CENTER SERIES
LOUIS LEOPOLD PAPERS

Born in Boston Mass on March 8, 1918 to Nathan and Mary (Meyers), Leopold's interest in electronics developed about age 5 or 6 through building crystal radios. In 1941, he earned a B.S. in chemistry and sciences from the University of Michigan. As a Captain in the U.S. Army Air Force during World War II, he attended Harvard-MIT Radar School (1943). After the war he worked as an Electrical Engineer for Kaiser-Frazer Corporation (1946-1949) and attended graduate studies in Electrophysiology at the University of Chicago Medical School (1949-1951). On December 27, 1947 he married Wilma Erika Miron. They had one son, Robert Louis. From 1952-1953 he worked as an Electronics Development Engineer for Magnecord in Chicago, before working as a Senior Electronics Project Engineer and Group Leader at Motorola Inc. While working for Motorola (1953-1959), he attended a one-year transistor course at Northwestern University (1953-1954), received a BSEE [bachelor of science, electrical engineering] from the Illinois Institute of Technology (1958), and began part-time studies on an MBA at the University of Chicago. In 1959 he joined the NASA Space Task Group at Langley, Virginia as an Electronics Research Engineer in the Electrical & Mechanical Systems Branch for Project Mercury, responsible for the communication systems onboard the Mercury capsules, including telemetry, voice, and antennas. From 1960-61, he served as the Project Mercury Representative at McDonnell Aircraft Corporation in St. Louis, monitoring and evaluating all electrical and electronic systems being manufactured for the Mercury space vehicles. In July of 1961, he became the group leader for the Antenna and Microwave Group for the Apollo vehicles in the Electronic Systems Section, Flight Systems Division. His responsibilities included radio frequency interference, radiation, and propagation tests and for the design and installation of three antenna ranges and the anechoic chamber where Apollo and other space vehicles were checked out for electrical, electronic, and radiation characteristics. JSC named Leopold Acting Head, Antenna Systems Section in April 1963, supervising the engineers developing the CM, SM, and LEM antenna systems, transmission lines and microwave units. A year later he became Senior Project Engineer in the Electromagnetic Systems Branch Instrumentation and Electronic System Division. Command Service Module flight antennas included VHF, S-Band and C-Band. The directable antenna systems included the LEM steerable antenna, CSM High Gain antenna and the Rendezvous radar antenna. He worked as Project Engineer on the CSM Omnidirectional Antennas. In 1969, Leopold was named Experiment Manager for the Apollo Lunar Exploration Missions (ALEM) in the Tele/Communications Systems Division (TCSD). As System manager for two lunar experiments, the S-Band Transponder & Bistatic Radar, he worked closely with the Science & Applications Division. After Apollo, Leopold focused on designing the microwave portions of new vehicles, the Solar-Powered Spacecraft and the Space Station. In 1977 he conducted an in-house study of solid state devices for SPS application. Leopold was recognized with four Group Achievement Awards; Mercury Project Office, 1962; Gemini Support Team, 1966; Lunar Landing Team, 1969; and the 'J' Mission Spacecraft Development Team, 1971. These documents arrived at the UHCL Archives in no particular order via donation in August 2006. Loose documents were loosely grouped by topic to our best determination. Other folders containing multiple memos and correspondence were kept together with the same heading. Twenty-seven series emerged when grouping materials. The Manned Spacecraft Deep Space Antenna Study contains multiple proposals, brief technical summaries, and the final engineering report by Hughes. Apollo Antennas materials are grouped loosely by proposals, specifications/certification/data, memos/TWX, and printed reports. Seven folders of memos and TWX are related to work developing various Apollo antennas. These papers were not found in any discernable order and have been grouped as found, unsorted. Leopold kept personal notebooks to track ideas, progress, meeting notes, action items, and other information as needed from 1965-1967 regarding the development of various Apollo antennas. The bulk under this heading consists of antenna documents, publications, presentations related to telecommunications for manned spaceflight, ultimately Apollo program. VHF Recovery Antenna series contains memorandum, specifications, requirements, and radiation pattern data for development of the VHF Recovery Antenna used on the Apollo Command Service Module. The S-Band Antenna is a general navigation antenna also used in various ALEM experiments. Some documents in this section refer to both the VHF Recovery and S-Band Antennas on the CSM. Documents include descriptions of the test setup, measurements and results of the block II S-band Omni pattern measurement on the CSM. Specification documents cover the requirements for the design, performance and testing of one type of omni flush mounted s-band antenna equipment. Three documents relate to the Unified S-Band system contracted to Collins Radio Company and incorporated into the Manned Space Flight Network to provide the primary tracking and communications data between earth and spacecraft. The Apollo S-Band High Gain Antenna