Pressurized Payloads Hardware Interface Control Document Template

International Space Station Program

November 1, 2000

Revision C

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ERU: /s/Beth Mason 04–06–01

INTERNATIONAL SPACE STATION

PRESSURIZED PAYLOADS HARDWARE INTERFACE CONTROL DOCUMENT TEMPLATE

NOVEMBER 1, 2000

PREFACE

This Interface Control Document (ICD) Template is the exclusive document used by National Aeronautics & Space Administration (NASA), the European Space Agency (ESA), National Space Development Agency of Japan (NASDA), and the NASA payload developer to identify and establish the pressurized payload physical / functional interfaces and to control the designs of these pressurized payload interfaces. This document contains the design implementation of the interface requirements in the Pressurized Payloads Interface Requirements Document (IRD), SSP 57000. Both sides of the interface are described and includes mechanical, structural, electrical, avionics, and functional interfaces. The Space Station Pressurized Payloads ICD Template contains an introduction, a list of applicable documents, subsections on general and detailed interfaces, along with appendices containing acronyms, and definitions. This document defines and controls required interfaces for compatibility with the International Space Station (ISS). This document is to be used as a template for the development of unique Pressurized Payload ICDs for NASA payloads which are to interface with the MPLM, US Laboratory, Attached Pressurized Module, Japanese Experiment Module, and the Centrifuge Accommodations Module. The applicability of these interfaces will depend upon the characteristics of the integrated rack payloads as specified in the individual Payload Integration Agreement (PIA). The interfaces outlined in this document are mandatory and may not be violated unless specifically agreed upon by the Multilateral Payloads Control Board (MPCB). This document is under the control of the MPCB, and changes or revisions will be approved by the MPCB.

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INTERNATIONAL SPACE STATION

PRESSURIZED PAYLOADS HARDWARE INTERFACE CONTROL DOCUMENT TEMPLATE

LIST OF CHANGES

NOVEMBER 1, 2000

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

SSCBD	ENTRY DATE	CHANGE	PARAGRAPH(S)
001823	18–DEC–98	57001–NA–0002C	TABLE OF CONTENTS 1.3, 2.1, 2.2, 4.0, 4.1, 4.2
			TABLE(S)
			4.2–1
			FIGURE(S)
			1.3–1
			FIGURE(S)
		57001–NA–0003	3.2.1.2–1
			PARAGRAPH(S)
		57001–NA–0004A	3.9.1, 3.9.2.A, 3.9.2.B, 3.9.2.1, 3.9.2.2, 3.9.3, 3.9.4.A, 3.9.4.B, 3.9.5, 3.9.6
			TABLE(S)
			3.9.2.1–1, 3.9.2.2–1 3.9.4–1, 3.9.6–1
			FIGURE(S)
			3.9.6–1

SSCBD	ENTRY DATE	CHANGE	PARAGRAPH(S)
		57001–NA–0005A	3.1, 3.1.1, 3.1.1.1.A 3.1.1.1.B, 3.1.1.1.C, 3.1.1.1.D, 3.1.1.2.A, 3.1.1.2.B, 3.1.1.3.A, 3.1.1.3.B, 3.1.1.3.C, 3.1.1.3.D, 3.1.2, 3.1.2.1, 3.1.2.2, 3.1.2.3, 3.9.1, 3.9.1.1, 3.9.1.2, 3.9.1.3
			TABLE(S)
			3.1.1.2.B–1, 3.1.1.2–1, 3.1.2–1, 3.1.2.1–1, 3.9.1.1–1, 3.9.1.3–1
			FIGURE(S)
			3.1.1.1.A–1, 3.1.1.1.A–2, 3.1.1.1.B–1, 3.1.1.1.C–1, 3.1.1.3.B.–1, 3.1.1.3.C–1, 3.1.2–1, 3.1.2–2, 3.1.2–3, 3.1.2–4, 3.1.2–5, 3.1.2.1–1 3.1.2.1–2, 3.1.2.2–1, 3.9.1.2–1

SSCBD	ENTRY DATE	CHANGE	PARAGRAPH(S)
		57001–NA–0006A	3.5.1.1, 3.5.1.2, 3.5.1.2.1.A, 3.5.1.2.1.B, 3.5.1.2.2, 3.5.1.2.3, 3.5.1.2.4, 3.5.1.2.5.A, 3.5.1.2.5.B, 3.5.1.3, 3.5.1.3.1.A, 3.5.1.3.1.B, 3.5.1.3.2, 3.5.1.3.3.A, 3.5.1.3.3.B, 3.5.1.3.4, 3.5.1.3.5.A, 3.5.1.3.5.B, 3.5.1.4, 3.5.1.4.1.A, 3.5.1.4.1.B, 3.5.1.4.2, 3.5.1.4.3.A, 3.5.1.4.3.B, 3.5.1.4.4, 3.5.1.4.5, 3.5.1.5, 3.5.1.5.1.A, 3.5.1.5.1.B, 3.5.1.5.2, 3.5.1.5.3, 3.5.1.5, 3.5.1.5.1, 3.5.1.5.1.1, 3.5.1.5.1.2, 3.5.1.5.2, 3.5.1.5.3, 3.5.1.6, 3.5.1.6.1, 3.5.1.6.1.1, 3.5.1.6.1.2, 3.5.1.6.2, 3.5.1.6.3, 3.5.1.7, 3.5.1.7.1.A, 3.5.1.7.1.B, 3.5.1.7.2.A, 3.5.1.7.2.B, 3.5.1.7.3, 3.5.1.7.4, 3.5.1.7.5.A, 3.5.1.7.5.B, 3.5.1.8, 3.5.1.8.1.A, 3.5.1.8.1.B, 3.5.1.8.2.A, 3.5.1.8.2.B, 3.5.1.8.3, 3.5.1.8.4, 3.5.1.8.5.A, 3.5.1.8.5.B, 3.5.1.9, 3.5.1.10
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			FIGURE(S)
			3.5.1.1–1, 3.5.1.2–1, 3.5.1.2.2–1, 3.5.1.2–2, 3.5.1.2.2–2, 3.5.1.3.1

SSCBD	ENTRY DATE	CHANGE	PARAGRAPH(S)
		57001–NA–0007	3.7, 3.7.1, 34.7.1.1, 3.7.1.2, 3.7.2, 3.7.2.1, 3.7.2.2, 3.7.3, 3.7.3.1, 3.7.3.2, 3.7.4, 3.7.4.1, 3.7.4.2
			FIGURE(S)
			3.7–1, 3.7.1.2–1 3.7–2, 3.7.2.2–1, 3.7.3.2–1, 3.7.4.2–1
			PARAGRAPH(S)
		57001–NA–0008	2.1, 3.8.1, 3.8.2
			TABLE(S)
			3.8–2
			FIGURE(S)
			3.8.1–1
			PARAGRAPH(S)
		57001–NA–0009A	3.6.1.A, 3.6.1.B, 3.6.1.1.A, 3.6.1.1.B, 3.6.1.2, 3.6.1.3, 3.6.2.A, 3.6.2.B, 3.6.2.1
			TABLE(S)
			3.6.1.1–1, 3.6.1.2–1, 3.6.2.1–1
			FIGURE(S)
			3.6.1–1, 3.6.2–1

SSCBD	ENTRY DATE	CHANGE	PARAGRAPH(S)
		57001–NA–0010A	3.3.1, 3.3.2.2, 3.3.3.1, 3.3.3.2, 3.3.4.1, 3.3.4.2, 3.3.5.1
			TABLE(S)
			3.3.3.2–1, 3.3.5.1–1, 3.3.5.2–1
			FIGURE(S)
			3.3.1–1, 3.3.3.1–1, 3.3.3.1–2, 3.3.3.1–3
			PARAGRAPH(S)
		57001–NA–0011A	3.4.1.2, 3.4.2.1
			TABLE(S)
			3.4.2.1–1
			FIGURE(S)
			3.4.1.2–1, 3.4.1.2–2
			PARAGRAPH(S)
		57001–NA–0012A	5.0, 5.1, 5.1.1, 5.1.2, 5.1.3, 5.1.4, 5.2, 5.2.1, 5.2.2, 5.2.3, 5.2.3.1, 5.2.3.1.1, 5.2.3.2, 5.2.3.3, 5.2.3.4, 5.2.3.4.5, 5.2.3.5.1, 5.2.3.5.2, 5.2.3.5.3, 5.2.3.5.4, 5.2.4, 5.3, 5.4
			TABLE(S)
			5.1–1, 5.2.2–1, 5.4–1
			FIGURE(S)
			5.0–1, 5.1–1, 5.2–1, 5.2.4–1
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			Appendix B

SSCBD	ENTRY DATE	CHANGE	PARAGRAPH(S)
		57001–NA–0013C	3.2.1.1, 3.2.1.2, 3.2..2.1, 3.2.3, 3.2.5, 3.2.5.1, 3.2.5.2.A, 3.2.5.2.B, 3.2.6, 3.2.6.B, 3.2.7
			TABLE(S)
			3.1.2–1, 3.2.1.2–1, 3.2.4–1, 3.2.4–2, 3.2.6–1, 3.2.7–1, 3.2.7–2
			FIGURE(S)
			3.2.1.1–1, 3.2.1.2–1, 3.2.1.2–2, 3.2.1.2–3, 3.2.1.2–4, 3.2.1.2–5, 3.2.1.2–6, 3.2.2.1–1, 3.2.2.1–2, 3.2.5–1, 3.2.5–2, 3.2.5–3, 3.2.5–4, 3.2.5–5, 3.2.5.1–1, 3.2.5.2–1, 3.2.5.2–2, 3.2.5.2–3, 3.2.5.2–4, 3.2.6–1, 3.2.6–2, 3.2.6–3, 3.2.6–4, 3.2.6–5, 3.2.6–6
			TABLE(S)
		57001–NA–0014	4.2–1
			TABLE(S)
002534	21–JULY–99	57001–NA–0015	3.5.1.2–2
			PARAGRAPH(S)
		57001–NA–0016	3.5.1.3
			TABLE(S)
			3.5.1.3–1
			TABLE(S)
		57001–NA–0017A	3.5.1.3–1

SSCBD	ENTRY DATE	CHANGE	PARAGRAPH(S)
		57001–NA–0018B	2.1, 3.1.1.3, 3.2.1.2, 3.2.1.3, 3.2.3, 3.2.4, 3.2.6, 3.3.1, 3.3.5, 3.3.5.1, 3.3.5.2, 3.3.5.3, 3.4.1.1, 3.5.1.5.3, 3.5.1.6, 3.6.1, 3.6.2, **TABLE(S)** 3.1.2–1, 3.2.1.2–1, 3.2.1.2–2, 3.2.1.3–1, 3.2.4–1, 3.2.4–2, 3.2.4–3, 3.2.6–1, 3.3.3.2–1, 3.5.1.2–1, 3.5.1.6–1, 3.5.1.8–1, **FIGURE(S)** 3.1.1.1–1, 3.1.1.1–2, 3.1.1.2–1, 3.1.1.3–1, 3.1.1.3–2, 3.2.1.1–1, 3.2.1.2–2, 3.2.1.2–4, 3.2.1.2–5, 3.2.1.2–6, 3.2.1.3–1, 3.2.1.3–2, 3.2.1.3–3, 3.2.1.3–4, 3.2.1.3–5, 3.2.1.3–6, 3.2.1.3–7, 3.2.1.3–8, 3.2.1.3–9, 3.2.1.3–12 3.2.2.1–1, 3.2.6–1, 3.2.6–4, 3.2.6–5, 3.2.7–2, 3.3.3.1–1, 3.3.3.1–2, 3.3.3.1–3, 3.3.5.3–1, 3.4.2.1–1, 3.6.1–1, 3.6.1–2, 3.6.1–3, 3.6.2–1 3.6.2–2, 3.6.2–3 3.6.2–2, 3.6.2–3 3.6.2–2, 3.6.2–3

SSCBD	ENTRY DATE	CHANGE	PARAGRAPH(S)
			FIGURE(S)
		57001–NA–0019A	3.2.5.2–1, 3.2.5.2–2, 3.2.5.2–3
			TABLE(S)
003164E	01–NOV–00	57001–NA–0020	3.5.1.3–1
			PARAGRAPH(S)
		57001–NA–0021G	3.5.1.2
			TABLE(S)
			3.5.1.2–1
			3.5.1.2–2
			ADDENDA
			Appendix A
			PARAGRAPH(S)
		57001–NA–0022	3.5.1.2
			TABLE(S)
			3.5.1.2–3
			FIGURE(S)
			3.5.1.2–3
		57001–NA–0023	**PARAGRAPH(S)**
			2.1,
			3.8.1
		57001–NA–0028	**PARAGRAPH(S)**
			3.8.2

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PARAGRAPH PAGE

APPENDIX

TABLES

FIGURES

FIGURES (Continued)

FIGURES (Continued)

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1.0 INTRODUCTION

1.1 PURPOSE

This Interface Control Document (ICD) Template is the primary source of design implementation and module specific interfaces of the Pressurized Payload Interface Requirements Document. This document is a template used to develop unique ICDs. The ICD controls the ISS and payload interfaces of 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 Mini-Pressurized Logistics Module (MPLM). The physical, functional, and environmental design implementation associated with payload safety and interface compatibility are included herein. The ICDs derived from this document control the hardware interfaces between the pressurized modules and specific payload racks.

1.2 SCOPE

The interfaces defined in this document apply to transportation and on-orbit phases of the payload mission cycle. Transportation interfaces are specific to the MPLM. The reader is referred to NSTS 21000-IDD-MDK for requirements related to transportation in the Shuttle middeck area and SSP 50018 for requirements related to ISS stowage. On-orbit interfaces apply to all integrated racks or payloads and sub–rack to ISS Utility Outlet Panel (UOP) in the pressurized volumes of the ISS.

1.3 USE

This document will form the basis for payload-unique ICDs. Section 3 of this document contains design implementation and module specific interface information while Section 4 has an applicability matrix that provides traceability back to the IRD requirements and corresponding verification requirements contained in SSP 57000, the Pressurized Payload Interface Requirements Document (IRD). Payload developers will be responsible for providing payload specific interface information in Section 3 when a specific interface is being utilized as well as identifying all applicable IRD requirements for that interface in the applicability matrix contained in Section 4. The information provided in these two sections are the fundamental elements for every payload–unique ICD. In addition, Section 5 contains a Table that payload developers will utilize to document exceptions to requirements in SSP 57000 or interfaces defined in this document.

Note: At this point in the development of payload-unique ICDs, a payload has the capability to take exception to any interface or requirement by following the procedures outlined in Section 5 of this document. However, by doing so, a payload developer will be responsible for any analysis, documentation and forwarding the exception for approval. Payload-unique ICDs will not alter the interfaces in this document; they can only identify which interface and requirements apply or do not apply, or those they take exception to. When a payload states that a requirement is applicable, it is also accepting the verification requirements in SSP 57000 as well. Figure 1.3–1 shows the inter–relationship of the IRD, ICD Template, and Unique Payload ICD.

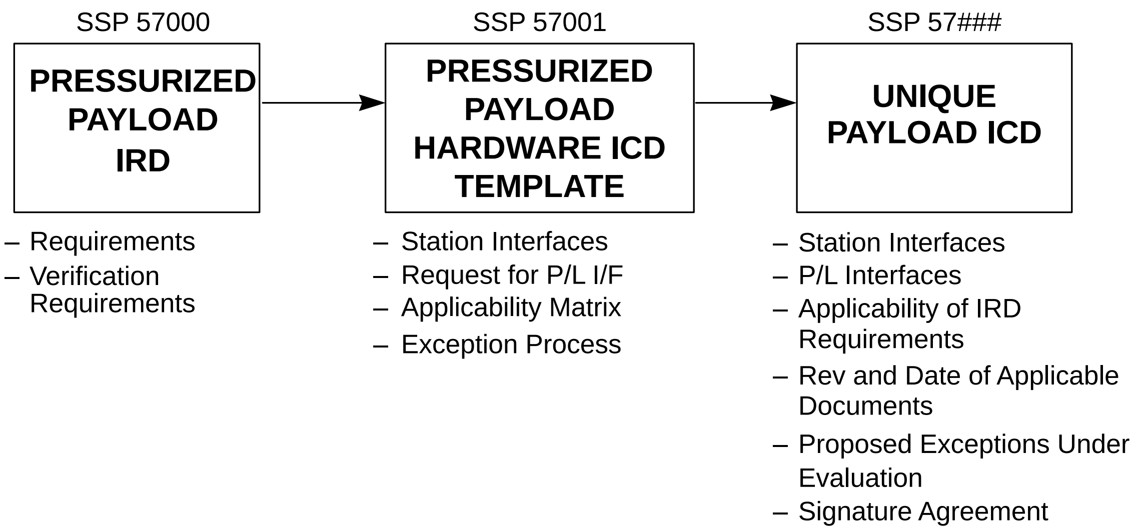


FIGURE 1.3–1 PAYLOAD INTERFACE REQUIREMENTS AND CONTROL PROCESS

1.4 PAYLOAD DESCRIPTION

> Note:
>
> The rack integrator will provide a top–level functional description and isometric view of their integrated racks. This includes, but is not limited to, purpose, physical and functional description, modes of operation and unique integrated rack or payload characteristics.

2.0 DOCUMENTATION

The following documents shown include specifications, models, standards, guidelines, handbooks, and other special publications. Specific date and revision number of documents under control of the Space Station Control Board can be found in SSP 50257, Program Control Document Index or SSP 50258, Prime Control Document Index. The documents in this section are inclusive to those specified in this document and form a part of this specification to the extent specified herein. In the event of a conflict between the documents referenced and the contents of this ICD, the contents of this ICD shall be considered a superseding requirement.

2.1 APPLICABLE DOCUMENTS

DOCUMENT NO.	TITLE
683–16348	Coupling, Quick Disconnects, Fluid, Self–sealing, Internal Envelope Drawing
683–50243	Envelope Drawing for Refrigerator/Freezer Rack Structure
MIL–C–38999	Connector, Electrical Circular, Miniature, High Density, Quick Disconnect, Environment Resisting, Removable Crimp and Hermetically Soldered Contacts
MIL–STD–1553B	Digital Time Division Command/Response Multiplex Data Bus
NSTS 1700.7B, ISS	Safety Policy and Requirements for Payloads using the International Space Station System
SSP 30426	External Contamination Control Requirements
SSP 30482 (V1)	Electric Power Specifications and Standards, Vol. 1: EPS Performance Specifications
SSP 30482 (V2)	Electric Power Specifications and Standards, Vol. 2: Consumer Constraints
SSP 30573	Space Station Program Fluid Procurement and Use Control Specification
SSP 41002	International Standard Payload Rack to NASA/NASDA Modules Interface Control Document
SSP 41017	Rack to Mini Pressurized Logistics Module Interface Control Document (ICD) Part 1 and Part 2
SSP 41162	Segment Specification for the United States On–Orbit
SSP 52051	ISS User Power Quality Specification
SSP 57000	Pressurized Payload Interface Requirements Document

DOCUMENT NO.	TITLE
SSP 57010	Generic Payload Verification Plan
SSQ 21635	Connectors and Accessories, Electrical, Rectangular, Rack and Panel
SSQ 21655	Cable, Electrical, MIL-STD-1553 Data Bus, Space Quality, General Specification for Document
SSQ 21676	Coupler, Data Bus, MIL–STD–1553B; Space Quality, General Specification
SSQ 26678	Interconnection, MIL–STD–1553B; Space Quality, General Specification

2.2 UNIQUE ICD APPLICABLE DOCUMENTS

Rack integrators will be developing their integrated racks to the current version of SSP 57000 and the Pressurized Payload IRD applicable documents that correspond to requirements marked as applicable in the Chapter 4 Applicability matrix of their unique ICD. This matrix provides the traceability back to the applicable IRD requirement and hence the corresponding verification requirement. Rack integrators will be responsible for impacting any changes processed as ISS Payload Office PIRNs to these applicable documents and report to the ISS Program Office as to whether the changes impact them. Changes that impact integrated rack development will be handled with either a waiver or design change that is approved by the ISS Program Office.

3.0 PAYLOAD INTERFACE

3.1 STRUCTURAL/MECHANICAL

3.1.1 RACK ATTACHMENT INTERFACES

3.1.1.1 GSE INTERFACES

A. The KSC Rack Insertion Device (RID) attaches to the GSE interfaces on the front of the rack as defined in SSP 41017 Part 2, paragraph 3.3.3, Ground Handling Attachment Interfaces, and will accommodate only the payload protrusions identified in SSP 41017 Part 1, paragraph 3.2.1.1.2 Static Envelope. It also pivots the rack to install it into the MPLM. The pivot keepout envelope is also identified in SSP 41017 Part 1, paragraph 3.2.1.1.2 Static Envelope. RID Ground handling loads for GSE points E, F, G, H are identified in SSP 41017 Part 1, paragraph 3.2.1.4.3 Interface Loads, and are much less than the launch and landing loads for points A, B, C, and D. The NASA 683–50243–4 ISPR and the NASDA ISPR meet the interfaces defined above.

Notes:
1. The rack integrator will provide a drawing of the integrated rack with all protrusions, including any payload GSE present during MPLM integration, beyond the rack posts dimensioned to show compliance with the static envelope. All identified protrusions will be dimensioned from the lower left GSE boss.
2. The rack integrator will provide a drawing that shows the lower front umbilical routing demonstrating that the RID keepout envelope is provided. Provide a brief description of the method by which the umbilicals will be restrained.
3. If different than a NASDA ISPR or NASA 683–50243–4 ISPR, detailed rack drawings which include GSE dimensions should be provided.

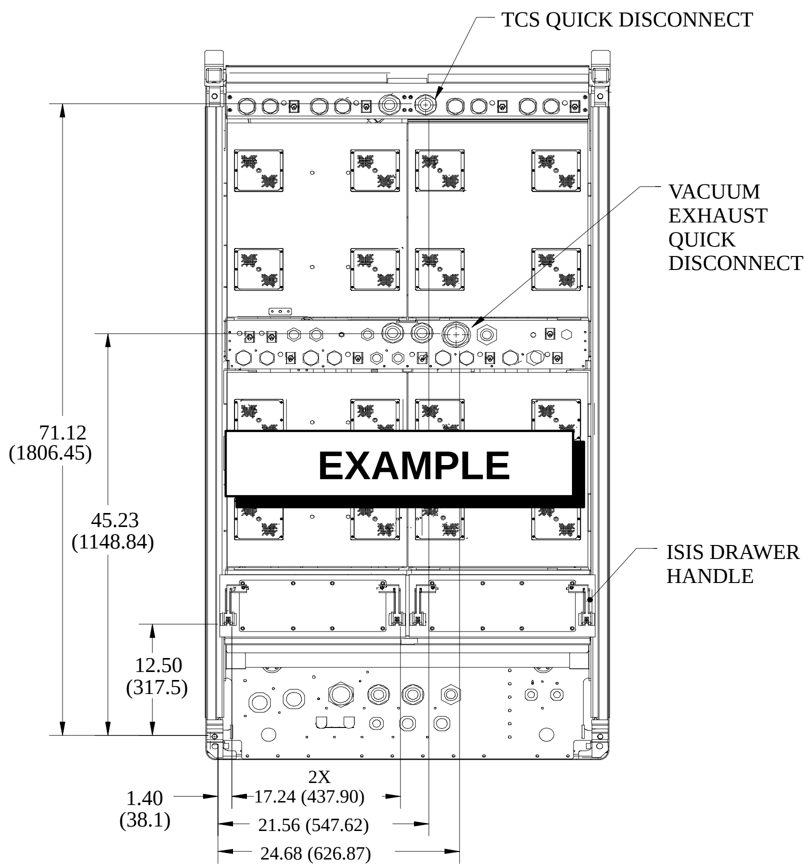
Rack Protrusions which affect ground processing are illustrated in Figure 3.1.1.1–1. The rack umbilical restraint envelope is shown in Figure 3.1.1.1–2.

B. All integrated racks may be shipped in an ISS–provided Rack Shipping Container (RSC). The integrated rack interfaces to the RSC per Teledyne Brown Engineering (TBE) drawing 220G07500, Shipping Container Integrated Assembly. The RSC accommodates the static envelope of the ISPR identified in SSP 41017 Part 1, paragraph 3.2.1.1.2 Static Envelope.

Note:

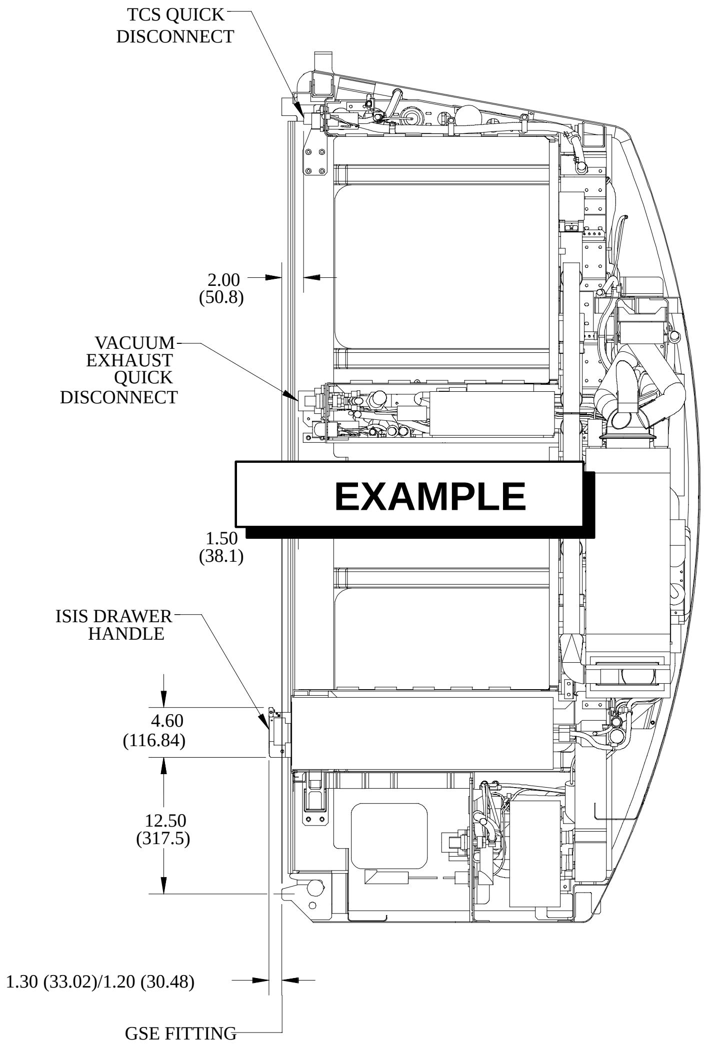
The rack integrator will identify whether the rack will be shipped in an ISS–provided RSC. If the integrated rack is shipped in an ISS RSC and the defined static envelope is exceeded, the rack integrator will provide a drawing of the integrated rack within the RSC identifying all clearance dimensions.

The Rack will [will not] utilize an ISS–provided RSC for shipping.



Dimensions Are In Inches (mm)

FIGURE 3.1.1.1–1 RACK PROTRUSIONS (SHEET 1 OF 2)



Dimensions Are In Inches (mm)

FIGURE 3.1.1.1–1 RACK PROTRUSIONS (SHEET 2 OF 2)

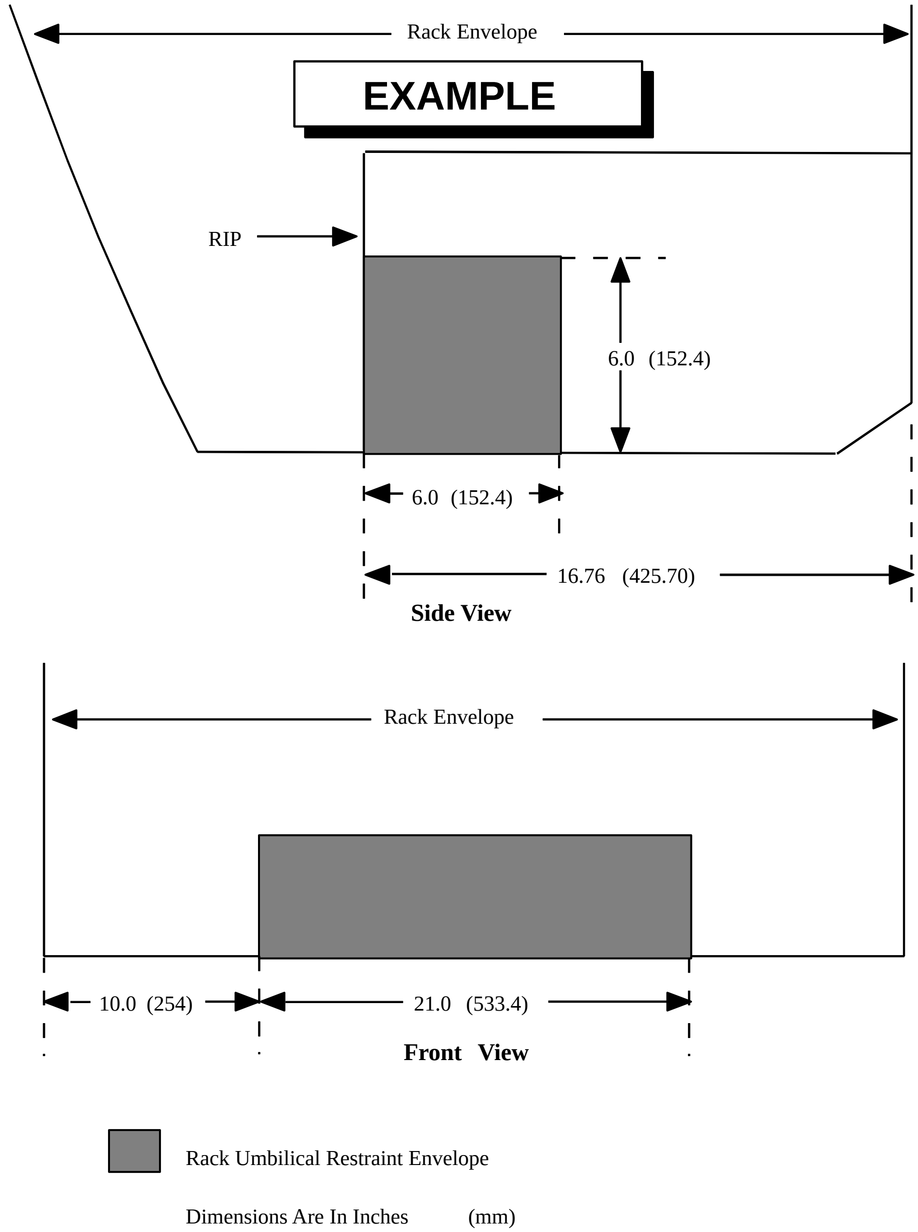


FIGURE 3.1.1.1–2 RACK UMBILICAL ROUTING

C. All NASA ISPRs are integrated in a Rack Handling Adapter (RHA). NASDA Racks may be integrated in a NASDA Rack Stand. The KSC Payload Test and Checkout System (PTCS) will only accommodate an integrated rack in an ISS RHA with SSPF Base. The integrated rack interfaces with the RHA per TBE drawings 220G07455 Upper Structure Assembly, 220G07470 MSFC Base Assembly, and 220G07475 SSPF Base Assembly. The RHA accommodates the static envelope of the ISPR identified in SSP 41017 Part 1, paragraph 3.2.1.1.2 Static Envelope.

> Note:
>
> The rack integrator will identify whether the rack will be integrated in an ISS–provided RHA. If the rack does not utilize the ISS RHA, indicate the GSE to be used for integration.

3.1.1.2 MPLM INTERFACES

A. MPLM interfaces for rack attach points A, B, (lower rear attach points) C, D (upper kneebrace attach points) and pivot points I, J are identified in SSP 41017 part 2, figure 3.1.1–1. Any MPLM location restrictions are identified in Figure 3.1.1.2–1.

> Notes:
>
> 1. If different than a NASA or NASDA ISPR, detailed drawings of the integrated rack to MPLM interfaces should be provided to ensure the rack meets the MPLM interfaces.
> 2. Any specific rack characteristics which may affect the location of the integrated rack within the MPLM must be identified. Based on the identified rack characteristics the module integrator will identify the location(s) to which the integrated rack's location must be restricted in Figure 3.1.1.2–1.

B. An integrated rack must weigh less than or equal to 1773 pounds.

> Note:
>
> The rack integrator will identify the estimated maximum rack weight and c.g. of the integrated rack for each of the following phases: integration, launch, on–orbit, and landing.

The Rack mass and center of gravity are defined in Table 3.1.1.2–1.

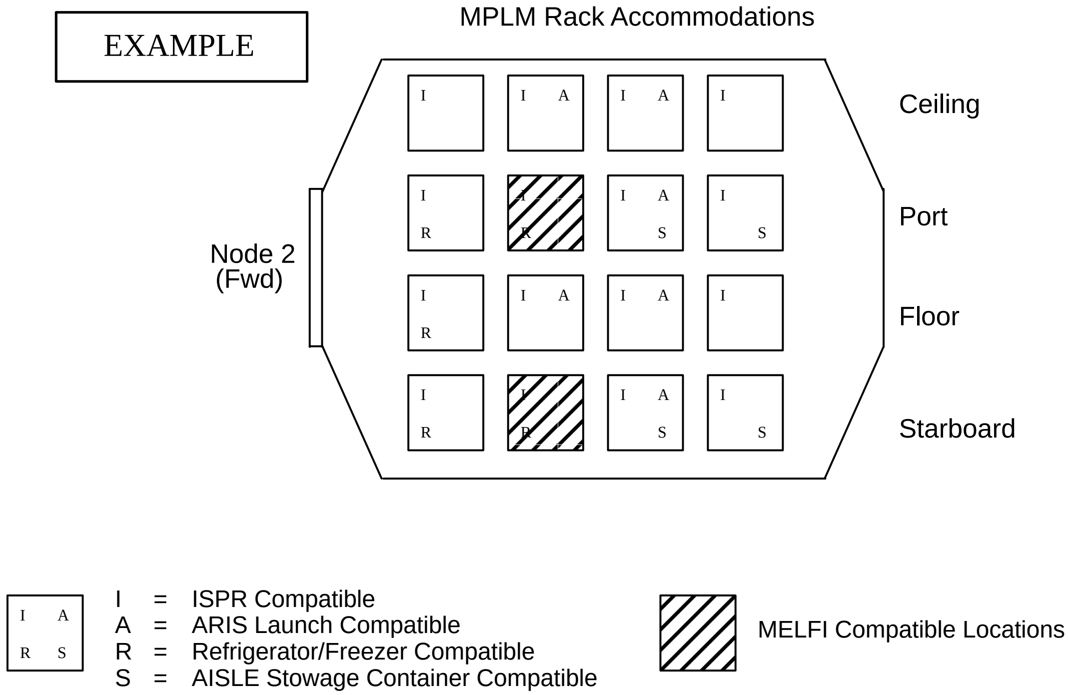


FIGURE 3.1.1.2–1 MPLM RACK RESTRICTIONS

TABLE 3.1.1.2–1 RACK MASS AND CENTER OF GRAVITY (CG)

PHASE	MASS (lbs)	CG (in)
Integration		x: y: z:
Launch		x: y: z:
On–Orbit		x: y: z:
Landing		x: y: z:

Note: The cg reference point is the Rack Datum Point defined in Figure 3.1.3–1, Rack Coordinate System of SSP 41017 Part 2.

3.1.1.3 ISS INTERFACES

A. An integrated rack interfaces to the ISS at attachment point locations C, D, I and J as defined in SSP 41017 Part 1, Section 3.2.1.1.1 and SSP 41047 Part 2, Section 3.1.1. The NASA and NASDA ISPRs meet these interfaces.

B. The Rack on–orbit protrusions are identified in Figure 3.1.1.3–1.

Notes:
1. The rack integrator will identify the dimensions and approximate location of all protrusions applicable for on–orbit operations. All identified protrusions will be dimensioned from the lower left GSE boss (center front of the hole).
2. Characterize the protrusions as permanent, semi–permanent, or temporary.
3. Identify the maximum rack rotation angle dictated by the protrusions which will be present during installation and maintenance activities.

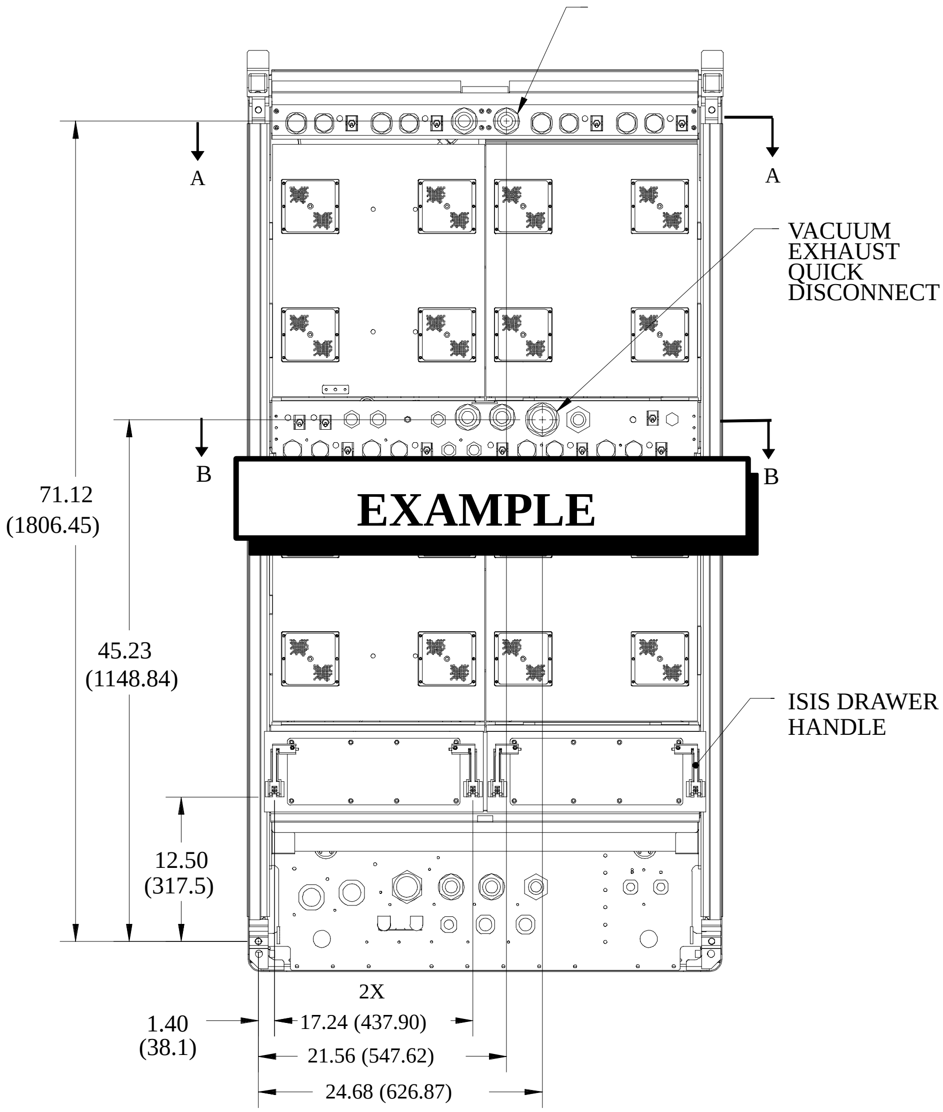
C. The integrated rack Portable Fire Extinguisher (PFE) access port, Rack Maintenance Switch (rack power switch), Smoke Indicator LED, and all Caution and Warning labels must be clearly visible and unobstructed. A keep out zone must be maintained for insertion of the PFE bottle. Figure 3.1.1.3–2 identifies the location of the PFE access port, Rack Maintenance Switch (rack power switch), Smoke Indicator LED, and all Caution and Warning labels.

Note:

The rack integrator will provide a drawing that identifies the location of all of the following:
1. All PFE access ports
2. Identify the keep out zones for the insertion of the PFE bottle
3. Rack Maintenance Switch (rack power switch)
4. Smoke Indicator LED
5. All Caution and Warning labels

Dimensions in each of the three coordinate axes referenced to the lower left GSE boss (center front of the hole) must be provided. The drawing should illustrate that each of these items are unobstructed.

D. The Integrated Rack on–orbit mass and c.g. are defined in Table 3.1.1.2–1.



Dimensions Are In Inches (mm)

FIGURE 3.1.1.3–1 RACK ON–ORBIT PROTRUSIONS (SHEET 1 OF 2)

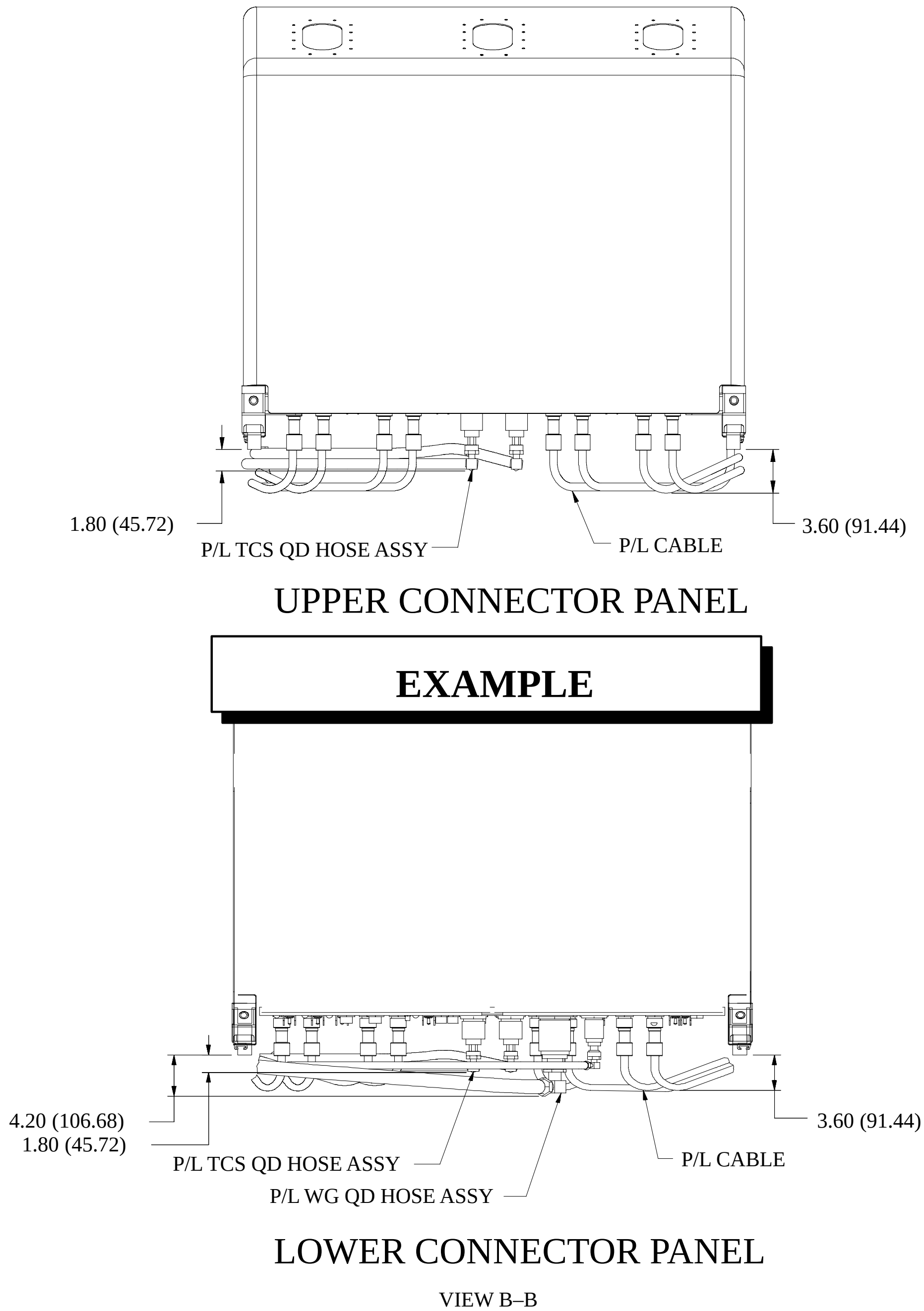


FIGURE 3.1.1.3–1 ON–ORBIT PROTRUSIONS (SHEET 2 OF 2)

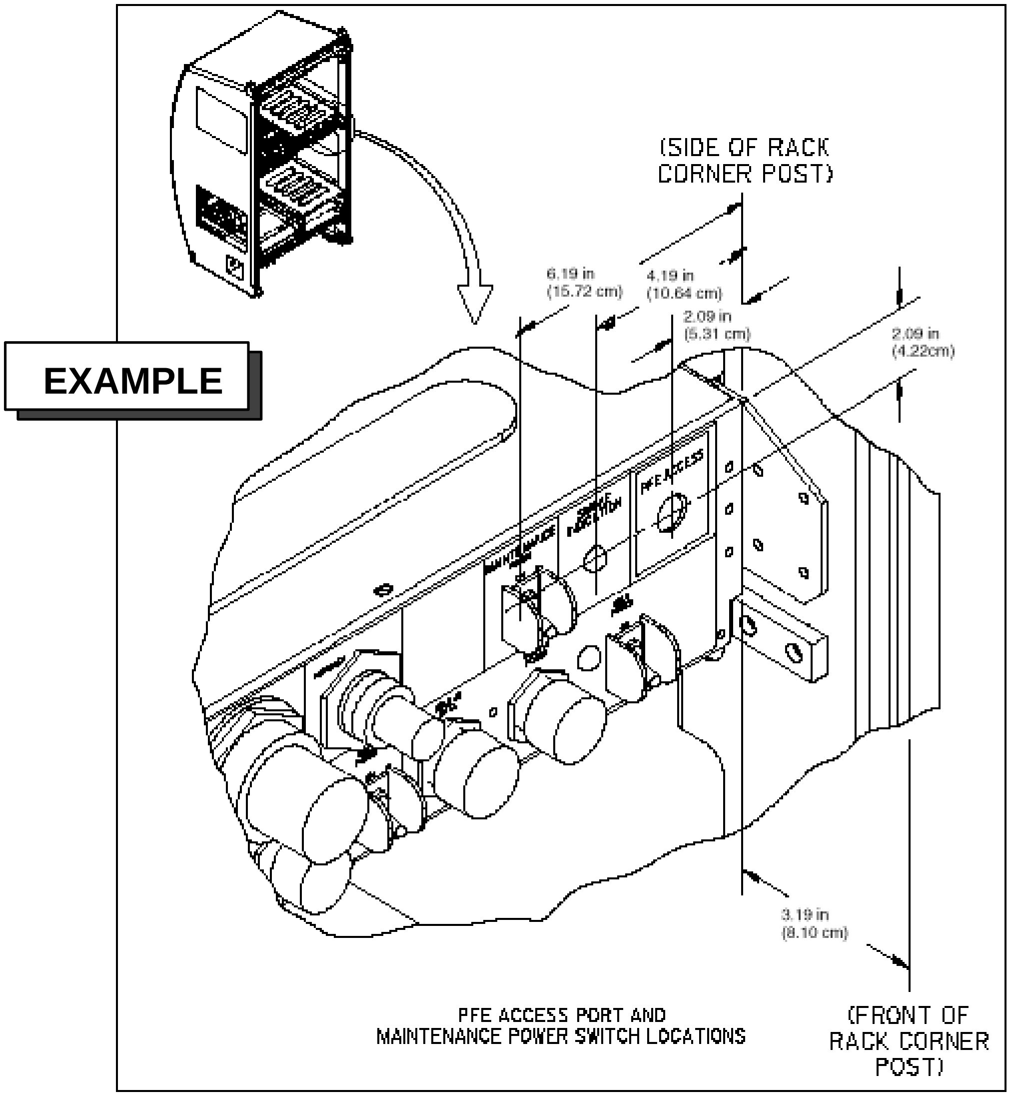


FIGURE 3.1.1.3–2 PFE ACCESS PORT LOCATION

3.1.2 CONNECTOR INTERFACES

The physical interface of the integrated rack to ISS system services is at the Utility Interface Panel (UIP). The UIP location is shown in Figure 3.1.2–1. The ISS system services connector layout at the UIP is shown in Figures 3.1.2–2 through 3.1.2–5. The ISS system services connectors are defined in Table 3.1.2–1.

