EDITOR'S PROFILE of this issue

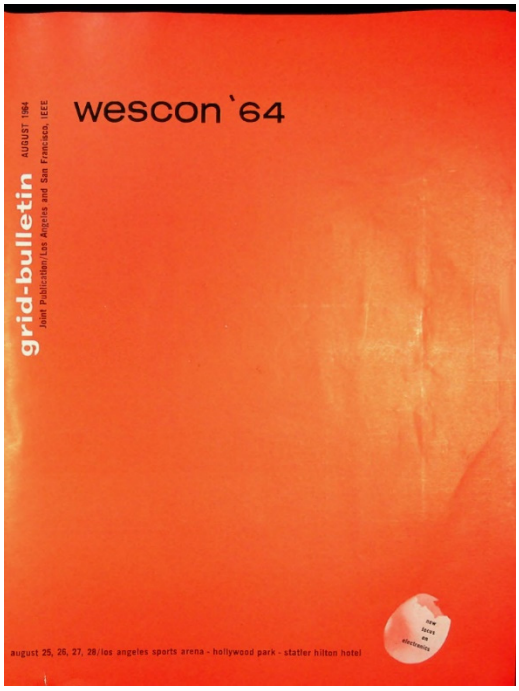
from a historical perspective …

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

August, 1964:

Cover: Joint WESCON'64 issue of the GRID-Bulletin published jointly by the SF Bay Area Council and the Lost Angeles Council

Page 62: A series of reports from the various Sections of the newly formed IEEE.

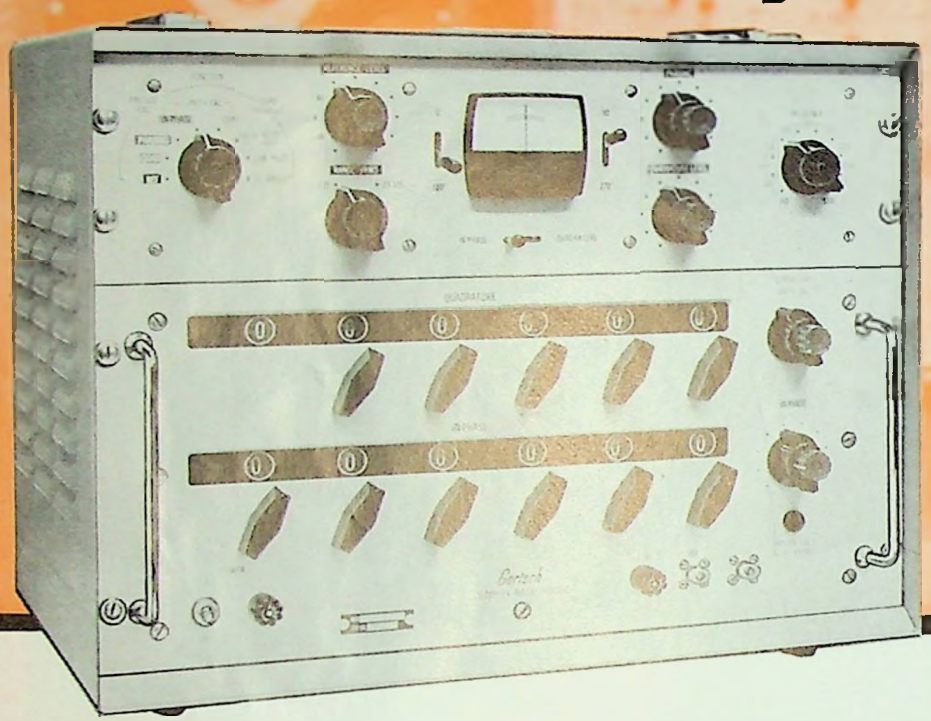


grid-bulletin AUGUST 1964
Joint Publication/Los Angeles and San Francisco, IEEE

wescon '64

august 25, 26, 27, 28/los angeles sports arena - hollywood park - statler hilton hotel

Dual readout—in-phase and quadrature voltage ratios —with high accuracy



CRB-8 complex ratio bridge for testing transformers, synchros, AC transducers, resolvers, tach-generators, amplifiers, and gyros.

This *Gertsch* bridge measures both in-phase and quadrature ratios of 3- and 4-terminal networks to an accuracy of .001% (10ppm). Voltage ratios are read from the *RatioTran** dials as rectangular coordinates (R+jX), or phase angle between signal and reference may be read directly in degrees.

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Model CRB-6—militarized to withstand wide temperature extremes.

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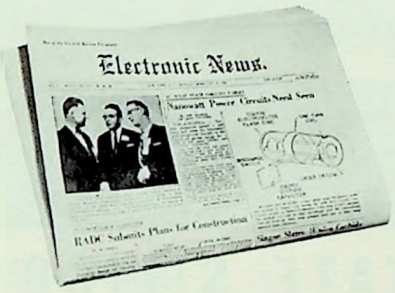
CIRCLE INQUIRY CARD NUMBER 1

Some Plain Talk About Electronics Publications

There are 80 publications which contain various types of information of interest to the electronics industry. Eighty probably seem like a lot to you. It does to us, too.

Of all these publications, there is only one devoted to news coverage of the entire industry. Electronic News.



Why should an engineer read a newspaper serving a technical industry? For this reason. Only a newspaper can satisfy the real need for up-to-the-minute technical and business news, so vital to an industry whose technology is in a constant state of flux. And there is only *one*. Electronic News.

In the technical area, Electronic News renders a unique service by reporting technical news and developments immediately and by following their progress each week from ideas to finished reliable products competing for the industrial dollar. In the business area EN's coverage includes everything from price fluctuations to promotions, from Wall Street to Washington, from the Common Market to Japan. To ignore the effect of developments in these areas is to ignore the fact that the electronics business *is* a business, faced with competition and struggling for profit, much as the steel, automotive and chemical industries.

Now, don't get us wrong. We're not saying that Electronic News is the only source of trade information you should read. Not by a long shot. There are many magazines that offer tutorial articles of value to engineers. There are others that deliver partial coverage of electronics in the process of dealing with a wider field, such as the aerospace industry. And still others, like the one you're reading now, keep association members informed of activities and meetings.

But there's only one up-to-the-minute news publication. Electronic News.

We hope that what you've read here makes sense. Enough for you to want to give Electronic News a try. Simply fill out the card facing this page and send it on to us. Why not do it now, while you're thinking about it?

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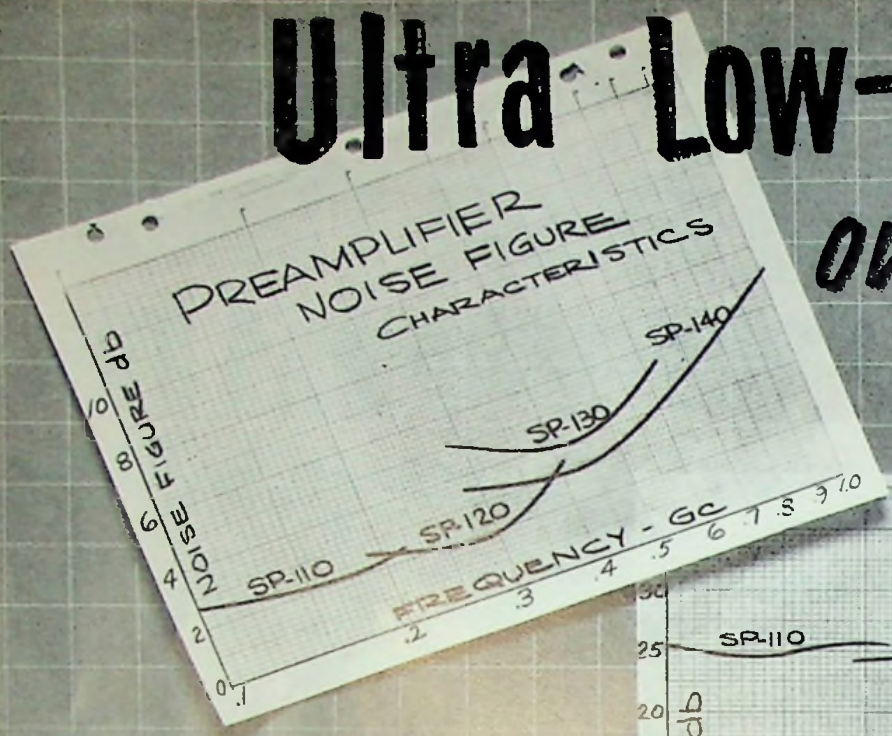

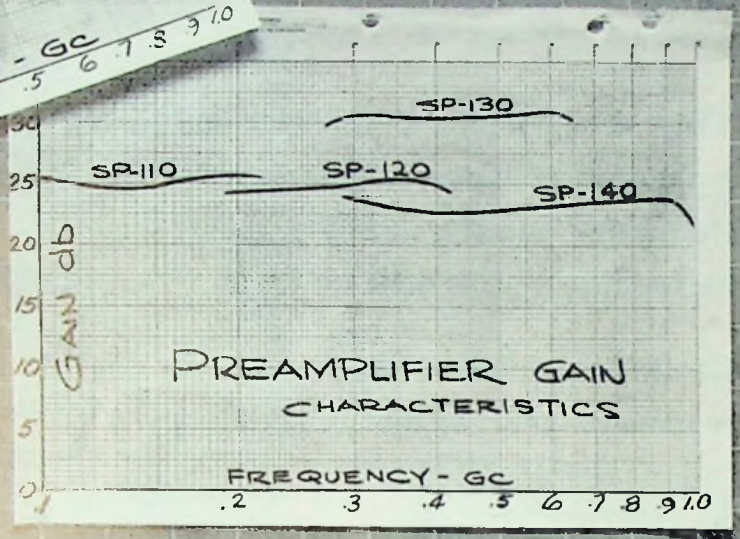

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CIRCLE INQUIRY CARD NUMBER 2

grid-bulletin

A Combined Publication of Los Angeles and San Francisco, IEEE

Volume 9 August, 1964 No. 2

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Versatility of the 123 is unmatched, too—thanks to a wide range of pulse repetition rates, pulse delays and pulse widths.

Behind these advanced features, you have the solid experience of E-H, world leader in pulse generators—your assurance of an instrument which will give long, low maintenance performance.

Check the specifications below, then ask for a 123 demonstration.

REPETITION RATE: 1 Kc to 20 Mc. May be externally driven from 0 to 10 Mc.

PULSE WIDTH: Continuously variable from 20 ns to 10 μs by a coarse selector and fine vernier.

WIDTH DUTY CYCLE: Pulse widths greater than 50% of the repetitive period are available below 10 mc; greater than 25% between 10 and 20 mc.

PULSE DELAY: The output pulse can be delayed from 20 ns to 100 μs. Delay is continuously variable by a step selector and fine vernier.

DELAY DUTY CYCLE: Delays up to 50% of the pulse rep period are available when the rep rate is determined internally. If delay controls are set to provide a delay greater than 50%, no output pulse appears. When pulse generator is externally driven, maximum delay available is width of driving pulse.

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OUTPUT: Amplitude of output pulse is variable from 0 to 50 v either positive or negative polarity into 50 Ω resistive. Pulse top distortion less than 10% at all amplitudes greater than 20 v; typically less than 5% at maximum amplitude. Both positive and negative pulses are d-c coupled out.

RISE TIME: Less than 7 ns (typically 5 ns) for negative pulses and for all positive pulses greater than 20 v amplitude.

TRIGGER OUTPUT: For sync purposes, a positive trigger pulse is provided. When terminated in 50Ω, the trigger pulse amplitude is greater than 1 volt. Pulse width is approximately 20 ns, and rise time is less than 5 ns.

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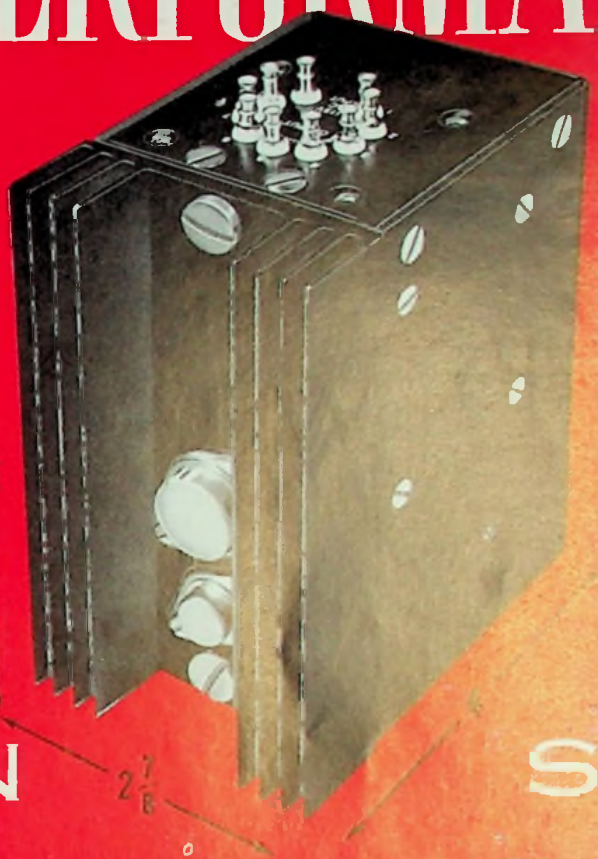

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JOHN C. BECKETT, CHAIRMAN
SAN FRANCISCO SECTION, IEEE

Our profession continues to be one involving frequent change with new demands and new opportunities. This fact is best illustrated at the WESCON show. Here we can visually see the progress being made in all fields of electrical and electronics engineering.

In addition, the technical sessions provide the means for communicating our experiences and ideas so that all members of the Institute may witness the contributions being made. This exchange is a major part of Institute membership.

The partnership of WESCON and IEEE has a tradition of success that stems from the attitude and desires of many people. The San Francisco Section of IEEE is pledged to continue this tradition and welcomes all participants.

John C. Beckett, Chairman
San Francisco Section, IEEE
1964-65

BRUCE S. ANGWIN, DIRECTOR
REGION SIX, IEEE

Welcome to WESCON in Los Angeles this year. As you review the program in this issue I believe you will find that it covers, even more than before, a broad spectrum of interest indicating the combined disciplines of the new IEEE. You will also find an increased emphasis on invited papers by outstanding speakers which will truly give us "A new focus on electronics", which is this year's theme. We hope that you will enjoy the expanded facilities and also the new feature: The company sponsored product sessions.

We trust that these, together with the many Technical Tours, the Future Engineers Show, the Industrial Design Competition and the many social functions for visitors and wives will make this a full and rewarding week.

William S. Moody, Chairman
Los Angeles District, IEEE
1964-65

WELCOME TO WESCON 1964

With August, comes the excitement of WESCON, that fabulous child of WEMA and IEEE. WESCON's continual innovation and experimentation, which supplements the proven successes of its format, reflects the dynamic progress and enthusiasm of our industry and profession in the West.

This year, WESCON's able Board has added new spice by broadening the Technical Program's base to include Electrical as well as Electronic subjects in recognition of the new, broader outlook of the IEEE. In addition, the product-oriented flavor of WESCON is being enhanced through the historic "first" of scheduling private, Industrial Seminars on the official Show program.

Add an outstanding Exhibit, Future Engineers Show, Field Trip Schedule, Women's Program, Banquet, and Cocktail Party, and the result is a professional and industrial extravaganza which Region Six is proud to co-sponsor with WEMA and indebted to its Los Angeles area Sections for their direct involvement as this year's representatives.

Bruce S. Angwin, Director
Region Six, IEEE

WILLIAM S. MOODY, CHAIRMAN
LOS ANGELES DISTRICT, IEEE

Welcome to WESCON/64!

This year's theme — A New Focus on Electronics Technology — is significant not only for its emphasis on the show's dramatic new format, but for the industry's ever-increasing attention to technological excellence.

In this era of many changes and many pressures, creativity and ingenuity in both technology and management must assume an even more important role than in the past.

WESCON — co-sponsored by IEEE — is a showcase for all that is new and important in technical products development. It is a forum for probing the state of the electronic art.

This is WESCON'S challenge: to bring together ideas, achievements and the interchange of information for the benefit of the industry, and the men and women who support it.

Burgess Dempster
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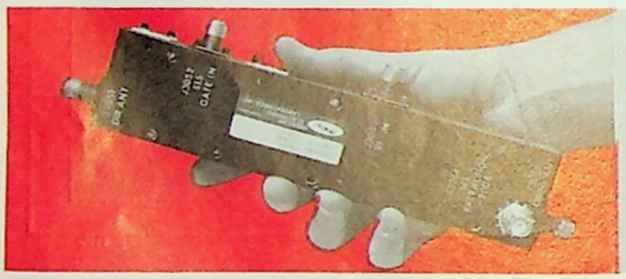
FEATURES INCLUDE...

- Mode 1, 2, 3 and 4 operation
- 10 KW peak power handling (30 watt average)
- Frequency — 1010 – 1110 Mc
- Less than 1 db insertion loss
- Over 35 db isolation
- Less than 150 nanosecond switching speed

STATE-OF-THE-ART

NOTE THESE HIGH POWER SWITCH DEVELOPMENTS ALSO

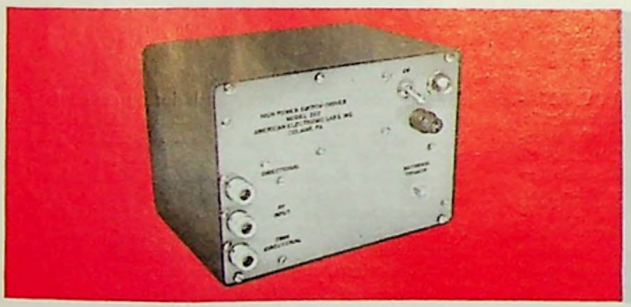


MODEL STB834A SPDT HIGH POWER SOLID STATE SWITCH

Featuring field replaceable diodes, this switch is designed for use with beacon transmitters modified for 3-pulse side lobe suppression. It includes a monitoring probe for the SLS pulse, P_2.

FEATURES INCLUDE...

- Mode 1, 2, 3 and 4 operation
- 7.5 KW peak power (15 watts avg.)
- Frequency — 1010 – 1110 Mc
- Less than 0.7 db insertion loss
- Over 35 db isolation
- Less than 150 nanosecond switching speed
- Fail-safe operation



MODEL 262 COMMERCIAL HIGH POWER SOLID STATE SWITCH AND DRIVER

Developed for use in commercial beacon transmitters modified for 3-pulse side lobe suppression, this device processes the 3 pulse train P_1, P_2 and P_3 so that P_1 and P_3 are transmitted to a directional antenna, and P_2 to an omnidirectional antenna. The switch driver utilizes low voltages to operate the switch in different modes.

FEATURES INCLUDE...

- Mode 1, 2, 3 and 4 operation
- 3 KW peak power handling (15 watts average)
- Frequency — 1010 – 1110 Mc
- 0.7 db insertion loss
- Over 40 db isolation
- Less than 150 nanosecond switching speed
- Fail-safe operation

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CIRCLE INQUIRY CARD NUMBER 7

CIRCLE INQUIRY CARD NUMBER 8 →

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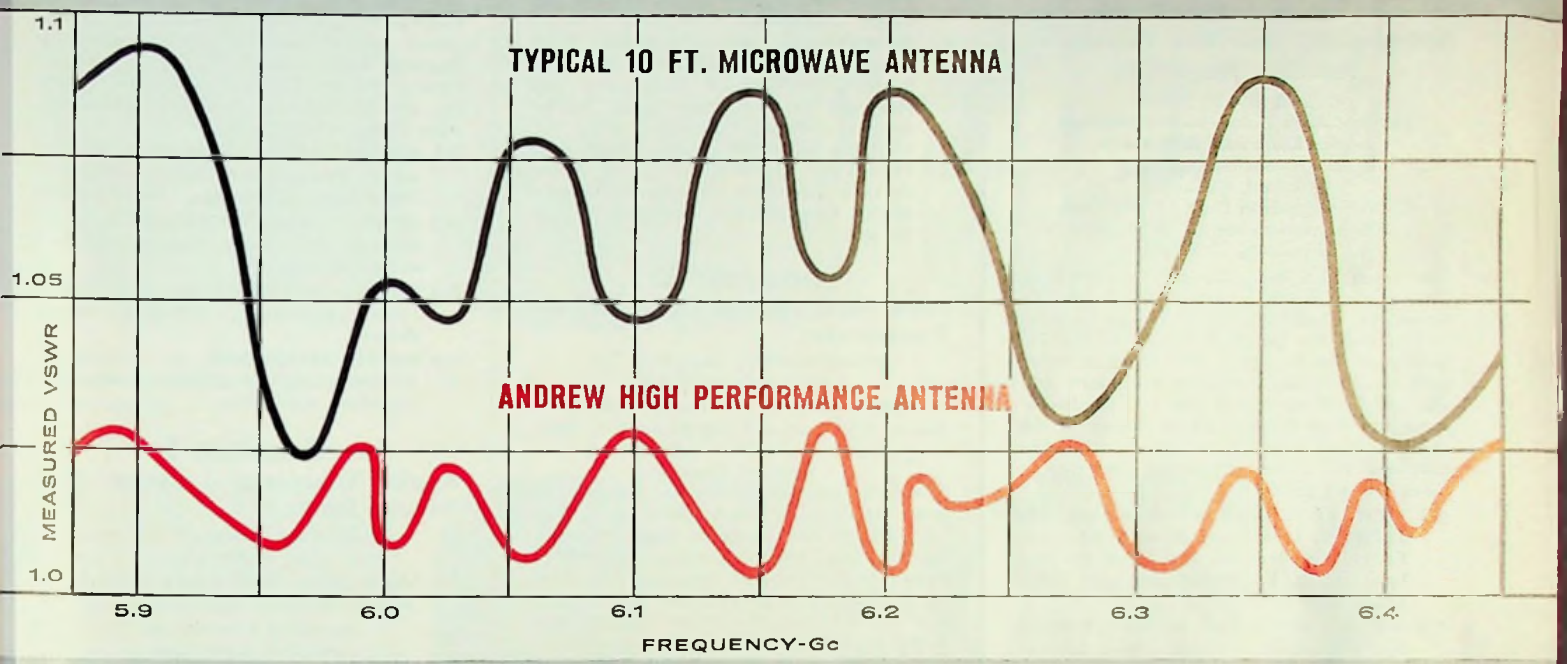
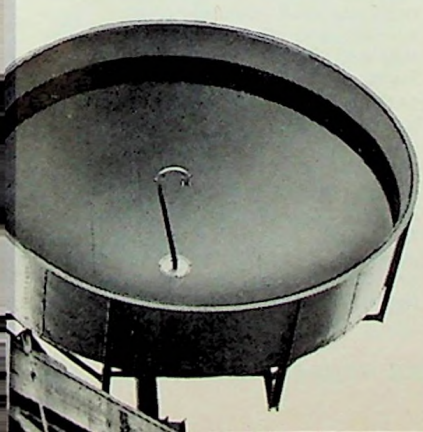


NEW high performance Microwave Antenna

5925-8250 Mc



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SPECIAL SESSIONS WESCON/64

Session A

Microelectronics — The Needs, The Approaches, And The Potentials

Tuesday, August 25

2:00 to 4:30 P.M.
Statler Hilton Hotel—Pacific Ballroom
Session Chairman: J. G. Linvill,
Stanford University,
Stanford, California
Session Organizer: R. D. Middlebrook,
California Institute of Technology
Pasadena, California

Microelectronics has already developed to the point where the possibilities are so diverse, the freedom in circuit design so much wider, and the potential effect on the industry so much deeper that it is a major problem to define boundary conditions and choose directions at all levels of endeavor from the most detailed circuit design to the most general company policy. Outstanding speakers will discuss important questions in three subject areas.

A.1 **MILITARY PARTICIPATION — AND OBJECTIVES,** by Richard Alberts, Electronic Technology Division, Air Force Avionics Laboratory, Wright-Patterson Air Force Base, Dayton, Ohio.

A.2 **WHICH APPROACH — AND WHEN?,** by William M. Webster, RCA Laboratories, Princeton, New Jersey.

A.3 **COMMERCIAL APPLICATIONS — THE CHALLENGE,** by Robert C. Sprague, Sprague Electric Company, North Adams, Massachusetts.

Session B

Instrumenting The Sea Floor — Why And How

Wednesday, August 26

2:00 to 4:30 P.M.
Statler Hilton Hotel—Pacific Ballroom
Session Chairman: R. A. Frosch,
Advanced Research Projects Agency,
Washington, D.C.
Session Organizer: Fred N. Spiess,
Scripps Institution of Oceanography,
San Diego, California

The session will be devoted to an exposition of needs and techniques in sea floor instrumentation, particularly in the fields of underwater acoustics, geophysics and their applications. The participants will present some examples of successfully used methods, problems of equipment installation and recovery, and ideas for future developments in the field.

B.1 **PROBLEMS REQUIRING SEA FLOOR INSTRUMENTATION,** by R. A. Frosch, Advanced Research Projects Agency, Washington, D.C.

B.2 **VEHICLES AND STATIONS FOR INSTALLATION AND MAINTENANCE OF SEA FLOOR EQUIPMENT,** by V. C. Anderson, Scripps Institution of Oceanography, San Diego, California.

B.3 **GEOPHYSICAL MEASUREMENTS WITH SEA FLOOR INSTRUMENTS,** by Hugh Bradner, Institute of Geophysics and Planetary Physics, University of California, Los Angeles, California.

B.4 **BOTTOM MOUNTED NAVIGATION AND TRACKING SYSTEMS,** by D. L. Potter, Defense Research Laboratory, General Motors Corporation, Santa Barbara, California.

Session C

Extra High Voltage Direct Current Transmission

Wednesday, August 26

8:00 P.M. to 10:00 P.M.
Statler Hilton Hotel — Pacific Ballroom
Session Chairman and Organizer: E. C. Starr,
Bonneville Power Administration
Portland, Oregon

Power transmission over long distances by means of direct current at potentials as high as 1,000,000 volts, presents many engineering problems. Recent investigations are reported in four papers covering the effects of EHVDC on communication, and navigation systems, and the effects of high level direct currents on underground structures.

C.1 **DESIGN AND DEVELOPMENT OF HIGH VOLTAGE PLASTIC BUSHINGS FOR DC TEST FACILITY,** by L. I. Gradasoff, Bonneville Power Administration, Portland, Oregon.

C.2 **BPA'S EXTRA HIGH VOLTAGE DIRECT CURRENT TEST PROJECT MEASUREMENTS AND INSTRUMENTATION,** by M. G. Poland, M. W. Belsher and A. A. Osipovich, Bonneville Power Administration, Portland, Oregon.

C.3 **DIRECT CURRENT GROUND ELECTRODE BEHAVIOR,** by Allen L. Kinyon, Bonneville Power Administration, Vancouver, Washington.

C.4 **GROUND CURRENT IN HIGH VOLTAGE D-C TRANSMISSION,** by T. Cantwell, P. Nelson, J. E. Webb, Geoscience, Inc., Cambridge, Massachusetts, C. L. Waugh, A. L. Kinyon, R. F. Stevens, Bonneville Power Administration, Portland, Oregon, and A. Orange, U.S. Air Force Cambridge Research Laboratories, Cambridge Massachusetts.

Session D

Information Sciences

Thursday, August 27

2:00 to 4:30 P.M.
Statler Hilton Hotel—Pacific Ballroom
Session Chairman: A. V. Balakrishnan,
University of California at Los Angeles
Los Angeles, California
Session Organizer: Andrew Viterbi,
University of California at Los Angeles
Los Angeles, California

The purpose of this session is to present recent significant achievements in the fields of communications, data processing and computers and is intended for the practicing engineer rather than the specialist. Professor Fano's and Dr. Cutrona's presentations will be accompanied by real-time demonstrations of operational systems.

D.1 **MULTIPLE ACCESS COMPUTING,** by Robert M. Fano, Massachusetts Institute of Technology, Cambridge, Massachusetts.

D.2 **OPTICAL DATA PROCESSING,** by Louis Cutrona, Conductron Corporation, Ann Arbor, Michigan.

D.3 **SEISMIC DETECTION,** by Paul Green, Lincoln Laboratory, Lexington, Massachusetts.

D.4 **RADAR ASTRONOMY,** by Richard M. Goldstein, Jet Propulsion Laboratory, Pasadena, California.

Session E

Apollo Electronics — Design And Present Status

Friday, August 28

2:00 to 4:30 P.M.
Statler Hilton Hotel—Pacific Ballroom
Session Chairman: George E. Mueller
Associate Administrator
Manned Space Flight
NASA Headquarters, Washington, D.C.

Project Apollo, the U.S. effort to land men on the moon and return them safely to earth imposes a number of interesting performance requirements which have guided the design of Apollo spacecraft electronic equipment. The discussion will include design and development status of representative Apollo electronic hardware, including communications and instrumentation systems.

E.1 **OVERALL APOLLO ELECTRONICS,** by George E. Mueller, Associate Administrator, Manned Space Flight, NASA Headquarters, Washington, D.C.

E.2 **APOLLO SPACECRAFT ELECTRONICS,** by Joseph F. Shea, Manager, Apollo Program Office, Manned Spacecraft Center, Houston, Texas.

E.3 **APOLLO GUIDANCE AND NAVIGATION ELECTRONICS,** by R. Cliff Duncan, Chief, Guidance and Control Division, Engineering and Development Directorate, Manned Spacecraft Center, Houston, Texas.

E.4 **SATURN V VEHICLE ELECTRONICS,** by Hans Fichtner, Chief, Electrical Systems Integration Division, Astrionics Laboratory, George C. Marshall Space Flight Center, Huntsville, Alabama.

E.5 **APOLLO COMMUNICATIONS AND TRACKING,** by Ozro Covington, Deputy Assistant Director, Office of Tracking and Data Systems, Goddard Space Flight Center, Greenbelt, Maryland.

