

Guide to the Records of the Massachusetts Institute of Technology Servomechanisms Laboratory, 1940-1959 AC.0151

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May 02, 2014

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Summary Information

Repository	Massachusetts Institute of Technology. Institute Archives and Special Collections
Creator	Massachusetts Institute of Technology. Servomechanisms Laboratory
Title	Massachusetts Institute of Technology, Servomechanisms Laboratory records
Date [inclusive]	1940-1959
Extent	56.0 cubic feet (170 manuscript boxes, 5 oversized flat boxes)
Location	Materials are stored off-site. Advance notice is required for use.
Language	English

Citation

Massachusetts Institute of Technology, Servomechanisms Laboratory Records, AC 151, box X. Massachusetts Institute of Technology, Institute Archives and Special Collections, Cambridge, Massachusetts.

Historical note

The Servomechanisms Laboratory was established at MIT in 1940 under the direction of Gordon S. Brown, then assistant professor of electrical engineering. The laboratory grew out of the Department of Electrical Engineering's increasing attention in the fall of 1939 to servomechanisms, specifically fire control (gun-positioning instruments) in response to a request from the U.S. Navy for a special course for naval fire control officers assigned to MIT. Harold Hazen, head of the department, was also Gordon Brown's doctoral advisor and asked him to develop the course. The 1939 MIT Course Bulletin lists for the first time two elective classes (6.605 and 6.606) titled Theory and Applications of Servo Mechanisms with Gordon S. Brown as instructor.

During World War II the laboratory's teams of research scientists and graduate students (who also produced thesis projects from their work) undertook research and development of feedback control systems for the U.S. government (Navy Ordnance, Army Ordnance, and the National Defense Research Committee) as well as commercial contractors. Research included servo-control systems for advanced radar used on U.S. Navy ships. Laboratory director Gordon Brown served as a consultant to the Sperry Gyroscope Company as well as to the War Department.

After World War II ended in 1945, the laboratory's newly created dynamic analysis and control group, directed by Albert C. Hall, continued to develop automated control systems for U.S. Navy guided missiles. In 1946 this group separated to form the Dynamic Analysis and Control Laboratory at MIT, which closed in 1958.

Early laboratory research, originating in 1944 as the ASCA (Aircraft Stability and Control Analyzer) project to develop a flight training simulator, was directed by Jay W. Forrester with the assistance of Robert R. Everett. The research focus was revised in 1946 to include the design and construction of a high-speed digital computer, and the project was renamed Project Whirlwind. In 1951 Project Whirlwind and its staff were separated from the Servomechanisms Laboratory and assigned to the newly created Digital Computer Laboratory, still under the direction of Forrester. Classified research related to development and use of Whirlwind in research projects was simultaneously carried out in Division 6 of the newly formed Lincoln Laboratory. Jay Forrester was director of both the Digital Computer Laboratory and Division 6, and Robert Everett served in both as assistant director.

Other major postwar efforts of the Servomechanisms Laboratory included the development of automatic controls for the reactor rods and instrumentation system of the first peacetime nuclear reactor, constructed in the late 1940s by the Atomic Energy Commission at the Brookhaven National Laboratory.

A significant postwar project that began in 1949 and continued and evolved through the 1950s was the work that led to numerical control of machine tools. Under a contract with the Parsons Company of Michigan, William M. Pease and James O. McDonough designed an experimental numerically-controlled milling machine which received directions through data on punched paper tape. The first working model of a continuous-path numerically-controlled milling machine was demonstrated in 1952. Further research was then carried out under the sponsorship of the U.S. Air Force. Subsequently, the laboratory's Computer Application Group, led by Douglas T. Ross, developed the Automatically Programmed Tool

Language (APT), an easy-to-use, special purpose programming language. Eventually, APT became the world standard for programming computer-controlled machine tools. The Servomechanisms Laboratory staff actively promoted the introduction and use of numerical control for industrial processes. It sponsored conferences and summer sessions aimed at industry personnel. The development of numerical controls had a profound impact on industry as with the introduction of automated controls it revolutionized the machine tool industry. In 1958, further development of the APT system was turned over to a coordinating group sponsored by the Aircraft Industries Association.

