency range will be discussed.

Among the many features of this antenna are: the matching problem, for up to ten bands, is solved by providing separate fixed tuned networks in the base selected by remote control; the antenna is center-fed through a coaxial cable terminated at the lower end by a lumped reactor connected to the vehicle body; the mechanical advantages of the whip configuration are retained with no telescoping sections, moving parts or lumped reactors in the antenna itself.

**2. Effects of Tower and Guys on Performance of Side-Mounted Vertical Antennas**

By R. F. H. Yang and F. R. Willis  
Andrew Corp.  
Chicago, Ill.

The Omni-directional pattern of a vertical antenna when side-mounted on a mast or tower, is distorted as a function of tower diameter and separation in wavelength. The pattern is further affected by obstruction of metallic tower guys. Laboratory and field measurements of these effects are presented. Possibility of taking advantage of these effects for special coverage is suggested. Tower effect an antenna impedance is briefly discussed.

**3. A Broadband 160 MC Colinear Array**

By R. F. H. Yang and L. H. Hansen  
Andrew Corp.  
Chicago, Ill.

The design of broadband colinear array is presented. It has a minimum gain of 4 db over a half-wavelength dipole and VSWR less than 1.5 over the 152-162 MC band. The circularity of its horizontal pattern is  $\pm \frac{1}{4}$  db. The array elements are enclosed in a Fiberglas tube and are grounded for lightning protection and reduction in static noise.

**4. Foamflex Coaxial Cable for Communications**

By John Arbuthnott, Jr., A. Laird McKean,  
and Sidney W. Trill  
Phelps Dodge Copper Products Corp.  
New York, N.Y.

During many years demands for very low loss coaxial cables have been satisfied by highly efficient semi-air spaced helix designs such as styroflex and spirafil. Interest in attention losses of similar order but in a cable combining also the physical attributes of a solid insulant led to the evolution of Foamflex.

The paper discusses design characteristics, applications and future developments of the Foamflex.

**SESSION 21**

**COMPONENT AND SYSTEMS RELIABILITY**

Thursday, August 25  
10:00 AM to 12:30 PM

Sports Arena - Room A

Type of Session: Panel Discussion Following  
Presentation of Paper

Chairman: Walter R. Kuzmin,  
Packard-Bell Electronics Corporation  
Los Angeles, California

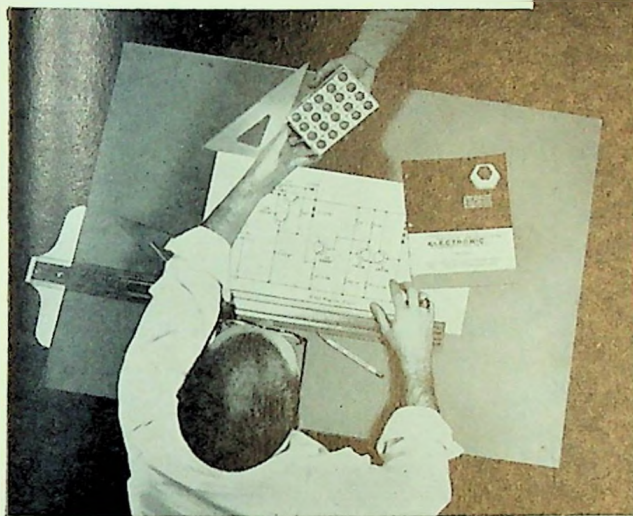
Panelists:

S. Gollin, Walter Darwin Teague Associates,  
New York, N.Y.

(Continued on Page 38)

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
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WESCON Report Cont. from Page 36  
man, General Electric; Dr. R. L. Power, Hoffman Electronics; Tedrow Watkins, Tally Register; Park Irvine, Autonetics; William D. Orr, Thompson-Ramo-Wooldridge; Peter N. Sherrill, Hewlett-Packard; Allen B. Church, Sandia; Mrs. Phyllis Huggins, Bendix Computer Division; Anthony A. Lietzan, System Development; and E. E. Ferrey, Hoffman Electronics. In mid-July Ferrey will take on new duties as manager of WEMA.

**Representatives**

The 1960 Distributor-Representative conference, traditionally held the day preceding WESCON, promises to set new records for 1960. Chairman W. Bert Knight anticipates that more than 600 distributors and factory representatives will be taking part in the all day meeting, which consists of 20 individual conferences, set up according to a  
(Continued on Page 40)

- S. Kukawka, Bourne Laboratory, Inc.,  
Riverside, Calif.
- A. Wood, Relay Division, Leach Corporation,  
Los Angeles, Calif.
- Carlyl C. Elrod, The Ralph M. Parsons Company,  
Pasadena, Calif.

**Using Failure Data for Component Part Derating**

By I. Doshay  
Aerogel-General Corporation  
Azusa, Calif.

The use of failure data on previously designed equipment is suggested for application in derating component part applications in new designs. Certain component part types have been found to exhibit tendencies to become high failure rate items. A means of segregating these items through histogram analysis is used to obtain data on normal and abnormal expectancy. A method of applying such data is explained by example.

Following the presentation of the paper, which presents failure rates of components in an airborne electronic system, a panel composed of component manufacturers listed above will comment from their points of view. The objective of this discussion is to ascertain degree of correlation between systems reliability observations of components and results of component manufacturers' observations regarding such factors as realistic failure rate, derating, application, etc.

**SESSION 22**

**AIR TRAFFIC CONTROL SESSION I**

Thursday, August 25  
10:00 AM to 12:30 PM

Sports Arena - Room B

Type of Session: Related Papers

Chairman: Vernon Weihe,  
General Precision, Inc.,  
Washington, D.C.

**1. Operational Considerations in Air Traffic Control Systems Design**

By Ralph F. Link  
Bureau of Research and Development  
Federal Aviation Agency  
Washington, D.C.

The Federal Aviation Agency's research and development program is directed towards developing a safe, efficient air traffic control and air navigation system for the users of our airspace. To achieve this goal, new concepts and philosophies are being explored. New equipments and systems are being developed and evaluated. Experimental tools are being developed to determine to operational and technical characteristics of the common systems.

The ATC system now under development is briefly described. Guiding principles of research, analysis and development programs for the future system are discussed. Technical and operational problems are reviewed, with some facts and figures on how FAA is solving them.

**2. An Airline Pilot Looks at ATC**

By J. D. Smith  
Air Line Pilots Association  
New York, N.Y.

The paper is directed towards high-lighting current ATC problems and exploring the ATC subject, and questioning whether satisfactory solutions are available in the near future.

**3. ATC from the Aircraft Owners' Viewpoint**

By Victor J. Kayne  
Aircraft Owners and Pilots Association  
Washington, D.C.

The electronic industry is facing a new and powerful challenge in the task of equipping the largest fleet of aircraft in the world (U.S. general aviation) to match the electronic capabilities of the air traffic control system.

Proposals now under consideration by the Federal Aviation Agency to fully exploit the present state of the art and the capabilities of the system should make the potentialities of this challenge all the more intriguing.

It is conceivable that the FAA proposals for "approved" type electronic equipment for all IFR and controlled VFR flight may trigger off a wholesale replacement of present aircraft radio equipment with new equipment designed to more exacting standards. Therein is the challenge to the electronics industry.

**SESSION 23**

**ANTENNAS, SESSION I**

Thursday, August 25  
10:00 AM to 12:30 PM

Sports Arena - Room C

Type of Session: Contributed Papers

Chairman: Louis L. Ballin,  
Hughes Aircraft Company,  
Culver City, California

**1. A New Approach to Antenna Beam-Shaping—The "Coke-Bottle" Antenna**

By C. C. Phillips  
Melpar, Inc.  
Falls Church, Virginia

The theoretical development of a new method of vertical plane beam shaping from Wullenweber three dimensional arrays is presented along with a particular design formulated from the theoretical techniques. The method consists of expanding the desired beam shape in a Fourier full-series expansion and relating the parameters in the expansion to the parameters in the Wullenweber array. Three parameters, interelement spacing, diameter of the Wullenweber at each element, and the amplitude or current distribution along the array are allowed to vary. These three variables are sufficient to derive any arbitrarily shaped antenna pattern with a least-squares approximation.

The antenna to be discussed is basically a Wullenweber array but particularly unique in that the diameter of the Wullenweber changes with height so that it has a characteristic "coke-bottle" shape with an asymmetrical, truncated cosecant-squared beam.

**2. Application of Frequency Scan to Circular Arrays**

By Paul Shelton  
Aero Geo Astro Corporation  
Alexandria, Virginia

The problem of obtaining focusing from a circular array and 360-degree scanning by frequency variation is considered. Whereas an evenly tapped serpentine transmission line provides frequency-scan capability for a linear array, it is shown that uniform variation of the line length between elements allows good focusing from a circular array, to the extent that the required phase correction is approximated by a parabola. The radiating aperture is limited to the appropriate sector of the circle by using filters in the coupling junctions between the serpentine line and the radiating elements. The relation between bandwidth and transmission-line folding factor is determined, and limitations imposed by element coupling, element spacing, and overlapping apertures at the band edges are found. Accuracy of focus is determined as a fourth-power function of aperture size relative to diameter and comparison with the circular reflector indicates this technique to be significantly more efficient. Aperture amplitude distribution is related to the filter characteristics and efficiency of coupling, and the even and odd components resulting from the asymmetrical feed system are calculated. The design of directional filters for partial coupling is described, and the effect of the transfer phase characteristic is calculated.

**3. Low Sidelobe Interferometer Antenna Patterns**

By H. Pfizenmayer and J. A. Kuecken  
Avco Corp.

(Continued on Page 40)

We promise you a reply  
within one week

The complexity of modern technology...the rapid increase in the number of specializations...and the frequent shifts in technological emphasis all have combined to require a staff of alert, aggressive, creative teams of engineering specialists. Their responsibility is to assist management in the formulation of plans for future efforts.

For our purposes the teams should be staffed by graduate Electronic Engineers and Physicists who have acquired several years of experience with radar, guided missiles, computers, infrared detection, nuclear radiation equipment, micro-electronics, underwater

Opportunities in:

## Exploratory Studies · Advanced Planning · Systems Analysis

detection, space propulsion systems or related areas. Several of the positions require the ability to present contract proposals to both technical and non-technical officials. Other positions require the ability to do preliminary systems design. There are twenty-three openings in the above areas at the present time.

All of the positions involve close associations with senior engineers. All of the salaries reflect the unusual backgrounds required.

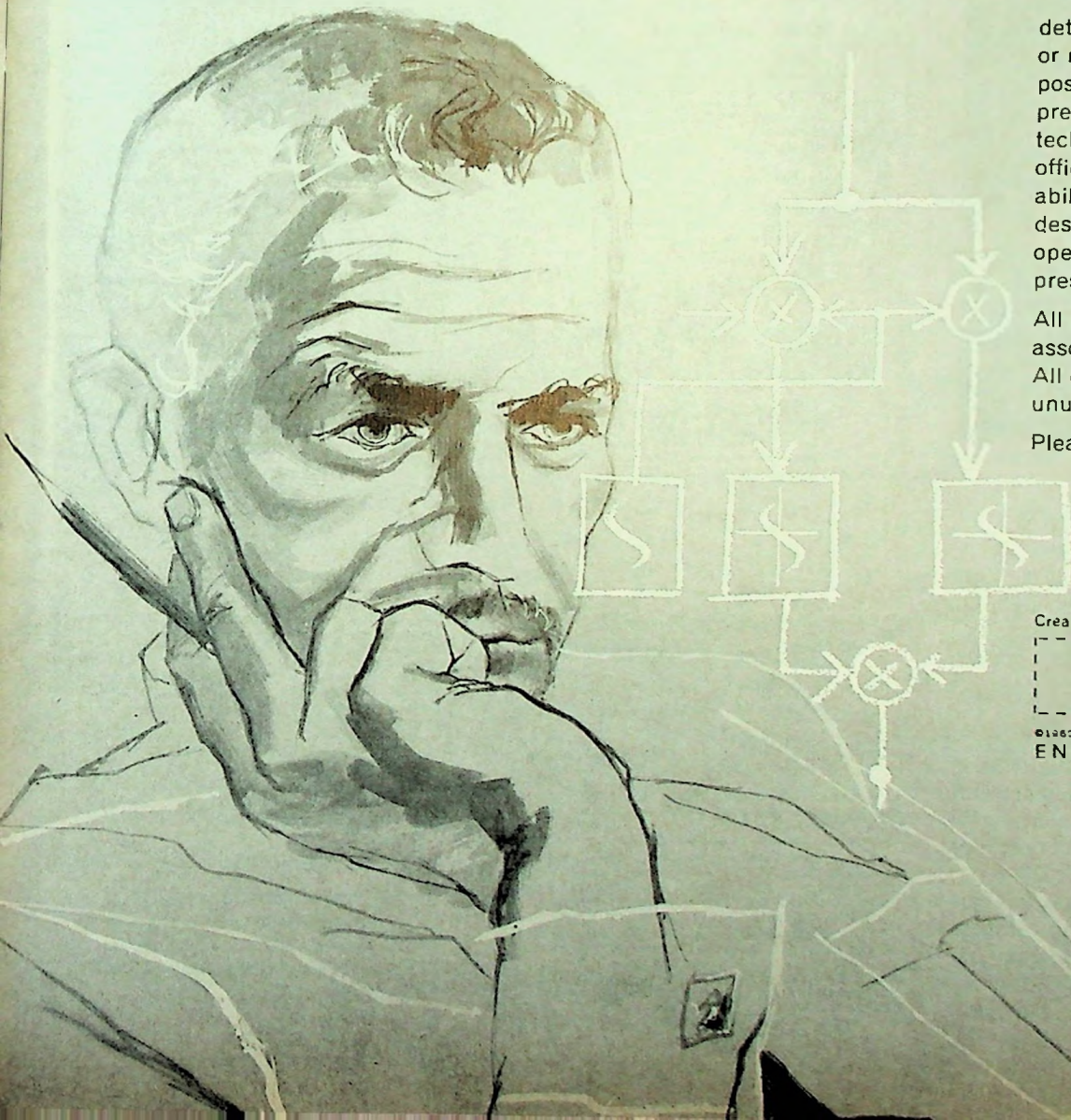
Please airmail your resume to

**Mr. Robert A. Martin**  
Supervisor, Scientific Employment  
Hughes Engineering Division  
Culver City, California

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ENGINEERING DIVISION





master plan in advance.

There will be a Continental breakfast preceding the conference on August 22 in the Ambassador Ballroom, then delegates will go to their first appointments. Ten morning and afternoon meeting periods will be separated by a luncheon.

Knight, assisted by R. V. Weatherford, has directed a planning committee which includes Wendell Fales, California Electronic Supply; A Wayne Prather, Western Radio & TV Supply; Elvin Feige, Elmar Electronics; Ray B. Velliquette, Radio Specialties & Appliance Corp.; Don Thostenson, Burt C. Porter Co.; Herb Becker, Herb Becker Co.; Charles N. Meyer, Meyer and Ross Co.; Carl Uhlmann, W. Bert Knight Co.; Lloyd Norberg, C & G Radio Supply; Jim Murphy, Lou Johnson Co.;



Edward C. Bertolet  
Chairman, All-Industry Luncheon

Allen I. Williams Jr., Allen I. Williams Co.; Andrew H. Fuchikami, Radio Wholesale & Supply; Burt C. Porter, Burt C. Porter Co.; D. W. Hornbrook, L. B. Walker Co. and Buel J. Hastin, Jim Hastin Sales Co.

#### WESCON Climax

Leaders of the industry will gather Friday, August 26 in the Pacific Ballroom of the Statler-Hilton hotel for the all-industry luncheon, traditionally the climactic event of WESCON.

Upwards of 850 persons will attend the affair, including officers of WESCON's co-sponsoring organizations, IRE and WEMA.

Arrangements for the luncheon

(Continued on Page 44)

#### Cincinnati, Ohio

The interferometer antenna is enjoying ever widening use in monopulse radar, radio astronomy and direction finding applications. The principle reason underlying this increase in favor stems from the superiority in angular accuracy over normal single lobed antenna patterns which this antenna can demonstrate on strong, singular, point-source targets. This paper reports the findings of an investigation intended to uncover a series of aperture distributions capable of providing low sidelobe levels and high crossover slopes from an interferometer array. Calculated and measured patterns are presented for small 8-element and large 36 and 60 element linear interferometer arrays.

#### 4. Design Techniques for a Light Weight High Power, Spiral Antenna

By J. P. Jones, P. E. Taylor,  
and C. W. Morrow  
Melpar, Inc.  
Falls Church, Virginia

A light weight spiral antenna with high power handling capabilities has been designed. The spiral is formed by a copper tube embedded in a dielectric material and is backed by a lightweight cavity. The development of this antenna involved an extensive experimental and theoretical investigation which resulted in new data regarding power handling capabilities, maximum absolute gain, polarization, VSWR, beamwidth and efficiency.

#### 5. Phase Distribution of Spiral Antennas

By Normand Barbano  
Sylvania Electric Systems  
Mountain View, Calif.

Several models of equiangular spiral antennas were investigated to determine if they had phase centers. A modified model of an Adcock direction-finding antenna was used in this investigation. This paper describes how the Adcock direction-finding antenna was used to measure the phase front and how it was determined from this that the equiangular spiral antennas do have a phase center. A description of the operation of the Adcock antenna is included.

In addition to discovering that the equiangular spiral antennas have a phase center, the results show the need for additional measurements. These measurements must be made on the phase front using at least an orthogonal polarization.

### SESSION 24

## SYNTHESIS AND DESIGN OF MAN-MACHINE SYSTEMS

Thursday, August 25  
10:00 AM to 12:30 PM

Sports Arena - Room D

Type of Session: Symposium

Chairman: Dr. H. Richard Van Saun,  
Federal Aviation Agency,  
Washington, D.C.

#### 1. Human Factors in the Establishment of System Design Requirements

By Ronald H. Schneider  
Dunlap and Associates, Inc.  
Santa Monica, Calif.

Given a set of operational requirements and a variety of constraints such as cost, design time environmental conditions, moral values and state of the art, the design team performs a systems analysis to determine the functional requirements of the system and uncover possible solutions.

The human factors specialist plays a direct role in establishing the functional requirements for a system whose objectives are man-oriented such as communications and displays systems or those designed to transport, sustain or shelter man.

The functions which man might perform in any of the suggested design solutions are prescribed by the human factors scientist. Among the functions which men can perform better than equipment are: the perception of patterns of light and sound, improvisation and use of flexible procedures, storage of large amounts of information and recall of relevant facts at the appropriate time.

#### 2. The Human Factors Laboratory as a System Design Tool

By Frank N. Marzocco  
Intellectronics Laboratories, Ramo-Wooldridge  
Canoga Park, Calif.

Human behavior is a function of the situation in which it occurs, and a great deal remains to be learned about human behavior in those particular situations of interest to the designer of particular systems. This feature of limited application, of prediction and control in a restricted universe, would raise questions as to specific applicability even if our general knowledge of human behavior were considerably better than it is. When one considers the additional feature that the behavior sciences frequently offer little help even in trying to guess at human capabilities and limitations under definable sets of boundary conditions, it becomes clear that one cannot depend very much upon prior knowledge in any attempt to incorporate humans into man-machine systems. While the behavior sciences are incapable of fulfilling in advance all an applicator's needs for knowledge, the methods used by those sciences are as useful to technology as they are to basic research. The fact that there are great gaps in our knowledge of behavior makes the human factors laboratory of invaluable assistance in the system design process.

The purpose of this paper is to show how one human factors laboratory, using the methods of the behavior sciences, has been able to make important contributions at each stage in the design of a man-machine system.

#### 3. On the Effect of CRT Transfer Function on Detection Threshold

By C. W. Miller  
Head, Radar Branch, Electronics Dept.,  
and  
W. R. Minty  
Engineering Assistant, Electronics Dept.  
Cornell Aeronautical Laboratory, Inc.  
Buffalo, N.Y.

Since the birth of radar systems, a scant few years ago, tremendous strides have been made in nearly all aspects of radar system improvement.

This is particularly true of all electronic and mechanical portions of the system which are amenable to precise measurements and evaluation. Yet, for the very large number of systems which utilize a cathode ray tube (CRT) display and human

observer as the data readout and interpretation system, a great amount of research must still be performed before optimum system performance can be achieved.

There is a great concern, for example, in a one db improvement in mixer crystal noise figure. This paper will review experiments which indicate that 6 db improvement can readily be obtained in the same system by optimization of a single variable parameter in the CRT-human observer link. This parameter of particular interest is the transfer function, the relationship which for a given input (and side conditions) determines a specific output.

#### 4. Introduction to Teaching Machines

By Stanley L. Levine  
Litton Industries  
Berly Hills, Calif.

A teaching machine is a controlled device with which, through the interaction of it and a student, the student's behavior is changed in a predetermined manner (the student learns what the device is programmed to teach). It differs from an audio-visual device in that it is specifically designed to utilize the laws of learning in facilitating learning rather than acting only as a teaching tool to be manipulated by a teacher.

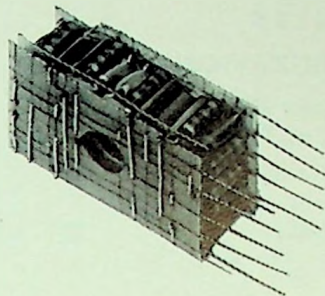
This paper will discuss the field of teaching machines and indicates possible implications.

A typical teaching machine is described, and the general theory of machine teaching is discussed. Applications, present and future, are described, and some speculation is made on the future of this rapidly expanding field.

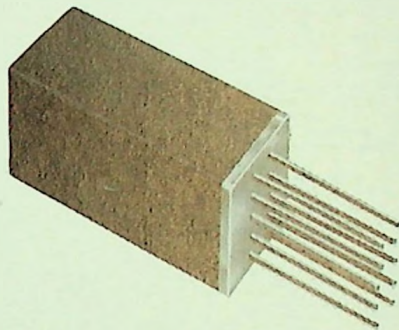
#### 5. A High-Speed Color Display Unit\*

By Wright H. Huntley, Jr.  
Systems Techniques Laboratory  
Stanford Electronics Laboratories  
Stanford University, Stanford, Calif.

(Continued on Page 42)



## how do you play the numbers game?

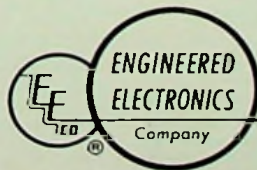


The current numbers game consists of seeing how many components you can wedge into a small space. But there's a catch to it.

Some circuit modules may seem small until you string them together and find that interconnections and supporting structure take more space than the modules themselves. That's why it's important, in evaluating miniaturization, not to consider the module size alone, but to be concerned with the over-all size, including module, interconnections, and supporting structure.

New **EECO MINIWELD** circuit modules are designed with over-all system size in mind. They offer optimum miniaturization not only of modules, but also of interconnections and supporting structure. Add to this the reliability of proven circuits incorporating readily available standard catalog components rather than hard-to-get specials, the superior strength of welded rather than soldered connections, and you have an unbeatable combination of advantages.

We invite you to see for yourself at **WESCON, Booth 1017.**



*Write, wire, or 'phone today for detailed information on the revolutionary new MINIWELD space-saving package.*

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E. H. Lockhart  
Vice-Chairman, All-Industry Luncheon

This paper describes a high-speed color display unit which has been constructed for the evaluation of color in increasing the information handling rate of operator-oriented electronic-readout systems. Ordinary CRT displays for some systems, when they encounter high data rates, tend either to overload the operator or to be so selective that much of the available information is lost.

System requirements and constraints are discussed, and the evaluation equipment, using a special Chromapix or "Laurence" tube, is described. Special problems are discussed, as well as some solutions, illustrated by color slides.

\*Work presented in this paper was supported jointly by USASRDL under Contract DA 36 (039)-sc-78296 and USAF under contract AF(616)-6207.

## SESSION 25

### MICROMINIATURIZATION

Thursday, August 25  
10:00 AM to 12:30 PM

Sports Arena - Room E

Type of Session: Tutorial Papers

Chairman: T. Liimatainen,  
Diamond Ordnance Fuze Laboratory,  
Washington, D.C.

#### 1. Design and Fabrication of a Microelectric I.F. Amplifier

By J. R. Black  
Motorola Corp.  
Phoenix, Ariz.

The design procedure and construction processes required to manufacture an electronic functional element in thin-film form are presented. A two-stage RC coupled 5 mc I.F. amplifier is used as an example. Emphasis is placed on the ease of design permitted through the use of thin film (two-dimensional) techniques. The ability to construct R and C components to a wide range of values and to close tolerances leads to designability. Factors concerning reliability, flexibility of design, cost, and component or functional densities will be included.

#### 2. A Packaged Micromodule Laboratory for Industry

By Donald T. Levy  
Semiconductor & Materials Division  
Radio Corporation of America  
Somerville, N.J.

The Micromodule concept presents an advanced, proven method for reducing circuit mass without any loss of performance reliability. This paper describes a compact, practical package Micromodule Laboratory containing processing equipment and microelement components together with instructions for this use. The package laboratory enables an engineer to design, assemble, and test experimental Micromodules. Microelement components have been specially designed for use in this packaged laboratory so that a minimum stock of microelements will provide a maximum range of component values. This widened range is made possible by the use of resistors and capacitors having adjustable values, and by allowance for many various termination possibilities. Simplified assembly and encapsulation techniques have been developed for use with the Laboratory, and a set of tools and fixtures which simplify the construction of experimental Micromodules is described.

#### 3. Semiconductor Packaging for High Component Density Applications

By George P. Walker  
Rheem Semiconductor Corp.  
Mountain View, Calif.

