IRN NO: **57000–0001**	**ISS PAYLOAD OFFICE IRN/PIRN/EXCEPTION FORM**	**(Page 1 of 28)** DATE PREPARED: 5–31–01

Doc. No., Rev. & Title: Document	SSP 57000, Revision E Pressurized Payloads Hardware Interface Requirements
PIRN NO:	57000–NA–0205A, 57000–NA–0198A, 57000–NA–0203, 57000–NA–0208, 57000–NA–0222, 57000–NA–0235A

(P)IRN TITLE:

Incorporation of P/IRNs into SSP 57000

ORIGINATOR:	PIRN Type: *Check One*	*For Payload Office Use Only*
Name: Tom Gallagher Agency: Boeing/TBE Phone: (281) 336–4074 Fax:	❑ Standard PIRN ❑ Exception	❑ Exceedance ❑ Deviation Waiver

UTILIZATION CHANGE ENGINEER.:	**SSCN/CR:**	RELATED PIRN NO.:
Name: Wade Geiger Agency: Boeing Phone: (281) 336–4284	SSCN 004176, SSCN 003970	N/A

Agency Tracking No.:	SYSTEM/ELEMENT AFFECTED:

REASON FOR CHANGE: (INCLUDE APPLICABLE ICAP NUMBER)

SSCD #004176, SSCD# 003970

PARAGRAPHS, FIGURES, TABLES AFFECTED (For PIRN use only)

Page	Paragraph(s)	Figure(s)	Table(s)
See Continuation Sheet			

AFFECTED INTERFACING PARTIES

SIGNATURE & ORGANIZATION	DATE	SIGNATURE & ORGANIZATION	DATE	SIGNATURE & ORGANIZATION	DATE
(A)					
(B)					
(C)					
(D)					
(E)					

IRN NO: 57000–0001	**ISS PAYLOAD OFFICE IRN/PIRN/EXCEPTION FORM CONTINUED**	PAGE NO. 2 DATE PREPARED: (05/31/01)

Doc. No., Rev. & Title: SSP 57000, Revision E Pressurized Payloads Interface Requirements Document	PIRN NO: 57000–NA–0205A, 198A, 0203, 0208, 0222, 0235A	DATE REVISED:

(P)IRN TITLE: Incorporation of P/IRNs into SSP 57000

PAGES, PARAGRAPHS, FIGURES, TABLES AFFECTED (For PIRN use only)

Page	Paragraph(s)	Figure(s)	Table(s)	*R	*A	*D
Cover Sheet				X		
1–1	1.1			X		
2–4	2.1			X		
3–30	3.2.2.3			X		
3–44	3.2.5.1.1			X		
	3.2.5.2			X		
3–45			3.2.5.2–1	X		
3–46 thru 3–48				X		
3–51	3.3.1					X
3–52	3.3.4.1.1.1			X		
3–53	3.3.4.1.1.2			X		
	3.3.4.1.2			X		
	3.3.4.1.3			X		
	3.3.4.1.4			X		
	3.3.4.2			X		
	3.3.4.2.1			X		
3–54	3.3.4.2.2			X		
3–61	3.3.6.1.1			X		
3–69	3.3.10.1			X		
3–99		3.3.4–2		X		
		3.3.4–3		X		
3–116	3.12.3.3.1			X		
3–116A			3.12.3.3.1–2		X	
3–117			3.12.3.3.2–1	X		
4–28	4.3.2.5.2			X		
4–54	4.3.3.10.1			X		
4–87	4.3.12.3.3.1			X		
A–3				X		

Pressurized Payloads Interface Requirements Document

International Space Station Program

November 1, 2000

Revision E

Incorporates IRN 0001

Type 1 – APPROVED BY NASA

NASDA 宇宙開発事業団

esa european space agency

National Aeronautics and Space Administration
International Space Station Program
Johnson Space Center
Houston, Texas
Contract No. NAS15–10000 (DR PA06)

NASA

REVISION AND HISTORY PAGE

REV.	DESCRIPTION	PUB. DATE
–	Initial Release per DR PA06	07–25–97
A	Revision A (Reference per SSCD 000887, EFF. 11/12/97). Revision A incorporates the following PIRNs: 57000–NA–0008B, 57000–NA–0011B, 57000–NA–0018A, 57000–NA–0019B, 57000–NA–0021A, 57000–NA–0027A, 57000–NA–0028A, 57000–NA–0030A, 57000–NA–0032, 57000–NA–0033, 57000–NA–0034A, 57000–NA–0035, 57000–NA–0036, 57000–NA–0038A, 57000–NA–0040A, 57000–NA–0044A	02–18–98
B	Revision B (Reference per SSCD 001168, EFF. 9/14/98) Revision B incorporates the following PIRNs: 57000–NA–0007C, 57000–NA–0009D, 57000–NA–0010B, 57000–NA–0012C, 57000–NA–0013B, 57000–NA–0014C, 57000–NA–0015C, 57000–NA–0016B, 57000–NA–0017C, 57000–NA–0020A, 57000–NA–0022C, 57000–NA–0024D, 57000–NA–0026B, 57000–NA–0029E, 57000–NA–0031B, 57000–NA–0039C, 57000–NA–0041C, 57000–NA–0042A, 57000–NA–0043A, 57000–NA–0045B, 57000–NA–0047, 57000–NA–0048, 57000–NA–0049A, 57000–NA–0050A, 57000–NA–0051A, 57000–NA–0052A, 57000–NA–0053A, 57000–NA–0054B, 57000–NA–0055, 57000–NA–0056, 57000–NA–0057C, 57000–NA–0058, 57000–NA–0059, 57000–NA–0060A, 57000–NA–0061, 57000–NA–0062, 57000–NA–0063B, 57000–NA–0064B, 57000–NA–0065, 57000–NA–0066B, 57000–NA–0067, 57000–NA–0068B, 57000–NA–0069A, 57000–NA–0070A, 57000–NA–0071A, 57000–NA–0072A, 57000–NA–0073A, 57000–NA–0074A, 57000–NA–0075, 57000–NA–0076B, 57000–NA–0077, 57000–NA–0078A, 57000–NA–0079A, 57000–NA–0080A, 57000–NA–0081A, 57000–NA–0082A, 57000–NA–0083A, 57000–NA–0084, 57000–NA–0085A, 57000–NA–0087, 57000–NA–0088A, 57000–NA–0089A, 57000–NA–0090, 57000–NA–0091A, 57000–NA–0092A, 57000–NA–0093A, 57000–NA–0096A, 57000–NA–0097, 57000–NA–0098A, 57000–NA–0099A, 57000–NA–0100B, 57000–NA–0101C, 57000–NA–0102, 57000–NA–0103B, 57000–NA–0104C, 57000–NA–0105, 57000–NA–0106C, 57000–NA–0107A, 57000–NA–0108	11–04–98
C	Revision C (Reference per SSCD 001822, EFF. 4/28/99). Revision C incorporates the following PIRNs: 57000–NA–0109B, 57000–NA–0111A, 57000–NA–0112A, 57000–NA–0113, 57000–NA–114D, 57000–NA–0115A, 57000–NA–0116C, 57000–NA–0117A, 57000–NA–0119B, 57000–NA–0120, 57000–NA–0121B, 57000–NA–122D, 57000–NA–0123A, 57000–NA–0126C, 57000–NA–0127B, 57000–NA–0128A, 57000–NA–0129A, 57000–NA–0130, 57000–NA–0131A, 57000–NA–0133A, 57000–NA–0135H, 57000–NA–136C, 57000–NA–0137	07–08–99