Research activities of the Servomechanisms Laboratory broadened in the late 1950s, and a decision was made in 1959 to change the name of the laboratory to the Electronic Systems Laboratory. The laboratory continued to report to the Department of Electrical Engineering until March 1978, when it became an inter-departmental laboratory reporting to the provost. In September 1978 it was renamed the Laboratory for Information and Decision Systems (LIDS).

Directors of the Servomechanisms Laboratory:

Gordon S. Brown, 1939-1952

William M. Pease, 1952-1953

J. Francis Reintjes, 1953-1959 (1959-1974, director of the successor Electronic Systems Laboratory)

More detailed accounts of the research activities of the Servomechanisms Laboratory can be found in the following publications:

A Century of Electrical Engineering and Computer Science at MIT, 1882-1982, by Karl L. Wildes. Cambridge, Mass.: MIT Press, 1985. Chapters 14 and 17.

Numerical Control: Making a New Technology, by J. Francis Reintjes. New York: Oxford University Press, 1991.

Q.E.D.: M.I.T. in World War II, by John E. Burchard. New York: J. Wiley, 1948.

Scope and Contents of the Collection

World War II

The Servomechanisms Laboratory's beginning years, 1940-1945, coincide with World War II and are partially documented in Series 1, files collected by staff member Robert Everett. Memos, graphs, drawings, and final reports relating to research about and application of feedback control to automate navy and army gun control systems, and development of servo-controls for advanced radar systems are the focus of the series. Also included in Series 1 are reports and writings of George Newton, Donald Campbell, H. Tyler Marcy, and other research staff. The mixture of basic research and war-time applications is also represented in a fuller set of memos, technical reports, and writings in the first five boxes of Series 2. Researchers interested in war-time laboratory projects should check both Series 1

and Series 2. Laboratory computation books contain research notes for war-time projects; as books are arranged alphabetically, check the list for dates 1941-1945 and projects numbered 6409 or lower.

Operational Flight Trainer/Project Whirlwind

Records covering the time span 1947-1954 document one of the laboratory's major postwar projects, which was directed by Jay Forrester assisted by Robert Everett (project 6345).

The project, originally called the Aircraft Stability and Control Analyzer Project (ASCA) and also known as the "operational flight trainer," was in development for the Bureau of Aeronautics, U.S. Navy. As the project research moved ahead, its focus moved from the simulator to the development of digital computing and the production of one of the first high-speed digital computers. The project was renamed "Whirlwind." Many Whirlwind engineering notes, memos, and summary reports are found in boxes 5-10 of Series 2. A useful list, January 1945-April 1952 of R-series, M-series, E-series, and C-series project documents, is located in box 10 of Series 2. Other records relating to Whirlwind can be found in two archival collections, the MIT Digital Computer Laboratory, AC 362, and Project Whirlwind Collection, MC 665.

Brookhaven Nuclear Reactor

Researchers interested in the history of nuclear reactors will also find the Servomechanisms Laboratory collection useful. An important postwar project well represented in Series 2 project files is the Brookhaven Nuclear Reactor Project (#6546) headed by William Pease and Truman Gray. The Servomechanisms Laboratory designed and built controls for the reactor rods and instrumentation of the Brookhaven reactor, the first peacetime nuclear reactor. Principal documents are engineering memos and reports dating from 1947 to 1949. Series 3, computation books, also contains laboratory notes for project 6546.

Numerical Control of Machine Tools

The development of numerical control systems (1949-1959, contract numbers 6694 and 6873) revolutionized the machine tool industry. Research on numerical control development and applications has by far the most extensive and richest documentation in the collection, totaling 30 boxes of reports, computation books, engineering reports, and memos, as well as 5 boxes of technical drawings. Researchers should check Series 2, boxes 26-27 and 52-53, for computation books relating to project 6694, numerical control. Information about the first demonstration of the numerically-controlled milling machine held in September 1952 can be found in Series 2, box 37.