Some packaging approaches for high component density circuits, are presented. The discussion will be primarily concerned with miniaturized packaging of transistors of the medium power class and diodes of the fast switching computer types.

A functional package of the conventional, i.e., glass to metal seal, resistance welded type will be described. Performance test data will be given. Other approaches, i.e., ceramic, ceramic-metal, etc. will be mentioned briefly, but emphasis will be on miniature packages using conventional sealing and welding techniques.

Thermal problems will be discussed and some functional design approaches for heat dissipation

indicated. Other packaging considerations that become more critical as the package size is reduced will be taken up. This will include mechanical and thermal stress problems in the seal area as a function of welding and temperature cycling, thermally induced stress in the semiconductor device as a function of surrounding materials and silicon device assembly techniques for some specific, small packages.

#### 4. Surface Passivation as Applied to Micro-Components

By T. C. Hall  
Pacific Semiconductors, Inc.  
Culver City, Calif.

A new approach to semiconductor micro-component packaging employing surface passivation is presented. The term "passivation" is defined to mean the generation on the semiconductor surface of a strongly-bound chemical film layer which does not adversely affect those surface electronic properties leading to acceptable device characteristics. In addition, a condition of electrical stability of the surface is provided, together with isolation from those electrical and chemical environmental influences leading to change in device characteristics. The merits of the new approach in contrast to conventional hermetic packaging are considered. Experimental results demonstrating the superior device performance-reliability characteristics of diode structures treated in this manner are discussed.

In addition to improved device performance and reliability, significant and critical advantages in microminiaturization and device fabrication are realized.

#### 5. Silicon Layer Junctions—A New Concept in Microcircuitry

By J. Allegretti and D. J. Shomberl  
Merck, Sharp & Dohme  
Rahway, N.J.

The deposition of successive layers of single crystal silicon on single crystal silicon substrates introduces an advance in technology for microelectronics. Alternating single crystal silicon layers of controlled resistivity and type permit the introduction of many functional elements directly into a structure. The functional elements that have been deposited include capacitors, resistors, rectifiers, voltage limiting Zener diodes, pnpn transistors and solar cells.

Each of the functional elements have been deposited and measured individually. Electrical performance and metallographic data of these configurations will be presented. A five layer and seven layer structure has been deposited and simple prototypes made from these structures are presented.

#### 6. Solid State Micrologic Elements

By L. Kattner, J. Last, and J. Nall  
Fairchild Semiconductor Corporation  
Palo Alto, Calif.

A family of low power — high speed micrologic elements is discussed. The elements, which include flip-flops, gates, adders, shift registers, and buffers, are compatibly designed to form an interconnectable set to perform all logic function requirements in a typical digital computer. In their design and use, the emphasis is placed on the logical function to be performed rather than on the circuit details of the element.

The elements, produced on single silicon substrates, are constructed using extensions of the conventional transistor fabrication techniques of solid-state diffusion, metal evaporation, and photolithography. The elements are packaged in multiple lead TO-5 and TO-18 headers for convenience in handling and to assure high reliability.

The elements are designed for operation at a speed of 10 mc over a temperature range of -55°C to +125°C, with an average power dissipation per element of 30 mw.

Operational data, reliability considerations, and systems applications will be discussed.

## SESSION 26

### GOVERNMENT AND INDUSTRY: ENGINEERING PROPOSALS

Thursday, August 25  
2:00 PM to 5:00 PM

(Continued on Page 44)



Al J. Rissi  
Chairman, Visitors' Services



C. T. "Kap" Kierulff  
Vice-Chairman, Visitors' Services



## UNIQUE NEW EIMAC 3CX10,000A3 CERAMIC TRIODE OFFERS VHF POWER - UP TO 20 KW

Eimac expands its ceramic tube line with the introduction of the 3CX10,000A3 — the only 10 kilowatt air-cooled ceramic triode in the field. This advanced power tube is intended for use at maximum ratings through 110 megacycles.

An outstanding feature of this clean, efficient ceramic triode is the large reserve of grid dissipation assured by platinum-clad tungsten grid wires. Overload protection has also been built into the 3CX10,000A3 to make it ideal for use in industrial heating — dielectric and induction.

This newly developed triode is also well suited for such applications as broadcast, FM and single-sideband transmitters, ultrasonic generators and sonar pulse amplifiers. It can also be used as a class-AB<sub>2</sub> or class-B linear amplifier in audio or r-f service.

A companion air-system socket and chimney, as shown above, is available with the 3CX10,000A3 to meet your specific requirements. Watch for a low mu version of this high-power triode in the near future.

### GENERAL CHARACTERISTICS

EIMAC 3CX10,000A3 CERAMIC TRIODE	Height	Diameter	Max. Operating Temp.	Filament Voltage	Filament Current	Frequency for Max. Ratings	Max. Plate-Diss. Rating
	8.25"	7.0"	250°C.	7.5	102 amp.	110 Mc.	10,000 watts

**EITEL-McCULLOUGH, INC.**  
San Carlos, California



**Sports Arena - Room A**

Type of Session: Panel Discussion

Moderator: Cmdr. W. Ten Hagen, USN,  
Bureau of Weapons, Western District,  
El Segundo, California

**Panelists:**

- James Tassen, Contracts Division, Bureau of Naval Weapons, Washington, D.C.
- C. E. Petrillo, U.S. Army Signal R&D Laboratory, Ft. Monmouth, N.J.
- J. B. Lewi, Packard-Bell Electronics Corp., Los Angeles, Calif.
- N. Klumph, Western Development Laboratories, Philco Corp., Palo Alto, Calif.
- Ray Nordlund, Wright Air Development Div., Dayton, Ohio

**Government and Industry:  
Engineering Proposals**

The defense electronics industry is justifiably concerned with the large amount of time and effort being devoted to engineering proposals prepared in the quest for military contracts. The increase in these costs can undoubtedly be attributed to several factors, including increased competition and government requirements. It is the purpose of this panel discussion to explore constructively from both industry and government viewpoints how the government can still select the most qualified bidder and yet reduce the total proposal cost to the bidders. Representatives from each prime service will explain their methods of evaluation and their needs for the requested information. Industry representatives will explore in depth the industry problem and suggest methods for streamlining the evaluation system.

Following discussion between panel members, questions from the audience will be actively solicited.

**SESSION 27**

**AIR TRAFFIC CONTROL  
SECTION II**

Thursday, August 25  
2:00 PM to 5:00 PM

**Sports Arena - Room B**

Type of Session: Related Papers

Chairman: Glen P. Biaging,  
Packard-Bell Electronics Corp.,  
Los Angeles, California

**1. Central Data Processor of the Air  
Traffic Control System**

By Lane Wolman  
Librascope Division  
General Precision, Inc.  
Glendale, Calif.

The paper discusses various features of the Central Data Processor designed for the Federal Aviation Agency. The system contains a high-speed general purpose computer, a file control system, a multiple magnetic drum file system, a highly multiplexed buffer system, and a switching system for rapid exchange of on-line and spare computers. Basic characteristics of the individual elements of the system such as extensive error checking are discussed, as well as special features such as the file key search, which are particularly needed for Air Traffic Control.

**2. Data Processing Requirements of the  
FAA Air Traffic Control Data  
Processing Central**

By Norman Pomerance  
GPI Division of General Precision, Inc.  
Pleasantville, N.Y.

This paper begins with a discussion of the functional requirements of the FAA Data Processing

Central which is composed of a central data processor and peripheral display console. Following the initial discussion, a description of the controller displays and their functions is presented. The paper concludes with a description of the system and peripheral display requirements imposed on the central data processor.

**3. Automation in Air Traffic Control**

By Rodger E. Davis  
Radio Corporation of America  
Camden, N.J.

Satisfaction of the need for automatic communications for Air Traffic Control in the form of an ATC data link has been delayed due to a lack of defined operational characteristics. Many factors have contributed to this lack.

FAA AGAGS (Automatic Ground/Air/Ground Communication System) developed by RCA for the R & D Bureau, is an experimental system designed to investigate automatizing more routine controller-pilot radio traffic. The concept utilizes two-way time division digital data transfer over existing communication links to provide the exchange of information requests and instructions.

This equipment has been delivered to the National Aviation Facilities Experimental Center and is under test and evaluation. The status of the program will be discussed together with a reflection of FAA test results.

**4. The Need for Automatic Air Traffic  
Control**

By Howard K. Morgan  
The Bendix Research Corp.  
Detroit, Mich.

Inability to "see and be seen" at high speed or altitude plus growing peak air traffic densities are giving rise to increasing "near miss" reports. Traffic control around terminals is not the answer since only part of the traffic is included. Neither will a projected increase of Controllers from 12,000 to 48,000 over ten years, or less, be effective as a means of increased control. Rather than slow control methods which private pilots dislike and the Military cannot tolerate, an Automatic Air Traffic Control System is required.

The features of Positive Area Control are found in using a computer to handle routine tasks, supplying positive continuous pilot information, expeditious resolution of potential delays, reducing verbal communications and eliminating calculated fix times. These plus the necessary elements of a Positive Area Control Concept will be discussed.

**5. Future Trends in Air Traffic Control as  
Influenced by Modern Data-Processing  
Techniques**

By A. G. VanAlstyne  
Gilfillan Bros., Inc.  
Los Angeles, Calif.

The present ATC-6 "posting system" evolved as a consequence of certain characteristics of the early navigation aids, and requires extensive participation of the pilot in the form of position reports. Modern navigation methods might free aircraft from the restraint of the air ways if the ATC system could accept and process position reports at random points and times. Data-processing methods are available which could perform such an ATC separation-monitoring function, but the data-input complex would be prodigious in size and cost. It is suggested that ATC data processors should be inputted by modern sophisticated radars designed especially to function with the data processors. The resulting system will at least separate the navigation function from the traffic control function and allow the maximum freedom of movement for all classes of air space users. Such a radar-inputted system would enjoy ready acceptance both economically and operationally.

**SESSION 28**

**ANTENNAS, SESSION II**

Thursday, August 25  
2:00 PM to 5:00 PM

**Sports Arena - Room C**

Type of Session: Contributed Papers

Chairman: Charles E. Dunn,

(Continued on Page 48)

**Ladies to Visit  
Unusual Homes**

Mrs. Lois Montgomery, chairman, WESCON'S Women's Events, has released details on the tour of two Southland homes.

The tour on August 24 will visit the Fred Cole and George Brubaker homes in Hollywood and Brentwood, respectively, and end with a special luncheon at the famed Santa Ynez Inn near the Pacific on Sunset Boulevard.

The home of Fred Cole (he is the originator of Cole swimwear) is high atop the Hollywood Hills above the Sunset Strip. Its contemporary Tahitian architecture and decor has been featured in national magazines as one of America's finest residences.

**Fire Fountain**

The two-level structure features a master bedroom with massive beamed ceilings just off the upper-level entry. On the opposite side is a triangular swimming pool, at the peak of which is a fire fountain used for evening entertaining.

The lower level includes a music room and den, with a sound system, television, and motion picture equipment in its entertainment center, and Russell Holmes iron sculpture over the fireplace.

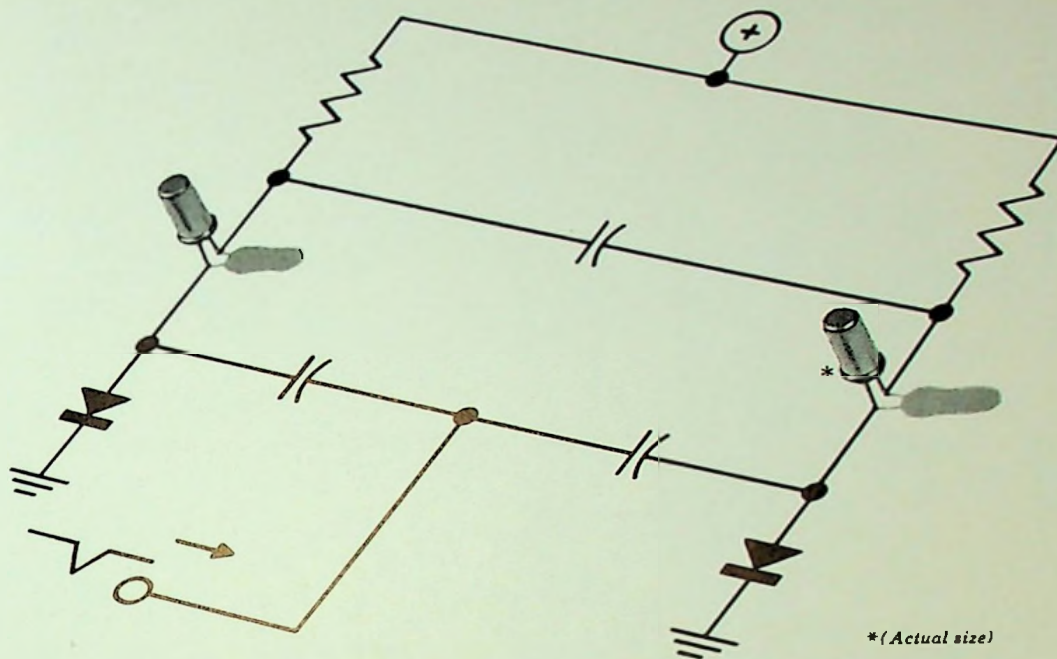
The adjoining living room has a triangular glass wall on each side, one of which opens to the landscaped pool area, the other to a cantilevered wooden deck. Draperies are beaded bamboo, reminiscent of glistening tropical rain. The third wall of the room is a fireplace wall of fieldstone, highlighted by a decorative Japanese wedding obi.

(Continued on Page 70)

**WESCON Report Cont. from Page 40**

are being directed by Edward C. Bertolet, Behlman Engineering, chairman, and E. H. Lockhart, R. O. Roberts Co., vice chairman, and a committee that includes V. J. Braun, System Development Corp.; R. H. Langer, Electronic Engineering; John S. McCullough, Eitel-McCullough; John O'Halloran, O'Halloran & Associates; J. V. N. Granger, Granger Associates, and Paul Hanover, Hughes Aircraft Co.

Visitors' Services, with information desks in each major hotel, providing information on the city and WESCON events will be handled by A. J. Rissi, and C. T. "Cap" Kierulff Electronics, Inc.



\*SHOCKLEY 4-LAYER DIODES used in simple and inexpensive multivibrator circuit for high speed operation over a wide range of temperatures.

## A NEW FLIP-FLOP CIRCUIT

A new and simple method for building flip-flop or multivibrator circuits is to use two (just two!) Shockley 4-layer diodes. After all, the 4-layer diode is a solid-state switch...just what's needed in a flip-flop.

Because of low cost, wide range of power handling, and high speed, 4-layer diodes can be used for many flip-flop applications - handling currents from a few milliamperes to 20 amperes...repetition rates as low as 1 cps to hundreds of kc...voltages from 20 to 200...temperature ranges from  $-60^{\circ}\text{C}$ . to  $+100^{\circ}\text{C}$ .

There is circuit versatility, too. It can be triggered or free running. It can be designed so positive pulses

drive it to one side, negative pulses to the other; or so each pulse drives it to one side for a specified time then reverts automatically to the other side until the next pulse. Best of all - only 9 components are required...the free running flip-flop has only 7!

Our new Multivibrator Data Sheet will tell you more. Or, maybe you're interested in how the 4-layer diode can simplify and solve other circuit problems, such as pulse modulators, ring counters, alarm circuits, magnetic memory driving, d-c to a-c inverters, oscillators, detonators, or pulse amplifiers. Call your local Shockley representative or write Dept. 5-2.

*Shockley* TRANSISTOR  
 UNIT OF CLEVITE TRANSISTOR  
 STANFORD INDUSTRIAL PARK, PALO ALTO, CALIF.



EXPANDING





*Herodotus, the historian, records (490 B.C.) the use of burnished shields for military signaling. This was the forerunner of the heliograph, invented by Sir Henry C. Mance, which came into wide use centuries later.*

# THE FRONTIERS OF SPACE TECHNOLOGY IN COMMUNICATIONS

Lockheed's interest in developing the science of communications extends from the depths of the oceans to deep space. Its Missiles and Space Division research programs deal with the development and application of statistical communication and decision theory in such areas as countermeasures; telemetry multiplexing and modulation; scatter communications; multiple vehicle tracking; millimeter wave generation and utilization; sonic signal detection and processing; avoidance of multipath degradation; and interference avoidance.

Associated research and development efforts are directed toward propagation studies and advanced antenna design; low noise amplifiers; vehicle borne signal transmission and reception, data storage and processing; solid state materials and devices.

The scope of such activities extends from advanced studies of naval communication problems on and under the oceans; the many applications to satellite vehicles; on to the specialized communication problems of deep space explorations. Latter needs are exemplified by high frequencies, low weight and power, high stability, low effective bandwidth, extreme reliability and basic simplicity requirements.

**Engineers and Scientists:** Investigating the entire spectrum of communications is typical of Lockheed Missiles and Space Division's broad diversification. The Division possesses complete capability in more than 40 areas of science and technology — from concept to operation. Its programs provide a fascinating challenge to creative engineers and scientists. They include: celestial mechanics; communications; computer research and development; electromagnetic wave propagation and radiation; electronics; the flight sciences; human engineering; magnetohydrodynamics; man in space; materials and processes; applied mathematics; oceanography; operations research and analysis; ionic, nuclear and plasma propulsion and exotic fuels; sonics; space medicine; space navigation; and space physics.

If you are experienced in work related to any of the above areas, you are invited to inquire into the interesting programs being conducted and planned at Lockheed. Write: Research and Development Staff, Dept. H-101, 962 W. El Camino Real, Sunnyvale, California. U.S. citizenship or existing Department of Defense industrial security clearance required.

## **Lockheed** / MISSILES AND SPACE DIVISION

*Systems Manager for the Navy POLARIS FBM;  
the Air Force AGENA Satellite in the DISCOVERER,  
MIDAS and SAMOS Programs; Air Force X-7; and Army KINGFISHER*

SUNNYVALE, PALO ALTO, VAN NUYS, SANTA CRUZ, SANTA MARIA, CALIFORNIA  
CAPE CANAVERAL, FLORIDA • ALAMOGORDO, NEW MEXICO • HAWAII



# Seventh Region Sections Enjoy Banner Year

In addition to the basic function of telling you, as a 7th Region IRE Member, about the preparations being made for your attendance at WESCON, the August issue of the Grid-Bulletin has attempted for the last couple of years to provide a forum in which each of the 16 sections of the Region may summarize their year's activities for the information of the remainder of the Region.

In compiling this year's 7th Region Roundup, the editors acknowledge with gratitude the cooperation that has been received from officers of the various sections. These busy individuals have found the time necessary to provide information and pictures in such quantities as to approach closely the editor's dream of 100 per cent coverage.

—Frank Haylock  
Grid Editor



Group of Alamogordo-Holloman officers comprises W. S. Stotts, secretary-treasurer, V. C. Nolte, chairman, H. E. Wagner, first vice-chairman, and H. R. Velliquette, second vice-chairman.

## Alamogordo-Holloman

Membership in the Alamogordo-Holloman Section has now grown to 125 and the Section is entering a period of expansion fully to realize its growth potential. Under the chairmanship of Dr. Mark Jones, the Section presented interesting meetings on such diverse subjects as Solar Flares (Dr. H. Evans), Modern Stereo (Paul W. Klipsch), Analog and Digital Computers (Major Clarence L. Johnson), Meteor Influence (Horace T. Castillo), Electronic Teaching Machines (Dr. R. F. Mager), and Amateur Radio (Capt. J. L. Reinhartz, USN).

One of the Section highlights of the year was a visit by John N. Dyer, vice president residing in North America and C. W. Carnahan, director of the Seventh Region IRE. A luncheon was set up with the Section officers attending and a field trip was conducted through

many of the facilities at the Air Force Missile Development Center.

The Student Papers Committee selected Charles Burmeister (from the State Science Fair held at the New Mexico State University) to represent the Section at the WESCON Future Engineers Show. His subject was "The Calculation of the Mass of an Unknown Particle in an Ionization Chamber." Later, in statewide IRE competition, Charles won and was awarded a \$500.00 scholarship to the University of New Mexico.

The annual meeting saw the following officers elected for the coming year: Major Ursel C. Nolte, chairman; Lt. Harry E. Wagner, first vice-chairman; Howard R. Velliquette, second vice-chairman; and William S. Stotts, secretary-treasurer. Due to military transfers, Major Nolte has already been forced

(Continued on Page 50)

Technical Program Cont. from page 44

Convair Division of General Dynamics, Inc.,  
Pomona, California

## 1. Continuous Bistatic Echo Area Range

By J. W. Eberle  
Ohio State University  
Columbus, Ohio

A description is given of an echo area range using coherent detection that has the capability of measuring the quadrature components of a complex scattered signal as a continuous function of bistatic angle. The system is of such a nature that no direct linkage is required between the transmitter and the bistatic receiver to maintain coherence thus permitting much improved accuracy. A technique is given that permits the effects of any background reflection to be eliminated, thus circumventing the need for any R.F. transmission line between transmitter and receiver for background nulling purposes. The bistatic range of the system is continuous from zero degrees (monostatic) to 180° (forward scatters). Typical patterns are shown as well as applications of such measurements.

## 2. Fresnel Region Boresight Methods

By Alfred Bogush  
Radio Corporation of America  
Moorestown, N.J.

Two methods of "boresighting" a monopulse antenna in the fresnel region of propagation are described and compared.

The first is a tower method and its limitations are described. Included is a discussion of a fresnel region equation with a theoretical null position variation with range shown along with measured results. The aperture distribution considered is the sum of a uniform and sinusoidal function.

The second method "Auto Collimation Boresighting" employs a boresighting screen positioned at ranges in the order of a reflector diameter. For the problem of field distribution behavior, a different employment of the same basic equation is discussed. This equation reduces the limitations of the fresnel region equation at points close to the aperture. Computed and measured results of the Auto Collimation method are presented.

## 3. The Zone Plate as a Focussing Element

By L. F. Van Buskirk and C. E. Hendrix  
U.S. Naval Ordnance Test Station  
China Lake, Calif.

Certain corrections to the Fresnel theory are necessary for zone plates with focal lengths of only a few wave-lengths. Formulas are derived for the gain of these zone plates as a function of the number of zones and the focal length. Theoretical values are compared with experimental results. The advantages of the zone-plate relative to a parabolic reflector are illustrated by a proposed design for a large radio telescope.

## 4. Beacon Antennas for Project Mercury

By D. F. Shea, D. Alstadler, W. O. Puro  
Melpar, Inc.  
Falls Church, Virginia

This paper describes the design and development of an S and C Band Beacon Antenna system for Project Mercury. Newly developed fabrication techniques facilitate the use of materials such as fused quartz which are unique in the field of antenna design. The systems provide circularly polarized, omnidirectional radiation coverage which is optimum for reliable lock-on of ground-based tracking antennas.

The design parameters of this relatively unexplored antenna type are presented in detail and the electrical performance characteristics, with illustrative graphs and radiation patterns, are discussed. Electrical behavior of the system during laboratory-simulated launch and re-entry conditions is also described.

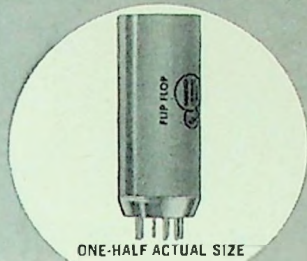
## 5. Miniaturized VHF-UHF Antenna

By F. P. Brownell and D. E. Kendall  
The Martin Co.  
Denver, Colo.

Miniaturized slot antennas are frequently required for aircraft and missile applications. A design procedure for ridged waveguide cavity fed slot antennas has been derived. The procedure may be used for both single ridge cavities and dual ridge cavities with the ridges laterally separated. Both configura-

(Continued on Page 50)

# EECO PACKAGED CIRCUIT MODULES for digital systems engineering



ONE-HALF ACTUAL SIZE



## T-SERIES Germanium Transistor Plug-in Circuit Modules

A complete family of reliable, low-cost, 250-kc transistorized digital circuits for service in compact systems and equipment. Units incorporate standardized signal levels for compatibility and discrimination against false triggering. They also feature consistently conservative electrical specifications, standard package outline, and simple power requirements ( $\pm 12$  volts), as well as compatibility with EECO N-Series decodes and R-Series Minisig indicators. This family also includes core-transistor circuits that are compatible in physical packaging, frequency, signal levels, and power supplies.

Circuit designs are based on derated specifications for the components used, and the resulting circuit specifications are then further derated to give reserve reliability. (Units typically designed for 50% greater frequency range than rated in guaranteed specifications.)

Typical 300-kc RS Flip-Flop, unit price \$26.80 to \$33.15.

## T-SERIES BREADBOARD EQUIPMENT

The unique EECO T-Series Breadboard and plastic circuit cards enable you to set up, change, or take down experimental arrangements quickly — without waste of time or materials. Unit contains all necessary permanent wiring to accommodate any regular T-Series circuit. All other circuit inter-connections are made by patch cords or plugs, with the prepunched circuit cards to guide you and to provide a symbolic diagram of the system when completed.



## MINISIG® Sensitive Transistorized Indicators

These proven sensitive indicator devices occupy no more panel space than conventional indicators, yet operate directly from low-level signals. Many different models are available, most of which incorporate built-in high-sensitivity transistorized driver circuit to give "on-off" indication where the signal excursion is too small (2 to 3 volts) for direct operation of neon or incandescent lamps. Models include neon, filament, high-temperature, and memory (thyatron), and are packaged in miniature, subminiature, and plug-in designs. Most models have adjustable operating characteristics controlled by external bias voltage and will accommodate a wide range of input signal conditions.