CONTINUED ON PAGE 16

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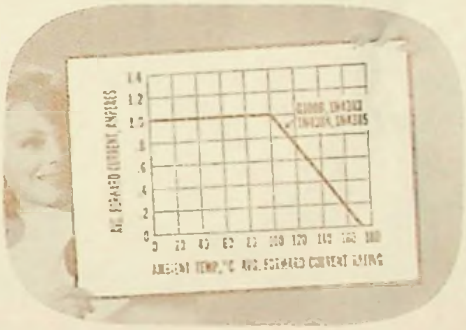

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WESCON QUICK-CHECK LIST

Events-Time-Costs-Places

Tuesday, August 25

8:30 AM to 5:00 PM	Women's Hospitality Lounge, Wilshire Room, Statler Hilton Hotel
9:30 AM to 6:30 PM	WESCON Exhibits, Hollywood Park and Sports Arena
9:30 AM to 12:00 NOON	Technical Session No. 1, Golden State Room, Statler Hilton Hotel
9:30 AM to 12:00 NOON	Technical Session No. 2, Pacific Ballroom, Statler Hilton Hotel
9:30 AM to 12:00 NOON	Technical Session No. 3, Los Angeles Room, Statler Hilton Hotel
9:30 AM to 12:00 NOON	Technical Session No. 4, Garden Room, Statler Hilton Hotel
9:30 AM to 11:30 AM	Technical Session No. 5, Sierra Room, Statler Hilton Hotel
9:30 AM to 12:00 NOON	Industrial Session W, Television Room, Hollywood Park
9:30 AM to 6:30 PM	International Exhibit, Hollywood Park
9:30 AM to 6:30 PM	Future Engineers Exhibit, Sports Arena
9:30 AM to 8:30 PM	Industrial Design Exhibit, Hollywood Park
9:30 AM	E.I.A. JS Committee on Controlled Rectifiers, Buffalo Room, Statler Hilton Hotel
12:00 NOON	SAMA Executive Committee Luncheon Meeting, Hartford Room, Statler Hilton Hotel
12:30 PM	Eta Kappa Nu Luncheon, Garden Room, Statler Hilton Hotel
1:00 PM	Women's "Musical Frolic in Shakespeare's Time", Pasadena Playhouse, Departure from Statler Hilton Hotel
1:00 to 5:00 PM	Technical Tour No. 1, TRW Space Technology Laboratory
2:00 to 4:30 PM	Special Technical Session A, Pacific Ballroom, Statler Hilton Hotel with special closed circuit viewing in the Television Room, Hollywood Park, and and the Television Room, Sports Arena.
2:00 PM	Instrument Society of America, Survey Committee for Transducers for Aero-Space Testing (SCOTFACT), St. Louis Room, Statler Hilton Hotel
6:30 PM to 8:30 PM	All Industry Cocktail Party, Holywood Park Club House

Wednesday, August 26

8:00 AM to 12:30 PM	Technical Tour No. 2, Rocketdyne Propulsion Field Lab
8:30 AM to 5:00 PM	Women's Hospitality Lounge, Wilshire Room, Statler Hilton Hotel (Lounge will be closed during Luncheon)
9:00 AM	WESCON Exhibitors Meeting, Television Room, Sports Arena
9:30 AM to 9:30 PM	WESCON Exhibits, Hollywood Park and Sports Arena
9:30 AM to 12:00 NOON	Technical Session No. 6, Garden Room, Statler Hilton Hotel
9:30 AM to 11:30 AM	Technical Session No. 7, Golden State Room, Statler Hilton Hotel
9:30 AM to 12:00 NOON	Technical Session No. 8, Sierra Room, Statler Hilton Hotel
9:30 AM to 12:00 NOON	Technical Session No. 9, Los Angeles Room, Statler Hilton Hotel
9:30 AM to 12:00 NOON	Technical Session No. 10, Pacific Ballroom, Statler Hilton Hotel
9:30 AM to 1:00 PM	Industrial Session X, Television Room, Hollywood Park
9:30 AM to 9:30 PM	International Exhibit, Hollywood Park
9:30 AM to 9:30 PM	Industrial Design Exhibit, Hollywood Park
11:00 AM to 4:30 PM	Technical Tour No. 3, Autonetics/Anaheim
12:00 NOON to 9:30 PM	Future Engineers Exhibit, Sports Arena
12:15 PM	Women's Luncheon, "Hedda Hopper's USA", Biltmore Bowl, Biltmore Hotel
12:15 PM	WEMA Luncheon, Golden State Room, Statler Hilton Hotel
1:00 PM to 5:00 PM	Technical Tour No. 4, Jet Propulsion Laboratory
2:00 PM to 4:30 PM	Special Technical Session B, Pacific Ballroom, Statler Hilton Hotel with special closed circuit viewing in the Television Room, Hollywood Park, and the Television Room, Sports Arena
8:00 PM to 10:00 PM	Special Technical Session C, Pacific Ballroom, Statler Hilton Hotel

Thursday, August 27

8:00 AM to 12:30 PM	Technical Tour No. 5, Southern California Edison
8:30 AM to 5:00 PM	Women's Hospitality Lounge, Wilshire Room, Statler Hilton Hotel
9:00 AM to 12:00 NOON	Future Engineers Symposium, Television Room, Sports Arena
9:30 AM to 6:30 PM	WESCON Exhibits, Hollywood Park and Sports Arena
9:30 AM to 12:00 NOON	Technical Session No. 11, Pacific Ballroom Statler Hilton Hotel
9:30 AM to 12:00 NOON	Technical Session No. 12, Garden Room, Statler Hilton Hotel
9:30 AM to 12:00 NOON	Technical Session No. 13, Golden State Room, Statler Hilton Hotel
9:30 AM to 12:00 NOON	Technical Session No. 14, Sierra Room, Statler Hilton Hotel
9:30 AM to 12:00 NOON	Technical Session No. 15, Los Angeles Room, Statler Hilton Hotel
9:30 AM to 11:45 AM	Industrial Session Y, Television Room, Hollywood Park
9:30 AM to 6:30 PM	Future Engineers Exhibit, Sports Arena
9:30 AM to 6:30 PM	Industrial Design Exhibit, Hollywood Park
9:30 AM to 6:30 PM	International Exhibit, Hollywood Park
10:00 AM	Women's "Focus on Your Beauty", Women's Hospitality Lounge, Wilshire Room, Statler Hilton Hotel
1:00 PM to 5:00 PM	Technical Tour No. 6, University of Southern California
2:00 PM to 4:30 PM	Special Technical Session D, Pacific Ballroom, Statler Hilton Hotel with special closed circuit viewing in the Television Room, Hollywood Park, and the Television Room, Sports Arena
8:00 PM	WESCON Banquet and Dinner Dance, Hollywood Palladium

Friday, August 28

8:30 AM to 12:30 PM	Technical Tour No. 7, California Institute of Technology
8:30 AM to 5:00 PM	Women's Hospitality Lounge, Wilshire Room, Statler Hilton Hotel
9:30 AM	Women's "Tour of Future Engineers Show", Sports Arena Departure from Statler Hilton Hotel
9:30 AM to 6:30 PM	WESCON Exhibits, Hollywood Park and Sports Arena
9:30 AM to 12:00 NOON	Technical Session No. 16, Garden Room, Statler Hilton Hotel
9:30 AM to 12:00 NOON	Technical Session No. 18, Los Angeles Room, Statler Hilton Hotel
9:30 AM to 12:00 NOON	Technical Session No. 17, Golden State Room, Statler Hilton Hotel
9:30 AM to 11:15 AM	Technical Session No. 19, Pacific Ballroom, Statler Hilton Hotel
9:30 AM to 12:00 NOON	Technical Session No. 20, Sierra Room, Statler Hilton Hotel
9:30 AM to 12:30 PM	Industrial Session Z, Television Room, Hollywood Park
9:30 AM to 6:30 PM	International Exhibit, Hollywood Park
9:30 AM to 6:30 PM	Future Engineers Exhibit, Sports Arena
9:30 AM to 6:30 PM	Industrial Design Exhibit, Hollywood Park
11:00 AM	Women's "Focus On You" Sun and Swim Party, Women's Hospitality Lounge, Wilshire Room, Statler Hilton Hotel
2:00 PM to 4:00 PM	Special Technical Session E, Pacific Ballroom, Statler Hilton Hotel with special closed circuit viewing in the Television Room, Hollywood Park, and the television Room, Sports Arena

(All Technical Tours depart from the Francisco Street side of the Statler Hilton Hotel.)

YOUNGSTERS: No one under ten admitted. Youngsters 10-18 admitted to the exhibit areas ONLY on Friday, August 28, and then only when accompanied by an adult, and after registering for the standard fee.

Technical Program (Continued)

Session W

Modern Techniques for the Derivation of Electrical Standards and Their Practical Use in Measurement

Presented by
Electro Scientific Industries, Inc.
Portland, Oregon

Tuesday, August 25
9:30 A.M.-12:00 Noon
Hollywood Park—Television Room (3rd Floor)
Session Moderator: Douglas C. Strain,
Electro Scientific Industries, Inc.
Portland, Oregon

W.1 **RESISTANCE STANDARDS,** J. L. Thomas (Retired), National Bureau of Standards.
W.2 **VOLTAGE STANDARDS,** George D. Vincent, Nortronics Systems Support Dept.
W.3 **CAPACITANCE STANDARDS,** Robert D. Cutkosky, National Bureau of Standards.
W.4 **RATIO TECHNIQUES,** Jack C. Riley, Electro Scientific Industries, Inc.

Session X

Integrated Circuits

Presented by
Texas Instruments, Inc.
Dallas, Texas

Wednesday, August 26
9:30 AM.-1:00 P.M.
Hollywood Park—Television Room (3rd Floor)
Session Moderator: Charles Phipps,
Texas Instruments, Inc.,
Dallas, Texas
Participants:
Members of the Integrated Circuits
Department Staff, Texas Instruments

Subjects:

1. Linear
   a. Broad-band Amplifiers
   b. Differential/Operational Amplifiers
   c. Memory Circuits
2. Optoelectronic Pulse Amplifiers
   a. Low-level Chopper
3. Advanced Digital Network
4. Advanced Network Technology and Related Products
5. Reliability
6. Successful System Applications

Session Y

Microelectronics — Present and Future

Presented by
Hughes Semiconductor Division
Newport Beach, California

Thursday, August 27
9:30 A.M.-11:45 A.M.
Hollywood Park—Television Room (3rd Floor)

PART I—MICROELECTRONICS: ITS TECHNOLOGIES AND DEVICES, Dietrich A. Jenny.
PART II—MICROCIRCUITS FOR NETWORKS AND SYSTEMS, Edson B. Gould III.

Session Z

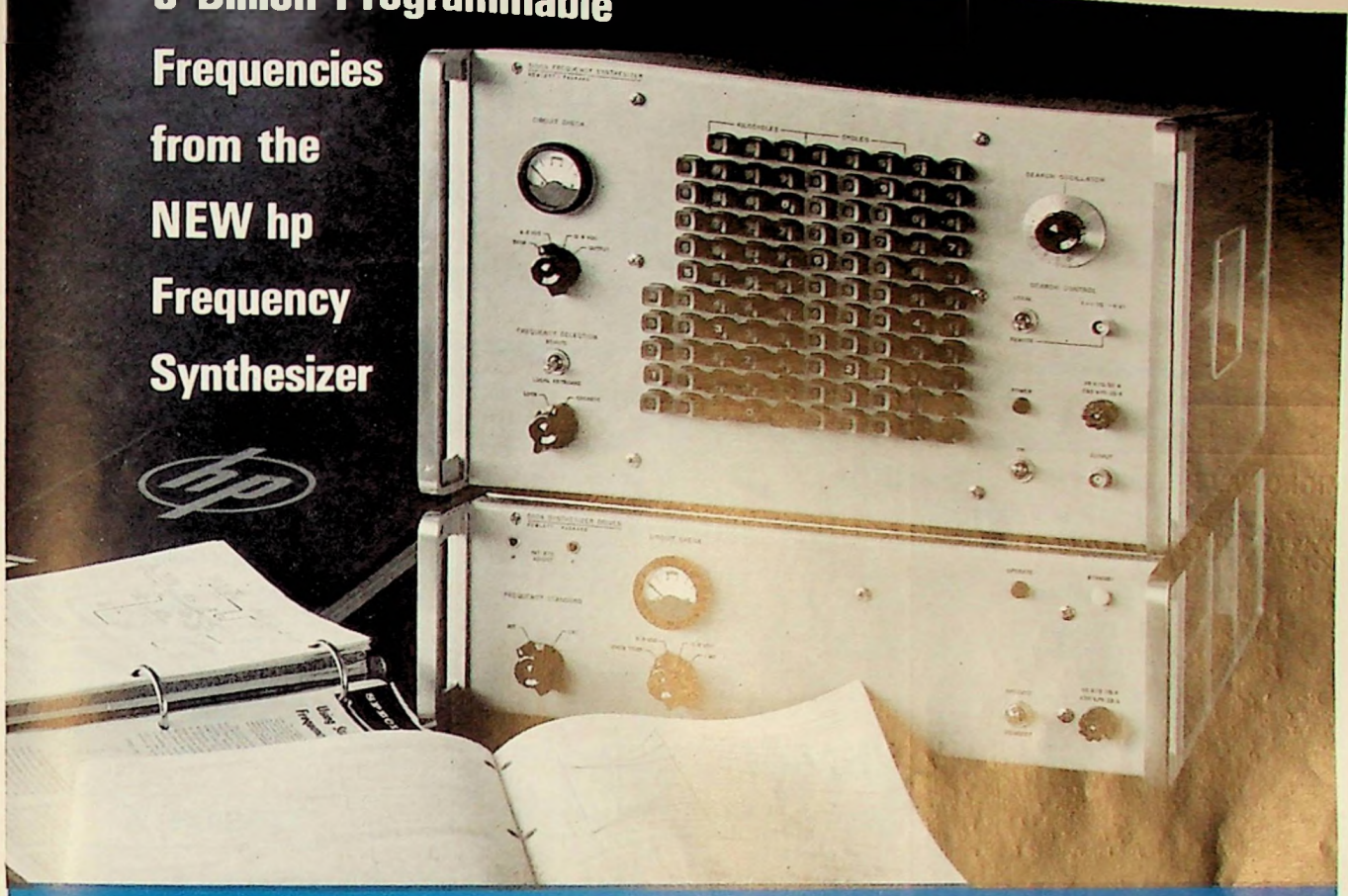
New Field-Effect Transistors

Friday, August 28
Presented by
Siliconix, Inc.
Sunnyvale, California

Friday, August 28
9:30 A.M.-12:30 P.M.
Hollywood Park—Television Room (3rd Floor)

Z.1 **INTRODUCTION,** Richard E. Lee.
Z.2 **CHOPPERS AND SWITCHING,** Arthur D. Evans.
Z.3 **DUAL-GATE FET,** James S. Sherwin.
Z.4 **DIFFERENTIAL FET AMPLIFIERS,** Lee L. Evans.

5 Billion Programmable Frequencies from the NEW hp Frequency Synthesizer



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Remote programming — 1 msec switching speed

High stability and spectral purity — spurious signals 90 db down

The new hp 5100A/5110A Frequency Synthesizer offers pushbutton convenience for fast, accurate selection of frequencies from 0.01 cps to 50 mc in steps as fine as 0.01 cps. Remote programming of frequencies may be accomplished in less than 1 millisecond. The system consists of the 5100A Frequency Synthesizer and the 5110A Synthesizer Driver. All output frequencies are derived from a single 1 mc quartz crystal oscillator which has a long-term stability of ±3 parts in 10^9 per day—or from your own frequency standard. Spurious signals, including power line components, are at least 90 db down. Check the specifications, then call your nearest Hewlett-Packard field engineer for further information. Or write Hewlett-Packard Company, Palo Alto, California 94304, Tel. (415) 326-7000; Europe: 54 Route des Acacias, Geneva; Canada: 8270 Mayrand St., Montreal.

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Output frequency:	0.01 cps to 50 mc
Digital frequency selection:	From 0.01 cps per step to 10 mc per step; selection is by front panel pushbutton or by remote contact closure
Spurious signals and harmonic distortion:	All non-harmonically related signals including power line components are more than 90 db below the selected frequency; harmonics are more than 30 db below the fundamental
Signal-to-phase-noise ratio:	More than 60 db down in a 3 kc band centered on the signal
Frequency stability and accuracy:	With internal standard, less than ±3 parts in 10^9 per day; with external standard, same as external standard
Output voltage:	1 v rms ±1 db from 100 kc to 50 mc; 1 v rms +2 db −4 db from 50 cps to 100 kc, into 50-ohm resistive load
Output impedance:	50 ohms nominal
Search oscillator:	Allows continuously variable frequency selection with an incremental range of 0.1 cps up to 1 mc, depending on the digit position being searched; dial accuracy is ±3% of full scale; linearity with external voltage control is within ±5% (−1 to −11 v)
External standard input:	1 or 5 mc, 0.2 v rms minimum, 5 v maximum across 500 ohms; purity of output signal will be determined partially by purity of external standard
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CIRCLE INQUIRY CARD NUMBER 11

TECHNICAL PROGRAM WESCON/64

SESSION 1

MICROWAVE TUBES

Tuesday, August 25, 9:30 A.M.-12:00 Noon
STATLER HILTON HOTEL — GOLDEN STATE ROOM

Session Chairman and Organizer:
JOHN MENDEL
Microwave Tube Division
Hughes Aircraft Company
Los Angeles, California

Recent developments in high power millimeter wave amplifiers offer new solutions to problems of high resolution radar and space communications. Practical, long life devices are now available to facilitate the concurrent advancement of system hardware. Also of significant interest to space engineers is the achievement of very rugged, high efficiency TWT's for communication satellites. The adaptation of magnetron generators to the purely commercial environment of home ovens opens up a very attractive market for microwave tube manufacturers.

1/1 SOME NEW RESULTS WITH HIGH POWER MILLIMETER-WAVE TUBES

J. F. HENEY
Hughes Research Laboratories
Malibu, California

Recent advances in the art of high power, millimeter wave tubes provide unique solutions to many system design problems. At 6 mm, an oscillator-amplifier chain is capable of up to 1 Kw of average power output. At 3 mm, a similar series of tubes will provide a cw output of more than 100 watts. These tubes are relatively low voltage, light weight units with efficiencies between 10 and 20%. Bandwidths are of the order of 10% and life has been measured up to many thousands of hours. These tubes find direct application in the area of high resolution radars, plasma penetration problems, and space communications.

1/2 S- AND X-BAND TRAVELING-WAVE TUBE AMPLIFIERS FOR SATELLITE APPLICATIONS

A. LUBARSKY, J. N. NELSON,
R. E. POSPISIL, O. T. PURL,
L. A. ROBERTS, G. WADA
Watkins-Johnson Company
Palo Alto, California

This paper describes two high efficiency, high reliability, traveling-wave tube amplifiers. The amplifiers have been designed specifically for long life satellite environments and are an integration of the latest "state-of-the-art" advances in microwave and solid state circuitry.

The S-band amplifier (WJ-164) utilizes a PPM traveling-wave tube (WJ-227) which operates over the frequency band of 2.20-2.40 Gc. The WJ-227 traveling-wave tube is presently the only 10 watt S-band tube in orbit. Typical electrical and mechanical characteristics are: rf power output 12 watts, rf power input 3-6 mw, efficiency 25 percent, noise figure 30 db, weight 6.2 lbs and volume 110 in³.

The X-band amplifier (WJ-130) which is capable of operation from 7.25-7.75 Gc utilizes a single reversal permanent magnet traveling-wave tube (WJ-251). Typical electrical and mechanical characteristics are: rf power output 2.5 watts, saturation gain 36 db, efficiency 25 percent, noise figure 27 db, weight 6.5 lbs and volume 115 in³.

Both amplifiers are capable of meeting all specifications with a dc input of 24-30 volts and operate without damage with inputs in the range of 20 to 50 volts. Also included in each amplifier are a 3 minute timer and five diagnostic circuits which are used to monitor the tube and power supply performance.

1/3 A NEW CW MAGNETRON FOR MICROWAVE COOKING

W. L. ADIKES, W. C. HICKMAN
Amperex Electronic Corporation
Hicksville, New York

The magnetron is the first really new source of energy for cooking in twenty years. Its acceptance has added a new chapter to the kitchen art.

A description of a CW magnetron for microwave cooking is given. Assembly techniques which result in considerable production economies are described including self-jigging ceramic to metal seals and heli-arc welding of final assemblies.

The procedure for coupling the magnetron to the microwave oven is explained and illustrated. Several coupling systems are shown, together with a number of oven designs. Methods for measuring rf power into the ovens are discussed and field pattern measurements are illustrated. The use of "field stirrers" to obtain uniform heating in foods is shown.

1/4 INVESTIGATION OF MAGNETIC MATERIALS TECHNOLOGY FOR PPM-FOCUSED LOW-NOISE TRAVELING-WAVE TUBES

D. A. SCHRUMPF
General Electric Company
Palo Alto, California

Until recently, low-noise traveling-wave tubes focused by a combination of a uniform field in the gun region and periodic field (PPM field) over the rest of the tube would have from 3-5 db higher noise figures than tubes focused by uniform magnetic fields (PM field). As a result of improvements in magnetic materials technology, a 7.9 db maximum noise figure has been achieved over the 6.4 to 12.0 Gc band in a 4.9 pound PPM package. Minimum noise figures of 6.7 to 6.8 db were achieved over the 9.6 to 10.2 Gc band.

Both Alnico 8 magnets magnetized in the axial direction and Alnico 5 magnets magnetized in the radial direction have been improved and experimentally investigated. The investigation included sintered Alnico 8 axial magnets and solid disk Alnico 5 radial magnets.

The final low-noise tube offers the volume and weight-saving advantages of PPM focused tubes while giving the low-noise performance of straight-field PM-focused tubes. In addition, the magnetic parameters required for reproducibility were evaluated and this has resulted in reproducibility of the r-f results and lower costs.

1/5 100 WATT CW TRAVELING WAVE TUBES WITH OCTAVE BANDWIDTHS

NORMAN POND
Microwave Device Division
Sylvania Electric Products Inc.
Mountain View, California

This paper describes a new type of traveling-wave tube which will find widespread use in countermeasures, telemetry, pulse radar and doppler radar systems. This new tube will provide greater than 100 watts of CW power over octave bandwidths in the X thru S-band frequency range. The key to the attainment of this power over such broad bandwidths is the utilization of a helix slow wave structure cooled by conduction thru its support rods. The construction techniques, relevant design data, and detailed performance characteristics are presented.

SESSION 2

MICROELECTRONICS

Tuesday, August 25, 9:30 A.M.-12:00 Noon
STATLER HILTON HOTEL — PACIFIC BALLROOM

Session Chairman and Organizer:
MORT PENBERG
Aerojet-General Corporation
Azusa, California

A survey of airborne computer, communication and navigation equipment indicates the quantitative increase in reliability obtainable through the use of microelectronics, as compared to standard off-the-shelf systems; a new integrated circuit fabrication technique minimizes parasitics; improved design and fabrication techniques extend bandwidth and reduce drift of d-c amplifiers.

2/1 AN ANALYSIS OF THE POTENTENTIAL AVIONIC RELIABILITY IMPROVEMENT THRU MICROELECTRONICS

JOHN R. LENNON
The Boeing Company
Renton, Washington

The reliability of avionic equipment can be significantly enhanced by microelectronic implementation. A physics of failure approach is combined with results of exhaustive environmental and accelerated tests and over fifty million hours of operating life tests performed by manufacturers. From the above it is quantitatively shown that microelectronic circuits have MTBFs considerably higher than their current discrete equivalents.

Projecting the estimated failure rates for 1965 and 1970 integrated circuits into avionic equipment of that time period, the reliability advantage of microavionics over tube, standard transistorized, and Minuteman quality computer, communication, and navigation equipments is shown.

This paper is one of the first quantitative approaches to a detailed microavionic analysis.

CONTINUED ON PAGE 20

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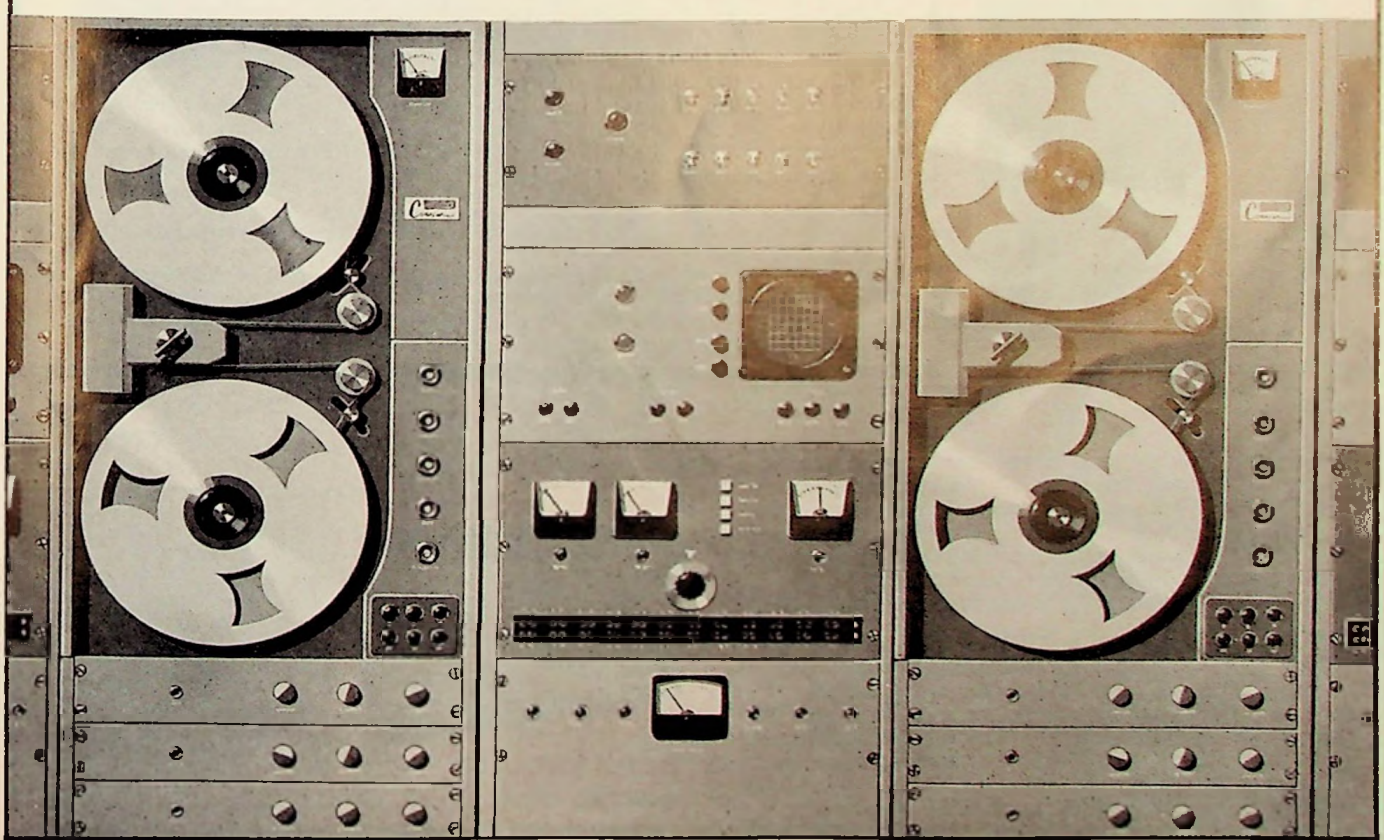

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C-LINE SYSTEMS OFFER THESE ADVANTAGES:

- no physical contact with test object; measure objects in motion without disturbing their natural modes
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- high frequency response — DC to 8 KC typically
- low noise — signal to noise ratios of 10^5 can be achieved
- economy — C-Line systems are priced from $346.50, no additional signal conditioning is needed.

LOW PRESSURE TRANSDUCERS

Capable of operating in adverse spaceborne environment, inexpensive enough for ground support use.

- Pressure ranges — 0.1 psi full scale to 100 psi full scale
- type of measurement — absolute, gage or differential
- output level — 0 to ±5 volts
- frequency response — DC to 1 KC
- overload characteristics — 10 times full scale range, or 15 psi, whichever is greater
- accuracy — 0.1% (laboratory environment)
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- low power consumption — 28 ± 5 V DC at 50 ma. protected against polarity reversal

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To measure the thermal characteristics of materials, paints or finishes, LRC offers: the EMISSOMETER for measuring emissivity and the REFLECTOMETER for measuring solar absorption. Both instruments have portable sensing heads which can be placed directly on the object under inspection. Readings are made instantly. There is no need for the use of special inspection samples. LRC instruments find all the invisible films, smudges or surface deterioration which may not show up on a special test sample. EMISSOMETERS and REFLECTOMETERS are fast and accurate for receiving inspection, production, quality control and final checks on the launching pad.

Model 25B EMISSOMETER measures total emission (epsylon) from 1 micron to 40 microns.

Model 25C REFLECTOMETER measures solar absorptance (alpha) from 2537 Å to 25000 Å. Measurements are made at discrete wavelengths thru the use of filters. Automatic alpha determination can be made with an attachment.

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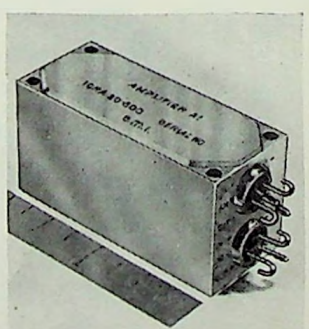

MODEL 703

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EPSCO INCORPORATED

Data System Products Division
Westwood, Massachusetts

MODEL ADS-95

MODEL VRS 611

EPSCO, founded in 1954, is known as the inventor of high speed analog-to-digital conversion techniques and their implementation. With the industry's most extensive background of experience EPSCO's abilities are unsurpassed in designing and delivering instrumentation to gather raw data, convert it to easily processable digital form and present it for reduction and display as meaningful information. The Data System Products Division has become singularly qualified to supply outstanding state of the art equipment in the field of information handling.

EPSCO's system capability includes Computer Formating, Data Aquisition and Reduction, Airborne PCM Telemetry and Telemetry Ground Stations.

From EPSCO's extensive system experience come these SYSTEM ORIENTATED COMPONENTS.

- High Level and Low Level Multiplexers
- High Speed A to D Converters for both ground based and spaceborne environment
- all silicon, fully automatic DVM, 0.01% accuracy
- wide band DC amplifiers, chopper stabilized — low noise, low drift

EPSCO is the only manufacturer of amplifiers who specifies noise and drift under actual field conditions, i.e. equivalent input noise voltage and equivalent input noise current; equivalent input voltage drift and equivalent input current drift.

For more than 2 years EPSCO amplifiers have proven their performance and reliability in the field. They excell in their applications as operational amplifiers, buffer amplifiers, summing amplifiers, inverter amplifiers, precision rectifiers, and active filters. Amplifiers are stabilized for use with a variety of inputs and feedback networks. Various models feature all silicon transistors, high gain, low noise, and high output current. Amplifiers are available on standard cards, custom cards, or as complete packages (model ADS-70) with integral power supplies for rack mounting or bench use.

MODEL ADS-95 FLOATING, ISOLATED DIFFERENTIAL DC AMPLIFIER

A high performance, solid-state, floating, isolated, truly differential DC amplifier with wide bandwidth. This amplifier is ideally suited for multiplexing data systems applications. The ADS-95 has the highest accuracy (±0.01%) with the simultaneous application of DIFFERENTIAL and COMMON MODE SIGNALS of ANY AMPLIFIER AVAILABLE. Settling time is extremely fast (200 μsec to within ±0.01% of final value). Other outstanding features are ±0.01% linearity, 200 μsec recovery time from 500% overload, variable bandwidth filter and ±0.01% stability. This stability (ordinarily attributed to mechanical or photo choppers) is achieved with a semi-conductor chopper which substantially increases the reliability and usefull life of the ADS-95. The extreme isolation (Low capacitance to ground and low capacitance from input to output) provides a common mode rejection of greater than 120 db, DC to 60 cps, at common mode voltages up to ±250 Volts DC or peak AC with up to 1000 ohms of source resistance unbalance. The high input resistance of at least 100 megohms minimizes source loading errors and insures high amplification accuracy. Low or high level multiplexing may be performed at either the input or the output of the amplifier. Many options such as variable gain and remote operation are available. Price — less than $750.00 in unit quantities. We'll be proud to demonstrate this amplifier to you.

At WESCON, visit EPSCO booth no. 611

PORTABLE VOLTAGE REFERENCE SOURCE, MODEL VRS 611

For the precise calibration of components, instruments, systems. The VRS 611 is a rugged, solid state reference source with selectable voltages in 1 mv steps from 0 to ±11.112 volts. It supplies up to 100 ma at all voltages; the output impedance is less than 50 milliohms. Offers unmatched reliability, and long term overall accuracy of ±0.025%. Precision plug-in attenuators make the VRS 611 adjustable in 1 μvolt steps, or other increments. Every calibration laboratory, data acquisition system needs an EPSCO VRS 611.