REVISION AND HISTORY PAGE

REV.	DESCRIPTION	PUB. DATE
D	Revision D (Reference per SSCD 002533, EFF. 08/02/99). Revision D incorporates the following PIRNs: 57000–NA–0132D, 57000–NA–0139B, 57000–NA–0140A, 57000–NA–141, 57000–NA–0143A, 57000–NA–0146A, 57000–NA–0147A, 57000–NA–149, 57000–NA–0150C, 57000–NA–0152A, 57000–NA–0153, 57000–NA–154, 57000–NA–0155, 57000–NA–0156A, 57000–NA–0157A, 57000–NA–0158, 57000–NA–0159, 57000–NA–0160, 57000–NA–0162A, 57000–NA–0163A, 57000–NA–164B, 57000–NA–0165A, 57000–NA–0166B, 57000–NA–0167, 57000–NA–0168B, 57000–NA–0170, 57000–NA–0174A, 57000–NA–0177A	11–16–99
E	Revision E (Reference per SSCD 003132, Rev. F, EFF. 02–21–01). Revision E incorporates the following PIRNs: 57000–NA–0151H, 57000–NA–0161C, 57000–NA–0179, 57000–NA–0180, 57000–NA–0181C, 57000–NA–0182, 57000–NA–0183A, 57000–NA–0184A, 57000–NA–0185A, 57000–NA–0189, 57000–NA–0190B, 57000–NA–0191A, 57000–NA–0192, 57000–NA–0193B, 57000–NA–0194, 57000–NA–0195E, 57000–NA–0196, 57000–NA–0202, 57000–ES–0001A, 57000–ND–0003C	4–18–01
–	IRN 0001 incorporates the following: SSCD 003970 incorporates PIRN 57000–NA–0205A SSCD 004176 incorporates PIRNS 57000–NA–0198A, 57000–NA–0203, 57000–NA–0208, 57000–NA–0222, 57000–NA–0235A	11–20–01

ERU: /s/ M. Hehn 11–20–01

SSCBD	ENTRY DATE	CHANGE	PARAGRAPH(S)
003970	24–APR–01	57000–NA–0205A	3.12.3.3.1.C, 4.3.12.3.3.1.C
			TABLE(S)
			3.12.3.3.1–2
			PARAGRAPH(S)
004176	24–APR–01	57000–NA–0198A	3.2.2.3
		57000–NA–0203	1.1, 2.1, 3.3.1, 3.3.4.1.1.1, 3.3.4.1.1.2, 3.3.4.1.2, 3.3.4.1.3, 3.3.4.1.4, 3.3.4.2, 3.3.4.2.1, 3.3.4.2.2, 3.3.6.1.1, Appendix A
			TABLE(S)
		57000–NA–0208	3.12.3.3.2–1
			PARAGRAPH(S)
		57000–NA–0222	3.2.5.1.1
		57000–NA–0235A	3.2.5.2, 3.3.10.1, 4.3.2.5.2, 4.3.3.10.1,
			TABLE(S)
			3.2.5.2–1

IRN 0001

1.0 INTRODUCTION

1.1 PURPOSE

This Interface Requirements Document (IRD) is the principle source interface design requirements document. It will be complied with in order to certify a pressurized payload for integration into applicable ISS modules. These include United States Laboratory (USL), Attached Pressurized Module (APM), Japanese Experiment Module (JEM), Centrifuge Accommodations Module (CAM), and Multi-Purpose Logistics Module (MPLM). NSTS 1700.7, ISS Addendum and NSTS 18798 provides the safety requirements for payload design. IRN 0001

1.2 SCOPE

The physical, functional, and environmental design requirements associated with payload safety and interface compatibility are included herein. The requirements defined in this document apply to ground handling and processing, transportation and on–orbit phases of the pressurized payload operation. Transportation requirements are specific to the MPLM. The reader is referred to NSTS 21000–IDD–MDK for requirements related to transportation in the Shuttle middeck area. On-orbit requirements apply to all the payloads in the USL, APM, JEM, MPLM, and CAM. The interface requirements defined herein primarily address the module to integrated rack interface. Subrack payloads should design their hardware compatible with the integrated rack or facility they will be transported and operated within.

1.3 USE

This document levies design interface and verification requirements on ISS pressurized payload developers or integrators. These requirements are allocated to a integrated rack or pressurized payload through the applicability matrix in the unique payload Interface Control Document. The unique payload ICD defines and controls the design of the interfaces between the ISS and the pressurized payload, including module unique interfaces, constraints, definition of selectable parameters, and stage unique constraints. This document acts as a guideline to establish commonality with the respect to analytical approaches, models, test methods and tools, technical data and definitions for integrated analysis. Engineering units and conversions will be per ASTM E380–86, Standard For Metric Practice.

1.4 EXCEPTIONS

The Unique Pressurized Payload Hardware ICD documents the payload implementation of the ICD blank book requirements. The Unique ICD is used to determine if the hardware design remains within the interface design parameters defined by this document. Limits of the ICD are established in a conservative manner to minimize individual payload and mixed cargo analyses.