Typical Neon Minisig (R-101), unit price \$5.60 to \$6.55.



## N-SERIES Transistorized DECADES

This family of miniaturized and transistorized plug-in decimal counters features high operating speed, simple power-supply requirements (typically  $-12$  volts only), low power consumption, and reserve reliability. Standard conservative counting rates are 0-250 kcs and 0-5 megacycles, and these units will work dependably even under adverse temperature ( $-54^{\circ}\text{C}$  to  $+71^{\circ}\text{C}$  typical) and  $\pm 10\%$  power supply variations. Completely compatible with EECO T-Series digital circuits and R-Series Minisig indicators and may be intermixed as required.

All units are repairable without special test equipment. Models include Incandescent, Nixie, and remote in-line readout, as well as non-indicating. Most models are available in a preset version.

Typical N-102 Incandescent Readout Decade, unit price \$198.00.

## STANDARD-SERIES and RUGGEDIZED-SERIES Packaged Plug-in Circuits

This family of proven enclosure plug-in circuits, for application in military and industrial electronic systems, is available in either the Standard-Series or the Ruggedized-Series package. More than 35 different catalog circuits and more than 300 custom circuits have been packaged in the Standard and Ruggedized-Series containers. More than 150,000 of these modules have been delivered to date. Both series are moisture- and fungus-proofed for optimum performance under extreme conditions of humidity. (Thousands of these units are in daily use in the tropics.)

In general, the Standard-Series units are designed for use in ground equipment at fixed installations. The Ruggedized-Series modules are designed for high temperature, shock, and vibration, and are suitable for service in mobile equipment. Representative circuits in the Ruggedized package have been tested against MIL-E-5272A for shock and vibration in  $-54^{\circ}\text{C}$  to  $+71^{\circ}\text{C}$  environment. Both series are compatible with the EECO Systems Development Rack and Single or Dual Power Supplies and offer the same wide selection of circuits as well as low-cost custom-circuit packaging. Both series plug into standard 8- or 11-pin socket, as appropriate to the circuit.

Standard-Series, Typical 100-kc T Flip-Flop, Z-8339, unit price \$8.00 to \$11.50.

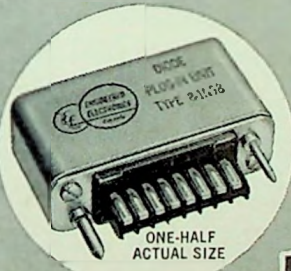
Ruggedized-Series, Typical 100-kc T Flip-Flop, Z-92002-8339, unit price \$10.80 to \$14.75.



## DIODE/MATRIX Plug-in Circuit Modules

Multiple clippers, limiters, de-restorers, modulators or demodulators, ring circuits, bridge circuits, rectifiers, diode gates, or circuits built to order and enclosed in a rugged case for plug-in use. These units eliminate the need for soldering diodes during breadboarding or production. Diode plug-in units are tested to diode manufacturer's specifications after assembly. Diodes are protected from physical damage at all times and can be tested or replaced in groups of 8, 12, or 16. Can be supplied with or without holdowns.

Typical 8-diode unit, employing 1N67A's, from \$16.00 to \$25.00.



ONE-HALF ACTUAL SIZE



ACTUAL SIZE

## CORE-DIODE/CORE-TRANSISTOR MODULES

We are actively engaged in a twofold development program in core-diode and core-transistor modules. We are miniaturizing our high-frequency core units as well as expanding our family of low-cost, low-frequency core units. Specific inquiries are invited.



## W-SERIES Silicon Transistor Plug-in Circuit Modules

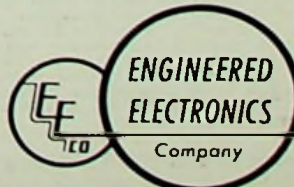
Premium units for  $-45^{\circ}\text{C}$  to  $+100^{\circ}\text{C}$  environment. Particularly suited for compact, high-temperature-environment military and industrial systems. A complete line of compatible circuits, including dc and pulse logic... the first family of its kind on the market with hermetically sealed silicon semi-conductors and other components.

Typical 150-kc RST Flip-Flop, unit price \$99.10 to \$121.55.

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View of the head table at the Annual Meeting, Albuquerque-Los Alamos Section, shows US Senator Clinton P. Anderson speaking on "Our New Atomic Frontiers". Seated officers and nominees are T. E. Lommasson, N. A. Bourgeois, E. C. Davis, R. C. Spence, R. C. Creveling, F. H. Jean, L. W. Davis, R. P. Noble, R. S. Lemm, J. E. Gross, and A. B. Church.

Region Report Cont. from page 48  
to resign as chairman and appoint  
Lt. Wagner in his place.

*Harry E. Wagner*

### Albuquerque-Los Alamos

The 1959-60 IRE year has been an eventful one for the Albuquerque-Los Alamos Section. The first significant event was the election of two members of the Section—Dr. Julius P. Molnar and Mr. Glenn A. Fowler to the grade of Fellow. This was the first time in history that two members of this Section have been elected to the grade of Fellow in one year and we are justifiably proud. An Awards Dinner was held on February 1 and Mr. Wes Carnahan, Director of Region 7, made the presentations before an audience of 218.

The next big event was the Section meeting held April 18, when we were honored to have Dr. Ronald McFarlan, international president of IRE, as speaker. Mr. Wes Carnahan introduced Dr. McFarlan to the 165 people attending.

The Annual Meeting of the Section was held on May 11. The principal speaker for the evening was the Honorable Clinton P. Anderson, United States Senator from New Mexico and also chairman of the Joint Congressional Committee on Atomic Energy, who addressed the group on "Our New Atomic Frontiers." Election of Section officers was held, and this was the first time since 1956 that a quorum of the voting membership was present for an annual meeting, thereby making it possible to elect officers without resorting to a mail ballot.

Another memorable occasion was  
(Continued on Page 52)

### Technical Program Cont. from page 48

tions utilize high dielectric constant fillers in the cavities. Resonant frequency of either type of antenna may be adjusted by a capacitive screw in the cavity, or by variation of a single cavity dimension, or both. A detailed analysis of impedance matching techniques as well as information on radiation pattern, gain, and efficiency characteristics is presented.

## SESSION 29

### THE PIONEER V EXPERIMENTS

*Thursday, August 25  
2:00 PM to 5:00 PM*

Sports Arena - Room D

Type of Session: Symposium

Chairman: C. P. Sonett,  
Space Technology Laboratories, Inc.,  
Los Angeles, California

#### 1. Preliminary Results from the Space Probe Pioneer V

By J. A. Simpson, C. Y. Fan, P. Meyer  
 Enrico Fermi Institute for Nuclear Studies  
 University of Chicago  
 Chicago, Illinois

The unique trajectory inside the orbit of the earth and the extended telemetry link for Pioneer V launches 11 March 1960 make possible some critical tests on the modulation of galactic cosmic rays and the solar production of high energy particles.

#### 2. Radiation Measurements Made by Space Probe Pioneer V

By R. L. Arnoldy, R. A. Hoffman, J. R. Winckler  
 School of Physics  
 University of Minnesota  
 Minneapolis, Minn.

The university of Minnesota radiation experiment aboard Pioneer V contains a Geiger counter and ionization chamber. These detectors are of the same type as those in the Minnesota experiment in Explorer VI satellite, and measure the flux and ionizing power of the interplanetary radiation. Data obtained in passing through the trapped radiation surrounding the earth indicates that the intensity is similar to that measured by Explorer VI from August 7 to August 14, 1959, before the large increase in intensity following the magnetic storm of August 16, 1959. Outside the trapped radiation, the intensity is at the cosmic ray level of 2.5 counts/sec. in the Anton type 302 Geiger counter, and has an ionizing power of about 1.1 times that for COP radiation. The first few days of measurement show no fluctuations in the interplanetary intensity. Data at larger distances from the earth will be available and discussed.

#### 3. Measurements of the Geomagnetic and Interplanetary Magnetic Fields: Pioneer V

By P. J. Coleman, D. I. Judge, E. J. Smith  
and C. P. Sonett

Space Technology Laboratories, Inc.  
Los Angeles, Calif.

The interplanetary probe, Pioneer V, a magnetometer to measure the geomagnetic and interplanetary magnetic fields. Results of these measurements are presented with some emphasis placed upon observations made as the vehicle passed through the interface between the geomagnetic field and the interplanetary field and those made during the period of the geomagnetic storm of 16 March. Comparisons are made between the aforementioned results and the observations obtained from the space probes Pioneer 1, III, and VI and the earth satellite Explorer VI.

#### 4. Determination of the Astronomical Unit by a Least Square Fit to the Orbit of Pioneer V

By B. McGuire, D. D. Morrison, and L. Wong  
Space Technology Laboratories, Inc.  
Los Angeles, Calif.

The astronomical unit may be thought of as the distance scale factor for the earth's motion around the sun. This scale factor is not measurable by standard astronomical techniques because only angles are directly measurable, and these are invariant to changes of scale.

If, however, one is concerned with a three-body problem, the effect of a change in the astronomical unit is to add a secular (i.e., time-increasing) perturbation to the motion. This effect has been utilized by Rabe in the so-called dynamical method of astronomical unit determination.

It was first suggested by Boodon that the orbit of an interplanetary probe would be affected (since it is a three-body problem) by a change in the astronomical unit, and thus the astronomical unit should be measurable by a least square fit to the radio doppler data from such a probe.

Previous determinations of the astronomical unit have been made by both dynamical and geometrical means. The most recent of the dynamical measurements is that by Rabe, which has a quoted accuracy of  $\pm 4.4$  parts in  $10^8$ . The most recent geometrical measurement is that of Spencer-Jones which has a quoted accuracy of  $\pm 1.1$  parts in  $10^8$ . The measured values of the astronomical unit, however, differ by 1 part in  $10^8$ .

At the time of writing of this abstract, the tracking of the Pioneer V probe is incomplete, thus the accuracy of the measurement of the astronomical unit is as yet unknown. Unfortunately, radio contact with Pioneer V will not be maintained to a sufficient distance from the earth to effect any improvement in the uncertainties in the astronomical unit quoted by Rabe. It is hoped, however, that sufficient accuracy will be attained to lend more weight either to the Rabe or the Spencer-Jones value of the astronomical unit.

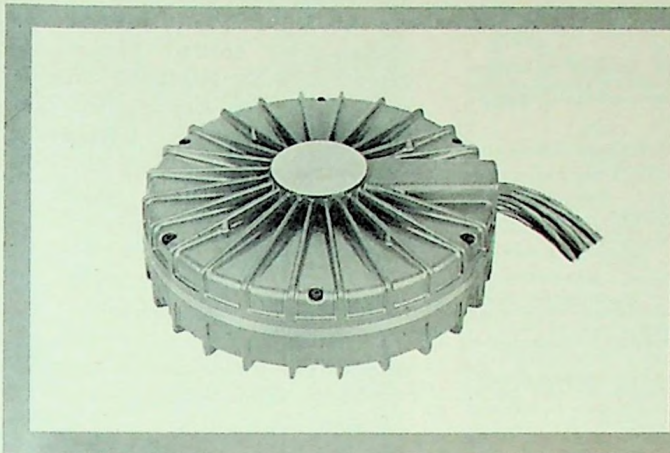
## SESSION 30

### MICROMINIATURIZATION

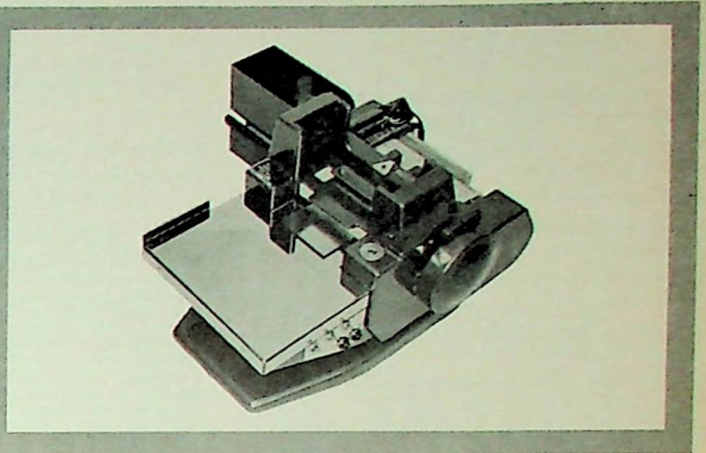
*Thursday, August 25  
2:00 PM to 5:00 PM*

Continued on Page 52)

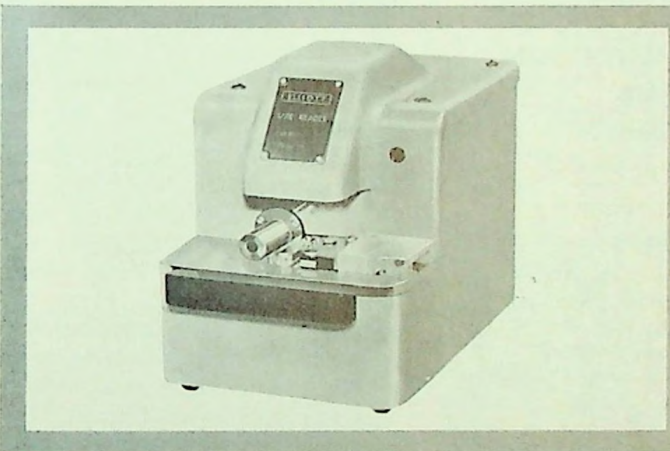
# SEE THESE NEW PRODUCTS



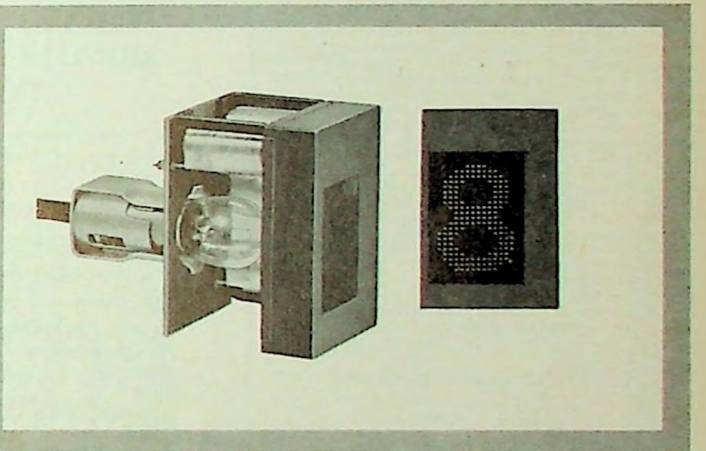
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# GENESYS

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LOS ANGELES 34, CALIFORNIA

EYE, TRY, BUY AT WESCON BOOTH 536

**Sports Arena - Room E**

Type of Session: Panel Discussion

Moderator: W. V. Wright,  
Electro Optical Systems, Inc.  
Pasadena, California

**Panelists:**

- W. B. Warren, Hughes Semiconductor Laboratories, Newport Beach, Calif.
- M. Kahn, Sprague Electronics, North Adams, Mass.
- J. S. Kilby, Texas Instruments, Inc., Dallas, Tex.
- D. Mackey, Radio Corporation of America, Somerville, N.J.
- H. C. Lin, Westinghouse Electric Corp., Pittsburgh, Pa.
- G. J. Selvin, Sylvania Electric Products, Inc., Waltham, Mass.
- E. E. Maiden, Pacific Semiconductors, Inc., Culver City, Calif.
- R. Norman, Fairchild Semiconductor Corp., Palo Alto, Calif.

**1. The Hughes Type I Microelectronic Circuit Concept**

By Wm. B. Warren  
Semiconductor Division  
Hughes Aircraft Company  
Newport Beach, Calif.

The Hughes Microelectronic Circuit Concept is based upon diodes, transistors, resistors, and capacitors packaged within an envelope essentially .050" diameter x .030" thick, and a perforated circuit board within the components are contained and on the two surfaces of which the interconnecting circuitry is carried. The system is demonstrated thru its application to an 85 component computer full adder wherein the importance of interconnecting circuitry is made evident. While, in several systems, packing densities of the order of millions of components per cubic foot are readily achievable in relatively small aggregates of components, it is shown that computer type circuitry requires inter-group communication which absorbs increasingly greater percentages of total volume as the number of components is increased. Means for producing packing densities of the order of 670,000 components per cubic foot, while retaining accessibility to components under operating conditions, and for radical reduction in interconnection joints are shown.

**2. Semiconductor Networks**

By J. S. Kilby  
Texas Instruments, Inc.  
Dallas, Texas

In the semiconductor network concept all of the components required for a desired circuit function are fabricated on or within a semiconductor wafer. This paper will review the present status of this concept and will describe the component types and ranges which are considered practical today.

Several examples of semiconductor network design will be given to show how an existing circuit may be reduced to a single crystal semiconductor structure. Performance data on several of the networks will be presented.

Some tentative thoughts on optimizing circuitry for semiconductor network design will be given as well as the discussion of the problems involved in attaining maximum size and weight reduction of systems using these devices.

**3. Micro-Module Equipment Packaging Considerations**

By D. Mackey  
Radio Corporation of America  
Somerville, N.J.

Major problems such as increased thermal and interconnection densities, coupling and strays, structuring and breadboarding are discussed. A concept has been developed, and reduced to practice.

Interconnection problems may be resolved by the use of flexprint utilized in a three-dimensional

manner by multi-lamination. Stress analysis indicates that an egg crate type of support structure adequately meets the requirements for minimum size and weight and maximum rigidity. With the aid of a thermal spring insert, dissipated thermal energy may be effectively transferred to the support structure and controlled.

Simplicity of the described micro-module packaging concept permits easy maintenance with minimum throw-away.

A method of breadboarding has been devised that permits the experimental geometry to approximate the final, thus minimizing the problems of coupling and strays.

**4. Reliable Superminiaturized Semiconductor Devices for Today's Microcircuits**

By E. E. Maiden  
Pacific Semiconductors, Inc.  
Culver City, Calif.

Reliable, superminiaturized semiconductor devices have been developed which make microcircuits practical today. These devices, reduced to their elemental size, retain the flexibility to meet varying electronic and circuit packaging requirements.

Diffused silicon diodes, transistors and variable capacitor diodes have been made not only one to two orders of magnitude smaller than conventional units, but with superior reliability, conformity to mil specs, and electrical characteristics equal to the best available today.

No longer laboratory curiosities, superminiaturized components offer immediate advantages to the designer without imposing requirements for revolutionary circuit design changes. Examples of microcircuits and new application possibilities are discussed.

**SESSION 31**

**SEEKING A LOGICAL BIOINSTRUMENTATION SYSTEM**

Friday, August 26  
10:00 AM to 12:30 PM

**Sports Arena - Room A**

Type of Session: Panel Discussion

Chairman: Vincent W. Blockley,  
Consultant, Environment Physiology,  
Santa Monica, California  
Moderator: Meyer Fishbein,  
System Development Corporation,  
Santa Monica, California

**Panelists:**

- David Douglas, Spacelabs, Inc., Los Angeles, Calif.
- Louis Fields, Starling Corp., Los Angeles, Calif.
- Truman McNeely, North American Aviation, Inc., Los Angeles, Calif.
- Miles McLennon, Aero Space Medical Div., Wright Air Development Center, Dayton, Ohio

**Speakers:**

- J. B. Dillon, M.D., University of California, Los Angeles, Calif.: THE ANESTHETIZED INDIVIDUAL IN A NORMAL ENVIRONMENT
- Toby Freedman, M.D., Ass'l Medical Director, North American Aviation, Inc., Los Angeles, Calif.: THE UNHEALTHY, CONSCIOUS INDIVIDUAL IN A NORMAL ENVIRONMENT
- Patrick Meehan, M.D., University of Southern California, Los Angeles, Calif.: THE HEALTHY, CONSCIOUS INDIVIDUAL IN AN ABNORMAL ENVIRONMENT
- Paul Tiffany, System Development Corporation, Santa Monica, Calif.: COMPUTERS AND PROGRAMMING IN A BIOINSTRUMENTATION SYSTEM.

the Annual Picnic held on June 4 in the Jemez Mountains north of Albuquerque. This meeting, attended by members and their families, was highlighted by the installation of the newly elected officers. The new officers are: Robert C. Creveling, chairman; Thomas E. Lom-masson, vice-chairman; Robert P. Nobel, secretary; and J. E. Gross, treasurer.

Another "first" for the Section was the appointment of Mrs. Edwina Gomel to the executive committee. She served as co-chairman of the social committee and was responsible for women's activities.

Finally, the Albuquerque—Los Alamos Section is especially pleased with the attendance at Section meetings during the 1959-60 year. The total attendance was 1210—an increase of 256 per cent over that for the previous year. This should be strong evidence that the membership is taking more interest in the IRE and its activities.

—R. C. Spence

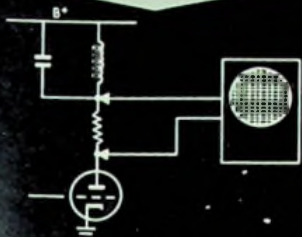
**Hawaii**

The Hawaii Section Annual Meeting was held June 10 at the Queen's Surf in Waikiki with wives and guests invited. Elections were held with Daniel L. Pang becoming chairman; Eugene Piety, vice chairman; and Dr. Ralph Patridge, secretary-treasurer. Officers during the past year have been Melvin Vittum, chairman; Daniel Pang, vice chairman; and Eugene Piety, secretary-treasurer.

Section meetings are held on the second Wednesday evening of each month (except July and December) at the Hawaiian Electric Co. auditorium on Ward Street. Pre-meeting dinners are usually held at the Evergreen Restaurant on Kapiolani Blvd. Visitors to the Islands are always welcome and, in fact, the Section has been fortunate during the past year in having three papers presented by visiting mainland engineers.

No field trips were made during the year but a number of interesting papers were presented on such topics as Satellite Signals, Ionospheric Scatter, Nuclear Reactors, Radio Astronomy, and others.

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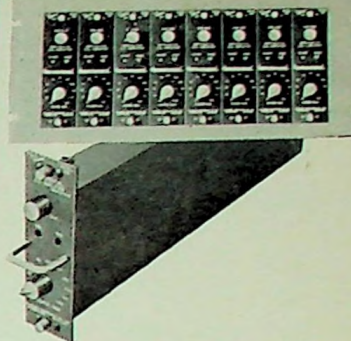
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Technical Program Cont. from Page 52

### Seeking a Logical Bio-Instrumentation System Panel Discussion

The panel will discuss bio-instrumentation requirements for gathering physiological data in three areas of modern medicine: (1) Anesthesiology—the anesthetized subject in a normal environment; (2) Cardiology—the unhealthy conscious individual in a normal environment; and (3) Space Physiology—the conscious individual in an abnormal environment.

Special attention will be directed to the significant elements in the recorded signal; and the information to be derived from direct and integrated measurements of physiological functions. The panel, composed of representatives from the medical and physical sciences, have been charged to critically examine the WHY of certain accepted practices in physiological measurements with the view of establishing an environment more favorable to an interdisciplinary understanding of common problems.

## SESSION 32

### MILITARY ELECTRONICS

Friday, August 26

10:00 AM to 12:30 PM

Sports Arena - Room B

Type of Session: Contributed Papers

Chairman: Lt. Col. Raymond Isenson,

Office Deputy Commander Army,

Pacific Missile Range,

Pt. Mugu, California

#### 1. System Implications of Electronic Ancestor Worship

By Bernard Baldrige

Light Military Electronics Department

General Electric

Utica, New York

Inadequate system planning has led to the evolution of equipments which are fast polluting the electronic environment. The problem is analogous to the modern day contamination of our streams with sewage. As unpolluted water becomes a more precious natural resource, a prohibition on unprocessed waste product disposal into streams is necessary.

Similarly, the indiscriminate disposal of acoustic, radio frequency, radio-active, and other offensive partical waste from our sacred electronic ancestors must be prohibited. Sewage disposal will be cheap compared to the disposal of unwanted RF, acoustic, or radioactive waste. The problem calls for an immediate re-examination of equipment specifications to include mandatory analysis of efficiency and operational capability factors early in design. Before a "seal of approval" is granted to a proposed sub-system, a two point analysis must be made. First, the potential environmental problems created for other systems must be determined. Second, the environmental problems faced by the proposed equipment itself must be considered.

#### 2. Implementation of a Modern Communication System on a National and a Global Basis

By C. K. Chappuis

Communication Systems Engineer

Los Angeles, Calif.

The problems of emergency communications for the Department of Defense and the civil government are quite similar. Equipments suitable for civil government use may be available somewhat earlier than some of those required for military use.

Switching, data-modems, terminal, storage, and security equipments can be available for implementation of modern communication systems in the 1961 to 1963 period for reasonably efficient use of the nominal 4-kc channel for most of the communication requirements of men and machines.

Careful utilization of available commercial services combined with provision of government facilities to provide system designs which will retain acceptable capabilities for emergency service is possible. The knowledge to combine the capabilities into acceptable systems exists today. Decisions for implementation can overcome the problems of

(Continued on Page 55)

auxiliary equipments, common languages, etc., which are obstacles to accomplishment.

Common usage of 4-kc channels will reduce costs as well as increase reliability.

### 3. Automatic Programming of Ground Support Equipment Using Computer Techniques

By Meyer Cook

Convair, Astronautics

San Diego, Calif.

and C. Keeler

United Research, Incorporated

Cambridge, Mass.

A method is described for producing Remington Rand (UNIVAC) punched cards for use with Automatic Programmed Checkout Equipment (APChE) directly from engineering input to an IBM 704 Computer. This is contrasted with original sequence of operations in which several translations and manual checks are required. Inspection methods are discussed and reliability of finished card decks prepared by both means.