Numerical control research was first sponsored by Parsons Corporation, Michigan (project 6694), then, starting in 1952, by the U.S. Air Force, Air Material Command (project 6873). Numerical control research information is in the following boxes of Series 2: boxes 26-28, 38, 64, and 81-85. Because Series 2 is arranged by project number, information about numerical control research is separated within the list, so both project numbers should be checked. Within the subset of project 6873, files are arranged alphabetically by title. It is advisable to browse all file titles numbered 6873 to understand the full complement of research activities. A summary, project statements, and history can be found in boxes 43 and 48, and the final report in box 85.

Automatic Programming Systems

The later phase of numerical control research in the middle 1950s was done by the laboratory's Computer Application Group, led by Douglas T. Ross, to develop the Automatically Programmed Tool Language (APT) for the introduction of the APT manufacturing system. APT programming manuals and development reports are located in Series 2, boxes 32-35.

Other

Much of the research in the Servomechanisms Laboratory was carried out by graduate students as part of their thesis work. A list of graduate theses covering the years 1937-1950, located in Series 2, box 80, offers information about thesis projects, and the computation books constituting Series 3 contain data for many different thesis projects. The Institute Archives retains a copy of all master and doctoral degree theses, accessible by name of student or advisor by searching the MIT Libraries' online catalog.

Economic evaluations of the potential application of research products is located in box 38, Series 2, and texts and documents about the summer course for industry personnel (1954-1955) are in Series 2, boxes 41 and 42. Patents can be found in box 45 of Series 2.

Arrangement note

Project reports can be found in both Series 1 and 2. Files kept by Robert R. Everett and transferred to the Institute Archives from MITRE Corporation in 1979 were kept together as Series 1. Other project files, transferred from Laboratory for Information Systems and Design in 2002, are designated as Series 2.

Project files in Series 2 are arranged in the order in which they were kept by the laboratory, by project number assigned by the MIT Division of Industrial Cooperation (DIC). Numbers are assigned chronologically campus-wide as grant contracts are signed, so Series 2 files are roughly in chronological order.

Detailed engineering drawings and wiring diagrams compiled for research project reports are located in Series 2, boxes 28, and 81-85, and can be matched to reports by project number.

A large set of laboratory computation books created by graduate students and laboratory staff was transferred to the Archives in 1980. Books dated from 1940 to 1959 constitute Series 3 of this collection. The original alphabetical arrangement by author, existing at transfer, has been maintained. A small number of computation books relating to the numerical control project were not transferred in 1980 but were part of the transfer of files in 2002. Therefore, researchers should check Series 2, boxes 26-27 and 52-53, for computation books relating to project 6694, numerical control, that were transferred in 2002.

Administrative Information

Publication Information

Massachusetts Institute of Technology. Institute Archives and Special Collections (1987, 2002-2004)

Revision Description

2009, 2012

Access note

The collection is open for research.

Intellectual Property Rights

Access to collections in the Institute Archives and Special Collections is not authorization to publish. Separate written application for permission to publish must be made to the Institute Archives. Copyright of some items in this collection may be held by respective creators, not by the creating office.

Related Materials

Related Materials

As the work of the Servomechanisms Laboratory broadened in scope, its name was changed in 1959 from Servomechanisms Laboratory to Electronic Systems Laboratory. Records of the Electronic Systems Laboratory constitute a separate but closely related collection (AC 528) and should be consulted by those studying research projects conducted in the mid-to-late 1950s.

