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SUMMARY TECHNICAL REPORT
OF THE
NATIONAL DEFENSE RESEARCH COMMITTEE

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SUMMARY TECHNICAL REPORT OF DIVISION 14, NDRC

VOLUME 3

BIBLIOGRAPHY OF DIVISION 14 AND RADIATION LABORATORY REPORTS

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VANNEVAR BUSH, DIRECTOR

NATIONAL DEFENSE RESEARCH COMMITTEE
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DIVISION 14
A. L. LOOMIS, CHIEF

WASHINGTON, D. C., 1946

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NOTES ON THE ORGANIZATION OF NDRC

The duties of the National Defense Research Committee were (1) to recommend to the Director of OSRD suitable projects and research programs on the instrumentalities of warfare, together with contract facilities for carrying out these projects and programs, and (2) to administer the technical and scientific work of the contracts. More specifically, NDRC functioned by initiating research projects on requests from the Army or the Navy, or on requests from an allied government transmitted through the Liaison Office of OSRD, or on its own considered initiative as a result of the experience of its members. Proposals prepared by the Division, Panel, or Committee for research contracts for performance of the work involved in such projects were first reviewed by NDRC, and if approved, recommended to the Director of OSRD. Upon approval of a proposal by the Director, a contract permitting maximum flexibility of scientific effort was arranged. The business aspects of the contract, including such matters as materials, clearances, vouchers, patents, priorities, legal matters, and administration of patent matters were handled by the Executive Secretary of OSRD.

Originally NDRC administered its work through five divisions, each headed by one of the NDRC members. These were:

Division A—Armor and Ordnance
Division B—Bombs, Fuels, Gases, & Chemical Problems
Division C—Communication and Transportation
Division D—Detection, Controls, and Instruments
Division E—Patents and Inventions

In a reorganization in the fall of 1942, twenty-three administrative divisions, panels, or committees were created, each with a chief selected on the basis of his outstanding work in the particular field. The NDRC members then became a reviewing and advisory group to the Director of OSRD. The final organization was as follows:

Division 1—Ballistic Research
Division 2—Effects of Impact and Explosion
Division 3—Rocket Ordnance
Division 4—Ordnance Accessories
Division 5—New Missiles
Division 6—Sub-Surface Warfare
Division 7—Fire Control
Division 8—Explosives
Division 9—Chemistry
Division 10—Absorbents and Aerosols
Division 11—Chemical Engineering
Division 12—Transportation
Division 13—Electrical Communication
Division 14—Radar
Division 15—Radio Coordination
Division 16—Optics and Camouflage
Division 17—Physics
Division 18—War Metallurgy
Division 19—Miscellaneous
Applied Mathematics Panel
Applied Psychology Panel
Committee on Propagation
Tropical Deterioration Administrative Committee

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NDRC FOREWORD

As events of the years preceding 1940 revealed more and more clearly the seriousness of the world situation, many scientists in this country came to realize the need of organizing scientific research for service in a national emergency. Recommendations which they made to the White House were given careful and sympathetic attention, and as a result the National Defense Research Committee [NDRC] was formed by Executive Order of the President in the summer of 1940. The members of NDRC, appointed by the President, were instructed to supplement the work of the Army and the Navy in the development of the instrumentalities of war. A year later, upon the establishment of the Office of Scientific Research and Development [OSRD], NDRC became one of its units.

The Summary Technical Report of NDRC is a conscientious effort on the part of NDRC to summarize and evaluate its work and to present it in a useful and permanent form. It comprises some seventy volumes broken into groups corresponding to the NDRC Divisions, Panels, and Committees.

The Summary Technical Report of each Division, Panel, or Committee is an integral survey of the work of that group. The first volume of each group's report contains a summary of the report, stating the problems presented and the philosophy of attacking them, and summarizing the results of the research, development, and training activities undertaken. Some volumes may be "state of the art" treatises covering subjects to which various research groups have contributed information. Others may contain descriptions of devices developed in the laboratories. A master index of all these divisional, panel, and committee reports which together constitute the Summary Technical Report of NDRC is contained in this volume, which also includes a record of microfilm numbers, pertinent technical laboratory reports and reference material.

Some of the NDRC-sponsored researches which have been declassified by the end of 1945 were of sufficient popular interest that it was found desirable to report them in the form of monographs, such as the series on radar by Division 14 and the monograph on sampling inspection by the Applied Mathematics Panel. Since the material treated in them is not duplicated in the Summary Technical Report of NDRC, the monographs are an important part of the story of these aspects of NDRC research.

In contrast to the information on radar, which is of widespread interest and much of which is released to the public, the research on subsurface warfare is largely classified and is of general interest to a more restricted group. As a consequence, the report of Division 6 is found almost entirely in its Summary Technical Report, which runs to over twenty volumes. The extent of the work of a Division cannot therefore be judged solely by the number of volumes devoted to it in the Summary Technical Report of NDRC: account must be taken of the monographs and available reports published elsewhere.

To A. L. Loomis, Chief of Division 14, the men who worked under his direction, and the personnel of the Division's contractors belongs major credit for the perfection of a device which forcefully altered the course of the war. The application of radar by all Services in all theaters of operation is an eloquent testimonial not only to the skill of these men but also to their will, their loyal cooperation, and their scientific integrity. The Summary Technical Report of the Division, prepared under the direction of the Division Chief and authorized by him for publication, therefore not only describes a major portion of their technical activities but is also a record of able American scientists and engineers cooperating fully in the defense of their country.

It is assuring to know that their contributions in the new field of microwaves will not be placed in intellectual cold storage to await purely military applications, but instead will soon find use in the industry, the transportation, the communications, and the scientific researches of a peacetime world.

For their work in opening a broad entrance to a new field of knowledge as well as for their invaluable contributions in a time of desperate strife, we join the Nation in expressing our sincere appreciation.

VANNEVAR BUSH, Director
Office of Scientific Research and Development

J. B. CONANT, Chairman
National Defense Research Committee

FOREWORD

DIVISION 14 of the National Defense Research Committee [NDRC] was responsible for the microwave radar and Loran developments within the Office of Scientific Research and Development [OSRD]. Its original purpose, as defined at one of the early division meetings, was, "to organize and coordinate research, invention, design and manufacture in order to obtain the maximum number of effective applications of microwaves in the minimum time." Under this directive, Division 14 established and administered a total of 137 OSRD contracts with 18 academic and private research institutions, and 39 industrial concerns entering into almost every phase of the country's war-time radar program. The principal contractor, accounting for approximately 80 per cent of the division's contract appropriations, was The Massachusetts Institute of Technology Radiation Laboratory [MIT-RL]. This laboratory, through continuous growth and expansion of the scope of its activities, became the center of microwave radar research and development effort.

Without question the success of the program was due to the close collaboration of the many participating agencies and institutions. Many of the country's academic and industrial institutions worked with MIT-RL in research and development programs under U. S. Army and U. S. Navy as well as OSRD contracts. Radio and electrical equipment manufacturers were responsible for final engineering and large scale production of components and systems. The U. S. Army and U. S. Navy carried out procurement planning, proof testing, training, and the elaborate functions of supply and maintenance. Close technical liaison, furthermore, was maintained throughout the war with radar research organizations of the British Commonwealth of Nations. The contributions of the many participating organizations must be acknowledged by any single agency attempting to present its final report.

The NDRC Summary Technical Report is intended to include the pertinent results of each division's program. The selection of material for such a report invariably presents a difficult problem. A choice must be made from the work of many organizations and individuals during a complex five-year program.

The Division 14 Summary Technical Report consists of three volumes. The first, *RADAR*, contains a summary of the Division 14 and MIT-RL activities, a report on HARP, and appendices listing the division's projects and contracts. Volume 2 of the Division 14 STR is entitled *MARS, Military Airborne Radar Systems*. This volume is a detailed treatment of the design, development, installation, maintenance and performance of aircraft radar for such applications as search, bombing, navigation, interception and fire control. The volume is intended as a general text for use by officers and civilian engineers concerned with almost any aspect of aircraft radar development, engineering, procurement, training, or operational use. Volume 3 is a complete Bibliography of the contractors' and divisional reports prepared during the course of the program. It is intended to serve as a general guide to the division's activities.

The largest publication effort of Division 14 is the *Radiation Laboratory Series* prepared by the MIT-RL for publication by the McGraw-Hill Book Company, Inc. This set of monographs is considered as a supplement to the Division 14 Summary Technical Report. It consists of some 27 volumes and an index and is a complete report on the state of the radar art at the end of the war, including texts on fundamental electronics, components and systems design and engineering, peace-time applications, and Loran navigation. A list of the titles and an abstract of each book is contained in the Bibliography of this volume.

The progress and interim technical reports submitted by MIT-RL and other Division 14 contractors constitute valuable reference material on the division's program. They cover specific aspects of the work and are not duplicated by the Summary Technical Report or the *Radiation Laboratory Series*. All these (approximately 2,000) reports have been indexed by report number, subject, organization, and, in the case of the MIT-RL reports, by author in the Bibliography of this volume. Microfilm

prints of these reports are avnilable to those who have access to the Summary Technical Reports.

Another category of reports which are included in the Bibliogrnphy and microfilms are the Division 14 Project Reports. These were Division 14's bimonthly reports of netivities to the U. S. Army and U. S. Navy. Included are pertinent technical details of the systems, projects, and summaries of the basic research und component development uctivities. The final project report, NDRC 14-565, dated December 1945, reviews the entire program of the division. It contnins an index of all Division 14 projects, including Service projects, with cross references to contracts and U. S. Army and U. S. Navy equipment desigoations.

The history of Division 14 has been prepared nnd edited by H. E. Guerlac for publication with the other volumes of the OSRD long history by the Little Brown Company, Inc., Boston. It traces the early work on rndar before the wur by the U. S. Army, U. S. Navy, British and various private institutions, describes the origin of NDRC's microwave development uctivities, outlines the foundation of the Radiation Laboratory, and gives an historical summury of the principal division systems and components research progrnm. A final section, which should be of general interest, reports on the field service activitles of the division and the operational results obtained with several types of microwave-rudar equipment.

Two important publications were originally intended for inclusion in the Division 14 Summary Technical Report but were deleted and published elsewhere. They are: *Development of Cadillac Airborne Early Warning Systems*, C. J. Kelly, Field Station, Nnval Research Laboratory [NRL], Boston; and *The Gun Fire-Control System, Mark 56*, Navy Publication OP-1600 E.

I should like to express my appreciation to the authors, L. A. DuBridge, H. E. Guerlac, M. H. Johnson, O. Halpern, and to the other members of MIT-RL and Division 14 staff who assisted in the preparation of this volume.

A. L. Loomis
Chief, Division 14

PREFACE

THE BIBLIOGRAPHY which follows indexes all of the approximately 2,000 technical reports on the microwave radar and Loran navigation research and development program of Division 14 of the National Defense Research Committee. The reports were prepared by The Massachusetts Institute of Technology Radiation Laboratory [MIT-RL] and the 58 other industrial and academic institutions under OSRD contract and in several instances by the Division 14 staff. All of these reports have been included in the Bibliography even though they have not been specifically referred to in the text of the two volumes of the Division 14 Summary Technical Report since they comprise, with the *MIT Radiation Laboratory Series*,* a complete technical record of Division 14 activities.

