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A SURVEY OF LITERATURE ON TECHNIQUES AND INSTRUMENTATION FOR MEASURING ELECTRICAL PULSE INTERVALS

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ABSTRACT

This bibliography is on the subject of rise time and width range of very short electrical pulses. Emphasis has been placed on how to measure time and peak amplitude by accurate nanosecond measurements. Special equipment and techniques are cited. The scope covers approximately a 12-year period with most of the literature encompassing the last four years.

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INTRODUCTION

PURPOSE

The purpose of this literature search was to aid in the study of measurement techniques (with better than 1% accuracy) of the peak amplitudes of very short electrical pulses with a width range of 1 nanosecond to 20 microseconds. Material has also been included on the measurement of rise time, which is the time it takes an electrical pulse signal to change its value from a zero level to its peak amplitude. The range of the short time intervals is between 1 nanosecond and 1 microsecond. One of the major problems of nanosecond pulse measurements is in the transmission of pulses from one point to another with the required fidelity. This bibliography suggests techniques and instruments especially programmed for this purpose, and includes references related to the general subject of electrical measurement with various applications.

Although many sources have been reviewed in the past months, any additional contributions the reader could provide will be appreciated. These suggestions of other literature sources will be maintained in the bibliographic files for future requestors' use.

ORGANIZATION

The 347 annotated references are arranged alphabetically by title and are followed by an author and a source index. The literature is divided into two sections, (A) Techniques and (B) Instrumentation, with emphasis on the reported progress of the last three years. This report was requested by Mr. R. F. Eno, Specialist in the Sub-Systems Group, Chief Engineering Services Section, Computer and Data Systems, Autonetics, Anaheim, California.

TECHNIQUES

1. 8- AND 11 Gc NANOSECOND CARRIER PULSES PRODUCED BY HARMONIC GENERATION. A. F. Dietrich. (IRE Proceedings, Vol. 49, No. 5, May 1961, pp. 972-973)

Two methods of displaying oscillograms of carrier pulses of nanosecond duration are described. The r.f. carrier is phase locked to the envelope. The first involves the use of a base-band stroboscopic technique previously described. The r.f. pulses are obtained by harmonic generation, using a Si mesa diode. The second method uses a band-pass stroboscope in which the pulses are amplified by travelling-wave tubes with a 2 Gc/s pass-band. Oscillograms of 8 Gc/s and 11 Gc/s carrier pulses approximately one nsec. in width are shown. In more recent experiments the principle has been extended to display pulses with a 56 Gc/s carrier.

2. ACCELEROMETER CALIBRATION. PART I: MEASUREMENT OF APPLIED ACCELERATION. Lawrence Moskowitz, Schaevitz Engineering. (Instruments and Control Systems, Vol. 34, No. 2, February 1961, pp. 257-260)

Accurate accelerometer calibration presents two problems—one comprises accurate measurement of the applied acceleration, the other the accurate measurement of the corresponding accelerometer response. The first part of this discussion deals with the measurement of applied acceleration. Accuracy factors are discussed for constant linear acceleration (g and rotary accelerator), nonconstant linear accelerators (shock and sinusoidal vibrators), constant angular accelerators (rotary units with constant angular acceleration or deceleration), periodic angular accelerators (pendulum or vibrator).

3. ACCELEROMETER CALIBRATION. PART II: MEASUREMENT OF ACCELEROMETER OUTPUT. Lawrence Moskowitz, Schaevitz Engineering. (Instruments and Control Systems, Vol. 34, No. 3, March 1961, pp. 467-470)

Part I discussed the techniques for measuring the applied acceleration. Techniques for measuring the output of an accelerometer include measuring the ratio of output to input by division and comparison, and involve consideration of waveform. Practical circuits are given.

4. ACCURATE MEASUREMENT OF TIME INTERVALS OF THE ORDER OF A MICROSECOND. J. Bourguignon. (Journal de Physique et la Radium, France, Vol. 21, Supplement No. 11, November 1960, pp. 217A-218A) In French

Time measurements by the classic oscillographic method present numerous disadvantages. A simple modification to the method is described which results in very accurate measurements.

5. ADVANCED ELECTRICAL MEASUREMENTS. W. C. Michels. (Van Nostrand, New York, 2nd Edition, 1941, 347 p.)

6. ADVANCED FERRET RECONNAISSANCE CONCEPTS STUDY (U). Albert F. Niessner, Jr. (HRB-Singer, Inc., State College, Pennsylvania, Contract AF 33(616)-7741, Report no. 281-2, Quarterly engineering report no. 2, February 1961-April 1961, 20 May 1961, 80 p., SECRET) AD-323 673

7. ADVANCED FERRET RECONNAISSANCE CONCEPTS STUDY (U). Albert F. Niessner, Jr. (HRB-Singer, Inc., State College, Pennsylvania, Contract AF 33(616)-7741, Report no. 281-3, Quarterly engineering report no. 3, May 1961-June 1961, 19 August 1961, 65 p., SECRET) AD-324 922

8. ADVANCED FERRET RECONNAISSANCE CONCEPTS STUDY (U). Ronald W. Ewing. (Contract AF 33(616)-7741, Continuation of Contract AF 33(616)-5958, Final report, Vol. 1, July 1958-December 1961, 20 December 1961, 78 p., 1 ref., ASD TDR 62-220, SECRET) AD-328 812

Title to volume 1 and abstract are classified.

9. ANALOG FREQUENCY—MEASURING CIRCUIT ACCURATE TO 0.1 PER CENT. J. Mitchell. (AIEE Transactions, Vol. 77, Part 1, Communication and Electronics, No. 40, Paper 58-1275, January 1959, pp. 983-985)

10. ANALYSIS AND MEASUREMENT OF PHASE CHARACTERISTICS IN MICROWAVE SYSTEMS. Peter Lacy, Wiltron Company, Palo Alto, California. (IRE WESCON, San Francisco, 22-25 August 1961, Paper 23/3, 8 p., 10 refs.)

Modern microwave systems under construction and in planning require phase control to accuracies as high as one degree over path lengths from hundreds to thousands of wavelengths. The paths are made up of many various components. The phase characteristics of the individual components and the cascaded system complexes must be considered. A model network complex is analyzed to show the nature of the phase shift contributions. Phase measurement methods are reviewed and the applicability of various methods to measurement problems are discussed. The major need is for swept frequency phase data of high accuracy.

11. ANALYSIS OF A FORM OF PEAK HOLDING CONTROL. G. J. Delio. (NACA, RM E56B10, March 1956, 57 p.)

12. APPLICATION OF AN X-Y PULSED MEASURING SYSTEM TO POLARIZATION STUDIES. PART 1. THE HYDROGEN REACTION ON PLATINUM. C. H. Presbrey, Jr., and S. Schuldiner. (Naval Research Laboratory, Washington, D. C., NRL report no. 5616, Interim report, 27 July 1961, 22 p., 26 refs.) AD-263 166

The X-Y pulsed measuring system developed at the Naval research Laboratory was modified for the study of electrochemical systems. It was possible to determine the electrokinetic parameters of fast reaction steps. Kinetic equations were derived which are applicable to the X-Y pulsed measuring system. An investigation of the H reaction on Pt in acid solution resulted in a quantitative separation and determination of solution resistance, charge on the double layer, and the discharge/ionization reaction step. Experimental results indicated that H atoms were associated with the Pt surface in three ways; some are weakly bonded to the surface; others are strongly bonded; and the residue of H atoms are absorbed in surface layers of Pt.

13. APPLICATION OF PULSE TECHNIQUES TO STRAIN GAGES. Newell D. Sanders and George H. Brodie. (National Advisory Committee for Aeronautics, Washington, D. C., Research memo RM E54B08, 4 May 1954, 17 p.) AD-29 849

"Pulse techniques have been applied to strain gages for increasing the output level and extending the usable range. Bonded and unbonded strain gages which normally operate with exciting potentials between 3.5 and 14 volts were operated satisfactorily with 200-volt pulses of 1-microsecond duration and a repetition rate of 350 per second. Outputs 15 times greater than normal outputs were measured. A pulse-generating circuit and a pulse-detecting circuit are described. An analysis of pulsed operation of strain gages is given."

14. APPROACH TO PEAK LOAD ECONOMICS. C. D. Galloway, L. K. Kirchmayer, W. D. Marsh and A. G. Mellor, General Electric Company, Schenectady, New York. (Power Apparatus and Systems, No. 49, August 1960, pp. 527-534, 8 refs.)

Increased attention is at present being given by the electrical utility industry to the problem of determining the most economical method of providing generation for the peak portion of the utility load. This paper describes a method of analysis which was first conceived to be a tool for evaluating the economics of low-cost peaking generation. The process of making the method realistic for this use, however, has resulted in what the authors believe will become a basic new tool for all generation economic studies whether of peaking, base load, steam, nuclear, or gas turbine units. The method is made feasible by the employment of a high-speed digital computer. An example is given of the use of the method in a typical peaking generation economic study.

15. ATOMIC AND MOLECULAR FREQUENCY STANDARDS. (Instruments and Control Systems, Vol. 34, No. 6, June 1961, pp. 1081-1084)

Three different types of atomic and molecular frequency standards have evolved during the past few years--the cesium beam standard, the ammonia maser, and gas-cell devices. Each is discussed in this article.

16. BOLOMETER MOUNT EFFICIENCY MEASUREMENT TECHNIQUE. G. F. Engen. (NBS Journal of Research, Vol. 65C, April-June 1961, pp. 113-124)

A variation of the impedance measurement method is described which gives increased accuracy and simplifies the operational procedure. It is independent of connector discontinuities and is applicable to matched and unmatched mounts.

17. CALIBRATION OF VIBRATION PICKUPS AT LARGE AMPLITUDES. E. Jones, S. Edelman and K. S. Sizemore. (Acoustical Society of America, Journal, Vol. 33, November 1961, pp. 1462-1466)

Navy-sponsored development of a method for the calibration of vibration pickups over the frequency range from below 1 kc. to above 20 kc. at acceleration levels up to 12,000g. The axial resonances of long rods and tubes, driven by an electromagnetic shaker at low frequencies and a piezoelectric ceramic-stack shaker at high frequencies, are used to generate motion. Vibration amplitude is measured microscopically using stroboscopic light, and by means of the interference-fringe-disappearance technique. A simple method for the measurement of the phase angle between the pickup signal and the motion is described, as is the construction of a small, light pickup which is unaffected by high acceleration levels.

18. COMPARISON OF ABSORPTION COEFFICIENTS OF THE IONOSPHERE FROM PULSE AMPLITUDE MEASUREMENTS AND FIELD-STRENGTH RECORDINGS. H. Schwentek and G. Umlauft. (Arch. Elekt. Ubertragung, Vol. 15, April 1961, pp. 200-204)

Ionospheric absorption was measured by two methods: (a) vertical-incidence soundings at 1.73 Mc; (b) field-strength measurements over an oblique-incidence path 295 km in length, at 2.61 Mc. These frequencies are such that, in both methods, the heights of reflection are equal. The absorption coefficients determined using the two methods have a correlation coefficient of 0.84 for both daily and monthly mean values, and are related to each other by the square of the effective frequency ($f+f_L$).

19. CONSIDERATION OF THE PROBLEM OF OPTIMUM FREQUENCY IN UNDERWATER SONAR SYSTEMS. H. Thiede. (Acustica, Vol. 11, No. 1, 1961, pp. 22-25) In German

The optimum frequencies of sonar systems for obtaining a given range are determined taking account of the frequency-dependent parameters of sound propagation in sea water. The relation between range and minimum areas of radiating surface is also calculated.

20. CORRECTION DE L'ERREUR DUE A LA FREQUENCE DANS LA MESURE DE LA VALEUR DE CRETE DES HAUTES TENSIONS PERIODIQUES PAR COURANT DE CAPACITE REDRESSE. J. LaGasse, R. LaCoste, and G. Gibbalt. (Revue Generale de l'Electricite, Vol. 68, No. 5, May 1959, pp. 369-376)

Correction of error due to frequency in measurement of peak values of periodical high voltages by means of rectified capacitor current; techniques of error correction relate to general method described previously by author.

21. CORRELATION MEASUREMENTS ON FREQUENCY DIVERSITY IN THE SHORT-WAVE RANGE. J. Grosskopf, G. Heinzelmann and K. Vogt. (Nachrtech. Z., Vol. 14, March 1961, pp. 124-128)

Report on investigations of frequency-diversity reception over the path Tokyo-Frankfurt (Main) using SSB transmitters on 19.79 and 14.73 Mc, the frequency diversity in each case being obtained by AF modulation of the transmitter. A reduction of the frequency spacing normally used in frequency-diversity systems appears to be possible.

22. CROSSED-FILM CRYOTRON AND ITS APPLICATION TO DIGITAL COMPUTER CIRCUITS. V. L. Newhouse, J. W. Bremer and H. H. Edwards, General Electric Company. (Eastern Joint Computer Conference Proceedings, 1-3 December 1959, pp. 255-260)

A crossed-film cryotron deposited on an insulated superconductor is described. This CFC has a time constant of less than 1 μsec and is approximately one hundred times faster than the original vacuum-deposited cryotron. The dc dissipation is less than 5 microwatts and the active area of each element is approximately 5×10^{-4} square centimeters. These cryotrons and all their interconnecting circuitry can be vacuum deposited at one and the same time in a few simple steps. The cryotrons can be applied to both switching and storage. Some experimental storage and shift-register circuits are described, which demonstrate a circuit property unique to superconductors. A shift-register circuit is shown which is deposited in an area corresponding to 20,000 active elements per square foot. Calculations are presented which show that with this component density, a computer or memory containing more than one million elements can be accommodated in a one-cubic-foot liquid helium container using presently available refrigeration methods.

23. CRYOGENIC MICROWAVE MEMORY TECHNIQUES (U). James Spencer and Robert Worden. (General Electric Company, Advanced Electronics Center, Ithaca, New York, Contract AF 33(616)-7560, Interim Engineering Report no. 1, 14 July 1960-15 July 1961, ASD TN 61-124, CONFIDENTIAL) AD-325 623

Classified Abstract

24. CYCLE COUNTING FOR DIGITAL TIMING CONTROL. J. L. Solomon, Sciaky Bros., Inc., Chicago, Ill. (Electrical Manufacturing, September 1957, pp. 96-101+)

The prevalent close regulation of a-c power line frequency permits cycle counting as an advantageous method of sequence and timing control. By treating time as the sum of discrete units, digital techniques such as the use of cold-cathode glow transfer tubes for counting may be employed to measure intervals. This effectively minimizes the consequence of voltage and component variations which can raise havoc in conventional timing circuits. The merits of this concept for equipment and system programming are well demonstrated as applied to the problem of resistance welding control, in which flexible, accurate timing of numerous functions in succession is essential.

25. D-C GRAPHICAL ANALYSIS OF JUNCTION TRANSISTOR FLIP-FLOPS. T. R. Bashkow, Bell Telephone Laboratories, Inc., Murray Hill, New Jersey. (AIEE Transactions, Vol. 75, Part I, Communication and Electronics, March 1956, pp. 1-7, 3 refs.)

Contents: General description of method; Modified collector family; Load line; Use of method; Conclusions; Appendix - Relationships, examples and measurements.

26. DESIGN STUDY OF AN INTEGRATED AIRBORNE TELEMETRY SYSTEM. (Telemetering Corporation of America, Contract DA 28-017-501- ORD -3577, Engineering report no. 707, Progress report no. 3, December 1959) AD-235 349 (Also) AD-235 66

Study efforts were devoted to analysis of system performance requirements system design configuration, system modulation method, materials, environmental conditions, and a survey of micro-miniature techniques and sources of manufacture. The results of this study indicate the following: (1) FM/FM system techniques are most applicable to a short term development program, (2) PCM/FM system techniques offer important theoretical advantages, however, a longer range development program would be required, (3) Techniques such as PDM, PPM, do not offer advantages over FM/FM or PCM/FM, and (4) Micro-miniature circuit techniques are directly and immediately applicable; grown circuits will require additional development.

27. DIFFERENTIAL MEASUREMENTS. V. B. Kwast, Daystrom, Incorporated. (Instruments and Control Systems, Vol. 34, No. 11, November 1961, pp. 2078-2083, 5 refs.)

When measurements involve only a selected span, such as monitoring the speed of a machine or a high temperature, the lower part of the scale only reduces the resolution and readability of the indication. Higher resolution can be achieved by suppressing the lower part of the scale or by using differential-measurement technique. Here are three basic differential techniques--(1) series differential, (2) parallel differential, and (3) differential bridge. The bridge is the most flexible technique.

28. DISTORTION OF FREQUENCY MODULATED SIGNALS IN ELECTRICAL NETWORKS. F. L. Stumpers. (Communication News, Vol. 9, 1948, p. 82)

29. DISTRIBUTION OF AMPLITUDE WITH TIME IN FLUCTUATION NOISE. V. D. London. (IRE Proceedings, New York, February 1941, p. 50)

30. DISTRIBUTIONAL CHARACTERISTICS AND QUALITY CONTROL OF INDIRECTLY MEASURED VARIABLES. Ferruccio G. Spadaro. (North American Aviation, Inc., Rocketdyne Division, Report R-RR-59-26)

31. EFFECT OF NOISE ON PULSE HEIGHT RESOLUTION. Irving M. Meth and Robert T. Graveson. (Health and Safety Laboratory, New York Operations Office, Atomic Energy Commission, Report No. N62-10341, January 1962, H&SL-118, 15 p., 5 refs., OTS, $.50)

A statistical study of base line fluctuations is used to relate noise measurements with the resolution spread of a pulse height analysis system. The resolution is inversely proportional to the signal-to-noise ratio. The proportionality constant is derived on the basis of a normal amplitude distribution for noise. A review of noise measuring techniques is given and adapted for use with electronic voltmeters. The form factors required to interpret meter readings in terms of the rms value of noise are described.

32. EIN VERFAHREN ZUR MATHEMATISCHEN AUSWERTUNG VON MESSERGEBNISSEN. H. R. Bachmann. (Technik, Vol. 12, No. 11, November 1957, pp. 725-728)

Simple reliable method for mathematical evaluation of measuring results, which, it is claimed, has never appeared in any textbook; simple example given of determination of force from path-time measurement by two-stage differentiation.

33. EINIGE GRUNDFRAGEN DES MESSENS, ETC. W. Spaeth. (Radex Rundschau, No. 7, November 1958, pp. 375-388)

Fundamental problems of measurement and graphic representation of measuring values; characteristics of limited series described, such as used for characterization of limited system; representation of similar probability of all elements of collective in unit circle; suggestion of angular scale and its comparison with customary linear scale; description of model for interpretation of correlations in nature; derivation of different types of curves according to selection of measuring method.

34. ELECTRIC RESISTANCE OF METALS IN THE CASE OF LARGE PULSED CURRENT DENSITIES. L. A. Ignat'yeva and S. G. Kalashnikov. (Feltman Research and Engineering Laboratories, Picatinny Arsenal, Dover, New Jersey, (Translation no. 91 of Zhurnal Eksperimental'noy i Teoreticheskoy Fiziki, Vol. 22, 1952, pp. 385-399)

The electric resistance of thin wires of gold, silver, copper, platinum, and tungsten under current pulses of approximately several times ten microsecond duration and current density up to 5×10^6 amp/sq cm were investigated as a function of the energy delivered to the wire. For gold, silver and copper the resistance under pulse conditions is the same as the resistance for high frequency currents. For platinum and tungsten, at current density above 10^6 amp/sq cm a sharp increase in the resistance is observed, and it exceeds several times the resistance for weak currents. The relative increase in the resistance of the platinum increases with decreasing temperature. Curves showing the dependence of the resistance on the energy supplied differ for different metals and have characteristic points corresponding to the phase transition (melting).

35. ELECTRICAL MEASUREMENTS. Harvey L. Curtis. (McGraw-Hill, New York, 1937, 302 p.)

36. ELECTRICAL MEASUREMENTS. F. K. Harris. (Wiley & Sons, New York, 1952, 784 p.)

37. ...ELECTRICAL MEASUREMENTS. F. A. Laws. (McGraw-Hill, New York, 2nd Edition, 1938, 738 p., Bibliog.)

38. ELECTRICAL MEASUREMENTS IN PRACTICE. F. M. Farmer. (McGraw-Hill, New York, 1917)

39. **ELECTRICAL MEASUREMENTS IN THEORY AND APPLICATION. A. W. Smith. (McGraw-Hill, New York, 4th Edition, 1948, 371 p.)**

40. **ELECTRICAL MEASUREMENTS MANUAL. C. H. Dunn and H. J. Barker. (Prentice-Hall, Englewood Cliffs, New Jersey, 1952, 112 p.)**

41. ELECTROLUMINESCENT DISPLAY PRESENTS NANOSECOND PULSES. R. W. Windebank. (Electronics, Vol. 34, No. 49, 8 December 1961, pp. 53-55)

Pulses fed into both ends of a delay line build up the voltage at the point of coincidence sufficiently to activate the phosphor strips connected at that point. Possible developments of the technique are suggested.

42. ELECTROMAGNETIC POLARIZATION ANALYSIS TECHNIQUES (U). P. A. Hicks, L. R. Hughes, and D. G. Turley. (Smyth Research Associates, San Diego, California, Contract AF 33(616)-8487, Report no. SRA-257, April 1962, 31 p., 4 refs., CONFIDENTIAL) AD-328 865

43. ELECTROMAGNETIC RADIATION PARAMETER STABILITY MEASUREMENT TECHNIQUES (U). Emory Richardson. (HRB-Singer, Inc., State College, Pennsylvania, Contract AF 33(616)-8501, Report no. 305-1, Quarterly engineering report no. 1, July 1961-October 1961, 30 October 1961, 22 p., SECRET) AD-326 443

44. EVALUATION OF DETECTION CHARACTERISTICS WITH QUADRATIC SIGNAL SUMMATION. V. G. Sragovich. (Radiotekhnika i Elektronika, Vol. 5, No. 4, 1960, pp. 1-8)

A method is proposed for calculating the output voltage distribution function of a circuit for the quadratic processing of signals with normal fluctuation.

45. EXPERIMENTAL INVESTIGATION OF HIGH-FREQUENCY CURRENT DISTRIBUTIONS ON CONDUCTING CYLINDERS. Lewis Wetzel and Donald B. Brick. (Harvard University, Cruft Laboratory, Cambridge, Massachusetts, Contract AF 19(604)-786, Scientific report no 4, 12 December 1955, 25 p., 10 refs., AFCRC TN-55-974) AD-100 664

Image-plane tecniques described by Kodis (Technical report no. 105, 1950) were used to measure the current distributions at a wavelength of 3.2 cm over elliptic cylinders of eccentricities 0, 0.552, 0.780, and 0.0910, each having a semi-major axis of 6.1 cm. The results for the circular cylinder were compared with the theoretically exact current calculated from the eigenfunction expansion. The results for the remaining cylinders were compared with the theoretical predictions of V. Fock (J. Physics U.S.S.R. Vol. 10, 1946, p. 130) for the current in the so-called penumbra region. Accuracy of the predicted penumbral currents was demonstrated for radii of curvature down to $kR_o = 2.2$.

46. EXPERIMENTAL MEASUREMENT OF MECHANICAL IMPEDANCE. J.W. Young, Jr. and R.O. Belsheim. (Naval Research Laboratory, Washington, D.C., NRL rept. 5458, 24 May 1960, 25 p. 9 refs. Order from LC mi$2.70, ph$4.80) PB 144 639

A mechanical impedance head and measuring system for experimentally determining mechanical impedance are described, following a brief review of the basic concepts. The system incorporates commercially available equipment for excitation, observation, and analysis of measurements. In order to check the measuring techniques, and to gain experience in the use of the equipment, solid blocks as well as a realistic structure were tested. The results for the various size blocks and for the structure were compared with the expected theoretical results. It is concluded that the system could be used to measure mechanical impedance over a frequency range of 10 to 500 cps. A flaw in the present system is that point-by-point measurements are required, whereas continuous measurements over the frequency range are essential for extensive measurements. The necessary revisions are feasible.

47. EXPERIMENTAL MEASUREMENTS IN CONTROLLED FUSION RESEARCH. M. A. Heald. (IRE Transactions on Nuclear Science, Vol. NS-6, September 1959, p. 33)

48. FAST-PULSE TECHNIQUES IN NUCLEAR COUNTING, PROCEEDINGS OF THE SECOND SYMPOSIUM. (Lawrence Radiation Laboratory, University of California, Berkeley, February 12 and 13, 1959, Report No. UCRL - 8706, OTS, Department of Commerce, Washington 25, D.C., $3.00)

The Second Symposium on Advances in Fast-Pulse Techniques for Nuclear Counting, sponsored by the Lawrence Radiation Laboratory, was held in Berkeley on February 12 and 13, 1959.

The first symposium had been organized by the Counting Panel of the Laboratory in February 1957 to assess the state of the art of detectors, transmission devices, coincidence circuits, amplifiers, scalers, and monitors and to better disseminate this information. Interest in fast-pulse techniques has greatly increased since the first symposium. The pressing needs of nuclear research have not only pushed the existing ideas to the limit but have also given rise to a number of new techniques.

The second symposium was organized to exchange and evaluate recent information, to explore the need for future study in the fractional-microsecond field of nuclear counting, and to consider photosensitive devices and pulse techniques. Generally the discussion was limited to the developments of the past two years.

