Mobile Servicing System (MSS) to User (Generic)

Interface Control Document Part I

International Space Station Program

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INTERNATIONAL SPACE STATION PROGRAM

MOBILE SERVICING SYSTEM TO USER (GENERIC)

INTERFACE CONTROL DOCUMENT

MAY 22, 1997

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INTERNATIONAL SPACE STATION PROGRAM

MOBILE SERVICING SYSTEM (MSS) TO USER INTERFACE CONTROL DOCUMENT

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PREFACE

SSP 42004, Mobile Servicing System (MSS) to User Interface Control Document (ICD) Part I shall be implemented on all new Program contractual and internal activities and shall be included in any existing contracts through contract changes. This document is under the control of the Space Station Control Board (SSCB) with the concurrence of Canadian Space Agency (CSA), and any changes or revisions will be approved by the SSCB and CSA.

Program Manager, Date
International Space Station

INTERNATIONAL SPACE STATION PROGRAM
MOBILE SERVICING SYSTEM TO USER (GENERIC)
INTERFACE CONTROL DOCUMENT PART 1

LIST OF CHANGES
MAY 22, 1997

All changes to paragraphs, tables, and figures in this document are shown below:

SSCBD	ENTRY DATE	CHANGE	PARAGRAPH(S)
			TABLE(S)
			FIGURE(S)
			APPENDIX(ES)
			ADDENDA

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1.0 INTRODUCTION

The Space Station provides a Mobile Servicing System (MSS) to assist in the assembly and external maintenance of the Space Station. The MSS will be used to service users, transport hardware about the Space Station, and support Extravehicular Activity (EVA) operations.

The flight segments of the MSS consist of the Space Station Remote Manipulator System (SSRMS), Mobile Remote Servicer Base System (MBS), the Special Purpose Dexterous Manipulator (SPDM), and the MSS Control Equipment (MCE). The Mobile Remote Servicer (MRS) comprises the MBS, and the SSRMS. The Space Station Manned Base (SSMB) Mobile Transporter (MT) provides the mobility function for the MBS. The SSRMS and SPDM provide the capabilities to support Space Station assembly, maintenance, servicing, and EVA. The control equipment consists of hardware and software to control the MSS.

1.1 PURPOSE AND SCOPE

This Interface Control Document (ICD) defines and controls the physical and functional interfaces which shall be provided by the Mobile Servicing System (MSS) for users.

Chapter 3 of this ICD is divided into 8 sections (A, B, C, D, E, F, G, & I) as shown in Figure 1.1–1. Definition for the Power and Data Grapple Fixture (PDGF) to user interfaces are in Section A. The MRS Base System (MBS) Common Attach System (MCAS) to user interfaces are defined in Section B. The ORU Tool Changeout Mechanism (OTCM) to user interfaces are defined in Section C. The micro conical interfaces to users are defined in Section D. The interfaces between the SPDM ORU Tool Platform (OTP) and the users are defined in Section E. The interfaces between the SPDM tool storage and the user tool holder are defined in Section F. The interface between the SPDM OTCM and user tools shall be as defined in Section G. The interface between the FRGF and the generic user including the PWP shall be as defined in Section I.

1.1.1 SECTION A PURPOSE AND SCOPE

This section of the ICD defines and controls the physical, electrical, and functional interface requirements between the Power Data Grapple Fixture (PDGF) and a user of the SSRMS, SPDM or MBS Payload/ORU Accommodation (POA). The specific structural, mechanical, and electrical attachments for the PDGF to the User will be defined in Part II of this ICD.

1.1.2 SECTION B PURPOSE AND SCOPE

This section of the ICD defines and controls the physical, electrical, and functional interface requirements between the MBS Common Attach System (MCAS) and a user. The specific structural, mechanical, and electrical attachments for the MCAS interface to the user will be defined in Part II of this ICD. The mechanical interface plane is defined between the MCAS (V–guides and the user guide pins, and the MCAS capture latch and user capture bar) and the user. The electrical interface plane is defined between the MCAS active half of the Umbilical Mechanism Assembly (UMA) and the user passive half of the UMAs.

1.1.3 SECTION C PURPOSE AND SCOPE

This section of the ICD defines and controls the physical and functional interfaces and constraints between the OTCM and users with Standard Dexterous Grasp Fixtures (SDGFs). This section of the ICD also defines and controls the generic physical and functional interfaces and constraints between the OTCM and the SPDM stabilization points.

1.1.4 SECTION D PURPOSE AND SCOPE

This section of the ICD defines and controls the generic physical and functional interfaces and constraints between the MCF Tool and users.

1.1.5 SECTION E PURPOSE AND SCOPE

This section of the ICD defines and controls the generic physical and functional interfaces and constraints between the OTP and the passive Common Structural Interface (CSI).

1.1.6 SECTION F PURPOSE AND SCOPE

This section of the ICD defines and controls the generic physical and functional interfaces and constraints between the SPDM and tool holsters.

1.1.7 SECTION G PURPOSE AND SCOPE

This section of the ICD defines and controls the generic physical and functional interfaces and constraints between the SPDM Tools and users.

1.1.8 RESERVED

1.1.9 SECTION I PURPOSE AND SCOPE

This section of the ICD defines and controls the physical, and functional interface requirements between the Flight Releasable Grapple Fixture (FRGF) and a typical user of the SSRMS, SPDM or MBS Payload/ORU Accommodation (POA). The specific structural and mechanical attachments for the FRGF to the User will be defined in Part II of this ICD.

1.1.10 RESERVED

1.1.11 RESERVED

1.1.12 RESERVED

1.1.13 RESERVED

1.1.14 APPENDIX A PURPOSE & SCOPE

This appendix of the ICD defines and controls the software interfaces between the MSS RWS CEU and the ISS payloads attached to the MSS. The scope of this document is limited to the software interfaces between CEU and ISS payloads, elements, and devices attached to the MSS. This document does not address software interfaces between the Special Purpose Dexterous Manipulator (SPDM) and ISS payloads, elements, and devices attached directly to the SPDM.

1.2 PRECEDENCE

In the event of conflict between the International Space Station System Specification and this ICD, the requirements in SSP 41000, the International Space Station System Specification shall take precedence.

1.3 CHANGE AUTHORITY

The responsibility for assuring the definition, control, and implementation of the interfaces identified in this document is vested with the National Aeronautics and Space Administration (NASA) Space Station Program Office and with the CSA. This document shall be formally approved and controlled in accordance with the provisions of SSP 30459, International Space Station Interface Control Plan.

1.4 COMMONALITY OF GRAPPLE FIXTURES AND END EFFECTORS (REFERENCE ONLY)

1.4.1 TYPES OF GRAPPLE FIXTURES

1.4.1.1 SS GRAPPLE FIXTURES

The type of grapple fixture being developed specifically for Space Station application is the PDGF (defined in this ICD). The PDGF is mechanically compatible with both the NSTS Standard End Effector (SEE) and the Latching End Effector (LEE). The PDGF is electrically compatible only with LEEs on the SSRMS, SPDM and the POA.

1.4.1.2 NSTS GRAPPLE FIXTURES

The FRGF is mechanically compatible with both the NSTS Standard End Effector (SEE) and the Latching End Effector (LEE) as shown in Table 1.4.1.2–1. The Electrical Flight Grapple Fixture (EFGF) is mechanically and electrically compatible only with the NSTS Special Purpose End Effector (SPEE) as shown in Table 1.4.1.2–1. Interfaces associated with the SSRMS manipulating a payload with the FRGF are defined in Section I of this ICD.

1.5 DEFINITION OF THE TERM "USER"

For purposes of this ICD, the term "user" shall be defined as any payload, pallet, or ORU combination that interfaces with the SSRMS LEE, the SPDM LEE, the POA, the MCAS, the SPDM OTP, or the SPDM manipulators.

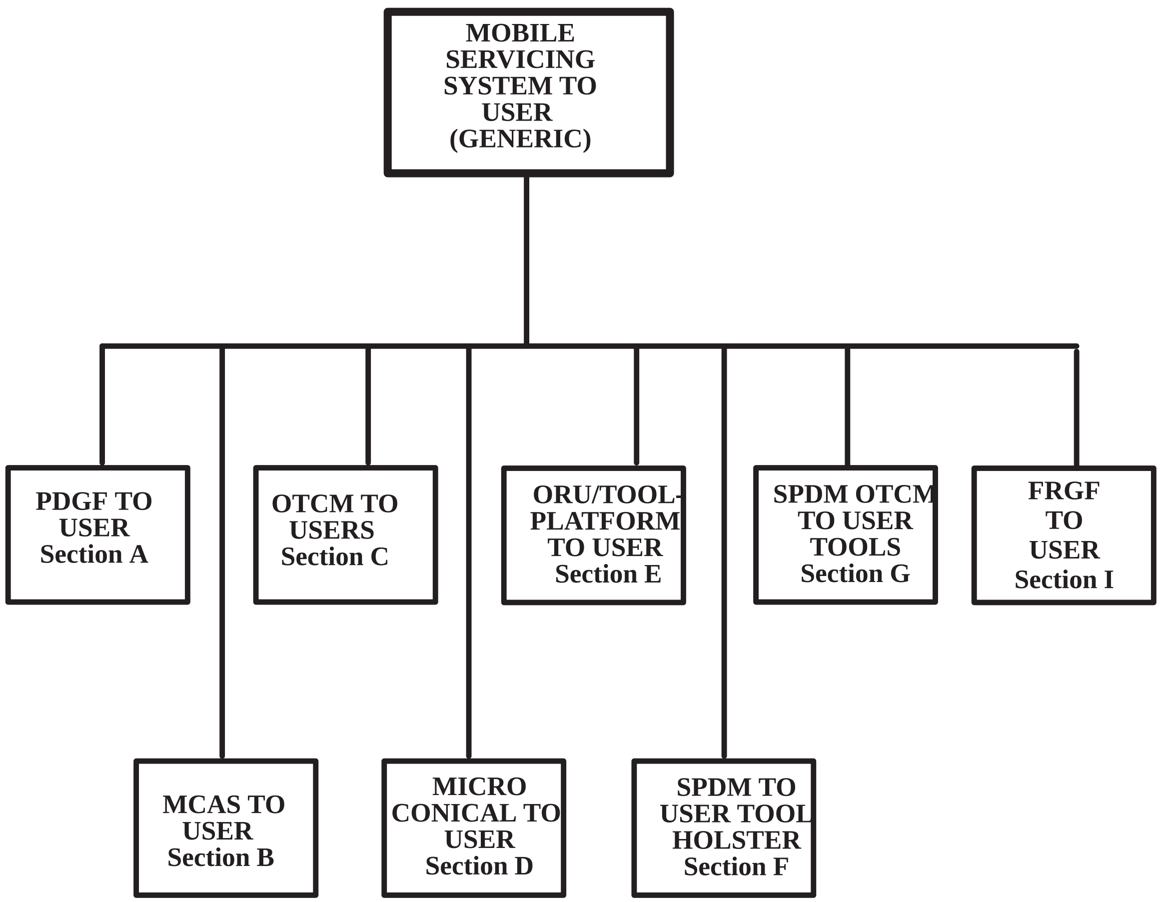


FIGURE 1.1–1 MOBILE SERVICING SYSTEM TO USER ICD SECTIONS

TABLE 1.4.1.2–1 NSTS GF COMPATIBILITY

NSTS GF	SEE		SPEE		LEE	
	Mechanical	Electrical	Mechanical	Electrical	Mechanical	Electrical
FRGF	X	N/A	X	N/A	X	N/A
EFGF	X	N/A	X	X	NO	NO

Legend:
- X Compatible
- N/A No electrical connector either on GF or EE.
- NO Not compatible.

2.0 DOCUMENTS

2.1 APPLICABLE DOCUMENTS

The following documents of the exact date and revision shown form a part of this ICD to the extent specified herein.

DOCUMENT NO.	TITLE
ANSI Y 14.5M 1982	Dimensioning and Tolerancing
MIL–STD–1553B Rev B, Notice 2 8 Sep 86	Digital Time Division Command/Response Multiplex Databus
References	A3.2.1.6.1, A3.2.2.6.1, B3.2.1.6.1, B3.2.2.6.1, C3.2.1.6, 3.2.2.6
NSTS–21000–IDD–ISS 2 May 95	Shuttle Orbiter/International Space Station Cargo Standard Interfaces
References	I3.2.1.2, I3.2.1.3, I3.2.1.5.1.1, I3.2.1.5.1.2, I3.2.1.5.1.3 I3.2.2.2, I3.2.2.3, I3.2.2.5.1.1, I3.2.2.5.1.2, I3.2.2.5.1.3
SSP 30219 Rev D 21 Jan 94	Space Station Reference Coordinate Systems
References	A3.1.2, B3.1.1.1, C3.1.1.1, D3.1.1.1, E3.1.1.1, F3.1.1.1
SSP 30240 Rev B 3 Jun 94	Space Station Grounding Requirements
References	A3.2.1.9.1.3, A3.2.2.9.1.3, B3.2.1.8.1.3, B3.2.2.8.1.3 C3.2.1.9.1.3, C3.2.2.9.1.3
SSP 30242 Rev C 3 Jun 94	Space Station Cable/Wire Design and Control Requirements for Electromagnetic Compatibility
References	A3.2.1.9.1.5, A3.2.2.9.1.5, B3.2.1.8.1.5, B3.2.2.8.1.5, C3.2.1.9.1.5, C3.2.2.9.1.5
SSP 30243 Rev C1 1 Jul 94	Space Station System Requirements for Electro Magnetic Capability
References	A3.2.1.9.1.1, A3.2.1.9.1.6, A3.2.1.9.1.7, A3.2.2.9.1.1, A3.2.2.9.1.6, A3.2.2.9.1.7, B3.2.1.8.1.1, B3.2.1.8.1.6, B3.2.1.8.1.7, B3.2.2.8.1.1B3.2.2.8.1.6, B3.2.2.8.1.7, C3.2.1.9.1.1, C3.2.1.9.1.6, C3.2.1.9.1.7, C3.2.2.9.1.1, C3.2.2.9.1.6, C3.2.2.9.1.7, D3.2.1.5.1.2, D3.2.1.5.1.3, D3.2.1.5.1.2, D3.2.1.5.1.3, E3.2.1.5.1.2, E3.2.1.5.1.3, E3.2.2.5.1.2, E3.2.2.5.1.3, F3.2.1.5.1.2, F3.2.1.5.1.3, F3.2.2.5.1.2, F3.2.2.5.1.3

SSP 30245 Rev B 3 Jun 94	Space Station Electrical Bonding Requirements
References	A3.2.1.5.3, A3.2.1.9.1.4, A3.2.2.5.2, A3.2.2.9.1.4, B3.2.1.5.3, B3.2.1.8.1.4, B3.2.2.5.3, B3.2.2.8.1.4, C3.2.1.5.3, C3.2.1.9.1.4, C3.2.2.5.3, C3.2.2.9.1.4, D3.2.1.5.1.1, D3.2.2.5.1.1, E3.2.1.5.1.1, E3.2.2.5.1.1, F3.2.1.5.1.1, F3.2.2.5.1.1)
SSP 30459 Rev G, R1 29 Aug 94	International Space Station Alpha Interface Control Plan
Reference	1.3
SSP 30482 Rev A, CN–001 1 Jan 94	Electrical Power Specification and Standards: Vol I, Electrical Performance Specifications
References	A3.2.1.5.1, A3.2.2.5.1, Figure A3.2.1.5.1–1, Figure A3.2.1.5.1–2, Figure A3.2.1.5.1–3, Figure A3.2.1.5.1–4, B3.2.1.5.1, B3.2.2.5.1
SSP 30482 Aug 91	Electrical Power Specification and Standards: Vol II, Electrical Performance Specifications
SSP 30263:002	Type II, VI RPCM Standard ICD
SSP 41000 Rev B 1 Nov 94	International Space Station System Specification
Reference	1.2
SSP 50002 Rev Basic 15 Sep 94	ISS Video Standard
References	A3.2.1.7.1, A3.2.2.7.1, C3.2.1.7.1, C3.2.2.7.1
SSP 50005 Rev B (Draft) 10 Aug 94	ISS Flight Crew Integration Standard
References	A3.2.1.2, A3.2.1.5.4, A3.2.2.2, A3.2.2.5.3, B3.2.1.2, B3.2.1.5.4B3.2.2.2, B3.2.2.5.4, C3.2.1.5.4, C3.2.2.5.4
SSP 50194	Cargo Handling Interface Assembly to User ICD
References	1.1.5, E3.1, Figure E3.1.1–1
SSQ 21635 Rev C	General Specifications for Connectors and Accessories, Electrical, Circular, Miniature, IVA/EVA/Robot Compatible, Space Quality
References	A3.2.1.4.1, A3.2.2.4.1, C3.2.1.4.1 C3.2.2.4.1

SSQ 21637	General Specification for Connectors and Accessories, Umbilical Interface, Environmental, Space Quality
References	B3.2.1.4, B3.2.2.4

3.0 GENERAL

3.1 ENGINEERING UNITS AND TOLERANCES

When identified, dimensions in this document are shown first in the English Inch Pound (IP) system, and then in the metric equivalent Systems International units (SI) shown in parenthesis. Conversion of units shall be in accordance with ASTM E380. Unless otherwise specified, all flight drawing dimensions are in accordance with ANSI–Y–14.5.

SECTION A3 PDGF TO USER INTERFACES

A3.0 REQUIREMENTS

A3.1 GENERAL

PDGFs are mounted on users to allow their manipulation by the LEEs associated with the SSRMS, the MBS POA, and the SPDM. The PDGF is also mechanically compatible with the NSTS SRMS.

A3.1.1 INTERFACE DESCRIPTION

The PDGFs will interface with the user via mechanical attachments and electrical connections. For users requiring electrical resources, a harness will be provided with the PDGF to support electrical connections. The mechanical/structural interface plane is at the mounting bolt hole pattern of the PDGF. The electrical interface plane is between the User connectors and the PDGF harness connectors.

A3.1.2 COORDINATE SYSTEMS

The PDGF Coordinate System is defined in Figure A3.1.2–1. The LEE Coordinate System is defined in Figure A3.1.2–2.

A3.1.3 PDGF INTERFACE FUNCTIONS

The PDGF shall :

A. Support mechanical and structural attachment to the user

B. Provide EVA access to interface attachments and connections

C. Provide an electrical bonding capability to the user

D. Support power, data, and video utility distribution to the user via a harness

A3.1.4 USER INTERFACE FUNCTIONS

The user shall :

A. Support mechanical and structural attachment of the PDGF

B. Provide EVA access to interface attachments and connections

C. Provide an electrical bonding capability to the PDGF

D. Support power, data, and video utility distribution from the PDGF harness

A3.1.5 INTERFACE RESPONSIBILITIES

The interface hardware responsibilities for the PDGF and the user will be as defined in Table A3.1.5–1.

A3.2 INTERFACE REQUIREMENTS

A3.2.1 PDGF INTERFACE REQUIREMENTS

A3.2.1.1 PDGF ENVELOPES

a) The PDGF envelope shall provide the capability to EVA install and release the PDGF ORU assembly to or from the PDGF mounting ring.

b) The PDGF envelope shall provide the capability to EVA install and release the PDGF harness to or from the PDGF mating connectors.

c) The EVA maintenance and approach envelopes are defined in Section A3.2.2.1.

A3.2.1.2 PDGF MECHANICAL INTERFACE

a) The PDGF shall provide a mounting ring for the mechanical attachment of the PDGF to the user.

b) The PDGF mounting ring shall accommodate holes for eight user mounting bolts.

c) The PDGF shall provide a target for SSRMS operations.

d) The PDGF electrical bonding shall be through the mounting ring to the user.

e) The attachment mechanisms shall comply with SSP 50005, International Space Station Flight Crew Standard.

A3.2.1.3 PDGF STRUCTURAL INTERFACE

The PDGF to User interface shall meet all performance requirements while being subject to the MBS POA and SSRMS Tip LEE interface loads as defined in Table A3.2.1.3–1.

A3.2.1.3.1 IMPACT LOADS

During capture of a user payload by the SSRMS/SPDM or berthing a user payload on the POA, the impact load to the PDGF shall be as defined in Figure A3.2.1.3.1–1.

A3.2.1.3.2 PDGF WEIGHT

The weight of the PDGF, including the internal PDGF cabling and connector halves shall not exceed 85 lbs (38.5 kg). The weight excludes the PDGF electrical harness for users.

A3.2.1.4 PDGF ELECTRICAL INTERFACE HARDWARE

The PDGF harness shall provide the capability to be tied down on the user and to be mated with the user connector.

A3.2.1.4.1 ELECTRICAL CONNECTORS

Electrical connectors shall comply with the requirements of SSQ 21635, General Specifications for Connectors and Accessories, Electrical, Circular, Miniature, IVA/EVA/Robot Compatible, Space Quality.

A3.2.1.5 PDGF POWER INTERFACE

The PDGF shall supply power to the user through the PDGF1 and PDGF2 power circuits. This interface is illustrated in Figure A3.2.1.5–1.

A3.2.1.5.1 POWER QUALITY

The interface power quality shall be in accordance with SSP 30482, Volume I and II, Interface C, with the exception of steady state voltage range as defined in Table A3.2.1.5.1–1.

A3.2.1.5.2 FAULT PROTECTION

Fault protection shall be provided in accordance with Table A3.2.1.5.1–1.

A3.2.1.5.3 DELETED

A3.2.1.5.4 ELECTRICAL CONNECTOR DEADFACING

The PDGF and PDGF harness shall comply with the electrical connector deadfacing requirements as defined in Figure A3.2.1.5.4–1.

A3.2.1.5.5 REDUNDANCY

The PDGF harness shall have the capability to provide a prime and redundant secondary power feed to the user.

A3.2.1.6 C&DH INTERFACES

The PDGF harness shall provide a 1553 data bus interface to the user as defined in Figure A3.2.1.5–1.

A3.2.1.6.1 MIL–STD–1553 INTERFACES

a) The PDGF harness shall provide the A channel of the MSS local bus (MSS LB) stub and the B channel of the MSS local bus (MSS LB) stub through separate connectors.

b) Data services shall only be available during the MT stationary mode of operation.

c) The payload to the RWS CEU data interfaces shall be defined in accordance with Appendix A.

A3.2.1.6.1.1 PROVIDE OUTPUT AMPLITUDE

PDGF harness shall provide a signal amplitude of a minimum of 3.6 volts, peak–to–peak, line–to–line, at the User interfaces for messages transmitted on MIL–STD–1553 bus.

A3.2.1.7 SYNC, CONTROL, AND VIDEO INTERFACES

The PDGF harness shall provide Pulse Frequency Modulation (PFM) sync, control, and video copper interfaces to the user as shown in Figure A3.2.1.5–1.

A3.2.1.7.1 VIDEO, SYNC, AND CONTROL TRANSMISSION AND SIGNAL CHARACTERISTICS

The video, sync, and control signals shall be transmitted between PDGF and user in accordance with TBD.

A3.2.1.7.2 SYNC AND VIDEO POWER LEVELS

a) The SSRMS Tip via the PDGF shall be capable of transmitting to the User a minimum of –4 dBm and a maximum of +9 dBm PFM sync signal.

b) The SSRMS Tip via the PDGF shall be capable of receiving from the User a minimum of –4 dBm and a maximum of +9 dBm PFM video signal.

c) The payload camera commands carried by the PFM sync and control signals and the telemetry carried by the video signal shall meet the requirements as defined in TBD.

d) The PFM sync and control signals transmitted to the User shall meet the video quality requirements as defined in TBD.

A3.2.1.8 PASSIVE THERMAL INTERFACE

A3.2.1.8.1 DELETED

A3.2.1.8.2 PDGF THERMAL CONDUCTANCE

The PDGF shall limit thermal conductance to the user to 3.0 W/°C maximum.

A3.2.1.9 ENVIRONMENTS

A3.2.1.9.1 ELECTROMAGNETIC EFFECTS

A3.2.1.9.1.1 ELECTROMAGNETIC COMPATIBILITY

The PDGF to user interface shall meet the requirements of SSP 30243, Space Station Systems Requirements for Electromagnetic Compatibility.

A3.2.1.9.1.2 GROUNDING

The PDGF to user interface shall meet the requirements of SSP 30240, Space Station Grounding Requirements.

A3.2.1.9.1.3 BONDING

a) The PDGF to user structural/mechanical interface shall meet the requirements of SSP 30245, Space Station Electrical Bonding Requirements.

b) Bonding provisions at the interface shall satisfy a Class H and R bond in accordance with the above reference document.

A3.2.1.9.1.4 CABLE AND WIRE DESIGN

The PDGF to user cable and wire interface shall meet the requirements of SSP 30242, Space Station Cable/Wire Design and Control Requirements for Electromagnetic Compatibility.

A3.2.1.9.1.5 ELECTROSTATIC DISCHARGE

The PDGF to user interface shall meet the requirements of SSP 30243.

A3.2.1.9.1.6 CORONA

The PDGF to user interface shall meet the requirements of SSP 30243.

A3.2.2 USER INTERFACE REQUIREMENTS

A3.2.2.1 USER ENVELOPES

Depending on how the user is being manipulated, the following envelopes apply.

a) The user shall accommodate the SSRMS approach envelope around the PDGF for static mode of operation as defined in Figure A3.2.2.1–1.

b) The user shall accommodate the SSRMS approach envelope around the PDGF for dynamic mode of operation (moving payload such as NSTS) as defined in Figure A3.2.2.1–2.

c) The user shall accommodate the POA approach envelope around the PDGF as defined in Figure A3.2.2.1–3.

d) The user shall accommodate the SPDM LEE approach envelope around the PDGF as defined in Figure TBD.

e) The EVA maintenance envelope around the PDGF shall be as defined in SSP 50005, section 14.3.2.3.1.

A3.2.2.1.1 DELETED

A3.2.2.2 USER MECHANICAL INTERFACE

a) The user shall provide accommodations for attachment of the PDGF mounting ring.

b) The user shall provide eight mounting bolts, tooling holes and nut assemblies for attachment of the PDGF mounting ring.

c) The electrical bonding shall be through the mounting bolts and nut assemblies.

d) The attachment mechanisms shall comply with SSP 50005, International Space Station Flight Crew Standard, requirements for accessibility by EVA crew members.

A3.2.2.3 USER STRUCTURAL INTERFACE

The PDGF user interface shall meet all performance requirements while being subject to the MBS POA and SSRMS Tip loads as defined in Table A3.2.1.3–1.

A3.2.2.3.1 IMPACT LOADS

During capture of a user payload by the SSRMS/SPDM or mating a user payload on the POA, the impact load to the user shall be as defined in Figure A3.2.1.3.1–1.

A3.2.2.3.2 USER STIFFNESS REQUIREMENTS

The user shall provide a stiffness at the interface that maintains a fundamental structural frequency as defined below while constrained only at the interface.

Mass (Kg.)	Minimum frequency (Hz.)
1000	0.5
20,900	0.18
116,000	0.032

A3.2.2.4 USER ELECTRICAL INTERFACE HARDWARE

The user shall provide the capability to tie down the PDGF harness.

A3.2.2.4.1 ELECTRICAL CONNECTORS

Electrical connectors shall comply with the requirements of SSQ 21635, General Specifications for Connectors and Accessories, Electrical, Circular, Miniature, IVA/EVA/Robot Compatible, Space Quality.

A3.2.2.5 USER POWER INTERFACE

The user shall provide the capability to receive power through the PDGF1 and PDGF2 power circuits. This interface is illustrated in Figure A3.2.1.5–1.

A3.2.2.5.1 POWER QUALITY

The interface power quality shall be in accordance with SSP 30482, Volume I and II, Interface C, with the exception of the steady state voltage range as defined in Table A3.2.1.5.1–1

A3.2.2.5.2 FAULT PROTECTION

The user shall be fault protected in accordance with Table A3.2.1.5.1–1.

A3.2.2.5.3 DELETED

A3.2.2.5.4 ELECTRICAL CONNECTOR DEADFACING

The user shall comply with the electrical connector deadfacing requirements as defined in Figure A3.2.1.5.4–1.

A3.2.2.6 C&DH INTERFACES

The user shall provide a 1553 data bus interface from the PDGF harness as defined in Figure A3.2.1.5–1.

A3.2.2.6.1 MIL–STD–1553 INTERFACES

a) The User shall communicate over the MSS LB with the interface characteristics as specified in MIL–STD–1553, Digital Time Division Command/Response Multiplex Databus.

b) The user harness shall receive the A channel of the MSS local bus (MSS LB) stub and the B channel of the MSS local bus (MSS LB) stub through separate connectors.

c) Data services shall only be available during stationary mode of operation. No data interface is available to users during MT translation.

d) The payload to the RWS CEU data interfaces shall be defined in accordance with Appendix A.