Section 1 of the Bibliography is a numerical list of reports which have been assigned Division 14 report numbers. These reports are identified by the number 14 which precedes the serial number (e.g., 14-501). These include principally the interim and final technical reports submitted by the industrial and academic organizations, other than MIT-RL, in connection with their performance of radar research and development under OSRD contract assigned to Division 14. Also included are the administrative and summary reports prepared by the Division 14 organization such as the bimonthly Project Report and the several volumes of the U. S. Radar Survey. In the numerical index complete data are given on each report title, author, organization and OSRD contract number, and date.

Section 2 is a numerical index of regular reports, manuals, special reports and texts issued by MIT-RL under OSRD Contract OEMsr-262. They are identified throughout the Bibliography by the letters RL which precede the report number (e.g., RL-501, RL M-9, RL S-9, RL T-9). MIT-RL reports 1 to 399 were renumbered for uniformity from an early system of identification by groups within the laboratory. The original combination of group and serial numbers is given in parenthesis after the revised serial number [e.g., RL-300 (61-18)].

Section 3 is a combined index by subject matter of both Division 14 and MIT-RL reports. Complete data are not repeated for each report so that reference to Sections 1 and 2 may be necessary.

Section 4 lists Division 14 reports by the organization responsible for their preparation. Reports issued by different divisions of a commercial concern or academic institution, or on different OSRD contracts, are combined under the titles of the central organizations.

Section 5 is an index of MIT-RL reports by author; it does not include the authors of NDRC reports of Division 14. Where two or more authors collaborated in the writing of a report, the report number is repeated under each name.

The security classifications of the reports are not given in the Bibliography. Advice as to the current classification of any OSRD report may be obtained from the Office of the Executive Secretary, OSRD, from the War Department Liaison Officer with NDRC, or from the Office of Research and Inventions, Navy Department.

The set of Division 14 and MIT-RL reports in the Bibliography have, with but a few exceptions, been microfilmed to facilitate future reference. The microfilm number assigned to the reports appears in references throughout this Bibliography and the Summary Technical Reports as 14-000.00-M1. Attention is directed to the classified index of Division 14 reports in the NDRC Summary Technical Report Microfilm Index Volume. Requests for microfilm prints of the set of reports should be addressed to the Research and Development Division, Office of Research and Inventions, Navy Department, Washington, D.C., or to the War Department Liaison Officer with the National Defense Research Committee, Army Service Forces, War Department, Washington, D.C.

Original copies of the Division 14 and MIT-RL reports will be found in the records of the Office of the Executive Secretary, OSRD; the OSRD Liaison Office; NDRC Division 14; MIT-RL Document Library. The reports were distributed also to several organizations in the

* *MIT Radiation Laboratory Series*, in publication by the McGraw-Hill Book Company, New York, N. Y.

Navy Department including the Research and Development Division, Office of Research and Inventions; Naval Research Laboratory; Bureau of Ships; Bureau of Aeronautics; Bureau of Ordnance; and the U. S. Naval Academy; and to organizations in the War Department including the Office of the War Department Liaison Officer with NDRC; Office of the Chief Signal Officer; Signal Corps Engineering Laboratories; Evans Signal Laboratory; Headquarters, Army Ground Forces; Army Ground Forces Board No. 1, Fort Bragg; Headquarters, Army Air Forces, AC/AS-4; Continental Air Forces, Operations Analysis Division; Air Materiel Command Radar Laboratory; Air Materiel Command Watson Laboratories; and the Army Air Forces Proving Ground Command.

Copies of OSRD reports which have been declassified have been filed with the Office of the Publication Board, Department of Commerce, Washington, D.C. Selected sets of these declassified reports from Division 14 have been given a limited distribution, through arrangement with the Library of Congress, to a number of technical reference libraries throughout the country including the following: National Bureau of Standards, The Library of Congress, The University of Chicago, Stanford University, Columbia University, California Institute of Technology, University of Illinois, Duke University, Iowa State College of Agriculture and Mechanic Arts, Princeton University, The New York Public Library, University of Michigan, Yale University, The University of Texas, The Johns Hopkins University, University of Rochester, The Ohio State University, Georgia School of Technology, Purdue University, Engineering Societies Library, University of Pennsylvania, Washington University, Cornell University, University of Minnesota.

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PART 1

NUMERICAL INDEX OF DIVISION 14, NDRC REPORTS

(Other than Radiation Laboratory Reports)

14-1 to 14-85 No reports.

14-86 *Report No. 1 of the Microwave Section*, J. G. Trump, Division D-1, NDRC, Mar. 10, 1941. Div. 14-504-M1

14-87 *Western Electric D-160448 Input Equipment and Western Electric X-61901 Oscillascope*, Bell Telephone Laboratories, Western Electric Company, November 1941, OEMsr-2. Div. 14-327.112-M1

14-88 *Long-Range Navigation Equipment, Microwave Committee Project 3*, R. N. Harmon, H. J. Dailey; Westinghouse Electric and Manufacturing Company, Sept. 15, 1941, OEMsr-73. Div. 14-327.114-M1

14-89 *Aircraft Position-Indicating Equipment (Receiving)*, R. A. Teare, Radio Corporation of America, July 22, 1941, NDCrc-71. Div. 14-327.111-M1

14-90 *Pulse Thyratrons, Progress Report for June 1941 to December 1941*, E. J. Lawton, General Electric Company, May 26, 1942, OEMsr-180. Div. 14-231.22-M2

14-91 *Instruction Book for Western Electric D-161131 Receiver and Western Electric D-161132 Indicator for a Long-Range Navigation System*, BTL-284, Bell Telephone Laboratories, Western Electric Company, October 1941, NDCrc-205. Div. 14-327.111-M6

14-92 *Two Megawatt Transmitters for NDRC Project 3*, General Electric Company, Dec. 9, 1941, OEMsr-9. Div. 14-327.112-M2

14-93 *Technical Report of Radiation Laboratory*, J. G. Trump, Division D-1, NDRC, June 1, 1941. Div. 14-502-M3

14-94 *Use of Microwave for Detection Purposes*, Division D-1, NDRC, Dec. 15, 1941. Div. 14-504-M2

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14-97 *Service Manual for Video Amplifier*, J. G. Brainerd, University of Pennsylvania, Jan. 25, 1943, OEMsr-387. Div. 14-241.31-M1

14-98 *Development of a Stable Non-Crystal Controlled Oscillator*, J. M. Cage, University of Colorado, Dec. 15, 1942, OEMsr-546. Div. 14-241.41-M2

14-99 *Development of a Tunable IF Amplifier*, W. F. Freeman, Sylvania Electric Products, Inc., Nov. 16, 1942, OEMsr-380. Div. 14-241.32-M2

14-100 *Use of Microwave for Detection Purposes, Bimonthly Report*, Division D-1, NDRC, Mar. 15, 1942. Div. 14-504-M2

14-101 *Use of Microwave for Detection Purposes, Bimonthly Report*, Division D-1, NDRC, June 1, 1942. Div. 14-504-M2

14-102 *The Principles of Crystal Rectifiers*, F. Seitz, S. Pasternack, University of Pennsylvania, June 10, 1942, OEMsr-388. Div. 14-233.13-M1

14-103 *Summary of Research on Radar Indicator Screens*, H. W. Leverenz, OSRD 891, RCA Manufacturing Company, Inc., Radio Corporation of America, Apr. 11, 1942, NDCrc-150. Div. 14-242.231-M2

14-104 *Work on Slow Phosphors for Radar Indicator Screens*, S. Dushman, OSRD 890, General Electric Company, May 18, 1942, OEMsr-248. Div. 14-242.231-M3

14-105 *Report on Pulser Tube Development*, C. M. Slack, Westinghouse Electric and Manufacturing Company, May 15, 1942, OEMsr-288. Div. 14-231.21-M1

14-106 *Three-Centimeter Receiving Tubes*, J. R. Pierce, A. L. Samuel, Bell Telephone Laboratories, Western Electric Company, June 22, 1942, NDCrc-157. Div. 14-241.4-M2

14-107 *Progress Report on Hydrogen-Filled Thyratrons*, H. W. Lord, F. W. Crapuchettes, General Electric Company, Aug. 18, 1942, OEMsr-180. Div. 14-231.221-M1

14-108 *Report on Developmental work on Pulse Thyratron Type ZG-473*, A. C. Gable, General Electric Company, May 9, 1942, OEMsr-180. Div. 14-231.22-M1

14-109 *Use of Microwave for Detection Purposes, Bimonthly Report*, Division D-1, NDRC, Oct. 1, 1942. Div. 14-504-M2

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14-112 *Compounds of Silicon and Germanium*, F. Seitz, Jr., University of Pennsylvania, Nov. 18, 1942, OEMsr-388. Div. 14-233.111-M2

14-113 *DC Burn-Out Temperature in Silicon Rectifiers*, A. W. Lawson, R. J. Maurer, P. H. Miller, L. I. Schiff, W. E. Stephens, University of Pennsylvania, Nov. 1, 1942, OEMsr-388. Div. 14-233.112-M2

14-114 *Indicator Types as of October 1942*, Division D-1, NDRC. Div. 14-242-M8

14-115 *Investigation of Crystal Rectifier DC Characteristics*, H. J. Yearian, Purdue University, Dec. 3, 1942, OEMsr-362. Div. 14-233.132-M1

14-116 *Theoretical Results on the TR Box*, H. A. Bethe, R. E. Marshak, J. Schwinger, Cornell University, Jan. 20, 1943, OEMsr-429. Div. 14-233.312-M6

14-117 *Perturbation Theory for Cavities*, H. A. Bethe, J. Schwinger, Cornell University, Mar. 4, 1943, OEMsr-429. Div. 14-211.5-M3

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14-121 *Progress Report on Ultra-high Frequency Dielectrics*, A. von Hippel, OSRD 1197, Laboratory for Insulation Research, Massachusetts Institute of Technology, January 1943, OEMsr-191. Div. 14-131.1-M1

14-122 *The Interaction Between Electromagnetic Fields and Dielectric Materials*, A. von Hippel, R. G. Breckenridge, OSRD 1198, Laboratory for Insulation Research, Massachusetts Institute of Technology, January 1943. OEMsr-191. Div. 14-131.1-M2

14-123 *Junction Effect of Two Unequal Matched Coaxial Lines*, E. Weber, PIB-1A, Polytechnic Institute of Brooklyn, Sept. 16, 1942, OEMsr-335. Div. 14-233.413-M3

14-124 *Summary of Projects, NDRC, Radar Division 14*, Mar. 1, 1943. Div. 14-501-M8

14-125 *Electron Microscopy of Tungsten Points*, A. W. Lawson, W. E. Stephens, University of Pennsylvania, Mar. 10, 1943, OEMsr-388. Div. 14-233.11-M1

