ESSEX
CORPORATION

FINAL REPORT

DEVELOPMENT OF SPACE TELESCOPE NON-ORU HARDWARE

CONTRACT NAS8-36364

DECEMBER 31, 1985

ESSEX REPORT NO. H-85-10

SPACE SYSTEMS GROUP • 690 Discovery Drive, Huntsville, Alabama 35806 • (205) 837-2046

FINAL REPORT

DEVELOPMENT OF SPACE TELESCOPE NON-ORU HARDWARE

Contract NAS8-36364

Submitted To:

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
George C. Marshall Space Flight Center
Marshall Space Flight Center, Alabama 35812

Prepared By:

Kem B. Robertson
David E. Henderson
ESSEX CORPORATION
690 Discovery Drive
Huntsville, Alabama 35812

Report Number: H-85-10

December 31, 1985

FOREWORD

This final report describes the tasks completed and end items developed by Essex Corporation during the performance of NASA MSFC contract NAS8-36364 titled "Development of Space Telescope Non-ORU Hardware." The work was performed under the direction of Fred Sanders and Charles Lewis, EL15, and the authors gratefully acknowledge their guidance and support. Any questions should be addressed to Mr. Sanders at (205) 453-0080 or Mr. Kem Robertson at (205) 837-2046.

TABLE OF CONTENTS

ACRONYMS

COR	Contracting Officer's Representative
DCE	Deployment Control Electronics
DIU	Data Interface Unit
DMU	Data Management Unit
EP/TCE	Electrical Power/Thermal Conditioning Electronics
ES	Equipment Section
EVA	Extravehicular Activity
HST	Hubble Space Telescope
LMSC	Lockheed Missiles and Space Company
MAT	Multiple Access Transponder
MCU	Mechanism Control Unit
MSFC	Marshall Space Flight Center
NBS	Neutral Buoyancy Simulator
OCE	Optical Control Electronics
ORU	Orbital Replacement Unit
OTA	Optical Telescope Assembly
PDU	Power Distribution Unit
SADE	Solar Array Drive Electronics
SAT	Single Access Transmitter
SSM	Support Systems Module

1.0 INTRODUCTION

1.1 Background

Since 1979 Essex has been involved in the development of the Hubble Space Telescope (HST) mockup and the performance of underwater simulations to evaluate proposed on-orbit servicing tasks. These tasks involve the planned changeout of scientific instruments and the unscheduled changeout of other orbital replacement units (ORUs) such as batteries and computers. The HST components and subsystems that originally were designated ORUs were the items that were mission critical and were designed for easy changeout. Other items located in the Optical Telescope Assembly Equipment Section (OTA/ES) and the Support Systems Module Equipment Section (SSM/ES) were later considered for on-orbit changeout since the items were accessible to the Extravehicular Activity (EVA) crew members and many items had EVA-compatible electrical connectors and mechanical fasteners.

In meetings held in October and November, 1984 between MSFC and Essex personnel, the initial test objectives and mockup design requirements were established in preliminary form. At these meetings the following ground rules were established:

1. The primary objective of the test would be to evaluate crew access to the potential ORUs and their electrical connectors and mechanical fasteners.

2. ORUs would be mounted to a bolt plate that would be mounted to the equipment section structure. This would allow removal of an ORU for modification or repair without removal of the entire equipment section.

3. Substitution of "like items" would be acceptable for long lead time components such as electrical connectors.

4. Pins would not be supplied for the electrical connectors.

5. Lockheed would supply any OTA/ES and SSM/ES drawings and photographs needed to develop the mockup.

In December, 1984, Essex was awarded a contract to design and fabricate mockups of 14 non-ORU items for the purpose of evaluating the EVA changeout tasks in the MSFC Neutral Buoyancy Simulator (NBS). The contract was later modified to include three additional non-ORUs.

1.2 Scope

High fidelity mockups of HST hardware not previously designated as ORUs were necessary for changeout studies conducted in the MSFC NBS. These mockups were developed by Essex and were identical to the flight hardware in terms of location and method of attachment to the spacecraft. The mockups had cable connectors identical to the flight hardware where possible. The mockups provided by Essex include:

- o Data Management Unit (DMU)
- o Multiple Access Transponder (MAT) (2 required)
- o Solar Array Drive Electronics (SADE) (2 required)
- o Tape Recorder (3 required)
- o Data Interface Unit (DIU) (2 required)
- o Power Distribution Unit (PDU) (2 required)
- o Deployment Control Electronics (DCE)
- o Electrical Power/Thermal Conditioning Electronics (EP/TCE)
- o Optical Control Electronics (OCE)
- o Single Access Transmitter (SAT)
- o Mechanism Control Unit (MCU).

The objectives of this design/fabrication/test activity were to design and fabricate the potential ORUs so they contained realistic interfaces and were compatible with the NBS environment. The attachment of the mockup hardware to the spacecraft mockup was similar to the flight version. Also, the hardware connectors were flight-like. The cabling from the spacecraft bays to the hardware was developed to closely simulate the flight hardware. The hardware produced includes:

- o DMU - This unit is located on the Bay 1 door and is attached by 22 fasteners. It has 38 connectors with accompanying cabling.

- o MAT - This unit is located on the Bay 5 door and is attached by 18 fasteners. It has 15 cables and interfacing connectors. Two MAT mockups were provided.

- o SADE - These two units are attached to the Bay 7 door by a total of 12 fasteners. There are 10 connectors and cables per unit.

- o Tape Recorder - There are two tape recorders mounted in the back of Bay 5. The tape recorders are held in place by four fasteners (eight total). The tape recorders have three connectors and cables each. A third tape recorder was built for changeout purposes.

- o DIU - The DIU is installed with six fasteners in the back of Bay 7. The DIU has 20 connectors and cables interfacing with it. Two DIUs were provided.

- o PDU - There are four PDUs. Two are high-fidelity and two are low-fidelity. The PDUs are held in place by 10 fasteners each and have 14 connectors and cables connected to each of them.

- o DCE - The DCE is located on the door of Bay 7. It is held in place by six fasteners. It has 14 cables and connectors attached to it.

- o EP/TCE - The EP/TCE is located in the rear of Bay H in the OTA Equipment Section. It contains four fastening screws and 28 connectors/cables.

- o OCE - The OCE is located on the Bay C door and is attached with four bolts. The OCE has 13 connectors and cables.

- o SAT - The SAT is located on the Bay 5 door and has five connectors and eight bolts.

- o MCU - The MCU is located inside Bay 7 above the DIU, and is attached with four bolts. It has six connectors and cables.

2.0 TECHNICAL APPROACH

The following paragraphs describe the tasks performed for the design and fabrication of the non-ORUs and the test support activity.

2.1 Task 1 - Review Space Telescope Drawings

Essex reviewed the NASA-provided drawings of the non-ORUs and their mountings. Flight-type fidelity was provided in areas of critical crew interface such as ORU connectors, spacecraft mountings, and module attach point interfaces. All electrical connectors were identified and ordered. Where the desired connector could not be obtained, connectors were used that most closely approximated the correct external dimensions. The connectors were pinless to reduce costs.

2.2 Task 2 - Prepare Mockup Drawings

Based on the information obtained in Task 1, engineering drawings were prepared or in some cases, flight drawings were redlined. The drawings incorporated high-fidelity areas of crew interface and low-fidelity design in other areas. Upon completion, these drawings were reviewed with the COR for approval.

2.3 Task 3 - Fabricate Hardware

Fabrication began immediately after COR approval of the drawings. As the items were completed, the finished products were checked by the project manager to verify proper dimensions and configuration.

2.4 Task 4 - Delivery and Installation and Support Tests

Essex then installed the non-ORUs into the Equipment Sections and delivered the completed mockup to the NBS. Essex divers assisted the NBS personnel in hardware installation and hardware support during the test activity.

3.0 HARDWARE DESCRIPTION

The non-ORU mockups were all constructed with 6061-T6 aluminum and stainless steel fasteners per redlined flight drawings or mockup drawings prepared by Essex. Crew-operated mechanical fasteners were identical to the flight configuration and fabricated with 300 series corrosion resistant steel. Electrical connectors were purchased with the same clocking and keying characteristics as the flight connectors, and cables were similar to the flight cables in number of wires and size of wire bundle. Descriptions of the individual non-ORUs are included in Paragraph 1.2. Appendix A lists the connectors used on each non-ORU. Appendix B includes photographs of the mockup hardware. Appendix C lists sources of information for each non-ORU.

4.0 PROBLEM AREAS

Two problems occurred during the performance of the design/ fabrication tasks that were unforeseen at the beginning of the project and affected the delivery schedule. These problems are briefly described below.

4.1 Drawing Accuracy and Availability

In November 1984, Essex requested drawings and photographs from Lockheed for each non-ORU since the drawings were not available at MSFC. When received, some ORU drawings were not detailed enough to start mockup fabrication. Key dimensions were missing and the drawings and photographs did not always agree. Additional drawings were requested on two later dates. When the drawing and photograph files were complete, it was noted that the Lockheed and vendor drawings did not agree in all areas. In the case of the Multiple Access Transponder (MAT), the dimensional differences between Lockheed and Motorola drawings were minor (< .2 in.) but were significant enough to cause fastener access problems and tool/fastener misalignment (Reference Lockheed drawing 4171844 and Motorola drawing 70-P07705L, Appendix D). If an "as built" drawing file is prepared to support maintenance and repair of the HST, care should be taken to acquire not only Lockheed's drawings but the drawings of the subcontractors and vendors as well.

No inconsistencies or other problems were encountered with the Perkin-Elmer drawings used.

4.2 Mockup Fidelity

The non-ORU mockups were originally to be used to evaluate crew access. After the contract was underway, it was determined that the tests would include evaluations of connector tools and would require high fidelity connectors and cable bundles. Although this did not impact cost, the lead time for information and supplier delivery for some of the connectors delayed hardware delivery in some cases.

Essex is not confident that the MAT, SAT, and DCE mockups reflect the as-built configuration due to accuracy of information supplied to Essex designers and potential modifications to the flight units that may have occurred after the drawings were prepared. Also, Essex is unsure of the fidelity of the coax connectors on the DMU. In these cases, the mockups were fabricated to meet NBS test schedules and Essex had to rely on the drawings that were available at the time.

APPENDIX A

LIST OF ELECTRICAL CONNECTORS USED ON NON-ORU MOCKUPS

ELECTRICAL CONNECTORS

Non-ORU/Connector	Part Number
Deployment Control Electronics (DCE)	
J1 - J14	MD50M2000
	MD50F2000
Solar Array Drive Electronics (SADE)	
J1	MD15M2000
	MD15F2000
J2 & J3	MD50M2000
J9 & J10	MD50F2000
J4	MD37M2000
	MD37F2000
J5, J6, J7, J8	MD25M2000
	MD25F2000
Data Interface Unit (DIU)	
J1 & J2	MS27508E-10F-35S
	MS27473E-10F-35P
J19 - J2	MS27508E-18F-355
	MS27473E-18F-35P
J3, J4, J13, J14	MS27508E-24F-355
	MS27473E-24F-35P
J5, J6, J11, J12	MS27508E-24F-35SA
	MS27473E-24F-35SA
J7, J8, J17, J18	MS27508E-24F-35SB
	MS27473E-24F-35PB
J9, J10, J15, J16	MS27508E-24F-35SC
	MS27473E-24F-35PC
Multiple Access Transponder (MAT)	
J1 & J2	SD 50M-1000
	SD 50F-1000
	SD 50F-000J (Cover)
J20, J3	SD 37M-1000
	SD 37M-1000
J21, J31	SD 25M-1000
	SD 25F-1000
5/16	SMA Coax Connectors
Tape Recorder	MS3126F-18-32P
	MS3122E-18-32S
	165-13
Data Management Unit (DMU)	
J1, & J2	MS27508E-14F-18S
	MS27473E-14F-18P
J23 & J24	MS27473E-20F-16P
	MS27508E-20F-16S
J25, J35, J37	M39012/28-0018
	M39012/26-0018

Data Management Unit (DMU) Continued	
J3, J4, J11, J12, J17, & J18	MS27508E-24F-35C
	MS27473E-24F-35P
J5, J6, J13, J14, & J19	MS27508E-24F-35SA
	MS27473E-24F-35PA
J7, J8, J15, J16, J21, & J22	MS27508E-24F-35SB
	MS27473E-24F-35SB
J9 & J10	MS27508E-24A-35SC
	MS27473E-24F-35PC
J36	MS27508E-8F-35P
	MS27473E-8F-35S
J38	MS27508E-8A-35S
	MS27473E-8F-350
Power Distribution Unit (PDU)	
J9	MS3474L-24-61PX
	MS3476L-24-61SX
J8	MS3474L-24-61PW
	MS3476L-24-61SW
J7	MS3474L-24-61P
	MS3476L-24-61S
J3, & J6	MS3474L-24-31PX
	MS3476L-24-31SX
J2 & J5	MS3474L-24-31PW
	MS3476L-24-31SW
J1, J4, & J11	MS3474L-24-31P
	MS3476L-24-31S
J10	MS3474L-22-12P
	MS3476L-22-12S
J12	MS27467E-25F-35PB
	MS27468E-25F-35SB
J13	MS27467E-25F-35PA
	MS27568E-25F-35SA
J14	MS27467E-25F-35PN
	MS27468E-25F-35SA
Single Access Transmitter (SAT)	
J1	MS27478Y-14D-18P
J2	MS27478Y-10D-35P
J3, J4 & J6	MS39012-61-3002
J5	MS5339-28-3001
5/16	SMA Coax Connectors
Optical Control Electronics Assembly (OCE)	
J1	MS27505E-17-35P
	MS27467T-17B-35S
J2	MS27505E-17B-35PA
	MS27467T-17B-35SA
J3	MS27505E-11-35S
	MS27467T-11-35P
J4	MS27505E-11-35SA
	MS27467T-11-35PA
J5	MS27505E-15-35S
	MS27467T-15B-35P

