



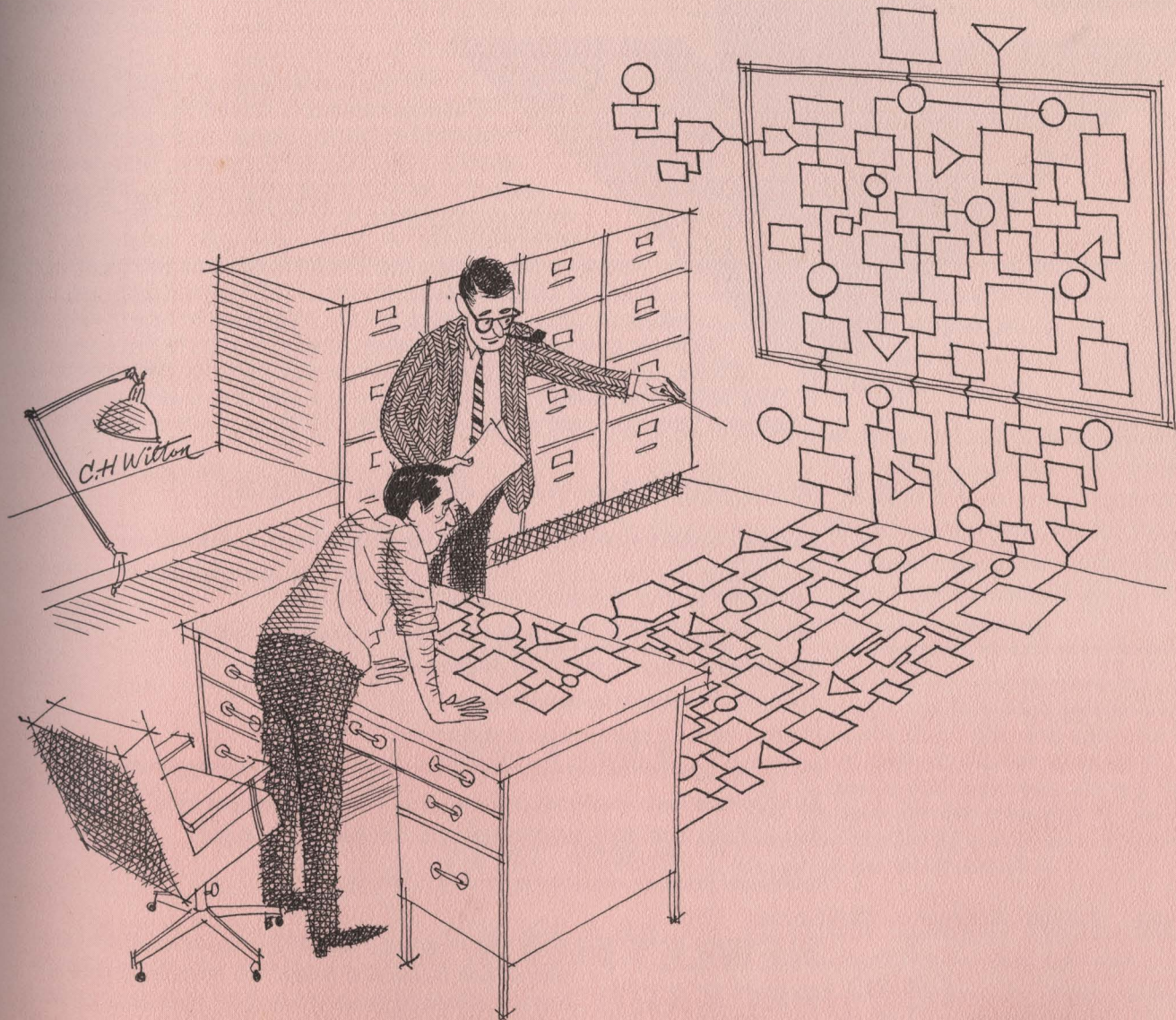
The Reflector

JANUARY 1964
VOLUME 12, No. 5

PUBLISHED BY THE BOSTON SECTION OF THE INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS

WINTER LECTURE SERIES

(SEE PAGES 2 & 3)



PERT & PERT/COST for Program Planning and Control

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The Reflector

JANUARY 1964



Volume XII, No. 5

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Cover Story

WINTER LECTURE SERIES

PERT AND PERT/COST

See pages 2 & 3

JANUARY 1964

Conference on Magnetic Recording to Be Held in London

AN International Conference on Magnetic Recording has been announced for the week beginning July 6, 1964. It will be held in the home of the Institution of Electrical Engineers, London, England. The conference is sponsored by the IEEE, the IEE, and the British IRE, and will be the first occasion on which the European Region of the Institute of Electrical and Electronics Engineers, working through its United Kingdom and Eire Section, has cosponsored an international conference.

The scope of the Conference will cover all magnetic recording on moving media and will include sessions on audio, video, computers, and data recording. The written version of papers to be presented should not exceed 2000 words, or equivalent including figures. Prospective authors should submit synopses of approximately 200 words by January 31, 1964. Full texts (three copies) will be required by March 31.

There will be an opportunity for items to be displayed in support of papers included in the technical program, and a supplementary program of social events and technical visits will be associated with the Conference. Further details may be obtained from the Secretariat, International Conference on Magnetic Recording, c/o Institution of Electrical Engineers, Savoy Place, London, W.C.2, England. Synopses of papers and manuscripts should also be sent to this address.

IEEE Group to Fly to London

THE Boston Section is laying tentative plans for a group of IEEE members to fly to London at the time of the Magnetic Recording Conference. The group flight, if it can be arranged, will leave Boston on July 6th and will return three weeks later, using regularly scheduled jet flights. Round-trip fare will be \$303 from Boston, or \$310 from New York, which contrasts very pleasantly with the regular round-trip economy-class fare of \$500.

Participation is open to all who, as of January 1, 1964, are IEEE members in good standing; it is also open to wives, children, and parents (if they live in the same residence) of such members. The group flight is not limited to those planning to attend the Conference, and IEEE members from outside the Boston Section are welcome. If you are interested, please inform Miss Shirley Whitcher, Boston Section IEEE, 313 Washington Street, Newton, Mass. 02158.

(Other IEEE Section publications, please copy.)

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WINTER LECTURE SERIES — PERT and

FOUR CONSECUTIVE THURSDAYS — 7:30pm — JANUARY 9, 16, 23, & 30

"MANAGEMENT, like invention, is no longer a matter of individual effort; Space-Age Programs are too complex. Management of major space, weapons, construction, military, or other programs is accomplished through large organizations of professional experts in administration, finance, science, engineering, and production,

to list but a few. Each program must be carefully planned, scheduled, evaluated, and managed toward attainment of specific objectives. The complexity of directing and controlling these programs has challenged conventional management techniques."—*PERT Guide for Management Use*, U. S. Government PERT Coördinating Group, June 1963.

THE new techniques which have been developed to meet the challenge of complex programs include PERT, PERT/COST, Line of Balance, and Program Definition. These are some of the topics which the Winter Series will address itself to. The speakers who will discuss these subjects have been invited because of their knowledge of the subjects. All have been working intensively in the field for many years.



J. KADET
Chairman

Mr. Kadet has had broad experience in engineering management. He is cur-

rently Manager, Program Management Methodology, Sylvania Electronic Systems Division. Since joining Sylvania in 1956, he has been extensively engaged in engineering management, project engineering, and program management activities. Prior to his present position, he was Program Manager of the Radio Communications Satellite Ground Terminals Program (ex-ADVENT). These terminals are currently being used with SYNCOM. From 1942 through 1956, he was affiliated with the U. S. Government and engaged in a broad spectrum of electronics activities, including nine years as Supervising Engineer for Shipborne Electronics with the U. S. Navy.

Thursday, January 9, 7:30pm PERT Session

MR. Frank is a Staff Specialist on PERT, PERT/COST, and Line of Balance at Sylvania Electronic Systems. His functions include acting as an internal consultant on these systems as well as conducting internal training programs for both engineering and management. Mr. Frank is the author of the Sylvania Electronic Systems "Networking Manual" and has been a guest lecturer at Boston University and for the New England Purchasing Agents Association.