49. FREQUENCY CONVERSION IN A MICROWAVE DISCHARGE. J. R. Baird and P. D. Coleman, University of Illinois, Ultramicrowave Group, Urbana. (IRE Proceedings, Vol. 49, No. 12, December 1961, pp. 1890-1900, 7 refs.)

One nonlinear property of a microwave discharge located between two closely spaced parallel plates whose dimensions are small compared to the wavelength is analyzed. This discharge geometry, with its small volume, permits the attainment of CW microwave power densities in the discharge of the order of 0.1 to 1 Mw/cm^3. It is concluded that the high power density coupled with the high diffusion rate of the closely spaced parallel plates results in a modulation of the electron density at the microwave frequency. The source of this nonlinearity is postulated to be a modulation of the ionization frequency ν_i whose functional form is taken to be $\nu_i = \alpha|\nu_d|$ where ν_d is the ordered drift velocity and α is a proportionality factor constant in time. The theoretical analysis is compared to experimental results obtained by approximating the assumed geometry in an X-band and K-band frequency multiplier and in an X-band mixer. Harmonics up through the seventh at X band and up through the fourth at K band have been studied. Frequency mixing of of 9- and 11-kMc signals to obtain a 20-kMc signal has yielded predictable results. Parametric amplification in a discharge is briefly considered.

50. FREQUENCY RESPONSE 10 CPS TO 10 MCPS, 0.5 MV TO 5.2V AND AC VOLTAGE CALIBRATION DC TO 10 MCPS, 0.1 TO 5.2 VOLTS. (Bureau of Naval Weapons, Washington, D.C., BuWeps-BuShips Calibration Program. 18 January 1960, 29 p. Secondary Standards Laboratory Measurement System Operation-Procedure BF-06, Order form OTS, $1.00) PB 171 216

This procedure describes the operation of a Secondary Standards Laboratory calibration system which is used to measure the frequency response and/or ac voltage of indicating and generating instruments.

51. FUNDAMENTAL CONSIDERATIONS OF POWER DISSIPATION LIMITS IN SOME BISTABLE TRANSISTOR PULSE CIRCUITS. H. Raillard, General Electric Company, Syracuse, New York. (AIEE Transactions, Vol. 79, Part I, Communication and Electronics, March 1960, pp. 53-55, 4 refs.)

The design procedures discussed here deal exclusively with non-saturating circuits in order to eliminate the transient delay variations caused by saturation. This is desirable because a wide range of pulse repetition frequencies will be used, including frequencies where saturation delay is significant and where it is not. This paper deals with the nonsaturating emitter-coupled and base-return configurations which are widely used. A constant collector voltage swing of 2 volts is assumed as a practical minimum value. For reliable and nonsaturating operation the minimum collector supply voltage E_{cc} is found to be 6 volts for emitter-coupled flip-flops and 4.5 volts for base-return flip-flops.

52. GALVANOMETER-TYPE AMPLIFIERS WITH PHOTO-CONVERTERS FOR OSCILLOSCOPES. R. R. Kharchenko. (Izmeritel'naia Tekhnika (Measurement Techniques), No. 2, February 1960, pp. 117-124) also (ARS Journal Supplement, Vol. 32, No. 1, January 1962, p. 178)

The main purpose of this analysis is the investigation of various correction circuits, which were designed for obtaining the required amplitude-frequency characteristics with an optimum transfer process. The analysis did not deal (it was outside the scope of investigations) with the effect of the resistance connected to the input of the GA on the amount of feedback, which determines the static accuracy and the adjustment of the correction. It should be noted that in these models the bandwidth exceeded 1000 cps, thus forcing the author to consider in his theoretical analysis small time constants of all the components, and deal with a system described by equations of the fourth and fifth degree.

53. HAMILTON PHYSICAL MEASUREMENTS LABORATORY. E. C. Fechter, Hamilton Watch Company, Lancaster, Pennsylvania. (Instruments and Control Systems, Vol. 34, No. 9, September 1961, pp. 1677-1678)

The Physical Measurements Laboratory serves as the Hamilton Watch Company internal bureau of standards. It administers a set of programs designed to provide adequate gage and measuring instrument controls. It is Hamilton's mechanical and optical measurements center. A primary responsibility of the Laboratory is to assign specifications to all gages and to determine that they meet these specifications.

A temperature of 68°F (20°C) and a humidity of less than 50% are maintained in the laboratory at all times. The laboratory is located on the ground floor to minimize vibration. There is no direct sunlight in the laboratory and it is maintained in a high state of cleanliness.

54. HIGH-ACCURACY X-Y PULSE MEASURING SYSTEM. G. A. Haas and F. H. Harris. (Review of Scientific Instruments, Vol. 30, No. 8, August 1959, pp. 623-625)

Pulse measuring technique which utilizes rectangular pulses, but presents information on both horizontal and vertical deflection plates of oscilloscopes; this is accomplished by applying to horizontal sweep system (superimposed on regular time base) portion of voltage pulse which appears across sample.

55. HIGH DENSITY DIGITAL MAGNETIC RECORDING TECHNIQUES. A. S. Hoagland and G. C. Bacon, IBM Corporation. (IRE Transactions on Electronic Computers, Vol. EC-9, March 1960, pp. 2-11)

The use of readback waveform synthesis through "single-pulse" superposition is discussed. A comprehensive, yet general, readback simulation program is described which will automatically, for any characteristic pulse, simulate all possible readback signal patterns and test them for specified reading logic as a function of bit density. Amplitude, phase, peak, etc., sensing are compared and the influence of parameter variation on performance is indicated. Good correlation with experiment has been realized and bench time has been greatly reduced. The significance of pulse waveform is clearly revealed and this study has provided a guide to head design (ring and probe), permitting the optimization of a total recording system for high-density storage.

56. IMPROVED STANDARD FOR THE CALIBRATION OF VIBRATION PICKUPS. R. R. Bouche. (Experimental Mechanics, Vol. 1, No. 4, April 1961, pp. 116-121)

57. INHERENT LIMITATIONS OF ACCELEROMETERS FOR HIGH-FREQUENCY VIBRATION MEASUREMENTS. Fred Schloss. (Noise Control, Vol. 7, July-August 1961, p. 37)

58. INSTRUMENTATION AND MEASUREMENT TECHNIQUES STUDY. (Illinois Institute of Technology, Armour Research Foundation, 31 January 1960)

59. INTERFERENCE STUDIES. O. M. Salati, R. A. Rosien and others. (University of Pennsylvania, Moore School of Electrical Engineering, Philadelphia, Contract AF 30(602)-1615, Report No. ES-27-030-05, Final Report, Task 1, Volume 1, 15 August 1956-15 April 1958, 15 April 1958, 210 p., 38 refs., RADC-TR-58-96) AD-148 812

This report presents the results of research on the theory of interference prediction and interference measurement techniques. Eight separate sections are devoted to permissible interference levels or susceptibilities, data presentation, methods and devices for measuring spurious and harmonic radiation, out of band pulsed and CW interference in a microwave receiver, loss of radar information due to blanking, bandwidth conservation in pulsed radars, graphical techniques for great circle calculations, comments on military interference specifications, and prevention of moding in magnetrons.

60. INTERVAL TIMER-PULSE COUNTER. D. W. Kean, H. B. Kimley and T. R. Parkin. (Naval Ordnance Test Station, China Lake, California, Technical memo no. 304-49, 31 August 1950) AD-136 941 (See also) AD-136 941

A description is presented of an interval timer developed by the Electronic Development Branch. The unit provides six decade indication and has internally generated time base rates of 1.0 m and 0.1 mc. It can also be used to count the number of pulses contained in an externally generated train, and in this mode of operation it is used in conjunction with the Binary-Decimal Translator.

61. INTRA-PULSE RF DECEPTION TECHNIQUES (U). B. Viglietta, R. Nitzberg and C. Johnson. (General Electric Company, Advanced Electronics Center, Ithaca, New York, Contract AF 33(616)-8182, Report no. CH CPR-853, Interim engineering report no. 1, 1 July 1961-1 September 1961, SECRET) AD-325 778

62. INVESTIGATING A METHOD OF MEASURING FREQUENCY DEVIATIONS OF FM SIGNALS BY MEANS OF BESSEL FUNCTION ZEROES. B. K. Karavashkin and P. A. Shpan'on. (Izmeritel'naia Tekhnika, No. 8, August 1960, pp. 684-687)

This method, as it is known, consists of recording by means of an indicating instrument the zero amplitudes of the carrier, or side frequencies, in the spectrum of a frequency-modulated signal, amplitudes of which are proportional to the Bessel functions of the first kind of the modulation index, the index of modulation being equal to one of the roots of this function. If the index of modulation is known, it is possible to determine the deviation, since the modulating frequency can be measured with the required degree of accuracy. This method can be applied by means of a narrow-band receiver or a spectral analyzer.

63. INVESTIGATION AND ANALYSIS OF THE RADIATION SPECTRUM OF THE MODEL TDP-1 LORAN TRANSMITTER. A. W. Coven and J. W. Brogden. (Naval Research Laboratory, Washington, D. C., NRL Report no. R-3269, 29 March 1948, 8 p., 3 refs.) AD-222 728

The spectrum of the radiation from a model TDP-1 Loran transmitter was determined. The peaks of the envelope of the frequency components diminish in amplitude to -50 decibels at approximately 200 kc from the center of the spectrum. The frequency distribution shows no evidence of phase or frequency modulation. No harmonics greater than -60 decibels were found in the frequency range of 0.5 to 18.0 mc.

64. INVESTIGATION OF FERRET ENVIRONMENT SURVEILLANCE PROBLEMS (U). E. L. Gliatti, A. Kiiss and others. (Airborne Instruments Laboratory, Inc., Mineola, New York, Contract AF 33(616)-5577, Report no. 4766-I-9, April 1960-June 1960, July 1960, SECRET) AD-318 055 (See also) AD-316 687

65. INVESTIGATION OF FERRET ENVIRONMENT SURVEILLANCE PROBLEMS (U). (Airborne Instruments Laboratory, Inc., Mineola, New York, Contract AF 33(616)-5577, Report no. 4766-I-11, Quarterly report no. 11, 1 October 1960-31 December 1960, January 1961, 10 p., SECRET) AD-321 411

66. INVESTIGATION OF LOW LEVEL R. F. VOLTAGE AND POWER MEASUREMENT TECHNIQUES. William H. Kurlans. (Franklin Institute, Laboratories for Research and Development, Philadelphia, Pennsylvania, Contract no. DA 36-039-sc-72827, Report no. Q-A1957-1, Quarterly engineering progress report no. 1, 1 July 1956-30 September 1956, 12 p., 56 refs.) AD-118 866

Research is being conducted to develop a new technique or system to enable the rapid, accurate, and simplified measurement of extremely low-level RF voltages and power normally associated with signal generators. The system designed will include calibration. A literature survey designed to cover as wide a background as possible was initiated. Primary consideration was given to thermal detectors with further emphasis on new techniques. The particular fields reviewed include calorimeters, thermal detectors, radiometers, radioastronomy, and electronic receiver systems. The literature survey did not reveal any general leads to the eventual solution, but it did eliminate thermal detectors from future consideration.

67. INVESTIGATION OF TECHNIQUES FOR DECEPTION OF FREQUENCY AGILITY SEARCH RADARS (U). (Lockheed Aircraft Corporation, Marietta, Georgia, Contract AF 33(616)-7997, Report no. ER-5224, Interim engineering report no. 1, 10 March 1961-15 June 1961, 69 p., SECRET) AD-323 727

68. INVESTIGATION OF TECHNIQUES FOR DECEPTION OF FREQUENCY AGILITY SEARCH RADARS (U). (Lockheed Aircraft Corporation, Marietta, Georgia, Contract AF 33(616)-7997, Report no. ER 5366, Interim engineering report no. 2, 16 June 1961-15 September 1961, 94 p., 55 refs., SECRET) AD-325 161

69. IONOSPHERIC MEASUREMENTS USING ENVIRONMENTAL SAMPLING TECHNIQUES. R. E. Bourdeau and others. (NASA, Technical Note D-491, September 1960)

70. IONOSPHERIC PULSE TRANSMISSION OVER LARGE DISTANCES: IDENTIFICATION OF TRACES. Rudolf Eyfrig and Karl Rawer. (Ionosphareren-Institut, Breisach, Germany, Contract AF 61(052)-129, Annual summary report 1959-1960, 30 November 1960, 23 p., 11 refs., AFCRL-537) AD-268 433

Research was continued on ionospheric pulse transmission over large distances. Identification of the traces from amplitude records alone is difficult, so that the rules for identification of traces in oblique incidence pulse records, rules for application, and detailed examples are given.

71. KOREKCJA PRZYPADKOWYCH UCHYBOW POMIAROWYCH NA ZASADZIE CIAGLOSCI PRZEZ PRZESTAWIANIE ZMIENNYCH. M. Mazur and M. Kruszynski. (Archiwum Elektrotechniki, Vol. 6, No. 3, 1957, pp. 461-472)

Correction of casual measuring errors; method of transposition of variables, which permits correction of casual errors without increasing amount of measuring points; applicability of method in cases where curve graphs have to be drawn on base of small amount of measuring points.

72. LINEAR DEAD-WEIGHT ACCELEROMETER CALIBRATOR. Herman Pinsky, Lockheed Aircraft Corporation, Missiles and Space Division, Van Nuys, California. (Instruments & Control Systems, Vol. 34, No. 7, July 1961, pp. 1262-1263)

Here is a simple technique for calibrating accelerometers using only known weights.

73. LOW-SPEED 2^6 COUNTER, MODEL II. Herbert J. Platt. (Massachusetts Institute of Technology, Digital Computer Laboratory, Cambridge, Engineering note no. E-521, 29 January 1953, 7 p.) AD-52 749

"The Low-Speed 2^6 Counter, Model II, is one of the pieces of standard test equipment used in Project Whirlwind. Its function is to count pulses and give an output after a given number of pulses, from 1 to a maximum of 64. This report describes the circuitry of the unit. The unit is operated by standard pulses at pulse repetition frequencies up to 200 kilocycles. It can be preset to any number up to 64. There is also an automatic preset feature which presets the counter with every output pulse. Another feature is the counted delay. This feature allows a random pulse fed into the present input to be delayed by a given number of counts. At the end of the delay period, up to 32 counts, a pulse is emitted 3.5 usec after the last input to the counters. Marginal checking is also provided. Individual circuits may be quickly tested to anticipate failure."

74. LOW-SPEED TIME-MULTIPLEXING WITH MAGNETIC LATCHING RELAYS. J. F. Meyer, California Institute of Technology. (IRE Transactions on Space Electronics and Telemetry, Vol. SET-7, June 1961, pp. 34-41)

Many satellite and spacecraft telemetry systems require that measurements be time-shared at relatively low rates (less than one sample per second) and that several rates be available in order to minimize redundant sampling. A multiplexing system designed specifically for low-speed operation and multiple-rate flexibility so as to gain advantage in other critical areas of performance is discussed. A unique synthesis of the basic circuit provides for the time-multiplexing of n measurements with n-1 magnetic latching relays. Assuming an external two-phase clocking source, no other components, active or passive, are required in the circuit. Other advantages of the circuit are: (1) low average power consumption; (2) no additional monitoring or reset circuitry required to insure proper operation at turn-on or after momentary power failure; (3) the virtual impossibility of switching more than a single measurement to the common output line, even in the case of component or wiring failure.

75. MAGNETIC FILM MEMORIES, A SURVEY. A. V. Pohm, Iowa State University of Science and Technology, Department of Electrical Engineering and Engineering Experiment Station, Ames and E. N. Mitchell, University of North Dakota, Physics Department, Grand Forks. (IRE Transactions on Electronic Computers, Vol. EC-9, No. 3, September 1960, pp. 308-314, 29 refs.)

An analysis is made of the modes of magnetization reversal and rotation in thin ferromagnetic films. The ways in which the various modes can be employed for destructive and non-destructive memories are discussed and their performance limitations considered. Existing film memory efforts are partially surveyed and the material and system problems are examined. Possible future developments are also discussed.

76. MANUAL TIMING TECHNIQUES. Gaston G. Wiley and Jack W. Heuer, Heuer Timer Corporation. (Instruments and Control Systems, Vol. 33, No. 10, October 1960, pp. 1747-1749)

Time is important in nearly every problem, every process and every phenomenon. In many cases it is measured with a stopwatch. Here are basic manual timing techniques—cumulative timing, instantaneous sequential timing, hours indications, split-action timing, and recording techniques.

77. MEASUREMENT AND STANDARDIZATION. J. Cassassolles. (Rev. gén. Élect., Vol. 70, April 1961, pp. 201-207)

A review of the work done by the Union Technique de l'Électricité (U.T.E.) on standardization of methods of measurement, measuring equipment and different reference standards.

78. MEASUREMENT AS A DESIGN TOOL. F. E. Fisher. (Machine Design, Vol. 31, No. 2, 22 January 1959, pp. 105-112)

Advantages of measurement are apparent in defining the system, trouble shooting, application of theory, accelerated experience, and application to other fields. The paper is concerned primarily with dynamic measurements, with the transducer as the key. Measurements of card and tape punches, keyboards, clutches, cam drives, magnetic tape transports, and relays can give results about such characteristics as acceleration, impact force, resonant frequency, momentum, torque, and contact bounce. These provide the raw material for development of impulse-momentum equations, stress calculations, spring mass simulation, et cetera. Several transducers are described in some detail. Also discussed are the means used to measure displacement, velocity and force.

79. MEASUREMENT OF PEAK-VALUES OF HIGH ALTERNATING VOLTAGES. II. CIRCUITS WITH DISCHARGE ELEMENTS. O. Völcker and W. Zaengl. (Arch. Tech. Messen, Germany, No. 305, Ref. V 3383-5, June 1961, pp. 125-128) In German

Discusses the principles of operation of and the errors involved in the various peak-voltage measuring circuits. In the "one-way" circuit of Davis, Bowdler and Standring, both discharge error and re-charging error are present. The discharge error arises from the fact that, depending on the type of measuring instrument used, either the mean square or the average value of the saw-tooth discharge wave is measured, which is less than the peak value of the rectified voltage. This error is frequency-dependent. For sinusoidal voltages and a discharge time-constant of 1 sec, at 50 c/s the error is 1% and at 16-2/3 c/s, 3%. The recharging error is important as it affects the transformation ratio of the voltage-divider itself, because during the recharging period the capacitor acts as a short-circuit. This error is also frequency dependent. In the "two-way" Rabus circuit this is eliminated. A modification of this circuit is discussed, employing an auxiliary discharge circuit which enables continuous peak measurements independent of frequency down to 16-2/3 c/s with low errors.

80. MEASUREMENT OF PLASMA PARAMETERS BY THE PULSE METHOD IN A HIGH CURRENT DISCHARGE. B. A. Mamyrin, translated by R. D. Lowde. (Atomic Energy Research Establishment, Great Britain, AERE Library translation no. 688;HD-2267; Translation of Zhur. Tech. Fix. Vol. 23, 1953, pp. 1915-1919 July 1956, 7 p.) AD-114 601

Consideration is given to the limit of application of the pulse method of probe measurement as the current density of the discharge is increased and the duration of the voltage pulse supplied to the probe reduced. As an example of measurements taken with discharge currents of the order of a hundred amperes, the electron density distribution over the transverse section of a discharge tube is reproduced.

81. MEASUREMENT OF PULSE-TIME JITTER. William T. Pope. (Rome Air Development Center, New York, Report no. RADC TR-54-61, December 1954, 31 p.) AD-53 604

A pulse-jitter tester was developed which will operate over a dynamic input range of ±5 to ±50 v pulse amplitude at a PRF of 200 to 6000 c with a pulse width of 0.2 to 25 μsec without manual gain controls or reversing switches. The unit can measure relative and pulse-width jitter down to 0.002 μsec and absolute jitter to less than 0.001 μsec. The equipment is reliable and simple to operate and calibrate.

82. MEASUREMENT OF QUANTITY OF ELECTRICITY IN SHORT CURRENT PULSE. I. N. Blazhevich and V. I. Smirnov. (Pribory i Tekhnika Eksperimenta (Instruments and Experimental Techniques), No. 2, March-April 1958, pp. 225-227)

Operation of instrument is based on method of ballistic amplification; measured value is indicated on counter in which one count corresponds to 10^{-12} coulomb; instrument also permits measurement of quantity of electricity in series of pulses.

83. MEASUREMENT OF REDUCED RADAR CROSS SECTIONS. R. C. Hansen, H. E. King and C. G. Bachman. (Aerospace Corporation, Los Angeles, California, Contract AF 04(647)-930, Report no. TDR-930(2119)-TN-1, October 1961, 60 p., 36 refs.) AD-266 739

Problems of measuring low radar cross sections of objects which are physically large are investigated. The 3 salient problems are: (1) determining the required distance between antenna and target, (2) reducing the background scattering due to terrain effects, etc., and (3) providing a target support of negligible cross section. Five types of cross section ranges are described and evaluated. These are the indoor anechoic chamber, the radome-enclosed chamber, the conventional outdoor range, the ground plane outdoor range, and the oblique range in which the target is suspended at an oblique angle above ground. A short pulse radar and a target support using nylon ropes are also indicated.

84. MEASUREMENT OF SHORT-CIRCUIT CURRENTS PARTICULARLY WITH PHOTOCELLS. W. Grundler. (Arch. Tech.Messen., No. 290, March 1960, pp. 57-60)

Potentiometer circuits particularly for use in light measurements are described.

85. MEASUREMENT OF SMALL PHASE SHIFTS WITH PHASE SENSITIVE VOLTMETER. D.J. Collins and J.E. Smith. (Electronic Engineering, Vol. 30, No. 361, March 1958, pp. 146-147)

Increase of systems using closed loop feedback control requires instrumentation capable of determining transfer functions of elements employed in control loop; method of measuring phase errors of order of one degree using conventional instrumentation is described.

86. MEASUREMENT OF SMALL REFLECTION COEFFICIENTS AT HIGH FREQUENCIES. K. Kohler. (Frequenz, Germany, Vol. 15, No. 1, January 1961, pp. 12-17) In German

Measurement accuracy of 0·1% is possible at 4 Gc/s using commercially available directional couplers and ancillary components with suitable technique. Amplitude and phase calibrations are effected by respectively replacing the test-piece with a short-circuit termination and comparative measurements with adjustment of a four stub tuner. The theoretical analysis includes a discussion of sources of error.

87. MEASUREMENT OF THE AMPLITUDE AND THE TIME VARIATION OF IMPULSE VOLTAGES. I. R. Ruhlmann. (Arch. Tech. Messen, Germany, No. 301, (Ref. V 3362-1), February 1961, pp. 29-32) In German

Measurement of both the normal 1/50 µsec form of impulse, and the chopped form, by means of a voltage divider and c.r. oscillograph is discussed. Four types of voltage divider are briefly described and their characteristics outlined. The types are: (1) the simple resistive voltage divider (2) the resistive voltage divider with voltage-graded screen; (3) the capacitive voltage divider; (4) the mixed voltage divider (resistors and capacitors in parallel).

88. MEASUREMENT OF THE PEAK VALUE OF HIGH ALTERNATING VOLTAGES. I. O. Völcker and W. Zaengl. (Arch. Tech. Messen, Germany, No. 303, Ref. V 3383-4, April 1961, pp. 81-82) In German

Summarizing information is given on the principle of operation and the characteristics of a variety of measuring devices and the errors to which they are subject. Amongst instruments for discontinuous indication reference is made to the sphere gap, the compressed gas capacitor voltage divider and the standard potential transformer with c.r.o. as null indicator in a balanced l.v. circuit. The principle using the charging current of a capacitor is outlined and its modern variations are mentioned. The operation is described of the electrostatic voltmeter with rotating disks.

89. MEASUREMENT TECHNIQUES IN HIGH ENERGY PLASMAS. H. R. Griem. (Fourth Symposium on Temperature, Columbus, Ohio, March 1961)

90. MEASUREMENTS OF MEAN LIFETIMES BETWEEN 10 mμsec and LESS THAN 0.1 mμsec BY PULSED-BEAM TECHNIQUES. Frank J. Lynch and R.E. Holland. Argonne National Laboratory. Lemont, Illinois. (Proceedings of the Second Symposium on Fast-Pulse Techniques in Nuclear Counting, 12-13 February 1959, Report No. UCRL-8706, University of California, Lawrence Radiation Laboratory, pp. 68-70)

Pulsed-beam experiments can be considered as the special class of delayed-coincidence measurements in which the initiating event is produced periodically. Although the apparatus described here was originally developed to measure neutron spectra by time of flight, it is also suitable for the measurement of the lifetimes of excited states of nuclei. The excited states are produced by nuclear transformation of Coulomb interaction when a short burst of charged particles strikes the target. The time distribution of the gamma rays emitted in eash transition from these states in then measured relative to the time of arrivel of the burst of particles.

91. MEASURING FREQUENCY STABILITY OF PULSED SIGNALS. R. H. Holman and R. B. Shields. (Electronics, Vol. 34, 21 April 1961, pp. 61-65)

A method of measuring the phase difference between pulses as a pulse-to-pulse rms deviation, which does not require synchronization or frequency reference from a signal source.