documents cover the study, development of, and presentations addressing the design and configuration of the 2kmc high gain antenna mounted to an extendable boom attached to the base of the service module. The S-Band Transponder experiment used precision Doppler tracking data of the CSM, LM and sub-satellite to provide new detailed information about the near side lunar gravity field. Records include purpose, objectives, statement of work, correspondence, progress and status reports. Stanford University's Center for Radar Astronomy submitted proposal RL 14-69 and received NASA contract NAS 9-10579 to conduct dual frequency Bistatic-radar observation of the lunar surface utilizing telemetry transmissions from the Apollo CSM. H Taylor Howard served as the principal investigator for the experiment. The Stanford-Apollo Bistatic Radar Experiment design was used to determine the principal electromagnetic and structural properties of the lunar surface from

observations of radio energy in near forward scatter by reflecting radio transmissions from the orbiting CSM off the lunar surface and back to Earth. The experiment utilized radio equipment and antennas normally carried for communication between CSM & LM and CSM and Earth. Documents include reports on early bistatic-radar experiments studying the lunar surface in 1967 using Explorer XXXV spacecraft, Stanford University proposals, and memorandum, data, and presentation documents related to NAS 9-10579 contract. Chronological correspondence folders were created from the loose pages found within the donation. First presented in 1968 by Dr. Peter Glaser of the A.D. Little Engineering firm, the Solar Power Satellite concept involved placing a large solar collector in geosynchronous orbit collect and convert solar energy to electrical energy, which is then transmitted via microwave technique to the Earth. The concept was analyzed by a number of groups and NASA in the early 1970s. Lou Leopold, assisted by Dr. Tom Gerson, performed an in-house study during the summer 1977, testing solid state devices for SPS application to identify those capable of generating microwave output power in excess of one watt efficiencies greater than 25%. Satellite Services documents contain presentation information from the 1982 Satellite Services Workshop, a forum for the exchange of information and identification of key issues associated with on-orbit servicing of satellites. Wireless Crew Communications Unit materials include selected weekly activity reports for the Electromagnetic Systems Section (Oct 1985) minutes from the JSC/KSC/VAFB Flight Equipment Operations Teleconference, and Space Shuttle Program Office Orbiter Logistics Control Board. Additional documents reflect trip reports, test preparation sheets, drawings and drawing change notices regarding the Zinc-Air Batteries. Tracking and Communications Division documents include the 1983 TDRSS Flight 1 KSA Anomaly Review, 1989-1990 Staff Meeting notes, and the FY1993 Annual Summary. The TDRSS: Tracking and Data Relay Satellite System developed by Goddard in the late 1970s, early 1980s, provided communications and tracking services to low-Earth orbiting user satellites and manned space missions. When launched in 1983, TDRSS Flight 1 was the largest and most sophisticated communications satellite ever built. Advanced Communications Technology Satellite, the first high-speed, all-digital communications satellite, was conceived in 1979 and consists of two segments: flight & ground. The flight segment (launched into geostationary orbit in September 1993) contains two sections – spacecraft bus and the Multi-beam Communications Package (MCP). Leopold worked on the separate Ka-band (30/20 GHz) antennas used for transmitting and receiving signals. Leopold kept various weekly and monthly activity reports for the Lockheed Electromagnetic Systems Section showing progress on various jobs including antenna analysis, multiple communication access issues, ERPCL, and ACTS. The Extended Range Payload Communications Link initially started in 1987 as DPCL Program using Air Force funding until the program was cancelled 1988. Funding resumed from NSTS Program Office and ERPCL flight hardware built 1991-1992 to support the SPAS-ORFEUS on STS-58 (9/92) Their objectives were to develop a low cost payload communications system to significantly extend the communication range for deployed payloads from 10 nautical miles to 100 nautical miles. ERPCL operates at S-band and utilizes the existing orbiter payload interrogator, fastens to the starboard side of the orbiter, with enough clearance for door closure. Deployed payload can be used at short ranges and switched to ERPCL for longer ranges. Supports both NASA and DOD payloads. Orbiting Retrievable Far and Extreme Ultraviolet Spectrometer – Shuttle Pallet Satellite is a remote manipulator system (RMS) deployed and retrieved free-flying payload to provide information on star formation and the properties of the interstellar medium. It was one of four planned missions in cooperation with the German Space Agency Deutsche Agentur Fur Raumfahrt-Angelegen (DARA) and the Office of Space Science and Applications (OSSA) at NASA Headquarters. Documents include minutes from a payload operations meeting and a flight planning annex document. The collection concludes with miscellaneous printed matter unrelated to any specific antenna design done by Leopold for a specific program.

