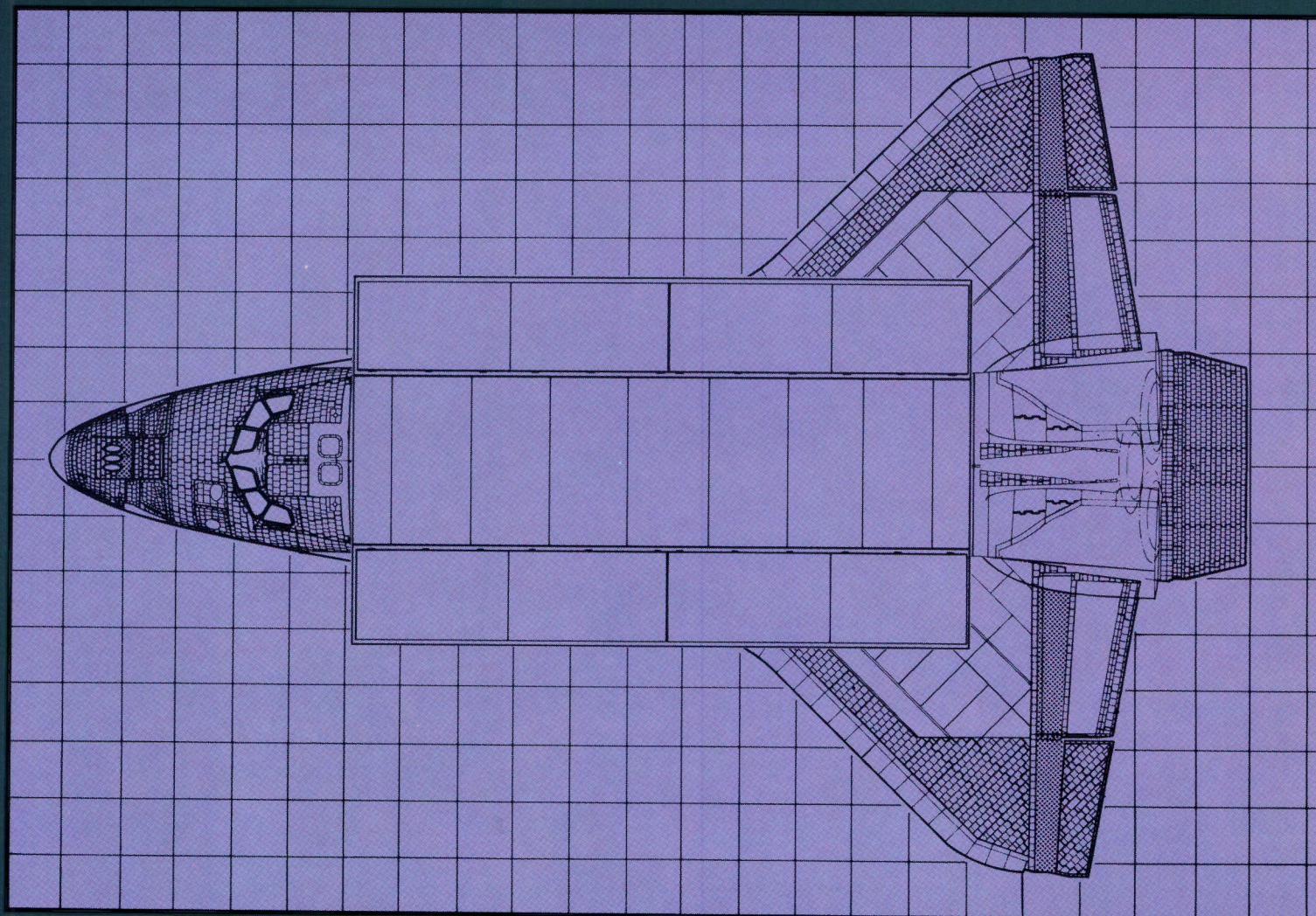


SHUTTLE  
ORBITER/CARGO  
STANDARD INTERFACES



**ICD 2-190001**

NSTS 07700

VOLUME XIV

ATTACHMENT 1

**NASA**

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Houston, Texas 77058





National Aeronautics and  
Space Administration

ICD 2-19001

**Lyndon B. Johnson Space Center**  
Houston, Texas

**ICD 2-19001**  
**SHUTTLE ORBITER/CARGO**  
**STANDARD INTERFACES**

**REVISION J**

**MAY 1, 1988**

Level II PROGRAM DEFINITION AND REQUIREMENTS  
ICD-2-19001 Shuttle Orbiter/Cargo Standard Interfaces

Revision J updates all previous issues of the document and incorporates the following directives:

PRCBD NOs. S40325 (IRN 279), dated 12/5/86; S40408 (IRN 282), dated 11/14/87; S40414 (IRN 281), dated 1/15/87; S40419 (IRN 282), dated 1/15/87; S40468 (IRN 283), dated 2/21/87; S40470 (IRN 284), dated 2/21/87; S40469 (IRN 285), dated 2/24/87; S40897 (IRN 286), dated 10/15/87; and S40936 (IRN 287), dated 2/5/88; plus all Design Requirements Review Dispositions (DRRDs) resulting from the Return to Safe Flight Review and signed by MICB Level II.

For ease of recognition, all the above updates are shown in this revision in either italicized print or black barred.

May 1, 1988

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## 1.0 SCOPE

### 1.1 PURPOSE

- a. Define and control the interfaces which shall be provided by the baseline Shuttle System, for total cargo use by all members of the payload units.
- b. Define and control all constraints which shall be observed by all members of the payload community in using the interfaces so defined.
- c. Establish commonalty with respect to analytical approaches, analytical models, technical data and definitions for integrated analyses by all interfacing parties.

### 1.2 ORGANIZATION OF DOCUMENT

Section 1 (Scope) and Section 2 (Applicable Documents) are standard and self-explanatory.

Section 3 (Physical Interfaces) identifies, codes and locates specifically all of the physical interfaces which are defined and controlled by this document. Included is a figure for each of the bulkheads, connector panels, stations, etc., which (1) identifies individual connectors, fittings, etc., (2) locates each dimensionally within the Shuttle Vehicle, and (3) references other paragraphs herein which provide detail performance/design data for each.

Sections 4 through 8 define, for each subsystem discipline, detail performance/design data necessary to achieve a satisfactory operational interface. When appropriate, the individual sections establish analytic methodologies for integrated analysis efforts. Where such data is voluminous (ie electrical connectors), some tables have been moved to the appendices in the rear of this document.

Section 9 (Software Interfaces) defines software detail performance/design data necessary to develop compatible software at the interfaces.

Section 10 (Environmental Interfaces) establishes induced environments for which the total cargo must be designed. When appropriate, it also establishes analytic methodologies for integrated analysis efforts.

Section 11 (Other Interface Constraints and Limitations) defines general constraints which must be observed in order to ensure satisfactory interface performance and design.

Section 12 (Reserved)

Section 13 defines the electrical wiring interfaces. Connector interface definitions and pin functions are given for both standard and non-standard cargo interfaces.

Section 14 defines the payload deployment and retrieval system. Detail performances and design data necessary to achieve a compatible interface is defined along with the analytical methodology involved.

Appendix A (Abbreviations and Acronyms) and Appendix B (Glossary) are self-explanatory.

Appendix C Lists the Channel Frequency Assignments for transmitting.

Appendices D through H and J through W (Reserved)

Appendix I defines the analytical techniques and data to be used to determine the compatibility of payload-induced loads with the Orbiter static limit-load capabilities.

Appendix X defines the length selection criteria and deflection data for alternate trunnion lengths.

### 1.3 EFFECTIVITY.

Unless otherwise specified, the interfaces defined and controlled herein are applicable to the operational configuration of the Shuttle System. The Orbiter Vehicle (OV) effectivity sequence is as follows: OV102, OV099, OV103, and Subs.

### 1.4 CHANGE POLICY.

1.4.1 Scope. All changes to this document shall be controlled in accordance with the procedures prescribed herein and by NSTS 07700, Volume IV. Dispositioned changes shall reflect program decisions and will record new, changed, and/or deleted requirements.

1.4.2 Change Initiation. Payload community PRCB members may initiate changes following NSTS 07700, Volume IV procedures. All other payload community initiated changes shall be submitted to the Shuttle Payload Integration and Development Program Office (SPIDPO) at NSTS. SPIDPO shall review the proposed change for technical adequacy, completeness, and validity. If SPIDPO review verifies that a change is required, a Change Request shall be submitted in accordance with NSTS 07700, Volume IV. All other initiators shall submit changes in accordance with NSTS 07700, Volume IV.

1.4.3 Change Processing/Disposition. A change may be processed outside the formal Level II change procedure and approved by the Level II PRCB Secretary when both the Orbiter Project Office and SPIDPO recommend approval and there is no Level II cost, schedule, weight, or performance impact. In this instance, the applicable change shall be coordinated with the Management Systems Office for special processing. Both the Orbiter Project Office and SPIDPO shall coordinate on the PRCBD prior to authorization signature for those specially processed changes. All other changes shall be processed for review and appropriate disposition action as specified by NSTS 07700, Volume IV.

*1.5 9CD Waivers, Deviations And Exceedances. 9CD agreements with payloads are based on NSTS allowed payload services and provisions are identified in this document. All Orbiter/SJS design to requirement for payloads is controlled at Level II.*

*Unique payload 9CD's are derivatives of this 9CD and do not require Orbiter Project approval if they remain within the Orbiter vehicle interface design parameters.*

Limits of this GCD are established in a conservative manner to minimize individual payload and mixed cargo analyses. (e.g. 90" radius maximum dynamic envelope allows 3" radius for Orbiter deflection to remain free of potential contact).

Total Orbiter capability for payloads is divided into four sub-sections for mixed cargo flights (e.g. 1.75 KW/Element is equal to this GCD's available power of 7 KW continuous).

Any exceedance or deviation in payload capabilities or services is documented in the payload specific GCD's, Section 20, and evaluated to assure that the stated condition is controlled in a manner to guarantee acceptable conditions to eliminate any added risk to the vehicle or crew.

**Definitions:**

**Exceedance:** Documentation of a condition that does not comply with stated requirements but does not add any risk due to intended usage or configuration and can be shown acceptable without special analysis or controls.

**Deviation:** A non-compliance that requires additional analysis or control to eliminate risk and is acceptable when properly documented.

**Waiver:** A condition that does not comply with the requirements of this GCD could add risk and requires special controls/analyses to assure adequate flight margins.

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## 2.0 DOCUMENTS

### 2.1 APPLICABLE DOCUMENTS

The following documents of the exact issue shown form a part of this document to the extent specified herein. In the event of conflict between the documents referenced and the content of this document the contents of this document shall be considered a superseding requirement.

#### Federal

FED-STD-595	Federal Standard Colors Ref. Fig. 3.4.1.2.1-1
SPEC-QQ-C-320B Class 2 June 17, 1974	Chromium Plating (Electro Deposited) Ref. Fig. 3.3.1.2.2-1, Fig. 3.3.1.2.1-1

#### Military

MIL-B-5087B August 31, 1970	Bonding, Electrical and Lightning Protection for Aerospace Systems Ref. Para. 10.7.4.2, 10.7.4.2.1, 10.7.4.2.2.2, 10.7.4.2.2.3, 10.7.4.2.2.4, 10.7.4.2.3.5
MIL-C-5541 Amendment 2 November 30, 1972	Chemical Conversion Coatings on Aluminum and Aluminum Alloys Ref. Para. 10.7.4.2
MIL-STD-1572 May 17, 1976	Telemetry Standards Ref. Para. 8.2.2.5, Ref. Table 8.2.2.5.13-2, 8.2.2.5.13-3
MIL-W-5088H July 20, 1979	Wiring Aerospace Vehicle Ref. Para. 3.3.2.2.1

#### NASA (National Aeronautics and Space Administration)

ES3-76-1 <i>July 1983</i>	Orbiter Midsection/Payload Bay Thermal Math Model Description Ref. Para. 6.1.2.1
ES3-77-3 <i>September 1983</i>	"390 Node" Atmospheric Orbiter Mid-section/ Payload Bay Thermal Math Model Description Ref. Para. 6.1.2.1
<i>JSC-19540 March 1984</i>	<i>Open Door Simplified Orbiter Thermal Simulator Description Ref. Para. 6.1.2.1</i>
<i>JSC-19692 May 1984</i>	<i>Closed Door Simplified Orbiter Thermal Simulator Description Ref. Para. 6.1.2.1</i>

SN-C-0005 (Current Issue)	Specification, Contamination Control Requirements for the Space Shuttle Program Ref. Para. 10.6.2.4, 10.6.2.1.1
SE-S-0073 February 14, 1977	Specification, Space Shuttle Fluid Procurement and Use Control Ref. Para. 5.8, 6.2.2.2
<i>gSCM-8080</i> Oct 16, 1972	<i>Acoustic Noise Criteria</i> Ref. Para. 4.2.2.1, 7.7.1
NSTS-08060 Rev D January 28, 1983	Space Shuttle System Pyrotechnic Specification Ref. Para. 10.7.4.1.1.5
<i>NSJS-18798</i>	<i>Interpretations of NSJS Payload Safety Requirements</i> Ref. Para. 7.3.1.2
<i>NSJS-SP-R-0022</i> Rev. A September 1974	Vacuum Stability Requirements of Polymeric Material for Spacecraft Applications, Specifications for Ref. Para. 10.6.2.2
40M38277 December 15, 1973	Connectors, Electrical, Circular Miniature High Density Environment Resisting, Specifications for Ref. Para. 13.2.2
40M38294 (Current Issue)	Specification, Connector, Electrical Circular Cryogenic Environment Resisting Ref. Para. 13.2.2
40M38298 (Current Issue)	Specification, Connector, Electrical, Special Miniature Circular Environment Resisting 200°C. Ref. Para. 13.2.2
40M39569 December 15, 1973	Connectors, Electrical Miniature Circular, Environment Resisting 200°C, Specification for Ref. Fig. 3.3.3-3, 3.3.3-4 3.4.1.2.2-1, 3.4.1.3.2-2, 3.4.1.1.2-1
ICD-3-0027-03	Crew Equipment Stowage Volume Control Ref. Para. 3.4.2.1
NHB 1700.7A December 1980	Safety Policy and Requirements for Payloads using the Space Transportation System (STS) Ref. Para. 10.7.4.1.1.5
<u>Industry</u>	
EIA-STD-RS170	Electrical Performance Standard - Monochrome TV Studio Facilities, Ref. Para. 8.2.8-1, Fig. 8.2.8.2-1



EIA-STD-RS330	Electrical Performance Standard for Closed Circuit TV Camera 525/60 Interlaced 2:1, Ref. Para. 8.2.8.1
MA0109-318 (Current Issue)	Chromium Plating (Electro-Deposited) on Titanium and Titanium Alloys Rockwell International, Space Division Ref. Fig. 3.3.1.2.1-1
MP572-0279-0002 (Current Issue)	Cable Electrical, Special Purpose, TFE, 2 Conductor, Shielded and Jacketed Ref. <i>Para. 8.2.12.2</i>
MP572-0388-0002	Cable, Electrical, Special Purpose, TFE, 2 Conductor, Shielded and Jacketed Ref. Para. 8.2.2.5.12, Tables 8.2.4.4-1, 8.2.4.5-1, 8.2.4.5-2, 8.2.6.1-1, 8.2.6.2-1, 8.2.6.3-1, 8.2.8.1-1, 8.2.14.1-1
SPAR-SG.459/010	Connectors, Electrical, Rectangular Type, Rack to Panel, Environment Resisting, 200°C Ref. Fig. 14.4.4-1
SPAR-51140D1897	Connector, Plug-Mod. End Effector Ref. Fig. 14.4.4-1
<u>Rockwell International</u>	
MBO150-048 Sept. 1987	<i>Wire and Cable, Electrical, Polyimide Insulated</i> Ref. <i>Table 7.3.1.2-1</i>
MC414-0614 (Current Issue)	Specification, Connector RF, SMA Series Ref. Para. 13.2.2
MC432-0222 (Current Issue)	Specification, Event Indicator Ref. Para. 13.4.2
MC450-0017 (Current Issue)	<i>Power Controller, Remote</i> Ref. <i>Table 7.3.1.2-1</i>
MC454-0026 (Current Issue)	Specification, Circuit Breaker, Thermal Single Phase Ref. Para. 13.4.2, <i>Table 7.3.1.2-1</i>
MC454-0032 (Current Issue)	<i>Circuit Breaker, Thermal Three Phase</i> Ref. <i>Table 7.3.1.2-1</i>
ME414-0234 (Current Issue)	Specification, Connector, Receptacle, Electric Wall Mounting Ref. Para. 13.2.2
ME414-0235 (Current Issue)	Specification, Connector, Plug, Electric Straight Ref. Para. 13.2.2

ME414-0247 (Current Issue)	Specification, Connector, TNC Bulkhead Cable Jack. Ref. Para. 13.2.2
ME414-0250 (Current Issue)	Specification, Connector, TNC Cable Plug. Ref. Para. 13.2.2
ME414-0561 (Current Issue)	Specification, Connector, Coaxial Bulkhead Pressurized Series TNC Ref. Para. 13.2.2
ME414-0562 (Current Issue)	Specification, Connector, Coaxial Bulkhead Pressurized Series "HN" Ref. Para. 13.2.2
ME414-0610 (Current Issue)	Specification, Cable Adapter, Connector Plug, Electric. Ref. Para. 13.2.2
ME414-0611 (Current Issue)	Specification, Connector, Hermetic Jam Nut, Electric. Ref. Para. 13.2.2
ME414-0612 (Current Issue)	Specification, Connector, Hermetic Flange Mount, Electric. Ref. Para. 13.2.2
ME418-0031 (Current Issue)	Specification, Contact, Socket Crimp, Clip Retained. Ref. Para. 13.2.2
ME418-0032 (Current Issue)	Specification, Contact, Pin Crimp, Clip Retained. Ref. Para. 13.2.2
<i>ME451-0009 (Current Issue)</i>	<i>Juse - Miniature Cartridge Ref. Table 7.3.1.2-1</i>
<i>ME451-0010 (Current Issue)</i>	<i>Juse - Microminiature with Axial Leads Ref. Table 7.3.1.2-1</i>
<i>ME451-0016 (Current Issue)</i>	<i>Juse - D. G. Limiter Type, High Current Ref. Table 7.3.1.2-1</i>
<i>ME451-0018 (Current Issue)</i>	<i>Juse - Subminiature Ref. Table 7.3.1.2-1, Para. 13.4.2</i>
ME452-0093 (Current Issue)	Specification, Rotary Switch Ref. Para. 13.4.3.2
ME452-0102 (Current Issue)	Specification, Toggle Switch Ref. Para. 13.4.2, 13.4.3.2
<i>SD73-SM-0226 Vol. 2 Book V Sept. 1985</i>	<i>Space Shuttle Program Thermodynamic Design Data Book Thermal Control System Constraints Ref. Para. 6.1.1.2.1</i>

## 2.2 REFERENCE DOCUMENTS

2.2.1 Cargo Ground Interfaces. The Orbiter/cargo ground interface requirements are defined and controlled by the following ICD's:

ICD-2-00003 Flight Vehicle/LPS Computational System Interfaces

ICD-2-1A001 Orbiter/Landing Station

ICD-2-1A002 Orbiter/Processing Facility

ICD-2-0A001 Shuttle System/VAB and MLP

ICD-2-0A002 Shuttle System/Launch Pad and MLP

ICD-2-1D003 Orbiter/Secondary Landing Station Interfaces

2.2.2 Middeck Accomodations. *Interface provisions for payloads in the middeck area of the crew compartment are controlled by the following document:*

*NSJS-21000-IDD-MDK*

*Middeck Interface Definitions Document*

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### 3.0 PHYSICAL INTERFACES

#### 3.1 GEOMETRIC RELATIONSHIPS

##### 3.1.1 Coordinate Systems.

3.1.1.1 Orbiter. The Orbiter coordinate system shall be in conformance with Figure 3.1.1.1-1.

3.1.1.2 Payload. The payload coordinate system shall be in conformance with Figure 3.1.1.2-1.

3.1.1.3 Instrument Pointing. The instrument pointing coordinate system shall be in conformance with Figure 3.1.1.3-1.

3.1.1.4 Orbiter Dynamic Body Coordinate System. *The Orbiter Dynamic Body Coordinate System* is shown in Figure 3.1.1.4-1.

3.1.1.5 Orbiter Guidance Navigation System Greenwich True of Date.

Mean versus true systems: The line of intersection of the ecliptic plane (the instantaneous plane of motion of the Earth and Sun) and the celestial equator (mean Earth equator) precesses among the fixed stars with a rate of one revolution in 26000 years. Additionally, the Earth wobbles slightly on its axis, relative to its mean position, with periods of oscillations of only a few years. The former phenomenon is called precession; the latter is called nutation. A mean system conveys the concept that precession is included when relating that system to another system at a different time, but the nutation phenomenon is not included. A true system, however, conveys the concept that a mean system at any specific instant of time is converted to a true system at the same instant of time by including terms associated with the nutation phenomenon. The coordinate systems are defined below.

3.1.1.5.1 Orbiter GN and C Data (GTOD). The origin of the Orbiter Axes used in describing the orbiter rotation rate is the orbiter center-of-mass. The X axis is parallel to the orbiter structural axis and is positive toward the nose. The Z axis is parallel to the orbiter plane of symmetry and is positive down with respect to the orbiter fuselage. The Y axis completes a right-handed orthogonal system (refer to Figure 3.1.1.4-1).

The origin of the GTOD (Greenwich True of Date) Coordinate System is the center of the earth. The Z-axis is directed along the earth's true-of-date rotational axis and is positive toward the north. The X-axis lies in the plane of the earth's true-of-date equator, and its positive direction is toward the prime meridian. The Y-axis completes a right handed system (refer to Figure 3.1.1.5.1-1).

The ordered transformation from GTOD to the Orbiter body is a right handed rotation about the positive GTOD Y-axis (pitch), right handed rotation about the intermediate positive Z-axis (yaw), and a right handed rotation about the positive Orbiter X-axis (roll). A right hand rotation is defined by placing the right hand thumb along the axis of rotation with the fingers curling in the direction of rotation.

Orbiter rotation rates are represented by instantaneous, right-handed rotations about the positive Orbiter Y, Z, and X axis respectively. These rates represent the instantaneous body fixed rates, and are not the derivatives of the Euler Angles.

The order of parameters within vectors transmitted to payloads is X, Y, Z for position and velocity vectors and pitch, yaw, roll for attitude, and Y, Z, and X for the body rates.

3.1.1.6 Orbiter GN and C Data (Aries M50). The origin of the Orbiter Axes used in describing the orbiter rotation rate is the Orbiter center-of-mass. The X-axis is parallel to the orbiter structural axis and is positive toward the nose. The Z-axis is parallel to the Orbiter plane of symmetry and is positive down with respect to the Orbiter fuselage. The Y axis completes a right-handed orthogonal system (refer to Figure 3.1.1.4-1).

The origin of the Aries M50 (mean of 1950) Coordinate system is the center of the earth. The Z-axis is directed along the earth's mean rotational axis of epoch (the epoch is the beginning of Besselian year 1950) and is positive toward the north. Its positive X-axis is directed toward the mean vernal equinox of epoch. The Y-axis completes a right-handed system (refer to Figure 3.1.1.6-1).

Orbiter rotation rates are represented by instantaneous, right-handed rotations about the positive Orbiter Y, Z, and X axis respectively. These rates represent the instantaneous body fixed rates, and are not the derivatives of the Euler Angles.

The order of parameters within vectors transmitted to payloads is X, Y, Z for position and velocity vectors and pitch, yaw, roll for attitude, and Y, Z, and X for body rates.

### 3.1.2 Limit Envelopes for Cargo-Chargeable Items.

#### 3.1.2.1 Cargo Bay.

3.1.2.1.1 Cargo Element Thermal and Dynamic Envelope. A 15 foot diameter (4.572 m) and 60 foot long (Xo582 to Xo1302), payload envelope shall be provided in the Orbiter payload bay for cargo installation. The centerline of this envelope is located at  $Y_0=0.0$  and  $Z_0=400$ . During flight events, this cargo envelope distorts due to Orbiter thermal and dynamic loads. The resulting payload envelope is a 15 foot diameter circle at each Orbiter Xo Station with the center of the circular envelope located at the distorted Orbiter centerline. The distorted Orbiter centerline is defined by displacing the undistorted centerline by the average motion of the right and left Orbiter longerons for each Xo Station. The effects of cargo element manufacturing and installation tolerances shall be included when calculating payload clearance losses with respect to the cargo envelope. Cargo element thermal and dynamic deflections and all payload protrusions except the payload attach fitting shall be contained within this envelope. Cargo element attachment fittings may extend beyond the payload thermal and dynamic envelope in order to mate with Orbiter attachment fittings as shown in Figure 3.1.2.1.1-1. Umbilicals required to interface the cargo element to the Orbiter or to GSE while the payload is in the cargo bay may also penetrate the envelope.

3.1.2.1.2 Cargo Bay Clearance. Clearance between the cargo thermal and dynamic envelope and the Orbiter vehicle structure and subsystems shall be provided by the Orbiter, except for penetrations defined in Paragraph 3.1.2.1.4. Payloads are constrained to the cargo thermal and dynamic envelope when subjected to the induced environment during the complete flight, beginning with payload installation and ending with payload deployment or removal.

A *static* clearance of three inches shall be provided between cargo elements and cargo bay kits, when installed.

3.1.2.1.3 On-Orbit Payload Positioning Envelope. The deployment/retrieval envelope (for removing and installing payloads on-orbit) shall be that created by the payload thermal and dynamic envelope being extended in the +Z direction until the payload 15 feet thermal and dynamic envelope diameter is clear of the orbiter longeron and the 60 feet thermal and dynamic envelope length is clear of the orbiter cargo bay forward and aft bulkheads. Lateral and longitudinal movement of the payloads during deployment/ retrieval operations shall be controlled to avoid localized orbiter structure and subsystems as shown on Figure 3.1.2.1.3-1.

3.1.2.1.4 Cargo Bay Protuberances. Installation of payloads into the cargo bay must consider potential interference of Orbiter protuberances into the cargo thermal and dynamic envelope, as defined in Figure 3.1.2.1.4-1. Another potential interference with large diameter cargo elements is the Cargo Bay Liner. The Cargo Bay Liner is installed across and attached to the orbiter structural frames, conforming to the internal mold lines of the lower cargo bay clearance area approximately from longeron to longeron except where cable trays and cargo attach hardware are located. The liner is attached to the lower side of the longerons at Z<sub>0</sub> 406 between all structural frames except between X<sub>0</sub> 576 to X<sub>0</sub> 582, where the upper limits extend to Z<sub>0</sub> 419. During orbiter ascent and/or descent the cargo bay liner could penetrate the cargo bay envelope and contact the large diameter cargo element with a pressure of less than 0.1 psi. The pressure *differential* across the liner causes a ballooning of the liner which penetrates the cargo envelope a maximum of 4.6 inches to a radius of 85.4 inches from the cargo bay centerline. When required, *local special hardware can be provided by the Orbiter to preclude the liner from violating the cargo 90" radius envelope as defined in Paragraph 3.1.2.1.1.*

3.1.2.1.5 Limit Envelopes for EVA and for Cargo Bay Kits.

3.1.2.1.5.1 EVA Envelopes. Envelopes shall be provided within the cargo bay for EVA activities, as required. Cargo elements may be installed within volumes required for EVA but shall be removable or jettisonable prior to committing to EVA activities. EVA envelopes shall be defined as follows:

- a. Inside Airlock Configuration. The first 48 inches aft of Station X<sub>0</sub> 579 shall be clear of cargo elements during EVA access and operation. (This configuration is illustrated in Figure 9-1 of Volume XIV.)

3.1.2.1.5.2 MMU/CBSA Limit Envelopes. The limit envelopes for the Manned Maneuvering Unit (MMU) and Cargo Bay Stowage Assembly (CBSA) at the sides of the cargo bay, when required, shall be defined as follows:

$X_0$  582.00 to 636.00

$Y_0$  Outboard of  $Y_0$  40.00 and  $Y_0$  -40.00

$Z_0$  341.00 to 414.00

The volumes above these limit envelopes shall be clear of cargo elements during EVA ingress/egress with the MMU/CBSA.

3.1.2.1.5.3 Docking Module. The limit envelope for the docking module shall be as defined in Figure 3.1.2.1.5.3-1.

3.1.2.1.5.4 Airlock/Tunnel Adapter. The limit envelope for the airlock/tunnel adapter shall be as shown in Figure 3.1.2.1.5.4-1.

3.1.2.1.5.5 *(Deleted)*

3.1.2.1.5.6 Overhead Docking Floodlight. The limit envelope for the overhead docking floodlight, when installed, shall be defined as follows:

$X_0$  581.5 to 586.5

$Y_0$  -3 to 3

$Z_0$  486 to 491

### 3.1.3 Visual Interfaces.

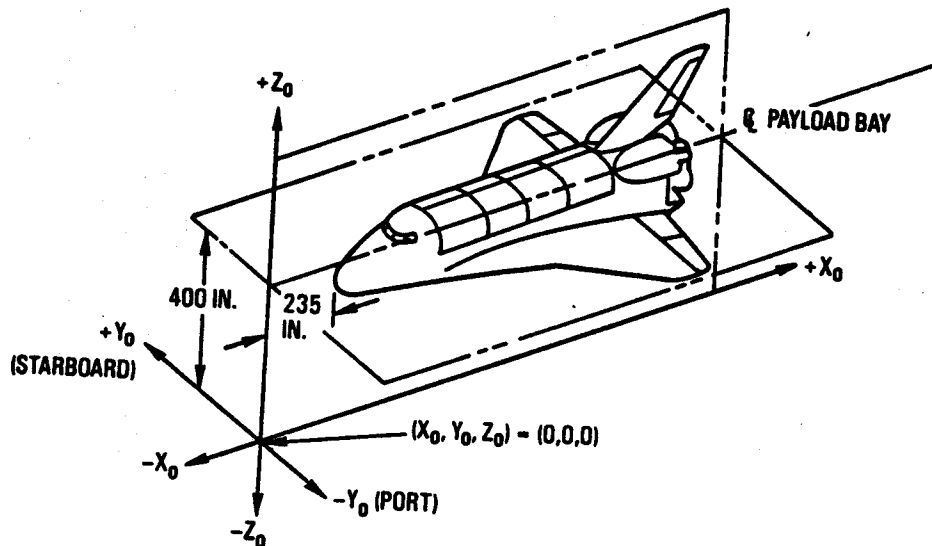
3.1.3.1 Lateral Field of View. The Orbiter shall provide the capability of exposing the entire length and full width of the cargo bay as defined in Figure 3.1.3.1-1. With the cargo bay doors and radiators open, the Orbiter shall provide an unobstructed 180-degree lateral field of view for any point along the line  $Y_0 = 0$ ,  $Z_0 = 429.5$  between  $X_0 = 582$  and  $X_0 = 1302$  (as shown in Figure 3.1.3.1-1) without such mechanisms as the docking module, manipulator arm, rendezvous sensor, payload retention guides, and the TV/light and bracket installed.

3.1.3.2 Cargo Bay Lighting. The Orbiter shall provide lighting within the cargo bay to support Orbiter/payload operations both internal and external to the cargo bay, including the modes of payload operations that are supported by the Remote Manipulator System (RMS). The cargo bay lighting shall consist of sources of illumination within the cargo bay nominally located as shown in Figure 3.1.3.2-1.

3.1.3.3 Television Viewing. The Orbiter shall provide closed circuit television viewing. Up to four cameras shall be mounted on the forward and aft cargo bay bulkheads (2 each) in positions identified in Figure 3.1.3.2-1, and two cameras (operated one at a time) can be installed on the RMS. Additionally, one camera may be installed along the keel on a given flight. The cameras require a space 22 inches in length and, when installed, can protrude into the cargo dynamic envelope.

*Up to two cameras can be displayed in the Orbiter crew compartment (up to four if split screen). One camera (two if split screen) can be recorded for subsequent play back to the ground, and one camera (two if split screen) can be transmitted to the ground in real time (when not playing back recorded data to the ground).*





ORIGIN: IN THE ORBITER PLANE OF SYMMETRY, 400 INCHES BELOW THE CENTER LINE OF THE PAYLOAD BAY AND AT ORBITER X STATION = 0

ORIENTATION: THE  $X_0$  AXIS IS IN THE VEHICLE PLANE OF SYMMETRY, PARALLEL TO AND 400 INCHES BELOW THE PAYLOAD BAY CENTERLINE. POSITIVE SENSE IS FROM THE NOSE OF THE VEHICLE TOWARD THE TAIL

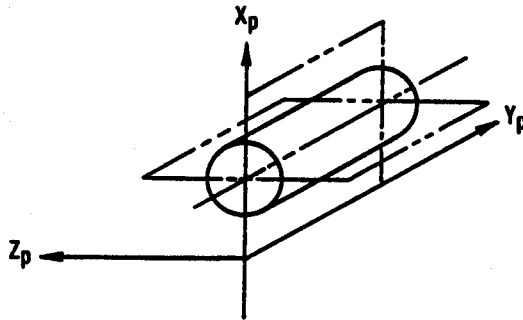
THE  $Z_0$  AXIS IS IN THE VEHICLE PLANE OF SYMMETRY, PERPENDICULAR TO THE  $X_0$  AXIS POSITIVE UPWARD IN LANDING ATTITUDE

THE  $Y_0$  AXIS COMPLETES A RIGHT-HANDED SYSTEM

CHARACTERISTICS: ROTATING RIGHT-HANDED CARTESIAN

THE STANDARD SUBSCRIPT IS 0 (E.G.,  $X_0$ ).

*Figure 3.1.1.1-1 Orbiter Coordinate System*



TYPE: ROTATING, PAYLOAD REFERENCED

ORIENTATION AND LABELING:

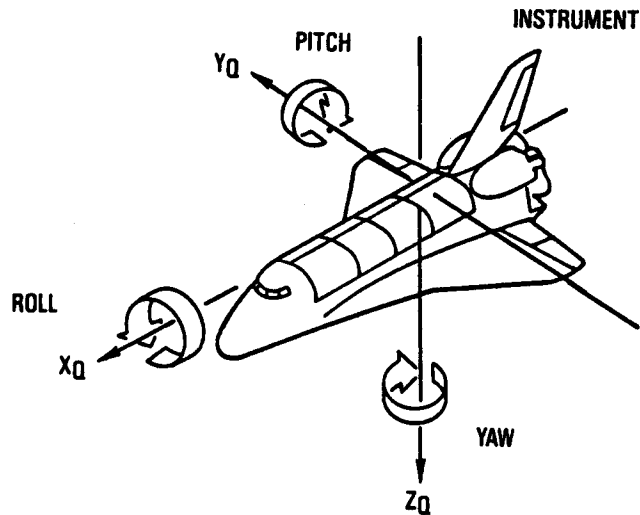
X AXIS IS NEGATIVE IN THE DIRECTION OF LAUNCH, PARALLEL TO THE ORBITER PAYLOAD BAY CENTERLINE

Z AXIS IS POSITIVE UPWARD IN THE ORBITER LANDED POSITION, PARALLEL TO ORBITER Z AXIS

Y AXIS COMPLETES THE RIGHT-HANDED SYSTEM

THE STANDARD SUBSCRIPT IS P

*Figure 3.1.1.2-1 Payload Coordinate System*



ORIGIN: INSTRUMENT CENTER OF ROTATION

ORIENTATION AND LABELING: THE  $X_Q$  AXIS IS PARALLEL TO THE CENTERLINE OF THE CARGO BAY, POSITIVE IN THE DIRECTION OF THE NOSE OF THE ORBITER

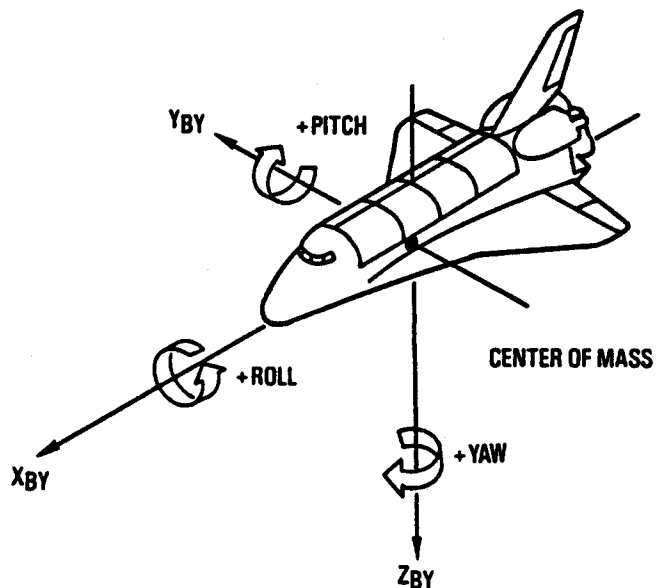
THE  $Z_Q$  AXIS LIES IN A PLANE PARALLEL TO THE PLANE OF SYMMETRY AND IS PERPENDICULAR TO THE  $X_Q$  AXIS AND IS POSITIVE DOWN IN THE LANDING ATTITUDE

THE  $Y_Q$  AXIS COMPLETES A RIGHT-HANDED SYSTEM

CHARACTERISTICS: ROTATING RIGHT-HANDED SYSTEM

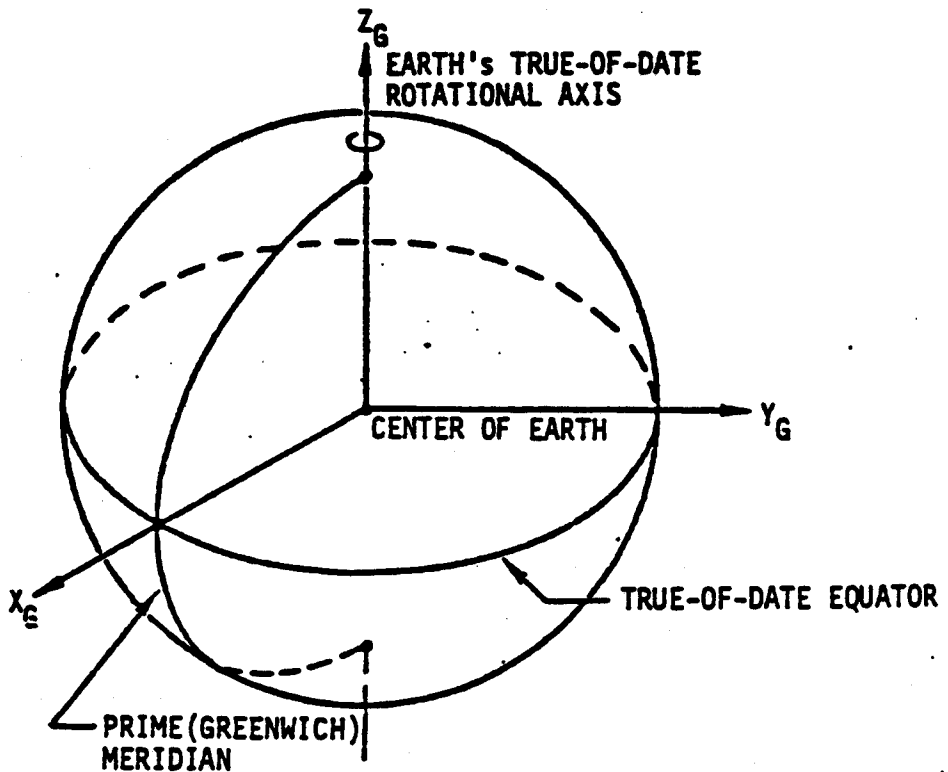
THE STANDARD SUBSCRIPT IS Q (E.G.,  $X_Q$ ).

FIGURE 3.1.1.3-1 INSTRUMENT POINTING COORDINATE SYSTEM



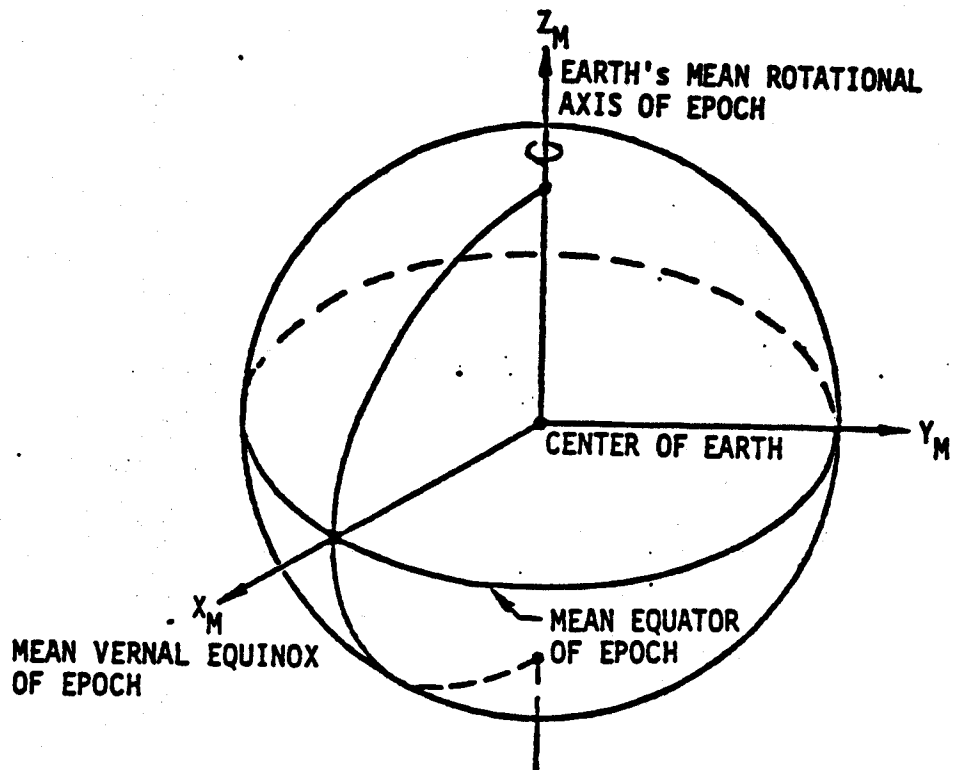
**NAME:** ORBITER DYNAMIC BODY COORDINATE SYSTEM  
**ORIGIN:** CENTER OF MASS  
**ORIENTATION:**  $X_{BY}$  AXIS IS PARALLEL TO THE ORBITER STRUCTURAL BODY  $X_0$  AXIS: POSITIVE TOWARD THE NOSE  
 $Z_{BY}$  AXIS IS PARALLEL TO THE ORBITER PLANE OF SYMMETRY AND IS PERPENDICULAR TO  $X_{BY}$ , POSITIVE DOWN WITH THE RESPECT TO THE ORBITER FUSELAGE  
**CHARACTERISTICS:** ROTATING, RIGHT-HANDED ORTHOGONAL SYSTEM  
 THE STANDARD SUBSCRIPT IS BY (E.G.,  $X_{BY}$ )

*Figure 3.1.1.4-1 Orbiter Dynamic Body Coordinate System*



- NAME:** GREENWICH TRUE-OF-DATE (GEOGRAPHIC) COORDINATE SYSTEM
- ORIGIN:** THE CENTER OF THE EARTH
- ORIENTATION:** THE  $X_G$ - $Y_G$  PLANE IS THE EARTH'S TRUE-OF-DATE EQUATOR.
- THE  $Z_G$  AXIS IS DIRECTED ALONG THE EARTH'S TRUE-OF-DATE ROTATIONAL AXIS AND IS POSITIVE NORTH
- THE  $+X_G$  AXIS IS DIRECTED TOWARD THE PRIME MERIDIAN
- THE  $Y_G$  AXIS COMPLETES A RIGHT-HAND SYSTEM
- CHARACTERISTICS:** ROTATING, RIGHT-HANDED, CARTESIAN. VELOCITY VECTORS EXPRESSED IN THIS SYSTEM ARE RELATIVE TO A ROTATING REFERENCE FRAME FIXED TO THE EARTH, WHOSE ROTATION RATES ARE EXPRESSED RELATIVE TO THE ARIES MEAN OF 1950 SYSTEM

FIGURE 3.1.1.5.1-1 GREENWICH TRUE OF DATE (GEOGRAPHIC)



NAME: ARIES-MEAN-OF-1950, CARTESIAN, COORDINATE SYSTEM

ORIGIN: THE CENTER OF THE EARTH

ORIENTATION: THE  $X_M$ - $Y_M$  PLANE IS THE MEAN EARTH'S EQUATOR OF EPOCH

THE  $X_M$  AXIS IS DIRECTED TOWARDS THE MEAN VERNAL EQUINOX OF EPOCH

THE  $Z_M$  AXIS IS DIRECTED ALONG THE EARTH'S MEAN ROTATIONAL AXIS OF EPOCH AND IS POSITIVE NORTH

THE  $Y_M$  AXIS COMPLETES A RIGHT-HANDED SYSTEM

CHARACTERISTICS: INERTIAL, RIGHT-HANDED, CARTESIAN SYSTEM

FIGURE 3.1.1.6-1 ARIES MEAN OF 1950, CARTESIAN

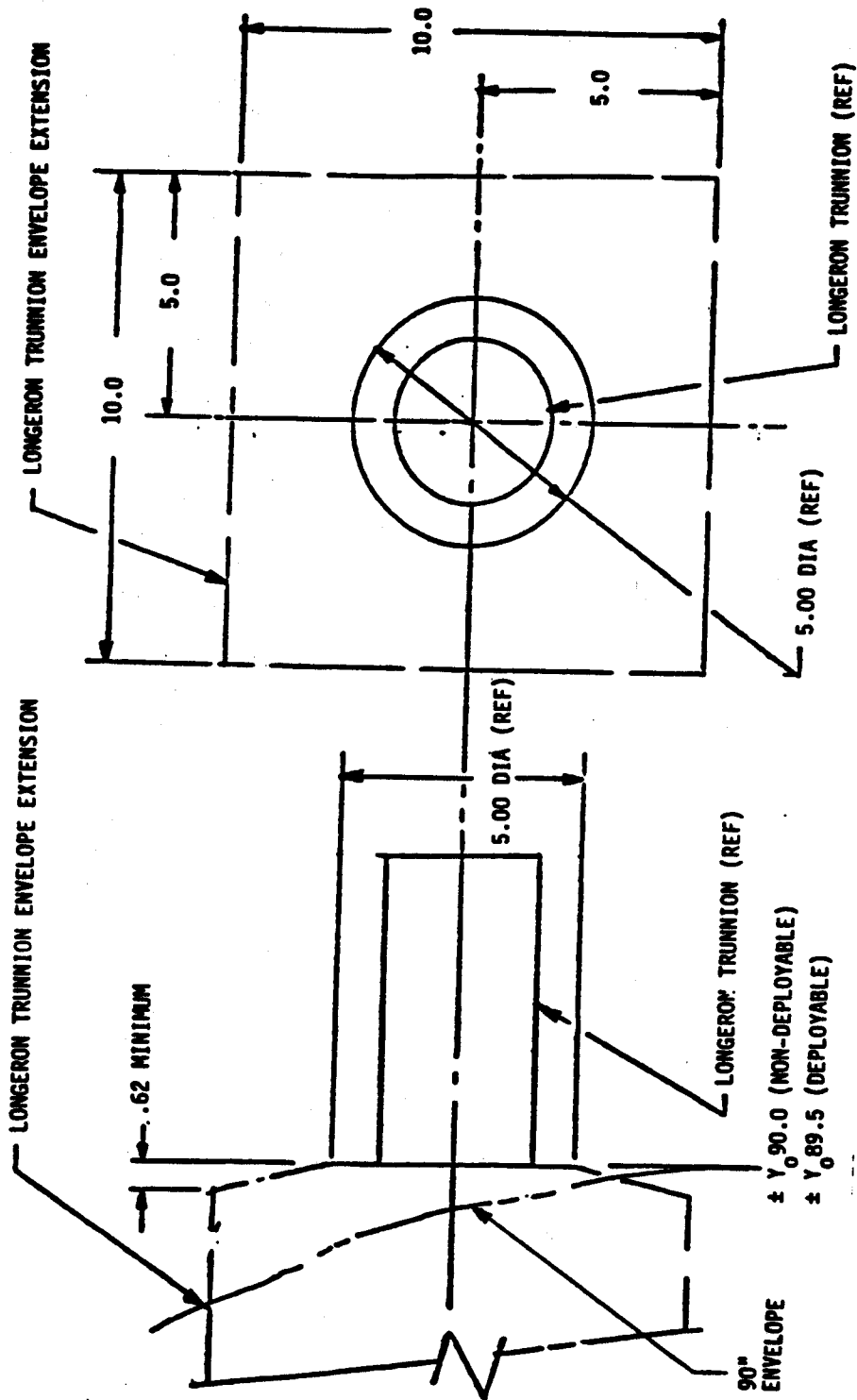


Figure 3.1.2.1.1-1 Cargo Element Longeron Trunnion Thermal And Dynamic Envelope Extension

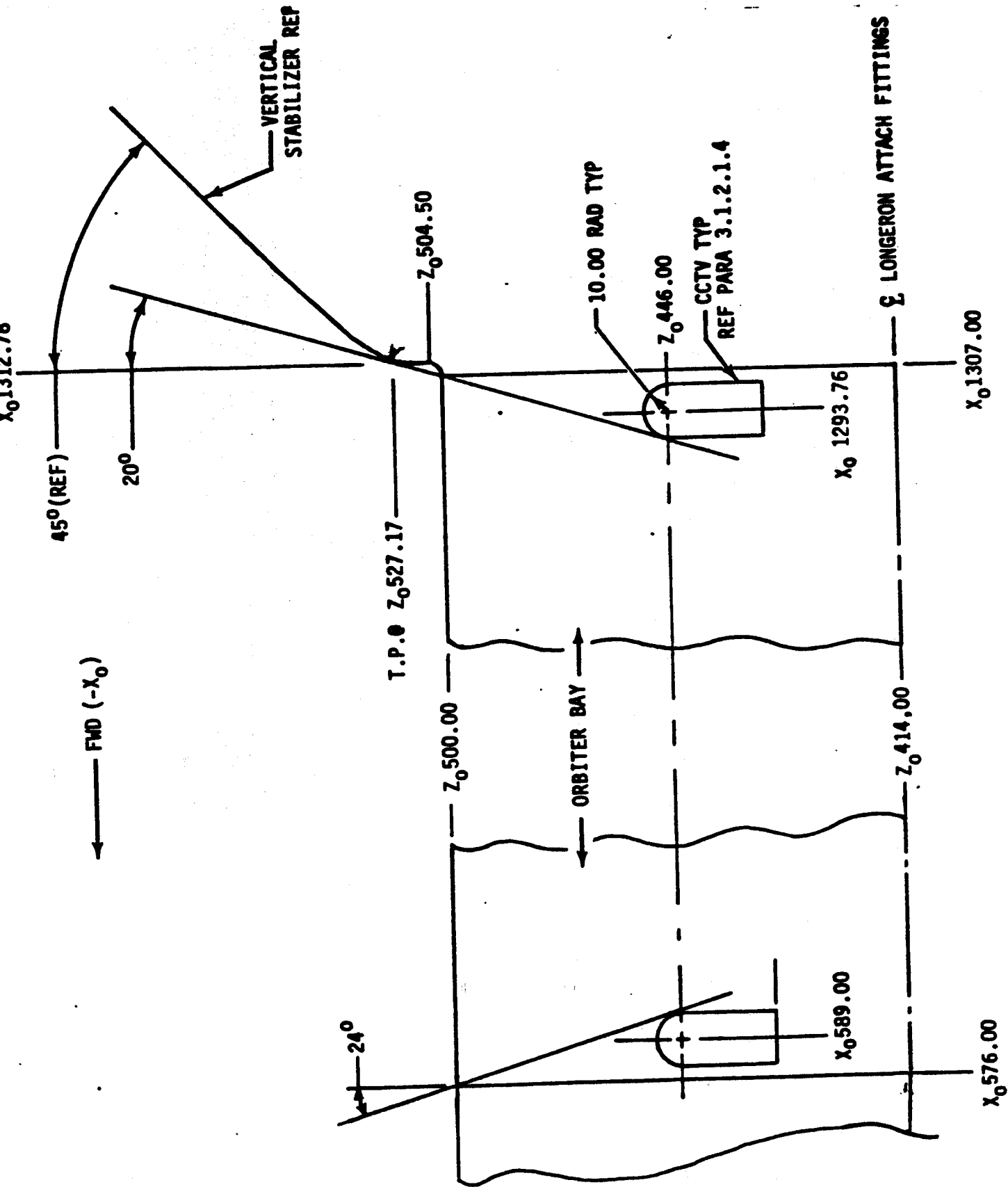


Figure 3.1.2.1.3-1 On-Orbit Deployment/Retrieval Clearances (Sheet 1 Of 3)



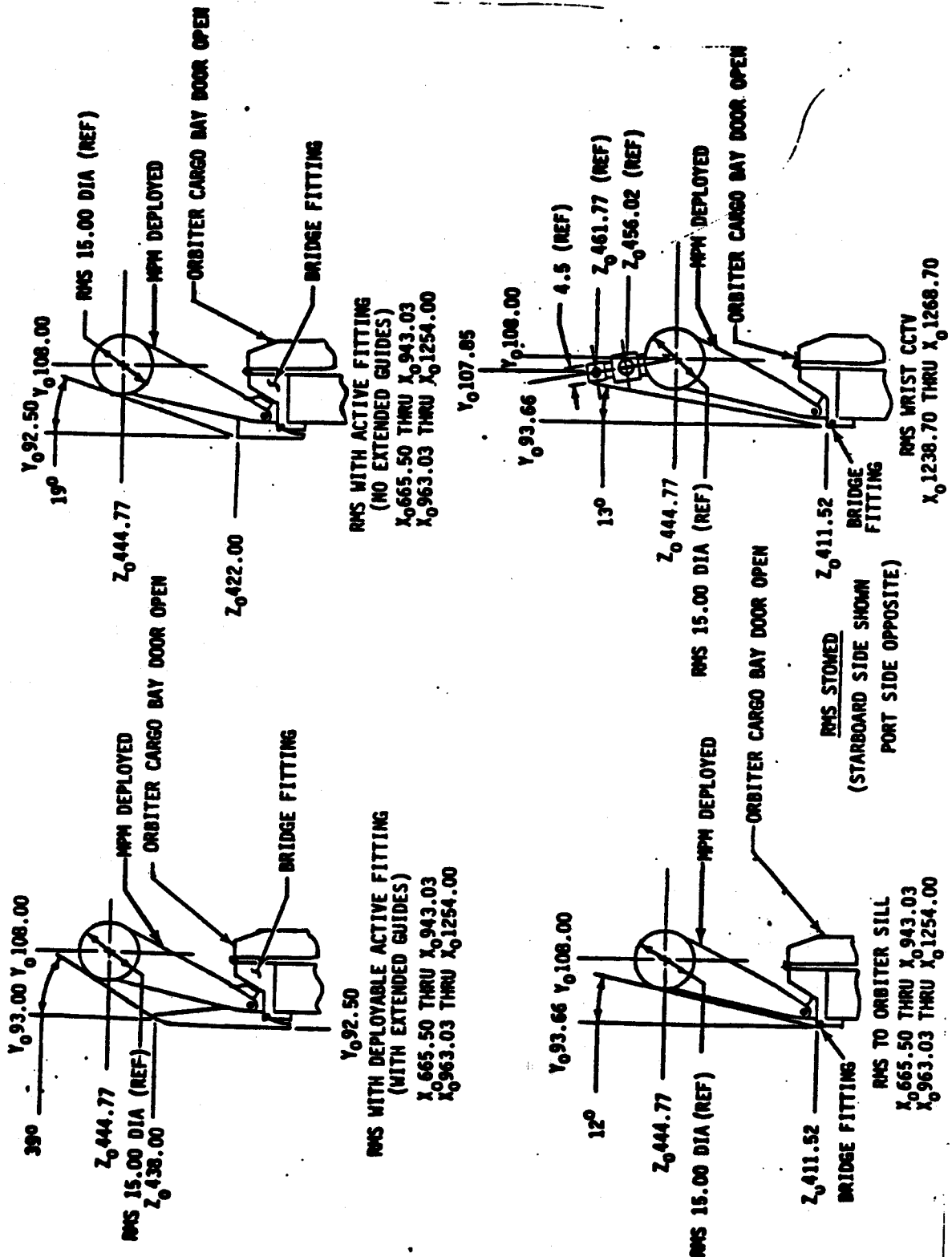


Figure 3.1.2.1.3-1 On-Orbit Deployment/Retrieval Clearances (Sheet 2 Of 3)

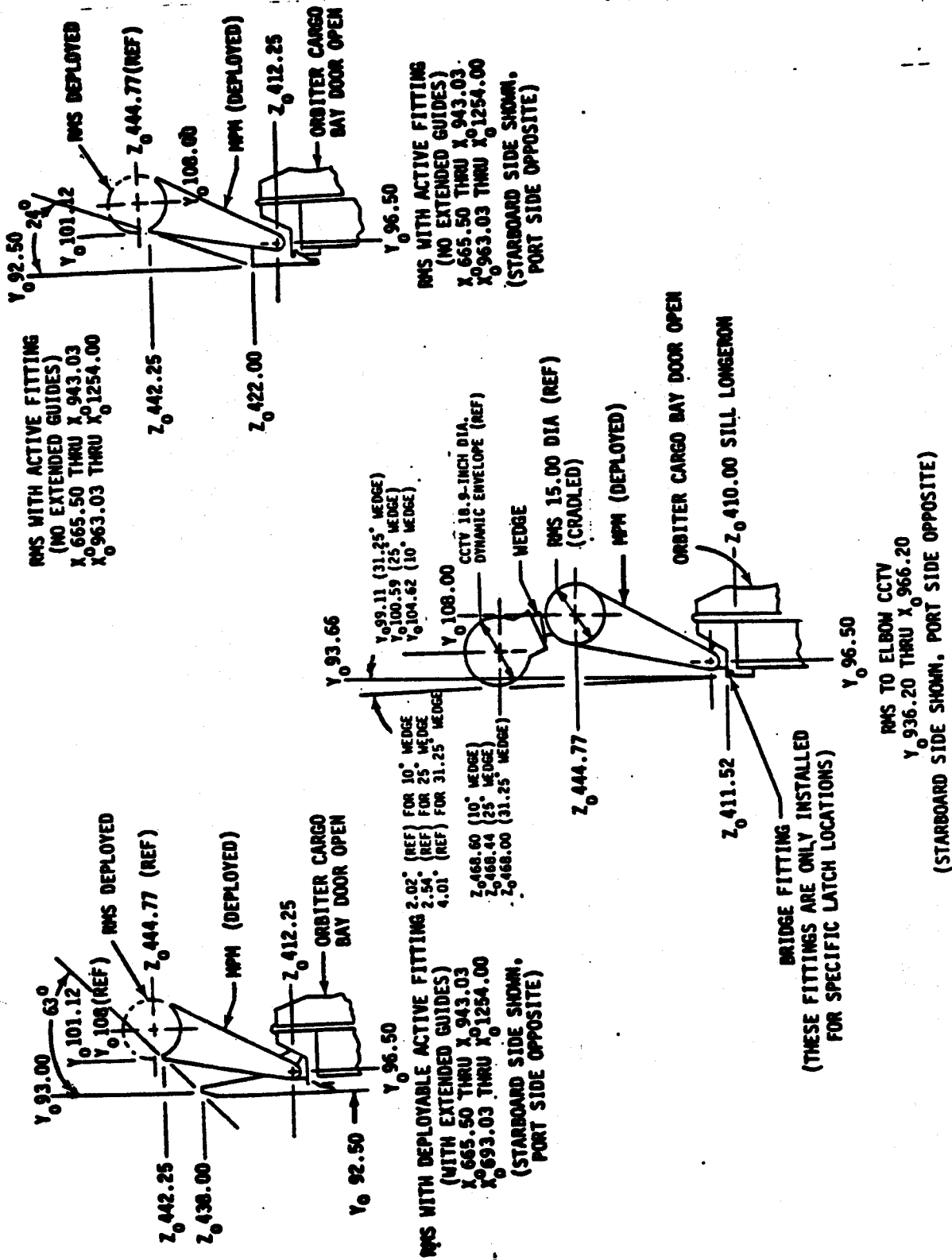


Figure 3.1.2.1.3-1 On-Orbit Deployment/Retrieval Clearances (Sheet 3 Of 3)

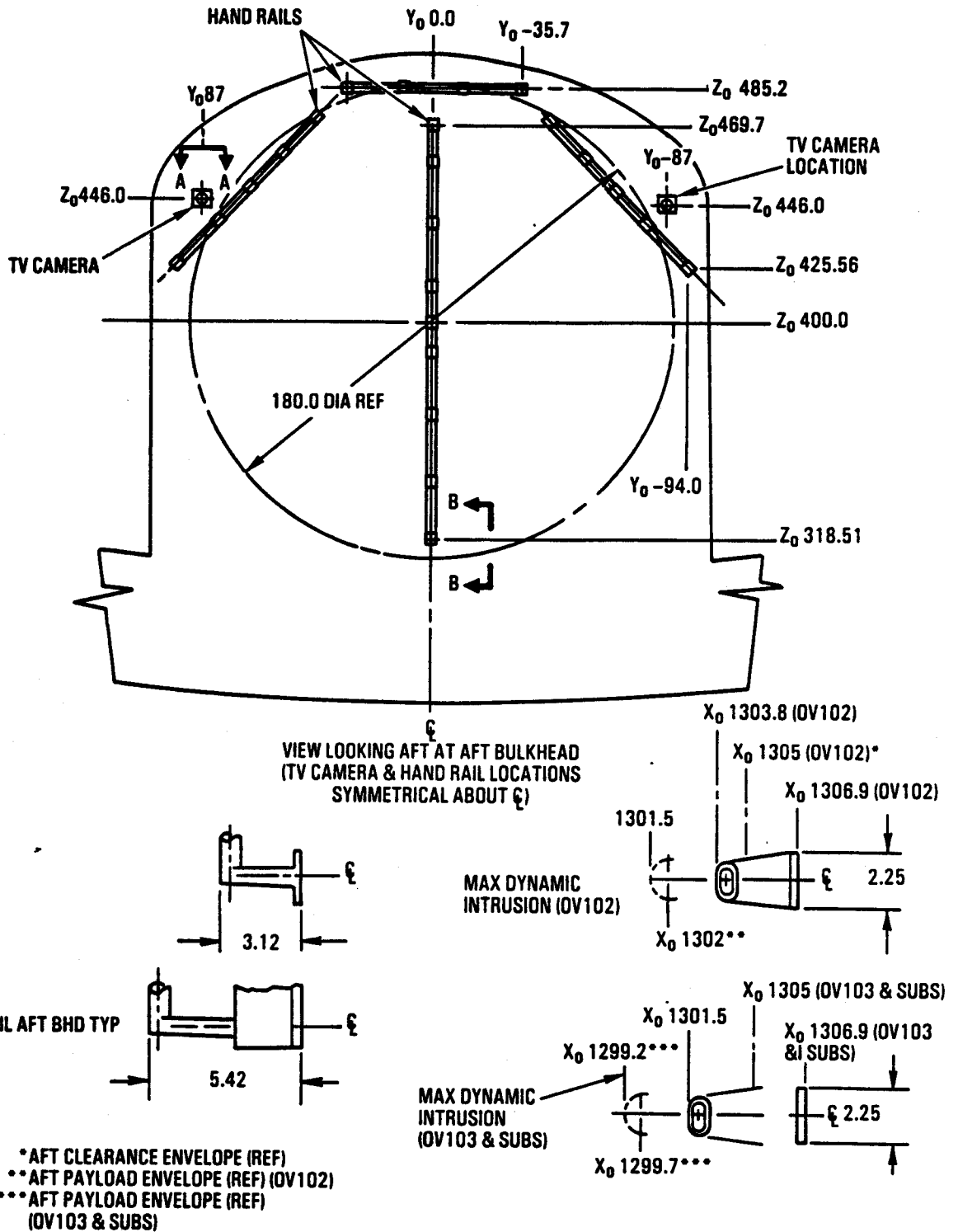


Figure 3.1.2.1.4-1 Payload Clearance Envelope Intrusions  
(Sheet 1 Of 8)

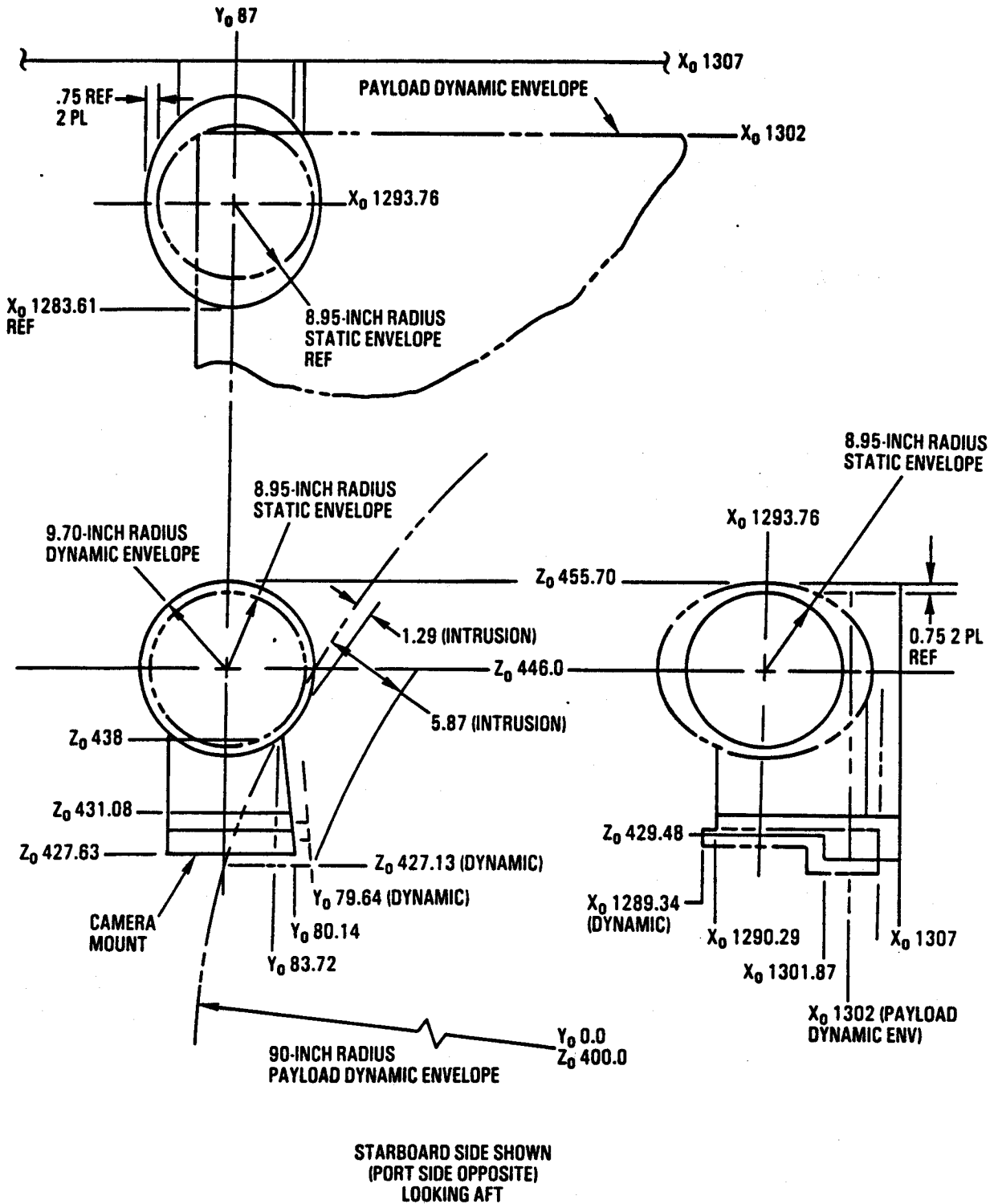


Figure 3.1.2.1.4-1 Payload Clearance Envelope Intrusions (Sheet 2 Of 8)

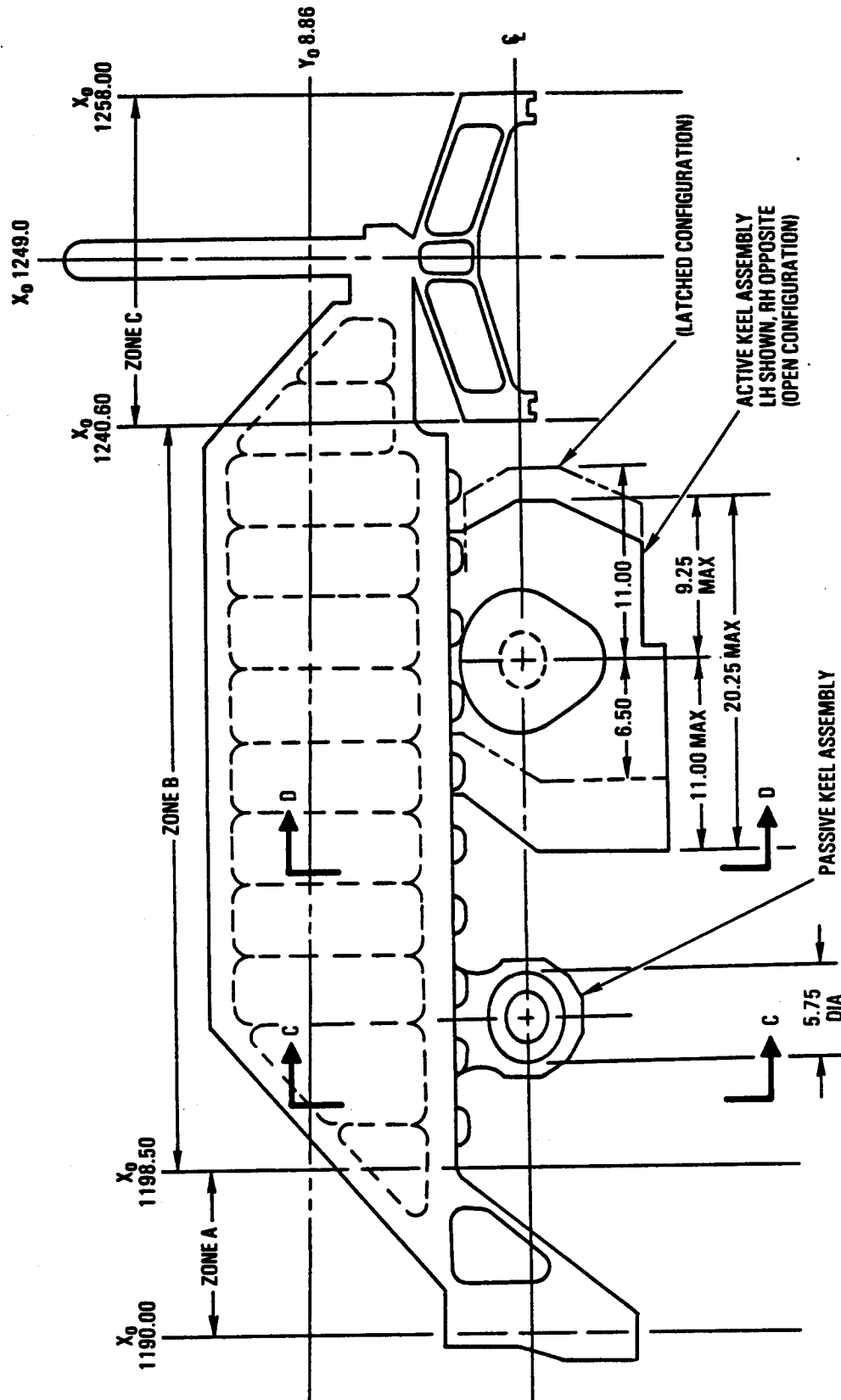


Figure 3.1.2.1.4-1 Payload Clearance Envelope Intrusions (Sheet 3 Of 8)

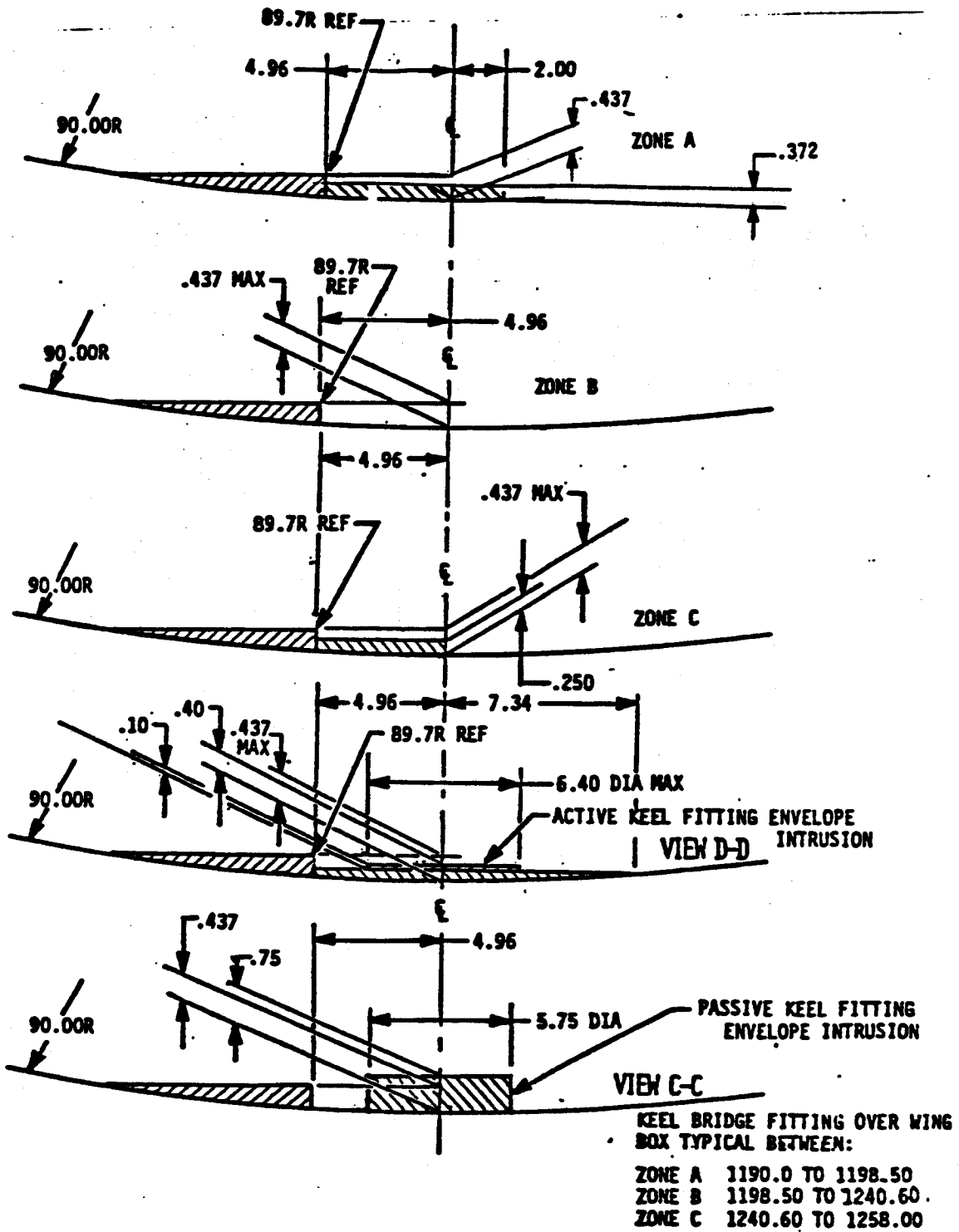
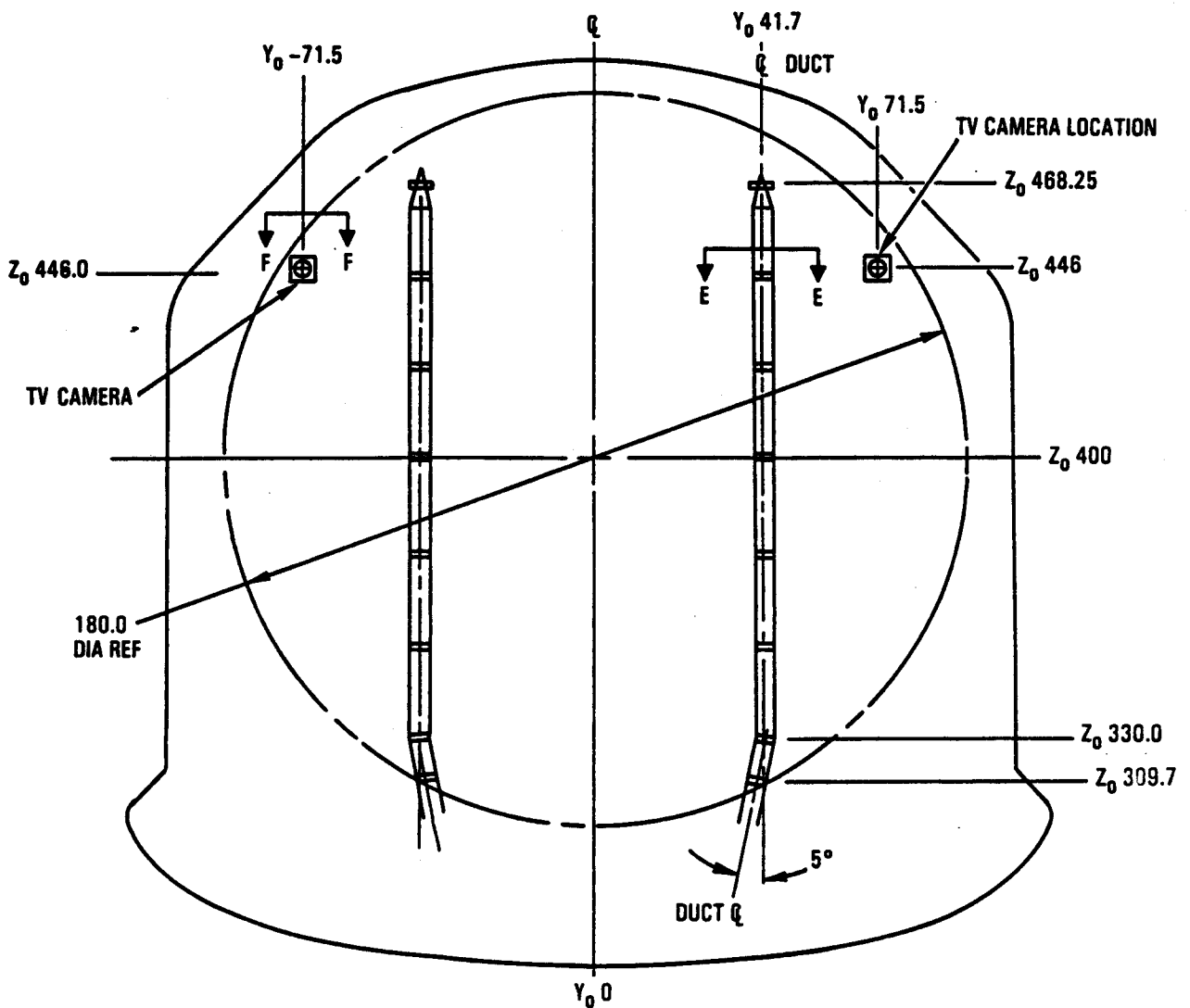
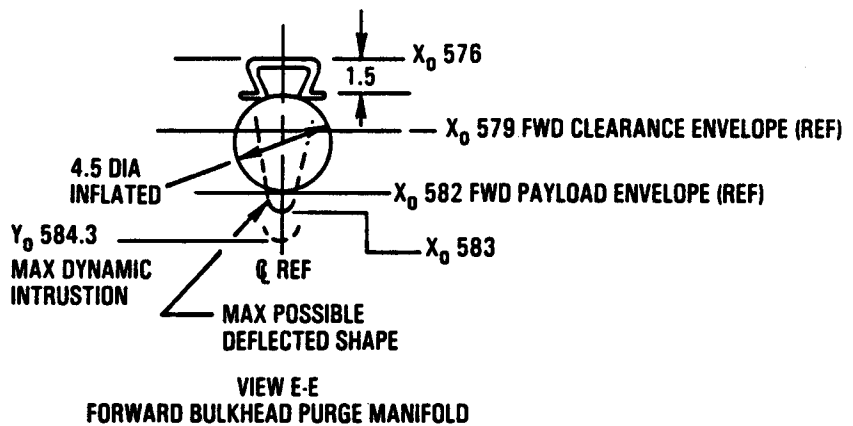


Figure 3.1.2.1.4-1 Payload Clearance Envelope Intrusions  
(Sheet 4 Of 8)



VIEW LOOKING FWD AT FWD BULKHEAD ( $X_0$  576)  
 (TV CAMERA & PURGE DUCT LOCATIONS SYMMETRICAL ABOUT  $Q$ )



VIEW E-E  
 FORWARD BULKHEAD PURGE MANIFOLD

Figure 3.1.2.1.4-1 Payload Clearance Envelope Intrusions  
 (Sheet 5 Of 8)

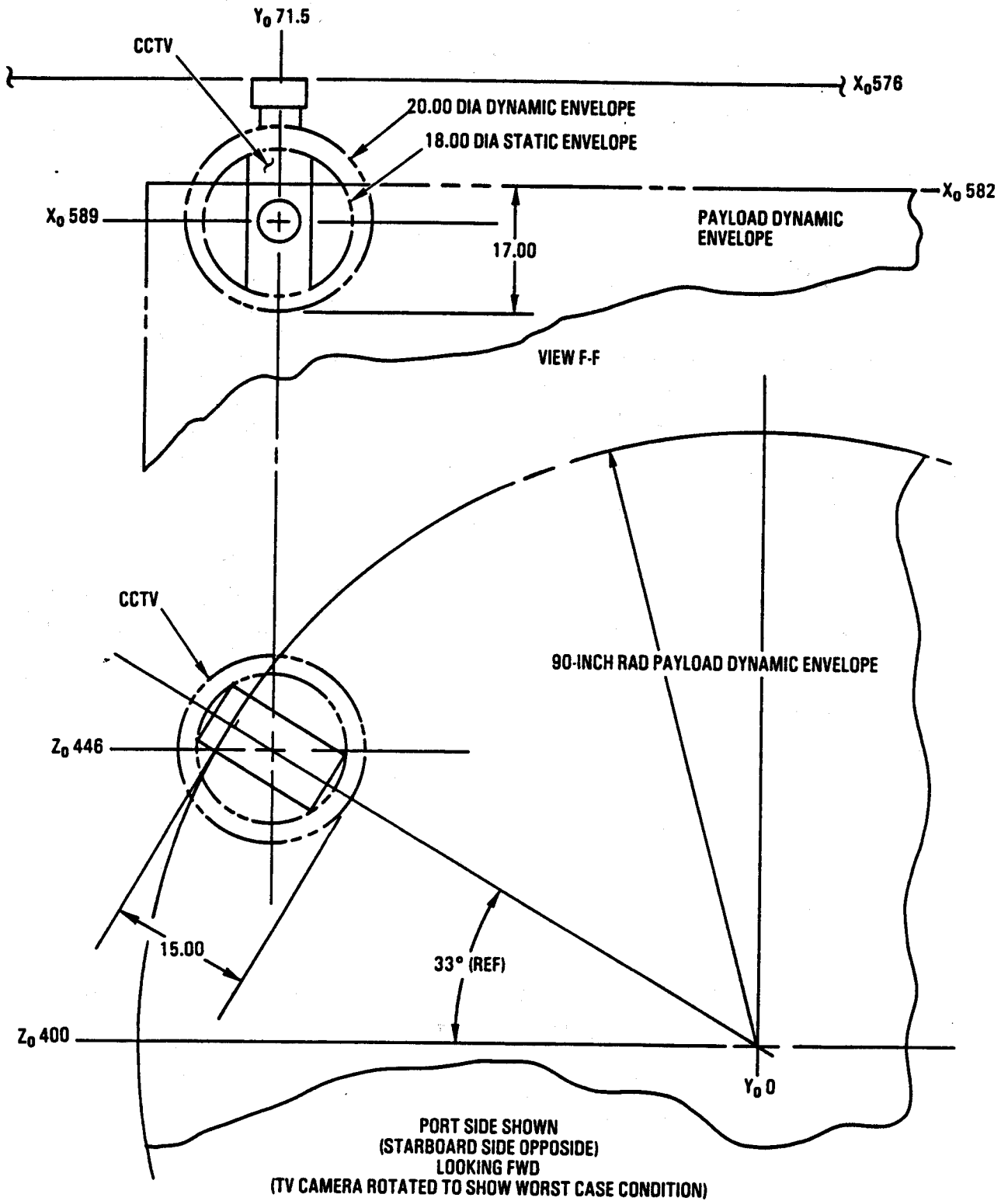


Figure 3.1.2.1.4-1 Payload Clearance Envelope Intrusions  
(Sheet 6 Of 8)



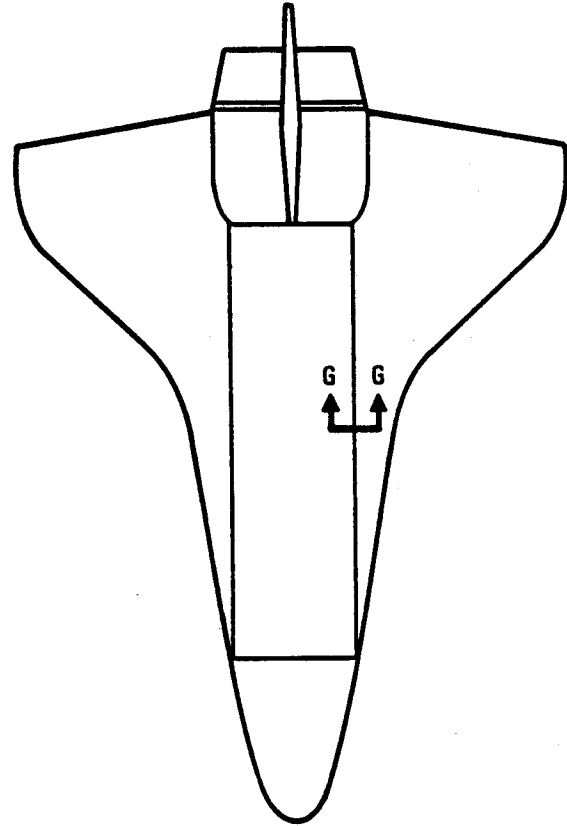
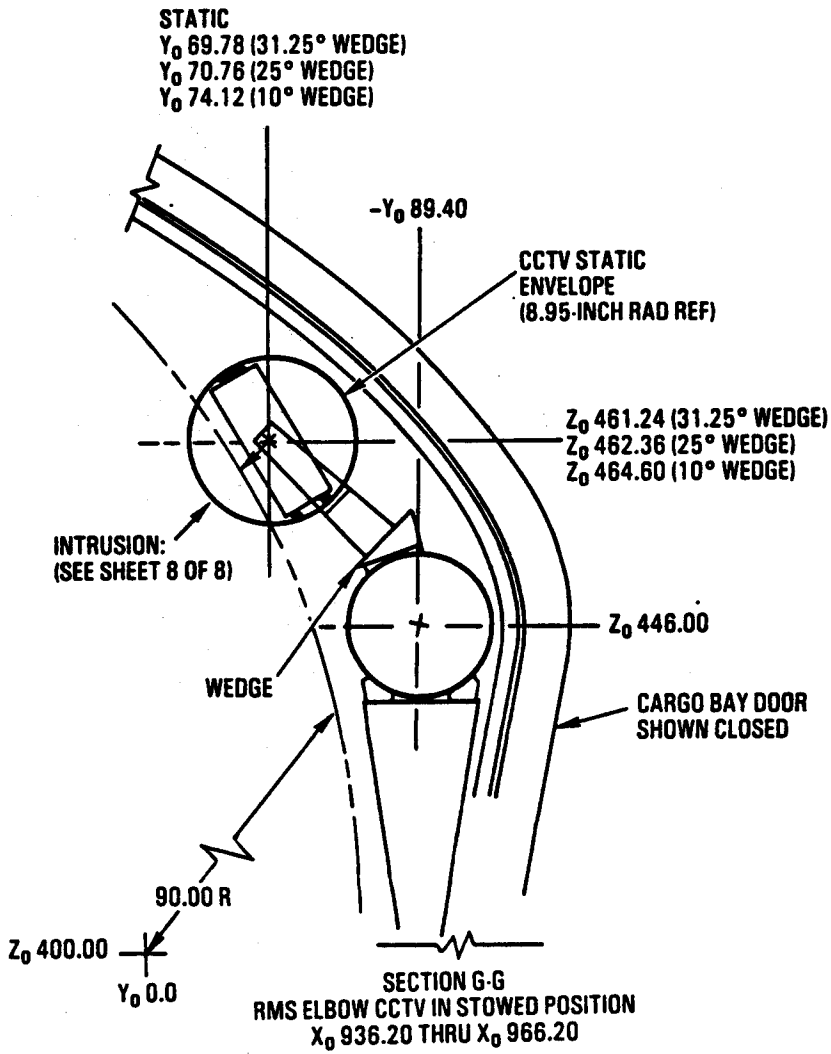


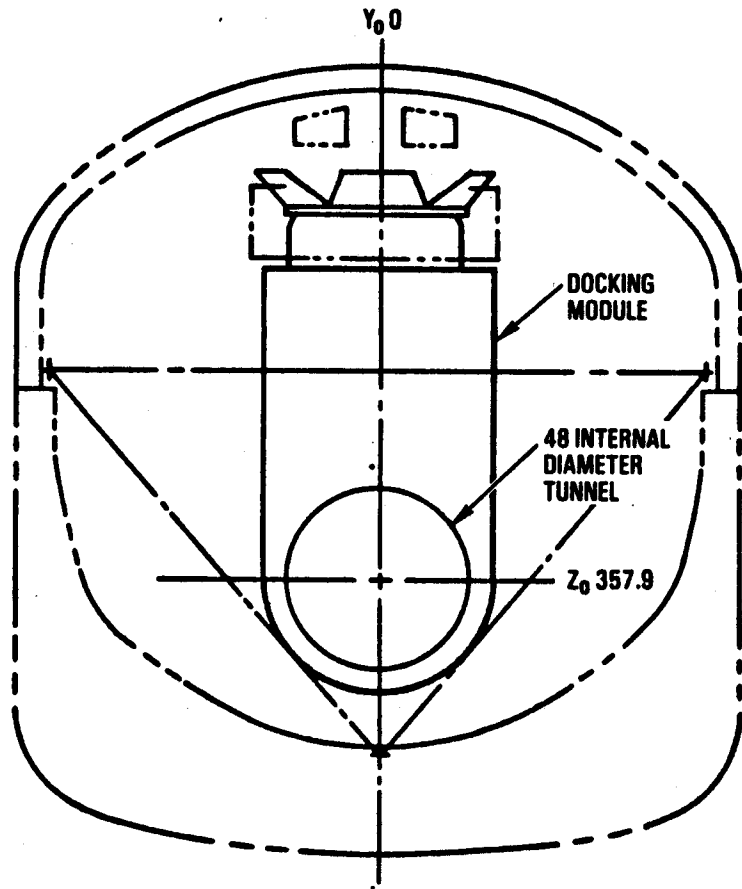
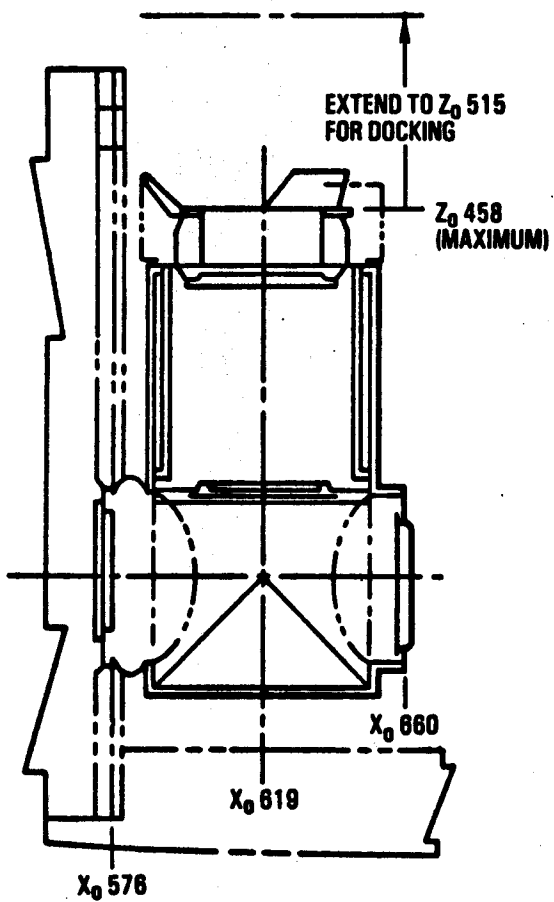
Figure 3.1.2.1.4-1 Payload Clearance Envelope Intrusions  
 (Sheet 7 Of 8)

INTRUSION

	<u>STATIC</u>			<u>DYNAMIC</u>
	CAMERA TANGENT 90" R ENV.	CAMERA PERPENDICULAR TO 90" R ENV.	CAMERA TANGENT TO 90" R ENV.	CAMERA PERPENDICULAR TO 90" R ENV.
31.25° WEDGE	0.04 (CLEARANCE)	6.11 (INTRUSION)	3.95 (INTRUSION)	10.1 (INTRUSION)
25° WEDGE	1.48 (CLEARANCE)	4.63 (INTRUSION)	2.52 (INTRUSION)	8.63 (INTRUSION)
10° WEDGE	5.52 (CLEARANCE)	0.63 (INTRUSION)	1.54 (CLEARANCE)	4.61 (INTRUSION)

NOTE: The 25° wedge will be standard. Use of the 10° and 31.25° wedges will require special evaluation by NASA/JSC.

*Figure 3.1.2.1.4-1 Payload Clearance Envelope Intrusions  
(Sheet 8 Of 8)*



NOTE: DIMENSIONS IN INCHES

FIGURE 3.1.2.1.5.3-1 DOCKING MODULE LIMIT ENVELOPE

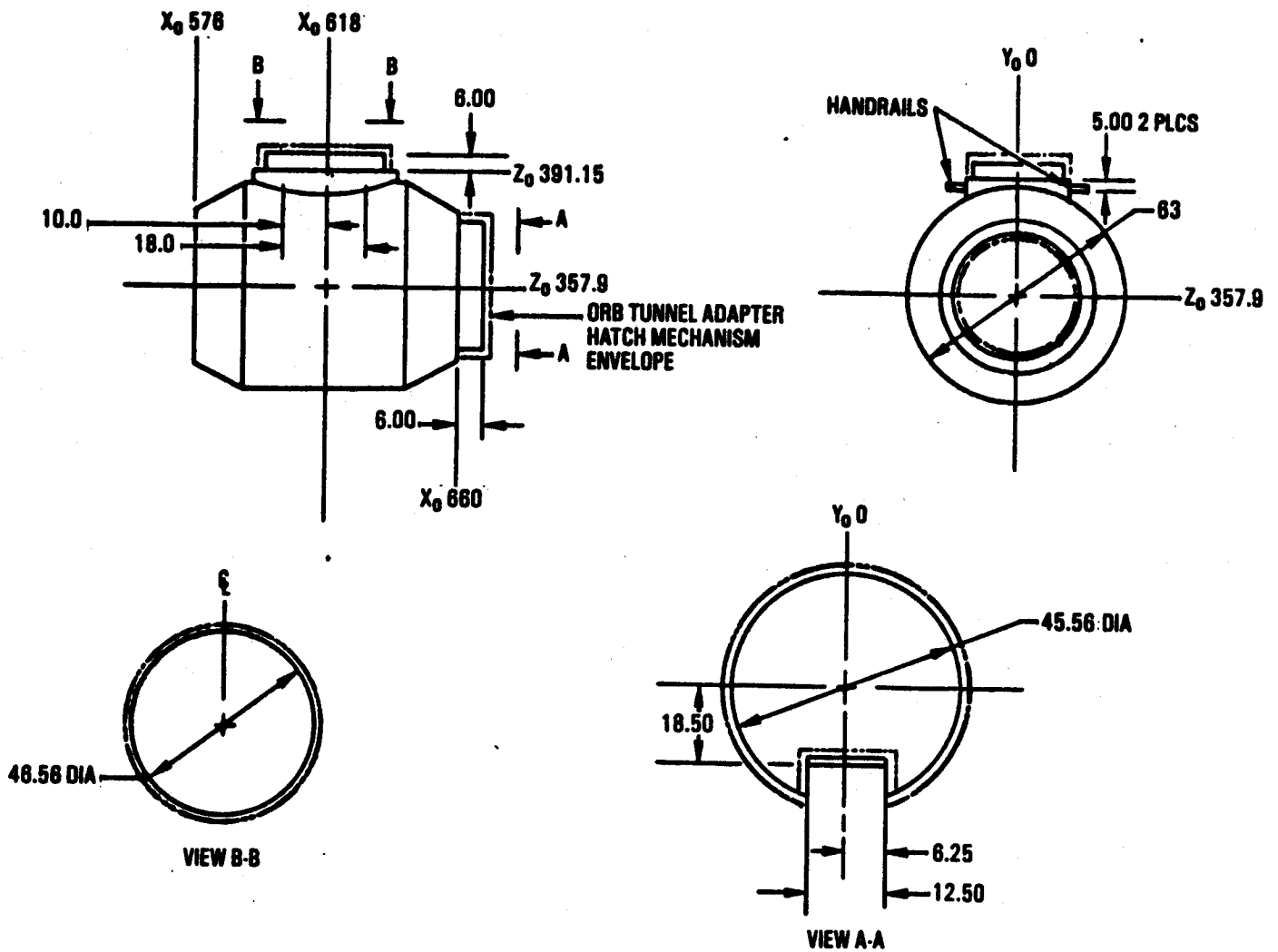


FIGURE 3.1.2.1.5.4-1 AIRLOCK/TUNNEL ADAPTER LIMIT ENVELOPE

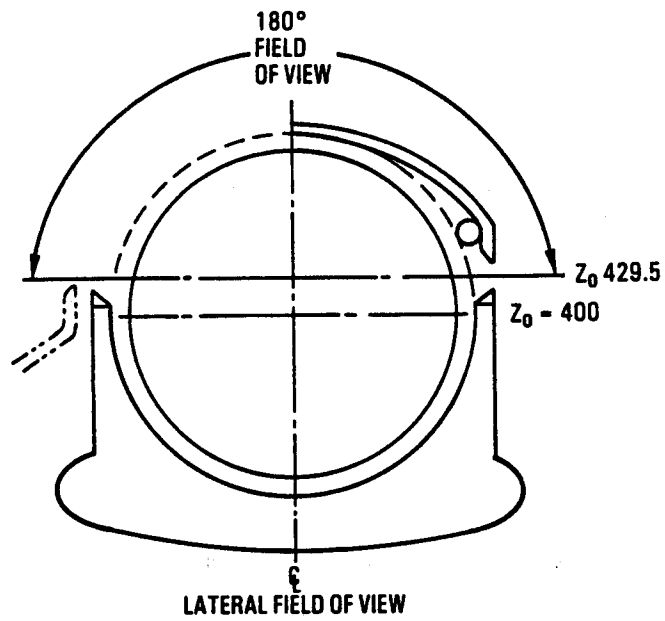
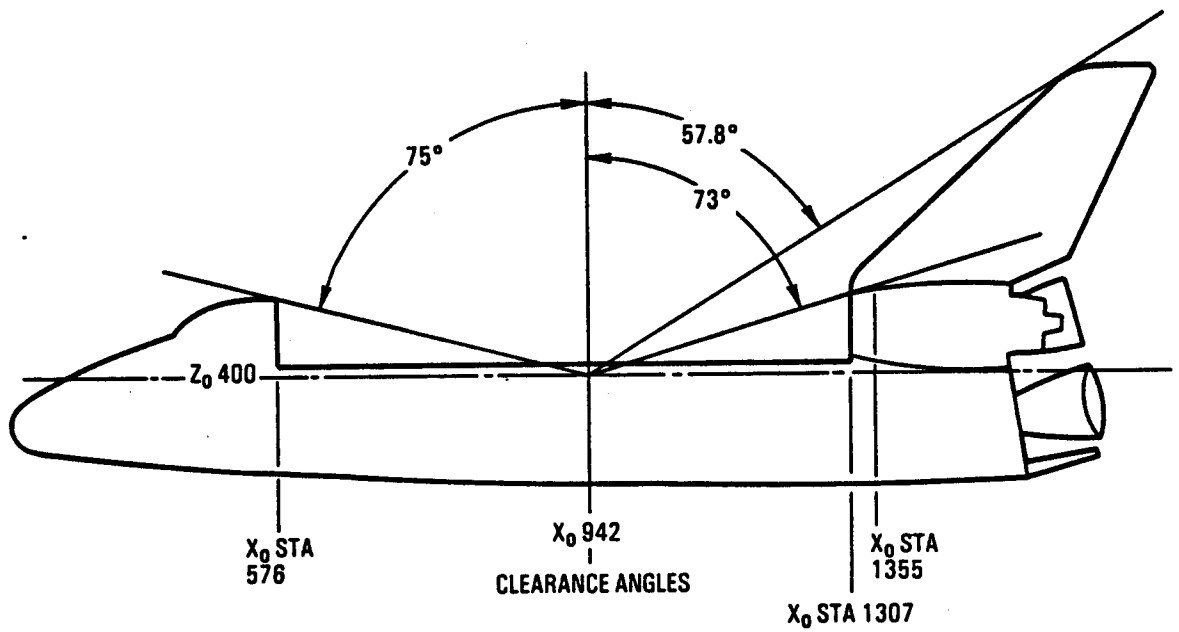
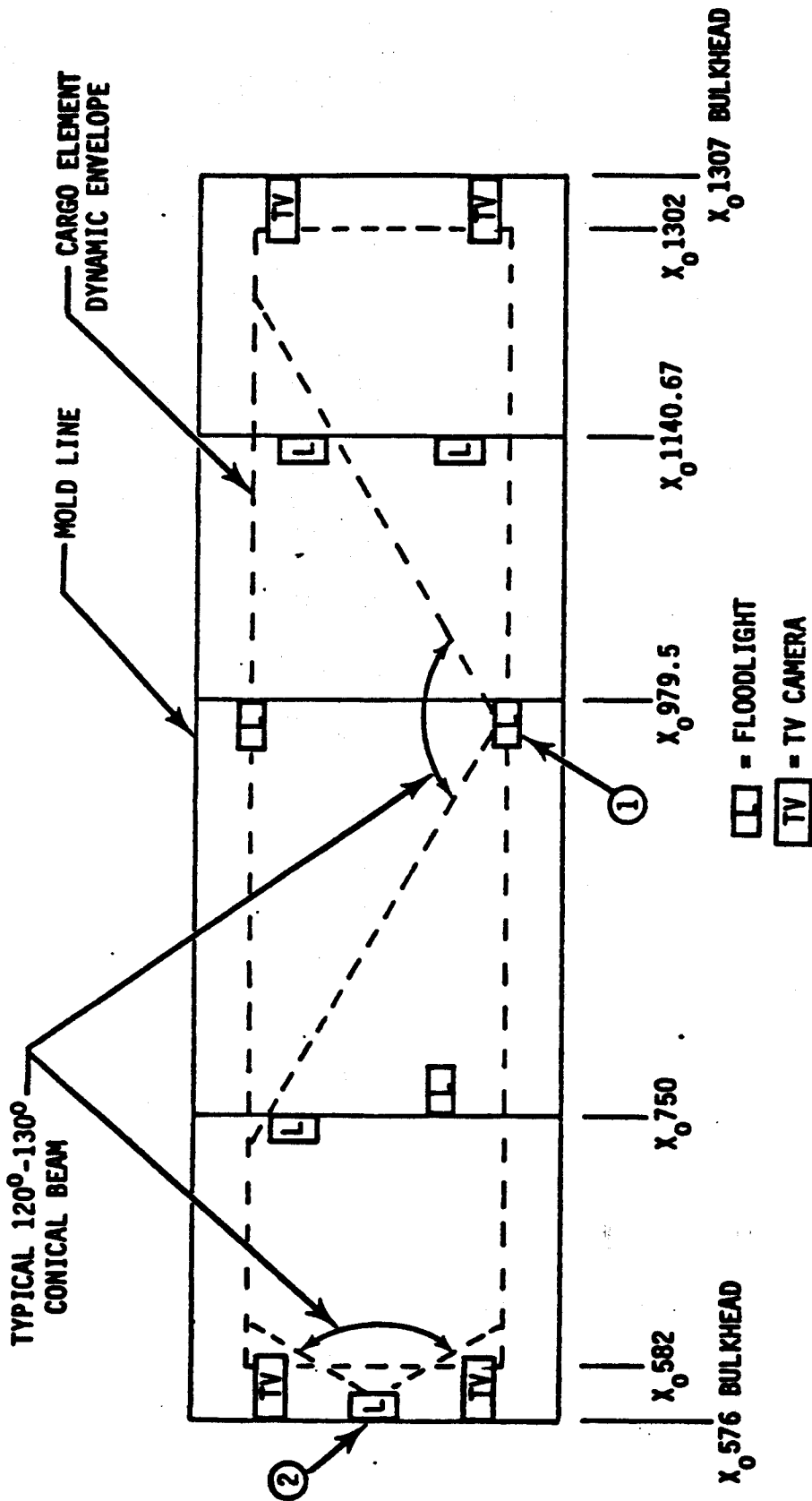


FIGURE 3.1.3.1-1 CARGO ELEMENT FIELD OF VIEW



NOTES:

- ① SIX LIGHTS MOUNTED OUTSIDE CARGO ELEMENT DYNAMIC ENVELOPE. (120° MINIMUM CONICAL BEAM POINTED WITHIN APPROX 5° OF NORMAL TO CARGO BAY CENTERLINE)
- ② FORWARD BULKHEAD FLOODLIGHT - 120° CONICAL BEAM POINTED IN +X DIRECTION PENETRATES 0.14x5.70 DIA INTO THE CARGO ELEMENT DYNAMIC ENVELOPE)
3. LIGHTING CHARACTERISTICS ARE SPECIFIED IN PARAGRAPH 10.9.1
4. CCTV CAMERAS ARE KITTABLE AND MAY BE REMOVED WHEN REQUIRED TO ACCOMMODATE MAXIMUM ENVELOPE CARGO ELEMENT
5. FIGURE NOT TO SCALE

Figure 3.1.3.2-1 Cargo Bay Lighting and TV Camera Locations  
(Sheet 1 Of 3)

	ATTACHMENT LOCATION		FIXTURE CENTERLINE	
	X <sub>0</sub>	Side	Y <sub>0</sub>	Z <sub>0</sub>
Lights	576	Aft	0	484.2
	750	Forward	56	325.2
	750	Aft	-48	320.0
	979.5	Forward	54.3	323.9
	979.5	Forward	-54.3	323.9
	1140.67	Forward	56	324.9
	1140.67	Forward	-56	324.9

	ATTACHMENT BULKHEAD	LENS EXTREME POSITION**	CAMERA CENTERLINE	
	X <sub>0</sub>	X <sub>0</sub>	Y <sub>0</sub>	Z <sub>0</sub>
Bulkhead TV Camera Locations	576	598	71.5	446
	576	598	-71.5	446
	1307	1285	87	446
	1307	1285	-87	446

<i>Camera Centerline</i>				
	X <sub>0</sub>	Y <sub>0</sub>	Z <sub>0</sub> (Lens Extended)	
<i>Keel TV Camera</i>	789.73	-1.4	316.14	
<i>72 Locations</i>	↑	-1.4	316.14	
	↓	-1.4	316.14	
	1124.07	-1.4	316.14	

\*\* Represents static position only, dynamic position could be one inch inboard of static position.

Figure 3.1.3.2-1 Cargo Bay Lighting And TV Camera Locations  
(Sheet 2 Of 3)

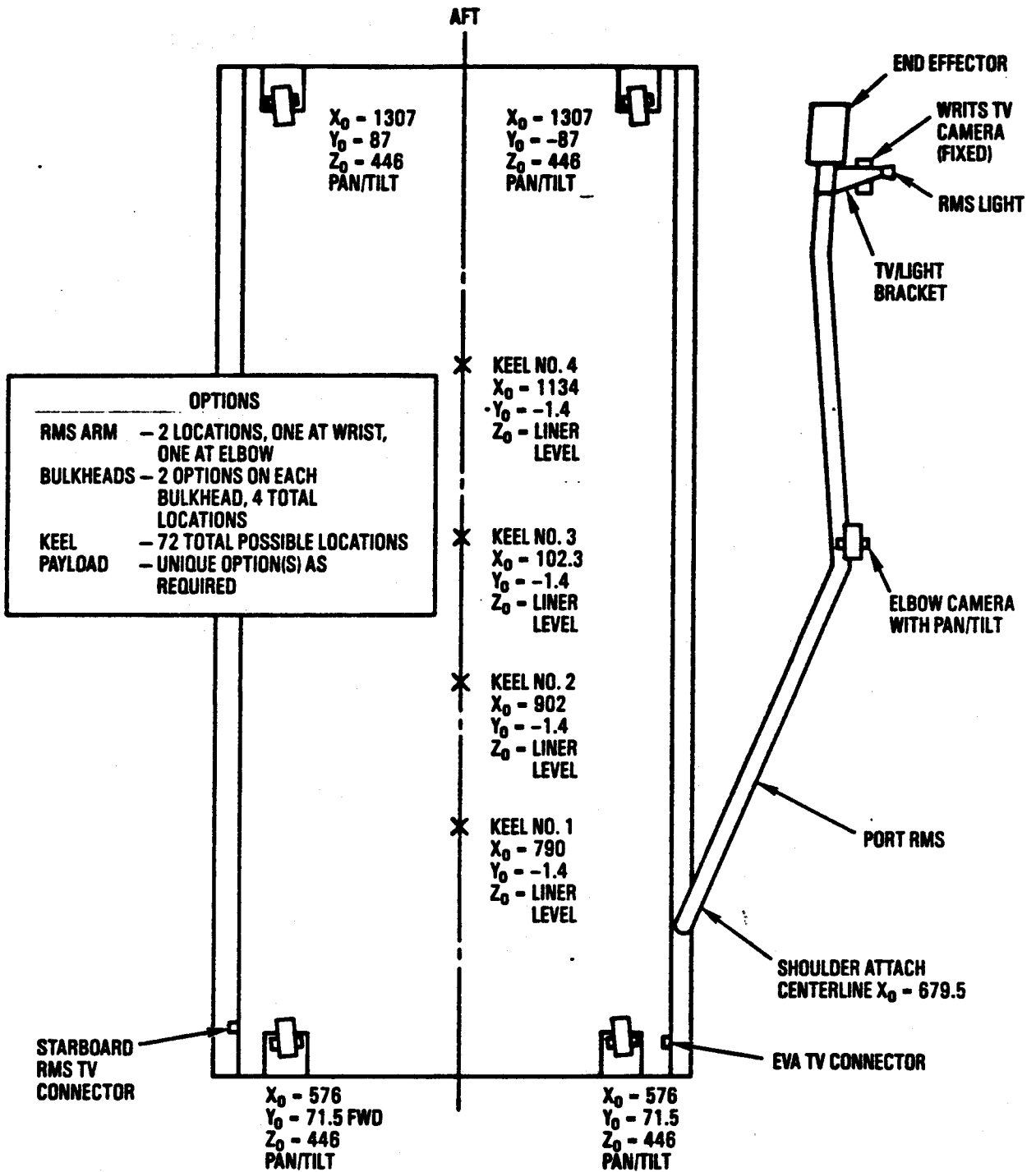


Figure 3.1.3.2-1 Cargo Bay Lighting And TV Camera Locations  
(Sheet 3 Of 3)



## 3.2 INTERFACE LOCATION AND DIMENSIONING

**3.2.1 Physical Interface Locations.** Shuttle Orbiter/Payload physical interface locations shall be in accordance with Figure 3.2.1-1. Standard payload electrical interface accommodations are available only at the cargo element end of Standard Mixed Cargo Harness (SMCH) cables in the cargo bay. Other electrical interfaces shown in Figure 3.2.1-1 are not directly available to cargo elements, but non-standard cables to the cargo element(s) can be provided from these interfaces. Connector and pin assignments definition of the majority of these accommodations are given in Section 13.0.

**3.2.2 Dimensions And Tolerances.** Unless otherwise specified, all linear dimensions are in inches, all angular dimensions are in degrees, and the tolerances for these are as follows:

Decimal:   X.X    =  $\pm 0.1$   
          X.XX   =  $\pm 0.03$   
          X.XXX =  $\pm 0.010$

Fractions:            $\pm 1/16$

*Angles:*            $\pm 0^{\circ} 30'$

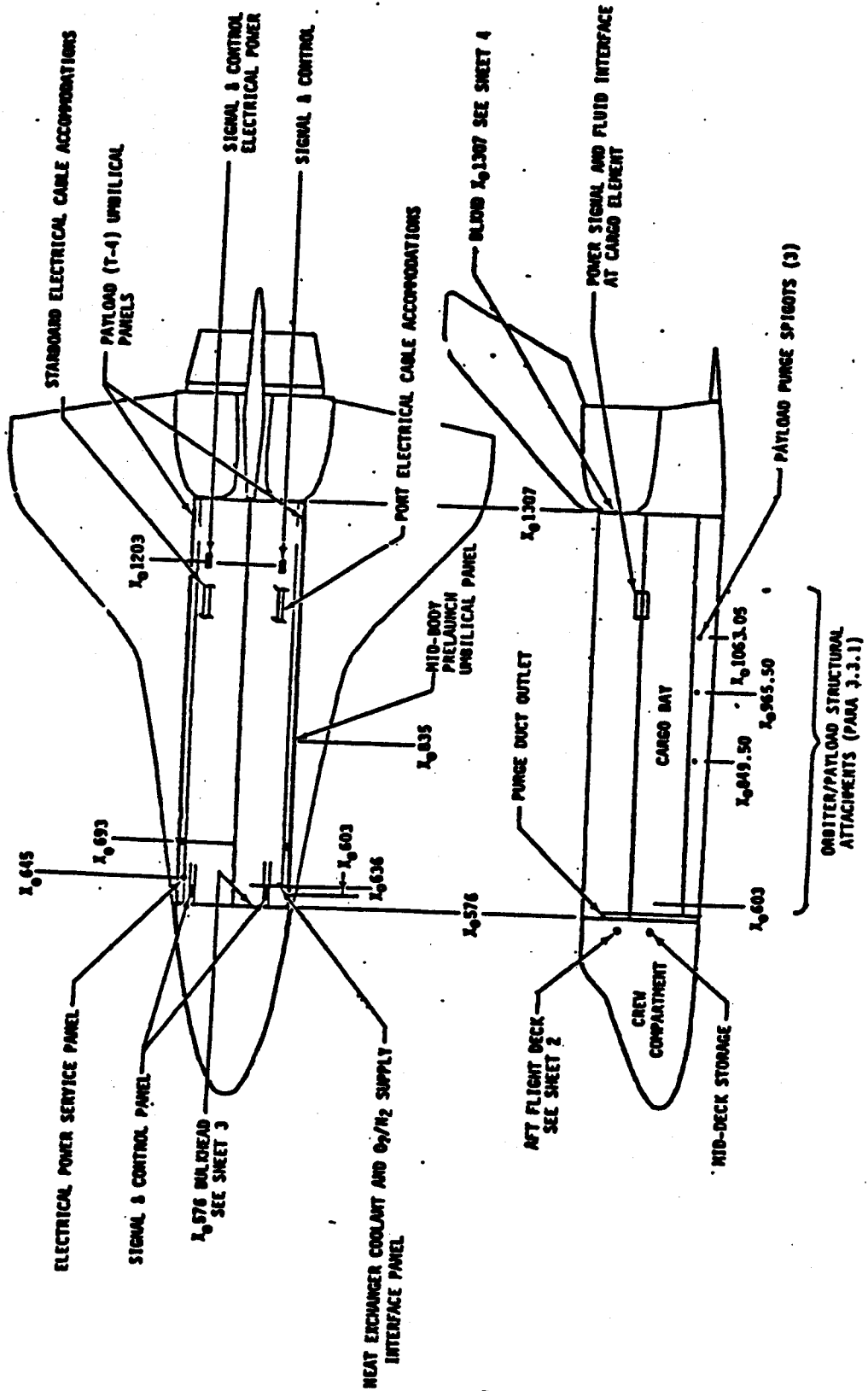


Figure 3.2.1-1 Shuttle Orbiter Payload Physical Interface Locations  
(Sheet 1 Of 4)

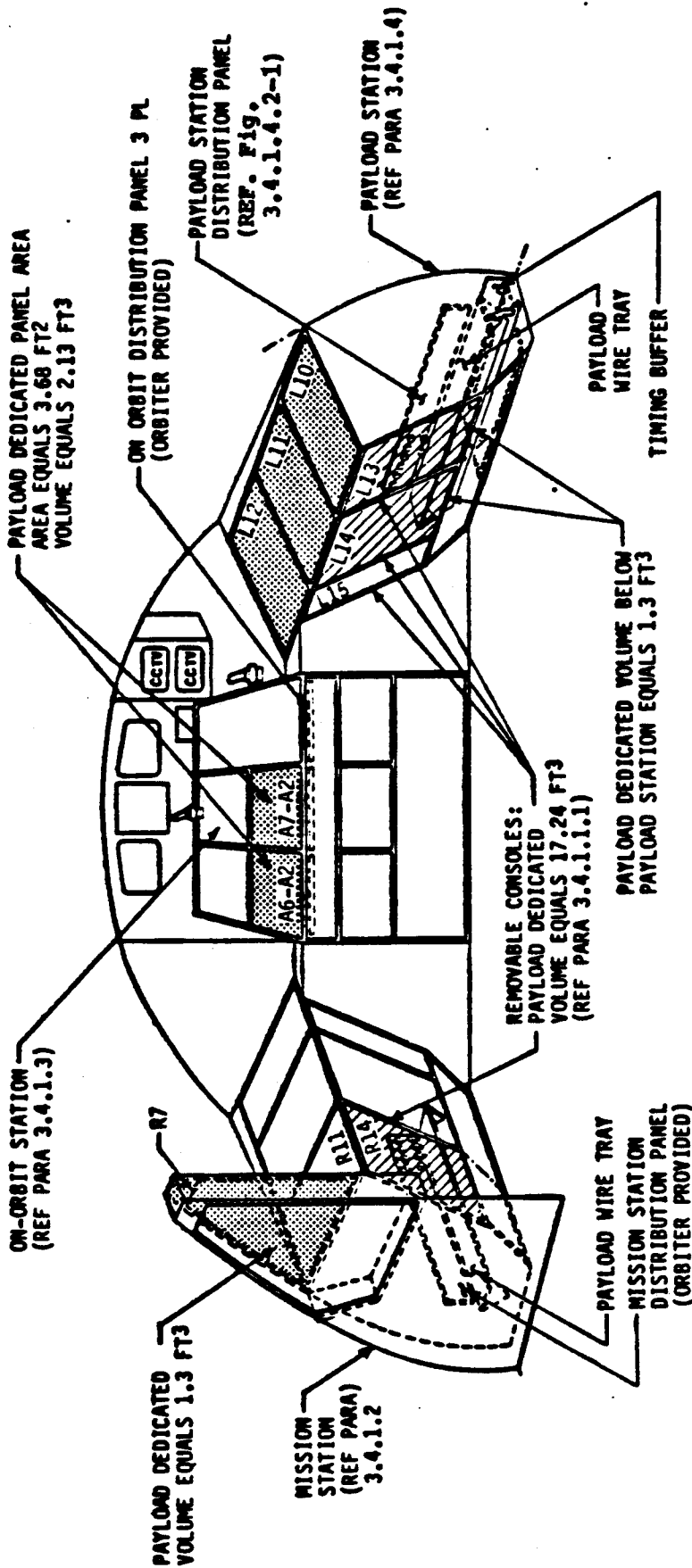


Figure 3.2.1-1 Shuttle Orbiter Payload Physical Interface Locations-  
Aft Flight Deck General Arrangement  
(Sheet 2 Of 4)

1. LEGEND



PAYLOAD DEDICATED PANEL AREA EQUALS 16.85 FT<sup>2</sup>. PANELS ARE DEFINED IN FIGURE 3:4.1.1.1-1.

ADDITIONAL PAYLOAD DEDICATED D&C PANELS ON INBOARD SURFACES OF THREE EQUIPMENT CONSOLES REQUIRE ALLOWANCE OF SIX (6) INCHES DEPTH OF NORMAL PANEL AREA. ALL COMPONENTS ON THESE SURFACES MUST BE FULLY RECESSSED. ADDITIONAL PANEL SURFACE AREA IS 5.5 FT<sup>2</sup>.

2. TOTAL PAYLOAD DEDICATED VOLUME IS 21.64 FT<sup>3</sup>.



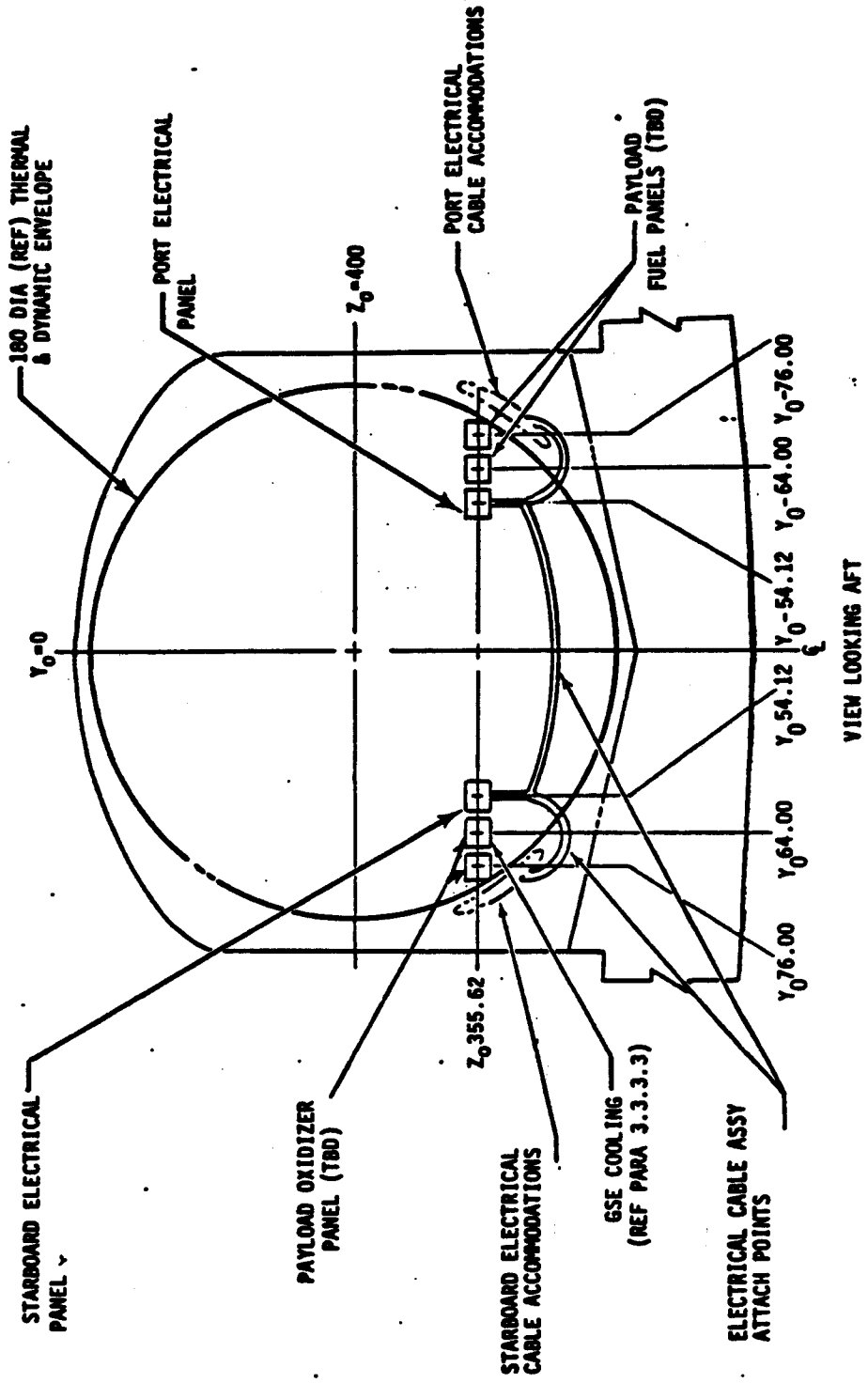


Figure 3.2.1-1 Shuttle Orbiter Payload Physical Interface Locations-  
 Xo 1307 Bulkhead  
 (Sheet 4 Of 4)

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### 3.3 PAYLOAD BAY

3.3.1 Orbiter/Payload Structural Attachments. Payloads/ Payload carriers shall be supported in the cargo bay on payload trunnions extending beyond the payload envelope in the  $\pm Y_0$  directions at  $Z_0 = 414$  and in the minus  $Z_0$  direction at  $Y_0 = 0$ . The trunnions shall be free to slide axially through split self-aligning bearings contained in Orbiter attach fittings defined below, which in turn shall be supported on bridges at the sides of the cargo bay (longerons) and the bottom of the cargo bay (keel). The bridges shall distribute the loads to Orbiter structure. The trunnion/bearing surfaces shall be the interfaces which transmit loads between the Orbiter and the Payload.

The design concept for payload retention at the longeron shall permit Stabilizing Fittings to carry only Z-Z loads by sliding fore and aft on the longeron bridge cap relieving X-X loads, while the payload trunnion is free to slide through the bearing relieving Y-Y loads. Insertion of shear pins between a longeron retention fitting and the bridge converts it to a Primary Fitting, which shall carry X-X loads in addition to Z-Z loads. The keel fitting shall carry only Y-Y loads from the payload keel trunnion which is free to slide in the bearing relieving Z-Z loads; the fitting is free to slide on the keel bridge in the  $X_0$  direction, thus relieving X-X loads (Auxiliary Fitting) or can be pinned to the keel bridge to carry X-X loads. Only the payload attachment fittings required for a particular flight will be installed.

- a. Payload 4-Point Statically Determinate Installation. Figure 3.3.1-1 depicts a 4-point statically determinate installation concept. Two opposite longeron primary fittings shall react both X-X and Z-Z loads. A single stabilizing fitting, installed on either side of the Orbiter, shall carry only Z-Z loads. The stabilizing fitting may be either forward or aft of the primary fitting. The auxiliary fitting, at the keel, shall react only Y-Y loads.
- b. Payload Statically Indeterminate Installation. Use of a statically indeterminate installation shall not be precluded provided the resultant loads are compatible with the Orbiter capability. Figure 3.3.1-2 presents a simple 5-Point statically indeterminate installation. Two opposite longeron primary fittings shall react both X-X and Z-Z loads. Two opposite longeron stabilizing fittings shall carry only Z-Z loads. The stabilizing fittings may be either forward or aft of the primary fittings. The auxiliary fitting at the keel shall react only Y-Y loads.
- c. Payload 3-Point Statically Determinate Installation. Figure 3.3.1-3 depicts a 3-point statically determinate installation. Two opposite longeron primary fittings shall react both X-X and Z-Z loads. The auxiliary fitting at the keel shall react both X-X and Y-Y loads.

3.3.1.1 Attachment Point Locations and Constraints. The Orbiter shall provide the attach points located by nominal  $X_0$ ,  $Y_0$  and  $Z_0$  coordinates as listed in Table 3.3.1.1-1. This table details those longeron attach points which may be used for active and passive longeron fittings defined in Paragraph 3.3.1.2, and the limitations on their use. It also details those keel attach points which may be used for the active and passive keel fittings, defined in Paragraph 3.3.1.3, and the limitations on their use. Further limitations on the availability of specific attach points due to limits on trunnion deflections are presented in Paragraphs 3.3.1.2.3 and 3.3.1.3.2 for longeron and passive keel fittings, respectively.

3.3.1.1.1 Attachment Point Location Tolerances. The Orbiter longeron and keel attachment point location tolerances shall be as defined in Figure 3.3.1.1.1-1. *These attachment tolerances include Orbiter manufacturing and assembly tolerances and the effects of Orbiter structural hysteresis. The attachment deflections due to Orbiter thermal and mechanical loading is discussed in Section 4.1.2.* Point "A" is shown as the primary fittings, Point "B" is at the stabilizing fitting and point "C" is at the keel fitting. Tolerances associated with points "A", "B" and "C" shall be applicable to: 1) Statically determinate or indeterminate cargo element suspension system, 2) Cargo elements which have their primary fittings at point B and their stabilizing fittings at point A, and 3) Keel locations independent of primary/stabilizing fittings. Points A, B and C shall be taken as nominal locations. Actual locations of each of these points shall fall within the tolerance envelope specified from its nominal location.

3.3.1.2 Longeron Attachment Interface. The design concept for the longeron attach fitting interface is a nominal *3.245-inch diameter (82.42mm)* smooth trunnion on the payload which mates with a split bearing retained in a housing (attach fitting) on the Orbiter longeron. The payload-to-Orbiter interface will be at the trunnion-to-bearing surface. The attach fitting will be furnished by the Orbiter.

3.3.1.2.1 Attach fitting for Non-Deployable Payloads. The mechanism for attachment of non-deployable payloads shall be as presented in Figure 3.3.1.2.1-1. This mechanism shall be capable of attaching all statically determinate payloads. It shall also be capable of attaching statically indeterminate payloads which have no longeron trunnion more than 0.412 inch out of the X-Y plane formed by the other three. For such Z redundant payloads, with each trunnion on a separate bridge, the center of the bearing of each longeron attach fitting due to Orbiter manufacturing tolerances shall be within 0.177 inch of the plane through the centers of any other three longeron attach fittings.

For the case of Z redundant payloads with two trunnions on the same longeron bridge (each side of the cargo bay), the out-of-planarity Orbiter tolerance will be within the root-sum-square of 0.030 inch and 0.174 inch times the ratio of the trunnion spacing to the respective bridge span length.

The attach fittings shall be capable of pulling the trunnions in line with the attach fittings. The force applied during installation to bring the trunnions in line with the attach fittings shall be determined by the Root-Sum-Square (RSS) of Orbiter and payload planarity errors due to manufacturing tolerances and by the payload stiffness. This preload shall be combined with the flight loads and assessed against the strength capability of the Orbiter as defined in Appendix I.

The torque imparted to the payload in latching an out-of-plane longeron trunnion will cause the longeron trunnions to deflect in the  $+Y$  direction and can cause the keel trunnion to deflect in the  $-Z$  direction. *See Appendix X for the limits on these deflections.*

3.3.1.2.1.1 Longeron Trunnion for Non-Deployable Payloads. The longeron trunnion for non-deployable payloads shall be as defined in Figure 3.3.1.2.1-1.



3.3.1.2.2 Attach Fitting for Deployable Payloads. The mechanism for deployment and retrieval of payloads shall be as presented in Figure 3.3.1.2.2-1. It shall contain an alignment guide and a payload trunnion latch to secure the payload; the trunnion latch shall be operated by an electromechanical actuator. *No more than two latches shall be actuated simultaneously.* The mechanism shall be capable of deploying and retrieving statically determinate or indeterminate payloads.

3.3.1.2.2.1 Payload Alignment Guide. The active attach fitting defined in Figure 3.3.1.2.2-1, provides for use of alignment guides extending *8, 16, 22 or 24 inches* above the attach point centerline. The 24 inch alignment guide shall have both left-hand and right-hand versions and shall be installed in the cargo bay with the higher guide on the far side of the fitting from the viewing position. Alignment guide heights selected for specific attach points shall be in accordance with Table 3.3.1.1-1.

3.3.1.2.2.2 Longeron Trunnion for Deployable Payloads. The longeron trunnion for deployable payloads shall be as defined in Figure 3.3.1.2.2.2-1. The scuff plate shall interface with the inboard surfaces of the alignment guides to restrict motion in the  $\pm Y_0$  directions and thus preclude inadvertent contact between the cargo element and Orbiter structure during installation or retrieval into the cargo bay.

3.3.1.2.3 Payload Longeron Trunnion  $Y_0$  Travel. Maximum and minimum longeron trunnion lengths shall be limited by Orbiter structure and by combined deflections of the Orbiter and the payload as defined in Paragraph X.1. To prevent excessive deflections in the trunnion  $Y_0$  direction from resulting in Payload/Orbiter structural interference, the payload design shall incorporate features that will make initial contact occur against the inboard surface of Orbiter attachment support structure.

3.3.1.2.4 Longeron Trunnion Spacing. Minimum allowable longeron trunnion spacing for vertical installation/removal of cargo elements shall be in accordance with Figure 3.3.1.2.4-1.

3.3.1.3 Keel Fitting Interface. The Orbiter shall provide either an active or a passive keel fitting for each payload/carrier. The active keel fitting shall be capable of capturing and releasing the payload keel trunnion, both on the ground and in flight; the passive keel fitting shall not have this capability.

3.3.1.3.1 Active Keel Fitting Interface. Payloads using the active keel fitting shall provide a keel trunnion in accordance with Figure 3.3.1.3.1-1. The interface between the active keel fitting and the payload keel trunnion shall be in accordance with Figure 3.3.1.3.1-1.

3.3.1.3.2 Passive Keel Fitting Interface. The passive keel fitting shall be used only for payloads which are installed with the Orbiter in the horizontal position and shall not be used in lieu of the active keel fitting for payload deployment or retrieval. Payloads using the passive keel fitting shall provide a keel trunnion in accordance with Figure 3.3.1.3.2-1. The interface between the passive keel trunnion and the passive keel fitting shall be as shown on Figure 3.3.1.3.2-2. Current hardware procurement plans do not include use of passive keel fitting by payloads other than Spacelab configurations using keel points deleted by active keel baseline change.

3.3.1.4 Ground Handling at KSC. Cargo elements maybe installed in the orbiter with the orbiter in either a horizontal or vertical attitude. All cargo elements shall be capable of being removed from the orbiter in a vertical attitude. For two flight longeron payloads, appropriate GSE (such as a ground handling trunnion) will be provided to facilitate ground handling for horizontal and vertical installation and removal.

3.3.1.4.1 Horizontal Cargo Element Installation and Removal. A clearance envelope at the longeron trunnion interface shall be provided for horizontal cargo element installation/removal operations in accordance with Figure 3.3.1.4.1-1. GSE end caps on longeron trunnion for cargo element horizontal installation/removal operations shall be in accordance with Figure 3.3.1.4.1-2.

3.3.1.4.2 Vertical Cargo Element Installation and Removal. A clearance envelope at the longeron turnnion interface shall be provided for vertical cargo element installation/removal operation in accordance with Figure 3.3.1.4.2-1.

3.3.2 Standard Interface Panel (SIP). Standard Interface Panels (SIP), located on the port and/or starboard sides of the Cargo Bay, shall provide interface provisions for the Standard Mixed Cargo Harness (SMCH), add-on black boxes, unique connector panels, structural support and clamps for cables *and the Payload Active Cooling Kit (PACK).* *The relationship of the SIP to the element within the Cargo Bay shall be as shown in Figure 3.3.2-1 for bridge and Adaptive Payload Carrier (APC) mount configuration..* For electrical interface definition refer to Section 13.0, specifically Figures 13.3.1.1-1, 13.3.1.2-1, 13.3.1.3-1, and 13.3.4-1. *For PACK interface definition, refer to Section 3.3.5.2, specifically Figure 3.3.5.2-1.*

3.3.2.1 Standard Mixed Cargo Harness - Standard Interface Panel (SMCH-SIP). SIP, with a SMCH Interface Panel Installed (SMCH-SIP), shall be the electrical interface between the Orbiter and the Cargo Element.

3.3.2.1.1 Port SMCH-SIP Connector Panel. The port SMCH-SIP connector panel shall be as shown on Figure 3.3.2.1.1-1.

3.3.2.1.2 Starboard SMCH-SIP Connector Panel. The starboard SMCH-SIP connector panel shall be as shown on Figure 3.3.2.1.2-1. The starboard SMCH-SIP connector panel shall provide cut-outs for additional connectors and one spare power connector. Connector cut-outs and spare power connector are available for cargo element use as defined in cargo element unique ICD's.

3.3.2.2 SMCH-SIP Connectors and Cargo Element Supplied Harness. All SMCH-SIP connectors shall consist of socket (female) contacts for interfacing with the SMCH cables and pin (male) contacts for interfacing with cargo element supplied cables. Cargo element supplied cables shall extend 48.0 +3.0, -0.0 inches beyond their departure from the cargo element structure, and either be hardwired to the cargo element or shall terminate in pin (male) contacts for interfacing with the cargo element. The departure point for the cargo element supplied cables shall be no more than 18 inches from the Orbiter sill.

3.3.2.2.1 Wire Harness Installation. Cargo element supplied wire harnesses shall be installed in accordance with MIL-W-5088. Wire harness installation and routing from the cargo element to the SMCH-SIP shall be a STS function. Wire harness departure from the cargo element structure *shall be in the forward direction and shall be as shown in Figure 3.3.2-1.*

**3.3.2.3 PRLA Power Interface Panel.** The PRLA Power Interface Panel shall be STS supplied as shown in Figure 3.3.2.3-1. It shall be mounted on Standard Interface Panels (SIP). Pin function assignments are as shown in Table 13.6.1.2-7.

**3.3.3 Non-Standard Electrical Interfaces (Independent of SMCH).** *Non-standard electrical interfaces shall be located at Xo 576, Xo 1307, Xo 603, Xo 645, and Xo 1203 as shown on Figures 3.3.3-1 thru 3.3.3-9. Interfaces for Get-Away-Special (GAS) payloads and retention system power as shown on Table 3.3.3-1. These interfaces shall not normally be used by a cargo element except as a non-standard service as defined in cargo element unique ICD's.*

**3.3.4 Fluid and Umbilical Panel Interfaces.** Cargo element usage of the atmospheric revitalization interface (Figure 3.3.4-1),  $GN_2$  purge interface (Figure 3.3.4-2), payload heat exchanger,  $O_2/N_2$  supply interface (Figure 3.3.4-3), payload purge spigots (Figures 3.3.4-4 and 3.3.4-5), mid-body pre-launch umbilical panel (Figure 3.3.4-6), and (T-4) umbilical panels (Figures 3.3.4-7 and 3.3.4-8), and payload active cooling kit (PACK) interface (Figure 3.3.5.2-1) shall be accomplished by installing cargo element supplied wiring and/or fluid lines in accordance with Paragraph 3.3.5.

**3.3.5 Midbody Attachment of Cargo Element Wiring, Fluid Lines and Other Lightweight Airborne Support Equipment (ASE).**

**3.3.5.1 Electrical Cable Accommodations.** The Orbiter shall provide wire trays along the sides of the Cargo Bay, extending from the connector panels at Xo 603 to those at Xo 1203, in accordance with Figure 3.3.5.1-1. The Orbiter shall also provide for egress of SMCH and cargo element provided cables from the wire trays, as required, without physical interference with installed cargo elements.

**3.3.5.2 Fluid Line Accommodations.**

**3.3.5.2.1 Payload Active Cooling Kit (PACK).** *Cargo elements requiring active cooling shall utilize the PACK. This kit provides secondary structure, hardware, insulation, and the generic portion of the coolant supply and return lines between the Payload Heat Exchanger Interface at Station Xo 636 and the PACK Interface at the S9P Structure.*

*The PACK is designed for a wet mate (quick-disconnect interface) and accommodates vertical installation of the Cargo elements.*

*Payloads will provide flex-lines to mate with STS provided quick-disconnects as shown in Figure 3.3.5.2-1. The flex-lines shall provide a 0.75 inch OD rigid tubing segment for a minimum of 4.85 inch to accommodate STS provided clamping. Payload support of the flex-lines shall be in accordance with Paragraph 3.3.5.3.*

**3.3.5.3 Power, Signal and Fluid Interfaces at Cargo Elements.** The cargo element shall provide power and signal cables, as required, to mate and demate with the SMCH-SIP connectors. The cargo element shall provide support for fluid lines and power and signal cables on their side of the departure point with adequate allowance for mating and demating of connectors. The cargo element shall provide cable and fluid line support, as required, such that there shall be no unsupported lengths of cables or fluid lines greater than 18 inches.

3.3.5.4 Midbody Scar. The Orbiter shall provide scar in the midbody for the attachment of cargo element hardware at locations shown in Figure 3.3.5.4-1. Load carrying capability shall be such that a ten pound weight can be carried at each scar location simultaneously. Use of this scar by each cargo element shall be limited to that specified in its unique ICD.

3.3.6 Cargo-to-Orbiter Electrical Bond. Each cargo element shall provide a cargo-to-orbiter electrical bond in accordance with Paragraph 3.3.6.1, 3.3.6.2, or 3.3.6.3 unless otherwise specified in the cargo element-unique ICD. All electrical bond interfaces shall conform to requirements specified in Paragraph 10.7.4.2.

3.3.6.1 Primary PL Bus Connector Bond. The PRI PL BUS connector bond is defined to be the main Orbiter-to-Cargo power interface and shall be accomplished by a single *wire in the power connector, as specified in Paragraph 10.7.4.2.2.1.1.*

3.3.6.2 Cargo-to-Orbiter Bond Strap. *In lieu of the power connector bond, the Cargo-to-Orbiter bond strap shall be SJS-provided (as an optional service) and shall be connected between Orbiter structure and cargo ground stud provisions. Orbiter ground stud provisions are defined in Figure 3.3.6.2-1. This bond shall meet the appropriate bond class requirements of Paragraph 10.7.4.2 and shall have less than or equal to 0.25 milliohms at each junction of the fault current interface. The specific implementation of this interface shall be defined in the payload unique ICD.*

3.3.6.3 Cargo-To-Orbiter Static Bonding At The Keel Trunnion. Cargo-To-Orbiter static bonding shall be provided through the Orbiter keel latch bonding assembly establishing and maintaining contact with the cargo element keel trunnion. Keel bonding characteristics shall be as specified in Paragraph 10.7.4.2.2.5.

3.3.7 Payload Purge Spigots. The payload purge spigots interface shall be in accordance with Figure 3.3.4-4 and 3.3.4-5.

Table 3.3.1.1-1 Attachment Point Locations and Constraints\*

Number	X <sub>0</sub> (Inches)	Keel Fitting			Longeron Fitting		
		Active	** Passive	Notes	Active	Passive	Notes
155	612.73	(13)	(13)				
156	616.67	x	x		(3,7,9)	(3)	
157	620.60	x	x		(3,7,9)	x	
158	624.53		(11)		(3,7,9)	(9)	
159	628.47				(3,7,9)	x	
160	632.40				(3,7,9)	x	
163	644.20				(3,7)	x	
164	648.13				(3,7)	x	
165	652.07		x		(3,7,10)	(10)	
166	656.00	x	x		(3,7,10)	(10)	
167	659.93	x	x		(3,7,10)	(10)	
168	663.87	x	x				
169	667.80	x	x				
170	671.73	x	x				
171	675.67	x	x				
172	679.60	(1,11)	(11)				
177	699.27				(3,6)	x	
178	703.20				(6)	x	
179	707.13				(6)	x	
180	711.07	(1)	x		x	x	
181	715.00	x	x		x	x	
182	718.93	x	x		(5)	x	
183	722.87	x	x		(5)	x	
184	726.80	x	x		(5)	x	
185	730.73	x	x		(3,5)	(3)	
186	734.67	x	x				
187	738.60		x				
188	742.53					(3)	
189	746.47					(4)	
192	758.27				(3,4,5)	x	
193	762.20				(5)	x	
194	766.13		(11)		(5)	x	
195	770.07	x	x		(5)	x	
196	774.00	x	x		x	x	
197	777.93	x	x		x	x	
198	781.87	x	x		(10)	(10)	
199	785.80	x	x		(10)	(10)	
200	789.73	x	x		(5)	x	
201	793.67	(1)	x		(5)	x	
202	797.60				(5)	x	
203	801.53				(3,5)	x	
206	813.33				(3)	x	
207	817.27				x	x	
208	821.20		(11)		x	x	
209	825.13	(1)	x		x	x	
210	829.07	x	x		x	x	

Table 3.3.1.1-1 Attachment Point Locations and Constraints\*  
(Continued)

Number	X <sub>0</sub> (Inches)	Keel Fitting			Longeron Fitting		
		Active	Passive	Notes	Active	Passive	Notes
211	833.00	x	x		x	x	
212	836.93	x	x		(10)	(10)	
213	840.87	x	x		(10)	(10)	
214	844.80	x	x		x	x	
215	848.73	x	x		(10)	(10)	
216	852.67		x		(10)	(10)	
217	856.60				(5)	x	
218	860.53				(3,5)	x	
221	872.33				(3)	x	
222	876.27				x	x	
223	880.20	(1)	x		x	x	
224	884.13	(1)	x		x	x	
225	888.07	x	x		x	x	
226	892.00	x	x		x	x	
227	895.93	x	x		(3)	x	
228	899.87	x	x				
229	903.80	x	x				
230	907.73		x				
234	923.47				(3,6)	x	
235	927.40				(6)	x	
236	931.33				(6,10)	(10)	
237	935.27		(11)		(5,10)	(10)	
238	939.20	x	x		(5)	x	
239	943.13	x	x		(5)	x	
240	947.07	x	x		x	x	
241	951.00	x	x		x	x	
242	954.93	x	x		(10)	(10)	
243	958.87	x	x		(3,10)	(3,10)	
244	962.80	x	x				
245	966.73		x				
247	974.60					x	
250	986.40				(3)	x	
251	990/33				x	x	
252	994.27		(11)		x	x	
253	998.20	x	x		x	x	
254	1002.13	x	x		x	x	
255	1006.07	x	x		x	x	
256	1010.00	x	x		x	x	
257	1013.93	x	x		(5)	x	
258	1017.87	x	x		(5)	x	
259	1021.80	x	x		(5)	x	
260	1025.73	x	x		(5)	x	
261	1029.67		x		(10)	(10)	
262	1033.60				(10)	(10)	
263	1037.53				(3)	x	
266	1049.33				(3)	x	

**Table 3.3.1.1-1 Attachment Point Locations and Constraints\***  
(Continued)

Number	X <sub>0</sub> (Inches)	Keel Fitting			Longeron Fitting		
		Active	** Passive	Notes	Active	Passive	Notes
267	1053.27				x	x	
268	1057.20	(1)	x		x	x	
269	1061.13	x	x		x	x	
270	1065.07	x	x		x	x	
271	1069.00	x	x		x	x	
272	1072.93	x	x		x	x	
273	1076.87	(1)	x		(5)	x	
274	1080.80				(3,5)	x	
277	1092.60				(3,5)	x	
278	1096.53				(10)	(10)	
279	1100.47				(10)	(10)	
280	1104.40				(10)	(10)	
281	1108.33	x	x		x	x	
282	1112.27	x	x		(5)	x	
283	1116.20	x	x		(5)	x	
284	1120.13	x	x		(5)	x	
285	1124.07	x	x		(5)	x	
286	1128.00		x		(5)	x	
287	1131.93				(5)	x	
288	1135.87				(3)	x	
292	1151.60				(3)	(3)	
293	1155.53		x		(8)	x	
294	1159.47	x	x		x	x	
295	1163.40	x	x		x	x	
296	1167.33	x	x		x	x	
297	1171.27	x	x		x	x	
298	1175.20	x	x		x	x	
299	1179.13		x			(3)	
304	1198.80					(3,10)	
305	1202.73				(8,10)	(10)	
306	1206.67	x	x		(5,10)	(10)	
307	1210.60	x	x		(5)	x	
308	1214.53	x	x		(5)	x	
309	1218.47	x	x		(5)	x	
310	1222.40	x	x		(8,12)	x	
311	1226.33	x	x		(12)	x	
312	1230.27				(9)	x	
313	1234.20				(9)	(9)	
314	1238.13				(9)	x	
315	1242.07				(9)	x	
316	1246.00				(3,9)	(3)	
322	1269.60					(3)	
323	1273.53				(3)	x	
324	1277.47					x	
325	1281.40					x	

**Table 3.3.1.1-1 Attachment Point Locations and Constraints  
(Continued)**

**$Y_0$  and  $Z_0$  Coordinates of Attach Points**

! Longeron: $Y_0 \pm 94.0$ , $Z_0$ 414.00	!
! Keel: Forward of $X_0$ 1191: $Y_0 = 0$ , $Z_0 = 305.0$	!
! Aft of $X_0$ 1191: $Y_0 = 0$ , $Z_0 = 308.4$	!

**GENERAL NOTES:**

- \* "x" denotes attachment capability. A number in parentheses indicates attachment capability as limited in note.
- \*\* Visual observation of the payload keel trunnion/keel attach fitting interface is required during installation of a payload using a passive keel fitting.

A 24 inch high trunnion guide may be used at all available longeron attach points which are not referenced to Note 5 or Note 6.

**SPECIAL NOTES:**

The following restraints are applicable to certain attach points as referenced in the "Notes" column and under attachment type. They do not apply to other attach points.

1. Payload retrieval capability at this location *may be marginal and must be evaluated on a case-by-case basis by NASA/JSC (latch opening not symmetrical about attach point  $X_0$  location in open position).*
2. Reserved.
3. These longeron attach points may be used only for primary fittings; i.e., the fitting must be pinned to the longeron.
4. Available at port side only.
5. These longeron attach points are available for deployment and retrieval operations only with an 8-inch-high trunnion guide.
6. These longeron attach points are available for deployment and retrieval operations with an 8-inch trunnion guide on the RMS side and either an 8-inch or a 24-inch-high trunnion guide on the non-RMS side.
7. *When the RMS is installed, these attach points are available for deployment and retrieval operations with only an 8 or 16-inch trunnion guide on the RMS side.*
8. *These longeron attach points are available with an 8 or 16-inch guide on the stabilizing fitting and a 22 or 24-inch guide on the primary fitting.*



**Table 3.3.1.1-1 Attachment Point Locations And Constraints  
(Concluded)**

**SPECIAL NOTES: (Cont)**

9. These longeron attach points are not available for use when the EVA slidewire is installed.
10. Trunnion lengths at these attach points shall be selected to meet the criteria in Appendix X when trunnion spacing in the  $X_0$  direction is greater than 100 inches.
11. Trunnion lengths at these attach points shall be selected to meet the criteria in Appendix X.
12. *Utilization of this longeron attach point with the EVA slidewire installed is dependent upon selection of specific latch configuration and orientation.*
13. *Use requires a special evaluation/analysis by NASA/JSC. This location normally restricted to a pinned passive fitting.*

Table 3.3.3-1 Retention System Power Connectors Locations

LOCATION NUMBER	PORT (-Yo101.75; Zo410.0)		Starboard (Yo101.75; Zo410.0)		Xo FOR CONN. J1 CENTER LINE	Xo FOR CONN. J2 CENTER LINE	BAY NO.
	J1	J2	J1	J2			
1	J9017	J9019	J9022	J9024	627.24	630.24	1
2	J9021	J9023	J9026	J9028	642.65	645.65	2
3(1)	J9049	J9051	J9048	J9052	708.30	709.65	3
4(1)	J9061	J9063	J9064	J9066	744.51	746.00	3
5(1)	J9073	J9075	J9078	J9082	811.25	814.25	5
6(1)	J9085	J9087	J9094	J9096	885.50	886.74	6
7(1)	J9097	J9099	J9108	J9112	924.75	926.35	7
8(1)	J9101	J9103	J9114	J9116	1003.75	1005.15	8
9	J9111	J9113	J9126	J9128	1050.40	1051.75	9
10	J9121	J9123	J9138	J9142	1106.75	1109.75	10
11	J9133	J9135	J9154	J9156	1160.55	1163.75	11
12	J9143	J9145	J9166	J9168	1229.20	1232.20	12

- (1) Connectors J1 at these cargo bay locations (Port/STBD) provide, in addition to retention system power service, electrical interfaces for Get-Away-Special (GAS) payloads.
2. For connector part numbers and pin assignments refer to Section 13.0.

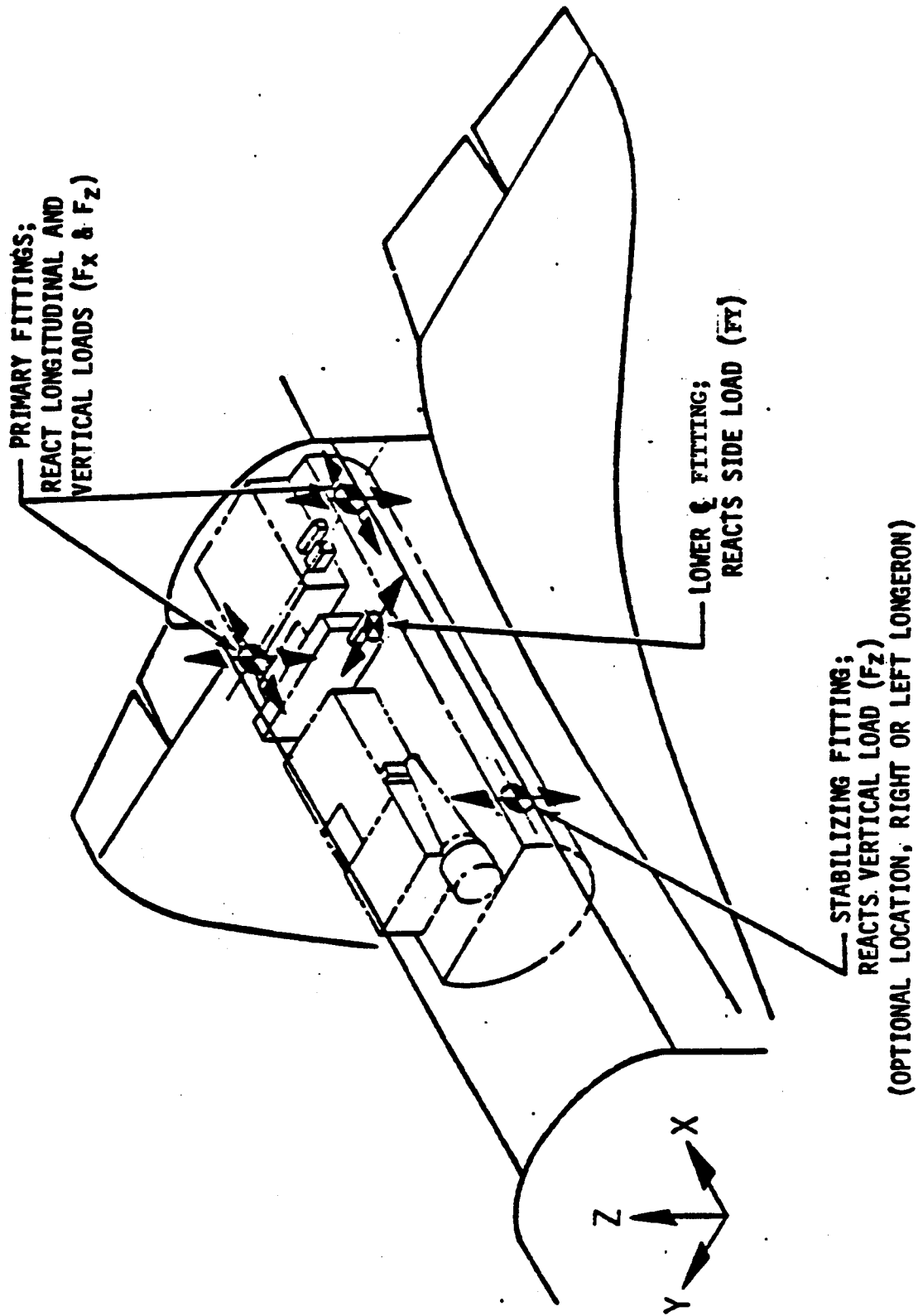


FIGURE 3.3.1-1 4-POINT PAYLOAD RETENTION SYSTEM (DETERMINATE)

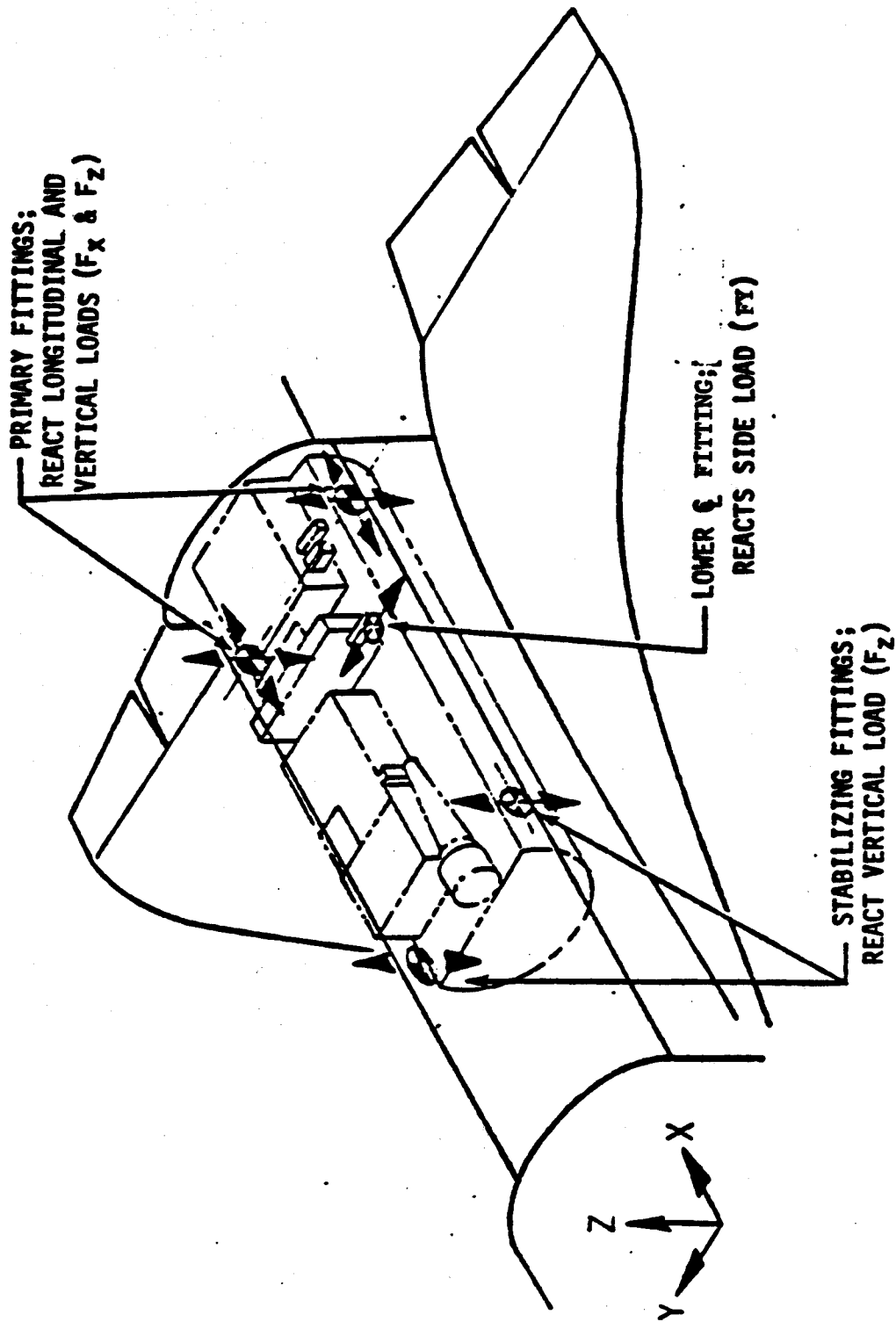


FIGURE 3.3.1-2 5-POINT PAYLOAD RETENTION SYSTEM (INDETERMINATE)

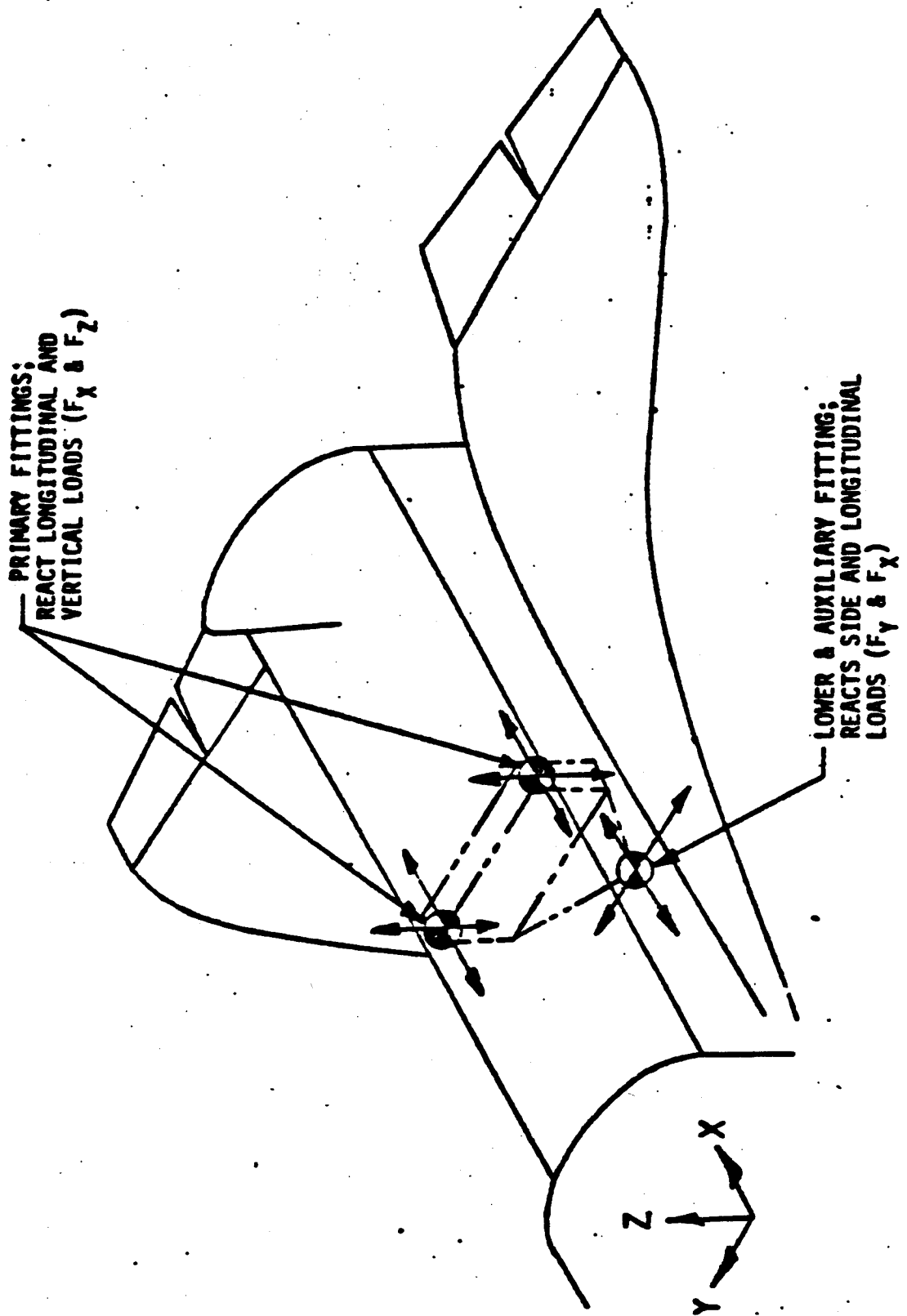
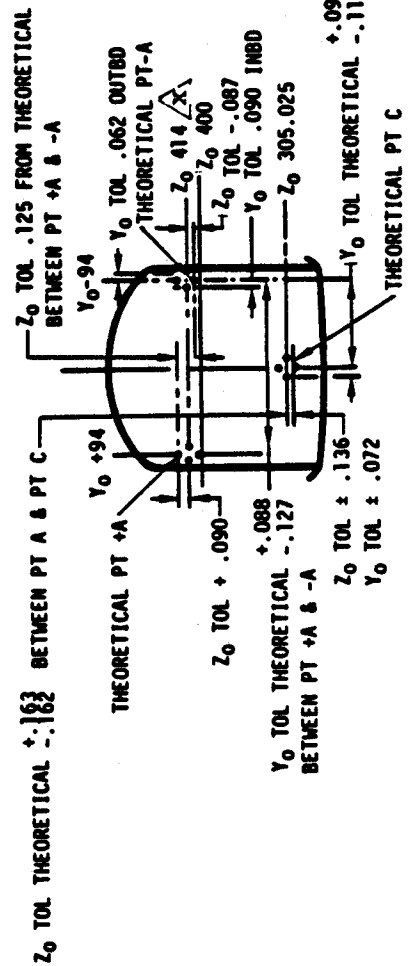
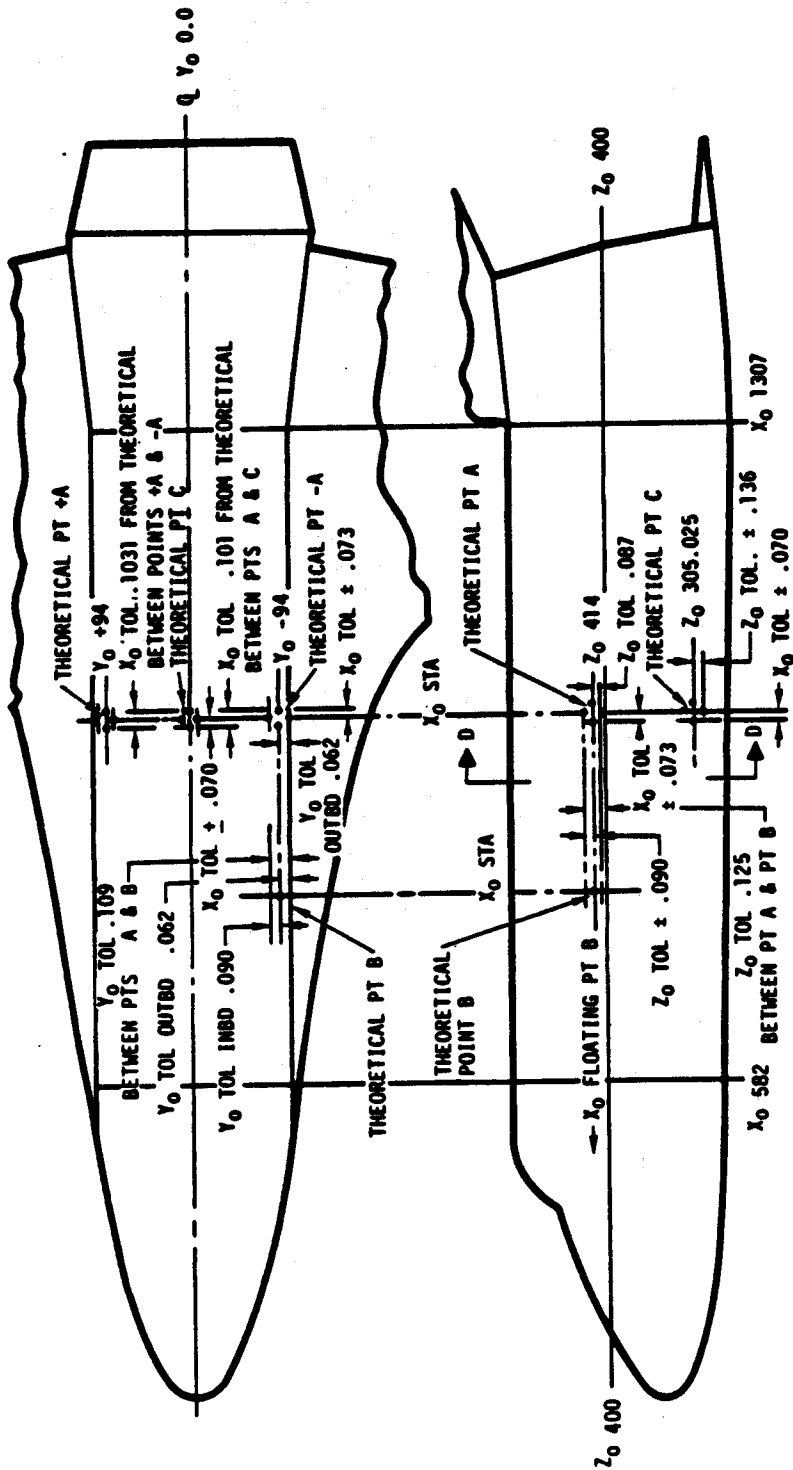
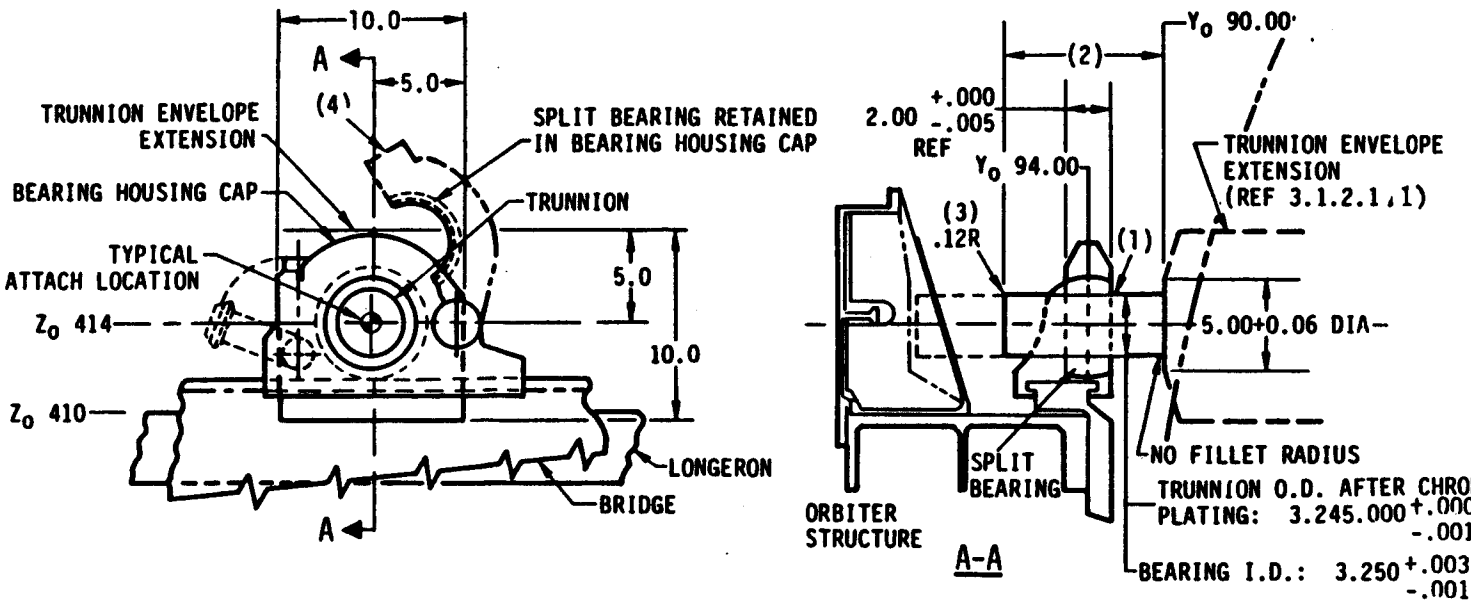


FIGURE 3.3.1-3 3-POINT PAYLOAD RETENTION SYSTEM (DETERMINATE)



Use  $Z_0$  414.00 for passive latches.  
 Use  $Z_0$  414.05 for active latches.

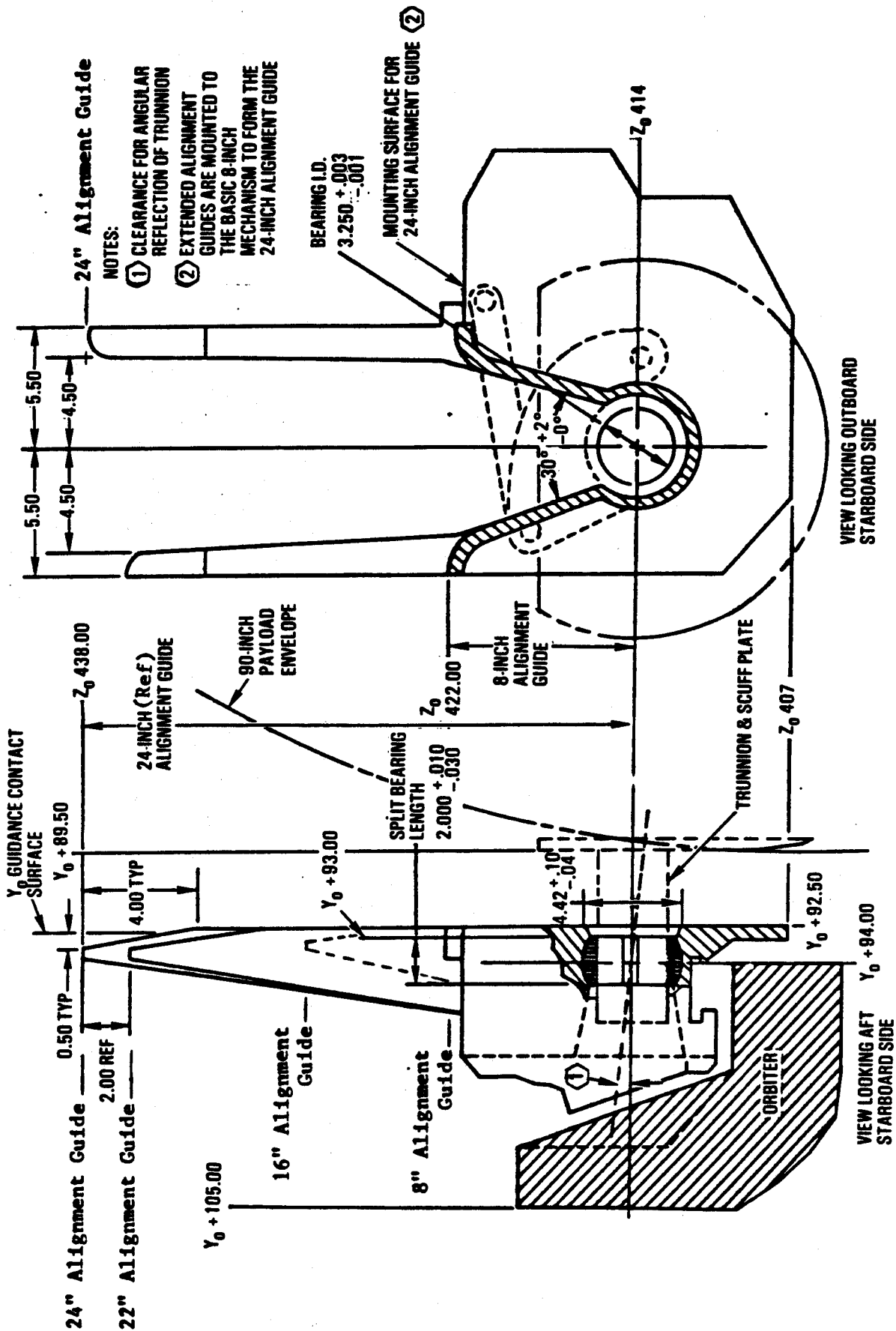
Figure 3.3.1.1.1-1 Payload Attach Point Location Tolerances



**NOTES:**

- (1) TRUNNION SURFACE MATERIAL:  
 ON NICKEL-BASED ALLOYS (e.g. INCONEL 718): ELECTRO-DEPOSITED CHROME (PER FEDERAL SPEC QQ-C-320B, CLASS 2); THICKNESS 0.0003 IN. (0.008MM) MINIMUM.  
 ON TITANIUM: ELECTRO-DEPOSITED CHROME (PER ROCKWELL SPEC MA0109-318); THICKNESS 0.002 IN. (0.05MM) MINIMUM. TRUNNION SURFACE FINISH AFTER CHROME PLATING  $\sqrt{8}$  (8 RHR, MEASURED IN MICRONICHES -- EQUIVALENT TO 0.2 MICRON). SUBSEQUENT TO GRINDING, THE FINAL SURFACE FINISH SHALL BE OBTAINED BY POLISHING, LAPPING, BUFFING, OR SIMILAR METHODS.
- (2) TRUNNION LENGTH SHALL BE IN ACCORDANCE WITH THE FOLLOWING:  
 FOR TRUNNION SPACING IN THE  $X_0$  DIRECTION OF 100 INCHES OR LESS -  
 LENGTH IS 6.5 INCHES  
 FOR TRUNNION SPACING GREATER THAN 100 INCHES -  
 LENGTH IS 7.75 INCHES
- (3) THIS RADIUS FAIRED WITH NO MISMATCH TO CYLINDRICAL SURFACE.
- (4) BEARING HOUSING CAP SHOWN SWINGING AFT. ATTACH FITTINGS ARE INTERCHANGEABLE FROM STARBOARD SIDE TO PORT, REVERSING SWING DIRECTION.