B. H. FRANK

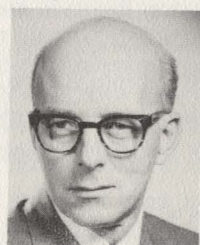


N. B. SOLOMON

Mr. Solomon is a Research Engineer in the Programming and Analysis Laboratory at Sylvania Electronic Systems. He is responsible for the design, development, and implementation of Sylvania's computer-based management-information system for planning and control of major research and development projects.

Thursday, January 16, 7:30pm PERT/COST Session

MR. Phoenix is Manager, Management Planning and Analysis, at the Itek Corporation. In this capacity he is responsible for management engineering, business planning, resource planning, management planning, and control systems and status analysis. Mr. Phoenix has presented papers to the Institute of Management Sciences and the Boston Section, IEEE. He is the author of an article which appeared in *Aerospace Management*.



W. H. PHOENIX

Mr. McCarthy is a Staff Analyst at Management Systems Corporation. He is engaged in assisting defense and commercial industrial clients who are implementing PERT and PERT/COST systems. He is also assisting the Air Force Systems Command in analyzing PERT/COST installations and further defining implementation procedures.



J. MCCARTHY

PERT/COST for Program Planning and Control

KNIGHT AUDITORIUM — BABSON INSTITUTE — WELLESLEY, MASS.

Thursday, January 23, 7:30pm — Implementation Roundtable



P. A. FITTER
Discussion Leader

LT. Col. Fitter is responsible for development and implementation of management systems and techniques at the Electronic System Division, Air Force Systems Command. He is a member of the Air Force Systems Command PERT Control Board Subgroup for PERT/COST Development.

Mr. Ashley is a Management Consultant for Mauchly Associates and is responsible for assisting both defense and commercial industrial clients in implementing PERT, CPM, and PERT/COST. He has published several articles and was the author of the chapter on application of network methods to research and development in the book, *Operations Research for Research and Development*, published by Wiley and Co., 1963.



W. ASHLEY

Mr. Gober is Deputy Program Manager for the Army MAULER Program. He is responsible for the accomplishment of overall planning, direction, and control of research and de-



L. I. GOBER

Mr. Kassel is the Director, Program Management Division, I.T.T. Intelcom, Inc. In this capacity, he is responsible



R. H. KASSEL

development, test procurement, distribution, production support, administrative, and physical effort associated with the MAULER Weapons System. In this capacity he was directly concerned with the Army pilot test of PERT/COST on the MAULER System.

for program control assistance to the Defense Communications Agency in development, procurement, and deployment of Defense Communications Satellite System.



W. T. SHEA

Mr. Shea is Senior Project Coördinator on the Low Observer Reentry Vehicle Program at the Avco Corporation. He is responsible for scheduling and planning on this program which employs PERT and PERT/COST.

Thursday, January 30, 7:30pm — Advance Aspects of PERT/COST Roundtable

MR. Miller is Director of Management Sciences for the Raytheon Company. His responsibilities include the total spectrum of new program management requirements and techniques including but not limited to all of those which will be discussed at this session. He is the author of articles which have appeared in the *Harvard Business Review* and the *MIT Industrial Management Review* and is also the author of the book, *Schedule, Cost, and Profit Control with PERT*, published in November 1963.



R. W. MILLER
Discussion Leader

Lt. Col. Bennett is Chief of the Management Systems Development Division, Directorate of Status Administration, DCS Controller, Air Force Systems Command. He is responsible for developing and integrating the various management systems and techniques. He is a member of the Department of Defense PERT Coördinating Group and is the Air Force PERT Administrator.



J. J. BENNETT

Mr. Gehringer is Head of the Production Section of

the Office of Naval Material. In this capacity he is in charge of monitoring production by Navy contractors and surveying manufacturing plants. He is the principal Navy Member of the Department of Defense PERT Coördinating Group, a member of the Navy PERT Advisory Committee.



A. C. GEHRINGER

Mr. Hamilton is head of Management Systems Development at the Mitre Corporation. He is responsible for research and development and evaluation of management systems for the Electronic Systems Division, AFSC, and for the Air Force System Command for systems management use in the Air Force.

Mr. Matthews is Director, Project Management, for Management Systems Corporation. He is, therefore, responsible for the work performed by Management Systems Corporation in the area of project management systems including PERT/COST. He is the author of "How to Implement PERT/COST" which appeared in the October 1963 issue of *Aerospace Management*.



R. E. MATTHEWS

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New Directions in DOD Procurement

STEPHEN W. Rowen, Director of Government Contracts for Raytheon Company, will discuss two new Department of Defense directives which will have a significant effect on contract profits and awards of new business. The Weighted Guideline method of profit determination is a new system which the contracting officer will use in establishing reasonable target profits. It essentially assigns a different rate of profit for varying kinds of cost, the summation of which represents the contract target profit.

The Contractor Performance Evaluation Report is a new requirement for progress reporting of contractors' performance on certain types of development contracts. This system will be used to evaluate a contractor's past performance prior to the award of any new contracts.

Mr. Rowen will show how the day-

to-day performance of technical and management personnel relate to the above requirements and will outline a few of the considerations necessary to make these reports work for a company rather than against it.

Mr. Rowen joined Raytheon in 1951 as sub-contracts manager for the Equipment Division. After successive promotions he was appointed in 1958 to the position of Director of Contracts for the Missile Systems Division. He attended Rensselaer Polytechnic Institute and was graduated from the U. S. Naval Academy. He also attended the Harvard University Graduate School of Business.



S. W. ROWEN
Raytheon Co.

TUESDAY, JANUARY 7
Dinner — Charterhouse Motel, Waltham — 6:00pm
Meeting — 8:00pm — Sylvania, 100 First Ave., Waltham

Modern Techniques in Ultra-Accurate AC Instrumentation

AGROWING field of applications has caused the development of techniques for measuring ac voltages and currents to accuracies of $\pm 0.01\%$.



F. M. YOUNG
Adage Inc.

The thermal-transducer, operational-rectifier, and peak-ready methods will be discussed. A demonstration will be given showing how both positive and negative peaks

of a sinusoid can be analyzed for absolute value and amplitude stability to better than 0.01% .

F. Mansfield Young received his SB from MIT in 1948 and attended graduate school at the Institute from 1948 to 1951. Mr. Young has served as President and Chairman of Adage, Inc. since his participation as one of its founders in 1957. In addition, he has played a major role in the design and development of the company's products.

TUESDAY, JANUARY 7
Meeting — 8:00pm — Sperry Rand Research Center, Sudbury

Safety Fundamentals in Substation Design

HENRY R. Kurth, Vice President and Director of Steam & Electric Operations, Boston Edison Company, will discuss the fundamental design features that contribute to safe operation and maintenance of substations, based on extensive knowledge and experience in this field. His talk will be illustrated with slides and exhibits showing design features and identification ideas that have been developed.

Mr. Kurth received his BS in Electrical Engineering from MIT in 1921. Following his graduation he worked for a period at the Elihu Thomson Research Lab

of the General Electric Co. before joining the Standardizing and Testing Laboratory at the Boston Edison Company. In 1924 he transferred to the Production Department where he established a new System Despatching Headquarters. He was promoted to Chief of Electrical Operations in 1943, to Assistant Vice President and Superintendent of the Production and System Operating Departments in 1952, and to his present position in 1956. He is a Registered Professional Engineer, a Fellow of IEEE, and a member of the MIT Alumni Council.



H. R. KURTH
Boston Edison

TUESDAY, JANUARY 14
7:30pm — MIT, Room 10-275

Regulation of Blood Pressure — A Nonlinear Biological Servomechanism

THE techniques of control analysis are being applied to an increasing extent to the study of biological processes. It is hoped that mathematical descriptions of biological control systems using this approach will increase understanding of the physiological processes which constitute the system and will also allow prediction of aspects of system performance that have not been explored directly.



W. H. LEVISON
RLE, MIT

The inherent nonlinearity of physiological control systems indicates that any analysis based on linear techniques may obscure the essence of the functions involved. An example of a nonlinear physiological control system is the pressoreceptor reflex system (PRS), one of the mechanisms which regulates arterial blood pressure in both man and animals.