METRIX, INCORPORATED

Walnut Creek California

Based on many years of instrumentation experience, METRIX designed some time saving, convenient instruments, such as:

MODEL 121 TRANSDUCER SIMULATOR:
Simulates any conventional strain gage transducer (or group of transducers) with sensitivities from 0.2 mv/V to 10.2 mv/V. The model 121 is used to:

- Calibrate transducer readout
- Trouble shoot systems
- Determine calibration (loading) effect of systems on transducers
- Use the 121 to find the sensitivity of transducers which are not calibrated.

MODEL 122 SHUNT CALIBRATOR:
Gives 10 steps of calibration (in microstrain) when used with half bridge gages. Ends the hunt for those hard to find precision calibration resistors.

MODEL PS7-LT PORTABLE STRAIN INDICATOR:
Can read strain directly; eliminates arithmetic which is often a source of error. Internal amplifier for driving galvanometers.

MODEL PS7-H STRAIN INDICATOR:
Small enough to be carried by a strap around your wrist while climbing test stands, ladders or trees. Gives ½% accuracy. Price also small ($375.00).

MODEL DS6/MTH, 6 CHANNEL CARRIER SYSTEM:
This highly portable system features all solid state design, 1 KC bandwidth. Can operate on internal rechargeable batteries, 12 volt battery or a 115 Volt AC line.

For engineering assistance or more information about any of these products, call or write to the Peter Pohl Co.

Technical Program (Continued)

2/2 INTEGRATED HIGH-FREQUENCY D.C. AMPLIFIERS

DAVID ROY BREUER
TRW Space Technology Laboratories
Lawndale, California

This paper will indicate some of the present capabilities of the integrated circuit in the field of high-frequency linear amplification. The inherent advantages of the integrated linear amplifier will be discussed.

The advanced processing capability needed to realize high-frequency amplifier performance will be examined. This includes epitaxial techniques, small-geometry components, and thin-film resistors.

A survey of compatible broadbanding techniques will lead to what appears to be an optimum linear amplification circuit organization for the integrated circuit. This technique, named SPAF for Series-Parallel Alternate Feedback will be expanded, including high-frequency and d.c. analytics. It will be shown that the integrated circuit parasitic capacitances are not necessarily detrimental, but can even enhance the performance.

Two amplifier design examples are used to demonstrate the capability of the integrated circuit. The first design uses triple-diffused components, and the second design uses buried-layer epitaxial active components and thin-film resistors. These examples, together with the background design information extends the present usefulness of the linear integrated high-frequency amplifier.

2/3 THE MINIMIZATION OF PARASITICS IN INTEGRATED CIRCUITS BY DIELECTRIC ISOLATION

D. A. MAXWELL, R. H. BEESON,
D. F. ALLISON
Signetics Corporation
Sunnyvale, California

A radically new technique for the fabrication of integrated circuits which completely changes microelectronic design will be described. In place of the back-biased pn junctions usually used for isolation of devices in a substrate, a dielectric is substituted whose properties are such that almost total isolation is achieved with no increase in area. Leakage currents are reduced by several orders of magnitude to around 10^{-10} amp/cm², stray capacitances to around 10^{-5} pf/cm², parasitic npnp and pnpn action is eliminated, and break-down voltage is increased to 1000 volts or more. Great flexibility in the design of components is achieved through the ability to place highly conductive "wells" where needed to obtain the benefits of epitaxial techniques, and by the ability to diffuse in gold selectively for lifetime control. The technique makes practically all circuit configurations possible, and greatly enhances the possibilities for fabrication of npn and pnp transistors in the same substrate. Details on circuits fabricated by this technique will be given, such as digital circuits having propagation delay times of 2-3 nanoseconds and a video amplifier with a gain-bandwidth product of 500 megacycles.

SESSION 3

LEARNING SYSTEMS

Tuesday, August 25, 9:30 A.M.-12:00 Noon
STATLER HILTON HOTEL — LOS ANGELES ROOM

Session Chairman and Organizer:

S. M. FOMENKO
North American Aviation, Inc.
Downey, California

The session is devoted to systems and devices which achieve the optimum performance through experience rather than through deterministic algorithms. Some theoretical, philosophical, and practical aspects of learning systems will be presented. Results of computer simulation of some new approaches to learning will also be reported.

3/1 SOME USES AND MISUSES OF BIO-COMPUTER PHILOSOPHY

M. L. BABCOCK
University of Illinois
Urbana, Illinois

The use of the term bio-computer in the title is applied to systems which show behavior similar to or have some of the attributes of living organisms, specifically those attributes which are usually associated with brain-like behavior. In this interdisciplinary field which encompasses such areas as artificial intelligence, self-organizing systems, adaptive machines, cognitive processes, brain modeling, and similar descriptive terms, the engineer, the physical scientist, and the mathematician have taken words from other areas of major interest, mainly psychology, where these words have a preempted meaning, and used them to describe systems and models of systems in their own areas of interest. Very often these terms have led to confusion and often even to apprehension.

This presentation will use the term "adaptation" and trace its meaning to illustrate the misuse of a bio-computer philosophy which has resulted not only in misrepresenting some of the capabilities of various systems to others than those immediately associated with the term but has also resulted in the degeneration of a descriptive term to a point of relative uselessness.

On the other hand, an example of the use of a bio-computer approach to a problem of auditory signal analysis will illustrate the utility of considering biological data, if that data is interpretable in terms of synthetic hardware.

Conjecturing on the future, some limitations and constraints on future bio-computer systems will be mentioned.

3/2 TRAINING A THRESHOLD LOGIC UNIT WITH IMPERFECTLY CLASSIFIED PATTERNS

R. O. DUDA, R. C. SINGLETON
Stanford Research Institute
Menlo Park, California

A threshold logic unit (TLU) having adjustable weights is a particularly simple machine that can be trained to dichotomize patterns. It is trained on a representative set of patterns, each pattern having been labeled with a desired category number. If the patterns so labeled are linearly separable, then any of several training procedures can be used to adjust the weights so that eventually the TLU classifies all of the patterns as desired.

There are many circumstances in which the patterns used for training are, in effect, occasionally mislabeled. This paper is concerned with training a TLU under such conditions. The patterns used for training are assumed to be selected from a linearly separable set. However, these patterns are presented to the TLU after having been randomly mislabeled with probability less than one-half. In addition to forming the usual (instantaneous) weight vector, a second (average) weight vector is formed by averaging the instantaneous weight vector. It is shown that for orthogonal pattern vectors the average weight vector converges to a solution vector for the correctly labeled pattern set. When the pattern vectors are not orthogonal, this need not always occur; however, experimental results show that the average weight vector usually performs much better than the instantaneous weight vector.

3/3 MULTI-LAYER LEARNING NETWORKS

ROGER A. STAFFORD
Philco Corporation
Newport Beach, California

Cascade networks of linear threshold elements with adjustable weights are discussed which are to receive various sets of inputs and respond with appropriate outputs. Whenever an incorrect response occurs, a process of weight change is begun which is to correct this error while minimizing the damage done to previously "learned" responses. This paper proposes some general properties the weight-change rules of such networks should have for successful operation. Some results are given for a computer simulation of a particular model of network which satisfies these properties.

3/4 LEARNING SYSTEMS IN AND OUT OF THE FACTORY

ROBERT M. STEWART
Space General Corporation
El Monte, California

Many conceivable operational applications of "learning systems" are being forecast, but we are primarily interested, and see the earliest and most promising potential technological value to engineering in using an electrochemical form of "learning in the factory," simply because it promises a possible unique breakthrough of the present "complexity barrier," rather than in some more esoteric form of adaptive behavior, per se, in the hands of the operational user.

3/5 GENERALIZED LEARNING THEORY

R. E. JACKSON
University of California at
Los Angeles
Los Angeles, California

A mathematical theory of learning is approached from the standpoint of the combined use of statistical decision theory and order statistics. A theory of learning, called Generalized Learning Theory, is derived. A machine which uses Generalized Learning Theory will optimally approximate the theoretically best decision rule, provided there exists some relationship between observations and decisions. Because the Theory requires no *a priori* information, it is ideally suited to those cases for which *a priori* information is absent. In a certain sense and under fairly general restrictions, the Theory is optimum in that no other learning theory given the same information can perform better.

SESSION 4

AUTOMATIC CONTROL

Tuesday, August 25, 9:30 A.M.-12:00 Noon
STATLER HILTON HOTEL — GARDEN ROOM

Session Chairman and Organizer:

DUANE T. MC RUER
Systems Technology, Inc.
Inglewood, California

A balanced program which includes optimal control theory and applications to manned and unmanned spacecraft attitude control. Considerations of redundancy and reliability are included.

4/1 ON TIME-OPTIMAL CONTROL WITH THRESHOLD LOGIC UNITS

JAMES W. BERKOVEC
Collins Radio Company
Cedar Rapids, Iowa

DONALD L. EPLEY
State University of Iowa
Iowa City, Iowa

Time-optimal control of a linear system may be viewed as a decision problem, namely a problem of deciding between two possible system input values. Such decisions may be made by adaptive networks of threshold logic units. In this paper, it is shown that time-optimal control of a single degree of freedom system with real characteristic roots may be achieved with arbitrary accuracy with a single threshold logic unit when the state variables of the systems are coded with a 1 out of n code. A time-optimal controller for single degree of freedom, second order systems is also shown to be realizable with arbitrary accuracy with a single threshold logic unit. The technique developed is shown to be applicable to certain two degree of freedom systems and to systems in which not all state variables are nulled.

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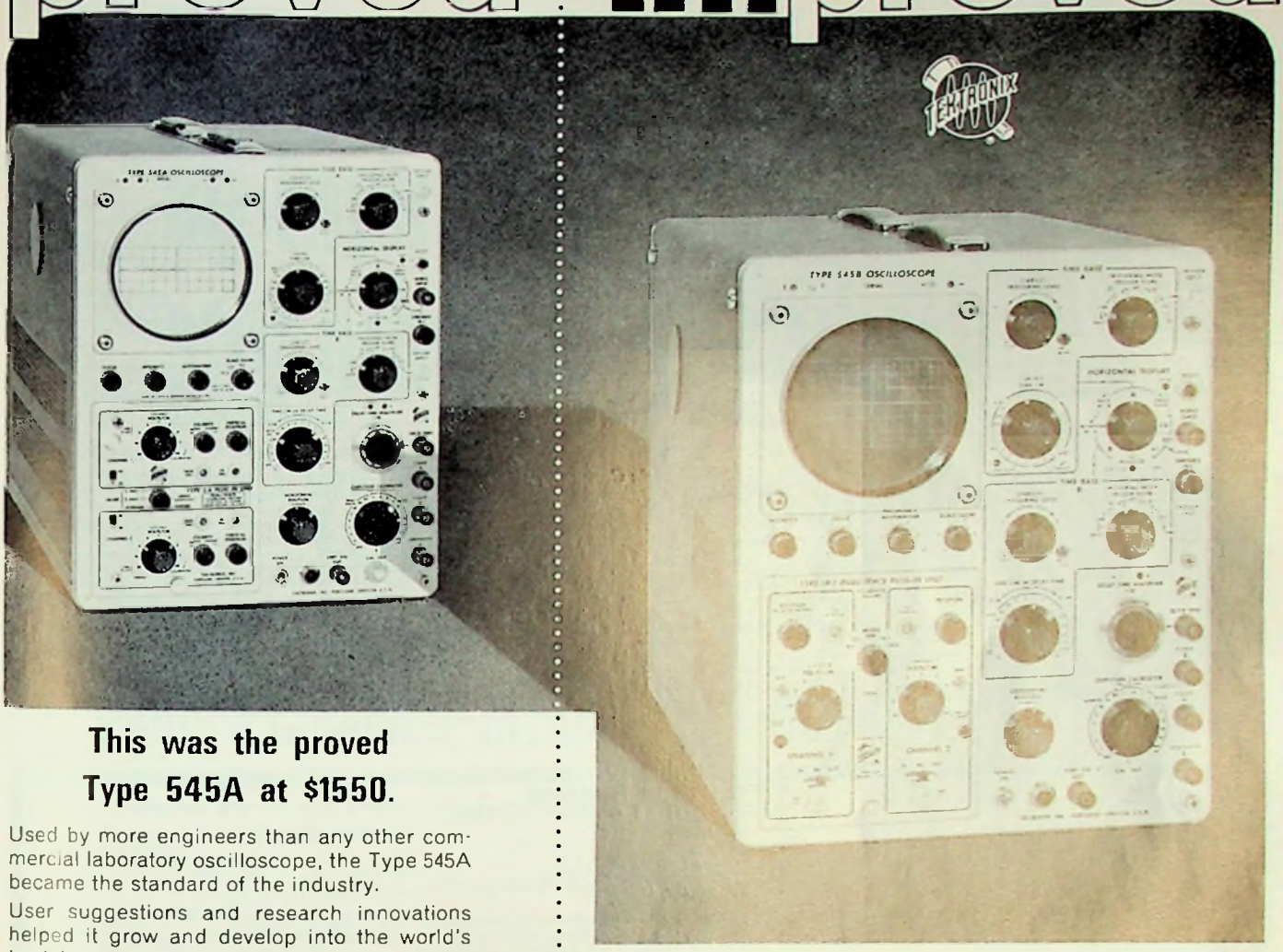
proved improved



This was the proved Type 545A at $1550.

Used by more engineers than any other commercial laboratory oscilloscope, the Type 545A became the standard of the industry.

User suggestions and research innovations helped it grow and develop into the world's best known laboratory oscilloscope—through five years as the Type 545, another five years as the Type 545A.

Over the years, better circuit components and design techniques led to simpler operation and application, greater accuracy and reliability, easier maintenance and calibration.

Seventeen amplifier plug-in units were developed to provide quick adaptability for particular applications. Other features were added or improved to update performance specifications.

With the dual-trace unit, the Type 545A provided 50 mv/cm sensitivity for a wide range of dc-to-24 Mc applications.

Further updating of the "A" Model to implement additional improvements has resulted in a new "B" Model—as the "A" Model was developed from the early Type 545.

So, now, the Type 545A is superseded by the Type 545B. Instrument support will continue to be available for the "A" Model, however, for at least 10 years.

Here is the improved Type 545B at $1550.

Looks about like the Type 545A. But added capabilities and convenience further enhance its value.

New crt. Internal no-parallax illuminated graticule. Improved resolution, uniform focus over the full 6-cm by 10-cm (50% greater) display area. New hybrid vertical amplifier—greater stability and reliability. Fixed-tuned delay cable, prevents misadjustments. Triggering beyond 30 Mc. Sweep delay, single-sweep, other features and refinements that equal or excel those of the present "A" Model.

Use all your Tektronix Type A to Z Plug-In Units at equal or better frequency response, or the new Type 1A1 or 1A2 Dual-Trace Plug-In Units for 50 mv/cm at dc-to-33 Mc. The Type 1A1 also offers 5 mv/cm at dc-to-23 Mc dual-trace, and, by cascading the two amplifiers, approximately 500 μv/cm at 2-cps-to-14 Mc.

Price at $1550 is the same as the Type 545A and includes two probes. Full field-engineering services back up every instrument.

But to hear the complete story, call your Tektronix Field Engineer. He will know if a Type 545B offers the best solution to your measurement problem. If the Type 545B appears to be the answer, try it. Use it in your own application—with one of your 17 letter-series plug-ins or one of the new amplifier plug-in units.

Tektronix, Inc.

Available throughout the world

CIRCLE INQUIRY CARD NUMBER 15

4/2 A MONITORLESS REDUNDANCY SCHEME FOR HIGHER CONTROL SYSTEM RELIABILITY

A. S. ESCOBOSA
Autonetics, NAA
Anaheim, California

In this paper, a novel unit level redundancy method will be presented. The paper is divided into three sections: Theory, Reliability Prediction, and Application.

In the first section, the basic unit redundancy theory is introduced. The structure and failure compensating characteristics of a typical unit are described and design requirements made evident.

In the second section, the concept of "redundancy efficiency" is defined and elaborated to show the increase in reliability of the unit redundancy approach over the current system level redundancy schemes.

In the third section, the mechanizations of the various units comprising an advanced flight control system are described.

Since the primary purpose of this paper is to introduce a novel scheme, the theory and application sections will be emphasized.

4/3 OPTIMAL DESIGN OF SEVERAL REACTION JET SWITCHING TECHNIQUES

J. L. HINSON, M. D. SARLES
Martin Company
Baltimore, Maryland

This paper presents the analytical development of design guides for the optimum design of eight reaction jet switching schemes. The optimum design is dictated by the application and is generally defined in terms of the limit cycle rate, the response time and the fuel utilization. The quest for the optimum design reduces to relating the switching scheme parameters to these three characteristics.

Digital computer computations are presented to verify the truth of the design guides developed. The digital computations employed iteration procedures to predict the solution of the transcendental, piecewise linear equations governing the operation of the various systems. Based on the digital computations, performance comparisons are drawn between the various switching techniques investigated, with a time-fuel optimal switching technique based on Pontriagin's Maximum Principle as the absolute standard of comparison.

4/4 COMPATIBILITY OF IMPULSE MODULATION TECHNIQUES WITH ATTITUDE SENSOR NOISE AND SPACECRAFT MANEUVERING

JAMES E. VAETH
Martin Company
Baltimore, Maryland

This paper compares three impulse modulation techniques, each of which provides precision control of spacecraft attitude with excellent fuel economy during limit cycle operation, in terms of compatibility with both sensor noise and maneuver (plus damping) requirements. Analog computation is used to efficiently simulate sensor noise and controller nonlinearities. Typical response plots are presented which demonstrate performance variations (attitude accuracy, rates, fuel economy, jet duty cycle, etc.) as functions of switching hysteresis, sensor noise spectrum, filter parameters, controller gains and time constants, etc. Based on analog results and theoretical correlation, design guides are evolved for selecting control system parameters and minimizing jet fuel usage in terms of mission performance requirements and sensor noise characteristics.

SESSION 5

ELECTRON DEVICES IN THE POWER INDUSTRY

Tuesday, August 25, 9:30 A.M.-11:30 A.M.
STATLER HILTON HOTEL — SIERRA ROOM

Session Chairman:

FORREST C. SIX
The Ralph M. Parsons Company
Los Angeles, California

Session Organizer:

WILLIAM S. MOODY
General Electric Company
Los Angeles, California

Larger systems, rapidly advancing technology, and increasingly strong emphasis on efficiency have imposed sophisticated requirements for communications and control on utility and industrial power systems. The power industry traditionally has employed highly sophisticated automation techniques, whereas the most rapid advances in efficient, reliable communication and control devices have been within the aerospace industry. New applications for aerospace developments are suggested in this session.

5/1 NEW FUNCTIONS IN STATIC RELAYS FOR TRANSMISSION LINE PROTECTION

W. C. MORRIS
General Electric Company
Philadelphia, Pennsylvania

Lines in directional comparison and combined phase and directional comparison schemes can now be obtained in a variety of combinations. The static relays that comprise the different schemes have mho, impedance, overcurrent and directional characteristics similar to those of their well known electromechanical counterparts. Their performance has been proven by extensive staged-fault tests in the field on high-voltage, high fault current systems and has been verified in actual service through months of severe lightning exposure. The use of solid state components has resulted in significant improvements in operating speed, reduced maintenance and reduced installation costs.

5/2 ELECTRONICS CAN BE EFFECTIVE IN REDUCING DISTRIBUTION CIRCUIT OUTAGE

G. G. AUER
General Electric Company
Schenectady, New York

In the recent 25th Anniversary issue of DISTRIBUTION magazine, the general theme refers to distribution systems of the future – projected into the year 1989, or 25 years hence. One of the articles in this issue is titled "Toward the Outage-Free System – Electronically."

The distribution system of the future may well be virtually outage-free in comparison with today's high standards of stability and service continuity. To provide it, consideration must be given to electronics for circuit planning, automatic equipment operation and fault detection. In addition, electronics must be used for automatic communications of fault location.

Protection planning is one area where electronic computers can offer a high degree of accuracy in selection of equipments, ratings, location and coordination limitations.

Equipment operation and fault detection could be entirely dependent upon electronics to provide the proper sequence of automatic tripping and also to dictate the open or closing of an emergency tie point when available.

It is an accepted fact that no distribution circuit, whether it be an overhead or an underground circuit, is immune from faults. Where and when permanent faults develop to cause loss of service, electronics can be useful in automatic communication to alert the trouble crews to the troubled area.

The use of electronics in distribution system protection is not something to be considered for the future. If we recognize the facilities available today and the means for product and functional integration, we have made progress toward trouble-free systems through the use of electronics.

5/3 STATIC CONTROL AND PROTECTIVE DEVICES IN ELECTRICAL TRANSMISSION AND DISTRIBUTION

J. A. LONGLEY
Allis-Chalmers Manufacturing Company
Milwaukee, Wisconsin

This paper covers some of the important applications of Solid State and Magnetic Devices now being used in both utility and industrial power systems. Static Protective Relays of several types are covered. The paper includes both the physical and application differences of these relays as compared to Electro-Mechanical types. New Static Tripping Devices used on 600 volt switchgear will be described.

Static Sensing and Control Units for regulating voltage on Step type voltage regulators and load ratio control power transformers are now in use. Mentioned also are installations of Static type Emergency tripping power supplies utilizing a small storage battery.

The paper discusses the major operating and maintenance benefits now being realized through the use of solid state designs in Electrical Transmission and Distribution Systems.

5/4 A NEW LOOK AT POWER LINE CARRIER SYSTEMS

R. V. RECTOR, M. C. ADAMSON
General Electric Company
Lynchburg, Virginia

The growth of the electric utility industry has brought certain changes in system operating concepts. The proven and reliable power line carrier communication systems must be expanded to a greater density of channels to keep pace with the larger need of communications. This paper describes the application of single side band equipment to power systems to offer increased use of the carrier spectrum at a lower cost per channel. A new equipment is described that incorporates the best of single side band experience and, at the same time, offers the first completely solid-state equipment having practical output power levels. Application concepts and typical system designs are also discussed.

SESSION 6

MICROWAVES

Wednesday, August 26,
9:30 A.M.-12:00 Noon
STATLER HILTON HOTEL — GARDEN ROOM

Session Chairman:

I. KAUFMAN
TRW Space Technology Laboratories
Redondo Beach, California

Session Organizer:

CLARENCE J. CARTER
Aerospace Corporation
Los Angeles, California

A broad spectrum of new or improved devices and new techniques are now providing solutions to some old microwave problems. Included are a new electrically tuned microwave receiver, a new idea for very high level microwave to dc power conversion, new information on groove waveguides, a millimeter wave tunnel diode signal generator, and a new concept in thermistor bead power monitoring.

6/1 GROOVE GUIDE MEASUREMENTS

F. J. TISCHER, F. W. SOMEROSKI
University of Alabama
Huntsville, Alabama

The groove guide consists of two parallel metallic strips with centrally located longitudinal grooves facing each other. The guide has properties similar to those of the H-guide but contains no dielectric material. Theory indicates that the attenuation decreases with increasing frequency so that the guide seems particularly suitable for the upper range of the microwave region and for millimeter waves.

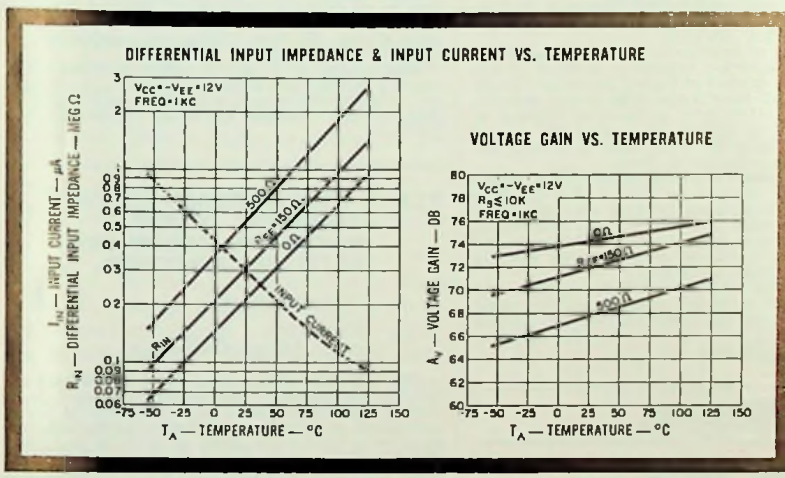
CONTINUED ON PAGE 26

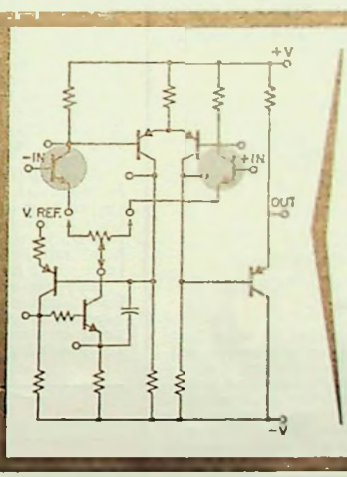
NOW... A Microelectronic Differential Amplifier with an Input Offset lower than any other... anywhere!

This  is it.

PC-201
(actual size)

(plus a Common-Mode Rejection Ratio > 120 DB)





ONE SECRET of the extreme stability and high performance of the General Instrument PC-201 Differential Amplifier is the exact matching of two 2N930 type input transistors, shown in the shaded areas, with an initial V_{BE} match typically 1mV (Industry Standard, 10mV) and a V_{BE} match with temperature, typically 5 μV/°C from −55°C to +125°C (Industry Standard, 25 μV/°C). Incidentally, such matched transistors are available as duals for your own custom-designed circuitry, on order.

BECAUSE GI's advanced Multichip technology permits exact matching of discrete components such as transistors (a technique impossible in conventional monolithic microcircuitry) —
AND BECAUSE (unlike bulky, conventional circuit-boards) matching parts are so close together physically, no significant temperature gradient exists between them —

AND FOR a variety of other significant reasons inherent in GI's Multichip know-how, this General Instrument ultra-linear, high-stability Differential Amplifier achieves performance characteristics not only hitherto impossible in any integrated circuit, but largely impossible in conventional circuits of any size! Complete specifications and data are available on request.

GENERAL INSTRUMENT CORPORATION
SEMICONDUCTOR PRODUCTS GROUP
600 West John Street, Hicksville, New York

CIRCLE INQUIRY CARD NUMBER 16

An infinite wall groove guide is at present under experimental investigation. The test set up consists of a region between two parallel conducting walls, terminated at the rim of the walls by matched absorbers. A horn radiates electromagnetic energy into this space between the walls into the central region where two grooves in the walls facing each other form the actual groove guide.

Measurements carried out on the test set up at X-band are described and the results presented.

6/2 MICROWAVE SUPERHETERODYNE RECEIVER FEATURING ELECTRICAL TUNING AND PRESELECTION

R. H. RECTOR, J. P. FITZPATRICK,
J. A. ALDECOA, R. W. HAEGELE
Watkins-Johnson Company
Palo Alto, California

Many microwave superheterodyne receivers with mechanically-tuned preselection have been developed in the past. These have excellent image response and low local oscillator radiation, but suffer from relatively slow tuning and susceptibility to misalignment caused by mechanical shock. More recently, electrically-tunable receivers have appeared, but these have suffered from relatively poor image response, about 20-30 db below the main signal. This paper describes a recently developed receiver which incorporates rapidly tunable preselection using yttrium-iron-garnet filters. Image response is down more than 80 db, other spurious is down over 90 db, local oscillator radiation is less than −100 dbm, noise figure is 7 db over the 2-4 Gc range, tuning is accomplished at millisecond rates with either analog or digital commands at distances up to 500 feet, mechanical and electrical ruggedness is very great, size and weight are small, and electrical efficiency is high. Calculated mean time to failure is over 5,000 hours, resulting from careful all-solid-state design except for the traveling-wave tubes and backward-wave oscillators, with the latter two made inplant with ultra-reliable techniques.

The techniques and components employed in this receiver are directly extensible to frequency ranges from 0.5 to 100 Gc. Components to extend the frequency range to 1-18 Gc have been completed, and modules using these components plus a display module will result in a 1-18 Gc receiving system of this kind in the near future.

6/3 POWER BEAMING AND HIGH LEVEL MICROWAVE RECTIFICATION

PETER P. KEENAN
Scientific Research Laboratory
Lockheed-California Company
Burbank, California

A review is given of the status of very large antenna systems and super-power microwave generators. This review suggests that the rapid development of very large antenna systems and super-power microwave generators and the apparent need for a wireless power cable in space suggest the feasibility of a microwave power beam. However, such a power beaming system will require an efficient, high level microwave rectifier which directly converts the microwave energy into useful DC electrical power.

A high level microwave rectifier using multipactor discharges is described. An analysis of this rectifier is presented which indicates an efficiency of 59 percent for a single-phase microwave cavity. A simple modification to permit two-phase rectification would appear to result in a rectification efficiency approaching 92 percent. These values compare very favorably with more complicated rectifiers that have been proposed. The assumptions upon which this analysis is based were critically examined and appear to be justified. In addition to potential high efficiency, the rectifier also appears to have high peak power (megawatts) and high average power (kilowatts) capability. Its response time is such that it could rectify radar pulses. Finally, the rectifier has the advantage of simplicity. It requires no filament or anode power supplies nor does it require magnetic fields for operation.

It appears that there will be an increased emphasis on the transmission of extremely high power microwaves. The proposed rectifier would appear to make a significant contribution to this technology.

6/4 MILLIMETER-WAVE GENERATION EMPLOYING A PACKAGED MICROWAVE TUNNEL DIODE

STANLEY V. JASKOLSKI, KORYU ISHII
Marquette University
Milwaukee, Wisconsin

Experimental results are presented which show that inexpensive, commercially available, packaged microwave tunnel diodes can generate millimeter wave frequencies in excess of presently accepted theoretical resistive cutoff frequency limits. A maximum frequency of 42,390 mc was generated with a D4168D X-band tunnel diode whose resistive cutoff frequency was 21,740 mc. The experimental results are verified through a theoretical analysis which re-defines the tunnel diode equivalent circuit. In so doing, the existence of negative resistance above the resistive cutoff frequency is illustrated. Circuit diagrams and circuit design equations are presented.

6/5 A SINGLE BEAD BROADBAND COAXIAL THERMISTOR MOUNT

EDWARD E. ASLAN
FXR, Division of Amphenol Borg
Woodside, L. I., New York

A new broadband coaxial thermistor mount is described which has as its major feature the virtual elimination of a subtle DC to RF substitution error commonly encountered in the measurement of RF power. Secondary features include the simplicity of the design and the potential ease of matching thermistors for temperature compensated power measurements.

The thermistor mount utilizes a single center tapped thermistor in place of the two thermistor beads normally used in coaxial mounts. The data taken on the thermistor mount indicates the elimination of an error described in detail in National Bureau of Standards Report No. 7934 "A DC-RF Substitution Error in Dual Element Bolometer Mounts." Typically this error is in the order of 1% at 10 mw and 2% at 15 mw of applied RF power for conventional dual bead thermistor mounts, and is due to the two beads having different dissipation constants and a shift in resistance when RF power is applied.

Measurement of resistance shifts and the dissipation constants of the respective sections of the thermistor for a number of tapped thermistor beads and mounts have been made. The results indicate that this substitution error is typically reduced to below 0.1% up to 15 mw of applied RF power. The error calculation is based upon a derived expression for the substitution error.

A coaxial thermistor mount is described which is usable at RF frequencies up to 12.4 Gc. The center tapped thermistor bead is also described both as it was initially conceived and with modification to minimize a residual VSWR due to the bead not being a simple center tapped element because of its geometric shape.

The use of the single bead also facilitates the fabrication of temperature compensated thermistor mounts, since only one bead for the RF portion need be matched to one bead for the slave or compensating thermistor.