Inventory

SubHeading:	Box Number: 01	
Personal	Biographical Notes	1955-1992
Personal	Introduction to ADA Programming and Software Development * University of Houston at Clear Lake City	March 1982
Personal	Bandpass matching to complex loads * lecture notes	ND
Personal	Semiconductor Equipment & Materials Institute Talk	March 1986
Personal	Writings: Apollo Manned Spacecraft Antenna Systems for the Lunar Mission	1969
Personal	Writings: Apollo Omnidirectional Antenna Design with Reentry Considerations	ND
Personal	Writings: Full Scale Apollo Manned Spacecraft Omni Antenna Measurements * Abstract	1967
Personal	Writings: S-Band Antenna Measurements for Manned Flight on the Apollo Program	February 1968
Personal	Writings: Design of the Apollo Helical	ND

	Omnidirectional S-Band Antenna	
Personal	Conference Notes	ND
Personal	Programming with Fortran Language * includes punch cards * University of Houston	1962
Personal	Programming with Fortran Language Primer * University of Houston	1962
Personal	UH Electrical Engineering Antenna Theory assignments	1966
Personal	Distinctions of Leadership * lecture notes	June 1992
Personal	Amplifier Design (lecture notes)	December 1985
SubHeading:	**Box Number: 02**	
Photographs	Lockheed Antenna Study Photographs	ND
Photographs	Official Photogaphs and Prints Apollo & Gemini flights	1969
Photographs	Microwave Integrated Circuit Facility Photographs	1985
Organization	MSC Announcement 71-52	April 1971
Organization	MSC Engineering & Development Directorate vacancies	1971
Organization	Future Communications Ad Hoc Team	1977
Organization	NASA Johnson Space Center Benefits Handbook	August 1990
Organization	Total Quality at the Johnson Space Center	March 1991
Test Facilities	Langley Research Center Facility No. 646 Drawing * oversized	March 1961
Test Facilities	Antenna Range and Anechoic Chamber Design Criteria	1962
Test Facilities	Proposal for an Antenna Test Range * Northrop	March 1962
Test Facilities	MSC Master Plan J3 Drawing * oversized	April 26, 1962
Photographs	Anechoic Chamber testing * Lunar Roving Vehicle * LRV	1967-1975
Photographs	Apollo Antenna Photographs	1964-1968
Photographs	Helmet Antenna photographs	ND
Photographs	Extended Range Payload Communication Link ERPCL Photographs	1991-1992
Photographs	Space Station Freedom Print	1990
Organization	Space Task Group (STG) Organization	1961
Organization	Apollo Spacecraft Program Office Organization	1963
Organization	Management Instruction 7100.1 Conduct of Space Science Program	April 29, 1964
Test Facilities	Aircraft Radome Test Facility Proposal * Lockheed	April 21, 1961
Test Facilities	Eccosorb Anechoic Chambers Requirements	1961
Organization	Reorganization of the Instrumentation and Electronic Systems Division	June 22, 1965
SubHeading:	**Box Number: 03**	
Test Facilities	Concept Study for Antenna Range and Associated Facilities Building 14 * Lummus	Sept. 5, 1963
Test Facilities	NASA MSC Antenna Range and Facility * Building 14 * Notes	1963-1964
Mercury	Mercury Amplifier System * 2 folders	1959-1960

Mercury	Biconical Antenna Feed & Antenna Fairing Tie Details – Drawing * oversized	1959
Mercury	C Band Radar Beacon 621D-1 P/O MAC 133 Communications Subsystem Design Approval Test Procedure * ACF Electronics	Sept. 22, 1959
Mercury	Communication System Checkout Procedures * McDonnell * Contract NASA 5-59	April 1960
Test Facilities	Building 14 Addition Project Justification	ND