FIGURE 3.3.1.2.1-1 LONGERON ATTACHMENT MECHANISM AND ASSOCIATED PAYLOAD TRUNNION FOR NON-DEPLOYABLE PAYLOAD



NOTES:  
 (1) CLEARANCE FOR ANGULAR REFLECTION OF TRUNNION  
 (2) EXTENDED ALIGNMENT GUIDES ARE MOUNTED TO THE BASIC 8-INCH MECHANISM TO FORM THE 24-INCH ALIGNMENT GUIDE

Figure 3.3.1.2.2-1 Active Attach Fitting



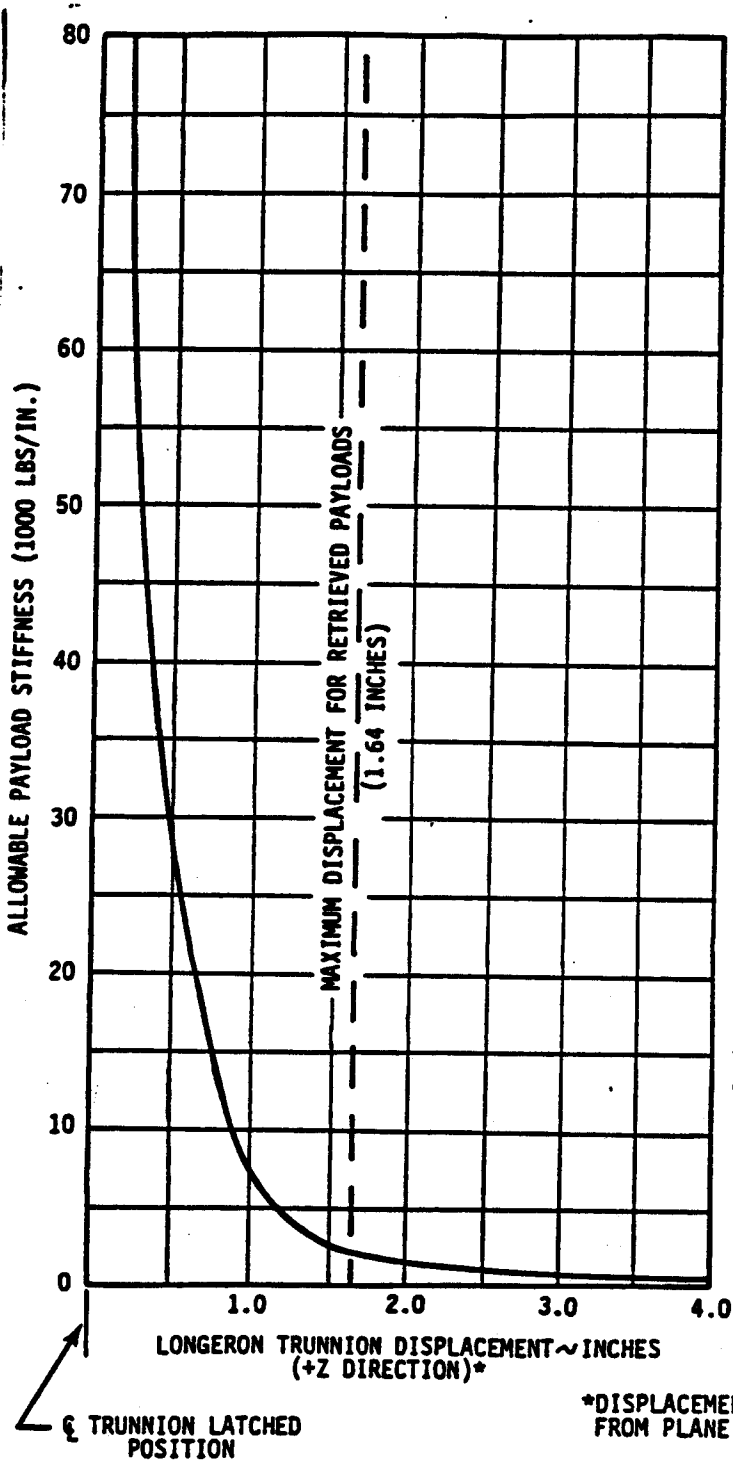


FIGURE 3.3.1.2.2-2 ALLOWABLE PAYLOAD STIFFNESS BASED ON ORBITER LATCHING CAPABILITY

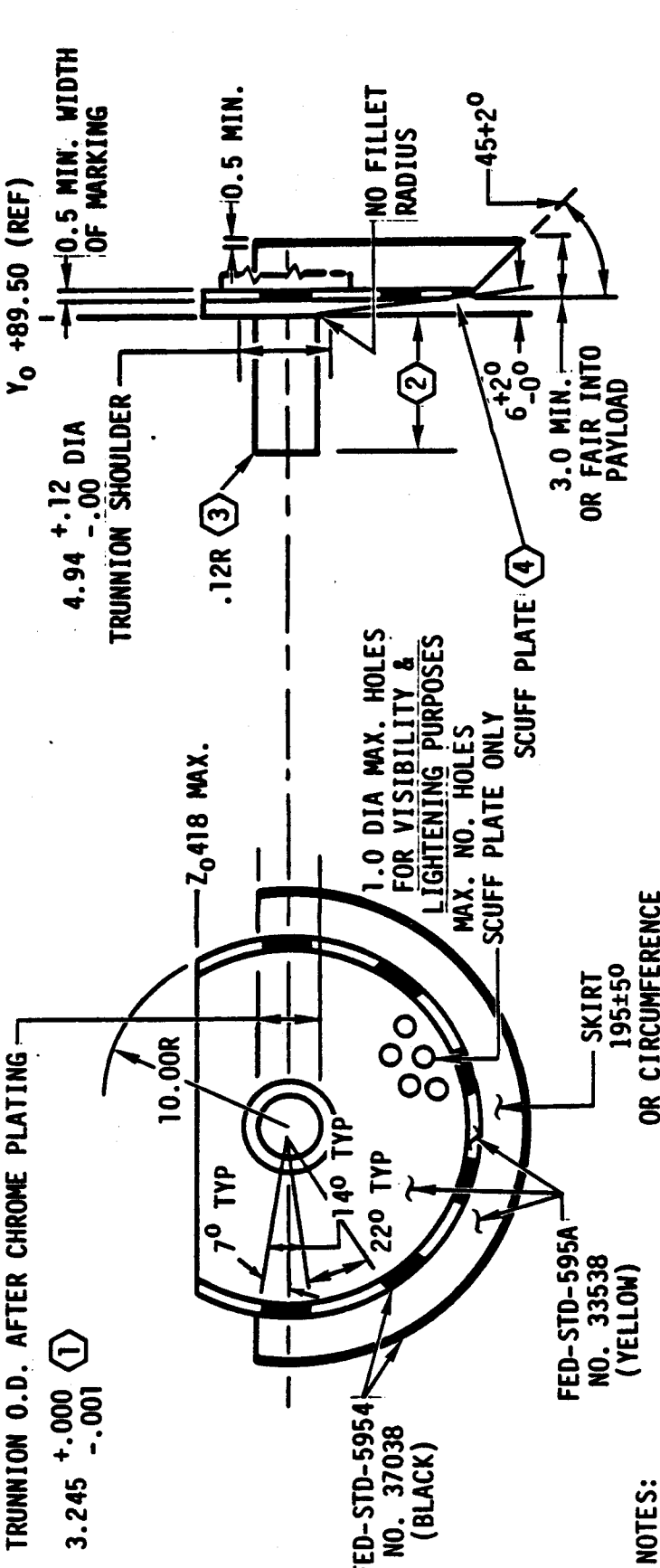


FIGURE 3.3.1.2.2.2-1 LONGERON TRUNNION AND SCUFF PLATE FOR DEPLOYABLE PAYLOADS

- NOTES:
- ① TRUNNION SURFACE MATERIAL:  
ON NICKEL-BASED ALLOYS (e.g., INCONEL 718): ELECTRO-DEPOSITED CHROME (PER FEDERAL SPEC. QQ-C-3208, CLASS 2); THICKNESS 0.0003 IN. (0.008MM) MINIMUM.  
ON TITANIUM: ELECTRO-DEPOSITED CHROME (PER ROCKWELL SPEC MA0109-318); THICKNESS 0.002 IN. (0.05MM) MINIMUM. TRUNNION SURFACE FINISH AFTER CHROME PLATING  $\sqrt{R}$  (8 RHR, MEASURED IN MICROINCHES - EQUIVALENT TO 0.2 MICRON). SUBSEQUENT TO GRINDING, THE FINAL SURFACE FINISH SHALL BE OBTAINED BY POLISHING, LAPPING, BUFFING, OR SIMILAR METHODS.
  - ② TRUNNION LENGTH SHALL BE IN ACCORDANCE WITH THE FOLLOWING:  
FOR TRUNNION SPACING IN THE X<sub>0</sub> DIRECTION OF 100 INCHES OR LESS - LENGTH IS 7.00 INCHES  
FOR TRUNNION SPACING GREATER THAN 100 INCHES - LENGTH IS 8.25 INCHES
  - ③ THIS RADIUS FAIRED WITH NO MISMATCH TO CYLINDRICAL SURFACE.
  - ④ AT SUPPLIERS OPTION, SCUFF PLATE MAY BE SEPARATE PIECE ATTACHED TO TRUNNION OR MAY BE INTEGRAL PART OF TRUNNION OR PAYLOAD.
  5. SCUFF PLATE IMPACT REQUIREMENT: ENERGY EQUIVALENT TO PAYLOAD MASS MOVING AT 0.11 FPS (32K CARGO ELEMENT MAX).

MINIMUM TRUNNION / J-HOOK SPACING FOR VERTICAL PYL INSTL / REMOVE

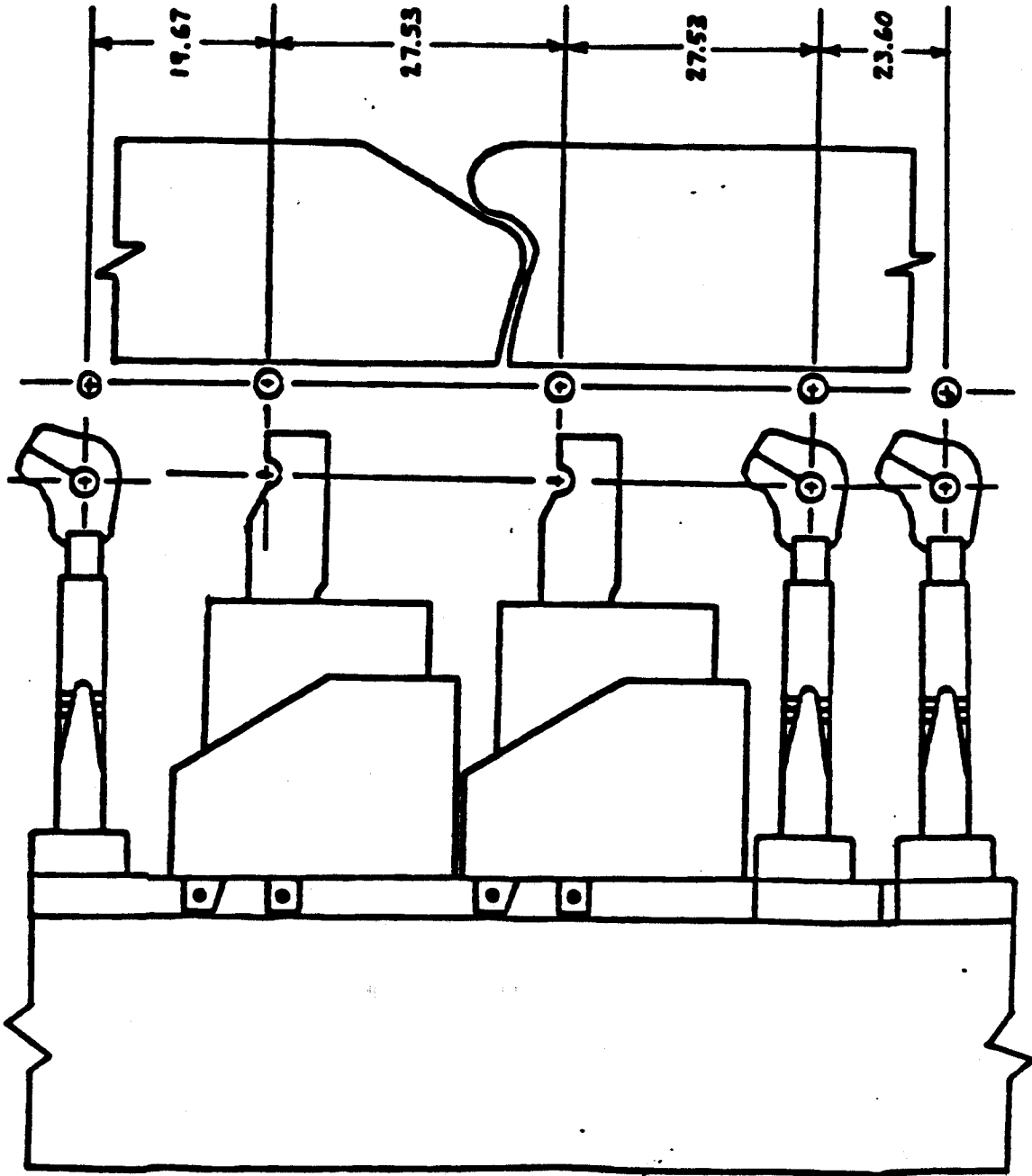
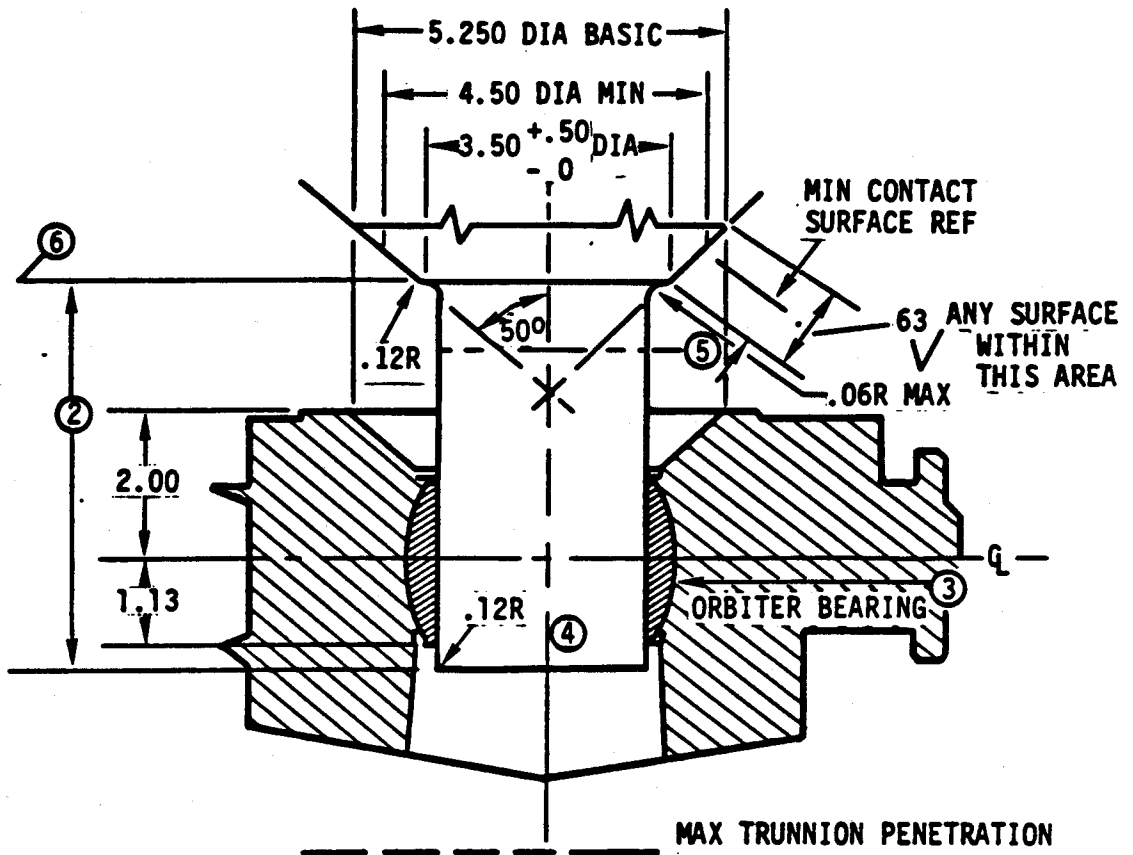


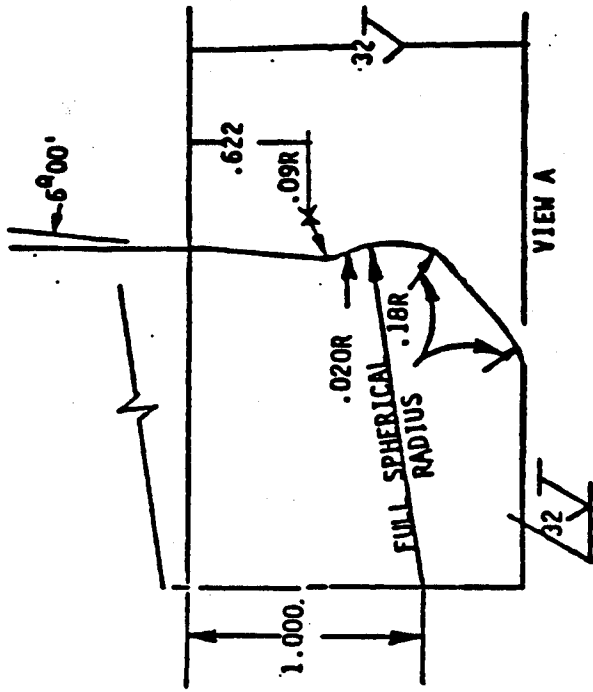
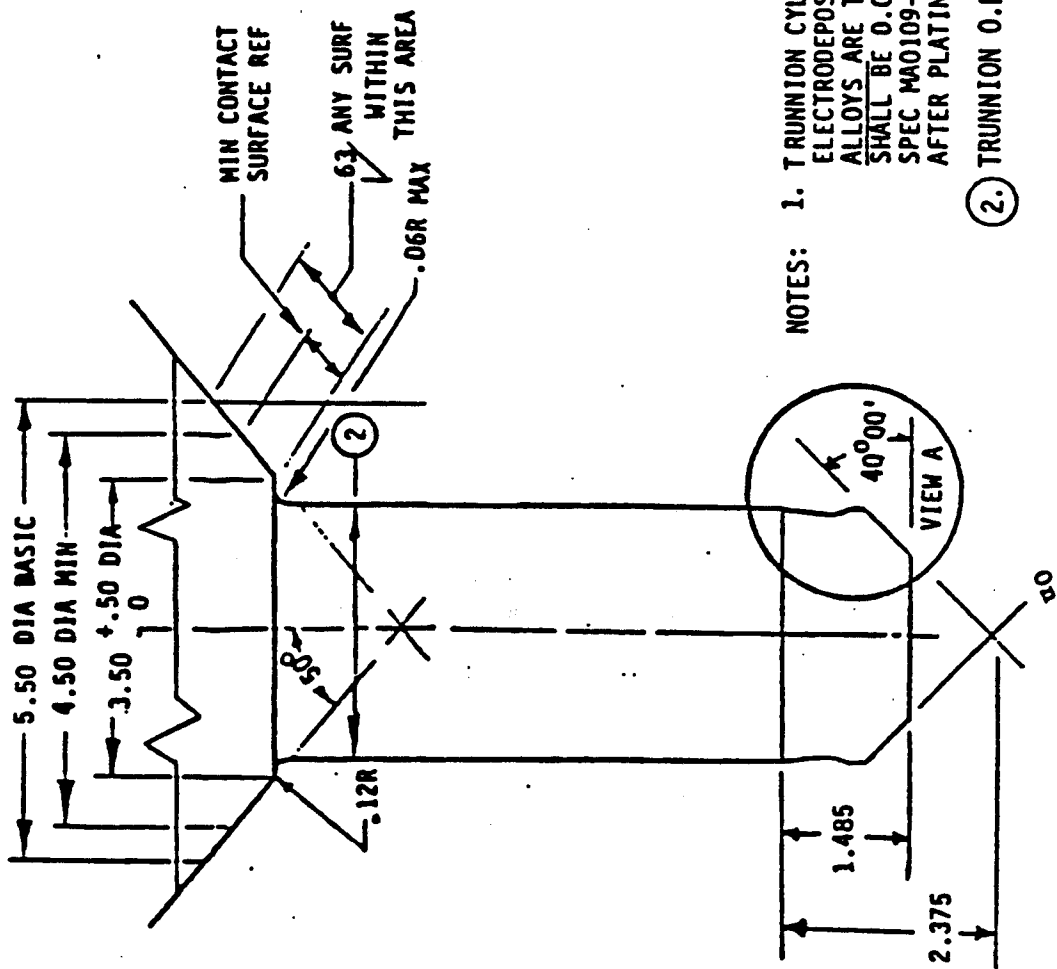
Figure 3.3.1.2.4-1 Minimum Allowable Longeron Trunnion Spacing For Vertical Installation/Removal



NOTES:

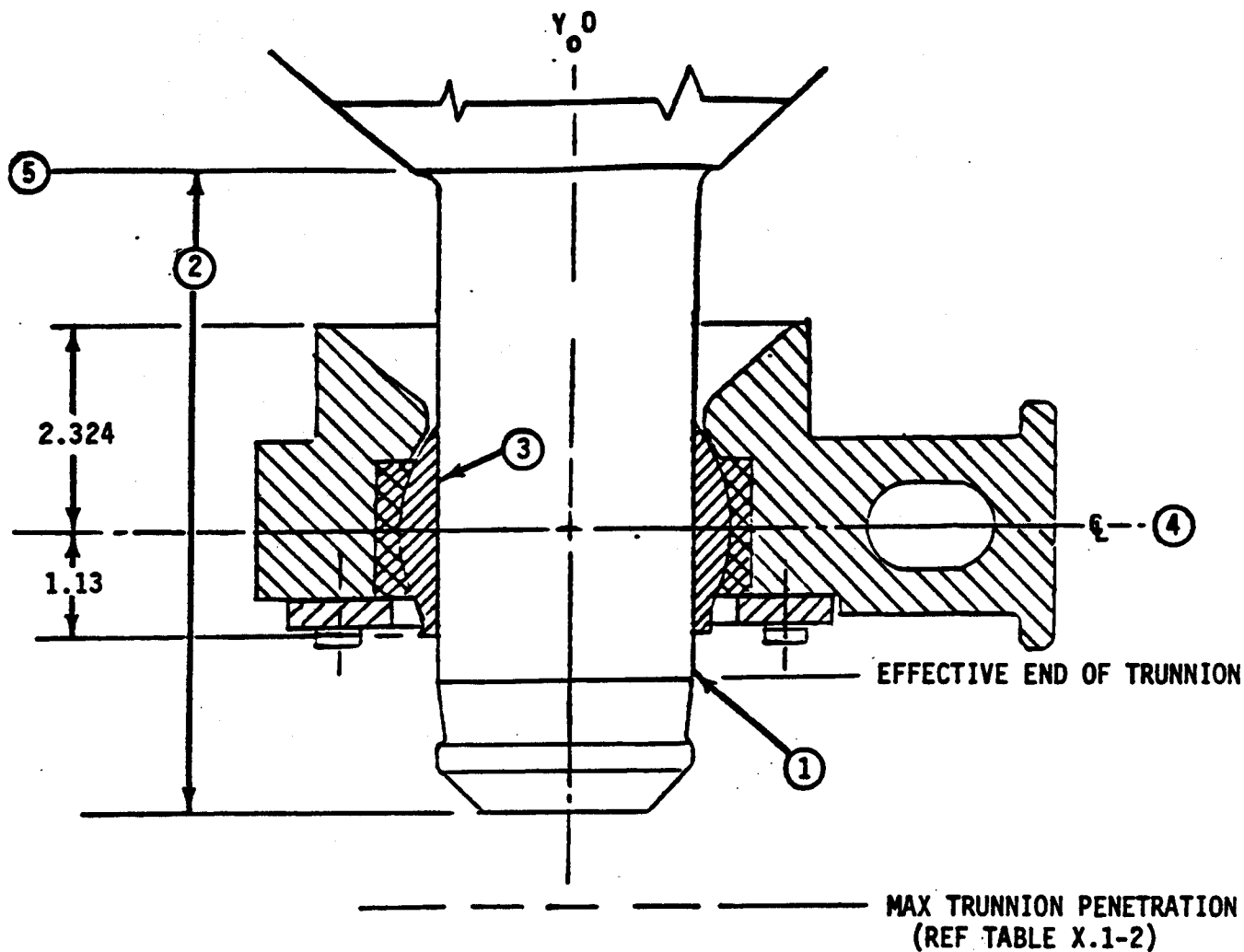
1. TRUNNION CYLINDRICAL SURFACE MATERIAL: HARD, DENSE, FINEGRAINED, ELECTRODEPOSITED CHROME TO WITHIN 0.15 INCH OF ROOT. NICKEL-BASED ALLOYS ARE TO BE PLATED PER FED SPEC QQ-C-320B, CLASS 2: THICKNESS SHALL BE 0.0003 INCH MIN. TITANIUM IS TO BE PLATED PER ROCKWELL SPEC MA0109-318: THICKNESS SHALL BE 0.002 INCH MIN. TRUNNION FINISH AFTER PLATING SHALL BE  $\sqrt{8}$  (8 RHR, MEASURED IN MICROINCHES).
- ② TRUNNION LENGTH SHALL BE IN ACCORDANCE WITH THE FOLLOWING:  
 FORWARD OF X<sub>01191.00</sub> - LENGTH IS 8.00 INCHES  
 AFT OF X<sub>01191.00</sub> - LENGTH IS 4.82 INCHES
- ③ SELF-ALIGNING SPLIT BEARING, INSIDE DIAMETER 3.000+0.001,-0.000. BEARING CENTERLINE AT Z<sub>0305.025</sub> FORWARD OF X<sub>01191</sub>, AT Z<sub>0308.40</sub> AFT OF X<sub>01191</sub>.
- ④ BLEND WITHOUT MISMATCH WITH CYLINDRICAL O.D.
- ⑤ TRUNNION O.D. AFTER CHROME PLATING: 2.9960+.0000  
 -.0010
- ⑥ TRUNNION STATIC LOCATION AT Z<sub>0309.50</sub> FORWARD OF X<sub>01191</sub>, AT Z<sub>0311.10</sub> AFT OF X<sub>01191</sub>.

FIGURE 3.3.1.3.1-1 PAYLOAD KEEL TRUNNION FOR ACTIVE KEEL FITTING



- NOTES:
1. TRUNNION CYLINDRICAL SURFACE MATERIAL: HARD, DENSE, FINE-GRAINED, ELECTRODEPOSITED CHROME TO WITHIN 0.25 INCH OF ROOT. NICKEL-BASED ALLOYS ARE TO BE PLATED PER FED SPEC QQ-C-320B, CLASS 2; THICKNESS SHALL BE 0.0003 INCH MIN. TITANIUM IS TO BE PLATED PER ROCKWELL SPEC MA0109-318; THICKNESS SHALL BE 0.002 INCH MIN. TRUNNION FINISH AFTER PLATING SHALL BE  $\sqrt{8}$  RHR, MEASURED IN MICROINCHES).
  2. TRUNNION O.D. AFTER CHROME PLATING 2.9960 +.0000, -.0010

FIGURE 3.3.1.3.2-1 PAYLOAD PASSIVE KEEL TRUNNION DETAILS



**NOTES:**

- ① PASSIVE KEEL TRUNNION - SEE FIGURE 3.3.1.3.2-1
- ② TRUNNION LENGTH SHALL BE SUCH THAT THE EFFECTIVE END OF TRUNNION SHALL REMAIN WITHIN THE LIMITS ESTABLISHED IN APPENDIX X UNDER COUPLED ORBITER AND CARGO ELEMENT DEFLECTIONS.
- ③ SELF-ALIGNING BEARING ASSEMBLY, INSIDE DIAMETER 3.0000+0.0010, -0.0000 AND 2.26 INCH LONG
- ④ BEARING CENTERLINE AT  $Z_0 305.025$  FORWARD OF  $X_0 1191$ ,  
AT  $Z_0 308.40$  AFT OF  $X_0 1191$
- ⑤ TRUNNION STATIC LOCATION AT  $Z_0 309.50$  FORWARD OF  $X_0 1191$ ,  
AT  $Z_0 311.10$  AFT OF  $X_0 1191$

FIGURE 3.3.1.3.2-2 PASSIVE KEEL ATTACHMENT INTERFACE DETAILS

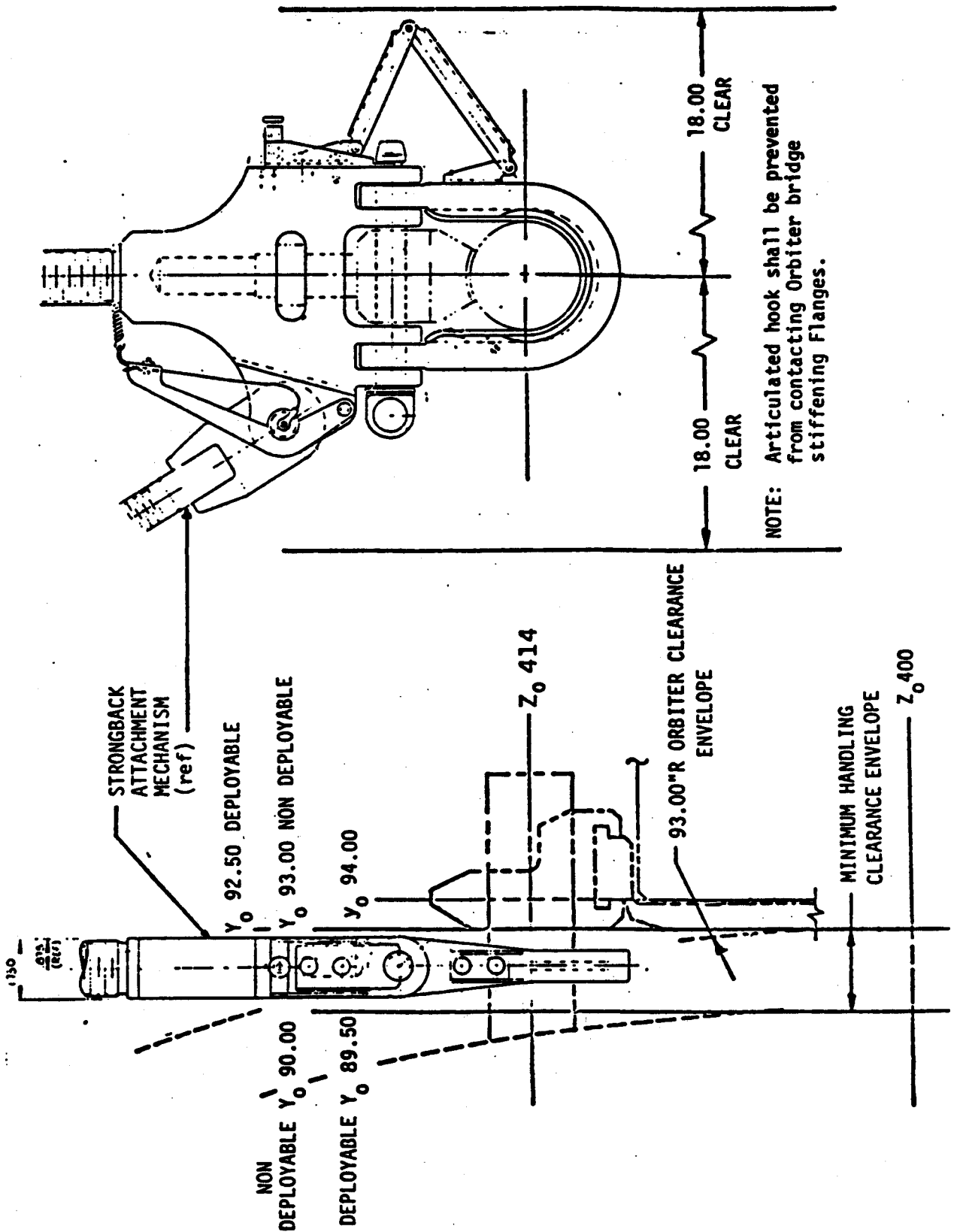


FIGURE 3.3.1.4.1-1 HORIZONTAL GROUND HANDLING ACCESS CLEARANCE ENVELOPE

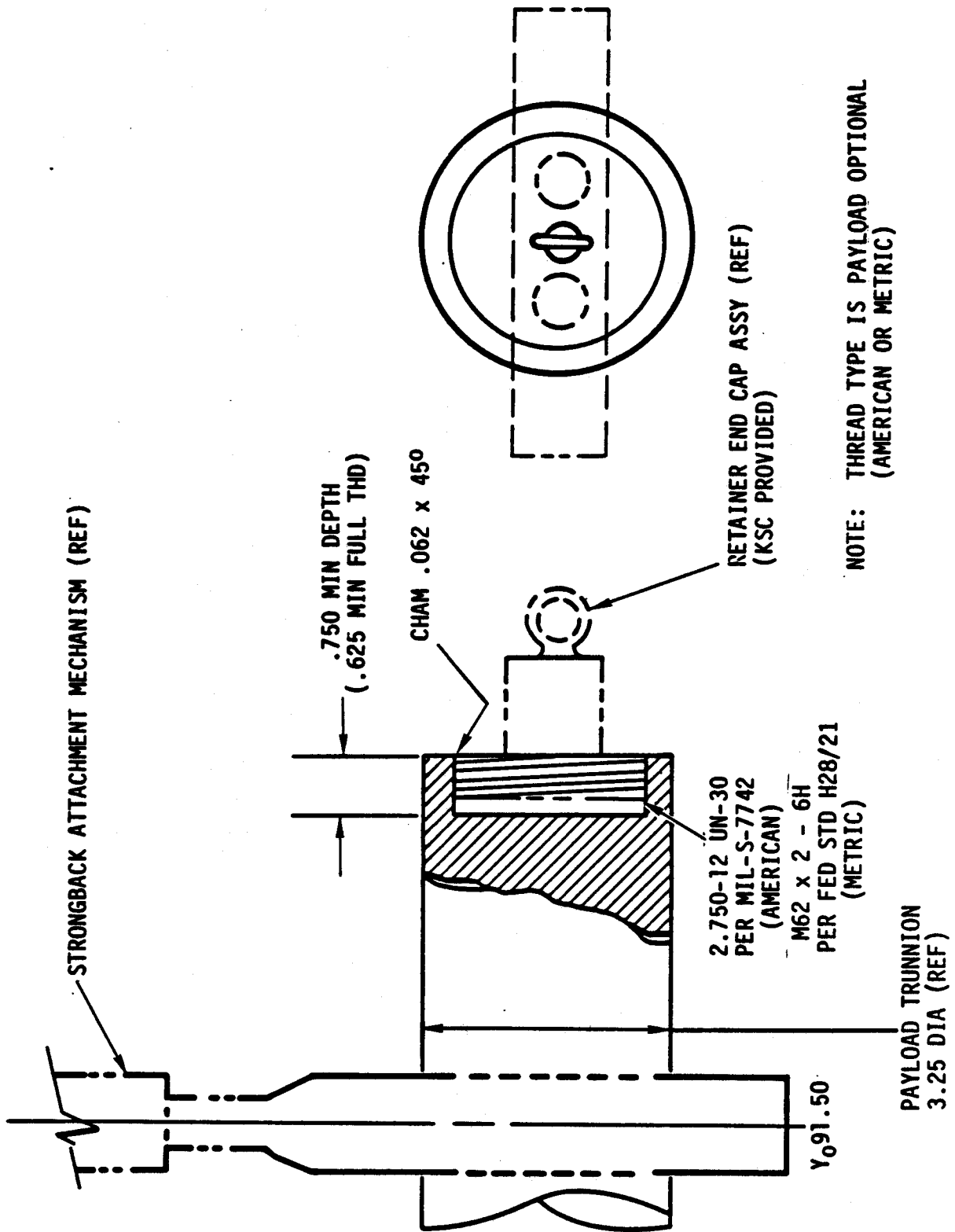


FIGURE 3.3.1.4.1-2 TRUNNION WITH END CAP



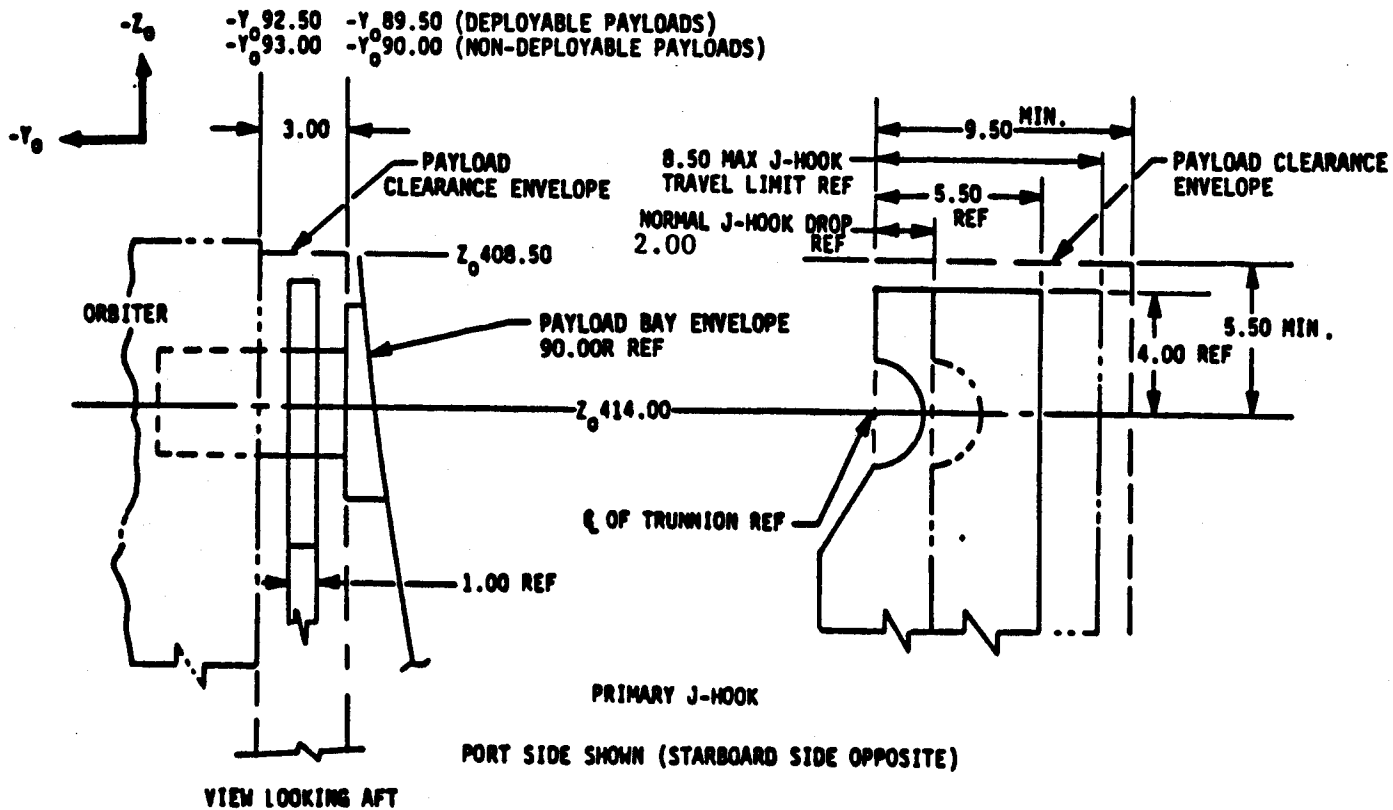


FIGURE 3.3.1.4.2-1 VERTICAL GROUND HANDLING CLEARANCE ENVELOPE FOR J-HOOK FITTING (SHEET 1 OF 2)

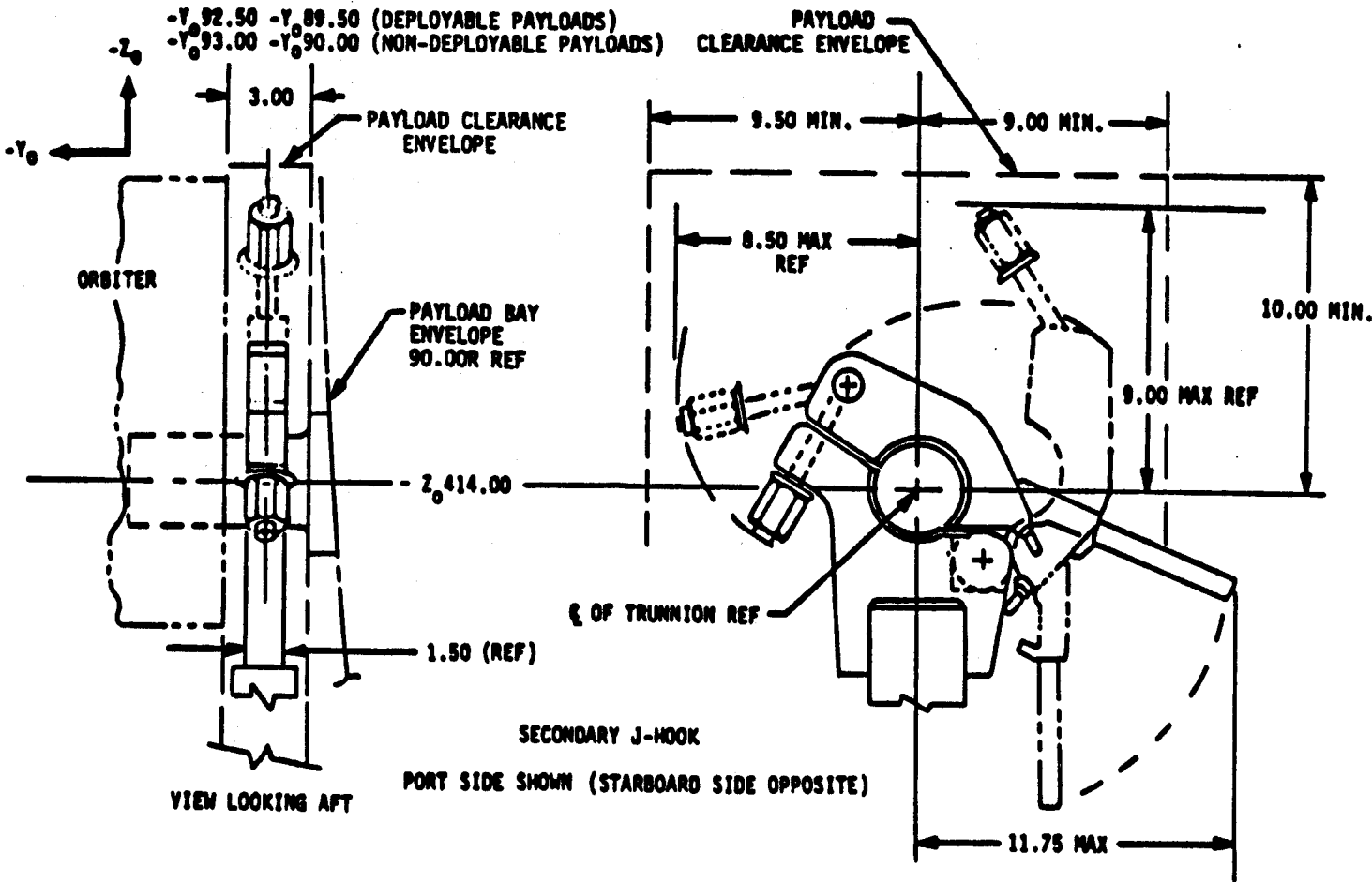


FIGURE 3.3.1.4.2-1 VERTICAL GROUND HANDLING CLEARANCE ENVELOPE FOR J-HOOK FITTING (SHEET 2 OF 2)

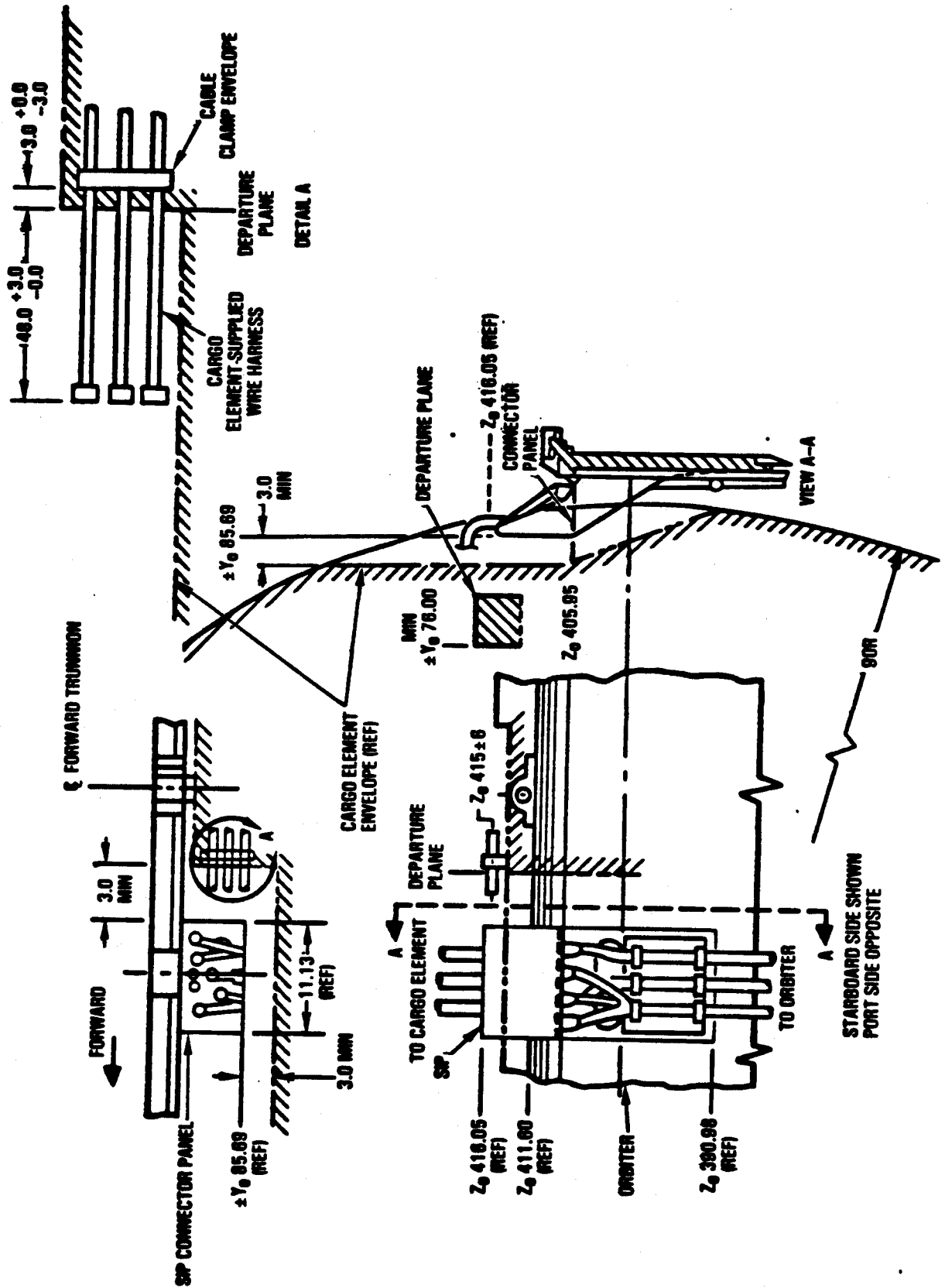


Figure 3.3.2-1 SSP Location (Bridge-Mounted)  
(Sheet 1 Of 2)

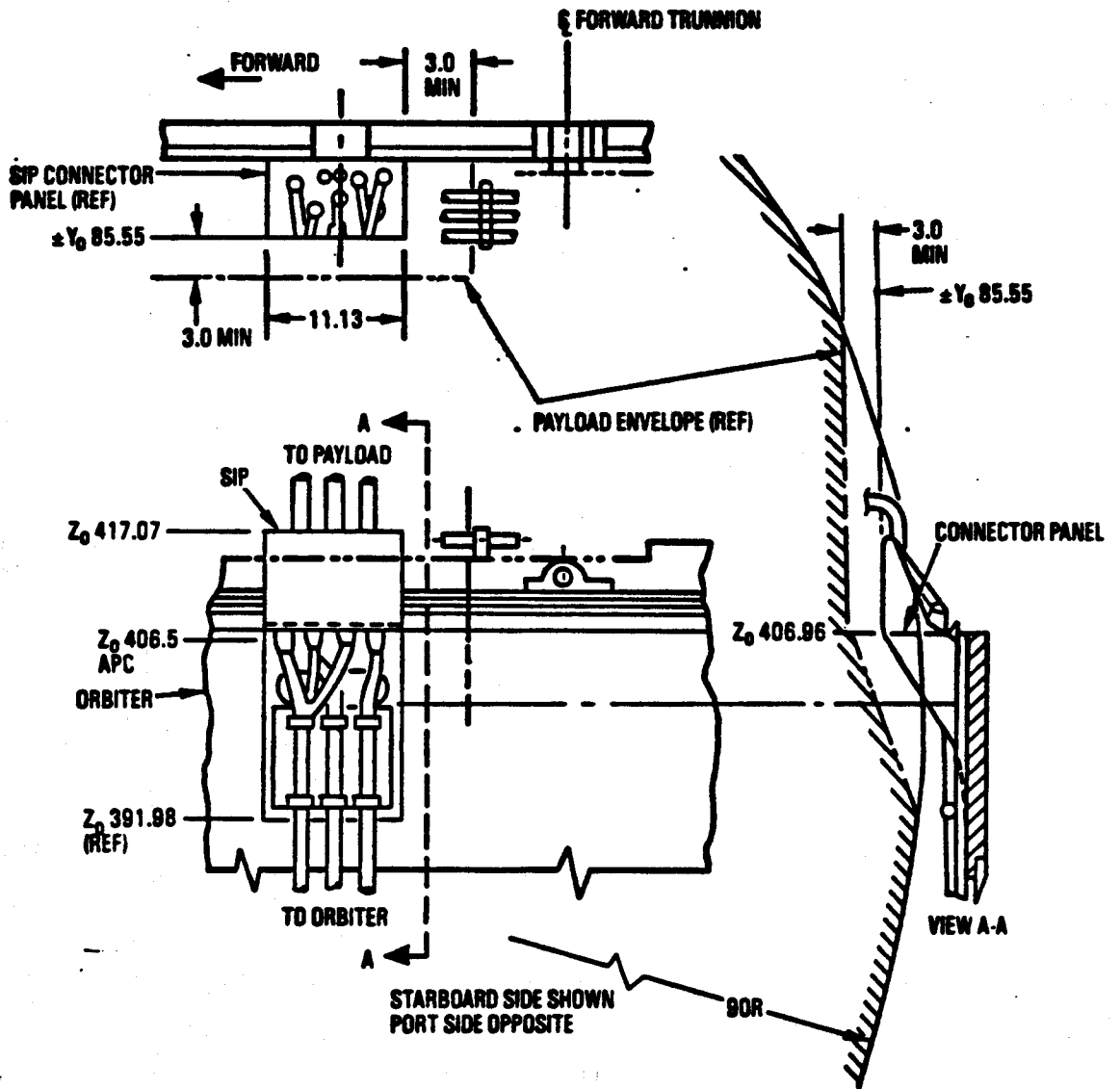
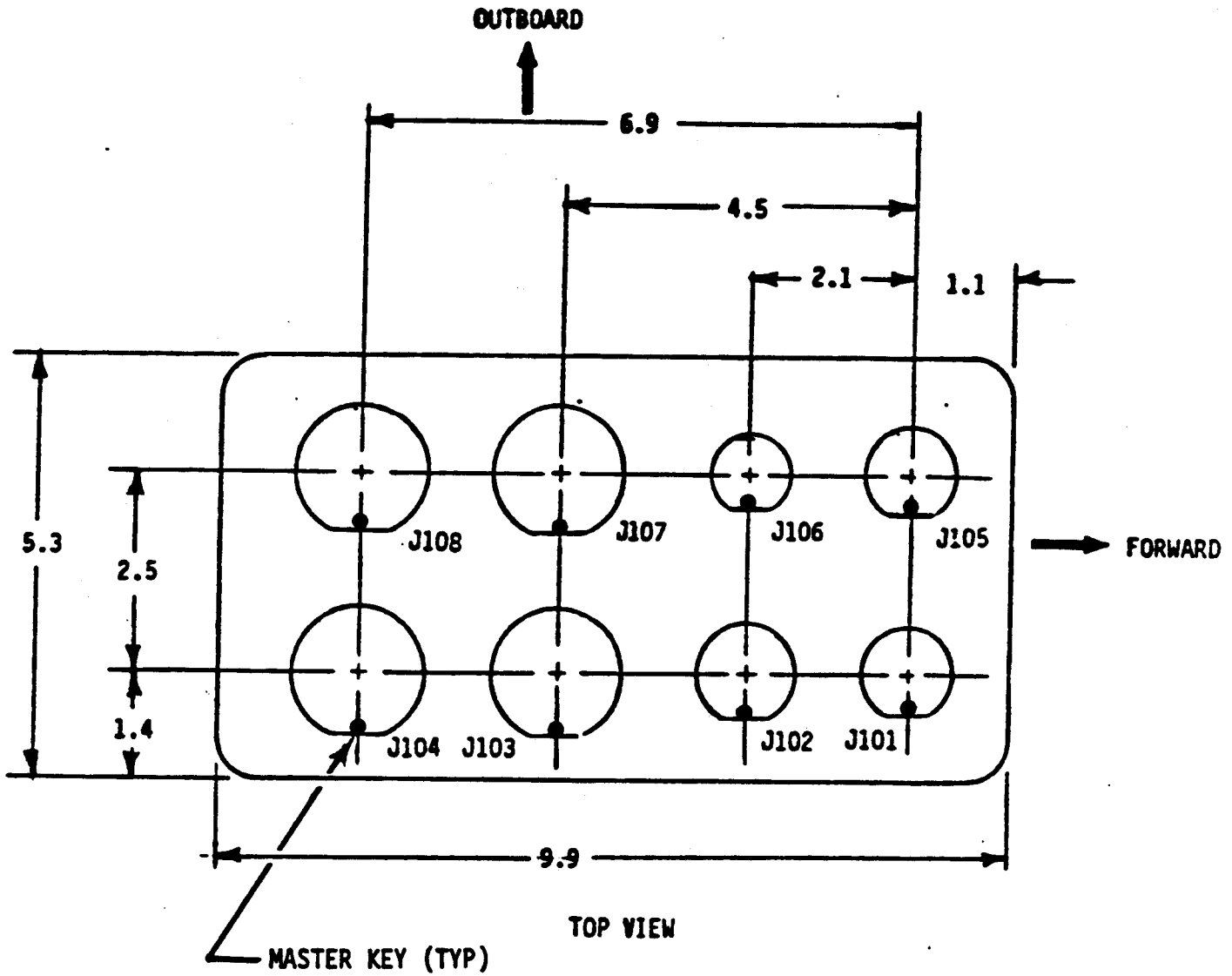
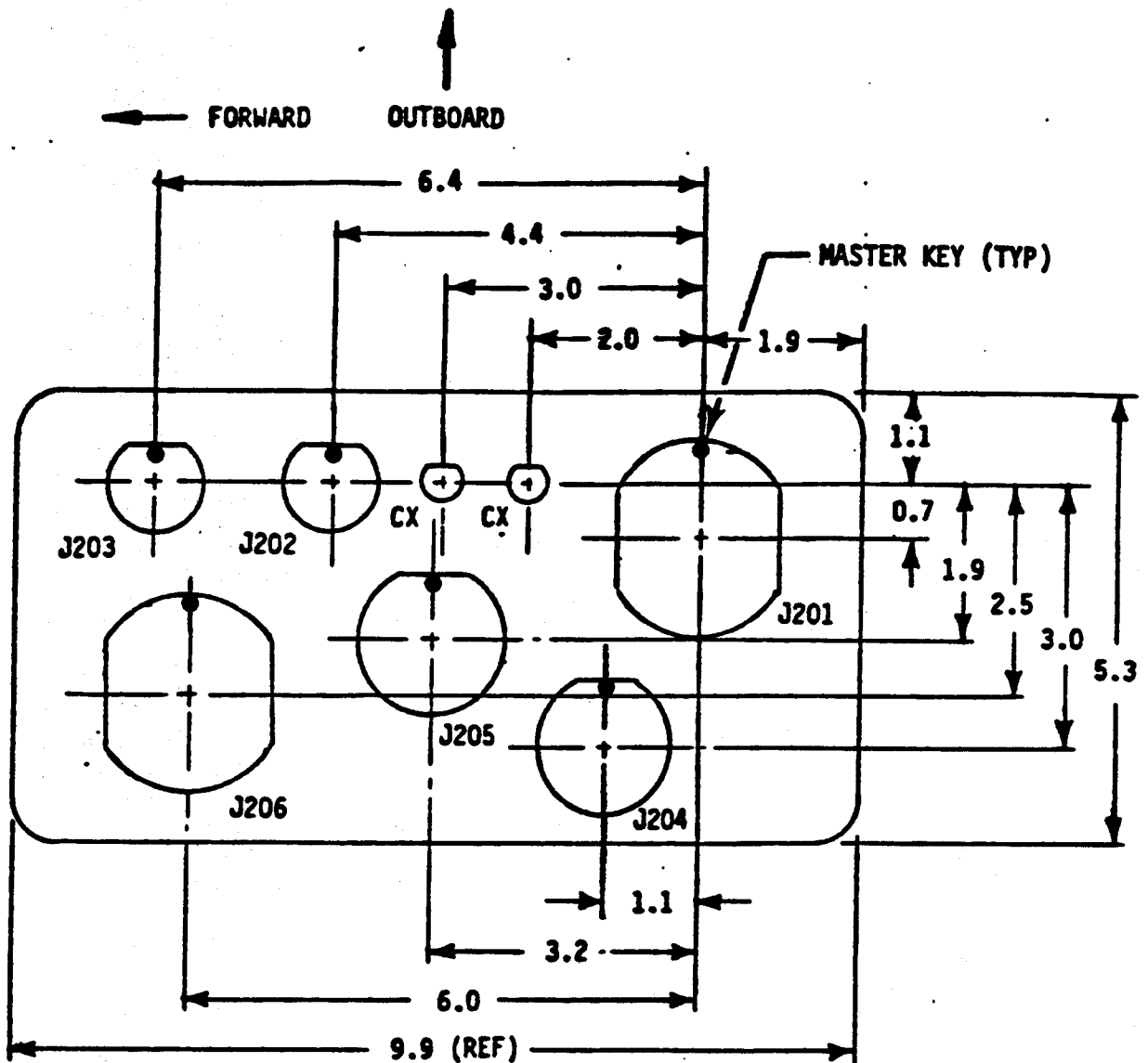


Figure 3.3.2-1 SIP Location (APC Mount)  
 (Sheet 2 Of 2)



**NOTE: ORBITER/CARGO ELEMENT INTERFACE CONNECTORS AND PIN ASSIGNMENTS ARE SPECIFIED IN SECTION 13**

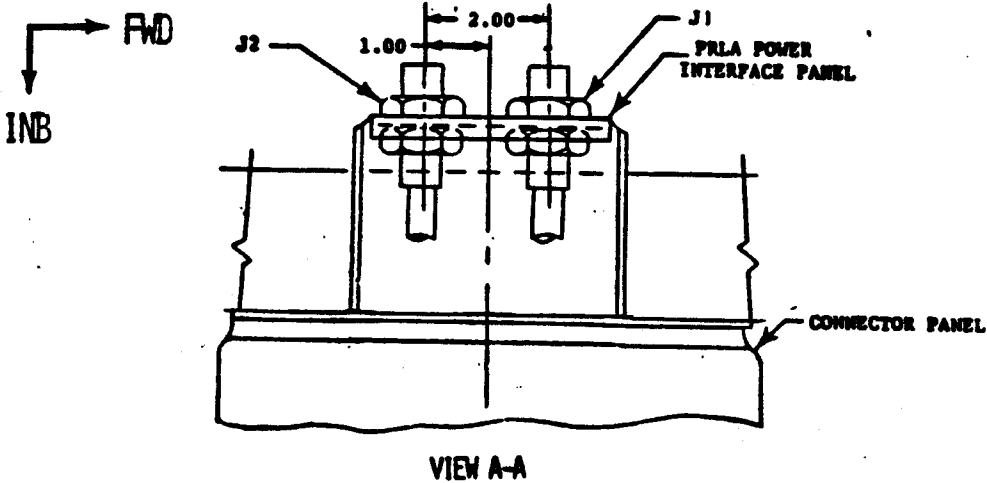
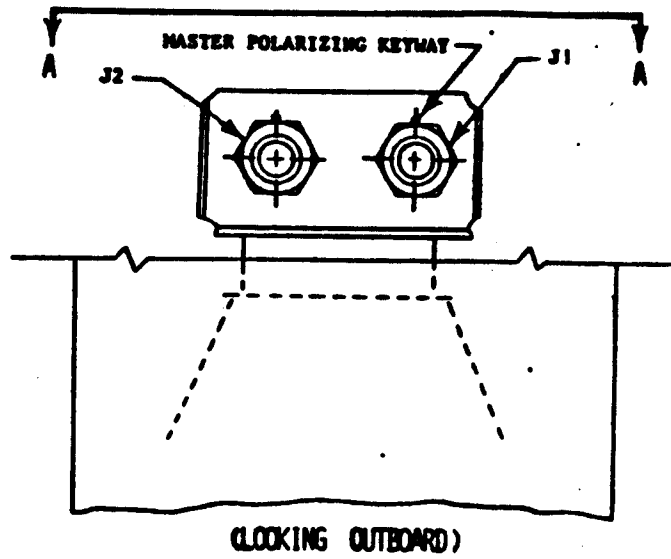
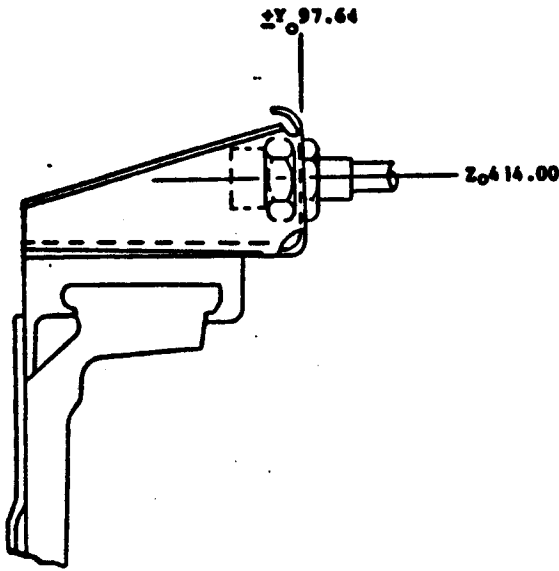
**FIGURE 3.3.2.1.1-1 PORT SMCH-SIP ELECTRICAL INTERFACES**



TOP VIEW

- NOTES:
1. ORBITER/CARGO ELEMENT INTERFACE CONNECTORS AND PIN ASSIGNMENTS FOR J201, J202 AND J203 ARE SPECIFIED IN SECTION 13.
  2. J201 AND J206 ARE IDENTICAL CONNECTORS. J201 SHALL BE USED AS AN AUXILIARY POWER CONNECTOR.
  3. CUTOUTS J204, J205 AND CX SHALL BE CAPABLE OF ACCOMMODATING AN 18 SHELL SIZE, A 22 SHELL SIZE AND COAXIAL CONNECTORS RESPECTIVELY.

FIGURE 3.3.2.1.2-1 STARBOARD SMCH-SIP ELECTRICAL INTERFACES



LH shown RH opposite

NOTES:

1. ORBITER/CARGO ELEMENT PRLA INTERFACE PIN ASSIGNMENTS ARE SPECIFIED IN TABLE 13.6.1.2-7.

FIGURE 3.3.2.3-1 PRLA POWER INTERFACE PANEL

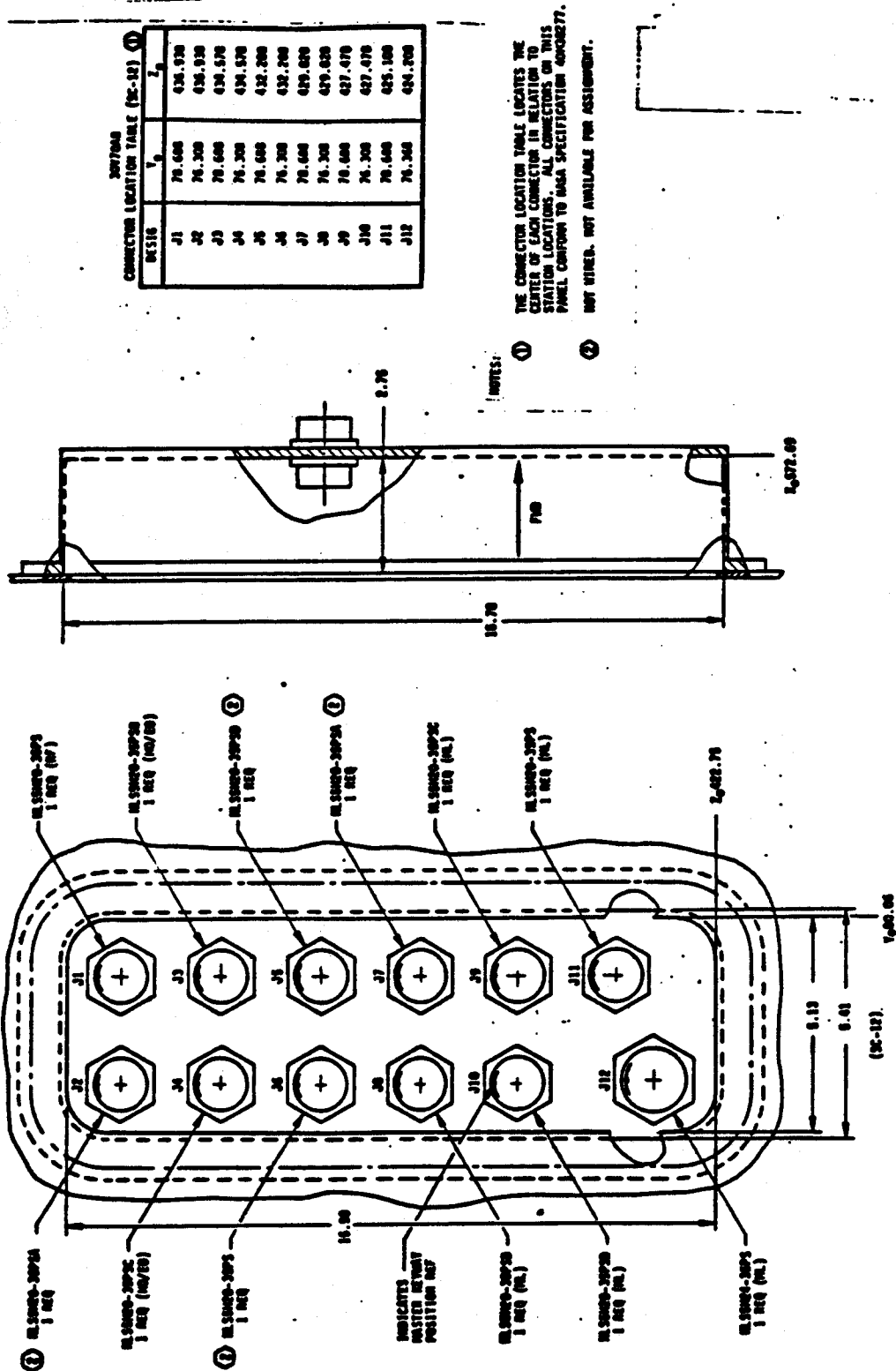


FIGURE 3.3.3-1 FEED-THROUGH CONNECTOR PANEL, STARBOARD SIDE  
BULKHEAD X<sub>0</sub> 576



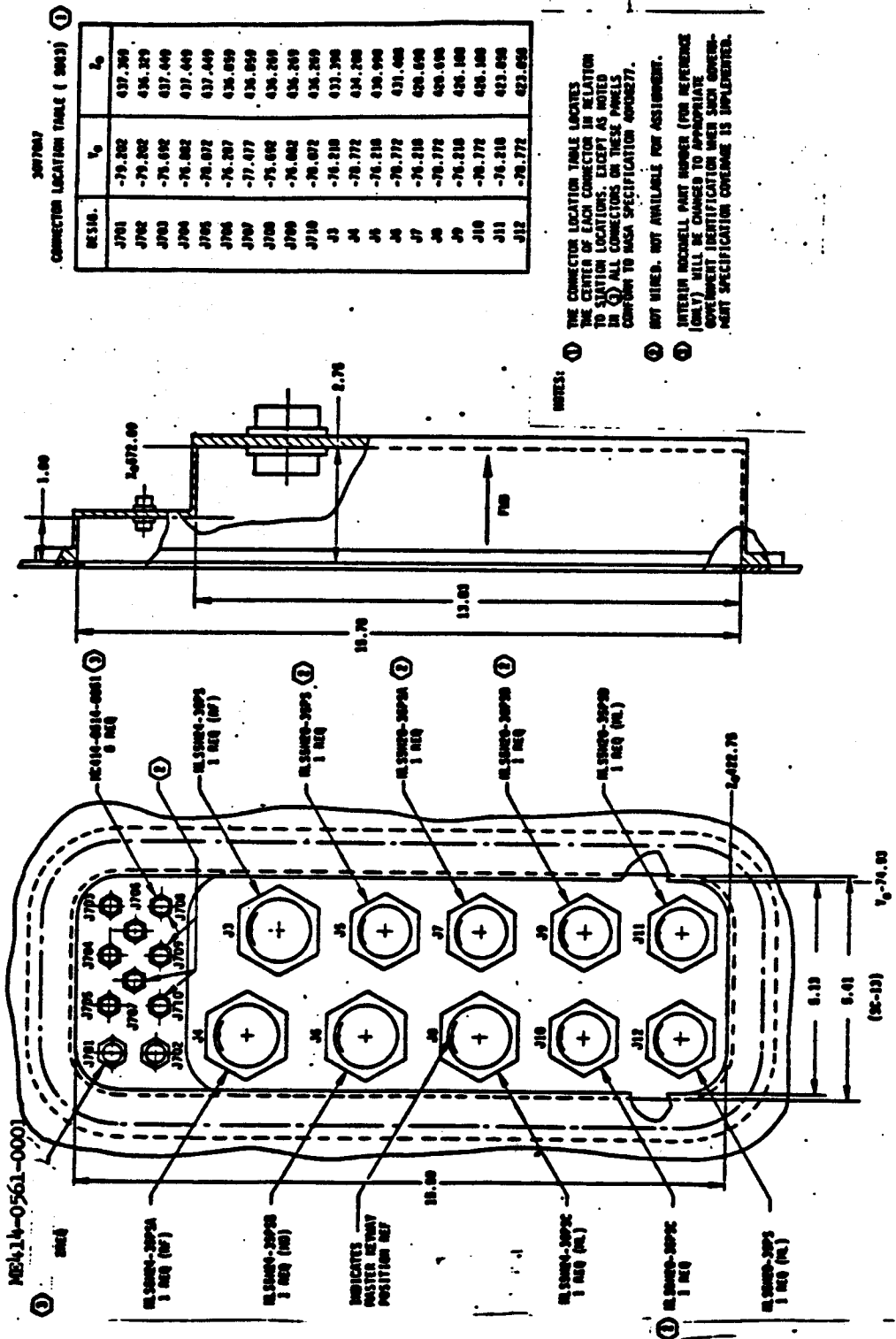


FIGURE 3.3.3-2 FEED-THROUGH CONNECTOR PANEL, PORT SIDE  
 BULKHEAD X<sub>0</sub> 576  
 (SHEET 1 OF 2)

3077663  
CONNECTOR LOCATION TABLE (SC-14) (1)

SC116.	V <sub>0</sub>	L <sub>0</sub>
J701	-67.610	434.025
J702	-68.070	434.025
J703	-70.122	434.025
J704	-71.374	434.025
J705	-68.244	434.125
J706	-69.496	434.125
J707	-70.748	434.125
J708	-67.610	433.425
J709	-68.870	433.425
J710	-70.122	433.425
J711	-71.374	433.425
J5	-66.100	431.050
J6	-70.002	431.050
J7	-68.100	429.350
J8	-68.100	429.000
J9	-70.002	429.000
J10	-68.100	427.050

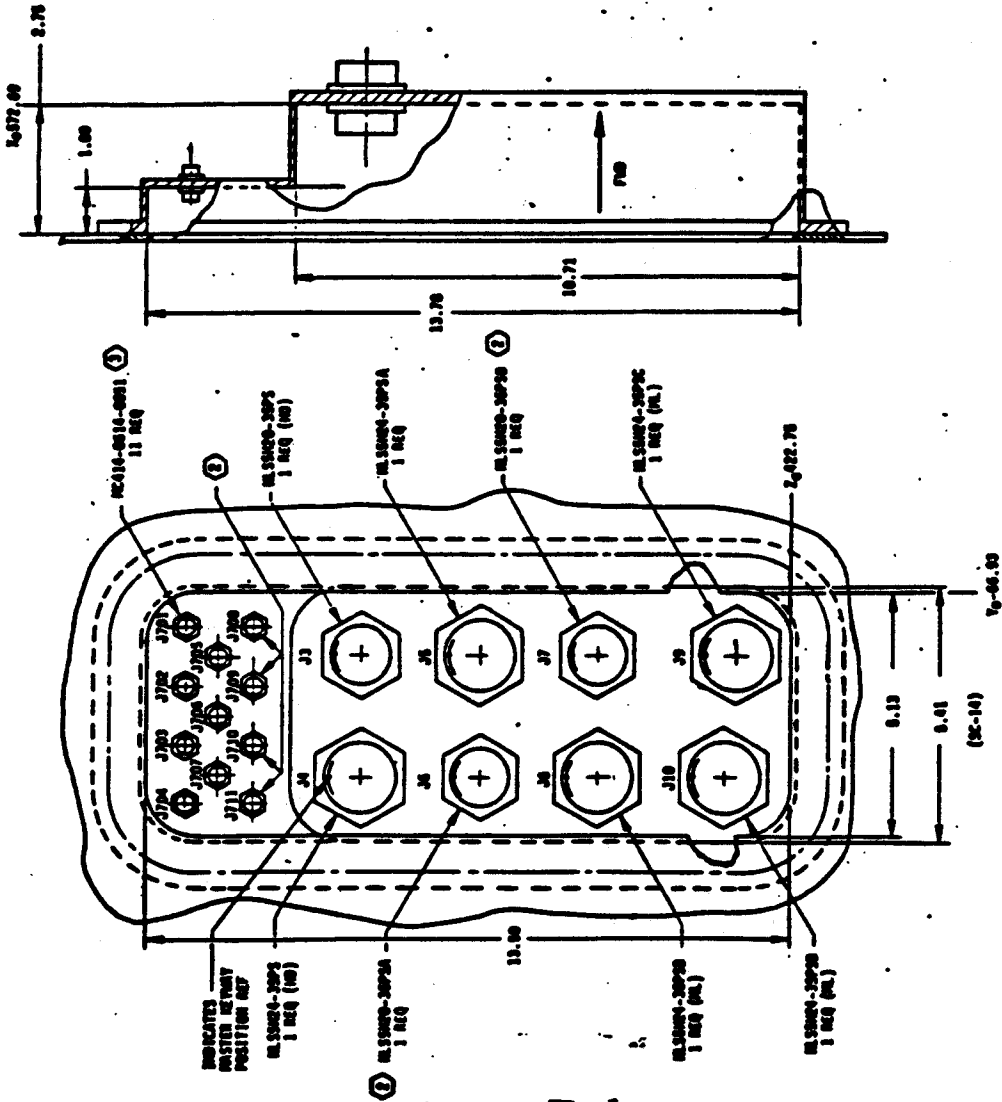
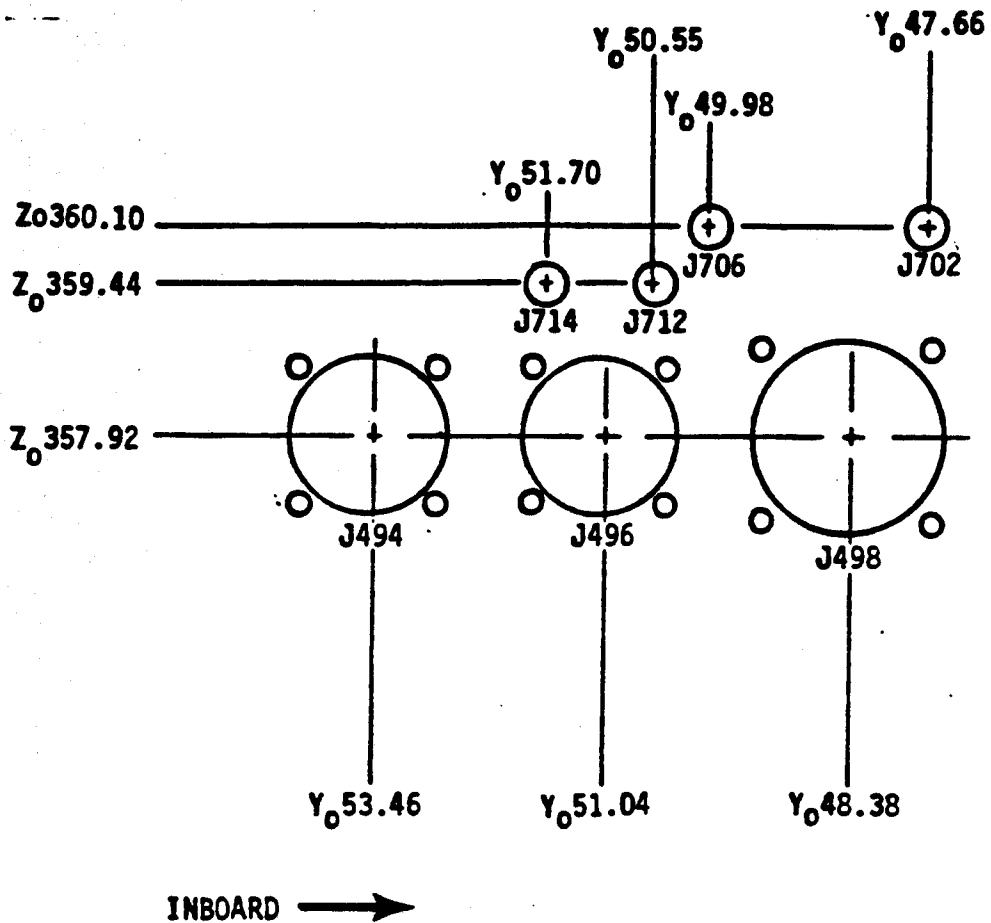


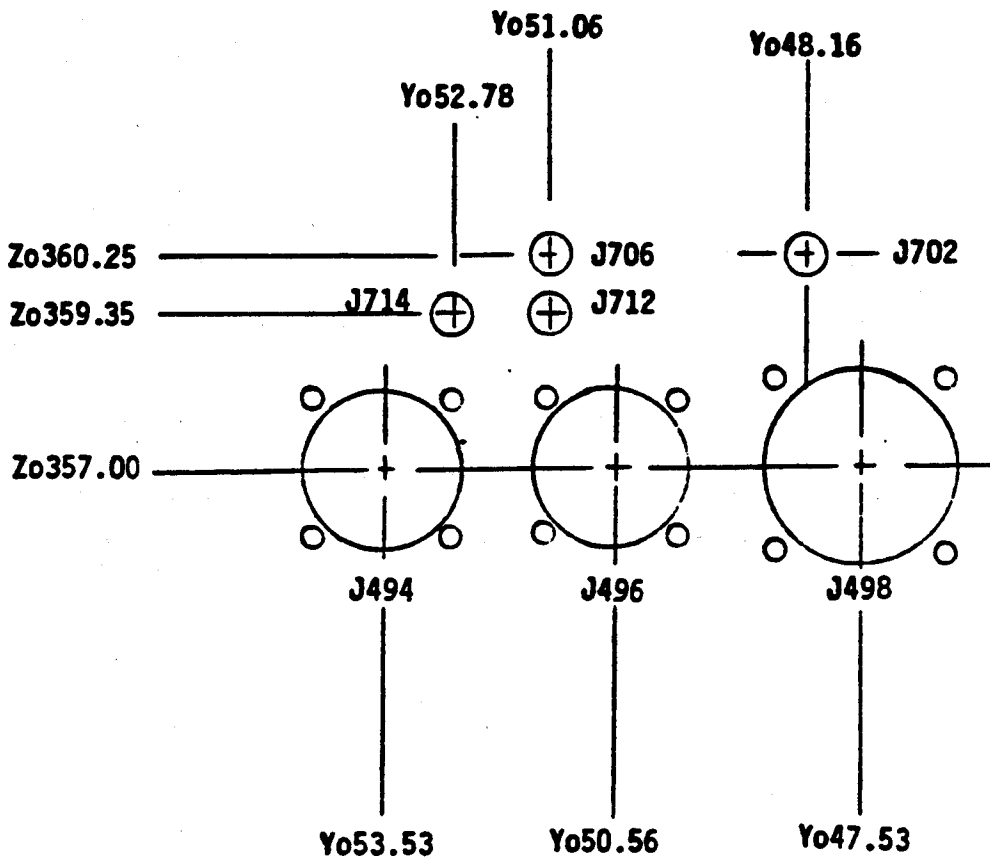
FIGURE 3.3.3-2 FEED-THROUGH CONNECTOR PANEL, PORT SIDE  
BULKHEAD X<sub>0</sub> 576  
(SHEET 2 OF 2)



EFFECTIVITY: Orbiter Vehicle 102

**NOTE: ORBITER/CARGO ELEMENT INTERFACE CONNECTORS AND PIN ASSIGNMENTS FOR J498 ARE SPECIFIED IN TABLE 13.6.1-1. OTHER CONNECTOR'S FUNCTIONS ARE ROUTED TO THE X<sub>0</sub> 1203 CONNECTOR PANEL.**

*Figure 3.3.3-3 X<sub>0</sub> 1307 Starboard Electrical Interfaces (Looking A37) (Sheet 1 Of 2)*

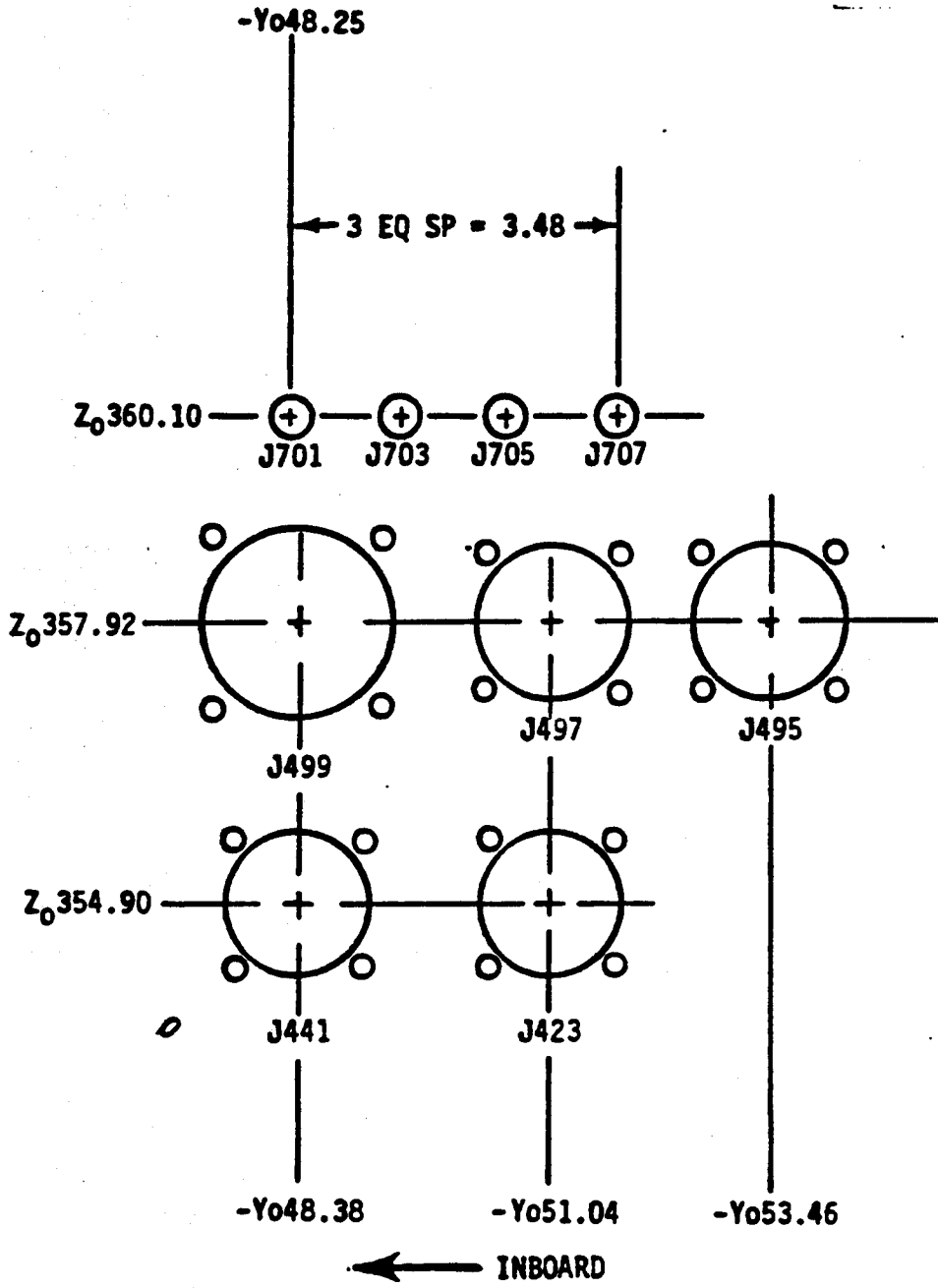


INBOARD →

EFFECTIVITY: Orbiter vehicles 103 & Subs.

**NOTE:** ORBITER/CARGO ELEMENT INTERFACE CONNECTORS AND PIN ASSIGNMENTS FOR J498 ARE SPECIFIED IN TABLE 13.6.1-1. OTHER CONNECTOR'S FUNCTIONS ARE ROUTED TO THE X<sub>0</sub> 1203 CONNECTOR PANEL.

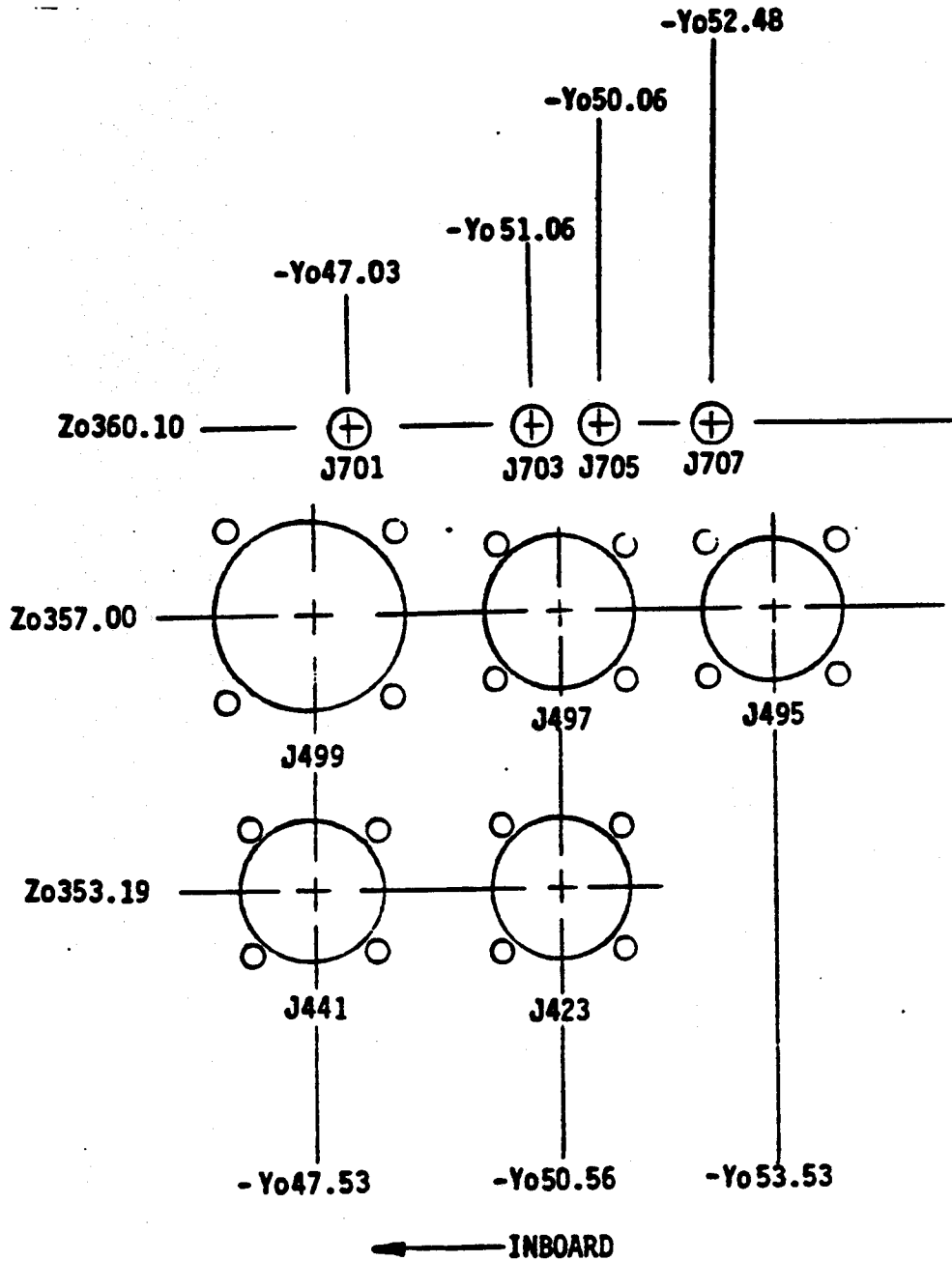
FIGURE 3.3.3-3 X<sub>0</sub> 1307 STARBOARD ELECTRICAL INTERFACES (LOOKING AFT) (SHEET 2 OF 2)



EFFECTIVITY: Orbiter Vehicle 102

**NOTE:** ORBITER/CARGO ELEMENT INTERFACE CONNECTORS AND PIN ASSIGNMENTS FOR J499, J701, J703, J705 AND J707 ARE SPECIFIED IN TABLE 13.6.1-1. OTHER CONNECTOR'S FUNCTIONS ARE ROUTED TO THE X<sub>0</sub> 1203 CONNECTOR PANEL.

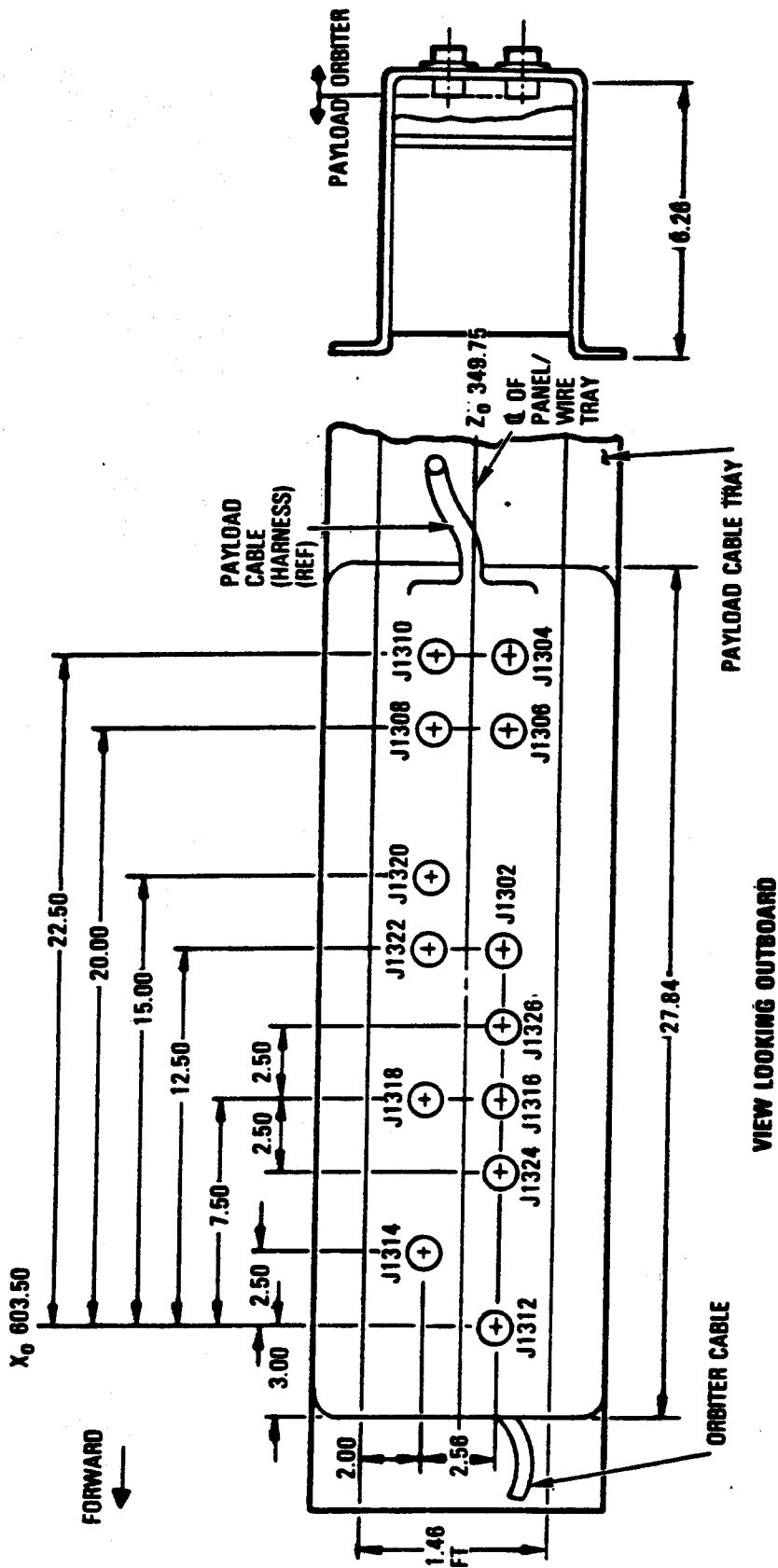
Figure 3.3.3-4 X<sub>0</sub> 1307 Port Electrical Interfaces (Looking A37) (Sheet 1 Of 2)



**EFFECTIVITY: Orbiter Vehicles 103 & Subs.**

**NOTE: ORBITER/CARGO ELEMENT INTERFACE CONNECTORS AND PIN ASSIGNMENTS FOR J499, J701, J703, J705, AND J707 ARE SPECIFIED IN TABLE 13.6.1-1. OTHER CONNECTOR'S FUNCTIONS ARE ROUTED TO THE X<sub>0</sub> 1203 CONNECTOR PANEL.**

**FIGURE 3.3.3-4 X<sub>0</sub> 1307 PORT ELECTRICAL INTERFACES (LOOKING AFT) (SHEET 2 OF 2)**



NOTE:  $\textcircled{1}$  ORBITER/CARGO ELEMENT INTERFACE CONNECTORS AND PIN ASSIGNMENTS FOR J1302, J1304, J1306, J1308, J1310, J1312, J1314, J1316, J1318, J1320, AND J1322 ARE SPECIFIED IN TABLE 13.6.1-1. J1324 AND J1326 ARE SPECIFIED IN TABLE 13.5.1.3-1.

FIGURE 3.3.3-5 X0 603 STARBOARD SIGNAL AND CONTROL PANEL

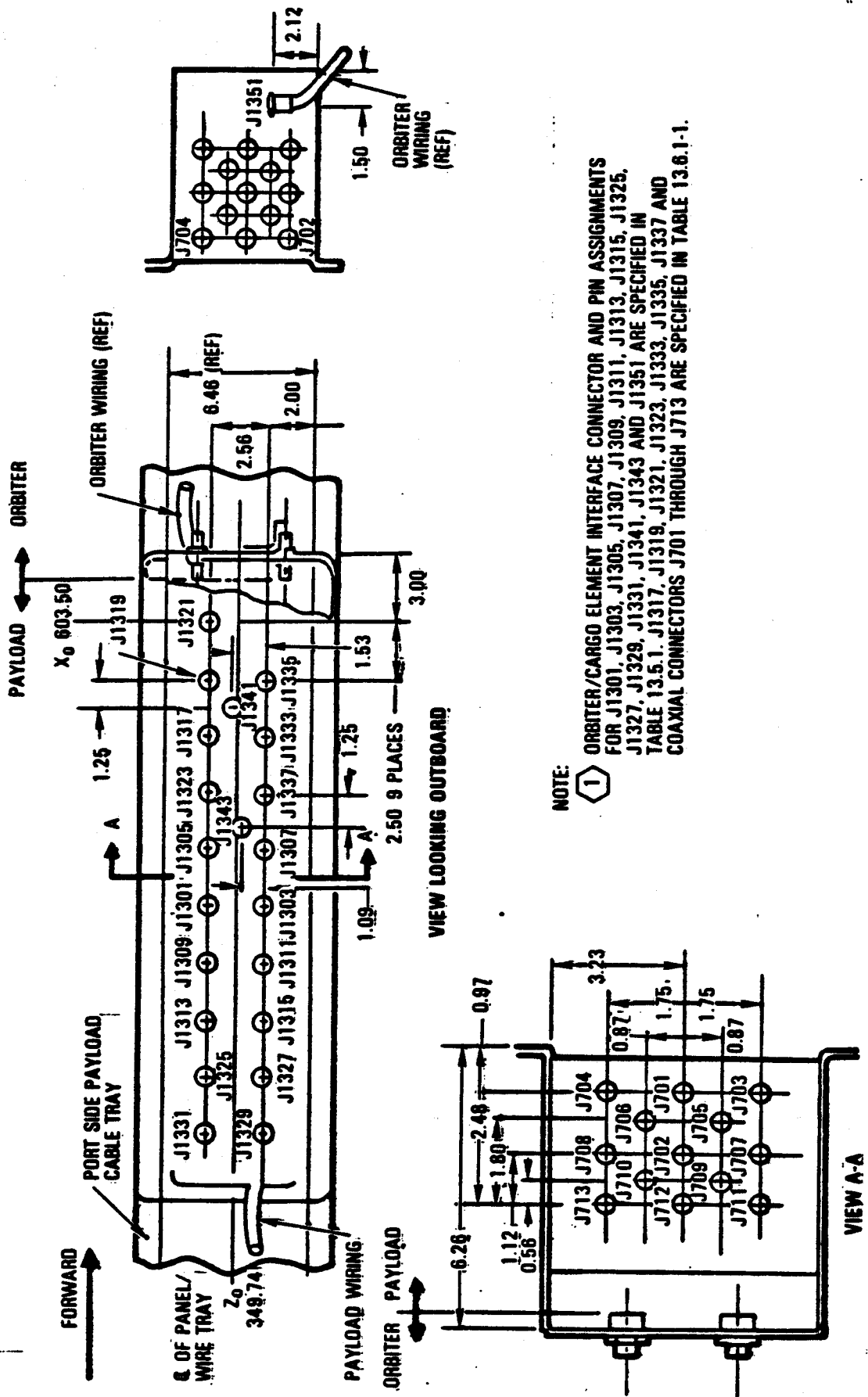
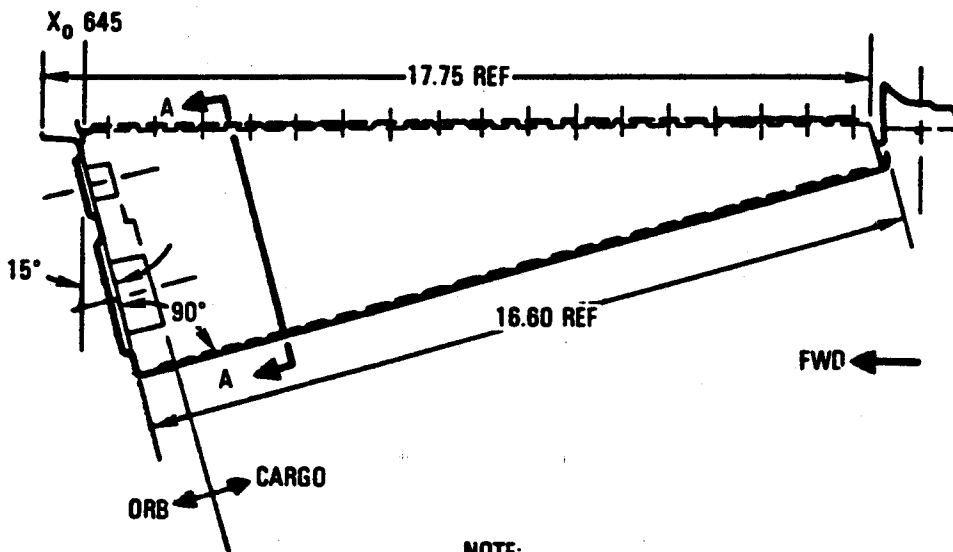
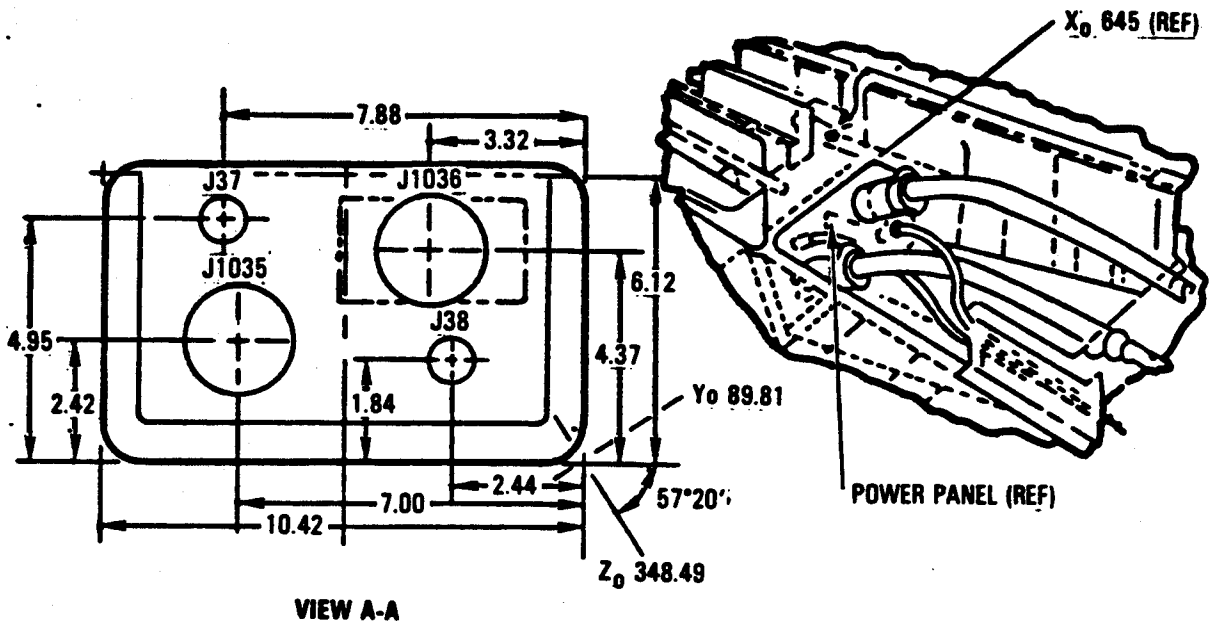


FIGURE 3.3.3-6 PORT SIGNAL AND CONTROL PANEL



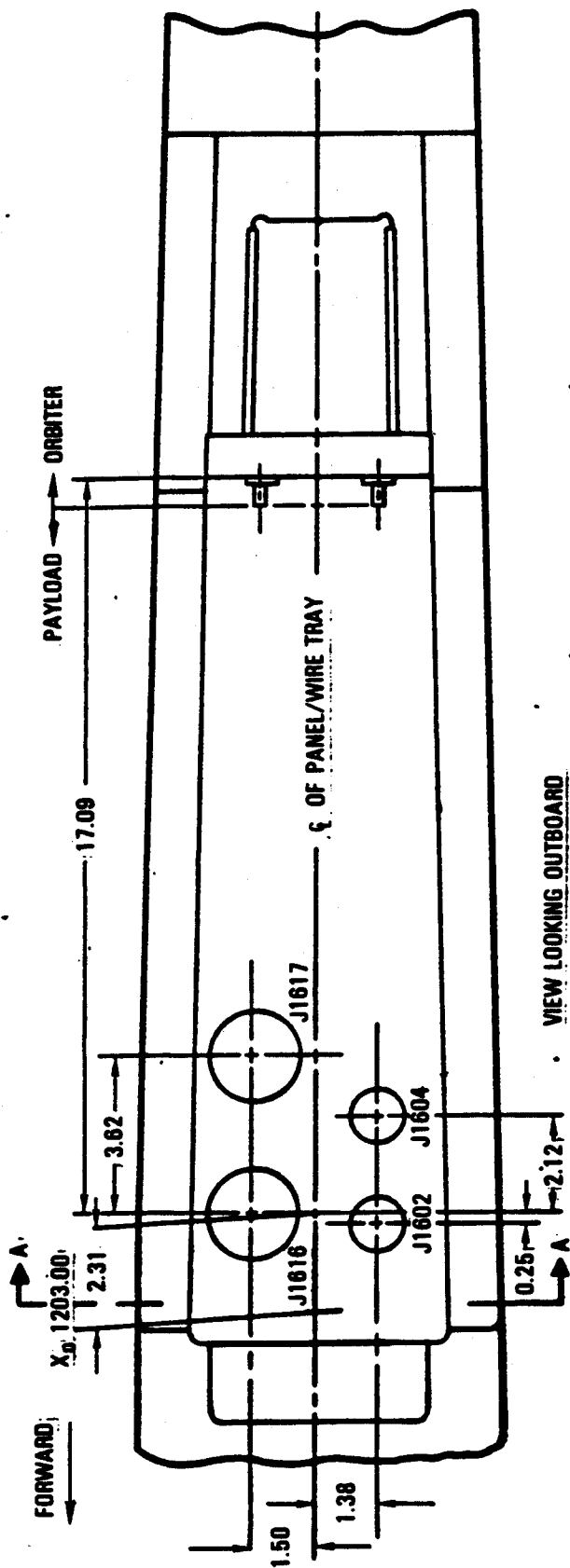


**NOTE:**

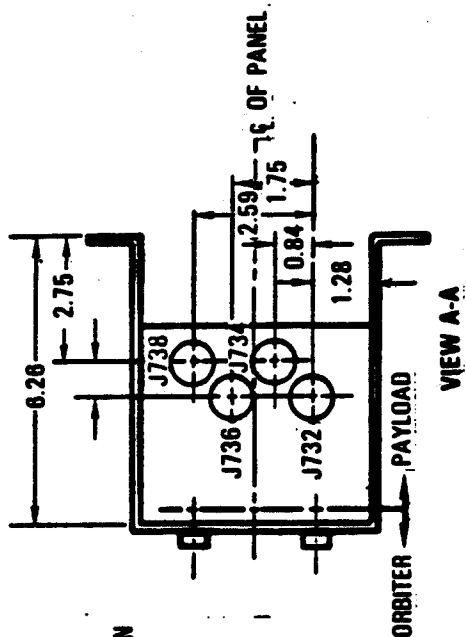
①

ORBITER/CARGO ELEMENT CONNECTORS AND PIN ASSIGNMENTS FOR J1035 AND J1036 ARE SPECIFIED IN TABLE 13.5.2.1-1. J37 AND J38 ARE SPECIFIED IN TABLE 13.6.1-1.

FIGURE 3.3.3-7 X<sub>0</sub> 645 ELECTRICAL POWER SERVICE PANEL



VIEW LOOKING OUTBOARD

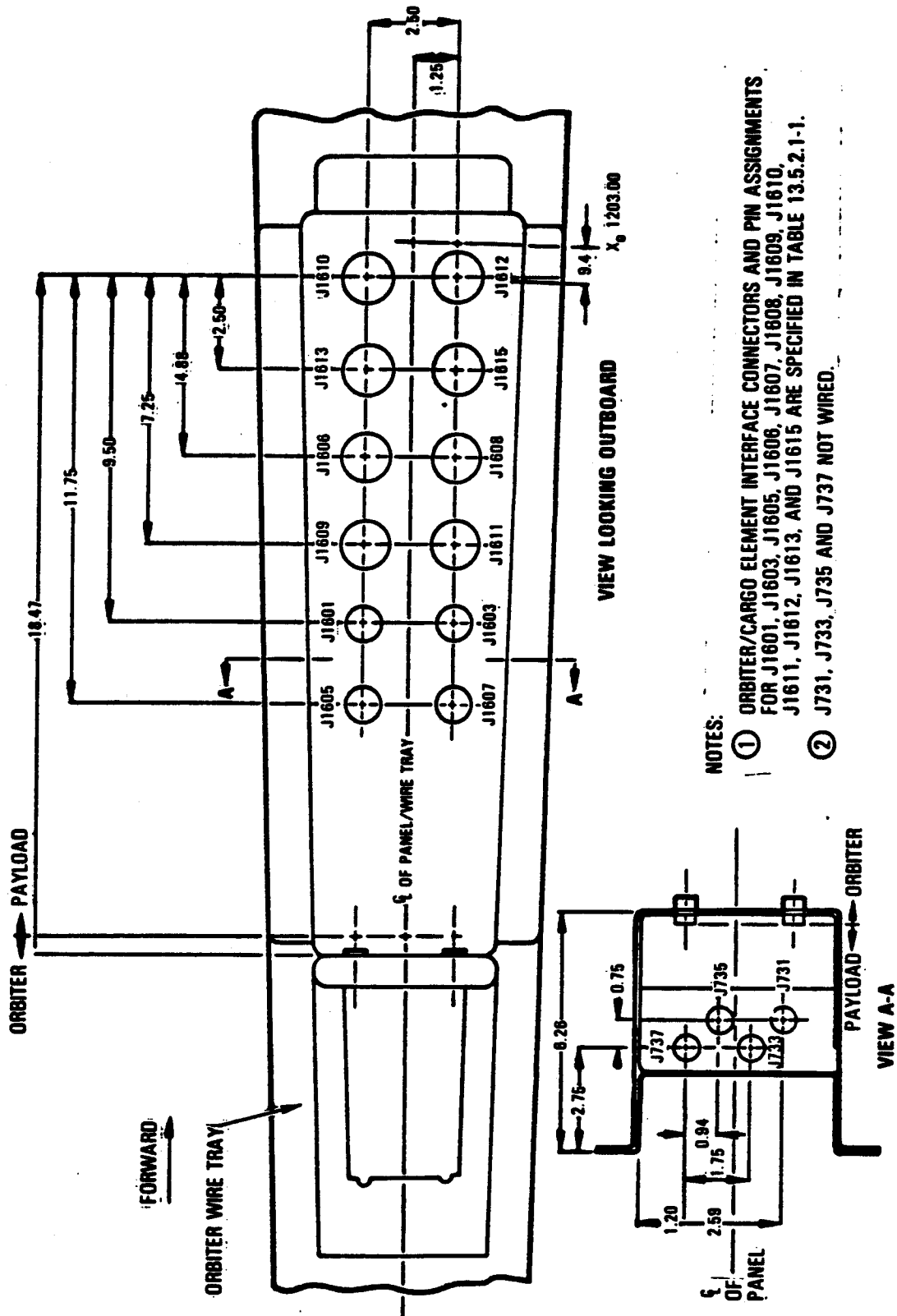


VIEW A-A

NOTES:

- ① ORBITER/CARGO ELEMENT INTERFACE CONNECTORS AND PIN ASSIGNMENT FOR J1602 AND J1604 ARE SPECIFIED IN TABLE 13.5.2.1-1. J732, J734, J736 AND J738 ARE SPECIFIED IN TABLE 13.6.1-1.
- ② J1616 AND J1617 NOT WIRED.

FIGURE 3.3.3-8 X<sub>0</sub> 1203 STARBOARD SIGNAL AND CONTROL PANEL



NOTES:

- ① ORBITER/CARGO ELEMENT INTERFACE CONNECTORS AND PIN ASSIGNMENTS FOR J1601, J1603, J1605, J1606, J1607, J1608, J1609, J1610, J1611, J1612, J1613, AND J1615 ARE SPECIFIED IN TABLE 13.5.2.1-1.
- ② J731, J733, J735 AND J737 NOT WIRED.

FIGURE 3.3.3-9 X<sub>0</sub> 1203 PORT SIGNAL AND CONTROL PANEL

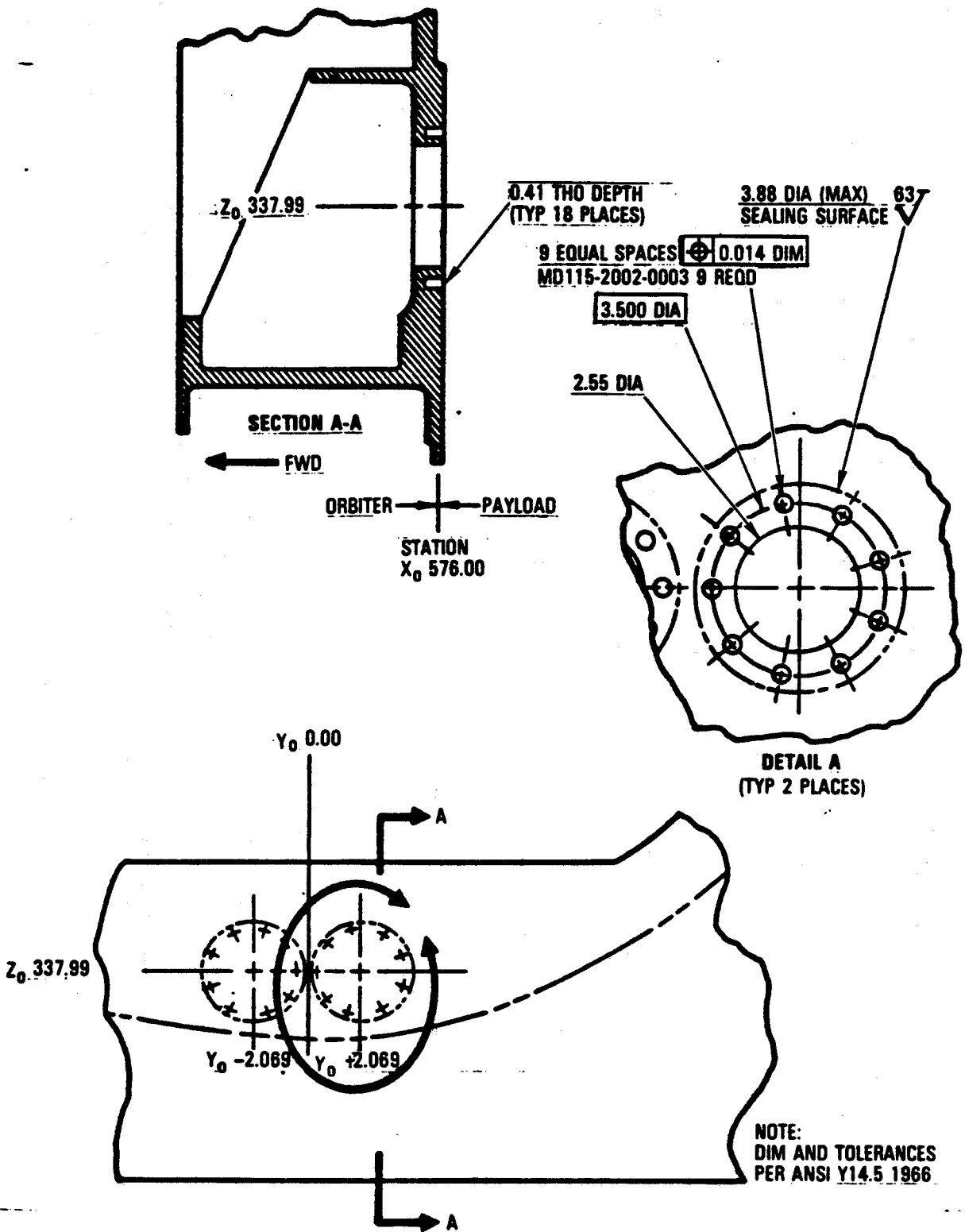


FIGURE 3.3.4-1 ATMOSPHERIC REVITALIZATION SYSTEM INTERFACE

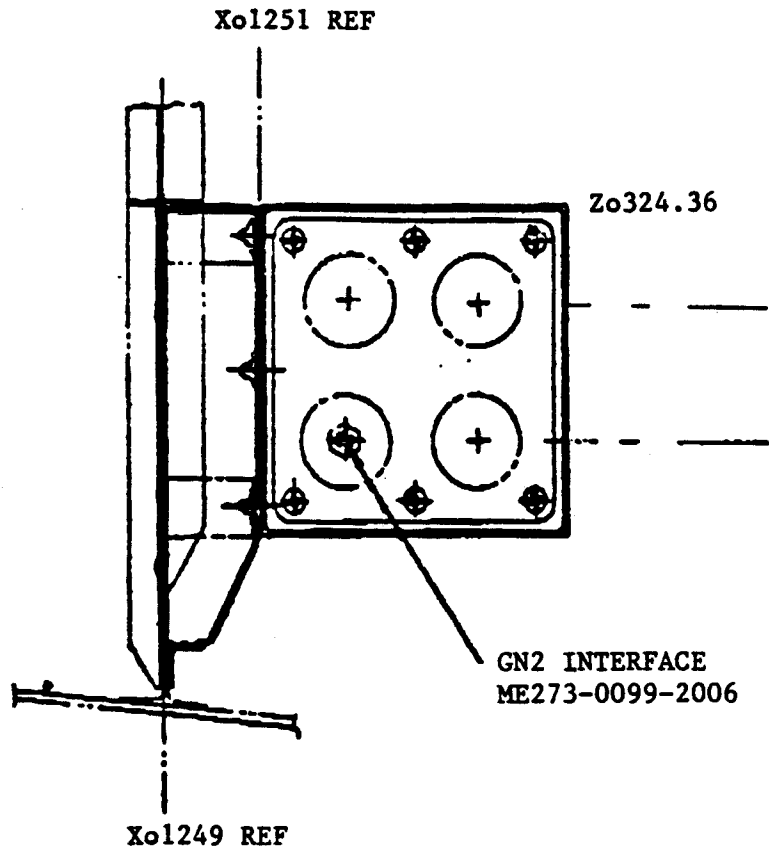


Figure 3.3.4-2 GN<sub>2</sub> Purge Interface at X0 1249

3/4 ME273-0130-1228 (4 PLACES)\* RESERVED FOR  
 PAYLOAD/PAYLOAD HEAT EXCHANGER INTERFACE  
 MATING CONNECTION 3/4 DIA DYNA TUBE  
 FEMALE INTERFACE CONNECTION

FLUID SERVICE CONNECTORS  
 1/4 ME273-0130-0420  
 (2 PLACES)\* O<sub>2</sub>/N<sub>2</sub> RESERVED FOR PAYLOAD  
 INTERFACE MATING CONNECTION  
 1/4 DIA DYNA TUBE FEMALE  
 INTERFACE CONNECTION

\*INTERIM ROCKWELL PART NUMBER (FOR REFERENCE  
 ONLY) WILL BE CHANGED TO APPROPRIATE GOVERNMENT  
 IDENTIFICATION WHEN SUCH GOVERNMENT SPECIFICATION  
 COVERAGE IS IMPLEMENTED

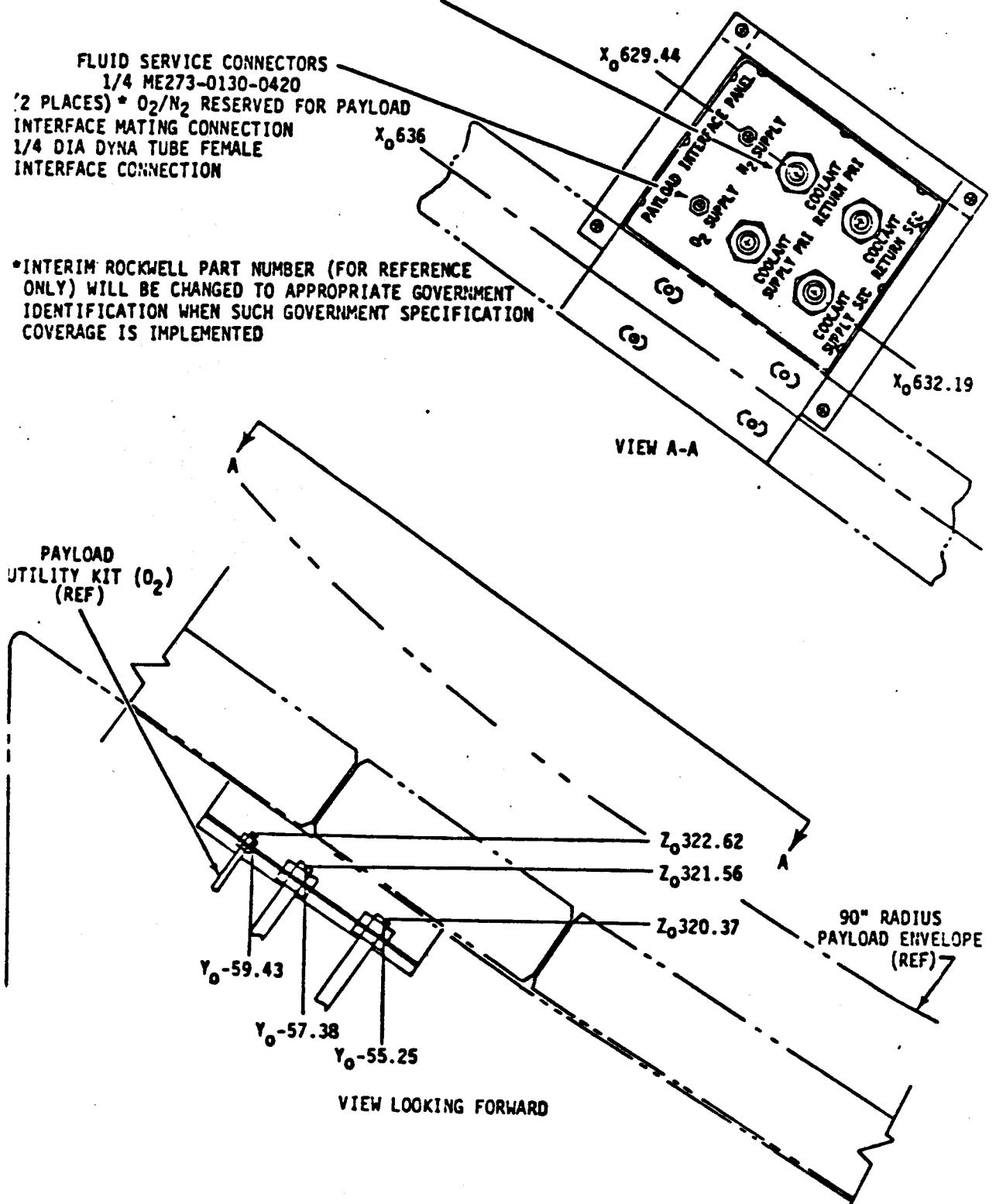
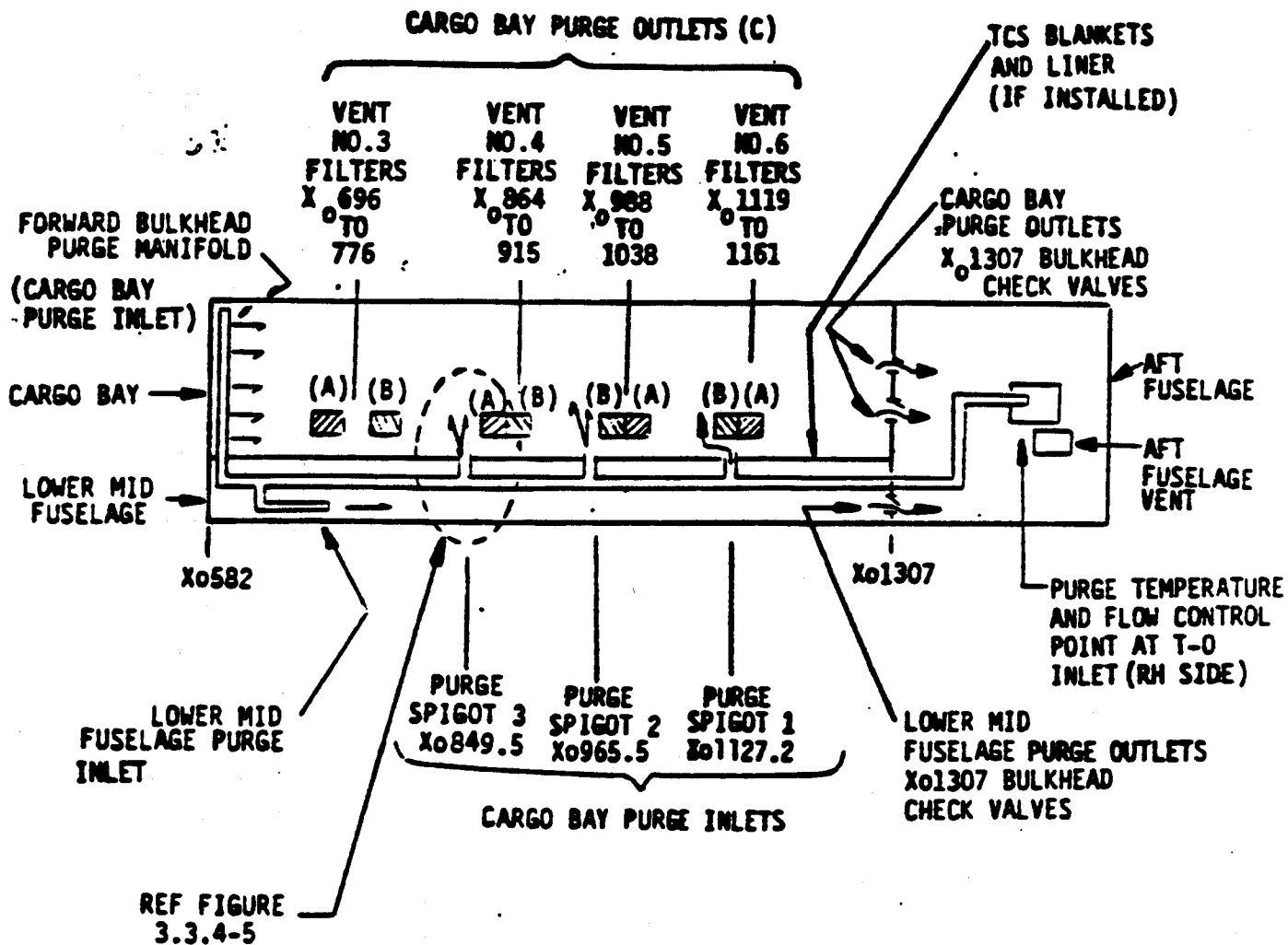


FIGURE 3.3.4-3 PAYLOAD HEAT EXCHANGER, O<sub>2</sub>/N<sub>2</sub> SUPPLY INTERFACES  
 X<sub>0</sub> 636



- o Ref Tables 6.2.1-1 and 6.2.1-2, Cargo Bay Purge Gas Characteristics
- o Purge inlet spigots 1, 2 and 3 normally capped off unless required by payload

**Notes:**

- (A) Indicates liner filter (8 total) - Connects Cargo Bay and Lower Mid Fuselage
- (B) Indicates vent filter (8 total) - Connects Cargo Bay to OML Vents and to Lower Mid Fuselage
- (C) Coordinates listed are for forward edge of forward filter and aft edge of aft filter

*Figure 3.3.4-4 Mid-Fuselage/Cargo Bay Purge System*

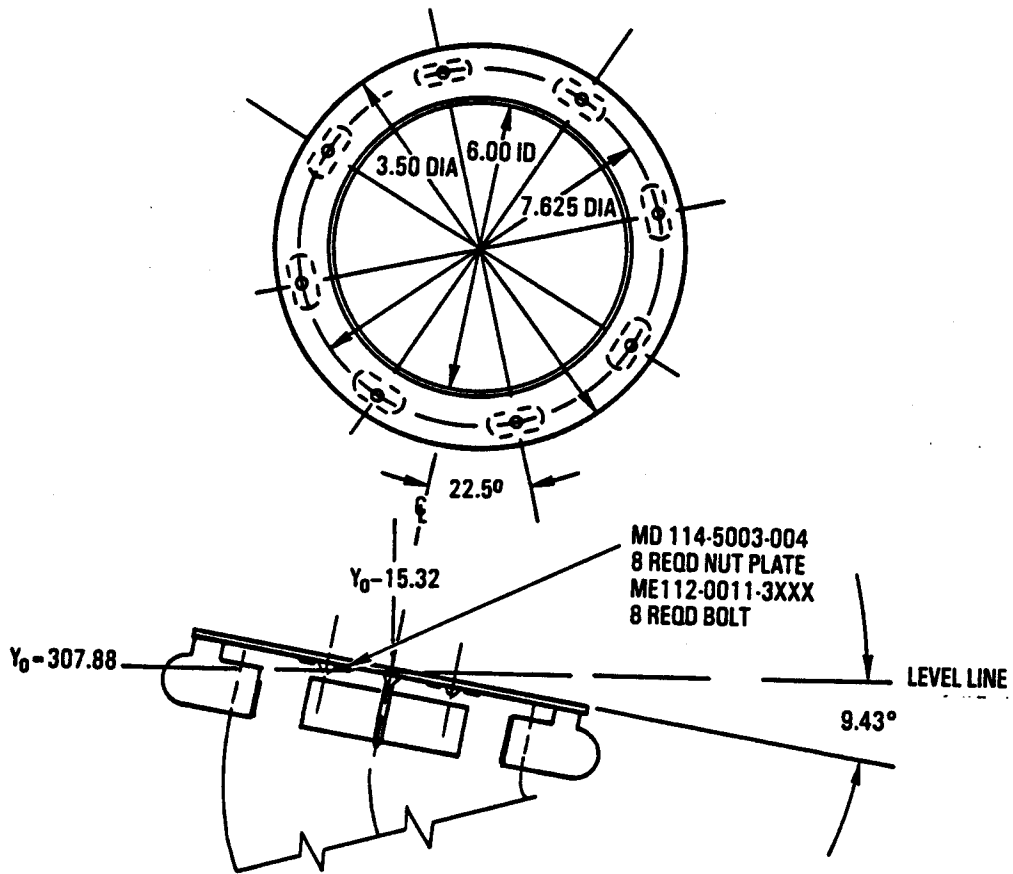


FIGURE 3.3.4-5 MID-FUSELAGE/CARGO BAY PURGE INLET SPIGOT



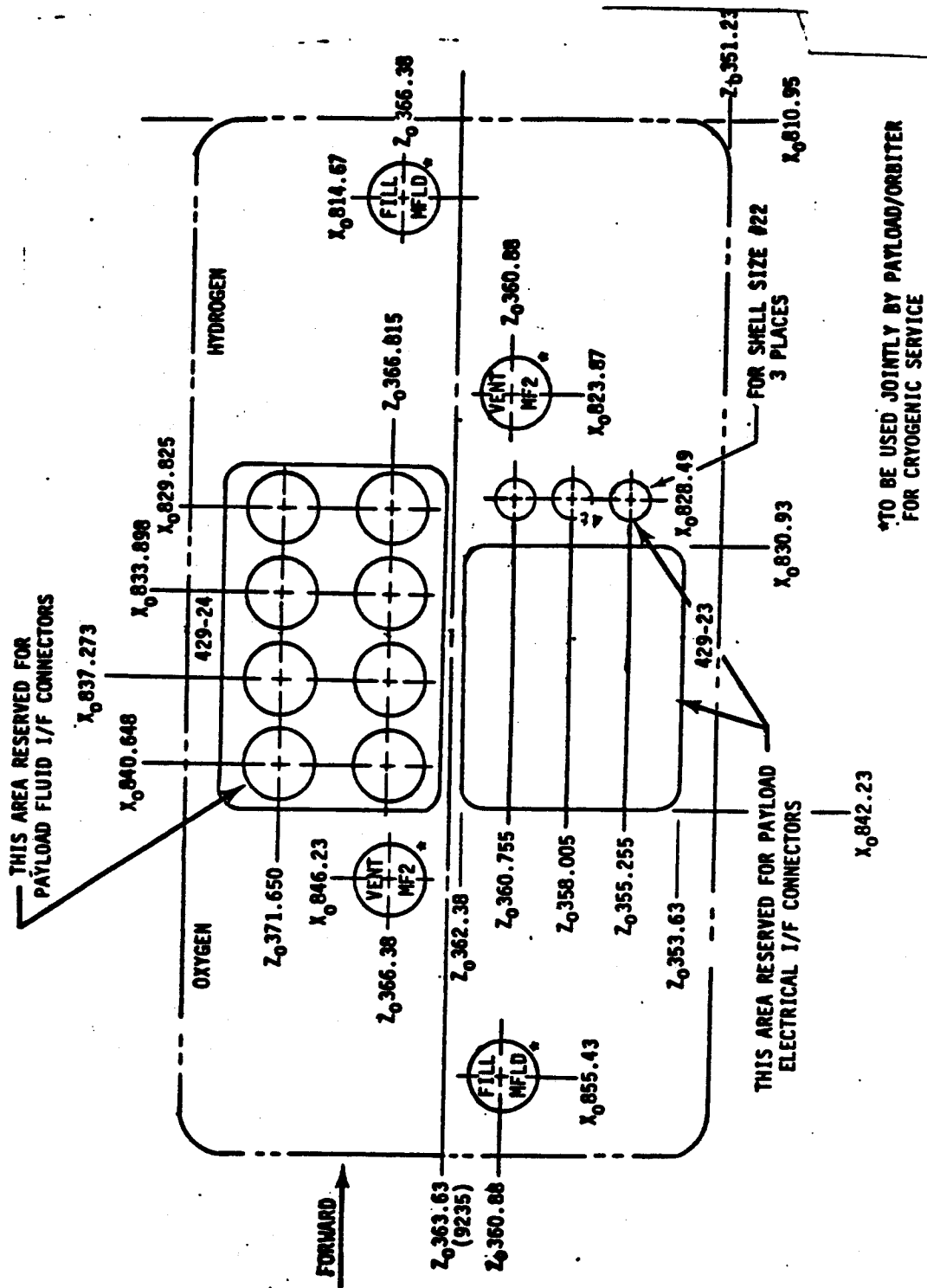


FIGURE 3.3.4-6 MID-BODY PRELAUNCH UMBILICAL PANEL (PORT SIDE AT  $Y_0 100.20$ )

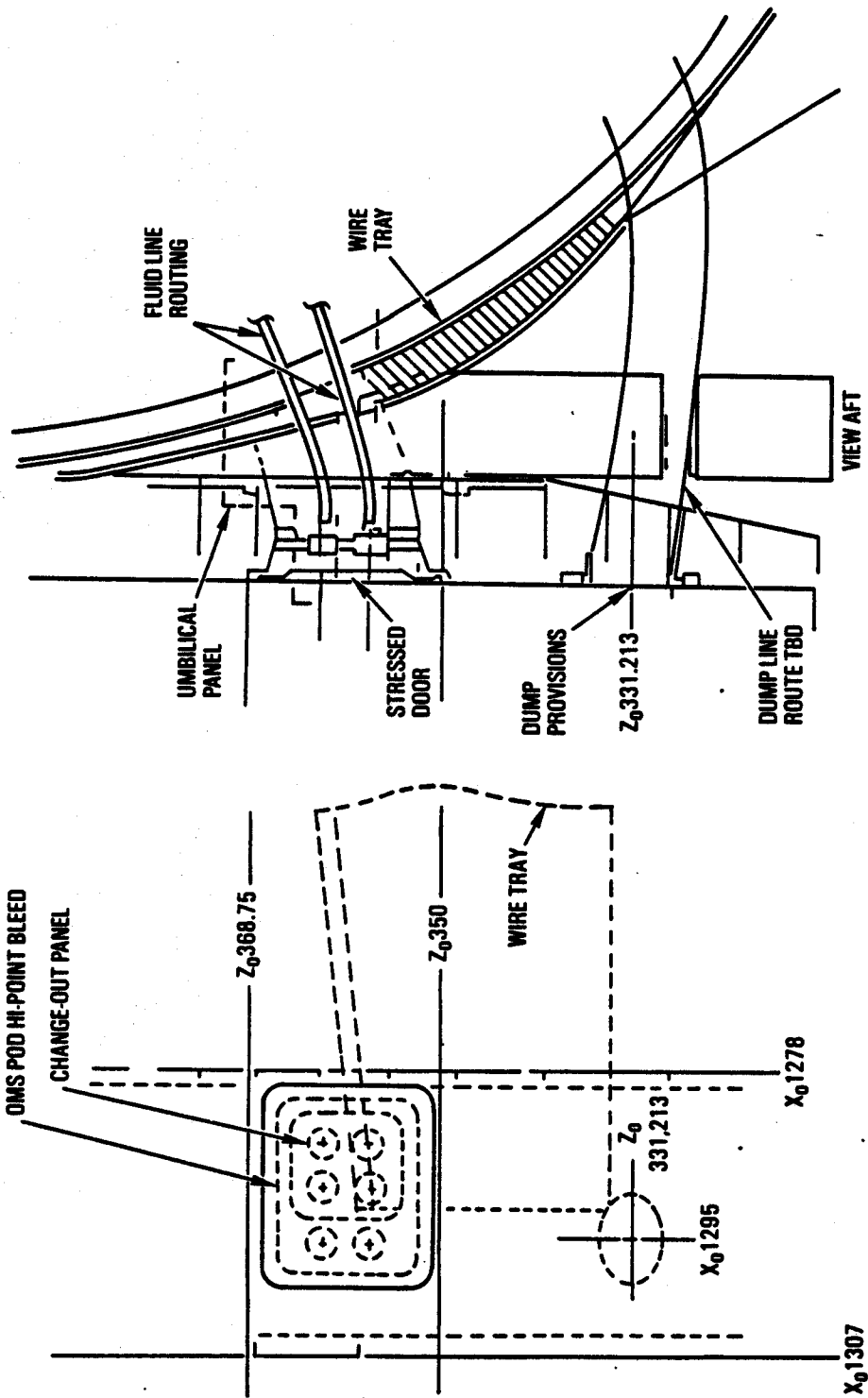


FIGURE 3.3.4-7 STARBOARD (T-4) PAYLOAD UMBILICAL PANELS AND DUMP PROVISIONS (ROUTING CONCEPTS)

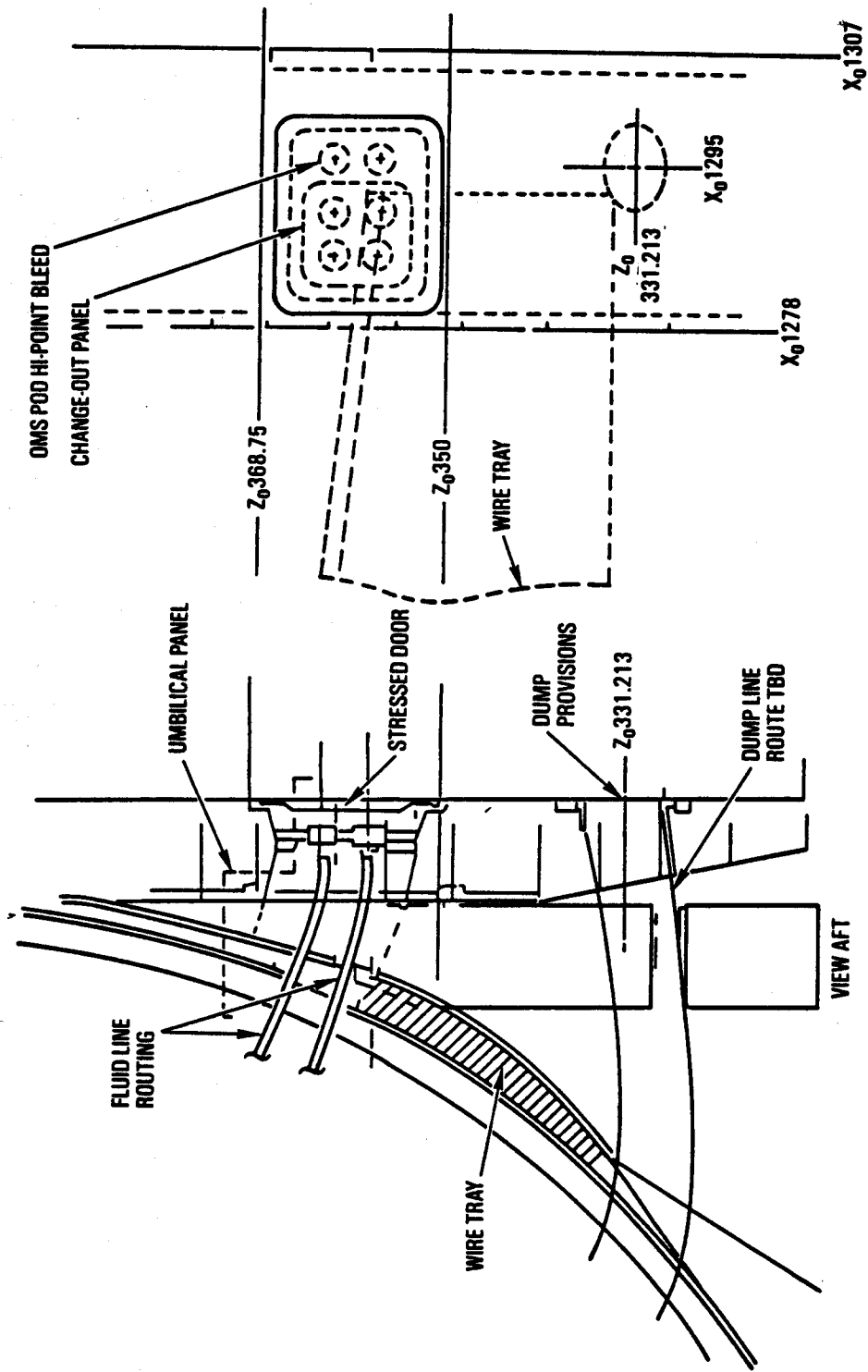
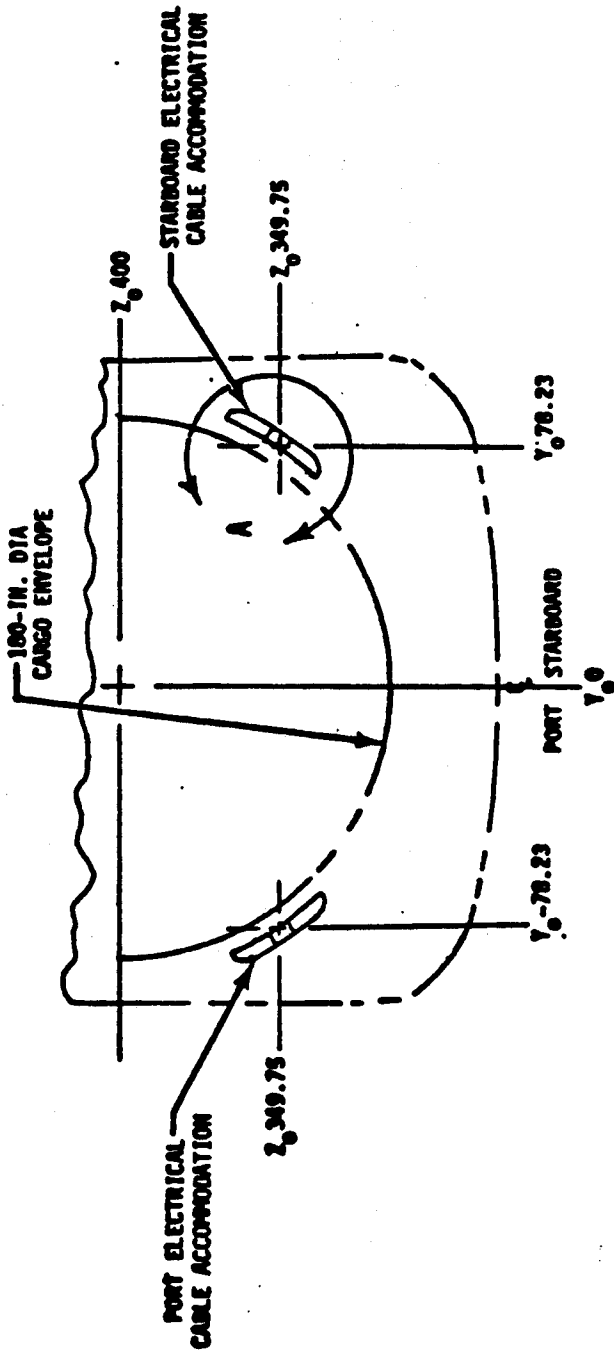


FIGURE 3.3.4-8 PORT (T-4) PAYLOAD UMBILICAL PANELS AND DUMP PROVISIONS (ROUTING CONCEPTS)



VIEW LOOKING FORWARD

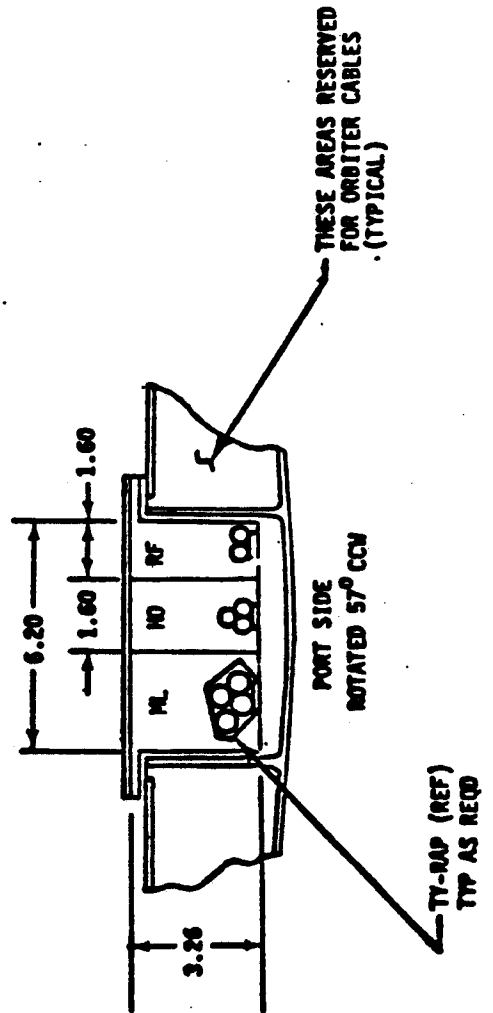
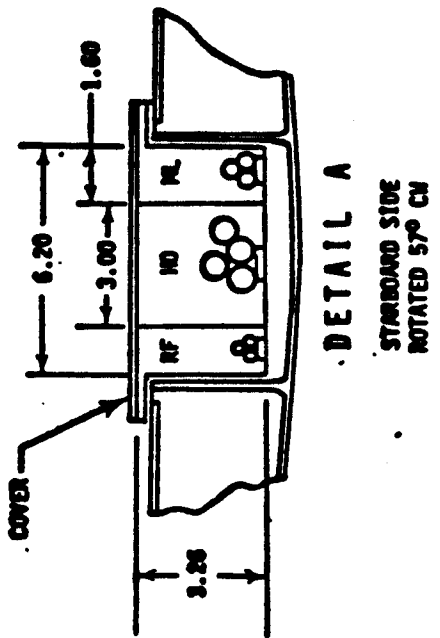


FIGURE 3.3.5.1-1 MID-BODY WIRE TRAYS

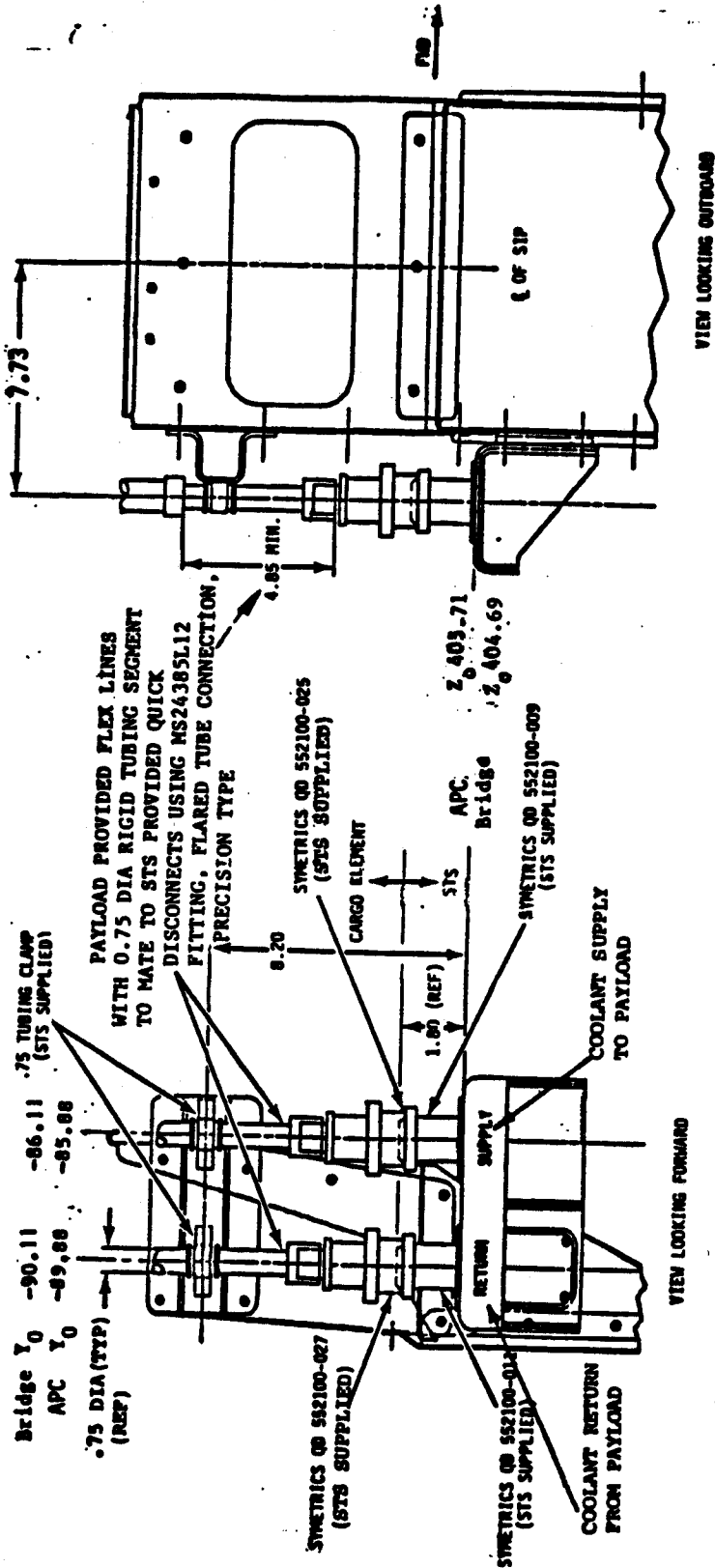


Figure 3.3.5.2-1 PACK Fluid Lines Installation

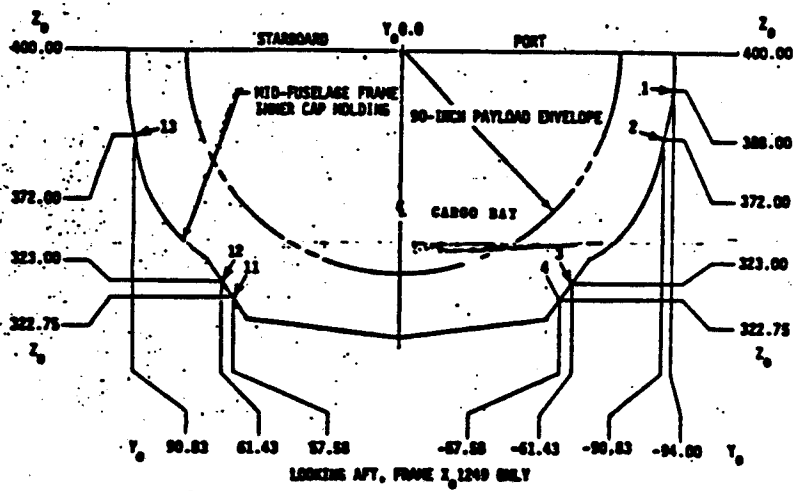
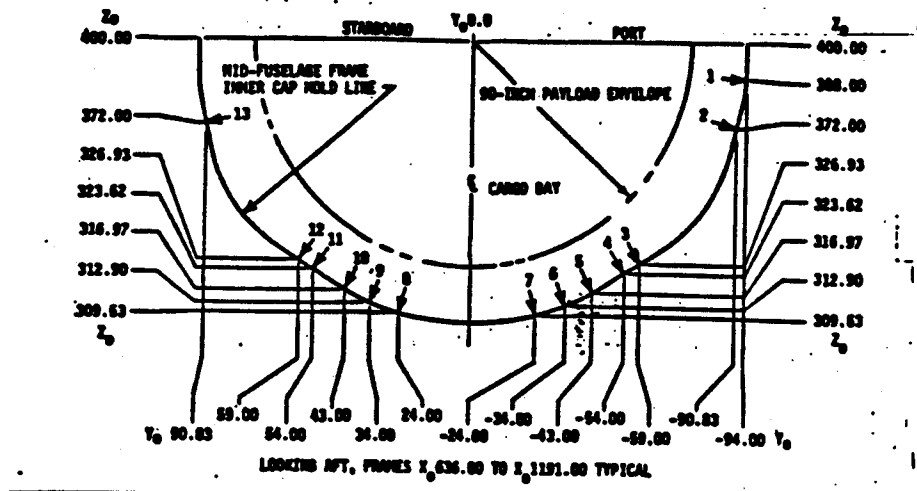


TABLE OF SCAR ATTACHMENT DETAILS\*

SCAR ATTACH ROW	X <sub>0</sub> FRAMES											
	636.00	693.00	750.00	807.00	863.00	919.00	979.50	1040.00	1090.33	1140.67	1191.00	1249.00
1	∞	B	B	B	B	B	B	B	B	B	B	B
2	B	B	C	B	B	C	C	B	B	B	B	B
3	E	B	B	B	B	B	B	B	B	B	E	F
4	A	A	A	A	A	A	A	A	A	A	A	G
5	A	A	A	A	A	A	A	A	A	A	A	G
6	A	A	A	A	A	A	A	A	A	A	A	G
7	A	A	A	A	A	A	A	A	A	A	A	G
8	A	A	A	A	A	A	A	A	A	A	A	G
9	A	A	A	A	A	A	A	A	A	A	A	G
10	A	A	A	A	A	A	A	A	A	A	A	G
11	A	A	A	A	A	A	A	A	A	A	A	G
12	E	B	B	B	B	B	B	B	B	B	B	E
13	B	B	B	B	C	C	C	B	B	B	B	B

\*DETAILS A AND B, SHEET 1 OF FIGURE 3.3.5.4-2, DETAILS C, D & E, SHEET 2 OF FIGURE 3.3.5.4-2  
 DETAILS F AND G, SHEET 3 OF FIGURE 3.3.5.4-2, ∞NO ATTACHMENT POINTS

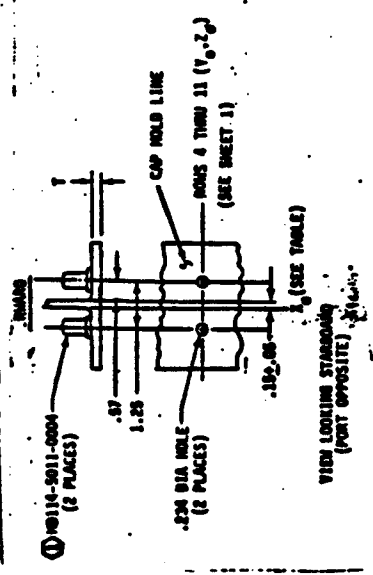
FIGURE 3.3.5.4-1 MID-BODY SCAR ATTACHMENT PROVISIONS (SHEET 1 OF 4)

T DIMENSION

SCAR ATTACH ROW	$T_0$	$T_1$	$T_2$	$T_3$	$T_4$	$T_5$	$T_6$	$T_7$	$T_8$	$T_9$	$T_{10}$	$T_{11}$
4	54.00	.150	.135	.135	.135	.149	.150	.150	.150	.150	.150	.150
5	43.00	.150	.135	.135	.135	.144	.150	.170	.200	.200	.200	.200
6	34.00	.150	.135	.135	.135	.140	.164	.204	.260	.260	.260	.260
7	24.00	.150	.135	.135	.135	.144	.181	.231	.260	.260	.260	.260
8	14.00	.150	.135	.135	.135	.144	.181	.231	.260	.260	.260	.260
9	4.00	.150	.135	.135	.135	.144	.164	.204	.260	.260	.260	.260
10	43.00	.150	.135	.135	.135	.144	.150	.170	.200	.200	.200	.200
11	54.00	.150	.135	.135	.135	.149	.150	.150	.150	.150	.150	.150

SEE SHEET 3 DETAIL 9

DETAIL A



T DIMENSION

SCAR ATTACH ROW	$T_0$	$T_1$	$T_2$	$T_3$	$T_4$	$T_5$	$T_6$	$T_7$	$T_8$	$T_9$	$T_{10}$	$T_{11}$
1	54.00	.350	.310	.310	.340	.260	.300	.371	.250	.500	.000	.780
2	50.83	.340	.330	.330	.330	.279	.330	.294	.318	.528	.748	.840
3	59.00	.0	.135	.135	.150	.150	.150	.309	.260	.200	.0	.0
12	59.00	.0	.135	.135	.150	.150	.150	.309	.260	.200	.0	.0
13	90.83	.340	.330	.290	.279	.0	.0	.294	.318	.528	.748	.840

SEE SHEET 3, DETAIL C  
 SEE SHEET 3, DETAIL E  
 SEE SHEET 4, DETAIL F  
 NO ATTACHMENT POINT

NOTES  
 INTERIM ROCKWELL PART NUMBER (FOR REFERENCE ONLY) WILL BE CHANGED TO APPROPRIATE GOVERNMENT IDENTIFICATION WHEN SUCH GOVERNMENT SPECIFICATION COVERAGE IS IMPLEMENTED.

DETAIL B

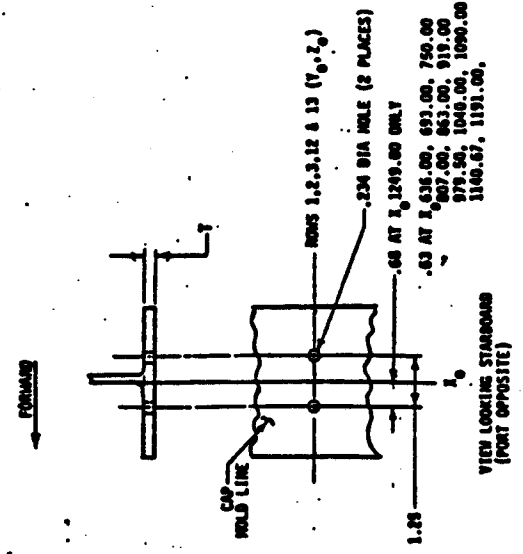
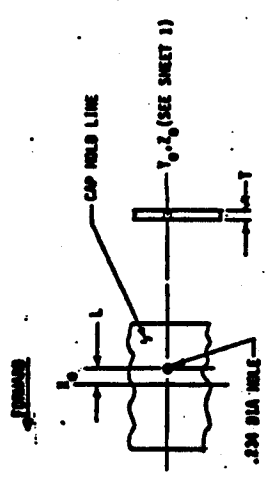


FIGURE 3.3.5.4-1 MID-BODY SCAR ATTACHMENT PROVISIONS (SHEET 2 OF 4)



L DIMENSION

SCAR ATTACH. ROW	V <sub>0</sub>	V <sub>1</sub>	V <sub>2</sub>	V <sub>3</sub>	V <sub>4</sub>	V <sub>5</sub>
2	90.83	.520	•	.520	.720	.720
13	90.83	•	.770	.520	.720	.720

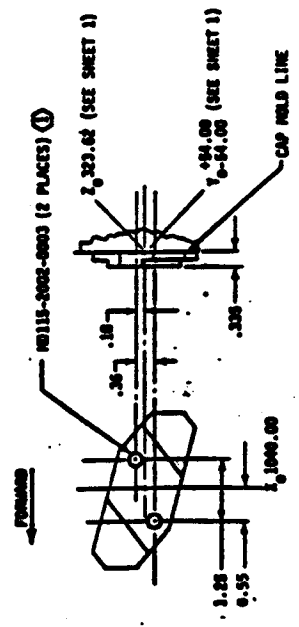
T DIMENSION

SCAR ATTACH. ROW	V <sub>0</sub>	V <sub>1</sub>	V <sub>2</sub>	V <sub>3</sub>	V <sub>4</sub>	V <sub>5</sub>
2	90.83	.270	•	.250	.270	.270
13	90.83	•	.330	.250	.270	.270

\*SEE SHEET 1, DETAIL B

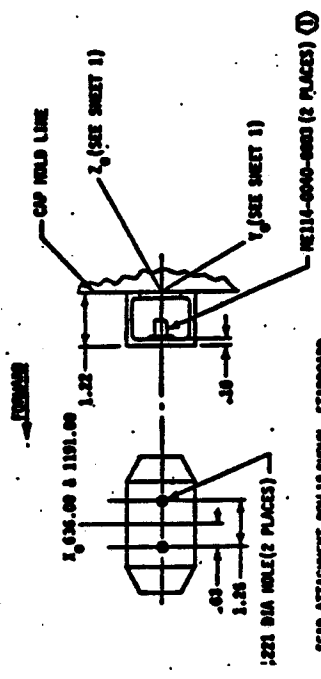
DETAIL C

SCAR ATTACHMENT ROW 13 SHOWN, STARBOARD  
SCAR ATTACHMENT ROW 2, PORT SIDE OPPOSITE



SCAR ATTACHMENT ROW 11 SHOWN, STARBOARD  
SCAR ATTACHMENT ROW 4 SHOWN, PORT SIDE OPPOSITE

DETAIL B

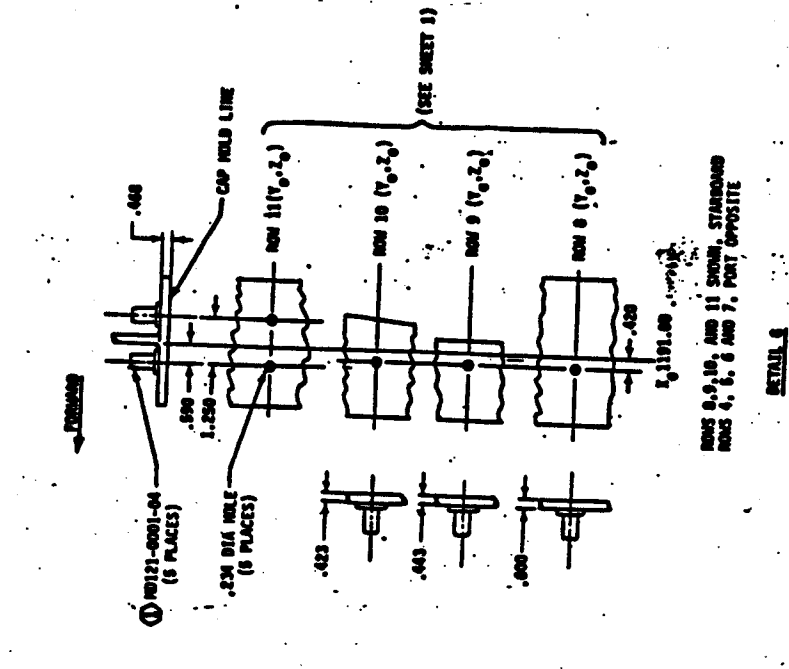


SCAR ATTACHMENT ROW 12 SHOWN, STARBOARD  
SCAR ATTACHMENT ROW 3, PORT SIDE OPPOSITE

DETAIL A

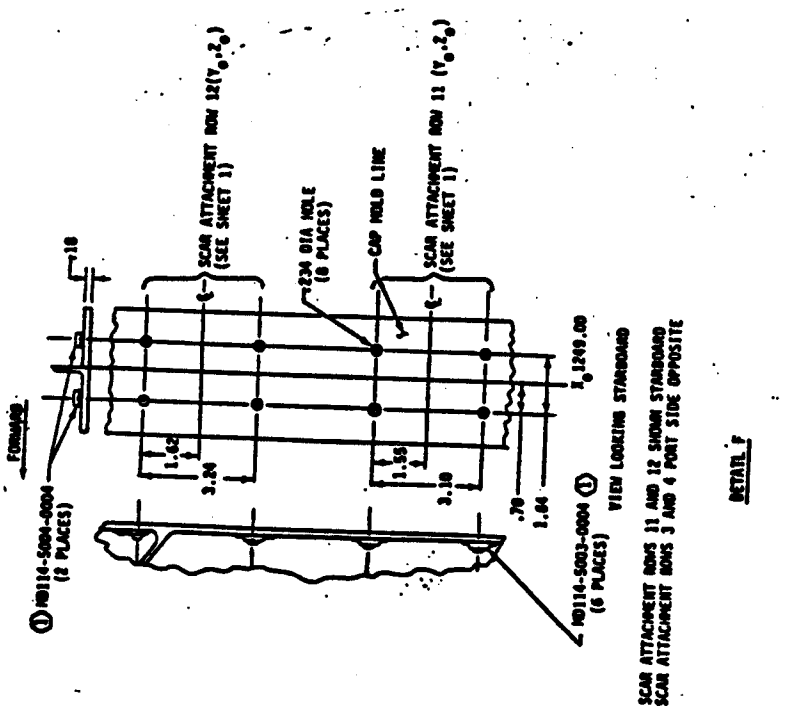
FIGURE 3.3.5.4-1 MID-BODY SCAR ATTACHMENT PROVISIONS (SHEET 3 OF 4)





ROWS 9, 10, AND 11 SHOWN, STARBOARD  
 ROWS 4, 5, 6 AND 7, PORT OPPOSITE

DETAIL E



DETAIL F

FIGURE 3.3.5.4-1 MID-BODY SCAR ATTACHMENT PROVISIONS (SHEET 4 OF 4)



### 3.4 Crew Compartment

3.4.1 Aft Flight Deck. A general arrangement of the aft flight deck is shown in *Figure 3.2.1-1 (Sheet 2 of 4)*.

#### 3.4.1.1 Payload Equipment Interfaces.

3.4.1.1.1 Equipment Consoles. The payload display and control panels and/or equipment shall be installed in Orbiter-provided removable consoles at the Mission Station and Payload station. The console, used at both stations, is defined in *Figure 3.4.1.1.1-1*. Each console shall accommodate the electrical equipment rack panels defined in *Figure 3.4.1.1.1-2*.

*The console and attachments are designed to accommodate a total equipment module weight of up to 135 lbs. Cantilever mounted modules are in each case to be bolted to the top frame as shown in Figure 3.4.1.1.1-3. To keep individual module loads within strength limits, the c.g. of each cantilevered module must fall within the limits of Figure 3.4.1.1.1-4. To keep combined module loads within strength limits, the overall c.g. of the modules must fall within the limits of Figure 3.4.1.1.1-5.*

*Equipment modules which fall outside the limits of Figure 3.4.1.1.1-4 shall have a lower support in addition to the upper attachment, to provide Y-direction support for lower end of the module. For structural purposes a single strut running from the lower center of the module to a lower corner of the container is sufficient. Access for attachment is through the front panel.*

3.4.1.1.2 Equipment Areas. Payload display and control panel areas shall be provided at the On-Orbit Station. The interface requirement for On-Orbit Station panels is defined in Paragraph 3.4.1.3.

3.4.1.1.3 Panel GSE Hard Points. Accommodations to install and remove cargo-provided panels in the consoles and panel areas shall be provided as required. GSE quick release pin T and U handles are available as GFE and payloads using this service shall provide receptacles in accordance with *Figure 3.4.1.1.3-1*.

3.4.1.1.4 Fire Protection. Each payload display/control panel shall have adequate provisions for fire protection.

3.4.1.1.4.1 Fire Holes. Each payload display/control panel shall have on its front surface a "fire hole", 0.5 inch in diameter, located so as to allow a fire extinguisher to be inserted for suppressing fire behind the panel. The hole shall be covered by a 0.75-inch-diameter GFE decal placed over the fire hole.

3.4.1.1.5 Electrical Short Prevention. A coating shall be required on all exposed wire terminations, component terminals, and other conductive surfaces of electrical and electronic equipment located in the Orbiter Crew Compartment, for protection against electrical shorts due to humidity and debris.

#### 3.4.1.2 Mission Station

3.4.1.2.1 Equipment Console and Display Panel. One equipment console shall be provided in accordance with paragraph 3.4.1.1.1. The panel envelopes for the two possible console installations are defined in Figure 3.4.1.2.1-2. In addition, space and mounting provisions for a display and control panel are defined in Figure 3.4.1.2.1-1.

3.4.1.2.2 Electrical Distribution Panel. The electrical distribution panel interface shall be in accordance with Figure 3.4.1.2.2-1.

3.4.1.2.3 Electrical Harness Supports. The supports for the electrical harnesses shall be in accordance with Figure 3.4.1.2.3-1.

3.4.1.2.4 Equipment Cooling. Orbiter provided ducting for the cooling of cargo element electrical equipment mounted in the MS console are shown in Figure 3.4.1.2.3-1 and Figure 3.4.1.2.4-1. Cooling air provided at the Mission Station shall be as defined in Paragraph 6.3.

### 3.4.1.3 On-Orbit Station

3.4.1.3.1 Display and Control Panels. Two areas for display and control panels shall be provided for payload use at the On-Orbit Station. The envelope for each shall be in accordance with Figure 3.4.1.3.1-1.

3.4.1.3.2 Electrical Distribution Panel. The port electrical distribution panel connector interfaces shall be in accordance with Figure 3.4.1.3.2-1. The starboard electrical distribution panel connector interfaces shall be in accordance with Figure 3.4.1.3.2-2.

3.4.1.3.3 Electrical Harness Supports. The electrical harness supports shall be in accordance with Figures 3.4.1.3.3-1 and 3.4.1.3.3-2.

3.4.1.3.4 Retention System Control. The Orbiter shall provide switch controls and talkback indicators for Retention System management. Switches on Panel A6A1, installed at the Aft Flight Deck On-Orbit Station, provide for the activation of a total of fifteen latches in the cargo bay, with no more than two latches being operated simultaneously.

### 3.4.1.4 Payload Station.

3.4.1.4.1 Equipment Consoles. Three equipment consoles shall be provided in accordance with Paragraph 3.4.1.1. The panel envelopes for each shall be in accordance with Figure 3.4.1.4.1-1.

3.4.1.4.2 Payload Station Distribution Panel (PSDP). The Orbiter shall provide electrical interfaces at the PSDP in accordance with Figure 3.4.1.4.2-1.

3.4.1.4.2.1 Electrical Characteristics at the Cargo Element Interface. Electrical interface characteristics are defined by function in Sections 8 and 13.

3.4.1.4.2.2 Standard Interface Cabling. The Orbiter shall provide standard cables, as defined in Paragraph 13.5.2.2 to extend from the PSDP to cargo element equipment installed at the Payload Station.

3.4.1.4.3 Electrical Harness Supports. The supports for the electrical harnesses shall be in accordance with Figure 3.4.1.4.3-1.

3.4.1.4.4 Equipment Cooling. *Orbiter provided ducting for the cooling of cargo element electrical equipment mounted in and below the PS console are shown in Figure 3.4.1.4.4-1.* Cooling air provided at the Payload Station shall be as defined in Paragraph 6.3.

3.4.1.4.5 Space Allocation. The space below the modules reserved for payloads shall be in accordance with Figure 3.4.1.4.5-1.

3.4.1.4.6 Standard Payload Display and Control Interface Modules. The STS shall provide Standard Payload Display and Control Interface (SPDCI) modules. The SPDCI shall include a Closed-Circuit Television (CCTV) Monitor Panel (TVMP), a Standard Switch Panel (SSP), a Manual Pointing Controller (MPC), and a Deployment/Pointing Panel (DDP) to which the MPC is attached by an STS-provided umbilical. Performance characteristics shall be as defined in Paragraph 13.4.

3.4.1.4.6.1 Television Monitor Panel (TVMP). The TVMP rear panel connector layout, shall be as shown in Figure 3.4.1.4.6.1-1.

3.4.1.4.6.2 Standard Switch Panel (SSP). The Standard switch panel primary location will be in payload dedicated console location L12, with optional locations in L10 or L11 when defined in cargo element-unique ICD's. Layout of the SSP front panel, including lettering, shall be as shown in Figure 3.4.1.4.6.2-1. The SSP rear panel connector designations and layout shall be as shown in Figure 3.4.1.4.6.2-2.

3.4.1.4.6.3 Manual Pointing Controller (MPC). The manual pointing controller (MPC) shall be attached by an electrical connection to the DPP by an eight-foot umbilical cable.

3.4.1.4.6.4 Deployment/Pointing Panel (DDP). Layout of the DPP front panel shall be as shown in Figure 3.4.1.4.6.4-1. The rear panel connector designations and layout shall be as shown in Figure 3.4.1.4.6.4-2.

3.4.1.5 (Reserved).

3.4.1.6 Bonding. All crew-compartment electrical bonding interfaces shall be prepared in accordance with Paragraph 10.7.4.2.

3.4.1.7 Harness/Connector Interface Between Orbiter and Cargo Element. *All cables, STS or cargo element supplied, interconnecting the Orbiter and cargo element shall have the following connector configuration at the cargo element termination of the cable:*

- a. *All cables shall terminate in connector plugs which consist only of pin (male) contacts for interfacing with cargo element modules, panels, components, etc.*
- b. *All interfacing cargo element modules, panels, components, etc., shall incorporate connector receptacles which consist only of socket (female) contacts for interfacing with cables interconnecting the Orbiter and cargo element.*

### 3.4.2 Mid Deck.

3.4.2.1 Stowage. All of the potential loose-equipment stowage locations and volumes, negotiable on a mission-by-mission basis for Cargo use, are defined and controlled in ICD-3-0027-03. A minimum volume of 89 cubic feet shall be dedicated to cargo use in each mission. A limited number of identical modular stowage units, defined in Figure 3.4.2.1-1, are included in the above total volume dedicated to Cargo use in each mission.