Optical Control Electronics Assembly (OCE) Continued

J6	MS27505E-15B-35P MS27467T-15F-35S
J7	MS27505E-13-8P MS27467T-13-8S
J8	MS27505E-13-8PA MS27467T-13-8SA
J9	MS27505E-15-18S MS27467T-15F-18P
J10	MS27505E-15-35SA MS27467T-15B-35PA
J11	MS27505E-15B-35SB MS27467T-15B-35PB
J12	MS27505E-15-35SC MS27467T-15F-35PC
J13	MS27505E-15B-35PA MS27467T-15B-35SA

Electrical Power and Thermal Control Electronics Assembly (EP/TCE)

J1	MS3470L-22-21P MS3476L-22-21S
J2	MS3470L-22-21PW MS3476L-22-21SW
J3	MS3470L-22-21PX MS3476L-22-21SX
J4	MS3470L-22-21PY MS3476L-22-21SY
J5	MS3470-10-6P MS3476-10-6S
J6	MS3470L-10-6PW MS3476L-10-6SW
J7	MS3470L-24-19S MS3476L-24-19P
J8	MS3470L-24-19SX MS3476L-24-19PX
J9	MS3470L-16-26P MS4376L-16-26S
J10	MS3470L-10-6S MS3476L-10-6P
J11	MS3470L-16-26PW MS3476L-16-26SW
J12	MS3470L-12-10SW MS3476L-12-10PW
J13	MS3470L-18-32S MS3476L-18-32P
J14	MS3470L-18-32SW MS3476L-18-32PW
J15	MS3470L-18-32SX MS3476L-18-32PX
J16	MS3470L-32SY MS3476L-18-32PY

Electrical Power & Thermal Control Electronics Assembly (EP/TCE) Continued

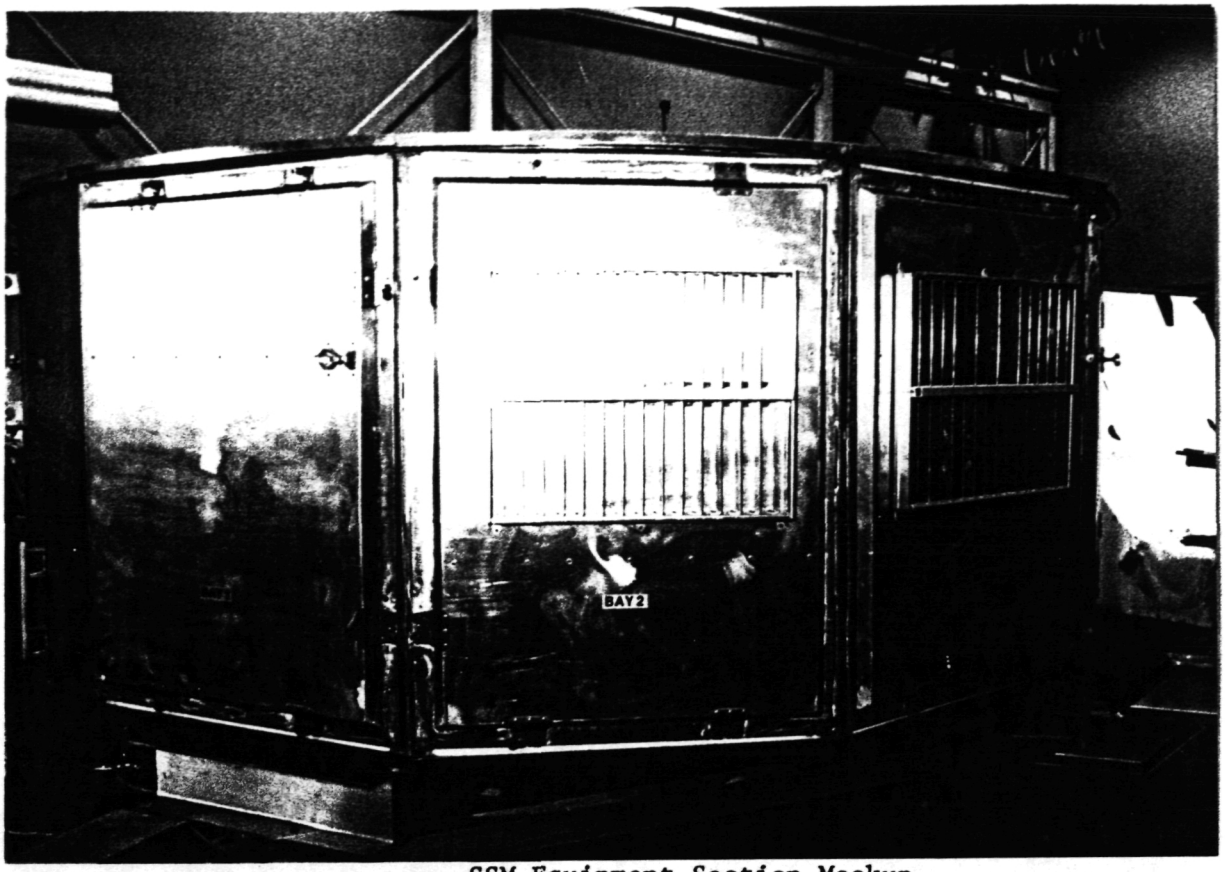
J17	MS3470L-18-32SZ
	MS3476L-18-32PZ
J18	MS3470L-16-26S
	MS3476L-16-26P
J19	MS3470L-20-41S
	MS3476L-20-41P
J20	MS3470L-24-61S
	MS3476L-24-61P
J21	MS3470L-24-61SW
	MS3476L-24-61PW
J22	MS3470L-20-41SW
	MS3476L-20-41PW
J23	MS3470L-24-61SX
	MS3476L-24-61PX
J24	MS3470L-24-61SY
	MS3476L-24-61PY
J25	MS3470L-22-21S
	MS3476L-22-21P
J26	MS3470L-22-21S
	MS3476L-22-21P
J27	MS3470L-22-21SW
	MS3476L-22-21PW
J28	MS3470L-22-21SW
	MS3476L-22-21PW
J29	MS3470L-12-10P
	MS34706L-12-10S

Mechanism Control Unit (MCU)

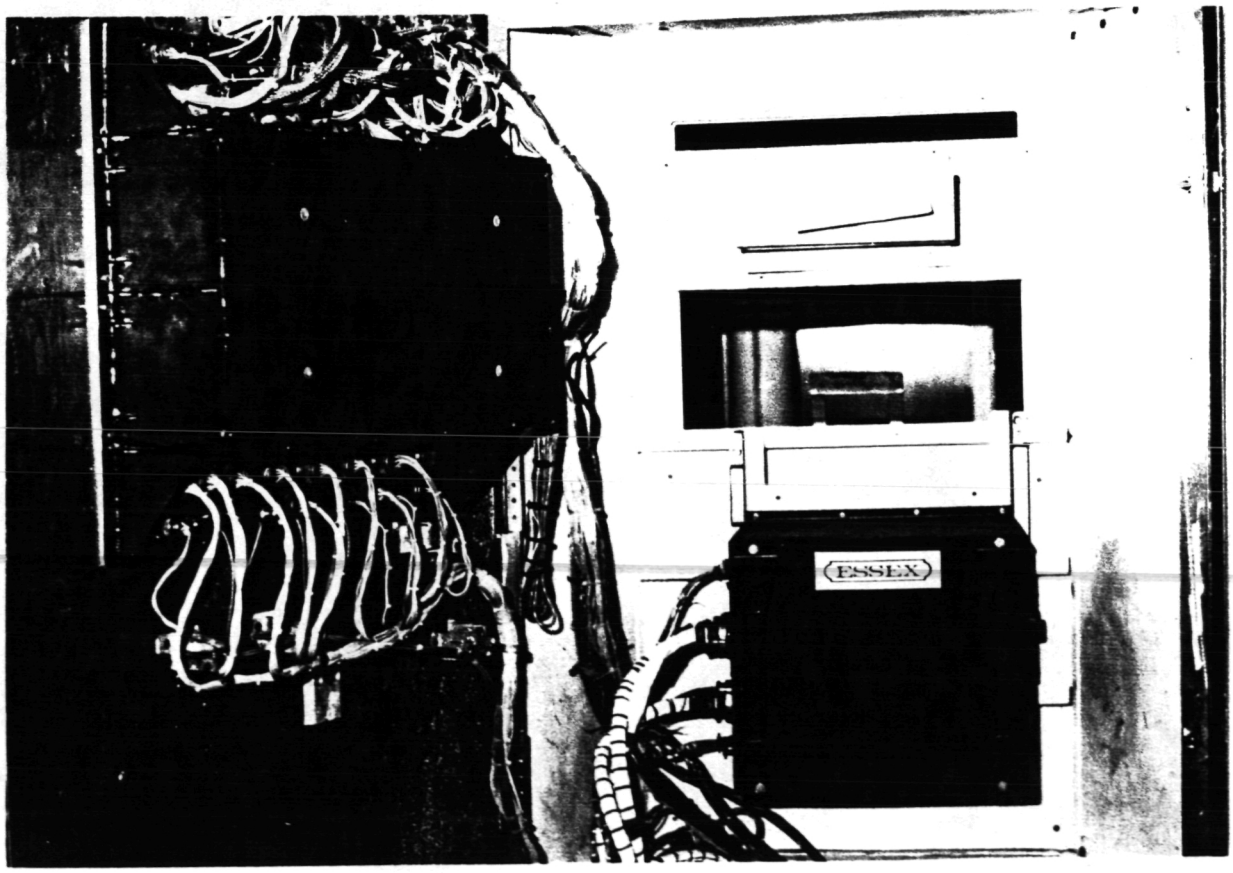
J1	MS34741L-12-10P
	MS3474L-12-10PW
J2	MS3474L-22-21S
	MS3474L-22-21SX
J3	MS3474L-22-21SW
	MS3474L-22-21SY
J4	MS27505E-17-35P
	MS27505E-17-35PA
J5	MS27505E-17-35S
	MS27505E-17-35SA
J6	MS27505E-17-35PB
	MS27505E-17-35PC