A3.2.2.6.1.1 BUS TERMINATION

a) The maximum allowable bus stub length for the User shall be limited to 11 feet as measured from the PDGF/User interface to the isolation transformer as defined in Figures A3.2.2.6.1.1–1 and A3.2.2.6.1.1–2.

b) The User shall provide terminations at both ends of the User bus interface as defined in Figure A3.2.1.6.1.1–1 through A3.2.1.6.1.1–3.

A3.2.2.6.1.2 MIL–STD–1553 DATA BUS ADDRESSES

The MIL–STD–1553 bus addresses for the User RT's on both the MSS LB and the PDGF LB shall be 2, 4, 7 and 21.

A3.2.2.6.1.3 PROVIDE OUTPUT AMPLITUDE

The User shall provide a signal amplitude of at least 3.6 volts, peak–to–peak, line–to–line at the PDGF interface.

A3.2.2.7 SYNC, CONTROL, AND VIDEO INTERFACES

a) The User shall receive PFM sync, control, and video interfaces from the PDGF harness as shown in Figure A3.2.1.5–1.

b) The User shall receive copper lines from the PDGF harness.

A3.2.2.7.1 VIDEO, SYNC, AND CONTROL TRANSMISSION AND SIGNAL CHARACTERISTICS

The video, sync, and control signals shall be transmitted between the PDGF and the User in accordance with TBD.

A3.2.2.7.2 SYNC AND VIDEO POWER LEVELS

a) The User shall be capable of receiving from the SSRMS Tip LEE a minimum of –4 dBm and a maximum of +9 dBm PFM sync signal via the User PDGF.

b) The User shall be capable of transmitting to the SSRMS Tip LEE a minimum of –4 dBm and a maximum of +9 dBm PFM video signal via the User PDGF.

c) The payload camera commands carried by the PFM sync and control signals and the telemetry carried by the video signal shall meet the requirements as defined in TBD.

d) The PFM sync and control signals received by the User shall meet the video quality requirements as defined in TBD.

A3.2.2.8 PASSIVE THERMAL INTERFACE

A3.2.2.8.1 PDGF THERMAL CONDUCTANCE

a) During non–operational periods for the PDGF, the User structure shall be capable of maintaining the PDGF within its non–operational limits of –157 Deg. C to +121 Deg. C.

b) During PDGF operations, the User structure shall be capable of maintaining the PDGF within its operational limits of –70 Deg. C to +90 Deg. C.

c) The thermal conductance from the User to the PDGF will be 3.0 W/Deg. C maximum.

A3.2.2.9 ENVIRONMENTS

A3.2.2.9.1 ELECTROMAGNETIC EFFECTS

A3.2.2.9.1.1 ELECTROMAGNETIC COMPATIBILITY

The PDGF to user interface shall meet the requirements of SSP 30243, Space Station Systems Requirements for Electromagnetic Compatibility.

A3.2.2.9.1.2 GROUNDING

The PDGF to user interface shall meet the requirements of SSP 30240, Space Station Grounding Requirements.

A3.2.2.9.1.3 BONDING

a) The PDGF to user structural/mechanical interface shall meet the requirements of SSP 30245, Space Station Electrical Bonding Requirements.

b) Bonding provisions at the interface shall satisfy a Class H and R bond in accordance with the above referenced document.

A3.2.2.9.1.4 CABLE AND WIRE DESIGN

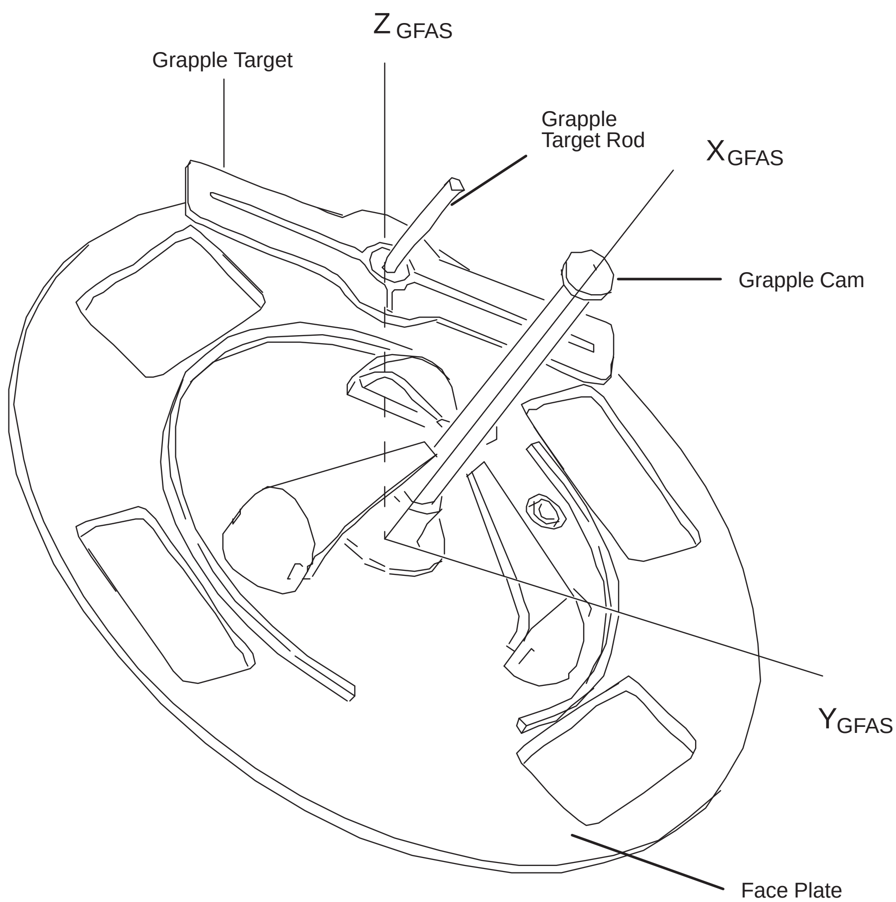
The PDGF to user cable and wire interface shall meet the requirements of SSP 30242, Space Station Cable/Wire Design and Control Requirements for Electromagnetic Compatibility.

A3.2.2.9.1.5 ELECTROSTATIC DISCHARGE

The PDGF to user interface shall meet the requirements of SSP 30243.

A3.2.2.9.1.6 CORONA

The PDGF to user interface shall meet the requirements of SSP 30243.



Name: Space Station PDGF Coordinate System

Orientation and Definition: The origin of the PDGF is at the origin of the EEOCS, when the SSRMS LEE and the PDGF are in fully rigidized configuration. See DRG 51800–0001 for clarification.

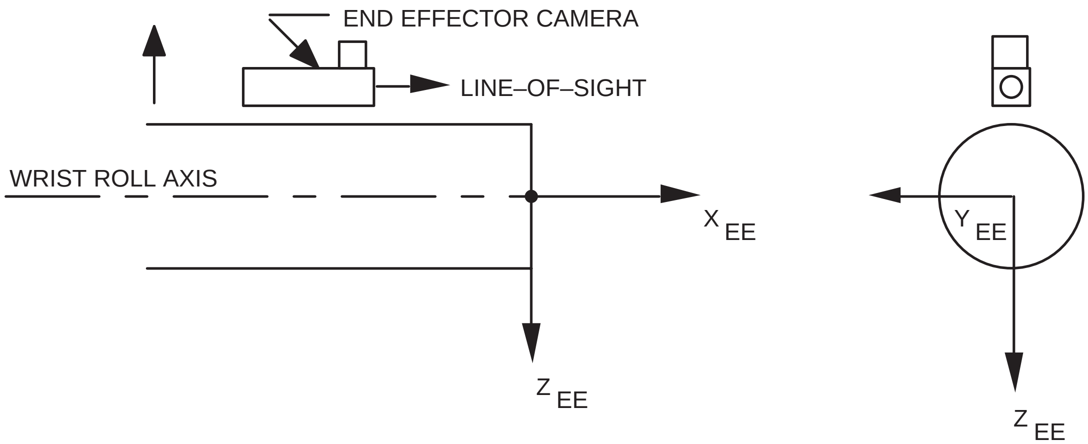
X_{GFAS} – Along the centerline of the Grapple Shaft directed towards the Grapple Cam.
Z_{GFAS} – Perpendicular to X_{GFAS} and directed toward the Grapple Target Rod centerline.
Y_{GFAS} – Completes the right hand triad.

The position and oriention of this coordinate system relative to the SS Coordinate System shall be available based on the location of the PDGF to which the SSRMS is fixed.

Characteristics: Rotating right–handed Coordinate System

GFAS – Grapple Fixture Axis System

FIGURE A3.1.2–1 PDGF COORDINATE SYSTEM



NAME: Latching End Effector (LEE) Operating System.

ORIENTATION AND DEFINITIONS: The origin is located on the wrist roll joint axis at the tip of the end effector.

The XEE–axis is parallel with the wrist roll axis. Positive XEE is along the Line–of–Sight at the End Effector camera. YEE is positive right as seen through the End Effector camera. Positive ZEE is down as seen through the End Effector camera.

CHARACTERISTICES: Rotating right–handed Cartesian System.

(Reference only)

FIGURE A3.1.2–2 LEE OPERATING COORDINATE SYSTEM

TABLE A3.1.5–1 PDGF TO USER INTERFACE HARDWARE RESPONSIBILITY

PDGF/User Interface Hardware Responsibilities (1)	NASA/User Hardware	CSA Hardware
SSRMS		X
SPDM		X
MBS POA		X
PDGF ORU (includes mounting ring)(1)	X	
PDGF bolt hole pattern, tooling holes and mounting bolts(2)	X	
PDGF harness(3)	X	
User PDGF harness connector	X	
Harness tie down points	X	

Notes:

1) PDGFs are designed, developed, and verified by CSA and supplied by NASA to users as GFE.

2) PDGF bolts are the responsibility of the user.

3) The PDGF harness is designed, developed, verified by NASA. The PDGF harness is terminated with connectors provided by CSA.

TABLE A3.2.1.3–1 PDGF TO USER STRUCTURAL LOADS

PDGF to User Loads [4]	Torsional[1] Moment ft lbf (N–m)	Bending[1] Moment ft lbf (N–m)	Shear[2][5] Force lbf (N)	Tensile[2][5] Force lbf (N)
From SSRMS Operations[7]	2280 (3100)	2280 (3100)	225 (1000)	225 (1000)
From SSRMS During[6][8] MT Translation	1200 (1600)	1200 (1600)	37 (165)	150 (667)
From POA During[6][8] MT Translation	1125 (1525)	1125 (1525)	37 (165)	150 (667)
From POA During[3] MT Stationary Operations	3000 (4068)	3000 (4068)	50 (222)	50 (222)
From SPDM Operations while SPDM is attached to the SSRMS	(TBD#1)	(TBD#1)	(TBD#1)	(TBD#1)

Notes:

1) The torsional moment and bending moment for either case will be applied separately.

2) The shear force and tensile force for either case will be applied separately. One moment and one force for either case can be applied simultaneously.

3) Stationary loads at POA assume a load of 50 lbf. at 60 ft.

4) Forces and moments are valid for any direction.

5) For payloads less than or equal to 1000 kg., the shear and tensile force is 310 lbf. (1380 N).

6) MT braking force is 150 lbf along the direction of travel.

7) For SSRMS operations, the elbow joint angle is not less than 60 degrees from straight arm configuration.

8) MT Loads during translation perpendicular to the direction of travel are 37 lbf.

Curvic Coupling: (445 N) 100lb applied to curvic both at any point.

Face Plate: (445 N) 100lb applied to the face plate at any point inside of the curvic coupling.

Grapple Shaft: (890 N) 200lb applied to the grapple cam at an angle of 20^o to the axis of the grapple shaft .

Cam Arm: (814 N) 183 lb applied to a cam arm at any point.

Note: For structural analysis purposes, these loads will be assumed static.

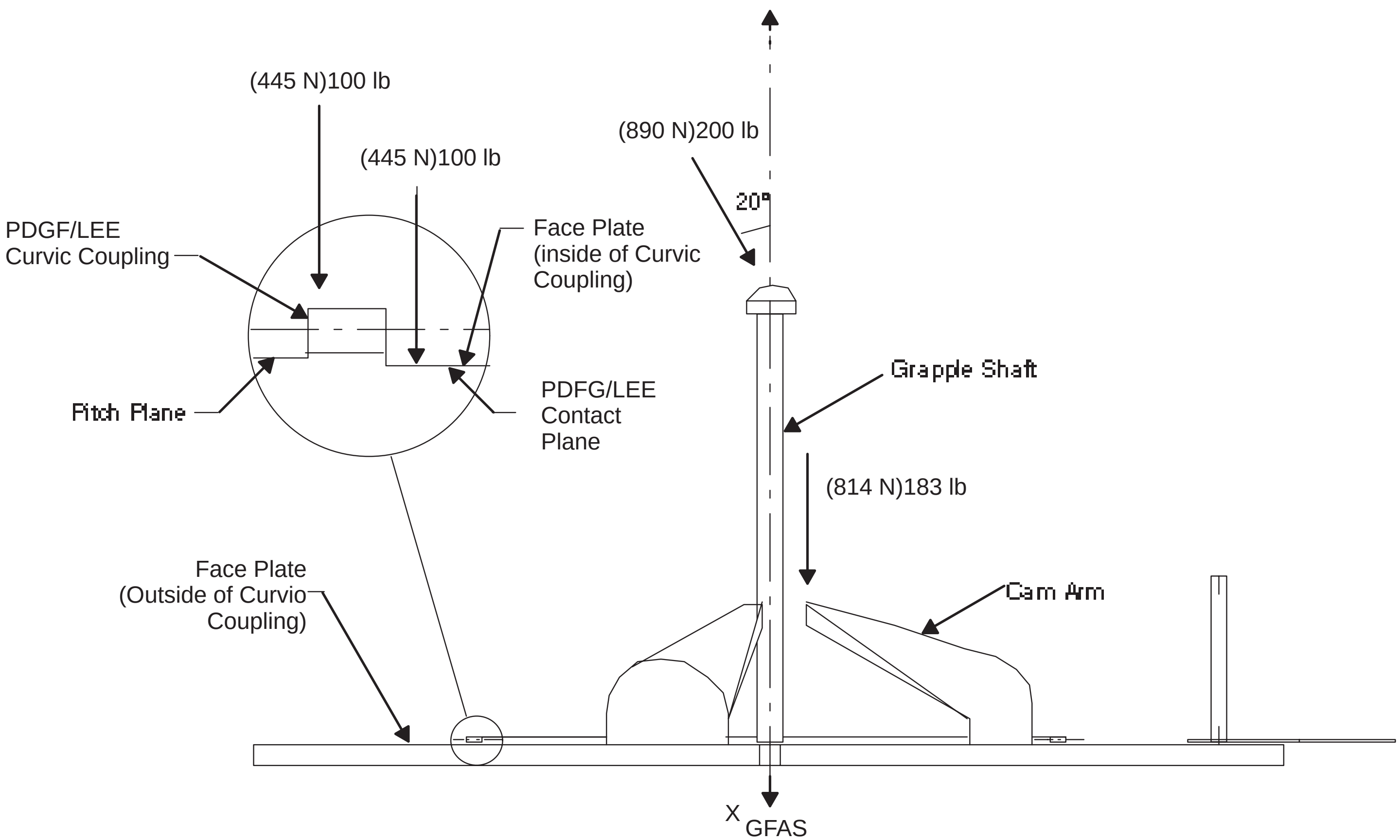


FIGURE A3.2.1.3.1–1 PDGF IMPACT LOADS

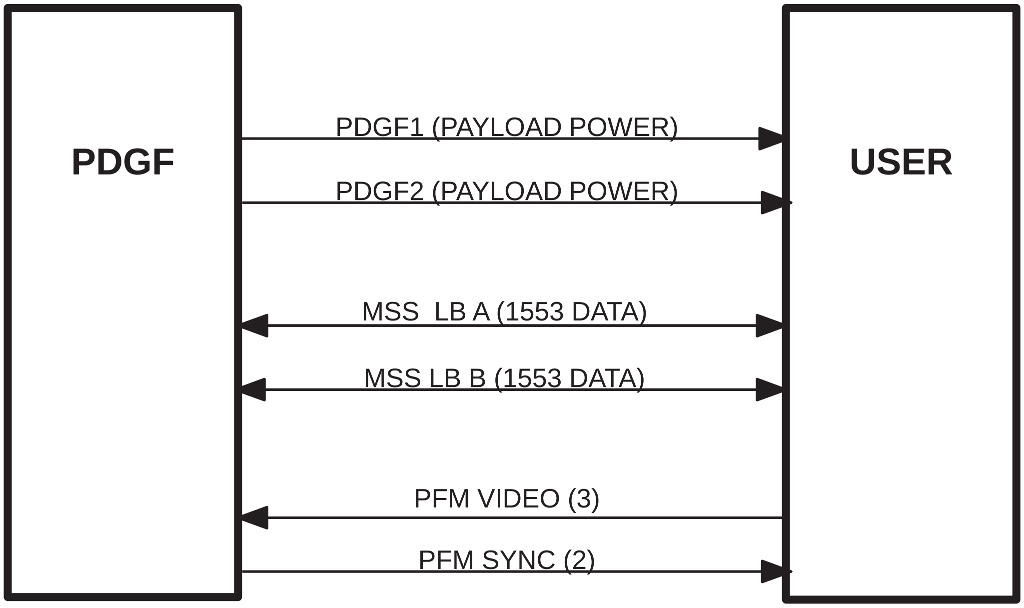


FIGURE A3.2.1.5–1 PDGF TO USER ELECTRICAL INTERFACES

TABLE A3.2.1.5.1–1 PDGF TO USER ELECTRICAL INTERFACE PARAMETERS

Circuit Name	INTERFACE V_{range} (volts) 3	Operating Current (amps)	Overcurrent Protection
PDGF1	107.5 to 126	0 to 16.7	1, 2
PDGF2	107.5 to 126	0 to 16.7	1, 2

NOTES:

1 Protection is equivalent with SSP 30263:002, Type II RPCM Standard ICD
2 Protection is equivalent with SSP30263:002, Type VI RPCM Standard ICD.
3 Minimum voltage includes 1 volt drop across the PDGF harness.

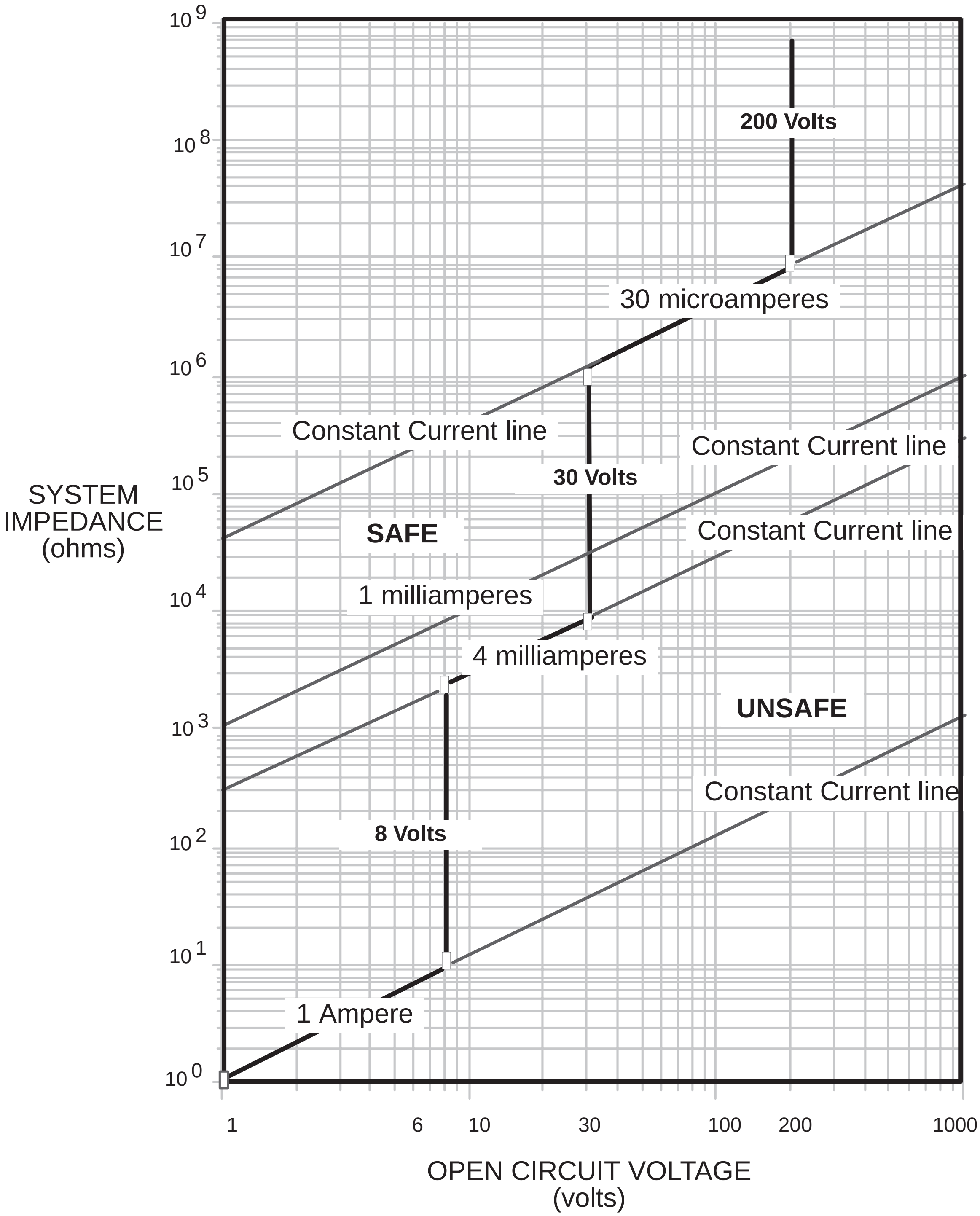
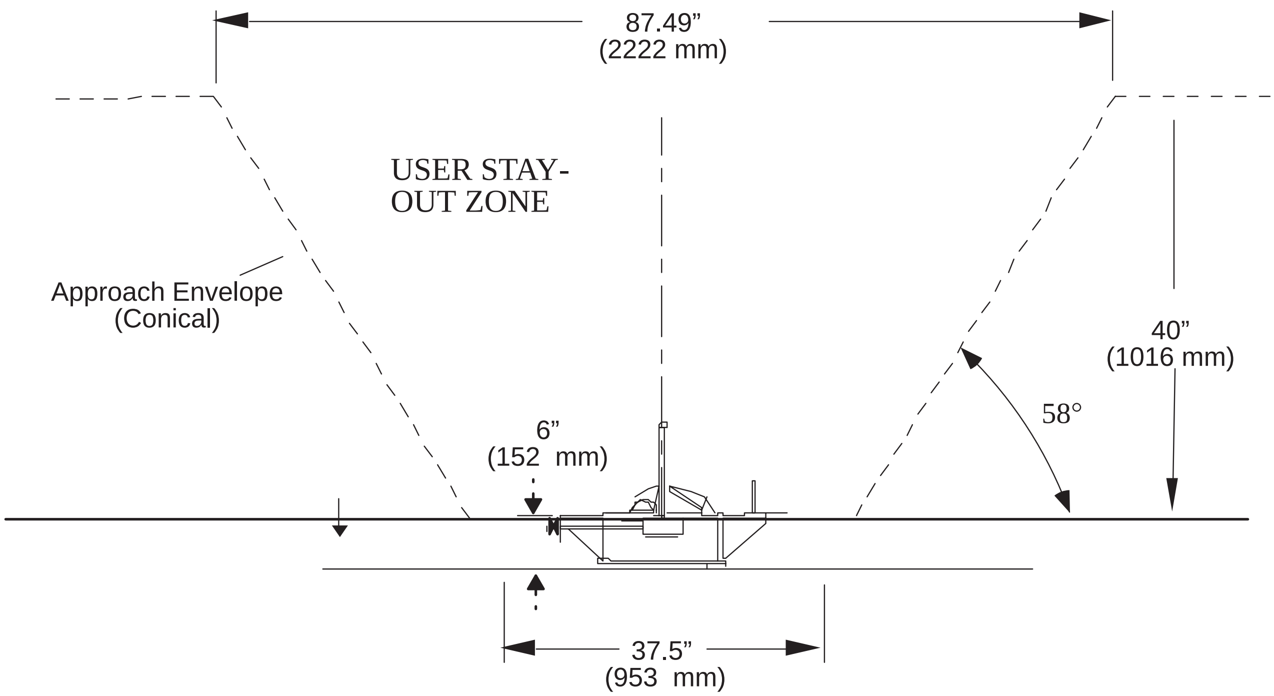


FIGURE A3.2.1.5.4–1 CONNECTOR DEADFACING REQUIREMENTS



Notes:

1) Clearance volume centered on centerline of PDGF

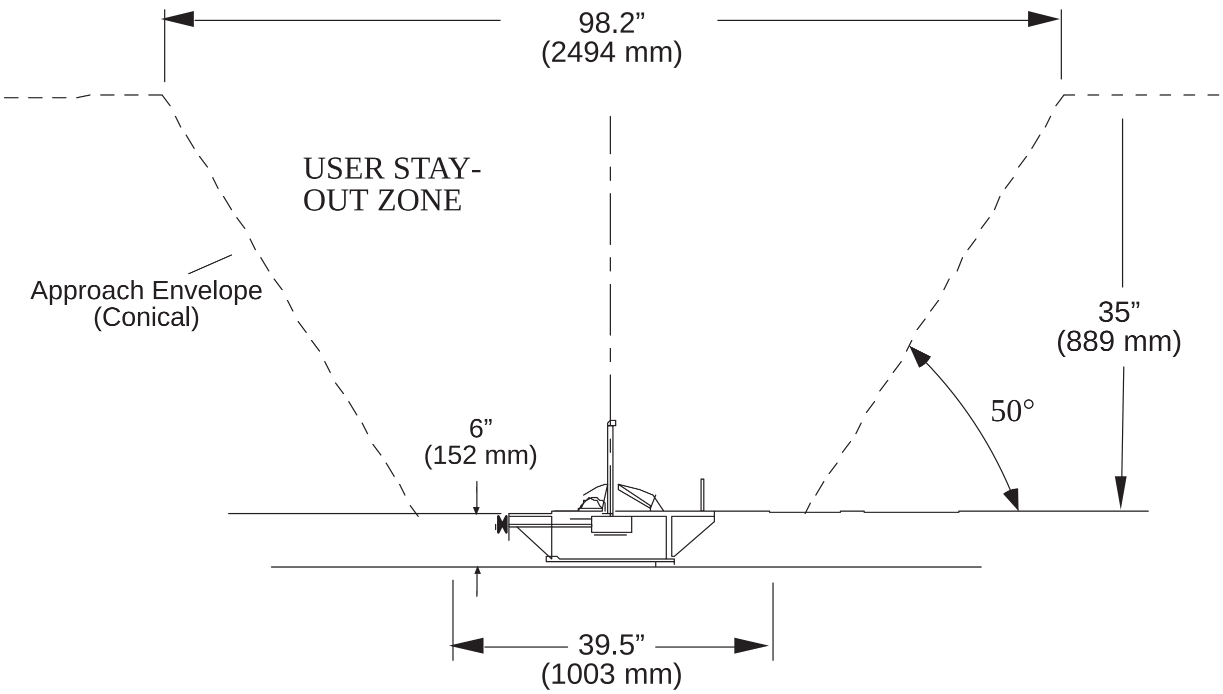
2) Clearance required beyond 40” (1016 mm) from attachment plane will be dependent on the user and the required SSRMS configuration.

3) The PDGF target mounting orientation on the user will be determined by the operational task and the required viewing reference for the operator.

4) Encroachment into this envelope by waiver only.

5) This approach envelop does not account for SSRMS runaway.