92. MEASURING RECOVERY TIME OF ULTRA-FAST DIODES. G. C. Messenger. (Electronic Industries, Vol. 20, April 1961, pp. 99-100)

An indirect method which gives accurate results below 1 nsec is described. Results have been obtained down to 0.05 nsec.

93. MEASURING THE LIFETIMES OF EXCITED STATES BY TIME-AMPLITUDE CONVERSION. J. Samueli and A. Sarazin. (Journal de Physique et la Radium, France, Vol. 21, No. 5, May 1960, pp. 390-393) In French

Low and Mean Energy Nuclear Physics Colloquium, Grenoble, 1960. A time-to-amplitude converter covering the interval from 0.1 to 10 nsec is described. The resolution for Na^{22} gamma ray annihilation radiation is 0.7 nsec. The system was used to measure the lifetime of the 80 keV gamma transition of I^{131}.

94. MEASURING THE LIGHTNING STRENGTH OF HIGH-VOLTAGE INSULATORS. A. D. Lantz, Jr., Ohio Brass Company, Barberton, Ohio. (Power Apparatus and Systems, No. 48, June 1960, pp. 298-302, 4 refs.)

A test method has been developed which provides a precise indication of inherent dielectric strength average and dispersion under impulse conditions. This is accomplished using techniques within reach of many laboratories equipped with an impulse generator and associated recording equipment. The test can be interpreted to provide a fairly complete understanding of dielectric strength requirements.

95. MEASURING WINDS WITH PULSED LIGHT. M. Horman and W. Nolan, Motorola, Inc., Systems Research Laboratory, Military Electronics Division, Riverside, California. (Electronic Equipment Engineering, Vol. 10, No. 2, February 1962, pp. 50-53)

Tracking balloons with pulsed-light theodolite provides data to computer-servo system to obtain direct readout at wind velocity and direction at altitudes to 3000 feet.

96. MECHANICAL MEASUREMENT. M. Nalecz. (Electronic Technology, Vol. 38, January 1961, pp. 15-17)

A method of measuring small displacements utilizing the Hall effect in semiconductors is described.

97. MESURE PRÉCISE D'INTERVALLES DE TEMPS DE L'ORDRE DE LA MICROSECONDE. J. Bourguignon. (J. de Physique et le Radium (Physique Appliquée), Vol. 21, No. 11, November 1960, pp. 217A-218A)

Precise measurement of microsecond time intervals; measurement method using classic oscillograph, with simple modification which does not prevent use of apparatus in conventional way.

98. METHOD OF RADIO INTERFERENCE MEASUREMENTS OF SMALL TIME INTERVALS USING FREQUENCY MULTIPLICATION. V. I. Medvedev, Moscow University, Cnair of Theory of Oscillations. (Vestnik Moskovskogo Universiteta (Bulletin of Moscow University), No. 6, 1959, pp. 112-119) also (ARS Journal, Vol. 32, No. 3, Russian Supplement, March 1962, pp. 458-461, 14 refs.)

99. METHODS FOR ANALYZING SHOCK VIBRATION. PART I. METHODS OF ANALYSIS OF COMPLEX TIME VARYING FUNCTIONS. John R. Ragazzini, Harold Saks, and Myron Kaufman. (General Applied Science Laboratories, Inc., Hempstead, N.Y., Library rept. no. 1 on Contract DA 36-039-sc-73022, Gruen rept. no. 1002-L-1; 23 January 1957, 34 p. 57 refs.) AD-204 756

Contents: On the filter problem of the power-spectrum analyzer; Communications applications of correlation analysis; Methods of obtaining amplitude-frequency spectra; Short-time autocorrelation functions and power spectra; The response of a resonant system to a gliding tone; Response of a linear resonant system to excitation of a frequency varying linearly with time; Measuring noise color; The sampling theory of a power spectrum estimate; The principles and practice of panoramic display; Analog equipment for processing randomly fluctuating data; a computer for correlation function; A high speed correlator; An extremely wide range electronically deviable oscillator.

100. METHODS OF ELECTRICAL MEASUREMENT. C. T. Baldwin. (Blackie, London, 1952, 182 p.)

101. MICROWAVE COMPUTER RESEARCH. M. P. Forrer, General Electric, Microwave Laboratory. (U. S. Government Research Reports, Vol. 32, 11 September 1959, p. 359(A)) (Order from LC mi$3.30, ph$7.80) PB-136 999

A detailed analysis of mμsec pulse transmission is carried out by means of the Fourier transformation. Gaussian pulse envelopes are assumed as a reasonable approximation to physically realizable pulses. Pulse deterioration due to amplitude and phase distortion (dispersion) is calculated and discussed.

102. MICROWAVE FREQUENCY, G-BAND (3.95 TO 5.85 KMCPS) ± 0.0002% 1" x 2" WAVEGUIDE SIZE. (Bureau of Naval Weapons, Washington, D.C., BuWeps BuShips Calibration Program. Measurement Procedure HF-06. Secondary Standards Laboratory, 18 December 1959, 25 p. Order from OTS $0.75) PB 171 231

This procedure describes the operation of a secondary standards laboratory calibration system with is used to calibrate G-band microwave frequency meters of waveguide size 1" x 2" (outside dimensions). This procedure normally applies to the calibration of Test Instruments with accuracies better than 0.04%.

103. MICROWAVE MEASUREMENTS FOR CALIBRATION LABORATORIES. (Hewlett-Packard Company, 1501 Page Mill Road, Palo Alto, California, Application Note No. 38, 1960, 5 sections + 4 addenda)

Contents include: Introduction; Frequency; Attenuation; Impedance; Power; Addendum A: Bolometer Mount Efficiency Measurement; Addendum B: Operating Notes -hp- Model K04 999C Line Length Set; Addendum C: Application Note # 3 - Measurement of the Carrier Frequency of RF Pulses; Addendum D: Analysis of Microwave Measurement Techniques by means of Signal Flowgraphs.

104. MICROWAVE STANDARDS PROSPECTUS. (Hewlett-Packard Company, 1501 Page Mill Road, Palo Alto, California, Application Note No. 21, Fourth Edition, June 1960, 5 sections + Appendix)

Contents include: General; Frequency Systems (including section on Measurement Accuracies); Attenuation Systems; Impedance Systems; Power Systems (including Accuracy Considerations, Peak Power Measurement Techniques, Barretter Mount Efficiency Measurement)

105. MULTIDIMENSIONAL PULSE-MEASURING TECHNIQUES. Dan G. Maeder.
Oak Ridge National Laboratory, Oak Ridge, Tennessee.
(Proceedings of the Second Symposium on Fast-Pulse Techniques in Nuclear Counting, 12-13 February 1959, Report No. UCRL-8706, University of California, Lawrence Radiation Laboratory, pp. 63-67.)

Many 3-D combinations may permit otherwise impossible experiments — for instance, for measuring

T_n, $E_{\gamma 1}$, and $E_{\gamma 2}$ for neutron-capture γ-ray cascades;
T_{f1}, T_{f2}, and E_{γ} for fission γ rays.

For truly multidimensional examples, we need only to look around the lab at Berkeley. Recent high-energy experiment experiments involve up to 20 counters whose individual pulse amplitudes are of interest in the evaluation of coincidences. Also listed are track lengths, angles and positions in track chambers as future candidates for multidimensional recording.

106. NANOSECOND PULSE MEASUREMENTS. C. N. Winningstad, Tektronix, Inc., Beaverton, Oregon. (IRE WESCON, San Francisco, 22-25 August 1961, Paper 23/1, 14 p., 18 refs.)

Transmission line methods are used to analyze nanosecond circuits, with emphasis on the first-order quantitization of circuit parameters. Other considerations discussed: Current and voltage sources for signal injection, probes for voltage and current measurements, and the non-gaussian response of transmission lines. The foregoing are used in a discussion of millipicojoule triggering, special jigs used to measure switching times of semiconductor devices, and distributed-deflection and sampling-type oscilloscopes.

107. NEW COMPONENTS FOR REDUCTION OF TRANSMITTER SPURIOUS RADIATION. (Electro-Mechanics Company, Austin, Texas, Contract DA 36-039-sc-87442, Quarterly report no. 3, 1 December 1961-1 March 1962, 1 March 1962, 24 p.) AD-275 433*

*No automatic release to foreign nationals.

Research continued toward new components or circuits which will reduce or eliminate the spurious signals radiated from communication transmitters. A theoretical study of the frequency selective feedback concept indicated that this circuit can reduce some spurious signals but the fundamental is also attenuated to an undesirable extent. The improvement in the spurious output of transmitter no. 1 brought about by the use of an acceptance network output circuit indicates that this circuit currently holds the greatest promise of success. The results also show that minor additions to the basic acceptance network provide even better spurious rejection characteristics.

108. NEW METHOD FOR MEASURING THE VOLUME RESISTIVITY OF SEMICONDUCTOR MATERIAL. G. L. Allerton and J. R. Seifert. (Semiconductor Products, Vol. 4, No. 6, June 1961, pp. 43-48)

The semiconductor slice is used to load a high Q resonator at 9 Gc/s. The signal transmitted through the cavity increases as the resistivity of the sample decreases. Pre-calibration by the normal four-point probe method is necessary, but subsequent operation is much quicker, with greater reproducibility.

109. NEW METHOD OF MEASURING VERY SMALL STANDING WAVES IN WAVEGUIDES. S. Hariharan and W. S. Stuart. (Institution of Telecommunication Engineers, Journal, India, Vol. 7, May 1961, pp. 149-152)

The method is based on inserting into the system a short length of waveguide provided with a nonradiating slot and a small probe.

110. NEW METHOD OF MEASURING VERY SMALL VARYING ELECTRICAL QUANTITIES. V. S. Voyutskii. (Radio Engineering and Electronics, Vol. 3, No. 2, 1958, pp. 340-346)

111. NEW TECHNIQUE FOR THE MEASUREMENT OF CORONA FIELD STRENGTH AND CURRENT DENSITY IN ELECTRICAL PRECIPITATION. P. Cooperman, Research-Cottrell, Inc., Bound Brook, New Jersey. (AIEE Transactions, Vol. 75, Part I, Communication and Electronics, March 1956, pp. 64-67, 4 refs.)

In the course of studies of the electrical precipitation of gas-borne dust, it became necessary to determine the electric-field strength in the negative space-charge region of a corona discharge in room air. However, no satisfactory technique for making such measurements was known to the writer or to the persons whom he consulted, nor did a brief survey of the literature offer anything of use. A number of attempts were made to use static probes of types encountered in electrostatics, but these were uniformly unsuccessful. Hence, it became necessary to develop an instrument based on a new principle. This principle makes use of the laws governing the charge picked up by a particle in a unipolar space-charge field as a function of field strength, current density, and time. Essentially, the quantities measured are the particle charge and the time spent by a particle in the field. By the use of the particle-charging laws, the values of the field strength E and of the current density may be deduced.

112. NON-LINEAR ENERGY CONVERSION MECHANISMS IN MATERIALS. D. B. Medved. (Astronautics, A Division of General Dynamics, San Diego, California, Contract AF 30(602)-2520, Quarterly Report No. 1, 20 June-20 October 1961, 20 October 1961, 4 p., RADC TDR 61-302) AD-270 532

The high-powered traveling wave test system for measuring the complex dielectric constant of polycrystalline and single crystal material was completed and placed in operation at C-band. Analyses of the variation of the transmission, reflection, and attenuation of a sample geometry is shown and calculations on samples of finite length were carried out to determine optimum operating conditions of a traveling wave system for maximum sensitivity of the measured circuit parameters as a function of small changes in dielectric constant and loss tangent. These analyses were completed. Analysis of cavity systems for measuring the variation of loss tangent and dielectric constant with field was completed and cavities designed.

113. NONLINEAR-SWEEP DISPLAY TECHNIQUES FOR PULSE ANALYSIS. Robert J. Solem. (Naval Research Laboratory, Washington, D. C., NRL Report no. 4095, 16 January 1953, 26 p., CONFIDENTIAL) AD-7351

114. ON A MATHEMATICAL DESCRIPTION OF NOISY MEASUREMENT SYSTEM PERFORMANCE. J. L. Hammond, Jr., Georgia Institute of Technology, School of Electrical Engineering, Atlanta. (IRE Proceedings, Correspondence, Vol. 49, No. 11, November 1961, pp. 1701-1702, 6 refs.)

The purposes of this note are: (1) to call attention to the precise definitions of two statistical parameters which can be used as measures of the performance of certain noisy measurement systems; and (2) to formulate quantitative expressions for measurement-system performance in terms of these quantities.

115. ON THE APPLICABILITY OF KOTEL'NIKOV'S THEOREM IN THE DISCRETE MEASUREMENT TECHNIQUE. V. N. Khlistunov. (Izmeritel'naya Tekhnika, No. 3, 1961, pp. 25-28) In Russian

116. ON THE DETECTABILITY OF AMPLITUDE-MODULATED RADAR SIGNALS (U). R. McCarty, W. Cutler, and S. Yadavalli. (Stanford Research Institute, Menlo Park, California, Contract DA 04-200-ORD-1009, Memorandum report no. 12, June 1961, 84 p., 16 refs., CONFIDENTIAL) AD-326 365

A mathematical analysis of amplitude-modulated pulsed radar signals is conducted for such signals in: (a) the absence of noise, and (b) the presence of noise. In particular, the minimum detectable modulation percentages are specified for a box car sequence of amplitude-modulated signal pulses, in the presence of random noise, as a function of received signal-to-noise ratio, pulse repetition frequency and final filter bandwidth. Also discussed are: (1) pertinent properties of non-stationary process, (2) power spectral analysis of data samples, (3) a mathematical model depicting radar cross-section variations due to target tumbling, and (4) some probabilistic concepts associated with the processes of signal detection. It is concluded for the type of tumbling target and radar receiver considered that the received signal-to-noise ratio would have to be approximately 28 db in order to consistently discern the amplitude-modulation percentages thus present. (U)

117. ON THE DYNAMIC CHARACTERISTICS OF FREE-LIQUID JETS AND A PARTIAL CORRELATION WITH ORIFICE GEOMETRY. J. H. Rupe. (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Report JPL-TR-32-207, January 1962)

118. ON THE MEASUREMENT OF TIME JITTER IN VIDEO PULSE TRAINS. J. L. Fitch. (Stanford Electronics Laboratories, Stanford University, California, Contract AF 19(604)-1847, Technical report no. 260-1, 28 July 1958, 57 p.) AD-203 098 (See also) AD-133 771

In the development of MTI radar systems time demodulation was investigated as a method for measuring small deviations from equal spacing of video pulses. This method achieves a linear time-amplitude conversion by comparing the time of occurrence of each pulse with the time of zero crossing of a sine wave having a frequency equal to an integral multiple of the average pulse recurrence rate. A study was also made of the short-time phase stability of the sine-wave oscillator. The concept was evolved of an oscillator output consisting, not of a sine wave, but of very narrow-band Gaussian noise. The problem to be solved is essentially that of finding the distribution of zero crossings of Gaussian noise. If the time interval is chosen equal to the correction time of the automatic phase-control circuit, the expected zero-crossing error is the rms jitter contributed by the sine-wave oscillator, and determines the ultimate usable sensitivity of measurement.

119. ON THE TRANSMISSION OF INFORMATION BY ORTHOGONAL TIME FUNCTIONS. H. F. Harmuth, Stromberg-Carlson Company, A Division of General Dynamics Corporation, Rochester, New York. (AIEE Transactions, Vol. 79, Part I, Communication and Electronics, July 1960, pp. 248-255, 5 refs.)

In a digital communication system each digit of a character may be represented by one function of an orthogonal set of functions. This function is multiplied by +1 or -1 if binary digits are being used. All functions of the character are added and transmitted in parallel. This sum of functions is correlated in the receiver with each function of the orthogonal set and voltages of amplitude +1 or -1 are obtained. No interference between the digits of a character occurs if the signal is not band limited. The crosstalk between the digits because of band limitation is computed for a system of orthogonal sine and cosine functions. The results show that a binary Teletype system transmitting 60 words per minute can be operated with about 25 cps (cycles per second) bandwidth. This figure decreases to the theoretical minimum of 15 cps per channel for a multi-channel system. Tests of experimental equipment have shown very good agreement with the theory.

120. OPREDELENIE CHASTOTNOI KHARAKTERISTIKI PRI POMOSHCHI RESHAIUSHCHIKH BLOKOV ELEKTRONNOI MODELI. L. N. Darovskikh. (Avtomatika i Telemekhanika, Vol. 23, February 1962, pp. 244-247) In Russian

Presentation of a method for the experimental determination of the phase-amplitude characteristic by means of computing blocks of electronic units. The method is based upon the measurement of amplitude and phase of the output signal, by comparison with the amplitude and phase of the input signal from the aperiodic unit, whose static amplification coefficient and time constant can be changed separately.

121. OPTIMUM DESIGN CONSIDERATIONS FOR RADIO RELAYS UTILIZING THE TROPOSPHERIC SCATTER MODE OF PROPAGATION. Charles A. Parry, Page Communications Engineers, Inc., Washington, D. C. (AIEE Transactions, Vol. 79, Part I, Communication and Electronics, March 1960, pp. 71-80, 53 refs.)

There are many areas of the world where the service which can be provided by the scatter link is needed, but cannot be justified economically. One approach toward reducing costs, suggested here, is to investigate the improvements achieved through optimizing system-design parameters.

It is shown that the nonlinear noise introduced by truncating the bandwidth may be used as a basic tool in this analysis. It is found that the signal-to-thermal-noise ratio may then be expressed purely as a function of traffic volume and noise bandwidth. Data are given relating this to such factors as trunk occupancy, speech volumes, grade of service offered by trunks, and the percentage of time during the busy hour for which the given performance is offered.

General expressions for the optimum bandwidth as a function of signal-to-noise ratio and traffic loading are also developed.

Expressions for minimum power also leads a design efficiency factor, expressed as the ratio of optimal power to actual power. In addition, an economic index is discussed.

122. OSCILLATIONS IN NONLINEAR SAMPLED-DATA SYSTEMS. M. A. Pai. (AIEE Paper No. CP62-91; Order by number and send remittance to: AIEE Order Department, 345 E. 47 St., New York 17, N.Y., 50¢ to members, $1.00 to nonmembers per preprint)

A method for examining the necessary conditions for existence of certain limit cycles in nonlinear sampled-data systems is based on the principle of specifying a certain repetitive output from the nonlinearity and finding under what conditions this sequency will be sustained. A particular example of force oscillation is considered and analyzed.

123. PEAK FOLLOWER. Charles Michael Hayward, Epsco, Inc., Instruments Division, Cambridge, Massachusetts. (Electronic Equipment Engineering, Vol. 10, No. 2, February 1962, p. 29)

The peak follower described accepts an ac input with a dc component and it provides two outputs proportional to the positive and negative peak amplitudes of the ac component. It features extremely long time constants while maintaining fast response to both increasing and decreasing peak amplitudes. Although the circuit shown accepts only signals which are positive with respect to the zero axis, it can be simply modified for positive and negative inputs, with or without a dc component.

124. PHASE DISTRIBUTION OF SIGNALS PLUS NOISE. A. E. Smoll. (General Electric Company, Syracuse, New York, Contract AF 33(038)-9199, TIS report no R55-ELP-10, 26 January 1955, 17 p.) AD-89 830

125. PHASE EQUILIBRIA STUDIES, AN EXTENDED USE OF MILLIVOLT SOURCES AND RECORDERS. Richard D. Potter. (Naval Ordnance Test Station, Inyokern, China Lake, California, NOTS 678; NAVORD Report no. 2022, 15 April 1953, 19 p.) AD-12 417

Methods are given for the utilization of millivolt sources, microvolt amplifiers, and millivolt recorders in the precise measurement of very small voltages. A discussion is also given of circuits and components used in monitoring a variety of signals, including thermocouple circuits, electrical resistance measurements, rotary and translatory motion (with differential transformers and magnetic pickups), and strain gage measurements.

126. PHASE SHIFT NETWORK WITH THIRD HARMONIC SUPPRESSION. Sergio Bernstein-Bervery, Perkin-Elmer Corporation, Norwalk, Connecticut. (Electronic Equipment Engineering, Vol. 10, No. 2, February 1962, pp. 35-36)

A simple, active network is described here which gives an accurate 90 deg phase shift at the carrier frequency. Moreover, it provides third harmonic rejection in excess of 20 db with ±2 per cent inductors, and ±5 per cent capacitors.

127. PHYSICAL MEASUREMENT--CHALLENGE TO SCIENCE AND ENGINEERING. A. V. Astin. (SAE, Paper No. 21R for Meeting 12-16 January 1959, 7 p.) also (SAE Journal, Vol. 67, No. 3, March 1959, pp. 26-28)

Measurement problems, instrumentation and techniques from viewpoint of National Bureau of Standards; science and technology discussed in four arbitrary areas; newer fields of scientific investigation such as plasma physics, established areas of research, newer fields of technology such as rocket and missile development, and established fields where precision measurement provides improved performance and reduced costs; examples of problems in these areas.

128. POTENTIOMETERS. Hugh Johnson. (Missile Design and Development, November 1957, pp. 20-21)

Selection and use of potentiometers in missile electronic systems.

129. POWER TRANSISTOR SWITCHING CIRCUIT. Chaang Huang, Sylvania Electric Products, Inc., Woburn, Massachusetts and Edwin Slobodzinski, IBM Corporation, Poughkeepsie, New York. (AIEE Transactions, Vol. 75, Part I, Communication and Electronics, July 1956, pp. 290-296, 3 refs.)

It is the purpose of this paper to describe the methods and results of the measurements of the d-c parameters of a 2N68 power transistor. With these data, several power transistor switching circuits are considered with an emphasis on the design of the base bias for temperature considerations. These design techniques can be easily adopted to permit their application to most direct-coupled switching circuits with the use of p-n-p or n-p-n transistors.

130. PRECISION DETERMINATIONS OF A-C VOLTAGE RATIOS. Andre Medvedeff. (Air Force Armament Center, Eglin Air Force Base, Florida, Armament test report AFAC TR-57-72, August 1957, 30 p.) AD-128 060

Descriptions are presented of three independent methods employed by the Standards Laboratory for the calibration of an inflight calibrator developed at AFAC for use with airborne oscillograph recording systems. The development of special test equipment and procedures was required, since the nature of the test item precluded the use of normal Standards Laboratory equipment. In particular considerable care was required to avoid loading errors. The first method determines d-c resistances established in the inflight calibrator to ±0.01% accuracy. The second method, made possible by local development of a high impedance voltmeter, measures absolute voltages to ±0.1% accuracy, from which resistances of the inflight calibrator components are calculated. The third method utilizes a powerful null system for measuring these alternating voltages directly to accuracies of ±0.05%.

131. PRECISION MEGOHM RATIO UNIT FOR HIGH VOLTAGE MEASUREMENTS. John N. Harris. (California Institute of Technology, Norman Bridge Laboratory of Physics, Pasadena, Contract N6onr-244, T. O. 4, Special technical report no. 18, 22 October 1951, 5 p.) AD-8223*

*Reprint form the Review of Scientific Instruments, Vol. 23, August 1952, pp. 409-413.

132. PRECISION METHOD FOR MEASURING DIFFERENCES OF CAPACITANCE AND INDUCTANCE BY A PULLING-IN-PHASE PROCEDURE. F. Klutke. (Arch. Tech. Messen, Germany, No. 300, Ref. V 3531-3, January 1961, pp. 7-10) In German

Two sinusoidal voltages of the same frequency, and in phase, produce when applied to the deflecting plates of a c.r.o. a straight line trace at 45°. If the wave-form of one voltage is distorted, the Lissajou figure becomes an elongated figure-8, and the position of the cross-over point on the trace permits a more accurate adjustment of phase (stated to be 0·5°). If two oscillators of almost the same frequency are loosely coupled they will oscillate coherently, but with a phase difference which depends on the amount they are out of tune. The pulling-in range is -90° to +90°; beyond that they fall out of step. The apparatus consists of a c.r.o., a fixed frequency oscillator incorporating a quartz crystal (with distorted wave-form) and a "measuring" oscillator of the Meissner type (with sinusoidal wave form). Precautions are taken to reduce uncontrolled coupling between the oscillators to a very small amount. Measurements are made by tuning the measuring oscillator by a standard variable capacitor, connecting the test capacitor in parallel with the standard and retuning, the phase difference being adjusted to 0° in both cases. The difference between the two standard capacitor readings is the value of the test capacitor.

133. PROBLEMS IN ACCURATE TIME MEASUREMENT AND INVESTIGATIONS OF ULTRASHORT DURATION PROCESSES. S.D. Fanchenko. (Instruments & Experimental Techniques, No. 1, January 1961-February 1961, p. 1-11, 35 refs.)

Survey of Soviet and foreign literature of most accurate time measurment methods; methods for observing ultrashort time intervals; electron-optical chronography method.

134. PROBLEM OF ANALYZING ERRORS IN MEASURING SYSTEMS. N. A. Chekhonadskii. (Izmeritel'naia Tekhnika, No. 10, October 1960, pp. 817-821)

In the operation of a linear measuring system with its elements subjected to various random external disturbances which produce in the elements additional static errors, transmitted to the output of the system together with the basic errors of the elements, a total static error is produced at the output. The latter error is the one which determines the accuracy of the measuring system under given conditions. If in experimental work the required variable is measured several times by means of a measuring system, whose elements are subjected to various random external disturbances, a statistical analysis of the measurement results may produce a certain compensation of the static measurement errors of this variable.