NOTES:

1. CONSOLE ACCOMMODATES PANELS UP TO SIZE "M" OR COMBINATIONS OF PANEL SIZES UP TO SIZE "M" PER FIG. 3.4.1.1.1-2
2. MOUNTING HOLE LOCATION DIMENSIONS ARE REFERENCE ONLY
3. MOUNTING HOLE LOCATIONS CONTROLLED PER ROCKWELL INTERNATIONAL TOOL #T-7135445
4. MAXIMUM WEIGHT OF CARGO ELEMENT COMPONENTS IN CONSOLE SHALL NOT EXCEED 135.0 LBS WITH CONTENT DENSITY OF NOT MORE THAN 30.0 LBS PER CUBIC FOOT
5. COMPONENTS MOUNTED ON PANELS R14, L13, AND L14 SHALL BE RECESSED SO THAT THERE WILL BE NO PROTRUSIONS BEYOND THE SURFACE OF THESE PANELS
6. PANEL KICK/PUSH LOADS PER PARAGRAPH 4.2.3

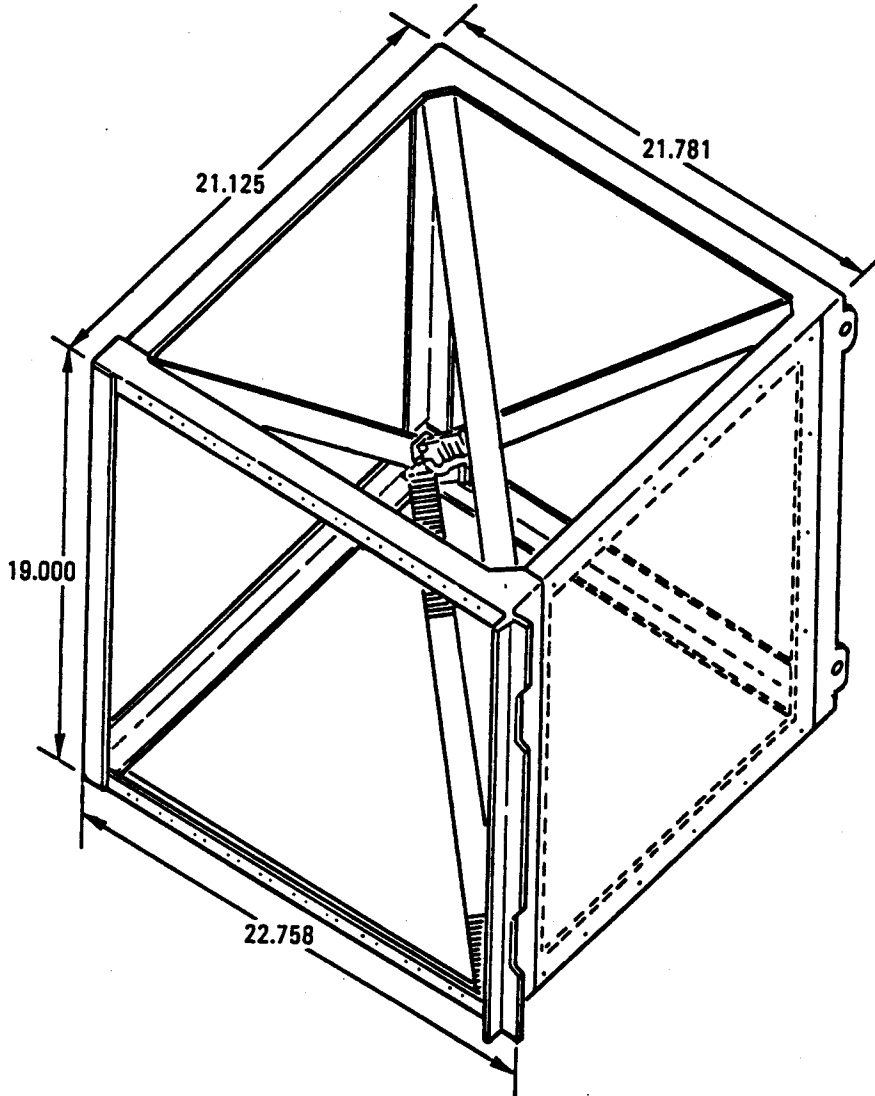


FIGURE 3.4.1.1.1-1 PAYLOAD DEDICATED CONSOLE, TYPICAL FOR L10, L11, L12, L13, L14, R11 OR R14 ON AFT FLIGHT DECK (SHEET 1 OF 3)

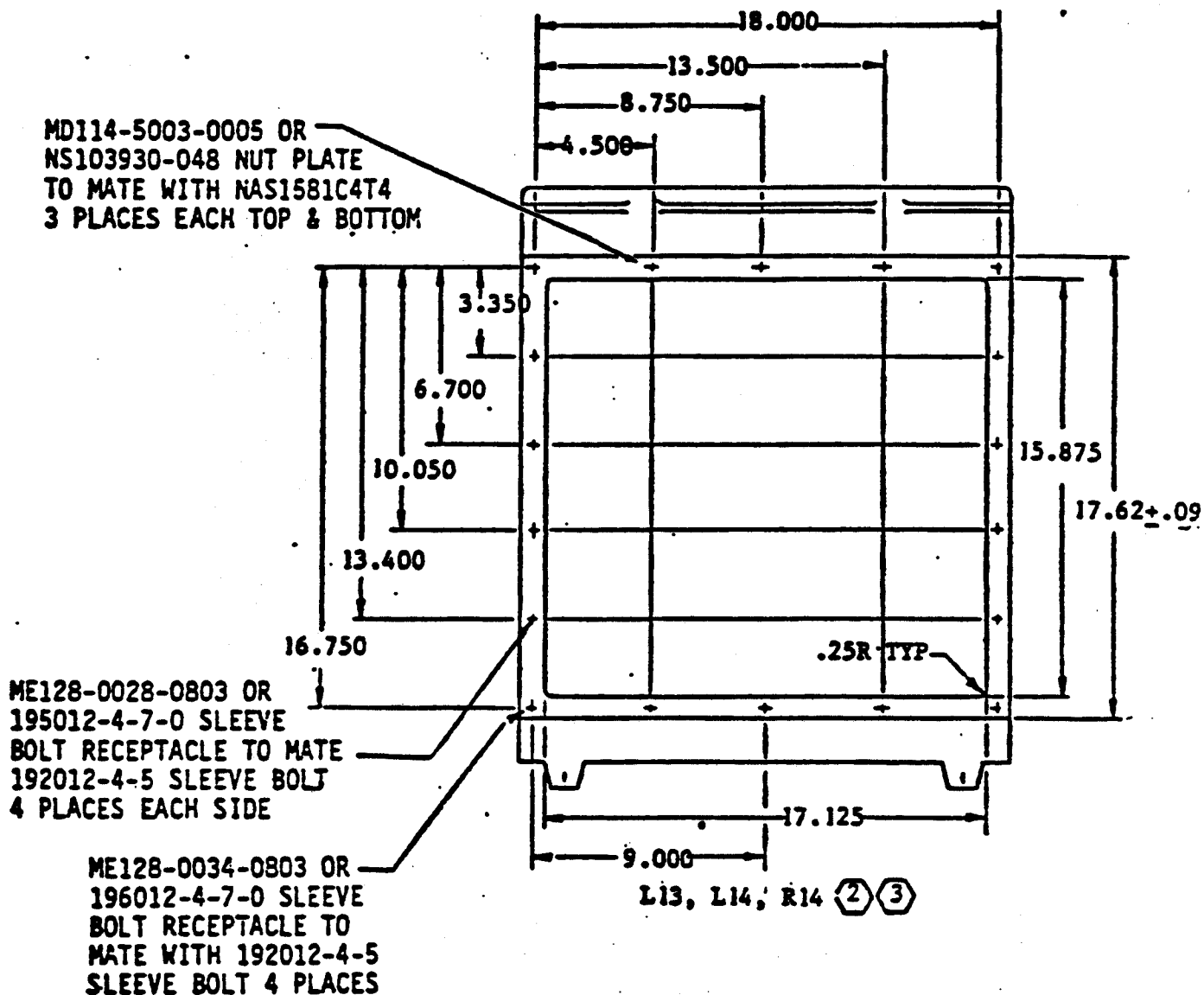


FIGURE 3.4.1.1.1-1 PAYLOAD DEDICATED CONSOLE, TYPICAL FOR L10,  
L11, L12, L13, L14, R14, R11 OR R12 ON AFT FLIGHT DECK  
(SHEET 2 OF 3)



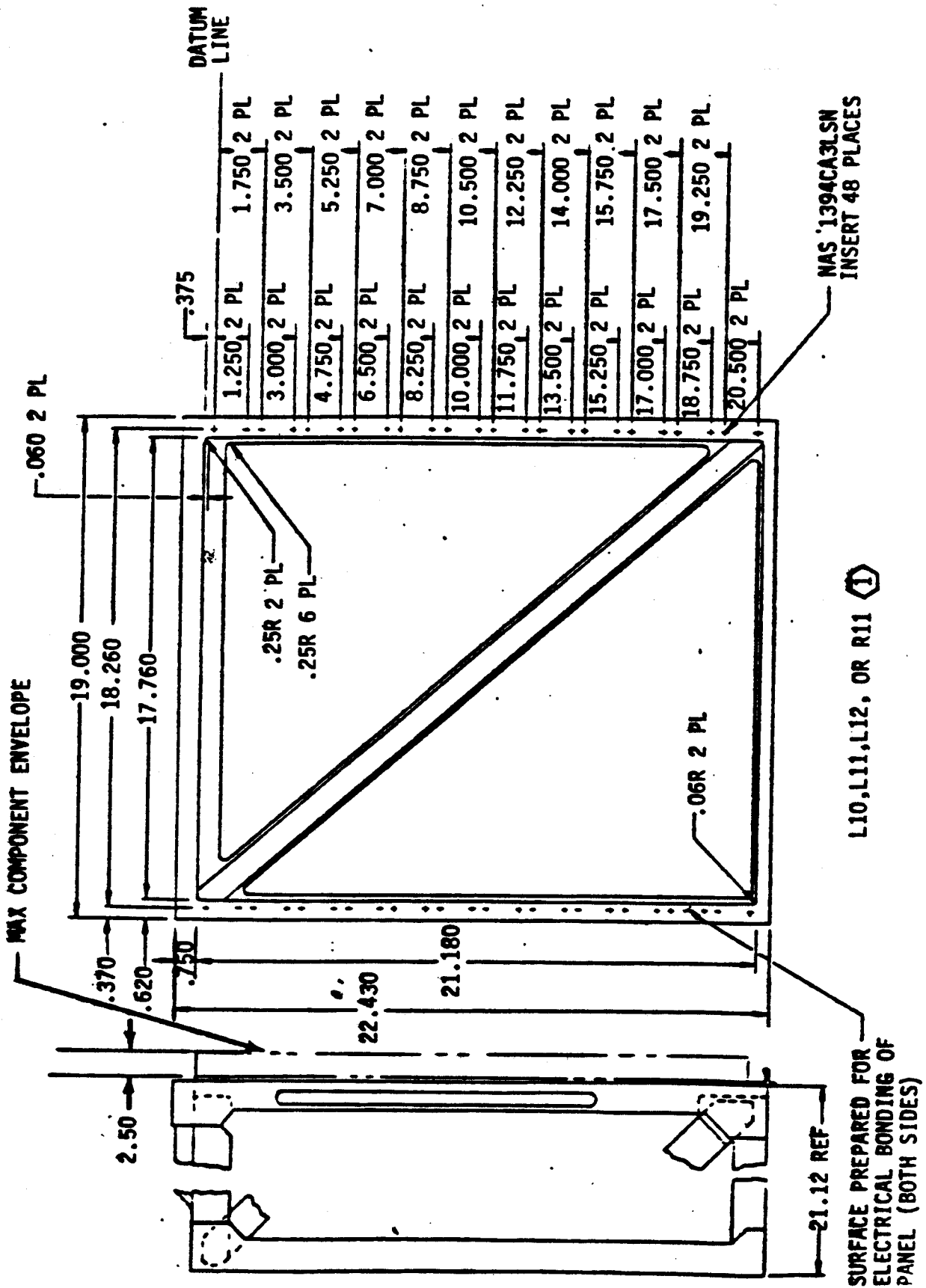
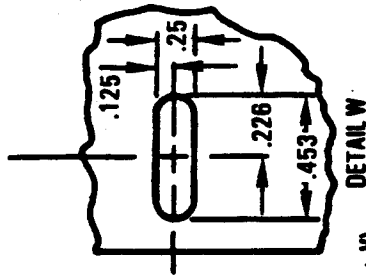


FIGURE 3.4.1.1.1-1 PAYLOAD DEDICATED CONSOLE, TYPICAL FOR L10, L11, L12 OR R11 ON AFT FLIGHT DECK (SHEET 3 OF 3)

PANEL DIMENSIONS

PANEL SIZE	P ±.015	Q	R	S	T	V
A	1.704	1.250				
B	3.454	3.000				
C	6.204	2.250				
D	6.954	4.000				
E	8.704	1.750	2.250	1.750		
F	10.454	2.250	3.000	2.250		
G	12.204	1.750	5.750	1.750		
H	13.954	3.500	4.000	3.508		
J	15.704	3.500	5.750	3.500		
K	17.454	3.500	7.500	3.500		
L	19.204	5.250	5.750	5.250	5.250	
M	20.954	1.750	5.250	4.000	5.250	1.750



NOTES:

1. PANEL THICKNESS SHALL BE .125, .188, .250, OR .313 IN., AS SPECIFIED IN INDIVIDUAL CONTRACT OR ORDER. OTHER PANEL DIMENSIONS IN INCHES WITH THEIR LETTER DESIGNATIONS (A, B, C, & OTHERS) SHALL BE AS SPECIFIED IN ABOVE TABLE. DIMENSIONS HAVE BEEN CHOSEN TO ALLOW A NOMINAL CLEARANCE OF .031 IN. BETWEEN PANELS ON ANY ONE RACK.
2. THIS FIGURE DOES NOT PRECLUDE USE OF FRONT PANELS CONFORMING TO MIL-STD-189 PROVIDED THE TOLERANCES ON DIMENSIONS OF FEATURES NOT SPECIFIED IN MIL-STD-189 ARE IDENTIFIED IN PAYLOAD UNIQUE ICDs.

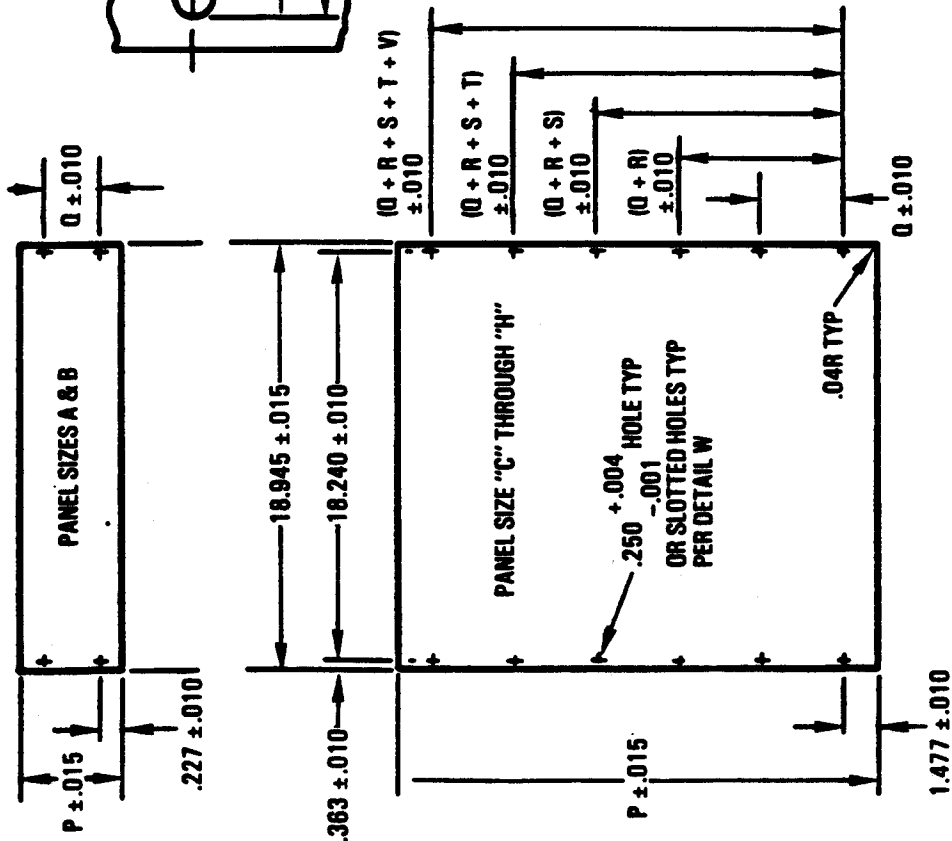


Figure 3.4.1.1.1-2 Limiting Dimensions For 19 9inch Electrical Equipment Rack Panels

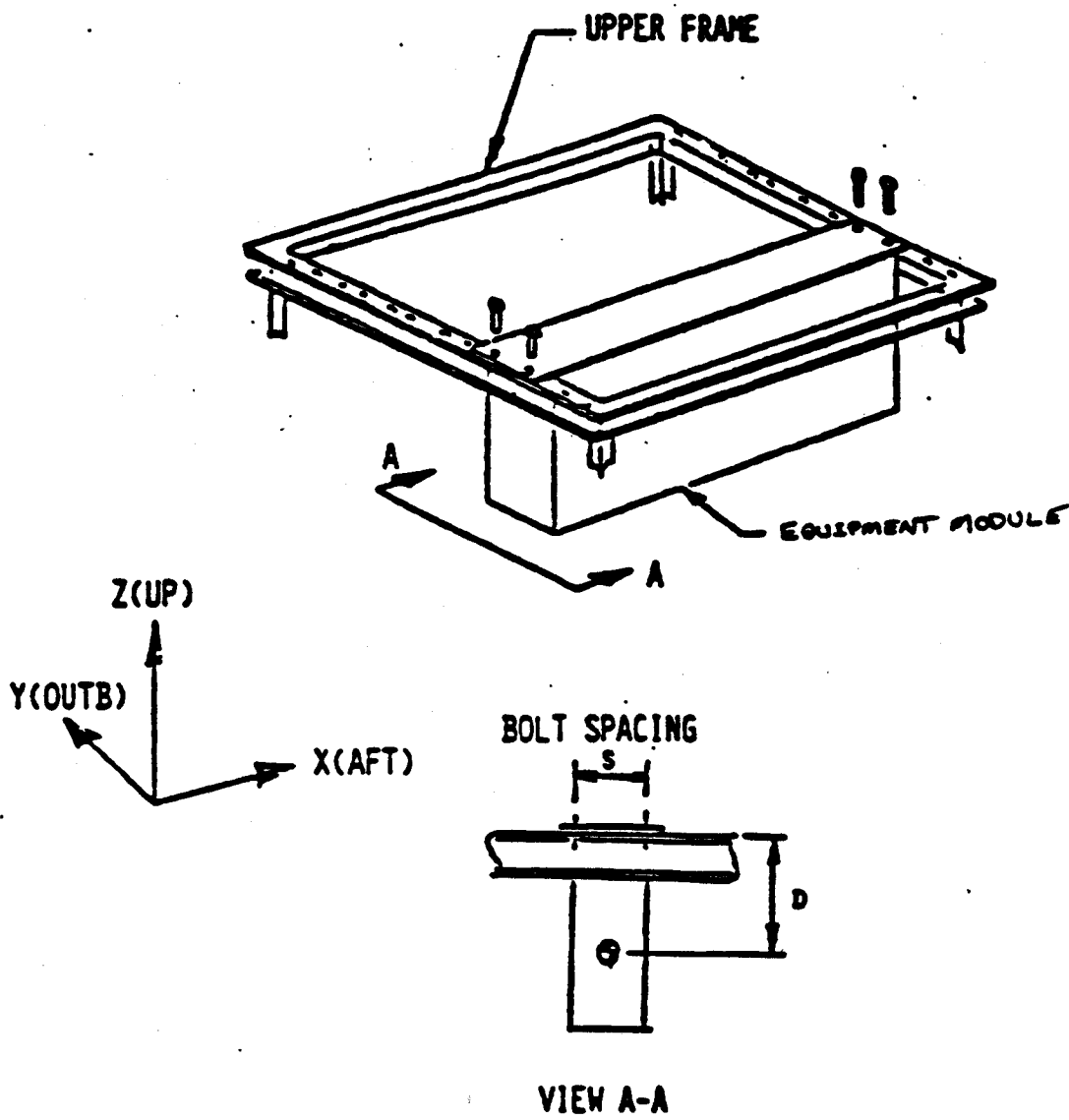


Figure 3.4.1.1.1-3 Equipment Attachment

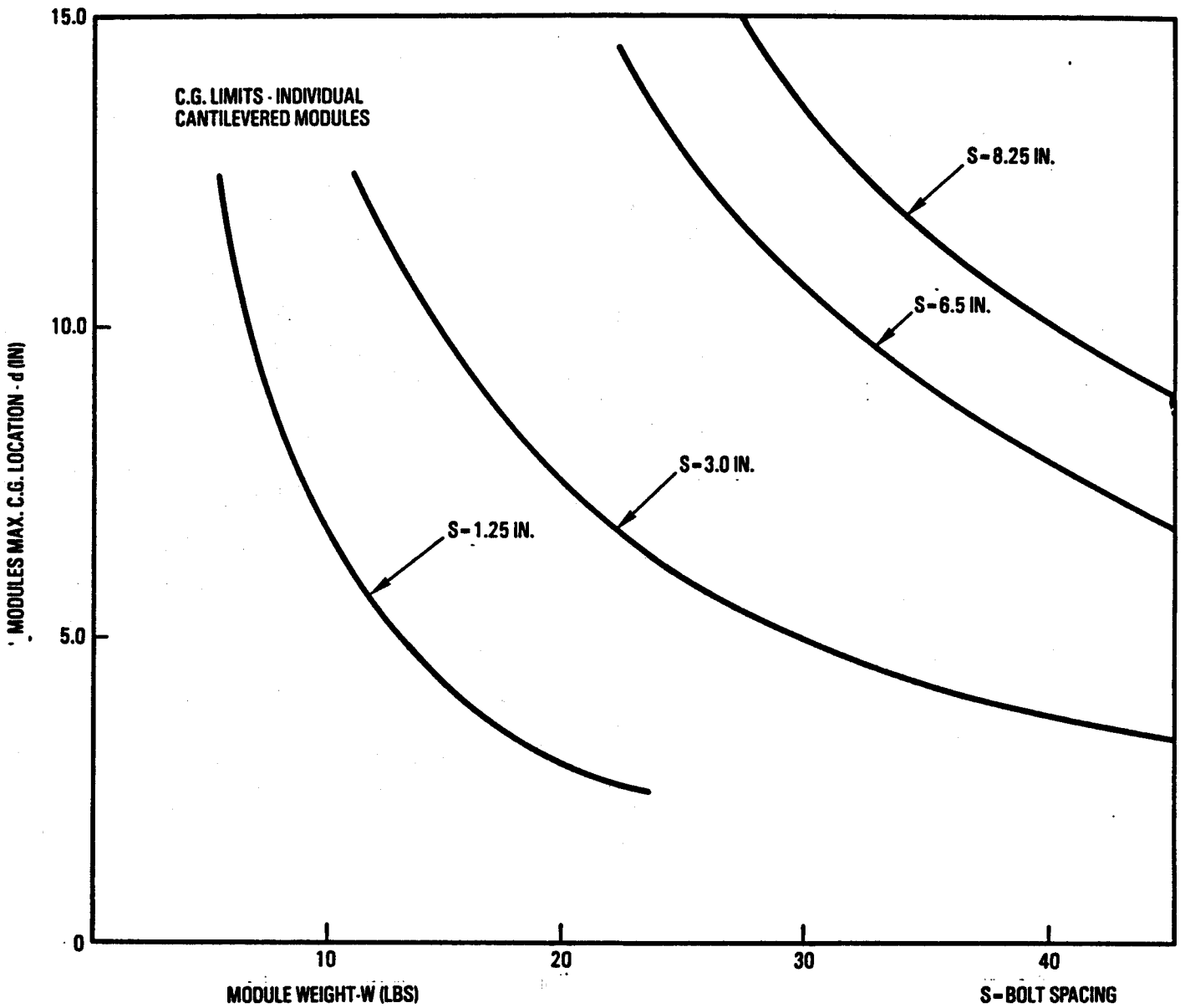


Figure 3.4.1.1.1-4 C.G. Limits - Individual Cantilevered Modules

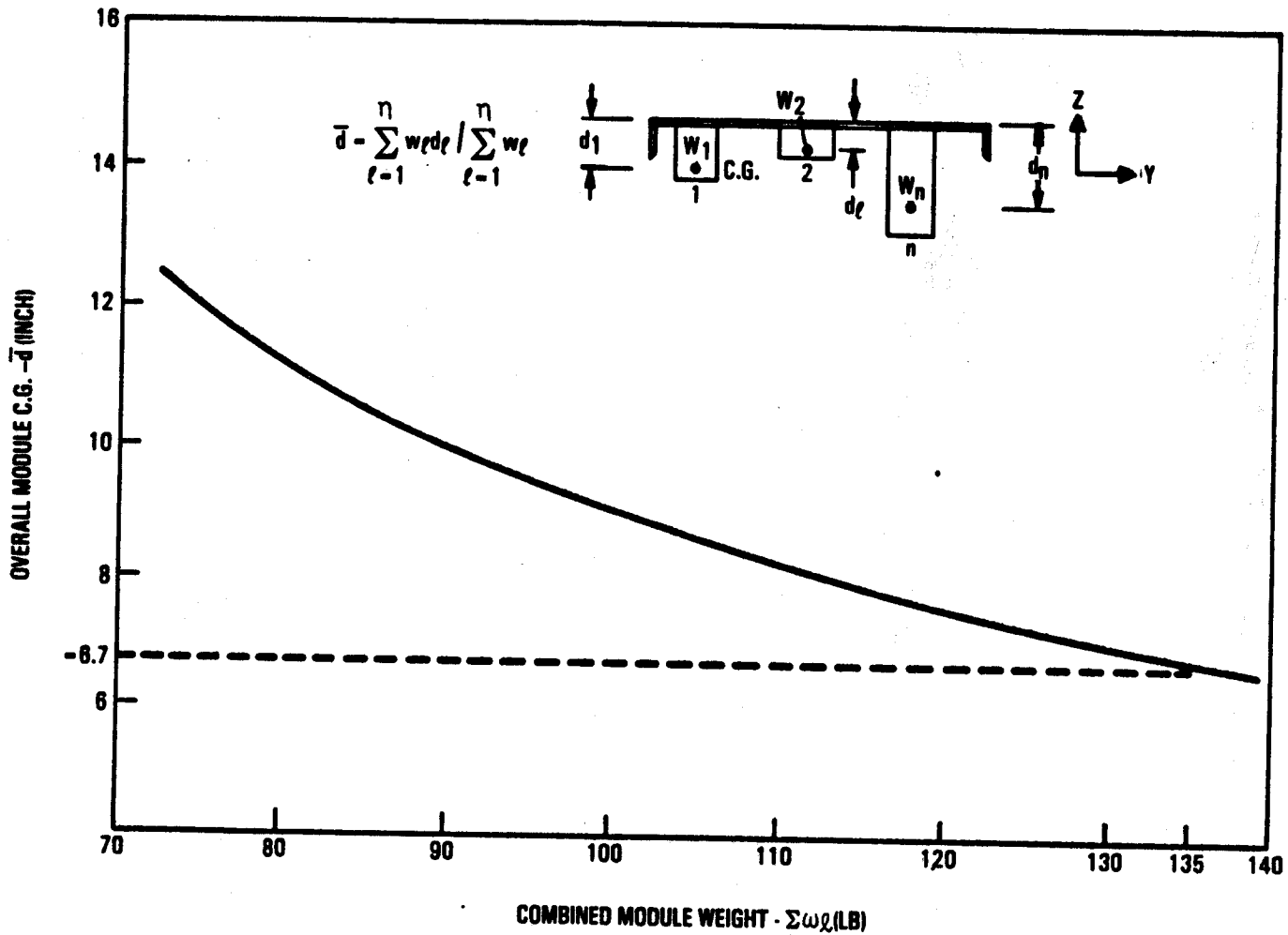
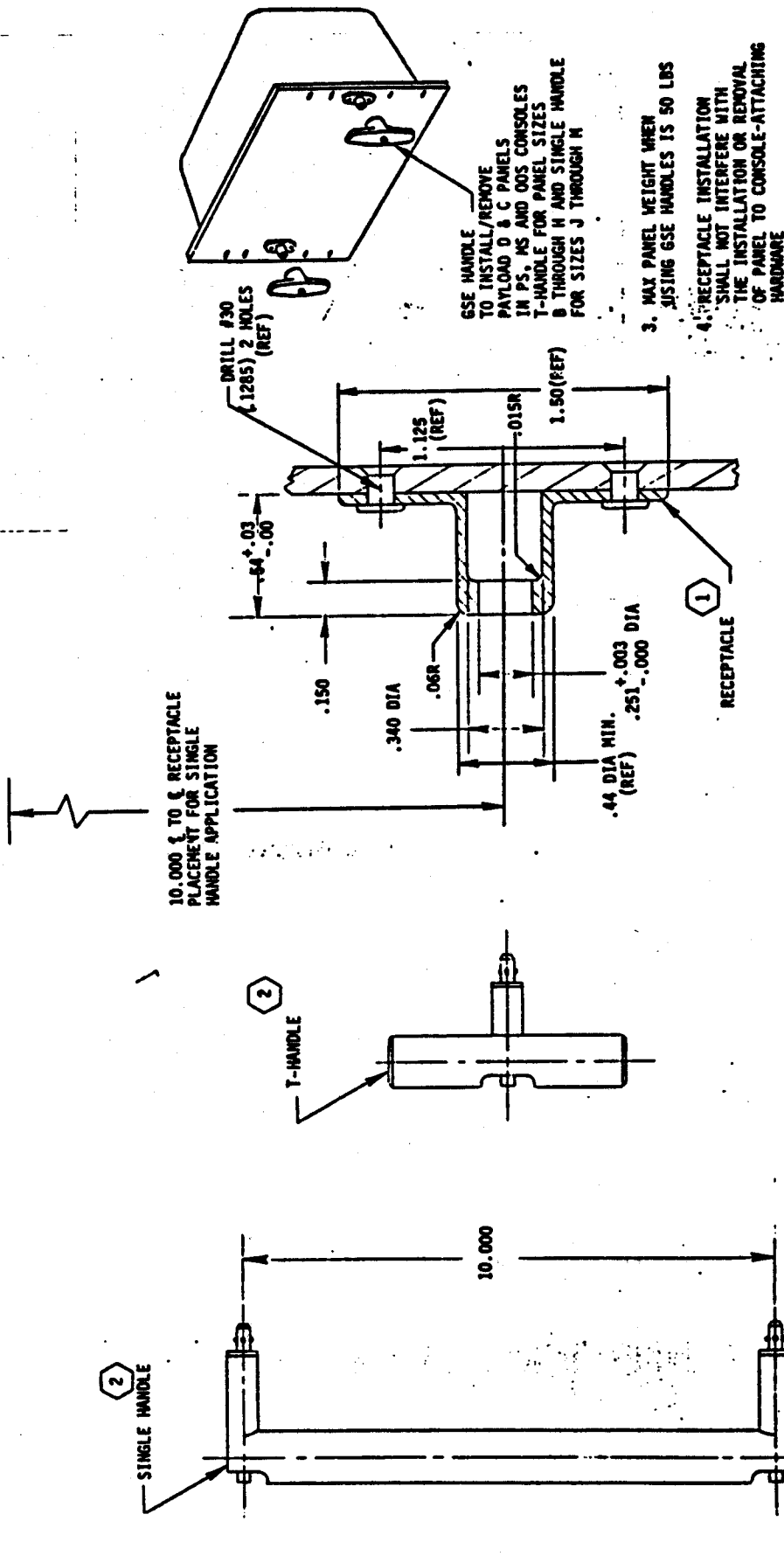
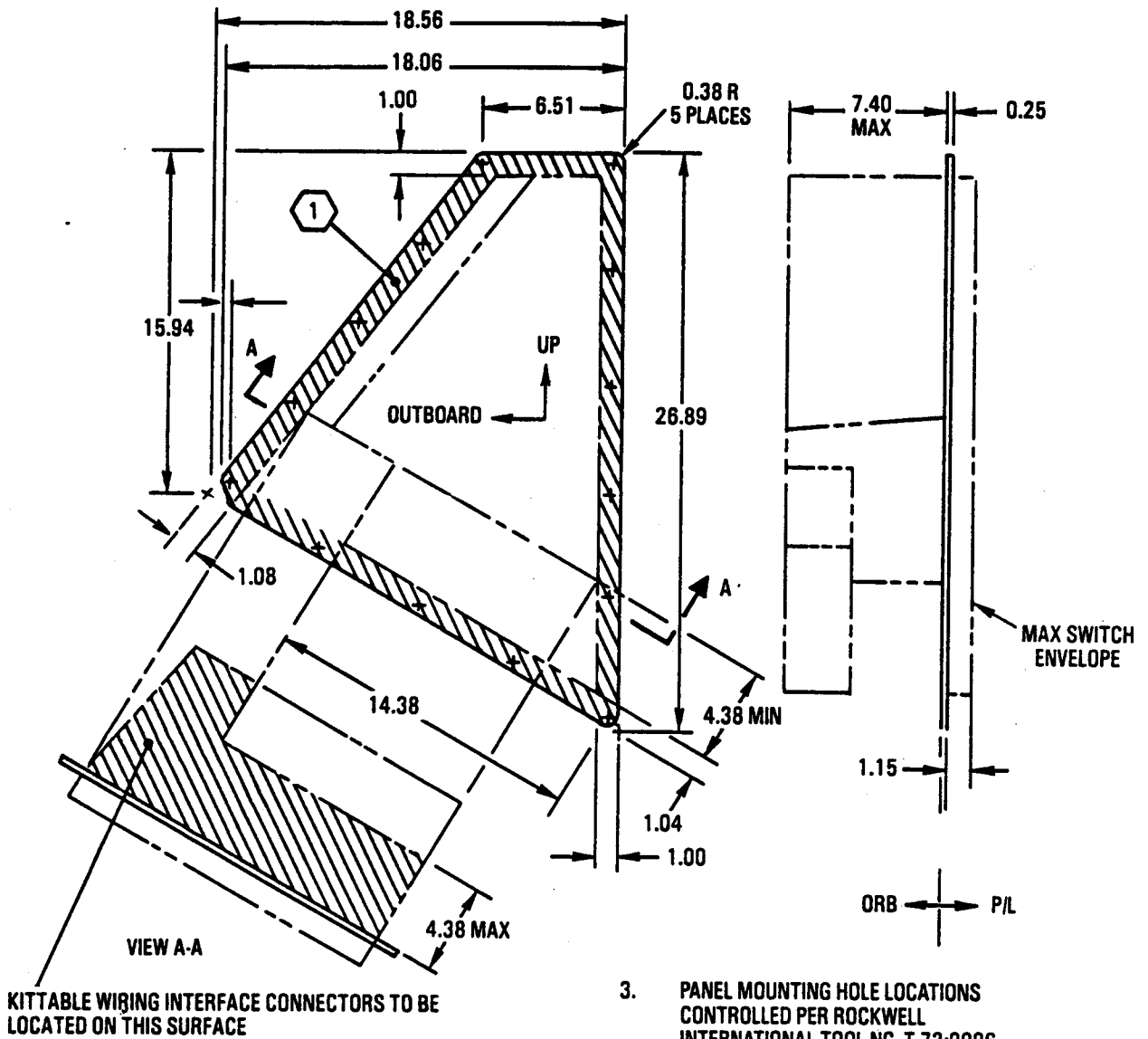


Figure 3.4.1.1.1-5 C.G. Limits - Combined Cantilevered Modules



- NOTES:
- 1 RECEPTACLE ROCKWELL INTERNATIONAL PART #7012-0012-0004 OR EQUIV. PAYLOAD PROVIDED.
  - 2 "T" AND SINGLE HANDLES GSE-PROVIDED AS A PART OF ORBITER HANDLING EQUIPMENT MODEL H70-0561

FIGURE 3.4.1.1.3-1 DISPLAY AND CONTROL PANELS GSE HARD POINTS



**NOTES:**

- 1. SURFACE PREPARED FOR ELECTRICAL BONDING OF PANEL PER PARAGRAPH 3.4.1.6 ALL AROUND MOUNTING FLANGE.
- 2. FIRE HOLE .50 DIA SHALL BE PROVIDED ON THE PANEL SURFACE TO INTERFACE WITH FIRE EXTINGUISHER NOZZLE. .75 DIA AREA AROUND THE FIRE HOLE ON PANEL SURFACE SHALL BE RED COLOR NO.31136, PER FED-STD-595.
- 3. PANEL MOUNTING HOLE LOCATIONS CONTROLLED PER ROCKWELL INTERNATIONAL TOOL NC. T-72;0006.
- 4. MOUNTING HOLE LOCATION DIMENSIONS SHOWN ARE REFERENCE ONLY.
- 5. CONTENT DENSITY SHALL NOT EXCEED 30.0 LBS PER CUBIC FOOT
- 6. PANEL KICK/PUSH OFF LOADS PER PARAGRAPH 4.2.3
- 7. PANEL THICKNESS AND FASTENER LENGTH (4XX) VARIES DEPENDING ON APPLICATION.

FIGURE 3.4.1.2.1-1 R-7 PANEL ENVELOPE  
(SHEET 1 OF 2)

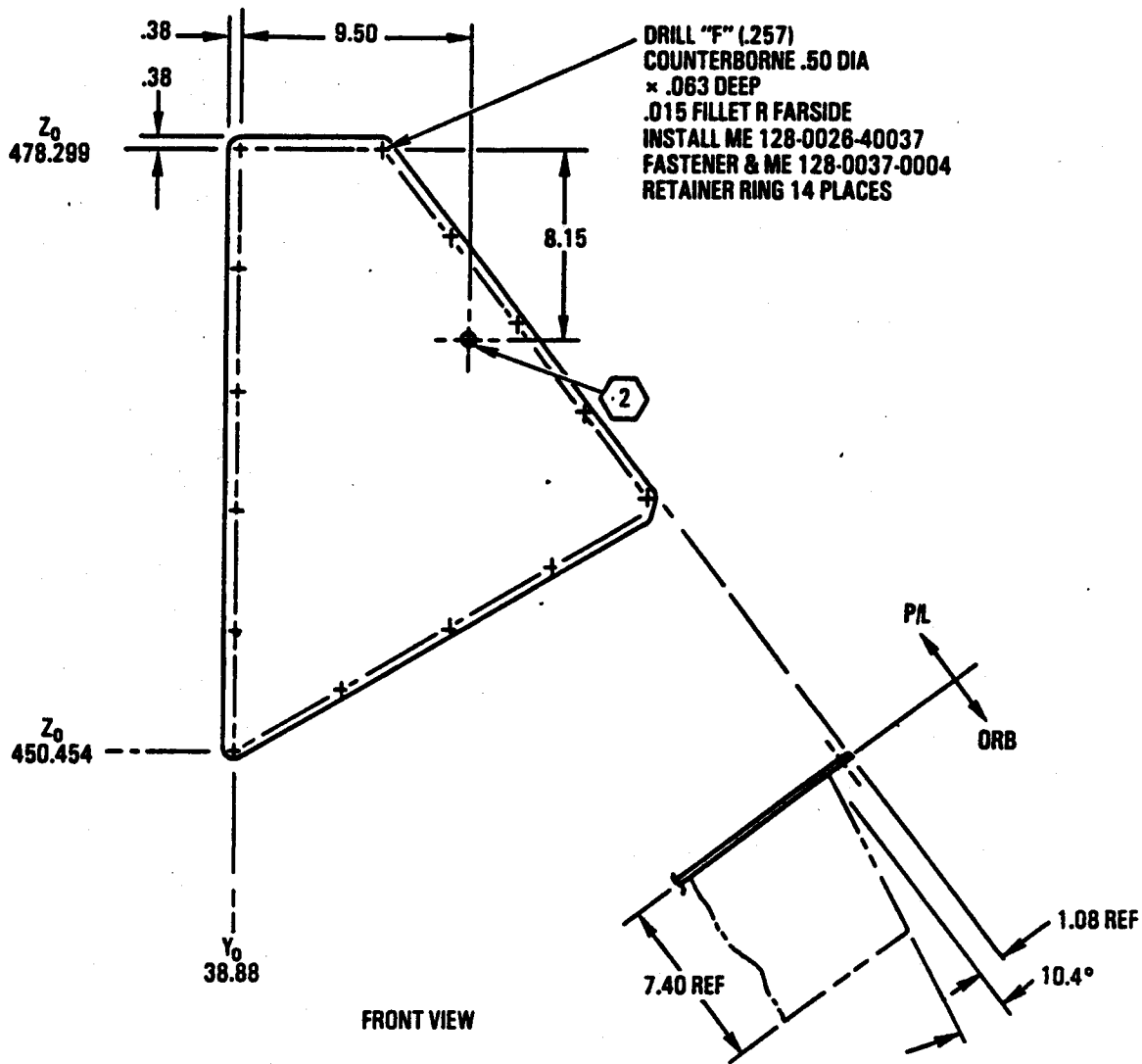
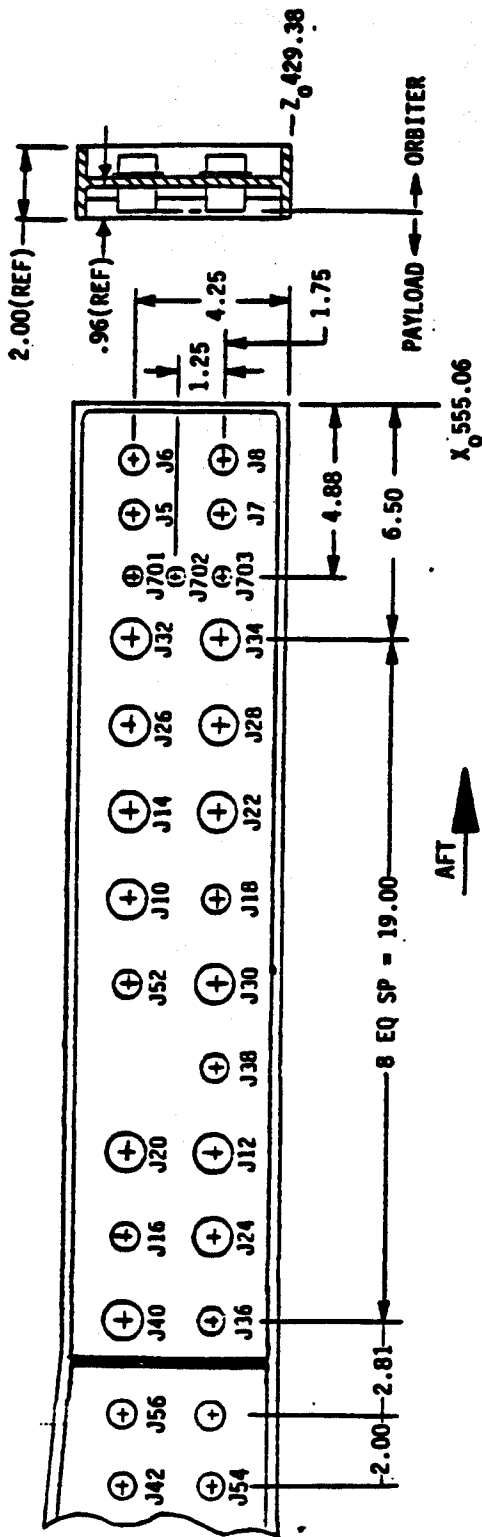


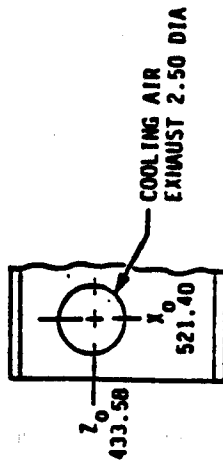
FIGURE 3.4.1.2.1-1 R-7 PANEL ENVELOPE  
(SHEET 2 OF 2)







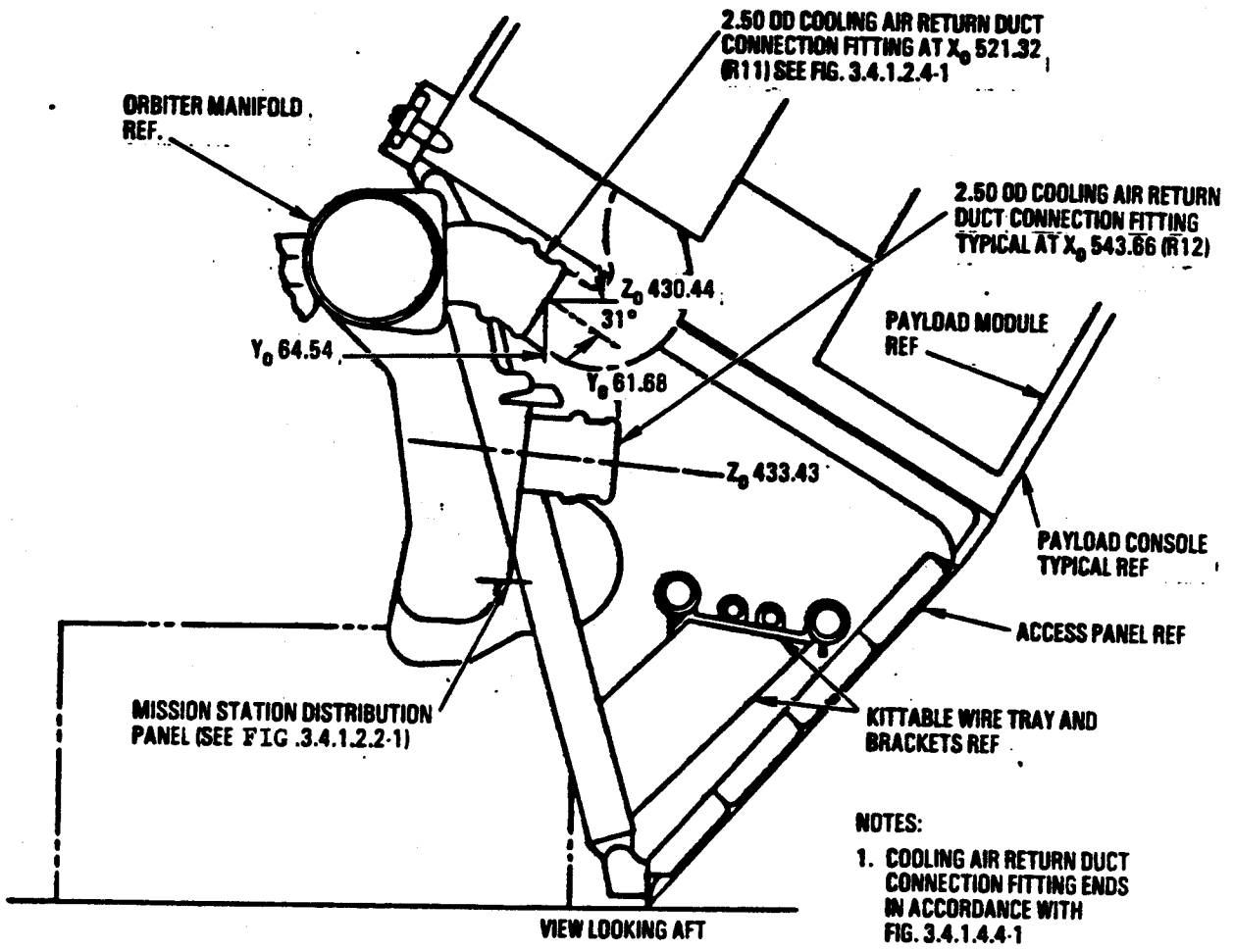
VIEW SHOWN LOOKING OUTBOARD



NOTES:

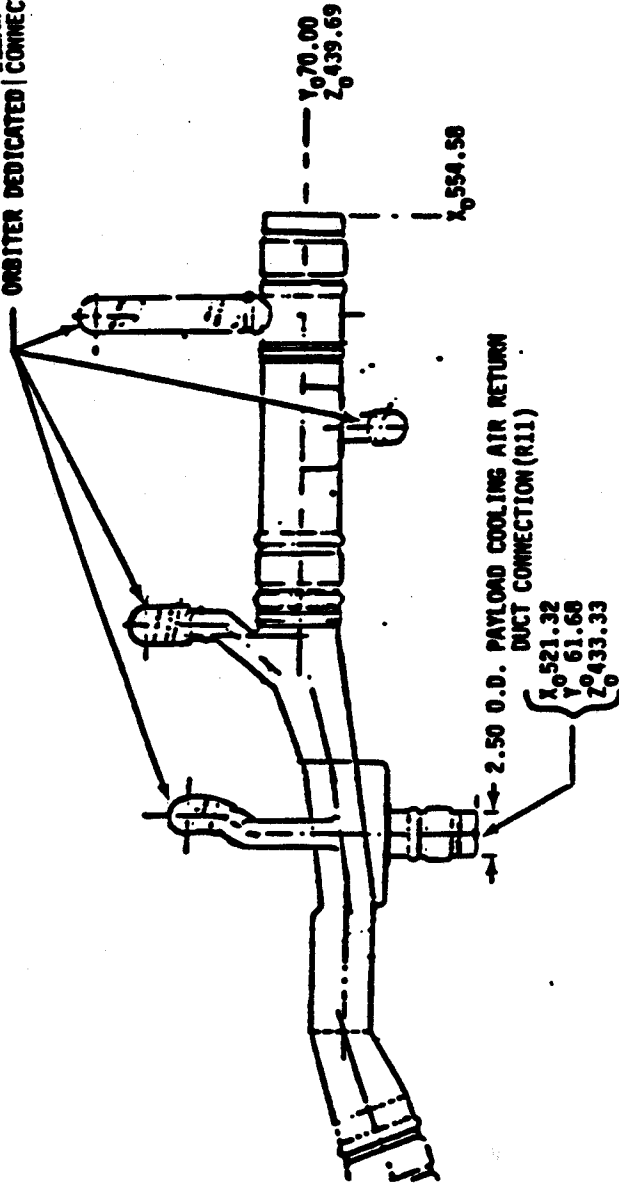
- ① ORBITER AND CARGO ELEMENT INTERFACE CONNECTORS SHALL BE AS SPECIFIED IN TABLE 13.6.2.2-1.
- ② J5, J6, J7, & J8 ARE ORBITER DEDICATED CONNECTORS.
3. CONNECTORS SHALL BE INSTALLED WITH KEYWAY AT TOP.
4. DETAILS OF COOLING AIR EXHAUST IS PROVIDED IN FIGURE 3.4.1.4.4-1.

Figure 3.4.1.2.2-1 Mission Station Distribution Panel



*Figure 3.4.1.2.3-1 Mission Station Distribution Panel, Cooling Duct Connections And Kitable Wire Tray Locations (See Figure 3.2.1-1 For Orientation Reference)*

ORBITER DEDICATED CONNECTIONS

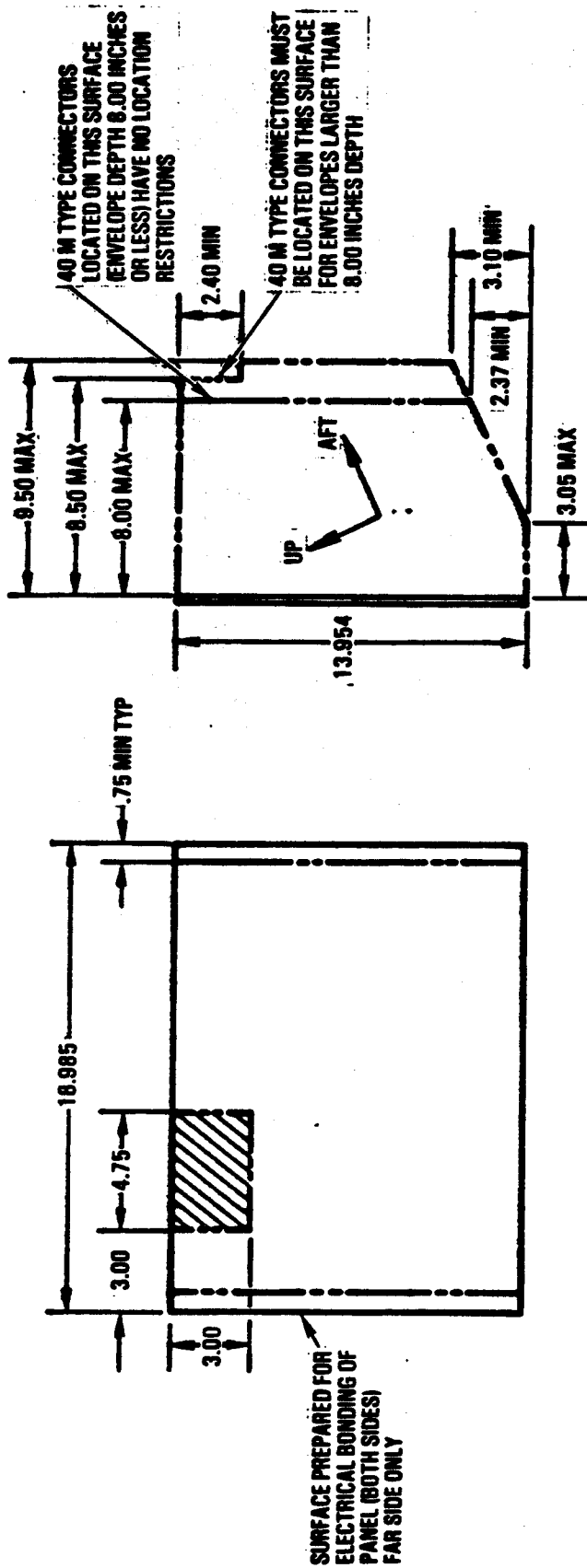


NOTE:

1. COOLING AIR RETURN DUCT CONNECTION FITTING ENDS IN ACCORDANCE WITH FIGURE 3.4.1.4.4-1.

VIEW LOOKING DOWN  
RIGHT HAND SIDE

Figure 3.4.1.2.4-1 Cooling Duct Connections For Mission Station On Aft Flight Deck

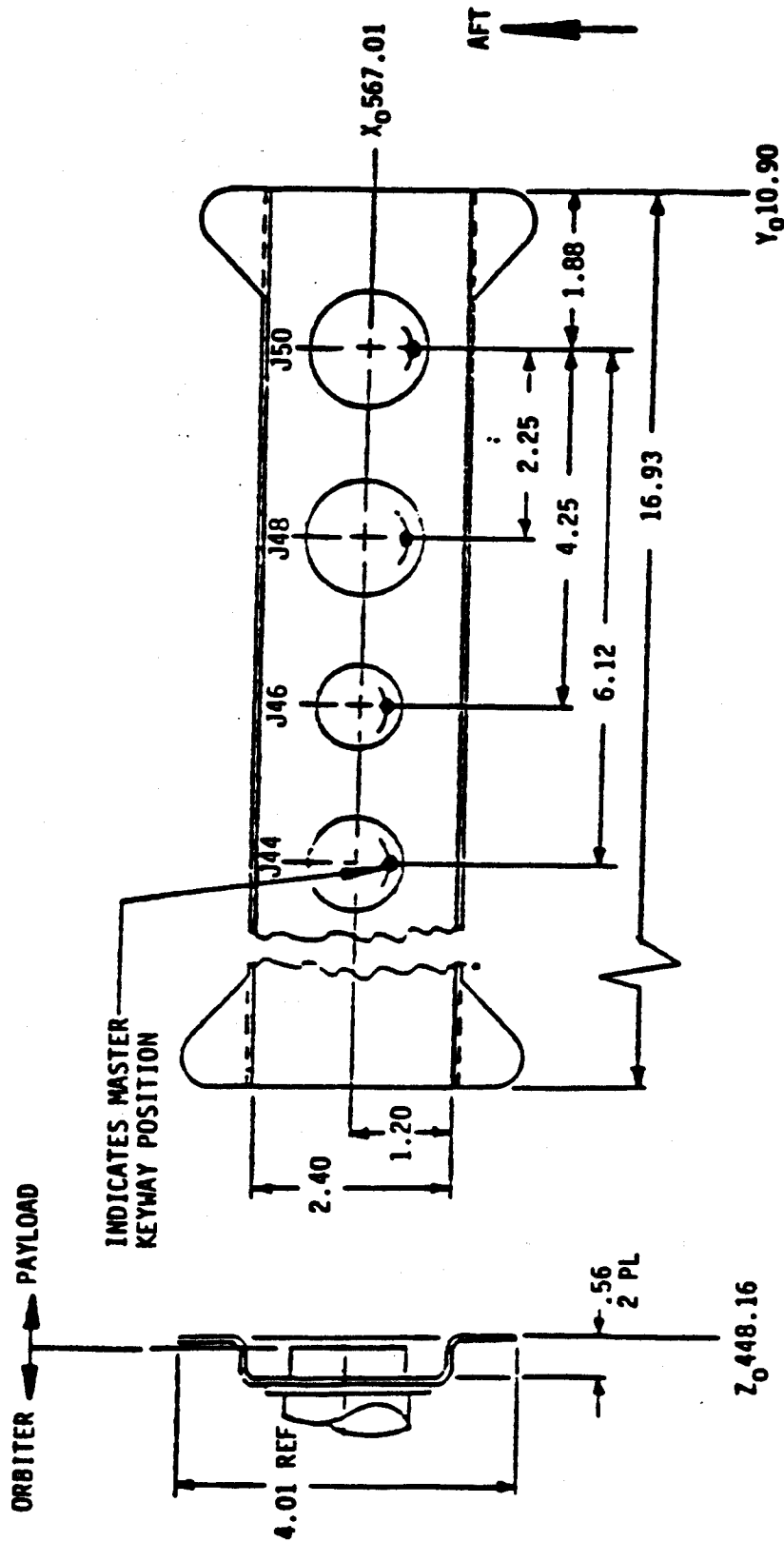


**NOTES:**

1. SHADED AREA TO BE FREE OF ELECTRICAL INTERFACES ON PANEL A7-A2 ONLY.
2. PANEL SIZE "H" OR COMBINATIONS OF PANEL SIZES UP TO SIZE "H" PER FIGURE 3.4.1.1.1-2.
3. FASTENERS ATTACHING PANEL TO MATE WITH MD-115-2002-003 INSERTS.
4. PANEL THICKNESS AND FASTENER LENGTH VARIES DEPENDING ON APPLICATION.

FIGURE 3.4.1.3.1-1 TYPICAL PAYLOAD DEDICATED PANEL ENVELOPE FOR ON-ORBIT STATION LOCATIONS A6-A2 AND A7-A2





NOTE: ① ORBITER/CARGO ELEMENT INTERFACE CONNECTORS & PIN ASSIGNMENT FOR J44, J46, J48 & J50 ARE SPECIFIED IN TABLE 13.6.2.3-1.

FIGURE 3.4.1.3.2-2 ON-ORBIT STATION DISTRIBUTION PANEL, STARBOARD SIDE

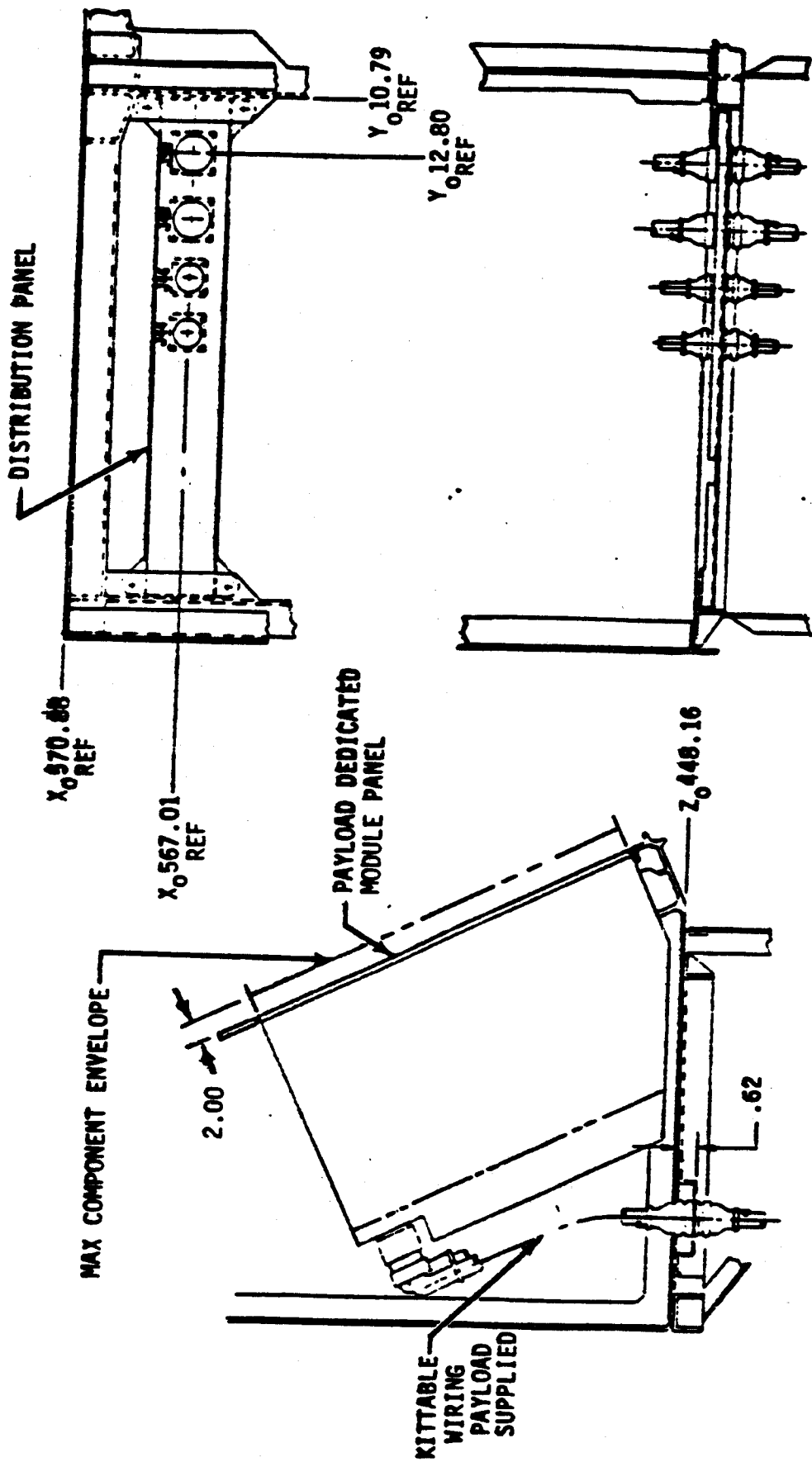


FIGURE 3.4.1.3.3-1 ON-ORBIT STATION LOCATION A6-A2



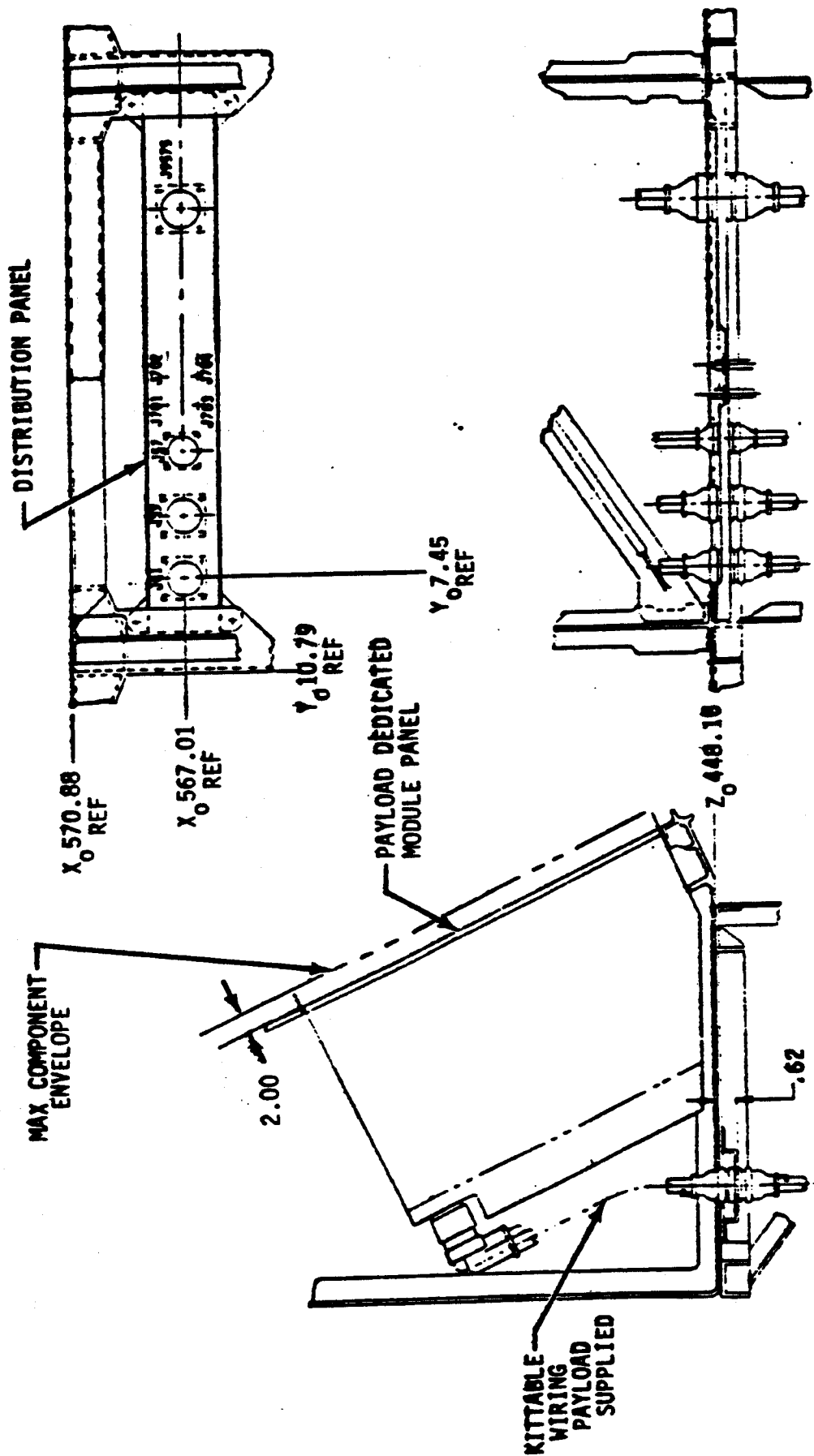
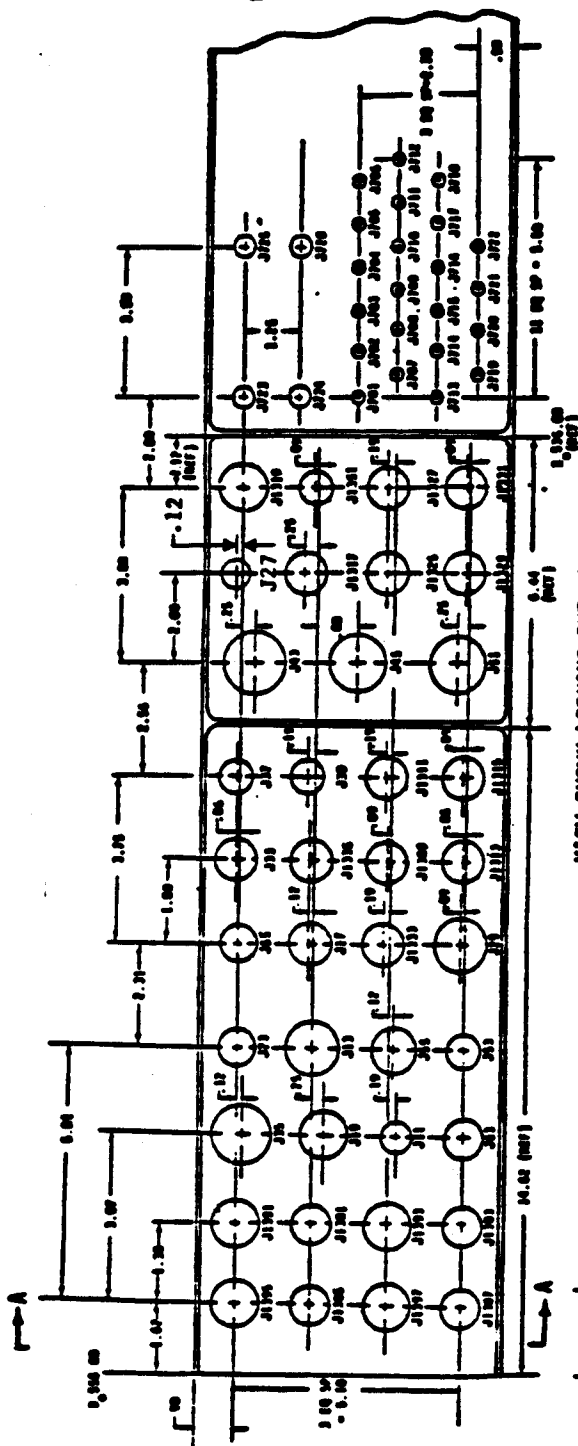


FIGURE 3.4.1.3.3-2 ON-ORBIT STATION LOCATION A7-A2



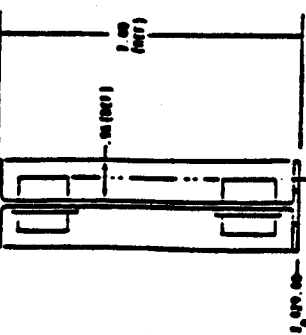




VIEW SHOWN LOOKING OUTBOARD  
← AFT

NOTES:

- ① ORBITER/CARGO ELEMENT INTERFACE CONNECTORS & PINS ASSIGNMENTS FOR J11, J13 & J63 ARE SPECIFIED IN TABLE 13.5.2.2-3-1. J1301, J1303, J1305, J1307, J1391, J1395 & J1397 ARE SPECIFIED IN TABLE 13.5.2.1-1. THE REMAINING "J" NUMBERS ARE SPECIFIED IN TABLE 13.6.2.1-1.
- ② J711, J712 & J713 CONNECTOR CUTOUTS ARE RESERVED.
3. CONNECTORS SHALL BE INSTALLED WITH KEYWAY AT TOP.
4. DETAILS OF COOLING AIR EXHAUST IS PROVIDED IN FIGURE 3.4.1.4.4-1.



VIEW A-A

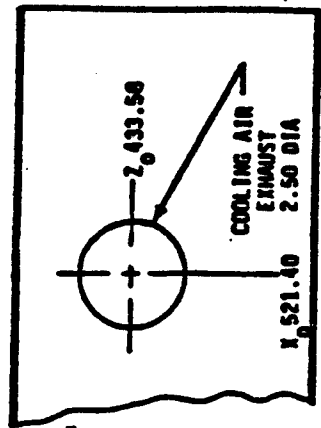
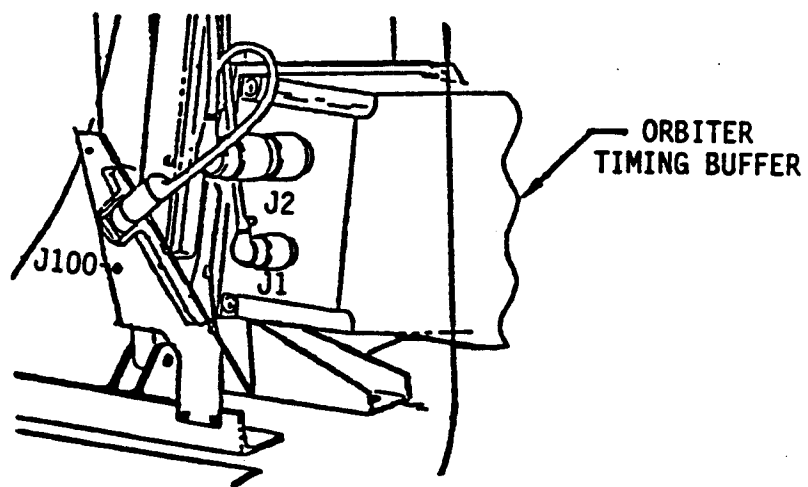


Figure 3.4.1.4.2-1 Payload Station Distribution Panel  
(Sheet 1 Of 2)  
(Refer To Figure 3.2.1-1 For Location)



*Figure 3.4.1.4.2-1 Payload Station Distribution Panel,  
Connector PSDP-9100 (Sheet 2 Of 2)  
(Refer To Figure 3.2.1-1 For Location)*

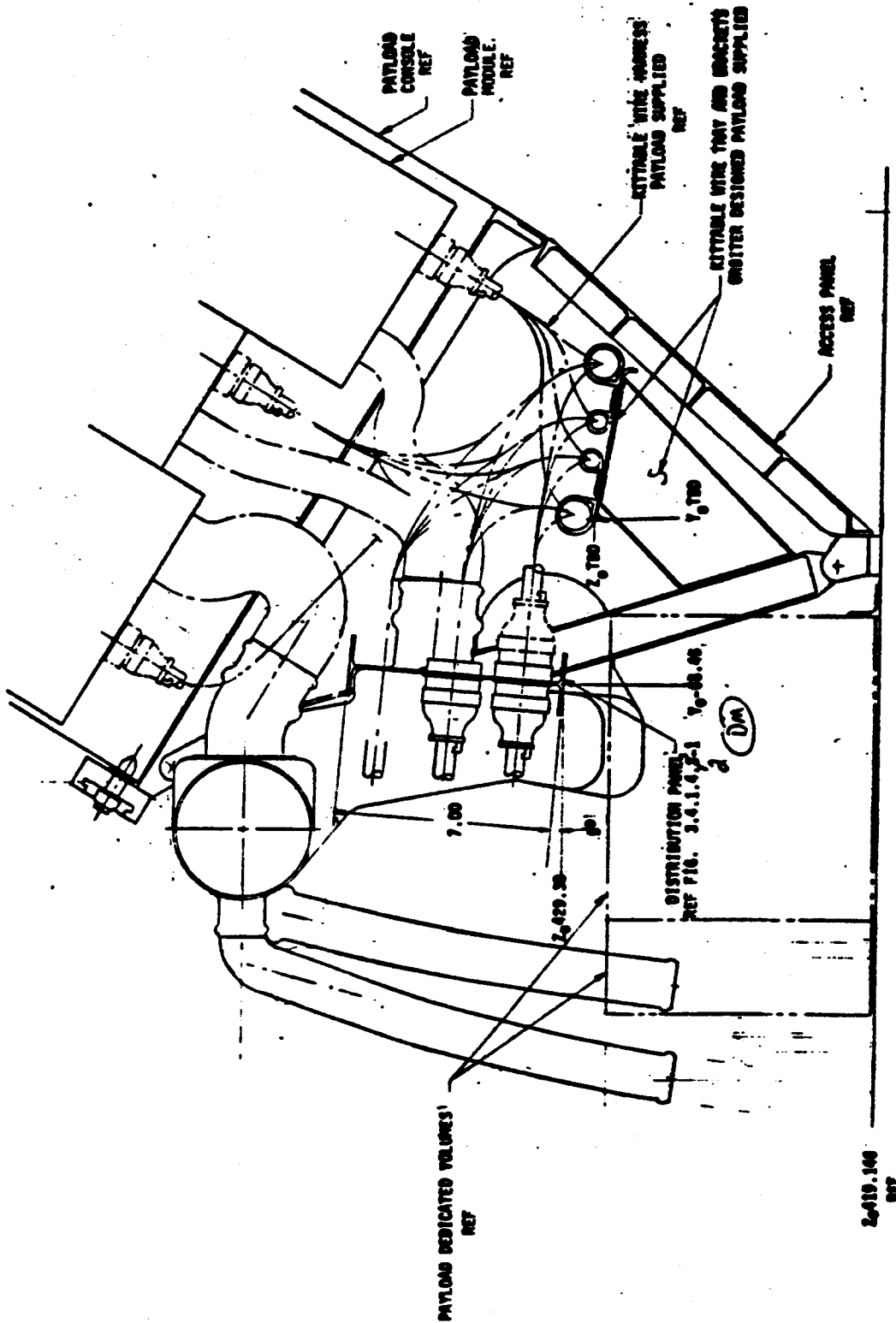


FIGURE 3.4.1.4.3-1 DISTRIBUTION PANEL AND KITTABLE WIRE TRAY AT PAYLOAD STATION

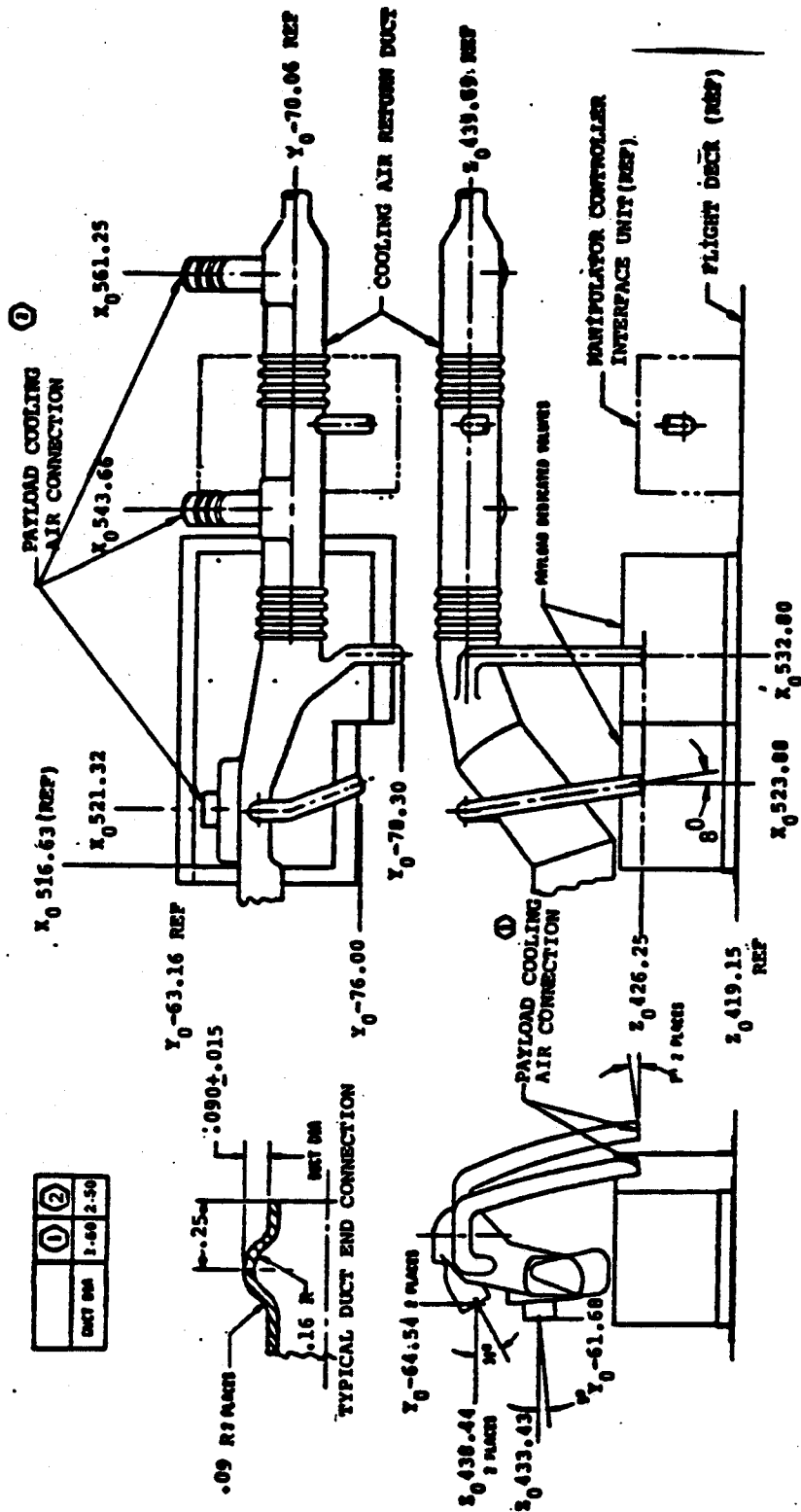
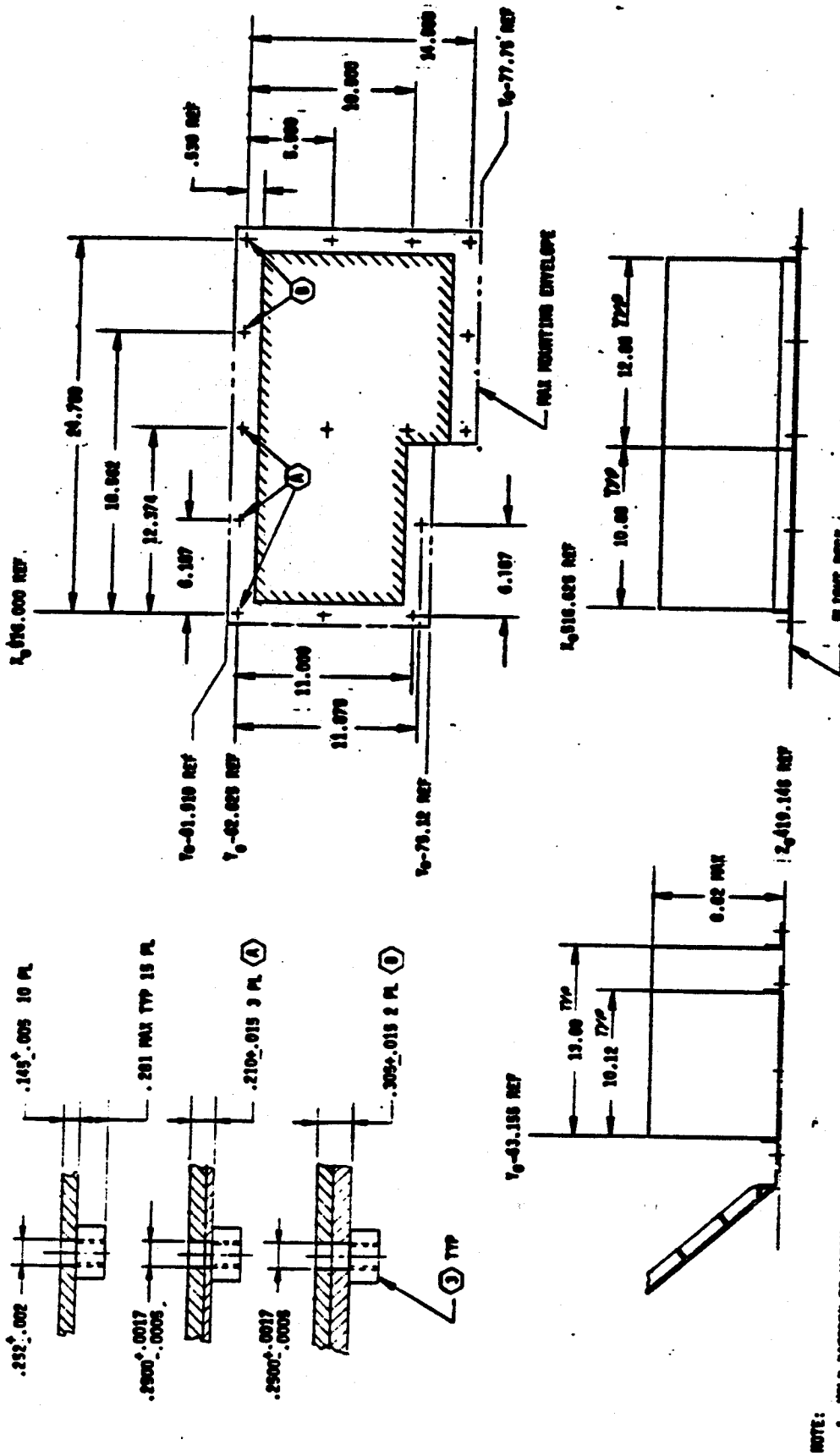


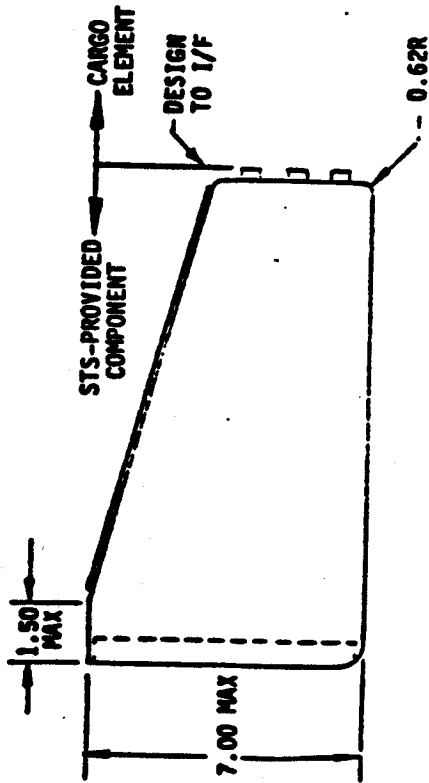
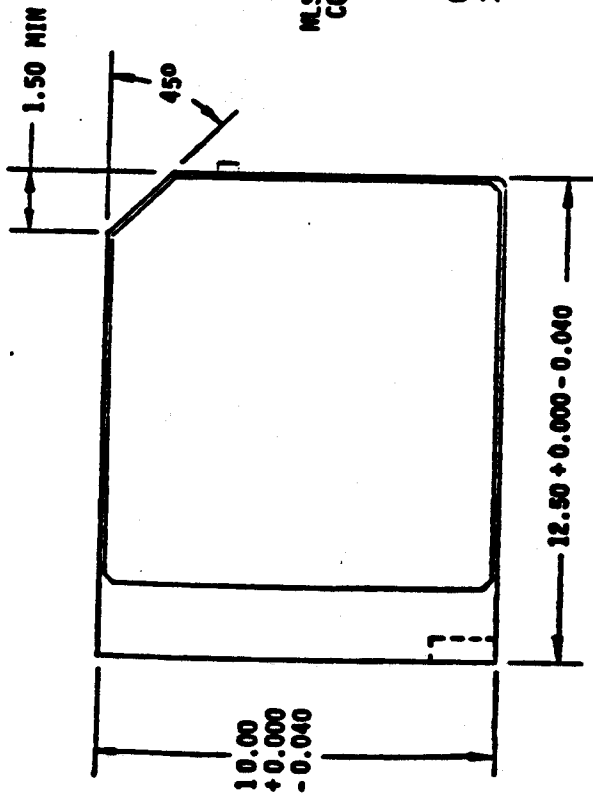
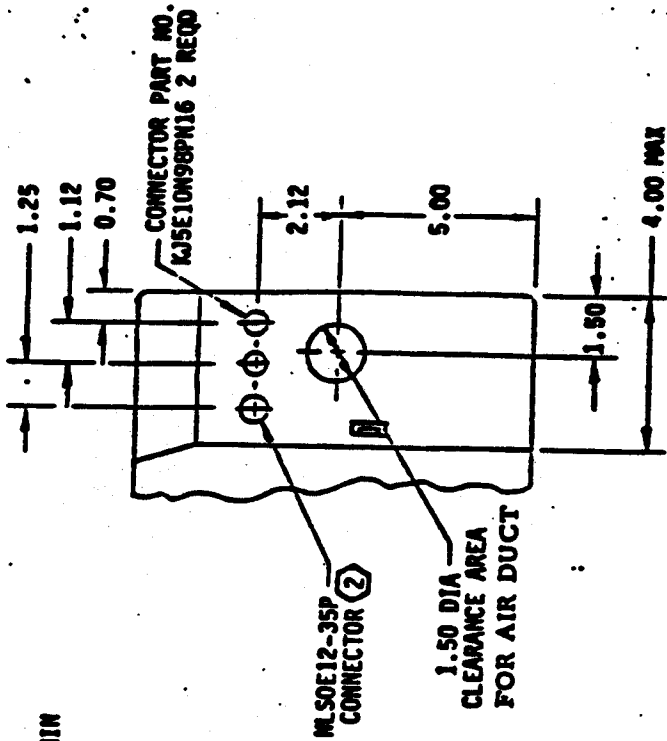
Figure 3.4.1.4.4-1 Cooling Duct Connections At Payload Station



- NOTE:
1. HOLE PATTERN TO MATCH R.J. MASTER TOOL 07125177.
  2. HOLE LOCATION 9TH. REF.
  3. FLOATING INITPLATE .2500-26 UNJF-38 SELF LOCKING THREAD TYP 15 PLACES.
  4. P/L VOLUME AVAILABLE = 1.7 CUBIC FEET MAX.

FIGURE 3.4.1.4.5-1 PAYLOAD DEDICATED VOLUME UNDER PAYLOAD STATION

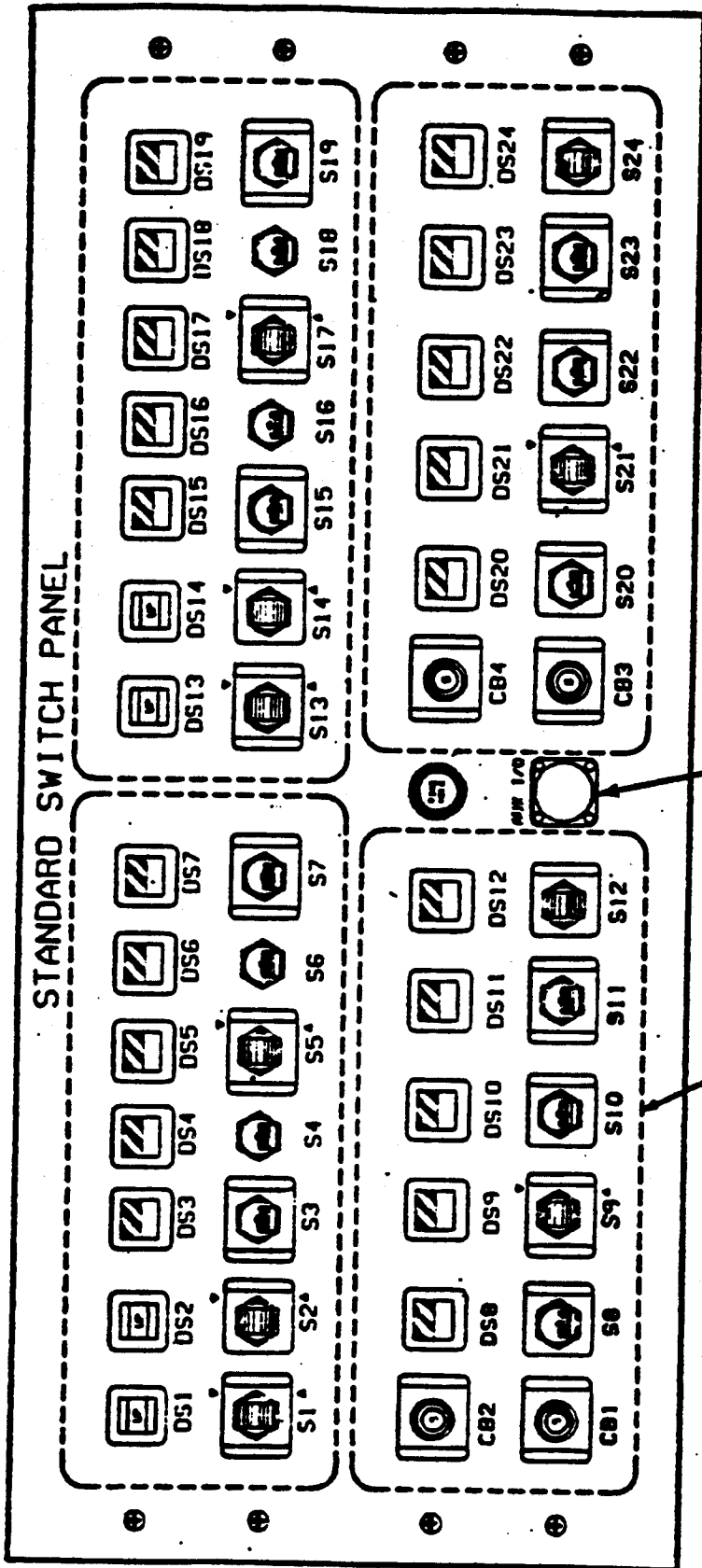




NOTES:

1. TOLERANCE .XX=+0.02, .XXX=0.010 ANGULAR=+10 UNLESS OTHERWISE SPECIFIED
- (2) CONFORMS TO NASA SPECIFICATION 40N38277

FIGURE 3.4.1.4.6.1-1 TVMP REAR CONNECTOR PANEL INTERFACE



J14 (NBOE8-98SN) ①

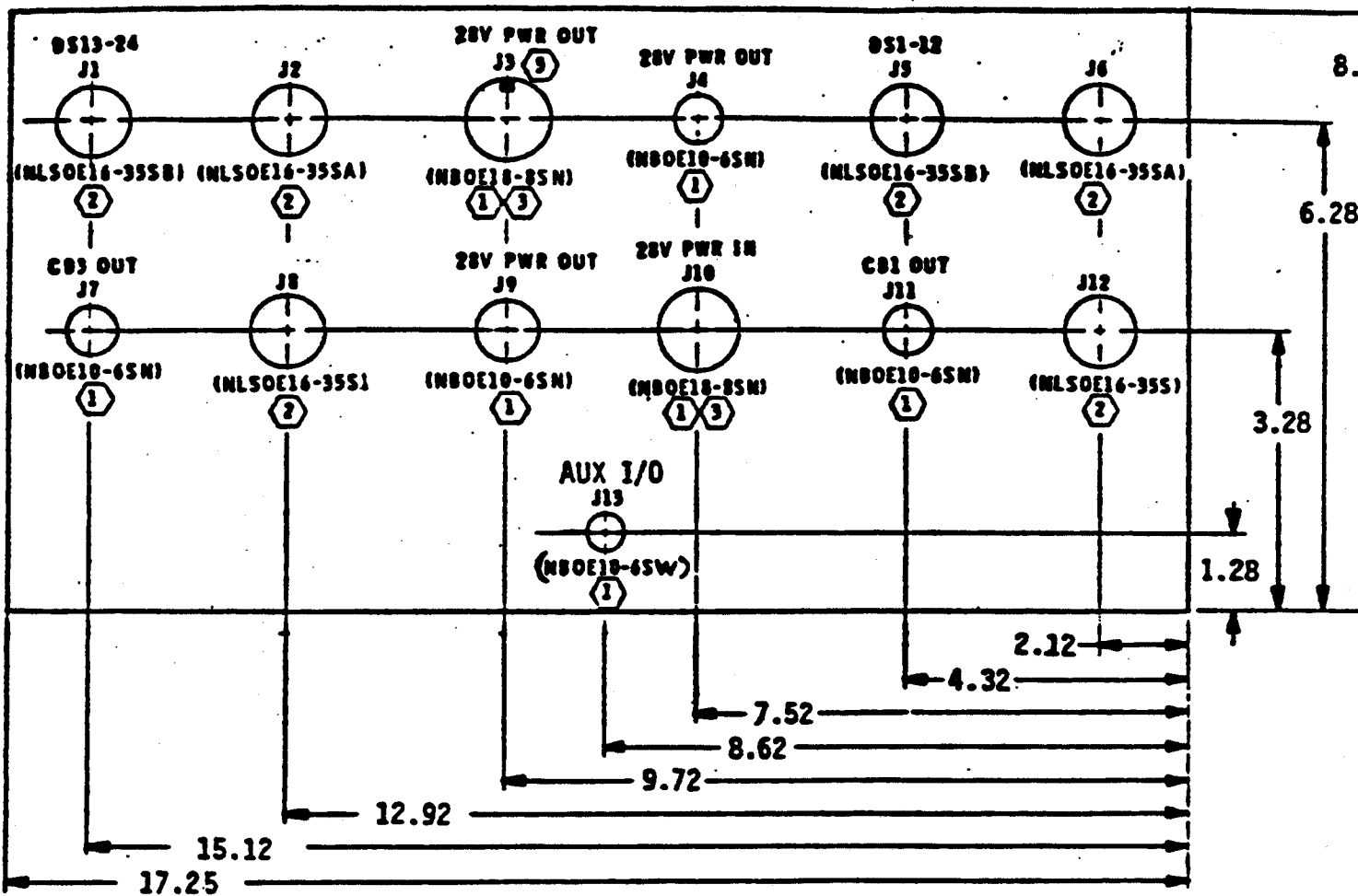
NOTES:

① CONFORMS TO NASA SPECIFICATION 40M39569

2. PANEL IS PANEL SIZE E AS DEFINED IN PARAGRAPH 3.4.1.1.1

MARKING OF FOUR OVERLAYS TO BE DONE BY JSC PER INDIVIDUAL CARGO ELEMENT REQUIREMENTS (OVERLAY WILL COVER COMPONENT DESIGNATORS)

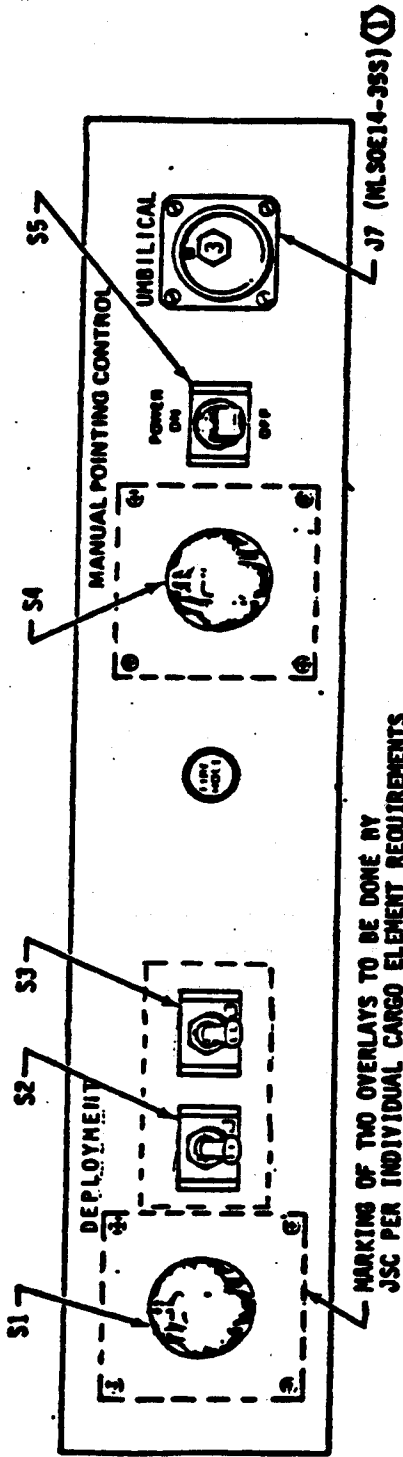
FIGURE 3.4.1.4.6.2-1 STANDARD SWITCH PANEL (SSP) FRONT PANEL LAYOUT



NOTES:

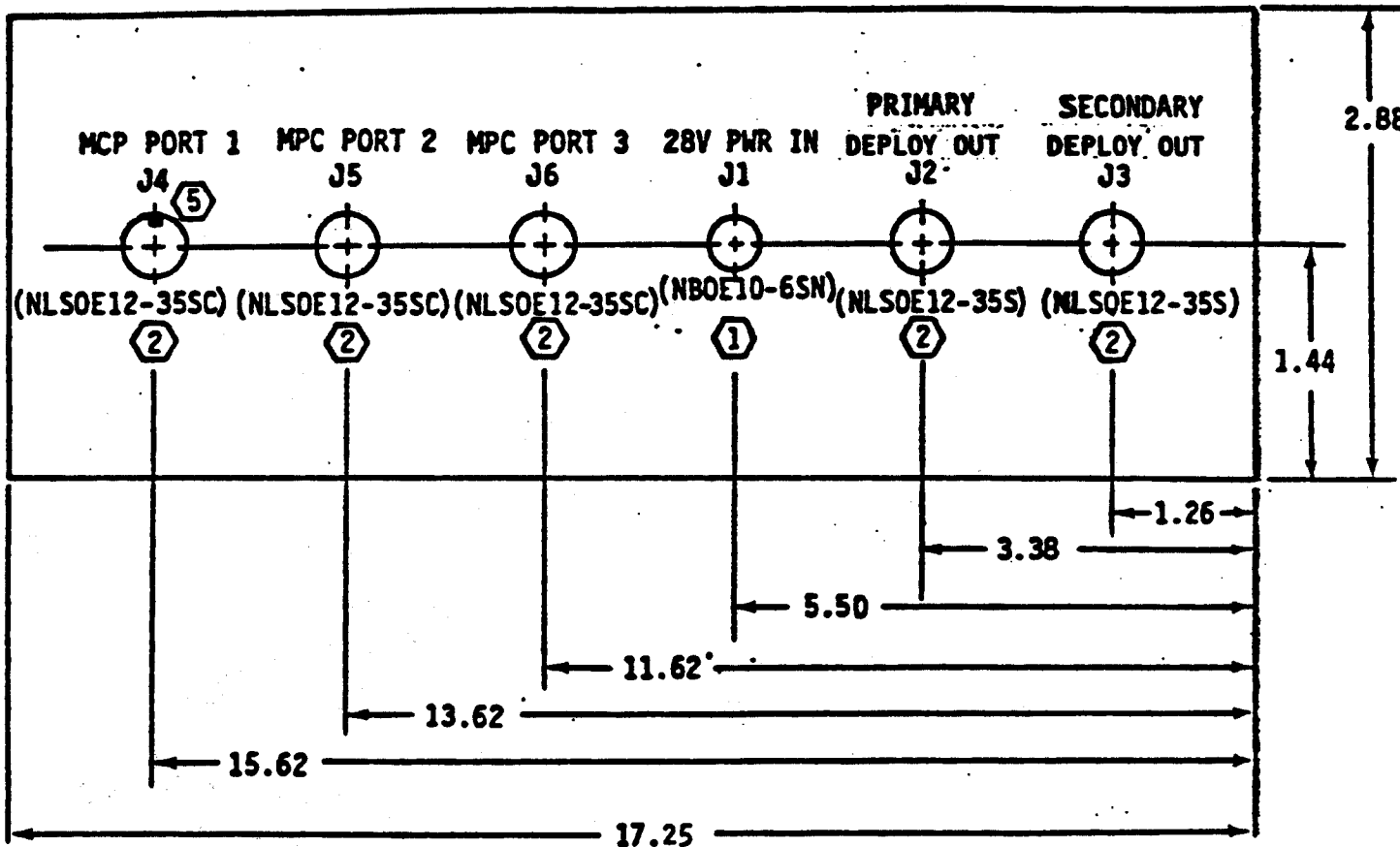
- ① CONFORMS TO NASA SPECIFICATION 40M39569
- ② CONFORMS TO NASA SPECIFICATION 40M38277
- ③ REQUIRED WIRE SIZE TO PINS IN CONNECTOR IS AWG 12. ALL OTHERS ARE AWG 22.
- 4. REAR PANEL CONNECTOR FACE IS LOCATED AT A DEPTH OF 8.5 INCHES FROM FACE OF FRONT PANEL IN L10, L11 OR L12 CONSOLE LOCATIONS.
- ⑤ CONNECTOR MASTER KEYWAY AT TOP (TYPICAL)

FIGURE 3.4.1.4.6.2-2 STANDARD SWITCH PANEL (SSP) REAR PANEL CONNECTOR LAYOUT



- NOTES:
- ① CONFORMS TO NASA SPECIFICATION 40M38277
  - 2. PANEL IS PANEL SIZE B AS DEFINED IN PARAGRAPH 3.4.1.1.1
  - ③ CONNECTOR MASTER KEYWAY AT TOP

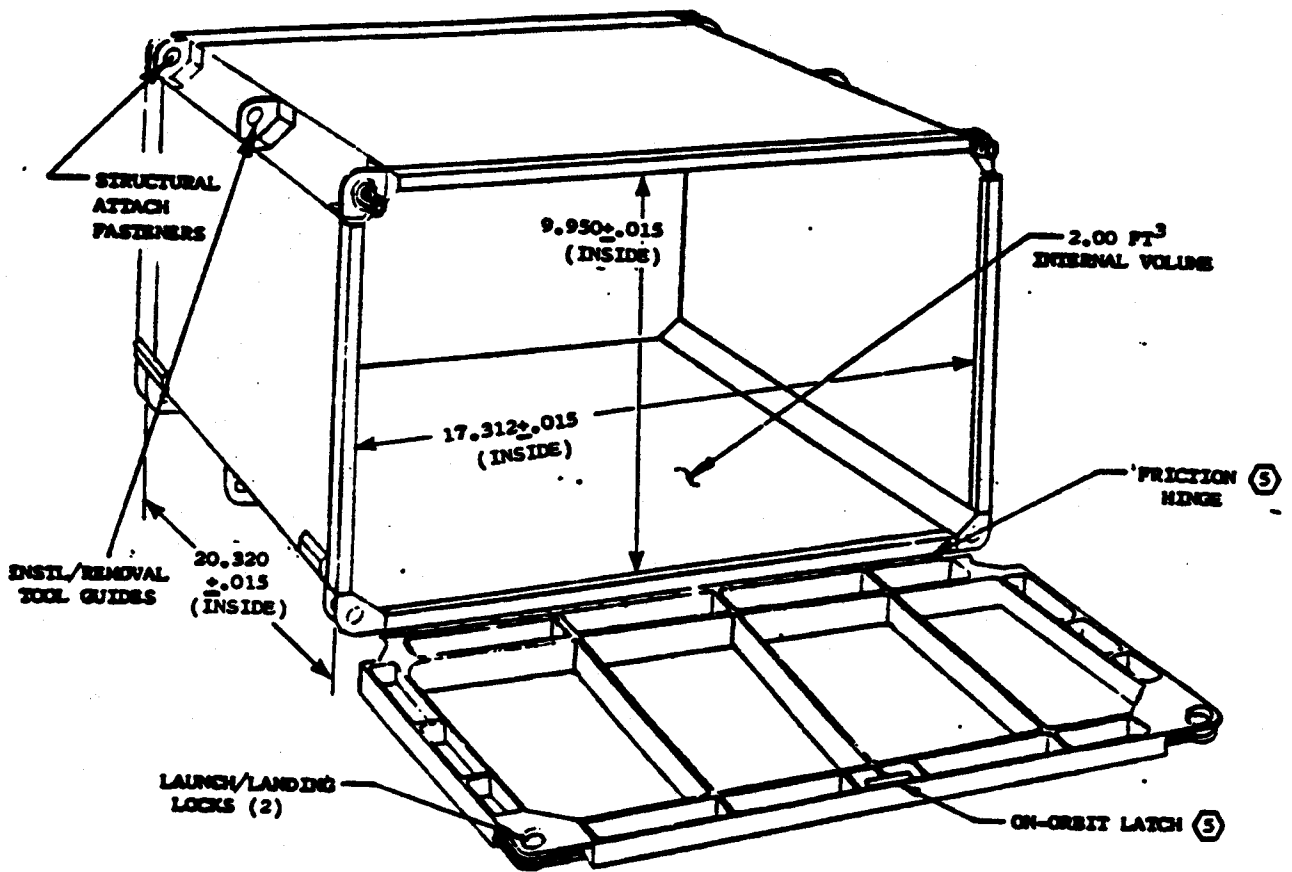
FIGURE 3.4.1.4.6.4-1 DEPLOYMENT/POINTING PANEL (DPP) FRONT PANEL LAYOUT



**NOTES:**

- ① CONFORMS TO NASA SPECIFICATION 40M39569
- ② CONFORMS TO NASA SPECIFICATION 40M38277
- 3. REQUIRED WIRE SIZE TO PINS IN ALL CONNECTORS IS AWG 22
- 4. REAR PANEL CONNECTOR FACE SHALL BE LOCATED AT A DEPTH OF 8.5 INCHES FROM FACE OF FRONT PANEL
- ⑤ CONNECTOR MASTER KEYWAY AT TOP (TYPICAL)

FIGURE 3.4.1.4.6.4-2 DEPLOYMENT/POINTING PANEL (DPP)  
REAR PANEL CONNECTOR LAYOUT



**NOTES**

1. STORAGE CONTAINER HAS A DESIGN DENSITY OF 30 LBS/FT<sup>3</sup>
  2. LOCKER CONTENTS MUST BE PACKAGED TO PREVENT LOAD SHIFTING
  3. INTERNAL LOCKER RESTRAINTS WILL NOT BE DESIGNED FOR CRASH CONDITIONS
  4. DOOR IS FLUSH WITH BOTTOM OF LOCKER WHEN OPENED 90 DEGREES AND CAN OPEN 180 DEGREES (STRAIGHT DOWN)
- (5) DOOR HAS FRICTION HINGE FOR ZERO-G OPERATION AND A MAGNETIC LATCH FOR TEMPORARY CLOSURE OF DOOR

FIGURE 3.4.2.1-1 MODULAR STOWAGE

## 4.0 STRUCTURAL INTERFACES

### 4.1 CARGO BAY

4.1.1 Interface Force Constraints. Interface forces shall be constrained to the Orbiter attach point limit-load capability defined in Appendix I.

4.1.1.1 Friction-Induced Loads. Design of the Orbiter and payloads shall include the effects of friction induced loads at both longeron and keel interfaces. The coefficient of friction ( $\mu$ ) for X, Y, and Z directions is shown in Figure 4.1.1.1-1 and Figure 4.1.1.1-2. The friction loads shall be combined with normal interface loads for payload design.

4.1.2 Attachment Mechanism Deflection Limits. With the exceptions of attachment mechanisms and umbilicals, the cargo in the cargo bay shall remain at all times within the payload thermal and dynamic envelope defined in Paragraph 3.1.2.1.1.

Payload attach fitting deflection limits used for longeron and keel trunnion length selection are specified in Appendix X. Trunnion lengths for most payload categories are standardized in Paragraphs 3.3.1.2 and 3.3.1.3 as shown in Figures 3.3.1.2.1-1, 3.3.1.2.2-1, 3.3.1.3.1-1. Trunnion length restrictions placed upon certain longeron and keel attach points are as specified in Table 3.3.1.1.-1 (Notes 10 and 11). The criteria in Appendix X must be satisfied for payloads requiring non-standard lengths.

The spherical bearings in the longeron and keel attach fittings provide for misalignment and for relative rotational deflection between the payload trunnion and the Orbiter structure. The available alignment cone angles constitute the limits on the relative rotational deflections between the payload trunnions and the Orbiter structure. These limits are apportioned to the payload and to the Orbiter in Table 4.1.2-1 for use in preliminary payload design. The total relative deflection limits for the final payload design shall be verified by coupled dynamic and quasi-static analyses.

4.1.3 Cargo Limit-Load Factors/Angular Accelerations. The load factors/angular accelerations specified in Tables 4.1.3-1, 4.1.3-2, 4.1.3-3 and 4.1.3-4 shall be used for preliminary design of cargo and carrier primary structure and for determination of preliminary Orbiter/Cargo interface loads as the guiding criteria only. The center-of-rotation for angular accelerations is at the cargo element center-of-gravity. The load factors *for emergency landing condition are defined in Paragraph 4.1.3.5.*

Cargo load factor/angular acceleration is defined as the total externally applied force/moment on the cargo or cargo component divided by the corresponding total or component weight/mass moment of inertia and carries the sign of the externally applied force/moment in accordance with the Orbiter coordinate system. (See Figure 4.1.3-1).

These load factors/angular accelerations are valid for any location in the bay. The load factors/angular accelerations result from the response of the Shuttle vehicle structure, including cargo, to external forces corresponding to both quasi-static and transient flight events. These external forces are generated by the thrust, aerodynamics, wind shear, prelaunch restraints, entry maneuvers, landing gears impact, etc.

Accelerations at specific points within the cargo will depend upon cargo design characteristics and mounting methods. Portions of the cargo that are cantilevered from their support points, or that have substantial internal flexibility, may experience higher accelerations than those reflected in the tables. The load factors/angular accelerations shall be considered in all combinations for each event.

**4.1.3.1 Quasi-Static Flight Events.** The load factors/angular accelerations associated with the quasi-static flight events are generated by external forces which change slowly with time and for which the vehicle elastic responses are relatively small. Consequently, coupled transient dynamic analyses are not normally required. However, for cargo with redundant Orbiter interfaces, a coupled static analysis of the various quasi-static flight events shall be used for determining deflections and cargo interface forces. Shuttle model and deflection data to analyze quasi-static flight events shall be included in the payload-unique ICD.

Load factors/angular accelerations are specified in Table 4.1.3-1, for quasi-static flight events during ascent and descent, for up to a maximum of 65,000 lb. (29,484 kg) lift-off cargo and up to a maximum of 32,000 lb (14,515 kg) landed cargo. These conditions are normal design conditions for the Orbiter structure.

**4.1.3.2 Transient Flight Events.** The transient flight events correspond to conditions for which the external forces are highly transient in nature and significant elastic response occurs. Shuttle lift-off and landing are events of this type. The associated cargo responses depend on the cargo geometry, stiffness, and mass characteristics. Consequently, design values of cargo/Shuttle interface forces and cargo design loads shall be determined by coupled dynamic analysis. Shuttle dynamic model and forcing functions used for the dynamic analysis shall be included in the cargo element-unique ICD. Typical load factors for the transient events are given in Table 4.1.3-2.

The load conditions in Table 4.1.3-2 are for an ascent cargo weight of up to a maximum of 65,000 lb (29,484 kg) lift-off cargo and up to a maximum of 32,000 lb (14,515 kg) landing cargo. *The maximum design landing sink speed is 9.6 fps (2.93 mps).*

#### **4.1.3.3 Descent Landing Loads.**

**4.1.3.3.1 Descent and Landing Loads for Returnable Cargoes.** *Returnable payloads, including empty cradles, are required to meet the descent and landing load factors of Table 4.1.3-1 and Table 4.1.3-2. The maximum design landing sink speed for returnable payloads is 9.6 fps (2.93 mps).*

*The landing load factors shall be used for preliminary design and shall be superseded by dynamic analysis results when available.*



**4.1.3.3.2 Descent and Landing Loads for Non-Returnable Cargoes.** *Non-returnable cargoes, are required to design for Orbiter descent and landing. Non-returnable payloads are required to meet the load factors of Table 4.1.3-3 and Table 4.1.3-4 for descent and landing of cargoes up to 65,000 pounds (29,484 kg). The maximum design landing sink speed for non-returnable cargoes is 7.2 fps (2.19 mps).*

*The landing load factors shall be used for preliminary design and shall be superseded by dynamic analysis results when available.*

4.1.3.4 (Reserved)

**4.1.3.5 Emergency Landing Load Factors.** The Orbiter Vehicle design considers safe crew egress following emergency landing or water ditching. Hence, the mounting structures for equipment and crew provisions vessels, and for the payload attachments, shall be designed to load factors equal to or greater than those shown in Table 4.1.3.5-1. Payload equipment inside the Orbiter crew compartment shall be designed to preclude hazards to the flight personnel after the application of the emergency landing loads defined in the table. The attachment structures (including fittings and fasteners) of the payloads must be designed for emergency landing loads. The attachment structure of payload equipment where failures could result in injury to personnel or prevent egress from the emergency landed vehicle must be designed for this requirement. Payload equipment design shall consider provisions to maximize the probability of safe crew egress following an emergency landing.

**4.1.3.6 Factors of Safety for Structural Design.** The structural design of all mounting hardware and/or bracketry (or any other structure which could be affected by flight loads) shall assure an ultimate factor of safety  $\geq 1.4$ . Pressurized lines and fittings less than 1.5 inch in diameter shall have an ultimate factor of safety  $\geq 4.0$ . Those equal to or larger than 1.5 inch in diameter shall have an ultimate factor of safety  $\geq 1.5$ .

**4.1.3.7 Fracture Control.** Structural components, including all pressure vessels the failure of which could cause destruction of the Orbiter or injury to the crew, shall be analyzed to preclude failures caused by propagation of pre-existing flaws.

**4.1.4 Mass Properties Characteristics of Total Cargo.**

**4.1.4.1 Center-of-Gravity (C.G.) Envelopes Provided by the Shuttle Vehicle.** Except for the flight segments indicated below, the Shuttle Vehicle shall perform satisfactorily with no constraints placed upon the Cargo C.G. For these exceptions, Cargo C.G. limit envelopes are defined for each axis by the following:

- a. X-axis: Cargo C.G. limits shall be calculated using the equations defined in Figure 4.1.4.1-1.
- b. Y-axis: Cargo C.G. limits shall be calculated using the equations defined in Figure 4.1.4.1-2.

- c. Z-Axis: Total Cargo C.G. limits shall be calculated using the equations defined in Figure 4.1.4.1-3.

C.G. limits for Cargo items mounted on the cargo bay attachments shall be as shown in Figure 4.1.4.1-3. In addition to these Cargo  $Z_0$  C.G. limits, the  $Z_0$  C.G. limits for the summation of all cargo elements mounted on attachment fittings in the cargo bay are defined by the curve ABCDEFGHIJ in Figure 4.1.4.1-3.

All items chargeable to Cargo, regardless of location, (e.g., within cargo bay, below cargo bay, in cabin, etc.) shall be included in the calculation to determine the location of the Cargo C.G. The Cargo C.G.'s shall be constrained within the three limit envelopes defined above during the following flight segments:

- a. Normal entry through landing.
- b. MECO through landing for RTLS abort.
- c. Entry through landing for all other intact abort modes. (Refer to TBD.)

4.1.5 Acoustics. The acoustic levels in an empty cargo bay that are defined in Table 4.1.5-1 represent the minimum level to which a payload must be certified to be considered safe to fly on the STS. The acoustic levels during orbit, entry, and landing are significantly below the ascent levels and shall be assumed negligible.

Acoustic levels for specific payloads are dependent on payload geometry, surface area and acoustic absorption characteristics and will differ from those of the empty cargo bay.

#### 4.1.6 Vibration.

##### 4.1.6.1 (Reserved)

4.1.6.2 Random Vibration. *The random vibration environments associated with STS lift-off are specified for trunnion mounted payloads, sidewall adapter mounted payloads, and orbiter longerons. The environments are applicable at Orbiter interfaces for all axial locations. The environments may be considered statistically uncorrelated.*

4.1.6.2.1 Random Vibration for Trunnion Mounted Payloads. *The random vibration environments for the longeron trunnion and keel trunnion interfaces are specified in Tables 4.1.6.2.1-1 and 4.1.6.2.1-2.*

4.1.6.2.2 Random Vibration for Sidewall/Adapter Mounted Payloads. *The random vibration environments for hardware mounted on the Orbiter sidewall through an adapter is given in Table 4.1.6.2.2-1.*

4.1.6.2.3 Random Vibration for Orbiter Longerons. *The random vibration for hardware mounted to the orbiter longerons is given in Table 4.1.6.2.3-1.*

#### 4.1.7 Payload Minimum Frequencies/Flight Control Interaction.

4.1.7.1 Applicability. The requirements herein are applicable to all flight control regimes (ascent, on-orbit, and descent) with the payloads in their stowed positions and the cargo bay doors closed. Acceptability in the on-orbit mode with payloads extended and the doors open is a loads and fuel consumption problem, and is not covered in this section. The acceptability criteria herein is based on the descent mode requirements. If these requirements are met, the system will be acceptable for all flight modes.

4.1.7.2 Single/Multiple Payloads Frequency Requirements. These requirements cover both multiple and single payloads for both nominal and heavy landed payloads (The latter are in excess of 32,000 pounds). The requirements are based on the lift-off mass and modal characteristics of the payloads and their constraint systems. The criteria consist of a definition of the minimum acceptable constrained frequency as a function of payload weight. Any individual payload that is a portion of the total cargo manifest (a multiple payload cargo) and whose lift-off weight is less than 45,000 pounds, shall meet the requirements for a 45,000 pound payload; if in excess of 45,000 pounds, the constrained frequency requirements for the heavier weight must be met. Constrained frequency is defined as the frequency of the payload on its mounts, with the mounts fixed to an infinite mass. These frequencies can be attributed either to the inherent flexible characteristics of the payload and/or to the suspension characteristics of the rigid payload.

4.1.7.3 Criteria. The minimum acceptable payload constrained frequency is presented in Figure 4.1.7.3-1 for damping ratios ( $z$ ) from 0.005 to 0.04 (0.5 percent to 4 percent). The plot is applicable to the pitch, roll and yaw (rudder/yaw jet) modes. The constrained frequencies are associated with the primary pitch/plunge and lateral payload modes. For damping ratios between the defined values, a linear interpolation is permissible. If  $z$  is greater than 0.04, the 0.04 value must be used.

Damping values up to 0.01 can be used for preliminary flight control interaction analysis. Higher damping ratios must be verified per JSC 14046 (Payload Interface Verification Requirements).

As shown, a 32,000 pound single payload with 0.01 damping requires a minimum frequency of 37.5 radians per second. The requirements for a single 45,000 pound payload, or for any lighter weight payload that is part of a 45,000 pound multiple payload cargo, is at least 39.75 radians per second when  $z$  is 0.01.

#### 4.1.8 Payload Fluid Lines/PACK Interface Structural Limitations.

4.1.8.1 Interface Loads. The maximum loads that may be transmitted by the payload coolant lines to the Payload Active Cooling Kit (PACK) are presented in Table 4.1.8.1-1. These loads are based on the analytic capability of the PACK support structure.

**4.1.8.2 Deflections.** *The payload fluid lines shall be designed to accommodate maximum deflections without producing loads that exceed the values given in Table 4.1.8.1-1. Total line deflection shall include maximum Orbiter deflection and relevant payload deflection. Maximum deflections are presented in Table 4.1.8.2-1. These values include Orbiter sidewall movement and permissible trunnion sliding. Relative motion of the payload fluid line clamp point with respect to the longeron trunnion shall be added to the deflections in Table 4.1.8.2-1. The deflections apply for any PACK payload bay location.*

#### **4.1.9 Pyrotechnic Shock**

**4.1.9.1 Payload Induced Pyrotechnic Shock.** *The payload generated pyrotechnic shock detected on the trunnion at the payload to Orbiter interface shall not exceed the shock response spectrum shown in Figure 4.1.9-1. Payload generated pyrotechnic shock is not acceptable in the middeck or the aft flight deck.*

**4.1.9.2 Pyrotechnic Shock From Other Sources.** *The maximum level of pyrotechnic shock detected on the trunnion at the payload to Orbiter interface transmitted from other payloads or Orbiter mounted equipment, such as the RMS or the KU Band Antenna, is shown in Figure 4.1.9.2-1.*

TABLE 4.1.2-1 PAYLOAD/ORBITER ROTATIONAL DEFLECTION LIMITS  
FOR PRELIMINARY DESIGN

INTERFACE LOCATION	ROTATIONAL DEFLECTION LIMITS DEGREES		
	PAYLOAD*	ORBITER*	TOTAL**
DEPLOYABLE LONGERON FITTING	3.0	3.0	6.0
NON-DEPLOYABLE LONGERON FITTING	5.0	3.0	8.0
ACTIVE AND PASSIVE KEEL FITTING	3.0	3.0	6.0

\* For preliminary design use only.

\*\* Total relative rotational deflection.

TABLE 4.1.3-1 CARGO LIMIT-LOAD FACTORS/ANGULAR ACCELERATIONS FOR DESIGN (QUASI-STATIC FLIGHT EVENTS)

FLIGHT EVENT	LOAD FACTOR g			ANGULAR ACCELERATION RAD/SEC <sup>2</sup>			CARGO WEIGHT
	N <sub>x</sub>	N <sub>y</sub>	N <sub>z</sub>	ϕ	θ	ψ	
<u>ASCENT</u>							
HIGH-Q BOOST ENVELOPE	-1.9	+0.40	0.25 -0.50	+0.10	+0.15	+0.15	Up to 65 Klb
INTEGRATED VEHICLE BOOST MAX N <sub>x</sub>	-2.9 -2.6	+0.06 +0.02	-0.15 -0.20	+0.20 +0.20	+0.25 +0.25	+0.25 +0.25	
ORBITER BOOST MAX N <sub>x</sub>	-3.17 -3.05	0.0 0.0	-0.60 -0.80	+0.20 +0.20	+0.25 +0.25	+0.25 +0.25	
POST SRB STAGING	-1.10	+0.12	-0.59				
<u>DESCENT</u>							
TAEM: PITCH MANEUVER	1.01 -0.15	0	2.50	0	0	0	Up to 32 Klb
	-0.25	0	2.50	0	-0.11	0	
	0.97 0	0	-1.00	0	0	0	
TAEM: ROLL MANEUVER	0.65	+0.12	1.98	+1.28	0.02	+0.13	
TAEM: YAW MANEUVER	0.60 0.56 0.61	+0.85 +0.49 +0.002	1.0 1.44 0.92	0 0 0	0 0 0	0 +0.044 +0.056	

*Table 4.1.3-2 Cargo Limit-Load Factors/Angular Accelerations  
For preliminary Design (Transient Flight Events)*

FLIGHT EVENT	LOAD FACTOR g			ACCELERATION RAD/SEC <sup>2</sup>			CARGO WEIGHT
	Nx	Ny	Nz	$\ddot{\phi}$	$\ddot{\theta}$	$\ddot{\psi}$	
<u>ASCENT</u>							
LIFT-OFF	-0.2 -3.2	+1.4	2.5 -2.5	+3.7	+7.7	+3.1	Up to 65 Klb (29484 kg)
<u>DESCENT</u>							
<i>Landing</i>	+1.8 -2.0	+1.5	+4.2 -1.0	+6.4	+11.3	+4.9	Up to 32 Klb (14515 kg)

TABLE 4.1.3-3 CARGO LIMIT-LOAD FACTORS/ANGULAR ACCELERATIONS FOR DESIGN (DESCENT OF NON-RETURNABLE CARGO)

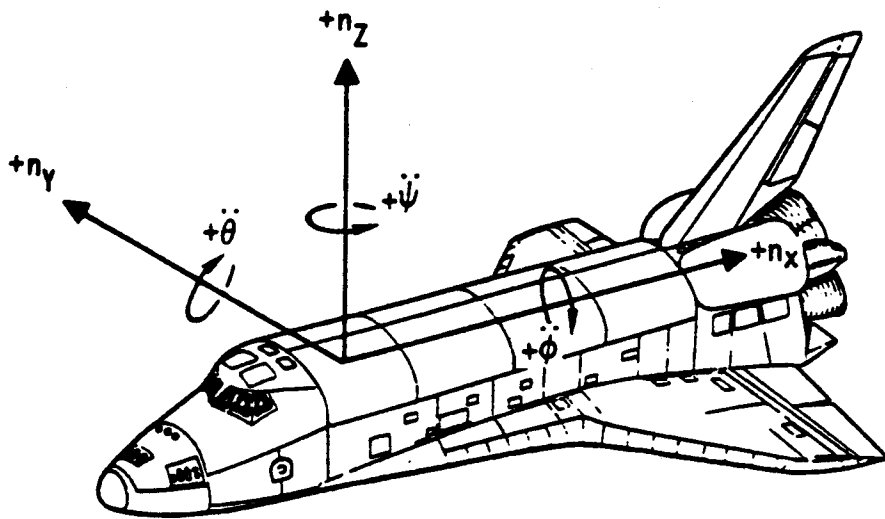
FLIGHT EVENT	LOAD FACTOR g			ACCELERATION RAD/SEC <sup>2</sup>			CARGO WEIGHT
	Nx	Ny	Nz	$\dot{\phi}$	$\dot{\theta}$	$\dot{\psi}$	
<b>DESCENT</b>							
TAEM: Pitch Maneuver	1.01	0	2.50	0	0	0	Up to 32 K1b
	-0.15						
	0.25	0	2.50	0	-0.11	0	
	0.97	0	-1.00	0	0	0	
	0						
TAEM: Roll Maneuver	0.65	+0.12	1.98	+1.28	0.02	+0.13	
TAEM: Yaw Man- euver	0.60	+0.85	1.0	0	0	0	
	0.56	+0.49	1.44	0	0	+0.044	
	0.61	+0.002	0.92	0	0	+0.056	
TAEM: Pitch Maneuver	0.83	0	2.07	0	0	0	65 K1b
	-0.21						
	0.21	0	2.07	0	-0.09	0	
	0.81	0	-0.83	0	0	0	
	0						
TAEM: Roll Maneuver	0.54	+0.10	1.65	+1.06	0.02	+0.11	
TAEM: Yaw Maneuver	0.51	+0.75	1.0	0	0	0	
	0.44	+0.45	1.53	0	0	+0.039	
	0.51	+0.012	0.93	0	0	+0.054	

NOTE: Load factors for non-returnable cargoes between 32,000 lbs and 65,000 lbs are found by linear interpolation between values given in the table.



*Table 4.1.3-4 Cargo Limit-Load Factors/Angular Accelerations  
For Preliminary Design (Landing Of Non-Returnable Cargo)*

FLIGHT EVENT	LOAD FACTOR g			ACCELERATION RAD/SEC <sup>2</sup>			CARGO WEIGHT
	$N_x$	$N_y$	$N_z$	$\ddot{\theta}$	$\ddot{\Theta}$	$\ddot{\Psi}$	
<u>Landing</u>	1.50	+1.0	+3.6	+4.8	+8.4	+3.2	All weights
	-1.70		-0.3				



*Figure 4.1.3-1 Sign Convention For Cargo Limit-Load Factors/Angular Accelerations*

TABLE 4.1.3.5-1 EMERGENCY LANDING DESIGN LOAD FACTORS

CONDITION	Load Factor 65 Klb (29484 kg) Up 32 Klb (14515 kg) Down			Load Factor 65 Klb (29484 kg) Down		
	X	Y	Z	X	Y	Z
Emergency Landing (Outside Crew Compartment)	+4.5 -1.5	+1.50 -1.50	+4.5 -2.0	+4.50 -0.738	+0.738 -0.738	+2.215 -0.985
Emergency Landing (Inside Crew Compartment)	+20.0 -3.3	+3.3 -3.3	+10.0 -4.4			

Sign convention follows that of the Orbiter coordinate system in Figure 4.1.3-1.

Emergency landing load factors are ultimate. The longitudinal load factors are directed in all aftward azimuths within a cone of 20 degrees half-angle. The specified load factors shall operate separately.

For cargo weight between 32 Klb and 65 Klb, use a linear interpolation between the load factors given.

TABLE 4.1.5-1 ORBITER CARGO BAY INTERNAL ACOUSTIC ENVIRONMENT

1/3 Octave Band Center Frequency (Hz)	Sound Pressure Level(dB) ref. $2 \times 10^{-5}$ N/m <sup>2</sup>	
	Lift-off	Aeronoise
	5 Seconds/Flight*	10 Seconds/Flight*
31.5	122.0	112.0
40.0	124.0	114.0
50.0	125.5	116.0
63.0	127.0	118.0
80.0	128.0	120.0
100.0	128.5	121.0
125.0	129.0	122.5
160.0	129.0	123.5
200.0	128.5	124.5
250.0	127.0	125.0**
315.0	126.0	125.0**
400.0	125.0	124.0**
500.0	123.0	121.5
630.0	121.5	119.5
800.0	120.0	117.5
1000.0	117.5	116.0
1250.0	116.0	114.0
1600.0	114.0	112.5
2000.0	112.0	110.5
2500.0	110.0	108.5
Overall	138.0	133.5

\*Time per flight does not include a scatter factor.

\*\*NOTE: Narrow band discrete noise is radiated from the cargo bay vent doors during transonic/low supersonic flight. The noise radiated from any one vent is described below:

This environment is not intended for full payload exposure but only to those areas of the payload adjacent to a cargo bay vent opening.

One-Third Octave Band Center Frequencies, Hz	Sound Power Level dB re $10^{-12}$ watts
	8 Seconds/Flight
250	128
315	136
400	130

**Table 4.1.6.2.1-1 Orbiter Cargo Bay Random Vibration Payload  
Longeron Trunnion/Orbiter Interface**

<b>X Axis</b>	20 - 58 Hz	.0025 $g^2$ /Hz
	58 - 125 Hz	+9 dB/Octave
	125 - 300 Hz	.025 $g^2$ /Hz
	300 - 900 Hz	-9 dB/Octave
	900 - 2000 Hz	.001 $g^2$ /Hz

**Overall = 3.1 Grms**

<b>Y Axis</b>	20 - 68 Hz	.004 $g^2$ /Hz
	68 - 125 Hz	+9 dB/Octave
	125 - 300 Hz	.025 $g^2$ /Hz
	300 - 900 Hz	-9 dB/Octave
	900 - 2000 Hz	.001 $g^2$ /Hz

**Overall = 3.1 Grms**

<b>Z Axis</b>	20 - 45 Hz	.009 $g^2$ /Hz
	45 - 125 Hz	+3 dB/Octave
	125 - 300 Hz	.025 $g^2$ /Hz
	300 - 900 Hz	-9 dB/Octave
	900 - 2000 Hz	.001 $g^2$ /Hz

**Overall = 3.2 Grms**

*The associated time duration is 20 seconds per axis per flight which includes a fatigue scatter factor of 4.*

**Table 4.1.6.2.1-2 Orbiter Cargo Bay Random Vibration Payload  
Keel Trunnion/Orbiter Interface**

<b>X Axis</b>	20 - 90 Hz	.008 g <sup>2</sup> /Hz
	90 - 100 Hz	+9 dB/Octave
	100 - 300 Hz	.01 g <sup>2</sup> /Hz
	300 - 650 Hz	-9 dB/Octave
	650 - 2000 Hz	.001 g <sup>2</sup> /Hz

**Overall = 2.3 Grms**

<b>Y Axis</b>	20 - 90 Hz	.008 g <sup>2</sup> /Hz
	90 - 100 Hz	+9 dB/Octave
	100 - 300 Hz	.01 g <sup>2</sup> /Hz
	300 - 650 Hz	-9 dB/Octave
	650 - 2000 Hz	.001 g <sup>2</sup> /Hz

**Overall = 2.3 Grms**

<b>Z Axis</b>	20 - 60 Hz	.0023 g <sup>2</sup> /Hz
	60 - 100 Hz	+9 dB/Octave
	100 - 300 Hz	.01 g <sup>2</sup> /Hz
	300 - 650 Hz	-9 dB/Octave
	650 - 2000 Hz	.001 g <sup>2</sup> /Hz

**Overall = 2.2 Grms**

*The associated time duration is 20 seconds per axis per flight which includes a fatigue scatter factor of 4.*

*Table 4.1.6.2.2-1 Orbiter Cargo Bay Random Vibration Payload  
Sidewall Adapters/Orbiter Interface*

*X Axis (same as longerons)*

20 - 32 Hz	.003 g <sup>2</sup> /Hz
32 - 100 Hz	+6 dB/Octave
100 - 500 Hz	.030 g <sup>2</sup> /Hz
500 - 2000 Hz	-4 dB/Octave

*Overall = 5.5 Grms*

*Y Axis*

20 - 45 Hz	+10 dB/Octave
45 - 600 Hz	.060 g <sup>2</sup> /Hz
600 - 2000 Hz	-6 dB/Octave

*Overall = 7.7 Grms*

*Z Axis (same as longerons)*

20 - 45 Hz	.009 g <sup>2</sup> /Hz
45 - 70 Hz	+12 dB/Octave
70 - 600 Hz	.050 g <sup>2</sup> /Hz
600 - 2000 Hz	-6 dB/Octave

*Overall = 7.0 Grms*

*The associated time duration is 20 seconds per axis per flight which includes a fatigue scatter factor of 4.*

**Table 4.1.6.2.3-1 Orbiter Cargo Bay Random Vibration  
Orbiter Longerons**

<b>X Axis</b>	20 - 32 Hz	.003 g <sup>2</sup> /Hz
	32 - 100 Hz	+6 dB/Octave
	100 - 500 Hz	.030 g <sup>2</sup> /Hz
	500 - 2000 Hz	-4 dB/Octave
	<b>Overall = 5.5 Grms</b>	
<b>Y Axis</b>	20 - 50 Hz	+10 dB/Octave
	50 - 120 Hz	.08 g <sup>2</sup> /Hz
	120 - 160 Hz	-3 dB/Octave
	160 - 600 Hz	.06 g <sup>2</sup> /Hz
	600 - 2000 Hz	-6 dB/Octave
<b>Overall = 7.8 Grms</b>		
<b>Z Axis</b>	20 - 45 Hz	.009 g <sup>2</sup> /Hz
	45 - 70 Hz	+12 dB/Octave
	70 - 600 Hz	.050 g <sup>2</sup> /Hz
	600 - 2000 Hz	-6 dB/Octave
<b>Overall = 7.0 Grms</b>		

*The associated time duration is 20 seconds per axis per flight which includes a fatigue scatter factor of 4.*

**Table 4.1.8.1-1 Maximum Interface Loads Payload Fluid Lines/PACK Interfaces**

<b>PACK Maximum Allowable Loads Per Fluid Line</b>						
<b>Interface Load</b>			<b>Interface Moment</b>			
<b>Direction</b>	<b>Load (Pounds)</b>		<b>Direction</b>	<b>Moment (In. Pounds)</b>		
$X_0$	$\pm$	112	$MX_0$	$\pm$	1032	
$Y_0$	$\pm$	124	$MY_0$	$\pm$	612	
$Z_0$	$\pm$	75	$MZ_0$	$\pm$	425	

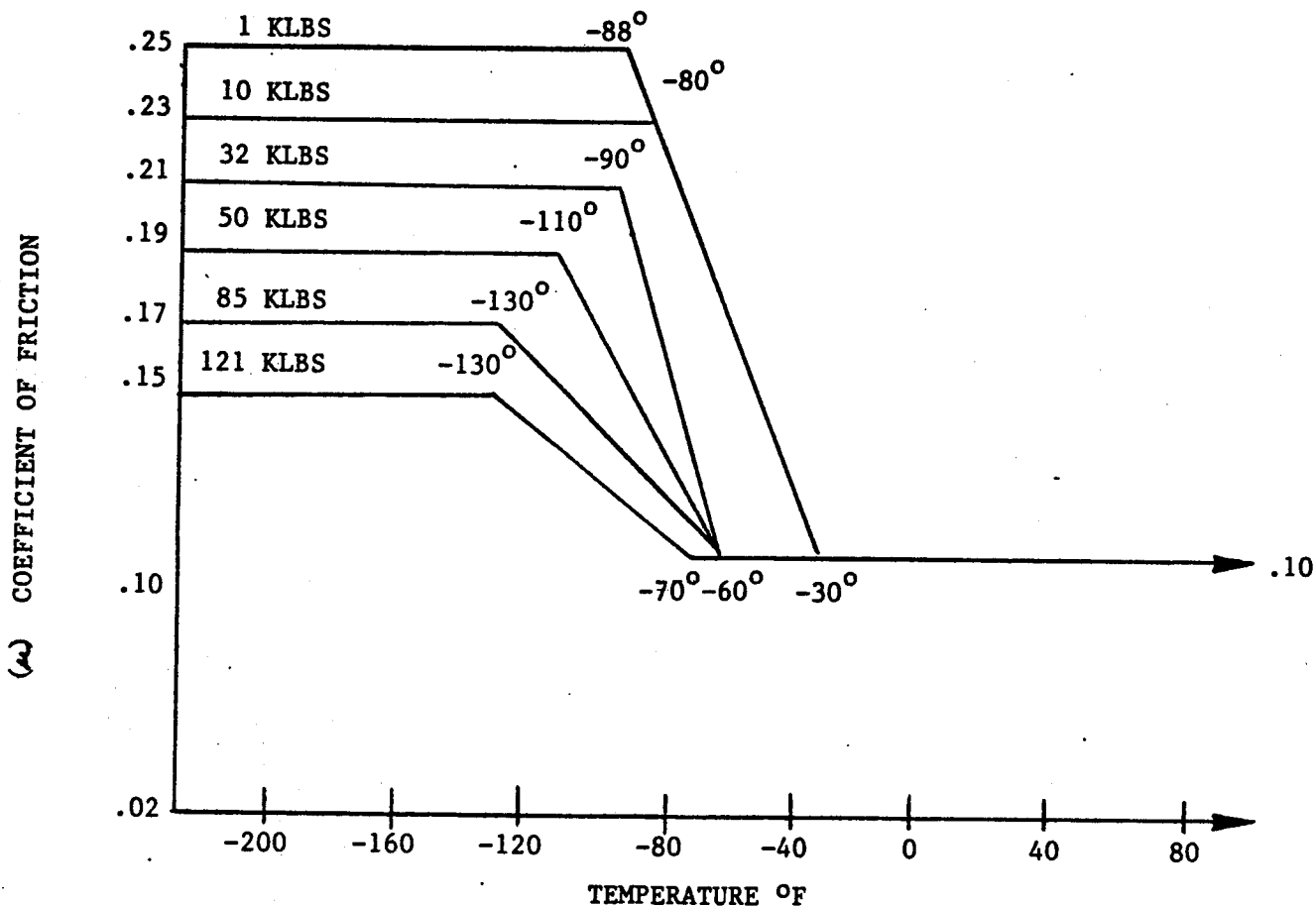
**Table 4.1.8.2-1 Maximum Interface Deflections Payload Fluid Lines/PACK Interface**

<b>Motion Together</b>						<b>Motion Apart</b>					
<b>(Inches)</b>						<b>(Inches)</b>					
<b>X</b>	<b>Y</b>	<b>Z</b>	<b>X</b>	<b>Y</b>	<b>Z</b>	<b>X</b>	<b>Y</b>	<b>Z</b>	<b>X</b>	<b>Y</b>	<b>Z</b>
0.80	3.00(1)	0.50	0.80	2.75(2)	0.50						

(1) Includes 0.93 inch payload motion

(2) Includes 1.99 inches payload motion





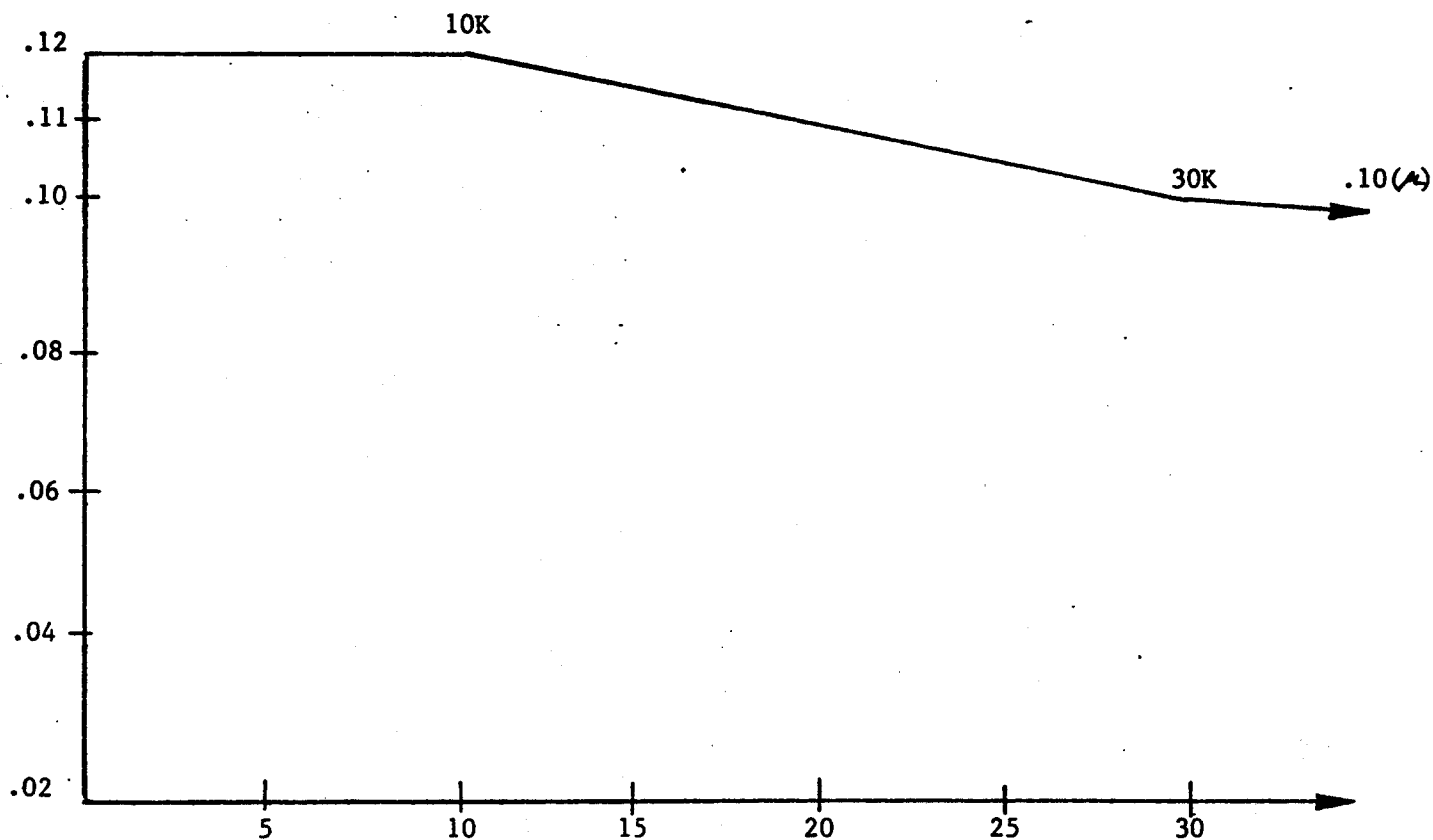
TRUNNION INTERFACE ONLY

VALUES TO BE USED FOR:

1. Y-Y Loads at Longeron Latch
2. Z-Z Load at Keel Latch
3. For Intermediate Load Values, Use Next Highest  $\mu$  Value Plotted

(NOTE: Do Not Interpolate)

FIGURE 4.1.1.1-1 ORBITER/PAYLOAD Y AND Z DIRECTION RETENTION SYSTEM  
COEFFICIENT OF FRICTION FOR FIBRILOID BEARING LINER  
WITH BRAYCO OIL



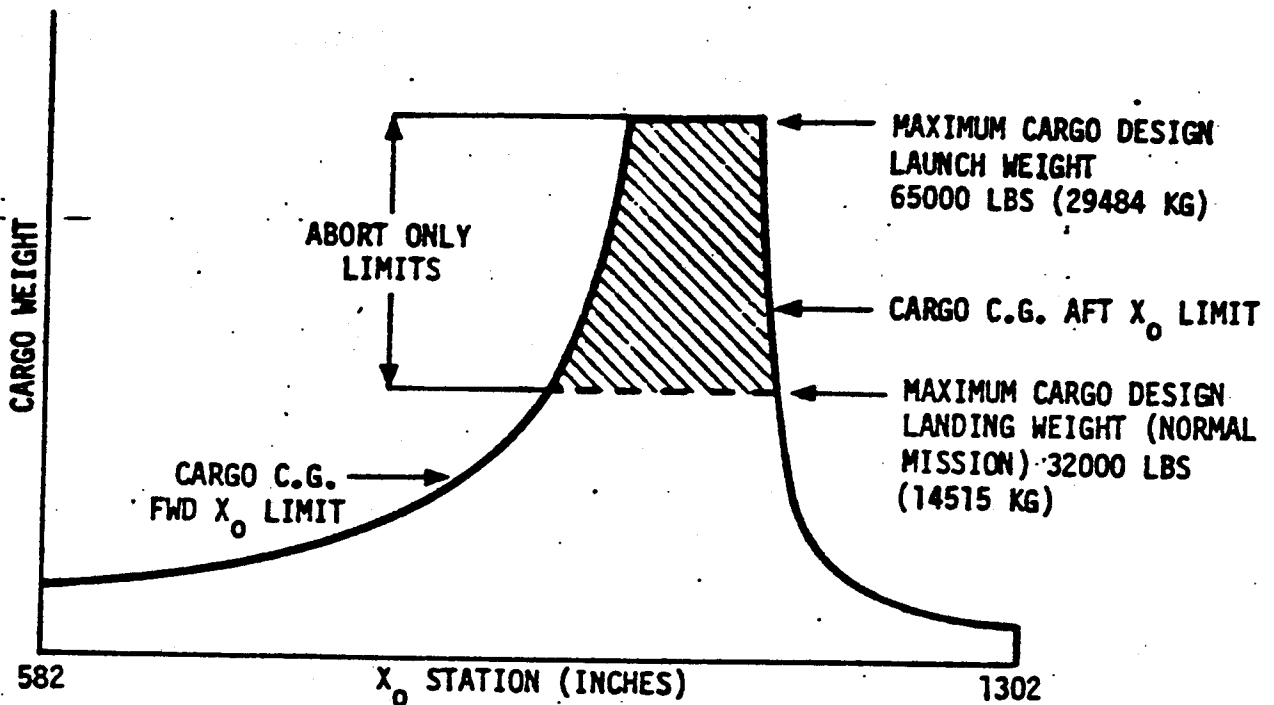
LOAD Y, X KLBS

LATCH/BRIDGE INTERFACE ONLY

VALUES TO BE USED FOR:

1. X-X Loads at Longeron Latch/Bridge
2. X-X Loads at Keel Latch/Bridge
3. All Temperature Environments (-200°F to +275°F)

FIGURE 4.1.1.1-2 ORBITER/PAYLOAD X-X DIRECTION RETENTION SYSTEM  
COEFFICIENT OF FRICTION FOR DRY FILM LUBRICANT  
LATCH/BRIDGE INTERFACE



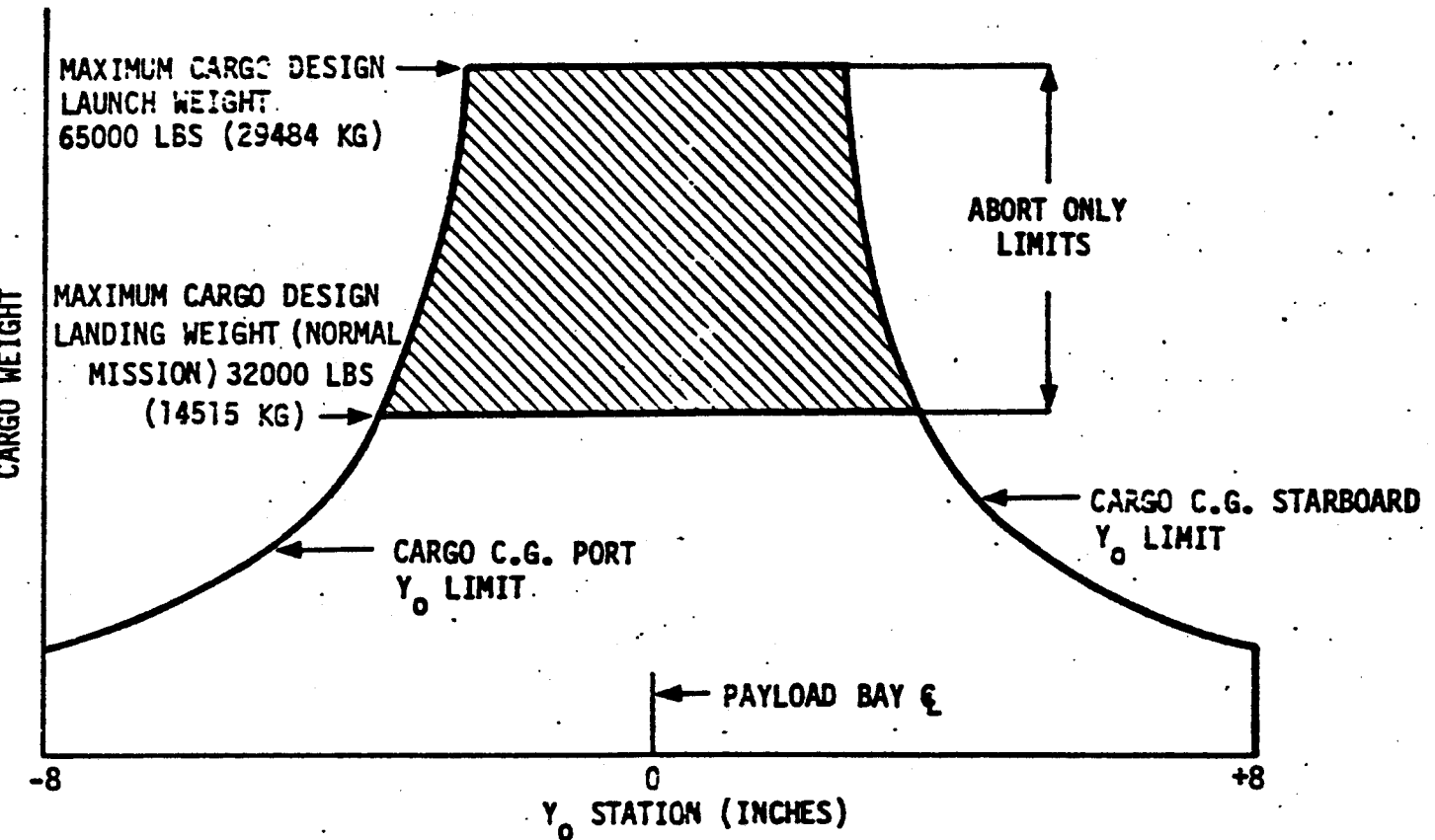
EQUATIONS FOR CALCULATING CARGO X<sub>0</sub> (STATION) C.G. LIMITS

$$\text{FWD LIMIT} = \frac{1076.7 W_c - 3.70 \times 10^6}{W_c}$$

$$\text{AFT LIMIT} = \frac{1108.95 W_c + 3.4 \times 10^5}{W_c}$$

WHERE  $W_c$  = CARGO WEIGHT IN LBS

FIGURE 4.1.4.1-1 ALLOWABLE CARGO C.G. LIMITS (ALONG X-AXIS)



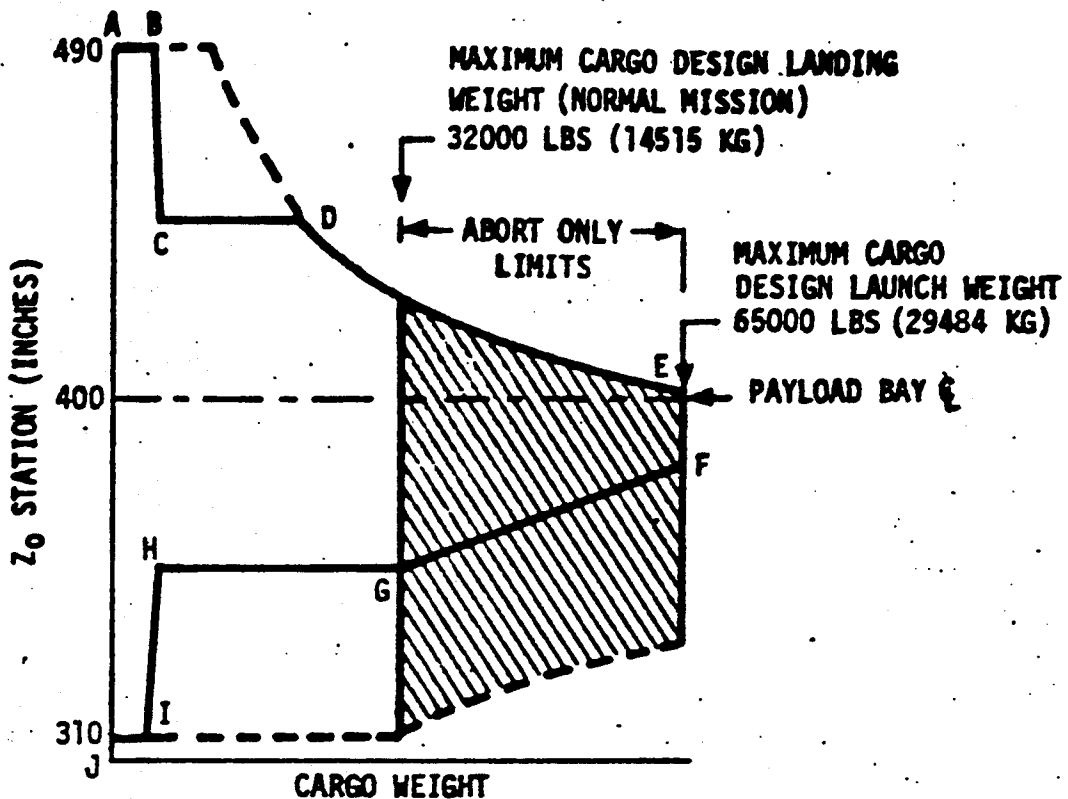
EQUATIONS FOR CALCULATING CARGO  $Y_0$  (STATION) C.G. LIMITS

$$\text{LIMIT} = \pm \left[ \frac{1.5 W_c + 6.265 \times 10^4}{W_c} \right]$$

WHERE  $W_c$  = CARGO WT IN LBS

Figure 4.1.4.1-2 Allowable Cargo C.G. Limits (Along Y-Axis)

FIGURE 4.1.4.1-2 ALLOWABLE CARGO C.G. LIMITS (ALONG Y-AXIS)



EQUATIONS FOR CALCULATING CARGO  $Z_0$  (STATION) C.G. LIMITS

$$\text{UPPER LIMIT} = \frac{384.5 W_c + 1.331 \times 10^6}{W_c}$$

$$\text{LOWER LIMIT} = \frac{360 W_c - 1.566 \times 10^6}{W_c}$$

WHERE  $W_c$  = CARGO WT IN LBS

PARTIAL PAYLOAD  $Z_0$  (STATION) C.G. LIMITS FOR SUMMATION OF ALL PAYLOADS MOUNTED ON ATTACHMENT FITTINGS IN PAYLOAD BAY ( $Z_0$  C.G. TO REMAIN WITHIN CURVE ABCDEFGHIJ, THE SEGMENTS OF WHICH ARE DEFINED BELOW)

IJAB: SAME AS CARGO C.G. LIMITS ABOVE FOR P/L WT UP TO 4000 LBS

BC: STRAIGHT LINE FROM POINT B (4000 LBS, STA 490) TO POINT C (6000 LBS, STA 445)

CD: STRAIGHT LINE AT STA 445 FROM POINT C (6000 LBS) AND POINT D ON CARGO C.G. LIMITS ABOVE

DEF: SAME AS CARGO C.G. LIMITS ABOVE FROM POINT D (STA 445) TO POINT F (STA 380)

FG: STRAIGHT LINE FROM POINT F (65,000 LBS, STA 380) TO POINT G (32,000 LBS, STA 355)

GH: STRAIGHT LINE AT STA 355 FROM POINT G (32,000) TO POINT H (6000 LBS)

HI: STRAIGHT LINE FROM POINT H (6000 LBS, STA 355) TO POINT I (4000 LBS, STA 310)

FIGURE 4.1.4.1-3 ALLOWABLE CARGO C.G. LIMITS (ALONG Z-AXIS)

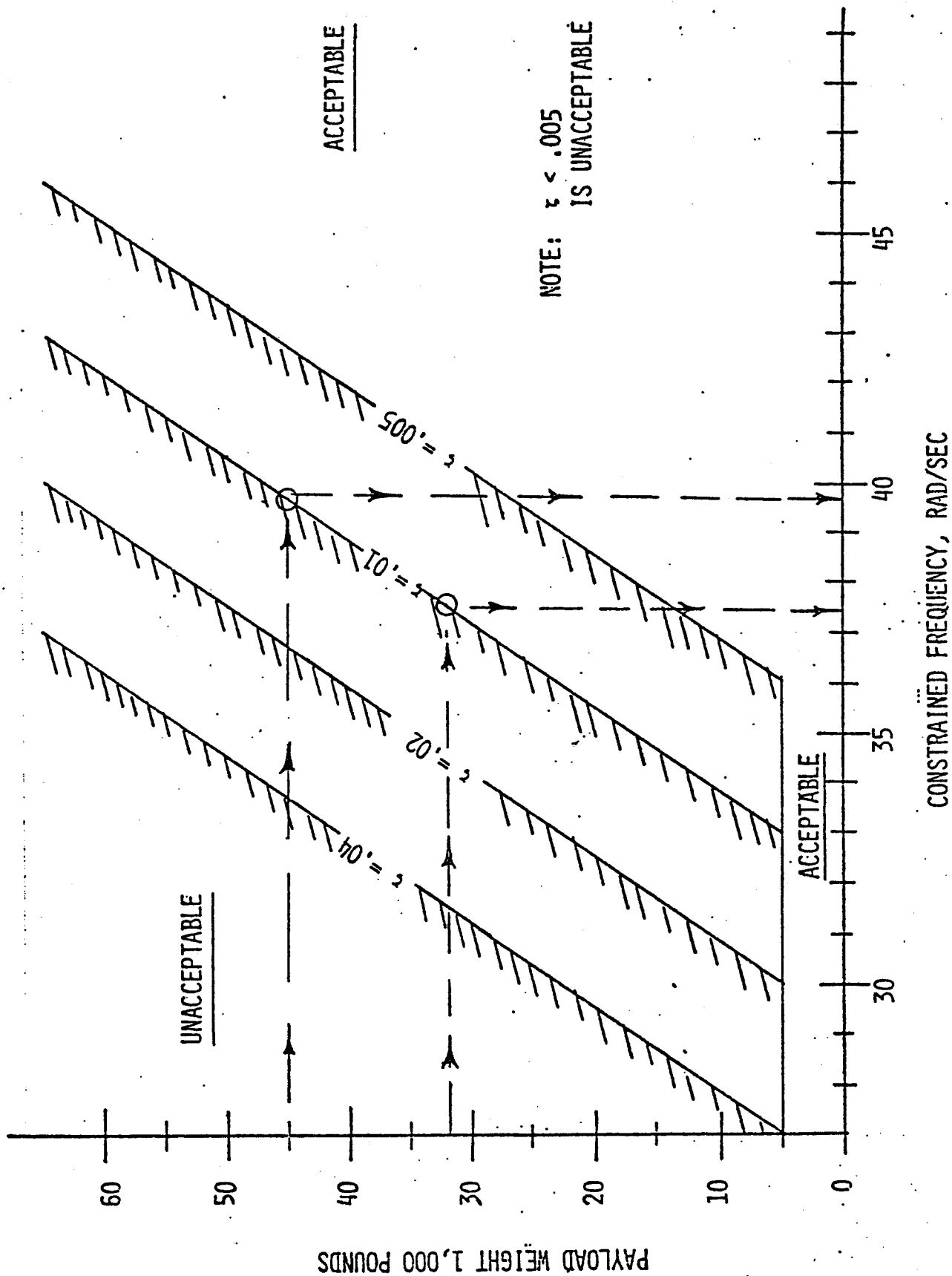


FIGURE 4.1.7.3-1. MINIMUM FREQUENCY REQUIREMENTS

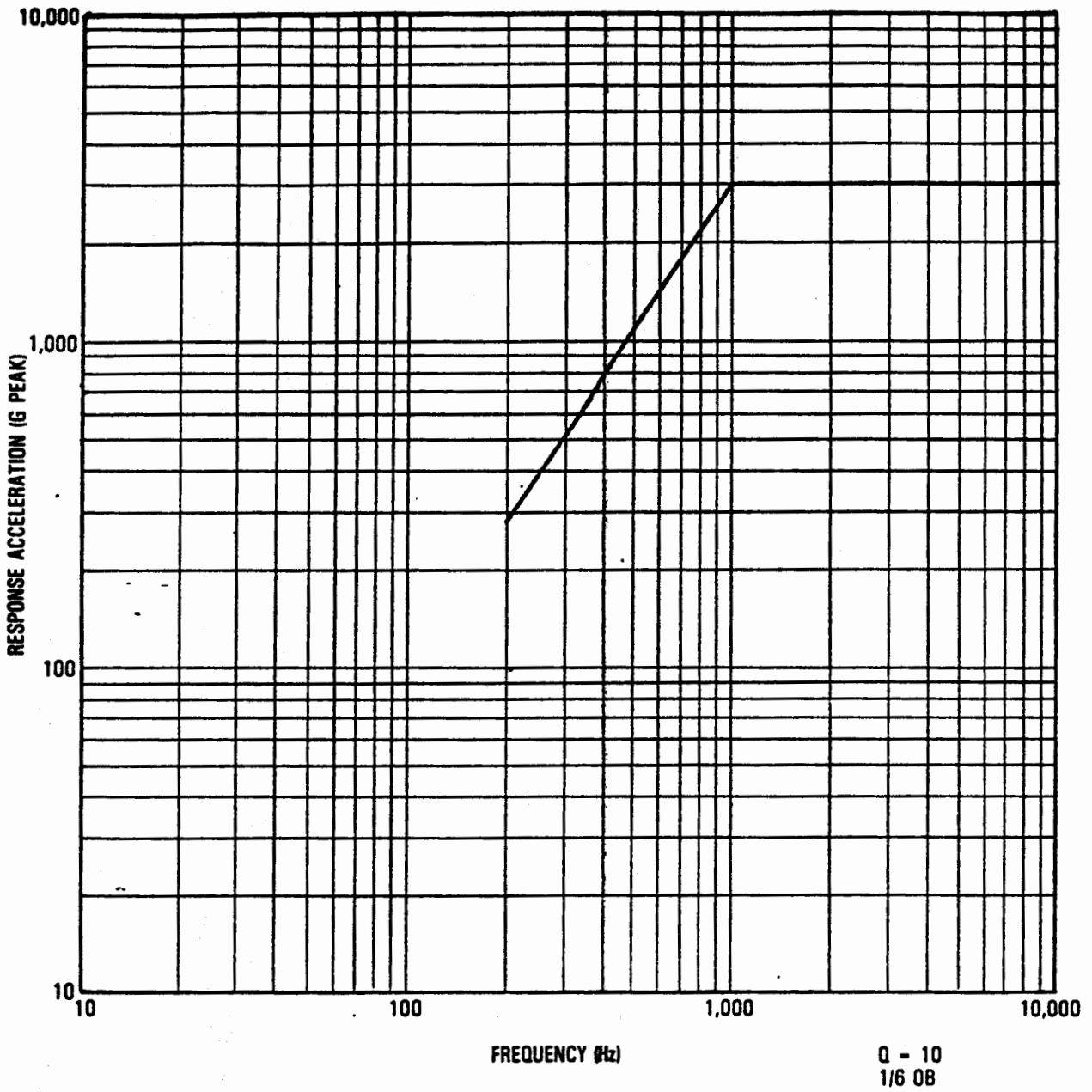
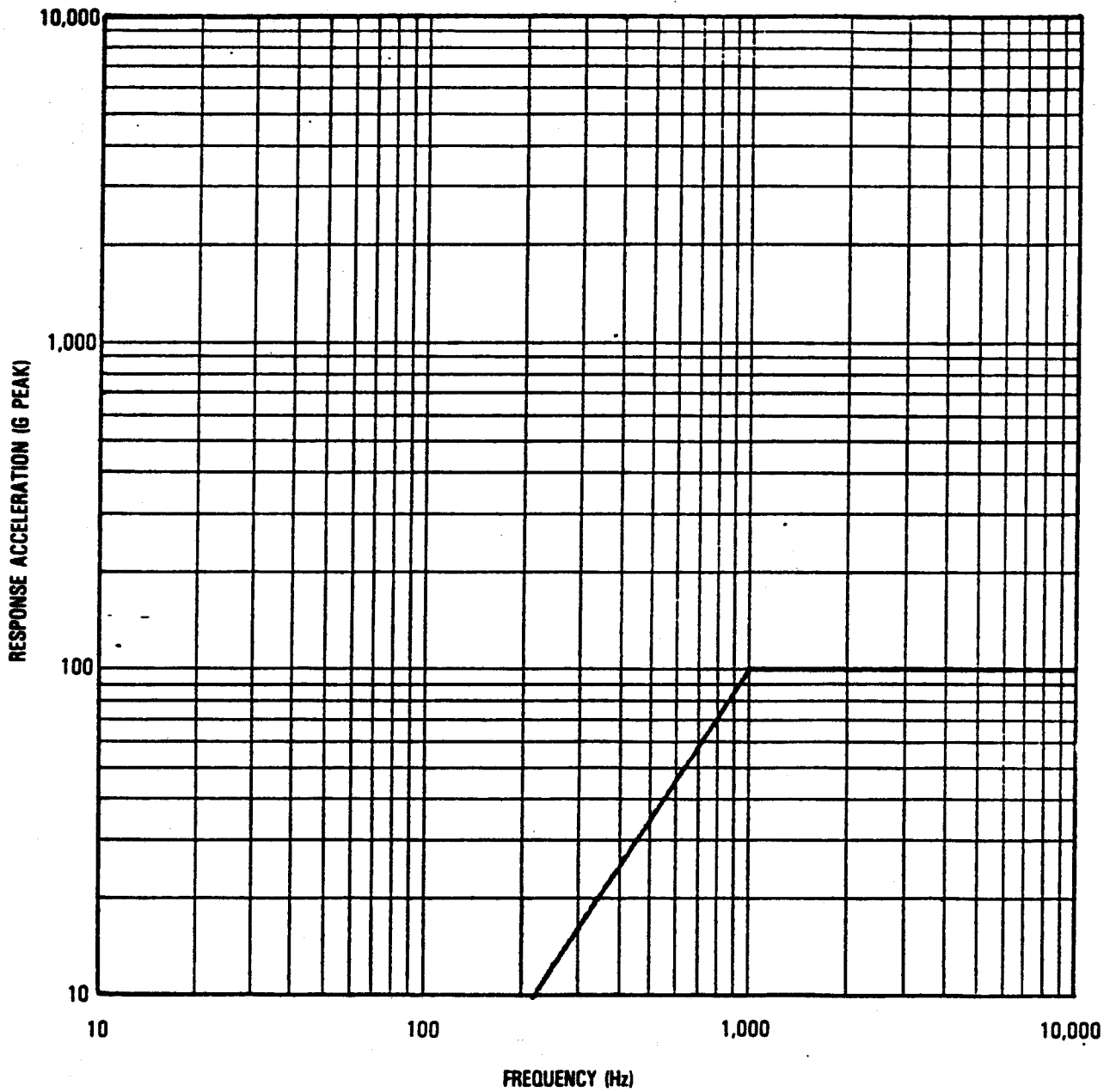


Figure 4.1.9.1-1 Orbiter/Payload Interface Shock Response Spectrum Payload Pyrotechnic Shock



*Figure 4.1.9.2-1 Orbiter/Payload Interface Shock Response Spectrum Orbiter Pyrotechnic Shock*



## 4.2 AFT FLIGHT DECK

### 4.2.1 Quasi-Static.

4.2.1.1 Limit Load Factors. (See paragraph 4.1.3 for definition of load factor).

4.2.1.1.1 Operational Inertia Load Factors. Operational inertia load factors shown in Table 4.2.1.1.1-1 shall apply to all secondary structure.

4.2.1.2 Emergency Landing Load Factors. The emergency load factors specified below shall apply to components mounted in the crew compartments. They shall not apply to items whose failure does not result in injury to personnel or prevent egress from the crashed vehicle.

Ultimate Inertia Load Factors		
$N_x$	$N_y$	$N_z$
20.0	3.3	10.0
-3.3	-3.3	-4.4

These load factors shall act independently, and the longitudinal load factors shall be directed within 20° of the longitudinal axis.

### 4.2.1.3 Vibration.

#### 4.2.1.3.1 (Reserved)

4.2.1.3.2 Random Vibration. The random vibration environments applicable to components mounted in the Aft Flight Deck during launch and ascent shall be as follows:

20 - 150 Hz	+6.00 db/Octave
150 - 1000 Hz	0.03 g <sup>2</sup> /Hz
1000 - 2000 Hz	-6.00 db/Octave
	Composite = 6.5 g(rms)

Environment exposure duration = 7.2 sec/flight in each of  $X_0$ ,  $Y_0$ , and  $Z_0$  axes.

The exposure duration of 7.2 seconds/flight does not include a fatigue scatter factor. A fatigue scatter factor appropriate for the materials and method of construction is required and shall be not less than 4.0.

**4.2.2 Acoustics.** Table 4.2.2-1 represents the minimum level to which equipment to be flown in the aft flight deck must be certified to be considered safe to fly on the STS. *Maximum continuous sound pressure levels in the aft flight deck for normal on-orbit operations resulting from all Orbiter-provided equipment shall meet the limits shown in Figure 4.2.2-1. Maximum sound pressure levels for intermittent Orbiter equipment shall meet the limits of Std 145 of JSCM-8080.*

**4.2.2.1 Payload Generated Acoustic Noise.** *The individual payload elements shall not emit continuous acoustic noise into the crew working/living spaces exceeding the levels shown in Figure 4.2.2.1-1 as measured one foot from the noise radiating surface(s). Maximum noise levels for intermittant noise generated by payload elements shall meet the limits of NASA Std. 145 in JSCM-8080.*

**4.2.3 Panel Kick/Push-Off Loads.** In areas where panel deflection could cause equipment damage to payload provided Aft Flight Deck equipment, the panel shall be capable of absorbing a limit 125 pound (56.7 kg) load distributed over a 4 in. x 4 in. (101.6 mm x 101.6 mm) square area.

TABLE 4.2.1.1.1-1 OPERATIONAL INERTIA LOAD FACTORS

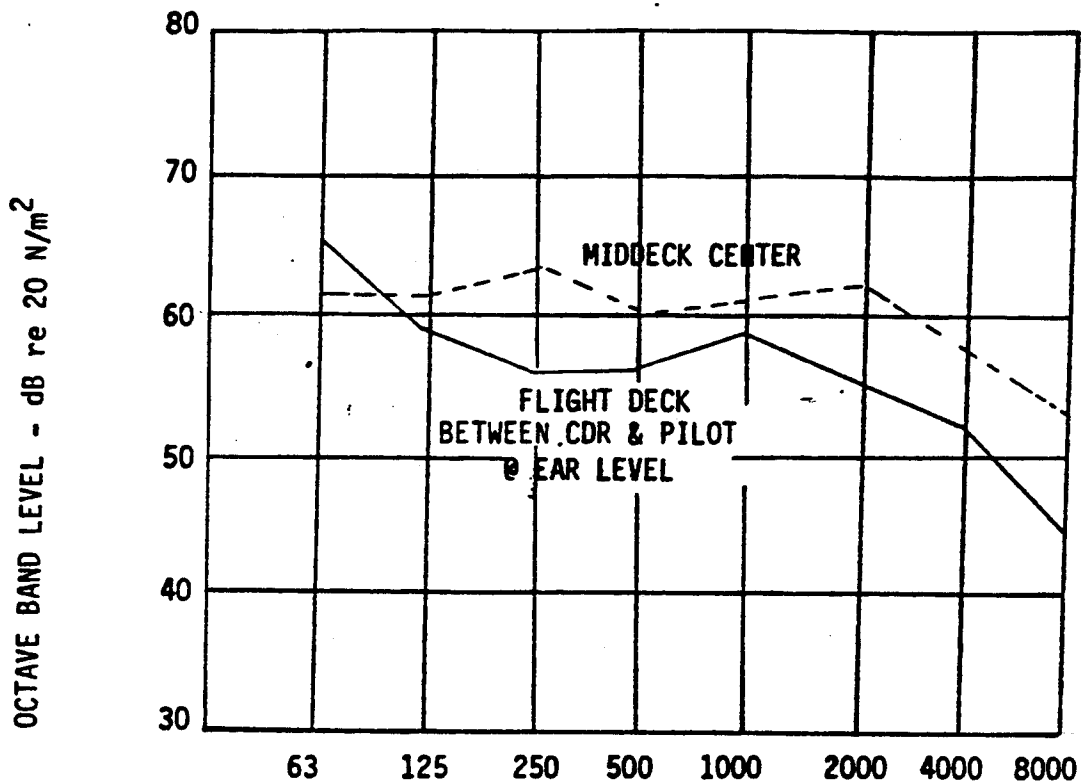
Condition	Limit	Load	Factors
	$N_x$	$N_y$	$N_z$
Lift-Off	-2.55	0	.55
	-2.23	-.03	1.68
	-1.28	.01	-2.05
High-q Boost	-1.90	.04	-.20
	-1.60	$\pm$ .20	-.20
Max Boost	-3.20	.09	-.20
Orbiter Max Load Factor	-3.25	-.02	-.60
	-3.01	0	-.77
TAEM Maneuvers	1.21	0	2.5
	0.53	1.67	1.02
	0.21	-1.39	0.90
Landing	3.57	0	.96
	-2.96	0	.35
	-.60	0	4.9(1)

(1)  $N_z$  is 4.9g at the crew module C.G. only. It varies linearly with X from 6.68g at the forward bulkhead to 3.70g at the aft bulkhead.

TABLE 4.2.2-1 AFT FLIGHT DECK ACOUSTIC ENVIRONMENT

1/3 Octave Band Center Frequency (Hz)	Sound Pressure Level - dB ref. $2 \times 10^{-5} \text{N/m}^2$	
	Lift-off	Aeronoise
	5 Seconds/Flight*	10 Seconds/Flight*
31.5	107	99
40.0	108	100
50.0	109	100
63.0	109	100
80.0	108	100
100.0	107	100
125.0	106	100
160.0	105	99
200.0	104	99
250.0	103	99
315.0	102	98
400.0	101	98
500.0	100	97
630.0	99	97
800.0	98	96
1000.0	97	95
1250.0	96	94
1600.0	95	93
2000.0	94	92
2500.0	93	91
Overall	117.5	111

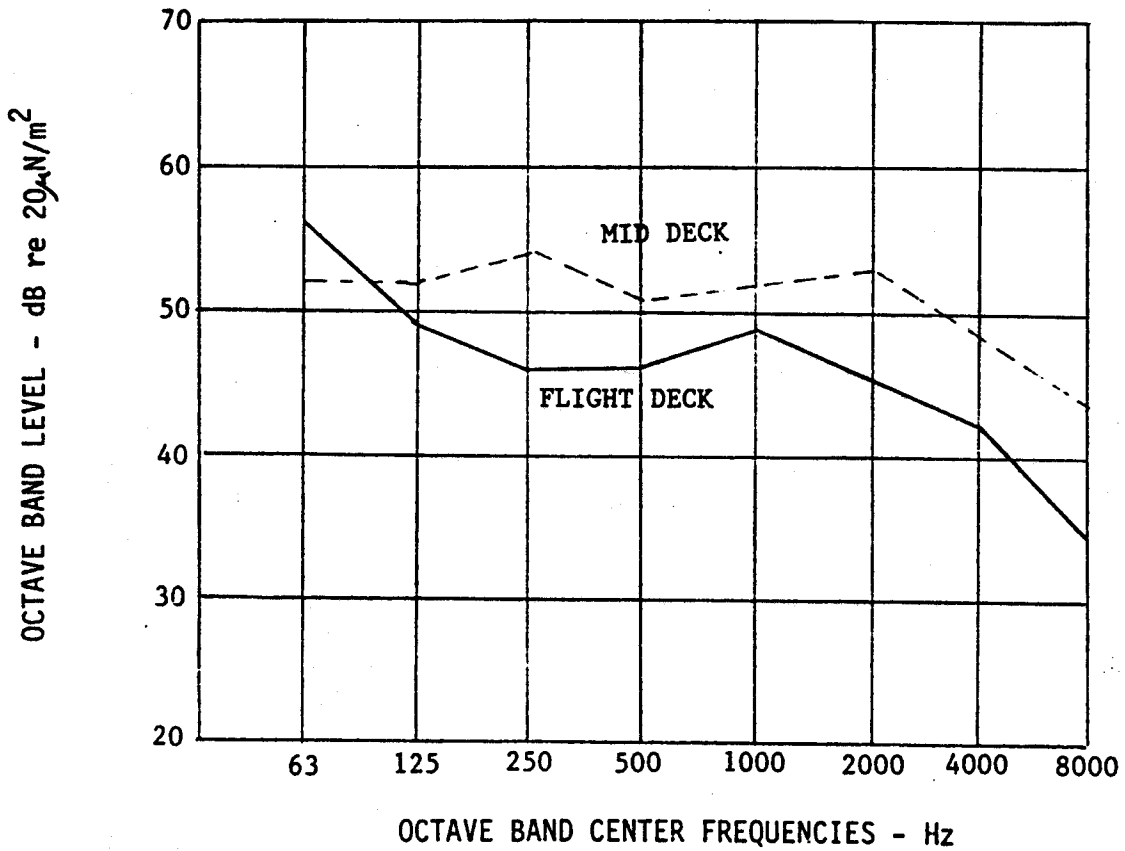
\*Time per flight does not include a scatter factor.



OCTAVE BAND CENTER FREQUENCIES - Hz

FREQ. Hz	63	125	250	500	1000	2000	4000	8000	O/A	dB A
FLIGHT DECK	66	59	56	56	59	56	52	45	68	63
MIDDECK	62	62	65	61	62	63	58	54	71	68

Figure 4.2.2-1 Crew Module Acoustic Noise Levels



FREQ. Hz	63	125	250	500	1000	2000	4000	8000	O/A	dB A
FLIGHT DECK	56	49	46	46	49	46	42	35	58	53
MID DECK	52	52	55	51	52	53	48	44	61	58

Figure 4.2.2.1-1 Crew Module Acoustic Noise Limits For Payloads

## 4.3 GENERAL ACCELERATIONS

4.3.1 RCS/VRCS Accelerations. During normal Orbiter attitude-keeping activities, thrusting of the Orbiter RCS will cause slight accelerations to be exerted on cargo elements depending on their locations with respect to the vehicle center of rotation (affected by weight distribution, but generally in the vicinity of  $X_0=1120$ ,  $Y_0=0$ ,  $Z_0=400$ ). RCS acceleration values shall be as defined in Table 4.3.1-1. Vernier RCS acceleration values shall be as defined in Table 4.3.1-1. In either case, all three angular accelerations may occur simultaneously.

4.3.2 Prelaunch Accelerations. Maximum and minimum limit-load factors/angular accelerations exerted on the cargo during prelaunch shall be as specified in Tables 4.3.2-1 and 4.3.2-2 for an unfueled (empty) and fueled (full) Shuttle External Tank (ET), respectively. These data are based upon the dynamic response of the cargo, with the cargo bay door closed, in a Shuttle vehicle which is exposed to ground wind loading, including gust and vortex shedding effects. The Rotating Service Structure (RSS) and other Shuttle service connections are retracted. The dynamic response is maximized such that these data may be applied conservatively to cargo elements of all weights at all locations.

Limit-load factor/angular acceleration, including sign convention, is defined in paragraph 4.1.3. The center-of-rotation for angular accelerations is at the cargo element center-of-gravity.  $0^\circ$  wind vector coincides with the Orbiter +Z axis. The wind vector rotates clockwise; therefore,  $90^\circ$  wind is from Orbiter +Y to Orbiter -Y. Prelaunch deflections are defined in ICD 2-OA002, SHUTTLE SYSTEM/LAUNCH PAD AND MLP.

4.3.3 OMS Accelerations. The maximum limit-load factors/angular accelerations exerted on the cargo during OMS engine operation shall be as specified in Table 4.3.3-1. The maximum values include the effects of OMS engine thrust overshoot, misalignment, and the dynamic magnification of the payload and Orbiter structures. Limit-load factor/angular acceleration, including sign convention, is defined in Paragraph 4.1.3. The center of rotation for angular accelerations is at  $X_0$  1094.9,  $Y_0$  0,  $Z_0$  372 for a 32,000 lb cargo element and at  $X_0$  1093.7,  $Y_0$  0,  $Z_0$  375.9 for a 65,000 lb cargo element.

4.3.4 Orbiter Jowing Loads. *The Orbiter shall not impose total acceleration levels in Cargo elements which exceed  $\pm 0.8g$  laterally,  $1 \pm 1.3g$  vertically, and  $1g$  axially.*

4.3.5 Payload Deployment Operations. During non-RMS deployment operations, the payload will be capable of sustaining loads imposed by the Shuttle as a result of RCS attitude control. The definition of the flight control system for RCS attitude control will be contained within the appropriate PIP or ICD. OMS and RCS translation will not be considered during payload deployment operations involving erection and/or extension. This requirement does not apply to payloads requiring the RMS for payload deployment/handling operations.

TABLE 4.3.1-1 ORBITER PER AXIS PRCS  
ACCELERATION LEVELS

Acceleration	Command	Maximum Hi-Mode	Nominal Mode	Time Average
<u>TRANSLATION (ft/sec<sup>2</sup>)</u>				
32 K Lbs Payload	+X	0.55*	0.27	0.29
	-X	N/A	-0.28	-0.27
	+Y	N/A	0.28	0.12
	-Y	N/A	-0.28	-0.15
	+Z	1.26**	0.42	0.43
	-Z	-0.94*	-0.55	-0.50
65 K Lbs Payload	+X	0.46*	0.23	0.24
	-X	N/A	-0.23	-0.22
	+Y	N/A	0.23	0.10
	-Y	N/A	-0.23	-0.12
	+Z	1.05**	0.35	0.35
	-Z	-0.80	-0.46	-0.42
<u>ROTATION (deg/sec<sup>2</sup>)</u>				
32 K Lbs Payload	+Roll	N/A	1.09	0.80
	-Roll	N/A	-1.09	-0.89
	+Pitch	N/A	1.29	1.16
	-Pitch	N/A	-0.86	-0.81
	+Yaw	N/A	0.72	0.70
	-Yaw	N/A	-0.72	-0.62
65 K Lbs Payload	+Roll	N/A	1.03	0.76
	-Roll	N/A	-1.03	-0.84
	+Pitch	N/A	1.18	1.06
	-Pitch	N/A	-0.79	-0.74
	+Yaw	N/A	0.66	0.64
	-Yaw	N/A	-0.66	-0.57

\* Hi-mode acceleration in +X and -Z is available only during OPS 1 (insertion) and OPS 3 (de-orbit) phases with TRANS DAP (Transition, digital autopilot).

\*\* Hi-mode acceleration in +Z is available only during OPS 2 (on-orbit) phase with on-orbit DAP (digital autopilot).