Other related collections in the Institute Archives and Special Collections

Gordon S. Brown papers, MC 24 (includes a 1985 oral history)

Walter Rosenblith papers, MC 55 (includes a 1982 oral history of Gordon Brown, Julius Stratton, and Victor Weisskopf)

Computers at MIT Oral History Collection, 1976-1977, MC 131 (Robert R. Everett, Jay W. Forrester, Harold Hazen)

Jay Forrester papers, MC 439 (includes a 1975 oral history)

Harold Hazen papers, MC 106

George Newton papers, MC 239

J. Francis Reintjes papers, MC 489

John E. Ward papers, MC 567

MIT Digital Computer Laboratory records, AC 362

Project Whirlwind Collection, MC 665

MIT Office of Sponsored Programs, grant and contract records, AC 157

Controlled Access Headings

Corporate Name(s)

- Massachusetts Institute of Technology. Servomechanisms Laboratory

Genre(s)

- Engineering drawings.

Personal Name(s)

- Brown, Gordon Stanley, 1907-1996
- Everett, Robert R.
- Forrester, Jay Wright
- Reintjes, J. Francis
- Ross, D.T. (Douglas Taylor)

Subject(s)

- DIC 6345.
- Electronic digital computers.
- Fire control (Aerial gunnery)
- Fire control (Gunnery)
- Massachusetts Institute of Technology--History
- Project Whirlwind.
- Radar--Antennas--Research.

- Servomechanisms--Design and construction.
- Whirlwind computer.

Bibliography

Burchard, John E. *Q.E.D.: M.I.T. in World War II*. New York: J. Wiley, 1948. MIT Libraries.

Reintjes, J. Francis. *Numerical Control: Making a New Technology*. New York: Oxford University Press, 1991. MIT Libraries.

Wildes, Karl L. *A Century of Electrical Engineering and Computer Science at MIT, 1882-1982*. Cambridge, Mass.: MIT Press, 1985. MIT Libraries.

Gutttag, John, editor. *The Electron and the Bit: EECS at MIT, 1902-2002*. MIT, Department of Electrical Engineering and Computer Science, 2005.

Project Files of Robert R. Everett

Collection Inventory

Series 1. Project Files of Robert R. Everett 1941-1947

Box

Project DIC #6179: Fuze Setter. Tests and Recommended Modifications of the T 33 Fuze Setter 1943

1

Project DIC #6043 (Hydraulic Transmissions, A-2 Antenna): Dodd, Stephen H., Jr., Design and Test of a Hydraulic Transmission 1945

1

Project DIC #6043: Dodd, Stephen H., Jr., memorandums 1943-1944

1

Project DIC #6043: Dodd, Stephen H., Jr., notes and graphs of the XP-1 and XP-2 Variable Stroke Axial Pump undated

1

Project DIC #6043: Memorandums B-T 1943-1945

1

Project DIC #6043: Pilot Model SG 3 Servos, drawings 1944

1

Project DIC #6043: Pilot Model SG-3 Servos, list of drawings as built by Westinghouse Brake 1944

1

Project DIC #6043: Pilot Model SG-3 Servos, Operating Instructions 1944

1

Project DIC #6043: Pilot Model SG-3 Servos, parts lists 1944

1

Project Files of Robert R. Everett

Project DIC #6043: Summary of the Engineering Data of the Antenna Hydraulic Servo Units Designed for the Raytheon Manufacturing Co. 1945	1
Project DIC #6043: Weekly Work Reports from Division T 1943-1944	2
Project DIC #6152: Hydraulic Transmissions, Oilgear. Automatic Control Characteristics of a .682 Cubic Inch Per Revolution Oilgear Hydraulic Transmission 1943	2
Project DIC #6469: Power Drives. Power Drive for Navy Wing-Tip Turret 1947	2
Project DIC #6041: Remote Control Systems. Description and Operating Instructions of the Sperry MIT Automatic Remote Control Systems for the T-36 Gun Motor Carriage 1942	2
Project DIC #6041: Remote Control Systems. Description and Operating Instructions of the Remote Control System T-8 for the T-62 Gun Motor Carriage 1942	2
Project DIC #6047: Remote Control Systems. Description and Operating Instructions of the Sperry Automatic Remote Control System T-15 for 37 mm and 40 mm Carriage 1942	2
Project DIC #6047: Remote Control Systems. Installation Instructions for the T-29 Director with the T-15 Remote Controls 1942	2
Project DIC #6047: Remote Control Systems. Studies on the Remote Control Systems M-1 and M-5 1942	2
Ahrendt, W. R., <i>Analysis of Resistance - Capacitance Null Circuits</i> 1945	2

