EDITOR'S PROFILE of this issue

from a historical perspective …

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

September, 1959:

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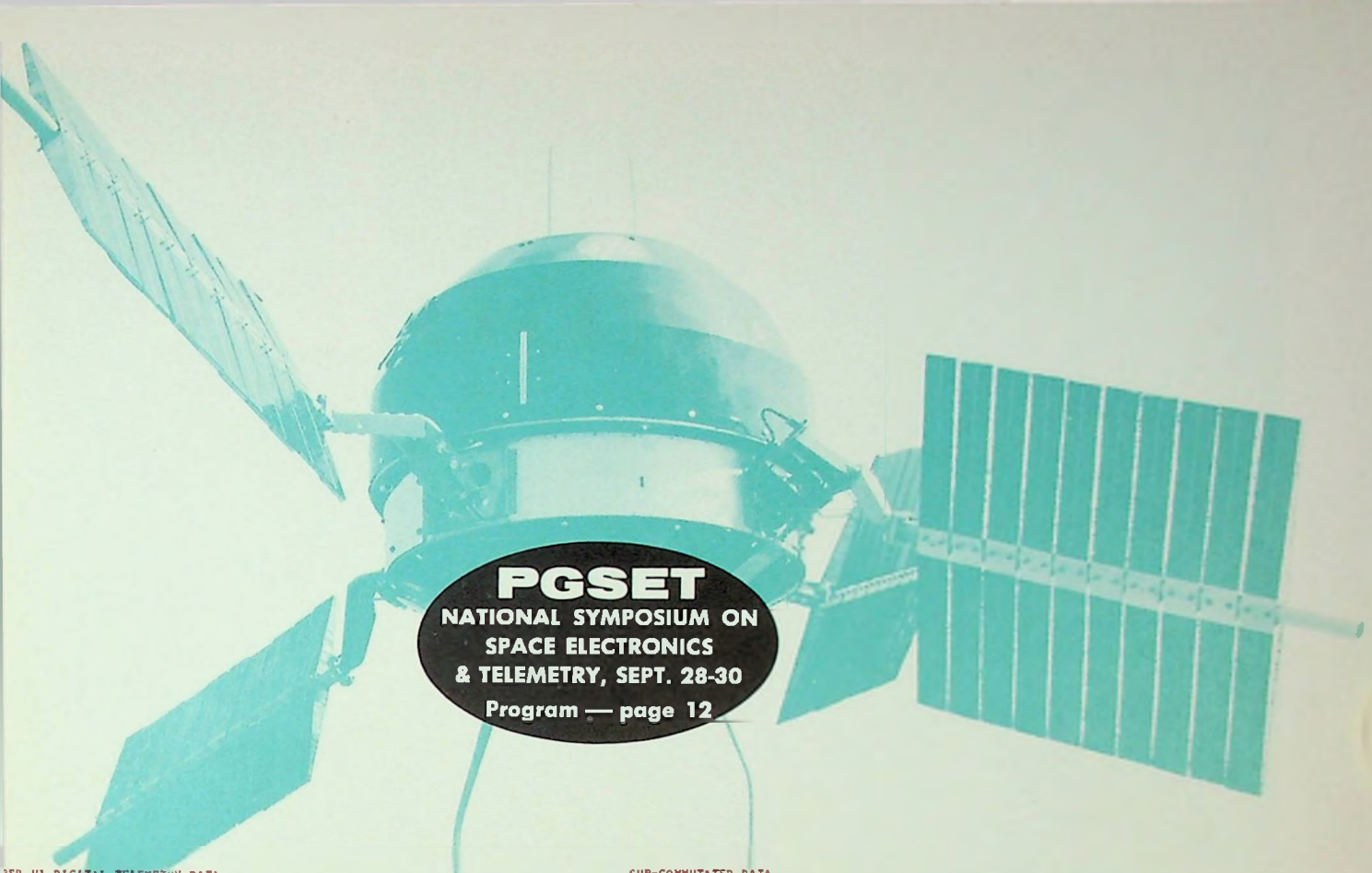

PGSET
NATIONAL SYMPOSIUM ON SPACE ELECTRONICS & TELEMETRY, SEPT. 28-30
Program — page 12

ER VI DIGITAL TELEMETRY DATA

SUB-COMMUTATED DATA

SC	U. CHICAGO COSMIC RAY COINCIDENCE TRIP	SINGL	U. MINN. CHAMBER CUTOFF G-M	ION	STANFORD WHISTLER MODE-VLF AMPL.	MICROME-TEORITE HITS MIMV	TOTAL	SCINTIL-OMETER COUNTS	MAGNETOMETERS SEARCH-COIL PHASE	AMPL.	FLUX-GATE AMPL.	RCVR. LOOP STRESS KC	SOLAR CELL MNTR. MA	BATTEY VLTS X10	TEMP DEGF	HEAT-SINKS DEG F XMTR	CNVTR	PADDLE-NO.2-DEG-F OUTBD FRNT	BK	INBD FRNT	TEST CELL	SHELL-TEMPS-DEG-F FWD. AXIS	EQUA TOR.	LOWER STRUC.	BIMETAL TEMP DEG F	RANGE KM
40	261	943	328	330	24	1	112	378	158	31	55			176												26358
42	261	943	333	343	24	1	112	331	158	31	55					78										26365
44	261	943	338	356	24	1	112	332	158	29	55						77									26371
46	261	943	343	369	23	1	112	333	158	31	55				90											26377
48	261	943	348	382	23	1	112	334	158	31	55															26384
51	261	943	353	395	23	1	112	336	158	30	55													21		26393
53	261	943	358	408	23	1	112	337	158	31	55											119				26400
55	261	944	531	421	23	1	112	339	158	31	55														44	26405
57	261	944	367	434	23	1	112	340	158	31	55															26412
1	261	944	377	460	26	1	112	343	158	31	55							24								26423
3	261	944	382	473	23	1	112	345	158	31	55								21							26431
5	261	944	387	484	23	1	112	346	158	31	55												86			26438
7	261	944	392	497	23	1	112	348	158	31	55									40						26444
9	261	944	397	510	23	1	120	349	158	31	55		588													26450
11	261	944	602	523	23	1	112	351	158	31	55			176												26457
13	261	944	607	536	23	1	112	352	158	31	55					78										26463
15	261	944	612	549	23	1	112	354	158	31	55						77									26469
17	261	944	617	561	23	1	112	355	158	31	55				90											26476
19	261	945	622	573	23	1	112	357	180	31	55															26482
21	261	945	627	586	23	1	112	358	158	31	55															26488
23	261	945	631	599	23	1	112	360	158	31	55													21		26495
26	261	945	636	612	23	1	112	361	158	31	55											119				26504
28	261	945	641	625	23	1	112	363	158	31	55														60	26511
30	261	945	646	638	26	1	112	364	158	31	55															26517
32	261	945	651	651	24	1	112	366	158	31	55							22								26523
34	261	945	656	664	23	1	112	367	158	31	55								24							26530
36	261	945	661	677	23	1	112	369	158	30	55															26536
38	261	945	666	690	23	1	112	370	158	31	55												86			26542
40	261	945	669	703	23	1	112	372	158	31	55		687													26549
42	261	946	674	719	23	1	112	373	158	31	55						77									26555
44	261	946	679	727	22	1	112	375	158	30	55															26561
	261	946	684	739	23	1	112	376	158	31	55															26567
	261	946	689	748	22	1	112	378																		
		946	694	761	22	1	112	379																		
		946	698	774	22	1	112	381																		
			703	787	22	1	112	382																		
				800	22	1	112	384																		
				824	30	1	112	387																		
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Grid

SEPTEMBER 1959

SAN FRANCISCO SECTION

IRE®

NOW! TRANSISTORIZED 100-600 AMPERES DC POWER SUPPLY

by PERKIN!

Response time adjustable to 20 milliseconds . . .

Excellent dynamic load regulation . . . low ripple

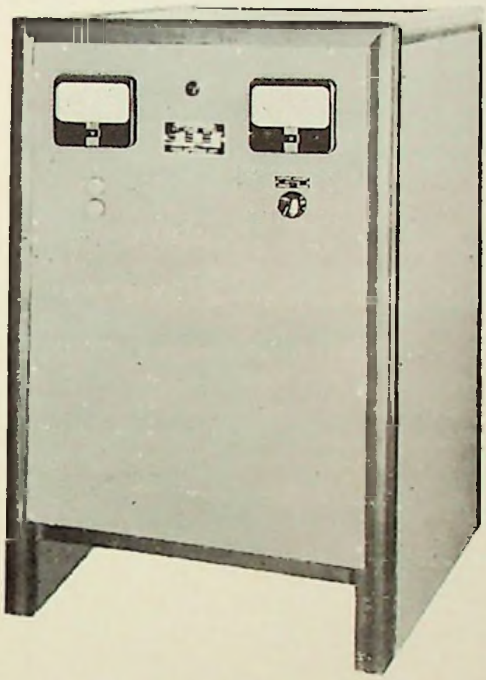
Proven in production use in the . . .

THOR . . . BOMARC . . . ATLAS . . .

JUPITER . . . POLARIS . . .

VANGUARD AND LA CROSSE

MISSILE PROGRAMS



SPECIFICATIONS

A.C. INPUT: 208/230/460 volt ±10%, 3 phase, 60 cycle.

RIPPLE: Less than 1% RMS.

RESPONSE TIME: A special control internally mounted in the Power Supplies handles adjustment of response time. The "load on" response time is adjustable from 20 to 200 milliseconds, and the "load off" from 40 to 400 milliseconds. An important advantage of this adjustable response is when used with inductive loads, such as inverters; recovery can be adjusted to avoid interaction between inductive load and power supply.

RATINGS AVAILABLE:

Model Number	D.C. Output		Regulation		Dimensions W" x H" x D"	Weight Lbs.
	Volts	Amps	Static-Line or Load	Dynamic-Load*		
MRST28-100	24-32	100	±0.1%	±6V	22"x36"x22"	430
MRST28-200	24-32	200	±0.1%	±6V	22"x36"x22"	550
MRST28-300	24-32	300	±0.1%	±6V	22"x46"x22"	700
MRST28-400	24-32	400	±0.1%	±6V	28"x58"x24"	1250
MRST28-500	24-32	500	±0.1%	±6V	26"x68 ½ x32"	1650
MRST28-600	24-32	600	±0.1%	±6V	26"x68 ½ x32"	1650
MRST2440-250	24-40†	250	±0.1%	±2V	26"x68 ½ x32"	1650

* For Full Load Charge

† In 2 Ranges

TECHNICAL DESCRIPTION

These units use silicon power rectifiers for increased reliability and efficiency. Silicon rectifiers provide constant efficiency and exhibit no aging characteristics as is more common in other type rectifiers. Magnetic components utilize grain oriented silicon steel and Class B insulation for compact design and efficient operation. The power section consists of a 3 phase magnetic amplifier with extremely high gain. Preamplifier is fully transistorized and utilizes silicon zener diodes as a reference element.

ADDITIONAL FEATURES

Output of units can be shorted without damage to the silicon rectifiers.

Units can withstand 400% overload for periods up to 1 second without damage to Power Supply components.

Remote sensing
low output impedance

Militarized versions of above units are also available.

For additional data contact factory or sales offices below:

Albuquerque, N.M. AMherst 8-1724
Angola, Ind. 217 & 8101-R
Atlanta, Ga. BLackburn 5-6660
Chicago, Ill. JUniper 8-0905
Cleveland, Ohio REdwood 2-7444
Dallas, Tex. FLeetwood 7-7080
Dayton, Ohio CHapel 4-5551
Denver, Colo. SUnset 1-7375
Detroit, Mich. HOward 8-2461
Indianapolis, Ind. STate 7-0009
Kansas City, Mo. HEdrick 2-2528
Los Angeles, Calif. HOllywood 9-7294
Minneapolis, Minn. Midway 6-2621
New York, N.Y. DIgby 4-2997
Orlando, Fla. CHerry 1-2128
Philadelphia, Pa. WAlnut 7-1820
Phoenix, Ariz. WHitney 6-2111
St. Louis, Mo. PArkview 1-6403
San Diego, Calif. ATwater 3-2081
San Francisco, Calif. EMerson 9-3354
Seattle, Wash. PArkway 3-9000
Syracuse, N.Y. GIbson 6-0220
Washington, D.C. JUniper 5-7550
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PERKIN ENGINEERING CORPORATION

345 KANSAS ST. • EL SEGUNDO, CALIF. • ORegon 8-7215
or EAstgate 2-1375.

New England Area Office: 46 Amesbury, Lawrence, Mass. • MUrdock 3-3252

SAN FRANCISCO SECTION

Grid

VOLUME 6 SEPTEMBER 1959 NUMBER 1

(Continued on page 8)

IN THIS ISSUE

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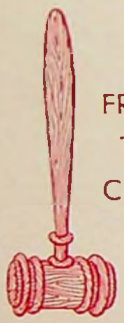
Corey



FROM THE CHAIR

Perspective

Twice during the year it is particularly interesting and important to look with perspective at the operations of our San Francisco Section as a whole: Once in prospect, at the start of the year's activities, to chart our course and define our objectives; once in retrospect, at years' end, to gage our progress and to learn from our experiences.

The view ahead is exciting rather than merely encouraging. San Francisco Section membership, now more than 3300, is expected to increase by some 300 or more during the next year. Funds managed by the Section will reach nearly $50,000 during the year ahead, including funds identified with **Grid** operations. Fourteen active professional groups crowd the meeting calendar with some 100 scheduled technical sessions including special lecture series. 1959 WESCON has already provided a most outstanding overture to our program.

Without question our San Francisco Section will grow and advance almost automatically as electronics research and the electronics industry continue their course of progress. But perhaps we may augment the growth of our Section or contribute to its order and stability by planning ahead, with due regard for the experience and counsel of those who have led the Section in prior years.

One of the ways in which we have opportunity to improve Section operations is through the use of a budget. At the outset of this year we are preparing an estimate of our income and expenditures on a monthly basis, which estimate is to be presented to the Executive Committee for approval or revision. One of the two major parts of the estimate deals exclusively with **Grid** operations, while the other part is concerned with all other business affairs of the Section. Upon acceptance in eventual form the estimate is to serve as a fiscal plan for our year's activities.

Prepared with the perspective afforded by our past fiscal records, and presented with the recommendation of Section representatives in key positions of authority and responsibility, such a plan can have multiple benefits. It necessitates an agreement on a considered plan which can then be utilized for control during the period of its effect. Basic agreement among individuals responsible for the plan lays emphasis on a common purpose to which all have been openly committed, so that only deviations from the accepted plan represent causes for debate or new decision. The Executive Committee is faced appropriately with the necessity to review, improve and take responsibility for a plan of action for the year ahead, rather than merely with an opportunity to give passive acceptance or futile objection to the year's record in retrospect. We hope that our experience with a fiscal plan during the coming year will be a significant item of progress.

Another area of some innovation relates to the Executive Committee for the Section. Composed of some thirty members, including Section officers and directors, chairmen of fourteen professional groups, and chairmen of various responsible committees, the Executive Committee has become so large that its business sessions must be protracted interminably in order to handle the multitude of items which have legitimate importance. Inefficiency has been the inevitable result, since the time of all is necessarily required for deliberation on each item.

In order to recognize and support the prime importance of professional group affairs in our Section, a Professional Group Committee has been formed within the Executive Committee, under the chairmanship of Dr. Donald Dunn, vice chairman of the Section. Through regular and independent meetings of this body, due attention can be given to many of the matters with which the professional groups can deal directly, and to other matters which can be reduced to concerted recommendation for action in the full Executive Committee. Similarly, it may be possible to handle much of the routine business of the Section, of doubtful interest to the full Executive Committee, in special meetings of an Operating Committee likewise formed within the Executive Committee, with large benefits of time saved in full session.

Other matters of plan or improvement for the coming year which may deserve fuller comment in future issues have to do with administrative, stenographic and clerical service afforded through WESCON; and with IRE participation in the administration of a new scholarship fund established and contributed by WESCON.

We have reason to be proud of our San Francisco Section for its growth, achievements and prospects; but without question we propose to improve. I wish to express my special appreciation to Dr. Earl Goddard, junior past chairman of the Section, for his numerous contributions and effective suggestions. In addition I want to make very clear that suggestion or constructive criticism from any quarter is most welcome.