SESSION 7

COMPONENT PARTS

Wednesday, August 26,
9:30 A.M.-11:30 A.M.
STATLER HILTON HOTEL — GOLDEN STATE ROOM

Session Chairman:

DONALD L. STEARN
TRW Space Technology Laboratories
Redondo Beach, California

Session Organizer:

NICHOLAS KHOURY
TRW Space Technology Laboratories
Redondo Beach, California

Two papers discuss effects of space radiation environment; two discuss conventional precision electronic parts. Radiation of semi-rigid encapsulation epoxies may cause drastic pressure changes. Experimental data are presented covering radiation-resistant diode development. Construction and testing of tantalum capacitors and wirewound resistors for high reliability are outlined.

7/1 EFFECTS OF GAMMA IRRADIATION IN SEMIRIGID EPOXIES

F. F. STUCKI, D. M. NEWELL
Lockheed Missiles & Space Company
Palo Alto, California

Static and dynamic radiation effects in a Scotchcast type epoxy are investigated. A small solid state microtransducer is used to monitor the transient and steady state of the epoxy while radiated.

It is shown that radiation leads to an after-curing effect, which delays exponentially with time. After a dosage of approximately 10^6 roentgen, the material is completely cured. Besides these curing effects, a shift of the secondary transient point from 10° to 250°C was experienced. Since at the secondary transition a pressure change of about 7000 psi is experienced, any electronic circuitry which is encapsulated into such an epoxy will be exposed to drastic pressure changes with a normal deviation from room temperature.

7/2 TOLERANCE OF SILICON DIODES TO ELECTRON AND NEUTRON RADIATION

WAYLON BRYAN
Texas Instruments Incorporated
Dallas, Texas

Radiation studies have been conducted on various Texas Instruments diodes and empirical data and device designs are presented.

These studies include a diode specifically designed for high radiation tolerance in the 200 to 400 volt range, as compared to a general purpose diode and a computer diode.

The effects of both neutron and electron radiation on all diode parameters are reported. Neutron studies were conducted only on the radiation tolerant diodes. Electron studies were conducted on all three types of diodes.

The effects of 2 and 3 MEV electrons were studied between the levels of 5×10^{11} and 5×10^{14} evt. Neutron effects were studied at energies greater than 10 KEV between the levels of 10^{13} and 5×10^{15} nvt.

7/3 A NEW APPROACH TO THE ATTAINMENT OF THE HIGHEST RELIABILITY IN TANTALUM CAPACITORS

JOHN BURNHAM
Ti-Tal Inc.
Santa Monica, California

The question of how to achieve the highest reliability for tantalum capacitors is discussed from both a theoretical and a practical point of view. A method of achieving reliabilities of the order of 99% at a confidence level of 99% is described which involves an analytical treatment of the physics of the mode of failure, accounting for over 90% of all failures, and a statistical model is derived which demonstrates this reliability on a highly accelerated test.

The test is applicable on a 100% basis to the production capacitors and as it is non-destructive it allows the attainment of a reliability figure for each capacitor. This also provides a method of establishing very high reliabilities at a low cost and the test can be carried out in twenty-four hours or less.

7/4 WIREWOUND RESISTORS — THE STATE OF THE ART

DANIEL POLIN
John Fluke Manufacturing Company, Inc.
Seattle, Washington

CONTINUED ON PAGE 28

Once a year unto all we beknighted men of electronics comes that refreshing, uplifting and challenging time destined to go down in history under the name of WESCON. Given to us are such benefits as hospitality suites, untold specification sheets, a few balloons for the kiddies and a race track. We are also told where to go (as far as restaurants and entertainment are concerned) in (as it happens this year) Los Angeles. Rantec has its own version. Herein... A Tour of Los Angeles and Orange Counties.

I THE HOLLYWOOD RANCH MARKET Open all night (on world-famous Vine Street) for the sole purpose of cashing checks for actors. As a secondary enterprise, this colorful bazaar also offers chili dogs, orange juice, chocolate covered doughnuts, chocolate covered bees, rattlesnake meat and toothpaste. Do not be seen here at 10 in the morning. Somebody will blow the whistle on you as some sort of deviate.

II VAGABOND THEATER Just west of MacArthur Park (No Canoes Available After Midnight), this supremely intellectual Bijou features mysterious movies from Sweden, India, Japan, Tasmania and The Bronx. It is, if you are at all interested, the perfect place for bird-watching. Birds to watch for: The Bearded Author, The Full-Breasted Pushover, The Black Leotard, The Italian Motor Scooter, The Underdeveloped Warbler, and The Political Thrasher. Guaranteed no motion picture dialogue in the English language.

III BEDFORD DRIVE At last count, there were more psychiatrists officed on Bedford Drive than the entire population of Pierre, South Dakota. A recent estimate shows that the combined accounts receivable of these medical men exceeds the total net assets of the Bank of America. This is undoubtedly one of the more colorful sections of this quaint city. Typical overheard conversation: "Do you hate your father?" "Goodness no, Myrtle ...hating your father was *last* year."

IV SCHWAB'S Schwab's is the place where actors, extras, writers, directors, producers, cameramen, publicists, columnists, business managers, assistant directors, associate producers, grips, best boys and, oh yes, actresses meet to discuss how terrible everything is. Unaccompanied girls wear very tight slacks, orange and yellow boleros showing a peak of bared midriff and sandals handmade by a bearded gentleman in Topanga Canyon. Unaccompanied men wear very tight slacks, orange and yellow...oh well, let's forget it.

V RANTEC This firm is in a town called Calabasas, California. Well, if all you're going to do is laugh, then come on out and see for yourself.

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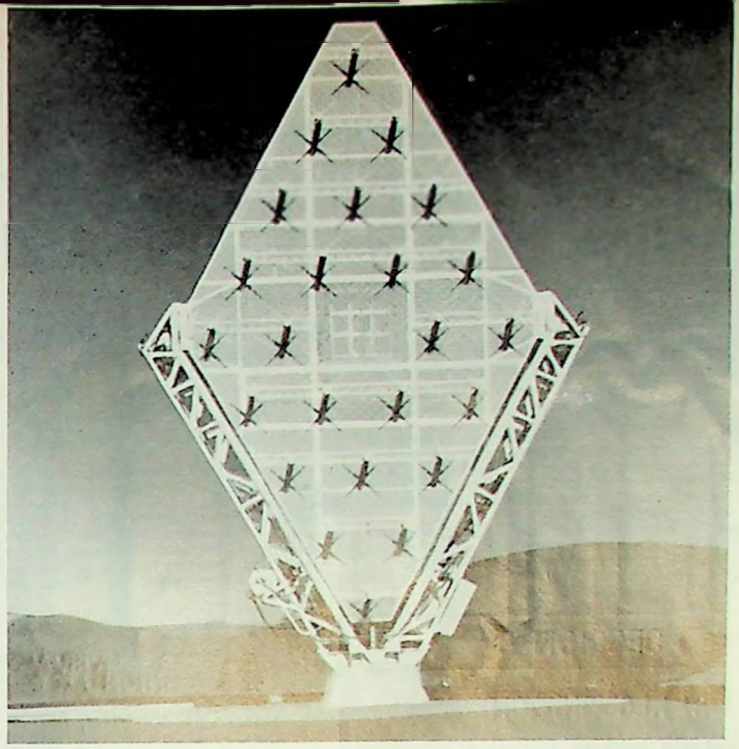

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AT WESCON—BOOTH 2081, SPORTS ARENA

CIRCLE INQUIRY CARD NUMBER 17

Pacing sophistication of high accuracy electronic gear are the significant advancements of the precision wirewound resistor. Reviewed are improvements and additions to the resistance alloy family, temperature coefficient, long term stability, construction types and reliability.

Increased knowledge in the selection and processing of manganin has led to improved standard resistors and low value shunt designs. Vacuum melting, slight alloy constituent changes and improved high temperature wire enamels have significantly advanced the state of the art for 800 ohm alloys. These significant advances coupled with improved fine wire drawing techniques and handling machinery have made possible extremely good precision wirewounds in the 5 to 10 megohm range.

Long term stability and reliability must be built into a wirewound resistor. It cannot be measured, tested or selected into it. Stress-free winding, high temperature stress-relief, packaging and encapsulation, and welding versus soldering termination techniques are discussed.

The paper is concluded with a look at some of the economical aspects of wirewound resistor manufacturing and what can be expected in future developments.

SESSION 8

PATTERN RECOGNITION

Wednesday, August 26,
9:30 A.M.-12:00 Noon
STATLER HILTON HOTEL—
SIERRA ROOM

Session Chairman and Organizer:

J. K. HAWKINS
Philco Corporation
Newport Beach, California

Real image data has enjoyed little favor in pattern recognition studies, for reasons of sheer quantity. Nevertheless, serious effort is being made to surmount this barrier. The results are crucial for yielding insight into the peculiar and complex nature of imagery. This session emphasizes studies which employ data of corresponding diversity.

8/1 AN EVALUATION OF CERTAIN PROPERTY FORMATION TECHNIQUES FOR PATTERN RECOGNITION

M. G. SPOONER, C. W. SWONGER, J. B. BEACH
Cornell Aeronautical Laboratory, Inc.
Buffalo, New York

The development of techniques for formation of properties which are useful for categorizing patterns is a research area central to all pattern recognition research. In many cases, when a sufficient number of relationships between the patterns and their classes can be devised, the use of rationally derived properties is a feasible approach. If a sufficient number of deterministic relationships between the patterns and their classes cannot be established, then properties based on rational statistical selection of points from the input space can still be used, such as in a perceptron organization. This paper discusses two rational techniques for statistical and deterministic property selection which provide better recognition rates with smaller systems than can be obtained completely with random selection of points. These rational property selection techniques have been experimentally evaluated with a large scale digital computer simulation using as inputs patterns that are significantly distorted from their prototypes. A large number of patterns were used in the separate testing and training sets to achieve computer results having reasonable statistical significance.

8/2 COMPUTER RECOGNITION OF HANDWRITTEN FIRST NAMES

FRANK N. MARZOCCO
System Development Corporation
Santa Monica, California

A learning program that incorporates a version of stimulus-sampling theory has been prepared for a digital computer. Handwritten first-name signatures coded in a 20 x 48 grid serve as inputs to study the effect of parameter changes in the program. Both learning rates and the final level of learning are sensitive to such changes.

8/3 TARGET DETECTION IN AERIAL PHOTOGRAPHY

L. N. KANAL, N. C. RANDALL
Philco Corporation
Blue Bell, Pennsylvania

The automatic identification of targets in tactical aerial photography, regardless of where they might appear, is accomplished via a two-level statistical decision procedure which involves modifications of classical methods of multivariate discriminant analysis. Computer simulated target detection experiments performed on actual tactical imagery produced impressive results on independent test samples.

8/4 A CLASS OF VISUAL PATTERN RECOGNITION ALGORITHMS

B. H. MCCORMICK,
R. NARASIMHAN, S. TOIDA
University of Illinois
Urbana, Illinois

Digital recognition procedures for a wide range of visual material (bubble chamber negatives, human faces, neurohistological slides) will be illustrated on a step-by-step basis. These techniques are appropriate for implementation on the new class of iterative array processors (e.g., the pattern articulation unit of ILLIAC III).

8/5 RECOGNITION OF LETTERS, PICTURES, AND SPEECH BY A DISCOVERY AND LEARNING PROGRAM

LEONARD UHR
University of Michigan
Ann Arbor, Michigan

The discovery program described develops its own set of characterizers as a function of examples of the patterns it is being asked to recognize. Because the search is directed, it learns relatively rapidly. Because it discovers, rather than using pre-programed characterizers, it is capable of attempting to recognize a variety of patterns. Some results are presented for recognition of handwritten letters, pictures of simple objects, faces, nonsense patterns, and spoken speech.

SESSION 9

STATIC POWER CONVERSION AND CONTROL

Wednesday, August 26,
9:30 A.M.-12:00 Noon
STATLER HILTON HOTEL—
LOS ANGELES ROOM

Session Chairman:

A. D. SCHOENFELD
TRW Space Technology Laboratories
Redondo Beach, California

Session Organizer:

BERTRAND FARBER
TRW Space Technology Laboratories
Redondo Beach, California

A high-voltage, high-power static switch using gate-controlled switches in a unique configuration features very short switching times; a 50-watt high-efficiency regulated converter operates from 0.75 to 1.5 vdc; a unique static commutation arrangement is used in a brushless dc motor; advantages, system design considerations, and voltage regulation techniques relative to 12 and 18 phase semiconductor rectifier systems.

9/1 A 20 KVA DC SWITCH EMPLOYING SLAVE CONTROL OF SERIES OPERATED, GATE CONTROLLED SWITCHES

JOHN W. MOTTO, JR.
Westinghouse Electric Corporation
Youngwood, Pennsylvania

The ability of the Gate Controlled Switch to control both turn-on and turn-off by short duration gate pulses is utilized to perform high voltage, high power DC switching in very short switching times.

The circuit details and performance of a 3.2 KV, 6.4 ampere DC switch are presented. The switch employs eight, serial connected, gate controlled switches which are controlled by a unique slave action where the turn-on and turn-off of a master unit controls the turn-on and turn-off of the series connected devices. The composite switch has a turn-on time of 2.0 microseconds and a turn-off time of 4.0 microseconds.

The performance indicates that slave control of series operated, gate controlled switches will be of significant value where high voltage, high power must be switched on and off in very short switching times.

9/2 LOW-INPUT VOLTAGE CONVERTER-REGULATOR

P. RAMIREZ
Electro-Optical Systems, Inc.
Pasadena, California

This paper discusses the design and application of a low-input voltage converter-regulator. Design considerations as well as design equations and component specifications are presented. The performance of a 50 watt converter-regulator that operates with an input voltage variation from 0.75 to 1.5 volts with an efficiency of 75 percent is discussed. The output of this converter is regulated to ± 1 percent at a nominal output voltage of 28 volts.

Application of this low-input voltage converter-regulator to space power systems is demonstrated. These power systems utilize thermionic diodes, fuel cells, solar cells and electro-chemical devices as the power source.

9/3 BRUSHLESS DC MOTOR

R. D. KINCER, R. G. RAKES
Sperry Farragut Company
Bristol, Tennessee

The conventional direct current motor is particularly suited for applications where the source of energy is a battery or wherever size, weight, and power consumption must be minimized. Unfortunately, its advantages are often nullified by the inherent defects of mechanical commutation.

Conventional commutation is essentially a high-speed switching operation with sliding contacts. The mechanical switching process is accompanied by friction, arcing, and wear which impair the life and reliability of the motor. In space applications, brush deterioration often becomes intolerable.

The function of the commutator is duplicated in the Sperry Farragut motor by a solid state, electronic switching system which results in the elimination of sliding parts and contacts. As a result, the motor has a longer life, virtually no RFI, and performs with a high degree of efficiency-to-weight ratio.

The rotor of the Sperry Farragut Brushless DC Motor carries a rotating cylindrical shield which encloses a stationary light source. An aperture in the shield forms a beam of light which impinges on an array of photoelectric devices surrounding the shield. As the rotor turns, the photoelectric devices are scanned in sequence and the electronic switching network is driven to cause a flow of armature (stator) current in the direction which develops maximum torque.

Various solid state circuits have been designed for commutator usage in non-allied motor appli-

CONTINUED ON PAGE 30

*PROJECT HIS

The Single Most Important Contribution to Relay Reliability Ever Developed

Before Project HIS, there was one barrier inhibiting the development of a truly reliable relay. This barrier was relay seal leakage: an insidious type of failure that manifests itself in many ways after service in the field. The product of the Hi-G Project HIS is a High-Integrity Seal—a seal so safe, so sure, that Hi-G can now assure a minimum leak rate for the life of the relay, and eliminate a serious random failure mode.

WHY WAS *HIS NEEDED? The glass-to-metal seals used in hermetically sealed relays are subject to a cumulative type of deterioration. Glass is very brittle; it has inherent structural faults in the bubbles that develop during the fusing process; and the seal bond is continuously strained by changing ambient temperatures and even by normal handling. The typical glass-to-metal relay seal begins to fail as soon as it starts on the assembly line, and the many tests that relays must pass before leaving the manufacturer place many strains on the bond. The most severe punishment occurs in the field: inserting and withdrawing the relays from test sockets and circuit sockets produce mechanical strains, and soldering relays into a circuit produces a considerable thermal shock. The combination of these stresses as well as some types of radiation increases the probability of eventual seal and relay failure. □ *Relay seal failures go undetected in a system.* They cannot be seen, and field leak tests are not conclusive. It is highly likely that leaks are the cause of many failures that are attributed to what are apparently more obvious reasons, such as high contact resistance, contact welding, or even metal fatigue. Today's relays are designed for maximum efficiency and minimum size which leaves little room for the safety of overdesign. The result is that these relays can only be expected to perform reliably *in a friendly atmosphere.* The introduction of moisture, oxygen, or the low pressures of high altitudes will cause several types of relay failures.

WHAT IS *HIS? The Hi-G High-Integrity Seal is a ceramic-to-metal seal. The seal is made by brazing the ceramic to a metal header blank. The result is a highly ductile joint that will maintain its integrity in spite of any twisting, bending, or pulling of the terminal; there will be no measurable leak *even after the leads have been twisted off.* The seal is virtually impervious to thermal shock; headers heated to 300°C and dropped into liquid nitrogen or icewater still maintain seal integrity. The high-purity alumina ceramic has very desirable electrical properties and is an excellent conductor of heat. □ The Hi-G High-Integrity Seal is not an all-ceramic header; the header blank is directly interchangeable with metal header blanks already in use. Only the glass has been replaced. This means that the strength and dimensional accuracies inherent in the steel blank are not sacrificed.

WHAT IS THE SIGNIFICANCE OF *HIS? The advent of the HIS relay eliminates a serious random failure mode. □ HIS promises to reduce system failures dramatically. □ HIS makes it possible for Hi-G to assure a minimum leak rate for the life of the relay. □ And finally, the HIS header will make it possible for Hi-G to produce a reliability-rated relay with a more accurately predicted reliability figure.

WHEN CAN YOU GET A *HIS RELAY? HIS Headers are available *now* on special order for most of the relays in the Hi-G catalog. Your Hi-G sales representative can give you information on availability, price, and delivery. Orders will be filled on the first come, first served priority.

WHO MAKES THE *HIS RELAY?

Only Hi-G, Inc.

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CIRCLE INQUIRY CARD NUMBER 18

cations. The circuits are reliable, simple and stable; there is essentially no change in motor characteristics over a temperature span of −10°C to +80°C. A reliability figure, excluding bearing failure rates, of 99.88% for a 100-hour mission, or 91% for a one-year mission, is predicted.

9/4 12 AND 18 PHASE SEMICONDUCTOR RECTIFIER SYSTEMS

W. WAHLGREN
Electro Engineering Works
San Leandro, California

The many advantages of 12 & 18 phase rectifier systems are discussed in light of the latest advances in semi-conductor components. Most of the disadvantages that discouraged their use in the past have been overcome with careful analysis and selection of components. Filter reactors and filament transformers are not required for most applications which accounts for a creditable size and cost reduction. When it is advisable, the power supply design is coordinated with the selection of system components such that it is an integral part of the complete system in which they are being used. Finally the paper describes the voltage regulation possible and some methods of manual and automatic voltage control that utilize highly reliable passive circuit components. A number of illustrations show actual usage and results of these designs.

SESSION 10

AUTOMATION OF STEAM ELECTRIC GENERATING PLANTS

Wednesday, August 26,
9:30 A.M.-12:00 Noon
STATLER HILTON HOTEL — PACIFIC BALLROOM

Session Chairman and Organizer:

JOHN D. ROSENBLATT
Bechtel Corporation
Vernon, California

These papers describe an excellent example of a very successful application of computer and electronic systems and components to automate a large complex commercial process. The total aspects of concept, design, dynamic testing and operating experience are covered. Of special value is the opportunity later to visit the completed, operating plant and to view the systems and equipments described.

10/1 ENGINEERING ASPECTS OF A FULLY AUTOMATED STEAM POWER PLANT

R. L. EMERSON, R. A. NORRY,
L. R. OQUIST
Bechtel Corporation
Vernon, California

The paper describes the application of a digital computer for on-line control of a 310 megawatt steam generating unit at Southern California Edison Company's Etiwanda Steam Station; the impact of computer application on the power plant designer; the engineering effort involved and problems encountered in applying a computer to the control of a large generating unit, together with an account of the method of testing used.

The first start-up, roll and synchronizing of Unit 4 at Etiwanda was carried out by computer and within construction schedule.

10/2 DESIGN AND EXPERIENCE WITH A COMPUTER SYSTEM OPERATION GUIDE AT THE CANADYS STEAM PLANT

M. C. JOHNSON
South Carolina Electric and Gas Company
Columbia, South Carolina

R. G. LIVINGSTON
General Electric Company
Phoenix, Arizona

One of the innovational features of the new South Carolina Electric and Gas Company's Canadys Station is the use of a stored program digital computer system which provides an operation guide function in addition to the now familiar data logging and performance calculation functions. It was initially equipped for Unit #1 with provision for expansion to handle Units #2 & #3.

The digital computer system operates as an on-line or real time system, scanning plant information as required. It provides output information to the operator through digital display, recording and indicating instruments, panel indicating lights and typewriter printouts.

The operation guide function is two fold; a sequence monitor portion and an operation monitor portion. The sequence monitor function provides the plant operators with an automatic checklist for the basic steps in starting-up or shutting-down the boiler-turbine-generator unit and associated auxiliaries. The operation monitor function provides the operator with an indication of any deviation from the ideal rates of boiler warm-up, turbine acceleration and generator loading. It also includes a guide for the transfer from full to partial arc admission.

The original objectives established during the planning phase for the operation guide functions were; safe and proper operation of plant equipment, a means of operator training as well as a guide to operation, gain experience with a semi-automated unit. The objectives associated with the data logging and performance calculations were: improved monitoring of the unit and major component performance and relieve the operator of the routine functions provided by data logging. Operating experience to date and in particular associated with the start-up of Unit #2 in April, 1964 indicates that these objectives either have been or will be realized.

10/3 COMPUTER SYSTEM ASPECTS OF THE ETIWANDA AUTOMATION

R. G. LIVINGSTON
General Electric Company
Phoenix, Arizona

The design of the new Units 3 & 4 at the Southern California Edison Company Etiwanda Steam Electric Station includes Computer Control Systems for the automatic operation of these units. Associated with each unit is a digital computer control system which provides a single pushbutton start-up or shut-down for the boiler turbine generator unit and its associated auxiliaries. Additional protective control functions are provided during the normal on-line operation of the unit as well as during start-up and shut-down. In addition to automatic control the Computer System also provides data logging and performance calculation functions.

This paper will cover the Computer System aspects of this automated Steam Plant, the application of the GE-412 Computer Control System for these functions, the basic elements and operation, pertinent program aspects, factory testing and related dynamic test experience at the site.

10/4 BASIC APPROACH AND EXPERIENCE WITH ETIWANDA AUTOMATION

R. N. KNAPP, A. A. WARD
Southern California Edison Company
Los Angeles, California

The paper describes the application of a digital computer for on-line control of a 310 megawatt steam generating unit at Southern California Edison Company's Etiwanda Steam Station.

This paper explains the considerations given to power plant automation and the ultimate decision to apply a digital computer to control start-up and shut-down. A brief description of the power plant is offered and the major computer control functions are mentioned. Finally, operating experience is related in terms of (1) plant and computer hardware problems, and (2) indoctrination of normal operating personnel.

SESSION 11

MILLIMETER WAVES

Thursday, August 27,
9:30 A.M.-12:00 Noon
STATLER HILTON HOTEL — PACIFIC BALLROOM

Session Chairman:

D. D. KING
Aerospace Corporation
Los Angeles, California

Session Organizer:

B. J. DUWALDT
Aerospace Corporation
Los Angeles, California

The development of components for the millimeter portion of the radio frequency spectrum has proceeded gradually over the years. Sufficient progress has been made so that planners have begun to think seriously of systems applications. This session will present a practical cross section view of the progress. Aerospace Corporation's millimeter research facility for systems applications will be described. Examples of important device progress will be given in three separate papers. One deals with 1-mm detectors, one with ferrite devices at 3-mm, and one with a survey of millimeter sources. The session will be concluded with a round-table discussion on the future of millimeter waves.

11/1 RESEARCH ON THE SUITABILITY OF MILLIMETER WAVELENGTH SYSTEMS FOR SPACE APPLICATIONS

B. J. DUWALDT
Aerospace Corporation
El Segundo, California

Aerospace Corporation is investigating the suitability of millimeter wavelength systems for space applications. The special qualities of millimeter wavelengths are high angular resolution and antenna gain with small structures, high doppler sensitivity, variety in atmospheric absorption, and low-loss propagation through dense plasmas. These qualities can be used to good advantage in military systems, and it is for this reason that Aerospace Corporation's millimeter wave research program was undertaken for the Air Force.

At the initiation of the project, it was felt that a key issue in the question of practicality of such systems would be resolved by the construction and operation of a large aperture ground-based antenna operating from a sea-level site. A 15-foot steerable reflector was specified for operation up to 300 Gc, but with initial operation at 94 Gc. The pointing control system was specified for a pointing accuracy of 20 seconds of arc in an inertial coordinate system, for tracking speeds from a fraction of sidereal rate up to 3 degrees per second. The antenna and its digital control equipment have been constructed and installed. The antenna has been operating with a 3.2 millimeter radiometer since December, 1963. Performance has been checked in operation as a radio telescope. Measurements were taken during the lunar eclipse of 30 December, and radiometric data is being taken on the earth's atmosphere, the sun, the moon, and Venus. Companion investigations of 94 Gc communications components are proceeding.

The experience on the project to date is summarized and plans for continuation of the work are described.

11/2 MILLIMETER WAVE RADIOMETRY UTILIZING LOW TEMPERATURE BOLOMETERS

FRANK J. LOW
National Radio Astronomy Observatory
Green Bank, West Virginia

CONTINUED ON PAGE 40

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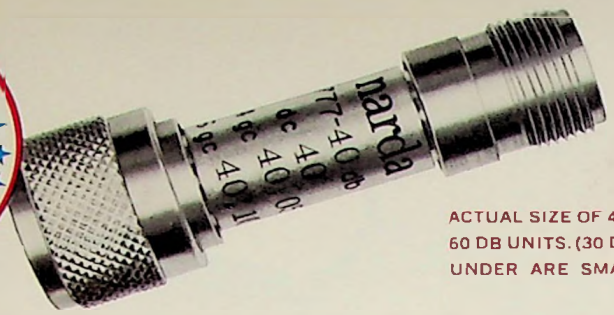

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DC to 12.4 Gc
3, 6, 10, 20, 30, 40, 50 & 60 db—$100

***Max. Freq. Deviation:**
DC-3 Gc . . . ±0.25 db
3-10 Gc . . . ±0.5 db
10-12.4 Gc, ±0.75 db

VSWR: DC-1 Gc = 1.1; 1-4 Gc = 1.15; 4-6 Gc = 1.2; 6-12.4 Gc = 1.3

SILVER PRECISION ATTENUATOR

MODEL 757B
(SILVER LABEL)

DC to 12.4 Gc
3, 6 and 10 db—$30
20 db—$40
30, 40, 50, 60 db—$60

***Max. Freq. Deviation:**
DC-3 Gc . . . ±0.3 db
3-6 Gc . . . ±0.5 db
6-12.4 Gc . . . ±1.0 db

CUSTOM ATTENUATOR

MODEL 773
(RED LABEL)

DC to 6 Gc
3, 6 & 10 db—$28
20 and 30 db—$30
40, 50, 60 db—$40

***Max. Freq. Deviation:**
DC-3 Gc . . . ±0.3 db
3-6 Gc . . . ±0.5 db

VSWR: 1.2 maximum

STANDARD ATTENUATOR

MODEL 771
(GREEN LABEL)

DC to 3 Gc
3, 6, 10, 20 db—$20
30 and 40 db—$25
50 and 60 db—$30

Max. Freq. Deviation:
±0.3 db

VSWR: 1.2 maximum

Power rating: 2 watts average, 2 Kw peak. Temperature stability: 0.0001 db/db/°C.
All models feature stainless steel connectors and gold-plated electrical contacts.
(Also available with miniaturized connectors—prefix model number with "4 ")

Only from Narda can you get a Precision Coax Attenuator covering the complete band from DC to 12.4 Gc! Only Narda gives you a Coax Attenuator this small! Only Narda supplies you with 40, 50 and 60 db units! (And we don't put two together to do it!)

The illustration above shows the actual size of the 40 through 60 db units. Attenuators for 3 through 30 db are 0.3" shorter.

Four different lines are available, in the event you don't need the full frequency range or the extreme accuracy of our top (Gold) models. Order the unit you need by specifying model number, followed by amount of db attenuation desired (examples: Model 777-40; Model 757B-20). Contact your local Narda rep for free demonstration.

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PRICE...AS LOW AS $525

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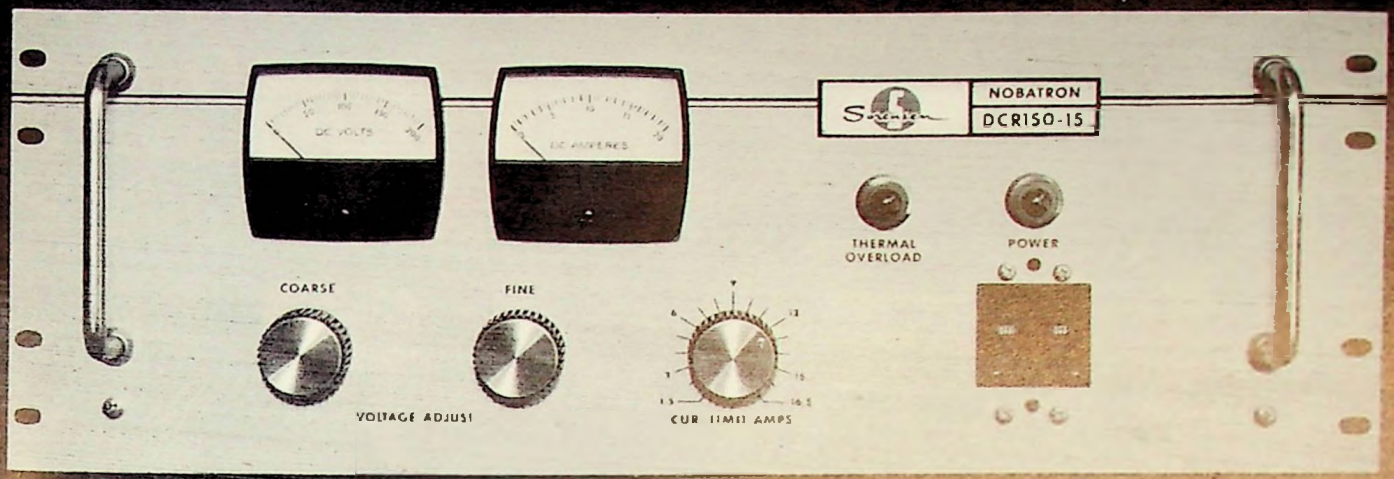

Here are the facts on Sorensen's new DCR power supplies

1. **12 SILICON CONTROLLED POWER SUPPLIES AVAILABLE**... Delivery in 30 days or less
2. **LOW PRICES**... Starting at $525 (Voltmeter and Ammeter included with no increase in price)
3. **COMPACT PACKAGING**... 7" or 5¼" Rack Height
4. **HIGH EFFICIENCY**
5. **CONSTANT VOLTAGE REGULATION**... with continuously adjustable current limiting
6. **CONSTANT CURRENT REGULATION**... with continuously adjustable voltage limiting
7. **AUTOMATIC CROSSOVER**... fully automatic transition from constant voltage to constant current operation, or from constant current to constant voltage operation, at any operating point.
8. **REMOTE PROGRAMMING**... Voltage and Current
9. **REMOTE SENSING**... At distances up to 200 feet
10. **SERIES OR PARALLEL OPERATION**
11. **VOLTAGE REGULATION**... ± (0.1% + 15 mv) Line and Load combined
12. **CURRENT REGULATION**... As low as ± 15 ma
13. **LOW RIPPLE**... 0.5% + 50 mv (RMS)
14. **UNITIZED CONTROL CIRCUITRY**... for easy maintenance
15. **COARSE AND FINE CONTROLS**... for Voltage Output

For complete data on the DCR series and other Sorensen products, send for the new, 140 page "Controlled Power Catalog and Handbook." Write to Sorensen, Richards Avenue, South Norwalk, Connecticut. Or use Reader Service Card Number 200.