DOCUMENT NO.	TITLE
SSP 30575	Interior and Exterior Operational Location Coding System
SSP 41000	System Specification for the International Space Station
SSP 41002	International Standard Payload Rack to NASA/NASDA Modules Interface Control Document
SSP 41017	Rack to Multi–Purpose Logistics Module Interface Control Document (ICD) Part 1 and Part 2
SSP 41155	Refrigerator/Freezer Rack to MPLM ICD
SSP 41172	Qualification and Acceptance Environmental Test Requirements
SSP 41175-02	Software ICD Part 1 Station Management and Control to ISS Book 2 General Interface Software Interfaces Requirement
SSP 41175–08	Software ICD Part 1 SMC to ISS Book 8 Payload Multiplexer/ Demultiplexer Interface
SSP 50005	International Space Station Flight Crew Integration Standard (NASA-STD-3000/T) Document
SSP 50007	Space Station Inventory Management System Label Specification
SSP 50008	International Space Station Interior Color Scheme
SSP 50014	International Space Station Utility Coding Specification
SSP 50184	High Rate Data Link Physical Media, Physical Signaling & Protocol Specifications
SSP 50200–8	Station Program Implementation Plan Vol. VIII, Increment Execution Preparation
SSP 50313	Display and Graphical Commonality Standard
SSP 50467	ISS Stowage Accommodations Handbook: Pressurized Volume
SSP 52005	ISS Payload Flight Equipment and Guidelines For Safety Critical Structures
SSP 52050	Software Interface Control Document Part 1, International Standard Payload Rack to International Space Station.
SSP 52051	Payload Interface Definition Document (IDD) Baseline – SSP 52051 – User Electric Power Specifications and Standards.
SSP 57001	Pressurized Payload Hardware ICD
SSP 57002	Pressurized Payload Software ICD
SSP 57005	Active Rack Isolation System to Payload ICD
SSQ 21635	Connectors and Accessories, Electrical, Rectangular, Rack and Panel

IRN 0001

B. Integrated rack internal and external EPCE shall not use diodes to electrically tie together independent ISS power bus high side or return lines. These requirements apply to both supply and return lines.

ISS provides the capability to support simultaneous use of Main (J1) and Auxiliary (J2) power at each ISPR location (except MPLM). Constrained element level payload operations may occur from individual payload racks which automatically switch to or require simultaneous use of auxiliary power. ISS is required to reserve the maximum auxiliary power needed on that channelized Bus (even when not in use) to prevent Bus overload. For this reason, auxiliary power feeds will nominally be powered off by the module RPC. Specific constraints on the use of auxiliary power will be defined in the payload unique ICD.

3.2.2.3 COMPATIBILITY WITH SOFT START/STOP RPC

IRN 0001

An integrated rack connected to Interface B or EPCE connected to Interface C shall initialize with the soft start/stop performance characteristics when power is applied, sustained, and removed by control of remote power control switches. The soft start/stop function, active only when the Remote Power Controller (RPC) is commanded on or off, is limited to 100 amps/ms, or less, by the RPC output. The response of the soft start/stop function is linear for resistive loads for 1 to 10 ms for U.S. LAB feeds, 1.5 to 5 ms for JEM 50 amp main feeds, 1.5 to 5 ms for JEM 25 amp main feeds, 0.1 to 5 ms for JEM 10 amp auxiliary feeds, and 0.1 to 50 ms for APM feeds between 10% and 90% of rated current level.

IRN 0001

Note: Soft start/stop characteristics of U.S. standard RPCMs are shown in Figure 3.2.2.3–1.

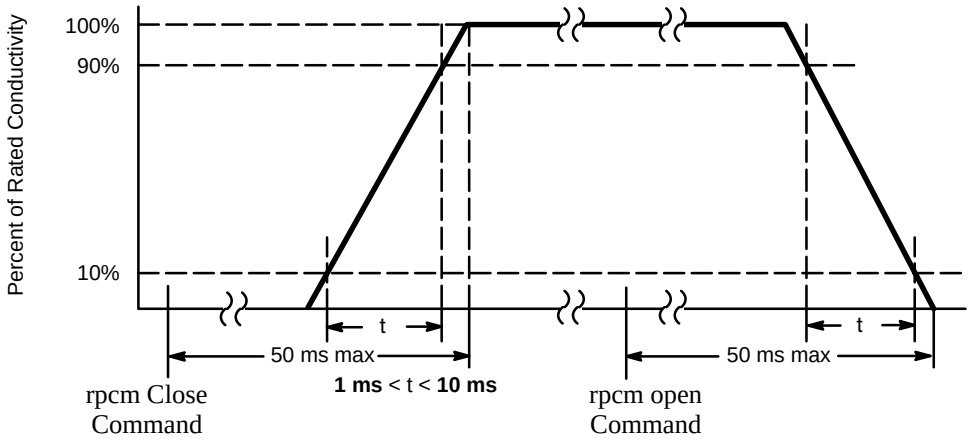

FIGURE 3.2.2.3–1 U.S. RPCM SOFT START/STOP CHARACTERISTICS

3.2.4.8 CORONA

Electrical and electronic subsystems, equipment, and systems shall be designed to preclude damaging or destructive corona in its operating environment. Guidance for meeting the corona requirement is found in MSFC–STD–531, High Voltage Design Criteria.

3.2.4.9 LIGHTNING

The integrated rack and EPCE shall meet the lightning induced environment requirement in paragraph 3.2.8.1 of SSP 30243.

3.2.4.10 EMI SUSCEPTIBILITY FOR SAFETY-CRITICAL CIRCUITS

Payload safety-critical circuits, as defined in SSP 30243, shall meet the margins defined in SSP 30243, paragraph 3.2.3.

3.2.5 SAFETY REQUIREMENTS

3.2.5.1 PAYLOAD ELECTRICAL SAFETY

3.2.5.1.1 MATING/DEMATING OF POWERED CONNECTORS

EPCE shall meet the electrical safety requirements as defined in NSTS 1700.7 Addendum. Payloads shall comply with the requirements for mating/demating of powered connectors specified in NSTS 18798, MA2–99–170. IRN 0001

Note: The module can provide one verifiable upstream inhibit which removes voltage from the UIP and UOP connectors. The module design will provide the verification of the inhibit status at the time the inhibit is inserted.

3.2.5.1.2 SAFETY-CRITICAL CIRCUITS REDUNDANCY

EPCE shall meet the electrical safety requirements as defined in NSTS 1700.7 Addendum. The EPCE connected to either Interface B or Interface C shall meet the safety-critical circuits redundancy requirements defined in NSTS 18798.