135. PRODUCTION OF HIGH INTENSITY ION PULSES OF NANOSECOND DURATION. L. Cranberg, R. A. Fernald, F. S. Hahn and E. F. Shrader. (Nuclear Instruments and Methods, Netherlands, Vol. 12, No. 2, July 1961, pp. 335-340)

A system for producing high intensity ion bursts of nanosecond duration is described. It consists of a Van de Graaff accelerator fitted with a deflection pulser in the terminal and a post-acceleration Mobley magnet with a bunching factor of about 12. Results are given on the overall performance at 3 MeV proton energy, observing the neutrons and gamma rays from the reaction $Mn^{55}(p,n)Fe^{55}$. The system performs in accordance with design expectations and delivers ion bursts of less than 1 nsec duration at a peak current of several milliamperes.

136. PROGRESS IN THE U.S. DURING THE LAST THREE YEARS ON FREQUENCY AND TIME INTERVAL STANDARDS AND MEASUREMENTS. E. A. Gerber. (Army Signal Research and Development Laboratory, Fort Monmouth, N.J., USASRDL Technical rept. 2119, 20 May 1960, 10 p.) Order from LC mi$1.80, ph$1.80 PB 149 416

The progress in U.S. during the last three years in the fields of quartz crystal standards, atomic frequency and time standards, and frequency and time measurement and comparison is reviewed. An attempt has been made to describe briefly the most important results of research and development in the above fields, based on the pertinent papers which have been published since May 1957.

137. PROTECTION OF MANOMETERS WHEN MEASURING PULSATING PRESSURES. A. S. Lifshits and I. P. Mandel'berg. (Izmeritel'naia Tekhnika, No. 6, June 1960, pp. 484-486)

Periodic (pulsating) variations in the pressure of the working substance (gas or liquid) occurs in the operation of many machines. This pressure (its mean value) is measured by a manometer of some type or other consisting of a sensitive element (tube, bellows, diaphragm, etc.) and a transmitting mechanism, which actuates a pointer or a remote operating unit. The peculiarity of such instruments consists in the existence of one or several resonance frequencies which produce oscillations of separate components, at a large amplitude when the pulsation frequency coincides with their natural frequency. Usually these oscillations lead to a rise in the measurement errors and even to the breaking of the instrument.

138. PULSE AND DIGITAL CIRCUITS. Jacob Millman, Columbia University, Department of Electrical Engineering and Herbert Taub, The City College of New York, Department of Electrical Engineering. (McGraw-Hill, New York, 1956, 687 p.)

Contents include chapters entitled, "Time modulation and measurement" and "Pulse and digital systems."

139. PULSE CODE MODULATION STUDY CONTRACT. Clarence M. Shapiro, Robert S. Dahlberg and others. (Philco Corporation, Philadelphia, Pennsylvania, Contract DA 36-039-sc-87169, Semi-annual report no. 1, 1 November 1960-1 May 1961, 1 May 1961, 154 p.) AD-260 270*

*Notice: Only Government Agencies may request from ASTIA. Others request approval of Army Signal Engineering Laboratory, Fort Monmouth, New Jersey.

Research is concerned with new circuit design, new logic and the construction of experimental models in the field of digital terminal equipment for time division multiplex communications systems. The modulation systems to be considered shall be limited to PCM and Delta techniques. Basic magnetic logic systems of several types were evaluated and several categories of magnetic and the associated designs were formulated. The magnetic approach appears to be attractive and leads to simplicity of the final equipment.

140. PULSE GENERATING CIRCUIT. D. R. Daykin. (IBM Technical Disclosure Bulletin, Vol. 4, August 1961, pp. 87-88)

Description of a pulse generating circuit which supplies pulses of high peak current and short duration to loads having reactive components. The circuit includes a transistor and a magnetic core which functions as an autotransformer as well as a switch.

141. PULSE VOLTAGE COMPARATOR MEASURES HEIGHT OF POSITIVE OR NEGATIVE PULSES. O. B. Laug. (Electronics, Vol. 34, 8 September 1961, pp. 70-71)

The circuit responds to pulses of width 50 nsec and duty cycle 10^{-7}.

142. PULSED NANOSECOND LIGHT SOURCE. Thomas G. Innes and Quentin A. Kerns, University of California, Lawrence Radiation Laboratory, Berkeley. (IRE WESCON, San Francisco, 22-25 August 1961, Paper 23/2, 8 p., 6 refs.)

A system for simulating the scintillations from nuclear events has been developed and is presently in use at Lawrence Radiation Laboratory. This paper primarily describes the pulsed light source used to simulate nuclear events; also, descriptions of the necessary nanosecond pulse techniques to measure the light source parameters and to operate large numbers of lamps are given.

The pulse light source uses field emitted electrons to initiate a discharge in hydrogen. The light pulse is about two nanoseconds in length and rises in less than one nanosecond. Pulse shape of the light is measured using sampling techniques. Spectral characteristics are also given. Considerations concerning distribution networks are shown. The use of the lamps as spark gap triggers is also discussed.

143. RF BANDWIDTH OF FREQUENCY DIVISION MULTIPLEX SYSTEMS USING FREQUENCY MODULATION. R. G. Medhurst. (IRE Proceedings, New York, February 1956, p. 189)

144. R. F. VOLTAGE MEASUREMENT TECHNIQUES. Bernard Harris, David Cohen, and Arthur Lubin. (New York University College of Engineering, New York, Contract DA 36-039-sc-52620, Quarterly progress report nos. 5-7, 1 June 1954-28 February 1955) AD-50 778 (See also) AD-40 390

Unabstracted reports with this title include:
Quarterly report no. 5, 1 June-31 August 1954, AD-50 778 (8/2, 30/3)
Quarterly report no. 6, 1 September-30 November 1954, AD-54 524 (30/3, 30/5)
Quarterly report no. 7, 1 December 1954-28 February 1955, AD-60 947 (8/2, 30/3, 30/5)

145. RADAR FINGERPRINTING. John L. Allen, Charles F. Douds and others. (Haller, Raymond, and Brown, Inc., State College, Pennsylvania, Contract DA 36-039-sc-63121, Final report, 31 March 1958, 125 p., USASA Board study no. 58-S-1, CONFIDENTIAL) AD-300 094

146. RADAR MEASUREMENT OF RANGE, VELOCITY AND ACCELERATION. E. J. Kelly. (Massachusetts Institute of Technology, Lincoln Laboratory, Lexington, 19 January 1961, 7 p.) AD-261 306*

*Reprint from IRE Transactions on Military Electronics MIL-5:51-57, April 1961. (Copies not supplied by ASTIA)

A study is presented of the ultimate attainable accuracy in the radar measurement of range, range rate, and range acceleration. It is assumed that these quantities are to be measured by a coherent radar with a large output signal-to-noise ratio. The approach is entirely theoretical, and the accuracy evaluated is the accuracy that would be attained with an ideal receiver which performs maximum-likelihood estimates of the unknown parameters. The transmitted waveform is fixed and arbitrary, and the error variances and covariances are evaluated in detail in terms of the amplitude and frequency modulation of the transmitted wave. Specific results are also given for constant amplitude pulses carrying arbitrary combinations of linear and quadratic frequency modulation.

147. RAPIDLY TUNABLE RECEIVER STUDY. (U) H.J. Manley. (Sylvania Electric Products, Inc., Boston, Massachusetts, Applied Research Memo No. 33; E 264. 9-1118-55, 21 April 1955, SECRET) AD-141 930*

*Available only by request to Sylvania Electric Products, Inc., Boston Engineering Laboratory, Electronics System Division, Boston, Massachusetts.

148. REFERENCE EQUIPMENT FOR REPRODUCING AND MEASURING SMALL INTERVALS OF TIME. D.P. Markovskii. (Measurement Techniques, No. 6, December 1961, pp. 443-445.)

149. REMARKS ON THE MEASUREMENT OF IMPULSE SIGNALS IN RANDOM NOISE. Kurt Ikrath and Arthur Gottfried. (Signal Corps Engineering Laboratories, Fort Monmouth, New Jersey, Technical memo no. M-1831, 11 October 1956, 31 p.) AD-115 821

"In measuring impulse type signals, the transformer input circuit has advantages over the aperiodic, series-tuned, and shunt-tuned circuits. The transformer circuit can be better matched to the antenna, and the primary can be electrostatically shielded from the secondary to eliminate spurious responses existing far off resonance that could overload the first tube. The maximum ratio of peak impulse to peak thermal or atmospheric noise is obtained in the input circuit when the capacity across which the output voltage is taken is made as large as possible consistent with keeping the Q of the secondary of the transformer above 10, and consistent with the possibility of tuning to the desired center frequency. As the Q of the input circuit increases, the peak impulse response increases until Q = 10, For Q's higher than 10, the peak impulse response becomes independent of Q."

150. RESOLVER, A CIRCUIT FOR REDUCING THE COUNTING LOSSES OF A SCALER. R. E. Bell, McGill University, Canada. (Canadian Journal of Physics, Vol. 34, 1956, pp. 563-576) AD-102 597

"The resolver is a circuit that reduces the counting losses of an ordinary scaler by storing up most of the pulses that otherwise would be lost in dead time, and releasing them uniformly at a safe rate for the scaler. Even for very short input pulses, the circuit contains no active elements that need to be fast enough to follow these pulses, and is thus simpler than an equivalent fast scaler. In a typical case the maximum permissible counting rate of the scaler is raised by a factor of the order of 30. The counting losses of such a circuit are computed. A detailed circuit and the results of tests on it are shown."

151. SATELLITE FREQUENCY MEASUREMENTS. O. P. Layden and H. D. Tanzman. (Army Signal Research and Development Laboratory, Fort Monmouth, New Jersey, USASRDL Technical Report 2067, 1 October 1959, 48 p.) AD-229 155

The investigation being carried out on the frequency observations of radio signals from the Russian and American satellites is discussed. Various plots of frequency versus time are given for the Russian and American satellites in orbit as well as take-off curves for all American satellites. The equipment used to obtain Doppler measurements is described and the frequency and time accuracy associated with the system is discussed.

152. SENSITIVITY ERROR IN FREQUENCY MEASUREMENTS WITH THE WIEN BRIDGE. H. H. Wolff. (Review of Scientific Instruments, Vol. 32, August 1961, pp. 902-905)

153. (CLASSIFIED TITLE). (Bissett-Berman Corporation, Santa Monica, California, Contract AF 30(602)-2407, Technical note no. 1, 18 August 1961, 57 p., RADC TN 61-164, CONFIDENTIAL) AD-324 982

154. SEQUENTIAL PULSE RECOGNIZER (U). M. H. Musser. (Stanford University, Stanford Electronics Laboratories, California, Contract AF 33(616)-6207, Technical report no. 614-1, 28 April 1961, 14 p., CONFIDENTIAL) AD-323 559

155. SERVO ERROR AMPLIFIER GAIN COMPENSATION NETWORK. Anthony Mellas, Hughes Aircraft Company, Radar Laboratory, Fullerton, California. (IRE Transactions on Automatic Control, Correspondence, Vol. AC-7, No. 1, January 1962, pp. 77-79)

An important consideration in the design of servo systems is the necessity of keeping the error sensitivity constant throughout the range of servo operation. This consideration requires the use of some form of gain stabilization in the general servo system in which a nonlinear relationship exists between the input voltage and the output control. A mathematical relationship between the gain compensation network needed and the control input function can easily be derived.

156. SEVENTEEN WAYS TO MEASURE ACCELERATION. H. B. Sabin. (Control Engineering, Vol. 8, No. 2, February 1961, pp. 106-110)

157. SHIFT OF PEAK VOLTAGE WITH TEMPERATURE IN TUNNEL DIODES. R. P. Nanavati, Syracuse University, Department of Electrical Engineering, New York. (IRE Proceedings, Vol. 49, No. 1, January 1961, p. 349, 1 refs.)

It is the purpose of this note to point out an effect in the static characteristics of tunnel diodes which is as yet unreported.

158. SHORT PULSE SIGNATURE STUDY (U). (Convair, San Diego, California, Contract AF 30(602)-2069, Report no. ZN-449, Semi-annual report, 12 June 1959-31 December 1959, May 1960, 30 p., RADC TN 60-33, SECRET) AD-321 548

159. SIMPLE METHOD OF GENERATING NANOSECOND PULSES AT X-BAND.
J. K. Pulfer and B. G. Whitford, National Research Council, Radio and Electrical Engineering Division, Ottawa, Canada. (IRE Proceedings, Correspondence, Vol. 49, No. 5, May 1961, p. 968, 4 refs.)

Present methods of generating nanosecond RF pulses use high-speed switches to amplitude modulated microwave energy. One approach uses fast semiconductor diodes, while A. C. Beck's utilizes the TWT as a switch. A TWT can also be used in a nonlinear feedback loop to form a regenerative pulse generator. The technique to be described, based on the impulse response of a TWT, is a simple means of generating short RF pulses.

160. SOME MEASUREMENTS OF THE POWER DISTRIBUTION OF SPEECH SIGNALS. D. L. Richards and J. N. Shearme. (Post Office Engineering Department, Great Britain, Research report no. 13677, 4 May 1953, 4 p.) AD-18 216

The results are presented for some measurements of the power distribution of speech signals. Measurements were made on the signals of 10 talkers who used both high-quality and commercial-quality circuits. Each talker read a book passage (selected at random) over each type of circuit. The duration of each reading was 120 sec. The proportion of time during which the mean power was exceeded was 18.7% for the high-quality circuit and 12.5% for the commercial. Analysis showed no significant difference between talkers for any of the values obtained, while the difference between circuits was significant at the 0.1% level. The measurements of the instantaneous power distributions for logatoms and for a sample of trisyllabic words indicated that the context of words has an effect on their power distributions.

161. SOME PRACTICAL METHODS OF OBTAINING TIME OF RESPONSE.
Roland L. Van Allen, National Aeronautics and Space Administration, Washington, D. C., Paul W. Covert, Magnetics, Inc., Butler, Pennsylvania and Thomas G. Wilson, Duke University, Durham, North Carolina. (AIEE Transactions, Vol. 78, Part I, Communication and Electronics, January 1960, pp. 900-905)

This paper presents a brief description of three methods of measuring time of response to a step function. They have been found to be particularly useful because of their simplicity and convenience.

162. STATISTICAL STUDY OF PULSE WIDTH MODULATED CONTROL SYSTEM (I). S. C. Gupta and E. I. Jury. (University of California, Electronics Research Laboratory, Berkeley, Contract AF 18(600)-1521, Series No. 60, Issue No. 403, 12 September 1961, 55 p., 48 refs., AFOSR-1628) AD-267 895

Efforts concern a statistical study of pulse width modulated control systems. The pulse width modulator (PWM) was first considered for positive signals only. The output of this was then compared with the output of the approximate model where the PWM was replaced with a sampler, saturating nonlinear element and a hold circuit based on equal area approximation. An example was worked to show that there is little error involved by this approximation. Using this as the basis, the open loop case was worked out for Gaussian inputs. The results were tabulated and graphed. In the solution of the closed-loop system the difficulty of the calculation of the crosscorrelation function was overcome by making another approximation based on the separability property of Gaussian Process. This facilitates the whole problem and the relationship of output MSV to input MSV was graphed for a simple example.

163. STATUS OF SAMPLED-DATA SYSTEMS. E. I. Jury, University of California, Berkeley. (AIEE Transactions, Vol. 78, Part I, Communication and Electronics, January 1960, pp. 769-777, 35 refs.)

This paper briefly describes in general terms procedures for analysis and methods of synthesis of sampled-data systems and indicates present areas of research and some of the important problems to be tackled in this field.

In particular, the following items are discussed: (1) Methods of analysis of linear sampled systems including the z-transform, frequency response, impulsive response, and difference equation methods. (2) Procedures for design of sampled-data systems or continuous-control systems employing digital computers. Both time and frequency-domain methods are described. (3) Types of physical implementation of discrete and continuous compensation networks. (4) Sampled-data systems with finite pulse width and pulse-modulated feedback systems and methods for their analyses. (5) Experimental study of a simulated system on a specially built computer.

This paper concludes by describing the present research activities in this field, enumerating some of the problems to be tackled, and suggesting areas for future research in this increasingly important field.

164. STUDIES OF CONTACTS WITH BARRIERS IN BETWEEN. Hans Meissner. (Johns Hopkins University, Baltimore, Maryland, Contract Nonr-24849, Final report, September 1959, 50 p., 28 refs.) AD-225 070

165. STUDY AND INVESTIGATION OF EXTREMELY HIGH ALTITUDE FERRET RECONNAISSANCE TECHNIQUES (U). P. E. Herman, T. Jones and others. (HRB-Singer, Inc., State College, Pennsylvania, Contract AF 33(616)-5471, Report no. 154-7, Quarterly engineering report no. 7, July 1959-September 1959, 15 October 1959, 45 p., SECRET) AD-313 381 (See also) AD-312 320

166. STUDY OF A DIODE BRIDGE NANOSECOND RESOLUTION COINCIDENCE CIRCUIT. S. C. Pancholi and N. K. Saha. (National Institute of Science, India, Proceedings, A, Vol. 27, 26 March 1961, pp. 155-160)

A highly stable circuit is described which can provide a resolution down to 0.7 nsec.

167. STUDY OF FAST EVENTS. W. G. Sykes. (Science, Vol. 130, No. 3382, 23 October 1959, pp. 1051-1058, 24 refs.)

How technique developed in explosives research can be applied to velocity measurements of high speed phenomena in general; review of such techniques including use of high speed cameras, such as image dissection, framing, and streak cameras; physical measurements.

168. STUDY OF LOW CURRENT HIGH GAIN TRANSISTORS. (New Brunswick University, Canada, ECRDC Project T-67, Quarterly report no. 1, 1 September 1961-30 November 1961, 16 p., 9 refs.) AD-272 822

Research was initiated on the phenomenon of very high gain observed at very low currents in certain silicon transistors. It was intended to determine, if possible, the reason for this phenomenon, and to study applications of defense interest. Four phases of the project were being carried out to some extent simultaneously. These are measurement of the characteristics of transistors eshibiting very high gain at very low currents, determination of the availability of these transistors, application of these transistors to circuits, and the search for an explanation of the phenomenon. Considerable work was done on the first 2 phases, whereas, circuit development was just begun and theoretical studies were restricted by lack of contact with the transistor manufacturer.

169. STUDY TO PROVIDE IMPROVED FREQUENCY MEASUREMENT CAPABILITITES FOR ELECTRONIC RECONNAISSANCE (U). Peter M. LaTourrette. (Melaboratories, Palo Alto, California, Contract AF 33(616)-7131, Quarterly engineering report no. 4, 1 February 1961-30 April 1961, 38 p., CONFIDENTIAL) AD-323 568

170. STUDY TO PROVIDE IMPROVED FREQUENCY MEASUREMENT CAPABILITIES FOR ELECTRONIC RECONNAISSANCE. (U) Bruce R. Barlow, William E. Budd and others. (Melaboratories, Palo Alto, California, Contract AF 33(616)-7131, Final engineering report, 1 May 1960-31 October 1961, 31 October 1961, 120 p., 11 refs., SECRET) AD-326 131

Electron and proton magnetic resonance detectors were combined to provide an automatic-tracking microwave frequency monitor with direct digital readout. The design and performance of a set of laboratory models with 0.01% accuracy are discussed in detail. A study of methods for measuring the frequencies of pulsed signals is reported. (U)

171. SYMMETRICAL FREQUENCY MULTIPLIER CIRCUITS. George W. Dick, Bell Telephone Laboratories, Inc., Murray Hill, New Jersey. (AIEE Transactions, Vol. 79, Part I, Communication and Electronics, May 1960, pp. 125-134, 4 refs.)

The purpose of this investigation is two fold. First, to determine generally what circuits constitute a frequency multiplier and to show what output frequencies are obtainable from such circuits. Secondly, to show the equivalence of various circuits so that the results obtained from a generalized analysis of one circuit can be used to evaluate several others.

172. SYNTHESIS PROCEDURE FOR AN n-PORT NETWORK. D. Hazony and H. J. Nain. (IRE Proceedings, Vol. 49, September 1961, pp. 1431-1432)

The method is based on the Bott-Duffin procedure for two-port networks.

173. TECHNICS OF NANOSECOND IMPULSES (REVIEW) (TEKHNIKA NANOSEKUNDNYKH IMPUL'SOV (OBZOR)). G. V. Glebovich and L. A. Morugin. (Izvestiia Vysshikh Uchebnykh Zavedenii, Radiotekhnika, No. 2, March-April 1960, pp. 137-152) In Russian

Reviews the modern state of technics of generation, amplification, transmittance and observation of nanosecond impulses.

174. TECHNIQUE FOR DETECTION OF PULSE COMPRESSION (CHIRP) RADARS (S). L. A. LoSasso and F. J. Mueller. (Airborne Instruments Laboratory Deer Park, Long Island, New York, Contract AF 33(616)-5577, Report no. 4766-S-3, February 1961, 6 p., SECRET) AD-323 918

175. TECHNIQUE FOR DETERMINATION OF RADAR CHARACTERISTICS FROM PULSE AMPLITUDE VARIATIONS (S). E. L. Gliatti and F. J. Mueller. (Airborne Instruments Laboratory, Deer Park, Long Island, New York, Contract AF 33(616)-5577, Report no. 4766-S-6, March 1961, 12 p., SECRET) AD-323 917

176. TEST SET FOR MEASUREMENT OF ENVELOPE DELAY DISTORTION AT AUDIO FREQUENCIES WITH 1-MICROSECOND PRECISION. W. Alfred Cedd, Stromberg-Carlson Company, A Division of General Dynamics Corporation, Rochester, New York. (AIEE Transactions, Vol. 79, Part I, Communication and Electronics, July 1960, pp. 241-245, 1 refs.)

This paper describes a test set which has been developed to overcome the disadvantages of the phasemeter method for envelope delay measurements in the audio-frequency range and to yield a precision of 1 μsec for measurements of envelope delay distortion up to 166 μsec.

177. THEORY FOR SPACE-CHARGE-LIMITED CURRENTS WITH APPLICATION TO ELECTRICAL PRECIPITATION. P. Cooperman, University of Pittsburgh, Pennsylvania. (AIEE Transactions, Vol. 79, Part I, Communication and Electronics, March 1960, pp. 47-50, 12 refs.)

The object of this paper is to present a new method for the calculation of the electrical parameters of space-charge-limited currents in gases, and to apply the method in two geometries of interest in electrical precipitation, namely, coaxial cylinder and duct geometry. The results of this work will be good approximations for low current densities and applied voltages not too far removed from the starting voltages. These conditions are, however, typical ones in electrical precipitation. For cylindrical geometry, the results are exactly the classical ones given by Thomson and Townsend. For duct geometry, i.e., a grating of equally spaced wires centered between parallel plates, the results are similar in form to those obtained by Deutsch; however, the numerical coefficients in the formulas are considerably different and, as a result, different conclusions are drawn.

178. THEORY OF PULSED SIGNAL MEASUREMENTS. Glenn W. Preston. (General Atronics Corporation, Bala-Cynwyd, Pennsylvania, Contract AF 30(602)-2120, Report no. 779-207-12, Final report on Enhanced Accuracy Pulses Study, 20 August 1960, 47 p.) AD-248 632

The fundamental theory of radar measurements has been extended and a general procedure has been evolved for determining the design of electrical measuring networks which give approximately optimum estimates of various target parameters. This procedure has been applied to the measurements of target velocity, target acceleration, target multiplicity (the measurement of the number of targets present at approximately the same range but having different velocities and cross-sections) and target spin. The measuring networks in these cases consist of a set of parallel filters at IF--the first member of which is the familiar matched filter. This matched filter set is followed by balanced mixers and static real time non-iterative video arithmetic matrix operations.

179. TIME SORTING OF MILLIMICROSECOND PULSES. C. Cottini, E. Gatti, Politecnico di Milano e Laboratori C. I. S. E., V. Svleto, and F. Vaghi, Laboratori C. I. S. E., Milano, Italy. (Paper presented by Emilio Gatti, Proceedings of the Second Symposium on Fast Pulse Techniques in Nuclear Counting, 12-13 February 1959, Report No. UCRL-8706, University of California, Lawrence Radiation Laboratory, pp. 49-54)

We will deal with a time sorting of millimicrosecond pulses, based on a vernier technique, which we have develpping since 1955, and which has led to several successively improved instruments and to a theoretical analysis of resolving time of scintillation-counter pulses. Other instruments have been developed according to our suggestions, and another with some different features has been independently developed.

180. TIME STANDARDS. A. G. McNish, National Bureau of Standards. (Instruments and Control Systems, Vol. 33, No. 8, August 1960, pp. 1340-1341)

The possibility of embodying our unit for time in a physical constant is attractive. We can measure time, and its reciprocal, frequency, with the greatest precision of any physical quantity. For example, we can compare the ratio of the average frequencies of two oscillators over concurrent time intervals with as great a precision as we choose. The limit is set by how long the oscillators will operate and how many cycles we wish to count, but such comparisons are pointless, if the frequencies of the oscillators are not relatively stable over the interval involved. Conversely, we may measure time with equal precision by counting cycles of a particular oscillator, assuming its frequency is constant.