A brief description of the APChE and its application precedes the major presentation.

### 4. The BMEWS Automatic Monitoring System

By E. L. Danheiser and M. Korsen

Radio Corporation of America

Moorestown, N.J.

This paper describes an automatic system which monitors and isolates faults for the vast BMEWS radar system. Utilizing digital as well as analog techniques, it provides fault sensing and fault isolation routines. Key signals in every major subsystem are continuously checked against thresholds set to system tolerances. A detailed sequential check of

the faulty subsystem is initiated when a continuous fault appears. Sequential checking is programmed by punched cards, with each card containing all information necessary to test a particular point. Examples of standard as well as special methods of fault sensing techniques are described. A detailed explanation of some of the key circuitry is given and its specific relation to the overall Automatic Monitoring system is described. Accuracies and tolerances for some of the key items are also included and reliability factors are discussed.

## SESSION 33

### INFORMATION THEORY AND MODULATION METHODS

Friday, August 26

10:00 AM to 12:30 PM

Sports Arena - Room C

Type of Session: Symposium

Moderator: Bernard Oliver,  
Hewlett-Packard Company,  
Palo Alto, California

#### Panelists:

Conrad Hoepfner, Electronetics, Melbourne, Fla.

R. L. Sink, Consolidated Electro Dynamics,  
Pasadena, Calif.

M. B. Rudin, Aeronutronic Systems, Inc.,  
Newport Beach, Calif.

J. W. Halina, International Telephone and  
Telegraph Co., Nutley, N.J.

Ray Sanders, Space Electronics Corp.,  
Glendale, Calif.

James L. Hollis, Rixon Electronics,  
Silver Springs, Md.

John Taber, Space Technology Laboratories,  
Inc., Los Angeles, Calif.

Duane Erway, Electro-Optical Systems, Inc.,  
Pasadena, Calif.

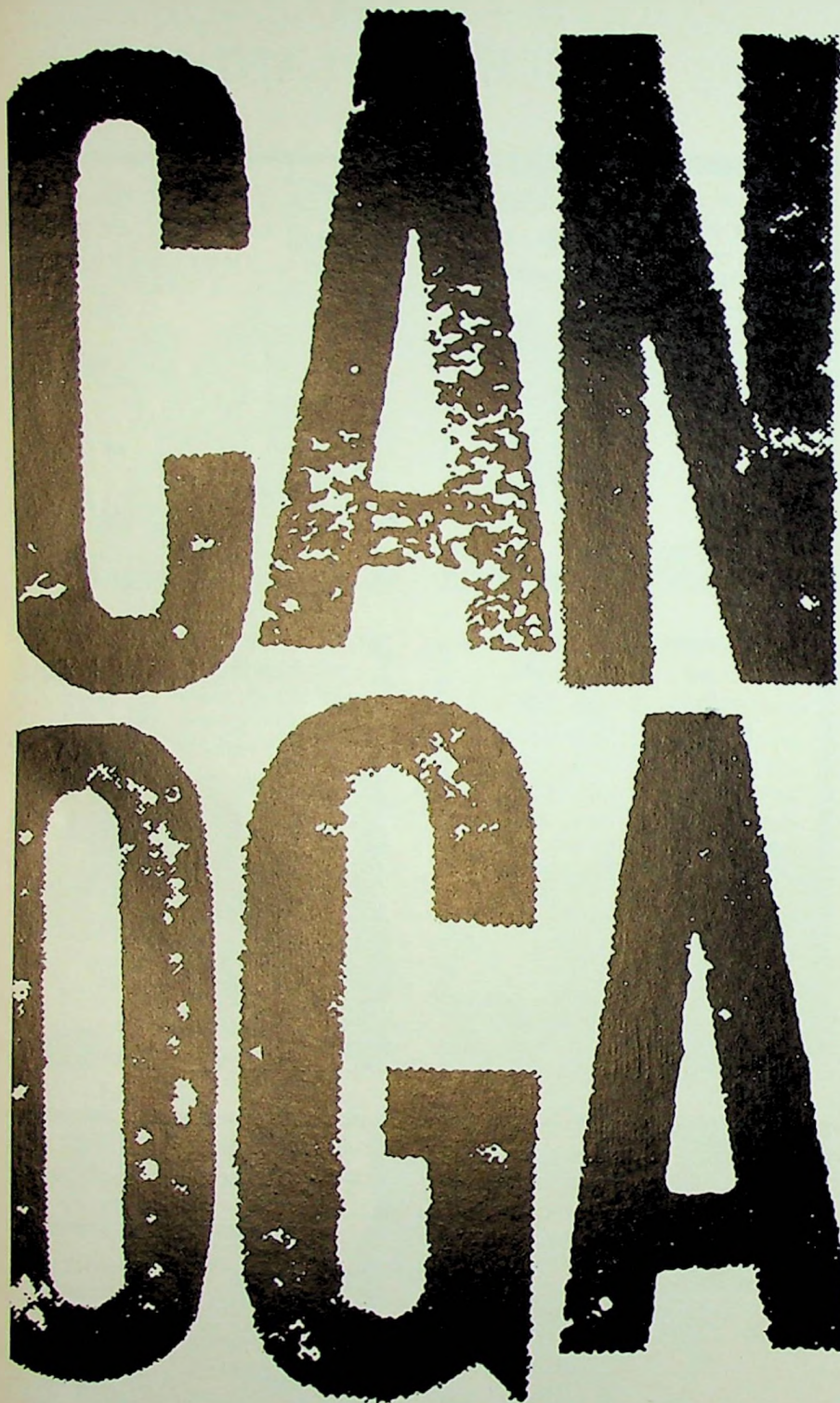
Elton N. Sherman, General Devices, Inc.,  
Sherman Oaks, Calif.

(Continued on Page 56)

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## 1. Pulse Position Modulation

By Conrad H. Hoepfner  
Electronics  
Melbourne, Fla.

It has been shown that pulse position modulation/amplitude modulation is a very efficient means of transmitting information and particularly time multiplexed data channels. It is quite unsurpassed in this respect when data of moderate accuracy such as encountered in aircraft and missile testing is conveyed.

Converters to PPM from analog voltages, variable resistance transducers and strain gages are extremely simple, reliable and accurate. Conversion of PPM to other intelligence forms such as graphic plots, analog indications and digital computer words is simple and is done more reasonably on the ground rather than in the flight vehicle.

## 2. Medium Accuracy PAM-FM Telemetry

By M. B. Rudin  
Aeronutronic Systems, Inc.  
Newport Beach, Calif.

Analytical and experimental studies of four frequency modulation systems (PAM, PCM, PM and FM) in use or advocated for missile range telemetry have been conducted. PAM-FM has been shown to require the least transmitted power and/or bandwidth where medium accuracy of the order of 2% RMS error is required. This error is composed of assumed mutually non-correlated fluctuation, cross-talk, distortion and sampling error.

The discussion will cover such basic operating techniques and parameters as transmitted power versus RF bandwidth; RF and video bandwidth and frequency deviation versus sample rate; duty, cycle, sampling error and sample rate versus information bandwidth and frame synchronization versus 100% transmit duty cycle.

## 3. Efficient Transmission of Information in Telephone Communications Networks

By J. W. Malina  
ITT Communications Systems, Inc.  
Nutley, N.J.

The mission of the telephone communications system engineer is the provision of information transmission channels to a multiplicity of users or subscribers. In general he begins with a high capacity channel or channels, temporally and spatially distributed in a network, and he wishes to partition, or channelize it, into "saleable parcels." In the telephone industry the universal package is the nominal "4 kc" telephone channel.

There is an inevitable penalty to packaging or channelizing bulk capacity. There is the cost of the package (channelizing equipment) per se and the loss of the bulk capacity incurred in partitioning it into small parcels.

The capacity of the bulk channel or transmission medium is defined by its power handling capability its noise and its effective overall bandwidth.

The author considers the modulation systems in current use as channelizing means namely, single sideband, double sideband emitted carrier amplitude modulation, double sideband suppressed carrier modulation, and narrow band fm from a theoretical, equipment, and cost point of view and develops measures of efficiency for each.

## 4. Operating Characteristics of the Digilock Communication System

By Ray W. Sanders  
Space Electronics Corporation  
Glendale, Calif.

This paper describes the Digilock Telemetry System and discusses its various operating parameters. The paper shows the extent to which this system can approach the limit of communication efficiency given by Shannon's channel capacity formula using practical hardware.

Several examples of the applicability of the Digilock technique to various communication requirements are given.

## 5. Digital Data on Communication Circuits

By J. L. Hollis  
Rixon Electronics  
Silver Spring, Md.

(Continued on Page 57)

Voice communications circuits with nominal bandwidths of 3000 cycles are almost universally available throughout the world. In order to take advantage of this widespread availability, digital data communications systems must be designed to operate within the limitation of these facilities. It is important then for engineers and designers who plan to utilize them to have a clear understanding of the basic characteristics of common voice facilities and how they affect the transmission of digital information.

### 6. Telebit as a Data Transmission System

By John E. Taber  
Space Technology Laboratories  
Los Angeles, Calif.

Telebit was conceived and designed early in 1959 to transmit data from interplanetary probes as rapidly and as efficiently as possible. The system was intended to convey information from several scientific experiments and several internal environment sensors to one of several earth tracking stations in a form that would permit rapid relaying to the Space Navigation Center in Los Angeles. The extreme ranges involved required the use of large peak transmitter powers with the consequent need for a low transmission duty cycle. Even with the large transmitter power data transmission would be limited to a few bits per second and because of the duty cycle a means for accumulating data during transmitter off periods was needed. The Telebit system which emerged as the answer to these requirements was designed, constructed, checked out and flown on Explorer VI within a period of less than eight months. Another unit is currently sending data from Pioneer V over distances exceeding ten million miles.

### 7. Optical Communications Systems Utilizing Solar Energy

By Duane D. Erway  
Electro-Optical Systems, Inc.  
Pasadena, Calif.

The paper presents an introduction to optical communication using solar energy as the light source and, in addition, contains the results of some comparative performance studies with RF systems. Examples of attractive applications are suggested.

After a general discussion of the requirements of the transmitter and receiver, a typical design is given. Particular attention is then given to the problem areas in solar-optical communication systems.

Performance limitations are outlined and analyzed; emphasis here is placed upon the noise encountered and the characteristics of the sun as a light source. The signal-to-noise equations are examined and plotted for several possible links using realizable parameters.

With the above as background, the advantages and disadvantages of solar-optical communication are explained. The performance of an RF system is then compared to that of a solar-optical system for a specific link. The results are presented as the required transmitted RF power to give the same information rate as a solar-optical system. For this comparison, equivalent antenna areas are assumed for both systems.

### 8. Pulse Amplitude Modulation—a High Performance, Low Cost Solution to Space Telemetry Problems

By Elton N. Sherman  
General Devices, Inc.  
Sherman Oaks, Calif.

The Inter-Range Instrumentation Group standard operating procedures were designed around, by today's technology, low performance vehicles. Recent advances in high performance vehicles, satellite instrumentation, as well as deep space vehicles, have called for a rather rigorous expansion of heretofore little-explored avenues in the telemetry realm. Pulse amplitude modulation is a logical choice for many data gathering/data retrieval systems in that it requires a minimum of conversion in order to adapt to operation with some of the more recent digital data concepts. It becomes readily apparent that PAM techniques are having a renaissance in the space age.

Recent studies made by many leading organizations show that pulse amplitude modulation both in standard IRIG and also many non-standard configurations is perhaps the most flexible, most reliable, highest performance technique available today and, last but not least, the most economical.

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## SESSION 34

### OPERATION AND TRAINING OF MAN-MACHINE SYSTEMS

Friday, August 26  
10:00 AM to 12:30 PM

Sports Arena - Room D

Type of Session: Symposium

Chairman: H. M. Parsons,  
System Development Corporation  
Santa Monica, California

#### 1. Deriving Time Requirements for Squadron Shop Repair of Units of an Airborne Electronic System

By D. S. Ellis  
Tactical Systems Laboratory  
Hughes Aircraft Company  
Culver City, Calif.

This paper presents a model for deriving shop repair time requirements for units of an airborne electronic system which have been removed from the aircraft. The need for such a model has arisen repeatedly in the design of ground support equipment for fire control systems. Required repair time is a variable which directly determines the design of the shop ground support equipment. If the time is within the bounds to be expected for unaided manual repair, unaided manual repair is acceptable. If, however, the required time is significantly shorter than that expected for unaided manual repair, then there is a clear need for automatic and other aids to the repair process.

#### 2. A General Model for Relating Human Factors to ADP Systems Performance

By John B. Teeple  
Thompson Ramo Wooldridge  
Sierra Vista, Ariz.

The human being is frequently contrasted with machine systems as being unpredictable, extremely variable and difficult to measure or quantify. In order to evaluate a system, and in spite of these difficulties, it is important to define the human component in the same terms as are used to define equipment performance. Once this has been done, it is possible to indicate certain relationships between man's performance and the performance of the system as a whole. The purpose of this paper is to develop such a general model, using time to process information as a criterion of system performance. The points in the system where human performance may affect this criterion value are identified, and mathematical formulas are presented to indicate how criterion values may change as a result of variations in human performance. The implications of this model for future experimental tests on human factors are indicated.

#### 3. Human Maintenance Functions in Man-Machine Systems

By Milton A. Grodsky and Girard W. Levy  
The Martin Co.  
Baltimore, Md.

Over a period of the last ten years, the importance of human maintenance functions in man-machine systems has increased, due to the increased complexity of equipments, particularly electronic equipments, and the increased importance of reliability in system functions. With consideration of man-machine space systems as feasible entities, maintenance behavior increases in importance as one of the operator's major functions. Though a great deal of research and study has been initiated in the area of maintenance behavior, very little in terms of definitive, empirically bound theory has been developed which would allow for generalization

from one maintenance situation to another. The lack of theory is probably due to the difficulty of conceptualizing the criteria involved in good maintenance behavior. Difficult as it may appear, it is deemed important to attempt to construct a model of maintenance behavior which would allow for empirical testing and description of the sub-behaviors involved in the human maintenance function. This

(Continued on Page 59)

problem is analyzed, and approaches to a solution are suggested.

#### 4. Human Factors in System Operations and Training

By James W. Singleton  
System Development Corporation  
Santa Monica, Calif.

The thesis of this paper is that in many respects, the system process begins rather than terminates at the point of implementation. System operations contain the pay-off to the entire process of system development. Neglecting the significance and professional responsibility inherent in system operations does a disservice to the role and reputation of the system developer.

System operations is typically the most neglected phase of system development. It is considered lacking in professional challenge and unworthy of serious attention. Time after time, descriptions of the system process conclude with the phrase "and then the system is implemented."

The major characteristics of the system operational period is that people are an integral part of the system for the first time. Although people infuse the process of system analysis, design and management, it is only in the operational period that operators, supervisors and managers serve an on-line capacity in making the system work.

#### 5. Measuring Human Interactions in Man-Machine Systems

By A. M. Freed  
System Development Corp.  
Santa Monica, Calif.

The paper is a first step toward a research effort intended to devise instruments for measuring human interactive behavior in man-machine systems. The search for such measurement grows out of the need of system operators as well as system trainers for a method of assessing system effectiveness and the effectiveness of training programs.

The proposition is posed that there are two aspects of man-machine systems: a conceptual system, which reflects the design and administration; and the operating system, which is the dynamic active system.

The suggestion is made that the interactive behavior of people in an operational system be observed and evaluated in terms of enhancement or hindrance in achievement of system goals. Such observation and discrimination become possible when interactional system behavior is described in operational terms.

Samples of the vast literature dealing with human interaction are presented. Implications for research and applications of prospective findings are described.

### SESSION 35

## VEHICULAR COMMUNICATIONS II: MOBILE RADIO AND PAGING SYSTEM

Friday, August 26  
10:00 AM to 12:30 PM

Sports Arena - Room E

Type of Session: Contributed Papers and Panel

Chairman and Moderator: Kenneth T. Corner,  
Comm. Dept.,  
City of Los Angeles, California

#### 1. Personal Radio Paging in the VHF Band

By John F. Mitchell  
Motorola, Inc.  
Chicago, Ill.

A city-wide one-way personal radio paging system with a capacity of 7500 subscribers has been developed by Motorola. Complete system and equip-

ment for compatible application in existing installations is discussed.

This system is designed to be compatible with all land mobile FM communications in the 50 and 150 ms bands. The voice message is sent after a two-tone-code is used to select the desired subscriber. The high performance miniaturized receiver (6" x 2 1/2" x 1") contains the tone selector using reed relays.

#### 2. A Personal Two-Way Radio Communication System Featuring Modular Construction

By T. H. Yaffe  
Bendix Radio Div., Bendix Corp.  
Baltimore, Md.

This paper describes a VHF "personal" communications receiver assembled entirely from individual circuit modules. The modules are constructed with standard, commercially available, sub-miniature components. This is desirable since a defective module may be rapidly replaced, minimizing system off-the-air time, and later repaired or modified if desired. Other receiver features include 1 microvolt sensitivity, double conversion, a crystal filter selectivity package at the high I.F. frequency, a non-tunable discriminator and a novel squelch gating circuit.

The companion transmitter, more conventional in construction, is also sub-miniaturized. It features a 1 watt power output, a transistorized modulator and a DC-DC converter type of power supply with rechargeable nickel cadmium batteries. The shirt pocket size receiver and the transmitter occupy a combined volume of less than 100 cubic inches and total less than 4 lbs. weight.

#### 3. System Performance, Compatibility, and Standards

By R. T. Buesing and N. H. Shepherd  
General Electric Co.  
Lynchburg, Va.

The two prime purposes of Industrial Standards, for two way land mobile radio equipment, are to assure high standards of customer performance and system compatibility. Examples of each are discussed separately.

The necessity and logic for standards defining frequency stability, receiver sensitivity and selectivity measurements, tone coded carrier deviation and performance of continuous tone-coded squelch systems are discussed. In addition, the proposed IRE standard defining vehicular noise is presented as a stepping stone to the much-needed standard for receiver performance in the presence of impulse noise.

#### 4. Police and Fire Department Communications Centers a Systems Approach to the Control Console and Related Facilities

By G. A. Brookes  
Westrex Corp.  
Los Angeles, Calif.

Police Departments, Fire Departments and other similar organizations which require communication with mobile units have similar problems. The equipment provision for a typical installation is discussed with particular emphasis on the facilities which are provided in the Communications Console.

A description is given of the module units such as amplifiers, control units, display units and signal actuated recorder which have been developed for this application.

### SESSION 36

## SEEKING A LOGICAL BIOINSTRUMENTATION SYSTEM

Friday, August 26  
2:00 PM to 5:00 PM

Sports Arena - Room A

Type of Session: Continuation of Session No. 31 on the above subject

(Continued on Page 60)

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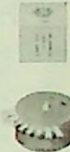


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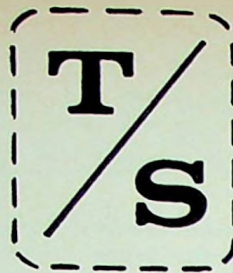
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### SESSION 37 CODING METHODS AND TELEMETRY

Friday, August 26  
2:00 PM to 5:00 PM

Sports Arena - Room B

Type of Session: Contributed Papers

Chairman: A. V. Balakrishnan,  
Space Technology Laboratories, Inc.,  
Los Angeles, California

#### 1. An Improved FM Discriminator-Detector for Airborne Telemetry Receivers

By G. E. Reis and C. E. Land  
Sandia Corporation  
Albuquerque, N. Mex.

Recently the design of an FM receiver for airborne telemetering applications led to a critical evaluation of existing discriminator-detector circuits. Existing circuits were compared on the basis of efficiency, complexity in both design and construction, ease of adjustment and adaptability to sub-miniature design and packaging techniques. This study led to the invention by Mr. L. G. Snyder of a new discriminator-detector circuit which is superior to existing circuits when evaluated as described above.

This paper is a description of the new circuit and a complete analysis of the theory and operation.

#### 2. Improved DOVAP Transponder

By Floyd M. Gardner  
Gardner Research Co.  
Orange, Calif.

DOVAP is a CW phase measuring system used for tracking missiles. A transponder in the missile frequency-doubles a ground-generated signal and re-transmits to the ground. Range, velocity, and acceleration are derived on the ground from the phase measurements of the two signals. Any transponder-generated phase changes show up as trajectory errors.

Three sources of phase change are prevalent: (1) AGC action detuning, (2) temperature change detuning, and (3) carrier frequency changes due to Doppler shift. Wide bandwidths, around 400 KC, amortize all of these errors to some extent. The resulting early units were simple, small and reasonably inexpensive; however, their phase variation would not allow precise tracking.

Occupancy of the NOVAP frequency spectrum (37 and 74 mc) has increased substantially and we have passed through the peak of a sunspot cycle. This combination has resulted in interference to the system. A narrow band has become necessary to avoid interference.

#### 3. Optimized Data Systems

By J. C. O'Brien  
Northronics Div., Northrop Corporation  
Hawthorne, Calif.

The basic problem of data systems, which include all types of testing, sensing and surveillance instrumentation, is to acquire, transfer and interpret information correctly. Until recently, such systems have not enjoyed the blessing of well integrated fundamental analytical laws of performance, such as have been developed for communication systems. However, the similarity between the transfer of time functions of information, such as messages, and the acquisition of meaningful data from physical situations, such as a surveillance area, has caused the author to adapt the concepts of information theory to the specific problems of data handling. This has been done by extending the time functions involved in communication, to include spatial dimensions, and converting the pertinent parameters, such as bandwidth and noise, etc., to their spatial counterparts.

#### 4. Reliable Fail-Safe Binary Communication

(Continued on Page 61)

Grote Reber was the speaker for our May meeting.

Our membership is made up of a good cross-section from the military, other government agencies, and industry. While many of our members have joined various professional groups, there has been little local professional-group activity as such. An Audio group has been organized but the Communications group finally turned back their charter due to inactivity.

—Melvin Vittum

## Las Vegas

During the past year an effort was made to generate interest in forming a local section of the IRE in the Las Vegas area. Many people may wonder what possible interest could be found in a resort area such as Las Vegas, but as the idea grew, so did the number of prospective members. These people came from many different fields of interest such as power, sound engineering, reactor engineering, and instrumentation. Subsequently, the Las Vegas Section was formed in April, 1960 and it now has 60 members with 22 applications pending.

The Section was very fortunate to have the participation of Dr. McFarlan, the national chairman and Dr. Carnahan, the Seventh Regional director in its first meeting. The talk given by Dr. McFarlan on the "Use of Microwave Power to Support a High-Altitude Platform" was the type of sendoff needed to insure the success of the new Section.

To keep the interest alive, this meeting was closely followed by a second one in which we were again fortunate. Barney Oliver of Hewlett-Packard consented to give a talk on "Filtering and Equalization in Optics". Because of the success of these two meetings we feel that the Las Vegas Section will grow and become a useful part of the IRE.

—E. R. Lutkehans, secretary

## Los Angeles

The Los Angeles Section undertook an ambitious year's schedule of technical meetings, symposium,

By J. J. Melzner and K. C. Morgan  
Research Div., New York University  
New York, N.Y.

Unidirectional systems which employ coding for error correction are unsatisfactory for high reliability transmission over channels with widely varying characteristics. This problem may be solved by employing long codes with feedback, correcting very small numbers of errors, and preventing any type of disturbance in the feedback channel from harming system reliability. The resulting system yields excellent reliability, "fails safe," and operates at a relatively high per-symbol information rate. This approach is particularly effective in situations where severe burst-type noise or heavy fading is encountered. Computing and storage requirements are far less than those of comparable unidirectional systems.

Analysis is presented of error probability and information rate for various channel conditions, computing and storage requirements, and transmission delay problems. The necessary coding and decoding procedures are discussed for various classes of codes, including Elias' sliding parity check codes and a modification thereof termed "rotational parity check codes."

### 5. Data Compression

By H. Schwab  
Applied Development Corporation  
Hawthorne, Calif.

Data compression is a data processing operation for reduction of specific information. Such compression is desired for bandwidth saving in communication and for simplification of successive data processing operations. Data compression has to be investigated in close connection to data encoding methods for best overall system efficiency. Typical examples for simple data compression are: sampling rate reduction, accuracy reduction, increment monitoring, event monitoring, source analysis. Data compression is of importance in space and industrial communication, reconnaissance, and high-speed high-volume data handling.

## SESSION 38

### INFORMATION THEORY AND MODULATION METHODS

Friday, August 26

2:00 PM to 5:00 PM

Sports Arena - Room C

Type of Session: Continuation of Session 33  
on the above subject

## SESSION 39

### EFFECTS OF NUCLEAR EXPLOSIONS

Friday, August 26

2:00 PM to 5:00 PM

Sports Arena - Room D

Type of Session: Contributed Papers

Chairman: Dr. Lester C. Van Atta

Department of Defense  
U. S. Government  
Washington 25, D.C.

#### 1. The Effective Range of a Nuclear Explosion for Electronic Equipment

By John Crittenden  
Electric Components Div.  
General Electric Co.  
Owensboro, Ky.

#### 2. Failure of Digital Computers in the Environment of an Atomic Explosion

By Marc Bendick  
System Development Corp.  
Santa Monica, Calif.

### 3. Transient Effects of Nuclear Radiation on Typical Electronic Sub Systems

By John W. Clark and T. D. Hanscom  
Hughes Aircraft Co.  
Los Angeles, Calif.

The speakers will discuss various aspects of vulnerability of certain electronic systems and components to nuclear explosions. The session will constitute an up-to-date summary of important investigations of this subject. Much of this material, although not classified, has never been released before.