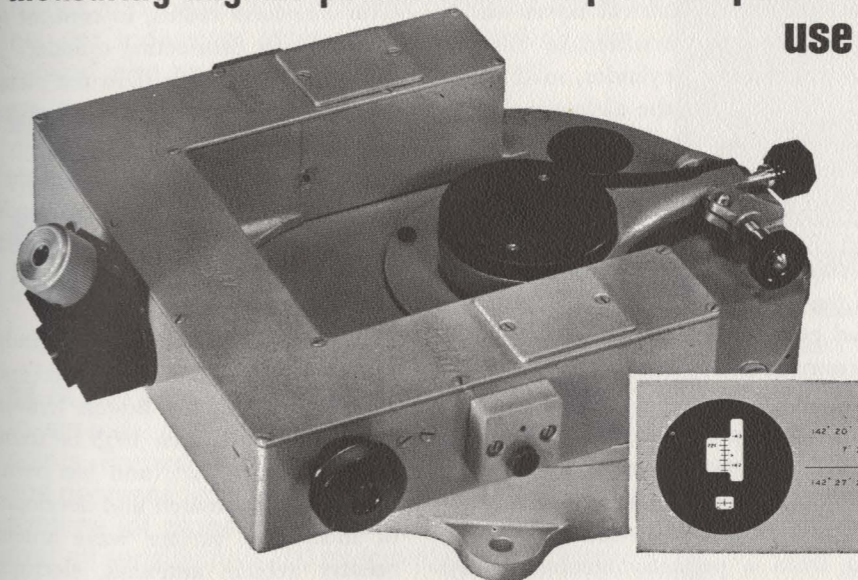
Mr. Levison has recently completed a detailed study of the PRS and will present a review of his work which emphasizes the nonlinear behavior. His talk will include discussion of the approach taken in the analysis of the system, an account of his experimental studies in the open-loop configuration, and consideration of a model of the PRS.

William H. Levison holds his SB (1958) and SM (1960) degrees from MIT's Department of Electrical Engineering and has been associated with the Research Laboratory of Electronics, MIT, since September 1958. He has also worked at MIT Lincoln Laboratory and at the Peter Bent Brigham Hospital, Boston. His research efforts at all of these locations have involved the application of engineering techniques to problems in medicine and biology, and he is currently completing the requirements for an ScD degree at MIT.

TUESDAY, JANUARY 14
Dinner — 6:00pm — MIT Faculty Club
Meeting — 8:00pm — MIT Room 4-231

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ANTENNAS AND PROPAGATION

DOUBLE MEETING

A Two-Millimeter Conical Scanning Antenna

D. M. GIDDINGS — TRG Company

A TWO-MILLIMETER conical-scanning antenna of Cassegrain type will be described. Features include operation at 3 and 4 millimeters and elimination of a rotary joint by spinning the subreflector off-axis. Scan speed is monitored by a photodiode which receives light from a rotating reflector. Some of the design, construction, and testing considerations

peculiar to antennas of this type will be discussed.

Orville M. Giddings is a staff member of TRG, Inc., where he has worked on the development of millimeter-wave antennas and components. Previous affiliations include Gabriel Electronics Division and Socony Mobil Research Laboratory. He received the BSEE from Rutgers University.

Scattering from Metallic, Dielectric and Dielectrically-Clad Cylinders at Arbitrary Incidence

A. S. THOMAS — A. S. Thomas Inc.

AN exact general formulation for scattering from N concentric homogeneous cylindrical layers will be presented and specialized to the perfectly conducting cylinder, solid dielectric cylinder, and the dielectrically-clad cylinder. Both the TE and TM modes of the incident field will be considered. The scattering from the perfectly conducting cylinder and perfectly conducting sphere will be compared with that of the solid dielectric and dielectrically-clad cylinder at arbitrary incidence and at normal incidence. It will be shown that:

1. For intermediate values of the dielectric constant, the back scattering from a solid dielectric cylinder is significantly higher than the back scattering from a perfectly conducting cylinder;
2. For both TE and TM modes of incident field on the dielectric and di-

electrically-clad cylinder, the oscillations in the scattered field persist indefinitely with increased radius, in contrast with the perfectly conducting cylinder;

3. In planes other than the plane of incidence, the scattered field contains the orthogonal mode;

4. The back scattering from the dielectrically clad sphere corresponds to the back scattering from the dielectrically clad cylinder for incident TE and TM modes.

Abdelnour S. Thomas is a graduate of the College of the Holy Cross (*magna cum laude*) and the Boston University Graduate School. In 1955 he founded A. S. Thomas, Inc., and has been responsible for research and development of modulated surface wave antennas, reentry vehicle antennas, electromagnetic absorbers, reflectivity, wave propagation, and the detection and camouflage of space vehicles.

TUESDAY, JANUARY 14

Dinner — 6:00pm — Waltham Motor Inn, Route 128, Winter St. exit, Waltham
Meeting — 8:00pm — Sylvania, 100 First Ave., Waltham — Room 1A1

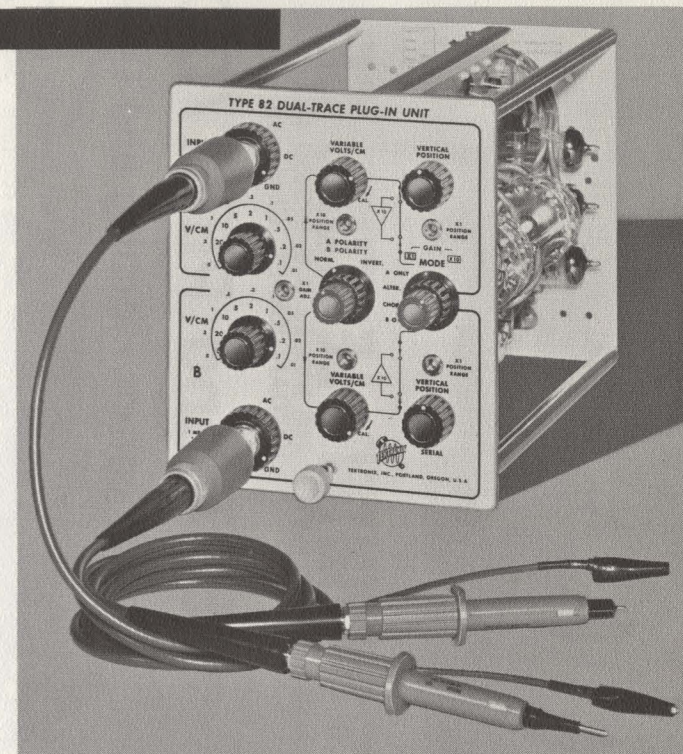
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Here's a new Tektronix dual-trace unit... to update older Type 580-series oscilloscopes

DC-to-80 MC at 10 mv/cm DC-to-85 MC at 100 mv/cm



Type 82 plug-in unit adds new convenience to display and measurement of high-sensitivity, wide-band, dual-trace presentations on the Type 580-Series Oscilloscopes.



Characteristics

■ DUAL-TRACE OPERATION with 4 operating modes and independent controls for each channel—for individual attenuation, positioning, inversion, and ac or dc coupling as desired.

■ PASSBAND typically DC-TO-85 MC (3-db down) at 100 mv/cm (12-db down at 150 Mc), and typically DC-TO-80 MC (3-db down) at 10 mv/cm.

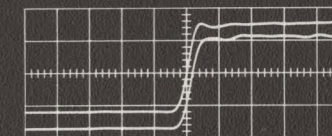
■ CALIBRATED SENSITIVITY in 9 steps from 100 mv/cm to 5 v/cm, and in 10X Amplifier Mode, from 10 mv/cm to 5 v/cm, variable between steps.

plus

■ SUPPLIED SMALL SIZE PASSIVE PROBES to simplify probe connection to signal-source points. Probes increase input R to 10 megohms and decrease input C to approximately 7 pf, with risetime (of probe, plug-in unit, oscilloscope) at over-all sensitivity of 100 mv/cm at approximately 4½ nsec.

Type 82 Dual-Trace Plug-In Unit \$650

Risetime of 4.3 nsec



Dual-trace display of input and output pulses of a transistor amplifier at 10 nsec/cm—with lower trace delayed 1 nsec by amplifier under observation. Type 580-Series/82 combination can display time coincidence between input channels with no measurable difference at 10 nsec/cm.