APPENDIX B

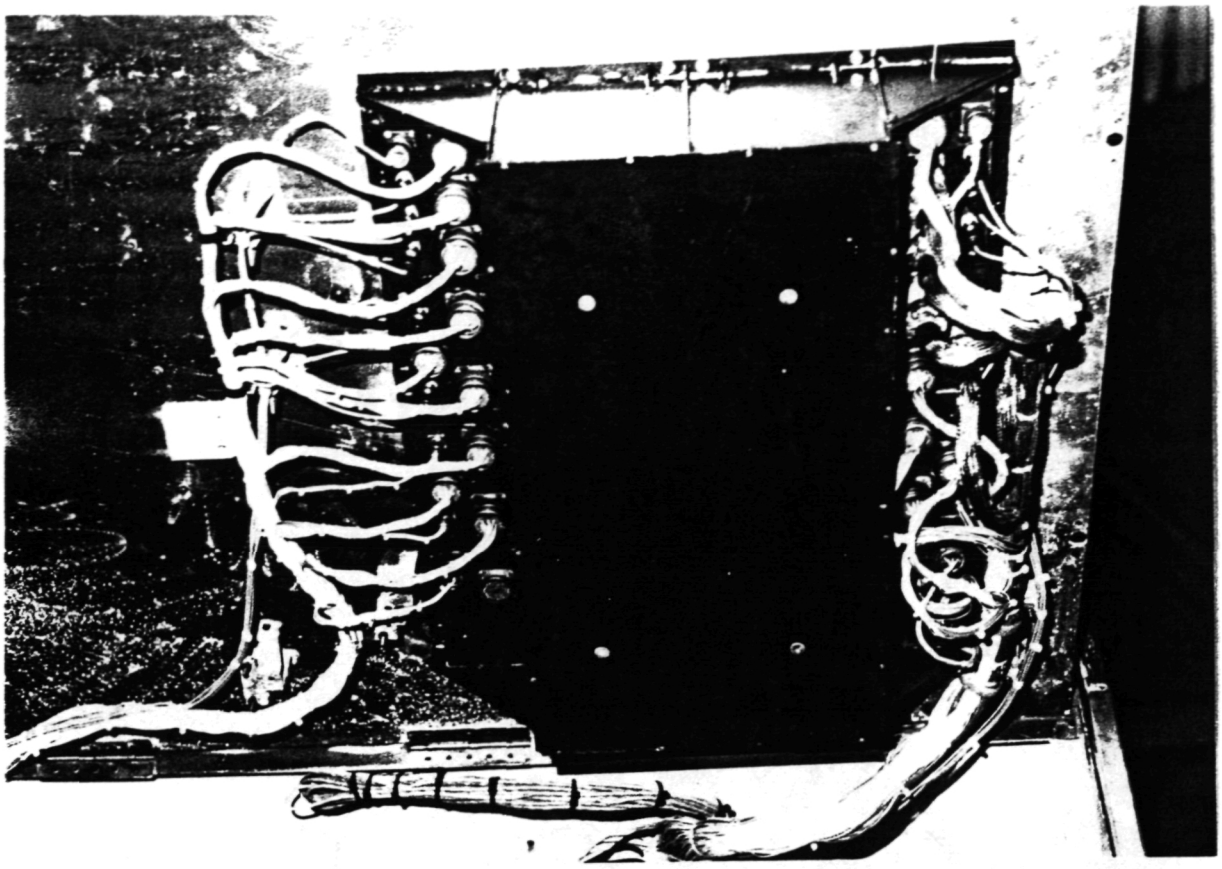
PHOTOGRAPHS OF NON-ORU MOCKUPS



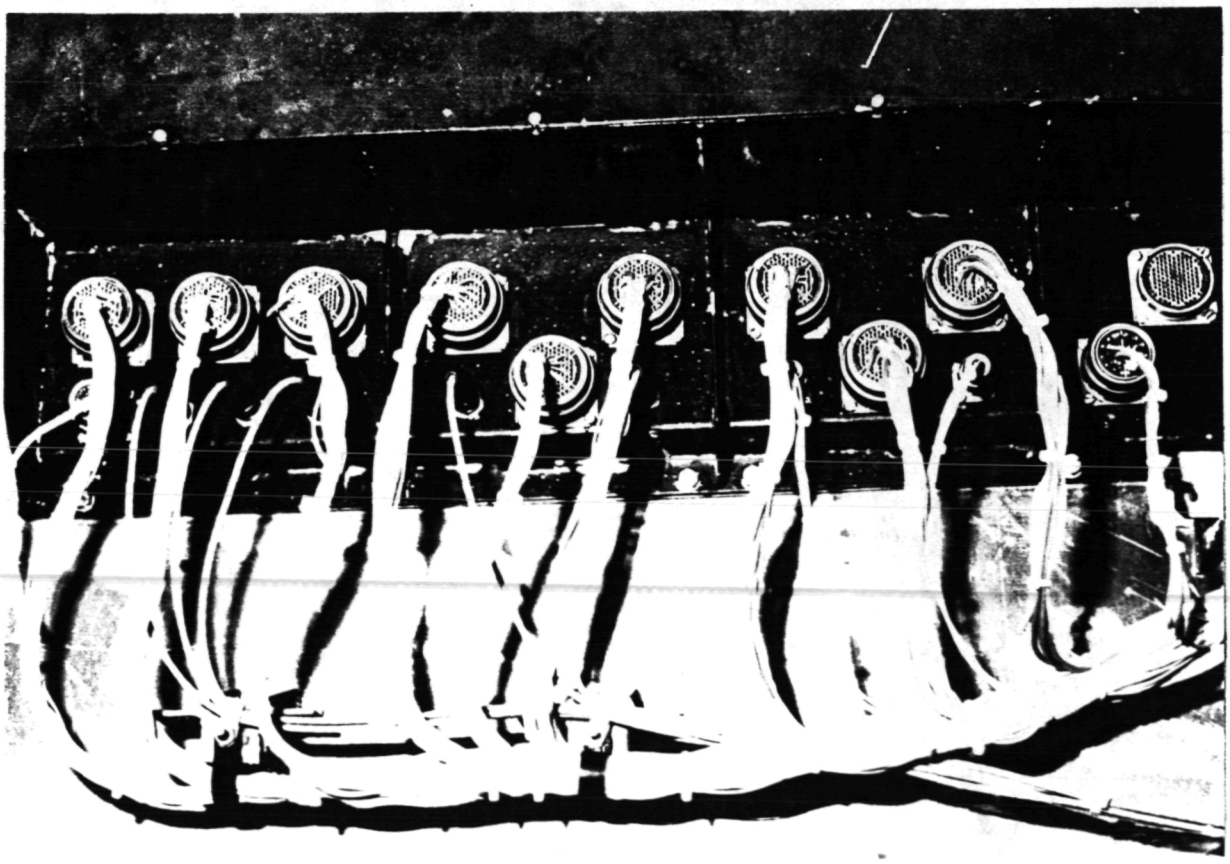
SSM Equipment Section Mockup



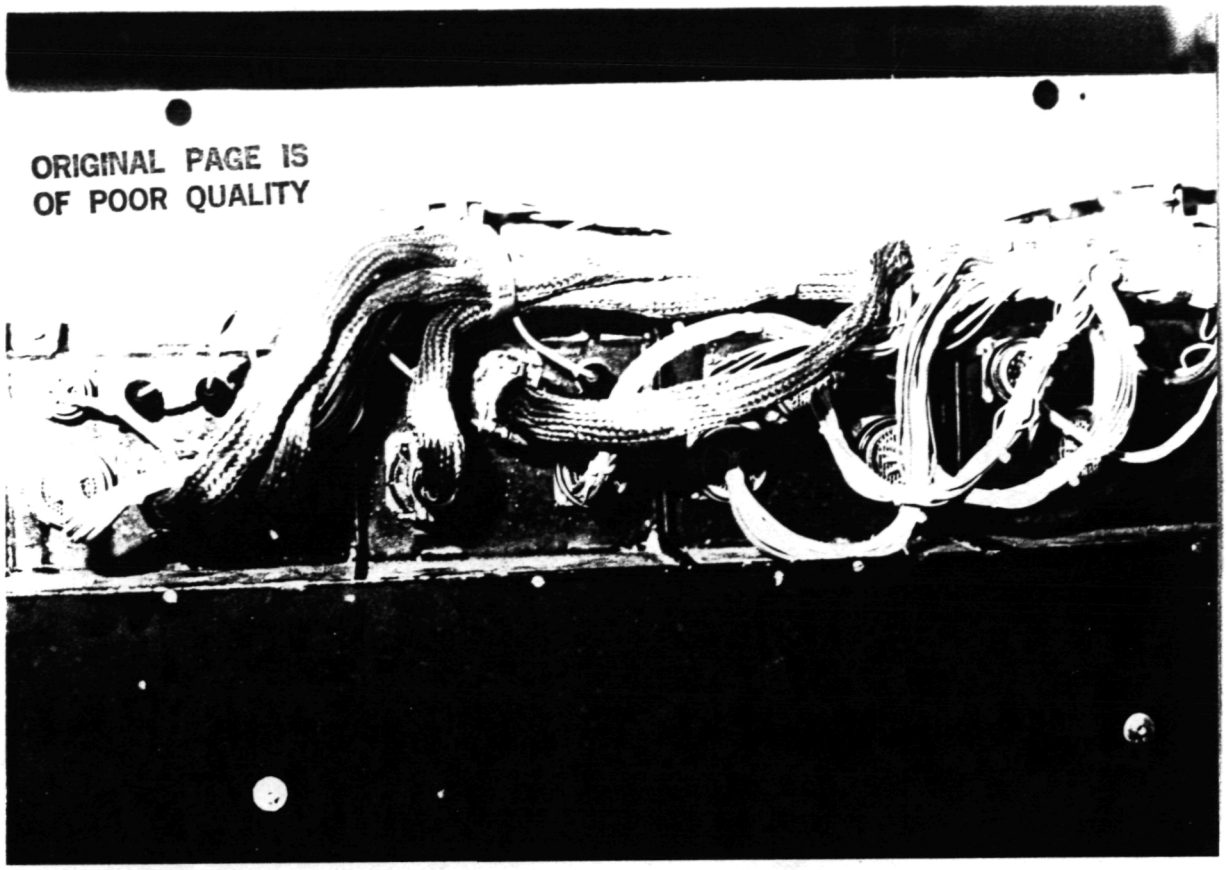
Bay 1 Door, DMU and DF224 Bay



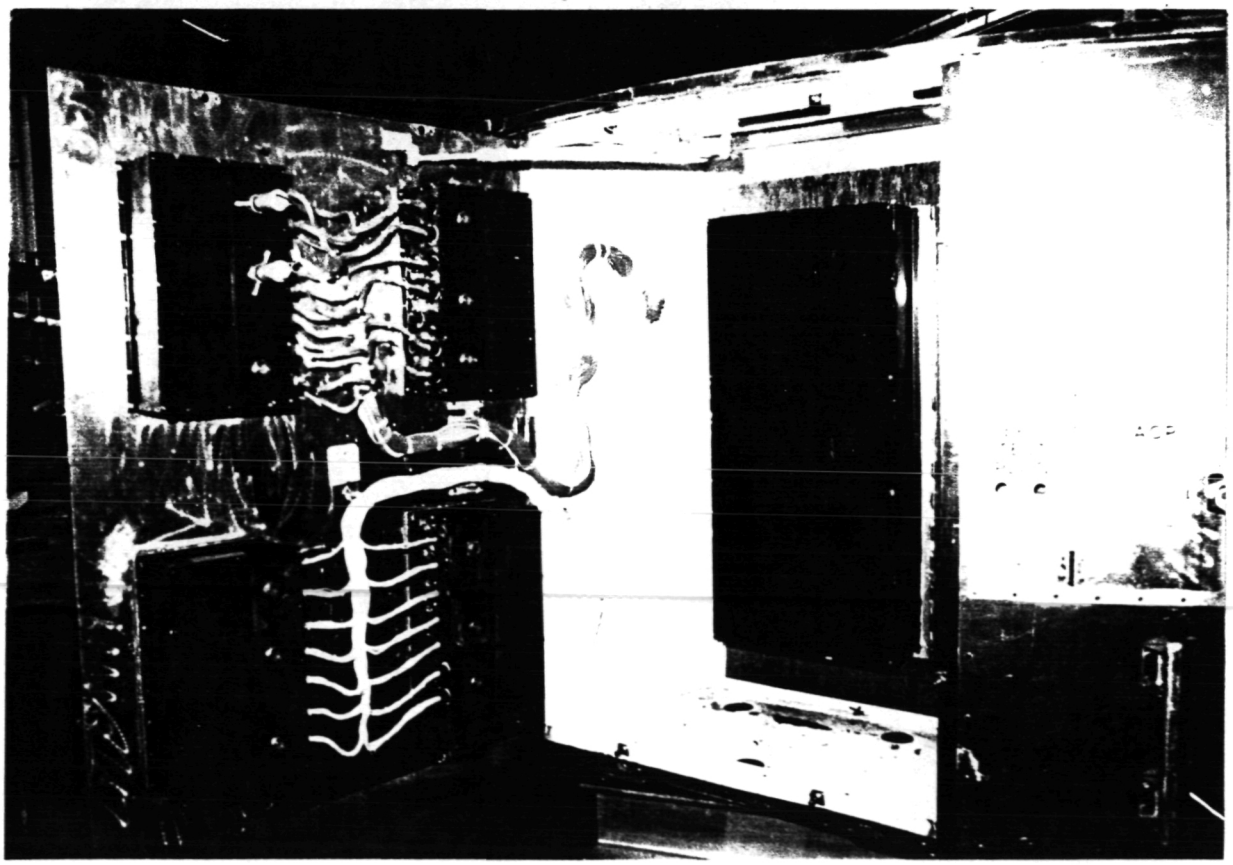
Bay 1 Door, DMU



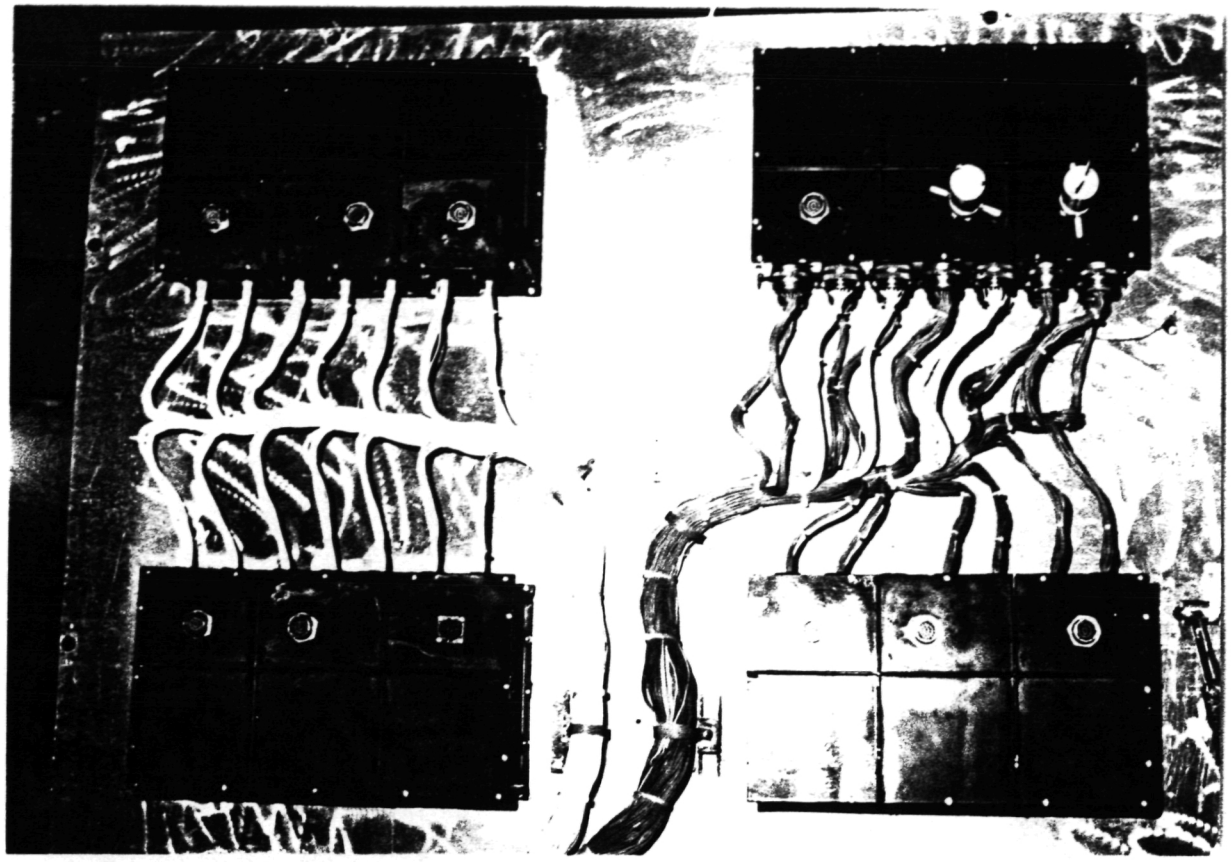
Bay 1 Door, DMU



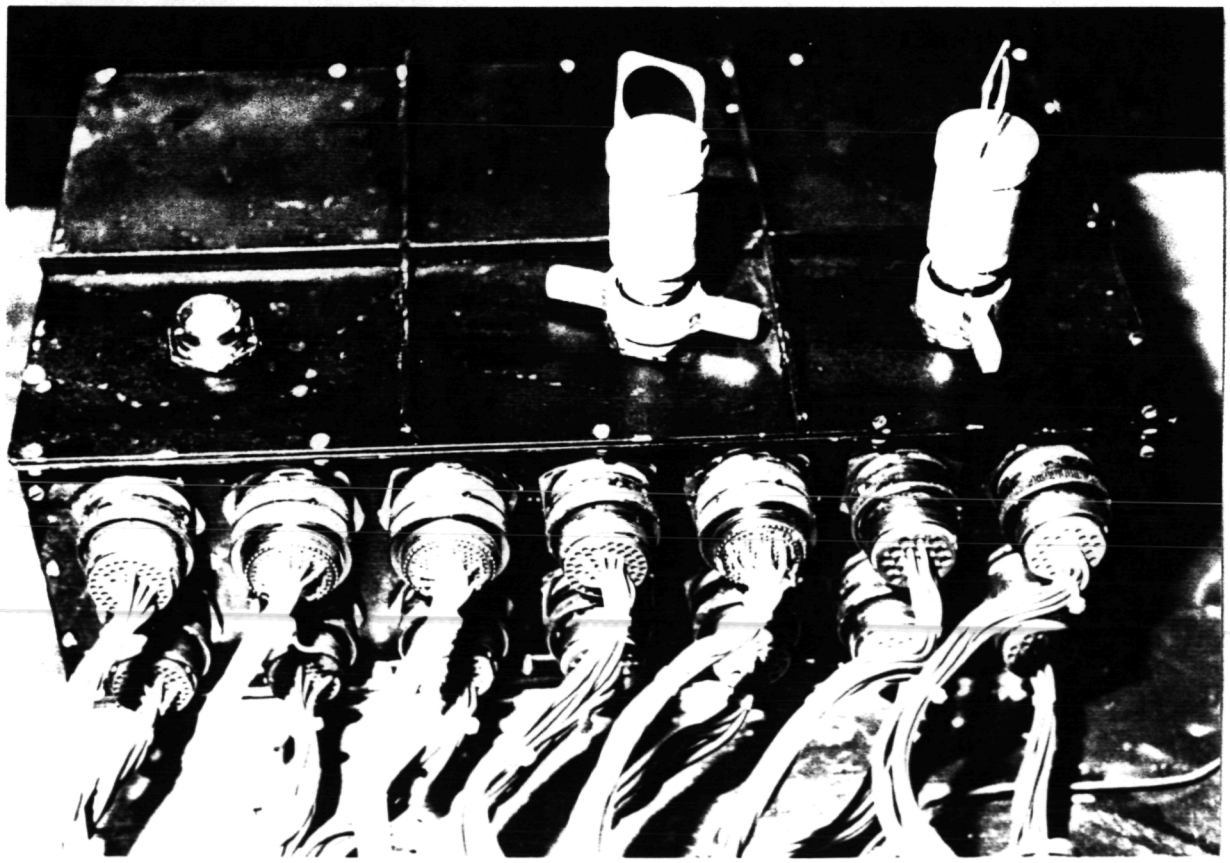
Bay 1 Door, DMU



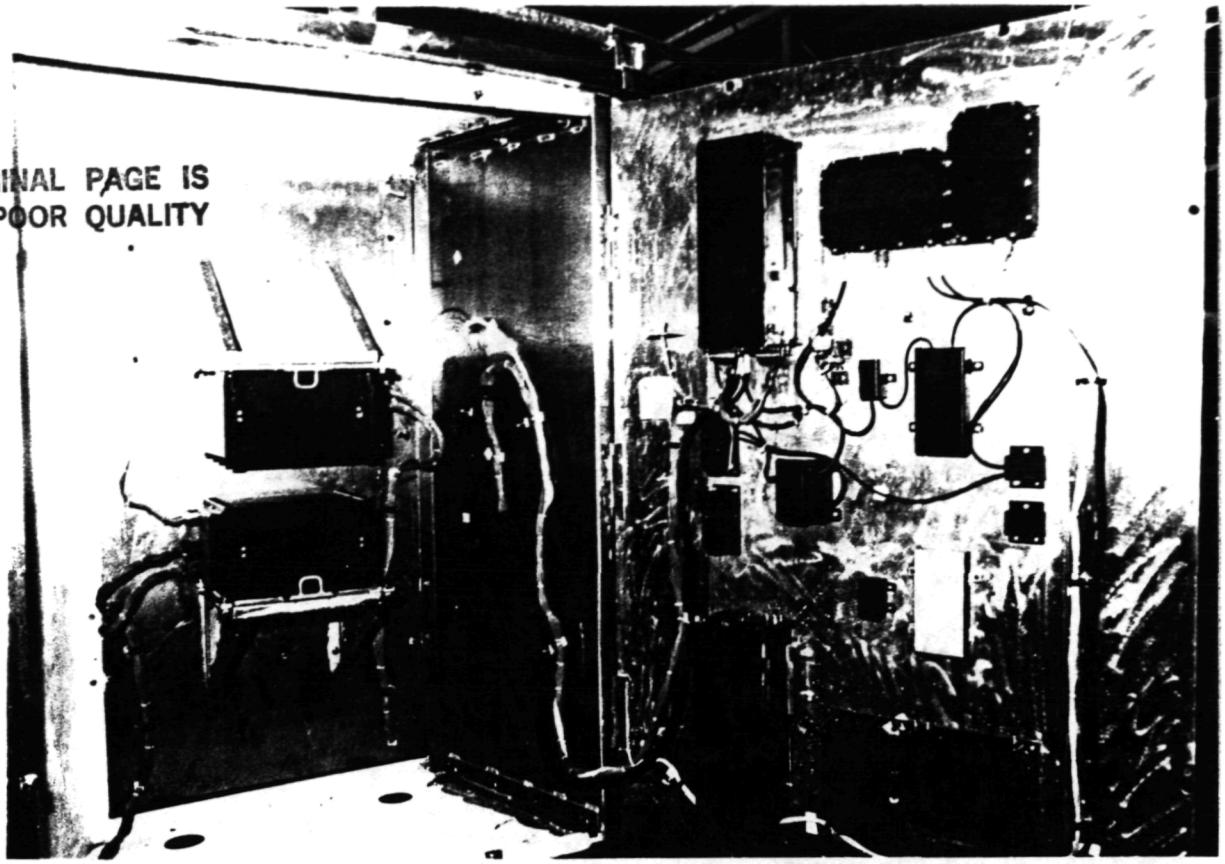
Bay 4 Door, PDU and PCU



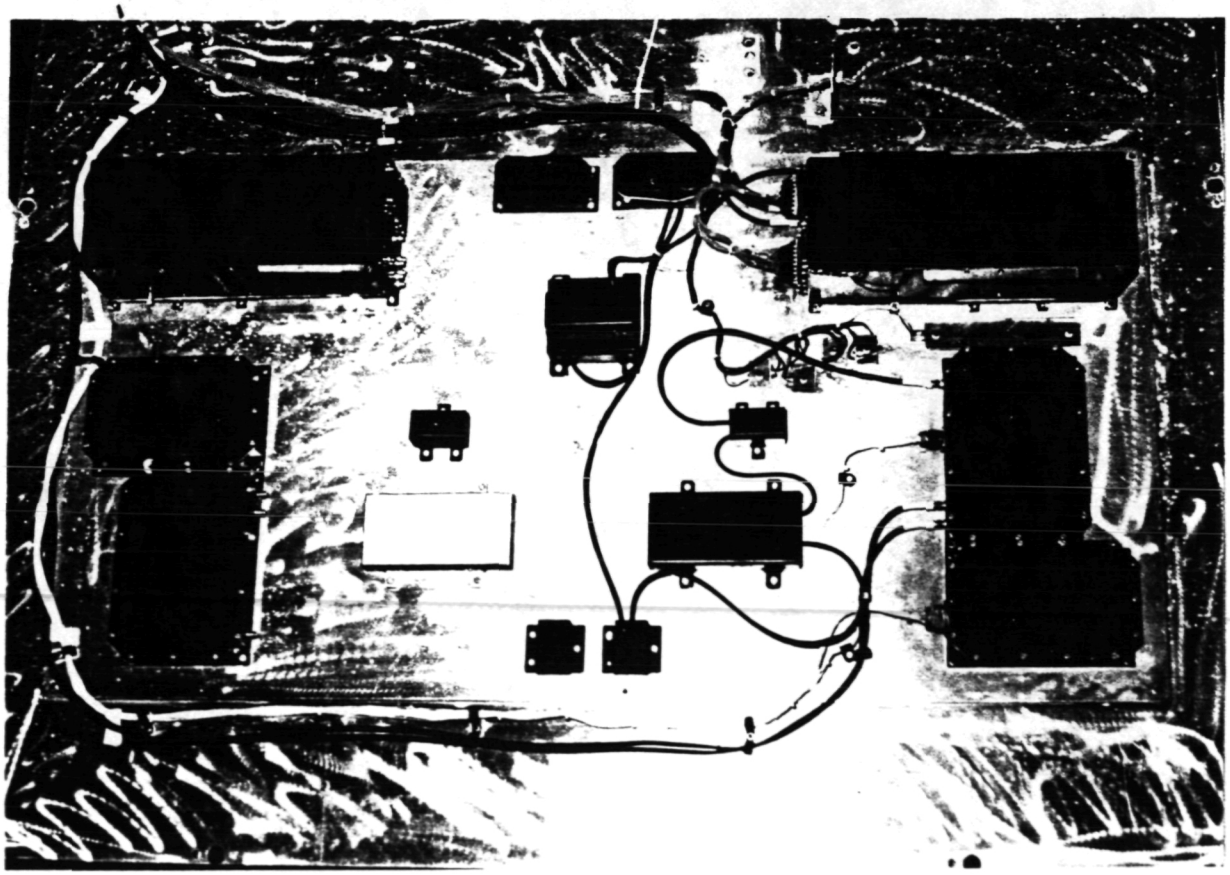
Bay 4 Door, PDUs, Quantity 4



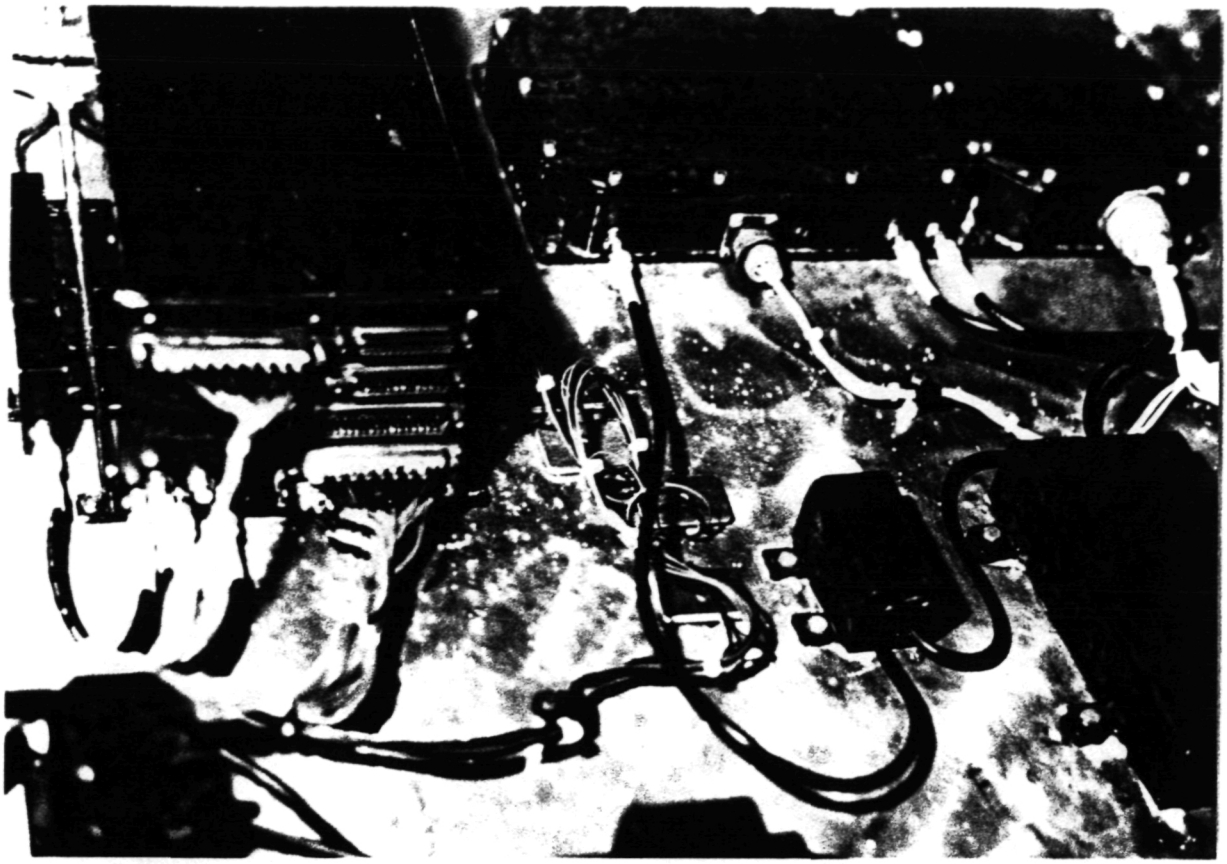
Bay 4 Door, PDU



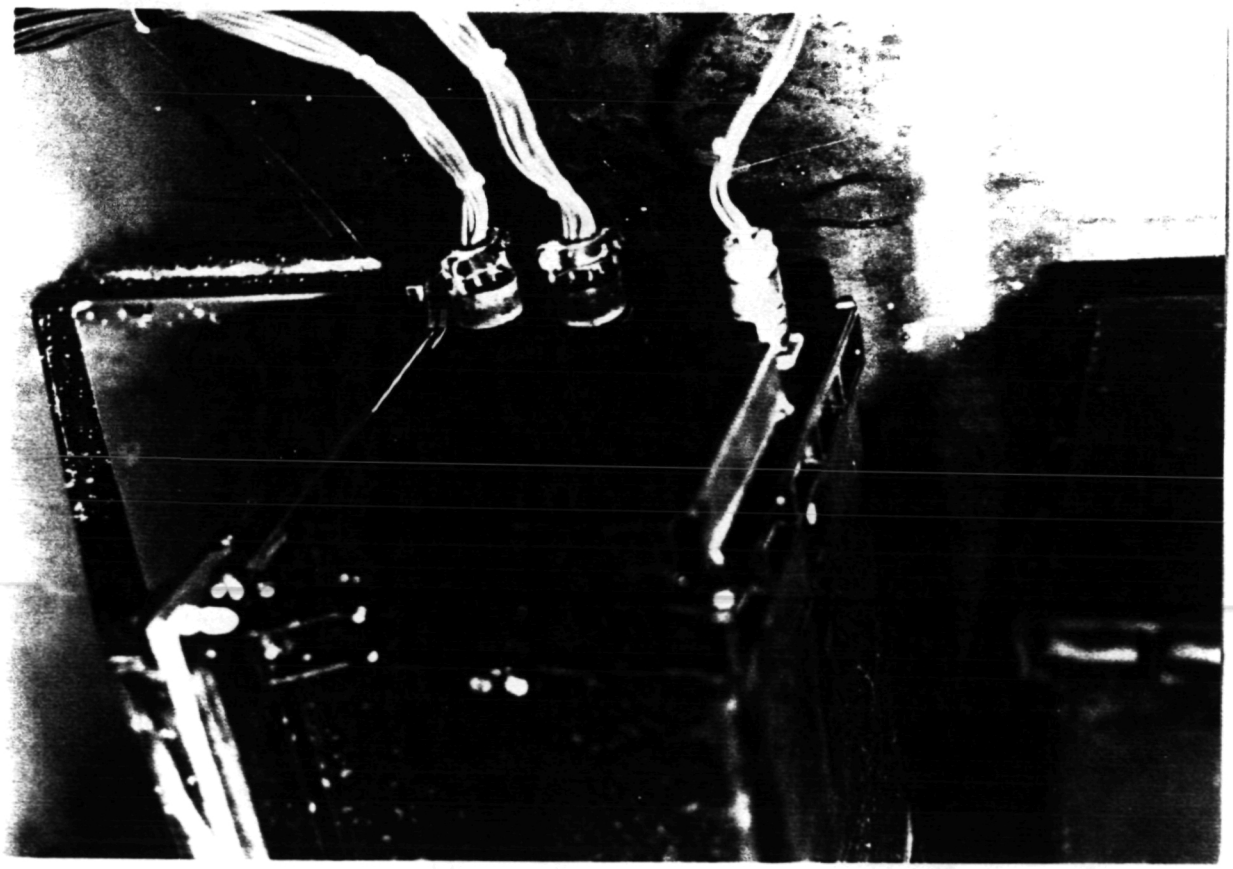
Bay 5, Tape Recorders #1 and #3



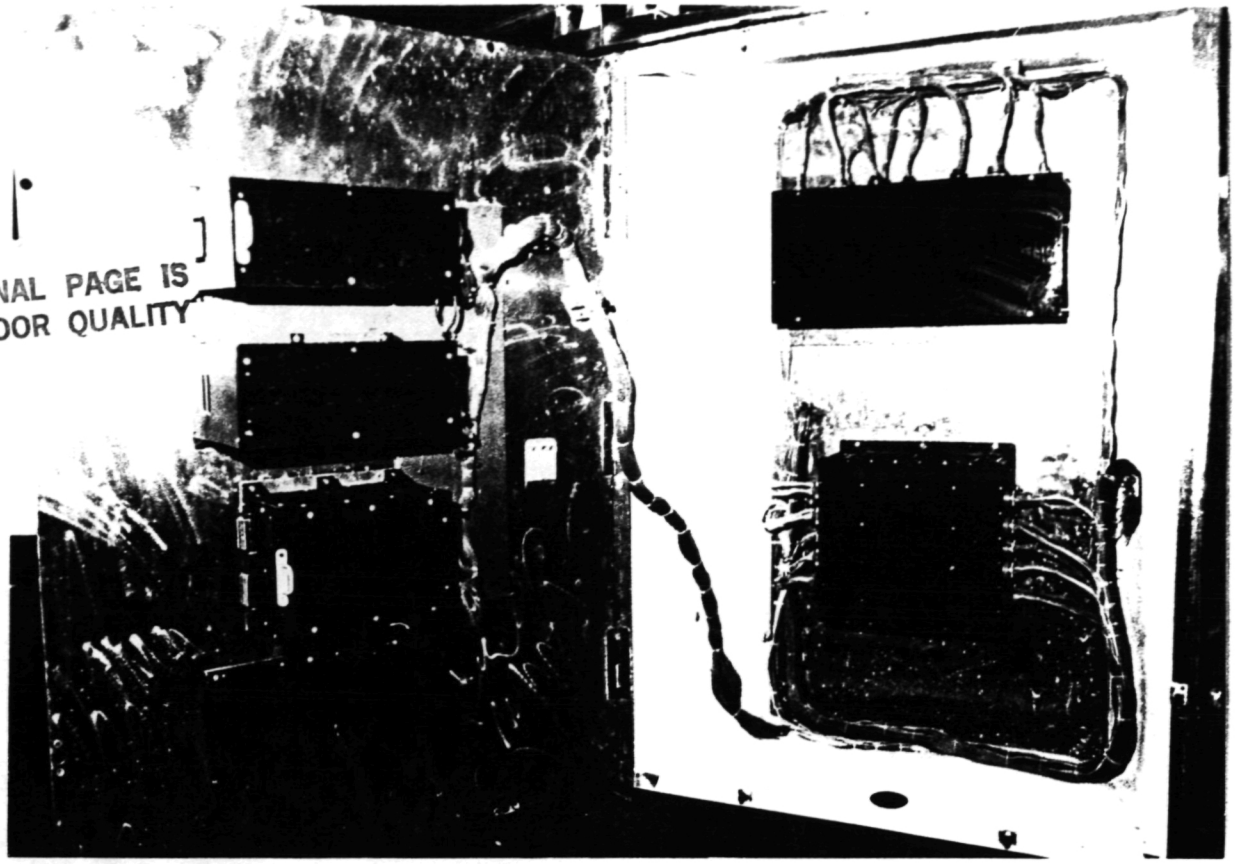
Bay 5 Door, MAT and SAT



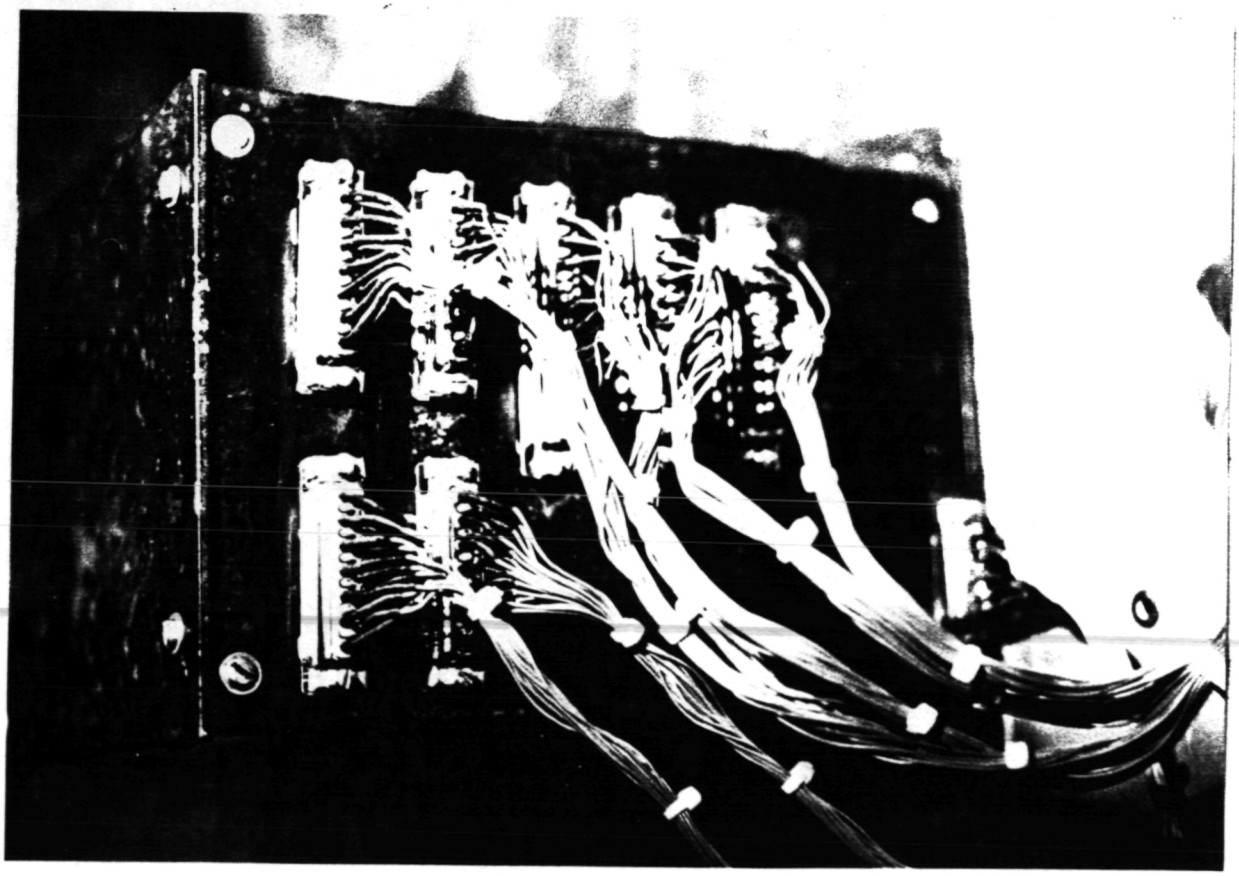
Bay 5 Door, MAT and SAT



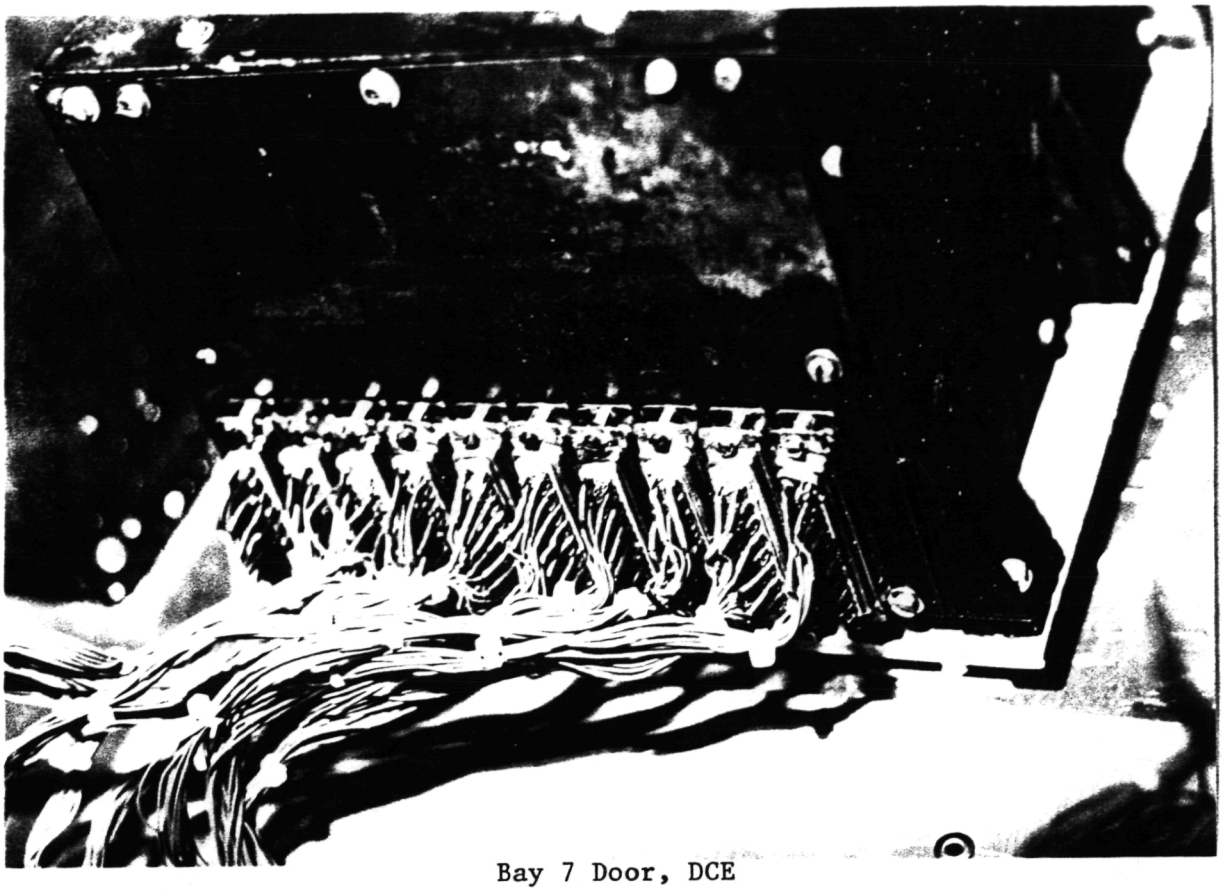
Bay 5 Tape Recorder



Bay 7, DIU and MCU

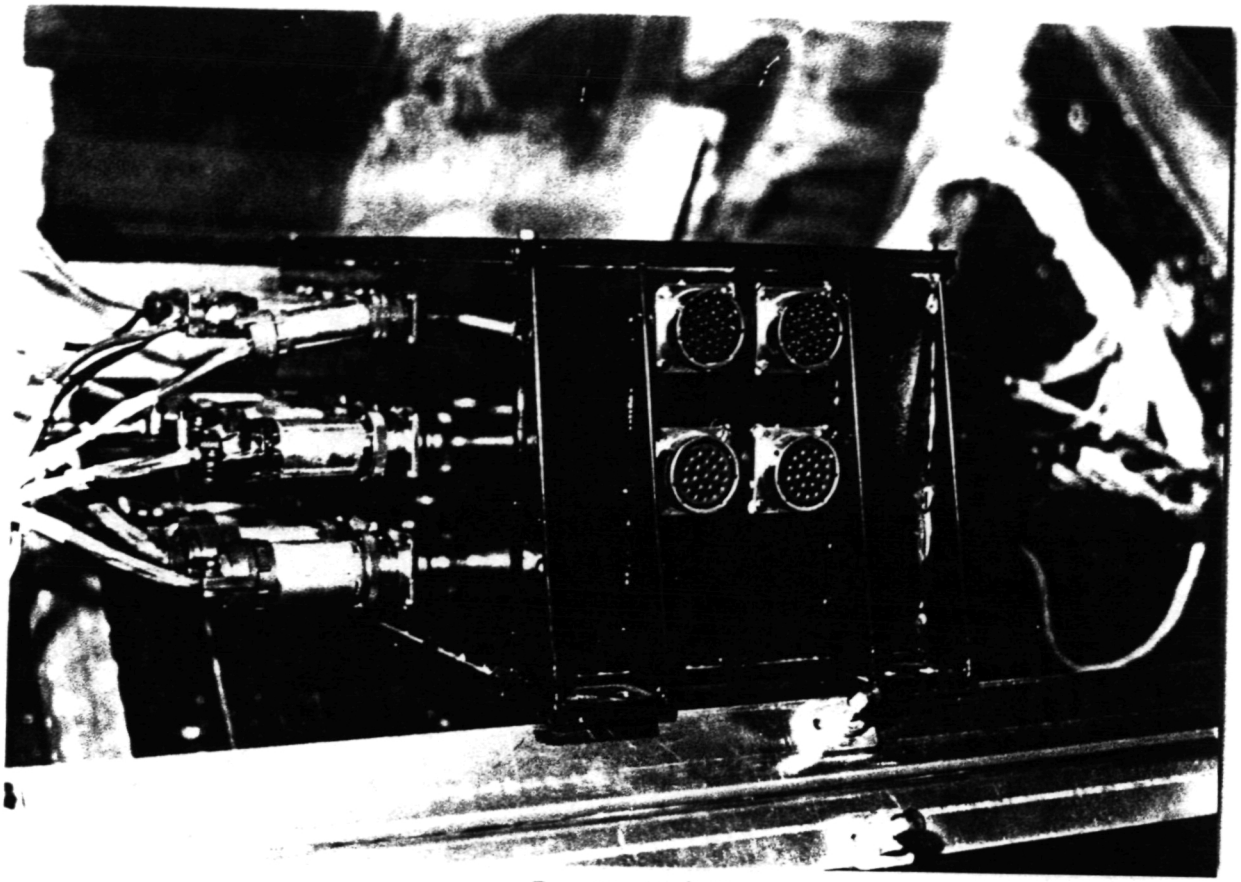


Bay 7 Door, SADE

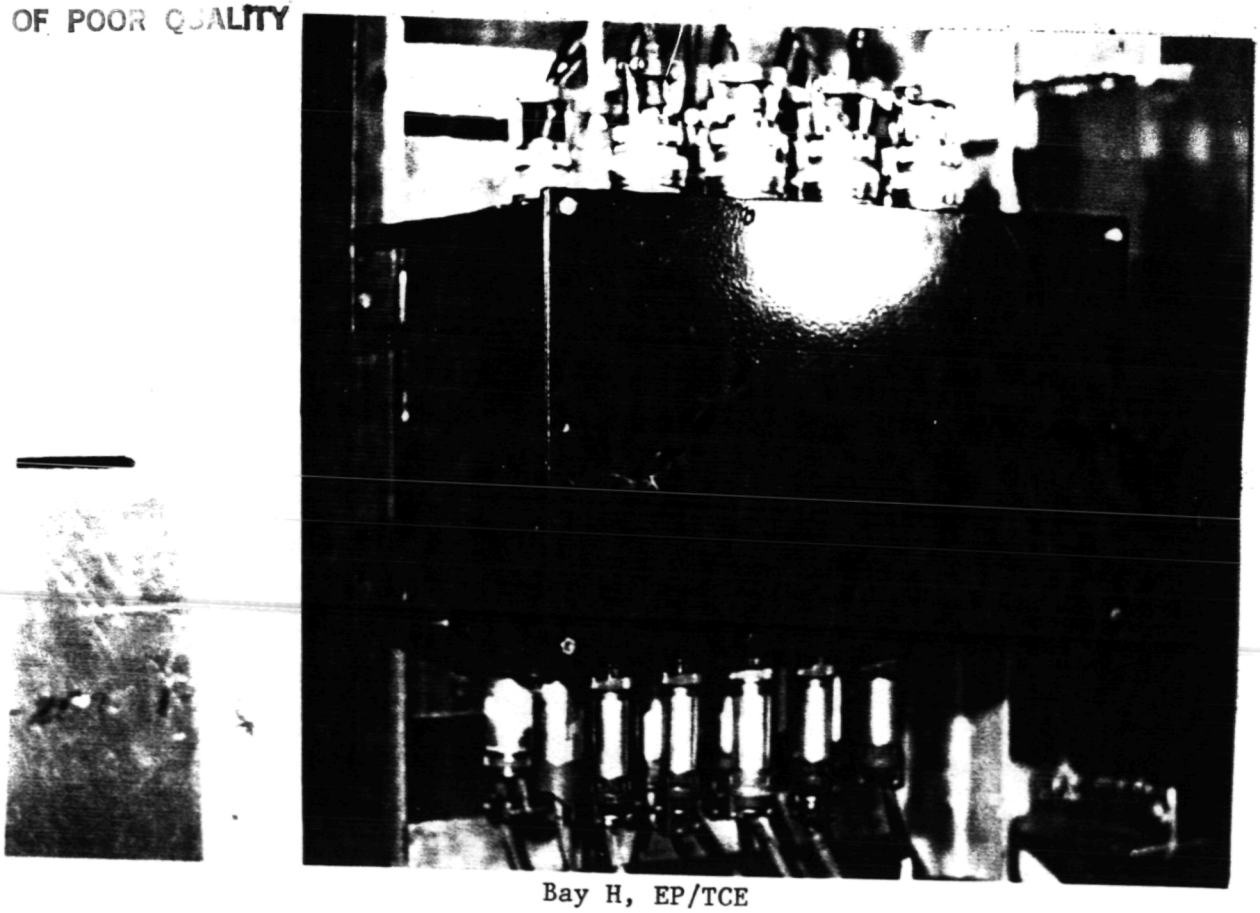


Bay 7 Door, DCE

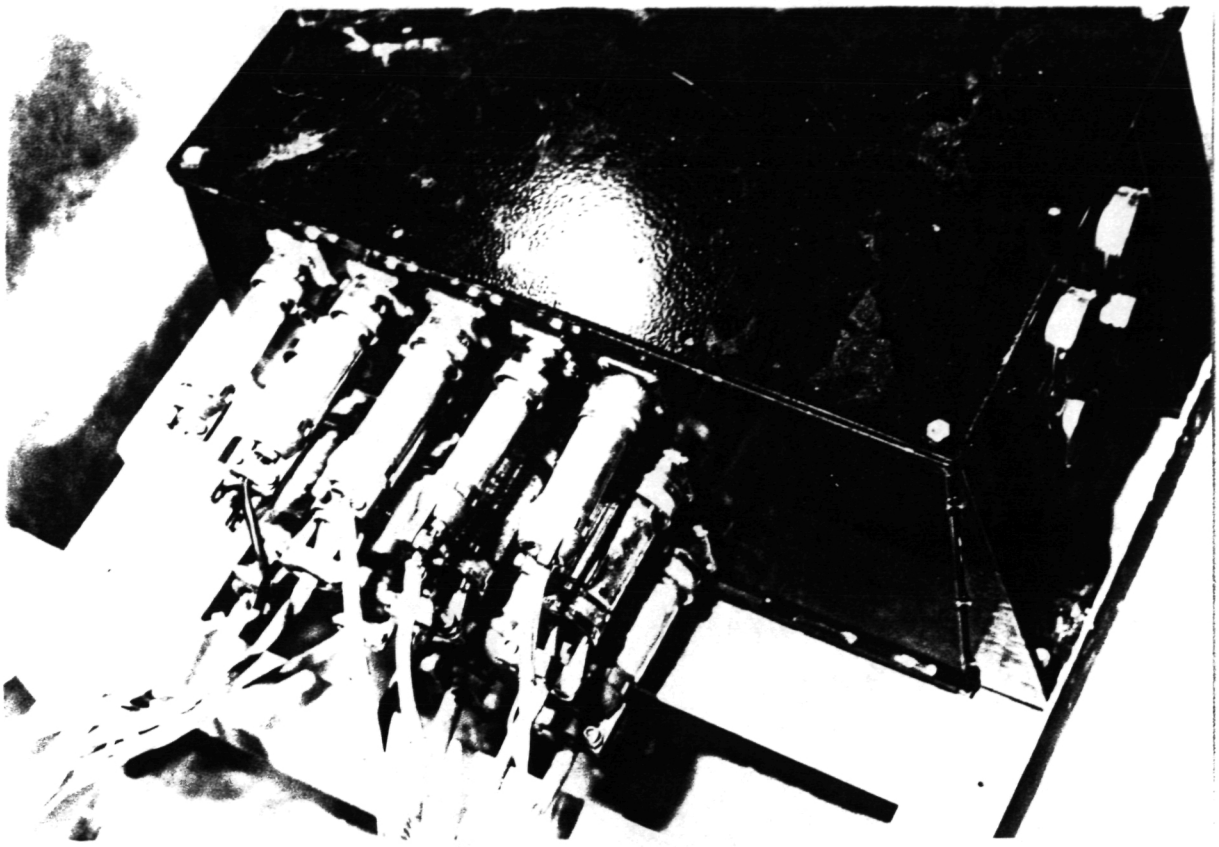
Bay 7, DIU



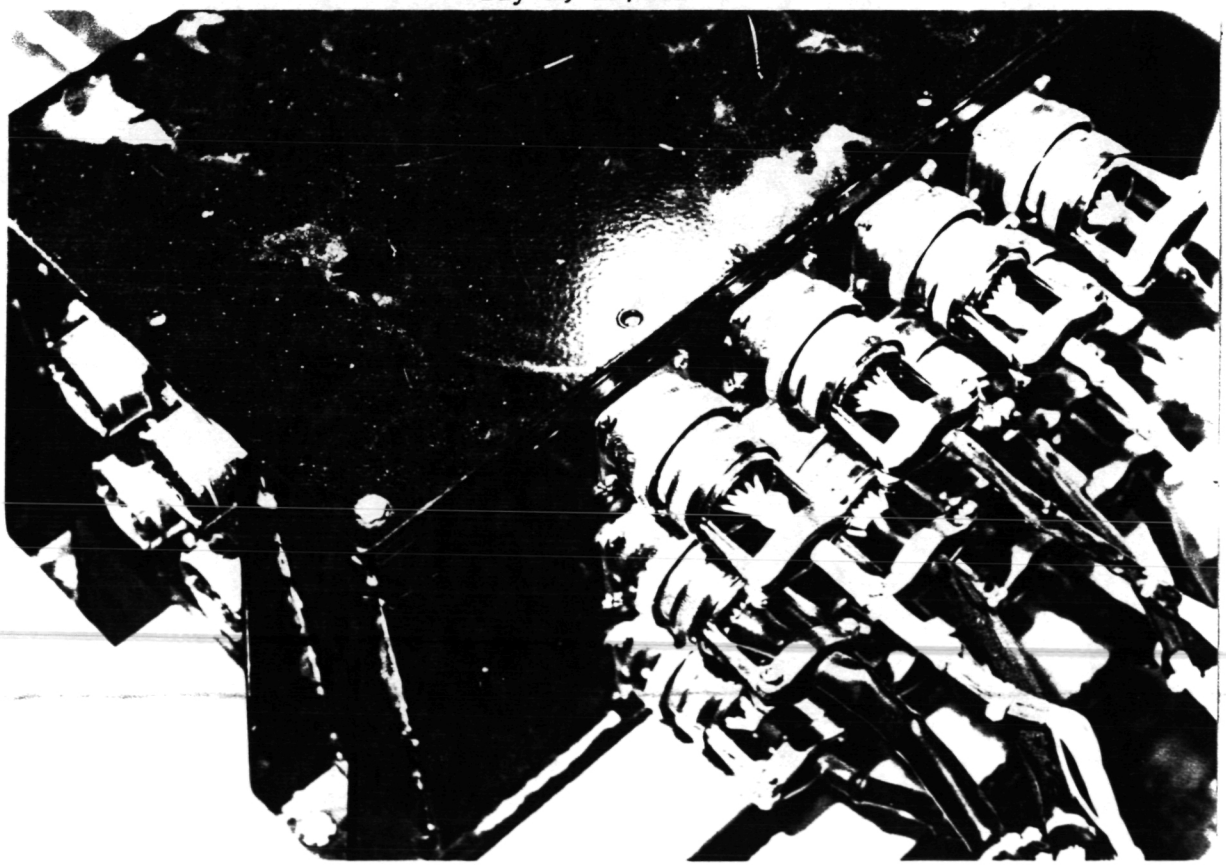
Bay H, EP/TCE



Bay H, EP/TCE



Bay H, EP/TCE



Bay H, EP/TCE

Bay C Door, OCE

APPENDIX C

INFORMATION SOURCES

INFORMATION SOURCES

DOCUMENT NO.	TITLE
ST/MR-16	LMSC/D977285
ST/ICD-Q58	