TABLE 4.3.1-2 ORBITER PER AXIS VRCS  
ACCELERATION LEVELS

Payload	Rotation Command	Per Axis Rotational Acceleration deg/sec <sup>2</sup>	Translational Crosscouple Acceleration, feet/second <sup>2</sup>		
			X	Y	Z
32 K Lbs	+Pitch	0.0209	-0.0003	0.0	-0.0056
	-Pitch	-0.0163	0.0	0.0	-0.0077
	+Roll	0.0209	-0.0001	0.0027	-0.0067
	-Roll	-0.0209	-0.0001	-0.0027	-0.0067
	+Yaw	0.0175	-0.0001	-0.0011	-0.0029
	-Yaw	-0.0175	-0.0001	-0.0011	-0.0029
65 K Lbs	+Pitch	0.0191	-0.0002	0.0	-0.0047
	-Pitch	-0.0149	0.0	0.0	-0.0064
	+Roll	0.0196	-0.0001	0.0023	-0.0056
	-Roll	-0.0196	-0.0001	-0.0023	-0.0056
	+Yaw	0.0160	-0.0001	-0.0009	-0.0024
	-Yaw	-0.0160	-0.0001	-0.0009	-0.0024

*Table 4.3.2-1 Maximum And Minimum  
Cargo Limit Factors/Angular Accelerations -  
Prelaunch, External Tank Unfueled (Empty)*

Ground Wind Speed and Direction	Load Factor			Angular Acceleration Rad/Sec <sup>2</sup>		
	$n_x$	$n_y$	$n_z$	$\ddot{\phi}$	$\ddot{\theta}$	$\ddot{\psi}$
72 Knots 0°	-1±0.10	±0.05	±0.15	±0.01	±0.10	±0.01
72 Knots 90°	-1±0.05	±0.10	±0.05	±0.06	±0.02	±0.06
72 Knots 180°	-1±0.10	±0.05	±0.15	±0.02	±0.10	±0.02

*Table 4.3.2-2 Maximum And Minimum  
Cargo Limit Factors/Angular Accelerations -  
Prelaunch, External Tank Fueled (Full)*

Ground Wind Speed and Direction	Load Factor			Angular Acceleration Rad/Sec <sup>2</sup>		
	$n_x$	$n_y$	$n_z$	$\ddot{\phi}$	$\ddot{\theta}$	$\ddot{\psi}$
49 Knots 0°	-1±0.05	±0.03	±0.08	±0.01	±0.05	±0.01
49 Knots 90°	-1±0.03	±0.05	±0.03	±0.03	±0.01	±0.03
49 Knots 180°	-1±0.05	±0.03	±0.08	±0.01	±0.05	±0.01

TABLE 4.3.3-1 MAXIMUM CARGO LIMIT-LOAD FACTORS/ANGULAR ACCELERATIONS FOR OMS OPERATION

Cargo Weight	Load Factor			Angular Acceleration Rad/Sec <sup>2</sup>		
	$N_x$	$N_y$	$N_z$	$\ddot{\phi}$	$\ddot{\theta}$	$\ddot{\psi}$
Up to 32 KLB	-0.273	$\pm 0.0048$	-0.089	$\pm 0.0104$	$\pm 0.0051$	$\pm 0.0045$
32K to 65KLB	-0.237	$\pm 0.0042$	-0.074	$\pm 0.0096$	$\pm 0.0048$	$\pm 0.0043$

**4.4 (Deleted)**

## 5.0 FLUID INTERFACES.

### 5.1 UMBILICALS.

5.1.1 Mid-Body Prelaunch Umbilical Panel. The physical characteristics of the fluid interfaces are defined in Figure 3.3.4-6.

5.1.2 Starboard Payload (T-4) Umbilical Panel. The physical characteristics of the fluid interfaces are defined in Figure 3.3.4-7.

5.1.3 Port Payload (T-4) Umbilical Panel. The physical characteristics of the fluid interfaces are defined in Figure 3.3.4-8.

5.2 CARGO BAY PURGE AND VENT. (See Paragraph 6.2.1)

5.3 HEAT EXCHANGER INTERFACE. (See Paragraph 6.2.2)

5.4 AIR REVITALIZATION SERVICE. (See Paragraph 6.3.)

5.5 OXYGEN SUPPLY. (See Paragraph 6.3.1)

5.6 PAYLOAD STATION AND MISSION STATION COOLING. (See Paragraph 6.3.2)

5.7 *(Deleted)*

5.8 Specification of Fluids. Fluid procurement and use control shall be in accordance with NASA Specification NSTS-SE-S-0073.

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## 6.0 ENVIRONMENTAL CONTROL INTERFACES

### 6.1 PASSIVE THERMAL CONTROL

#### 6.1.1 Thermal Design Mission.

##### 6.1.1.1 (RESERVED)

6.1.1.2 Orbiter Vehicle Attitude Constraints. *During on-orbit operations, the Orbiter attitude-hold time limits depend on a combination of the following factors:*

- a. Sun angle to orbital plane (Beta angle)
- b. Orbiter altitude
- c. Orbiter attitude and attitude history
- d. Water management for heat rejection
- e. On-orbit thermal conditioning requirements
- f. Preentry thermal conditioning requirements

*Because these factors depend on orbiter operations in response to payload mission requirements, the Orbiter's attitude-hold capability will be established in payload-unique 9CDs and mission-specific Payload Integration Plans (P9Ps) for each payload which requires attitude-hold periods greater than the minimum durations defined in Paragraph 6.1.1.2.1, including the deorbit and entry requirements defined in Paragraph 6.1.1.2.3. The attitude-hold periods presented in this paragraph are composite values based on consideration of a number of Orbiter thermal issues. The durations are referenced from specific initial conditions (passive thermal control (PTC) steady-state conditions at the particular beta angle). The attitude-hold periods are intended only as an initial simplified presentation of orbiter capabilities for SJS users.*

6.1.1.2.1 Orbiter Constraints as a Function of Attitude and Sun Angle-to-Orbital Plane (Beta Angle). *Depending on the combination of factors noted in Paragraph 6.1.1.2, the maximum attitude-hold capability for the Orbiter will be limited to the durations and ranges given in the table below for  $0^\circ \leq \text{beta angle} < 20^\circ$ ,  $20^\circ \leq \text{beta angle} < 60^\circ$ , and  $60^\circ \leq \text{beta angle} \leq 90^\circ$ . Attitude-hold periods longer than the minimum specified durations may impose constraints on mission variables such as vehicle orientation, orbital parameters, etc. Such extended attitude holds, and the corresponding mission constraints, shall be specified in applicable payload-unique 9CDs and mission-specific P9Ps as a basis for mission planning. Before the attitude-hold durations can be repeated, the Orbiter must be placed in a preferred attitude for a specific duration to allow the accumulation of fuel cell generated water used for active thermal control and/or passive thermal conditioning, also to be defined in applicable 9CDs and P9Ps.*

! Cargo Bay Orientation*	! Orbiter Attitude-Hold Duration Limits ! From PJC Initial Conditions (Hours)+		
	! $0^\circ \leq \beta < 20^\circ$	! $20^\circ \leq \beta < 60^\circ$	! $60^\circ \leq \beta \leq 90^\circ$
! Three-Axis Inertial	!	!	!
! Solar Viewing ! (Bay to Sun)	! -160	! -160	! 52 to 160
! Other Inertial Attitudes	!	!	!
! - Tail Sun	! 12	! 6	! 5
! - Nose Sun	! 37	! 35	! 33
! - Side Sun	! 110	! 110	! 98
! - Bottom Sun	! 160	! 160	! 14
! Local Vertical (LV)**	!	!	!
! Earth Viewing ! (Bay to Earth)	!	!	!
! - With Nose Toward Sun ! at Beta Near $90^\circ$ ! (Wing on UV)	! ---	! ---	! 7
! - With Tail Toward Sun ! (Wing on UV)	! 61 to 160	! 71 to 160	! 5
! - With Either Side ! Toward Sun (Nose or ! Tail on UV)	! 160	! 37 to 160	! 16 to 160
! Other LV Attitudes	!	!	!
! - Port Side LV with ! Tail Toward Sun	! 160	! 6	! 5
! - Bottom LV with Tail ! Toward Sun	! 160	! 6	! 5
! - Starboard Side LV ! with Tail Toward Sun	! 160	! 7	! 5
! - Bottom LV with Either ! Side Toward Sun	! 160	! 7	! 7
! - Tail LV with Bottom ! Toward Sun	! 160	! 12	! 7
! - Tail LV with Either ! Side Toward Sun	! 160	! 12	! 7
! - Tail LV with Top ! Toward Sun	! 160	! 120	! 90 to 160
! - Nose LV with Top ! Toward Sun	! 160	! 120	! 71 to 160
! - Nose LV with Bottom ! Toward Sun	! 160	! 160	! 160
! - Bottom LV with Nose ! Toward Sun at Beta ! $75^\circ$	! ---	! ---	! 16



! (Continued) ! Cargo Bay Orientation*	! Orbiter Attitude-Hold Duration Limits ! From PJC Initial Conditions (Hours)+		
	! $0^\circ \leq \beta < 20^\circ$	! $20^\circ \leq \beta < 60^\circ$	! $60^\circ \leq \beta \leq 90^\circ$
! - Either Side LV with ! Nose Toward Sun at ! $\beta > 75^\circ$	! ---	! ---	! 23
! - Either Side LV with ! Top Toward Sun at ! $\beta > 75^\circ$	! ---	! ---	! 48 to 160
! Orbrate (Single-Axis ! Inertial) ***			
! Solar Viewing (Bay to Sun)	! -160	! -160	! 63 to 160
! Space Viewing (Bay Heating ! Near Zero)			
! - Tail Sun with Top to ! Space	! 7	! 6	! 5
! - Nose Sun with Top to ! Space	! 23	! 7	! 7
! - Nose Sun (But Pitched ! up $-10^\circ$ with Top to ! Space)	! 160	! 7	!
! Other Orbrate Attitudes			
! - Tail Sun with Star- ! board Side to Space	! 7	! 6	! 5
! - Tail Sun with Port ! Side to Space	! 7	! 7	! 5
! - Tail Sun with Bottom ! to Space	! 12	! 7	! 5
! - Nose Sun with Bottom ! to Space	! 25	! 7	! 7
! - Nose Sun with Either ! Side to Space	! 23	! 23	! 23
! - Side Sun with Top to ! Space	! 110	! 7	! 7
! - Side Sun with Nose to ! Space	! 110	! 7	! 7
! - Side Sun with Bottom ! to Space	! 160	! 43 to 160	! 18 to 160
! - Bottom Sun with Nose ! to Space	! 160	! 7	! 7
! - Bottom Sun with Side ! to Space	! 160	! 7	! 7
! - Bottom Sun with Tail ! to Space	! 160	! 160	! 160

- \* *The orientations shown are generalized attitudes with no intent to include a tolerance. For significant deviations from the general attitude, unique assessment may be required.*
- \*\* *Local vertical attitudes are those with an orbiter axis (usually a major axis) pointed continually toward the Earth (e.g., top or bay local vertical).*
- \*\*\* *Orbrate attitudes are those with a single orbiter axis (usually a major axis) inertial but with a rotation period about that axis equal to one orbit period. Orbrate orientations can produce the most severe thermal conditions for the orbiter or payload.*
- + *The orbiter attitude-hold periods shown are based on consideration of both passive and Active Thermal Control System (ATCS) limits. The passive limits included were obtained from "Space Shuttle Program Thermodynamic Design Data Book - Thermal Control System - Constraints" (Rockwell International Document SD73-SH-0226, Volume 1E, Book V, September 1985). The passive thermal limits are referenced from specific initial conditions (PJC steady-state conditions at each beta angle). ATCS attitude duration limits are strong functions of the internal heat load added to the Orbiter Freon loops and these heat loads are highly dependent on the specific mission, the payload configuration, and other operational factors. Attitude duration limits for specific payload configurations and missions must be determined by analysis, and these will be addressed in the payload-unique ICDs and the mission-specific P9Ps. The ATCS duration limits presented here reflect a nominal on-orbit supply water quantity (478 pounds) at the beginning of each attitude hold, a 245 pound minimum on-orbit supply water quantity redline, orbiter fuel cell power of 22 kilowatts, a constant water production rate of 18 pounds per hour, a 110°F radiator Freon inlet temperature, a seven member crew, a deployed forward radiator panel configuration, and eight radiator panels. The attitude-hold periods shown are intended only as an initial simplified presentation of orbiter capabilities for SJS users.*

6.1.1.2.2 (Reserved)

6.1.1.2.3 Orbiter Constraints for De-orbit and Entry Preparation. Orbiter pre-entry thermal conditioning attitudes and duration requirements are dependent upon the thermal state of the orbiter and nature (normal or contingency) of the impending entry. The orbiter pre-entry thermal conditioning time will be established during the mission using real-time temperature measurements. These data will be used to determine the actual required pre-entry thermal conditioning duration within the range defined in the following table.

<i>! Beta Angle</i>	<i>! Long Term Orbiter Orientation</i>	<i>! Thermal Conditioning</i>	<i>!</i>
<i>! Range,</i>	<i>! Prior To Pre-Entry Thermal</i>	<i>! Time Range, Hours</i>	<i>!</i>
<i>! Degrees</i>	<i>! Conditioning</i>	<i>!</i>	<i>!</i>
<i>! 0° To 90°</i>	<i>! Any</i>	<i>! 0 To 12</i>	<i>!</i>

The operational objective will be to accomplish pre-entry conditioning required for normal entry by attitude holds compatible with both the orbiter and payload operational or refurbishment requirements. If mutually compatible requirements cannot be established, pre-entry conditioning will be accomplished by passive thermal conditioning (PTC) by rotating the orbiter at 2 to 5 revolutions per hour about the X-axis with the orientation of the X-axis within +/-20 degrees of the perpendicular to the sun vector.

For an aborted entry resulting from an orbiter problem, the pre-entry thermal conditioning will be constrained only by the payload flight safety constraints defined in the PGP Annex. However, for an aborted entry, effort will be made to satisfy the pre-entry thermal requirements without violating the payload operational or refurbishment attitude-hold constraints also defined in the cargo element PGP.

6.1.1.2.4 On-Board Support Equipment. On-Board Support Equipment remaining in the cargo bay after deployment of the payload shall be designed to be compatible with the Orbiter attitude-hold capability defined in Paragraphs 6.1.1.2.1 and 6.1.1.2.3. However, the use of active cooling shall not be required to meet Orbiter compatible attitude-holds.

6.1.1.3 Space Environment. The numerical values of the parameters defining the space environment shall be as follows:

- a. Solar Radiation (hot case)      444 Btu/hr. - ft.<sup>2</sup>
- b. Earth albedo                      30 percent of solar radiation
- c. Earth Radiation                  77 Btu/hr. - ft.<sup>2</sup>
- d. Space Sink Temperature        0°R

6.1.1.4 (Deleted)

6.1.2 Thermal Design Configurations/Models.

6.1.2.1 Orbiter Interface Models. Orbiter thermal models for integrated analysis shall be as defined in *ES3-76-1, ES3-77-3, JSC-19540 and JSC-19692*.

6.1.2.2 Coating Surface Properties.

6.1.2.2.1 Orbiter Surfaces. For thermal design purposes, the infrared emittance and solar absorptance of the Orbiter surfaces shall be as defined in Figure 6.1.2.2.1-1 and Table 6.1.2.2.1-1.

6.1.2.2.2 (Deleted)

6.1.3 Structural Attachment Thermal Interfaces. *The structural attachments for the cargo element/Orbiter configurations shall be as defined in Paragraph 3.3.1. These interfaces shall be defined by the contact conductances between cargo element provided attachment hardware and Orbiter provided attachment hardware. For thermal analysis purpose the contact conductances should be assumed to be either zero or infinite, whichever is the worst thermal design case.*

6.1.4 Thermal Environment.

6.1.4.1 Cargo Bay Wall Temperature. Typical temperature ranges at the cargo bay walls are defined in Table 6.1.4.1-1. Actual temperatures are dependent upon flight parameters and upon cargo element configuration. The maximum temperature for the radiator panels when the doors are closed shall not exceed 210°F.

6.1.4.2 Entry Air Inlet Conditions. *The temperature and mass flowrate of the repressurizing air entering the cargo bay and the cargo bay pressure during entry to be utilized for cargo design thermal analysis is as defined in Figures 6.1.4.2-1, 6.1.4.2-2, and 6.1.4.2-3.*

6.1.4.3 Reflected Solar Energy. Cargo Elements and Orbiter components which extend above the cargo bay door hinge line (Zo 400.00 ref.), or are deployed transversely over the radiators, may be subjected to locally concentrated solar radiation. The magnitude of the local fluxes will be a function of cargo element or component location and Orbiter orientation relative to the sun. Objects located over the radiators may be irradiated with a flux substantially higher than the solar constant due to focusing by the *reflective radiators*.

6.1.4.4 Prelaunch and Post-landing Environments. Worst case hot and cold prelaunch and post-landing environments, as well as nominal environments are defined, which shall be used in verifying Orbiter/cargo elements thermal compatibility. Constant values for environmental extremes are provided which may be used for calculating conservative thermal predictions. Diurnal data is also provided which may be used for performing more rigorous predictions.

6.1.4.4.1 Solar Flux. The solar constant, which is defined as the heating flux to a surface normal to the incident solar radiation, has a mean value of 429 BTU/hr-ft<sup>2</sup> outside the earth's atmosphere. Because of attenuation due to atmospheric interference, the solar constant at the earth's surface varies as a function of time of day. Figure 6.1.4.4.1-1 shows the diurnal variation of the solar constant to be used for normal hot and cold environment cases of

*prelaunch and post-landing analyses.* For prelaunch conditions, it shall be assumed that the Orbiter is in the vertical position on the launch pad with its tail facing south at the Eastern Test Range (ETR) or facing west at the Western Test Range (WTR). For landings at the ETR the Orbiter is assumed to be generally oriented with the X-axis in a north-south direction; for the WTR, the orientation is also assumed to be generally in the north-south direction.

For hot case analysis, the flux represents the direct flux for a surface normal to the flux. The direct fluxes for the various surfaces of the Orbiter must be corrected for the angle of incidence which varies for each surface and with time of day. For cold case analysis, the flux is assumed to represent the diffuse flux for a cloudy day and does not need to be corrected for the angle of incidence.

Figure 6.1.4.4.1-2 shows the curve to be used for the maximum solar flux at contingency landing sites. The curve was generated assuming a March "noontime" equatorial flux of 396 BTU/hr-ft<sup>2</sup> and the timewise distribution *equation shown on Figure 6.1.4.4.1-2*. Minimum flux at a contingency landing site is assumed to be equal to zero.

For cases where it is desirable to use constant (conservative) values for the solar flux, the following values may be used:

Hot Environment\*

Prelaunch and normal post-landing	363 BTU/hr-ft <sup>2</sup>
Contingency landing	396 BTU/hr-ft <sup>2</sup>

Cold Environment\*\*

Prelaunch and normal post-landing	70 BTU/hr-ft <sup>2</sup>
Contingency landing	0 BTU/hr-ft <sup>2</sup>

\* For prelaunch hot conditions with the Orbiter in a vertical position on the pad, assume the sun is in the Orbiter X-Z plane at an angle 38° up from the local horizontal at the ETR, and in the Orbiter X-Y plane at an angle 31° up from the local horizontal at the WTR. For hot analyses for normal post-landing and contingency landings, assume the *sun is directly overhead, Figure 6.1.4.4.1-1.*

\*\* For cold conditions, assume the *flux is diffuse, Figure 6.1.4.4.1-1.*

6.1.4.4.2 Ambient Air Temperature. The ambient air temperature varies with time of day, season and local weather conditions. Figure 6.1.4.4.2-1 and 6.1.4.4.2-2 show diurnal air temperatures for ETR and WTR locations for cold, hot and *nominal days for representative months.* The temperatures for hot and cold days represents the maximum and minimum values, respectively, for 95 percent of all measurements while the temperature for a "nominal" day represents the median (50 percentile) of all measurements.

Figure 6.1.4.4.2-3 shows diurnal air temperatures for hot and cold days at contingency landing sites. The curve for a hot day was synthesized assuming a maximum temperature of 110°F at noon and the minimum temperature at ETR in *July for 95 percent hot day, Figure 6.1.4.4.2-1*. The curve for a cold day was synthesized assuming a minimum temperature of 0°F and a 50°F temperature rise and fall in the morning and afternoon, respectively.

Where it is desired to use constant (conservative) values of ambient temperature, the following values are recommended:

Hot Environment

<i>Prelaunch and normal post-landing</i>	99°F
Contingency landing	110°F

Cold Environment

<i>Prelaunch and normal post-landing</i>	25°F
Contingency landing	0°F

6.1.4.4.3 Ground Surface Temperature. The ground surface temperature is influenced by incident daytime solar radiation, sky/ground radiation interchange, air temperature and velocity, and surface properties. Generally, it is assumed that the ground surface temperature is the same as the air temperature. If desired, the ground temperature may be assumed to be equal to the diurnal air temperature. When constant (conservative) values are appropriate, the following values may be used:

Hot Environment

<i>Prelaunch</i>	99°F (60°F*)
<i>Normal post-landing</i>	99°F
<i>Contingency landing</i>	110°F

Cold Environment

<i>Prelaunch</i>	25°F
<i>Normal post-landing</i>	25°F
<i>Contingency landing</i>	0°F

\* When in a vertical position on the launch pad, the bottom of the Orbiter views the external tank which has a temperature of approximately 60°F.

6.1.4.4.4 Sky Temperature. The sky temperature is influenced by climatic conditions such as ambient temperature and cloud cover and time of day. While on the runway the upperbody surfaces of the Orbiter radiate heat primarily to the sky. While on the launch pad in a vertical position, these surfaces radiate approximately one-half to the ground and one-half to the sky. The following constant values are recommended for design purposes:

Hot Environment

Prelaunch	50°F*
Normal post-landing	50°F
Contingency landing	50°F

## Cold Environment

Prelaunch	5°F
Normal post-landing	-22°F
Contingency landing	-22°F

- \* Average radiation temperature viewed by Orbiter top surfaces is 76°F assuming sky temperature of 50°F and ground temperature of 99°F.

### 6.1.5 (Deleted)

*6.1.6 Cargo Bay Floodlight Thermal Characteristics. Depending upon the degree of payload blockage of the cargo bay floodlight's view to space, operation of the lights may be constrained due to payload or floodlight thermal limitations. Thermal configuration and maximum temperatures of the lights are presented in Figure 6.1.6-1 and direct light beam short wavelength (excluding 9R) maximum heat flux is presented in Figure 6.1.6-2 for use in payload thermal design analyses. These data are included for use in identifying potential floodlight operational constraints due to payload thermal considerations. If constraints are indicated, a more detailed analysis shall be accomplished to define the required operational constraints. A thermal math model of a typical floodlight is available, if required, for detailed thermal analysis. Specific locations of the cargo bay lights are presented in Figure 3.1.3.2-1, Section 3.0.*

Table 6.1.2.2.1-1 Thermo-Optical Properties Of Orbiter Surfaces

Surface Description	Design Criterion	Surface Material	$\alpha$ New	$\alpha$ Degr.	$\epsilon$ New	$\epsilon$ Degr.	$P$ Diffuse Percent	$P$ Specular Percent
Cargo Bay Liner	$\alpha / \epsilon \leq .4$ $\epsilon \geq .8$	Teflon Coated Gloss Cloth	.22	.36	.9	.9	99	none
Fwd Bulkhead	$\alpha / \epsilon \leq .4$ $\epsilon \geq .8$	Teflon Coated Gloss Cloth	.22	.36	.9	.9	99	none
Aft Bulkhead	$\alpha / \epsilon \leq .4$ $\epsilon \geq .8$	Teflon Coated Gloss Cloth	.22	.36	.9	.9	99	none
Radiator Concave Surface	N/A	Silver-Coated Teflon	.08	.11	min .8	.8	50	50
Radiator Convex Surface	N/A	Silver-Coated Teflon	.08	.11	min .8	.8	50	50
Cargo Bay Doors Concave Surface	Fwd 2 Pnl's	Silver-Coated Teflon	.08	.11	min .8	.8	50	50
	Fourth Pnl (w/o radiator) $\alpha / \epsilon \leq .4$ $\epsilon \geq .8$	Teflon-Coated Gloss Cloth	.22	.36	.9	.9	99	none
Cargo Bay Doors Convex Surface	$\alpha / \epsilon = .2$ to .4 $\epsilon \geq .8$	FRSI (1) LRSI (2)	.16	.32	$\geq .8$	$\geq .8$	N.A.	N.A.
Fuselage Mid Section Sides	$\alpha / \epsilon = .2$ to .4 $\epsilon \geq .8$	.32 FRSI (1) LRSI (2)	.16	.32	$\geq .8$	$\geq .8$	N.A.	N.A.
Wing Upper Surface	$\alpha / \epsilon = .2$ to .4 $\epsilon \geq .8$	FRSI(1) LRSI (2)	.16	.32	$\geq .8$	$\geq .8$	N.A.	N.A.



Table 6.1.2.2.1-1 Thermo-Optical Properties Of Orbiter Surfaces  
(Continued)

Surface Description	Design Criterion	Surface Material	$\alpha$ New	$\alpha$ Degr.	$\epsilon$ New	$\epsilon$ Degr.	$P$ Diffuse Percent	$P$ Specular Percent
Wing Lower Surface	$\alpha / \epsilon = .7$ S to 1.1 $\epsilon \geq .85$	LI 900 HRSI(3)(4)	.92	$\geq .6$	.85	.85	N.A.	N.A.
Bottom of Orbiter	$\alpha / \epsilon = .7$ S to 1.1 $\epsilon \geq .85$	LI 900 HRSI(3)(4)	.92	$\geq .6$	.85	.85	N.A.	N.A.
Fuselage Fwd Section (Top and Portion of Sides, See Figure 6.1.2.2.1-1)	$\alpha / \epsilon = .2$ S to .4 $\epsilon \geq .8$	FRSI (1) LRSI (2)	.16	.32	$\geq .8$	$\geq .8$	N.A.	N.A.
Fuselage Fwd Section (Nose and Portion of Sides, See Figure 6.1.2.2.1-1)	$\alpha / \epsilon = .7$ S to 1.1 $\epsilon \geq .85$	LI 900 HRSI(3)(4)	.92	$\geq .6$	.85	.85	N.A.	N.A.
Fuselage Aft Section Sides	$\alpha / \epsilon = .2$ S to .4 $\epsilon \geq .8$	FRSI (1)	.16	.32	$\geq .8$	$\geq .8$	N.A.	N.A.
Vertical Fin	$\alpha / \epsilon = .2$ S to .4 $\epsilon \geq .8$	FRSI (1)	.16	.32	$\geq .8$	$\geq .8$	N.A.	N.A.
Base Heat Shield	$\alpha / \epsilon = .7$ S to 1.1 $\epsilon \geq .85$	LI 900 HRSI(3)(4)	.92	$\geq .6$	.85	.85	N.A.	N.A.
OMS Pods	$\alpha / \epsilon = .2$ S to .4 $\epsilon \geq .8$	FRSI (1) LRSI (2)	.16	.32	$\geq .8$	$\geq .8$	N.A.	N.A.

Table 6.1.2.2.1-1 Thermo-Optical Properties Of Orbiter Surfaces  
(Concluded)

Surface Description	Design Criterion	Surface Material	$\alpha$ New	$\alpha$ Degr.	$\epsilon$ New	$\epsilon$ Degr.	$\rho$ Diffuse Percent	$\rho$ Specular Percent
Body Flap (Upper and Lower Surfaces)	$\alpha / \epsilon = .7$ <sup>S</sup> to 1.1 $\epsilon \geq .85$	LI 900 HRSI(3)(4)	.92	$\geq .6$	.85	.85	N.A.	N.A.
SSME Nozzles External Surfaces	$\alpha / \epsilon = 1.0$ <sup>S</sup>	Inconel 718	.8	.85	.8	.85	N.A.	N.A.
SSME Nozzles Internal Surfaces	$\alpha / \epsilon = 1.8$ <sup>S</sup>	A286 Stainless Steel	.55	.55	.3	.3	N.A.	N.A.

NOTE:

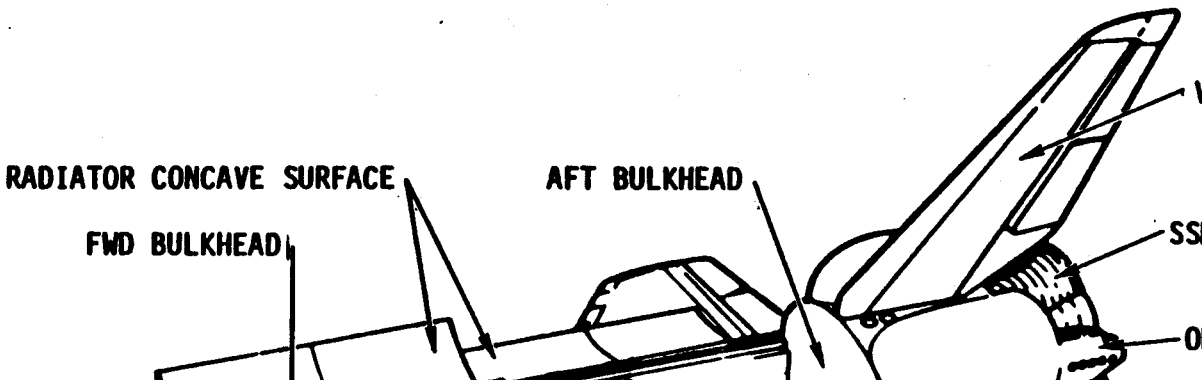
- (1) Felt reusable surface insulation.
- (2) Low-temperature reusable surface insulation.
- (3) High-temperature reusable surface insulation.
- (4) HRSI coating absorptance is highest when new and decreases with degradation.
- (5) Small Orbiter surfaces (e.g. wing and vertical fin leading edges, nose cone, T-O umbilical, etc.) and minor Orbiter vehicle differences are not shown.

*Table 6.1.4.1-1 Cargo Bay Wall Temperature*

CONDITION	TEMPERATURE	
	Minimum	Maximum
1. <i>Prelaunch (1)</i>	+40°F	+120°F
2. <i>Launch (1)</i>	+40°F	+150°F
3. <i>On-Orbit (doors open) (2) (4)</i>	-250°F	+200°F
4. <i>Entry and Post-landing (3) (4)</i>	-50°F	+220°F

NOTES:

- (1) Conditions 1 and 2 are for an assumed adiabatic cargo element.
- (2) Condition 3 is for an assumed empty cargo bay. The effect on wall temperature which results with a cargo element installed is dependent upon cargo element configuration, cargo element location in the bay, and on-orbit attitude. Under hot case conditions, cargo element effects can cause local insulation surface wall temperatures to exceed 200°F substantially.
- (3) Condition 4, minimum, is for an assumed adiabatic cargo element with an initial -250°F cargo bay wall temperature. Condition 4, maximum, is for an assumed empty cargo bay.
- (4) Conditions 3 and 4 should be analyzed using detailed integrated Orbiter/cargo element math models to define cargo element and Orbiter cargo bay temperatures for specific cargo element configurations.



*Figure 6.1.2.2.1-1 Orbiter Surface*

ICD-2-19001

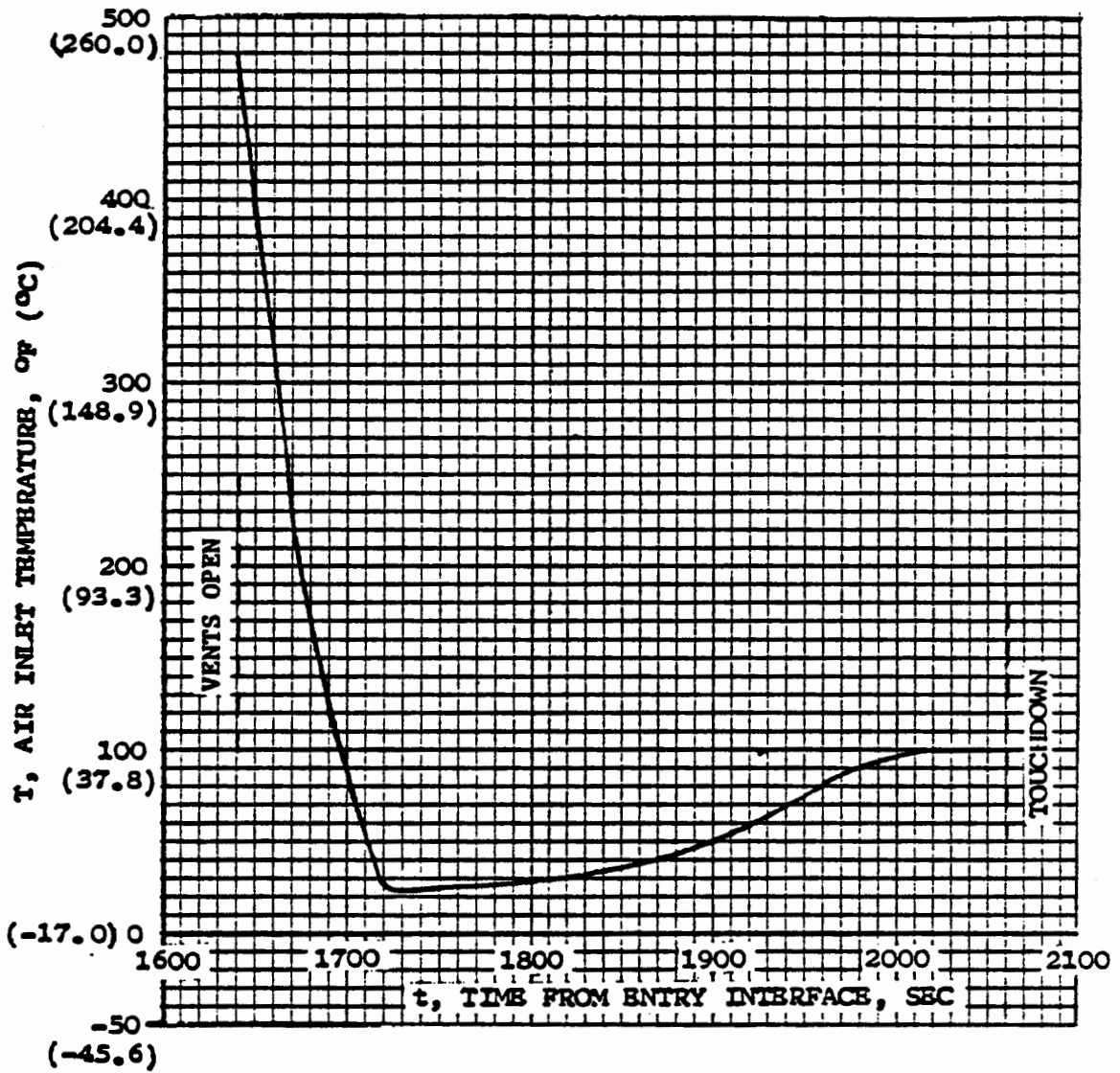
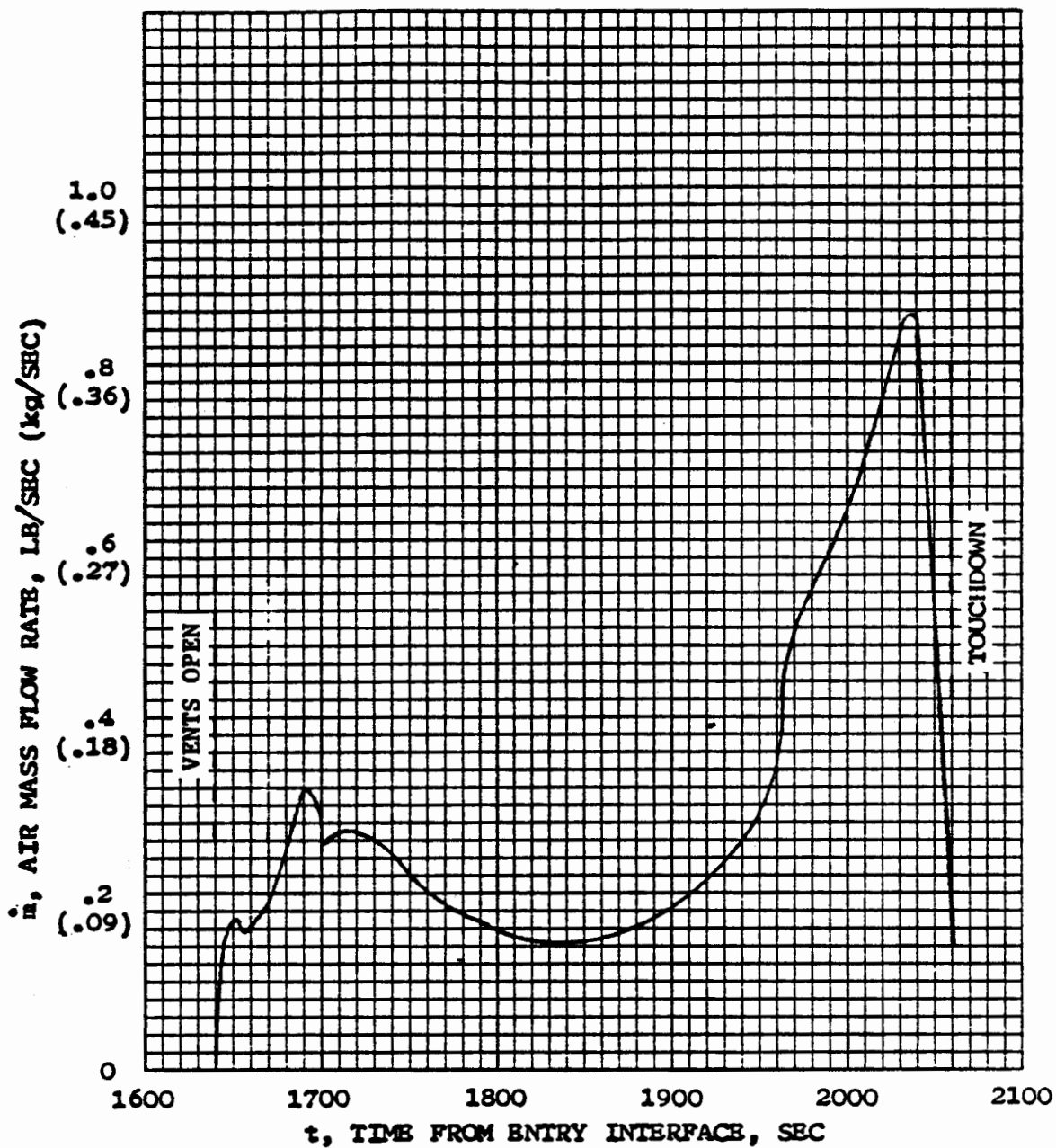


Figure 6.1.4.2-1 Temperature Of Air Entering The Cargo Bay During Entry - Max Air Temperature Case



NOTE: MASS FLOW RATE SHOWN FOR SINGLE VENT.  
 TYPICAL FOR EACH OF EIGHT CARGO  
 BAY VENTS.

Figure 6.1.4.2-2 Mass Flow Rate of Air Entering The Cargo Bay During  
 Entry - Max Air Temperature Case

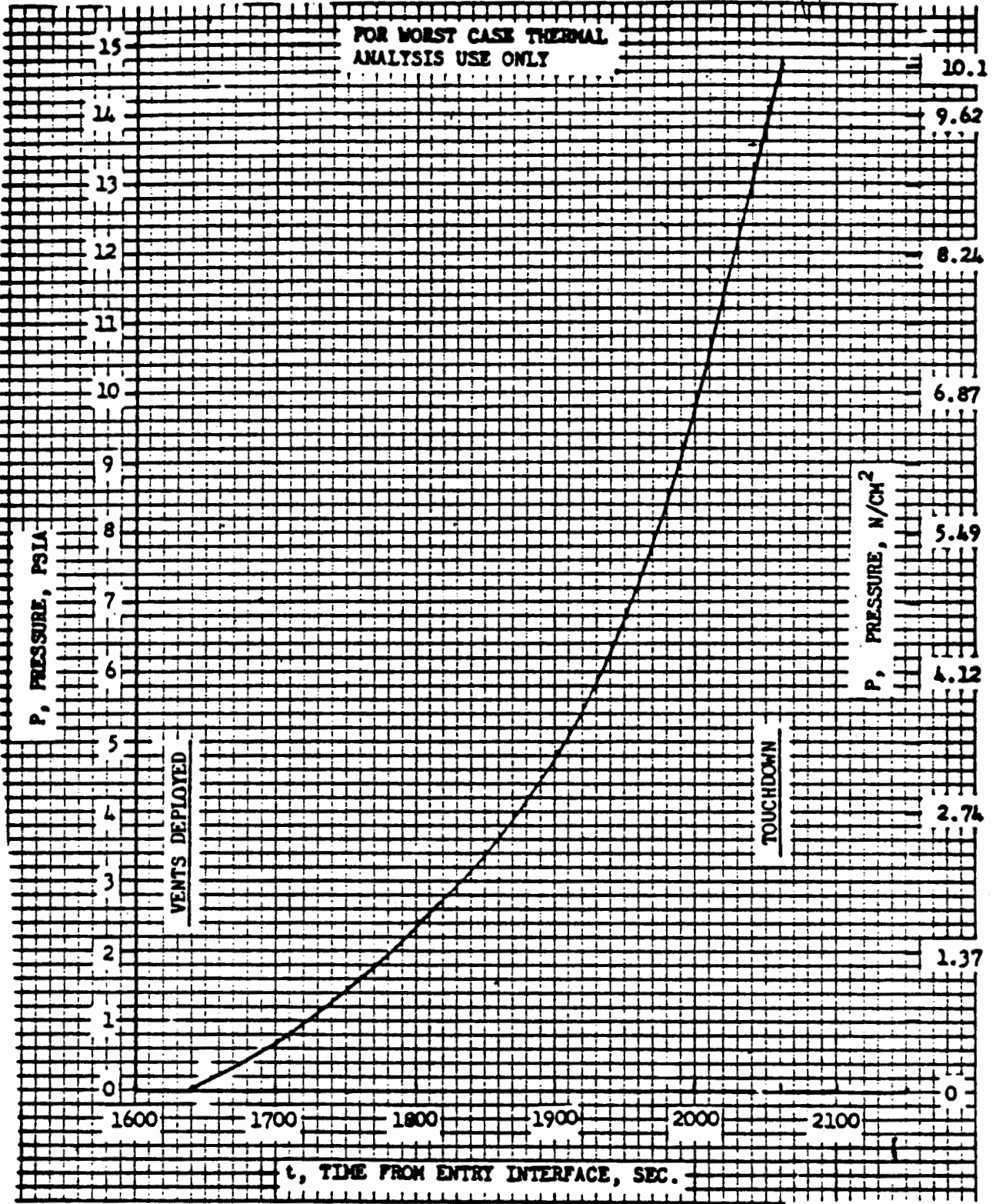


Figure 6.1.4.2-3 Cargo Bay Air Pressure During Entry For Estimated Thermal Worst Case

TIME OF DAY	DESIGN HIGH SOLAR RADIATION		DESIGN LOW SOLAR RADIATION	
	BTU/FT <sup>2</sup> /HR	GM-CAL/CM <sup>2</sup> /MIN	BTU/FT <sup>2</sup> /HR	GM-CAL/CM <sup>2</sup> /MIN
0500	0	0.00	0	0.00
1100	363	1.64	70	0.32
1300			80	0.36
1400	363	1.64		
2000	0	0.00	0	0.00

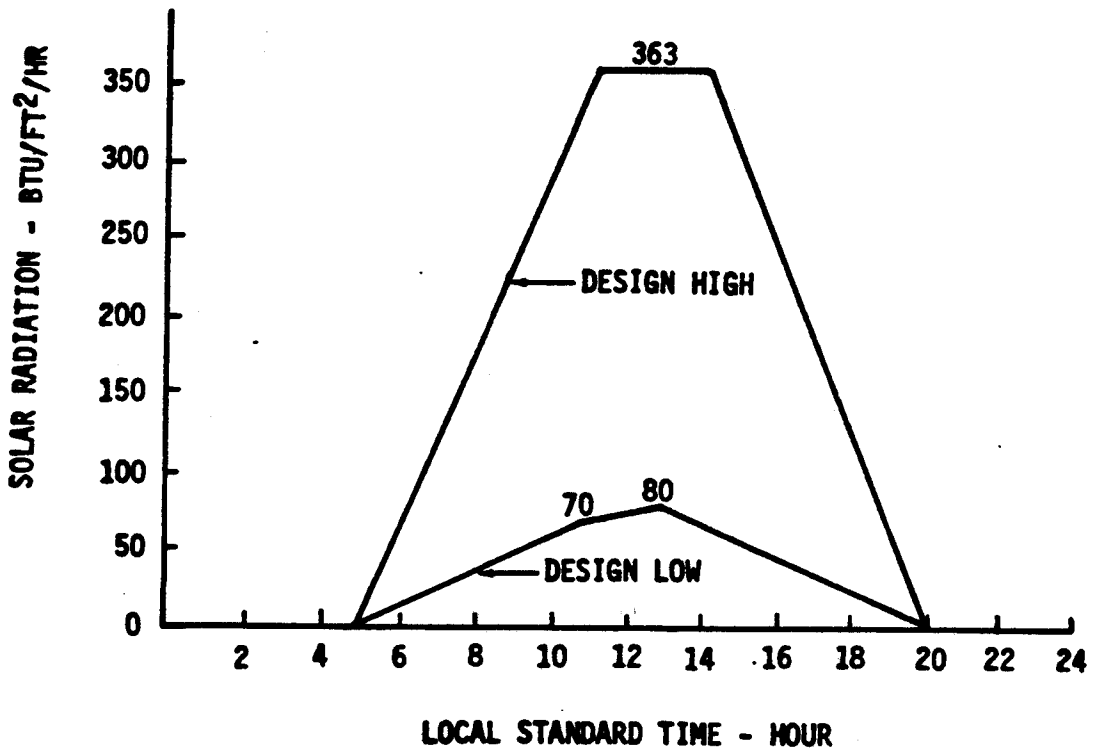
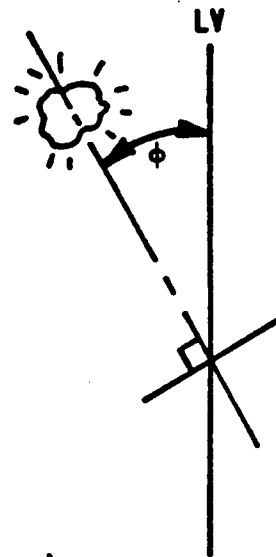


Figure 6.1.4.4.1-1 Diurnal Variation For Solar Constant





$$\text{SOLAR CONSTANT} = 442 \times e^{-(.1175/\cos\phi)}$$

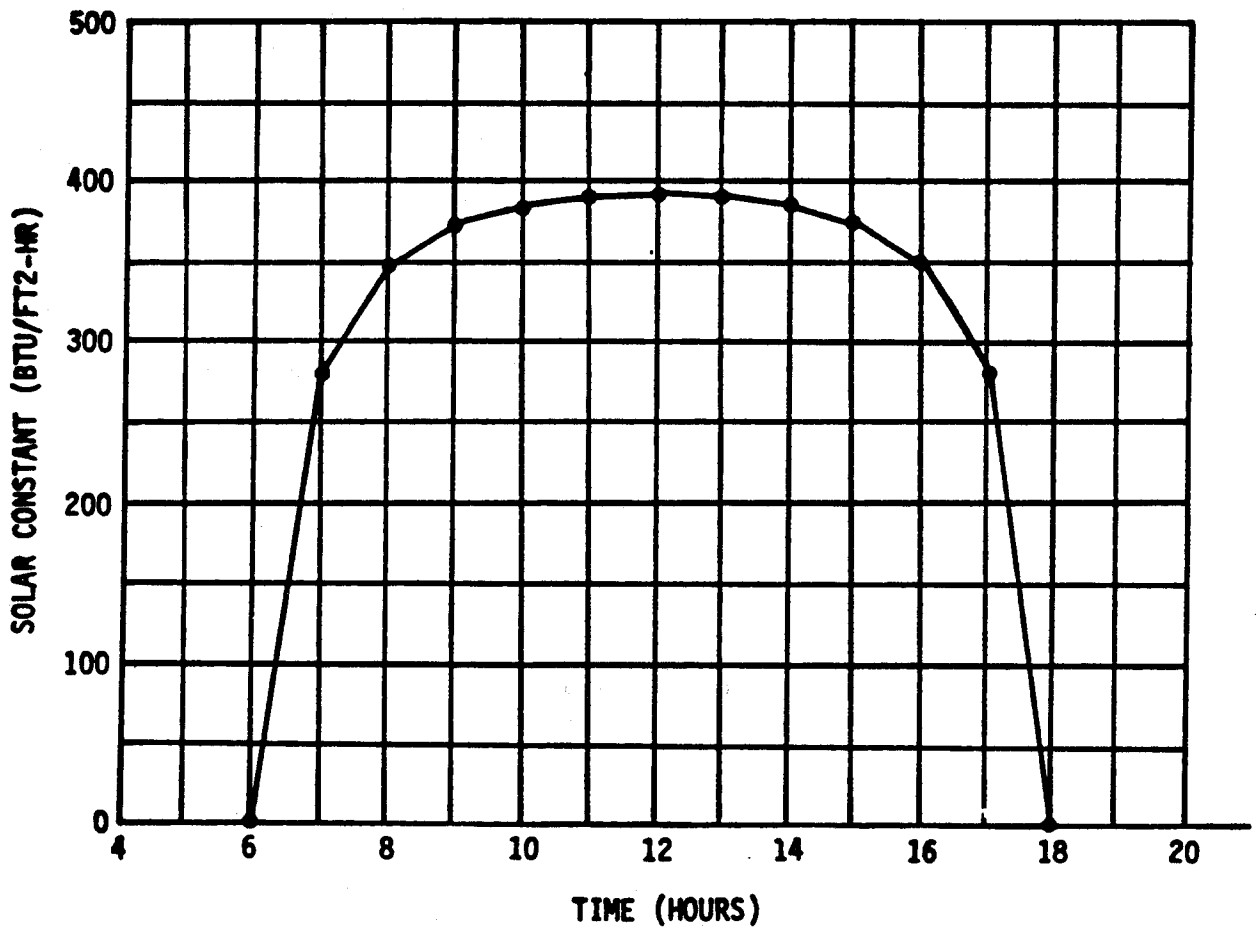


Figure 6.1.4.4.1-2 Equatorial Solar Constant Variation At Contingency Landing Sites

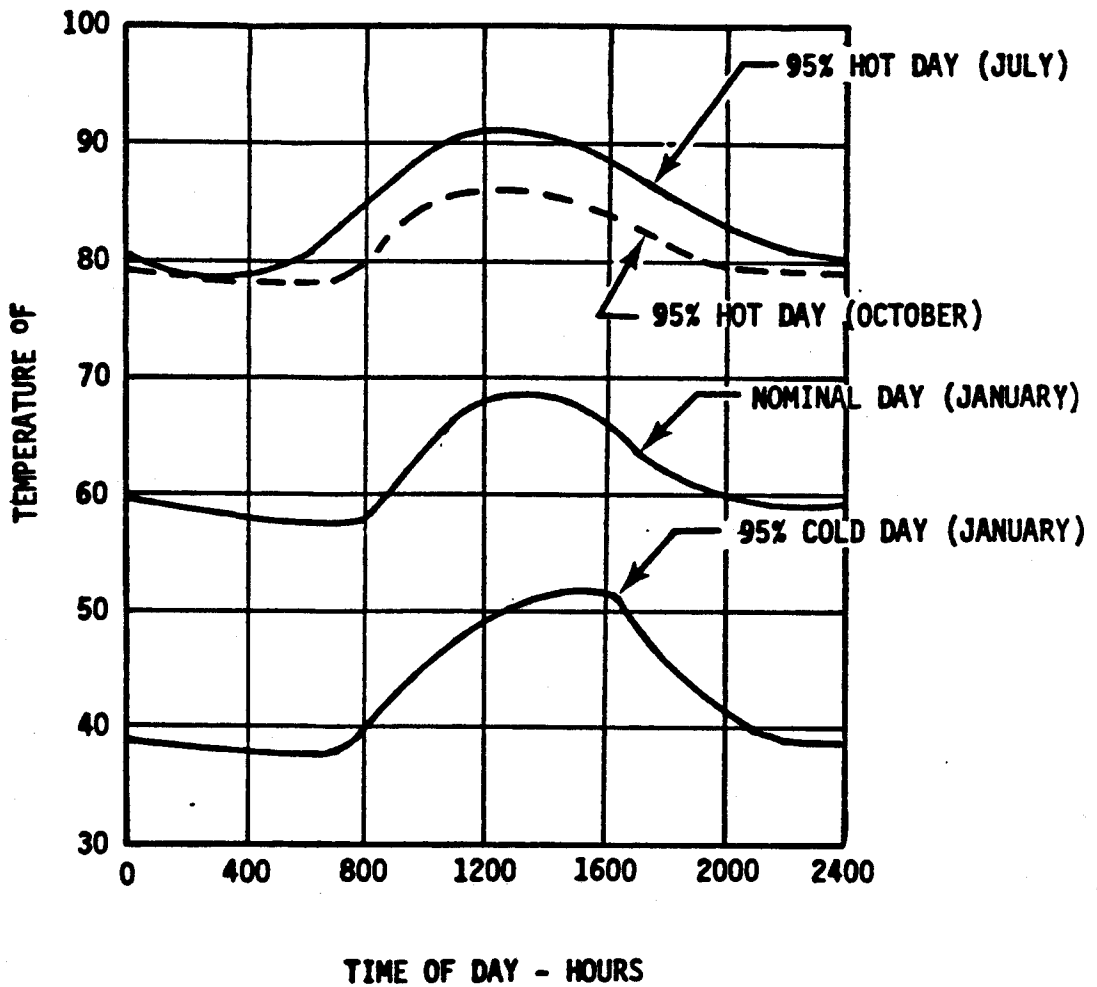


Figure 6.1.4.4.2-1 Eastern Test Range (ETR) Diurnal Air Temperature Experience

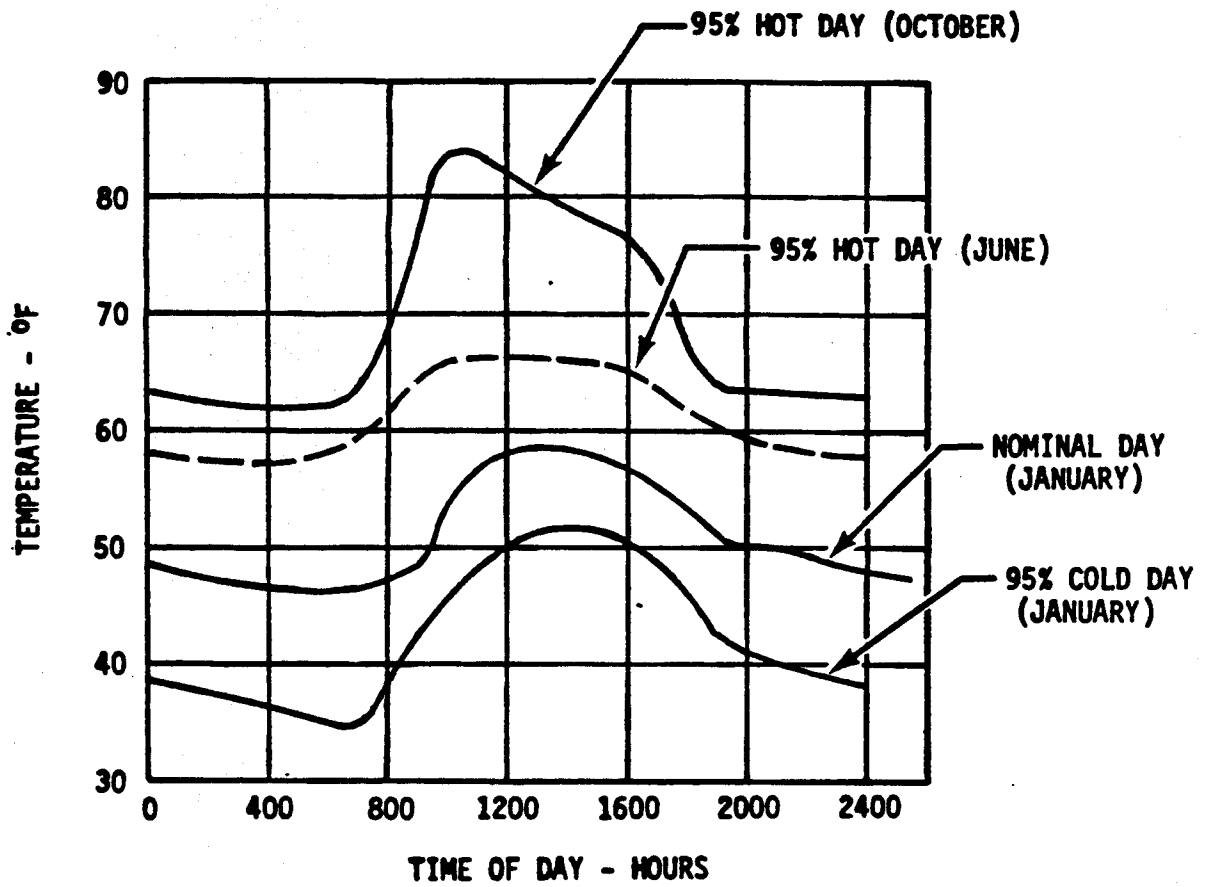


Figure 6.1.4.4.2-2 Western Test Range (WJR) Diurnal Air Temperature Experience

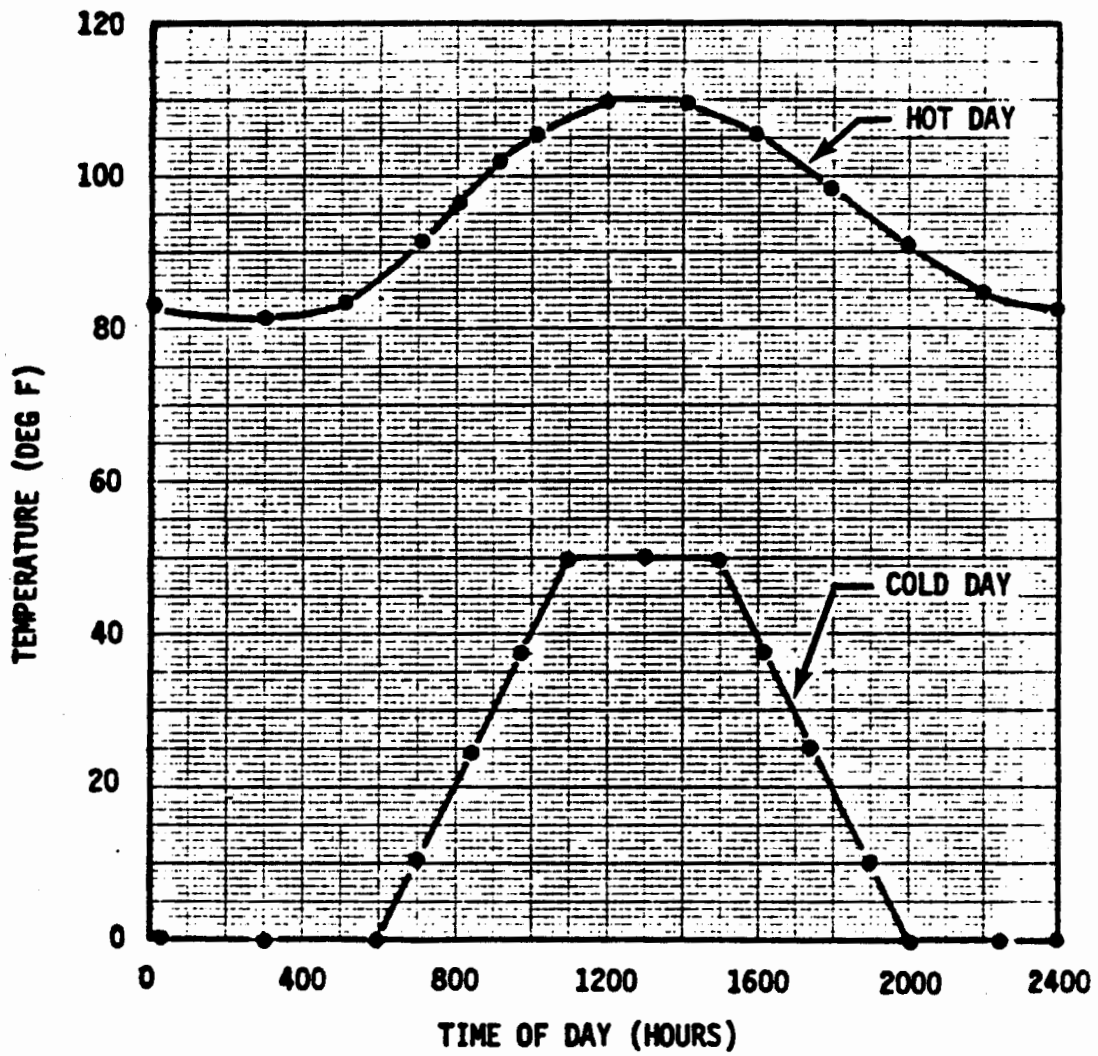


Figure 6.1.4.4.2-3 Worst Case Diurnal Air Temperature At Contingency Landing Sites

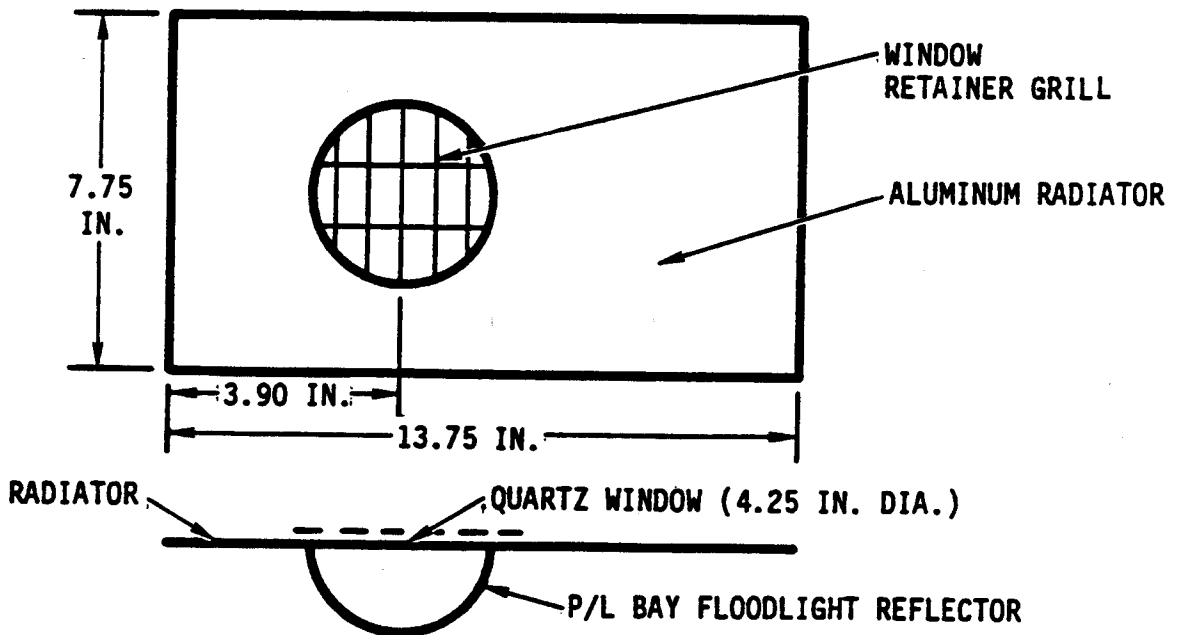
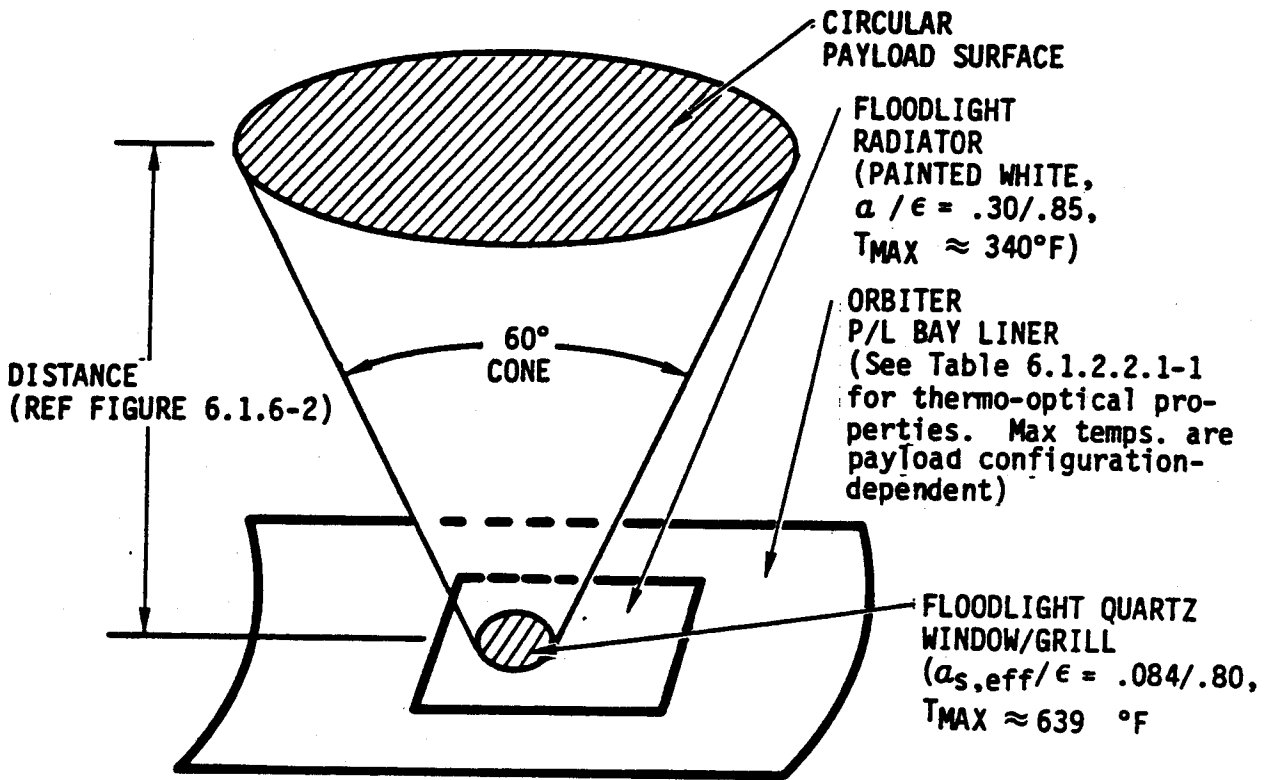


Figure 6.1.6-1 P/L Bay Floodlight Thermal Configuration/Characteristics

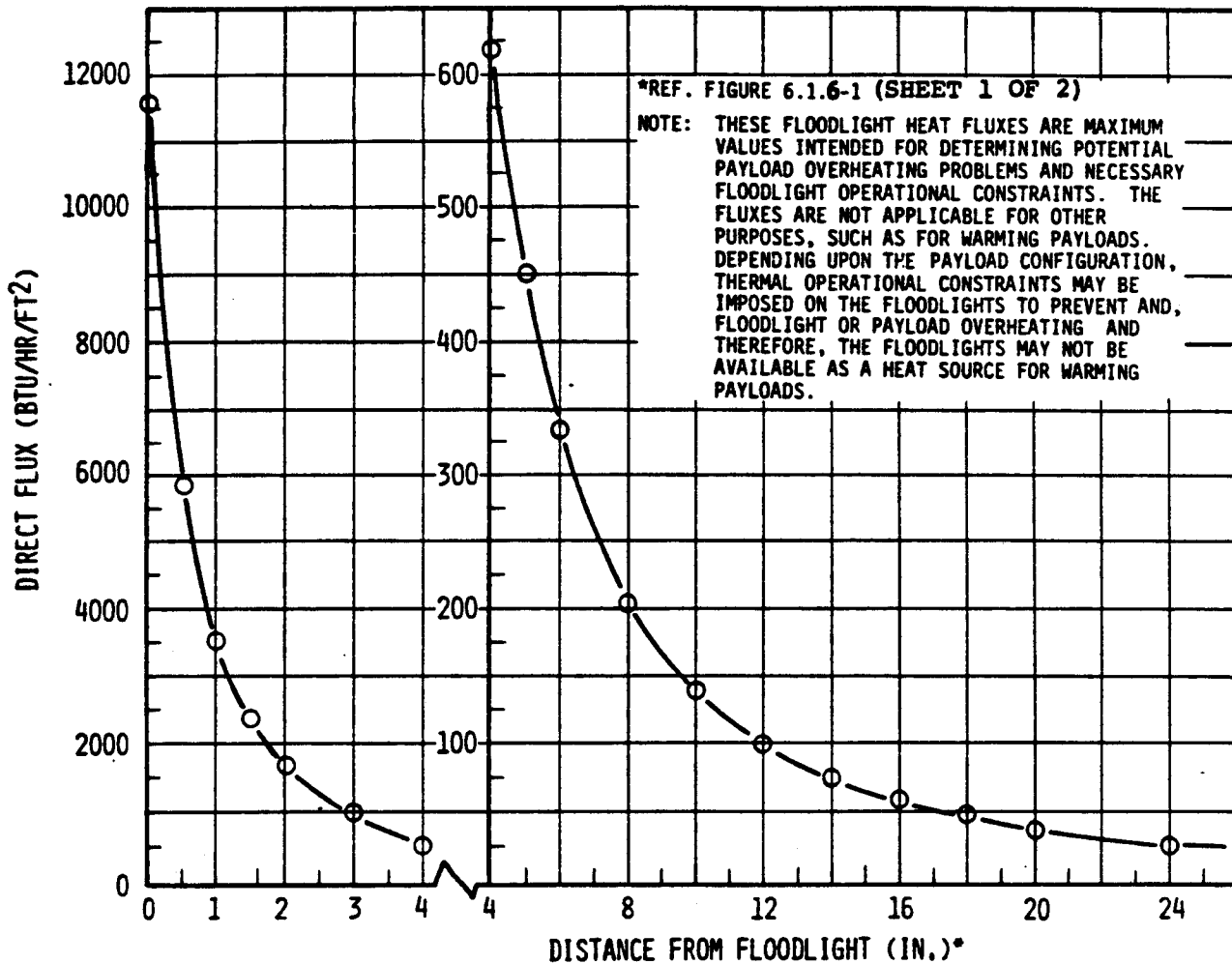


Figure 6.1.6-2 Direct Light Beam Short Wavelength Heat Flux (Excluding 9R) (Flux For 60° Cone)

## 6.2 ACTIVE THERMAL CONTROL

6.2.1 Purge and Vent of Cargo Bay. The Orbiter shall provide a ground purge system which is comprised of a ground-system supplied, on-board duct network which distributes Air/GN<sub>2</sub>. The purge gases supplied by the Orbiter to the payload and cargo bay shall be of the type consistent with the specific phase of prelaunch and post-landing operations as shown in *Tables 6.2.1-1 and 6.2.1-2*. A representative purge flow distribution in the cargo bay without spigot flow is shown in *Figure 6.2.1-1*. As noted, cargo bay purge flow is lost to the lower mid-fuselage at the vent filters due to the slight cargo bay purge positive pressure. The actual flow rate distribution is a function of the manifold and spigot flow rates.

### 6.2.2 Coolant Interfaces for Active Thermal Control.

6.2.2.1 Payload Heat Exchanger. A heat exchanger within the Orbiter is used for the transfer of heat from a payload coolant loop to the Orbiter Active Thermal Control Subsystem (ATCS).

The heat exchanger provides two coolant passages for total payload utilization. One passage is normally used for a payload in the cargo bay, the other passage is plumbed for payload use in the cabin. Although each passage shall be capable of handling the total coolant flow required for maximum allowable payload heat rejection by the Orbiter vehicle, the total payload heat rejection of both passages shall not exceed the maximum allowable heat rejection. Heat rejection capability is specified in *Table 6.2.2.1-1*. The duration for which the specified on-orbit heat rejection rate can be maintained is a function of vehicle constraints as defined in *Paragraph 6.1.1.2*. The cargo element shall control coolant loop flow rate and heat exchanger inlet temperature on the cargo element side of the heat exchanger.

Thermal performance of heat exchanger is defined in *Figure 6.2.2.1-1*. A payload coolant loop interfacing with the payload heat exchanger shall not operate at a pressure greater than 200 psia. In addition, the payload coolant loop shall be designed to be compatible with a maximum operating pressure of 200 psia.

6.2.2.2 Payload Active Cooling Kit (PACK). Cargo elements, located in the cargo bay and requiring active cooling, shall utilize the Payload Active Cooling Kit (PACK). This kit, provided as an optional service by SJS, is comprised of the plumbing required to connect to the Payload Heat Exchanger and provides a fluid interface to the payload on a port-side Standard Interface Panel (SIP) (Reference Sections 3.3.2 and 3.3.5.2). The PACK hardware elements are defined in *Section 3.3.5.2.1*. This interface utilizes quick-disconnects and is designed to be compatible with water, Freon-21, and Freon-114. Freon-114 is recommended. Coolant fluid specifications are defined in *SE-S-0073*.

Flow, pressure control, filtration, and instrumentation are responsibilities of the payload. If water is utilized as a coolant a minimum continuous flow rate of 200 lbs/hr shall be maintained for all on-orbit periods to prevent local freezing.

Pressure drop vs coolant flow rate is defined in *Figure 6.2.2.2-1*. These values reflect total SJS side pressure drop including the Payload Heat Exchanger. Predicted heat gain/loss for the PACK is defined in *Figure 6.2.2.2-2*.

**6.2.2.3 Active Cooling for Cabin Located Payloads. Cargo elements, located in the Orbiter cabin and requiring active cooling, are referred to 9SC-21000-9DD-MDK for interface definition.**



Table 6.2.1-1 Low Flow Rate Cargo Bay Purge Gas Characteristics  
 For Total Prelaunch Cargo Bay Flow Rates From  
 56.8 To 123 Kg/Min (125 To 270 Lb/Min)

Parameter	Pad Low Pressure	Runway To OP3/ OMC3, VAB VAB To Pad OMC3 To Pad	OP3/OMC3
Gas Type	Air/GN <sub>2</sub> (A)(C)	Air (B) (C)	Air (C)
Temperature: (G) deg. C (deg. F)	7-37.8(45-100)	7-37.8(45-100)	18-29 (65-85)
Selectable throughout range with accuracy of ± 1C(± 2F)			
Humidity:			
grams H <sub>2</sub> O/Kg (grains H <sub>2</sub> O/lb)			
Ground controlled Not selectable			
Air	≤ 4.14 (≤ 29)	≤ 4.86 (≤ 34)	≤ 4.86 (≤ 34)
GN <sub>2</sub>	≤ 0.14 (≤ 1)	-----	-----
Flow Rate: Spigots Closed: (D)			
Kg/min (lb/min)			
Manifold	56.8 (125) (minimum)	56.8 (125) (minimum)	56.8 (125) (minimum)
	109 (240) (maximum)	100 (220) (maximum)	100 (220) (maximum)
Flow Rate with Minimum Total Cargo Bay			
Flow/Spigots Open: (D)			
Kg/min (lb/min)			
Manifold	29.5 (65) (minimum)	29.5 (65) (minimum)	29.5 (65) (minimum)
Spigots (E) (F)	27.3 (60) (maximum)	27.3 (60) (maximum)	27.3 (60) (maximum)
Flow Rate with Maximum Total Cargo Bay			
Flow/Spigots Open: (D)			
Kg/min (lb/min)			
Manifold	54.5 (120) (minimum)	50 (110) (minimum)	50 (110) (minimum)
Spigots (E) (F)	68.2 (150) (maximum)	61.4 (135) (maximum)	61.4 (135) (maximum)

NOTES: (Notes 1, 2 and 3 general: Notes A through G apply to specific table locations)

Table 6.2.1-1 Low Flow Rate Cargo Bay Purge Gas Characteristics  
For Total Prelaunch Cargo Bay Flow Rates From  
56.8 to 123 Kg/Min (125 To 270 Lb/Min) (Continued)

Notes: (Continued)

1. Flow rates in the table are lower than Vehicle/GSE interface flow rates due to flow distributed to Lower Mid Fuselage. Total Vehicle/GSE Interface flow rates at the Pad, range from 140 (lb/min) to 300 (lb/min), and all other locations specified in the table, range from 140 (lb/min) to 275 (lb/min).
2. The cargo bay internal pressure shall not exceed .30 PSID above ambient.
3. The cargo bay depressurization rate (on the ground) shall not exceed 0.18 PSID/sec. This dp/dt is associated with the prelaunch vent opening sequence at T-38 sec.
- (A) Initiation of GN<sub>2</sub> purge prior to CRYO Janking for inerting Cargo Bay is defined in ICD-2-0A002 "Shuttle System Launch Pad and MLP".
- (B) Purge flow to be initiated within touchdown +45 minutes at primary landing site and touchdown +90 minutes at secondary landing site. No purge available at contingency landing site.
- (C) Continuous purging during closed Cargo Bay operations except during switch-over between mobile and facility GSE at OPF/OMCF, and Pad and during towing from OPF until mating operations are complete in VAB.
- (D) Measurement and accuracy of the flow rate is specified and controlled at the Orbiter/Facility interface within  $\pm 5$  percent.  
  
Starting no earlier than T-11 minutes, the cargo bay total flow rate (manifold plus spigot) is reduced to between 65.9-72.7 kg/min (145-160 lb/min) should the total flow rate be greater than this range. Spigot and manifold flow rates will decrease proportionally with the cargo bay total flow rate as a result of the flow reduction.
- (E) Maximum flow rate out all three (3) spigots shall not exceed 68.2 kg/min (150 lb/min) or exceed 45.5 kg/min (100 lb/min) out any single spigot. Nominal flow rate out each spigot is 22.7 kg/min (50 lb/min).
- (F) Maximum pressure downstream of purge spigots is 0.50 psig-measured above payload bay pressure.
- (G) Temperature controllable within specified range to  $\pm 2^{\circ}\text{F}$  at the Orbiter/ Facility interface with the following exceptions:
  - (i) Allowable temperature variations during air to GN<sub>2</sub> or GN<sub>2</sub> to air changeover are  $\pm 15^{\circ}\text{F}$  for the first 15 minutes after changeover followed by  $\pm 5^{\circ}\text{F}$  until one hour has elapsed.

**Table 6.2.1-1 Low Flow Rate Cargo Bay Purge Gas Characteristics  
For Total Prelaunch Cargo Bay Flow Rates From  
56.8 To 123 Kg/Min (125 To 270 Lb/Min) (Concluded)**

Notes: (Continued)

(ii) Allowable temperature variations during purge flow rate adjustments:

Set Point (°F)	Max Deviation (°F)	Time (min)	Cargo Bay Purge Flow Rate Decrease or Increase (lb/min)
45	± 2	JBD	270 to 125 or 125 to 270
55	± 4	JBD	270 to 125 125 to 270
75	± 10	JBD	270 to 125 125 to 270
100	± 16	JBD	270 to 125 125 to 270

Table 6.2.1-2 High Flow Rate Cargo Bay Purge Gas Characteristics For  
 Total Prelaunch Cargo Bay Flow Rates From 56.8 To 120.5 Kg/Min  
 (125 To 265 Lb/Min) Air, And From 109 To 185 Kg/Min  
 (240 To 408 Lb/Min) GN<sub>2</sub>

Parameter	Pad Low Pressure	Pad High Pressure	Runway To OP3/ OMC3, VAB, VAB To Pad OMC3 To Pad	OP3/OMC3
Gas Type	Air (C)	GN <sub>2</sub> (A) (C)	Air (B) (C)	Air (C)
Temperature: (G) deg. C ((deg. F))	7-37.8(45-100)	7-37.8(45-100)	7-37.8(45-100)	18-29 (65-85)
Selectable throughout range with accuracy of ± 1C(± 2F)				
Humidity: grams H <sub>2</sub> O/Kg (grains H <sub>2</sub> O/lb)				
Ground controlled Not selectable	≤ 4.14 (≤ 29)	≤ 0.14 (≤ 1)	≤ 4.86 (≤ 34)	≤ 4.86 (≤ 34)
Flow Rate: Spigots Closed: (D) Kg/min (lb/min)				
Manifold	56.8 (125) (minimum) 109 (240) (maximum)	109 (240) (minimum) 167 (365) (maximum)	56.8 (125) (minimum) 100 (220) (maximum)	56.8 (125) (minimum) 100 (220) (maximum)
Flow Rates with Minimum Total Cargo Bay Flow/Spigots Open: (D) Kg/min (lb/min)				
Manifold	31.8 (70) (minimum)	55.9 (123) (minimum)	31.8 (70) (minimum)	31.8 (70) (minimum)
Spigots (E) (F)	25 (55) (maximum)	53.2 (117) (maximum)	25 (55) (maximum)	25 (55) (maximum)
Flow Rates with Maximum Total Cargo Bay Flow/Spigots Open: (D) Kg/min (lb/min)				
Manifold	61.4 (135) (minimum)	94.5 (208) (minimum)	56.8 (125) (minimum)	56.8 (125) (minimum)
Spigots (E) (F)	59.1 (130) (maximum)	90.0 (200) (maximum)	54.4 (120) (maximum)	54.4 (120) (maximum)

Notes: (Notes 1, 2 and 3 general; Notes A through G apply to specific table locations)

*Table 6.2.1-2 High Flow Rate Cargo Bay Purge Gas Characteristics For  
Total Prelaunch Cargo Bay Flow Rates From 56.8 To 120.5 Kg/Min  
(125 To 265 Lb/Min) Air, And From 109 To 185 Kg/Min  
(240 To 408 Lb/Min) GN<sub>2</sub> (Continued)*

Notes: (Continued)

1. Flow rates in the table are lower than Vehicle/GSE interface flow rates due to flow distributed to Lower Mid Fuselage. Total Vehicle/GSE interface flow rates at the Pad, range from 140 (lb/min) A9R to 460 (lb/min) GN<sub>2</sub>, and all other locations specified in the table, range from 140 (lb/min) to 300 (lb/min).
  2. The cargo bay internal pressure shall not exceed .64 PSID above ambient.
  3. The cargo bay depressurization rate (on the ground) shall not exceed .35 PSID/sec. This dp/dt associated with the prelaunch vent opening sequence at T-38 sec.
- (A) Initiation of GN<sub>2</sub> purge prior to CRYO Janking for inerting Cargo Bay is defined in 9CD-2-0A002 "Shuttle System Launch Pad and MLP".
- (B) Purge flow to be initiated within touchdown +45 minutes at primary landing site and touchdown +90 minutes at secondary landing site. No purge available at contingency landing site.
- (C) Continuous purging during closed Cargo Bay operations except during switch-over between mobile and facility GSE at OPF/OMCF, and Pad and during towing from OPF until mating operations are complete in UAB.
- (D) Measurement and accuracy of the flow rate is specified and controlled at the Orbiter/Facility interface within  $\pm 5$  percent.
- Starting no earlier than T-11 minutes, the cargo bay total flow rate (manifold plus spigot) is reduced to between 65.9-72.7 kg/min (145-160 lb/min) should the total flow rate be greater than this range. Spigot and manifold flow rates will decrease proportionally with the cargo bay total flow rate as a result of the flow reduction.
- (E) Maximum flow rate out all three (3) spigots shall not exceed 90.9 kg/min (200 lb/min) or exceed 63.6 kg/min (140 lb/min) out any single spigot.
  - (F) Maximum pressure downstream of purge spigots is 0.50 psig-measured above payload bay pressure.
  - (G) Temperature controllable within specified range to  $\pm 2^{\circ}\text{F}$  at the Orbiter/ Facility interface with the following exceptions:
    - (i) Allowable temperature variations during air to GN<sub>2</sub> or GN<sub>2</sub> to air changeover are  $\pm 15^{\circ}\text{F}$  for the first 15 minutes after changeover followed by  $\pm 5^{\circ}\text{F}$  until one hour has elapsed.

Table 6.2.1-2 High Flow Rate Cargo Bay Purge Gas Characteristics For Total Prelaunch Cargo Bay Flow Rates From 56.8 To 120.5 Kg/Min (125 To 265 Lb/Min) Air, And From 109 To 185 Kg/Min (240 To 408 Lb/Min) GN<sub>2</sub> (Concluded)

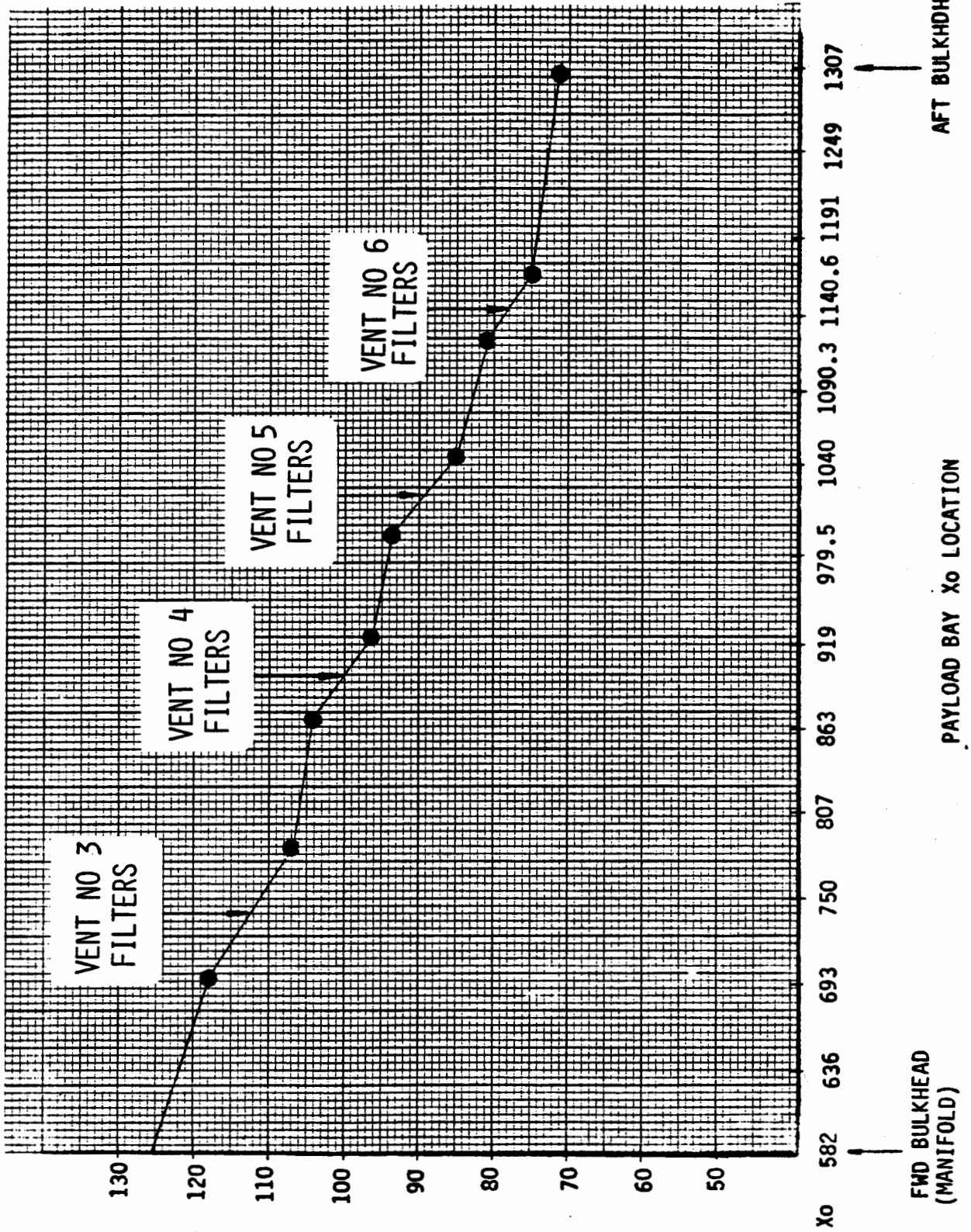
Notes: (Continued)

(ii) Allowable temperature variations during purge flow rate adjustments:

Set Point (°F)	Max Deviation (°F)	Time (min)	Cargo Bay Purge Flow Rate Decrease or Increase (lb/min)
45	± 2	JBD	270 to 125 or 125 to 270
55	± 4	JBD	270 to 125 125 to 270
75	± 10	JBD	270 to 125 125 to 270
100	± 16	JBD	270 to 125 125 to 270
45	± 3	JBD	408 to 125 or 125 to 408
55	± 6	JBD	408 to 125 125 to 408
75	± 20	JBD	408 to 125 125 to 408
100	± 34	JBD	408 to 125 125 to 408

Table 6.2.2.1-1 Payload Heat Rejection Capabilities Provided By Orbiter

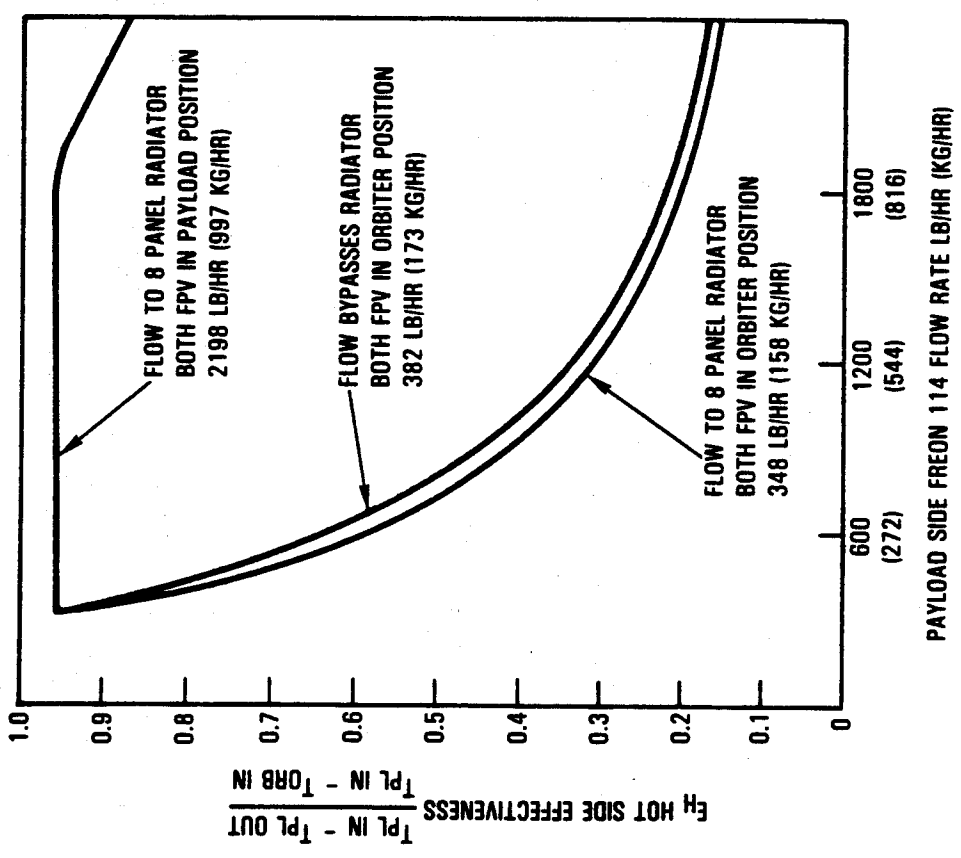
<u>Mission Phase</u>	<u>Design Heat Rejection BTU/HR</u>	<u>Max Hz Out Temp At Design Heat Rejection °F/°C</u>	<u>Notes</u>
<i>Prelaunch</i>			
<i>P/L Max Cooling</i>	29,000	45/7	<i>Requires preschedule and coordination with Orbiter operations.</i>
<i>P/L Normal Cooling</i>	5,200	45/7	
<hr/>			
<i>Ascent</i>	5,200	45/7	<i>Hx outlet temp will rise up to 90°F/32°C from T-15 sec to T+135 sec.</i>
<hr/>			
<i>On-Orbit</i>	5,200	45/7	<i>Cooling limited with cargo bay doors closed see specific P9P for door operation time.</i>
	29,000	45/7	<i>Available with cargo bay doors open.</i>
<hr/>			
<i>Deorbit/Entry</i>	5,200	45/7	
<hr/>			
<i>Postlanding</i>	5,200	45/7	<i>Available at primary landing site.</i>
<hr/>			



PURGE GAS FLOW RATE  
GN2 - lb/min

*Figure 6.2.1-1 Cargo Bay Purge Gas Flow Distribution (Typical Low Flow Rate Purge, No Spigot Flow)*





**NOTES:**

1.  $Q = \epsilon_H C_H (T_{PL IN} - T_{ORB IN})$  BTU/HR  
WHERE  $C_H$  - HOT SIDE FLOW RATE-FLUID HEAT CAPACITANCE. BTU/HR $^{\circ}$ F
2. PREDICTED PERFORMANCE BASED ON VENDOR ANALYTICAL DATA, DATED NOV. 16, 1982.
3. TOTAL ORBITER FREON-21 FLOW TO PAYLOAD HX BASED ON NOMINAL PUMPS, IS SHOWN FOR EACH CONFIGURATION.
4. ONE PAYLOAD LOOP IS FLOWING.
5. COUNTERFLOW HEAT EXCHANGER.  
 $UA = 42.79 \cdot W_2 \cdot 0.2922 \cdot W_1$  BTU/HR $^{\circ}$ F
- WHERE:  $W_1$  - TOTAL ORBITER FLOW ENTERING HEAT EXCHANGER, LB/HR  
 $W_2$  - TOTAL PAYLOAD FLOW ENTERING HEAT EXCHANGER, LB/HR
6. NOMINAL ORBITER SUPPLY TEMPERATURE,  $T_{ORB IN}$   
RADIATOR CONTROLLING  $38 \pm 2^{\circ}$ F( $3.3 \pm 1.1^{\circ}$ C)  
FLASH EVAPORATOR CONTROLLER  $39 \pm 1^{\circ}$ F( $3.8 \pm 0.5^{\circ}$ C)  
AMMONIA BOILER CONTROLLING  $35 \pm 2^{\circ}$ F( $1.6 \pm 1.1^{\circ}$ C)
7. FPV - FLOW PROPORTIONING VALVES IN ORBITER FREON LOOP.

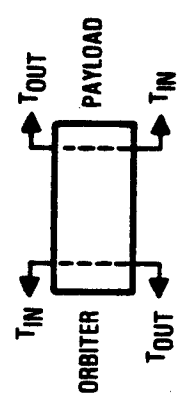
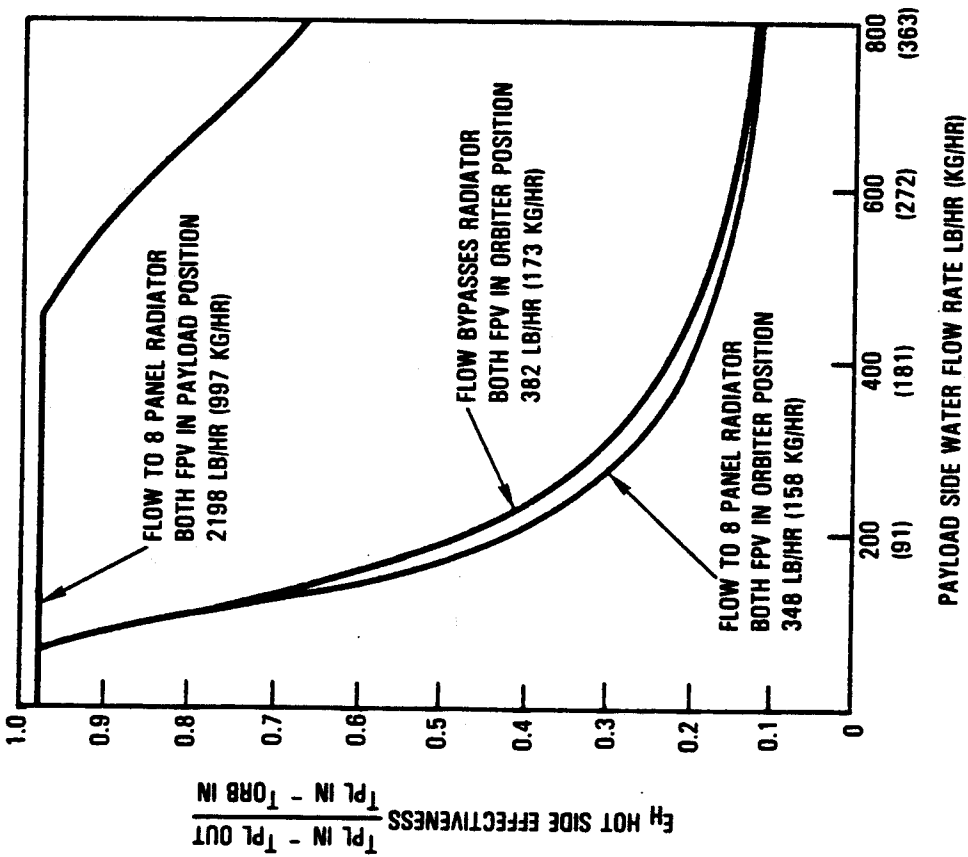


Figure 6.2.2.1-1 Payload Heat Exchanger Performance - Freon 114 (Sheet 1 Of 3)



**NOTES:**

1.  $Q = E_H C_H (T_{PL IN} - T_{ORB IN})$  BTU/HR  
 WHERE  $C_H$  - HOT SIDE FLOW RATE-FLUID HEAT CAPACITANCE.  
 BTU/HR $^{\circ}$ F
2. PREDICTED PERFORMANCE BASED ON VENDOR OV103 PAYLOAD HX TEST DATA, DATED MAY 1976.
3. TOTAL ORBITER FREON-21 FLOW TO PAYLOAD HX BASED ON NOMINAL PUMPS, IS SHOWN FOR EACH CONFIGURATION.
4. ONE PAYLOAD LOOP IS FLOWING.
5. COUNTERFLOW HEAT EXCHANGER.  
 $UA = 0.234 \cdot W_1 \cdot 1.317$  BTU/HR $^{\circ}$ F  
 WHERE:  $W_1$  - TOTAL ORBITER FLOW ENTERING HEAT EXCHANGER, LB/HR
6. NOMINAL ORBITER SUPPLY TEMPERATURE,  $T_{ORB IN}$   
 RADIATOR CONTROLLING  $38 \pm 2^{\circ}$ F( $3.3 \pm 1.1^{\circ}$ C)  
 FLASH EVAPORATOR CONTROLLER  $39 \pm 1^{\circ}$ F( $3.8 \pm 0.5^{\circ}$ C)  
 AMMONIA BOILER CONTROLLING  $35 \pm 2^{\circ}$ F( $1.6 \pm 1.1^{\circ}$ C)
7. FPV - FLOW PROPORTIONING VALVES IN ORBITER FREON LOOP.

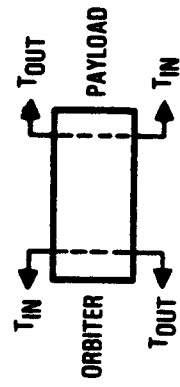


Figure 6.2.2.1-1 Payload Heat Exchanger Performance - Water  
 (Sheet 2 Of 3)

**NOTES:**

1.  $Q = E_H C_H (T_{PL IN} - T_{ORB IN})$  BTU/HR  
WHERE  $C_H$  - HOT SIDE FLOW RATE-FLUID HEAT CAPACITANCE.  
BTU/HR $^{\circ}$ F
2. PREDICTED PERFORMANCE BASED ON VENDOR OV103 PAYLOAD HX TEST DATA, DATED MAY 1974.
3. TOTAL ORBITER FREON-21 FLOW TO PAYLOAD HX BASED ON NOMINAL PUMPS, IS SHOWN FOR EACH CONFIGURATION.
4. ONE PAYLOAD LOOP IS FLOWING.
5. COUNTERFLOW HEAT EXCHANGER.  
 $UA = 29.23 \cdot W_1 \cdot 0.459 \cdot W_2 \cdot 0.2384$   
BTU/HR $^{\circ}$ F
- WHERE:  $W_1$  - TOTAL ORBITER FLOW ENTERING HEAT EXCHANGER, LB/HR  
 $W_2$  - TOTAL PAYLOAD FLOW ENTERING HEAT EXCHANGER, LB/HR
6. NOMINAL ORBITER SUPPLY TEMPERATURE,  $T_{ORB IN}$   
RADIATOR CONTROLLING  $38 \pm 2^{\circ}$ F( $3.3 \pm 1.1^{\circ}$ C)  
FLASH EVAPORATOR CONTROLLER  $39 \pm 1^{\circ}$ F( $3.8 \pm 0.5^{\circ}$ C)  
AMMONIA BOILER CONTROLLING  $35 \pm 2^{\circ}$ F( $1.6 \pm 1.1^{\circ}$ C)
7. FPV - FLOW PROPORTIONING VALVES IN ORBITER FREON LOOP.

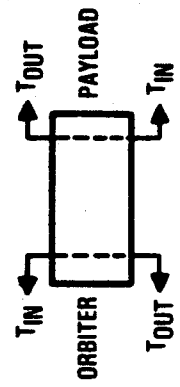
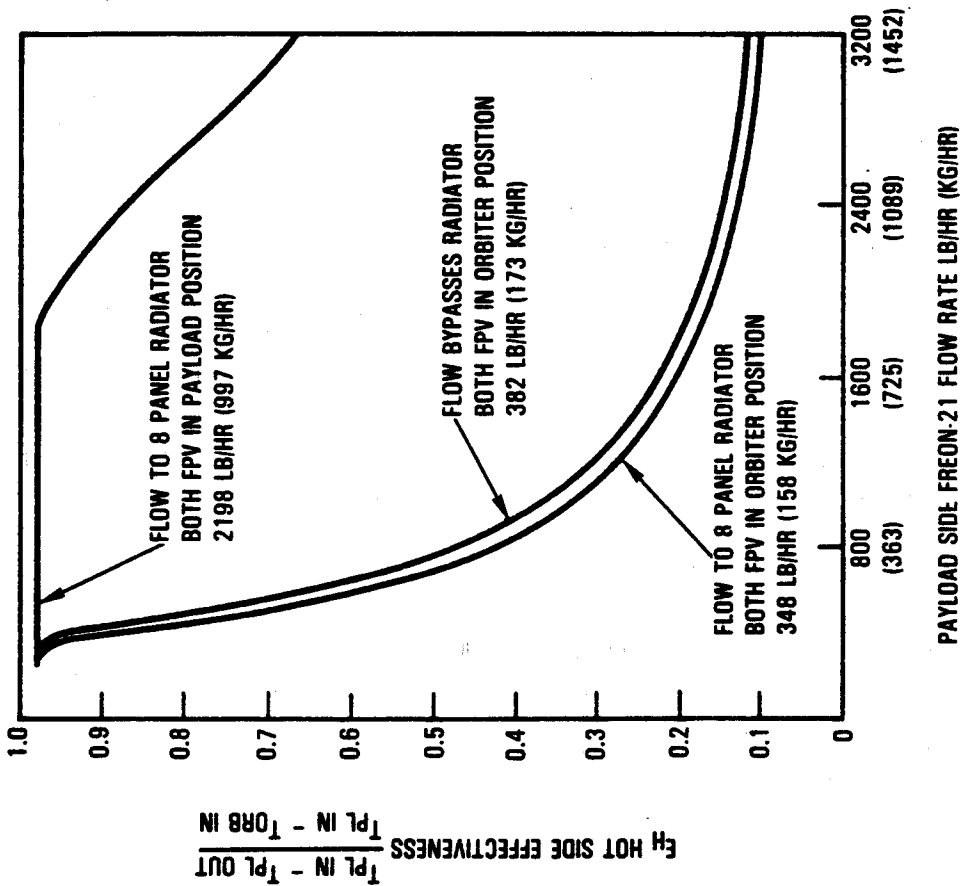


Figure 6.2.2.1-1 Payload Heat Exchanger Performance - Freon 21  
(Sheet 3 Of 3)

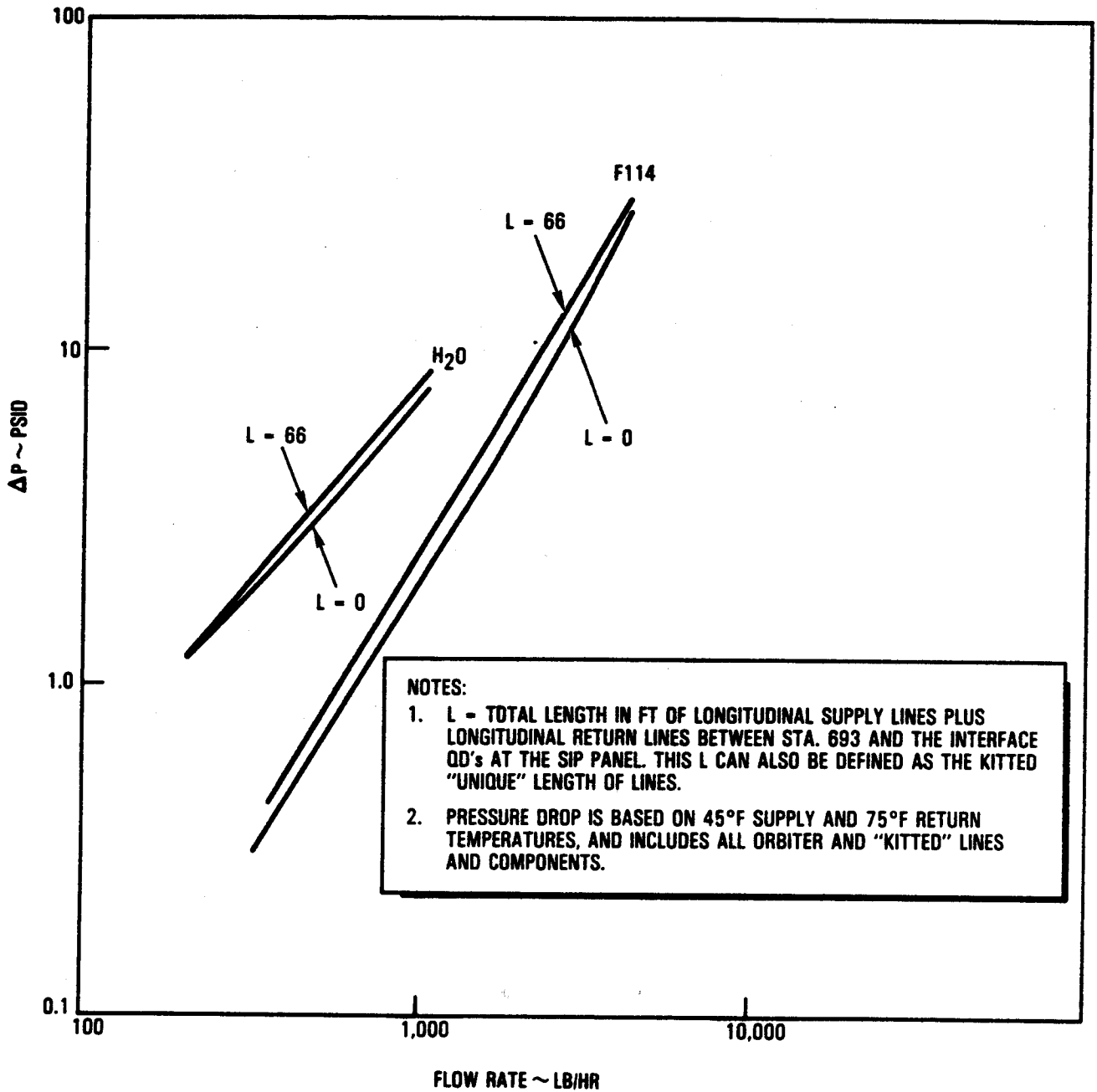


Figure 6.2.2.2-1 Total PACK Pressure Drop

P/L HX TO X693 & CROSS SHIP & SIP

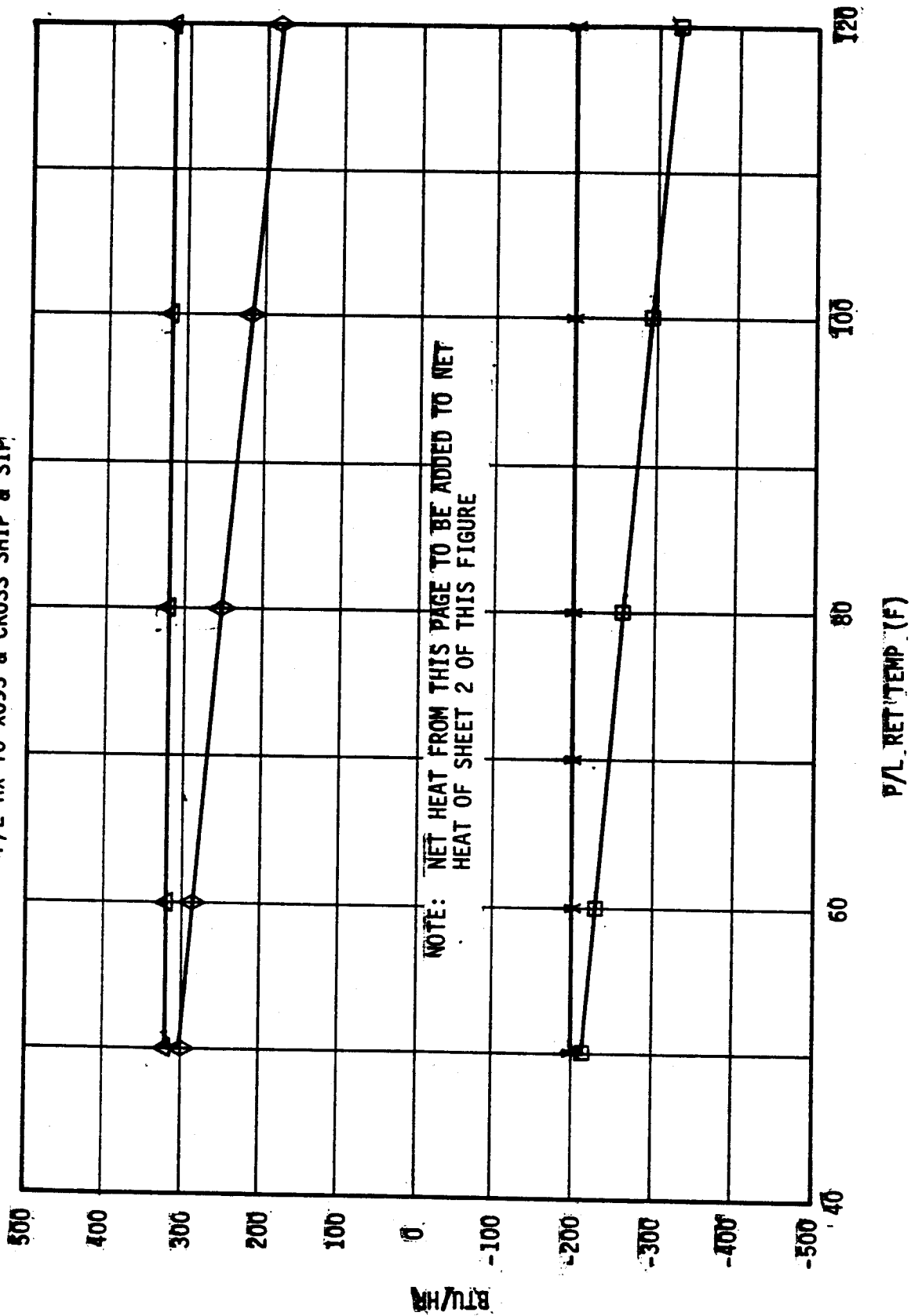
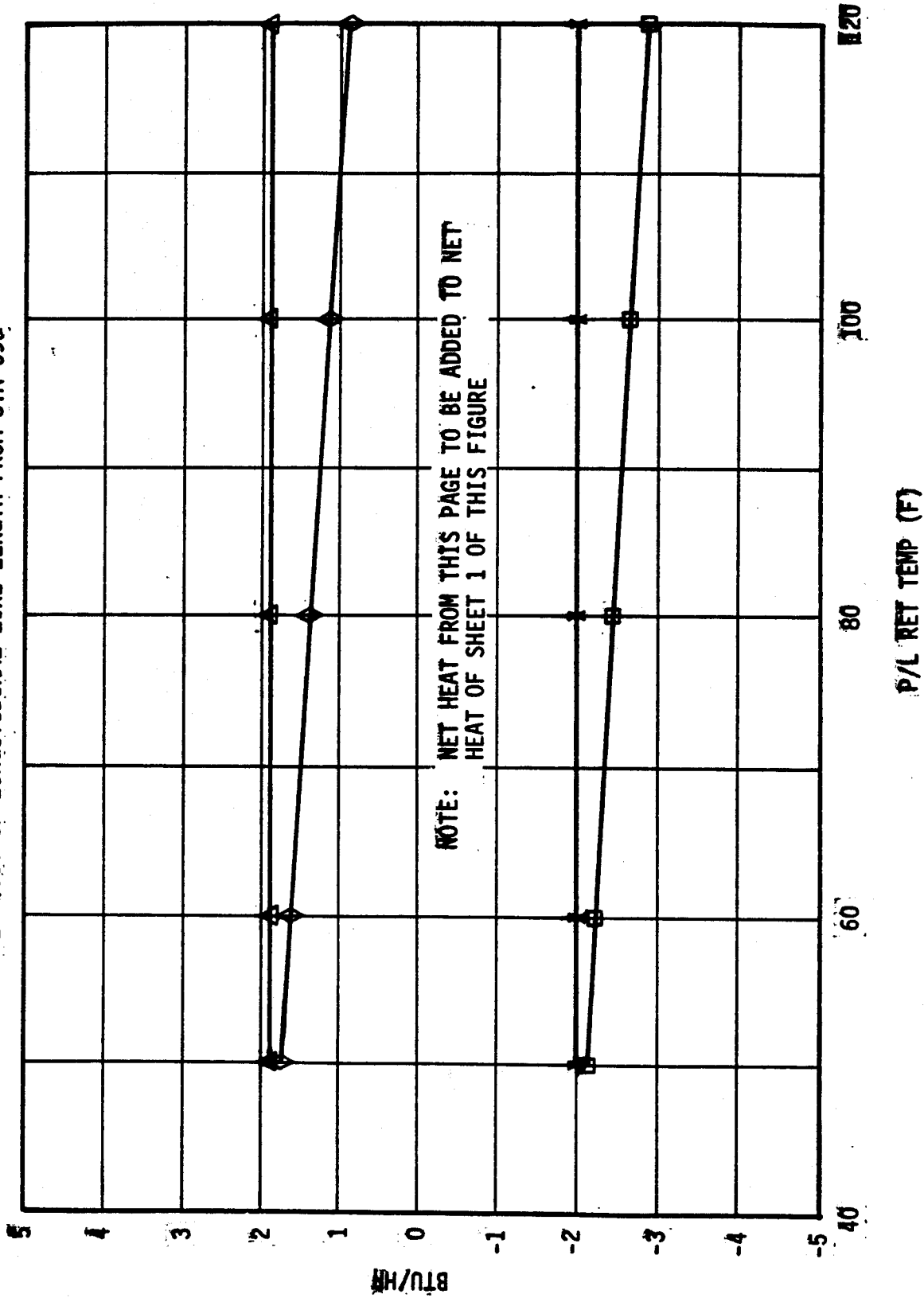


Figure 6.2.2.2-2 Predicted PACK Heat Gain And Loss (Sheet 1 Of 2)

PER FOOT OF LONGITUDINAL LINE LENGTH FROM STA 693



□ RET LOSS/FT  
 X RET SUP LOSS/FT  
 ◇ RET GAIN/FT  
 △ RET SUP GAIN/FT

Figure 6.2.2.2-2 Predicted PACK Heat Gain And Loss (Sheet 2 Of 2)

### 6.3 ATMOSPHERIC REVITALIZATION SYSTEM (ARS)

6.3.1 Oxygen Supply to Station X<sub>0</sub> 636. The Orbiter shall supply low-pressure oxygen to the interface at the payload heat-exchanger panel per Figure 3.3.4-1. The characteristics of the oxygen supply at the payload heat-exchanger panel interface shall be as follows:

- a. Pressure: Minimum pressure is a function of the flow demand since a restrictor limits the flow to a maximum of 7 lb/hr per loop. Nominal 114.7+10/-15 psia (5934+517/-776 mm Hg). "No Flow" Max 139.7 psia (7227 mm Hg)
- Maximum: (failed regulator) 259.7 psia (13,434 mm Hg)
- b. Temperature: +35 to +120°F (1.6 to 48.9°C)
- c. Flow: Nominal: 0.46 lb/hr (0.209 kg/hr) (Except during Orbiter airlock operations, EVA suit purges, or 8 psia (414 mm Hg) pressure maintenance.)
- Maximum: One regulator operating 7 lb/hr (3.18 kg/hr). Two regulators operating 14 lb/hr (6.35 kg/hr). (Oxygen is flow-limited by a restrictor. Its flow rate shall be limited to 6 to 7 lb/hr with an inlet pressure of 115 psia and 70±10°F).
- d. Mass: 56 lbs (25.43 kg) available from each EPS cryo kit added for payload power.

6.3.2 Payload Station and Mission Station Support (14.7 psia Cabin Pressure). The cooling at these locations shall be provided by drawing air from the cabin through *the air cooled payload and* into the Orbiter ducting system. The Orbiter shall provide cooling for the removal of a combined maximum of 2475 Btu/hr average, and 3413 Btu/hr peak (15 minutes once every 3 hours), from both stations during on-orbit operations. For prelaunch, ascent, descent and post-landing a combined maximum of 1193 Btu/hr *cooling capability shall be provided*. The above values shall include up to 341 Btu/hr (100 watts) cooling for Aft Flight Deck (AFD) payload equipment consuming small quantities of power (*maximum* 10 watts each) by direct radiation or convection to the cabin; specific forced-air cooling shall not be provided. Cabin air temperature is allowed to exceed specification limits by 1°F when the 100 watt load is cooled by convection or radiation to the cabin.

*Total cooling air flow available to the AFD stations is dependent on the heat load and air flow distribution between the payload and mission stations as defined in Figure 6.3.2-1. Air-cooled-avionics air flow will be provided at a rate of 0.406 lbs/hr per watt of connected heat load, and therefore cooling design shall be based on an air temperature increase of 35°F (19.5°C) across each equipment item with a cabin pressure of 14.7 psia.*

*Air cooling kits are provided by SJS and are payload unique. The kits provide the necessary ducting between the orbiter manifold shown in Figures 3.4.1.2.4-1, 3.4.1.2.3-1, and 3.4.1.4.4-1 and the payload. The interface definition, at the payload, shall be negotiated between SJS and the payload. The pressure drop allocation for the payload is dependent on the payload interface location, the flow requirement, and the ducting size selection. Although interface ducting is normally 1.5 inches, ducting as large as 2.5 inches is compatible with the 2.5 inch ports shown in the figures. Since 1 inch of water is the total pressure drop available for the ducting to the manifold plus the payload, the pressure drop available to the payload will be less than 1 inch of water. The maximum available to the payload will be determined by SJS and defined in the unique ICD.*

6.3.2.1 (Deleted)

6.3.2.2 (Deleted)

6.3.3 Cabin Environment.

- Dew Point, max. +61°F (+16°C)
- Surface temperature of equipment accessible to crewman, max 113°F (45°C)
- Cooling air inlet temperature range: (except ascent and Entry) 65 to 80°F (18 to 27.0°C)
- Air inlet temperature, max (ascent and descent phase) 95°F (35°C)
- Atmosphere pressure (normal operation) 14.7 ± 0.2 psia (1.013 ± 0.014 bar)
- Orbiter ground pressurization tests 18.1 psia max (1.24 bar) at ±2.0 psi/min (.14 bar/min) max rate of pressure change
- Cabin rate of pressure 2.0 psi/min (0.14 bar/min) (on-orbit airlock operation) 9.0 psi/min (0.61 bar min) emergency on-orbit re-entry conditions
- Particulate level Cabin Air
- Cabin O<sub>2</sub> concentration
  - Normal operation and EVA insuit prebreathe procedure* 25.9 percent at 14.7 psia
  - EVA reduced cabin pressure procedure* 30.0 percent at 10.2 psia



*Contingency hole in cabin  
(payload required to be  
powered off)*

*32.0 percent at  
8 psia*

*All payload hardware located in the Orbiter crew cabin shall be certified safe for the above environments.*

*For design or analysis purposes, the mounting structure to which the payload attaches and the average radiant environment within the consoles shall be considered 90°F maximum during on-orbit operations, and 120°F during ascent and descent phases. The radiation environment should be considered to be a heat sink at constant temperature, whereas, the mounting structure may be driven above 90°F when power is applied.*

6.4 (Deleted)

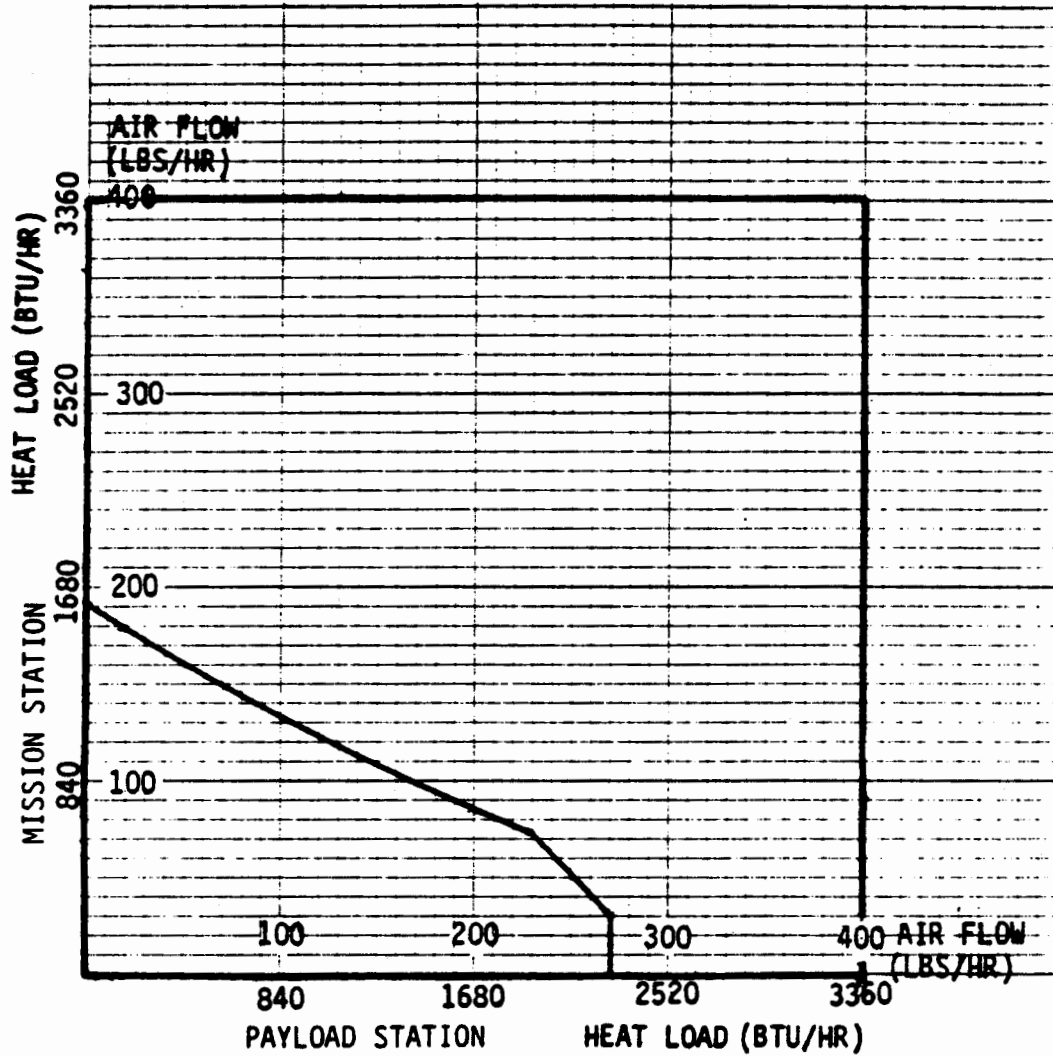


Figure 6.3.2-1 Air Flow And Heat Load Distribution In Payload And Mission Stations

## 7.0 ELECTRICAL POWER INTERFACES

### 7.1 (RESERVED)

## 7.2 ELECTRICAL ENERGY

7.2.1 Baseline Energy Allocation. Energy allocation to the individual Cargo Elements shall be defined in the Payload Integration Plan (PIP) for each Cargo Element.

## 7.3 DC POWER

7.3.1 DC Electrical Power Accommodations. Accommodations for the Cargo bay primary PL bus and *cabin payload bus* are divided into four sections, with each section *allocated* one-fourth of the total power available. *Additionally, as a non-standard service, accommodations are available from Auxiliary Bus A, Auxiliary Bus B, Aft Payload Bus B and Aft Payload Bus C. The total power available from all accommodations, per section, shall not exceed the allocations noted in Table 7.3.2.1-1. The accommodations as stated below are the total available to the cargo elements.* PL GSE power accommodations via Orbiter port T-0 umbilical are divided into four sections. Accommodations via Orbiter Starboard T-0 umbilical are the total available to payloads.

7.3.1.1 DC Electrical Power System. The Orbiter DC electrical power system switches, fuses, and *routing are shown* for information purposes in *Figures 7.3.1.1-1, 7.3.1.1-2, and 7.3.1.1-3.*

7.3.1.2 Fusing Criteria The cargo element is required to provide circuit protection in the form of fuses, resistors, or other current limiting devices on its side of the interface in order to protect *Cargo Element and Orbiter wiring.*

*When three or four main DC feeders are bussed together on the payload side of the interface, then each feeder shall be fused on the payload side of the interface with a fuse rated at 200 amperes or less.*

*Orbiter wiring is either Kapton or teflon insulated and rated for 200°C. Wiring that is rated for temperatures less than 200°C is current limited and results in larger wiring sizes to remain compatible with the circuit protection devices. The selection of wiring types rated for less than 200°C which are used in conjunction with circuit protection devices shall not result in wire size incompatibilities at the Cargo Element/Orbiter interface, nor shall the selection of circuit protection devices result in inadequate protection of Orbiter wiring.*

*Table 7.3.1.2-1 lists the circuit protection devices and maximum wire current recommended for payload wiring between No. 0 gauge and No. 26 gauge with an insulation rating of 200°C. Additional NASA design criteria will be found in JSC 18798.*

7.3.1.3 SSP Current Protection. *When the power for the circuit to be switched or displayed by the SSP is not provided by the SSP, that circuit shall be current limited on the cargo element side of the interface to the equivalent of a 7.5 amps fuse or smaller.*

### 7.3.2 Cargo Bay Primary PL BUS.

7.3.2.1 SMCH-SIP Interface. Main DC electrical power provided by the Orbiter to the Primary PL BUS for each mission phase, shall be as specified in Table 7.3.2.1-1. The *payload electrical* power interfaces are located at the termination of SMCH-cables at the Standard Interface Panel (SIP). On-Orbit voltage level *at the SIP* is as shown in Figure 7.3.2.1-1.

Table 7.3.1.2-1 Circuit Protection And Characteristics

Specification, Circuit Breaker, Thermal (MC454-0026)

!Dash ! No.	! Ampere ! Rating	! Maximum ! Load	! Ultimate Trip			! * ! Volt	! Min. ! Wire	! Drop ! Size
			! %	! Amps	! Amps			
!2010	! 1.0	! 95	! 0.95	! 1.10	! 1.45	!1.100	! 26	!
!2020	! 2.0	! 95	! 1.90	! 2.20	! 2.90	!0.750	! 26	!
!2030	! 3.0	! 95	! 2.85	! 3.30	! 4.35	!0.550	! 26	!
!2050	! 5.0	! 95	! 4.75	! 5.50	! 7.25	!0.265	! 24	!
!2075	! 7.5	! 95	! 7.125	! 8.25	! 10.875	!0.250	! 22	!
!2100	! 10.0	! 95	! 9.50	! 11.00	! 14.50	!0.280	! 20	!
!2150	! 15.0	! 95	! 14.25	! 16.50	! 21.75	!0.200	! 14	!
!2200	! 20.0	! 95	! 19.00	! 22.00	! 29.00	!0.180	! 12	!

Circuit Breaker, Thermal Three Phase (MC454-0032)

!Dash ! No.	! Ampere ! Rating	! Maximum ! Load	! Ultimate Trip			! * ! Volt	! Min. ! Wire	! Drop ! Size
			! %	! Amps	! Amps			
!3030	! 3.0	! 95	! 2.85	! 3.30	! 4.35	!0.550	! 26	!

Remote Power Controller (MC450-0017)

!Dash ! No.	! Ampere ! Rating	! Maximum ! Load	! Ultimate Trip			! * ! Volt	! Min. ! Wire	! Drop ! Size
			! %	! Amps	! Amps			
!1030	! 3.0	!100	! 3.0	! 3.750	! 4.50	! 0.50	! 26	!
!1050	! 5.0	!100	! 5.0	! 6.250	! 7.50	! 0.50	! 24	!
!1075	! 7.5	!100	! 7.5	! 9.375	! 11.25	! 0.50	! 22	!
!1100	! 10.0	!100	! 10.0	! 12.500	! 15.00	! 0.50	! 20	!
!1150	! 15.0	!100	! 15.0	! 18.750	! 22.50	! 0.50	! 14	!
!1200	! 20.0	!100	! 20.0	! 25.000	! 30.00	! 0.50	! 12	!

Table 7.3.1.2-1 Circuit Protection And Characteristics (Continued)

Fuse - D. C. Limiter Type, High Current (ME451-0016) (Large Size)

Dash No.	Ampere Rating	Maximum Load	Ultimate Trip			* Volt Drop	Min. Wire Size
			%	Amps	Amps		
!2035	!35.0	!100	!35.0	!38.5	!59.5	!0.222	!8
!2050	!50.0	!100	!50.0	!55.0	!85.0	!0.227	!8
!2080	!80.0	!100	!80.0	!88.0	!188.0	!0.059	!4
!2100	!100.0	!100	!100.0	!110.0	!235.0	!0.066	!0
!2125	!125.0	!100	!125.0	!137.5	!250.0	!0.072	!0
!2150	!150.0	!100	!150.0	!165.5	!300.0	!0.079	!0
!2200	!200.0	!100	!200.0	!220.5	!400.0	!0.091	!0

Fuse - D. C. Limiter Type, High Current (ME451-0016) (Slowblow)

Dash No.	Ampere Rating	Maximum Load	Ultimate Trip			* Volt Drop	Min. Wire Size
			%	Amps	Amps		
!3035	!35.0	!100	!35.0	!38.5	!84.0	!0.056	!8
!3050	!50.0	!100	!50.0	!55.0	!120.0	!0.056	!6
!3150	!150.0	!100	!150.0	!165.0	!360.0	!0.106	!0
!3200	!200.0	!100	!200.0	!220.0	!480.0	!0.125	!0

Fuse - Miniature Cartridge (ME451-009)

Dash No.	Ampere Rating	Maximum Load	Ultimate Trip			* Volt Drop	Min. Wire Size
			%	Amps	Amps		
!1023	!0.5	!50	!0.25	!0.5	!0.75	!0.800	!26
!1001	!1.0	!50	!0.50	!1.0	!1.50	!0.680	!26
!1002	!2.0	!50	!1.00	!2.0	!3.00	!0.320	!26
!1003	!3.0	!50	!1.50	!3.0	!4.50	!0.200	!26
!1021	!5.0	!50	!2.50	!5.0	!6.75	!0.338	!24
!1019	!7.5	!50	!3.75	!7.5	!10.125	!0.200	!22
!1005	!10.0	!50	!5.00	!10.0	!13.50	!0.250	!20
!1006	!15.0	!50	!7.50	!15.0	!20.25	!0.135	!16
!1007	!20.0	!50	!10.00	!20.0	!27.00	!0.165	!12
!1008	!25.0	!50	!12.50	!25.0	!33.75	!0.479	!10
!1009	!30.0	!50	!15.00	!30.0	!40.50	!0.125	!10

Table 7.3.1.2-1 Circuit Protection And Characteristics (Continued)

Fuse - Microminiature With Axial Leads (ME451-0010)

! Dash ! ! No. !	! Ampere ! ! Rating !	! Maximum ! ! Load !	! Ultimate Trip			! * ! ! Volt ! ! Drop !	! Min. ! ! Wire ! ! Size !
			! % !	! Amps !	! Amps !		
! 1001 !	! 0.125 !	! 50 !	! 0.0625 !	! 0.125 !	! 0.188 !	! 2.676 !	! 26 !
! 1002 !	! 0.25 !	! 50 !	! 0.125 !	! 0.25 !	! 0.375 !	! 0.455 !	! 26 !
! 1005 !	! 0.50 !	! 50 !	! 0.250 !	! 0.50 !	! 0.750 !	! 0.290 !	! 26 !
! 1007 !	! 0.75 !	! 50 !	! 0.375 !	! 0.75 !	! 1.125 !	! 0.330 !	! 26 !
! 1010 !	! 1.00 !	! 50 !	! 0.500 !	! 1.00 !	! 1.50 !	! 0.200 !	! 26 !
! 1015 !	! 1.50 !	! 50 !	! 0.750 !	! 1.50 !	! 2.25 !	! 0.216 !	! 26 !
! 1020 !	! 2.00 !	! 50 !	! 1.00 !	! 2.00 !	! 3.00 !	! 0.236 !	! 26 !
! 1030 !	! 3.00 !	! 50 !	! 1.50 !	! 3.00 !	! 4.50 !	! 0.210 !	! 26 !
! 1040 !	! 4.00 !	! 50 !	! 2.00 !	! 4.00 !	! 6.00 !	! 0.235 !	! 24 !
! 1050 !	! 5.00 !	! 50 !	! 2.50 !	! 5.00 !	! 7.50 !	! 0.221 !	! 24 !
! 1070 !	! 7.00 !	! 50 !	! 3.50 !	! 7.00 !	! 10.50 !	! 0.210 !	! 22 !
! 1100 !	! 10.00 !	! 50 !	! 5.00 !	! 10.00 !	! 15.00 !	! 0.190 !	! 18 !

Fuse - Subminiature Plus 9n (ME451-0018)

! Dash ! ! No. !	! Ampere ! ! Rating !	! Maximum ! ! Load !	! Ultimate Trip			! * ! ! Volt ! ! Drop !	! Min. ! ! Wire ! ! Size !
			! % !	! Amps !	! Amps !		
! 0012 !	! 0.125 !	! 50 !	! 0.625 !	! 0.125 !	! 0.188 !	! 0.580 !	! 26 !
! 0025 !	! 0.25 !	! 50 !	! 0.125 !	! 0.25 !	! 0.375 !	! 0.225 !	! 26 !
! 0050 !	! 0.50 !	! 50 !	! 0.25 !	! 0.50 !	! 0.750 !	! 0.210 !	! 26 !
! 0075 !	! 0.75 !	! 50 !	! 0.375 !	! 0.75 !	! 1.125 !	! 0.185 !	! 26 !
! 0100 !	! 1.00 !	! 50 !	! 0.500 !	! 1.00 !	! 1.50 !	! 0.180 !	! 26 !
! 0150 !	! 1.50 !	! 50 !	! 0.750 !	! 1.50 !	! 2.25 !	! 0.180 !	! 26 !
! 0200 !	! 2.00 !	! 50 !	! 1.00 !	! 2.00 !	! 3.00 !	! 0.215 !	! 26 !
! 0300 !	! 3.00 !	! 50 !	! 1.50 !	! 3.00 !	! 4.50 !	! 0.185 !	! 26 !
! 0400 !	! 4.00 !	! 50 !	! 2.00 !	! 4.00 !	! 6.00 !	! 0.155 !	! 24 !
! 0500 !	! 5.00 !	! 50 !	! 2.50 !	! 5.00 !	! 7.50 !	! 0.150 !	! 24 !
! 0750 !	! 7.50 !	! 50 !	! 3.75 !	! 7.50 !	! 11.25 !	! 0.130 !	! 22 !
! 1000 !	! 10.00 !	! 50 !	! 5.00 !	! 10.00 !	! 15.00 !	! 0.160 !	! 18 !

Table 7.3.1.2-1 Circuit Protection And Characteristics (Concluded)

MB150-048 Wire And Cable, Electrical, Polyimide Insulated

! Wire ! ! Gauge !	! Maximum ! ! Current !	! OHMS/ft. ! ! At 200°F !	! Wire ! ! Gauge !	! Maximim ! ! Current !	! OHMS/ft. ! ! At 200°F !
! 0 !	! 240.0 !	!0.000146 !	! 14 !	! 24.5 !	!0.003873 !
! 2 !	! 220.0 !	!0.000229 !	! 16 !	! 20.0 !	!0.006146 !
! 4 !	! 160.0 !	!0.000335 !	! 18 !	! 17.0 !	!0.007876 !
! 6 !	! 115.0 !	!0.000563 !	! 20 !	! 14.0 !	!0.012614 !
! 8 !	! 83.0 !	!0.000896 !	! 22 !	! 11.0 !	!0.020658 !
! 10 !	! 49.0 !	!0.001601 !	! 24 !	! 8.6 !	!0.037339 !
! 12 !	! 33.0 !	!0.002556 !	! 26 !	! 5.2 !	!0.061281 !

Notes:

- \* Maximum voltage drop at rated current. Adjust for actual circuit current.
- 1. Based on 200°F and  $1 \times 10^{-6}$  torr
- 2. Of a fuse rated at 150 amps or greater is open due to fault, all circuitry downstream of that fuse, to the next protective device, must be inspected and approved before it can be re-flown.
- 3. Maximum Load - Maximum current which the design should apply to the device.
- 4. Ultimate Trip Maximum - Maximum current which device can provide under overload conditions.



*Table 7.3.2.1-1 Primary P.L Bus/Single-Section SMCN (At end of SMCN)*

MISSION PHASE	VOLTS RANGE (VDC)	POWER (WATTS)		TIME LIMIT ON PEAK POWER	REMARKS
		CONT. MAX.	PEAK		
<i>Ground operation</i>					
	<i>TBD</i>	<i>250</i>	<i>375</i>	<i>15 min/3 hr</i>	<i>(1)</i>
	<i>(2)</i>	<i>1750</i>	<i>3000</i>	<i>15 min/3 hr</i>	<i>(3)</i>
<i>Ascent/Descent/Post-landing</i>	<i>TBD</i>	<i>250</i>	<i>375</i>	<i>2 min/mission phase</i>	
<i>On-orbit</i>	<i>(2)</i>	<i>1750</i>	<i>3000</i>	<i>15 min/3 hr</i>	

- (1) Orbiter systems powered to greater than on-orbit levels.*
- (2) See Figure 7.3.2.1-1 for voltage levels.*
- (3) Orbiter systems powered to on-orbit levels.*

7.3.2.2 Xo645 Interface. Main DC electrical power provided by the Orbiter to the Primary PL BUS for each mission phase, shall be as shown in Table 7.3.2.2-1. The primary electrical power interfaces are located at the Xo645 electrical power panel. Electrical power at the Xo645 interface shall not be available for cargo use except as agreed to in payload unique ICD's.

*Table 7.3.2.2-1 Primary PL Bus - Xo645 Electrical Power Panel*

MISSION PHASE	VOLTS RANGE (VDC)	POWER (KW)		TIME LIMIT ON PEAK POWER	REMARKS
		MAX. CONT.	PEAK		
Ground Operation	27.2-32	1.0	1.5	15 min/3 hr	(1)
	27.2-32	7.0	12.0	15 min/3 hr	(2)
Prelaunch / Ascent / Descent / Post-Landing	27.2-32	1.0	1.5	2 minutes per mission phase	
On-Orbit	27.2-32	7.0	12.0	15 min/3 hr	

- (1) Orbiter systems powered to greater than on-orbit levels.
- (2) Orbiter systems powered to on-orbit levels.

7.3.3 Cabin Payload Bus. DC electrical power provided by the Orbiter to Cabin PL BUS (AFD), for each Cargo Element section by mission phase shall be as specified in Table 7.3.3-1.

*Table 7.3.3-1 Cabin Payload Bus/Single-Section SMC4*

MISSION PHASE	VOLTS RANGE (VDC)	POWER (WATTS)		TIME LIMIT ON PEAK POWER	REMARKS
		CONT. MAX.	PEAK		
Ground operation	25.7-32	188	250	15 min/3 hr	
Ascent/Descent/ Post-Landing	24.2-32	88	105	2 min/mission phase	
On-orbit	24.2-32	188	250	15 min/3 hr	

7.3.4 Aux PL A or Aux PL B. Total DC electrical power provided by the Orbiter through Aux PL A or Aux PL B, for each mission phase shall be as specified in Table 7.3.4-1, at station X<sub>0</sub>645 and AFD respectively.

The total auxiliary power utilized from both buses shall not exceed the allocations specified in Table 7.3.4-1. This table specifies power available at either one of these two buses. Power may be drawn from either one or both simultaneously. The auxiliary buses may be tied together if diode isolated. However, the total power capability is limited to that of a single auxiliary bus, which is 0.4 Kw maximum continuous at station X<sub>0</sub>645, of which 0.2 Kw maximum continuous is available at the AFD. *Aux PL A and Aux PL B are available at separate connectors at X<sub>0</sub>645 and at the AFD for each bus.*

*Table 7.3.4-1 AUX PL A Or AUX PL B*

MISSION PHASE	VOLTS RANGE (VDC)	POWER		TIME LIMIT ON PEAK POWER	REMARKS
		CONT. MAX. (KW)	PEAK (AMP)		
Any phase (X <sub>0</sub> 645)	26.1-32	0.4	25	2 seconds	
Any phase (AFD)	25.7-32	0.2	25	2 seconds	

7.3.5 Aft PL B or Aft PL C. Total DC electrical power provided by the Orbiter to Aft PL B or Aft PL C, for each mission phase shall be as specified in Table 7.3.5-1. This table specifies power available at either or both buses simultaneously.

*Table 7.3.5-1 A3J PL B Or A3J PL C (X<sub>0</sub>1307)*

MISSION PHASE	VOLTS RANGE (VDC)	POWER (KW)		TIME LIMIT ON PEAK POWER	REMARKS
		CONT. MAX.	PEAK		
Ground operation	25.7-32	1.5	2	2 min/3 hr	(1)
Ascent/Descent/ Post-landing	25.7-32	1	1.5	2 min/3 hr	(1)
On-orbit	24-32	1.5	2	2 min/3 hr	(1)

(1) Total power available to payloads from both A3J PL B and/or A3J PL C combined.

7.3.6 PL GSE Power. GSE power via the T-0 umbilical is independent of Orbiter power distribution subsystems. GSE power shall be provided in accordance with Paragraphs 7.3.6.1 and 7.3.6.2.

7.3.6.1 T-0 Wiring. Cargo Elements shall utilize T-0 wiring for power within the limits specified in Table 7.3.6.1-1. Each Cargo Element section shall be provided T-0 accommodations on the Orbiter port side SIP (connectors: J102, J104 and J106). *The entire T-0 power accommodations on the starboard SIP are provided via T-0 connector J74.* Utilization of T-0 wires for commands and signals requires that these functions meet the EMC criteria (including voltage limits) specified in Paragraph 10.7.1. Connectors and pin assignments are specified in Section 13.

7.3.6.2 T-0 Power Source. The power source(s) for T-0 power, whether Cargo Element or STS -provided, shall meet the EMC requirements specified in Paragraph 7.3.7 (e). Current limiting shall be provided by the Cargo Element for each wire pair utilized, such that the limits of table 7.3.6.1-1 are not exceeded.

Table 7.3.6.1-1 J-O Wiring Characteristics

ELEMENT	CONNECTOR	VIA	MAXIMUM CURRENT PER WIRE SEGMENTS (AMPS)	MAXIMUM VOLTAGE AT PWR SOURCE (VDC)	MAX. ROUND TRIP DC RESISTANCE (OHMS)				REMARKS
					SIP/T-0 CONN.	SIP RM 10A	SIP RM 220	SIP RM 221	
HO	P1502/1504 (12)	J74	22	100	0.42	1.0**	1.5**	1.8**	
HO	J102 (20)	J55 AND J58	6	100	2.28	8.0	12.8	13.1	
HO	J102 *	J55 AND J58	6	100	2.28	3.0*	3.5*	3.8*	
HO	J104 (22)	J67 AND J69	1	100	2.88	9.6	11.0	11.6	
RF	J106 (24)	J59	1	100	2.83	13.2	17.5	18.1	

1. These voltage and current limits apply only when wires of these connectors are utilized to the Cargo Element.
2. Power returns must be twisted with corresponding hot wires.
3. Returns shall be single-point grounded at the payload (flight end) only.
4. When wire bussing is utilized, current limiting (e.g. fusing, etc.) shall be provided for individual wires (hot side) at one end only when two wire pairs are utilized. When wire bussing of three or more wire pairs is utilized, current limiting shall be provided at each end of each wire pair (hot side only).
5. *Due to atmospheric conditions and life cycle connector wear, the payload ground and flight hardware shall be designed to accommodate resistance variations of +10/-20 percent.*
6. *From 30 minutes before launch until launch, the amount of current being transferred through the J-O umbilical shall be limited to 100 milliamps per circuit (wire pair).*

\* See Table 13.5.1.1-4 for low resistance circuit paths.

\*\* Calculated values, actual values are TBD.

7.3.7 DC Power Ripple and Transient Limits. Ripple and transient limits for electrical power provided by the Orbiter at the indicated interfaces shall not exceed the voltage values specified in the following sub-paragraphs.

a. Inflight DC power bus ripple at the interface shall not exceed:

1. 0.9 Volts peak-to-peak narrowband (30 Hz to 7 KHz) falling 10 dB per decade at 0.28 volts peak-to-peak at 70 KHz, thereafter remaining constant to 400 MHz.
2. The momentary coincidence of 2 or more signals at any one frequency shall not exceed the envelope defined as 1.6 volts peak-to-peak (30 Hz to 7 KHz), falling 10 db per decade to 0.5 volts peak-to-peak at 70 KHz, thereafter remaining constant to 400 MHz.
3. Under the conditions of a passive payload (resistive simulation of load), the ripple on the power supplied shall not be greater than 0.8 volts peak-to-peak broadband (DC to 50 MHz); no discrete frequency shall exceed 0.4 volts peak-to-peak. This condition shall apply at the mid-body power interface only.

b. Inflight DC Power Transients.

1. Inflight DC power transients on the Orbiter DC power buses at the cargo element interface (measured common-mode) shall not exceed the voltage envelope of Figures 7.3.7-1 and 7.3.7-2.
2. Hydraulic circulation pump produced transient voltages on the Aft PL B and Aft PL C DC buses, at the cargo element interface, shall not exceed the voltage envelope of Figure 7.3.7-3. Hydraulic circulation pump produced transient voltages on the PRI PL Bus, Aux PL A, Aux PL B and the Cabin PL Bus, at the cargo element interfaces, shall not exceed the voltage envelope of Figure 7.3.7-4.
3. Cargo element design shall accommodate sawtooth transient oscillations, having a maximum amplitude of 11 volts peak-to-peak on Aft PL B and Aft PL C DC buses and 4 volts peak-to-peak on the PRI PL Bus, Aux PL A, Aux PL B and the Cabin PL Bus, at the cargo element interface. The oscillation has a base frequency between 500 and 700 Hertz and contained within the inner envelope shown in Figures 7.3.7-3 and 7.3.7-4 respectively. These bus voltage transients (caused by activation of the hydraulic circulation pump connected to that bus) may occur at any time during on-orbit operations, plus activation at touchdown, and shall not be subjected to pre-flight scheduling.

c. The common-mode\* voltage for the longest Cargo Bay dimension (Station X<sub>0</sub>585 to X<sub>0</sub>1307 bulkhead) shall not exceed 0.3 volts peak-to-peak, when measured in the time domain with an instrument bandwidth of at least 50 MHz (*linear function*). This is inclusive of the DC component which may exist in the vehicle structural members. Voltages measured at discrete frequencies shall not exceed 0.15 volts peak-to-peak.

Transient excursions shall be limited to  $\pm 50 \times 10^{-6}$  volt seconds with rise and fall rates not greater than 56 volts/microsecond; peak voltage shall not exceed  $\pm 2$  volts when measured between Station X<sub>0</sub>585 and X<sub>0</sub>1307 bulkhead.

\*Common mode voltage, as used here, is defined as the voltage drop across two points of Orbiter structure caused by a current through the impedance between those two points.

d. Ground DC Power (via Orbiter EPDS)

1. The narrowband ripple voltage at the interface shall not exceed an envelope with limits 1.2 volts peak-to-peak (30 Hz to 7 KHz) falling log-linear to 0.28 Volts peak-to-peak at 70 KHz, thereafter remaining constant to 400 MHz.
  2. The momentary coincidence of two or more signals at any one frequency shall not exceed an envelope with limits 2.0 volts peak-to-peak (30 Hz to 7 KHz), falling log-linear to 0.5 volts peak-to-peak at 70 KHz, thereafter remaining constant to 400 MHz.
  3. Transients (measured common mode) shall not exceed the impulse equivalent of  $300 \times 10^{-6}$  volt seconds above or below normal line voltage. Peak transients shall be limited to  $\pm 50$  volts from nominal bus voltage on the positive line, and  $\pm 30$  volts from nominal on the negative line. Rise and fall times shall not be less than one microsecond.
- e. PL GSE power source(s) for T-0 power, whether cargo element or STS-provided, shall meet the same EMC requirements specified for Cargo Equipment Level (cabin) in Figure 10.7.3.1-1.
- f. During normal equipment operation, for both ground power and fuel cell power, voltage transients of opposite polarity shall not occur simultaneously on the positive and return dc power buses.



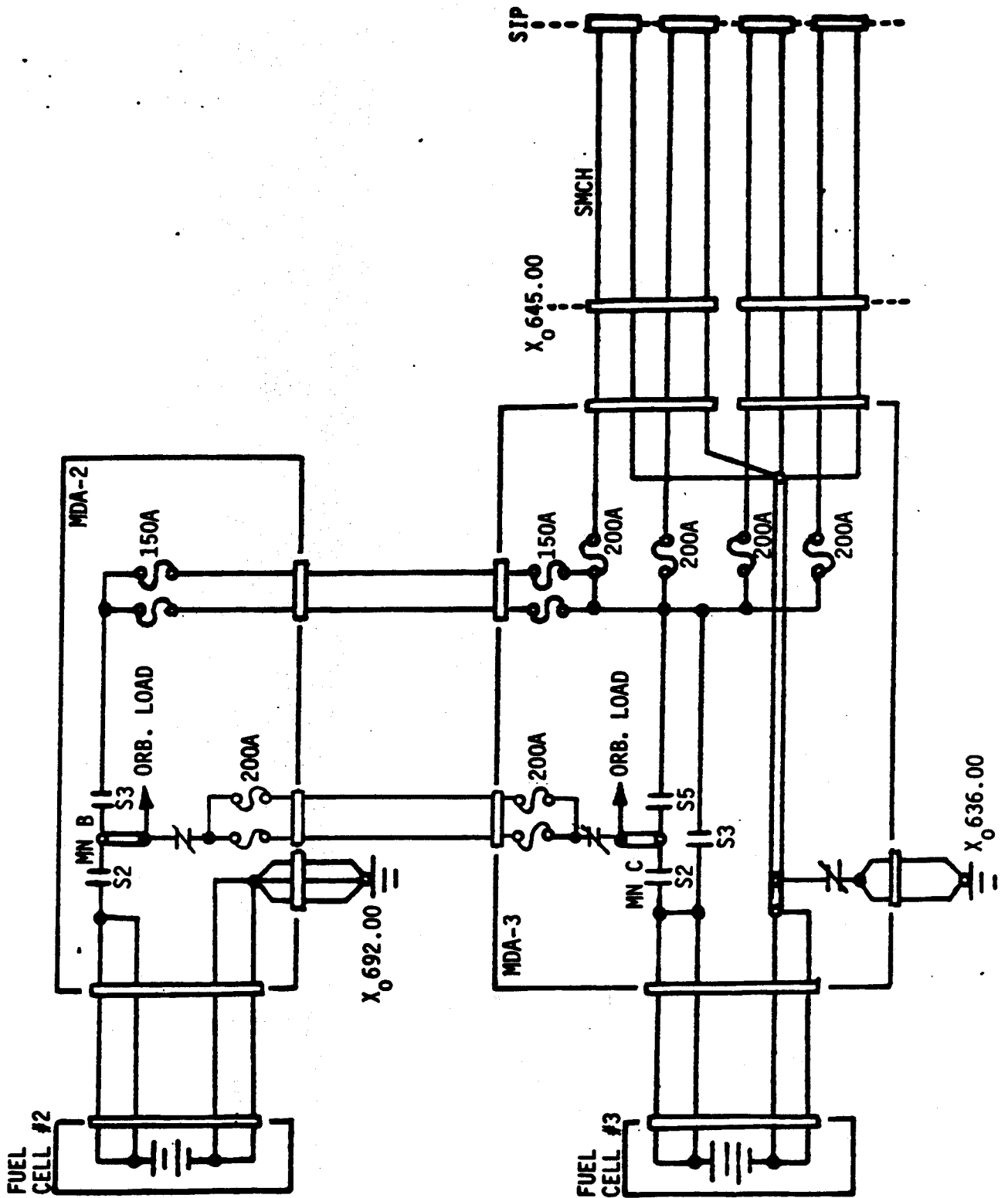


FIGURE 7.3.1.1-1 ORBITER MAIN DC POWER DISTRIBUTION TO THE CARGO BAY

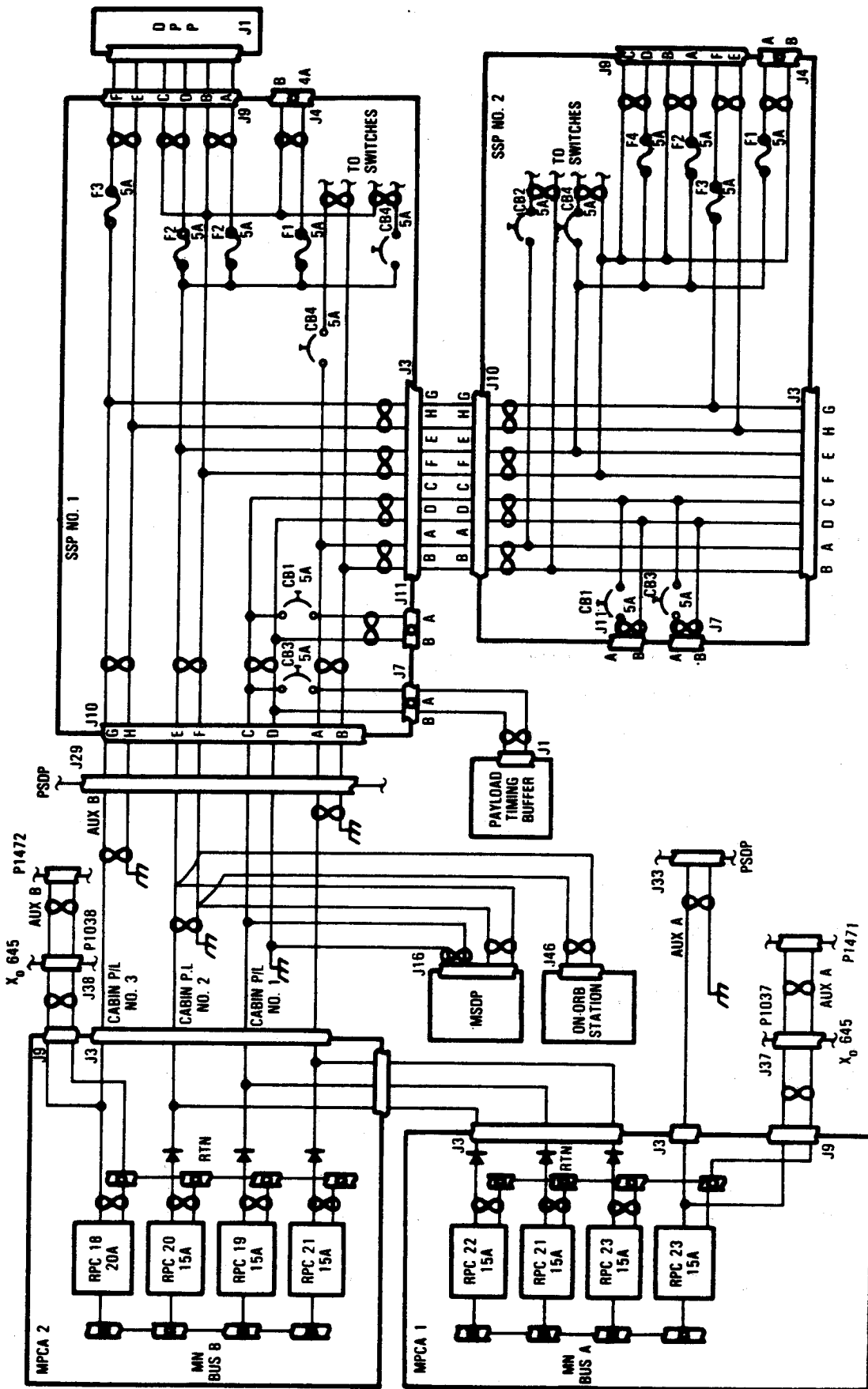


FIGURE 7.3.1.1-2 ORBITER DC POWER DISTRIBUTION TO THE AFT FLIGHT DECK AND CARGO BAY

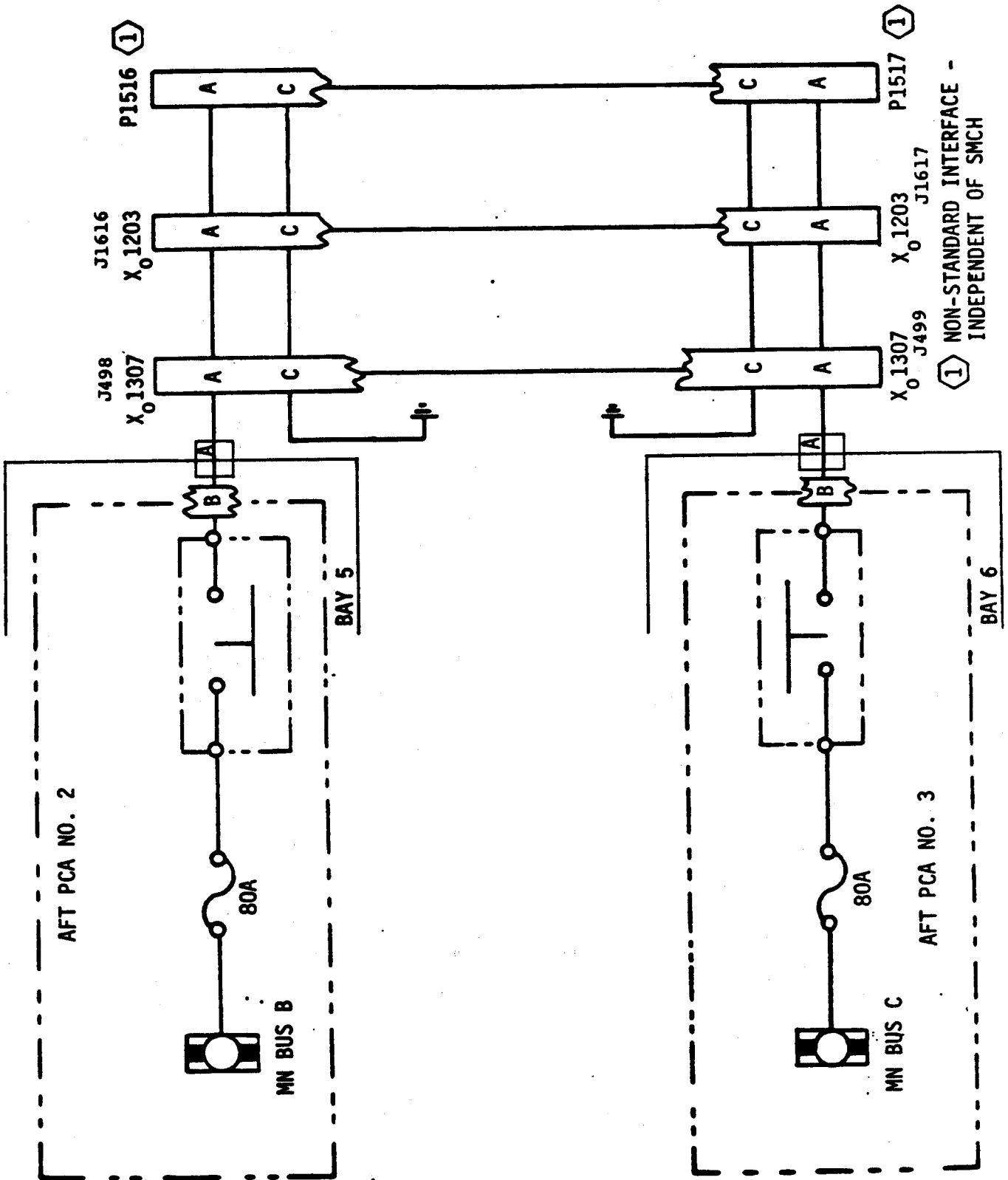
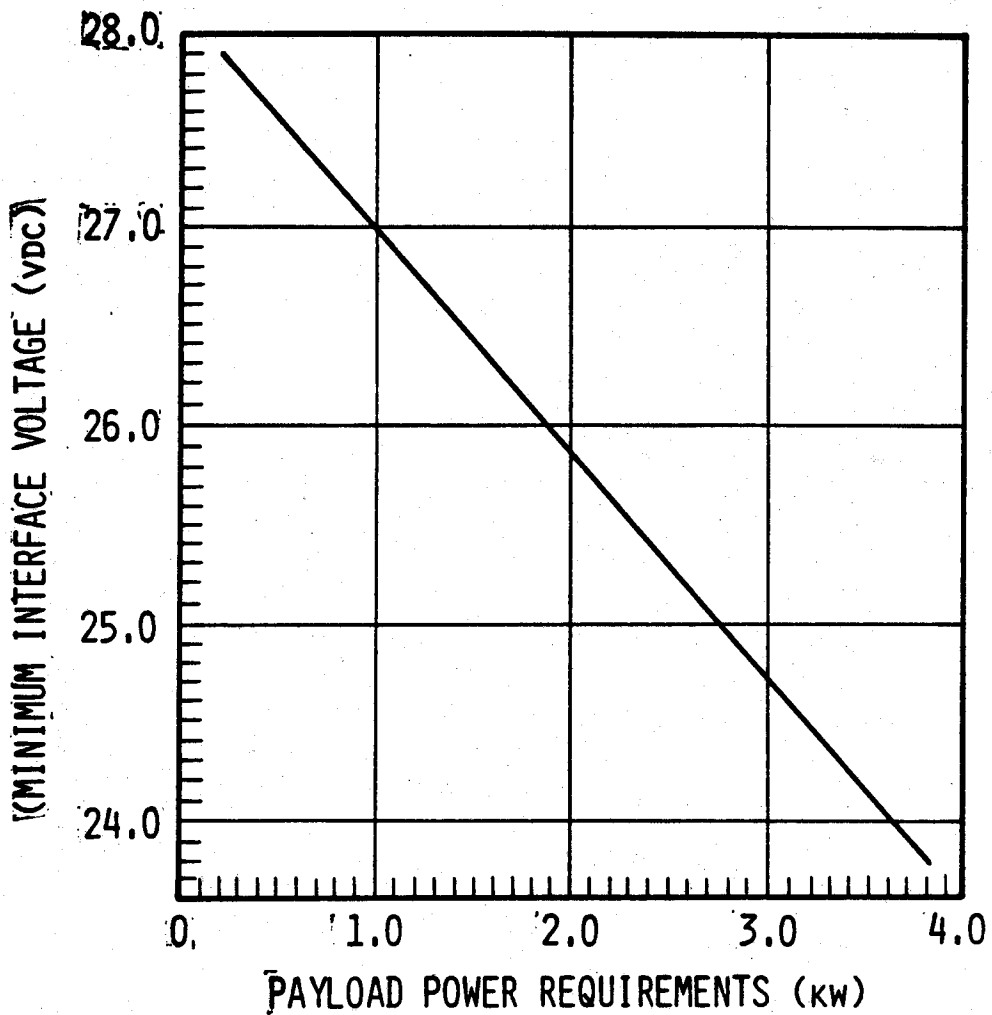


FIGURE 7.3.1.1-3 ORBITER AFT DC POWER DISTRIBUTION TO THE CARGO BAY



**General Notes:**

1. Voltage levels as specified are for single SMCJ section payloads.
2. Voltage levels as specified are at the end of the SMCJ cables or at the SMCJ Standard Interface Panel (SIP), whichever is applicable.
3. Maximum voltage shall be 32 VDC.
4. Assumes one section at peak power, two sections at maximum continuous power, and one section at 25% of maximum continuous power.

*Figure 7.3.2.1-1 SMCJ Interface Voltage Levels*

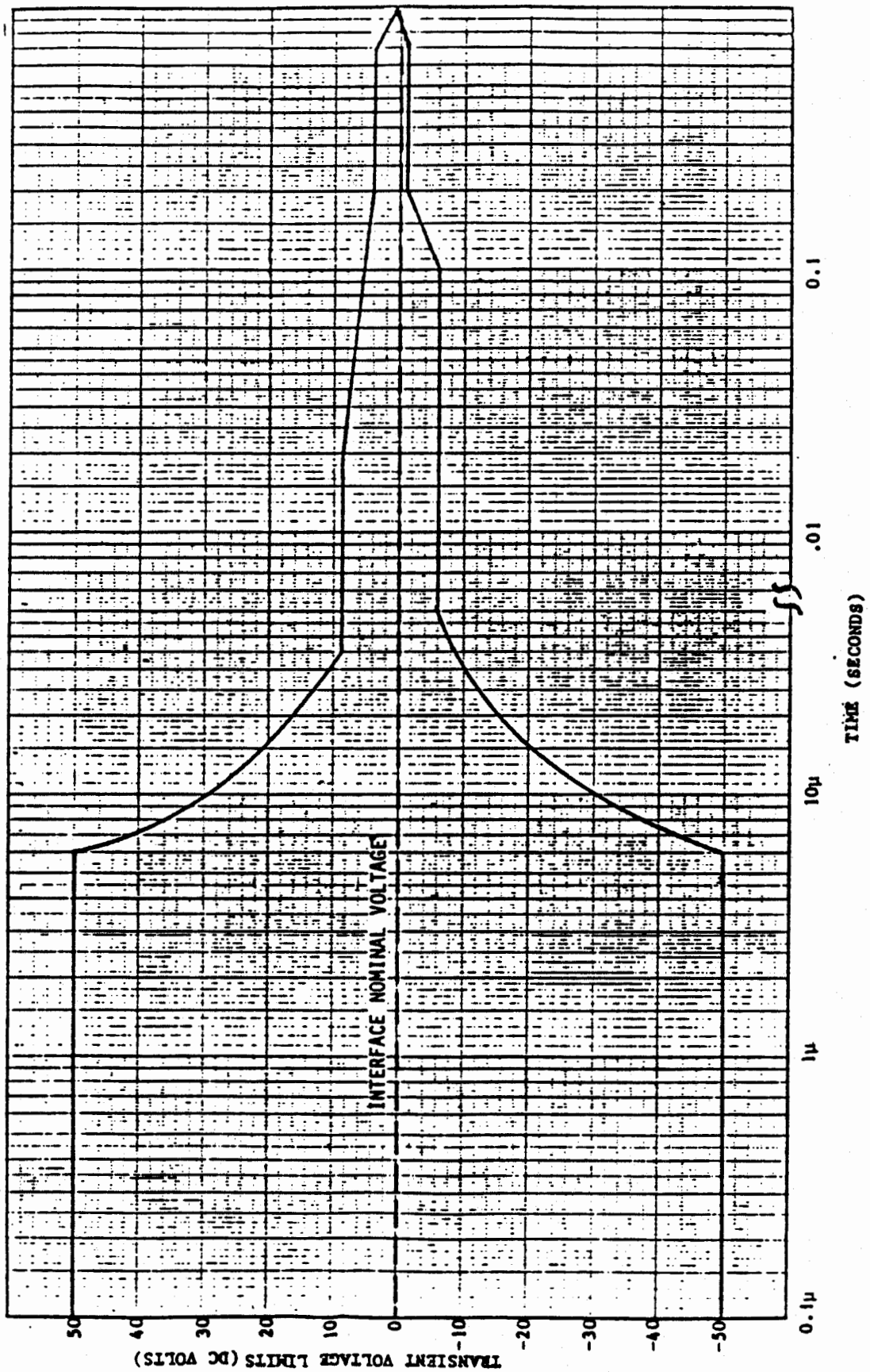


Figure 7.3.7-1 Inflight DC Power Transients (Measured Line-To-Structure) At All Cargo Element Positive DC Power Interfaces

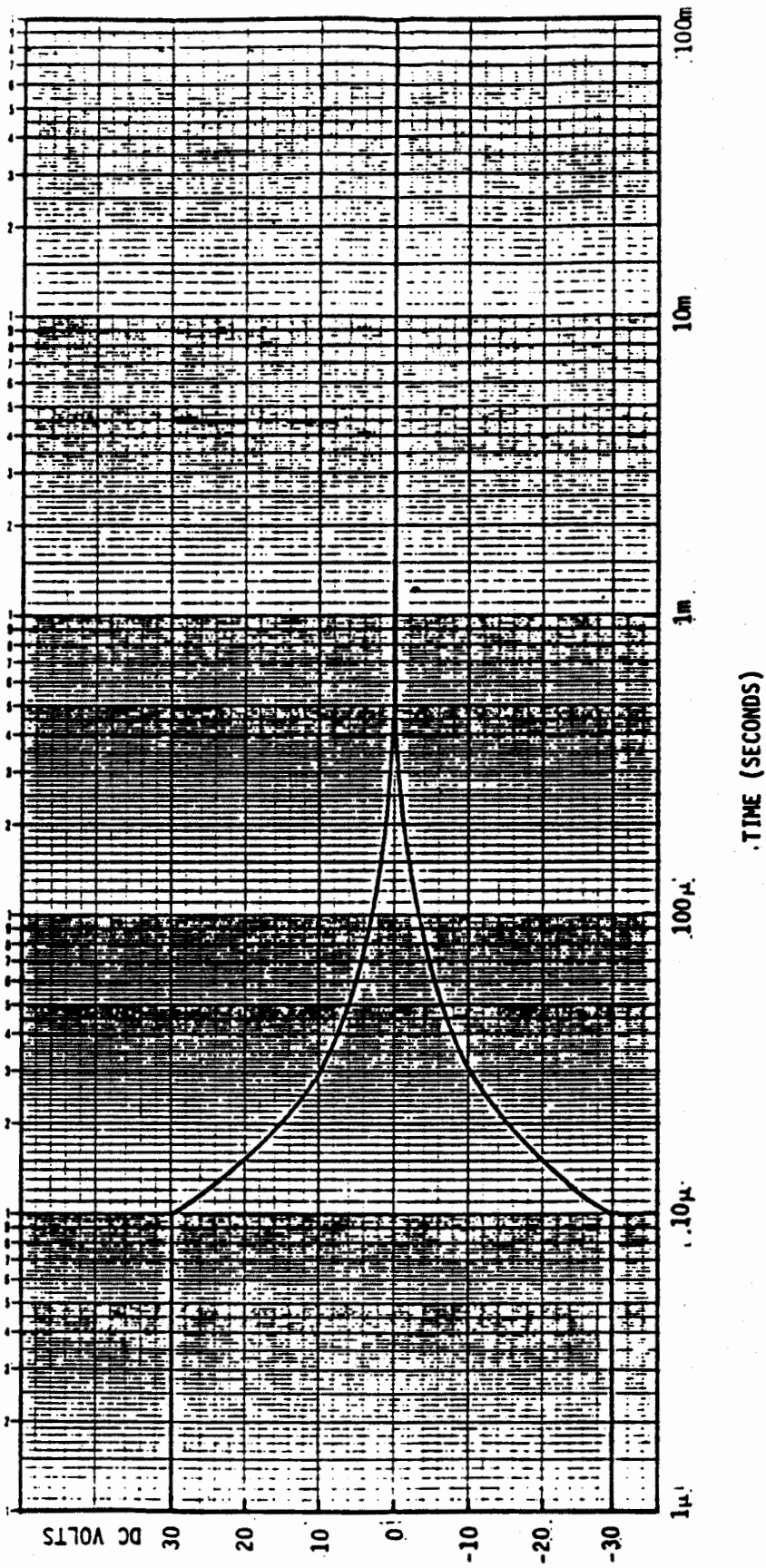


FIGURE 7.3.7-2 INFLIGHT DC POWER TRANSIENTS  
 (MEASURED LINE-TO-STRUCTURE) AT ALL CARGO ELEMENT DC POWER RETURN INTERFACES

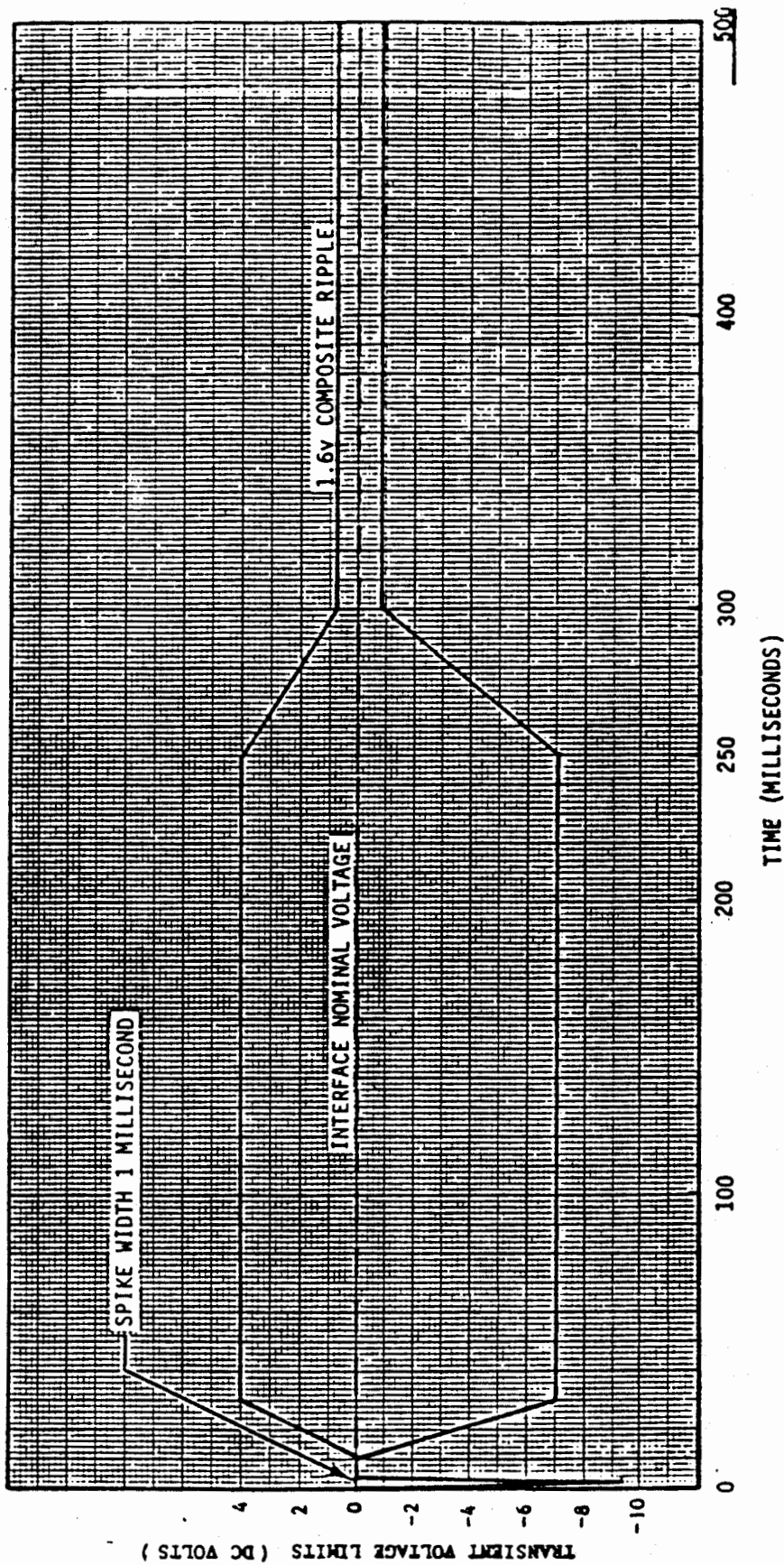
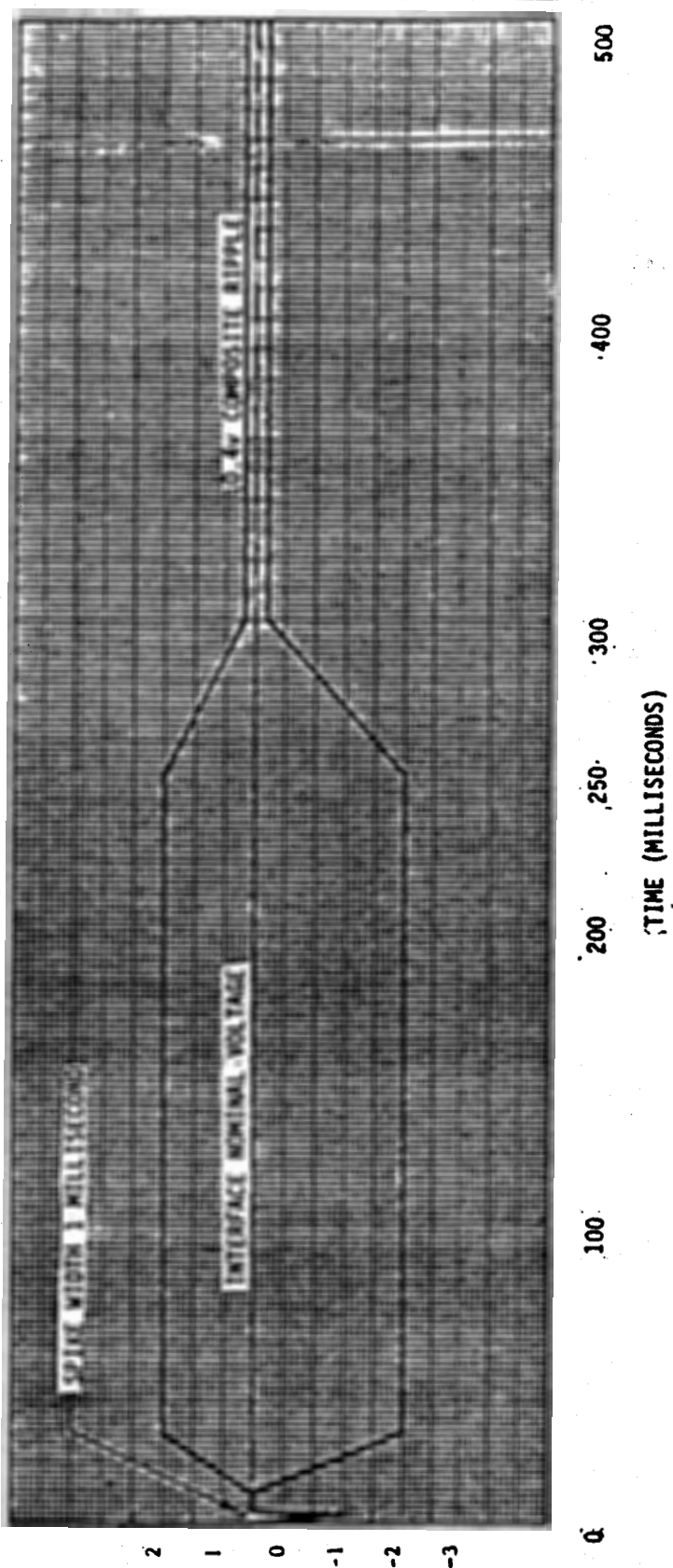


FIGURE 7.3.7-3 TRANSIENT VOLTAGE ON THE AFT PL B AND C DC BUSES PRODUCED BY OPERATION OF THE HYDRAULIC CIRCULATION PUMP



TRANSIENT VOLTAGE LIMITS (DC VOLTS)

FIGURE 7.3.7-4 TRANSIENT VOLTAGE ON THE PRI PL BUS, AUX PL A, AUX PL B AND THE CABIN PL BUS AT THE CARGO ELEMENT INTERFACE PRODUCED BY OPERATION OF THE HYDRAULIC CIRCULATION PUMP



## 7.4 AC POWER

7.4.1 AC Power Characteristics. Total AC electrical power shall be provided in the Aft Flight Deck (AFD) for use in the AFD and/or cargo bay (X<sub>0</sub>603) for each mission phase as specified in Table 7.4.1-1. This table specifies power available at either or both buses simultaneously.