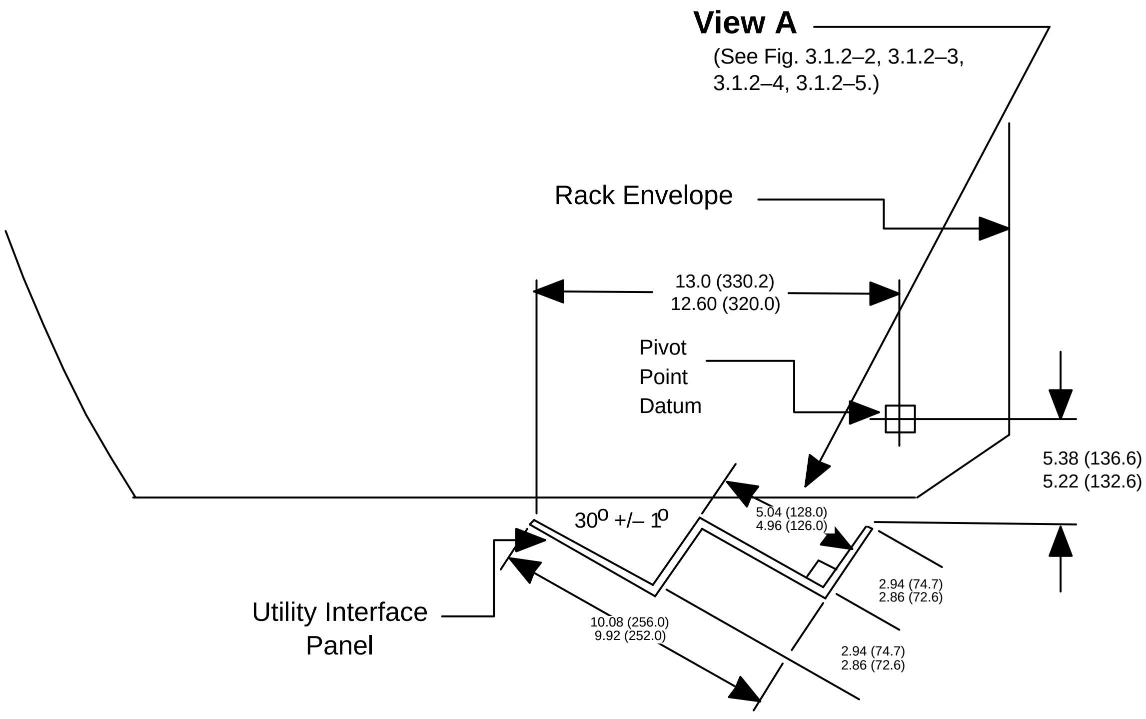
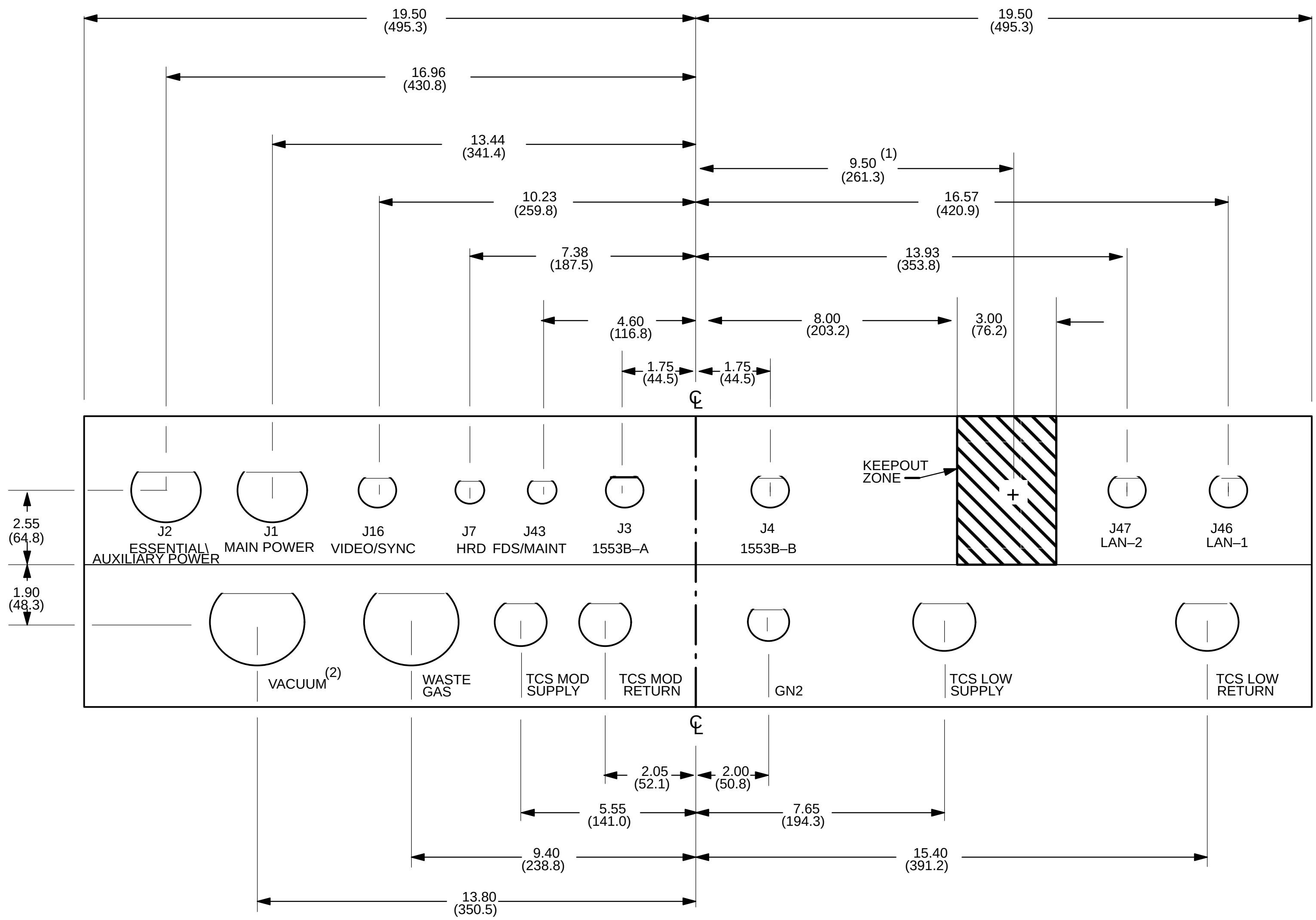
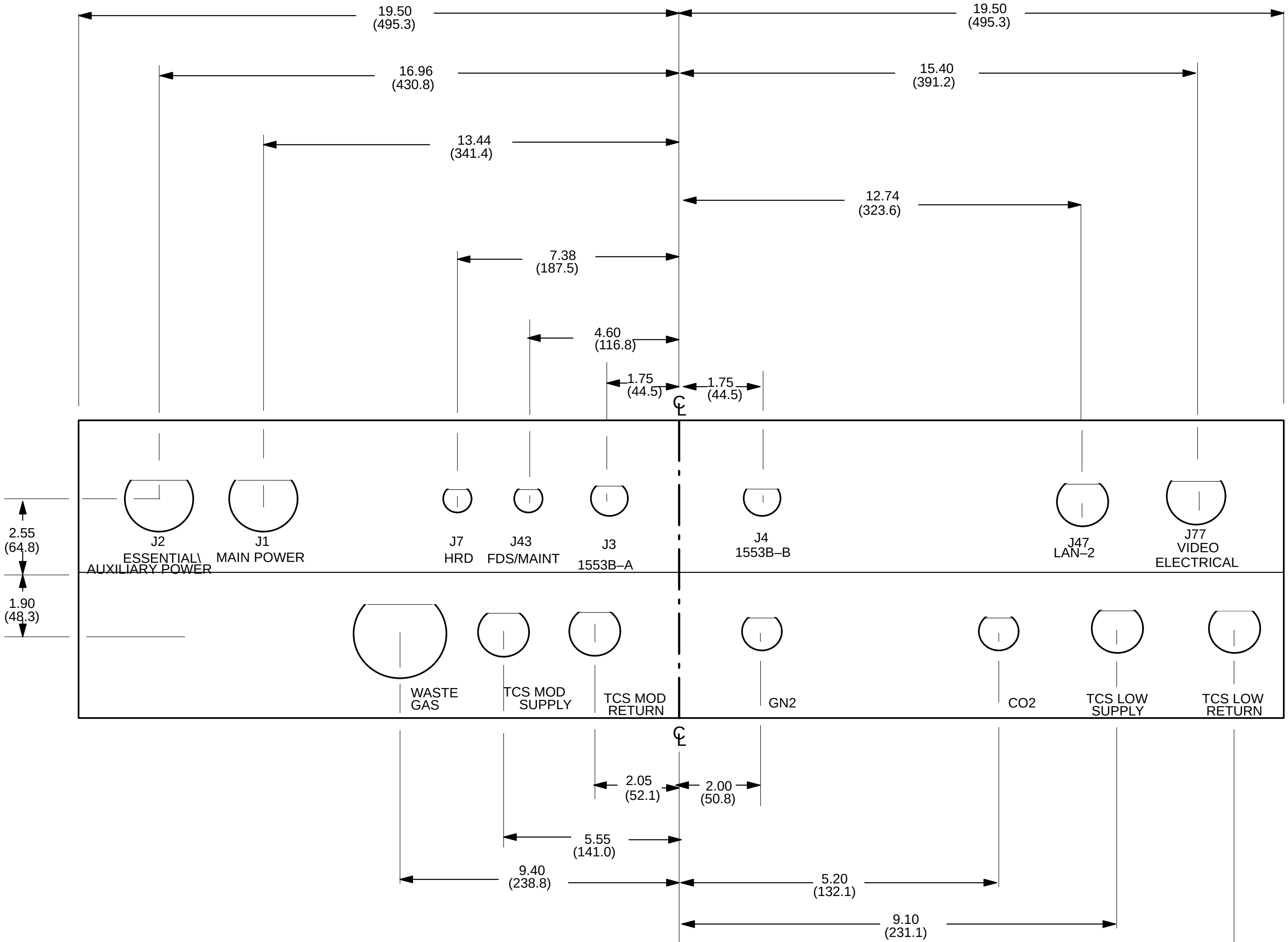


FIGURE 3.1.2–1 UIP LOCATION AND DIMENSIONS



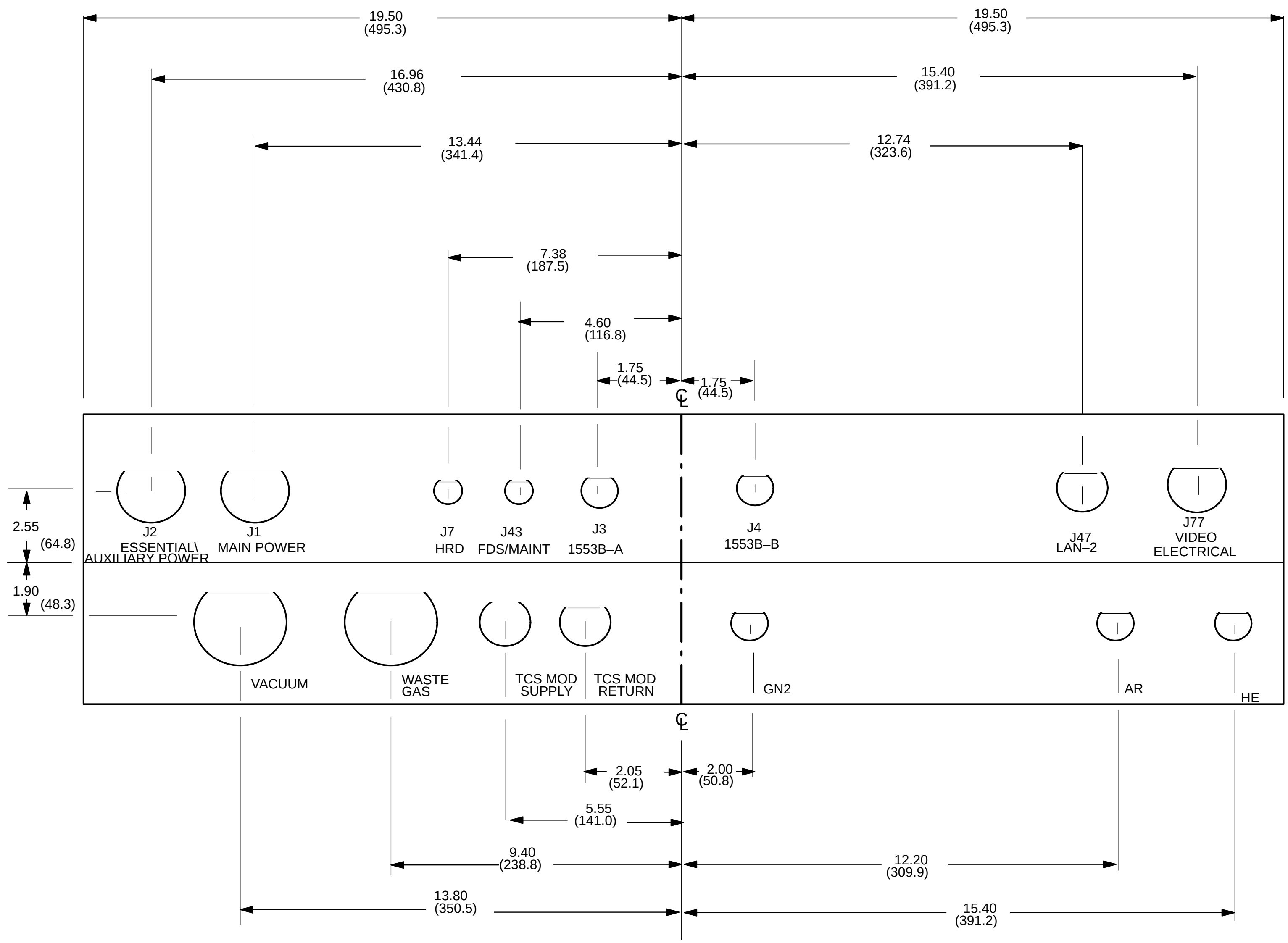
1) Receptacle P/N 991R2–1BP to be installed at location shown.
2) Not available on USL Racks LAP1, PLAP2, LAP4, LAF3. All dimensions are nominal dimensions.

FIGURE 3.1.2–2 USL SPECIFIC CONNECTOR LOCATIONS



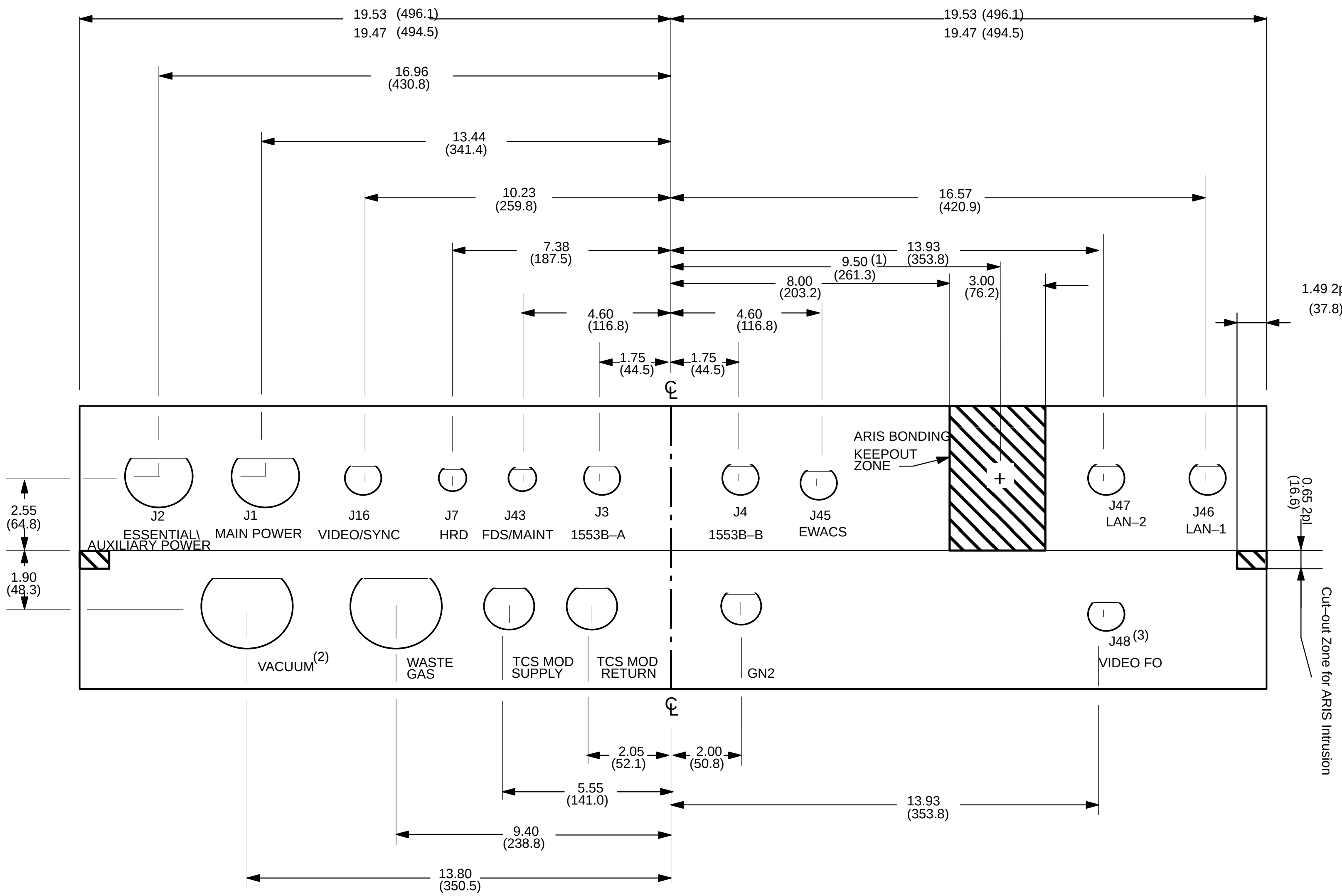
NOTE : All dimensions are nominal dimensions.

FIGURE 3.1.2–3 NASDA LIFE SCIENCE RACK CONNECTOR LOCATIONS



NOTE : All dimensions are nominal dimensions.

FIGURE 3.1.2–4 NASDA MATERIAL PROCESSING RACK CONNECTOR LOCATIONS



1) Receptacle P/N 991R2–1BP to be installed at location shown.
2) NA for rack O1 and rack O2.
3) Connector J48 VIDEO FO is present in Rack A4 ONLY.All dimensions are nominal dimensions.

FIGURE 3.1.2–5 APM SPECIFIC CONNECTOR LOCATIONS

TABLE 3.1.2–1 ISS SYSTEM SERVICES CONNECTOR PART NUMBERS

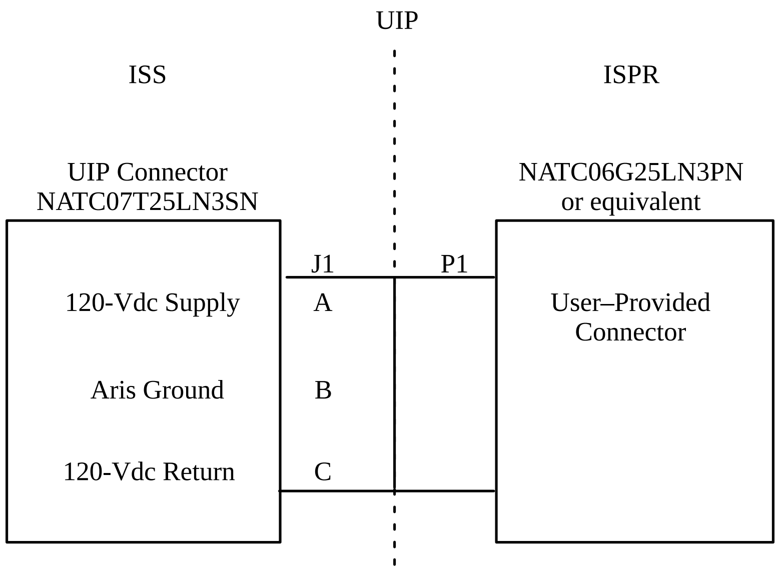
ISS Resource	ISS Connector Designation	ISS Part Number	Integrated Rack Part Number
UIP			
Main Power	J1	NATC07T25LN3SN	
Essential/Auxiliary Power	J2	NATC07T25LN3SA	
MIL–STD–1553B Bus A	J3	NATC07T15N35SN	
MIL–STD–1553B Bus B	J4	NATC07T15N35SA	
HRDL	J7	NATC07T13N4SN	
Optical Video	J16	NATC07T15N97SB	
FDS/Power Maintenance	J43	NATC07T13N35SA	
EWACS	J45	NATC07T11N35SC	
LAN–1	J46	NATC07T11N35SA	
LAN–2	J47	NATC07T11N35SB	
Electrical video	J77	NATC07T13N35SB	
TCS Moderate Temp Loop Supply	TCS MOD SUPPLY	683–16348, Male Category 6, Keying B	
TCS Moderate Temp Loop Return	TCS MOD RETURN	683–16348, Male, Category 6, Keying C	
TCS Low Temp Loop Supply	TCS LOW SUPPLY	683–16348, Male, Category 6, Keying B	
TCS Low Temp Loop Return	TCS LOW RETURN	683–16348, Male, Category 6, Keying C	
Vacuum Exhaust System	WASTE GAS	683–16348, Male, Category 3, Keying B	
Vacuum Resource System	VACUUM	683–16348, Male, Category 3, Keying A	
Gaseous Nitrogen	GN2	683–16348, Male, Category 8, Keying B	
Argon	Ar	683–16348, Male, Category 8, Keying C	
Helium	He	683–16348, Male, Category 8, Keying E	
Carbon Dioxide	CO2	683–16348, Male, Category 8, Keying D	
Fluid Services			
Potable Water	Potable Water	683–16348, Male, Category 7, Keying D	
Fluid System Servicer	Fluid System Servicer	683–16348, Male, 0.50 inch QD, Universal (no keying)	
UOP			
UOP Power/Data	J3	NATC00T15N97SN	
UOP Power/Data	J4	NATC00T15N97SN	
UOP Power/Data	J4	NATC00T15N97SA	
SUP – APM			
Power/Data	J1	NATC00T15N97SN	
Power/Data	J2	NATC00T15N97SN	
Power	J3	NATC00T15N97SN	
APM Payload 1553 Bus	J4 (SUP 1 & 4 only)	NATC00T15N35SN	
APM IEEE 802.3 Nominal LAN	J5	NATC00T11N35SN	
Video/High Rate Data	J6 (SUP 1 & 4 only)	NATC00T15N97SN	
Smoke Sensor/EWACS	J7 (SUP 1 & 4 only)	NATC00T13N35SA	
Reserved	J8	Reserved	
APM IEEE 802.3 Redundant LAN	J9	NATC00T11N35SN	

3.2 ELECTRICAL POWER INTERFACES

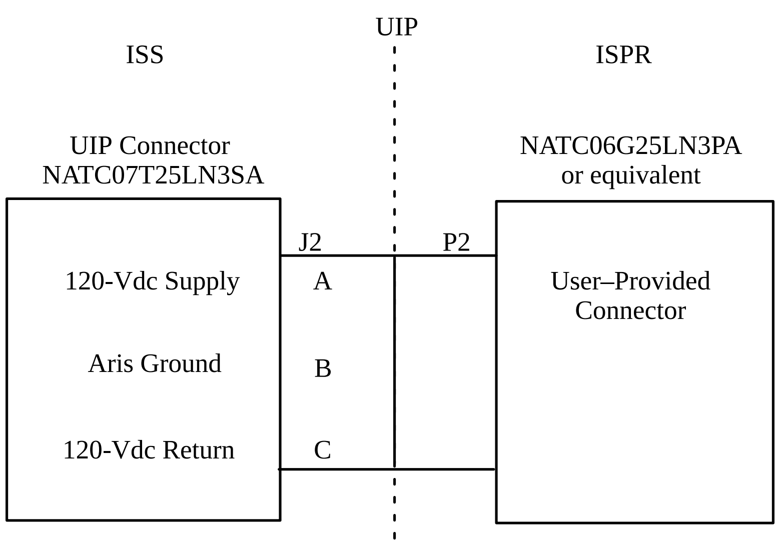
3.2.1 CONNECTORS

3.2.1.1 UTILITY INTERFACE PANEL

The Integrated rack electrical power connectors, J1 and J2, interfaces at the UIP are defined in Figures 3.1.2–1 through 3.1.2–5. The J1 and J2 part numbers are defined in Table 3.1.2–1 and the pin assignments are defined in Figure 3.2.1.1–1.



P1 Power Interface (3 kW or 6 kW)



P2 Power Interface (1.2 kW to 1.44 kW) or (6kW in 12 kW Location)

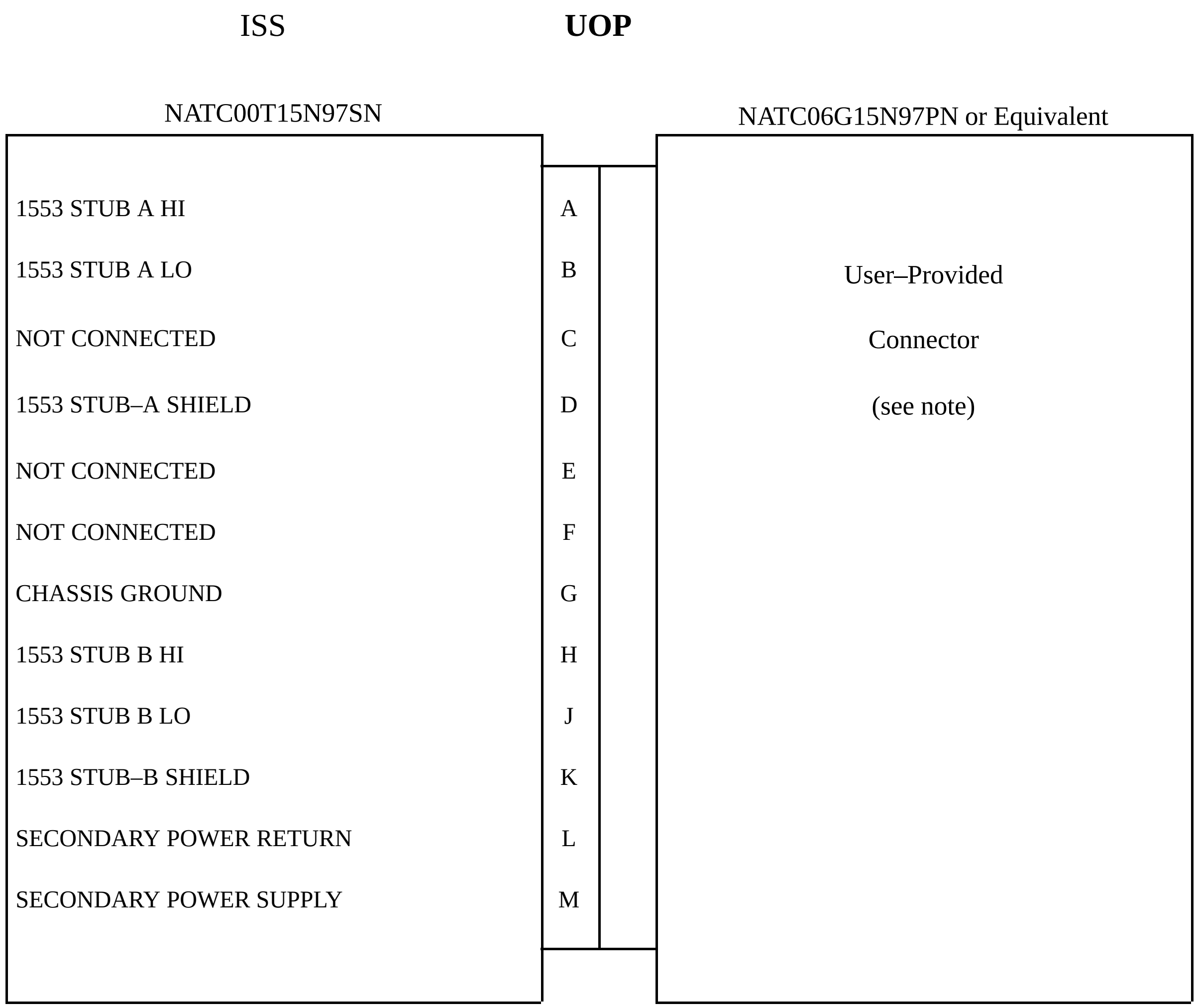
NOTE: Pin B only used for ARIS racks.
The ARIS Ground in the JEM is only available at ISPR locations A1, A5, and F1.

> NOTE: The integrated rack developer will define the integrated rack pin assignments for the UIP J1/J2 connectors in Figure 3.2.1.1–1.

FIGURE 3.2.1.1–1 UIP ELECTRICAL POWER CONNECTORS AND PIN ASSIGNMENTS

3.2.1.2 UTILITY OUTLET PANEL

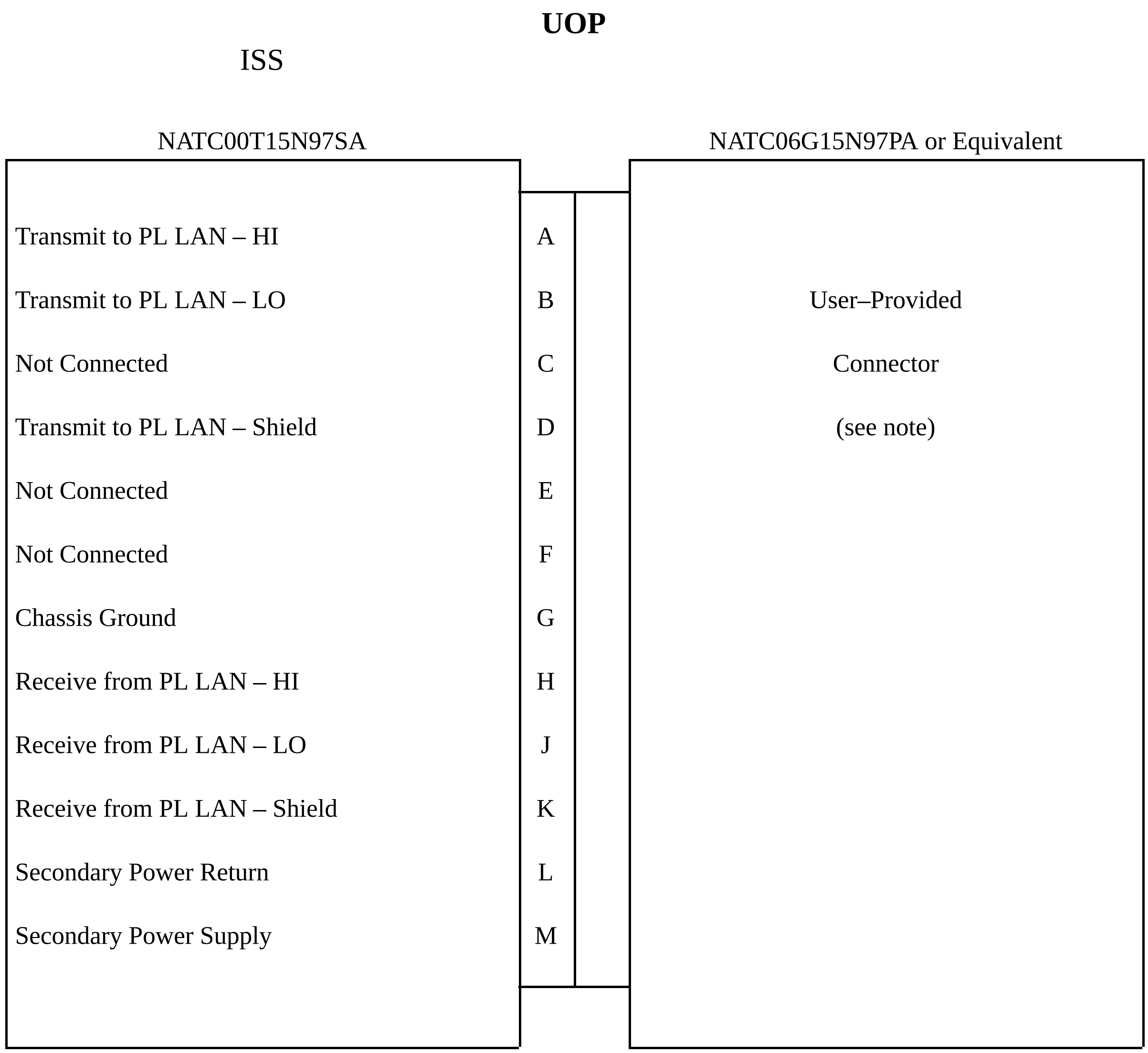
The Utility Outlet Panel (UOP) electrical power and data connectors, J3 and J4, part numbers are defined in Table 3.1.2–1. The pin assignments for the UOP, module connector numbers NATC00T15N97SN and NATC00T15N97SA, are defined in Figure 3.2.1.2–1 and 3.2.1.2.–2 respectively. UOP locations for the USL, JEM, and CAM are shown in Figures 3.2.1.2–3, 3.2.1.2–4, and 3.2.1.2–5 respectively. The UOP capabilities by module are summarized in Table 3.2.1.2–1 and 3.2.1.2–2.



Note: User has the option of connecting data cable shields directly to connector backshell or mating shields to shield pins D and K respectively.

> Note:
> The integrated rack developer will define the integrated rack pin assignments for the UOP (module connector number NATC00T15N97SN) in Figure 3.2.1.2–1.

FIGURE 3.2.1.2–1 UOP ELECTRICAL POWER/1553 CONNECTOR AND PIN ASSIGNMENTS



Note: User has the option of connecting data cable shields directly to connector backshell or mating shields to shield pins D and K respectively.

> Note:
> The integrated rack developer will define the integrated rack pin assignments for the UOP (module connector number NATC00T15N97SA) in Figure 3.2.1.2–2.

FIGURE 3.2.1.2–2 UOP ELECTRICAL POWER/ETHERNET CONNECTOR AND PIN ASSIGNMENTS

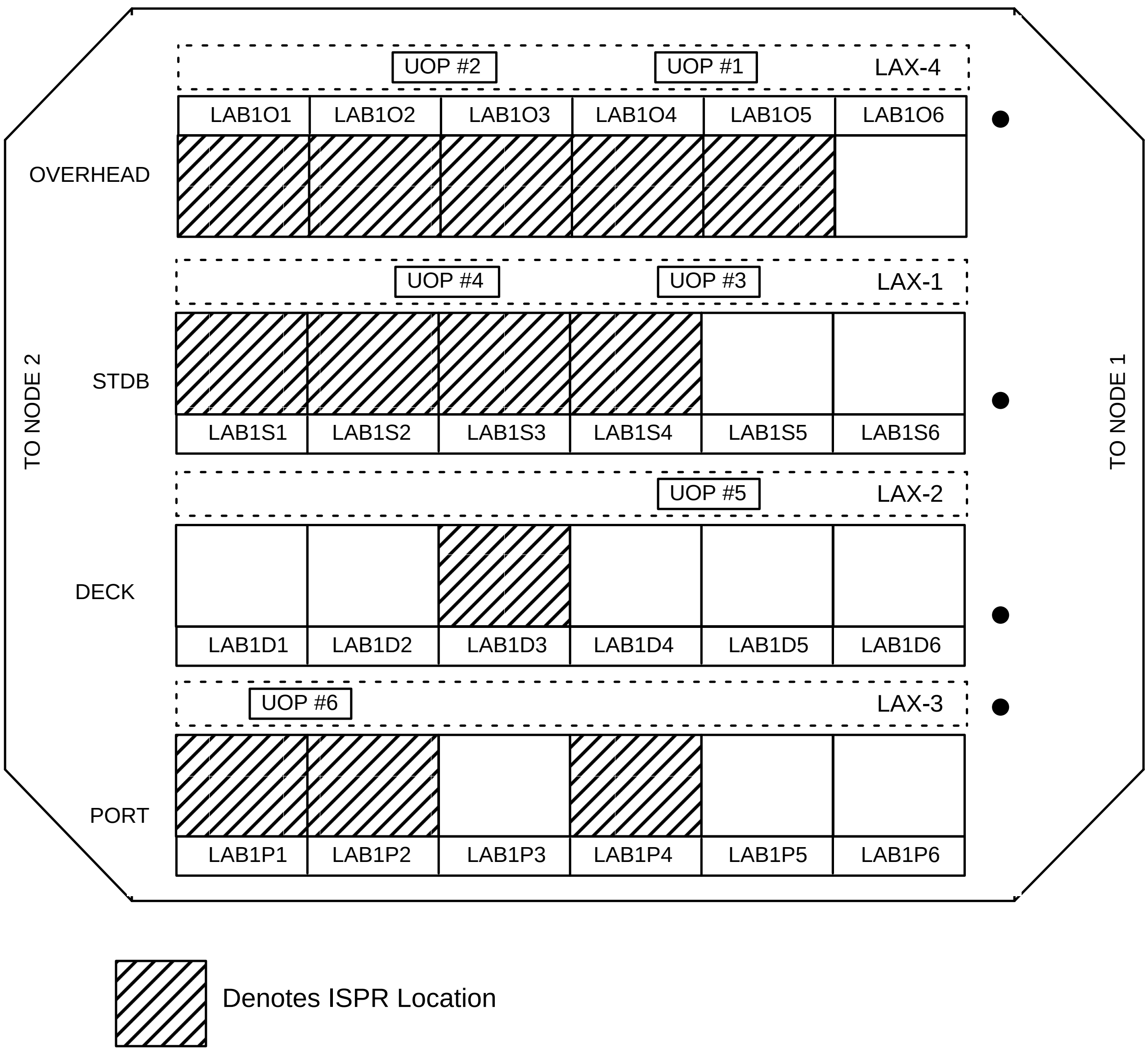


FIGURE 3.2.1.2–3 UOP LOCATIONS – USL

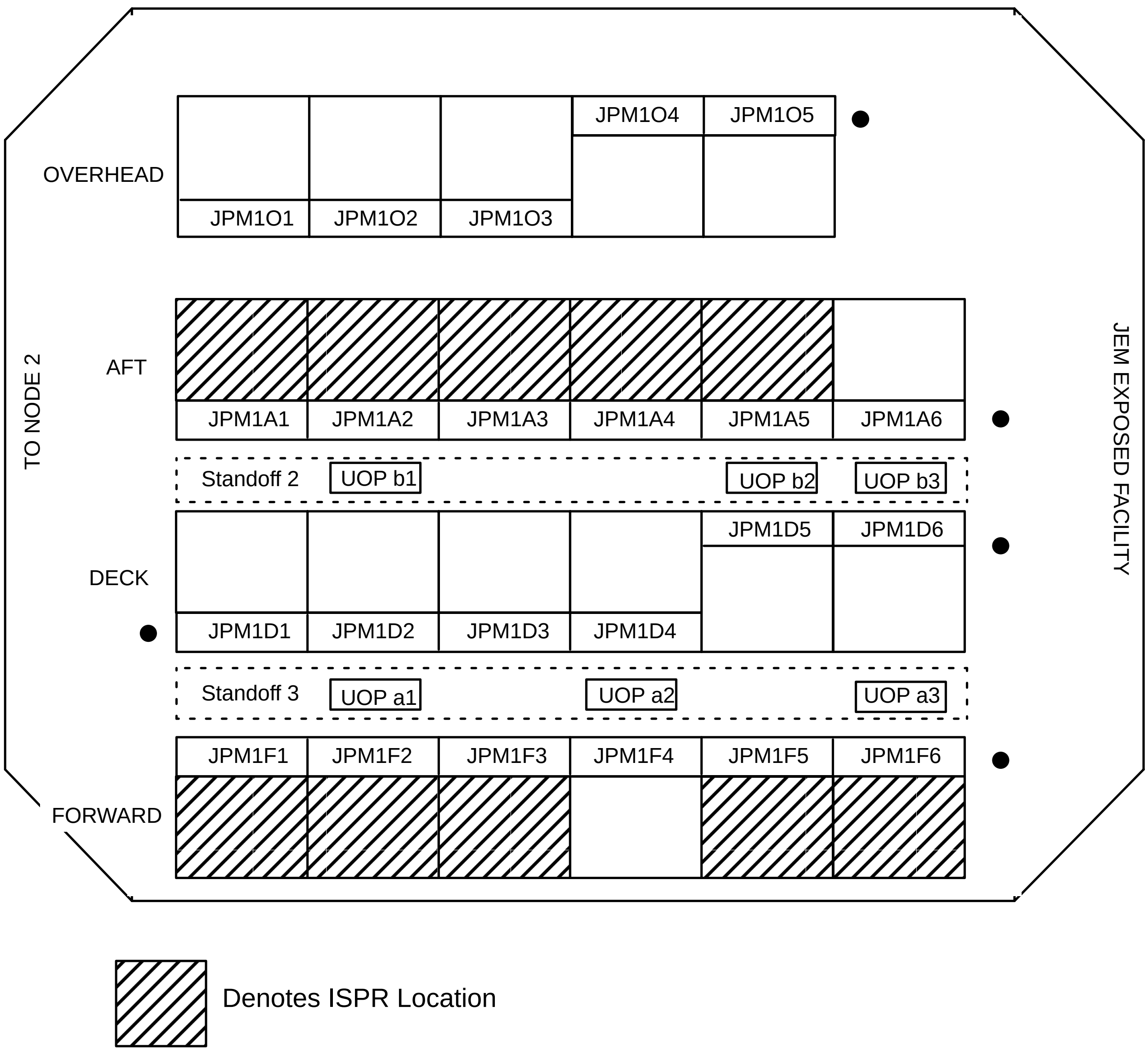


FIGURE 3.2.1.2–4 UOP LOCATIONS – JEM

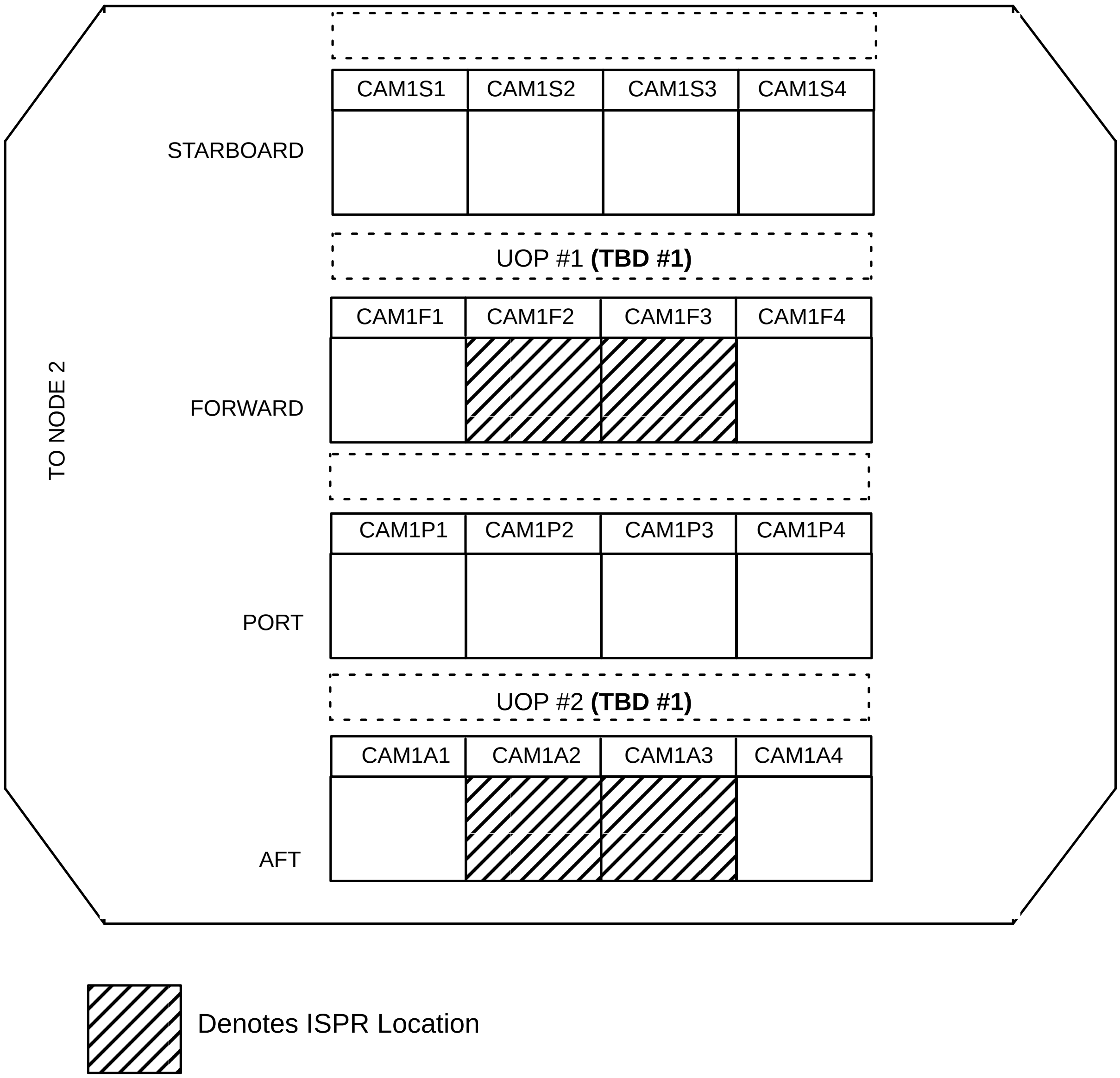


FIGURE 3.2.1.2–5 UOP LOCATIONS – CAM

TABLE 3.2.1.2–1 UOP SUMMARY – USL/CAM

Module	UOP #1		UOP#2		UOP#3		UOP#4		UOP#5		UOP#6	
	J3	J4	J3	J4	J3	J4	J3	J4	J3	J4	J3	J4
USL	C	PLE	NPL	PL	Ch	Ch	PL	PLE	C	C	C	Ch
CAM	PL	PW	PL	PW	N/A	N/A	N/A	NA	N/A	N/A	N/A	N/A

Notes:

Key:
- C Power/Core 1553 Bus
- Ch Power/CHeCS 1553 Bus
- NPL Power/NASDA Payload 1553 Bus
- PL Power/Payload 1553 Bus
- PLE Power/Ethernet
- PW Power Only

TABLE 3.2.1.2–2 UOP SUMMARY – JEM

Module	UOP #a1		UOP #a2		UOP #a3		UOP #b1		UOP #b2		UOP #b3	
	J3	J4	J3	J4	J3	J4	J3	J4	J3	J4	J3	J4
JEM	Ch	PW	NPL	PLL	C	J	PL	NPL	C	J	Ch	PPL

Key:
- C Power/Core 1553 Bus
- Ch Power/CHeCS 1553 Bus
- J JEM System
- NPL Power/NASDA Payload 1553 Bus
- PL Power/Payload 1553 Bus
- PLL Power/ P/L LAN (MRDL)
- PPL Power/PCS LAN
- PW Power Only

3.2.1.3 STANDARD UTILITY PANEL – APM

The APM Standard Utility Panel (SUP) provides 120 Vdc power, APM IEE 802.3 LAN, high rate data/video, and 1553 APM Payload Bus connections for payload use. The connector part numbers are provided in Table 3.1.2–1. The layout of the SUP is shown in Figure 3.2.1.3–1. The pin assignments for the SUP connectors are defined in Figures 3.2.1.3.1-2 through 3.2.1.3.1–11. The SUP locations for the APM are shown in Figure 3.2.1.3–12. The SUP capabilities are summarized in Table 3.2.1.3–1.