14-126 *Noise in Crystal Rectifiers*, L. I. Schiff, University of Pennsylvania, Mar. 10, 1943, OEMsr-388. Div. 14-233.131-M1

14-127 *Spectroscopic Determination of Aluminum in Silicon*, A. W. Lawson, P. H. Miller, University of Pennsylvania, Mar. 10, 1943, OEMsr-388. Div. 14-233.112-M5

13-128 *Theory of the TR Box*, H. A. Bethe, Cornell University, May 14, 1943, OEMsr-429. Div. 14-233.312-M7

14-129 *The Diffusion Theory of Crystal Rectifiers*, R. G. Sachs, Purdue University, Sept. 10, 1942, OEMsr-362. Div. 14-233.13-M2

14-130 *Computers for Radar Control of Plane-to-Plane Gunfire*, J. B. Russell of Division 7, NDRC, J. C. Sheridan, Mar. 15, 1943. Div. 14-321.1-M1

14-131 *Theory of Dark-Trace Tubes, I*, F. Seitz, O. Stern, I. Estermann, R. J. Maurer, Carnegie Institute of Technology, April 27, 1943, OEMsr-900. Div. 14-242.232-M2

14-132 *Abridged Report on Circuits for Improving Focus on Electrostatic Cathode-Ray Tubes under Conditions of Intensity and Deflection Modulation*, H. E. Farnsworth, Brown University, June 1, 1943, OEMsr-382. Div. 14-242.24-M1

14-133 *Theory of Noise in Conductors, Semiconductors, and Crystal Rectifiers*, V. F. Weisskopf of University of Rochester, Purdue University, May 12, 1943, OEMsr-362. Div. 14-125-M6

14-134 *Investigation of Power Supply Requirements as a Function of Future Radar Circuit Developments*, M. M. Hubbard, Mar. 8, 1943, OEMsr-262. Div. 14-235-M2

14-135 *Power Supply for Airborne Radar Equipment*, M. M. Hubbard, Feb. 11, 1943, OEMsr-262. Div. 14-235.1-M2

14-136 *Analysis of Commutation of Direct-Current Machinery at High Altitudes*, I. E. Ross, Jr., Consultant of Division 14 for Project SC-34, Nov. 28, 1942. Div. 14-235.11-M1

14-137 *Simulated High-Altitude Brush Testing Equipment*, I. E. Ross, Jr., Consultant of Division 14 for Project SC-34, Mar. 30, 1943. Div. 14-235.11-M2

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RL-514 *High-Ambient Life Test of an Oil-Filled Pulse Transformer*, H. R. Zeller, Jan. 19, 1944. Div. 14-211.41-M8

RL-515 *Proposed Method for Measuring Instantaneous Magnetron Input Impedance with the Aid of a Delay Network*, O. T. Fundingsland Feb. 22, 1944. Div. 14-232.19-M12

RL-516 *A Condenser Phase-Shifter Range Unit with Sine-Wave Tracking for AN/TPG-1, AN/FPG-1, SCR-598*, G. Hite, G. E. Whitham, Mar. 3, 1944. Div. 14-243.2-M4

RL-517 *S-Band Horizontally Polarized Nondirectional Antennas*, H. J. Riblet, Feb. 14, 1944. Div. 14-234.111-M1

RL-518 *Pulse Shapes and R-F Spectra for Combinations of Strowberg-Carlson Mark I and Mark II Modulators with 2J22, 2J21, and 725A Magnetrons*, G. N. Glasoe, Mar. 17, 1944. Div. 14-124.2-M3

RL-519 *Aspen Airborne Antenna*, H. J. Riblet, Aug. 25, 1944. Div. 14-329.132-M9

RL-520 *High-Frequency Characteristics of Resistors*, D. T. Drake, Mar. 9, 1944. Div. 14-211.1-M1

RL-521 *A Diode-Type Pulse Voltmeter*, O. T. Fundingsland, A. S. Jerrems, July 6, 1944. Div. 14-252.2-M1

RL-522 *Tests of Beacon Receiver on V-Beam*, J. M. Sturtevant, Dec. 4, 1944. Div. 14-322.1-M8

RL-523 *Voltage Pulse Rate-of-Rise Measurements*, O. T. Fundingsland, July 10, 1944. Div. 14-252.2-M2

RL-524 *Stagger-Tuned I-F Amplifiers*, H. Wallman, Feb. 23, 1944. Div. 14-241.32-M4

RL-525 *Thyrite Bridge-Controlled Voltage Regulator*, H. E. Kallmann, Mar. 9, 1944. Div. 14-235.2-M2

RL-526 *Elimination of Ground Clutter*, E. C. Pollard, Mar. 13, 1944. Div. 14-263.1-M2

RL-527 *Effect on Current Pulse of Resistance in Series with the Magnetron*, W. H. Bostick, Feb. 21, 1944. Div. 14-232.19-M11

RL-528 *The Effect on Noise Figure of Phasing the Gain Control on the First I-F Stage*, Y. Beers, A. B. Macnee, Mar. 9, 1944. Div. 14-241.32-M5

RL-529 *High Impedance Cable*, H. E. Kallmann, Mar. 13, 1944. Div. 14-233.411-M4

RL-530 *Bombing Errors*, E. H. B. Bartelink, A. J. F. Siegert, Feb. 16, 1944. Div. 14-329.15-M1

RL-531 *Rotating Corrugated Eccentric Line Antennas*, L. Buchwalter, G. G. Harvey, June 13, 1944. Div. 14-234.122-M3

RL-532 *Theoretical Calculation on Best Smoothing of Position Data for Gunnery Prediction*, R. S. Phillips, P. R. Weiss, Feb. 16, 1944. Div. 14-244.4-M1

RL-533 *Observations of Life Rafts Equipped with Corner Reflectors*, E. L. Hudspeth, J. P. Nash, Feb. 15, 1944. Div. 14-267.1-M1

RL-534 *Space Charge between Parallel Plane Grids*, J. K. Knipp, Mar. 22, 1944. Div. 14-113-M3

RL-535 *A Hard-Tube Servoamplifier for Fractional Horsepower DC Motors*, W. K. Hodder, Mar. 14, 1944. Div. 14-214.3-M5

RL-536 *Polarization Studies at S and X Frequencies*, O. J. Baltzer, W. M. Fairbank, J. D. Fnirbank, Mar. 14, 1944. Div. 14-123-M4

RL-537 *Observations on Signal Stability at S and X Frequencies*, O. J. Baltzer, W. M. Fairbank, J. D. Fairbank, Mar. 14, 1944. Div. 14-322.1-M6

RL-538 *Performance of Coupling for 1½-In. by 3-In. Waveguide*, H. F. Webster, Mar. 6, 1944. Div. 14-233.422-M10

RL-539 *Stagger-Damped Double-Tuned Circuits*, H. Wallman, Mar. 23, 1944. Div. 14-212.2-M1

RL-540 *A Range-Measuring System Using an RC Linear Sweep*, V. W. Hughes, Sept. 18, 1944. Div. 14-212.5-M6

RL-541 *An Automatic Frequency-Control and Frequency-Selection System for Magnetrons*, C. A. Helber, Apr. 27, 1944. Div. 14-232.15-M1

RL-542 *Lighthouse RF Envelope Indicator*, P. A. Cole, J. B. H. Kuper, K. R. More, Apr. 7, 1944. Div. 14-251.9-M8

RL-543 *Crystal Life Tests under Flat Pulses*, H. B. Huntington, Apr. 7, 1944. Div. 14-233.15-M4

RL-544 *Frequency Division with Blocking Oscillators, Part I*, R. B. Woodbury, Apr. 10, 1944. Div. 14-212.5-M5

RL-545 *The Evaluation of an Equivalent Circuit for a Pulse Transformer*, W. H. Bostick, P. R. Gillette, H. L. Rehkopf, H. R. Zeller, May 8, 1944. Div. 14-212.3-M2

RL-546 *Analysis of the Influence of Pulse Transformers on Current Pulse Shape*, W. H. Bostick, P. R. Gillette, H. L. Rehkopf, H. R. Zeller, June 16, 1944. Div. 14-211.41-M9

RL-547 *Microwave Transmission over Water and Land under Various Metrorological Conditions*, Pearl J. Rubenstein, Isadore Katz, L. J. Neelands, R. M. Mitchell, July 13, 1944. Div. 14-122.2-M4

RL-548 *A Littlefuse Direct-Reading Wattmeter*, C. M. Sorvang, Apr. 28, 1944. Div. 14-252.41-M7

RL-549 *Model 6, Modulator Performance Tests*, P. C. Hettler, Apr. 22, 1944. Div. 14-231.3-M5

RL-550 *Equalized Delay Lines*, H. E. Kallmann, June 3, 1944. Div. 14-211.2-M2

RL-551 *Nomograms for Computation of Modified Index of Refraction*, R. H. Burgoyne, Apr. 6, 1945. Div. 14-122.21-M2

RL-552 *The Sealing of Air at Rotating Shafts and Joints*, A. I. Winslow, Apr. 18, 1941. Div. 14-225-M1

RL-553 *Pulse Doppler for Detection of Moving Ground Targets*, R. F. Thomson, Apr. 21, 1944. Div. 14-310.13-M2

RL-554 *An Airborne S-Band Racon for Rooster Operation*, E. R. Gaerttner, June 28, 1944. Div. 14-328.121-M4

RL-555 *Servos with Torque Saturation, Part I*, W. Hurewicz, N. B. Nichols, May 1, 1944. Div. 14-214.3-M17

RL-556 *Fading Simulator*, W. Roth, May 10, 1944. Div. 14-412-M2

RL-557 *Leaky Waveguide Rapid Scanner*, J. Steinberger, Nov. 18, 1944. Div. 14-234.322-M3

RL-558 *A 60-Mc Parallel Schering Bridge*, Y. Beers, Apr. 22, 1944. Div. 14-261.1-M2

RL-559 *Final Report on SMTR to January 1944*, C. F. Chubb, June 13, 1944. Div. 14-232.113-M7

RL-560 *A Precision Plan-Position Indicator*, W. L. Flock, June 16, 1944. Div. 14-242.3-M10

RL-561 *Wave Form Analysis*, O. Abbiati, May 29, 1944. Div. 14-235.1-M6

RL-562 *A Moving Target Selector Using Deflection Modulation on a Storage Mosaic*, R. A. McConnell, A. G. Emslie, F. Cunningham, June 6, 1944. Div. 14-263-M1

RL-563 *A Precision Z-Sweep Generator*, R. A. McConnell, May 23, 1944. Div. 14-242.5-M3

RL-564 *Rieke Diagrams and Probe-Plate Plunger Charts of Lighthouse Tubes in a Re-entrant Cavity*, R. E. Taylor, July 3, 1944. Div. 14-241.42-M4

RL-565 *Stabilized High Voltage Supply*, E. A. Holmes, May 19, 1944. Div. 14-235.1-M5