Table 7.4.1-1 AC Power Characteristics/AC2 Or AC3 (1)

MISSION PHASE	VOLTS RANGE (VAC RMS)	VOLTS-AMP(VA)		TIME LIMIT ON PEAK POWER	REMARKS
		CONT. MAX.	PEAK		
Ground operation	115 ± 5	690	1000	2 min/3 hr	(2)
Descent/Postlanding	115 ± 5	350	420	2 min/3 hr Phase	(2)
On-orbit	115 ± 5	690	1000	2 min/3 hr	(2)

- (1) AC power is not available during prelaunch countdown and ascent phases.
- (2) AC loads greater than 100 VA must be balanced three phase loads. Single phase loads are limited to less than 100 VA.

7.4.2 Voltage Characteristics. Voltage characteristics on each AC power bus shall be as specified below:

Type: AC, 3-phase, 4-wire, wye.

Voltage: System: 115/200 volts RMS  
Steady-state: 115 ±5 volts RMS  
Modulation: 3.5 volts maximum when measured as the peak-to-valley difference between the maximum and minimum voltages reached on the modulation envelope over a period of at least one second.  
Transient limits: 115 ±15 volts RMS - with 5 to 10 msec recovery to steady-state limits.  
Spikes: -600 volts to +600 volts (refer to Paragraph 7.4.2.1)

Frequency: Limits: 400 ±7 Hz  
Modulation: ±1 Hz

Waveform: Sine with crest factor of  $1.41 \pm 0.15$   
Total harmonic: 5 percent of fundamental (RMS)  
Individual harmonic: 4 percent of the fundamental RMS  
when measured with a harmonic analyzer.

Phase: Sequence: A-B-C  
Displacement:  $120 \pm 2^\circ$

Power Factor: Equipments shall present as near  
unity power factor as practicable. The fully loaded  
equipment loads shall present a power factor on the  
worst phase within the limits defined in Figure 7.4.2-1

In addition, the average Orbiter inverter efficiency is 76.5 percent. Inverter losses in supplying AC power to the cargo shall be included in calculations of Cargo chargeable energy.

7.4.2.1 AC Power Ripple and Transients. AC power bus ripple shall be limited to 1.5 volts RMS from 30 Hz to 1.5 KHz falling to 0.6 volts RMS at 50 KHz thereafter remaining constant to 400 MHz, except that the ripple shall not exceed 4 percent RMS of the A.C. line voltage at inverter harmonic frequencies. With the AC neutral line grounded to Orbiter structure, the transient spikes measured on the three phases shall not exceed the levels defined in Figure 7.4.2.1-1 for both normal and abnormal AC system operation. The impedance into which the spikes are generated shall be 50 ohms minimum for significant frequency components of the spikes. Figure 7.4.2.1-1 is not intended to represent actual spikes, but rather to define stress levels for design purposes.

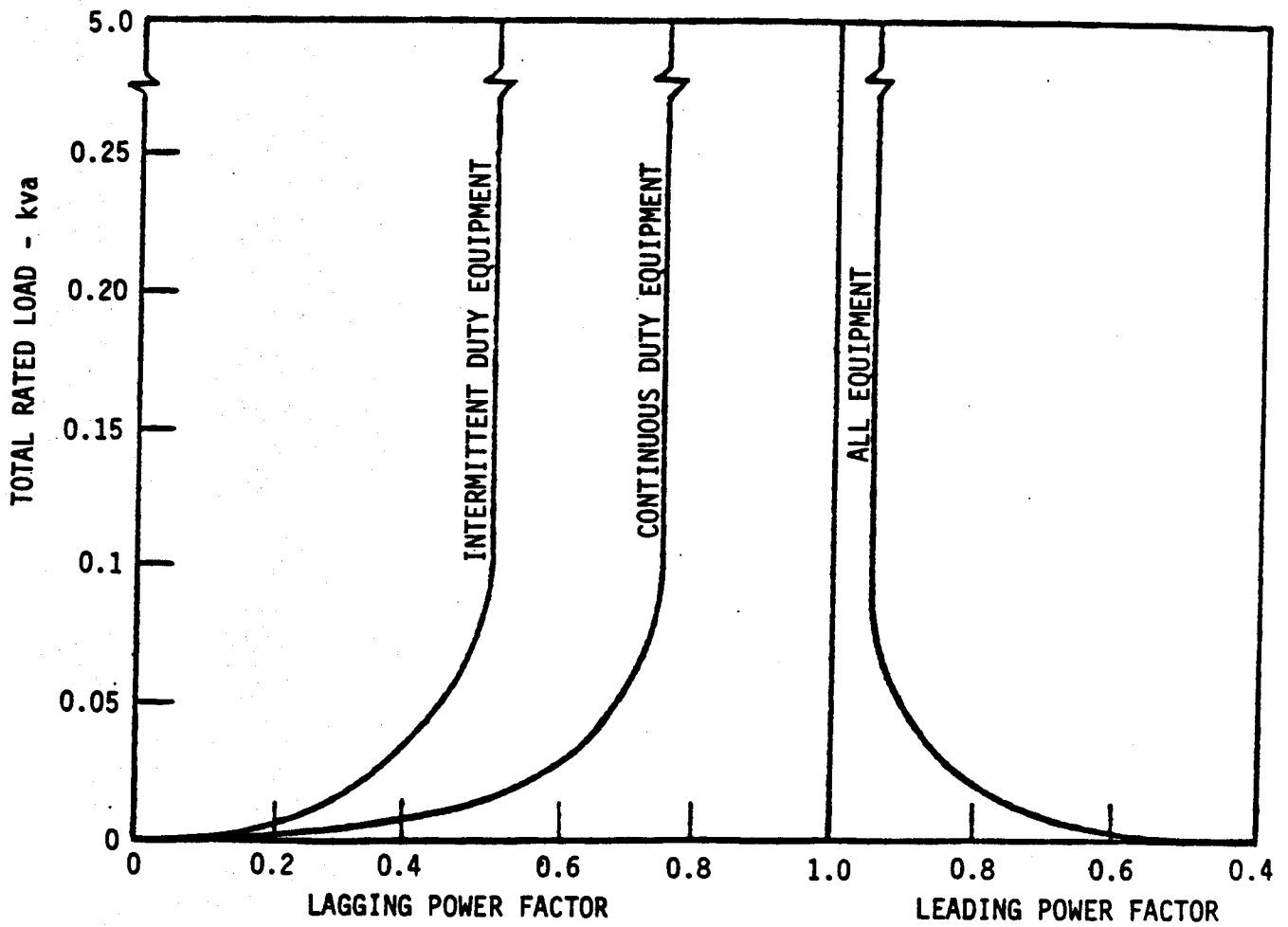


FIGURE 7.4.2-1 POWER FACTOR LIMITS FOR UTILIZATION EQUIPMENT

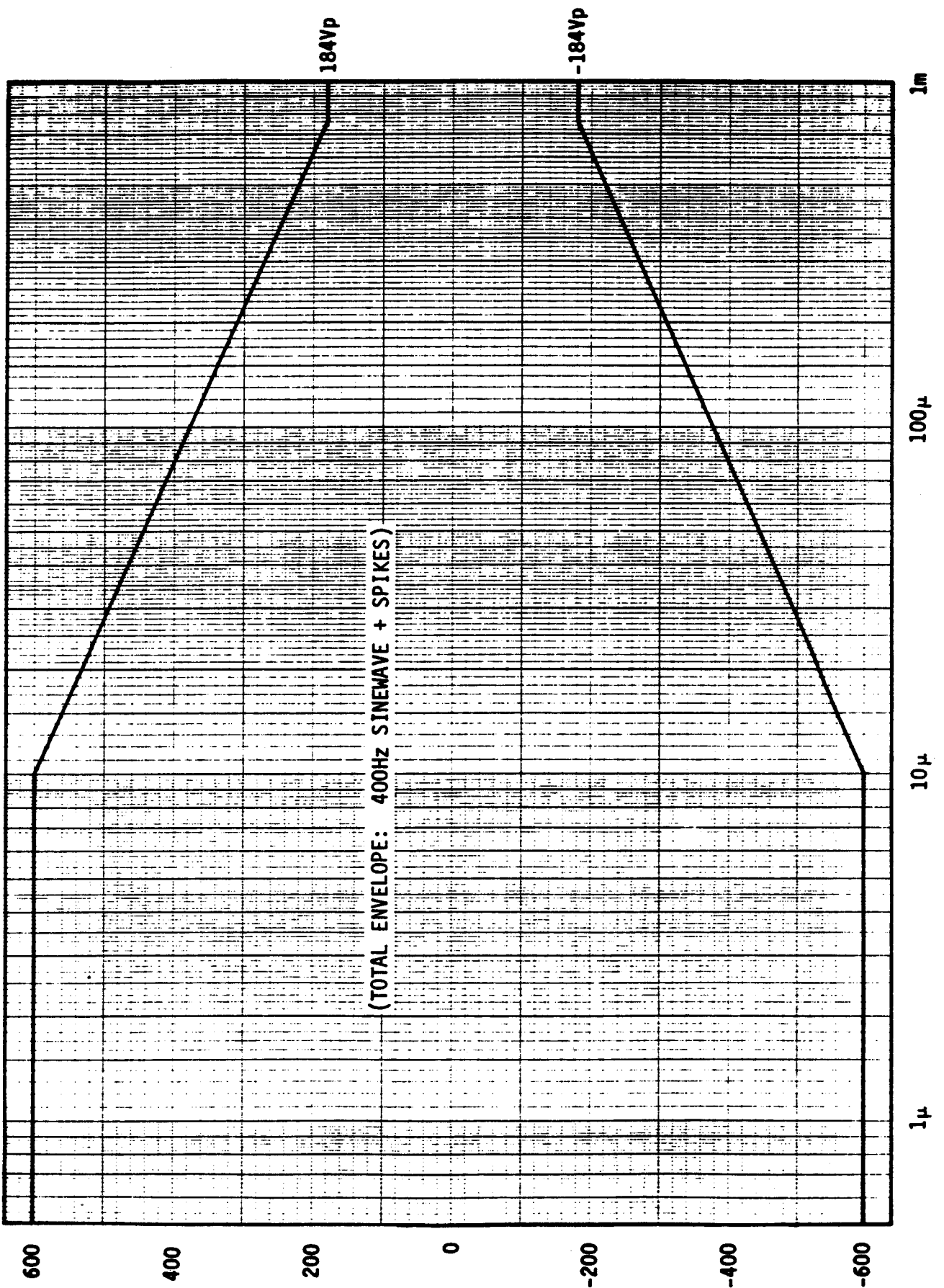


FIGURE 7.4.2.1-1 ENVELOPE OF PAYLOAD-PRODUCED SPIKES ON THE AC POWER BUS

## 7.5 LIMITATIONS ON CARGO UTILIZATION OF ELECTRICAL POWER

7.5.1 *(Deleted)*

7.5.2 *(Deleted)*

7.5.3 Cargo Element Activation/Deactivation and Isolation. Each cargo element shall be able to disconnect via crew-operated controls all Orbiter power supplied to the cargo element, except for a total amount not to exceed one (1) amp. A maximum of 500 Watts of power per single-section payload allocation shall be latched on, such that if inadvertent power disconnection to the cargo element occurs, all cargo element loads except for a maximum of 500 Watts shall be disconnected.

7.5.4 Pyrotechnic Initiation. Orbiter PRI PL or Auxiliary PL DC power can be utilized by each payload for pyrotechnic initiation under the following conditions:

- a. Payload pyrotechnic initiations, either singly or grouped, shall require no more than 80 amps. (peak) per initiation from the Orbiter PRI PL power source measured at the interface defined in the cargo element unique-ICD (the initiator(s) should be assumed shorted "0 ohms" for this calculation). Current limiting shall be included in each initiator firing circuit which limits current to 10 amps (peak) per initiator firing circuit. When using the Orbiter Auxiliary PL DC power, the total current limit is 20 amps (peak). When a payload utilizes pyrotechnic initiation via the PRI PL source and one or both Auxiliary buses, the total power utilized per initiation shall not exceed 80 amps (peak) measured at the interface defined in the cargo element unique-ICD.
- b. The capability to turn-off firing circuits within 10 seconds after utilization via timer or crew command shall be provided in order to preclude continuous draw if the initiator(s) shorts.
- c. Figure 7.5.4-1 shows the voltage reduction for the firing transient and subsequent "on" time, which shall be applied (subtracted) from the minimum interface voltage levels defined for the PRI PL Bus and Auxiliary PL Buses, in their respective tables.
- d. A minimum of 10 seconds shall elapse between pyrotechnic initiation commands.
- e. Power consumption due to pyrotechnic initiation shall be included as part of the peak power allocated to the PRI PL or Auxiliary PL DC buses, as specified in the cargo element unique - ICD.

7.5.5 Emergency Power Availability. *During Orbiter emergency conditions, power will be provided temporarily to payloads as required for payload safing up to the power level specified by the unique payload P9P and 9CD.*

7.6 Retention System Power Provisions.

7.6.1 Availability to Cargo Elements. Orbiter/Cargo Element retention system power shall be used on an as-available basis to operate latches attaching deployable payloads to cargo element ASE or for other electrically actuated functions compatible with system capability.

7.6.2 Retention System DC Excitation Voltage and Returns. The Orbiter shall provide 28V DC nominal (32V DC maximum) stimulus voltage to the cargo element. This voltage shall be used exclusively for switch closure return to the Orbiter for the purpose of driving indications and stimulating control logic. The Orbiter shall provide current limited outputs for this voltage. The cargo element shall feed back to the Orbiter three 28V DC (nominal) signals. These signals shall be as follows:

- a. Ready for Latch Function. Signal indicating payload is mechanically oriented for latching.
- b. Latched Indication. Switch closure signal signifying latching system has achieved locked-up position.
- c. Released Indication. Switch closure which is activated when latch is in fully open condition.

Function (a) shall be used by the Orbiter to operate crew talkback indicators and telemetry status signals. Indications (b) and (c) shall be used by the Orbiter to inhibit and enable AC latch power as well as provide status signal inputs to telemetry.

7.6.3 AC Power Accommodations. The Orbiter PRLA voltage is 115 + 5, -7 VAC RMS (steady state) with the characteristics specified in Paragraphs 7.4.2 and 7.4.2.1. In addition, the Orbiter AC power shall provide for phase sequencing to reverse motor operation. Maximum latch power requirements are as follows:

- 170 Watts per motor operating
- 1.42 Amps per phase per motor operating
  
- 315 Watts per motor starting
- 2.0 Amps per phase motor starting

The Orbiter shall provide three-ampere (derated to 2.85 ampere) circuit breaker/phase protection for this service.

## 7.7 ELECTRICAL CONNECTORS

7.7.1 Electrical Connector Deadfacing. Electrical deadfacing of interfacing connectors when mating or demating shall comply with JSCM-8080, Standard 69, except that connectors which mechanically demate in flight will not require electrical deenergizing of signals prior to demating under the following conditions:

- a. The demating connector is in the Orbiter cargo bay.
- b. At the time of connector demate, the Orbiter shall be in the "on-orbit" flight phase with the cargo bay doors open.

- c. At the time of connector demate, the current on any single circuit shall not exceed 500 milliamperes.
- d. The demated connector retained on the Orbiter side shall be mechanically retained.
- e. Either the demated connector retained on the Orbiter side shall be the socket (female) side of the connector, or all power shall be removed from the demated connector in the Orbiter bay before the entry phase of the flight.

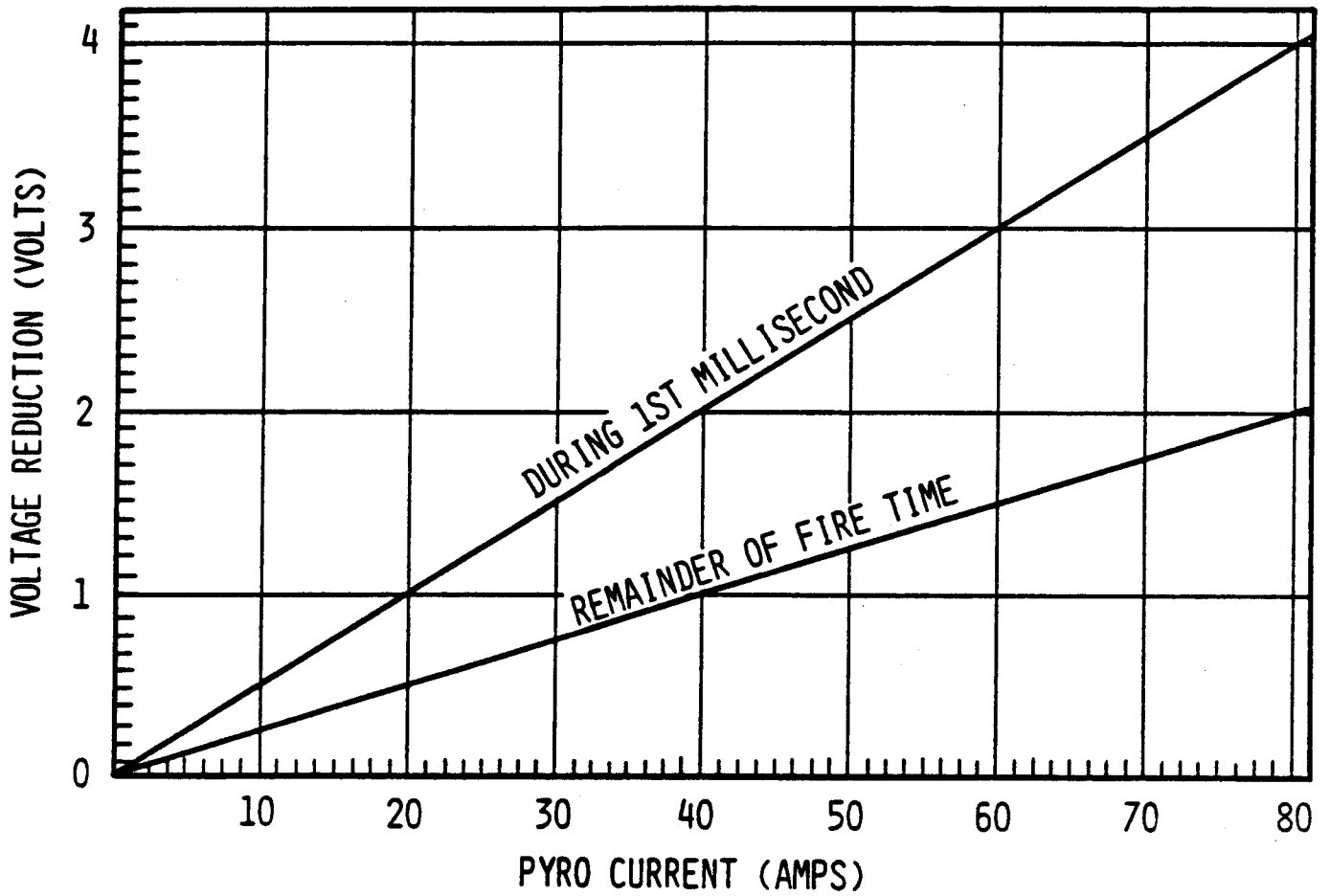


FIGURE 7.5.4-1 VOLTAGE REDUCTION DUE TO PYROTECHNIC FIRING



## 8.0 AVIONICS INTERFACES

### 8.1 CARGO ELEMENT AVIONICS SYSTEMS FUNCTIONAL DESCRIPTION

(To be defined in the cargo element-unique ICD's.)

### 8.2 ATTACHED PAYLOADS

**8.2.1 Payload Data Interleaver (PDI) Interface.** The Orbiter shall provide for the acquisition of asynchronous Payload Pulse Code Modulation (PCM) telemetry data via the PDI. For attached Cargo Elements, the PDI provides five input channels of which four are standard services with the fifth input channel an optional service. For detached Payloads, the PDI provides a single dual redundant input channel via the Orbiter's Payload Interrogator and Payload Signal Processor. The PDI is capable of simultaneously processing up to four Payload PCM telemetry inputs both for inclusion within Orbiter's PCM Telemetry Downlink, and for Orbiter GPC software services. Refer to Figure 8.2.1-1 for PDI data flow.

**8.2.1.1 PDI Input Data Characteristics - Shuttle Standard Formats.** The Shuttle Orbiter Standard Telemetry Formats for Payloads are three in number, and are designated Format Synchronization Mode Type 1 Format, Type 2 Format, and Type 3 Format. The distinctive characteristic of these three types of Payload PCM Telemetry formats is that their structure enables both the Orbiter's PDI and the Orbiter's GPC software services to process Payload measurement data, and as a group satisfies the requirements of Table 8.2.1.1-1 and Figures 8.2.1.1-1, 8.2.1.1-2, 8.2.1.1-4, 8.2.1.1-5 and 8.2.1.1-6. Each of these three Shuttle Standard Formats also enables the PDI to process Payload Frame data as Time Homogenous Data Sets for inclusion within the Orbiter's PCM Telemetry Downlink.

With respect to the Orbiter's PCM Telemetry Downlink, a Time Homogenous Data Set is defined to be those eight bit words decommutated from a Payload frame such that those words from one Payload frame shall never be mixed with those words from any other Payload frame within either the PDI or PCMMU (PCM Master Unit) (refer to Figure 8.2.1.1-3). With respect to Orbiter GPC software services, maintaining the time homogeneity for both individual *multiword* Payload measurements and Payload measurement word sets cannot be guaranteed.

**8.2.1.1.1 Type 1 Format.** A Type 1 Payload Format is herein defined as a format consisting of Master Frames only (refer to Figure 8.2.1.1-2), and a Master Frame sync pattern which occurs once every Master Frame.

**8.2.1.1.1.1 Orbiter PCM TLM Downlink Service.** Throughputting Payload data to the ground via the Orbiter's PCM TLM Downlink is implemented via the PDI's Toggle Buffer for individual Master Frames. Before individual Master Frames can be transferred to the PDI's Toggle Buffer, recognition by the PDI of two successive valid Master Frame Sync patterns must first occur. When this has happened, Toggle Buffer storage of each Master Frame shall proceed as follows:

- a. The Time Homogenous Data Set (THDS) within the PDI's Toggle Buffer shall, in part, consist of a complete Payload Master Frame or a subset thereof. The subset may consist of any number of uniquely identifiable contiguous or noncontiguous 8-bit Master Frame words. The THDS to be downlinked shall be an even number of 8-bit words. If an even number of 8-bit words are not specified, the PDI will add 8-bits of fill data.

- b. The remainder of the THDS shall consist of three additional 16 bit Status Words appended to the master Frame words by the PDI as shown in Figure 8.2.1.1-3.

**8.2.1.1.1.2 Orbiter GPC Software Service.** Transferring individual Payload measurements to the Orbiter's GPC Software Services is implemented via the PDI's Data RAM. Before individual measurements within the Master Frame can be transferred to the PDI's Data RAM, recognition of two successive valid Master Frame Sync patterns must first occur. When this has happened, Data RAM storage for each Payload measurement shall proceed as follows:

- a. Each Master Frame eight bit word associated with a Payload measurement that is required to be processed by the Orbiter's GPC Software Services shall be stored within a separate Data RAM byte address.
- b. A *multiword* Payload Measurement shall have its constituent eight bit bytes independently stored within a separate Data RAM byte address whenever its word position within the Master Frame is processed.
- c. Maintaining the time homogeneity for both individual *multiword* Payload measurements and Payload measurement word sets cannot be guaranteed.

**8.2.1.1.2 Type 2 Format.** A Type 2 Payload Format is herein defined as a format consisting of Master Frames and Minor Frames (refer to Figure 8.2.1.1-4). Every Minor Frame shall be identified by a Minor Frame Sync pattern which occurs once each Minor Frame, and shall be the same sync pattern for all Minor Frames. A Master Frame, in general, shall contain two or more Minor Frames; otherwise, there is no distinction with a Type 1 Format. The start of a Master Frame shall be identified by a Master Frame Sync pattern which occurs once per Master Frame.

**8.2.1.1.2.1 Orbiter PCM TLM Downlink Service.** Throughputting Payload data to the ground via the Orbiter's PCM TLM Downlink is implemented via the PDI's Toggle Buffer for individual Minor Frames. Before individual Minor Frames can be transferred to the PDI's Toggle Buffer, recognition by the PDI of two successive valid Minor Frame Sync patterns must first occur. When this has happened, Toggle Buffer storage for each Minor Frame shall proceed as follows:

- a. The THDS within the PDI's Toggle Buffer shall, in part, consist of a complete Minor Frame or a subset thereof. The subset may consist of any number of uniquely identifiable contiguous or noncontiguous 8-bit Minor Frame words. The THDS to be downlinked shall be an even number of 8-bit words. If an even number of 8-bit words are not specified, the PDI will add 8-bits of fill data.
- b. The remainder of the THDS shall consist of three additional 16 bit Status Words appended to the Minor Frame words by the PDI as shown in Figure 8.2.1.1-3.

**8.2.1.1.2.2 Orbiter GPC Software Service.** Transferring individual Payload measurements to the Orbiter's GPC Software Services is implemented via the PDI's Data RAM. Before individual measurements within the Minor Frame can be transferred to the PDI's Data RAM, recognition of the second consecutive valid Master Frame Sync pattern with valid Minor Frame Sync patterns in all Minor Frames between the Minor Frames which contain these Master Frame Sync patterns must first occur. When this has happened, Data RAM storage for each Payload measurement shall proceed as follows:

- a. Within each Minor Frame word column of a Master Frame, those eight bit words containing data samples for a Payload measurement which is required to be processed by the Orbiter's GPC Software Services shall be stored within the same Data RAM byte address.
- b. A *multiword* Payload measurement shall have its constituent eight bit bytes independently stored within a separate Data RAM byte address whenever its word position within the appropriate Minor Frame is processed.
- c. Maintaining the time homogeneity for both individual *multiword* Payload measurements and Payload measurement word sets cannot be guaranteed.

8.2.1.1.3 Type 3 Format. A Type 3 Payload Format is herein defined as a format consisting of Master Frames and Minor Frames (refer to Figure 8.2.1.1-6). Every Minor Frame shall be identified by a Minor Frame Sync pattern which occurs once each Minor Frame, and shall be the same sync pattern for all Minor Frames.

A Master Frame, in general, shall contain two or more Minor Frames; otherwise, there is no distinction with a Type 1 Format. Additionally, every Minor Frame shall contain an eight bit Minor Frame Count word. The start of a Master Frame shall be identified as the Minor Frame which contains an initial value of the Minor Frame Count word.

8.2.1.1.3.1 Orbiter PCM TLM Downlink Service. Identical to 8.2.1.1.2.1.

8.2.1.1.3.2 Orbiter GPC Software Service. Transferring individual Payload measurements to the Orbiter's GPC Software Services is implemented via the PDI's Data RAM. Before individual measurements within the Minor Frame can be transferred to the PDI's Data RAM, valid recognition of two successive Minor Frame Sync patterns and their corresponding Minor Frame Count patterns must first occur. *Data storage starts at the beginning of the 1st master frame following this occurrence*. When this has happened, Data RAM storage for each payload measurement shall proceed as follows:

- a. Within each Minor Frame word column of a Master Frame, those eight bit words containing data samples for a Payload measurement which is required to be processed by the Orbiter's GPC Software Services shall be stored within the same Data RAM byte address.
- b. A *multiword* payload measurement shall have its constituent eight bit bytes independently stored within a separate Data RAM byte address whenever its word position within the appropriate Minor Frame is processed.
- c. Maintaining the time homogeneity for both individual *multiword* payload measurements and payload measurement word sets cannot be guaranteed.

8.2.1.2 PDI Input Data Characteristics - Shuttle Non Standard Formats. The Shuttle Orbiter Non-Standard Telemetry Format is designated the Block Mode Format. The distinctive characteristic of the Block Mode Format is that the incoming Payload data can only be inserted into the Orbiter's PCM Telemetry Downlink since the PDI is not capable of processing individual Payload measurements for utilization by the Orbiter GPC software services (refer to Table 8.2.1.2-1).

**8.2.1.2.1 Block Mode.** The PDI does not recognize that the incoming Payload data possesses any format structural properties (e.g. Master Frame, Minor Frame, Word interval, etc.) other than bit intervals, and as such cannot process individual Payload measurements for the Orbiter GPC. The PDI will restructure the incoming Payload bit intervals into Data Blocks appropriate for inclusion within the Orbiter's PCM Telemetry Downlink.

**8.2.1.2.1.1 Orbiter PCM TLM Downlink Service.** Throughputting block mode Payload data to the ground via the Orbiter's PCM TLM Downlink is implemented via the PDI's Toggle Buffer for individual Data Blocks. Before individual Data Blocks can be transferred to the PDI's Toggle Buffer, establishment by the PDI of valid bit lock with the Payload must first occur. When this has happened, Toggle Buffer storage for each Data Block will proceed as follows:

- a. A Data Block Sync Word, generated by the PDI, shall first be transferred to the Toggle Buffer.
- b. The sequentially inputted Payload bit intervals shall next be transferred to the Toggle Buffer.
- c. Lastly, the PDI shall append three additional 16 bit Status words as delineated within Figure 8.2.1.1-3.
- d. *The PDI inserted pseudo sync and the three 16 bit status words are removed by the NASA/JSC Mission Control Center (MCC) prior to routing the TLM data stream to payload users.*

**8.2.1.3 Electrical Interface Characteristics.** For Payloads using one of the three BI<sub>0</sub> data codes (BI<sub>0</sub>-L, M or S), the PDI is capable of extracting associated Clock information and determining bit period boundary definition.

For Payloads using one of the three NRZ data codes (NRZ-L, M or S), the PDI requires the Payload to provide a CLOCK interface along with the DATA interface so as to enable the PDI to determine bit period boundary definition.

**8.2.1.3.1 PDI Data Input.** The PDI Data input electrical interface characteristics at the Orbiter/payload interface shall be as defined in Table 8.2.1.3.1-1 and Figures 8.2.1.3.1-1, 8.2.1.3.1-2 and 8.2.1.3.1-3.

**8.2.1.3.2 PDI Clock Input.** The PDI clock input electrical interface characteristics at the Orbiter/payload interface shall be as defined in Table 8.2.1.3.2-1 and Figure 8.2.1.3.2-1.

**8.2.1.4 Reserved**

**8.2.1.5 Grounding and Shielding.** Grounding and shielding shall be as shown in Figure 8.2.1.5-1.

Table 8.2.1.1-1 PD9 Input Data Characteristics-Attached Interface Shuttle Standard Format

Parameter	Dimension	PD9 Tolerance	Data Formats			Notes
			1	2	3	
Bit rate (center frequency)	BPS	110 BPS to 64 KBPS	x	x	x	
Input Signal Code		NRZ-L	x	x	x	(1)
		NRZ-M				
		NRZ-S				
		1390-L				
		1390-M				
		1390-S				
Word length	Bits	8 or multiples of 8	x	x	x	(2)
Master Frame	Words	8 to 1024 (8-bit words)	x			(3)
	Minor Frames	12 to 256		x	x	(4)
Master Frame Sync	Bits	8, 16, 24 or 32	x			(5)
	Bits	8 bits of unique sync pattern		x		(6)
	Bits	8 bit Minor Frame Counter			x	(7)
Minor Frame Length	Words	8 to 1024 (8-bit words)		x	x	
Minor Frame Sync	Bits	8, 16, 24, or 32		x	x	(8)
Frame Rate	Master Frame/Sec	1200 maximum	x			
	Minor Frames Per Sec	1200 maximum		x	x	
Formats Sample Rates (Non-standard)	Samples/Master Frame	Limited only by payload input bit rate	x	x	x	(9)
Format Sample Rates (Standard)	Samples/Master Frame	Master Frame rate only	x			(10)
		One equal to Minor Frame rate		x		(11) (12)

**Table 8.2.1.1-1 PDD Input Data Characteristics-Attached Interface Shuttle Standard Format (Continued)**

Parameter	Dimension	PDD Tolerance	Data Formats			Notes
			1	2	3	
		Six equal to integer submultiple of Minor Frame rate.		x		
		One equal to Minor Frame rate			x	(11) (12)
		Six equal to integer submultiple of Minor Frame rate.	x		x	

**Notes:**

- (1) Refer to Figure 8.2.1.1-1. Bit rate clock is required with NRZ codes.
- (2) Multiword measurements (multiples of 8 bits) shall be structured with the most significant byte first-least significant byte last. Bit packing shall have the measurement's most significant byte located within the most significant word (most significant bit first) with unused bits located within the least significant word (most significant bit first).
- (3) Refer to Figure 8.2.1.1-2.
- (4) Refer to Figures 8.2.1.1-4 and 8.2.1.1-6.
- (5) Any pattern (with exception JAZ320M bit pattern shall not be used) of contiguous bit position located in first or last word(s) of every master frame. Utilization of the last word(s) may preclude telemetry data stream processing at KSC.
- (6) Any pattern located within the first or last minor frame in any word column, other than the minor frame sync word column(s).
- (7) Ascending or descending binary count which increments or decrements one count each minor frame. Initial count value is programmable. Count pattern shall always be Most Significant Bit (MSB) first and right justified. Location of the minor frame count word within each minor frame can be any word column, other than minor frame Sync word column(s), but has to be same for every minor frame.

An example of the Minor Frame Counter (MFC) with a Type 3 format with 8 minor frames is as follows:

The initial value of the MFC is 00000000, signifying the start of the master frame. The MFC increments each minor frame to a count of 00001111, signifying end of master frame.

**Table 8.2.1.1-1 PD9 Input Data Characteristics--Attached  
Interface Shuttle Standard Format (Concluded)**

- (8) *Any pattern of contiguous bit positions located in first or last word(s) of every minor frame. (See Note 5 for KSC limitations.)*
- (9) *For those payloads which require no Orbiter GPC software services (payload data via the PD9 toggle buffer only), their PCM telemetry formats can utilize nonstandard sample rates. Any sample rate which is not an integer multiple/submultiple of the payload frame rate is considered a nonstandard rate.*
- (10) *Refer to Figure 8.2.1.1-5. Payload measurements within the Master Frame (Type 1) whose measurements are at the Master Frame rate can be processed by the PD9 only when multiple Measurement Stimulus Identification Document (MSID) numbers are used to specify each payload measurement.*
- (11) *Format Type 2 shall contain a maximum of seven sample rates per format. One of sample rates shall be equal to the number of minor frames per master frames. The remaining six sample rates shall be any submultiple of the minor frame rate as described by Figure 8.2.1.1-5.*
- (12) *Refer to Figure 8.2.1.1-5. Payload measurements within the minor frame whose sample rates are integer multiples of the minor frame rate can be processed by the PD9 but only when multiple MSID numbers are used to specify each payload measurement.*

*Each payload measurement is identified by a unique alphanumeric code (MSID) assigned by NASA/JSC as directed by "Space Shuttle Master Measurement List", document number JSC - 08220.*

*The PD9 is not capable of processing payload sample rates which are less than the smallest integer submultiple of the payload minor frame rate (Y) as defined within Figure 8.2.1.1-5.*

TABLE 8.2.1.2-1 PDI INPUT DATA CHARACTERISTICS-ATTACHED  
INTERFACE SHUTTLE NON-STANDARD FORMATS

Parameter	Dimension	PDI Tolerance	Payload Characteristic	Notes
Bit Rate (center frequency)	BPS	10 BPS to 64 KBPS		
Input Signal Code		NRZ-L NRZ-M NRZ-S BIØ-L BIØ-M BIØ-S		Refer to Figure 8.2.1.1-1. Bit rate clock is required with NRZ codes.



**TABLE 8.2.1.3.1-1 PDI DATA INPUT/PAYLOAD-TO-ORBITER  
ELECTRICAL INTERFACE CHARACTERISTICS**

Parameter	Dimension	Characteristics Orbiter/Payload Interface	Notes
Signal Type		Differential-Balanced	Refer to Figures 8.2.1.3.1-1 and 8.2.1.3.1-2
Amplitude	Volts Pk-pk	2.4 Min 9.0 Max	Measured line-to- line
Duty Cycle	Percent	50 ± 5	(1)(2)
Bit-Rate Accuracy	Percent	±3.25	(3)
Stability		≤ 1 part in 10 <sup>5</sup> over 60 sec Period	
Waveform Distortion		Overshoot and undershoot less than 20 percent of peak amplitude level	
Noise	Milli- volts	50 pk-pk, differential line-to-line, DC to 100 KHz	Payload transmit- ting, not transmit- ting, or failed
Cable		2 conductor twisted, shielded, jacketed, controlled impedance	Rockwell design standard MP572- 0328-0002
Cable impedance Z <sub>0</sub>	Ohm	70 Min 80 Max	Measured conductor to conductor at 1 MHz
Cable Capacitance (Orbiter)	Pico- farads	2530 Max	(8)
Input Impedance (Orbiter)	Ohm	74 Min 90 Max	DC resistance line- to-line includes cable resistance (8)
Rise/Fall Time		Max: Refer to Differ- ential Phase Skew	(4) RT/FT are indepen- dent of bit rate and data code type (Bi0 or NRZ).

**Table 8.2.1.3.1-1 PDS Data Input/Payload-To-Orbiter  
Electrical Interface Characteristics (Continued)**

Parameter	Dimension	Characteristics Orbiter/Payload Interface	Notes
Skew- Differential Phase	Nano- second to Milli- second depending on PL bit rate		(5) (7)
For BiØ data:		<p>Max:  <math>T_p = .841 T_p - (1 \times 10^{-6}) - 2 N T_p - .125 \times 10^6 -</math></p> $T_{LR} = \text{LOG}_e \left( \frac{V_{LPK} - 100 \text{ millivolts}}{V_{LPK} - 300 \text{ millivolts}} \right)$ $T_{TR} = \text{LOG}_e \left( \frac{V_{TPK} + 300 \text{ millivolts}}{V_{TPK} + 100 \text{ millivolts}} \right)$	
		<p>Where:  N = Payload Duty Cycle Offset <math>0 \leq N \leq 0.05</math>  V<sub>LPK</sub> = Peak amplitude level of BiØ waveform  leading edge.  V<sub>TPK</sub> = Peak amplitude level of BiØ waveform  trailing edge.  T<sub>p</sub> = Reciprocal of max. payload bit rate.  T<sub>LR</sub> = Max. rise time of BiØ waveform  leading edge measured between 10  percent and 90 percent points.  T<sub>TR</sub> = Max. fall time of BiØ waveform  trailing edge measured between 10  percent and 90 percent points.</p>	

Table 8.2.1.3.1-1 P/D Data Input/Payload-To-Orbiter  
Electrical Interface Characteristics (Continued)

Parameter	Dimension	Characteristics Orbiter/Payload Interface	Notes
Skew- Differential Phase (Cont.)			
For NRZ data:		Max:	
		$T_p - .691 \tau - N T_p -$	
		$T_{CR} \text{ LOG } \left( \frac{V_{CPK - 100 \text{ millivolts}}}{V_{CPK - 300 \text{ millivolts}}} \right)$	
		$T_{DR} \text{ LOG } \left( \frac{V_{DPK + 300 \text{ millivolts}}}{V_{DPK + 100 \text{ millivolts}}} \right)$	
		<p>Where:</p> <p><math>N</math> = Payload Clock Duty Cycle Offset <math>0 \leq N \leq 0.05</math></p> <p><math>V</math> = Peak amplitude level of Payload CPK CLOCK signal.</p> <p><math>V</math> = Peak amplitude level of Payload NRZ DPK DATA signal</p> <p><math>f_p</math> = Reciprocal of max. payload bit rate (Center Frequency)</p> <p><math>T_{CR}</math> = Max. transition time (rise or fall time) of payload CLOCK signal measured between 10 percent and 90 percent points.</p> <p><math>T_{DR}</math> = Maximum transition time (rise or fall time) of payload NRZ DATA signal measured between 10 percent and 90 percent points.</p>	

**Table 8.2.1.3.1-1 PDI Data Input/Payload-To-Orbiter  
Electrical Interface Characteristics (Continued)**

Parameter	Dimension	Characteristics Orbiter/Payload Interface	Notes
Common Mode	Volt	Not to exceed $\pm 3$ , Line to ground	(6) Payload and PDI Connected

- (1) Relative position of  $Bi_0$ -L mid bit transition at interface.
- (2) Any bit or clock transition point occurs in time at the 50 percent pk-pk amplitude point.
- (3) The PDI shall set an error flag within its BITE Status Register whenever the Payload bit rate exceeds  $\pm 3.25$  percent of its specified center frequency.
- (4) The maximum limit for Payload signal Rise/Fall time is not to be determined independently, but instead is to be determined as part of a tradeoff with other related offsets. In order to make that tradeoff, the appropriate general case equation for Differential Phase Skew shall be utilized.
- (5) These two general case equations for  $Bi_0$  data and NRZ data are an expression of how the Payload bit period is partitioned between the PDI's Bit Lock Range, Payload Duty Cycle Offset, PDI Programmed Bit Rate Offset (for  $Bi_0$  data only), and Payload maximum Rise and Fall time. The solution for each of these two general case equations indicates that amount of the Payload bit period which remains for partitioning between the payload signal Differential Phase Skew and/or Phase Shift. A solution for either of these two general case equations which produces a negative results indicates that the appropriate Offsets themselves have utilized all the remaining Payload bit period such that none is available for Differential Phase Skew and/or Phase Shift. PDI Bit Lock Range identifies the absolute minimum amount of the Payload bit period required for the PDI's Bit Synchronizer to achieve and maintain bit lock.

<u>Data Type</u>	<u>Bit Lock Range</u>
$Bi_0$	$0.841 T_p \pm (1 \times 10^{-6})$
NRZ	$0.691 T_p$

Payload Signal Differential Phase Skew, as defined here, shall consist of the absolute value of the difference between the Leading Edge Phase Shift and the Trailing Edge Phase Shift (refer to Figure 8.2.1.3.1-3), and is independent of Payload amplitude level.

TABLE 8.2.1.3.1-1 PDI DATA INPUT/PAYLOAD-TO-ORBITER  
ELECTRICAL INTERFACE CHARACTERISTICS (Continued)

Payload Signal Phase Shift is the time differential between the 50 percent points of associated amplitude transitions of the two Payload differential inputs.

PDI Programmed Bit Rate Offset shall be 0.125  $\mu$ sec for all bit data rates from 10 BPS to 64 KBPS.

- (6) Volts over frequency spectrum from DC to 100 KHZ.
- (7) The example illustrates how the Bit Data general case equation for Differential Phase Skew shall be utilized by a Payload user. The following Payload interface characteristics are utilized as part of the first tradeoff for determining the Payload user's upper limit for each of the Offsets applicable to that Payload.

Bit Rate (Center Frequency):	1600 BPS
Bit Data Duty Cycle:	50 $\pm$ 5 percent
Bit Data Peak Amplitude:	1.25 volts
Maximum Transition Time: (Rise and Fall Time)	5 $\mu$ sec

For the specified center frequency of 1600 BPS, the corresponding amount of time for one bit period is:  $T_p = \frac{1}{1600 \text{ BPS}} = 625 \mu\text{seconds}$ .

Within each Payload bit period ( $T_p$ ), the general case equation for Bit Data Differential Phase Skew provides for the following amounts to  $T_p$  time to be dedicated to:

- 1) PDI's Bit Lock Range:

$$0.841 T_p + 1 \times 10^{-6} = 0.841 (625 \mu\text{sec}) + 1 \mu\text{sec} = 526.625 \mu\text{sec}$$

- 2) Payload Bit Data Duty Cycle Offset: 0.125  $\mu$ sec

$$2 N T_p = 2 (0.05) (625 \mu\text{sec}) = 62.50 \mu\text{sec with } N = 0.05 \text{ corresponding to a 5 percent Duty Cycle Shift.}$$

- 3) PDI Programmed Bit Rate Offset: 0.125  $\mu$ sec

- 4) Ambiguity in Change of PDI Receiver Output Due to Slow Transition Time of Payload Data Differential Inputs:

$$T_{LR} \left[ \text{LOG}_e \left( \frac{V_{LPK} - 100 \text{ MV}}{V_{LPK} - 300 \text{ MV}} \right) \right] + T_{TR} \left[ \text{LOG}_e \left( \frac{V_{TPK} + 300 \text{ MV}}{V_{TPK} + 100 \text{ MV}} \right) \right] =$$

TABLE 8.2.1.3.1-1 PDI DATA INPUT/PAYLOAD-TO-ORBITER  
ELECTRICAL INTERFACE CHARACTERISTICS (Concluded)

$$5 \mu\text{sec} \left[ \text{LOG}_e \frac{1.25 - 0.10}{1.25 - 0.30} \right] + 5 \mu\text{sec} \left[ \text{LOG}_e \frac{1.25 + 0.30}{1.25 + 0.10} \right] =$$

$$5 \mu\text{sec} \left[ \text{LOG}_e (1.21) \right] + 5 \mu\text{sec} \left[ \text{LOG}_e (1.15) \right] = 1.64 \mu\text{sec}$$

The remaining amount of  $T_p$  time which is available to the Payload user for partitioning between Payload Bit Data Differential Phase Skew and/or Phase Shift is:

$$\text{Diff. Phase Skew/Phase Shift} = 625 \mu\text{sec} - 526.625 \mu\text{sec} - 62.5 \mu\text{sec} - 0.125 \mu\text{sec} - 0.125 \mu\text{sec} - 1.64 \mu\text{sec} = 34.11 \mu\text{sec}.$$

This completes the first tradeoff such that the general case equation for Bit Data Differential Phase Skew has enabled the Payload user to dedicate the following amounts of time as upper limits for:

$$0 \leq \text{Duty Cycle Offset} \leq 62.5 \mu\text{seconds}$$

$$0 \leq \text{Transition Time Ambiguity} \leq 1.64 \mu\text{seconds}$$

$$0 \leq \text{Diff. Phase Skew/Phase Shift} \leq 34.11 \mu\text{seconds}$$

If these upper limits are acceptable, then the Payload user shall determine the actual amounts of time to be allocated to each appropriate Offset. These "Actual Values" shall be specified within the corresponding Unique Payload/Shuttle Orbiter ICD so as to characterize the Payload-to-PDI interface. If these upper limits are not acceptable, then the Payload user shall have to develop a second tradeoff with an appropriate change in either the Duty Cycle Shift, Maximum Transition Time, or Peak Amplitude. It should be noted that a Payload user can only change PDI Bit Lock Range by choosing a different Payload Bit Rate.

The general case equation for NRZ Data Differential Phase Skew is utilized in a manner identical to its Bit Data counterpart with the exception that PDI Programmed Bit Rate Offset is not included.

(8) Calculations based upon 110 feet from PDI to payload interface (end of SMCH)

TABLE 8.2.1.3.2-1 PDI CLOCK INPUT/PAYLOAD-TO-ORBITER  
ELECTRICAL INTERFACE CHARACTERISTICS

Parameter	Dimension	Characteristics Orbiter/Payload Interface	Notes
Signal Type		Differential-balanced	Refer to Figures 8.2.1.3.1-1 and 8.2.1.3.1-2
Amplitude	Volts Pk-pk	Min: 2.4 Max: 9	Measured Line-to- line
Duty Cycle	Percent	50 ± 5	NRZ bit rate clock
Skew - Data to clock (NRZ)		Max: ±10 percent of clock period	Bit rate clock to NRZ bit start (1). See Figure 8.2.1.3.2-1.
Stability		≤ 1 part in 10 <sup>5</sup> over 60 sec period	
Clock Accuracy	Percent	± 3.25	(2)
Waveform Distortion		Overshoot and undershoot less than 20 percent of peak amplitude level	
Noise	Milli- volts	100 pk-pk, differential line-to-line, DC to 100 KHz	Payload transmit- ting, not transmit- ting, or failed
Cable		2 conductor, twisted, shielded, jacketed, controlled impedance	Rockwell design standard MP572- 0328-0002
Cable Impedance Z <sub>0</sub>	Ohm	70 Min 80 Max	Measured conductor to conductor at 1 MHz
Cable Capacitance	Pico- farads	2530	(4)
Input Impedance (Orbiter)	ohm	74 Min 90 Max	DC resistance line- to-line at inter- face includes cable resistance (4)

TABLE 8.2.1.3.2-1 PDI CLOCK INPUT/PAYLOAD-TO-ORBITER  
ELECTRICAL INTERFACE CHARACTERISTICS (CONCLUDED)

Parameter	Dimension	Characteristics Orbiter/Payload Interface	Notes
Rise/Fall Time		Max: Refer to differ- ential phase skew	RT/FT are independ- ent of bit rate and data code type (BiØ or NRZ)
Skew Differential Phase	Nanosec to milli- sec depending on bit rate	Maximum value shall be the same as that speci- fied for associated NRZ data	
Common Mode	Volt	Min: -3 pk-pk continuous or -60 pk-pk for 10µsec for damage level Max: +3 pk-pk continuous or +60 pk-pk for 10µsec for damage level	+3V from EMI, neg- ligible from pay- load or PDI (3)

- (1) Any bit or clock transition point occurs in time at the 50 percent pk-pk amplitude points.
- (2) The PDI shall set an error flag within its BITE Status Register whenever the Payload bit rate exceeds  $\pm 3.25$  percent of its specified center frequency.
- (3) Volts across frequency spectrum from DC to 100 KHz.
- (4) Calculations based upon 110 ft from PDI to Payload Interface (End of SMCH).



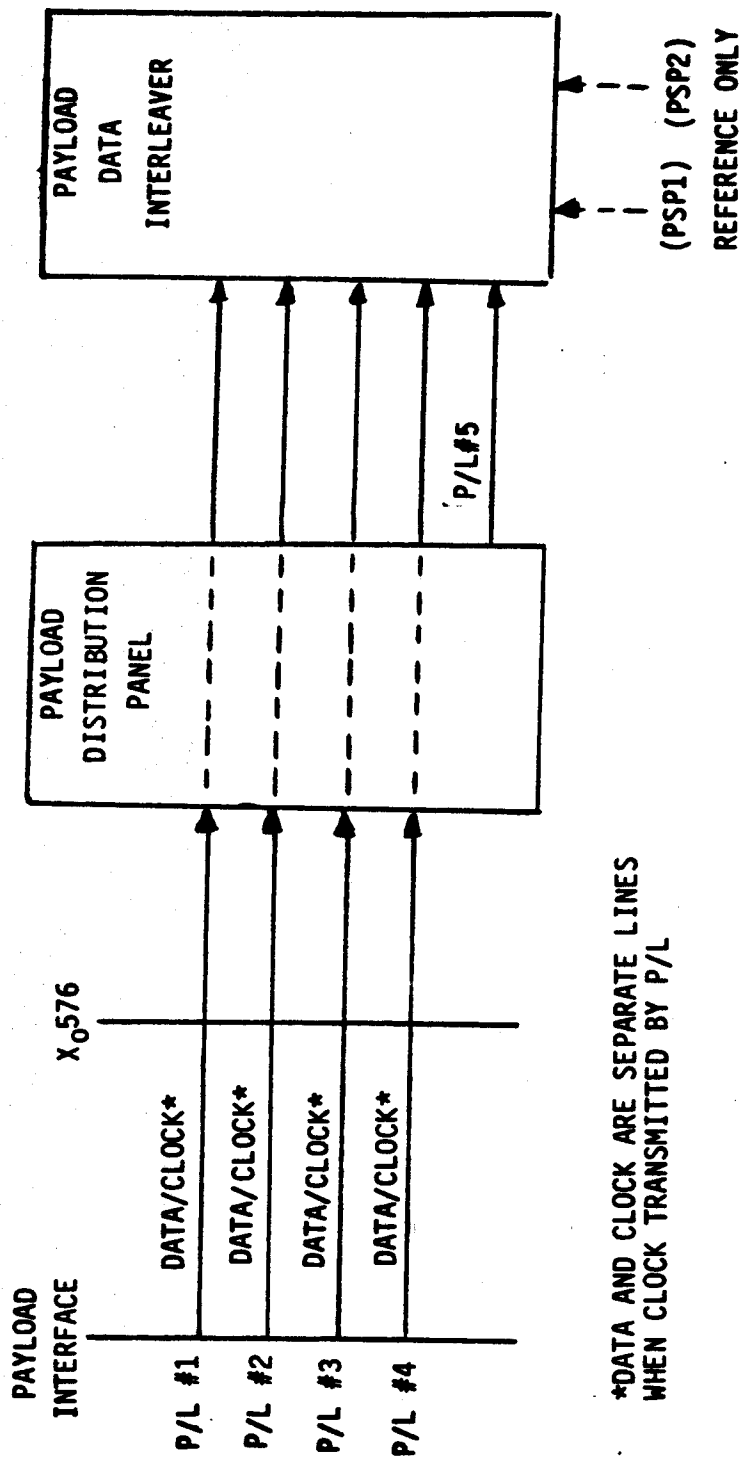
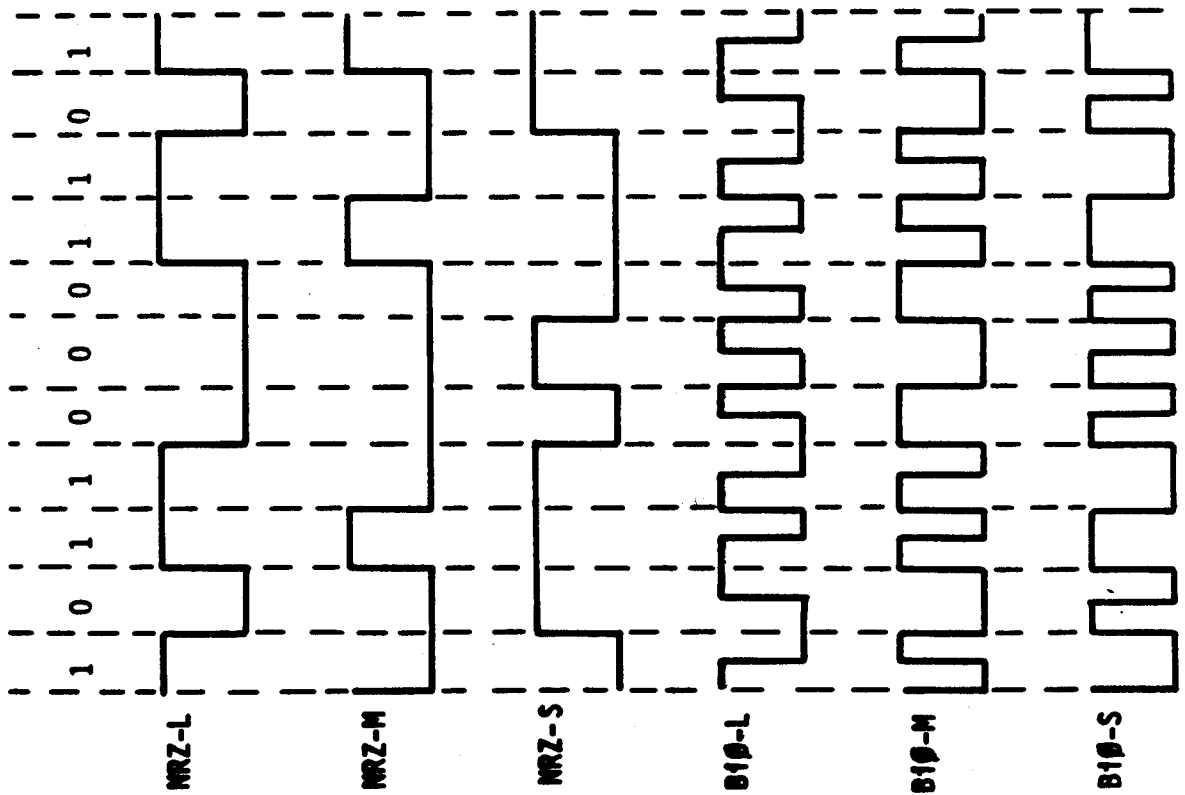


FIGURE 8.2.1-1 PAYLOAD DATA INTERLEAVER DATA FLOW



**NRZ-LEVEL (OR NRZ CHANGE):**  
 "ONE" IS REPRESENTED BY ONE LEVEL;  
 "ZERO" IS REPRESENTED BY THE OTHER LEVEL

**NRZ-MARK**  
 "ONE" IS REPRESENTED BY A CHANGE IN LEVEL;  
 "ZERO" IS REPRESENTED BY NO CHANGE IN LEVEL

**NRZ-SPACE**  
 "ONE" IS REPRESENTED BY NO CHANGE IN LEVEL;  
 "ZERO" IS REPRESENTED BY A CHANGE IN LEVEL

**BI-PHASE LEVEL (OR BI-PHASE-CHANGE):**  
 A TRANSITION OCCURS AT CENTER OF EVERY BIT PERIOD;  
 "ONE" IS REPRESENTED BY A "ONE" LEVEL WITH THE  
 TRANSITION TO THE "ZERO" LEVEL.  
 "ZERO" IS REPRESENTED BY A "ZERO" LEVEL WITH THE  
 TRANSITION TO THE ONE LEVEL

**BI-PHASE-MARK:**  
 A TRANSITION OCCURS AT THE BEGINNING OF EVERY  
 BIT PERIOD;  
 "ONE" IS REPRESENTED BY A MIDBIT TRANSITION;  
 "ZERO" IS REPRESENTED BY NO MIDBIT TRANSITION

**BI-PHASE SPACE:**  
 A TRANSITION OCCURS AT THE BEGINNING OF EVERY  
 BIT PERIOD;  
 "ONE" IS REPRESENTED BY NO MIDBIT TRANSITION;  
 "ZERO" IS REPRESENTED BY A MIDBIT TRANSITION

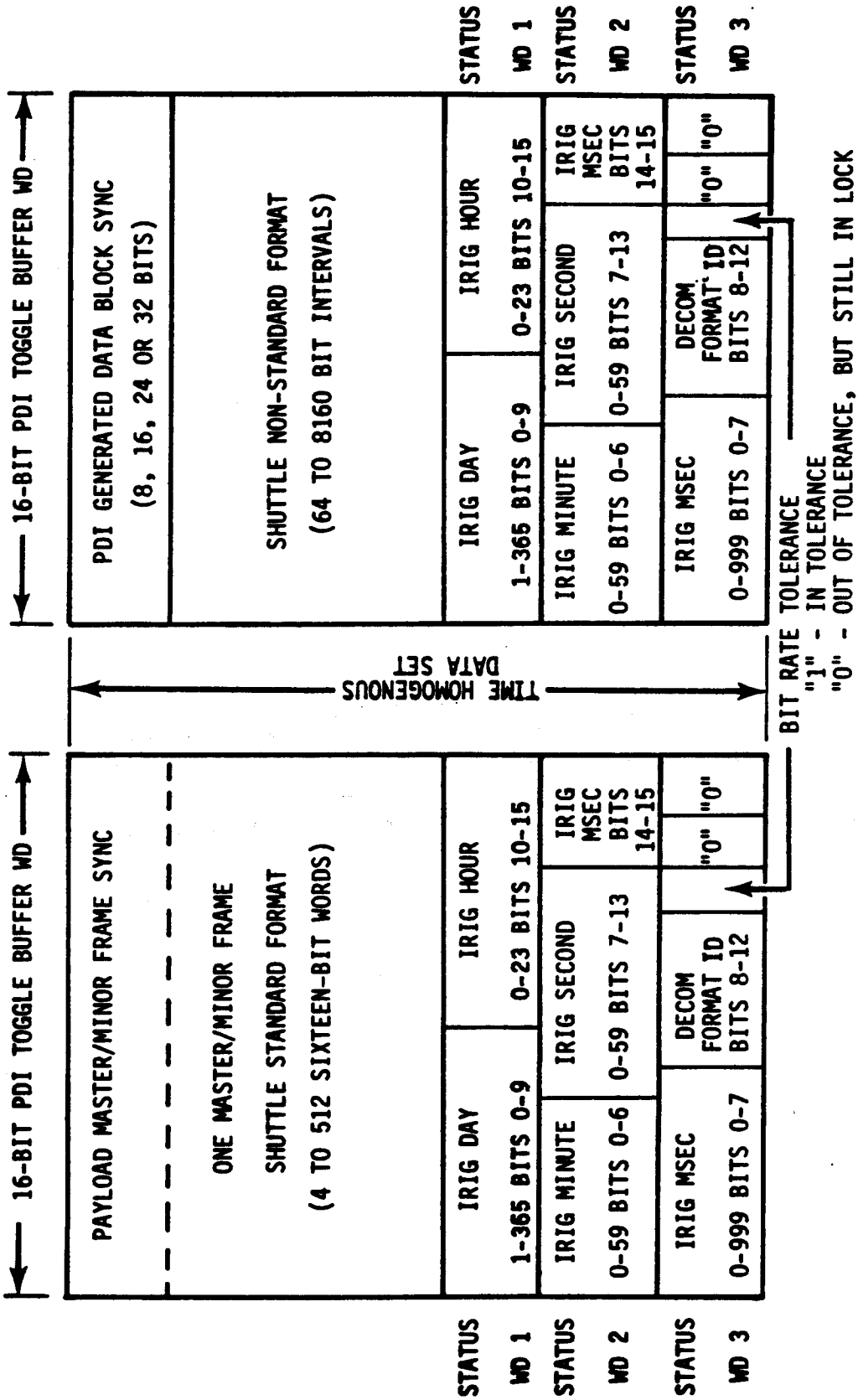
FIGURE 8.2.1.1-1 PCM INPUT CODES

MASTER FRAME ONLY

8-1024 WORDS

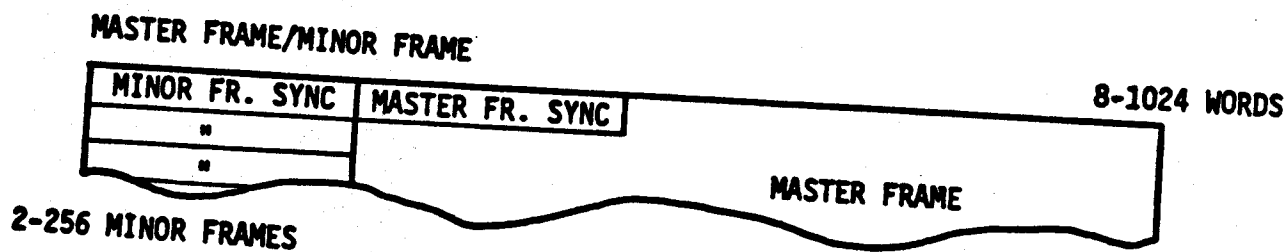
MASTER FR. SYNC	MASTER FRAME
"	"
"	"

FIGURE 8.2.1.1-2 TYPE 1 SHUTTLE STANDARD FORMAT

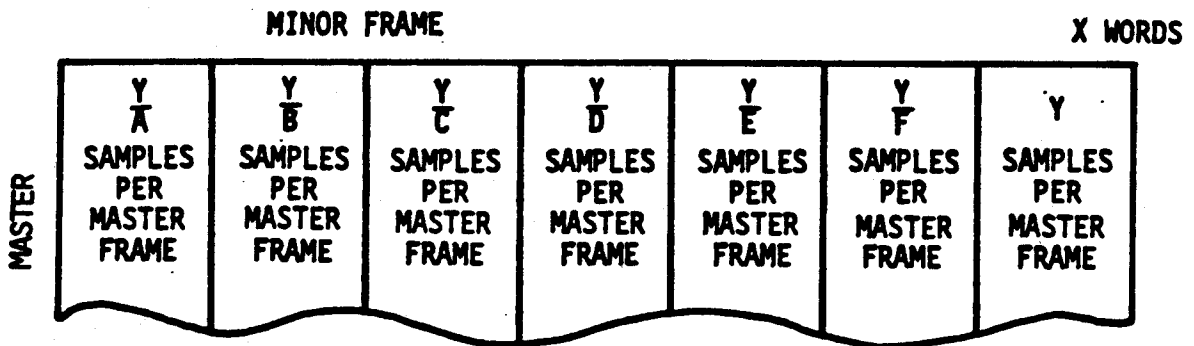


IRIG DAY, HOUR, MINUTE, AND SECOND ARE BCD CODED, MSB FIRST  
 IRIG MSEC IS BINARY CODED, MSB FIRST

FIGURE 8.2.1.1-3 FRAME DATA SET STATUS WORDS



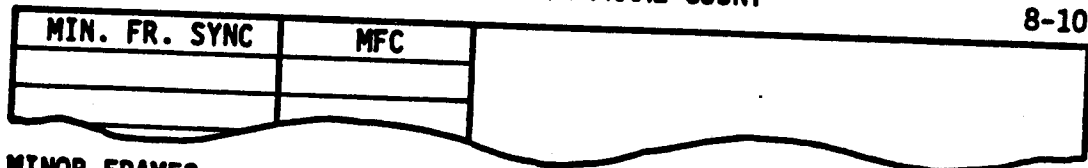
**FIGURE 8.2.1.1-4 TYPE 2 SHUTTLE STANDARD FORMAT**



**Y MINOR FRAMES PER MASTER FRAME NOTE: A,B,C,D,E,F,X, AND Y MUST BE INTEGERS. Y Y Y Y Y Y MUST BE A B C D E F INTEGERS**

**FIGURE 8.2.1.1-5 SHUTTLE STANDARD FORMAT SAMPLE RATES**

**MASTER FRAME/MINOR FRAME WITH MINOR FRAME COUNT**



**8-1024 WORDS**

**MINOR FRAMES  
2-256**

**MFC = MINOR FRAME COUNT**

**FIGURE 8.2.1.1-6 TYPE 3 SHUTTLE STANDARD FORMAT**

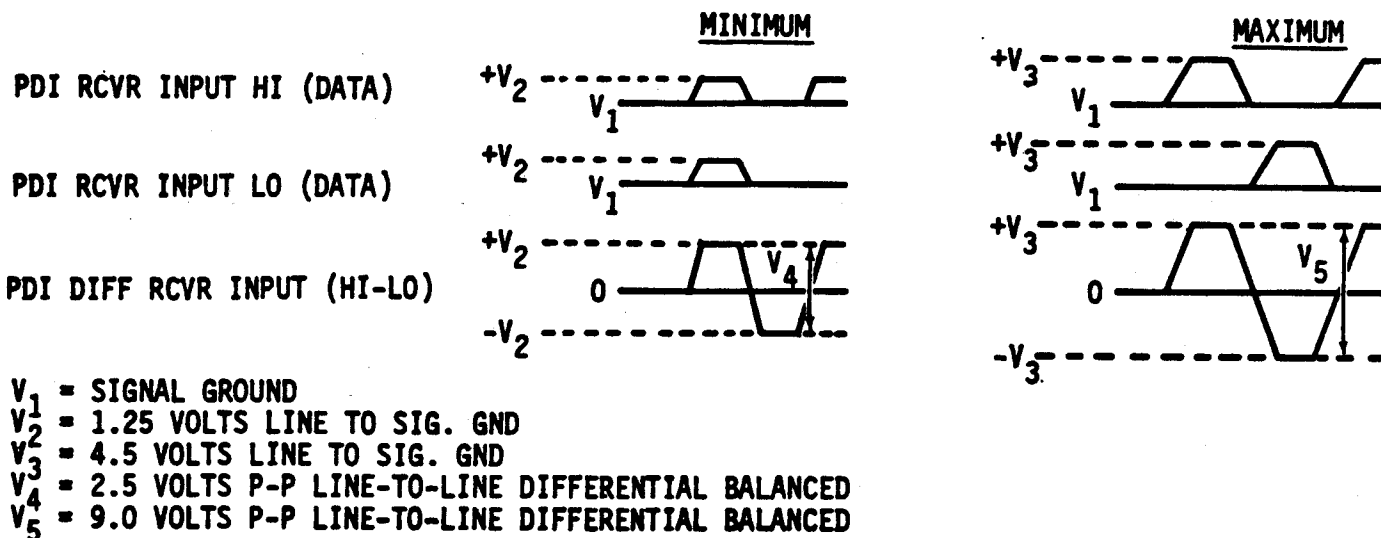


FIGURE 8.2.1.3.1-1 DATA/DATA - DIFFERENTIAL TRANSMISSION



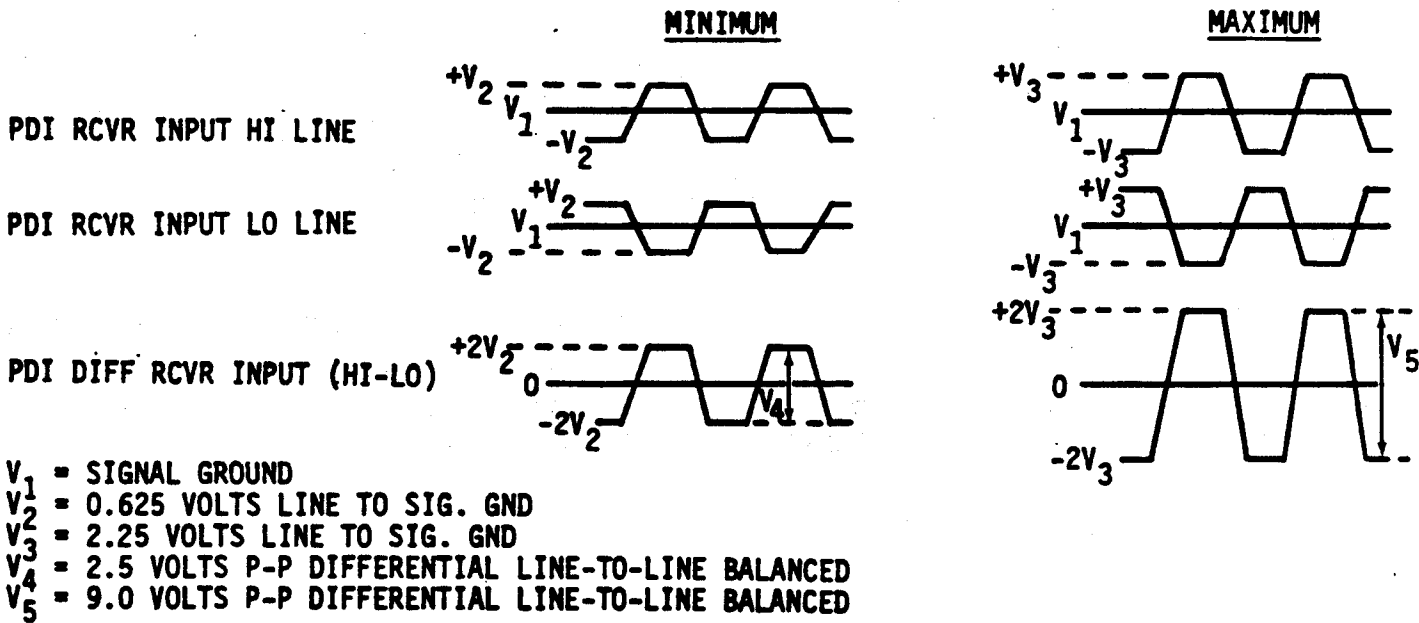
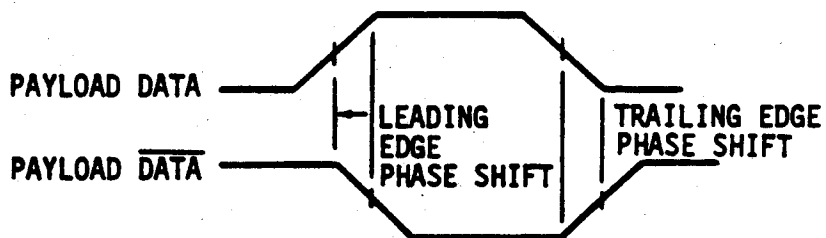


FIGURE 8.2.1.3.1-2 BI-POLAR LINES - DIFFERENTIAL TRANSMISSIONS

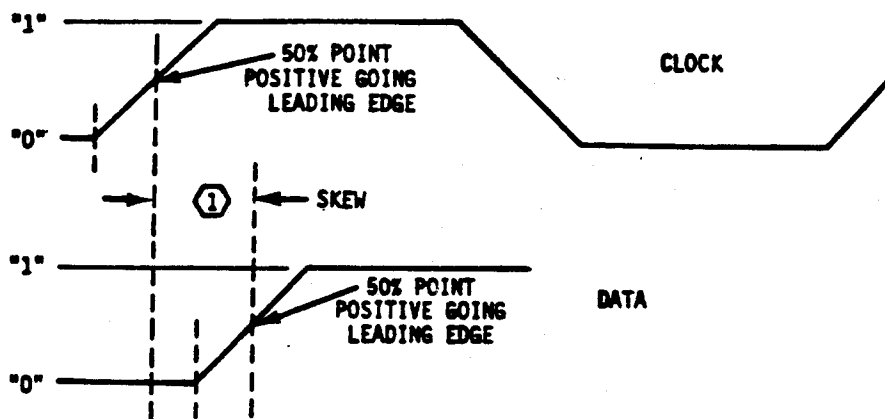


**DIFFERENTIAL PHASE SKEW = LEADING EDGE PHASE SHIFT - TRAILING EDGE PHASE SHIFT**

**WHERE:**

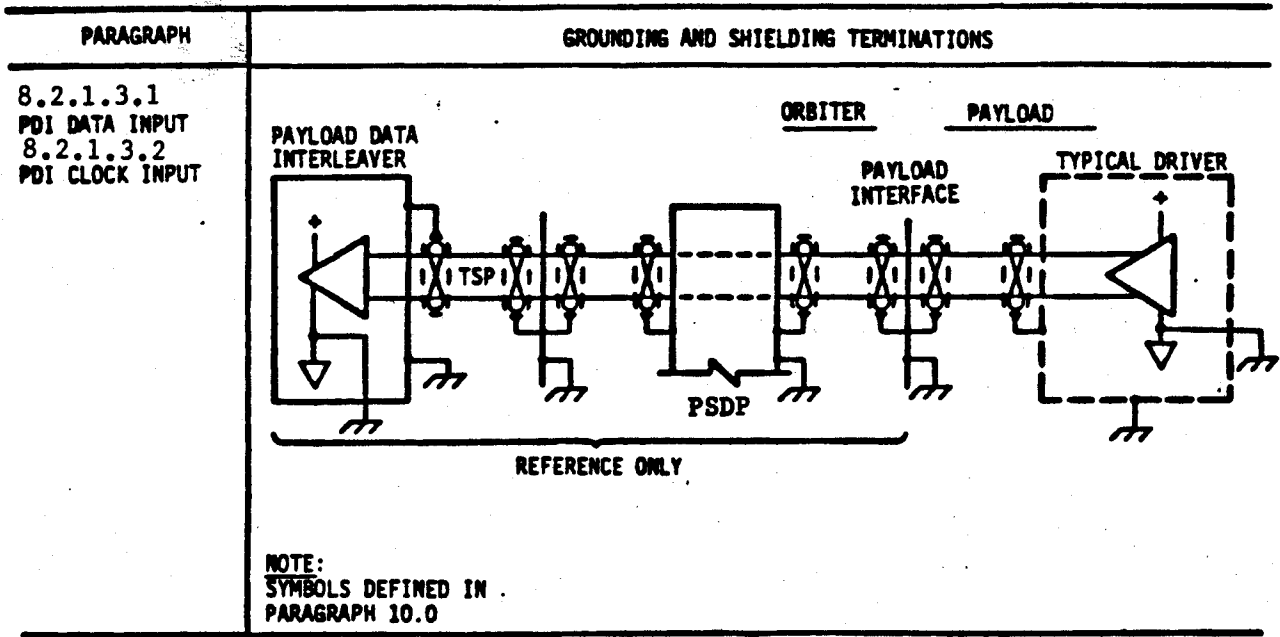
**LEADING/TRAILING EDGE PHASE SHIFT IS THE TIME DIFFERENTIAL BETWEEN 50% POINTS OF ASSOCIATED AMPLITUDE TRANSITIONS OF THE DIFFERENTIAL INPUTS.**

**FIGURE 8.2.1.3.1-3 DIFFERENTIAL PHASE SKEW**



① THE RISING EDGE OF EACH CLOCK SIGNAL SHALL BE COINCIDENT WITH THE STARTING EDGE OF THE CORRESPONDING DATA BIT PERIOD WITHIN PLUS OR MINUS 10 PERCENT OF THE CLOCK PERIOD MAXIMUM.

FIGURE 8.2.1.3.2-1 SKEW



*Figure 8.2.1.5-1 Payload Data Interleaver Grounding And Shielding Interface*

**8.2.2 Multiplexer/Demultiplexer (MDM) Interface.** The Orbiter shall provide data channels for the acquisition and control of attached payloads through MDM's which are under control of the on-board computers. MDM signal transfer capabilities at the Orbiter/payloads interfaces are:

- a. Low Level Discrete Outputs (DOL)
- b. High-Level Discrete Outputs (DOH)
- c. Low Level Discrete Inputs (DIL)
- d. Low-Level Differential Analog Inputs (AID)
- e. Serial Input/Output (SIO)
- f. High-Level Discrete Inputs (DIH)

The MDM data flow is as shown in Figure 8.2.2-1.

Measurement, Command, and Processing requirements to activate these interfaces shall be specified in the Software Section of the Unique ICD.

**8.2.2.1 Low Level Discrete Outputs (DOL).** The Electrical Interface characteristics of the MDM low level discrete output Commands at the Orbiter/Payload Interfaces shall be as shown in Table 8.2.2.1-1.

**8.2.2.2 High-Level Discrete Outputs (DOH).** The electrical interface characteristics of the MDM high level discrete output commands at the Orbiter/payloads interfaces shall be as shown in Table 8.2.2.2-1.

**8.2.2.3 Low Level Discrete Inputs (DIL).** The electrical interface characteristics of the MDM low level discrete input signals from the attached payloads, at the Orbiter/payload interfaces, shall be as shown in Table 8.2.2.3-1.

**8.2.2.4 Low Level Differential Analog Inputs (AID).** The electrical interface characteristics of the MDM low level differential analog inputs at the Orbiter/cargo interfaces shall be as shown in Table 8.2.2.4-1.

**8.2.2.5 Serial Input/Output (SIO).** Each serial I/O channel shall be dedicated to a single payload interface and when commanded from the Orbiter General Purpose Computer (GPC), one of two message discrettes shall be output to the Payload interface to identify the direction of data transfer on the data line, as shown in Figure 8.2.2.5-1. A third discrete line shall gate each word transferred. Each transaction shall start with Word 1 and shall contain up to 32 words per transaction. Each word shall contain 16 data bits preceded by a Sync pattern and followed by parity as shown in Figure 8.2.2.5-2. Data and parity shall be Manchester II format as defined in MIL-STD-1572 at 1-microsecond per bit.

**8.2.2.5.1 Channel Interface.** One serial digital I/O channel shall consist of the following signal paths: (Figure 8.2.2.5-1).

- a. Data (half-duplex)

- b. Word discrete (MDM-generated)
- c. Message out discrete (MDM-generated).
- d. Message in discrete (MDM-generated).

The "true" state of message in and out discrettes (c and d) shall be mutually exclusive. *The cable shall have characteristics as specified in Section 8.2.2.5.12.*

**8.2.2.5.2 Clock.** The transmitting device shall generate data based on its internal clock with an average output bit rate of 1-mbps, plus or minus 0.1 percent per word. When receiving data, the receiver shall derive the clock from the Manchester II code format as received.

**8.2.2.5.3 Word Format.** Word sync shall be a non-valid Manchester code, negative pulse followed by a positive pulse as shown in Figure 8.2.2.5.3-1. *The transmitting device shall generate the sync and data pulses based on its internal clock. The sync pulse width, measured from break point to break point of the negative pulse, shall be 1.5 microseconds plus or minus 3 percent. The positive half sync pulse measured from break point to break point, of a 01 bit code following sync, shall be 1.5 microseconds plus or minus 3 percent as shown in Figure 8.2.2.5.3-1. A Manchester II/10 code immediately following the data word sync will increase the apparent width of the affected pulse to 2.0 microseconds plus or minus 4.75 percent. Word sync shall be immediately followed by the first data bit. Sixteen data bits shall be followed by one parity bit making the number of true data bits for each word odd. Following the parity bit of the previous word, the sync shall include an uncontrolled region of the negative going pulse that forms the first half of the word sync detail shown on Figure 8.2.2.5.3-1. The word format is shown in Figure 8.2.2.5-2.*

**8.2.2.5.4 Data Transfer.** Serial data transmission shall be under MDM control and shall be as follows:

- a. Transmission of word discrettes and subsequent data shall be initiated when the message discrete is switched to a logic "1" state, and shall be ended when the message discrete is switched to a logic "0" state. When a multiple word message is transferred, the message discrete shall remain in the logic "1" state during the entire multiple word message.
- b. Multiple word transfers shall take place beginning with the first word. The number of words transferred shall be a function of the number of word discrettes issued from the MDM while the message discrete is true. A new message-in discrete "True" condition shall cause the Payload to start its response with word one. A new message - out discrete "True" condition shall cause the Payload to expect an input from the Orbiter, starting with word one.
- c. The word discrete shall gate each word transferred between the MDM and Payload.
- d. The message-out discrete shall control data transmission from the MDM to the Payload. The message-in discrete shall control data transmission from the Payload to the MDM.

- e. The time phasing of the discrettes and data words shall be as shown in Figure 8.2.2.5.4-1. The rise and fall times for serial I/O discrettes shall be as shown in Figure 8.2.2.5.4-2.
- f. Data transfers shall be transmitted MSB first.

8.2.2.5.5 Data Validation by Hardware(Payload or Orbiter). Logic shall be provided in the data receiver to recognize the following: (1) improperly coded signals received from the data transmitter; (2) data dropouts in the received signals; and (3) excessive noise in the received signals. Each received word shall conform to the following minimum validation criteria.

- a. Detection of a valid Manchester II bit rate.
- b. Checks shall be made to determine that only 10 or 01 patterns occur and that only the proper number of receiver decision threshold transitions occur within each bit time.
- c. The data word shall consist of 20 bits; 3 sync, 16 data and odd parity bit.
- d. Parity bit verification. When a word fails to conform to the preceding criteria, the word shall be considered invalid and shall not be accepted by the receiving system. The receiving system shall set the proper bit in the BITE status word to indicate the applicable errors that have been detected; i.e., sync, validity, parity, etc.

8.2.2.5.6 Receiver Performance Characteristics.

8.2.2.5.6.1 Payload Serial I/O Receiver Circuit Characteristics. The receiver circuit shall be compatible with the incoming signals specified herein, and shall demonstrate a word error rate performance of less than 2 in  $10^6$  words. This performance shall be established with a line-to-line signal amplitude of 2.0 volts peak, having a rise and fall time of 250 nanoseconds measured between *the break and the opposite threshold* and impressed white Gaussian noise of 300 millivolts RMS distributed over the band 1000 Hz to 4.0 MHz. All measurements are made at the appropriate receiver input terminals.

Word Error Rate is defined as:

$$1 - \frac{\text{Total number of correctly received words}}{\text{Total number of words transmitted}}$$

The receiver shall operate with input waveforms varying from a square wave to a sine wave.

8.2.2.5.6.2 MDM Serial I/O Receiver Circuit Characteristics. The receiver circuit shall be compatible with the incoming signals specified herein, and shall demonstrate a word error rate performance of less than 2 in  $10^6$  words. This performance shall be established with a line-to-line signal amplitude of 2.3 volts peak, having a rise and fall time of 200 nanoseconds measured between 10 and 90 percent of the peak to peak amplitude and impressed white Gaussian noise of 300 millivolts RMS distributed over the band 1000 Hz to 4.0 MHz. All measurements are made at the appropriate receiver input terminals.

Word Error Rate is defined as:

$$1 - \frac{\text{Total number of correctly received words}}{\text{Total number of words transmitted}}$$

The receiver shall operate with input waveforms varying from a *square* wave to a sine wave.

**8.2.2.5.7 Receiver Common-Mode Rejection.** The MDM and Payload data receivers shall reject common mode signals for frequencies from DC to 2 MHz. The MDM shall not respond for amplitudes up to 10 volts peak, line-to-shield ground. The Payload shall not respond for amplitudes up to 10 volts peak, line to shield ground. The serial I/O transformers shall tolerate voltages between windings and ground, for up to plus or minus 50 volts DC peak. The Payload discrete receivers shall tolerate up to plus or minus 32 volts on either inputs to signal ground without damage and shall reject common mode voltage from DC to 2 MHz sinusoidal between -10 to +10 volts peak.

**8.2.2.5.8 Receiver Input Sensitivity (Data Channel Receiving End).** The data receiver shall respond to an input signal amplitude from plus or minus 8.0 volts peak line-to-line, down to a threshold level of plus or minus 0.6 volts peak, line-to-line. The receiver shall not respond to input signals less than plus or minus 0.4 volt peak. The receiver shall operate with input signal levels from plus or minus 8.0 volts peak, line-to-line, down to plus or minus 1.5 volts peak, line-to-line as measured at the input to the receiver. The input circuit shall reject noise at all frequencies below 1000 Hz and between 5 MHz and 30 MHz for voltages up to 6 volt peak line-to-line with a current limitation on the Payload data receiver of 5 MA for frequencies below 1 KHz. The message and word discrete receivers shall recognize a line to line voltage of plus 0.5 volts to plus 5.9 volts as a logic "1" and minus 0.5 volts to minus 5.9 volts as a logic "0".

**8.2.2.5.9 Output Waveform Distortion.** Distortion of the waveform by the output circuit, including overshoot and ringing shall not exceed 250 millivolts peak-to-peak, line-to-line measured on the receiver input and feedthrough.

**8.2.2.5.10 Shield Grounding.** The shield on the cable, for data and discrete interfaces, shall be grounded at the MDM and Payload I/O interface. Intermediate ground points shall be permitted by negotiation.

**8.2.2.5.11 MDM Power Off.** Signal levels due to an unpowered MDM shall be interpreted by the Payload to indicate a failed channel and shall not cause any other degradation to other data processing assembly functions.

**8.2.2.5.12 Interface Cable.** The interface cable for the SIO channel shall be a two-conductor twisted, shielded, jacketed cable. It shall conform to Specification MB0150-051 and Design Standard *MP572-0279-0002* and shall not exceed 150 feet (46 M) in total length between the Orbiter MDM and the Payload *I/O unit (up to 125 ft. from the Orbiter MDM to SMC4-SAP interface and 25 ft. from SMC4-SAP interface to Payload I/O unit).*

**8.2.2.5.13 Electrical Interface Characteristics.** The electrical interface Characteristics of the MDM SIO Channel message-in discrete, message out discrete and word discrete shall be as shown in Table 8.2.2.5.13-1. The electrical interface characteristics of the MDM SIO channel data line for the transmission and reception modes shall be as shown in Tables 8.2.2.5.13-2 and 8.2.2.5.13-3, respectively.



8.2.2.6 Grounding and Shielding. Grounding and shielding shall be as shown in Figure 8.2.2.6-1.

8.2.2.7 High-Level Discrete Inputs (DIH). The electrical interface characteristics of the MDM high-level discrete input signals from the attached payloads, at the Orbiter/Payload interfaces, shall be as shown in Table 8.2.2.7-1.

Table 8.2.2.1-1 Low-Level Discrete Output (DOL)/Orbiter-To-Payload, Electrical Interface Characteristics

Parameter	Dimension	Characteristics Orbiter/Payload Interface	Notes	
Type		Single-Ended Discrete	Load isolated (1)	
Code		Step-Level (Software Programmed)		
Analog Range				
Min	Volt	NA		
Max	Volt			
Discrete- False ("0")	Min Max	Volt Volt	-0.5 +0.5	(1) (1)
Discrete- True ("1")	Min Max	Volt Volt	+4.0 +6.0	(1)
Ripple and Noise				
Max	Milli- Volt		400	
CMV	Max	Volt	NA	
Rise/Fall Time	Min Max	Microsec Microsec	1 20	(2) (2)
(10 to 90 percent)				
Noise Sup- pression Bandwidth	Hertz		NA	
Roll-off Rate	Min	dB/Octave	NA	
CMRR	dB		NA	
Distortion			NA	
Frequency	MBPS		NA	
Bit Rate	MBPS		NA	
Transfer		Direct Coupled	Grounded at Orbiter	

*Table 8.2.2.1-1 Low-Level Discrete Output (DOL)/Orbiter-To-Payload,  
Electrical Interface Characteristics (Concluded)*

Parameter	Dimension	Characteristics Orbiter/Payload Interface	Notes
Source Impedance Min (Orbiter)	Ohm	30	
Max	Ohm	100	
Load Impedance Min (Payload)	Ohm	600	
Max	Ohm	4K	(3)
Capacitance Max	Pico-Farad	3500	Payload not to exceed 1500
Pwr. Off Impedance Min	Ohm	10K(+6 Vdc)	Payload shall exceed 600
Current Drive	Milliamp	10 (Logic "1")	
Current Sink	Milliamp	-10 (Logic "0")	±0.5 volts
Overvoltage Protection Max	Volt	±32	(4)
Fault Voltage Emission Max	Volt	±15	(4)
Fault Current Limitation Max	Milliamp	±20	
Power-Ground Isolation	Megohms	10	

**Notes:**

*0.2 millisecond state uncertainty maximum following power up.*

- (1) Reference MDM Signal Ground
- (2) 400 OHM±5 percent in parallel with 5 nanofarad ±10 percent load
- (3) An open input shall not result in an ambiguous logic state
- (4) Line-to-line and line to ground

Table 8.2.2.2-1 High-Level Discrete Output (DOW)/Orbiter-To-Payload.  
Electrical Interface Characteristics

Parameter	Dimension	Characteristics Orbiter/Payload Interface	Notes
Type		Single-Ended Discrete	(1)
Code		Step Level	
Min: Volt Max: Volt Analog Range		NA	
Discrete- False ("0")	Min: Volt Max: Volt	0 3	
Discrete- True ("1")	Min: Volt Max: Volt	19.5 32	(3)
Ripple and Noise	Max: Millivolt	0.9 V P-P single Freq., 1.6 V P-P Broadband	(2)
CMV	Max: Volt	NA	
Rise/Fall Time	Min: Microsec Max: Microsec	10 100	
Noise Sup- pression Bandwidth	Hertz	NA	
Roll-off Rate	Min: dB/Octave	NA	
CMRR	dB	NA	
Distortion		NA	
Frequency	Hertz	NA	
Bit Rate	MBPS	NA	
Transfer		Direct Coupled	

TABLE 8.2.2.2-1 HIGH-LEVEL DISCRETE OUTPUT (DOH)/ORBITER-TO-PAYLOAD,  
ELECTRICAL INTERFACE CHARACTERISTICS (Concluded)

Parameter	Dimension	Characteristics Orbiter/Payload Interface	Notes
Source			
Impedance Min	Ohm	0	
(Orbiter) Max	Ohm	450	
Load Imped-			
ance Min	Ohm	3.2K	
(Payload) Min	Ohm	10K	
Capaci-	Max	Pico-	
tance		Farad	Payload 1500 Max
		3500	
Pwr. Off			
Impedance Min	Ohm	10K (<8 Vdc)	Payload 3K Min
Current Drive	Milliamp	10 (Logic "1")	
Current Sink	Milliamp	NA	
Overvoltage Protection			
	Max	Volt	±32
Fault Voltage			
Emission Max	Volt	±32	
Fault Current Limitation			
	Max	Milliamp	20

- (1) Reference 28-volt power return.
- (2) 2.8 K Ohms ±5 percent parallel with 5000 Picofarads ±10 percent loads.
- (3) Orbiter MDM minimum power voltage is 24 Vdc.

Table 8.2.2.3-1 Low-Level Discrete Input (LDDI)/Payload-To-Orbiter, Electrical Interface Characteristics

Parameter	Dimension	Characteristics Orbiter/Payload Interface	Notes
Type		Single-Ended Discrete	Payload referenced to MDM ground
Code		Threshold Decision	
Analog Range			
Min: Volt		NA	
Max: Volt			
Discrete-False ("0")	Min: Volt Max: Volt	-0.5 +2.0	(1) (1) (2)
Discrete-True ("1")	Min: Volt Max: Volt	+2.5 +6.0	(1) (1)
Ripple and Noise	Milli- Max: Volt	300	
CMV	Max: Volt	NA	
Rise/Fall Time	Min: Microsec Max: Microsec	NA	
Noise Suppression Bandwidth	Hertz Max:	1K ± 12 percent	
Roll-off Rate	Min: dB/Octave	6	
CMRR	dB	NA	
Distortion		NA	
Frequency	Hertz	NA	
Bit Rate	MBPS	NA	
Transfer		Direct Coupled	

*Table 8.2.2.3-1 Low-Level Discrete Input (DLC)/Payload-To-Orbiter, Electrical Interface Characteristics (Concluded)*

Parameter	Dimension	Characteristics Orbiter/Payload Interface	Notes
Source Impedance Min (Payload) Max	Ohm Ohm	0 1K	
Load Impedance Min (Orbiter) Max	Ohm Ohm	14K 21K	
Capacitance max	Pico- Farad	5000	
Pwr-Off Input Impedance Min Max	Ohm Ohm	10K 14K	(3)
Current Drive	Milliamp	NA	
Current Sink Max	Milliamp	0.43	At 6.0 volts
Overvoltage Protection Max	Volt	±32	
Fault Voltage Emission Max	Volt	±15V	
Fault Current Limitation Max	Milliamp	2	

- (1) Reference return line
- (2) Open input interpreted as logic "0"
- (3) With ±6.0 volts or less applied.

TABLE 8.2.2.4-1 LOW-LEVEL DIFFERENTIAL ANALOG INPUT (AID),  
PAYLOAD-TO-ORBITER,  
ELECTRICAL INTERFACE CHARACTERISTICS

Parameter	Dimension	Characteristics Orbiter/Payload Interface	Notes
Type		Differential Analog	
Code		Balanced Input	Line-to-Line
Analog Range			(2)
Min	Volt	-5.0	
Max	Volt	+5.0	
Discrete- False			
Min	Volt	NA	
Max	Volt	NA	
Discrete- True			
Min	Volt	NA	
Max	Volt	NA	
Ripple and Noise	Milli- Max Volt	NA	
Common Mode Voltage	Max Volt	+10	
Rise/Fall Time	Min:Microsec Max:Microsec	NA	
Noise Sup- pression Bandwidth	Hertz	DC to 40 ±10 percent	
Roll-off Rate	Min: dB/Octave	6	
CMRR	dB	60 (within BW)	
Accuracy	Percent	±0.5	(1) With 10 Ohms Maximum Unbalance
Frequency	Hertz	See Filter Bandwidth and Sampling Rate	
Bit Rate	MBPS	NA	
Transfer		Direct Coupled	



TABLE 8.2.2.4-1 LOW-LEVEL DIFFERENTIAL ANALOG INPUT (AID),  
PAYLOAD-TO-ORBITER,  
ELECTRICAL INTERFACE CHARACTERISTICS (Concluded)

Parameter	Dimension	Characteristics Orbiter/Payload Interface	Notes
Source			
Impedance Min	Ohm	0	
(Payload) Max	Ohm	100	(1)
Load			
Impedance Min	Ohm	500K	≥100K power off
(Orbiter) Max	Ohm	NA	
Capacitance	Max: Pico-Farad	5000	
Pwr-Off			
Impedance Min	Ohm	100K	
Current Drive	Milliamp	NA	
Current Sink	Milliamp	0.024	At 5.0 volts
Overvoltage Protection			
Max	Volt	+32	
Fault Voltage Emission	Max: Volt	+15	
Fault Current Limitation			
Max	Milliamp	1	
Cable		TSP-ML	

- (1) Source impedance 100 Ohms maximum with 10 Ohms maximum unbalance for 0.5 percent RMS one sigma of F.S. encoding accuracy.
- (2) The measurement accuracy shall be within 0.50 percent (1 sigma full scale). The accuracy is directly affected by input noise within the filter passband or signals changing during the AID conversion time.

TABLE 8.2.2.5.13-1 MDM SERIAL INPUT/OUTPUT DISCRETE LINE,  
ORBITER-TO-PAYLOAD,  
ELECTRICAL INTERFACE CHARACTERISTICS

Parameter	Dimension	Characteristics Orbiter/Payload Interface	Notes
Type		Discrete	Complementary Single-Ended Driver
Code		Message-In Message-Out Word Discrete	
Analog Range			
Min	Volt	NA	
Max	Volt	NA	
Discrete True ("1")	Min Max Volt Volt	+2.2 +5.0	(1)(2)
Discrete False ("0")	Min Max Volt Volt	-2.2 -5.0	(1)(2)
Ripple and Noise	Milli- Max Volt	+500	
CMV	Max Volt	+10	
Rise/Fall Time	Min Max Microsec Microsec	See Figure 8.2.2.5.4-2	
Noise Sup- pression Bandwidth	Hertz	NA	
Roll-Off Rate	Min dB/Octave	NA	
CMRR	dB	NA	
Distortion	Max Volt Pk	±0.25	
Frequency	Hertz	See Figure 8.2.2.5-2	
Bit Rate	mbps	NA	

TABLE 8.2.2.5.13-1 MDM SERIAL INPUT/OUTPUT DISCRETE LINE,  
ORBITER-TO-PAYLOAD,  
ELECTRICAL INTERFACE CHARACTERISTICS (CONCLUDED)

Parameter	Dimension	Characteristics Orbiter/Payload Interface	Notes
Transfer		Direct Coupled	
Source			
Impedance Min (Orbiter)	Ohm	NA	
Max	Ohm	100	
Load			
Impedance Min (Payload)	Ohm	See Figure 8.2.2.5.4-2	
Max	Ohm	100	
Capacitance	Max: Pico-Farad	Cable length (ft) X 36/Ft	See Figure 8.2.2.5.4-2
Pwr Off			
Impedance Min	Ohm	Diode to ground	
Current			
Drive	Min: Milliamp	20	
Current Sink	Milliamp	NA	
Overvoltage Protection			
Max	Volt	$\pm 32$ VDC via 320 Ohms	(4)
Fault Voltage Emission	Max: Volt	+8	(5)
Fault Current Limitation			
Max	Milliamp	40	
Cable		Twisted shielded pair	(3)

- (1) Reference Signal Return Line (L-L)
- (2) Based on 150-ft cable length
- (3) Cable impedance is  $75 \pm 5$  ohms with 20 pf/ft  $\pm 10$  percent, line-to-line.
- (4) This is for over voltage protection of the MDM from a user generated voltage source.
- (5) This is for maximum MDM output voltage to a user.

**Table 8.2.2.5.13-2 TMDM Serial Input/Output Data Line TMDM Transmitting, Orbiter-To-Payload, Electrical Interface Characteristics**

Parameter	Dimension	Characteristics Orbiter/Payload Interface	Notes
Type		Serial Half Duplex	
Code		MIL-STD-1572 Manchester II BiØ-L	
Analog Range			
Min	Volt	NA	
Max	Volt	NA	
Peak Positive Level	Min: Volt Max: Volt	2.5 6.0	
Peak Negative Level	Min: Volt Max: Volt	-2.5 -6.0	
Ripple and Noise	Max: Milli-Volt	200rms +350Pk	Excluding Overshoot and Undershoot
CMV	Max: Volt	NA	
Rise/Fall Time (10 to 90 percent)	Min: Microsec Max: Microsec	0.06 0.25	
Noise Sup- pression Bandwidth	Hertz	Up to 6.0 V rejection below 1 KHz and between 5 and 30 MHz	(1)
Roll-off Rate	Min: dB/Octave	NA	
CMRR	dB	NA	
Distortion	Min: Milli- Max: Volt	-150 250	(1)
Frequency	Hertz	NA	
Bit Rate	mbps	1±0.1 percent (Data)	

**Table 8.2.2.5.13-2 MDM Serial Input/Output Data Line MDM Transmitting, Orbiter-To-Payload, Electrical Interface Characteristics (Concluded)**

Parameter	Dimension	Characteristics Orbiter/Payload Interface	Notes
Data Transfer		Transformer Coupled	At both ends of line
Source Impedance Min (Orbiter)	Ohm	75±10 percent	
Max (Orbiter)	Ohm	NA	
Load Impedance Min (Payload)	Ohm	75±10 percent	
Max (Payload)	Ohm	NA	
Quiescent State Recovery		75 MV max from 5 micro-sec after parity until next word sync pattern	
Capacitance Max	Pico-Farad	NA	
Pwr-Off Impedance Min	Ohm	NA	
Current Drive	Milliamp	90	At 6.0 volts peak
Current Sink	Milliamp	NA	
Overvoltage Protection Max	Volt Pk	+32 DC CM	Line to power, chassis, single gnd
Fault Voltage Emission Max	Volt	±7 +32 (Line-to-Gnd)	(1)
Fault Current Limitation Max	Milliamp	120	
Word Rate	WPS	See Figures 8.2.2.5-2 and 8.2.2.5.4-1	
Pulse Width Jitter	Nano-Second	40	

**Notes:** (1) Reference Return Line (L-L)

Table based on 150 Feet (45.7m) maximum total Orbiter plus Payload cable length.

Thruput is defined as 1 minus Bit Error Rate (BER) (i.e., valid bits received per bits transmitted). Equivalent word error rate of  $(1.9 \times 10)^{-7}$  may be used for validation (word thruput =  $1 - 1.9 (10)^{-7}$ ).

**Table 8.2.2.5.13-3 TDM Serial Input/Output Data Line TDM Receiving,  
Payload-To-Orbiter,  
Electrical Interface Characteristics**

Parameter	Dimension	Characteristics Orbiter/Payload Interface	Notes
Type		Serial Half Duplex	
Code		MIL-STD-1572 Manchester II Bi0-L	
Analog Range			
Min	Volt	NA	
Max	Volt	NA	
Peak Positive Level(2)	Min	+1.7	
	Max	+8.0	
Pk Negative Level (1)	Min	-1.7	
	Max	-8.0	
Ripple and Noise	Milli- Max	250 rms	Excluding overshoot and undershoot
CMV	Max	+10V from DC to 2 MHz sine	
Rise/Fall Time (10 to 90 percent)	Min	0.06	
	Max	0.22	
Noise Sup- pression Bandwidth	Hertz	Reject up to 6V below 1 kHz and between 5 MHz and 30 MHz	(1)
Roll-off Rate	Min	dB/Octave	NA
CMRR	dB	NA	
Distortion	Millivolt	±250 Max	(1)
Frequency	Hertz	NA	
Bit Rate	mbps	±0.1 percent (Data)	
Transfer		Transformer Coupled	At both ends of line

**Table 8.2.2.5.13-3 MDM Serial Input/Output Data Line MDM Receiving,  
Payload-To-Orbiter,  
Electrical Interface Characteristics (Concluded)**

Parameter	Dimension	Characteristics Orbiter/Payload Interface	Notes
Source			
Impedance Min	Ohm	75±10 percent	
(Payload) Max	Ohm	NA	
Load			
Impedance Min	Ohm	75±10 percent	
(Orbiter) Max	Ohm	NA	
Quiescent State Recovery (Pk) (1)		75MV Max from 5Msec after parity until next sync word	
Capaci- Max tance Payload Cable	Pico- Farad	NA	
Pwr-Off			
Impedance Min	Ohm	75±10 percent	
Load Current	Milliamp	120 at 8V Pk	
Overvoltage Protection			
Min	Volt Pk	8 Diff. 350 kHz-1.5 MHz	
Max		+32 CM	
Fault Voltage			
Emission Max	Volt	±7	(1)
Max	Volt	+32 (Line-to-Gnd)	
Fault Current Limitation			
Max	Milliamp	NA	
Pulse Width Jitter	Nano- Second	50	
Word Rate	WPS	See Figures 8.2.2.5-2 and 8.2.2.5.4-1	

**Note:** (1) Reference Return Line

Table based on 150 Feet (45.7m) maximum total Orbiter plus Payload cable length.

(1) Thruput is defined as 1 minus Bit Error Rate (BER) (i.e., valid bits received per bits transmitted). Equivalent word error rate of  $(1.9 \times 10)^{-7}$  may be used for validation (word thru put =  $1 - 1.9(10)^{-7}$  ).

TABLE 8.2.2.7-1 HIGH-LEVEL DISCRETE INPUT (DIH)/ORBITER-TO-PAYLOAD ELECTRICAL INTERFACE CHARACTERISTICS

Parameter	Dimension	Characteristics Orbiter/Payload Interface	Notes
Type		Single-Ended Discrete	
Code		Threshold Decision	
Analog Range	Min: volt Max: volt	NA	
Discrete- False ("0")	Min: volt Max: volt	0 6	
Discrete- True ("1")	Min: volt Max: volt	10 32	
Ripple and Noise	Max: Millivolt	600	
CMV	Max: volt	NA	
Rise/Fall Time	Min: Microsec Max: Microsec	10 100	
Noise Suppression Bandwidth	Hertz	DC--1K $\pm$ 12 percent	(Low-Pass Filter)
Roll-Off Rate	Min: dB/Octave	6	
CMRR	dB	NA	
Distortion		NA	
Frequency	Hertz	NA	
Bit Rate	mbps	NA	
Transfer		Direct Coupled	
Source Impedance (Payload)	Min: ohm Max: ohm	0 1K	



TABLE 8.2.2.7-1 HIGH-LEVEL DISCRETE INPUT (DIH)/ORBITER-TO-PAYLOAD ELECTRICAL INTERFACE CHARACTERISTICS (CONCLUDED)

Parameter	Dimension	Characteristics Orbiter/Payload Interface	Notes
Load Impedance (Orbiter)	Min: ohm Max: ohm	245K 357K	
Capacitance	Max: Pico-Farad	5000	
Pwr-Off Input Impedance	Min: ohm Max: ohm	245K 357K	
Current Drive	Milliamp	NA	
Current Sink	Max: Milliamp	0.13	At 32 volts
Over-voltage Protection	Max: volt	+32	
Fault Voltage Emission	Max: volt	+32	
Fault Current Limitation	Max: Microamp	320	
Power-Ground Isolation	Megohms	10	

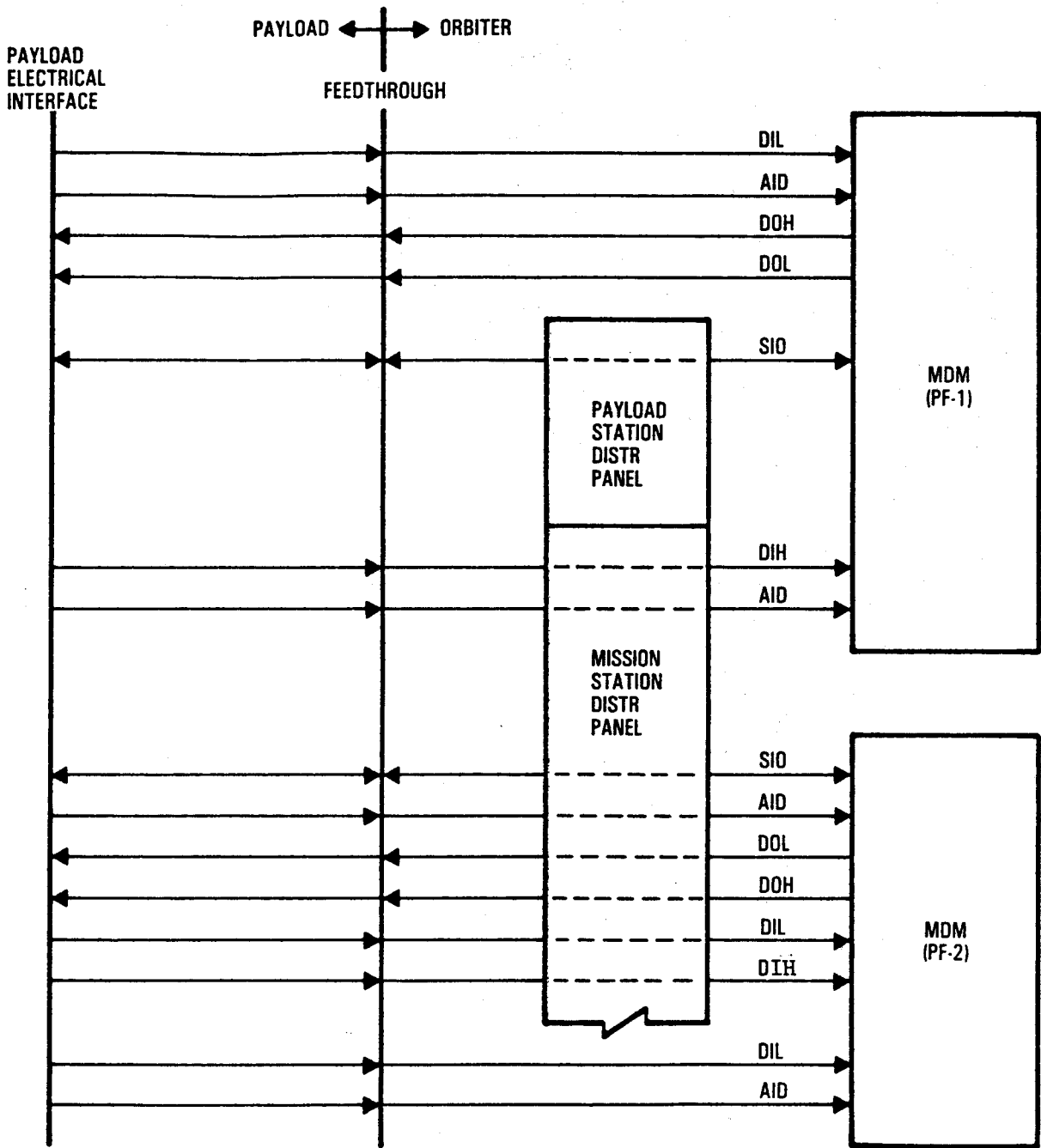


Figure 8.2.2-1 MDM Data Flow Diagram - Interface

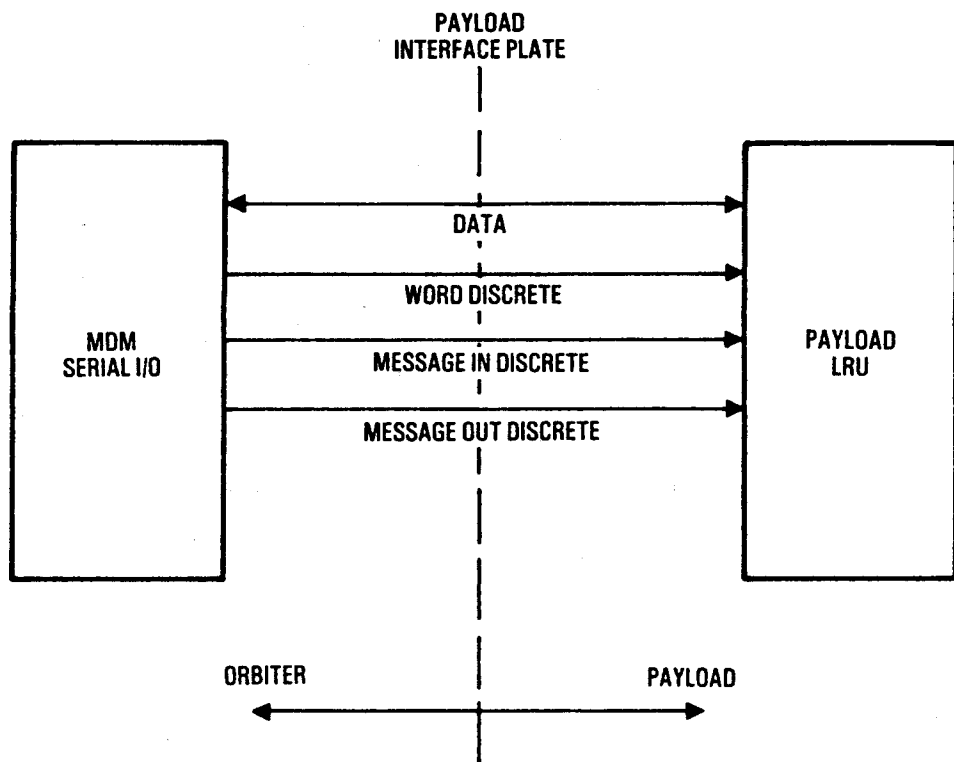


FIGURE 8.2.2.5-1 MDM SERIAL I/O INTERFACE

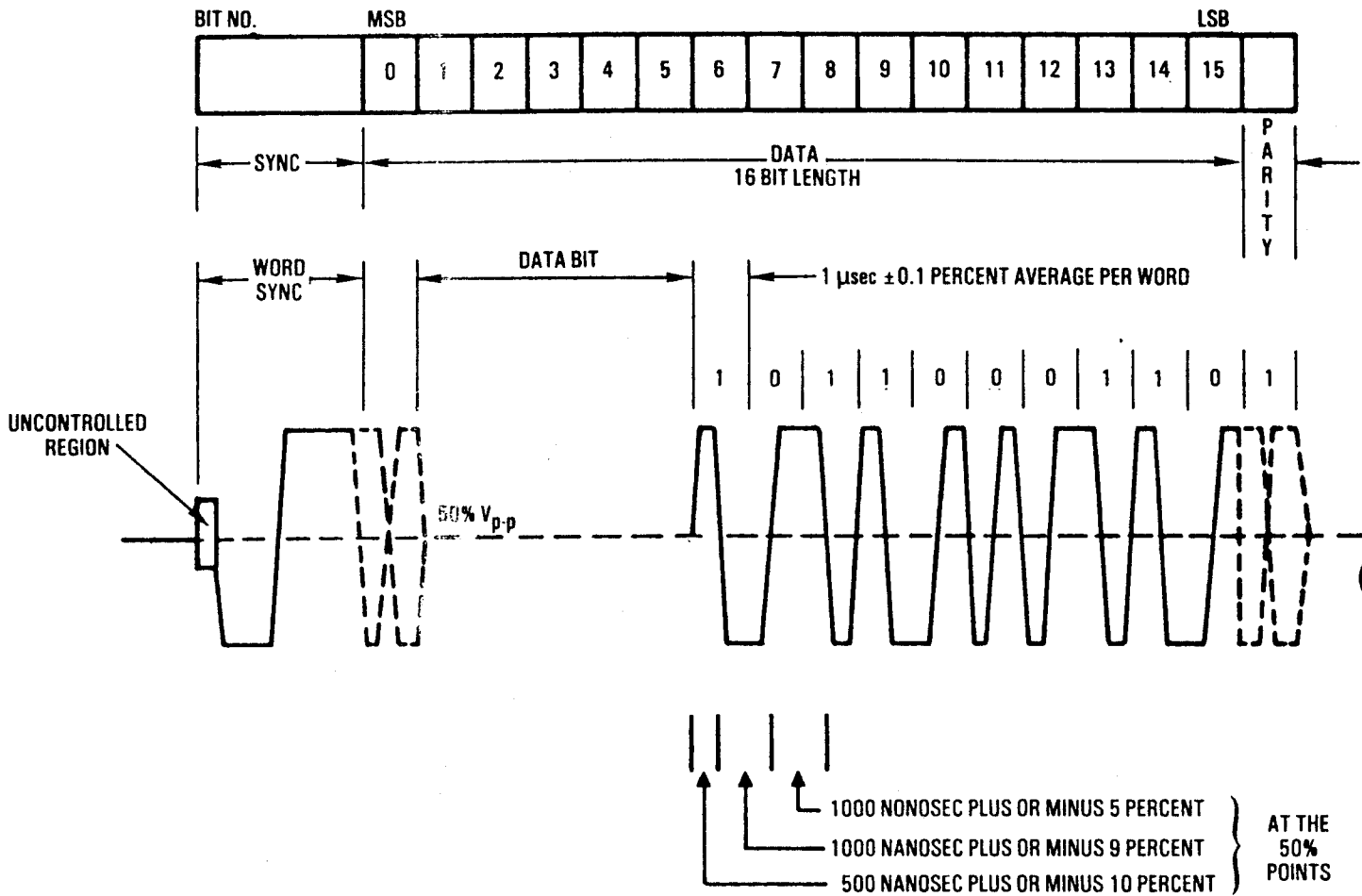
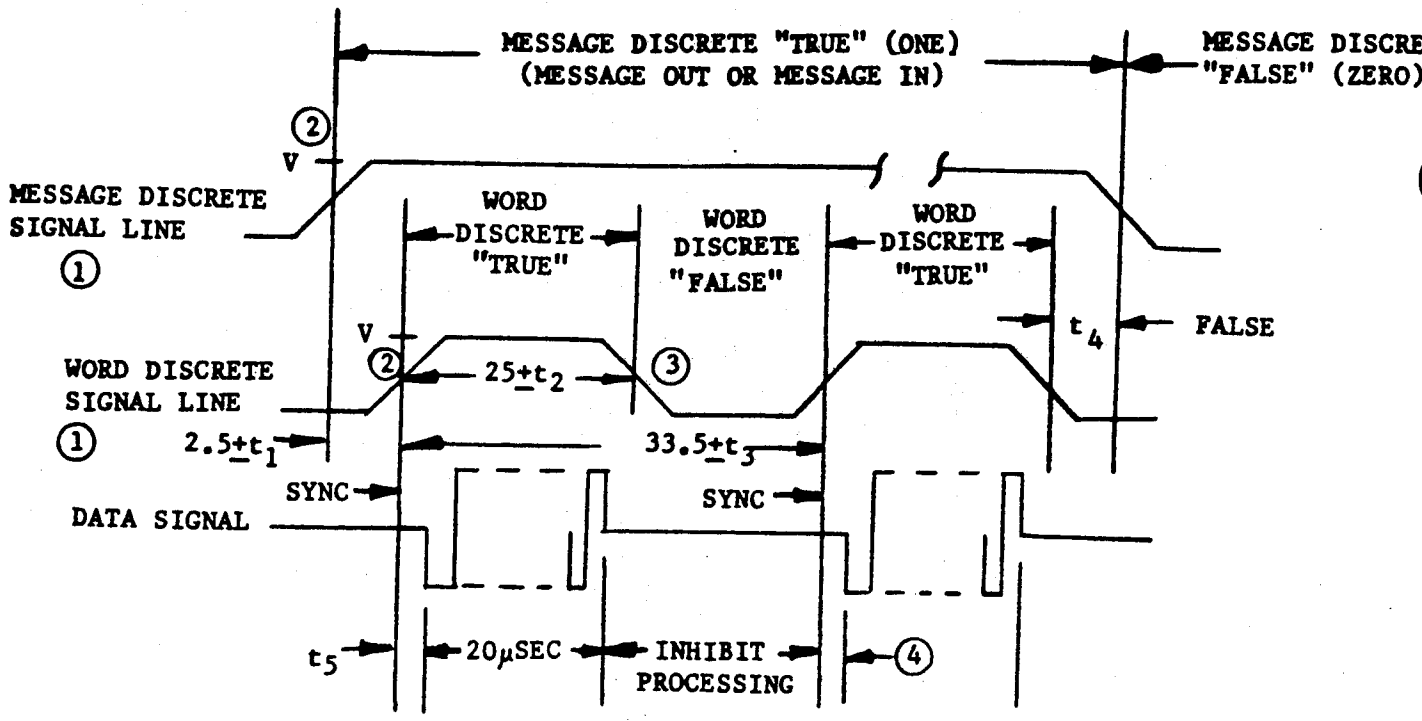


Figure 8.2.2.5-2 MDM Serial I/O Word Format



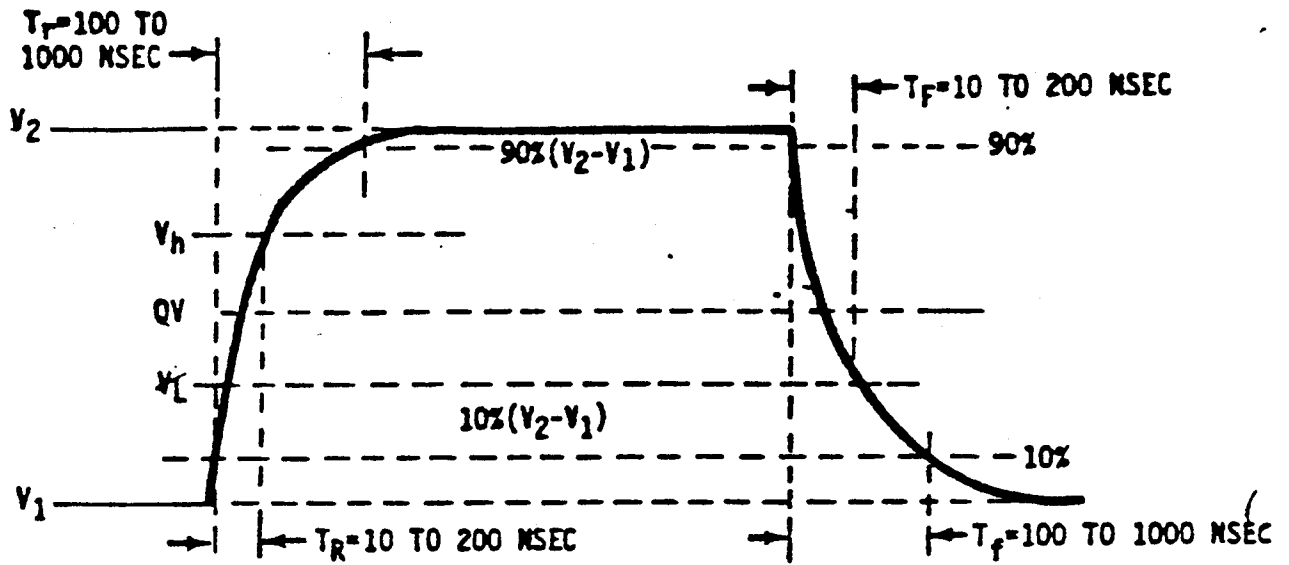


	VOLTAGE LEVELS (V) ②				TIME TOLERANCES (μSEC)					
	DISCRETE TRUE		DISCRETE "FALSE"		t <sub>1</sub>	t <sub>2</sub>	t <sub>3</sub>	t <sub>4</sub>	t <sub>5</sub>	
	SIG/GND	RET/GND	SIG/GND	RET/GND						
I/F DUE TO MDM	VERIFY LINE-TO-LINE PER FIGURE 8.2.2.5.4-2				+0.6	+1.0	+1.5	2 TO 16	XMIT	1.5±0.6
									RCV	1.8±1.0
I/F PAYLOAD REQ	VERIFY LINE-TO-LINE PER FIGURE 8.2.2.5.4-2				+0.7	+1.3	+1.8	2 TO 16	XMIT	1.5±0.6
									RCV	1.5±0.7

NOTES:

1. DISCRETE RETURN LINE CARRY LOGIC COMPLEMENT OF SIGNAL LINE LEVELS.
2. VOLTAGE LEVELS ARE SHOWN AND TABULATED WITH REFERENCES TO MDM SIGNAL GO GROUND.
3. ALL TIMING PARAMETERS ARE REFERENCED TO THE MIDPOINT OF LEADING AND TRAILING EDGES.
4. INHIBIT RESPONSES TO NOISE DURING THIS INTERVAL.
5. INTERPRET OPEN RECEIVER INPUT AS LOGIC-0.
6. MAX CABLE LENGTH 150 FEET.
7. VOLTAGE LEVELS SPECIFIED IN TABLE 8.2.2.5.13-1

FIGURE 8.2.2.5.4-1 MDM SERIAL I/O TIMING



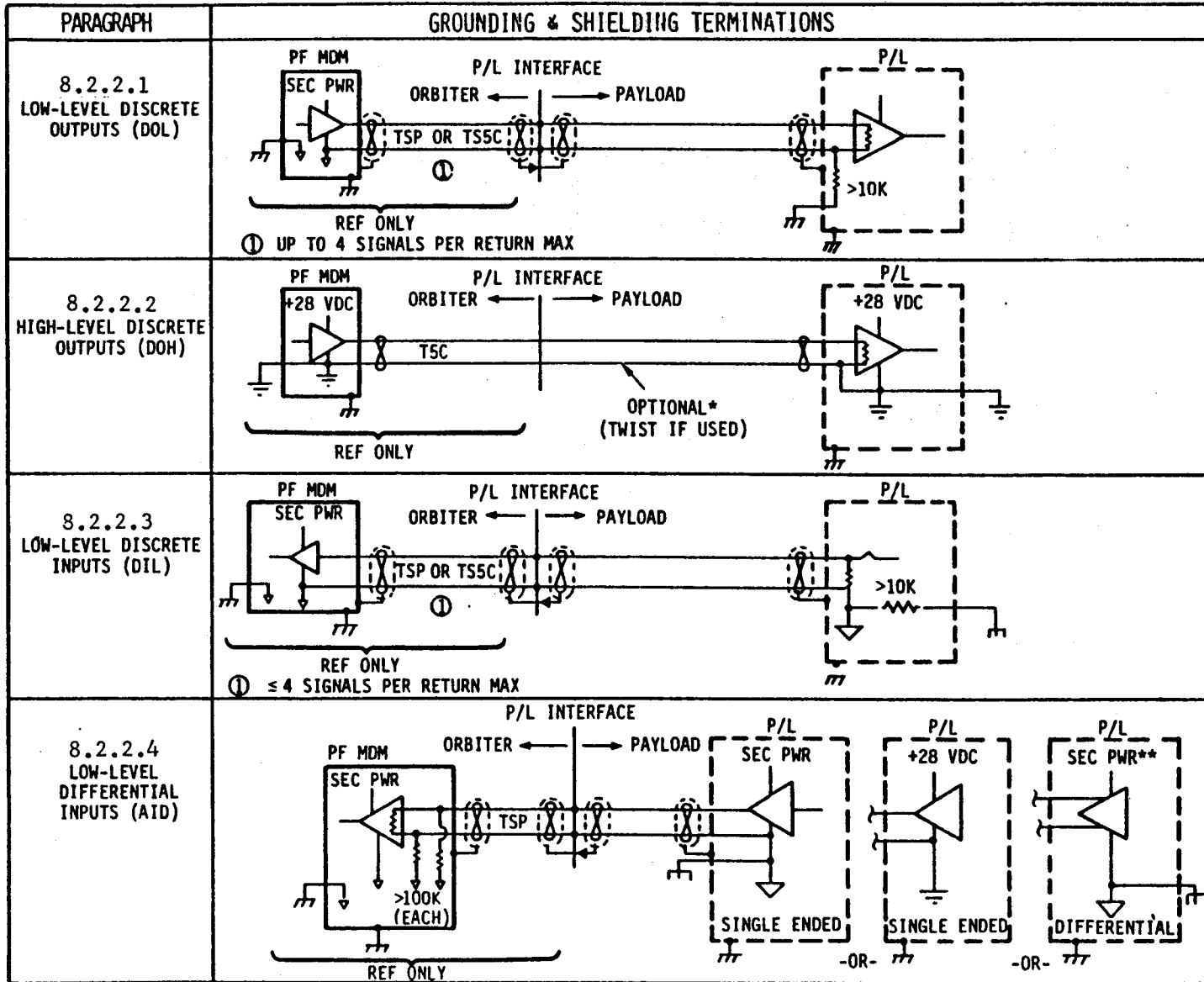
NOTE: WAVE FORM REPRESENTS LINE-TO-LINE VOLTAGE EXCURSION

FIGURE 8.2.2.5.4-2 RISE AND FALL TIMES FOR SERIAL I/O DISCRETES (SHEET 1 OF 2)

	LINE TERMINATION	V <sub>1</sub> VOLTS	V <sub>2</sub> VOLTS	V <sub>L</sub> VOLTS	V <sub>H</sub> VOLTS
RECEIVER INTERFACE PAYLOAD	<p>(INSIDE PAYLOAD)</p> <p>*BALANCED WITHIN 15%</p>				
INTERFACE DUE TO MDM		-2.2 TO -5.0	+2.2 TP +5.0	-2.2	+2.2
INTERFACE LOAD REQUIREMENT		-2.1 TO -5.9	+2.1 TO +5.9	-2.1	+2.1

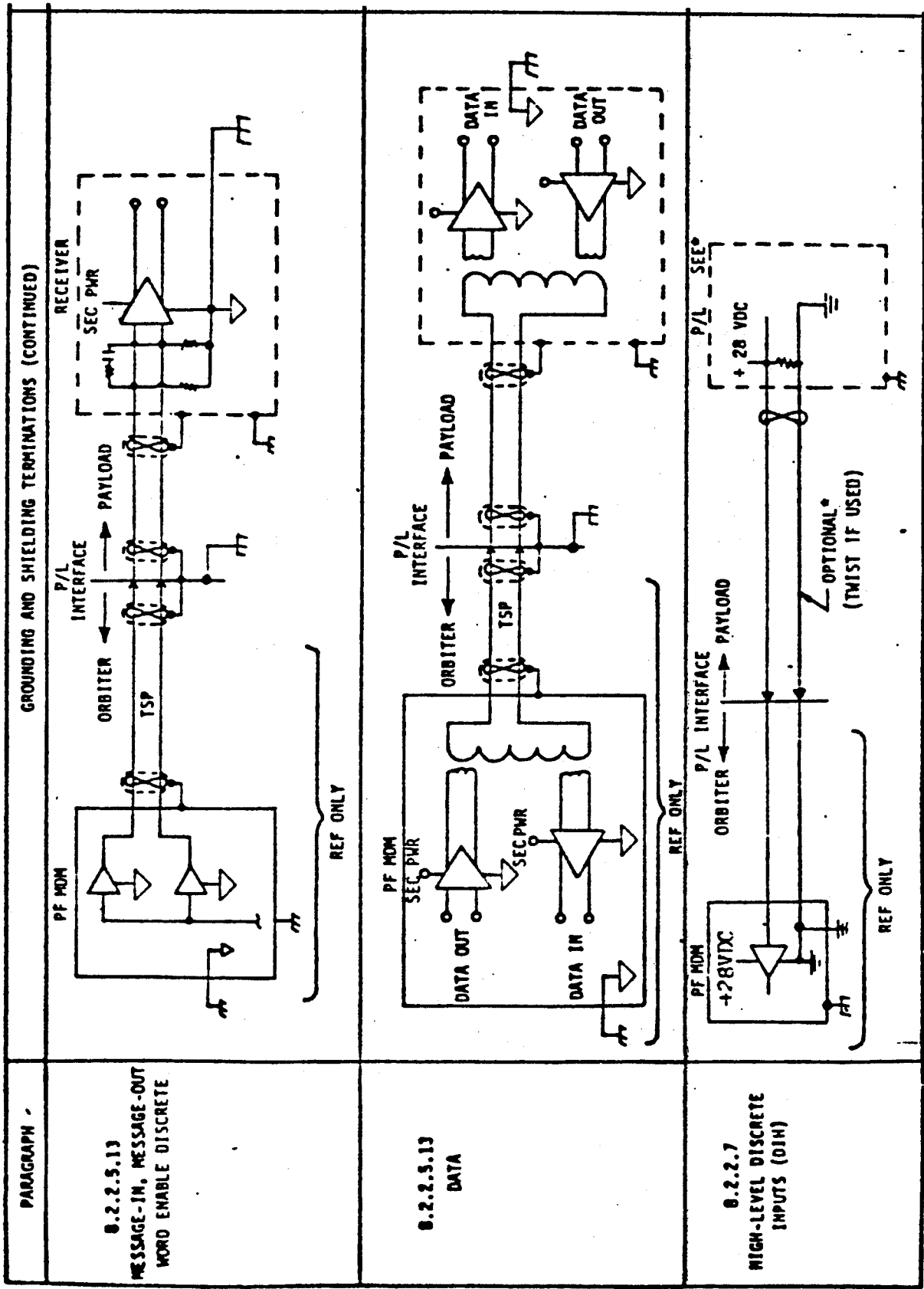
FIGURE 8.2.2.5.4-2 RISE AND FALL TIMES FOR SERIAL I/O DISCRETES  
(SHEET 2 OF 2)





NOTE: SYMBOLS DEFINED IN PARAGRAPH 10.0  
 \*SEE LIMITATIONS IN PARAGRAPH 10.0  
 \*\*10 V MAXIMUM WITH RESPECT 10 MDM IN COMMON MODE

Figure 8.2.2.6-1 MDM Interface Grounding And Shielding (Sheet 1 Of 2)



NOTE: SYMBOLS DEFINED IN PARAGRAPH 10.7.4.2.7  
 \*SEE LIMITATIONS IN PARAGRAPH 10.7.4.1.1

FIGURE 8.2.2.6-1 MDM INTERFACE GROUNDING AND SHIELDING (SHEET 2 OF 2)

**8.2.3 Orbiter/Payload Recorder (OPR) Interface.** The OPR shall provide the capability to record Biphase-Level digital and analog data. Both digital and analog data may be recorded simultaneously on up to 14 tracks. Recording of either analog or simultaneous recording of digital and analog data requires hardware programming at the Payload Distribution Panel.

Orbiter/payload Interface inputs to the payload Recorder are as shown in Figure 8.2.3-1. Data timing reference shall be supplied by the payload.

**8.2.3.1 Digital Data Recording.** The OPR shall provide the capability to record a single channel of digital data by serial track sequencing of up to 14 tracks. The payload recorder bit error rate shall be equal to or less than 1 error in  $10^6$  bits.

**8.2.3.1.1 Standard Record Speeds.** The OPR shall record at the standard speed of 7 1/2 ips for mixed-cargo flights requiring recording of two or more cargo elements. Three other standard speeds (6, 38, and 120 ips) shall be available (as documented in payload-unique ICD's) for flights requiring recording of a single cargo element. Their respective digital recording characteristics are as shown in Table 8.2.3.1.1-1.

**8.2.3.1.2 Non-Standard Record Speeds.** Ten non-standard record speeds (9.5, 12, 15, 19, 24, 30, 48, 60, 76, and 96 ips) are available. However, their usage requires Orbiter Mission changes. Utilization of these speeds necessitates rewiring of the program plugs at the recorder. The digital recording characteristics of each non-standard speed are as shown in Table 8.2.3.1.2-1.

**8.2.3.1.3 Digital Data Electrical Interface Characteristics.** The electrical interface characteristics at the Orbiter/payload interface for digital recordings shall be as shown in Table 8.2.3.1.3-1.

**8.2.3.2 Analog Data Recording.** The OPR shall provide the capability to record up to 14 analog channel inputs for a single pass only. Use of this capability requires hardware reprogramming at the Payload Distribution Panel. Amplitude and phase recording fidelity of analog data is not provided by the recorder. The pre-emphasis requirement for multiplexed analog data recording shall be negotiated in the unique ICD.

**8.2.3.2.1 Standard Record Speeds.** The standard record speeds are defined in Paragraph 8.2.3.1.1. Their corresponding analog recording characteristics are as shown in Table 8.2.3.2.1-1.

**8.2.3.2.2 Non-Standard Record Speeds.** The non-standard record speeds are defined in Paragraph 8.2.3.1.2. However, their usage requires Orbiter mission changes. Utilization of these speeds necessitates rewiring of the program plugs at the recorder. The analog recording characteristics of each non-standard speed are as shown in Table 8.2.3.2.2-1.

**8.2.3.2.3 Analog Data Electrical Interface Characteristics.** The electrical interface characteristics at the Orbiter/payload interface for analog recording shall be as shown in Table 8.2.3.2.3-1.

**8.2.3.3 Grounding and Shielding.** Grounding and shielding for the payload tape recorder interfaces shall be as shown in Figure 8.2.3.3-1.

TABLE 8.2.3.1.1-1 ORBITER-PAYLOAD-RECORDER DIGITAL RECORDING CHARACTERISTICS, STANDARD SPEEDS

Record/ Playback Speed	Data Rate (Kbps)	Record Time (Per Track) (1)	"Turn Around" Interruption (Max Per Direction Reversal)
6 IPS	25.5 to 51	80 Minutes	6 Sec
7.5 IPS	32 to 64	64 Minutes	6 Sec
38 IPS	162 to 324	12.6 Minutes	6 Sec
120 IPS	512 to 1024	4 Minutes	6 Sec

(1) Record time based on minimum tape length (BOT to EOT) of 2400 feet.

TABLE 8.2.3.1.2-1 ORBITER-PAYLOAD-RECORDER DIGITAL RECORDING CHARACTERISTICS, NON-STANDARD SPEEDS

Record/ Playback Speed	Data Rate (Kbps)	Record Time (Per Track) (1)	"Turn Around" Interruption (Max Per Direction Reversal)
9.5 IPS	40.5 to 81	50.5 Minutes	6 Sec
12 IPS	51 to 102	40 Minutes	6 Sec
15 IPS	64 to 128	32 Minutes	6 Sec
19 IPS	81 to 162	25.3 Minutes	6 Sec
24 IPS	102 to 205	20 Minutes	6 Sec
30 IPS	128 to 256	16 Minutes	6 Sec
48 IPS	205 to 410	10 Minutes	6 Sec
60 IPS	256 to 512	8 Minutes	6 Sec
76 IPS	324 to 648	6.3 Minutes	6 Sec
96 IPS	409 to 819	5 Minutes	6 Sec

(1) Record time based on minimum tape length (BOT to (EOT) of 2400 feet.

TABLE 8.2.3.1.3-1 DIGITAL DATA RECORDING  
ELECTRICAL INTERFACE CHARACTERISTICS

Parameter	Dimension	Characteristics Orbiter/Payload Interface (4)	Notes
Bit Rate	kbps		To be supplied in unique ICD (1)
Signal Type		Differential (Bi $\phi$ -L)	
Rise and Fall Time	Percent Bit Cell Time(BCT)	10 Max	
Signal Amplitude	V, P-P	3.6 Min 9 Max	
Jitter and Assymetry	Percent of BCT	+2	
Input Impedance (Recorder)	Ohms, L-L	75 $\pm$ 10 percent	
Source Impedance (Payload)	Ohms, L-L	TTL Compatible	(5)
Common-Mode Voltage	Volts	+15	(2)
Cable Type		Twisted Shielded Pair	(3)
Cable Impedance (Orbiter)	Ohms	75 $\pm$ 5	(3)
Cable Capacitance (Orbiter)	Pico- farads	2440 Max	(3)
Cable Resistance (Orbiter)	Ohms	6.4 Max	(3) (6) Round Trip

(1) Refer to Table 8.2.3.2.1-1 and 8.2.3.1.2-1

(2) Referenced to Signal Ground

(3) EMI class 'RF'. Refer to Table 10.7.1-1. Cable electrical characteristics typified by MP572-0328-0002.

(4) Based on 106-ft cable length (End of SMCH).

(5) TI SN55114, or equivalent driver.

(6) At 68°F maximum.

TABLE 8.2.3.2.1-1 ORBITER-PAYLOAD-RECORDER,  
ANALOG, RECORDING CHARACTERISTICS  
STANDARD SPEEDS

Record Playback Speed	Data Rate	Record Time (1)
6 IPS	1.9 KHz to 100 KHz	80 Min
7.5 IPS	1.9 KHz to 125 KHz	64 Min
38 IPS	4.8 KHz to 632 KHz	12.6 Min
120 IPS	15 KHz to 1.6 MHz	4 Min

(1) Record time based on minimum tape length (BOT to EOT) of 2400 feet.

TABLE 8.2.3.2.2-1 ORBITER-PAYLOAD-RECORDER, ANALOG, RECORDING CHARACTERISTICS, NON-STANDARD SPEEDS

Record Playback Speed	Data Rate	Record Time (1)
9.5 IPS	1.9 KHz to 158 KHz	50.5 Minutes
12 IPS	1.9 KHz to 200 KHz	40 Minutes
15 IPS	1.9 KHz to 250 KHz	32 Minutes
19 IPS	2.4 KHz to 316 KHz	25.3 Minutes
24 IPS	3.0 KHz to 400 KHz	20 Minutes
30 IPS	3.8 KHz to 500 KHz	16 Minutes
48 IPS	6.0 KHz to 800 KHz	10 Minutes
60 IPS	7.5 KHz to 1.0 MHz	8 Minutes
76 IPS	9.5 KHz to 1.26MHz	6.3 Minutes
96 IPS	12 KHz to 1.6 MHz	5 Minutes

(1) Record time based on minimum tape length (BOT to EOT) of 2400 feet.



TABLE 8.2.3.2.3-1 ANALOG DATA RECORDING,  
ELECTRICAL INTERFACE CHARACTERISTICS

Parameter	Dimension	Characteristics Orbiter/Payload Interface (4)	Notes
Freq.	Min: Hertz Max: Hertz		(1) (7) To be supplied in unique ICD.
Signal Type		Differential	
Amplitude	Volts-RMS	1.18 ± 10 Percent at 1 MHz	(3)
Common Mode Voltage	Volts	±15 Volts	(2)
Load Impedance (Recorder)	Ohms	75 ± 5 percent	Isolated, trans- former input
Cable Type		Twisted Shielded Pair	(3)
Cable Impedance (Orbiter)	Ohms	75 ± 5	(3)
Cable Capaci- tance (Orbiter)	Max: Pico- farads	2400	(3)
Cable Resistance (Orbiter)	Max: Ohms	6.4	Round-trip (3) (5)
Pre-Emphasis			(6) (7) To be supplied in unique ICD.

- (1) Refer to Table 8.2.3.2.1-1. Constrained by tape speed.
- (2) Referenced to Signal Ground.
- (3) EMI class "RF". Refer to Table 10.7.1-1. Cable electrical characteristics typified by MP572-0328-0002.
- (4) Based on 106-ft cable length (End of SMCH).
- (5) At 68°F max.
- (6) Pre-emphasis applicable only to FM/composite frequency signal from payload.
- (7) The peak of any spurious or unwanted frequency signals below 5 MHz shall be down a minimum of 30 db from the highest data frequency voltage level.

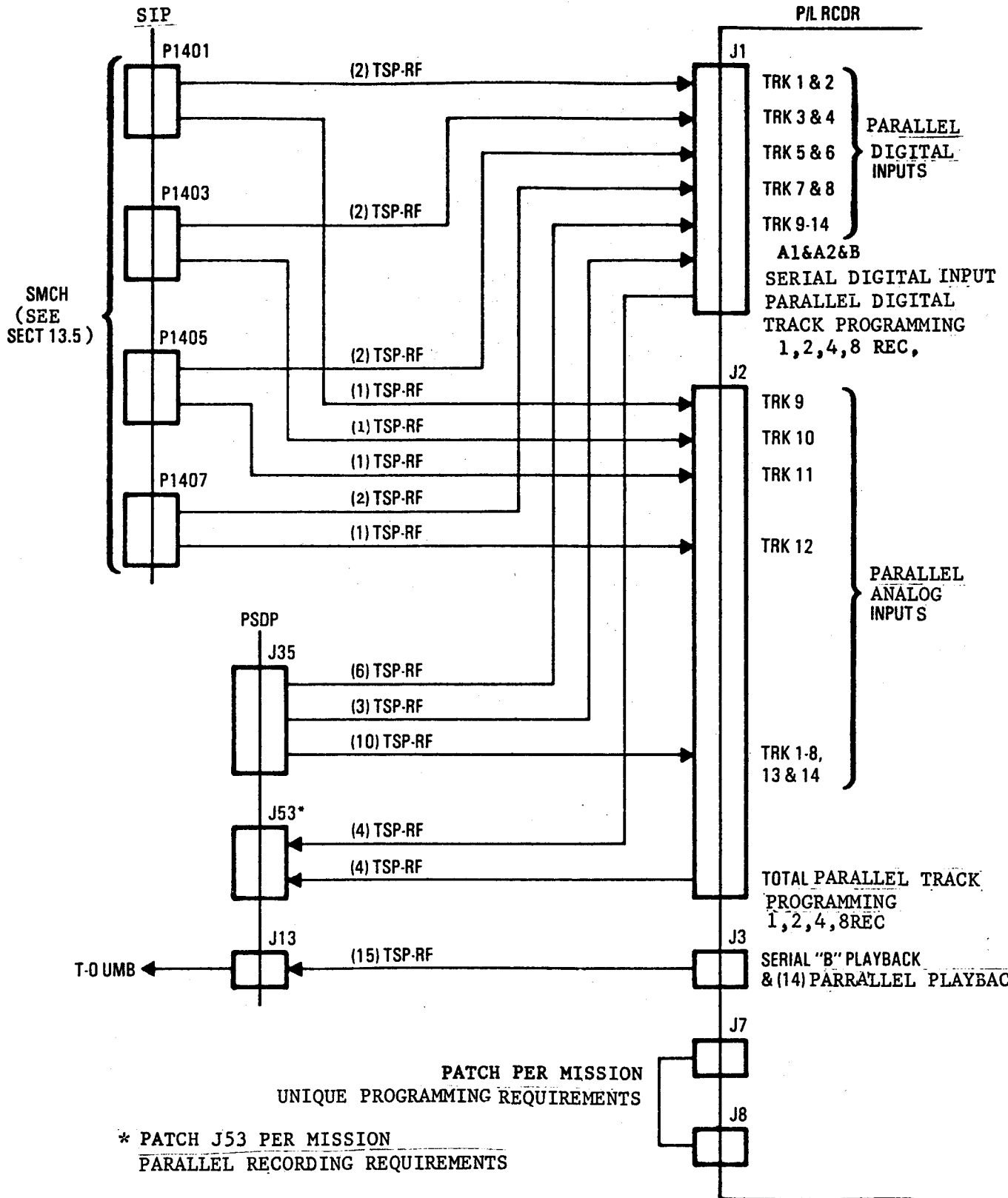
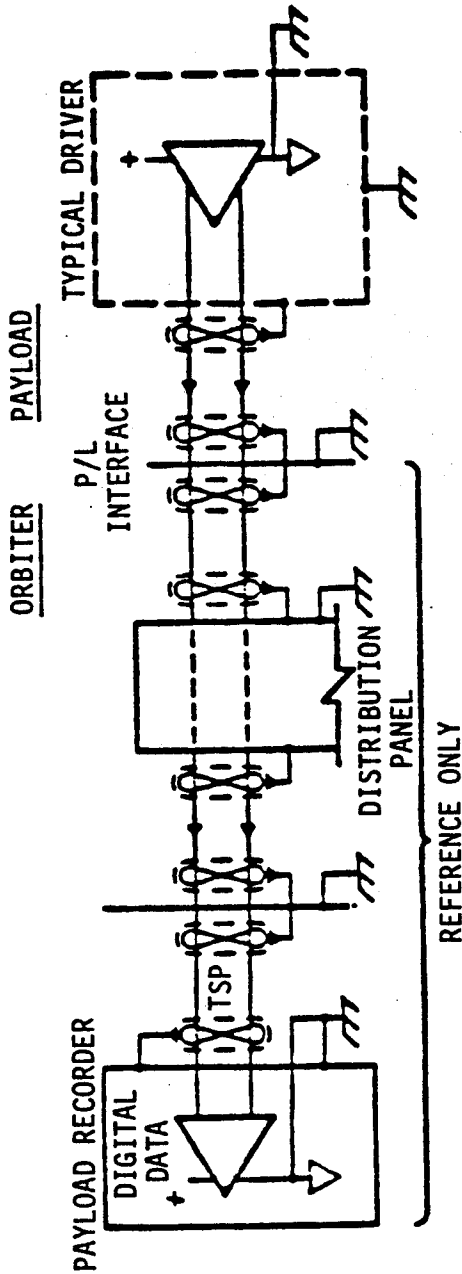


Figure 8.2.3-1 Orbiter Payload Recorder Interface For Payloads

GROUNDING AND SHIELDING TERMINATIONS

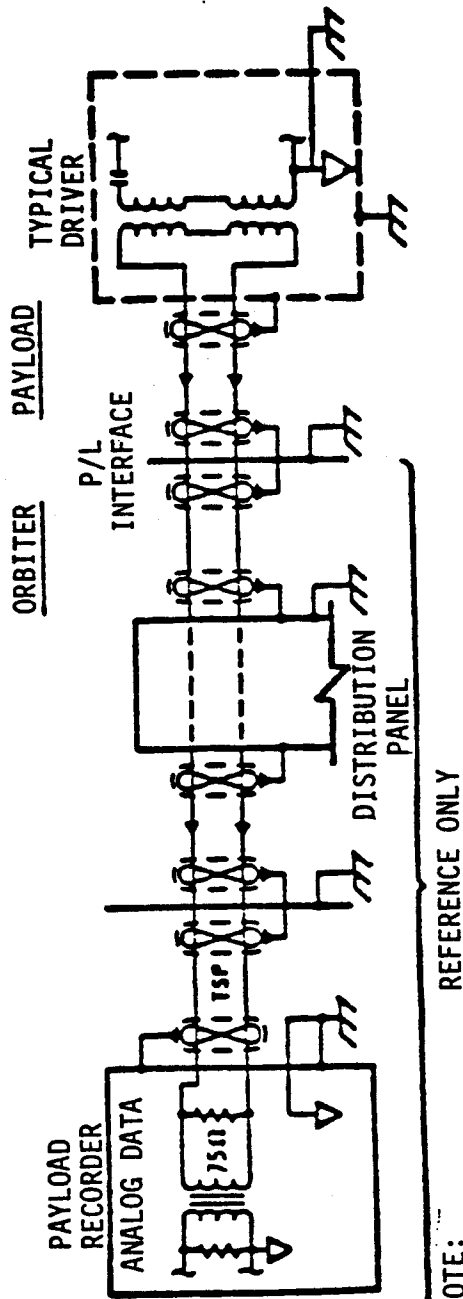
PARAGRAPH

8.2.3.3.1  
DIGITAL DATA  
RECORDING  
(TYPICAL 31  
DATA INPUTS)



REFERENCE ONLY

8.2.3.3.2  
ANALOG DATA  
RECORDING  
(TYPICAL 31  
DATA INPUTS)



REFERENCE ONLY

NOTE:  
SYMBOLS DEFINED IN  
PARAGRAPH 10.0

Figure 8.2.3.3-1 Orbiter Payload Recorder Grounding And Shielding

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**8.2.4 Ku-Band Signal Processor Interface.** The Ku-Band signal processor shall be capable of accepting data from and providing data to attached payloads as shown in Figure 8.2.4-1.

**8.2.4.1 High Data Rate Maximum, Digital-Data and Clock Inputs.** The 2 to 48-mbps data and clock signals from the payload shall have the characteristics shown in Tables 8.2.4.1-1 and 8.2.4.1-2, respectively.

**8.2.4.2 Low Data Rate, Digital-Data Input.** The 16-Kbps to  $1.024(BI\emptyset-L/M/S)/2(NRZ-L/M/S)$ mbps data signals from the payload shall have the characteristics shown in Table 8.2.4.2-1.

**8.2.4.3 High Data Rate, Digital-Data Input.** The 16-Kbps to 4-mbps data signals from the payload shall have the characteristics shown in Table 8.2.4.3-1.

**8.2.4.4 Analog-Data Input.** The DC to 4.5 MHz analog signals from the payload shall have the characteristics shown in Table 8.2.4.4-1.

**8.2.4.5 Forward Link, Data and Clock Outputs.** The 128-Kbps data and clock signals supplied to the payload shall have the characteristics shown in Table 8.2.4.5-1 and 8.2.4.5-2 respectively. *The definition of Forward Link Data-to-Clock offset shall be as shown in Figure 8.2.4.5-1.*

**8.2.4.6 Grounding and Shielding.** Grounding and shielding shall be as shown in Figure 8.2.4.6-1.

Table 8.2.4.1-1 2 To 48 MBPS Data Input Electrical Interface Characteristics

Parameter	Dimension	Value	Notes
Data Rate	Mbps	12 to 48 mbps	(3)
Data Type		NRZ-L, M or S	
Data Asymmetry	Percent	≤ 16 at 50 Mbps, increasing linearly to 38 at 8.5 Mbps constant at 38, for rates < 8.5 Mbps	
Data Stability	Percent	≤ 0.01	
Rise/Fall Time	Nanosec	13.5 or 5 percent of bit duration, which ever is greater	(1) From 10 percent to 90 percent of initial to final amplitude-at S9P
Frequency Jitter	Percent rms	±0.01 of the data rate at a rate of 0.01 percent rms of the data rate	
Amplitude	Volts	Logic "1": 4.5 min to 6.5 max. Logic "0": 0 ± 0.5	(1)
Load Impedance	Ohms	50±10 percent	
Source Coupling		Single-ended coaxial	
SNR(RMS)	db	30 min	Relative to RMS noise at input to Ku SPA - Noise B/W to 200 MHz
Cable Type		RG 142 B/U	50 ohms nominal (2)
Grounding		Figure 8.2.4.6-1	Shield multipoint grounded.

- (1) Based on 92-ft cable length, from LRU (SPA) to P/L interface at end of SMCN.
- (2) The data cable and the associated clock cable shall not differ in the overall length by more than 12 inches. The environment of the data and clock cables shall be uniform and essentially the same for both cables.
- (3) The maximum data rate which can be accommodated by the JDRS ground station's statistical multiplexer prior to transmission to the Mission Control Center via domestic satellite is 48 MBPS ± 1 percent.

Table 8.2.4.1-2 2 To 48 MBPS Clock, Electrical Interface Characteristics

Parameter	Dimension	Value	Notes
Clock Rate	Mbps	2 to 48	Same rate as data
Clock Type		Square wave (RZ)	
Clock Asymmetry	Percent of bit period	$\leq (10 + R_0/5)$	$R_0$ is a number equal to the input clock rate in MHz
Clock Stability	Percent	$\leq .01$	
Duty Cycle	Percent	$50 \pm 5$ of period	
Data-to-Clock Offset (skew)	Percent of bit period	$\pm 21$	
Amplitude	Volts	Logic "1": 4.5 min to 6.5 max. Logic "0": $0 \pm 0.5$	(1)
SNR RMS	db	30 min	Relative to RMS noise at input to Ku SPA noise B/W to 200 MHz
Load Impedance	Ohms	$50 \pm 10$ percent	
Source Coupling		Single-ended (coaxial)	
Cable Type		RG142 B/U	50 ohms nominal
Grounding		Refer to Figure 8.2.4.6-1	Shield multipoint grounded
Bit Jitter	Percent	$\pm 2$ of bit period	Clock phase jitter relative to data
Frequency Jitter	Percent rms	$\pm 0.01$ of the input data rate at a rate of 0.01 percent rms of data rate!	

(1) Based on 92-ft cable length, from LRU (SPA) to P/L interface at end of SMCN.

**Table 8.2.4.2-1 Low Data Rate, Digital - Data Input  
Electrical Interface Characteristics**

Parameter	Dimension	Value	Notes
Data Rate and Data Type	bps	16 Kbps to 1.024 Mbps Bi-ø-L, -M, or -S	
		16 Kbps to 2 Mbps, NRZ-L, M or S	
Rise/Fall Time	Nanosec	40 or 4 percent of Bit period whichever is smaller	As measured between the 10 and 90 percent points
Frequency Jitter	Percent rms of data rate	± frequency deviation of 0.01 percent rms of the data rate at a rate of 0.01 percent rms of the data rate	
Amplitude	Volts P-P	2.7 to 5.0, line-to-line	(3)
Load Impedance	Ohms	75 ± 5	(1)
Source Coupling		Balanced differential direct coupled	
SNR (RMS)	db	35 min	Relative to noise at Ku SPA input
Common Mode Voltage	Volts	DC to 10 KHz ≤ ± 10 10 to 100 KHz Decreasing at 10 db/decade Above 100 KHz Decreasing at 10 db/octave	(4)
Data Stability	percent	≤ 0.01	
Cable Type		Twisted shielded pair	(2) MP572-0328-0002
Capacitance	Pf	2093	(3)
Grounding		See Figure 8.2.4.6-1	Shield multipoint grounded

**Notes:**

- (1) The load impedance shall be a resistive load matched to the line impedance over a 3dB bandwidth of 0 to 2 MHz.
- (2) EMI class 'RF' referenced to Table 10.7.1-1.
- (3) Based on 91-ft cable length, from LRU (SPA) to interface at end of SMCW.
- (4) Consist of discrete and spectral components to frequency interval four times maximum data rate. Spectral component Gaussian noise with power spectral density of 10-20 watts/Hz. Discrete components randomly distributed over channel bandwidth.



**Table 8.2.4.3-1 High Data Rate, Digital - Data Input,  
Electrical Interface Characteristics**

Parameter	Dimension	Value	Notes
Data Rate	bps	16 Kbps to 4 Mbps	
Data Type		NRZ-L, M or S	
Data Stability	Percent	≤0.01	
Rise/Fall	Nanosec	40 or 4 percent of Bit period whichever is smaller	As measured between the 10 and 90 percent points
Frequency Jitter	Percent rms of data rate	± frequency deviation of 0.01 percent rms of the data rate at a rate of 0.01 percent rms of the data rate	
Amplitude	Volts P-P	2.7 to 5.0, line-to-line	(3)
Load Impedance	Ohms	75 ± 5	(1)
Termination		Balanced differential direct coupled	
SNR (RMS)	db	35 min	
Common Mode Voltage	Volts	See Table 8.2.4.2-1	
Data Stability	Percent	< 0.01	
Cable Type		Twisted shielded pair	(2) MP572-0328-0002
Capacitance	PF	2093	(3)
Grounding		See Figure 8.2.4.6-1	Shield multipoint grounded

**Notes:**

- (1) The load impedance shall be a resistive load matched to the line impedance over a 3dB bandwidth of 0 to 4 MHz.
- (2) EMI9 class 'R3' referenced to Table 10.7.1-1.
- (3) Based on 91-ft cable length, from LRU (SPA) to interface at end of SMC.H.

**Table 8.2.4.4-1 Analog - Data Input, Electrical Interface Characteristics**

Parameter	Dimension	Value	Notes
Data			
Bandwidth	Hz	DC to 4.5 MHz	(3)
Amplitude	Volts P-P	10 to 1.1, line-to-line	Shall not have a DC bias with respect to signal ground
			(1) (2)
Load Impedance	Ohms	75 ± 5	
Source Impedance	Ohms	75 ± 5	
Source Coupling		Balanced Differential Direct Coupled	
SNR	dB	45 Min	P-P signal to RMS noise
Phase Jitter	Percent	+2 of pulse period for TV synchronizing pulse	
Common Mode Voltage	Volts	See Table 8.2.4.2-1	
Cable Type		Twisted Shielded Pair	MP572-3228-0002
Capacitance	pF	2093	(2)
Grounding		See Figure 8.2.4.6-1	Shield multipoint grounded

**NOTES:**

- (1) The load impedance shall be a resistive load matched to the line impedance over a 3 dB bandwidth of 0 to 4 Mhz.
- (2) Based on 91-ft cable length from LRU (SPA) to interface at end of SMCN.
- (3) Because the frequency response of the MP572-0328-0002 twisted wire pair cable is poor above 2 MHz, the user must provide compensating networks at his line driver.

**Table 8.2.4.5-1 128 KBPS Data Output To A Payload,  
Electrical Interface Characteristics**

Parameter	Dimension	Value	Notes
Data Rate	Kbps	128	
Data Type		NRZ-L	
Data Stability	Percent of bit rate	≤0.01	
Data Asymmetry	Percent of bit period	10 max	
Rise/Fall Time	Nanosec	250 max	(1) 10 percent and 90 percent points
Frequency Jitter	Percent RMS	± a frequency deviation of 0.1 percent rms of the data rate at a rate of 0.1 percent rms of the data rate	Determined by ground station
Amplitude	Volts	Logic "1": 1.8 to 3.5 Logic "0": 0 to 0.45	(1) Signal line measured with respect to signal ground
		Logic "1": 0 to 0.45 Logic "0": 1.8 to 3.5	Signal return line measured with respect to signal ground (1)
Load Impedance	Ohms	75±5	
Load Coupling		Balanced differential direct-coupled	
Cable Type		JSP	MP572-0328-0002
Capacitance	Pf	2093	(1)
Grounding		See Figure 8.2.4.6-1	Shield multipoint grounded

(1) Based on 91-ft cable length, from LRU (SPA) to P/L interface at the end of SMCN.

Table 8.2.4.5-2 128 KBPS Clock Output To A Payload,  
Electrical Interface Characteristics

Parameter	Dimension	Value	Notes
Clock Rate	KHz	128	
Clock Type	Percent	Square wave	
Asymmetry	Percent of bit period	10 max	
Duty Cycle	Percent of bit period	50 ± 5	
Data-to-Clock Offset (skew)	Nanosec	Leading edge of clock (logic "0" to logic "1") occurs at the middle of the data bit period within 150 nanosec.	
Amplitude	Volts	Logic "1": 1.8 to 3.5 Logic "0": 0 to 0.45	(1) Signal line measured with respect to signal ground
		Logic "1": 0 to 0.45 Logic "0": 1.8 to 3.5	Signal return line measured with respect to signal ground. (1)
Frequency Jitter		+ a frequency deviation of 0.1 percent rms of the data rate at a rate of 0.1 percent rms of the data rate	
Phase Jitter	Percent rms of bit period	±2	With respect to data
Load Impedance	Ohms	75±5	
Rise/Fall Times	Nanosec	250 max	Measured at 10 to 90 percent ampli- tude points

**Table 8.2.4.5-2 128 KBPS Clock Output To A Payload,  
Electrical Interface Characteristics  
(Concluded)**

Parameter	Dimension	Value	Notes
Load Coupling		Balanced differential direct-coupled	
Cable Type		TSP	MP572-0328-0002
Capacitance	PF	2093	(1)
Grounding		See Figure 8.2.4.6-1	
Data/Clock jitter	Percent	10 (of bit period)	Clock jitter to data

(1) Based on 91-ft cable length, from LRU (SPA) to P/L interface at the end of SMCN.

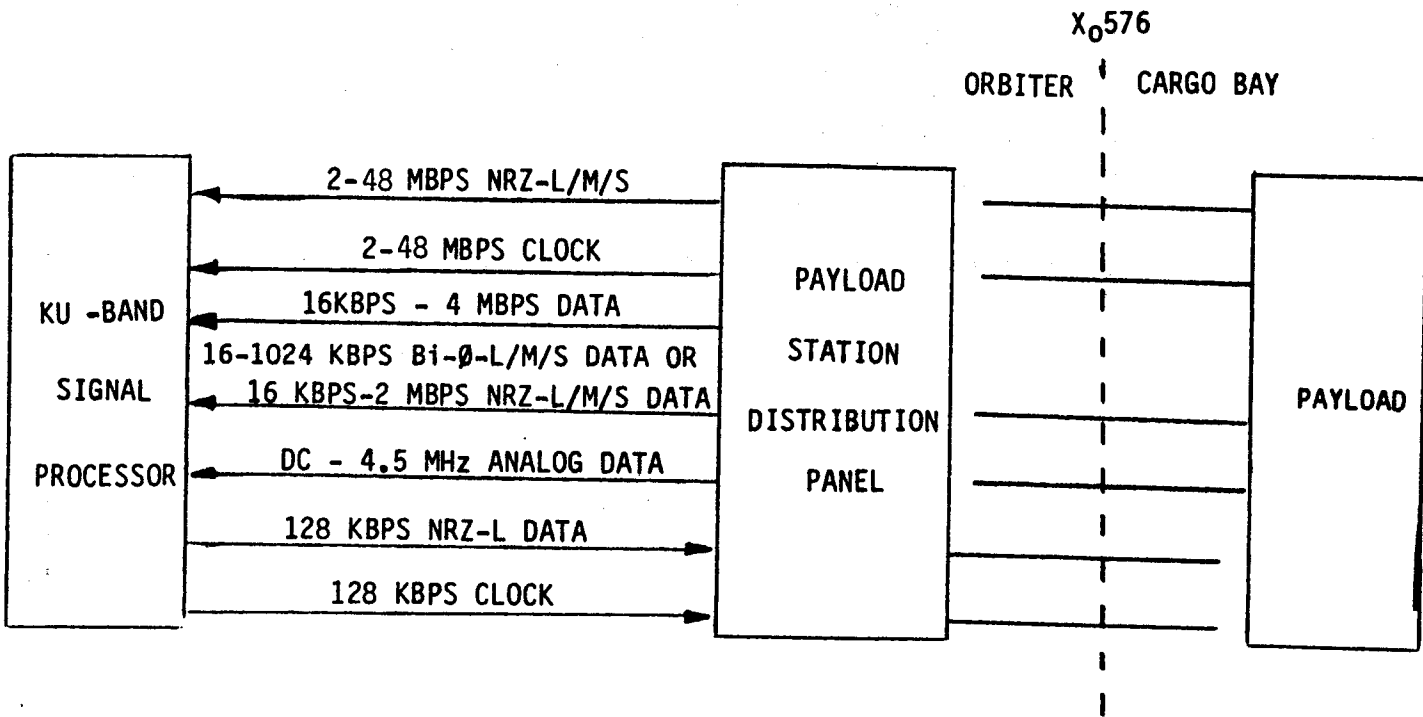


FIGURE 8.2.4-1 KU-BAND SIGNAL PROCESSOR INTERFACE

CLOCK PERIOD = DATA BIT CELL TIME =  $\tau$

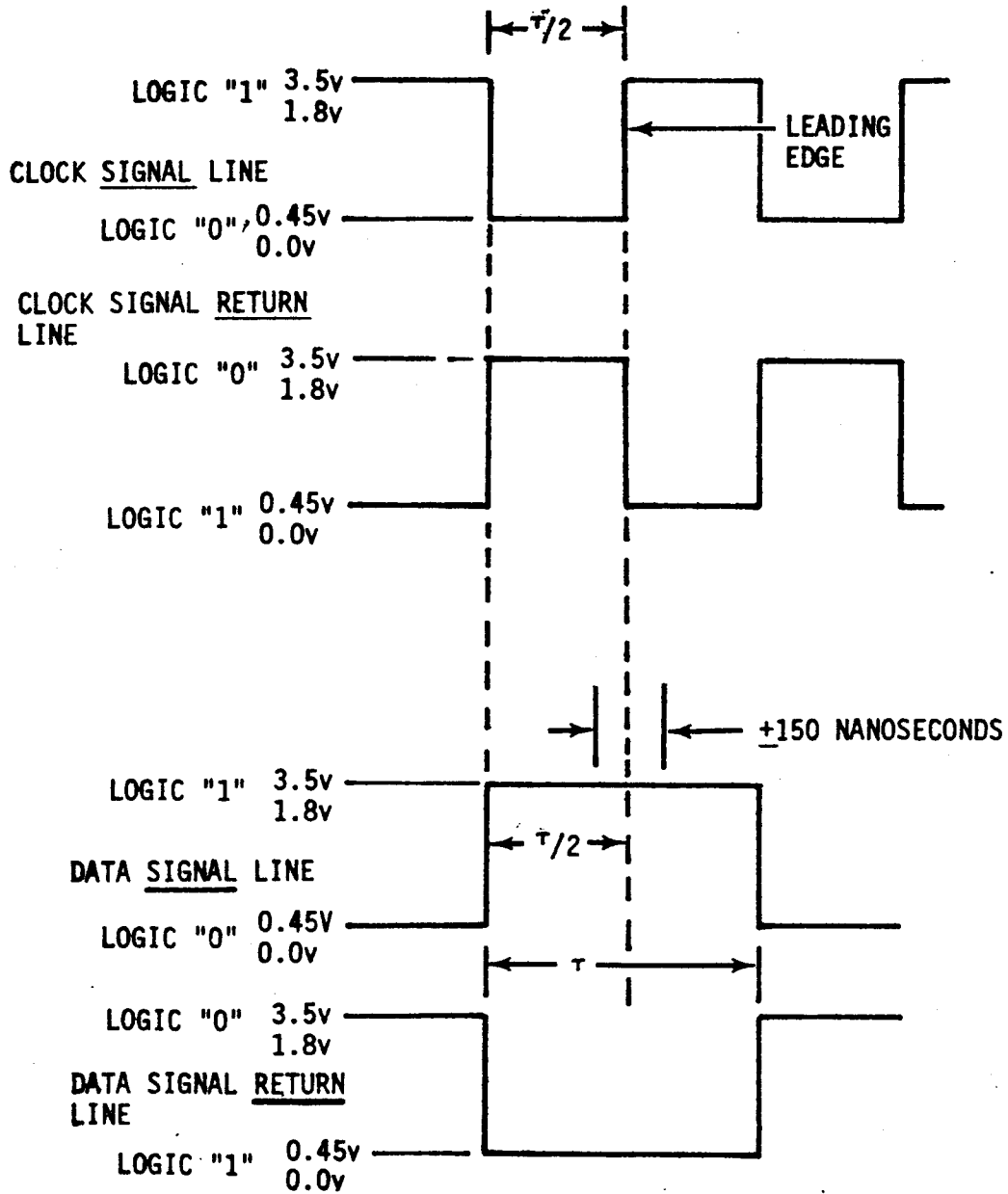
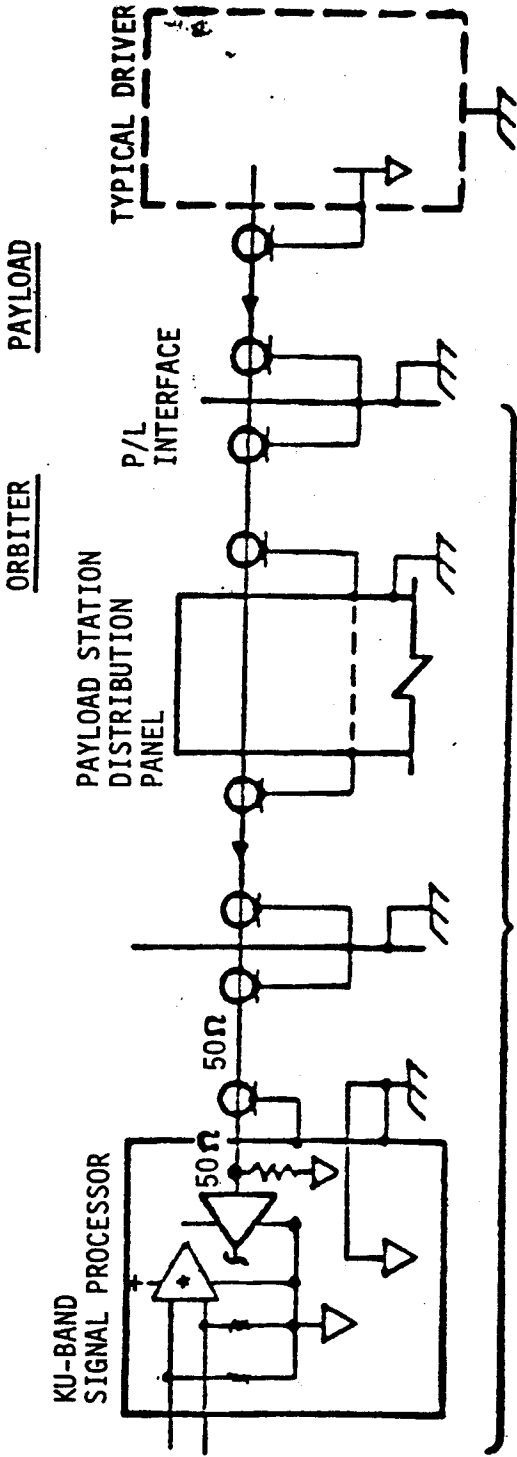


Figure 8.2.4.5-1 Definition Of Forward Link Data-To-Clock Offset

GROUNDING AND SHIELDING TERMINATIONS

PARAGRAPH

8.2.4.1  
21 TO 48  
MBPS  
DATA AND  
CLOCK INPUT



REFERENCE ONLY

PAYLOAD

ORBITER

KU-BAND SIGNAL PROCESSOR

PAYLOAD STATION DISTRIBUTION PANEL

P/L INTERFACE

TYPICAL DRIVER

8.2.4.2  
16 KBPS TO  
2 MBPS  
DATA INPUT

8.2.4.3  
16 KBPS TO  
4 MBPS  
DATA INPUT

8.2.4.4  
DC TO 4.5 MHZ  
ANALOG INPUT

PAYLOAD

ORBITER

KU-BAND SIGNAL PROCESSOR

PAYLOAD STATION DISTRIBUTION PANEL

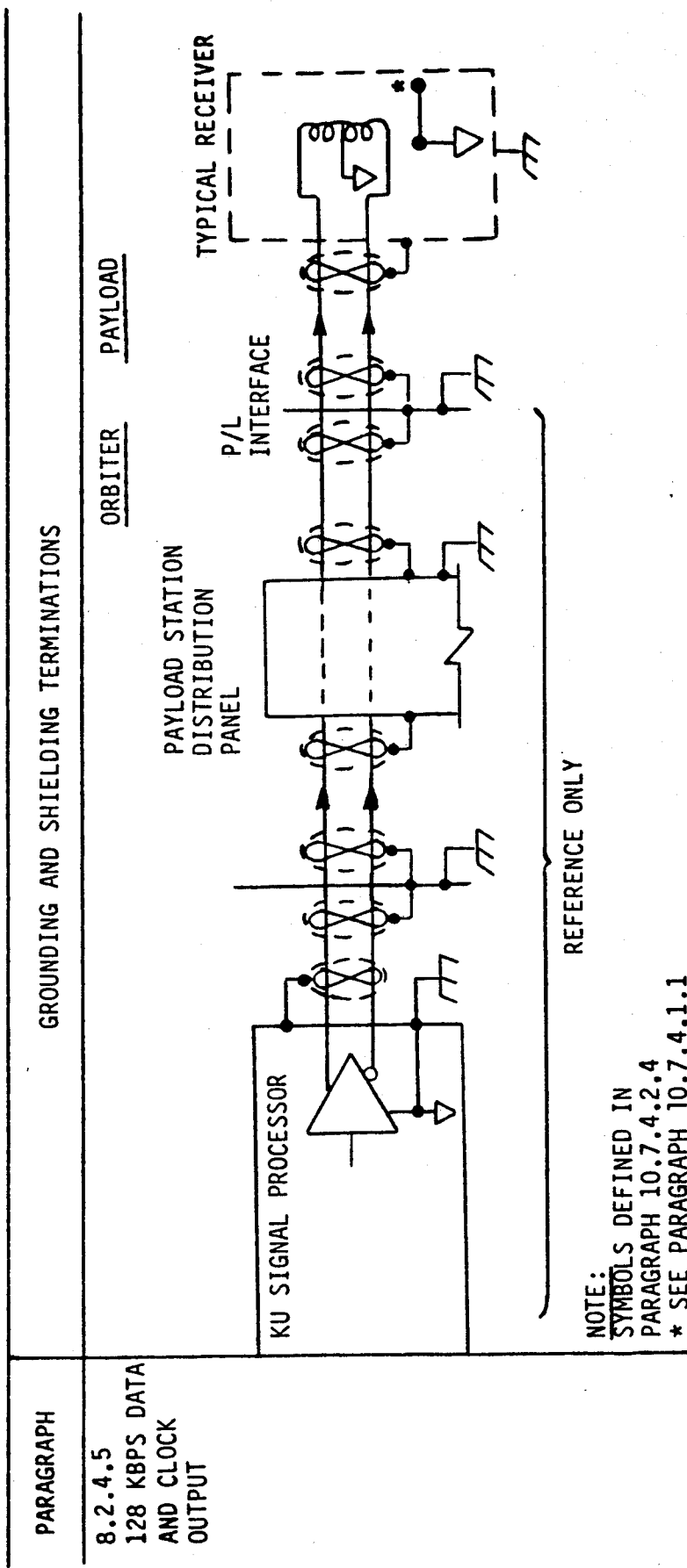
P/L INTERFACE

TYPICAL DRIVER

REFERENCE ONLY

Figure 8.2.4.6-1 Ku-Band Grounding And Shielding (Sheet 1 Of 2)





NOTE:  
 SYMBOLS DEFINED IN  
 PARAGRAPH 10.7.4.2.4  
 \* SEE PARAGRAPH 10.7.4.1.1

Figure 8.2.4.6-1 Ku-Band Grounding And Shielding  
 (Sheet 2 Of 2)

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8.2.5 Payload Signal Processor Interface. The Payload Signal Processor (PSP) shall provide command data to up to five attached payloads, while operating in the attached-payload mode, or to one detached payload at a time, via the Payload Interrogator while operating in the detached-payload mode (Reference Paragraph 8.3). It shall also be capable of receiving telemetry data from detached payloads via the Payload Interrogator. (Reference Figure 8.2.5-1).

8.2.5.1 PSP Command Data Output. The PSP command data output shall have the characteristics shown in Table 8.2.5.1-1. Commanding shall be limited to a single payload at a time, attached or detached.

8.2.5.1.1 PSP Command Data Formats. The format of the commands to be transmitted to payloads shall be defined in the unique ICD *software section as defined in Paragraph 9.4.2.1 Data Formats and 9.4.2.1.1 Payload Communication (one or more commands)*.

8.2.5.1.2 Command Bit Idle Pattern. A software selectable idle bit pattern shall be available when actual command bits are not being processed. *This capability applies for both attached and detached payloads. Utilization of the idle pattern shall be as defined in the software section, Paragraph 9.4.2.2.4 "PSP Idle Pattern".*

8.2.5.2 (Reserved)

8.2.5.2.1 (Reserved)

8.2.5.3 Grounding and Shielding. Grounding and shielding shall be as shown in Figure 8.2.5.3-1.

**Table 8.2.5.1-1 PSP Command Data Output,  
Electrical Interface Characteristics**

Parameter	Dimension	Value	Notes
Subcarrier Frequency	KHz	$16 \pm 0.001$ percent (Long Term)	Sine Wave
Subcarrier Harmonic Distortion	Percent	Less than 2 percent of the total power in the subcarrier fundamental	Total harmonic distortion
Subcarrier Frequency Stability		$\leq 10^{-7}$ of the sub-carrier frequency over a ten second period (Short Term)	(1)
Subcarrier Modulation		PSK	
Data Rates	bps	2000, 1000, 500, 250, 125, 125/2, 125/4, 125/8, or 125/16 $\pm 0.001$ percent (Long Term)	(1)
Data Rate Stability		$10^{-7}$ over a ten second period. (Short Term)	(1)
Data Types		NRZ-L, -M or -S	
Frequency-to-Bit Rate Ratio		Exact multiple of the allowed data rates	Data waveform shall conform to sub-carrier zero crossings within $\pm 10$ degrees
Data Transition		Data shall alter sub-carrier phase by $\pm 90$ degrees $\pm 10$ percent	
Amplitude	Volts P-P	3.2 to 4.4, line-to-line	(2) (3)
Phase Jitter	Percent of bit period	3 max	
Data Asymmetry	Percent of bit period	2 max	

**Table 8.2.5.1-1 PSP Command Data Output,  
Electrical Interface Characteristics (Concluded)**

Parameter	Dimension	Value	Notes
Channel-to-Channel Isolation	dB	40 min	(2) Between-channel isolation when each channel is terminated with 75 ohms
Source Impedance	Ohms	<15	(2)
Load Impedance	Ohms	75±10 percent	(2)
Output Type		Differential	(2)
Load Termination		Differential, direct coupled	(2) Controlled by special payload integration provisions
Offset	Volts	10 ± .5, either line-to-signal ground	(2)
Capacitance	pFarads	2875	(2) (3)
Cable Type		Twisted shielded pair RI Spec. MP572-0328-0002	(2) EMI class 'RF' refer to Table 10.7.1-1

- (1) Based upon MTU accuracy and stability.  
 (2) Applicable to attached cargo element interfaces only.  
 (3) Based on 125-ft cable length, from LRU to P/L interface at end of SMCU.