SD-679-1005	Design Specification Actuator Control Electronics Assembly Rev. AV
SD-679-1007	Design Specification Optical Control Electronics Assembly Rev. AZ
SD-679-1090	Design Specification Electrical Power and Thermal Control Electronics Assembly Rev. AJ

DWG NO.	TITLE	REV/DATE
Bay 1		
4172743	Bay 1 Door Assembly	B/82-12-08
4171584	Bay 1 Installation	B/84-01-09
4176154	Wire Harness Provisions	A/83-12-13
4171915	DMU Assembly	-/83-02-14
4172524	DMU Enclosure	-/82-07-13
4172525	DMU Top Cover	A/83-02-04
4172526	DMU Bottom Cover	-/82-06-02
4172527	DMU Matrix Assembly	-/82-11-19
4172528	DMU Matrix Plate	B/82-06-18
4173947	DMU Terminal Board	-/82-06-04
4175841	DMU GSE Assembly	-/82-12-02
1617815	Connector	G/83-08-08
LS-41164	Connector	AU/84-10-31
M39012 /28-0018	Connector	
4171885	GEA	D/84-05-16
MS-25083		
4176578	DF-224 ORU Assembly	
4171869	DF-224	C/80-02-26
1680250	Protective Cap	D/84-07-15
Bay 2		
4171585	Bay 2 Installation	B/83-07-19
4176155	Wire Harness Provisions	-/83-05-04
4171401	Oscillator Assembly	D/81-12-14
4171965	Charge Current Controller	A/83-05-06
4172835	Battery ORU Assembly	C/83-07-19
4171971	Battery	B/83-07-21
4176588	Louver Assembly	B/84-01-09
N/A	Louver Installation Layout Bay 2	N/A

DWG NO.	TITLE	REV/DATE
Bay 3		
4172827	Bay 3 Installation	
4176156	Wire Harness Provisions	-/83-04-09
4171965	Charge Current Controller	(See Bay 2)