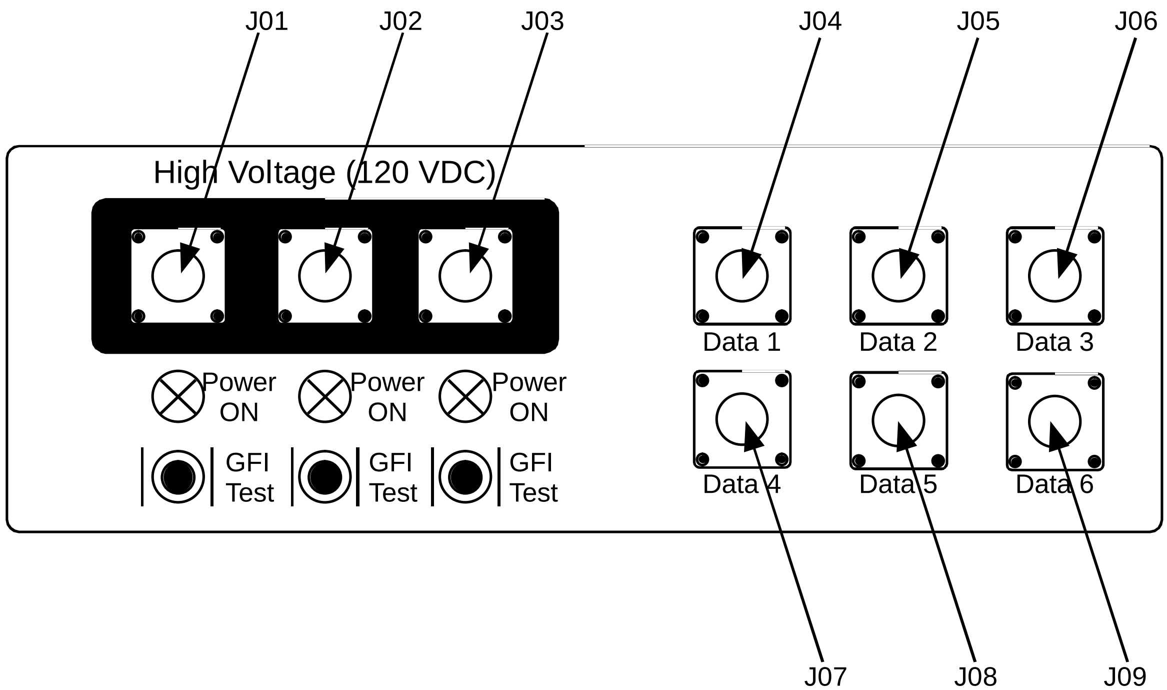


FIGURE 3.2.1.3–1 SUP PANEL LAYOUT

APM NATC00T15N97SN	SUP	Experiment NATC06G15N97PN
CHECS DATA A HI	A	
CHECS DATA A LO	B	
NOT CONNECTED	C	
NOT CONNECTED	D	
NOT CONNECTED	E	
NOT CONNECTED	F	
CHASSIS GROUND	G	
CHECS DATA B HI	H	
CHECS DATA B LO	J	
NOT CONNECTED	K	
POWER RETURN	L	
120 V POWER	M	

FIGURE 3.2.1.3–2 SUP–1/SUP–4 CONNECTOR J01 PIN ASSIGNMENTS

APM NATC00T15N97SN	**SUP**	Experiment NATC06G15N97PN
ISS C&C BUS 1 A HI	A	
ISS C&C BUS 1 A LO	B	
NOT CONNECTED	C	
NOT CONNECTED	D	
NOT CONNECTED	E	
NOT CONNECTED	F	
CHASSIS GROUND	G	
ISS C&C BUS 1 B HI	H	
ISS C&C BUS 1 B LO	J	
NOT CONNECTED	K	
POWER RETURN	L	
120 V POWER	M	

FIGURE 3.2.1.3–3 SUP–2 CONNECTOR J01 PIN ASSIGNMENTS

APM NATC00T15N97SN	**SUP**	Experiment NATC06G15N97PN
ISS C&C BUS 2 A HI	A	
ISS C&C BUS 2 A LO	B	
NOT CONNECTED	C	
NOT CONNECTED	D	
NOT CONNECTED	E	
NOT CONNECTED	F	
CHASSIS GROUND	G	
ISS C&C BUS 2 B HI	H	
ISS C&C BUS 2 B LO	J	
NOT CONNECTED	K	
POWER RETURN	L	
120 V POWER	M	

FIGURE 3.2.1.3–4 SUP–3 CONNECTOR J01 PIN ASSIGNMENTS

APM NATC00T15N97SN	SUP	Experiment NATC06G15N97PN
NOT CONNECTED	A	
NOT CONNECTED	B	
NOT CONNECTED	C	
NOT CONNECTED	D	
NOT CONNECTED	E	
NOT CONNECTED	F	
CHASSIS GROUND	G	
NOT CONNECTED	H	
NOT CONNECTED	J	
NOT CONNECTED	K	
POWER RETURN	L	
120 V POWER	M	

FIGURE 3.2.1.3–5 SUP–1/SUP–4 CONNECTOR J02 PIN ASSIGNMENTS

APM NATC00T15N97SN	SUP	Experiment NATC06G15N97PN
ISS P/L BUS A HI	A	
ISS P/L BUS A LO	B	
NOT CONNECTED	C	
NOT CONNECTED	D	
NOT CONNECTED	E	
NOT CONNECTED	F	
CHASSIS GROUND	G	
ISS P/L BUS B HI	H	
ISS P/L BUS B LO	J	
NOT CONNECTED	K	
POWER RETURN	L	
120 V POWER	M	

FIGURE 3.2.1.3–6 SUP–2/SUP–3 CONNECTOR J02 PIN ASSIGNMENTS

APM NATC00T15N97SN	SUP	Experiment NATC06G15N97PN
120 VDC SUPPLY	M	
GND	G	
120 VDC RETURN	L	

FIGURE 3.2.1.3–7 SUP CONNECTOR J03 PIN ASSIGNMENTS

APM NATC00T15N35SN	SUP	Experiment NATC06G15N35PN
APM P/L BUS +	13	
APM P/L BUS –	8	
APM Red. BUS +	3	
APM Red. BUS –	12	

Note: Interface to the APM Payload Bus for ESA use only.

FIGURE 3.2.1.3–8 SUP CONNECTOR J04 PIN ASSIGNMENTS

APM NATC00T11N35SN	SUP	Experiment NATC06G11N35PN
TRANSMIT DATA +	F	
TRANSMIT DATA –	E	
RECEIVE DATA +	B	
RECEIVE DATA –	C	

Note: Interface to the APM LAN for ESA use only.

FIGURE 3.2.1.3–9 SUP CONNECTORS J05/J09 PIN ASSIGNMENTS

APM NATC00T15N97SA	SUP	Experiment NATC06G15N97PA
F.O. VIDEO/DATA	G	
F.O. VIDEO DATA	L	
F.O. SYNC	M	

FIGURE 3.2.1.3–10 SUP CONNECTOR J06 PIN ASSIGNMENTS

APM NATC00T13N35SA	SUP	Experiment NATC06G13N35PA
OBSCURATION	37	
OBSCURATION RTN	36	
SCATTER	29	
SCATTER RTN	28	
AIR CIRCULATION	22	
AIR CIRCULATION RTN	32	
FIRE INDICATION	9	
FIRE INDICATION RTN	10	
EMERGENCY SGN	25	
EMERGENCY SGN RTN	34	
WARNING SGN	27	
WARNING SGN RTN	13	
SAFING CMD 1	21	
SAFING CMD 1 RTN	5	
SAFING CMD 2	19	
SAFING CMD 2 RTN	20	

FIGURE 3.2.1.3–11 SUP CONNECTOR J07 PIN ASSIGNMENTS

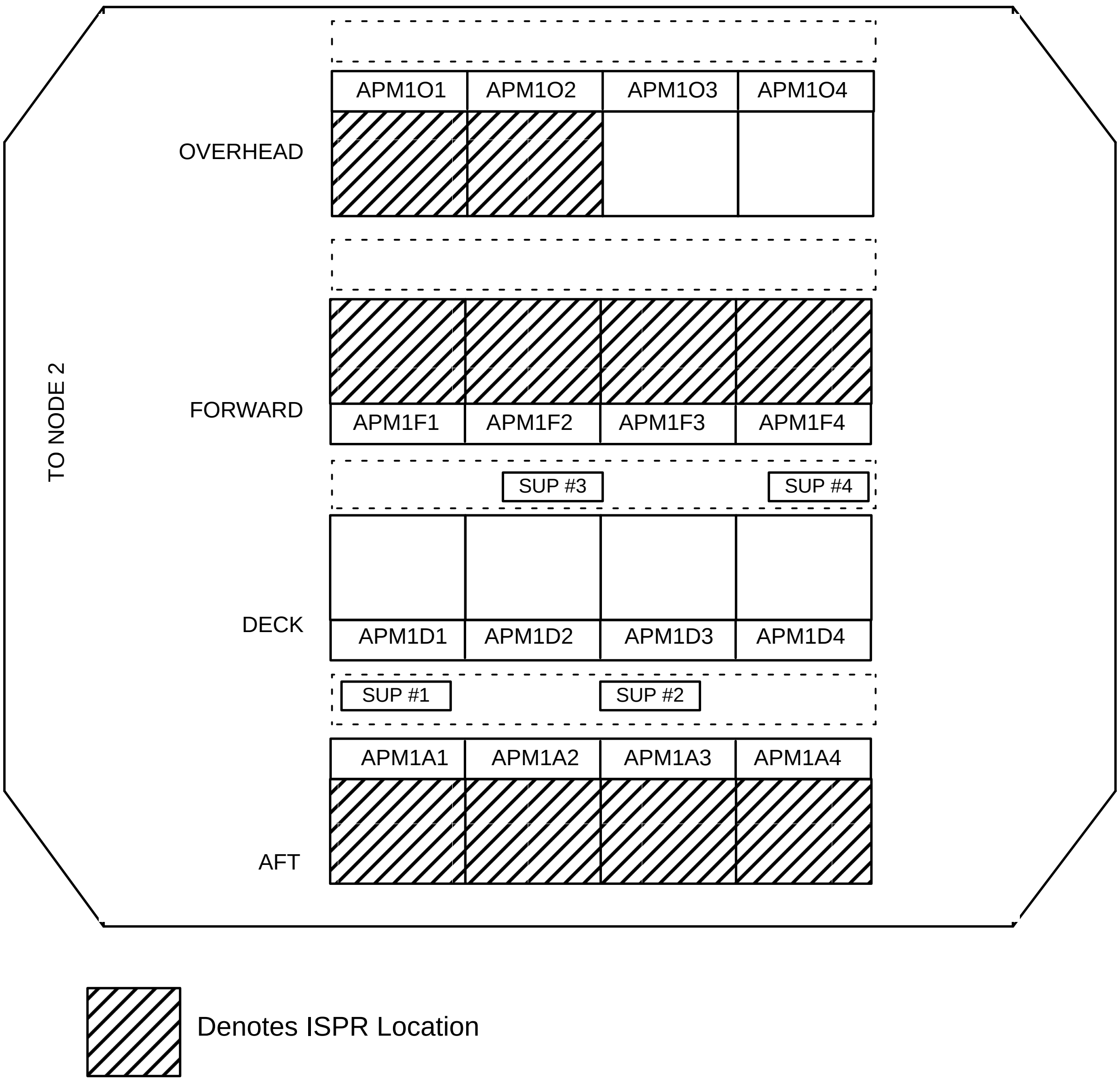


FIGURE 3.2.1.3–12 SUP LOCATIONS – APM

TABLE 3.2.1.3–1 SUP SUMMARY

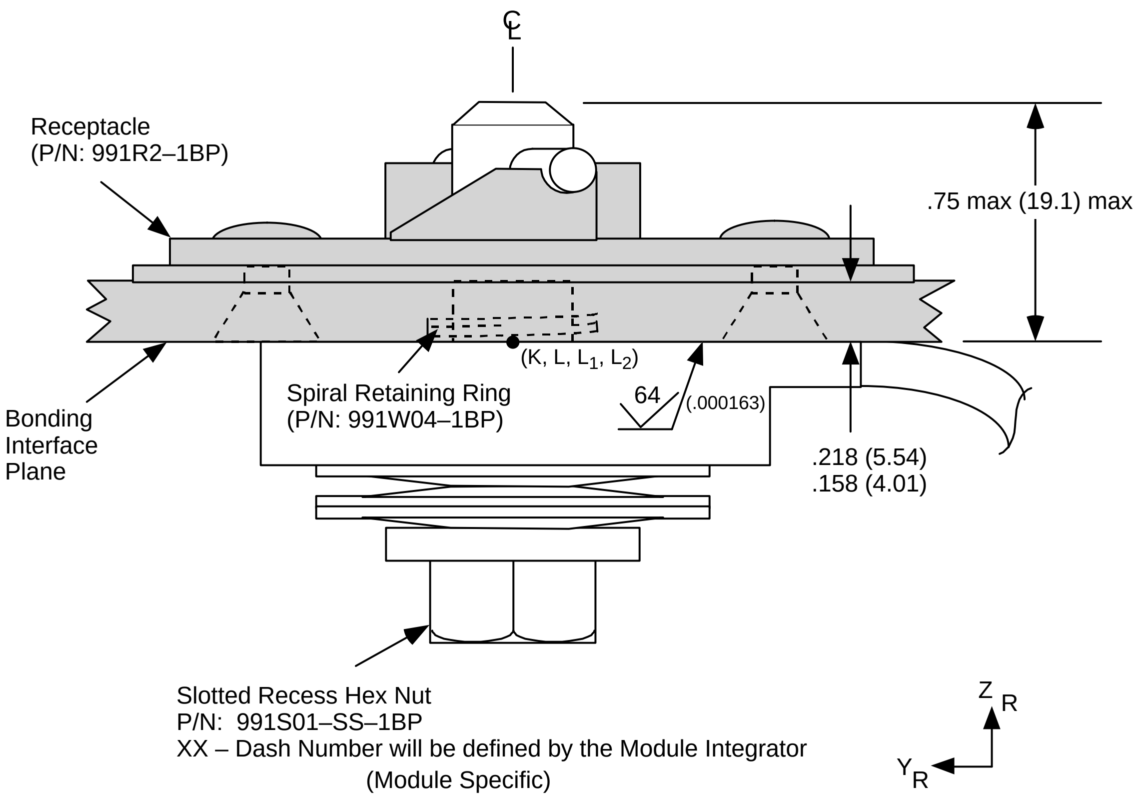
Connector	SUP #1	SUP #2	SUP #3	SUP #4
J01/Power	Ch	C	C	Ch
J02/Power	P	PL	PL	P
J03/Power	P	P	P	P
J04/Data 1	AB	Spare	Spare	AB
J05/Data 2	EN	EN	EN	EN
J06/Data 3	VHR	Spare	Spare	VHR
J07/Data 4	SS	SS	SS	SS
J08/Data 5	Reserved	Reserved	Reserved	Reserved
J09/Data 6	ER	ER	ER	ER

Key:
- C Power/Core 1553 Bus (Not Available For Payload Use)
- Ch Power/CheCS 1553 Bus (Not Available For Payload Use)
- P Power Only
- PL Power/ISS Payload 1553 Bus
- AB APM Payload 1553 Bus
- EN APM IEEE 802.3 Nominal LAN
- VHR Video/High Rate Data (fiber optics)
- SS Smoke Sensor/EWACS
- ER APM IEEE 802.3 Redundant LAN

3.2.2 ELECTROMAGNETIC COMPATIBILITY

3.2.2.1 BONDING

The bonding interface is as shown in Figure 3.2.2.1–1, Rack Bonding Interface Profile, and Figure 3.2.2.1–2, Rack Bonding Surface (Bottom View). The surfaces at the bonding interface are electroless nickel plated to a minimum thickness of 0.0015 in. (0.038 mm). Each rack will contain two bonding interfaces as shown in Figure 3.2.2.1–3, Rack Bonding Interface Locations. The modules will accommodate bonding interfaces as per Table 3.2.2.1–1, Module Bonding Interfaces.



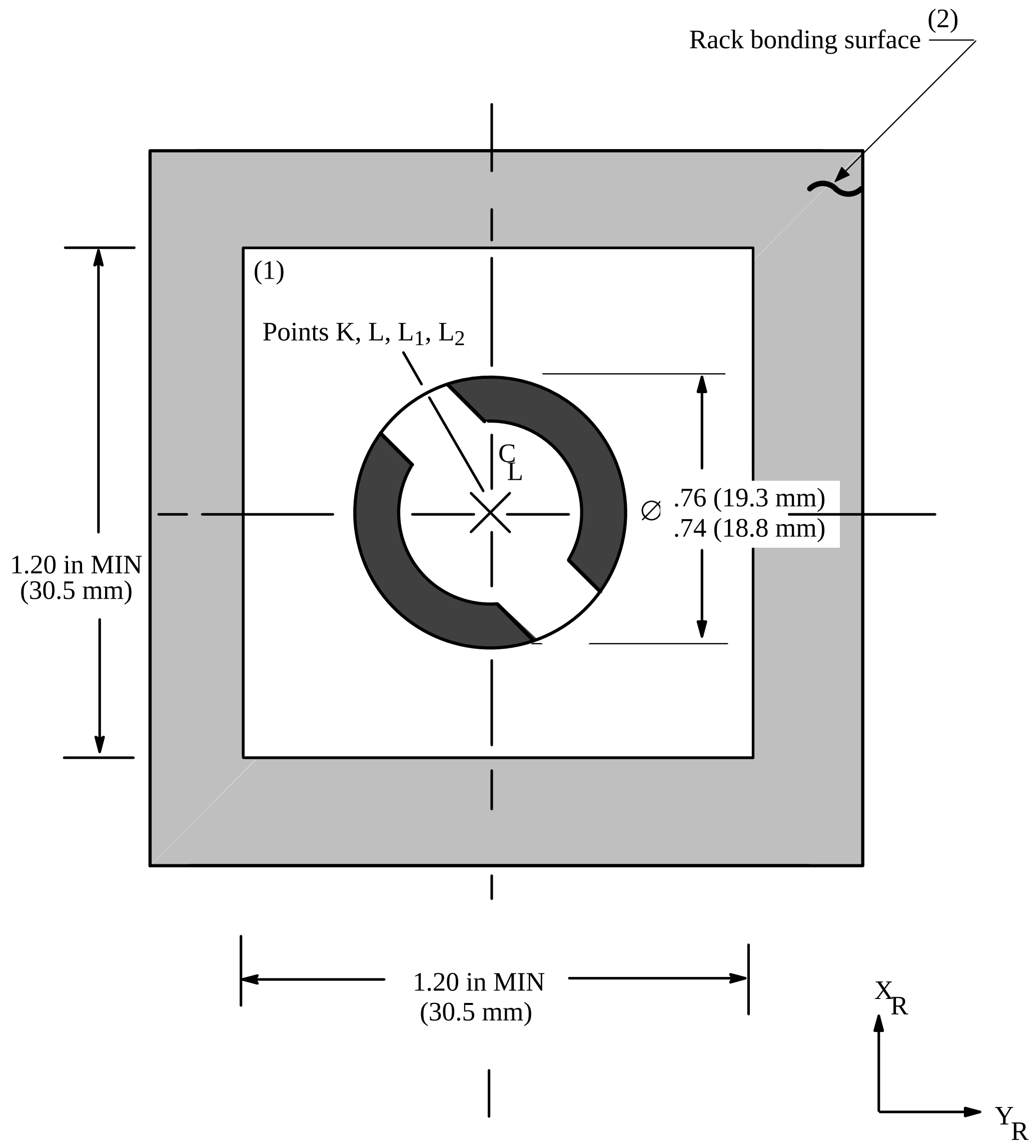
Dimensions Are In Inches (mm)

Rack Structure

Note: 1/4 Turn Fastener Assembly is a product of Camlock Germany. All part numbers are Camlock Germany part numbers.

[TBR–1]

FIGURE 3.2.2.1–1 RACK BONDING INTERFACE PROFILE

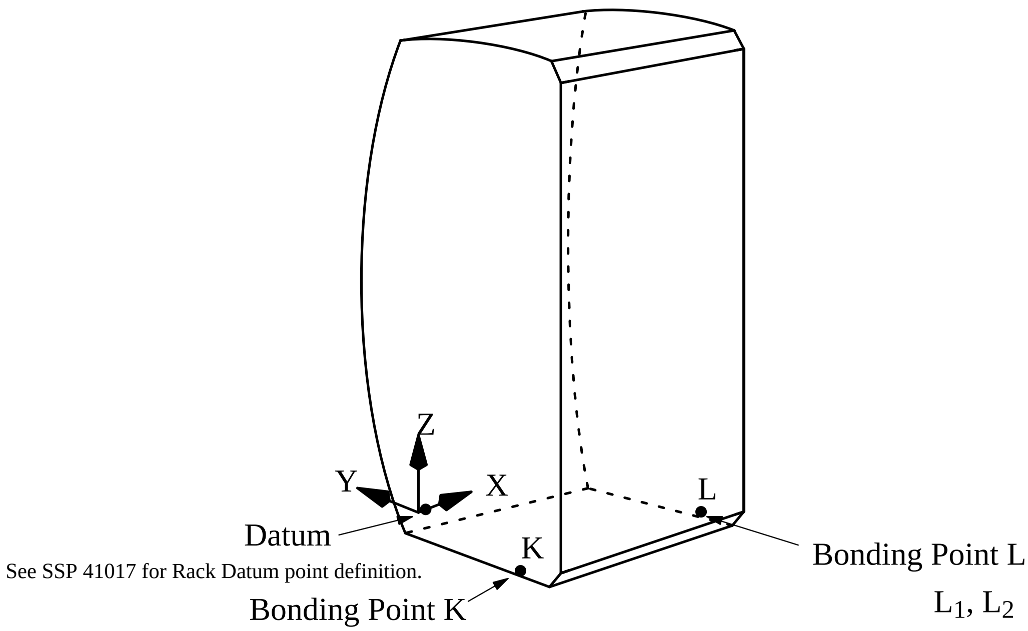


1/4 Turn Fastener receptacle viewed through access hole in the rack bonding surface (Orientation is for reference only)

(1) – Minimum Bonding Surface Contact area
(2) – Reference only

Note: Dimensions are in inches (mm)

FIGURE 3.2.2.1–2 RACK BONDING SURFACE (BOTTOM VIEW)



From Datum	X	Y	Z
Rack Bonding Interface Coordinates (1) K	0.06 (1.5) –0.06 (–1.5)	–16.76 (–425.6) –16.84 (–427.7)	–1.35 (–34.3) –1.59 (–40.4)
Rack Bonding Interface Coordinates L	38.21 (970.5) 38.09 (967.5)	–20.458(–519.6) –20.538(–521.7)	–1.53 (–38.9) –1.59 (–40.4)
Rack Bonding Interface (1) L_1	39.36 (999.7) 39.24 (996.7)	–16.76 (–425.6) –16.84 (–427.7)	–1.35 (–34.3) –1.59 (–40.4)
Rack Bonding Interface (2) L_2	38.21 (970.5) 37.74 (958.6)	–20.458 (–519.6) –20.538 (–521.7)	–1.35 (–34.3) –1.59 (–40.4)

NOTE: Coordinates are defined at the centerline of the access hole shown in Figure 3.2.2.1–2.
(1) – NASDA UNIQUE, NASDA RACKS IN JEM
(2) – NASDA RACK IN USL

FIGURE 3.2.2.1–3 RACK BONDING INTERFACE LOCATIONS

TABLE 3.2.2.1–1 MODULE BONDING INTERFACES

Module	Bonding Interface
APM	Point L, L_2
JEM	Points K,L,L_1
USL	Point L, L_2

3.2.3 POWER QUALITY

Integrated racks and EPCE requiring ISS power will receive power that complies with SSP 30482, Volume 1.

3.2.4 POWER HANDLING CAPABILITY

A. Specific characteristics of ISPR locations are shown in Table 3.2.4–1.

B. Specific characteristics of UOP locations are shown in Table 3.2.4–2.

C. Specific characteristics of SUP locations are shown in Table 3.2.4–3.

TABLE 3.2.4–1 ISPR LOCATIONS WITH SPECIFIC EPS CHARACTERISTICS

LOCATION		MAIN (kW)	MAIN POWER MAX STEADY STATE CURRENT (Amps)	AUXILIARY POWER MAX STEADY STATE CURRENT (Amps)
US	O1	3	25	12
	O2	3	25	12
	O3	12	* 2 - 50	* 1 of 2 - 50
	O4	6	50	12
	O5	3	25	12
	S1	3	25	12
	S2	6	50	12
	S3	12	* 2 - 50	* 1 of 2 - 50
	S4	6	50	12
	D3	3	25	12
	P1	6	50	12
	P2	12	* 2 - 50	* 1 of 2 - 50
	P4	6	50	12
APM	O1	3	25	10
	O2	3	25	10
	F1	6	50	10
	F2	6	50	10
	F3	6	50	10
	F4	3	25	10
	A1	6	50	10
	A2	6	50	10
	A3	3	25	10
	A4	3	25	10
JEM	A1	3	25	10
	A2	3	25	10
	A3	3	25	10
	A4	6	50	10
	A5	6	50	25
	F1	3	25	10
	F2	3	25	25
	F3	6	50	10
	F5	3	25	10
	F6	6	50	10
MPLM	S1	0.598	5.3	NA
	S2	1.05	9.8	NA
	F1	0.598	5.3	NA
	P1	0.598	5.3	NA
	P2	1.05	9.8	NA
CAM	A2	3	25	12
	A3	3	25	12
	F2	3	25	12
	F3	3	25	12

* Note: 12 kW Locations receive power from two independent 6 kW power feeds. Each 6 kW feed contains a Type III RPC for upstream circuit protection.

TABLE 3.2.4–2 UOP LOCATIONS WITH SPECIFIC EPS CHARACTERISTICS

LOCATION		MAIN (kW)	MAX STEADY STATE CURRENT (Amps)
US	LAX1	1.44	12
	LAX1	1.44	12
	LAX2	1.44	12
	LAX3	1.44	12
	LAX4	1.44	12
	LAX4	1.44	12
JEM	Standoff 2	1.2	10
	Standoff 2	1.2	10
	Standoff 2	1.2	10
	Standoff 3	1.2	10
	Standoff 3	1.2	10
	Standoff 3	1.2	10
CAM	**(TBD #2)**	1.44	12
MPLM		N/A	N/A

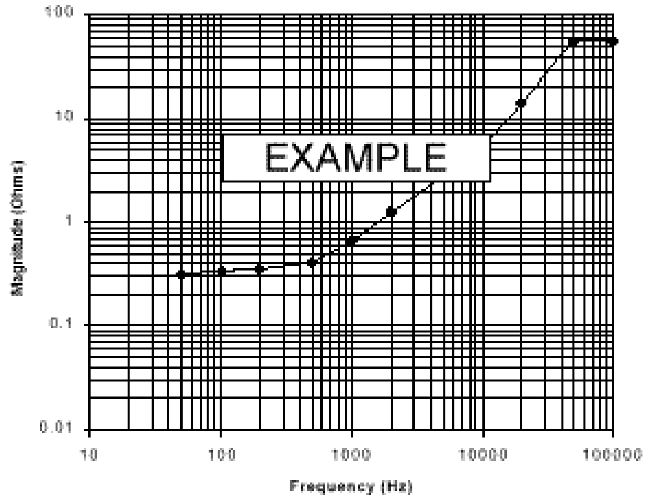
TABLE 3.2.4–3 SUP LOCATIONS WITH SPECIFIC EPS CHARACTERISTICS

LOCATION		MAIN (kW)	MAX STEADY STATE CURRENT (Amps)
APM	SUP–1	1.2	10
	SUP–2	1.2	10
	SUP–3	1.2	10
	SUP–4	1.2	10

3.2.5 IMPEDANCE LIMITS

3.2.5.1 LOAD IMPEDANCE LIMITS

The rack load impedance magnitude and phase limits at the UIP (UOP) interface is defined in Figure 3.2.5.1–1.



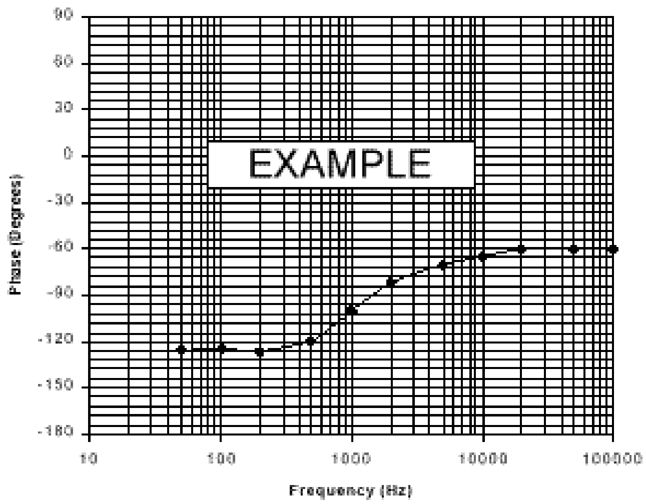


FIGURE 3.2.5.1–1 RACK LOAD IMPEDANCE LIMITS

Note:
The integrated rack developer will provide the rack load impedance magnitude and phase limits at 50 Hz through 100 kHz in Figure 3.2.5.1–1.

3.2.5.2 SOURCE IMPEDANCE LIMITS

A. The source impedance at UIP locations, except MPLM rack locations, will meet the limits as shown in Figures 3.2.5.2–1, 3.2.5.2–2 and 3.2.5.2–3.

B. The source impedance at UOP (TBV for MPLM rack locations) locations will meet the limits as shown in Figure 3.2.5.2–4.

3.2.6 REMOTE POWER CONTROLLER OVERLOAD LIMITS

The overload protection characteristics of the Rack power distribution and circuit protection system is illustrated in Figure 3.2.6–1.

The ISS power source will provide protection to the rack interface for ISPR overload conditions by means of a remote power controller. The figures define the trip region for RPCs connected to ISPR locations in the JEM, APM and US Lab Modules.

The overload limitation characteristics of the power feeders are defined in Figures 3.2.6–2, 3.2.6–3, 3.2.6–4, 3.2.6–5 and 3.2.6–6. Overload Protection Characteristics. The curves define the region for RPCs connected to ISPR locations in the JEM, APM and USL Modules.

For current limiting switches, the shaded regions in the figures show the current limit regions from the time the protection devices start to control the current within the specified range, to the maximum time where the protection device trips and interrupts the current flow.

For non–current limiting switches, the shaded regions in the figure show the range of the over–current threshold from minimum trip decision time, to the maximum trip decision time.

Table 3.2.6–1 defines the characteristics of the remote power controllers.

USL/CAM: ISPR locations are connected to non–current limiting RPCs for 3 and 6 kW feeds, and to current limiting RPCs for 1.44 kW (Auxiliary) feeds. Nominal current ratings are 25, 50, and 12 amperes respectively.

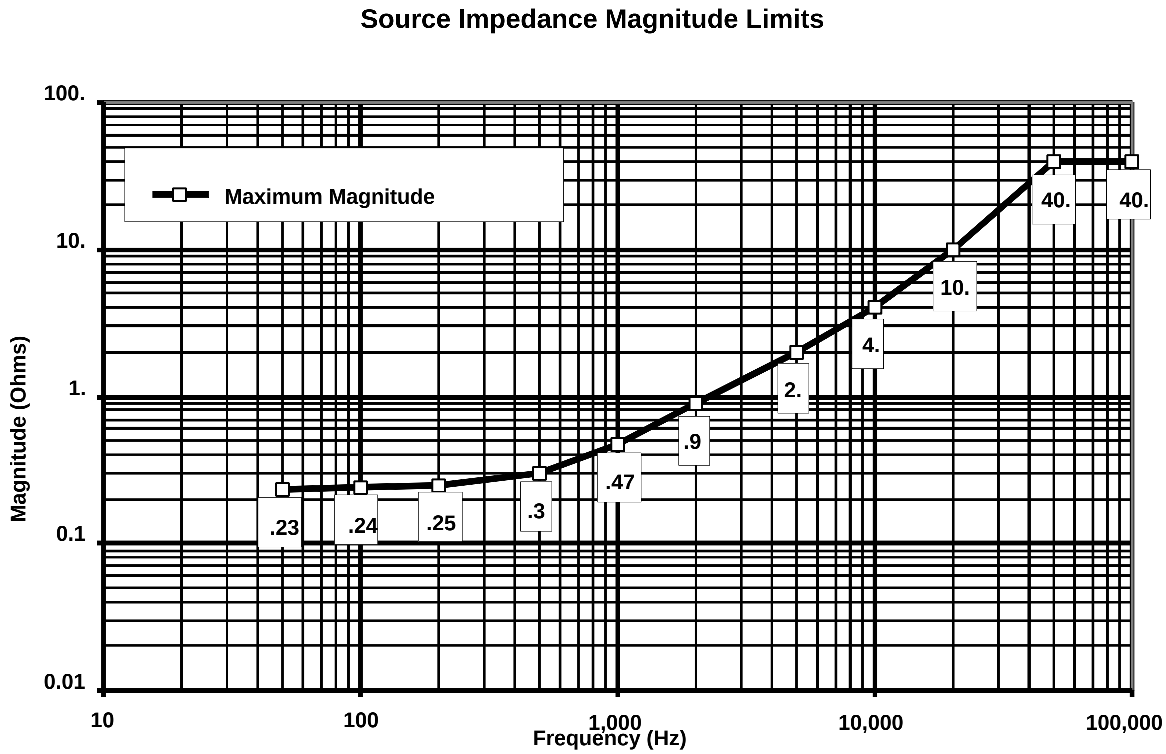
For the non–current limiting RPCs:

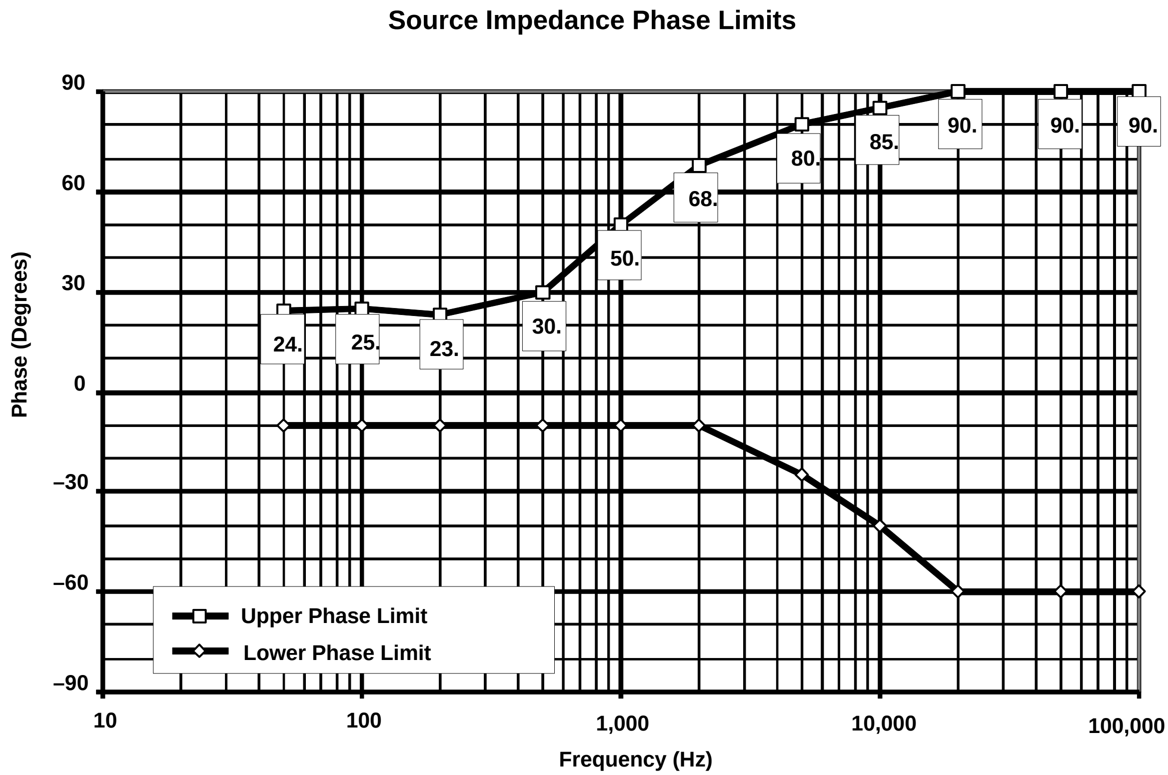
– A feeder current above the threshold at 500%–600% of nominal rating for 0 to 10 microseconds will cause the RPC to trip

– A feeder current above the threshold at 190%–210% of nominal rating for 1 to 2 milliseconds will cause the RPC to trip.

– A feeder current above the threshold at 110%–120% of nominal rating for 40 to 48 milliseconds will cause the RPC to trip.

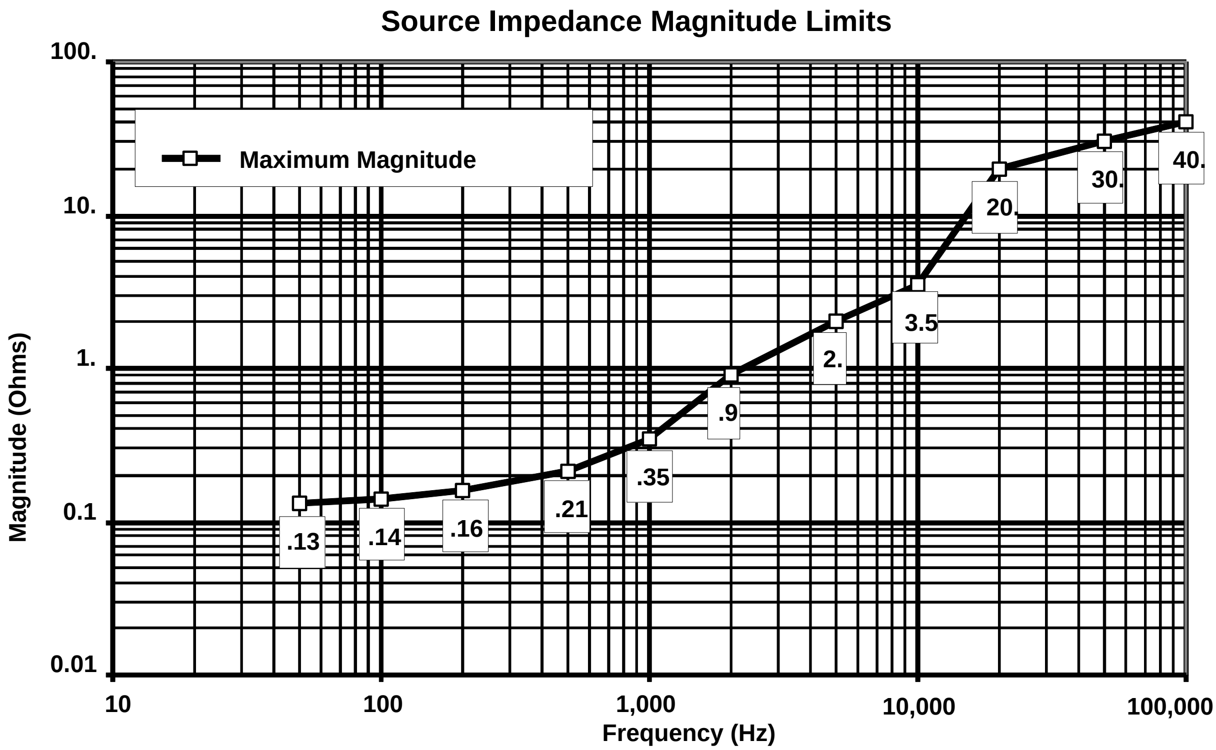
For the current limiting RPCs on the 1.44 kW feeds:

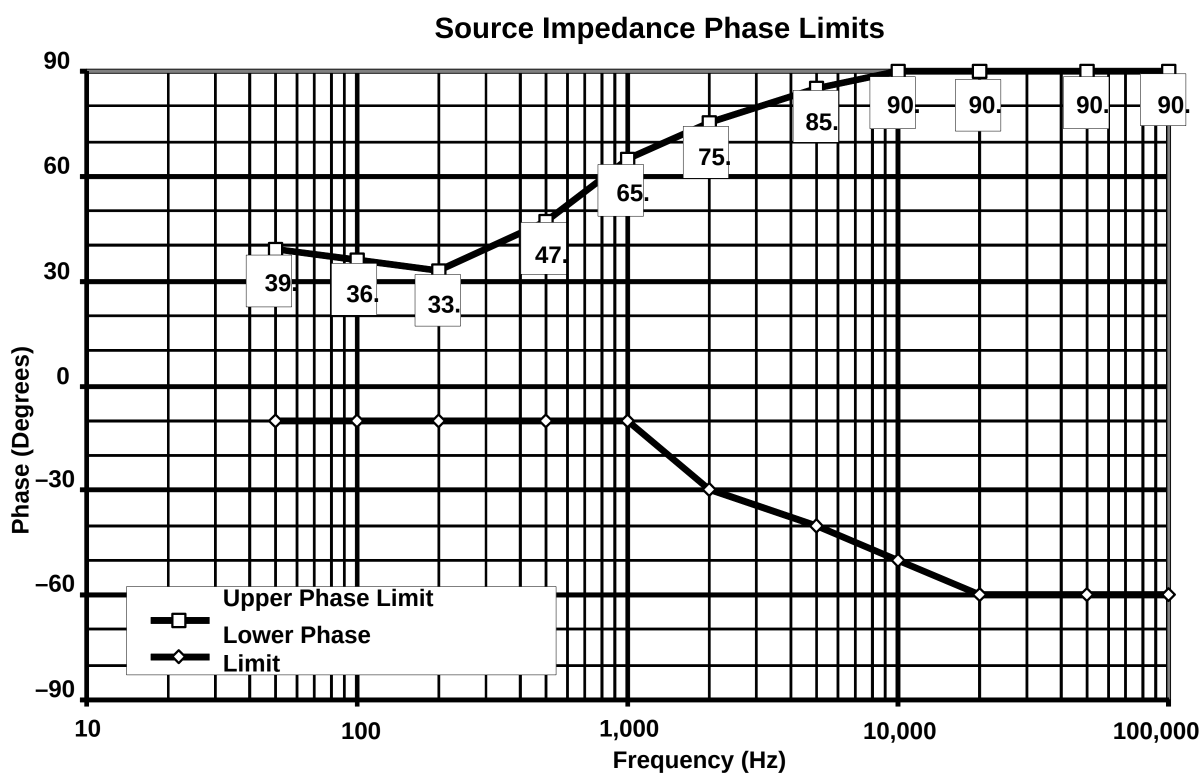




Notes:
1. This is for one DDCU as the source

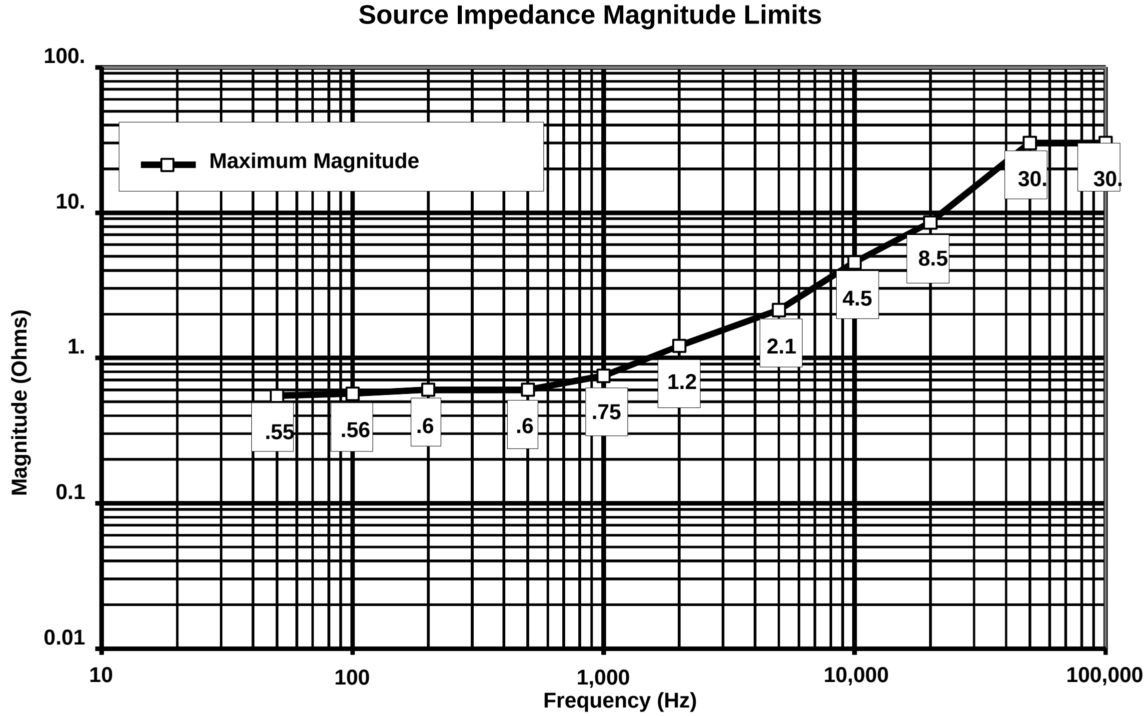
FIGURE 3.2.5.2–1 3 kW INTERFACE B POWER SOURCE IMPEDANCE LIMITS

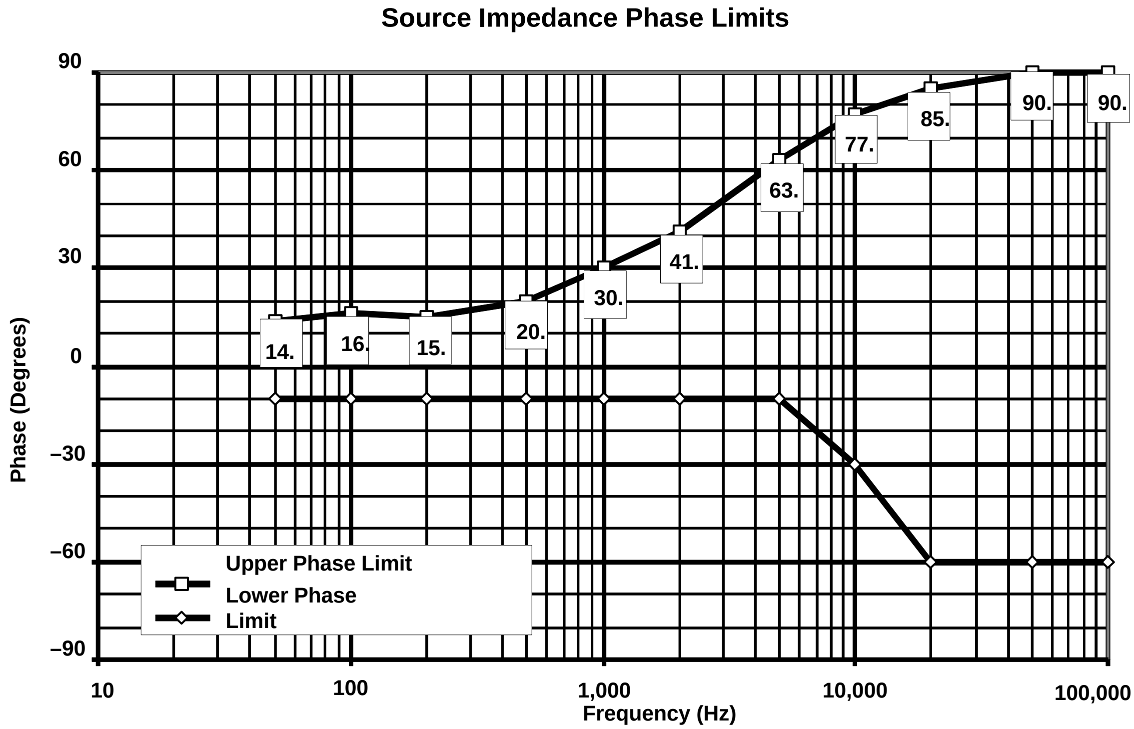




Note: 1. This is for one DDCU as the source

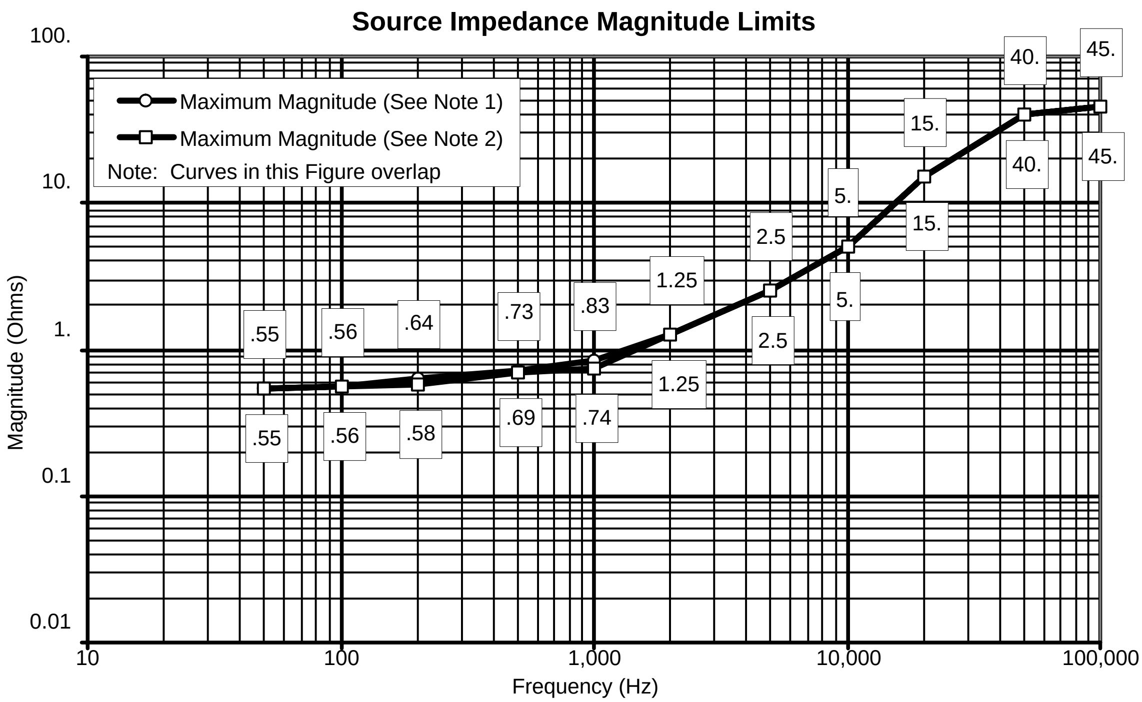
FIGURE 3.2.5.2–2 6 kW INTERFACE B POWER SOURCE IMPEDANCE LIMITS

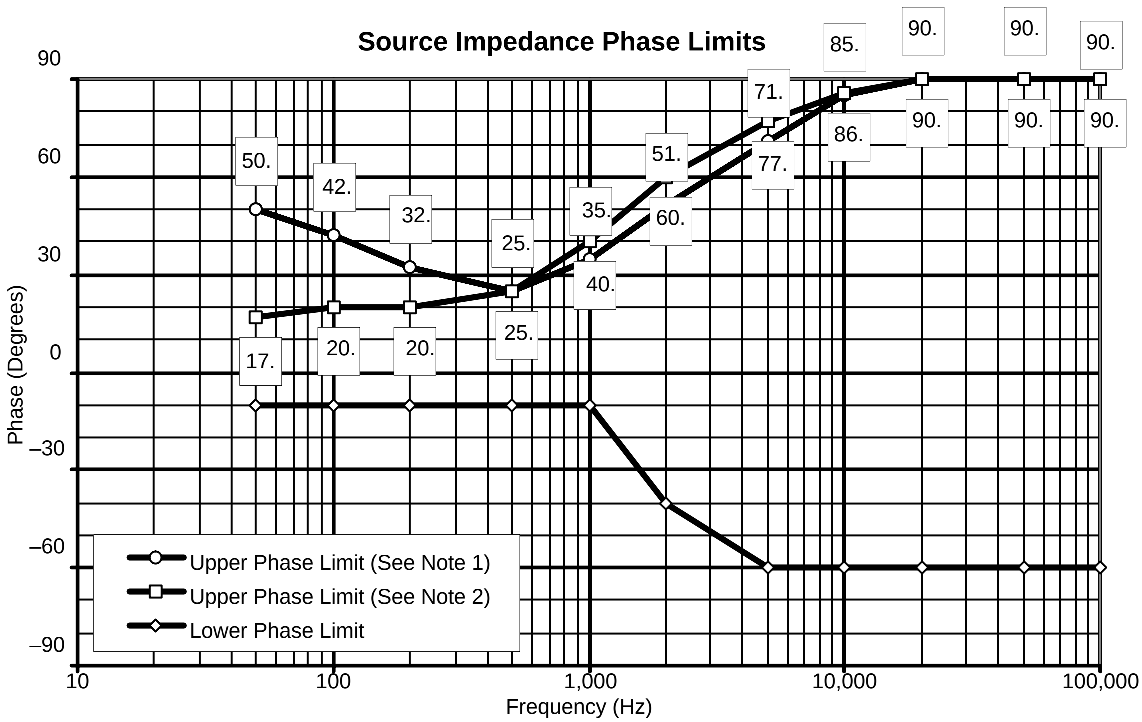




Note: 1. This is for one DDCU as the source

FIGURE 3.2.5.2–3 1.2 – 1.44 kW INTERFACE B POWER SOURCE IMPEDANCE LIMITS





1. Limit when total load on the Secondary Power Source is less than 400 watts.
2. Limit when total load on the Secondary Power Source is at least 400 watts.