3.2.5.2 RACK MAINTENANCE SWITCH (RACK POWER SWITCH)

A. Each integrated rack shall provide a guarded, two-position, manually operated lever lock switch that initiates the removal of power to the integrated rack, installed in a visible and accessible location on the front of the rack. IRN 0001

B. The Integrated Rack shall be wired such that the switch in the UP position provides a CLOSED circuit on the J43 connector pins 19 and 20. IRN 0001

C. Each Integrated Rack shall be labeled with JSC 27260 decal SDG32106318 with dash number as specified in Table 3.2.5.2–1.

Note: The MPLM does not have J43 connectors on rack locations to allow RMS implementation.

TABLE 3.2.5.2–1 RACK MAINTENANCE SWITCH (RACK POWER SWITCH) LABEL

USL Pre–8A	USL / CAM Post – 8A	JEM / APM
–001	–002	–003

3.2.5.3 POWER SWITCHES/CONTROLS

The following power switches/controls requirements apply to power to power interfaces with open circuit voltage exceeding 30 volts rms or dc nominal (32 volts rms or dc maximum).

A. Switches/controls performing on/off power functions for all power interfaces shall open (dead-face) all supply circuit conductors except the power return and the equipment grounding conductor while in the power-off position.

B. Power-off markings and/or indications shall be used only if all parts, with the exception of overcurrent devices and associated EMI filters, are disconnected from the supply circuit.

C. Standby, charging, or other descriptive nomenclature shall be used to indicate that the supply circuit is not completely disconnected for this power condition.

3.2.5.4 GROUND FAULT CIRCUIT INTERRUPTERS (GFCI)/PORTABLE EQUIPMENT DC SOURCING VOLTAGE

A. A non-portable utility outlet with output voltages exceeding 30 volts rms or dc nominal (32 volts rms or dc maximum) intended to supply power to portable equipment shall include a GFCI, as an electrical hazard control, in the power path to the portable equipment.

B. GFCI trip current DC detection shall be independent of the portable equipment’s safety (green) wire.

C. GFCI trip current AC detection shall be dependent on the portable equipment’s safety (green) wire when the safety (green) wire is present.

D. Portable equipment that has internal voltages greater than 30 volts rms or dc nominal (32 volts rms or dc maximum) and has a credible fault path or return path to a crewmember shall

include GFCI protection for that credible path with trip point characteristics such that tripping will not exceed the currents specified in the profile shown in Table 3.2.5.4–1.

E. GFCI will be designed to trip below the threshold of let-go based upon the 99.5 percentile rank of adults. Non-portable utility outlets supplying power to portable equipment shall include a GFCI with trip point characteristics such that tripping will not exceed the currents specified in the profile shown in Table 3.2.5.4–1.

F. GFCIs shall remove power within 25 milliseconds upon encountering the fault current.

G. GFCI shall provide an on-orbit method for testing trip current detection threshold at DC and at a frequency within the maximum human sensitivity range of 15 to 70 Hertz.

Note: The definitions of hazard requirements are specified in NSTS 1700.7, ISS Addendum, paragraph 200.

TABLE 3.2.5.4–1 LET-GO CURRENT PROFILE THRESHOLD VERSUS FREQUENCY

Frequency (Hertz)	Maximum Total Peak Current (AC + DC components combined) (milliamperes)
DC	40
15	8.5
2000	8.5
3000	13.5
4000	15.0
5000	16.5
6000	17.9
7000	19.4
8000	20.9
9000	22.5
10000	24.3
50000	24.3
(Based on 99.5 Percentile Rank of Adults)	

3.2.5.5 PORTABLE EQUIPMENT/POWER CORDS

A. Non-battery powered portable equipment shall incorporate a three-wire power cord. A three–wire power cord consists of a (+) supply lead, a (–) return lead and a safety (green) wire; one end of the safety (green) wire is connected to the portable equipment chassis (and all exposed conductive surfaces) and the other end is connected to structure of the utility outlet (Payload provided outlet, UOP, etc.) or through the GFCI interface if GFCI is used. A system of double insulation or its equivalent, when approved by NASA, may be used without a ground wire.

B. Fault currents resulting from a single failure within a non-battery powered portable equipment that has internal voltage above 30 volts rms or dc nominal (32 volts rms or dc maximum) and has a credible fault path or return path to the crewmember shall not exceed the total peak currents specified in Table 3.2.5.4–1 for fault current frequencies of 15 Hertz and above.

Note: The SUP power outlet in the APM does not provide AC protection.

3.2.5.6 DELETED

3.2.6 MPLM

An integrated rack (including Refrigerator/Freezer Rack) may require power while located in the MPLM. MPLM provides power to high power locations which are able to sustain a maximum steady-state current of 9.8 A and low power locations which are able to sustain a maximum steady-state current of 5.3 A. An integrated rack receiving power from the MPLM electrical power system must meet all requirements in Sections 3.2.6.1 through 3.2.6.5. An integrated rack designed to operate in both the MPLM and any ISPR location must meet all requirements in Sections 3.2.6.1 through 3.2.6.5 and all Interface B requirements in Section 3.2.

3.2.6.1 MPLM ELECTRICAL POWER CHARACTERISTICS

The interface between an integrated rack (Refrigerator/Freezer Rack) and the MPLM electrical power system is shown in Figure 3.2.1–1, Electrical Power System Interface Locations. The integrated rack shall operate and be compatible with the Interface C electrical power characteristics in the following paragraphs:

A. Paragraph 3.2.1.1.2

B. Paragraph 3.2.1.2.1

C. Paragraph 3.2.1.2.2

D. Paragraph 3.2.1.3.2

E. Paragraph 3.2.1.3.3

F. Paragraph 3.2.1.3.4, A

G. Paragraph 3.2.1.3.4, B

H. Deleted

I. Deleted

3.2.6.2 MPLM ELECTRICAL POWER INTERFACE

Integrated rack shall meet the Interface C electrical power interface requirements in the following paragraphs:

A. Paragraph 3.2.2.6.1.1, B

B. Paragraph 3.2.2.6.1.1, D

C. Paragraph 3.2.2.7.2

D. Paragraph 3.2.2.8

E. Paragraph 3.2.2.9

F. Paragraph 3.2.2.10

3.2.6.2.1 MPLM UIP CONNECTORS AND PIN ASSIGNMENTS

A. Integrated rack connectors P1 mating requirements to the UIP connectors J1 are specified in paragraph 3.1.1.6.1, A.

B. Integrated rack connectors P1 shall meet the pin out interfaces of the UIP connectors J1 as specified in SSP 57001, paragraph 3.2.1.1.