DCR ELECTRICAL AND MECHANICAL SPECIFICATIONS:

MODEL NUMBER	VOLTAGE RANGE (VDC)	VOLTAGE REG. (LINE & LOAD COMBINED)	OUTPUT CURRENT (AMPS.)	CONSTANT CURRENT RANGE (AMPS.)	CURRENT REG.	RMS RIPPLE	TRANSIENT RESPONSE	PACKAGE SIZE (INCHES) WIDTH	HEIGHT	DEPTH	WEIGHT (LBS.)	PRICE
DCR 150-5	0-150	±(0.1% + 15mv)	0-5	0.5 to 5.5	±15ma	0.5% + 50mv	30msec*	19	5¼	18	70	$525
DCR 80-10	0-80	±(0.1% + 15mv)	0-10	1.0 to 11.0	±20ma	0.5% + 50mv	30msec*	19	5¼	18	70	525
DCR 60-13	0-60	±(0.1% + 15mv)	0-13	1.3 to 14.3	±20ma	0.5% + 50mv	30msec*	19	5¼	20	70	525
DCR 40-20	0-40	±(0.1% + 15mv)	0-20	2.0 to 22.0	±25ma	0.5% + 50mv	30msec*	19	5¼	20	70	525
DCR 150-10	0-150	±(0.1% + 15mv)	0-10	1.0 to 11.0	±20ma	0.5% + 50mv	30msec*	19	7	18	95	710
DCR 80-18	0-80	±(0.1% + 15mv)	0-18	1.8 to 19.8	±25ma	0.5% + 50mv	30msec*	19	7	18	98	710
DCR 60-25	0-60	±(0.1% + 15mv)	0-25	2.5 to 27.5	±25ma	0.5% + 50mv	30msec*	19	7	20	100	710
DCR 40-35	0-40	±(0.1% + 15mv)	0-35	3.5 to 38.5	±35ma	0.5% + 50mv	30msec*	19	7	20	102	710
DCR 150-15	0-150	±(0.1% + 15mv)	0-15	1.5 to 16.5	±25ma	0.5% + 50mv	30msec*	19	7	18	115	825
DCR 80-30	0-80	±(0.1% + 15mv)	0-30	3.0 to 33.0	±30ma	0.5% + 50mv	30msec*	19	7	18	120	875
DCR 60-40	0-60	±(0.1% + 15mv)	0-40	4.0 to 44.0	±40ma	0.5% + 50mv	30msec*	19	7	20	130	900
DCR 40-60	0-40	±(0.1% + 15mv)	0-60	6.0 to 66.0	±60ma	0.5% + 50mv	30msec*	19	7	20	131	925

*To return to ±1% band for change from half to full or full to half load

Sorensen

A UNIT OF RAYTHEON COMPANY

WESCON '64
BOOTHS
1516-17
Sorensen

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O'HALLORAN ASSOCIATES
O'

STANDARD SIGNAL GENERATOR – Model 65-B

WESCON '64
BOOTH
1518
MEASUREMENTS

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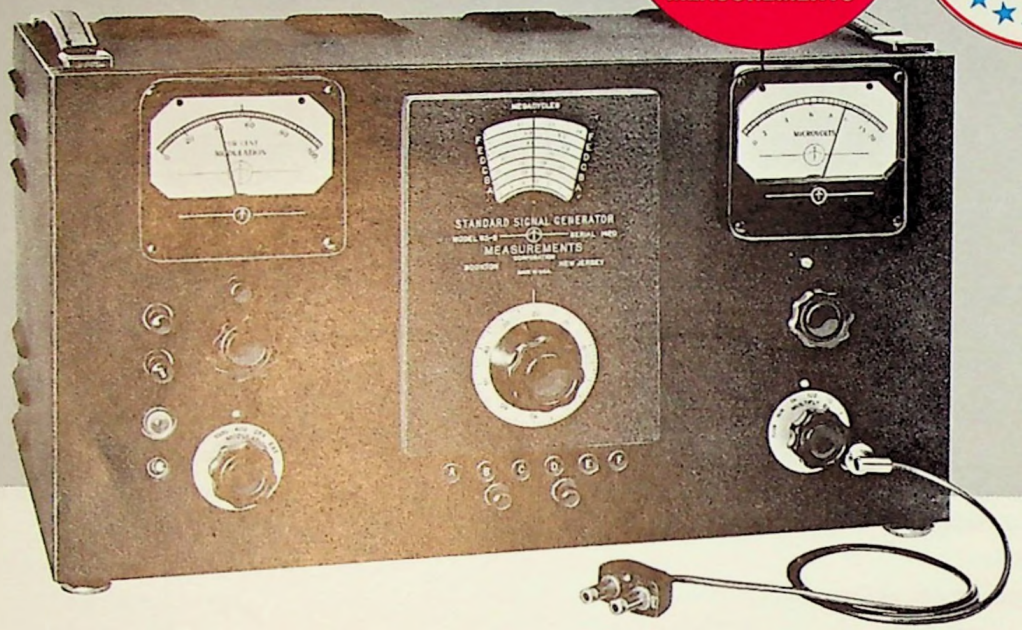

SPECIFICATIONS

Frequency Range: 75 kilocycles to 30 megacycles in 6 push-button ranges.

Frequency Accuracy: Individually calibrated dial direct reading to an accuracy of ± 0.5%. Backlash less than 1 part in 2300.

Output Voltage: Continuously variable from 0.1 microvolt to 2.2 volts.

Output System: Without cable connected, the impedance at the panel jack is 6.0 ohms plus internal lead and contact resistance. With 50-ohm cable (furnished with instrument) output impedance is 5 ohms to 200,000 microvolts, rising to 15 ohms at 2.2 volts.

Output Voltage Calibration: Accuracy at 1 volt ± 4% between 1 megacycle and 25 megacycles.

Accuracy of Fixed Attenuator Steps: ± 5% per step except for the 1-0.1 step which is − 9% to + 2%. Total cumulative step error less than ± 20%.

Modulation: Continuously variable from 0 to 100%, indicated directly by a panel meter. Modulation may be obtained either from an internal source of 400 or 1000 cycles or from an external source of 50 to 10,000 cycles depending on the carrier frequency.

Envelope Distortion: 4% at 100% modulation at 1 megacycle. 8% at 100% modulation at 15 megacycles. 1% at 30% modulation.

Frequency Modulation: Less than 0.02% for 30% amplitude modulation.

Leakage: Less than 0.1 microvolt leakage with attenuator set for 0 output.

Power Supply: 115 or 230 volts ± 10%, 50-60 cycles. 115 watts.

Dimensions: 11⅞" high x 20 3/16" wide x 10½" deep, overall.

Weight: Approximately 55 pounds.

Price: $875.00 f.o.b. Boonton, N. J.

WESCON '64
BOOTHS
1521
DATAPULSE

REPRESENTED BY
O'HALLORAN ASSOCIATES
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★ pulse POWER

WITH UNMATCHED WAVEFORM CONTROL

DATAPULSE MODEL 108L PULSE GENERATOR
50v output
Independently variable linear rise & fall time from 12 ns
Ultraclean waveform
10mc rep. rate
50% duty cycle

★ pulse VERSATILITY

DATAPULSE MODEL 110 PULSE GENERATOR
40mc rep. rate
Independently variable linear rise & fall time from 5 ns
10v output
Variable pulse DC offset
Solid state

★ pulse ECONOMY

DATAPULSE MODEL 109 PULSE GENERATOR
40mc rep. rate
5 ns rise time
10v output
Very low cost
Solid state

★ ★ ★ ★ ★

★ pulse FLEXIBILITY

Datapulse Model 103M, used with P900 series plug-in output units, is a flexible source of single pulses, double pulses and delayed triggers. Repetition rates to 5mc. Delays to 5 millisec. Output characteristics determined by plug-in output units selected. Solid state.

P901 Output Unit for simultaneous pos. and neg. pulse outputs with variable fast rise and fall times.

P902 Output Unit for variable DC level pulse output or a modulated carrier output.

P903 Output Unit for economical source of fast rise time pulse outputs variable in duration, polarity, and amplitude.

P904 Output Unit for economical source of two channel output.

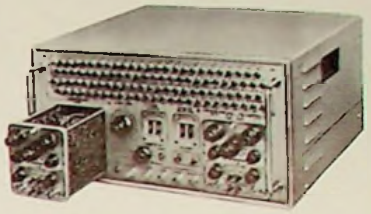
P905 Output Unit for fast rise time and ±30v output.

P906 Output Unit for sub-nanosecond rise times and very narrow pulse widths.

★ ★ ★ ★ ★

DATAPULSE
Division of Datapulse Incorporated
509 Hindry Ave., Inglewood, Calif.
678-3983 TWX 213-673-0390

Data Systems • Pulse Instrumentation



★ pulse PROGRAMMING CAPABILITIES

DATAPULSE MODEL 200M DATA GENERATOR
used with P900 series plug-in output units, is a general purpose digital test instrument offering simulated serial data, serial words or pulse programs. Output is fully controllable as to clock rate, word or frame length, data content, data format, and output signal characteristics. Solid state.
1 to 100 serial bits single channel
1 to 50 serial bits two channels
2 cps to 2mc, external clock or pushbutton clock
Continuous recycling or single cycle on command
Clock sync, bit no. one sync, or selected bit sync
Selectable 1's 0 coding within the data cycle for each channel

DATAPULSE MODEL 208 CHARACTER GENERATOR
5 cps to 5mc clock rate
1 to 16 serial bits per word plus variable repeats
8 parallel channels
6v into 50 ohms (approx. 12v from 50 ohms)
RZ and NRZC formats

DATAPULSE MODEL 206 CHARACTER GENERATOR
2 cps to 2 mc clock rate
16 serial bits fixed word length plus variable repeats
6 parallel channels
Programmed trigger output
Solid state

★ ★ ★ ★ ★

THE NEW MICROWELDER MARK II WELDS FLAT PACKS *and* THIN FILMS

Why buy two welders? Aerojet's versatile Mark II welds large external flat pack leads, fine wires onto thin films... and a host of other applications in between —both conventional and "exotic." Consider the Microwelder Mark II for *your* microelectronic needs. It's unsurpassed in versatility, economy and flexibility.

SPECIFICATIONS

GENERAL

A series, resistance-welding machine which provides precisely controlled a-c electrical energy for microminiature bonding.

WELDING CAPABILITY*

Wire Size	*0.0003 to 0.025 in.*
Ribbon Thickness	*0.00025 to 0.004 in.*
Film Thickness	*Down to 200 angstroms*

*Weldability of various material combinations and sizes dependent upon their metallurgical compatibility.

WELD PARAMETERS

Weld Electrodes	*RWMA Group B, Classes 11, 13, & Molybdenum.*
Weld Force	*Dead-weight system—adjustable from 10 to 1600 gm.*
Weld Control	*Manual and semiautomatic operation.*
Weld Cycles	*Two sequential, independently adjustable weld cycles.*
Weld Time	*Adjustable from 1 to 100 weld pulses per cycle.*
Weld Power	*Four step range control provides peak power adjustment of 100:1. Energy per weld pulse continuously adjustable over 6:1 range.*
Timing	*Synchronous pulse control at all weld settings.*

Price: $5250—F.O.B. Azusa, California

Commercial Products
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COMMERCIAL PRODUCTS / Azusa, California

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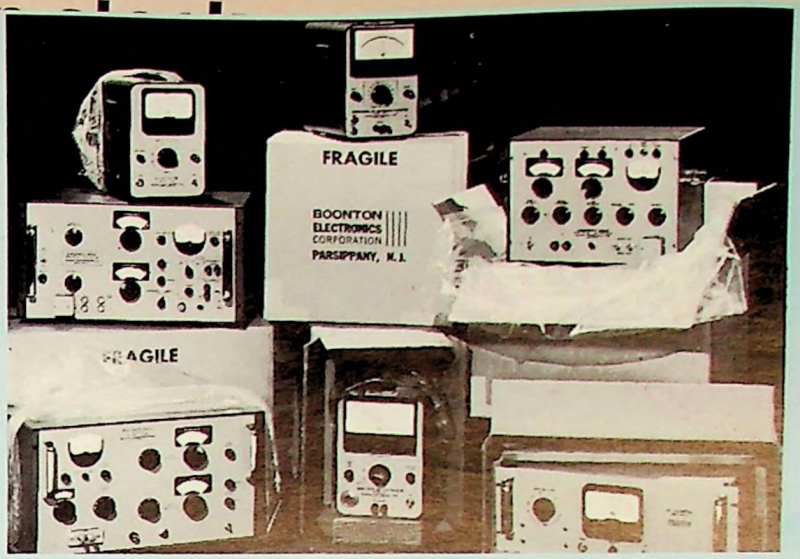

BOONTON ELECTRONICS CORPORATION
PARSIPPANY, N.J. 07054

Boonton Electronics Corporation is devoted exclusively to the development and production of precision electronic instrumentation for laboratory use as well for high speed, automated production testing. The tabular listings below outline only very briefly the major characteristics of our primary products. Complete technical information on each, including full specifications, is naturally available on request.

Boonton Electronics is represented throughout the world by a force of highly skilled, independent sales engineering representatives, who are thoroughly qualified to offer guidance and consultation on your instrumentation problems as well as to provide additional information or answer specific questions regarding any of this equipment.

PRECISION INSTRUMENTATION

CAPACITANCE BRIDGES

MODEL	TEST FREQUENCY	CAPACITANCE RANGE	CONDUCTANCE RANGE	BASIC ACCURACY	DC BIAS CAPABILITY	PRICE
75A-S8	1 Mc	200 μpf to 1000 pf	0.01 μmho to 1000 μmhos	Capacitance 0.25% Conductance 10% (+ range factors)	Internal —5 v to +100 v External up to 400 v	$1200.
75B-S8	1 Mc	20 μpf to 1000 pf	0.01 μmho to 1000 μmhos	Capacitance 0.25% Conductance 10% (+ range factors)	Internal —5 v to +100 v External up to 400 v	$1450.
75C	5 Kc-500 Kc (Variable)	200 μpf to 1000 pf	0.001 μmho to 1000 μmhos	Capacitance 0.25% Conductance 10% (+ range factors)	Internal only —5 v to +100 v	$1900.
74C-S8	100 Kc	200 μpf to 11,000 pf	0.001 μmho to 1000 μmhos	Capacitance 0.25% Conductance 10% (+ range factors)	Internal only —5 v to +100 v	$1125.

INDUCTANCE BRIDGES

MODEL	INDUCTANCE RANGE	RESISTANCE RANGE	TEST FREQUENCY RANGE	BASIC ACCURACY	PRICE
63A	0.002 μh to 1.1h	0.002 Ω to 110 KΩ	1 Kc to 100 Kc	Inductance: 0.25% Resistance: 3% (+ range factors)	$1850.
63B	0.02 μh to 11h	0.002 Ω to 110 KΩ	400 cps to 20 kc	Inductance: 0.25% Resistance: 3% (+ range factors)	$1850.
63C	0.0002 μh to 110 mh	0.0002 Ω to 11 KΩ	5 Kc to 500 Kc	Inductance: 0.25% Resistance: 3% (+ range factors)	$1850.

RF - ADMITTANCE BRIDGE

MODEL	TEST FREQUENCY	CAPACITANCE RANGE	CONDUCTANCE RANGE	BASIC ACCURACY	DC BIAS CAPABILITY	PRICE
33A	1-100 Mc (7 steps) Xtal osc.	0.05 pf to 150 pf	0.5 μmho to 25,0000 μmhos (0-40 Ω)	Capacitance 1% Conductance 2% (+ range factors)	Internal —5 to +100 v External 250 v	$2000.

UHF GRID DIP METER

MODEL	FREQUENCY RANGE	ACCURACY	FEATURES	PRICE
101B	300 Mc to 1000 Mc (in 3 ranges)	±2%	May also be used as diode detector for measuring frequency of external sources	$350.

RF VOLT METERS

MODEL	VOLTAGE RANGE	FREQUENCY RANGE	ACCURACY	INCLUDED ACCESSORIES	PRICE
91D	300 μv to 300 v	20 Kc to 1200 Mc *	50 Kc — 50 Mc ± 3% 25 Kc — 200 Mc ± 5% 20 Kc — 1200 Mc ± 10%	RF Probe "TEE" Adapter 50 Ω termination Voltage Divider "N" Adapter	$750
91CA	300 μv to 3 v	20 Kc to 600 Mc *	50 Kc — 400 Mc ± 5% 20 Kc — 1200 Mc ± 10%	RF Probe 50 Ω Adapter	$550
91C	1 mv to 3 v	20 Kc to 600 Mc *	50 Kc — 400 Mc ± 5% 20 Kc — 1200 Mc ± 10%	RF Probe 50 Ω Adapter	$450

* Useful indication to 2500 Mc

RF DISTORTION METERS

MODEL	FREQUENCY RANGE	TYPE OF MEASUREMENTS	ACCURACY	SENSITIVITY	OTHER FEATURES	PRICE
85B	1 Mc to 100 Mc	Total harmonic distortion	±2 db	60 db below 1 v	Untuned RF Voltmeter 20 Kc — 600 Mc	$925.
85C	100 Kc to 6 Mc	Total harmonic distortion	±2 db	60 db below 1 v	Untuned RF Voltmeter 20 Kc — 600 Mc	$525.

DC INSTRUMENTS

DESCRIPTION	MEASURES	ACCURACY	FEATURES	PRICE
Model 95A Wide range DC Microvolt-Ammeter	Voltage: 1 μv to 1000 v (in 17 ranges) Current: 0.1 μμa to 1 a (in 25 ranges)	Voltage: 3% Full Scale Current: 4% Full Scale	DC Output with level control. Floating or grounded input. Constant 10 MΩ Input resistance on voltage ranges.	$550.
Model 97A DC Microvoltmeter	Voltage 10 μv to 1000 v (in 14 ranges)	3% FS	DC Output. Extra high input resistance to 100 MΩ.	$375.
Model 98A Differential DC Microvoltmeter	Voltage 10 μv to 1000 v (in 14 ranges)	3% FS	DC Output. Common mode rejection 80 db	$450.
Model 56A DC Null Detector	Voltage 1 μv to 100 v (in 8 ranges)	Uncalibrated	DC Output. Gain compression for wide hunting range. Floating input.	$450.

AUTOMATIC TESTING EQUIPMENT

MODELS 122A & B AUTOMATIC RESISTANCE BRIDGES

Perform up to 36,000 go/no-go dual-limit resistance tests/hour; Provide test conditions in conformance with MIL SPECS; Freedom from drift permits unattended operation; Modular construction allows for future expansion. Control Unit (with Model 122A only) supplies actuation signals to mechanical handling equipment for high-speed production testing.

Resistance range: 1 Ω to 100 megΩ
Test resolution: Down to 0.1 Ω, depending on range
Excitation range: 0 to 100 v dc
Tolerance range: 0% to + and — 30%, individually adjustable

MODEL 77A CAPACITANCE LIMIT BRIDGE

A single-limit capacitance bridge for high speed determination of capacitance with respect to pre-selected value; Visual indication (with contacts actuating for external equipment) provides go/no-go test; Test resolution, 0.01 pf; Basic bridge specifications identical to those of Model 75A (see above). **Price:** $2000

TYPE 53A MINIATURE VOLTAGE COMPARATOR

Useful as voltage cross-over detector or ultra-sensitive relay; Provides SPDT relay action plus logic level output when input signal reaches or exceeds predetermined level; "latching" and "inhibit" functions controlled by external jumpers; all solid-state circuitry; high input impedance; millisecond response time.

Resolution: Better than 1 millivolt
Max. input potential: 200 v dc
Primary power: 115 v, 60 or 400 cps
Dimensions: 2-1/4" x 2-1/2" x 4" (height)

BOONTON ELECTRONICS CORPORATION • PARSIPPANY, N. J. — 07054 • PHONE (201) 887-5110 • TWX: (201) 887-5059

WILTRON COMPANY
for better electronics measurements

MODEL 310

(1 Gc TO 12.4 Gc IN FIVE BANDS)

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BOOTH
1520
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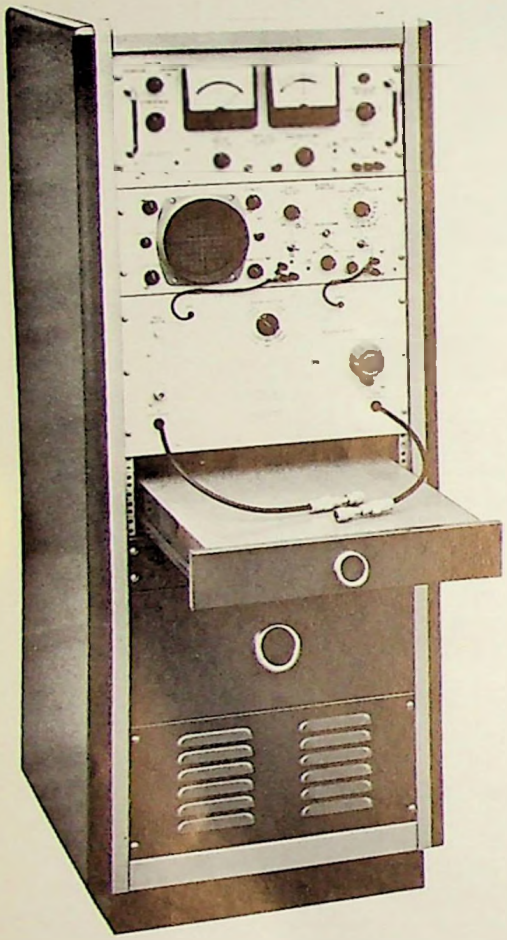
ALL-ELECTRONIC MICROWAVE PHASE METER and AUTOMATIC IMPEDANCE PLOTTER

NOW YOU CAN GREATLY REDUCE THE ENGINEERING ASSOCIATED WITH MICROWAVE PHASE AND IMPEDANCE MEASUREMENTS with this new All-Electronic Phase Meter, a product of WILTRON'S long experience in designing phase measuring equipment .You will find that it is today's closest approach to the complete microwave test set.

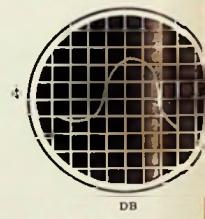


In addition to swept frequency oscilloscope displays shown at the right the meter readouts on the Model 310 above present level and phase information at a fixed frequency.

First, you are provided a scope plot of **PHASE-VERSUS-FREQUENCY** with absolute calibration.

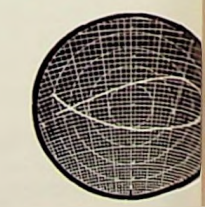
Second, you have a plot of **LEVEL (Gain or Loss)-VERSUS-FREQUENCY.**

Third, you are offered a readout of **PHASE-VERSUS-LEVEL** with logarithmic level display.



Fourth, you have a complete **SMITH CHART PLOT of IMPEDANCE** giving a scope presentation of reflection coefficient and phase angle.

Also available are expanded range **SMITH CHART** displays such as 1.5:1 full scale shown at right.



This new WILTRON instrument offers the industry's fastest scope display readout with **20 SWEEPS PER SECOND** to provide a **FLICKER FREE TRACE.**

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Carpenter electronic, magnetic and glass sealing alloys

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These alloys are in stock now:

Glass Sealing "52"	Vacumet Nicoseal	HyMu "80"
a 51% nickel-iron alloy developed for glass-to-metal seals with the special soft glasses and certain ceramics. Glass Sealing "52" is available in 8" wide strip in several closely controlled thicknesses.	a vacuum induction melted nickel-cobalt-iron alloy for glass-to-metal seals with hard glasses such as 7052 manufactured to ASTM Specification F15-61T. Vacumet Nicoseal is completely vacuum melted from virgin material to assure highest quality. Nicoseal is available either as strip in a variety of widths and controlled thicknesses, or as machining bar stock.	a nickel-molybdenum-iron alloy which offers very high initial permeability and maximum permeability at low magnetizing forces with minimum hysteresis loss for transformer cores, tape wound toroids, stamped laminations and shields. HyMu "80" is available from stock in the three most commonly used strip thicknesses.

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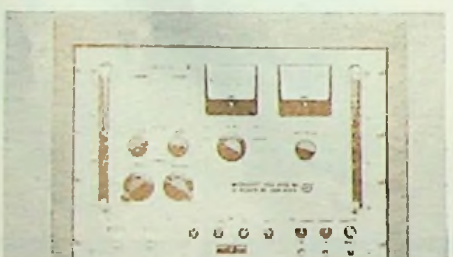
CIRCLE INQUIRY CARD NUMBER 19

Power Oscillators? We've Got Quintuplets!

5 MICRODOT MODELS 10-1800 MC FREQUENCY

Microdot now offers a family of *five* power oscillators, identical except for their frequency ranges which vary from 10 to 1800 mc. The units offer superior performance for antenna evaluation, calibration of power measuring devices, driving amplifiers, providing more than 50 watts between 10-1000 mc and more than 25 watts between 900-1800 mc.

They provide extremely constant output and highly accurate frequency control. Excellent power stability is ensured by power supply regulation to 1%. Resettability up to 0.002% is achieved by a logging scale of four-place accuracy with a high ratio dial having negligible backlash. A selector knob permits operations in three modes.



COMPANION POWER AMPLIFIER

Model 248 Power Amplifier operates in the 200-1000 mc range. Can be used with Microdot Power Oscillators or other driving sources. Input 25 watts; output 150 watts to 600 mc, 100 watts to 1000 mc. Incidental AM less than 1%. Write for detailed specs.

MICRODOT INC.

220 Pasadena Avenue
South Pasadena, California

SEE US AT WESCON — BOOTHS 2003, 04, 05.

CIRCLE INQUIRY CARD NUMBER 20

Technical Program (Continued)

Sensitive radiometers for the atmospheric window centered at 1.2 mm have been built using the low temperature germanium bolometer described previously.

Observations of the Sun and Moon and detections of Jupiter and Venus with a 60" diameter telescope have shown that under good atmospheric conditions the over-all system can have an r.m.s. temperature fluctuation of 0.2°K for an integration time of 10 seconds. Taking the antenna efficiency and atmospheric losses into account, this implies a basic radiometer sensitivity better than 0.05°K for a spectral bandwidth of 1×10^{11} cps. Methods of cancelling fluctuating sky emission have been tested which should allow at least an order of magnitude improvement over the present sensitivity.

The beam characteristics and efficiency of the telescope are affected by the method of coupling the detector to the antenna and by the filter techniques. These problems will be discussed.

A figure of merit for the low temperature germanium bolometer has been discussed when it is used as a perfectly black Lambertian detector of infrared radiation. A new figure of merit applicable to the millimeter wave region is derived.

Based on the present experimental results, an extrapolation to longer wavelengths indicates that useful radiometer sensitivities can be obtained at 4 mm, and that at 8 mm wavelength an excellent radiometer would result if the bolometer were preceded by a single low noise traveling wave tube.

11/3 FERRITE DEVICES FOR THE 3 MM BAND

ALAN J. SIMMONS,
ORVILLE M. GIDDINGS
TRG, Inc.
Boston, Massachusetts

Ferrite circulators, isolators, switches and attenuators have been designed and built to operate over a 5% band in the neighborhood of 3.2 mm. The basis of operation of these devices is Faraday rotation. The advantages of using the Faraday rotation principle in the millimeter-wave region are: 1) magnetic fields of relatively small magnitude are needed, just enough to saturate the ferrite; 2) the physical configuration, that of a ferrite rod centered in a circular tube, is simple and lends itself to the precision required; 3) ferrite material with no special properties other than low loss and large $4\pi M_s$ can be used. Disadvantages of the configuration used are the frequency sensitivity with the ferrite mounted in circular waveguide, and the relatively long structure, in terms of wavelength.

The desired ferrite devices have been built by proper connection of two basic devices: a dual-mode transducer and a ferrite rotator, with addition of suitable loads and resistive cards. The design and construction of a relatively broadband transducer from two orthogonal rectangular waveguides to circular waveguide has been carried out, and 45° and 90° rotator designs developed. These have been assembled to make up a number of devices whose characteristics will be described.

11/4 MID-1964 REVIEW OF AVAILABLE MILLIMETER WAVE SOURCES

D. C. FORSTER
Hughes Research Laboratories
Malibu, California

The recent interest in applications of millimeter wavelengths and the increasing availability of standard components in this portion of the spectrum have served to stimulate development of many new power sources in the last few years. Power levels and operating efficiencies have both increased by several orders of magnitude. Practical sources, even for airborne and space application, are becoming a reality. In this paper, we shall attempt to review these developments, to indicate areas where problems still exist, and to estimate what may be possible in the near future.

We will separate the available sources into three general categories: a) low power c-w sources, b) high power c-w sources, and c) pulsed sources. A few miscellaneous devices, such as low-noise amplifiers, will be described separately.

In the first category, low power c-w sources, several new lines of reflex klystrons and backward-wave oscillators are of particular interest. Both domestic and foreign suppliers have developed such sources. In the second category, truly significant progress has taken place in both power levels and efficiency. Comparisons with sources of this type, available only two to three years ago, are quite revealing. Some progress has been evident in pulsed sources; however, this area appears to have been neglected somewhat. Implications of possible new approaches to such sources are described.

General design characteristics of millimeter-wave sources are described. The effects of design tradeoffs on the gross properties of the devices are described, and in particular, how they affect practical application. Advantages to be realized by realistic specification of requirements are emphasized.

Closing remarks will be devoted to comments on cost, reliability, and prospects for change should quantity production become a reality.

11/5 THE FUTURE OF MILLIMETER WAVES

A round table discussion by the chairman and authors.

SESSION 12

SILICON DEVICES FOR HIGH FREQUENCIES

Thursday, August 27,
9:30 A.M.-12:00 Noon
STATLER HILTON HOTEL — GARDEN ROOM

Session Chairman:

D. B. MEDVED
Electro-Optical Systems, Inc.
Pasadena, California

Session Organizer:

STEPHEN KAYE
Electro-Optical Systems, Inc.
Pasadena, California

The four papers in the session discuss high-frequency silicon devices. The first paper discusses a transistor which combines field effect with avalanche breakdown to produce a 7 kmc device. A paper on a high-power pulse modulator follows. The last two papers discuss a diode utilizing charge storage for frequency multiplication, and improvements in diodes for tuning purposes.