Modification for Early Instruments

Some early Type 580-Series Oscilloscopes must be modified to accept the new Type 82 Dual-Trace Unit or the new Type 81 Single-Trace Unit. After modification, these oscilloscopes—with serial numbers below No. 970 for Type 581's and below No. 2585 for Type 585's—will have improved and standardized transient response (and improved performance with the Type 80/P80 combination). To determine whether your particular instrument needs this modification, please call your Tektronix Field Engineer. Modification Kit (Part Number 040-275) \$25
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JANUARY 1964



January IEEE Meetings

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS

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JANUARY 7

Tuesday, 8:00pm
Sylvania Electronic Systems
100 First Ave., Waltham

ENGINEERING MANAGEMENT - See page 4

NEW DIRECTIONS IN DOD PROCUREMENT

Stephen W. Rowen, Raytheon Co.
Dinner - Charterhouse Motel
Rte. 128, Waltham - 6:00pm

JANUARY 7

Tuesday, 8:00pm
Sperry Rand Research Center
Sudbury

INSTRUMENTATION AND MEASUREMENTS - See page 4

MODERN TECHNIQUES IN ULTRA-ACCURATE AC INSTRUMENTATION

F. Mansfield Young, Adage, Inc.

JANUARY 14

Tuesday, 8:00pm
Sylvania Electronic Systems
100 First Ave., Waltham

ANTENNAS AND PROPAGATION - See page 6

A TWO-MILLIMETER CONICAL SCANNING ANTENNA

Orville M. Giddings, TRG, Inc.

SCATTERING FROM METALLIC, DIELECTRIC, AND DIELECTRICALLY-CLAD CYLINDERS AT ARBITRARY INCIDENCE

Abdelnour S. Thomas, A. S. Thomas, Inc.

Dinner - Waltham Motor Inn, Winter St. (off Rte. 128) - 6:00pm

JANUARY 14

Tuesday, 8:00pm
MIT, Room 4-231

BIOMEDICAL ELECTRONICS - See page 5

REGULATION OF BLOOD PRESSURE: A NONLINEAR BIOLOGICAL SERVOMECHANISM

William H. Levison, MIT

Dinner - MIT Faculty Club - 6:00pm

JANUARY 14

Tuesday, 7:30pm
MIT, Room 10-275

UTILITY SYSTEMS - See page 4

SAFETY FUNDAMENTALS IN SUBSTATION DESIGN

Henry R. Kurth, Boston Edison Co.

JANUARY 15

Wednesday, 8:00pm
MIT, Room 4-270

MICROWAVE THEORY & TECHNIQUES - See page 10

BIOPHYSICAL ASPECTS OF LASER RADIATION

David Bushnell, Raytheon Co. and Paul E. McGuff, M.D.

Dinner - Coach Grille, Harvard Sq. - 6:30pm

JANUARY 15

Wednesday, 8:00pm
Raytheon Executive Offices
Lexington

ENGINEERING WRITING AND SPEECH - See page 10

HOW TO WRITE MAGAZINE ARTICLES

Edward E. Grazda, Electronic Design Magazine
Dinner - Charterhouse Motel, Rte. 128, Waltham - 6:00pm

JANUARY 20

Monday, 7:30pm
Avco R & D
Wilmington

MERRIMACK VALLEY SUBSECTION - See page 10

AVCO'S DATA PROCESSING CENTER

Calvin G. Cook, Avco R & D

Dinner - Avco Executive Dining Room - 6:00pm

JANUARY 21

Tuesday, 7:45pm
Sylvania Electronic Systems
40 Sylvan Road, Waltham

PRODUCT ENGINEERING AND PRODUCTION - See page 12

THE CASE FOR THIN-FILM MICROELECTRONICS

Gerald J. Selvin, Sylvania

JANUARY 21

Tuesday, 8:00pm
Sylvania Electronic Systems
100 First Ave., Waltham

AUTOMATIC CONTROL AND AEROSPACE AND NAVIGATIONAL ELECTRONICS - See page 11

ORBITING ASTRONOMICAL OBSERVATORY PROGRAM

Norman Gundersen, Sylvania Electronic Systems

JANUARY 22

Wednesday, 8:00pm
MIT Penthouse
50 Memorial Drive

SPACE ELECTRONICS AND TELEMETRY - See page 12

COMMUNICATIONS SATELLITES - A 1964 PERSPECTIVE

Burton I. Edelson, Cmdr., USN

Dinner - MIT Faculty Club Penthouse - 6:30pm

JANUARY 28

Tuesday, 8:00pm
MIT, Room 4-231

INFORMATION THEORY - See page 14

PATTERN RECOGNITION APPLIED TO SPEECH COMPRESSION SYSTEMS

Bernard Gold, MIT Lincoln Lab

Dinner - MIT Faculty Club - 6:15pm

JANUARY 28

Tuesday, 8:00pm
MIT, Room 10-275

ELECTRONIC COMPUTERS - See page 13

THE LINC

Charles E. Molnar, AFRC

Dinner - Clipper Ship, 540 Memorial Drive, Cambridge - 6:30pm

JANUARY 29

Wednesday, 7:30pm
National Magnetic Lab.
17 Albany St.,
Cambridge

INDUSTRIAL POWER SYSTEMS AND LYNN SUBSECTION

See page 15

NATIONAL MAGNET LABORATORY TOUR

C. G. Adams, D. T. Stevenson and R. R. Lang

Dinner - Smith House, Memorial Drive, Cambridge - 6:30pm
Call JA 4-2906 for reservations by January 22, 1964

WINTER LECTURE SERIES

JORDAN KADET, Chairman

PERT and PERT/COST

For Program Planning and Control

MANAGEMENT, like invention, is no longer a matter of individual effort; Space-Age Programs are too complex. Management of major space, weapons, construction, military, or other programs is accomplished through large organizations of professional experts in administration, finance, science, engineering, and production, to list but a few. Each program must be carefully planned, scheduled, evaluated, and managed toward attainment of specific objectives. The complexity of directing and controlling these programs has challenged conventional management techniques."

PERT Guide for Management Use

U. S. Government PERT Coördinating Group, June 1963

The new techniques, which have been developed to meet the challenge of complex programs, include PERT, PERT/COST, Line of Balance and Program Definition. These are some of the topics to which the Winter Lecture Series will address itself. The speakers who will discuss these subjects have been invited because of their knowledge of the subjects. All have been working intensively in the field for many years.

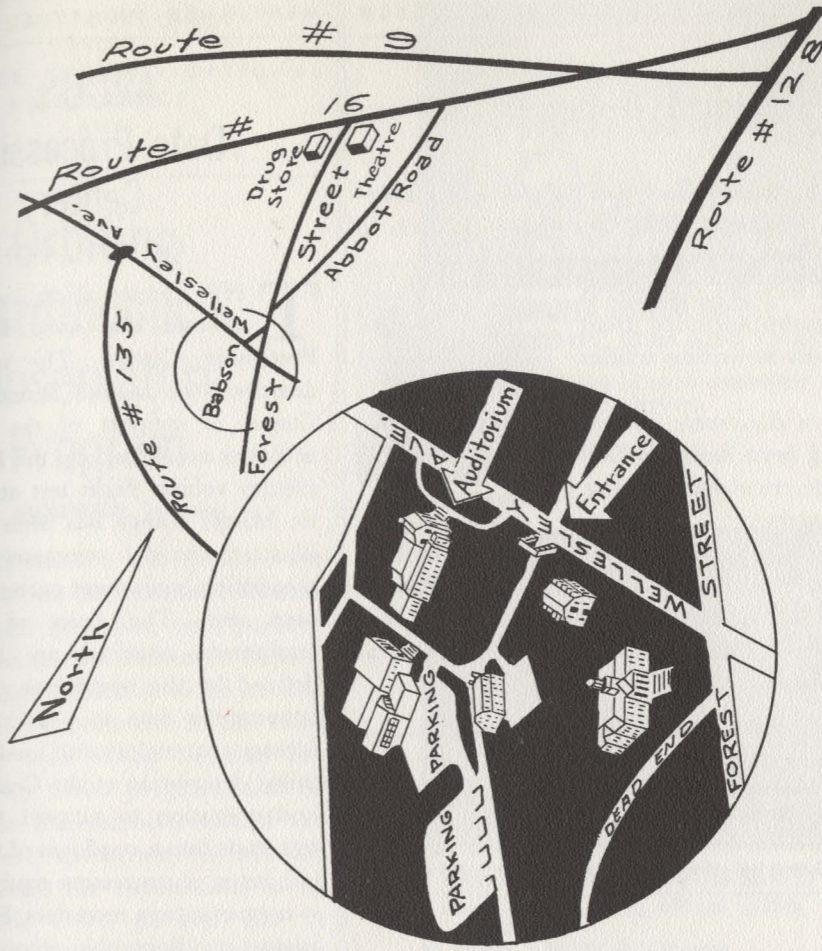
FOUR CONSECUTIVE THURSDAY EVENINGS

7:30 - 10:30pm

JAN. 9 PERT
JAN. 16 PERT/COST
JAN. 23 PERT/COST

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How to Write Magazine Articles

"How to Write Articles" is a presentation directed to would-be engineering authors. The talk tries to explain a direct and easy approach to writing articles. It attempts to tell engineers how to go about the task of writing an article and it also includes suggestions on what to write about. Although examples are cited from *Electronic Design*, the points discussed apply to writing articles for any technical magazine.