RL-566 *N² Gate Attachment for SCR-584*, J. S. White, R. B. Leuchman, May 3, 1944. Div. 14-243.21-M1

RL-567 *Magnetron Tuning and Stabilization*, W. V. Smith, July 13, 1944. Div. 14-232.16-M7

RL-568 *Further Measurements of 3- and 10-Cm Reflection Coefficients of Sea Water at Small Grazing Angles*, W. T. Fishback, P. J. Rubenstein, May 17, 1944. Div. 14-122.112-M1

RL-569 *Preliminary Report on the Fluctuations of Radar Signals*, H. Goldstein, P. D. Bales, May 16, 1944. Div. 14-122.114-M1

RL-570 *Characteristics of Recent 725A/B Tubes*, D. N. Sands, F. S. Bailey, May 18, 1944. Div. 14-241.41-M8

RL-571 *Effect of Pulse Length on System Performance and Operation*, R. Rollefson, A. H. Nelson, L. A. Hartman, May 30, 1944. Div. 14-124.1-M2

RL-572 *Clamping Tubes*, C. W. Sherwin, May 12, 1944. Div. 241.4-M3

RL-573 *A Precision Self-Synchronous Range System for P3I*, G. Hite, G. E. Whitham, W. L. Flock, May 26, 1944. Div. 14-243.1-M3

RL-574 *Vertebrae Type Flexible Waveguide*, E. L. Younker, June 15, 1944. Div. 14-233.412-M16

RL-575 *Revision of General Radio Type 605-B Signal Generator for Pulsing*, C. E. Ingalls, June 13, 1944. Div. 14-251.6-M7

RL-576 *A High Resolution K-Band Ship Search Set*, W. M. Fairbank, W. T. Harrold, G. D. Sheckels, J. D. Fairbank, Dec. 7, 1944. Div. 14-310.32-M2

RL-577 *S-Band End-Fire Array Antenna*, H. J. Riblet, H. L. Birchard, July 11, 1944. Div. 14-234.111-M2

RL-578 *Accuracy Criteria for the Gun Director MK 56*, R. S. Phillips, C. H. Dowker, June 9, 1944. Div. 14-323.32-M2

RL-579 *Medium Precision Range System for CXGQ, Project Henry*, G. Hite, Sept. 9, 1944. Div. 14-243.1-M4

RL-580 *A Survey of High-Vacuum Diodes Used for Surge-Limiting Operation in Modulators*, S. J. Krulikoski, Jr., Sept. 5, 1944. Div. 14-211.61-M3

RL-581 *Ultraportable Microwave Radar Beacons as Beam-Approach Aids in Aircraft Landing*, L. H. Orpia, July 4, 1944. Div. 14-325-M3

RL-582 *Simple Computation of Distance on the Earth's Surface*, B. W. Sitterly, J. A. Pierce, July 8, 1944. Div. 14-112-M2

RL-583 *BUPS (AN/UPN-1, 2) an Ultraportable S-Band Radar Beacon and Its Tactical Uses*, A. Roberts, June 24, 1944. Div. 14-328.121-M3

RL-584 *An H-2 Impact Predicting Computer Assuming Constant Indicated Airspeed for Use with AN/APS-15A Radar*, R. N. Close, June 23, 1944. Div. 14-329.144-M2

RL-585 *Corners, Bends, and Twists in Rectangular Waveguide*, R. M. Walker, July 6, 1944. Div. 14-233.422-M11

RL-586 *Effects of Variation of Vane Width and Cathode Size on the Operation of Magnetrons*, M. Healea, Aug. 1, 1944. Div. 14-232.113-M8

RL-587 *Dielectric Windows in Waveguide*, R. M. Walker, June 23, 1944. Div. 14-233.423-M7

RL-588 *Performance Characteristics of Army-Navy Preferred Type Electrostatic Cathode-Ray Tubes*, R. P. Abbenhouse, July 6, 1944. Div. 14-242.21-M3

RL-589 *Summary of Life-Test Data on Sylvania 4C35 Hydrogen Thyratrons*, S. J. Krulikoski, Jr., Feb. 1, 1945. Div. 14-231.221-M5

RL-590 *Siting and Range of Microwave Beacons*, W. M. Preston, July 5, 1944. Div. 14-328-M2

RL-591 *Results of Field Tests on AN/UPN-1, -2 (Experimental Models of BUPS) at Boca Raton, Florida*, January-March, 1944, R. P. Ghelardi, Aug. 12, 1944. Div. 14-328.121-M6

RL-592 *Servos with Torque Saturation, Part II*, W. Hurewicz, Sept. 28, 1944. Div. 14-214.2-M9

RL-593 *Chemical Methods for Maintaining the Partial Pressure of Water Vapor in TR Tubes*, R. Levine, F. L. McMillan, Jr., July 13, 1944. Div. 14-233.31-M6

RL-594 *The 1B27 TR Tube*, L. D. Smullin, H. A. Leiter, Oct. 4, 1944. Div. 14-233.31-M9

RL-595 *The SCR-584 Plotting-Table System*, E. M. Lyman, July 3, 1944. Div. 14-265.3-M1

RL-596 *Florida Tests on ROSEBUPS Against SCR-582, SCR-615, MEW*, R. P. Ghelardi, July 27, 1944. Div. 14-328.121-M5

RL-597 No report.

RL-598 *A Range Only Set for Close-in Seeing*, C. E. Mandeville, W. T. Harrold, July 13, 1944. Div. 14-310.32-M1

RL-599 *Standards for Microwave Frequencies*, P. A. Hower, Aug. 17, 1944. Div. 14-121.2-M3

RL-600 *GE GL2C40 Tank Grid Lighthouse Tubes*, P. A. Cole, Nov. 14, 1944. Div. 14-232.2-M4

RL-601-1 *Antenna Measuring Equipment*, O. A. Tyson, Oct. 6, 1944. Div. 14-234.4-M6

RL-601-2 *Antenna Measuring Equipment, High Power CW Transmitter for S-Band*, O. A. Tyson, Aug. 24, 1944. Div. 14-234.4-M5

RL-601-3 *Antenna Measuring Equipment, 100-Db Linear Audio Amplifier*, O. A. Tyson, Aug. 23, 1944. Div. 14-234.4-M4

RL-601-4 *Antenna Measuring Equipment, Automatic Antenna Pattern Recorder*, O. A. Tyson, Jan. 16, 1945. Div. 14-234.4-M7

RL-602 *Statistics of Beacon Interrogation*, H. H. Bailey, Feb. 5, 1945. Div. 14-328-M3

RL-603 *Measurements of the Attenuation of K-Band Waves by Rain*, G. T. Rado, Mar. 7, 1945. Div. 14-122.13-M4

RL-604 *Video Stretching as a Method for Improving X-Band Beacon Reception*, T. H. Waterman, S. D. Bennett, Aug. 31, 1944. Div. 14-328.111-M3

RL-605 *Trigger Requirements of the 4C35 and 3C45 Hydrogen Thyratrons*, S. J. Krulikoski, Jr., Aug. 31, 1944. Div. 14-231.221-M4

RL-606 *A Description of AN/TPS-10 and Its Performance in Mountainous Terrain*, T. M. Moore, Aug. 3, 1944. Div. 14-322.1-M7

RL-607 *Vixen X*, M. M. Mann, F. T. Worrell, F. Shoemaker, Dec. 15, 1944. Div. 14-329.145-M1

RL-608 *Corner Reflectors for Life Rafts*, E. L. Hudspeth, J. P. Nash, Aug. 1, 1944. Div. 14-267.1-M2

RL-609 *Cathodes for Pulsed Magnetrons, Part I, Correlations Between Oscillating and Diode Conditions*, E. A. Coomes, J. G. Buck, A. Fineman, Aug. 30, 1944. [See RL-683 for Part II.] Div. 14-232.143-M5

RL-610 *Matching Resistance Curves by Means of Two Linear Ganged Potentiometers and a Three-Terminal Resistance Network*, N. H. Painter, Aug. 17, 1944. Div. 14-211.3-M8

RL-611 *Testing of Fixed-Tuned, Low-Q, ATR Tubes*, L. D. Smullin, Dec. 6, 1944. Div. 14-233.32-M1

RL-612 *Errors in Target Velocity Due to the Rolling and Pitching of the Ship*, W. Hurewicz, Aug. 28, 1944. Div. 14-600-M5

RL-613 *Modification of the Amplifier of the AN/APN-2 to Give Sharp Cut-off Wide-Band Response*, H. Wallman, G. H. Suits, Sept. 18, 1944. Div. 14-241.3-M5

BL-614 *Nomograms for Radar Bombing with the 100-Lb Practice Bomb M38A2*, W. M. Cady, Aug. 29, 1944. Div. 14-329.11-M1

RL-615 *Low-Altitude Navigation Antennas Developed in Connection with AN/-APS-10*, J. H. Gardner, Oct. 3, 1944. Div. 14-234.122-M5

RL-616 *Effects of Line- and Cathode-Follower Terminations on Pulse Shape*, C. Butt, Sept. 11, 1944. Div. 14-124.2-M4

RL-617 *Life Test of Contact Material on Standard Linear Wire-Wound Potentiometers*, F. E. Dole, Mar. 12, 1940. Div. 14-211.3-M9

RL-618 *A Method of Virtual Displacements for Electrical Systems with Applications to Pulse Transformers*, P. D. Crout, Oct. 6, 1944. Div. 14-211.41-M10

RL-619 *Energy Loss in Copper under Pulse Conditions*, W. H. Bostick, Dec. 22, 1944. Div. 14-211.4-M1

RL-620 *Stability of Magnetrons Operated by Spark-Gap Modulators*, D. F. Winter, H. A. Miley, Oct. 9, 1944. Div. 14-231.23-M3

RL-621 *Increasing Stability of Operation of 4J31, 35 Magnetrons in the AN/CPS-1 System*, D. F. Winter, H. A. Miley, K. R. More, Jan. 25, 1945. Div. 14-232.16-M8

RL-622 *Influences of Pulse Transformer Design on 4J31, 35 Magnetron Stability*, D. F. Winter, H. A. Miley, Aug. 11, 1945. Div. 14-232.16-M9

RL-623 *S-Band Vertically Polarized Non-directional Antennas*, H. J. Riblet, Dec. 20, 1944. Div. 14-234.111-M3

RL-624 *K-Band Cosec² Antennas with a Line Source and Shaped Cylindrical Reflector*, W. Siehak, E. M. Purcell, Nov. 3, 1944. Div. 14-234.113-M1

RL-625 *The Future of Hyperbolic Navigation*, J. A. Pierce, Aug. 18, 1945. Div. 14-327-M4

RL-626 *An Extension of Lagrange's Equations to Electromagnetic Field Problems, Equivalent Networks*, P. D. Crout, Oct. 6, 1944. Div. 14-111-M10

RL-627 *Comparison of Theoretical and Experimental Requirements for Microwave Beacon Transmitter Power and Receiver Sensitivity*, E. R. Gaerttner, T. H. Waterman, H. S. Gardner, Jr., H. W. Grissler, Oct. 13, 1944. Div. 14-328.2-M2