181. TIME—TO—PULSE-HEIGHT CONVERSION. John H. Neiler. Oak Ridge National Laboratory, Oak Ridge, Tennessee. (Proceedings of the Second Symposium on Fast-Pulse Techniques in Nuclear Counting, 12-13 February 1959, Report No. UCRL-8706, University of California, Lawrence Radiation Laboratory, pp. 59-61)

The paper describes one application of time—to—pulse-height conversion with the hope that in will stimulate the builders of such circuits to make them more stable and capable of taking higher counting rates, because some uses require a different accent than ultraspeed. It also describes one version of such a circuit, which also has some other desirable attributes.

182. TIME-VARYING NETWORKS: PART I. L. A. Zadeh. (IRE Proceedings, Vol. 49, October 1961, pp. 1488-1503, 138 refs.)

An analysis is presented of some significant developments in the last decade, in the theory of time-varying network.

183. TIMING SYNCHRONIZATION TO 10^{-6} SECOND. (Instruments and Control Systems, Vol. 33, No. 12, December 1960, p. 2086)

In timing applications a problem exists in setting two or more clocks to agree with one another. The greater the requirement for agreement between the clocks and the greater the distance between them, the more difficult the problem becomes. Because of unpredictable variations in the rotation of the earth, the initial settings of individual clocks may differ by milliseconds. This system permits synchronization to microseconds.

184. TRANSISTOR CURRENT GAIN AT U.H.F. MEASUREMENT TECHNIQUES. B. N. Harden. (Electronic Technology, Great Britain, Vol. 38, No. 9, September 1961, pp. 312-316)

A coaxial-line system and a twin-channel comparator are used to determine amplitude and phase variations of current gain. Results in the frequency range 300-800 Mc/s are compared with values obtained by a bridge method.

185. TRANSISTORIZED PULSE-SORTING AND DISPLAY SYSTEM. J.-C. de Broekert and G. S. Bahrs. (Stanford Electronics Laboratories, Stanford University, California, Contract AF 33(616)- 6207, Technical report no. 507-1, 24 December 1959.) AD-230 816

A transistorized pulse analysis system for classifying video pulses in amplitude and duration is described. This system has two independent functions. The first is to develop and store voltages for display of pulse amplitude vs pulse duration on a CRT. Each pulse is presented as an intensified dot whose coordinates indicate the amplitude and duration. The second function provides a variable pulse-duration "window" and amplitude threshold which allow only signals with prescribed characteristics to pass. The upper and lower pulse-duration limits of the window are independently variable, as is the amplitude threshold. Pulses which pass through the window are available at both video and stretched-audio terminals. These transistor circuits are part of a larger system which includes vacuum tube circuits. Only the transistor circuits will be described here.

186. TUNNEL DIODE NANOSECOND COINCIDENCE CIRCUIT. P. Franzini. (Review of Scientific Instruments, Vol. 32, No. 11, November 1961, pp. 1222-1223)

A fast coincidence circuit using tunnel diodes is described. In ideal conditions, resolving times as low as 0.5nsec were measured. But in a practical case of beam particles crossing scintillation counters, a typical resolving time is $\approx$ 1.5nsec. The same circuit can also be used as an anticoincidence whose total dead time can be as low as 5nsec.

187. UNIFIED APPROACH TO THE THEORY OF SAMPLING SYSTEMS. R. E. Kalman and J. E. Bertram. (Franklin Institute, Journal, Vol. 267, No. 5, May 1959, pp. 405-436)

A new method is shown for the analysis of sampling (or sampled data) systems. Unlike methods currently in use, it is not necessary to assume that the sampling operations are synchronous, performed at constant rate, and representable by means of an impulse modulator. Several different types of sampling operations are considered in detail, with the analysis proceeding similarly in each case. The paper concludes with a brief study of the stability of sampling systems and a generalization of Floquet's theorem.

188. USE OF FREQUENCY-TIME TRANSPOSITION TO MEASURE AN UNKNOWN FREQUENCY. II. R. H. Baumann. (Ann. Radioelect., France, Vol. 16, January 1961, pp. 69-92)

The limitations of a previously described system are discussed from both theoretical and experimental aspects, in particular the effect of spurious reflections and changes with temperature of delay and attenuation of the quartz delay line used. Several methods for improving the system stability are proposed; with one of these systems values of N = 400 corresponding to a twenty-fold improvement in the signal to noise ratio were obtained with a resultant determination of Doppler frequency to 0·5%.

189. WIDE RANGE TIMING CIRCUIT. T. P. Sylvan, General Electric Company, Semiconductor Products Department, Syracuse, New York. (Electronic Equipment Engineering, Vol. 10, No. 2, February 1962, p. 28)

Significant advantages in applications where long timing intervals and good temperature stability are required can be provided by this timing circuit. It is similar to the hybrid one-shot multivibrator circuits described in the literature, but offers improvements in operating margins, recovery time, and temperature stability.

INSTRUMENTATION

190. 0.7 MICROSECOND FERRITE CORE MEMORY. W. H. Rhodes, L. A. Russell, F. E. Sakalay and R. M. Whalen. (IBM Journal of Research and Development, Vol. 5, July 1961, pp. 174-182)

The design and performance of a low-power, high-speed magnetic-core memory are described. A two-dimensional array organization and partial switching of toroidal cores were employed. The drive system features a combination of a current-steering diode matrix and a load-sharing magnetic switch. The operating memory has a storage capacity of 73,728 bits and executes instructions reliably up to a repetition rate of 1.47 Mc. The discussion includes a description of the organization, the series-parallel delay line clock, the control of critical timing pulses, and the actual measured performance.

191. 2.18-MICROSECOND MEGABIT CORE STORAGE UNIT. C. A. Allen, G. D. Bruce and E. D. Council. (IRE Transactions on Electronic Computers, Vol. EC-10, June 1961, pp. 233-237)

A magnetic-core memory having a read-write cycle time of 2.18 μsec, an access time of 1 μsec, and a storage capacity of 1,179,648 bits is described. The array configuration and the design of the driving system are shown. The core and transistor requirements are discussed, and the sensing and the driving circuitry are described. Design factors which governed the choice of the three-dimensional system organization are presented.

192. 25-CM-EPSTEINRAHMEN. W. Krug. (Archiv fuer Technisches Messen, No. 270, July 1958, pp. 147-150)

25 cm Epstein apparatus with measuring amplifier in voltage circuit; calculation of appropriate division of windings between primary and secondary circuits, when amplifier is used in voltage circuit.

193. CLASSIFIED TITLE. (Electronic Communications, Inc., Timonium, Maryland, Contract NOa(s) 58-762-c, Quarterly progress report nos. 1-2, 1 June 1958-31 December 1958, CONFIDENTIAL) AD-326 068

This card is on reference and may be reviewed at Autonetics Main Technical Library or at any ASTIA Agency.

194. CLASSIFIED TITLE. A. Dresner. (Airborne Instruments Laboratory, Inc., Mineola, New York, Contract AF 33(616)-5869, January 1961, 48 p., 14 refs., SECRET SECRET) AD-324 100

This card is on reference and may be reviewed at Autonetics Main Technical Library or at any ASTIA Agency.

195. AN/DLD-1(V) (XH-1), VOLUME III (U). A. Boecker, J. F. McDonald, and others. (Airborne Instruments Laboratory, Inc., Menlo Park, California, Contract AF 33(604)-14319, Final development report no. 3843-1, Vol. 3, December 1960, ASD TR 61-214, CONFIDENTIAL) AD-326 542

This volume contains the illustrations associated with the text of Volume II. (U)

196. ADDITION TO OUR MAGNETIC TAPE REVIEW. (Instruments and Control Systems, News Item, Vol. 34, No. 7, July 1961, p. 1263)

Del Mar Engineering Laboratories offer a Model DS-500 magnetic tape programmer with multichannel precise timing functions. It provides contact closure at precise intervals over relatively long periods of time after actuation of "start time." It incorporates amplifiers and control circuitry for remote operation. The package contains two separate units--a tape transport section and an electronic section. Six-channel outputs in the programmer independently control six simultaneous functions. Timing accuracy is within 5 parts per million over a 15-minute program.

197. ADVANCE IN THIN FILM MEMORY RESEARCH. SPEED MEASURED IN NANOSECONDS. (Computer News, Vol. 6, No. 3, March 1962, pp. 4-5)

Successful operation at a speed of 100 nanoseconds (1,000 nanoseconds = 1 microsecond) of an experimental magnetic thin film memory developed at the IBM Research Laboratory in Zurich, Switzerland has been announced by International Business Machines Corporation. This speed is claimed to be about four times faster than that of any operating thin film memory of the same size reported up to now.

Although years away from full technical development, such high-speed memories will open up new scientific and industrial uses and are expected to be more economical in some complex operations than present units which already operate in microseconds. Advantages of magnetic thin films for computer memory applications are greater speed, smaller size and lower power requirements.

198. AMPLIFIER FOR THE GENERATION OF ACCURATELY CONTROLLED MICROSECOND PULSES. J. B. Gunn. (Review of Scientific Instruments, Vol. 32, July 1961, pp. 804-807)

A description is given of a pulse amplifier whose output voltage can be accurately controlled by the setting of a ten-turn potentiometer. The output amplitude and pulse lengths are variable up to 1000 v, 2.6 a, and 10 μsec, respectively.

199. ANALIZATOR PLOTNOSTI RASPREDELENIIA VEROIATNOSTEI SLUCHAINYKH PROTSESSOV. I. N. Bocharov and R. I. Stakhovskii. (Avtomatika i Telemekhanika, Vol. 23, February 1962, pp. 169-175) In Russian

Description of the model of a probability distribution density analyzer developed to analyze processes with frequency from less than 1 mc. to 8 mc. The time and accuracy of measurement are found to be satisfactory, and recommendations for further improvement are made.

200. ANALOG FREQUENCY METER FOR MODERN MEASUREMENTS. C. G. Chitouras. (General Radio Experimenter, Vol. 35, Nos. 1-2, January-February 1961, pp. 3-13)

Describes the principles, construction and applications of a frequency meter and discriminator, which is basically a frequency-to-direct-current convertor, operating on the principle of a pulse-count discriminator. Frequencies between 3 c/s and 1·5 Mc/s can be measured directly, the nominal accuracy being 0·2% of full scale for all but the extremes of the frequency range. Input signals of 30 mV peak amplitude are adequate over most of the range, and the sensitivity is independent of input waveform. The frequency range, particularly for frequency-drift and incidental measurements, can be extended to thousands of Mc/s if the frequency to be measured is heterodyned with a known standard. The meter used has a linear scale for the first 15% of full scale, the remaining 85% being logarithmic, and a special interpolation technique enables the second and third digits of the reading on the meter to be easily seen. In this way an accuracy of 0·1% of full scale on any of the five ranges of the meter is achieved. Descriptions, with block diagrams of the equipment used, are given of many practical applications.

201. ANALYSIS OF AN AFC SYSTEM FOR AN AUTOMATIC SEARCH-TRACK RECEIVER. Harold E. Thiel and Keith E. Root. (Electronic Defense Laboratories, Mountain View, California, Contract DA 36-039-sc-87475, Technical memo EDL-M443, 28 February 1962, 47 p., 4 refs.) AD-274 386

The general behavior of a sampled data automatic frequency control loop for use in receiving pulsed radio frequency signals is described. A functional description of the system blocks is used to develop automatic frequency control (AFC) loop stability criteria. Tracking capabilities of the AFC loop are formulated and equations are derived to permit an estimation of frequency set errors. Design considerations are discussed. The frequency to voltage converter and the frequency control circuits are discussed in detail.

202. ANALYSIS OF MILLIMICROSECOND PULSES BY USE OF A CHARGE-STORAGE TYPE OF PULSE-HEIGHT ANALYZER. Louis Costrell and R.E. Breuckmann, National Bureau of Standards, Washington, D. C. (Proceedings of the Second Symposium on Fast-Pulse Techniques in Nuclear Counting, 12-13 February 1959, Report No. UCRL-8706, University of California, Lawrence Radiation Laboratory, pp. 31-36)

Our interest has been in pulses of about 1/2- µ sec duration and a time resolution of about 2 µ sec for use with NaI(Tl) crystals. However, fast scintillators permit much shorter resolution, the full utilization of which would necessitate much faster pulses. We have therefore tried to get much faster pulses. We have however tried to get some idea of how the basic system will operate with pulses as short as 2 m µsec. It should be emphasized that this work with fast pulses is of a preliminary nature and that the limited results presented are indicative rather than conclusive.

203. ANALYZER FOR TIME MEASUREMENTS BY MEANS OF SPARK COUNTERS. L.I. Artemenkov and M.V. Babykin. (Instruments & Experimental Techniques, No. 1, January-February 1960, p. 46-50)

Analyzer is based on principle of extending time intervals to be measured and transforming them into pulses of given amplitude which are fed to amplitude analyzer.

204. APPLICABILITY OF ACTIVE FILTERS TO THE MEASUREMENTS OF THE FREQUENCY SPECTRA OF PULSES. H.G. Jungmeister. (Arch. elekt. Ubertragung, Vol. 14, October 1960, pp. 432-434)

The use in frequency analyzers of active filters comprising amplifiers with double-T type RC networks, results in higher Q-values at low frequencies than is possible with stagger-tuned LC circuits. The error assessment given by Seeger and Stäblein (Abstract 1497 of 1958 IRE Proceedings) is also applicable to this type of circuit.

205. APPLICATION OF TRANSISTORS TO THE DISCRIMINATOR DEVELOPED FOR THE RANGE TRACKING SYSTEM OF RED DEAN. Sheppard and R. E. Wright. (General Electric Company, Ltd., Great Britain, Report no. SL. 087, 23 February 1954, 23 p., JSRP Control no. 570531, SECRET) AD-130 081

206. APPLICATION OF ULTRASONICS TO ELECTROCHEMISTRY. (Western Reserve University, Ultrasonics Research Laboratory, Cleveland, Ohio, Contract N7onr-47002, Status report no. 10, 1 April 1951-30 March 1951, 138 p.) AD-222 441

Contents:
Measurement of ionic vibration potentials
- Electrokinetic probe for the detection of ultrasonic waves
- Effect of ultrasonic waves on hydrogen overvoltage.
- Production of alternating components in the potential of a gas electrode with ultrasonic waves
- Effect of ultrasonic waves on the electrodeposition of metals
- Instrumentation for measurements with pulse-modulated ultrasonic waves

207. APPLYING THE KERR CELL TO NANOSECOND PHOTOGRAPHY. S. M. Hauser and H. Quan, Electro-Optical Instruments, Inc., Pasadena, California. (Electronics, Vol. 34, No. 33, 18 August 1961, pp. 56-59, 8 refs.)

Kerr cell must operate at high voltage with low time-jitter, low r-f noise and high rates of current rise. Hydrogen thyratrons and low-inductance circuits permit 5-nsec exposures.

208. AUTOMATIC MEASUREMENT OF SMALL DEVIATIONS IN PERIODIC STRUCTURES. H. T. Closson, W. E. Danielson and R. J. Nielsen. (Review of Scientific Instruments, Vol. 29, No. 10, October 1958, pp. 855-859)

Description of accurate microdeviometer, originally developed for measurement and recording of pitch uniformity of helices in traveling wave tubes; instrument combines optical, mechanical, and electronic techniques; electronic circuitry automatically stores and processes position information and feeds processed information, in form of deviations from corresponding ideal structure, to pen recorder.

209. BINARY COUNTER PERFORMANCE. Philip Emile, Jr., E. L. Cox and A. I. Goodman. (Diamond Ordnance Fuze Laboratories, Washington, D. C., Project no. 90292, DOFL report no. TR-858, 17 March 1961, 29 p.) AD-254 822

The performance of several two-transistor binary counter circuits is described. The voltage, frequency and load variations which the circuits would tolerate before failure are listed. The tests were performed at various operating temperatures, and several types of transistors, both germanium and silicon, were used. A critical analysis of the performance trends is presented. A low-power design using germanium transistors dissipated 20 mw per stage and operated up to 65 C and a maximum frequency of 4.5 kc. One circuit design using germanium transistors performed satisfactorily up to 70 C and a maximum frequency of 27 kc. A binary counter using silicon transistors, type 2N697, performed satisfactorily at rates up to 45 kc and operated over the temperature range -40 C to +150 C with essentially no changes in its operating parameters. For operation over this wide temperature range, it was necessary to use special capacitors.

210. CHARACTERIZATION OF SWITCHING TRANSISTORS. J. Ekiss, P. Spiegel and others. (Philco Corporation, Lansdale Division, Pennsylvania, Contract DA 36-039-sc-88891, Quarterly report no. 1, 14 July 1961-14 October 1961, January 1962, 40 p., 8 refs.) AD-271 122 *

*No automatic release to Foreign Nationals.

Research concerns (1) the development of a means of predicting the switching performance of juction transistors in terms of a minimum number of significant device parameters; (2) the determination of the ultimate limits of switching as determined by transistor structure, (3) the development of techniques for simple and accurate measurement of the required parameters and characteristics, and (4) the development of procedures for the design of optimum switching circuits for any transistor type. Eight types of switching transistor type. Eight types of switching transistors, silicon and germanium, representing a variety of manufacturing processes or geometries were tested to determine the extent to which their transient performance could be readily and accurately predicted through use of the change control theory.

211. CLOSED-LOOP FLIP-FLOP CONTROL SYSTEMS. Milton Rogers, Air Force Office of Scientific Research, Mechanics Division and George Shapiro, Astronautics Institute, Air Arm Division. (Aerospace Sciences, Journal, Vol. 27, No. 11, November 1960, pp. 841-853, 5 refs.)

On-off, or flip-flop control systems, as they are called, are assuming an ever-increasing, important role in the development of advanced missiles and rockets. The primary limitation to the immediate acceptance and use of flip-flop control systems by the engineering community lies in the fact that such systems are essentially nonlinear. The development of such systems, therefore, departs from the body of knowledge and experience gained by the engineer in designing linear control systems, which have been so successful to date in advancing the horizons of controlled flight and automation.

Here the basic concepts underlying the synthesis and analysis of closed-loop, flip-flop control systems of the electromechanical type are developed. Generalized design and analysis charts are presented to aid the engineer in gaining quickly an understanding of the relative importance of various elements in the system to the system's performance and stability.

212. COHERENT MEMORY FILTER (U). (Federal Scientific Corporation, New York, Contract AF 30(602)-2044, Report no. FSC-TN-1/106, 31 December 1959, 119 p., RADC TN 59-371, CONFIDENTIAL) AD-314 891

213. COMPARATIVE PERFORMANCE OF SATURATING AND CURRENT-CLAMPED HIGH FREQUENCY PULSE CIRCUITS. V. P. Mathis, H. Raillard and J. J. Suran. (Semiconductor Products, Vol. 3, February 1960, pp. 35-40) (Abstract Only, IRE Transactions on Electronic Computers, Vol. EC-9, June 1960, p. 175)

The relative performance of saturating and current-clamped flip-flops are compared with regard to such properties as stability, loading capability, pulse repetition frequency, trigger energy requirement and pulse propagation time; theoretical and experimental results are considered.

214. CONSTANT-CURRENT GENERATOR MEASURES SEMICONDUCTOR RESISTANCE. P. J. Olshefski. (Electronics, Vol. 34, No. 47, 24 November 1961, p. 63)

Isolated constant-current generator reduces the time required to obtain resistivity profiles. High accuracy is obtained by reading current from dial settings instead of meters.

215. CONTRIBUTION TO THE EXACT MEASUREMENT OF ALTERNATING CURRENTS. (EIN BEITRAG ZUR EXAKTEN MESSUNG VON WECHSELSTROEMEN) G. Trautner. (Archiv fur Elektrotechnik, Vol. 42, 1955, pp. 94-99, Translated by Ministry of Supply, Great Britain, Translation no. TIL/T4674, September 1956, 8 p., JSRP Control no. 570146) AD-121 644

The exact measurement of direct current magnitudes is effected in a manner sufficient for all practical requirements by a Weston standard cell in conjunction with a potentiometer. While the potentiometer can also be operated without difficulty with alternating current, the true reference standard for the voltage or current is lacking. The paper gives an account of methods for providing such a standard, and in particular, of a method for the precise determination of an alternating current by means of a Wheatstone bridge circuit with load-dependent resistances, calibrated with direct current.

216. DC CURRENT INSTRUMENTS 1.0 TO 200 AMPERES FULL SCALE. (Bureaus of Naval Weapons, Washington, D. C., BuWeps-BuShips Calibration Program, 26 November 1958, 20 p., Order form OTS $.50) PB 171 210

This procedure describes the calibration of direct current ammeters herein referred to as the Test Instrument. A sample "Calibration Report" form has been included at the conclusion of this procedure. The Weston Model 901 DC Ammeter has been selected as a Representive form. When calibrating other Test Instruments, the sample report should be used as a guide. This procedure normally applies to the calibration of instruments with full-scale angles from 1.0 to 200 amperes, and with full-scale accuracies between 0.2% and 0.75%. Instruments of lesser accuracy than 0.75% full scale should be calibrated by a less accurate system than utilized herein, is such is available.

217. DELAY VARIATION IN TELEMETRY FILTERS. K. L. Berns. (Naval Ordnance Laboratory, Corona, California, Report no. NOLC 553, 1 November 1961, 18 p.) AD-265 936

Advances in telemetry equipment performance give new importance to time delay characteristics of filter networks used in these equipments. The significance of filter delay characteristics in telemetry applications is discussed, and fundamental terms are defined. Suggested methods of delay measurement are presented, and experimental results are given.

218. DESIGN STUDY OF AN INTEGRATED AIRBORNE TELEMETRY SYSTEM. Hugh Pruss. (Telemetering Corporation of America, Sepulveda, California, Contract DA 28-017-501-ORD-3577, Engineering report no. 707, Progress report no. 7, April 1960, 17 p.) AD-256 563*

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Present effort included the design of the multiplexer, oscillator and the amplifier network units. Finalizing of general system packaging was started and work on additional units was begun with new modifications.

219. DETECTOR MOUNT, G-BAND (3.95 TO 5.85 KMC). (Bureau of Naval Weapons, Washington, D. C., Secondary Standards Laboratory Instrument Calibration Procedure GD-05, BuWeps-BuShips Calibration Program, 31 March 1960, 16 p.) PB-181 056

The Test Instrument is a device for measuring or detecting RF power. The Test Instrument with a fixed bolometer element is tested by measuring the input VSWR. The bias current is supplied by an external bolometer bridge. Test Instruments with adjustable bolometer mounts are also functionally tested to determine whether they can be adequately tuned through the frequency range.

220. DEVELOPMENT AND APPLICATION OF TIME-DIVISION MULTIPLEXING TELEMETERING EQUIPMENT FOR DATA TRANSMISSION ON AN ELECTRIC POWER SYSTEM. C. P. Almon, Jr. and John Donelson, Jr., Tennessee Valley Authority, Chattanooga. (AIEE Transactions, Vol. 79, Part I, Communication and Electronics, May 1960, pp. 155-159)

The Tennessee Valley Authority (TVA) devised experimental equipment to transmit six hydro plant readings over one impulse channel from the Nashville Load Dispating Office to the Chattanooga Load Dispatching Office. Later the hydro plant readings were replaced by six substation load readings that are used in a computer for system economic loading purposes. This equipment has operated over a 1-tone channel of a microwave system about 130 miles in length for more than 1½ years and the operation has been satisfactory.

221. DEVELOPMENT OF A BALLOON-BORNE PARTICLE COUNTER. A. Lieberman. (Armour Research Foundation, Chicago, Illinois, Contract AF 19(604)-5895, Final report no. ARF 3157-14, 15 June 1959-31 August 1960, 27 p., AFCRL TR 60-404) AD-243 861

A laboratory prototype light scattering single particle counter is developed which would demonstrate the feasibility of constructing flyable balloon-born instrumentation to analyze particles 1 micron and larger at altitudes ranging from 30,000 to 100,000 feet. Design drawings for such flyable instrumentation were prepared. Investigation of air handling, optics, and electronics were carried out. An unsheathed nonlaminar air stream would permit straightline particle flow in its center. A large diameter intake and flow system minimizes the effects of wall deposition. An optical design that permits a viewing volume of 50 mm^3 and a signal-to-noise ratio of 2.5:1 for 1 micron particles was used for the prototype. Electronic circuitry was used that permitted measurements of signal-to-noise ratios and pulse shape for several operating conditions. Sufficient information was obtained to permit extablishing feasibility of design and the layout of transistor logic from the laboratory prototype data. Working drawings for the optics and air handling sections were prepared and level detectors circuitry was breadboarded for the pulse height analyzer.

222. DEVELOPMENT OF RECEIVER-ANALYZER QRC-212(T)-4 (U). E. W. Lichfield, T. F. Barone and H. M. Harper. (HRB-Singer, Inc., State College, Pennsylvania, Contract AF 33(604)-34621, Report no. 295-1, Monthly technical report no. 1, 23 June 1961, 11 p., SECRET) AD-323 883

223. DEVICE FOR MEASURING SMALL CAPACITANCES. W. P. Davis, Jr., Dartmouth College, Department of Physics, Hanover, New Hampshire. (Review of Scientific Instruments, Vol. 31, No. 2, February 1960, pp. 217-218, 3 refs.)