Project Files

Campbell, Donald P., *A Discussion of the Decibel Log Frequency Methods of Analysis and Synthesis of Automatic Control System Behavior* 1945 2

Newton, George C., MIT Servomechanisms Laboratory, Council on Symbols, *Manual of Schematic Diagrams* 1941 2

Nichols, Nathaniel B., *Hydraulic Transmission Theory* 1942 2

Marcy, H. Tyler, *Parallel Circuits in Servomechanisms* 1946 2

Marcy, H. Tyler and Irving H. Van Horn, Jr., *Factors Limiting the Load Inertia of a Servomechanism* 1942 2

Van Horn, Irving H., Jr., *Studies of .341 Cubic Inches Per Revolution Oilgear Hydraulic Transmission and Stroke Control* 1946 2

Series 2. Project Files 1940-1959

Box

Project 5955A, Report, "The Development of MIT Torque Motors for the Period March 1941 to March 1942" 1941-1942 1

Project 5955A, Memorandum, "Tests to Determine Characteristics of an Hydraulic Power Transmission" 1941 June 24 1

Project 6041, Report, "Automatic Remote Control Systems for the T-35 Gun Motor Carriage" 1942 August 11 1

Project Files

Project 6041, Report, "Description and Operating Instructions for Remote Control System T-8 for the T-62 Gun Motor Carriage" 1942 November 23	1
Project 6043, Report, "SG3 Antenna Stabilizing System, Advanced Technical Release" 1944 April	1
Project 6043, Report, "Antenna Hydraulic Servo Units Designed for Raytheon Manufacturing Company" 1945 March	1
Project 6043, Report, "Design and Test of a Hydraulic Transmission for Raytheon Manufacturing Company" 1945	1
Project 6043A, Report, "Preliminary Report – Investigation of Causes of ‘Spoking’ in Raytheon Remote PP1 (VD-2)" 1944 October 10	1
Project 6047, Memorandum, "Cold Tests on Two Oil Units for 40 M/M Gun" 1942 July 29	1
Project 6047, Report, "Description and Operating Instructions – Sperry MIT Automatic Remote Control System T-15 for the 37 MM and 40 MM Cartridges" 1942 August 31	1
Project 6047, Report, "Supplement to Instruction Guide – Remote Control System M-1" 1942 September 28	1
Project 6047, Report, "Report of Studies on the Remote Control Systems M-1 and M-5" 1942 November	1
Project 6047, Report, "Installation Instruction for the T-29 Director with the T-15 Remote Controls" 1942 December 7	1

Project Files

Project 6047, Report, "Report on Remote Control System T-15" 1943 June 1	1
Project 6060, Technical Note 57-159, "Gradient Methods for the Computer Solution of System Optimization Problems" 1957 September	2
Project 6097, Report, "Instruction Manual – Servomechanism for 90 MM Combination Fuze-Setter, Rammer T7" 1943 February 1943	2
Project 6117, Report, "Description and Operating Instructions for the Oil Gears M3B1 When Used with the Remote Control System M9 or M10" 1943 March 1	2
Project 6117, Report, "Specifications and Test Procedure for Oil Gear M3" 1943 May 4	2
Project 6132, Report, "Description and Operating Instructions for the Remote Control System T6E1 When Used with the 75 MM Gun Carriage T8E1" 1943 March 16	2
Project 6145, Report, "Description and Operating Instructions for Control System and Oil Gears M3B1 as Modified for T-65-1 Gun Carriage, Preliminary" undated	2
Project 6145, Report, "Description and Operating Instructions for Control System and Oil Gears M3B1 as Modified for T-65 Gun Carriage Motor" 1943 October	2
Project 6146, Report, "On-Carriage Manually-Controlled Power Drive System for a 40 MM Antiaircraft Gun Mount" 1943 November 25	2
Project 6146, Report, "Notes on Installation and Operation of 7-10 Drive Controller as a Local Control System for 40 MM. Gun M2 with Oil Gears M3" 1944 March	2