FIGURE A3.2.2.1–1 SSRMS LEE APPROACH ENVELOPE (STATIC)



Notes:
1) Clearance volume centered on centerline of PDGF,

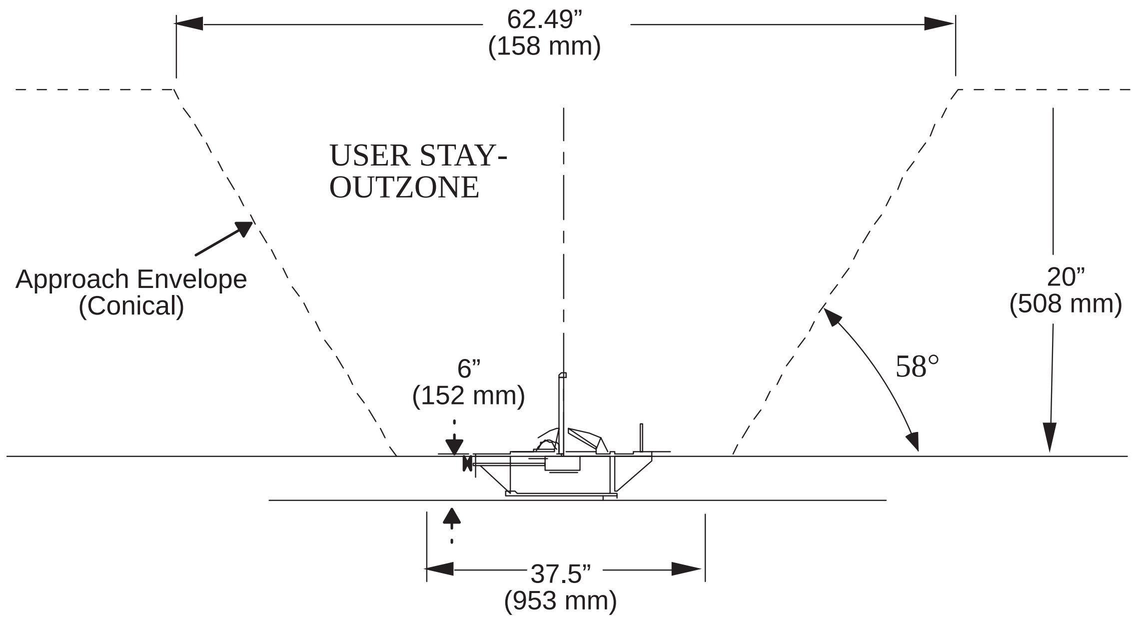
2) Clearance required beyond 35” (899 mm) from attachment plane will be dependent on the user and the required SSRMS configuration.

3) The PDGF target mounting orientation on the user will be determined by the operational task and the required viewing reference for the operator.

4) Encroachment into this envelope by waiver only.

5) This approach envelop does not account for SSRMS runaway.

FIGURE A3.2.2.1–2 SSRMS LEE APPROACH ENVELOPE (DYNAMIC/FREE FLYER)



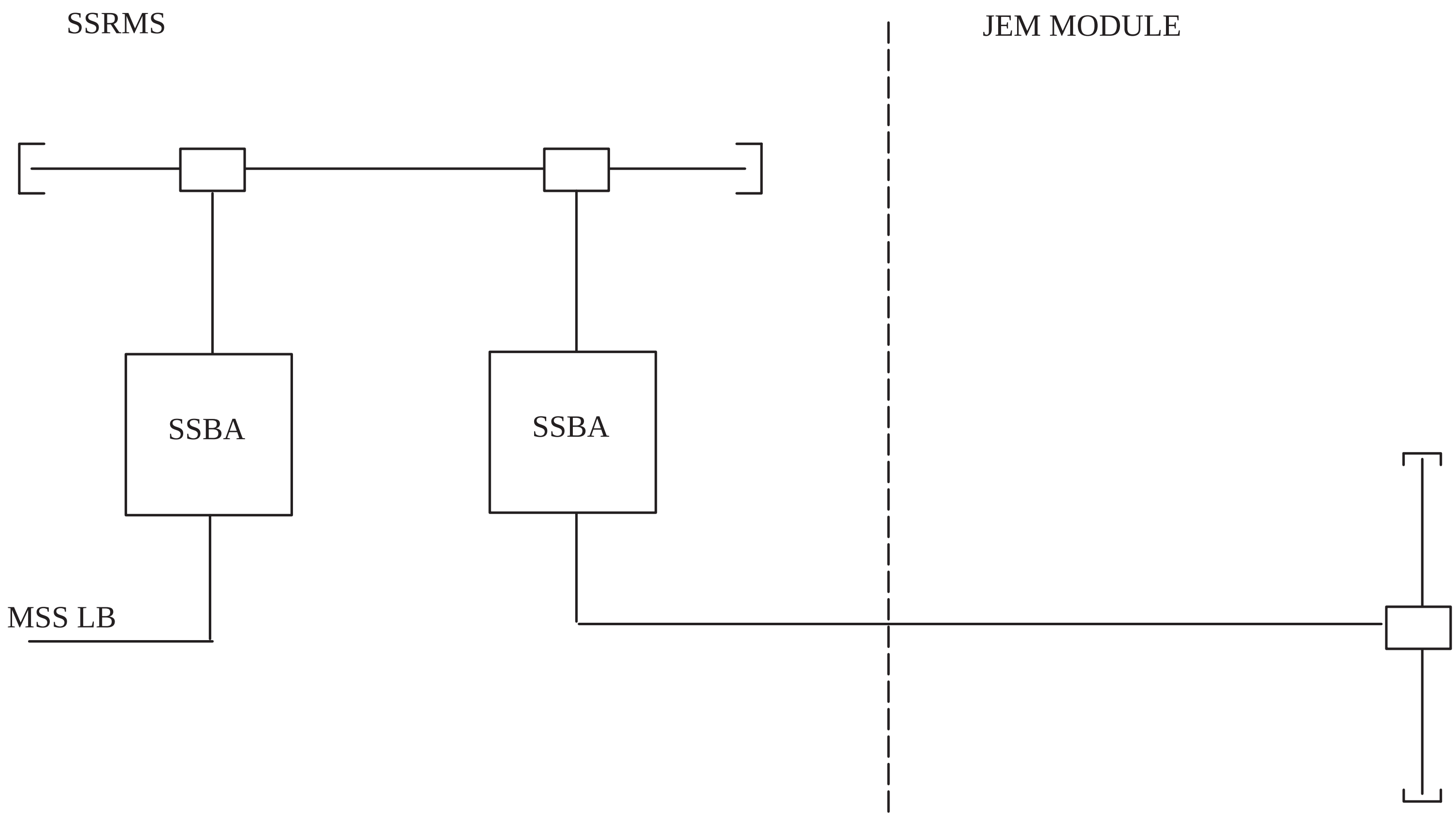
Notes: 1) Clearance volume centered on centerline of PDGF

2) Clearances required beyond 20” (508 mm) from attachment plane will be dependent on the user and the required SSRMS configuration that allows SSRMS to handoff to the POA.

3) The PDGF target mounting orientation on the user will be determined by the operational task and the required viewing reference for the operator.

4) Encroachment into this envelope by waiver only.

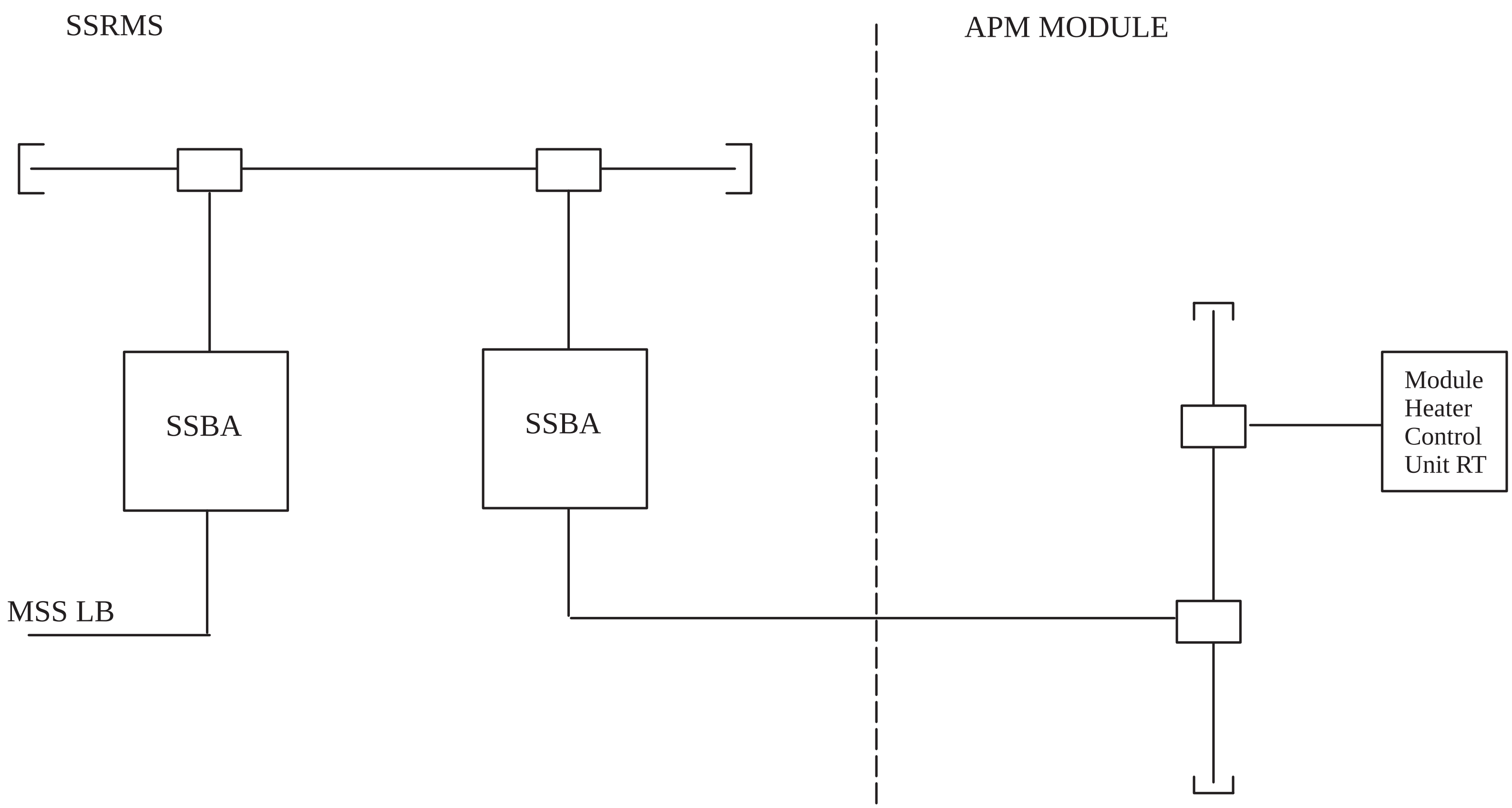
FIGURE A3.2.2.1–3 POA APPROACH ENVELOPE



Note:
1) Module to provide terminated DBC during installation

Legend
SSBA: SS Buffer Amplifier
□ Bus Coupler
Bus Termination

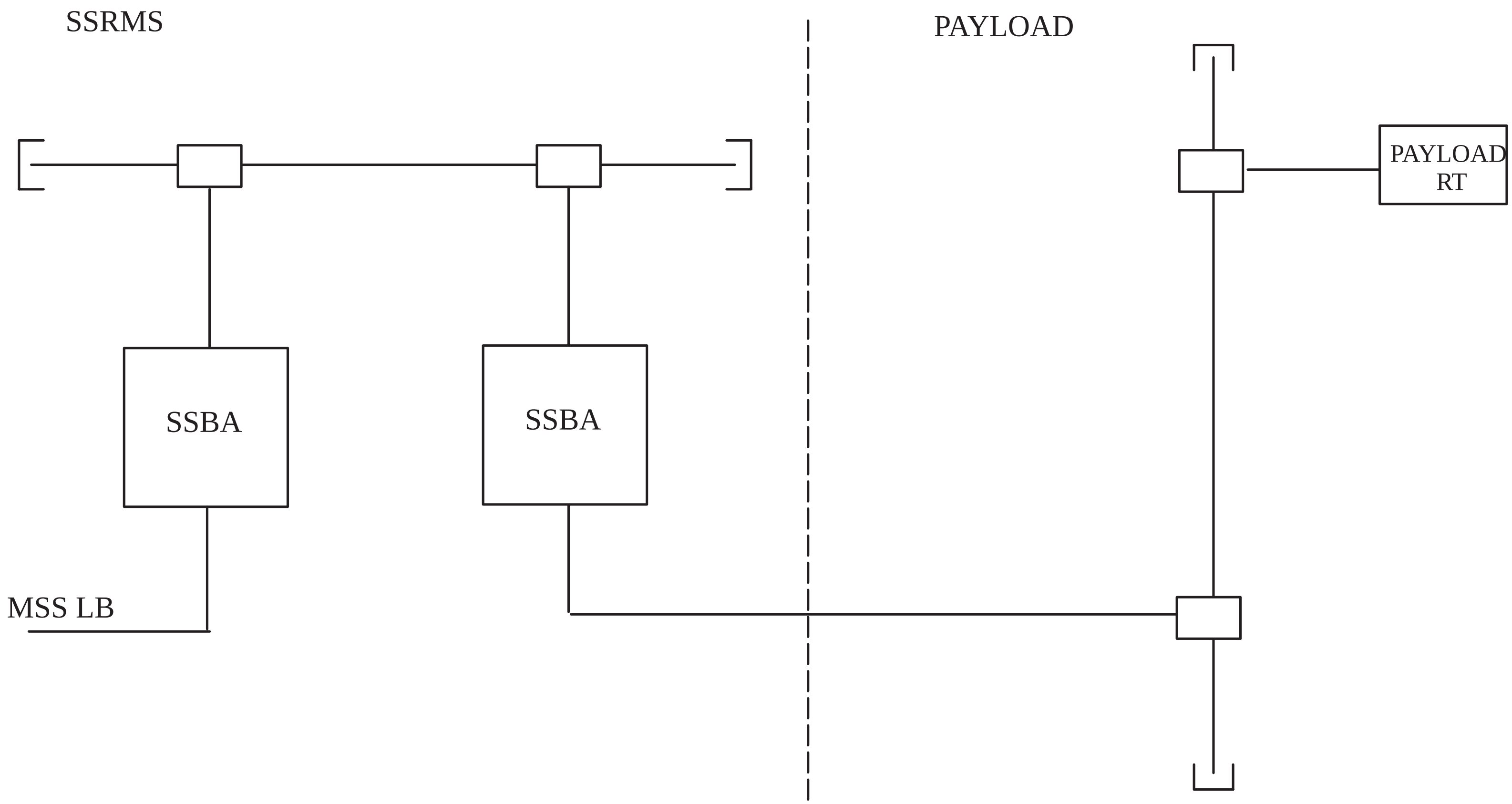
FIGURE A3.2.2.6.1.1–1 JEM–PM MODULE DURING INSTALLATION



Note:
1) Module to provide terminated DBC during installation

Legend
SSBA: SS Buffer Amplifier
Bus Coupler
Bus Termination

FIGURE A3.2.2.6.1.1–2 APM MODULE KEEP–ALIVE DURING INSTALLATION



Note:
1) Payload to terminate MSS LB when data bus is used otherwise data bus left open

Legend
SSBA: SS Buffer Amplifier
□ Bus Coupler
⌊ Bus Termination

FIGURE A3.2.2.6.1.1–3 GENERIC PAYLOAD

SECTION B3 MCAS TO USER INTERFACE

B3.0 REQUIREMENTS

B3.1 GENERAL

The MBS provides a MBS Common Attach System (MCAS) to accommodate users for transportation and servicing. The MCAS provides both structural and electrical interfaces to users. The hardware on the MCAS consists of three V–guides with Ready–To–Latch (RTL) indicators, one capture latch, and one electrical Umbilical Mechanism Assembly (UMAs). The UMA will provide the active mating half of the MCAS interface. The user passive half hardware consists of guide pins, a capture bar, and the passive umbilical harness including connector.

The MCAS will interface with the user via mechanical attachments and electrical connections. Users will be provided with power and data connections via the MCAS UMA.

The MCAS does not support video interfaces.

B3.1.1 INTERFACE DESCRIPTION

The MCAS to user interface consist of structural, mechanical, thermal, power and data interfaces.

B3.1.2 COORDINATE SYSTEM

The Space Station integrated stage configuration and elements will be in accordance with the coordinate systems defined in SSP 30219, Space Station Reference Coordinate Systems. SSP 30219 defines the MSC Operating Coordinate Systems. The MCAS operating coordinate system shall be as defined Figure B3.1.2–1.

B3.1.3 MCAS INTERFACE FUNCTIONS

The MCAS shall:

A. Support structural and mechanical attachment to the user

B. Provide the active mechanical attachment

C. Support the mating and demating of users

D. Support utility distribution to the user

E. Provide EVA access to interface attachments and connections

F. Support indication of user attachment

G. Provide and circuit protect power to the user

H. Control the power supply to the user

I. Supply and receive data at the user interface

J. Define the user envelope

B3.1.4 USER INTERFACE FUNCTIONS

The user shall:

A. Support structural and mechanical attachment to the MCAS

B. Provide the passive mechanical attachment to the MCAS

C. Support utility distribution from the MCAS

D. Provide EVA access to interface attachments and connections

E. Receive power from the MCAS

F. Supply and receive data from the MCAS interface

G. Accommodate defined user envelope.

B3.1.5 INTERFACE RESPONSIBILITIES

The interface hardware responsibilities will be as defined in Table B3.1.5–1.

B3.2 INTERFACE REQUIREMENTS

B3.2.1 MCAS INTERFACE REQUIREMENTS

B3.2.1.1 ENVELOPE REQUIREMENTS

a) The MCAS shall accommodate the maximum user envelope as defined in Figure B3.2.1.1–1.

b) The MCAS attachment envelope shall accommodate access to the capture latch and UMA by an EVA crew member, in accordance with SSP 50005, Section 14.3.2.3.1, ISS Flight Crew Integration Standard, Requirements for Accessibility by EVA Crew Members.

B3.2.1.2 MECHANICAL ATTACHMENT

a) The MCAS shall provide three V–guides for the alignment and capture of the user.

b) The MCAS shall provide a capture latch to secure the active and passive sides of the interface.

c) The MCAS shall provide RTL microswitches for indication of user attachment.

d) The MCAS shall provide an active electrical umbilical mechanism to mate with the user.

e) The mechanical design of the capture latch and active UMA shall allow an EVA crew member to mate and demate the interface in accordance with SSP 50005.

B3.2.1.3 STRUCTURAL LOADS

The MCAS shall withstand structural loads as defined in Table B3.2.1.3–1.

B3.2.1.3.1 LOAD SPECTRUM

The MCAS load spectrum shall be as defined in Table B3.2.1.3.1–1 **(TBD)**.

B3.2.1.3.2 MCAS IMPACT LOADS

During berthing of a user onto the MCAS, the impact loads to the MCAS shall be limited to a maximum of 2050 lbf axially and 900 lbf laterally on any V–guide (vane).

B3.2.1.3.3 MCAS STIFFNESS REQUIREMENTS

The MCAS, when integrated with the MBS, shall provide a minimum stiffness at the passive MCAS interface as defined below:

Rotational stiffness about X , Y and Z axis = 4.3 x 10e5 ft–lb/rad.

B3.2.1.4 ELECTRICAL CONNECTORS

The characteristics for electrical connectors at the MCAS connector panel shall be in accordance with SSQ 21637, General Specification for Connectors and Accessories, Umbilical Interface, Environmental, Space Quality.

B3.2.1.5 MCAS ELECTRICAL INTERFACE

a) The MCAS shall provide electrical interfaces to the user as defined in Figure B3.2.1.5–1.

b) The MCAS shall provide electrical power to the User during the stationary mode of operation (MT plugged into a utility port).

B3.2.1.5.1 POWER QUALITY

The MCAS interface power quality shall be in accordance with SSP 30482, Volume I and II, Interface C, with the exception of the steady state voltage range defined in Table B3.2.1.5.1–1.

B3.2.1.5.2 FAULT PROTECTION

The MCAS shall provide fault protection as shown in Table B3.2.1.5.1–1.

B3.2.1.5.3 DELETED

B3.2.1.5.4 ELECTRICAL CONNECTOR DEADFACING

The MCAS shall comply with the electrical connector deadfacing requirements as defined in Figure A3.2.1.5.4–1.

B3.2.1.5.5 REDUNDANCY

The MCAS shall have the capability to provide primary and redundant power feeds to the user.

B3.2.1.6 MCAS C&DH INTERFACE

a) The MCAS shall provide a MSS LB stub interface to the user as defined in Figure B3.2.1.6–1.

b) The MCAS shall provide the A channel of the MSS local bus (MSS LB) stub and the B channel of the MSS local bus (MSS LB) stub through one User connector.

c) Data services shall only be available during MT stationary mode of operation.

d) The MCAS payload to the RWS CEU data interfaces shall be defined in accordance with Appendix A.

B3.2.1.6.1 PROVIDE OUTPUT AMPLITUDE

The MCAS shall provide a signal amplitude of at least 2.35 volts peak–to–peak, line–to–line at the user interface for messages transmitted on a MIL–STD–1553 bus.

B3.2.1.6.2 MIL–STD–1553 ADDRESS

The MCAS shall provide MSS LB Remote Terminal (RT) Address 21 for the user.

B3.2.1.7 SYNC, CONTROL AND VIDEO INTERFACES

Not applicable

B3.2.1.8 THERMAL INTERFACE

The MCAS will provide a passive thermal interface to the user.

B3.2.1.9 ENVIRONMENTS

B3.2.1.9.1 ELECTROMAGNETIC EFFECTS

B3.2.1.9.1.1 ELECTROMAGNETIC COMPATIBILITY

The MCAS to user interface shall meet the requirements of SSP 30243, Space Station Systems Requirements for Electromagnetic Compatibility.

B3.2.1.9.1.2 GROUNDING

The MCAS to user interface shall meet the requirements of SSP 30240, Space Station Grounding Requirements.

B3.2.1.9.1.3 BONDING

a) The MCAS to user structural/mechanical interface shall meet the requirements of SSP 30245, Space Station Electrical Bonding Requirements.

b) Bonding provisions at the interface shall satisfy a Class H bond in accordance with the above reference document.

B3.2.1.9.1.4 CABLE AND WIRE DESIGN

The MCAS to user cable and wire interface shall meet the requirements of SSP 30242, Space Station Cable/Wire Design and Control Requirements for Electromagnetic Compatibility.

B3.2.1.9.1.5 ELECTROSTATIC DISCHARGE

The MCAS to user interface shall meet the requirements of SSP 30243.

B3.2.1.9.1.6 CORONA

The MCAS to user interface shall meet the requirements of SSP 30243.

B3.2.2 USER INTERFACE REQUIREMENTS

B3.2.2.1 ENVELOPE REQUIREMENTS

a) The user shall not exceed the envelope defined in Figure B3.2.1.1–1.

b) The user envelope shall accommodate access to the capture latch and UMA by an EVA crew member in accordance with SSP 50005, section 14.3.2.3.1.

B3.2.2.2 MECHANICAL ATTACHMENT

a) The user shall provide three guide pins for the alignment of the user to MCAS.

b) The user shall provide a capture bar for use in securing the active and passive sides of the interface.

c) The user shall provide a passive electrical UMA.

d) The attachment mechanisms shall comply with SSP 50005, International Space Station Flight Crew Integration Standard.

B3.2.2.3 STRUCTURAL LOADS

The user shall withstand structural loads as defined in Table B3.2.1.3–1.

B3.2.2.3.1 USER IMPACT LOADS

During berthing of a user onto the MCAS, the impact loads to the MCAS shall be limited to a maximum of 2050 lbf axially and 900 lbf laterally on any V–guide (vane).

B3.2.2.3.2 USER STIFFNESS REQUIREMENTS

The user shall provide a stiffness at the passive MCAS interface that maintains a fundamental structural frequency of 1.0 Hz while constrained at the interface.

B3.2.2.4 USER ELECTRICAL CONNECTORS

The characteristics for the user electrical connectors shall be in accordance with SSQ 21637, General Specification for Connectors and Accessories, Umbilical Interface, Environmental, Space Quality.

B3.2.2.5 USER ELECTRICAL INTERFACE

a) The User shall receive electrical interfaces from MCAS as defined in Figures B3.2.1.5–1.

b) The user shall receive electrical power from MCAS during the stationary mode of operation (MT plugged into a utility port). No power is available during MT translation for periods of up to 120 minutes.

B3.2.2.5.1 POWER QUALITY

The User interface power quality shall be in accordance with SSP 30482, Volume I and II, Interface C, with the exception of the steady state voltage range as defined in Table B3.2.1.5.1–1.

B3.2.2.5.2 FAULT PROTECTION

The user shall receive fault protection as shown in Table B3.2.1.5.1–1.

B3.2.2.5.3 DELETED

B3.2.2.5.4 REDUNDANCY

The user shall have the capability to receive prime and redundant power feeds from the MCAS.

B3.2.2.6 USER C&DH INTERFACE

a) The user shall receive a MSS LB stub interface as defined in Figure B3.2.1.6–1. No data interface is available during MT translation.

b) The user shall receive the A channel of the MSS local bus (MSS LB) stub and the B channel of the MSS local bus (MSS LB) stub through one User connector.

c) Data services shall only be available during stationary mode of operation.

d) The MCAS payload to the RWS CEU data interfaces shall be defined in accordance with Appendix A.

B3.2.2.6.1 PROVIDE OUTPUT AMPLITUDE

The user shall provide a signal amplitude of at least 17 volts peak–to–peak, line–to–line at the MCAS interface.

B3.2.2.6.2 MIL–STD–ADDRESS

The User shall receive MSS LB Remote Terminal (RT) address 21.

B3.2.2.7 SYNC, CONTROL AND VIDEO INTERFACE

Not applicable

B3.2.2.8 THERMAL INTERFACE

The User will provide a passive thermal interface to the MCAS.

B3.2.2.9 ENVIRONMENTS

B3.2.2.9.1 ELECTROMAGNETIC EFFECTS

B3.2.2.9.1.1 ELECTROMAGNETIC COMPATIBILITY

The MCAS to user interface shall meet the requirements of SSP 30243, Space Station Systems Requirements for Electromagnetic Compatibility.

B3.2.2.9.1.2 GROUNDING

The MCAS to user interface shall meet the requirements of SSP 30240, Space Station Grounding Requirements.

B3.2.2.9.1.3 BONDING

a) The MCAS to user structural/mechanical interface shall meet the requirements of SSP 30245, Space Station Electrical Bonding Requirements.

b) Bonding provisions at the interface shall satisfy a Class H bond in accordance with the above reference document.

B3.2.2.9.1.4 CABLE AND WIRE DESIGN

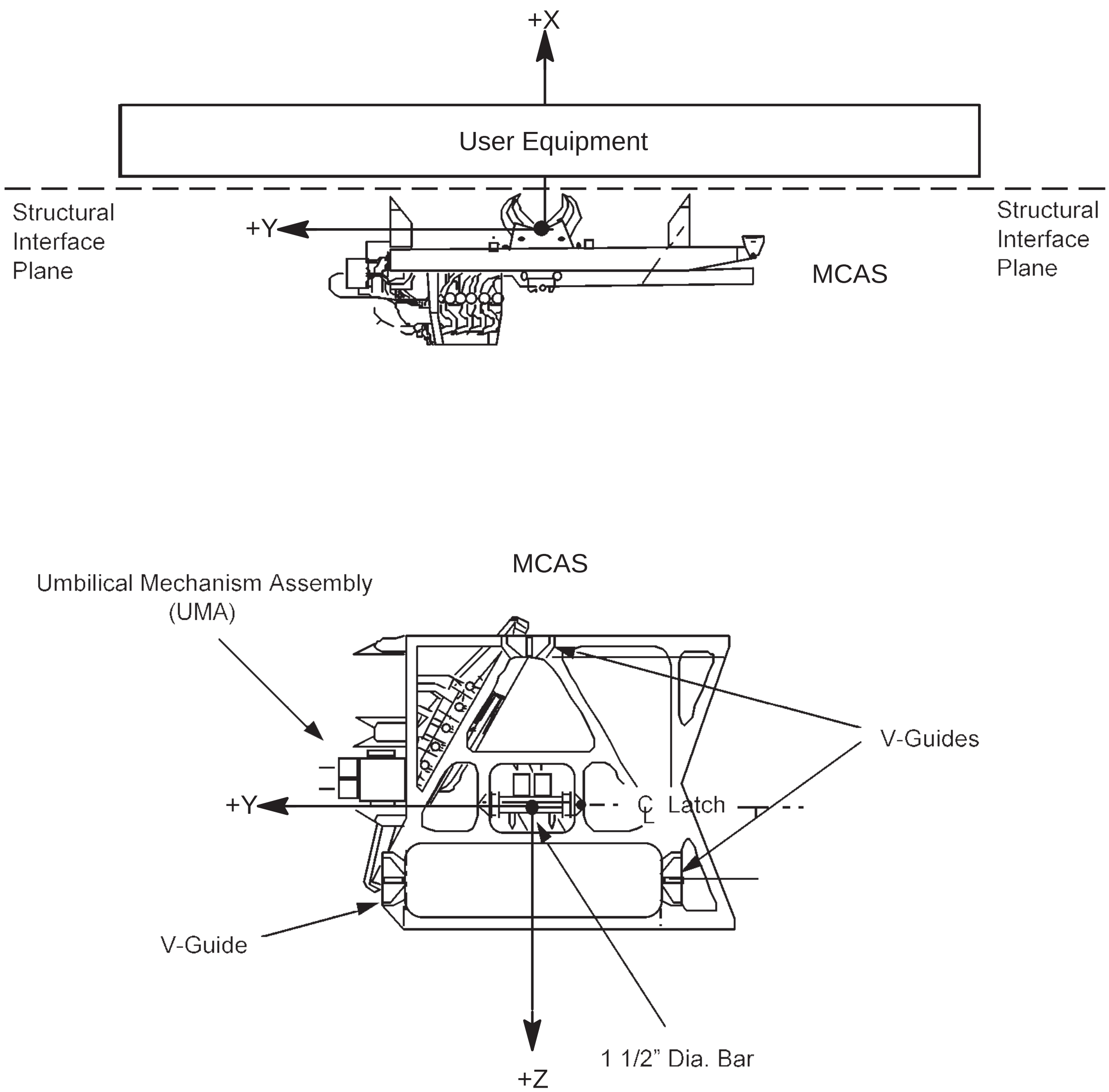
The MCAS to user cable and wire interface shall meet the requirements of SSP 30242, Space Station Cable/Wire Design and Control Requirements for Electromagnetic Compatibility.