4172835	Battery ORU Assembly	(See Bay 2)
4171971	Battery	(See Bay 2)
4176588	Louver Assembly	(See Bay 2)
N/A	Louver Installation Layout Bay 3	N/A
Bay 4		
4172828	Bay 4 Installation	D/83-08-02
4176157	Wire Harness Provisions	-/83-04-11
4172020	PCU Assembly	A/84-07-18
4173531	PCU Enclosure	A/84-07-16
4175782	PCU Support	A/83-04-20
4173560	PCU Skin	A/84-07-08
4173561	PCU Skin	A/84-06-29
4173563	PCU Printed Wire Board	-/82-12-14
4172050	PDU Assembly	B/84-03-20
4172056	PDU Enclosure	A/82-09-09
4172047	PDU Cover	A/83-10-28
4172058	PDU Base Plate	-/81-06-23
4176696	PDU Enclosure Assembly Modification	-/84-04-04
Bay 5		
4171586	Bay 5 Installation	A/83-04-21
4176158	Wire Harness Provisions	-/83-04-29
4171844	Transponder	D/84-05-17
4171857	SA Transmitter	D/83-02-03
4171458	RF Circulator Switch	E/82-11-05
4171909	RF Transfer Switch	D/83-02-15
4171907	RF Switch	D/83-02-15
4171911	RF Multiplexer	E/83-01-10
4172780	Mounting Plate	-/82-03-15
4171675	Tape Recorder	D/81-11-11
Bay 6		
4176159	Wire Harness Provisions	-/83-04-14
4175569	Reaction Wheel Frame	B/83-12-06
4176686	Reaction Wheel Assembly	-/84-10-24
4175547	RWA Frame Weldment	-/82-03-25
4176554	RWA Connector Bracket	-/83-12-07
4176556	RWA Connector Fitting Bracket	-/83-11-16
Bay 7		
4171588	Bay 7 Installation	C/84-10-22
4176160	Wire Harness Provisions	-/83-04-14
4171954	DIU Assembly	A/84-06-29

DWG NO.	TITLE	REV/DATE