Project Files

Project 6151, Report, "Report on DIC Project 6151" 1943 September 28	2
Project 6152, Report, "Automatic Control Characteristics of a 0.682 Cubic Inch Per Revolution Oilgear Hydraulic Transmission" 1943 June	2
Project 6152, Report, "Variable-Speed A-C Operation of a Stunt Motor" 1943 October	2
Project 6152, Report, "Notes on Materiel – Description and Operating Instructions for the ‘Servotraverse’ Mechanism for Medium Tanks M4 and Modifications" 1943 December	2
Project 6152, Report, "Experimental and Design Studies of the Servotraverse Mechanism for Medium Tanks M4 and Modifications" 1944 February	2
Project 6168, Report, "Development of a Servo Control System for Guided Missiles – Preliminary Report" 1945 July 2	3
Project 6168, Report, "Development of a Servo Control System for Guided Missiles" 1945 October 31	3
Project 6172, Report, "Description and Operating Instructions for Experimental Navy Quad Mount Director" 1945 July 23	3
Project 6175, Report, "Report on Tests on Army Director Mount T75 Equipped with T30B1, T30B2 and T4E1 Sights" 1943 November 12	3
Project 6179, Report, "Tests and Recommended Modifications of Fuze Setter, 733" 1943 June 21	3

Project Files

Project 6182, Report, "Report on Work Performed Under OSRD Contract OEMsr 1167" 1944 July 11	3
Project 6198, Report, "Description and Operating Instructions for H2K Indicator Servo" 1944 April	3
Project 6206, Report, "Description and Operating Instructions for An/APS-I Indicator Servo" 1944 February 3	3
Project 6208, Report, "Life Test Studies on Oil Gears M3B1" 1943 November	3
Project 6208, Report, "Installation and Alignment of Oil Gears M3 – 40MM, Antiaircraft Gun Material M2" 1944 January 17	3
Project 6209, Report, "Description and Operating Instructions for Drive Controller T-14 and Modified Oil Gears M3B1 on T-65-E1 Gun Motor Carriage" 1943 December	3
Project 6209, Report, "Description and Operating Instructions for Drive Controller T-14 and Modified Oil Gears M3B1 on Gun Mount T-98" 1944 March	3
Project 6219, Report, "Report of Test on Slide Block Bearing Assembly of M3 Oilgear" 1944 January 15	3
Project 6219, Report, "Description of Local-Remote Power Control System for 40 MM. Gun Mount M3" 1944 August	3
Project 6221, Report, "Investigation of Power Drives for Gun Director, MK 49" 1945 May	3

Project Files

Project 6234, Report, "Description of Servo-Stabilized 40 MM. Power Drive for Single 40 MM. Gun Mount M3" 1944 August	4
Project 6234, Report, "Report on Development of Servo Stabilized Drive for Single 40 MM Gun Mount and Adaptation of the Drive to Remote Control" 1945 August	4
Project 6234, Report, "Performance Specifications for Servo Stabilized 40 MM. Power Drive" 1945 October 2	4
Project 6235, Report, "Report on the Investigation of Field Troubles Encountered in Fuze Setter Amplifier M1A1" 1945 July 6	4
Project 6248, Report, "Feasibility of an On-Carriage Lead-Computing Sight for the 90 MM Antiaircraft Gun" 1944 September	4
Project 6256, Report, "Description and Operation of the Stabilized Damper System and the Stabilized Power Tracking System for Handstand Directors" 1945 January 29	4
Project 6269, 6270, 6271, Report, "40 MM Gun Carriage M241 Equipped with MK 14 Gun Sight, T23 Drive Controller, T1E1 Target Selector, and an M3E1 Azimuth Oil Gear" 1945 June 20	4
Project 6288, Report, "Specifications for Pilot Models of Servotraverse Mechanism, Model #2 for the Heavy Turret" 1945 January 20	4
Project 6288, Report, "Requirements of a Tank Stabilization System" 1945 March 6	4
Project 6288, Report, "Description of Stroke Control for Elevating Mechanism" 1945 September 14	4