B3.2.2.9.1.5 ELECTROSTATIC DISCHARGE

The MCAS to user interface shall meet the requirements of SSP 30243.

B3.2.2.9.1.6 CORONA

The MCAS to user interface shall meet the requirements of SSP 30243.



Origin: At the Center of the Captured Bar (1 1/2” Dia) and the Latch when fully closed.

Orientation: – Positive ”X” axis away from the latch as shown
– Positive ”Y” and ”Z” axis as shown in the figure relative to the 3–V guides

FIGURE B3.1.2–1 MCAS OPERATING COORDINATE SYSTEM

TABLE B3.1.5–1 INTERFACE HARDWARE DESIGN RESPONSIBILITY

MCAS /User Interface Hardware Responsibilities	User Hardware	CSAHardware
MCAS (V–guides, RTL indicators)		X
MCAS capture latch		X
MCAS one active UMA		X
Passive guide pins	X	
Passive capture bar	X	
One Passive UMA	X	

Point	X(in)	Z(in)
A	4.32	-92.92
B	-2.16	-68.78
C	0.00	-49.00
D	0.00	17.00
E	71.50	113.34
F	76.83	115.82
G	103.53	58.57
H	108.88	61.07
I	178.28	-87.75

Notes:
1. Viewed looking in the -y direction.
2. This is a static envelope.
3. Dimensions given in MCAS OCS.

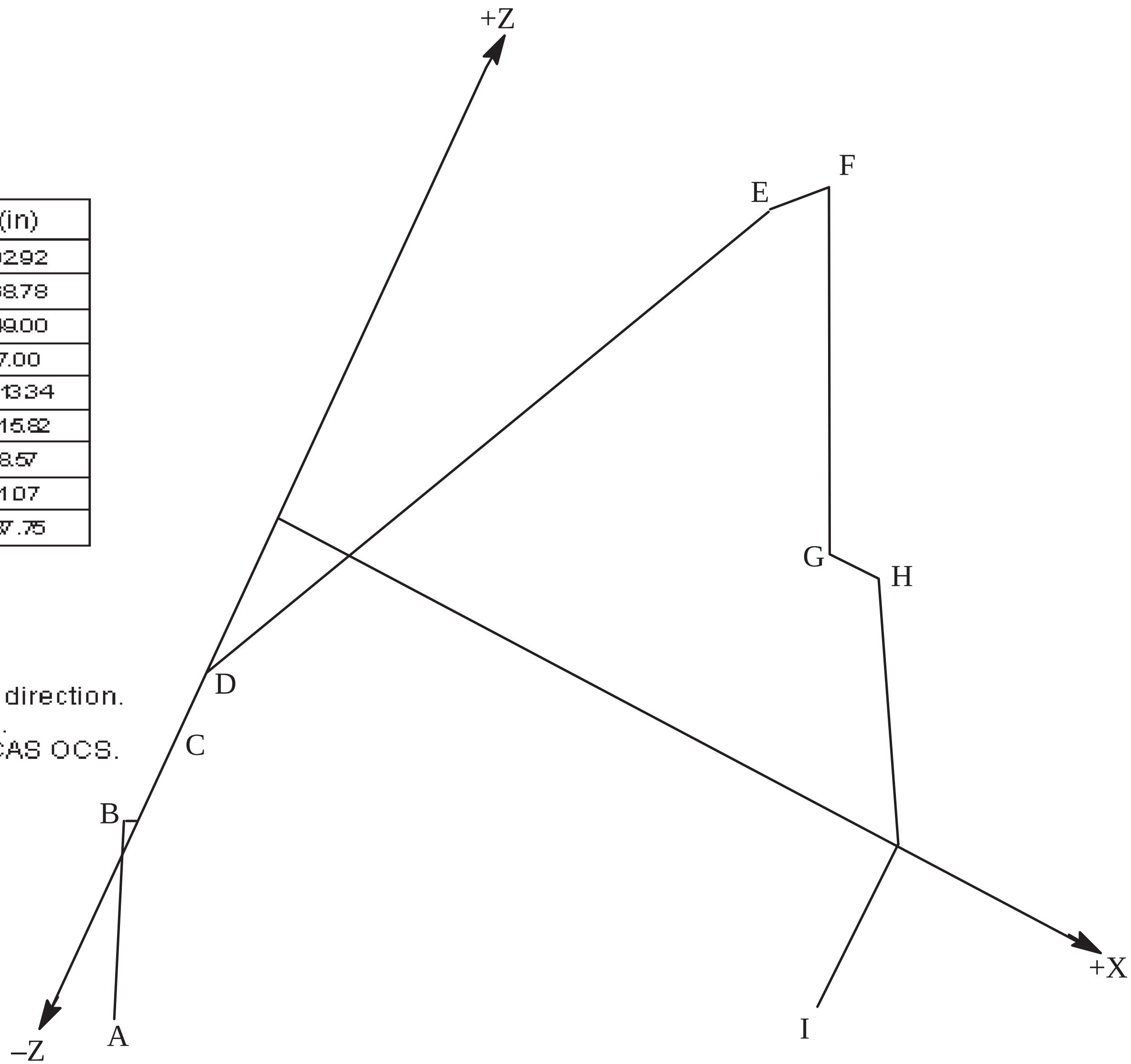


FIGURE B3.2.1.1–1 MCAS USER ENVELOPE

TABLE B3.2.1.3–1 MCAS TO USER STRUCTURAL LOADS

MCAS to User Loads	Torsional Moment ft lbf (N–m)	Bending Moment ft lbf (N–m)	Shear Force lbf (N)	Tensile Force lbf (N)
During MT translation	9000 (12202)	9000 (12202)	150 (667)	150 (667)
During MT stationary operations	9000 (12202)	9000 (12202)	200 (890)	200 (890)

Notes:

1) The torsional moment and bending moment for either case will be applied separately.
2) The shear force and tensile force for either case will be applied separately. One moment and one force for either case can be applied simultaneously.
3) MT braking force is 150 lbf. along Y–axis. Maximum force vector in XZ plane is 37 lbf.

TABLE B3.2.1.3.1–1 MCAS TO USER LOAD SPECTRUM

TBD

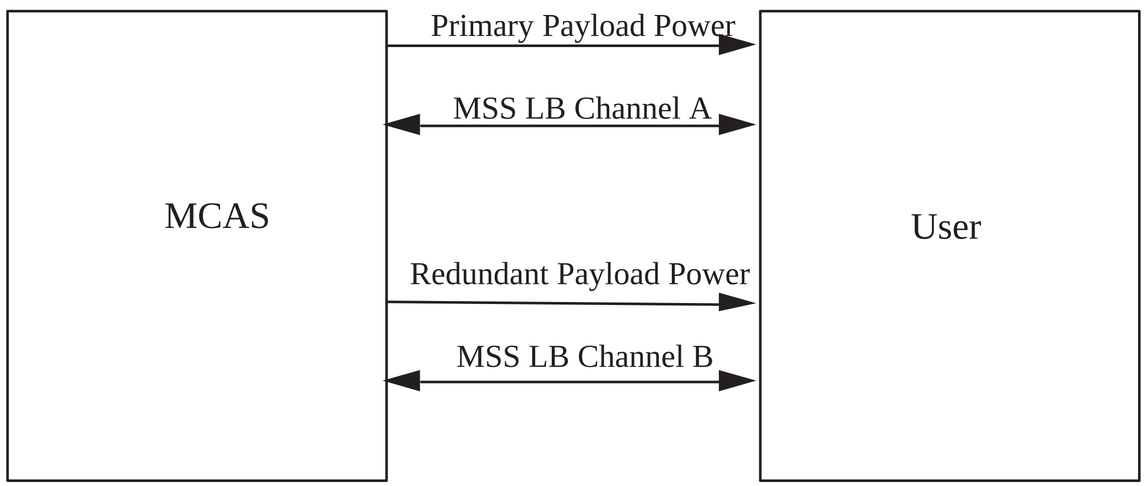


FIGURE B3.2.1.5–1 MCAS TO USER ELECTRICAL FUNCTIONAL DIAGRAM

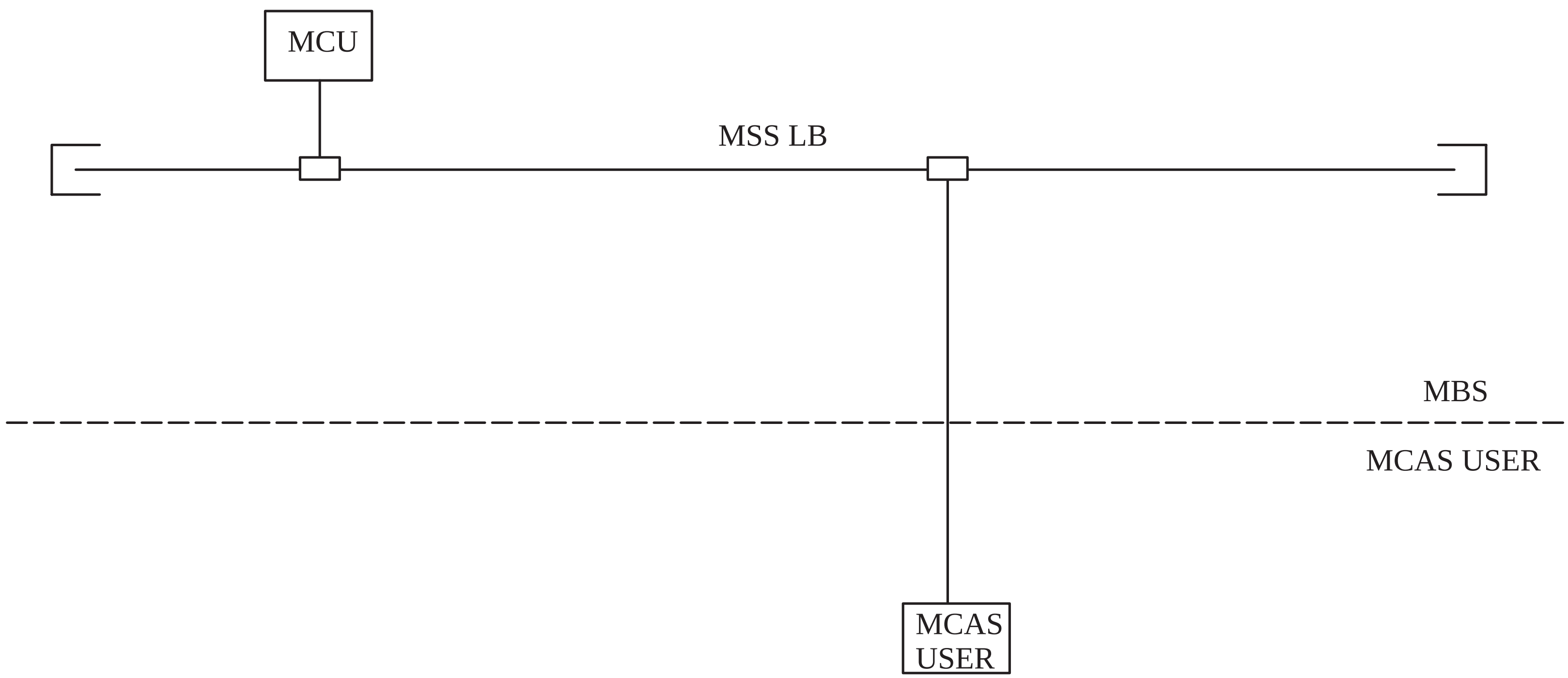
TABLE B3.2.1.5.1–1 MCAS TO USER ELECTRICAL INTERFACE REQUIREMENTS

Circuit Name	INTERFACE V_{range} (volts dc)	Operating Current (amps)	Overcurrent Protection
MCAS USER1	112.5 to 126	0 to 12	NOTE 1
MCAS USER2	112.5 to 126	0 to 12	NOTE 1

NOTES:

1 Protection is equivalent with SSP 30263:002, Type I RPCM Standard ICD.

2 The operating current is 9.7 A with 113 Vdc minimum interface voltage.



Note:
1) The MCAS to user electrical interface is located where the MCAS UMA active half meets the user passive half.

Legend
MCU: MSS Control Unit
□ Bus Coupler
⌊ Bus Termination

FIGURE B3.2.1.6–1 MCAS TO USER C&DH INTERFACE

SECTION C3 OTCM TO USER INTERFACES

C3.0 REQUIREMENTS

C3.1 GENERAL

The SPDM reach and manipulation capabilities allow servicing and maintenance of user equipment. The SPDM OTCM can interface mechanically with user equipment by grasping a standard dexterous grasp fixture (SDGF) attached to the user equipment. An SDGF may be an H– fixture, a Micro fixture, a Parallel Jaw fixture, or a Modified Micro. A clearance envelope is required around the SDGF before it can be grasped by the OTCM. A dexterous handling target (DHT) is required to be located in a spatial relationship to the SDGF (TBD#12). The DHT is used in conjunction with the OTCM camera and lights to provide a means of aligning the OTCM to the SDGF prior to grasping the SDGF.

Once the mechanical interface between the OTCM and the user equipment has been established, the OTCM can establish further interfaces with the user equipment as follows:

i) by extending a socket driver from the OTCM to a standard 7/16 inch bolt head colocated with the SDGF, and subsequently applying torque to the bolt head,

ii) by extending an umbilical connector from the OTCM into an appropriately positioned mating connector on the user equipment, and subsequently transferring electrical power, data, and video sync to the user and/or receiving data and video from the user equipment.

In addition, the SPDM can interface mechanically with micro conical fixtures and with standard 7/16 inch bolt heads not colocated with an SDGF using the SPDM Standard Tools as defined in Sections D and G of this ICD.

C3.1.1 INTERFACE DESCRIPTION

The OTCM to user interfaces consist of structural, mechanical, thermal, power, data, and video interfaces. The interface definition is shown in Figure C3.1.1–1.

The mechanical/structural interface plane defined in this ICD is between the mounting surface of the user and the grasp fixture and DHT. An interface plane is also defined between the socket drive and the Standard 7/16 bolt head (user). The electrical interface plane defined in this ICD is between the OTCM umbilical connector (male half) and the user connector (female half).

C3.1.1.1 COORDINATE SYSTEMS

The Space Station integrated stage configuration and elements shall be in accordance with the coordinate systems defined SSP 30219, Space Station Reference Coordinate Systems

C3.1.1.1.1 OTCM OPERATIONS COORDINATE SYSTEM

The OTCM Operating Coordinate System is as shown in Figure C3.1.1.1.1–1 **(TBD#13).**

C3.1.1.1.2 H–FIXTURE OPERATIONS COORDINATE SYSTEM

The H–Fixture Operating Coordinate System is as shown in Figure C3.1.1.1.2–1.

C3.1.1.1.3 MICRO FIXTURE OPERATIONS COORDINATE SYSTEM

The Micro Fixture Operating Coordinate System is as shown in Figure C3.1.1.1.3–1.

C3.1.1.1.4 PARALLEL JAW FIXTURE OPERATIONS COORDINATE SYSTEM

The Parallel Jaw Fixture Operating Coordinate System is as shown in Figure C3.1.1.1.4–1 **(TBD#14).**

C3.1.1.1.5 MODIFIED MICRO FIXTURE OPERATIONS COORDINATE SYSTEM

The Modified Micro Fixture Operating Coordinate System is as shown in Figure C3.1.1.1.5–1 **(TBD#15).**

C3.1.1.2 OTCM INTERFACE FUNCTIONS

The OTCM shall:

A. Support structural/mechanical attachment to the user

B. If required, support utility distribution to the user

C. Provide for EVA release of OTCM from a user interface in the event of an OTCM failure

D. Provide for viewing of targets and method of aligning OTCM for attachment to SDGF

E. Provide torque and OTCM axial force to activate bolts, tools, and other user mechanisms

F. Provide and circuit protect power to the user

G. Control the power supply to the user

H. Supply and receive data at the user interface

I. Supply video sync and control to the user

J. Receive video from the user

C3.1.1.3 USER INTERFACE FUNCTIONS

The user shall:

A. Support structural/mechanical attachment of OTCM via an SDGF

B. If required, support utility distribution from the OTCM

C. Provide EVA access to interface attachments and connections

D. Support targets for OTCM attachment

E. Receive power from the OTCM

F. Provide and receive data at the OTCM interface

G. Receive video sync and control from the OTCM

H. Provide video to the OTCM

I. Provide for transmission of torque and OTCM axial force where required to activate bolts, tools or other user mechanisms

C3.1.2 INTERFACE RESPONSIBILITIES

The interface hardware responsibilities for the OTCM interface components and the user shall be as defined in Table C3.1.2–1.

C3.2 INTERFACE REQUIREMENTS

C3.2.1 OTCM INTERFACE REQUIREMENTS

C3.2.1.1 ENVELOPES

C3.2.1.1.1 H–FIXTURE ENVELOPE

The access envelope around each H–fixture shall be as defined in Figures C3.2.1.1.1–1 through C3.2.1.1.1–3. This envelope includes the OTCM, DHT and Gripper Jaw envelope for each H–fixture.

C3.2.1.1.2 MICRO FIXTURE ENVELOPE

The access envelope around each Micro fixture shall be as defined in Figure C3.2.1.1.2–1 through C3.2.1.1.2–3. This envelope includes the OTCM, DHT and Gripper Jaw envelope for each micro fixture.

C3.2.1.1.3 PARALLEL JAW FIXTURE ENVELOPE

The access envelope around a Parallel Jaw interface shall be as defined in Figure C3.2.1.1.3–1 **(TBD#16)**. This envelope includes the OTCM, DHT and Gripper Jaw envelope for each parallel jaw fixture.

C3.2.1.1.4 MODIFIED MICRO FIXTURE ENVELOPE

The access envelope around each Modified Micro fixture shall be as defined in Figure C3.2.1.1.4–1 through C3.2.1.1.4–3 **(TBD#17).** This envelope includes the OTCM, DHT and Gripper Jaw envelope for each micro fixture.

C3.2.1.1.5 EVA ACCESS

C3.2.1.1.5.1 OTCM RELEASE ENVELOPE

The clearance envelope around the OTCM for EVA access to release the OTCM gripper and demate the OTCM umbilical connector shall be as defined in Figure C3.2.1.1.5.1–1 **(TBD#18).**

C3.2.1.2 SDGF MECHANICAL INTERFACE

The grasp fixtures shall be equipped with holes to accommodate user mounting bolts. The OTCM shall provide an umbilical connector which mates with the user connector. The DHT shall provide **(TBD#19)** features for mounting to the user equipment. The SDGF shall be equipped with a central hole to accommodate a 7/16 inch bolt head with clearance for the tool used to actuate the bolt.

C3.2.1.3 SDGF STRUCTURAL INTERFACE

The on–orbit loads transmitted to H–fixtures and Micro fixtures on User hardware during manipulation, under nominal (operational) conditions, shall be as defined in Table C3.2.1.3–1. Worst case SPDM failure loads are given in this table for information. The on–orbit nominal loads transmitted to an H–Fixture for stabilization shall be as defined in Table C3.2.1.3–2. Worst case SPDM failure loads are given in this table for information. All loads are measured at the structural interface located at the mounting plane between the SDGF and the user hardware or supporting structure.

C3.2.1.3.1 IMPACT ENERGY

The SDGF shall be capable of withstanding the impact energy defined in Table C3.2.1.3.1–1 during capture of the user equipment by the OTCM.

C3.2.1.4 OTCM ELECTRICAL INTERFACE HARDWARE

C3.2.1.4.1 ELECTRICAL CONNECTORS

OTCM umbilical electrical connectors shall comply with the requirements of SSQ 21635, General Specifications for Connectors and Accessories, Electrical, Circular, Miniature, IVA/EVA/Robot Compatible, Space Quality.

C3.2.1.5 OTCM ELECTRICAL POWER INTERFACE

The SPDM OTCM shall supply power to the user through a single OTCM power circuit. This interface is illustrated in Figure C3.2.1.5–1.

C3.2.1.5.1 POWER QUALITY

The interface power quality shall be in accordance with SSP 30482, Volume I and II, Interface C, with steady state voltage range as defined in Table C3.2.1.5.1–1.

C3.2.1.5.2 FAULT PROTECTION

The SPDM shall provide protection as shown in Table C3.2.1.5.1–1.

C3.2.1.5.3 ELECTRICAL BONDING INTERFACES

The OTCM electrical connections shall be in compliance with SSP 30245, SSP Electrical Bonding Requirements. Bonding provisions at the interface shall satisfy a Class H and R bond in accordance with the above reference document.

C3.2.1.5.4 ELECTRICAL CONNECTOR DEADFACING

The OTCM electrical connections shall comply with the electrical connector deadfacing requirements as defined in Figure A3.2.1.5.4–1.

C3.2.1.6 OTCM DATA INTERFACE

If required, the OTCM shall provide data resources to the user as defined in Figure C3.2.1.5–1.

The data link for the OTCM to user interface shall not be available when the OTCM is attached via the parallel jaw fixture. The data bus shall communicate to the user with the interface characteristics as specified in MIL–STD–1553, Digital Time Division Command/Response Multiplex Databus. The data rates during stationary and transport operations shall be as defined in Table C3.2.1.6–1. No data interface is available during MSC translation.

C3.2.1.7 OTCM VIDEO INTERFACE

If required, the OTCM shall provide sync, control, and video interfaces to the user as defined in Figure C3.2.1.5–1. Video interface for the OTCM to user interface shall not be available when the user is attached to the OTCM via the parallel jaw fixture. Each OTCM shall accept one composite video input signal from the user. External video inputs from either OTCM shall be selectable as part of the three video channel allocation. No video interface is available during MSC translation.

C3.2.1.7.1 VIDEO, SYNC, AND CONTROL TRANSMISSION AND SIGNAL CHARACTERISTICS

The video, sync, and control shall be transmitted between OTCM and the User in accordance with SSP 50002, ISS Video Standard. The video, sync, and control signal characteristics shall be in accordance EIA–RS–170A.

C3.2.1.8 OTCM THERMAL CONTROL INTERFACE

The worst case predicted temperatures on the OTCM–side of the OTCM to user interface, prior to acquiring of a grasp fixture by the gripper jaws, shall be within (TBD#20)°F and **(TBD#20)**°F..

OTCM to user thermal conductance (H, micro, parallel jaw, and modified micro fixtures only) shall be limited to **(TBD#20**) W/°C maximum.

C3.2.1.9 ENVIRONMENTS

C3.2.1.9.1 ELECTROMAGNETIC EFFECTS

C3.2.1.9.1.1 ELECTROMAGNETIC COMPATIBILITY

The OTCM to user interface shall meet the requirements of SSP 30243, Space Station Systems Requirements for Electromagnetic Compatibility.

C3.2.1.9.1.2 GROUNDING

The OTCM to user interface shall meet the requirements of SSP 30240, Space Station Grounding Requirements.

C3.2.1.9.1.3 BONDING

The OTCM to user structural/mechanical interface shall meet the requirements of SSP 30245, Space Station Electrical Bonding Requirements.

C3.2.1.9.1.4 CABLE AND WIRE DESIGN

The OTCM to user cable and wire interface shall meet the requirements of SSP 30242, Space Station Cable/Wire Design and Control Requirements for Electromagnetic Compatibility.

C3.2.1.9.1.5 ELECTROSTATIC DISCHARGE

The OTCM to user interface shall meet the requirements of SSP 30243.

C3.2.1.9.1.6 CORONA

The OTCM to user interface shall meet the requirements of SSP 30243.

C3.2.2 USER INTERFACE REQUIREMENTS

C3.2.2.1 ENVELOPES

C3.2.2.1.1 H–FIXTURE ENVELOPE

The user shall provide an access envelope around each H–fixture as defined in Figures C3.2.1.1.1–1 through C3.2.1.1.1–3. This envelope includes the OTCM, DHT and Gripper Jaw envelope for each H–fixture.

C3.2.2.1.2 MICRO FIXTURE ENVELOPE

The user shall provide an access envelope around each Micro fixture as defined in Figure C3.2.1.1.2–1 through C3.2.1.1.2–3. This envelope includes the OTCM, DHT and Gripper Jaw envelope for each Micro fixture.

C3.2.2.1.3 PARALLEL JAW FIXTURE ENVELOPE

The user shall provide an access envelope around a Parallel Jaw interface as defined in Figure C3.2.1.1.3–1 **(TBD#21**). This envelope includes the OTCM, DHT and Gripper Jaw envelope for each Parallel Jaw fixture.

C3.2.2.1.4 MODIFIED MICRO FIXTURE ENVELOPE

The user shall provide an access envelope around each Modified Micro fixture as defined in Figure C3.2.1.1.4–1 through C3.2.1.1.4–3 **(TBD#22)**. This envelope includes the OTCM, DHT and Gripper Jaw envelope for each Micro fixture.

C3.2.2.1.5 EVA ACCESS

C3.2.2.1.5.1 OTCM RELEASE ENVELOPE

The user shall provide a clearance envelope around the OTCM for EVA access to release the OTCM gripper and demate the OTCM umbilical connector as defined in Figure C3.2.1.1.5.1–1 **(TBD#23).**

C3.2.2.2 USER MECHANICAL INTERFACE

The user shall provide mounting bolts to mount the grasp fixture. If electrical resources are required, the user shall provide a fixed connector for the OTCM umbilical. The user shall provide mounting features required for mounting the DHT. If fastener activation is required, the user shall provide 7/16 inch bolt head colocated with the SDGF.

C3.2.2.3 USER STRUCTURAL INTERFACE

The on–orbit loads to be sustained during manipulation by User hardware equipped with H–Fixture and Micro fixtures, under nominal (operational) conditions, shall be as defined in Table C3.2.1.3–1. Worst case SPDM failure loads are given in this table for information. The on–orbit nominal loads to be sustained by structures supporting H–Fixtures for stabilization shall be as defined in Table C3.2.1.3–2. Worst case SPDM failure loads are given in this table for information. All loads are measured at the structural interface located at the mounting plane between the SDGF and the user hardware or supporting structure.

C3.2.2.3.1 IMPACT ENERGY

The user shall be capable of withstanding the impact energy defined in Table C3.2.1.3.1–1 during capture of the user equipment by the OTCM.

C3.2.2.3.2 USER NATURAL FREQUENCY (FOR MANIPULATION)

The minimum natural frequency of the user, assuming the user is structurally constrained only by the corresponding SDGF, shall be 8 Hertz.

C3.2.2.3.3 USER ROTATIONAL STIFFNESS (FOR STABILIZATION)

The minimum rotational stiffness required from a user providing a stabilization site (via an H–fixture) at the user mounting surface of the H–fixture shall be 5,000 ft–lb/rad about all axes.

C3.2.2.3.4 OTCM UMBILICAL MECHANISM MATE LOADS

The user electrical umbilical connector shall be capable of withstanding a force of 50 lbf normal to the umbilical mate/demate interface.

C3.2.2.3.5 USER LINEAR STIFFNESS (FOR STABILIZATION)

The minimum linear stiffness required from a user providing a stabilization site (via an H–fixture) at the user mounting surface of the H–fixture shall be 1,000 lb/in in all directions.

C3.2.2.4 OTCM ELECTRICAL INTERFACE HARDWARE

C3.2.2.4.1 ELECTRICAL CONNECTORS

Electrical connectors shall comply with the requirements of SSQ 21635, General Specifications for Connectors and Accessories, Electrical, Circular, Miniature, IVA/EVA/Robot Compatible, Space Quality.