Now for the serious business of 1959-1960-

Victor B. Corey, chairman,
San Francisco Section—IRE

MEETINGS AHEAD

EAST BAY SUBSECTION

7:30 P.M. • Monday, October 5

"Design of Transistor High-Speed Digital Computer Circuitry"
Speaker: Jerome Russell, electronic engineer, Lawrence Radiation Lab.
Place: Lawrence Radiation Laboratory Auditorium, Livermore, Calif.
Dinner: 6:00 P.M., Livermore
Reservations: Mr. Stripeika, Hilltop 7-1100, Ext. 84203, by Friday, Oct. 2

PROFESSIONAL GROUPS

Antennas & Propagation

8:00 P.M. • Tuesday, October 13

(Details to be announced)

Electron Devices

8:00 P.M. • Wednesday, September 30

(Joint meeting with PGMTT)
"Recent Developments in Masers"
Speaker: Anthony Siegman, assistant professor of electrical engineering, Stanford University
Place: Room 100, Physics Building, Stanford University

Electronic Computers

7:30 P.M. • Tuesday, September 22

"Trip to Russia and Russian Computers"
Speaker: Mr. Morton Astrahan, manager, small business systems, IBM
Place: Village Auditorium, Stanford Research Institute, Menlo Park
(Wives are invited)

Microwave Theory & Techniques

8:00 P.M. • Wednesday, Sept. 30

(Joint meeting with PGED, see above)

Production Techniques

8:00 P.M. • Tuesday, September 22

"Production Planning and Rapid Growing of Electronic Factories"
Speakers: Charles V. Anderson, professional products, production control manager, Ampex Corporation; George M. Eustachy, production manager, Berkeley Division of Beckman Instruments; Olof Landeck, production manager, Electro Engineering Works, Inc.
Place: Physics Hall, Stanford University, Stanford

Reliability & Quality Control

Sixth Annual Bay Area Quality Control Conference

9:30 A.M. • Thursday, September 17

"Human Relations Problems in Quality Control"
Speaker: R. H. Hamstra, president, Executive Futures, Inc.
Luncheon: 12:00
"Quality Control in Aircraft Accidents"
Speaker: Major General Joseph D. "Smokey" Caldera, deputy inspector general, headquarters flight safety research, USAF, Washington, D. C.
Four sessions each on Management and Administration (non-statistical presentations), Quality Control Engineering (statistical presentations), and Inspection Clinic (measuring and testing techniques)
Place: Cubberley Hall, Stanford University

8:00 P.M. • Tuesday, September 29

"How to Prepare a Glossary of Terms"
Speaker: Dr. Louis Fein, consultant, Palo Alto
Followed by a panel discussion on reliability definitions
Place: Hal's Restaurant, 4085 El Camino Way, Palo Alto
Dinner: 6:00 P.M. Hal's Restaurant, 4085 El Camino Way, Palo Alto
Reservations: John Hall, LYtell 1-1414, by Friday, September 25

Space Electronics & Telemetry

8:00 P.M. • Thursday, October 1

Place: Lockheed Missiles and Space Auditorium, 3251 Hanover, Palo Alto

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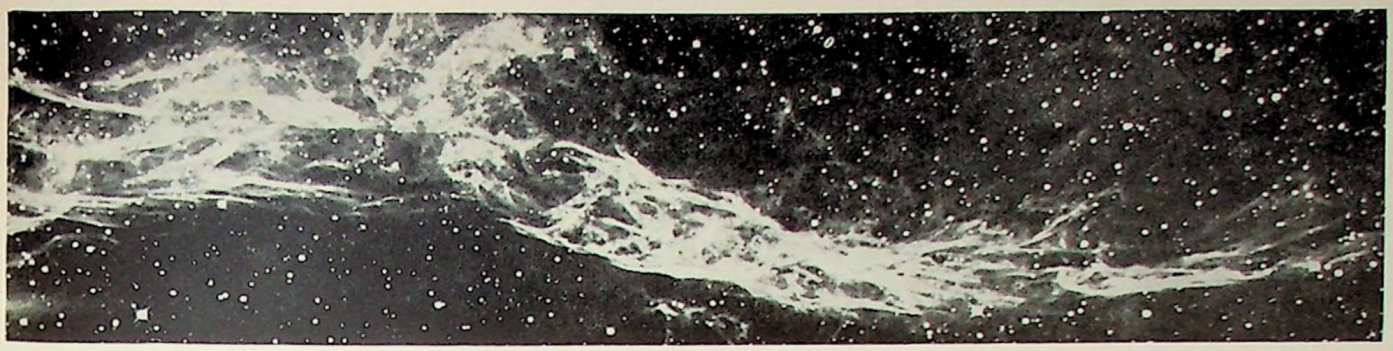
CHRONOLOGICAL RECAP

September 17—Sixth Annual Bay Area Quality Control Conference
September 22—Electronic Computers, Production Techniques
September 29—Reliability & Quality Control
September 30—Electron Devices/Microwave Theory & Techniques
October 1—Space Electronics & Telemetry
October 5—East Bay Subsection
October 13—Antennas & Propagation



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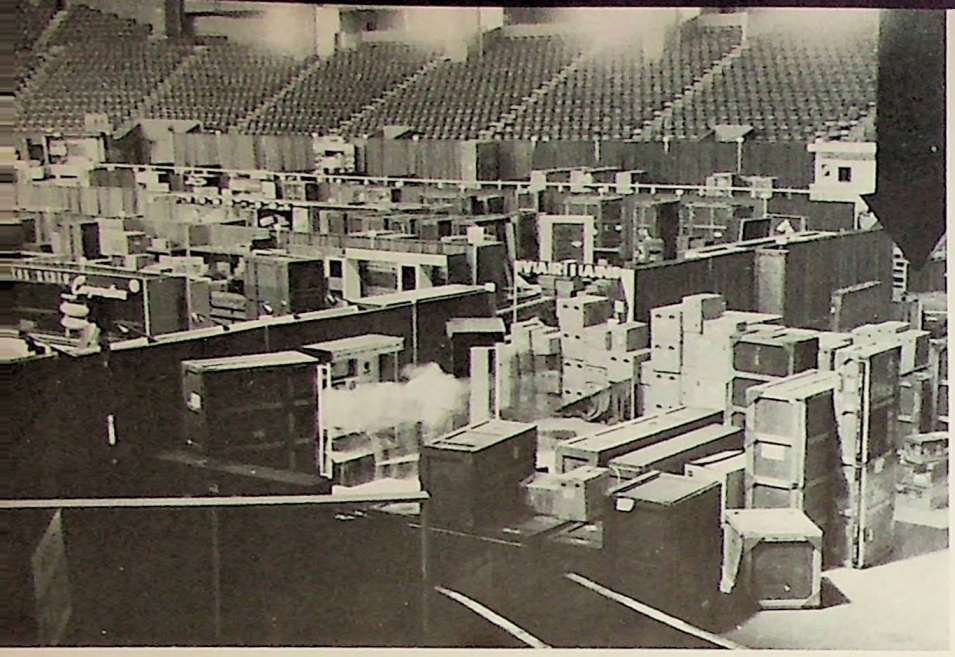


Above, the WESCON few people see. Pre-opening view notable chiefly for earnest activity in the Varian booth. Left, the WESCON 30,898 saw. Symbolized sun was orbited by Pioneer IV Probe from JPL

WESCON 1959

They Went Thataway

Another WESCON has come and gone, much as we predicted it would. There were, of course, some surprises and previously unannounced moments of high entertainment and technical interest.

Opening ceremonies, for example, consisted of a four-way conference communication between personnel on a temporary stage in front of the Cow Palace; Jodrell Banks, Manchester, England; Space Technology Laboratories in Los Angeles; and Explorer VI flying through space 18,300 miles over Africa. Over the objections of reluctant STL engineers, a second model of Explorer VI was exposed to the elements on the same stage at the Cow Palace. What Explorer VI had to say appears in digital form on the cover.

Routine activities such as technical sessions, engineering field trips, and the like went off pretty much as announced in the summer issues of the **Grid-Bulletin,** and in the opinion of many, more smoothly than ever. Public

(Continued on page 12)

ABOUT THE COVER

Word from Out There

On the cover of this issue, in its native habitat, is seen Explorer VI accompanied by a sampling of the kind of information it telemeters back to a network of ground stations on earth. Seen monitoring the incoming data are Bernard M. Oliver, chairman, executive committee, WESCON; H. Myrl Stearns, chairman, board of directors, WESCON; and E. Micheal Boughton, STL.

Featured in the opening-day ceremonies at WESCON (discussed elsewhere in this issue), this scene also appropriately fits the forthcoming National Symposium on Space Electronics & Telemetry in San Francisco on September 28-30 (also discussed elsewhere in this issue).

Explorer VI is the paddle-wheel satellite launched August 7, 1959. Presently traveling an elliptical path around the earth, the satellite was instrumented by its designers, Space Technology Laboratories, Inc., of Los Angeles, to conduct a series of experiments in such important areas as radiation, magnetic field, and propagation.

The wide elliptical orbit makes it possible to study the vast and important region of space in the immediate proximity of earth. In addition, the plane of the orbit will slowly tilt upwards toward the equator during the year-long life of the satellite. It is this area that is most interesting to space scientists. Explorer VI weighs 142

(Continued on page 12)

NATIONAL SYMPOSIUM

Electronics in Space

The National Symposium on Space Electronics & Telemetry is to be presented by PGSET in San Francisco, September 28 through 30, 1959.

Featuring nine sessions of 41 papers total (in the Civic Auditorium); as well as a reception and cocktail party, a banquet, and a luncheon (all at the Whitcomb Hotel); the event was organized under the general chairmanship of Robert E. Rawlins of Dymec, Inc. Members of Rawlins' committees were as follows:

G L. Larse, Lockheed Missiles and Space Division, Sunnyvale, technical program chairman;

Robert A. Grimm, Dymec, Inc., Palo Alto, exhibits and arrangements chairman; and

Robert De Liban, Barrett Electronics Corp., Menlo Park, publicity chairman.

In addition to the program which follows, complete with abstracts, the technical presentation includes a product exhibition in the Civic Auditorium with 35 commercial displays. Exhibits will be open on Monday and Wednesday from 10 A.M. to 6 P.M. and on Tuesday from 10 A.M. to 9 P.M.

A "Proceedings" will be available at the registration desk at a cost of $5.00 or by mail—address: NSSET c/o Dymec, 395 Page Mill Rd., Palo Alto.

PROGRAM

SESSION 1

SPACE ELECTRONICS I COMMUNICATION

Monday, September 28
10 A.M. to 12:30 P.M.

Chairman: C. H. Hoeppner
Radiation, Inc., Melbourne, Fla.

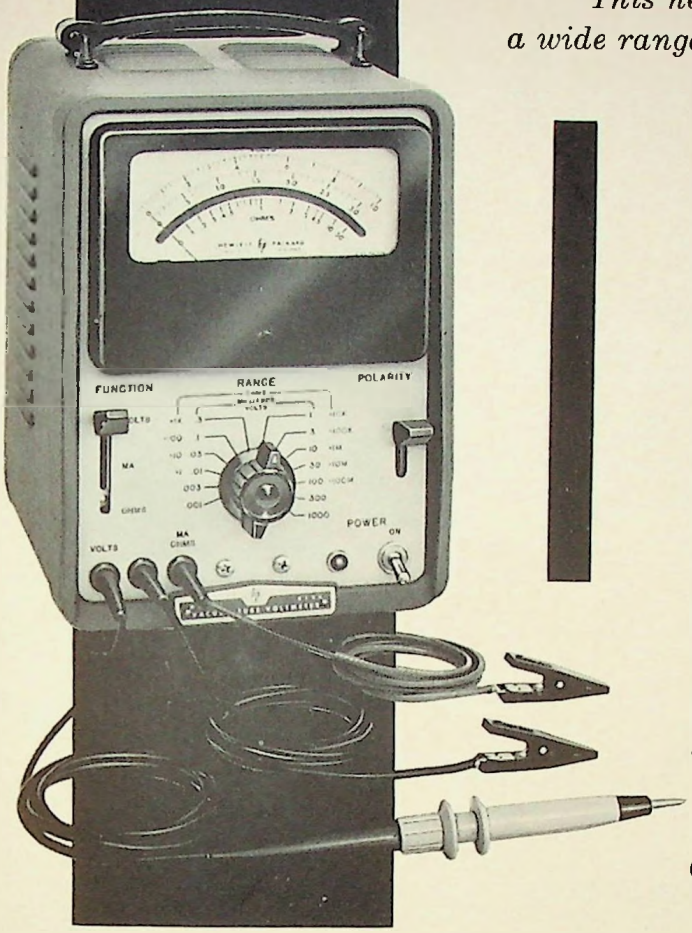
1. **DESIGN AND EVALUATION OF SPACE COMMUNICATIONS SYSTEMS USING COMPUTER SIMULATION TECHNIQUES**

D. R. J. White, American Machine and Foundry Company, Alexandria, Virginia.

(Continued on page 12)

R. E. Rawlins, national chairman, NSSET

This new precision DC VTVM is also a wide range, precision ohmmeter and ammeter!



1% accuracy 100 μv to 1,000 volts!

Also 2% accuracy, 1 μa to 1 amp full scale.

Measures 0.02 ohms to 5,000 megohms.

No zero adjustment. 1 minute warm-up.

Floating chassis. $1,000 worth of convenience for $350!

Haven't you wished for one compact, simple instrument that would make *precision* dc voltage, dc current and resistance measurements over a wide range?

The new hp 412A is it! In its VTVM circuit, the 412A uses an exclusive hp photo-chopper instead of old-style mechanical vibrators—no drift, no 60 cps pickup. Input is floating, with resistance increasing from 10 megohms on the 1 mv range to 200 megohms on ranges above 100 mv. Current and voltage ranges have a 10 db sequence for maximum readability and overlap. The ohmmeter is a modified Kelvin bridge eliminating lead resistance error; you measure resistance accurately on hook-up wire sections as short as 6".

Model 412A also includes a 1 v or 1 ma recorder output, and 3 separate probes. Call your hp rep today for a demonstration on your bench. Price, $350.

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400L LOGARITHMIC VOLTMETER—$325

New hp voltmeter covers 10 cps to 4 MC; accuracy high as ±2% of reading or 1% of full scale. Voltage range 0.3 mv to 300 v, 12 ranges, 1-3-10 sequence. Max. full scale sensitivity 1 mv. Large 5" true log voltage scale, linear 12 db scale, generous overlap. High stability, high input impedance. Also useful as amplifier for small signals, or to monitor waveforms.

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Extreme accuracy as high as ±1% to 500 KC, ±2% to 1 MC, ±5% full range. Frequency coverage 10 cps to 4 MC. Large 5" meter with precision mirror scale. Voltage range 0.1 mv to 300 v; max. full scale sensitivity 1 mv. High 10 megohm input impedance minimizes circuit disturbances. Amplifier with 56 db feedback insures lasting stability. Reads direct in db or volts.

400D WIDE RANGE VOLTMETER—$225

Highest quality, extremely versatile. Covers 10 cps to 4 MC. Highly sensitive, accurate to within ±2% to 1 MC. Measures 0.1 mv to 300 v; max. full scale sensitivity 1 mv. Reads direct in dbm. High 10 megohm input impedance virtually eliminates circuit loading. 56 db amplifier feedback insures high stability and freedom from change due to external conditions.

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

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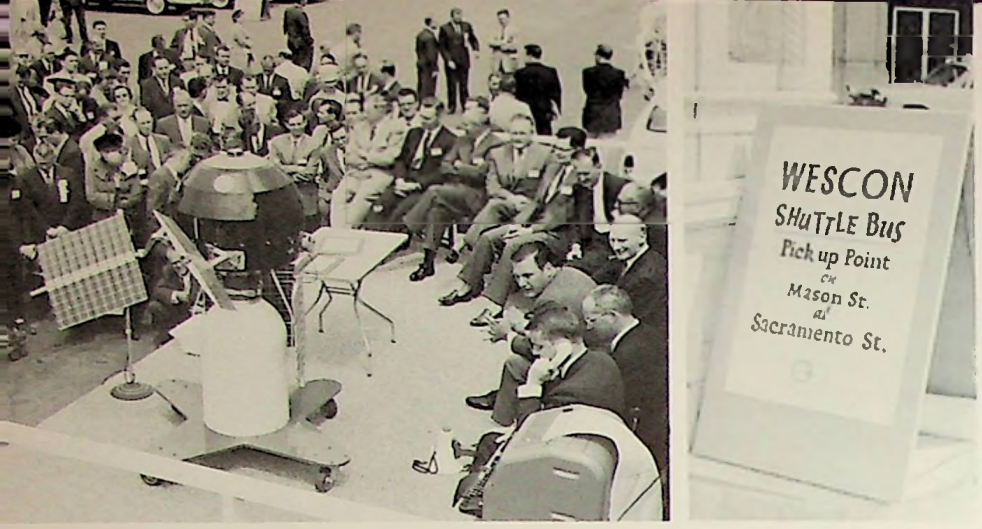
Los Angeles, 3939 Lankershim Blvd., North H'wd., ST 7-0721; San Carlos, 501 Laurel St., LY 1-2626; Sacramento, 1317 Fifteenth St., GI 2-8901; San Diego, 1055 Shafter St., AC 3-8106; Phoenix, 641 E. Missouri Ave., CR 4-5431; Tucson, 232 So. Tucson Blvd., MA 3-2564; Albuquerque, 107 Washington St., S.E., AL 5-5586; Las Cruces, 126 S. Water St., JA 6-2486.