Edward E. Grazda is Editor-in-Chief of *Electronic Design*. His publishing experience includes having been Assistant Editor at *Electronics*, Associate Editor at *Electrical Engineering*, and Editor of *Electrical Equipment* magazine.

In 1952 Mr. Grazda helped start *Electronic Design* at Hayden Publishing Company, Inc., and has been Editor from the very beginning of the publication. His present duties also include those of an Editorial Director of *MicroWaves*, and he is in charge of special scientific and engineering publishing projects at the Hayden Book Company.



E. E. GRAZDA
Electronic Design

WEDNESDAY, JANUARY 15

Dinner — 6:00pm — Charterhouse Motor Hotel, Waltham
Meeting — 8:00pm — Raytheon Executive Offices, Lexington

Biophysical Aspects of Laser Radiation

D. BUSHNELL
Raytheon Company

P. E. MCGUFF
Tufts Medical

THE purpose of the presentation is to discuss the biophysical aspects of laser radiation. To accomplish this objective we intend to present a review of the operation of the laser; a review of the state of the laser art in terms of energy and power; a discussion of the first phase of our biological experiment; and the implications of our experiment and other similar studies on laboratory safety. The discussion will be illustrated by slides and by a short motion picture.

David Bushnell received his BS (Physics) at the University of Washington, and his MS (Physics) at the State College of Washington. He joined the Raytheon Company in 1961 as a staff engineer in the Ordnance Radar Department and was primarily concerned with missile range instrumentation. After moving to the Advanced Development Laboratory he assumed responsibility for the development of system applications of the laser. He is now concerned with the use of the laser and other optical devices in radar-like applications. Mr. Bushnell is a staff member of Tufts Medical School (consultant in Physics).

Paul E. McGuff received his BS in Indiana in 1938, his MD in Indiana in 1944, and his MS in surgery at the Mayo Clinic. He is a candidate for his PhD at Tufts Medical School. Dr. McGuff is presently the Ernest W. Lawson Fellow of the Massachusetts Heart Association. Dr. McGuff has been in private practice for fourteen years with extensive experience in abdominal and cardiac surgery.

WEDNESDAY, JANUARY 15

Dinner — 6:30pm — Coach Grille, Harvard Sq., Cambridge
Meeting — 8:00pm — MIT, Room 4-270

AVCO's Data Processing Center

C. G. COOK, AVCO

THE presentation will center around the Avco RAD Data Processing Center. The introduction describes the overall function of the Center in support of the many test activities conducted by the Division. A reentry vehicle flight test at the Atlantic Missile Range has been selected to illustrate typical telemetry and data acquisition equipment currently in common use. The types of processing equipment required are functionally defined by the operations necessary to convert the data to a usable form for subsequent engineering analysis. A detailed description of the Center's design and operation to support this specific test leads into a rundown of the individual items of processing equipment used—magnetic tape recorders, FM discriminators, oscillographic recorders, timing equipment, analog-to-digital converters—and how they have been integrated into a highly automated processing system. A tour of the Data Processing Center is also planned.

Calvin G. Cook received the BSEE from Northeastern University in 1956. He has been with the Avco Research and Advanced Development Division since 1958 where he now heads the Electronic Data Processing Group. In this capacity he has directed the Group's activity through all of the major reentry vehicle test programs and support of other in-house scientific test programs. In the technical area he has concentrated on the analysis of the overall data handling system which consists of the instrumentation, data acquisition, and data processing subsystems. Mr. Cook is a member of IEEE, Tau Beta Pi, and Eta Kappa Nu.

MONDAY, JANUARY 20

AVCO, Wilmington — Executive Dining Room
For reservations please call Dan Di Menna
OLiver 8-8911, ext. 2200
Meeting — 7:30pm

Orbiting Astronomical Observatory Program

N. GUNDERSEN, Sylvania

MR. Gundersen will speak on the Orbiting Astronomical Observatory (OAO) program, with particular emphasis on the Princeton Experiment Package, which is to be orbited as the prime experiment in the third OAO. He will briefly describe the history of the OAO program, and he will describe the characteristics of the "standardized" spacecraft. He will also briefly describe the experiments to be orbited with OAO #1 and #2. A detailed description of the Princeton Experiment Package electronics and optics will be given. The talk will be illustrated with color slides.

Mr. Norman Gundersen is currently Technical Manager of the Princeton Experiment Program at Sylvania. He holds a BSEE and an MS in Physics, both from Tufts University. He has worked in engineering for over fifteen years in the fields of radar, navigation, and scientific instruments.

TUESDAY, JANUARY 21

Sylvania — 100 First Ave.
Waltham — Rooms 1A1 and 1A2
Meeting — 8:00pm

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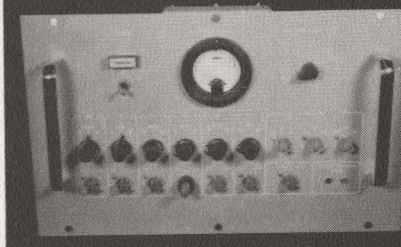
AD-YU ELECTRONICS, INC.

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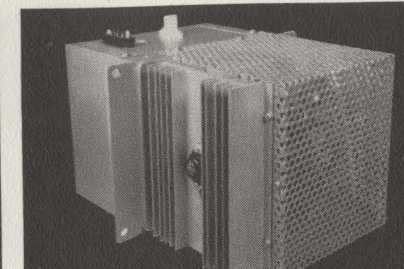
COMPUTER SYSTEM SUPPLY

Input: 108/220 VAC., 60 cps $\pm 10\%$ 3 phase,
4 wire
Output: 4.4 VDC @ 0-12 amps. (overvoltage,
overcurrent protection)
Regulation: $\pm 0.1\%$
Ripple: 1 MV, peak to peak
Temp: 0-50° C
Mil Specs: Mil-E-4158, Mil-Q-9858



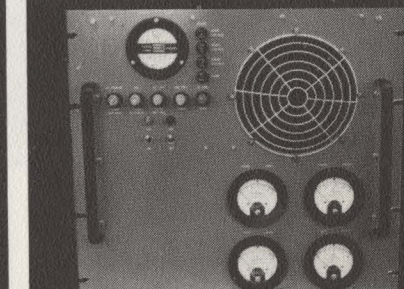
MULTIPLE OUTPUT SYSTEM SUPPLY

Input: 115 VAC $\pm 10\%$, 400 cps $\pm 10\%$,
3 phase
Outputs: +50 VDC @ 0.25 amps
+10 VDC @ 3.0 amps
-5 VDC @ 12 amps
-10 VDC @ 8 amps
-12 VDC @ 0.75 amps
-30 VDC @ 1.5 amps
Regulation: 1%
Ripple: 8 MV, peak to peak
Temp: -29°C to +55°C
Mil Specs: Mil-I-945, Mil-Q-9858



ADJUSTABLE HIGH VOLTAGE SUPPLY

Input: +20 VDC @ 1.4 amps max.
Output: Adjustable 4 KVDC to 5 KVDC
@ 2.0 ma.
Regulation: $\pm 1\%$
Ripple: $\pm 0.05\%$
Temp: 0-65°C



GROUND SUPPORT POWER SUPPLY

Input: 120 VAC $\pm 10\%$, 48-62 cps.
Single phase
Outputs: 145 to 155 VDC, 0-2.5 amps
10 to 16 VDC, 0-2.5 amps
6.2 to 6.8 VDC, 25 amps
Regulation: 1 and 2...0.15%, 3...2%
Ripple: outputs 1 & 2 less than 0.05%
output 3, less than 5%
Temp: 0-55°C
Mil Specs: Mil-E-4158, Mil-E-4970,
Mil-R-26474