FIGURE 3.2.5.2–4 10–12 AMPERE INTERFACE C POWER SOURCE IMPEDANCE LIMITS

– The current will be controlled to within the limiting level of 13.2 to 14.4 amperes within 1 millisecond. The RPC will trip if the current remains in the limiting region up to the decision time of 34.5 ± 3.5 milliseconds.

JEM: ISPR locations are connected to current limiting RPCs. A current level above its percent of the RPC nominal rating may cause the RPC to begin limiting the current. The limiting level will not exceed I_{lu} percent of the nominal RPC current rating. Current limiting will be within this region within 50 microseconds after the onset of an overcurrent condition. The RPC will trip, if the current limiting continues to the decision time of 15 ±5 milliseconds. In addition, the RPC provides a trip threshold which will be within the decaying region shown from 20 to 500 milliseconds after the overcurrent condition occurs. The RPC will trip if the overcurrent condition crosses the trip threshold. During this interval, I_{tu} is the guaranteed trip level, and I_{td} is the guaranteed no–trip level. Nominal current ratings are shown in Figure 3.2.6–3.

APM: All ISPR locations are connected to current limiting SSPCs (solid state power controller). Current limit levels and trip times are defined in Table 3.2.6–1. Trip coordination (selective protection) is achieved by utilization of Payload provided downstream protection devices with a current limit below the current limit region of the SSPCs or with a trip time of 1 ms (or shorter). The SSPC will trip if overload is not removed before decision time.

A. The overload limitation characteristics of the power feeders interfacing to the UIP are defined in Figures 3.2.6–2, 3.2.6–3, and 3.2.6–4.

B. The overload limitation characteristics of the power feeders interfacing to the UOP are shown in Figure 3.2.6–5.

MPLM: The overload limitation characteristics of the power feeders interfacing to the MPLM are shown in Figure 3.2.6–6.

TABLE 3.2.6–1 DETAILED UPSTREAM PROTECTION CHARACTERISTICS

PWR INTERFACE	MAIN PWR FEEDER				
	CURRENT LIMITATION LEVEL		MINIMUM* TRIP THRESHOLD	TRIP DECISION TIME (1)	
	MIN.	MAX		MIN.	MAX.
3 kW ISPR					
APM	36.0 A	39.6 A	N/A	1.5 ms	3.5 ms
JEM	(2)	(2)	N/A	(2)	(2)
USL	N/A	N/A	27.5 A	40 ms	48 ms
6 kW ISPR					
APM	72.0 A	79.2 A	N/A	1.5 ms	3.5 ms
JEM	(3)	(3)	N/A	(3)	(3)
USL	N/A	N/A	55.0 A	40 ms	48 ms
12 kW ISPR					
USL FEED A/BUS 1	N/A	N/A	55.0 A	40 ms	48 ms
FEED B/BUS 2	N/A	N/A	55.0 A	40 ms	48 ms

PWR INTERFACE	AUX PWR FEEDER				
	NOM. POWER	CURRENT LIMITATION LEVEL		TRIP DECISION TIME (1)	
		MIN.	MAX	MIN.	MAX.
ISPR					
APM Lateral	1.2 kW	36.0 A	39.6 A	1.5 ms	3.5 ms
APM Overhead	1.2 kW	18.0 A	19. 2 A	1.5 ms	3.5 ms
JEM	1.2 kW	(4)	(4)	(4)	(4)
USL	1.44 kW	13.2 A	14.4 A	31 ms	38 ms
CAM	1.44 kW	13.2 A	14.4 A	31 ms	38 ms

Note:
(1) trip decision time within range of min. and max. limiting/trip threshold
(2) see Figure 3.2.6–3 apply 25A RPC characteristics
(3) see Figure 3.2.6–3 apply 50A RPC characteristics
(4) see Figure 3.2.6–3 apply 25A RPC characteristics for JEM ISPR F2 and A5 locations and apply 10A RPC characteristics for the other locations

> Note:
> Rack integrator and/or payload developer will provide overload protection characteristics curve. Format will be identical to that of Figure 3.2.6–2 for up to 500 ms.

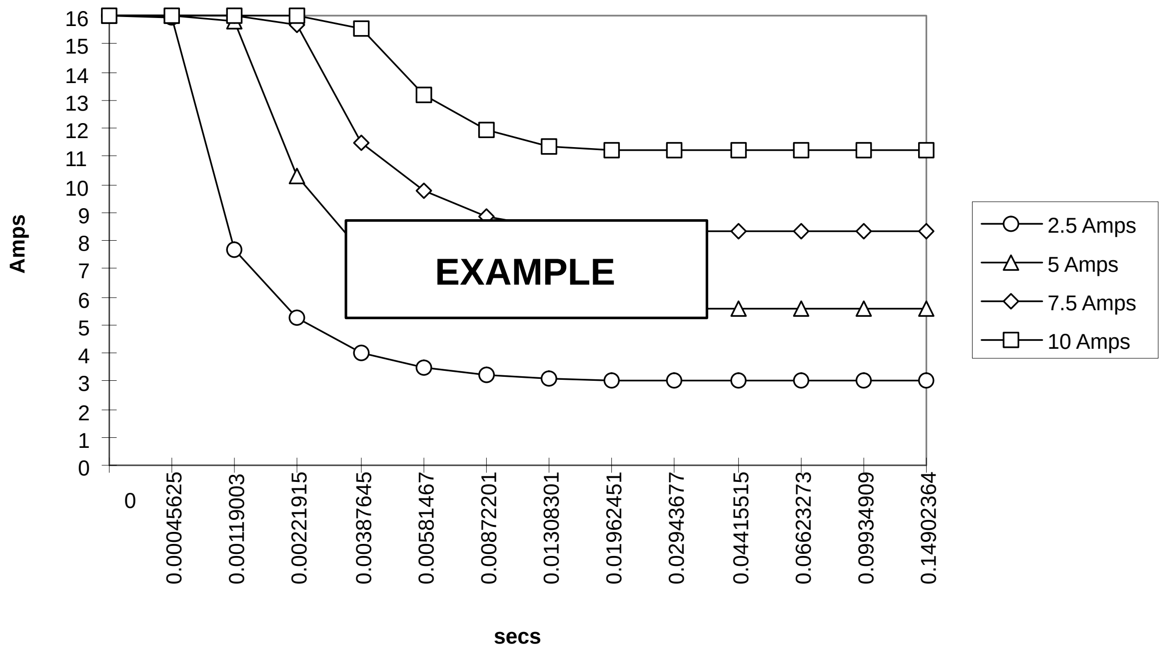


FIGURE 3.2.6–1 RACK OVERLOAD PROTECTION CHARACTERISTICS

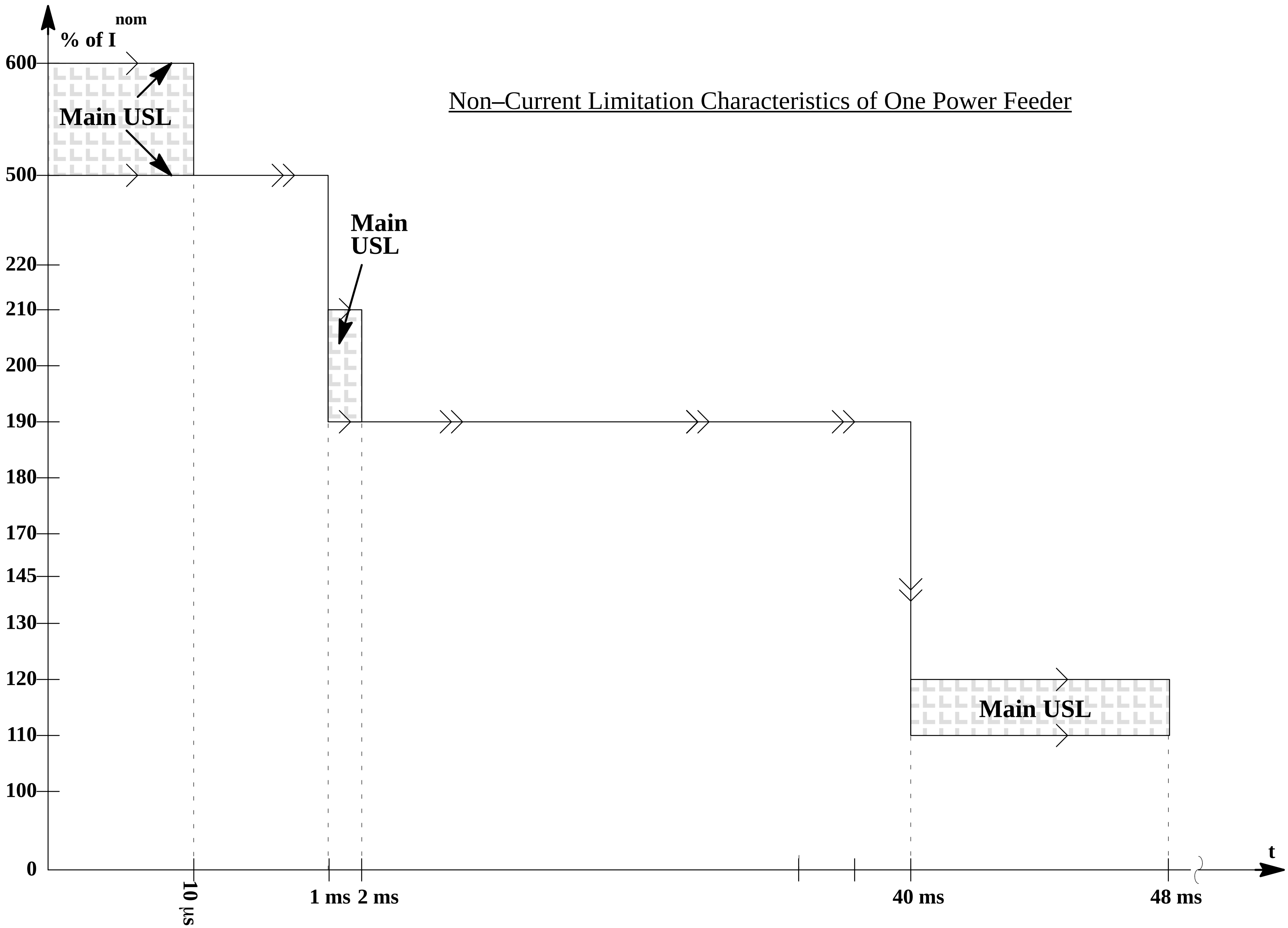
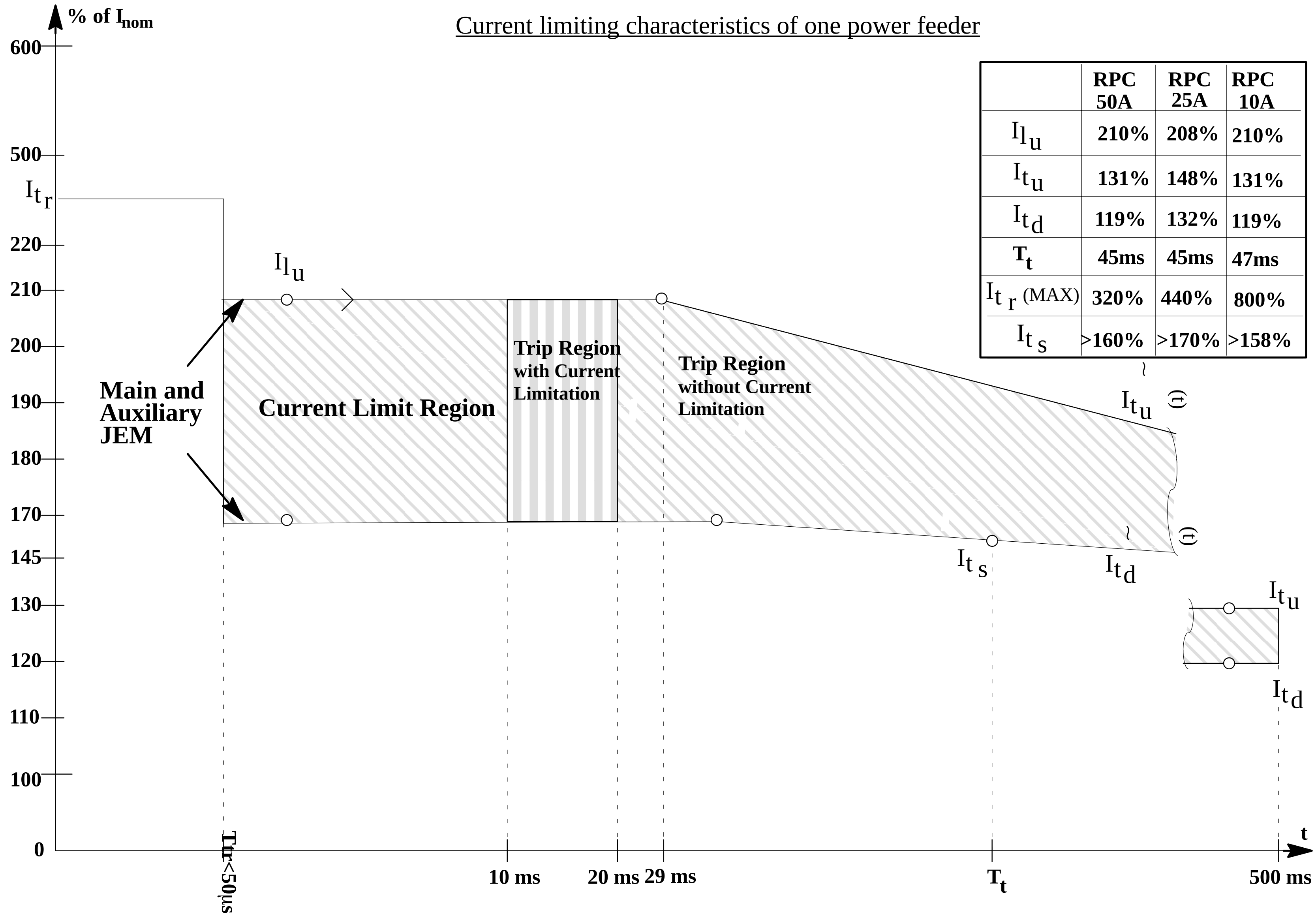
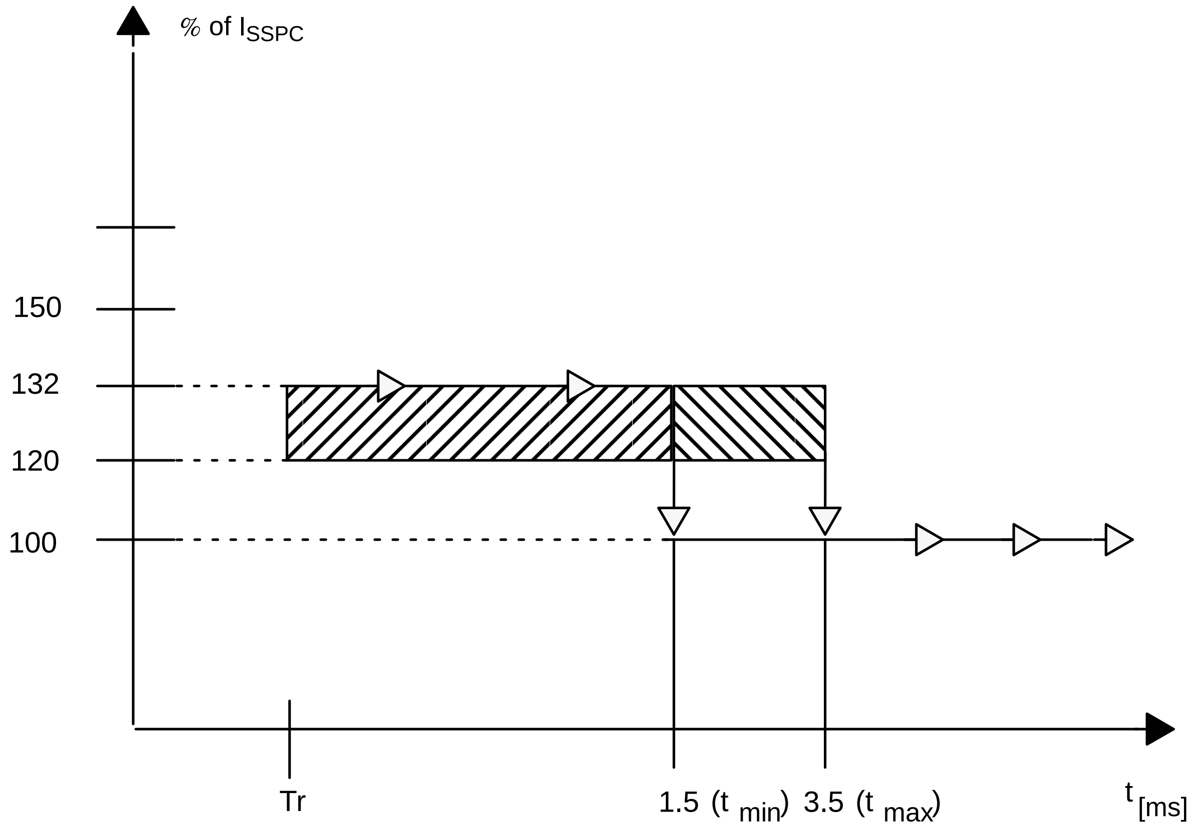


FIGURE 3.2.6–2 USL OVERLOAD PROTECTION CHARACTERISTICS



	RPC 50A	RPC 25A	RPC 10A
I_{lu}	210%	208%	210%
I_{tu}	131%	148%	131%
I_{td}	119%	132%	119%
T_t	45ms	45ms	47ms
I_{tr} (MAX)	320%	440%	800%
I_{ts}	>160%	>170%	>158%

FIGURE 3.2.6–3 JEM OVERLOAD PROTECTION CHARACTERISTICS



I_{SSPC}	=	60A for 6kW main power feeder
	=	30A for 3kW main power feeder
	=	15A for aux power feeder in overhead rack positions (O1 and O2)
Tr	=	Reaction time (duration not specified)
t_{min}, t_{max}	=	min/max triptime

FIGURE 3.2.6–4 APM OVERLOAD PROTECTION CHARACTERISTICS

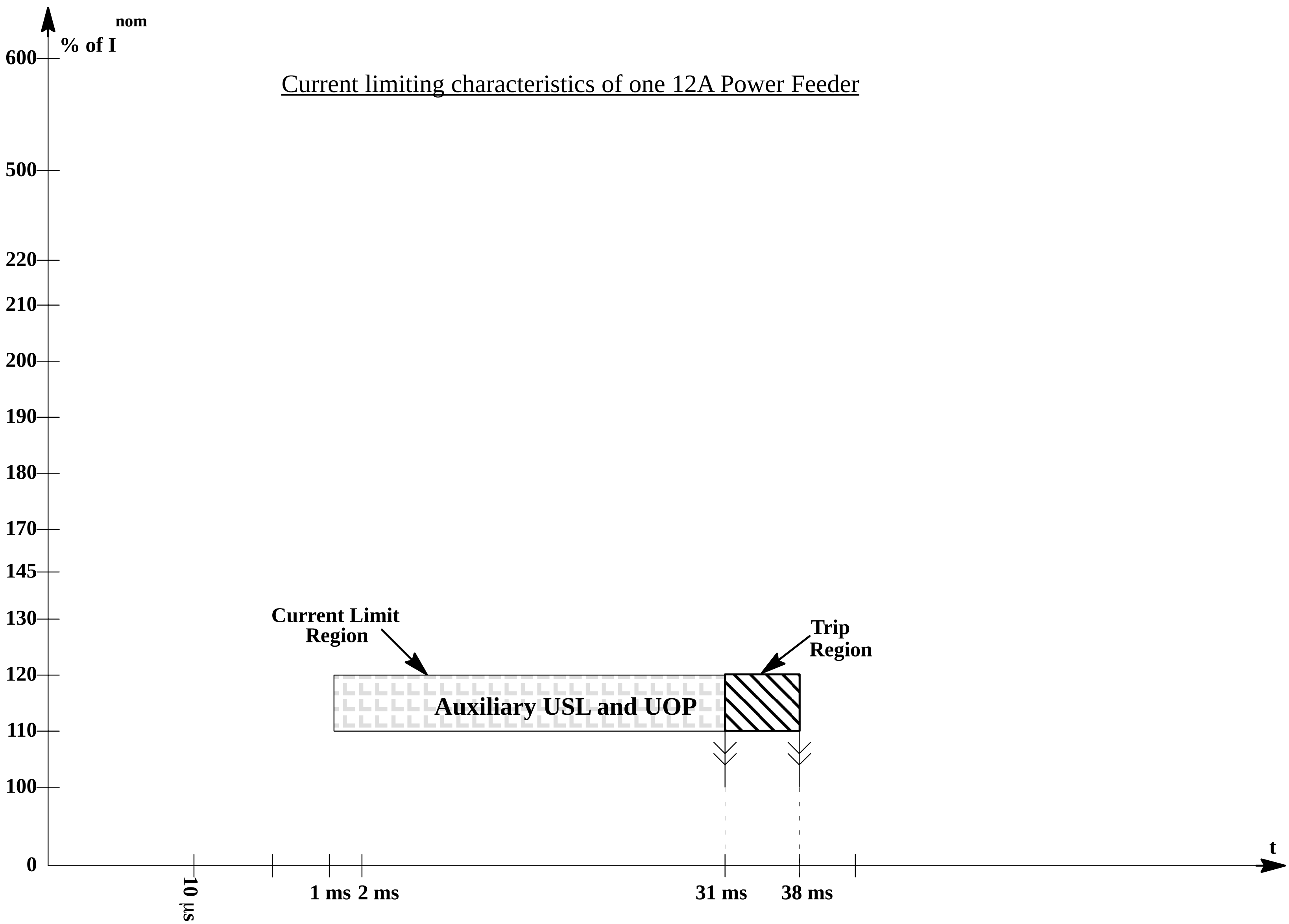


FIGURE 3.2.6–5 USL UOP OVERLOAD PROTECTION CHARACTERISTICS

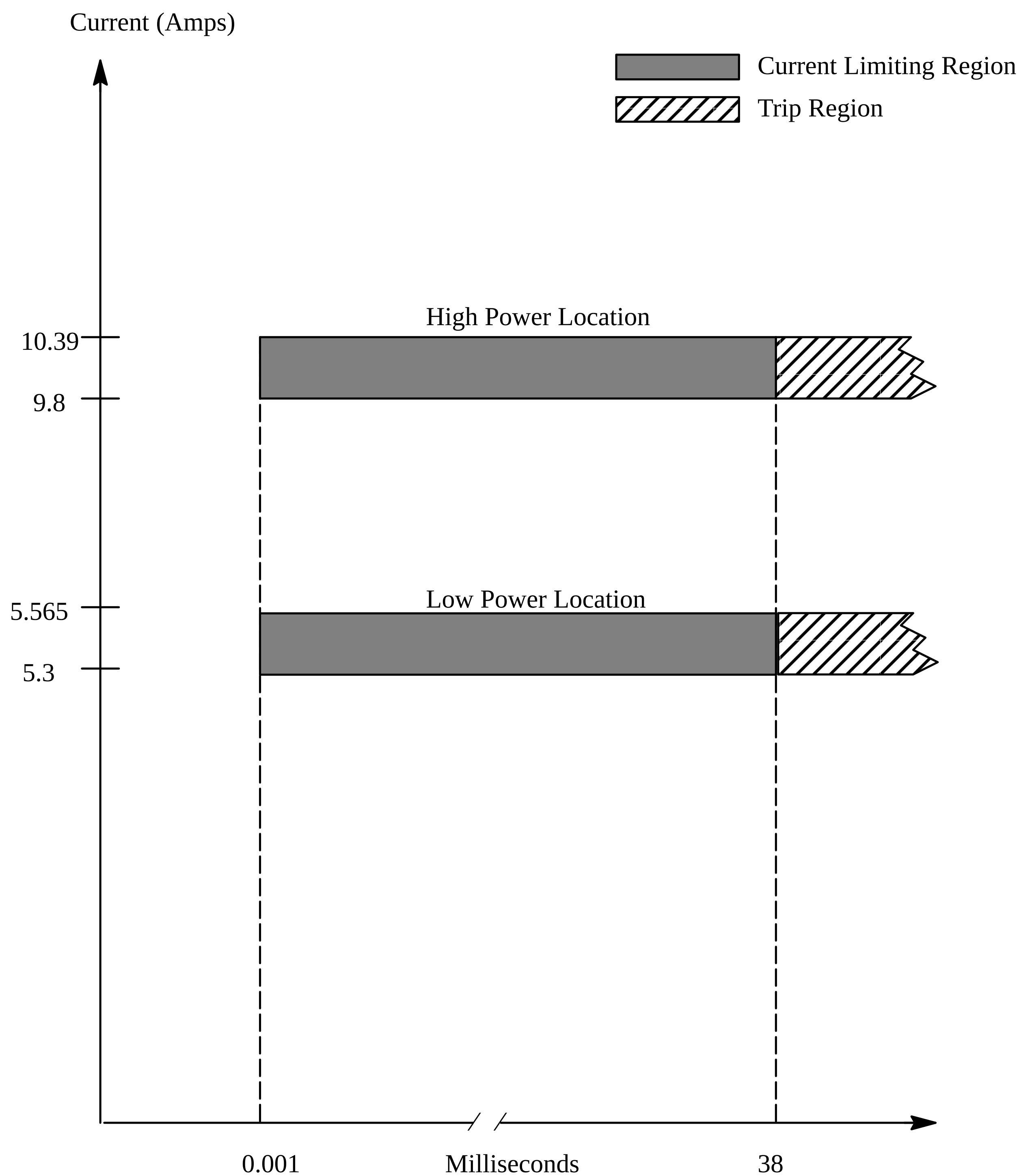


FIGURE 3.2.6–6 MPLM OVERLOAD PROTECTION CHARACTERISTICS

3.2.7 ELECTRICAL POWER CONSUMING EQUIPMENT (EPCE) INTERFACE WITH THE UIP OR UOP

The Rack power consumption and current draw is defined in Table 3.2.7–1. The surge current for the Rack is illustrated in Figure 3.2.7–1. An electrical schematic of the Rack is provided in Figure 3.2.7–2.

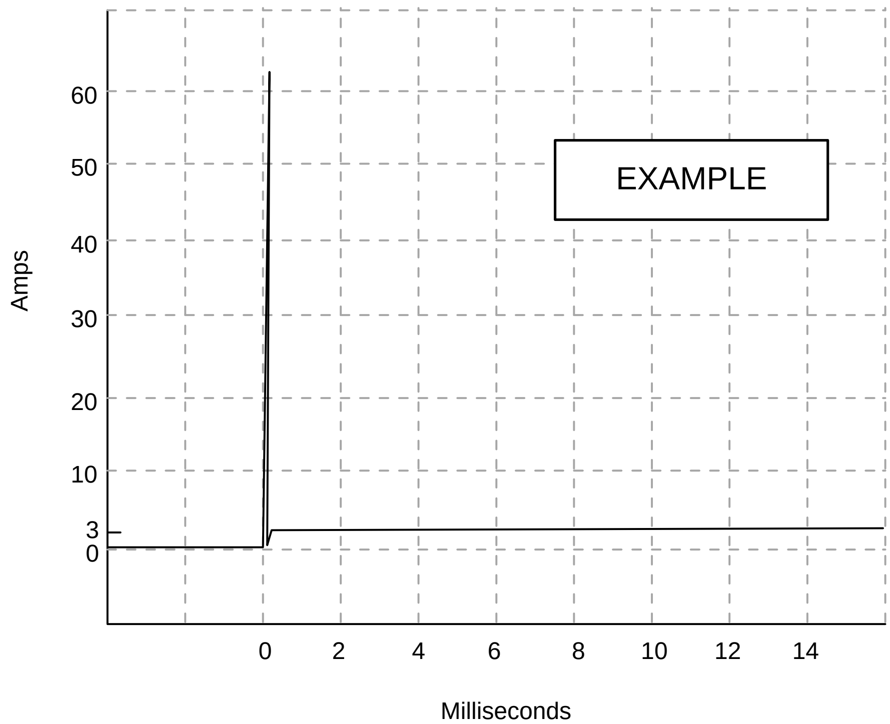


FIGURE 3.2.7–1 RACK SURGE CURRENT

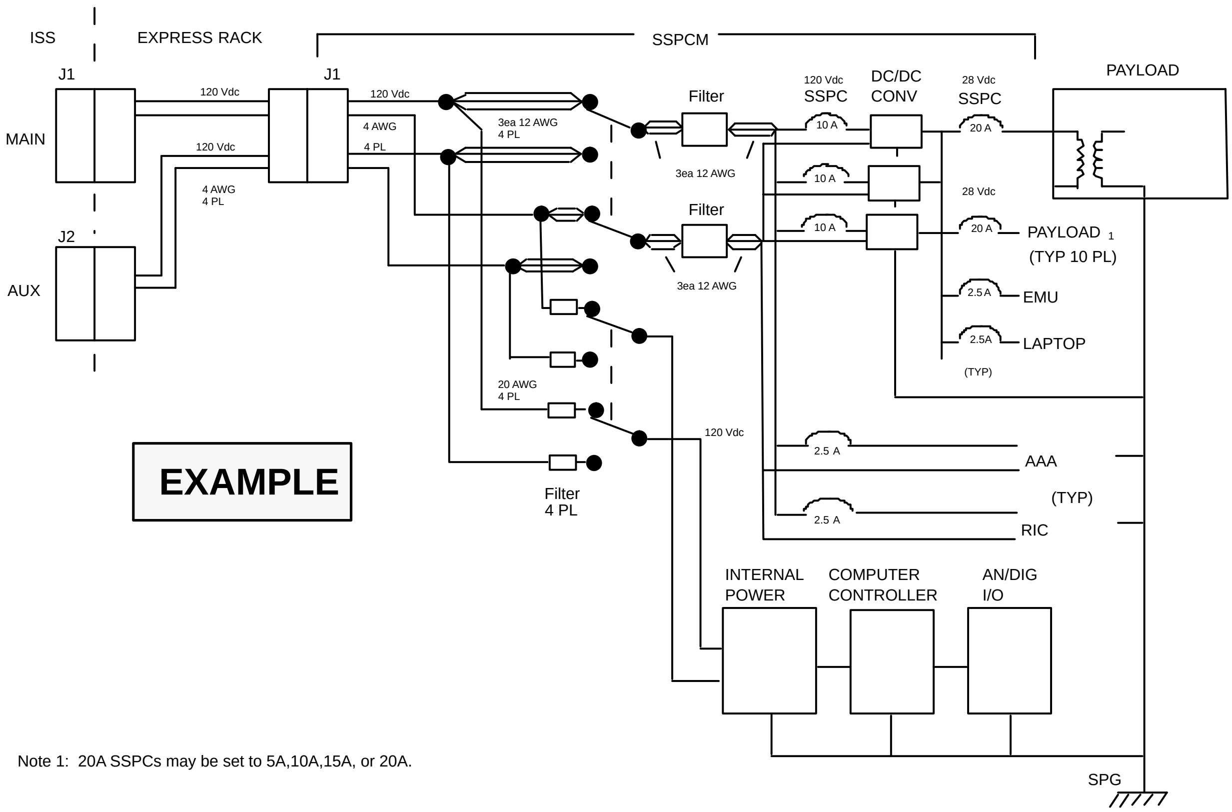
TABLE 3.2.7–1 INTERFACE B OR C

		POWER (WATTS) MAIN FEED			P/L Characteristics	POWER (WATTS) AUXILIARY FEED		
		Peak	Max Cont	Keep Alive		Peak/Duty Cycle (%)	Max Cont/ Duty Cycle (%)	Keep Alive/Duty Cycle (%)
Prelaunch								
Ascent								
On–Orbit								
Descent								
Postlanding								

Note: Prelaunch, ascent, descent, and post landing apply only to refrigerators and freezers.
Peak power is defined as the highest power requirement lasting greater than 50 msec.

Note:

Rack integrator and/or payload will provide payload characteristics that specify whether payload resistive, constant power, or both. If both, state the percentage of constant power.



Note 1: 20A SSPCs may be set to 5A,10A,15A, or 20A.

FIGURE 3.2.7–2 ELECTRICAL SCHEMATIC OF THE INTEGRATED RACK OR ELECTRICAL POWER CONSUMING EQUIPMENT INTERFACING TO THE UIP OR UOP RESPECTIVELY

Note:
Rack Integrator and/or payload developer will provide a detailed electrical schematic that includes, but is not limited to, wire gauge, circuit protection devices, integrated rack power removal switch, GFCI, portable equipment power cords, isolation resistance between main and auxiliary feeds, electrical grounding scheme, etc. Filtered schematics are to be supplied including component values and minimum component resistance (for estimation of Q related effects). Qualified aerospace enclosures are to be identified if reduced size wiring or parallel wiring is used.

3.3 COMMAND AND DATA HANDLING INTERFACE REQUIREMENTS

This section applies to all payload commands and data on the Low Rate Data Link (LRDL), Medium Rate Data Link (MRDL), and High Rate Data Link (HRDL) and MDM supported analog and discrete measurements, including those necessary to interface with the Fire Detection and Suppression System.

3.3.1 GENERAL REQUIREMENTS

The following sections contain description of the unique characteristics of rack data links. The combination of Integrated Data Flow Schematics and details provided in subsequent sections define routing, switching and electrical characteristics as required to perform payload operations and to support link level analysis, test and troubleshooting. Rack internal connectors and cables which require crew interaction for installation or on–orbit operation are also defined by location, connector pin function.

The Integrated Data Flow Schematic for the Rack is provided in Figure 3.3.1–1.

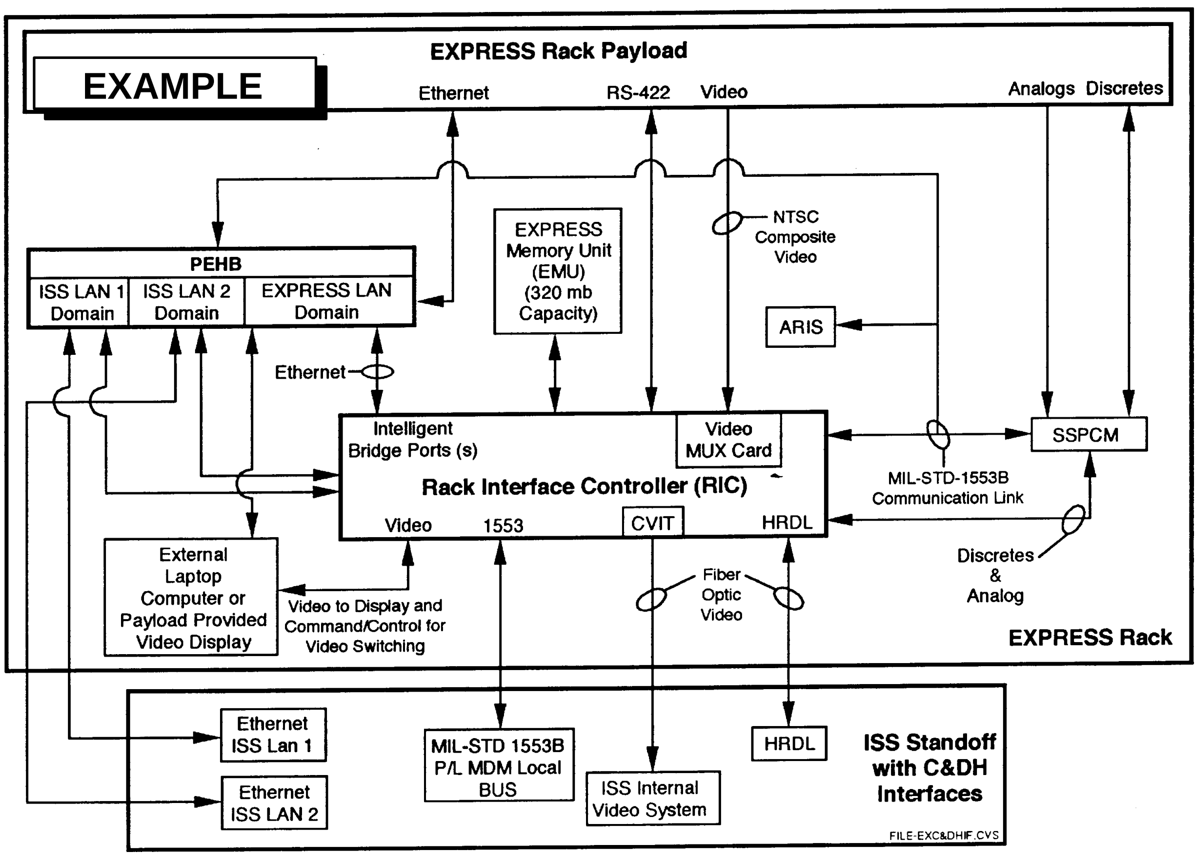


FIGURE 3.3.1–1 INTEGRATED DATA FLOW SCHEMATIC

3.3.2 STANDARD PAYLOAD 1553B LOW RATE DATA LINK

The LRDL electrical interfaces will be in accordance with MIL–STD–1553B, using the interconnection requirements as specified in SSQ 22678, paragraph 4.5.1.1.

3.3.2.1 ELECTRICAL INTERFACE

The rack integrator MIL–STD–1553B internal wiring stub length will be listed in Table 3.3.2.1–1.

TABLE 3.3.2.1–1 LRDL ELECTRICAL CHARACTERISTICS

	Recommended	**Actual**
Type	**Twisted Shielded**	
* Stub Length	≤ 12 Feet	
* Measured from the RT to the ISPR Utility Panel		

> Note:
> The rack integrator will record the actual LRDL electrical characteristics in Table 3.3.2.1–1 in the unique ICD.

3.3.2.2 CONNECTORS

The integrated rack 1553B bus connectors, J3 and J4, pin assignments are shown in Figures 3.3.2.2–1 and 3.3.2.2–2, respectively. The MIL–STD–1553B bus connectors are defined in Table 3.1.2–1.

The integrated rack 1553B bus connectors to the UOP, J3 and J4, pin assignments are shown in Figure 3.2.1.2–1 (refer to Section 3.2, Electrical Power Interfaces).

UTILITY I/F PANEL
NATC07T15N35SN
or
340105601B07–15–35SN

ISPR

NATC06G15N35PN (NASA SSQ 21635)*

1553 BUS A	J3	P3
STANDARD P/L BUS BIT0 ADDRESS (USL)	1	
STANDARD P/L BUS BIT1 ADDRESS (USL)	2	
STANDARD P/L BUS BIT2 ADDRESS (USL)	3	
STANDARD P/L BUS BIT3 ADDRESS (USL)	4	
STANDARD P/L BUS BIT4 ADDRESS (USL)	5	
STANDARD P/L BUS PARITY (USL)	6	
STANDARD P/L BUS LOGIC GND (USL)	7	
SPARE	8	
JEM MOD. SPEC. P/L1 BUS BIT0 ADDRESS	9	
JEM MOD. SPEC. P/L1 BUS BIT1 ADDRESS	10	
JEM MOD. SPEC. P/L1 BUS BIT2 ADDRESS	11	
JEM MOD. SPEC. P/L1 BUS BIT3 ADDRESS	12	
JEM MOD. SPEC. P/L1 BUS BIT4 ADDRESS	13	
JEM MOD. SPEC. P/L1 BUS PARITY	14	
JEM MOD. SPEC. P/L1 BUS LOGIC GND	15	
SPARE	16	
JEM MOD. SPEC. P/L3 BUS BIT0 ADDRESS	17	
JEM MOD. SPEC. P/L3 BUS BIT1 ADDRESS	18	
JEM MOD. SPEC. P/L3 BUS BIT2 ADDRESS	19	
JEM MOD. SPEC. P/L3 BUS BIT3 ADDRESS	20	
JEM MOD. SPEC. P/L3 BUS BIT4 ADDRESS	21	
JEM MOD. SPEC. P/L3 BUS PARITY	22	
JEM MOD. SPEC. P/L3 BUS LOGIC GND	23	
SPARE	24	
APM MODULE SPECIFIC P/L BUS A–	25	
APM MODULE SPECIFIC P/L BUS A+	26	
JEM MODULE SPECIFIC P/L4 1553B BUS A–	27	
JEM MODULE SPECIFIC P/L4 1553B BUS A+	28	
JEM MODULE SPECIFIC P/L3 1553B BUS A–	29	
JEM MODULE SPECIFIC P/L3 1553B BUS A+	30	
SPARE	31	
JEM MODULE SPECIFIC P/L2 1553B BUS A–	32	
JEM MODULE SPECIFIC P/L2 1553B BUS A+	33	
JEM MODULE SPECIFIC P/L1 1553B BUS A–	34	
JEM MODULE SPECIFIC P/L1 1553B BUS A+	35	
STANDARD P/L 1553B BUS A– (USL)	36	
STANDARD P/L 1553B BUS A+ (USL)	37	

NOTE: Data buses are controlled impedance twisted shielded pairs with the shield terminated on the connector backshell.

NOTE: JEM module specific P/L bus interfaces are not applicable to the APM.
JEM module specific P/L2, P/L3 and P/L4 bus interfaces are not applicable to the USL.
JEM module specific P/L3 and P/L4 bus interfaces are applicable only to limited locations in the JEM.
APM module specific P/L bus interfaces are not applicable to the JEM and USL.

NOTE: The bus address logic ground shall be connected to the ISPR Remote Terminal chassis ground.

* International Payload Buses IP Negotiation Dependent.

FIGURE 3.3.2.2–1 PAYLOAD 1553B BUS A CONNECTOR PIN/ASSIGNMENT – J3

Note:
The rack integrator will provide connector pin out information to define interface pin functions used.

UTILITY I/F PANEL
NATC07T15N35SA
or
340105601B07–15–35SA

ISPR
NATC06G15N35PA (NASA SSQ 21635)
or
340105601B06–15–35PA (ESA SCC 3401/056)

1553 BUS B	J4	P4
APM MOD. SPEC. P/L BUS BIT0 ADDRESS	1	
APM MOD. SPEC. P/L BUS BIT1 ADDRESS	2	
APM MOD. SPEC. P/L BUS BIT2 ADDRESS	3	
APM MOD. SPEC. P/L BUS BIT3 ADDRESS	4	
APM MOD. SPEC. P/L BUS BIT4 ADDRESS	5	
APM MOD. SPEC. P/L BUS PARITY	6	
APM MOD. SPEC. P/L BUS LOGIC GND	7	
SPARE	8	
JEM MOD. SPEC. P/L2 BUS BIT0 ADDRESS	9	
JEM MOD. SPEC. P/L2 BUS BIT1 ADDRESS	10	
JEM MOD. SPEC. P/L2 BUS BIT2 ADDRESS	11	
JEM MOD. SPEC. P/L2 BUS BIT3 ADDRESS	12	
JEM MOD. SPEC. P/L2 BUS BIT4 ADDRESS	13	
JEM MOD. SPEC. P/L2 BUS PARITY	14	
JEM MOD. SPEC. P/L2 BUS LOGIC GND	15	
SPARE	16	
JEM MOD. SPEC. P/L4 BUS BIT0 ADDRESS	17	
JEM MOD. SPEC. P/L4 BUS BIT1 ADDRESS	18	
JEM MOD. SPEC. P/L4 BUS BIT2 ADDRESS	19	
JEM MOD. SPEC. P/L4 BUS BIT3 ADDRESS	20	
JEM MOD. SPEC. P/L4 BUS BIT4 ADDRESS	21	
JEM MOD. SPEC. P/L4 BUS PARITY	22	
JEM MOD. SPEC. P/L4 BUS LOGIC GND	23	
SPARE	24	
APM MODULE SPECIFIC 1553B P/L BUS B–	25	
APM MODULE SPECIFIC 1553B P/L BUS B+	26	
JEM MODULE SPECIFIC P/L4 1553B BUS B–	27	
JEM MODULE SPECIFIC P/L4 1553B BUS B+	28	
JEM MODULE SPECIFIC P/L3 1553B BUS B–	29	
JEM MODULE SPECIFIC P/L3 1553B BUS B+	30	
SPARE	31	
JEM MODULE SPECIFIC P/L2 1553B BUS B–	32	
JEM MODULE SPECIFIC P/L2 1553B BUS B+	33	
JEM MODULE SPECIFIC P/L1 1553B BUS B–	34	
JEM MODULE SPECIFIC P/L1 1553B BUS B+	35	
STANDARD P/L 1553B BUS B– (USL)	36	
STANDARD P/L 1553B BUS B+ (USL)	37	

NOTE: Data buses are controlled impedance twisted shielded pairs with the shield terminated on the connector backshell.

NOTE: JEM module specific P/L bus interfaces are not applicable to the APM.
JEM module specific P/L2, P/L3 and P/L4 bus interfaces are not applicable to the USL.
JEM module specific P/L3 and P/L4 bus interfaces are applicable only to limited locations in the JEM.
APM module specific P/L bus interfaces are not applicable to the JEM and USL.

NOTE: Both the NASA SSQ21635 and ESA SCC3401/056 connectors are intermatable.

NOTE: The bus address logic ground will be connected to the ISPR Remote Terminal chassis ground.

FIGURE 3.3.2.2–2 PAYLOAD 1553B BUS B CONNECTOR/PIN ASSIGNMENT – J4

Note:
The rack integrator will provide connector pin out information to define interface pin functions used.

3.3.3 MEDIUM RATE DATA LINK (MRDL)

3.3.3.1 CONNECTORS

The integrated rack MRDL connectors, J46 and J47, pin assignments are shown in Figures 3.3.3.1–1 and 3.3.3.1–2, respectively. The ISS Payload MRDL Architecture is shown in Figure 3.3.3.1–3. The MRDL connectors are defined in Table 3.1.2–1.

ISS NATC07T11N35SA or 340105601B07–11–35SA	J46	P46	ISPR NATC06G11N35PA Or 340105601B06G–11–35PA
SPARE	1	1	
Receive Data + from APM LAN–1 (APM HUB–N)	2	2	
Receive Data – from APM LAN–1 (APM HUB–N)	3	3	
Receive Data – from USL/CAM LAN–1	4	4	
SPARE	5	5	
SPARE	6	6	
SPARE	7	7	
Transmit Data – to USL/CAM LAN–1	8	8	
SPARE	9	9	
Transmit Data + to APM LAN–1 (APM HUB–N)	10	10	
Transmit Data – to APM LAN–1 (APM HUB–N)	11	11	
Receive Data + from USL/CAM LAN–1	12	12	
Transmit Data + to USL/CAM LAN–1	13	13	

NOTE: Interface to the APM LAN–1 for ESA use only. Interface only applicable to the APM. Interface to USL/CAM LAN–1 not applicable to the APM.