In order to utilize ultra-high vacuum techniques for the evacuation and subsequent filling of discharge tubes, it is necessary to incorporate in the vacuum system a device for measuring the filling pressure which is itself capable of being evacuated to about 10^{-10} mm Hg. Two general types of such devices are in use: the well-trapped oil manometer, and the so-called null-reading absolute manometer of Alpert, Matland and McCoubrey.

224. DEVICE FOR OBTAINING THE QUOTIENT FROM THE DIVISION OF TWO PULSES. R. G. Karpov. (Air Force Systems Command, Foreign Technology Division, Wright-Patterson Air Force Base, Ohio, [Translations no. FTD-TT-61-460 of Soviet Patent no. 130688, 13 May 1959, pp. 1-3] 15 February 1962, 3 p.) AD-272 536

There are devices for obtaining the quotient from the division of two pulse trains simulating the continuous change of physical values in the form of the frequency change of a pulse sequence. However, when using this method of simulation, the preliminary operation of converting frequency-pulse information into direct current for machines of continuous operation, or of binary coding of instantaneous information values for discrete calculating devices, is certainly applicable. Obviously, information conversion in both cases will be carried out with a certain error, directly affecting the accuracy of the result of the operation of the machine as a whole. The device suggested here carries out division, not requiring preliminary conversions, and puts out a new pulse train whose frequency is directly proportional to the change in one physical value (dividend) and inversely proportional to the change in another (divisor), which makes it possible to use the device directly with transducers.

225. DIE MESSUNG KLEINSTER GLEICHSTROEME. G. Eckhardt. (Archiv fuer Technisches Messen, No. 267, April 1958, pp. 65-66; No. 269, June 1958, pp. 113-116)

Measurement of smallest direct currents, such as encountered in ionization chambers, X-ray radioactivity, electron tube lattice current, etc; sensitivity limits of galvanometers and amplifiers used in conjunction with them; electrometric procedures; features of various electrometric instruments and tubes.

226. DIFFERENCE COUNTERS. A. F. Fischmann. (Electronic Engineering, November 1957, pp. 546-550, 16 refs.)

Discussion of some applications of a device for counting the difference in number between two sequences of pulses inserted at two different input terminals. Two practical examples are given, each being designed for a different speed.

227. DISTRIBUTION ANALYZER. M. F. Gordon and A. E. Noyes. (Brown University, Providence, Rhode Island, Contract Nonr-56205, Final Report Technical no. 3, January 1955, 11 p.) AD-52 519 (See also) Ad-17 942

"The experimental program was initiated to continue the study of those properties of gated narrow-band noise and signal which present formidable analytical problems. At the same time experimental verification of certain analytical model results was desired. An eight channel distributions analyzer was constructed to measure the probability distributions of gated and processed signals in the presence of noise. Due to the varied nature of the experimental studies contemplated, the analyzer was designed to be as flexible as possible without sacrificing stability. The analyzer was essentially completed and preliminary checks had been made on various test signals; the noise sources and necessary auxiliary equipment for the measurements was in the process of construction at the termination of the effort."

228. ELECTRICAL COUNTER MX2006. (Ramo-Wooldridge Corporation, Los Angeles, California, Contract DA 36-039-sc-74865, Quarterly progress report no. 2, 1 November 1958-1 February 1958, 15 p.) AD-161 177 (See also) AD-153 163

Breadboards of the electronic circuitry and the electromechanical assemblies were completed. A teletype simulator was developed and used to check the operation of the electronic circuitry. Two solutions are outlined for the poor LF response of the input circuitry. The standard noise-reduction techniques appeared adequate for reducing mechanical noise.

229. ELECTRICAL MEASURING INSTRUMENTS. C. V. Drysdale and A. C. Jolley. (Benn, London, 1924-1929, 3 Vols.)

230. ELECTRONIC LONG-DELAY TIMER. Ira Marcus. (Diamond Ordnance Fuze Laboratories, Washington, D. C., Project 46300, DOFL Report No. TR-995, 12 December 1961, 44 p., 3 refs.) AD-270 265

A settable all-electronic long-delay timer is described. The timer is settable in five-minute increments from five minutes to forty-nine hours fifty-five minutes. At the end of the set-in time a silicon controlled rectifier is latched on that is capable of delivering 2 amp at 6 v. The time remaining to fire may be read out upon command at any time. The time base is a 100.1 cps unijunction transistor oscillator. Countdown is by magnetic core shift registers. The total volume for the timer and its 100-hr power supply is 35 cu. in.

231. ELECTRONIC LONG DELAY TIMER (U). C. M. Pozarowski. (ITT Federal Laboratories Fort Wayne, Indiana, Contract DA 49-186-502-ORD-988, Final report, 10 July 1961, 41 p., CONFIDENTIAL) AD-324 742

232. ELECTRONIC STANDARD DEVIATION COMPUTER. C. I. Beard and J. L. Kulp. (Electronic Defense Laboratories, 2 January 1961, 35p., 16 refs.) AD-251 175

An all-electronic standard deviation computer was built to decrease the time required to reduce statistically fluctuating signals, i.e., it replaces the graphical and numerical procedures which are usually applied to long chart records of instantaneous signals. The computer will accept signals whose frequency spectra extend from 0 to above 250 c/s. The computing accuracy is 0.1% for signals of less than 5 c/s; for an 80 c/s sinusoidal input, the error in the square of the standard deviation is 1%.

233. ELECTRONIC TECHNIQUES IN OCEANOGRAPHY. M. J. Tucker. (British IRE Journal, Vol. 20, December 1960, pp. 921-931)

Underwater acoustics is discussed and a shipborne wave recorder and a Vibrotron FM pressure gauge are described.

234. ELECTRONIC TIMING. R. F. Lander, Electronic Engineering Company of California. (Instruments and Control Systems, Vol. 34, No. 10, October 1962, pp. 1879-1881)

Electronic timing equipment must be used for precise timekeeping and synchronization of equipment separated by large distances. Primary use is in correlation of data taken at several sites.

235. EVALUATION OF VOLTAGE AND CURRENT MEASURING EQUIPMENT OF INTEREST TO UNITED STATES AIR FORCE. (Carl L. Frederick and Associates, Bethesda, Maryland, Contract AF 33(600)-28276, 1 April 1955) AD-68 205

An evaluation was made of 235 equipments to determine which are the most versatile in application.

236. EXCITATEURS ET CAPTEURS DE VIBRATIONS À SYSTEME COMPENSATEUR DE MASSE ET RAIDEUR. H. Loiseau. (La Recherche Aèronautique, September-October 1957, pp. 23-27) In French

Description of vibration exciting and recording devices and of improvement of their operation and applications.

237. FAST-RISE SAMPLING OSCILLOSCOPE AND PULSE GENERATOR. Robert M. Sugarman and F. C. Merritt, Brookhaven National Laboratory, Upton, New York. (Proceedings of the Second Symposium on Fast-Pulse Techniques in Nuclear Counting, 12-13 February 1959, Report No. UCRL-8706, University of California, Lawrence Radiation Laboratory, pp. 93-96)

A simple and inexpensive sampling oscilloscope and mercury-switch pulse generator are described whose combined step-function rise time is 2.6×10^{-10} sec. The oscilloscope will display a 30-milivolt signal with negligible noise, and has a band pass from zero to 2000 Mc. The pulse generator is used both as a source of strobe pulses for the scope and as a signal generator for the circuit under test. The instrument may be used to display any wave form, synchronous with the mercury-switch pulse source.

238. FAST TRANSISTORIZED TIME-TO-PULSE-HEIGHT CONVERTER. G. Culligan and N. H. Lipman. (Review of Scientific Instruments, Vol. 13, No. 11, November 1960, p. 1209-14)

Transistorized converter which has timebase range of 0 to 15 nanosec and stability of 10^{-10} sec used at CERN for mass analysis of particle beams of time-of-flight; time resolutions of 10^{-9} sec were obtained using conventional scintillation counters; circuit has short dead time ($3x10^{-7}$ sec), contains gating facility, but is of simple design.

239. FEASIBILITY AND ERRORS OF CURVATURE RADAR FOR SURVEILLANCE RADAR STATIONS (U). J. F. Bartram. (G. C. Dewey and Company, Inc., New York, Contract DA 36-039-sc-71218, Report no. TM-102/1, 30 August 1956, 40 p., SECRET) AD-314 335

240. FEASIBILITY STUDY OF VIBRATION AND SHOCK EXCITER USING ELECTRIC FIELD MODULATION OF HYDRAULIC POWER. John J. Eige and Edward C. Fraser. (Stanford Research Institute, Menlo Park, California, Contract AF 33(616)-6942, Report for December 1959-March 1960 on Flight Vehicle Environmental Investigations, July 1961, 27 p., WADD TR 61-185) AD-268 094

A feasibility study was made of the use of magnetic fields controlling shear stresses in magnetizable fluids and of electric fields controlling shear stresses in electrically active fluids, for driving a high-power, high-frequency vibration and shock exciter. This report is concerned with the actual design, construction, and testing of a prototype shock-shaker. A theoretical analysis of the electric-fluid mechanics is presented. The prototype demonstrated the technical feasibility of electric-field valving of hydraulic power in a shock-shaker. The peak accelerations and frequency bandwidth were less than the specifications because of deliberate lack of refinement of this first experimental model and because the only available fluid had a lower sensitivity than the earlier fluids.

241. FLIP-FLOP. D. D. Tech. (IBM Technical Disclosure Bulletin, Vol. 4, February 1962, p. 49)

A transistor flip-flop uses Zener diodes to enable appreciable output current capability at the significant voltage level.

242. FREQUENCY COUNTER. Ross E. Hupp, Erie Resistor Corporation, Erie-Pacific Division. (Instruments and Control Systems, Vol. 33, No. 10, October 1960, p. 1715)

This frequency counter uses count-down technique to obtain direct-reading accuracy of a low frequency (400 cps) to 1 part in 40,000, without waiting for 40,000 counts (cycles).

243. FREQUENCY MEASURING SET AN/GLQ-1(XW-2) (INSTANTANEOUS FREQUENCY RESOLVING EQUIPMENT) (U). S. D. Lerner. (Polytechnic Research and Development Company, Inc., Brooklyn, New York, Contract AF 30(602)-1436, Interim development report no. 1 on Phase 2, 29 July 1958-28 October 1958, 15 p., Report no. RADC TN-59-329, CONFIDENTIAL) AD-313 559

244. FREQUENCY MEASURING SET AN/GLQ-1(XW-2) (INSTANTANEOUS FREQUENCY RESOLVING EQUIPMENT) (U). S. D. Lerner. (Polytechnic Research and Development Company, Inc., Brooklyn, New York, Contract AF 30(602)-1436, Quarterly interim development report no. 2 on Phase 2, 29 October 1958-28 January 1959, 15 p., RADC TN 60-38, CONFIDENTIAL) AD-316 428 (See also) AD-315 178

245. FREQUENCY MEASURING SET AN/GLQ-1(XW-2) (INSTANTANEOUS FREQUENCY RESOLVING EQUIPMENT) (U). S. D. Lerner. (Polytechnic Research and Development Company, Inc., Brooklyn, New York, Contract AF 30(602)-1436, Interim development report no. 3 on Phase 2, 29 January 1959-28 April 1959, 16 p., RADC TN 59-398, CONFIDENTIAL) AD-315 178

246. FREQUENCY METER TS-173/UR. (Bureau of Naval Weapons, Washington, D. C., Standards Laboratory Instrument Calibration Procedure AF-25, BuWeps-BuShips Calibration Program, 16 August 1961, 16 p.) PB-181 049

The Test Instrument is a frequency meter with a frequency range from 90 to 450 megacycles, and a minimum sensitivity of 20 microvolts. It will function properly with line voltage variations from 105 to 125 volts. When used as an RF signal generator, the output voltage is variable from 465 microvolts to 0.1 volt, and can be modulated with a 1000-cps signal.

247. GATED PULSE GENERATOR. F. J. Soychak. (IBM Technical Disclosure Bulletin, Vol. 4, January 1962, p. 44)

A circuit is given for a pulse generator with the output pulses timed by the inherent delay characteristics of the circuit components. It is rendered quiescent by the application of gate pulses to various terminals.

248. GENERAL RADIO 1210-C UNIT OSCILLATOR. (Bureau of Naval Weapons, Washington, D. C., Secondary Standards Laboratory Instrument Calibration Procedure AG-29, BuWeps-BuShips Calibration Program, 8 January 1960, 36 p.) PB-181 061

The Test Instrument is a compact oscillator that has a frequency range from 20 cps to 500 kc. The output waveform is either sinusoidal or square, and the amplitude is continuously adjustable. An external power supply is required to provide the necessary B + and filament voltages.

249. GENERAL RADIO 1215-B UNIT OSCILLATOR. (Bureau of Naval Weapons, Washington, D. C., Secondary Standards Laboratory Instrument Calibration Procedure AG-16, BuWeps-BuShips Calibration Program, 18 March 1959, Revised 31 May 1960, 16 p.) PB-181 004

The Test Instrument is a compact oscillator that has a frequency range from 50 to 250 Mc. It requires an external power supply and can be amplitude modulated by an external audio source.

250. GENERATION OF NANOSECOND CARRIER PULSES AT X-BAND WITH TUNNEL DIODES. L. U. Kibler, Bell Telephone Laboratories, Inc., Holmdel, New Jersey. (IRE Proceedings, Correspondence, Vol. 49, No. 7, July 1961, p. 1204, 3 refs.)

A gallium antimonide point contact tunnel diode has been used to obtain nanosecond carrier pulses at a 10-Mc rate in X-band waveguide.

251. GENERATION OF VARIABLE SQUARE PULSES IN THE NANOSECOND RANGE. F. Maisenhälder, H. D. Purps and E. Pfender. (Arch. Elekt. Übertragung, Vol. 15, May 1961, pp. 253-256)

A generator is described which is capable of producing pulses of duration variable between 20 nsec and 1.4 μsec with pulse rise and decay (between 10 per cent and 90 per cent of pulse height) within 10 nsec.

252. GENERATOR, LOW FREQUENCY FUNCTION, HEWLETT PACKARD 202A. (Bureau of Naval Weapons, Washington, D. C., Secondary Standards Laboratory Instrument Calibration Procedure AG-19, BuWeps-BuShips Calibration Program, 2 July 1959, Revised 1 August 1960, 19 p.) PB-181 062

The Test Instrument is an oscillator for generating sine, square, and triangular wave signals in the range from 0.008 to 1200 cps.

253. HEWLETT PACKARD 100D LOW FREQUENCY STANDARD. (Bureau of Naval Weapons, Washington, D. C., Secondary Standards Laboratory Instrument Calibration Procedure AG-12, BuWeps-BuShips Calibration Program, 3 January 1959, 23 p.) PB-181 048

The Test Instrument is a secondary frequency standard that provides accurate sine wave signals of 10 cps, 100 cps, 1 kc, 10 kc, and 100 kc; rectangular waves of 10 cps, 100 cps 1 kc, and 10 kc; and marker pips at intervals of 100, 1000, and 10,000 microseconds. It includes a 100 kc crystal oscillator, frequency dividing and wave shaping circuits, and a simple oscilloscope.

254. HIGH-ACCURACY FREQUENCY METER. R. I. Utyamyshev. (Instruments and Experimental Techniques (Pribory i Tekhnika Eksperimenta), No. 3, May-June 1958, pp. 386-389)

Description of high speed electronic computer in which high accuracy is attained through use of quartz crystal oscillator controlling repetition frequency of control pulses which operate counters; system can be used to measure frequencies in range 100-100,000 cps, angular velocities in range 100-100,000 rpm and time periods ranging from 100 μsec to 1000 sec; accuracy is 0.01%.

255. HIGH DENSITY DIGITAL MAGNETIC RECORDING TECHNIQUES. A. S. Hoagland and G. C. Bacon. (IRE Transactions on Electronic Computers, Vol. EC-9, March 1960, pp. 2-11)

The merit of any high density detection method is ultimately dependent on the "resolution" characteristic of the magnetic recording components. Justification of readback waveform synthesis through "single pulse" superposition is given. A comprehensive, yet general, readback simulation program for the IBM 650 is described which will automatically, for any characteristic pulse, simulate all possible readback signal patterns and test them for specified reading logic as a function of bit density. Amplitude, phase, peak, etc., sensing are compared and the influence of parameter variation on performance indicated.

256. HIGH SPEED CIRCUIT BREAKERS. C. D. Todd. (Semiconductor Products, Vol. 4, No. 10, October 1961, pp. 31-34)

The normal fuse or circuit breaker does not act with sufficient speed to give adequate protection for some devices. For most cases a rather severe overload must occur before any protection is afforded due to the lack of precision in setting the trigger point. Utilizing the highly stable peak current of tunnel diodes, a high speed circuit breaker which offers protection for a ten% overload may be designed. The elapsed time before the current is returned to the design level may be made under a microsecond, even for severe overloads. Additional features gained are stability with temperature and vibration, and the ability to trigger or reset the breaker from a remote point.

257. HIGH-SPEED CIRCUIT TECHNIQUES UTILIZING MINORITY CARRIER STORAGE TO ENHANCE TRANSIENT RESPONSE. L. P. Retzinger, Litton Industries, Beverly Hills, California. (Western Joint Computer Conference, Proceedings, Sponsored by AIEE, ACM and IRE, Los Angeles, 6-8 May 1958, pp. 149-155, 4 refs.)

This paper describes another approach to semiconductor digital-computer switching circuitry. Here the normally undesired minority carrier storage effects of high-conductance silicon junction diodes are utilized in combination with transistors to produce very fast transient response in flip-flop and pulse circuits.

258. HYSTERESIS LOOPS IN DIELECTRIC AMPLIFIERS. Earl Wingrove, General Electric Company, Syracuse, New York and Louis Depian and W. Lee Shevel, Carnegie Institute of Technology, Pittsburgh, Pennsylvania. (AIEE Transactions, Vol. 75, Part I, Communication and Electronics, July 1956, pp. 283-289, 13 refs.)

Dielectric amplifiers are circuits which utilize the nonlinear characteristics of capacitors made with so-called ferroelectric materials as dielectrics. To predict the performance of a dielectric amplifier, the behavior of the nonlinear capacitor must be determined and some means of representing it analytically must be devised. The purpose of this paper is to investigate the behavior of a commonly used nonlinear capacitor under conditions encountered in dielectric amplifier circuits, to provide a basis for an analytical representation.

259. INSTANTANEOUS FREQUENCY RESOLVING EQUIPMENT (U). (Polytechnic Research and Development Company, Inc., Brooklyn, New York, Contract AF 30(602)-1436, Interim development report no. 1, 28 November 1955-27 February 1956, 50 p., Report no. RADC TN-56-205, CONFIDENTIAL) AD-92 167

260. INSTRUMENT FOR MEASURING THE TIME CONSTANTS OF INTEGRATORS USED ON ELECTRONIC ANALOGUE COMPUTERS. R. J. Garvey. (Royal Aircraft Establishment, Great Britain, Technical memo no. GW 305, April 1957, 15 p., JSRP Control no. 570995) AD-138 393

This note describes an instrument that has been designed to measure the time constants of integrators used on electronic analogue computers. The instrument consists basically of a gate which switches a voltage to the integrator for a specific time and a simple ratiometer circuit which measures the ratio of the input and output voltages of the integrator. This ratio is a direct measure of the time constant. Accuracy is estimated to be within ±0.2%.

261. INSTRUMENTATION FOR MEDIUM ENERGY GAMMA-RAY SCATTERING MEASUREMENTS. E. L. Garwin and A. S. Penfold. (University of Chicago, Enrico Fermi Institute of Nuclear Studies, Illinois, 6 May 1960, 8 p.) AD-244 189*

*Reprint from the Review of Scientific Instruments 31:853-860, August 1960, (Copies not supplied by ASTIA)

A system for the energy analysis of scattered gamma rays of up to 70-Mev energy is described. A 5 inch diam, 4 inch long NaI(TI) crystal was the energy sensitive element. The net amplification between the ten-stage photomultiplier output and the pulse-height analyzer input was 1.8. The pulse-height-to-channel transfer charateristic of the system departs from linearity by less than 0.05 channel between the 50th and 16th channel and by one channel between the 16th and sixth. It is demonstrated that the light-to-voltage transfer characteristic of the photomultiplier is linear up to at least 30-v output levels. Provision for direct determination of the effect of superposed pulses (pileup) is incorporated into the system.

262. INSTRUMENTATION FOR THE AUTOMATIC MEASUREMENT OF CHANGES IN PHASE HEIGHT AND AMPLITUDE OF PULSED RADIO SIGNALS. Walter Sawchuck. (Ionosphere Research Laboratory, University Park, Pennsylvania, Contract AF 19(604)-4563, Scientific report no. 117, 1 March 1959, 13 refs., AFCRC TN-59-618) AD-227 947

Equipment is described that was designed and built for automatically measuring changes in phase and amplitude of a pulsed radio-carrier wave. The design of the phase part of the equipment is based on the null principle of servo-mechanics. Phase angles can be read to four degrees, Sensitivity can be increased to one degree by a simple change of gear ratio. Amplitude is measured by peak detection of gated echo pulse. Phase and amplitude information is presented separately on a dual channel pen recorder. Present equipment operates at a carrier frequency of 60 kc but can be easily adapted to any other frequency by using 60 kc as an Intermediate Frequency. The components comprising the recording system are given in complete detail. This is done with block diagrams, schematics, graphs and photographs. Alignment and testing procedures are included.

263. INVESTIGATION OF LOW-LEVEL RF VOLTAGE AND POWER MEASUREMENT TECHNIQUES. G. Fleming, M. M. Hirsch and B. Lalevic. (Franklin Institute, Laboratories for Research and Development, Philadelphia, Contract DA 36-039-sc-78284, Continuation of Contract DA 36-039-sc-72827, Report no. Q-A2264-2, Quarterly report no. 2, 18 May 1959-14 August 1959, 33 p.) AD-226 845

The complete circuitry for the test model of the direct reading modulated RF bridge is presented and described. Noise tests of this bridge and of the bridge components indicate that its sensitivity is limited by current noise. An explicit expression for the bridge sensitivity was derived. Criteria are also given for the choice of a semiconductor as a bolometer element. Based on these criteria, InSb was chosen as a suitable material for this element. Room temperature measurements of RF power were made utilizing this InSb bolometer, and the experimental results justify the use of the chosen material The completed cryogenic set-up is described. Detailed drawings of the construction are given. (See also AD-220 565)

264. INVESTIGATION OF LOW LEVEL R. F. VOLTAGE AND POWER MEASUREMENT TECHNIQUES. William H. Kurlans and Donald L. Birx. (Franklin Institute, Laboratories for Research and Development Philadelphia, Pennsylvania, Contract DA 36-039-sc-72827, Report no Q-A1957-4, Quarterly engineering report no. 4, 1 April 1957-30 June 1957, 14 p.) AD-149 525

An anlysis of thermal detectors was initiated to determine the limits of their application. Preliminary studies show that bolometer detectors have excellent frequency accomodation but a large gain in sensitivity may be required before they can be used at the required power levels. Adequate elimination of noise by filtering requires a bandpass so narrow that frequency stability of the source will be difficult. An integration-comparison is proposed as a method of measuring the signal in the presence of noise.

265. INVESTIGATION OF LOW LEVEL RF VOLTAGE AND POWER MEASUREMENT TECHNIQUES. Donald L. Birx. (Franklin Institute, Laboratories for Research and Development, Philadlphia, Pennsylvania, Contract DA 36-039-sc-72827, Report no. Q-A1957-5, Quarterly engineering report no. 5, 1 July 1957-30 September 1957, 14 p.) AD-149 909 (See also) AD-149 525

A literature survey indicated that (1) noise prevents the use of thermal type detectors for measuring FR signals below 10^{-10} to 10^{-11} w; and (2) a detector consisting of an antenna plus a square law rectifier is theoretically capable of detection down to 10^{-17} to 10^{-20} w, depending upon bandwidth.

266. KROHN-HITE 440A PUSH-BUTTON OSCILLATOR. (Bureau of Naval Weapons, Washington, D. C., Secondary Standards Laboratory Instrument Calibration Procedure AG-18, BuWeps-BuShips Calibration Program, 30 June 1959, 28 p.) PB-181 047

The Test Instrument is a push-button oscillator providing sine and square-wave signals in the range from 0.001 to 100,000 cps.

267. LABORATORY MODEL OF THE DELAY-LINE ANALYZER (U). Thomas Jones. (HRB-Singer, Inc., State College, Pennsylvania, Contract AF 33(616)-5471, Report no. 154-R-16, Interim engineering report, 14 March 1960, 42 p., SECRET) AD-315 895*

*Notice: All requests require approval of Wright Air Development Division, Wright-Patterson AFB, Ohio. Attn: WCLRR

268. LABORATORY STANDARD SIGNAL-TO-NOISE EQUALIZER. Anthony K. Newman. (Ohio State University, Research Foundation, Columbus, Contract no. AF 19(604)-4575, Technical report no. 59, December 1960, 15 p., AFCCDD TN 60-59) AD-260 458

An instrument is described which was designed to measure and equate the peak voltage of a word, or the average peak voltage of a group of words, with the rms voltage of suitably filtered Gaussian noise in such a way as to produce a well-defined standard signal-to-noise ratio of zero db. Relative to this zero standard ratio, any practical signal-to-noise ratio may be obtained by adjusting either the noise or the speech channel attenuators. An increase in the attenuation of the noise or a decrease in the attenuation of the speech will have the effect of increasing the signal-to-noise ratio.