Opening ceremonies found WEMA and IRE luminaries on the WESCON stage: Bruce S. Angwin, Victor B. Corey, John A. Chartz, Walter E. Peterson, Hugh P. Moore, D. C. Duncan, O. H. Brown, Albert J. Morris, IRE President Ernst Weber, Bernard M. Oliver, H. Myrl Stearns

MORE WESCON

address systems faltered in just enough cases to set the proper tone. A new twist was introduced during the opening ceremony where dignitaries labored to get some assistance from the microphone on the stage only to discover that it was not a public address system at all but part of the Ampex Videotape equipment on hand to document the event.

Before all the dust cleared away, the hoped-for attendance of 30,000 had been exceeded by 898.

Eight hundred fifty-seven companies occupied 960 booths with a floor space of 259,000 sq ft. They hawked their wares with the help of 1,500,000 pounds of displays and equipment valued at $20 million and consuming 1,800,000 watts of electricity.

(Continued on page 14)

Allen M. Peterson receives Seventh Region Achievement Award from Glenn A. Fowler, IRE Seventh Region director

MORE COVER

pounds and has a diameter of 29 in.

Meanings of the tabular headings are as follows. Zebra identifies a 24-hour Greenwich Mean Time clock. The University of Chicago experiment aboard consists of both single- and triple-coincidence cosmic-ray counters. The University of Minnesota experiment includes Geiger-Mueller and ion-chamber measurement of particles at different energy levels. The Stanford experiment was proposed by Professor Robert A. Helliwell and implemented by a special radio receiver developed by Louis H. Rorden of Stanford Research Institute and Robert N. Beatie of Develco, Inc., of Belmont. This picks up very-low-frequency signals at 15.5 kc from the Navy's big Annapolis transmitter, and relays them to the ground—the objective being to measure the approximate height at which the D layer of the ionosphere reflects the signal.

Micrometeorite hits are counted in two categories: high mass-times-velocity, which represents particles of pin-head size; and total, which represents dust. The next column reports a scintillation counter reading total radiation flux.

Magnetometer data shows the phase and amplitude of a search-coil device used in conjunction with a flux-gate magnetometer to permit mapping of the vector magnetic field, sun referenced.

Various temperature readings from the equipment compartment and the solar-battery paddles are seen to be telemetered on a sub-commutated basis as are current and voltage measurements which permit determination of storage-battery and solar-cell condition. The last column, range from the earth's surface, is computed. Position can be expressed in any desired coordinates.

MORE PROGRAM

This paper describes a high-speed digital computer simulation approach to the design and evaluation of space communications systems. Emphasis is placed on the synthesis of requirements and determination of expected performance of either existent or proposed system designs.

Several mathematical models and operation logic of transmitter and receiver characteristics, their antenna systems, of propagation phenomena, signal intelligibility criteria, and scoring techniques are combined with physical realizability weighting factors to evaluate performance in light of either certain objectives or known users' needs. While approximately 100 variables and many theoretical and empirical relations are programmed on an IBM-704 computer, different trial designs can be quantitatively compared in the computer as these variables are manipulated to obtain an optimum overall systems design.

2. THE USE OF PCM IN DATA LINKS WITH SATELLITES, SPACE VEHICLES AND LONG-RANGE MISSILES

R. L. Sink, Consolidated Electrodynamics Corporation, Pasadena, California.

This paper is devoted to examining the feasibility and possibilities of using digital methods for the storage, transmission and recovery of data in vehicles operating under marginal or limiting transmission conditions. The emphasis will be placed upon establishing the probable limits of capabilities of digital methods as data transmission and storage links as determined by probable state-of-the-art advances within the next five years. Definitions of the problems are given and compared with the data link requirements in terms of speed, bandwidth, storage, resolution, etc. The types of data considered for transmission and storage will include visual, engineering, and space information. Comparisons will be made on the basis of alternate storage, modulation, and circuit methods. Some methods of reducing the amount of redundant information to be transmitted and stored will be suggested.

3. PHASE-LOCK IN SPACE COMMUNICATIONS

F. A. Ruegg and W. F. Sampson, Hallamore Electronics Company, Anaheim, California.

The assumptions, analysis and results of the

(Continued on page 14)

G. L. Larse, technical program chairman, NSSET

INTER-OFFICE CORRESPONDENCE

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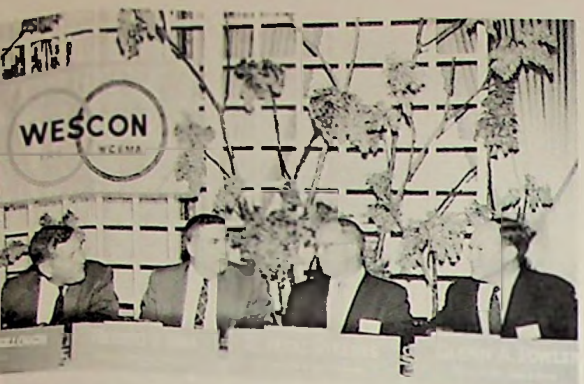

Informal shot of a segment from the head table at WESCON All-Industry Luncheon. York was principal speaker

Lloyd V. Berkner, president of the Associated Universities, Inc., spoke on IGY

Technical sessions featured "new sound" embodied in panel of peers seen here at right in typical post-paper discussion

MORE WESCON

Awards

Dr. Allen M. Peterson was given the 1959 Achievement Award for "leadership in basic electronic physics research in support of the national defense program."

Manager of the Stanford Research Institute communications and propagation laboratory and an associate professor of electrical engineering at Stanford University, Peterson was a member of the founding publications board of the **Grid** in 1955.

An international authority on radio-wave propagation, he has made numerous major scientific contributions to the discovery and interpretation of propagation phenomena. Among these are the discovery of the ground backscatter of radio signals and meteor-burst communications. He has conducted research on radio propagation in auroral zones which is of prime importance to military communications and the long-range detection of ballistic missiles. His research in radio-propagation effects of nuclear explosions has resulted in a reappraisal of U. S. defense planning. The ground-based experiments he directed has provided the basis for the scientific interpretation of Project Argus.

On a more earthly basis, 18 winners were announced for the first industrial design competition sponsored by WESCON. Winners were chosen by a professional jury from among 140 submissions. Awards of Excellence were made to Ampex Corp., Cannon Electric Co., Electronics International Co., the Digitran Co., Hewlett-Packard Co., Santa Anita Engineering Co., and the industrial products division of ITT.

Awards of Merit were made to Ampex Corp., Autonetics, Electronic Associates, Inc., General Electric Co., Librascope, Inc., Tally Register Corp., and Voltron Products.

At the junior age levels, awards were made in the Future Engineers Show by a committee of judges including Joseph M. Pettit, Dean A. Watkins, Earl G. Goddard, John V. N. Granger, William Eitel, Jack L. Melchor, Alexander Poniatoff, George E. Mueller, Lester E. Reukema, Andrew V. Haeff, C. J. Burnside, and W. J. Linder, all under the supervision of Glenn A. Walters of the committee.

The awards were as follows:

1st place — David Milne, Crawford High School, San Diego; 2nd place—David Skaar, Burroughs High School, China Lake; 3rd place—Sidney Hoover, Los Altos High School, Los Altos; 4th place—Theo W. Thomson, Logan High School, Logan, Utah; and 5th place—Philip Condit, Acalanes High School, Lafayette.

MORE PROGRAM

Jaffe-Rechtin optimization of the phase-lock loop for the detection of sine wave signals in noise are reviewed and summarized as a basis for extensions of this analysis. New results include a secondary optimization of the second order loop in the presence of a constant acceleration, and some interesting comparisons between the characteristics of second and third order loops. Practical application of these results is illustrated by several typical problems encountered in space communications.

4. A COMMUNICATION SYSTEM FOR A SMALL INTERPLANETARY VEHICLE*

Merrill I. Skolnik and Lincoln Cartledge, Massachusetts Institute of Technology, Lincoln Laboratory, Lexington, Massachusetts.

The design of a communications system to transmit a message to the Earth from an interplanetary vehicle such as a Mars reconnaissance probe is described. The communication range equation is used as the basis of design. Each of the various factors which influence the choice of the frequency are discussed. These include the energy per bit available from the transmitter, the vehicle antenna gain, the receiving antenna aperture, the receiver effective temperature, the needed signal-to-noise ratio, the stability of the transmitter, and the availability of components. The optimum frequency range of operation is derived and several possible transmitter configurations are discussed which use presently available devices. The particular problems involved in the selection of the modulation waveform are also mentioned. It is concluded that the transmission range of 250 million n. mi. required for a Mars probe is possible using present techniques. Extrapolations of present capabilities to the future are also given.

*The work reported in this paper was performed by Lincoln Laboratory, a center for research operated by Massachusetts Institute of Technology; this work was supported by the U.S. Air Force.

5. ENCODING, DECODING AND RECODING WITH BINARY-DECIMAL NUMBERS: AN EXPANDED VIEW

Bernard Lippel, U.S.A. Signal R&D Laboratories, Fort Monmouth, New Jersey.

The paper reviews the subject of decimal numbers represented by combinations of binary digits with particular emphasis on three areas in which a liberalization of generally-prevalent viewpoints and definitions results in additional degrees of freedom for design of encoding and decoding equipments. For brevity, the paper will be limited to these three areas of emphasis:

1) The extension of the definition of "constant-weight" codes, and its implication for voltage-to-digital and digital-to-voltage conversion.

2) A unifying discussion of unit-distance decimal codes for displacement digitizers and the relations between digitizer codes, translation processes, and target codes.

3) A generalized discussion of logical selection processes, (which are alternative to unit distance coding and subsequent translation) and illustrations of payoff in break-throughs in equipment design.

SESSION 2

DATA PROCESSING SYSTEMS AND TECHNIQUES

Monday, September 28
2 P.M. to 4:30 P.M.

Chairman: Joseph E. Hinds, Jr.
Ampex Corporation, Washington, D. C.

(Continued on page 16)

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Hughes has several hundred openings for engineeers and physicists whose training and experience are applicable to the research, development, design and testing of airborne electronic equipment for use in supersonic military aircraft; in solid state physics, nuclear electronics, industrial dynamics, and related areas.

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*College*_____ *Degree*_____ *Year*_____

I am interested in one of the following types of assignment:

- ☐ RESEARCH
- ☐ DEVELOPMENT
- ☐ PRODUCT ENGINEERING
- ☐ TECH. ADMIN.
- ☐ SYSTEMS
- ☐ FIELD TEST
- ☐ OTHER:_____
- ☐ _____

I have had professional experience in the following specific areas:

- ☐ CIRCUIT ANALYSIS AND DESIGN
- ☐ DIGITAL COMPUTERS
- ☐ GUIDANCE DEVICES
- ☐ MICROWAVES
- ☐ STRESS ANALYSIS
- ☐ INDUSTRIAL DYNAMICS
- ☐ MATERIALS
- ☐ SYSTEMS ANALYSIS
- ☐ R-F CIRCUITS
- ☐ RELIABILITY
- ☐ ATOMIC AND/OR SOLID STATE PHYSICS
- ☐ INSTRUMENTATION
- ☐ ELECTRO-MECHANICAL DESIGN
- ☐ OTHER:_____
- ☐ _____
- ☐ _____

I have had a total of _____ years of experience.

MEETING AHEAD

Maser Miscellany

Continuing the happy association established in last year's lecture series, the Professional Groups on Electron Devices and Microwave Theory & Techniques will join forces again this season. First scheduled meeting on the calendar will be on Wednesday, September 30 (see "Meetings Ahead").

Dr. Anthony Siegman, assistant professor of electrical engineering at Stanford, will discuss recent work in traveling-wave masers and review briefly the other types. Dr. Siegman will also give highlights of the Conference on Quantum Electronics including recent activities in vhf masers.

MEETING REVIEW

Man in Space Tank

Space technology was the subject of the May meeting of the PGED, only in this case it was not satellites but the "Design of Vacuum Tube Devices Using the Manned Space Tank." James Orr of Litton Industries presented the results of a project whose purpose was to investigate the feasibility of using the manned space tank to design beam-type tubes.

The advantage of this method is the ability to see the beam shape, due to ionized particles in the vacuum, and the way the beam shape changes as physical dimensions of the tube are changed. The man inside the space tank can, of course, change these dimensions quite simply without any need for complex external controls because he is inside the vacuum chamber along with the tube. The space tank can be evacuated to a pressure of 3×10^{-6} mm Hg with pumps which have a capacity of 15,000 liters per second.

Orr gave a complete summary of the project, starting with a background of M type devices, which is the only type he considered, and following with a discussion of the design criteria of electron guns for M type tubes. After the preliminary gun design is made, a scaled-up model is made with transparent (wire screen) gun parts to allow the electron beam to be viewed at all parts of its transit.

The model is then operated in the space tank, and photographs are taken of the beam to evaluate the design. Positions of all the parts are changed during this operation, and the effect upon the beam is observed. Some excellent photographs were taken in color and in black-and-white showing "good" and "bad" gun designs. A blue filter was used for increasing the resolution and minimizing the cathode glow.

A discussion of the errors made in

(Continued on page 18)

EXCOM—SFS

Microminutes

On August 31, the first Executive Committee meeting of the San Francisco Section for the new season was held at the Villa Chartier.

Committee Operation. Committee appointments (as printed in the Section Directory elsewhere in this issue) were announced by Chairman Corey and confirmed by the committee. Changes from past practice include a merger of the arrangements and public relations functions into one committee and the appearance of a new historical committee. Concerning professional group activities, a new professional group committee with Vice Chairman Dunn as chairman, was set up as a means of expediting the handling of PG matters without involving the entire executive committee in long deliberations.

In another step to streamline executive-committee functions, it was proposed that an operating committee be formed to permit rapid action on matters which could not wait for a full-scale executive committee meeting. After considerable discussion, it was determined that an ad hoc committee be formed of the officers, directors, and Junior Past Chairman Goddard to draw up a definition of membership and functions for this new group. Target dates of less than 90 days and more than 60 days were established.

Money. Treasurers' reports included both a recapitulation of last year's finances and a projection for the coming year. Publication activities and other Section activities were discussed separately in both these considerations.

For the period 1 July 1958 to 30 June 1959, **Grid** operations showed an approximate $600 contribution to equity, with "Grid-Bulletin" activities adding another $300. Other Section activities brought this total to about $2500, with approximately $17,000 on hand at closing.

In the prediction department, **Grid** activities were expected to approximately break even, "Grid Bulletin" publication to contribute approximately $4,000, and other Section activities to range somewhere between break-even and a gain of $1,000.

Meeting Notices. Considerable discussion was held concerning the desire of some of the professional groups to issue meeting notice reminders to augment their coverage in the **Grid** and the "San Francisco Engineer." This comes about largely through the production schedules of the two publications which inevitably favor certain dates and create a disadvantage for others.

(Continued on page 18)

Robert A. Grimm, exhibits and arrangements chairman, NSSET

MORE PROGRAM

1. **MATHEMATICAL APPROACH TO HYBRID COMPUTING**

George Birkel Jr., Radiation, Inc., Melbourne, Florida.

Hybrid (analog and digital) computation techniques simplify sampled data reductions and control function problems. The techniques are inherently compatible with usual equation formats.

The operational laws are largely determined by linear transformations or mappings. A finite algebraic field is defined by the system. Floating-point arithmetic inherently establishes a simple yet very flexible information format. A coding mesh related to a bounded reference subspace is defined with respect to a modulus or radix by a proportionality constant. A quantizing width defines the smallest possible mesh.

Normalizing operations are performed on digital data prior to arithmetic operations. Normalizing techniques used are similar to the usual floating-point procedures. Provisions for underflow and overflow conditions are included. Techniques for analyzing and minimizing errors are especially simple in such a finite algebra.

2. **HIGH SPEED HYBRID COMPUTER**

Meryl C. Burns, Radiation, Inc., Mountain View, California.

Hybrid computation tehniques are adaptable to the solution of many problems of process control and computation where on-line computing is desired. These techniques combine the best performance of digital and analog equipment to produce a unique combination capable of operating at extremely high speeds and at high accuracies. Accuracies and speeds approach those obtainable with high priced digital computers. The basic techniques of hybrid computing, using conventional analog-to-digital digital-to-analog, electronic commutators and NOR logic, are described in detail. Methods of scale adjusting, error detection and use of error analysis are described. A typical problem setup illustrates a practical computer configuration. Conclusions are drawn as to the adaptability of hybrid computer systems for process control, routine computation and simulation.