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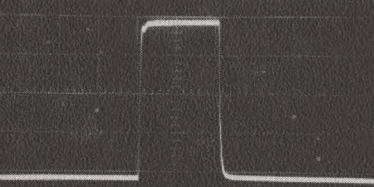
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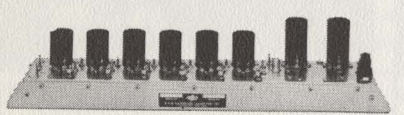
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UNRETOUCHED PHOTO OF OUTPUT PULSE, MODEL L2005 (Horizontal scale: 5 μ sec/cm)



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L1003	10 mc	3 mc	80 db	0.3 μ sec
L1505	15 mc	5 mc	80 db	0.2 μ sec
L2005	20 mc	5 mc	80 db	0.2 μ sec
L3002	30 mc	2 mc	90 db	0.5 μ sec
L3010	30 mc	10 mc	80 db	0.1 μ sec
L6002	60 mc	2 mc	90 db	0.5 μ sec
L6010	60 mc	10 mc	80 db	0.1 μ sec
L6020	60 mc	20 mc	80 db	0.05 μ sec
L7002	70 mc	2 mc	90 db	0.5 μ sec
L12020	120 mc	20 mc	80 db	0.05 μ sec

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The Case for Thin-Film Microelectronics

G. J. SELVIN, Sylvania

AN integrated circuit is defined as the physical realization of a number of circuit elements inseparably associated on or within a continuous body to perform the function of a circuit. The two major approaches to accomplishing integrated circuits are: (1) by operating within a continuous body of semiconductor material, and (2) by thin films deposited on the surface of an insulating structural supporting material. In addition, there are various hybrid combinations of these two, frequently merged with discrete microminiature components.

There is considerable controversy over which approach to use, the relative merits of the various techniques, when all-thin-film circuits will be available, and what the future holds. While the feeling is that there is not a competition between the two and each has its role to play, there is a certain amount of overlap and trade-offs can be made. This program will provide the answers to many of the questions relative to the use and manufacture of thin-film circuits.

The talk will be illustrated by slides and various samples of microelectronic devices. In addition to the various thin-film technologies, including active element deposition, the talk will cover various approaches to making the devices and the special processing equipment required.

Gerald J. Selvin is Manager of the Microelectronics Laboratory at Sylvania in Waltham. He founded the program and laboratory in 1959, and is responsible for all aspects of the microelectronics operation and its growth.

TUESDAY, JANUARY 21

Meeting - 7:45pm - Sylvania - 40 Sylvan Road, Waltham
(Cafeteria, Center Entrance of Building)

PTG

SPACE ELECTRONICS AND TELEMTRY

Communications Satellites - A 1964 Perspective

B. I. EDELSON, USN

THE IEEE Executive Committee has approved the petition for establishment of a Chapter of the Professional Technical Group on Space Electronics and Telemetry. An organizational meeting of the Chapter was held December 18th at MIT under the chairmanship of Jack Larsen, organizer and interim chairman.

The first Section meeting under the auspices of the new Chapter will be held January 22. At that time the newly elected officers will be introduced to the membership. Principal speaker for this meeting will be Dr. Burton I. Edelson, Cmdr., USN, a member of the staff of President Johnson's National Aeronautics and Space Council. His topic will be "Communications Satellites—A 1964 Perspective." Dr. Edelson has staff responsibility for the review and coordination of all technical aspects of Communication Satellite developments. His talk will deal with national goals and the contributions of various agencies and programs toward their achievement.

Dr. Edelson is a graduate of the U.S. Naval Academy, Class of 1947, and is detailed to the Council on Special Assignment. He has pursued graduate studies in metallurgy at Yale University, where he received the MS degree in 1954 and the PhD in 1960. As a line officer of the Navy his assignments are now in engineering duty only.

WEDNESDAY, JANUARY 22

MIT Faculty Club Penthouse
Meeting - 8:00pm Dinner - 6:30pm

The LINC

C. E. MOLNAR, USAF

THE Laboratory INstrument Computer is a small but powerful stored-program instrument which has been designed especially for use as a laboratory tool. Development of the LINC was begun at the MIT Lincoln Laboratory and completed at the MIT Center Development Office by a group under the supervision of Mr. W. A. Clark of MIT and Lt. C. E. Molnar of the Air Force Cambridge Research Laboratories. The high operating speed of the LINC suits it for real-time processing of experimental data as well as for controlling experiments. It is able to accept analog as well as digital inputs and has a variety of outputs that can be conveniently connected to other equipment. Additional features which make the LINC versatile and easy to use in the laboratory include its rich order code, direct means of communication with the experimenter, and a novel digital tape system. More than a dozen LINC's were assembled at MIT during the past summer by groups of biomedical researchers and are now in use in their laboratories throughout the country.

Charles E. Molnar is currently a Lieutenant in the USAF, assigned to the Data Sciences Laboratory at the Air Force Cambridge Research Center. Prior to service in the Air Force, he was a Staff Associate at the MIT Lincoln Laboratory and the MIT Communications Biophysics Laboratory. He received the BSEE and MSEE from Rutgers University in 1956 and 1957, respectively.

TUESDAY, JANUARY 28

Meeting - 8:00pm - MIT Room 10-275
Dinner - Clipper Ship, 540 Memorial Drive, Cambridge - 6:30pm



Spectrum Surveillance System—mobile RFI monitoring facility for missile test range, 0.5 mc to 10.7 Gc, includes beacon checkout tester.

... in signal intercept, analysis, and measurements

A rich background of experience covering test equipment, ECM and RFI techniques, data analysis, and microwave instrumentation has enabled AEL to make a wide variety of important developments in . . . airborne, ground based, surface, and underwater systems.

Significant contributions to state-of-the-art have been made through theoretical and experimental studies to determine the vulnerability of equipment to ECM, and techniques to minimize interference effects on receivers.

The broad range of AEL's capabilities in this field is indicated by the following typical developments, and by the accompanying illustrations.

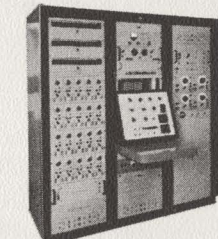
- Ultra-stable microwave signal generators
- Instantaneous direction finding equipment
- New applications for traveling wave tube amplifiers
- Low noise receivers for counter-measures operation and spectrum signature
- Missile checkout equipment
- Pulse analysis equipment
- Crystal video receivers for beacon checkout
- Swept panoramic receivers for site RFI evaluation

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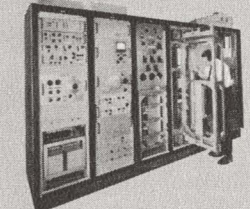
Panoramic Receiver (display unit)—simultaneous coverage 1 to 10.7 Gc in 4 bands for rapid site monitoring.



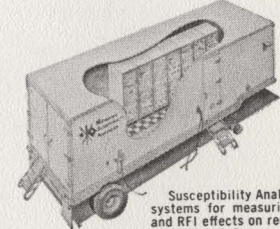
Portable Pulse Analyzer—transistorized, battery operated unit displaying pulse rate, width, and rise times.



Power Spectrum Density Analyzer—continuous analysis and recording of mechanical vibrations, 10 to 10,000 cps.



High Power Signal Source—ultra-stable 40 mc to 40 Gc system for electromagnetic compatibility and RFI measurements.



Susceptibility Analyzers—systems for measuring ECM and RFI effects on receivers, 10 kc to 18 Gc.



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Pattern Recognition Applied to Speech Compression Systems

B. GOLD, MIT Lincoln Laboratories

THE most embarrassing gap in the communication technology is the gap between the amount of information inherently required to transmit high quality voice (variously estimated at several hundred bits per second) and the quality of channels that must, in practice, be provided for voice conversations (typically twenty to fifty thousand bits per second capacity). At various times in the past twenty-five years a number of types of bandwidth-reduction devices, given the generic name "vocoder," have been proposed. These devices have remained marginal for general communication use. Although they are generally more or less successful in reproducing the broad characteristics of speech which govern intelligibility, they generally fail in reproducing the details which produce the standard of quality to which the user of telephone systems, for example has become accustomed. The successful description of these details, such as patterns of voicing, is in fact a

problem in pattern recognition, in which the pattern to be recognized is statistical rather than deterministic.