## SESSION 40

### VEHICULAR COMMUNICATIONS III: NEW IDEAS AND CONCEPTS FOR MOBILE TELEPHONE OPERATION

Friday, August 26

2:00 PM to 5:00 PM

Sports Arena - Room E

Type of Session: Contributed Papers and Panel

Chairman and Moderator: A. Culbertson,  
Lenkurt Corp.,  
San Carlos, California

Panelists:

R. C. Crabb, Mobilfone, Los Angeles, Calif.  
A. R. Ogilvie, Secode Corp., San Francisco, Calif.  
Charles W. Schwiager, Pacific Telephone and  
Telegraph Corp., San Diego, Calif.

#### 1. Pushbutton Mobile Dial Radio- telephone an Advanced Concept in Common Carrier Mobile Service

By James R. Stewart  
Motorola, Inc.  
Chicago, Ill.

A push button "dial" mobile telephone using a sequential two out of four tone arrangement for the dialing tones has been developed by Motorola. The mobile controlhead with 10 illuminated push-buttons, one for each digit of the telephone dial controls the various tone signals to be transmitted from the mobile unit. At the dial exchange, terminal equipment ties the mobile radio system into standard telephone circuits.

System concept, equipment and operation are discussed.

#### 2. Guarded Tone Signalling

By William B. Smith  
Bendix Radio Div., Bendix Corp.  
Baltimore, Md.

A novel method of tone code transmission which conveys a maximum of information in a minimum number of tone channels is described. The use of a positive space to initiate sampling, as well as a limited sampling interval, enhances the reliability. The presence of the positive space in all code signals also permits failure indication at the remote point in the event that partial failure occurs in either encoder or decoder. The method of decoding provides an inherent decade group call. Principles of operation will be the main topic, but application and equipment will also be covered. In particular, equipment for party line telephone selective ringing which has been on field test will be shown.

#### 3. System Concepts for Address Communication Systems

By Donald H. Hamsher  
U.S. Army Signal Corps  
R & D Laboratories  
Ft. Monmouth, N.J.

The U.S. Army Signal Research and Development Laboratory has been investigating the concept of address communication systems in form known as non-

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1026-6	100-3000	50 or 75
1026-4	150-3000	50 or 75
1026-2	300-3000	50 or 75

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1136-HV	0-500	3 1/8"

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1112	0-1000	1 5/8"	1.03
1110	0-650	3 1/8"	1.03

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1027-L	120-240	1.4	-50
1027-M	240-480	1.5	-50
1027-N	480-960	1.6	-50
1098	960-1600	1.6	-40
1102	1600-2400	1.5	-40
1104	2400-3600	1.5	-34
1100-K	60-120	1.4	-55
1100-L	120-240	1.4	-55
1100-M	240-480	1.5	-55
1100-N	480-960	1.6	-55
1099-N	800-960	1.2	-50
1099-O	975-1175	1.2	-50
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Technical Program Cont. from page 61

synchronous or asynchronous communication. This concept exploits the random character of speech transmission so that some talkers are transmitting during the quiescent period of others. In a system many transmitters are radiating signals more or less simultaneously and the receivers must pick in each instance the signal intended for him. The approach investigated by the Laboratory has been termed "random access discrete address." Concepts for this type of communication system and variations hereof are presented and discussed.

### 4. The Application of Telephone Trunking Principles to Multi-Channel Mobile Service

By Edwin S. Randel

American Telephone & Telegraph Co.  
New York, N.Y.

Because of the nature of the development of the service, mobile service channels have generally been used and administered on a single channel basis. Transmitters and receivers have been capable of operation on one channel only and therefore could be given access only to that channel regardless of the number of channels in operation in a given location. Thus, in figuring total call carrying capacity, with a constant grade of service, one channel plus one channel merely equals two channels. However, in the provision of telephone trunks one plus one does not equal two since individual trunks are combined to operate as multi-channel groups to which a customer or operator may have access.

This paper attempts to demonstrate potential increases in call carrying capacities which might be achieved through multi-channel mobile operation with the channels now available and also with hypothetical broad bands of adjacent channels.

## WORKSHOP I MANAGEMENT OF MAN-MACHINE SYSTEMS

Tuesday, August 23  
2:00 PM to 5:00 PM

Location: Golden State Room  
Statler Hilton Hotel

Type of Session: Roundtable Discussion  
with Panel

Moderator: R. L. Clark  
Department of Defense,  
Washington, D.C.

### Panelists:

Robert Gilson, Stromberg-Carlson Co.,  
Rochester, N. Y.

Paul Engelder, Sylvania Electric Products,  
Mountain View, Calif.

Edward Speakman, Radio Corporation of  
America, Camden, N.J.

William Duke, Space Technology Laboratories,  
Inc., Los Angeles, Calif.

(This is a continuation of Session No. 4)

## WORKSHOP II ANALYSIS OF MAN-MACHINE SYSTEMS

Wednesday, August 24  
2:00 PM to 5:00 PM

Location: National Technical Schools  
(Room 313)

4000 S. Figueroa Street, Los Angeles, Calif.

Type of Session: Roundtable Discussion  
with Panel

Moderator: Lt. Col. Anthony Debons,  
Rome Air Development Division,  
Rome, N.Y.

(Continued on Page 63)

**Panelists:**

- John Salver, Rama Wooldridge, Canoga Park, Calif.
- L. Blumstein, Cornell Aeronautical Laboratory, Buffalo, N.Y.
- L. Seale, Bell Aircraft Corp., Buffalo, N.Y.
- M. Adelson, Hughes Aircraft Co., Fullerton, Calif.

(This is a continuation of Session No. 14)

**WORKSHOP III**

**SYNTHESIS AND DESIGN OF MAN-MACHINE SYSTEMS**

*Thursday, August 25  
2:00 PM to 5:00 PM*

Location: National Technical Schools  
(Room 313)  
4000 S. Figueroa Street, Los Angeles, Calif.

Type of Session: Roundtable Discussion  
with Panel

Moderator: D. T. McRuer,  
Systems Technology, Inc.,  
Los Angeles, California

**Panelists:**

- R. K. Ausbourne, Hughes Aircraft Corp., Culver City, Calif.
- W. Evans, Aeronutronic Systems, Inc., Newport Beach, Calif.
- L. Christie, System Development Corp., Santa Monica, Calif.
- Harold Van Cott, International Business Machines Corp., Bethesda, Md.

(This is a continuation of Session No. 24)

**WORKSHOP IV**

**OPERATION AND TRAINING OF MAN-MACHINE SYSTEMS**

*Friday, August 26  
2:00 PM to 5:00 PM*

Location: National Technical Schools  
(Room 313)  
4000 S. Figueroa Street, Los Angeles, Calif.

Type of Session: Roundtable Discussion  
with Panel

Moderator: J. Lyman,  
University of California,  
Los Angeles, California

**Panelists:**

- H. K. Weiss, Aeronutronic Systems, Inc., Santa Ana, Calif.
- J. Bialek, Stanford Research Institute, Palo Alto, Calif.
- J. Maatsch, System Development Corp., Santa Monica, Calif.
- L. Stoyanoff, Hoffman Electronics Corp., Los Angeles, Calif.

(This is a continuation of Session No. 34)

**WOMEN'S SESSION**

**ENGINEERING:  
THE WOMAN'S ROLE**

*Wednesday, August 24  
3:30 PM to 5:00 PM*

Golden State Room  
Statler-Hilton Hotel

(Continued on Page 64)



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Technical Program Cont. from Page 63

Type of Session: Invited speakers with audience participation

Chairman: Noel E. Porter,  
Hewlett-Packard Company,  
Palo Alto, California

### 1. A Woman Engineer?

By Rose Mary (Decker) Bernstein  
Douglas Aircraft Co., Inc.  
Santa Monica, Calif.

Most people are curious about such questions as: What kind of women want to do engineering? Can they engineer?

Are they accepted by their "fellow" engineers?

This discussion will give a woman engineer's answers to these questions and bring up related subjects, as the engineer's technical competence and the sociological adjustments necessary for both the

woman engineer and the men working with her.

A question and answer period will follow the paper presentation to allow members of the audience to ask any questions in which they have a personal interest.

### 2. Debugging the Engineer

By Barbara B. Leitner  
Los Angeles, Calif.

The Engineering Secretary copes not only with a complicated subject but with complicated people. Both are frequently confusing and may require evaluation and definition. Human factors involved are given emphasis, the girl who pushes the Engineering Paper Pusher presenting her view of engineers with some practical suggestions for standardization and quality control. As the wife of an engineer, certain comments are addressed to other wives.

### 3. Engineering: Staff and Distaff

By Phyllis R. Huggins  
Bendix Computer Div.  
Los Angeles, Calif.

A brief review of the variety of fields of supporting services to an engineering staff in which women may be found, their reasons for entering the more off-beat fields, their motives, drives, the pros and cons they may bring to the effectiveness of a technical organization, and the personal pros and cons their being in these fields brings to them.

An example of a specific case of a woman working with technical people illustrated by the different types of technical people, the public relations problems they present, and how these problems may be met by the distaff side of an organization.

## Sub-Section Goes Gay Nineties

On August 6th the San Fernando Valley Sub-Section will hold its annual dinner-dance, this year to be a Gay 90's Affair. It will be held at the Sportsmen's Lodge, 12833 Ventura Boulevard, North Hollywood.

The cocktail hour begins at 6:00 PM, with Dinner at 7:00 PM and the program beginning at 8:30 PM. Cost is \$11.50 per couple. If you live in the Los Angeles area, reservations can be made through Jack Wills, Dickens 3-9958.

The Valley Sub-Section is the largest in LA if not the nation, with more than 1600 members. Jack Wills, Rantec Corp. will be installed as chairman at the Gay 90's affair.

and convention — all starting in September when the Section hosted the Third National Symposium of the Professional Group on Engineering Writing and Speech at the Ambassador Hotel, under the guidance of Joseph Cryden, chairman. In February, Los Angeles was the scene of the First West Coast Convention on Military Electronics. This event was co-sponsored by the National PGMIL and the Section. Eighty-three papers were presented — some being classified and made available through the cooperation of the ARDC—and produced a total attendance of over 2,000. Maj. Gen. O. J. Ritland was the honor speaker at the Military Services Banquet.

During the year, twenty chapters of the following professional groups were active in the Section: PGAP, PGAP/PGMTT (Orange Belt), PGAC, PGBME, PGCT, PGCS, PGCP, PGED, PGEC, PGEM, PGEWS, PGIT, PGI, PGMTT, PGMIL, PGROC, PGSET, and PGVC. At mid-year, a new entry into the fold was PGNS.

There are six subsections in Los Angeles: Buena Ventura, Orange Belt, Pasadena, San Fernando Valley, Santa Ana, and Santa Barbara. These held monthly meetings and most of them hosted the main Los Angeles Section some time during the year. Over 300 members were present at a Pasadena meeting when Professor A. C. B. Lovell, director of the Jodrell Bank Station, Manchester, England, spoke on his specialty of Radio Astronomy.

In May, Buena Ventura and Santa Barbara's six months of preparation proved fruitful when their "Host L.A. Meeting" attracted many Southland members to an all-day field trip of Point Arguello, with an evening banquet at the Miramar Convention Center in Santa Barbara. Separate activities were planned for the ladies during the day, but all joined together at the banquet when Adm. J. P. Monroe spoke on "The Navy in the Space Age."

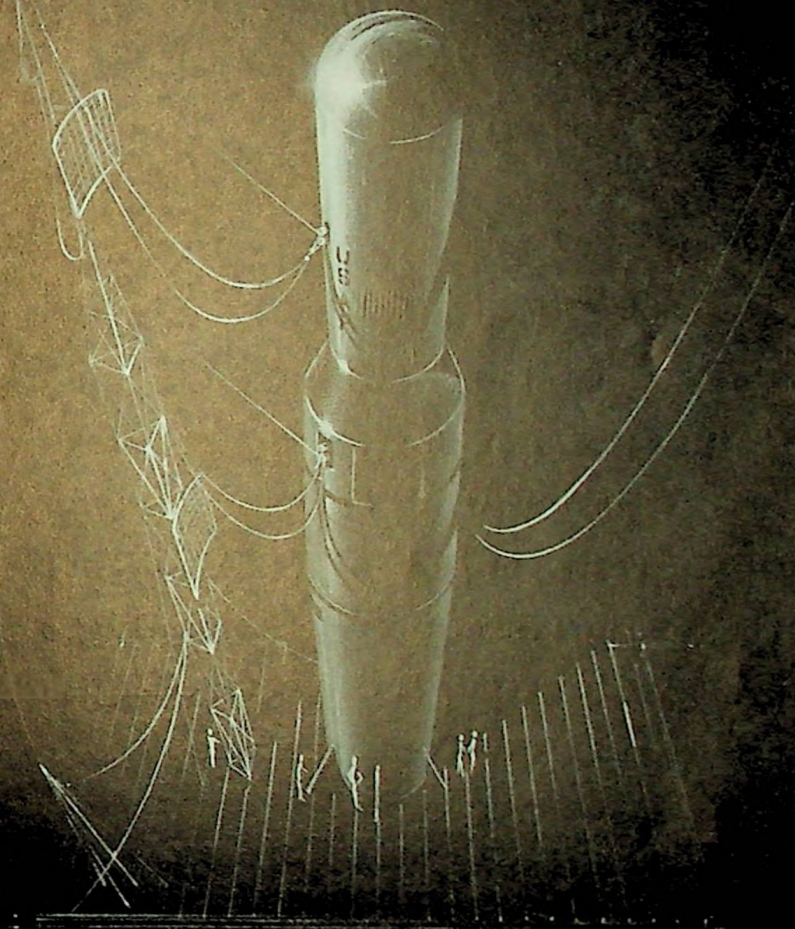
The six-hour Point Arguello tour included examination of launch sites for the Tumbleweed, Sunflare, Samos, and Midas radi-

(Continued on Page 66)

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Region Report Cont. from page 65

tion samplers and satellites.

Santa Ana hosted the Los Angeles Section during January with an unusual meeting on Earthquakes and their Measurement by Scientific Means. When this meeting proved successful, Pasadena quickly followed with a repeat performance. Santa Ana had the largest turnout for any one meeting, when over 700 heard Dr. Joseph Banks Rhine of Duke University speak on the subject of extra-sensory perception. There was no doubt that the subject was popular, since an earlier PGI meeting, featuring Dr. Andrija Puharich, had drawn 300.

The San Fernando Valley meetings covered wide ranges of subjects and offered some interesting field trips. The Valley presented the Annual All-Industry meeting which saw major executives from most Valley engineering firms in attendance. Dr. William Pickering, director of JPL, was the speaker.

All in all, 165 meetings were held in the Section, with a total attendance of close to 12,000. Although the Section membership was increased by 900 over the past year, to 8300, the students are not forgotten. With the Section's student membership ranging between 700 and 1000, the Annual Student Day program brings many of these students together with industry. In March, we returned to the Biltmore Hotel, the site of February's PGMIL Convention, to host 225 students in an all-day program of technical sessions, exhibits, and evening banquet, all at no charge to the students.

In April, the Section hosted the National IRE President, Dr. Ronald McFarlan, at a luncheon with the professional group chairman, and dinner with the Section's Executive Committee.

For the first time, four members-at-large joined the Executive Committee, after being elected by the Section membership. This was in accordance with the previous year's by-law changes which were adopted and proved successful in allowing for more experience and greater representation on the Committee. The Section concluded its activities for the year with a final inaugural ball for the new officers.

*Ronald Tansky*

*Assistant Business Manager*

(Continued on Page 67)

### Phoenix

It was a busy year, and a productive one, for the Phoenix Section. During the summer of 1959, a poll of the membership was taken. Results indicated that the members preferred not to have dinner meetings, as had been held previously. Therefore, it was decided that meetings during the 1959-1960 season would be held at the Westward Ho Hotel, with refreshments served afterwards. A dinner party would be given the speaker of the evening before the meeting by the section officers, with members and their guests invited.

Approximately fifty people have been involved in the operation of the Section during the past season, serving on the various committees, including the 1961 Seventh Region Conference which will take place here at the Westward Ho, April 26 to 28.

A special project has been the formation of a Bylaws Committee charged with the responsibility of revising the Section bylaws to help simplify Section organization and provide uniform administrative operating procedures. It has also been recommended that we appoint a Section historian to compile records of the section from 1951 to 1960.

Section membership has grown from 435 one year ago to slightly over 500 at the present time. The total membership is made up of 6 Fellows, 69 senior members, 338 members, and 90 associate members. There are also 117 student members within the boundaries of the Section.

The Section held ten meetings during the year with an average attendance of 50, or 10% of the total memberships, a small gain over previous years.

The first meeting of the newly organized Professional Group Chapter on Electronic Computers was held in April at Arizona State University. Dr. Carl R. Zimmer presented an informative paper on tunnel diodes. The attendance far exceeded expectations with a total of 145 actually at the meeting. The last meeting of the season, in June featured Dr. Richard Stasier of G.E., speaking on Circuit Techniques of Tunnel Diodes. A nomin-

(Continued on Page 68)

• Huggins Laboratories Inc., Sunnyvale, Calif. • The Narda Microwave Corp., Mineola, N. Y. • Levithal Electronic Products Inc., Palo Alto, Calif. • Menlo Park Engineering, Menlo Park, Calif. • Electronic Associates Inc., Long Branch, N. J. • Slatham Development Corp., Los Angeles, Calif. • Weinschel Engineering Co., Kensington, Md. • Covering The Electronics Industry in California, Arizona and Nevada • Electronic Measurements Co., Inc., Eatontown, N. J. • Boonton Electronics Corp., Morris Plains, N. J. • Optimized Devices, Thornwood, N. Y. • JOHN FRANCIS O'HALLORAN & ASSOCIATES... ELECTRONICS ENGINEERS • SALES REPRESENTATIVES



ations committee was appointed at this meeting and the election of officers will be held at the first meeting in the fall.

The IRE executive board has also approved a petition to form a statewide chapter of PGMIL. The membership of this group will include interested members of the Phoenix, Tucson, and Fort Huachuca Sections. Meetings will be held alternately at each of the three locations.

Student activities during the season included: a joint meeting with the student branch at ASU, Tempe; presentation of the Annual IRE Student Award to Carl N. Gotch, a senior at ASU; \$75 award to Leroy Baker, also a senior at ASU, for his winning paper in the annual student-papers contest entitled Feedback Amplifier Design Using Matrix Methods. Baker's paper was further selected for presentation at the Seventh Region Technical Conference at Seattle.

Each year, the Phoenix Section sends one or two high-school students to the WESCON Future Engineers Show as a result of competition conducted in conjunction with the Central Arizona Regional Science Fair. This year the winning exhibit at the fair was by Nick Hagen of Phoenix West High. Hagen's project has to do with The Effect of Ozone on the Dielectric of a Flyback Transformer. Both the exhibit and a paper will be presented by the student at the WESCON Show in August. The prizes include a substantial scholarship award and savings bonds.

This year saw the formation of a Section awards committee consisting of nine members representing industry, education, electronics, engineering and radio-television. The purpose of this committee is to select deserving candidates from within the Section for the annual Section achievement award, the Seventh Region Electronic Achievement Award, and awards at the National IRE level.

The objective of the Section achievement award is to give recognition for outstanding contributions in the Phoenix Section area. This year the awards committee

(Continued on Page 69)



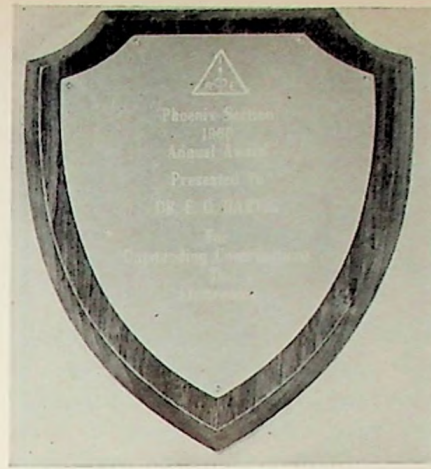
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Dr. E. O. Hartig  
Phoenix Section Award Winner

Dr. E. O. Hartig, Goodyear Aircraft Corp., received the Phoenix Section Award, illustrated above. The winner's company also receives a roving counterpart. Hartig was honored for contributions to the development of advanced radar systems and outstanding leadership in research.

Region Report Cont. from page 68  
has named Dr. E. O. Hartig, assistant manager of the aerophysics department, Goodyear Aircraft, as the winner of the Section award. Hartig's citation is for outstanding leadership in research and development of advanced radar systems. The award consists of an individual plaque, and also another plaque to serve as the roving award to be displayed at the recipient's company.

Edward Shepard, chairman

### Portland

The Portland Section has seen three of its long-sought objectives come to life during the past season:

1. Concrete plans for graduate-level engineering study in Portland have been made. Classes start in September. This has been a long uphill struggle, with many people and other organizations helping.

2. The Professional Group on BIO Medical Electronics has gotten off to an active and very promising start. The Medical School of the University of Oregon is located in Portland and is engaged in many fine research projects, most of which require electronic instrumentation. The new group has already been responsible for many fine meetings which we are sure will be a help to the medical and electronic people in this area in the future.

3. A monthly IRE newspaper known as the "Portland Pi" has just completed its first hectic year. Only those of you who have tried starting a newspaper will realize how hectic a first year can be.

One activity of the Portland Sec-

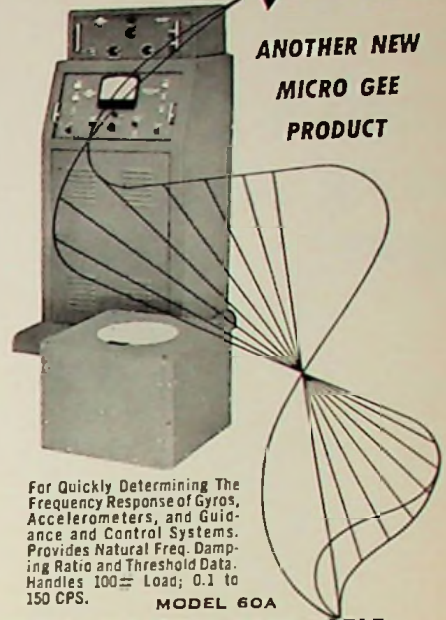
tion which might be of interest to other IRE Sections is our annual meeting with the student section at Oregon State College. The format for this meeting consists of a one-hour formal meeting with a speaker or panel from the Portland Section discussing the problems which will be faced by an engineering graduate. This meeting is held on "Dad's Day" at the College and the students are encouraged to attend a luncheon with their fathers. The IRE visitors and the college staff have lunch together and are informed of the progress of the engineering and science branches of the college. During the afternoon a display of the products from local electronics firms and manufacturers' representatives is presented. The students are urged to bring their fathers to this exhibit and it provides an opportunity for the Section members, the students and their parents to get to know each other better. The day is finally topped off by a basketball game.

The local student papers competition is gaining in both scope and number of colleges participating. This year's winners were James M. Donally of Reed College with a paper on the "Anelastic Behavior of Brass," Wallace Helm and Gilbert Marguth of Oregon State College with a paper on "A Binary Counter Using Rectangular Looped Magnetic Material" and Roger Colgan of Lewis and Clark College with a paper discussing "The Maser". Linfield College was also added to the list of participants this time.

New officers for 1960-61 are  
(Continued on Page 71)

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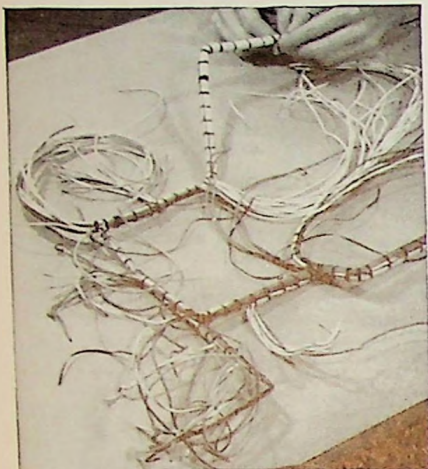
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Ladies Cont. from page 44

In the center of the room is a recessed circular area in which there are a circular sofa and dining table. The kitchen and guest rooms are also on the lower level.

Electronics Executive George Brubaker designed his own Brentwood home to include many unusual features, one of which is a circular dining room with a floor that slowly revolves to give each guest a view of the classical Japanese garden outside.

Rijiro Nunakawa, internationally known Japanese landscape architect, designed the grounds, which include authentic handcarved granite lanterns dating to the 17th century, a *do bashi* bridge brought from Japan, and an authentic tea-house.

The living room of the house features a fireplace with a fireproof glass back wall, behind which are tropical plants. The family room features an honest-to-goodness soda fountain. Rooms are grouped around a central patio with a free-form pool. The master bedroom includes a large "working" desk, adjoining bath and sitting pool.

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as follows: Lang Hedrick, Tektronix Inc., chairman; Dr. Kenneth E. Davis, Reed College, vice chairman; Dr. Merle M. Morgan, Electro Scientific Industries, secretary-treasurer.

—Jack C. Riley, past chairman

**Salt Lake City**

The Salt Lake City Section started its 1959-1960 year by honoring as distinguished visitors Dr. Ernst Weber, past president of the Institute, and Mrs. Weber. Leaders of Utah's engineering schools and electronic industries gathered at a special dinner at the Hotel Utah which culminated in a talk by Dr. Weber, "Space Age and IRE."