C. Integrated rack connectors P1 shall meet the requirements of SSQ 21635 or equivalent.

3.2.6.2.2 COMPATIBILITY WITH RPC SOFT START/STOP IN MPLM

An integrated rack connected to Interface C in MPLM shall be compatible with the MPLM RPC soft start/stop performance characteristics defined in Figure 3.2.6.2.2–1 when power is applied, sustained, and removed by control of remote power control switches.

I. Paragraph 3.2.4.9, Lightning

J. Paragraph 3.2.4.10, EMI Susceptibility for Safety-Critical Circuits

3.2.6.4.1 MPLM BONDING

Integrated rack shall incorporate structural/mechanical provisions class R bonding to the MPLM in accordance with SSP 30245, Space Station Electrical Bonding Requirements.

3.2.6.5 MPLM SAFETY REQUIREMENTS

The integrated rack shall meet the safety requirements in the following paragraphs:

A. Paragraph 3.2.5.1.1

B. Paragraph 3.2.5.1.2

C. Paragraph 3.2.5.2

D. Paragraph 3.2.5.3

E. Paragraph 3.2.5.4

F. Paragraph 3.2.5.5

3.3 COMMAND AND DATA HANDLING INTERFACE REQUIREMENTS

3.3.1 DELETE

IRN 0001

3.3.2 WORD/BYTE NOTATIONS, TYPES AND DATA TRANSMISSIONS

This section applies to all payload commands and data on the Low Rate Data Link (LRDL), all header/trailer data on the Medium Rate Data Link (MRDL) and High Rate Data Link (HRDL) stated in section 3.3 of this document.

3.3.2.1 WORD/BYTE NOTATIONS

The integrated racks shall use the word/byte notations as specified in paragraph 3.1.1, Notations in SSP 52050.

3.3.2.2 DATA TYPES

The integrated racks shall use the data types as specified in paragraph 3.2.1 and subsections, Data Formats in SSP 52050.

3.3.2.3 DATA TRANSMISSIONS

A. The integrated rack data transmission on Low Rate Data Link (LRDL), MIL–STD–1553B shall use the data transmission order in accordance with paragraph 3.4, Non-Signal Data Coding Standards in D684–10056–01, Prime Contractor Software Standards and Procedures Specification.

B. The integrated rack data transmission on Medium Rate Data Link (MRDL) shall use the data transmission order in accordance with paragraph 3.3.3.1, Transmission Order in SSP 52050.

C. The integrated rack data transmission on High Rate Data Link (HRDL) shall use the data transmission order in accordance with paragraph 1.6, Bit Numbering Convention and Nomenclature in CCSDS 701.0–B–2.

3.3.3 DELETED

3.3.4 CONSULTATIVE COMMITTEE FOR SPACE DATA SYSTEMS

Integrated racks will use the Consultative Committee for Space Data Systems (CCSDS) standards for Space to Ground and Ground to Space data and time requirements as specified in this section.

3.3.4.1 CCSDS DATA

A. Integrated rack data that is space to ground shall be either CCSDS Data Packets or CCSDS Bitstream.

B. Integrated rack data that is ground to space shall be CCSDS Data Packets.

C. Integrated rack to Payload MDM data shall be CCSDS Data Packets.

3.3.4.1.1 CCSDS DATA PACKETS

Integrated rack data packets shall be developed in accordance with paragraph 3.1.3 of SSP 52050. Integrated racks CCSDS data packets consist of a primary header and a secondary header followed by the data field.

3.3.4.1.1.1 CCSDS PRIMARY HEADER

IRN 0001

Integrated racks shall develop a CCSDS primary header in accordance with paragraph 3.1.3.1 CCSDS Primary Header Format of SSP 52050.

3.3.4.1.1.2 CCSDS SECONDARY HEADER

IRN 0001

A. Integrated racks shall develop a CCSDS secondary header immediately following the CCSDS primary header.

B. The CCSDS secondary header shall be developed in accordance with paragraph 3.1.3.2, CCSDS Secondary Header Format of SSP 52050.

3.3.4.1.2 CCSDS DATA FIELD

IRN 0001

The integrated rack CCSDS data field shall contain the integrated rack data from the transmitting application to the receiving application, and the CCSDS checksum in accordance with paragraph 3.1 and subparagraphs, Data Formats and Standards, of SSP 52050.

3.3.4.1.3 CCSDS DATA BITSTREAM

IRN 0001

Integrated rack bitstream data shall be developed in accordance with paragraph 2.3.2.3, Bitstream Service of CCSDS 701.0–B–2.

3.3.4.1.4 CCSDS APPLICATION PROCESS IDENTIFICATION FIELD

IRN 0001

The CCSDS Application Process Identification (APID) will be used for routing data packets as described in paragraph 3.3.2.1.3, APID routing, of SSP 41175–2. The format of APIDs is shown in Table 3.3.2.1.1–1, CCSDS Primary Header Field Definitions, of SSP 41175–2.

Telemetry APIDs for a payload or subrack payload will be assigned by the Payload Engineering and Integration function upon request from the payload or subrack payload developer or rack integrator, and will be recorded in the integrated rack unique software ICD.

3.3.4.2 CCSDS TIME CODES

IRN 0001

3.3.4.2.1 CCSDS UNSEGMENTED TIME

Integrated racks shall use CCSDS unsegmented time code (CUC) in the secondary header as specified in paragraph 2.2, CCSDS Unsegmented Time Code (CUC), of CCSDS 301.0–B–2.

3.3.4.2.2 CCSDS SEGMENTED TIME

IRN 0001

Segmented time code will be sent to the integrated rack by a broadcast message on the Payload MIL–STD–1553B. Segmented time code formats is specified in paragraph 2.4, CCSDS Calendar Segmented Time Code (CCS), of CCSDS 301.0–B–2.

The broadcast time will be received at subaddress #29 on each Payload MIL–STD–1553B bus. The broadcast time signal will be updated once a second and is accurate to ±2.5 ms with respect to the Space Station Global Positioning System (GPS) receiver.

3.3.5 MIL-STD-1553B LOW RATE DATA LINK (LRDL)

Each integrated rack shall implement a single MIL–STD–1553B Remote Terminal (RT) to the payload unique MIL–STD–1553B bus in accordance with paragraph 3.2, MIL–STD–1553B Interface, of SSP 52050.

3.3.5.1 MIL-STD-1553B PROTOCOL

3.3.5.1.1 STANDARD MESSAGES

Integrated racks shall develop standard message for the Payload MIL–STD–1553B in accordance with paragraph 3.2.3.3, Standard Messages of SSP 52050.