C3.2.2.5 USER ELECTRICAL POWER INTERFACE

The user shall provide the capability to receive power through the OTCM power circuit. This interface is illustrated in Figure C3.2.1.5–1.

C3.2.2.5.1 POWER QUALITY

The interface power quality shall be in accordance with SSP 30482, Volume I and II, Interface C, with steady state voltage range as defined in Table C3.2.1.5.1–1.

C3.2.2.5.2 DELETED

C3.2.2.5.3 ELECTRICAL BONDING INTERFACES

The user electrical connections shall be in compliance with SSP 30245, SSP Electrical Bonding Requirements. Bonding provisions at the interface shall satisfy a Class H and R bond in accordance with the above reference document.

C3.2.2.5.4 ELECTRICAL CONNECTOR DEADFACING

The user electrical connections shall comply with the electrical connector deadfacing requirements as defined in Figure A3.2.1.5.4–1.

C3.2.2.6 USER DATA INTERFACE

If required, the OTCM shall provide data resources to the user as defined in Figure C3.2.1.5–1.

The data link for the OTCM to user interface shall not be available when the OTCM is attached via the parallel jaw fixture. The data bus shall communicate to the user with the interface characteristics as specified in MIL–STD–1553, Digital Time Division Command/Response Multiplex Databus. The data rates during stationary and transport operations shall be as defined in Table C3.2.1.6–1. No data interface is available during MSC translation.

C3.2.2.7 OTCM VIDEO INTERFACE

If required, the OTCM shall provide sync, control, and video interfaces to the user as defined in Figure C3.2.1.5–1. Video interface for the OTCM to user interface shall not be available when the user is attached to the OTCM via the parallel jaw fixture. Each OTCM shall accept one composite video input signal from the user. External video inputs from either OTCM shall be selectable as part of the three video channel allocation. No video interface is available during MSC translation.

C3.2.2.7.1 VIDEO, SYNC, AND CONTROL TRANSMISSION AND SIGNAL CHARACTERISTICS

The video, sync, and control shall be transmitted between the OTCM and the User in accordance with SSP 50002, ISS Video Standard. The video, sync, and control signal characteristics shall be in accordance EIA–RS–170A.

C3.2.2.8 USER THERMAL CONTROL INTERFACE

The worst case predicted temperatures on the user–side of the OTCM to user interface, prior to acquiring of a grasp fixture by the gripper jaws, are as given in Table C3.2.2.8–1 **(TBD#24)**. OTCM to user thermal conductance (H, micro, parallel jaw, and modified micro fixtures only) shall be limited to **(TBD#24)** W/°C maximum.

C3.2.2.9 ENVIRONMENTS

C3.2.2.9.1 ELECTROMAGNETIC EFFECTS

C3.2.2.9.1.1 ELECTROMAGNETIC COMPATIBILITY

The OTCM to user interface shall meet the requirements of SSP 30243, Space Station Systems Requirements for Electromagnetic Compatibility.

C3.2.2.9.1.2 GROUNDING

The OTCM to user interface shall meet the requirements of SSP 30240, Space Station Grounding Requirements.

C3.2.2.9.1.3 BONDING

The OTCM to user structural/mechanical interface shall meet the requirements of SSP 30245, Space Station Electrical Bonding Requirements.

C3.2.2.9.1.4 CABLE AND WIRE DESIGN

The OTCM to user cable and wire interface shall meet the requirements of SSP 30242, Space Station Cable/Wire Design and Control Requirements for Electromagnetic Compatibility.

C3.2.2.9.1.5 ELECTROSTATIC DISCHARGE

The OTCM to user interface shall meet the requirements of SSP 30243.

C3.2.2.9.1.6 CORONA

The OTCM to user interface shall meet the requirements of SSP 30243.

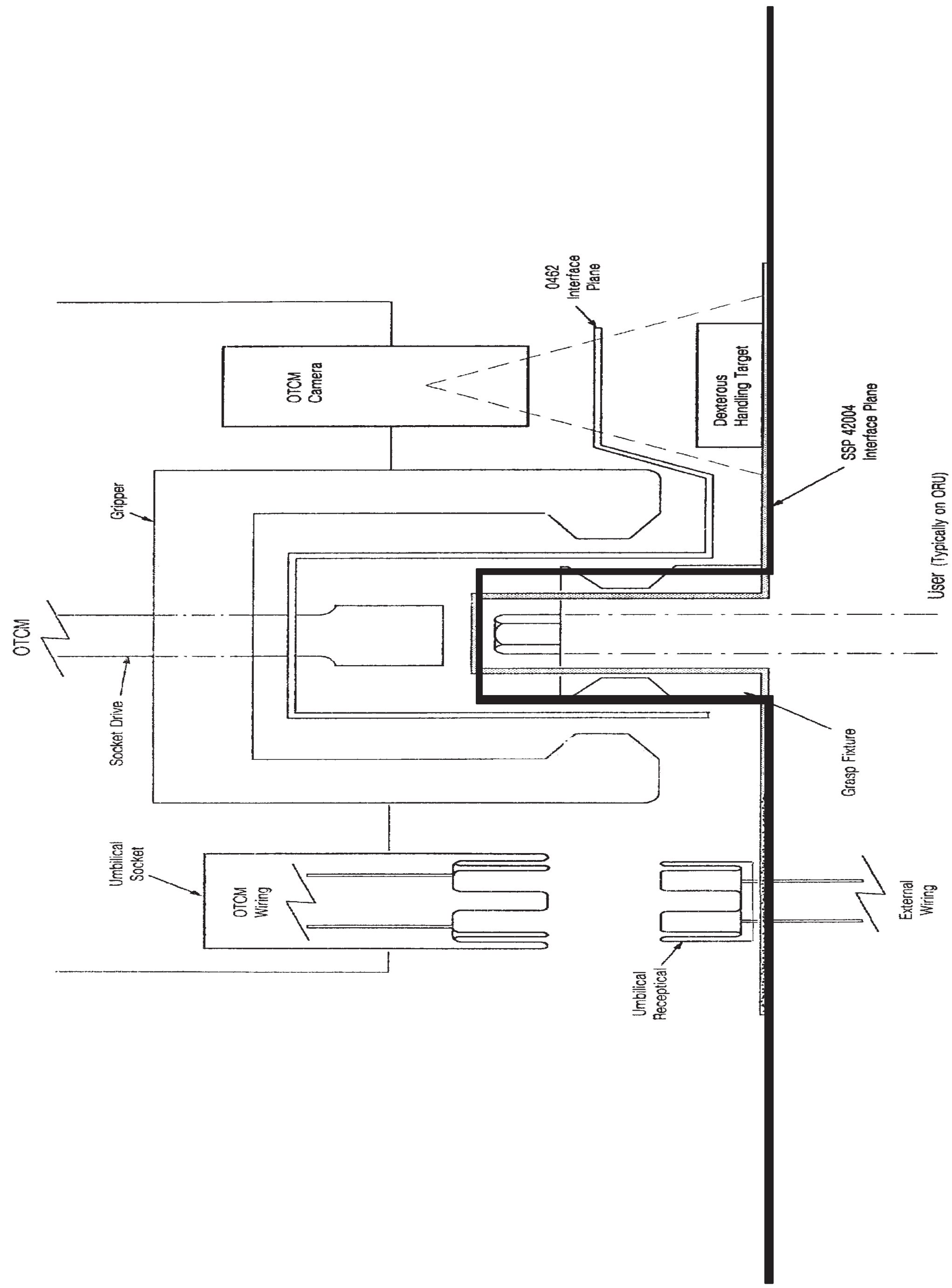
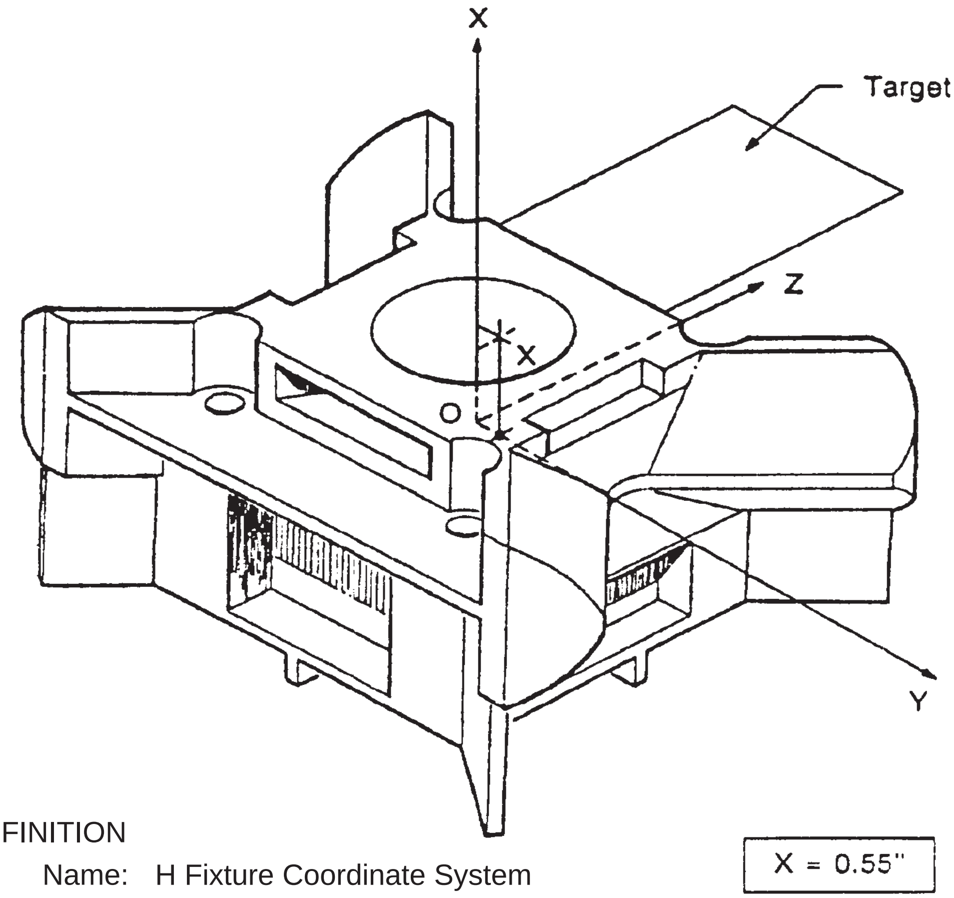


FIGURE C3.1.1–1 OTCM TO USER INTERFACE PLANE



DEFINITION

Name: H Fixture Coordinate System

Orientation and Definition: Origin of the SDGF frame is located at the geometric center of the gripping interface. (Origin of the SDGF frame coincide with the origin of the OTCM fram when the SDGF is fully grasped by the gripped mechanism of the OTCM. The top surface of the SDGF is parallel to the Y–Z plane at X=0.55 inches.)

+X axis is normal to the top surface of the SDGF and points away from the SDGF mounting surface.

+Z axis points towards the DHT.

+Y axis completes the right–handed Cartesian coordinate system.

Characteristics: Right–handed Cartesian Coordinate.

Note: for reference only

FIGURE C3.1.1.1.2–1 H FIXTURE OPERATING COORDINATE SYSTEM

TABLE C3.1.2–1 OTCM INTERFACE COMPONENTS RESPONSIBILITIES

OTCM Interface Components	NASA	CSA	User
OTCM		X	
H–Fixture		X	
Micro Fixture (–1)		X	
Micro Fixture (–3)		X	
Parallel Jaw Fixture		**(TBD#25)**	
Modified Micro	X		
DHT Target		X	
H Fixture mounting bolts and Standard Bolt Head			X
Micro Fixture (–1) mounting bolts and Standard Bolt Head			X
Micro Fixture (–3) mounting bolts and Standard Bolt Head			X
Parallel Jaw Fixture mounting bolts and Standard Bolt Head			X
DHT mounting arrangement			X
OTCM umbilical connector		X	
User umbilical connector		X	

H–Fixture, Micro (–1) Fixture, Micro (–3) Fixture, Parallel Jaw Fixture, DHT Target and OTCM umbilical are designed, developed and verified by CSA. Modified Micro Fixture is designed developed and verified by NASA

TABLE C3.2.1.3–1 ON–ORBIT SDGF STRUCTURAL INTERFACE LOADS FOR MANIPULATION

LOADS / FIXTURE	Moment ft–lbf		Force lbf	
	Nominal	Worst Case Failure	Nominal	Worst Case Failure
H–Fixture	250	250	50	50
Micro Fixture	125	172.5	50	50

Note:

1) Moments are bending and torsional moments.
2) Forces are shear and tensile / compressive forces.
3) Resultant forces and moments can be applied simultaneously in any direction.

TABLE C3.2.1.3.1–1 SDGF IMPACT ENERGY

Loads	Maximum Impact Energy (J)
H–Fixture	**(TBR#26)** (0.1)
Micro (–1 and –3)	**(TBR#26)** (0.1)
Parallel Jaw Fixture	**(TBR#26)** (0.1)
Modified Micro	**(TBD#26)**

TABLE C3.2.1.3–2 ON–ORBIT SDGF STRUCTURAL INTERFACE LOADS FOR STABILIZATION

STABILIZATION LOADS	Moment ft–lbf		Force lbf	
FIXTURE	Nominal	Worst Case Failure	Nominal	Worst Case Failure
H–Fixture	250	250	50	50

Note:

1) Moments are bending and torsional moments.

2) Forces are shear and tensile / compressive forces.

3) Resultant forces and moments can be applied simultaneously in any direction.

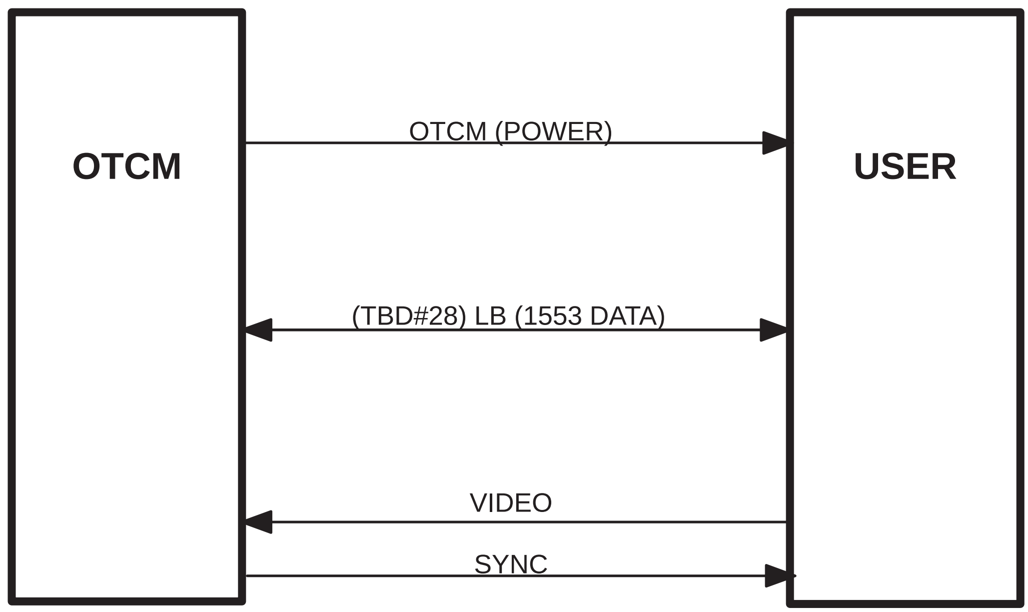


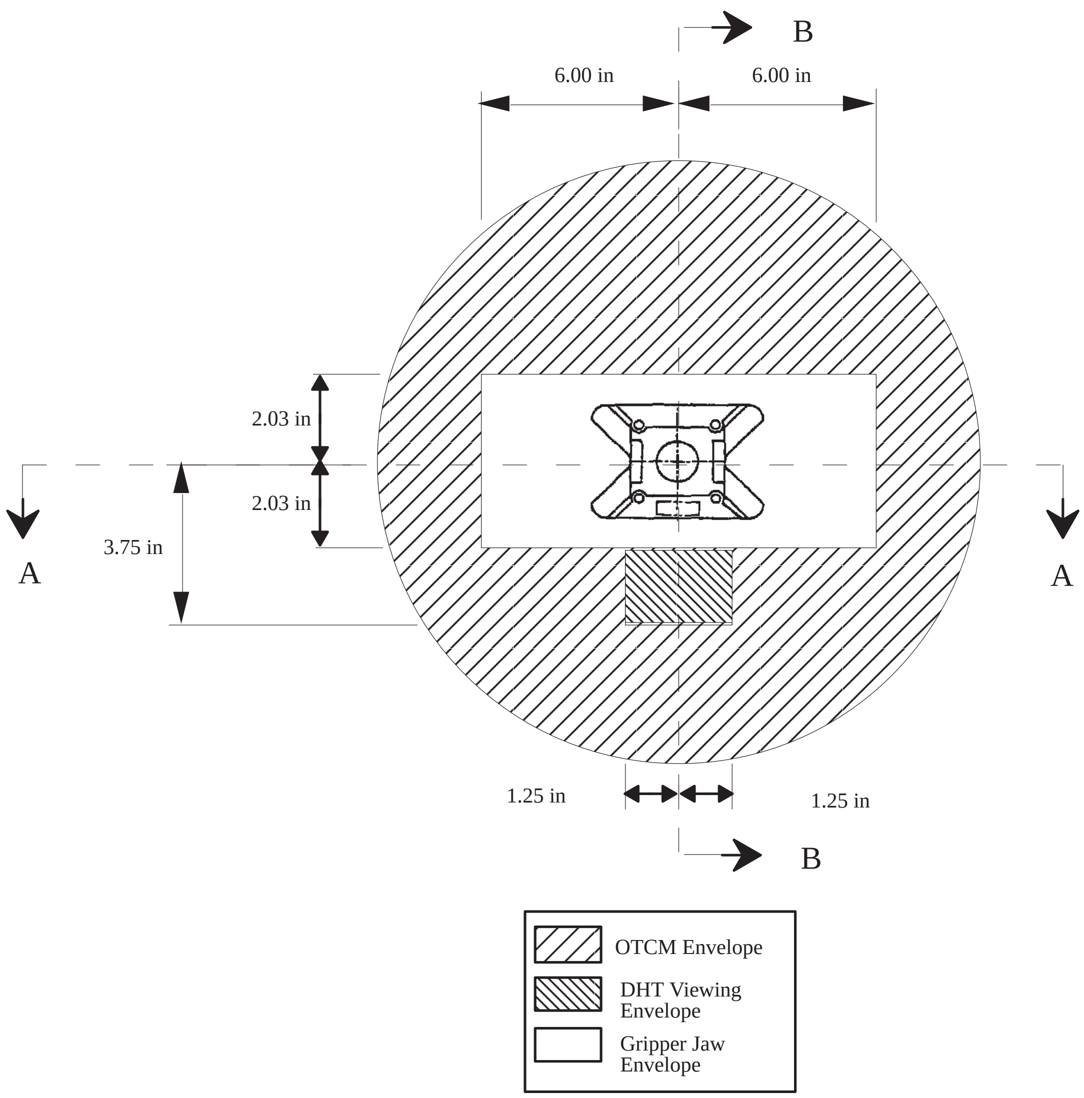
FIGURE C3.2.1.5–1 SPDM OTCM TO USER ELECTRICAL INTERFACES

TABLE C3.2.1.5.1–1 SPDM OTCM TO USER ELECTRICAL INTERFACE PARAMETERS

Circuit Name	INTERFACE V_{range}[1] (volts)	Operating Current (amps)	Overcurrent Protection
OTCM	**(TBD#27)** to 126	0 to (**TBD#27)**	**(TBD#27)**

TABLE C3.2.1.6–1 OTCM DATA RATES FOR SPDM TO USER

Link	MSS Mode[1)]	
	Stationary	Transport
SPDM to User (via OTCM)	2 kbps	NA
User to SPDM (via OTCM)	16 kbps	NA



NOTE: NOT TO SCALE

FIGURE C3.2.1.1.1–1 CLEARANCE ENVELOPE FOR H–FIXTURE (SHEET 1 OF 3)

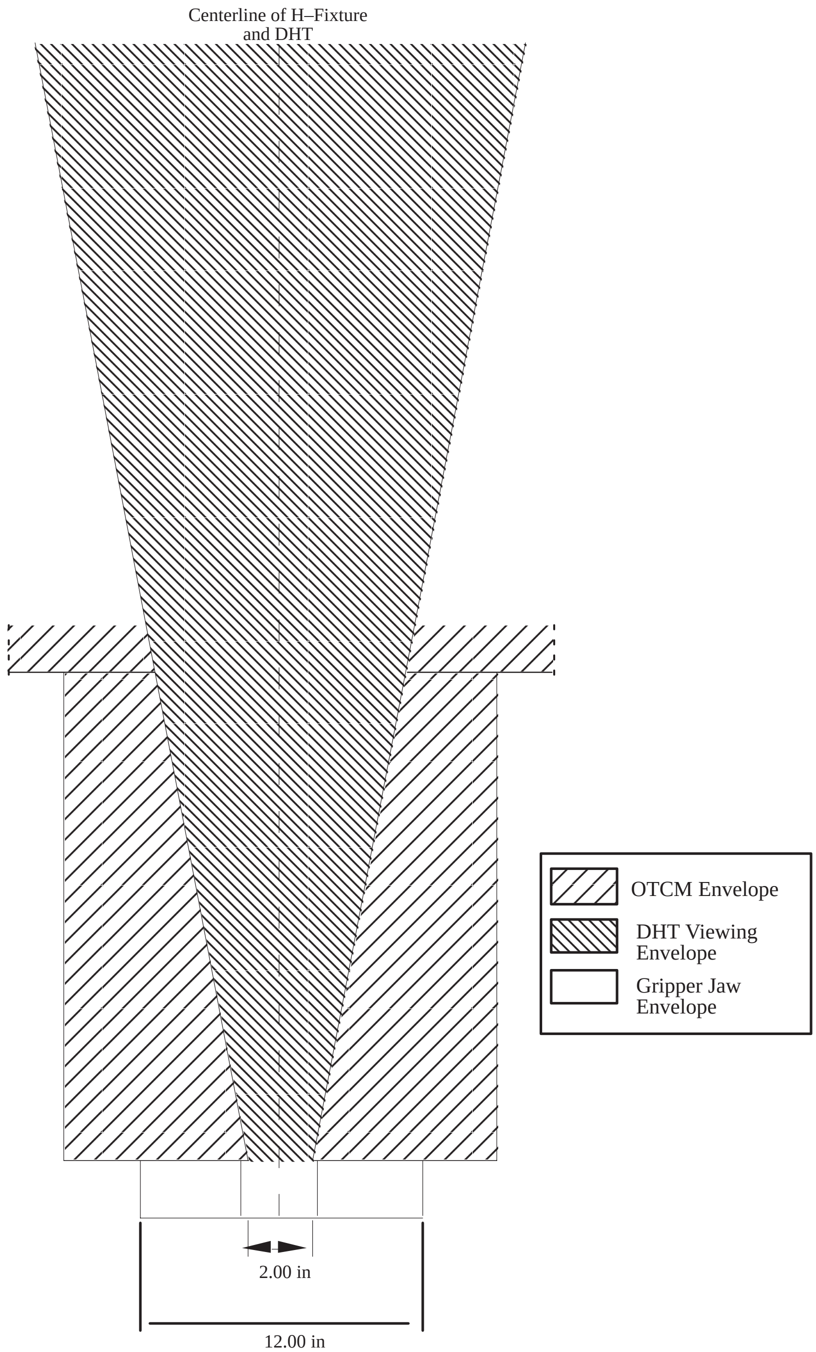
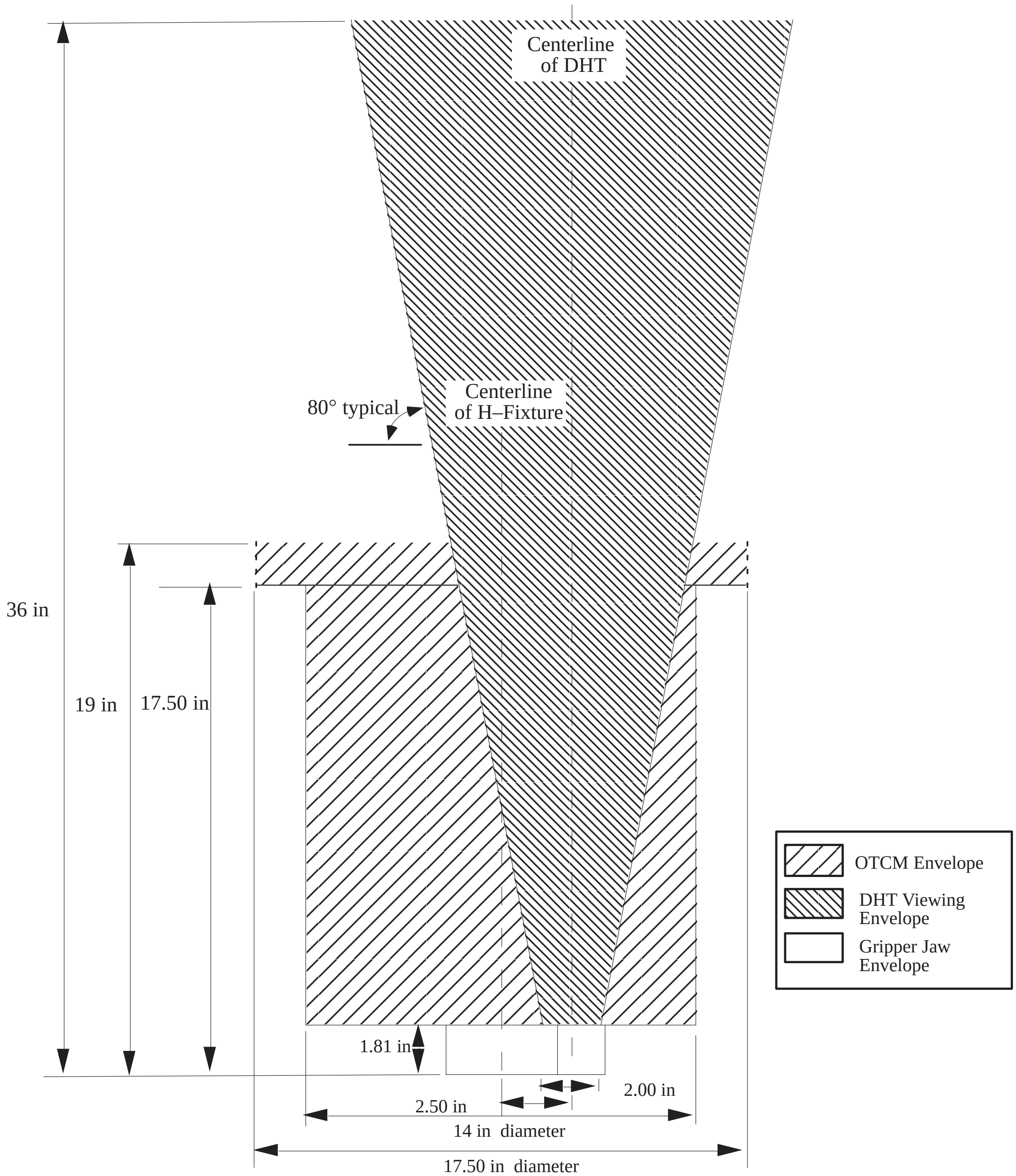
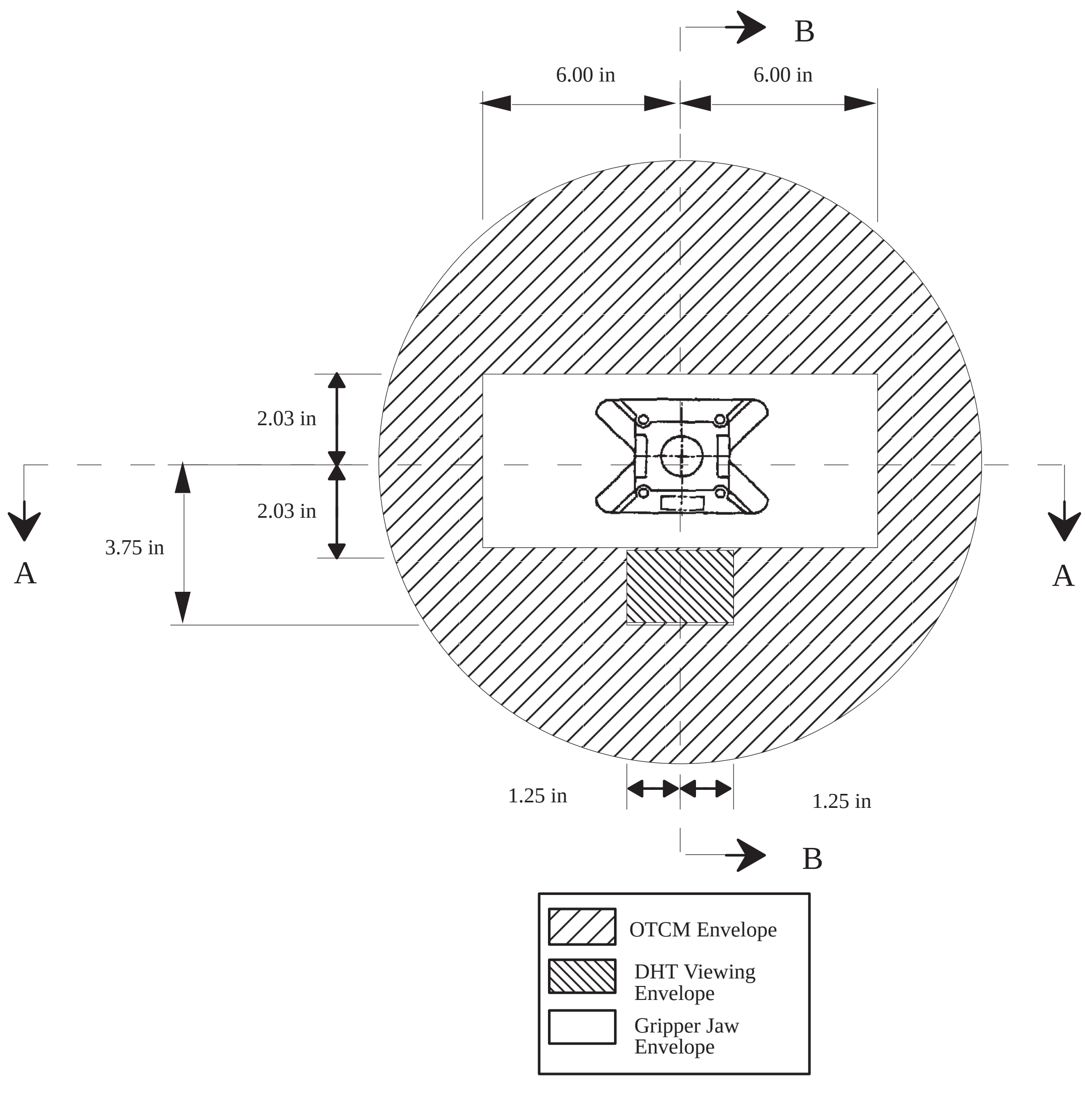