3. **HIGH SPEED DIGITAL PLOTTER**

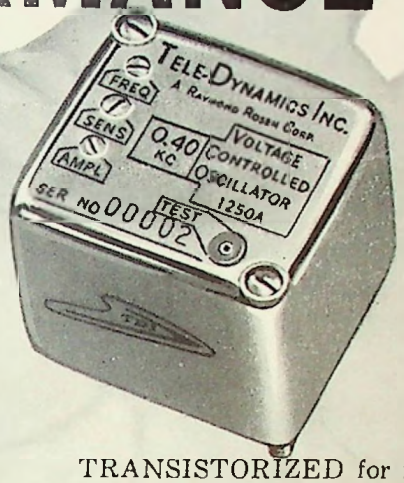
R. Saperstein, Lockheed Missiles and Space Division, Sunnyvale, California.

The High Speed Digital Plotter accepts a mag-

(Continued on page 18)

An advance in the state of the art for SUB-CARRIER OSCILLATORS

TELE-DYNAMICS puts a NEW PERFORMANCE STANDARD



TDI Type 1250A
Sub-Carrier Oscillator.
Shown actual size—dimensions:
$1\frac{7}{16}$ x $1\frac{7}{16}$ x $1\frac{5}{16}$"
weight: 3 ounces (approx)

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TRANSISTORIZED for reliability, miniaturization, and power conservation . . . this versatile oscillator for voltage or current control provides outstanding operating characteristics for the severe environments of missile and drone telemetry. Silicon transistors permit operation up to 100° C under extreme conditions of vibration and impact shock. Linearity is held to within ±.25% of design bandwidth; stability is maintained within ±1% with ±10% variation in supply voltage.

This design delivers predictable performance . . . insures extremely long life with stability and repeatability. A highly efficient band pass filter is incorporated and the entire unit is encapsulated.

The deviation sensitivity, center frequency and output voltage adjustments on the 1250 provide UNIQUE VERSATILITY for all telemetry applications.

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H. G. Markey, staff engineer, IBM research lab, leading tour through the facilities at the June PGEM meeting

Robert De Liban, publicity chairman, NSSET

Perrone

Dunbar

Left, scenes from the June PGEM meeting

MEETING REVIEW

Think Piece

The June meeting of the PGEM was held at the San Jose laboratory of IBM.

Speakers for the evening were J. Perrone; L. D. Stevens, manager of production development laboratories; and Ray Johnson, manager of advance systems designs. These gentlemen discussed the reasons behind the recent national reorganization of IBM.

Principal effects of this reorganization are separation of the data-processing division into separate marketing and manufacturing operations, thereby providing increased marketing potential. Also discussed were IBM methods of bringing a new product into being, starting with an idea presented by a design artist and traversing various committee discussions. Each new product must represent a definite advance over existing products.

The new advanced systems-design group under Johnson will provide new fundamental ideas. It is expected that the maximum results will be obtained by providing pleasant working environment, adequate facilities and support, with constant emphasis upon advanced education.

The meeting was followed by a tour of the research lab in San Jose.

—W. S. Chaskin

MORE SPACE

scaling was also presented. The most serious error was the inability to scale the thermal velocities, which were more pronounced in the scaled model. This error contributed a slight fuzziness to the edges of the beam.

—Berin Fank

MEETING REVIEW

The Lockheed Environment

The Lockheed Aircraft Corporation's missiles and space division hosted the final meeting of the season for the PGRQC Chapter of the San Francisco Section in May. After dinner in the company's Sunnyvale cafeteria, staff members of the quality assurance and test service branch described their respective operations. Fittingly, Ross Bumstead, assistant director quality assurance and test services, led off by highlighting each of Lockheed's many and varied

(Continued on page 20)

MORE EXCOM

As a result of this discussion, it became apparent that the special bulletin-board meeting notices produced by the **Grid** were not generally known about. These notices, printed on heavy paper and suitable for bulletin board mounting, reproduce the meeting calendar from the forward section of each issue of the **Grid** and are mailed out somewhere in the neighborhood of a week ahead of the corresponding issue of the **Grid**.

Distribution and mounting of these notices is generally a function of the membership committee, but anyone within the Section having a situation in which these would be helpful is invited to contact the **Grid** office to be placed on this mailing list for any desired number of these notices.

Because of the fact that the services available in the WESCON office include the distribution of notices for individual professional groups, it was the expression of the executive committee that these should be distributed through such channels where they will be helpful, but that costs for such activities done externally should not be a part of standard professional group budgets.

MORE PROGRAM

netic tape input and records the output on moving electrolytic facsimile paper. The maximum plotting rate is in excess of 4000 points per second in addition to the grid pattern. The plotter is normally used to record data complete with coordinate system and alpha numeric annotation, such as scale factors, title blocks, and important event markings. Resolution and accuracy of the Plotter is 0.01 inch, and the nominal paper drive speed is 1.0 inch per second.

With the use of this instrument, completely annotated curves can be produced in final form, requiring no further manual work, save the addition of an approval signature, at the rate of many hundreds per day.

4. AN INTEGRATED GROUND FLIGHT TEST DATA REDUCTION CENTER

E. N. Sherman, EPSCO, Inc., Boston, Massachusetts.

This paper describes a completely integrated system capable of accepting PDM, PAM, FM-FM or PCM information at high dynamic rates. Included are a high rate primary data acquisition digital tape transport, editing features which allow the selection of portions of the data, and a PCM microwave link for transmission of the data over land for distances up to 50 miles. The final output of the system is a digital tape in IBM 704 computer format.

5. TELEMETRY DATA PROCESSING AT CONVAIR-ASTRONAUTICS

R. G. Madsen, Convair-Astronautics, San Diego, California.

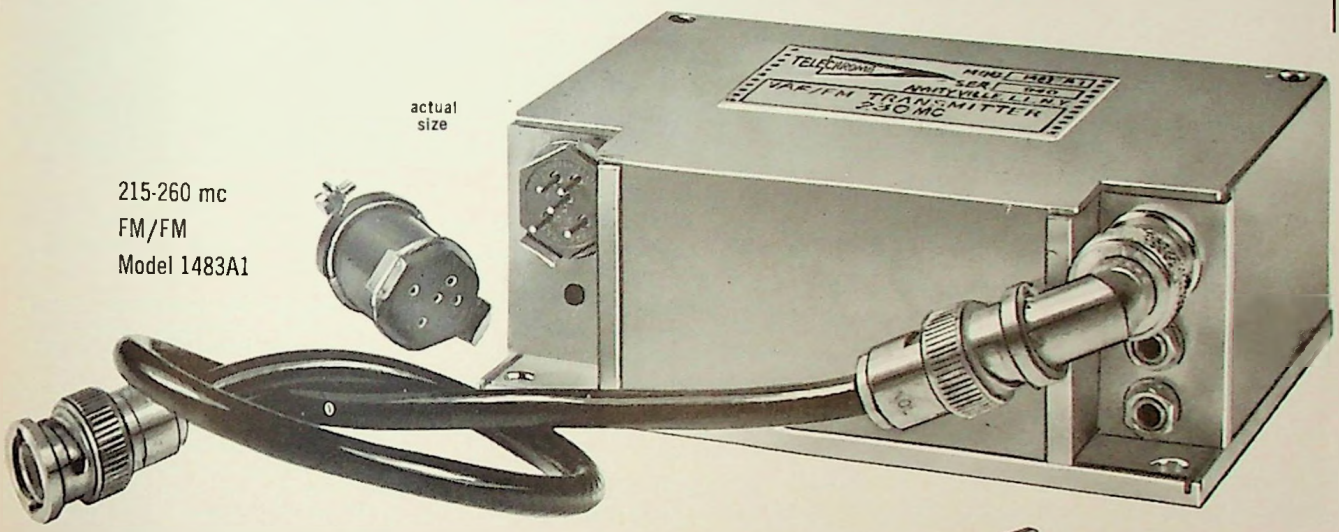
The Data Processing Station at Convair-Astronautics is designed to process large quantities of telemetry data at high production rates. Data is processed in real time from magnetic tape with all corrections handled automatically; i.e., wow and flutter, zero offset, scale factor, (VC), zero drift (VCO), nonlinearity, and timing offset. Analog trace graph and digital output records are direct reading in elapsed time and convenient physical units. A Central Control Console using perforated tape provides automatic programming and automatic checkout of all major equipments.

The Data Processing Station is one of three laboratories in the Computer and Simulation Section and is physically located adjacent to the Analog Computer and the IBM 704 Digital Computer. When needed, all three laboratories are interconnected to provide an extremely versatile and powerful tool for post flight simulation and analysis.

(Continued on page 20)

TELECHROME TRANSMITTER

SEE IT AT BOOTH 201



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Model 1483A1

Features:

- Power output 4 watts min.
- AFC Loop crystal controlled for ± .005% carrier stability.
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- Silicon Transistors for Low Noise and High Efficiency.
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- Size 1⅝" x 2¾" x 4".

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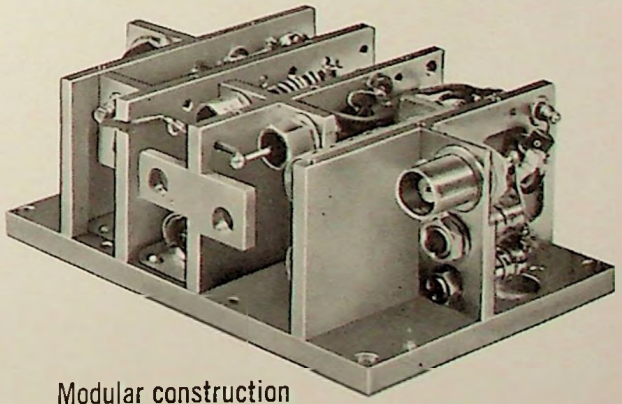

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test facilities. In addition to launch pads at Cape Canaveral, such facilities include a sophisticated installation entitled a ship motion simulator. This device simulates the pitch, roll and heave of a ship at sea and its motion is controlled from tape recordings actually made on board vessels which will be used for launching the Polaris missile.

At the Holoman Air Defense Center, Lockheed makes flight tests on high-speed drones using ramjet engines. These vehicles are recovered by parachute, making it possible to get several flights from each vehicle.

Located at San Clemente Island, Lockheed maintains an underwater launch facility where Polaris missiles are tossed into the air from a vessel anchored to an underwater pad which simulates a submarine at sea. Utilizing the equipment, problems in underwater stability, launching techniques and the structural integrity of the vehicle are studied to guarantee a reliable weapon system.

Lockheed maintains a static-firing test site in the Santa Cruz mountains. Here solid and liquid propellant type missiles are test fired while being held to the test stands. At the Santa Cruz site "soft mounts" are utilized. The vehicles are held by four struts which are focused at the cg at one end and supported at the other by a hydraulic damping device. These struts have flexure pivots which allow the vehicle to move in pitch and yaw, and the damping device allows several inches in axial motion. Except for lack of longitudinal acceleration, this engine-firing test simulates the missile in its airborne environment. During the test all subsystems such as guidance, flight control, etc., are operated to establish their reliability.

Environmental Laboratory

Harry Cuzner, in describing the "Role of the Environmental Laboratory in the XA and XN Projects" called attention to the fact that while two of the programs at Lockheed, the Discoverer and the Polaris, have somewhat different environmental requirements, the overall environmental test doctrine necessary is the same. The Polaris program does not require testing to the hyper altitude of the Discoverer, nor is the Discoverer required to sustain a depth charge attack.

The environmental laboratory acts in three major capacities (1) as a tool for the design organization to assist in product evaluation during development, (2) as a semi-independent and unbiased testing organization to determine if a prototype article can meet the qualification environments of the vehicle, (3) to determine the reliability of a qualified article.

During the first phase, extremely close liaison is maintained between the test and design organizations. At this time, the laboratory provides an advisory service on difficulties to be anticipated during testing. Breadboards of components and systems are tested in a limited number of environments such as vibration, shock, temperature, altitude, etc. Tests peculiar to the particular program may be requested in addition to those listed.

During the qualification phase, the test laboratory acts as a member of the quality assurance team. In this capacity it has the responsibility to determine if a component system or assembly will perform satisfactorily during the ultimate environmental conditions to be expected during flight. Here the specimen is subjected to the full range of environmental conditions required in the qualification specification.

Reliability testing includes qualification of parts and components under environmental and extended-life-test conditions. In addition, static firings are employed to provide a measure of system reliability.

Many of the random vibration specifications received by test laboratories do not adequately specify the parameters necessary for the establishment of a known random-vibration environment. The proper interpretation of an adequate specification, by the test personnel, is just as important as the specification. In describing "A Practical Approach to Random Vibration Testing," Ray Bell, supervisor of the environmental test laboratory, presented a plea for proper interpretations of test specifications.

Cathcart described the space environment chamber now in use at Lockheed. This unit was designed and built to LMSD specifications. The test chamber is unique in that it consists of a large chamber capable of being evacuated quite rapidly and, in addition to simulating high altitude conditions, the chamber is outfitted internally with a series of 14 panels, 12 of which form a cone with additional panels top and bottom. Each of these panels is capable of being separately cycled. Conceivably adjacent panels might be opposite ends of the temperature limits of the test chamber. Units to be tested under simulated space environments are placed inside the cone. Through automatic cycling of various panel temperatures, it is possible to simulate a satellite's environment while in orbit, i.e., high temperatures occurring during exposure to sunlight and low temperatures being experienced while in the shadow of the earth.

The technical (verbal) session served as prelude to a guided tour through a

(Continued on page 22)

MORE PROGRAM

SESSION 3
PROPAGATION PROBLEMS AND RECEPTION METHODS

Monday, September 28
2 P.M. to 4:30 P.M.

Chairman: Robert B. Muchmore
Space Technology Laboratories, Los Angeles

1. DATA RECOVERY — NEW APPROACHES REQUIRED FOR RE-ENTRY VEHICLE INSTRUMENTATION

P. A. Lathrop, General Electric Company, Philadelphia, Pennsylvania.

A phenomenon common to all re-entry vehicle flights to date is the ionized sheath which forms and impedes electromagnetic transmission from the vehicle at the most critical time of flight. Some of the solutions to the problem of data recovery from this portion of the flight—the most crucial from the standpoint of vehicle survival—will be discussed.

For collection of data at or near the time of final impact with the earth, the normal problem of horizon limitations on propagation at short wavelengths associated with telemetry is still with us. Some of the other old familiar problems plaguing these systems are transmission link noise, bandwidth limitations in terms of frequency allocation and equipment capabilities. A new approach to minimizing these problems will be presented, together with a discussion of the equipment involved.

Both system and component design will be discussed, showing how successful results have been obtained from Thor and Atlas Re-entry Vehicle Flights, gathering data for proving existing designs and for generating new designs for re-entry vehicles and space vehicles.

2. ANALYSIS AND PREDICTION OF RADIO SIGNAL INTERFERENCE EFFECTS DUE TO IONIZED LAYER AROUND A RE-ENTRY VEHICLE

W. C. Taylor, Lockheed Missiles and Space Division, Sunnyvale, California.

The theoretical section of this paper discusses the electromagnetic properties of the ionized shock layer about a missile re-entering the atmosphere; a treatment is then given to the problem of predicting the transmission, through the shock layer, of electromagnetic waves originating on the vehicle. The major portion of this section is given to outlining the important quantitative aspects for calculating the extent of the attenuation problem.

The experimental section is devoted to a discussion of the plans and results to date of an experimental program which is designed to supplement or verify theory and to point the way to possible solutions of the transmission problem. One of the most important phases of this program is tests on scale models greater than 5" in diameter in the Lockheed 24" spark-heated tunnel involving flow velocities greater than those predicted for the longest planned Polaris trajectories.

3. RADIO FREQUENCY PROPAGATION TO AND FROM ICBM'S AND IRBM'S

F. S. Howell and W. H. Drake, Space Technology Labs., Inc., Los Angeles, California.

An analysis has been made of a large number of ICBM and IRBM instrumented launches to determine the causes of data "drop-outs". Results of the analysis show effects produced by flame, antenna ionization, antenna pattern and pressure shock wave. Recommendations are included which will assist systems engineers to reduce the detrimental aspects of the effects encountered. These effects are applicable to all systems at all frequencies. Data includes radar, Azusa, telemetry and other equipment operating on frequencies from 200 megacycles to X-band.

(Continued on page 22)

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portion of the environmental test facilities. Equipment included in the tour consisted of the 25,000-lb Calidyne vibration machine (this unit requires a 250-kw amplifier to drive the exciter), a 1000-g centrifuge (not yet completed), a walk-in type vacuum chamber (capable of attaining a pressure of 10^{-6} mm Hg), and various arrangements of test equipment for analyzing power spectra.