FIGURE 3.3.3.1–1 USL/CAM LAN–1 INTERFACE CONNECTOR/PIN ASSIGNMENT – J46

ISS NATC07T11N35SB or 340105601B07–11–35SB	J47	P47	ISPR NATC06G11N35PB (NASA SSQ 21635) or 340105601B06G–11–35PB
SPARE	1	1	
Receive Data + from APM LAN–2 (APM HUB–R)	2	2	
Receive Data – from APM LAN–2 (APM HUB–R)	3	3	
Receive Data – from USL/JEM/APM LAN–2	4	4	
SPARE	5	5	
SPARE	6	6	
SPARE	7	7	
Transmit Data – to USL/JEM/APM LAN–2	8	8	
SPARE	9	9	
Transmit Data + to APM LAN–2 (APM HUB–R)	10	10	
Transmit Data – to APM LAN–2 (APM HUB–R)	11	11	
Receive Data + from USL/JEM/APM LAN–2	12	12	
Transmit Data + to USL/JEM/APM LAN–2	13	13	

NOTE: Interface to the APM LAN–2 for ESA use only. Interface only applicable to the APM

FIGURE 3.3.3.1–2 USL/JEM/APM LAN–2 INTERFACE CONNECTOR/PIN ASSIGNMENT – J47

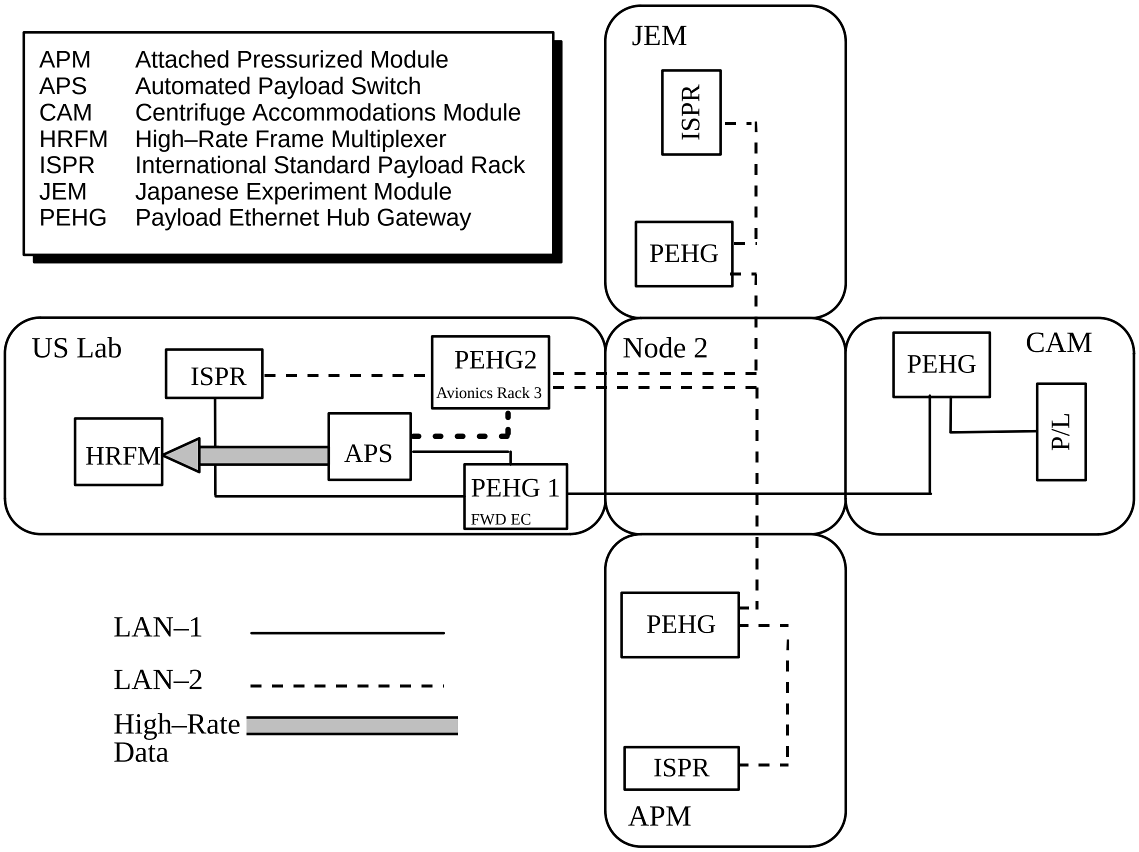


FIGURE 3.3.3.1–3 ISS PAYLOAD MRDL ARCHITECTURE

3.3.3.2 ELECTRICAL INTERFACE

The integrated rack internal MRDL wiring cable length will be listed in Table 3.3.3.2–1.

TABLE 3.3.3.2–1 MRDL RACK WIRING CABLE LENGTH

	Recommended	Actual
Type	Twisted Shielded	
Cable Length	16.4 feet (5.0 meters) maximum	

3.3.4 HIGH RATE DATA LINK (HRDL)

3.3.4.1 CONNECTOR

The integrated rack HRDL connector, J7, pin assignments are shown in Figure 3.3.4.1–1. The HRDL bus connector is defined in Table 3.1.2–1.

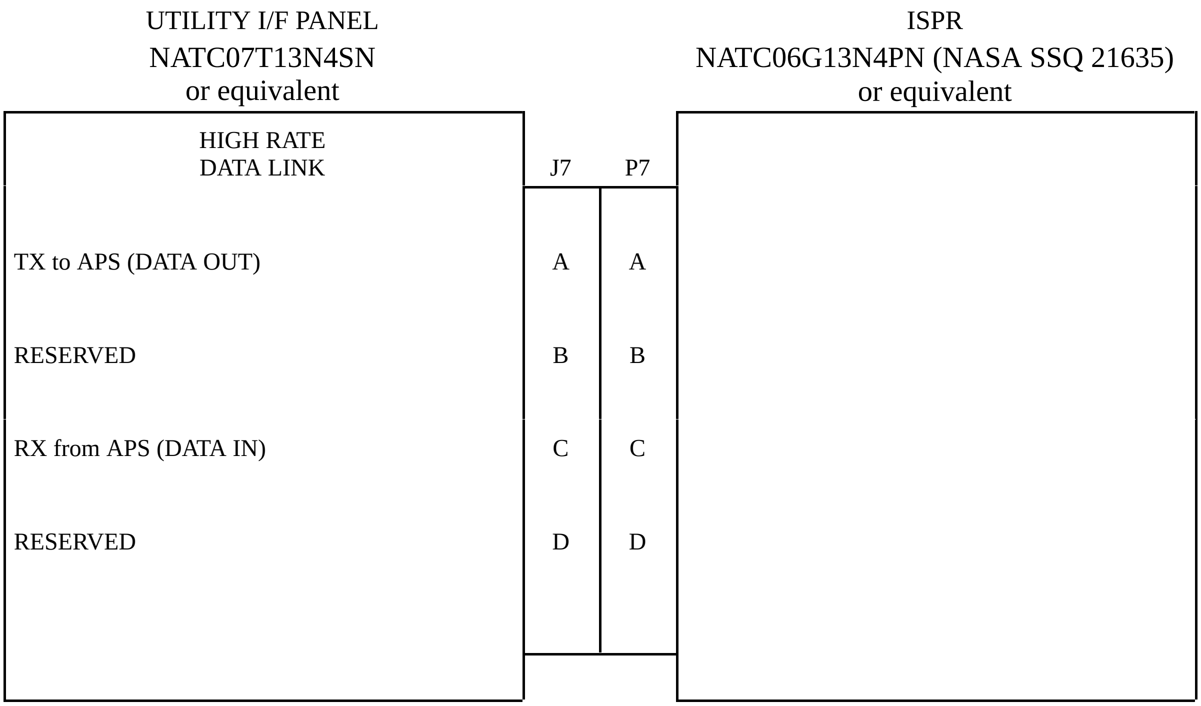


FIGURE 3.3.4.1–1 STANDARD HIGH RATE DATA CONNECTOR PART NUMBER AND PIN ASSIGNMENT – J7

3.3.4.2 FIBER OPTIC SIGNAL CHARACTERISTICS

> Note:
> The rack integrator will record the actual optical power at the HRDL I/F.

The Rack Fiber Optic signal power at the HRDL J7 I/F is: ______ dBm.

3.3.5 FDS/MAINTENANCE (POWER) SWITCH INTERFACE

3.3.5.1 CONNECTOR

The integrated rack fire detection support and Rack Maintenance (rack power) switch signals connector, J43, pin assignments are shown in Figure 3.3.5.1–1. The fire detection support and power removal switch connector is defined in Table 3.1.2–1.

UTILITY I/F PANEL NATC07T1EN35SA or 340105601B07–13–35SAB01			ISPR NATC06G13N35PA 340105601B06–13–35PAB01
MAINTENANCE SWITCH/FIRE DETECTION SUPPORT INTERFACE	J43	P43	
SMOKE DET SCATTER –	1	1	
SPARE	2	2	
SPARE	3	3	
SPARE	4	4	
SPARE	5	5	
SPARE	6	6	
SPARE	7	7	
SPARE	8	8	
SPARE	9	9	
SPARE	10	10	
SPARE	11	11	
FAN VENTILATION IND +	12	12	
FAN VENTILATION IND –	13	13	
SMOKE DET SCATTER +	14	14	
SMOKE IND CMD –	15	15	
SMOKE DET OBSCURATION +	16	16	
SMOKE DET OBSCURATION –	17	17	
SMOKE DET BIT ENABLE –	18	18	
PWR REMOVAL SWITCH POSITION –	19	19	
PWR REMOVAL SWITCH POSITION +	20	20	
SMOKE IND CMD +	21	21	
SMOKE DET BIT ENABLE +	22	22	

FIGURE 3.3.5.1–1 INTEGRATED RACK POWER REMOVAL SWITCH DETECTION PIN ASSIGNMENTS – J43

3.3.5.2 SMOKE SENSOR CIRCUIT CHARACTERISTICS

The interface for the rack unique smoke detector is as depicted in the simplified schematic of Figure 3.3.5.2–1. Rack unique smoke detector functional characteristics are shown in Table 3.3.5.2–1.

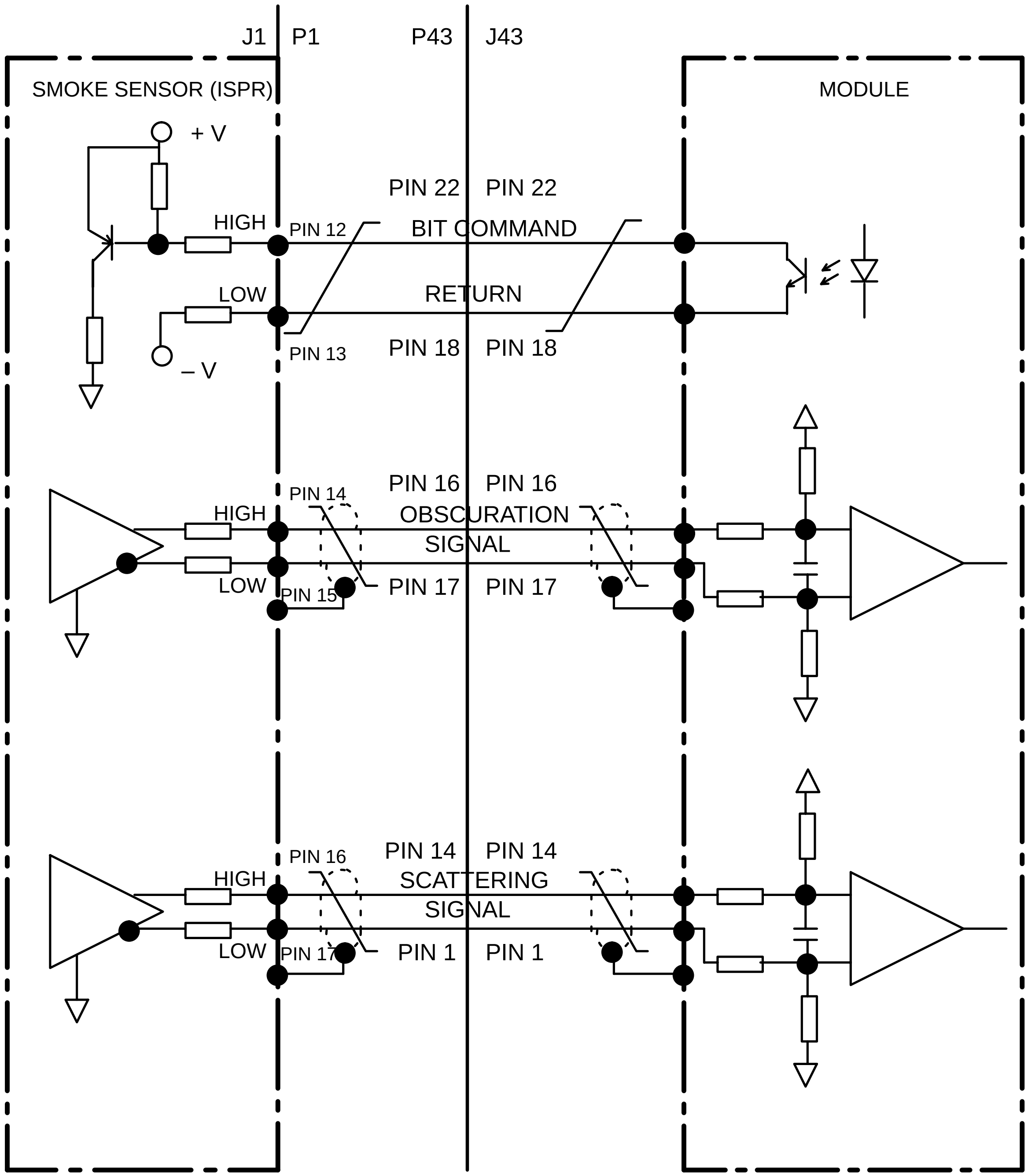


FIGURE 3.3.5.2–1 PRINCIPAL CIRCUIT FOR THE SMOKE SENSOR INTERFACE

Note: The rack integrator is to provide revised unique schematic if modified.

TABLE 3.3.5.2–1 SMOKE DETECTION SUPPORT FUNCTIONAL CHARACTERISTICS

TYPE	SIGNAL NAME	SIGNAL TYPE	CONDITION	SIGNAL RANGE	VOLTAGE RANGE (SIGNAL RANGE) NOMINAL
Smoke Detector	BIT input	Discrete	Nominal	Open (high)	V= +5.0 Vdc
Smoke Detector	BIT input	Discrete	BIT ON	Closed (low)	V< +5.0 Vdc
Smoke Detector	Obscuration Output	Analog	Nominal	0 to 100% light attenuation	V= +4 to -4 Vdc
Smoke Detector	Obscuration Output	Analog	BIT ON	Laser OFF	V< -3.8 Vdc
Smoke Detector	Scatter output	Analog	Nominal	0 to 2% OBS/ ft	0 to 4.5 Vdc
Smoke Detector	Scatter output	Analog	BIT ON	0.9 to 2.1 % OBS/ ft	1.8 to 4.2 Vdc
Smoke Detector	Scatter output	Analog	BIT Off (Quiet Period)	0% OBS/ ft	0 to 0.5 Vdc
FAN Ventilation	Ventilation output	Analog	Nominal	+/ - 5VDC	+/ - 5VDC
Smoke Indicator	Indication input	Discrete	N/ A	N/ A	N/ A

Note:
The rack integrator will provide the fan speed signal value that corresponds to the minimum air flow across the rack smoke sensor required for smoke detection.

The rack air flow threshold voltage for smoke–detection is: ___________ VDC

Note:
The rack integrator will provide a circuit diagram for the fan and Smoke Indicator LED.

3.3.5.3 RACK MAINTENANCE (POWER) SWITCH CIRCUIT CHARACTERISTICS

The modules provide at each ISPR location one switch closure command line for switching off the main/auxiliary power feeds implemented at the J43 connector. The interface for the Rack Maintenance Switch is depicted in the simplified schematic in Figure 3.3.5.3–1.

An open switch results that the power will be off. The power can not be re–applied to the ISPR unless the switch will be returned to the closed position. **[TBR–2]**

3.4 PAYLOAD VIDEO INTERFACE REQUIREMENTS

This is limited to internal video interfaces. The USL and APM provides a fiber optic video interface and the JEM provides an NTSC electrical video interface. The MPLM does not have video.

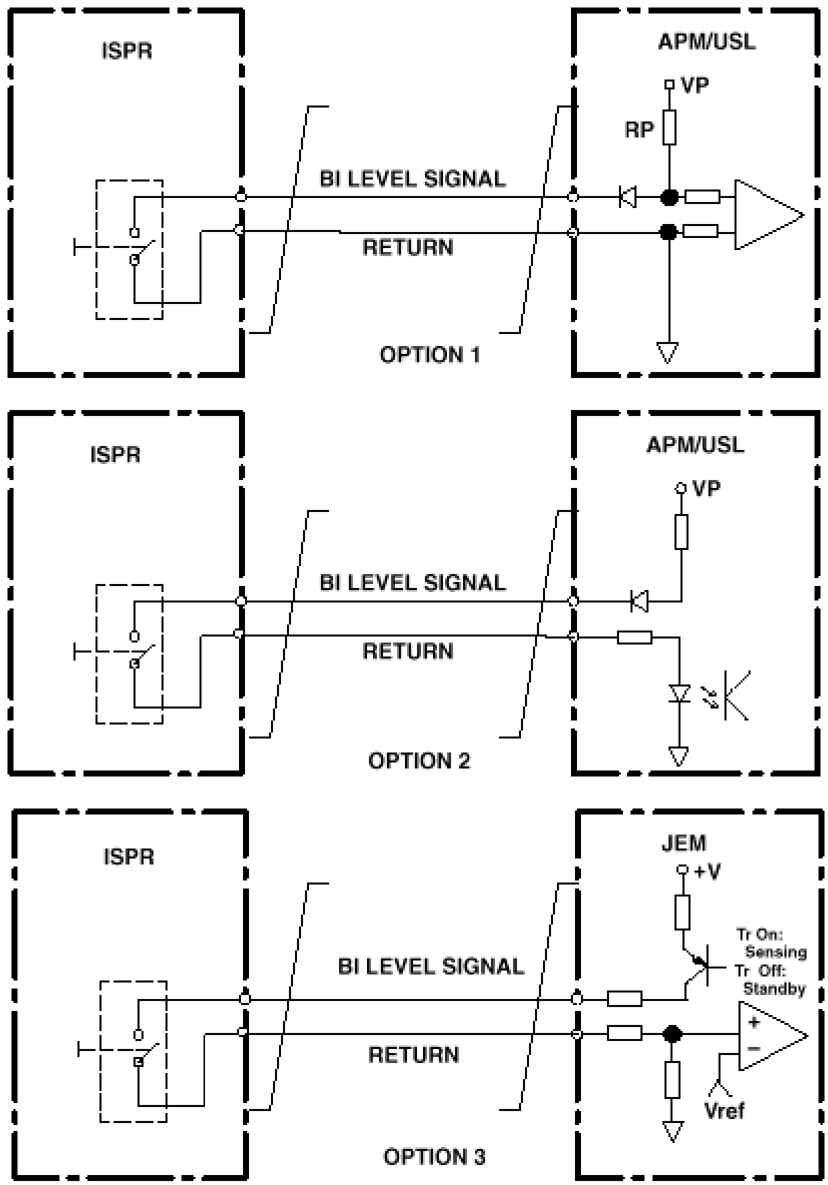


FIGURE 3.3.5.3–1 PRINCIPLE CIRCUIT FOR THE RACK MAINTENANCE SWITCH INTERFACE

3.4.1 NTSC FIBER OPTIC VIDEO

3.4.1.1 PULSE FREQUENCY MODULATION NTSC FIBER OPTIC VIDEO CHARACTERISTICS

The pulse frequency modulation (PFM) fiber optical video interface consists of one video channel into the rack, one video channel out of the rack, and one synchronization and control channel. The video hardwired addresses are allocated in Table 3.4.2.1–1.

3.4.1.2 PFM NTSC OPTICAL CONNECTOR

The integrated rack PFM NTSC video optical connector, J16, pin assignments are shown in Figure 3.4.1.2–1. The location of the video optical connector, J16, interface at the UIP is defined in Figures 3.1.2–1, 3.1.2–2, and 3.1.2–5. The video optical connector is defined in Table 3.1.2–1.

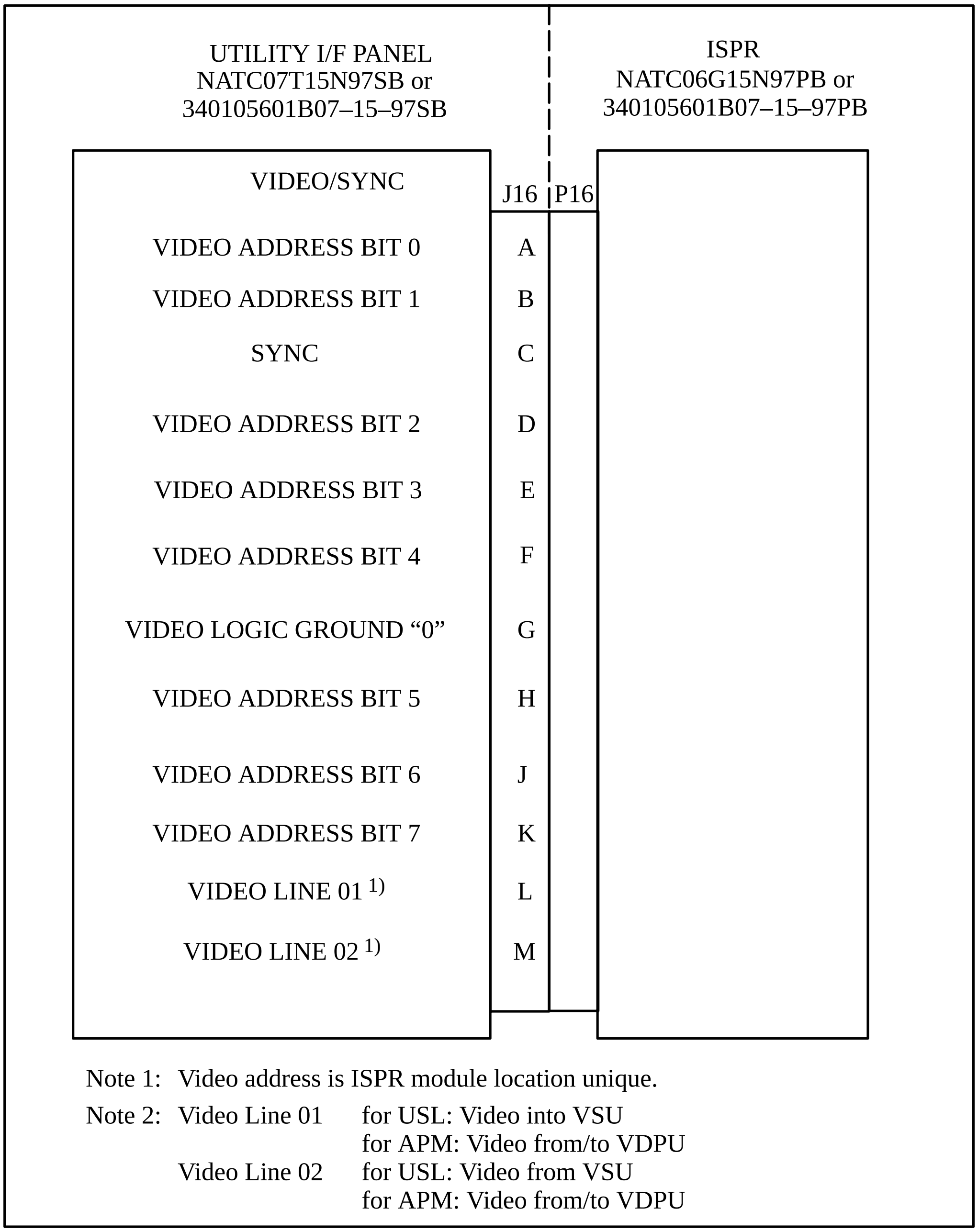
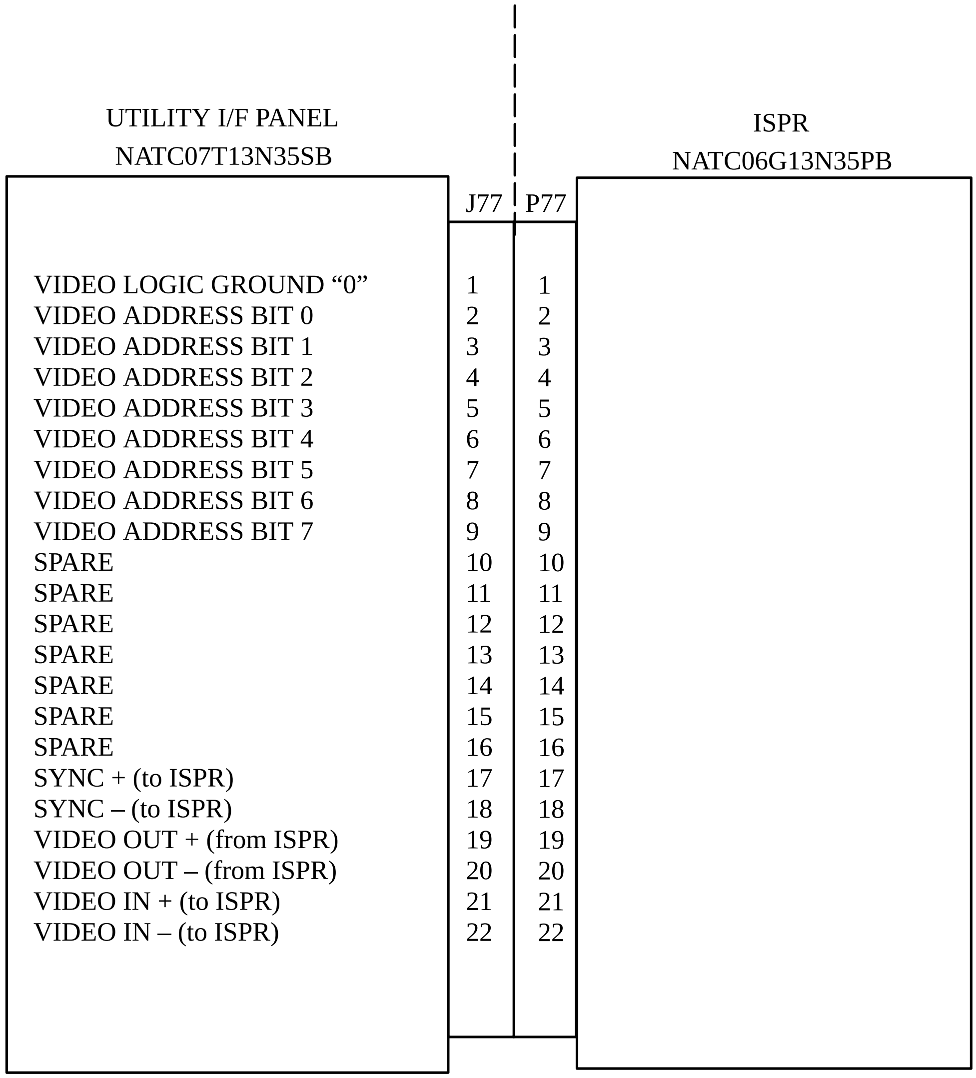


FIGURE 3.4.1.2–1 OPTICAL VIDEO CONNECTOR/PIN ASSIGNMENT – J16

3.4.2 NTSC ELECTRICAL VIDEO INTERFACES

3.4.2.1 ELECTRICAL VIDEO CONNECTOR

The integrated rack electrical video connector, J77, pin assignments are shown in Figure 3.4.2.1–1. The location of the electrical video connector, J77, interfaces at the UIP are defined in Figures 3.1.2–3 and 3.1.2–4. The electrical video connector is defined in Table 3.1.2–1. The video hardwired addresses are allocated in Table 3.4.2.1–1.



NOTE: J77 is available in the JEM only.

FIGURE 3.4.2.1–1 ELECTRICAL VIDEO SYSTEM INTERFACE CONNECTOR/PIN ASSIGNMENT – J77

TABLE 3.4.2.1–1 VIDEO HARDWIRED ADDRESSES

APM ISPR		JEM ISPR		US–LAB ISPR		CAM ISPR	
Location	Video Hardwired Address	Location	Video Hardwired Address	Location	Video Hardwired Address	Location	Video Hardwired Address
F1	210	F1	91	LAC1	179	O1	**(TBD #3)**
F2	211	F2	92	LAC2	180	O2	**(TBD #3)**
F3	212	F3	93	LAC3	181	F1	**(TBD #3)**
F4	213	F5	94	LAC4	182	F2	**(TBD #3)**
A1	214	F6	95	LAC5	183	F3	**(TBD #3)**
A2	215	A1	96	LAS1	184	F4	**(TBD #3)**
A3	216	A2	97	LAS2	185	A1	**(TBD #3)**
A4	217	A3	98	LAS3	186	A2	**(TBD #3)**
O1	218	A4	99	LAS4	187	A3	**(TBD #3)**
O2	219	A5	100	LAF3	188	A4	**(TBD #3)**
				LAP1	189		
				LAP2	190		
				LAP4	191		

NOTES:
1. Decimal values to be mapped in 8 bit presentation, bit 0 = LSB. See Figures 3.4.1.2–1 and 3.4.2.1–1.
2. Jumpering address line to ground = logic 0.

3.5 THERMAL CONTROL INTERFACE REQUIREMENTS

3.5.1 INTERNAL THERMAL CONTROL SYSTEM (ITCS) INTERFACE REQUIREMENTS

3.5.1.1 CONNECTOR

The location of the ITCS Moderate Temperature Loop (MTL) and Low Temperature Loop (LTL) interfaces at the UIP are defined in Figures 3.1.2–1 through 3.1.2–5. The MTL and LTL connectors are defined in Table 3.1.2–1.

3.5.1.2 ITCS COOLANT FLOW RATE AND PRESSURE DROP

The integrated rack can request to be supplied a specific flow rate within the ranges specified in Table 3.5.1.2–1. Multiple flow rate settings can be accommodated provided the control system time constant requirements are met and the flow rate setting changes are properly coordinated with the Module Integrator. Each payload location utilizing a module–provided valve has an off or “zero–flow” capability. During nominal operations a payload should receive ITCS coolant from the interface at the requested rate plus or minus the system control capability. The maximum pressure drop across an integrated rack in each module for the MTL and the LTL is defined in Table 3.5.1.2–2. The coolant flow rate required by the integrated rack and the corresponding pressure drop across the rack is defined in Figure 3.5.1.2–3.

TABLE 3.5.1.2–1 ITCS COOLANT FLOW RATE CAPABILITY

Element:	System Control Capability	Moderate Temperature Loop		Low Temperature Loop	
		lb/hr (kg/hr)	lb/hr (kg/hr)	lb/hr (kg/hr)	lb/hr (kg/hr)
		Module Total	Available at Single P/L Location	Module Total	Available at Single P/L Location
USL (Post 20A)	± 5% > 350 lb/hr ± 10% ≤ 350 lb/hr	745 (339)	100 – 745 (45 – 339)	890 (403)	100 – 890 (45 – 403)
USL[1] (Pre 20A)	± 5% > 350 lb/hr ± 10% ≤ 350 lb/hr	395 (180)	100–395 (45 – 180)	890 (403)	100 – 890 (45 – 403)
APM	± 10% of calibrated flow [2]	1,430 (650)	66 – 419 (30 – 190)		
JEM[3]	–0/+154 lb/hr MT –0/+176 lb/hr LT	218 – 1,014[4] (99–462)	100 – 436 (45 – 198)	343 – 686[5] (156 – 312)	100 – 512 (45 – 232)
CAM	± 5% > 350 lb/hr ± 10% ≤ 350 lb/hr	1,489 (675)	100 – 400 (45 – 181)	821[6] (372)	100 – 400[6] (45 – 181)
MPLM	± 15% of flow set at P_E/4.4 [7]			500 (227)	P_E/5.0 to P_E/4.4

Note:
[1] The airlock requires 350 lb/hr (159 kg/hr) of USL MTL prior to the arrival of Node 3 on flight 20A.
[2] The APM will provide a pressure drop across the interface of 5.8 psid (40 kPa) for all flow rates within the specified range when the Water Flow Selectability Valve (WFSV) is fully open. Reduction in flow rate can be achieved either by partial closing of the WFSV, leading to a reduced pressure drop across the interface, or by internal flow control valves, if such valves are present. If the payload is utilizing internal flow control valves, the payload must be capable of accommodating this pressure drop for all flow rates equal to or less than the rack maximum flow rate. The APM will provide an accuracy of +/– 10% corresponding to the flow rate calibrated for that rack on the ground at a pressure differential across the interface of 5.8 psid (40 kPa).
[3] The JEM will provide a pressure difference higher than 6.0 psid (41.4 kPa) across an integrated rack for all flow rates within the specified range. The payload will be capable of accommodating this pressure drop for all required flow rates. Any changes in MTL or LTL flow rate must be coordinated with NASDA MCC.
[4] Total available depends on MTL use by JEM airlock, RMS, and EF as well as operating configuration (single or dual loop).
[5] Total available depends on flow through condensing heat exchangers and operating configuration (single or dual loop).
[6] Payload use of CAM LTL is limited to 321 lb/hr (146 kg/hr) when the MPLM is docked.
[7] P_E=payload electrical power in watts.

TABLE 3.5.1.2–2 ITCS PRESSURE DROP

Loop/Lab	USL psid (kPa)	APM psid (kPa)	JEM psid (kPa)	MPLM [1] psid (kPa)	CAM psid (kPa)
MTL	Figure 3.5.1.2–1	5.8 ± 0.2 (40 ± 1.4)	5.8 ± 0.2 (40 ± 1.4)		Figure 3.5.1.2–2
LTL	Figure 3.5.1.2–1		5.8 ± 0.2 (40 ± 1.4)	2.0 + 0/–0.2 (13.8 + 0/–1.4)	Figure 3.5.1.2–2

Note: Both halves of each mated QD pair will be included as part of the payload pressure differential.

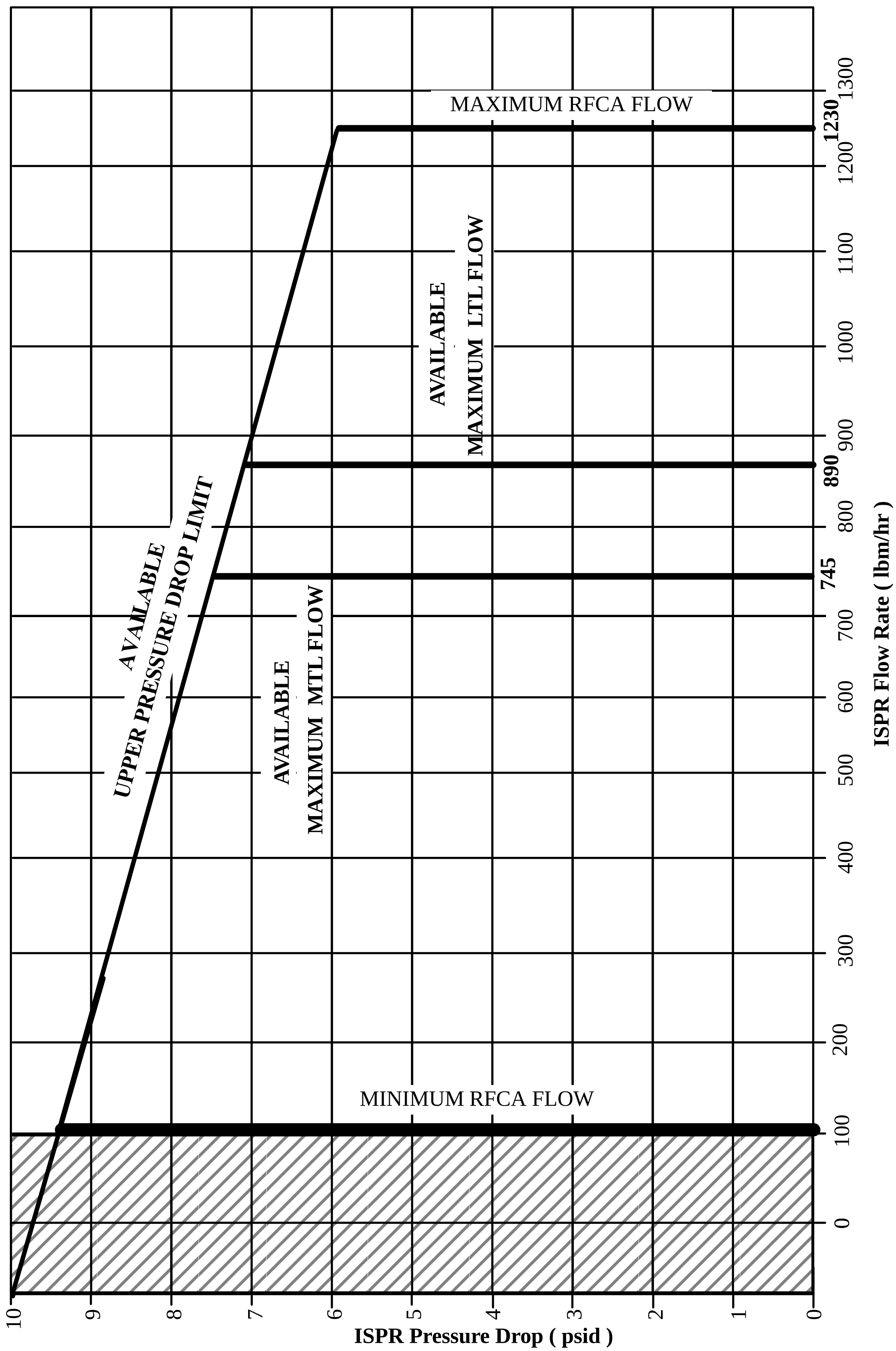


FIGURE 3.5.1.2–1 U.S. LAB AVAILABLE PRESSURE DROP VS. FLOW RATE

[TBD #4]

FIGURE 3.5.1.2–2 CAM AVAILABLE PRESSURE DROP VS. FLOW RATE

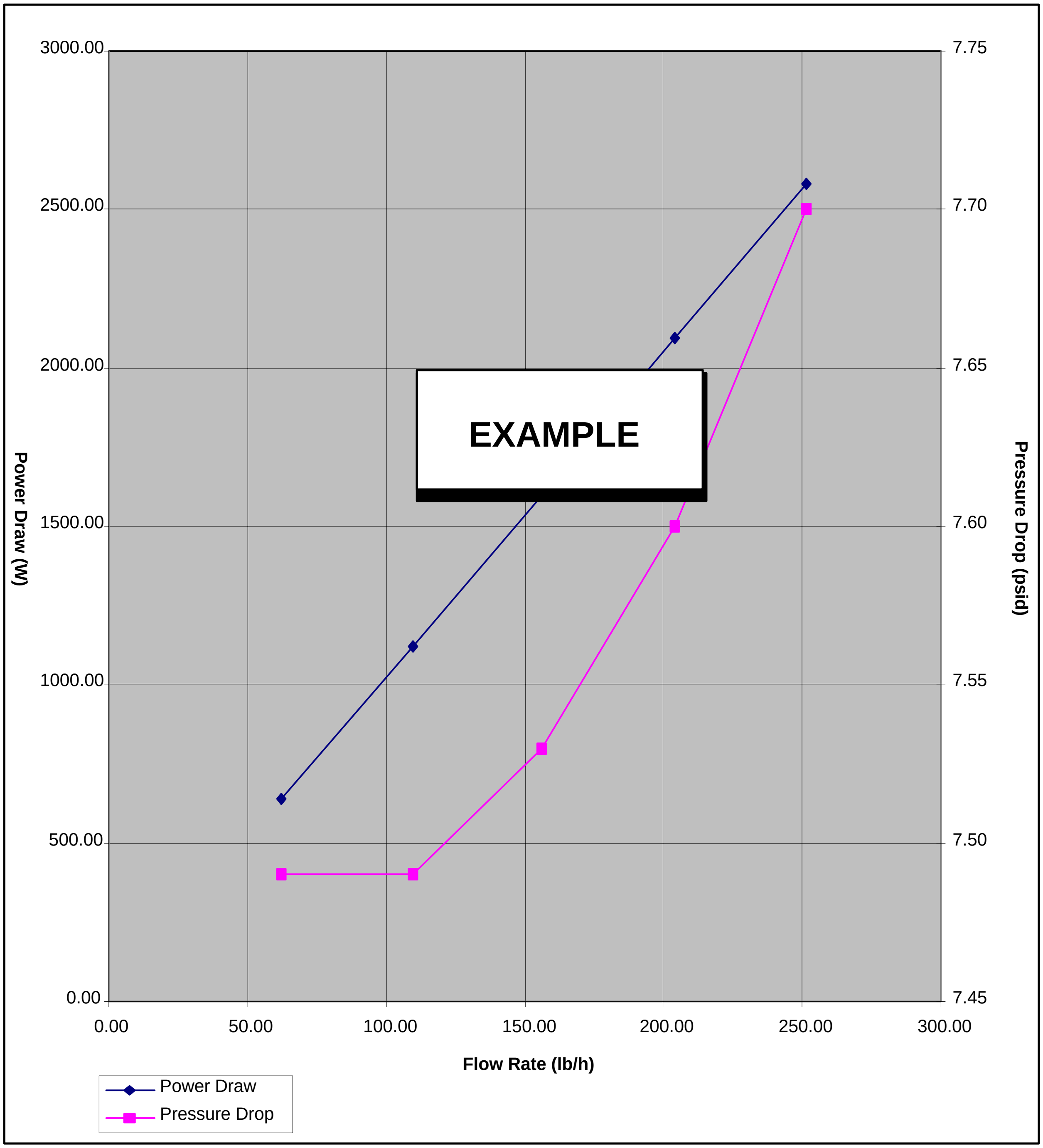


FIGURE 3.5.1.2–3 INTEGRATED RACK POWER DRAW AND PRESSURE DROP VERSUS FLOW RATE

> Note:
> Provide the integrated rack coolant flow rate requirement, pressure drop, and power draw for the range of operational modes the integrated rack is capable of.

3.5.1.3 COOLANT SUPPLY TEMPERATURE

The ITCS coolant loop supply temperatures in each module are defined in Table 3.5.1.3–1.

TABLE 3.5.1.3–1 ITCS COOLANT SUPPLY TEMPERATURES

Loop/Lab	USL °F (°C)	APM °F (°C)	JEM ° F (°C)	MPLM [1] °F (°C)	CAM °F (°C)
MTL	61 – 65 (16 – 18.3)	61 – 68 (16 – 20)	61 – 73.4 (16 – 23)		61 – 65 (16 – 18.3)
LTL	38 – 42 (3.3 – 5.6)		34 – 50 (1.1 – 10)	38 – 45 (3.3 – 7.2)	38 – 43 (3.3 – 6.1)

1. After a period of stagnant water conditions, MPLM TCS start up will result in actively cooled payloads receiving low temperature coolant at a maximum temperature of 140 °F (60 °C) for no more than 10 seconds, a maximum of 113 °F (45 °C) for no more than 500 seconds, and a maximum of 55 °F (12.8 °C) for no more than 650 seconds. During these conditions the actively cooled payload will be switched off. After the start up phase, each payload shall receive low temperature coolant from the MPLM at 38 to 45 °F (3.3 to 7.2 °C) during operations on station and 35 to 47 °F (1.7 to 8.3 °C) during operations in the orbiter.

3.5.1.4 MAXIMUM COOLANT PRESSURE

The ITCS maximum coolant pressure in each module is defined in Table 3.5.1.4–1. The rack maximum design pressure (MDP) is defined in Table 3.5.1.4–1.

TABLE 3.5.1.4–1 ITCS MAXIMUM COOLANT PRESSURE

Loop/Lab	USL psid (kPa)	APM psid (kPa)	JEM psid (kPa)	MPLM psid (kPa)	CAM psid (kPa)	**Rack MDP psia (kPa)**
MTL	100 (689.5)	121 (834.3)	100 (689.5)		100 (689.5)	
LTL	100 (689.5)		100 (689.5)	210 (1448.0)	100 (689.5)	

> Note:
> Provide the integrated rack maximum design pressure in Table 3.5.1.4–1

3.5.1.5 SIMULTANEOUS COOLING

3.5.1.5.1 USL AND CAM SIMULTANEOUS COOLING

The moderate temperature loop and low temperature loop may not be connected to each other. However, payload racks in the USL and CAM can be simultaneously supplied with both low temperature and moderate temperature coolant, provided the following stipulations for each of the implementation methods listed below are satisfied by the payloads:

3.5.1.5.1.1 FIXED FLOW AND MANUAL FLOW CONTROL OPTION

A. The integrated rack will provide automatic shut-off capability between the payload and ITCS system for fault detection and isolation.

B. The integrated rack shut-off or isolation valve will fail in a safe position.

C. The integrated rack will provide temperature and flow rate sensors.

> Note:
> The rack integrator will provide the simultaneous cooling implementation information.

3.5.1.5.1.2 PAYLOAD AUTOMATIC FLOW CONTROL

A. The integrated rack will provide automatic shut-off capability between the payload and ITCS system for fault detection and isolation.

B. The integrated rack flow control device or assembly will fail in a safe position.

C. The integrated rack will provide temperature and flow rate sensors.

D. The integrated rack will provide payload flow control device status to the PL MDM which would include flow rate, and outlet temperature.

> Note:
> The rack integrator will provide a schematic and description of the simultaneous cooling implementation information.

3.5.1.5.2 APM SIMULTANEOUS COOLING

The APM provides only moderate temperature coolant for integrated racks.

3.5.1.5.3 JEM SIMULTANEOUS COOLING

The integrated racks in the JEM at ISPR locations F1, F2, A1, and A2 can interface with both low temperature and moderate temperature coolant, and can be simultaneously supplied with both of them.

3.5.1.6 INTEGRATED RACK COOLANT QUANTITY

The maximum available total water volume available for payload use in each module is defined in Table 3.5.1.6–1. The quantity of coolant contained in the integrated rack is provided in Table 3.5.1.6–1.

Note: Payload racks are to have a design target for total rack coolant volume of no more than 1.82 gallons (6.90 liters) on the MTL and 0.91 gallons (3.44 liters) on the LTL (limited by JEM total coolant volume capacity).

TABLE 3.5.1.6–1 MODULE COOLANT QUANTITY AVAILABLE FOR PAYLOADS

Loop/Lab	USL Limit gal. (l)	APM Limit gal. (l)	JEM Limit gal. (l)	MPLM Limit gal. (l)	CAM Limit gal. (l)	Rack gal. (l)
MTL	42.25 (159.9)	21.14 (80.0)	18.23 (69.0)		8.45 (31.98)	
LTL	42.25 (159.9)		4.54 (17.2)	1.06 (4.01)	8.45 (31.98)	

Note:
Provide the quantity of coolant contained within the integrated rack in Table 3.5.1.6–1.

3.5.1.7 INTEGRATED RACK ALLOWABLE AIR INCLUSION

The integrated rack internal cooling loop air inclusion limits in each module are defined in Table 3.5.1.7–1. The quantity of air contained in the integrated rack coolant is provided in Table 3.5.1.7–1.

TABLE 3.5.1.7–1 INTEGRATED RACK AIR INCLUSION

Loop/Lab	USL Limit in. ^{3} (l)	APM Limit in. ^{3} (l)	JEM Limit in. ^{3} (l)	MPLM Limit in. ^{3} (l)	CAM Limit in. ^{3} (l)	Rack in. ^{3} (l)	FSS Use
MTL	8.88 (0.146)	4.85 (0.08)	0 (0)		8.88 (0.146)		
LTL	8.88 (0.146)		0 (0)	8.88 (0.146)	8.88 (0.146)		

Note:
Provide the quantity of air contained in the integrated rack coolant in Table Table 3.5.1.7–1. Indicate with and “X” in the FSS Use column of Table 3.5.1.7–1 if the FSS will be used on–orbit.

3.5.1.8 CABIN AIR HEAT LEAK

The integrated rack will not exceed the allowable cabin air sensible heat load capability limits of Table 3.5.1.8–1. The numbers in this Table are the total cabin sensible heat load allocation for all the ISPR's on a module basis. The integrated rack will not exceed the allowable cabin air latent heat load capability limits of Table 3.5.1.8–2. The numbers in this Table are the total cabin latent heat load allocation for all the ISPR's on a module basis.

TABLE 3.5.1.8–1 CABIN AIR SENSIBLE HEAT LOAD PER MODULE

APM Limit	USL Limit	JEM Limit	CAM Limit	MPLM Limit		RACK LOAD
500 W	500W	250W	500W	Ambient Temperature	Heat Load	
				15.5 °C (60 °F)	–254 W	
				29.4 °C (85 °F)	–317 W	
				48.9 °C (120 °F)	–526 W	

> Note:
> The rack integrator will provide the total integrated rack sensible heat leak into cabin air in Table 3.5.1.8–1. The heat load should include all associated ancillary provided equipment even if it is not directly connected to the rack. The ISS PCS loads are not to be included.

TABLE 3.5.1.8–2 CABIN AIR LATENT HEAT LOAD

APM Limit	USL Limit	JEM Limit	CAM Limit	RACK LOAD
70 W	70 W	5.3 W	70 W **[TBC]**	

> Note:
> Provide the integrated rack latent heat load in Table 3.5.1.8–2.