Bernard Gold has studied and demonstrated the kinds of improvements that can be made in vocoder speech transmissions when pattern recognition techniques are applied to determine the excitation functions, the pitch buzz-hiss voice decision. He will describe these techniques and demonstrate their use both in computer simulation and in a real-time channel vocoder.

Bernard Gold received the BSEE from CCNY in 1944 and the PhD in EE from Brooklyn Polytechnic Institute in 1948. He has been at Lincoln Laboratory since 1953, with the exception of one year (1954-55) which he spent in Rome as a Fulbright Research Fellow. His work has been in radar, noise theory, pattern recognition, and speech bandwidth compression.

TUESDAY, JANUARY 28
Meeting — 8:00pm — MIT, Room 4-231

Reliability Control Lecture Series

E. F. DERTINGER — Instructor

Five Consecutive Mondays 7:00-9:00pm
Sylvania, Building #7, 60 First Ave., Waltham

- JAN. 27 — RELIABILITY CONTROL CONCEPTS
- FEB. 3 — PRINCIPLES OF MAINTAINABILITY AND AVAILABILITY
- FEB. 10 — DESIGN REVIEW AND ANALYSIS
- FEB. 17 — DATA COLLECTION AND ANALYSIS
- FEB. 24 — TESTING PROGRAMS
- MAR. 2 — MANAGEMENT OF A RELIABILITY CONTROL PROGRAM

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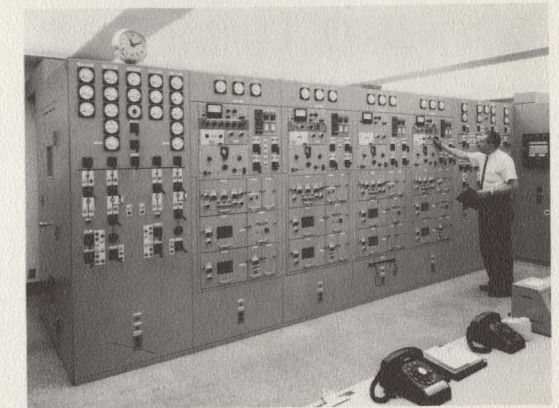
National Magnet Laboratory Tour



THE National Magnet Laboratory was established at MIT in 1960 to promote the advancement of basic research on the fundamental properties of matter. It is sponsored by the Office of Aerospace Research, Air Force Office of Scientific Research.

Construction of the actual laboratory facility was completed in the Spring of 1963, and preliminary testing was completed in the Summer. It is unique with respect to the magnitude of magnetic fields which will be produced on a continuous basis in a useful experimental volume, 250 kilogauss, a value heretofore unobtainable using classical magnet design. In addition, by use of the stored energy in the flywheels, fields of 400 kGs will be produced for periods of 2 seconds.

These fields are produced in special water-cooled, air-core solenoids; as a general rule, iron is not useful since the magnetic fields are too intense. The dc magnet power is furnished from two motor-generator sets (see picture above) equipped with 80-ton flywheels and controlled by an ingenious control system to produce steady-state, pulse, and sweep currents with unusual stability, control, reproducibility, and ripple characteristics. Power is transmitted to each of ten test cells by four pairs of 10 000-ampere copper busses. By means of special hydraulic disconnect switches, all possible series and parallel combinations of four generator outputs can be furnished at each test cell. Since the efficiency of the system is zero, all power supplied to the magnets must be absorbed by the cooling water flowing through the magnets. Cooling water is furnished at the rate of 12 000 gal/min from the Charles River to a closed distilled, deionized cooling-water loop furnishing 4000 gal/min at 150 lbf/in² to the magnets. The motor-generator sets, the test-cell setups and all auxiliary functions are controlled directly from a central room (see picture above).

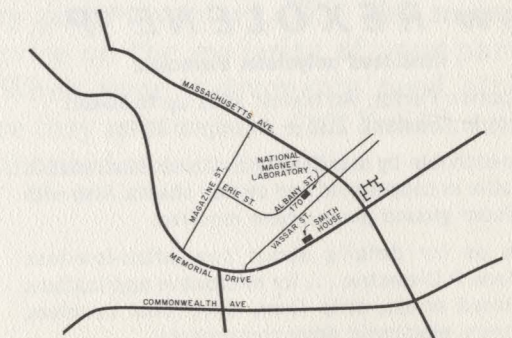


The Chairman of the meeting will be Mr. Crawford G. Adams. Mr. Adams has served as the Project Manager of Jackson & Moreland, Inc., responsible for the design and supervision of construction of the Laboratory. Mr. Adams's talk will be oriented towards the unusual problems encountered during the design, construction, and start-up of this unique laboratory facility.

Prior to joining Jackson & Moreland in 1957, Mr. Adams was employed by the General Electric Co. in the Atomic Power Equipment Department and in the Central Station Engineering Department concerned with the design and application of large electrical apparatus.

Dr. Donald T. Stevenson of MIT and Mr. Robert R. Lang of General Electric will assist Mr. Adams with the presentation. Dr. Stevenson, Assistant Director of the National Magnet Laboratory, will briefly discuss the mission of the laboratory and the techniques employed in creating strong magnetic fields. Mr. Lang, Assistant Manager of Installation and Service, will briefly discuss some of the problems which General Electric encountered in manufacturing and installing the motor-generator sets and control equipment.

Following the lecture, the speakers will conduct tours through the laboratory to demonstrate the equipment in operation under actual testing conditions.



WEDNESDAY, JANUARY 29

Dinner — 6:30pm — Smith House, Memorial Drive, Cambridge

Meeting — 7:30pm — National Magnetic Laboratory, 170 Albany Street, Cambridge

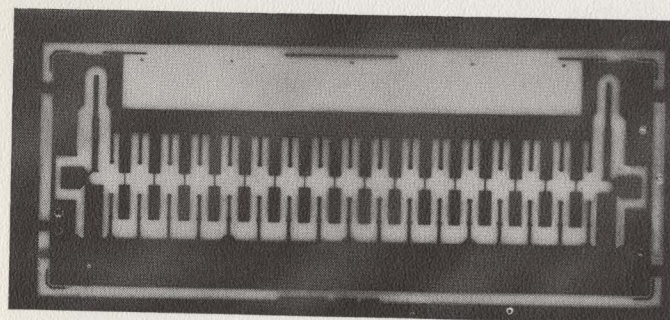
Call JA 4-2906 for dinner reservations by January 22, 1964

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CALIFORNIA VS MASSACHUSETTS

RONALD E. SCOTT
 Chairman — Boston Section

IN terms of dollar volume California is now the foremost state in the nation in the areas of research and development. Relatively speaking Massachusetts is slipping behind. One reason for this trend is revealed in the recent book *The Uses of the University* by President Kerr of the University of California. President Kerr's book is sharp and incisive. His views on education in modern America are clear and challenging. His insights will offend some, disturb others, and influence a great many more.

The University of California is a new type of institution for which Kerr coins the term "Multiversity." It operates on a new scale and with a new relationship to the community. It attempts to meet a broad spectrum of educational needs. It caters not only to the elite at the top of the intellectual ladder, but also to the average group at the working level of society. The University of California has 100 000 regular students, 200 000 extension students, and 30 000 graduate students. It has a budget of a half billion dollars per year for current operations. It employs 40 000 people on a hundred different campuses. It has contact with nearly every industry, nearly every level of government, and nearly every person in California.

Education itself is a growing industry. It accounts for almost 30 per cent of our gross national product, and it is growing at twice the rate of the rest of the economy. The impact of an educational complex on the surrounding region is immense. Talented people seek out the intellectual areas of the country, industries follow them and population and prosperity follow the industries. There are three great "Ideopolises" in the country at present — the east coast from Boston to Washington, California from San Francisco to Los Angeles, and the Big Ten area around Chicago. Of the three, the California area seems to have best understood its mission. The integration of the intellectual life and society has proceeded furthest there. Isolationism for intellectuals is now as dead as isolationism for politicians.