—R. A. Davis

MEETING REVIEW

Bandwidth Prodigality

The Professional Group on Space Electronics & Telemetry held a regular meeting at Philco Corporation, Western Development Laboratories, in June. A. S. Westneat, Jr., formerly of ASCOP, now with the Ortholock Division of Gulton Industries was the guest speaker. Westneat's subject was "Reduction of Bandwidth Through the Use of Statistical Techniques."

Westneat discussed some thoughts on the telemetering of vibration data using statistical methods to reduce the bandwidth. He pointed out that many telemetering systems are too complicated and prodigal of bandwidth, since 90 per cent of information is thrown away after transmission. Studies have been made on the actual use made of vibration data which show that transient conditions are not usually used in their entirety.

ASCOP has developed transistorized synthesizers for power spectrum analyzers, amplitude analyzers, and cross correlation analyzers These have been tested under actual environmental conditions encountered in missile flights. These units are being evaluated by ABMA to determine their practicality to the types of problems encountered.

Westneat described the principles involved and the circuits used for the various applications. He showed slides of actual curves taken from magnetic-tape records of in-flight tests. In the discussion which followed the talk, many interesting points relative to the actual progress to date and plans for the future were developed.

Dr. J. W. Muehlner presided at the meeting, which was attended by 74 members of the Professional Group and their guests. Following the meeting, R. W. Isaacs of Philco Corporation conducted a tour of the Philco Transac S2000 computer facility and explained and demonstrated how this computer is used in space-electronics engineering computations.

—G. O. Moore

MORE PROGRAM

4. A DIVERSITY COMBINER FOR TELEMETRY

C. C. Hall, Nems-Clarke Company, Silver Spring, Maryland.

The advantages of diversity reception in telemetry ore most fully realized when the available receiver outputs ore combined before data processing. A diversity combiner has been developed for this purpose. It accepts the outputs of four receivers and produces a single output, to which each receiver contributes in proportion to its signal-to-noise ratio. The combiner output signal-to-noise ratio is equal to, or higher than, the best receiver signal-to-noise ratio, when the receiver output noises are uncorrelated. A common-cathode combining circuit is used, in which each receiver's contribution to the combined output is controlled by sampling the receiver noise output.

The combiner is designed for use with a standard telemetry receiver having IF bandwidths of 500 kc and 100 kc. It handles the RDB FM/FM and PDM/FM telemetry signals with negligible data degradation.

5. TELEMETRY DIVERSITY RECEPTION TECHNIQUES

V. A. Ratner, RCA Service Company, Patrick Air Force Base, Florida.

The design and application of post-detection diversity combining equipment for missile telemetry is discussed in this presentation. Basic principles and recent developments in this field ore summarized, and their telemetering implications exploited in detail. The relative merits of spaced, polarization, and frequency diversity systems are presented along with a comparison of RF, IF, and video combining. The need for diversity and the advantages to be realized with its utilization at AMR are analyzed and correlated with actual observed phenomena. Experimental combining equipment is described and specifications are given for the high performance units being developed for AFMTC by the Nems-Clarke Company.

The results of engineering evaluation tests at Cape Canaveral and aboard the C-54 Airborne Telemetry System are included with oscillographic recordings of comparative data gathered during "live" missile tests.

RECEPTION AND COCKTAIL PARTY

Monday, September 28
5:30 P.M. to 7:00 P.M.
Vista Sky Room, Whitcomb Hotel

SESSION 4
COMMUTATION

Tuesday, September 29
10 A.M. to 12 Noon

Chairman: M. V. Kiebert, Jr.
Consulting Engineer, Claremont, Calif.

1. A NOVEL CONCEPT APPLIED TO AIRBORNE COMMUTATION

E. H. Stroehley, EPSCO, Inc., Cambridge, Massachusetts.

Several approaches taken in the attempt to develop a commutator for airborne digital telemetry systems are shown. The realization of the commutator using operational multiplexing is then outlined. This discussion includes switching, programming, and packaging of the commutator. Finally, performance data of the device is presented.

2. A STATUS REPORT ON MISSILE COMMUTATION

R. J. Farrelly, General Electric Co., Philadelphia, Pennsylvania.

This paper will consider the state of the art in missile commutation, and will attempt to present a comparison between mechanical and electronic commutation at the present time.

During the past few years, the General Electric Missile and Space Vehicle Department has utilized commutators for re-entry vehicle flight testing. In the course of this time, they have evaluated many types of commutators which seemed to offer promise for missile telemetry application. This evaluation included both mechanical and electronic commutators, and in general involved complete environmental testing of the units. Of particular interest is the fact that extended life test data and field failure data was accumulated on each type of unit.

Electronic and mechanical commutation techniques will be compared with regard to such factors as desired accuracy, system environment, signal level, available power, speed, cost, and life.

3. AN IMPROVED TRANSISTORIZED PDM KEYER FOR THE MULTI-CHANNEL DATA ACQUISITION SYSTEM

Boris Stefanov, Kauke and Co., Santa Monica, California.

Some of the basic problems associated with the use of a mechanical sampling switch are reviewed. It becomes apparent that the contact dwell time on the channel information rows should be reduced to a minimum. Further, contact bouncing or high resistance should not affect the system performance in any way.

To solve these problems, the keyer design incorporates a high input impedance memory that demands at the most about ten per cent (10%) of contact dwell time during the sampling period. Once the memory capacitor has been charged, the input is electronically disconnected from the commutator, and the same capacitor is used for the linear rundown in converting the voltage pulse amplitude to pulse width within the given specifications. Immediately after the conversion has been completed, the keyer is in its initial state so that the pulse output duty cycle can be in excess of 95% without degrading the keyer performance in any manner. The conversion and linearity errors have been found to be in the order of a small fraction of a percent.

As an added feature, the keyer will clip all input pulse amplitudes above a pre-determined limit, and will generate a minimum pulse width (less than that corresponding to a zero), for all negative voltage. Transistor-wise, the circuit utilizes six (6) NPN and one (1) PNP silicon transistors.

SESSION 5
DATA ACQUISITION AND CONVERSION

Tuesday, September 29
10 A.M. to 12 Noon

Chairman: William E. Miller, Jr.
Range Instrumentation Development Division, White Sands Missile Range, N. M.

1. A PCM DATA ACQUISITION AND PROCESSING SYSTEM FOR SOLID PROPELLANT ENGINE TESTING

J. P. Knight, Radiation, Inc., Melbourne, Florida.

A complete PCM Data Acquistion, Editing, Timing and Computer entry facility is described. The system was developed by Radiation, Inc. for the Thickol Chemical Corporation, Brigham City, Utah, to obtain complete evaluating data on the performance of solid propellent rocket engines.

The entire system is comprised of six sub-systems. Subsystem "A", used for thrust and pressure measurements, is capable of sampling 12 channels, 2500 times per second to an accuracy exceeding ±0.1%. Subsystem "B", used to measure temperatures and other relatively low bandwidth parameters, consists of a 24-channel system capable of sampling each channel 625 times per

(Continued on page 24)

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AND FIELD INTENSITY MEASURING EQUIPMENT

covering a frequency range of 30 cps to 1000 mc

NM-40A (AN/URM-41)
30 cps to 15 kc

SELECTIVE OPERATION/Specifications

Sensitivity: For a one-to-one signal-to-noise ratio, the sensitivity of the NM-40A is better than 0.15 microvolt from 1000 to 15,000 cps, 0.25 microvolt from 300 to 1000 cps and 1.0 microvolt from 30 to 300 cps, when used as a selective two-terminal voltmeter with its narrowest bandwidth and an input impedance of 100,000 ohms.

Spurious Responses:

$2F_0' >$ 60db down from F_0
$3F_0' >$ 55db down from F_0
All others > 75 db down
} where F_0 is any input signal using selective operation

WIDEBAND OPERATION/Specifications

Frequency Response: 30 cps to 15 kcs, ±0.5 db.

Sensitivity: 15 microvolts sensitivity at input impedance of 100,000 ohms.
Input Impedance: 50, 600, 10,000 and 100,000 ohms.
The NM-40A may also be used as an ultra-sensitive AUDIO frequency WAVE ANALYZER.

NM-10A (AN/URM-6B)
14 kc to 250 kc

GENERAL SPECIFICATIONS:

Sensitivity: Electrostatic pickup using rod antennas, one microvolt-per-meter to 2 volts-per-meter. Electro-magnetic pickup using shielded loop antennas, 10 microvolts-per-meter to 100 volts-per-meter. As a two-terminal voltmeter, either balanced or unbalanced, one microvolt to one volt.

Effective Random Noise Bandwidth: Varies from approximately 55 cps to 400 cps over the frequency range. Calibration charts give exact figures for each frequency.

Image Rejection: Better than 50 db.

I.F. Rejection: Greater than 60 db.

The equipment is of sturdy drip-proof construction and may be operated for prolonged periods in driving rain or snow with no deleterious effects.

NM-20B (AN/PRM-1A)
150 kc to 25 mc

GENERAL SPECIFICATIONS:

Sensitivity: As a two-terminal voltmeter, either balanced or unbalanced, one μv to one volt. Electrostatic pick-up using rod antenna, 2 μv/meter to 2 volts-per-meter. Electromagnetic pick-up using shielded loop antenna: SMALL LOOP, 10 to 30 μv/meter min. to 10,000 to 30,000 μv/meter max.; LARGE LOOP, 2 to 6 μv/meter min. to 20,000 to 60,000 μv/meter max.

Image Rejection: Better than 50 db.

I.F. Rejection: > 45 db.

BFO is provided for C. W. reception.

NM-30A (AN-URM-47)
20 mc to 400 mc

Sensitivity: Radiated pick-up using a calibrated, tuned dipole (without reflector), 0.6 to 60 μv/meter, depending on frequency. Conducted pick-up via 50-ohm matched coaxial line, 0.5 to 1 μv from 20 to 240 mc, less than 6 μv from 240 to 400 mc.

Spurious Response Rejection: Better than 40 db.

I.F. Rejection: > 60 db.

NM-50A (AN/URM-17)
375 mc to 1000 mc

Sensitivity: Radiated pick-up using a calibrated, tuned dipole (without reflector) 35 to 160 μv/meter, depending on frequency. Conducted pick-up via 50-ohm matched coaxial line, 2 to 5 μv.

Impulse Bandwidth: Approximately 600 kc over frequency range.

Image Rejection: Better than 40 db.

Spurious Response Rejection: Better than 40 db.

I.F. Rejection: > 80 db.

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NM-40A (AN/URM-41)	30cps-15Kc	CLASS "1"	Not Req'd	Not Req'd	Not Req'd	Not Req'd	Not Req'd
NM-10A (AN/URM-6B)	14Kc-250Kc	CLASS "1"	Not Req'd	APPROVED	Not Req'd	C63.2 (Proposed)	Not Req'd
NM-20B (AN/PRM-1A)	150Kc-25Mc	CLASS "1"	CLASS "1" *CATEGORY "A"		Not Req'd	C63.2 (Proposed)	**
NM-30A (AN/URM-47)	20Mc-400Mc	CLASS "1"	CLASS "1" *CATEGORY "A"	APPROVED	APPROVED	C63.3 (Proposed)	APPROVED
NM-50A (AN/URM-17)	375Mc-1000Mc	CLASS "1"	CLASS "1" *CATEGORY "A"	APPROVED	Not Req'd	C63.3 (Proposed)	Not Req'd

**Can be supplied with C.I.S.P.R. Recommended detector time constants.
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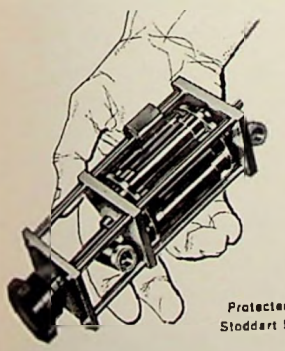

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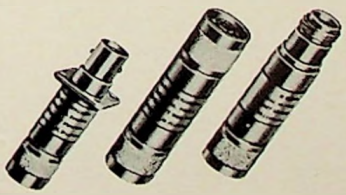

Available in any conceivable combination of male and female Type C and Type N connectors. Maximum length of 3" for any attenuation value.

GENERAL SPECIFICATIONS:
VSWR: < 1.2 to 3000 mc for values from 10 to 60 db; as value decreases below 10 db, VSWR increases to not over 1.5.
Characteristic Impedance: 50 ohms.
Attenuation Value: Any value from 0 db to 60 db including fractional values.
Accuracy: ±0.5 db; values above 50 db have rated accuracy of attenuation through 1000 mc only.
Power Rating: 1.0 watt sine wave.

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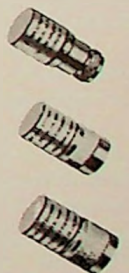

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1-Watt: 50 ohms impedance, dc to 3000 mc or dc to 7000 mc, Type N or Type C connectors, male or female; VSWR less than 1.2, 70 ohm, Type N, male or female terminations available.

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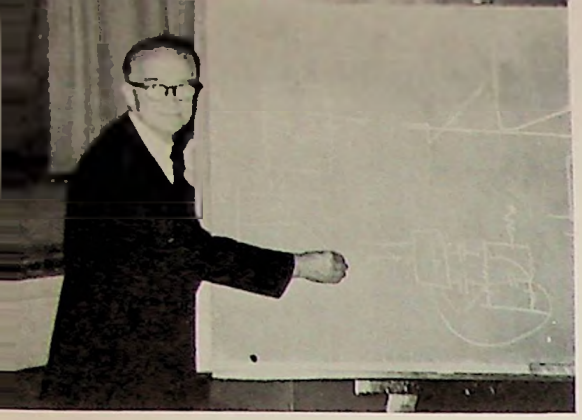

William Shockley explains a point during his appearance before PGEC in June

MEETING REVIEW

Switching Sandwich

The PGEC was highly honored as well as pleased to have as speaker at its June meeting Dr. William Shockley, who presented a highly informative and entertaining discussion of the recently developed four-layer diode and its possible role in digital computers. As its inventor (and as a co-inventor of the transistor) Shockley is eminently well qualified to discuss both its theory and its potential applications.

The four-layer diode is a two-terminal solid-state "switch," which goes into its conducting or "on" state when the terminal voltage is raised to above a certain level. It remains in that state until the resulting current is reduced below a certain level, when it goes back into its non-conducting or "off" state. The "on" and "off" threshold levels can be controlled in the fabrication process, and units with widely different specifications are available.

Shockley first described briefly the theory of the diode junction and the principles of the four-layer diode. He then showed how the latter can be used as a circuit element in several basic computer building blocks, such as pulse generators, flip-flops, and pulse amplifiers. He demonstrated a working model of a compact ten-state ring counter constructed of four-layer diodes, conventional diodes, resistors, and capacitors, powered by a small battery.

Finally he discussed some of the advantages of the four-layer diode over three-terminal transistors in switching applications, including a somewhat higher possible switching speed and lower cost.

As is well known, Shockley was one of the three recipients of the Nobel Prize in Physics in 1956 for his work on semiconductors and the discovery of the transistor effect. He is also the recipient of the Presidential Award for Merit in 1946 and the Morris Liebmann Award in 1952, and of honorary degrees of Doctor of Science from the Uni-

(Continued on page 26)

MORE PROGRAM

second, also to an accuracy exceeding ±0.1%. Subsystem "C", used for high frequency vibration and transient analysis, consists of an analog-type system capable of recording six channels of information, each having bandwidths of 10 kc, to an accuracy of ±2%. Subsystem "D" consists of a tape-to-tape converter which is used for translating information collected on Subsystem "A" and "B" into an IBM 650 format. Subsystem "E" consists of a range time generator which supplies timing pulses to the entire PCM system and also to camera units used to photograph the engine performance.

2. SOME NEW TECHNIQUES IN AIRBORNE DATA ACQUISITION

E. P. Brandeis and M. E. Harrison, Ampex Corporation, Redwood City, California.

This paper contains a brief analysis of the present status of airborne magnetic tape data acquisition systems. Each of the major modulation techniques presently in use is examined, with special emphasis on performance, including direct recording, frequency-modulation recording, pulse duration modulation recording, and digital-pulse code modulation recording. The functional operation of each of the systems is presented, with an outline of the advantages and limitations of each of the techniques. Future trends are analyzed with particular emphasis on pulse code modulation recording, including serial PCM using the Videotape® principle, combination analog and digital recording, and a universal recording system.

Construction practices are discussed, including modular subsystem and system elements as well as plug-in components for ease of system change and maintenance. Some recent developments in airborne recorder construction are presented. Environmental conditions which effect design considerations of magnetic tape recorders are discussed.

3. DIGITAL TO ANALOG CONVERSION FOR PCM TELEMETRY AND DIGITAL DATA TRANSMISSION SYSTEMS

Max Palevsky, Donald Black and G. Slocomb, Packard Bell Computer Corporation, Los Angeles, California.

The transmission of data by PCM or other digital techniques requires that a conversion device be provided if analog representation is required at the receiver. This analog is required in the PCM case for "quick look" facilities or to drive servo systems, if, for example, the data is part of a control system.