3.5.1.9 CABIN AIR COOLING

Cabin air cooling is the amount of heat transferred from the cabin air into an integrated rack. Integrated rack heat load absorption shall be no greater than the maximum values listed in Table 3.5.1.9–1, with linear interpolation to ambient temperatures between the specified values.

TABLE 3.5.1.9–1 AIR HEAT LOAD

Ambient Temperature	Max Heat Load	Rack Load
15.5 °C (60 °F)	68 W	
49 °C (120 °F)	140 W	

> Note:
> Supply the total amount of heat that the integrated rack will remove from the ISS cabin in Table 3.5.1.9–1.

3.6 VACUUM SYSTEM REQUIREMENTS

3.6.1 VACUUM EXHAUST SYSTEM (VES)/WASTE GAS SYSTEM (WGS)

The Vacuum Exhaust System/Waste Gas System (VES/WGS) is capable of reaching a pressure at the ISPR interface of 1 x 10^{-3} torr (.13 Pa) in less than two hours for a single payload/facility volume of 100 liter at an initial pressure of 14.7 psia (101 kPa); dry air at 70 °F (21 °C) assuming zero leakage and out/off gassing and infinite conductivity between payload/facility volume and the rack interface. The ISPR locations in the USL, JEM, and APM providing VES/WGS capabilities are illustrated in Figures 3.6.1–1, 3.6.1–2 and 3.6.1–3. The location of the VES/WGS interfaces at the UIP is defined in Figures 3.1.2–1 through 3.1.2–5 (WASTE GAS SYSTEM). The VES/WGS connector is defined in Table 3.1.2–1.

3.6.1.1 ACCEPTABLE EXHAUST GASES

A list of acceptable exhaust gases with verified compatibility to the VES is documented in Figure 3.6.1.5.1–1 of the IRD. The Rack vented gases are identified in Table 3.6.1.1–1.

TABLE 3.6.1.1–1 RACK VENTED GASES

Constituent	Mass (kg)	Temperature °C	Total Pressure (kPa)	Concentration

> Note:
> The rack integrator will define each gas to be vented through the VES and its associated characteristics in Table 3.6.1.1–1 for each venting event. Contingency events must also be addressed.

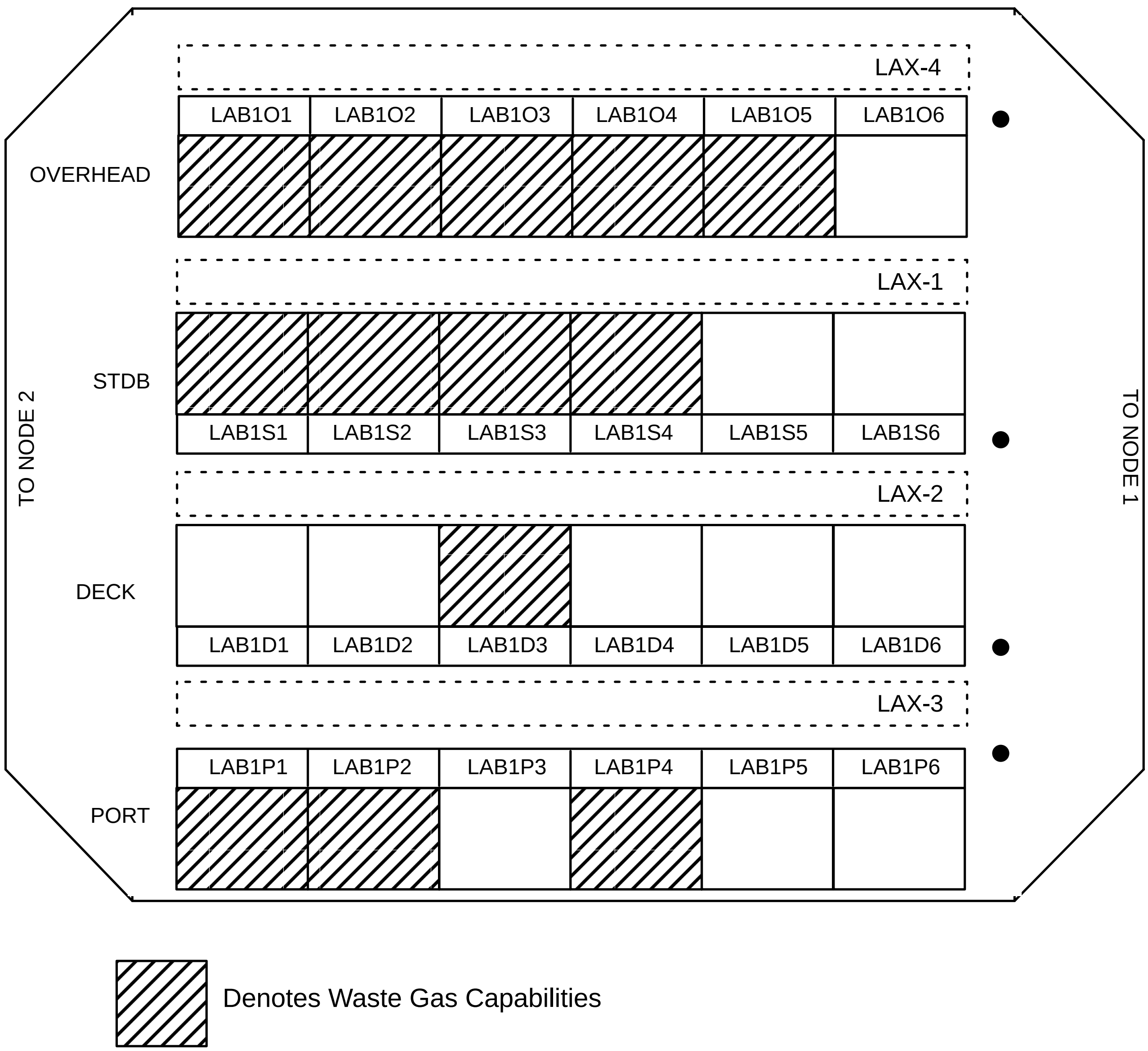


FIGURE 3.6.1–1 USL VES/WGS INTERFACE LOCATIONS

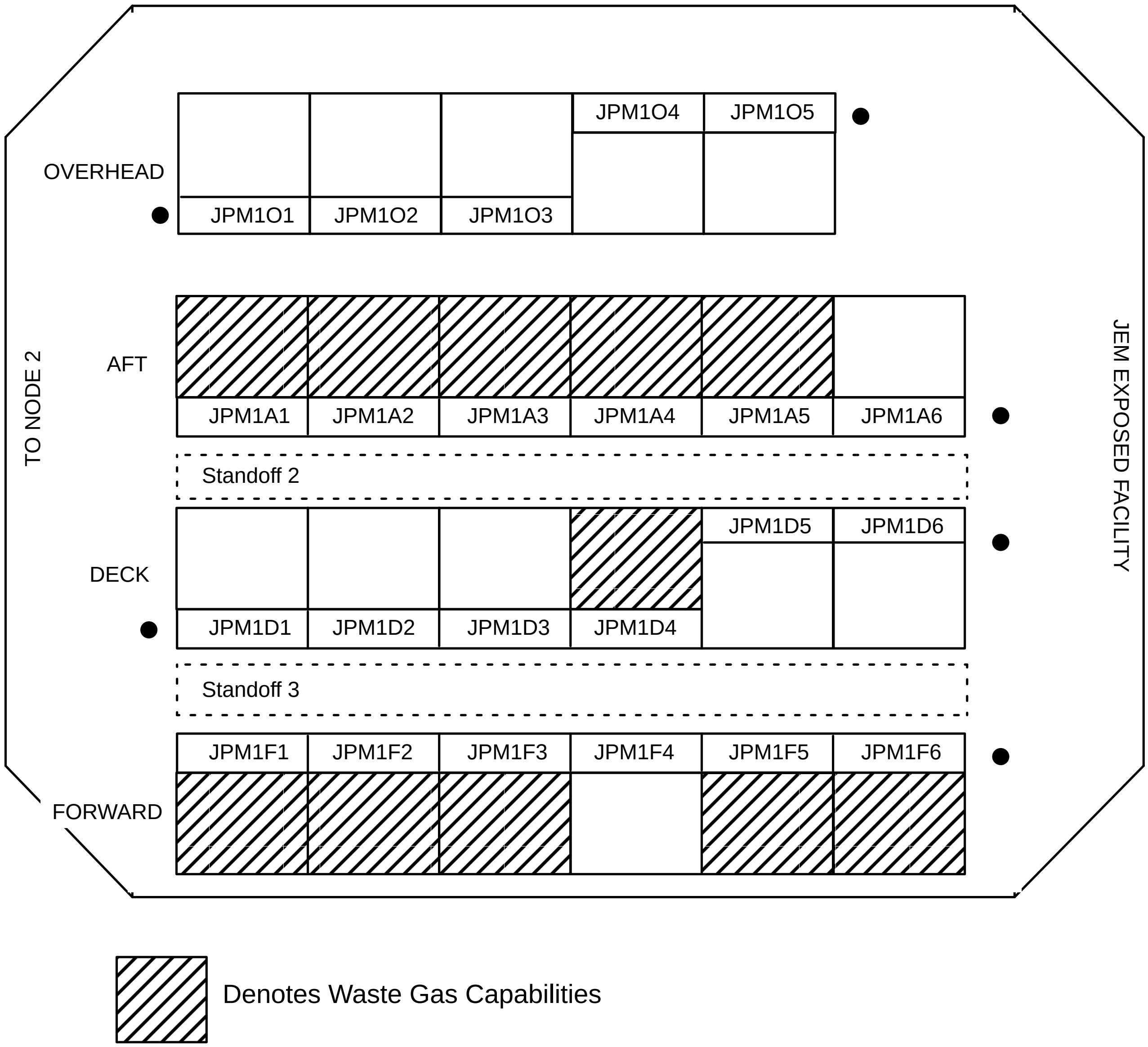


FIGURE 3.6.1–2 JEM VES/WGS INTERFACE LOCATIONS

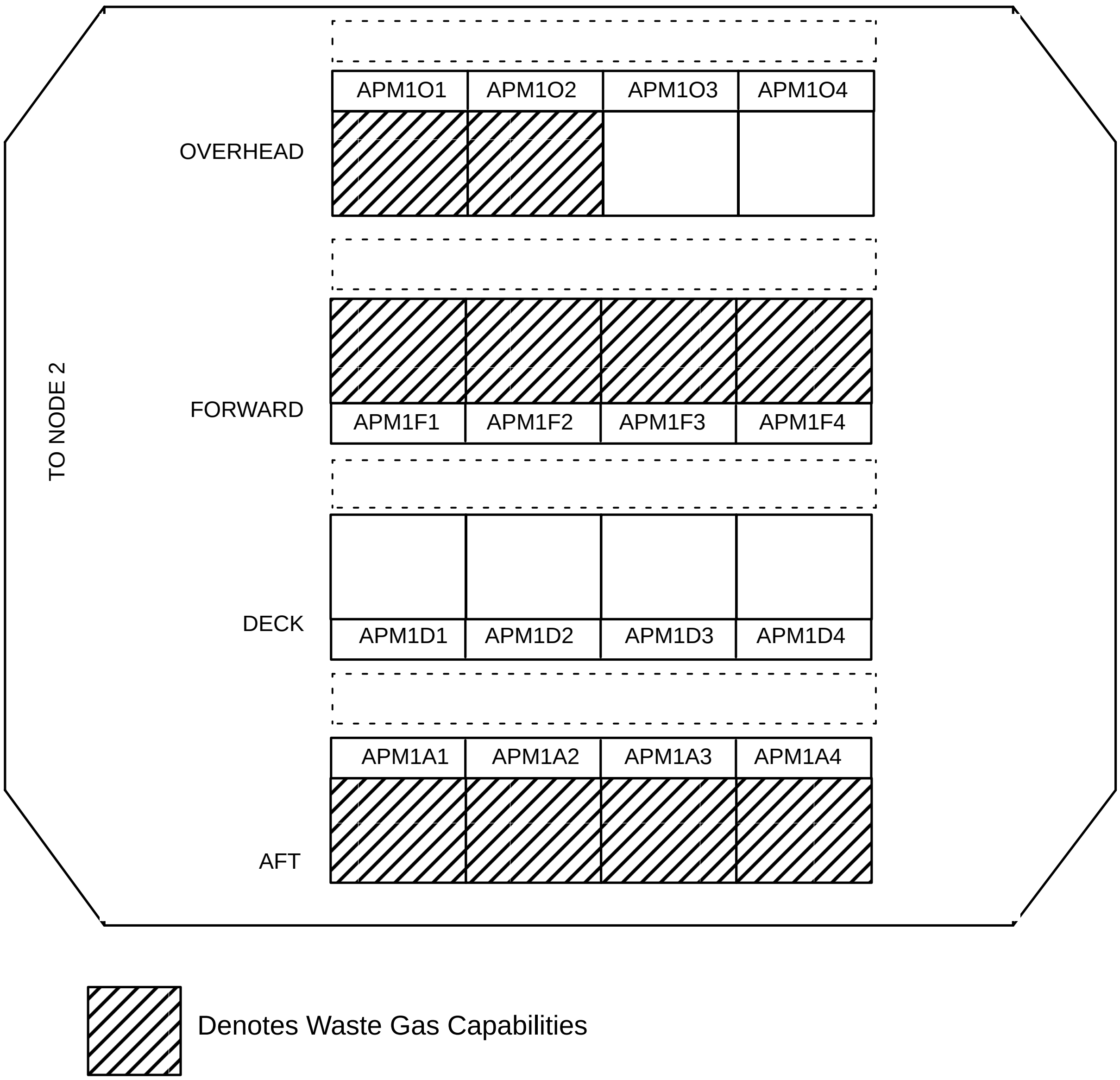


FIGURE 3.6.1–3 APM VES/WGS INTERFACE LOCATIONS

3.6.1.2 INCOMPATIBLE GASES

The integrated rack will provide containment, storage, and transport hardware for gases that are incompatible with the vacuum exhaust or external environment. The gasses utilized by the Rack which are not compatible with the VES or external environment are identified in Table 3.6.1.2–1.

TABLE 3.6.1.2–1 INCOMPATIBLE GASES

Gas	Mass (kg)	Temperature °C	Containment Method

> Note:
> The rack integrator will provide an overview of the method by which the incompatible gas is stored during the transportation and on–orbit phases.

3.6.2 VACUUM RESOURCE SYSTEM (VRS)/VACUUM VENT SYSTEM (VVS)

The Vacuum Resource System/Vacuum Vent System (VRS/VVS) in the USL and JEM has the capability to maintain a single payload facility volume at 0.13 Pa when the total gas load, including leakage and out/offgassing does not exceed 1.0 x 10–3 mbar–liter/sec assuming infinite conductance between payload facility volume and the ISPR interface. The VRS/VVS in the APM has the capability to maintain a single payload facility volume at 0.17 Pa when the total gas load, including leakage and out/offgassing does not exceed 1.0 x 10–3 mbar–liter/sec assuming infinite conductance between payload facility volume and the ISPR interface. The location of the VRS/VVS interfaces at the UIP are defined in Figures 3.1.2–1 through 3.1.2–5. The VRS/VVS connector is defined in Table 3.1.2–1. The ISPR locations which provide VRS/VVS capabilities are identified in Figures 3.6.2–1, 3.6.2–2 , and 3.6.2–3.

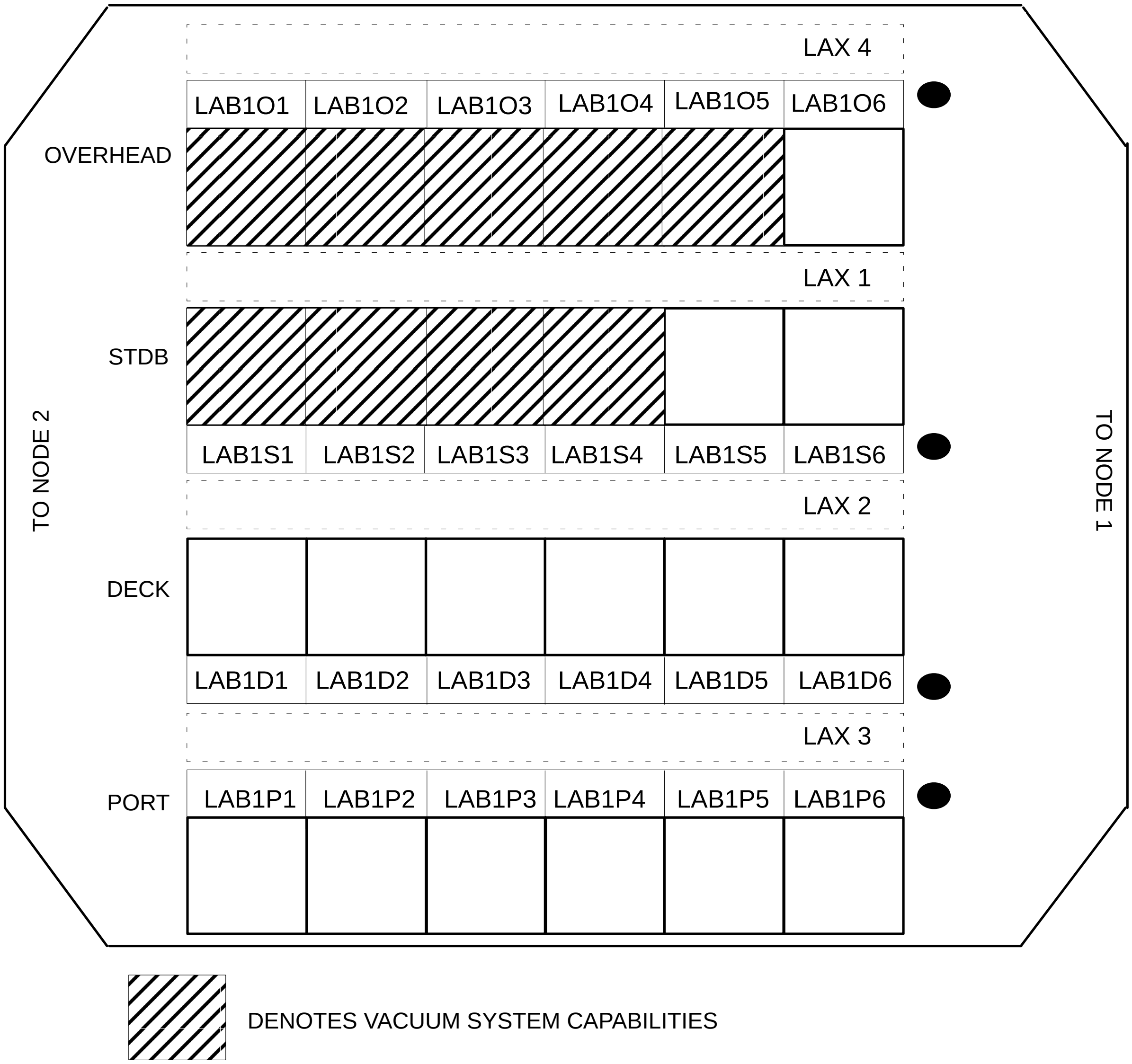


FIGURE 3.6.2–1 USL VRS/VVS INTERFACE LOCATIONS

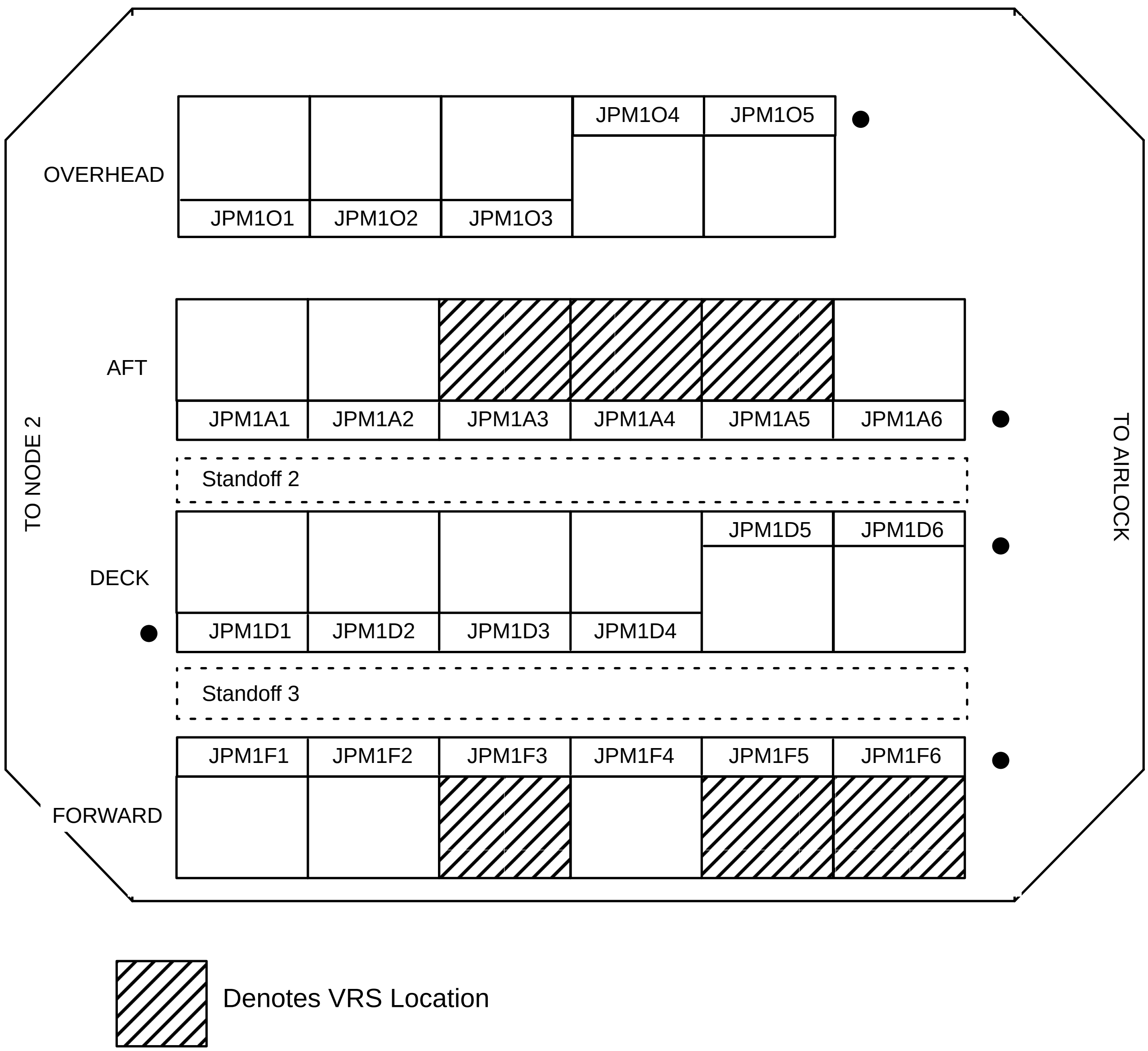


FIGURE 3.6.2–2 JEM VRS/VVS INTERFACE LOCATIONS

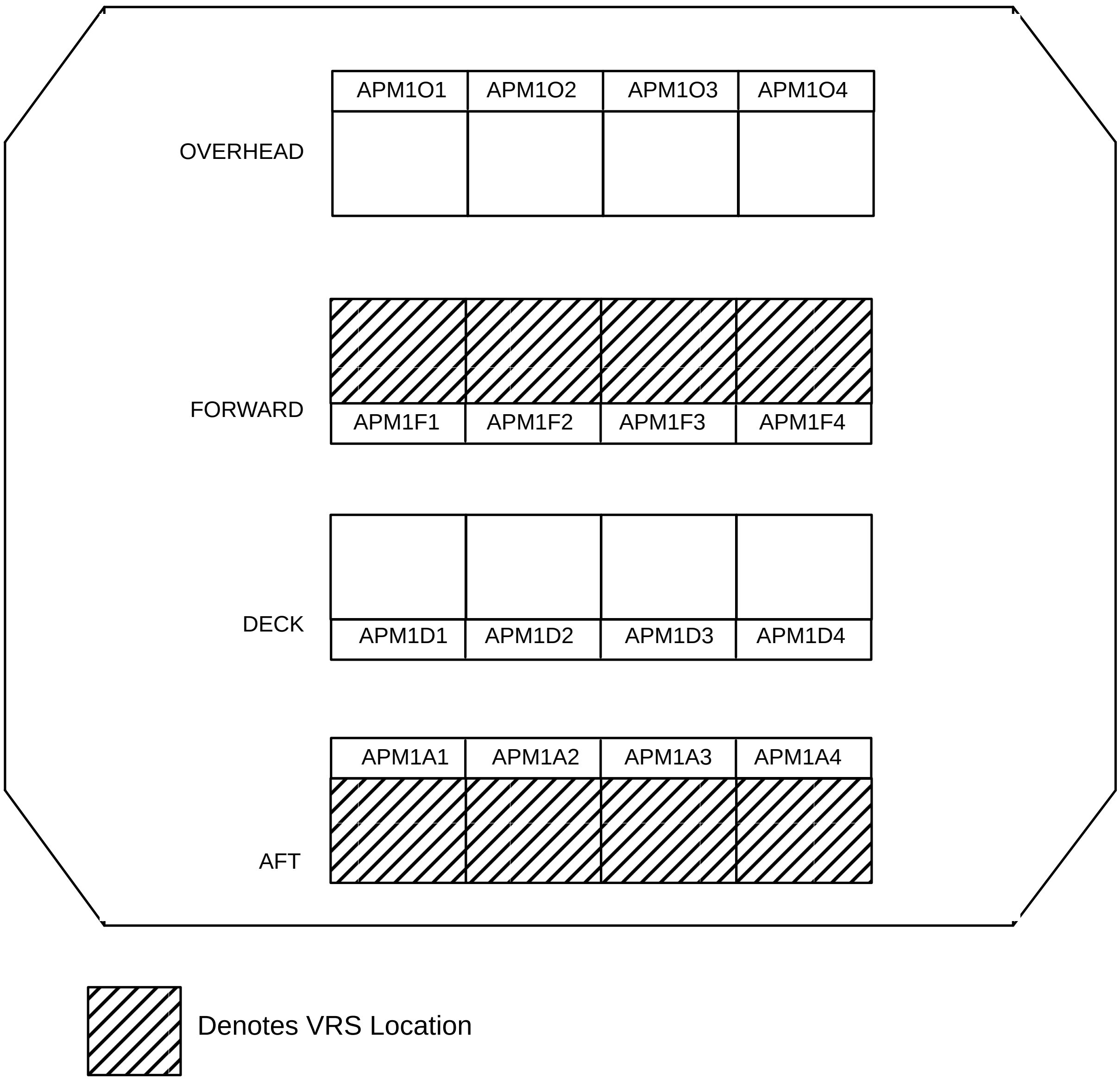


FIGURE 3.6.2–3 APM VRS/VVS INTERFACE LOCATIONS

3.6.2.1 ACCEPTABLE GASES

A list of acceptable gases with verified compatibility to the VRS will be documented in Table 3.6.1.5–1 of SSP 57000. A list of the Rack VRS gases is provide in Table 3.6.2.1–1.

TABLE 3.6.2.1–1 RACK VRS GASES

Constituent	Mass (kg)

3.7 PRESSURIZED GASES INTERFACE REQUIREMENTS

The ISS provides gaseous nitrogen (GN2), argon (Ar), helium (He), and carbon dioxide (CO2) to the integrated rack. GN2 is provided in the USL, APM, and JEM modules. Ar and He are provided only at the JEM Materials Science Rack locations. CO2 is provided only at the JEM Life Science Rack locations. The locations of the Materials Science and Life Science racks within the JEM are depicted in Figure 3.7–1. The CAM does not provide pressurized gases.

The location of the pressurized gases interfaces at the UIP are defined in Figures 3.1.2–1 through 3.1.2–5. The pressurized gases connectors are defined in Table 3.1.2–1.

The physical and chemical properties of the provided gases are per SSP 30573, Space Station Program Fluid Procurement and Use Control Specification.

A schematic of the Rack pressurized system is provided in Figure 3.7–2.

Notes:
Provide a schematic of the integrated rack pressurized gas system. Identify the major components of the system, such as shut off valve, relief valves, pressure regulators, tanks, etc. The symbols used for the schematic should adhere to JSC 10506, Mission Operations Directorate Drafting Standards.

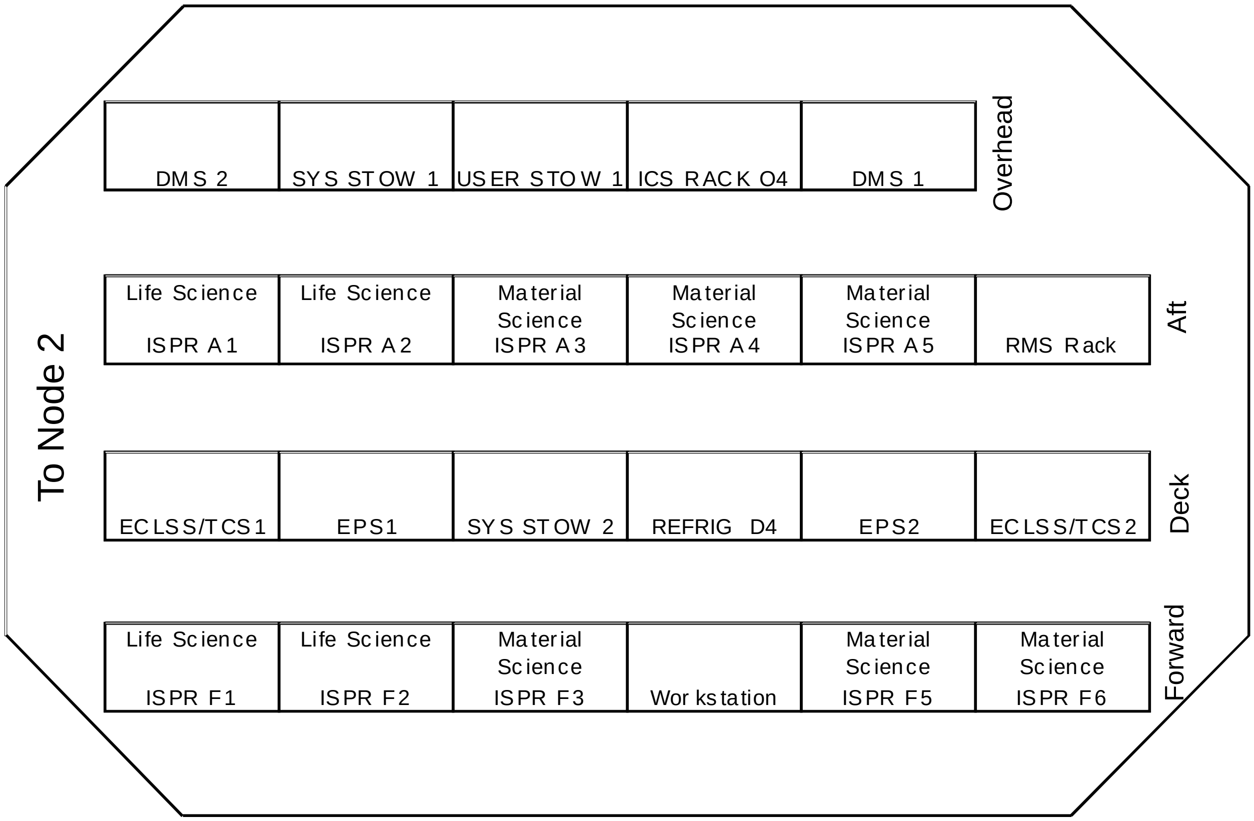


FIGURE 3.7–1 JEM MATERIALS SCIENCE AND LIFE SCIENCE RACK LOCATIONS

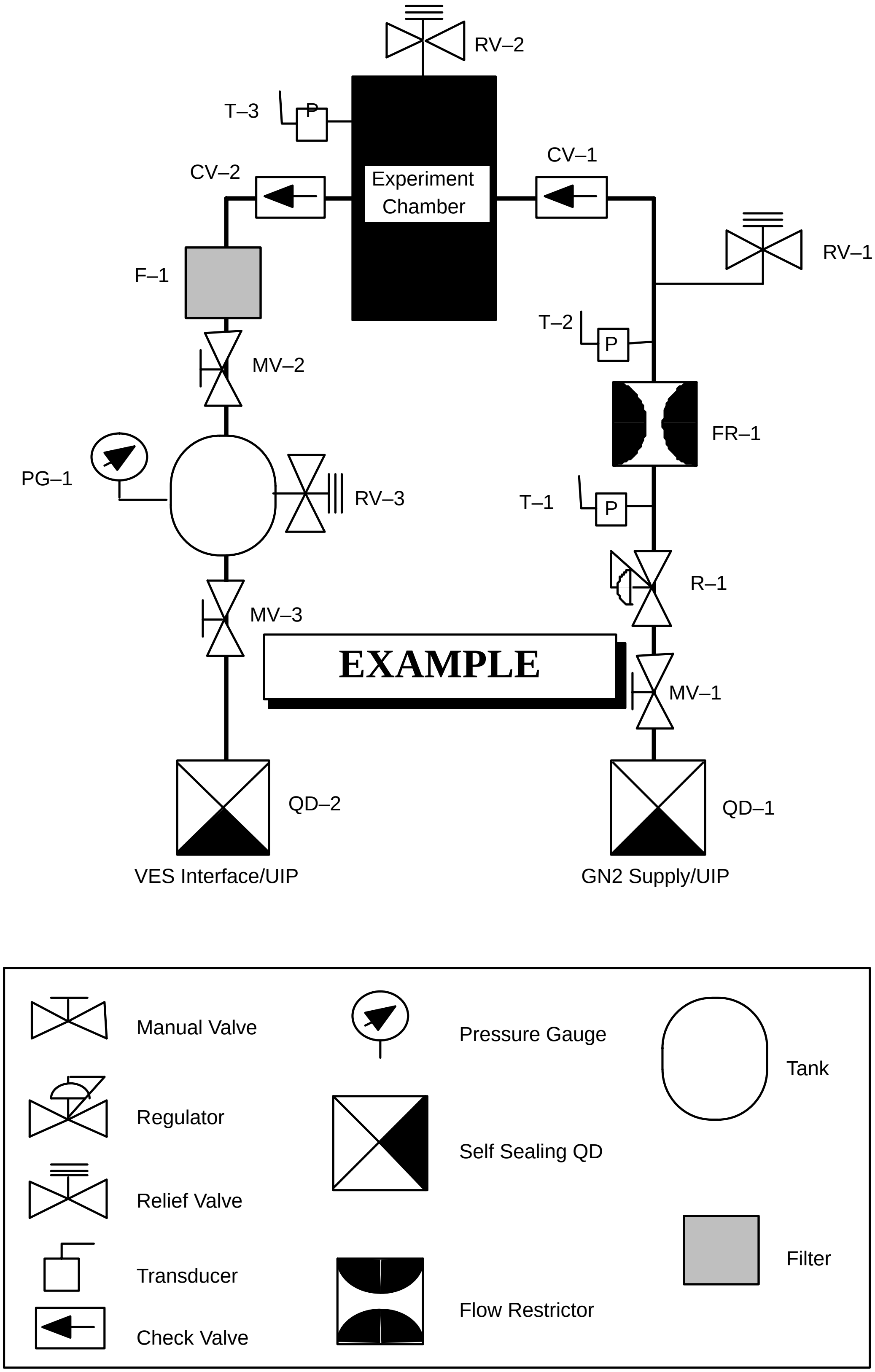


FIGURE 3.7–2 RACK PRESSURIZED GAS SCHEMATIC

3.8 PAYLOAD SUPPORT SERVICES INTERFACES REQUIREMENTS

3.8.1 POTABLE WATER INTERFACE

The ISS provides potable water for use by the integrated rack. The integrated rack must provide the container for transporting the potable water from the ISS interface to the integrated rack location. The potable water interface connectors are defined in Table 3.1.2–1. The physical and chemical properties of the potable water are per SSP 41162, Table XVI. The ISS provides protection against backflow into the ISS potable water system.

Note: Additional information about ISS Water Systems can be found in SSP 57020, Pressurized Payload Accommodation Handbook.

3.8.2 FLUID SYSTEM SERVICER

The Fluid System Servicer (FSS) can supply ITCS coolant water to or remove it from the integrated rack on–orbit. The FSS interface connectors are defined in Table 3.1.2–1. The physical and chemical properties of the ITCS coolant water are per SSP 30573.

TABLE 3.8.2–1 FSS USAGE

Process	Quantity Required (gal)	Quantity Returned (gal)

Note:
Define how the integrated rack plans to utilize the FSS, how much coolant it will require to be provided, and how much coolant it will return as applicable.

3.9 ENVIRONMENTAL INTERFACES

3.9.1 MICROGRAVITY

3.9.1.1 QUASI–STEADY REQUIREMENTS

The Rack quasi–steady disturbance sources are defined in Table 3.9.1.1–1.

TABLE 3.9.1.1–1 QUASI–STEADY DISTURBANCE

FORCE (LBS)	UNIT VECTOR COMPONENTS			DURATION (SEC)
	X	Y	Z	

Note:
The rack integrator will identify the quasi–steady disturbance sources that exceed 0.01 lbs within any 1000 second period along any ISS coordinate system vector.

3.9.1.2 VIBRATORY REQUIREMENTS

The Rack vibratory disturbances are defined in Figure 3.9.1.2–1.

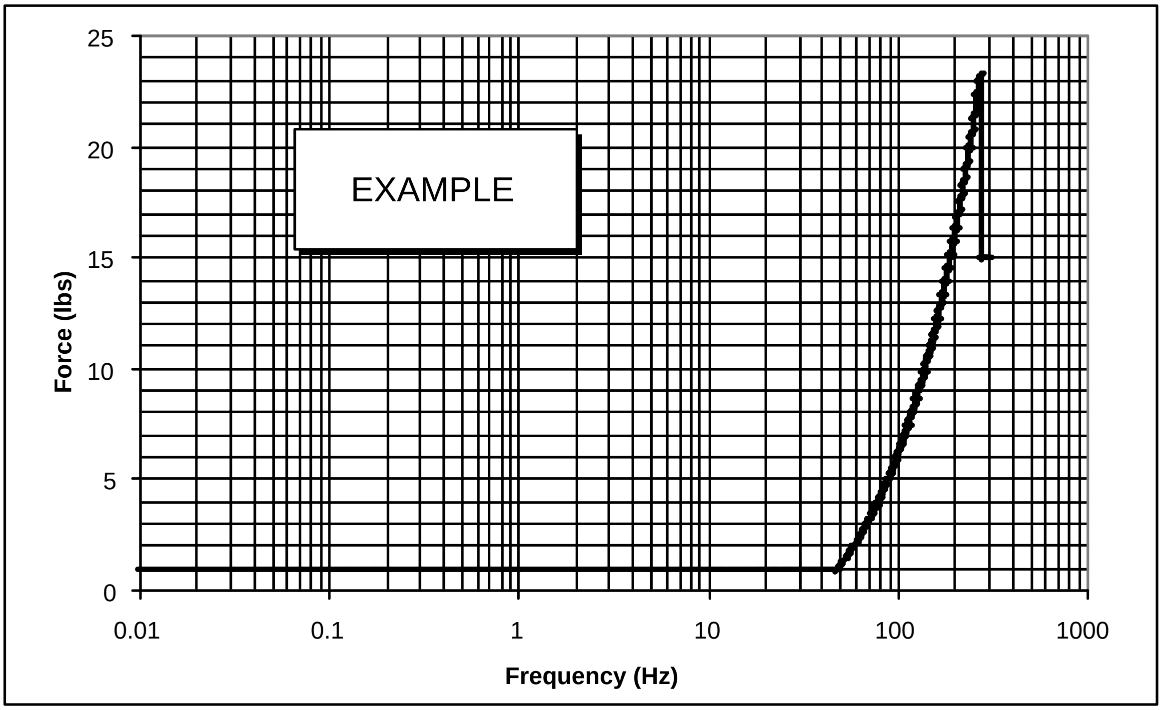


FIGURE 3.9.1.2–1 VIBRATORY DISTURBANCE

Note:
The rack integrator will identify the vibratory disturbance sources (in units of force) in the 0.01 to 300 Hz range and their duration.

3.9.1.3 TRANSIENT REQUIREMENTS

The rack transient disturbances are defined in Table 3.9.1.3–1.

TABLE 3.9.1.3–1 RACK TRANSIENT DISTURBANCES

Source	Force (lbs)	Frequency [1] (Hz)	Duration (sec)	Separation [2] (sec)

Notes:
1. Frequency of “0” Indicates Pulse
2. Time Between Transients (Mean)

> Note:
> The rack integrator will identify the transient disturbance sources (in units of force), their frequency and duration associated with the disturbance.

3.9.2 ACOUSTICS

3.9.2.1 CONTINUOUS NOISE

An integrated rack which operates for more than 8 hours in a 24 hour period and generates a Sound Pressure Level (SPL) greater than or equal to 37 dBA is classified as a Continuous Noise Source. An integrated rack which is classified as a Continuous Noise Source must either meet the limits defined in Table 3.9.2.1–1 or demonstrate that the cumulative time it generates noise above the limits defined in Table 3.9.2.1–1 during a 24 hour period meets the Intermittent Noise Limits defined in Table 3.9.2.2–1.

The Rack Continuous Noise characteristics are defined in Table 3.9.2.1–1.

TABLE 3.9.2.1–1 CONTINUOUS NOISE

Overall A Weighted SPL (dBA)		
Frequency Band (Hz)	**Integrated Rack SPL (dB) Limit**	**Rack Continuous SPL (dB)**
63	64	
125	56	
250	50	
500	45	
1000	41	
2000	39	
4000	38	
8000	37	

Note: The integrated rack SPL is to be measured at a distance of 0.6 meters from the test article.

Note:
1. The Integrated Rack Developer will provide the integrated rack SPL in dBA for the octave bands of 63 Hz through 8 kHz measured at a 0.6 meter distance from the noisiest part of the rack.
2. If this value exceeds 37_dBA then the integrated rack SPL in each of the octave bands defined in Table 3.9.2.1–1 is to be provided.
3. The acoustic noise data should represent the best data available and can be obtained analytically via estimation or calculation, obtained from developmental testing, or obtained using measured data from similar hardware. The Element Integrator will use this data to avoid co–location of noisy equipment thereby reducing noise source concentration.

3.9.2.2 INTERMITTENT NOISE

An integrated rack which operates for less than 8 hours in a 24 hour period and generates a SPL greater than or equal to 37 dBA measured at a distance of 0.6 meters from the noisiest part of the rack is classified as an Intermittent Noise Source. An integrated rack classified as an Intermittent Noise Source must meet the total rack A–weighted SPL limits defined in Table 3.9.2.2–1.

The Rack Intermittent Noise characteristics are defined in Table 3.9.2.2–1.

TABLE 3.9.2.2–1 INTERMITTENT NOISE LIMITS

Maximum Rack Noise Duration Per 24 Hour Period	Total Rack A–Weighted SPL (dBA) Limit	Rack Intermittent SPL (dBA)
8 Hours	49	
7 Hours	50	
6 Hours	51	
5 Hours	52	
4 Hours	54	
3 Hours	57	
2 Hours	60	
1 Hour	65	
30 Minutes	69	
15 Minutes	72	
5 Minutes	76	
2 Minutes	78	
1 Minute	79	
Not Allowed	80	

Note:

1. The Integrated Rack Developer will identify each intermittent noise applicable to the integrated rack with the corresponding A–weighted SPL and duration of each intermittent noise source.
2. The acoustic noise data should represent the best data available and can be obtained analytically via estimation or calculation, obtained from developmental testing, or obtained using measured data from similar hardware. The Element Integrator will use this data to avoid co–location of noisy equipment thereby reducing noise source concentration.

3.9.3 HUMIDITY INTERFACE

Notes:
The rack integrator will provide a schematic and process description of any equipment that condenses humidity from the cabin atmosphere and an estimate of total mass removed with time phasing.

3.9.4 ACTIVE AIR EXCHANGE

Cabin air may be used for ventilation but may not be used for cooling of payload equipment mounted in a rack.

TABLE 3.9.4–1 ACTIVE AIR EXCHANGE PROCESSES

Process	Inputs/ Byproducts	Quantity	Duration	Repetitions

Notes:

1. The rack integrator will provide a description of all processes involving active air exchange with the cabin atmosphere (for example, metabolic purposes) including a schematic of the process.
2. Identify the constituents and quantities of process byproducts which are released to or removed from the cabin atmosphere.

4.0 APPLICABILITY MATRIX

4.1 PURPOSE

The purpose of this payload Unique Interface Control Document (ICD) is to define and control the design of interfaces between the International Space Station and the BLANK payload. The integrated rack or payload interfaces are defined by direct reference to the corresponding sections and subsections of the Pressurized Payload Interface Requirements Document (IRD), SSP 57000. The Payload Developer and the ISS Payloads Office must mutually disposition each IRD paragraph and record that disposition in an applicability matrix contained in the unique payload ICD. The documented applicability matrix for the unique payload serves as the basis for developing the Unique Payload Verification Plan according to SSP 57010, the Generic Payload Verification Plan.

4.2 ORGANIZATION

The Unique Interface Control Document Applicability Matrix, Table 4.2–1, has the same numbers (IRD PARAGRAPH) and titles (IRD REQUIREMENT) for each section and subsection as the Pressurized Payload Interface Requirements Document, SSP 57000. Corresponding paragraphs in SSP 57001 are identified in the column titled “CORRESPONDING ICD PARA”. Those fields in Table 4.2–1’s “PAYLOAD APPLICABILITY” column, which are shaded are included for reference only and are not to be dispositioned in the Unique Payload ICD.

Each paragraph of the IRD shall be dispositioned in the “PAYLOAD APPLICABILITY” column with one of the following:

A — Applicable to this ICD, indicating that the referenced interface is utilized by the integrated rack facility or payload hardware item.

N/A — Not Applicable to this ICD, indicating that the referenced interface is not utilized by the integrated rack facility or payload hardware item.

E-## — Exception with the exception identifier (reference) number ## as listed in the “Exceptions” table.