Bay 7, Continued		
4172472	DIU Enclosure	A/81-12-17
LS 41209	Connector	R/84-06-06
MS 27497	Connector	
4172099	DIU BCD	C/81-06-20
4172473	DIU Top Cover	-/81-07-22
4172474	DIU Bottom Cover	-/81-12-11
4171887	MCU Assembly	-/84-06-05
Bay 8		
4172352	Bay 8 Installation	C/83-04-81
4176161	Wire Harness Provisions	-/83-04-06
4171976	PSEA	H/84-09-27
4172818	RMGA	8/82-11-11
4171859	ICU	-/82-09-20
Bay 9		
4176162	Wire Harness Provisions	-/83-04-14
4175569	Reaction Wheel Frame	(See Bay 6)
4176686	Reaction Wheel Assembly	(See Bay 6)
4175547	RWA Frame Weldment	(See Bay 6)
4176554	RWA Connector Bracket	(See Bay 6)
4176556	RWA Connector Fitting Bracket	(See Bay 6)
Bay 10		
4171589	Bay 10 Installation	-/82-02-24
4176163	Wire Harness Provisions	-82-01-11
4171776	ECU	F/83-12-19
4172869	ECU BCD	-/82-10-08
4172099	DIU BCD	(See Bay 7)
4171954	DIU Assembly	(See Bay 7)
Wire Harness Support Brackets		
4176604	Wear Pad	-/84-02-07
4176605	Wire Harness Bracket	-/84-01-01
4176606	Extension Bracket	-/84-02-01
4176110	Wire Harness Support	-/83-03-10
4176011	Wire Harness Support	-/83-03-10
4176112	Wire Harness Support	-/83-03-21
4176113	Wire Harness Support ZEE	-/83-03-22
4176115	Wire Harness Support ZEE	-/83-03-23
4176117	Wire Harness Support	-/83-03-29
4176118	Wire Harness Support	-/83-03-30
4176433	Ground Stud	-/83-11-19
4176135	Wire Harness Support - Bay 10	-/83-04-04