With a small number of variables, digital decommutation is appropriate together with a digital to analog converter for each variable. As the number of variables increases cost and component count becomes prohibitively high, requiring an alternate approach. This employs a single digital to analog converter and an analog decommutator. Some form of analog store is now required. The characteristics of such storage devices—their accuracy, frequency response and stability—are discussed and a newly developed magnetic analog store is described.

SESSION 6

SPACE ELECTRONICS II INSTRUMENTATION

Tuesday, September 29
2 P.M. to 4:30 P.M.

Chairman: F. J. Lehan
Space Electronics Corp., Glendale, Calif.

1. BIOMEDICAL INSTRUMENTATION IN THE "DISCOVERER" SATELLITE (Part One)—ANIMAL EXPERIMENTS

Stanley A. Hall, Lockheed Missiles and Space Division, Sunnyvale, California.

The ARPA-USAF-LOCKHEED Biomedical program, which calls for recovering mice and monkeys from orbital space, is paving the way for future man-in-space experiments.

In addition to providing guidance in the technique of designing and building light-weight instrumentation for biological measurement, the program is yielding much useful information on the principles of metabolic support equipment design. Much is being learned, too, concerning certain behavioral aspects of the experimental animals themselves which may be applied to man-in-space programs.

The recovery requirement led to the development of recovery techniques applicable to manned space vehicles. Re-entry is accomplished by slowing the detached capsule by means of a retro-rocket. Suitable means are employed to protect the capsule and the "life cell" against the heat of re-entry. When the capsule reaches the earth's atmosphere, the life cell and contents are lowered by parachute. The system will be snatched out of the air by C-119 airplanes fitted with special pick-up gear.

The Biomedical Program is being supported by a complex of medical vans which brings a new and highly developed medical capability to the Air Force.

2. BIOMEDICAL INSTRUMENTATION IN THE "DISCOVERER" SATELLITE (Part Two)—INSTRUMENTATION DESIGN DETAILS AND DATA

R. M. Adams, School of Aviation Medicine, Air University Command, United States Air Force, Brooks Air Force Base, Texas*

A discussion is given of the general biomedical instrumentation and data return problems that are encountered in orbital recoverable vehicles containing animal payloads. Details are presented as to how these problems were resolved in the Discoverer Biosatellites and specific information is included concerning the parameters measured, types of sensors used, accuracy and conditions of measurement, and effectiveness of data return. Biomedical data received from Discover III and typical readouts expected from future biosatellites are included.

*Mr. Adams is a consultant to the Bioastronautics Directorate of the Air Force Ballistic Missiles Division, Air Research and Development Command, Inglewood, California.

3. DIGILOCK TELEMETRY SYSTEM

R. W. Sanders, Space Electronics Corporation, Glendale, California.

This paper describes a digital telemetry system which possesses much greater communication efficiency in terms of transmitted energy required per bit than conventional telemetry systems. The system is based on a set of orthogonal signals utilizing matched filter techniques. The approach results in an extremely simple digital telemeter of great flexibility. An experimental realization of the system is described with test results.

4. TELEMETRY ADDITION TO THE AZUSA TRACKING SYSTEM

E. W. Bush, Convair-Astronautics, San Diego, California.

The Azusa Tracking System is presently a primary source of information for range safety at Cape Canaveral, Florida. All ballistic missiles being fired from that base are required to carry an Azusa Transponder aboard.

It has been established that certain advantages could be gained by adding a telemetry capability to the Azusa system. Using the Azusa Transponder as a telemetry transmitter eliminates an

(Continued on page 26)

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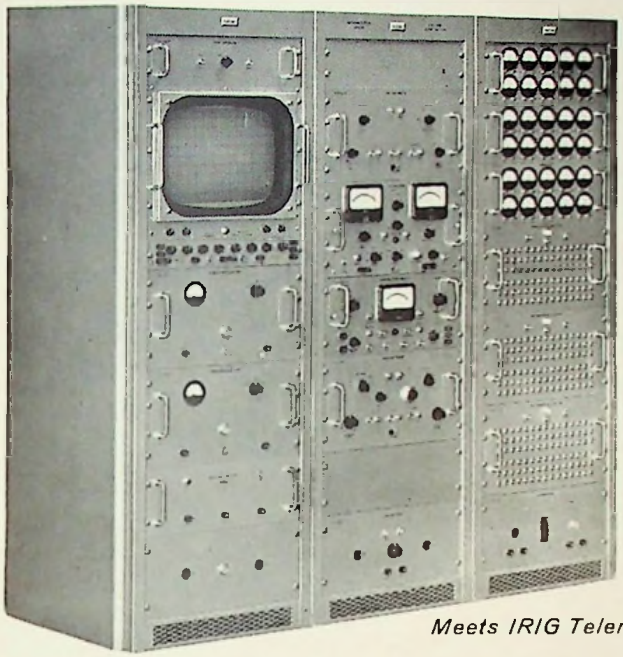

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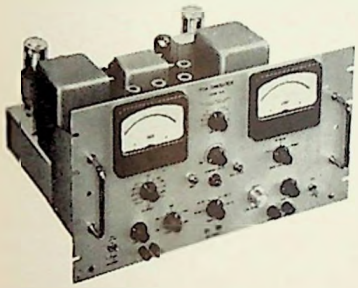

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After receiving the BS degree from the California Institute of Technology and the PhD degree in physics from the Massachusetts Institute of Technology, he joined the Bell Telephone Laboratories, where he performed work on vacuum-tube and electron-multiplier design, radar development, magnetism, solid-state physics, and semiconductors. He has recently become president of the Shockley Transistor Corporation, a subsidiary of Beckman Instruments, Inc.

Shockley anticipates many new and exciting developments in semiconductors as the field is further exploited.

—Keith W. Henderson

MEETING REVIEW

Where to Put the Postoffices?

One of our big problems in the next 40 years will be getting used to the idea of expanded governmental activities. This is the word from a leading economist, Professor Lorie Tarshis, executive head of the economics department at Stanford, who spoke to the Annual Meeting of the San Francisco Section, substituting for the announced speaker, Eugene Burdick, who was prevented from appearing by an unannounced heart attack.

Giving a preview of the economy for the time of our grandchildren, Tarshis pointed out that the need to maintain consumption equivalent to our growing ability to produce would require expanded government spending. And, since there is a reasonable limit to the expansion of time-honored government activities such as post offices and highways, the need would have to be met by the assumption of new areas of activity.

(Continued on page 36)

Professor Lorie Tarshis, Stanford University, at the June Section meeting

MORE PROGRAM

electronics package and thereby reduces the overall size, weight, complexity and power consumption of the telemetry system aboard the missile. The Azusa system operates at 5 kmc, thus avoiding the crowded spectrum in the telemetry band and taking advantage of lower galactic noise at the higher frequency. It also offers the additional advantage of reduced susceptability to interference caused by ionization during re-entry.

This paper describes the modulation scheme for the telemetry addition, utilizing an FM-AM (suppressed carrier)—FM system. An analysis of system performance is also presented.

5. THE GOLDSTONE TRACKING STATION

Robertson Stevens, Jet Propulsion Laboratory, California Institute of Technology, Pasadena, California.

(Invited paper, no abstract available.)

BANQUET

Tuesday, September 29, 6:30 P.M.
Crystal Ballroom, Whitcomb Hotel

"PROBLEMS OF SPACE EXPLORATION"

Speaker: **Dr. Robert Jastrow, Chief of the Theoretical Division, Goddard Space Flight Center, National Aeronautics and Space Administration.**

SESSION 7

TELEMETRY SYSTEMS AND TECHNIQUES

Wednesday, September 30
10 A.M. to 12:30 P.M.

Chairman: H. B. Schultheis, Jr.
Hewlett-Packard Company, Palo Alto

1. A HIGH CAPACITY PAM-FM-FM TELEMETERING SYSTEM FOR THE SATURN BOOSTER

O. B. King, Army Ballistic Missile Agency, Redstone Arsenal, Alabama.

The most severe problems in connection with telemetering the Saturn Booster have resulted from the magnitude of the missile system. As eight engines are employed in the Saturn first stage, a very large number of measurements are required and present telemetering systems have insufficient channel capacity. This paper describes a time division multiplexing system designed at ABMA for telemetering lower response engine measurements such as temperatures, pressures, and flow rates which create the majority of channel requirements.

The input data is grouped in blocks of eight, the same measurement on each of the eight engines, and applied to a synchronized submultiplexer. A multiplexer having 27 data channels samples the outputs of the submultiplexer at the rate of 3600 PPS. Since each submultiplexer has 8 data inputs, a total of 216 channels may be accommodated by the system. The PAM signals are applied to the input of a wideband FM subcarrier oscillator. Since the RF carrier is fully deviated by a single subcarrier of wide deviation, the wide band gain of the system is such that a two watt carrier is adequate for normal applications.

2. SS-FM: A FREQUENCY DIVISION TELEMETRY SYSTEM WITH HIGH DATA CAPACITY

W. O. Frost and O. B. King, Army Ballistic Missile Agency, Redstone Arsenal, Alabama.

A major shortcoming of presently available standard telemetering systems is low bandwidth capacity. For example, the total data bandwidth capability of a fully utilized FM/FM telemetry link operating at a sub-carrier modulation index of 5 is approximately 4 kc corresponding to a baseband utilization efficiency of less than 6%.

This paper describes the preliminary design of a telemetry system which can readily accommodate the vibration, sound intensity, and other high response data that is needed for R&D flights of

(Continued on page 28)

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(Confirmed dates, **bold-face**; tentative dates, light-face type.)

San Francisco Section—Oct. 27, May 6, June 16

East Bay Subsection—Oct. 5, Nov. 2, January, April, June

Professional Group on:

Antennas & Propagation—**Oct. 13; Nov. 10; Jan. 12; Feb. 9; Apr. 5*, 12*, 19*, 26*; May 10**

Audio—Oct. 6, Dec. 1, Mar. 1, May 3

Broadcasting—Dec. 1, April 5

Communications Systems—**Oct. 27, Nov. 24, Jan. 26, Feb 23, May 24**

Electron Devices—**Sept. 30; Oct. 28; Nov. 25; Jan. 27; Feb. 24;** Apr. 6, 13, 20, 27; May 25

Electronic Computers—**Sept. 22, Oct. 27, Nov. 24, Dec. 22, Jan. 26, Feb. 23, Mar. 22,** Apr. 6, **May 24, June 28**

Engineering Management—**Oct. 13, Dec. 8, Feb. 9, Apr. 12, June 14**

Engineering Writing & Speech—**Oct. 20,** Jan. 19, Mar. 15, May 17

Medical Electronics—**Oct. 27, Nov. 24, Jan. 26, Feb. 23, Mar. 22, Apr. 26, May 24**

Microwave Theory & Techniques—**Sept. 30,** Oct. 20, Nov. 17, Jan 19, Feb. 16, Apr. 19, May 17

Military Electronics—**Oct. 6, Nov. 3, Dec. 1, Jan. 5, Mar. 1, Apr. 5, May 3, June 7**

Production Techniques—**Sept. 22, Oct. 27, Nov. 24, Jan. 26, Feb. 23, Apr. 26, May 24**

Reliability & Quality Control—**Sept. 29,** Nov. 24, Jan. 26, Feb 23, May 6, June 28

Space Electronics & Telemetry—**Oct. 1, Nov. 17, Dec. 15, Jan. 19, Feb. 16, Mar. 15, Apr. 19, May 17, June 21**

*Tutorial series on radio astronomy

SEPTEMBER 22, **PGEC, PGPT;** 29, **PGRQC;** 30, **PGED/PGMTT**

OCTOBER 1, **PGSET;** 5, **EBSS;** 6, PGA, **PGMIL;** 13, **PGAP, PGEM;** 20, **PGEWS,** PGMTT; 27, **SFS/AIEE, PGCS, PGEC, PGME, PGPT;** 28, **PGED**

NOVEMBER 2, EBSS; 3, **PGMIL;** 10, **PGAP;** 17 PGMTT, **PGSET;** 24, **PGCS, PGEC, PGME, PGPT, PGRQC;** 25, **PGED**

DECEMBER 1, PGA, PGB, **PGMIL;** 8, **PGEM;** 15, **PGSET;** 22, **PGEC**

JANUARY 5, **PGMIL;** 12, **PGAP;** 19, PGEWS, PGMTT, **PGSET;** 26, **PGCS, PGEC, PGME, PGPT, PGRQC;** 27, **PGED**

FEBRUARY 9, **PGAP, PGEM;** 16, PGMTT, **PGSET;** 23, **PGCS; PGEC, PGME, PGPT, PGRQC;** 24, **PGED**

MARCH 1, PGA, **PGMIL;** 15, PGEWS, **PGSET,** 22, **PGEC, PGME**

APRIL 5, **PGAP***, PGB, **PGMIL, PGRQC;** 6, PGED/PGEC; 12, **PGAP*, PGEM;** 13, PGED; 19, **PGAP***, PGMTT, **PGSET;** 20, PGED; 26, **PGAP*, PGME, PGPT;** 27, **PGED**

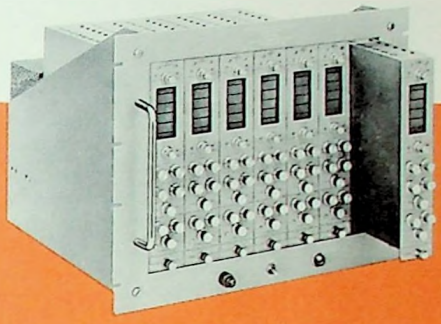
MAY 3, PGA, **PGMIL;** 6, SFS/PGRQC in Monterey USNPGS; 10, **PGAP;** 17, PGEWS, PGMTT, **PGSET;** 24, **PGCS, PGEC, PGME, PGPT;** 25, PGED

JUNE 7, **PGMIL;** 14, **PGEM;** 16, SFS/EBSS Annual Meeting; 21, **PGSET;** 28, **PGEC,** PGRQC

*Lecture series

Reprints of this Directory of Officers and 1959-1960 Calendar are available from the IRE Office, 60 West 41 Avenue, San Mateo -- FIreside 1-3471

NEW MONITOR OSCILLOSCOPES



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5444

MORE PROGRAM *(from page 26)*

large ballistic missiles and space vehicle boosters. The system basically consists of single-sideband AM sub-carriers on an FM carrier, making the letter designation SS-FM appropriate.

An analytical comparison with FM-FM is made of the S/N performance of a 15 channel SS-FM system. Particular emphasis is also placed on problems concerning the filters, modulators, and oscillators of the channeling and frequency synthesizer portions.

3. A PULSE POSITION TELEMETRY SYSTEM

Lloyd Weisman and Erwin S. Teltscher, Ford Instrument Company, Long Island City, New York.

A miniaturized pulse position telemetry system consisting of nine data channels and one reference and synch ionizing channel is described. The system can be made to operate over a wide range of P.R.F.'s within limits prescribed by the beam switching tubes utilized in the equipment. An airborne radar beacon transponder telemeters pulse position modulated signals to the ground. The ground telemetry units have been highly miniaturized, consisting of a decommutator and separate demodulator channels. The demodulators have been transistorized, using a novel compact pulse position demodulator. The introduction of a quasi-feedback type link between the airborne transmitter and the ground equipment demodulator ensures highly stable and accurate operation during flight.

Reference is made to a paper by J. W. Poliseo, contained in the National Telemetering Conference, Chicago, 1955, and to a paper by the authors of the present article, contained in the I.R.E. National Convention Record, Part 5, March 1958, which gives many of the preliminary design features of the equipment to be described.

4. SOME METHODS OF OBTAINING MORE VIBRATION DATA ON FEWER TELEMETRY CHANNELS

W. D. Hancock, Endevco Corporation, Pasadena, California.

Approximately 95% of today's telemetered data is contained in 5% of the bandwidth utilized and 5% of the data consumes approximately 95% of the bandwidth (channels). Vibration data is part of this 5% — and on top of this at least 50% of the available information is thrown away since it is never transmitted — it is filtered out at the VCO or SCO.

Current piezoelectric (crystal) accelerometers and their associated electronics are capable of measurements from 2 cps to well above 10 kc — yet the usual spectrum telemetered stops at 2 kc. Hardly ever is vibration above 2 kc transmitted.

Recently, with the advent of higher speed vehicles, solid fueled engines, high acoustic noise and greater sophistication there has been an increasing awareness of the usefulness of high frequency vibration information. (For purposes of this paper frequencies above 2 kc are considered to be high.)

One of the known methods for compressing this high frequency data is by means of rectification or averaging, however, there are several forms of information which cannot be simply averaged or rectified such as peak amplitude, resonance points and frequency distribution.