TABLE 4.2–1 APPLICABILITY MATRIX

IRD PARAGRAPH	IRD REQUIREMENT	PAYLOAD APPLICABILITY
3.0	PAYLOAD INTERFACE REQUIREMENTS AND GUIDANCE	
3.1	STRUCTURAL/MECHANICAL AND MICROGRAVITY AND STOWAGE INTERFACE REQUIREMENTS	
3.1.1	STRUCTURAL/MECHANICAL	
3.1.1.1.A	GSE INTERFACES	
3.1.1.1.B	GSE INTERFACES	
3.1.1.1.C	GSE INTERFACES	
3.1.1.1.D	GSE INTERFACES	
3.1.1.2.A	MPLM INTERFACES	
3.1.1.2.B	MPLM INTERFACES	
3.1.1.2.C	DELETED	
3.1.1.2.D	DELETED	
3.1.1.2.E	MPLM INTERFACES	
3.1.1.2.1	MPLM LATE/EARLY ACCESS REQUIREMENTS	
3.1.1.2.1.1.A	MPLM LATE ACCESS ENVELOPE (KSC)	
3.1.1.2.1.1.B	MPLM LATE ACCESS ENVELOPE (KSC)	
3.1.1.2.1.1.C	MPLM LATE ACCESS ENVELOPE (KSC)	
3.1.1.2.1.2.A	MPLM EARLY ACCESS ENVELOPES (KSC AND DFRC)	
3.1.1.2.1.2.B	MPLM EARLY ACCESS ENVELOPES (KSC AND DFRC)	
3.1.1.3.A	LOADS REQUIREMENTS	
3.1.1.3.B	LOADS REQUIREMENTS	
3.1.1.3.C	LOADS REQUIREMENTS	
3.1.1.3.D	LOADS REQUIREMENTS	
3.1.1.3.E	LOADS REQUIREMENTS	
3.1.1.3.F	LOADS REQUIREMENTS	
3.1.1.4.A	RACK REQUIREMENTS	
3.1.1.4.B	RACK REQUIREMENTS	
3.1.1.4.C	RACK REQUIREMENTS	
3.1.1.4.D	RACK REQUIREMENTS	
3.1.1.4.E	RACK REQUIREMENTS	
3.1.1.4.F	RACK REQUIREMENTS	
3.1.1.4.G	DELETED	
3.1.1.4.H	DELETED	
3.1.1.4.I	RACK REQUIREMENTS	
3.1.1.4.J	DELETED	
3.1.1.4.K	RACK REQUIREMENTS	
3.1.1.4.L	RACK REQUIREMENTS	
3.1.1.4.M	RACK REQUIREMENTS	
3.1.1.4.1.A	LAB WINDOW RACK LOCATION REQUIREMENTS	

TABLE 4.2–1 APPLICABILITY MATRIX (CONTINUED)

IRD PARAGRAPH	IRD REQUIREMENT	PAYLOAD APPLICABILITY
3.1.1.4.1.B	LAB WINDOW RACK LOCATION REQUIREMENTS	
3.1.1.4.1.C	LAB WINDOW RACK LOCATION REQUIREMENTS	
3.1.1.5.A	SAFETY CRITICAL STRUCTURES REQUIREMENTS	
3.1.1.6	CONNECTOR AND UMBILICAL PHYSICAL MATE	
3.1.1.6.1	CONNECTOR PHYSICAL MATE	
3.1.1.6.2	UMBILICAL PHYSICAL MATE	
3.1.1.7.A	ON–ORBIT PAYLOAD PROTRUSIONS	
3.1.1.7.B	ON–ORBIT PAYLOAD PROTRUSIONS	
3.1.1.7.1	ON–ORBIT PERMANENT PROTRUSIONS	
3.1.1.7.2.A	ON–ORBIT SEMI–PERMANENT PROTRUSIONS	
3.1.1.7.2.B	ON–ORBIT SEMI–PERMANENT PROTRUSIONS	
3.1.1.7.2.C	ON–ORBIT SEMI–PERMANENT PROTRUSIONS	
3.1.1.7.3.A	ON–ORBIT TEMPORARY PROTRUSIONS	
3.1.1.7.3.B	ON–ORBIT TEMPORARY PROTRUSIONS	
3.1.1.7.4	ON–ORBIT MOMENTARY PROTRUSIONS	
3.1.1.7.5.A	ON–ORBIT PROTRUSIONS FOR KEEP–ALIVE PAYLOADS	
3.1.1.7.5.B	ON–ORBIT PROTRUSIONS FOR KEEP–ALIVE PAYLOADS	
3.1.2	MICROGRAVITY	
3.1.2.1.A	QUASI-STEADY REQUIREMENTS	
3.1.2.1.B	QUASI-STEADY REQUIREMENTS	
3.1.2.2.A	VIBRATORY REQUIREMENTS	
3.1.2.2.B	VIBRATORY REQUIREMENTS	
3.1.2.3.A	TRANSIENT REQUIREMENTS	
3.1.2.3.B	TRANSIENT REQUIREMENTS	
3.1.2.4	MICROGRAVITY ENVIRONMENT	
3.1.2.5	ARIS INTERFACES	
3.1.3	STOWAGE	
3.2	ELECTRICAL INTERFACE REQUIREMENTS	
3.2.1	ELECTRICAL POWER CHARACTERISTICS	
3.2.1.1	STEADY–STATE VOLTAGE CHARACTERISTICS	
3.2.1.1.1	INTERFACE B	
3.2.1.1.2	INTERFACE C	
3.2.1.2	RIPPLE VOLTAGE CHARACTERISTICS	
3.2.1.2.1	RIPPLE VOLTAGE AND NOISE	
3.2.1.2.2	RIPPLE VOLTAGE SPECTRUM	
3.2.1.3	TRANSIENT VOLTAGES	
3.2.1.3.1	INTERFACE B	
3.2.1.3.2	INTERFACE C	

TABLE 4.2–1 APPLICABILITY MATRIX (CONTINUED)

IRD PARAGRAPH	IRD REQUIREMENT	PAYLOAD APPLICABILITY
3.2.1.3.3	FAULT CLEARING AND PROTECTION	
3.2.1.3.4.A	NON–NORMAL VOLTAGE RANGE	
3.2.1.3.4.B	NON–NORMAL VOLTAGE RANGE	
3.2.2	ELECTRICAL POWER INTERFACE	
3.2.2.1.A	UIP AND UOP CONNECTORS AND PIN ASSIGNMENTS	
3.2.2.1.B	UIP AND UOP CONNECTORS AND PIN ASSIGNMENTS	
3.2.2.1.C	UIP AND UOP CONNECTORS AND PIN ASSIGNMENTS	
3.2.2.1.D	UIP AND UOP CONNECTORS AND PIN ASSIGNMENTS	
3.2.2.1.E	UIP AND UOP CONNECTORS AND PIN ASSIGNMENTS	
3.2.2.1.F	UIP AND UOP CONNECTORS AND PIN ASSIGNMENTS	
3.2.2.2.A	POWER BUS ISOLATION	
3.2.2.2.B	POWER BUS ISOLATION	
3.2.2.3	COMPATIBILITY WITH SOFT START/STOP RPC	
3.2.2.4	SURGE CURRENT	
3.2.2.5	REVERSE ENERGY/CURRENT	
3.2.2.6	CIRCUIT PROTECTION DEVICES	
3.2.2.6.1	ISS EPS CIRCUIT PROTECTION CHARACTERISTICS	
3.2.2.6.1.1.A	REMOTE POWER CONTROLLERS (RPCs)	
3.2.2.6.1.1.B	REMOTE POWER CONTROLLERS (RPCs)	
3.2.2.6.1.1.C	REMOTE POWER CONTROLLERS (RPCs)	
3.2.2.6.1.1.D	REMOTE POWER CONTROLLERS (RPCs)	
3.2.2.6.1.1.E	REMOTE POWER CONTROLLERS (RPCs)	
3.2.2.6.2	EPCE RPC INTERFACE REQUIREMENTS	
3.2.2.6.2.1	RPC TRIP COORDINATION	
3.2.2.6.2.1.1	PAYLOAD TRIP RATINGS	
3.2.2.7	EPCE COMPLEX LOAD IMPEDANCES	
3.2.2.7.1.A	INTERFACE B	
3.2.2.7.1.B	INTERFACE B	
3.2.2.7.2	INTERFACE C	
3.2.2.8	LARGE SIGNAL STABILITY	
3.2.2.9	MAXIMUM RIPPLE VOLTAGE EMISSIONS	
3.2.2.10.A	ELECTRICAL LOAD–STAND ALONE STABILITY	
3.2.2.10.B	ELECTRICAL LOAD–STAND ALONE STABILITY	
3.2.2.10.C	ELECTRICAL LOAD–STAND ALONE STABILITY	
3.2.2.11	ELECTRICAL LOAD INDUCTANCE	
3.2.3	ELECTRICAL POWER CONSUMER CONSTRAINTS	
3.2.3.1.A	WIRE DERATING	
3.2.3.1.B	WIRE DERATING	
3.2.3.1.C	WIRE DERATING	

TABLE 4.2–1 APPLICABILITY MATRIX (CONTINUED)

IRD PARAGRAPH	IRD REQUIREMENT	PAYLOAD APPLICABILITY
3.2.3.2.A	EXCLUSIVE POWER FEEDS	
3.2.3.2.B	EXCLUSIVE POWER FEEDS	
3.2.3.3	LOSS OF POWER	
3.2.4	ELECTROMAGNETIC COMPATIBILITY	
3.2.4.1	ELECTRICAL GROUNDING	
3.2.4.2	ELECTRICAL BONDING	
3.2.4.3	CABLE/WIRE DESIGN AND CONTROL REQUIREMENTS	
3.2.4.4	ELECTROMAGNETIC INTERFERENCE	
3.2.4.5	ELECTROSTATIC DISCHARGE	
3.2.4.6	ALTERNATING CURRENT (ac) MAGNETIC FIELDS	
3.2.4.7	DIRECT CURRENT (dc) MAGNETIC FIELDS	
3.2.4.8	CORONA	
3.2.4.9	LIGHTNING	
3.2.4.10	EMI SUSCEPTIBILITY FOR SAFETY–CRITICAL CIRCUITS	
3.2.5	SAFETY REQUIREMENTS	
3.2.5.1	PAYLOAD ELECTRICAL SAFETY	
3.2.5.1.1	MATING/DEMATING OF POWERED CONNECTORS	
3.2.5.1.2	SAFETY–CRITICAL CIRCUITS REDUNDANCY	
3.2.5.2	RACK MAINTENANCE SWITCH (RACK POWER SWITCH)	
3.2.5.3.A	POWER SWITCHES/CONTROLS	
3.2.5.3.B	POWER SWITCHES/CONTROLS	
3.2.5.3.C	POWER SWITCHES/CONTROLS	
3.2.5.4.A	GROUND FAULT CIRCUIT INTERRUPTERS (GFCI)/PORTABLE EQUIPMENT dc SOURCING VOLTAGE	
3.2.5.4.B	GROUND FAULT CIRCUIT INTERRUPTERS (GFCI)/PORTABLE EQUIPMENT dc SOURCING VOLTAGE	
3.2.5.4.C	GROUND FAULT CIRCUIT INTERRUPTERS (GFCI)/PORTABLE EQUIPMENT dc SOURCING VOLTAGE	
3.2.5.4.D	GROUND FAULT CIRCUIT INTERRUPTERS (GFCI)/PORTABLE EQUIPMENT dc SOURCING VOLTAGE	
3.2.5.4.E	GROUND FAULT CIRCUIT INTERRUPTERS (GFCI)/PORTABLE EQUIPMENT dc SOURCING VOLTAGE	
3.2.5.4.F	GROUND FAULT CIRCUIT INTERRUPTERS (GFCI)/PORTABLE EQUIPMENT dc SOURCING VOLTAGE	
3.2.5.4.G	GROUND FAULT CIRCUIT INTERRUPTERS (GFCI)/PORTABLE EQUIPMENT dc SOURCING VOLTAGE	
3.2.5.5.A	PORTABLE EQUIPMENT/POWER CORDS	
3.2.5.5.B	PORTABLE EQUIPMENT/POWER CORDS	
3.2.6	MPLM	
3.2.6.1.A	MPLM ELECTRICAL POWER CHARACTERISTICS	
3.2.6.1.B	MPLM ELECTRICAL POWER CHARACTERISTICS	

TABLE 4.2–1 APPLICABILITY MATRIX (CONTINUED)

IRD PARAGRAPH	IRD REQUIREMENT	PAYLOAD APPLICABILITY
3.2.6.1.C	MPLM ELECTRICAL POWER CHARACTERISTICS	
3.2.6.1.D	MPLM ELECTRICAL POWER CHARACTERISTICS	
3.2.6.1.E	MPLM ELECTRICAL POWER CHARACTERISTICS	
3.2.6.1.F	MPLM ELECTRICAL POWER CHARACTERISTICS	
3.2.6.1.G	MPLM ELECTRICAL POWER CHARACTERISTICS	
3.2.6.2.A	MPLM ELECTRICAL POWER INTERFACE	
3.2.6.2.B	MPLM ELECTRICAL POWER INTERFACE	
3.2.6.2.C	MPLM ELECTRICAL POWER INTERFACE	
3.2.6.2.D	MPLM ELECTRICAL POWER INTERFACE	
3.2.6.2.E	MPLM ELECTRICAL POWER INTERFACE	
3.2.6.2.F	MPLM ELECTRICAL POWER INTERFACE	
3.2.6.2.1.A	MPLM UIP CONNECTORS AND PIN ASSIGNMENTS	
3.2.6.2.1.B	MPLM UIP CONNECTORS AND PIN ASSIGNMENTS	
3.2.6.2.1.C	MPLM UIP CONNECTORS AND PIN ASSIGNMENTS	
3.2.6.2.2	COMPATIBILITY WITH RPC SOFT START/STOP IN MPLM	
3.2.6.2.3.A	MPLM SURGE CURRENT	
3.2.6.2.3.B	MPLM SURGE CURRENT	
3.2.6.2.3.C	MPLM SURGE CURRENT	
3.2.6.2.3.D	MPLM SURGE CURRENT	
3.2.6.2.4	MPLM REVERSE ENERGY/CURRENT	
3.2.6.2.5	MPLM PAYLOAD TRIP RATINGS	
3.2.6.3.A	MPLM ELECTRICAL POWER CONSUMER CONSTRAINTS	
3.2.6.3.B	MPLM ELECTRICAL POWER CONSUMER CONSTRAINTS	
3.2.6.3.C	MPLM ELECTRICAL POWER CONSUMER CONSTRAINTS	
3.2.6.3.D	MPLM ELECTRICAL POWER CONSUMER CONSTRAINTS	
3.2.6.4.A	MPLM ELECTROMAGNETIC COMPATIBILITY	
3.2.6.4.B	MPLM ELECTROMAGNETIC COMPATIBILITY	
3.2.6.4.C	MPLM ELECTROMAGNETIC COMPATIBILITY	
3.2.6.4.D	MPLM ELECTROMAGNETIC COMPATIBILITY	
3.2.6.4.E	MPLM ELECTROMAGNETIC COMPATIBILITY	
3.2.6.4.F	MPLM ELECTROMAGNETIC COMPATIBILITY	
3.2.6.4.G	MPLM ELECTROMAGNETIC COMPATIBILITY	
3.2.6.4.H	MPLM ELECTROMAGNETIC COMPATIBILITY	
3.2.6.4.I	MPLM ELECTROMAGNETIC COMPATIBILITY	
3.2.6.4.J	MPLM ELECTROMAGNETIC COMPATIBILITY	
3.2.6.4.1	MPLM BONDING	
3.2.6.5.A	MPLM SAFETY REQUIREMENTS	
3.2.6.5.B	MPLM SAFETY REQUIREMENTS	
3.2.6.5.C	MPLM SAFETY REQUIREMENTS	

TABLE 4.2–1 APPLICABILITY MATRIX (CONTINUED)

IRD PARAGRAPH	IRD REQUIREMENT	PAYLOAD APPLICABILITY
3.2.6.5.D	MPLM SAFETY REQUIREMENTS	
3.2.6.5.E	MPLM SAFETY REQUIREMENTS	
3.2.6.5.F	MPLM SAFETY REQUIREMENTS	
3.3	COMMAND AND DATA HANDLING INTERFACE REQUIREMENTS	
3.3.1	GENERAL REQUIREMENTS	
3.3.2	WORD/BYTE NOTATIONS, TYPES AND DATA TRANSMISSIONS	
3.3.2.1	WORD/BYTE NOTATIONS	
3.3.2.2	DATA TYPES	
3.3.2.3A	DATA TRANSMISSIONS	
3.3.2.3B	DATA TRANSMISSIONS	
3.3.2.3C	DATA TRANSMISSIONS	
3.3.3	DELETED	
3.3.4	CONSULTATIVE COMMITTEE FOR SPACE DATA SYSTEMS	
3.3.4.1.A	CCSDS DATA	
3.3.4.1.B	CCSDS DATA	
3.3.4.1.C	CCSDS DATA	
3.3.4.1.1	CCSDS DATA PACKETS	
3.3.4.1.1.1	CCSDS PRIMARY HEADER	
3.3.4.1.1.2.A	CCSDS SECONDARY HEADER	
3.3.4.1.1.2.B	CCSDS SECONDARY HEADER	
3.3.4.1.2	CCSDS DATA FIELD	
3.3.4.1.3	CCSDS DATA BITSTREAM	
3.3.4.1.4	CCSDS APPLICATION PROCESS IDENTIFICATION FIELD	
3.3.4.2	CCSDS TIME CODES	
3.3.4.2.1	CCSDS UNSEGMENTED TIME	
3.3.4.2.2	CCSDS SEGMENTED TIME	
3.3.5	MIL–STD–1553B LOW RATE DATA LINK (LRDL)	
3.3.5.1	MIL–STD–1553B PROTOCOL	
3.3.5.1.1	STANDARD MESSAGES	
3.3.5.1.2	COMMANDING	
3.3.5.1.3	HEALTH AND STATUS DATA	
3.3.5.1.4.A	SAFETY DATA	
3.3.5.1.4.B	SAFETY DATA	
3.3.5.1.4.1	CAUTION AND WARNING	
3.3.5.1.4.1.1	CLASS 1 – EMERGENCY	
3.3.5.1.4.1.2	CLASS 2 – WARNING	
3.3.5.1.4.1.3	CLASS 3 – CAUTION	
3.3.5.1.4.1.4	CLASS 4 – ADVISORY	
3.3.5.1.5	SERVICE REQUESTS	

TABLE 4.2–1 APPLICABILITY MATRIX (CONTINUED)

IRD PARAGRAPH	IRD REQUIREMENT	PAYLOAD APPLICABILITY
3.3.5.1.6	ANCILLARY DATA	
3.3.5.1.7	FILE TRANSFER	
3.3.5.1.8	LOW RATE TELEMETRY	
3.3.5.1.9	DEFINED MODE CODES	
3.3.5.1.10	IMPLEMENTED MODE CODES	
3.3.5.1.11	UNIMPLEMENTED/UNDEFINED MODE CODES	
3.3.5.1.12	ILLEGAL COMMANDS	
3.3.5.2	MIL–STD–1553B LOW RATE DATA LINK (LRDL) INTERFACE CHARACTERISTICS	
3.3.5.2.1	LRDL REMOTE TERMINAL ASSIGNMENT	
3.3.5.2.1.1	LRDL CONNECTOR/PIN ASSIGNMENTS	
3.3.5.2.1.2.A	MIL-STD-1553B BUS A AND B CONNECTOR/PIN ASSIGNMENT	
3.3.5.2.1.2.B	MIL-STD-1553B BUS A AND B CONNECTOR/PIN ASSIGNMENT	
3.3.5.2.1.2.C	MIL-STD-1553B BUS A AND B CONNECTOR/PIN ASSIGNMENT	
3.3.5.2.1.3	DELETED	
3.3.5.2.1.4.A	REMOTE TERMINAL HARDWIRED ADDRESS CODING	
3.3.5.2.1.4.B	REMOTE TERMINAL HARDWIRED ADDRESS CODING	
3.3.5.2.1.4.C	REMOTE TERMINAL HARDWIRED ADDRESS CODING	
3.3.5.2.1.4.D	REMOTE TERMINAL HARDWIRED ADDRESS CODING	
3.3.5.2.1.4.E	REMOTE TERMINAL HARDWIRED ADDRESS CODING	
3.3.5.2.2	LRDL SIGNAL CHARACTERISTICS	
3.3.5.2.3	LRDL CABLING	
3.3.5.2.4	MULTI–BUS ISOLATION	
3.3.6	MEDIUM RATE DATA LINK (MRDL)	
3.3.6.1	MRDL PROTOCOL	
3.3.6.1.1	INTEGRATED RACK PROTOCOLS ON THE MRDL	
3.3.6.1.2.A	MRDL ADDRESS	
3.3.6.1.2.B	MRDL ADDRESS	
3.3.6.1.2.C	MRDL ADDRESS	
3.3.6.1.3.A	ISPR MRDL CONNECTIVITY	
3.3.6.1.3.B	ISPR MRDL CONNECTIVITY	
3.3.6.1.3.C	ISPR MRDL CONNECTIVITY	
3.3.6.1.4.A	MRDL CONNECTOR/PIN ASSIGNMENTS AND WIRE REQUIREMENTS	
3.3.6.1.4.B	MRDL CONNECTOR/PIN ASSIGNMENTS AND WIRE REQUIREMENTS	
3.3.6.1.4.C	MRDL CONNECTOR/PIN ASSIGNMENTS AND WIRE REQUIREMENTS	
3.3.6.1.4.D	MRDL CONNECTOR/PIN ASSIGNMENTS AND WIRE REQUIREMENTS	

TABLE 4.2–1 APPLICABILITY MATRIX (CONTINUED)

IRD PARAGRAPH	IRD REQUIREMENT	PAYLOAD APPLICABILITY
3.3.6.1.5	MRDL SIGNAL CHARACTERISTICS	
3.3.6.1.6	MRDL CABLE CHARACTERISTICS	
3.3.6.1.6.1	INSERTION LOSS	
3.3.6.1.6.2	DIFFERENTIAL CHARACTERISTIC IMPEDANCE	
3.3.6.1.6.3	MEDIUM TIMING JITTER	
3.3.7	HIGH RATE DATA LINK (HRDL)	
3.3.7.1	PAYLOAD TO HIGH RATE FRAME MULTIPLEXER (HRFM) PROTOCOLS	
3.3.7.2	HRDL INTERFACE CHARACTERISTICS	
3.3.7.2.1	PHYSICAL SIGNALING	
3.3.7.2.1.1.A	PHYSICAL SIGNALING DATA RATES	
3.3.7.2.1.1.B	PHYSICAL SIGNALING DATA RATES	
3.3.7.2.1.1.C	PHYSICAL SIGNALING DATA RATES	
3.3.7.2.2	ENCODING	
3.3.7.3	INTEGRATED RACK HRDL OPTICAL POWER	
3.3.7.3.1	INTEGRATED RACK HRDL TRANSMITTED OPTICAL POWER	
3.3.7.3.2	INTEGRATED RACK HRDL RECEIVED OPTICAL POWER	
3.3.7.4	HRDL FIBER OPTIC CABLE	
3.3.7.5	HRDL FIBER OPTIC CABLE BEND RADIUS	
3.3.7.6.A	HRDL CONNECTORS AND FIBER	
3.3.7.6.B	HRDL CONNECTORS AND FIBER	
3.3.7.6.C	HRDL CONNECTORS AND FIBER	
3.3.7.6.D	HRDL CONNECTORS AND FIBER	
3.3.8	PERSONAL COMPUTERS	
3.3.8.1.A	PAYLOAD LAPTOP	
3.3.8.1.B	PAYLOAD LAPTOP	
3.3.8.1.C	PAYLOAD LAPTOP	
3.3.8.1.D	PAYLOAD LAPTOP	
3.3.8.1.E	PAYLOAD LAPTOP	
3.3.8.1.F	PAYLOAD LAPTOP	
3.3.8.1.G	PAYLOAD LAPTOP	
3.3.8.1.H	PAYLOAD LAPTOP	
3.3.8.2.A	PCS	
3.3.8.2.B	PCS	
3.3.8.2.C	PCS	
3.3.8.2.1.A	PCS TO UOP INTERFACE	
3.3.8.2.1.B	PCS TO UOP INTERFACE	
3.3.8.2.2.A	760XD LAPTOP TO RACK INTERFACE	
3.3.8.2.2.B	760XD LAPTOP TO RACK INTERFACE	

TABLE 4.2–1 APPLICABILITY MATRIX (CONTINUED)

IRD PARAGRAPH	IRD REQUIREMENT	PAYLOAD APPLICABILITY
3.3.8.2.2.C	760XD LAPTOP TO RACK INTERFACE	
3.3.8.2.2.D	760XD LAPTOP TO RACK INTERFACE	
3.3.8.3.A	SSC	
3.3.8.3.B	SSC	
3.3.9	UOP	
3.3.10	MAINTENANCE SWITCH, SMOKE DETECTOR, SMOKE INDICATOR, AND INTEGRATED RACK FAN INTERFACES	
3.3.10.1.A	RACK MAINTENANCE SWITCH (RACK POWER SWITCH) INTERFACES	
3.3.10.1.B	RACK MAINTENANCE SWITCH (RACK POWER SWITCH) INTERFACES	
3.3.10.2	SMOKE DETECTOR INTERFACES	
3.3.10.2.1	ANALOG INTERFACE CHARACTERISTICS	
3.3.10.2.2	DISCRETE COMMAND BUILT-IN-TEST INTERFACE CHARACTERISTICS	
3.3.10.2.3	SMOKE INDICATOR ELECTRICAL INTERFACES	
3.3.10.2.4	FAN VENTILATION STATUS ELECTRICAL INTERFACES	
3.3.10.3.A	RACK MAINTENANCE SWITCH (RACK POWER SWITCH)/FIRE DETECTION SUPPORT INTERFACE CONNECTOR	
3.3.10.3.B	RACK MAINTENANCE SWITCH (RACK POWER SWITCH)/FIRE DETECTION SUPPORT INTERFACE CONNECTOR	
3.3.10.3.C	RACK MAINTENANCE SWITCH (RACK POWER SWITCH)/FIRE DETECTION SUPPORT INTERFACE CONNECTOR	
3.4	PAYLOAD NTSC VIDEO AND AUDIO INTERFACE REQUIREMENTS	
3.4.1	PAYLOAD NTSC VIDEO INTERFACE REQUIREMENTS	
3.4.1.1.A	PAYLOAD NTSC OPTICAL VIDEO CHARACTERISTICS	
3.4.1.1.B	PAYLOAD NTSC OPTICAL VIDEO CHARACTERISTICS	
3.4.1.1.C	PAYLOAD NTSC OPTICAL VIDEO CHARACTERISTICS	
3.4.1.2	NTSC FIBER OPTIC VIDEO	
3.4.1.2.1.A	PULSE FREQUENCY MODULATION NTSC FIBER OPTIC VIDEO CHARACTERISTICS	
3.4.1.2.1.B	PULSE FREQUENCY MODULATION NTSC FIBER OPTIC VIDEO CHARACTERISTICS	
3.4.1.2.2	INTEGRATED RACK NTSC PFM VIDEO TRANSMITTED OPTICAL POWER	
3.4.1.2.3	INTEGRATED RACK NTSC PFM VIDEO AND SYNC SIGNAL RECEIVED OPTICAL POWER	
3.4.1.2.4	FIBER OPTIC CABLE CHARACTERISTICS	
3.4.1.2.5	PFM NTSC VIDEO FIBER OPTIC CABLE BEND RADIUS	
3.4.1.2.6	DELETED	
3.4.1.2.7.A	PFM NTSC OPTICAL CONNECTOR/PIN ASSIGNMENTS	
3.4.1.2.7.B	PFM NTSC OPTICAL CONNECTOR/PIN ASSIGNMENTS	

TABLE 4.2–1 APPLICABILITY MATRIX (CONTINUED)

IRD PARAGRAPH	IRD REQUIREMENT	PAYLOAD APPLICABILITY
3.4.1.2.7.C	PFM NTSC OPTICAL CONNECTOR/PIN ASSIGNMENTS	
3.4.1.3	NTSC ELECTRICAL VIDEO INTERFACES	
3.4.1.3.1	CABLES	
3.4.1.3.2	SIGNAL STANDARD	
3.4.1.3.3	INTERFACE CIRCUIT	
3.4.1.3.4	CROSS TALK	
3.4.1.4.A	NTSC ELECTRICAL CONNECTOR/PIN ASSIGNMENTS	
3.4.1.4.B	NTSC ELECTRICAL CONNECTOR/PIN ASSIGNMENTS	
3.4.1.4.C	NTSC ELECTRICAL CONNECTOR/PIN ASSIGNMENTS	
3.4.2	U.S. ELEMENT AUDIO INTERFACE REQUIREMENTS	
3.5	THERMAL CONTROL INTERFACE REQUIREMENTS	
3.5.1	INTERNAL THERMAL CONTROL SYSTEM (ITCS) INTERFACE REQUIREMENTS	
3.5.1.1.A	PHYSICAL INTERFACE	
3.5.1.1.B	PHYSICAL INTERFACE	
3.5.1.2.A	ITCS FLUID USE AND CHARGING – ITCS Fluid Use	
3.5.1.2.B	ITCS FLUID USE AND CHARGING – Integrated Rack Charging	
3.5.1.3.A	ITCS PRESSURE DROP – On–Orbit Interfaces	
3.5.1.3.B	ITCS PRESSURE DROP – MPLM Interfaces	
3.5.1.4.A	COOLANT FLOW RATE–MTL	
3.5.1.4.B	COOLANT FLOW RATE–LTL	
3.5.1.5.A	COOLANT SUPPLY TEMPERATURE–MTL	
3.5.1.5.B	COOLANT SUPPLY TEMPERATURE–LTL	
3.5.1.6.A	COOLANT RETURN TEMPERATURE	
3.5.1.6.B	COOLANT RETURN TEMPERATURE	
3.5.1.6.C	COOLANT RETURN TEMPERATURE	
3.5.1.6.D	COOLANT RETURN TEMPERATURE	
3.5.1.7.A	COOLANT MAXIMUM DESIGN PRESSURE–MTL	
3.5.1.7.B	COOLANT MAXIMUM DESIGN PRESSURE–LTL	
3.5.1.7.C	COOLANT MAXIMUM DESIGN PRESSURE–MPLM Temperature Loop	
3.5.1.8	FAIL SAFE DESIGN	
3.5.1.9.A	LEAKAGE	
3.5.1.9.B	LEAKAGE	
3.5.1.10	QUICK–DISCONNECT AIR INCLUSION	
3.5.1.11	RACK FRONT SURFACE TEMPERATURE	
3.5.1.12	CABIN AIR HEAT LEAK	
3.5.1.13	MPLM CABIN AIR COOLING	
3.5.1.14.A	SIMULTANEOUS COOLING	
3.5.1.14.B	SIMULTANEOUS COOLING	

TABLE 4.2–1 APPLICABILITY MATRIX (CONTINUED)

IRD PARAGRAPH	IRD REQUIREMENT	PAYLOAD APPLICABILITY
3.5.1.15	CONTROL SYSTEM TIME CONSTANT	
3.5.1.16	PAYLOAD COOLANT QUANTITY	
3.5.1.17	PAYLOAD GAS INCLUSION	
3.6	VACUUM SYSTEM REQUIREMENTS	
3.6.1	VACUUM EXHAUST SYSTEM (VES)/WASTE GAS SYSTEM (WGS) REQUIREMENTS	
3.6.1.1	VES/WGS PHYSICAL INTERFACE	
3.6.1.2.A	INPUT PRESSURE LIMIT	
3.6.1.2.B	INPUT PRESSURE LIMIT	
3.6.1.2.C	INPUT PRESSURE LIMIT	
3.6.1.3	INPUT TEMPERATURE LIMIT	
3.6.1.4	INPUT DEWPOINT LIMIT	
3.6.1.5.A	ACCEPTABLE EXHAUST GASES	
3.6.1.5.B	ACCEPTABLE EXHAUST GASES	
3.6.1.5.C	ACCEPTABLE EXHAUST GASES	
3.6.1.5.D	ACCEPTABLE EXHAUST GASES	
3.6.1.5.1.A	ACCEPTABLE GASES - LIST	
3.6.1.5.1.B	ACCEPTABLE GASES - LIST	
3.6.1.5.1.C	ACCEPTABLE GASES - LIST	
3.6.1.5.2	EXTERNAL CONTAMINATION CONTROL	
3.6.1.5.3.A	INCOMPATIBLE GASES	
3.6.1.5.3.B	INCOMPATIBLE GASES	
3.6.1.6	PAYLOAD VACUUM SYSTEM ACCESS VALVE	
3.6.2	VACUUM RESOURCE SYSTEM (VRS)/VACUUM VENT SYSTEM (VVS) REQUIREMENTS	
3.6.2.1	VRS/VVS PHYSICAL INTERFACE	
3.6.2.2.A	INPUT PRESSURE LIMIT	
3.6.2.2.B	INPUT PRESSURE LIMIT	
3.6.2.2.C	INPUT PRESSURE LIMIT	
3.6.2.3	VRS/VVS THROUGH PUT LIMIT	
3.6.2.4	ACCEPTABLE GASES	
3.7	PRESSURIZED GASES INTERFACE REQUIREMENTS	
3.7.1	NITROGEN INTERFACE REQUIREMENTS	
3.7.1.1	NITROGEN INTERFACE CONTROL	
3.7.1.2	NITROGEN INTERFACE MDP	
3.7.1.3	NITROGEN INTERFACE TEMPERATURE	
3.7.1.4	NITROGEN LEAKAGE	
3.7.1.5	NITROGEN PHYSICAL INTERFACE	
3.7.2	ARGON INTERFACE REQUIREMENTS	

TABLE 4.2–1 APPLICABILITY MATRIX (CONTINUED)

IRD PARAGRAPH	IRD REQUIREMENT	PAYLOAD APPLICABILITY
3.7.2.1	ARGON INTERFACE CONTROL	
3.7.2.2	ARGON INTERFACE MDP	
3.7.2.3	ARGON INTERFACE TEMPERATURE	
3.7.2.4	ARGON LEAKAGE	
3.7.2.5	ARGON PHYSICAL INTERFACE	
3.7.3	CARBON DIOXIDE INTERFACE REQUIREMENTS	
3.7.3.1	CARBON DIOXIDE INTERFACE CONTROL	
3.7.3.2	CARBON DIOXIDE INTERFACE MDP	
3.7.3.3	CARBON DIOXIDE INTERFACE TEMPERATURE	
3.7.3.4	CARBON DIOXIDE LEAKAGE	
3.7.3.5	CARBON DIOXIDE PHYSICAL INTERFACE	
3.7.4	HELIUM INTERFACE REQUIREMENTS	
3.7.4.1	HELIUM INTERFACE CONTROL	
3.7.4.2	HELIUM INTERFACE MDP	
3.7.4.3	HELIUM INTERFACE TEMPERATURE	
3.7.4.4	HELIUM LEAKAGE	
3.7.4.5	HELIUM PHYSICAL INTERFACE	
3.7.5	PRESSURIZED GAS SYSTEMS	
3.7.6	MANUAL VALVES	
3.8	PAYLOAD SUPPORT SERVICES INTERFACES REQUIREMENTS	
3.8.1	POTABLE WATER	
3.8.1.1	POTABLE WATER INTERFACE CONNECTION	
3.8.1.2	POTABLE WATER INTERFACE PRESSURE	
3.8.1.3.A	POTABLE WATER USE	
3.8.1.3.B	POTABLE WATER USE	
3.8.2	FLUID SYSTEM SERVICER	
3.9	ENVIRONMENT INTERFACE REQUIREMENTS	
3.9.1	ATMOSPHERE REQUIREMENTS	
3.9.1.1	PRESSURE	
3.9.1.2	TEMPERATURE	
3.9.1.3	HUMIDITY	
3.9.2	INTEGRATED RACK USE OF CABIN ATMOSPHERE	
3.9.2.1.A	ACTIVE AIR EXCHANGE	
3.9.2.1.B	ACTIVE AIR EXCHANGE	
3.9.2.2	OXYGEN CONSUMPTION	
3.9.2.3	CHEMICAL RELEASES	
3.9.3	RADIATION REQUIREMENTS	
3.9.3.1	INTEGRATED RACK CONTAINED OR GENERATED IONIZING RADIATION	

TABLE 4.2–1 APPLICABILITY MATRIX (CONTINUED)

IRD PARAGRAPH	IRD REQUIREMENT	PAYLOAD APPLICABILITY
3.9.3.2	IONIZING RADIATION DOSE	
3.9.3.3	SINGLE EVENT EFFECT (SEE) IONIZING RADIATION	
3.9.3.4	LAB WINDOW RACK LOCATION RADIATION REQUIREMENTS	
3.9.3.4.1	WINDOW RACK INFRARED RADIATION REQUIREMENTS	
3.9.3.4.2	WINDOW RACK ULTRAVIOLET RADIATION REQUIREMENTS	
3.9.4	ADDITIONAL ENVIRONMENTAL CONDITIONS	
3.10	FIRE PROTECTION INTERFACE REQUIREMENTS	
3.10.1	FIRE PREVENTION	
3.10.2	PAYLOAD MONITORING AND DETECTION REQUIREMENTS	
3.10.2.1	SMOKE DETECTION	
3.10.2.1.1.A	SMOKE DETECTOR	
3.10.2.1.1.B	SMOKE DETECTOR	
3.10.2.1.2	FORCED AIR CIRCULATION INDICATION	
3.10.2.1.3A	FIRE DETECTION INDICATOR	
3.10.2.1.3B	FIRE DETECTION INDICATOR	
3.10.2.2	PARAMETER MONITORING	
3.10.2.2.1	PARAMETER MONITORING USE	
3.10.2.2.2	PARAMETER MONITORING RESPONSE	
3.10.2.2.2.1.A	PARAMETER MONITORING IN SUBRACK	
3.10.2.2.2.1.B	PARAMETER MONITORING IN SUBRACK	
3.10.2.2.2.2.A	PARAMETER MONITORING IN INTEGRATED RACK	
3.10.2.2.2.2.B	PARAMETER MONITORING IN INTEGRATED RACK	
3.10.3	FIRE SUPPRESSION	
3.10.3.1.A	PORTABLE FIRE EXTINGUISHER	
3.10.3.1.B	PORTABLE FIRE EXTINGUISHER	
3.10.3.2	FIRE SUPPRESSION ACCESS PORT ACCESSIBILITY	
3.10.3.3	FIRE SUPPRESSANT DISTRIBUTION	
3.10.4.A	LABELING	
3.10.4.B	LABELING	
3.11	MATERIALS AND PARTS INTERFACE REQUIREMENTS	
3.11.1	MATERIALS AND PARTS USE AND SELECTION	
3.11.1.1	COMMERCIAL PARTS	
3.11.2.A	FLUIDS	
3.11.2.B	FLUIDS	
3.11.2.C	FLUIDS	
3.11.3	CLEANLINESS	
3.11.4	FUNGUS RESISTANT MATERIAL	
3.12	HUMAN FACTORS INTERFACE REQUIREMENTS	
3.12.1.A	STRENGTH REQUIREMENTS	

TABLE 4.2–1 APPLICABILITY MATRIX (CONTINUED)

IRD PARAGRAPH	IRD REQUIREMENT	PAYLOAD APPLICABILITY
3.12.1.B	STRENGTH REQUIREMENTS	
3.12.2	BODY ENVELOPE AND REACH ACCESSIBILITY	
3.12.2.1	ADEQUATE CLEARANCE	
3.12.2.2.A	ACCESSIBILITY	
3.12.2.2.B	ACCESSIBILITY	
3.12.2.3	FULL SIZE RANGE ACCOMMODATION	
3.12.3	HABITABILITY	
3.12.3.1	HOUSEKEEPING	
3.12.3.1.1	CLOSURES OR COVERS	
3.12.3.1.2.A	BUILT-IN CONTROL	
3.12.3.1.2.B	BUILT-IN CONTROL	
3.12.3.1.3	DELETED	
3.12.3.1.4	DELETED	
3.12.3.1.5	ONE-HANDED OPERATION	
3.12.3.2	TOUCH TEMPERATURE	
3.12.3.2.1	CONTINUOUS/INCIDENTAL CONTACT - HIGH TEMPERATURE	
3.12.3.2.2	CONTINUOUS/INCIDENTAL CONTACT - LOW TEMPERATURE	
3.12.3.3	ACOUSTIC REQUIREMENTS	
3.12.3.3.1.A	CONTINUOUS NOISE LIMITS – Subracks not changed out	
3.12.3.3.1.B	CONTINUOUS NOISE LIMITS – Subracks changed out	
3.12.3.3.1.C	CONTINUOUS NOISE LIMITS – Independently operated equipment	
3.12.3.3.2	INTERMITTENT NOISE LIMITS	
3.12.3.4.A	LIGHTING DESIGN	
3.12.3.4.B	LIGHTING DESIGN	
3.12.3.4.C	LIGHTING DESIGN	
3.12.3.4.D	LIGHTING DESIGN	
3.12.3.4.E	LIGHTING DESIGN	
3.12.4	STRUCTURAL/MECHANICAL INTERFACES	
3.12.4.1	DELETED	
3.12.4.2	PAYLOAD HARDWARE MOUNTING	
3.12.4.2.1	EQUIPMENT MOUNTING	
3.12.4.2.2	DRAWERS AND HINGED PANELS	
3.12.4.2.3	DELETED	
3.12.4.2.4	DELETED	
3.12.4.2.5	ALIGNMENT	
3.12.4.2.6	SLIDE-OUT STOPS	
3.12.4.2.7	PUSH-PULL FORCE	
3.12.4.2.8	ACCESS	
3.12.4.2.8.1	COVERS	

TABLE 4.2–1 APPLICABILITY MATRIX (CONTINUED)

IRD PARAGRAPH	IRD REQUIREMENT	PAYLOAD APPLICABILITY
3.12.4.2.8.2	SELF-SUPPORTING COVERS	
3.12.4.2.8.3	DELETED	
3.12.4.2.8.4	UNIQUE TOOLS	
3.12.4.3	CONNECTORS	
3.12.4.3.1	ONE-HANDED OPERATION	
3.12.4.3.2.A	ACCESSIBILITY	
3.12.4.3.2.B	ACCESSIBILITY	
3.12.4.3.3.A	EASE OF DISCONNECT	
3.12.4.3.3.B	EASE OF DISCONNECT	
3.12.4.3.4	INDICATION OF PRESSURE/FLOW	
3.12.4.3.5	SELF LOCKING	
3.12.4.3.6.A	CONNECTOR ARRANGEMENT	
3.12.4.3.6.B	CONNECTOR ARRANGEMENT	
3.12.4.3.7	ARC CONTAINMENT	
3.12.4.3.8	CONNECTOR PROTECTION	
3.12.4.3.9	CONNECTOR SHAPE	
3.12.4.3.10	FLUID AND GAS LINE CONNECTORS	
3.12.4.3.11.A	ALIGNMENT MARKS OR GUIDE PINS	
3.12.4.3.12.A	CODING	
3.12.4.3.12.B	CODING	
3.12.4.3.13	PIN IDENTIFICATION	
3.12.4.3.14	ORIENTATION	
3.12.4.3.15.A	HOSE/CABLE RESTRAINTS	
3.12.4.3.15.B	HOSE/CABLE RESTRAINTS	
3.12.4.3.15.C	HOSE/CABLE RESTRAINTS	
3.12.4.3.15.D	HOSE/CABLE RESTRAINTS	
3.12.4.4	FASTENERS	
3.12.4.4.1	NON–THREADED FASTENERS STATUS INDICATION	
3.12.4.4.2	MOUNTING BOLT/FASTENER SPACING	
3.12.4.4.3	DELETED	
3.12.4.4.4.A	MULTIPLE FASTENERS	
3.12.4.4.5	CAPTIVE FASTENERS	
3.12.4.4.6.A	QUICK RELEASE FASTENERS	
3.12.4.4.6.B	QUICK RELEASE FASTENERS	
3.12.4.4.7	THREADED FASTENERS	
3.12.4.4.8.A	OVER CENTER LATCHES – NONSELF–LATCHING	
3.12.4.4.8.B	OVER CENTER LATCHES – LATCH LOCK	
3.12.4.4.8.C	OVER CENTER LATCHES – LATCH HANDLES	
3.12.4.4.9	WINGHEAD FASTENERS	

TABLE 4.2–1 APPLICABILITY MATRIX (CONTINUED)

IRD PARAGRAPH	IRD REQUIREMENT	PAYLOAD APPLICABILITY
3.12.4.4.10	DELETED	
3.12.4.4.11.A	FASTENER HEAD TYPE	
3.12.4.4.11.B	FASTENER HEAD TYPE	
3.12.4.4.11.C	FASTENER HEAD TYPE	
3.12.4.4.12	ONE-HANDED ACTUATION	
3.12.4.4.13	DELETED	
3.12.4.4.14	ACCESS HOLES	
3.12.5	CONTROLS AND DISPLAYS	
3.12.5.1	CONTROLS SPACING DESIGN REQUIREMENTS	
3.12.5.2	ACCIDENTAL ACTUATION	
3.12.5.2.1	PROTECTIVE METHODS	
3.12.5.2.2	NONINTERFERENCE	
3.12.5.2.3	DEAD-MAN CONTROLS	
3.12.5.2.4	BARRIER GUARDS	
3.12.5.2.5	RECESSED SWITCH PROTECTION	
3.12.5.2.6	DELETED	
3.12.5.2.7	POSITION INDICATION	
3.12.5.2.8	HIDDEN CONTROLS	
3.12.5.2.9	HAND CONTROLLERS	
3.12.5.3.A	VALVE CONTROLS – LOW TORQUE VALVES	
3.12.5.3.B	VALVE CONTROLS – INTERMEDIATE TORQUE VALVES	
3.12.5.3.C	VALVE CONTROLS – HIGH TORQUE VALVES	
3.12.5.3.D	VALVE CONTROLS – HANDLE DIMENSIONS	
3.12.5.3.E	VALVE CONTROLS – ROTARY VALVE CONTROLS	
3.12.5.4	TOGGLE SWITCHES	
3.12.6	RESTRAINTS AND MOBILITY AIDS	
3.12.6.1.A	STOWAGE DRAWER CONTENTS RESTRAINTS	
3.12.6.1.B	STOWAGE DRAWER CONTENTS RESTRAINTS	
3.12.6.1.C	STOWAGE DRAWER CONTENTS RESTRAINTS	
3.12.6.2.A	STOWAGE AND EQUIPMENT DRAWERS/TRAYS	
3.12.6.2.B	STOWAGE AND EQUIPMENT DRAWERS/TRAYS	
3.12.6.3	CAPTIVE PARTS	
3.12.6.4	HANDLE AND GRASP AREA DESIGN REQUIREMENTS	
3.12.6.4.1	HANDLES AND RESTRAINTS	
3.12.6.4.2	DELETED	
3.12.6.4.3	HANDLE LOCATION/FRONT ACCESS	
3.12.6.4.4	HANDLE DIMENSIONS	
3.12.6.4.5.A	NON-FIXED HANDLES DESIGN REQUIREMENTS	
3.12.6.4.5.B	NON-FIXED HANDLES DESIGN REQUIREMENTS	

TABLE 4.2–1 APPLICABILITY MATRIX (CONTINUED)

IRD PARAGRAPH	IRD REQUIREMENT	PAYLOAD APPLICABILITY
3.12.6.4.5.C	NON-FIXED HANDLES DESIGN REQUIREMENTS	
3.12.7	IDENTIFICATION LABELING	
3.12.8	COLOR	
3.12.9	CREW SAFETY	
3.12.9.1.A	ELECTRICAL HAZARDS	
3.12.9.1.B	ELECTRICAL HAZARDS	
3.12.9.1.C	ELECTRICAL HAZARDS	
3.12.9.1.D	ELECTRICAL HAZARDS	
3.12.9.1.E	ELECTRICAL HAZARDS	
3.12.9.1.1	MISMATCHED	
3.12.9.1.2	DELETED	
3.12.9.1.3	DELETED	
3.12.9.1.4	OVERLOAD PROTECTION	
3.12.9.1.4.1	DEVICE ACCESSIBILITY	
3.12.9.1.4.2	EXTRACTOR -TYPE FUSE HOLDER	
3.12.9.1.4.3	OVERLOAD PROTECTION LOCATION	
3.12.9.1.4.4	OVERLOAD PROTECTION IDENTIFICATION	
3.12.9.1.4.5	AUTOMATIC RESTART PROTECTION	
3.12.9.2	SHARP EDGES AND CORNERS PROTECTION	
3.12.9.3	HOLES	
3.12.9.4	LATCHES	
3.12.9.5	SCREWS AND BOLTS	
3.12.9.6	SECURING PINS	
3.12.9.7	LEVERS, CRANKS, HOOKS, AND CONTROLS	
3.12.9.8	BURRS	
3.12.9.9.A	LOCKING WIRES	
3.12.9.9.B	LOCKING WIRES	
3.12.9.10.A	AUDIO DEVICES (DISPLAYS)	
3.12.9.10.B	DELETED	
3.12.9.10.C	AUDIO DEVICES (DISPLAYS)	
3.12.9.10.D	AUDIO DEVICES (DISPLAYS)	
3.12.9.11	DELETED	
3.12.9.12	EGRESS	
3.12.10	PAYLOAD IN-FLIGHT MAINTENANCE	

5.0 EXCEPTION PROCESSING

Any exception to requirements, capabilities, or services defined in a Payload IRD and/or interfaces defined in the ICD template must be submitted under specific procedures and guidelines to assure proper control, evaluation and approval. This section describes the process by which a Payload–proposed non–compliance to an IRD requirement, or to the interfaces defined in this document, is processed and dispositioned. These non–compliances are referred to in this document as *Exceptions*. The conditions of the exception will determine further classification as either an Exceedance, Deviation or Waiver. The terms exceedance, deviation, and waiver are defined in Section 5.1. The specific requirement or interface excepted, along with a description of the existing condition, and a rationale for acceptance will be documented in the unique ICD. Any proposed exception will require preparation of an Exception/PIRN to the payload–unique ICD. This section describes how exceptions are documented. It also describes how the International Space Station Program PIRN Technical Review panel (PTR) processes exceptions, and provides for disposition either directly or through appropriate Program Control Boards. An overview of the documentation, approval, and implementation flow of Exception requests is provided in Figure 5–1.