Project Files

Project 6288, Memorandum, "Compensatory Network for Power Cylinder Elevating Mechanism" 1946 January 6	4
Project 6288, Report, "Description and Operating Instructions for MIT Fire Control System for the Heavy Tank T29" 1946 May	4
Project 6288, Report, "The Open Cycle Frequency Response Tests of the Heavy Tank T29 Elevating Mechanism" 1947 May 13	4
Project 6295, Report 22, "Preliminary Investigation of Summing Circuits" 1945 February 22	4
Project 6295, Report 44, "Detectors, Phase-Sensitive, Full-Wave" 1945 April 20	4
Project 6305, Memorandum, "Amplidyne Tests – Summary of" 1946 January 25	5
Project 6305, Report, "Manual of Operation and Maintenance Instructions for the Modified A-31 Aircraft Turret" 1947 January 1	5
Project 6345, Engineering Note E-84, "Model Two Crystal Tester" 1947 December 16	5
Project 6345, Engineering Note E-121, "Gate and Delay Unit" 1948 May 14	5
Project 6345, Engineering Note E-126, "Scope Synchroniser" 1948 July 21	5
Project 6345, Engineering Note E-137, "Performance of Chains of Gate Tubes" 1948 August 5	5

Project Files

Project 6345, Engineering Note E-144, "Basic Circuits – Revisions" 1948 September 16	5
Project 6345, Engineering Note E-232, "Results of Tests of RT47, RT47-1 and RT-50, Beam-Analyzer Tubes" 1949 May 2	5
Project 6345, Engineering Note E-245, "Calculation of Correlation Functions by WWI" 1949 June 1	5
Project 6345, Engineering Note E-264, "The History of the Development of High-Vacuum, Hot-Cathode, Electrostatic Electron Guns" 1949 July 25	5
Project 6345, Engineering Note E-281, "Multivibrator Frequency Divider" 1949 August 22	5
Project 6345, Engineering Note E-317, "Flip-Flop Balance Checking in WWI" 1950 February 23	5
Project 6345, Engineering Note E-323, "Standard Operating Conditions for 100-Series Whirlwind Electrostatic Storage Tubes" 1950 January 19	6
Project 6345, Engineering Note E-328, "Pulse Transformers and Interstage Coupling in Whirlwind I" 1950 Januar 31	6
Project 6345, Engineering Note E-329, "Techniques for Using Standard Automatic Subroutines" 1950 February 10	6
Project 6345, Engineering Note E-337, "Accelerated Life Test for Cathode Interface in Receiving Type Tubes (A paper presented at the MIT Conference on Physical Electronics, March 30, 1950)" 1950 April 3	6

Project Files

Project 6345, Engineering Note E-338, "Test Results of L9B and F8B Productions of TAD7 Tubes" 1950 April 11	6
Project 6345, Engineering Note E-345, "The Transition Region between Negative and Positive Regions of Storage Tube Surfaces" 1950 June 15	6
Project 6345, Engineering Note E-352, "Compensation of Deflection Defocusing in Storage Tubes" 1950 June 15	6
Project 6345, Engineering Note E-356, "Equipment and Techniques for Inserting Information into WWI" 1950 July 12	6
Project 6345, Engineering Note E-380, "Operation of Interim Tape Reader Equipment" 1950 September 12	6
Project 6345, Engineering Note E-392, "Crystal Diode Investigation – Initial Results" 1950 November 2	6
Project 6345, Engineering Note E-393, "Marginal Checking System, WWI" 1950 December 2	6
Project 6345, Engineering Note E-395, "Cathode Interface Impedance and its Effects in Aged Vacuum Tubes (Paper delivered at conference on electron tubes for computers in Atlantic City, New Jersey, December 11, 12, 1950)" 1951 January 2	6
Project 6345, Engineering Note E-396, "Crystal Diode Life Experience in WWI Computer Circuits (Paper delivered at conference on electron tubes for computers in Atlantic City, New Jersey, December 11, 12, 1950)" 1951 January 2	6