4176136	Wire Harness Support Leg	-/83-04-04
4176137	Wire Harness Support Mat	A/82-02-22
4176038	Door Bracket	-/82-08-04

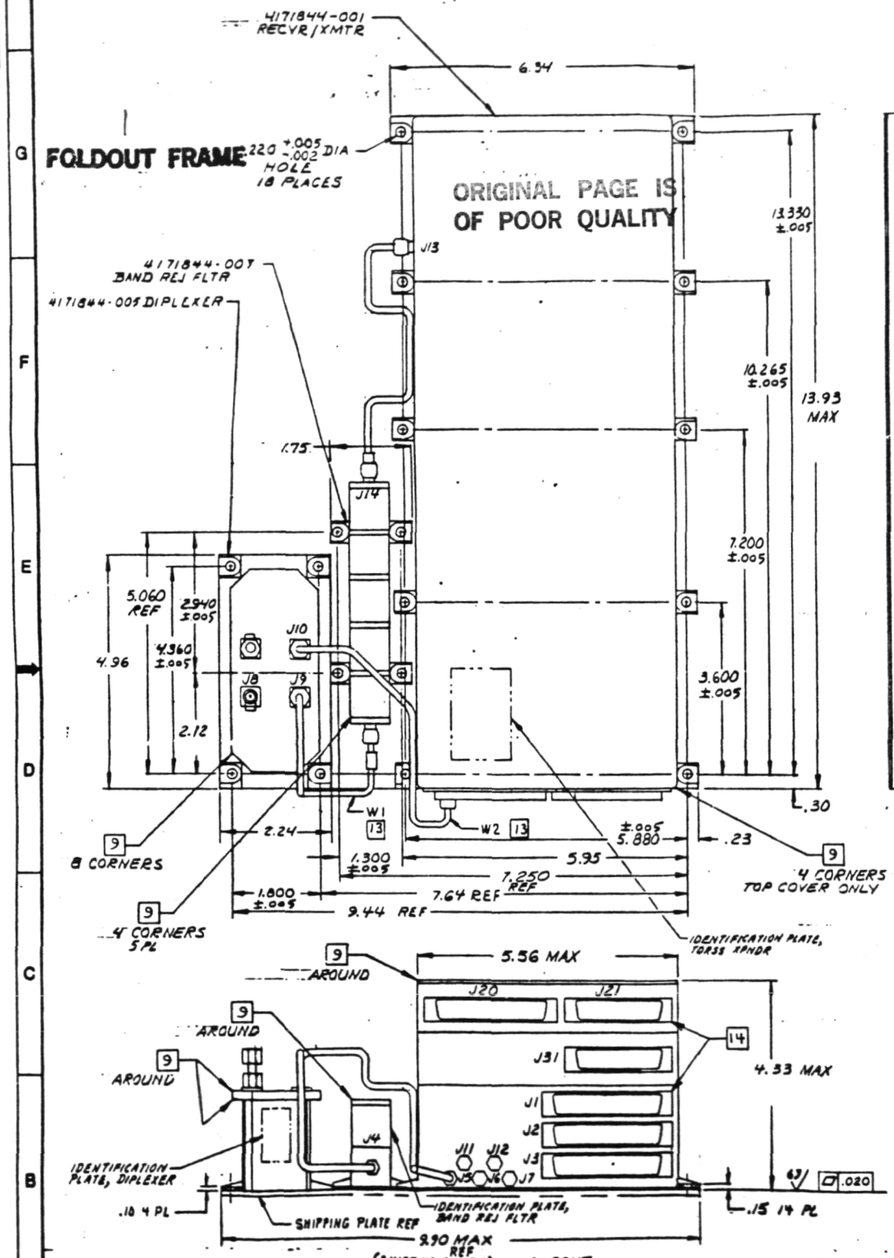
DWG NO.	TITLE	REV/DATE
Wire Harness Support Brackets, Continued		
4176139	Wire Harness Support ZEE	-/83-04-05
4176142	Wire Harness Support ZEE	-/83-04-16
4176561	Computer Connector Bracket	-/83-12-10
4176363	Delrin Washer	-/83-07-11
4176364	Bearing	-/83-07-11
4176365	Sleeve	-/83-07-11
4176365	Bracket	-/83-07-11
4176368	Slide Bracket	-/83-07-11
4176369	Slide Bracket	-/83-07-11
4176370	Wire Harness Bracket	-/83-07-11
4176174	Wire Harness Support Bracket	-/83-04-25
4176175	Wire Harness Support	-/83-04-26
4176176	Wire Harness Support	-/83-04-30
4176182	Wire Harness Support	-/83-04-28
4176385	Wire Harness "D" Hole	-/83-04-28
Bay H		
679-0620-008	Final Assembly EP/TCE Box	
679-5780-014	Cable Installation OTA Equip. Section (Bay H) EP/TCE TO ORU Fuse Module	
911-5814-001	MLI Blanket, EP/TCE Box	
679-0627-005	Housing, EP/TCE	
679-0630-067	System Assembly EP/TCE	
Bay C		
679-5780-014	Cable Installation OTA Equip. Section	
679-5408-003	OCE Assembly	
679-5453-003	Electro-Mechanical Assembly (OCE)	
679-5459-001	Plate, Side-L.H. OCE	
679-5456-001	Panel, Front OCE	
679-5457-001	Panel, Rear OCE	
679-5458-001	Plate, Side-R.H. OCE	
679-5578-001	Envelope Drawing OCE	