Test Facilities	Proposed Test Procedure for Setting-up and Determining Accuracy of NASA-MSC Radar Boresight Range	Sept. 26, 1963
Mercury	Scimitar Antenna Characteristics	1956-1957
Mercury	Design Approval Test Procedure for UHF Rescue Antenna 237L-1	June 19, 1959
SubHeading:	**Box Number: 04**	
Mercury	RCA Design Philosophy and Performance Characteristics of the AN/FPQ-6 and AN/TPQ-18 Radars	March 23, 1961
Mercury	Project Mercury Logic Diagram Capsule 15	May 1961
Mercury	Battery and Inverter Temperature Power Evaluation during Simulated 3-orbit Mission Profile * McDonnell	May 8, 1961
Mercury	Electrocardiogram * EKG * Amplifier Specification Control Drawing	May 18, 1961
Mercury	Qualification Test Report for Mercury EKG Amplifier MAC P/N 45-88926-1 TRW P/N 805024 to meet MAC SCD 45-88726 Rev. C	Sept. 22, 1961
Mercury	Model 133-Project Mercury Capsule No. 16 Capsule System Tests CST-16 Final	February 15, 1962
Manned Spacecraft Deep Space Antenna Study (RFP MSC-63-752P)	AVCO Proposal for Manned Spacecraft Deep Space Antenna Study	August 20, 1963
Manned Spacecraft Deep Space Antenna Study	Conductron Proposal for Manned Spacecraft Deep Space Antenna Study	August 22, 1963
SubHeading:	**Box Number: 05**	
Manned Spacecraft Deep Space Antenna Study	Motorola Proposal for Manned Spacecraft Deep Space Antenna Study	August 21, 1963
Manned Spacecraft Deep Space Antenna Study	Space-General Proposal for Manned Spacecraft Deep Space Antenna Study, Vol. 1 Technical	August 21, 1963
Manned Spacecraft Deep Space Antenna Study	Westinghouse Proposal for Manned Spacecraft Deep Space Antenna Study	August 20, 1963
Manned Spacecraft Deep Space Antenna Study	Technical Evaluation of Manned Spacecraft Deep Space Antenna Study Proposals	September 1963
Manned Spacecraft Deep Space Antenna Study	Cutler-Hammer Proposal for Manned Spacecraft Deep Space Antenna Study	August 1963
Manned Spacecraft Deep Space Antenna Study	Dalmo Victor Proposal for Manned Spacecraft Deep Space Antenna Study	August 16, 1963
Manned Spacecraft Deep Space Antenna Study	Goodyear Proposal for Manned Spacecraft Deep Space Antenna Study	August 14, 1963
Manned Spacecraft Deep Space Antenna Study	Hallicrafters Technical Proposal for Manned Spacecraft Deep Space Antenna Study	1963

Manned Spacecraft Deep Space Antenna Study	Martin Proposal for Manned Spacecraft Deep Space Antenna Study Vol. 1 Technical Proposal	August 1963
Manned Spacecraft Deep Space Antenna Study	Melpar Technical Proposal for Manned Spacecraft Deep Space Antenna Study	August 1963
SubHeading:	**Box Number: 06**	
Apollo Antennas	Apollo Antenna Memos * no discernable order * unsorted * two folders	1962-1973
Manned Spacecraft Deep Space Antenna Study	Final Engineering Report: Manned Spacecraft Deep Space Antenna Study * Hughes NAS 9-2099	April 15, 1964
Apollo Antennas	Apollo Antenna TWX * no discernable order * unsorted * three folders	1962-1973
Apollo Antennas	Apollo Antennas Personal Notebook Sept-Nov 1965	1965
SubHeading:	**Box Number: 07**	
Apollo Antennas	Technical Discussion for Development and Fabrication of an Ultra-Low-Noise, 1700 mc Solid State Parametric Amplifier * Hughes	September 13, 1962
Apollo Antennas	Apollo Antennas Personal Notebook May-Oct 1966	1966
Apollo Antennas	Apollo Antennas Personal Notebook March-Sept 1967	1967
Apollo Antennas	Project Apollo Compilation of Worldwide Track and Communication Facilities offering Possibilities for Use in Project Apollo- Working Paper #1007	January 23, 1961