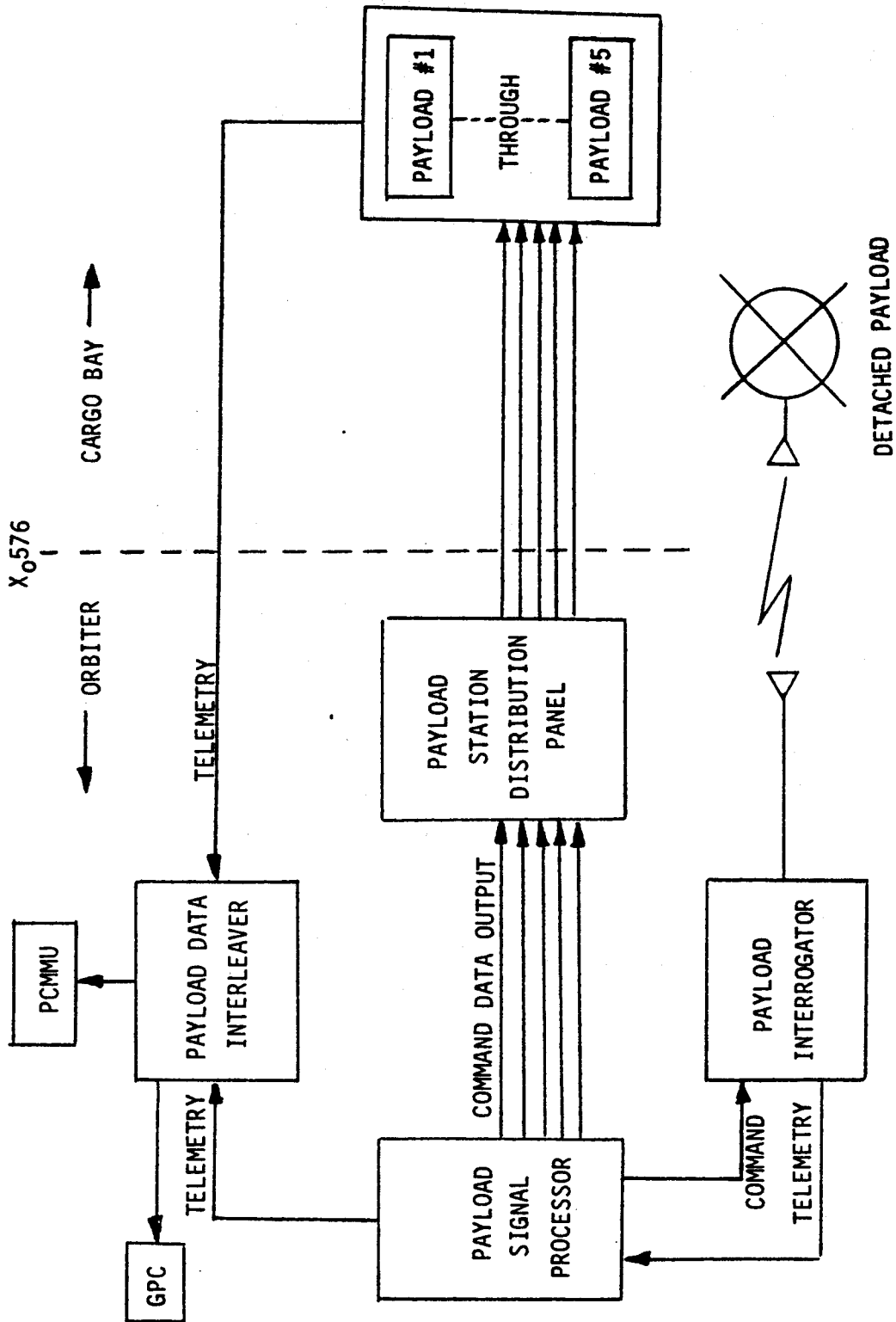


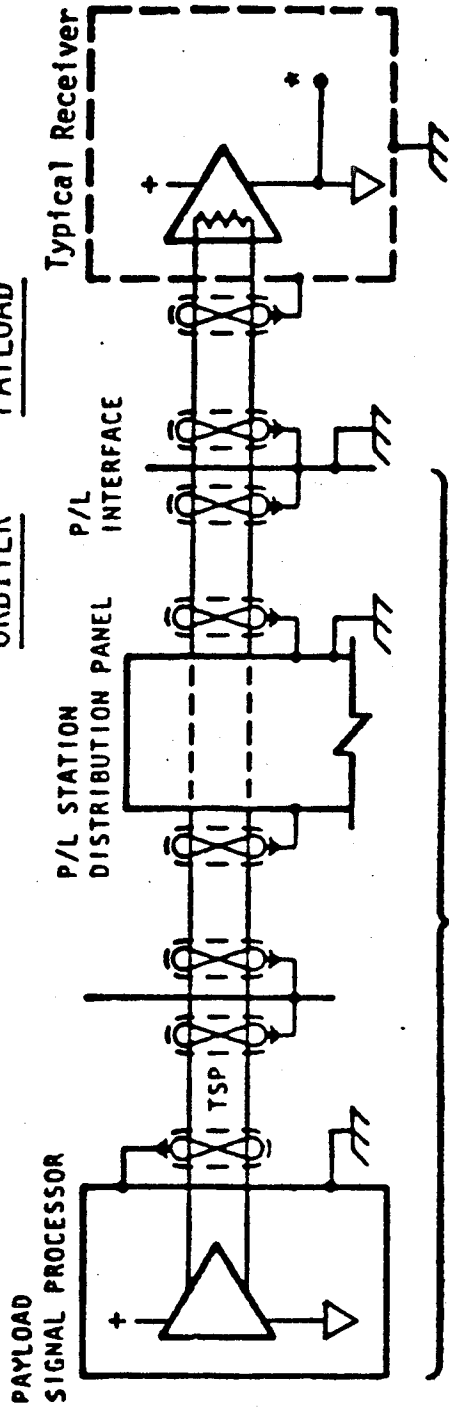
FIGURE 8.2.5-1 PAYLOAD SIGNAL PROCESSOR INTERFACE

**GROUNDING AND SHIELDING TERMINATION**

**PARAGRAPH**

8.2.5.1  
PSP COMMAND  
DATA OUTPUT

ORBITER      PAYLOAD



REFERENCE ONLY SEE EMC PARAGRAPH 10.7.4

**NOTE:**

SYMBOLS DEFINED IN  
PARAGRAPH 10.7.4.2.4

\*SEE PARAGRAPH 10.7.4.1.1

Figure 8.2.5.3-1 Payload Signal Processor Grounding And Shielding

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8.2.6 S-Band FM Signal Processor Interface. The S-Band FM signal processor shall accept data from attached payloads as shown in Figure 8.2.6-1.

8.2.6.1 300 Hz to 4 MHz Analog Data Input. The 300 Hz to 4 MHz analog signals from attached payloads shall have the characteristics shown in Table 8.2.6.1-1.

8.2.6.2 200 bps to 5 Mbps Data Input. The 200-bps to 5 mbps digital data from attached payloads shall have the characteristics shown in Table 8.2.6.2-1.

8.2.6.3 250 bps to 256 Kbps DOD Data Input. The 250 bps to 256 Kbps digital data from attached DOD payloads shall have the characteristics shown in Table 8.2.6.3-1.

8.2.6.4 Grounding and Shielding. Grounding and shielding shall be as shown in Figure 8.2.6.4-1.

TABLE 8.2.6.1-1 WIDEBAND ANALOG DATA INPUT,  
ELECTRICAL INTERFACE CHARACTERISTICS

Parameter	Dimension	Value	Notes
Data Bandwidth	Hz	300 Hz to 4 MHz	
Amplitude	Volts	1.38 Volts, peak-to-peak, line-to-line ±6 percent (V <sub>1</sub> )	
Source Coupling		Balanced, Differential	
Load Termination		Balanced, Differential	
Source Impedance (Payload)	Ohms	75 Ohms ±10 percent	
Load Impedance (Orbiter)	Ohms	75 Ohms ±10 percent	
Cable Characteristic Impedance (Orbiter)	Ohms	70 to 80	MP572-0328-0002
Cable Capacitance (Orbiter)	Pfarad (max)	2440	
SNR	dB p-p Sig. to RMS Noise	55, for 45 out of Signal Processor	DC to 2 MHz
Overvoltage Protection	Volts	10 peak-to-peak	

TABLE 8.2.6.2-1 WIDEBAND DIGITAL DATA INPUT,  
ELECTRICAL INTERFACE CHARACTERISTICS

Parameter	Dimension	Value	Notes
Data Rate	BPS	200 BPS to 5 MBPS, NRZ-L	
Data Type		200 BPS to 2 MBPS, Bi- $\phi$ -L	
Rise/Fall Time	Micro-seconds	Less than 50 nanoseconds	
Amplitude	Volts	6.50 peak-to-peak, line-to-line $\pm$ 0.3 volts ( $V_1$ )	(1)(2)
Source Coupling		Balanced Differential	
Load Termination		Balanced Differential	
Source Impedance (Orbiter)	Ohms	75 $\pm$ 10 percent	
Load Impedance (Orbiter)	Ohms	75 $\pm$ 10 percent	
Cable Characteristic Impedance (Orbiter)	Ohms	70 to 80	MP572-0328-0002
Cable Capacitance (Orbiter)	Pfarad (max)	2440	
SNR	dB p-p Sig. to RMS Noise	46, for 45 out of Signal Processor	DC to 2 MHz
Overvoltage Protection	Volts	10 peak-to-peak	

- (1) Based on worse case attenuation, at 2.5 MHz and 106 ft total cable length from the LRU (FM Sig. Processor) to the payload interface at the end of the SMCH cable. Signal amplitude requirements at other operating frequency/frequencies and cable lengths (SMCH harness) are determined by the generic equation defined by note (1) in Table 8.2.6.1-1.
- (2) Signal requirement at the S-Band FM Signal processor (LRU) is 5.0 volt, peak-to-peak, line-to-line  $\pm$  0.5 volt.

*Table 8.2.6.3-1 DOD Digital Data Input,  
Electrical Interface Characteristics*

Parameter	Dimension	Value	Notes
Data Rate	BPS	250 BPS to 256 KBPS	
Data Type		Bi- $\phi$ -L or NRZ-L	
Amplitude	Volts	1.03 peak-to-peak, $\pm 0.5$	(1)
Rise/Fall Time	Micro-seconds	Less than 100 Nanoseconds	
Source Coupling		Balanced Differential	
Load Termination		Balanced Differential	
Source Impedance	Ohms	$75 \pm 10$ percent	
Load Impedance	Ohms	$75 \pm 10$ percent	
Cable Type	Ohms	TSP	MP572-0328-0002
SNR	dB		DC to 2 MHz

(1) Based on 150 foot cable length.

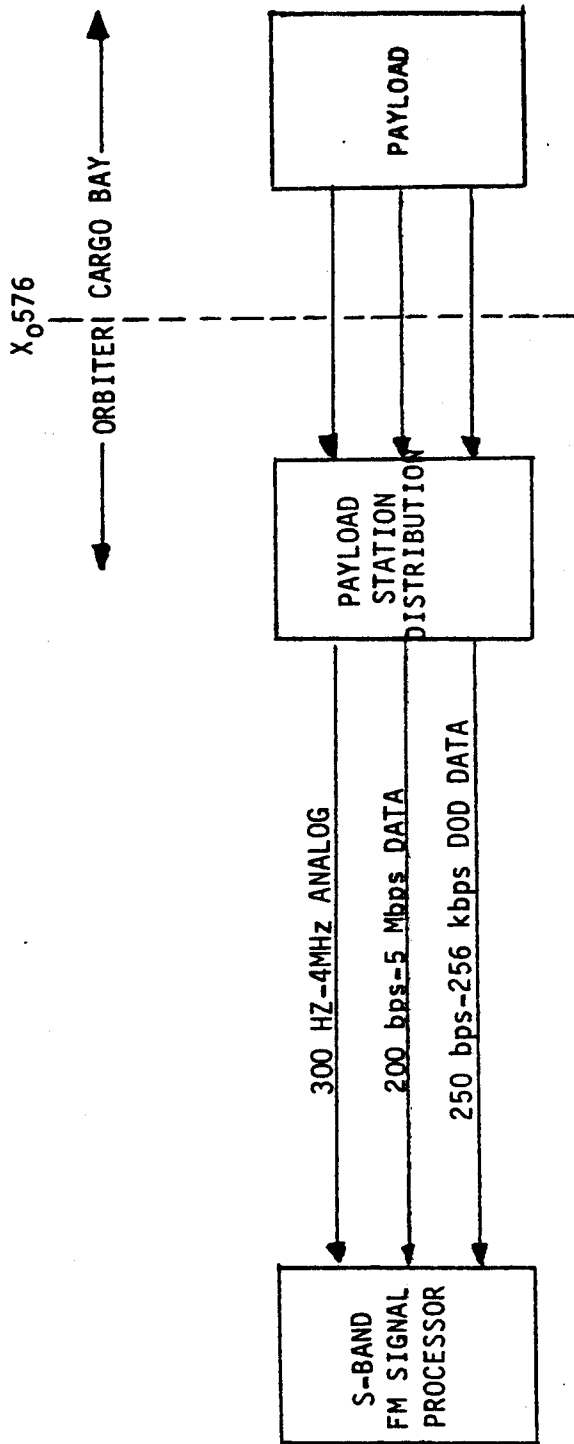


FIGURE 8.2.6-1 S-BAND FM SIGNAL PROCESSOR INTERFACE

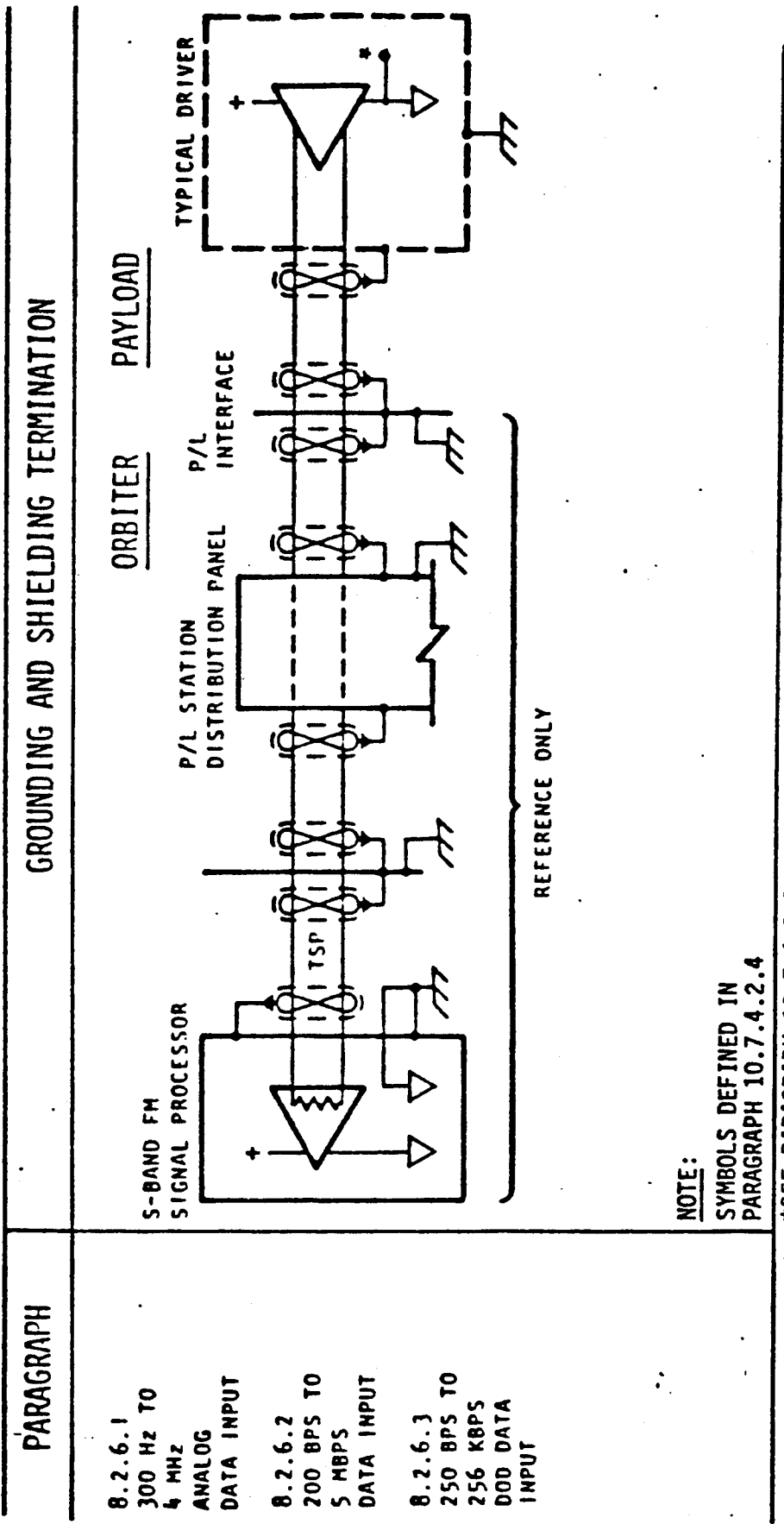


FIGURE 8.2.6.4-1 S-BAND FM SIGNAL PROCESSOR GROUNDING AND SHIELDING

8.2.7 Audio Central Control Network Interface. The Orbiter Audio Central Control Network (ACCN) shall provide duplex voice communications, paging, and aural caution and warning to attached manned payloads as shown in Figure 8.2.7-1.

8.2.7.1 Channels. The Orbiter ACCN shall provide the following analog channels with the characteristics defined in Tables 8.2.7.1-1 and 8.2.7.1-2.

Air to Ground 1	AG1
Air to Ground 2	AG2
Intercomm A	I/CA
Intercomm B	I/CB
Air-to-Air	AA
Page	

*The page channel audio shall operate at a fixed higher volume level such that all audio stations can hear a page voice regardless of audio on other channels. The Orbiter shall provide the capability for recording the five audio channels.*

8.2.7.2 Caution and Warning. The Orbiter ACCN shall distribute caution and warning signals to manned attached payloads with the characteristics shown in Table 8.2.7.2-1.

8.2.7.3 Transmitter and Page Key Line. *Cargo elements requiring access to the Orbiter ACCN shall provide key lines with the characteristics defined in Table 8.2.7.3-1 for keying a simplex transceiver for voice transmission over the AA channel and keying paging onto the Orbiter operational channels.*

8.2.7.4 Grounding and Shielding. Grounding and shielding shall be as shown in Figure 8.2.7.4-1.

TABLE 8.2.7.1-1 ACCN ORBITER-TO-PAYLOAD AUDIO CHANNELS,  
ELECTRICAL INTERFACE CHARACTERISTICS

Parameter	Dimension	Value	Notes
Bandwidth/ Freq Response	Hz	300 to 2300: $\pm 3$ dB 2300 to 3000: +3dB, -6dB	
Filter Rolloff	dB per Octave	18 dB per octave below 300 Hz and above 3kHz	
Signal Level at 1 kHz	dBm	.0 dBm $\pm 3$ dB	(1)
Crest Factor	dB	3dB (Nominal) Sinewave 6dB (Nominal) Voice	Ratio of peak to rms signal level controlled by voice processing
Nominal Amplitude	Volts, pk-to-pk	2.2 $\pm 3$ dB	(1)
Source Coupling	Ohms	Transformer coupled, balanced center tapped	
Load Termination		Transformer coupled, balanced, center tapped	Terminated in 600 Ohms whether in use or not
Cable Type		TSP	
Cable Charac- teristic Impedance	Ohms	71 $\pm 10$ percent (Nominal)	(2)

(1) Based upon 104 ft. cable length; from ACCN to P/L interface at end of SMCH.

(2) Cable characteristic impedance uncontrolled by Rockwell design standard but manufacturing process of TSP cable is similar to MPS72-0528-0002.



TABLE 8.2.7.1-2 ACCN PAYLOAD-TO-ORBITER AUDIO CHANNELS,  
ELECTRICAL INTERFACE CHARACTERISTICS

Parameter	Dimension	Value	Notes
Bandwidth/ Freq Response	Hz	300 to 2300: $\pm 3$ dB 2300 to 3000: +3dB, -6dB	
Filter Rolloff	dB per Octave	18 dB per octave below 300 Hz and above 3kHz	
Signal Level at 1 kHz	dBm	.0 dBm $\pm$ 3dB	(1)
Crest Factor	dB	3 (Nominal) Sinewave 6 (Nominal) Voice	Ratio of peak to rms signal level controlled by voice processing
Nominal Amplitude	Volts pk-to-pk	2.2 $\pm$ 3dB	(1)
Internal Noise	dB	57 dB below nominal 0dBm	
Channel-to- Channel Isolation	dB	Greater than 57 dB	Any channel to any other channel
Crosstalk	dB	More than 50 dB down	Measured from talk- line of one channel to listen-line of another channel
Source Coupling	Ohms	Transformer coupled, balanced center tapped	
Load Termination		Transformer coupled, balanced, center tapped	Terminated in 600 Ohms whether in use or not
Cable Type		TSP	
Cable Charac- teristic Impedance	Ohms	71 $\pm$ 10 percent (Nominal)	(2)

(1) Based upon 104 ft. cable length; from ACCN to P/L interface at end of SMCH.

(2) Cable characteristic impedance uncontrolled by Rockwell design standard but manufacturing process of TSP cable is similar to MPS72-0328-0002.

TABLE 8.2.7.2-1 ACCN EMERGENCY, CAUTION AND WARNING, AND SYSTEMS MANAGEMENT AUDIO TONES TO PAYLOAD, ELECTRICAL INTERFACE CHARACTERISTICS

Parameter	Dimension	Value	Notes
Siren:			
Frequency	Hz	666 to 1470	
Cycle	Sec	.5	
Klaxon		2500 Hertz squarewave at a duty cycle of 2.1 milliseconds ON and 1.6 milliseconds OFF, gated by a 270 Hertz square-wave at a duty cycle of 215 milliseconds ON and 70 milliseconds OFF	
Caution and Warning		375 and 1000 (Square)	2.5 Hz Steps
System Management		550 (Square)	1 sec (Nominal)
Amplitude	Volts pk-to-pk	2.2 ± 3dB	(1)
Noise	db	-60dBm at 600 Ohms	
Source Impedance	Ohms	600 ± 10 percent	
Load Impedance	Ohms	600 ± 10 percent	
Source Coupling		Balanced, Transformer Coupled	
Load Coupling		Balanced, Transformer Coupled	
Cable Type		TSP	
Cable Characteristic Impedance	Ohms	75 ± 10 percent (Nominal)	(2)

(1) Based upon 104 ft. cable length; from ACCN to P/L interface at end of SMCH.

(2) Cable characteristic impedance uncontrolled by Rockwell design standard but manufacturing process of TSP cable is similar to MP572-0328-0002.

TABLE 8.2.7.3-1 ACCN KEYLINE CHARACTERISTICS,  
ELECTRICAL INTERFACE CHARACTERISTICS

Parameter	Dimension	Value	Notes
Closed Circuit Impedance	Ohms	Less than 25 Ohms	
Open Circuit Impedance	Ohms	Greater than 100 K Ohms	
Closed Circuit Current	Milli- amperes	Less than 150 Milli- amperes	
Open Circuit Current	Micro- amperes	Less than 280 Micro- amperes	
Closed Circuit Voltage	Volts	Less than 3 volt drop	
Power/Ground Isolation	Ohms	Greater than 1 Meg ohm	

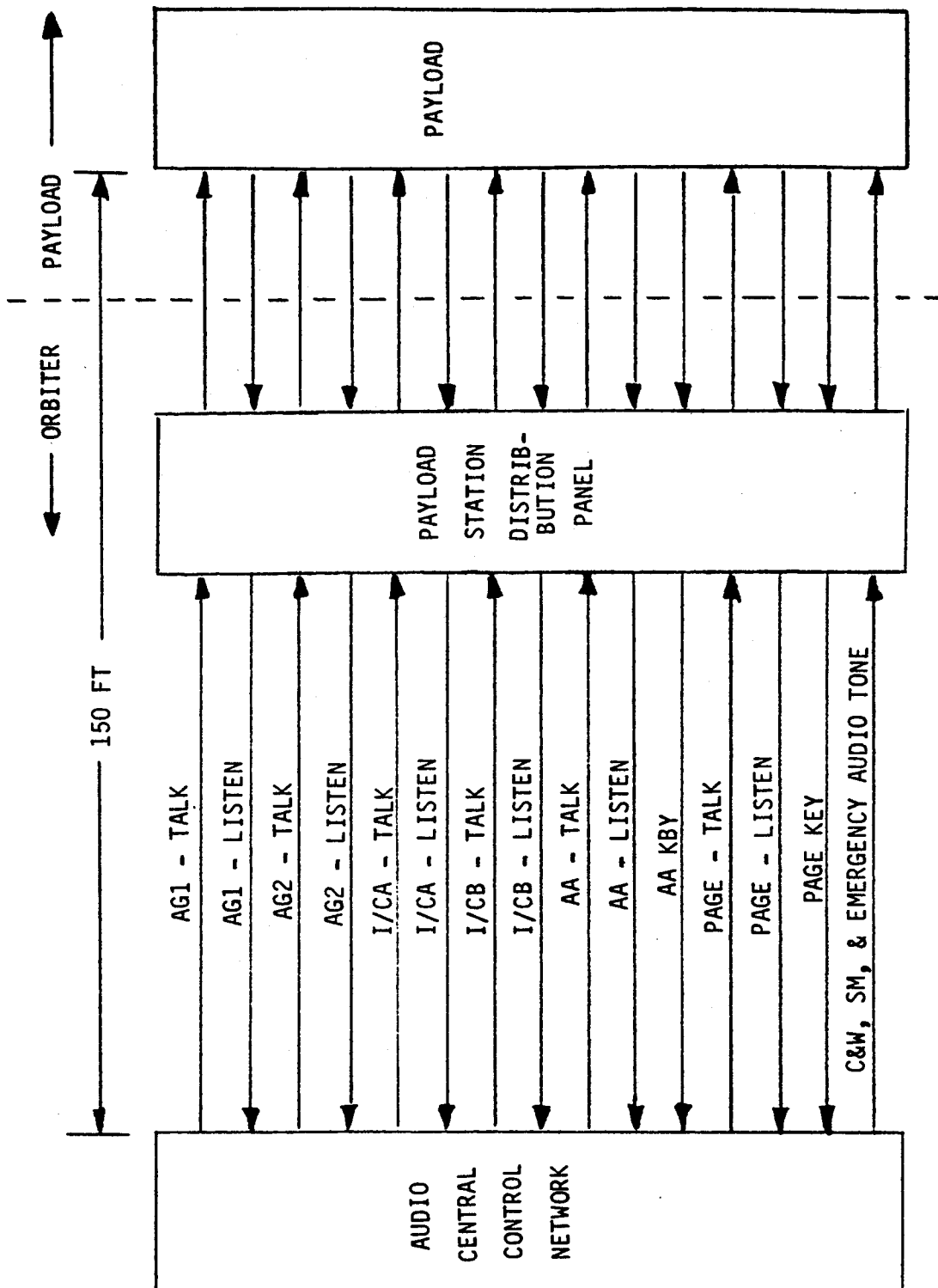
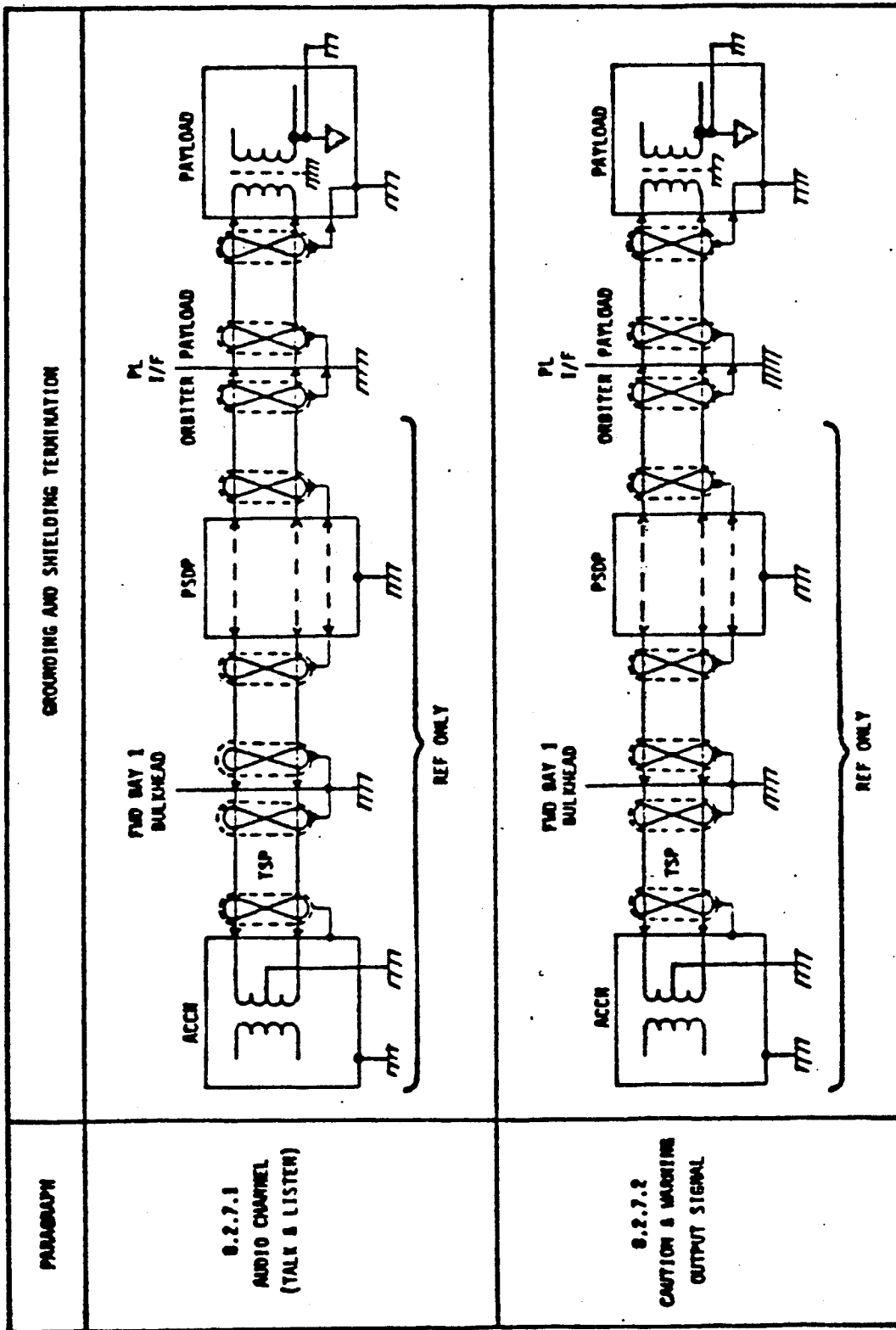


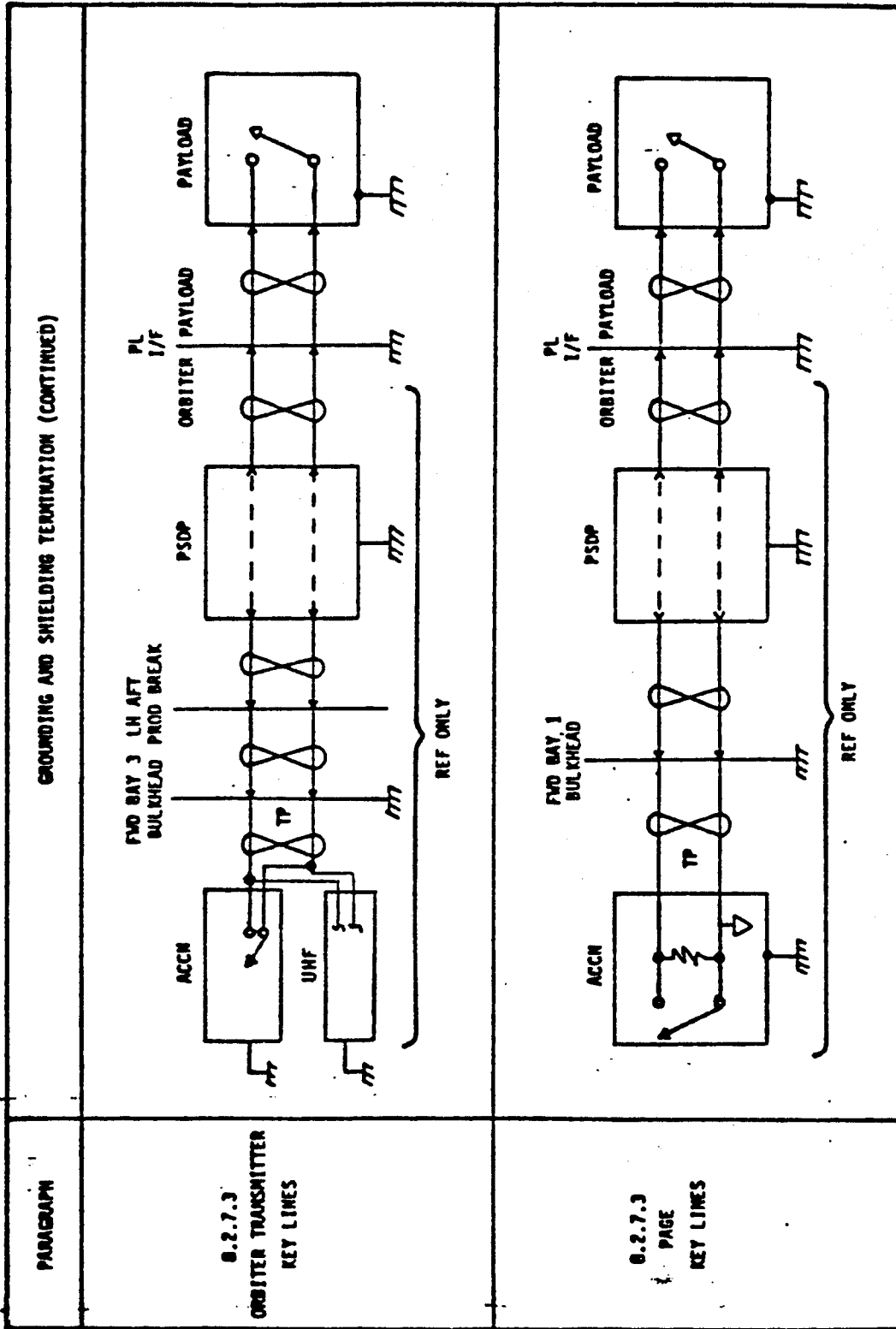
FIGURE 8.2.7-1 AUDIO CENTRAL CONTROL NETWORK INTERFACE



NOTE:

SYMBOLS DEFINED IN  
 PARAGRAPH 10.7.4.2.4

FIGURE 8.2.7.4-1 AUDIO CENTRAL CONTROL NETWORK GROUING AND SHIELDING INTERFACE (SHEET 1 OF 2)



NOTE:  
SYMBOLS DEFINED IN  
PARAGRAPH 10.7.4.2.4

FIGURE 8.2.7.4-1 AUDIO CENTRAL CONTROL NETWORK GROUNDING AND SHIELDING INTERFACE (SHEET 2 OF 2)

**8.2.8 CCTV Video Control Unit Interface.** The CCTV video control unit shall provide and accept the video, sync, and control signals to/from attached payloads as shown in Figure 8.2.8-1. The Orbiter shall transmit, on a time-available basis, selected payload video signals to ground facilities over S-band FM and/or Ku-band links.

**8.2.8.1 Video Signal Characteristics.** All television video signals to/from attached payloads shall conform with EIA specifications RS170 and RS330 as modified by Table 8.2.8.1-1 and Table 8.2.8.1-2.

**8.2.8.2 Sync and Control Signal Output.** The format of the sync and control signal provided to an attached payload shall be as shown in Figure 8.2.8.2-1.

**8.2.8.3 Composite Video Waveform.** All television video signals to/from attached payloads shall conform to the waveforms shown in Figure 8.2.8.3-1.

**8.2.8.4 Grounding and Shielding.** Grounding and shielding shall be as shown in Figure 8.2.8.4-1.

*Table 8.2.8.1-1 CCTV Video Characteristics From Orbiter To Payloads,  
Electrical Interface Characteristics*

Parameter	Dimension	Value	Notes
Frame Rate	frames/ sec	29.97	
Lines per Frame	inter- laced lines/ frame	525	
Fields	Inter- laced fields/ sec	59.9	
Aspect Ratio		4/3	
Horizontal Scanning Frequency	Hz	15,734.264 ± 0.044	
Horizontal Frequency Drift	Hz/sec	0.00044	
Vertical Scanning Frequency	Hz	Horiz freq/262.5	
Composite Video Bandwidth	MHz	4.5	Orbiter Communi- cations system limits video to 4.5 MHz.
Composite Video Amplitude	volts pk-to-pk	0.83 ± 10 percent	(1)
Sync Tip Amplitude	Volts pk	0.00 ± 0.05	Differentially, line-to-line.
Polarity		White positive Black negative	The white signal level shall be .83 ± 10 percent volts, pk-to-pk, dif- ferentially, line- to-line.



*Table 8.2.8.1-1 CCTV Video Characteristics From Orbiter To Payloads,  
Electrical Interface Characteristics (Continued)*

Parameter	Dimension	Value	Notes
Video Character-istics	!db	! (2)	!Pk-pk signal !(1 volt) to RMS !noise.
Crosstalk	!db	!-40 db or less	!Channel-to-channel
Source Coupling		!Direct coupled	
Load Coupling		!Direct coupled	
Source Impedance (Orbiter)	!ohms	!75 $\pm$ 5 percent	!0 to 4.5 MHz !differentially, !line-to-line.
Load Impedance (payload)	!ohms	!75 $\pm$ 5 percent	!0 to 4.5 MHz !differentially, !line-to-line.
Signal/Ground Isolation		!Video and sync signal shall be isolated from !power ground by at least 1.0 Meg ohm in the !payload	
Cable Type		!TSP	!(MP 572-0328-002)
Cable Character-istic Impedance		!75 $\pm$ 5 percent	
Cable Shield Grounding		!multiple point	

- 1) *Measured at the end of a cable 61 feet from the Xo 603 interface panel. Voltage required at the Xo 576 A891 connector is 1.0  $\pm$  10 percent volts. Worst case used for calculation is 1.62 db attenuation at 4.5 Mhz.*
- 2) *Video should meet RS-170 characteristics for amplitude, timing, and SNR requirements applied to a balanced, differential drive signal with exceptions as noted below:*
  - a) *The horizontal line frequency is equal to 15,734.264  $\pm$  0.044 Hz. The vertical field frequency is equal to 2/525 times the horizontal line frequency.*

**Table 8.2.8.1-1 CCTV Video Characteristics From Orbiter To Payloads,  
Electrical Interface Characteristics (Concluded)**

- b) The synchronizing signal, as measured from blanking level to sync tip will be minus  $0.286 \pm 0.03$  volts (nominally 40 9RE units). The sync tip will be 0.0 volts DC.**
- c) The blanked picture signal, as measured from blanking level to reference white level, will be plus  $0.714 \pm 0.07$  volts (nominally 100 9RE units).**

Table 8.2.8.1-2 CCTV Video Characteristics From Payloads To Orbiter,  
Electrical Interface Characteristics

Parameter	Dimension	Value	Notes
Frame Rate	frames/ sec	29.97	
Fields	Inter- laced Fields/ sec	59.9	
Lines per frame	inter- laced lines/ frame	525	
Aspect Ratio		4/3	
Horizontal Scanning Frequency	Hz	15,734.264 ± 0.044	
Horizontal Frequency Drift	Hz/sec	0.00044	
Vertical Scanning Frequency	Hz	Horiz Freq/262.5	
Composite Video Bandwidth	MHz	4.5	Orbiter Communi- cations System limits video to 4.5 MHz.
Composite Video Amplitude	Volts, pk-to-pk	1.20 ± 10 percent	(1)
Sync Tip Amplitude	Volts pk	0.00 ± 0.05	Differentially, line-to-line.
Polarity		White positive Black negative	The white signal level shall be 1.20 ± 10 percent volts, pk-to-pk dif- ferentially, line- to-line.

**Table 8.2.8.1-2 CCTV Video Characteristics From Payloads To Orbiter,  
Electrical Interface Characteristics (Continued)**

Parameter	Dimension	Value	Notes
Video Characteristic	db	(2)	1Pk-to-pk signal (1 volt) to RMS Noise.
Source Coupling		Same as video from Orbiter-to-payloads	
Load Coupling		Direct coupled	
Source Impedance (payload)	ohms	75 ± 5 percent	Differentially, line-to-line
Load Impedance (Orbiter)	ohms	75 ± 5 percent	Differentially, line-to-line
Crosstalk	db	-40 db or less	Measured between video channels
Signal/Ground Isolation		Video and sync signal return shall be isolated from power ground by at least 1.0 Meg ohm in the Orbiter	
Cable Type		TSP	(MP 572-0328-0002)
Cable Characteristic Impedance	ohms	75 ± 5 percent	
Cable Shield Grounding		Multiple point	

- (1) Measured at the input of the SMCN, based upon 73 ft. cable length from the X<sub>o</sub>576 bulkhead connector A891. Voltage required at the X<sub>o</sub> 576 connector is 1.0 ± 10 percent volts. Worst case used for calculation is 1.62 db attenuation at 4.5 Mhz.
- (2) Video should meet RS-170 characteristics for amplitude, timing, and SNR requirements applied to a balanced, differential drive signal with exceptions as noted below:
  - a) The horizontal line frequency is equal to 15,734.264 ± 0.044 Hz. The vertical field frequency is equal to 2/525 times the horizontal line frequency.

*Table 8.2.8.1-2 CCTV Video Characteristics From Payloads To Orbiter,  
Electrical Interface Characteristics (Concluded)*

- b) The synchronizing signal, as measured from blanking level to sync tip will be minus  $0.286 \pm 0.03$  volts (nominally 40 9RE units). The sync tip will be 0.0 volts DC.*
- c) The blanked picture signal, as measured from blanking level to reference white level, will be plus  $0.714 \pm 0.07$  volts (nominally 100 9RE units).*

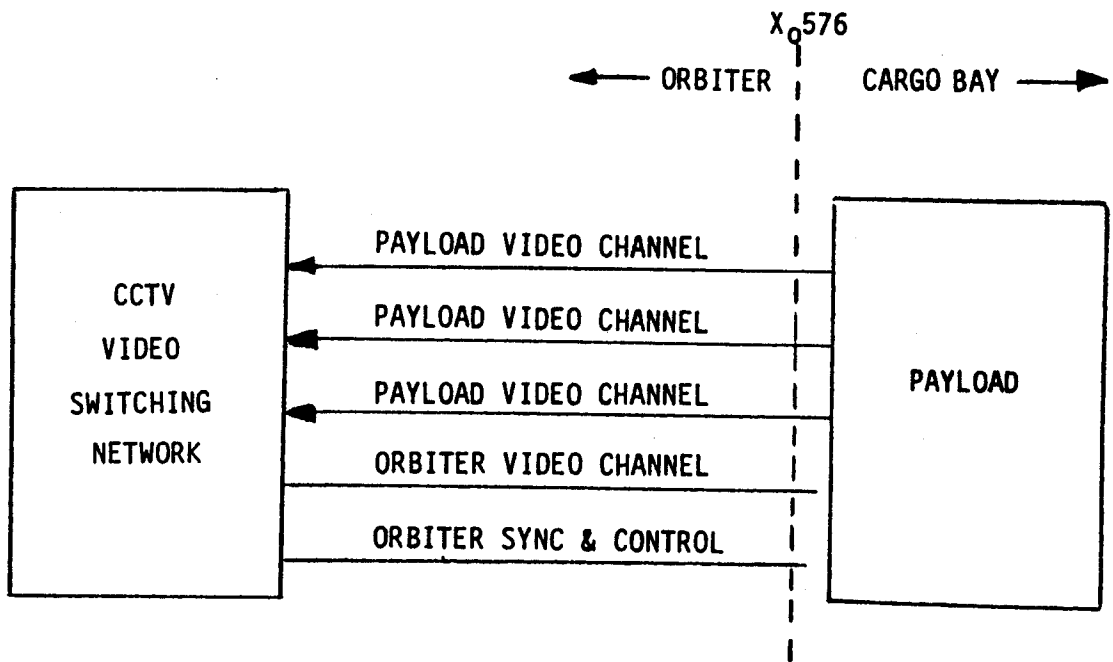
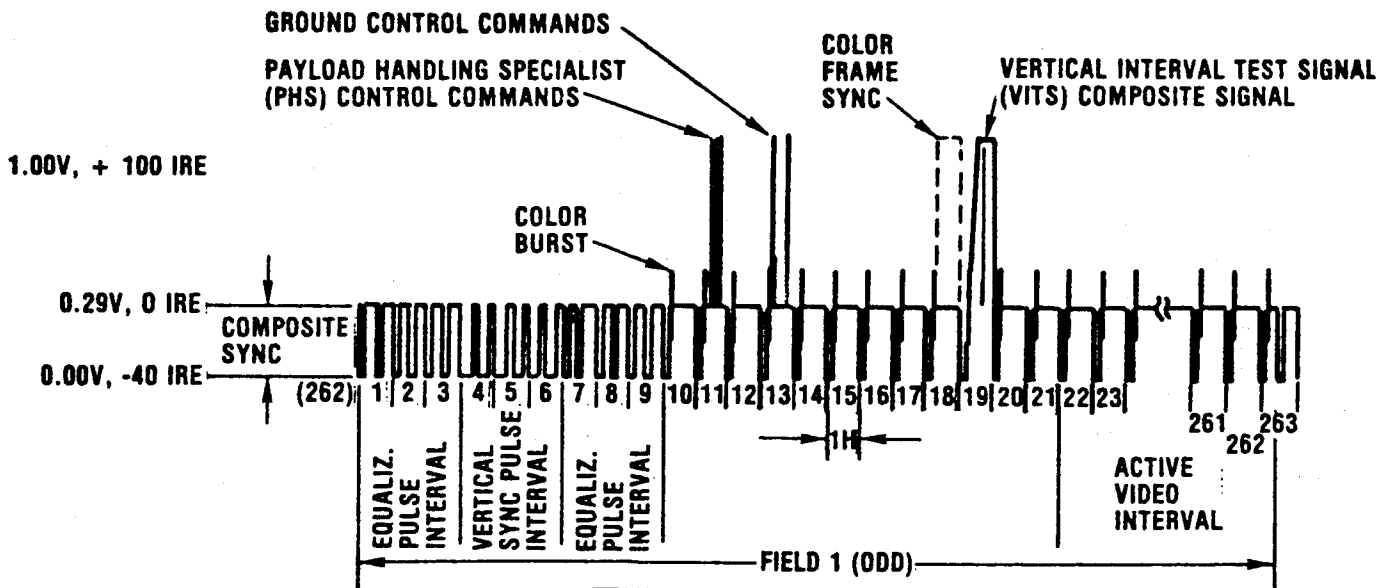
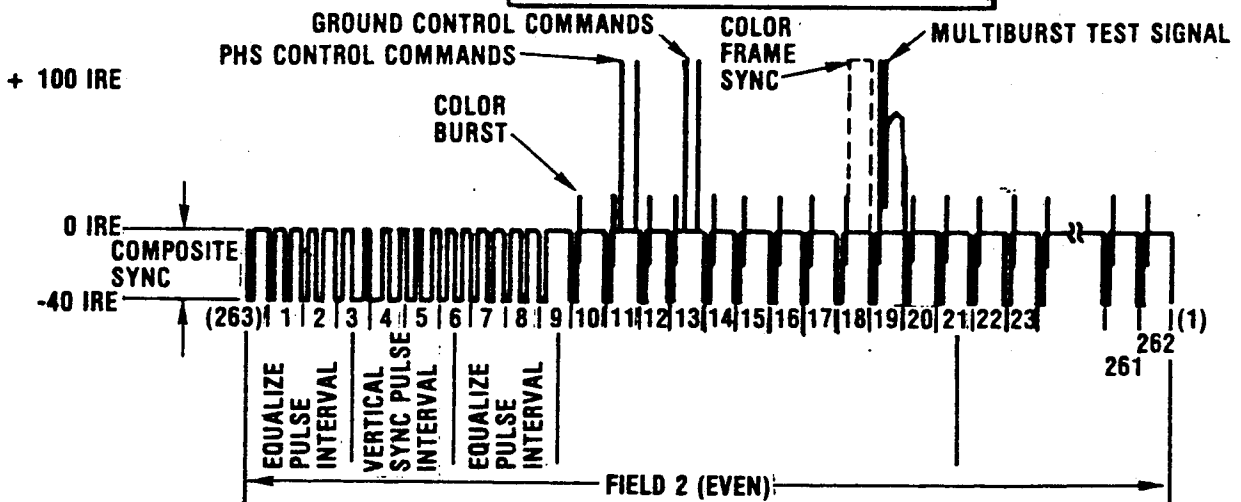


FIGURE 8.2.8-1 CCTV VIDEO SWITCHING NETWORK INTERFACE



NOTE: NUMBERS BELOW WAVEFORM ARE LINE NUMBERS

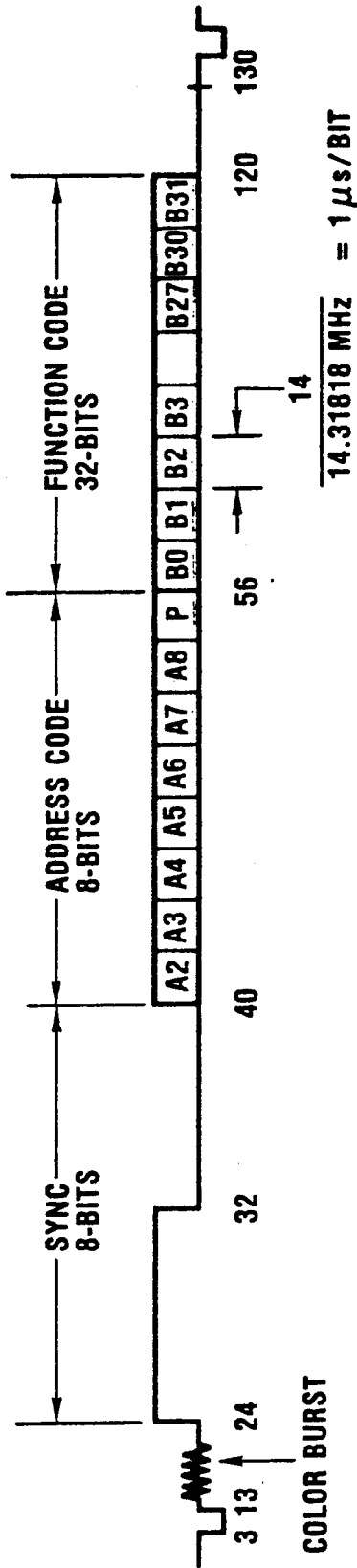


NOTES:

1. COMPOSITE SYNC TIMING IS DEFINED BY EIA STANDARD RS 170.
2. THE HORIZONTAL FREQUENCY IS 15,734.264 Hz.
3. COLOR FRAME SYNC IS TRANSMITTED EVERY THIRD FIELD.
4. COLOR BURST IS DEFINED BY EIA STANDARD RS-240, APPENDIX "A"

FIGURE 8.2.8.2-1 SYNC AND CONTROL SIGNAL FORMAT (SHEET 1 OF 6)

**CCTV SYNC LINE-COMMAND FORMAT**



**SYNC**

1110000 AN 8-BIT CODE SYNC EXISTS, EVEN IF NO COMMAND IS BEING TRANSMITTED

**ADDRESS CODES**

**BITS A2 THROUGH A8:** THESE ARE THE SAME CODES DEFINED IN FIGURE 1. HOWEVER, UPLINK VCU COMMANDS DENOTED BY A7, A8 = 00 WILL NOT APPEAR ON THE SYNC LINE. AN ALL 0s CODE MEANS A COMMAND IS NOT PRESENT

**BIT P:** A PARITY BIT. TO MAKE THE 8-BIT ADDRESS CODE ODD PARITY. (WHEN A COMMAND IS NOT PRESENT, THE PARITY BIT MAY BE "0" OR "1")

**BITS B0 THROUGH B31:** A 32-BIT COMMAND FIELD. COMMAND ASSIGNMENT FOR CAMERA IS GIVEN IN FIGURE 2. A UNIT SHALL NOT RESPOND TO THE FUNCTION CODE UNLESS THE ADDRESS CODE MATCHES ITS OWN LOCATION ADDRESS

- NOTES:**
- 1) NUMBERS BELOW WAVEFORM ARE THE "2.045" MHz HORIZONTAL LINE COUNT
  - 2) FIGURES NOT-TO-SCALE
  - 3) COMMANDS MAY APPEAR ON VIDEO LINE 11 AND/OR LINE 13 OF BOTH ODD & EVEN FIELDS. HOWEVER, IF COMMANDS APPEAR ON BOTH LINES IN A FIELD, THE ADDRESS CODE WILL NEVER BE IDENTICAL

FIGURE 8.2.8.2-1 SYNC AND CONTROL SIGNAL FORMAT (SHEET 2 OF 6)



### CCTV VIDEO INPUT ADDRESS ASSIGNMENTS

<u>ADDRESS</u>	<u>SYNC ADDRESS CODE</u>						<u>VIDEO INPUT</u>	<u>TV MONITOR DISPLAY CODE</u>
	<u>A2</u>	<u>A3</u>	<u>A4</u>	<u>A5</u>	<u>A6</u>	<u>A7</u> <u>A8</u>		
0	0	0	0	0	0	0 1	CABIN CAMERA 1 (FLT DECK)	C1
1	0	0	0	0	1		FORWARD BAY CAMERA	FB
2	0	0	0	1	0		AFT BAY CAMERA	AB
3	0	0	0	1	1		SPARE (VTR)	VT
4	0	0	1	0	0	0 1 ONLY SEE NOTES	CABIN CAMERA 3	C3
5	0	0	1	0	1		KEEL CAMERA	KB
6	0	0	1	1	1		PORT RMS CAMERA	RP
7	0	0	1	1	1		STARBOARD RMS CAMERA	RS
8	0	1	0	0	0	0 1	CABIN CAMERA 2 (MID-DECK)	C2
9	0	1	0	0	1		VIDEO TEST SIGNAL	TS
10	0	1	0	1	0		SPLIT SCREEN A	(N/A)
11	0	1	0	1	1		SPLIT SCREEN B	(N/A)
12	0	1	1	0	0		CABIN CAMERA 4	C4
13	0	1	1	0	1		PAYLOAD 1	P1
14	0	1	1	1	0		PAYLOAD 2	P2
15	0	1	1	1	1		PAYLOAD 3	P3

- NOTES:**
- 1) THESE ADDRESS ASSIGNMENTS VALID ONLY FOR THE A2, A7, A8 BIT CODES SHOWN
  - 2) A7, A8 = 01 — DEFINES CAMERA CONTROL COMMAND — THE ASSOCIATED COMMAND IS OUTPUT ON THE SYNC SIGNAL INCLUDING COMMANDS TO ADDRESSES 9, 10, & 11
  - 3) A7, A8 = 00 — DEFINES VCU COMMAND (VIDEO OUTPUT SELECT, VCU MODE, CAMERA POWER, & CAMERA STOP-MOTION COMMANDS) THESE COMMANDS NOT OUTPUT ON SYNC SIGNAL
  - 4) ADDRESSES WITH A2 = 1 & ADDRESSES WITH A7, A8 = 10 OR 11 ARE CURRENTLY UNASSIGNED

FIGURE 8.2.8.2-1 SYNC AND CONTROL SIGNAL FORMAT (SHEET 3 OF 6)

## COMMAND ASSIGNMENT

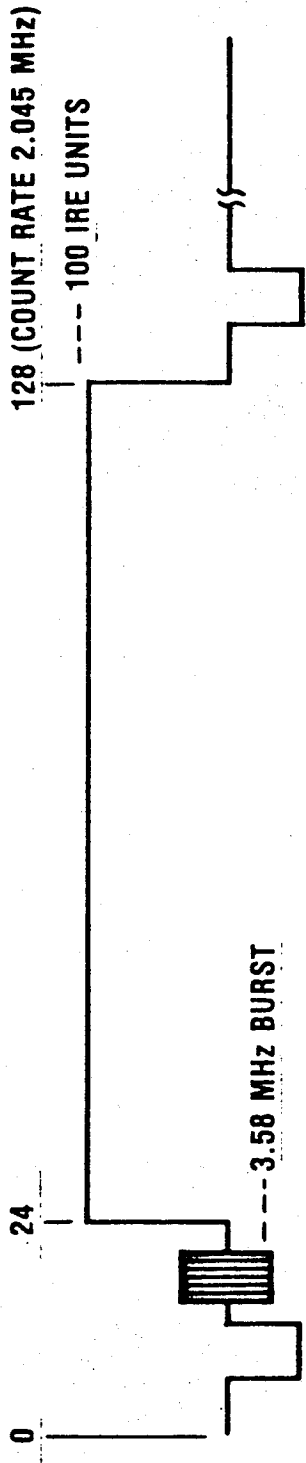
COMMAND ASSIGNMENT	SYNC SIGNAL BIT POSITION
(FOR A7, A8 = 01 ONLY)	
SPARE 1A	B0
SPARE 1B	B1
SPARE 1C	B2
SPARE 1D	B3
SPARE 1E	B4
SPARE 1F	B5
SPARE 1G	B6
SPARE 1H	B7
DLR PEAK	B8
DLR MID	B9
DLR AVG	B10
GAMMA WHITE STRETCH	B11
GAMMA NORMAL	B12
GAMMA BLACK STRETCH	B13
AUX OFF	B14
AUX ON	B15
SPARE 3	B16
PAN-TILT RESET	B17
PAN-TILT SLOW	B18
PAN-TILT FAST	B19
PAN-RIGHT	B20
PAN LEFT	B21
TILT UP	B22
TILT DOWN	B23
IRIS CLOSE	B24
IRIS OPEN	B25
FOCUS FAR	B26
FOCUS NEAR	B27
ZOOM OUT	B28
ZOOM IN	B29
SPARE 2A	B30
SPARE 2B	B31

**NOTE:**

1. PRESENCE OF A COMMAND ON THE SYNC SIGNAL IS DENOTED BY A DATA '1' IN THE BIT POSITION
2. COMMANDS B20 THROUGH B31 ARE REPEATED EVERY FIELD UNTIL CANCELLED BY AN UPLINK STOP MOTION COMMAND
3. BIT B18 OR B19 IS A '1' WHENEVER A PAN OR TILT COMMAND IS PRESENT
4. ALL OTHER COMMANDS ARE INSERTED ON THE SYNC SIGNAL FOR ONE FIELD ONLY & MUST BE LATCHED IN THE LRU AS NEEDED

FIGURE 8.2.8.2-1 SYNC AND CONTROL SIGNAL FORMAT (SHEET 4 OF 6)

COLOR FRAME SYNC SIGNAL

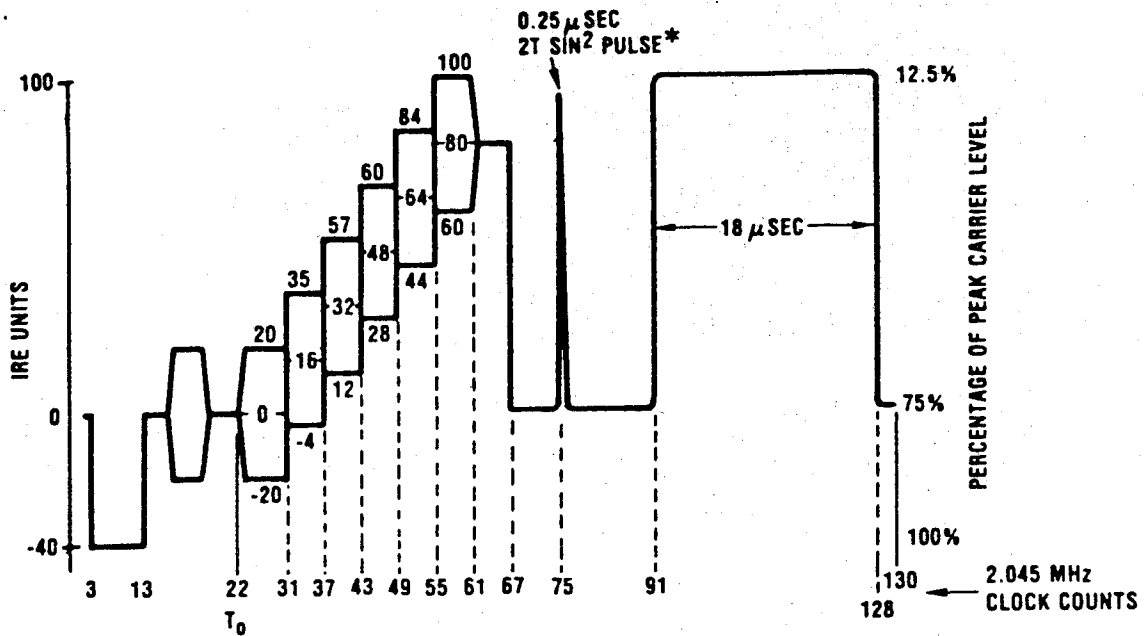


NOTE:

1. COLOR FRAME SYNC ON LINE 18
2. COLOR FRAME SYNC IS TRANSMITTED EVERY THIRD FIELD

FIGURE 8.2.8.2-1 SYNC AND CONTROL SIGNAL FORMAT (SHEET 5 OF 6)

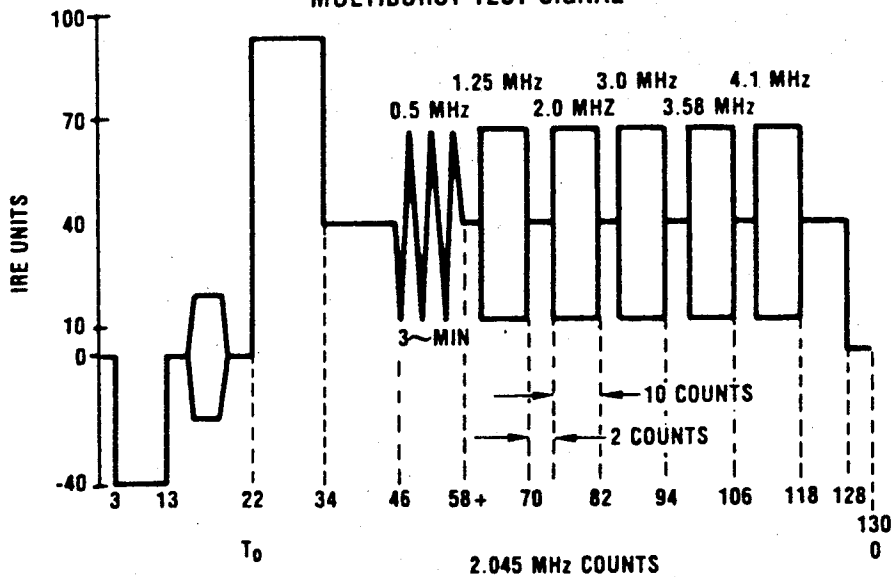
### VERTICAL INTERVAL TEST SIGNAL



\*HALF AMPLITUDE DURATION

- NOTES:
1. SUBCARRIER OF STAIRCASE IN PHASE WITH BURST
  2. RISE & DECAY OF ALL LUMINANCE SIGNALS NOT LESS THAN 0.2 μSEC  
RISE & DECAY OF ENVELOPE OF SUBCARRIER COMPONENT OF STAIRSTEP SIGNAL SHALL BE APPROX SINE SHAPED & RISE TIME 375 μSEC
  3. T<sub>0</sub> = NOMINAL START OF ACTIVE PORTION OF LINE 19, FIELD 1

### MULTIBURST TEST SIGNAL



NOTES:

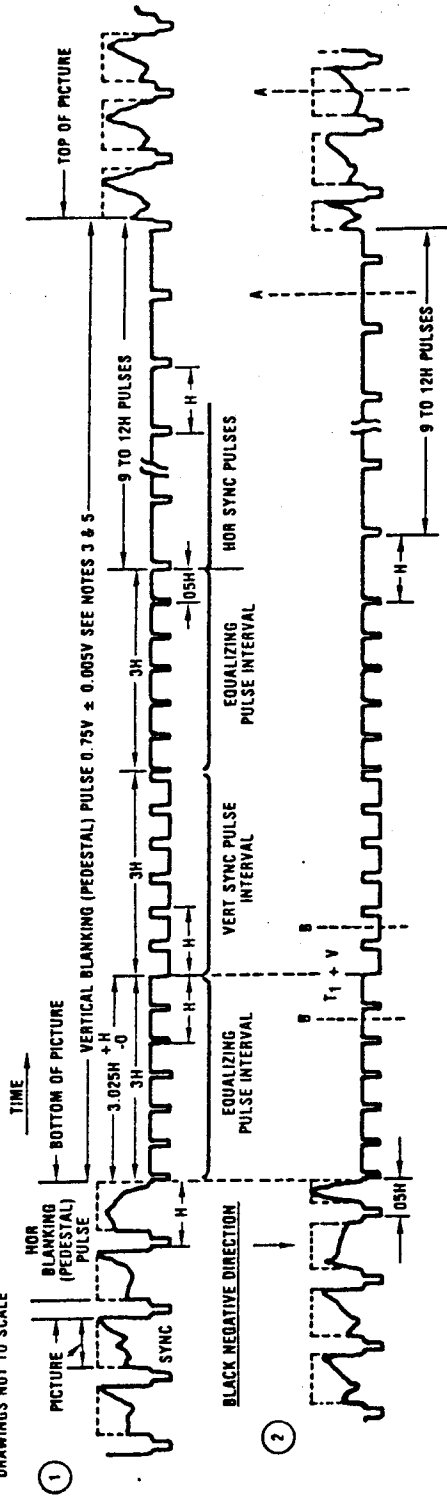
1. EACH BURST = 60 IRE UNITS PEAK TO PEAK
2. T<sub>0</sub> = NOMINAL START OF ACTIVE PORTION OF LINE 19, FIELD 2
3. RISE & FALL OF WHITE BAR SHALL HAVE RISE TIME OF NOT LESS THAN 0.2 μS

FIGURE 8.2.8.2-1 SYNC AND CONTROL SIGNAL FORMAT (SHEET 6 OF 6)

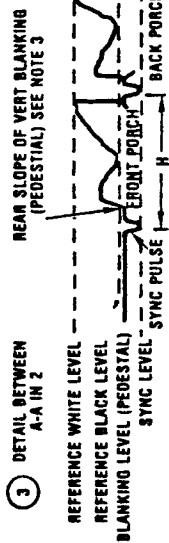
MONOCHROME TELEVISION  
 PICTURE LINE AMPLIFIER STANDARD OUTPUT  
 SYNC SIGNAL AMPLITUDE SHALL BE HELD CONSTANT WITHIN  
 $\pm 4\%$  DURING TRANSMISSION  
 $\beta = 0.714$  VOLTS  
 $\alpha = 0.286$  VOLTS

(VISUAL TRANSMITTER INPUT SIGNAL WAVEFORM)

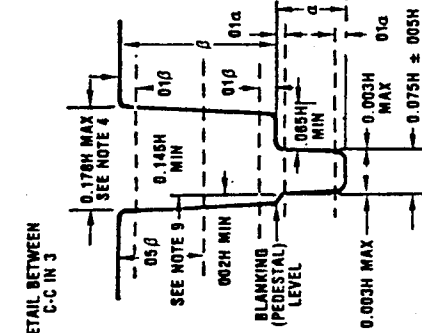
DRAWINGS NOT TO SCALE



③ DETAIL BETWEEN A-A IN 2



⑤ DETAIL BETWEEN C-C IN 3



NOTE:

1. H = TIME FROM START OF ONE LINE TO START OF NEXT LINE
2. V = TIME FROM START OF ONE FIELD TO START OF NEXT FIELD
3. LEADING & TRAILING EDGES OF VERTICAL BLANKING (PEDESTAL) SHALL BE COMPLETE IN LESS THAN 0.1H
4. LEADING & TRAILING EDGES OF HORIZONTAL BLANKING (PEDESTAL) SHALL BE STEEP ENOUGH TO PRESENT MIN & MAX VALUES OF DURATIONS UNDER ALL CONDITIONS OF PICTURE CONTENT
5. ALL TOLERANCES & LIMITS SHOWN IN THIS DRAWING ARE PERMISSIBLE ONLY FOR LONG-TIME VARIATIONS
6. EQUALIZING PULSE AREA SHALL BE BETWEEN 0.45 & 0.5 OF THE AREA OF A HORIZONTAL SYNC PULSE
7. ALL RISE & DECAY TIMES SHALL MEASURE BETWEEN 0.1 & 0.9 AMPLITUDE REFERENCE LINES
8. THE OVERSHOOT ON BLANKING (PEDESTAL) SIGNAL SHALL NOT EXCEED 0.02AT THE BEGINNING OF THE FRONT PORCH & SHALL NOT EXCEED 0.05P AT THE END OF THE BACK PORCH. THE OVERSHOOT ON SYNC SIGNALS SHALL NOT EXCEED 0.05P ANY OTHER EXTREMES SIGNALS ON THE BLANKING (PEDESTAL) SIGNAL SHALL NOT EXCEED 0.02P
9. FOR SETTING ASPECT RATIO, THE HORIZONTAL BLANKING (PEDESTAL) DURATION SHOULD BE SET TO 0.175H AT THE 0.5P POINT
10. RISE TIME & DECAY TIME OF HORIZONTAL BLANKING SHALL NOT EXCEED 0.003H

④ DETAIL BETWEEN B-B IN 2

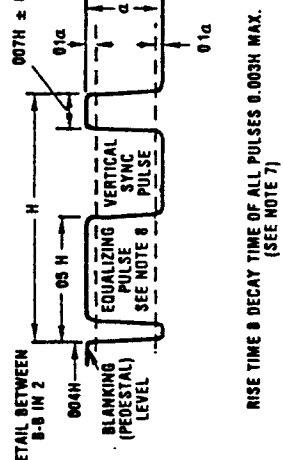


FIGURE 8.2.8.3-1 COMPOSITE VIDEO WAVEFORM

PARAGRAPH

8.2.8.1  
VIDEO SIGNAL  
(TO & FROM  
PAYLOAD)

8.2.8.2  
SYNC &  
CONTROL  
OUTPUT

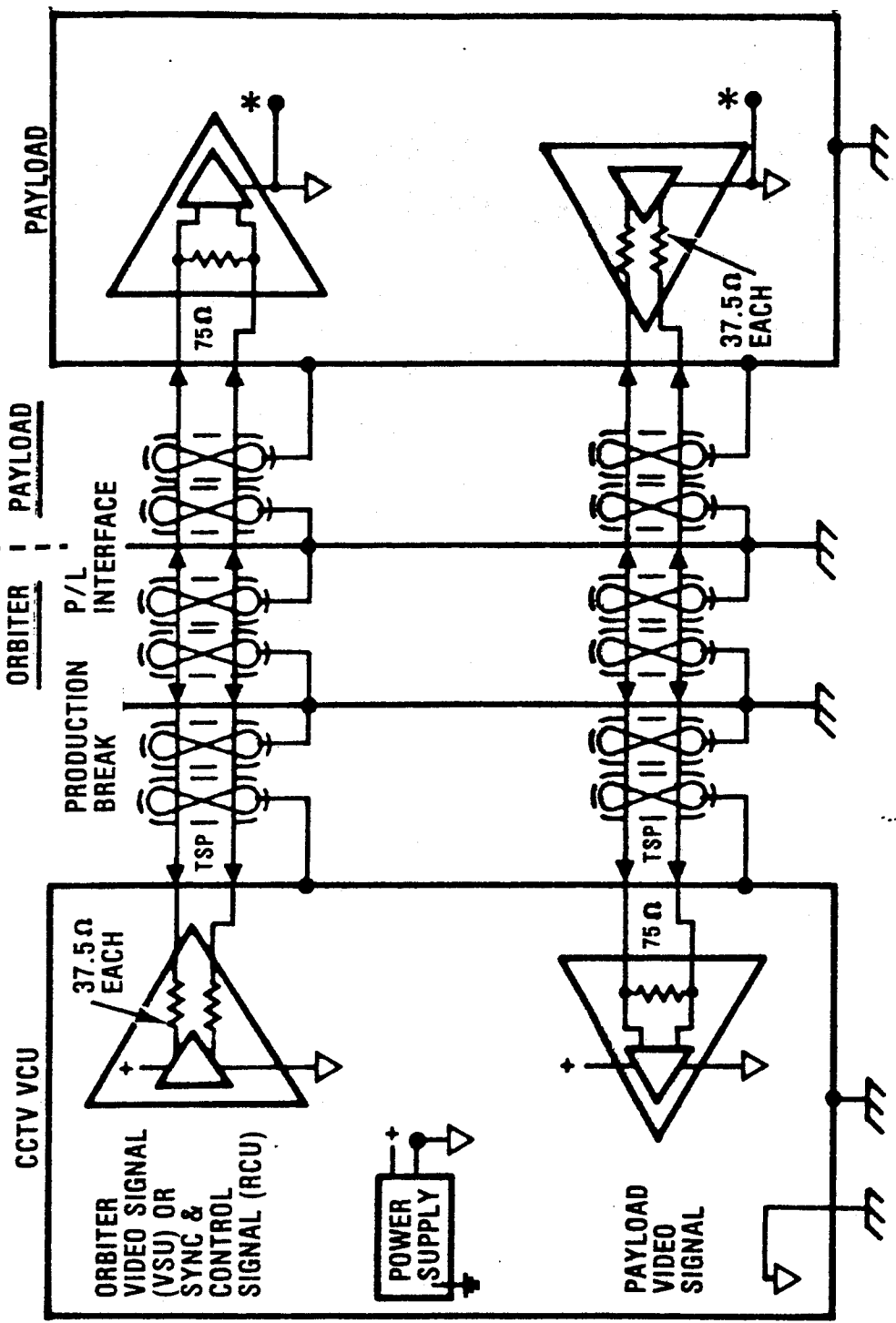


FIGURE 8.2.8.4-1 CCTV VIDEO CONTROL UNIT GROUNDING AND SHIELDING INTERFACE

8.2.9 Caution and Warning Electronics Assembly (CWEA) Interface. The hardwired interfaces to the CWEA available for payload use are shown in Figure 8.2.9-1. Classified under emergency signals for habitable payloads are the two Fire/Smoke inputs (discrete signals) to the CWEA. In addition, for both habitable and non-habitable payloads, five warning parameter direct inputs are available at the interface. A relay switch closure for actuation of a Master Alarm Light for a habitable payload is also provided.

In addition, Payload Caution and Warning parameters, either analog or discrete, may be hardwired to MDM inputs as defined in Paragraph 8.2.2. Use of this interface requires Orbiter Computer Software Support, as defined in Section 9.0. Annunciation is provided via the Caution/Warning MDM interface.

8.2.9.1 Fire/Smoke Input. The electrical interface characteristics for the Fire/Smoke emergency inputs at the Orbiter/payload interface are defined in Table 8.2.9.1-1.

8.2.9.2 (Reserved)

8.2.9.3 Caution and Warning Discrete Inputs. The electrical interface characteristics for the Caution and Warning discrete inputs at the Orbiter/payload interface shall be as shown in Table 8.2.9.3-1.

8.2.9.4 Caution and Warning Analog Inputs. The electrical interface characteristics for the Caution and Warning analog inputs at the Orbiter/payload interface shall be as shown in Table 8.2.9.3-1.

8.2.9.5 Payload Master Alarm Light. The Orbiter shall provide a switch closure to activate a master alarm light in habitable payload modules. The switch closure shall activate on all emergency, warning or caution signals.

The electrical interface characteristics for the Payload Master Alarm Light output at the Orbiter/payload interface shall be as shown in Table 8.2.9.5-1.

8.2.9.6 Grounding and Shielding. Grounding and shielding shall be as shown in Figure 8.2.9.6-1.

TABLE 8.2.9.1-1 FIRE/SMOKE INPUT-ALARM, PAYLOAD TO ORBITER,  
ELECTRICAL INTERFACE CHARACTERISTICS

Parameter	Dimension	Characteristics Orbiter/ Payload Interface	Notes
Type		Single-ended	(1)
Discrete- False	Min: Volt Max: Volt	0 4	
Discrete- True	Min: Volt Max: Volt	21 32	
Transfer		DC Coupled	
Load Impedance (Orbiter)	Min: Kilohm Max: Kilohm	4.88 15.92 14.95	(2)
Pwr-Off Impedance	Min: Kilohm	4.88	
Drive Capability	Min: Milliamp	150	
Load Current	Max: Milliamp	6.6	(3)
Over- voltage Protection	Max: Volt	37.5	
Fault Voltage Emission	Max: Volt	+15.0	
Fault Current Limitation	Max: Milliamp	10	

- (1) Orbiter common hardware  
(2) If signal source referenced to structure.  
(3) At 32 volts



TABLE 8.2.9.3-1 CAUTION AND WARNING ANALOG/DISCRETE-INPUT  
HARDWARE, PAYLOAD TO ORBITER,  
ELECTRICAL INTERFACE CHARACTERISTICS

Parameter	Dimension	Characteristics Orbiter/ Payload Interface	Notes
Type(Orbiter)		Differential Analog	
Analog Range	Volt	0 to 5	(1)
Discrete-False	Volt	0 ± 0.5	(1), (2)
Discrete-True	Volt	4 to 28	(1), (2)
Ripple and Noise (Orbiter)	Max: Millivolt	25	(3)
CMV	Max: Volt	5	
Rise/Fall Time	Min: Microsec Max: Microsec	N/A	
Noise Suppression Bandwidth		N/A	
CMR	dB	40	(4)
Transfer		DC Coupled	
Source Impedance (Payload)	Max: ohm	100 or Less	0-5 Volt Analog Input Signals (7)
Load Impedance (Orbiter)	Min: Kilohms	200	5 VDC discrete and 0-5 volt analog input signals (5)

TABLE 8.2.9.3-1 CAUTION AND WARNING ANALOG/DISCRETE-INPUT  
HARDWARE, PAYLOAD TO ORBITER,  
ELECTRICAL INTERFACE CHARACTERISTICS (Concluded)

Parameter	Dimension	Characteristics Orbiter/ Payload Interface	Notes
Pwr-Off Impedance	Min: Kilohm	22	5 VDC discrete
Cable Capacitance (Orbiter)	Max: Pico-farads	2231	(8)
Load Current (Orbiter)	Max: Microamp	25	5 VDC discrete and 0-5 volt analog input signals (6)
Over-Voltage Protection	Max: Volt	+37.5	
Fault Voltage Emission Max	Volt	+ 15	
Fault Current Limitation Max	Milliamp	1.28	

- NOTES:
- (1) Payload input must be maintained between 0 and 2.5 volts or master alarm will be generated. C and W payload analog and discrete inputs are the same and have been set for 2.5 volts high trip. High alarm level adjustable.
  - (2) 100 msec minimum pulse duration.
  - (3) As determined using a 50-MHz bandwidth measuring device.
  - (4) For 5 VDC discrete and 0 to 5 volt analog signals, with  $\pm 5$  volts peak common-mode signal over a frequency range of DC to 1.0 KHz. For 28 VDC discrete inputs, the presence of  $\pm 5$  volts peak common-mode signal over a frequency range of DC to 1.0 KHz shall not cause the input to be misinterpreted.
  - (5) Load impedance (Orbiter) is 2.8 kilohms minimum for 28 VDC discrete input signals.
  - (6) Load current is 10 milliamperes maximum for 28 VDC discrete input signals. 28 volt discrettes are internally Zener limited to 12 volts.
  - (7) 5 volt and 28 volt discrettes capable of sinking or supplying 10 MA max.
  - (8) Based upon 97 ft. cable length from CWEA to P/L interface at end of SMCH. TSP cable capacitance based upon controlled impedance cable MP572-0328-0002.

TABLE 8.2.9.5-1 PAYLOAD MASTER ALARM LIGHT OUTPUT,  
ORBITER TO PAYLOAD,  
ELECTRICAL INTERFACE CHARACTERISTICS

Parameter	Dimension	Characteristics Orbiter/ Payload Interface	Notes
Type		Discrete	Isolated relay contact closure
Discrete- False		Relay Contacts Open	
Discrete- True		Relay Contacts-Closed	
Rise/Fall Time		N/A	Contact closure
Transfer		DC Coupled	
Source Impedance (Orbiter)	Ohm	0.1 Contact Closed Max	
Cable Resistance	Ohms	3.4	Round-trip resist- ance between Cargo element interface and Orbiter switch (1) (2)
Capaci- tance (Orbiter)	Max Pico- farad	1846	(2)
Drive Capability Load Current	Max Amp	1	

(1) At a maximum temperature of 200°F.

(2) Calculations based upon 80.25 ft. from D and C panel R13A1 to P/L interface at end of SMCH.

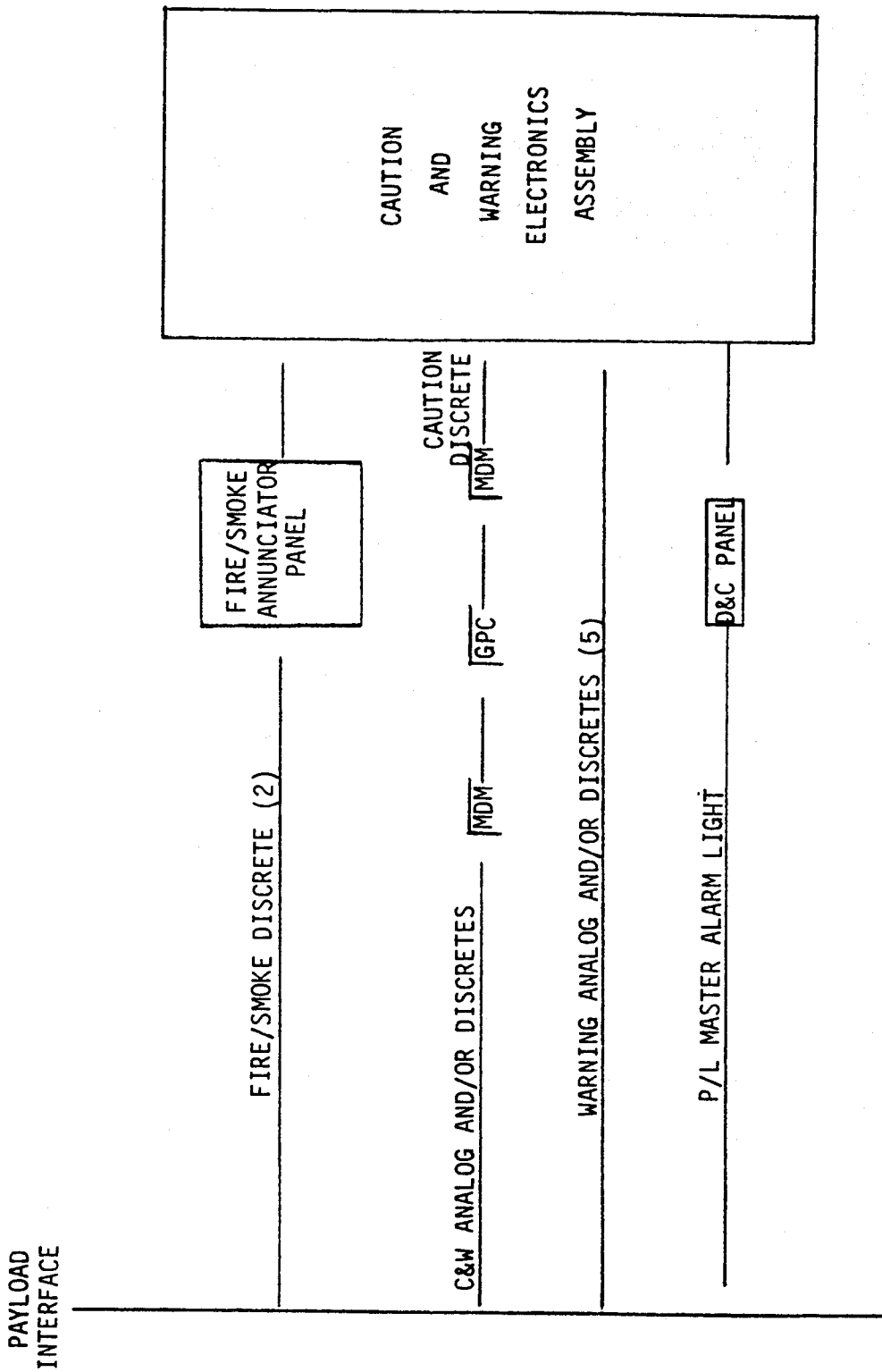
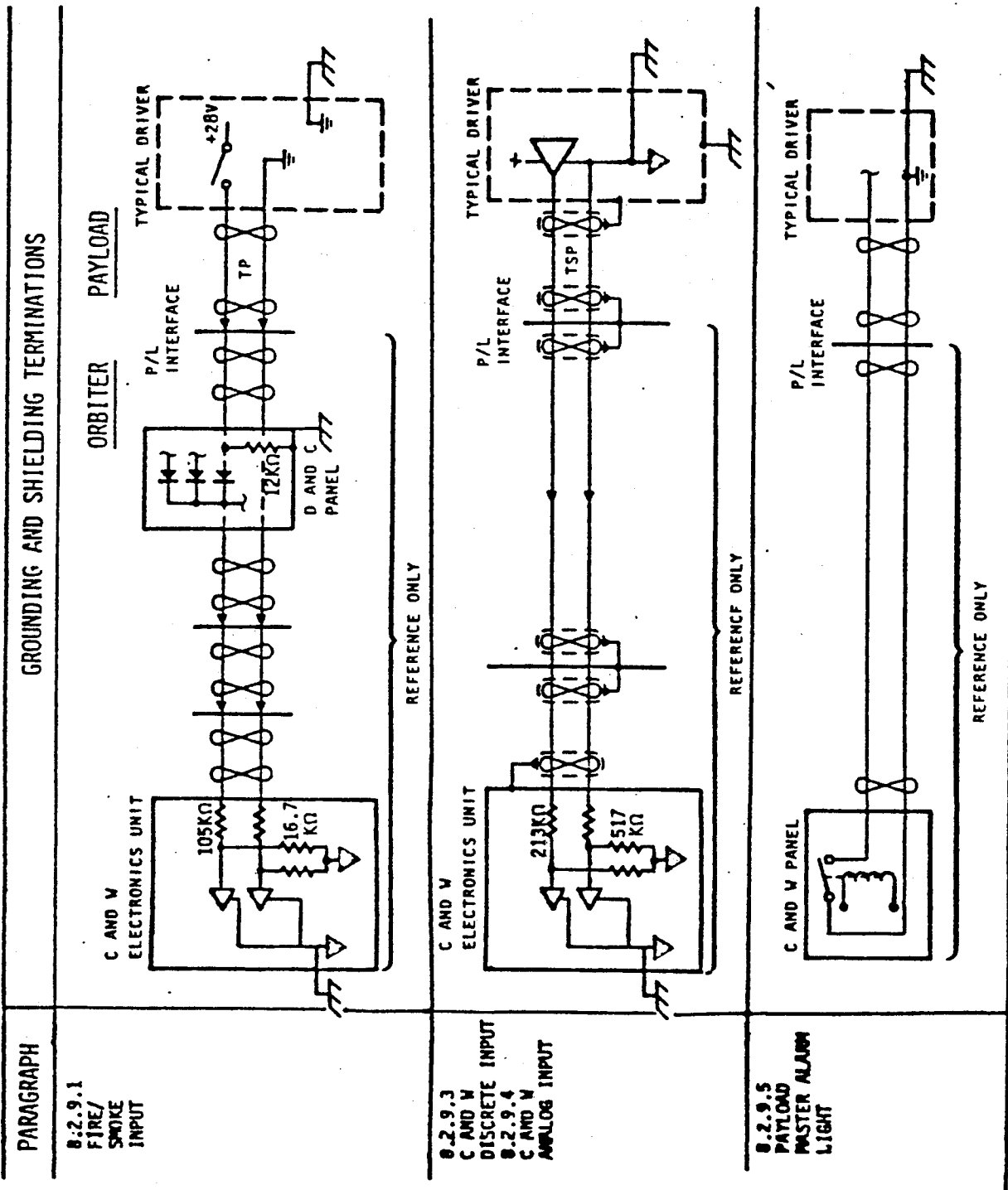


FIGURE 8.2.9-1 CAUTION AND WARNING SIGNAL FLOW



**NOTE:**  
 SYMBOLS DEFINED IN  
 PARAGRAPH 10.7.4.2.4

FIGURE 8.2.9.6-1 CWEA GROUNDING AND SHIELDING INTERFACE

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#### 8.2.10 Master Timing Unit (MTU) and Payload Timing Buffer (PTB) Interfaces.

The MTU has the following Payload dedicated outputs:

- a. Greenwich Mean Time (GMT)
- b. Mission Elapsed Time (MET)
- c. 4.608 MHz Reference Square-Wave Frequency
- d. 1.024 MHz Reference Square-Wave Frequency
- e. 1 KHz Reference Square-Wave Frequency
- f. 100 Hz Reference Square-Wave Frequency
- g. 10 Hz Reference Square-Wave Frequency

The payload timing buffer shall accept single GMT and MET input signals from the MTU and provide to Cargo elements eight isolated GMT output timing signals and four isolated MET output timing signals. Figure 8.2.10-1 shows MTU and PTB interfaces data flow.

##### 8.2.10.1 Time Accumulator Interface.

8.2.10.1.1 Greenwich Mean Time (GMT). The absolute time data, at any time during a seven day mission, shall not deviate by more than  $\pm 10$  milliseconds from the ground station GMT Reference Time Standard and shall be synchronized with the ground GMT at certain times during a mission, subject to mission procedural constraints to prevent unacceptable time base perturbations. The accuracy of these time updates shall be  $\pm 5$  milliseconds. The MTU frequency offset and drift rates shall constrain the time error growth rate to a maximum of  $\pm 10$  milliseconds per 24 hours.

GMT time is measured beginning with day count 001 on January 1st of each year. If lift-off occurs in one year and landing in the next, GPC time continues to increment across year end with an equivalent day count greater than 365. The MTU generated GMT, however, automatically resets to Day 001 following Day 365. The MTU day count will normally be maintained in agreement with the GPC equivalent day count via a GPC software Specialist Function, Item Entry. Once an update is initiated, the MTU and GPC times will differ for approximately 2 minutes due to a time out requirement which is part of the MTU update mechanization. Updating of the MTU clock, in order to maintain its day count equivalency with the GPC is required following days 365, 366, 375, and 376. Following the last update to Day 377 the MTU will increment to a maximum day count of 399. (See Para. 9.4.5.1.2 for additional GMT information.)

The GMT output format shall be a modified IRIG-B as shown in Figure 8.2.10.1.1-1. The GMT electrical interface characteristics shall be as shown in Table 8.2.10.1.1-1.

8.2.10.1.2 Mission Elapsed Time (MET). The Mission Elapsed Time shall be reset to zero by the Orbiter at T-0 and shall be synchronized and updated from the ground. MET time error growth rate shall not exceed  $\pm 10$  milliseconds per 24 hours.

The MET output format output format shall be a modified IRIG-B as shown in Figure 8.2.10.1.1-1. The MET electrical characteristics shall be as shown in Table 8.2.10.1.1-1.

**8.2.10.2 Square-Wave Reference Frequencies.** The clock frequencies shall be derived from a single divider chain in the MTU. No permanent phase relationship shall exist between the various clock frequencies. Short term timing relationships (during a single power-up period) fall within the limits of the individual jitter specifications. The clock signals shall not have a fixed phase relationship with respect to the one second transition mark in the IRIG-B time code outputs and the frequency accuracy shall be determined by the MTU Master oscillator. For a stabilized MTU (16 hours after power-on) the offset shall not exceed  $10 \text{ pp } 10^8$  from center frequency and the drift rate shall be  $\pm 1 \text{ pp } 10^9$  per 24 hours maximum.

**8.2.10.2.1 4.608 MHz Square-Wave Reference Frequency.** The 4.608 MHz square-wave reference frequency electrical interface characteristics at the Orbiter/payload interface shall be as shown in Table 8.2.10.2.1-1.

**8.2.10.2.2 1.024 MHz Square-Wave Reference Frequency.** The 1.024 MHz square-wave reference frequency electrical interface characteristics at the Orbiter/payload interface shall be as shown in Table 8.2.10.2.2-1.

**8.2.10.2.3 1 kHz Square-Wave Reference Frequency.** The 1 kHz square-wave reference frequency electrical interface characteristics at the Orbiter/payload interface shall be as shown in Table 8.2.10.2.3-1.

**8.2.10.2.4 100 Hz Square-Wave Reference Frequency.** The 100 Hz square-wave reference frequency electrical interface characteristics at the Orbiter/payload interface shall be as shown in Table 8.2.10.2.4-1.

**8.2.10.2.5 10 Hz Square-Wave Reference Frequency.** The 10 Hz, square-wave, reference frequency, electrical interface characteristics at the Orbiter/payload interface shall be as shown in Table 8.2.10.2.5-1.

**8.2.10.2.6 Unused Output Termination.** All frequency output interface connectors shall be capped when not used. Any extension from the interface shall be executed with multiple grounded TSP cable. Load impedance termination shall not be required when these constraints are met.

**8.2.10.3 Phase Relationship.**

- a. No fixed phase relationship shall exist between the one-second transitions occurring on the GMT and MET Time outputs.
- b. No fixed phase relationship shall exist between the 1024 kHz and MET time outputs.
- c. No fixed phase relationship shall exist between the 1024 kHz and GMT time outputs.

**8.2.10.4 Short-Circuit Protection.** All MTU and PTB interface output drivers shall withstand indefinite line-to-line or line-to-ground short circuits.



8.2.10.5 Grounding and Shielding. Grounding and shielding shall be as shown in Figure 8.2.10.5-1.

TABLE 8.2.10.1.1-1 MTU GREENWICH MEAN TIME/MISSION ELAPSED TIME,  
ORBITER-TO-PAYLOAD,  
ELECTRICAL INTERFACE CHARACTERISTICS

Parameter	Dimension	Characteristics Orbiter/ Payload Interface	Notes
Time Code Format		Modified IRIG-B	See Figure 8.2.10.1.1-1
Type		Digital (Pulse Duration)	
Element Rate	Pulse/Sec	100	See Figure 8.2.10.1.1-1
Time Frame	Sec	1	
Time Accuracy	msec	+10 Max Error Per Day	
Signal Level	V pk-pk	3.6 to 6	(1)
Rise/Fall Time	Micro- Sec	< 50	Measured from 10 to 90 percent Point(1)
Skew	Nano-Sec	<20 at 50 percent Point	
Signal/Nose Ratio		NA	
Max Output Voltage	Volt	10	Under any Failure Condition
Impedance - Source (Orbiter)	OHM	≤ 100	
Impedance - Load (Payload)	OHM	70 to 80	
Impedance - Line	OHM	70 to 80	Per MP572-0328
Capacitance Line	PF	1886	(1)

(1) Based on 82-ft cable length, from PTB to interface at the end of SMCH.

TABLE 8.2.10.2.1-1 MTU 4.608 MHz SQUARE-WAVE REFERENCE FREQUENCY,  
ORBITER-TO-PAYLOAD,  
ELECTRICAL INTERFACE CHARACTERISTICS

Parameter	Dimension	Characteristics Orbiter/ Payload Interface	Notes
Type		Digital (Square-Wave)	
Duty Cycle	Percent	50 ± 3	
Signal Level	V pk-pk	2.5 to 5.4	(1)
DC Offset	Vdc	≤ 0.5 Line-to-Gnd	
Rise/Fall Time	Nano-Sec	<100	Measured from 10 to 90 percent point(1)
Skew	Nano-Sec	<20 at 50 percent point	
Jitter	Percent	1	
Overshoot	V pk-pk	<6 Signal Plus Overshoot	
Max Output Voltage	Vdc	10	Under any failure condition
Long Term Stability		1 part in 10 <sup>9</sup> per day	
Source Impedance (Orbiter)	Ohm	≤100	
Load Impedance (Payload)	Ohm	70-80	
Line Impedance	Ohm	75 ± 10 percent	Coax Hs 179B
Common Mode Output Voltage	Volt	<10	Under normal Operation
Capacitance (Line)	PF Nom	1794	(1)

(1) Based on 92-ft cable length, from MTU to the STS/Payload interface.

TABLE 8.2.10.2.2-1 MTU 1.024 MHz SQUARE-WAVE REFERENCE FREQUENCY,  
ORBITER-TO-PAYLOAD,  
ELECTRICAL INTERFACE CHARACTERISTICS

Parameter	Dimension	Characteristics Orbiter/ Payload Interface	Notes
Type		Digital (Square-Wave)	
Duty Cycle	Percent	50 ± 5	
Signal Level	V pk-pk	3.2 to 6	(1)
DC Offset	VDC	≤ 0.5 Line-to-Gnd	
Rise/Fall Time	Nano-sec	≤300	Measured from 10 to 90 percent point(1)
Skew	Nano-sec	20	
Jitter	Percent	1.0	
Overshoot	V pk-pk	<6 Signal Plus Overshoot	
Max Output Voltage	Vdc	10	Under any failure condition
Long Term Stability		1 part in 10 <sup>9</sup> per day	
Source Impedance (Orbiter)	Ohm	≤100	
Load Impedance (Payload)	Ohm	70-80	
Line Impedance	Ohm	70-80	Per MP572-0328
Common Mode Output Voltage	Volt	<10	Under normal Operation
Capacitance (Line)	PF Max	2116	(1)

(1) Based on 92-ft cable length, from MTU to interface at the end of SMCH.

TABLE 8.2.10.2.3-1 MTU 1 kHz SQUARE-WAVE REFERENCE FREQUENCY,  
ORBITER-TO-PAYLOAD,  
ELECTRICAL INTERFACE CHARACTERISTICS

Parameter	Dimension	Characteristics Orbiter/ Payload Interface	Notes
Type		Digital (Square-Wave)	
Duty Cycle	Percent	50 ± 10	
Signal Level	V pk-pk	3.5 to 6	(1)
DC Offset	VDC	≤ 0.5 Line-to-Gnd	
Rise/Fall Time	Nano-sec	≤ 700	Measured from 10 to 90 percent point(1)
Skew	Nano-sec	20	
Jitter	Percent	0.5	
Overshoot	V pk-pk	< 6 Signal Plus Overshoot	
Max Output Voltage	VDC	10	Under any failure condition
Long Term Stability		1 part in 10 <sup>9</sup> per day	
Source Impedance (Orbiter)	Ohm	≤ 100	
Load Impedance (Payload)	Ohm	70-80	
Line Impedance	Ohm	70-80	Per MP572-0328
Common Mode Output Voltage	Volt	< 10	Under normal Operation
Capacitance (Line)	PF Max	2116	(1)

(1) Based on 92-ft cable length, from MTU to interface at the end of SMCH.

TABLE 8.2.10.2.4-1 MTU 100 Hz SQUARE-WAVE REFERENCE FREQUENCY,  
ORBITER-TO-PAYLOAD,  
ELECTRICAL INTERFACE CHARACTERISTICS

Parameter	Dimension	Characteristics Orbiter/ Payload Interface	Notes
Type		Digital (Square-Wave)	
Duty Cycle	Percent	50 ± 10	
Signal Level	V pk-pk	3.5 to 6	(1)
DC Offset	VDC	≤ 0.5 Line-to-Gnd	
Rise/Fall Time	Nano-sec	≤ 700	Measured from 10 to 90 percent point(1)
Skew	Nano-sec	20	
Jitter	Percent	0.5	
Overshoot	V pk-pk	< 6 Signal Plus Overshoot	
Max Output Voltage	VDC	10	Under any failure condition
Long Term Stability		1 part in 10 <sup>9</sup> per day	
Source Impedance (Orbiter)	Ohm	≤ 100	
Load Impedance (Payload)	Ohm	70-80	
Line Impedance	Ohm	70-80	Per MP572-0328
Common Mode Output Voltage	Volt	< 10	Under normal Operation
Capacitance (Line)	PF Max	2116	(1)

(1) Based on 92-ft cable length, from MTU to interface at the end of SMCH.

TABLE 8.2.10.2.5-1 MTU 10 Hz SQUARE-WAVE REFERENCE FREQUENCY,  
ORBITER-TO-PAYLOAD  
ELECTRICAL INTERFACE CHARACTERISTICS

Parameter	Dimension	Characteristics Orbiter/ Payload Interface	Notes
Type		Digital (Square-Wave)	
Duty Cycle	Percent	50±10	
Signal Level	V pk-pk	3.5 to 6	(1)
DC Offset	VDC	≤0.5 Line to Gnd	
Rise/Fall Time	Nanosec	<700	Measured from 10 to 90 percent Point(1)
Skew	Nanosec	<20	Measured at 50 percent Point
Jitter	Percent	0.5	
Overshoot	V pk-pk	<6 Signal Plus Overshoot	
Max Output Voltage	VDC	10	Under any failure Condition
Long Term Stability		1 Part in 10 <sup>9</sup> per day	
Source Imped- ance (Orbiter)	Ohm	≤100	
Load Imped- ance (Payload)	Ohm	70-80	
Line Imped- ance	Ohm	70-80	Per MP572-0328
Common Mode Output Volt- age	Volt	<10	Under normal oper- ation
Capacitance (Line)	PF Max	2116	(1)

(1) Based on 92-ft cable length, from MTU to interface at the end of SMCH.

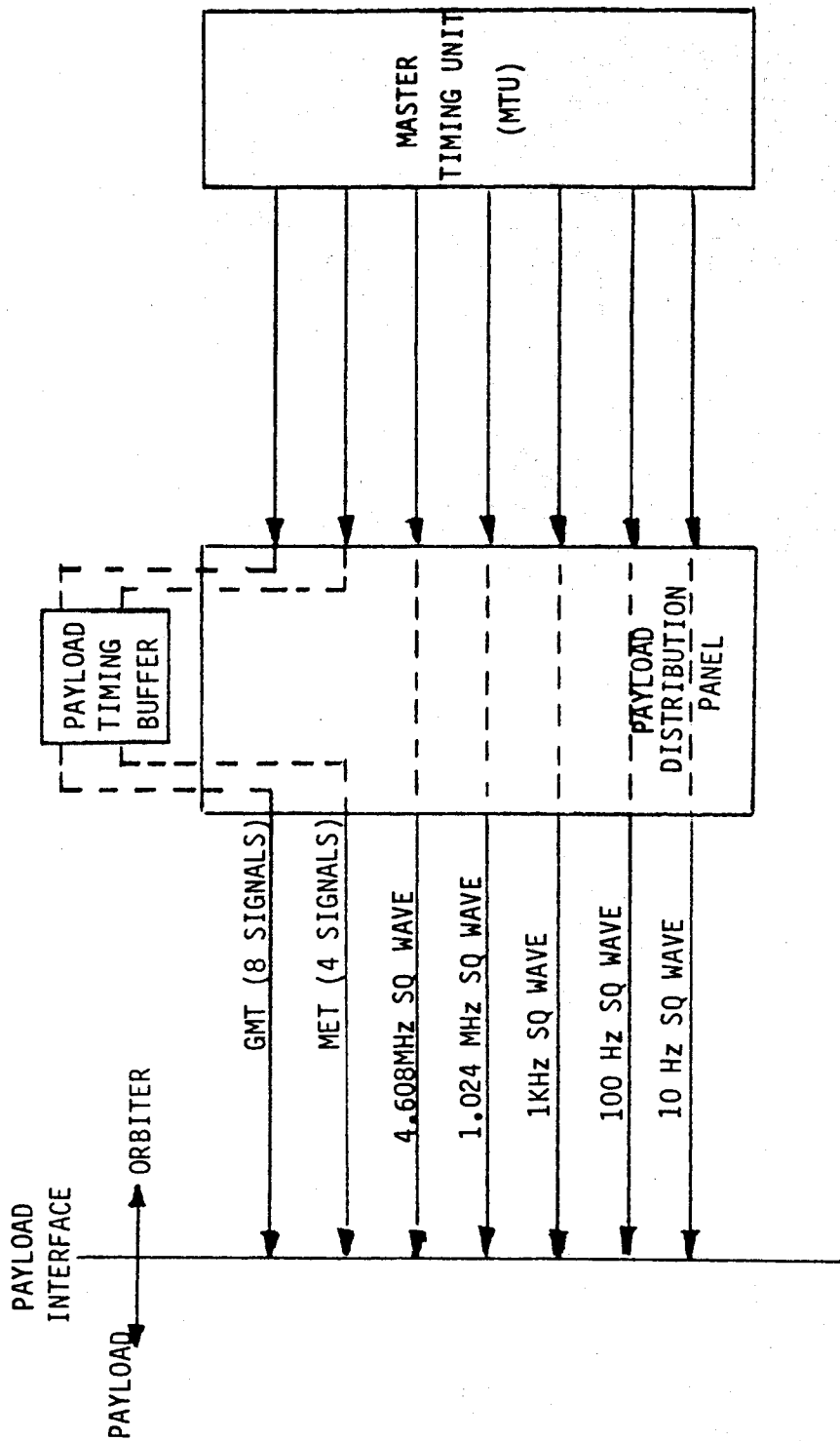
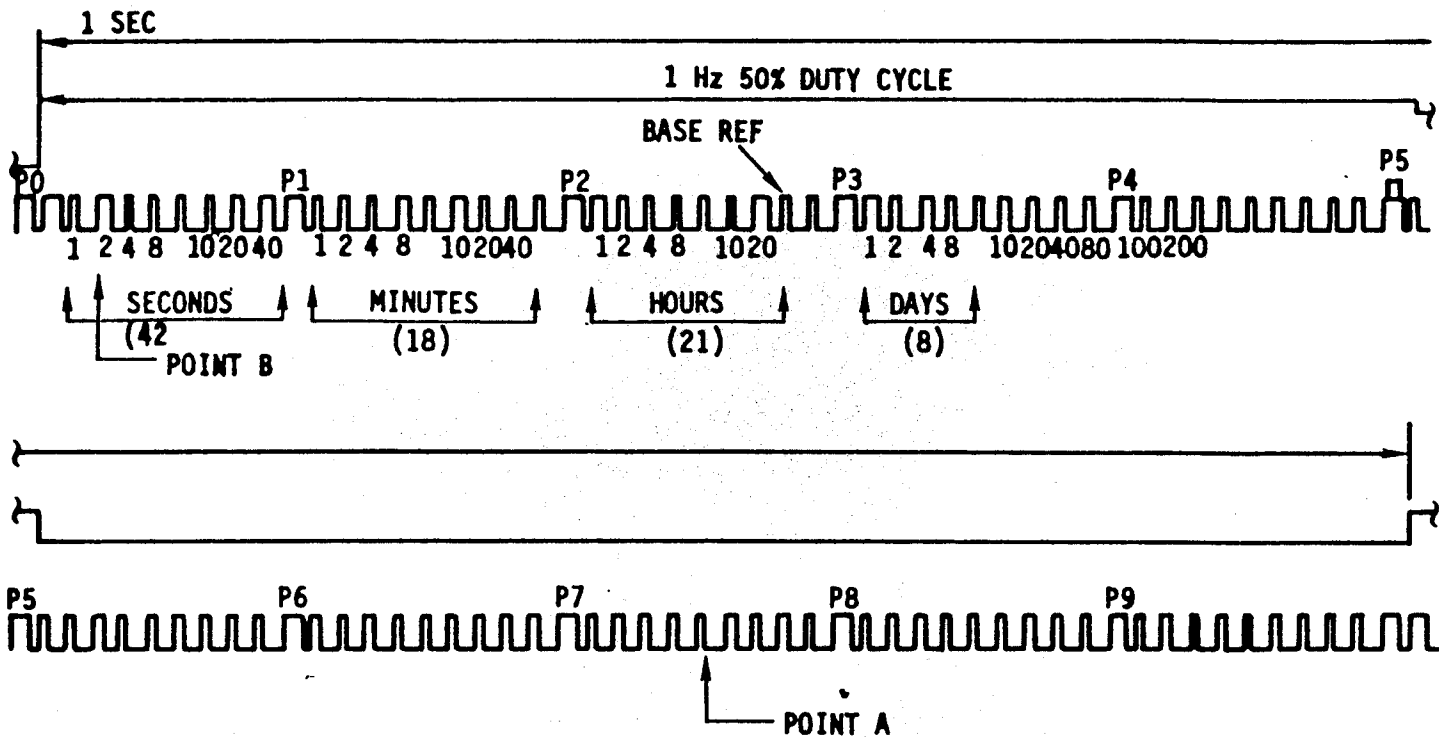


FIGURE 8.2.10-1 TYPICAL MASTER TIMING UNIT AND PAYLOAD TIMING BUFFER INTERFACES DATA FLOW





FRAME TIME - 1 SECOND  
 100 PPS (10 MS BETWEEN PULSES)  
 BCD  
 "ON TIME" REF - LEADING EDGE  
 POSITION IDENTIFIER = 8 ms DURATION  $\pm$  50 MICROSECONDS  
 BINARY 0 = 2 MS DURATION  $\pm$  50 MICROSECONDS  
 BINARY 1 = 5 MS DURATION  $\pm$  50 MICROSECONDS  
 TIME AT POINT A = 191 DAYS, 14 HOURS, 08 MINUTES, 32.530 SECONDS  
 TIME AT POINT B = 191 DAYS, 14 HOURS, 08 MINUTES, 32.760 SECONDS

NOTE: THE IRIG-B FORMAT IS MODIFIED SUCH THAT THE 1 KHZ MODULATED CARRIER AND THE "STRAIGHT BINARY SECONDS" ARE ELIMINATED. THE TIME SIGNAL IS TRANSMITTED SERIALLY AT 100 PULSES PER SECOND WITH A RESOLUTION OF 10 MILLISECONDS AND WITH THE LEAST SIGNIFICANT BIT BEING TRANSMITTED FIRST.

FIGURE 8.2.10.1.1-1 MASTER TIMING UNIT GMT AND MET OUTPUT FORMATS

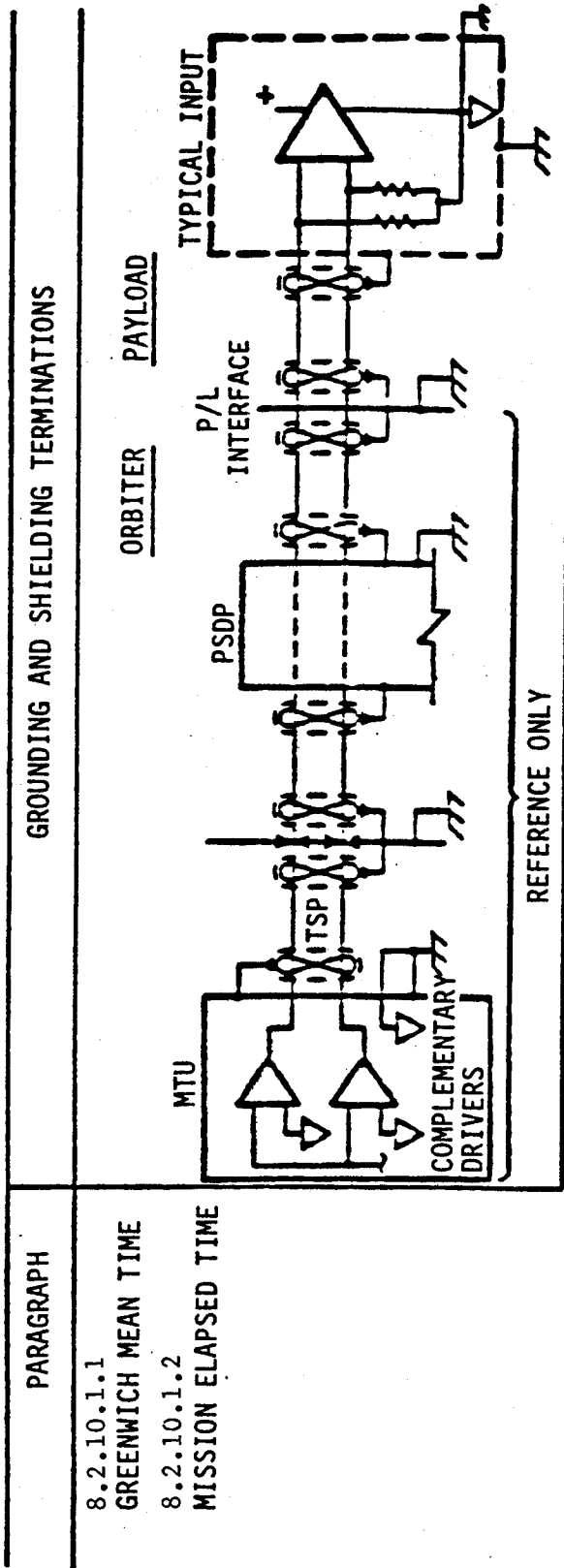
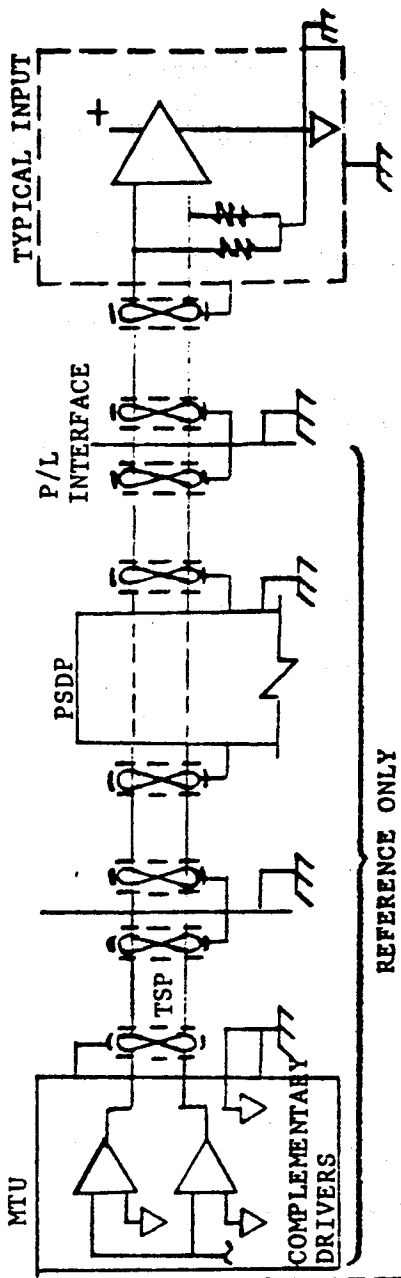


Figure 8.2.10.5-1 MJU Grounding And Shielding Interface  
(Sheet 1 OF 2)

GROUNDING AND SHIELDING TERMINATIONS

PARAGRAPH

ORBITER PAYLOAD



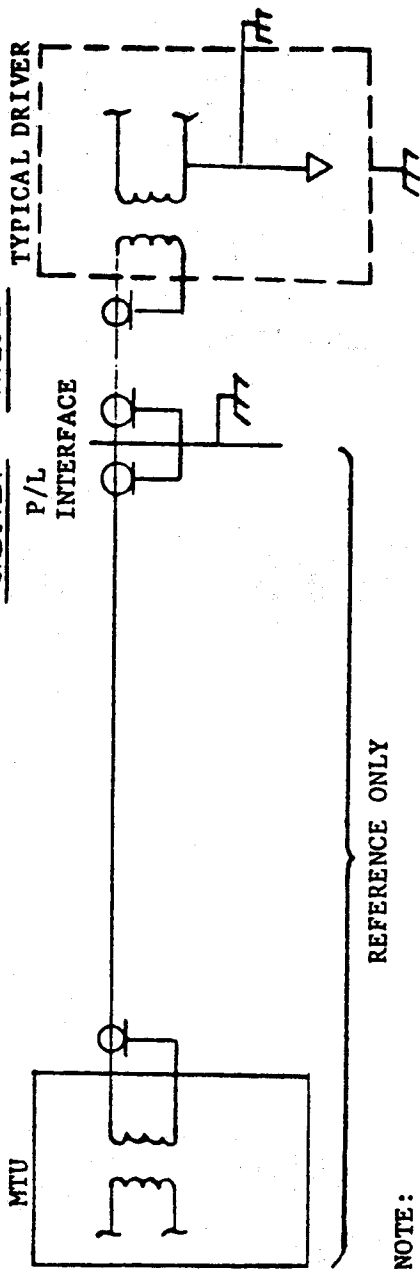
SQUARE WAVE  
REFERENCE  
FREQUENCY

- 8.2.10.2.2 1.024 MHz
- 8.2.10.2.3 1KHz
- 8.2.10.2.4 100Hz
- 8.2.10.2.5 10Hz

REFERENCE ONLY

- 8.2.10.2.1 4.608 MHz

ORBITER PAYLOAD



REFERENCE ONLY

NOTE:  
SYMBOLS DEFINED IN  
PARAGRAPH 10.7.4.2.4

FIGURE 8.2.10.5-1 MTU GROUNDING AND SHIELDING INTERFACE (SHEET 2 OF 2)

8.2.11 Payload Safing-Command Interface. The hardwired interfaces available for Payload Safing commands area are as shown in Figure 8.2.11-1. Five switches from the Center Console Panel (C3A5) on the Flight Deck provide redundant ACTIVE/SAFE functions.

8.2.11.1 Commands. The electrical interface characterisitcs for the Payload Safing ACTIVE/SAFE functions are as defined in Table 8.2.11.1-1.

8.2.11.2 Grounding and Shielding. Grounding and shielding shall be as shown in Figure 8.2.11.2-1.

TABLE 8.2.11.1-1 PAYLOAD SAFING COMMAND-HARDWARE,  
ORBITER-TO-PAYLOAD,  
ELECTRICAL INTERFACE CHARACTERISTICS

Parameter	Dimension	Characteristics Orbiter/ Payload Interface	Notes
Type		Switch Contact	
Input Voltage to Orbiter	Max Volt DC	32	
Transfer		Direct	
Input Current to Orbiter	Max Ampere	8.5	Closed contacts
Circuit Resistance	Max Ohms	4.2	(1)

(1) Round trip distance between cargo element interface at end of SMCH and the Orbiter switch is 211 ft. Resistance value calculated at a maximum temperature of 200°F in the cargo bay. (Note: Round-trip resistance from X<sub>0</sub>603 interface to Orbiter switch measured 1.84 ohms at ambient). If SMCH not utilized, new calculation must be performed.

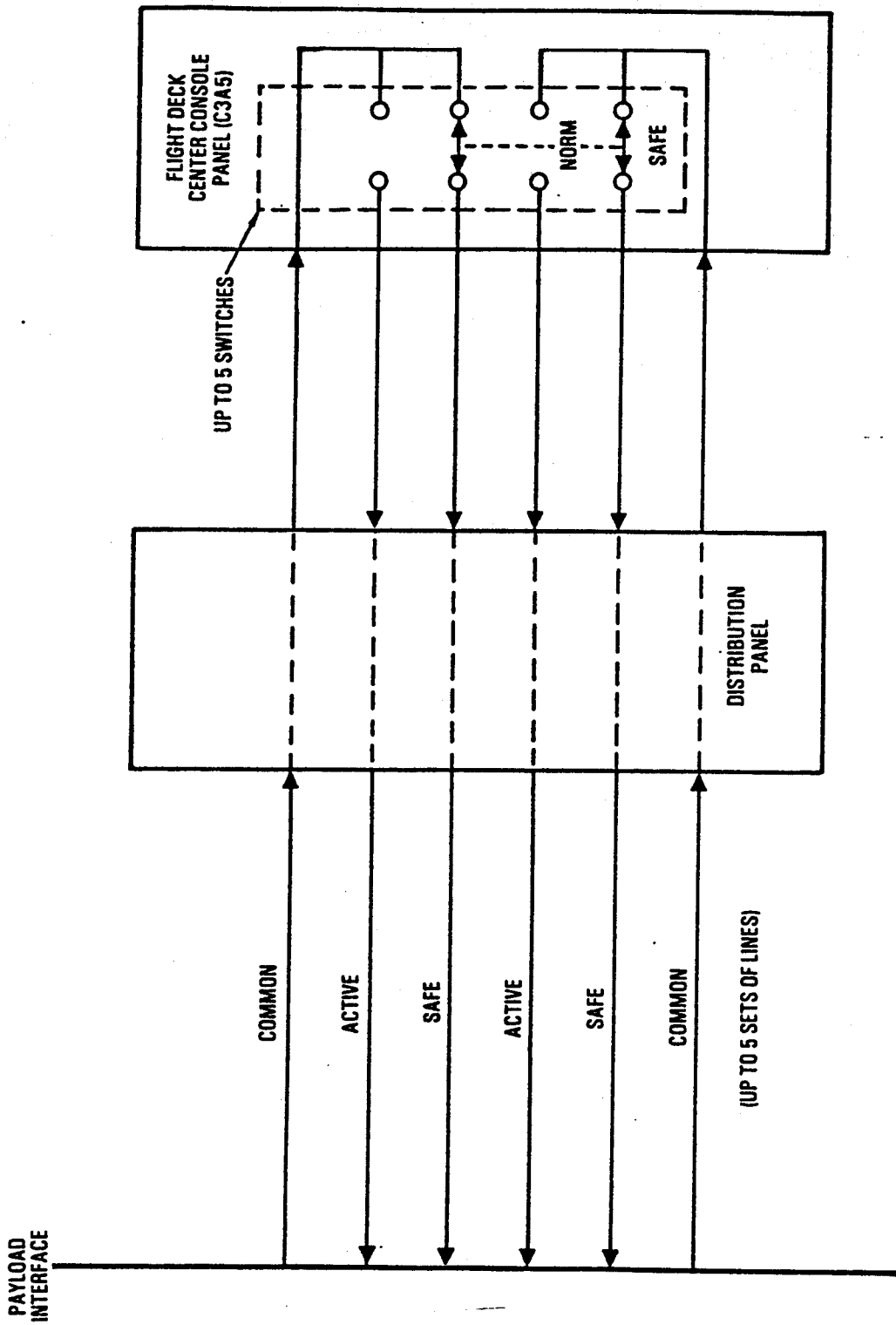


Figure 8.2.11-1 Payload Safing Command Signal Flow

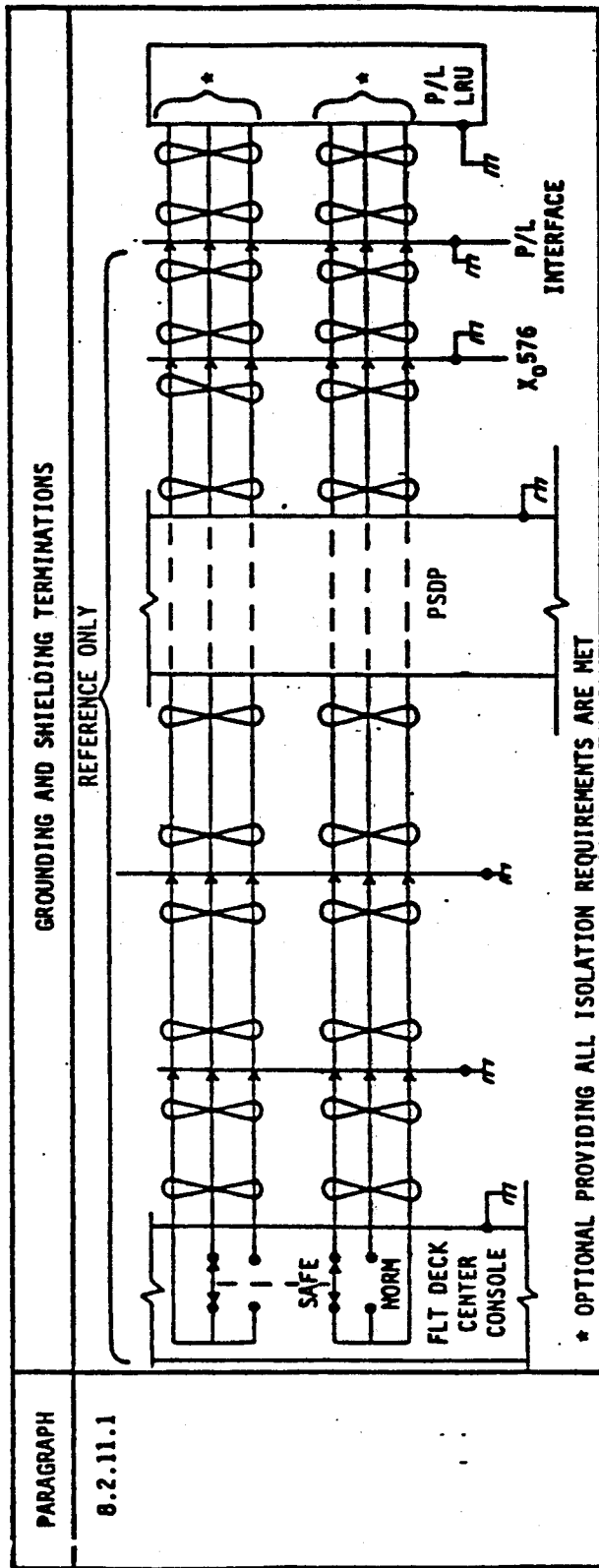


FIGURE 8.2.11.2-1 PAYLOAD SAFING COMMAND GROUNDING AND SHIELDING

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8.2.12 Orbiter to Cargo Element Data Bus System (DBS) Interfaces. The Orbiter shall provide data bus interfaces to accommodate cargo servicing by the Orbiter data processing equipment. *A data bus cable* shall interconnect the cargo element to support the flight manifest as shown in Figure 8.2.12-1. Each DBS provided, (PL Bus 1, PL Bus 2, Launch Bus 1, Launch Bus 2), shall be terminated within the cargo bay at the end of the Bus. (See Figures 8.2.12-1 and 8.2.12-2.) The DBS shall conform to Orbiter standards for parts, interfaces, matching, isolation and fault protection to allow the Orbiter GPC, Orbiter Bus Terminal Units (BTU), and cargo BTUs to operate as a digital transmission system. The following notes provide the necessary requirements to meet this objective:

Notes:

- a. All cargo BTUs shall interface with the DBS via a dedicated DBC (Data Bus Coupler, Rockwell Specification MC409-0020-0001), and cable stub as shown in Figures 8.2.12-1, 8.2.12-2, 8.2.12-3 and 8.2.12-4. The data bus interface characteristics shall be as shown in Table 8.2.12-1 for Orbiter transmission and in Table 8.2.12-2 for cargo element transmission.

The vehicle data bus shall not be interrupted throughout flight. The stub cable may be interrupted due to separations, but only to an open state. Bus routing and pin assignments shall be as shown in Figures 8.2.12-1, 8.2.12-2, 8.2.12-3 and 8.2.12-4 and in Paragraph 13.5.1.3. Depending upon flight requirements, the two alternate DBC connections shall be as shown in Figure 8.2.12-2, view (B) for continuing and view (A) for terminating the data bus. Bus termination lengths greater than 6 cm shall use MP572-0279-002 cable. Shorter unshielded lengths shall meet the requirements of Rockwell Specification MP572-0504-002. Rockwell Specification MP572-0279-002, shall be used for the data bus stub and bus termination jumper.

- b. All Orbiter BTUs utilize a common data bus transceiver/decoder to interface with the data bus. This module is referred to as a Multiplexer Interface Adapter (MIA) and is packaged within the BTU. This unit is required for cargo equipment interfacing with the data bus and can be procured to Rockwell Specification MC615-0010 from the manufacturer, Singer/Kearfott Division, Little Falls, New Jersey. Rockwell Specification MC615-0010 is being invoked on an interim basis and will be replaced by applicable government specifications when such coverage is implemented.
- c. Any BTU which separates from the DBS during flight shall be connected to the DBS via a Data Bus Isolation Amplifier (DBIA), Rockwell Specification MC409-0019-0002. The DBIA is required to protect the DBS against any significant impedance changes. The DBIA is not an STS standard service. The DBIA shall be connected to the Orbiter DBS in a manner similar to any BTU. The other side of the DBIA shall provide a data bus extension. (See Figure 8.2.12-4.) The bus extension shall interface with the cargo element BTUs in accordance with the same requirements and constraints as the Orbiter DBS and as per the following:

- (1) The bus extension shall be hardwired to the DBIA.

- (2) The bus extension shall be terminated on both ends; the DBIA end per Figure 8.2.12-4 and the other end per Figures 8.2.12-1 and 8.2.12-2.
  - (3) There shall be a maximum time delay of 5.25  $\mu$ s for signal transfer through the DBIA in both directions.
- d. The connectors at the Orbiter/Cargo interface (Figures 8.2.12-1 and 8.2.12-2 and Tables 13.5.1.3-1) shall be as follows: Rockwell Specification ME414-0630-4001 feedthrough connector on the Orbiter side and NASA\* NLS6GT12-35S, receptacle on cargo side. The interface connector plate shall be the SMCH-SIP connector panel unless otherwise specified in the cargo element-unique ICD.
  - e. All data bus and stub cable shields shall be terminated at both ends of the cable within 3 cm of the connector grommet and individually grounded to the backshell tag ring.
  - f. DBC and DBIA thermal environments shall be maintained within -65°F to +165°F under operating and non-operating conditions.
  - g. Cable bend radii shall be greater than or equal to 10 times the data bus cable diameter to preclude changes in cable impedances.
  - h. MDM or FMDM addressing shall be accomplished by jumpering within the connector backshell a valid address code listed in Table 8.2.12.6.1.1-1, and shall be assigned by the payload integrator. The code wires shall be 26 ga., less than 3 cm long, and jumpered in back of the plug and inside the backshell.
  - i. The maximum cargo BTUs allowable on the data bus shall be no more than four BTUs.
  - j. Orbiter data bus cable length requirements are as follows: (Ref. Figure 8.2.12-3)
    1. Total bus cable length shall not exceed 350 feet between end BTU couplers.
    2. 100 feet of each data bus is permanent Orbiter scar. The remaining 250 feet length limit is established by each manifest.
    3. The cable length from the end BTU coupler to the termination resistor shall not exceed 65 feet.
    4. As a design guideline, the cable length shall be held to a minimum to avoid data bus signal degradation.
  - k. Cargo element data bus cable length requirements are as follows: (Ref. Figures 8.2.12-1 and 8.2.12-3)
    1. The maximum length of the data bus within a payload, from the payload interface to the coupler(s) and back to the interface, shall not exceed 40 feet.

2. The maximum length of the data bus termination circuit within a payload, from the cargo BTU to the payload interface and back to the BTU termination resistor, shall not exceed 40 feet.

NOTE: The data bus may be terminated on the cargo element side of the interface in order to satisfy Paragraph 8.2.12 (j) (3).

3. As a design guideline, cable lengths shall be held to a minimum to avoid data bus signal degradation.

**8.2.12.1 Data Bus Transfer.** All communications on a particular data bus shall be initiated by command words from the Orbiter bus control unit in control of that bus. The command words will identify the cargo BTU for which the command is intended and indicate the function to be performed. Data transfer will be in the form of messages. A message will consist of a command word transmitted by the bus controller followed by either command data words from the bus controllers or by response data words transmitted by a BTU. BTUs will neither transmit nor respond on a bus unless commanded to do so by the Orbiter unit in control of that data bus. The information shall be transferred over the half duplex data bus in serial/digital pulse code modulation form and shall be Bi-Phase Level as defined in MIL-STD-1572 and as shown in Figure 8.2.12.1-1. A logic "1" shall be transmitted as a bipolar coded signal 10 (a positive pulse followed by a negative pulse). A logic "0" shall be a bipolar coded signal 01 (a negative pulse followed by a positive pulse). Data shall be transferred at a 1.0 MBPS  $\pm$  0.1 percent data rate and when receiving data, the cargo BTU I/O shall derive clocking as necessary to decode the received data message. The command and data words shall consist of 24 data bits plus sync and parity. Each response message shall be in a form of data words, each word of which shall consist of 24 data bits, plus sync and parity.

The command word/data word sync patterns shall be non-valid Bi-Phase Level codes as shown in Figure 8.2.12.1-2. The width of the positive and negative going pulses that form a message sync pattern shall be 1.58 microseconds  $\pm$  5 percent for the first half cycle and 1.5 microseconds  $\pm$  3 percent for the second half cycle at the zero crossover, measured at the transmitter output, when terminated into a 70 ohm  $\pm$  5 percent resistive load (on the stub). Note that a Bi-Phase Level 01 code immediately following the command sync will increase the apparent width of the affected pulse to 2.0 microseconds plus or minus 4.75 percent. Also, the Bi-Phase Level 10 code immediately following the data sync will increase the apparent width of the affected pulse to 2.0 microseconds plus or minus 4.75 percent.

Each word shall contain a parity bit which shall be assigned a value such that the total number of "ones", including the parity bit in the word, is odd. During the reception the parity shall be checked by determining whether or not the received word contains an odd number of "ones". The sync field shall not be included in parity generation/validation. Consecutive words transmitted onto the data bus by the bus controller or BTUs shall be separated by a 5.5  $\pm$  0.5 microsecond gap time.

8.2.12.2 Data Bus Transmission Line. The data bus transmission line shall be a two conductor twisted, shielded, jacketed cable. The stub shall be the same cable type as the data bus and shall not exceed 8 ft (2.43 m) in length. The cables in the Cargo which extend and interface with the data bus shall be procured under Rockwell Design Standard MP572- 0279-0002. This Rockwell document is being invoked on an interim basis and will be replaced by applicable government documents when such coverage is implemented. The data bus phasing (Hi/Lo) shall be carefully preserved throughout any single bus, stubs, terminations, and BTU connections.

8.2.12.3 Output Circuit Characteristics. The signal output voltage shall be between 12 and 15 volts peak line-to-line as measured at the output of the Orbiter data bus controller or Cargo BTU transmitter on the stub when driving a resistive load (on the stub) of 70 ohms plus or minus 5 percent. The waveform seen at the output of the Orbiter or cargo BTU data bus transmitter shall be a bipolar signal with characteristics as shown in Table 8.2.12-1. The rise and fall times of this signal, for positive or negative values, shall be 150 plus or minus 50 nanoseconds (as measured between 10 percent and 90 percent of the plus or minus voltage limits) during transmission when driving a resistive load of 70 ohms plus or minus 5 percent. For a load resistance between 66.5 ohms and 63.5 ohms (faulted conditions), the minimum output voltage shall be 9 volts peak line-to-line.

Line-to-line distortion of the waveform (within a 1.0 microsecond time period) by the output circuit, including ringing, shall not exceed 1.5 volts of overshoot or exceed 125 millivolts of undershoot at the plus and minus 15-volt levels, as shown in Figure 8.2.12.3-1, when driving a resistive load of 70 ohms plus or minus 5 percent.

In the non-transmitting state, transmitter output noise shall be no greater than 50 millivolts peak-to-peak. When signals are not being transmitted or when power is removed, the input impedance to the data bus terminals shall be a minimum of 6000 ohms in parallel with a maximum capacitance of 75 pF line-to-line from 330 KHz to 1.5 MHz.

8.2.12.4 Orbiter Bus Controller/Cargo Bus Terminal Unit Receiver Circuit Characteristics. The receiver circuit shall be compatible with the incoming signals specified herein and shall demonstrate a word error rate performance of less than 3 in  $10^7$  words. This performance shall be established with a line-to-line signal amplitude of 2.0 volts peak, having a rise and fall time of 250 nanoseconds measured between 10 and 90 percent of the peak to peak amplitude and impressed white Gaussian noise of 300 millivolts RMS distributed over the band 1000 Hz to 4.0 MHz. All measurements are made at the appropriate receiver input terminals.

Word Error Rate is defined as:

$$1 - \frac{\text{Total number of correctly received words}}{\text{Total number of words transmitted}}$$

The receiver shall operate with input waveforms varying from a square wave to a sine wave.

8.2.12.4.1 Input Sensitivity. The receiver shall respond with an input signal amplitude from plus or minus 15.0 volts peak, line-to-line, down to threshold level of  $\pm 0.6$  volt peak, line-to-line.

The receiver shall not respond to input signals of 0.0 volts to  $\pm 0.4$  volts peak, line-to-line. The receiver shall operate as specified in Section 8.2.12.4 with an input signal level of  $\pm 15.0$  volts peak, line-to-line, down to  $\pm 2.0$  volts peak, line-to-line, measured at the Orbiter bus controller/Cargo BTU input terminals.

Input circuit impedance of the receiver with the transmitter not operating or with the power removed shall be a minimum of 6000 ohms in parallel with maximum capacitance of 75 pf line-to-line between 330 KHz and 1.5 MHz.

The input circuit shall reject noise at all frequencies below 1000 Hz and between 5.0 MHz and 30 MHz for voltages up to 10 volts peak, line-to-line.

Signals from DC to 2.0 MHz with amplitudes up to plus or minus 32 volts peak, line-to-ground, applied to both the BTU receiver input circuit terminals, shall not cause the receiver to operate.

8.2.12.5 Orbiter Bus Controller/Cargo Bus Terminal Unit Receiver Data Validation. The cargo BTU I/O coupler or the MIA shall output an error indication to the host LRU for invalid messages received from the data bus. The validation criteria shall be as follows:

- a. The word begins with a valid sync pattern.
- b. The bit orientation in the received waveform reflects a valid Bi-Phase Level code. Checks shall be made to determine that only a "10" or "01" pattern occurs and that only the proper number of receiver threshold transitions occur within each bit time.
- c. The word contains 25 data bits including the parity bit.
- d. Parity bit verification.

8.2.12.6 BTU-GPC Command/Response Protocol.

- a. GPC-to-BTU Data Transfer. The message sequence for the transfer of data to the BTU from the GPC consists of one command word (CW) followed by up to 32 command data words, for a standard command. If a command word is not accepted by a BTU, the BTU does not respond to the subsequent command data words in that message. Figure 8.2.12.6-1 shows the message sequence for GPC-to-BTU data transfers.
- b. BTU-to-GPC Data Transfer. The message sequence from the transfer of data to the GPC from the BTU consists of one command word followed by 1 to 32 response data words (RDW) for a response to a standard command. Exceptions are defined in Paragraphs 8.2.12.6.2.7(c), 8.2.12.6.2.12(c3) and 8.2.12.6.2.12(c5). Figure 8.2.12.6-2 shows the message sequence for BTU-to-GPC data transfers.

8.2.12.6.1 Data Bus Word Formats.

8.2.12.6.1.1 Command Word Format. The BTU command word format consists of a standard command format, a PROM sequence command format, or a BITE Test command format.

(1) Standard or Direct Command Format.

1	3 4	8 9	13 14	17 18	22 23	27 28
! Cmd	! MIA	! Mode	! Module	! Channel	! Number	! P
! Sync	! Address	! Control	! Address	! Address	! Of Words	!
!	!	!	!	!	!	!
! (3)	! (5)	! (5)	! (4)	! (5)	! (5)	! (1)!

The definition of contents of the standard command word is:

Bit Position

- 1-3        Command Sync. Three-bit non-valid Manchester code for a command data sync.
- 4-8        MIA Address. Five-bit code defined in Table 8.2.12.6.1.1-1 that identifies the BTU that will respond to a given command word. Address zero (00) is a non-valid address, and a BTU will not respond to it.
- 9-13      Mode Control Field. Five-bit code used for determining the operational mode of the BTU.

Bit Position

9 10 11 12 13

- 0 1 0 0 0    Receive Command. Commands the BTU to receive command data.
- 0 1 0 0 1    Transmit Command. Commands the BTU to transmit response data.
- 0 1 0 1 0    BITE Status Request (BSR). Commands the BTU to transmit the contents of the BITE status register and to then reset the BITE status register.
- 0 1 0 1 1    Master Reset. Commands the BTU to reset all registers.
- 0 1 1 0 0    Return Command Word. Commands the BTU to return the received word.
- 0 1 1 0 1    Spare.

0 1 1 1 0 Load BITE. Commands the BTU to load the BITE status register with the contents of the command data words.

0 1 1 1 1 Spare.

14-17 Module Address. A four-bit code (decimal 0 to 15) which identifies the I/O module where the selected channels are located.

18-22 Channel Address. Five-bit code (decimal 0 to 31) that identifies one out of a maximum of 32 channels on the I/O module. This code also identifies a starting channel address for a multiple-word data transfer. The channel addresses available for the corresponding I/O module are:

<u>IOM Type</u>	<u>Number of Channels</u>	<u>Channel Addresses</u>
DIL, DIH, DOL, DOH, POH	3	0 to 2
SIO	4	0 to 3
AOD	16	0 to 15
AID	32	0 to 31

The following different coding of these channel address bits is used during discrete output control.

Bit Position

18 Logical 1 indicates SET, logical 0 indicates RESET.

19-20 Spare

21-22 Selects one of three discrete channels.

21 22

0	0	Channel 0
0	1	Channel 1
1	0	Channel 2
1	1	Illegal Code

23-27 Number of Words. Five-bit code that identifies the number of data words to be transmitted or received. The number of words shall be equal to the contents of the "Number of Words" field plus one (00000 = 1 word, ....., 11111 = 32 words. The BTU shall transmit/receive words from/to a channel address increasing monotonically starting at the channel address specified in bits 18-22. If the initial channel address is a serial channel, the "number of words" field shall be interpreted to be the number of words transmitted/received on the serial channel.

28 Parity. Odd parity.

(2) PROM or Indirect Command Format.

1	3 4	8 9	13 14	22 23	27 28
! Cmd !	! MIA !	! Mode !	! Starting From !	! Number of !	! P !
! Sync !	! Address !	! Control !	! Address !	! Instructions !	! !
! (3) !	! (5) !	! (5) !	! (9) !	! (5) !	! (1) !

The definition of the contents of the PROM Sequence command word is:

Bit Position

- 1-8 Command Sync and MIA Address. Same as Standard command format.
- 9-13 Mode Control Field. Five-bit code used for determining the operational mode of the BTU.

Bit Position

9 10 11 12 13

0 0 0 0 0 Spare.

0 0 0 0 1 Return PROM Address Word. Commands the BTU to return the word at the specified PROM address.

0 0 0 1 0 Execute Command. Commands the BTU to execute the PROM command at the specified PROM address.

0 0 0 1 1 Spare.

- 14-22 PROM Starting Address. Nine-bit code that identifies the first PROM instruction to be executed.

- 23-27 Number of Instructions. Five-bit code that identifies the number of PROM instruction to be executed by the BTU. The number of instructions shall be equal to the contents of the "Number of Words" field plus one.

28 Parity. Odd parity.

- (3) BITE Test Command Format. When the BTU receives the BITE Test format, it sets bits in the BITE status register, as described in Paragraph 8.2.12.6.2.3(c), and waits for a new command word.



1	3 4	8 9	13 14	17 18	22 23	27 28
! Cmd !	! MIA !	! Mode !	! Module !	! Channel !	! Number !	! P !
! Sync !	! Address !	! Control !	! Address !	! Address !	! Channels !	! !
! (3) !	! (5) !	! (5) !	! (4) !	! (5) !	! (5) !	! (1) !

The definition of the contents of the BITE Test command word is:

Bit Position

1-8 Command Sync and MIA Address. Same as Standard command format.

9-13 Mode Control Field. Five-bit code used for determining the operational mode of the BTU.

Bit Position

9 10 11 12 13

0 0 1 0 0 BITE Test 1 Command. Commands the BTU to execute BITE Test 1 (SCU Test).

0 0 1 0 1 BITE Test 2 Command. Commands the BTU to execute BITE Test 2 (A/D Test).

0 0 1 1 0 BITE Test 3 Command. Commands the BTU to execute BITE Test 3 (PS Test).

0 0 1 1 1 BITE Test 4 Command. Commands the BTU to execute BITE Test 4 (ICM Test).

14-17 Module Address. A four-bit code (decimal 0 to 15) which identifies the I/O module where the selected channels are located.

18-22 Channel Address. Five-bit code (decimal 0 to 31) that identifies one out of a maximum of 32 channels on the I/O module. This code also identifies a starting channel address for a multiple-word data transfer. The channel addresses available for the corresponding I/O Module are the same as for the Standard or Direct Command Format, format (1) above.

23-27 Number of channels. Five-bit code that identifies the number of channels to test.

28 Parity. Odd parity.

8.2.12.6.1.2 Command Data Word Format. The command data word format is as follows:

1	3 4	8 9	24 25	27 28
! Data !	! MIA !	! Data !	! Pattern !	! P !
! Sync !	! Address !		! Check !	! !
! !	! !		! 1 0 1 !	! !
! (3) !	! (5) !	! (16) !	! (3) !	! (1) !

The definition of the contents of the command data word is:

Bit Position

- 1-3 Data Sync. Three-bit non-valid Manchester code for a command data sync.
- 4-8 MIA Address. Five-bit code that identifies the BTU that shall accept the command data word.
- 9-24 Data. Contains the data to be transferred from the GPC to the subsystem.
- 25-27 Pattern Check. Three-bit pattern, "101" for message validity test.
- 28 Parity. Odd parity.

8.2.12.6.1.3 Response Data Word Format. The response data word format is as follows:

1	3 4	8 9	24 25	26	27	28
! Data !	! MIA !	! Data !	! S !	! E !	! V !	! P !
! Sync !	! Address !		! !	! !	! !	! !
! !	! !		! !	! !	! !	! !
! (3) !	! (5) !	! (16) !	! (1) !	! (1) !	! (1) !	! (1) !

The definition of the contents of the response data word is:

Bit Position

- 1-3 Data Sync. Three-bit non-valid Manchester code for a response data sync.
- 4-8 MIA Address. Five-bit code that identifies the BTU responding to the command word.
- 9-24 Data. Contains the requested subsystem or BITE data.

- 25 Power Transient Flag. Logical 1 in bit 25 indicates normal operation. Logical 0 in bit 25 indicates the occurrence of a power down/power up sequence since the transmission of the last message.
- 26 Error Flag. Logical 1 in bit 26 indicates a subsystem serial channel error occurred during transmission of this word. The GPC may request BITE status information after the message transmission to determine the type of error.
- 27 Validity Flag. Logical 1 in bit 27 indicates normal operation. Logical 0 in bit 27 indicates an internal BTU error has occurred. The computer may request BITE status at the end of the message transmission.
- 28 Parity. Odd parity.

SEV bit shall be forced to "101" for transmitting BSR data word response.

8.2.12.6.2 BTU Modes.

8.2.12.6.2.1 Receive Command. Commands the BTU to receive command data words.

a. Command to BTU.

1	3 4	8 9	13 14	17 18	22 23	27 28
! Cmd	! MIA	! Mode	! Module	! Channel	! Number	! P
! Sync	! Address	! Control	! Address	! Address	! Of Words	! !
! :	! :	! 0 1 0 0 0	! X X X X	! X X X X X	! X X X X X	! !
! (3)	! (5)	! (5)	! (4)	! (5)	! (5)	! (1)!

b. Command Data to BTU. As appropriate.

c. Response Data from BTU. None

8.2.12.6.2.2 Transmit Command. Commands the BTU to transmit response data words.

a. Command to BTU.

1	3 4	8 9	13 14	17 18	22 23	27 28
! Cmd	! MIA	! Mode	! Module	! Channel	! Number	! P
! Sync	! Address	! Control	! Address	! Address	! Of Words	! !
! :	! :	! 0 1 0 0 1	! X X X X	! X X X X X	! X X X X X	! !
! (3)	! (5)	! (5)	! (4)	! (5)	! (5)	! (1)!

b. Command Data to BTU. None

c. Response Data from BTU. As appropriate.

8.2.12.6.2.3 BITE Status Request. Commands the BTU to transmit the contents of the BITE status register and then reset the BITE status register. The BTU BITE status register is used to report BTU monitored conditions and BITE results to the GPC. All monitored fault conditions, except for power applied/interrupt, set the validity bit (bit 27) in a response data word to a zero state indicating to the GPC that the BITE status register should be interrogated. The BITE status register is reset after a BITE status command, or a Master Reset Command.

a. Command to BTU.

1	3 4	8 9	13 14	17 18	22 23	27 28
! Cmd	! MIA	! Mode	! Module	! Channel	! Number	! P
! Sync	! Address	! Control	! Address	! Address	! Of Words	! !
! !	! !	! 0 1 0 1 0	! - - - -	! - - - -	! - - - -	! !
! (3)	! (5)	! (5)	! (4)	! (5)	! (5)	! (1)!

b. Command Data to BTU. None.

c. Response Data from BTU.

(1) Normal BSR, i.e. No BTU BITE Command Transmitted.

GPC Bit	BTU Bit	
0	1	Power to the BTU has been applied, or interrupted.
1	2	The BTU has detected an error in the incoming data from the GPC.
2	3	The BTU has been requested to access a non-existent channel.
3	4	The BTU is unable to transfer data to/from a subsystem.
4	5	The BTU received too many words from the GPC in the last message.
5	6	The last command received from the GPC by the BTU was not completed.
6	7	Simultaneous execution on the primary and backup data bus has been.
7	8	An illegal mode has been commanded.
8	9	An internal BTU error has been detected.
9	10	A gap-time error has been detected.
10	11	BITE test has been successfully completed.

11-15 12-16 BITE sub-test number that failed.

(2) BSR After BITE Test 1 (Reference Paragraph 8.2.12.6.2.9). As a result of the BITE Test 1 command, one of the following 7 conditions will be loaded into the BSR, and may be accessed by the GPC 1.1 msec after the BITE Test 1 command:

1 1 1 1 1 1  
0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5  
0 0 1 0 1 1 0 1 0 0 0 0 0 0 0 1

Output of sequence memory parity network always indicates odd parity.

0 0 1 1 1 1 0 1 0 0 0 0 0 0 0 1

Command Data Word Check pattern checker recognizes bad check pattern as good.

0 0 1 1 1 1 0 1 1 0 0 0 0 0 0 1

Command Data Word check pattern checker does not recognize good check pattern.

0 0 1 1 1 1 0 1 0 0 0 0 0 0 1 0

Sequence memory parity tree failure.

0 1 1 1 1 1 0 1 1 1 0 0 0 0 1 1

Register file failure:

a. Read/Write error

b. Addressing error

0 1 1 1 1 1 0 1 1 1 0 0 0 0 0 0

Module Interface Test:

a. Addressed module responds to bad check bits, or

b. Addressed module reply line always asserted, or

c. Addressed module not powered.

Note:

If SCU BITE is repeated without cycling BTU power, bits 3 and 4 will not be set for error conditions b. and c. above.

Bits 12 through 15 contain the binary address of the failed module.

0 1 1 1 1 1 0 1 1 1 1 1 0 0 1 1

Successful SCU BITE completion.

(3) BSR after BITE Test No. 2 (Reference Paragraph 8.2.12.6.2.10). As a result of the BITE Test 2 command, one of the following 7 conditions will be loaded into the BSR, and may be accessed by the GPC:

1 1 1 1 1 1  
0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5  
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1

First A/D Bite value transferred.

0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0

Second A/D Bite value transferred.

0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 Third A/D Bite value transferred.  
 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 Fourth A/D Bite value transferred.  
 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 1 Fifth A/D Bite value transferred.  
 0 0 0 0 0 0 0 0 1 0 0 0 0 0 1 1 0 A/D Reply line always asserted.  
 0 0 0 0 0 0 0 0 0 0 1 0 0 1 1 0 Successful A/D Bite completion.

Note: Bit 4 set during any of the above is an additional failure condition. It indicates the A/D reply line was asserted at the wrong time, or was never asserted. This condition will affect the V bit of the Response Data Words.

(4) BSR After BITE Test No. 3 (Reference Paragraph 8.2.12.6.2.11). As a result of the BITE Test 3 command, one of the following 4 conditions will be loaded into the BSR, and may be accessed by the GPC 43 msec. after the BITE Test 3 command:

  1 1 1 1 1 1  
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5  
 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 1 Power supply BITE reply line always indicates test pass.  
 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 First half of power supply BITE failed.  
 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 Second half of power supply BITE failed. (Redundant BTU only).  
 0 0 0 0 0 0 0 0 0 0 1 0 0 0 1 1 Successful power supply BITE completion.

8.2.12.6.2.4 Master Reset. Commands the BTU to reset all registers.

a. Command to BTU.

1	3 4	8 9	13 14	17 18	22 23	27 28
! Cmd	! MIA	! Mode	! Module	! Channel	! Number	! P
! Sync	! Address	! Control	! Address	! Address	! Of Words	!
!	!	! 0 1 0 1 1	! - - - -	! - - - -	! - - - -	!
! (3)	! (5)	! (5)	! (4)	! (5)	! (5)	! (1)

b. Command Data to BTU. None

c. Response Data from BTU. None

8.2.12.6.2.5 Return Command Word. Commands the BTU to return the received command word.

a. Command to BTU.

1	3 4	8 9	13 14	17 18	22 23	27 28
! Cmd !	MIA !	Mode !	Module !	Channel !	Number !	P !
! Sync !	Address !	Control !	Address !	Address !	Of Words !	! !
! !	! !	! 0 1 1 0 0 !	! - - - - !	! - - - - !	! - - - - !	! !
! (3) !	! (5) !	! (5) !	! (4) !	! (5) !	! (5) !	! (1) !

b. Command Data to BTU. None

c. Response Data from BTU. One word containing the contents of the received command word. The BTU shall transmit 14 bits of the command word starting with bit 14 and ending with bit 27. Bits 14-27 of the command word are inserted into bits 9-22 of the response word. Bits 23 and 24 of the response word are loaded with "ZEROS".

8.2.12.6.2.6 Load BITE. Commands the BTU to load the BITE status register.

a. Command to BTU.

1	3 4	8 9	13 14	17 18	22 23	27 28
! Cmd !	MIA !	Mode !	Module !	Channel !	Number !	P !
! Sync !	Address !	Control !	Address !	Address !	Of Words !	! !
! !	! !	! 0 1 1 1 0 !	! - - - - !	! - - - - !	! - - - - !	! !
! (3) !	! (5) !	! (5) !	! (4) !	! (5) !	! (5) !	! (1) !

b. Command Data to BTU. One word with the same format as the BSR.

c. Response Data from BTU. None

8.2.12.6.2.7 Return the Word at the PROM Address. Commands the BTU to return the word at the specified PROM address.

a. Command to BTU.

1	3 4	8 9	13 14	22 23	27 28
! Cmd !	MIA !	Mode !	Starting Prom !	Number of !	P !
! Sync !	Address !	Control !	Address !	Instruction !	! !
! !	! !	! !	! !	! to Execute !	! !
! !	! !	! 0 0 0 0 1 !	! X X X X X X X X X !	! X X X X X !	! !
! (3) !	! (5) !	! (5) !	! (9) !	! (5) !	! (1) !

b. Command Data to BTU. None

c. Response Data from BTU. For a PROM sequence command, the message consists of up to 512 response data words.

8.2.12.6.2.8 Execute Command. Commands the BTU to execute the PROM command(s) starting at the specified PROM address.

a. Command to BTU.

1	3 4	8 9	13 14	22 23	27 28
Cmd	MIA	Mode	Starting Prom	Number of	P
Sync	Address	Control	Address	Instruction	
		0 0 0 1 0	X X X X X X X X X	to Execute	
(3)	(5)	(5)	(9)	X X X X X	!(1)!

b. Command Data to BTU. As appropriate.

c. Response Data from BTU. As appropriate.

8.2.12.6.2.9 BITE Test 1. Commands the BTU to execute BITE Test 1 Sequence Controller Unit (SCU) test.

a. Command to BTU.

1	3 4	8 9	13 14	17 18	22 23	27 28
Cmd	MIA	Mode	Module	Channel	Number	P
Sync	Address	Control	Address	Address	Of Words	
		0 0 0 1 0	---	---	---	---
(3)	(5)	(5)	(4)	(5)	(5)	!(1)!

b. Command Data to BTU. None.

c. Response Data from BTU. None.

d. SCU Test Description. the following tests are initiated internal to the BTU during the SCU test.

- (1) BTU receiver addressing is checked to insure response to only 1 of 32 addresses by internally forcing all possible receiver addresses and verifying only one result in the BTU selected.
- (2) Data word pattern checking is verified by internally generating incorrect check patterns and verifying an error can be detected.
- (3) All counters are checked against one another by loading and monitoring simultaneous overflow.
- (4) PROM odd parity checking is verified by forcing bad parity.
- (5) PROM cyclic checking is verified by executing a sequence with an incorrect cyclic check.
- (6) SCU OUT BUS, SCU IN BUS and ICM interfaces are verified by selecting and communicating with each ICM, and monitoring for the correct response. The ability of the IOMs and SCU to recognize bad check bits on the SCU OUT BUS and SCU IN BUS will also be verified at this time.



The above tests are further subdivided into up to 32 subtests. The number of the failed subtest is loaded into the BSR. Any detected failure while testing the SCU will stop the test with the BITE subtest failed number in the BSR. The GPC, after allowing time (1.1 milliseconds) for the BTU to perform its BITE test, may interrogate the BSR status.

8.2.12.6.2.10 BITE Test 2. Commands the BTU to execute BITE Test 2, Analog to Digital Converter (A/D) Test. The A/D converter is tested with a GPC command to execute the A/D test. Five references are converted and sent to the GPC for evaluation. The GPC should evaluate these references against programmed constants. The constants and sequence are as shown in the Response Data.

a. Command to BTU.

1	3 4	8 9	13 14	17 18	22 23	27 28
! Cmd	! MIA	! Mode	! Module	! Channel	! Number	! P
! Sync	! Address	! Control	! Address	! Address	! Of Words	!
!	!	! 0 0 1 0 1	! - - - -	! - - - -	! - - - -	!
! (3)	! (5)	! (5)	! (4)	! (5)	! (5)	! (1)!

b. Command Data to BTU. None

c. Response Data from BTU.

Correct Bit Pattern (16 Bits)

WORD 5	0111111111000000	+Full Scale
WORD 1	1000000000000000	-Full Scale
WORD 2	1011010XXX000000	-Reference
WORD 4	0100101XXX000000	+Reference
WORD 3	0000000XXX000000	Null
or WORD 3	1111110XXX000000	Null

8.2.12.6.2.11 BITE Test 3. Commands the BTU to execute BITE Test 3, Power Supply (PS) Test. During the PS Test, the associated core power-supply regulators are placed in a slight offset condition and monitored for back-up takeover. Primary, secondary, and 28V sources are verified.

Any detected failure while testing the PS will stop the test with the BITE subtest failed number in the BSR. The GPC, after allowing time for the MDM to perform the test (43 msec), may interrogate the BSR status.

a. Command to BTU.

1	3 4	8 9	13 14	17 18	22 23	27 28
! Cmd	! MIA	! Mode	! Module	! Channel	! Number	! P
! Sync	! Address	! Control	! Address	! Address	! Of Words	!
!	!	! 0 0 1 1 0	! - - - -	! - - - -	! - - - -	!
! (3)	! (5)	! (5)	! (4)	! (5)	! (5)	! (1)!

- b. Command Data to BTU. None
- c. Response Data from BTU. None

8.2.12.6.2.12 BITE Test 4. Commands the BTU to execute BITE Test 4, Input Output Module (IOM) Test. A command may test a module sequentially or on a single channel basis using the normal module address, channel number, and number of words fields in the command word.

- a. Command to BTU.

1	3 4	8 9	13 14	17 18	22 23	27 28
! Cmd !	MIA !	Mode !	Module !	Channel !	Number !	P !
! Sync !	Address !	Control !	Address !	Address !	Of Words !	! !
! !	! !	! 0 0 1 1 1 !	! X X X X !	! X X X X X !	! X X X X X !	! !
! (3) !	! (5) !	! (5) !	! (4) !	! (5) !	! (5) !	! (1) !

- b. Command Data to BTU. See a through e.
- c. Response Data from BTU. See a through e.

(1) AOD Module Type. Test of the AOD modules will result in one response data word per channel. The AOD test response should be compared by the GPC with the Programmed output. During AOD test, the GPC must account for output settling before testing. When testing an AOD module the GPC should compare the programmed output with the BITE reply by subtracting the two. The difference should be less than a predetermined value as given by the following equation.

$$(\text{Programmed output}) - (\text{BITE Reply})$$

$$= 000000XXXX000000$$

or

$$= 111111XXXX000000$$

- (2) DOH, DOL, and POH Module Type. Test of the these modules will result in one response data word per channel. The value of the responses data word(s) will be the state of the actual command discrete output signals.
- (3) DIH and ~~DOL~~ Module Type. Test of DIH or ~~DOL~~ modules will result in two response words per channel, not to exceed 64 response data words. The two input IOM test response words should be compared by the GPC against each other. These test words will consist of predetermined complement bit patterns, independent of subsystem inputs. The GPC should verify that the two test words are complement bit patterns of the correct form. The bit patterns for each channel are:

Channel	Word	Bit Pattern
0	1	0 0 0 0 1 1 1 1 1 1 1 1 0 0 0 0
0	2	1 1 1 1 0 0 0 0 0 0 0 0 1 1 1 1
1	1	0 0 0 0 1 1 1 1 0 0 0 0 0 1 1 1 1
1	2	1 1 1 1 0 0 0 0 0 1 1 1 1 0 0 0 0
2	1	1 1 1 1 0 0 0 0 0 1 1 1 1 0 0 0 0
2	2	0 0 0 0 1 1 1 1 0 0 0 0 0 1 1 1 1

- (4) SIO Module Type. The bit pattern will be alternate ones and zeros starting with a one in the first bit.

	Bit Pattern
WORD 1	1010101010101010
WORD 2	0101010101010101

- (5) AID Module Type. Test of the AID module will result in two response data words per channel, not to exceed 64 response data words.

The first word will consist of the actual analog input modified by a gain change and constant. The second word will be the actual analog input. The GPC should unmodify the first word using a programmed gain change and constant and compare it against the second word. The equation which the GPC should implement is as follows, where BIT RESPONSE is the first response word and ACTUAL RESPONSE is the second:

$$(\text{BIT RESPONSE}) - (\text{ACTUAL RESPONSE})/2 = \text{CONSTANT}$$

The value of the CONSTANT is either positive or negative depending on the channel number and the bit patterns should be as given below.

	Bit Pattern
CONSTANT (+)	0 0 1 1 0 X X X X X 0 0 0 0 0 0
CONSTANT (-)	1 1 0 0 1 X X X X X 0 0 0 0 0 0

The channel number and sign are as follows:

CHANNEL	SIGN	CHANNEL	SIGN	CHANNEL	SIGN	CHANNEL	SIGN
0	+	8	-	16	-	24	+
1	-	9	+	17	+	25	-
2	-	10	+	18	+	26	-
3	+	11	-	19	-	27	+
4	-	12	+	20	+	28	-
5	+	13	-	21	-	29	+
6	+	14	-	22	-	30	+
7	-	15	+	23	+	31	-

8.2.12.6.3 BTU Data Characteristics. The Data Conventions and Scaling Requirements are defined in Section 9.0, Software Interfaces, Paragraph 9.4.4, Orbiter Data Bus System Interface.

8.2.12.6.3.1 (Deleted)

8.2.12.6.3.2 (Deleted)

8.2.12.6.3.3 (Deleted)

8.2.12.6.3.4 (Deleted)

8.2.12.6.3.5 (Deleted)

8.2.12.6.3.6 (Deleted)

8.2.12.7 Cargo Terminal Address Codes. Cargo terminal (BTU) address codes are allocated according to Table 8.2.12.6.1.1- 1. Only these addresses shall be used for the Orbiter/Payload (BTU) communications.

Orbiter bus controller support for multiple BTU's is defined in Section 9.0. Cargo elements shall make accommodations to change cargo terminal address codes on a mission basis. These addresses will be assigned when the cargo element is manifested for each flight.

8.2.12.8 Cargo Bus Terminal Unit Error Handling. The address field of all command and command data words shall be decoded and checked within the BTU. When a command word is received by a BTU which does not have that BTU's address the BTU shall not respond to the command word nor the following command data words in any way. If a command word which contains a BTU's address is received by that BTU, but the word is otherwise invalid, the BTU shall not use that command word, shall not respond to any following command data words in that message, and shall set a bit in the BITE status register in the BTU.

When a command data word is received by a BTU that does not have that BTU's address, but has been preceded by a valid command word addressed to that BTU, the command data word shall be considered invalid by the BTU, and a bit shall be set in the BTU BITE status register. Logic shall be provided in the BTU to detect an invalid check bit pattern in the command data word. When a BTU receives a command data word with an invalid check bit pattern or data validation errors as defined in paragraph 8.2.12.5, the command data word shall be considered invalid by the BTU, and a bit shall be set in the BTU BITE status register.

The BTU shall also contain logic to count the words in a message and compare it to the number of words indicated in the command word. All BTUs shall check to insure that a word has not been missed in a message as the result of an inter-word gap time-out. This time-out shall be between 8 and 35 microseconds. When a BTU detects a time-out it does not respond to any of the command data words following the time-out, it shall set a bit in the BTU BITE status register, and it shall disregard the entire message which was not completed.

8.2.12.9 Orbiter Bus Controller Error Handling. The bus controller shall be capable of detecting errors, generating error status information, and processing error status information. Upon detection of one or more errors, a status word shall be generated which indicates error condition detected.

8.2.12.9.1 Error Detection.

8.2.12.9.1.1 Address Check. The address or outgoing command words shall be saved and compared with the address on the returned response data word. If an invalid address is detected in the response word, the word shall be considered invalid.

8.2.12.9.1.2 Pattern Check. If a response data word is received with a pattern other than "101" in bit locations 25- 27, The data word shall be considered invalid.

8.2.12.9.1.3 Data Validation Errors. If a response data word is received with a data *validation* error, as defined in paragraph 8.2.12.5, the data word shall be considered invalid.

8.2.12.9.1.4 Missing Word. The bus controller shall detect missing words within a data stream received on a data bus.

8.2.12.9.1.5 Turnaround Time. The Orbiter bus controller shall perform a check to insure that the maximum turnaround time is not exceeded. The turnaround time is the time between the last bit of the command word transmitted and the first bit of the received response word. This time will depend on the particular bus terminal unit being addressed. If the maximum turnaround time is exceeded, an error condition will be presumed to exist and the data shall be considered invalid. The cargo BTU turnaround time shall be 5 to 23 microseconds.

8.2.12.10 Failure Detection and Isolation. The Orbiter bus controller shall be capable of utilizing the information derived from error checking and BITE status failure detection and fault isolation.

8.2.12.11 Grounding and Shielding. Grounding and Shielding shall be as shown in Figure 8.2.12-2.

*Table 8.2.12-1 Orbiter/Cargo Data Bus (Orbiter Transmitting)  
Orbiter Transmitting - Cargo BTU Receiving Electrical  
Interface Characteristics*

PARAMETER	DIMENSION	ICD INTERFACE (5)	
		DUE TO SOURCE	Load Requirements
Type		Serial Burst (See Figure 8.2.12.6.2)	Serial Burst (See Figure 8.2.12.6.2)
Code		MIL-STD-1572 Bi-Phase L	MIL-STD-1572 Bi-Phase L
Analog Range	Min: Volt Max: Volt	NA NA	NA NA
Positive Signal Peak	Max: Volt	NA	+0.56 (NO RESPONSE)
	Min: Volt Max: Volt	+2.5 (4) +5.9	+1.0 (MUST RESPOND) +7.9
Negative Signal Peak	Min: Volt	+2.6	+2.5 (Ref. Paragraph 8.2.12.4.1)
	Max: Volt Min: Volt Max: Volt	NA -2.5 (4) -5.9	-0.56 (NO RESPONSE) -1.0 (MUST RESPOND) -7.9
Ripple and Noise (Excluding overshoot and undershoot)	Min: Volt	-2.6	-2.5 (Ref. Paragraph 8.2.12.4.1)
	Max: Millivolt	300 RMS	300 RMS
CMV	Max: Volt	+10V Peak from dc to 2 MHz sine Ref shield	No Response to +32 V Peak from dc to 2 MHz sine Ref shield
Rise/Fall Time (10 to 90 percent)	Min: Microsec	0.10	0.10
	Max:	0.26 (3)	0.26 (3)
Noise Supp Bandwidth	Hertz	NA	Reject up to +14 V Peak below 1KHz and between 5MHz and 30 MHz
CMRR	dB	NA	Reject CMV

Table 8.2.12-1 Orbiter/Cargo Data Bus (Orbiter Transmitting)  
 Orbiter Transmitting - Cargo BTU Receiving Electrical  
 Interface Characteristics (Concluded)

PARAMETER	DIMENSION	ICD INTERFACE (5)	
		DUE TO SOURCE	Load Requirements
Distortion	Max Volts	!10 percent overshoot to !1 percent undershoot !(Ref signal Peak)	!10 percent overshoot to !1 percent undershoot !(Ref signal peak)
Frequency Bit Rate	!MBPS	!1 ± 0.1 percent !(See Figure 8.2.12.1-1)	!1 ± 0.1 percent !(See Figure 8.2.12.1-1)
Transfer		!Direct !Coupled !Balanced	!Direct !Coupled !Balanced
Impedance	Min Ohm Max Ohm	!70 !80	!70 !80
Pwr-Off Imp Per Stub	!Ohm	!NA	!NA
Drive Capability	!Milliamps	!85 Peak at !5.9V	!NA
Load Current	Max Milliamps	!NA	!101 Peak at !7.9V
Overvoltage Protection	Max Volt	!NA !+8 Diff (1)	!32 Vdc CM !+8 Diff (1)
Fault Voltage Emission	Max Volt	!+8 Diff (1) !NA (2)	!+8 Diff (1) !NA (2)
Fault Current Limitation (Estimate)	Max Milliamps	!200	!200

- (1) Within the signal bandwidth of 330 KHz - 1.5 MHz.
- (2) Single point fault voltage cannot draw current on unreferenced, transformer isolated lines.
- (3) Operational Boundaries.
- (4) Faulted condition.
- (5) Main data bus parameters.

Table 8.2.12-2 Orbiter/Cargo Data Bus (Cargo BSU Transmitting)  
 Cargo BSU Transmitting - Orbiter Receiving Electrical  
 Interface Characteristics

PARAMETER	DIMENSION	ICD INTERFACE (5)	
		DUE TO SOURCE	Load Requirements
Type		Serial Burst (See Figure 8.2.12.6.2)	Serial Burst (See Figure 8.2.12.6.2)
Code		MIL-STD-1572 Bi-Phase L	MIL-STD-1572 Bi-Phase L
Analog Range	Min: Volt Max: Volt	NA NA	NA NA
Positive Signal Peak (1)	Min: Volt	+2.5 (4)	+1.0 (MUST RESPOND)
	Min: Volt	+2.6	+2.5
	Max: Volt	+5.9	+7.9 (Ref. Paragraph 8.2.12.4.1)
	Max: Volt	NA	+0.56 (NO RESPONSE)
Negative Signal (1) Peak	Min: Volt	-2.5 (4)	-1.0 (MUST RESPOND)
	Min: Volt	-2.6	-2.5
	Max: Volt	-5.9	-7.9 (Ref. Paragraph 8.2.12.4.1)
	Max: Volt	NA	-0.56 (NO RESPONSE)
Ripple and Noise (Excluding overshoot and undershoot)	Max: Volt	NA	-0.56 (NO RESPONSE)
	Max: Millivolt	300 RMS	300 RMS
CMV	Max: Volt	±10V Peak from dc to 2 MHz sine Ref. shield	No Response to ±32 Volts Peak from dc to 2 MHz sine Ref. shield
Rise/Fall Time (10 percent to 90 percent)	Min: Microsec	0.10	0.10
	Max: Microsec	0.25(3)	0.26(3)
Noise Supp Bandwidth	Hertz	NA	±14 Volts Peak Below 1KHz and between 5 MHz and 30 MHz
CMRR	dB	NA	Reject CMV



**Table 8.2.12-2 Orbiter/Cargo Data Bus (Cargo BTU Transmitting)  
Cargo BTU Transmitting - Orbiter Receiving Electrical  
Interface Characteristics (Concluded)**

PARAMETER	DIMENSION	ICD INTERFACE (5)	
		DUE TO SOURCE	Load Requirements
Distortion	Max Volts	!10 percent overshoot to !1 percent undershoot (Ref Peak Sig.)	!10 percent overshoot to !1 percent undershoot (Ref Peak Sig.)
Frequency	Hertz	!NA	!NA
Bit Rate	MBPS	!1 ± 0.1 percent (See Figure 8.2.12.1-1)	!1 ± 0.1 percent (See Figure 8.2.12.1-1)
Transfer		!Direct Coupled Balanced	!Direct Coupled Balanced
Impedance	Min Ohm	!70	!70
	Max Ohm	!80	!80
Pwr-Off Imp	Ohm	!NA	!NA
Drive Capability	Max Milliamps	!85 Peak at !5.9V	!NA
Load Current	Max Milliamps	!NA	!101 Peak at !7.9 V
Overvoltage Protection	Max Volt(PK)	!NA !±8 Diff (1)	!±32V dc CM !±8 Diff (1)
Fault Voltage Emission	Max Volt(PK)	!NA (2) !±8 Diff	!NA (2) !±8 Diff
Fault Current Limitation	Max Milliamps	!200	!200

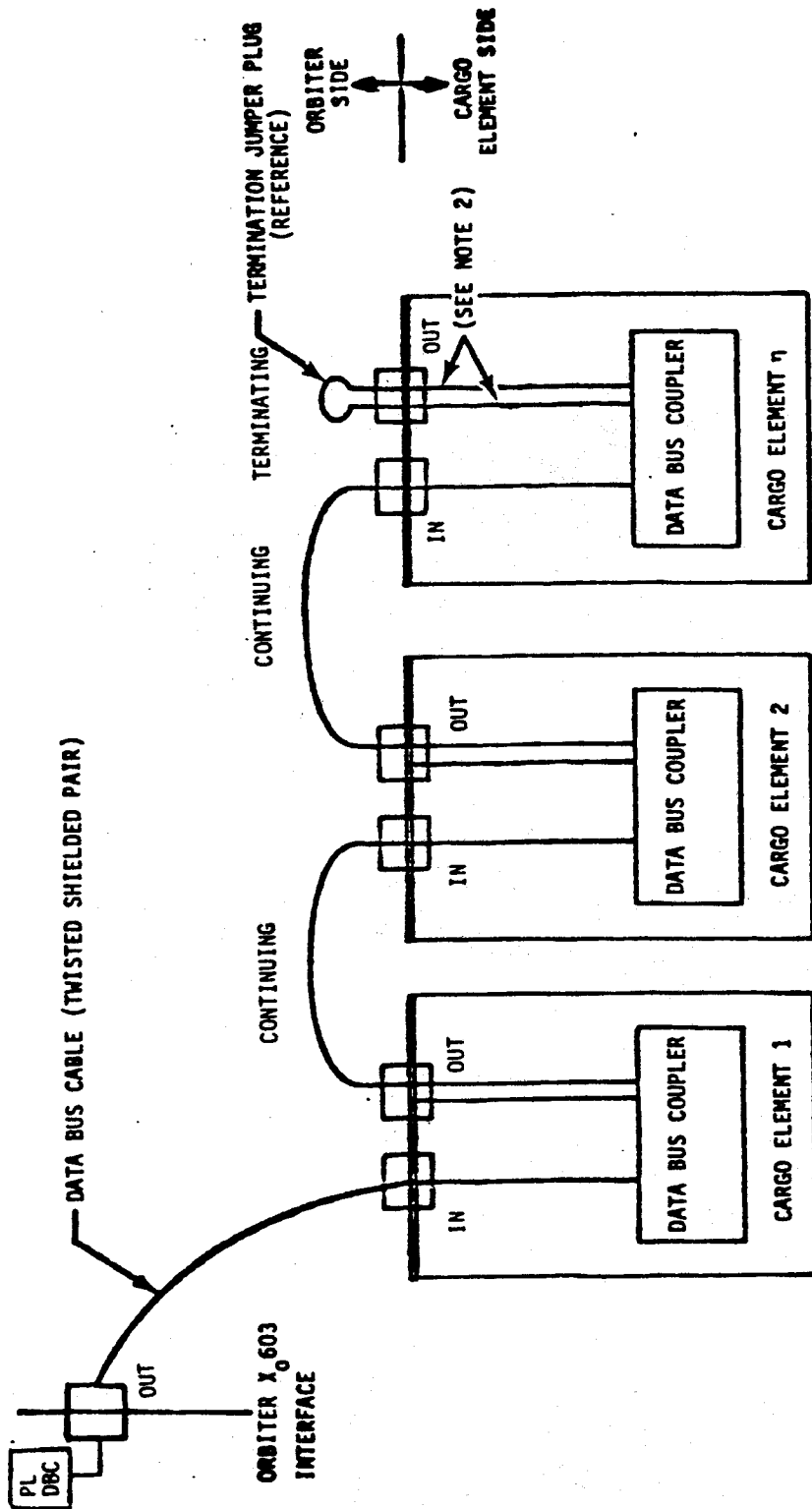
- (1) Within the signal bandwidth of 330 KHz - 1.5 MHz.
- (2) Single point fault voltage cannot draw current on unreferenced, transformer isolated lines.
- (3) Operational Boundaries.
- (4) Faulted condition.
- (5) Main data bus parameters.