Presented by diagrams, slides and discussion are several methods of compressing the information and maintaining a high degree of integrity. These methods are based on time sharing and programming the transmission of full frequency, peak amplitude, averaged and/or spectral density (g²/cps) information. It is believed that one of these methods or approaches is adaptable to a variety of existing requirements and that they maintain the usefulness of the data gathered.

(Continued on page 34)

Behlman Engineering Company

Data Instruments Div. of Telecomputing Corp.

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Franklin Electronics, Inc.

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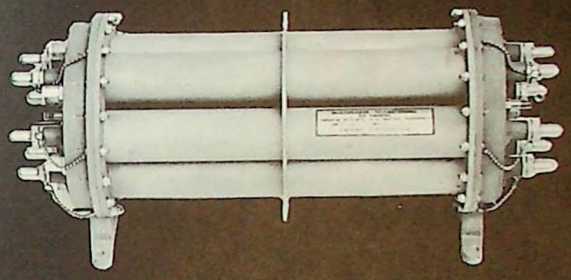

In flight, The Martin Company's highly reliable Titan transmits an immense amount of telemetry data. Yet, with Rantec multiplexers, it avoids the weight and space problems of a complex antenna system. It is now easily possible to couple two, three, four or six telemetry signals of slightly different frequencies to one antenna system. This is done with minimum insertion loss and maximum isolation (the six channel model illustrated has a minimum isolation between channels of 20db and a maximum insertion loss of 1.5db). Rantec multiplexers, as utilized in Martin's Titan, are another example of Rantec's adaptation of highly-sophisticated R&D to the design and manufacture of reliable, state of the art hardware. Technical data and reprints are available upon request.

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MORE PROGRAM

5. EXTREME ENVIRONMENT TELEMETER

J. J. Weippert, J. S. Piontkowski and M. J. Huskey, Tele-Dynamics Inc., Philadelphia, Pa.

This paper discusses the problems associated with the design of a new airborne PDM/FM/PM telemetering transmitting system for reliable operation under unusually severe environmental conditions encountered in the wing of the Bomarc interceptor missile.

The system is designated the C-4 telemeter, the latest telemetry system in the series for the Boeing Airplane Company, Bomarc Interceptor Missile. Because of the airframe restrictions, the system was housed in two separate packages, mounted in either wing. The RF equipment, sub-carrier oscillators, wide-band amplifier and the high voltage power supply were located in one package. The other contained the PDM commutator and keyer, signal conditioning equipment and low voltage power supply.

Except for the RF equipment, the system is completely transistorized, utilizing silicon transistors for high temperature operation and extreme vibration environments.

LUNCHEON

Wednesday, September 30, 12:45 P.M.
Crystal Ballroom, Whitcomb Hotel

SESSION 8
GROUND STATION EQUIPMENT

Wednesday, September 30
2 P.M. to 4:30 P.M.

Chairman: Charles H. Doersam, Jr.
Sperry Gyroscope Co., Great Neck, N. Y.

1. A SOLID STATE DECOMMUTATOR

J. H. Porter, Consultant with RCA, Missile and Surface Radar Dept., West Los Angeles, Calif.

Techniques are described for producing a linear analog DC voltage proportional to the amplitude or width of any selected pulse in a pulse group. Solid state circuitry is used throughout to provide a maximum of reliability and minimum of volume and power requirements. Heart of the device is a serial to parallel shift register using ferrite switching cores and transistors to generate discrete gating signals corresponding to the pulses in the group, with as many stages as there are pulses in a group. The basic design aim is to provide automatic operation by elimination of panel controls for operation over the complete IRIG pulse rate range. A typical 88 channel system for either PAM or PDM modes, is packaged with power supply to extend but 13" behind the 5¼ x 19" front panel, is capable of producing simultaneous DC outputs from all channels, weighs less than 75 pounds and consumes approximately 50 watts.

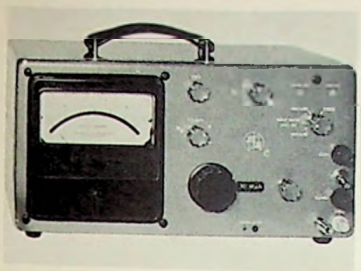
2. AN ADVANCED DECOMMUTATOR SYSTEM

Lyman H. Beman, Telecomputing Corporation, Data Instrument Division, Los Angeles, Calif.

A new decommutation station designed to improve reliability and accuracy of PDM and PAM telemetry is described. The paper outlines some problem areas in this field and illustrates how these problems were solved in this decommutator. Details are given of the system's unusual accuracy, operating simplicity and synchronization ability. Precision analogue computer techniques and careful system engineering are shown to produce high accuracy. Details are given of how operating simplicity is achieved by the use of continuously self-adjusting electronic circuitry. Methods of preserving synchronization ability through noise, signal dropout, and missing data pulses are outlined, and photographic records of ability to tolerate wide variations in commutator speed are shown.

(Continued on page 36)

NEW Belleville-Hexem WIDE RANGE AMMETER



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SPECIFICATIONS

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MORE POSTOFFICES *(from page 26)*

Charles Susskind, the inimitable, served as toastmaster. Since he knows (or makes it his business to discover) various bits of arcane data concerning those he is called upon to introduce, the audience was brought into an eerie sort of rapport with the luminaries on display. These included, naturally, the outgoing chairman, Earl Goddard, and the incoming chairman, Vic Corey, both of whom made suitable backward- and forward-looking remarks.

Edgar Post, chairman of the tellers' committee, presented the newly elected slate of officers whose identities, PhD's all, are revealed elsewhere in this issue. Fellow awards were made to Seymour Cohn and Otto J. M. Smith in person, to John T. Bolljahn, William R. Rambo, David H. Sloan, H. Myrl Stearns, and Stanley E. Webber in absentia, and to Mrs. Lippincott for Donald K., posthumously.

Outstanding student awards were made to Charles Finila, University of California, James H. Kerins, University of Santa Clara; Gary Walter Deley, Stanford University; Maurice Lee McGrath, San Jose State; and Lt. John K. Pegues, U.S. Naval Postgraduate School, the latter three in absentia.

Now, back to economics. By 2000 AD, according to Tarshis, our economy, at present the world's largest, will be three times its present size—or $1.6 trillion of annual product. Our population will be 60 per cent larger and the earnings per average family head will be twice as large, in real dollars, as it is now. Inflation, however, which is a built-in part of our system, will have caused the national product to show up on the books as $3 to $4 trillion.

Other adjustments our grandchildren, if not ourselves, will have to face, include the likelihood that Russia will have an economy twice as large as ours by that time. China will rank second (with a population five times ours), and India, probably, third. We'll come in just out of the money but with twice as much to spend, if that isn't too confusing a thought.

—*George Spelvin*

MORE PROGRAM

3. CROSSTALK IN TIME SHARED SYSTEMS AS AFFECTED BY DISCRIMINATOR CHARACTERISTICS

O. J. Ott, Data-Control Systems, Inc., Danbury, Connecticut.

The transient characteristics of a subcarrier discriminator are analyzed to determine the amount of crosstalk to be expected in PAM-FM-FM and PDM-FM-FM commutated systems for various band cut-off frequencies and commutated sample rates. Various methods of decommutation are considered to determine which technique provides the best overall accuracy in reduced data and a system utilizing the information from previous channels to provide a first order cancellation of the filter transient effects is discussed.

4. A DECOMMUTATION SYSTEM FOR FM/FM TELEMETRY

W. Kroll, Lockheed Missiles and Space Division, Sunnyvale, California.

This paper describes a system developed at the Lockheed Missiles and Space Division for demultiplexing commutated FM/FM telemetering signals. Significant features of the system to be described are listed as follows:

1) Operates on a non-return to zero (or reference) signal. This is sometimes referred to as 100 per cent duty.

2) Accommodates commutator speeds from below 60 to over 600 points per second without resorting to plug-in devices.

3) Accommodate 30, 45 or 60 point commutators readily.

4) Automatic synchronization when signal first appears and sustained synchronization when commutator speed changes occur.

5) Accommodation of commutator speed changes of ±30 per cent during a run.

6) Loss of frame synchronization for several frames does not affect operation of the system.

7) Simple, fool-proof method of comparing data channels to calibration channels, permitting data reduction personnel to correct for zero drifts and sensitivity changes at their discretion.

5. PACIFIC MISSILE RANGE TELEMETRY FACILITIES

Benjamin O. Hicks, Chief, Telemetry Systems Engineering Branch, Pacific Missile Range, Point Mugu, California.

(Invited paper, no abstract available.)

SESSION 9

TELEMETRY COMPONENTS AND TECHNIQUES

Wednesday, September 30
2 P.M. to 4:30 P.M.

Chairman: Daniel Hochman
Lockheed Missiles and Space Division, Palo Alto, Calif.

1. FACTORS AFFECTING CHOICE OF LOOP FILTERS IN PHASE-LOCKED LOOP DISCRIMINATORS

R. A. Runyan, Data-Control Systems, Inc., Danbury, Connecticut.

The use of phase-locked loop discriminators in FM/FM ground stations requires that the user choose the loop filter to be used in addition to the band-pass and output filters which represent the only elements of choice when pulse-averaging discriminators are used. The margin of superiority to be expected of a phase-locked loop depends upon this choice with the improvement to be expected increasing as the loop filter pass-band is reduced. However, the use of too narrow a filter will cause the unit to lose lock. The considerations that enter into this choice are described.

2. TRANSISTORIZED SUBCARRIER OSCILLATOR PRINCIPLES

William H. Swain, Electro-Mechanical Research, Inc., Sarasota, Florida.

Desirable characteristics of FM subcarrier oscillators include precise linearity, freedom from impedance and current effects on the input information source, freedom from delay distortion in the output circuits, freedom from spurious outputs, and high efficiency of power conversion.

(Continued on page 38)

MORE PROGRAM

The principles of several transistor voltage-controlled, potentiometer-controlled, and strain gage oscillators achieving these characteristics are described. One of the VCO circuits uses an accurate four-quadrant analogue multiplier as a modulating element.

3. A REACTANCE-MODULATED FM TRANSMITTER FOR SPACE COMMUNICATIONS OR TELEMETRY

R. Pasos and G. Heninger, Philco Corporation, Palo Alto, California.

Microwave power may be generated at the 2 KMC region with a cavity oscillator using a planar power triode in a grid-isolation circuit.

Such a transmitter has been developed which uses crystal diodes coupled into the cathode cavity to obtain a variable reactance for frequency modulation.

The theory of operation is presented, treating in turn the following: r-f generator, modulator, automatic frequency control, and the power supply.

4. A NEW TELEMETRY TRANSMITTER USING A VOLTAGE TUNED MAGNETRON FOR SPACE ENVIRONMENT

C. L. Jensen, Philco Corporation, Philadelphia, Pennsylvania.

To use the voltage-tuned magnetron in a narrow band telemetry application posed many serious problems, since the tube was originally designed as a wide-band oscillator with FM deviation sensitivity in the order of 1Mc/volt. When tight frequency stability is coupled to operation in a space environment, the design problems assume major significance.

To meet the rigid specifications it was necessary to invent and develop a new technique for automatic frequency control. This method involves using a crystal oscillator output as a reference against the multiplied crystal frequency's mixed signal with the magnetron output frequency. The frequencies from crystal and mixer are switched, amplified, detected, amplified and finally synchronously detected to provide correction to a saturable reactor regulator. Using this technique the voltage tunable magnetron, a wide-band device, can be used in a narrow band application with excellent frequency stability.

5. A TUNABLE AIRBORNE VHF TRANSMITTER OF HIGH STABILITY FOR WIDE DEVIATION FM WITH LOW DISTORTION

W. H. Swain and S. Fisher, Electro-Mechanical Research, Inc., Sarasota, Florida.

Stable frequency control of a VHF telemetering transmitter has been achieved through the use of a quartz dielectric resonator (rather than the conventional pieze electric crystal) operating at the transmitter output frequency. The technique provides a tunable oscillator of high stability, capable of low-distortion frequency modulation from D.C. to megacycle rates, and allows design of transmitters without frequency multipliers, free from spurious radiations. The quartz dielectric provides several mechanical advantages over air dielectric resonators.

(END)

GRID RETURNS

Letters to the Editor

Sunnyvale

Dear Sir:

I wish to lodge a complaint. At a recent meeting of a certain Professional Group, the announced time for the

(Continued on page 40)

Russell Varian, who, working with his brother Sigurd, founded Varian Associates and altered the face of the Peninsula, the electronic industry, and national defense, will not be with us any longer. He died of a heart attack on July 28 while vacationing in Alaska.

He will not be with us, that is, except everywhere that a klystron is used or thought about. Also, widely, in the hearts of those who considered it their privilege at one time or another to be associated in his great endeavors.

ELECTION NEWS

East Bay Subsection

Donald O. Pederson, University of California, chairman. Since 1955, Pederson has been associate professor of electrical engineering. Previously, he was a member of the technical staff of Bell Telehone Laboratories at Murray Hill and a research associate in the electronic research laboratory at Stanford University.

He holds a BS from North Dakota Agricultural College, and an MS and PhD from Stanford. Memberships include Sigma Xi and Eta Kappa Nu.

Alexander J. Stripeika, University of California Lawrence Radiation Labora-

(Continued on page 42)

Donald O. Pederson, chairman, EBSS

MORE LETTERS

meeting was 8:00 P.M. The acting chairman, speakers, and some twenty additional members arrived at the meeting place at 8:35 P.M. At least forty people had been waiting for 35 minutes for the meeting to get started. But, of course, one should not start the meeting without chairman and/or speakers.

Well, it turned out that the chairman was out of town anyway. The vice chairman opened the meeting with some apology for the delay, and then in the course of things it was announced that he, the vice chairman, had been elected chairman of the group. This reflects rather badly on the membership. Why they should have voted into office a man who had demonstrated a lack of punctuality and attention to detail, is somewhat beyond my comprehension.

It seems to me that a scheduled meeting should start reasonably close to the announced time. And I would not define 35 minutes late as reasonably close. The membership has a legitimate complaint if meetings are not started on time, even if the program is a good one. As one of the membership, I voice that complaint. As one of the officers, I pledge to try to keep it from happening again.

Sincerely yours,
A. S. Dunbar, PGEM

Palo Alto

Dear Sir:

On page 20 of the June 1959 issue of the **Grid** there is a report on the student paper contest by William McGuire.

Apart from the fact that the writer has managed to make two errors in spelling my name he also mixed the titles of the two graduate students papers and quoted a completely incorrect title for mine.

The subject of my paper, which was awarded first prize, was "Remarks on the elementary introduction to electrodynamics." I do not think that field theory is taught in electrical engineering courses at all. It was Mr. Glavitsch who gave the paper on circuit breakers.

On closer perusal of the report I find that there are three errors not only two in the spelling of my name—your correspondent could hardly contrive to make more of them.

I wonder how reliable an information one can get from your magazine and I would be interested to find out whether you are going to take the trouble of publishing a correction. A half-done work is worse than nothing.

Yours truly,
Vladislav Bevc,
Student Member

Dunbar, move over, will you?—Ed

MORE ELECTION

Alexander J. Stripeika, vice chairman, EBSS

tory, vice chairman. Presently head of the design and development divisions of the electronics engineering department, Stripeika has been with the Lawrence laboratory since 1946.

Holder of a BS in electrical engineering, he served as an electronics officer in the U.S. Navy. He is a senior member of the Institute.

Eugene A. Aas, Sandia Corporation, Livermore Laboratory, secretary-treasurer. A division leader in the product engineering department, Aas joined Sandia in 1949.

Previously he has been with Farnsworth Television and Radio Corp, on misssile-guidance development, with the Signal Corps as a radar officer, and with General Electric as a test engineer.

He has a BSEE degree from North Dakota Agricultural College. He is a member of Tau Beta Pi and a senior member of IRE.

Eugene A. Aas, secretary-treasurer, EBSS

Professional Group on Antennas & Propagation

E. A. Blasi, Lockheed Missiles and Space Division, chairman. At LMSD, Blasi holds the position of manager of electromagnetics.

MORE ELECTION

E. A. Blasi, chairman, PGAP

Having a BSEE from New York University, he did graduate work in physics at Ohio State University. He was formerly a member of the technical staff of the Hughes R&D Laboratories.

Richard C. Honey, vice chairman, PGAP

Richard C. Honey, Stanford Research Institute, vice chairman. Honey is a senior research engineer in the microwave group of the electromagnetics laboratory. He received a BS in physics from California Institute of Technology and after serving as a radio technician in the U.S. Navy, received degrees of electrical engineer and PhD in electrical engineering from Stanford University.

He holds memberships in the PGMTT, RESA, and Sigma Xi.

Von R. Eshleman, Stanford University, secretary. An associate professsor, Eshleman is active in the special fields of radar astronomy and radio communication.

He holds a BEE from George Washington University and an MS and PhD, both in electrical engineering, from Stanford. Before joining the faculty in 1952 he was associated with the Atomic Energy Commission as a Fellow, and served in the U.S. Navy.