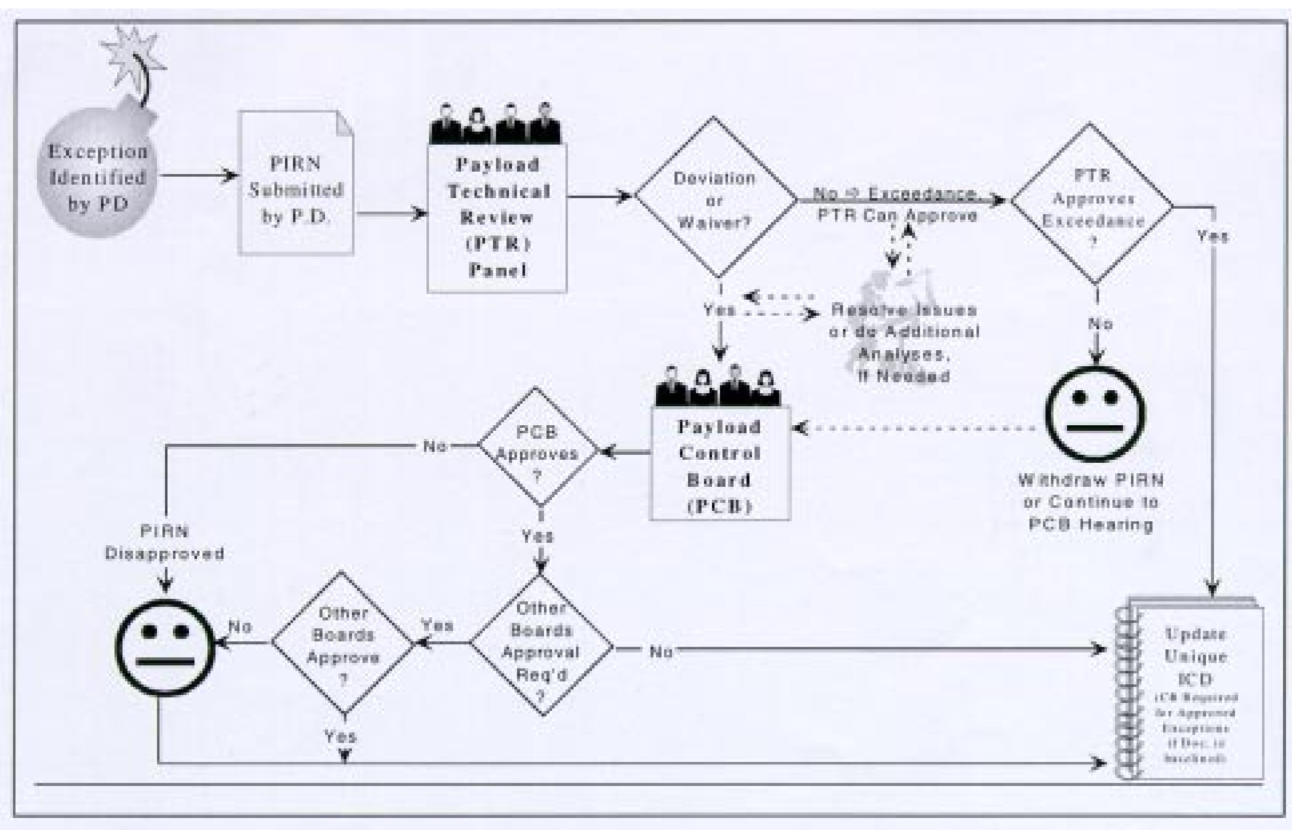


FIGURE 5–1 OVERVIEW OF EXCEPTION PROCESS

5.1 DEFINITIONS

5.1.1 EXCEPTION

The general term used to identify any payload–proposed departure from specified requirements or interfaces. An exception is further classified as an exceedance, deviation or waiver per the descriptions provided below.

5.1.2 EXCEEDANCE

An Exceedance is a condition that does not comply with a stated IRD requirement or ICD template interface, which is identified prior to baselining the payload–unique ICD. It exceeds the defined payload limits but when combined with the remaining payload complement the module/ISS limits are not exceeded, or it does not impact the performance of the remaining payload complement, and it does not impact vehicle subsystems performance . The exception can be shown to be acceptable within the framework of the standard element level analysis cycle without any unique analysis or controls.

An Exceedance can be approved by the PTR and documented in the payload– unique ICD. Exceedances do not require approval by Control Board.

For Example: One of the requirements is that the delta–T on the Moderate Temperature Loop should be at least 35°F. If “Payload X” wishes to have a delta–T of 32°F, this would be classified as an exceedance. It does not exceed vehicle limits or affect safety; it only influences the efficiency of the use of the Moderate Temperature Loop.

5.1.3 DEVIATION

A Deviation is a non–compliance to an IRD requirement or ICD Template interface, which is identified prior to baselining the payload–unique ICD. It is different from an Exceedance in that the defined exception exceeds module/ISS limits. Additional analysis outside the scope of the standard element analysis cycle or unique operational guidelines or constraints may be needed to approve the exception. Deviations must be approved by a Control Board.

For Example: One of the requirements is that the maximum return temperature of the Moderate Temperature Loop should be 120°F. If “Payload Y” wishes to have a return temperature of 123°F, and their ICD has not been baselined, this would be classified as a Deviation. The vehicle is designed to accommodate return temperatures of 120°F or less, and special analysis must be done to determine if the vehicle can accommodate this, or if operational constraints will be required.

5.1.4 WAIVER

A Waiver is a condition found in non–compliance to an IRD requirement or to the baselined payload–unique ICD, which is identified after baselining the payload–unique ICD. Typically this will occur as a result of the final as–built hardware verification program. It may require additional analysis outside of the scope of the standard element analysis cycle or unique operational guidelines or constraints to approve the exception. Waivers must be approved by a Control Board.

For Example: One of the requirements is that the continuous acoustic noise must not exceed NC40. “Payload Z” has already baselined their ICD, and recent testing of the flight hardware shows that their continuous noise level is NC45. Additional evaluation will be required to determine if this can be accepted, and it may result in operational constraints.

5.2 EXCEPTION PROCESSING DETAILS

All proposed exceptions to IRD requirements are evaluated by the PIRN Technical Review panel (PTR). The PTR is part of the ISS Program Payloads office. Exceedances may be approved by the PTR and documented in the Unique Payload ICD. Approval/Disposition signature authority rests with the PTR for those exceptions within their limit of authority.

The Payload Control Board (PCB) has authority to approve exceptions that impact the overall payload complement but do not affect overall ISS requirements.

Exceptions that affect ISS subsystems must be approved by the Development Control Board (DCB). Exceptions that affect Partner modules must be approved by the Multilateral Payload Interface Control Board (MPICB).

Evaluation is conducted by reviewers of the appropriate technical or program discipline. Their comments are presented as part of the Exception–PIRN disposition either to the PTR, the PCB, DCB, or the MPICB, according to the criteria discussed above. Section 5.4 contains the “Mandatory Evaluators List” to be used as a reference for notification to review exceptions pertaining to specific disciplines. The list is intended to be used as a guideline only, and is subject to change.

5.2.1 EXCEPTION LOGGING AND TRACEABILITY

Each Payload–Unique ICD will identify each Exception pertaining to it, and show traceability to its applicable IRD requirement (paragraph). The approved non–compliant condition will be documented in Appendix C of the unique ICD.

5.2.2 EXCEPTIONS TABLE

Each Unique ICD shall contain a Table of Exceptions which provides the following information concerning each exception.

The paragraph number of the IRD requirement and the corresponding ICD paragraph number that is proposed to be excepted will be entered in the first column of the Table. When the classification (i.e., exceedance, waiver, or deviation) is determined, it will be listed in column 2. Until the classification is determined, the item will be listed simply as an Exception. A unique identifier will be assigned to each Exception. A short description of the exception will be included in column 4. The status of the Exception will be listed as Open until the Exception has been approved by the appropriate authority. Once approved the PIRN number and SSCN will be listed in the Status column to document approval.

TABLE 5.2.2–1 EXCEPTIONS TABLE

IRD/ICD PARAGRAPH NUMBER	CLASSIFICATION	IDENTIFIER (REFERENCE #)	DESCRIPTION	STATUS
List the Corresponding IRD and ICD Paragraph #	Classify Exception as an Exceedance, Deviation or Waiver	Unique Identification Number	Provide a Short Description of the Exception	Open or PIRN No./SSCN

5.2.3 PROCESS

Figure 5.2.3–1 reflects the process for proposal, evaluation, and disposition of exceptions.

5.2.3.1 SUBMITTAL REQUESTS

The Payload Developer (PD) will be responsible for submitting any required Exception Requests. Once the need for an exception is identified, the first step in submitting a request is to provide the pertinent information on an Exception/PIRN form. The Exception/PIRN form and instructions for completion may be obtained from the Payloads Office Documentation Page.

5.2.3.1.1 DATA SUBMITTAL RESPONSIBILITY

The Payload Developer is responsible for providing all data that is needed to evaluate the Exception Request for approval. Data, in addition to the data submitted with the Exception Request or contained in the unique ICD may be required to evaluate the exception. The PD must supply the required additional data before the Exception Request can be processed The Payload Office may, at its discretion, assist in data collection, analysis, or issue resolution, but this is done as a courtesy only, depending upon available labor, time and resources.

5.2.3.2 RECORDING AND MAINTAINING

The book manager of a payload–unique ICD collects all exception requests. Once a request is submitted, the book manager verifies that sufficient information has been provided, assigns a preliminary tracking number, and records the necessary information in a database. Additional data may be requested at any time during the Exception review process.

5.2.3.3 INTERNAL SCREENING

When the payload–unique ICD book manager receives an exception request, he/she coordinates the initial review phase with the chairmen of the Internal PIRN Coordination (IPC) meeting. The IPC is co–chaired by representatives of the payload integration offices of NASA and Boeing, and is supported by the ICD book managers or other initiators of each exception. The IPC will classify the exception request as either an exceedance, deviation, or waiver. The IPC will identify whether the exception potentially impacts vehicle subsystem performance or Partner modules and will assign mandatory evaluators based upon this assessment.

The Internal PIRN Coordination panel is an informal venue for assuring that the wording and formatting of the Exception–PIRN are correct, and that the technical content of each request merits formal review. The request may be approved for formal review as–is, or the IPC panel may request additional information or some action. If the IPC panel concludes that the Exception request is unacceptable, they may request that the Exception–PIRN be withdrawn by the PD.

5.2.3.4 PREPARATION FOR FORMAL REVIEW

If an Exception Request is approved for formal review, the IPC assigns it a classification of either exceedance, deviation or waiver (based on the definitions provided in section 5.1 of this document), assigns a Technical Lead within OZ3 (typically the ICD Book Manager), assigns the Mandatory Evaluators (Reference Section 5.4), and assigns the tracking number. The Exception Request is routed to the designated Mandatory Evaluators via the standard PIRN review process.

5.2.3.5 FORMAL REVIEW

5.2.3.5.1 PEI ANALYSIS

The IPC will route the Exception Request to the appropriate PEI discipline for assessment. The PEI Discipline Representative will perform an analysis of the Exception Request which will determine if the Exception can be approved or not. The PEI Discipline Representative will coordinate with any groups outside of PEI which must participate in the analysis of the Exception Request. If the Exception does not impact the integrated payload complement the analysis can be performed upon receipt of the Exception Request. If the Exception impacts the integrated payload complement the Exception must be analyzed as part of the standard Element

Analysis process. The PEI Discipline analysis will identify any operational constraints that are required to approve the Exception. Any identified operation constraints will be documented in the Payload Operations Guidelines and Constraints document, (SSP 57500 series). The Exception Request will be updated by the Technical Lead to incorporate the PEI analysis results. The updated Exception Request will then be routed by the Technical Lead to the mandatory evaluators for assessment. The mandatory evaluators will provide their recommendations to the Technical Lead for presentation to the PTR. Any issues and/or comments generated during the PEI Analysis process or by the mandatory evaluators will be coordinated with the PD by the Technical Lead.

5.2.3.5.2 PTR

Each exception may be dispositioned at a different board level depending on its classification and/or the timing of the request submittal (prior to or after ICD baseline). All exception requests (regardless of classification) must first be dispositioned through the PIRN Technical Review (PTR). The PTR has approval authority for those exceptions that are classified as Exceedances. The PTR assesses the Exception Request, results of the PEI Analysis, and the Mandatory Evaluators recommendations. The PTR may approve the Exception Request, disapprove the Exception Request or may request additional data from the PD or PEI Discipline representative in order to be able to adequately assess the Exception Request. The Technical Lead will update the Exception Request to incorporate the PTR’s recommendation.

If the approved Exception Request is classified as an Exceedance it is incorporated into the unique hardware ICD. If the Exception Request is classified as a Deviation or Waiver it is forwarded to the PCB with a recommendation from the PTR to approve.

If the Exception Request is disapproved, the PD is requested to provide cost and schedule impacts to modify the design/hardware to eliminate the noncompliance. The Exception Request with the PTR’s recommendation to disapprove and the cost/schedule impact data are brought to the PCB for final disposition regardless of classification.

5.2.3.5.3 CONTROL BOARDS

Exception Requests classified as Deviations or Waivers must be assessed and approved by the appropriate Control Board(s). The PCB assessed the Exception Requests, the PEI Analysis results, the Mandatory Evaluators recommendations, and the PTR recommendations forwarded by the PTR. The PCB will either recommend forwarding the Exception Request to the DCB or the MPICB as appropriate, or direct the PD to modify hardware to meet the IRD requirement in question. PEI and the PD will coordinate the Exception Request with the DCB and/or MPICB as required to gain approval of the exception. An approved Exception Request is incorporated into the unique hardware ICD.

5.2.3.5.4 SAFETY EXCEPTIONS

Exceptions (non–compliances) to safety requirements are handled by the Payload Safety Review Panel, with final approval from the Joint Mission Integration Control Board (JMICB) and the Joint Program Review Control Board (JPRCB).

5.2.4 OPERATIONAL CONSTRAINTS

Most ISS payloads will be on–orbit for more than one stage, and will be included within more than one payload complement. Exceptions that are granted which impact the integrated payload complement must be reassessed during the Element Analysis Cycle for each subsequent Increment. Any operational constraints associated with the Exception may be modified as required for each subsequent Increment and will be documented in the Payload Operations Guidelines and Constraints document for that Increment.

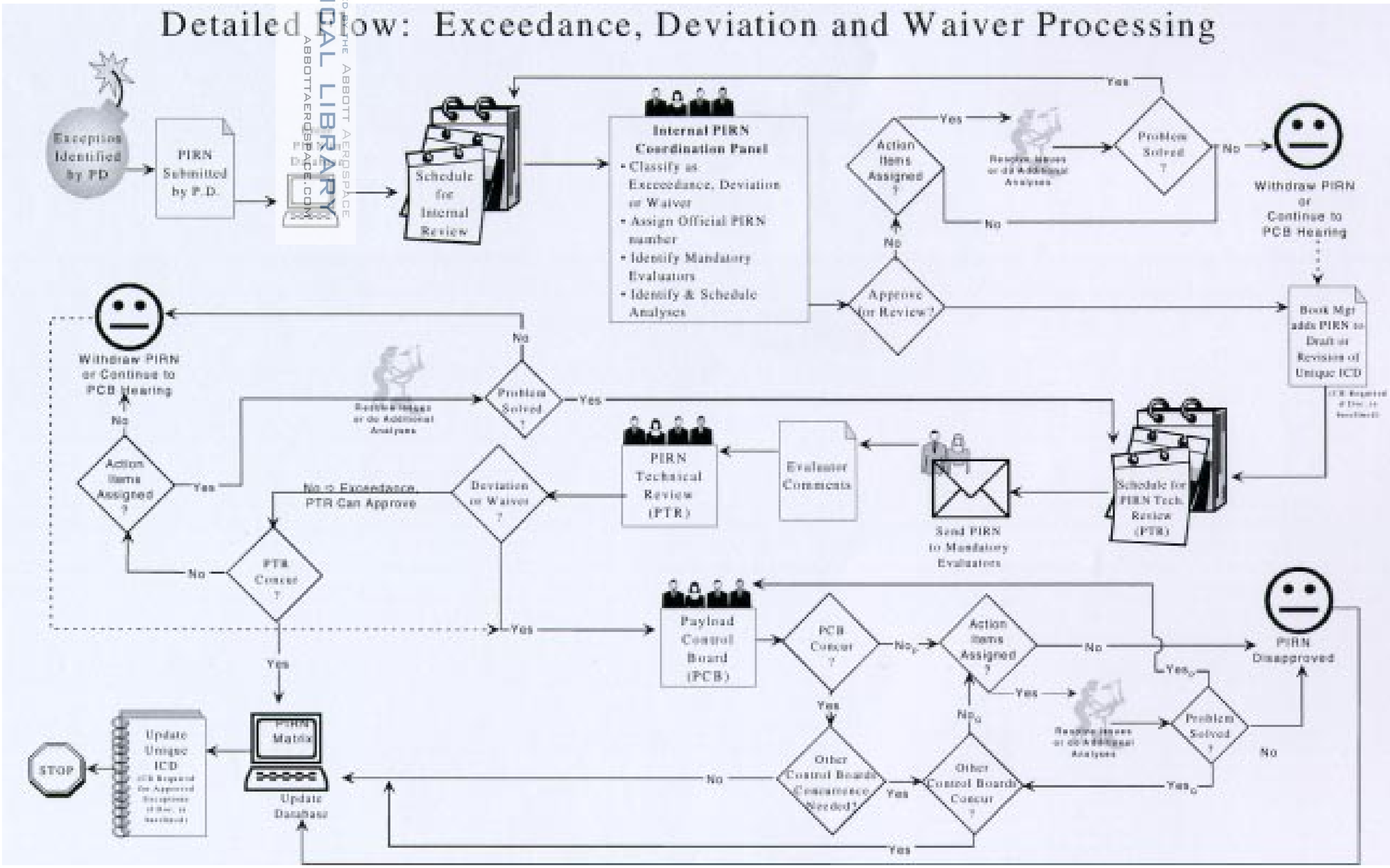


FIGURE 5.2.4–1 EXCEPTION PROCESS

5.3 EXCEPTION–REQUEST FORMAT

The following is provided as an example of how to structure an Exception Request.

IRN NO:	INTERNATIONAL SPACE STATION INTERFACE REVISION NOTICE	PAGE 1 OF 13 DATE PREPARED: 05/26/98

Doc. No., Rev. & Title: **SSP 57217** **Fluids & Combustion Facility, Combustion Integrated Rack, Interface Control Document**	PIRN NO: **SSP 57217-NA-0001**

(P)IRN TITLE:

Deviation Approval Request For On-Orbit Temporary Protrusion Exceedance

ORIGINATOR:	PIRN Type: *Check one*	*For Program Use Only*
Name: **Dwayne Kiefer** Agency: **Fluids and Combustion Facility** Phone: **216-977-0052** FAX: **216-977-0030**	☐ Standard PIRN ☒ Exception:	☐ Exceedance ☐ Deviation ☐ Waiver
	SSCN/CR **None**	RELATED PIRN No.: **None**
Agency Tracking No.:	SYSTEM/ELEMENT AFFECTED: **None**	

REASON FOR CHANGE: (INCLUDE APPLICABLE ICAP NUMBER)

The FCF CIR Optics Bench design violates section 3.1.1.7.3 of the IRD Rev. B, On–Orbit Temporary Protrusions. The FCF design minimizes crew resources, saves space by providing an alternative to rotating the rack for reconfiguration. The FCF developed Optics Bench provides structural support, electrical connections, and mounting locations for all science support hardware. The Optics Bench will be deployed only while crew attended, meets the human interface requirements for interfaces and operation as defined in SSP 57000 and allows for rapid reconfiguration of the rack for increased science throughput. The Optics Bench is quickly restowed and will pose no user interface issues.

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

Doc	Paragraph(s)	Figures(s)	Table(s)
FCF ICD	3.1.1.3		

EXAMPLE

AFFECTED INTERFACING PARTIES

	SIGNATURE & ORGANIZATION	DATE	SIGNATURE & ORGANIZATION	DATE	SIGNATURE & ORGANIZATION	DATE
CONCUR	(A)					
	(B)					
	(C)					
	(D)					
	(E)					
	(F)					
	(G)					

EXCEPTION REQUEST

FROM:

Identify the requirement which is not to be complied with.

SSP 57000 Section 3.12.4.1 requires that temporary protrusions be limited to not more than 26 inches beyond the plane of the NASA ISPR front face GSE attachment points.

TO:

State specifically what the non–compliance is.

FCF requires a maximum of 46.18 inch protrusion beyond the plane of the NASA ISPR front face GSE attachment points as shown in Figure 3 attached.

DESCRIPTION OF EXCEPTION

Provide detailed description of the non–compliance and enough supporting rationale for approval to support an analysis of it's acceptability.

IRD Section 3.1.1.7.3 limits on–orbit temporary protrusions to 6 inches past the GSE plane. The FCF will require an exception to this requirement to allow for a maximum of 46.18 inch protrusion past the GSE plane to allow for reconfiguration of the Optics Bench to support different science requirements.

OPTICS BENCH

The bulk of the crew time required by the FCF will be for specific PI experiment reconfiguration. The FCF design utilizes an Optics Bench to mount PI specific diagnostics such as cameras. The Optics Bench provides all the power, fluid & air cooling pass through, and C&DH interfaces for the diagnostic instruments. The Optics Bench and it's operation is depicted in FIGURE 1. The rack in its on–orbit, operational configuration is shown in dimensioned top, front and side views, FIGURES 2–4. To reconfigure the rack for a PI, a crew member will pull the Optics Bench out of the rack as shown in dimensioned top, front and side views, FIGURES 5–7. Once the Optics Bench has reached it's stops, it is rotated 90 degrees as shown in dimensioned top, front and side views, FIGURES 8–10.

BENEFITS

- Requires only one crew member to completely reconfigure
- Ease of Optics Bench and diagnostics manipulation
- Speed of reconfiguration
- Space savings (as opposed to rack rotation)
- Workspace openness
- No need for special equipment (i.e. restraints)

DURATION EXTENDED

Nominally the Optics Bench would be extended briefly during each PI setup. This will occur approximately 5 times per year. Estimates indicate that the entire reconfiguration process will take one crew member less than 1 hour to complete.

PEI Analysis Results

This will be supplied by PEI, it will document the analysis performed by the PEI Discipline representative to determine the acceptability of the non–compliance.

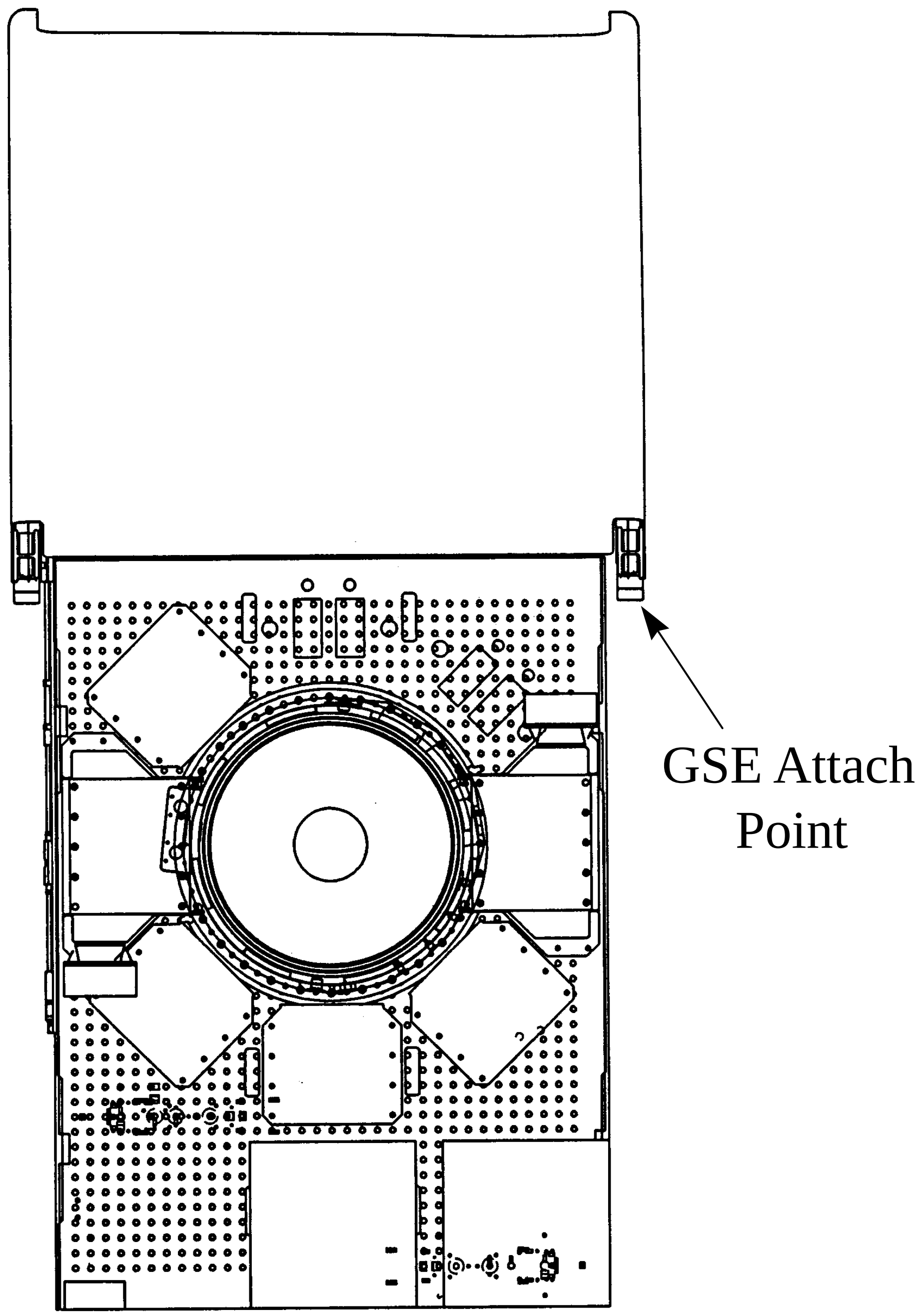
PEI Recommendation

This will be supplied by PEI, it will document the recommendation of PEI based upon the analysis results.

PTR Disposition

This will be supplied by the PTR, it will document whether the PTR recommends approval or disapproval of the Exception Request.

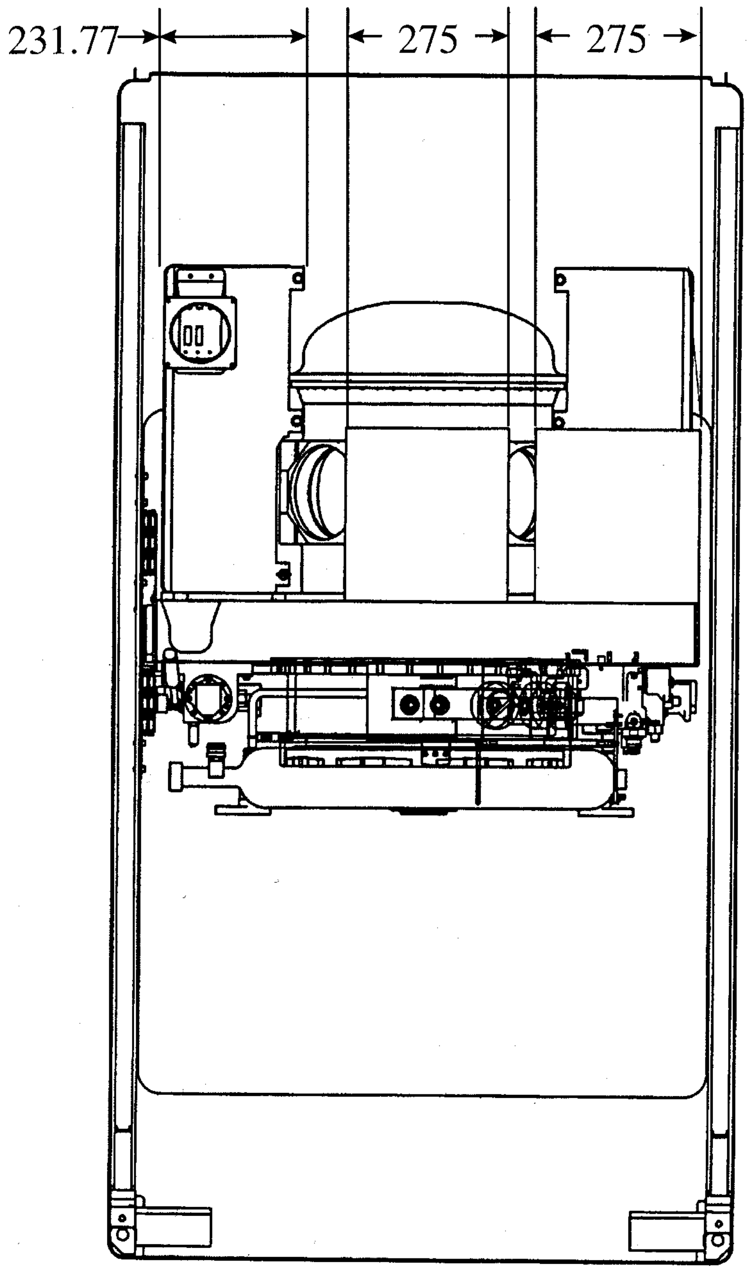
Top View
FCF Integrated Rack
in Deployed Configuration



Dimensions Are In Millimeters

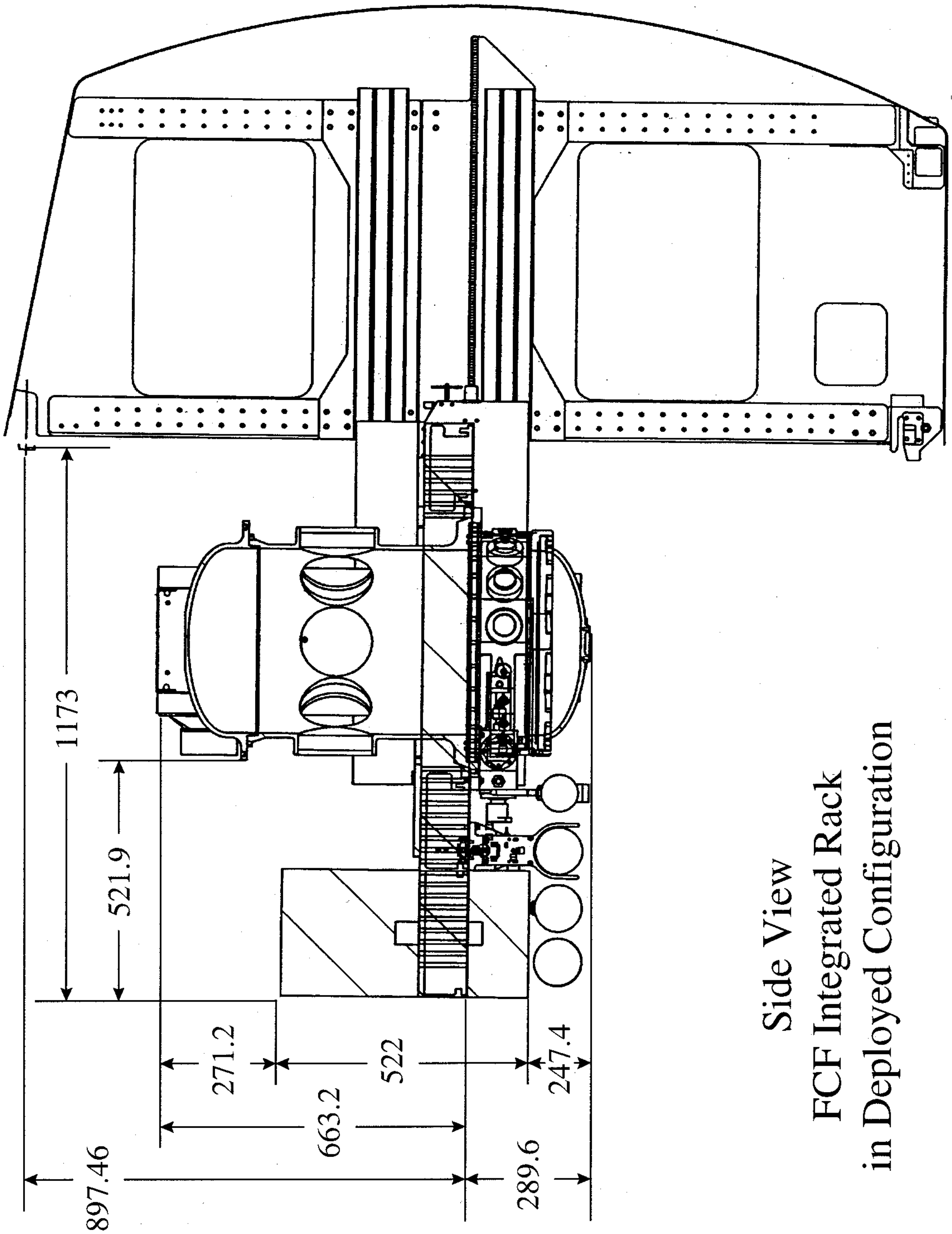
FIGURE 1

Front View
FCF Integrated Rack
in Deployed Configuration



Dimensions Are In Millimeters

FIGURE 2



Side View
FCF Integrated Rack
in Deployed Configuration

Dimensions Are In Millimeters
FIGURE 3

5.4 MANDATORY EVALUATORS

Table 5.4–1 provides the mandatory evaluator of an Exception Request for each IRD requirement.

TABLE 5.4–1 PAYLOAD PIRN MANDATORY EVALUATORS LIST

IRD Section	Section Title	Utilization	Vehicle	Ops	Crew	Safety	Other*
3.1	**Structural/Mechanical, Stowage & Microgravity Requirements**						
3.1.1	Structural/Mechanical	PEI Structures Lead	Structures Working Group			Boeing P/L S&MA NASA SR&QA	KSC Utilization
3.1.2	Microgravity	PEI Microgravity Lead	Microgravity Working Group				
3.1.3	Stowage						
3.2	**Electrical Interface Requirements**						
3.2.1	Electrical Power Characteristics	PEI Electrical Lead	EPS Board			Boeing P/L S&MA NASA SR&QA	
3.2.2	Electrical Power Interface	PEI Electrical Lead	EPS Board			Boeing P/L S&MA NASA SR&QA	
3.2.3	Electrical Power Consumer Constraints	PEI Electrical Lead	EMEC Board			Boeing P/L S&MA NASA SR&QA	
3.2.4	Electromagnetic Compatibility	PEI Electrical Lead	EMEC Board			Boeing P/L S&MA NASA SR&QA	
3.2.5	Safety Requirements	PEI Electrical Lead				Boeing P/L S&MA NASA SR&QA	

IRD Section	Section Title	Utilization	Vehicle	Ops	Crew	Safety	Other*
3.2.6	**MPLM**						
3.2.6.1– 3.2.6.3	MPLM Electrical Power Characteristics	PEI Electrical Lead	EPS Board			Boeing P/L S&MA NASA SR&QA	
3.2.6.4–	MPLM Electromagnetic Compatibility	PEI Electrical Lead	EMEC Board			Boeing P/L S&MA NASA SR&QA	
3.2.6.5	MPLM Safety Requirements	PEI Electrical Lead				Boeing P/L S&MA NASA SR&QA	
3.3	**Command and Data Handling Interface Requirements**						
3.3.1 – 3.3.4		PEI C&DH Lead	Avionics S/W Control Panel			Boeing P/L S&MA NASA SR&QA	PSIV
3.3.5	MIL–STD–1553B Low Rate Data Link (LRDL)	PEI C&DH Lead	Avionics S/W Control Panel			Boeing P/L S&MA NASA SR&QA	PSIV
3.3.6	Medium Rate Data Link (MRDL)	PEI C&DH Lead	Avionics S/W Control Panel			Boeing P/L S&MA NASA SR&QA	PSIV
3.3.7	High Rate Data Link (HRDL)	PEI C&DH Lead	Avionics S/W Control Panel			Boeing P/L S&MA NASA SR&QA	PSIV
3.3.8	Portable Computer System (PCS)	PEI C&DH Lead	Avionics S/W Control Panel	MOL	Code CB	Boeing P/L S&MA NASA SR&QA	PSIV

IRD Section	Section Title	Utilization	Vehicle	Ops	Crew	Safety	Other*
3.3.9	UOP	PEI C&DH Lead	Avionics S/W Control Panel			Boeing P/L S&MA NASA SR&QA	PSIV
3.3.10	Maintenance Switch, Smoke Detector, Smoke Indicator, and Integrated Rack Fan Interfaces	PEI C&DH Lead	Avionics S/W Control Panel			Boeing P/L S&MA NASA SR&QA	PSIV
3.4	**Payload NTSC Video and Audio Interface Requirements**						
3.4.1	Payload NTSC Video Interface Requirements	PEI C&DH Lead	Avionics S/W Control Panel			Boeing P/L S&MA NASA SR&QA	
3.4.2	U.S. Element Audio Interface Requirements	PEI C&DH Lead	Avionics S/W Control Panel			Boeing P/L S&MA NASA SR&QA	
3.5	**Thermal Control Interface Requirements**						
3.5.1	Internal Thermal Control System (ITCS) Interface Requirements	PEI Thermal Lead				Boeing P/L S&MA NASA SR&QA	
3.6	**Vacuum System Requirements**						
3.6.1	Vacuum Exhaust System Requirements	PEI Materials Lead	M&P Group			Boeing P/L S&MA NASA SR&QA	
3.6.2	Vacuum Resource System Requirements	PEI Materials Lead	M&P Group			Boeing P/L S&MA NASA SR&QA	

IRD Section	Section Title	Utilization	Vehicle	Ops	Crew	Safety	Other*
3.7	**Pressurized Gases Interface Requirements**						
3.7.1	Nitrogen Interface Requirements	PEI ECLSS Lead	ECLSS Group			Boeing P/L S&MA NASA SR&QA	
3.7.2	Argon Interface Requirements	PEI ECLSS Lead	JEM			Boeing P/L S&MA NASA SR&QA	
3.7.3	Carbon Dioxide Interface Requirements	PEI ECLSS Lead	JEM			Boeing P/L S&MA NASA SR&QA	
3.7.4	Helium Interface Requirements	PEI ECLSS Lead	JEM			Boeing P/L S&MA NASA SR&QA	
3.7.5	Pressurized Gas Bottles	PEI ECLSS Lead				Boeing P/L S&MA NASA SR&QA	
3.7.6	Manual Valves	PEI ECLSS Lead				Boeing P/L S&MA NASA SR&QA	

IRD Section	Section Title	Utilization	Vehicle	Ops	Crew	Safety	Other*
3.8	**Payload Support Services Interfaces Requirements**						
3.8.1	Potable Water	PEI ECLSS Lead				Boeing P/L S&MA NASA SR&QA	
3.8.2	Fluid System Servicer	PEI ECLSS Lead				Boeing P/L S&MA NASA SR&QA	
3.9	**Environment Interface Requirements**						
3.9.1	Atmosphere Requirements	PEI ECLSS Lead				Boeing P/L S&MA NASA SR&QA	
3.9.2	Integrated Rack Use of Cabin Atmosphere	PEI ECLSS Lead				Boeing P/L S&MA NASA SR&QA	
3.9.3	Ionizing Radiation Requirements	PEI Safety Lead				Boeing P/L S&MA NASA SR&QA	
3.10	**Fire Protection Interface Requirements**						
3.10.1	Fire Prevention	PEI Safety Lead				Boeing P/L S&MA NASA SR&QA	
3.10.2	Payload Monitoring and Detection Requirements	PEI Safety Lead				Boeing P/L S&MA NASA SR&QA	

IRD Section	Section Title	Utilization	Vehicle	Ops	Crew	Safety	Other*
3.10.3	Fire Suppression	PEI Safety Lead				Boeing P/L S&MA NASA SR&QA	
3.10.4	Labeling	PEI Human Factors Lead	FCSD			Boeing P/L S&MA NASA SR&QA	
3.11	**Materials and Parts Interface Requirements**						
3.11.1	Materials and Parts Use and Selection	PEI Materials Lead	M&P Group			Boeing P/L S&MA NASA SR&QA	
3.11.2	Fluids	PEI Materials Lead	M&P Group			Boeing P/L S&MA NASA SR&QA	
3.11.3	Cleanliness	PEI Materials Lead	M&P Group			Boeing P/L S&MA NASA SR&QA	
3.11.4	Fungus–Resistant Material	PEI Materials Lead	M&P Group			Boeing P/L S&MA NASA SR&QA	

IRD Section	Section Title	Utilization	Vehicle	Ops	Crew	Safety	Other*
3.12	**Human Factors Interface Requirements**						
3.12.1 –2		PEI Human Factors Lead			Code CB	Boeing P/L S&MA NASA SR&QA	
3.12.3	Requirements	PEI Human Acoustics Lead	Acoustic Working Group			Boeing P/L S&MA NASA SR&QA	
3.12.4–3.12.8		PEI Human Factors Lead			Code CB	Boeing P/L S&MA NASA SR&QA	
3.12.9	Crew Safety	PEI Human Factors Lead			Code CB	Boeing P/L S&MA NASA SR&QA	
3.12.9.1	Electrical Hazards	PEI Human Factors Lead			Code CB	Boeing P/L S&MA NASA SR&QA	
3.12.9.1.1	Mismatched	PEI Human Factors Lead			Code CB	Boeing P/L S&MA NASA SR&QA	
3.12.9.1.2	DELETED						
3.12.9.1.3	DELETED						
3.12.9.1.4	Overload Protection	PEI Human Factors Lead			Code CB	Boeing P/L S&MA NASA SR&QA	

IRD Section	Section Title	Utilization	Vehicle	Ops	Crew	Safety	Other*
3.12.9.1.4.1	Device Accessibility	PEI Human Factors Lead			Code CB	Boeing P/L S&MA NASA SR&QA	
3.12.9.1.4.2	Extractor -Type Fuse Holder	PEI Human Factors Lead			Code CB	Boeing P/L S&MA NASA SR&QA	
3.12.9.1.4.3	Overload Protection Location	PEI Human Factors Lead			Code CB	Boeing P/L S&MA NASA SR&QA	
3.12.9.1.4.4	Overload Protection Identification	PEI Human Factors Lead			Code CB	Boeing P/L S&MA NASA SR&QA	
3.12.9.1.4.5	Automatic Restart Protection	PEI Human Factors Lead			Code CB	Boeing P/L S&MA NASA SR&QA	
3.12.9.1.5	DELETED						
3.12.9.1.5.1	DELETED						
3.12.9.2	Sharp Edges and Corners Protection	PEI Human Factors Lead			Code CB	Boeing P/L S&MA NASA SR&QA	
3.12.9.3	Holes	PEI Human Factors Lead			Code CB	Boeing P/L S&MA NASA SR&QA	
3.12.9.4	Latches	PEI Human Factors Lead			Code CB	Boeing P/L S&MA NASA SR&QA	

IRD Section	Section Title	Utilization	Vehicle	Ops	Crew	Safety	Other*
3.12.9.5	Screws and Bolts	PEI Human Factors Lead			Code CB	Boeing P/L S&MA NASA SR&QA	
3.12.9.6	Securing Pins	PEI Human Factors Lead			Code CB	Boeing P/L S&MA NASA SR&QA	
3.12.9.7	Levers, Cranks, Hooks, and Controls	PEI Human Factors Lead			Code CB	Boeing P/L S&MA NASA SR&QA	
3.12.9.8	Burrs	PEI Human Factors Lead			Code CB	Boeing P/L S&MA NASA SR&QA	
3.12.9.9	Locking Wires	PEI Human Factors Lead			Code CB	Boeing P/L S&MA NASA SR&QA	
3.12.9.10	Audio Devices (Displays)	PEI Human Factors Lead			Code CB	Boeing P/L S&MA NASA SR&QA	
3.12.9.11	DELETED						
3.12.9.12	Egress	PEI Human Factors Lead			Code CB	Boeing P/L S&MA NASA SR&QA	

IRD Section	Section Title	Utilization	Vehicle	Ops	Crew	Safety	Other*
3.12.10	Payload In–Flight Maintenance	PEI Human Factors Lead			Code CB	Boeing P/L S&MA NASA SR&QA	
3.12.11	Display	PEI Human Factors Lead			Code CB	Boeing P/L S&MA NASA SR&QA	PCS/PSIV/ MBF

APPENDIX A
ABBREVIATIONS AND ACRONYMS

ac	Alternating Current
amps	Amperes
APM	Attached Pressurized Module
APS	Automated Payload Switch
ARIS	Active Rack Isolation System
ARPC	Auxiliary Remote Power Controller
BPDU	Bitstream Protocol Data Unit
C	Centigrade
C&DH	Command & Data Handling
CCSDS	Consultative Committee for Space Data Systems
CAM	Centrifuge Accommodations Module
cg	Center of Gravity
COF	Columbus Orbiting Facility
dB	deciBel
dBm	deciBels Referenced to One Milliwatt
dc	Direct Current
DFRC	Dryden Flight Research Center
EEE	Electrical, Electronic, and Electromechanical
EF	Exposed Facility
EMC CS–01, 02	Electromagnetic Compatibility; Conducted Susceptibility –01 (CS–01), Conducted Susceptibility –02 (CS–02)
EMI	Electromagnetic Interference
EPCE	Electrical Power Consuming Equipment
EPS	Electrical Power System
ESA	European Space Agency
EVA	Extra Vehicular Activity
F	Fahrenheit

FSS	Fluid System Servicer
FWHM	Full Width Half Maximum
GFCI	Ground Fault Circuit Interrupter
GSE	Ground Support Equipment
HRDL	High Rate Data Link
HRFM	High Rate Frame Multiplexer
hr	hour
Hz	Hertz
ICD	Interface Control Document
IDD	Interface Design Document
IEC	International Electro Technical Commission
IEEE	Institute of Electrical and Electronic Engineers
IRD	Interface Requirements Document
ISO	International Standards Organization
ISPR	International Standard Payload Rack
ISS	International Space Station
ITCS	Internal Thermal Control System
JEM	Japanese Experiment Module
kg	kilograms
kHz	kiloHertz
kPa	kiloPascal
KSC	Kennedy Space Center
kW	kiloWatt
LAN	Local Area Network
lbm	pounds mass
LRDL	Low Rate Data Link
LSB	Least Significant Bit
LTL	Low Tempeature Loop

mA	milliAmperes
MCC	Mission Control Center
MDM	Multiplexer–Demultiplexer
MDP	Maximum Design Pressure
MIL–STD	Military Standard
MPLM	Mini Pressurized Logistics Module
MRDL	Medium Rate Data Link (Ethernet)
MSB	Most Significant Bit
MSFC	Marshall Space Flight Center
MTL	Moderate Temperature Loop
N/A	Not Applicable
NASA	National Aeronautics and Space Administration
NASDA	National Space Development Agency of Japan
NSTS	National Space Transportation System
NTSC	National Television Systems Committee
ORU	Orbital Replacement Unit
Pa	Pascal
PCS	Portable Computer System
PFE	Portable Fire Extinguisher
PFM	Pulse Frequency Modulation
PIA	Payload Interface Agreement
PIRN	Preliminary/Proposed Interface Revision Notice
PL	Payload
PN	Part Number
psia	pounds per square inch absolute
psid	pounds per square inch differential
QD	Quick Disconnect
R/FR	Refrigerator/Freezer
Rev	Revision
RHA	Rack Handling Adapter

RID	Rack Insertion Device
RMS	Remote Manipulator System
RPC	Remote Power Controller
RPCS	Remote Power Controllers
RSC	Rack Shipping Container
RT	Remote Terminal
SEE	Single Event Effect
SI	International System of Units
SSC	Station Support Computer
SSP	Space Station/Shuttle Program
SSPC	Solid State Power Controller
SSQ	Space Station Qualified
SUP	Standard Utility Panel
TBC	To Be Confirmed
TBD	To Be Determined
TCS	Thermal Control System
UIP	Utility Interface Panel
UOP	Utility Outlet Panel
USL	United States Laboratory
VES	Vacuum Exhaust System
VRS	Vacuum Resource System
VTR	Video Tape Recorder
VVS	Vacuum Vent System
WFSV	Water Flow Selectability Valve
WGS	Waste Gas System

APPENDIX B
GLOSSARY OF TERMS

Access Port: Hole that allows penetration of the Portable Fire Extinguisher nozzle

Active Air Exchange: Forced convection between two volumes. For example, forced convection between a subrack payload and the internal volume of an integrated rack, or forced convection between a subrack payload and the cabin air.

Deviation: Uniquely defined for Payloads Processes; refer to Section 5.1 of this document.

Exceedance: Uniquely defined for Payloads Processes; refer to Section 5.1 of this document.

Exception: Uniquely defined for Payloads Processes; refer to Section 5.1 of this document.

Non-Normal: Pertaining to performance of the Electrical Power System outside the nominal design due to ISS system equipment failure, fault clearing, or overload conditions.

Operate: Perform intended design functions given specified conditions.

Safety-Critical: Having the potential to be hazardous to the safety of hardware, software, and/or personnel.

Waiver: Uniquely defined for Payloads Processes; refer to Section 5.1 of this document.

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APPENDIX C
EXCEPTIONS AND "APPLICABLE WITH NOTES"

C.1 PURPOSE AND SCOPE

The purpose of this appendix is to provide for a repository for PIRN forms prepared as a function of Exceptions to paragraphs of the IRD and/or the ICD Template as well as a listing of those paragraphs identified as Applicable With Notes. Each Payload Unique ICD will include an Appendix containing the data referenced above.

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APPENDIX D
EXCEPTIONS AND OPEN ITEMS

TABLE D–1 TO BE DETERMINED ITEMS

TBD No.	Description	Document Section	Page No.	Responsible	Due Date
1	UOP Locations – CAM	Figure 3.2.1.2–5	3 – 24	NASDA CAM Project Office	
2	UOP Locations with Specific EPS Characteristics – CAM	Table 3.2.4–2	3 – 38	NASDA CAM Project Office	
3	Video Hardwired Addresses – CAM	Table 3.4.2.1–1	3 – 71	NASDA CAM Project Office	
4	CAM Available Pressure Drop Vs. Flow Rate	Figure 3.5.1.2–2	3 – 74	NASDA CAM Project Office	

TABLE D–2 TO BE RESOLVED

TBR No.	Description	Document Section	Page No.	Responsible	Due Date
1	There is a tolerance mismatch between the partners ISPR bonding plates and the camlock fasteners used for the bond strap. Resolution as documented in SSP 41002 will be incorporated once approved (reference NASA Change Request #2137)	Figure 3.2.2.1–1	3–33	Per Change Request #2137	Per Change Request #2137
2	NASA Change Request 1554, proposing to modify the switch open/close and power on/off relationship, may affect the definition of the herein defined open/closed switch.	3.3.5.3	3–66	Per Change Request #1554	Per Change Request #1554

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