PTG NUCLEAR SCIENCE
 MHD POWER GENERATION

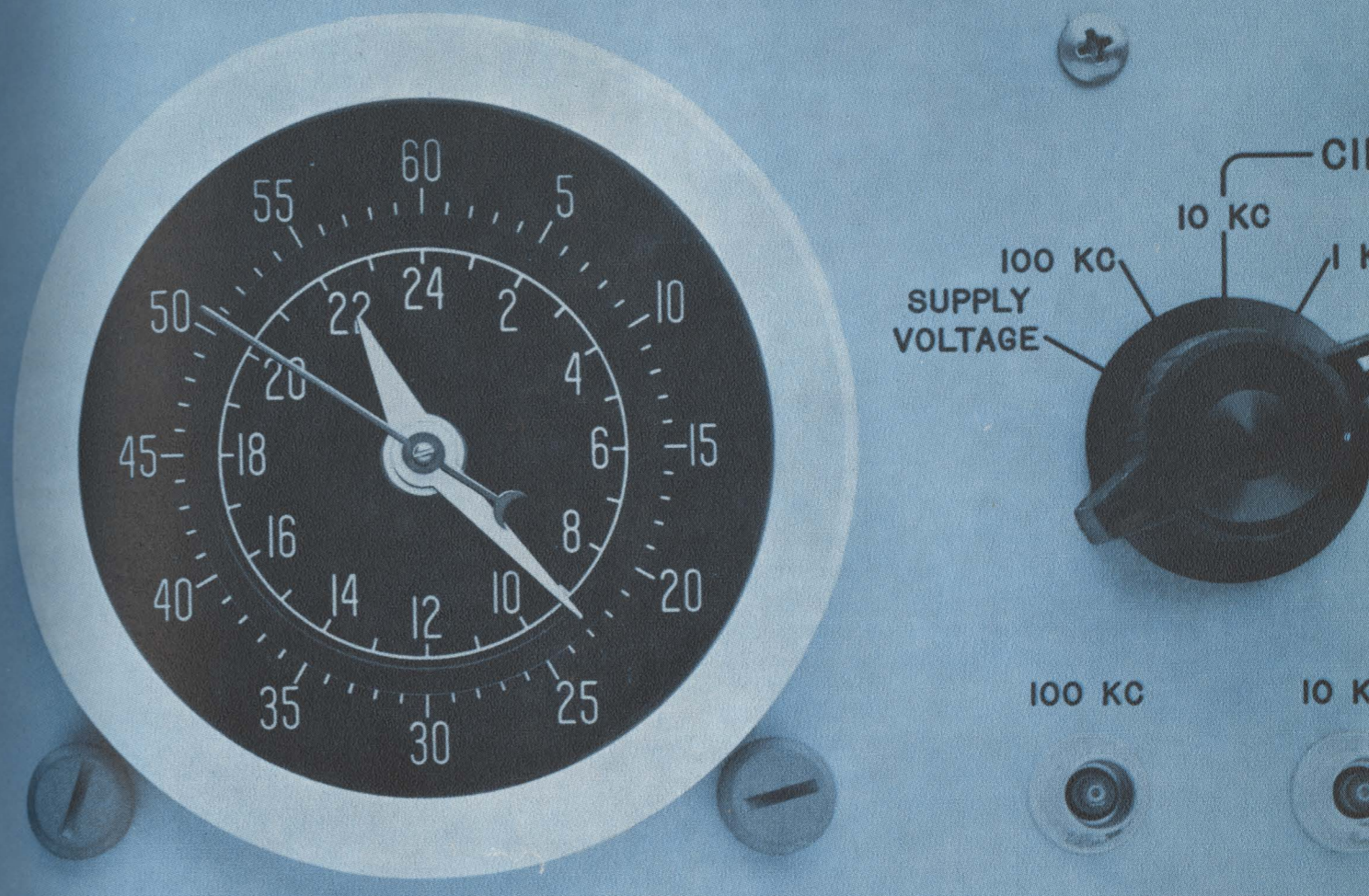
Dr. Arthur Kantrowitz, Vice President and Director, Avco Everett Research Laboratories, will be the speaker for the third meeting of PTGNS. His talk will be on MHD power generation. The meeting is scheduled for February 25.

TUESDAY FEBRUARY 25

THE REFLECTOR

FREQUENCY DIVIDER AND CLOCK

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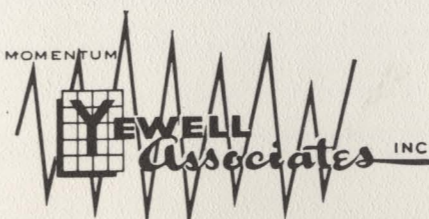
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Heard about this connector?

ITS VSWR AT 4 Gc IS LESS THAN 1.005!

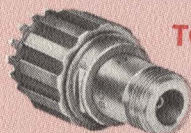
- ... and less than 1.01 at 9 Gc
- ... VSWR differs by less than 0.05% as connection is broken and remade
- ... leakage is better than 130-db below signal level
- ... characteristic impedance is 50 ohms \pm 0.1%
- ... any two connectors mate
- ... designed for $\frac{3}{16}$ " line size, measures $1\frac{1}{16}$ " long by $1\frac{1}{16}$ " diameter, overall
- ... production units are 100% inspected against VSWR specification

Type 900-BT Precision Coaxial Connector ... \$35

A new criterion for measurement accuracy has been established with the development of GR's Type 900-BT Precision Coaxial Connector. Now, highly accurate measuring equipment can be designed without regard to the limitations heretofore imposed by connectors.

The successful development of this precision connector has spearheaded the creation of a completely new GR line of precision coaxial components and instruments. The items shown here are a few of those that are presently available; more are under development and will be available soon.

Adaptors



TO TYPE N

Type 900-QNJ \$50.00

contains Type 900-BT Connector and an improved type N jack, VSWR below $1.004 + 0.004f_{Gc}$, up to 9 Gc.

Type 900-QNP \$50.00



contains Type 900-BT Connector and an improved type N plug; same VSWR as Type 900-QNJ.

TO TYPE 874



Type 900-Q874 ... \$45.00

contains Type 900-BT Connector and a Type 874-BL Locking Connector; VSWR below $1.00 + 0.015f_{Gc}$ to 1Gc and $1.01 + 0.005f_{Gc}$ from 1 to 7Gc.

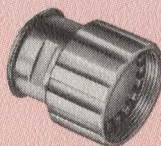
Terminations

TYPE 900-W50 50-ohm

Standard Termination ... \$60.00



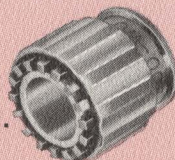
At 1Gc, the combined VSWR of a Type 900-W50 Termination plus a Type 900-QNJ or -QNP Precision Adaptor is less than 1.018.



Type 900-WN Short-Circuit Termination ... \$9.00

Used for establishing a reference plane in coaxial measurements and for making loss measurements. Reflection coefficient greater than 0.999.

Type 900-WO Open-Circuit Termination ... \$9.00



Establishes an open circuit 2.6 ± 0.2 mm beyond the face of a Type 900-BT Precision Connector. Reflection coefficient greater than 0.9995.

Rod & Tubing

Used in fabricating custom components to take Type 900 Connectors

Inner-Conductor Rod ... \$25

precision, centerless-ground, silver-overlaid brass rod stock with a nominal 0.24425-inch diameter and 27 inches long. Diameter accuracy of ± 65 microinches.

Outer-Conductor Tube ... \$35.00

Forged, silver-lined brass tubing 27 inches long with a nominal OD of 0.830-inch and a nominal ID of 0.5625-inch. Nominal wall thickness is 0.134-inch. Inner diameter accuracy is ± 140 microinches.

Air Lines



Type 900-L30 30-cm Air Line ... \$100

Type 900-L15 15-cm Air Line ... \$90

Type 900-L10 10-cm Air Line ... \$85

Short sections of precision, 50-ohm air line with Type 900-BT Precision Connectors on both ends. VSWR is less than 1.007 at 4Gc; less than 1.013 at 9Gc.



The Type 900-LB Precision Slotted Line has the same low VSWR as the Type 900 Connector ... adapts to Types N, 874, and other commonly used systems ... \$575.

Openings exist for permanent positions in Development and Sales Engineering. If interested, write M. A. Nacey.

GENERAL RADIO COMPANY

WEST CONCORD, MASSACHUSETTS