Leadership for the Salt Lake Section during the year was very ably provided by Rowland W. Haegele, manager of the Eitel-McCullough plant in Salt Lake City. Professor Charles Alley of the University of Utah served as vice chairman, and A. W. Vodak of Sperry Utah Engineering Laboratories served as secretary-treasurer. For the forthcoming year, the chairman will be Professor Alley, vice chairman, A. W. Vodak; and secretary-treasurer, Professor J. Dalley, University of Utah.

During the past year Prof. Alley, R. W. Haegele, and Dr. L. Dale Harris of the University of Utah served as judges for the Utah State High School Science Fair. Winners for the electronic division were high school students Law and Magalby, of Highland High School. These students under the guidance of their science teacher, Grandy, constructed an outstanding exhibit of Doppler Radar. The exhibit actually works and is reported to have been built for a cost of only \$12.00. The Section is sending all three individuals to WESCON in August.

Another highlight of the Salt Lake City Section 1959-1960 year was the presentation of technical papers by college engineering students. These papers were given by Robert L. Allen of Utah State University, Malcom D. Crawford of the Brigham Young University, and Alvin M. Despain of the University of Utah. Despain won first prize with his paper on Non-Linear Network Frequency Divider.

Membership of the Salt Lake



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**SCHWARTZ**

**Selected Semiconductor Circuits Handbook.**  
1960. 506 pages. \$12.00

**BENDAT**

**Principles and Applications of Random Noise Theory.**  
1958. 431 pages. \$11.00

**SANGREN**

**Digital Computers and Nuclear Reactor Applications.**  
1960. Approx. 228 pages. Prob. \$8.50

**VAN VALKENBURG**

**Introduction to Modern Network Synthesis.**  
1960. 498 pages. \$11.75

**ADLER, CHU, FANO**

**Electromagnetic Energy Transmission and Radiation.**  
1960. 621 pages. \$14.50

**FANO, CHU, ADLER**

**Electromagnetic Fields, Energy and Forces.**  
1960. 520 pages. \$12.00

**MEYERHOFF**

**Digital Applications of Magnetic Devices.**  
1960. Approx. 656 pages. Prob. \$14.00

**EGLI**

**Thermoelectricity.** 1960. Approx. 416 pages. Prob. \$10.00

**LEE**

**Statistical Theory of Communication.**  
1960. Approx. 504 pages. Prob. \$18.00

**BUBE**

**Photoconductivity of Solids.** 1960. 461 pages. \$14.75

**GATOS, FAUST**

**The Surface Chemistry of Metals and Semiconductors.**  
Ready in August.

**RALSTON, WILF**

**Mathematical Methods For Digital Computers.**  
1960. 293 pages. \$9.00

**JONSCHER**

**Principles of Semiconductor Device Operation.** 1960. \$5.75

**DUMMER, GRIFFIN**

**Electronic Equipment Reliability.** 1960. In press.

**TECHNOLOGY PRESS RESEARCH MONOGRAPHS, M.I.T.**

**AIGRAIN, COELHO, ASCARELLI**

**Electronic Processes In Solids.**  
1960. Approx. 100 pages. Prob. \$6.00

**HOWARD**

**Dynamic Programming and Markov Processes.**  
1960. Approx. 112 pages. \$5.75

**GRAY**

**The Dynamic Behavior of Thermoelectric Devices.**  
1960. 136 pages. \$3.50

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Discussion Group follows formal Executive Committee meeting in San Francisco, addressed during May by IRE President McFarlan. From left: S. F. Kaisel, Microwave Electronics Corp., secretary, Dr. McFarlan, Victor B. Corey, Palomar Scientific, chairman, Peter D. Lacy, Wiltron Co., treasurer, and Don Harris, SRI, chairman, Awards Committee.

Region Report Cont. from Page 71  
 Section now exceeds 250. Meetings are usually held on the campus of the University of Utah.

—A. W. Vodak

### San Diego

The San Diego Section wound up its 1959 season with an election of new officers by mail ballot with a contest occurring in both the vice chairman and secretary-treasurer offices due to the withdrawal from the election race of last year's secretary-treasurer. The new officers are R. E. Honer, chairman; D. G. DeHaas, vice chairman; E. W. Carlson, secretary-treasurer. Participation in the election was again approximately 50 per cent, which still speaks well for mail balloting in a Section with 850 members.

Regular monthly meetings were held through the remainder of the year from July of 1959 until the present writing of this report.

Included in the topics covered were — Recent Studies of the Sun by Radio; Semiconductor Physics and Devices; Engineering Techniques for Special Telephone Services; Principles and Applications of Inertial Guidance; New Developments in Radio Astronomy; The Use of Electronics in Neurophysiology; Interplanetary Travel; Elec-

troluminescence; Optimization of Airborne Special-Purpose Computers; Soviet Computer Technology 1959; Geodetic SECOR for World Mapping and Thermal Noise at Microwave Frequencies.

The outstanding event of the year was the National Professional Group Symposium on Microwave Theory and Techniques held at the Hotel del Coronado in May.

Describing this symposium, *Electronic Design* reported as follows:

“... Conduct of the meeting definitely shattered some old myths about the narrow bandwidth and information-handling capabilities of the human being. Information passed steadily soon after eight in the morning until midnight. Whenever the neuron activity rose too high or existed for too long a duration, signal sources were shut down temporarily and nerve conductors were cooled by a dip in the ocean. Buffer storages were cleared by a quick inhalation of sea breeze. Within a few minutes the flow of information would continue.

“If one calculated the figure of merit of the convention as the dividend of information received over miles traveled, even the Boston visitors fared well. Cost of travel

proved no barrier as attendance at the southwestern tip of the United States was as high as if the conference were held in the center of the microwave industry.

“The convention did not try to be all things to all people. All papers focused on only a few themes. There were no commercial exhibits so the noise level of all communications was exceptionally low...”

To the existing PGAP, PGA, PGBME, PGMTC, and PGMIL, are being added two new chapters: PGROC and PGSET.

At the 7th Region Executive Committee Meeting held in Seattle on May 26 it was agreed that the 7th Region Convention would be held in San Diego in 1963. The San Diego Section Executive Committee has already started action to establish dates and early planning necessary for this convention.

—E. W. Carlson

### San Francisco

Around San Francisco, this may be looked back upon as the year in which the Section took stock of its growth and ramification and inaugurated procedures and organizational changes leading toward greater efficiency in its routine activities. Having within its compass one Sub-Section and fourteen active Professional Group chapters at the beginning of the year, the Executive Committee authorized formation of a new Operating Committee (OPCOM) comprising the officers

(Continued on Page 73)



Bert A. Ould receives from Dr. A. Oliver the certificate of the Microwave Prize Award for the outstanding paper of 1959, “The Synthesis of Symmetrical Waveguide Circulators, in PGMTC Transactions at San Diego.

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**E. STRUMWASER, ME, MSEE.**  
President / Antennae; ferrite devices-application, and material study; parametric amplifiers, R-F filters

**R. I. FOGEL, MSEE,** Head of Ferrite Device Section / High-power ferrite duplexers and phase shifters; low-frequency miniaturized ferrite components, associated microwave devices

**H. M. ENDLER, MS Physics,** Technical Staff / Missile systems analysis, radar transmitter circuitry, microwave components, parametric amplifiers

**M. R. MILLET, MSEE,** Technical Staff / Design and development of microwave systems and components; low-noise mixers, diode switches, ferrite devices, parametric amplifiers

**C. E. NELSON, BSEE,** Head of Parametric Amplifier Section / Advanced design and development of microwave components: filters, ferrite devices, parametric amplifiers

**R. B. STEINKOLK, MSEE,** Technical Staff / Microwave instrumentation, circuit design, radome instrumentation, parametric amplifiers


**G. S. UEBELE, MSEE,** Technical Staff / Design and development of microwave components: ferrite diodes to microwave local oscillators and transmitters

**R. T. MCGOY,** Technical Staff / Design of doppler radar guidance systems, phase-stable oscillator; applications of non-linear reactive diodes to microwave local oscillators and transmitters

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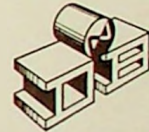
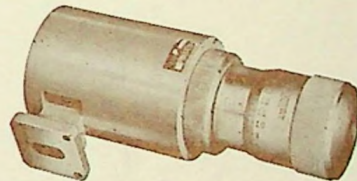
**Region Report Cont. from Page 72**

and directors of the Section which could meet relatively often to relieve the Executive Committee (EXCOM) from routine matters. By year's end, this procedure had saved the Section hundreds of man hours of meeting time. Opcomposition was Victor B. Corey, chairman; Donald A. Dunn, vice chairman; Stanley F. Kaisel, secretary, Peter D. Lacy, treasurer; Earl G. Goddard, Jr., past chairman; and Samuel Silver, C. W. Carnahan, and John V. N. Granger, directors.

Simultaneous with this development was the inauguration of a new professional groups committee under the direction of the vice chairman, Donald A. Dunn. This group concerned itself chiefly with integration of the various professional group meetings for the best utilization of time and the least conflict of interest.

A new bylaws committee, under the chairmanship of Peter D. Lacy, undertook the necessary research and development to produce the first draft of a new set of bylaws

(Continued on Page 75)



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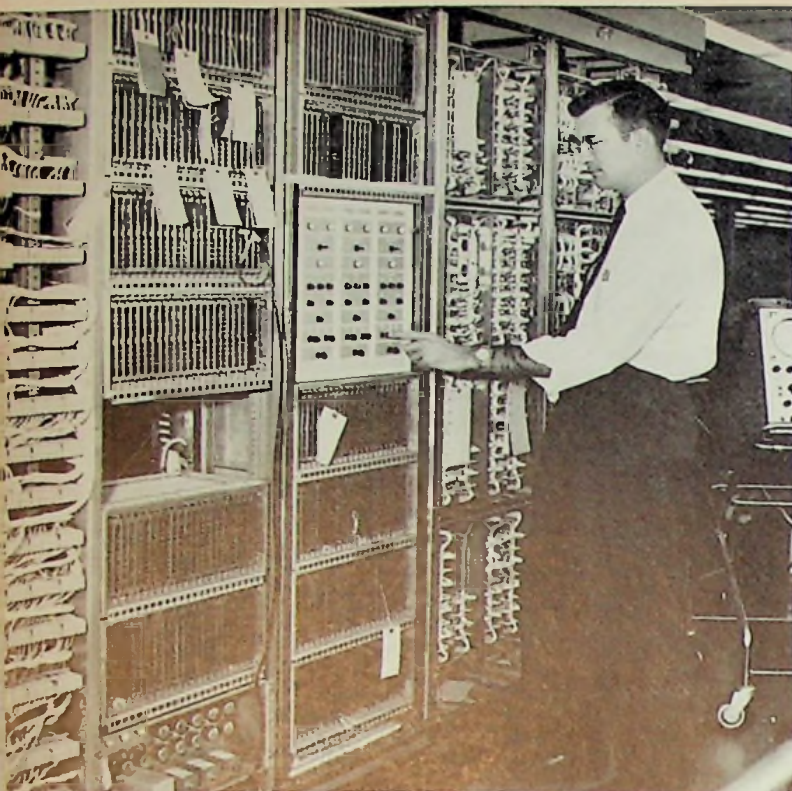
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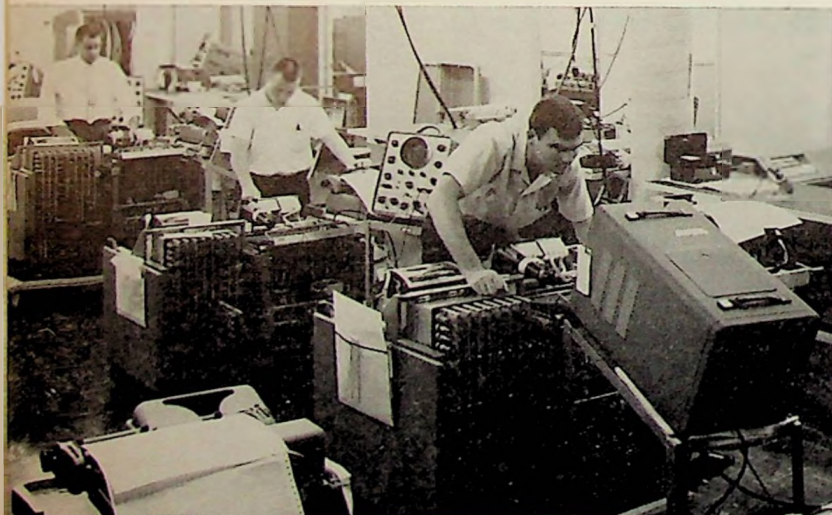
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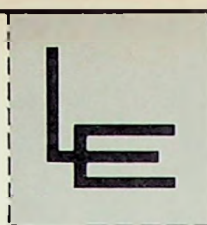
Field Trip No. 6 takes visitors to RCA's Missile & Surface Radar Div., Van Nuys, Calif. to see a new 50 acre research development. Picture shows computer racks in Digital Systems Laboratory.



Field Trip No. 2 at Space Technology Laboratories will show visitors center for payload Lab test experiments related to Explorer and Pioneer missile series. Here STL engineers test Pioneer V (sun orbit) gear.



Field Trip No. 7 includes a trip to Librascope, manufacturers of large scale industrial control equipment and digital computers. Picture shows check-out facility in Burbank for LGP-30 digital computers.

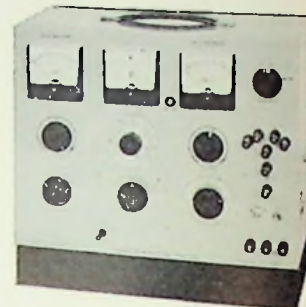


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covering in full the Section operation at its present level of complexity and, hopefully, projecting for the problems of future growth. These bylaws were approved by the Section membership at the annual meeting in June.

In another major shift of function, the IRE Section Office, the joint activity of WESCON, WEMA, and IRE, was moved from its previous location in the Villa Hotel Building, San Mateo, to the Whelan Building, 701 Welch Road, Palo Alto. A full-time manager, Miss Grace Pacak, was installed. This shift and the organization necessary to handle the expanded volume of Section services rendered from this location were handled under the direction of Stan Kaisel, Section secretary.

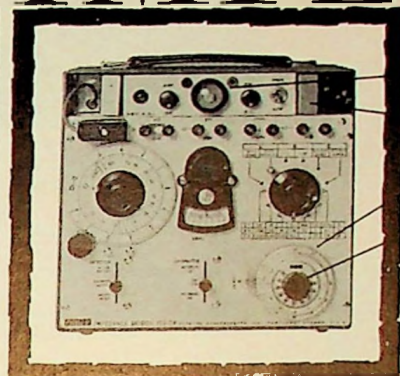
Other Section individuals providing services beyond the call of duty during the season included Earl Goddard and Jerry Rosenberg for their work with the Section historical committee, Don Harris for his outstanding contributions through the awards committee, and Henry Schroeder for his competent handling of those problems which always descend upon the arrangements committee.

Through the year, the Section exhibited a 17 per cent growth in membership to arrive at a figure of 3892. Members' interests are distributed throughout the activities of the following sub-organizations: (Of 88 total meetings held in the Section during the season, individual figures are shown in parentheses after each group. Since many of these were joint meetings, the figures actually total 113.) San Francisco Section (7), East Bay Subsection (5), PGAP (10 including a 3-part lecture series), PGA (3), PGB (3), PGBME (7), PGCS (4), PGED (9), PGEC (9), PGEM (5), PGEWS (5), PGMIL (10), PGMTT (7), PGPT (9), PGROC (9), and PGSET (10). PGI held their first post-organizational meeting.

Within the broader-scale activities of the Section during the season were several symposia. In September, the National Symposium on Space Electronics & Telemetry,

(Continued on Page 77)

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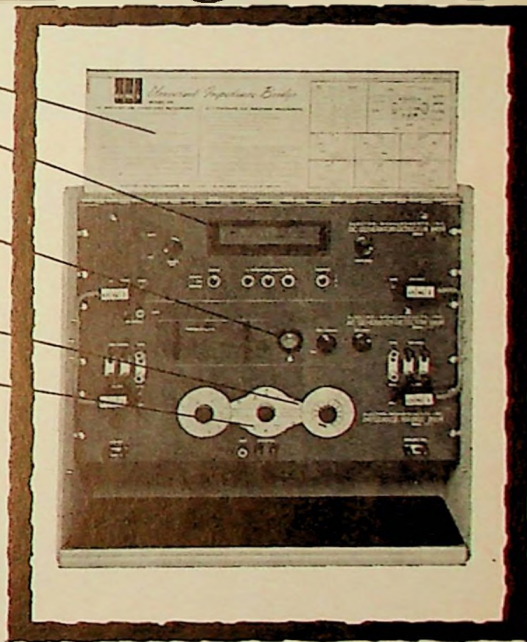
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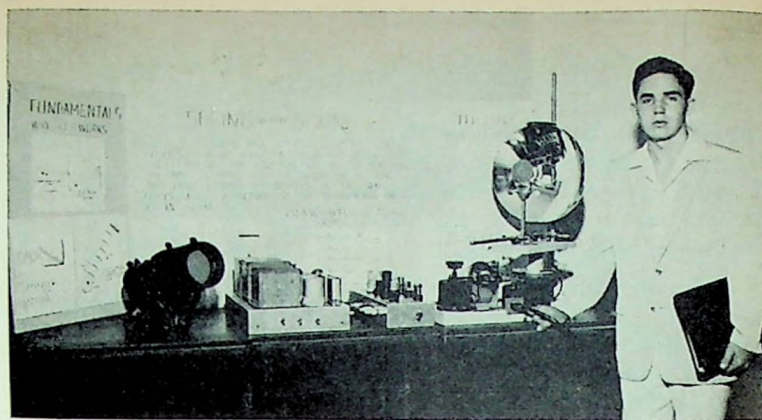


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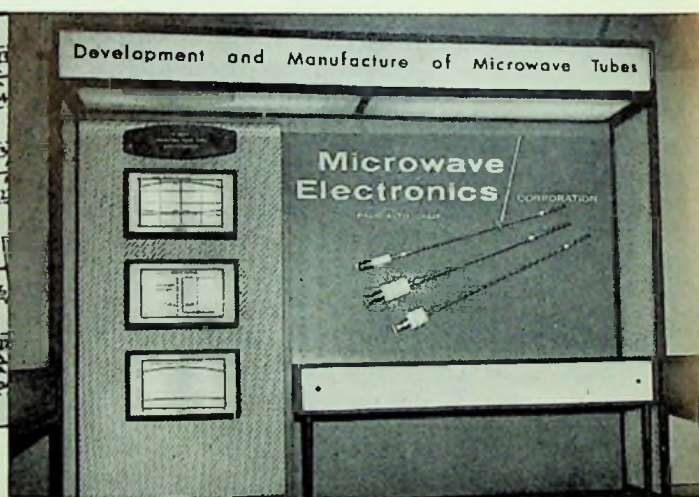
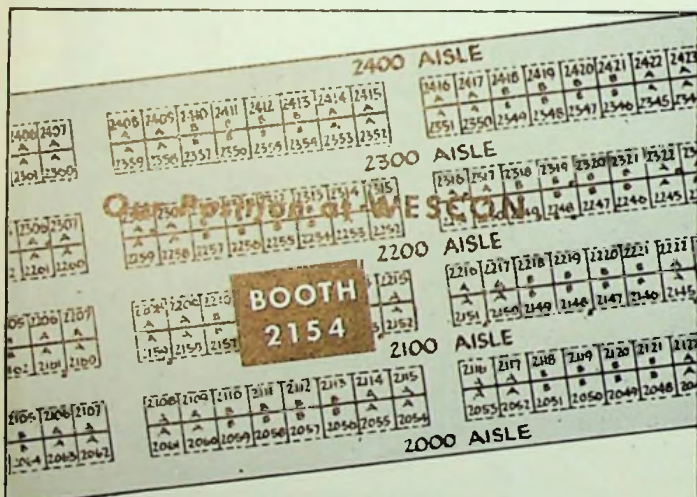
Top left: Arnold Schimsky, San Diego with his project: "Silicon Carbide Diode".

Bottom left: Jerry Busick, Puyallup High School, Washington.

Top right: Steve Walther, Punahou School, Honolulu, "Seeing with Sound".

Bottom right: Cloud Chamber Research", by Melvin Rosowski, Concord, Calif.

Bottom right: Melvin Rosowski's "Cloud Chamber Research", Clayton Valley HS, Concord, Calif., Richard Mack, left and John Coral of SF Section selection committee study exhibit.



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sponsored by PGSET, presented nine sessions of 41 papers and a full range of other activities including exhibits, under the general chairmanship of R. E. Rawlins, Dymec; and the technical program chairmanship of G. L. Larse, Lockheed. In May, the San Francisco Section was host to the Western Joint Computer Conference, a joint endeavor of AIEE, ACM, and IRE. General chairman was Robert M. Bennett, IBM, while Howard M. Zeidler, SRI, was chairman of the technical program.

This event was followed almost immediately by the Second Annual Bay Area Reliability Seminar in Monterey. This was operated by the San Francisco Chapter PGRQC under the chairmanship of C. Bruce Clark, with cooperation from ASQC.

Following a mail ballot, new officers for the forthcoming year were determined as follows: Donald A. Dunn, Eitel - McCullough, Inc., chairman; Stanley F. Kaisel, Microwave Electronics Corp., vice chairman; Peter D. Lacy, Wiltron Co.,

## ELECTRONIC ENGINEERS

Here is your chance to get in on the ground floor. Two small but rapidly growing NORTHERN CALIFORNIA companies, Donner Scientific Company and Systron Corporation, have just combined their facilities and professional know-how to form a new organization, the SYSTRON-DONNER CORPORATION.

We offer a steady future and challenging work to competent, design-minded engineers with experience in

- ANALOG COMPUTER SYSTEMS • HIGH SPEED DIGITAL COUNTING EQUIPMENT
- DATA LOGGING SYSTEMS • TRANSDUCERS • FLIGHT CONTROL SYSTEMS

(See our products at the WESCON SHOW)

Systron-Donner Corporation is located within driving distance from San Francisco and the University of California in Berkeley. Our employees enjoy a smog-free climate, plenty of elbow room, easy commuting, good schools, and almost every type of outdoor recreation.

U.S. Citizenship not required

Send your resume to  
Herb Oestreich, Personnel Manager,

**SYSTRON-DONNER CORP.**  
888 Galindo, Concord, Calif.  
MULberry 2-6161

## Circuit Designers!

... at last a dependable all-transistor power supply

Model No. W612A

**\$5495** List

It has to be good, it's guaranteed for 1 full year by Honeywell



### TWO BIG SPECIAL FEATURES:

#### Honeywell Circuitry

- provides instant starting at low ambient temperatures • increases efficiency over entire output range—no load to full load\*
- protects components from overloading—high voltage tap fades out on unsafe overload • saves batteries—current input proportional to output\* • gives higher power output—surpasses other power supplies of same price range • provides continuous full load service at rated ambient without damage, loss of efficiency, or regulation

#### Sturdy Case

- encloses all electronic components—protects transistors from mechanical damage and accidental shorting • provides excellent heat dissipation under the most adverse high temperature conditions and extra strength for toughest mobile service—heavy gauge aluminum (1½ lbs.) chassis. • utilizes perforated steel cover with adequate ventilation • high ambient rating permits mounting in engine compartment—withstands vibration and moisture • uses all screw-terminal connections to make positive stay-tight contact • affords simplified mounting and wiring

\*See data on graph below.

#### SPECIFICATIONS:

INPUT: 12.6 v dc (nominal) with 17 amp maximum current draw at full load.

OUTPUT: Dual voltage—250 and 500 v dc, nominal. Current—

Up to 300 milliamperes on 500 volt tap.

Up to 200 milliamperes on 250 volt tap.

Max. Total Power—150 watt total continuous load.

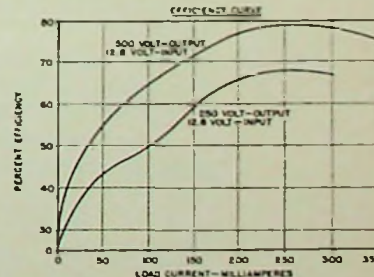
EFFICIENCY: 78%

AMBIENT TEMPERATURE LIMITS: 0 to 130 degrees Fahrenheit continuous at full load (150 watt output). 140 degrees Fahrenheit at 50% transmit (normal use).

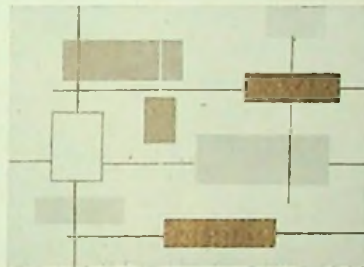
RIPPLE: Less than 1.2 volts RMS ripple.

DIMENSIONS: (inches) 6-1/16 high, 5½ wide, 3¼ deep.

FINISH: Gray enamel.



## HOPKINS PLASTIC MOLDED Metallized paper capacitors



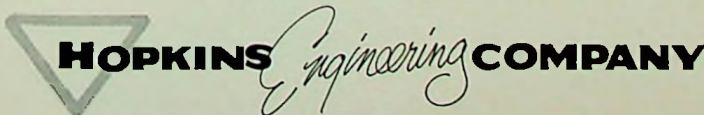
- excellent environmental qualities
- space-saving design

Hopkins molded capacitors are fully insulated, and offer a resistance to heat and moisture closely matching that of a hermetically sealed unit. They're designed with a unique rectangular shape to give maximum space economy.

**Extremely rugged**—casing is virtually indestructible, and provides complete protection against severe usage. The case is highly resistant to shock and vibration . . . will not develop cracks or fissures.

**Accurate sizes**—units are compression molded under precise dimensional control to insure consistent accuracy in size.

**Attractive blue color** of Hopkins molded capacitors compliments the circuitry in which they're used . . . makes identification easy. Standard units supplied from .005 to 4.0 mfd. Higher capacities are available.