FIGURE C3.2.1.1.2–2 CLEARANCE ENVELOPE FOR MICRO–FIXTURE (SECTION A–A) (SHEET 2 OF 3)



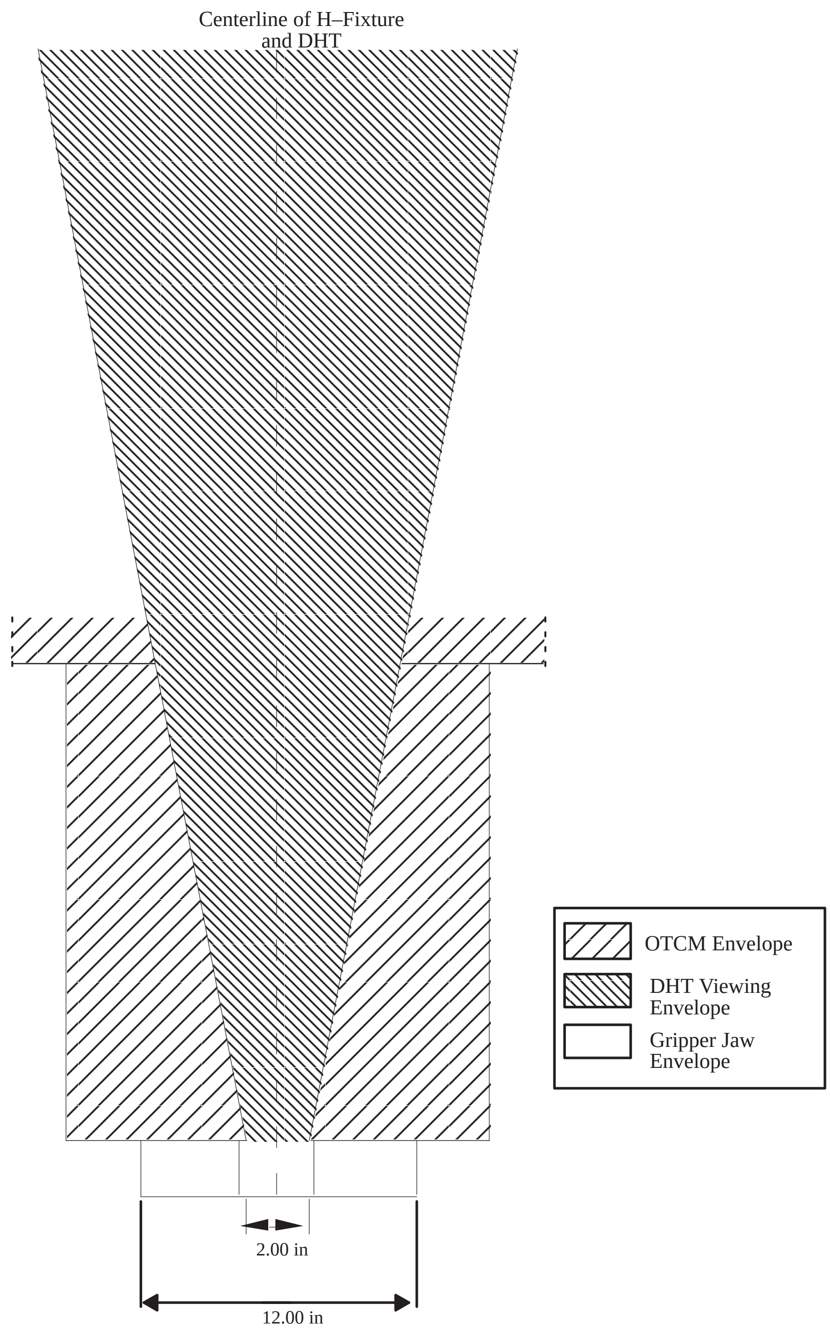
NOTE: NOT TO SCALE

FIGURE C3.2.1.1.1–3 CLEARANCE ENVELOPE FOR H–FIXTURE (SECTION B–B) (SHEET 3 OF 3)



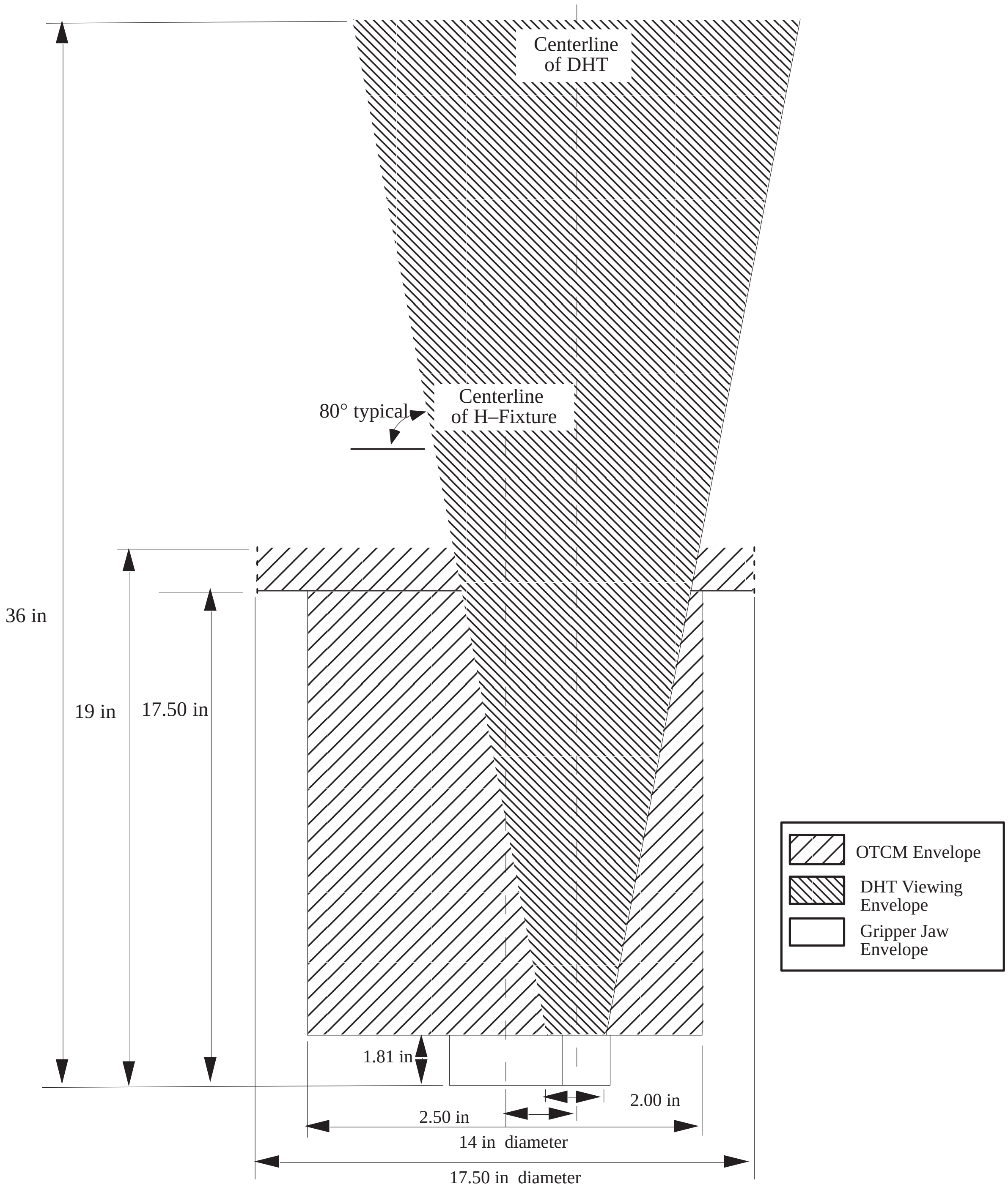
NOTE: NOT TO SCALE

FIGURE C3.2.1.1.2–1 CLEARANCE ENVELOPE FOR MICRO–FIXTURE (SHEET 1 OF 3)



NOTE: NOT TO SCALE

FIGURE C3.2.1.1.1–2 CLEARANCE ENVELOPE FOR H–FIXTURE (SECTION A–A) (SHEET 2 OF 3)



NOTE: NOT TO SCALE

FIGURE C3.2.1.1.2–3 CLEARANCE ENVELOPE FOR MICRO–FIXTURE (SECTION B–B) (SHEET 3 OF 3)

SECTION D3 MICRO CONICAL FITTING TO USER INTERFACES

D3.0 REQUIREMENTS

D3.1 GENERAL

The SPDM reach and manipulation capabilities allow servicing and maintenance of user equipment. The SPDM by itself can interface with user equipment provided with an SDGF as defined in Section C. The OTCM can also grasp a micro conical fitting (MCF) via the Micro Conical (MC) Tool. The MC Tool is carried on the SPDM and can be grasped by the OTCM as required. Visual cues are required to be located in a spatial relationship to the MCF **(TBD#29)**). The visual cues are used in conjunction with the OTCM camera and lights to provide a means of aligning the MC Tool to the MCF prior to grasping the MCF . The MC Tool can apply torque to a standard 7/16 inch bolt head colocated with the MCF. There are no electrical interfaces associated with the MCF to user interface.

D3.1.1 INTERFACE DESCRIPTION

The MC Tool to user interfaces consist of structural, mechanical, and thermal interfaces. The mechanical/structural interface plane defined in this ICD is between the mounting surface of the user and the MCF and MCF visual cues. An interface plane is also defined between the MC Tool socket drive and the Standard 7/16 bolt head (user).

D3.1.1.1 COORDINATE SYSTEMS

The Space Station integrated stage configuration and elements shall be in accordance with the coordinate systems defined SSP 30219, Space Station Reference Coordinate Systems

D3.1.1.1.1 MC TOOL OPERATIONS COORDINATE SYSTEM

The MC Tool Operating Coordinate System is as shown in Figure D3.1.1.1.1–1 **(TBD#30).**

D3.1.1.2 MC TOOL INTERFACE FUNCTIONS

The MC Tool shall:

A. Support structural/mechanical attachment to the user

B. Provide EVA access to interface attachments

C. Provide torque and OTCM axial force to activate bolts and other user mechanisms

D3.1.1.3 USER INTERFACE FUNCTIONS

The user shall:

A. Support structural/mechanical attachment of MCF

B. Provide EVA access to interface attachments and connections

C. Support targets for MC Tool alignment

D. Provide for transmission of torque and axial force where required to activate bolts and other user mechanisms

D3.1.2 INTERFACE RESPONSIBILITIES

The interface hardware responsibilities for the MC Tool and the user shall be as defined in Table D3.1.2–1.

D3.2 INTERFACE REQUIREMENTS

D3.2.1 MCF INTERFACE REQUIREMENTS

D3.2.1.1 ENVELOPES

D3.2.1.1.1 MCF ENVELOPE

The access envelope around each MCF shall be as defined in Figure D3.2.1.1.1–1. This envelope includes the OTCM, MC Tool, and MCF Target.

D3.2.1.1.2 MC TOOL RELEASE ENVELOPE

The clearance envelope around the MC Tool for EVA access to release the MC Tool be as defined in Figure D3.2.1.1.2–1 **(TBD#31).**

D3.2.1.2 MCF MECHANICAL INTERFACE

The MCF shall accommodate holes for the user mounting bolts. The electrical bonding shall be through the MCF. The visual cues shall provide **(TBD#32)** for mounting to the user.

D3.2.1.3 MCF STRUCTURAL INTERFACE

The MCF on orbit loads shall be as defined in Table D3.2.1.3–1. The structural interface between the MCF and the user exists at the mounting plane between the MCF and the user.

Structural loads are transmitted by bolts and other mounting features which penetrate the interface plane. The grasp fixture shall be capable of transmitting the limit loads specified in Table D3.2.1.3–1 without separation or backlash. The grasp fixtures shall be capable of withstanding the stresses induced by the mounting bolts used to attach the MCF to the user equipment when torqued to **(TBD#33)** ft–lbs.

D3.2.1.3.1 IMPACT ENERGY

The MCF shall be capable of withstanding an impact energy of .1 Joules during capture of the user equipment by the MC Tool.

D3.2.1.4 MCF THERMAL CONTROL INTERFACE

The worst case predicted temperatures on the OTCM–side of the MC Tool to user interface, prior to acquiring of an MCF by the MC Tool, shall be between **(TBD#34)**°F and **(TBD#34)**°F. MC Tool to user thermal conductance shall be limited to **(TBD#34)** W/°C maximum.

D3.2.1.5 ENVIRONMENTS

D3.2.1.5.1 ELECTROMAGNETIC EFFECTS

D3.2.1.5.1.1 BONDING

The MCF to user structural/mechanical interface shall meet the requirements of SSP 30245, Space Station Electrical Bonding Requirements.

D3.2.1.5.1.2 ELECTROSTATIC DISCHARGE

The MCF to user interface shall meet the requirements of SSP 30243.

D3.2.1.5.1.3 CORONA

The MCF to user interface shall meet the requirements of SSP 30243.

D3.2.2 USER INTERFACE REQUIREMENTS

D3.2.2.1 ENVELOPES

D3.2.2.1.1 MCF ENVELOPES

The user shall provide an access envelope around each MCF as defined in Figure D3.2.1.1.1–1. This envelope includes the MC Tool, MCF, and visual cues.

D3.2.2.1.2 MC TOOL RELEASE ENVELOPE

The user shall provide a clearance envelope around the MC Tool for EVA access to release the MC Tool as defined in Figure D3.2.1.1.2–1 **(TBD#35)**.

D3.2.2.2 USER MECHANICAL INTERFACE

The user shall provide mounting bolts to mount the grasp fixture. The electrical bonding shall be through the user bolts. The user shall provide the mounting features for the visual cues. If fastener activation is required, the user shall provide 7/16 inch bolt head colocated with the MCF.

D3.2.2.3 USER STRUCTURAL INTERFACE

The user on orbit loads shall be as defined in Table D3.2.1.3–1. The structural interface between the MCF and the user exists at the mounting plane between the MCF and the user. Structural loads are transmitted by bolts and other mounting features which penetrate the interface plane. The user shall be capable of transmitting the limit loads specified in Table D3.2.1.3–1 without separation or backlash. The user shall be capable of withstanding the stresses induced by the mounting bolts used to attach the MCF to the user equipment when torqued to **(TBD#36)** ft–lbs.

D3.2.2.3.1 IMPACT ENERGY

The user shall be capable of withstanding an impact energy of .1 Joules during capture of the user equipment by the MC Tool.

D3.2.2.4 USER THERMAL CONTROL INTERFACE

The worst case predicted temperatures on the user–side of the MC Tool to user interface, prior to acquiring of an MCF by the MC Tool shall be between **(TBD#37)**°F and **(TBD#37)**°F. MC Tool to user thermal conductance shall be limited to **(TBD#37)** W/°C maximum.

D3.2.2.5 ENVIRONMENTS

D3.2.2.5.1 ELECTROMAGNETIC EFFECTS

D3.2.2.5.1.1 BONDING

The MCF to user structural/mechanical interface shall meet the requirements of SSP 30245, Space Station Electrical Bonding Requirements.

D3.2.2.5.1.2 ELECTROSTATIC DISCHARGE

The MCF to user interface shall meet the requirements of SSP 30243.

D3.2.2.5.1.3 CORONA

The MCF to user interface shall meet the requirements of SSP 30243.

TABLE D3.1.2–1 MCF TO USER INTERFACE RESPONSIBILITIES

MC Tool Interface Compnents	NASA	CSA	User
MC Tool	X		
MCF	X		
Visual Cues	**(TBD#38)**	**(TBD#38)**	**(TBD#38)**
MCF Mounting Bolts & Standard Bolt Head			X
OTCM		X	

MCF IS DESIGNED, DEVELOPED AND VERIFIED BY NASA

TABLE D3.2.1.3–1 MCF TO USER STRUCTURAL LOADS

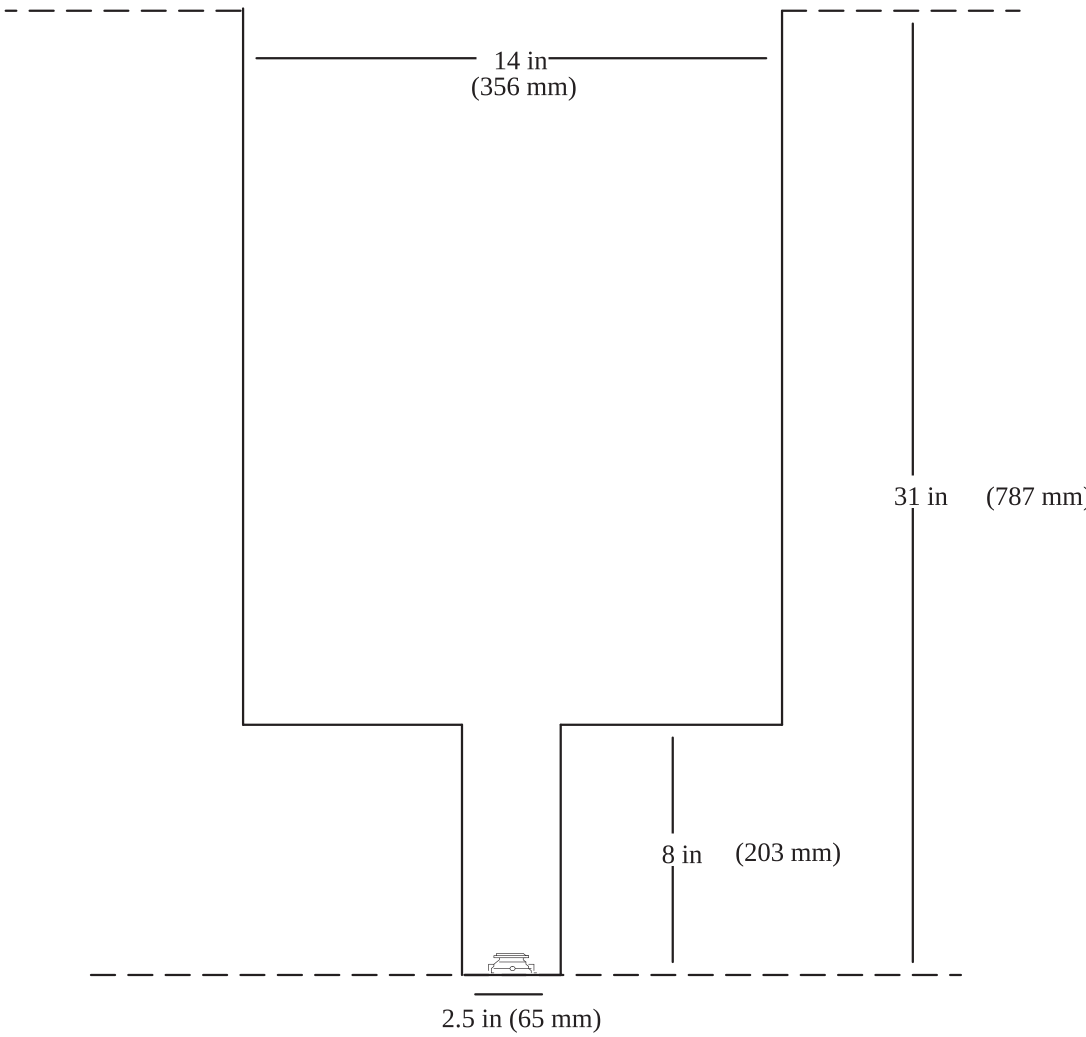
Loads	Moment FT–LBF	Force LBF
MCF	125	50

Note:

1) Moments are bending and torsional moments.

2) Forces are shear and tensile forces.

3) Resultant forces and moments can be applied simultaneously in any direction.



Notes:
1) Clearance volume centered on centerline of MCF
2) Clearances required beyond 31” (787 mm) from attachmanet plane will be dependent on the user and the required SPDM configuration.
3) The MCF visual cues mounting orientation on the user will be determined by the operational task and the required viewing reference for the operator
4) Encroachment into this envelope by waiver only.

FIGURE D3.2.1.1.1–1 USER APPROACH ENVELOPE FOR MC TOOL

SECTION E3 SPDM OTP TO USER INTERFACES

E3.0 REQUIREMENTS

E3.1 GENERAL

The SPDM provides an ORU/Tool Platform (OTP) for temporary storage of user payloads. A Common Structural Interface (CSI) device is used at the OTP for the user interface. The OTP provides a structural and mechanical interface with the passive CSI and is the interface defined in this ICD. The user will interface with the active CSI as defined in SSP 50194, CHIA to User ICD.

E3.1.1 INTERFACE DESCRIPTION

The OTP to CSI interfaces consist of structural, mechanical, and thermal interfaces. The structural, mechanical, and thermal interface is between the OTP and the passive CSI as shown in Figure E3.1.1–1.

E3.1.1.1 COORDINATE SYSTEMS

The coordinate system shall be in accordance with the coordinate systems defined SSP 30219, Space Station Reference Coordinate Systems.

E3.1.1.1.1 OTP OPERATING COORDINATE SYSTEM

The OTP Operating Coordinate System (OTP OCS) is as shown in Figure E3.1.1.1.1–1 **(TBD#39).**

E3.1.1.2 OTP INTERFACE FUNCTIONS

The OTP shall:

A. Support structural/mechanical attachment to the passive CSI

B. Provide EVA access to interface attachments

C. Provide a CSI envelope

E3.1.1.3 CSI INTERFACE FUNCTIONS

The CSI shall:

A. Support structural/mechanical attachment

B. Provide EVA access to interface attachments and connections

E3.1.2 INTERFACE RESPONSIBILITIES

The interface hardware responsibilities for the OTP and the CSI shall be as defined in Table E3.1.2–1.

E3.2 INTERFACE REQUIREMENTS

E3.2.1 OTP INTERFACE REQUIREMENTS

E3.2.1.1 ENVELOPES

The OTP shall provide a 12” x 12” x **(TBD#40)** envelope for the passive CSI.

E3.2.1.1.1 OTP ENVELOPE

DELETED

E3.2.1.1.2 OTP PASSIVE CSI RELEASE ENVELOPE

DELETED

E3.2.1.2 OTP MECHANICAL INTERFACE

The OTP shall interface to the passive half of the CSI. The OTP shall provide a bolt hole pattern for the passive CSI to interface with as defined in Figure E3.2.1.2–1. **(TBD #44)**

E3.2.1.3 OTP STRUCTURAL INTERFACE

The OTP to passive CSI shall sustain a maximum of 500 lbf and 1000 ft–lbf loads measured at the center of the CSI during on–orbit transport of the SPDM. The maximum on on–orbit loads at the OTP to passive CSI platform with the active CSI attached to the passive CSI shall be 50 lbf and 125 ft–lbf moment during normal berthing or deberthing of ORUs to the active CSI. The OTP to passive CSI interface shall withstand the launch induced loads as defined in **(TBD#41).**

E3.2.1.3.1 IMPACT ENERGY

The OTP to passive CSI interface shall be capable of withstanding an impact energy of 0.1 joules when the SPDM is attaching the active CSI to the passive CSI.

E3.2.1.4 OTP THERMAL CONTROL INTERFACE

The worst case predicted temperatures on the OTP–side of the OTP to passive CSI interface shall be between **(TBD#42)** °F and **(TBD#42)** °F. OTP to user thermal conductance shall be limited to **(TBD#42)** W/°C maximum.

E3.2.1.5 ENVIRONMENTS

E3.2.1.5.1 ELECTROMAGNETIC EFFECTS

E3.2.1.5.1.1 BONDING

The OTP to passive CSI structural/mechanical interface shall meet the requirements of SSP 30245, Space Station Electrical Bonding Requirements.

E3.2.1.5.1.2 ELECTROSTATIC DISCHARGE

The OTP to passive CSI interface shall meet the requirements of SSP 30243.

E3.2.1.5.1.3 CORONA

The OTP to passive CSI interface shall meet the requirements of SSP 30243.

E3.2.2 PASSIVE CSI INTERFACE REQUIREMENTS

E3.2.2.1 ENVELOPES

The maximum envelope for the passive CSI shall be **12”** x **12”** x **(TBD#43).**

E3.2.2.1.1 OTP ENVELOPES

DELETED

E3.2.2.1.2 OTP RELEASE ENVELOPE

DELETED

E3.2.2.2 PASSIVE CSI MECHANICAL INTERFACE

The passive CSI shall interface to the OTP. The passive CSI shall provide the bolts for OTP to interface with as defined in Figure E3.2.1.2–1 **(TBD#44)**.

E3.2.2.3 PASSIVE CSI STRUCTURAL INTERFACE

The OTP to passive CSI shall sustain a maximum of 500 lbf and 1000 ft–lbf loads measured at the center of the CSI during on–orbit transport of the SPDM. The maximum on on–orbit loads at the OTP to passive CSI platform with the active CSI attached to the passive CSI shall be 50 lbf and 125 ft–lbf moment during normal berthing or deberthing of ORUs to the active CSI. The OTP to passive CSI interface shall withstand the launch induced loads as defined in **(TBD#45)**.

E3.2.2.3.1 IMPACT ENERGY

The passive CSI to OTP interface shall be capable of withstanding an impact energy of 0.1 joule when the SPDM is attaching the active CSI to the passive CSI.

E3.2.2.4 PASSIVE CSI THERMAL CONTROL INTERFACE

The worst case predicted temperatures on the passive CSI of the OTP to user interface shall be between **(TBD#46)**°F and **(TBD#46)**°F. Passive CSI to OTP thermal conductance shall be limited to **(TBD#46)** W/°F maximum.

E3.2.2.5 ENVIRONMENTS

E3.2.2.5.1 ELECTROMAGNETIC EFFECTS

E3.2.2.5.1.1 BONDING

The OTP to passive CSI structural/mechanical interface shall meet the requirements of SSP 30245, Space Station Electrical Bonding Requirements.

E3.2.2.5.1.2 ELECTROSTATIC DISCHARGE

The OTP to passive CSI interface shall meet the requirements of SSP 30243.

E3.2.2.5.1.3 CORONA

The OTP to passive CSI interface shall meet the requirements of SSP 30243.