RL-628 *Analysis of Tracking Data, Description of Calculations*, P. A. Samuelson, Oct. 3, 1944. Div. 14-323.32-M3

RL-629 *A Treatment of Echo-Box Problems by Lagrangian Procedures*, P. D. Crout, N. H. Painter, Jan. 13, 1945. Div. 14-251.3-M8

RL-630 *Theory of Ringing Time of Tunable Echo Boxes*, A. Baños, Jr., Nov. 3, 1944. Div. 14-251.3-M6

RL-631 *Design of an Improved X-Band Echo Box*, A. Baños, Jr., Dec. 7, 1941. Div. 14-251.3-M7

RL-632 *Field Station for Antenna Measurements*, R. E. Hiatt, Feb. 26, 1945. Div. 14-234.4-M8

RL-633 *Errors in the Condenser Type Continuous Phase Shifter*, G. R. Gamertsfelder, Dec. 6, 1944. Div. 14-243.22-M1

RL-634 *Reduction of Power-Line Noise in Modulators*, G. J. Wheeler, Dec. 11, 1944. Div. 14-231.5-M2

RL-635 *Linear Electric Scanner*, J. S. Foster, Jan. 6, 1945. Div. 14-234.324-M2

RL-636 *Vertical Coverage of a 1½-Ft by*

5-Ft Antenna Designed for SG-3 (Experimental Data Obtained with an SNB Aircraft as Target), C. E. Moore, R. W. Blue, Dec. 7, 1944. Div. 14-234.121-M2

RL-637 *Rentizability of Filters*, H. Wallman, Dec. 8, 1944. Div. 14-241.7-M3

RL-638 *Crystal Detectors and the Crystal-Video Receiver*, R. Beringer, Nov. 16, 1944. Div. 14-233.12-M8

RL-639 *SG-1 Antenna Mark 2*, R. W. Thickens, Jan. 9, 1945. Div. 14-234.121-M3

RL-640 *Antiaircraft Target Designation Equipment for Ships*, R. W. Blue, C. E. Moore, Dec. 19, 1944. Div. 14-323.32-M4

RL-641 *1B38 (Pre-TR)*, L. D. Smullin, Dec. 5, 1944. Div.14-233.31-M16

RL-642 *Design of a 4-Ft Corner Reflector for K-Band*, E. G. Martin, Aug. 20, 1945. Div. 14-267-M6

RL-643 *The Use of the Magic Tee Microwave Bridge in Measuring Impedance*, R. L. Kyhl, Dec. 12, 1944. Div. 14-252.1-M6

RL-644 *Dielectric Properties of Water and Ice at K-Band*, E. L. Younker, Dec. 4, 1944. Div. 14-131.14-M1

RL-645-1 *QA-2B Servoadaptor*, W. Roth, Dec. 16, 1944. Div. 14-214.3-M16

RL-645-2 *Q1-2 and Q-3 Servoamplifier*, R. U. Nathe, W. Roth, Sept. 25, 1945. Div. 14-214.3-M12

RL-645-3 *H-3 Trigger Unit*, S. B. Cohen, Feb. 22, 1945. Div. 14-412.2-M1

RL-645-4 *The I-3 Signal Unit*, S. B. Cohen, May 23, 1945. Div. 14-412.1-M1

RL-645-5 *The J-2 Modulator Unit*, E. M. Jones, July 19, 1945. Div. 14-412-M3

RL-645-6 *The H-2 Trigger Unit*, S. B. Cohen, Aug. 7, 1945. Div. 14-412.2-M2

RL-645-7 *I-2 Signal Unit*, S. R. Cohen, Aug. 30, 1945. Div. 14-412.1-M2

RL-645-8 *The R-1 and the R-2 Crystal Drivers*, S. Frankel, Feb. 4, 1946. Div. 14-422.1-M5

RL-645-9 *The ML-1A, ML-1B, and ML-3A Course Mechanisms*, C. M. Connelly, Lieutenant J. R. Higley, Nov. 28, 1945. Div. 14-412-M6

RL-645-10 *S-2, S-2B, S-3, S-4, S-4B Motor Control Units*, C. M. Gilbert, Feb. 11, 1946. Div. 14-412.3-M1

RL-645-11 *The S-5 and S-5B Motor Control Units*, Lieutenant J. B. Higley, Feb. 25, 1946. Div. 14-412.3-M2

RL-645-12 *The U-1 and U-2 Preamplifier Units*, S. Frankel, Dec. 14, 1945. Div. 14-422.1-M4

RL-645-13 *X-1 Error Integrator*, W. Hodder, W. Roth, Nov. 27, 1945. Div. 14-412-M5

RL-645-14 *N-1 IFF Unit*, G. W. McClure, Mar. 22, 1946. Div. 14-412-M8

RL-646 *Parallel Plate Optics for Electrical Scanning*, S. B. Myers, Dec. 15, 1944. Div. 14-234.324-M1

RL-647 *Overland Falcon*, E. H. B. Bartelink, Feb. 7, 1945. Div. 14-323.2-M8

RL-648 *Electrical Design of the AN/TPS-10 Antenna*, C. S. Pao, Dec. 28, 1944. Div. 14-234.123-M4

RL-649 *Over-Water Transmission Measurements, 1944, Part I, Preliminary Analysis of Radio and Radar Measurements*, P. J. Rubenstein, Dec. 15, 1944. Div. 14-122.22-M2

RL-650 *A Qualitative Analysis of Hysteresis in Reflex Oscillators*, J. B. Garrison, Feb. 4, 1946. Div. 14-241.413-M9

RL-651 *Modified Index Distribution Close to the Ocean Surface*, R. B. Montgomery, R. H. Burgoyne, Feb. 16, 1945. Div. 14-122.24-M1

RL-652 *Frequency — Wavelength Conversion Tables*, E. DeAmicis, Jan. 4, 1945. Div. 14-112-M4

RL-653 *Flared Box Horn*, S. J. Mason, July 9, 1945. [Report Withdrawn.]

RL-654 *Rotating Corner Reflectors for Ship Identification*, J. M. Sturtevant, Jan. 1, 1945. Div. 14-267.1-M3

RL-655 *Shaping the Primary Pattern of a Horn Feed*, C. S. Pao, Jan. 22, 1945. Div. 14-234.21-M9

RL-656 *Characteristics of Horn Feeds on Rectangular Waveguide*, J. R. Risser, Dec. 28, 1945. Div. 14-233.412-M25

RL-657 No report.

RL-658 *A Microfilm Chart Projector for Radar Navigation*, D. B. McLaughlin, C. A. Smith, Jan. 23, 1945. Div. 14-327-M2

RL-659 *SU-2 Antenna—Shipborne Stabilized Radar Antenna for Sea Search*, T. J. Keary, J. I. Bohnert, Mar. 7, 1945. Div. 14-234.112-M4

RL-660 *SU-2 Antenna—Line-of-Sight Stabilization of a Radar Beam by Reflector Tilt*, J. I. Bohnert, T. J. Keary, Feb. 19, 1945. Div. 14-234.112-M3

RL-661 *Reflections from Smooth-Curved Surfaces*, R. C. Spencer, Jan. 26, 1945. Div. 14-122.111-M1

RL-662 *A Microwave Frequency Discriminator*, R. V. Pound, Aug. 4, 1945. Div. 14-212.8-M7

RL-663 *Frequency Drift of Certain X-Band*

Magnetrons, K. R. More, W. W. Mathison, Jan. 23, 1945. Div. 14-232.112-M5

RL-664 *Further Theoretical Investigations on the Atmospheric Absorption of Microwaves*, J. H. Van Vleck, Mar. 1, 1945. Div. 14-122.13-M3

RL-665 *Stabilized SG-3 Antenna*, J. I. Bohnert, H. Krutter, Feb. 7, 1945. Div. 14-234.121-M4

RL-666 *Equivalent Circuit of a Pulse-Transformer Core*, H. L. Rehkopf, Mar. 20, 1945. Div. 14-212.3-M3

RL-667 *A Feedback Circuit for Measuring Output Noise Ratio of Crystal Rectifiers*, S. Roberts, Jan. 10, 1945. Div. 14-233.131-M3

RL-668 *A Conversion Loss Set for Testing K-Band Crystal Rectifiers*, C. A. Whitmer, Jan. 16, 1945. Div. 14-233.152-M3

RL-669 *A Simple Trainer for GCA Approach Controller*, C. M. Gilbert, G. F. Tape, C. R. Haupt, Jan. 24, 1945. Div. 14-325.1M3

RL-670 *Identification of GCA Search Targets*, B. F. Greene, Jan. 10, 1945. Div. 14-325.1-M2

RL-671 *Theory of Radar Return from the Schnorkel*, F. M. Marcus, Jan. 15, 1945. Div. 14-321.12-M3

RL-672 *Block Matrix—Coincident Cross-Bund Transmitter for S-Band Radar [AKW]*, C. E. Stone, G. D. Perkins, H. J. Lipkin, M. D. O'Day, Dec. 28, 1944. Div. 14-321.14-M4

RL-673 *Data Smoothing*, F. P. Caffin, P. D. Crout, F. E. Bothwell, Jan. 23, 1945. Div. 14-244.4-M2

RL-674 *Deflection Yoke Design Information*, R. D. Rawcliffe, Feb. 23, 1945. Div. 14-242.24-M4

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(Discontinued April 1944)

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CONTRACT NUMBERS, CONTRACTORS, AND SUBJECT OF CONTRACT

Contract Number	Contractor	Subject
NDCrc-25	University of California, Berkeley, California	Resnatron tubes
NDCrc-53	Massachusetts Institute of Technology, Cambridge, Massachusetts	Superseded by OEMsr-262
NDCrc-73	RCA Manufacturing Company, Camden, N. J.	Microwave components
NDCrc-74	RCA Manufacturing Company, Camden, N. J.	Pulse transmitter tubes and receivers for Loran
NDCrc-150	Radio Corporation of America Manufacturing Co., RCA Victor Division, Camden, N. J.	Long-delay and dark-trace cathode-ray tubes
NDCrc-174	Western Electric Company, Bell Telephone Laboratories, New York, N. Y.	3-cm generator
NDCrc-175	Western Electric Company, Bell Telephone Laboratories, New York, N. Y.	Magnetrons and oscillators
NDCrc-192	Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.	Laboratory pulsers
NDCrc-203	Massachusetts Institute of Technology, Cambridge, Massachusetts	Superseded by OEMsr-262
NDCrc-205	Western Electric Company, Bell Telephone Laboratories, New York, N. Y.	Development of receivers for long-range navigation system
OEMsr-2	Western Electric Company, Bell Telephone Laboratories, New York, N. Y.	Pulse timers for Loran
OEMsr-5	Massachusetts Institute of Technology, Cambridge, Massachusetts	Raytheon magnetron model shop
OEMsr-7	General Electric Company, Schenectady, N. Y.	Five experimental permanent magnets
OEMsr-8	General Electric Company, Schenectady, N. Y.	Magnets and receivers, etc.
OEMsr-9	General Electric Company, Schenectady, N. Y.	One Loran pulse transmitter and four tubes
OEMsr-10	General Electric Company, Schenectady, N. Y.	(a) Long-delay phosphors, (b) 10-cm magnetrons, (c) two gun hurrents
OEMsr-15	Sperry Gyroscope Company, Brooklyn, N. Y.	Antenna parabolae and gears
OEMsr-53	Sperry Gyroscope Company, Brooklyn, N. Y.	Pulse receivers for LRN
OEMsr-61	Massachusetts Institute of Technology	Superseded by OEMsr-262
OEMsr-67	Sperry Gyroscope Company, Brooklyn, N. Y.	Klystron oscillators
OEMsr-73	Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.	Pulse transmitters