3.3.5.1.2 COMMANDING

Integrated racks shall receive and process commands from the Payload MDM that originate from the Ground, Timeliner, Payload MDM and Portable Computer System (PCS) in accordance with paragraph 3.2.3.4, Commanding of SSP 52050.

3.3.5.1.3 HEALTH AND STATUS DATA

Integrated racks shall develop health and status data in accordance with paragraph 3.2.3.5 Health and Status of SSP 52050. The health and status data shall be documented in accordance with the data field format defined in Table A–5, Health and Status ISS Processed Data Packets, of SSP 57002. The definition of health and status data is provided in the Glossary of Terms, Appendix B of this document.

Integrated racks shall respond to their respective payload MDM polls for health and status data with updated data at a 1 Hz or 0.1 Hz rate.

TABLE 3.3.5.2.3–1 MIL–STD–1553B NETWORK CHARACTERISTICS

Characteristic	Parameter
Type	Twisted Shielded Pair SSQ 21655 or Equivalent
Characteristic Impedance	75 ± 5 Ohm
Cable Size	22 AWG or 24 AWG
Nominal wire-to-wire Capacitance	66 pf/m

The integrated rack MIL–STD–1553B internal wiring stub length shall not exceed 12 feet, 3.65 meters, when measured from the internal MIL–STD–1553B Remote Terminal to the ISPR Utility Interface Panel.

3.3.5.2.4 MULTI–BUS ISOLATION

For Payloads utilizing multiple ISS Payload MIL–STD–1553B data buses, the signal isolation between the buses shall be no less than 58 dB. A data bus consists of a redundant pair, channel A and channel B. It matters not that the data buses exit the payload on the same or different connectors, nor that the data buses are connected to the same or different buses. This requirement does not apply to payload unique buses.

3.3.6 MEDIUM RATE DATA LINK (MRDL)

3.3.6.1 MRDL PROTOCOL

Integrated racks that communicate via the MRDL shall conform with ISO/IEC 8802–3 10–Base-T protocol in accordance with paragraph 3.3, Medium Rate Data Link of SSP 52050.

3.3.6.1.1 INTEGRATED RACK PROTOCOLS ON THE MRDL

Integrated racks that communicate via the MRDL shall conform with ISO/IEC 8802–3 10–Base-T protocol in accordance with paragraph 3.3, Medium Rate Data Link (MRDL) of SSP 52050.

Payloads sending data to the ground through the USOS Space to Ground Link shall use the CCSDS protocol and gateway protocol in paragraph 3.3.4, Gateway Protocol and 3.3.3.7, Length in SSP 52050. IRN 0001

3.3.6.1.2 MRDL ADDRESS

A. Integrated racks implementing MRDL shall have a (unique) IEEE issued Ethernet Media Access Control (MAC) physical address (MAC Address), for each MRDL attachment.

3.3.8.3 SSC

The SSC shares the same hardware platform as the PCS (IBM 760), and is provided as a shared ISS resource. The primary purpose of the SSC is to provide crew support applications, including the Manual Procedures & Onboard Short Term Plan viewers, the Inventory Management System Database, Worldmap and other such tools. The SSC communicates via Ethernet as part of the ISS Ops LAN (IOL), and does not interface with any 1553 MDM systems. The SSC utilizes a Windows 95 O/S and follows Microsoft Windows display standards for GUI generation. The SSC connects to the UOP's for power only. RS 232, 422, or Ethernet connections exist to support direct connectivity to payload hardware.

A. Each integrated rack shall be limited to one shared SSC. The SSC is not dedicated to a rack; memory and hard drive availability for payload displays and software must be negotiated with the Payload Software Control Panel.

B. SSC displays shall be in accordance with SSP 50313, Display and Graphic Commonality Standard. (not unique to SSC).

3.3.9 UOP

UOP mating, pinout, and SSQ requirements are located in section 3.2.2.1.

3.3.10 MAINTENANCE SWITCH, SMOKE DETECTOR, SMOKE INDICATOR, AND INTEGRATED RACK FAN INTERFACES

3.3.10.1 RACK MAINTENANCE SWITCH (RACK POWER SWITCH) INTERFACES

The integrated rack power off command interface characteristics shall be in accordance with Table 3.3.10.1–1, Bi-Level Data Characteristics (Switch Contact). IRN 0001

Editorial

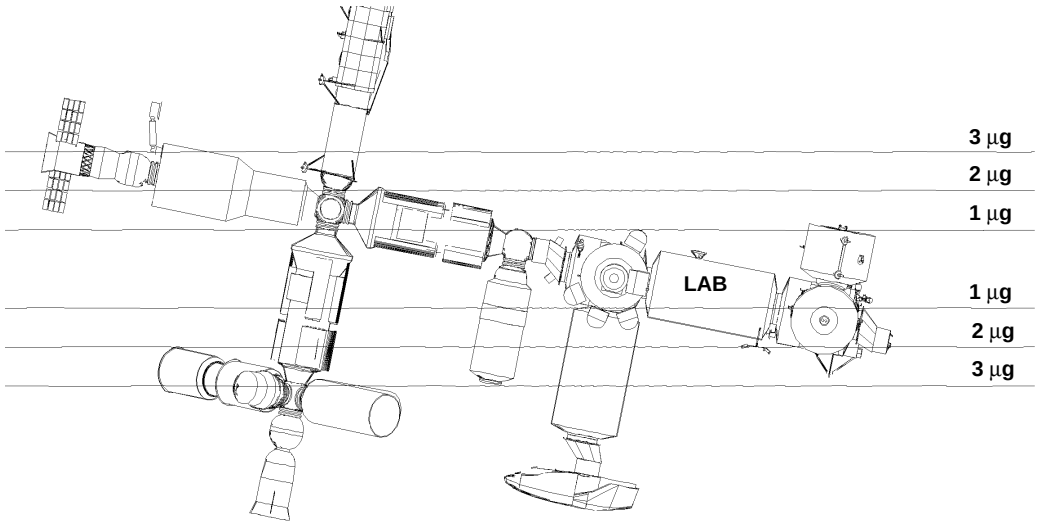

FIGURE 3.9.4–2 ASSEMBLY COMPLETE QUASI-STEADY STATE MICROGRAVITY CONTOURS (SIDE)