Project Files

Project 6345, Engineering Note E-397, "Some Basic Relay Pulse Circuits of General Interest" 1951 January 18	6
Project 6345, Engineering Note E-400, "Vacuum Tube Pulse Current Tester" 1951 March 15	6
Project 6345, Engineering Note E-406, "Preliminary Tests on the Four-Core Magnetic-Memory Array" 1951 June 18	7
Project 6345, Engineering Note E-407, "Electrolytic Corrosion as a Possible Future Source of Trouble Affecting WWI Reliability" 1951 June 25	7
Project 6345, Engineering Note E-408, "Transistor Conference, June 12, 1951" 1951 July 3	7
Project 6345, Engineering Note E-410, "The Complimentary Circuit Method for Determination of Interface Resistance" 1951 July 23	7
Project 6345, Memorandum M-62, M-63, M-64, M-66, M-69, M-76, "Lectures by Project Whirlwind Staff on Electronic Digital Computers" 1947 March and April	7
Project 6345, Memorandum M-77, "Use of a D.C. Restorer Circuits as a Means of Eliminating D.C. Coupling in Digital Computer Circuits" 1947 May 28	7
Project 6345, Memorandum M-103, "Gate-Tube Development" 1947 September 17	7
Project 6345, Memorandum M-207, "Meeting of Electronics Group, January 7, 1948" 1948 January 9	7

Project Files

Project 6345, Memorandum M-769, "Tube Characteristic Drawings" 1949 February 1	7
Project 6345, Memorandum M-788-1, "Suggestions for Mental or Manual Binary Conversion" 1949 February 16	7
Project 6345, Memorandum M-969, "Accelerated Life Test for Cathode Interface" 1950 January 19	7
Project 6345, Memorandum M-1000, "A Proposed Binary to Analog Converter" 1950 March 6	7
Project 6345, Memorandum M-1020, "Conference on Automatic Computing Machinery, Rutgers University (March 28-29, 1950)" 1950 April 6	7
Project 6345, Memorandum M-1036, "The Differential Analyzer Approach in Digital Computers" 1950 May 3	8
Project 6345, Memorandum M-1038, "Checking the Holding Ability of Flip-Flops" 1950 May 9	8
Project 6345, Memorandum M-1045, "Data on Electron Gun Currents in MIT Storage Tubes" 1950 May 18	8
Project 6345, Memorandum M-1056, "Development of Type SR-1047 Vacuum Tubes: Tests on Lots D-2 and C-9674" 1950 June 20	8
Project 6345, Memorandum M-1226, "Additions to Project Reports of Current Interest, Report R-173-1" 1951 June 8	8

Project Files

Project 6345, Memorandum M-1247, "The Electronic Temperature of Oxide Cathodes – Methods of Measurements and Results by Robert Champeix, Doctor of Engineering, Laboratory Heud, The Society La Radiotechnique" 1951 July 19	8
Project 6345, Memorandum M-1252-M-1484, "Project Whirlwind – Bi-Weekly Reports" 1951 August 6 to 1952 May 9	8
Project 6345, Memorandum M-2741, "Operating Procedure for CSII" 1954 April 21	9
Project 6345, Report L-3, "Forecast for Military Systems Using Electronic Digital Computers" 1948 September 17	9
Project 6345, Report R-129, "Conversion of Shaft Position to Binary Code" 1947 October 15	9
Project 6345, Report R-133, "Timing of Whirlwind I" 1947 December 15	9
Project 6345, Report R-142, "Talk Delivered by Jay W. Forrester at UCLA" 1948 July 29	9
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