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# DIGITAL MULTIMETERS

**NOW IN A SINGLE 5 $\frac{1}{4}$ " OR 8 $\frac{3}{4}$ " x 19" PANEL** Digital Multimeters for measuring any combination of AC/DC volts, AC/DC ratios, and resistance, with pre-amps for higher sensitivities, and optional electrical outputs and print control capabilities!

This new line of all-electronic, solid state instruments meets the growing requirement for precision, multi-purpose measuring instruments. Any combination of AC and DC voltages, AC and DC ratios, resistances . . . every electrical parameter which is of interest to the instrumentation designer . . . can now be measured quickly, accurately, with a single instrument.

**Unmatched specifications!** These Multimeters are the first to have a combination of high input impedance, 4 digit accuracy, automatic ranging, automatic polarity and high speed in a single instrument!

**All electronic, solid state circuitry!** Exclusive use of transistors and diodes provides a light, compact instrument possessing exceptionally high reliability and accuracy. The experience of more than 6,000 digital instruments has gone into their design.

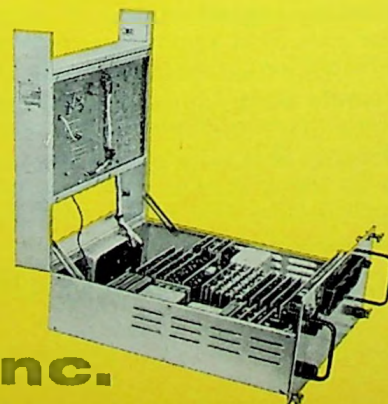
**Unique reference supply gives unequalled stability!** For these new instruments, EI has developed a pre-regulated, twin Zener diode bridge with the Zener diodes in a temperature-stabilized oven. Temperature stability and drift characteristics of this reference

are better than .005% and unequalled in the industry. **Easily integrated into semi- or completely automatic systems!** These new instruments reflect EI's active-participation in the building of small and medium size digital systems. All necessary control logic is available at rear panel connectors for external control. Every instrument is ideally suited for automatic input signal conditioning or scanning operation. Models with electrical outputs will operate directly in multi-point scanning and print-out data logging systems without any additional circuitry or auxiliary equipment.

**Electrical outputs optional!** Where "hard copy" of test results is not required, the addition of electrical outputs and print control capabilities is a costly, unnecessary luxury. EI provides these new instruments, in every measuring configuration, either with or without these features.

**Sensitivity control eliminates effect of noisy readings!** A front panel sensitivity control is provided on each of the instruments to overcome unusual noise conditions and give, as a by-product, a qualitative measurement of the noise present.

**FLIP-TOP BOX CONSTRUCTION  
FOR EASY MAINTENANCE.**



**Electro Instruments, Inc.**

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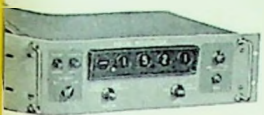
Pick the instrument that exactly meets needs and order by model number!



MODEL 830  
DC Volts/DC Ratios



MODEL 838  
DC Volts/Ratio With Electrical Outputs



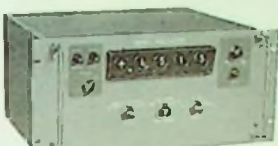
MODEL 841  
DC Volts/DC Ratios/Resistance



MODEL 835  
DC Volts/DC Ratios/Resistance With Electrical Outputs



MODEL 842  
DC Volts/DC Ratios/AC Volts



MODEL 850  
DC Volts/DC Ratios/AC Volts With Electrical Outputs



MODEL 843  
DC Volts/DC Ratio/AC Volts/Resistance



MODEL 851  
DC Volts/DC Ratio/DC Volts/Resistance With Electrical Outputs



MODEL 844  
DC Volts/Ratio/DC Pre-Amplifier



MODEL 852  
DC Volts/Ratio/DC Pre-Amplifier With Electrical Outputs



MODEL 845  
DC Volts/Ratio/Resistance/DC Pre-Amplifier



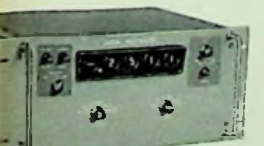
MODEL 853  
DC Volts/Ratio/Resistance/DC Pre-Amplifier With Electrical Output



MODEL 846  
DC Volts/Ratio/AC Volts/DC Pre-Amplifier



MODEL 854  
DC Volts/Ratio/AC Volts/DC Pre-Amplifier With Electrical Outputs



MODEL 847  
Volts/Ratio/AC Volts/Resistance/Pre-Amplifier



MODEL 855  
DC Volts/Ratio/AC Volts/Resistance Pre-Amplifier With Electrical Outputs

*Faster conversion times, higher input impedance, greater accuracies, plus all of the other specifications you wanted in a digital multimeter!*

**DC VOLTAGE SPECIFICATIONS:** Apply to all instruments incorporating the pre-amplifier

**Range:** ±.00001 to .09999;  
.0001 to .9999;  
1.000 to 9.999;  
10.00 to 99.99;  
100.0 to 999.9 v

**Accuracy:** 0.02% ± 1 digit for 10 microvolt range of .00001 to .09999 v; 0.01% ± 1 digit from .0001 to 999.9 v

**Input Impedance:** 1000 megohms up to 9.999 v; 11 megohms up to 999.9 v

**Average Reading Time:** 50 milliseconds

**Operating Ambient Temperature:** 0-50°C

**Maximum Source Impedance:** 5 K ohms on 10 microvolt range only; noncritical all other

**Automatic Features:** Ranging, polarity

**DC VOLTAGE SPECIFICATIONS:** Apply to all instruments except those incorporating the pre-amplifier

**Range:** ±.0001 to ±.9999;  
±1.000 to ±9.999;  
±10.00 to ±99.99;  
±100.0 to ±999.9 v

**Accuracy:** 0.01% ± 1 digit

**Input Impedance:** 1000 megohms to ±9.999 v; 11 megohms to ±999.9 v

**Average Reading Time:** 50 milliseconds

**Max. Balance Time:** 200 milliseconds

**Operating Ambient Temperature:** 0-50°C

**Automatic Features:** Ranging, polarity

**DC RATIO SPECIFICATIONS:** Apply to all instruments measuring DC ratios

**Range:** .0000 to .9999°

**Accuracy:** ±1 digit

**Input Impedance:** 1000 megohms

**Average Reading Time:** 50 milliseconds

**Max. Balance Time:** 100 milliseconds

**Reference Voltage:** 10 volts ± 10% (nominal)

**Reference Input Impedance:** 1000 megohms

**Operating Ambient Temperature:** 0-50°C

°With properly chosen reference supply, ratios of up to 100 times unity may be measured.

**AC VOLTAGE SPECIFICATIONS:** Apply to all instruments measuring AC voltages

**Range:** .0000 to .9999 VAC;  
1.000 to 9.999 VAC;  
10.00 to 99.99 VAC;  
100.0 to 999.9 VAC

**Accuracy:** 0.1% and two digits

**Frequency Response:** 30 cps to 10,000 cps

**Input Impedance:** 1 megohm shunted by 30 mmfd up to 9.999 VAC; 10 megohms shunted by 30 mmfd up to 999.9 VAC

**Average Reading Time:** 2 secs. low freq.; ½ sec. high freq. (400 cps and up)

**Operating Ambient Temperature:** 0-50°C

**Automatic Features:** Ranging

**RESISTANCE SPECIFICATIONS:** Apply to all instruments measuring resistances

**Range:** 000.1 ohms to 999.9 ohms;  
1000. ohms to 9999. ohms;  
10.00 K ohms to 99.99 K ohms;  
100.00 K ohms to 999.9 K ohms

**Accuracy:** 0.01% ± 1 digit to 99.99 K ohms; 0.03% ± 1 digit to 999.9 K ohms

**Average Balance Time:** 200 milliseconds

**Operating Ambient Temperature:** 0-50°C

**Automatic Features:** Ranging (decimal point placement)

**ELECTRICAL OUTPUT SPECIFICATIONS:** Apply to all instruments incorporating electrical outputs

• Both 2-4-2-1 Binary Coded Decimal and 10 Line Coded Decimal are provided

variations of these basic models including AC ratiometers, millimeters, microvoltmeters and specialized measuring instruments tailored to individual systems requirements are available in the same configurations.

your sales office or representative for complete information.



<b>TRANSFORMERS</b>	<b>INDUCTORS</b>	<b>COILS</b>
<b>TOROIDS</b>	<div style="border: 1px solid black; padding: 5px;"> <b>PAECO</b>  <b>CUSTOM DESIGNED MAGNETICS</b>  <b>BOOTH 544</b> </div>	<b>FILTERS</b>
<b>MAGNETIC AMPLIFIERS</b>	<b>DELAY LINES</b>	<b>POWER SUPPLIES</b>

Palo Alto Engineering Co., 620 Page Mill Rd., Palo Alto, Calif.  
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Region Report Cont. from page 77  
secretary; Charles Susskind, University of California, treasurer; and Albert J. Morris, Levinthal Electronic Products, director. These announcements were made at the annual meeting which filled the Empire Room of Berkeley's Claremont Hotel. Attendees hailed the eight new Fellows (P. W. Crapuchettes, R. A. Helliwell, J. G. Linvill, Theodore Moreno, T. H. Morrin, Walter T. Selsted, D. F. Tuttle, Jr., and V. H. Rumsey); applauded the awards to outstanding students from five local educational institutions; and listened with mixed awe and skepticism to a paper on Extrasensory Perception by Dr. Andrija Puharich, neurophysiologist and research consultant in the field of parapsychology.

As the season drew to a close, Section members were saddened by the news that a respected and



Dr. John T. Bolljahn  
Fellow, IRE  
1918-1960

beloved colleague, Jack Bolljahn, had lost his struggle against cancer. A founding member of the Section Publications Board and 1959 Westcon Technical program vice chairman, Jack was executive vice president of Granger Associates and formerly assistant director of engineering research at Stanford Research Institute. His absence from the San Francisco scene will diminish every one of us.

—Frank Haylock

**Seattle**

This year the Seattle Section had the privilege of playing host for the 7th Region Conference. The three-day technical program featured nearly 50 invited papers covering  
(Continued on Page 81)



MODEL 200AB

PRICE  
**\$449.00**

- ⊙ 2° absolute accuracy
- ⊙ Readings not affected by noise and harmonics
- ⊙ Frequency range 15 CPS — 30KC
- ⊙ Accuracy to .01 degree with simple circuit techniques
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- ⊙ Can measure in-phase & quadrature voltage component

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- **Other Electronic Test Equipment**



Dr. D. K. Reynolds, newly-elected chairman, Seattle Section.

Region Report Cont. from page 80

the three fields of solid state electronics, control systems, and electromagnetics.

The trade show, co-sponsored by the Instrument Society of America, brought to Seattle the largest and best technical exhibit of instruments and electronic equipment yet to be seen here. Over 180 display booths in the National Guard Armory were occupied by the exhibits.

Dr. Frank S. Holman, chairman of the conference, was ably assisted by Rush Drake, exhibits; Frank Little, treasurer; John Tate, secretary; Mel Paisley, arrangements; Bill Harrold, publicity; Dr. Don Reynolds, technical program; and Joanne Holman, women's activities.

The Section was privileged to receive visits from two IRE Presidents in the same year. Dr. Ernst Weber addressed the Section at the season's opening meeting in August, 1959, and Dr. Ronald McFarlan addressed the opening session of the 7th Region Conference in May, 1960.

The Section's activities were suspended for the summer following a well attended field trip to the U.S. Navy's megawatt transmitter at Jim Creek, Washington.

The Section is enjoying a steady growth in membership which now stands at 820 of member grade or above.

—L. C. Perkins, chairman

#### Tucson

The Tucson Section of the IRE enjoyed an array of excellent speakers discussing many interesting and

(Continued on Page 82)

# FMC CALIFORNIA

offers career opportunities for challenging assignments in commercial products R & D to:

## TRANSISTOR CIRCUIT DESIGN ENGINEERS

FMC's Central Engineering Laboratories has started a major digital activity using the latest techniques in the design of special purpose computers and memory devices. Experience is desirable in transistor circuitry, logical design, systems design, memory systems and input/output equipment.

## ELECTRONIC EXPLORATION ENGINEERS

To find and initiate work in new areas of industrial electronics, with emphasis on machines and systems rather than components. Technical and business experience required as well as thorough knowledge of industrial electronics and the business problems of an electronic operation. Should be interested in some travel; capable of appraising ideas and problems in discussions with outside organizations.

## ELECTRONIC ENGINEERS OR PHYSICISTS

Circuit designers, systems engineers and specialists experienced in industrial electronics and automation are needed to work on advanced assignments in the design of optimum systems using electronic and mechanical components.

FMC's Central Engineering Laboratories' major expansion program requires well-qualified engineers with a high degree of creative imagination to staff our new million dollar facilities in the San Francisco Bay Area. BS required and advanced degrees desirable for these responsible positions.

Interested? Send a resume of your background and professional experience to E. M. Card Jr., FMC Central Engineering, 1105 Coleman Avenue, San Jose, California, or telephone CYPRESS 4-8124 for interview appointment.

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**LOWEST COST**    **SMALLEST SIZE**    **LIGHTEST WEIGHT**

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**MEETS MAXIMUM TEMPERATURE SHOCK AND VIBRATION SPECIFICATIONS**

**NO SEGMENTED FAILURE**

**LONGEST LIFE — 100,000 HOURS**

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**READOUT FACT FINDER**

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**MOLDED  
 CHOKE  
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ACTUAL SIZE

10,000 UH

Nicknamed the "Micro Mite", these reliable, rugged coils exhibit high Q, very low distributed capacity, all concentrated into an amazingly small package.

Miller's new "Micro Mite" coils are perfect for use where weight, space and high Q considerations are involved. Their volumetric reduction ranges up to 80%, with current ratings approximately 75-300 millamps and standard series values up to 10,000 uh.

The "Micro Mite" coil construction permits miniaturization without the use of ferrite materials, thus maintaining temperature stability to 125° C. These hermetically sealed molded coils conform to MIL-C-15305A.

ASK FOR OUR MICRO-MITE BULLETIN

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Region Report Cont. from Page 81  
 timely subjects during the season.

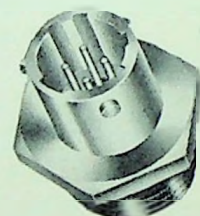
Lectures on the following topics were presented at regular monthly meetings during the period of September, 1959 to June, 1960: The University of Arizona TRIGA Reactor, Magnetic Amplifier Circuits and Applications, Applications of Tunnel Diodes, Log Periodic Antennas, Atomic Clocks and Satellite Applications, Military Tropospheric Scatter Systems, the Orbiting Astronomical Observatory Program of AURA Inc., Guided Missile Systems, and Radio Intcrrference Investigations and Equipment Compatibility Problems.

There was little change in the Tucson Section membership during the year.

—Ernest L. Morrison, secretary

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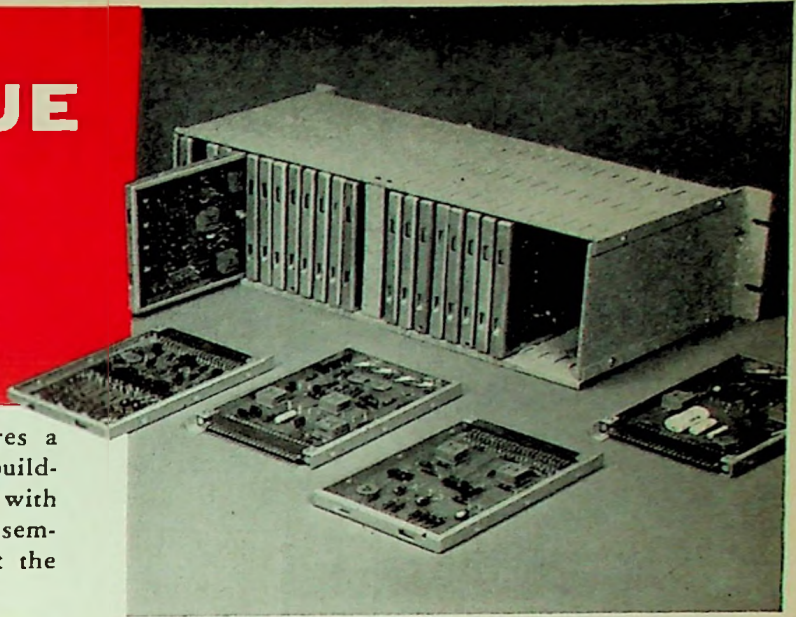
# New! SPRAGUE LOGILINE\* CIRCUITRY

for digital system design

Sprague's latest line, the LOGILINE, features a series of 5 mc/s transistor switching circuits in building block form. Completely interchangeable with comparable units, these packaged component assemblies have gained wide acceptance throughout the digital industry.



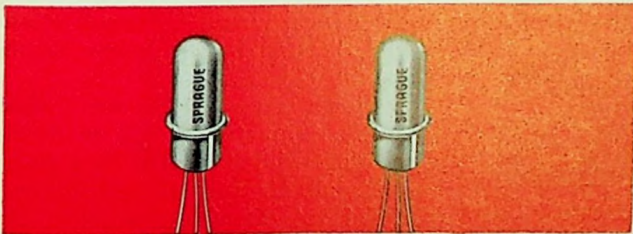
LOGILINE offers designers either the flexibility of conventional wiring board construction for standard equipment assembly, or the versatility of encapsulated packages for miniaturized equipment.



The complete series of LOGILINE modules includes: Inverter, Diode Gate, Flip-Flop, Dual Flip-Flop, Delay, 3-Digit Shift Register, Clock, Pulse Amplifier, Pulse Generator, Indicator Driver.

\*Trademark

## Super high-speed switching TRANSISTORS available at sensible prices!



Sprague's Type 2N501 and 2N501A Germanium Micro-Alloy Diffused-Base Transistors are priced below other units with comparable electrical characteristics. Expanded production facilities permit shipment of quantity orders on short notice. And because these transistors exhibit the fastest switching time in commercial production today, they may provide solutions to some of your latest circuit design problems.

Storage and junction temperatures for these transistors is 85 C for Type 2N501 and 100 C for Type 2N501A.

## Subminiature metal-clad HYREL® Q CAPACITORS for Highest Reliability



Sprague's Type 195P Capacitors are the most reliable sub-miniatures possible in the present state of the art. In every phase of their design, testing, and manufacture, the primary consideration is optimum reliability. Sprague can substantiate its claims with the most extensive test data available in the entire electronic industry.

Intended for military electronics, electronic computers, and complex equipment in which extreme system reliability is vitally important, Hyrel Q Capacitors are subjected to lot-by-lot environmental tests, giving each customer complete assurance of reliability.

Don't forget to visit Sprague Booths 445 and 446 at the WESCON Show, Los Angeles, August 23-26, 1960

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And we'll see you at Wescon  
\*Represented in California and Nevada

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7814 Ivanhoe Avenue, La Jolla, California • GL 4-2191

### Fieldtec Appointed

Fieldtec field engineering service, Tustin, Calif., has been appointed sales-service representative for Cryogenic Engineering Company of Denver.

### Business Activity—North

#### Rockwood to Varian

Varian Associates announces the appointment of Clifton G. Rockwood as manager of applications engineering. Reporting to Rockwood will be five regional application engineering managers for the United States. Rockwood will be directing the tube division's sales activities in cooperation with Varian's nationwide staff of sales representative groups.



Clifton G. Rockwood

#### AFCEA Names Stoner

Frank E. Stoner, assistant to the president, Varian Associates, has been named Fourth Vice President and West Coast Representative on the Executive Committee of the Armed Forces Communications and Electronics Association, Washington, D.C.

Stoner served with the United States Army from 1914 to 1947, retiring with the rank of Major General. He was United Nations' Chief of Communications from 1946 to 1950. During the Palestine Truce, for which Ralph Bunche received the Nobel Prize for World Peace in 1953, he served as a member of Count Bernadotte's staff.

#### Raytheon Moves

Raytheon Company has announced the move of their San Mateo, Calif., commercial sales office to new quarters at 486 El Camino Real, Redwood City, Calif. Addition of the following sales representatives is being made at this time: E. J. Leonelli, commercial apparatus and systems division, and R. C. Bosshard, communications and data processing.

(Continued on Page 88)

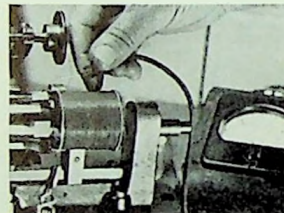
## TURBOPOWER\* MEANS



TURBOPOWER\* COILS HAVE MORE TURNS AT THE COIL CENTER



POSITIVE DIMENSIONING



RESISTANCE CHECK

## MORE AMPERE TURNS



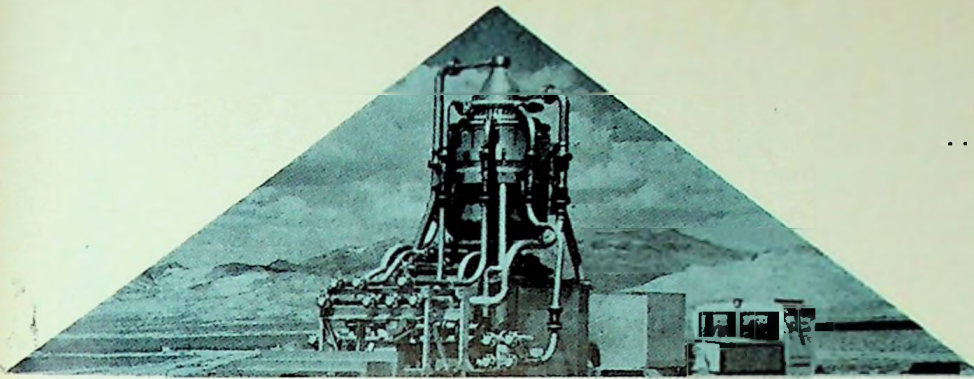
AT WESCON BOOTH 461

**TUR-BO JET PRODUCTS CO., INC.**

424 SOUTH SAN GABRIEL BLVD. SAN GABRIEL, CALIFORNIA  
CUMBERLAND 3-5191

\*Patents Applied For

# AT THE CONTROLS on three new frontiers . . .



## ROCKET TESTING

Rover . . . one of EG&G's major current activities is the design and operation of a control, instrumentation and data acquisition system for Project Rover, the project for development of nuclear powered rocket engines and vehicles for deep outer space exploration. EG&G is the principal instrumentation contractor for all past and presently planned full-scale testing of the Rover engines.

## UNDERWATER EXPLORATION

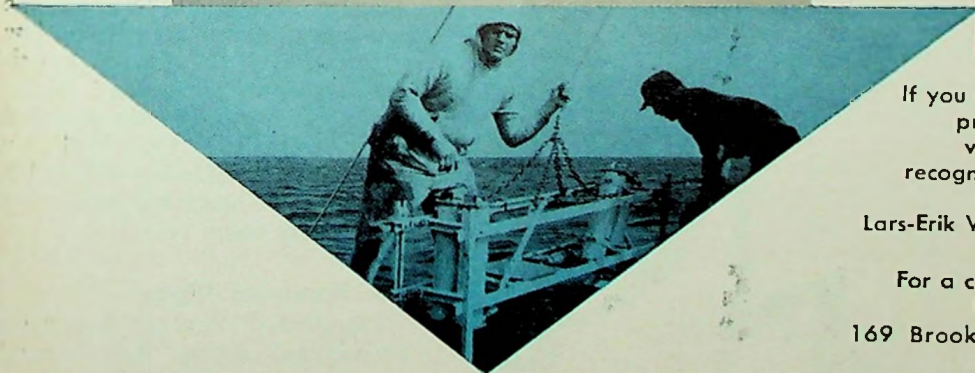
As one of the earliest pioneers of underwater photography, EG&G's capabilities in this field are unique. EG&G camera and sonar equipment can penetrate to the ultimate 37,500 ft. depth and are adding substantially to man's knowledge of the undersea world.

## NUCLEONICS & INSTRUMENTATION

Plowshare . . . this is the program for development of peacetime uses of nuclear explosions. Measurement, timing, control and recording instrumentation by EG&G is vital to Plowshare's Project Gnome, the project for the evaluation of techniques for underground generation of nuclear power and production of isotopes for industrial use.

Vela . . . EG&G, oriented in the design, installation and operation of nuclear detection and measurement systems, is contributing its skills to this international nuclear explosions detection program.

Rover . . . Plowshare . . . Vela . . . the ocean's floor . . . here at these outposts of advanced engineering you will find EG&G men and techniques.



If you are interested in really unusual professional opportunities with a vigorous, young organization of recognized professional stature, send your confidential resume to Lars-Erik Wiberg, 160 Brookline Avenue, Boston 15, Massachusetts.

For a copy of "EG&G CAPABILITIES" brochure, write to: Dept. MDA, 169 Brookline Ave., Boston 15, Mass.