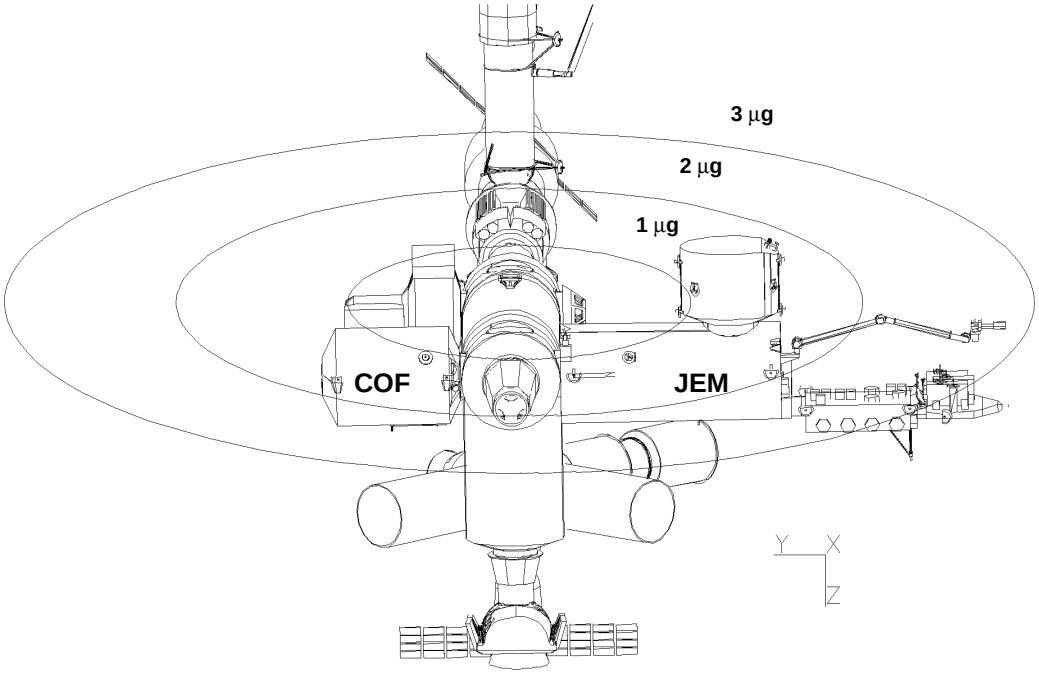

FIGURE 3.9.4–3 ASSEMBLY COMPLETE QUASI-STEADY STATE MICROGRAVITY CONTOURS (FRONT)

adjunct active portable equipment operated outside the integrated rack that is within or interfacing with the crew habitable volume) whose sub-rack equipment will be changed out on-orbit shall not, except in those cases when the rack meets the Intermittent Noise Source requirements specified in section 3.12.3.3.2, exceed the limits specified in Table 3.12.3.3.1–1 for all octave bands (NC–40 equivalent) when the equipment is operating in the loudest expected configuration and mode of operation that can occur on orbit under nominal crew, or hardware operation circumstances, during integrated rack setup operations, or during nominal operations where doors/panels are opened or removed. NOTE: These acoustic requirements do not apply during failure or maintenance operations.

C. **Independently Operated Equipment** – Any independently operated (e.g.UOP) equipment designed to operate within the habitable volume and not part of any integrated rack system shall individually comply with the acoustic requirements in Table 3.12.3.3.1–2. IRN 0001

TABLE 3.12.3.3.1–1 CONTINUOUS NOISE LIMITS

Rack Noise Limits Measured At 0.6 Meters Distance From The Test Article	
Frequency Band Hz	**Integrated Rack Sound Pressure Level (SPL)**
63	64
125	56
250	50
500	45
1000	41
2000	39
4000	38
8000	37

IRN 0001

TABLE 3.12.3.3.1–2 NOISE LIMITS FOR INDEPENDENTLY OPERATED EQUIPMENT

Noise Limit at 0.6 Meters Distance From Equipment		
Frequency Band (Hz)	**Sound Pressure Level (SPL) Until UF–3 Undocking (NC–40)**	**Sound Pressure Level (SPL) UF–3 and Subsequent (NC–34)**
63	64	59
125	56	52
250	50	45
500	45	39
1000	41	35
2000	39	33
4000	38	32
8000	37	31

3.12.3.3.2 INTERMITTENT NOISE LIMITS

The Integrated rack (including any supporting adjunct active portable equipment operated outside the integrated rack that is within or interfacing with the crew habitable volume) Intermittent Noise Source (See Glossary of Terms) shall not exceed the Total Rack A-weighted SPL Limits during the Maximum Rack Noise Duration as specified in Table 3.12.3.3.2–1 when the equipment is operating in the loudest expected configuration and mode of operation that can occur on orbit under any planned operations. NOTE: These acoustic requirements do not apply during failure or maintenance operations.

TABLE 3.12.3.3.2–1 INTERMITTENT NOISE LIMITS

Rack Noise Limits Measured at 0.6 meters distance from the test article	
Maximum Rack Noise Duration Ü	**Total Rack A-weighted SPL (dBA)**
8 Hours	49
7 Hours	50
6 Hours	51
5 Hours	52
4.5 Hours	53
4 Hours	54
3.5 Hours	55
3 Hours	57
2.5 Hours	58
2 Hours	60
1.5 Hours	62
1 Hour	65
30 Minutes	69
15 Minutes	72
5 Minutes	76
2 Minutes	78
1 Minute	79
Not Allowed	80

IRN 0001

IRN 0001

IRN 0001

IRN 0001

The Rack Noise Duration is the total time that the rack produces intermittent noise above the NC–40 limit during a 24 hour time period. This duration is the governing factor in determining the allowable Intermittent Noise Limits. Regardless of the number of separate sources and varying durations within a rack, this cumulative duration shall be used to determine the A-weighted SPL limit in column B.

For example, if a rack produces 65 dBA for 30 minutes in a start-up and warm-up mode and then settles down to 60 dBA for a one hour period of normal data acquisition, the duration is 1.5 hours. To meet the requirement, the noise can be no greater than 60 dBA, and in this case, the rack would not meet the requirement, even though two separate payloads, one that operated at 65 dBA for 30 minutes and another that operated at 60 dBA for one hour, would be acceptable (see Figure 3.12.3.3.2–1).

4.3.2.5.1.2 SAFETY-CRITICAL CIRCUITS REDUNDANCY

Verification that the equipment connected to Interface B or Interface C meets the loss of power safety requirements specified in NSTS 1700.7, ISS Addendum shall be performed and submitted to the PSRP in accordance with NSTS 13830. Verification shall be considered successful when hazard reports and safety data presented to the PSRP during the phased safety reviews are approved.