269. LINEAR MEASUREMENTS--INSTRUMENTS AND APPARATUS. (ASME Power Test Codes, No. PTC 19.14, 1958 Supplement, ASME, New York, 1958, 14 p.)

Types of instruments and methods of linear measurement likely to be required by ASME Power Test Codes; instructions as to limits and sources of error, corrections, calibration, etc., of various types of instruments which determine their range of application.

270. MAGNETIC PULSE GENERATOR. D. W. Tesdall and P.E. Lorentzen. (AIEE Paper No. CP62-1065; Order by number and send remittance to: AIEE Order Department, 345 E. 47 St., New York 17, N.Y., $.50 each to members, $1.00 to nonmembers per preprint)

A magnetic pulse generator having ring-counter-like outputs has been developed. The circuit is a magnetically coupled multivibrator with a multicore output transformer. It is useful for applications where high reliability and minimum maintenance are required. The first of two units which have been designed has six output signals and a repetition frequency of 30 cps. Higher repetition frequencies and shorter pulse widths can be accomplished with small ferrite cores.

271. MEASUREMENT OF CORRELATION FUNCTIONS OF MODULATED CARRIERS AND NOISE FOLLOWING A NONLINEAR DEVICE. R. A. Johnson and D. Middleton. (Harvard University, Cruft Laboratory, Cambridge, Massachusetts, Contract N5ori-76, T. O. 1) also (Paper presented at Symposium on Application of Communication Theory, London, September 1952, 17 p., 24 refs.) AD-122 693

An analog electronic device capable of measuring auto- and cross correlation functions is described. A variable time delay is achieved by moving a pickup head slowly along a rotating magnetic drum, on which the signal under investigation is recorded. A second channel has a fixed delay, so that zero (or negative) delays can be obtained. Multiplication of the two signals is accomplished by an analog electronic multiplier. The desired correlation function is then plotted by a recording meter which indicated the average value of the multiplier output as the time delay is varied. Data recorded in investigating the rectification of a modulated carrier and noise are presented.

272. MEASUREMENT OF MAGNETIC-FIELD ATTENUATION BY THIN SUPER CONDUCTING FILMS. E. Erlbach, R. L. Garwin and M. P. Sarachik, IBM Corporation. (IBM Journal of Research and Development, Vol. 4, April 1960, pp. 107-115)

Measurement of the dependence of the field attenuation of thin superconducting films on temperature and superimposed dc magnetic field with a sensitive RF bridge is discussed. Since theoretically the penetration depth λ can be derived from the attenuation measurements, the experiment yields λ as a function of temperature and dc magnetic field. Changes in λ can be detected to an accuracy of ±0.03 per cent. Preliminary data on the temperature dependence of $\bar{\lambda}$ for lead are compared with the predictions of the Bardeen-Cooper-Schrieffer theory and are shown to be consistent with an energy gap between $4.9kT_c$ and $5.4kT_c$ at $0^\circ K$. Detailed descriptions of the apparatus and of the preparation of the samples are given.

273. MEASUREMENT OF PEAK AND INSTANTANEOUS VALUES IN PERIODICALLY RECURRING CURRENT AND VOLTAGE WAVE FORMS. A. D. Kratirov. (Elektrosvyaz [Telecommunications], No. 2, 1958, pp. 199-205)

Theoretical basis of proposed method and principal circuits of measuring arrangements making use of detector devices and electromagnetic measuring apparatus with two types of rectifier; it is shown that it is possible to measure alternating compound (pulse value) of rectified voltage and currents using dial type voltmeters and ammeters.

274. MEASUREMENT OF QUANTITY OF ELECTRICITY IN CURRENT PULSE. I. N. Blazhevich and V. I. Smirnov. (Pribory i Tekhnika Eksperimenta (Instruments and Experimental Techniques), No. 2, March-April 1958, pp. 222-224)

Relaxation type capacitative integrator designed for measurement of electricity in current pulse from ionization chamber; with currents of 10^{-8} 10^{-4} amp, measurement is carried out with accuracy of 10^{-9} coulomb; instrument permits measurement of Q in current pulse of length 1.6 usec or greater, with error at 5%.

275. MEASUREMENTS IN THE FIELD OF VISION OF OPTICAL INSTRUMENTS BY MEANS OF AN OPTICALLY INDEPENDENT MEASURING DEVICE. D. N. Ulezko. (Izmeritel'naia Tekhnika (Measurement Techniques), No. 2, February 1960, pp. 155-158)

The optical independent measuring device described provides optical measurements of small dimensions or differences in dimensions by the sighting method with an accuracy exceeding several times that attained in the normal methods of sighting measurements. The suggested construction of a special screen with a mirror sight will probably raise the accuracy of measurements when the image is projected onto that screen.

276. MEASUREMENTS USING A POLARIZATION INSTRUMENTATION RADAR ON NAVIGATIONAL BUOYS. I. D. Olin and F. D. Queen. (Naval Research Laboratory, Washington, D. C., NRL report no. 5701, 21 November 1961, 39 p., 6 refs.) AD-268 727

A pulsed radar system for studying the polarization characteristics of targets was built which is capable of transmitting any 1 of 4 selected polarized components, (V, H, R, L) while receiving all 4 simultaneously for each pulse. In addition, an amplitude technique for examining the tilt angle of the total polarized return is incorporated within the system. Measurements were made on three different standard radar navigational buoys. It was found that vertical and horizontal polarized transmission resulted in no observable depolarization in the received signal. Use of circularly polarized transmission, however, resulted in substantial depolarization in the received signal.

277. MEASURING IMPEDANCES BY MEANS OF OSCILLOSCOPES. K. P. Mikhailovskaya. (Measurement Techniques (Translation of Izmeritel'naya Tekhnika), No. 9, September 1960, pp. 775-777)

278. MEASURING PHASE WITH TRANSISTOR FLIP-FLOPS. J. R. Woodbury. (Electronics, Vol. 34, 22 September 1961, p. 56)

A circuit is given for measurement of phase difference to within about 1° in the range 0.2-20 kc.

279. MEASURING THE RESISTANCE OF SEMICONDUCTORS AT HIGH FREQUENCIES. V. G. Sidyakin and E. T. Skorik. (Pribory I Tekhnika Eksperimenta (Instruments and Experimental Techniques), No. 2, March-April 1960, pp. 326-329)

A simple method of measuring the resistance of semiconductors at high a-c frequencies by means of an ordinary Q-meter is described. A formula for calculating the resistance of the sample from measurements of the Q and capacitance of the Q-meter tank in which the sample is placed is given in conclusion.

The method presented of measuring the resistance of semiconductor samples is adequately effective, and insures high accuracy. If it is necessary to raise the working frequency for similar measurements, analogous instruments in the decimeter and centimeter range can be used. In this case, the measurement of the inserted resistance is determined by the change in the Q of a distributed-constant tank, or a cavity resonator.

280. MECHANICAL MEASUREMENTS BY ELECTRICAL METHODS. H. C. Roberts. (The Instruments Publishing Co., Inc., Pittsburgh, Pa., 1951, 357 p.)

Various instruments and transducers giving an electrical output for the measurement of physical quantities are described. Operating design features, methods of application, and characteristics of operation are discussed. Auxiliary equipment, power supplies, and circuitry are described. The following are among the principles of operation discussed: Variations of Capacitance; Variations of Inductance; Variations of Resistance; Photoelectric Methods; Piezoelectric Methods; and Thermoelectric, and Acoustic Methods. Bridge and Potentiometer Circuits, Indicating Instruments, and Calibration Devices are described.

281. MECHANO-ELECTRICAL ANALOGUES FOR THE FILTERING OF ELECTROACOUSTIC DRIVE SYSTEMS. W. Wolf. (Tech. Mitt. BRF, Berlin, Vol. 5, March 1961, pp. 1-9; June 1961, pp. 49-58)

The problem of overcoming fluctuations in mechanical tape transport mechanisms is investigated with the aid of electromechanical analogs and measurements on equivalent electrical circuits.

282. MEGACYCLE METER MEASUREMENTS CORP. 59, 59LF, 59UHF. (Bureau of Naval Weapons, Washington, D. C., Secondary Standards Laboratory Instrument Calibration Procedure AF-20, BuWeps-BuShips Calibration Program, 5 April 1960, 27 p.) PB-181 050

The signal source is coupled to the Test Instrument coil by means of a short antenna. Frequency coincidence is detected by means of headphones connected to the Test Instrument, whereby the beat note or modulating tone is detected aurally. The frequency of the signal source is then measured by means of the Electronic Counter and appropriate plug-in units up to 210 Mcps, and by using the Transfer Oscillator and Counter for higher frequencies.

283. MESURE DE DUREE DE VIE D'ETATS EXCITES PAR CONVERSION TEMPS-AMPLITUDE. J. Samueli et A. Sarazin, Institut d'Etudes Nucleaires, Alger. (Le Journal de Physique et le Radium, Tome 21, Mai 1960, pp. 391-393.) In French

A time to pulse height converter covering the range from 0.1 to 10 ns is described. The resolution, for ^{22}Na gamma ray annihilation radiation is 0.7 ns. The system has been used to measure the lifetime of the 80 keV gamma transition of ^{131}I.

284. MICRO-SWEEP RECEIVER RESEARCH (U). H. J. Manley and K. T. Lang. (Sylvania Electric Products, Inc., Waltham, Massachusetts, Applied Research memo no. 43, 20 October 1955, 15 p., SECRET) AD-142 791 (See also) AD-65 220

285. MICROWAVE ATTENUATORS, WAVEGUIDE 0 TO 50 DB 2.60 TO 26.50 Gc(KMC). (Bureau of Naval Weapons, Washington, D. C., Standards Laboratory Instrument Calibration Procedure GA-04, BuWeps-BuShips Calibration Program, 17 September 1961, 41 p.) PB-181 057

This procedure utilizes the audio substitution method for attenuator calibration, in which audio attenuation is substituted for RF attenuation to maintain a constant audio output with the Test Instrument first removed and then inserted into the microwave line.

286. MICROWAVE FREQUENCY, J-BAND (5.85 TO 8.2 KMCPS.) (Bureau of Naval Weapons, Washington, D. C., Secondary Standards Laboratory Measurement System Operation Procedure HF-03, BuWeps-BuShips Calibration Program, 29 June 1959, 14 p.) PB-181 024

This procedure describes the operation of a secondary standard calibration system which is used to calibrate J-Band Microwave Frequency Meters of waveguide size 3/4" x 1 1/2" (outside dimensions).

287. MILLIMICROSECOND GAMMA-RAY DETECTOR AND OSCILLOSCOPE SYSTEM. Robert B. Patten. Edgerton, Germeshausen & Grier, Inc., Las Vegas, Nevada. (Proceedings of the Second Symposium on Fast Pulse Techniques in Nuclear Counting, 12-13 February 1959, Report No. UCRL-8706, University of California, Lawrence Radiation Laboratory, pp. 71-75)

With the advent of high-energy short-pulse radiation sources, such as linear accelerators there is a need for a high-resolution wide-dynamic-range detection and recording system. This paper discusses a single channel of a gamma-detection and - recording system which satisfies these requirements.

The equipment is capable of resolving radiation rise times of less than 1 musec. A single channel has a dynamic range of 30,000 and a band width of about 1,000 Mc.

288. MONITOR FOR TIME MULTIPLEXED TELEMETRY SIGNALS. P. R. Barkway. (Royal Aircraft Establishment, Great Britain, Technical note RAD. 799, May 1961, 6 p.)AD-264 944

The monitoring of the signal content of a time multiplexed telemetry signal is considered. The design of a visual monitor intended to overcome some of the difficulties is discussed. Some features of the design which are less commonly encountered are described in some detail. An indication is given of some of the applications of the device.

289. MULTIMETER AN/USM-34. (Bureau of Naval Weapons, Washington, D. C., Standards Laboratory Instrument Calibration Procedure AQ-16, BuWeps-BuShips Calibration Program, 13 September 1961, 30 p.) PB-181 058

The Test Instrument is a general purpose broad-band VTVM which measures resistance, direct current, direct voltage, alternating voltages between 50 cps and 50 kc, and with an RF probe, voltages from 1 kc to 100 Mc.

290. NANOSECOND LOGIC BY AMPLITUDE MODULATION AT X BAND. W. C. G. Ortel, Bell Telephone Laboratories, Inc. (IRE Transactions on Electronic Computers, Vol. EC-8, September 1959, pp. 265-271)

A basic circuit which consists of a diode modulator controlled by the signal from a diode detector and which can perform logical AND, EXCLUSIVE-OR, and OR functions upon pulsed microwave signals is described. Pulse rates up to 500 mc have been used at a carrier frequency of 11,000 mc. To demonstrate that microwave circuits can be used for the regeneration and circulating storage of pulses, as well as for logic, a digital arithmetic unit has been built which multiplies two 8-digit binary numbers. Various forms of the basic circuit have been studied in operation.

291. NANOSECOND PULSE TRANSFORMERS. C. Norman Winningstad. (IRE Transactions on Nuclear Science, Vol. NS-6, No. 1, March 1959, pp. 26-31)

Nanosecond pulse transformer is considered from point of view of transmission lines. Advantages achieved by this design approach are described.

292. NANOSECOND SWITCHING IN THIN MAGNETIC FILMS. W. Dietrich, W. E. Proebster and P. Wolf. (IBM Journal of Research and Development, Vol. 4, April 1960, pp. 189-196, 12 refs.)

A special pulse equipment include a pulse-sampling oscilloscope with an over-all response time of 0.35 nanosecond for the observation of the nanosecond flux change in thin permalloy films is described. Film switching signals as short as 1 nanosecond are discussed with respect to the underlying processes. Inverse switching time versus driving-field curves for films of different thicknesses show that thinner films switch faster than thick ones.

293. NEW DEVICE FOR THE RECORDING AND SUMMATION OF PERIODS OF TIME. A. G. Fleer. (Izmeritel'naia Tekhnika, No. 12, December 1960, pp. 1017-1018)

The described device makes it possible to determine the sum of a considerable number of arbitrary periods of time and to record the number of these periods. The instrument makes it considerably easier to determine the second and its hundredths by reducing the time needed for the calculations. In addition, the computing chronoscope, whose output is binary, can form a basis for the automation of the calculation processes which are carried out in determining time.

294. NEW IMPULSE METERING SYSTEM. C. J. Snyder and C. A. Booker, Jr., Westinghouse Electric Corporation, Raleigh, North Carolina and Cheswick, Pennsylvania respectively. (AIEE Transactions, Vol. 79, Part I, Communication and Electronics, May 1960, pp. 159-163)

The increasing number of power loads in the 100-mw (megawatt) and higher ranges with the attendant problems of metering and totalizing several supply sources has disclosed the inability of much of the present impulse-operated metering equipment to render the dependable, accurate, and maintenance-free service required.

This is in part due to the relatively low activity of such apparatus which has not justified extensive design improvement.

Recent developments, however, have made possible a new concept of impulse metering which features high impulse rates and accuracies. The purpose of this paper is to describe the development and the principles of operation of the new units now available to meet this high level of performance.

295. NONLINEAR PRF FILTER FOR SIGNAL SORTING (U). W. M. Waters. (Radiation Laboratory, John Hopkins University, Baltimore Maryland, Contract no AF 33(616)-3374, Technical report no. AF-48, April 1958, 46 p., CONFIDENTIAL) AD-157 739

296. OPERATING AND SERVICING MANUAL FOR MODEL 202C LOW FREQUENCY OSCILLATOR. Serial 142 and Above. (Hewlett-Packard Company, 275 Page Mill Road, Palo Alto, California, Report No. 202C001-2, 1955, 39 p.)

Contents include: General Description; Operating Instructions; Circuit Description; Maintenance (includes Calibration and frequency measurement device); and Table of Replaceable Parts.

297. OPERATION OF BOLOMETERS UNDER PULSED POWER CONDITIONS. Max Sucher, Leonard Sweet, and Herbert J. Carlin. (Polytechic Institute of Brooklyn, New York, Contract AF 30(602)-18, Report no. R-291-52; RIB-230, 4 May 1953, 49 p.) AD-16 893

The thermal behavior of Wollaston thin-wire bolomerters was examined both theoretically and experimentally. Several electrical analogs to the thermal circuit of the bolometer are presented. The simple RC analog was not strictly correct; the bolometer has no unique time constant. The temperature rise of the bolometer during a short pulse of power was less than expected from the calculated heat capacity of the wire. Possible explanations for this are discussed. Measurement errors resulting from the time variation of bolometer resistance under pulsed-power conditions are treated in detail. Methods of avoiding or reducing these errors are discussed as well as methods of estimating and correcting for the errors when they cannot readily be avoided.

298. OSCILLATOR, AUDIO TS-382A/U THROUGH TS-382F/U. (Bureau of Naval Weapons, Washington, D. C., Secondary Standards Laboratory Instrument Calibration Procedure AG-35, BuWeps-BuShips Calibration Program, 28 March 1960, 25 p.) PB-181 060

The Test Instrument is an oscillator with a frequency range of from 20 cps to 200 kc. It contains a vibrating reed frequency meter and an output voltmeter. The output voltage is variable from 0 to 10 volts into 1000 ohms.

299. PRF DISCRIMINATOR QRC-63(T). (Dayton Electronic Products Company, Ohio, Contract AF 33(604)-18068, Progress report no. 1, 1958, 12 p., CONFIDENTIAL) AD-153 489

300. "PERSISTOR"--A SUPERCONDUCTING MEMORY ELEMENT. E. C. Crittenden, Jr. and J. N. Cooper, U. S. Navy, Naval Postgraduate School, and F. W. Schmidlin, Space Technology Laboratories. (IRE Proceedings, Vol. 48, July 1960, pp. 1233-1246)

A new computer memory element called the Persistor is described. The basic components of a Persistor are a superconducting inductor in parallel with a switch element which is normally superconducting, but which becomes resistive when the current exceeds a critical value. When a suitable current pulse is applied to a Persistor memory element, a persistent circulating current is stored. A second pulse in the same direction as the first makes no change, but a pulse in the opposite direction reverses the circulating current and produces a voltage across the element. By mutual inductance coupling to two or more driving circuits, these memory elements can be made to operate in matrices similar to those employed with ferromagnetic cores. Persistor memory elements utilizing lead inductors and thin tin or indium films have performed typical memory unit functions for pulses of 15-μsec duration and a repetition rate of 15 Mc. Performance at higher speeds is possible.

301. PIONEER'S RADIATION-DETECTION INSTRUMENT. Conrad Josias, California Institute of Technology, Jet Propulsion Laboratory, Pasadena. (Astronautics, Vol. 4, No. 7, July 1959, pp. 32-33+)

The beautiful engineering of the lunar probe radiation experiment, described in this article, represents a high point of electronics art and an intimation of things to come in space technology.

302. PROBABILITY DENSITY MEASUREMENT WITH AN ELECTRODE MOUNTED IN THE FACE OF A CATHODE-RAY TUBE. Hwachii Lien. (John Hopkins University, Baltimore Maryland, Contract AF 49(638)-248, 25 September 1959, 3 p., AFOSR TN 59-992) AD-235 193*

*Reprint from the Review of Scientific Instruments Vol. 30, December 1959, pp. 1100-1102.

A small electrode mounted inside the face of a cathode-ray tube gives a window comparable to its own dimensions when the bias voltages are set so that secondary electron emission current dominates. Under these conditions the device can be used for measurement of probability densities of random signals.

303. **A PROBABILITY DISTRIBUTION ANALYSER. D. G. Lampard and I. K. Harvey. (Journal of Electronics and Control, London, Vol. 9, No. 3, September 1960, pp. 233-239)**

Stationary time processes are analysed by sampling their amplitudes at regular intervals. The sampled amplitude determines the time elapsing between the sampling pulse and a second, delayed pulse. The complete interval is divisible in 64 sub-intervals, each corresponding to one amplitude range and the number of pulses appearing in each sub-interval is counted to a maximum of 32 767. The numbers are stored in an electrostatic memory and the complete distribution may be displayed in analogue form on a c.r.t. screen following digital-to-analogue conversion. Typical displays are illustrated of a range of distributions obtained from a random square-wave source by varying degrees of low-pass filtering.

304. PROTOTYPE ANALYZER-RECORDER(U). (Trionics Corporation, Madison, Wisconsin, Contract NObsr-81195, Interim engineering report, 1-30 April 1960, 15 May 1960, 15 p., CONFIDENTIAL) AD-322 254*

*Notice: Only Military Offices may request from ASTIA. Others request approval of Bureau of Ships, Navy Department, Washington, D. C., Attention: Code 335.

Techniques for improving the signal-to-noise ratio of the coaxial recorder and providing frequency discrimination in the waveguide recorder were tested. Further development efforts will be concentrated on the waveguide recorder because it now provides all desired performance functions (detection of pulse repetition frequency, time of arrival, and write-in frequency) and is closest to completion in prototype form. (U)

305. PULSE AMPLITUDE EVALUATOR. Philip C. Murray, Scope, Inc., Fairfax, Virginia. (Electronic Equipment Engineering, Vol. 10, No. 2, February 1962, p. 37)

The circuit shown in this article was devised to locate pulses falling within a given range of amplitudes, rejecting all others falling above or below the present limits of acceptance. The evaluation may be performed at any required level, with the upper and lower limits of acceptance variable to the desired range.

306. PULSE HEIGHT INDICATOR. U. Galil and D. Ophir. (Israel Institute of Technology, Haifa, Contract AF 61(052)-196, Technical note no. 1, 23 February 1960, 4 p.) AD-257 094

A method is described which was developed for the analysis of pulses produced by the various detectors of an extensive air shower array. It is applicable to many other experiments whenever the need arises for the determination of instantaneous pulse heights at the times of occurrence of certain physical phenomena. An application of digital methods is presented for pulse measurement, which was found very satisfactory where some 25 sources of information had to be analyzed in 16 amplitude channels each. The display consists of dekatrons, where each dekatron (in conjunction with one neon bulb) represents one source of information and the amplitude channel is given by the reading of the dekatron (the neon lamp supplies the information if the number on the dekatron is below or above 10).

307. PULSE POSITION MODULATION ANALOG COMPUTER. E. V. Bohn. (IRE Transactions on Electronic Computers, Vol. EC-9, June 1960, pp. 256-261, 8 refs.)

An important field of application for computers is in real-time systems simulation. This requires the generation of nonlinear functions, obtaining the sums and products of these functions and solving systems of nonlinear differential equations. A flight simulator is an example of such a system. This paper describes a new type of analogue computer suitable for systems simulation. This computer has the desirable features of a digital computer in that it can handle a large number of operations with a small number of arithmetic elements and that a magnetic drum can be used for storage. The information to be handled is assigned channels on a time-sharing basis and tracks on an operating-sharing basis. A variable is represented by the time interval between a fixed channel pulse and a variable pulse. The arithmetic unit accepts these pulse in time sequence and generates the required output, in other words it effects modulation of pulse position.

308. PULSE RECEIVER FOR IONOSPHERIC ABSORPTION MEASUREMENTS. R. W. Southern. (Defence Research Telecommunications Establishment, Canada, RPL project report no. 1-2-4, Report no. L-327-57, January 1957, 17 p.) AD-134 453

For absorption measurements, a 4-band superheterodyne pulse receiver was developed for use in the HF band in conjunction with a pulse transmitter. Conventional circuitry is used except for the detection system which presents a linear output when measured in decibels......Circuitry and operational details are described for the RF amplifier, oscillator and mixer, linear IF amplifier, logarithmic IF amplifier and detectors, video amplifier, and the power supply.

309. PULSE-WIDTH DISCRIMINATOR FOR THE AN/APG-44(XN-1). Robert L. Morgan. (Naval Ordnance Test Station, Inyokern, China Lake, California, Technical memo no. TM 1665, 16 December 1953, 7 p.) AD-25 158

The electrical and physical characteristics are described of an AN/APG-44 range computer having circuits modified to overcome computer lock-on to high noise level inputs and ground interference. The pulse-width discriminator is such that it provides as a lock-on signal a voltage which is independent of noise level or altitude signal. Both subtractor-pulse stretcher stage and an amplifier-inverter stage are incorporated in the discriminator. The circuit does not depend upon complete cancellation of the triple coincidence-tube outputs; only positive output from the substractor stage can energize the lock-on stage. A discriminator modification was recommended as a permanent part of the range computer.

310. PULSED ANALOG-DIGITAL ENCODER. N. R. Powell. (AIEE Paper No. DP62-978; Order by number and send remittance to: AIEE Order Department, 345 E. 47 St., New York 17, N.Y., 50¢ each to members, $1.00 to non-members per preprint.)

The use of pulse code modulation in space telemetry has created the need for simple, efficient analog-digital converters which have an accuracy consistent with the resolution of the sensors providing the input to the converters. The device described can provide 1 to 5 per cent accuracy at bit rates from 1 kc to 1 mc, covering the majority of space telemetry applications. A pulsed bipolar integrator is used in conjunction with a train of pulses, the duration of which diminishes in binary fashion from the second bit to the last bit over the word period.