TABLE 8.2.12.6.1.1-1 CARGO TERMINAL ADDRESS CODES

PAYLOADS BTU:	BTU 1	BTU 2	BTU 3	BTU 4	BTU 5
DATA BUS					
PL1 (P)	6	9	15	29	30
PL2 (S)	6	9	15	29	30

(P) - PRIMARY PORT  
(S) - SECONDARY PORT

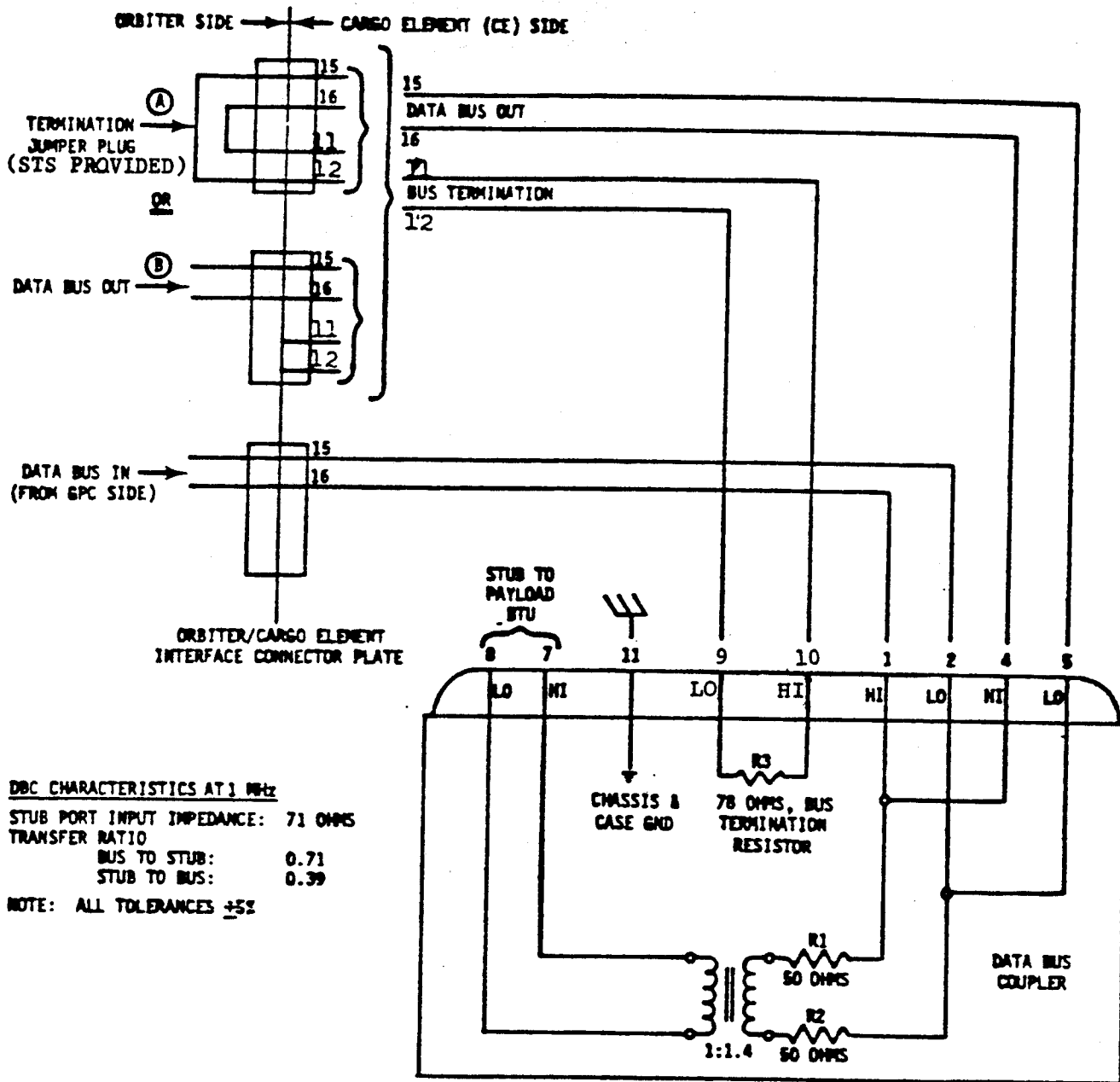
NOTE: On the Orbiter/Payload Data Bus System there are 5 BTU addresses available to support a maximum of four cargo BTUs.



**NOTES:**

1. FOR DETAILS SEE PARAGRAPH 8.2.12.
2. MAXIMUM TERMINATION CABLE LENGTH FROM TERMINATION COUPLER TO PAYLOAD INTERFACE AND BACK TO THE COUPLER'S TERMINATION RESISTOR SHALL NOT EXCEED 40 FT. IN TOTAL LENGTH.

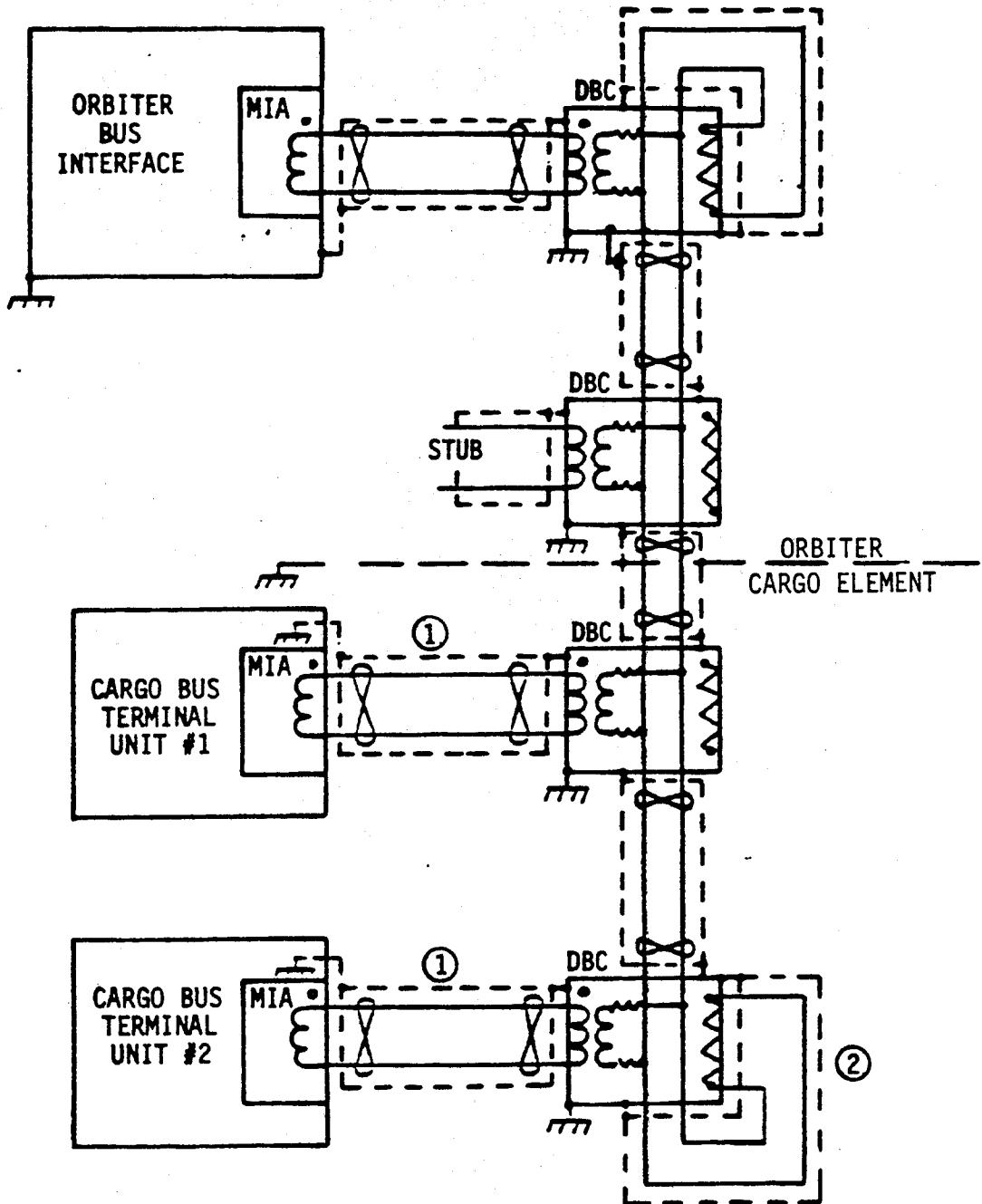
Figure 8.2.12-1 Cargo Element Data Bus Cable Configuration. General Schematic



**NOTES:**

1. INTERFACE SHOWN IS TYPICAL
2. MOUNT DBC TO METAL STRUCTURE WHEN POSSIBLE

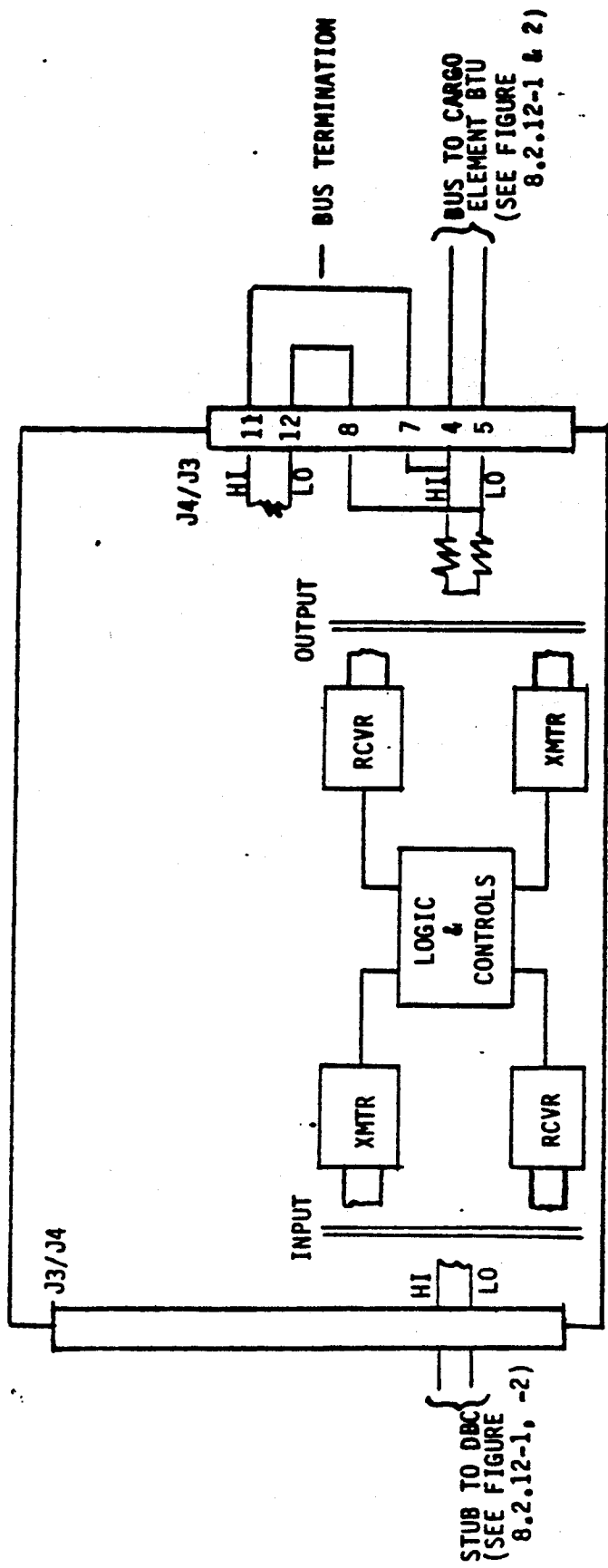
Figure 8.2.12-2 Data Bus Interface And Coupler Schematic



DBC = DATA BUS COUPLER  
MIA = MULTIPLEXER INTERFACE ADAPTER

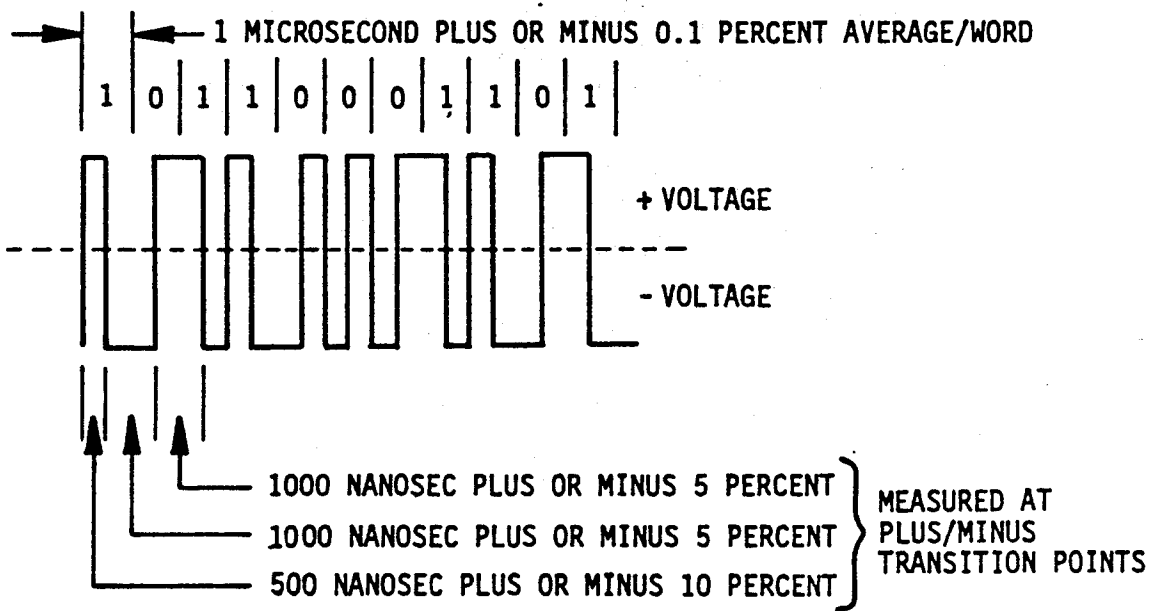
- ① FOR DATA BUS STUB LENGTH SEE PARAGRAPH 8.2.12.2
- ② FOR DATA BUS TERMINATION LENGTH SEE PARAGRAPH 8.2.12  
(CONFIGURATION IS TYPICAL, BUT NEED NOT RETURN TO SAME DBC FOR TERMINATION)

FIGURE 8.2.12-3 ORBITER/CARGO BTU INTERFACE



- NOTES:
1. CIRCUIT TYPICAL, TWO TIMES PER DBIA
  2. INTERFACE TYPICAL

FIGURE 8.2.12-4 DBIA INTERFACE



NOTE: BI-PHASE LEVEL (MANCHESTER II)  
 "1" REPRESENTED BY 10  
 "0" REPRESENTED BY 01

FIGURE 8.2.12.1-1 DATA CODE

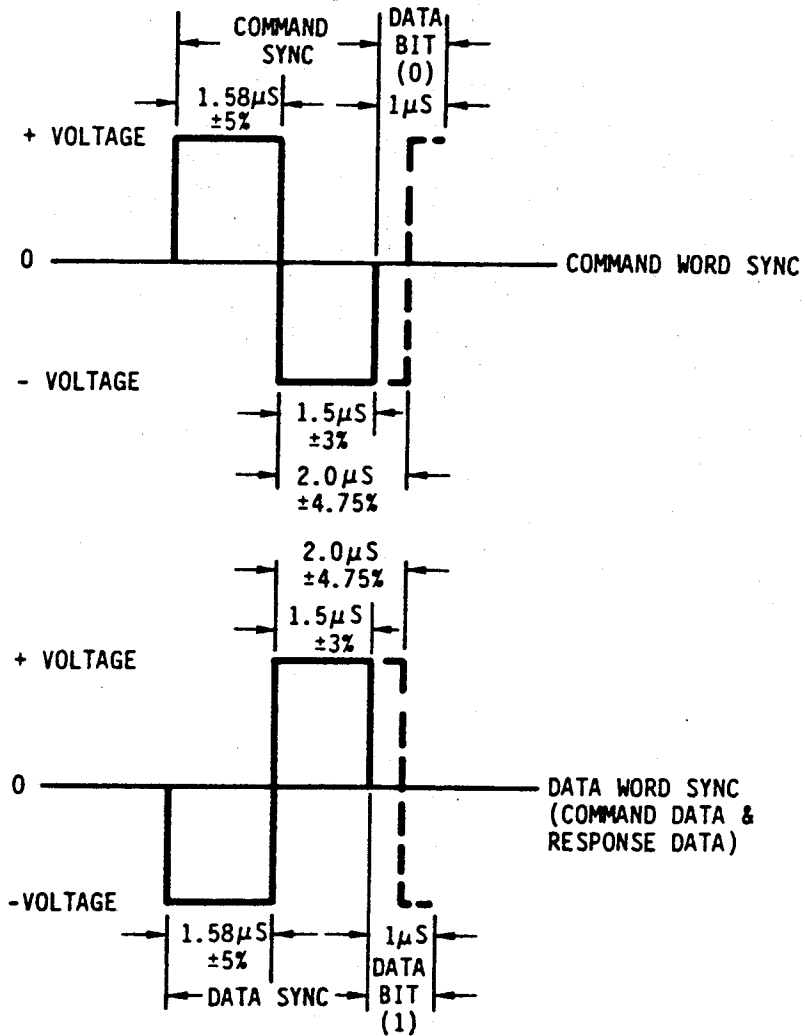


FIGURE 8.2.12.1-2 WORD SYNCs, NONVALID MANCHESTER CODE



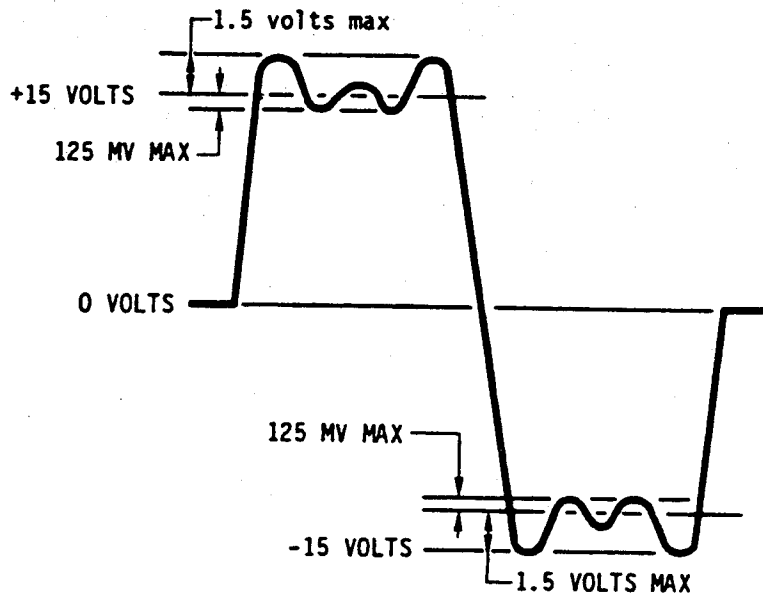


FIGURE 8.2.12.3-1 TRANSMITTER OUTPUT WAVEFORM DISTORTION

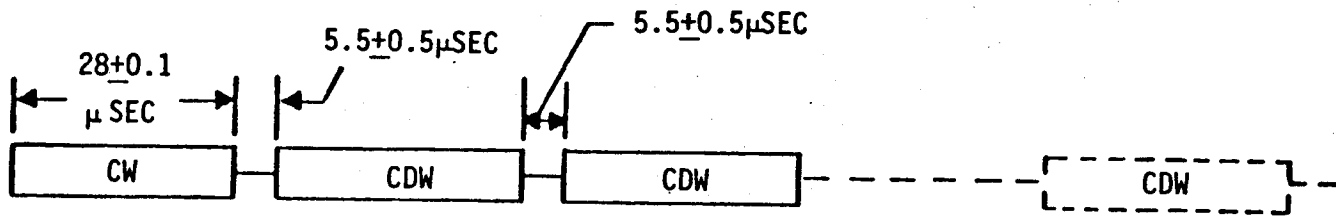


FIGURE 8.2.12.6-1 DATA TRANSFER FROM GPC TO INTERFACE UNITS

CW - COMMAND WORD  
 CDW - COMMAND DATA WORD  
 RDW - RESPONSE DATA WORD

NOTE: SEE PARAGRAPH 8.1.6.9.1.5 FOR TURNAROUND TIMES

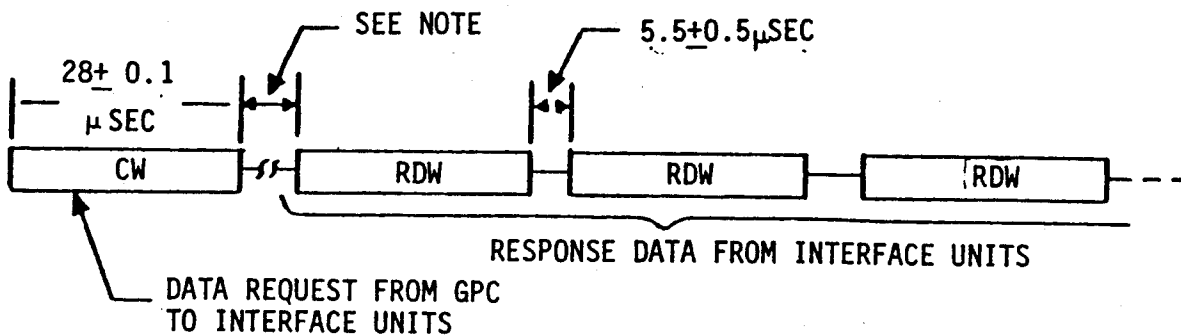


FIGURE 8.2.12.6-2 DATA TRANSFER FROM INTERFACE UNITS TO GPC

8.2.13 (Deleted)

8.2.14 (Deleted)

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### 8.3 DETACHED PAYLOADS

The Payload Interrogator shall provide full duplex RF communication between the Orbiter and detached payloads. This capability shall include transmission of commands to, and the reception of telemetry data from, such payloads. Both NASA (STDN and DSN) and DOD (SGLS) transmit/receive frequency pairs shall be available. See Appendix C for specific selectable channels.

In addition to two-way RF communication, Ku-band rendezvous radar shall also be available. *The radar shall skin-track targets.*

In the following paragraphs, "characteristics" refers to those Orbiter avionics characteristics of which the payload must be cognizant, and "requirements" refers to specifications placed upon payload communication equipment.

#### 8.3.1 Payload Interrogator (PI) RF Interfaces.

8.3.1.1 Transmitter Characteristics. The principal transmitter characteristics shall be as listed in Table 8.3.1.1-1.

8.3.1.2 Receiver Characteristics. The principal receiver characteristics shall be as listed in Table 8.3.1.2-1.

8.3.1.3 Antenna Characteristics. The PI/Payload link shall utilize a single beam antenna for both transmission and reception. The antenna shall have a beam width bounded by an 80° cone aligned with the +Z axis. Polarization, either RHCP or LHCP, shall be switch selectable in the Orbiter.

8.3.2 PI Data Interfaces. Data interfaces provided for detached payload use are classed as standard or non-standard. Standard interfaces are prewired interfaces provided by the baseline Orbiter employing pre-established data handling methods. Non-standard interfaces are those requiring payload-provided unique wiring and processing equipment to be installed at the AFD. Input/output data interfaces shall be available at the PSDP for access to and from the PI. Figure 8.3.2-1 presents a block diagram of the signal routing for both standard and non-standard operation.

#### 8.3.2.1 Standard Payloads.

8.3.2.1.1 Commands. Command data shall be accepted by the Payload Signal Processor from the GPC. This data shall be modulated onto a 16 KHz subcarrier and handed off to the PI for RF transmission to detached payloads. Refer to Para. 8.2.5 and Table 8.2.5.1-1 for command structure and subcarrier performance characteristics.

8.3.2.1.2 Telemetry. Telemetry data in standard operation shall be modulated onto a 1.024 MHz subcarrier by the payload. The PI receiver shall strip the RF carrier and hand off the subcarrier signal to the PSP. A single form of telemetry signal shall be allowed with summary requirements as listed in Table 8.3.2.1.2-1.

#### 8.3.2.2 Non-Standard Payloads.

8.3.2.2.1 Commands. A payload selectable input port to the PI transmitter shall exist at the payload station distribution panel (PSDP) (Ref. Para. 8.3.2.2.3). This port shall allow non-standard command signals to directly modulate the PI transmitter. Such signals shall comply with the requirements shown in Table 8.3.2.2.1-1.

8.3.2.2.2 Telemetry. An output port from the PI receiver shall exist at the PSDP. The interface characteristics for demodulated RF signals from the PI shall be as defined in Table 8.3.2.2.2-1.

8.3.2.2.2.1 Telemetry Modulation Criteria. Phase modulation (PM) of the payload transmitter carrier shall be the only allowable type. (Quadrature modulation shall not be allowed). When employed, subcarriers shall be either phase or frequency modulated. Further restrictions on the use of subcarriers will follow. Direct carrier modulation by analog signals shall not be allowed; however, direct modulation by digital signals shall be allowed subject to restrictions to follow. Carrier modulation by periodic signals having fundamental frequencies less than 250 KHz shall not be permitted. No incidental and/or spurious discrete frequency component sideband levels shall be greater than 29 db below the unmodulated carrier within a frequency range of 250 KHz about the carrier.

8.3.2.2.2.1.1 Frequency Modulated Subcarriers.

a. Analog Modulations. The subcarrier frequency shall be greater than 250 KHz and the analog modulation shall satisfy the inequality:

$$f_m \Delta f > 4.6 \times 10^5$$

where  $f_m$  is the bandwidth or maximum frequency of the baseband analog signal in Hz and  $\Delta f$  is the peak frequency deviation of the subcarrier in Hz. Provided the above inequality is satisfied, the maximum allowable carrier phase modulation index,  $\beta$ , by the frequency modulated sinusoidal subcarrier shall be the lessor of 1.85 radians (106°) or the  $\beta$  which satisfies the relationship:

$$J_1(\beta)/J_0(\beta) = 2.0 \times 10^{-7} f_m \Delta f$$

b. Digital Modulations. The subcarrier frequency shall be greater than 250 KHz and the data bit rate ( $R_b$ ) of the frequency shift keyed (FSK) modulation shall be greater than 2KBPS. Provided  $R_b$  is greater than 2KBPS, the maximum allowable carrier phase modulation index,  $\beta$ , by the FSK modulated sinusoidal subcarrier shall be the lessor of 1.85 radians (106°) or the  $\beta$  which satisfies the relationship:

$$J_1(\beta)/J_0(\beta) \geq 1.25 \times 10^{-9} (R_b)^2$$

8.3.2.2.2.1.2 Phase Modulated Subcarriers.

a. Analog Modulations. Phase modulation of subcarriers by analog baseband signals shall not be allowed.

- b. Digital Modulations. The subcarrier frequency shall be greater than 250 KHz and  $R_b$  of the phase shift keyed (PSK) modulation shall be greater than 2KBPS. Provided  $R_b$  is greater than 2 KBPS the maximum allowable carrier phase modulation index,  $\beta$ , by the PSK modulated sinusoidal subcarrier, shall be the lessor of 1.85 radians (106°) or the  $\beta$  which satisfies the relationship:

$$J_1(\beta)/J_0(\beta) \leq 1.25 \times 10^{-9}(R_b)^2$$

8.3.2.2.2.1.3 Direct Carrier Modulation.

- a. Analog Modulations. Direct phase modulation of the carrier by an analog baseband signal shall not be allowed.
- b. Digital Modulations. The allowable NRZ bit rate must satisfy the following inequality:

$$R_b > 9.2 \times 10^4 (\tan^2\beta)^{1/2}$$

The maximum number of such bits without transition shall be less than  $1.0 \times 10^{-4}R_b$ . The minimum Bi- $\theta$ -L bit rate allowed shall be the larger bit rate calculated from:

$$R_b = 1.23 \times 10^3 \tan^2\beta \quad , \text{ or}$$

$$R_b = 2.83 \times 10^4 \sqrt{\tan\beta}$$

The modulation index  $\beta$  for all digital modulations shall not exceed 71.5° or 1.25 radians.

8.3.2.2.3 PI/PS Control Discrete. A control discrete shall be provided via the PSDP to the PI to enable the *Payload Station (PS)* input and output ports and disable the PSP input and output ports to/from the PI. The characteristics of the control discrete shall be as follows:

True State (PS ports to/from PI enabled)	18 to 32 VDC
False State (PSP ports to/from PI enabled)	0 to 3 VDC
Termination	Single ended return to pwr grnd
True State Current	10 milliamps maximum
Power Off Impedance	10 K ohms minimum
Load Impedance	3.2 K ohms minimum

Cargo element signal processors installed in the PS shall utilize an indication of which PI has been selected for use to direct command data and the PS control discrete to the correct interrogator. One of two circuits from the forward load control assemblies (LCA No.2 and No. 3) shall contain a 28 VDC signal indicating which of the two interrogators has been powered on. Interfaces with these circuits at the PSDP shall be used to provide limited control power, as required, for the PI. The characteristics of the two circuits shall be as follows:

Logic '1' State (PI on)	24 to 32 VDC
Logic '0' State (PI off)	0 plus 2.5, minus 0 VDC
Maximum Current	125 milliamps
Termination	Single ended return to power ground

Circuit protection shall be provided in the cargo element user unit such that overloads shall not fault the fusing in the LCA's.

If a power return line is required in the Cargo element user unit, power return for Bus A, B or C shall be used.

8.3.2.3 Payload Interrogator Receiver Status Data. The Orbiter acquires and displays the Payload Interrogator's (PI) configuration status. The Orbiter GPC processes and displays the following PI receiver parameters:

- a. Phase Lock - Determine if Phase Lock has occurred and indicated YES or NO.
- b. Phase Error - +85 KHz to -85 KHz.
- c. Payload Signal Strength - Indicates the relative signal strength of the received cargo element telemetry data stream - displays 0 to 5 volts (-102 dbm to -20 dbm). *Voltage presentation is relative (but not proportional) to the measured signal strength received.*

In addition to the above a dedicated AGC (received signal strength) meter is provided at the Flight Station.

8.3.3 Bent Pipe Modes for Detached Payloads. The Orbiter Payload Interrogator shall provide a 'bent-pipe' mode for detached payloads to permit the remodulation of received S-Band signals onto the Ku-band return link carrier. The Ku-band signal processor shall accept the demodulated signal from the payload interrogator and, as a function of its frequency content, route the signal, in response to external commands, to either the narrowband channel (Channel 2, mode 1 or mode 2) or the wideband channel (Channel 3, mode 2). Received data modulated on a single subcarrier and having its highest frequency component less than 2 MHz, shall be routed to the narrowband channel. Data modulated on more than one subcarrier and/or having frequency components between 2 MHz and 4.5 MHz, shall be routed to the wideband channel.

*NOTE: The bent-pipe mode shall be selected only after the detached payload communications have been established with the P9. The bent-pipe operations shall be terminated when the detached payload signal strength decreases to a marginal level (below -111.3 dBm). This operational precaution will prevent the degradation and/or loss of the Ku-band return link when P9 noise becomes the predominant "Signal" in the absence of a detached payload signal.*

#### 8.3.4 Ku-Band Rendezvous Radar Interfaces.

8.3.4.1 Interface Characteristics. The rendezvous radar shall have the interface characteristics defined in Table 8.3.4.1-1.

8.3.4.2 (Deleted)

8.3.4.3 (Deleted)



Table 8.3.1.1-1 Principal P9 Transmitter Characteristics\*

PARAMETER	VALUE	UNITS	NOTES
DOD/L-Band Frequency Range (SGLS)	1763.721 to 1839.795	MHz	See Appendix C for individual channel frequency selections
NASA/S-Band Frequency Range:			
STDN	2025.833400 to 2117.916600	MHz	
DSN	2110.243056 to 2119.792438	MHz	
Carrier Frequency Stability	$\pm 0.0012$	Percent	
Carrier Phase Noise	$\leq 10$	Degrees RMS	(1)
Carrier Spurs	$\leq -55^{**}$	dBc	
Carrier Sweep Range			
NASA (Wide)	$\pm 75 \pm 5$	KHz	
DOD (Wide)	$\pm 55 \pm 5$	KHz	
NASA/DOD (Narrow)	$\pm 33 \pm 3$	KHz	
Carrier Sweep Rates			
75 KHz Range (Nominal)	$10 \pm 3$	KHz/sec	
55 KHz Range (Nominal)	$10 \pm 3$	KHz/sec	
33 KHz Range (Nominal)	$250 \pm 75$	Hz/sec	
ERP-- High	+31.4	dBm	Three selectable levels at antenna interface.(2)
Medium	+21.4	dBm	
Low	-2.6	dBm	

\* at Orbiter interface.

\*\* 0.2 MHz to 16 GHz from carrier

(1) Steady state error for a 100 Hz (Nominal) tracking loop bandwidth.

(2) Specified for 80 deg. cone

Table 8.3.1.2-1 Principal R9 Receiver Characteristics\*

PARAMETER	VALUE	UNITS	NOTES
DOD/S-Band Frequency Range (SGLS)	2202.500 to 2297.500	MHz	See Appendix C for individual channel freq selections
NASA/S-Band Frequency Range:	2200.000 to 2300.000	MHz	selections
STDN	2290.185185 to 2299.814815	MHz	
DSN			
Noise Figure (Max)	6.0 max.	dB	***
Carrier Acquisition Sweep Range (Min)	± 80	KHz	
Carrier Phase Lock Time	≤ 3	Sec	10.9 probability
Carrier Sweep Range			
Minimum	±112	KHz	
Maximum	±132	KHz	
Modulation Index	1.0±10 percent		
False Lock Immunity Sideband Components Signal Levels	**		
Output Frequency Response	.003 to 4.3	MHz	-3db Point, 1 side
Flux Density at Orb. I/F Acquisition	3.63x10 <sup>-12</sup>	W/m <sup>2</sup>	80° antenna cone at 2200 MHz
Tracking:			
Threshold	1.44x10 <sup>-12</sup>	W/m <sup>2</sup>	
InLock (Min)	9.12x10 <sup>-12</sup>	W/m <sup>2</sup>	
InLock (Max)	1.34 (1)	W/m <sup>2</sup>	
Max. Level w/o Damage	2.69x10 <sup>2</sup>	W/m <sup>2</sup>	
G/T (Gain/Temp)	-36.2	dB/degree K	
Input Phase Noise (Max.)	8	degrees rms	100 Hz to 5.5 MHz
Freq. Shift Rate	<17	KHz/Sec	
Freq. Shift	<87	KHz	
Carrier Suppression	<10	dB	
Modulation Types			
Carrier	PM		
Subcarriers	PM(PSK) or FM(FSK)		
Bent Pipe Limiting Ratio	2.9 to 4.4	V-P/V-RMS	****

*Table 8.3.1.2-1 Principal P9 Receiver Characteristics\* (Concluded)*

\* At Orbiter interface

\*\* To preclude false lock no periodic modulation components greater than -29 dbc shall be allowed within 250 KHz of the carrier frequency.

\*\*\* Referenced to the RF PI input/output port.

\*\*\*\* *2.0 volts rms  $\pm$  0.4 volts line-to-line, with 7 volts peak-to-peak, maximum.*

(1) Will not lock or track above this level.

TABLE 8.3.2.1.2-1 STANDARD TELEMETRY SIGNAL REQUIREMENTS

PARAMETER	VALUE	UNITS	NOTES
Waveform	Sinusoidal	-	
Modulation	PSK, $\pm 90$	Degrees	(1)
Subcarrier Frequency	1.024 $\pm 0.01$ percent	MHz	(2)
Subcarrier Harmonic Distortion (Max)	$\leq 1.0$	Percent	
Subcarrier Frequency Stability over a 10 second period	$< 0.001$	Percent	(2)
P/L Modulation Index	$1.0 \pm 0.1$	Radians	
Bit Rate	16,8,4,2,1	kbps	
Bit Rate Accuracy	within $\pm 0.04$	Percent	
Bit Format	NRZ-L, M or S, or Bi $\emptyset$ -L, M, or S	-	
Data Asymmetry	$\leq 2$	Percent	
Bit Rate Stability over a 10 second period	$< 0.01$	Percent	
Data Formatting Reqts.	See Paragraph 8.2.1.1		
Transition Density	$\geq 64$ transitions in 512 bits  $\leq 64$ consecutive bits w/o transition		

- (1) The data bits and subcarrier phase may be asynchronous or, if synchronous, no specific relationship is required.
- (2) The combination of subcarrier frequency stability and accuracy shall not exceed  $\pm 0.01$  percent.

*Table 8.3.2.2.1-1 PSDP To P9 Data Input Electrical Interface Requirements*

PARAMETER	VALUE	UNITS	NOTES
Carrier Modulation	PM/FSK		
Modulator Type	Linear		
Modulator Input Bandwidth	1 to 200	KHz	3db, One-Sided
Signal Level		Volts	(1)
Load Impedance	75 ± 5	Ohms	
Load Termination	Differential, balanced direct coupled		

- (1) 1.0 to 8.0 ± 10 percent peak-to-peak line-to-line ( $0.2 \leq \beta \leq 2.5$ ). The phase deviation shall be directly proportional to the amplitude of the input signal. The linearity of the phase modulator shall be maintained to within 10 percent from 0.2 radians to 2.5 radians when measured from best straight line. (1.0 ± 0.1 volts P-P, L-L, is equivalent to 0.3 radians; 8.0 ± 0.8 volts, P-P, L-L, is equivalent to 2.4 radians.)

TABLE 8.3.2.2.2-1 PI TO PSDP DATA OUTPUT ELECTRICAL  
INTERFACE CHARACTERISTICS

PARAMETER	VALUE	UNITS	NOTES
Output Frequency Response	.001 to 4.5	MHz	one sided, 3 dB
Output Signal Level	2.0+0.4 -0.6	VRMS	Not to exceed 8 volts P-P, L-L.
Load Impedance	75±5	ohms	
Load Termination	Differen- tial, balanced direct coupled		

TABLE 8.3.4.1-1 RADAR PASSIVE MODE  
ELECTRICAL INTERFACE CHARACTERISTICS

Parameter	Dimension	Value	Notes
1. Target Type			
Size	Meter <sup>2</sup>	1.0 Minimum	(1)
Scintillation Characteristics		Swirling Case I target	Target stabilized in 3 axes to an angular rate of TBD deg/sec.
2. Radar			
Operating Frequency	GHz	Nominal Minimum at 13.779	(2)
3. Antenna Characteristics			
Sidelobe	db relative to mainbeam	20 minimum	
4. Transmitter Power			
EIRP	dbw	52 peak	At 13.779GHz (3)
PRF	pulses/sec	nominal 7000 and 3000	PRF varies with range
5. Receiver			
Noise Figure	db	5	

- (1) Radar system is designed to detect a 1 m<sup>2</sup> scintillating target at 12 NM with a probability of detection of 0.99. Angular searchfield varies with range from a 20 degree half angle cone at 12 NM to a maximum of a 30 degree half angle cone at 8 NM or less.
- (2) 5 frequency, 4 step frequency diversity - 52 MHz per step during search, acquisition and tracking.
- (3) Peak and average power vary with range and duty cycle. Duty cycle varies with range from approximately 0.001 to 0.3. Peak power selectable - medium and low power selections provide nominal reductions of 12 or 24 dB respectively. Automatic switch to TWT bypass (approx. 40 dB reduction in transmitted power) at short ranges.

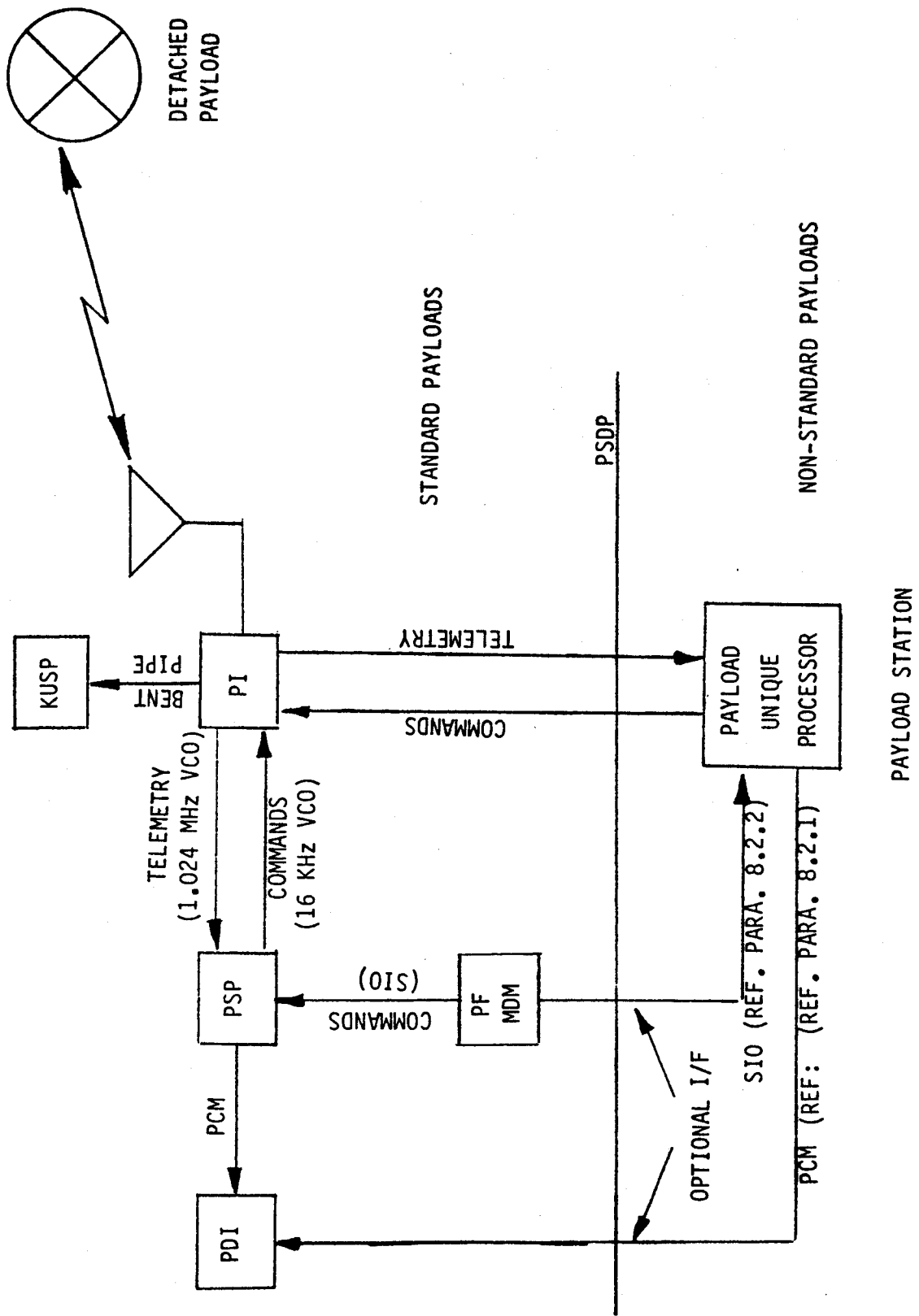


FIGURE 8.3.2-1 DETACHED PAYLOAD COMMUNICATION FLOW

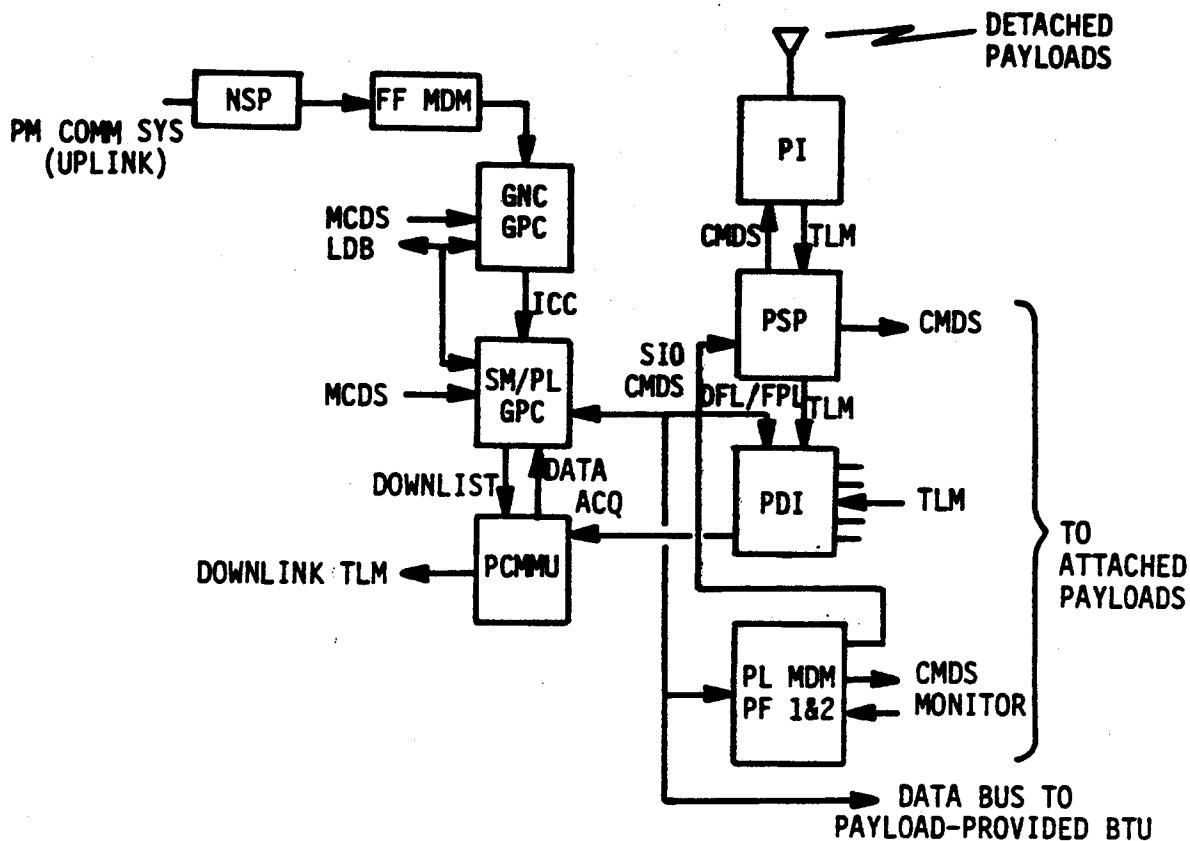


## 9.0 SOFTWARE INTERFACES

### 9.1 SOFTWARE OVERVIEW

9.1.1 Scope. The software system functional interfaces between the Orbiter and the payloads shall be as shown in Figure 9.1.1-1. *The interfaces associated with software* are the Payload-Orbiter Payload Data Interleaver (PDI) interface, the Orbiter Payload Signal Processor (PSP) interface, the Orbiter MDM interface, and the Orbiter data bus interface. The detailed hardware requirements and characteristics of these interfaces are described in Section 8.0. The constraints, formats, and data content that are software dependent for each of these interfaces shall be as defined in the following Paragraphs.

9.1.2 Hardware/Software Correlation. *SMCM (Standard Mixed Cargo Harness) hardware/software correlation is specified in Table 13.5.1.1-2 for the PSP and PDI interfaces and in Tables 13.5.1.1-2 and 13.5.1.1-3 for the Orbiter MDM interface. In order to insure hardware/software compatibility when using Orbiter MDM SMCM capability the signal function (DOL 1, DOL 2 . . . ., DDL 1, DDL 2 . . . ., etc.) should be included as part of the specific command/measurement nomenclature in Annex 4 (Command and Data Annex).*



**LEGEND**

PF	PAYLOAD FORWARD
PI	PAYLOAD INTERROGATOR
PSP	PAYLOAD SIGNAL PROCESSOR
PDI	PAYLOAD DATA INTERLEAVER
DFL	DATA FORMAT LOAD
BTU	BUS TERMINAL UNIT
NSP	NETWORK SIGNAL PROCESSOR
PL	PAYLOAD
FF	FLIGHT CRITICAL FORWARD
ICC	INTERCOMPUTER CONTROL
DATA ACQ	DATA ACQUISITION
FPL	FETCH POINTER LOAD
GPC	GENERAL PURPOSE COMPUTER
GNC	GUIDANCE, NAVIGATION AND CONTROL
SM	SYSTEMS MANAGEMENT
MDM	MULTIPLEXER/DEMULTIPLEXER
PCMMU	PULSE CODE MODULATION MASTER UNIT
MCDS	MULTIFUNCTION CRT DISPLAY SYSTEM
TLM	TELEMETRY
CMDS	COMMANDS
LDB	LAUNCH DATA BUS
SIO	SERIAL INPUT/OUTPUT

FIGURE 9.1.1-1 ORBITER - PAYLOAD SOFTWARE FUNCTIONAL INTERFACE

9.2 ORBITER GPC SOFTWARE INTERFACE. The Orbiter provides the following software interfaces for use by the payload.

9.2.1 Payload Data Interleaver/PCMMU. Payload data interleaver/ PCMMU for data acquisition and monitor for attached or detached payloads.

9.2.2 Payload Signal Processor. Payload Signal Processor for attached or detached payloads (commands to attached/detached and telemetry for detached).

9.2.3 Payload MDM. Payload MDM for data monitoring and command for attached payloads.

9.2.4 Data Bus. Data bus interface with payload provided BTUs for data monitor and commands for attached payloads.

9.3 FLIGHT PHASE APPLICABILITY. *The ability of the GPC software to support the payloads is both flight and flight time (event) dependent.*

*Time Line. Normally, other than supporting PDI data throughput to the ground, the only GPC software that supports payloads is an on-orbit memory configuration, Systems Management (SM). For a nominal mission SM is available from approximately 77 minutes after lift-off until approximately three hours prior to entry. SM software is also briefly installed during ground processing after payload installation into the Orbiter and before payload bay door closure in order to support agreed-to payload testing.*

*There are two other memory configurations, B3S and VU/G9, containing very limited payload services that are only available when specifically agreed to in the P9P. B3S is used during ascent/descent. It is installed from approximately 1-20 minutes until on-orbit when SM is loaded and from approximately three hours prior to descent through landing. VU/G9 is used during other Orbiter prelaunch operations. Paragraph 9.3.1.3 describes the prelaunch (post and pre-payload bay door closure) payload software support restrictions.*

9.3.1 Prelaunch (VU/G9). The Orbiter software (vehicle utility) in conjunction with ground software provides the services in this section periodically during the prelaunch phase of the flight for critical payload command and monitoring function. The availability of these services during prelaunch depends on the Orbiter schedule. *Table 9.3.1-1 describes the prelaunch (post and pre-payload bay door closure) payload software support restrictions.*

9.3.1.1 Payload Control and Monitoring. The Orbiter software provides the ground complex the capability to communicate with the payload subsystems utilizing the launch data bus interface. This capability allows the ground to send individual requests to the Orbiter GPC for execution. The capability also exists to specify that a resulting response be transmitted to the ground via the launch data bus.

9.3.1.1.1 Data Acquisition. The Orbiter GPC provides the capability to acquire data from the PCMMU/PDI interface, Orbiter payload MDM interface, and payload BTUs attached to the payload buses. The legal BTU modes for the payload MDMs and payload BTUs attached to the payload buses are defined in Paragraph 8.2.12.6.1.1. The data bus configuration for payload BTUs attached to the payload data buses shall be as defined in Section 9.4.4.1. The capabilities supported via the payload PDI interface are defined in Section 9.4.1.

9.3.1.1.2 Data Output. The Orbiter GPC provides the capability to output data to the Orbiter payload MDM interface, and to payload BTUs attached to the payload buses. Up to 64-sixteen bit data words can be output to the PSP, but only through the Launch Data Bus Interface. Depending on the IO module, up to 32-sixteen bit words can be output to Orbiter payload MDMs and payload BTUs (refer to Paragraph 8.2.12.6.1.1).

9.3.1.2 Payload Data Acquisition for Downlink. The Orbiter GPC provides the capability to acquire data at 1 Hz from the Orbiter payload MDMs and payload BTUs attached to the payload buses. This data is made available to the ground via the Orbiter downlink. The only BTU mode supported via this service is transmit command (mode 01001, refer to Paragraph 8.2.12.6.1.1). The data types acquired are defined in Paragraph 9.4.3.1.4, 9.4.3.3, 9.4.3.4, 9.4.4.3.4, 9.4.4.6 and 9.4.4.7. The GPC shall acquire data from a maximum of fourteen data acquisition elements per payload BTU or per Orbiter payload MDM. The following are data acquisition elements:

- a. An Analog Input Module. One to 32 ten bit analogs may be acquired from this element.
- b. A Discrete Input Module. One to 3-sixteen bit packed discrete words may be acquired from this element.
- c. A Serial I/O Channel. One to 32-sixteen bit data words containing any of the data types specified in Paragraphs 9.4.4.3.4 or 9.4.3.1.4 may be acquired from this element.

9.3.2 Ascent/Descent (RTS). The data available for payload support during critical flight phases (ascent, abort, descent) shall be limited. This support includes acquisition, first order scaling, limit sensing, fault detection and annunciation, display and *downlist\**.

The GPC cannot process subcommutated data. That is each time a data element is acquired, it will be processed as a different sample of the same payload measurement. The software system functional interfaces between the Orbiter and the payload shall be as shown in Figure 9.3.2-1. The interfaces associated with software are the Orbiter MDM interfaces and the Orbiter data bus interface, and the Orbiter pulse code modulation master unit (PCMMU). The constraints, formats, and data content that are software dependent for each of these interfaces shall be as defined in the following paragraphs.

\* *PD9 data to the ground is standard and is available when specified in the PSP and in Paragraph 8.2.1.*

9.3.2.1 Payload MDM interface. Data shall be input/output from Orbiter GPC to/from the payload via the payload MDMs. The types of input/output shall be analog and discretely. The only capability to output commands shall be via Orbiter uplink. The Orbiter software provides the capability to acquire a maximum of 50 payload parameters, including those defined in Paragraphs 9.3.2.2 and 9.3.2.3.

9.3.2.1.1 Uplink Discrete Commands. The Orbiter GPC provides the capability to throughput uplink commands to payloads. These uplink commands shall be limited to discrete commands as defined in Paragraphs 8.2.2.1 and 8.2.2.2.

9.3.2.1.1.1 Single Stage Discrete Commands. The single stage discrete command consists of a reset command and a set command. These commands do not require preview by the ground. The Orbiter GPC software provides at least 150 microseconds between the reset and set command.

9.3.2.1.1.2 Two-Stage Discrete Commands. *The two-stage discrete command consists of a reset command followed by a set command. These commands will normally be transferred to the designated channel within 2 seconds of validation/correction by the sender and receipt of a cooperative command to execute the uplink load. The Orbiter software provides at least 150 microseconds between the reset command and the set command.*

9.3.2.1.1.2.1 Multiple Discrete Commands. *The multiple discrete command consists of up to ten pairs of reset and set commands (two-stage discrete commands). The number of groups of reset/set commands to discrete within a multiple command group shall be limited to a maximum of ten.*

9.3.2.1.1.3 Multiple Discrete Stored Program Commands. Multiple Stored Program Commands (SPCs) have an execution time associated with them. SPCs via the MDM discrete channel consists of up to 10 discrete command groups. Normally the SPC shall be transferred to MDM discrete channels within 2 seconds after GMT time of execution has occurred. If the GMT time of execution has already occurred when the load is received, the SPC shall normally be output within 2 seconds of receipt. The GPC storage (including those required to support Orbiter functions) is limited to a maximum of 10 at any given time in the mission.

9.3.2.1.2 Discrete Inputs. The Orbiter GPC software provides the capability to acquire discrete parameters under GPC control. The payload acquisition rate shall be at 1.04 Hz. The hardware characteristics of Discrete Input Low/High (DIL/DIH) are as defined in Paragraph 8.2.2.3 and 8.2.2.7, respectively.

9.3.2.1.3 Analog Inputs. The Orbiter GPC software provides the capability to acquire analog parameters from the MDMs under GPC control. The analog parameter acquisition rate shall be at 1.04 Hz. The hardware characteristics of analog input are as defined in Paragraph 8.2.2.4. The analogs are converted for GPC processing to 10-bit two's complement binary by the MDM. The Orbiter GPC will provide the capability to acquire analog data which is in the format defined below. The bit numbers refer to the serial GPC/MDM data bus format.

Signed Ten-Bit Analog. Each analog parameter shall be a signed parameter (bits 9 through 18 of the command data word) with the MSB (bit 9) representing polarity. Positive values are indicated when bit 9 is equal to binary zero. Negative values are in the form of binary two's complement when bit 9 is equal to binary one. The analog-to-digital conversion convention for analog parameters is defined as follows:

<u>Volts</u>	<u>MSB</u>	<u>Binary</u>	<u>LSB</u>	<u>Decimal Value</u>	
+5.11 VDC =	0	111 111	111 =	511	Maximum positive value PCM count
+0.01 VDC =	0	000 000	001 =	1	Minimum positive value PCM count
0.00 VDC =	0	000 000	000 =	0 0	
-0.01 VDC =	1	111 111	111 =	-1	Maximum positive value PCM count
-5.12 VDC =	1	000 000	000 =	-512	Minimum negative value count

Bits 19 through 24 shall contain fill zeros.

9.3.2.1.3.1 Analog Input Scaling. Analog parameters (10 bit) acquired by the GPC are scaled from PCM counts to engineering units for display and limit sensing. The scaling is accomplished using a linear polynomial equation as follows:

$$EU = A_0 + A_1 X$$

Where: EU = the engineering unit value desired for display

X = the decimal value of the PCM count

A<sub>0</sub>, A<sub>1</sub> = the polynomial coefficient

9.3.2.1.4 Downlist. The Orbiter GPC provides the capability to acquire data at 1.04 Hz in the Orbiter high data rate payload MDMs. The data is made available to the ground in the Orbiter high data rate downlink. There are 25 16-bit words assigned for payload downlist, including those defined in paragraph 9.3.2.2.5.

Twenty-five analog parameters, or 50 discrete parameters, or a combination of both, ranging from 49 discrettes and 1 analog, to 24 analogs and 1-16 discrettes, can be downlisted. Since all payload parameters processed are required to be downlisted, their quantity and data type mixture are constrained by these downlist processing requirements.

Downlist processing is not affected by invalid or mission data.

9.3.2.2 Orbiter Data Bus System Interface. The Orbiter GPC shall provide for the acquisition/output of data to a unique payload BTU via the Orbiter data bus system. The data bus interface shall be a demand response system under Orbiter GPC control. The interface constraints, formats, and data convention are defined in the following paragraphs.

9.3.2.2.1 Data Bus Interface Configuration. The Orbiter GPC shall provide unique address codes for payload BTUs interfacing with the data bus system (refer to Paragraph 8.2.12.6.1.1). The assigned address codes shall be used by the GPC when communicating with payloads via data bus PL 1 or PL 2 (refer to Paragraph 8.2.12.7, Cargo Terminal Address Codes).

The Orbiter GPC shall communicate with one of a maximum of five different BTU address codes per flight.

Each address code may be supported via one bus only (single port BTUs) or via both buses (dual port BTU which is either a single BTU with a redundant port or two redundant single port BTUs). The Orbiter shall provide the BTU address and bus assignment at the cargo integration review for each flight. For a dual port payload BTU interfacing with the Orbiter data bus system, one BTU port will interface with PL 1 and the other with PL 2. The two BTU ports shall have identical channelization and shall appear to the GPC as identical systems. This interface design shall not preclude the GPC from addressing other BTUs on both PL 1 and PL 2 at any time. The GPC shall communicate with the dual port BTU via only one bus at a time in accordance with the PL bus mode (primary or secondary) selected by the crew.

A maximum of three BTUs can be accessed on each PL bus in either the primary or secondary mode. BTUs which are supported via both buses will be assigned a primary bus and a secondary bus (by the Orbiter software contractor). *Figure 9.4.4.1-1* defines the types of BTUs which may be attached to the payload buses. Payload BTUs shall be designed such that their function is not affected by data bus transmission to other address codes.

9.3.2.2.2 Data Bus Interface Communication Conventions. The message sequence for transfer of data to/from the payload via the data bus interface shall be as defined in Paragraph 8.2.12.6. GPC support for data bus word formats and BTU modes shall be as defined in Paragraph 8.2.12.6.1, Data Bus Formats, and Paragraph 8.2.12.6.2 BTU Modes, to the extent specified below.

9.3.2.2.2.1 Command Word Formats. The GPC supports the direct command word format. The GPC support of control modes is specified in Paragraph 9.3.2.2.3, BTU Control Modes.

9.3.2.2.2.2 Data Word Formats. The GPC shall support the response data word format defined in Paragraph 8.2.12.6.1.3 and the command data word format defined in Paragraph 8.2.12.6.1.2.

9.3.2.2.3 Command Word Mode Control (BTU Mode). The control modes supported by the GPC are defined below.

9.3.2.2.3.1 Receive Command. The receive command control mode (01000) shall be used to transmit commands to the payload via the Orbiter data bus system. The sequence of transmission from the GPC is defined in Paragraph 8.2.12.6.2.1, Receive Command. Commands must be uplinked and throughput by the GPC (no crew initiated commands onboard).

9.3.2.2.3.2 Transmit Command. The transmit command control mode (01001) shall be used to acquire data from the payload via the data bus system. The sequence to acquire data to the GPC is defined in Paragraph 8.2.12.6.2.2.

9.3.2.2.4 Flex MDM (or MDM BTU). The Orbiter GPC provides the capability to transmit or receive data via the data bus system to and from a payload-supplied MDM. The types of input/output shall be analog and discrettes. The only capability to output commands shall be via Orbiter uplink. The Orbiter software provides the capability to acquire a maximum of 50 payload parameters including those defined in *Paragraphs 9.3.2.1 and 9.3.2.3*.

9.3.2.2.4.1 Uplink Discrete Commands. The Orbiter GPC provides the capability to throughput uplink commands to payloads. These uplink commands shall be limited to discrete commands as defined in Paragraph 8.2.2.1 and 8.2.2.2.

9.3.2.2.4.1.1 Single stage Discrete Commands. The single stage discrete command consists of a reset command and a set command. These commands do not require preview by the ground. The Orbiter GPC software provides at least 150 microseconds between the reset and set command.

9.3.2.2.4.1.2 Multiple Discrete Commands. The multiple discrete command consists of a reset command followed by a set command. These commands will normally be transferred to the designated channel within 2 seconds of validation/correction by the sender and receipt of a cooperative command to execute the uplink load. The Orbiter software provides at least 150 microseconds between the reset command and the set command. The number of groups of reset/set commands to MDM discrete channels within a multiple command group shall be limited to a maximum of 10.

9.3.2.2.4.1.3 Multiple Discrete Stored Program Commands. Multiple Stored Program Commands (SPCs) have an execution time associated with them. SPCs via the MDM discrete channel consists of up to 10 discrete command groups. Normally the SPC shall be transferred to MDM discrete channels within 2 seconds after GMT time of execution has occurred. If the GMT time of execution has already occurred when the load is received, the SPC shall normally be output within 2 seconds of receipt. The GPC storage (including those required to support Orbiter functions) is limited to a maximum of 10 at any given time in the mission.

9.3.2.2.4.2 Discrete Inputs. The Orbiter GPC software provides the capability to acquire discrete parameters from BTUs under GPC control. The payload parameter acquisition rate shall be at 1.04 Hz. The data bus characteristics of Discrete Input Low/High (DIL/DIH) are defined in Paragraphs 8.2.12.6.1.1 (1) mode 01001, 8.2.12.6.1.3, (response data word format) and 8.2.12.6.2.2 (transmit command).

9.3.2.2.4.3 Analog Input. The Orbiter GPC software provides the capability to acquire analog parameters from BTUs under GPC control. The analog parameter acquisition rate shall be at 1.04 Hz. The data characteristics of analog input are as defined in Paragraphs 8.2.12.6.1.1 (1) and 8.2.12.6.1.3. The analogs shall be 10-bit two's complement binary format defined below. The bit numbers refer to the serial GPC/BTU data bus format.

Signed Ten-Bit Analog. Each analog parameter shall be a signed parameter (bits 9 through 18 of the command data word) with the MSB (bit 9) representing polarity. Positive values are indicated when bit 9 is equal to binary zero. Negative values are in the form of binary two's complement when bit 9 is equal to binary one. The analog-to-digital conversion convention for analog parameters is defined as follows:



<u>MSB</u>	<u>Binary</u>	<u>LSB</u>	<u>Decimal Value</u>	
0	111 111	111 =	511	Maximum positive value PCM count
0	000 000	001 =	1	Minimum positive value PCM count
0	000 000	000 =	0 0	
1	111 111	111 =	-1	Maximum negative value PCM count
1	000 000	000 =	-512	Minimum negative value count

Bits 19 through 24 shall contain fill zeros.

9.3.2.2.4.3.1 Analog Input Scaling. Analog parameters (10 bit) acquired by the GPC are scaled from PCM counts to engineering units for display and limit sensing. The scaling is accomplished using a linear polynomial equation as follows.

$$EU = A_0 + A_1 X$$

Where: EU = the engineering unit value desired for display

X = the decimal value of the PCM count

A<sub>0</sub>, A<sub>1</sub> = the polynomial coefficients

9.3.2.2.5 Downlist. The Orbiter GPC provides the capability to acquire data at 1.04 Hz from the Orbiter payload flex MDMs. The data is made available to the ground in the Orbiter high data rate downlink. There are 25 16-bit words assigned for payload downlist, including those defined in paragraph 9.3.2.1.4.

Twenty-five analog parameters, or 50 discrete parameters, or a combination of both, ranging from 49 discrettes and 1 analog, to 24 analogs and 1-16 discrettes, can be downlisted. Since all payload parameters processed are required to be downlisted, their quantity and data type mixture are constrained by these downlist processing requirements.

Downlist processing is not affected by invalid or missing data.

9.3.2.3 Payload-PD9 Interface. The orbiter GPC software provides the capability to access PD9 data from the PCMMU during ascent and descent. The orbiter software provides the capability to acquire a maximum of 50 payload parameters, including those defined in Paragraphs 9.3.2.1 and 9.3.2.2.4.

9.3.2.3.1 Data Acquisition. Data is acquired on a parameter basis and transferred to the PCMMU for acquisition by the GPC. The parameter, its word location within a minor frame, the first minor frame in which it appears, and its sample rate will be specified as part of the decommutation program.

a. Data Selection. The PD9 will select the parameter each time it appears in the payload JLM stream and store same for access by the Orbiter GPC via the PCMMU. The constraints and format types supported are defined in Paragraph 8.2.1.1.

b. Data Types. The Orbiter GPC software provides the capability to process 8-bit analog parameters and 8-bit discrete words (Reference 9.3.2.3.1.1). All data is decommutated as 8-bit words.

c. The allowable process rates for data acquired by the GPC shall be limited to 1.04 Hz.

For GPC processing, the PD9 is not capable of processing payload sample rates which are less than the smallest integer submultiple (Y/A, Y/B, Y/C, Y/D, Y/E, Y/F) of the payload minor frame rate delineated within Figure 8.2.1.1-5 and Table 8.2.1.1-1.

Maintaining the time homogeneity of individual measurements with the length greater than 8-bits or payload measurement word sets cannot be guaranteed.

9.3.2.3.1.1 Data Types. The following are the only data types recognized by the Orbiter GPC software via the PD9 interface.

9.3.2.3.1.1.1 Analogs. The following type of analogs will be recognized by the Orbiter GPC. For all analogs the most significant bit (MSB) is bit 0 and is transmitted first.

9.3.2.3.1.1.1.1 Signed 8-bit. Each analog parameter shall be a signed parameter with the sign in bit 0 and the least significant bit in bit 7. Positive values are indicated when the sign bit is equal to binary 0. Negative values are in the form of binary 2's complement when the sign bit is equal to binary 1. The analog-to-digital conversion convention shall be as follows:

<u>MSB</u>	<u>Binary</u>	<u>LSB</u>	<u>Decimal Value</u>	
01	111	111 =	127	Maximum positive value PCM count
00	000	001 =	1	Minimum positive value PCM count
00	000	000 =	0	0
11	111	111 =	-1	Maximum negative value PCM count
10	000	000 =	-128	Minimum negative value count

9.3.2.3.1.1.2 Unsigned 8-Bit. Each analog will be unsigned, 8-bit, positive number with the most significant bit in the bit 0 and the least significant bit in the bit 7. The analog-to-digital conversion convention shall be as follows:

<u>MSB</u>	<u>Binary</u>	<u>LSB</u>	<u>Decimal Value</u>	
11	111	111 =	255	Maximum positive value PCM count
00	000	001 =	1	Minimum positive value PCM count
00	000	000 =	0	0

9.3.2.3.1.1.3 Analog Input Scaling. Analog parameters (8 bit) acquired by the GPC are scaled from PCM counts to engineering units for display and limit sensing. The scaling is accomplished using a first order polynomial equation as follows:

$$EU = A_0 + A_1X$$

Where EU = The engineering units value desired for display.

X = The decimal value of the PCM count.

$A_0, A_1$  = The polynomial coefficients.

9.3.2.3.2 Discretes. Discrete parameters are packed with a maximum of 8 bits per word (bits 0 through 7).

9.3.3 On-Orbit (SM). The orbiter software processes acquired payload data and displays to the crew, the health, performance and configuration of payload subsystems. Processing capability includes limit sensing, fault detection and annunciation, display, payload sequencing, payload unique computations and transferring data (downlist) to the Orbiter PCMMU for downlinking. The GPC cannot process subcommutated data. That is, each time a data element is acquired, it will be processed as a different sample of the same payload measurement. The Orbiter software also provides the capability to send commands, either crew initiated or via Orbiter uplink. *The constraints, format, and data content that are software dependent for each of these interfaces shall be as defined in Paragraph 9.4.*

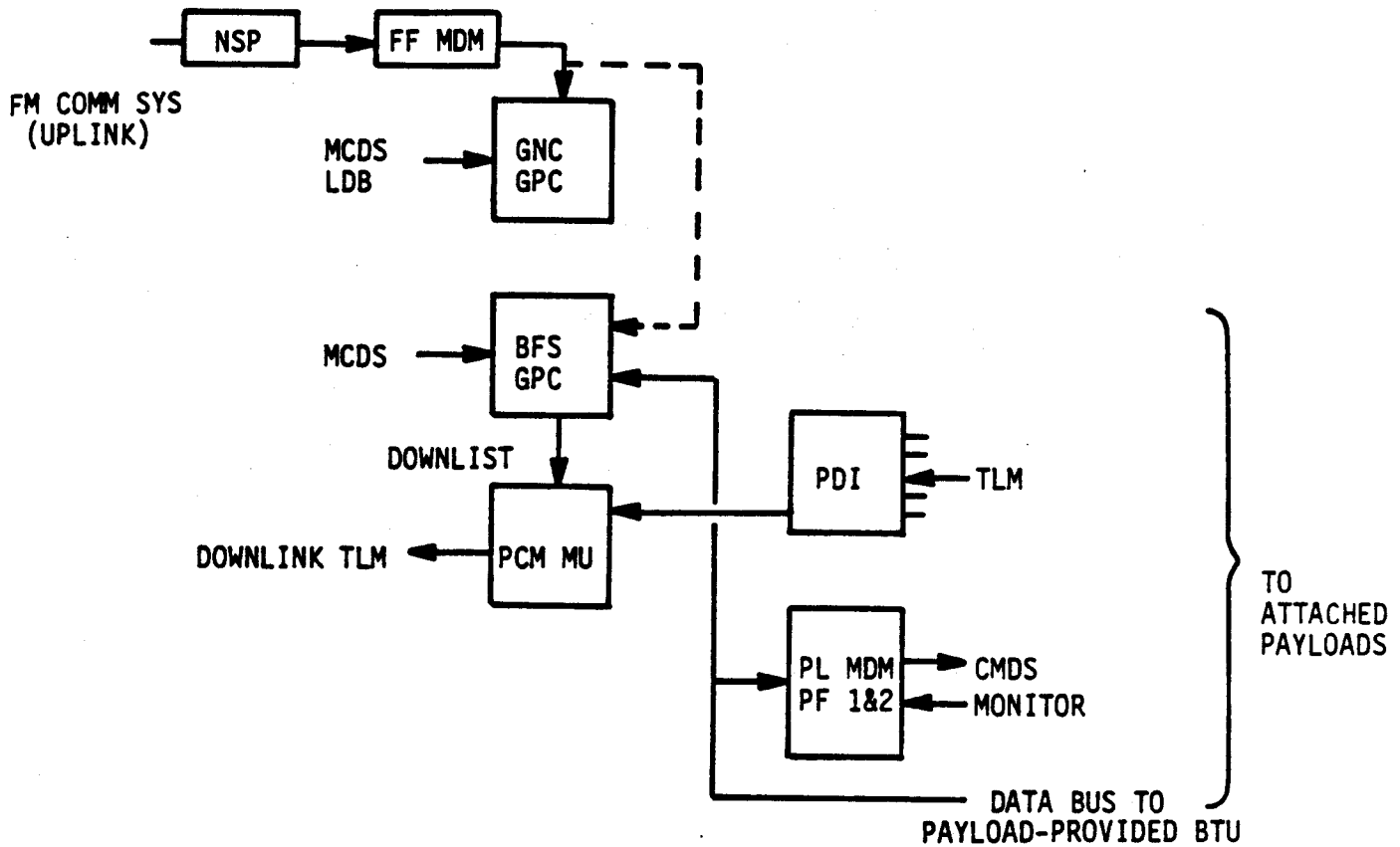
Table 9.3.1-1 Launch Processing System (LPS)  
Prelaunch Support For Payloads

Function	Mate To P/LRD Close	P/LRD Close To J-20 Min1	J-20 Min. To J-0
LDB (Control and Monitor)	(1) (2)	(3)	N/A
Uplink Commands	(1)	(6)	N/A
128/64 KBPS Downlink Telemetry Via:			
1. P/L MDM 9/3 and P/L BJUs Attached To P/L Busses	(1) (4)	(4)	(4)
2. PCMMU/PD9 9/3	(1)	(5)	(5)

N/A = Not Applicable

Notes:

- (1) Command and/or telemetry support is provided for payloads during the following:
  - a. Interface Verification Test (IVT)
  - b. End-to-End
  - c. Payload specific testing agreed to in the P9P
- (2) Launch Data Bus commanding/data acquisition support is provided for by LPS but must be procedurally coordinated with the Orbiter test team.
- (3) Launch Data Bus commanding/data acquisition support is severely restricted because of the Orbiter configurations and operations.
- (4) Data acquisition via GPC polling of P/L MDM's and BJU's is restricted by GPC memory configuration. This data is included in the downlist which is part of the 128/64 Orbiter downlink.
- (5) Data acquisition is restricted by Telemetry Format Load (TFL) configuration. Change in TFL configuration must be procedurally coordinated with Orbiter operations.
- (6) Uplink commands sent hardline via LPS are restricted by GPC memory configuration and Orbiter operations.



LEGEND

PF	Payload Forward	PCMMU	Pulse Code Modulation Master Unit
PDI	Payload Data Interleaver	MCDS	Multifunctional CRT Display System
BTU	Bus Terminal Unit	TLM	Telemetry
NSP	Network Signal Processor	CMDS	Commands
PL	Payloads	BFS	Backup Flight System
FF	Flight Critical Forward	LDB	Launch Data Bus
GPC	General Purpose Computer	PM	Phase Modulation
GNC	Guidance, Navigation and Control	COMM	Communications
MDM	Multiplexer/Demultiplexer	SYS	System

Figure 9.3.2-1 BJS-Payload Software Function Interface

## 9.4 SOFTWARE CONSTRAINTS/COMMUNICATION CONVENTIONS.

9.4.1 Payload - PDI Interface. Selection of up to four payload asynchronous Pulse Code Modulation (PCM) streams and the required decommutation program (stored in mass memory unit) is provided to the PDI under GPC control. The Orbiter PDI provides two modes of decommutation; format synchronization mode and block mode.

9.4.1.1 Format Synchronization Mode. In the format synchronization mode, the PDI decommutates payload telemetry data into two different groups for transfer to the PCM master unit.

9.4.1.1.1 Data Group 1. Data Group 1 includes payload data selected on a telemetry frame basis and transferred via the PDI Toggle Buffer (TB) to the PCMMU solely for interleaving (by the PCMMU) into the operational downlink. The constraints and format type are defined in Paragraph 8.2.1.1.

9.4.1.1.2 Data Group 2. Data Group 2 is selected on a parameter basis and transferred to the PCMMU for acquisition by the GPC. For data Group 2, a parameter, its word location within a minor frame, the first minor frame in which it appears, and its sample rate will be specified as part of the decommutation program.

- a. Data Selection. The PDI will select the parameter each time it appears in the payload TLM stream and store same for access by the Orbiter GPC via the PCMMU. The constraints and format types supported are defined in Paragraph 8.2.1.1.
- b. Data Types. The Orbiter GPC software provides the capability to process eight bit analog parameters and eight bit discrete words (Reference 9.4.1.1.2.1). All data is decommutated as eight bit words.
- c. The allowable process rates for data acquired by the GPC shall be limited to 0.52 or 1.04 Hz.

For GPC processing, the PDI is not capable of processing payload sample rates which are less than the smallest integer submultiple (Y/A, Y/B, Y/C, Y/D, Y/E, Y/F) of the payload minor frame rate delineated within Figure 8.2.1.1-5 and Table 8.2.1.1-1.

Maintaining the time homogeneity of individual measurements with length greater than 8 bits or payload measurement word sets cannot be guaranteed.

9.4.1.1.2.1 Data Types. The following are the only data types recognized by the Orbiter GPC software via the PDI interface.

9.4.1.1.2.1.1 Analogs. The following type of analogs will be recognized by the Orbiter GPC. For all analogs the Most Significant Bit (MSB) is bit 0 and is transmitted first.

9.4.1.1.2.1.1.1 Signed Eight Bit. Each analog parameter shall be a signed parameter with the sign in bit 0 and the least significant bit in bit 7. Positive values are indicated when the sign bit is equal to binary zero. Negative values are in the form of binary two's complement when the sign bit is equal to binary one. The analog-to-digital conversion convention shall be as follows:

<u>MSB</u>	<u>Binary</u>	<u>LSB</u>	<u>Decimal Value</u>	
01	111	111 =	127	Maximum positive value PCM count
00	000	001 =	1	Minimum positive value PCM count
00	000	000 =	0	
11	111	111 =	-1	Maximum negative value PCM count
10	000	000 =	-128	Minimum negative value count

9.4.1.1.2.1.1.2 Unsigned Eight Bit. Each analog will be unsigned, eight bit, positive number with most significant bit in bit 0 and the least significant bit in bit 7. The analog-to-digital conversion convention shall be as follows:

<u>MSB</u>	<u>Binary</u>	<u>LSB</u>	<u>Decimal Value</u>	
11	111	111 =	255	Maximum positive value PCM count
00	000	001 =	1	Minimum positive value PCM count
00	000	000 =	0	0

9.4.1.1.2.1.1.3 Signed Parameter Plus Magnitude Eight Bit. Each analog parameter shall be a signed parameter plus magnitude with the sign bit in bit 0 and the least significant bit in bit 7. Positive values are indicated when the sign bit is equal to binary zero. Negative values are indicated when the sign bit is equal to binary one. The analog-to-digital conversion convention shall be as follows:

<u>MSB</u>	<u>Binary</u>	<u>LSB</u>	<u>Decimal Value</u>	
01	111	111 =	127	Maximum positive value PCM count
00	000	001 =	1	Minimum positive value PCM count
00	000	000 =	0	
10	000	001 =	-1	Maximum negative value PCM count
11	111	111 =	-127	Minimum negative value PCM count

9.4.1.1.2.1.1.4 Analog Input Scaling. Analog parameters (8 bit) acquired by the GPC are scaled from PCM counts to engineering units for display and limit sensing. The scaling is accomplished using a third order polynomial equation as follows:

$$EU = A_0 + A_1X + A_2X^2 + A_3X^3$$

Where EU = The engineering units value desired for display.

X = The decimal value of the PCM count.

A<sub>0</sub>, A<sub>1</sub>, A<sub>2</sub>, A<sub>3</sub> = The polynomial coefficients.

9.4.1.1.2.1.2 Discretes. Discrete parameters are packed with a maximum of eight bits per word (bits 0 through 7).

9.4.1.2 Block Mode. Block mode allows the PDI to throughput payload nonstandard telemetry formats into the Orbiter operational telemetry downlink. Since the PDI cannot decommutate this non-standard data, data cannot be acquired or processed by the GPC. For details on the block mode, see Paragraph 8.2.1.2.

9.4.2 PSP/Payload Interface. Hardware characteristics of the PSP/payload interface are as defined in Paragraph 8.2.5. The Orbiter GPC software provides the capability to process command data loads to an attached or detached payload via this link.

9.4.2.1 Data Formats. Each load transferred to the payload via the PSP shall be structured as follows:

9.4.2.1.1 Payload Communications (One or More Commands). The Orbiter vehicle software limits the maximum message length to the equivalent of 64 x 16 bits (1024) transmitted to the payload without a break in transmission. Each command/data word format shall be preflight-defined and specified in the payload-unique ICD.

9.4.2.2 Data Content. The data content of the message transmission shall consist of Orbiter computed data, uplink throughput, or data prestored in the GPC for transmission under crew control. *The time interval between command messages could be as long as the time required by the PSP to output the command data from the command output buffers plus 1.5 seconds:*

$$\text{Example: } t_m = \frac{\text{Command Message Length in Bits}}{\text{PSP Command Bit Rate in BPS}} + 1.5 \text{ seconds}$$

Where: t<sub>m</sub> = Time Minimum

BPS = Bits per Second

9.4.2.2.1 Orbiter State Vector/Attitude. The Orbiter state vector/attitude message shall be transmitted to the payload on demand, utilizing Orbiter keyboard entry. The Orbiter state vector/attitude data sets for payloads are defined in Paragraph 9.4.5.1.



9.4.2.2.2 On-Board Command Data Loads. The Orbiter software provides the capability to execute prestored command/data loads to the PSP utilizing CRT/keyboard entry. The PSP command load is executed by accessing a prestored command load and a payload dependent configuration message and transmitting of both to the PSP. The Orbiter GPC provides the capability to prestore command/data loads. The prestored command/data load for any single load may consist of up to 64-sixteen bit payload command words.

The total storage required for the sixteen bit payload command words (including those defined in Paragraph 9.4.3.1.6.2 and 9.4.4.3.6.2) shall not exceed 2000-sixteen bit words for all payloads manifested per flight.

9.4.2.2.3 Uplink Throughput Data Loads. The uplink throughput data load provides the capability to uplink data and/or commands to payloads. The Orbiter GPC software shall not be required to be aware of the data content/format internal to these 16 bit words. Any command sent before transfer completion of the previous command will cause a rejection of the later command. The Orbiter will support the uplink throughput data loads as defined below.

9.4.2.2.3.1 Throughput Command Data Load. The capability is provided to throughput up to 64-sixteen bit (1024 bits) payload command words per transmission. These words will be downlisted for ground validation/correction before being transferred to the PSP. These words will normally be transferred to the designated PSP channel within two seconds after receipt of a cooperative command to execute the uplink load.

9.4.2.2.3.2 Throughput Command Data Load-Single Stage Processing. The capability is provided to throughput up to 64-sixteen bit (1024 bits) payload command words per transmission. These words will normally be transferred to the designated PSP channel within two seconds after receipt of the last command word in the uplink load. The Orbiter does not provide validation of these commands and therefore, for critical commands, the payload must provide two-stage execution or other comparable validation systems.

9.4.2.2.3.3 Time Executed Commands (TEC). TECs via the PSP consist of a configuration ID, and up to 63-sixteen bit payload command data words per transmission. Normally, the TEC shall be transferred to the PSP within two seconds after GMT time of execution has occurred. If the GMT time of execution has already occurred when the load is received, the TEC shall normally be output within 2 seconds of receipt. GPC storage of TEC (including those defined in Paragraphs 9.4.3.1.6.3.3 and 9.4.4.3.6.3.3) is limited to a maximum of 10 at any given time in the mission. *If more than one command has the same GMT time of execution or more than one command GMT time of execution has already occurred, they may be executed in any order.*

9.4.2.2.4 PSP Idle Pattern. The capability is provided for the PSP to generate an idle pattern consisting of alternating ones and zeros. The idle pattern is selectable by the Orbiter GPC and shall be generated at the preselected command data rates in NRZ-L, M, or S format as specified.

If no idle pattern is required or the previous command data output utilized the same umbilical (1-5) or PI selection, the command data will be output to the PSP without delay.

If an idle pattern is required and the umbilical number (1-5) or umbilical versus PI selection differs from the previous command transmission, the GPC shall configure the PSP to generate an idle pattern. After a minimum of 150 idle pattern bits have been generated, the GPC will output the command data.

9.4.2.2.4.1 Payload Commands. Each command message transferred to the payload via the PSP link shall consist of an idle pattern, followed by command word(s). The interval between consecutive command transmissions with no transmission interruption shall be filled by the PSP idle pattern. There shall be no idle pattern between consecutive command words of the same command transmission.

Upon receipt of command data, the idle pattern will terminate with a logic zero and command data will be transmitted. At the completion of command transmission, the idle pattern will again be generated and start with a logic one. If the payload requires a minimum idle pattern, it shall be provided through procedural control.

The idle pattern between consecutive command transmissions, and following the last command to a particular payload, shall begin with a logic one and end with a logic zero. The PSP shall always output command data words in multiples of 16 bits. Command data words less than multiples of 16 bits shall contain fill data. The command data will be transmitted Most Significant Bit (MSB), Most Significant Syllable (MSS) first.

9.4.2.2.4.2 Non-Standard Idle Pattern. Payloads requiring preamble or postscript idle patterns other than alternating ones and zeros shall include their unique idle pattern as part of the prestored command data. The command data, including idle pattern, is limited to the equivalent of 64 X 16 bits per command transmission. The total prestored command data load shall not exceed the limits set in paragraph 9.4.2.2.2.

9.4.2.3 PSP/Payload Telemetry Interface. The Orbiter provides the capability to acquire RF telemetry in the format synchronization mode from the payloads in NRZ-L, S, M or BI-O-L, S, M. The RF telemetry link to the Orbiter shall be via the PI/PSP to the PDI. The PSP shall demodulate the PCM from its carrier and output the PCM data to the PDI in NRZ-1 format with clock. The capability supported via this link shall be as defined in Paragraph 9.4.1.1.

9.4.3 Payload MDM Interface. Data shall be input/output from the GPC to/from the payload via the payload MDMs. The types of inputs/outputs shall be analog, discrete, and digital (SIO) data (refer to Paragraph 8.2.2). The GPC shall normally acquire data at 1.04 Hz from a maximum of fourteen data acquisition elements per payload MDM. The following are data acquisition elements.

- a. An Analog Input Module. *One to 16 ten bit analogs* may be acquired from this element.
- b. A Discrete Input Module. One to three 16 bit packed discrete words may be acquired from this element.
- c. A Serial I/O Channel. One to 32 16 bit data words containing any of the data types specified in Paragraph 9.4.3.1.4 may be acquired from this element.

9.4.3.1 Serial Input/Output. The Orbiter GPC provides the capability to transmit or receive data via the MDM serial input/ output (SIO) channel. Data transmissions between the MDM to/from the payload shall be under GPC control. Up to eight Standard Serial Interfaces (SSI) shall be supported per mission (including those defined in Paragraph 9.4.4.3). Procedurally there shall be no more than four simultaneously active serial interfaces. Two basic standard serial interface configuration exists; single channel and dual channel.

9.4.3.1.1 Single Channel Standard Serial Interface. Single channel Standard Serial Interface (SSI) will be assigned a single MDM module and channel address to be used for both commanding and data acquisition.

9.4.3.1.2 Dual Channel Standard Serial Interface. A dual channel SSI will be assigned a single MDM address and a single module address 15 (01111 binary format) and up to two channel addresses 0 and 1 (00000, 00001 in binary format). Data shall be acquired from two channels and output to one. Output commands may consist of up to 32-bit words. Data shall be acquired from up to 32-bit words for each of the SIO channels. The read request (acquisition) of data from the two SIO channels shall be output from the GPC within 5 milliseconds of each other. The time from the last word of the first read request to the start of the second read request shall be at least 300 microseconds.

9.4.3.1.3 Input Data Processing. Each SSI will have the capability to acquire up to 32-bit data words from each of its assigned channel(s) at a cyclic rate of 1.04 Hz while the SSI is enabled. The activation of the SSI data acquisition will be initiated by the crew.

9.4.3.1.4 Data Types. The data types recognized by the Orbiter GPC via the MDM SIO channel are defined below (bit numbers refer to the specific bits in the serial data format defined in Paragraph 8.2.2.5). Capability is provided to access any of the 8 bit analog parameter types defined below and an 8 bit discrete word from the same 16 bit word (data bit 0 through 15, reference Figure 8.2.2.5-2). When this occurs, the analog will start in either bit 0 or 8.

9.4.3.1.4.1 Analogs. The following type analogs will be recognized by the Orbiter GPC. For all analogs the Most Significant Bit (MSB) is bit 0 and is transmitted first.

9.4.3.1.4.1.1 Signed Ten-Bit Analog. Each analog parameter shall be a signed parameter with the sign bit in bit 0 and the least significant bit in bit 9. Positive values are indicated when bit 0 is equal to binary zero. Negative values are in the form of binary two's complement when bit 0 is equal to binary one. The analog-to-digital conversion convention for analog parameters is defined as follows:

<u>MSB</u>	<u>Binary</u>	<u>LSB</u>	<u>Decimal Value</u>	
0	111 111	111 =	511	Maximum positive value PCM count
0	000 000	001 =	1	Minimum positive value PCM count
0	000 000	000 =	0	0
1	111 111	111 =	-1	Maximum negative value PCM count
1	000 000	000 =	-512	Minimum negative value PCM count

Bits 10 through 15 shall contain fill zeros.

9.4.3.1.4.1.2 Signed Eight Bit Analog. One or two 8 bit analog parameters per 16 bit word. Each analog parameter shall be a signed parameter with sign in bits 0 and 8, respectively, and least significant bits in bits 7 and 15, respectively. Positive values are indicated when the sign bit is equal to binary zero. Negative values are in the form of binary two's complement when the sign bit is equal to binary one. The analog-to-digital conversion convention for analog parameters is as follows:

<u>MSB</u>	<u>Binary</u>	<u>LSB</u>	<u>Decimal Value</u>	
01	111	111 =	127	Maximum positive value PCM count
00	000	001 =	1	Minimum positive value PCM count
00	000	000 =	0	0
11	111	111 =	-1	Maximum negative value PCM count
10	000	000 =	-128	Minimum negative value PCM count

9.4.3.1.4.1.3 Unsigned Eight Bit Analog. One or two eight bit analog parameters per sixteen bit word. Each analog will be an unsigned eight bit positive number with the most significant bit in bits 0 and 8, respectively, and the least significant bit in bits 7 and 15, respectively. The analog-to-digital conversion convention for these parameters is as follows:

<u>MSB</u>	<u>Binary</u>	<u>LSB</u>	<u>Decimal Value</u>	
11	111	111 =	255	Maximum positive value PCM count
00	000	001 =	1	Minimum positive value PCM count
00	000	000 =	0	0

9.4.3.1.4.1.4 Sign Plus Magnitude Eight Bit Analog. One or two eight bit analog parameters per sixteen bit word. Each analog parameter shall be a signed parameter plus magnitude with the sign bit in bits 0 and 8, respectively, and the least significant bit in bits 7 and 15, respectively. Positive values are indicated when the sign bit is equal to binary zero. Negative values are indicated when the sign bit is equal to binary one. The analog-to-digital conversion convention for these parameters is as follows:

<u>MSB</u>	<u>Binary</u>	<u>LSB</u>	<u>Decimal Value</u>	
01	111	111 =	127	Maximum positive value PCM count
00	000	001 =	1	Minimum positive value PCM count
00	000	000 =	0	0
10	000	001 =	-1	Maximum negative value PCM count
11	111	111 =	-127	Minimum negative value PCM count

9.4.3.1.4.1.5 Analog Input Scaling. Analog parameters (8 or 10-bit) acquired by the GPC are scaled from PCM counts to engineering units for display and limit sensing. The scaling is accomplished using a third order polynomial equation as follows:

$$EU = A_0 + A_1X + A_2X^2 + A_3X^3$$

WHERE  
 EU = The engineering units value desired for display.  
 X = The decimal value of the PCM count.

$A_0, A_1, A_2, A_3$  = The polynomial coefficients.

9.4.3.1.4.2 Discretes. Packed with a maximum of 16 bits per word (bits 0 through 15).

9.4.3.1.5 Command Data Formats. The Orbiter GPC software provides the capability to process command data loads to an attached payload via this link. Each load transferred to the payload via the MDM SIO channel shall be structured as follows.

9.4.3.1.5.1 Payload Command Communication (One or More Commands). The Orbiter GPC software limits the maximum message length to 32-sixteen bit words per transmission. Each command/data word format shall be premission-defined and specified in the payload- unique ICD. Payload command communication via an MDM serial channel (either single or dual) will be assigned a single MDM module and channel address per standard serial interface.

9.4.3.1.6 Data Content. The data content of the message transmission may consist of Orbiter computed data, uplink throughput, or data prestored in the GPC for transmission under crew control.

9.4.3.1.6.1 Orbiter State Vector/Attitude. The Orbiter state vector/attitude message shall be transmitted to the payload on demand utilizing Orbiter keyboard entry or cyclically at 0.52 Hz, also initiated/terminated via the keyboard. The Orbiter state vector/attitude data sets for payloads are defined in Paragraph 9.4.5.1.

9.4.3.1.6.2 On-board Command Data Loads. The Orbiter GPC software provides the capability to execute prestored command/data to the MDM SIO channel utilizing CRT/keyboard entry.

The prestored command/data load for any single load may consist of up to 32-sixteen bit payload command words.

The total storage required for the sixteen bit payload command words (including those defined in Paragraphs 9.4.2.2.2 and 9.4.4.3) shall not exceed 2000 sixteen bit words per flight.

9.4.3.1.6.3 Uplink Throughput Data Loads. The uplink throughput data load provides the capability to uplink data and/or commands to payloads. The Orbiter GPC software shall not be required to be aware of the data content/format internal to these 16 bit words. Any command sent before transfer completion of the previous command will cause a rejection of the later command. The Orbiter supports the uplink throughput as defined below.

9.4.3.1.6.3.1 Throughput Command Data Load-Two Stage Processing. The capability is provided to throughput up to 32-sixteen bit words of data received via uplink to a payload via MDM SIO channel. These words will be downlisted for ground validation/correction before being transferred. These words will normally be transferred to the designated SIO channel within two seconds after receipt of a cooperative command to execute the uplink load.

9.4.3.1.6.3.2 Throughput Command Data Load-Single Stage Processing. The capability is provided to throughput up to 32-sixteen bit (512 bits) payload command words per transmission. These words will normally be transferred to the designated SIO channel within two seconds after receipt of the last command word in the uplink load. The Orbiter does not provide validation of these commands and therefore, for critical commands, the payload must provide two-stage execution of other comparable validation systems.

9.4.3.1.6.3.3 Time Executed Commands. TECs via the MDM SIO consist of up to 32-sixteen bit payload command data words per transmission. Normally, the TEC shall be transferred to the SIO channel within two seconds after GMT time of execution has occurred. If the GMT time of execution has already occurred when the load is received, the TEC shall normally be output within 2 seconds of receipt. GPC storage (including those defined in Paragraphs 9.4.2.2.3.3 and 9.4.4.3.6.3.3) of TEC's is limited to a maximum of 10 at any given time in the mission. *If more than one command has the same GMT time of execution or more than one command GMT time of execution has already occurred, they may be executed in any order.*

9.4.3.2 Discrete Output. Discrete command outputs shall be "crew-initiated" or via uplink. Discrete commands are comprised of a command word and a command data word. The two types of discrete command outputs available are Discrete Output Low (DOL) and Discrete Output High (DOH). The hardware characteristics of the discrete outputs are defined in Paragraphs 8.2.2.1 and 8.2.2.2, respectively. MDM discrete output logic levels are controlled by the reset and set masks, reference Paragraph 8.2.12.6.1.1 (1). When bit 18 of the command word is a logic one, the command data word (8.2.12.6.1.2) following will set mask. Conversely, when bit 18 of the command word is a logic zero, the command data word following will be a reset mask.

The command data word format (8.2.12.6.1.2) contains 16 data bits, bit 9 through 24. For the reset mask, when any of the 16 data bits (bit 9 through 24) are a logic one, the corresponding MDM discrete output bit will be set to a logic zero. For a set mask, when any of the 16 data bits (bit 9 through 24) are set to a logic one, the corresponding MDM discrete output bits are set to a logic one. The command data word's bit 9 through 24 corresponds to the MDM discrete outputs bit 0 through 15 respectively. Discretes either reset or set are accomplished 16 bits at a time. The Orbiter GPC support for discrete output command is defined below.

9.4.3.2.1 MDM Discrete Commands. The Orbiter GPC provides for a request via crew initiation to output reset and set commands to a Discrete Output Low (DOL) or Discrete Output High (DOH) channel on the payload MDM. When the command is initiated by the crew, the reset mask will be sent to the specified channel followed by the set mask.

The current set/reset status of each discrete channel commanded by an MDM discrete command *is available on request for display and/or downlist*. This is accomplished by means of MDM Bite Test 4 which allows the current status of the discrete output channel to be read by the Orbiter GPC.

*The time interval* between the reset command and the set command shall be from 300 microseconds to 1.0 second.

*The time interval* between the set command and the MDM Bite Test 4 shall be from 300 microseconds to 1.0 second.

9.4.3.2.2 Pulsed MDM Discrete Commands. The Orbiter GPC provides for request via crew initiation for pulsed output to a discrete channel on the payload MDM. When the command is initiated by the crew, the set mask shall be sent to the specified channel. Between 35 milliseconds and two-seconds later the same mask shall be sent as a reset command.

9.4.3.2.3 Uplink Discrete Command. The Orbiter provides the capability to throughput uplink discrete command to payloads. These uplink commands shall be limited to discrete commands as defined in Paragraphs 8.2.2.1 and 8.2.2.2.

9.4.3.2.3.1 Single Stage Discrete Commands. The single stage discrete command consists of a reset command and a set command. These commands will normally be transferred to the designated channel within two seconds of receipt. The Orbiter software provides from 300 microseconds to 200 milliseconds between the reset and the set command.

9.4.3.2.3.2 Two-Stage Discrete Commands. The two-stage discrete commands consist of a reset command followed by a set command. These commands will normally be transferred to the designated channel within two seconds of validation/corrections by the sender and receipt of a cooperative command to execute the uplink load. The Orbiter software provides from 300 microseconds to 200 milliseconds between the reset and set command.

9.4.3.2.3.2.1 Multiple Discrete Commands. The multiple discrete command consists of up to ten pairs of reset and set commands (two-stage discrete commands). The number of groups of reset/set commands to discrete within a multiple command group shall be limited to a maximum of ten.

9.4.3.2.3.3 Multiple Discrete Stored Program Commands. Multiple Stored Program Commands (SPCs) has an execution time associated with it. SPCs via the MDM discrete channel consists of up to 10 discrete command groups. Normally the SPC shall be transferred to MDM discrete channels within 2 seconds after GMT time of execution has occurred. If the GMT time of execution has already occurred when the load is received, the SPC shall normally be output within 2 seconds of receipt. The GPC storage (including those required to support Orbiter functions) is limited to a maximum of 10 at any given time in the mission.

9.4.3.3 Discrete Inputs. The Orbiter GPC software provides the capability to acquire discrete parameters from MDMs under GPC control. The parameter acquisition rate shall be 1.04 Hz. The hardware characteristics of Discrete Input Low/High (DIL/DIH) are as defined in Paragraph 8.2.2.3 and 8.2.2.7, respectively.

9.4.3.4 Analog Input. The Orbiter GPC software provides the capability to acquire analog parameters from MDM's under GPC control. The analog parameter acquisition rate shall be 1.04 Hz. The hardware characteristics of analog inputs are as defined in Paragraph 8.2.2.4. The analogs are converted for GPC processing to 10 bit two's complement binary by the MDM. The Orbiter GPC will provide the capability to acquire analog data which is in the format defined below. The bit numbers refer to the serial GPC/MDM data bus format.

Signed ten-bit analog. Each analog parameter shall be a signed parameter (bits 9 through 18 of the command data word) with the MSB (bit 9) representing polarity. Positive values are indicated when bit 9 is equal to binary zero. Negative values are in the form of binary two's complement when bit 9 is equal to binary one. The analog-to-digital conversion convention for analog parameters is defined as follows:

<u>Volts</u>	<u>MSB</u>	<u>Binary</u>	<u>LSB</u>	<u>Decimal Value</u>	
+5.11 VDC =	0	111 111	111 =	511	Maximum positive value PCM count
+0.01 VDC =	0	000 000	001 =	1	Minimum positive value PCM count
0.00 VDC =	0	000 000	000 =	0	0
-0.01 VDC =	1	111 111	111 =	-1	Maximum negative value PCM count
-5.12 VDC =	1	000 000	000 =	-512	Minimum negative value count

Bits 19 through 24 shall contain fill zeroes.



9.4.3.4.1 Analog Input Scaling. Analog parameters (10-bit) acquired by the GPC are scaled from PCM counts to engineering units value for display and limit sensing. The scaling is accomplished using a third order polynomial equation as follows:

$$EU = A_0 + A_1X + A_2X^2 + A_3X^3$$

Where EU = The engineering units value desired for display.

X = The decimal value of the PCM count.

$A_0, A_1, A_2, A_3$  = The polynomial coefficients.

9.4.4 Orbiter Data Bus System Interface. The Orbiter shall provide for the acquisition/output of data to a unique payload BTU via the Orbiter data bus system. The physical characteristics for interfacing a unique payload BTU to the Orbiter data bus shall be as defined in Paragraph 8.2.12. The data bus interface shall be a demand response system under Orbiter GPC control. The interface constraints, formats, and data conventions are defined in the following paragraphs.

9.4.4.1 Data Bus Interface Configuration. The Orbiter shall provide unique address codes for payload BTUs interfacing with the data bus system (refer to Paragraph 8.2.12.6.1.1). The assigned address codes shall be used by the GPC when communicating with payloads via data bus PL 1 or PL2 (refer to Paragraph 8.2.12.7, Cargo Terminal Address Codes).

The GPC shall communicate with a maximum of five different BTU addresses codes per flight.

Each address code may be supported via one bus only (single port BTUs) or via both buses (dual port BTU which is either a single BTU with redundant ports or two redundant single port BTUs).

The Orbiter shall provide the BTU address and bus assignment at the cargo integration review for each flight. For a dual port payload BTU interfacing with the Orbiter data bus system, one BTU port will interface with PL 1 and the other with PL 2. The two BTU ports shall have identical channelization and shall appear *to the GPC as identical systems*. This interface design shall not preclude the GPC from addressing other BTUs on both PL 1 and PL 2 at any time. The GPC shall communicate with the dual port BTU via only one bus at a time in accordance with the PL bus mode (primary or secondary) selected by the crew.

A maximum of three BTUs can be accessed on each PL Bus in either the primary or secondary mode. BTUs which are supported via both buses will be assigned a primary bus and a secondary bus (by the Orbiter software contractor). Figure 9.4.4.1-1 defines the types of BTUs which may be attached to the payload buses.

9.4.4.1.1 Payload BTU Design Constraints. Payload BTUs shall be designed such that their function is not affected by data bus transmission to other address codes.

Payload BTUs shall be designed such that module address codes 0, 2, 7 are not used for command data transmission (receive data BTU mode) from the GPC to the payload BTU. These module addresses correspond to output cards on Orbiter payload MDMs. Any receive command from the GPC with an incorrect output module address shall be rejected by the BTU.

When payloads have multiple payload BTUs connected to the same data bus, output cards should not be assigned to the same module address on different BTUs. In addition the same module address in a given BTU should not be used for input and output data transmission. The intent of these constraints is to prevent inadvertent commanding of a payload BTU due to address decoder failures.

9.4.4.1.2 Payload Unique Data Bus Interface Configuration. The data bus interface configuration for each payload shall be specified in the payload unique ICD. Use of bus address code 15 may preclude payload support at the KSC Cargo Integrated Test Equipment (CITE) for payload checkout.

9.4.4.2 Data Bus Interface Communication Conventions. The message sequence for transfer of data to/from the payload via the data bus interface shall be as defined in Paragraph 8.2.12.6. GPC support for data bus word formats and BTU modes shall be as defined in Paragraph 8.2.12.6.1, Data Bus Word Formats, and Paragraph 8.2.12.6.2, BTU Modes, to the extent specified below.

9.4.4.2.1 Command Word Formats. The GPC supports the direct command word format and the BITE test command word format. The GPC support of special control modes is specified in Paragraph 9.4.4.2.3, BTU Control Modes. There will be 300 microseconds minimum between the end of the one command transmission and the initiation of the next command transmission.

9.4.4.2.2 Data Word Formats. The GPC shall support the response data word format defined in Paragraph 8.2.12.6.1.3 and the command data word format defined in Paragraph 8.2.12.6.1.2.

9.4.4.2.3 Command Word Mode Control (BTU Mode). The control modes supported by the GPC on-orbit are defined below:

9.4.4.2.3.1 Receive Command. The receive command control mode (01000) shall be used to transmit commands to the payload via the Orbiter data bus system. The sequence of transmission from the GPC is defined in Paragraph 8.2.12.6.2.1, Receive Command. Commands may be either prestored in the GPC, and initiated by the GPC, or uplinked and throughput by the GPC, as defined in Paragraph 9.4.4.3.6.2 and 9.4.4.3.6.3.

Any received commands from the GPC without a legal module address shall be rejected.

9.4.4.2.3.2 Transmit Command. The transmit command control mode (01001) shall be used to acquire data from the payload via the data bus system. The sequence to acquire data to the GPC is defined in Paragraph 8.2.12.6.2.2. The GPC shall normally acquire data at 1.04 Hz from a maximum of fourteen data acquisition elements per payload BTU. The following are data acquisition elements.

a. An Analog Input Module. One to 32-ten bit analogs may be acquired from this element.

- b. A Discrete Input Module. One to three-16 bit packed discrete words may be acquired from this element.
- c. A Serial I/O Channel. One to 32-sixteen bit data words containing any of the data types specified in Paragraph 9.4.4.4 may be acquired from this element.

9.4.4.2.3.3 Bite Test 4. The BITE test and command control mode (00111) used in conjunction with discrete output command (refer to Paragraph 9.4.4.4.1). The sequence of command transmission and data acquisition is defined in Paragraph 8.2.12.6.2.12 (a), (b), (c)(2). (Excluding pulse commands reference Paragraph 9.4.4.4.2 and 9.4.4.4.3.

9.4.4.3 Serial Input/Output. The Orbiter GPC provides the capability to transmit or receive data via the data bus system. Data transmission between the data bus system to/from the payload shall be under GPC control.

Up to eight Standard Serial Interfaces (SSI) shall be supported per mission (including those defined in Paragraph 9.4.3.1). Procedurally there shall be no more than four simultaneously active serial interfaces. Two basic standard serial interface configurations exists; single channel and dual channel.

9.4.4.3.1 Single Channel Standard Serial Interface. Single channel Standard Serial Interface (SSI) will be assigned a single BTU address and a single BTU module address to be used for both commanding and data acquisition.

9.4.4.3.2 Dual Channel Standard Interface. A dual channel SSI will be assigned a single BTU address and up to three module and channel address combinations. Data shall be acquired from two module/channel addresses and output to one module/channel address. Output commands may consist of up to 32-16 bit words from each of the SIO channels. The read request (acquisition) of the data from the two SIO channels shall be output from the GPC within 5 milliseconds of each other. The time from the last word of the first read request to the start of the second read request shall be at least 300 microseconds.

9.4.4.3.3. Input Data Processing. Each SSI will have the capability to acquire up to 32-sixteen bit data words from each of its assigned channel(s) at a cycle rate of 1.04 Hz while the SSI is enabled. The activation of the SSI data acquisition will be initiated by the crew.

9.4.4.3.4 Data Types. The data types recognized by the Orbiter GPC via the MDM SIO channel are defined below (bit numbers refer to the specific bits in the serial format defined in Paragraph 8.2.2.5). Capability is provided to access any of the 8-bit analog parameter types defined below and an 8-bit discrete word from the same 16-bit data word (data bits 0 through 15), reference Figure 8.2.2.5-2) when this occurs, the 8-bit analog shall start in either bit 0 or 8.

9.4.4.3.4.1 Analog Input Data. The GPC shall provide the capability to acquire analog data at 1.04 Hz. The analog data shall conform to the following format for GPC analog conversion algorithm. For all analogs the most significant (MSB) is bit zero and is transmitted first.

9.4.4.3.4.1.1 Signed Ten-Bit Analog. Signed ten-bit analog words include bits 9 through 18 of the response data word, with the MSB (bit 9) representing polarity. Positive values are indicated when bit 9 is equal to binary zero. Negative values are in the form of binary two's complement when bit 9 is equal to binary one. The analog-to-digital conversion convention for analog parameters is defined as follows:

<u>MSB</u>	<u>Binary</u>	<u>LSB</u>	<u>Decimal Value</u>	
0	111 111	111 =	511	Maximum positive value PCM count
0	000 000	001 =	1	Minimum positive value PCM count
0	000 000	000 =	0	0
1	111 111	111 =	-1	Maximum negative value PCM count
1	000 000	000 =	-512	Minimum negative value count

Bits 19 through 24 shall contain fill zeros.

9.4.4.3.4.1.2 Signed Eight-Bit Analog. One or two eight bit analog parameters per sixteen bit word. Each analog parameter shall be a signed parameter with sign in bits 9 and 17, respectively, and least significant bits in bits 16 and 24, respectively. Positive values are indicated when the sign bit is equal to binary zero. Negative values are in the form of binary two's complement when the sign bit is equal to binary one. The analog-to-digital conversion convention for analog parameters is as follows:

<u>MSB</u>	<u>Binary</u>	<u>LSB</u>	<u>Decimal Value</u>	
01	111	111 =	127	Maximum positive value PCM count
00	000	001 =	1	Minimum positive value PCM count
00	000	000 =	0	0
11	111	111 =	-1	Maximum negative value PCM count
10	000	000 =	-128	Minimum negative value PCM count

9.4.4.3.4.1.3 Unsigned Eight-Bit Analog. One or two eight-bit analog parameters per 16 bit word. Each analog shall be an unsigned eight bit positive number with the most significant bit in bits 9 and 17, respectively, and the least significant bit in bits 16 and 24, respectively. The analog-to-digital conversion convention for these parameters is as follows:

<u>MSB</u>	<u>Binary</u>	<u>LSB</u>	<u>Decimal Value</u>	
11	111	111 =	255	Maximum positive value PCM count
00	000	001 =	1	Minimum positive value PCM count
00	000	000 =	0	0

9.4.4.3.4.1.4 Sign Plus Magnitude Eight-Bit Analog. One or two eight bit analog parameters per sixteen bit word. Each analog parameter shall be a signed parameter plus magnitude with the sign bit in bits 9 and 17, respectively, and the least significant bit in bits 16 and 24, respectively. Positive values are indicated when the sign bit is equal to binary zero. Negative values are indicated when the sign bit is equal to binary one. The analog-to-digital conversion convention for these parameters is as follows:

<u>MSB</u>	<u>Binary</u>	<u>LSB</u>	<u>Decimal Value</u>	
01	111	111 =	127	Maximum positive value PCM count
00	000	001 =	1	Minimum positive value PCM count
00	000	000 =	0	0
10	000	001 =	-1	Maximum negative value PCM count
11	111	111 =	-127	Minimum negative value PCM count

9.4.4.3.4.1.5 Analog Input Scaling. Analog parameters (8 or 10-bit) acquired by the GPC are scaled from PCM counts to engineering units for display and limit sensing. The scaling is accomplished using a third order polynomial equation as follows:

$$EU = A_0 + A_1X + A_2X^2 + A_3X^3$$

WHERE EU = The engineering units value desired for display.  
X = The decimal value of the PCM count.

$A_0, A_1, A_2, A_3$  = The polynomial coefficients.

9.4.4.3.4.2 Discretes. Packed with a maximum of 16 bits per word (bits 9 through 24 of the response data word). The discrete parameter acquisition rate shall be at 1.04 Hz.

9.4.4.3.5 Command Data Formats. The Orbiter GPC software provides the capability to process command data loads to an attached payload via this link. Each load transferred to the payload via the payload BTU SIO channel shall be structured as follows.

9.4.4.3.5.1 Payload Command Communication (one or more commands). The Shuttle vehicle software limits the maximum message length to 32-sixteen bit words per transmission. Each command/data word format shall be premission-defined and specified in the payload-unique ICD. Payload communication via a BTU serial channel will be assigned a single BTU module and channel address per standard serial interface.

9.4.4.3.6 Data Content. The data content of the message transmission may consist of Orbiter computed data, uplink throughput, or data prestored in the GPC for transmission under crew control.

9.4.4.3.6.1 Orbiter State Vector/Attitude. The Orbiter state vector/attitude message shall be transmitted to the payload on demand utilizing Orbiter keyboard entry or cyclically at 0.52 Hz, also initiated/terminated via the keyboard. The Orbiter state vector/attitude data sets for payloads are defined in Paragraph 9.4.5.1.

9.4.4.3.6.2 On-board Command Data Loads. The Orbiter GPC software provides the capability to execute prestored command/data to the BTU SIO channel utilizing CRT/keyboard entry.

The pre-stored command/data load for any single load may consist of up to 32-sixteen bit payload command words.

The total storage required for the sixteen bit payload command words (including those defined in Paragraphs 9.4.2.2.2 and 9.4.3.1.6.2) shall not exceed 2000 sixteen-bit words per flight.

9.4.4.3.6.3 Uplink Throughput Data Loads. The uplink throughput data loads provides the capability to uplink data and/or commands to payloads. The Orbiter GPC software shall not be required to be aware of the data content/format internal to these 16-bit words. Any command sent before transfer completion of the previous command will cause a rejection of the latter command. The Orbiter supports the uplink throughput as defined below.

9.4.4.3.6.3.1 Throughput Command Data Load-Two Stage Processing. The capability is provided to throughput up to 32-sixteen bit words of data received via uplink to a payload via BTU SIO channel. These words will be downlisted for ground validation/correction before being transferred. These words will normally be transferred to the designated SIO channel within two seconds after receipt of a cooperative command to execute the uplink load.

9.4.4.3.6.3.2 Throughput Command Data Load-Single Stage Processing. The capability is provided to throughput up to 32-sixteen bit (512 bits) payload command words per transmission. These words will normally be transferred to the designated SIO channel within two seconds after receipt of the last command word in the uplink load. The Orbiter does not provide validation of these commands and therefore, for critical commands the payload must provide two-stage execution or other comparable validation systems.

9.4.4.4 Discrete Output. Discrete command outputs shall be crew initiated or via uplink. Discrete commands are comprised of a command word and a command data word. The two types of discrete command outputs available are Discrete Output Low (DOL) and Discrete Output High (DOH). The hardware characteristics of the discrete outputs are defined in Paragraphs 8.2.2.1 and 8.2.2.2 respectively. MDM discrete output logic levels are controlled by the reset and set masks, reference Paragraph 8.2.12.6.1.1 (1). When bit 18 of the command word is a logic one, the command data word (8.2.12.6.1.2) following will be a set mask. Conversely, when bit 18 of the command word is a logic zero, the command data word following will be a reset mask.

The command data word format (8.2.12.6.1.2) contains 16 data bits, bit 9 through 24. For the reset mask, when any of the 16 data bits (bit 9 through 24) are a logic one, the corresponding MDM discrete output bit will be set to a logic zero. For a set mask, when any of the 16 data bits (bit 9 through 24) are set to a logic one, the corresponding MDM discrete output bits are set to a logic one. The command data word's bit 9 through 24 corresponds to the MDM discrete output bit 0 through 15 respectively. Discrete either reset or set are accomplished 16 bits at a time. The Orbiter GPC support for discrete output command is defined below.

9.4.4.4.1 BTU Discrete Commands. The Orbiter GPC provides for a request via crew initiation to output reset and set commands to a Discrete Output Low (DOL) or Discrete Output High (DOH) channel on the payload BTU. When the command is initiated by the crew, the reset mask will be set to the specified channel followed by the set mask.

The current set/reset status of each discrete channel commanded by a BTU discrete command *is available on request for display and/or downlist*. This is accomplished by means of BTU Bite Test 4 which allows the current status of the discrete output channel to be read by the Orbiter GPC.

*The time interval* between the reset command and the set command shall be from 300 microseconds to 1.0 second.

*The time interval* between the set command and MDM Bite Test 4 shall be from 300 microseconds to 1.0 seconds.

9.4.4.4.2 Pulsed BTU Discrete Commands. The Orbiter GPC provides for request via crew initiation for pulsed output to a discrete channel on the payload BTU. When the command is initiated by the crew, the set mask shall be sent to the specified channel. Between 35 milliseconds and two-seconds later the same mask shall be sent as a reset command.

9.4.4.4.3 Data Bus Discrete Commands to Hardware Pulsed Channels. The Orbiter GPC provides for a request via crew initiation to output a set command to a Pulsed Output High (POH) channel on a payload BTU. When the command is initiated by the crew, the set mask will be sent to the specified channel. The POH discretely will be automatically reset by the BTU.

9.4.4.4.4 Uplink Discrete Command. The Orbiter provides the capability to uplink discrete commands to payloads.

9.4.4.4.4.1 Single Stage Discrete Commands. Single stage discrete commands consist of a reset command and a set command. The commands will normally be transferred to the designated channel within two seconds of receipt. The Orbiter software provides from 300 microseconds to 200 milliseconds between the reset and the set command.

9.4.4.4.4.2 Two-Stage Discrete Commands. The two-stage discrete commands consist of a reset command followed by a set command. These commands will normally be transferred to the designed channel within two seconds of validation/corrections by the sender and receipt of a cooperative command to execute the uplink load. The Orbiter software provides from 300 microseconds to 200 milliseconds between the reset and set command.

9.4.4.4.4.2.1 Multiple Discrete Commands. The multiple discrete command consists of up to ten pairs of reset and set commands (two-stage discrete commands). The number of groups of reset/set commands to discrete within a multiple command group shall be limited to a maximum of ten.

9.4.4.4.4.3 Multiple Discrete Stored Program Commands. Multiple Stored Programs Commands (SPCs) has an execution time associated with it. SPCs via the BTU discrete channel consists of up to 10 discrete command groups. Normally the SPC shall be transferred to BTU discrete channels within 2 seconds after GMT time of execution has occurred. If the GMT time of execution has already occurred when the load is received, the SPC shall normally be output within 2 seconds after GMT time of execution has occurred. The GPC storage (including those required to support Orbiter functions) is limited to a maximum of 10 at any given time in the mission.

9.4.4.5 Analog Outputs. The GPC shall provide the capability to transmit analog data on demand via keyboard entry. Command data for an analog shall consist of a single sixteen bit word containing a ten bit analog value. The command data for an analog channel (non-SIO) shall be computed from the desired Engineering Unit (EU) value, entered via keyboard.

Analog Output Scaling. Analog values are output by the GPC in the form of signed 10-bit two's complement parameters as described below. The PCM count output is derived from the computed value in engineering units using a linear polynomial as follows:

$$EU = A_0 + A_1X \quad X = \frac{EU - A_0}{A_1}$$

WHERE EU = The engineering units value used in the computation.  
X = The decimal value of the PCM count output.

A<sub>0</sub>, A<sub>1</sub> = The polynomial coefficients.

The analog command data shall conform to the following format for GPC analog conversion algorithm.

Analog Signed Ten Bit. Ten bit words (bits 9 through 18 of the command data word) with the MSB (bit 9) representing polarity. Positive values are indicated when bit 9 is equal to binary zero. Negative values are in the form of binary two's complement when bit 9 is equal to binary one. The digital to analog conversion convention for analog parameters is defined as follows:



<u>MSB</u>	<u>Binary</u>	<u>LSB</u>	<u>Decimal Value</u>	
0	111 111	111 =	511	Maximum positive value PCM count
0	000 000	001 =	1	Minimum positive value PCM count
0	000 000	000 =	0	0
1	111 111	111 =	-1	Maximum negative value PCM count
1	000 000	000 =	-512	Minimum negative value count

Bits 19 through 24 shall contain fill zeros.

9.4.4.6 Discrete Inputs. The Orbiter GPC provides the capability to acquire discrete parameters from BTUs under GPC control. The payload parameter acquisition rate shall be 1.04 Hz. The data bus characteristics of Discrete Input Low/High (DIL/DIH) are as defined in Paragraphs 8.2.12.6.1.1 (1) and 8.2.12.6.1.3, respectively. GPC data acquisition does not imply that the data are acquired and downlisted in a fixed time interval. The time interval between data acquisition samples will nominally be one second divided by the sample rate  $\pm 55$  ms. The variable time interval between data and the fact that data acquisition and downlist processing are asynchronous to each other might cause some data samples to be double downlisted or skipped.

9.4.4.7 Analog Input. The Orbiter GPC provides the capability to acquire analog parameters from BTUs under GPC control. The analog parameter acquisition rate shall be 1.04 Hz. The data bus characteristics of analog inputs are as defined in Paragraphs 8.2.12.6.1.1 (1) and 8.2.12.6.1.3. The analogs shall be 10-bit two's complement binary in the format defined below. The bit numbers refer to the serial GPC/BTU data bus format. GPC data acquisition does not imply that the data are acquired and downlisted in a fixed time interval. The time interval between data acquisition samples will nominally be one second divided by the sample rate  $\pm 55$  ms. The variable time interval between data and the fact that data acquisition and downlist processing are asynchronous to each other might cause some data samples to be double downlisted or skipped.

Signed Ten-bit analog. Each analog parameter shall be signed parameter (bits 9 through 18) with the MSB (bit 9) representing polarity. Positive values are indicated when bit 9 is equal to binary zero. Negative values are in the form of binary two's complement when bit 9 is equal to binary one. The analog-to-digital conversion convention for analog parameters is defined as follows:

<u>MSB</u>	<u>Binary</u>	<u>LSB</u>	<u>Decimal Value</u>	
0	111 111	111 =	511	Maximum positive value PCM count
0	000 000	001 =	1	Minimum positive value PCM count
0	000 000	000 =	0	0
1	111 111	111 =	-1	Maximum negative value PCM count
1	000 000	000 =	-512	Minimum negative value count

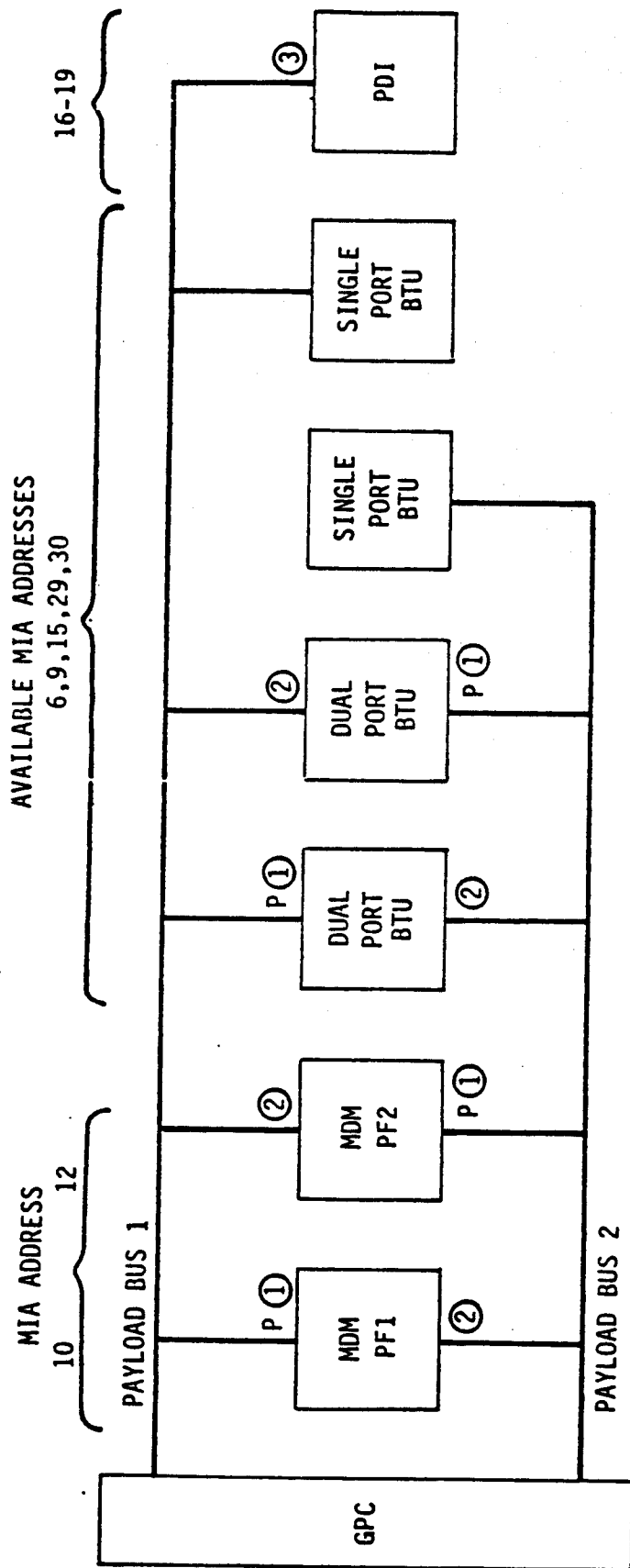
Bits 19 through 24 shall contain fill zeros.

9.4.4.7.1 Analog Input Scaling. Analog parameters (10-bit) acquired by the GPC are scaled from PCM counts to engineering units for display and limit sensing. This scaling is accomplished using a third order polynomial equation as follows:

$$EU = A_0 + A_1X + A_2X^2 + A_3X^3$$

WHERE EU = The engineering units value desired for display.  
X = The decimal value of the PCM count.

A<sub>0</sub>, A<sub>1</sub>, A<sub>2</sub>, A<sub>3</sub> = The polynomial coefficients.



**LEGEND**

P = PRIMARY PORT (ORBITER SOFTWARE CONTRACTOR SELECTED FOR BTU PAIRS TO LOAD BALANCE THIS DATA BUS)

① THIS PORT USED IF PAYLOAD BUS MODE = PRIMARY

② THIS PORT USED IF PAYLOAD BUS MODE = SECONDARY

③ THIS IS A LEGAL BTU AND IS INCLUDED FOR INFORMATION ONLY

Figure 9.4.4.1-1 Payload Bus Configuration/Legal Payload BTU Types

9.4.5 Orbiter Computed Data. The capability exist to transfer the output of payload related Orbiter processes to the payload. The Orbiter computed data and Orbiter/payload related processes available to support payloads are defined in the following paragraphs.

9.4.5.1 Orbiter State Vector/Attitude Data. The capability is provided to transfer Orbiter State vector/attitude data to payloads. The data to be transferred consists of the Orbiter State vector and attitude relative to Greenwich true of date Cartesian or Aries mean of 1950 Cartesian coordinate system and Orbiter attitude rates about the Orbiter body axes (reference Paragraph 3.1.1.5 and 3.1.1.6).

9.4.5.1.1 Guidance Navigation Parameters. The Orbiter software shall provide parameters listed in the following paragraphs as time-homogeneous data sets. Homogeneity of a data set shall be maintained during transfer of the data to the payload via the PSP, Orbiter payload MDM serial input/output channel or data bus interface. However, time homogeneity shall not exist between data sets. The parameters other than for PSP are single-precision floating-point except for the time tags and Orbiter position, which are double-precision floating-point parameters, and the header word, which is an integer. The time homogeneity of the attitude/attitude rate set will be maintained to within 100 ms.

9.4.5.1.2 Guidance Navigation Data Transfer. The data transfer contains the GMT time tag of the transferred parameters. The GMT time tag other than for PSP shall be in one double-precision floating-point word. The GMT tag of the Orbiter state vector shall be as measured from the beginning of the year the mission started. The initial value of this time on January 1, of the year in which the mission started is the equivalent of one day, zero hours, zero minutes, zero seconds (i.e., 0001 of January 1 is represented by one day, zero hours, one minutes, zero seconds). If lift-off occurs in one year and landing occurs in the following year this time tag will not reset to one day at midnight of December 31 of the lift-off year. Instead it will continue to monotonically increment across the end of the year.

Time Tag Accuracy. Under error-free on-orbit conditions, the GMT shall be within plus or minus five milliseconds of the time at whcih the state vector or attitude is calculated.

Transport Lag. The Orbiter state vector/attitude message shall be output from the GPC no later than five seconds past the GMT time tag of the data. However, errors occurring in the Orbiter Data Processing System (DPS) and GN&C sensors may cause, occasional degradation of this interface.

The specific data set content and sequence of transfer of Orbiter state vector, attitude, and attitude rate shall be as defined in the following sub-paragraphs.

Data defined below shall be transmitted Most Significant Bit (MSB), Most Significant Syllable (MSS) first.

9.4.5.1.2.1 Data Set 1 Greenwich True of Date (TOD) State Vector.

<u>Data Word</u>	<u>Name</u>	<u>Type</u>	<u>Units</u>
DW1	Header (AAAA)	N/A	hex
DW2-DW5	GMT time tag of state vector	DP	sec
DW6-DW9	Orbiter X position (TOD)	DP	ft
DW10-DW13	Orbiter Y position (TOD)	DP	ft
DW14-DW17	Orbiter Z position (TOD)	DP	ft
DW18-DW19	Orbiter X velocity vector (TOD)	SP	fps
DW20-DW21	Orbiter Y velocity vector (TOD)	SP	fps
DW22-DW23	Orbiter Z velocity vector (TOD)	SP	fps

9.4.5.1.2.2 Data Set 2 Greenwich True of Data Attitude/Attitude Rate.

<u>Data Word</u>	<u>Name</u>	<u>Type</u>	<u>Units</u>
DW1	Header (5555)	N/A	hex
DW2-DW5	GMT time tag of attitude/attitude rate	DP	sec
DW6-DW7	Orbiter earth relative pitch angle	SP	rad
DW8-DW9	Orbiter earth relative yaw angle	SP	rad
DW10-DW11	Orbiter earth relative roll angle	SP	rad
DW12-DW13	Orbiter pitch rate	SP	rad/sec
DW14-DW15	Orbiter yaw rate	SP	rad/sec
DW16-DW17	Orbiter roll rate	SP	rad/sec

9.4.5.1.2.3 Data Set 3 Aries Mean of 1950 (M50) State Vector.

<u>Data Word</u>	<u>Name</u>	<u>Type</u>	<u>Units</u>
DW1	Header (A5A5)	N/A	hex
DW2-DW5	M50 state vector time tag (GMT)	DP	sec
DW6-DW9	Orbiter X position (M50)	DP	ft
DW10-DW13	Orbiter Y position (M50)	DP	ft
DW14-DW17	Orbiter Z position (M50)	DP	ft
DW18-DW19	Orbiter X velocity vector (M50)	SP	fps
DW20-DW21	Orbiter Y velocity vector (M50)	SP	fps
DW22-DW23	Orbiter Z velocity vector (M50)	SP	fps

9.4.5.1.2.4 Data Set 4 Aries Mean of 1950 (M50) Attitude/Attitude Rate.

<u>Data Word</u>	<u>Name</u>	<u>Type</u>	<u>Units</u>
DW1	Header (5A5A)	N/A	hex
DW2-DW5	M50 attitude data time tag (GMT)	DP	sec
DW6-DW7	Orbiter Body to M50 Quaternion* Element One	SP	-
DW8-DW9	Orbiter Body to M50 Quaternion* Element Two	SP	-
DW10-DW11	Orbiter Body to M50 Quaternion* Element Three	SP	-
DW12-DW13	Orbiter Body to M50 Quaternion* Element Four	SP	-
DW14-DW15	Orbiter pitch rate	SP	rad/sec
DW16-DW17	Orbiter yaw rate	SP	rad/sec
DW18-DW19	Orbiter roll rate	SP	rad/sec

\* The quaternion for the transformation from Orbiter body coordinates to Aries-Mean of 1950, inertial Cartesian, coordinate system is defined below:

Cos  $\alpha$ , Cos  $\beta$ , Cos  $\gamma$  are the direction cosines of the eigen axis for the transformation with respect to the x, y, and z axes, respectively, of either coordinate system.

$\theta$  is the magnitude of the right handed rotation about the eigen axis required to carry out the transformation.

The elements of the quaternion are defined by:

Element One =  $\cos \theta/2$   
Element Two =  $\sin \theta/2 \cos \alpha$   
Element Three =  $\sin \theta/2 \cos \beta$   
Element Four =  $\sin \theta/2 \cos \gamma$

The parameters in each data set shall be transmitted in 16 bit words in the parameter order defined. Each parameter shall be transmitted with the most significant bit and most significant syllable first. The time homogeneity of each data set shall be maintained.

9.4.5.1.3 GN&C Data Transfer Sequence. Crew keyboard entries are used to transfer GN&C data. GN&C state vector and/or attitude and attitude rate shall be transferred to the payload in the following modes.

- a. Single Shot Mode. A single state vector data set or a single attitude/attitude rate data set is transferred when initiated by keyboard command.
- b. Cyclic Mode. (Data bus and MDM SIO Interfaces Only). State vector and/or attitude and attitude rate data set are transferred repeatedly when initiated by keyboard command until terminated by keyboard command. When state vector and attitude/attitude rate is the data set selected for transfer, the time between state vector and attitude/attitude rate may be as great as 960 milliseconds or as short as 300 microseconds. A data set is transferred once in every 1.92 second time period.

9.4.5.1.4 PSP Unique Orbiter State Vector/Attitude Data. The Orbiter state vector/attitude message shall be transmitted via the PSP to the payload on demand utilizing Orbiter keyboard entry. The state vector/attitude data set for payloads is defined in the following paragraphs.

9.4.5.1.4.1 Payload Communications. Each state vector/attitude message transferred to the payload via the PSP link will be structured as follows:

```
-----  
! PREAMBLE !   CMD 1 !   . . .   !   CMD N ! POSTAMBLE !  
-----
```

1. The command message preamble shall consist of alternating ones and zeros followed by command word(s), and ending with a postamble consisting of alternating ones and zeros. The preamble and postamble begin with a one and end with a zero.

The interval between consecutive command message transmissions shall be procedurally controlled such that the minimum preamble/postamble may be satisfied by the PSP IDLE pattern.

2. Each command word is 40 bits. Command words shall be formatted as follows:

<u>BITS</u>	<u>DESCRIPTION</u>
1-8	Ambiguity Word - Fixed 8-bit (11110010) sequence used to resolve subcarrier phase ambiguity, fixed for all missions.
9-15	Address - 7-bit address code (1110000), fixed for all missions.
16-18	Identification - 3-bit identification code, bit 16 message control. Zero State = start of command (data word one). One State = continuation word.
	<u>Bit Position</u>
	16 17 18
	0 0 0 First word of command (header word).
	1 0 0 Data words for multi-word commands.
19-26	Byte 1 - 8-bit command data.
27-34	Byte 2 - 8-bit command data.
35	Odd parity such that bit 16-35 contain an odd number of one's.
36-40	Fill - Fixed bit pattern 01010.

9.4.5.1.4.2 Orbiter State Vector. The Orbiter state vector data messages shall contain the following.

The Orbiter state vector data shall be a time homogeneous data set. The data content and sequence of data transmission shall be as follows:

DW1	Command Headed - 1101000000000000
DW2-DW3	GMT time tag of the Orbiter state is in the fixed point format for the PSP (See Paragraph 9.4.5.1.2).
DW4-DW5	As part of the conversion process for the GMT timetag, a constant equal to $0.01 \times (2^{31})$ seconds is subtracted to ensure that the required LBS resolution can be met. The payload is required to add this constant back in order to determine the true GMT time.
DW6-DW7	Orbiter Y position in the Aries Mean of 1950, Inertial Cartesian, coordinate system.
DW8-DW9	Orbiter Z position in the Aries Mean of 1950, Inertial Cartesian, coordinate system.



- DW10-DW11 Orbiter X velocity vector element in the Aries Mean of 1950, Inertial Cartesian, coordinate system.
- DW12-DW13 Orbiter Y velocity vector element in the Aries Mean of 1950, Inertial Cartesian, coordinate system.
- DW14-DW15 Orbiter Z velocity vector element in the Aries Mean of 1950, Inertial Cartesian, coordinate system.

Data items contained in DW2 through DW15 shall be double precision 32-bit fixed point integers as defined in Paragraph 9.4.5.2.3. The binary point shall be to the right of the LSB.

The data defined above shall be transmitted MSB, Most Significant Syllable (MSS) first. Each data word defined above (DW1-DW15) shall be transferred in bits 19 through 34 of the respective command word, refer to Paragraph 9.4.5.1.4.1. While the payload is attached to or detached from the Orbiter, this data shall be transmitted to the payload on demand via crew initiation.

9.4.5.1.4.3 Orbiter Attitude. The Orbiter attitude shall be a time homogeneous data set. The Orbiter attitude data content and sequence of data transmission shall be as follows:

- DW1 Header - 1101100000000000
- DW2-DW3 Element one of the quaternion representing the transformation from Orbiter body coordinates to the Aries Mean of 1950, Inertial Cartesian, coordinate system. (See Note 1)
- DW4-DW5 Element 2 of the quaternion described for DW2-DW3.
- DW6-DW7 Element 3 of the quaternion described for DW2-DW3.
- DW8-DW9 Element 4 of the quaternion described for DW2-DW3.

Data items contained in DW2 through DW9 shall be double precision 32-bit fixed point integers as defined in paragraph 9.4.5.2.3. The binary point shall be to the right of the LSB. Each data word defined above (DW1-DW9) shall be transferred in bits 19 through 34 of the respective command word, refer to Paragraph 9.4.5.1.4.1. While the payload is attached to the Orbiter, this data shall be transmitted to the payload on demand via crew initiation.

Note 1: The quaternion for the transformation from Orbiter body coordinates to the Aries Mean of 1950, Inertial Cartesian Coordinate System is defined as follows:

$\cos \alpha$ ,  $\cos \beta$ ,  $\cos \gamma$  are the direction cosines of the eigen axis for the transformation with respect to the x, y, and z axes, respectively, of either coordinate system.

$\theta$  is the magnitude of the right handed rotation about the eigen axis required to carry out the transformation.

The elements of the quaternion are defined by:

Element One =  $\cos \theta/2$   
Element Two =  $\sin \theta/2 \cos \alpha$   
Element Three =  $\sin \theta/2 \cos \beta$   
Element Four =  $\sin \theta/2 \cos \gamma$

a. Transport Lag Requirements. The Orbiter state vector message shall be output from the GPC no later than 5 seconds past the GMT time tag of the data when operating under error-free on-orbit conditions. The Orbiter attitude shall be output from the GPC no later than 5 seconds past the GMT of its computation by the GPC under error-free on-orbit conditions.

b. Transformation/Resolution Requirements. The transformation/resolution requirements are as follows:

State Vector Time Tag (GMT)	LSB = 0.01 sec
Orbiter Position	LSB = 1.0 ft
Orbiter Velocity	LSB = 0.1 ft/sec
Orbiter Attitude Quaternion	LSB = $2^{-31}$

c. Time Tag Accuracy. Under error-free on-orbit condition, the GMT shall be within  $\pm 5$  ms of the time for which the state vector is calculated.

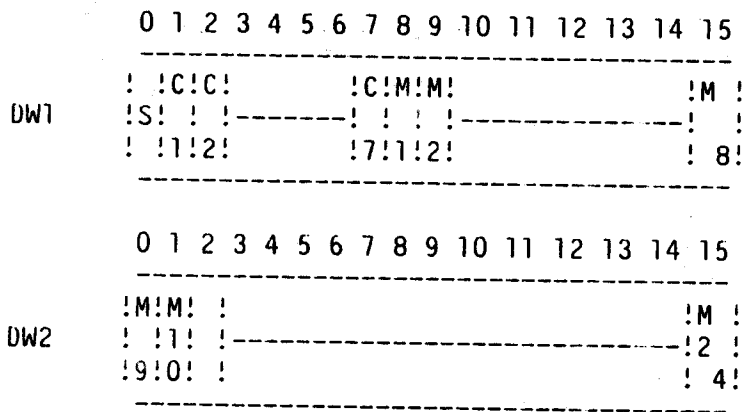
9.4.5.1.4.4 PSP Orbiter State Vector/Attitude Transfer. The PSP state vector/attitude command load is executed by accessing the state vector or attitude data and a payload dependent configuration message and transmission of both to the PSP.

The command load provides data sets consisting of fifteen 40-bit command words (state vector set) or nine 40-bit command data words (attitude set). An 8-bit pattern of 10101010 is added to the data set after the last command word.

The configuration message format (1-5) to be used shall be the same for either load and shall be a single permission defined format. The Orbiter uplink process provides the capability to change the permission defined format to support multiple payloads.

9.4.5.2 Data Conventions. The GN&C data transferred by the Orbiter GPC software via output to the PSP, payload MDM serial input/output, and data bus input/output to a payload BTU shall be as defined below.

9.4.5.2.1 Single-Precision, Floating-Point (SP). The SP shall consist of a number, X, in hexadecimal format and transmitted as two 16-bit data words in the order DW1, then DW2 (the bit sequence is S, C<sub>1</sub> ---- M<sub>8</sub>, then M<sub>9</sub>, M<sub>10</sub> ---- M<sub>24</sub>).



- S - Sign of Mantissa:                    1 = Negative  
    0 = Positive
- C<sub>1</sub> - C<sub>7</sub> - Characteristics:            Coded Hex EXCESSIVE 40<sub>16</sub>
- M<sub>1</sub> - M<sub>24</sub> - Mantissa (M):            Normalized by HEX digits to the range  
    (16<sup>-1</sup>, 1-16<sup>-14</sup>)

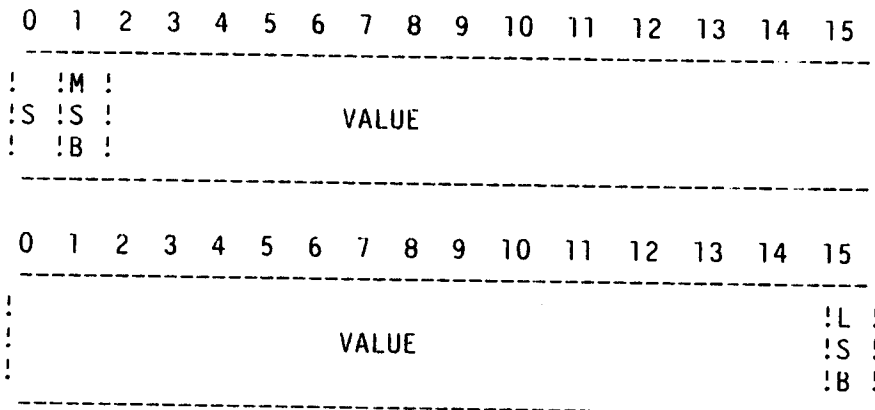
$$x = (\text{Sign}) 16^V - M$$

$$\text{Where } V = C_{16} - 40_{16}$$



9.4.5.2.3 Double Precision Fixed Point. The data transferred to the S/C shall consist of the following data type.

Double Precision Fixed Points:



Fixed point values consist of 32 bits contained in two 16-bit data words. Positive values are indicated when bit zero of data word one is equal to a binary zero; negative values are in the form of binary two's complement when bit zero of data word one is equal to binary one.

9.4.5.3 Payload Sequencing/Payload Unique Computations. The Orbiter software provides services which can be used to perform payload unique computations for crew display and/or payload sequencing. The basic Input/Output (I/O) services are described in paragraphs 9.4.5.3.1 and 9.4.5.3.2. The minimum computational operations provided with these services include addition, subtraction, multiplication, division and logical "and", "or", and "exclusive or". These services also include the capability for the crew to control and monitor the computations via the keyboard and display.

The availability and definition of these services will be negotiated on an individual payload basis.

9.4.5.3.1 Data Acquisition. The capability is provided to acquire data (of the types defined in the referenced paragraphs) from the PCMMU/PDI (refer to Paragraph 9.4.1.1.2.1), payload MDM interface (refer to Paragraphs 9.4.3.1.4, 9.4.3.3 and 9.4.3.4), and Orbiter data bus system interface (refer to Paragraphs 9.4.4.3.4, 9.4.4.6, and 9.4.4.7).

9.4.5.3.2 Output Data Processing. The capability is provided to output data to payload MDM's and payload BTUs on the Orbiter data bus system. The only mode that shall be supported is receive command data (mode "01000"). Output shall be at a 1.04 Hz rate to *up to 16 contiguous channels* on an analog module or *up to three contiguous channels* on a discrete module. The total command data output to these channels is limited to fifty sixteen-bit words per flight.

The capability is also provided to output up to 32 16-bit data words via a standard serial interface (refer to Paragraphs 9.4.3.1 and 9.4.4.1).

The capability is provided to output up to 64 16-bit data words via the PSP interface (refer to Paragraph 9.4.2).

Data values to be output via the above services shall be calculated by the payload unique computations.

## 10.0 INDUCED ENVIRONMENTS

### 10.1 VIBRATION

(See Paragraphs 4.1.6 and 4.2.1.3)

### 10.2 ACOUSTICS

(See Paragraphs 4.1.5.2 and 4.2.2)

### 10.3 SHOCK

*Payload induced pyrotechnic shock to the Orbiter and pyrotechnic shock from other sources is discussed in Paragraph 4.1.9. Cargo located in the aft flight deck shall not generate pyrotechnic shock nor experience any Orbiter induced pyrotechnic shock.*

### 10.4 LOAD FACTORS

(See Paragraphs 4.1.3 and 4.2.1)

### 10.5 TEMPERATURE

(See Paragraphs 6.1.3 and 6.1.4)

## 10.6 ORBITER/CARGO BAY PARTICULATES AND GASES ENVIRONMENT

### 10.6.1 Purge Gas in the Cargo Bay.

10.6.1.1 Ground Operations With Closed Cargo Bay. Conditioned gas (air or GN<sub>2</sub>) which has been HEPA filtered, Class 5000, and containing 15 PPM or less hydrocarbons based on methane equivalent, shall be used to purge the cargo bay as specified in Table 6.2.1-1. *The cargo shall have been installed, the cargo bay doors closed, and the Shuttle Vehicle fully mated before purge is started.*

10.6.1.2 Lift-off Through Orbit Insertion. The cargo bay gas shall be the residue remaining from the Orbiter ground purge conducted prior to lift-off. The nominal cargo bay pressure during ascent shall be within the curves shown in Figure 10.6.1.2-1. The maximum cargo bay ascent pressure decay rate (i.e., dP/dt) is shown in Figure 10.6.1.2-2 with a maximum value of 0.76 psi/second. Table 10.6.1.2-1 presents values for the data plotted in Figures 10.6.1.2-1 and 10.6.1.2-2.

10.6.1.3 Entry and Descent. Atmospheric air filtered through 35-micron glass-bead-rating filters shall be used to repressurize the cargo bay. Figure 10.6.1.3-1 defines the Orbiter Cargo Bay internal pressure history to be used by payloads for design and venting analyses. Orbiter Cargo Bay vent door opening shall occur at altitudes between 70,000 ft (21,336 m) and 94,000 ft (28,651 m). The repressurization rate (i.e., dP/dt) of the Cargo Bay shall not exceed 0.3 psi/sec during descent.

### 10.6.2 Contamination.

10.6.2.1 Accessibility for Cleaning. Interior surfaces of the Cargo Bay and exterior surfaces of the Cargo shall be designed to provide accessibility for cleaning purposes.

10.6.2.1.1 Cargo Bay and Cargo Element Cleaning Condition. Internal Cargo Bay surfaces and external Cargo element surfaces shall be maintained to a visibly clean level, as defined in NSTS Specification SN-C-0005, both prior to and following, Cargo element installation in the Cargo Bay.

10.6.2.2 Cargo Effluents. *The formation or transfer, within the cargo bay of any cargo effluents which can result in payload cross-contamination or jeopardize the performance of Orbiter systems (i.e., radiators, windows, optics, etc.) shall be precluded.* The Cargo shall provide cleanable exterior surfaces. All nonmetallic materials exposed to the cargo bay shall be selected for low outgassing characteristics. Material selection criteria of 1 percent, or less, total mass loss and 0.1 percent, or less, volatile condensable material (VCM) as defined in NASA/JSC specification SP-R-0022A, or its equivalent, shall be used.

10.6.2.3 Gases and Liquids Vented Overboard. Fluids vented overboard shall limit contamination of the cargo, cargo bay, Orbiter windows, optical surfaces, and/or Orbiter thermal protection system surfaces to a level which does not jeopardize mission objectives. Dump design shall be time-selectable in order to program occurrences to be compatible with other flight operations. No payload shall dump or vent any fluids into the Cargo Bay during ascent or descent (including aborts). On-orbit dumps of non-hazardous fluids shall be performed only with the Cargo Bay doors open. Venting or dumping, as used in this paragraph, shall not include the release of non-hazardous gases in internal unpressurized volumes at atmospheric pressure at liftoff which are continuously vented during ascent and continuously repressurized during entry. All other requirements for payload venting will be included in payload unique ICD's.

10.6.2.4 Cargo Bay Liner. The Orbiter shall provide a cargo bay liner, as required, to isolate cargo element surfaces which are sensitive to particulate contamination effects from the Orbiter lower mid-fuselage. The liner shall prevent the transfer of particulates greater than 35 microns GBR (nominal max. particle size 87 microns in length) from the lower mid-fuselage to the cargo bay. All cargo bay surfaces, including the cargo bay liner shall be cleaned to a visibly clean level as defined in NSTS specification SN-C-0005.

10.6.2.5 Orbiter Sources of Contamination. Number column density and return flux predictions for outgassing, flash evaporator, leakage, and *RCS effluents for various lines-of-sight and altitudes are shown in Table 10.6.2.5-1.*

10.6.3 Thruster Bipropellant Combustion Products. Table 10.6.3-1 lists the RCS and VRCS exhaust products due to the combustion of the MMH/N<sub>2</sub>O<sub>4</sub> bipropellant. Distribution of these products within the engine plumes is defined in paragraphs 11.2.2 and 11.2.3.



TABLE 10.6.1.2-1 ASCENT CARGO BAY PRESSURE AND DECAY RATE

TIME	MAXIMUM CARGO BAY PRESSURE	MINIMUM CARGO BAY PRESSURE	MAXIMUM RATE OF DEPRESSURIZATION
10	14.45	14.20	0.155
20	13.20	12.50	0.255
30	11.25	10.00	0.360
35	10.05	8.90	0.510
38	9.40	8.20	0.735
39	9.15	7.60	0.760
40	8.95	7.20	0.760
41	8.70	6.80	0.760
45	7.75	5.70	0.640
48	7.20	5.10	0.570
49	7.05	4.90	0.575
50	6.90	4.70	0.550
51	6.60	4.50	0.520
52	6.10	4.30	0.455
55	5.35	3.65	0.355
60	4.30	2.70	0.273
65	3.50	2.00	0.255
70	2.70	1.40	0.195
80	1.30	0.60	0.150
90	0.60	0.20	0.115
100	0.25	0.10	0.075

NOTE:

- (1) PRESSURE IN PSIA
- (2) RATE OF DEPRESSURIZATION IN PSI/SECOND
- (3) TIME IN SECONDS FROM LIFT-OFF

Table 10.6.2.5-1 Predicted Number Column Density And Return Flux Contributions From Shuttle Orbiter Sources Of Contamination

Source	Parameter	Number Column Density (Molecules/cm <sup>2</sup> )	Return Flux (RF) (Molecules/cm <sup>2</sup> /sec)		
			300 Km	400 Km	700 Km
Outgassing	LOS 1	2.1x10 <sup>10</sup>	5.2x10 <sup>10</sup>	1.1x10 <sup>10</sup>	2.5x10 <sup>8</sup>
	3	3.1 x10 <sup>10</sup>	2.9x10 <sup>10</sup>	6.2x10 <sup>9</sup>	1.4x10 <sup>8</sup>
	7	2.7 x10 <sup>10</sup>	2.5x10 <sup>10</sup>	5.3x10 <sup>9</sup>	1.2x10 <sup>8</sup>
JES	LOS 1	6.7 x10 <sup>13</sup>	3.0x10 <sup>12</sup>	6.3x10 <sup>11</sup>	1.4x10 <sup>10</sup>
	7	3.3 x10 <sup>14</sup>	1.6x10 <sup>12</sup>	3.4x10 <sup>11</sup>	7.9x10 <sup>9</sup>
VRCS AJJ -Z Right Side	LOS 1	2.8x10 <sup>14</sup>	1.4x10 <sup>13</sup>	2.9x10 <sup>12</sup>	6.6x10 <sup>10</sup>
	7	6.8x10 <sup>14</sup>	3.4x10 <sup>12</sup>	7.2x10 <sup>11</sup>	1.7x10 <sup>10</sup>
VRCS AJJ +Y	LOS 1	1.6x10 <sup>14</sup>	8.1x10 <sup>12</sup>	1.7x10 <sup>12</sup>	4.0x10 <sup>10</sup>
	7	8.7x10 <sup>14</sup>	3.7x10 <sup>12</sup>	7.9x10 <sup>11</sup>	1.8x10 <sup>10</sup>
PRCS AJJ -Z Right Side	LOS 1	8.9x10 <sup>15</sup>	5.4x10 <sup>13</sup>	1.1x10 <sup>13</sup>	2.6x10 <sup>11</sup>
	7	3.6x10 <sup>16</sup>	5.4x10 <sup>12</sup>	1.1x10 <sup>12</sup>	2.6x10 <sup>10</sup>
PRCS AJJ +Y	LOS 1	8.6x10 <sup>15</sup>	6.0x10 <sup>13</sup>	1.3x10 <sup>13</sup>	3.0x10 <sup>11</sup>
	7	2.9x10 <sup>16</sup>	5.4x10 <sup>12</sup>	1.1x10 <sup>12</sup>	2.6x10 <sup>10</sup>

NOTES:

- (1) Ambient velocity direction: -Z, Field of view: 10°, medium density atmosphere.
- (2) Maximum temperature, after 100 hours.
- (3) LOS 1, zero degree line-of-sight (in the +Z<sub>o</sub> direction) originating at X<sub>o</sub> = 1107, Y<sub>o</sub> = 0, Z<sub>o</sub> = 507.  
 LOS 3, 60° off of +Z towards + X<sub>o</sub> (backward) originating at X<sub>o</sub> = 1107, Y<sub>o</sub> = 0, Z<sub>o</sub> = 507.  
 LOS 7, 60° off of +Z towards +Y<sub>o</sub> (right) originating at X<sub>o</sub> = 1107, Y<sub>o</sub> = 0, Z<sub>o</sub> = 507.
- (4) Elevon is in nominal position, maximum flow.

TABLE 10.6.3-1 N<sub>2</sub> O<sub>4</sub>/MMH EXHAUST PRODUCTS (MOLE FRACTIONS)  
AND TRACE PARTIALLY REACTED CONTAMINANTS

Steady State Operations	RCS	VRCS	OMS ENGINE
Completely Reacted Products			(TBD)
H <sub>2</sub> O	0.339	0.333	
N <sub>2</sub>	0.309	0.312	
H <sub>2</sub>	0.163	0.181	
CO	0.129	0.129	
CO <sub>2</sub>	0.042	0.042	
O <sub>2</sub>	0.002	Traces	
NO	0.001	--	
Free Radicals			(TBD)
H	0.012	0.003	
OH	0.006	Traces	
O	Traces	Traces	
Pulse Mode Trace Products (solid or liquid)			(TBD)
MMH	N <sub>2</sub> H <sub>3</sub> CH <sub>3</sub>		(TBD)
MMH-nitrate	N <sub>2</sub> H <sub>2</sub> CH <sub>3</sub> NO <sub>3</sub> ; N <sub>2</sub> H CH <sub>3</sub> (NO <sub>3</sub> ) <sub>2</sub>		
Nitric Acid	HNO <sub>3</sub>		
Ammonium nitrate	NH <sub>4</sub> NO <sub>3</sub>		

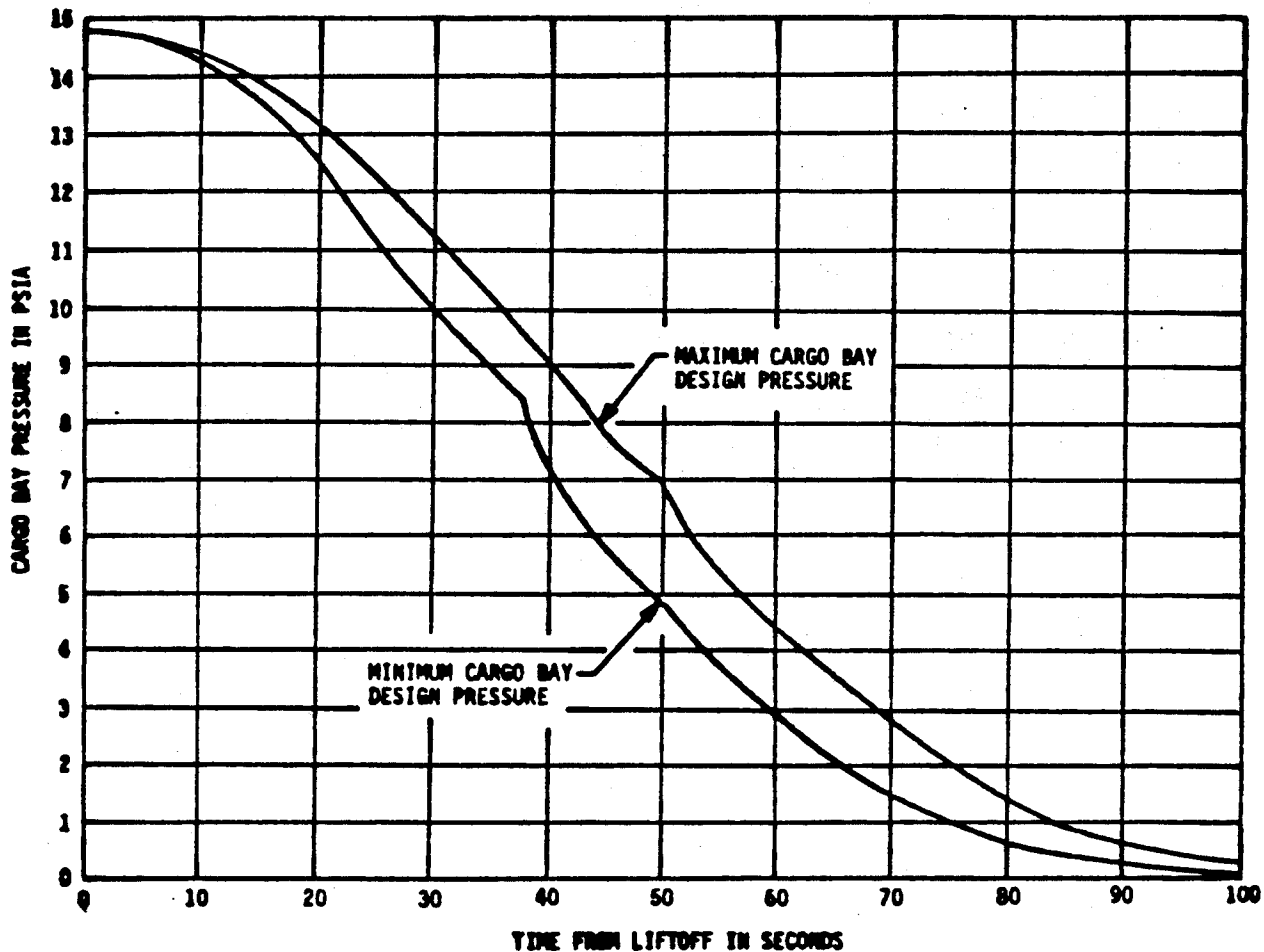


FIGURE 10.6.1.2-1 ORBITER CARGO ELEMENT INTERNAL PRESSURE HISTORY DURING ASCENT

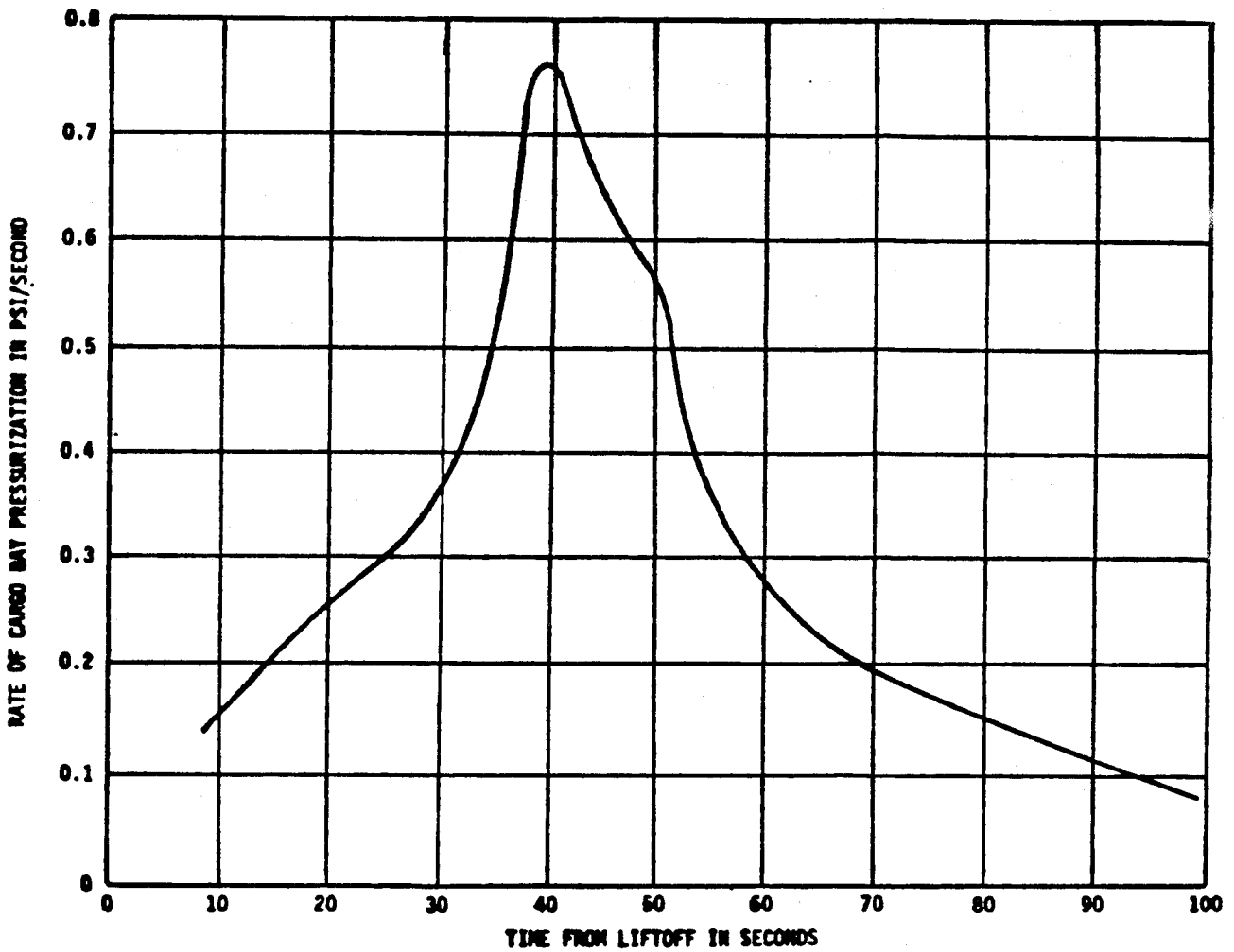
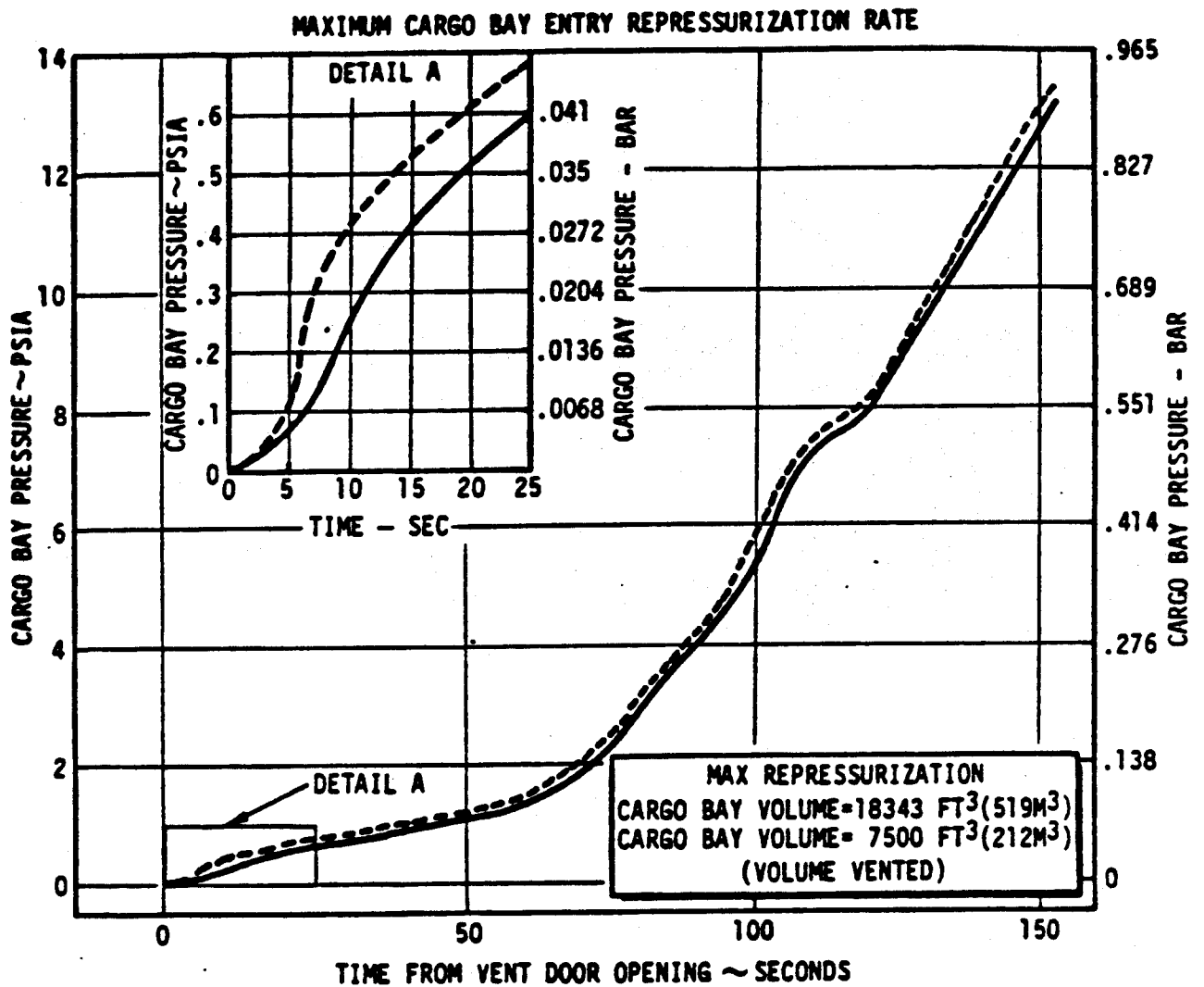


FIGURE 10.6.1.2-2 MAXIMUM CARGO BAY PRESSURE DECAY RATE DURING ASCENT



(NASA/JSC PSEUDO TRAJECTORY, MAXIMUM  
DYNAMIC PRESSURE (375/450) PSF)

FIGURE 10.6.1.3-1 ENTRY PHASE CARGO BAY INTERNAL PRESSURE VALUES,  
TO BE USED FOR PAYLOAD DESIGN

## 10.7 ELECTROMAGNETIC COMPATIBILITY (EMC)

**10.7.1 Circuit EMEC Classifications.** Circuit EMEC Classifications are as defined in Table 10.7.1-1. As a design goal, cargo wiring on the payload side of the interface shall meet the requirements of Table 10.7.1-2, or utilize equivalent shielding. In any event, the payload shall comply with the radiated and conducted electromagnetic interference requirements of Paragraphs 10.7.3, 10.7.3.1 and 10.7.3.2.

### 10.7.2 Shuttle-Produced Interference Environment.

**10.7.2.1 Conducted Interference.** (See Paragraphs 7.3.7 and 7.4.2.1).

**10.7.2.2 Radiated Interference.** The Shuttle-produced radiated fields environment shall be limited as follows:

- a. AC magnetic fields shall be limited to less than 140 dB above 1 picotesla (30 Hz to 2KHz), falling 40 dB per decade to 50 KHz. The dc field shall be less than 170 dB above 1 picotesla. The above are worst case values for locations near the Orbiter power buses at  $Y_0 = \pm 79$ ,  $Z_0 = 349$ ,  $X_0 =$  any value in the cargo bay.

The above values of magnetic flux density are reduced in accordance with the following equation for separation from the power busses in the Y-Z plane.

$\text{dB (reduction)} = 20 \log_{10} (57R^2)$  where R (meters) = radial separation in the Y-Z plane from the nearest port or starboard power bus described by the above location coordinates.

For locations within 2.5 meters of the 576 or 1307  $X_0$  locations, the value of R in the equation should be the separation from the  $X_0 = 576$  or  $X_0 = 1307$  locations in meters.

- b. Electric fields along the cargo bay center line under normal operating modes are defined in Figures 10.7.2.2-1 and 10.7.2.2-2 for unintentional emissions. These levels should be considered when evaluating the possibility of operating radio frequency receiving equipment or electric field sensing instruments in the cargo bay. The worst case electric field intensities produced by Orbiter-installed transmitters, with the exception of the Ku-Band system, are defined for the cargo bay and for the volume above the cargo bay/cabin. The values defined in Figure 10.7.2.2-3 are the maximum field intensities on the upper (+X, +Y), (+Z, -Y) quadrants of the payload bay envelope with the doors open. The values defined in Figures 10.7.2.2-4, 10.7.2.2-5, 10.7.2.2-6 and 10.7.2.2-7 are the maximum field intensities that may impinge on payloads in the +Z hemisphere above the Orbiter during deployment and retrieval operations. The electrical field strengths produced by Orbiter installed transmitters are defined in Figure 10.7.2.2-3. These values, with the exception of the Ku-Band system, are worst case values in the upper (+Z) quadrant of the cargo bay envelope with doors open. The Ku-Band levels are greater along a line defined by the  $+Y_0=90$  and  $+Z_0=444$ . Reduced levels can be expected in the lower Y and Z areas of the cargo bay; however, the levels are payload geometry dependent.

For equipment that can be in the main beam of the Ku-Band Antenna, the field level can be approximated by  $E = \frac{2500}{R}$  (R= METERS) See Figure

R

10.7.2.2-8 for electrical field intensities when operating in the communications mode and Figure 10.7.2.2-9 when operating in the radar mode. When operating the Ku Band system in the radar mode the field may be attenuated in accordance with Paragraph 8.3.4.1.

Table 10.7.2.2-1 gives the frequency range and modulation type associated with the transmitter field strength in Figure 10.7.2.2-3.

- c. *Lightning produced magnetic fields in the Payload Bay for vehicles in flight shall not exceed a peak level of 20 amperes/meter; for vehicles on the ground protected by facility or other structures the peak level shall not exceed 40 amperes/meter; and for vehicles on the ground not protected by facility or other structures the peak level shall not exceed 75 amperes/meter. The lightning produced magnetic fields in the Crew Compartment for vehicles in flight shall not exceed a peak level of 3 amperes/meter; for vehicles on the ground protected by facility or other structures the peak level shall not exceed 5 amperes/meter; and for vehicles on the ground not protected by facility or other structures the peak level shall not exceed 10 amperes/meter. The rise to peak value is 2 microseconds and the fall to zero value is 100 microseconds. The payload shall be designed so that a failure due to lightning strike shall not propagate to the Shuttle.*
- d. The design of the cargo bay and cargo bay doors shall preclude any electrostatic discharges.

### 10.7.3 Cargo-Produced Interference Environment.

10.7.3.1 Cargo-Produced Conducted Noise. The Cargo-generated conducted emission limits, applicable to all DC and AC power interfaces, shall be as follows:

- a. DC Power
  - 1) The power line conducted emissions shall be limited to the levels indicated in Figure 10.7.3.1-2. These levels may be exceeded when operating from a dedicated fuel cell provided the radiated emissions limits of Paragraph 10.7.3.2 below are met; however, the power-bus ripple voltages of Paragraph 10.7.2 shall not be applicable.
  - 2) The cargo-generated spikes produced on DC power lines by switching or other operations shall not exceed the limits defined in Figure 10.7.3.1-2 when fed from a source impedance close to but not less than the values\* defined in Figures 10.7.3.1-3 and 10.7.3.1-4. Rise and fall times shall be greater than 1.0 microseconds.

\*The use of a battery cart is preferable to regulated DC power supplies.



b. AC Power

- 1) The AC-power-line-conducted emissions of the Cargo AFD equipment shall not exceed the limits defined in *Figure 10.7.3.1-1*.
- 2) AC power bus transient spikes generated by the Cargo AFD equipment shall not exceed the limits defined in *Figure 10.7.3.1-5* for both normal and abnormal operations when fed from a source impedance not greater than 10 ohms. Peak spikes below 10 microseconds duration, for normal electric system operations, shall be limited to  $\pm 60$  volts superimposed on the 400Hz sine wave. Rise and fall times shall be greater than 1.0 microseconds.

10.7.3.2 Cargo-Produced Radiated Fields. The Cargo-produced radiated fields shall be limited as follows:

- a. The generated AC magnetic fields (applies at a distance of 1 meter from any payload equipment) shall not exceed 130 dB above 1 picotesla (30 Hz to 2 KHz) falling 40 dB per decade to 50 KHz. *The generated DC magnetic fields shall not exceed 170dBpT at the payload envelope. This limit applies to electromagnetic and permanent magnetic devices.*
- b. The *unintentional* radiated electric fields shall not exceed the levels defined in Figures 10.7.3.2-1 and 10.7.3.2-2 except that the broadband emissions for Cargo equipment in the cargo bay shall be limited to 70 dB above 1 microvolt/meter/MHz in the frequency range of 1770 MHz to 2300 MHz. Narrowband emissions shall be limited to 25 dB above 1 microvolt/meter from 1770 MHz to 2300 MHz, excluding any payload intentional transmitters.
- c. Allowable levels of radiation from payload transmitter antenna systems are shown in Figure 10.7.3.2-3. These radiation limits apply at the surfaces defined as follows:
  1. The allowable Payload-to-Payload (cargo element-to-cargo element) *limit\** is defined as the radiation impinging upon imaginary planes (Orbiter Y, Z) located at the smallest and largest  $X_0$  allocated to the radiating payload, or upon the imaginary planes (Orbiter X, Z) located at the smallest and largest  $\pm Y_0$  allocated to the radiating payload. These limits have been established to permit flexibility in manifesting payloads.
  - \* *Payload contractors required to demonstrate performance margins when their payloads are exposed to these limits, are advised to raise the test emissions levels proportionately in their radiated susceptibility procedures.*
  2. The allowable Payload-to-Orbiter limit is defined as the radiation impinging upon an imaginary surface 3-inches beyond the payload allowable envelope for envelope  $Z_0$  of 410 or less. This does not limit radiation at higher levels with a directional antenna through open cargo bay doors ( $Z_0 > 410$ ).

3. The allowable Payload-to-Remote Manipulator System (RMS) limit for payloads attached to the RMS is defined as the radiation impinging upon an imaginary plane containing the RMS wrist roll joint end face, which is the mating interface for the Standard End Effector to the RMS.

The allowable Payload-to-RMS limit for payloads intentionally producing radiated fields while mounted in the cargo bay is defined as the radiation impinging on an imaginary surface 3-inches beyond the envelope of the actual surface of the payload in the  $\pm X$ ,  $\pm Y$ , and  $\pm Z$  direction during RMS operation.

The foregoing is in reference to radiation with the cargo bay doors open. No intentional radiation will be permitted with doors closed.

- d. *Allowable levels of radiation from cabin payload or experiment transmitter systems are shown in Figure 10.7.3.2-4. These limits apply at 1 meter from window mounted antennas. Other antenna mounted locations will be negotiated with the SJS.*
- e. Electrostatic discharges shall not occur within the cargo bay other than those isolated from the AFD and cargo bay gaseous environment (hydrogen-oxygen mixture) and shielded by the Cargo to satisfy the requirements of subparagraphs a and b above.
- f. Payloads intentionally producing radiated fields before deployment shall include remote turn on/off capability, from either ground stations or from the aft flight deck, to be implemented in the event of an unanticipated RF interference problem.

#### 10.7.4 Avionics Electrical Compatibility.

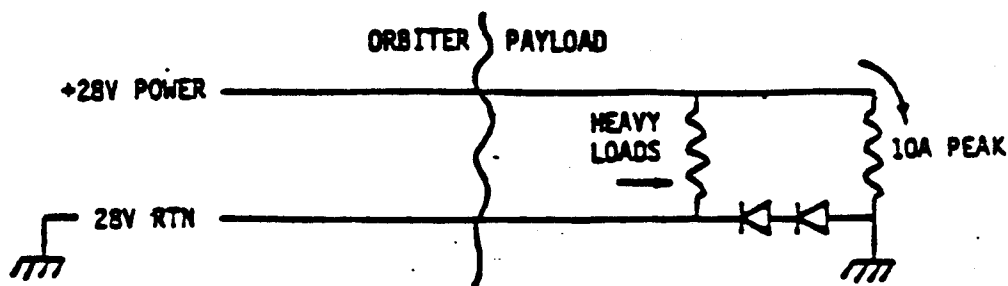
10.7.4.1 Secondary Power and Signal Returns. Circuit returns and isolation of circuit returns for DC signal circuits, plus the handling of shield grounds, shall be as identified in the following paragraphs. Interface circuits shall comply with the circuit-return criteria defined herein.

10.7.4.1.1 Cargo Elements Secondary Power and Signal Returns. *The basic ground reference isolation requirement for cargo elements is: A one megohm DC isolation between Orbiter primary DC, Orbiter primary AC, Orbiter secondary power/signal references, and structure ground is required in the cargo element. The structure reference shall be provided in the Orbiter. Primary power return isolation requirements are more completely specified in Paragraph 10.7.4.3. Exceptions to this basic requirement are discussed below, along with the general interface power and signals ground reference criteria. Specific exceptions to the basic requirement will be defined in the cargo unique 9CD.*

*For payloads using a single point ground reference to structure for power and signal interfaces, the following are also acceptable techniques by which this 28 V return structure ground in the cargo element can be made compatible with the Orbiter:*

- a. Cargo element shall use a dedicated power supply, return floated in the cargo element, for all low level discrete interfaces with the Payload MDM,

- b. Cargo element shall use a *payload BSTU* where possible excessive 28 V return current will affect only that cargo element's circuits, or
- c. Cargo element shall restrict level of 28 V DC return current to less than 10 amperes peak including transients. The heavier load currents shall be returned to the Orbiter via wire only. Hard wire return for the light current loads grounded to cargo element structure shall be provided by dioding between the heavy load and the light load returns so that current flows from the light load return to the heavy load return. The circuit shall be equivalent to that shown in the diagram below. *Low level signal P3 MDM isolation requirements (> 10K ohms) must be maintained. MDM discrete inputs from the cargo element shall be balanced.* Cargo elements using this option should be identified in the unique ICD.



The following subparagraphs contain criteria for the referencing of typical circuit returns used in the Shuttle.

10.7.4.1.1.1 Orbiter Signal Interfaces. The single-ended discrete signal interfaces shall be as illustrated in Figure 8.2.2.6-1 for DOL, DOH, DIL and DAW. *DAL and DOL signals shall maintain at least 10K ohms resistance between its circuit return and primary power ground/structure.* Use of single-ended circuits can result in ground loops in the return wires and structures at the LRU. Single-ended circuits with the same reference in the cargo element and interfacing with the Payload MDM shall be treated as shown in Figure 8.2.2.6-1 (Par. 8.2.2.1 and 8.2.2.3). Figure 8.2.2.6-1 (AID) shows an analog signal circuit removing the potential ground loop problems of circuits for DIL because they have isolation from signal reference. These circuits may be used concurrently between equipment in the Orbiter and the cargo element.