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# Rapid commercial expansion creates **IMPORTANT NEW OPPORTUNITIES IN LOS ANGELES FOR KEEN MINDS IN TRANSISTOR CIRCUITS & ELECTRONIC DESIGN**

**TRANSISTOR CIRCUITS ENGINEERS (Senior and Intermediate)** Highly creative positions are available in circuit analysis and design. Duties include advanced mathematical studies in transistor circuitry, evaluation of transistor circuitry, component studies and keeping abreast of computer circuit advances. Circuit analysis ability and solid understanding of transistor theory essential. E. E. degree required. ■ **ELECTRONIC DESIGN ENGINEERS (Senior and Intermediate)** To form new group in design of general-purpose digital buffers and peripheral equipment. Three to five years' logical and transistorized circuit design of digital equipment preferred, with additional background in ferrite magnetic core memories or input-output equipment. ■ **ELECTRONIC PRODUCT DESIGN ENGINEERS** To form nucleus of a new product engineering and manufacturing liaison group. Positions require 2-3 years of electronic design experience, preferably in digital computing equipment or transistor circuits. ■ **PRODUCT DEVELOPMENT** Experience desired in system design of data-processing equipment, central processor, command codes, peripheral equipment and associated buffers; writing of functional specifications with additional experience or training in logical design, programming techniques or systems and procedures for data-processing. ■ Additional openings in: **TRANSISTOR POWER SUPPLY DESIGN AND TEST EQUIPMENT DESIGN.** ■ Please send resume to Norval Powell, Personnel Manager ■ The National Cash Register Company ■ **ELECTRONICS DIVISION** ■ 1401 E. El Segundo Boulevard, Hawthorne (Los Angeles), Calif. \* Trade Mark Reg. U.S. Pat. Off.

*National\**



J. M. Loge

## Loge Expands

J. M. Loge, pioneer Los Angeles sound engineer and electronics manufacturer, has announced the incorporation of his company under the new name of Loge Electronics, Inc. The firm has been known as J. M. Loge, Sound Engineers, since its establishment in 1923.

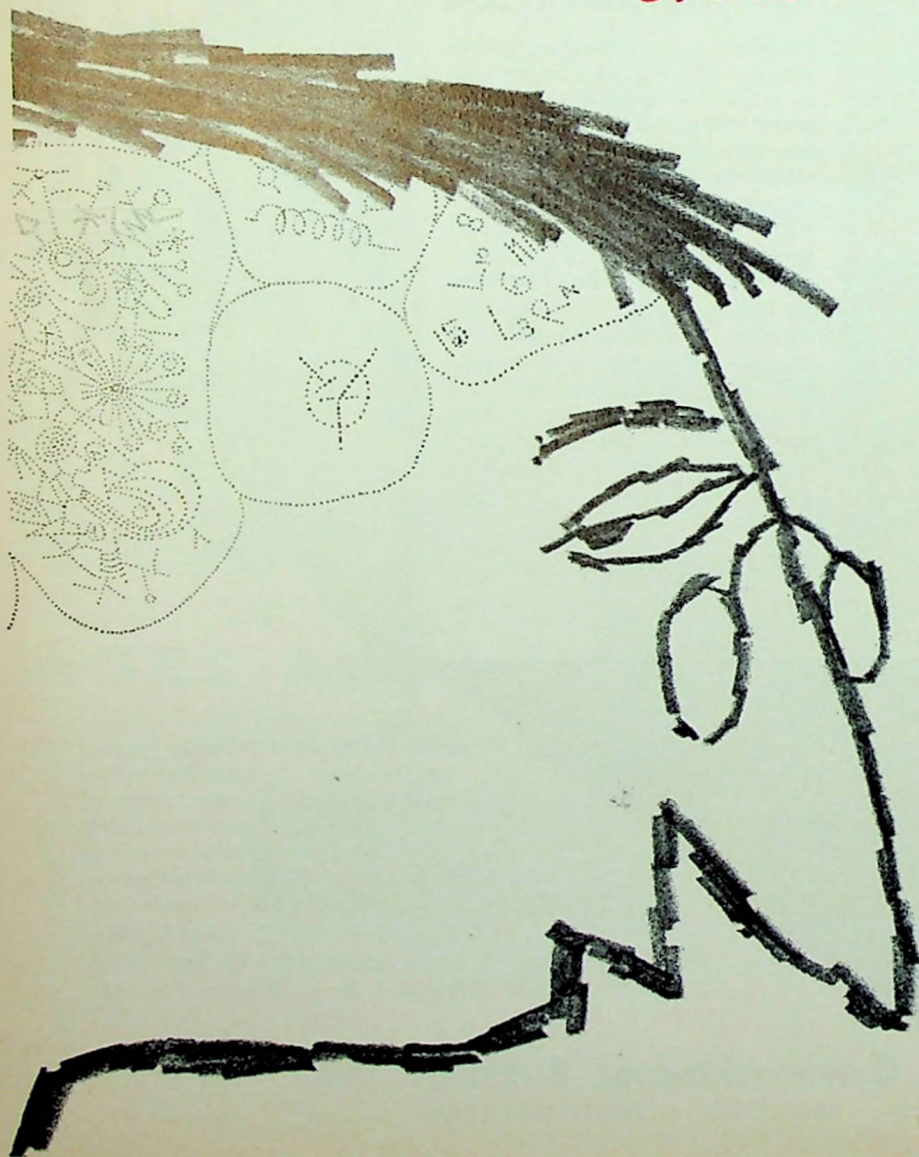
Loge, who remains president and treasurer, said the new corporate structure would enable the firm to expand its operation in the advanced design and development of intercommunications systems. "Within 60-90 days we will initiate a program that will double our present manufacturing facilities," Loge said.

He predicted that the company's manpower would be increased 80% as a result of the growing demand for quality and specialized communication systems by the industry-at-large, missile test ranges and other military installations. The firm manufactures a complete line of electronic inter-office communication equipment. Featured in the product line is the newly patented executive model "Kwik-Kall", a miniturized space-saving unit which incorporates a telephone instrument of matching color.

## SIA Renames Riggs

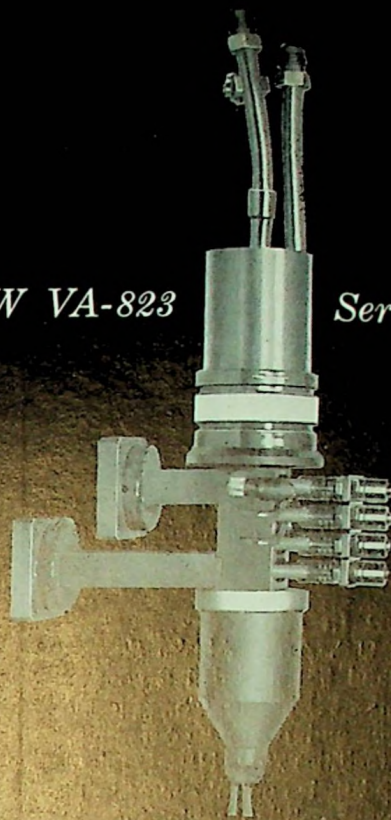
Directors of Strategic Industries Association, during their annual convention at Apple Valley Inn, renamed Harvey Riggs of Glendale, president of International Electronics Research Corp., Burbank, as president for the 1960-61 term.

(Continued on Page 88)



*NEW VA-823*

*Series Klystrons*



## VARIAN IS DELIVERING THE HIGHEST CW POWER AT X-BAND

5 kilowatts CW • 1.3 to 10.0 kMc • Noise 100 db below carrier\*  
50 db gain • 20 Mc bandwidth • Tunable 100 Mc\*\*

Conservatively rated at 3 kilowatts CW in operational environments, the VA-823 has produced over 20 kilowatts CW under test conditions. In system use these tubes are providing extremely low noise performance for radar CW radar and communications. They open a new area of design possibilities in microwave radar, communications, and radio astronomy. To assist you in your particular system design problems, Varian makes available its broad experience in super-power tubes at UHF and microwave frequencies. May we work with you or furnish further data?

\*AM and FM noise is more than 100 db below the carrier in any 1 kc channel more than 1 kc removed from the carrier.  
\*\*Tubes in the range from 9.0 to 10.0 kMc tune 200 Mc.

*Representatives thruout the world*



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E. E. Ferrey

Activity South Cont. from page 86

### WEMA Chooses Ferrey

E. E. Ferrey, a public relations executive in the electronics industry for more than a decade, has been appointed manager of the Western Electronic Manufacturers Association.

His appointment was announced by S. H. Bellue, of Los Angeles, president of WEMA which now has more than 300 electronic companies in the 11 western states.

Ferrey leaves Hoffman Electronics Corporation as PR director and will begin his new duties as WEMA manager late in July.

He was director of public relations for Lenkurt Electric Co., San Carlos, Calif., from 1952 until 1960, and previously held a similar position at Farnsworth Television & Radio Corp., Fort Wayne, Ind.

A former newspaperman and radio news director, he served four years on the public relations staff of Indiana University following graduation there.

Ferrey is a member of the Public Relations Society of America, American Management Association, Los Angeles Press Club and the San Francisco Press & Union League Club.

WEMA has grown rapidly since its formation in 1943. Its councils now hold regular meetings for electronics management people in the Los Angeles, San Francisco, San Diego, Seattle and Portland areas.

In addition to its main offices in Los Angeles, WEMA has a branch office in Palo Alto.

Activity North Cont. from page 84

### Nixon-Khrushchev Tape Planted

The now-famous television tape recording of the Moscow debate between Vice President Richard Nixon and Soviet Premier Nikita Khrushchev became a permanent part of U.S. history when Ampex Corporation presented its original VIDEOTAPE recording of the event to the U.S. Library of Congress.

In ceremonies at his office, Nixon accepted the historic tape on behalf of the Library from Phillip L. Gundy, vice president of Ampex Corporation, developers of the VIDEOTAPE television recorder. The gift was turned over to L. Quincy Mumford, Librarian of Congress, who was also in attendance at the ceremonies.

### Lenkurt In Alaska

The U.S. Army Alaska Support Command has awarded a contract to Lenkurt Electric Co., Inc., to maintain and operate communications facilities for NIKE missile sites and their control center in the Anchorage-Fairbanks vicinity.

The sites comprise missile battery installations providing anti-aircraft defense for the Air Force bases in the area.

### A&P Sales Selected

Federated Electronics has appointed A & P Electronics Sales, San Francisco, as sales representatives for its complete line of constant-temperature crystal ovens and frequency-control devices.

### Marquardt Gets Board Post

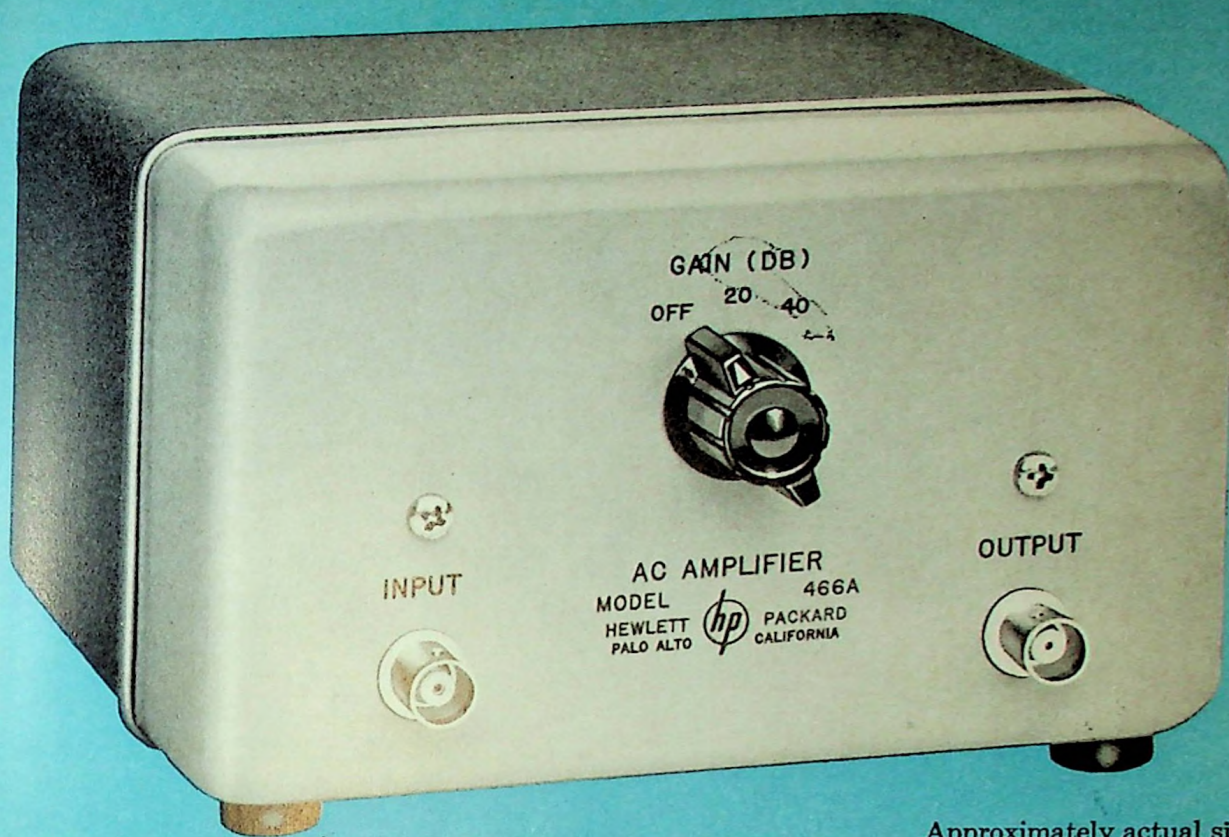
Roy E. Marquardt, president of Marquardt Corporation of Van Nuys, California, has been elected to the board of directors of Systron-Donner Corporation, Concord, Calif.

In 1944 Roy Marquardt founded the company which bears his name. He is a graduate of California Institute of Technology, where he received his Bachelor's (1940) and Master of Science (1942) degrees in Aeronautical Engineering.

In 1942 he was appointed Engineer in Charge of Naval Research at Northrop Aircraft, Inc. As a result of research in methods of cooling engines mounted within the wings of an airplane, he rediscovered and expanded on the principles of the ramjet engine.


## August 1960 Advertiser's Index

Advertiser	Page No.
Alford Manufacturing Co.	62
Andrew California Corp.	90
Arnold Engineering Co.	10
Ballantine Labs, Inc.	7
Behlman Engineering Co.	54
Bud Radio, Inc.	35
Burroughs Corp.	
Electronic Tube Div.	82
Burton Silverplating	57
Canoga Corp.	55-56
DeMornay-Bonardi	73
E. I. du Pont de Nemours & Co.	15
DynaSales Co.	53
Edgerton, Germeshausen & Grier, Inc.	85
Eitel-McCullough, Inc.	43
Electro-Instruments, Inc.	78-79
Electronic Seals, Inc.	82
Electro Scientific Ind.	75
Electronic Engineering Co. of Calif.	70
Elmar Electronics, Inc.	37
Elmar/General Electric	66
Engineered Electronics Co.	41-49
FXR	19
Food Machinery & Chemical Corp.	81
General Radio Co.	3
Genesys	51
Gertsch Products, Inc.	2
Gudebrod Bros. Silk Co.	70
Hewlett-Packard Co.	89
Honeywell	77
Hopkins Engineering Co.	77
Hughes Aircraft Co.	39
Industrial Test Equipment	80
International Business Machines	21
International Rectifier	23
Jerrold Electronics Corp.	27
Kay Electric Co.	58
Kierulff Electronics, Inc.	9
Kittleson Co.	31
Librascope	13
Lockheed Missiles & Space Div.	46-47
Luscombe Engineering Co.	74
McCarthy Associates, Inc.	63
Meridian Metalcraft, Inc.	84
Micro Gee Products	69
Micromega	73
Microwave Chemicals Corp.	34
Microwave Electronics Corp.	76
J. W. Miller Co.	82
National Cash Register	86
Neely Enterprises	91
Nems-Clarke Co.	64
John Francis O'Halloran & Assoc.	67
Osborne Electronics	59
Palo Alto Engineering Co.	80
Professional & Technical Recruiting Assoc.	70
R.C.A. Defense Electronic Products	25
Ramo-Wooldridge Labs	92
Rantec	29
Repath Pacific Div.	17
Shockley Transistor Corp.	45
T. Louis Snitzer	84
Sony Corp. of America	33
Space Electronics	65
Sprague Electric Corp.	83
Systron-Donner Corp.	77
Tech-Ser, Inc.	60
Tektronix, Inc.	4
Tur-Bo Jet Products Co., Inc.	84
Varian Associates	87
Watkins-Johnson Co.	68
John Wiley & Sons, Inc.	71




Approximately actual size

This 3 lbs. of transistorized new AC amplifier gives you 20 or 40 db gain, increases scope or VTVM sensitivity 10 or 100!

This new  466A AC Amplifier is just 4" high, 6" wide and 6" deep. Yet it can become one of the most helpful instruments on your bench, or in the field. It is ac or battery powered; battery operation gives you hum-free performance and easy portability. Response is flat within approximately  $\frac{1}{2}$  db over the broad range of 10 cps to 1 MC, distortion is

less than 1%, and gain is stabilized by substantial negative feedback to virtually eliminate effects of transistor characteristics and environment.

For a demonstration on your laboratory or field application, call your  representative or write direct.

#### Specifications

Gain:	20 and 40 db, $\pm 0.2$ db at 1000 cps.	Distortion:	Less than 1%, 10 to 100,000 cps.
Frequency Response:	$\pm 0.5$ db, 10 cps to 1 MC; $\pm 3$ db, 5 cps to 2 MC.	Power:	Ac line power normally supplied, but battery operation available. (12 radio type mercury cells, battery life about 160 hours.) Specify battery operation if desired.
Output Voltage:	1.5 v rms across 1500 ohms.	Dimensions:	6 $\frac{1}{4}$ " wide, 4" high, 6 $\frac{1}{4}$ " deep.
Noise:	75 $\mu$ v rms referred to input, 100,000 ohm source.	Weight:	approx. 3 lbs.
Input Impedance:	1 megohm shunted by 25 $\mu$ mf.	Price:	\$150.00 f.o.b. factory. (Either ac or battery operation.)
Output Impedance:	Approximately 50 ohms.		

Data subject to change without notice.

**HEWLETT-PACKARD COMPANY**

CONTACT OUR ENGINEERING REPRESENTATIVES, NEELY ENTERPRISES, FOR INFORMATION—Los Angeles, 3939 Lankershim Blvd., North H'wd., TR 7-0721; San Carlos, 501 Laurel St., LY 1-2626; Sacramento, 1317 Fifteenth St., GI 2-8901; San Diego, 1055 Shafter St., AC 3-8106; Phoenix, 641 E. Missouri Ave., CR 4-5431; Tucson, 232 So. Tucson Blvd., MA 3-2564; Albuquerque, 6501 Lomas Blvd., N.E., AL 5-5586; Las Cruces, 114 S. Water St., JA 6-2486.

# weather conditioned microwave

## ANDREW RADOME EQUIPPED ANTENNAS DEFY ICE...SNOW...WIND

Andrew radomes provide excellent 2-way year-round protection for Andrew microwave antenna systems. First, they protect feed and reflecting surface against the attenuating effects of snow, ice and debris accumulation. Secondly, for tower mounted antennas they reduce the effects of wind thrust by 35%.

All Andrew radomes are lightweight and easy to install—clip directly to the dish rim of existing antennas. Unheated radomes are suitable for all but exceptional cases. In areas where freezing rain occurs, heated radomes can be provided.

### SPECIFICATIONS STANDARD RADOMES

Dia. Feet	Type No.	Attenuation @ 6 kmc. db	VSWR Contribution @ 6 kmc	Thrust at* 30 psf (Flats), lbs.
10	R10	0.4	0.02	1,990
8	R8	0.4	0.02	1,270
6	R6	0.4	0.02	714
4	R4	0.4	0.02	320
2	R2	0.4	0.02	75

\*Including antenna

### HEATED RADOMES

Dia. Feet	Type No.	Attenuation @ 6 kmc. db	VSWR Contribution @ 6 kmc.	Thrust at* 30 psf. (Flats), lbs.	Power** Reqmts.
10	HR10	0.7	0.02	1,990	3,400 watts
8	HR8	0.7	0.02	1,270	2,400 watts
6	HR6	0.7	0.02	714	1,200 watts
4	HR4	0.7	0.02	320	550 watts
2	HR2	0.7	0.02	75	150 watts

\*Including antenna

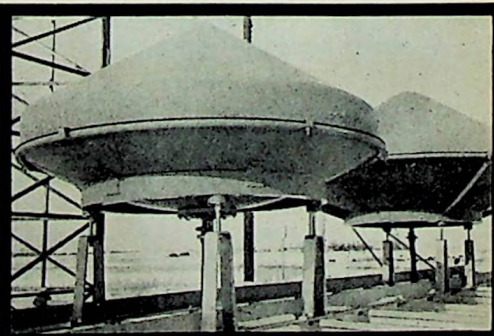
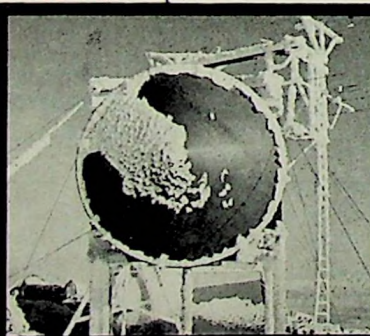
\*\*Power requirements for HR10 and HR8 are 3 wire single phase 60 cycle 220 volts.

Power requirements for HR6, HR4 and HR2 are single phase 60 cycle 115 v.

For further details on ANDREW Microwave Antennas, Radomes, Wave Guides write for new Andrew Catalog M.

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"We have paid particular attention to antennas during high wind conditions of gusts up to 40-60 m.p.h. It is very obvious that these radomes quite materially reduce the wind loading on the parabolas—due to their shape factor." *Washington State Patrol, Kennewick, Washington*

"We have had up to four inches of ice on the radome with practically no reduction of antenna effectiveness." *KLIX-AM-TV, The KLIX Corporation, Twin Falls, Idaho*

"Our field forces report that the radomes produce a signal loss of less than 1 db per antenna. Several radomes were removed and antennas inspected following a heavy snow storm and no snow or ice was found in the antennas." *Natural Gas Pipeline Company of America*

VISIT ANDREW BOOTH NO. 439 AT THE WESCON SHOW



**BALDWIN-LIMA-HAMILTON**  
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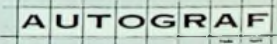
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TWX: TS 5981



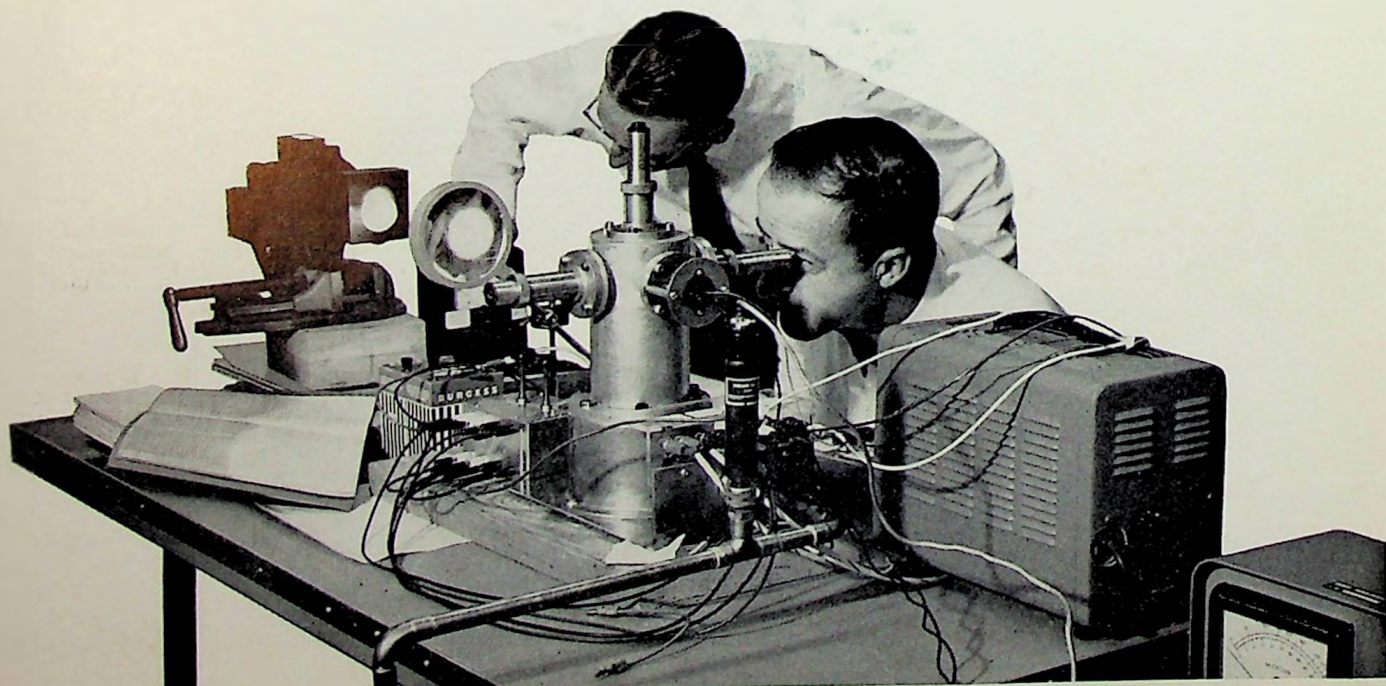
## At The Ramo-Wooldridge Laboratories... integrated programs of research & development of electronic systems and components.

The new Ramo-Wooldridge Laboratories in Canoga Park provide an environment for creative work in an academic setting. Here, scientists and engineers seek solutions to the technological problems of today. The Ramo-Wooldridge research and development philosophy places major emphasis on the imaginative contributions of the members of the technical staff. ■ There are outstanding opportunities for scientists and engineers. *Write* Dr. Richard C. Potter, Head, Technical Staff Development, Department 34-G



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An electron device permits scientists to study the behavior of charged dust particles held in suspension.