CONTRACT NUMBERS, CONTRACTORS, AND SUBJECT OF CONTRACT (*Continued*)

Contract Number	*Contractor*	*Subject*
OEMsr-74	Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.	Laboratory pulsers
OEMsr-84	Raytheon Manufacturing Company, Waltham, Massachusetts	3-cm magnetrons
OEMsr-118	Sperry Gyroscope, Inc., Brooklyn, N. Y.	Additional Klystron work
OEMsr-157	Western Electric Company (Bell Telephone Laboratories), New York, N. Y.	3-cm receiving tube
OEMsr-164	Research Construction Company, Cambridge, Mass.	Radar model shop
OEMsr-168	Sperry Gyroscope Company, Brooklyn, N. Y.	Crystal mixer receivers
OEMsr-180	General Electric Company, Schenectady, N. Y.	Permanent gas thyratrons
OEMsr-191	Massachusetts Institute of Technology (Laboratory for Insulation Research), Cambridge, Mass.	Development and wide frequency investigation of dielectrics
OEMsr-233	General Electric Company, Schenectady, N. Y.	AGL-1 airborne gun-laying radar system
OEMsr-248	General Electric Company, Schenectady, N. Y.	Long-delay and dark-trace cathode ray tubes
OEMsr-252	RCA Victor Division (RCA Laboratories), Camden, N. J.	Noise reduction system
OEMsr-262	Massachusetts Institute of Technology, Cambridge, Mass.	Radiation Laboratory
OEMsr-281	Link Aviation Devices, Inc., Binghamton, N. Y.	A1-10 training gear
OEMsr-288	Westinghouse Electric & Manufacturing Company, Bloomfield, N. J.	Cold emission power tubes
OEMsr-335	Polytechnic Institute of Brooklyn, Brooklyn, N. Y.	Development of attenuators and RF test equipment
OEMsr-344	Georgia School of Technology, Atlanta, Ga.	Highly selective audio-amplifier and narrow-band lock-in type amplifier
OEMsr-358	Franklin Institute (Bartol Research Foundation), Philadelphia, Pa.	Magnetron cathode studies
OEMsr-360	Franklin Institute (Bartol Research Foundation), Philadelphia, Pa.	Electronic switch
OEMsr-362	Purdue Research Foundation, Lafayette, Indiana	Crystal detectors
OEMsr-369	Zenith Radio Corporation, Chicago, Illinois	Lightweight range-only unit
OEMsr-380	Sylvania Electric Products, Inc., (Formerly Hygrade Sylvania, Inc.), Emporium, Pennsylvania	A special tunable intermediate frequency amplifier

CONTRACT NUMBERS, CONTRACTORS, AND SUBJECT OF CONTRACT (*Continued*)

Contract Number	*Contractor*	*Subject*
OEMsr-382	Brown University, Providence, Rhode Island	Cathode-ray tube project
OEMsr-386	Eastman Kodak Company, Rochester, N. Y.	Microwave absorbent paint
OEMsr-387	University of Pennsylvania, Trustees of the Philadelphia, Pa.	Radar ranging system and high-frequency video amplifiers
OEMsr-388	University of Pennsylvania, Trustees of the Philadelphia, Pa.	Crystal research
OEMsr-429	Cornell University, Ithaca, N. Y.	Theoretical aid
OEMsr-443	RCA Victor Division (License Division Laboratory), Camden, N. J.	Loran receiver for receiver trainer
OEMsr-477	RCA Victor Division, Harrison, N. J.	Tube model shop service for Columbia Radiation Laboratory
OEMsr-485	Columbia University, Trustees of New York, N. Y.	Columbia Radiation Laboratory
OEMsr-486	Harvey Radio Laboratories, Inc., Cambridge, Massachusetts	Six transmitting sets for long-range navigation project
OEMsr-507	Radio Engineering Laboratories, Inc., Long Island City, N. Y.	Thirty-six Loran transmitters
OEMsr-511	Harvey-Wells Communications, Inc., Southbridge, Mass.	Fifteen Loran receivers
OEMsr-540	General Electric Company, Schenectady, N. Y.	Precision aircraft scanners
OEMsr-543	General Electric Company, Schenectady, N. Y.	Two truck-mounted XT-1A anti-aircraft fire control radars
OEMsr-546	University of Colorado, Boulder, Colorado	Stable noncrystal controlled low-frequency oscillator
OEMsr-557	General Electric Company Schenectady, N. Y.	Four (4) AGL-1 equipments
OEMsr-560	Kansas State College, Manhattan, Kansas	Time-delay measuring instruments
OEMsr-582	General Electric Company, Fort Wayne, Ind. and Pittsfield, Mass.	Transformer model shop
OEMsr-583	Sylvania Electric Products, Inc., Emporium, Pennsylvania	Special signal generators
OEMsr-589	Raytheon Manufacturing Company, Newton, Massachusetts	Transformer model shop
OEMsr-609	Leland Electric Company, Dayton, Ohio	Three-phase aircraft alternator
OEMsr-619	American Machine Defense Corporation	Precision antenna mount for use with the CXBL set (SM prototype)
OEMsr-633	Fada Radio & Electric Company, Long Island City, N. Y.	Loran receivers

CONTRACT NUMBERS, CONTRACTORS, AND SUBJECT OF CONTRACT (*Continued*)

Contract Number	*Contractor*	*Subject*
OEMsr-634	Carnegie Institution of Washington, Geophysical Laboratory, Washington, D. C.	Cathode-ray tube screens
OEMsr-642	Sperry Gyroscope Company, Garden City, N. Y.	AGL-2 fire control system
OEMsr-652	University of California, Berkeley, California	High-vacuum switch
OEMsr-663	Gilfillen Bros., Inc., Los Angeles, Cal.	Ground-control-of-approach landing systems AN/MPN-1 (XE-1) and construction of two
OEMsr-684	RCA Victor Division (RCA Laboratories), Princeton, N. J.	Lightweight Racon development (BUPX)
OEMsr-689	Foxboro Company, Foxboro, Massachusetts	Trainer for SCR-584, anti-aircraft fire control radar
OEMsr-691	RCA Victor Division (RCA Laboratories), Camden, New Jersey	UHF propagation studies
OEMsr-709	Westinghouse Electric & Manufacturing Company, Bloomfield, N. J.	High-pressure spark gap
OEMsr-723	General Electric Company, Schenectady, N. Y.	Loran receivers
OEMsr-728	State College of Washington, Pullman, Washington	Microwave propagation studies
OEMsr-768	Cornell University, Ithaca, N. Y.	Theoretical aid
OEMsr-770	Harvey-Wells Communications Inc., Southbridge, Mass.	Fifty Loran receivers
OEMsr-777	Western Electric Company (BTL) New York, N. Y.	Interference and field strength study
OEMsr-781	Rensselaer Polytechnic Institute, Troy, N. Y.	Trigger circuits
OEMsr-789	Radio Manufacturing Engineering Laboratories, Inc., Long Island City, N. Y.	Five Loran training equipment
OEMsr-805	Harvey Radio Laboratories, Inc., Cambridge, Mass.	Twenty Loran transmitters
OEMsr-812	Fairchild Camera & Instrument Corporation (formerly Fairchild Aviation Corporation), Jamaica, N. Y.	(a) AGL central-station computer and (b) AGS gyro sight and spinner mount
OEMsr-821	Franklin Institute (Bartol Research Foundation), Philadelphia, Pa.	Crystal clock for Loran receiver
OEMsr-832	Philco Corporation, Philadelphia, Pa.	LHTR unit for ARO radar and construction of six
OEMsr-872	RCA Victor Division, Harrison, N. J.	RF tube development

CONTRACT NUMBERS, CONTRACTORS, AND SUBJECT OF CONTRACT (*Continued*)

Contract Number	*Contractor*	*Subject*
OEMsr-874	Fairchild Aviation Corporation, Jamaica, N. Y.	Range follow-up for ARO
OEMsr-890	Emerson Radio & Phonograph Corporation, New York, N. Y.	Trainer for SH radar
OEMsr-900	Carnegie Institute of Technology, Pittsburgh, Pa.	Dark-trace cathode-ray tubes
OEMsr-918	Galvin Manufacturing Corporation, Chicago, Illinois	BPP, portable radar beacon (AN/PPN-2)
OEMsr-960	Dulmp-Victor, Inc., San Francisco, California	Development of radar scanners
OEMsr-972	Gnivin Manufacturing Corporation, Chicago, Illinois	Airborne range only ARO
OEMsr-977	RCA Victor Division (License Division Laboratory), Camden, N. J.	Loran receiver developments
OEMsr-988	Sylvania Electric Products, Inc., Emporium, Pennsylvania	Radar tube for pulsed and CW operation
OEMsr-999	Sylvania Electric Products, Inc., Salem, Massachusetts	Tube model shop
OEMsr-1022	Stevens Institute of Technology, Hoboken, N. J.	Development of electric brushes through power metallurgy
OEMsr-1025	RCA Victor Division, Camden, N. J.	Lightweight tail warning system (AN/APS-13)
OEMsr-1029	RCA Victor Division (License Division Laboratory), Camden, N. J.	Lodar direction-finding receivers
OEMsr-1032	Kuthe Electric Company, Newark, N. J.	Development of the H-50 hydrogen thyratron
OEMsr-1043	RCA Victor Division, Lancaster, Pennsylvania	Radar tube model shop
OEMsr-1044	Librascope, Incorporated, Burbank, California	Radar bombing computers and ballistic computer for gun director Mark 56
OEMsr-1052	Galvin Manufacturing Corporation, Chicago, Illinois	BGS beacons, construction of forty
OEMsr-1054	Douglas Aircraft Company, Santa Monica, California	Antenna installation for project "Eagle" (AN/APQ-7)
OEMsr-1089	International Projector Corporation, New York, N. Y.	Model of scanning antenna for Eagle (AN/APQ-7)
OEMsr-1091	Wilcox & Gibbs Sewing Machine Company, New York, N. Y.	Equation solver for SM and SCR-615 trainers
OEMsr-1112	Westinghouse Electric & Manufacturing Company, Sharon, Pa.	Transformers model shop I
OEMsr-1127	RCA Victor Division (National Broadcasting Company), Camden, New Jersey	Relay radar system