Apollo Antennas	Project Apollo Preliminary Concept of Apollo Spacecraft Communications and Tracking Equipment	March 20, 1961
Apollo Antennas	Broadband Ridge Waveguides and Components Final Report	December 1961
Apollo Antennas	Antenna System R&D Telemetry	March 9, 1962
Apollo Antennas	Spaceborne Telemetry System for Apollo Test Vehicle Rev. A * Bendix	April 3, 1962
Apollo Antennas	Communications During Re-entry of Manned Vehicles at Hyperbolic Velocities	July 1962
Apollo Antennas	Handbook for UHF Diplexer Model FUV-7003	August 16, 1962
Apollo Antennas	Antenna and RF Distribution Systems	May 1, 1963
Apollo Antennas	Electromagnetic Interference Control Plan for AOC	April 1, 1963
Apollo Antennas	Apollo Antennas Personal Notebook Nov 1965-Feb 1966	1965-1966
SubHeading:	**Box Number: 08**	
Apollo Antennas	Apollo EVA Suit Telemetry and Communication System	1963
Apollo Antennas	Erectable Antenna Flexible Ribs Drawing * oversize * Goodyear	1963
Apollo Antennas	The Design of an Omnidirectional Antenna System for the Apollo Spacecraft Report #1791.1	September 22, 1964
Apollo Antennas	Summary of coverage provided by modified scimitar antenna #1 and #2 on Service Module	September 1965
Apollo Antennas	Personalized Space Antennas by Thomas E. Tice and Earl R. Murphy	1965
Apollo Antennas	Apollo Operations Handbook CSM Block II Preliminary Subsection 2.8 Telecommunications System * For training purposes only	March 17, 1967

Apollo Antennas	Apollo Training: Telecommunication Subsystem Block II	April 8, 1968
Apollo Antennas	Lightweight Erectable Space Antennas * Goodyear	July 8, 1963
Apollo Antennas	Apollo Environmental Design and Test Requirements	November 20, 1963
Apollo Antennas	Project RAM Budget Summary * Radio Attenuation Measurements	1963
Apollo Antennas	CSM Communications Systems * Command Service Module	1963-1964
Apollo Antennas	Antenna External Configurations	1963-1964
Apollo Antennas	Hughes Aircraft Company Invention Disclosure: Conical Reflector Antenna with Polarization Correcting Line Source Feed	August 1964
Apollo Antennas	Hughes Aircraft Company Invention Disclosure: Phase Multiplying Electronic Scanning Array	August 1964
Apollo Antennas	Hughes Aircraft Company Invention Disclosure: Virtual Wall Slot Circularly Polarized Planar Array	August 1964
Apollo Antennas	Customer Acceptance Readiness Review Board CM 007A NAA Minutes	Jaunary 9, 1968
Apollo Antennas	Antennas Under Ablation Materials by William F. Croswell	June 1965
SubHeading:	**Box Number: 09**	
Apollo Antennas	Evolution of a Spacecraft Antenna System	1969
Apollo Antennas	Experiment Implementation Plan Dielectric Constant Experiment	March 5, 1970
Apollo Antennas	55-Nitinol for Self Erectable Antennas	1970
Apollo Antennas	Apollo Experience Report - The AN/ARD-17 Direction Finding System JSC-06026	September 1973
Apollo Antennas	Performance Characteristics of Apollo Spacecraft Antennas (table)	ND
Apollo Antennas	NAA Electrical Systems Panel Meeting #5 – Reentry Blackout Study	ND
Apollo Antennas	Radio Frequency Transmission Characteristics of Several Ablation Materials	ND
Apollo Antennas	Unfurlable Antennas	ND
Apollo Antennas	Project Apollo OCP-P-0130-A-SC011	ND
Apollo Antennas	Engineering Summary of the 210-foot diameter Advanced Antenna System	ND
Apollo Antennas	Apollo Operations Handbook CSM Block II Preliminary Subsection 2.8 Telecommunications System (For training purposes only)	April 23, 1968
Apollo Antennas	Summary of CM-MSFN RF Acquisition Tests	1968