12/1 THE SURFACE CONTROLLED AVALANCHE TRANSISTOR

W. SHOCKLEY, W. W. HOOPER
Clevite Semiconductor
Palo Alto, California

A new amplifying principle utilizes electrical charge on a "gate" electrode, consisting of metal evaporated onto an oxide layer over a silicon p-n junction, to make an electric field penetrate through the surface into the space-charge layer between an (n^+) "source" region and a p "drain" region. Consequently, "input" gate-source voltage modulates the avalanche breakdown voltage between source and drain and controls "output" current. SiO_2 can sustain substantially larger dielectric displacements than 5×10^{-4} coulombs/cm^2 = (1.04 pf/cm) (500,000 volt/cm) = KF_B the displacement required for avalanche breakdown in silicon. High frequency performance is predicted from short transit times for carriers generated by avalanche with drift velocities of $v_m = 2 \times 10^7$ cm/sec.

Modulation of drain-source breakdown voltage by a factor of two and current and power gains > 10^4 have been obtained for low surface-breakdown units. Calculations based on "unit cube" space-charge-plasma conductances of $K\,v_m = 2 \times 10^{-5}$ mhos agree with measured output resistances.

Design theory predicts voltage gains > 10 and power gains > 20 db at 7 kmc for structures with "stripe" width of 4×10^{-4} cm and space-charge width of 6×10^{-4} cm.

12/2 A NEW HIGH POWER FOUR-LAYER DIODE AS A PULSE MODULATOR SWITCH

WALTER SCHROEN, KURT HUBNER,

JACQUES BEAUDOUIN, R. M. SCARLETT
Shockley Laboratory
Clevite Corporation
Palo Alto, California

The paper describes the structure and circuit operation of a new type four-layer diode. This diode is specialized for high power switching and permits series operation in highly simplified circuits. The main applications of this diode are in pulse modulators of various types. The most evident feature of the new four-layer diode is a voltage-current characteristic prior to switching similar to that of an avalanche diode. This property is achieved by short-circuiting one emitter-base junction. The short-circuiting is performed over the entire area in order to maintain uniform current conduction. Devices switching at 500 volts or higher, with pulse capability of peak currents of 1000 amperes or more are described. The complexity of pulse modulator circuitry is reduced, since series operation of many devices is possible without dividing networks. New resonantly charged circuits exhibit a high degree of operating reliability and temperature insensitivity.

12/3 VARACTOR DIODES AND CIRCUITS FOR HIGH POWER OUTPUT AND LINEAR RESPONSE

GERALD SCHAFFNER, JOHN COCHRAN
Motorola Semiconductor Division
Phoenix, Arizona

New varactors are described which achieve power outputs which range between 200 watts at 100 MC and 10 watts at 1000 MC. In addition amplitude modulated signals can be multiplied with little distortion up to about 65% of the peak power rating of the varactor.

These varactors depend on charge storage effects more than capacity-voltage variations to generate harmonics. A special resistivity profile peaking near the depletion layer is utilized. As a result, higher voltage breakdown varactors with consequent higher operating power capabilities can be used with the same efficiency than if the devices were abrupt junction. Also less circuit detuning with power level changes occurs with these varactors than with the usual abrupt junction type.

A 200 to 600 MC tripler is described for the IN 4387 which has a 22 watt output. A 500 MC to 1000 MC doubler is described using the MV 1806 having greater than a 10 watt output. Finally two push-push doubler circuits are described which give 200 watts out at 100 MC and 100 watts out at 300 MC, respectively; the varactor used is the IN 4386.

12/4 LARGE-AREA 200-VOLT PLANAR VOLTAGE-VARIABLE CAPACITANCE DIODES

G. L. SCHNABLE, A. J. CERTA,
L. F. WALLACE
Lansdale Division
Philco Corporation
Lansdale, Pennsylvania

The results of a research and development program directed toward fabrication of high-performance high-capacitance voltage-variable capacitance diodes for electronic tuning are reported. Devices are fabricated by epitaxial and planar technology, with the diode prepared by boron diffusion into n-type silicon to approximate an abrupt junction.

Objective specifications require completed devices with capacitance of 250 and of 1000 pf (8 volts), breakdown voltage, $V_{(BR)}$, > 200 volts, capacitance change ratio of > 5.6 (4-200 volts), quality factor (Q) > 200 (10 mc), and very low reverse leakage.

The principal problem to be overcome was the $V_{(BR)}$ limitation of planar diodes which results, at least in part, from the tendency of thermally oxidized n-type silicon to form an accumulation (enhancement) layer in the high resistivity silicon at the Si-SiO_2 interface. The planar process was refined to permit achievement of large-area 200-volt planar diodes, while maintaining the other diode characteristics which are essential to high performance, by the introduction of a number of structural and processing modifications to lower the electrical field of the pn junction at the surface. Two structural modifications, the guard ring and the double-epitaxial layer, and several processing changes including improved photolithographic techniques and gettering, were each found to result in a significant increase in the level of $V_{(BR)}$ of planar diodes.

SESSION 13

INFORMATION THEORY AND COMMUNICATIONS

Thursday, August 27,
9:30 A.M.-12:00 Noon
STATLER HILTON HOTEL — GOLDEN STATE ROOM

Session Chairman and Organizer:

LEONARD KLEINROCK
University of California at Los Angeles
Los Angeles, California

Of interest to both the specialist and those who interface with communications techniques and systems, this session covers a variety of topics including coding and decoding, detection, phase-locked techniques, and fading. A somewhat tutorial flavor will prevail.

13/1 OPTIMUM DETECTION AND SIGNAL SELECTION FOR PARTIALLY COHERENT BINARY COMMUNICATION

ANDREW J. VITERBI
University of California, Los Angeles, California

The optimum detectors for coherent and noncoherent reception of binary signals and the resulting error probabilities were obtained by Helstrom. In many practical communication systems a reasonable estimate of the phase of the received signal is available as the result of an auxiliary tracking operation of the carrier signal by a coherent tracking device such as a phase-locked loop. It is shown that the optimum detector for this case, which we refer to as partially coherent reception, is a linear combination of the correlation detector and the squared envelope correlation detector which are optimum for the coherent and noncoherent cases, respectively.

The error probabilities are also obtained as a function of the energy-to-noise ratio of the channel and the variance of the error in the phase estimate, which is a function of the SNR in the tracking loop. The signal selection problem is considered in terms of these parameters.

13/2 ANALOG COMMUNICATION OVER RANDOMLY-TIME-VARYING CHANNELS

H. L. VAN TREES
Lincoln Laboratory
Massachusetts Institute of Technology
Cambridge, Massachusetts

In this paper, we consider the problem of analog communication over a randomly-time-varying channel.

The message to be transmitted is a sample function from a Gaussian random process $a(t)$ whose correlation function is known. In order to transmit the message, we phase-modulate it onto a suitable carrier. For non-dispersive channels, a sine wave carrier is used. For dispersive channels a wideband pseudo-noise carrier is used.

The effect of the channel on the signal can be characterized by a vector Gaussian random process. Thus, if the transmitted signal is $S_t(t, a(t))$, the received signals is $r(t) = S(t, a(t), b(t)) + n(t)$, where $b(t)$ is a vector Gaussian random process and $n(t)$ is additive Gaussian noise.

The integral equation which specifies the maximum a posteriori estimate of $a(t)$ is derived. We show that, under certain conditions, the maximum a posteriori estimator of $a(t)$ is obtained by simultaneously estimating $a(t)$ and the channel vector process $b(t)$.

CONTINUED ON PAGE 42

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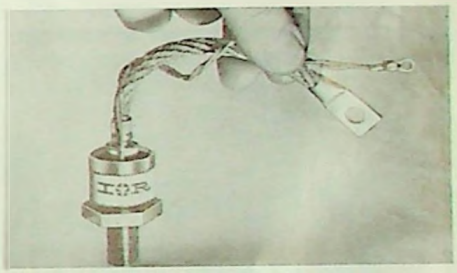
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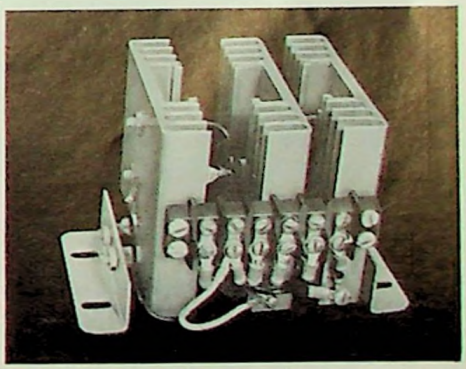
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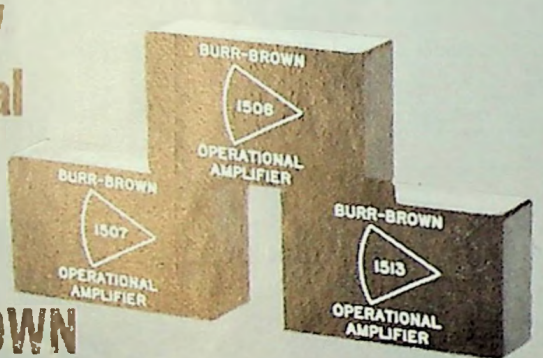

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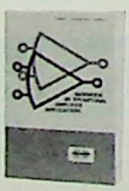

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CIRCLE INQUIRY CARD NUMBER 23

Technical Program (Continued)

This result is applied to three kinds of channels:
(i) a single Rayleigh fading channel
(ii) M independent Rayleigh channels
(iii) a dispersive channel which we characterize by a tapped delay line with randomly-time-varying gains.

For each case, the integral equation suggests an optimum non-realizable demodulator structure. We demonstrate how the non-realizable structure can be approximated by a realizable structure with delay. In the limit of high signal-to-noise ratio, the performance of the realizable structure can be made arbitrarily close to the optimum system.

The performances of the various systems are evaluated for some simple cases. Various areas for future research are indicated.

13/3 CAPABILITIES OF BOUNDED DISTANCE DECODING

A. D. WYNER
Bell Telephone Laboratories
Murray Hill, New Jersey

The theoretical capabilities of bounded distance decoding are studied. In bounded distance decoding, disjoint spheres in the space of possible received vectors of radius d/2 are constructed about each code word (d is the minimum distance between code words). If the received vector is in the sphere about code word i, it is decoded as code word i; otherwise an error is announced. The following three channels are considered: (A) the discrete memoryless channel with q inputs and outputs, (B) the time discrete amplitude continuous memoryless channel with additive Gaussian noise and energy constraint, and (C) the same as channel B, but with amplitude and not energy constraint.

For channel A, a new and relatively easily derived upper bound on $M(n, d)$, the maximum number of code words in a code of length n and minimum distance d, is obtained. For sufficiently large n, this bound is sharper than any other known bound. For channel C, asymptotic upper and lower bounds on $M(n, d)$ are obtained. For all three channels the following is shown to hold: There exists a fixed rate C_R below which it is possible (asymptotically) to obtain exponentially small error probability using bounded distance decoding. Upper and lower bounds on the error exponent are also obtained. In channels A and B, C_R is shown to be strictly less than the channel capacity.

13/4 DISTRIBUTION-FREE COINCIDENCE DETECTION PROCEDURES

D. G. LAINIOTIS, J. C. HANCOCK
Communication Sciences Laboratory
Purdue University
Lafayette, Indiana

In this paper coincidence detection procedures with invariant or distribution-free false-alarm rates are proposed and investigated. The motivation for considering such detection procedures arises from the need of insuring an acceptable performance in a changing and/or incompletely known environment. In the distribution-free coincidence procedures investigated herein, the threshold is chosen to be a specified noise distribution quantile so that the test statistic possesses under no-signal conditions asymptotically a known distribution, independent of the statistics of the detection problem. The invariant nature of the test statistic distribution under no-signal conditions insures a false-alarm invariant with respect to changes in channel statistics. The classes of detection problems for which the coincidence detection procedures herein proposed remain distribution-free are also obtained. The distribution-free coincidence detectors are then applied to various detection problems of practical importance, and their performance evaluated and compared to that of likelihood detectors. Thus, it is found that the distribution-free detectors are reasonably efficient, though suboptimal, for channels with gaussian statistics, and highly efficient for channels with a combination of gaussian and impulse noise.

13/5 ANALYSIS OF THE INTRINSIC SECURITY, BANDWIDTH AND SYMMETRY PROPERTIES OF THREE CLASSES OF CODES

E. H. BROTHMAN

A. H. MILLER

Transitel International Corporation
Paramus, New Jersey

E. H. BROTHMAN

Public Service Company of
New Jersey
Newark, New Jersey

The security of binary data transmissions against undetectable erroring is met in great measure by the code systems which are used to convey the information. In the matter of optimizing data security, a coding method makes its accommodations via the code's intrinsic security parameters and its bandwidth requirement properties. Regardless of whether the security measures are based on horizontal protections and/or block protections, a code contributes towards error detection and error correction goals by its intrinsic minimum distance property. Its contributions to the problems of minimizing link-induced error are by way of its bandwidth requirement properties. The coding's bandwidth properties are determined by the number of autocorrelation levels which it exhibits and by the magnitudes of its several autocorrelation levels.

The goal of this paper is to provide quantitative means of evaluating both the distance and the autocorrelation properties of commonly used classes of codes. These will include algebraic recirculation type codes, "5"-out-of-"n_5" codes, and m-bit binary codes with appended uniformly generated redundancy sets.

SESSION 14

INSTRUMENTATION AND NAVIGATION

Thursday, August 27,
9:30 A.M.-12:00 Noon
STATLER HILTON HOTEL — SIERRA ROOM

Session Chairman:

MYRON KAYTON
Litton Industries
Woodland Hills, California

Session Organizer:

T. J. HARRIMAN
Giannini Controls Corporation
Duarte, California

A digital approach is used in a new instrument. RF techniques are applied to propellant gaging under zero-gravity conditions. Transistor switching is utilized to power gyros. A tutorial paper is included on inertial navigational systems for ground and aerospace applications.

14/1 DIGITAL COUNTER UTILIZING DYNAMIC MEMORY

DONALD E. LEHMER
Berkeley Division
Beckman Instrument, Inc.
Richmond, California

Digital counters are well established in the industry as an instrumentation tool for the measurement and display of the average frequency of unknown waveforms. This is accomplished through the accumulation of the input events occurring during a known period of time. An accurate time standard is generated through the accumulation of a stable high frequency standard for a definite number of cycles.

Commercially available counters use a cascade (serial) connection of a multiplicity of binary dividing circuits for accumulating input events, and dividing the frequency standard. In the interest of component count reduction, AC logic is frequently used, sometimes in exchange for system reliability.

In the instrument described in this paper, the binary dividing circuits are replaced by a dynamic memory and limited arithmetic logic. The memory is separated into two separate words, one for the accumulation of the input events, and the other for the accumulation of the time standard. Accumulation of either "count" data or "time base" data is performed by adding "one" to the words stored in the memory when required. The data stored in the dynamic memory at the end of a measurement is transferred to the digital display by sampling the dynamic memory output with appropriate (synchronous) clock pulses, and storing the result in capacitors. This generates a continuous parallel data output which operates the display drivers. The display drivers are designed to latch and maintain data, providing continuous display of the previous sample, while the instrument accumulates the next sample. This system reduces the component count for this type of instrument and increases reliability of electronic counters by utilizing direct coupled logic. The dynamic memory also allows expansion of the counter application to other related operations by including other arithmetic operations, such as subtract, compare, etc. This additional flexibility often will allow reversing counters and preset controllers to be constructed more economically and efficiently than had previously been possible.

This technique represents a significant departure from the standard technique adopted by the industry for instrumentation of this type. It is expected to open up new areas in instrumentation not economically attractive in the past.

14/2 ZERO-GRAVITY PROPELLANT GAGING UTILIZING RADIO FREQUENCY TECHNIQUES IN A SPHERICAL RESONATOR

R. GARRIOTT
General Dynamics/Astronautics
San Diego, California

G. A. BURNS
San Diego State College
San Diego, California

The resonant properties of a spherical cavity are described as a means of gaging liquid propellants in a zero-gravity field. The configuration of a liquid propellant in a partially filled spherical cavity have been shown to be such that a spherical vapor bubble exists in the center of the cavity. Spherical wave functions are developed and the boundary conditions applied to give an analytical expression for the cavity resonant frequency as a function of volumetric propellant loading. An aluminum scale-model, two inches in diameter, spherical cavity was constructed and loaded with varying dielectric shells to verify the mathematical predictions. Close agreement, within several per cent, was obtained for three different dielectric constants, 2.5, 5, and 10.

14/3 A UNIFIED APPROACH TO THE ERROR ANALYSIS OF AUGMENTED DYNAMICALLY EXACT INERTIAL NAVIGATION SYSTEMS

J. F. CALIGIURI, S. FAGIN
Sperry Gyroscope Company
Great Neck, New York

A model for all-inertial navigation systems is defined which describes a wide class of dynamically exact systems for terrestrial, airborne and space applications. Based on this model a standard error block diagram is described and it is shown how the conventional simplifying assumptions lead to the specific versions used for terrestrial, airborne or space applications.

To efficiently treat augmented inertial systems a generalized approach to error analysis of estimation systems is introduced. This approach, discussed in an earlier paper, is amplified as it pertains to augmented inertial systems. It is shown how the standard error propagation block diagram can be used to place the augmented inertial navigation system error analysis in the canonical form necessary for a generalized error analysis. Augmentations considered are position, velocity and attitude. Specific examples are given.

14/4 TECHNIQUES OF ENERGIZING AIR CORE ELECTROMAGNETIC SIMULATORS

CONTINUED ON PAGE 44

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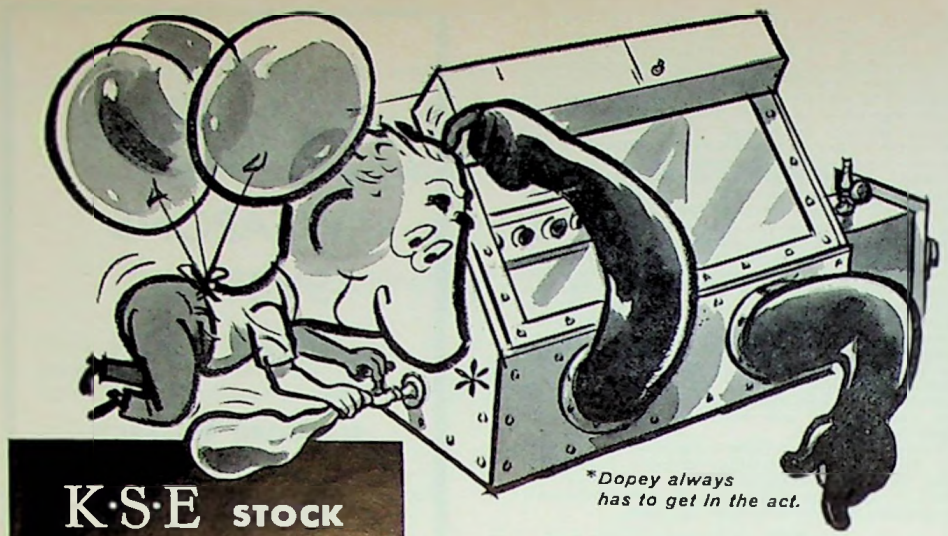

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CIRCLE INQUIRY CARD NUMBER 26

Technical Program (Continued)

L. J. JOHNSON, ALBERT LUCIC
Autonetics, NAA
Anaheim, California

Modern environmental laboratories must include electromagnetic simulators for the production of highly charged electromagnetic environments for the proof testing of complete electronic systems in simulated hostile environments. Systems designed for military use must remain operative even while passing through thunder storms where electromagnetic potentials are increased over normally calm environment by several orders of magnitude; for instance a lightning flash may generate a pulsed magnetic transient field of 100 oersteds at near miss distance. Electric field transients are generated by rate of change of magnetic fields and may be as high as 10^4 volts per meter at reasonable distances from a discharge path.

Transient generating techniques using high voltage high current vacuum switches and Tesla transformers in conjunction with distributed parameter designed test chambers for the simulation of hostile environments uniformly distributed over sufficiently large volumes to test modern weapon control systems and air or space craft guidance systems are to be presented in this paper. Means of calculating the field uniformity and how to design uniform field chambers are included.

14/5 TECHNIQUES FOR PULSE OPERATION OF GYROSCOPE MOTORS

A. K. DORSMAN, H. F. KINNER
Autonetics, NAA
Anaheim, California

In the research for more efficient gyro motor power supplies and more precise speed control, the sine wave type of supply has been superseded by square wave supplies with digital-logic phase-angle control. This technique, together with fast switching, has resulted in the development of several quasi-square wave power supplies in which the phase angle stability and power efficiency have been greatly improved.

A method is described for accurately generating three phase pulse voltages with precise 120 degree separation.

A three phase power switch for efficiently driving gyro motors is illustrated.

SESSION 15

COMMUNICATIONS CHANNELS AND POWER SYSTEM PROTECTIVE RELAYS

Thursday, August 27,
9:30 A.M.-12:00 Noon
STATLER HILTON HOTEL – LOS ANGELES ROOM

Panel Chairman:

D. A. GILLIES
Bonneville Power Administration
Portland, Oregon

Panel Members:

A. B. DAY
Idaho Power
Boise, Idaho

L. D. MARTIN
Arizona Public Service
Phoenix, Arizona

R. W. HIRTLER
Los Angeles Department of Water and Power
Los Angeles, California

Special Guest:

G. EVERETT FARMER
TVA (Retired)
Signal Mountain, Tennessee

Power system protective schemes require communication channels with varied characteristics. The capability and limitations of the various channels and relays employed to provide these requirements will be discussed. Included will be a presentation on the use of overhead static wires for carrier transmission.

SESSION 16

ANTENNAS

Friday, August 28, 9:30 A.M.-12:00 Noon
STATLER HILTON HOTEL—
GARDEN ROOM

Session Chairman:

R. C. HANSEN
Aerospace Corporation
Los Angeles, California

Session Organizer:

H. E. KING
Aerospace Corporation
Los Angeles, California

The session covers the gamut of current interests in antennas. A paper on wind tunnel measurements of large dish antennas is highly pertinent to the large antennas being built for deep space tracking. Electrically short VLF antennas for submarine communications are covered in a paper which gives scale model measurements of umbrella loading. Moving to the phased array field, a novel scanning scheme uses a Luneberg lens to excite a transmitting array through a battery of coaxial cables thereby utilizing the excellent scanning properties of the Luneberg lens with the array advantages. Random errors in arrays are also covered. Finally, optical correlation and formation of multiple beams in image space are described.

16/1 WIND FORCES ON PARABOLIC ANTENNAS

H. HIRST, K. E. MCKEE
Andrew Corporation
Chicago, Illinois

The forces and moments acting on parabolic antennas due to wind forces are presented in this paper. The variables considered include wind velocity, focal length to diameter ratio, backup structure, orientation to the wind and surface construction.

The data presented in the paper is based on an evaluation of a variety of wind tunnel tests and theoretical analyses. The results, based on the authors' interpretations and evaluations of the available data, are presented in forms directly useful to the designer. For the applicable cases, the results are compared with the convention rule-of-thumb approaches. Particular attention is given in this paper to the limitations on and sources of the data.

The form of presentation used in this paper is useful since it demonstrates the methods for presenting and interpreting wind tunnel data. The paper has been prepared to be self-contained and readable without previous knowledge.

16/2 THE CHARACTERISTICS OF ELECTRICALLY SHORT, UMBRELLA TOP-LOADED ANTENNAS

A. F. GANGI, S. SENSIPER, G. R. DUNN
Space-General Corporation
El Monte, California

Experimental measurements of the electrical characteristics of umbrella top-loaded, electrically short antennas have been performed. Electrically short antennas generally have very high Q's and, consequently, narrow bandwidths. Top-loading, such as umbrella top-loading of electrically short monopole antennas, leads to antennas which have lower Q's and larger bandwidths.

The experimental measurements were made using a scale model facility. The antennas measured on the scale model facility were 100th scale models of the anticipated full scale antennas. The experimental results obtained from the model study have been correlated with computer calculations and good correlation has been obtained. The computer calculation was based on a quasi-static analysis of electrically short, umbrella top-loaded antennas. From this computer calculation, the static capacitance, the static effective height, and the static Q of these antenna configurations were determined. The values of these parameters were also measured using the scale model antenna and reasonably good correlation was obtained. Additionally, determination of the dynamic characteristics of the antenna was possible using the data obtained from the model studies. The additional parameters determined by the scale model studies were the antenna inductance, the dynamic radiation resistance, and the dynamic effective height.

Graphs of a number of the measurements made in the model study are presented along with a nomograph which summarizes the theoretical and experimental data.

16/3 OMNI-DIRECTIONAL PHASED SPHERICAL ARRAY ANTENNA

SIMON M. PRISTOOP
Aerospace Division
Westinghouse Electric Corporation
Baltimore, Maryland

The spherical array antenna represents the ultimate that can be achieved in the way of antenna design for omnidirectionality, versatility, and invariance of beam characteristics with beam direction. The capabilities for developing a successful phased spherical array are now well within the state-of-the-art. This paper derives the mathematical structure that describes the radar characteristics of a phased spherical array antenna at any point in space beyond the near field of the primary radiating element. Typical computations are plotted graphically to illustrate the gain pattern of the array antenna. Excellent agreement is demonstrated between the computed beam characteristics of the phased spherical array and the characteristics predicted by classical antenna theory.

16/4 NEW RESULTS IN THE THEORY OF RANDOM ERRORS IN PHASED ARRAYS

JOEL L. EKSTROM
Sylvania Electronic Systems
Waltham, Massachusetts

The classical Rondinelli analysis of the effects of random element current phase and amplitude errors on the sidelobe levels of multi-element phased arrays is extended in several directions. The problem of correlation, occurring in two-level beamforming and steering systems having element error components common to each element in a column, but independent from column to column, is treated for the general case where the phase and amplitude quadrature components of the element excitation error vectors have unequal variances. This generally makes the probability density of the far field magnitude have a form more complicated than the usual modified Rayleigh distribution because the variances of the random components of the far field magnitude become unequal. The computation of these variances is in general laborious, but the computation of their sum is much simpler. Using this sum as a basis, an upper bound on the degradation of a design sidelobe level is derived as a function of the ratio of the design sidelobe level to the total variance, and several probabilities that the actual degradation will not exceed the upper bound.

Application to sidelobe degradation in phase monopulse sum and difference beams is given.

16/5 AN OPTICAL TECHNIQUE FOR SIMULTANEOUS BEAMFORMING AND CROSS-CORRELATION

D. C. BESTE, E. N. LEITH
Institute of Science and Technology
The University of Michican
Ann Arbor, Michigan

This paper presents a method of greatly simplifying the processing of received signals from antenna arrays through the use of a coherent optical

CONTINUED ON PAGE 46

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system for signal processing. It is shown that a coherent optical system is ideally suited for carrying out beamforming operations. Several other advantages of coherent optics for this application are also discussed.

A major result is a technique of simultaneously forming all beams from each of two antenna arrays while cross-correlating the signal on each beam of one array with the signal on every beam of the other array. The coherent optics technique permits this quite complex operation to be carried out with extreme simplicity.

SESSION 17

LASERS

Friday, August 28, 9:30 A.M.-12:00 Noon
STATLER HILTON HOTEL — GOLDEN STATE ROOM

Session Chairman:

THEODORE H. MAIMAN
Korad Corporation
Santa Monica, California

Session Organizer:

MAX T. WEISS
Aerospace Corporation
Los Angeles, California

Several quite recent developments of practical significance will be presented. The first paper reviews a new class of gaseous lasers which now provide cw output throughout the visible spectrum and into the ultraviolet. A new technique for deflecting and modulating light beams is discussed as is atmospheric propagation. The last paper treats some of the implications of coherence. The session will conclude with a round table discussion of the future of lasers.

17/1 NOBLE GAS ION LASERS THROUGHOUT THE VISIBLE SPECTRUM

WILLIAM B. BRIDGES
Hughes Research Laboratories
Malibu, California

Laser action by ions produced in a high current density gas discharge has yielded over 100 new laser wavelengths in the visible and near ultraviolet portions of the spectrum, from 8000 A to 2600 A. These new transitions occur in ionized Neon, Argon, Kryton, Xenon and Oxygen. Lines from singly-, doubly-, and triply-ionized atoms have been observed. Both pulsed and continuous operation have been obtained, with pulsed peak power over 5 watts and cw power over 0.1 watt. Single pass optical gain greater than 10 db/meter has been obtained on the stronger transitions. This paper will discuss the more recently obtained laser characteristics, along with an outline of the spectroscopy and possible population-depopulation mechanisms.

17/2 ELECTRO-OPTIC DIFFRACTION GRATINGS FOR LIGHT BEAM MODULATION AND DEFLECTION

E. I. GORDON, M. G. COHEN
Bell Telephone Laboratories, Incorporated
Murray Hill, New Jersey

The interaction between a strong traveling microwave signal and an optical beam in an electro-optic material is described in the limit of very high microwave dielectric constant and low loss tangent. The interaction produces effects analogous to those produced by a moving diffraction grating. When the optical beam is wider than the wavelength of the microwave signal, the first grating order is resolved from the zero order or main beam. Under this condition two types of devices become possible: (1) a beam deflector which can position an optical maser beam on, for example, 10^5 distinct points with negligible crosstalk and with address times of order 10^{-7} sec, (2) a baseband light intensity modulator which is founded on the fact that light deflected into the first order beam by the microwave signal is removed from the main beam. The amount deflected into the first order beam is proportional to the microwave power; the intensity modulation follows the microwave envelope. The power required for a given modulation depth is inversely proportional to the seven halves power of the dielectric constant. As an example, for a not unrealistic choice of dielectric constant of 10[1],* complete transfer from the zero order to the first order beam requires 5 watts of microwave power. The interaction length is of order one centimeter and the interaction bandwidth is essentially unlimited. As a baseband modulator, the maximum instantaneous bandwidth is of order 10% of the subcarrier frequency.

Comparison is made to low frequency modulators in which, for example, a uniform index change is produced in a prism to effect beam deflection. For deflection rates below 10^5 cps, the low frequency device is superior. For higher rates the grating type of modulator is superior.

Experiments verifying the basic concepts in the frequency range 1-10 Kmc have been performed at room temperature using electro-optic materials with a dielectric constant of several thousand. Particularly pertinent is the microwave matching problem because of the extremely high dielectric constants. Another practical problem relates to the required d-c bias since the materials are quadratic.

Wide band matching has been achieved and significant amounts of deflection observed. Experimental details will be presented.

*Such materials exist and have good optical properties in substantial size.

17/3 PROPAGATION OF LASER BEAMS THROUGH THE ATMOSPHERE

W. P. BROWN, F. E. GOODWIN, A. D. JACOBSON
Hughes Research Laboratories
Malibu, California

Point-to-point laser communications studies have revealed that turbulence in the atmosphere can cause severe amplitude fluctuations. The mechanism of image motion or "seeing" disturbances is the most serious manifestation of turbulence since it causes the laser beam wave front to scan and break up, thereby introducing severe modulation of intensity at the receiver. The problem is compounded for heterodyne detection because the random angle of arrival introduces more undesirable modulation. Image motion data obtained by photographic means will be presented and the limitations of communication systems utilizing amplitude modulation and simple quantum counter detection will be discussed.

An attractive alternative employs the use of frequency modulation. In particular, an FM system has the advantage of being much less sensitive to the amplitude fluctuations of the received laser signal which are introduced by the turbulent atmosphere. However, an FM system is subject to noise of another type. The fluctuations of the optical path length through the atmosphere and the inherent frequency instability of the laser oscillator are sources of phase noise. An experimental method for the determination of the spectral characteristics to the amplitude fluctuations of the received laser communications systems will be presented and the prospects for FM laser communication in the atmosphere will be discussed.