CONTRACT NUMBERS, CONTRACTORS, AND SUBJECT OF CONTRACT (*Continued*)

Contract Number	*Contractor*	*Subject*
OEMsr-1139	E. I. du Pont de Nemours, Inc., Wilmington, Delaware	Research on sintering of boron and laboratory preparation of pure germanium
OEMsr-1140	Allen B. DuMont Laboratories, Inc., Passaic, New Jersey	PPI indicator units
OEMsr-1141	Allen B. DuMont Laboratories, Inc., Passaic, New Jersey	Development of cathode-ray tube screens
OEMsr-1143	Emerson Radio & Phonograph Corporation, New York, N. Y.	Power supply for Iodar receivers
OEMsr-1146	Machlett Laboratories, Inc., Springfield, Connecticut	High-power S-band magnetron
OEMsr-1149	General Electric Company, Schenectady, New York	Gyro lead computer sight for the AGS radar
OEMsr-1162	Massachusetts Institute of Technology (Servomechanisms Laboratory), Cambridge, Massachusetts	Servos for gun director Mark 58
OEMsr-1165	Westinghouse Electric & Manufacturing Company, Bloomfield, New Jersey	K-band transmitter tube developments
OEMsr-1167	Chrysler Corporation, Detroit, Michigan	Radar scanning units for SCR-584 and gun director Mark 56
OEMsr-1186	Sylvania Electric Products, Inc., Salem, Massachusetts	K-band RF head
OEMsr-1199	E. I. du Pont de Nemours, Inc., Wilmington, Delaware	HARP protective coatings
OEMsr-1212	Western Electric Company, New York	Thermistors for RF power measurement
OEMsr-1218	Western Electric Company (BTL), New York, N. Y.	Broad-band TR and anti TR
OEMsr-1220	Franklin Institute (Bartol Research Foundation), Philadelphia, Pennsylvania	Loran supersonic trainer
OEMsr-1239	Westinghouse Electric & Manufacturing Company, Sharon, Pa.	Transformer model shop II
OEMsr-1242	Chicago Telephone & Supply Company, Elkhart, Indiana	Special winding machine
OEMsr-1269	Utah Radio Products Company, Chicago, Illinois	Design and sample production of pulse transformers
OEMsr-1283	Federal Telephone & Radio Corporation, Newark, New Jersey	High impedance cable
OEMsr-1291	Maguire Industries, Inc., (General Electronics Industries Division), Greenwich, Connecticut	Stabilized scanner for the H2K radar and the construction of five
OEMsr-1295	Sylvania Electric Products, Inc., Emporium, Pa.	Cathode-ray tube screens
OEMsr-1299	General Electric Company, Schenectady, New York	Gun director Mark 56

CONTRACT NUMBERS, CONTRACTORS, AND SUBJECT OF CONTRACT (*Continued*)

Contract Number	*Contractor*	*Subject*
OEMsr-1306	General Electric Company, Schenectady, New York	Broad-band TR and anti TR
OEMsr-1311	California Institute of Technology, Pasadena, California	Precision measurement of waveguide discontinuities
OEMsr-1336	General Electric Company, Schenectady, New York	Stable base unit for radar antenna
OEMsr-1337	Sperry Products, Inc., Hoboken, New Jersey	MTI computing radar sight
OEMsr-1338	International Business Machines Corporation, Endicott, New York	Counter for Mark III Loran indicator
OEMsr-1352	Sylvania Electric Products, Inc., Salem, Massachusetts	Transformer model shop
OEMsr-1358	Fairchild Camera & Instrument Corporation, Jamaica, New York	Cameras for aerial radar photography
OEMsr-1360	University of Michigan, Ann Arbor, Michigan	Infrared absorption by water vapor
OEMsr-1361	American Type Founders, Elizabeth, New Jersey	Antenna mounts for high-resolution radar
OEMsr-1377	General Electric Company, Schenectady, New York	K-band crystals
OEMsr-1394	General Electric Company, Schenectady, New York	Components for two SCI radars (CXHR)
OEMsr-1408	Western Electric Company (BTL), New York, N. Y.	Germanium crystal rectifiers for radar
OEMsr-1409	Western Electric Compony (BTL), New York, N. Y.	High-power enclosed fixed-gaps
Purchase Order 600,072	Western Electric Company, New York, N. Y.	Procurement of Type D-160207 oscillator
Purchase Order 600,073	Western Electric Company, New York, N. Y.	Procurement of Type D-160537 magnetrons
Order TPS-38541	General Electric Company, Schenectady, New York	Procurement of one square wave generator and two oscilloscopes

Note: Subject of contract includes D-1, NDRC.

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THE RADIATION LABORATORY SERIES

FROM ITS FORMATION in November 1940 to its dissolution at the end of 1945, the Radiation Laboratory, maintained at the Massachusetts Institute of Technology under contract with the National Defense Research Committee of the Office of Scientific Research and Development, was the foremost U. S. research and development institution in the field of microwave radar. OSRD was instructed by President Roosevelt to record and preserve for the public at large the durable values of the wartime work it sponsored. The series was undertaken by Dr. L. A. DuBridge, director of the Radiation Laboratory. Work on the series has been under way since May 1945, under the general supervision of Louis N. Ridenour, editor-in-chief, and George B. Collins, deputy editor-in-chief.

The series as planned consists of 27 titles and a general index. It has been written and edited principally, but not entirely, by members of the Radiation Laboratory. Since the laboratory has been a principal focus for the interchange of information among all agencies working in radar during the war, it has been able to collect all of the important information in the field.

While the investigations which led to the results reported had the single aim of giving our Army and Navy the best possible military radar equipment, the implications and the usefulness of the basic knowledge thus gained extend far beyond the limited practical field of radar. The part of the electromagnetic spectrum, in which the generation, modulation, reception, and measurement of continuous waves has now become an everyday matter, has been extended to include the frequency range between 30,000 and 300 megacyles per second—a region inaccessible before the war, practically speaking. The work on accurate range measurement by means of radar has given us techniques which enable the measurement of a time interval of a hundred-millionth of a second with the same ease and accuracy which used to characterize the measurement of a thousandth of a second. Advances in our understanding of the design and behavior of vacuum tube circuits, together with great improvements in tubes and other components of such circuits, enable the postwar designer to perform by electronic means an astonishing variety of process and measurement and calculating functions which were formerly the province of mechanical devices. The cathode-ray tube, still an instrument of somewhat limited and special utility when we entered the war, has emerged as the basis of a whole new art of measurement and display of complicated data of various sorts. Not only television pictures and radar indications, but also the results of any sort of measurement the instrumentation of which can be reduced to electrical terms, can be displayed on cathode-ray tubes. The lumped-constant electrical circuits of prewar experience have now their analogues in microwave waveguide circuits; and the theory and engineering principles necessary to deal with these circuits have largely been worked out since the war.

It is the aim of the series to treat the advances arising from radar work in a fashion which will emphasize the role of these advances as the basis for the new electronics, rather than to treat each part of the work in terms of its contributions to radar. The editors hope that the usefulness of the series can thus extend over all the fields—of communication, of television, of industrial instrumentation and control, of research in the biological and physical sciences, and of radar itself—in which electronic techniques are of great and increasing applicability and importance.

RADAR SYSTEM ENGINEERING
Louis N. Ridenour

It is the aim of this book to outline the general principles of design of radar systems. On the one hand, it collates, from the standpoint of the radar designer, the detailed information which has been given extensively in the other books of the series; on the other hand, it considers fully the basic considerations which underlie and are particular to systems design. It is intended as a basic treatise and reference book for anyone interested in making any application of radar.

RADAR AIDS TO NAVIGATION
J. S. Hall

The principal aim of this book is to point out in nontechnical form the advantages and limitations of various types of radar as aids to the

solution of various problems encountered in navigation and pilotage. These types include airborne, shipborne and ground-based systems. Radar beacons and other auxiliary equipment are also discussed.

RADAR BEACONS
A. Roberts

This volume deals with the design and use of radar responder beacons. The employment of systems involving beacons for navigation and for identification is critically discussed. Systems using radar sets as interrogators and systems using special interrogators are both treated. Full information is given on the practical experience so far available regarding the field installation, operation, and maintenance of beacons.

LORAN
J. A. Pierce, A. A. McKenzie, R. H. Woodward

This book gives a complete account of the design and use of the long-range pulse navigation system known as Loran, both in its original form and as skywave-synchronized Loran. The greater part of the discussion will be devoted to equipment now in operational use. Sections are included on radio propagation at Loran frequencies and on methods for the computation and preparation of Loran navigational charts.

PULSE GENERATORS
G. N. Glasoe, J. V. Lebacqz

This book deals with the theoretical and practical aspects of the generation of power pulses. Pulse powers in the range of 100 watts to 20 megawatts and pulse durations from 0.03 to 10 microseconds are considered. The treatment is as general as possible, with emphasis on such problems as: pulse formation; the effect of circuit parameters on the pulse shape; pulse power, average power, power transfer, and circuit efficiency; impedance transformation by pulse transformers; and characteristics and design of pulse transformers.

MICROWAVE MAGNETRONS
George B. Collins

This covers quite completely the theoretical and practical aspects of multicavity magnetrons in the frequency range from 1,000 to 24,000 megacycles per second and in the power output range from 10 watts to 3,000,000 watts. The circuit theory and electronics of this type of oscillator are discussed with special attention to the subjects of starting phenomena, electronic tuning, and stabilization of frequency. Practical problems of magnetron design and special applications of the magnetron principle to both pulsed and c-w tubes are dealt with in full. The book concludes with a compilation of the operating characteristics of microwave magnetrons developed during the war.

KLYSTRONS AND MICROWAVE TRIODES
D. R. Hamilton, J. K. Knipp, J. B. H. Kuper

This book is primarily concerned with low-power microwave triodes and klystrons, and their performance as local oscillators, signal generators, and low-power transmitters. A theoretical treatment is given covering the use of triodes and klystrons as mixers, amplifiers, oscillators, and frequency multipliers. The performance of planar triodes with small electrode spacing as low power sources of CW and pulse power is dealt with next. The balance of the book deals with the theory and use of two-cavity and reflex klystrons.

PRINCIPLES OF MICROWAVE CIRCUITS
C. G. Montgomery, E. M. Purcell, R. H. Dicke

Starting from Maxwell's equations, a description is given of guided electromagnetic waves. The concept of impedance is generalized to apply to waveguide circuits. Following a review of low-frequency network theory, general network theorems which apply both to high- and to low-frequency circuits are developed. The properties of waveguide circuit elements are fully discussed. These general properties are applied to the discussion of microwave devices. The results which follow from the symmetry properties of microwave junctions are emphasized.