Apollo Antennas	Apollo Program Review Mule Failure Summary Dalmo Victor	1968
Apollo Antennas	Apollo Communications Antenna Systems Presentation Slides	ND
Apollo Antennas	Transmission of Antenna Patterns (includes photos)	ND
Apollo Antennas	Mission Requirements H-3 Type Mission Change B SPD9-R-056	ND
Apollo Antennas	Investigations of Unique Memory Properties of 55-Nitinol Alloy	1969
Apollo Antennas	Lunar Orbital Science Study Experiment Description Document RF Transponder	September 30, 1968

SubHeading:	**Box Number: 10**	
Antenna Proposals	Technical Proposal Vol. III Proposal for an Operational Beacon Antenna Study * RAD-B366-063 * Avco	January 15, 1963
Antenna Proposals	Technical Proposal Recovery Antenna Systems for the Apollo Space Craft * DeHavilland	August 1962
Apollo Antennas	Saturn Antenna Systems SA-7 * GSFC	ND
Antenna Proposals	Technical Proposal No. 60780 NASA Vehicle Antenna System * ITT Federal Laboratories	October 1961
Antenna Proposals	Technical Proposal for Antennas for Pre-Apollo Space Environment Test Vehicle * Melpar, Inc.	November 1961
Antenna Proposals	Technical Proposal R&D Beacon Antenna System for Apollo Spacecraft * Rantec	May 10, 1962
Antenna Proposals	Technical Proposal Vol. III Apollo Recovery Antenna System * Melpar	May 1962
Antenna Proposals	Preliminary Proposal for an Erectable Lunar Surface Antenna * Dalmo Victor	July 10, 1963
SubHeading:	**Box Number: 11**	
VHF Recovery Antennas	Design and Development of VHF Recovery for the CM photographs	May 20, 1968
Antenna Proposals	Proposal for Advanced Multiplexer System * Motorola	August 25, 1964
Antenna Proposals	Technical Proposal for Apollo High-Gain Antenna System * Hughes	October 30, 1964
Antenna Proposals	A Proposal for a Study of Ablation Material Effects on Antenna Performance * Lockheed * ETP-603	April 5, 1965
VHF Recovery Antennas	Leopold Notebook VHF Recovery Antenna Sept 18, 1967-Jun 4, 1968	1967-1968
VHF Recovery Antennas	VHF Recovery Antennas	1965-1971
VHF Recovery Antennas	Preliminary Evaluation of the Effect of Proposed Ablative Materials on the Apollo VHF and S-band Antenna Efficiencies	June 12, 1963
VHF Recovery Antennas	VHF Scimitar and S-Band Basic Assembly drawings & presentation	August 19, 1965
VHF Recovery Antennas	VHF SM/SLA Scimitar Antenna Second Monthly Engineering Report	November 3, 1965
VHF Recovery Antennas	VHF SM/SLA Scimitar Antenna Fourth Monthly Engineering Report	January 3, 1966
VHF Recovery Antennas	Design and Development of VHF Recovery for the Command Module * includes oversized drawing and test data * 2 folders	January 1965
VHF Recovery Antennas	Design and Development of VHF Recovery for the CM * memos	1966, 1968
SubHeading:	**Box Number: 12**	
Apollo Antenna Test Data Specifications	Environment Test Configuration SD-102751 C/M S/M with LEM in Docked Position * drawings	1964
VHF Recovery Antenna	VHF Recovery Antenna Radiation Pattern Data CSM 101 * TDR 68-086 * Report No. 5	April 12, 1968
VHF Recovery Antennas	VHF Recovery Antenna Radiation Pattern Data CSM 102, 103, 104, 106 & subs. TDR 68-093 Report No. 6	ND
Apollo Antenna Test Data Specifications	Scin-Antenna Chart 353401-353600 Sheet No. 18 * oversized	April 30, 1964
Apollo Antenna Test Data Specifications	NAA Revised Work Statement “ Apollo Category I IDWA Performance Requirements ”	September 24, 1965

VHF Recovery Antennas	VHF Recovery Antennas Checkout, Requirements, and Specifications	1967-1968