17/4 STATISTICS OF LASER AND THERMAL RADIATION

HENRI HODARA
National Engineering Science Company
Pasadena, California

With the advent of Laser Communications, some of the concepts of communication theory, when applied to coherent optical frequencies, must be used with care. Thus, the performance of a communication system as measured by its signal-to-noise ratio may vary significantly according to the statistics of both signal and noise. In particular with laser multi-mode operation, it is important to know the signal statistics in order to predict the performance of the system components; for instance, a detector whose performance under incoherent illumination is well established behaves quite differently in a coherent communication link because of the difference in signal statistics. In this paper, the statistics of multi-mode laser signals are derived and compared to those of an incoherent radiation. It is found that the statistics are greatly different if the laser operates in a single mode but become similar as the mode purity is degraded.

17/5 FUTURE OF LASERS

A Round Table Discussion by the Chairman and Authors

SESSION 18

NEW CIRCUIT ELEMENTS AND PRINCIPLES

Friday, August 28, 9:30 A.M.-12:00 Noon
STATLER HILTON HOTEL – LOS ANGELES ROOM

Session Chairman and Organizer:

NORTON W. BELL
Bell and Howell Research Center
Pasadena, California

Design of thin-film distributed RC networks to have a desired input impedance; design of thin-film quartz resonators to form elements of band-pass filters; a new application of an effect in conventional transistors makes possible a simple one-transistor bistable circuit; temperature of a microcircuit chip is controlled by a feedback system whose sensor is a novel bridge using semiconductor elements.

18/1 THE EXACT REALIZATION OF DISTRIBUTED RC DRIVING POINT FUNCTIONS

RALPH W. WYNDRUM, JR.
Bell Telephone Laboratories
Whippany, New Jersey

This paper presents the first comprehensive and exact mathematical procedures which may be used to synthesize a prescribed immittance magnitude function with distributed RC (RC) networks. The characterization of RC networks by hyperbolic functions of $\sqrt{s}$ is duly recognized by a magnitude approximation procedure which comprises polynomial factors that are rational in $\exp\sqrt{s}$. These factors form the basis for the RC network mathematical characterization. Thenceforth, the synthesis procedure is direct and mathematically *exact*. Realizability conditions for RC network realizations are given, followed by a detailed and general synthesis procedure. The final physical embodiment develops as a single, in-line RC one-port, which may be conveniently deposited as a three-layer homogeneous and continuous thin film structure.

18/2 QUARTZ UNI-WAFER FILTER, A THIN FILM DEVICE

D. B. CURRAN, W. J. GERBER,
D. J. KONEVAL, K. A. PIM
Electronic Research Division
Clevite Corporation
Cleveland, Ohio

Complete quartz crystal filters have been realized on a single quartz wafer by using thin film techniques and energy-trapping theory. By operating the individual electroded areas below the cut-off frequency for wave propagation in the wafer as a whole, the resulting vibratory energy is essentially confined to the electroded area with an external energy distribution decreasing exponentially with distance away from the electrode edge. With appropriate choice of design parameters, all of the resonators required for a filter can be obtained within a single quartz wafer.

Quartz Uni-Wafer ladder and lattice filters have been designed with from 2 to 9 resonators per filter. These include simple and cascaded hybrid lattice filters designed on an image parameter basis and more complex hybrid lattices using insertion loss design techniques. Performance data are presented for several filters of each type centered at 10 and 20 Mc. Each filter is fabricated using a single quartz wafer no larger than 1" diameter by 7 mils thick. Experimental filters have been packaged in two-dimensional fashion using ceramic circuit boards and glass cover plates. This work has been supported by the U. S. Army Electronics Research and Development Laboratory, Fort Monmouth, New Jersey.

18/3 A ONE-TRANSISTOR FLIP-FLOP

B. E. BRILEY
Automatic Electric Laboratories, Inc.
Northlake, Illinois

A transformerless, one-transistor flip-flop utilizing a conventional bipolar junction transistor and a hitherto unreported effect is described.

The effect (the "collector-following effect") is described in detail, and a theoretical explanation is developed. Application of the effect to several other novel circuits is described. The one-transistor flip-flop is shown to evolve as a remarkable application of this effect.

The characteristics of the flip-flop are described in detail, and a theoretical analysis is given, yielding an unusual fanout expression. Operation of the flip-flop in a shift register is described, and some unique problems which arise are discussed.

18/4 TEMPERATURE CONTROLLED MICROCIRCUITS

B. WEIR, T. PROSSER
Amelco Semiconductor
Mountain View, California

The work describes a method to reduce effects of temperature drifts in microcircuit components such as amplifiers, reference diodes, and other analog circuits. The solution carried out is to control the temperature of the microcircuit chip itself at some value above the ambient by means of a heater element inside the chip. The power generated in the heater element is controlled by a thermostat using the different coefficients of resistance of metallic thin film resistors and diffused silicon resistors as a means of detecting temperature errors. The controlled temperature device, containing six transistors plus four extra transistors which can be used for other circuits, measures less than 0.1 inch square. It may be used also to control the temperature of other microcircuits which are mounted on the same isolated heat sink. Examples of operational amplifiers and voltage reference are cited.

SESSION 19

DATA HANDLING AND COMMUNICATIONS IN SPACE

Friday, August 28, 9:15 A.M.-11:15 A.M.
STATLER HILTON HOTEL – PACIFIC BALLROOM

Session Chairman:

ROBERT GOTTFRIED
TRW Space Technology Laboratories
Redondo Beach, California

Session Organizer:

EUGENE MATHEWS
North American Aviation, Inc.
Downey, California

This session is a blend of the two closely related disciplines of data handling and communications. General coverage of the telemetry and data handling fields is offered, plus a paper relating to communications handover for medium altitude satellite communications systems.

19/1 SAMPLED DATA PREDICTION FOR TELEMETRY BANDWIDTH COMPRESSION

J. E. MEDLIN
Lockheed Missiles and Space Company
Sunnyvale, California

A portion of an exploratory investigation conducted recently at Lockheed Missiles & Space Company (LMSC) into the comparative effectiveness of various data compression techniques is described. The comparisons were made by simulation with an IBM 7090 digital computer with the use of approximately 150,000 samples of actual vehicle telemetry data received during a typical

CONTINUED ON PAGE 50

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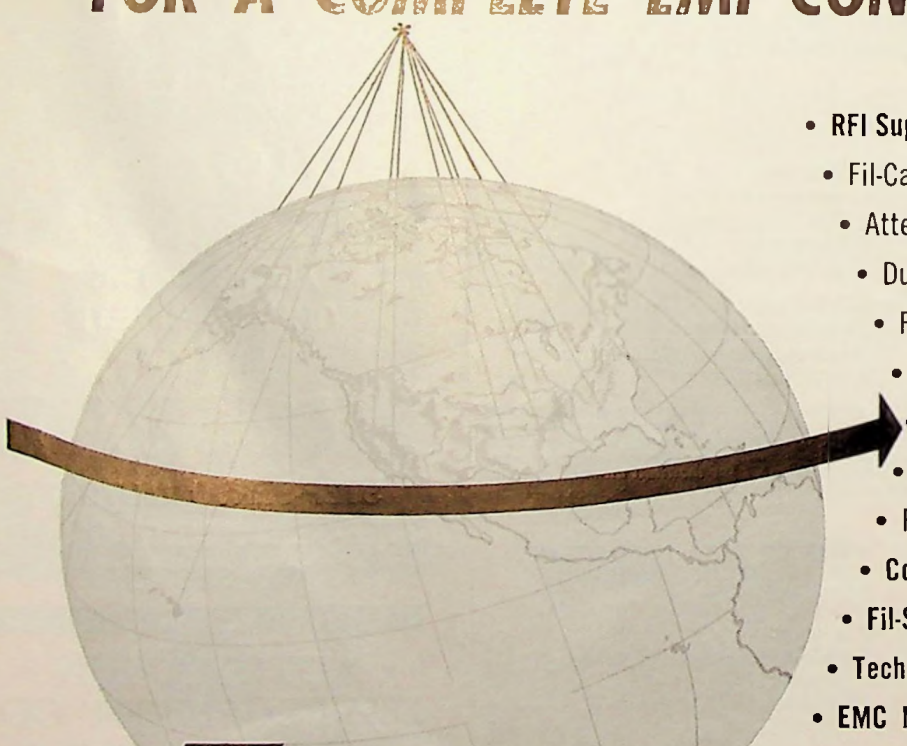

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satellite launching, in addition to synthetic telemetry data. The compression techniques discussed employed zero, first, and second-order polynomial predictors, or modifications thereof.

The results showed that one of the zero-order techniques (one which would be relatively simple to implement) was the most effective in removing redundancy from the data. Although these data were somewhat limited both in scope and quantity, the results tend to support the oft-repeated objection to polynomial predictors that an inordinate amount of emphasis is given to sample points far removed from the point to be predicted, compared to that afforded the most recent samples.

Also presented are brief descriptions of two data compressors, including one space-borne unit, which have been mechanized at LMSC.

19/2 COMMUNICATIONS HANDOVER FOR MEDIUM ALTITUDE SATELLITE SYSTEMS

ANDREW WERTH
ITT Federal Laboratories
Nutley, New Jersey

This paper discusses the problems and solutions of communications handover in a multi satellite system. Various methods of handover are presented together with a description of the geometric boundaries of the basic problem. The effect of variable path delay on voice, teletype and data transmissions is discussed. The paper then proceeds to formulate the specific design of an instantaneous handover system based on digital range measurement at each site, applicable to medium altitude satellite systems using digital data rates of 2400 bits per second. Expansion of the system to accommodate higher rates is shown to be relatively straightforward.

19/3 APPLICATION OF DATA COMPRESSION TO FLIGHT DATA PROCESSING

WILLIAM L. MORRISON, JR.
W. P. HOGAN
R. M. PENTZ
Lockheed Missiles and Space Company
Sunnyvale, California

Typical flight telemetry data will be described. The present method of processing this data by digital computer at LMSC will be described. The general concept of data compression as applied to this flight telemetry data will be developed. Results in the application of data compression to flight telemetry data will be demonstrated. Typical compression ratios of 10-100 are shown to have been achieved using computer simulation of various compression algorithms. A typical hardware system making use of data compression and projected cost savings in computer lease time will be discussed.

19/4 THEORETICAL CONSIDERATIONS OF EXTENDED BANDWIDTH FM

P. A. GODINEZ
Leach Corporation
Azusa, California

Extended bandwidth FM operation is rapidly becoming an accepted method of recording predetection telemetry data such as PCM, PDM, FM/FM and other broad band data because of its DC response. This technique is a natural outgrowth of the recent trend towards the use of predetection recording and demands for higher FM bandwidth. The same basic techniques of extended bandwidth direct recording are used to obtain a higher carrier frequency. A special FM modulation scheme is then used to obtain the highest data bandwidth of the given carrier. FM bandwidths are now available with responses twenty times that of the standard IRIG.

The proposed paper will consider analytically the techniques for achieving the higher data bandwidth and will also show the trade-offs of signal to noise and bandwidth at a given tape speed. A typical application and the data obtained will then demonstrate the applicability of the preceding analysis.

SESSION 20

POWER TRANSMISSION AND DISTRIBUTION

Friday, August 28, 9:30 A.M.-12:00 Noon
STATLER HILTON HOTEL — SIERRA ROOM

Session Chairman and Organizer:

JAMES E. CONNOR
Southern California Edison Company
Los Angeles, California

The continuing demand for electric power requires bulk power transmission systems employing new concepts and techniques for increased reliability. This session will review both analytical and field test data on representative extra high voltage transmission systems presently in either design or operation. In addition, new techniques for the protection of line and substation facilities will be presented.

20/1 APPLICATION OF PREDISCHARGE CURRENTS OF PARALLEL ELECTRODE GAPS

C. F. WAGNER
Consulting Engineer
Pittsburgh, Pennsylvania

An earlier paper by Wagner and Hileman discussed the predischarge currents of gaps formed by two parallel electrodes which the authors called pipe-pipe gaps. A later paper extended the investigation of these properties. In the former paper it was shown that by the installation of pipe-pipe gaps on each tower, the performance of transmission lines can be improved greatly. It was also pointed out that the ground wires and the conductors form naturally a gap of this character and it was indicated that with conventional constructions strokes to midspan were very unlikely to cause flashover at the stricken point, but that the point of flashover might be transferred to the insulator string. It is one purpose of this paper to explore the mechanism of such transfer in more detail. In certain types of wood-pole constructions, by simple modifications, it is possible to take advantage of the predischarge currents of the gap formed by the ground wire and the conductors so as to make the line substantially lightning-proof even if the pole-grounding resistance is very high. This application will also be discussed.

20/2 SWITCHING SURGE TESTS ON SIMULATED EHV TOWER-INSULATED SYSTEMS

A. W. ATWOOD, JR.
Southern California Edison Company
Los Angeles, California

A. R. HILEMAN, J. W. SKOOGLUND
Westinghouse Electric Corporation
East Pittsburgh, Pennsylvania

J. F. WITTIBSCHLAGER
The Ohio Brass Company
Barberton, Ohio

Investigations have been conducted of switching surge phenomena on the recent addition of the 292 mile 345 KV transmission lines to Arizona Public Service Company's system. Prior to the construction of the new lines, a study was performed on the Transient Network Analyzer in order to arrive at balanced design and operating conditions with regard to surge voltages. Upon completion of the line, several field tests of line and equipment switching were undertaken for the purpose of verifying or modifying current concepts and analytical procedures and of enhancing the understanding of switching surges on EHV systems through contributions to the growing pool of field results.

At the present time, data correlation studies are in progress on the analyzer. Here field test setups are simulated in a three phase representation, including the sequential closing and timing of the breaker poles.

Through the presentation and discussion of examples of pertinent data from each of the foregoing investigations, it is the purpose of this paper to give an interim report consolidating results and conclusions on switching lines and equipment at 345 KV.

Haggerty Addresses WEMA Luncheon

Featured speaker at the WEMA Luncheon this year is Patrick E. Haggerty, President, Texas Instruments. He is a former IEEE President, and was a key figure in the IEEE merger.

In his talk, the full title of which is "Innovation is the Key", he will discuss the necessity for innovation in management, marketing and manufacturing as well as product development.

Tickets cost $6.00 per person. The luncheon will be held in the Golden State Room, Statler-Hilton Hotel, on Wednesday, August 26th.

DuBridge Honored

Dr. Lee A. DuBridge, Caltech President, will be honored by induction to Eminent Membership in Eta Kappa Nu, the national engineering honorary fraternity during Wescon. The Joint Wescon-Eta Kappa Nu affair is scheduled for 12:30 PM, Tuesday, August 25, in the Garden Room, Statler-Hilton Hotel, with a $4.75 per person ticket price. The luncheon is open to the public.

Tech. Program (Cont.)

In this paper recognition is given to the wide band width of EHV switching surge flashovers and a probability method of analyzing the flashover tests is described. The most severe switching surge wave shape for suspension insulators in a typical transmission tower configuration is established as having a wave front of 80 to 120 microseconds. From full scale outdoor tests, a set of estimating curves for both wet and dry withstand voltage of various numbers of suspension insulators and transmission tower window widths are established, with a considerable degree of confidence in the range of dimensions being considered for 500 KV transmission tower design.

20/3 ANALOG COMPUTER STUDY OF SWITCHING SURGE TRANSIENTS FOR THE 500 KV SYSTEM OF THE SOUTHERN CALIFORNIA EDISON COMPANY

J. SABATH
Southern California Edison Company
Los Angeles, California

H. M. SMITH, R. C. JOHNSON
Westinghouse Electric Corporation
East Pittsburgh, Pennsylvania

The presented paper discusses the results of an analog computer study which was conducted jointly by Edison and Westinghouse Engineers in 1962/1963 in East Pittsburgh, Pennsylvania. The purpose of this study was to determine the switching surge transients on the planned 500 KV Southern California Edison system and to find means to limit them to a magnitude which would give economic design parameters for the system.

The study included high and low side switching operations on open ended as well as transformer terminated lines of different lengths and sources. Interrupting duties as existing initially and expected ultimately on the Southern California Edison System were used.

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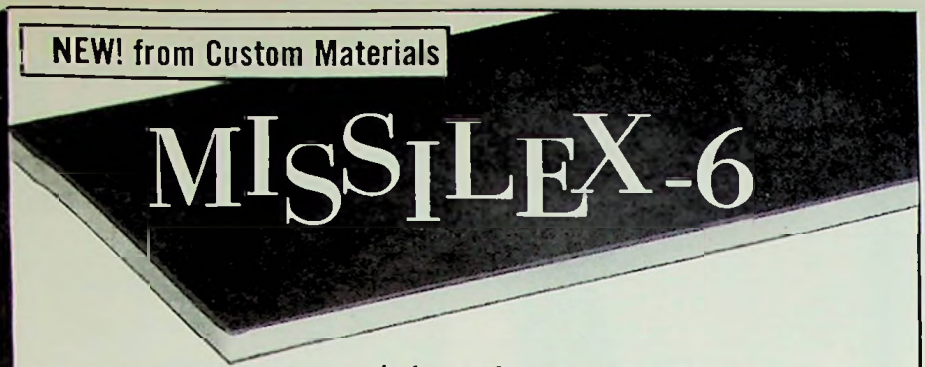

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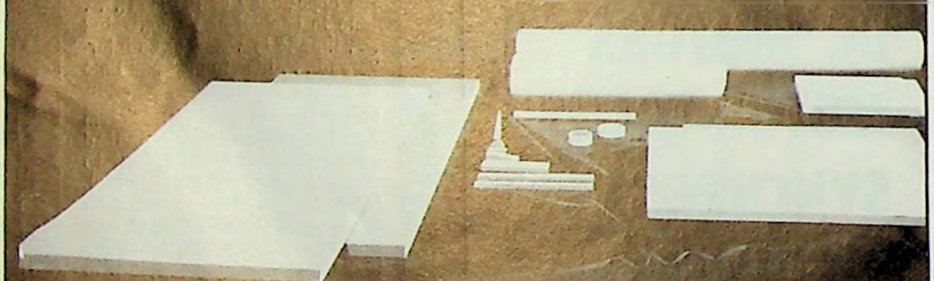

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Future Engineers . . .

The future of western electrical and electronics engineering may well be in the hands of the twenty-eight youngster's participating in this years' Wescon Future Engineers Program.

The Future Engineers Program serves as both a stimulus and stage for the engineer of the coming generation. The secondary-school students, selected by the IEEE Sections in Region 6, will display their technical achievements, and participate in a symposium with the hopes of garnering valuable prizes: The Lee De Forest Award provides a $1,000 scholarship for the best project in the exhibit category. There are second, third and fourth awards in amounts of $600, $400 and $200. In the technical symposium, the winning presentation is accorded the Frederick Emmons Terman Award, which carries a $300 scholarship, with $200 to the runner-up.

All visitors to Wescon should take a moment to visit the Future Engineers show at the Sports Arena and encourage these bright, promising young engineers.

The hours of the Future Engineers show are exactly the same as for the regular Wescon exhibits, with the exception of Wednesday, August 26, when the exhibits are closed for judging from 9:00 AM to 11:45 AM. The hours are:

Tuesday, August 25, 9:30 AM to 6:30 PM

Wednesday, August 26, Noon to 9:30 PM

Thursday, August 27, 9:30 AM to 6:30 PM

Friday, August 28, 9:30 AM to 6:30 PM

Wescon pays the way for at least one student and one instructor from each of the Sections in the Region. Some Sections pay for the attendance of more than one student. In addition, the students will be treated to a Tanner bus tour of the city on August 25.

The eighteen students who submitted technical papers will present them during a Symposium in the Sports Arena Meeting Room, Thursday, August 27. The Symposium, open to all Wescon visitors, will take place from 9:30 AM to 11:15 AM. A luncheon at USC with John Moore, President of Autonetics as speaker, and tours of Pacific Telephone and NBC provide a full schedule for the youngsters.

Students exhibiting this year are:

Tucson
Allen F. Divis
6861 Nasumpta Drive
Tucson, Arizona

Utah
Eric Campbell
555 West 4th North
Logan, Utah

Albuquerque
Dennis Kraft
2932 La Palomita, N.E.
Albuquerque, New Mexico

Anchorage
Stephen Curtis Drew
Star Route B, Box 3886
Spenard, Alaska

Boise
Jon M. Jones
Box 296
Meridian, Idaho

Idaho
Robert B. Smith
60 South 70 East
Malad City, Idaho

Los Angeles District
Martin Folb
651 N. Kilkeu Drive
Los Angeles, Calif. 90048
James L. Granger
10831 Loch Avon Drive
Whittier, California
Warren G. Haby
1286 Sonoma Drive
Altadena, California
Frank Barry Knotts
2681 Valencia
San Bernardino, Calif.
Grant Logan
780 W. California
Blythe, California
Terry Masters
600 Los Cerritos
Glendora, California
Jim Nagashima
21930 S. Norwalk Street
Artesia, California
Michael Sommer
4144 Popular St.
San Diego, California
Joseph Szabo, Jr.
1146 Indian Summer Ave.
La Puente, California
John Young
7462 Valera Street
Buena Park, California

Phoenix
Dennis A. Kodimer
2301 West Orange Drive
Phoenix, Arizona

Portland
Eric Sweetman
13500 S. W. Walker Road
Beaverton, Oregon

Richland
Joe W. Parmelee
Route 1, Box 60
Walla Walla, Washington

CONTINUED ON PAGE 54

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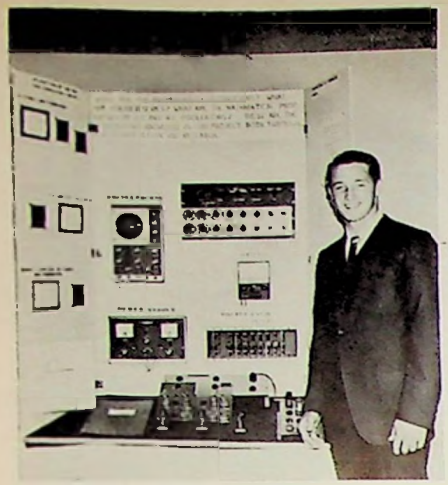

Robert M. Main, Jr., attends Skyline High School, Oakland. Project is titled "An Investigation of Complex Wave Forms Using Fourier Analysis."

Warren George Haby, attends Don Bosco Technical High School, San Gabriel, Calif.

Banquet . . .

A highlight of Wescon week that none should miss is the Wescon Banquet, to be held at the Hollywood Palladium, near Sunset and Vine in Hollywood. This will be an evening of fun and glamour on Thursday, August 27th, at 8:00 PM. The no-host bar opens at 7:30 PM with a price tag of $1.00 for drinks. Menu will be Roast Choice New York Steak, at a cost of $9.00 per person. Since the Palladium is used to serving presidential parties, top Hollywood stars and international celebrities, the food is excellent.

The Committee, headed by John Guarrera, has left the way clear for uninterrupted pleasure—there are no serious talks scheduled for the evening. Instead, guests will enjoy the Lawrence Welk Troupe, and the humorous comments of Pat Buttram, TV and movie star, who will serve as Master of Ceremonies. Sometime after the end of the dinner and the few official comments that it will be necessary to make, the Lawrence Welk musicmakers will present their specialty show, including songs by the Lennon sisters. Lawrence Welk himself will not be on hand that evening. For the rest of the evening, attendees will be invited to dance to the music of the ten-piece band.

Those who know the Palladium can testify to its sprightly, beautifully designed setting. It combines a beauty and charm quite sufficient to carry the visitor away from the workaday world. On this particular evening, Wesconites will have the entire room to themselves; the public will not be admitted.

Company tables may be purchased at $72 per table of eight persons, so that entire parties may sit together. Single tickets may be bought in advance or at the door, since there will be plenty of room. Inasmuch as the location is off course for the rest of Wescon, no transportation will be provided, but the Palladium, located at the corner of Argyle and Sunset Blvd., at 6215 Sunset Blvd., is only a short hop by private car or taxi from the major downtown hotels.

The Wescon Cocktail Party, traditionally held the opening day of the show, attracts attendees by the thousands. This year the gala event takes place at Hollywood Park.

Cocktail Party . . .

The biggest party in the world that day will take place on Tuesday, August 25th, when Wescon opens the gates at Hollywood Park, Inglewood, for its annual cocktail party. For a mere $5.50 guests can intermingle in a pleasant haze of good drinks, plentiful hors-d'ouevres, meatballs, peanuts, pretzels, greeters in bright colored blazers, the outdoor-indoor beauty of the Southland's finest race track, and friends, friends, friends. About 2500 are expected. Tickets may be bought in advance or at the door.

With a sumptiousness, to be expected of a first-class race-track, the drinks will be good, the food outstanding and the setting delightful. But this is only the background to the real purpose of the event, which is to match friend with friend, acquaintance with acquaintance, and produce incredible decibels of conversation. In order that the visitor shall be able to meet and communicate with his friends, all other noisemaking is out this year—there are to be no bands, nor hired professional entertainers to dilute the opportunity to talk.

The exhibits will be closed of course, at both locations for this event. Buses will continue to run between the downtown hotels and Hollywood Park so that those who do not drive will have transportation. Since there is a large parking lot at Hollywood Park, there will be no squeeze on parking space for private cars.

Although the Cocktail Party takes place at Hollywood Park race-track, it will *not* be in the same area as the exhibits. This is an event at which the ladies should definitely appear and are most cordially welcome, a chance to meet many of her husband's business friends who have only been names to her before. The event generally runs for two hours, so that it is still possible to schedule other activities later in the evening. It is placed at the beginning of the show so that visitors may discover who is in town, for contact-making later in the week, if necessary. All in all, the Cocktail Party sounds like a must to Wescon visitors, especially this year, in its new attractive location.

FUTURE ENGINEERS CONT. FROM PAGE 53

Sacramento
Richard Bradley
2650 Garrett Way
Rancho Cordova, Calif.

San Diego
O. Eugene Dial, Jr.
1114 Monserate
Chula Vista, Calif.
Philip Samson
1571 Desert Gardens Drive
El Centro, California

San Francisco
Michael Kaku
750 Christine Dr.
Palo Alto, Calif.
Robert M. Main, Jr.
7089 Exeter Drive
Oakland 11, California
Steven Sparks
1027 Ray Ave.
Los Altos, Calif.
Edward Stoneham
830 LaVerne
Los Altos, Calif.
William Wise
163 So. Gordon Way
Los Altos, Calif.

Spokane
John D. Potter
418 South Van Buren
Moscow, Idaho

Exhibits . . .

As a result of a survey taken of visitors to the 1963 show, Wescon has taken a bold step in departmentalizing the 1964 exhibits.

Of the two show locations — Hollywood Park and the Sports Arena, Components, Automatic Control and Data Processing & Conversion will be shown at the Hollywood Park Race Track, (under the cover of the grandstand, of course). The rest of the categories, Measurement, Production Equipment, Communications & Detection, Air & Space Systems, Audio & Closed Circuit TV, and Publishers, will be shown at the Sports Arena.

This dramatic new format of two prime locations eliminates the old Wescon tent, which was unsuitable both for exhibitors and visitors.

Hollywood Park is only 5 minutes from International Airport, 20 minutes from the Sports Arena. The Sports Arena is only five minutes from major downtown hotels. The two locations will be linked with a free rapid shuttle bus system which will give the visitors excellent service between the two locations.

Exhibit Hours are:

Tuesday, August 25, 9:30 AM to 6:30 PM (Followed by Cocktail Party at Hollywood Park)

Wednesday, August 26, 9:30 AM to 9:30 PM

Thursday, August 27, 9:30 AM to 6:30 PM

Friday, August 28, 9:30 AM to 6:30 PM

There will be an international exhibit for foreign consuls, trade commissions, etc. at Hollywood Park, adjacent to the Clubhouse Restaurant.

Wescon is held on alternate years between Los Angeles and San Francisco. In 1962 there were 1230 booths in Wescon. This year the figure will be about 1240. Attendance in Los Angeles ran about 46,000 in 1962, and should run over 50,000 in 1964. Attendance figures and registration totals seem to run neck-and-neck with the growth of the industry in the West. Ten years ago, in 1954, attendance was 22,936 with 523 exhibits. With record attendance expected this year at Wescon, the industry also finds itself at a high-level.

The Chairman of the Exhibit Committee is Ben Warner, Jr., Packard-Bell. He has two Vice-Chairmen, one for each of Wescon's two locations. Edward Watts, Instruments Specialists, Inc., and Robert Guss, Beckman Instruments.

Technical Tours . . .

Wescon's seven technical tours encompass much of the vast real estate known as Southern California. With the tours keyed to the technical program, facilities to be visited are: North American's Autonetics Division (Anaheim), California Institute of Technology (Pasadena), Jet Propulsion Laboratories (also Pasadena), North American's Rocketdyne Division (Santa Susanna Mountains), Southern California Edison's Etiwanda Steam Plant (near Fontana), Space Technology Laboratories (Redondo Beach), and the University of Southern California (in the heart of Los Angeles, within walking distance of the Sports Arena).

Air conditioned busses with loud speaker systems will be provided.

TRW Space Technology Laboratory

Tuesday, August 25—1-5 PM. Adults Only—No Cameras. Price, $2.00 Per Person

At STL visitors will first congregate for a coffee hour and brief lecture on the company, and see historical displays of STL spacecraft. In visiting one of the two main buildings, small groups will see and hear lectures on the spacecraft and the building itself, including the clean room, environmental lab and details of mechanical construction. The tour of the R-3 building will cover real-time data reduction techniques and background on their value in research. Probable space vehicles to be shown include the Orbiting Geophysical Observatory (OGO), the Pioneer vehicle, and the Nuclear Detection Satellite, as well as associated electronic gear.

Rocketdyne Propulsion Field Lab

$2.50 Per Person.
Wednesday, August 26—8 AM to 12:30 PM. Adult Men Only—No Cameras. Price, $2.00 Per Person.

The Rocketdyne Propulsion Field Laboratory covers 1700 acres outside of Canoga Park. Here are 19 large test stands, six control blockhouses, five component test labs, a lox plant and a research laboratory all combined to make up what is believed to be the world's most extensive rocket engine testing facility.

Engines developed here cover 90% of all United States space launch vehicle power plants, including the Redstone, Jupiter, Thor and Atlas. Test firings can *not* be promised.

Autonetics/Anaheim

Wednesday, August 26—11 AM to 4:30 PM. Adult U.S. Nationals—No Cameras. Free Snacks. Price, $2.00 Per Person.

Here visitors will see the Microelectronics Lab (integrated circuits and multi-layer interconnection boards), the Minuteman Computer Assembly Test, the D37B, the Ceramic Printed

Over 1200 booths will present the most up-to-date industry show case in the world. Two exhibit locations will be featured in the 1964 Wescon Show . . . The L.A. Sports Arena and Hollywood Park. Each location will only display specific areas of interest. See story above.

Circuit Fabrication Shop and special exhibits in the Research Facility patio of items not seen on the tour.

Jet Propulsion Laboratory

Wednesday, August 26—1-5 PM. Adult U.S. Nationals—No Cameras. Price, $2.00 Per Person.

Visitors will view actual spacecraft of the Ranger series and Mariner series spacecraft, as well as assembly operations, testing and checkout facilities and a new communications control center.

Southern California Edison

Etiwanda Steam Station. Thursday, August 27—8 AM to 12:30 PM. Adults Only—No Cameras. Price, $2.00 Per Person.

Southern California Edison generates more than 900,000 kilowatts of power in this four unit plant located 50 miles from LA. The four units were built in pairs, installed ten years apart, offering an interesting study in contrasts. The 1953 units generate about 125,000 kilowatts each. The 1963 units were the first in the world to undergo computer controlled initial start-up. This plant also features the world's largest cooling towers.