TABLE E3.1.2–1 OTP TO CSI INTERFACE RESPONSIBILITIES

OTP Interface Components	NASA	CSA
OTP		X
OTP bolt pattern and fastener for passive CSI bolts		X
Passive CSI Half	X	
Passive CSI mounting bolts	X	
Active CSI Half	X	

Note : Passive half of CSI is bolted onto the OTP.

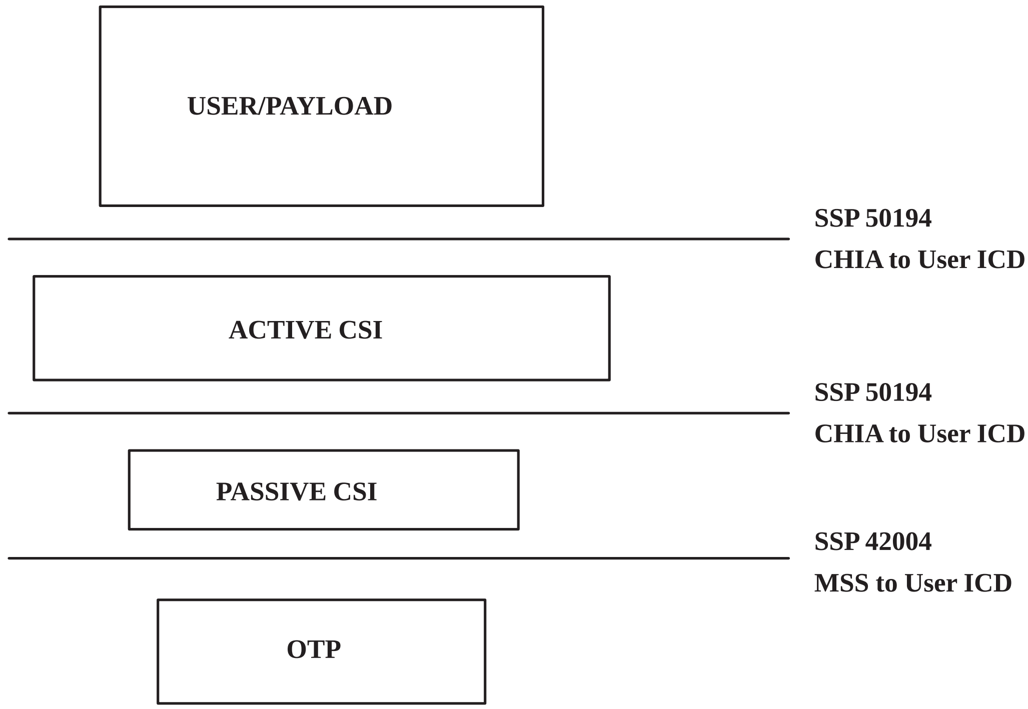


FIGURE E3.1.1–1 OTP/PASSIVE CSI INTERFACE PLANE

SECTION F3 SPDM TO USER TOOL HOLSTER INTERFACES

F3.0 REQUIREMENTS

F3.1 GENERAL

The SPDM carries several grasping and manipulating attachments as part of its normal equipment. These attachments are known as the SPDM Standard Tools. Each tool is carried in a holster from which it is grasped by the OTCM and subsequently removed or replaced, as required. Each holster is specific to the tool it carries. However, there is a standard interface between the holster and the SPDM as defined below.

F3.1.1 INTERFACE DESCRIPTION

The SPDM to tool holster interfaces consist of structural, mechanical, and thermal interfaces.

F3.1.1.1 COORDINATE SYSTEMS

The Space Station integrated stage configuration and elements shall be in accordance with the coordinate systems defined SSP 30219, Space Station Reference Coordinate Systems

F3.1.1.1.1 SPDM OPERATIONS COORDINATE SYSTEM

The SPDM Operating Coordinate System (SPDM OCS) is as shown in Figure F3.1.1.1.1–1 **(TBD#47).**

F3.1.1.2 SPDM INTERFACE FUNCTIONS

The SPDM shall:

A. Support structural/mechanical attachment to the tool holster

F3.1.1.3 USER INTERFACE FUNCTIONS

The tool holster shall:

A. Support structural/mechanical attachment of SPDM

F3.1.2 INTERFACE RESPONSIBILITIES

The interface hardware responsibilities for the SPDM and the tool holster shall be as defined in Table F3.1.2–1.

F3.2 INTERFACE REQUIREMENTS

F3.2.1 SPDM INTERFACE REQUIREMENTS

F3.2.1.1 ENVELOPES

F3.2.1.1.1 SPDM ENVELOPE

The SPDM shall provide an access envelope to grasp the tools within the tool holsters.

F3.2.1.1.2 SPDM RELEASE ENVELOPE

The SPDM shall provide a clearance envelope around the tool holsters for EVA access to release the tool within the tool holster as defined in Figure F3.2.1.1.2–1 **(TBD#48).**

F3.2.1.2 SPDM MECHANICAL INTERFACE

The SPDM shall interface to the tool holster with a bolt hole pattern.

F3.2.1.3 SPDM STRUCTURAL INTERFACE

The SPDM shall support the loads to the holster interface planes as defined in Table F3.2.1.3–1 **(TBD#49).**

F3.2.1.4 SPDM THERMAL CONTROL INTERFACE

The worst case predicted temperatures on the SPDM –side of the SPDM to tool holster interface shall be between **(TBD#50)**°F and **(TBD#50)**°F. SPDM to tool holster thermal conductance shall be limited to **(TBD#50)** W/°C maximum.

F3.2.1.5 ENVIRONMENTS

F3.2.1.5.1 ELECTROMAGNETIC EFFECTS

F3.2.1.5.1.1 BONDING

The SPDM to tool holster structural/mechanical interface shall meet the requirements of SSP 30245, Space Station Electrical Bonding Requirements.

F3.2.1.5.1.2 ELECTROSTATIC DISCHARGE

The SPDM to tool holster interface shall meet the requirements of SSP 30243.

F3.2.1.5.1.3 CORONA

The SPDM to tool holster interface shall meet the requirements of SSP 30243.

F3.2.2 TOOL HOLSTER INTERFACE REQUIREMENTS

F3.2.2.1 ENVELOPES

F3.2.2.1.1 SPDM ENVELOPES

The tool holster shall provide a clearance envelope around the tool for EVA access to release the tool within the tool holster as defined in Figure F3.2.1.1.2–1 **(TBD#51).**

F3.2.2.2 TOOL HOLSTER MECHANICAL INTERFACE

The tool holster shall interface to the SPDM with interface bolts. The electrical bonding shall be through the tool holster fasteners.

F3.2.2.3 TOOL HOLSTER STRUCTURAL INTERFACE

The tool holster shall support the loads to the SPDM interface planes as defined in Table F3.2.2.3–1 **(TBD#52).**

F3.2.2.4 TOOL HOLSTER THERMAL CONTROL INTERFACE

The worst case predicted temperatures on the tool holster–side of the SPDM to tool holster interface, prior to acquiring of an SPDM by the tool holster, shall be between **(TBD#53)**°F and **(TBD#53)**°F. Tool holster to SPDM thermal conductance shall be limited to **(TBD#53)** W/°C maximum.

F3.2.2.5 ENVIRONMENTS

F3.2.2.5.1 ELECTROMAGNETIC EFFECTS

F3.2.2.5.1.1 BONDING

The SPDM to tool holster structural/mechanical interface shall meet the requirements of SSP 30245, Space Station Electrical Bonding Requirements.

F3.2.2.5.1.2 ELECTROSTATIC DISCHARGE

The SPDM to tool holster interface shall meet the requirements of SSP 30243.

F3.2.2.5.1.3 CORONA

The SPDM to tool holster interface shall meet the requirements of SSP 30243.

TABLE F3.1.2–1 SPDM TO TOOL HOLSTER INTERFACE RESPONSIBILITIES

SPDM INTERFACE COMPONENT	NASA	CSA	TOOL PROVIDER
SPDM		X	
Tool Holster			X

SECTION G SPDM TOOLS AND USER INTERFACES

G3.0 REQUIREMENTS

(TBD#54)

G3.1 SOCKET EXTENSION TOOL TO USER

(TBD#55)

G3.2 SPDM TO OFFSET TOOL

(TBD#56)

G3.3 OTHER TOOLS

(TBD#57)

SECTION H RESERVED

RESERVED

SECTION I FLIGHT RELEASEABLE GRAPPLE FIXTURE TO USER INTERFACES

I3.0 REQUIREMENTS

I3.1 GENERAL

NSTS Flight Releasable Grapple Fixtures (FRGF) are mounted on users to allow their manipulation by the LEEs associated with the SSRMS, the MBS POA, and the SPDM and by the NSTS SRMS. The NSTS Electrical Flight Grapple Fixture (EFGF) is not compatible with the LEE

I3.1.1 INTERFACE DESCRIPTION

The FRGF's will interface with the user via mechanical attachments. The mechanical and structural interface plane is at the mounting plane of the FRGF. The Interface Plane is shown in Figure I3.1.1–1.

I3.1.2 COORDINATE SYSTEMS

The LEE Coordinate System is defined in Figure A3.1.2–2. The FRGF Coordinate System is defined in Figure I3.1.2–1.

I3.1.3 FRGF INTERFACE FUNCTIONS

The FRGF shall :

A. Support mechanical/structural attachment to the user

B. Provide EVA access to FRGF Release Mechanism

I3.1.4 USER INTERFACE FUNCTIONS

The user shall :

A. Support mechanical/structural attachment to the FRGF

B. Provide EVA access to FRGF Release Mechanism.

I3.1.5 INTERFACE RESPONSIBILITIES

The interface hardware responsibilities for the FRGF and the user will be as defined in Table I3.1.5–1.

I3.2 INTERFACE REQUIREMENTS

I3.2.1 FRGF INTERFACE REQUIREMENTS

I3.2.1.1 FRGF ENVELOPES

a) The FRGF shall provide the capability to EVA install and release the FRGF pin.

b) The EVA maintenance and approach envelopes around the FRGF are defined in Section A3.2.2.1.

I3.2.1.2 FRGF MECHANICAL INTERFACE

a) The FRGF to user mechanical interfaces shall be as defined in NSTS–21000–IDD–ISS (Shuttle Orbiter/International Space Station Cargo Standard Interfaces), section 14.4.1.5, Dimensional Fit.

b) The FRGF pin install and release mechanism shall comply with SSP 50005, International Space Station Flight Crew Integration Standard.

I3.2.1.3 FRGF STRUCTURAL INTERFACE

The FRGF to User structural interface loads shall be as defined in NSTS–21000–IDD–ISS, section 14.4.5.1.

I3.2.1.3.1 IMPACT LOADS

During capture of a user payload by the SSRMS/SPDM or berthing a user payload on the POA, the impact load to the FRGF shall be as defined in NSTS–21000–IDD–ISS, section 14.4.1.6.

I3.2.1.3.2 FRGF WEIGHT

The weight of the FRGF shall not exceed 28 lbs. (62 kg.).

I3.2.1.4 PASSIVE THERMAL INTERFACE

The FRGF to user thermal interfaces shall be as defined in NSTS–21000–IDD–ISS, section 14.4.7.

I3.2.1.5 ENVIRONMENTS

I3.2.1.5.1 BONDING

The FRGF to user structural/mechanical bonding interface shall be as defined in NSTS–21000–IDD–ISS, section 14.4.6.

I3.2.2 USER INTERFACE REQUIREMENTS

I3.2.2.1 USER ENVELOPES

Depending on how the user is being manipulated, the following envelopes apply.

a) The user shall accommodate the SSRMS LEE approach envelope around the FRGF for static mode of operation as defined in Figure A3.2.2.1–1.

b) The user shall accommodate the SSRMS LEE approach envelope around the FRGF for dynamic mode of operation (moving payload such as NSTS) as defined in Figure A3.2.2.1–2.

c) The user shall accommodate the POA approach envelope around the FRGF as defined in Figure A3.2.2.1–3.

d) The user shall accommodate the SPDM LEE approach envelope around the FRGF as defined in Figure **TBD**.

e) The EVA maintenance envelope around the FRGF shall be as defined in SSP 50005, section 14.3.2.3.1.

I3.2.2.2 USER MECHANICAL INTERFACE

a) The user to FRGF mechanical interfaces shall be as defined in NSTS–21000–IDD–ISS, section 14.4.1.5.

b) The user to FRGF mounting requirements shall be as defined in NSTS–21000–IDD–ISS, section 14.4.3.

I3.2.2.3 USER STRUCTURAL INTERFACE

The FRGF to user interface shall meet all performance requirements while being subject to the MBS POA and SSRMS Tip loads as defined in NSTS–21000–IDD–ISS, section 14.4.5.1.

I3.2.2.3.1 IMPACT LOADS

During capture of a user payload by the SSRMS or berthing a user payload on the POA, the impact load to the user FRGF shall be as defined in NSTS–21000–IDD–ISS, section 14.4.1.6.

I3.2.2.3.2 USER STIFFNESS REQUIREMENTS

The user shall provide a stiffness at the interface that maintains a fundamental structural frequency as defined in NSTS–21000_IDD–ISS, section 14.4.5.2.

I3.2.2.4 PASSIVE THERMAL INTERFACE

I3.2.2.4.1 FRGF THERMAL CONDUCTANCE

The user to FRGF thermal interfaces shall be as defined in NSTS–21000–IDD–ISS, section 14.4.7.

I3.2.2.5 ENVIRONMENTS

I3.2.2.5.1 BONDING

The user to FRGF structural/mechanical bonding shall be as defined in NSTS–21000–IDD–ISS, section 14.4.6.

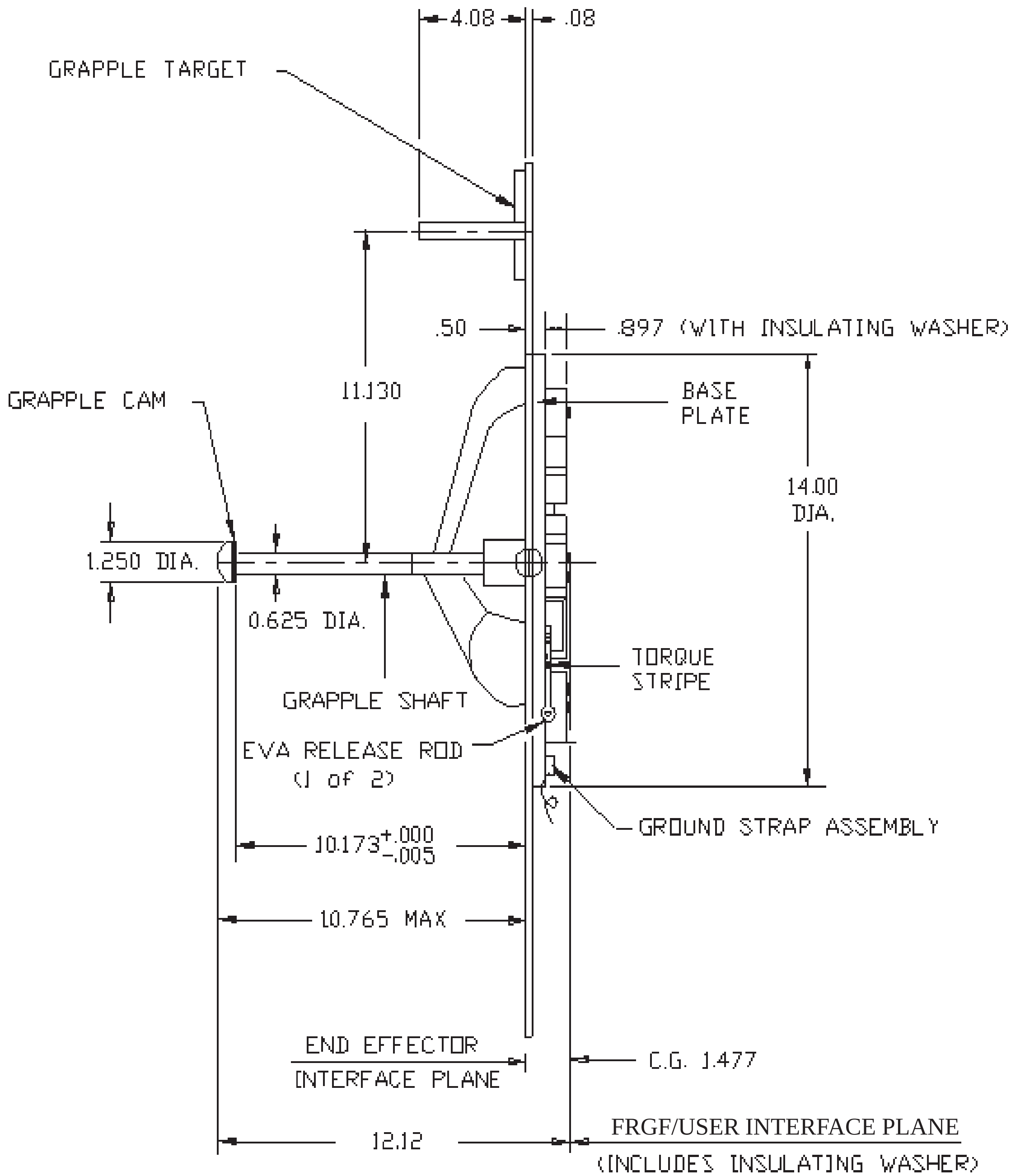


FIGURE I3.1.1–1 FRGF TO USER INTERFACE PLANE

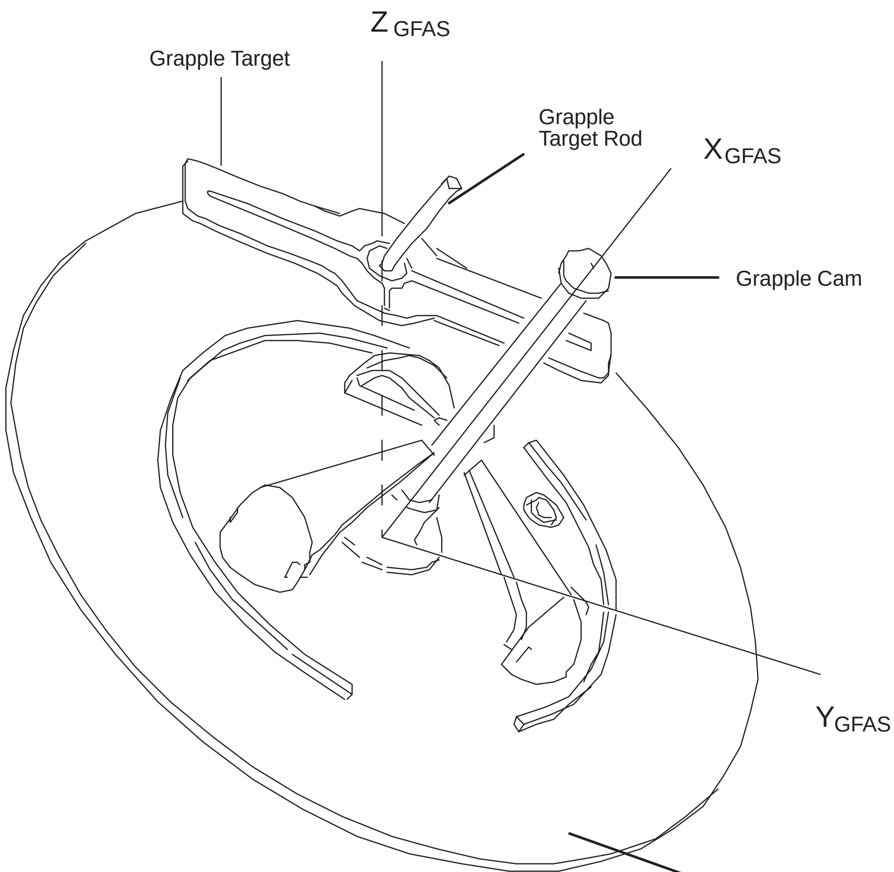


FIGURE I3.1.2–1 FRGF COORDINATE SYSTEM

TABLE I3.1.5–1 FRGF TO USER INTERFACE HARDWARE RESPONSIBILITY

FRGF/User Interface Hardware Responsibilities[1]	NASA/User Hardware	CSA Hardware
SSRMS LEE		X
SPDM LEE		X
MBS POA LEE		X
FRGF (including thermal isolators)	X	
FRGF bolt hole pattern and mounting bolts	X	

Note:

1) FRGFs are supplied by NASA to users as GFE. FRGF bolts are the responsibility of the user.

SECTION J RESERVED

RESERVED

SECTION K RESERVED

RESERVED

SECTION L RESERVED

RESERVED

SECTION M RESERVED

RESERVED

APPENDIX A TABLE OF CONTENTS

FIGURES

TABLES

APPENDIX A SOFTWARE INTERFACE DEFINITION BETWEEN THE CONTROL ELECTRONICS UNIT AND ISS PAYLOADS ATTACHED TO MSS ELEMENTS

1.0 INTRODUCTION

1.1 PURPOSE & SCOPE

The purpose of this document is to provide definition of the software interface requirements between the Mobile Servicing System (MSS) Robotics Workstation (RWS) Control Electronics Unit (CEU) Configuration Item and International Space Station (ISS) payloads attached to MSS elements. The scope of this document is limited to the software interfaces between CEU and ISS payloads, elements, and devices attached to the MSS. This document does not address software interfaces between the Special Purpose Dexterous Manipulator (SPDM) and ISS payloads, elements, and devices attached directly to the SPDM.

1.2 PRECEDENCE

In the event of conflict between SSP 41167, MSS Segment Specification, and the contents of this Interface Control Document (ICD), the requirements of the MSS Segment Specification shall take precedence.

1.3 RESPONSIBILITY AND CHANGE AUTHORITY

This document is prepared and maintained in accordance with SSP 30459, International Space Station Interface Control Plan.

1.4 SYSTEM DESCRIPTION

1.4.1 MOBILE SERVICING SYSTEM (MSS)

The MSS comprises the Space Station Remote Manipulator System (SSRMS), the Special Purpose Dexterous Manipulator (SPDM), the Mobile Remote Servicer Base System (MBS), the Artificial Vision Unit (AVU) and any attached payloads. The Robotics Workstation (RWS) Control Electronics Unit (CEU) interfaces with the payloads attached to the MSS to allow commanding and monitoring of these components. This document describes the CEU to MSS Payload software interface.

1.4.2 MOBILE SERVICING SYSTEM (MSS) PAYLOAD

The MSS provides the capability for a MIL–STD–1553 command and monitoring interface to payloads attached to MSS elements. These payloads may be either core systems and elements requiring data services during installation or transport, or actual ISS payloads providing science data to the crew and ground. The capabilities provided for MSS Payloads differ from services available to normal ISS payloads, as described within this document. This document identifies the capabilities and constraints for interfacing with the RWS CEU as an MSS Payload.

2.0 DOCUMENTS

2.1 APPLICABLE DOCUMENTS

The following documents of the exact date and revision shown form a part of this ICD to the extent specified herein.

DOCUMENT NO.	TITLE
MIL–STD–1553B Rev B, Notice 2 8 Sep 86	Digital Time Division Command/Response Multiplex Databus
D684–10018–1 Rev. A Nov. 11, 1994	International Space Station Alpha United States On–Orbit Segment Prime Contractor Interface Control Plan Interface Control Document
D684–10056–1 Rev. A July 29, 1994	International Space Station Alpha Prime Contractor Software Standards and Procedures Specification
SSP 30459 Rev G, R1 29 Aug 94	International Space Station Interface Control Plan
SSP 41175–2 Rev A May 1, 1996	Software Interface Control Document Part I Station Management and Control to International Space Station Book 2, General Software Requirements
SPAR–SS–ICD–1148 Issue E March 1996	MSS Local Busses Interface Control Document

3.0 MSS PAYLOAD INTERFACE

3.1 INTERFACE FUNCTIONS

There are two Mobile Servicing System (MSS) Robotics Workstation (RWSs) on orbit; one in the USL, and one in the Cupola. Each RWS contains a Control Electronics Unit (CEU), which provides command and monitor capability to all MSS elements. The CEU is a remote terminal to the Command and Control (C&C) Multiplexer–Demultiplexer (MDM) on either the International Space Station (ISS) CB EXT–1 or CB EXT–2 data bus.

The MSS provides a command and monitoring interface capability for MSS Payloads. These payloads may be either core systems and elements requiring data services during installation or transport, or actual ISS payloads providing science data to the crew and ground. The Space Station Remote Manipulator System (SSRMS) and the Mobile Remote Servicer Base System (MBS) provide the MSS physical connection to the MSS Payload. The CEU provides the logical interface to the MSS Payload.

The system interface in Figure 3.1–1 defines the data connectivity among the C&C MDM, RWS CEU, and MSS Payloads.

3.1.1 INITIALIZATION

Initialization of the MSS Payload requires setting up the MSS Payload data paths through the CEU and C&C MDM.

The C&C MDM will receive a command from the operator to begin polling the CEU for MSS Payload data. Additionally, the C&C MDM will receive a command to define the routing required for this data. Presently, only two paths have been defined:
1) Route Science Power Platform data to Service Module Central Computer
2) Collect Attached Pressurized Module Heater Control Unit data and route as a preemptive Housekeeping packet.
Implementation of other MSS Payload routing paths will require modification to the C&C MDM software.

The CEU will receive a Payloads_Data_Acq_Profile command (defined in SSP 41175–10) from the operator defining the MSS Payload Remote Terminal (RT) address and subaddress to be polled for MSS Payload status data (up to a maximum of three RTs, due to the limitation of the CEU–C&C MDM MSS Payload status boxcar allocation). The parameter values in this command are defined by the configuration and requirements of the MSS Payload. MSS Payload RT addresses are constrained to 2, 4, 7, and 21 on the MSS LB and MSS PDGF LB; for MSS Payloads attached to the MCAS data interface, the RT address will be 21. Upon receipt of this command, the CEU will begin polling the requested MSS Payload(s). Additionally, the CEU will provide a point–to–point sync at 10 Hz if requested. The point–to–point sync should be requested only once per payload, regardless of the number of boxcars being polled.

The MSS Payload will receive a command to be defined by the MSS Payload to begin data transfer to the CEU. The MSS Payload will provide data in the subaddress(es) as defined in the

Payloads_Data_Acq_Profile command(s) to the CEU. The MSS Payload initialization will not require any special commands or interfaces directly from the CEU to the MSS Payload.

The MSS Payload Power–On Self Test (POST) results, if provided, can be made available for telemetry, either as standard cyclic status data or in separate subaddresses. The POST results can be retrieved by cyclically polling these subaddresses.

3.1.2 REMOTE TERMINAL CAPABILITIES

3.1.2.1 SUBADDRESS UTILIZATION

To support MSS Payloads, a certain level of flexibility is required for the interface. Some of the MSS Payloads are only temporarily attached to the MSS; additional configurations for MSS Payloads may require interfaces with either the payload or core MIL–STD–1553 data system. Since the MSS Payload interface is primarily a temporary interface, the flexibility has been driven into this interface. The CEU must provide the capability to configure the standard command transfer subaddresses and the cyclic status data transfer subaddresses based on input from the crew or ground, based on the configuration of the specific payload.

a. The CEU shall configure the standard command transfer subaddresses and the cyclic status data transfer subaddresses for a specific Remote Terminal address, as commanded by the crew or ground.
b. The CEU and MSS Payload shall implement the MIL–STD–1553 subaddresses in accordance with Table 3.1.2.1–1. Auto–indexing is not implemented for this interface.
c. The MSS Payload shall define separate subaddresses for the standard command transfer (2 contiguous subaddresses) and the cyclic status data transfer (maximum of 3 subaddresses; not required to be contiguous).

3.1.3 GENERAL INTERFACE REQUIREMENTS

A block diagram of the CEU to MSS Payload interface is shown in Figure 3.1.3–1.

3.1.3.1 STANDARD COMMAND TRANSFERS

Standard commands are sent to MSS Payloads by the CEU. The commands are CCSDS packets and are composed of 64 words with unused words zero–filled. Each MSS Payload command is only sent once by the CEU. The CEU will increment the bus counter on the appropriate bus if a MIL–STD–1553 bus error is detected on the MSS payload command transfer.

The MSS Payload will provide status data in MSS Payload Cyclic Status to the operator to determine if the command has been properly executed. It is the responsibility of the operator to resend the command if the status data indicates the command has not been executed. The MSS Payload shall be able to reject a duplicate command.

CCSDS command sources include any PCS, the CCS, and ground control. MSS Payload command destinations include only APIDs identified for RWS_CEU_Active. The APIDs supported for MSS Payloads are provided in Table 3.1.3.1–1, MSS PAYLOAD SUPPORTED APIDS. Additionally, the Function Code in the command is used by the CEU to determine the destination of the command beyond the CEU. The Function Codes for MSS Payloads are provided in Table 3.1.3.1–2, MSS PAYLOAD FUNCTION CODES. The available command bandwidth of 10 commands/second (constrained by the CCS–to–CEU interface) is shared among all MSS elements, the MSS Artificial Vision Unit (AVU), and a maximum of three MSS Payloads.