4.3.2.5.2 RACK MAINTENANCE SWITCH (RACK POWER SWITCH)

IRN 0001

A. Verification shall be by inspection. Verification shall be considered successful when the inspection shows the integrated rack is equipped with a guarded, two position, manually operated lever lock switch located on the front of the integrated rack.

B. Verification shall be by inspection. The inspection shall be of as–built wiring schematics. The verification shall be considered successful when the inspection demonstrates the switch provides an OPEN circuit while in the DOWN position and provides a CLOSED circuit while in the UP position.

C. Verification shall be by inspection. Verification shall be considered successful when the inspection of the drawings reveals that the proper label has been used. Review and approval, shall be granted by the ISS Payload Label Approval Team.

4.3.2.5.3 POWER SWITCHES/CONTROLS

The power switches/controls requirements shall be verified by analysis for power interfaces with open circuit voltage exceeding 30 volts rms or dc nominal (32 volts rms or dc maximum).

A. Switches/controls requirement shall be verified by analysis. An analysis shall be performed to ensure the switches/controls performing on/off functions for all power interfaces open (dead-face) all supply circuit conductors, except the power return and equipment grounding conductor, while in the power-off position. Verification shall be considered successful when analysis of electrical circuit schematics shows the switches/controls performing on/off power functions for all power interfaces open (dead-face) all supply conductors except the power return and equipment grounding conductor, while in the power-off position.

B. Power-off markings and/or indications requirement shall be verified by analysis. The analysis shall ensure power-off markings and/or indications exist when all electrical connections with the power supply circuit are disconnected. The verification shall be considered successful when analysis shows power switches/controls power-off markings and/or indication(s) exist when all electrical connections with the power supply circuit are disconnected.

B. SSC displays shall be verified by demonstration. The demonstration shall be performed on the flight hardware. Verification shall be considered successful when the demonstration to the Payload Display Review Panel (PDRP) shows the requirements in SSP 50313 have been met.

4.3.3.9 UOP

NVR

4.3.3.10 MAINTENANCE SWITCH, SMOKE DETECTOR, SMOKE INDICATOR, AND INTEGRATED RACK FAN INTERFACES

NVR

4.3.3.10.1 RACK MAINTENANCE SWITCH (RACK POWER SWITCH) INTERFACES

Verification for correct operation of the rack maintenance switch shall be by test, with the use of the PRCU or equivalent. The test shall be considered successful when the signal characteristics comply with Table 3.3.10.1–1.

IRN 0001

4.3.3.10.2 SMOKE DETECTOR INTERFACES

Verification of the smoke detector interface shall be by inspection.

Verification shall be by inspection of the smoke detector interfaces are powered from the integrated rack to the unique integrated rack hardware ICD against and SSP 57001.

4.3.3.10.2.1 ANALOG INTERFACE CHARACTERISTICS

Verification of the analog interface characteristics shall be by inspection.

Verification shall be by inspection of the analog interface characteristics to the unique integrated rack hardware ICD against and SSP 57001.

S1.4 and ANSI S1.11) to measure the SPL on the integrated rack at the loudest location 0.6 meters from the rack surface in each of eight octave bands: 63 Hz, 125 Hz, 250 Hz, 500 Hz, 1000 Hz, 2000 Hz, 4000 Hz and 8000 Hz.

The verification shall be considered successful when the test shows the loudest noise location exposed directly to the habitable volume on the integrated rack SPL is at or below the levels specified in Table 3.12.3.3.1–1.

B. **Integrated Racks Whose Sub-Rack Equipment Will Be Changed Out** – Verification of Continuous Noise Sources (See Glossary of Terms) for integrated racks whose sub-rack equipment will be changed out, shall be verified using a test-correlated analytical model, or some other method approved and documented in the Acoustics Noise Control Plan section of the unique Payload Verification Plan (PVP). The analytical model shall include system noise sources and anticipated sub-rack payload complement noise sources. The test-correlated model process is shown in Figure 4.3.12.3.3.1–1.

The verification shall be considered successful when the results from the test-correlated analytical model predicts the loudest location 0.6 meters from the rack surface exposed to the crew habitable volume, in each of the eight octave bands defined in Table 3.12.3.3.1–1, to be at or below the levels specified in Table 3.12.3.3.1–1 for additions, deletions or configuration changes to any sub-rack equipment within the integrated rack.

C. **Independently Operated Equipment** – Verification of Continuous Noise Sources (See Glossary of Terms) for independently operated equipment shall be performed by test.

Sound Pressure Level (SPL) test measurements shall be obtained at 0.6 meters from all sides of the equipment. The SPL test shall use a Type 1 Sound Level Meter (SLM) (ANSI S1.4 and ANSI S1.11) to measure the SPL in each of eight octave bands: 63 Hz, 125 Hz, 250 Hz, 500 Hz, 1000 Hz, 2000 Hz, 4000 Hz and 8000 Hz.

The verification shall be considered successful when the test shows the equipment SPL noise level is at or below the levels specified in Table 3.12.3.3.1–2. IRN 0001

4.3.12.3.3.2 INTERMITTENT NOISE LIMITS

Verification of Intermittent Noise Sources (See Glossary of Terms) for integrated racks whose sub-rack equipment will not be changed out shall be performed by test.

Sound Pressure Level (SPL) test measurements shall be obtained for the integrated rack. The test configuration shall include any adjunct equipment, such as integrated rack-provided external computers, fans, etc., added in support of the rack system. The SPL test shall use a Type 1 Sound Level Meter (SLM) (ANSI S1.4 and ANSI S1.11) to measure the Total Rack A-weighted SPL noise level and quantify the intermittent noise characteristics in terms of:

ISO	International Standards Organization
ISPR	International Standard Payload Rack
ISS	International Space Station
ITCS	Internal Thermal Control System
IVA	Intravehicular Activity
JEM	Japanese Experiment Module
kg	kilograms
kHz	kiloHertz
kPa	kiloPascal
KSC	Kennedy Space Center
kW	kiloWatt
LAN	Local Area Network
lbm	pounds mass
LED	Light Emitting Diode
LISN	Line Impedance Simulation Network
LLC	Logical Layer Control
LRDL	Low Rate Data Link
mA	milliAmperes
Mbps	MegaBytes per second
MDM	Multiplexer–Demultiplexer
MDP	Maximum Design Pressure
MIL–STD	Military Standard
MPICB	Multilateral Payload Implementation Control Board
MPLM	Multi–Purpose Logistics Module
MRB	Microgravity Rack Barrier

IRN 0001