311. QUANTITATIVE MAPPING OF RADAR WEATHER SIGNALS. Nobuhiko Kodaira. (Massachusetts Institute of Technology, Cambridge, Contract DA 36-039-sc-75-30, Research report no. 30 on Weather Radar Research, June 1959, 39 p., 37 refs.) AD-228 154

Instrumentation is described which (1) averages the rapidly fluctuating radar video signals from weather, (2) applies an appropriate range correction to the signals, and (3) displays them on a PPI screen in the form of iso-echo contours. In order to provide the necessary dynamic range a logarithmic receiver is used. Signal averaging is accomplished by a quartz delay line integrator which superposes the signal from a number of consecutive pulses. The range correction unit normalizes the signal to a given range and compensates for atmospheric gas absorption. Examples of the measurements and estimates of the accuracy are presented.

312. RECEIVING-ANTENNA VOLTAGES (U). Francis X. Urrico, Jr. and William G. Long. (Naval Research Laboratory, Washington, D. C., NRL Report no. 4233, 29 September 1953, 12 p., CONFIDENTIAL) AD-19 381

313. ROOT MEAN SQUARE MEASURING INSTRUMENT FOR NON-PERIODIC VOLTAGES. D. E. Verrian. (Royal Aircraft Establishment, Great Britain, Technical note no. GW 297, February 1954, 7 p.) AD-29 094

"A description is given of an instrument which may be used to measure the RMS value of alternating voltages. It is primarily designed for measuring the RMS values of random noise voltages. It may be used to measure voltages of from 0.2 volts to 50 volts, over time intervals up to 100 seconds, with an error not exceeding 2% of the maximum scale reading."

314. SAMPLED DATA PROCESSOR. R. A. Rasmussen. (Scripps Institution of Oceanography, 12 December 1958, 37 p.) PB-143 613

This report describes a semi-automatic data sampler and computer accommodating two channels of information representing optically stored, magnetically stored, or direct electrical data in the form of time varying potentials. All data are converted to time modulated pulses and directed to a computer where a combination of analogue and digital computer circuits can be adjusted to perform a variety of mathematical operations on the data with accuracies of the order of $\pm$ 0.1%. Results are displayed numerically on decimal totalisers, the registered numbers being proportional to the computed functions.

315. SAMPLING MODELS FOR LINEAR TIME-VARIANT FILTERS. Thomas Kailath. (Massachusetts Institute of Technology, Research Laboratory of Electronics, Cambridge, Contract DA 36-039-sc-78108, Technical Report 352, Master's Thesis, 25 May 1959, 52 p., 27 refs.) AD-230 489

A large class of communication channels can be represented by linear time-variant filters. Different constraints can be imposed on these filters in order to simulate the actual operating conditions of such channels. The constraints permit the original filter under the operating constraints. These new filters need not resemble the physical channel at all, and need not be equivalent to the actual channel, except under the given constraints. The constraints considered are those of finite input and output channel signals and finite channel memory. Other cases can be studied by similar methods. Methods of characterizing linear time-variant filters are investigated in order to determine the most convenient descriptions for the different constraints. These descriptions are used to obtain sampling theorems and models for the filter under the various constraints. The theorems are used to find the conditions under which a linear time-variant filter can be determined by input-output measurements only.

316. SAMPLING PULSE OSCILLOSCOPE UNIT TRANSISTORIZED "SPOUT". Phillip Emile, Jr. and George R. Yetter. (Diamond Ordnance Fuze Laboratories, Washington, D. C., Project no. UI1-9004, DOFL Report no. TR-761, 6 November 1959, 49 p.) AD-229 082*

*Not releasable for Foreign Nationals

A sampling pulse oscilloscope unit transistorized, "Spout", capable of resolving repetitive pulses with risetimes in the order of 1 mμs was designed and built. Spout was built as a plug-in unit for a standard oscilloscope. A narrow pulse (approximately 1 mμs wide) is generated by an avalanche transistor switch and used to sample repetitive unamplified input pulses. From the samples, a composite picture of the input pulse is formed on a cathode-ray tube (CRT). The main advantage of spout and sampling oscilloscopes in general, is the possibility of viewing narrow (mμs) pulses with a low frequency CRT by trading sampling time for bandwidth. The disadvantages of the sampling method are that the pulse must be repetitive, the maximum and minimum input pulse rates are limited, and only a small dynamic range of input pulses can be observed.

317. SAMPLING OSCILLOSCOPES. Norman B. Schrack, Hewlett-Packard, Inc., Palo Alto, California. (Proceedings of the Second Symposium on Fast-Pulse Techniques in Nuclear Counting, 12-13 February 1959, Report No. UCRL-8706, University of California, Lawrence Radiation Laboratory, p. 97)

An advantage from the manufacturer's standpoint is that the sampling scope can be made largely from available and conventional components. Aside from the fast circuitry and the sampling circuit all the rest of the scope, including the CRT, is composed of ordinary items. We don't actually know just what is most desirable to use in the sampling circuit; we are at present trying to use semiconductors. In terms of disadvantages it is of course necessary to have a repetitive signal unless one can apply the idea mentioned by Dr. Gatti. The other principal disadvantage is the limited repetition rate that the circuit can handle. When the input is not terminated one must also be careful about reaction on the circuit under test.

318. SEARCHING THE LITERATURE FOR TRANSDUCER INFORMATION. PART II. A SURVEY OF THE FIELD. J. Pearlstein. Diamond Ordnance Fuze Laboratories, Ordnance Corps, Washington 25, D.C., Report No. TR-898, 1 December 1960) AD-249 131

A survey is presented of current knowledge with respect to the availability, application, design, calibration, and testing of transducers. The literature references covered are restricted to the following forms of literature: bibliographies, tutorial papers, surveys (including state-of-the-art studies), guides, handbooks, monographs, treatises, and comprehensive catalogs of commercially available transducers. The items are arranged under the following principal headings: Transducers and Instrumentation in General; Commercial transducers; Effects, Principles, and Phenomena; Basic Materials; and Measurands (quantities, magnitudes, or phenomena that may be measured, observed, or sensed). Twenty eight tables pertaining to the use, performance, and availability of transducers are included.

319. SEARCHING THE LITERATURE FOR TRANSDUCER INFORMATION, A SURVEY OF THE FIELD. J. Pearlstein. (Diamond Ordnance Fuze Laboratories, Washington, D. C., Project 30330, DOFL Report No. TR-996, Supplement to Report No. TR-898 (AD-249 131), Supplement No. 1 to Part 2, 10 November 1961, 46 p.) AD-267 216

An annotated bibliography is presented of state-of-the-art surveys pertaining to the availability, application, design, calibration, and testing of transducers. The references were collected during 1961 and are supplementary to those presented in DOFL report TR-898, Searching the Literature for Transducer Information, Part II, A Survey of the Field, 1 December 1960.

320. SECONDARY EMISSION PULSE CIRCUIT, ITS ANALYSIS AND APPLICATION. Jan A. Narud. (Harvard University, Cruft Labortaory, Cambridge, Massachusetts, Contract Nonr-186616, Technical report no. 245, 5 April 1957, 11 refs.) AD-131 984 (See also) AD-56 153

A regenerative pulse circuit is described which uses a single EPF 60 thermionic secondary emission tube (made by Phillips in Holland) that can generate pulses with a 6-mμsec rise time and a continuously variable width from 25 mμsec to 12μsec. A circuit analysis wherein expressions are derived for pulse width and resolving time is followed by various practical circuit realizations which include a millimicrosecond pulse generator and a fast pulse-height discriminator. The analysis showed that the ratio between the saturation current and the product of total capacitance (C) times the grid-voltage interval between saturation and cutoff represents a figure of merit for how well a vacuum tube will perform in a switching circuit. The analysis suggested that the loop gain equals unity at the points from which jumps take place.

321. SENSITIVE, COHERENT, X-BAND ECHO-MEASURING SYSTEM FOR SPECIAL APPLICATIONS. R. Wayne Crawford and Summers A. Redick. (Ohio State University Research Foundation, Antenna Laboratory, Columbus, Contract no. AF 33(616)-5341, Report no. 777-22, 31 October 1960, 23 p.) AD-251 434

A coherent detection system is employed to detect a small, modulated signal component in the presence of a large unmodulated component. The system provides both amplitude and phase information. The details of the circuitry are described, including a discussion of a 22.5-cps selective amplifier. The dynamic range of the system is in excess of 50 db. Recommendations for future system improvements are made.

322. SET RECOGNITION FROM PULSE SHAPE SAMPLES OF FPS-14 RADARS (U). W. Griffin, R. Ewing and others. (HRB-Singer, Inc., State College, Pennsylvania, Contract AF 33(616)-5958, Report no. 180-F, Vol. 5, 31 December 1960, 66 p., SECRET) AD-322 459

323. SHORT PULSE 8.6mm RADAR FOR INDOOR SCATTERING MEASUREMENTS. T. H. Legg. (Defence Research Telecommunications Establishment, Canada, RPL report no. 47-0-2, January 1958, 14 p., 10 refs, CONFIDENTIAL) AD-158 057

324. SIGNAL ANALYZER AND DATA RECORDER (U). H. Sherman. (Loral Electronics Corporation, New York, Contract DA 36-039-sc-78142, Report no. 1009-5, Quarterly progress report no. 5, 1 July 1959-30 September 1959, 24 p., CONFIDENTIAL) AD-315 364 (See also) AD-312 700

325. SIGNAL SUMMING WITH ELECTROLYTIC CAPACITORS. C. C. Minter. (Naval Research Laboratory, Washington, D. C., NRL report no. 5299, Interim report, 22 April 1959, 6 p.) AD-216 124

A method is described for obtaining the algebraic sum of several low-voltage dc signals. The apparatus consists of a polarized electrolytic capacitor and a double-pole double-throw switch for each signal entering the summation. In one position of the synchronized switches each capacitor is charged while in the other position of the switches the capacitors are connected in series for the summation.

326. SIGNAL TRACER MIL-T-16345 (SHIPS). (Erie Resistor Corporation, Pennsylvania, Contract NObsr-57064, Interim development report, 1 August 1952-30 December 1952, 8 p.) AD-43 541

327. SPECIFYING A PULSE TRANSFORMER FOR COMPUTER USE. R. R. Blessing, IBM Corporation, Poughkeepsie, New York. (AIEE Transactions, Vol. 79, Part I, Communication and Electronics, March 1960, pp. 44-47, 8 refs.)

The pulse transformer described in this paper is a specialized current-driven device that functions as a precision component in large-scale ferrite-core memories, and also as a switching device in computer logic. Typical transformer characteristics do not satisfy the exacting demands of computer applications. Greater precision in specifying and measuring these components is required along with closer tolerances.

The paper will show how the specifications are arrived at, how the devices are measured, and how these characteristics are related to the application.

328. STANDARDS CALIBRATION PROCEDURES. (Hewlett-Packard Company, 275 Page Mill Road, Palo Alto, California, Application Note No. 39, 1959, 14 Sections)

Contents include: X752A Directional Coupler; X382A Variable Attenuator; X532A Frequency Meter; X485B Detector Mount (with barretter); H01 872A Slide Screw Tuner; X870A Slide Screw Tuner; 415B Standing Wave Indicator; 430C Power Meter; 614A and 616A Signal Generator; 715A Klystron Power Supply; 540B Transfer Oscillator; 202A Low Frequency Function Generator; 205AG Audio Signal Generator.

329. SUBMICROSECOND CORE MEMORIES USING MULTIPLE COINCIDENCE. H. P. Schlaepp and I. P. V. Carter, IBM Corporation, Research Laboratory Zurich, Adliswil-Zurich, Switzerland. (IRE Transactions on Electronic Computers, Vol. EC-9, No. 2, June 1960, pp. 192-198, 5 refs.)

Memories using toroidal ferrite cores with cycle times less than a microsecond are described; the selection ratio is increased by the use of biasing and the multiple coincidence principles of R. C. Minnick and R. L. Ashenhurst. It is shown that this mode of operations leads to important changes in the structure of the store; in particular, the classical core switch does not fulfill the new requirements. The "two-core switch" is then briefly described; it permits an elegant and economic solution of the problems arising at high selection ratios. Details of the design and operation of memories embodying these ideas are given; it is shown, for example, that standard core memory matrices can be used very efficiently at a selection ratio of 3:1 to achieve a cycle time of 2 microseconds. Further illustrations are given from a model of a 100 x 100 store operated at 4:1 and 7:1 selection ratios, and it is shown that a store of 10,000 8-bit characters with a cycle time of 0.25 microsecond is feasible.

330. SUBMINIATURE PULSE TRANSFORMERS. Pieter R. Wiederhold, Transformer Engineering Department, Sylvania Electric Products Inc., Ipswich, Mass. (Electrical Manufacturing, August 1956, pp. 86-90)

The selection of the proper pulse transformer core material and the type of core construction used is largely dependent on the circuit application. Core materials and their properties are discussed with emphasis on their application to pulse transformer design.

Measured over a certain load impedance, the pulse shape may be defined as follows:

T = pulse width in microseconds

α = pulse rise time in microseconds, to me measured from 10 per cent to 90 per cent of the amplitude. This is the most linear part of the leading edge.

β = pulse decay time in microseconds to be measured from 90 per cent to 10 per cent of the remaining pulse amplitude.

τ = recovery time in microseconds.

A = pulse amplitude in volts.

O = overshoot in per cent of the pulse amplitude.

BS = backswing in volts.

331. THERMAL VOLTAGE CONVERTERS FOR ACCURATE VOLTAGE MEASUREMENTS TO 30 MEGACYCLES PER SECOND. F. L. Hermach and E. S. Williams, National Bureau of Standards, Washington, D. C. (AIEE Transactions, Vol. 79, Part I, Communication and Electronics, July 1960, pp. 200-205, 6 refs.)

Thermal voltage converters, each consisting of a resistor in series with a thermoelement in a coaxial line, have been developed for measurements of rms voltages of 1 to 200 volts at frequencies from 3 cps (cycles per second) to 30 mc (megacycles). An accuracy of 0.1% or better may be obtained by a-c-d-c transfer techniques up to at least 10 mc and 0.2% at 30 mc.

332. THREE-COMPONENT ARC-SUPPRESSION NETWORK. P. N. Budzilovich, ITT Laboratories, Nutley, New Jersey. (Electronics, Vol. 33, No. 36, 2 September 1960, p. 58)

Simplicity of design is a feature of a three-component network that provides high-quality arc suppression for contacts operating into inductive loads such as relay coils. It offers protection for relay and similar contacts without requiring a compromise in quality of suppression to limit decay time.

333. TIME-DELAY—TO—AMPLITUDE CONVERTER. Zoltan Bay and F. McLernon. National Bureau of Standards, Washington, D. C. (Proceedings of the Second Symposium on Fast-Pulse Techniques in Nuclear Counting, 12-13 February 1959, Report No. UCRL-8706, University of California, Lawrence Radiation Laboratory, pp. 55-58)

The conversion of time delay to amplitude together with the use of a multichannel pulse-height sorter turns a coincidence circuit into a multichannel coincidence system. The theoretical advantages of such a system are discussed below. In the experimental part of this paper a circuit is described which performs the pulse-height limiting of the input pulses by means of a grid-controlled secondary-electron diode bridge conincidence circuit is applied in the differential operation. The circuitry is operated in such a manner that the pulses in the photo-multiplier (PMT) are limited at a few tenths of a volt. Data concerning the sensitivity and time-resolution properties of the system are presented.

334. TIMING POTENTIALS OF LORAN-C. R. H. Doherty, G. Hefley and R. F. Linfield. National Bureau of Standards, Radio Systems Division, Boulder, Colorado. (IRE Proceedings, Vol. 49, No. 11, November 1961, pp. 1659-1673, 16 refs.)

The Loran-C navigation system is capable of synchronizing and setting clocks to a relative accuracy of better than 1 usec throughout the system's service area. A Loran-C receiver functions as a slaved oscillator and a trigger generator. The generated triggers bear a time relationship to the triggers at the master transmitter, which is known to within a microsecond. Clocks operating from these sources are compared with clocks operation from independent free-running oscillators.

A fundamental relationship between time and position is considered. Loran-C as a navigation and timing system can provide both position and time simultaneously. The East Coast Loran-C chain will be time synchronized. The national frequency standards and uniform time source located at Boulder will be used to monitor these signals. Time synchronization and time distribution have been demonstrated on the Atlantic Missile Range. Inter-range time synchronization and precise time for large areas of the world could be provided in the future.

Appendix I describes briefly the results of ground wave measurements made on the Loran-C (Cytac) system. Appendix II describes the results of sky wave measurements made with the system.

335. TRANSFER OSCILLATOR, HEWLETT PACKARD 540A OR 540B. (Bureau of Naval Weapons, Washington, D. C., Standards Laboratory Instrument Calibration Procedure AQ-12, BuWeps-BuShips Calibration Program, 9 May 1960, 23 p.) PB-181 008

The Test Instrument is a transfer oscillator capable of extending the range of electronic frequency counters from 10 Mc to 12.4 KMc and beyond. Frequency comparison is made by means of a variable frequency oscillator; a broadband, untuned, diode mixer system; a video amplifier; and an oscilloscope zero beat indicator.

336. TRANSISTOR SWITCHING CIRCUIT. (U. S. Patent No. 2928009, Assigned to National Cash Register Company, 8 March 1960)

A switching circuit, which can be used for driving magnetic cores of a memory matrix, comprises a high power and a low power transistor whose combined current conduction in response to a square wave pulse forms a load current square wave pulse having a short rise time.

337. TRANSISTOR, VHF, SILICON, POWER (25 W - 100 MC). L. Ornik and M. Wilson. (Pacific Semiconductors, Inc., Lawndale, California, Contract DA 36-039-sc-87342, PSI Report no. TE 4000:12-Q-2, Quarterly report no. 2, 1 October 1961-31 December 1961, 41 p.) AD-274 943*

*No automatic release to foreign nationals.

Emphasis was centered on determining the maximum power and the maximum efficiency of the scaled version of the transistor, and establishing the optimum input parameters. Improvement of the dc characteristics of the planar process was achieved. Engineering sample transistors for the second shipment were prepared and evaluated. Power output of 10 to 12.7 watts at 100 mc with power gain of 9.4 to 10.4 db was obtained from these samples. The fabrication of full size transistors was initiated.

338. TRANSISTORIZED BLOCKING OSCILLATOR DISCRIMINATOR AND COINCIDENCE CIRCUIT. M. Feldman, Cornell University, Floyd Newman Laboratory of Nuclear Studies, Ithaca, New York. (Review of Scientific Instruments, Vol. 31, December 1960, pp. 1356-1357) AD-254 419

It is frequently desired to make pulses of a standard shape and length. This is particularly true in coincidence circuits where one does not want the resolving time to vary with the pulse shape. A blocking oscillator is discribed that was used as the discriminator of a moderately fast (16-nsec resolving time) coincidence circuit for about a year. It produced a 2-v pulse into a 100-ohm load, and had a sharp and stable threshold. The time jitter for marginal pulses was about 7 nsec. The dead time was about 25 nsec.

339. TRANSISTORIZED TWENTY-PULSE GENERATOR. Ralph W. Leurgans and Harold Thiel. (Electronic Defense Laboratory, Mountain View, California, Contract DA 36-039-sc-85402, Technical memo no. EDL-M346, 14 April 1961, 40 p.) AD-258 863

A transistorized multipulse generator is described which was designed, built, and tested to evaluate problems encountered in miniaturization of multipulse generators. Individual units of the generator are described, and results of various tests are reported. It is concluded that transistorized multipulse generators are feasible, and that their space and power requirements are considerably reduced over those of a tube-type generator. Cost of transistorized units is higher, however.

340. TRIGGERED NANOSECOND LIGHT SOURCE. Q. A. Kerns and G. C. Cox. (Nuclear Instruments and Methods, Netherlands, Vol. 12, No. 1, June 1961, pp. 32-38)

A nanosecond light source based on a corona discharge started by field emission was developed for attachment to scintillation counters. These individual light sources, placed to illuminate each phototube and fired by a pulse generator through splitting transformers and cable delays, have facilitated the coincidence timing of an array of photomultiplier detectors. Pulse generation, a pulse-splitting transformer, light-source construction, and timing properties, as well as spectral intensity are discussed. An optical attenuator designed for the source is described.

341. TUBES FOR USE IN A 25-WATT DISTRIBUTED AMPLIFIER. (General Electric Company, Schenectady, New York, Contract DA 36-039-sc-75070, Quarterly progress report no. 12, 1 July 1961-30 September 1961, 25 p.) AD-268 097*

*No automatic release to Foreign Nationals.

High level performance of tubes to date at low frequency (70 mc) was very encouraging and indicated that the tubes are capable of delivering power outputs in excess of 100 watts. Performance at 500 mc, although much poorer, was still quite encouraging, a high level gain of 8.5 db having been obtained. Close agreement was obtained between theory and experiment of transit time and circuit loading, indicating that the large loading is due to circuit properties. Initial measurements now being made indicate that the necessary alteration of the circuit properties should be possible. This change should improve the tube's high frequency performance considerably.

342. USE OF HIGH-SPEED DIGITAL COMPUTERS TO STUDY PERFORMANCE OF COMPLEX SWITCHING NETWORKS INCORPORATING TIME DELAYS. Y.N. Chang and O.M. George. (Communication and Electronics, January 1960, pp. 982-987, 4 refs.)

This paper provides a functional description of an IBM 704 program written to check the compatibility of a switching network and the sequence of events directed by input conditions and by the time delays of the network elements. The application of the program to a simplified relay switching network for controlling an ore conveying and treating plant is described.

343. USING INDUCTIVE CONTROL IN COMPUTER CIRCUITS. W. M. Carey, Minneapolis-Honeywell Regulator Company. (Electronics, Vol. 32, 18 September 1959, pp. 31-33)

Transistorized digital computer time-measuring circuits which utilize inductance as the passive time-measuring or storage elements are discussed. The circuits include a differentiator, a single-shot multivibrator which provides output pulses longer in duration than the input trigger, a self-starting choke-controlled free-running multivibrator, a transformer-controlled free-running multivibrator, a counter circuit which uses conventional linear transformers instead of the usual square hysteresis loop core, and a shift register. The advantages of inductance over capacitance control are pointed out. All these circuits have been utilized in a commercial data processor for several thousand hours without a component or computational failure of any kind.

344. VERY LOW FREQUENCY TRANSMITTER PULSE EQUIPMENT. V. Ritter and J. Balogh. (HRB-Singer, Inc., State College, Pennsylvania, Contract AF 30(602)-2119, Report no. 228-R-3, 1 September 1960, 31 p., RADC TN 60-182) AD-243 998

An interim counter unit was designed, built, and installed at the VLF transmitter site located at Forestport, New York. This counter unit generates a 36 kc output signal which is derived from the standard 100 kc signal available via the microwave link signal originated at Stockbridge, New York. A counter unit was designed, built, and installed at the BLF transmitter site located at Forestport, New York. This counter unit generates an output signal at any 1 kc interval between 10 and 40 kc. A VLF pulse exciter unit was designed, built, and installed at the VLF transmitter site located at Forestport, New York. This unit features external and internal synchronization, variable pulse repetition rate, variable pulse delay time, variable pulse width, a switch to give continuous-wave operation, and a circuit which adds a "tail chopper" signal. A pulse "tail chopper" was designed, built, and installed at the VLF transmitter site located at Forestport, New York. This unit features external synchronization and adjustable phase correction.

345. WIDE-OPEN INSTANTANEOUS FREQUENCY DISCRIMINATOR (U). M. Crane and J. Y. Gilkey. (Stanford University, Stanford Electronics Laboratories, California, Contract AF 33(616)-6207, Technical report no. 518-1, 29 August 1960, 76 p., 24 refs., CONFIDENTIAL) AD-319 324

346. WIDE RANGE TIME TO PULSE HEIGHT CONVERTER. P. Thieberger. (Nobel Institute for Physics, Sweden, Contract AF 61(052)-188 in Cooperation with Royal Institute of Technology, Sweden, Technical Note No. 9, 10 February 1962, 8 p., 14 refs., AFOSR-2244) AD-272 430

A fast pulse sampling circuit used with the sawtooth generator of a fast oscilloscope is described. The arrangement is intended for time measurements such as arising in nuclear half-life determinations or time of flight experiments. It is shown that it is useful for times ranging from about 10 to the -10th power sec to about 100 sec.

347. WIDE-RANGE VOLT-AMPERE CONVERTER FOR CURRENT AND VOLTAGE MEASUREMENTS. F. L. Hermach and E. S. Williams, National Bureau of Standards, U. S. Department of Commerce, Washington, D. C. (AIEE Transactions, Vol. 78, Part I, Communication and Electronics, September 1959, pp. 384-388, 5 refs.)

Technological developments have brought increasing needs for convenient, protable instruments for measuring current and voltage with high accuracy over a wide range of frequencies. A "universal" volt-ampere (VA) converter has been developed for making such measurements to 0.05% with alternating current at frequencies from 5 cps (cycles per second) to 50 kc and with direct current. The new model is based on an earlier, much more limited prototype converter, and, like it, is used with a null-type d-c potentiometer. With this single, self-contained, portable, 44-range instrument, the 1.5-volt range of a suitable potentiometer can be used to make a-c (rms) and d-c measurements from 7.5 milliamperes (ma) to 20 amperes and from 0.5 volts to 600 volts. With a more sensitive external galvanometer, the instrument can also be used as an ac-dc transfer standard for ac-dc difference measurements to 0.02% over the same frequency range.

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