(Continued on page 44)

Von R. Eshleman, secretary, PGAP

Douglas E. Engelbart, chairman, PGEC

MORE ELECTION

He is a Fellow, RAS; senior member IRE and AAS, and member of Sigma Tau, Sigma Xi, and U.S. Commission III of URSI.

Professional Group on Electronic Computers

Douglas C. Engelbart, Stanford Research Institute, chairman. Engelbart is a senior research engineer in the computer-techniques laboratory at SRI. He was formerly president and technical director of Digital Techniques, Inc., and before that an assistant professor of electrical engineering at the University of California.

He has also been a research associate in the University of California computer laboratory and an electrical engineer with NACA at Ames Aeronautical Laboratory. His PhD and ME degrees in electrical engineering are both from the University of California, while his BS is from Oregon State College. He is a member of Sigma Xi.

Arthur J. Critchlow, vice chairman, PGEC

Arthur J. Critchlow, International Business Machines Corporation, vice chairman. Critchlow is presently on a one-year special assignment at the IBM advanced systems division, San Jose, studying data processing and artificial intelligence.

He obtained a BS in applied physics from the California Institute of Technology in 1947. Before joining IBM he worked on missile telemetering, microwaves, and missile-guidance problems at Convair and Ryan.

He is a member of the Association for Computing Machinery, the American Physical Society and PGED.

Richard I. Tanaka, Lockheed Missiles and Space Division, secretary-treasurer. Recipient of BS and MS degrees in electrical engineering from the University of California, Tanaka took his PhD in electrical engineering and physics at the California Institute of Technology.

Prior to Lockheed he was with the Hughes Aircraft Company and North American Aviation, Inc. He is a member of Phi Beta Kappa, Sigma Xi, Tau Beta Pi, and Eta Kappa Nu.

Richard I. Tanaka, secretary-treasurer PGEC

GRID SWINGS

It Is Reported That:

Varian Associates has added Dr. **Herbert Kromer** from Hamburg to its central research team. His title is senior research scientist. After graduation with a PhD from the University of Gottingen, Kromer spent several years as a research physicist in the semiconductor group at RCA Laboratories, Princeton. He returned to Hamburg in 1957 to head the semiconductor group of the German branch of Philips. **Emmet Cameron** has been advanced from vice president and general manager to executive vice president and general manager.

Kromer *Cameron*

Monogram Precision Industries, Inc., has named **Robert A. Lehman** as senior vice president. Lehman, who was general manager of the electronics divisions in Los Gatos, now heads the proprietary products divisions in the company's San Fernando Valley facilities.

Dr. **Roy E. Olson** has been named chief engineer of the Monogram Precision Industries, Lewis and Kaufman Division, Los Gatos. Olson, formerly with Eitel-McCullough as a physicist in the advanced research group, received his doctorate in physics from the University of California and served with that university's radiation laboratory. Position of Lewis and Kaufman chief engineer was formerly held by **Alfred Thompson,** now general manager.

Lewis *Olson*

Robert E. Lewis joins **Beckman & Whitley, Inc.** of San Carlos as a senior optical engineer on the development of optical systems for high-speed instrumentation. Lewis was previously in the scientific bureau of Bausch & Lomb Op-

(Continued on page 48)

MORE SWINGS

tical Company of Rochester, N. Y. He has also been a member of the field-engineering group of the Chicago Midway Laboratories of the University of Chicago.

Broadview Research Corporation, Burlingame, realized a 70% gain in volume during its last fiscal year, now employes 100 persons, one of the most recent of whom is Dr. **Peter Viet Zuan Phung,** a senior research analyst on the management-sciences staff. Phung received a PhD from the University of Notre Dame in 1957 and has been there since as a research associate.

Schulz *Engelder*

Hart *King*

Sylvania electronic systems promotes **Robert F. Schulz** from manager, reconnaissance systems laboratory to manager of special programs He is succeeded by **Paul O. Engelder,** formerly in the electronic defense laboratory. **Richard E. Smith,** formerly general foreman, now becomes manufacturing superintendent in the Mountain View tube plant. **Bruce Bryant** is appointed sales engineer in the computer products operations in Santa Cruz. **Norman Stein** has become a staff specialist in reliability engineering in the reconnaissance systems laboratory.

Plans were announced for the beginning of construction on a 40,000-sq-ft special tube operations laboratory, fourth building on the 39-acre site. **Alden L. Hart** is research and development sales manager.

In the electronic defense laboratory, **Robert H. Nord** is promoted from head of the transmitter section to manager of transmission-facilities development; **Charles E. Sibley,** formerly an engineer-

MORE SWINGS

in-charge, succeeds Robert Gray to the post of head of products-engineering section; **Norman S. Johnson** joins the staff as an engineering specialist in the missile-analysis section; Dr. **Gabriel F. Herrmann,** formerly with Bell Telephone Laboratories, goes to the microwave physics laboratory as an engineering specialist; **Herbert M. King** is promoted from head of the field-operations section to manager of the liaison department; and **C. Jack Napier,** formerly a field engineer, becomes head of the field-operations section succeeding King.

Sibley *Napier*

A new building that will double present floor space has been announced by **Granger Associates,** Palo Alto.

Watkins-Johnson Co. will triple its facilities in Stanford Industrial Park in a $400,000 building program.

Jay Stone and Associates, Sunnyvale, has been appointed to represent Bogart Manufacturing Company (microwave components and sub-assemblies) and PCA Electronics (delay lines and pulse transformers).

Bill Wilson, a BSEE graduate from the University of California, with **Neely Enterprises** since 1957, has been assigned to the San Carlos office.

(Continued on page 50)

Norman Neely, left, and Robert L. Boniface, right, are shown with the 100th employee of Neely Enterprises, George Combs

MORE SWINGS

Ground-breaking ceremonies in Stanford Industrial Park for the new 33,000-sq-ft building of Microwave Engineering Laboratories, Inc., brought this group together: W. LaMar Talbot, Perry H. Vartanian, Robert E. Edwards, Jack L. Melchor, Joseph M. Pettit, Lloyd A. Addleman, Major O. R. Hill, Dean A. Watkins, Wesley P. Ayers, and William J. Swanson

Applied Electronics Company, Inc., has announced a new 22,000-sq-ft plant addition to its South San Francisco plant.

Microwave Electronics Corp., Palo Alto, has appointed **Fred M. Schumacher** senior engineer. Schumacher, a specialist in traveling-wave-tube development, has been with the G.E. Microwave Laboratories as a consulting engineer for the past four years. He has also been a research assistant in the Stanford Electronic Laboratories. **Arthur L. Webb** has been appointed production manager. Webb has been in the electron tube division of Litton Industries and formerly with the Hughes Aircraft tube division.

Ultek Corporation is a newly formed electronic organization specializing in electronic vacuum pumps and related equipment. The new concern is located at 920 Commercial Street, Palo Alto.

Officers of the new corporation are **Lewis D. Hall,** president; **Reid W. Dennis,** vice president; and **J. William Sugg,** secretary-treasurer. Other present staff department heads include **Charles F. Brothers, Charles A. Piercey, Victor H. Soules,** and **Buck W. Wong.**

Dr. Hall, president and technical director, was recently research engineer at Varian Asociates.

Hall *Webb*

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MORE SWINGS

A recent move by the **Menlo Park Engineering Co.** of Menlo Park to a new location at 711 Hamilton Avenue has resulted in tripling the available space. Personnel additions include **John Pettigrew,** formerly of Hallicrafters, Chicago. Pettigrew becomes chief engineer.

EVENTS OF INTEREST

Meetings Summary

September 23-25—**Non-Linear Magnetics & Magnetic Amplifiers.** Shoreham Hotel, Washington, D.C. F. G. Timmel, Westinghouse Air Arm Division, Box 746, Baltimore, Md.

September 25-26 — **Ninth Annual Broadcast Symposium.** Willard Hotel, Washington, D. C. George E. Hagerty, Westinghouse, 122 E. 42 Street, New York City.

September 30-October 1—**Industrial Electronics Symposium.** Mellon Institute, Pittsburgh, Pennsylvania. Gary Muffly, Gulf Res. & Dev. Co., P. O. Drawer 2038, Pittsburgh 30, Pennsylvania.

October 5-7—**Communications Symposium.** Hotel Utica, Utica, N. Y. Ralph L. Marks, 126 Glen Rd., South-Mounted Route, Rome, N. Y.

October 6-8—**Radio Interference Reduction.** Museum of Science and Industry, Chicago, Ill. S. I. Cohn, Armour Res. Found., 10 W. 35 Street, Chicago 16, Ill.

October 6-9 — **International Symposium on High Temperature Technology.** Asilomar, California. Public Relations Office, Stanford Research Institute, Menlo Park.

October 7-9—**IRE Canadian Convention.** Toronto, Canada. Convention Office, 1819 Yonge Street, Toronto 7, Canada.

October 12-15—**National Electronics Conference.** Sherman Hotel, Chicago, Ill. Hal Bergen, 185 N. Wabash Avenue, Chicago 1, Ill.

Papers Calls

October 9 — 300-word abstract explaining the nature of the contribution, its significance, theoretical and experimental results, for 1960 Solid-State Circuits Conference (Philadelphia, Penna., February 10-12). Send to: Tudor R. Finch, Bell Telephone Laboratories, Inc., Murray Hill, N. J.

October 23—100-word abstract and 500-word summary, both in triplicate; title of paper, name, and address; indicating the technical field in which the paper falls; for 1960 IRE National Convention (Waldorf-Astoria Hotel and New York Coliseum, New York City, March 21-24). Send to: Gordon K. Teal, The Institute of Radio Engineers Inc., 1 East 79 Street, New York 21, N. Y.

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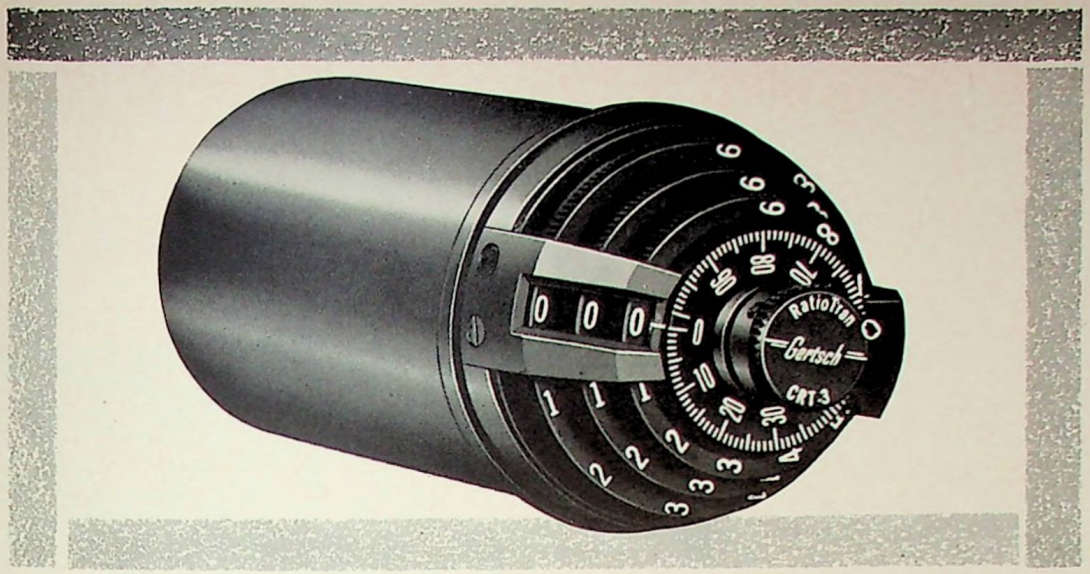

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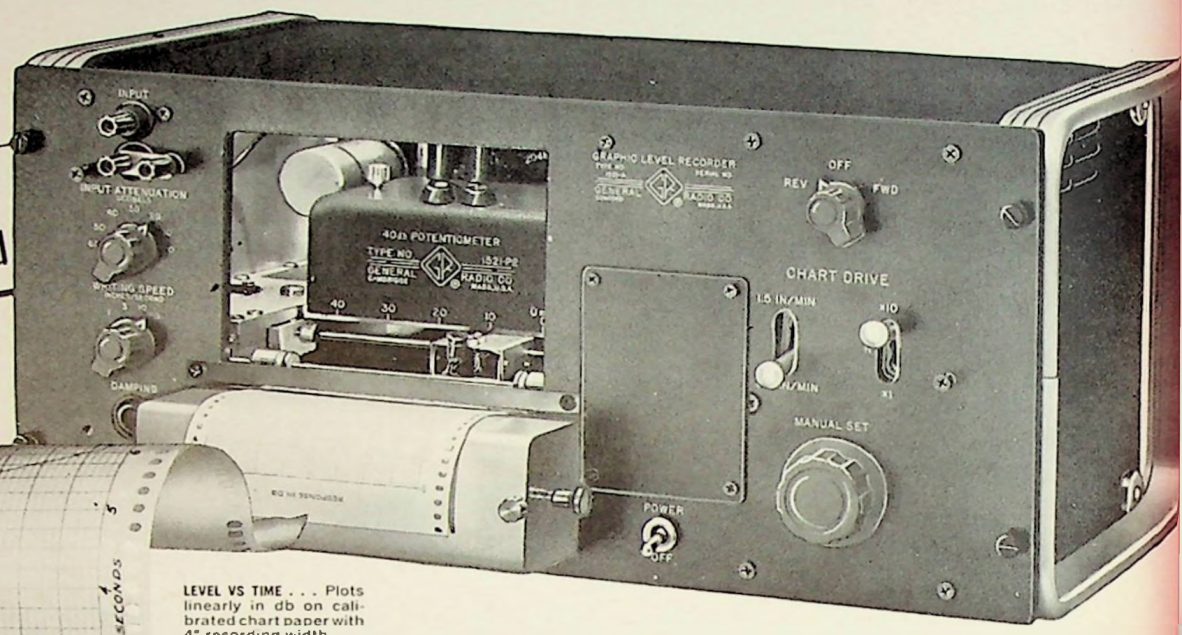

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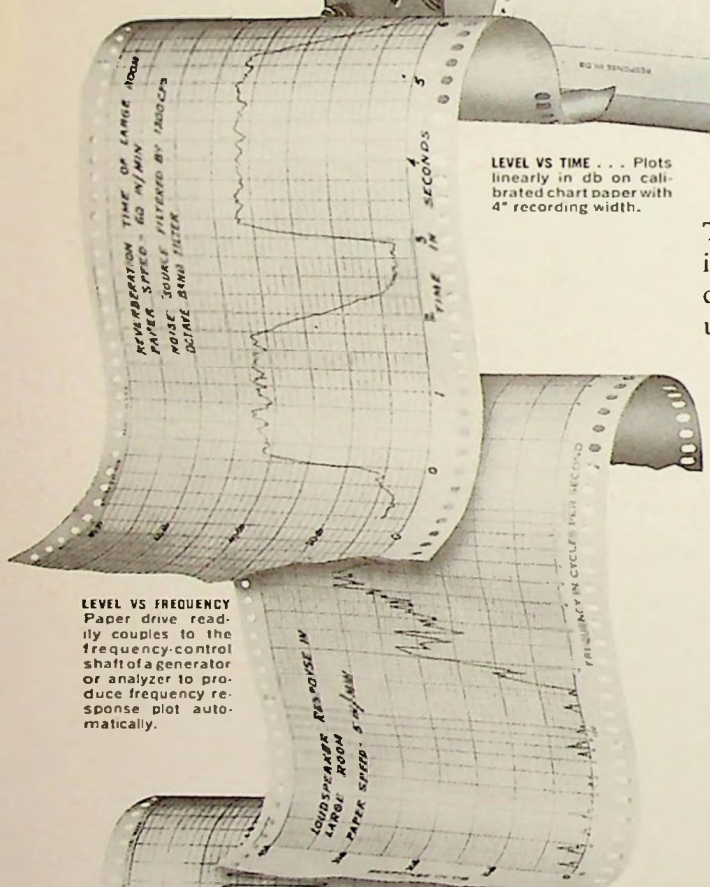

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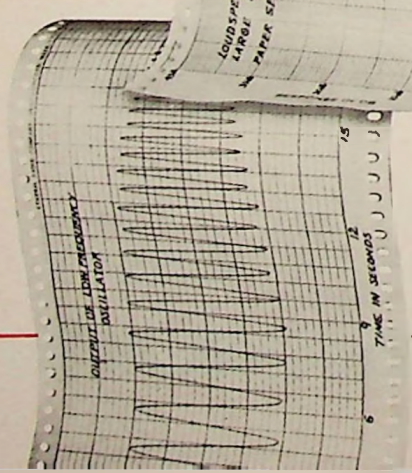

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