A. The CEU shall provide the capability to route commands to a maximum of three simultaneous MSS Payload RTs.

3.1.3.2 MSS PAYLOAD DATA

Ninety–six (96) words at 10 Hz have been allocated to the transfer of attached payload data to the CEU from up to three payloads. This transfer rate and size is the aggregate capability for all MSS Payloads; if multiple MSS Payload RTs require simultaneous communication, the MSS Payload data will be multiplexed to fit within the CEU–to–CCS MSS Payload data allocation.

The CEU will provide the capability to poll up to three MSS Payload RTs simultaneously. All MSS Payloads will be polled at a 10 Hz rate. The CEU will receive a command from the crew or ground to define which subaddress(es) will be polled for each RT, up to a maximum of three boxcars of aggregate MSS Payload data (maximum bandwidth available from CEU to C&C MDM).

. The CEU shall configure the cyclic status data transfer for a specific Remote Terminal address, based on command to configure for MSS Payload polling from the crew or ground.

. The MSS Payload shall multiplex data to fit within the available CEU polling allocation, as defined in the external command.

3.1.4 SSP 41175 BOOK 2 APPLICABILITY

This section lists the applicability of Book 2 to the MSS Payload interface. Exceptions are noted.

3.1.4.1 BOOK 2 SECTION–BY–SECTION APPLICABILITY

The following Book 2 sections are applicable to the MSS Payload interface:

A. SSP 41175 Book 2 paragraph 3.2, titled “Physical Layer” is applicable.

B. SSP 41175 Book 2 paragraph 3.3, titled “Link Layer” is applicable.

C. SSP 41175 Book 2 paragraph 3.3.1, titled “Media Access Control” is applicable.

D. SSP 41175 Book 2 paragraph 3.3.1.1, titled “Implemented Mode Code Definitions” is not applicable.

E. SSP 41175 Book 2 paragraph 3.3.1.2, titled “Status Word Usage” is applicable as modified:

The MSS Payload will implement the status words as specified in Table 3.3.1.2–1 SSP 41175, Book 2 under the section entitled “Status Word Usage”. The MSS Payload will provide the status word to the operator as cyclic telemetry data.

F. SSP 41175 Book 2 paragraph 3.3.1.3, titled “General 1553 Characteristics” is not applicable.

G. SSP 41175 Book 2 paragraph 3.3.2, titled “Link Layer” is applicable.

H. SSP 41175 Book 2 paragraph 3.3.2.1, titled “Link Layer Characteristic Definition” is not applicable.

I. SSP 41175 Book 2 paragraph 3.3.2.1.1, titled “CCSDS Protocol Definition” is not applicable.

J. SSP 41175 Book 2 paragraph 3.3.2.1.2, titled “Processing Synchronization” is applicable. MSS Payloads which multiplex their data will have to implement processing synchronization. MSS Payloads can use either a point–to–point sync or the MSS Payload cyclic data poll from the CEU as a synchronization signal. The CEU shall provide the point–to–point synchronization signal to the MSS Payload every 100 msec +/– 100 usec when requested by the operator. The CEU shall provide the RWS Frame Count as a data word with the point–to–point synchronization signal.

K. SSP 41175 Book 2 paragraph 3.3.2.1.3, titled “APID Routing” is applicable. The CEU is the CCSDS endpoint for all MSS components, including MSS Payloads.

L. SSP 41175 Book 2 paragraph 3.3.2.1.4, titled “Word Formatting” is not applicable.

M. SSP 41175 Book 2 paragraph 3.3.2.1.4.1, titled “Intel Format (for MDMs)” is not applicable.

N. SSP 41175 Book 2 paragraph 3.3.2.1.4.2, titled “Non–Intel Format” is not applicable.

O. SSP 41175 Book 2 paragraph 3.3.2.1.5, titled “I/O Structure” is not applicable.

P. SSP 41175 Book 2 paragraph 3.3.2.2, titled “Pipe Definition” is not applicable.

Q. SSP 41175 Book 2 paragraph 3.3.2.2.1, titled “Broadcast Sync” is not applicable. A Point–to–Point sync will be available to a payload if requested.

R. SSP 41175 Book 2 paragraph 3.3.2.2.2, titled “Broadcast Time” is not applicable.

S. SSP 41175 Book 2 paragraph 3.3.2.2.3, titled “Broadcast Ancillary Data” is not applicable.

T. SSP 41175 Book 2 paragraph 3.3.2.2.4, titled “Standard Command” is not applicable.

U. SSP 41175 Book 2 paragraph 3.3.2.2.4.1, titled “Bus Controller Requirements” is not applicable.

V. SSP 41175 Book 2 paragraph 3.3.2.2.4.2, titled “RT Requirements” is not applicable.

W. SSP 41175 Book 2 paragraph 3.3.2.2.4.3, titled “Command Validation Requirements” is not applicable.

X. SSP 41175 Book 2 paragraph 3.3.2.2.4.4, titled “Data Formats” is not applicable.

Y. SSP 41175 Book 2 paragraph 3.3.2.2.4.5, titled “System Function Codes for Commands” is not applicable.

Z. SSP 41175 Book 2 paragraph 3.3.2.2.5, titled “Data Load Command Transactions” is not applicable.

AA. SSP 41175 Book 2 paragraph 3.3.2.2.5.1, titled “Bus Controller Requirements” is not applicable.

AB. SSP 41175 Book 2 paragraph 3.3.2.2.5.2, titled “RT Requirements” is not applicable.

AC. SSP 41175 Book 2 paragraph 3.3.2.2.5.3, titled “Data Formats” is not applicable.

AD. SSP 41175 Book 2 paragraph 3.3.2.2.6, titled “Normal Data Dump Packet Transactions” is not applicable.

AE. SSP 41175 Book 2 paragraph 3.3.2.2.6.1, titled “Description of Start Data Dump Command” is not applicable.

AF. SSP 41175 Book 2 paragraph 3.3.2.2.6.2, titled “Description of Setup Data Dump Command” is not applicable.

AG. SSP 41175 Book 2 paragraph 3.3.2.2.6.3, titled “Bus Controller Requirements” is not applicable.

AH. SSP 41175 Book 2 paragraph 3.3.2.2.6.4, titled “Remote Terminal Requirements” is not applicable.

AI. SSP 41175 Book 2 paragraph 3.3.2.2.6.5, titled “Data Formats” is not applicable.

AJ. SSP 41175 Book 2 paragraph 3.3.2.2.7, titled “Extended Data Dump Packet Transactions” is not applicable.

AK. SSP 41175 Book 2 paragraph 3.3.2.2.7.1, titled “Bus Controller Requirements” is not applicable.

AL. SSP 41175 Book 2 paragraph 3.3.2.2.7.2, titled “RT Requirements” is not applicable .

AM. SSP 41175 Book 2 paragraph 3.3.2.2.7.3, titled “Data Formats” is not applicable.

AN. SSP 41175 Book 2 paragraph 3.3.2.2.8, titled “Command Poll/Command Requests” is not applicable.

AO. SSP 41175 Book 2 paragraph 3.3.2.2.9, titled “Cyclic Data Acquisition” is not applicable.

AP. SSP 41175 Book 2 paragraph 3.3.2.2.9.1, titled “Loss of Sync Indication” is not applicable.

AQ. SSP 41175 Book 2 paragraph 3.3.2.2.9.2, titled “File/Memory Transfer Status” is not applicable.

AR. SSP 41175 Book 2 paragraph 3.3.2.2.9.3, titled “Processing Frame Counter” is not applicable.

AS. SSP 41175 Book 2 paragraph 3.3.2.2.9.4, titled “Command Responses” is not applicable.

AT. SSP 41175 Book 2 paragraph 3.3.2.2.9.5, titled “Emergency, Caution and Warning and Advisory Indicators” is not applicable.

AU. SSP 41175 Book 2 paragraph 3.3.2.2.9.6, titled “Mode Code Command Response” is not applicable.

AV. SSP 41175 Book 2 paragraph 3.3.2.2.9.7, titled “Reserved” is not applicable.

AW. SSP 41175 Book 2 paragraph 3.3.2.2.9.8, titled “ECW Panel Switch Status” is not applicable.

AX. SSP 41175 Book 2 paragraph 3.3.2.2.9.9, titled “Command Response Counters” is not applicable.

AY. SSP 41175 Book 2 paragraph 3.3.3, titled “System Management” is not applicable.

AZ. SSP 41175 Book 2 paragraph 3.3.3.1, titled “BC Initialization” is not applicable.

BA. SSP 41175 Book 2 paragraph 3.3.3.2, titled “RT Initialization” is not applicable.

BB. SSP 41175 Book 2 paragraph 3.3.3.3, titled “Bus Failure Detection, Isolation and Recovery” is not applicable.

BC. SSP 41175 Book 2 paragraph 3.3.3.4, titled “Bus Controller FDIR” is applicable, in the sense that after losing communications with CEU for 300 milliseconds, the MSS Payload should initiate an equipment safing response.

BD. SSP 41175 Book 2 paragraph 3.3.3.5, titled “Remote Terminal FDIR” is not applicable.

BE. SSP 41175 Book 2 paragraph 3.4, titled “Application Layer” is not applicable.

BF. SSP 41175 Book 2 paragraph 3.4.1, titled “File and Memory Transfer Requirements” is not applicable.

BG. SSP 41175 Book 2 paragraph 3.4.1.2, titled “Data Load Command” is not applicable.

BH. SSP 41175 Book 2 paragraph 3.4.1.3, titled “Data Dump Set–up Command” is not applicable.

BI. SSP 41175 Book 2 paragraph 3.4.1.4, titled “Start Data Dump Command” is not applicable.

BJ. SSP 41175 Book 2 paragraph 3.4.2, titled “Reserved” is not applicable.

BK. SSP 41175 Book 2 paragraph 3.4.3, titled “Time Management” is not applicable.

BL. SSP 41175 Book 2 paragraph 3.4.3.1, titled “General Description” is not applicable.

BM. SSP 41175 Book 2 paragraph 3.4.3.2, titled “Requirements” is not applicable.

BN. SSP 41175 Book 2 paragraph 3.4.4, titled “Data Acquisition and Decommutation” is not applicable.

BO. SSP 41175 Book 2 paragraph 3.4.5, titled “E,C,W and Advisory Processing” is not applicable.

BP. SSP 41175 Book 2 paragraph 3.4.6, titled “MDM Health” is not applicable.

3.1.4.2 TRANSACTION RATES AND SIZES

Each of the status poll transactions below contains their own 10 Hz, 1 Hz, and 0.1 Hz data areas. As a reference, SPAR–SS–ICD–1148 defines the total set of bus transactions on the MSS LB and MSS PDGF LB, where the MSS Payload transactions are a subset of the transaction on these buses.

A. The CEU shall support the data/command transaction rates and sizes as specified in Table 3.1.4.2–1.

B. The MSS Payload shall support the data/command transaction rates and sizes as specified in Table 3.1.4.2–1.

3.2 CEU OUTPUTS TO MSS PAYLOAD

This section presents the command and data information that is sent from the CEU to the MSS Payload.

It is divided according to whether or not the CEU performs any unique processing associated with the information. PUI numbers are designated as NRxxxxx or CRxxxxx to distinguish whether the item is the responsibility of NASA (N) or CSA (C).

3.2.1 COMMAND INTERFACE

There are no CEU commands to the MSS Payload.

3.2.2 DATA INTERFACE

Table 3.2.2–1 lists the data that originates from the CEU and are sent to the MSS Payload. By convention, the five–digit numerical PUI suffix assigned to this class of data elements ranges from 01000 through 01999.

3.2.3 PASS–THROUGH INTERFACE

Table 3.2.3–1 lists the commands that the CEU receives from outside sources (PCS, ground) and passes along to the MSS Payload. By convention, the five–digit numerical PUI suffix assigned to this class of commands ranges from 02000 through 02999.

3.3 MSS PAYLOAD OUTPUTS TO CEU

This section presents the command and data information that is sent from the MSS Payload to the CEU. It is divided according to whether or not the CEU performs any unique processing associated with the information.

3.3.1 COMMAND INTERFACE

There are no MSS Payload commands to the CEU.

3.3.2 DATA INTERFACE

There are no MSS Payload data items explicitly for the CEU.

3.3.3 PASS–THROUGH INTERFACE

Tables 3.3.3–1 lists the data that the MSS Payload sends to the CEU for pass–through to outside sources such as the PCS or ground. By convention, the five–digit numerical PUI suffix assigned to this class of data elements ranges from 05000 through 99999.

3.4 PRIMITIVE DEFINITIONS

Table 3.4–1, MSS Payload Interface Primitives, contains the MSS Payload primitive data dictionary.

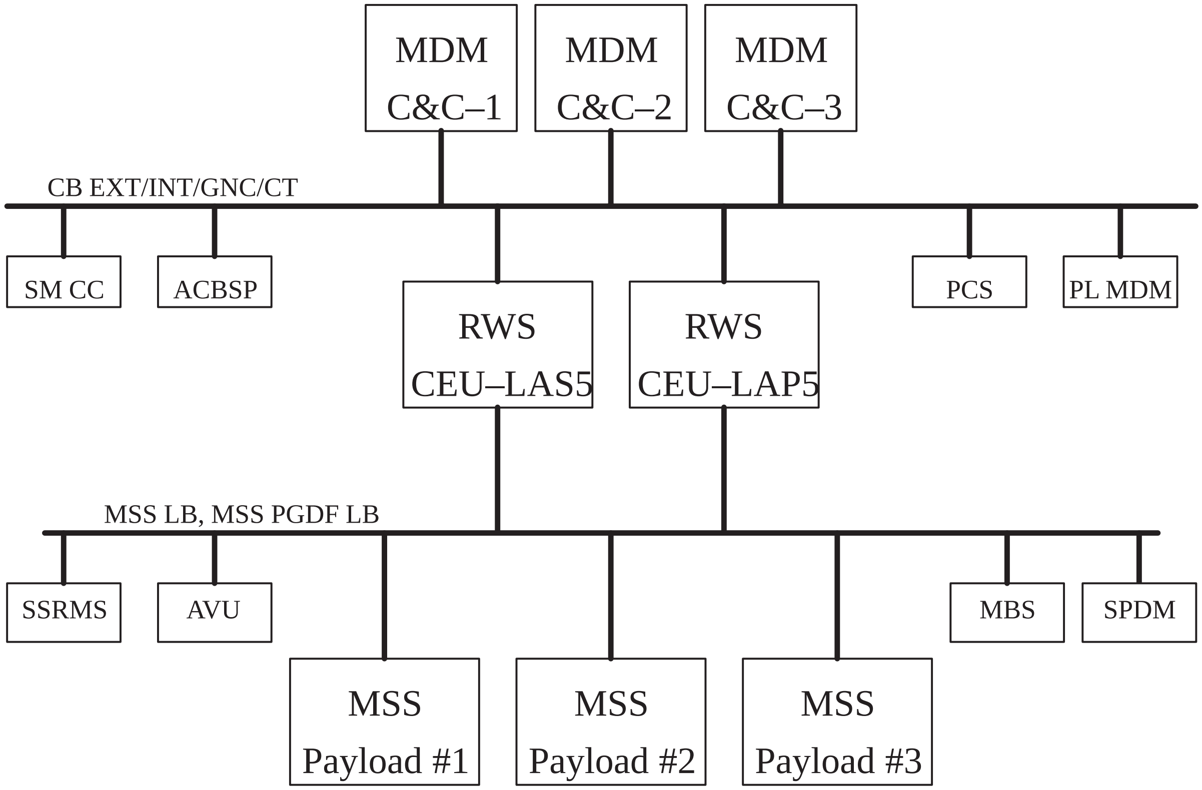


FIGURE 3.1–1 SYSTEM INTERFACE DIAGRAM

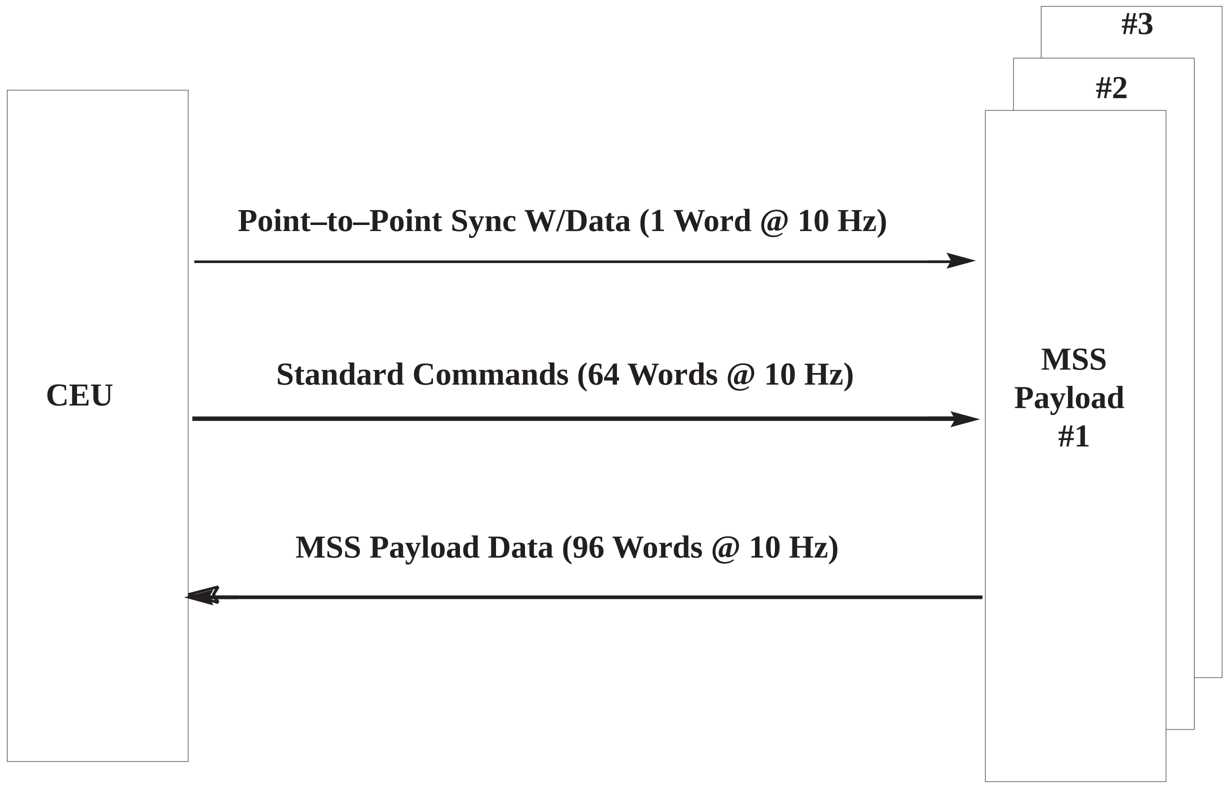


FIGURE 3.1.3–1 CEU TO MSS PAYLOAD INTERFACES

TABLE 3.1.2.1–1 MSS PAYLOAD SUPPORTED MIL–STD–1553 SUB–ADDRESSES

Subaddress	BC to RT	RT to BC
00	Mode Code	Mode Code
01	Available	Available
02	Available	Available
03	Available	Available
04	Available	Available
05	Available	Available
06	Available	Available
07	Available	Available
08	Available	Available
09	Available	Available
10	Available	Available
11	Available	Available
12	Available	Available
13	Available	Available
14	Available	Available
15	Available	Available
16	Available	Available
17	Available	Available
18	Available	Available
19	Available	Available
20	Available	Available
21	Available	Available
22	Available	Available
23	Available	Available
24	Available	Available
25	Available	Available
26	Available	Available
27	Available	Available
28	Available	Available
29	Available	Available
30	Reserved by MIL–STD–1553 for Data Read/Wrap (Unsupported)	Reserved by MIL–STD–1553 for Data Read/Wrap (Unsupported)
31	Broadcast Mode Code	Mode Code

TABLE 3.1.3.1–1 MSS PAYLOAD SUPPORTED APIDS

APID	FROM	TO
98	C&C_Hot	RWS_CEU_Active
747	MCC–H	RWS_CEU_Active
748	Orbiter	RWS_CEU_Active
763	PCS/C–1	RWS_CEU_Active
764	PCS/C–2	RWS_CEU_Active
769	PCS/C–3	RWS_CEU_Active
792	PCS/C–4	RWS_CEU_Active
793	PCS/C–5	RWS_CEU_Active
794	PCS/C–6	RWS_CEU_Active
795	PCS/C–7	RWS_CEU_Active
796	PCS/C–8	RWS_CEU_Active
798	Timeliner	RWS_CEU_Active
1019	APM_CC	RWS_CEU_Active
1025	MCC–M	RWS_CEU_Active
1102	CC_SM	RWS_CEU_Active
1103	CPC–1	RWS_CEU_Active
1104	CPC–2	RWS_CEU_Active
1105	PL_Pri	RWS_CEU_Active

TABLE 3.1.3.1–2 MSS PAYLOAD FUNCTION CODES

FUNCTION CODE (FC)	DESTINATION	COMMAND STARTING SUBADDRESS (SA)
32 – 59	MSS LB, RT Address = 2	SA = FC – 31
60 – 87	MSS LB, RT Address = 4	SA = FC – 59
88 – 115	MSS LB, RT Address = 7	SA = FC – 87
116 – 143	MSS LB, RT Address = 21	SA = FC – 115
144 – 171	MSS PDGF LB, RT Address = 2	SA = FC – 143
172 – 199	MSS PDGF LB, RT Address = 4	SA = FC – 171
200 – 227	MSS PDGF LB, RT Address = 7	SA = FC – 199
228 – 255	MSS PDGF LB, RT Address = 21	SA = FC – 227

Note: MSS Payloads attached to the MCAS are constrained to RT Address = 21 on the MSS PDGF LB.

TABLE 3.1.4.2–1 CEU TO MSS PAYLOAD TRANSACTION RATES AND SIZES

Functional Interface Identification	Transaction Rate	Number of words per transaction/ number of subaddresses per transaction (1)	I/O Subframe
Point–to–Point Sync	10 Hz	1/1	0
MSS Payload Data	10 Hz	96/3	6
Standard Command	10 Hz	64/2	7
Note: (1) Data volumes include overhead associated with logical protocol.			

TABLE 3.2.2–1 CEU DATA OUTPUTS TO MSS PAYLOAD

CEU Data Outputs To MSS Payload (Page 1 of 1)						
PUI	**Name**	**Description**	**Freq**	**Primitive Name**	**Primitive PUI**	**Instances**
TBD	Point–to–Point Sync	Point–to–Point Sync	10 Hz	RWS Frame Count	NR04016	3

TABLE 3.2.3–1 CEU PASS–THROUGH DATA OUTPUTS TO MSS PAYLOAD

CEU Pass–Through Data Outputs To MSS Payload						
PUI	Name	Description	Freq	Primitive Name	Primitive PUI	Instances

TABLE 3.3.3–1 MSS PAYLOAD PASS–THROUGH DATA OUTPUTS TO CEU

MSS Payload Pass–Through Data Outputs to CEU						
PUI	Name	Description	Freq	Primitive Name	Primitive PUI	Instances

TABLE 3.4–1 MSS PAYLOAD INTERFACE PRIMITIVES

MSS Payload Interface Primitives							
PUI	Name	Description	Data Type	Units	Limits/ Range	Accura-cy	Preci-sion

APPENDIX B ABBREVIATIONS AND ACRONYMS

B.1 CONTROL AUTHORITY

Appendix A is not subject to SSCB change control. Responsibility for control of configuration management abbreviations and acronyms is delegated to Configuration Management.

This appendix will be reviewed as required and changes will be issued as replacement pages or by complete revision of the appendix as appropriate. All requested changes will be directed to Configuration Management.

B.2 ABBREVIATIONS AND ACRONYMS

AVU	Artificial Vision Unit
CCTV	Closed Circuit Television
CSA	Canadian Space Agency
CSI	Common Structural Interface
DHT	Dexterous Handling Target
EFGF	Electrical Flight Grapple Fixture
EMI	Electromagnetic Interference
EVA	Extravehicular Activity
FRGF	Flight Releasable Grapple Fixture
ft	feet
Hz	Hertz
ICD	Interface Control Document
in	inch
IP	International Partner
IPI	Integrated Program Interface
ITA	Integrated Truss Assembly
kbps	kilo bits per second

kg	kilograms
kN–m	kiloNewton–meter
kW	kilowatt
lbs	pounds
LEE	Latching End Effector
m	meter
mA	milliAmps
MBS	MRS Base System
MC	Micro Conical
MCAS	MBS Common Attach System
MCE	MSS Control Equipment
MCF	Micro Conical Fitting
MRS	Mobile Remote Servicer
MSS	Mobile Servicing System
MT	Mobile Transporter
NASA	National Aeronautics and Space Administration
N	Newton
NSTS	National Space Transportation System
OMCS	Operations Management and Control Software
ORU	Orbit–Replaceable Unit
OTCM	ORU/Tool Changeout Mechanism
OTP	ORU/Tool Platform
PDGF	Power and Data Grapple Fixture
PFM	Pulse Frequency Modulation
POA	Payload/ORU Accommodation
PSA	Payload/ORU Support Assembly

PWP	Portable Workplatform
rad	Radian
RSGF	Rigidize Sensing Grapple Fixture
RT	Remote Terminal
SDGF	Standard Dexterous Grasp Fixture
SEE	Standard End Effector
SI	Systems International
SPDA	Secondary Power Distribution Assembly
SPDM	Special Purpose Dexterous Manipulator
SPEE	Special Purpose End Effector
SSCB	Space Station Control Board
SSL	SSRMS Support Latch
SSRMS	Space Station Remote Manipulator System
TBD	To Be Determined
TBR	To Be Reviewed
TUS	Trailing Umbilical System
UMA	Umbilical Mechanism Assembly
Vdc	Volts, direct current
W	Watts

APPENDIX C ISSUE SHEETS

MSS TO USER ICD Part 1 ISSUES – Date 7 March ’94 – Page 1

ACTION NUMBER: 42004–PART1–002 – Runaway vs Normal Ops Loads

ISSUE DESCRIPTION :

CSA/SPAR has a requirement to work to failure loads. NASA has a requirement to-work to normal operating loads. Structure may not meet failure loads generated by afailed OTCM unless normal loads x margin of safety is greater than failure loads.

AFFECTED PARAGRAPHS :

Section C and D.

ACTION PLAN :

Conduct follow up telecon with NASA, Prime, CSA, and SPAR to understand the CSA/SPAR requirement. Ensure that the failure moment falls with in the factor of safety margin of PG’s. Determine if ICD should define normal or failure loads.Determine impacts (if any) of the agreement and present to the VAIT. Update the ICDPart I accordingly. Action – Loads AIT.

DUE DATE : April 15, 1994

MSS TO USER ICD Part 1 ISSUES – Date 7 March ’94 – Page 1

ACTION NUMBER: **42004–PART1–004 – Commonality of Grasp Fixtures**

ISSUE DESCRIPTION :

SPAR, Rocketdyne, and MDA are developing several types of grasp fixtures to be used on OURs. SPAR is designing and manufacturing the H Fisture and the Micros. MDA is designing and manufacturing three type of micro conicals and manufacturing the H–Fixtures and SPAR micros. Rocketdyne is manufacturing modified SPAR micros and MDA micro conicals to incorporate a bolt retention device. Rocketdyne is manufacturing, SPAR H–Fixture. Boeing is procuring directly.

AFFECTED PARAGRAPHS :

Sect C and D.

Note: Commonality of the grasp fistures simplifies the number of interfaces. Presently, the ICD defines the interface between the SPAR provided Micros and H–Fixtures to the user and the MDA provided microconical to the user. The microconical interfaces directly with the MCF tool. The Micros and H–Fixtures interface directly with the OTCM. Additional interface planes may be established with the SPDM OTCM with the MDA manufactured H–Fixtures and micros and the Rocketdyne manufactured and modified H–Fixtures and micros. Rocketdyne is also modifying the microconical to incorporate the bolt retention device.

ACTION PLAN :

Ensure the Program is aware of the number of the various type of grasp fistures. The VAIT should determine if the program should proceed as is or try to obtain more commonality the grasp fixtures. To look at commanality, a trade study should be performed to look at the cost delta (savings and impacts) from common suppliers of the grasp fixtures (impacts to existing boxes bs cost saving of manufacturing and verifying). Update the ICD interfaces accordingly.

DUE DATE : June 30, 1994

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