VHF Recovery Antennas	Block II Apollo VHF Recovery Antenna System Radiation Pattern Data Report No. 3 * NA-67-207	1967
VHF Recovery Antennas	Qualification Test Report Block II VHF Recovery Antenna System NA 68-294	April 19, 1968
VHF Recovery Antennas	Lunar VHF Subsatellite for Backside Doppler Measurements Technical Summary	September 1971
SubHeading:	**Box Number: 13**	
Apollo Antenna Test Data Specifications	Qualification Test on Apollo Cable Connector Assemblies SID 67-238	February 1967
Apollo Antenna Test Data Specifications	CSM 102 Rev. A Test Data	1968
Apollo Antenna Test Data Specifications	Certification Tests Description * Apollo Spacecraft 101/102	1968
S-Band Antenna	Proceedings of the Apollo Unified S-Band Technical Conference	July 15, 1965
S-Band Antenna	Analysis of the Spurious Spectral Components Appearing about the S-Band Carrier Project Technical Report Task E-9E NAS 9-8166	May 9, 1969
S-Band Antenna	S and C Band Antenna Pattern Characteristics showing Isotropic Level	ND
S-Band Antenna	Thermal Evaluation of Proposed S-Band Antenna Installations	July 29, 1965
S-Band Antenna	Communication Subsystem Block I and II VHF/S-Band Antenna Switching Review	May 7, 1965
Apollo Antenna Test Data Specifications	Apollo Communication Receiver Specification #MC 901-0712	January 1968
S-Band Antenna	Specification Antenna Equipment S-Band Flush Mounted Omni	June 16, 1966
S-Band Antenna	Block II Command and Service Module S-Band Omni Antenna Patterns, EE-66-9	December 1966
Apollo Antenna Test Data Specifications	NAA Specification Change Notice Block II GFE CSM-MSFN Signal P&I Specifications	1968
S-Band Antenna	Review of the Unified S-Band System Tests Contract NAS 9-2563 Motorola	June 1964
SubHeading:	**Box Number: 14**	
S-Band Antenna	S-Band Phased Array Antenna presentation viewgraphs	ND c. 1985
S-Band High Gain Antenna	S-Band Antenna History High Gain System	1963
S-Band High Gain Antenna	Apollo High-Gain Antenna Study Monthly Progress Report for Hughes Aircraft Co. Preliminary Design Study.	August 1964
S-Band High Gain Antenna	Apollo Command Service Module (CSM) High Gain Antenna (HGA) Status Review NAA-NASA	June 13, 1966
S-Band High Gain Antenna	Apollo CSM High Gain Antenna Engineering Status Presentation	January 5, 1967
S-Band High Gain Antenna	Apollo High Gain Antenna Program Review	March 15, 1968
S-Band Antenna	Full Scale Block I Spacecraft 017 and 020 S-Band Omni Antenna Patterns 67-EE-15	June 1967
S-Band Antenna	Full Scale Block II Command Module S-Band Omni Antenna Patterns 68-EE-3	February 1968
S-Band Antenna	S-Band Data: Block I-CSM, Pattern 34, Surviving SCIN located 0=343	December 2, 1966
S-Band Antenna	S-Band Data: Block II-CSM, Pattern	1967

	18-C; Helix Omni C located 0=315	
S-Band Antenna	S-Band Data: S/C017 and 020 CM; Pattern 76, Helices 2 and 4 in parallel	March 23, 1967
S-Band Antenna	S-Band Data: Block II CM, Pattern 3-C; Helix Omni A located 0=135	June 15, 1967
S-Band Antenna	S-Band Power Amplifier TWT History	March 1983
SubHeading:	**Box Number: 15**	
S-Band Transponder Experiment	S-Band Transponder Experiment (S-164) Correspondence	1969-1971
S-Band Transponder Experiment	Cost and Technical Proposal for CSM/LM Transponder and Subsatellite S-Band Transponder Experiments	ND
S-Band Transponder Experiment	S-Band Transponder Experiment (S-164) * Experiment Description Document	September 30, 1968
S-Band Transponder Experiment	S-Band Transponder Experiment (S-164) * Experiment Proposal Statement of Work	1969-1970