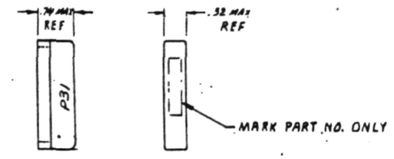
APPENDIX D

MAT DRAWINGS

LOCKHEED DATA				SUPPLIER DATA				
QUANTITY REQUIRED PER ASSEMBLY	PART NUMBER	NOMENCLATURE	SPECIFICATION	CODE IDENT	PART NUMBER	DRAWING NUMBER	NAME AND ADDRESS	
	4171844-001	RECVR/XMTR	4171845	94930	70-P02705L	70-P02705L	MOTOROLA I.Y.C. 8201 EAST MC DOWELL ROAD SCOTTSDALE, ARIZONA 85257	
	4171844-003	BAND REJ. FLTR	4171845					
	4171844-005	DIPLEXER	4171845					
	4171844-007	PROGRAM CONN.	4171845					
	4171844-009	PROGRAM CONN.	4171845					

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APVD
	NC	RELEASE FOR BID ONLY		
	A	REVISED PER MOTOROLA DWG ADDED SHT 2	4-7-87 4-14-87	
	7G	DIM (WAS) .220 +.005 -.002 DIA (ADDED) TO LOCKHEED DATA & TO NOTE 4 FOR -007 & -009 PROGRAMING CONNECTOR.	NOV 20 1987	
	3F	(ADDED) 4171844-007 & -009 PROGRAMING CONNECTOR ON FACE SF DWG		
	7C	(ADDED) 7.250 REF		
	5D	(ADDED) 1.25 MAX DIM.		
	6D5	ADDED) IDENTIFICATION PLATE		
	7C			
	B	SEE SH 2 RELEASED FOR PROCUREMENT	12-23-87	
	8E	REMOVED 5.95 DIM	10-2-88	
	7F	REMOVED C/G DESIGNATION AND DIM E	10-3-88	
	5C			
	8B	ADDED SHIPPING PLATE REF AND .10 4 PL DIM		
	6B	DIM (WAS) .15 18 PL REMOVED NOTE 10 ADDED NOTES 12, 13, 14		
	3F	ADDED REF TO DIM, CHANGED ID NOTE NOTE 4 WEIGHT (WAS) 15.67 LBS		
		NOTE 7 ADDED (NOT APPLICABLE TO -007 & -009). ADDED ± .005		
	C	TO MTG DIMENSIONS. SEE SH 2	11-8-89	
	D	SEE SH. 2	17-5-89 17-5-89	





ORIGINAL PAGE IS OF POOR QUALITY

2

FOLDOUT FRAME

NOTES:

1. DOCUMENTATION AND CHANGE CONTROL REQUIREMENTS SHALL BE IN ACCORDANCE WITH THE PROCUREMENT DOCUMENT.
2. SPECIFICATION LISTED IN LOCKHEED DATA BLOCK ABOVE GOVERNS THE PROCUREMENT AND ACCEPTANCE OF THIS ITEM.
3. PACKAGING AND PRESERVATION SHALL BE AS SPECIFIED IN THE PROCUREMENT DOCUMENT.
4. MAXIMUM TOTAL WEIGHT - 15.17 POUNDS (INCLUDING -007 OR -009)
   - -001 - RECVR/XMTR 13.35 LBS.
   - -003 - BAND REJ FLTR .82 LBS.
   - -005 - DIPLEXER 1.00 LBS.

4. CONT.
   - -007 PROGRAMING CONN. .1 LBS.
   - -009 PROGRAMING CONN. .1 LBS.
5. MANUFACTURE IN CONFORMANCE WITH PROCESS SPECIFICATIONS LISTED IN LOCKHEED DATA BLOCK ABOVE OR IN NOTES. ANY DEVIATION MADE BY THE VENDOR TO THESE SPECIFICATIONS OR TO PREVIOUSLY APPROVED VENDOR SPECIFICATIONS SHALL BE REPORTED TO LMSC PROCUREMENT. APPROVAL OF ANY DEVIATION SHALL BE FORMALLY INDICATED BY LMSC ISSUANCE OF A NEW OR REVISED SPECIFICATION OR ENVELOPE DRAWING PRIOR TO ACCEPTANCE OF ANY HARDWARE MANUFACTURED IN CONFORMANCE WITH SUCH DEVIATION.
6. WHEN CHANGES ARE MADE TO PROCESS SPECIFICATIONS CONSIDERED TO BE VENDOR PROPRIETARY, THE VENDOR MUST ADVISE LMSC PROCUREMENT OF THE IMPACT OF ANY CONTEMPLATED CHANGE PRIOR TO THE CHANGE AND THE SERIAL OR LOT NUMBER ON WHICH THE CHANGE WILL BECOME EFFECTIVE.
7. UNIT IDENTIFICATION WILL BE IN ACCORDANCE WITH MIL-STD-130, AND SHALL CONTAIN, AS A MINIMUM, THE FOLLOWING INFORMATION: (NOT APPLICABLE TO -007 AND -009)
   NOMENCLATURE
   LMSC PART NUMBER
   LMSC CUSTOMER'S PRIME CONTRACT NUMBER AS REFLECTED ON THE PROCUREMENT DOCUMENT
   MANUFACTURE'S NAME OR CODE IDENT NUMBER.
   ASSIGN THE FOLLOWING CCA FAMILY NUMBERS PLUS DASH AND APPLICABLE LMSC-SUPPLIED SERIAL NUMBER TO THE FOLLOWING UNITS:
   - 4171844-001 RECVR/XMTR 4494
   - 4171844-003 BAND REJ FLTR 4495
   - 4171844-005 DIPLEXER 4496

   US
8. TUNED SET COMPONENTS, -001 AND -005 SHALL BE INSTALLED AND MAINTAINED AS A SET.
9. CORNERS AND EDGES AS INDICATED TO BE A MINIMUM .06 RADIUS.
10. -REMOVED
11. FINISH: BASE AND MOUNTING FEET - CHEMICAL FILM PER MIL-C-5541, CLASS 3, ALODINE 1200 OR EQUIVALENT. SHEAR PANELS AND TOP COVERS - LOW OUTGASSING, HIGH EMISSIVITY BLACK ENAMEL. CONNECTORS TO BE FREE OF PAINT.
12. ONE PROGRAMMING CONNECTOR P31, SHALL BE SHIPPED ATTACHED TO UNIT AT J31. THE OTHER P31 CONNECTOR SHALL BE SHIPPED SEPARATELY PACKAGED IN SHIPPING CONTAINER.
13. CABLES W1 & W2 ARE NOT FLIGHT CABLES AND SHALL NOT BE PAINTED, USED FOR TEST ONLY, THEY SHALL BE PACKAGED WITH, BUT NOT ATTACHED TO, TRANSPONDER.
14. J1 & J21 ARE DIRECT ACCESS TEST CONNECTORS AND SHALL BE COVERED WITH MATING METAL COVERS FOR FLIGHT PRIOR TO SHIPMENT.

LMSC RELEASED CONTROLLED

QTY REQD	CODE IDENT	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION	SOLDERING-BRAZING-WELDING OR NOTE	MATERIAL SPECIFICATION	ZONE	ITEM NO

PARTS LIST

INTERPRET DWG PER

UNLESS OTHERWISE SPECIFIED DIM ARE IN INCHES. TOLERANCES ON: FRACTIONS = ± 1/16; DECIMALS: .X = ± .1, .XX = ± .03, .XXX = ± .010; ANGLES = ± 2 DEG

CONTRAN 53-32697

CCA, C1/F6 NOTE 7

NEXT ASSY | USED ON APPLICATION

DATE 28-OCT-10
DWN
APVD
APVD
ENGR
CHKR
APVD
APVD

LOCKHEED MISSILES & SPACE COMPANY INC
A SUBSIDIARY OF LOCKHEED AIRCRAFT CORPORATION
SUNNYVALE, CALIFORNIA

MULTIPLE ACCESS TRANSPONDER ENVELOPE DRAWING

SIZE	CODE IDENT	DRAWING NO	REV
E	06887	4171844	D

SCALE 1/1 | SHEET 1 of 2

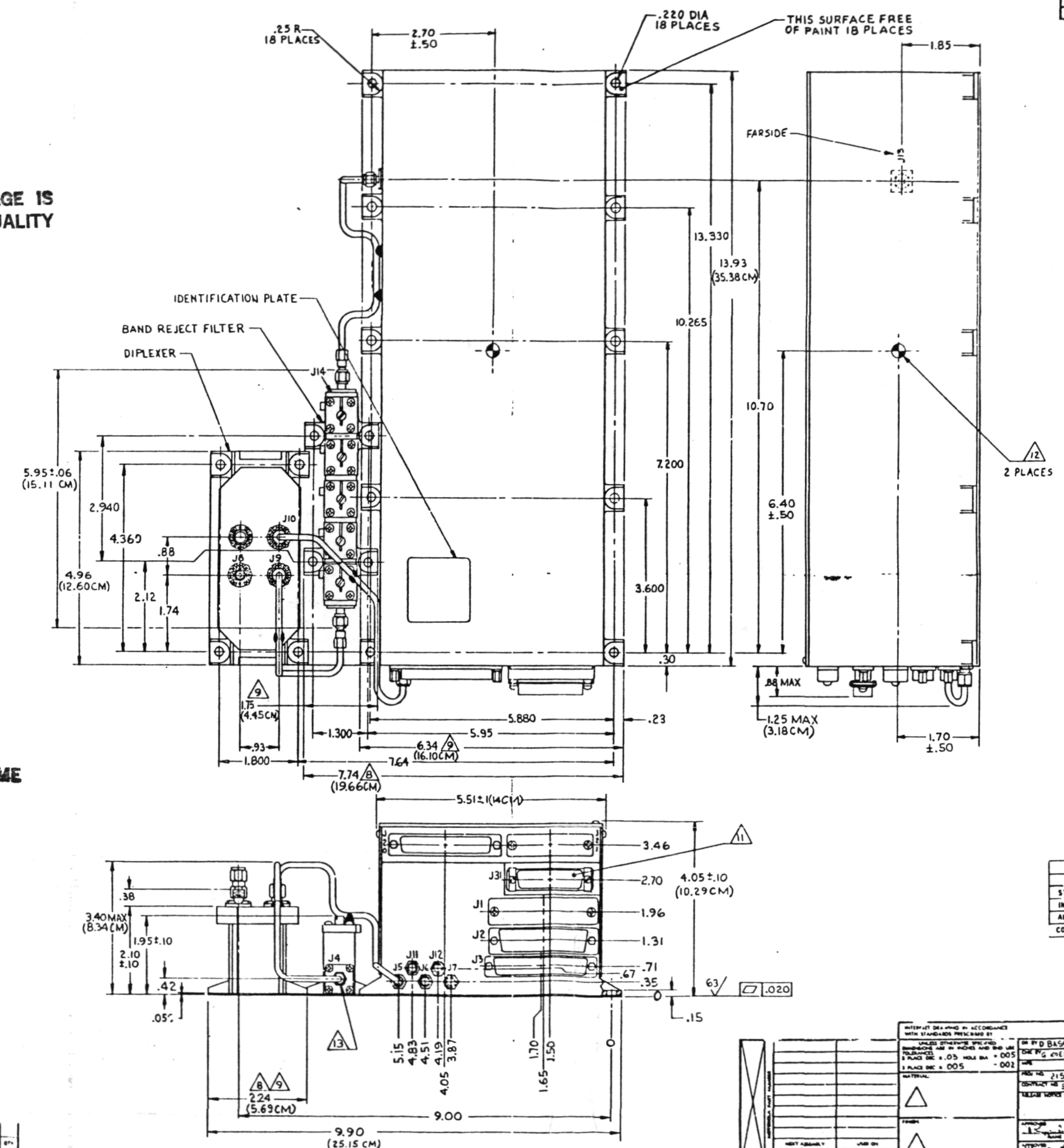
EJAT FLMVL01400601X 0162-32

4171844

ASTERISK INDICATES DATA WHICH IS NONMANDATORY — FOR INFORMATION ONLY.

LTR	DESCRIPTION	DATE	APPROVED
A	REVISED	3 MAR 77	
B	REVISED SH 1, ADDED SH 2	13 OCT 77	
C	REVISED DIMENSIONS AND TOLERANCES SHT 1. REVISED NOTES 3, 8 AND 9 AND CHANGED CONNECTOR PART 28-P06398J001 TO 28-P06398J008 SHT 2	4 OCT 78	
D	REVISED PER MCO EB 79-2-6	79-[illegible]	[illegible]
E	REVISED PER MCO EB 79-7-26	79-[illegible]	[illegible]514

ORIGINAL PAGE IS OF POOR QUALITY



ORIGINAL PAGE IS OF POOR QUALITY

2

FOLDOUT FRAME

1

FOLDOUT FRAME

TABLE I REFERENCE DOCUMENTS	
TITLE	DOCUMENT NO.
STANDARD TRANSPONDER ASSEMBLY - TDRSS	01-P02700L
INTERCONNECT DIAGRAM - TDRSS	69-P02701L
ALIGNMENT AND TEST PROCEDURES - TDRSS	12-P02702L
CONFIGURATION DEFINITION	00-P0270CL

INTERFACE CONTROL DRAWING

DR BY D BASG 13 JAN 77
CHK BY G MOEPKE 20 MAR 78
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES; TOLERANCES 2 PLACE DEC ±.03, 3 PLACE DEC ±.005, HOLE DIA +.005 -.002
PROJ NO 2151
CONTRACT NO 954308

MOTOROLA INC. Government Electronics Division, 8201 East McDowell Road, Scottsdale, Arizona 85257

TDRSS USER TRANSPONDER

SIZE F | CODE IDENT NO 94990 | DRAWING NO 70-P02705L
SCALE 1/1 | SHEET 1 OF 2

70-P02705L

•589-22-19

ORDER P I I 7-26-79 7 PRINTS