University of Southern California

Electrical Engineering Dept. Thursday, August 27—1-5 PM. Adults Only. Price, $2.00 Per Person.

This tour covers 7 university labs and a demonstration on Television Bandwidth Compression Experiments. Labs visited include: the Semi-conductor Lab, the Magnetism Lab, the Solid State Chemistry Lab, the Superconductivity Lab, the Electron Microprobe Analysis Lab, the Plasma and Electromagnetic Lab, and the Systems Simulation Lab. There will be an orientation lecture to introduce these various tours.

California Institute of Technology

Friday, August 28—8:30 AM to 12:30 PM. Adults Only. Price, $2.00 Per Person.

Attendees will visit the Willis H. Booth Computing Center, consisting of three large scale interconnected digital computers, the communication system and remote station inputs, the Biological Systems Laboratory which includes material from fundamental research on information processing in living systems, such as insect vision and insect nervous system to higher life orders, Solid State Physics demonstrations where the faculty are engaged on research on solid state physics related to electronic device oriented principles, and the Synchrotron Laboratory. The Synchrotron accelerates electrons at velocities close to the speed of light.

WESCON design judges choose 19 products for Industrial Design Awards show at the convention in August. Left to right, above, are Harry Greene (Merendino/Greene and Associates); James Powell (IDA committee member); David Malk (Beckman Instruments); and Jack Stringer (IBM, San Jose).

Industrial Design . . .

Why does a person select one product over another, when both appear to be equal in performance? Specifically, when an engineer has built a black box full of electronic goodies, can he do anything further to assure its selection by the user? Industrial design specialists feel that he can, that good design is integral to good performance and to certain aspects of human engineering which permit optimum operation by the user.

Wescon recognizes this trend towards excellence in design with its Industrial Design show. Manufacturers involved with Wescon, WEMA, or companies associated with exhibitors are encouraged to enter their best products into a judging, from which outstanding items are selected and displayed for Wescon visitors in a special location at Hollywood Park, known as the Industrial Design show. This year 132 products came before the judges; 19 were selected to appear at Hollywood Park. Of these, each will receive an Award of Merit Certificate, to denote its success in the first competition. Of the 19, some additional award of excellence certificates will be given and one product will receive the treasured Pacesetter Award. This final Award will be announced and given at the Wescon Banquet on Thursday at the Hollywood Palladium.

Those who live in Los Angeles may see the Industrial Design display at the California Museum of Science and Industry between July 25th and August 19th, after which date the products will be moved to Hollywood Park. It is during this time that internationally-known judges will study the 19 to select the Awards of Excellence and the one Pacesetter Award.

The products shown are drawn from the representative electronic components or instruments fields and must have been marketed prior to June 1, 1964. In addition to this year's items, the Pacesetter Awards from the 1962 and 1963 Industrial Design Competitions will be shown. Committee Chairman Phil Quinn announces that Milton Immerman, well-known specialist from Walter Dorwin Teague Associates will make the Pacesetter presentation at the Thursday Banquet . . .

Harold S. Rothman passed away at El Camino Hospital in Mountain View, California, on July 11, 1964, at the age of 32.

Mr. Rothman was a Research Engineer at Stanford Research Institute. He joined IRE as a Student Member in 1950, and became a Member in 1960.

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Wescon Service Committees . . .

This year Wescon will embark upon the strongest public relations program in its history, to stimulate interest and to forestall any drop-off of attendance that some trade shows have experienced. Wescon has already held meetings with exhibitors and sent its professional representative, Ted Shields, West Associates, back East to talk to editors. A full volunteer staff under the Chairmanship of Dave Traitel, Electro-Optical Systems, has been working for months with each of the committees to produce stories for the various public Wescon events. In addition, there will be outdoor billboard advertising in LA and SF to remind engineers of the Wescon dates, and Wescon will take publication advertising for the first time. Company executives will be contacted by letter asking that they send key employees to Wescon: Wescon will publish its tabloid newspaper and send out an advance program to 80,000 engineers. House organ editors will be hosted at a special meeting; prizes given for the best coverage. In addition to the usual press conferences, there will be an attempt to capture the consumer press interest with some "gee-whiz" electronic items. The publicity program falls under the supervision of Don Larson, Wescon Manager. The volunteer committeemen include: Vice-Chairman Don Flamm, Aeronutronic, Philco, John Bergman, Beckman Instruments, Dick Harmon, Cohu Electronics, Dick Hoffman, Nortronics, Park Irvine, Autonetics, Gene Mathews, North American, Ted Michel, Giannini and Ralph (Doc) Power, Consultant.

Facilities . . . It is the job of William Wilson, Neely Enterprises, and his facilities committee to provide four important types of service to Wescon. The Equipment Procurement Sub-Committee must see that all necessary show equipment, whether a typewriter or a projector, is available at the right time and place, the Transportation Sub-Committee must arrange all bus transportation, including the five-minute shuttle between the Sports Arena and Hollywood Park, the Personnel Sub-Committee must recruit from willing companies some 100 room monitors for the Technical program, and the Signs and Posters Sub-Committee must provide these essential tools.

William Wilson is assisted by Benton Bejach, as Vice-Chairman of the overall Facilities Committee. Others are: Personnel Procurement Sub-Committee: Lewis Habersatter, assisted by Myron H. Hunt, Transportation Sub-Committee. Donald Montgomery, assisted by Morey W. Eggleston, Signs and Posters Sub-Committee Jack Easterbrook, assisted by Jack S. Toney, and James K. Berger and Equipment Procurement Sub-Committee: Jack Wills assisted by Bruce Copeland.

Registration . . . Ted L. Golmis, Hughes Aircraft, and John Barker, North American, head this important Committee. It is the job of Registration to minimize delays while passing 45,000 visitors through the various Wescon locations, visitors who fall into various categories and who must be armed with a Wescon inquiry card before being turned loose in the Sports Arena or Hollywood Park. This card enables visitors to leave names at specific booths so that literature need not be handed out (and lost or wasted) during the show itself. Registration costs $2.00 and registration locations, planned for rapid traffic flow, will be available at the Sports Arena, Hollywood Park and the Statler-Hilton.

The Hospitality Committee, this year headed by William J. Moreland, Conrac, assisted by Charles C. Olsefsky, North American, does a special job for Wescon, seeing to it that important visitors, usually non-electronics individuals, such as public officials, finance executives and other non-industry leaders are made welcome and introduced to that portion of Wescon which interests them. Hospitality also assists national officers of IEEE and WEMA officers to make the many important contacts they need to make in a limited amount of time they have available in L.A.

The Visitors' Services Committee is a Hospitality Committee-at-large. It maintains seven locations, including the airport and major hotels, where out-of-towners may ask any type of question from "where to eat" to "where to get a tuxedo" and expect a quick answer. For this committee Chairman Robert C. Tetherow, Arnold Engineering, assisted by Charles Fetty, WESTRON, choose salesmen and other who are adept at dealing with the public.

Distributor-Rep.-Mfgr's. Conference . . .

To many a Wescon visitor, the Distributor - Manufacturers - Representatives Conference has remained a mystery. In the first place, it takes place the day before Wescon — this year on Monday, August 24, 1964. Secondly, it is held at a non-Wescon location, this year at the Ambassador Hotel Convention Center. Third, it is involved in the mystiques of "selling" which up until recently has been a muted word in electronic circles. But with more difficult times in the industry the magic art of distributing and selling products is coming into its own.

At this DMR Conference, this year under the Chairmanship of Herb Becker, Herb Becker Co., the various distributors will have table locations during the day at the Ambassador Convention center. Here will come the various manufacturers with their representatives to talk about the possibility of distributor tie-ins. So far more than 100 manufacturers have indicated an interest in participating in these interviews. Interview periods are set for 20 minutes at the end of which time a buzzer sounds and the manufacturers and representatives move onto the next table. There is also a general area at the Convention Center where participants may mingle freely. There will be 20 of these twenty minute sessions during the day, and there will also be a continental breakfast, a no-speaker luncheon and coffee breaks. Registrants will pay $7.50 per person for this package. There will be no evening banquet as there has been in previous years. The DMR Conference is set on Monday, before Wescon opens so that the distributors, manufacturers and representatives may attend to their normal affairs during Wescon itself, either manning the booths or making local contacts. Thus, in another quiet way, Wescon serves the overall electronics industry by presenting the DMR Conference.

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Ladies Program . . .

This year the focus is on the "dramatic" look for the Ladies who visit Wescon. Four days of events run the gamut from a musical program on "Merrie England", capturing the life and gaiety of the England of "Tom Jones" of a later period, to the contemporary views on Hollywood by the glamorous Hedda Hopper.

Wescon plays homage to Shakespeare on his four hundredth birthday by presenting a program on "Merrie England" at the Pasadena Playhouse on Tuesday, August 25, at 1:45 PM. The musical program features the John Biggs Consort, a talented ensemble. Salli Terri, a recording artist of renown, is a featured soloist. The program will consist of the musical performance, refreshments, and a brief tour of the Playhouse which is located to 39 S. El Molino Ave., Pasadena.

Buses leave the Statler-Hilton at 12:30 PM, and will bring the travelers back by 4:30 PM. The cost of the Pasadena afternoon is $3.00. $5.00 if the bus is taken. Both the Playhouse and the buses are air-conditioned.

Miss Hedda Hopper, commentator on the Hollywood scene, will give a Biltmore Bowl audience an inside look at show business on Wednesday, August 26. There will be a musical program which includes Lauren Rhoades, violinist, and Betty Rhoades, harpist. The luncheon is served at 12:15 PM and is preceded at 11:30 by a social hour. Price is $7.50 per person.

On Thursday, August 27, a three-part Fashion show comes into focus for the Ladies. The Wilshire Room of the Statler-Hilton will open its doors for a wig show beginning at 10:00 AM, presented by designer Michelangelo. A cosmetic demonstration by I. Magnin and Company, and a swimwear fashion show by Rose Marie Reid, complete the program ending at 12:30 PM.

On Friday, the ladies travel to the sports arena via shuttle bus, leaving the Statler-Hilton at 9:30 PM. In store for the ladies is a visit to the Future Engineers Show and a tour of the regular Wescon exhibits. Mrs. Dana Johnson, Chairman of the Women's Activities Committee, has planned some time for relaxation on the last day of Wescon. Beginning at 11:00 AM, a Statler-Hilton swim party and suntan fiesta puts the finishing touch to an exciting week.

PLEASE NOTE

The "Special Preview — Abraham Lincoln" play originally announced for the Ladies Program at the Pasa-

CONTINUED ON PAGE 62

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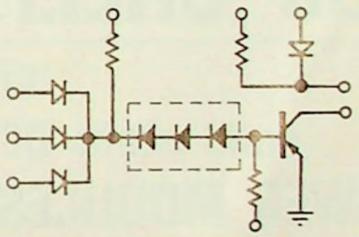

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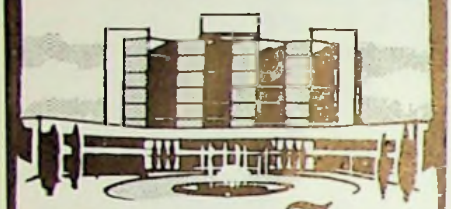

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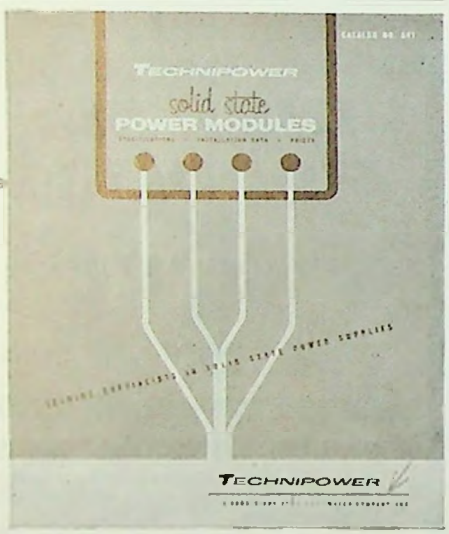

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LADIES PROGRAM CONT. FROM PAGE 61

dena Playhouse will not be held. This change was due to circumstances beyond the control of the program planners, but occurred after the advance mailing on Wescon went out. However, there will be a musical event held at the Pasadena Playhouse, same day and time. See story on Women's Activities for details.

Region Roundup . . .

Albuquerque Section . . . Under the guidance of outgoing Chairman T. L. Pace, membership of the section increased 20% during the past year, now numbering 935. Membership should exceed 1000 by the first meeting this fall . . . The section publication, THE BLAST, was put into a paying position this year, averaging a $200.00 profit for each issue . . . credit goes to A. B. Church, BLAST editor.

K. Dan Hardin, Chairman-elect, indicates that major efforts for 1964-65 center around methods of improving participation in section activities and revisions of section bylaws to establish continuity in executive committee and to form needed permanent committees for special problems.

Anchorage Section . . . The Alaskan earthquake badly damaged the FAA building in downtown Anchorage where the regular monthly Section meetings are held. The Alaskan Communications Region at Elmendorf AFB extended the use of their facilities to hold meetings, but the tremendous amount of repair work caused by the earthquake precluded the normal attendance of many members . . . Chairman-elect, Lt. Col. Samuel Plame, reports that 'with the fishing season open now, the members will get a much earned rest and meet again in the fall.'

Boise Section . . . The first full year's operation as the IEEE for the Boise Section included nine meetings and inspection trips ranging in subject matter from underground nuclear blasts to 'Ladies Night'. Until the merger there was no IRE Section, so electronics engineers were not previously served. Programs have been scheduled to attract these potential members . . . officers for the present calendar year are: Louie J. Schmitt, Chairman, L. E. Garlinghouse, Vice-Chairman, Del L. Andrews, Secretary/Treasurer and J. R. McDonald, Publicity Director.

China Lake Section . . . In August, 1963, the section elected to join the Los Angeles District, and in so doing, became a charter member. During the spring, a series of technical lectures on lasers and related topics

were well attended, and a similar activity may be forthcoming this year . . . the newly-elected officers installed at the annual section banquet are James C. Mitchell, Jr., Chairman, Phil G. Arnold, Vice-chairman and Arthur H. Thomas, Secretary/Treasurer.

Foothill Section . . . Electrical and electronic subjects shared the spotlight during the section meetings which featured outstanding speakers presenting important aspects of the electrical fields and general discussions on the latest advances in electronics . . . the highlights of the year included the formation of the first Power Group Chapter in the IEEE and a lecture series on "New Electrical and Electronic Technologies" . . . officers elected to serve during 1964-65 are Everett Ross, Chairman, Herbert Barr, Vice-Chairman, Robert Irvine, Treasurer and Lloyd Flannigan, Secretary.

Phoenix Section . . . A variety of meetings were held, including a pre-meeting golf match, and the 13th Annual Treasure Hunt. Initiated in 1950, the Hunt drew its largest crowd this year, 348 members . . . LeRoy C. Graham was awarded the annual Achievement Award of the Section and the traveling plaque accompanying this award was presented to his company, Goodyear, to be held one year . . . Dr. Elmer O. Hartig, John C. Cacheris and Dr. I. Arnold Lesk were presented with Fellow certificates at the April meeting . . . twenty meetings of technical groups were held, and a new Automatic Control Group Charter will begin this fall.

New officers of the Phoenix Section, IEEE are, from Left: Tom Morong, Secretary, SRP; Dick Quisenberry, Chairman, Westinghouse; George T. Royden, Past-Chairman; M. F. Cook, Treasurer, Motorola/Military, and Bob Peterson, Vice-Chairman, Goodyear.

Portland Section . . . The more successful section meetings included a tour of the Bonneville Power Administration's high-voltage, direct-current laboratory, a hi-fi sound demonstration, and numerous technical meetings . . . programming in the future will probably include one general interest meeting each month, plus many technical group meetings scheduled to avoid conflicts with the general meetings . . . Bio-Medical Engineering and Power are the active Group Chapters . . . the section will conduct the National 1967 Power Group meeting at the new Portland Hilton Hotel, July 9 to 22 . . . two courses were conducted during the winter. The first, a course in Electrical Measurements and Standards was acceptable for graduate credit. The second was a review to aid graduates in preparation for the Oregon Professional Engineers examination.

Metropolitan Los Angeles Section . . . The section began its existence on July 1, 1963. Five meetings were held during the year with an average attendance of 101. Four of these were dinner meetings with an after-dinner program which included a speaker on a technical subject of interest to the membership . . . the May, 1964 meeting was a dinner-dance at which the newly-elected 1964-65 officers were introduced: George L. Barcus, Chairman, H. F. Saliger, Vice-Chairman, Howard R. King, Secretary, and Arthur D. Crino, Treasurer.

Richland Section . . . The section's major goal for the year was accomplished with effective integration of the AIEE and IRE groups, and a substantial increase in membership . . . included in twelve exceptionally fine meetings was a visit by Bruce Angwin, Region 6 Director . . . technical meetings covered a wide range of subjects from EHV to space flights and solid state equipment . . . three highly successful ventures sponsored by the section during the year were courses in Boolean Algebra, Engineering Refresher and Management; all well attended and profitable . . . plans are underway to establish a Power Chapter and conduct additional courses for member participation . . . new section officers are G. L. Swezea, Chairman, J. C. Spanner, Vice-Chairman, and J. H. Budd, Secretary/Treasurer.

CONTINUED ON PAGE 64

Alford Paull, Past Chairman, San Diego Section, IEEE hands gavel to incoming Chairman Kenneth R. O'Neal on the left. Other officers for the 1964-65 term are: Vice-Chairman, F. W. Garrison; Secretary, R. Hively; Treasurer, William A. Davis; Department of Membership, Glen Eggen; Department of Student Relations, Everett Wiedmann; Gene A. Burns; C. L. Thacker; Department of Section Administration, F. W. Garrison; Department of Professional Development & Recognition, Edmond W. Carlson, Department of Publicity, Donald C. Prim; Department of Meetings and Programs, Gene A. Burns; Department of Technical Operations, Eric Herz.

1964-65 officers of the Richland Section, IEEE will be (L-R) Jack Spanner, Vice-Chairman; G. L. Swezea, Chairman and J. H. Budd, Secretary-Treasurer.

Boise Section Officers for 1964 were (L-R, top row) Lester E. Garlinghouse, Vice-Chairman; Del L. Andrews, Secretary-Treasurer; James R. McDonald, Publicity Director, and Louie J. Schmitt, Chairman (seated).

Sacramento Section . . . Starting with the September program on Electronic Musical Instruments and continuing through May with Bernard Oliver's talk on "Time Domain Reflectometry," a variety of technical presentations were enjoyed . . . A field trip to the U.S. Navy Mare Island facility, and a joint meeting with the section's Reno sub-section was held in Reno . . . the section participated in Engineer's Week activities with talks to the areas high schools on engineering as a profession . . . 1964-65 section officers will be W. G. Urseny, Chairman, F. S. Schrader, Vice-Chairman, M. Jerome, Treasurer and H. T. Williams, Secretary.

San Fernando Valley Section . . . Outstanding meeting of the past year consisted of a microwave cooking demonstration attended by 150 members and wives. Dr. Norman Moore, President, Atherton Div., Litton Industries presented the technical description of the cooking unit . . . a ten day tour of Hawaii and the islands was enjoyed by many of the section's members . . . since the installation of new officers could not be accomplished in Hawaii as planned, a dinner-dance installation is being planned as one of the first meetings of the new year . . . new section officers are, John C. McAdam, Chairman, Dr. Don Lebell, Vice-Chairman, William W. Wilson, Treasurer, and William X. Lamb, Secretary.

San Francisco Section . . . John C. Beckett, Hewlett-Packard Co., Palo Alto, is the 1964-65 Chairman of the San Francisco Section. Other officers are: Jack Melchor, h-p Associates, Vice-Chairman; Gerard K. Lewis, Allis-Chalmers Mfg. Co., San Francisco, Secretary, and Fred J. MacKenzie, Stanford Research Institute, Men'o Park, Treasurer.

The 11th Annual Petroleum Industry Conference will be held in San Francisco, August 24-26, with headquarters at the St. Francis Hotel. Convention Chairman is R. B. Pearce, Standard Oil Company of California.

General and technical sessions will cover human obsolescence; electronic schools for refinery electricians and instrument men; and petroleum manufacturing, production and transportation.

Inquiries should be directed to R. R. Rawson, Westinghouse Electric Corp., 410 Bush St., San Francisco 8, Calif.

Santa Barbara Section . . . Nine meetings were held this past year, ranging from very specialized topics such as MOST semiconductors to general interest topics such as experiences related to the early days of rocketry . . . the meeting with the largest attendance was the annual student meeting. It appears that the section can easily reach the point where half the membership will be student members. Servicing these students and working with them will require an increasing proportion of the budget . . . plans next year will include emphasis on "Engineers Week". Several programs will be worked out by Chairman-elect George Sayre to coordinate activities with other local engineering societies during this Week.

Seattle Section . . . The section successfully merged 1000 AIEE members with 1000 IRE members and completed a full year of IEEE activities covering every facet of local interest . . . three new Group Chapters were formed with a fourth on the way . . . in addition to 10 section, 10 sub-section, and 60 chapter meetings, there was a theatre-dinner party, an annual banquet with guest speaker Jim Whittaker, a field trip to the Scott Paper Company, and a student paper contest . . . the monthly section publication, DATA LINK was supplemented by a monthly flyer called MISSING LINK which iterated all the known meeting notices as a reminder to the entire membership. This flyer replaced the numerous post cards, telephone calls, etc. used by the chapters, and reduced costs . . . new section officers are Clere S. Alger, Chairman, Dr. Irene Carswell Peden, Vice-Chairman, Alfred W. Moody, Secretary, and Richard B. Shulz, Treasurer . . . Is Dr. Irene Peden IEEE's first lady Vice-Chairman?

South Bay Harbor Section . . . The subject matter of section meetings generally involved problems related to space activities, culminating in an interesting series of talks on investigations regarding the physical affects on man in space. One outstanding meeting consisted of a field trip through the Los Angeles Police Department's Technical Labs to view the electronic gadgetry . . . the section participated in a joint meeting with the Long Beach Chapter of the CSPE during Engineers' Week. The meeting consisted of a talk on space craft and a tour of the engineering labs at Long Beach State College . . . officers-elect are Dr. Owen Fiet, Chairman, F. W. Parrish, Vice-Chairman, Darwin McClintock, Secretary and Richard Lepper, Treasurer.

Spokane Section . . . The section sponsored a very successful paper competition in August . . . F. B. Chew, a senior in EE at Washington State University won the 1964 paper competition between the universities located in the Inland Empire . . . officers elected during the coming year are Attie L. Betts, Chairman, R. W. Anderson, Vice-Chairman, and L. W. DeMaster, Secretary/Treasurer.

Utah Section . . . The section completed one of its most active years presenting technical programs with subjects varying from EHV transmission to space communication problems . . . two new group chapters on Power and Instrumentation and Telemetry were formed . . . attendance at meetings averaged about 20 to 25% of the total section membership . . . the major event of the year was the first Region 6 Annual Conference. Over 1000 registrants for the three-day meetings, with a wide range of technical papers and 85 exhibitors . . . new section officers are D. F. Folland, Chairman, Ralph Radford, Vice-Chairman, and Robert Stephenson, Secretary/Treasurer.

Wenatchee Section . . . Ten meetings were held during the year, including one field trip. The Banquet and meeting on the "Wells Hydro-Combine" were the best attended . . . increasing the membership from the present 51 members poses a problem for the future due to the wide-spread geographical area of the section plus a limited number of engineers in the area . . . 1964-65 officers are A. V. Miller, Chairman, T. A. Goodwin, Vice-Chairman and J. W. Carlson, Secretary/Treasurer.

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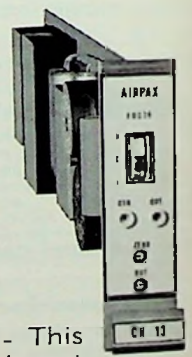

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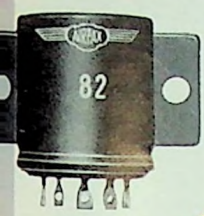

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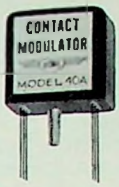

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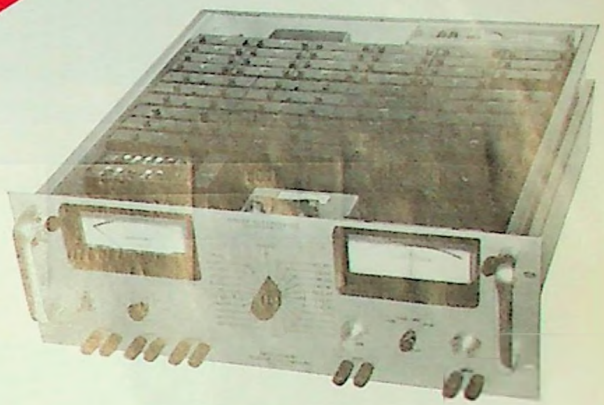

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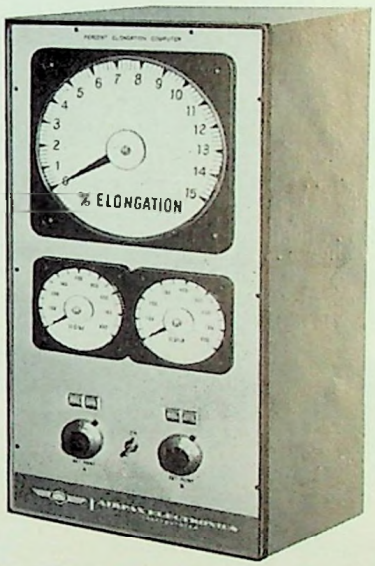
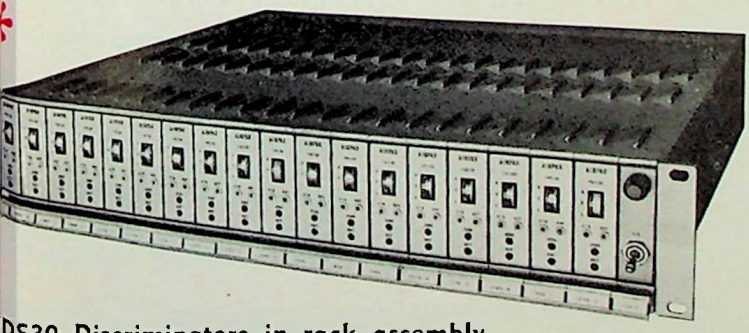


Percentage difference between two shaft speeds determines elongation or stretch of strip, wire, cloth or thread. The **Airpax Elongation Computer** consists of two Airpax tachometers plus a unique (patents applied for) analog computer where the speed difference is divided by the speed of either shaft. Output is DC and precisely linear. It can be used directly with servo speed controls, recorded, and displayed as shown.



DS30 Discriminators in rack assembly

ighteen discriminators side by side in a stand- rd relay rack mounting, had space left over, we used it for a switch panel. Any and all andard IRIG channels, or constant band idth channels are available.

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★ Completely automatic . . . on command, instrument:
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2. Makes balance, displays measured values.
3. Presents digital output data for printers, memory-base systems, and oth digital equipment.

★ Direct reading in capacitance and dissipation factor (or conductance) . . . Numer indicators also give direct presentation of units and decimal-point location

★ Fast . . . balance is completed in ¼ second . . . measurement rate can be set from 2 p second to 1 every 10 seconds.

★ Accurate . . . ±0.1% of reading . . . permits accurate remote measurements.

★ Optimum logic . . . logic circuits handle equally well successive measurements that a either a long way or a short way from previously measured value.

★ A "true" bridge circuit . . . both unknowns are balanced simultaneously.

★ A three-terminal, guarded bridge . . . dependent only on stable passive standards.

★ BCD outputs for data printers or other processing equipment.

★ Ideal for tracking varying capacitances, reliability studies, and large-quantity co ponent tests.

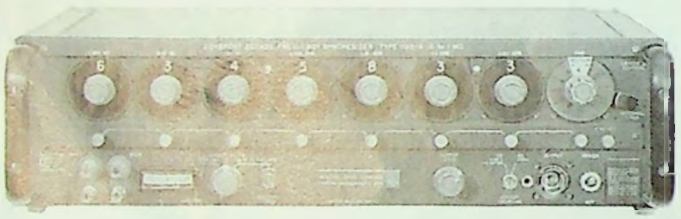
RANGES

Frequency	120c	400c	1kc
Capacitance	100pf to 1000μf 4 ranges	0.01pf to 100μf 7 ranges	0.01pf to 100μf 7 ranges
Conductance	1μ to 1 4 ranges	0.1n to 1 7 ranges	0.1n to 1 7 ranges

Dissipation Factor: 0.0001 to 1.0 in one range

NEW **Type 1115-B Standard-Frequency Oscillator . . . $2050**
A 5-Mc, 5th-overtone crystal oscillator with a short-term stability of better than 1 x 10⁻¹¹, measured over a 1-second averaging time . . . additional outputs at 1 Mc and 100 kc . . . all silicon transistor circuits . . . built-in battery supply and charger for emergency operation up to 35 hours . . . spectral line width less than 0.25c at 10 Gc.

NEW **Type 1123-A Digital Syncronometer® Time Comparator . . . $25**
A solid-state digital clock for time and frequency standardization . . . operates with the 1115-B Standard-Frequency Oscillator for time co parisons to 10 μsec . . . Numerik in-line readout of hours, minutes, a seconds . . . readout can be programmed to read up to 100 hours bef recycling. Self-contained 24-hour emergency power supply.



NEW COHERENT DECADE FREQUENCY SYNTHESIZER

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Provide precisely known stable signals, continuously variable, or in crystal-locked steps.

Type 1162-A Synthesizer, illustrated . . .
dc to 1Mc continuously or in 0.1-cycle crystal-locked steps.

Consists of seven convenient modular decades plus a continuously adjustable unit that permits either step- or continuous-frequency selection. At least 9-figure readability including two significant figures provided by the continuously adjustable decade, which can be self-calibrated to three figures or more. Models are available complete or in stripped-down versions with as few as 3 digits installed; remaining digits can added later, as desired. Frequency can be varied by an external dc vo age — can be swept, fm modulated, or phase-locked to other signa Operates from self-contained crystal standard or from external standard Up to 2v output into 50 ohms. Fits into only 5¼ inches of rack space.

Also on display

Digital Time & Frequency Meter . . . measures frequencies to 400kc, periods to 20kc, and frequency ratios. Has input circuits that permit a choice of input sensitivity, impedance, trigger level, and ac or dc coupling.

Digital-to-Analog Converter . . . 0.1% accuracy D/A converter capable of 10,000 conversions per second.

Capacitance Bridge . . . 0.01% direct-reading with 6-figure resolution.

New Megohm Bridge . . . 1-kilohm to 1000-teraohm (10^{15} ohms) range . . . ΔR dial for incremental resistance measurements . . . 7 test voltages from 10v to 1000v . . . built in null detector and self-checking standards.

New Microwave Oscillator . . . 1.7 to 4.1 Gc

Slotted-Line Recorder System . . . For automatic recording of VSWR fr 1.001 to 1.20 over a 300Mc to 9Gc range.

Precision Coaxial Connector . . . A low-VSWR connector — less than 1.0 to 1Gc, 1.01 to 9Gc. Many new coaxial accessories also on display.

Wave Analyzer 20c to 50kc range . . . 3-, 10-, and 50-cycle bandwidths accessory recorder available for automatic recording of spectra.

Sound and Vibration Analyzer . . . A one-third and one-tenth octave-ba analyzer operating over a 2.5c to 25kc range. Also drives auxil chart recorder.

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