MICROWAVE TRANSMISSION CIRCUITS
G. L. Ragan

The problems of the transmission of power from one place to another at microwave frequencies are fully discussed in this volume from a practical point of view. The elementary theory of operation and the complete design procedure are described for many essential components of transmission lines. Consideration of power-

handling capacity, loss, and convenience of use ure discussed in relation to the best choice of the type of transmission line for a given application. The use of the circle diagrnm, matching techniques, and methods for extending the frequency range for good operation are treated.

WAVEGUIDE HANDBOOK
N. Marcuvitz

The Waveguide Handbook will present in compact form all currently available theoretical data, and some experimental data, on the properties of micrownve transmission lines, microwave circuit elements (obstacles, windows, discontinuities, bends, jnnctions and couplings) and of some other structures, such as cavities, which may be considered us composites of these. Data will be given in the form most easily applied in practical circuit design. Theoretical results will be stated in analytical form, but the greater part of the book will consist of graphs presenting results in numerical form. When theoretical results nre not nvnilnble, experimental results may be given. Textual material will be restricted to that needed to explain the form of presentation nnd, in some cases, to indicate methods of applicntion.

TECHNIQUE OF MICHOWAVE MEASUREMENTS
C. G. Montgomery

This book describes in detnil the procedures for measuring the properties of microwaves and the circuits in which they are used. After an introduction which discusses the measurable quantities, there is a description of the sources of power suitable for measuring purposes and the means for detecting energy at microwave frequencies. Standing-wave measurements and the determination of impedance are considered. The meusurement of wavelength and frequency is similarly treated. Techniques are described for the measurement of power and attenuation covering the whole range of power levels which are encountered. Various microwave devices sach as directional couplers, spectrum nnnlyzers, und Impedance bridges are treated in detail.

MICHOWAVE ANTENNA THEORY AND DESIGN
S. Silver

This book provides u comprehensive survey of theory and design techniques for microwave antennas, and a full discussion of antenna mensurement methods. A survey of those parts of electromagnetic and optical theory which are basic to the subject is followed by a series of chapters discussing various types of antennn feeds and the complete antenna systems used for producing all principal types of microwave beams. The aberrations and special features of micrownve optical systems are discussed in relation to rapid scan antennas.

PROPAGATION OF SHORT RADIO WAVES
D. E. Kerr

Becuuse of the intensive development during the war of radar and communication equipment operating at frequencies above 100 megacycles per second considerable effort has been directed toward Investiguting the propngation characteristics of radiation at frequencies too high to be effected by the ionosphere. It is the purpose of this book to collect nnd summarize the results of these investigations, in such a way that they will be rendily available to present and future workers in the field.

MICROWAVE DUPLEXERS
L. D. Smullin, C. G. Montgomery

This book deals with the generni problem of using a single antenna for both receiving and transmitting and is, therefore, mainly of interest for pulsed transmission applications. A discussion Is given of the low-level properties of TR und ATR tubes and the methods for their design. The high-level operation is described in detail and discussed in connection with the properties of the gases used for filling the tubes. A chapter is devoted to the discussion of the circuits used for duplexing, including both the simpler branched circuits and the more complex balanced types. There is a chapter on how to measure the performance of the tubes as well ns the duplexer as a whole.

CRYSTAL RECTIFIERS
H. C. Torrey, C. A. Whitmer

This book discusses the theory, properties, manufacture, and use of the silicon and germanium point-contact rectifiers which have been developed for use ns microwave converters and for other circuit applications. Treatment of the theory of semiconductors, of the aemiconductor-metal contact, of frequency conversion by recti-

fiers and of noise generation by crystals is followed by engineering information on the production and use of practical crystal types. Crystal rectifiers with special properties are also considered. Low level detectors, high inverse voltage crystals, and crystals with negative i-f conductance are discussed in detail.

MICROWAVE MIXERS
R. V. Pound

This book deals with the microwave portions of receivers for very high frequency waves. After a general discussion of the various types of receiving systems and their relative merit, the conversion frequency problem is treated in all its aspects. Practical mixers are described and their design problems are discussed. A chapter is devoted to the special properties of balanced mixers. Schemes are described for maintaining a constant absolute frequency of the local oscillator as well as those for stabilizing to a constant frequency difference between the transmitter and local oscillator.

COMPONENTS HANDBOOK
John F. Blackburn

This book codifies available information on the properties and characteristics of electronic components. It includes the results of original measurements made at the Radiation Laboratory on manufactured components. Fixed components—wires, cables, resistors, capacitors, inductors, and transformers—are treated in the first part, which also includes information on various types of contact rectifiers. The second part deals with electromechanical devices: potentiometers, variable condensers, rotary inductors, instrument meters, tachometer generators, relays, magnetic clutches, and piezoelectric crystals. Part 3 is devoted to vacuum tubes, and includes a brief summary of the properties of cathode-ray tubes.

VACUUM TUBE AMPLIFIERS
George E. Valley, Jr., Henry Wallman

This book seeks to analyze completely, to give design principles of, and to describe the special constructional techniques pertaining to many important types of amplifiers. The amplifiers selected for treatment are, in general, characterized either by very high gain, by large bandwidth, by great dynamic range, or by precise response. Following a theoretical introduction, video amplifiers, wide-band high-frequency band-pass amplifiers, low-frequency band-pass amplifiers, and direct-coupled amplifiers are discussed. Noise in amplifiers is treated rigorously, and the practical design of minimal noise amplifiers described.

WAVEFORMS
Britton Chance, F. C. Williams, V. W. Hughes, D. Sayre, E. F. MacNichol, Jr.

This volume describes the generation and use of precisely controlled voltages and currents having various time dependence and duration. Introductory chapters present new methods of wave shaping by linear circuit elements and negative feedback amplifiers. The properties of vacuum tubes as nonlinear circuit elements and their applications to waveform manipulations are presented in detail. The operation of various types of multivibrators, blocking oscillators, and other basic circuits, is discussed with special emphasis upon wave shape and stability. Waveforms of precisely adjustable duration are emphasized. Other chapters treat the use of linear and nonlinear circuit elements in modulation, demodulation, frequency multiplication and division, and in rapidly executed mathematical operations.

ELECTRONIC TIME MEASUREMENTS
Britton Chance, R. I. Hulsizer, E. F. MacNichol, Jr.

This book opens with a survey of the use of precision timing methods in distance finding with detailed designs of precision ranging circuits depending upon both manual and automatic control. The second part treats electrical circuits using supersonic delay elements for the cancellation of recurrent waveforms as used in moving target indication systems. The third part presents several precision methods for data transmission employing pulse timing techniques.

ELECTRONIC INSTRUMENTS
I. A. Greenwood, Jr., D. MacRae, Jr., H. J. Reed, J. V. Holdam, Jr.

Details of the design of simple electronic computing systems are followed by several illustrative applications to the solution of the aircraft navigation problem and the synthesis of

radar data for training purposes. A second part is devoted to the practical aspects of the design of lightweight, low-power electronic servomechanisms, and a number of practical examples taken from various radar and fire-control applications are included. The last two parts treat the practical design of accurately stabilized power supplies and the problems of design and construction of prototype equipment with special emphasis upon lightweight techniques and the limitations of available components.

CATHODE-RAY TUBE DISPLAYS
J. T. Soller, M. A. Starr, George E. Valley, Jr.

Those interested in the design of instruments employing cathode-ray tubes will find in this book a practical discussion of their basic characteristics, principles of operation, and methods of application. The design and construction of beam deflection and focusing devices, optical projection and measuring apparatus, and auxiliary mechanical equipment is explained. A comprehensive treatment of cathode-ray tube screens includes a discussion of long-persistent phosphors. A compilation of design techniques, whereby instruments using cathode-ray tubes as major components can be synthesized to fulfill various functions, comprises a major portion of the book. Television is not emphasized.

MICROWAVE RECEIVERS
S. N. Van Voorhis

This book treats together all the elements making up a wide-band receiver. Its first section deals with the individual circuit types from which a complete receiver is assembled. The second section deals with general matters concerning the assembly, testing, and maintenance of microwave receivers. The third section describes actual receivers chosen as examples because they are typical of the important combinations of circuits.

THRESHOLD SIGNALS
J. L. Lawson, G. E. Uhlenbeck

This book is intended to provide an analysis, both theoretical and experimental, of the factors which affect the perception of desired signals in the presence of various kinds of interference, principally inherent receiver noise. While emphasis is placed on signals and interference which are usually encountered in pulsed systems, other systems such as continuous-wave ones modulated either in frequency or amplitude are briefly discussed. In addition to signals which consist of trains of pulses, a treatment is given of pulse trains which are amplitude-modulated in some desired way.

THEORY OF SERVOMECHANISMS
H. M. James, N. B. Nichols, R. S. Phillips

This book falls into two main parts: a presentation and extension of the standard theory of servomechanism design, and an account of a new technique. Part I deals with the frequency-response techniques of servomechanism design, which makes use of transfer loci, attenuation versus log-frequency plots, and phase-angle versus log-frequency plots. The required mathematical background is summarized and applications are described. Part II presents a new design technique, which depends upon minimization of the rms error with which the mechanism produces a desired result, in the presence of electrical noise and other disturbances. The approach makes fundamental use of statistical methods, which are here presented, together with necessary background material. The relation of this technique to that discussed in Part I is explored. The discussion is illustrated with many examples. The book closes with an account of the application of these techniques to servomechanisms operating with pulsed data.

RADAR SCANNERS AND RADOMES
W. M. Cady, M. B. Karelitz, L. A. Turner

The first part of this book takes up the problems of mechanical and electrical engineering and of servo design which underlies the design of scanners for practical radar sets. Land-based, shipborne, and airborne scanners are treated. Gyroscopically controlled antenna stabilization is discussed. The second part is devoted principally to the practical mechanical, electrical, and aerodynamic problems of the design of radomes (housings for scanners). It also includes discussion of the properties of the most useful materials, and some development of the theory of the effects of such housings on the radiated waves.

COMPUTING MECHANISMS AND LINKAGES

A. Svoboda

This book provides a general discussion of computing mechanisms in general, and a detailed study of the design of bar linkages for use in computers. It includes a full account of novel methods for the design of bar linkages serving as generators of functions of one and two independent variables. Special attention is paid to the design of bar-linkage multipliers.

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A bibliography indexes approximately all of the 2000 technical reports on the microwave radar and Loran navigation research and development program of Division 14 of the NDRC. The reports are indexed by report number, subject, organization, and in the case of MIT Radiation Laboratory, by author. Microfilm prints of the reports are available to those with access to the Summary Technical Reports. A list of titles and an abstract of each book of the Radiation Laboratory Series are given.

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Approximately 2000 technical reports on the microwave, rader and Loran navigation research and development program of Division 14 of the National Defense Research Committee are indexed in this bibliography. Section 1 contains a numerical list of reports which have been assigned Division 14 report numbers. Section 2 is a numerical index of regular reports, manuals, special reports and texts issued by MIT-RL under OSRD contract OEMsr-262. Section 3 is a combined index by subject matter of both Division 14 and MIT-RL reports. Section 4 lists Division 14 reports by the organization responsible for their preparation. Section 5 is an index of MIT-RL reports by author.