S-Band Transponder Experiment	S-Band Transponder Experiment (S-164) Monthly Progress Report	1971
S-Band Transponder Experiment	S-Band Transponder Experiment (S-164) Purpose and Objectives	1971-1972
S-Band Transponder Experiment	S-Band Transponder Experiment (S-164) Status and Planning	1969-1970
Bistatic Radar	Bistatic-Radar Detection of Lunar Scattering Centers with Lunar Orbiter I	July 14, 1967
Bistatic Radar	Lunar Orbital Science Study Experiment Description Document: Bistatic Radar	September 30, 1968
Bistatic Radar	Digital Spectral Analysis of Bistatic-Radar Echoes from Explorer XXXV Tech Report 3609-5 * G. Leonard Tyler	October 1969
Bistatic Radar	Bistatic Radar Observations of the Moon presentation	ND
Bistatic Radar	Outline of Bistatic Radar Experiment Notes	ND
Bistatic Radar	Bistatic Radar Measurement of Long Period, Directional Ocean-Wave Spectra with LORAN	ND
Bistatic Radar	Bistatic-Radar Imaging and Measurement Techniques for the Study of Planetary Surfaces * George Leonard Tyler, Jr.	May 1967
Bistatic Radar	Proposal to NASA for Bistatic Radar Studies of the Moon RL 16-69	April 1969
Bistatic Radar	Downlink Bistatic Radar Observations of the Moon Using Apollo Spacecraft, Proposal RL 14-69 Stanford University	1969
Bistatic Radar	Experiment Implementation Plan Downlink Bistatic Radar Observations of the Moon S170	September 30, 1969
SubHeading:	**Box Number: 16**	
Bistatic Radar	Mars Station Configuration for Apollo Bistatic Radar Experiment S-170	November 6, 1970
Bistatic Radar	Apollo Bistatic Radar S-Band / VHF / DSN Integration Meeting Minutes	1970
Bistatic Radar	Functional Dependencies of Bistatic Radar Frequency Spectra & Cross Sections on Surface Scattering Laws * G. Leonard Tyler	November 1970
Bistatic Radar	Bistatic Radar Chronological Memorandum	1969-1971
Bistatic Radar	Bistatic Radar Monthly Progress Reports for NAS 9-10579	1971-1973
Bistatic Radar	Stanford Telemetry Monitoring Experiment on Lunar Explorer 35	October 1969

Bistatic Radar	Bistatic Radar Experiment Status and Planning	1969-1970
Bistatic Radar	Stanford / Apollo 14 Bistatic-Radar Investigation	1969-1970
Bistatic Radar	Apollo VHF and S-band Bistatic Radar Experiments	1970
Bistatic Radar	Apollo Bistatic Radar Link Margin Calculations	1970
Bistatic Radar	Bistatic Radar Attitude Study	1970
Bistatic Radar	CSM/Bistatic Radar Functional Requirements Exp.S170	May 5, 1970
Bistatic Radar	CSM/Bistatic Radar Functional Requirements Exp S170 Revisions	January 1971
Bistatic Radar	Scientific Analysis Plan Stanford * Bistatic Radar	June 30, 1970
Bistatic Radar	Proposal to NASA for Downlink Bistatic Radar Observations of the Moon using Additional Apollo Spacecraft Proposal RL 42-70	August 1970
Bistatic Radar	Bistatic Radar Test Data Package * HASD 642D-836275	September 15, 1970
Bistatic Radar	Experiment S-170 Down Link Bistatic Radar Observations * includes photograph	1971
Bistatic Radar	Dual-Frequency Bistatic Radar Investigations of the Moon with Apollos 14 and 15 * G. Leonard Tyler	May 1970
Bistatic Radar	S-Band Bistatic Radar Apollo 15	ND
Bistatic Radar	Apollo 16 Preliminary Science Report Bistatic Radar Investigation	ND
Bistatic Radar	Bistatic Radar Miscellaneous Notes	ND
SubHeading:	**Box Number: 17**	
ALEM	Leopold Notebook 1: Apollo Lunar Exploration Missions (ALEM)	1969
ALEM	Apollo Orbital Experiments Status	1969-1970
ALEM	Apollo CSM “J” Series Mission Experiments	February 14, 1970
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