*Unless discussed in following paragraphs, all other cargo element signal interfaces to Orbiter avionics equipment that do not utilize coaxial cabling shall be differential and isolated from structure by at least 10K ohms, except as follows:*

- a. *Data bus interfaces shall be isolated from structure, primary and secondary power references by 1 megohm minimum.*

b. *Audio Central Control Network circuits shall be transformer-coupled, balanced circuits. All circuits, including transmitter and page circuits, shall be isolated from structural and primary power return by 1 megohm minimum.*

c. *Orbiter payload recorder analog input circuits shall be transformer-coupled and isolated from primary power reference and structure by 1 megohm minimum.*

10.7.4.1.1.2 MDM Serial I/O. *The serial I/O data exchange shall be isolated from structure and power reference as shown in Figure 8.2.2.6-1 for Message Discretes and Data. The message discretes shall be isolated from structure by 10,000 ohms minimum and the data circuits shall be isolated from structure by 1 megohm minimum.*

10.7.4.1.1.3 CCTV Interfaces. *The Orbiter CCTV video, control and sync signal interfaces with cargo elements are shown in Figure 8.2.8.4-1. They are differential signals and shall be isolated from structure and primary power references by 1 megohm. Special shielded-twisted pair cables (nominally 75 ohms) shall be used for these circuits.*

10.7.4.1.1.4 Controlled Impedance Signals.

10.7.4.1.1.4.1 COAX Cables. *Circuits using coax cables will inherently create multiple point grounding situations. Such circuits shall be coordinated with the SJS and shall be identified in the payload unique ICD.*

10.7.4.1.1.4.2 RF Signals. *All pulse or clock interface circuits having a pulse repetition rate of greater than 50K PPS or signals with fundamental frequencies greater than 50 KHz or circuits processing pulse rise/fall times equal to or less than 10 microseconds shall carry an RF classification. The distribution shall be via shielded-twisted-pair cabling. The method of shield termination shall be via wire pigtailed to the connector backshell. No RF circuit shield shall be broken out such that more than 2.0 inches of wiring is exposed within the connector metal backshield. RFI backshells with individual shield grounding provisions are required for multiple RF shield terminations.*

10.7.4.1.1.5 Electrical Explosive Device (EED) Firing Circuitry. *EED firing circuits, if utilized, shall be isolated from other electrical circuits and each other. This isolation requirement does not apply during the actual firing phase (when power is being applied to the initiator). Each firing circuit shall be routed as a multiple-point-grounded, shielded twisted pair and shall be connected to structure at one point only by *bleeder resistors* from each side of the circuit. EED's and Firing Circuits shall comply with the requirements of specification NSTS 08060 and/or NHB 1700.7, Paragraph 210. Further requirements are specified in Paragraph 7.5.4, if Orbiter power is utilized. *The EED firing circuit is defined as the circuit between the Pyro Initiator Control Junction and the Pyro.**

10.7.4.1.1.6 (Reserved.)

10.7.4.1.1.7 Wire Shield References. *See grounding and shielding diagrams.*

10.7.4.1.1.7.1 Single-Ended and Differential Analogs. Shields for single-ended and differential analogs shall be referenced to structure at only one point and in general this reference shall be at the load end of the circuit. For interface circuits within the Orbiter, the reference shall be at the Orbiter end of the circuit. Lightning protection may add multiple point grounding of an overall shield.

10.7.4.1.1.7.2 5-V and 28-V Discretes. When shields are required on 5-V and 28-V discretes, the shields shall be referenced to structures at the source and load and at all intermediate breakpoints.

10.7.4.1.1.7.3 RF Circuits. All digital data, pulse and high frequency circuits with a basic frequency greater than 50 KHz or having a rise or fall time less than 10 microseconds shall be considered RF circuits. The shields of RF circuits shall be referenced to structure at the source and load and at all intermediate breakpoints.

10.7.4.1.1.7.4 Electrical Explosive Device (EED) Firing Circuits. If utilized, EED firing circuit shields shall be continuous from the Pyro Initiator Controller to the EED case. At the EED the shields shall be terminated to the connector backshells with 360 deg. circumferential coverage.

10.7.4.2 Electrical Bonding. The Orbiter-to-Cargo electrical bonding interface shall be electrically bonded to provide homogeneous electrical characteristics. All electrical and mechanical elements shall be securely bonded to structure in compliance with *M9L-B-5087B*. All aluminum surfaces used for bonding shall be originally cleaned to bare metal and then chemical filmed per MIL-C-5541, Class 3 (gold alodine 1200LN9368, or equivalent). *Three classes of bonds per M9L-B-5087B are applicable: Class S, C, and R. These bond classes are defined in the next three subparagraphs.*

- a. *Static Bond-Class S. Refer to Paragraph 10.7.4.2.3.5.*
- b. *Fault-Current Bond-Class C. All cargo elements using Orbiter power shall have mechanically secure electrical connection to the Orbiter structure capable of carrying the maximum trip return current. RMS users are an exception as defined in Paragraph 14.4.2.*
- c. *RF Potentials Bond-Class R. Cargo elements containing electrical circuits which generate radio frequencies or circuits which are susceptible to radio frequency interference may require a low-impedance path to structure in order to meet the EMC requirements of Paragraph 10.7.2.2 or 10.7.3.2. The DC resistance of a Class R bond shall be less than 2.5 milliohms. RMS users are an exception as defined in Paragraph 14.4.2.*

10.7.4.2.1 Electrical Bonding of Equipment. Equipment containing electrical circuits which may generate radio frequencies or circuits which are susceptible to radio frequency, shall be so installed that there will be a continuous, low-impedance path from the equipment enclosure to structure. The metallic shells of all electrical connectors shall be electrically bonded to the equipment case or the bulkhead mount with a DC resistance of less than 2.5 milliohms. The DC resistance between the mated halves of the connectors shall not exceed 50 milliohms.

Wire harness shields external to equipment, requiring grounding at the equipment, shall have provisions for grounding the shields to the equipment through the harness connector backshell, or for carrying single point grounded shields through the connector pins.

All equipment electrical bonds and their respective interfaces shall comply with MIL-B-5087.

#### 10.7.4.2.2 Electrical Bonding of Structures.

##### 10.7.4.2.2.1 Cargo-to-Orbiter Main Bond.

10.7.4.2.2.1.1 Primary PL BUS Connector Bond. *Payloads shall utilize one of the wires in the power connector as the principle Orbiter/Cargo electrical bond.*

*Payloads using the Standard Umbilical Retraction System (SURS) or the Remotely Operated Electrical Umbilical (ROEU) may use multiple wires of smaller gage as the main interface bond. The current carrying capability of "0" gage to 26 gage wire is given in Paragraph 7.3.1.2. The current carrying capability of these multiple wires shall be greater than the maximum ultimate trip current of the circuit protection device(s) in the payload power wiring.*

*These bonds shall meet the appropriate bond class requirements of Paragraph 10.7.4.2 and shall have less than or equal to 0.25 milliohms at each junction of the fault current interface.*

10.7.4.2.2.1.2 Cargo-to-Orbiter Bond Strap. *In lieu of the power connector bond, the cargo-to-Orbiter bond strap shall be SJS-provided (as an optional service) and shall be connected between Orbiter structure and cargo ground stud provisions. This bond shall meet the appropriate bond class requirements of Paragraph 10.7.4.2 and shall have less than or equal to 0.25 milliohms at each junction of the fault current interface.*

10.7.4.2.2.2 Cargo-to-Orbiter Attachment Fittings. The "Payload Retention System" electrically isolates all payloads from Orbiter structure, except when Paragraph 3.3.6.3 is applicable.

Each sill longeron bridge fitting shall be Class-R bonded to Orbiter structure per ~~MIL-B-5087B~~ if active electronics are mounted on the bridge, otherwise a Class-S static bond is applicable.

10.7.4.2.2.3 Cargo-to-Orbiter Gas and Fluid Lines Bonding. All metallic pipes (hardlines) used to connect the Cargo environmental control system to the Orbiter, including the GO<sub>2</sub> and H<sub>2</sub>O services, shall be Class-S electrically bonded per ~~MIL-B-5087B~~.

10.7.4.2.2.4 Tunnel, Orbiter to Cargo Bonding. An Orbiter-to-Cargo tunnel may create an additional bonding path between the Orbiter and Cargo module structure. This bond path shall not be relied upon as a designated bond path. However, all electrical or mechanical equipment installed within the tunnel shall comply with ~~MIL-B-5087B~~.

10.7.4.2.2.5 Bonding for Cargo Element On-Orbit Reberthing. Cargo elements with reberthing requirements are required to provide a Class S electrical bond to Orbiter structure upon berthing. Payloads which utilize Orbiter power after reberthing are required to make provisions for a Class C electrical bond to Orbiter structure upon reberthing. Class R bonding may be required for reberthed payloads in order to meet the EMC requirements of Paragraphs 10.7.2.2 or 10.7.3.2.

10.7.4.2.3 Electrical Bonding for Static Protection. All Orbiter and cargo interfaces shall comply with Paragraph 10.7.4.2.

10.7.4.2.3.1 (Reserved)

10.7.4.2.3.2 (Reserved)

10.7.4.2.3.3 (Reserved)

10.7.4.2.3.4 (Reserved)

10.7.4.2.3.5 Static Electricity Protection. All cargo hardware elements shall comply with the Class S bond requirements of MIL-B-5087B. All conducting items subject to triboelectric (frictional) or any other charging mechanism shall have a mechanically secure electrical connection to the cargo element structure. The resistance of the connection shall be less than one (1) ohms.

Thermal blankets of metalized multilayer construction and metalized surfaces shall be bonded so that the D.C. resistance between any two blanket test tabs and between test tabs and cargo structure shall be less than 10 ohms. Redundant grounding tabs on all blankets are required as a minimum. Tabs should be located on blanket edges and spaced so as to minimize the maximum distance from any point on the blanket to the nearest tab. Extra tabs may be needed to meet additional conditions (i.e. any point on any blanket should be within one (1) meter of a ground tab).

Cargo elements using high volume resistivity materials (greater than  $10^9$  OHM CM) shall be designed to prevent differential charging between cargo element parts and the Orbiter. The specific requirements and design methods employed shall be negotiated with SJS.

10.7.4.2.4 Circuit Reference Symbols. The circuit reference symbols for use on the Space Shuttle program shall be as illustrated and defined as follows:



Structure reference - a connection to vehicle structure.



Primary power reference - a connection to the vehicle primary dc power return.



Signal reference - a connection to an LRU signal return.

10.7.4.3 Power Circuit Isolation and Grounding.

10.7.4.3.1 Remote Manipulator System (RMS) to Cargo Element Electrical Bonding. The grapple fixture/cargo element interface is the normal static bond interface and shall be the only conductive path to the RMS structure. This path shall have a resistance of not less than 5 k ohms and not more than 10 k ohms. The cargo element may also utilize pins 15 and 25 (structure ground) of the SEE (Standard End Effector)/payload interface (9/1411) for Class S Bonding. Cargo elements utilizing the RMS are required to furnish Primary Power Circuit protection, (i.e., fuses, circuit breakers), within the element. (Reference Paragraph 14.4.1.3)

10.7.4.3.2 DC Power Ground Reference. Orbiter DC power supplied to a cargo element shall be structure referenced in the Orbiter and DC isolated from structure ground at the cargo element by 1 megohm, except as specified in Paragraph 10.7.4.1.1. The Orbiter primary DC power return system shall be a combination of a hardwired return system and a structure-return system, with the use of the wire return restricted to specific load-sensitive areas as shown in Figure 10.7.4.3.2-1.

10.7.4.3.3 AC Power Ground Reference. Orbiter AC power supplied to a cargo element shall be structure referenced in the Orbiter and DC isolated by 1 megohm in the cargo element from the other AC buses, DC primary power, signal/secondary power and structure references. The Orbiter AC neutral is a wire-return system grounded at a single point at Station X<sub>0</sub> 576 for each AC bus, as shown in Figure 10.7.4.3.2-1.

10.7.4.3.4 Crew Compartment Electrical Grounding. A one megohm DC isolation between Orbiter primary DC, Orbiter primary AC, Orbiter secondary power/signal references, and structure ground is required in all cargo equipment mounted in the Crew Compartment. The design criteria for wire shield references is given in Table 10.7.1-1. The distribution of primary DC power to dedicated payload LRU's in the aft flight deck (AFD) shall have a hardwire-return path to the Power Control Assembly common return bus and shall be referenced to structure at the X<sub>0</sub> 576 Bulkhead. The AC neutrals shall be isolated from each other, structure and DC power returns by one megohm DC resistance in AFD cargo equipment.

10.7.4.3.5 Cargo Bay Power-Circuit Returns. When Orbiter power is supplied to the Cargo Bay, the returns shall be referenced to structure in the Orbiter only, except as specified in Paragraph 10.7.4.1.1 and during Orbiter power to payload internal power changeover switching (switch-over time duration greater than 200 milliseconds shall be reported to SJS for review).

10.7.4.3.6 Signal-Circuit Returns. Cargo equipment may have primary power returns connected to signal returns if treated per Paragraph 10.7.4.1.1.

10.7.4.3.7 Ground Support Equipment Isolation and Grounding. GSE interfacing with payloads shall be isolated from payload circuits (power and signal return lines) by a minimum of 1 megohm, except where balanced differential circuits are used. In the case of balanced differential circuits, each side of the circuit shall be balanced to ground by no less than 4000 ohms. Coax cables, with their inherent grounding of the signal return to structure, are permitted, providing their interface with other LRU's or systems does not propagate that ground to circuits which are already referenced to ground at some other point.



TABLE 10.7.1-1 CIRCUIT EMEC CLASSIFICATIONS

Freq of Rise and/or Fall Time	Source Impedance (ohms)	Load Impedance (ohms)	Voltage or Sensitivity	Circuit Classification	Wire Type Req'd	Shielding Grounding
Analog, Alternating or Direct Current	<100	100-600K	>100mv to ≤6v	ML	TWS	SPG**
		0-200	>6v to ≤40v	HO	TW	None
		0-200	>40v	EO	TW	None
	≤2.5K	100-600K	≤100 mv	ML	TWS	SPG
		>600K		ML	TWDS	SPG
	<100	≥200	>100mv to ≤6v	ML	TWS	SPG
		>200	>6v to ≤40v	HO	TW	None
		≥200	>40v	EO	TW	None
≤50 KHz or Rise and Fall Time >10 Micro Seconds	<100	≥10K	≤6v	ML	TWS	SPC
		0-200	>6 to ≤40v	HO	TW	None
		0-200	>40v	EO	TW	None
	<2.5K	100-600K	≤100mv	ML	TWS	SPG
		>600K		ML	TWDS	SPG
	≥200	>200	>100mv to ≤6v	ML	TWS	SPG**
		>200	>6v to ≤40v	HO	TW	None
		>200	>40v	EO	TW	None
>50 KHz or Rise and Fall Time ≤ 10 Microsecs ≤1.024 MHz	All	All	≤100mv	RF	TWDS*	MPG
		All	>100mv to >6	RF	TWS*	MPG
		<1000	>6v	RF	TWS*	MPG
		≥1000			TWDS	MPG
>1.024 MHz	All	All	All	RF	COAX	MPG
TV Video				RF	TWS	MPG***

Symbols Used

KHz - KiloHertz	RF - Radio Frequency	< - less than
mv - Millivolts	TWS - Twisted Shielded	≤ - less than or equal to
SPG - Single Point Ground	AF - Audio Frequency	> - greater than
MPG - Multiple Point Ground		≥ - greater than or equal to
TW - Twisted		
TWDS - Twisted Double Shielded		

\* If the capacitance per foot is critical, controlled-impedance wiring, special shielded-twisted-pair cables (nominal 75 ohms), should be used.

\*\* If circuit is balanced by transformer, differential or optical, the shield shall be multi-point grounded to structure.

\*\*\* Distance between shield grounds shall not exceed 18 meters.

TABLE 10.7.1-2 CARGO EDGE-TO-EDGE BUNDLE SEPARATION REQUIREMENTS

Bundle	Routed Parallel To Bundle	Separation (in inches for parallel runs of D [feet])			
		$D > 1'$	$1' \leq D < 3'$	$3' \leq D \leq 5'$	$D \geq 5'$
ML	HO	0	1.0	2.0	4.0
	EO	0	1.5	3.0	6.0
	RF	0	2.5	5.0	10.0
HO	EO	0	0.5	1.0	2.0
	RF	0	1.5	3.0	6.0
EO	RF	0	1.0	2.0	4.0

TABLE 10.7.2.2-1 TRANSMITTER CHARACTERISTICS

TRANSMITTER	ANTENNA (1)	CARRIER FREQ( $f_c$ )	MODULATION
S-BAND FM	S-BAND HEMI	2250.0 MHz	FM
S-BAND PM (NETWORK TRANSPONDER)	S-BAND QUAD	2217.5 OR 2287.5 MHz	PSK, PM
PAYLOAD INTERROGATOR			
STDN (NASA) (2)	S-BAND PAYLOAD	2025.8334 TO 2117.9166 MHz	PM
DSN (NASA) (3)	S-BAND PAYLOAD	2110.2431 TO 2119.7924 MHz	PM
SGLS (DOD) (4)	S-BAND PAYLOAD	1763.721 TO 1839.795 MHz	PM
KU-BAND	KU-BAND		
	RETURN LINK	15.0034 GHz	QPSK, FM
	RADAR RANGING	13.883 GHz (5)	PULSED CARRIER PULSE RATES: 268,3000, 7000 PPS PULSE WIDTH - 66.4 $\mu$ s max. 122.0 ns min.
EVA/ATC	UHF	243.0, 259.7 OR 296.8 MHz (SELECTABLE)	AM (90 PERCENT) (VOICE AND DATA)

- 1) Cargo bay radiation levels defined in Figure 10.7.2.2-3.
- 2) 801 Selectable channels over indicated frequency range.  
(See TABLE 8.3.1.1.1-1)
- 3) 29 Selectable channels over indicated frequency range.  
(See TABLE 8.3.1.1.2-1)
- 4) 20 Selectable channels over indicated frequency range.  
(See TABLE 8.3.1.1.3-1)
- 5) Passive tracking uses frequency diversity technique employing center frequencies of 13.779, 13.831, 13.883, 13.935 and 13.987 GHz.

# SHUTTLE-PRODUCED PAYLOAD BAY RADIATED BROADBAND EMISSIONS

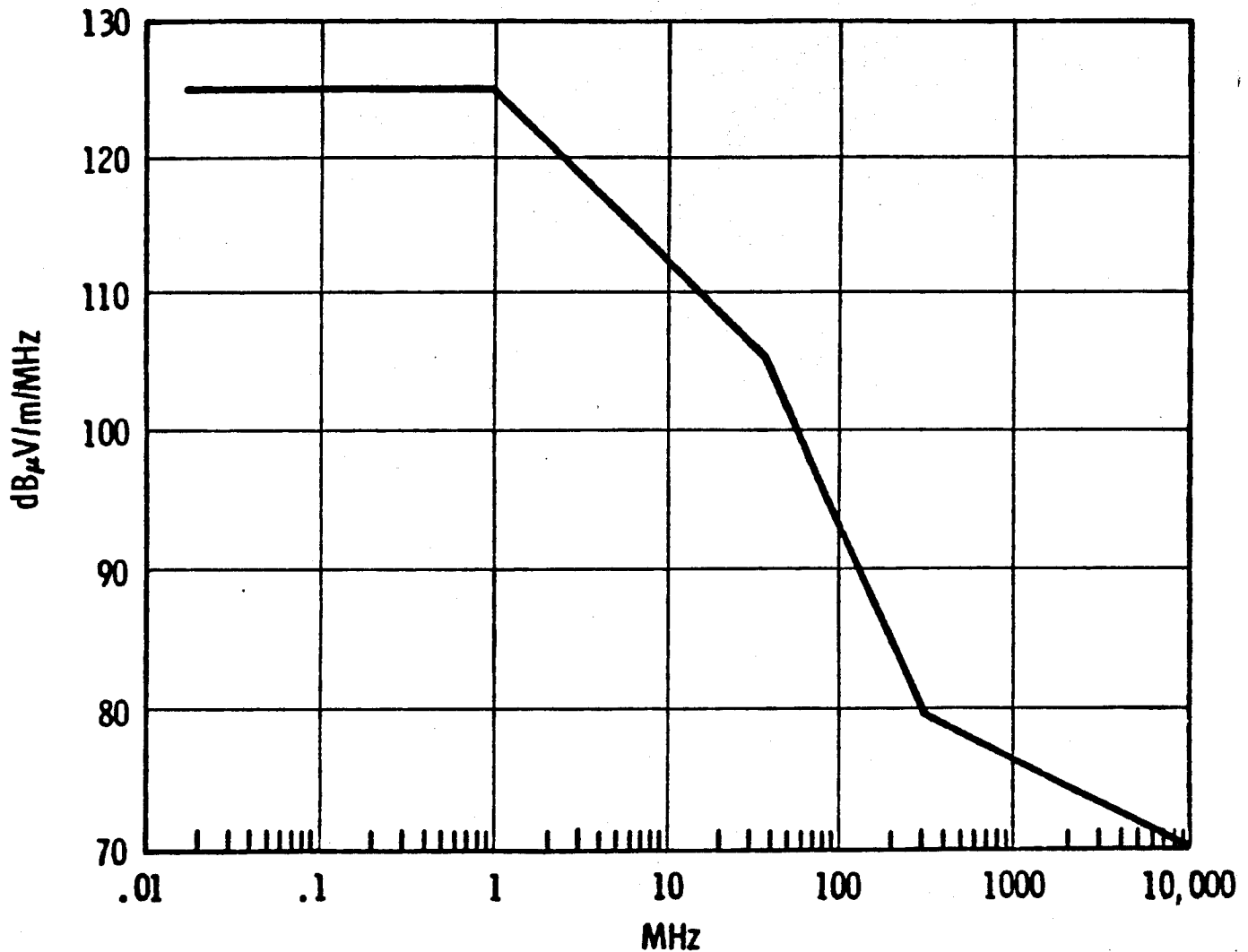


FIGURE 10.7.2.2-1 SHUTTLE-PRODUCED CARGO BAY RADIATED  
BROADBAND EMISSIONS

SHUTTLE-PRODUCED PAYLOAD BAY  
RADIATED NARROWBAND EMISSIONS

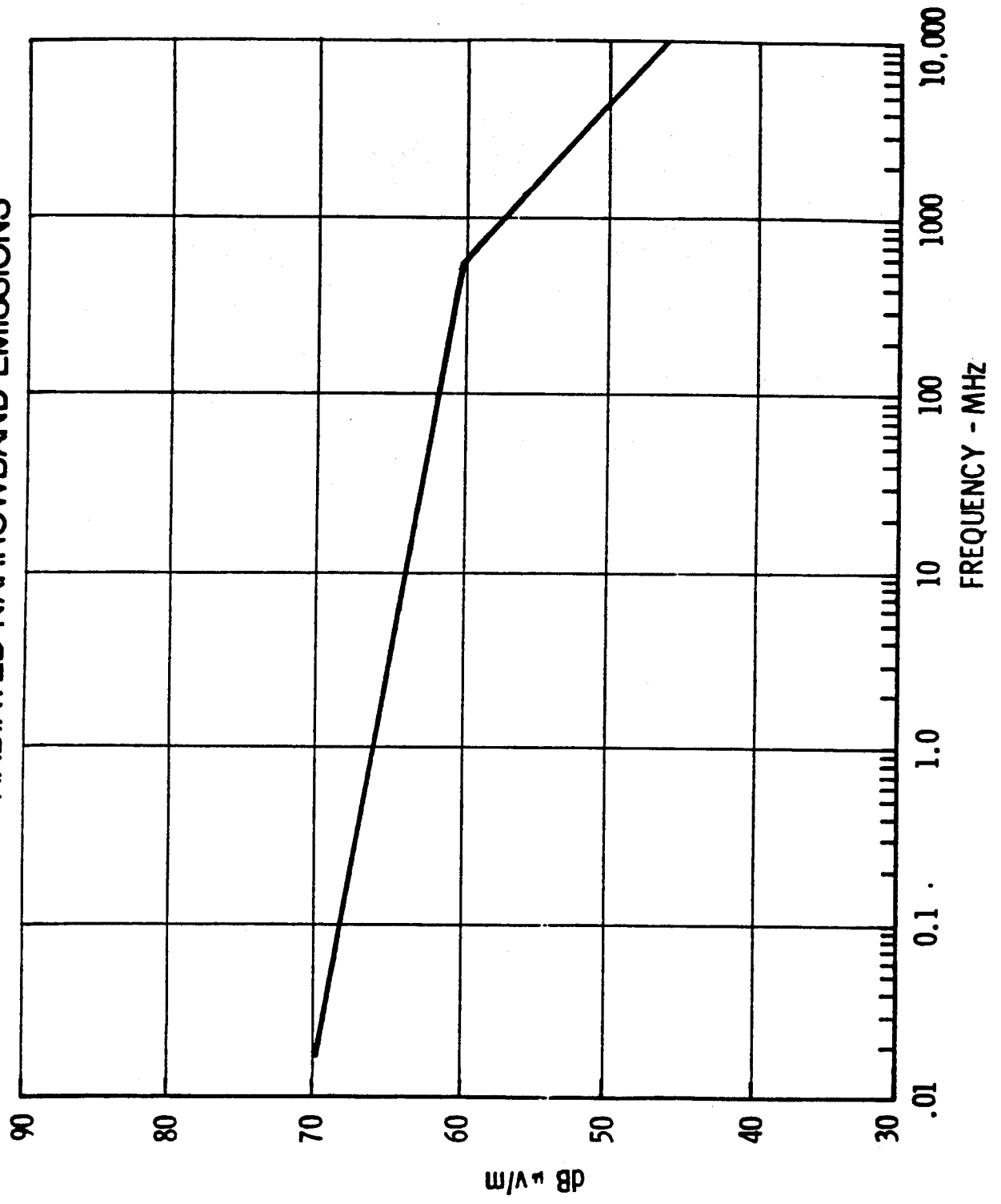


FIGURE 10.7.2.2-2 SHUTTLE-PRODUCED CARGO BAY RADIATED  
NARROW BAND EMISSIONS

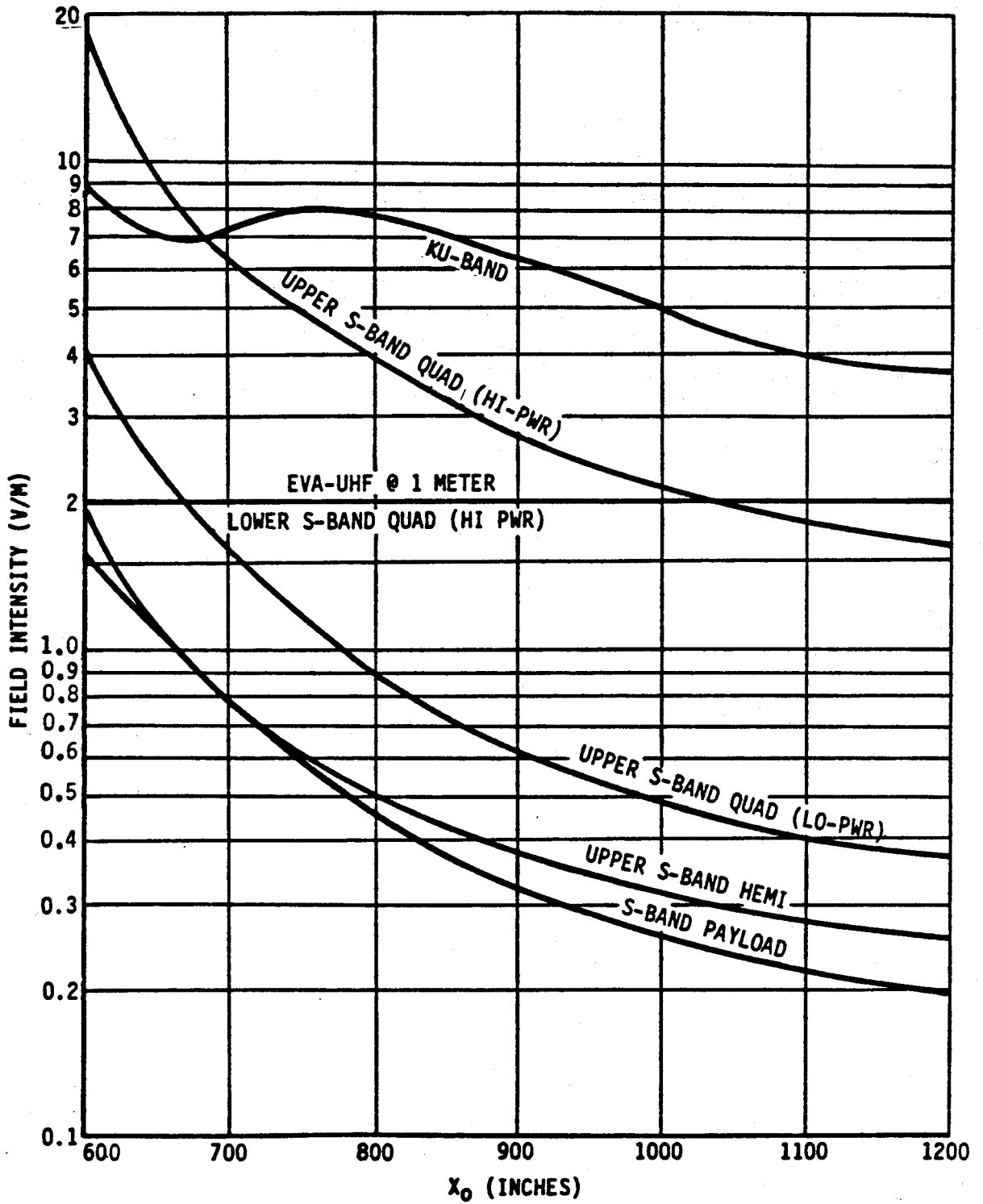


Figure 10.7.2.2-3 Maximum Field Intensities On Payload Envelope

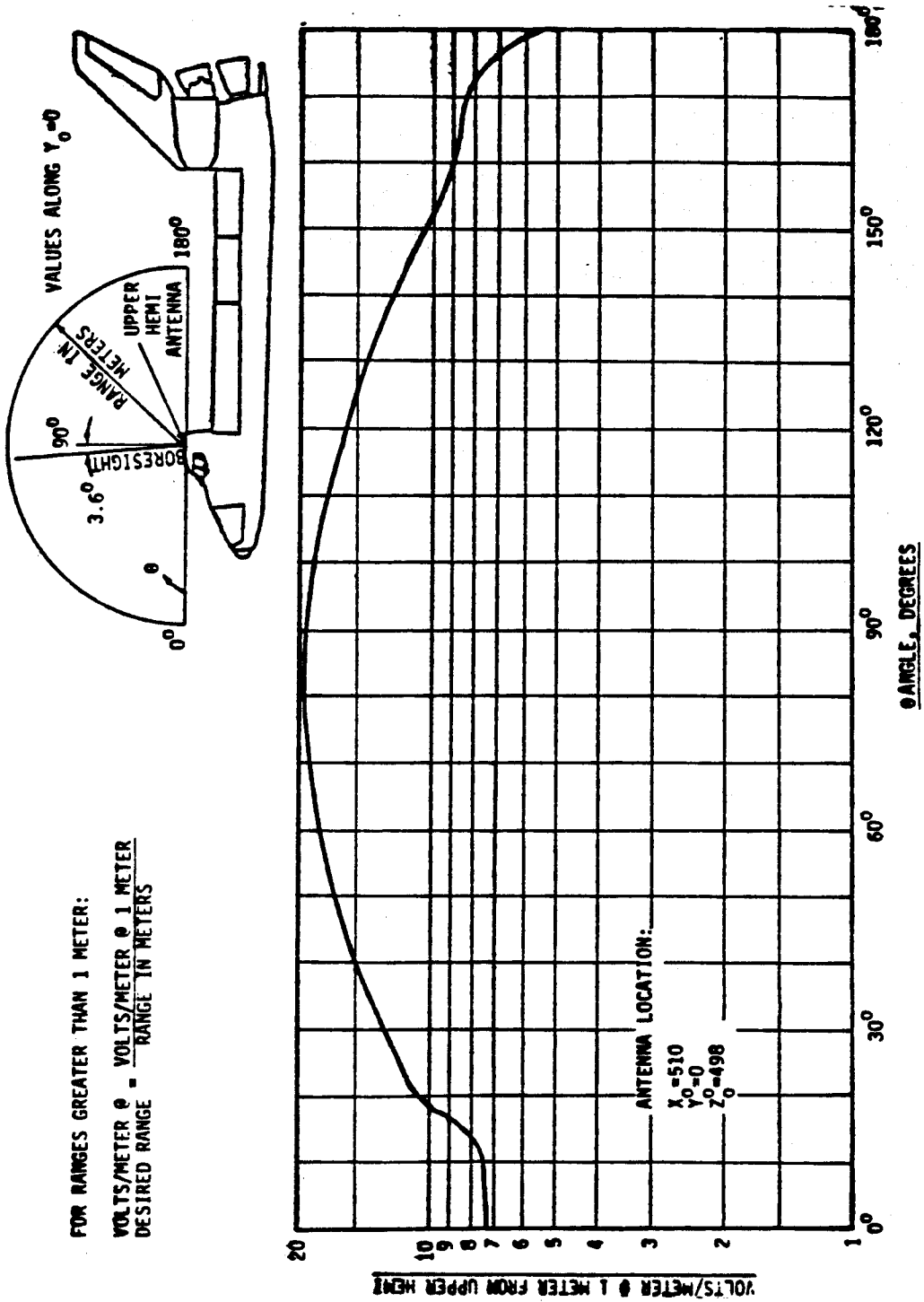


FIGURE 10.7.2.2-4 S-BAND FM TRANSMITTER, UPPER HEMI ANTENNA, MAXIMUM FIELD INTENSITIES

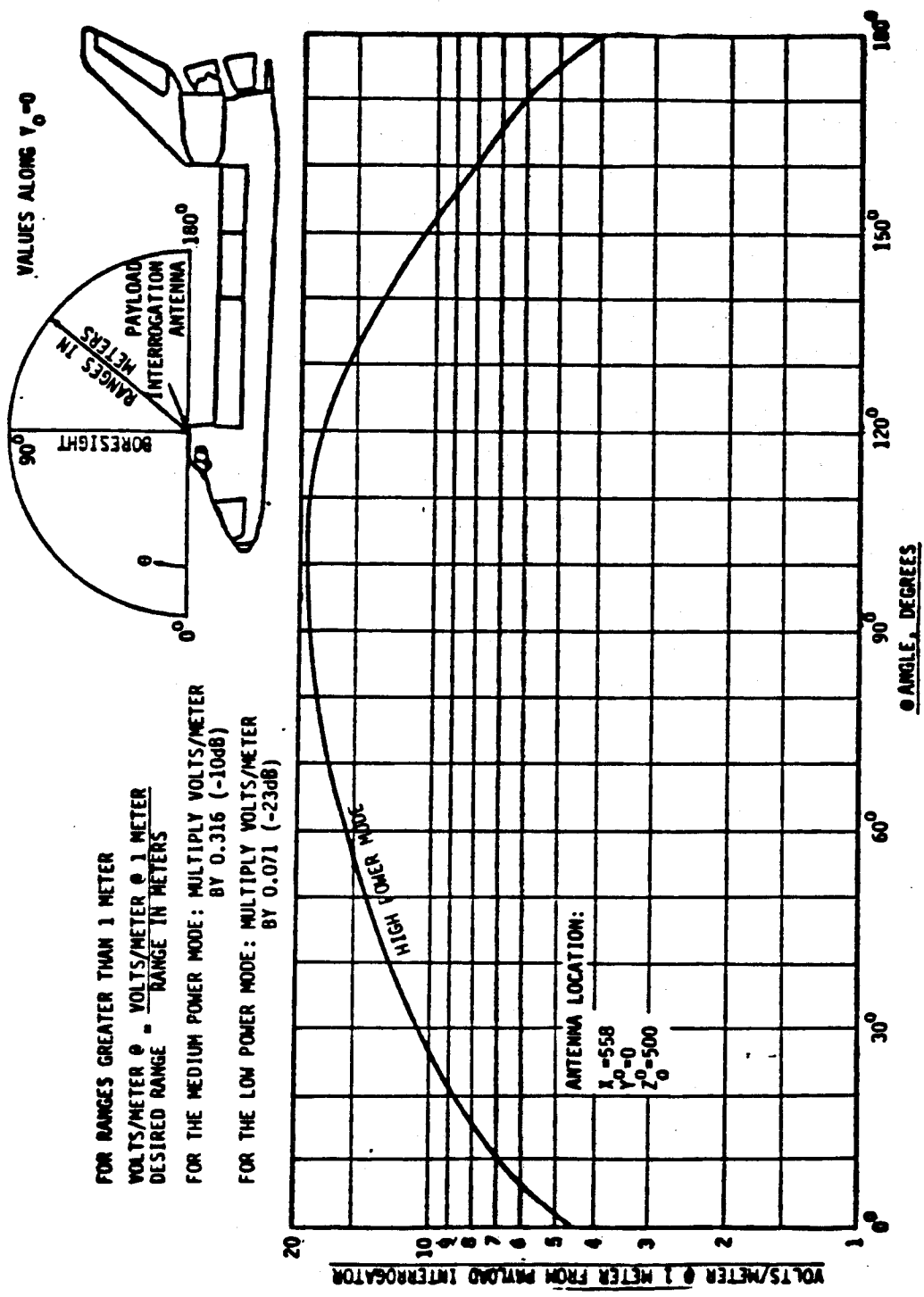


Figure 10.7.2.2-5 S-Band Payload Interrogator, Maximum Field Intensities



FOR RANGES GREATER THAN 1 METER: FOR THE LOW POWER MODE: MULTIPLY VOLTS/METER BY 0.158 (-16dB)

VOLTS/METER @ 1 METER FROM EITHER UPPER QUAD ANTENNA  
 DESIRED RANGE =  $\frac{\text{VOLTS/METER @ METER}}{\text{RANGE IN METERS}}$

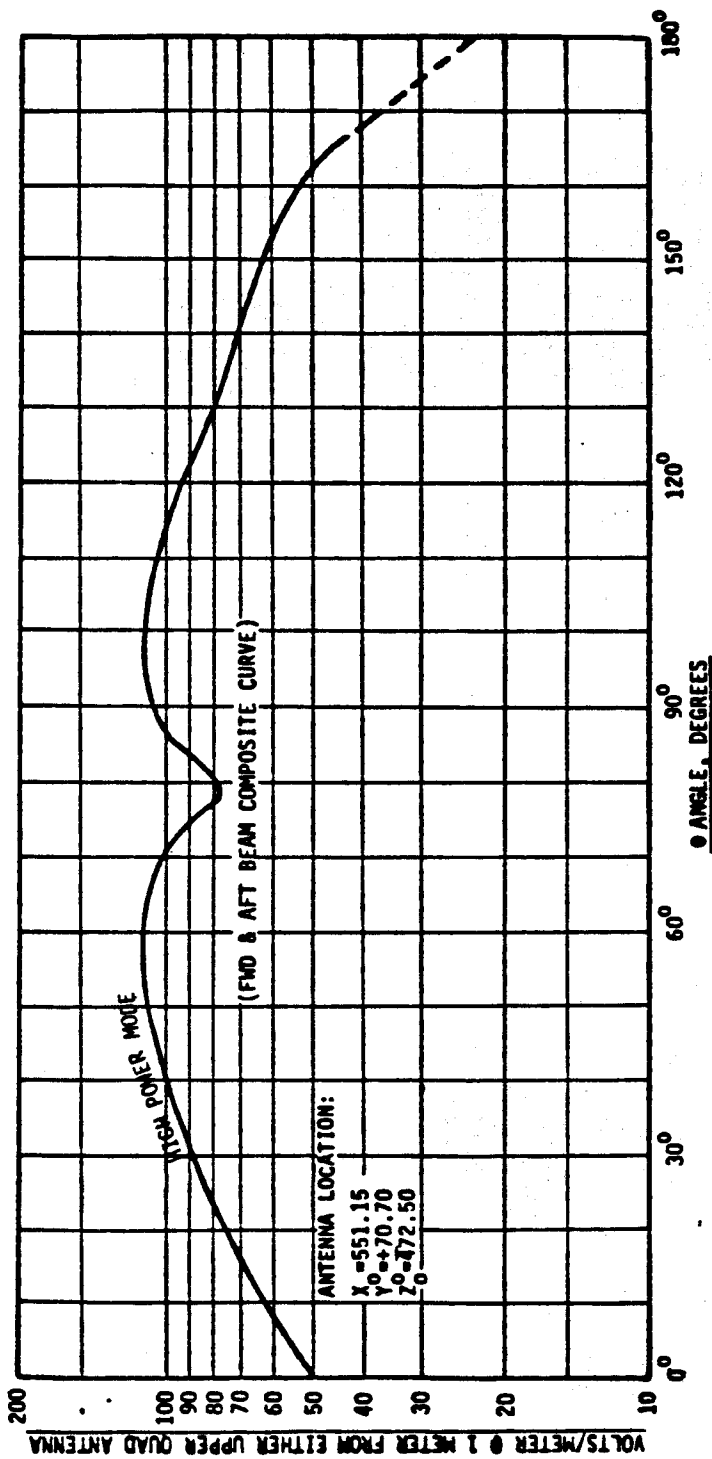
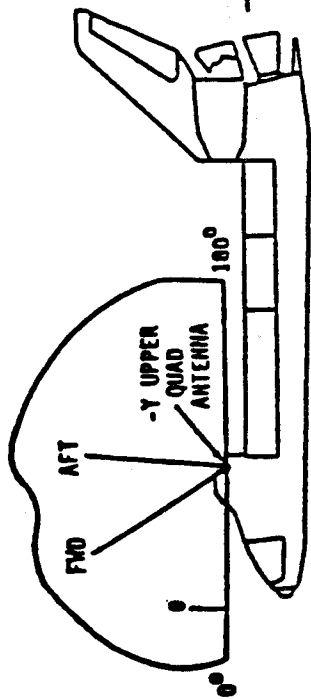
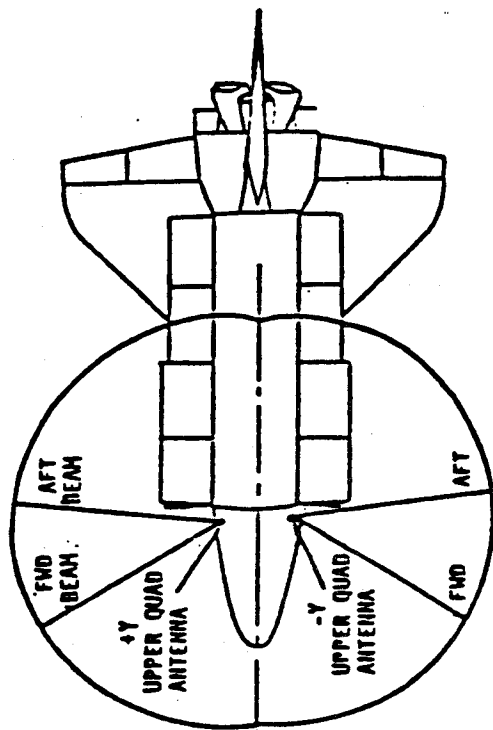


Figure 10.7.2.2-6 S-Band Network Transponder, Upper Quad Antennas, Maximum Field Intensities



- ONLY ONE QUAD TURNED ON AT ONE TIME
- EITHER FORWARD OR AFT BEAM SELECTED ON THE SELECTED QUAD

MAXIMUM VALUES GIVEN  
ON FIGURE 10.7.2.2-6  
ALONG 45° PLANE  
(REF. CALL OUT)

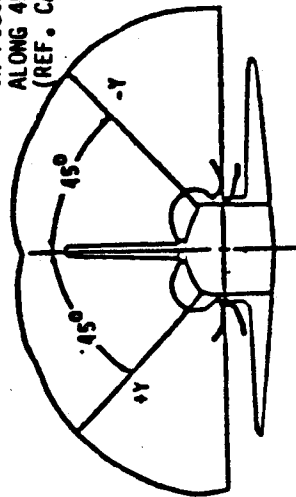


Figure 10.7.2.2-7 S-Band Network Transponder, Upper Quad Antennas, Beam Configuration

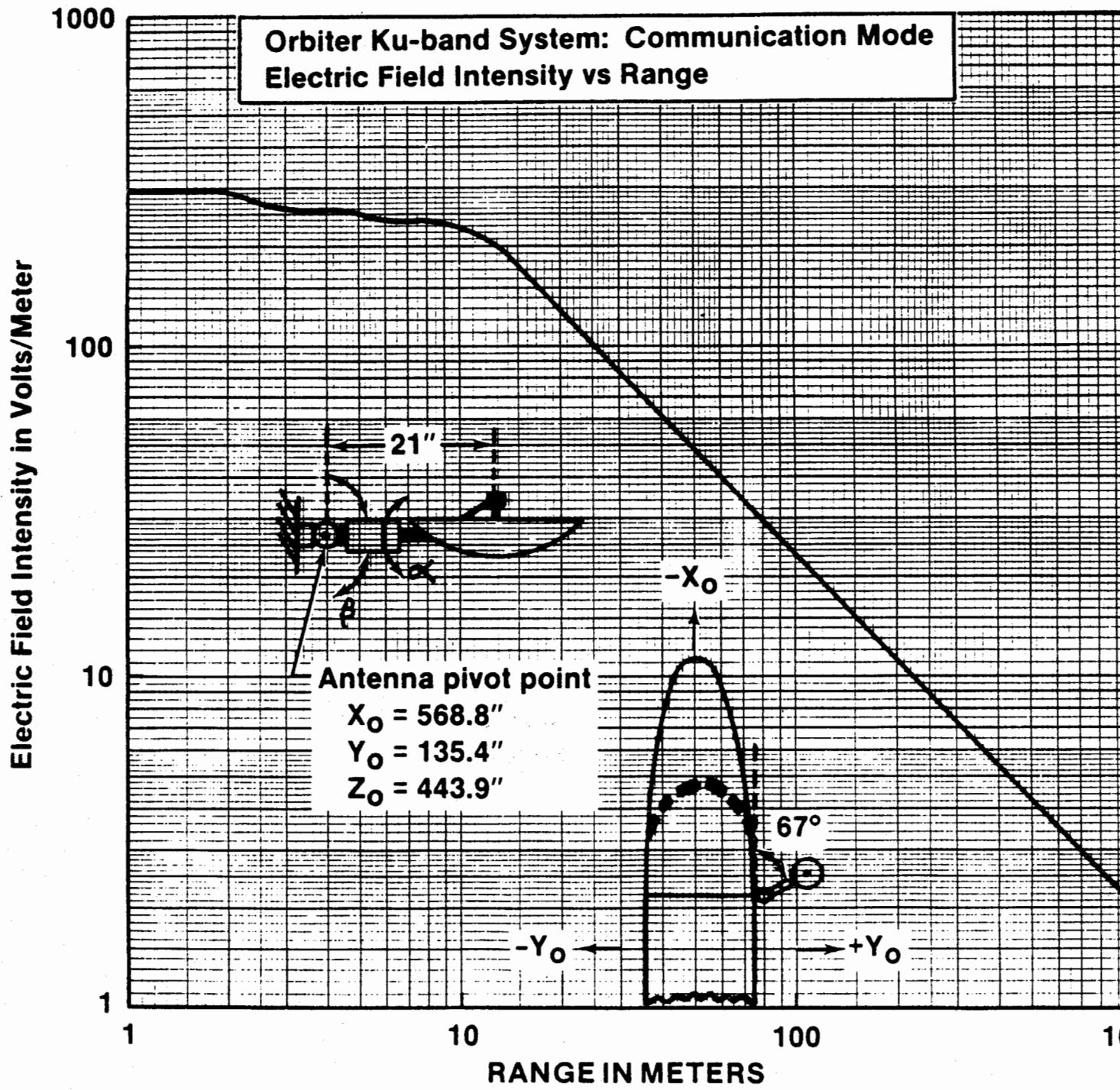


FIGURE 10.7.2.2-8 Orbiter Ku-Band System: Communication Mode Electric Field Intensity vs Range

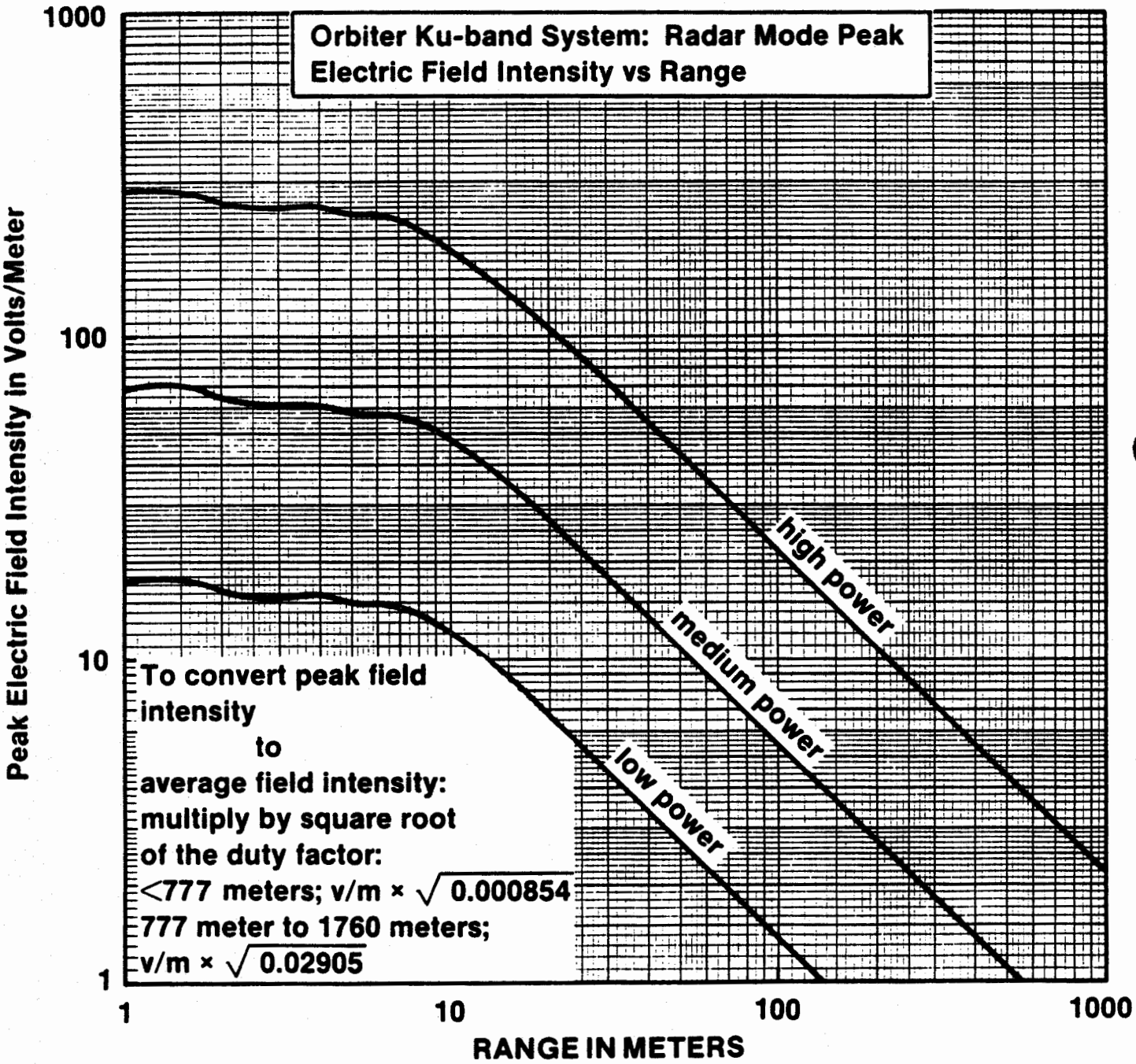


Figure 10.7.2.2-9 Orbiter Ku-Band System: Radar Mode Peak Electric Field Intensity vs Range

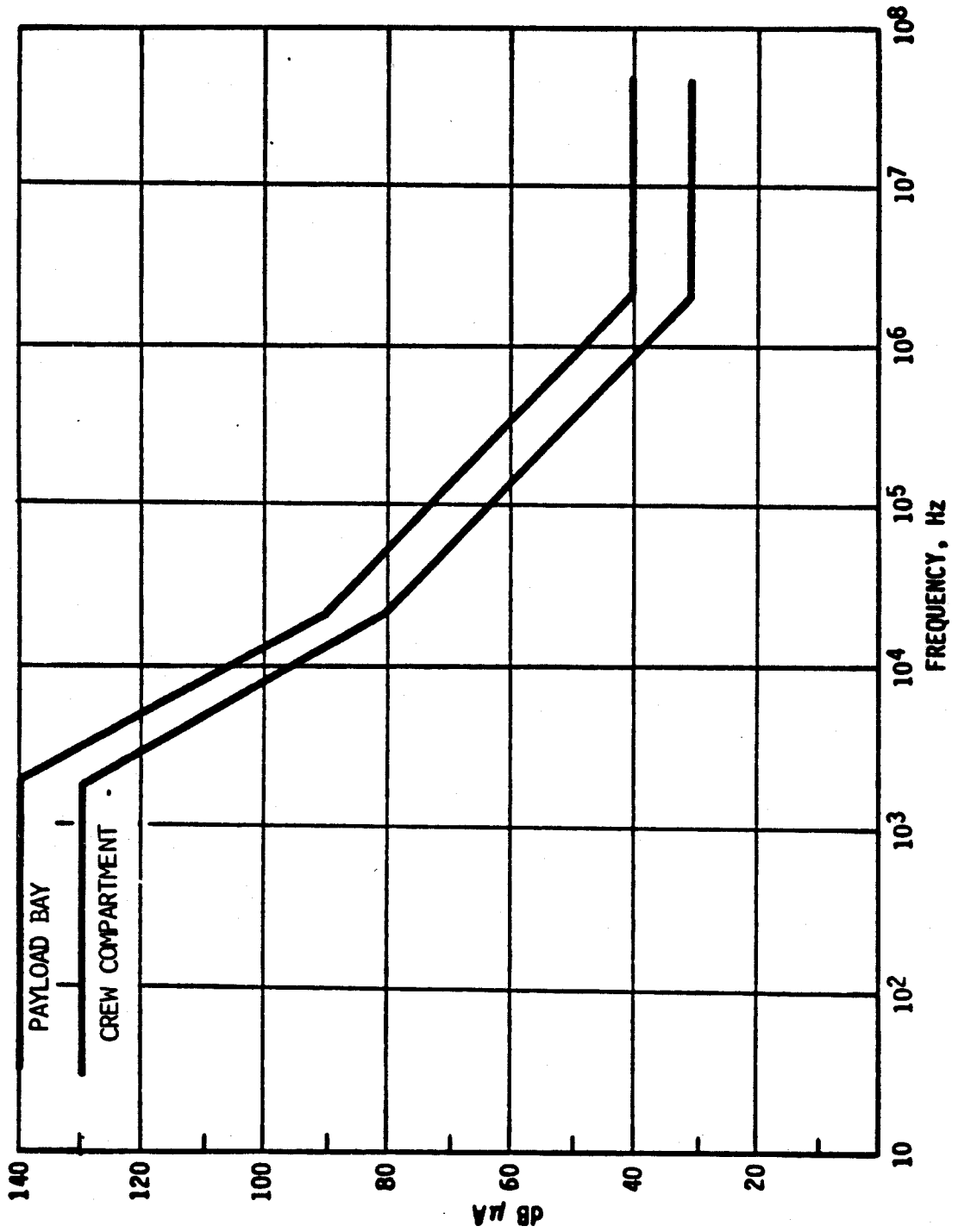


Figure 10.7.3.1-1 Cargo Allowable Conducted Narrow-Band Emissions

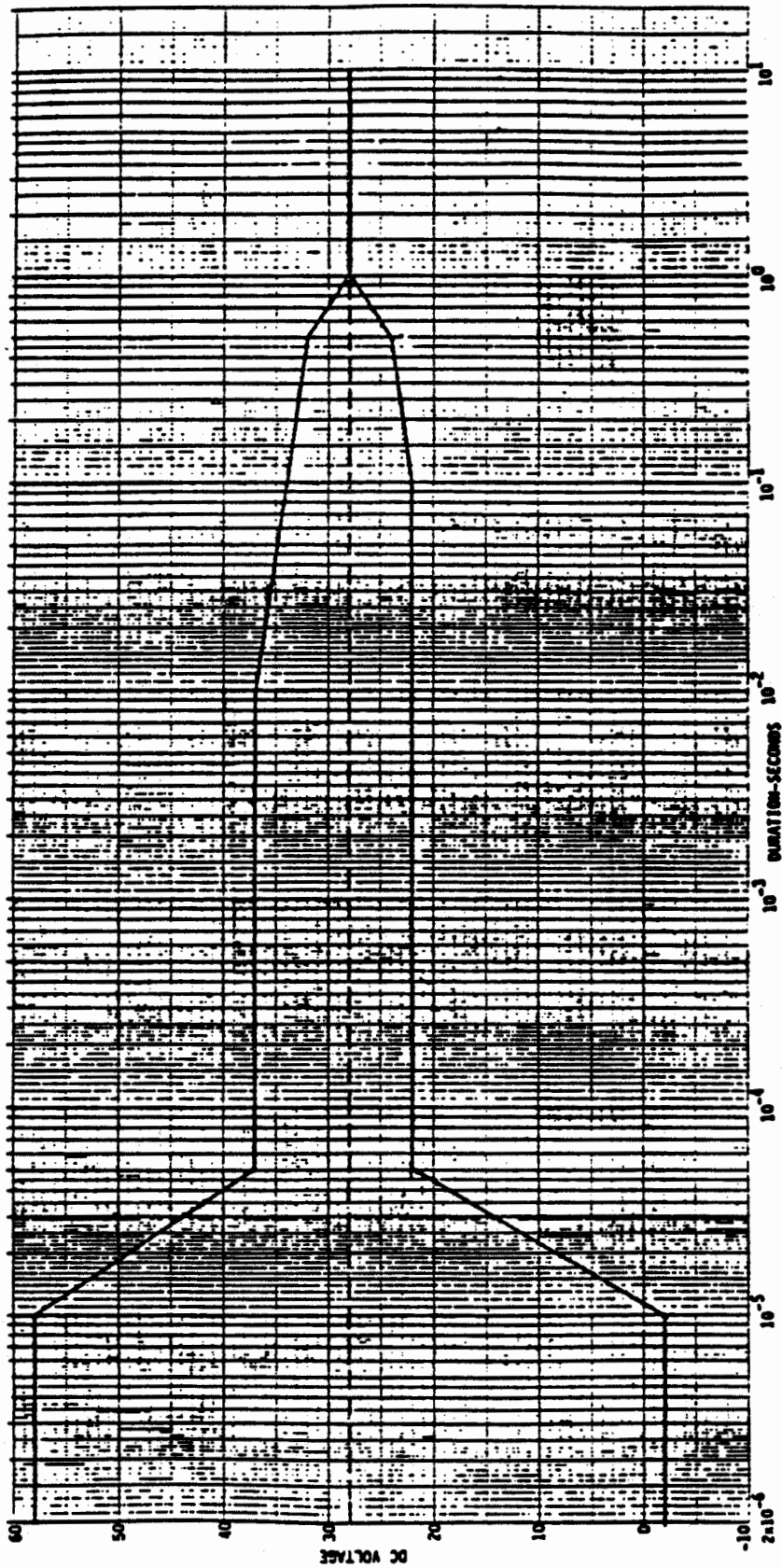


Figure 10.7.3.1-2 Limit Envelope Of Cargo-Generated Transients (Line-To-Line) On DC Power Buses For Normal Electrical System

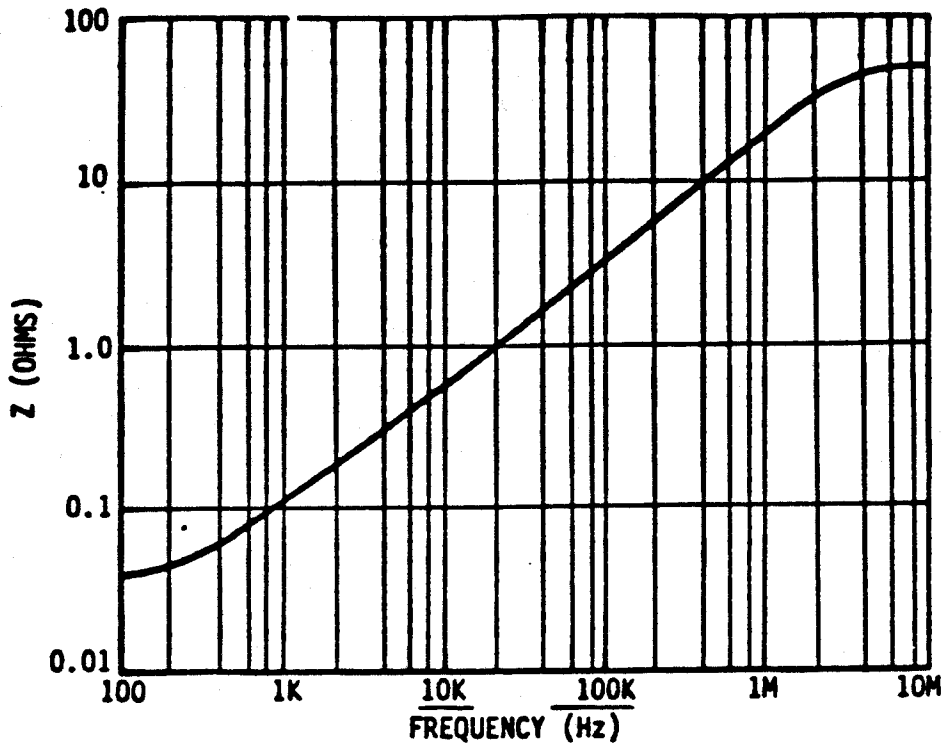


Figure 10.7.3.1-3 Orbiter DC Power Source Impedance (Ground Power)

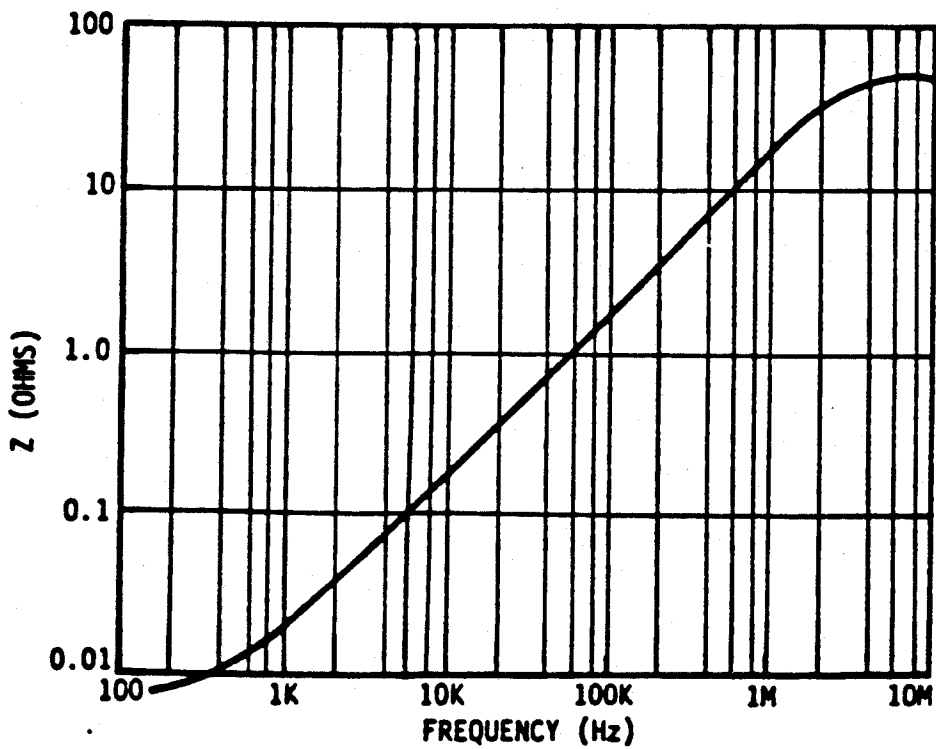


Figure 10.7.3.1-4 Orbiter DC Power Source Impedance (In Flight)

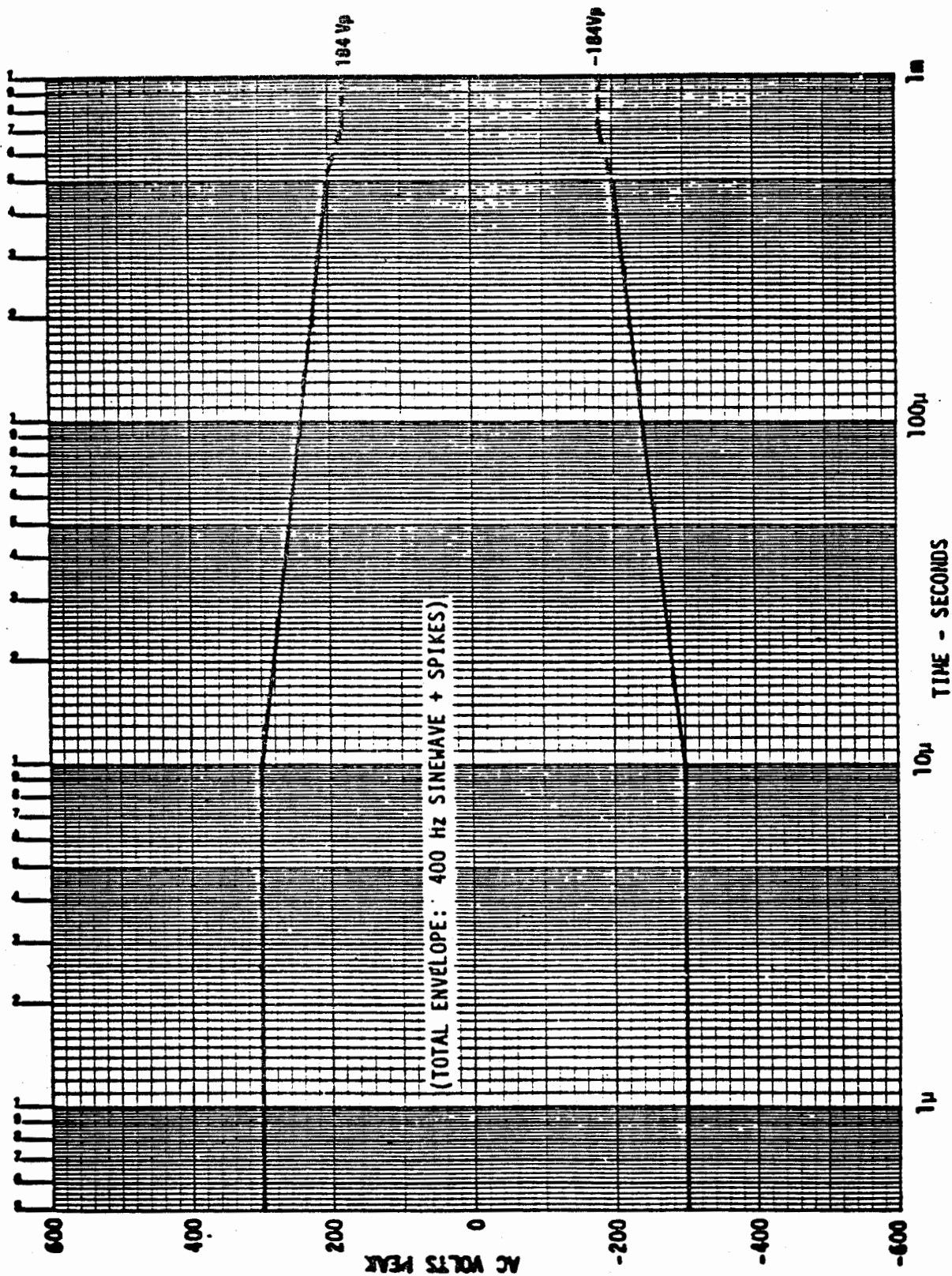


FIGURE 10.7.3.1-5 ENVELOPE OF CARGO ALLOWED SPIKES ON THE AC POWER BUS



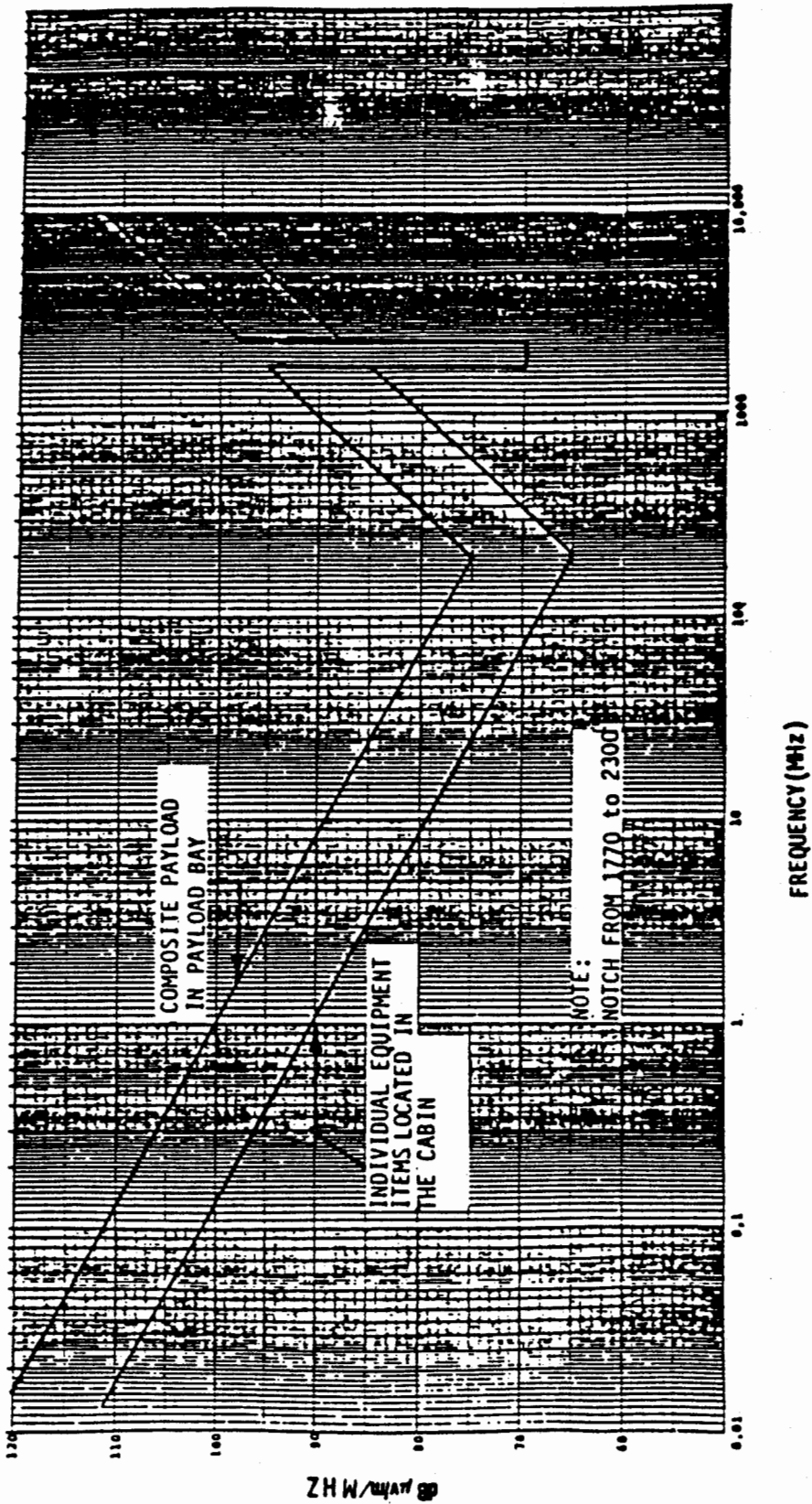


Figure 10.7.3.2-1 Cargo Allowable Unintentional Radiated Broadband Emissions

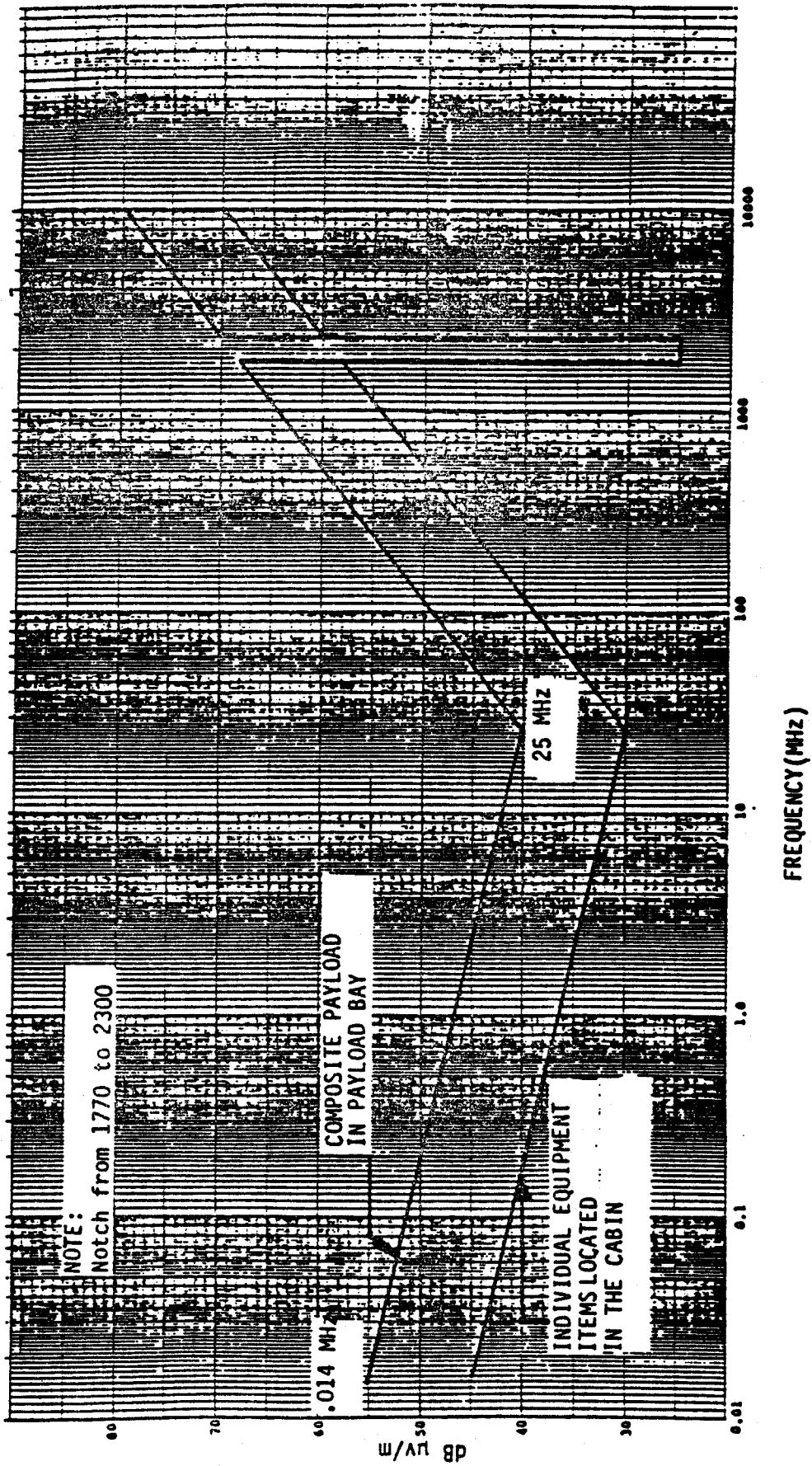


Figure 10.7.3.2-2 Cargo Allowable Unintentional Radiated Narrowband Emissions

ELECTRIC FIELD STRENGTH VS. FREQUENCY

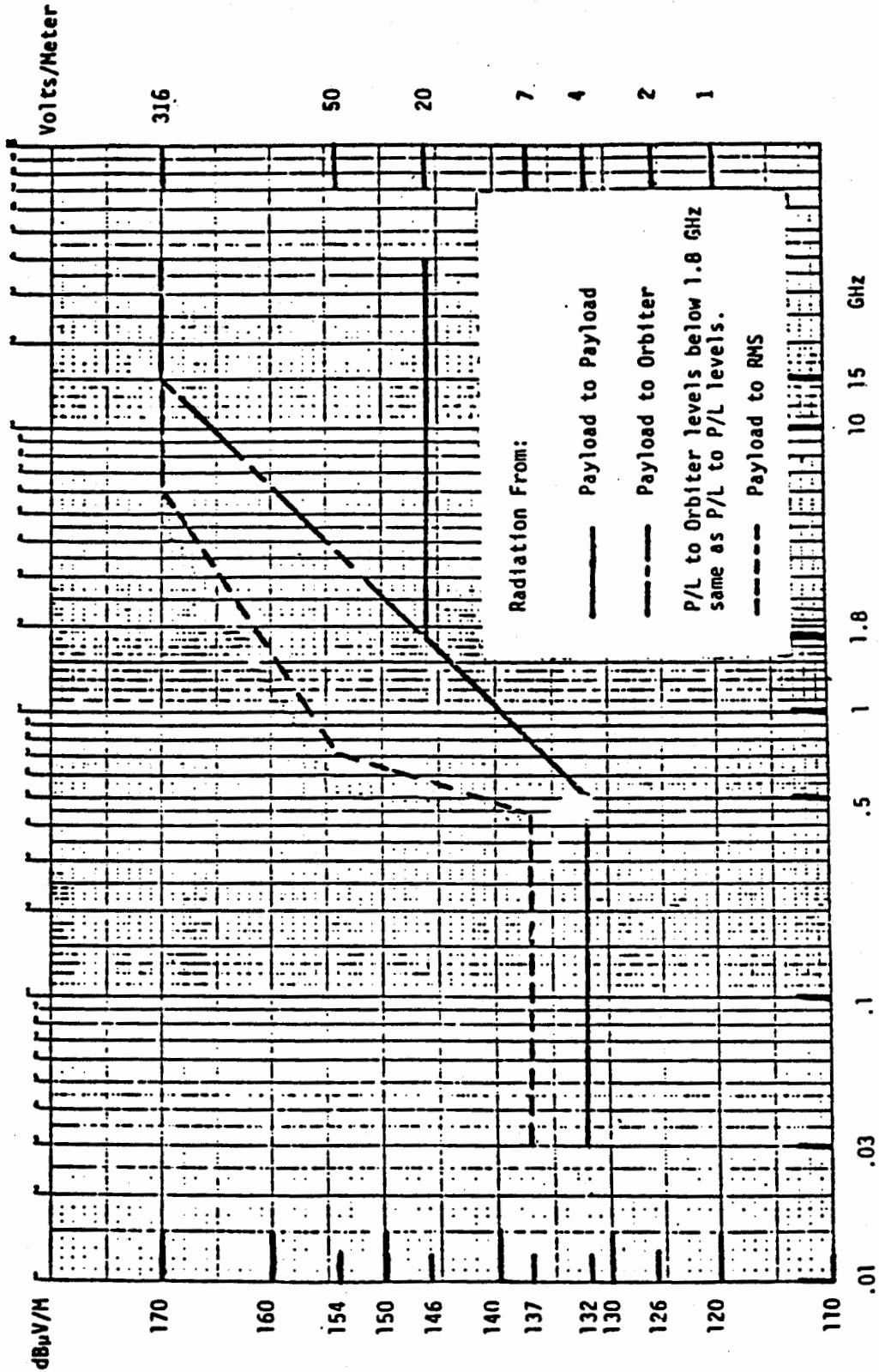


Figure 10.7.3.2-3 Allowable Intentional Electric Field Strength in The Cargo Bay

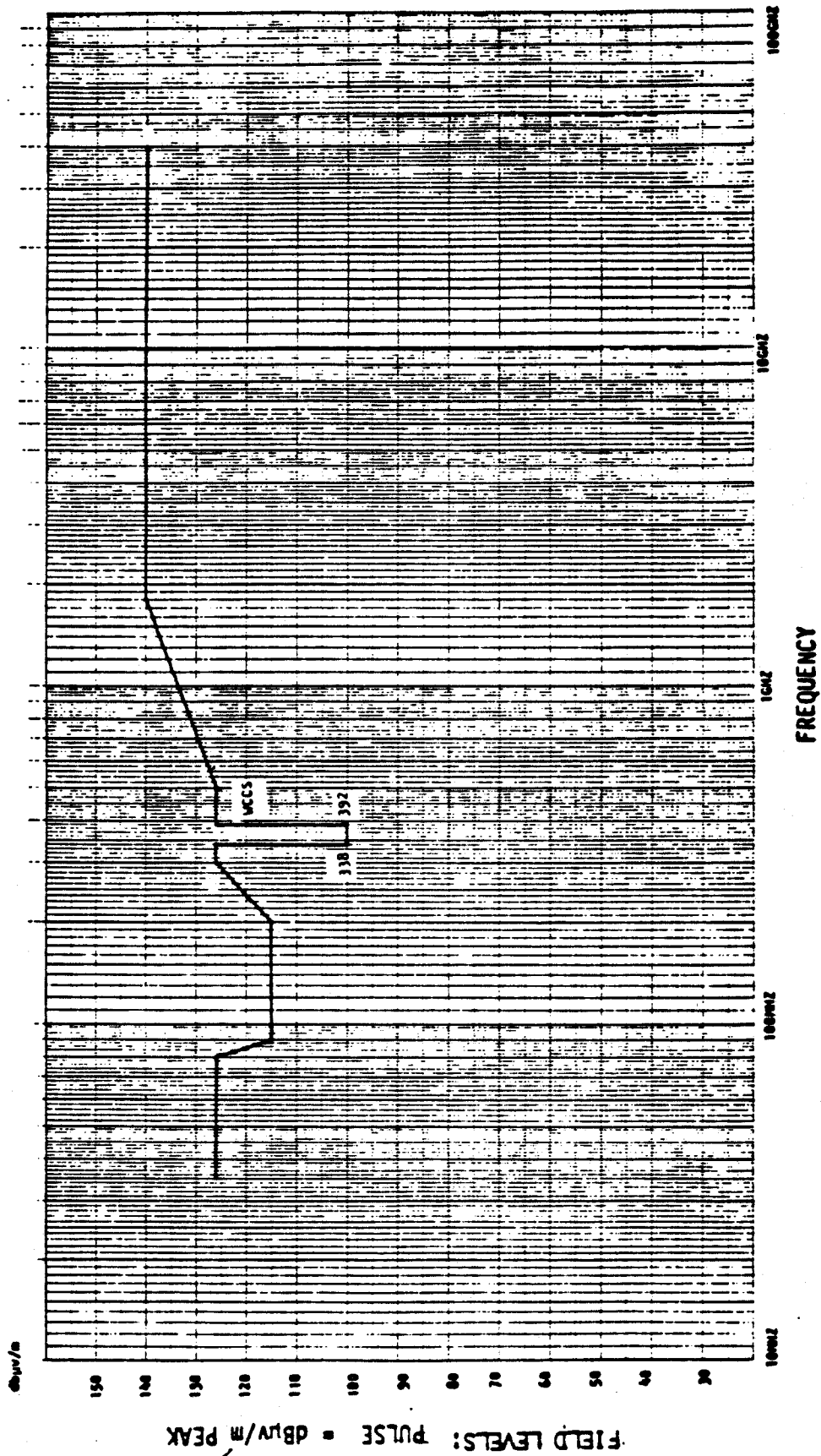


Figure 10.7.3.2-4 Allowable Intentional Electric Field Strength in The Crew Compartment



## 10.8 NUCLEAR RADIATION

Materials used in any of the Orbiter or payload subsystems, containing natural or man-made radioisotopes (in any quantity, including trace amounts), shall be avoided without prior approval by waiver obtained from NASA-JSC. The waiver request shall specify the radioisotope species, quantities or activities, and other pertinent data such as the location on the Orbiter where the material is to be installed.

## 10.9 ILLUMINATION

10.9.1 Cargo Bay Lighting. The lights provided to illuminate the Cargo Bay shall be as specified in Table 10.9.1-1.

*Table 10.9.1-1 Cargo Bay Lighting And Illumination*

Component Performance	Orbiter Baseline
Payload Bay Floodlights Watts Lumens/Watt Type Beam	200 (a) 40 Minimum Arc Discharge 135° x 135°
Docking Floodlight Watts Lumens/Watt Beam	200 40 Minimum 120° x 120°
Overhead/Docking Light Watts Lumens/Watt Beam	130 12 Minimum 120° x 120°
RMS Light Watts Lumens/Watt Beam	150 12 Minimum 80°

(a) *Includes 40 watts in cold-plated ballast*

10.10 Cargo Bay Ferry Flight Environments. During Ferry Flight Operations, the payload within the cargo bay will be exposed to ambient conditions which will not be controlled or monitored. Payloads normally will not be powered nor any heating or cooling systems activated. The following Ferry Flight Environment conditions within the cargo bay shall be generally considered as extreme conditions to which a payload may be exposed. For payloads which require a conditioned environment during surface operations, purge cooling/heating can be made available at selected sites. Payloads having special thermal requirements for either surface or flight operations shall specify such requirements in the applicable PSP.

10.10.1 Pressure. Pressure shall be as follows:

Surface	12.36 to 15.23 psia
16,000 Feet Pressure Altitude	8.00 psia minimum

10.10.2 Temperature. Temperatures shall be as follows:

Surface - Uncontrolled: *	+103 to +1253
Surface - Conditioned: **	+483 to +1003 at 165 lb/min. flow
Altitude: ***	+353 to +803

\* The temperature extremes apply only for ferry flights between primary or secondary landing sites and are the extremes of the diurnal variations for cold and hot conditions respectively.

\*\* Conditioned purge air at the specified temperature range and flow can be made available at selected sites. The temperature range to be provided shall be negotiated based on shared cargo considerations.

\*\*\* Obtained by altitude adjustment. Maximum duration of any flight segment is 4 hours.

10.10.3 Humidity. The relative humidity for both surface and altitude conditions may range between 2 percent to 98 percent.

10.10.4 Dynamic Induced Environments. Dynamic loads, acoustic noise, and vibration induced environments for ferry flight conditions other than carrier aircraft landing are less critical as compared to Shuttle launch and landing. For carrier aircraft landing at high sink rates, the payload components being ferried may experience load factors on the same order as launch and landing. If such a "hard landing" occurs the SJS will conduct analyses to determine the severity of the loading environment.



## 11.0 OTHER INTERFACE CONSTRAINTS AND LIMITATIONS

### 11.1 Safety Critical Interfaces.

11.1.1 Interface Identification. (MSIS to payload interfaces which are associated with failure tolerance requirements of NHB 1700.7 shall be identified in the payload unique 9CD.)

### 11.2 ENGINE PLUMES

11.2.1 OMS Engines. Nominal locations of the two OMS engines and orientations of the plumes are shown in Figure 11.2.1-1. Nominal engine characteristics affecting definition of OMS plume flowfields are shown in Table 11.2.1-1. Typical, plume, constant-density contours generated by a single engine operating in a vacuum are shown in Figure 11.2.1-2. Figure 11.2.1-3 shows the nominal gas static temperature, as a function of the density constant  $K\rho$ , throughout the plume shown in Figure 11.2.1-2. Figure 11.2.1-4 shows the nominal plume gas Mach number, as a function of the density constant  $K\rho$ , throughout the plume shown in Figure 11.2.1-2. Figure 11.2.1-5 shows the nominal relationship between gas static pressure and impingement force on a normal flat plate (computed by means of the Diffuse Newtonian Gas Dynamic Interaction Model), both as functions of the density constant  $K\rho$ , throughout the plume shown in Figure 11.2.1-2. The referenced figures were generated by source flow analysis, represent single engine only (multiple engine effects not considered), valid for continuum flow only, free molecular flow not considered, and are presented for preliminary assessment use only.

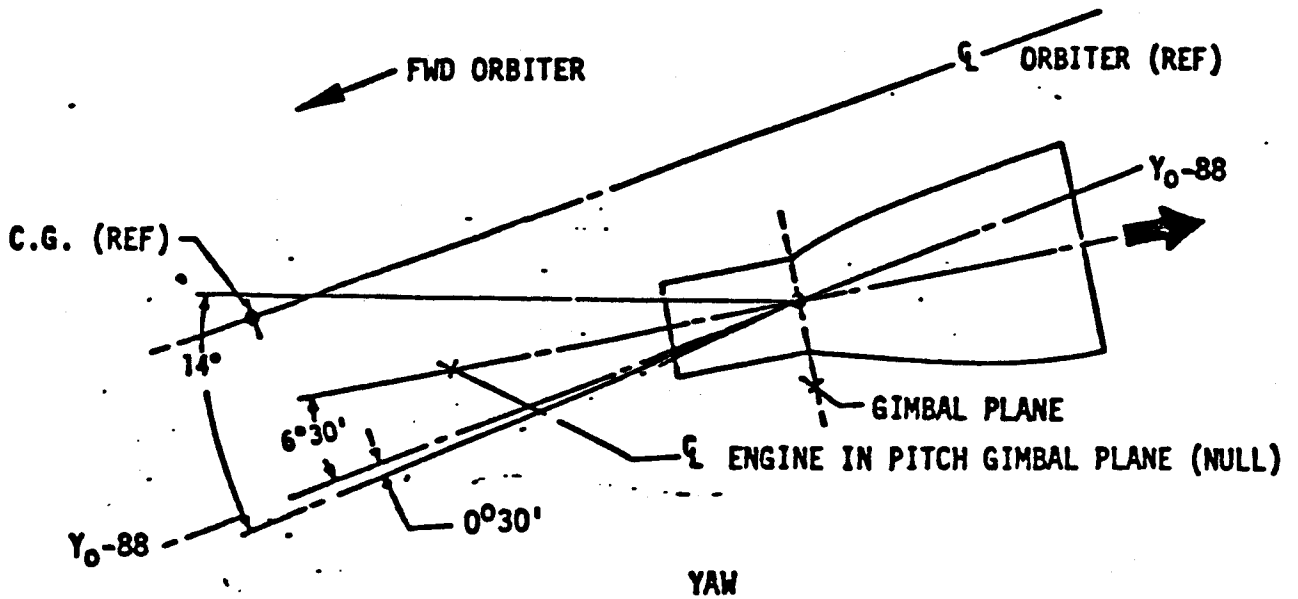
11.2.2 RCS Engines. Nominal locations, nomenclature and orientations of the thirty-eight RCS engines and plumes are shown in Figure 11.2.2-1. Nominal engine characteristics affecting definition of RCS plume flowfields are shown in Table 11.2.1-1. The engine plume characteristics described in the following figures corresponds to the effective engine thrust vector, rather than the engine/nozzle centerline due to the effects of nozzle scarfing to conform to the Orbiter outer moldline. Typical, plume, constant-density contours generated by a single engine operating in a vacuum are shown in Figure 11.2.2-2. Figure 11.2.2-3 shows typical, contaminants (liquid/solid phase), constant mass-flux-rate contours throughout the plume shown in Figure 11.2.2-2. With the nominal RCS nozzle configuration ( $\epsilon$ , defined in Table 11.2.1-1) and the computed non-gas (liquid/solid) phase flow rate, the contaminants plume has the maximum angular displacement ( $\theta_M$ ) defined in Table 11.2.1-1, and it lies entirely within the gas-phase envelope. The distribution of contaminants in this plume is such that the largest mass particles are contained within a cone defined by the effective nozzle expansion angle  $\theta_N$ . Composition of the contaminants is defined in Paragraph 10.6.3. Figure 11.2.2-4 shows the nominal gas static temperature, as a function of the density constant  $K\rho$ , throughout the plume shown in Figure 11.2.2-2. Figure 11.2.2-5 shows the nominal plume gas Mach number, as a function of the density constant  $K\rho$ , throughout the plume shown in Figure 11.2.2-2. Figure 11.2.2-6 shows the nominal relationship between gas static pressure and impingement force on a normal flat plate (computed by means of the Diffuse Newtonian Gas Dynamic Interaction Model), both as functions of

the density constant  $K\rho$ , throughout the plume shown in Figure 11.2.2-2. The referenced figures were generated by source flow analysis, represent single engine only (multiple engine effects not considered), valid for continuum flow only, free molecular flow not considered, and are presented for preliminary assessment purposes only.

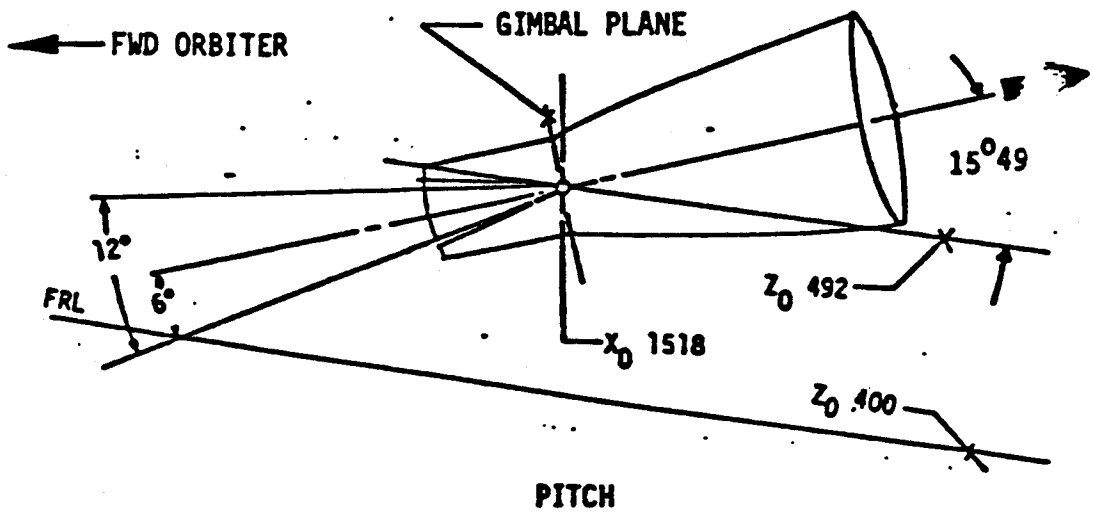
11.2.3 Vernier RCS (VRCS) Engines. Nominal locations and orientations of the six VRCS engines and plumes are shown in Figure 11.2.2-1. Nominal engine characteristics affecting definition of VRCS plume flowfields are shown in Table 11.2.1-1. The engine plume characteristics described in the following figures corresponds to the effective engine thrust vector, rather than the engine/nozzle centerline due to the effects of nozzle scarfing to conform to the Orbiter outer moldline. Typical, plume, constant-density contours generated by a single engine operating in a vacuum are shown in Figure 11.2.3-1. Figure 11.2.3-2 shows typical, contaminants (liquid/solid phase), constant mass-flux-rate contours throughout the plume shown in Figure 11.2.3-1. With the nominal VRCS nozzle configuration ( $\epsilon$ , defined in Table 11.2.1-1) and the computed non-gas (liquid/solid) phase flow rate, the contaminants plume has the maximum angular displacement ( $\theta_M$ ) defined in Table 11.2.1-1, and it lies entirely within the gas-phase envelope. The distribution of contaminants in this plume is such that the largest mass particles are contained within a cone defined by the effective nozzle expansion angle  $\theta_N$ . Composition of the contaminants is defined in Paragraph 10.6.3. Figure 11.2.3-3 shows the nominal gas static temperature, as a function of the density constant  $K\rho$ , throughout the plume shown in Figure 11.2.3-1. Figure 11.2.3-4 shows the nominal plume gas Mach number, as a function of the density constant  $K\rho$ , throughout the plume shown in Figure 11.2.3-1. Figure 11.2.3-5 shows the nominal relationship between gas static pressure and impingement force on a normal gas plate (computed by means of the Diffuse Newtonian Gas Dynamic Interaction Model), both as a function of the density constant  $K\rho$ , throughout the plume shown in Figure 11.2.3-1. The referenced figures were generated by source flow analysis, represent single engine only (multiple engine effects not considered), valid for continuum flow only, free molecular flow not considered, and are presented for preliminary assessment purposes only.

Table 11.2.1-1 Engine Characteristics Affecting Definition Of Plume Flowfields

PARAMETER	OMS	RCS	VRCS
$P_C$ , Chamber Pressure (psi)	131.0	152.0	110.0
$T_t$ , Chamber Temperature ( $^{\circ}R$ )	5684.0	5468.0	4342.0
$R$ , Gas Constant (ft-lb/lb $^{\circ}R$ )	74.88	75.0	75.0
$\gamma$ , Ratio of Specific Heats	1.228	1.28	1.28
$F$ , Thrust (lbs.)	6000.0	870.0	24.0
$I_{sp}$ , Specific Impulse (sec)	313.2	280.0	265.0
$\epsilon$ , Exit-to-Throat Area Ratio (nominal)	55.0	22.0	20.7
$l_N$ , Nozzle Length (nominal, in.)	-	9.42	3.43
$\theta_N$ , Effective Nozzle Expansion Angle (nominal, deg.)	-	21.77	12.15
$\theta_M$ , Solid-Phase Limiting Streamline Angle (nominal, deg.)	-	53.37	40.97
$X_p$ , Effective Farfield Contaminants Fraction	(TBD)	0.03	0.06



NOTE: BOTH VIEWS ARE SHOWN PERPENDICULAR TO ENGINE CENTERLINE IN NULL POSITION, WITH THE EXCEPTION OF THE PITCH NULL ANGLE (15°49') WHICH IS SHOWN IN THE XZ PLANE.



➔ DIRECTION OF PLUME THRUST

OMS ENGINE LEFT HAND  
SIDE OF ORBITER SHOWN  
RIGHT SIDE SYMMETRICAL

FIGURE 11.2.1-1 OMS ENGINE LOCATION AND ORIENTATION

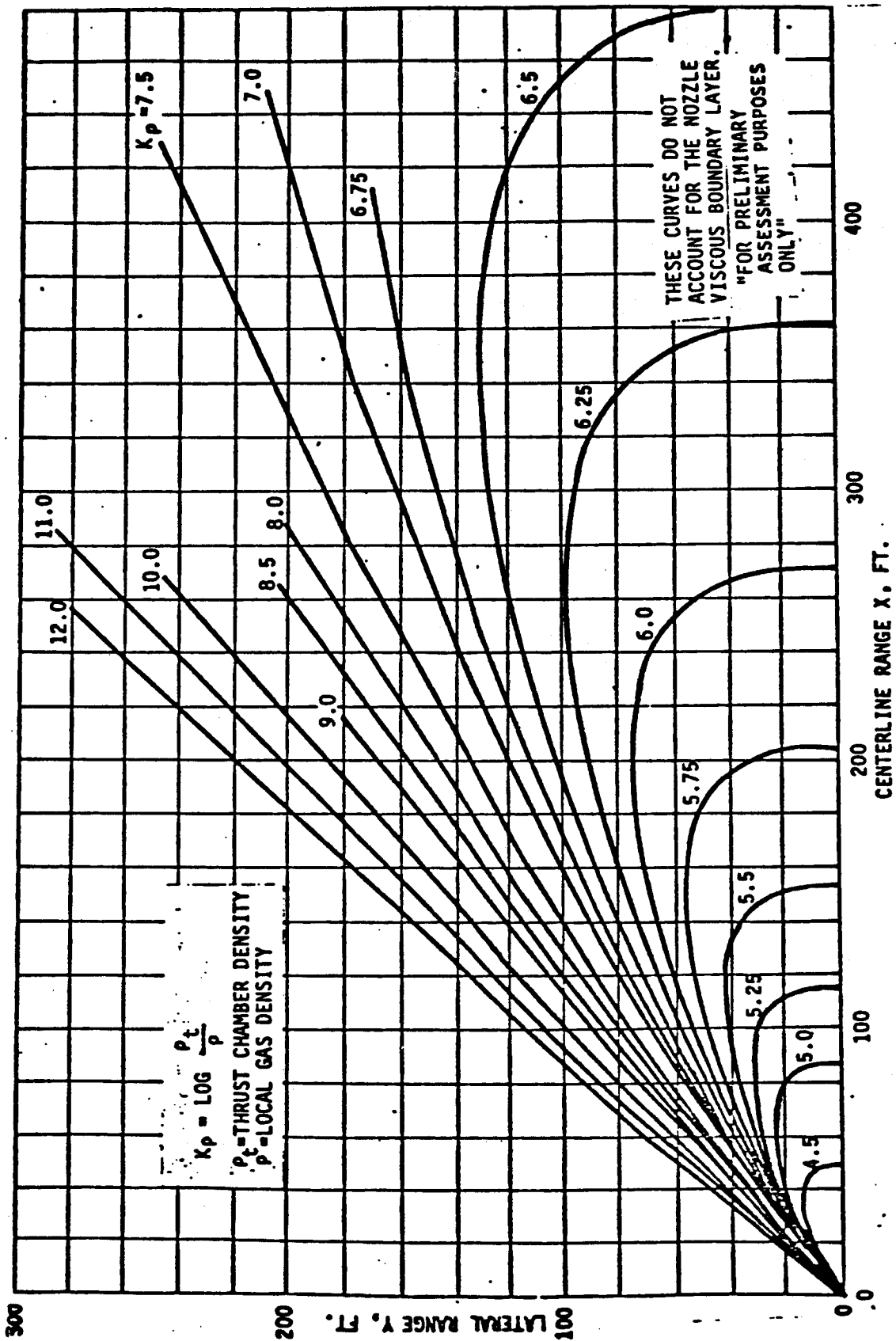


FIGURE 11.2.1-2 OMS PLUME CONSTANT DENSITY CONTOURS,  $K_p$

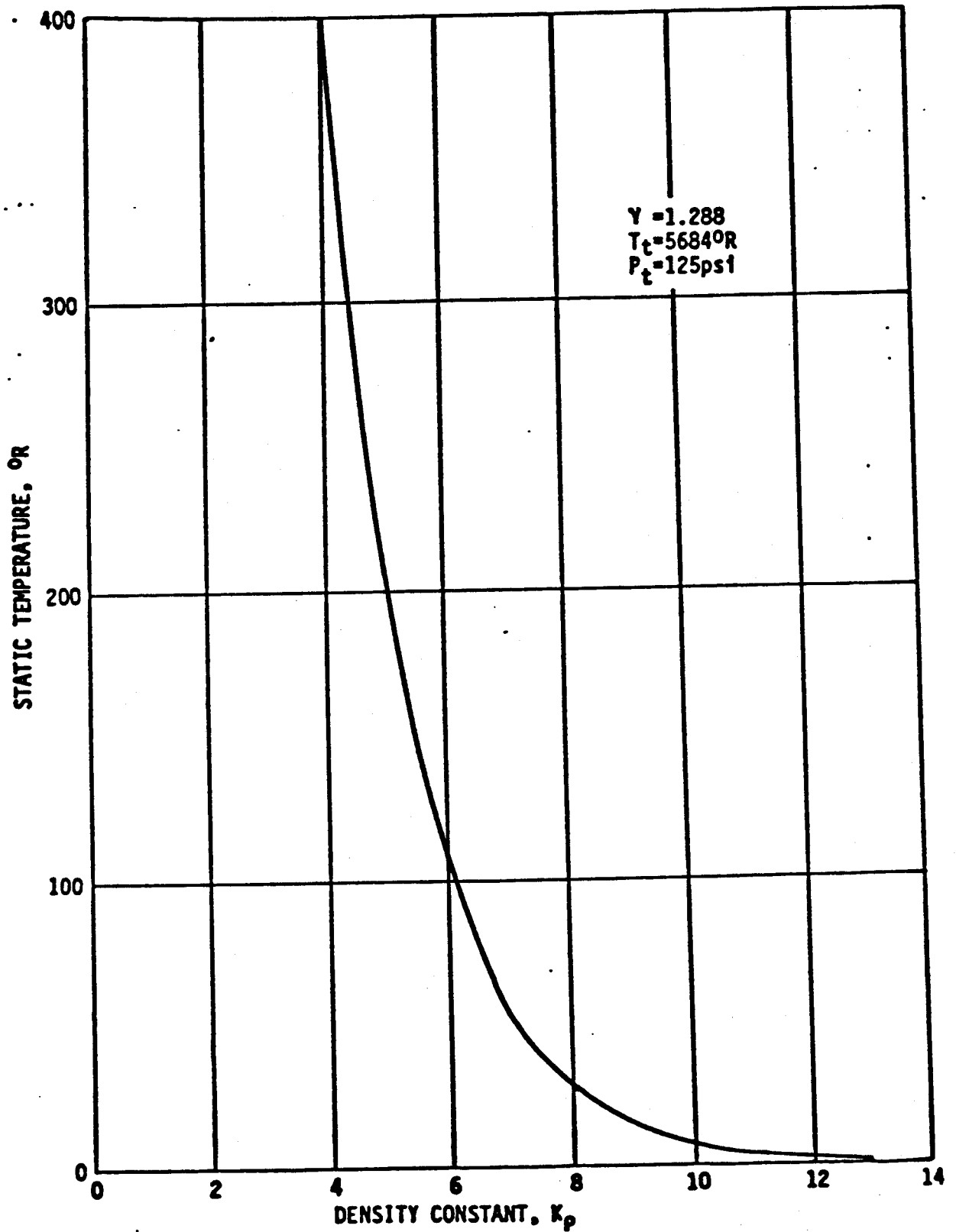


FIGURE 11.2.1-3 OMS PLUME STATIC TEMPERATURE,  $^{\circ}\text{R}$ , AS A FUNCTION OF DENSITY CONSTANT,  $K_{\rho}$

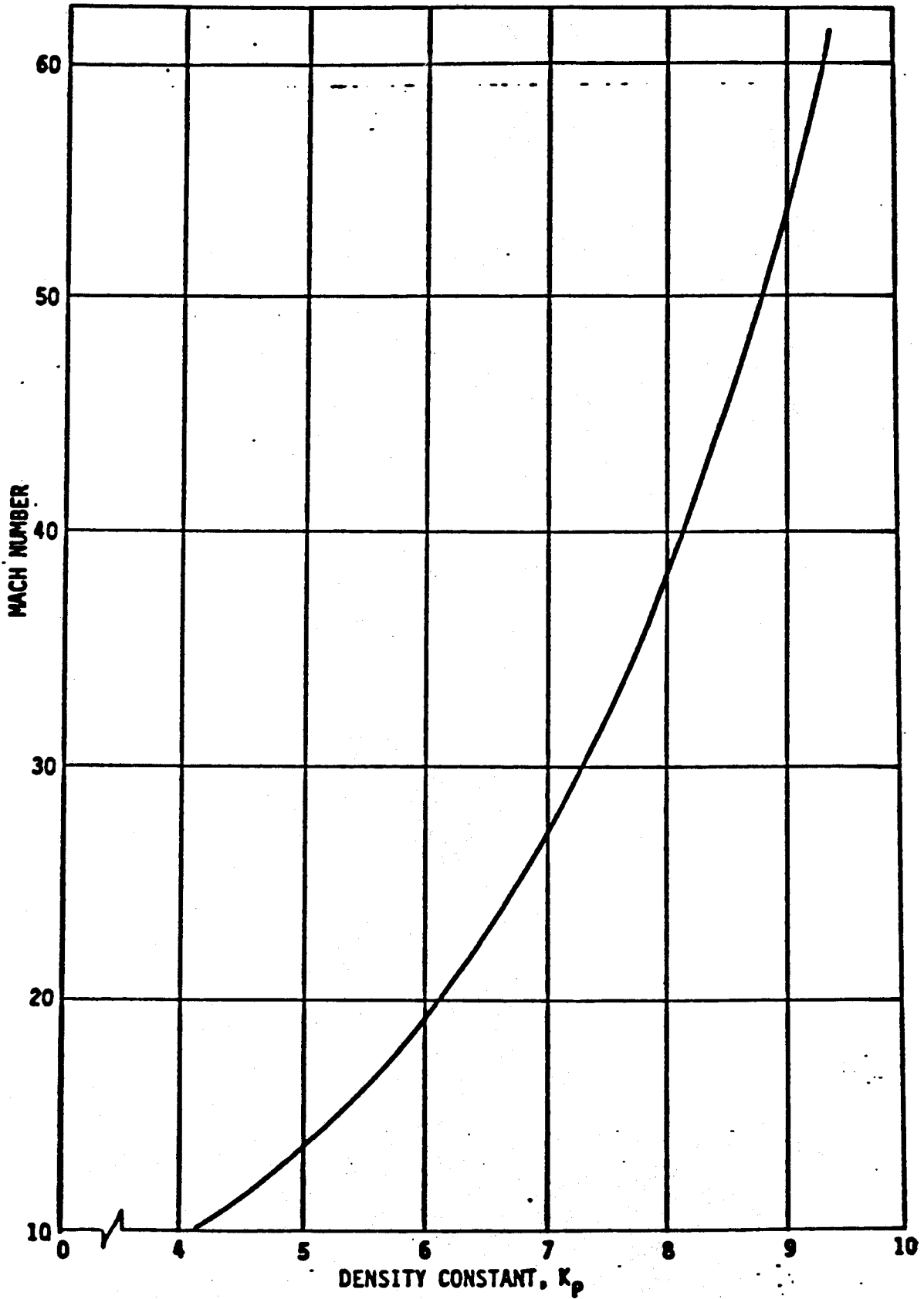


FIGURE 11.2.1-4 MACH NUMBER vs DENSITY CONSTANT,  $K_\rho$  - OMS ENGINE

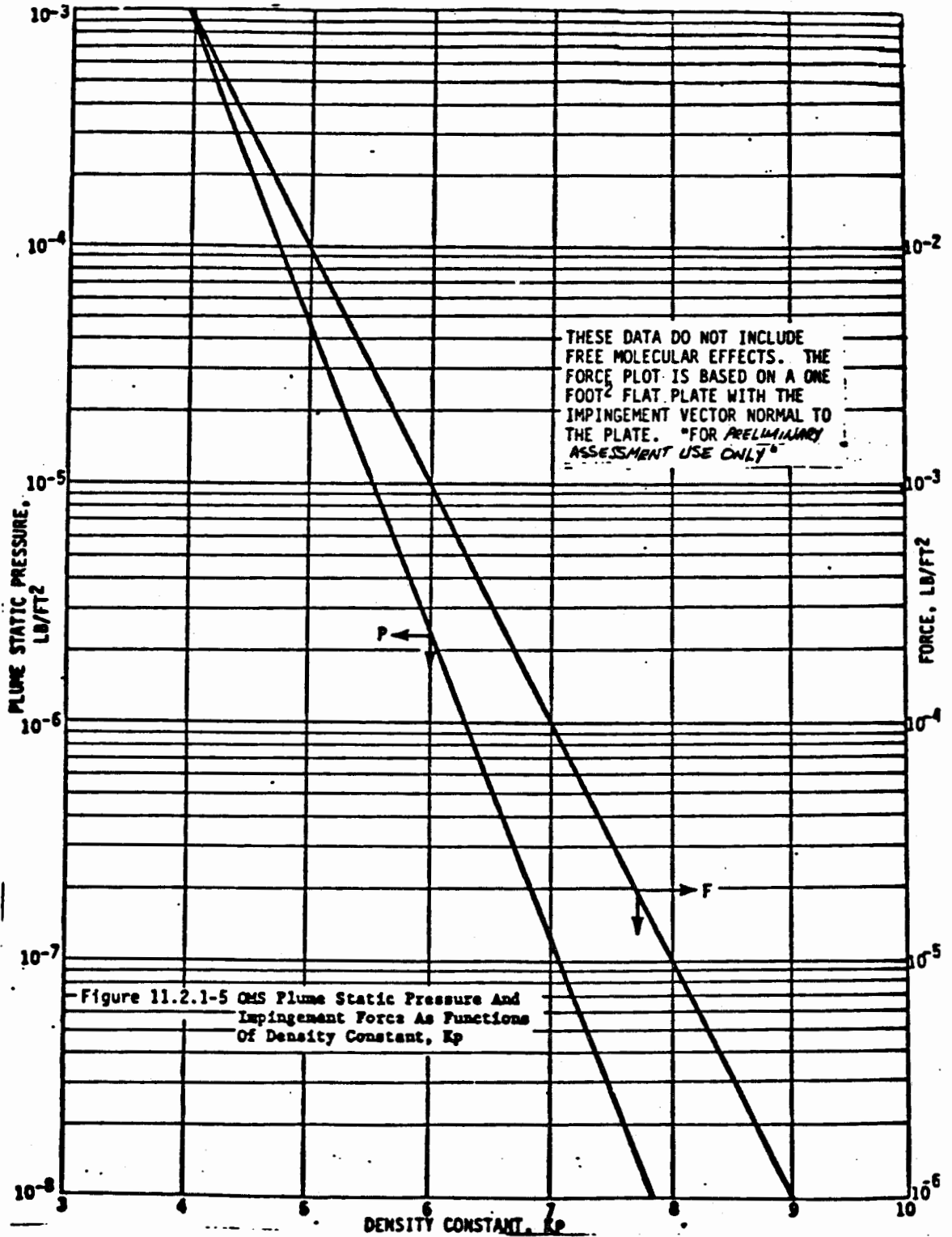


FIGURE 11.2.1-5 OMS PLUME STATIC PRESSURE AND IMPINGEMENT FORCE AS FUNCTIONS OF DENSITY CONSTANT,  $K_p$



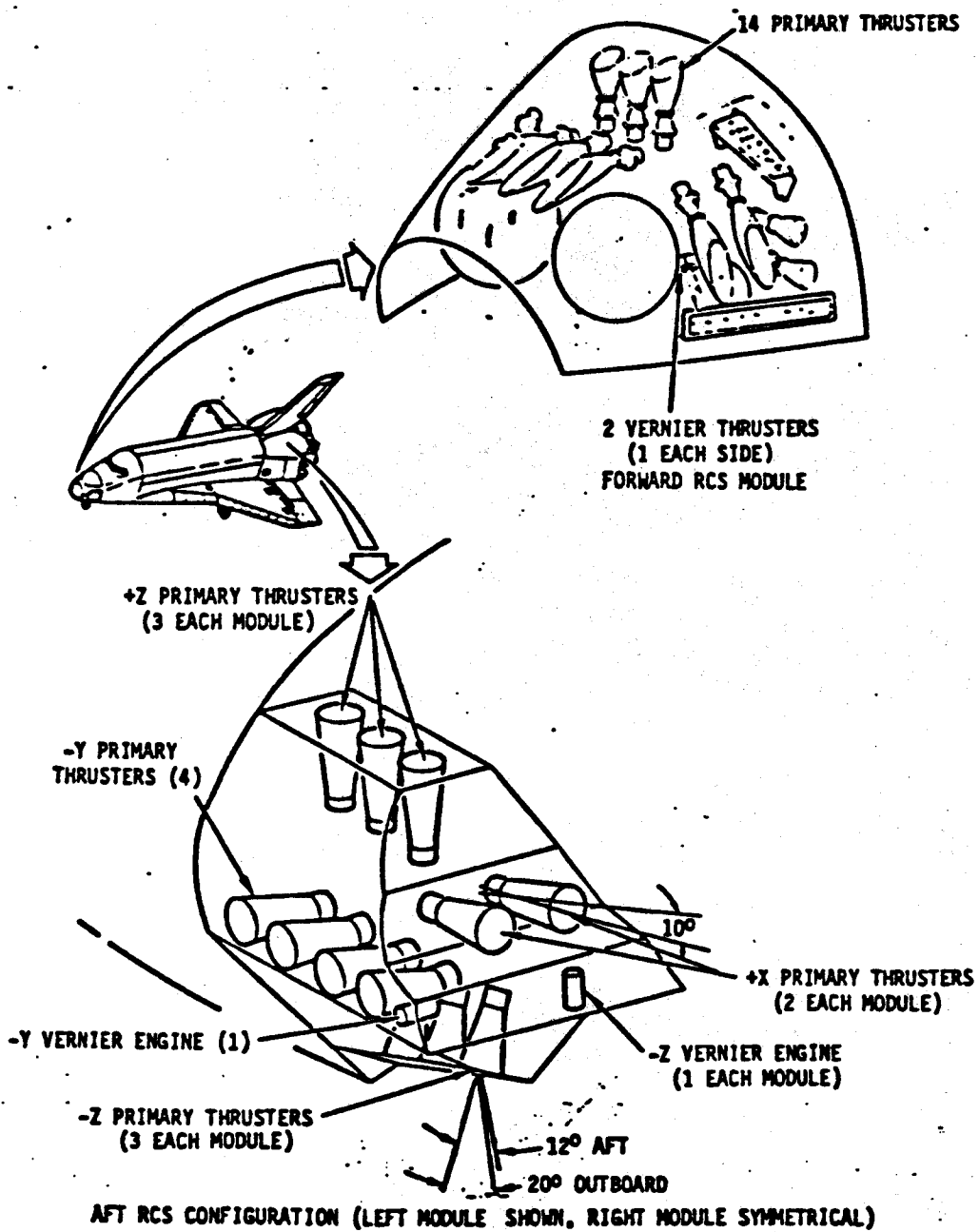
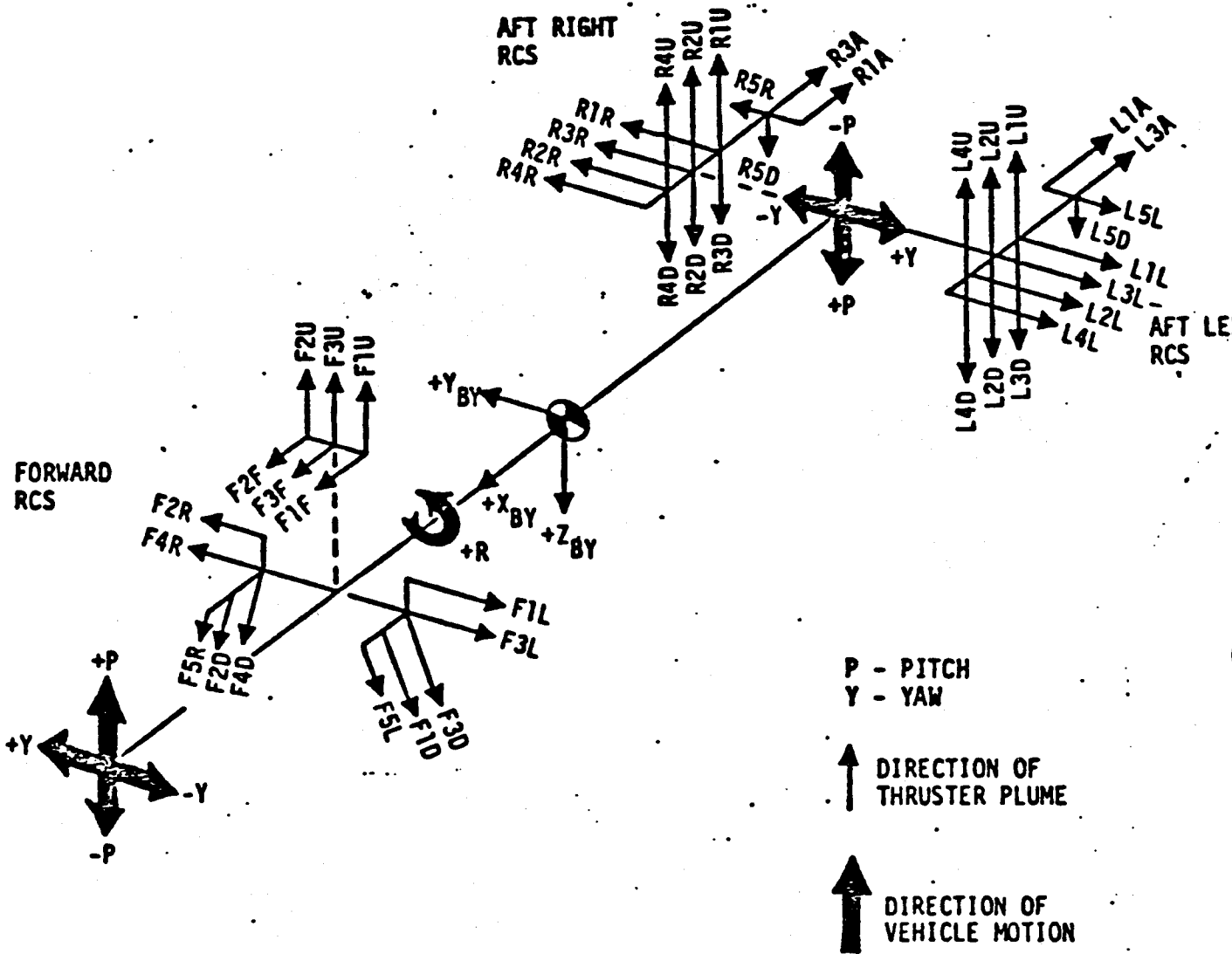


FIGURE 11.2.2-1 RCS/VRCS THRUSTER LOCATIONS AND ORIENTATIONS  
(SHEET 1 OF 4)



**RCS Jet Locations and Plume Directions**

**FIGURE 11.2.2-1 RCS/VRCS THRUSTER LOCATIONS AND ORIENTATIONS (SHEET 2 OF 4)**

NOMINAL THRUST COMPONENTS AND APPLICATION LOCATIONS  
AFT RCS THRUSTS

NOMINAL DIRECTION	THRUSTS ID	THRUST COMPONENTS, (1) LBS			THRUST APPLICATION (2) LOCATION		
		FX <sub>BY</sub>	FY <sub>BY</sub>	FZ <sub>BY</sub>	X <sub>0</sub>	Y <sub>0</sub>	Z <sub>0</sub>
+X	R3A	856.8	0.0	151.1	1555.29	137.00	473.06
	R1A	856.8	0.0	151.1	1555.29	124.00	473.06
	L3A	856.8	0.0	151.1	1555.29	-137.00	473.06
	L1A	856.8	0.0	151.1	1555.29	-124.00	473.06
+Y	L4L	0.0	870.5	-22.4	1516.00	-149.87	459.00
	L2L	0.0	870.5	-22.4	1529.00	-149.87	459.00
	L3L	0.0	870.5	-22.4	1542.00	-149.87	459.00
	L1L	0.0	870.5	-22.4	1555.00	-149.87	459.00
-Y	R4R	0.0	-870.5	-22.4	1516.00	149.87	459.00
	R2R	0.0	-870.5	-22.4	1529.00	149.87	459.00
	R3R	0.0	-870.5	-22.4	1542.00	149.87	459.00
	R1R	0.0	-870.5	-22.4	1555.00	149.87	459.00
+Z	L4U	0.0	0.0	870.0	1516.00	-132.00	480.50
	L2U	0.0	0.0	870.0	1529.00	-132.00	480.50
	L1U	0.0	0.0	870.0	1542.00	-132.00	480.50
	R4U	0.0	0.0	870.0	1516.00	132.00	480.50
	R2U	0.0	0.0	870.0	1529.00	132.00	480.50
	R1U	0.0	0.0	870.0	1542.00	132.00	480.50
-Z	L4D	170.4	291.8	-801.7	1516.00	-111.95	437.40
	L2D	170.4	291.8	-801.7	1529.00	-111.00	440.00
	L3D	170.4	291.8	-801.7	1542.00	-110.06	442.60
	R4D	170.4	-291.8	-801.7	1516.00	111.95	437.40
	R2D	170.4	-291.8	-801.7	1529.00	111.00	440.00
	R3D	170.4	-291.8	-801.7	1542.00	110.06	442.60
-Z(Vernier)	L5D	0.0	0.0	-24.0	1565.00	-118.00	455.44
	R5D	0.0	0.0	-24.0		118.00	455.44
+Y(Vernier)	L5L	0.0	24.0	-0.6		-149.87	459.00
-Y(Vernier)	R5R	0.0	-24.0	-0.6		149.87	459.00

FIGURE 11.2.2-1 RCS/VRCS THRUSTER LOCATIONS AND ORIENTATIONS  
(SHEET 3 OF 4)

NOMINAL THRUST COMPONENTS AND APPLICATION LOCATIONS AFT RCS THRUSTS							
NOMINAL DIRECTION	THRUSTS ID	THRUST COMPONENTS, (1) LBS			THRUST APPLICATION (2) LOCATION		
		FX <sub>BY</sub>	FY <sub>BY</sub>	FZ <sub>BY</sub>	X <sub>0</sub>	Y <sub>0</sub>	Z <sub>0</sub>
-X	F2F	- 879.4	- 26.2	119.9	306.72	14.65	392.96
	F3F	- 879.5	0.0	122.7	306.72	0.0	394.45
	F1F	- 879.4	26.2	119.9	306.72	- 14.65	392.96
+Y	F1L	- 26.3	873.6	18.2	362.67	- 69.50	373.73
	F3L	- 21.0	870.3	0.5	364.71	- 71.65	359.25
-Y	F2R	- 26.3	-873.6	18.2	362.67	69.50	373.73
	F4R	- 21.0	-870.3	0.5	364.71	71.65	359.25
+Z	F2U	- 32.3	- 11.7	874.4	350.93	14.39	413.46
	F3U	- 31.9	0.0	873.5	350.92	0.0	414.53
	F1U	- 32.3	11.7	874.4	350.93	- 14.39	413.46
-Z	F2D	- 28.0	-616.4	-639.5	333.84	61.42	356.95
	F1D	- 28.0	616.4	-639.5	333.84	- 61.42	356.95
	F4D	- 24.8	-612.6	-639.4	348.44	66.23	358.44
	F3D	- 24.8	612.6	-639.4	348.44	- 66.23	358.44
-Z (Vernier)	F5R	- 8.0	- 17.0	- 17.6	324.35	59.70	350.12
	F5L	- 8.0	17.0	- 17.6	324.35	- 59.70	350.12

- (1) MOTION COORDINATES BODY AXIS COORDINATE SYSTEM, SEE FIGURE 3.1.1.4-1  
(2) STATION COORDINATES ORBITER STRUCTURAL COORDINATE SYSTEM, SEE FIGURE 3.1.1.1-1.

FIGURE 11.2.2-1 RCS/VRCS THRUSTER LOCATIONS AND ORIENTATIONS  
(SHEET 4 OF 4)

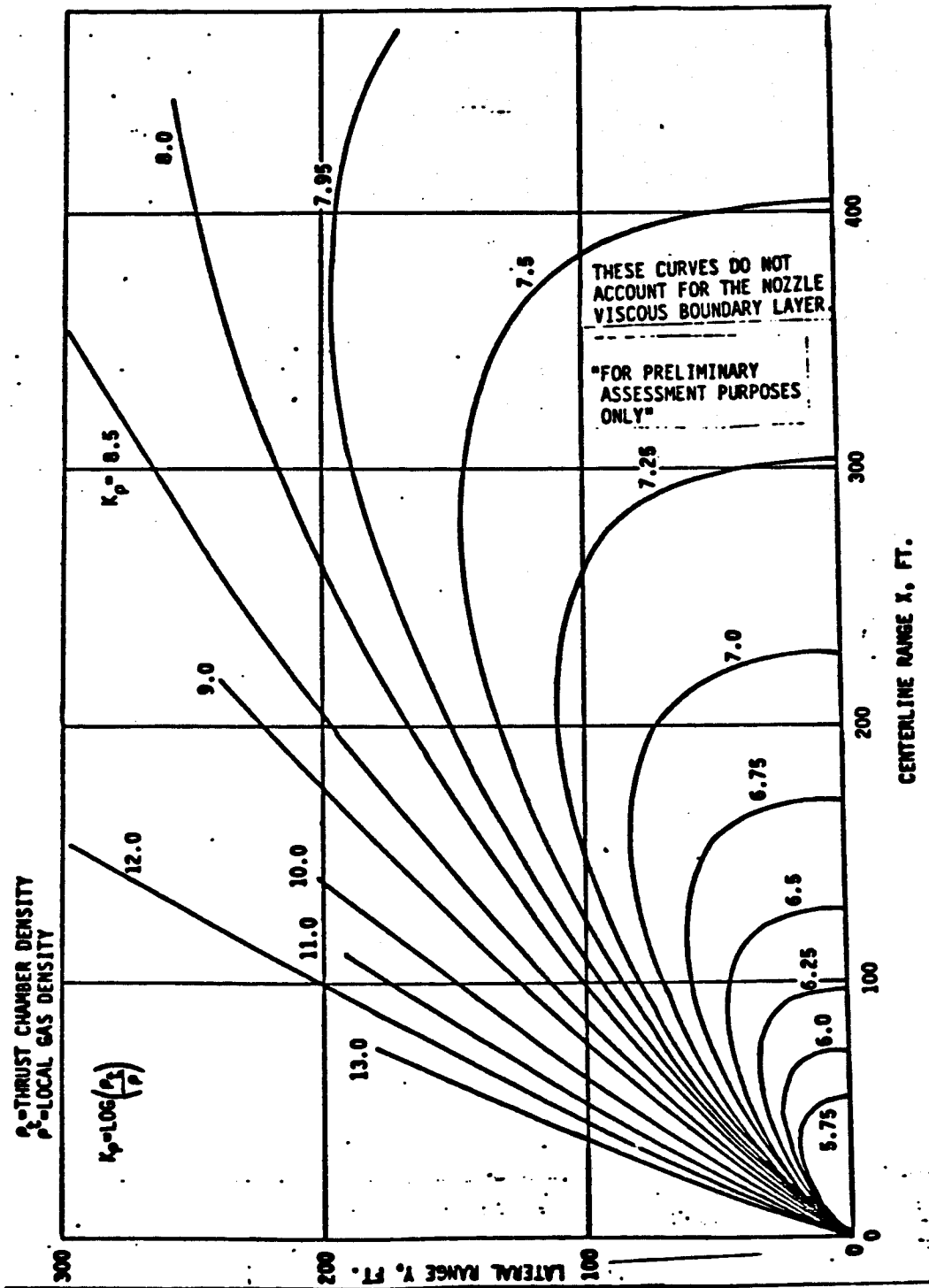


FIGURE 11.2.2-2 RCS PLUME CONSTANT DENSITY CONTOURS -  $K_p$

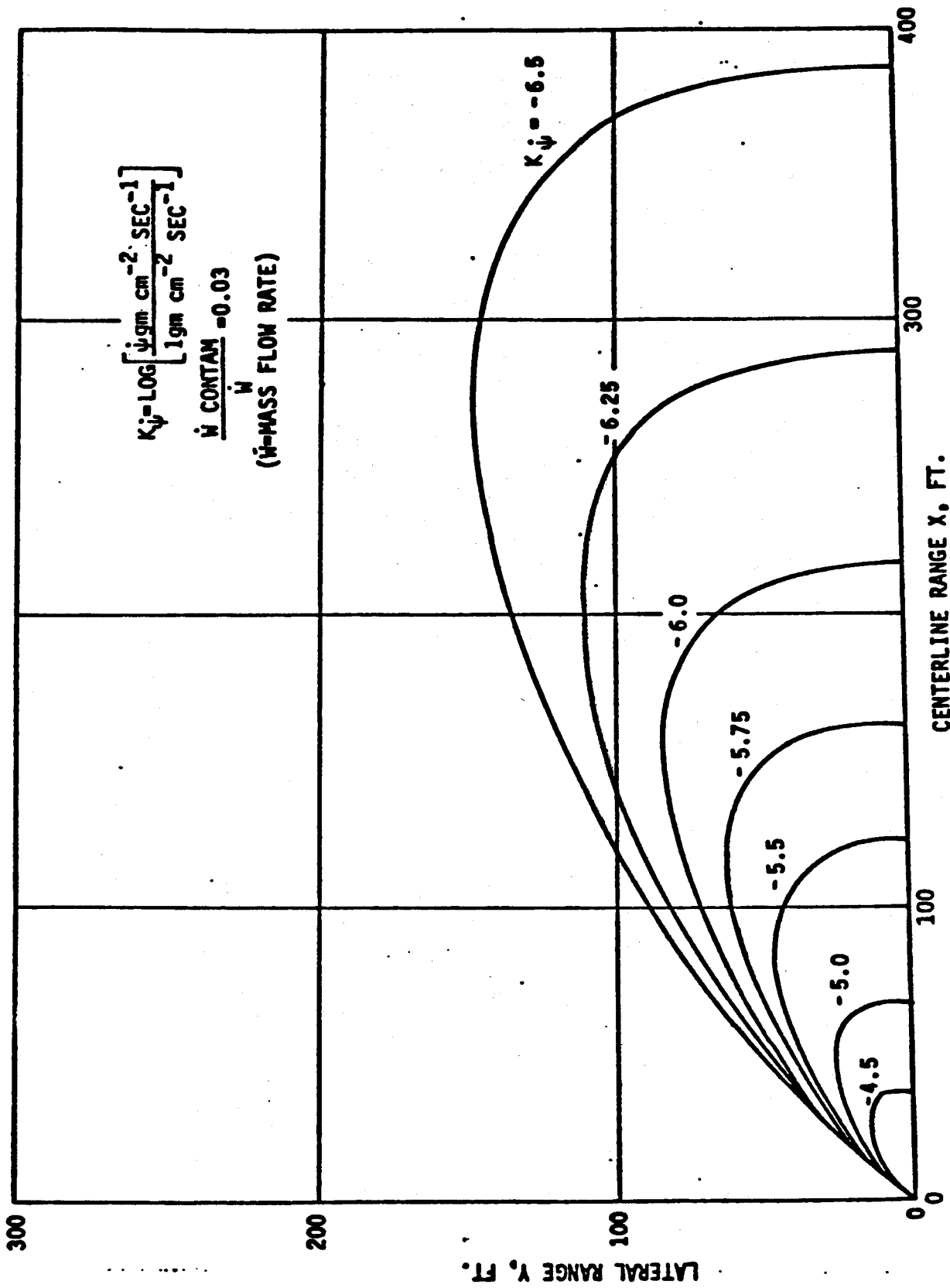


FIGURE 11.2.2-3 RCS CONTAMINANTS CONSTANT MASS-FLUX-RATE CONTOURS

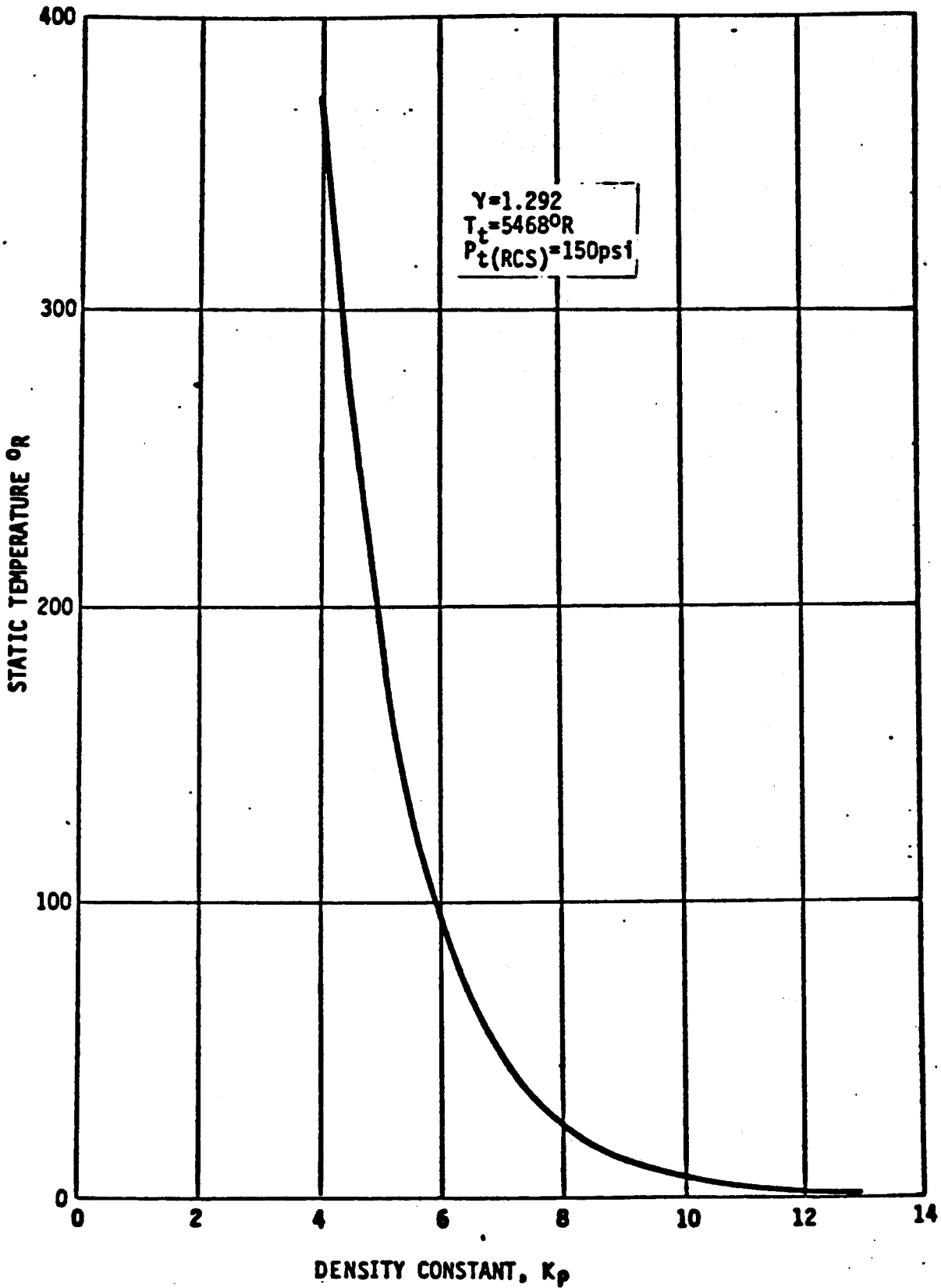


FIGURE 11.2.2-4 RCS PLUME STATIC TEMPERATURE ( $^{\circ}\text{R}$ ) AS A FUNCTION OF DENSITY CONSTANT,  $K\rho$

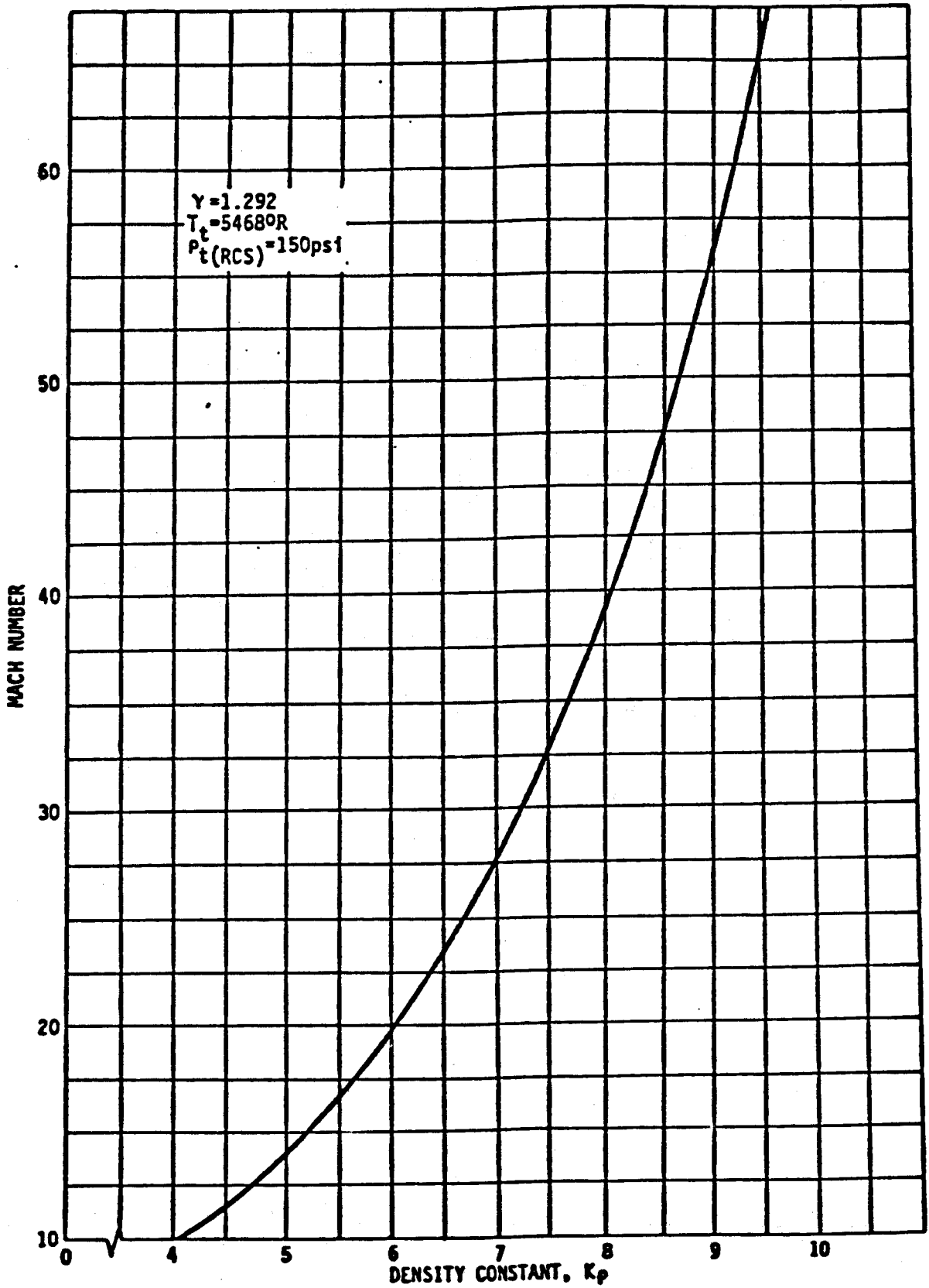


FIGURE 11.2.2-5 RCS PLUME MACH NUMBER AS A FUNCTION OF DENSITY CONSTANT,  $K_\rho$



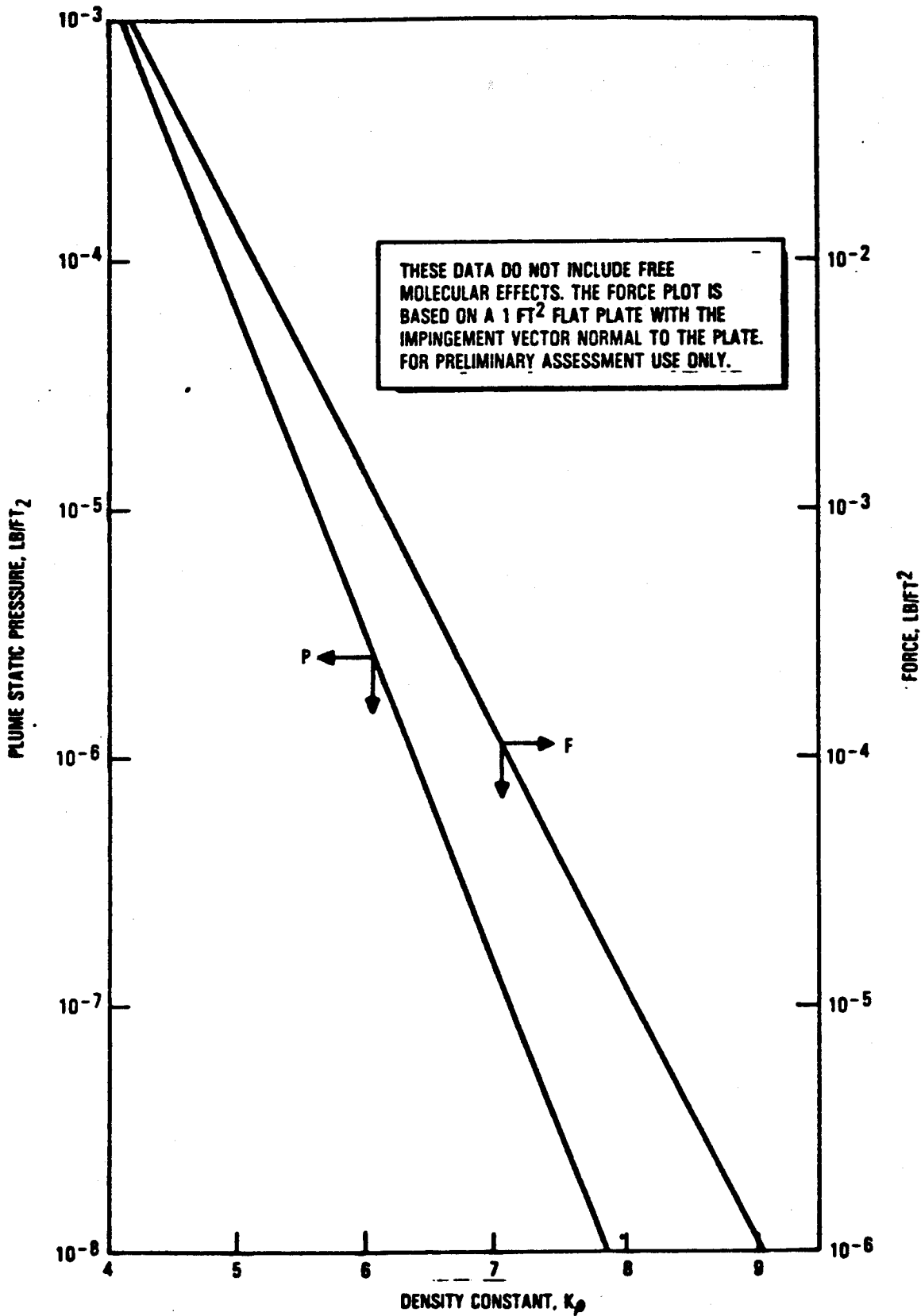


FIGURE 11.2.2-6 RCS PLUME STATIC PRESSURE AND IMPINGEMENT FORCE AS A FUNCTION OF DENSITY CONSTANT,  $K\rho$

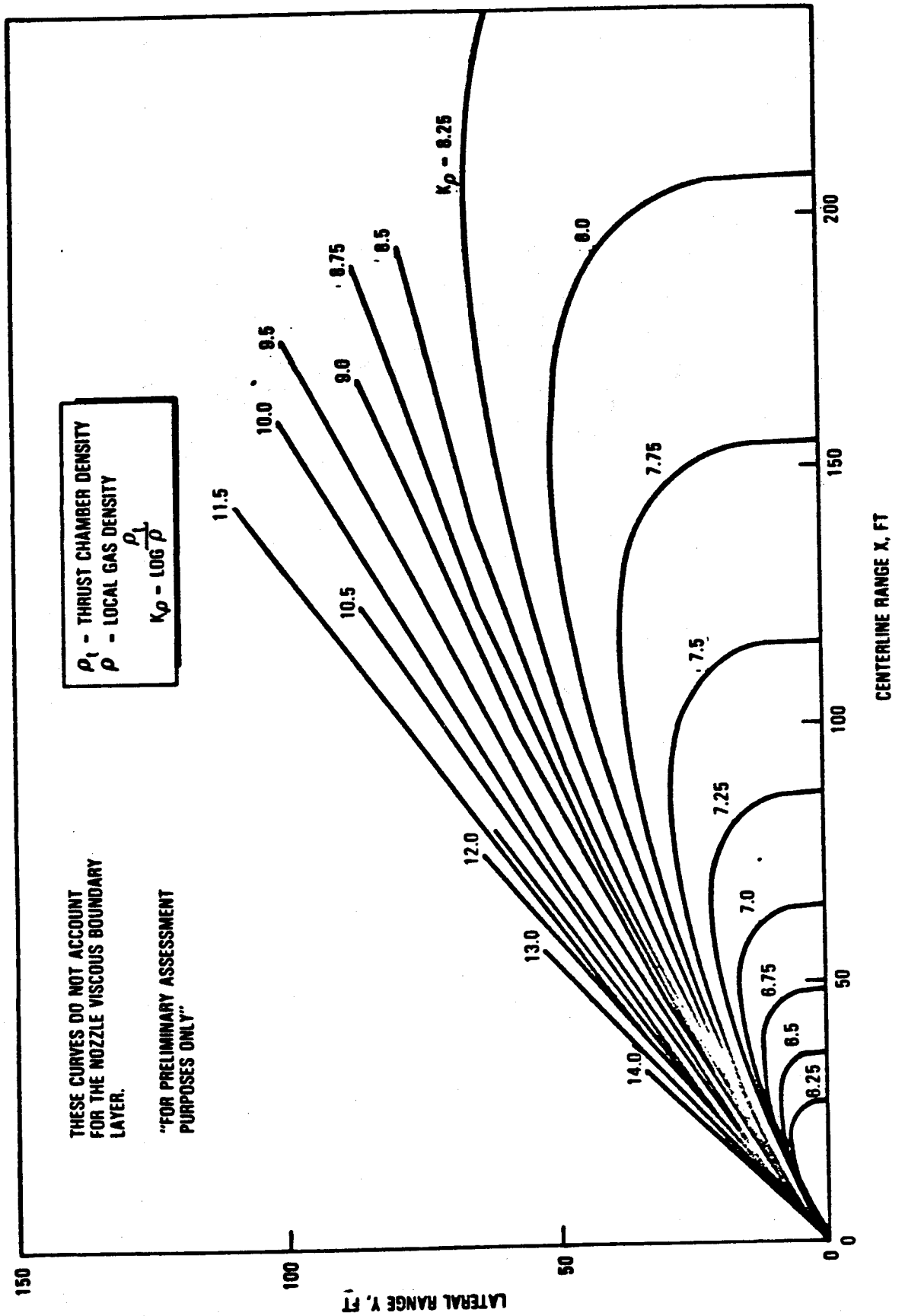


FIGURE 11.2.3-1 VRCS CONSTANT DENSITY CONTOURS,  $K_p$

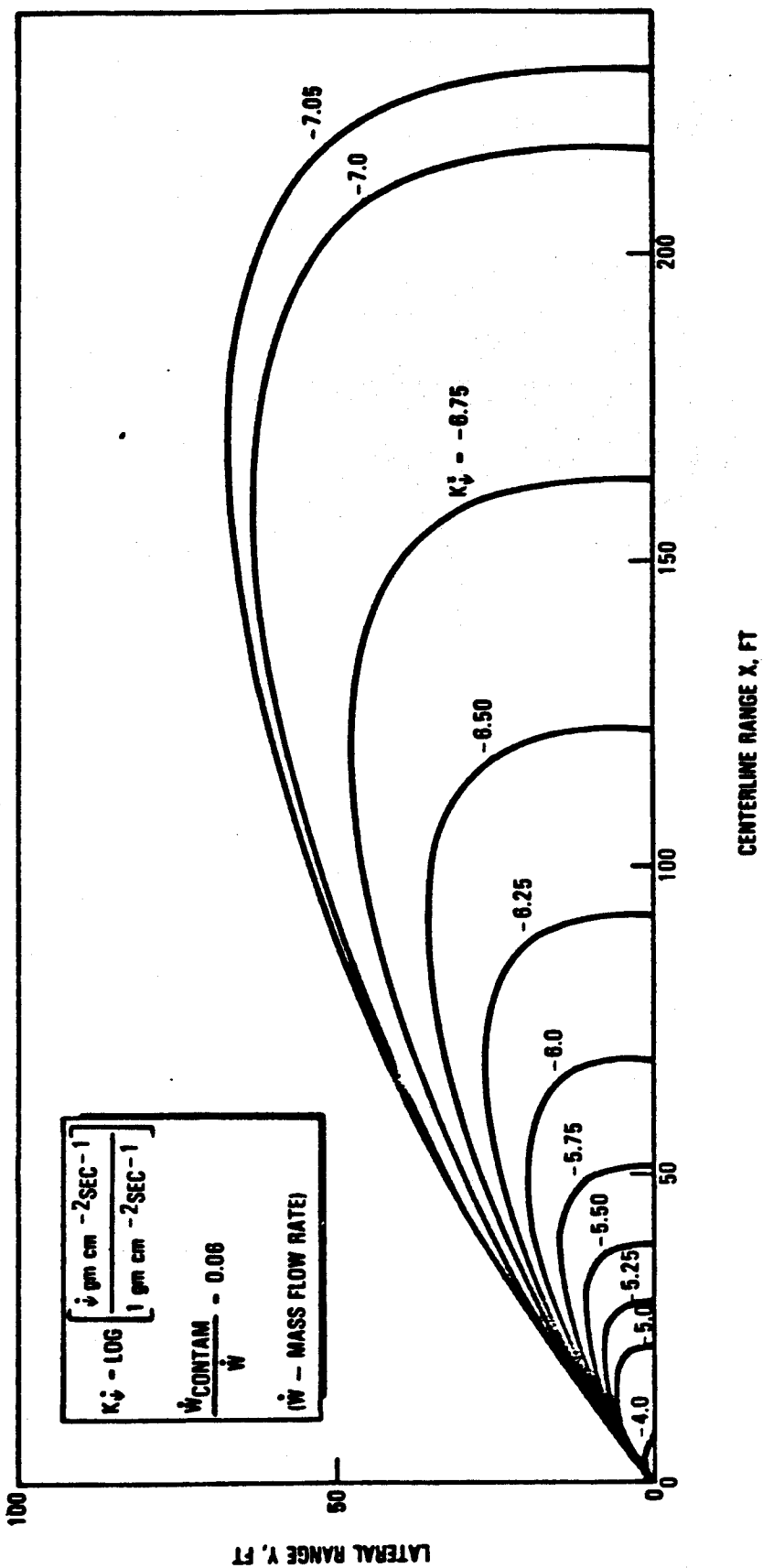


FIGURE 11.2.3-2 VRCS CONTAMINANTS CONSTANT MASS-FLUX-RATE CONTOURS

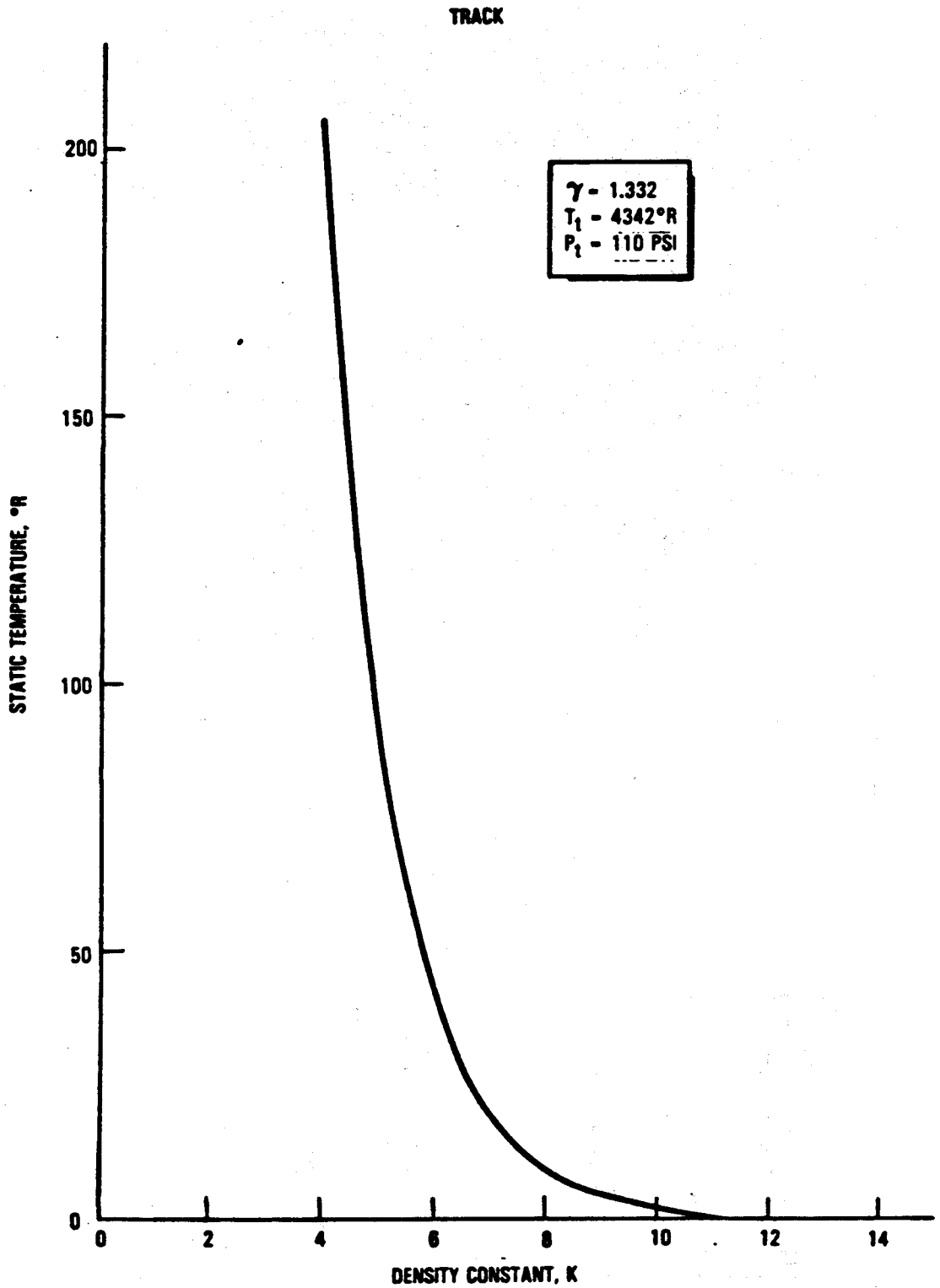


FIGURE 11.2.3-3 VRCS PLUME STATIC TEMPERATURE vs DENSITY CONSTANT,  $K_\rho$

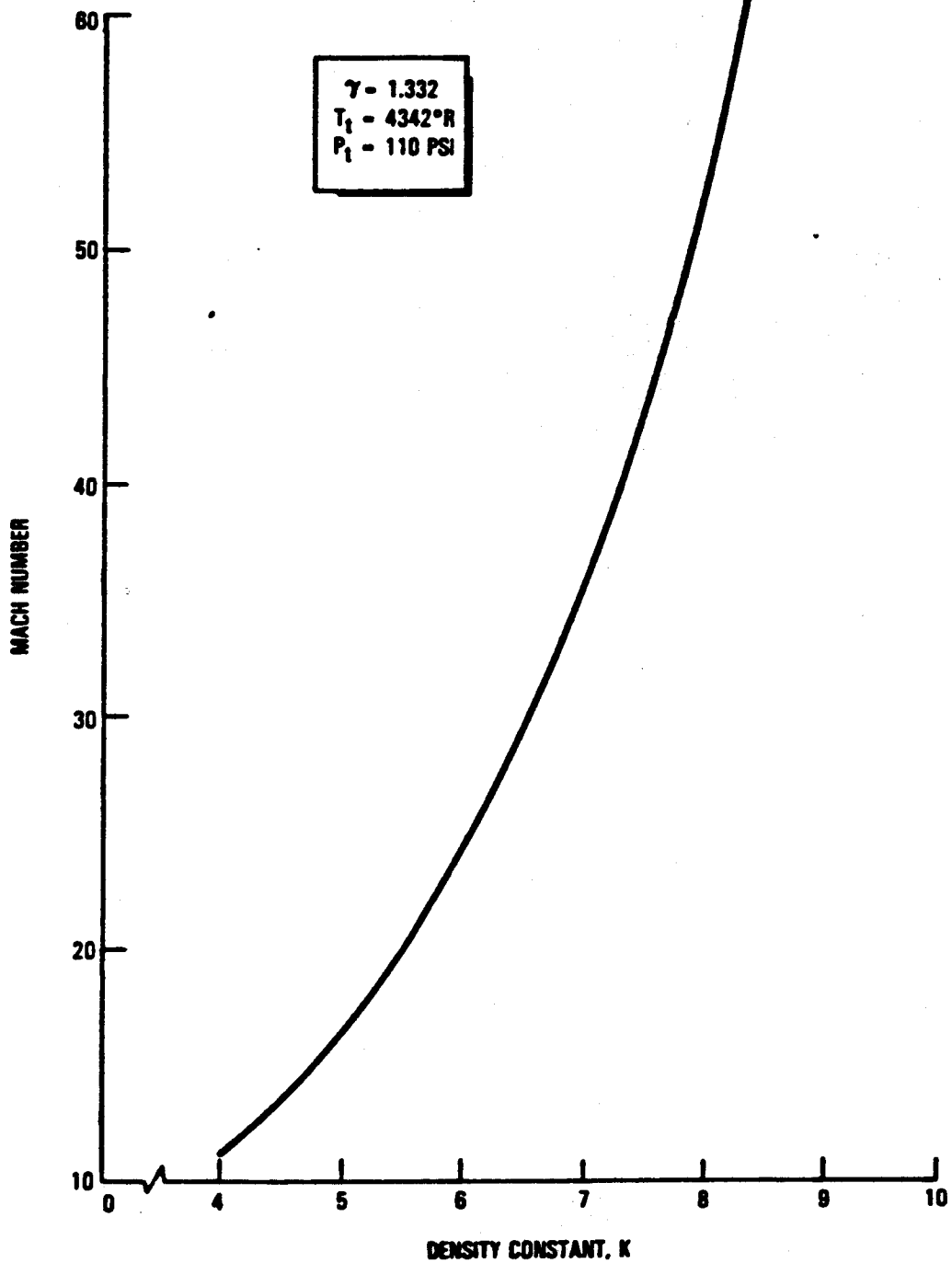


FIGURE 11.2.3-4 VRCS PLUME MACH NUMBER vs DENSITY CONSTANT  $K\rho$

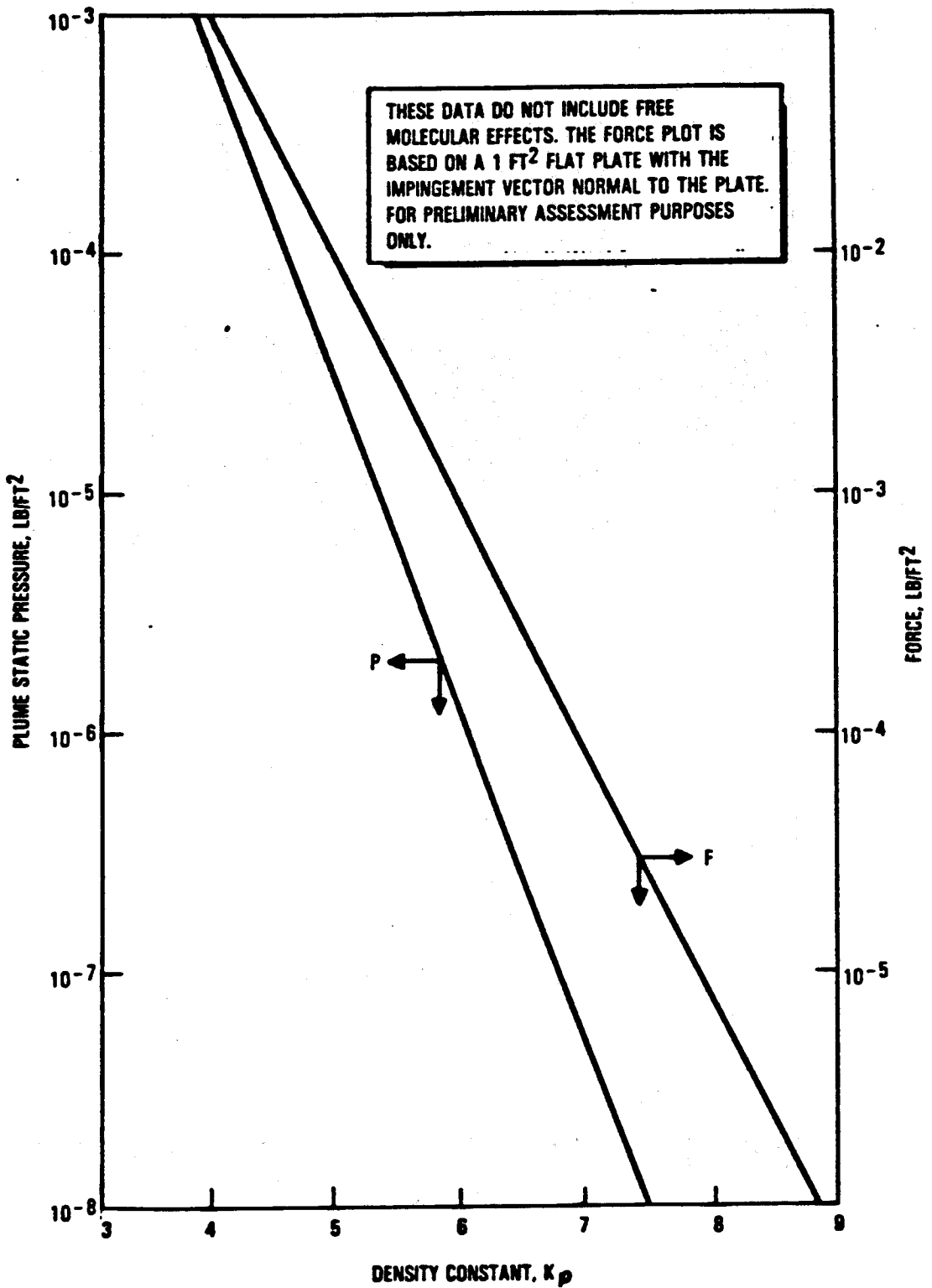


FIGURE 11.2.3-5 VRCS PLUME STATIC PRESSURE AND IMPINGEMENT FORCE vs DENSITY CONSTANT,  $K\rho$

12.0 (Reserved)

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## 13.0 ELECTRICAL WIRING INTERFACES.

### 13.1 INTERFACE ALLOCATION (DEFINED IN THE CARGO-ELEMENT ICD).

#### 13.2 GENERAL.

##### 13.2.1 Connector Interface Definitions.

13.2.1.1 Standard Cargo Interfaces. Standard cargo electrical interfaces shall be located in both the cargo bay and the AFD to provide standard services for cargo element use.

13.2.1.1.1 Cargo Bay. Standard cargo electrical interfaces in the cargo bay are defined to include the following:

- a. Standard-Interface-Panel standard (SIP-Standard) interfaces, consisting of all the connectors (receptacles) that are (1) mounted on the Standard Mixed Cargo Harness-SIP's (SMCH-SIP), (2) are continuations of the SMCH cables, and (3) are accessible to cables from cargo elements.
- b. SMCH-Standard interfaces (relating to SIP), consisting of all the SMCH connectors (plugs) that normally terminate on the SMCH-SIP's and only become accessible as optional cargo interfaces when the SMCH-SIP's are removed. (Although the shell configurations are different, the pin assignments of any SMCH-Standard interface shall be identical to that of its corresponding SIP-Standard interface).
- c. SMCH-Standard interfaces (independent of SIP), consisting of all the connectors (plugs) at the cargo end of those SMCH cables which do not terminate on the SMCH-SIP.

13.2.1.1.2 Aft Flight Deck. Standard cargo electrical interfaces are defined to include all of the connectors (plugs) at the Standard Switch Panel (SSP) end of the SMCH in the AFD Payload Station.

13.2.1.2 Non-Standard Cargo Interfaces (Relating to SMCH). Non-Standard Cargo Element Interfaces (related to SMCH) are defined as those which become available for cargo use after removal of SMCH cables/components.

13.2.1.2.1 Cargo Bay. Non-standard cargo electrical interfaces (relating to SMCH) in the Cargo Bay shall consist of only those connectors (receptacles), on starboard and port panels at the stations listed below, which become available for cargo use after removal of the SMCH cables that are connected to them.

- X<sub>0</sub> 603, port
- X<sub>0</sub> 645, starboard
- X<sub>0</sub> 693, starboard and port
- X<sub>0</sub> 1203, port

13.2.1.2.2 Aft Flight Deck. Non-standard cargo electrical interfaces (relating to SMCH) in the AFD shall consist of only those connectors (receptacles) on the PSDP which become available for cargo use after removal of the SMCH cables that are connected to them.

13.2.1.3 Non-Standard Cargo Interfaces (Independent of SMCH). Non-standard cargo electrical interfaces (independent of SMCH) are defined as those which are accessible to optional cables in addition to those provided by, or related to, SMCH.

13.2.1.3.1 Cargo Bay. Non-standard cargo electrical interfaces (independent of SMCH) in the Cargo Bay shall consist of only those connectors (receptacles), on starboard and port panels at the stations listed below, which are not assigned to SMCH.

X<sub>0</sub> 603, starboard and port  
X<sub>0</sub> 645, starboard  
X<sub>0</sub> 1203, starboard and port  
X<sub>0</sub> 1307, starboard and port

13.2.1.3.2 Aft Flight Deck. Non-standard cargo electrical interfaces (independent of SMCH) in the AFD shall consist of the following:

- a. Connectors (receptacles) on the Payload Station Distribution Panel (PSDP).
- b. Connectors (receptacles) on the starboard and port On-Orbit Station Distribution Panels (OOSDP).
- c. Connectors (receptacles) on the Mission Station Distribution Panel (MSDP).

13.2.2 Approved Connectors for Cargo Element Use. All cargo element electrical connectors and connector contacts that interface with the Orbiter shall be selected from the following NASA and Rockwell International specifications, as applicable.

NASA

40M38277  
40M39569  
40M38298  
40M38294

Rockwell International

ME414-0234  
ME414-0235  
ME414-0610  
ME414-0611  
ME414-0612  
ME414-0247  
ME414-0250  
ME414-0561  
ME414-0562  
MC414-0614  
ME418-0031  
ME418-0032

13.2.3 Substitution of Cargo-Unique Items for Standard Service Items.

13.2.3.1 Cables to Cargo Bay Panels (Other than Bulkheads X<sub>0</sub>576/X<sub>0</sub>1307) for SMCH. Substitution of cargo-unique cables for SMCH cables shall be possible on a cable-by-cable basis.

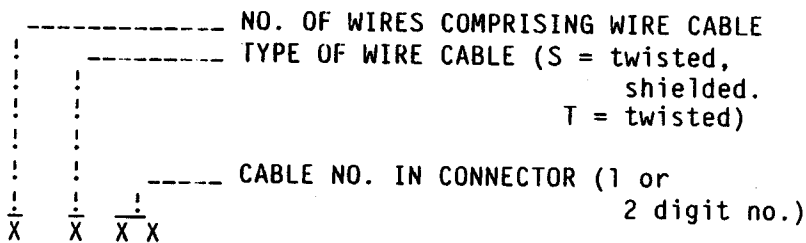
13.2.3.2 Payload-Unique Panel for Standard Switch Panel. The substituted payload-unique panel shall provide connector interfaces identical to those in the SSP (1) for the SMCH cables leading to the Cargo, and (2) for any services provided to the Orbiter by the SSP.

13.2.4 Coding Used in Tables. In the connector summary tables under the column headed "WIRE TYPE", the following coding has been used:

COAX	coaxial
SC	single conductor
TXC	X-conductors, twisted *
TP	twisted pair
TSXC	X-conductors, twisted, shielded *
TSP	twisted shielded pair

\* X = number of conductors

In the detail connector/pin assignment tables under the column headed "CABLE DESC", the following coding has been used:



(e.g., 2S1 is the first shielded pair at the subject connector.)

### 13.3 CABLE SCHEMATICS.

#### 13.3.1 Signal and Control.

13.3.1.1 RF. RF signal and data cable interfaces and routing are shown, for information purposes, in Figure 13.3.1.1-1.

13.3.1.2 ML. ML signal cable interfaces and routing are shown, for information purposes, in Figure 13.3.1.2-1.

13.3.1.3 HO. HO signal and control cable interfaces and routing are shown, for information purposes, in Figure 13.3.1.3-1.

13.3.1.4 Get-Away-Special(GAS) ML signal cable interfaces and routing to accommodate the Get-Away-Special containers are shown, for information purposes, in Figure 13.3.1.4-1.

13.3.2 Electrical Power. DC and AC electrical power cable interfaces and routing are shown, for information purposes, in Figure 13.3.2-1.

13.3.3 Coaxial. Coaxial cable interfaces and routing are shown, for information purposes, in Figure 13.3.3-1.

13.3.4 Data Bus. Data bus cable interfaces and routing are shown, for information purposes, in Figure 13.3.4-1.

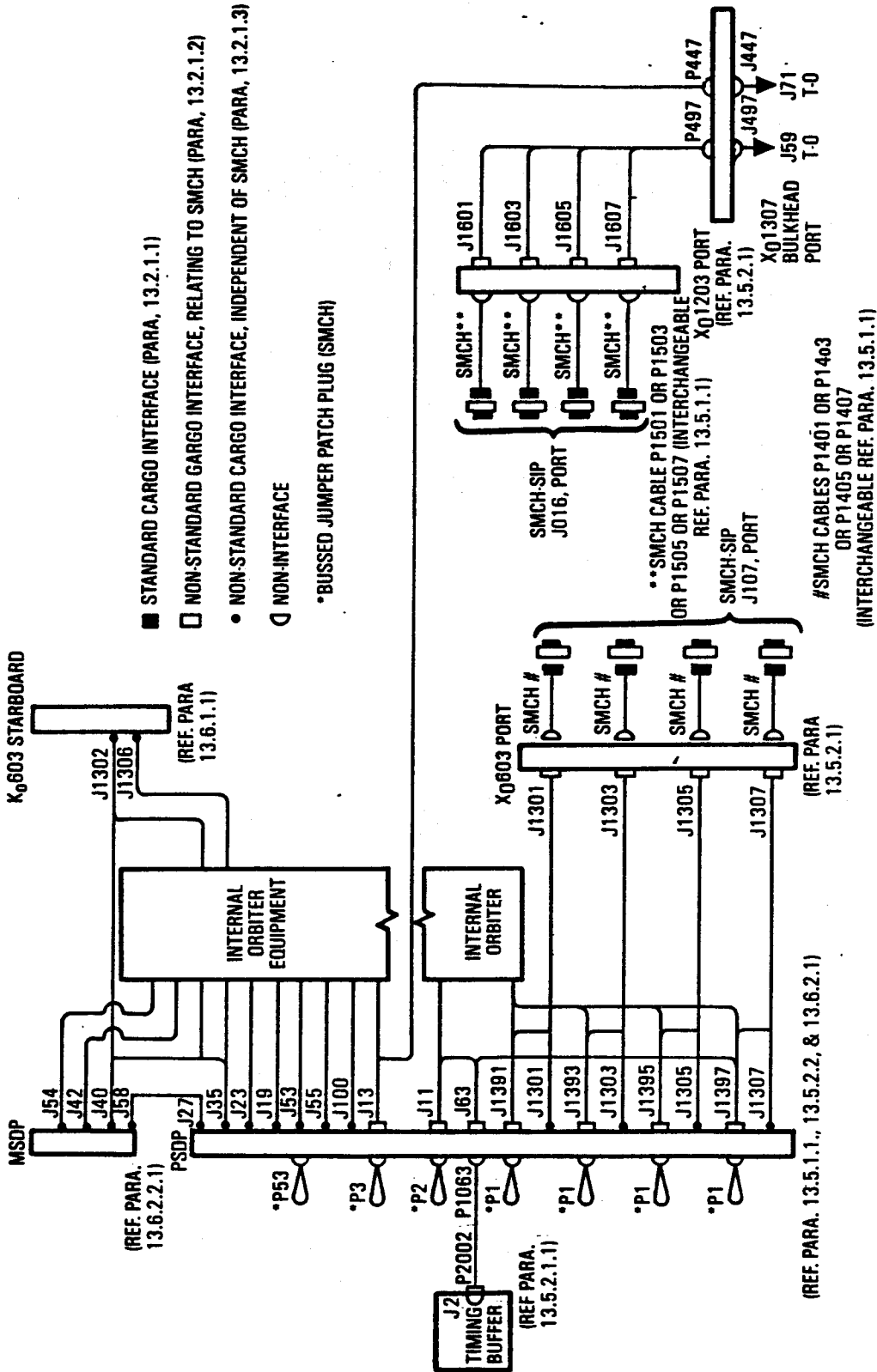


Figure 13.3.1.1-1 Interface Schematic For RJ Connectors



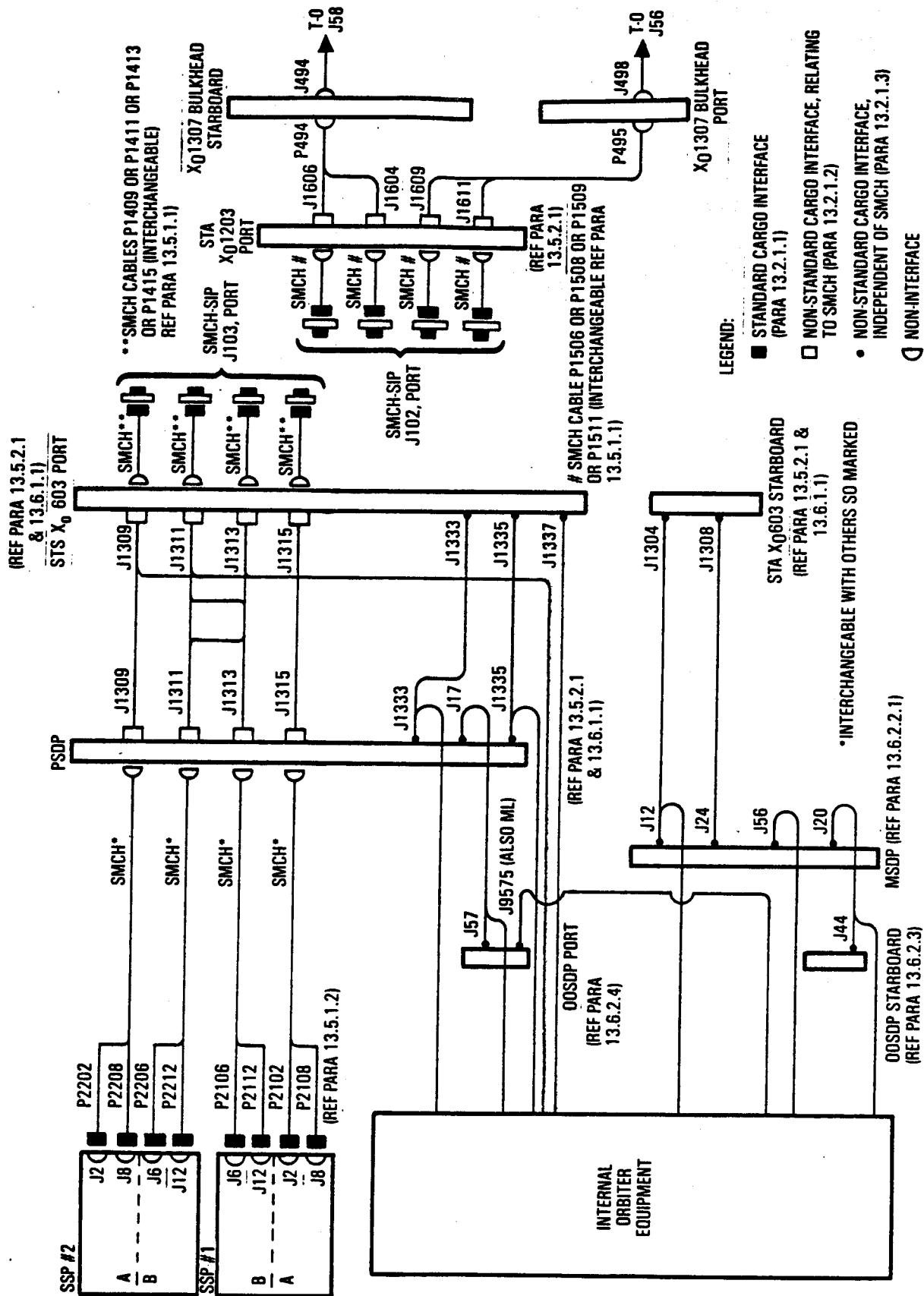


Figure 13.3.1.3-1 Interface Schematic For HO Connectors

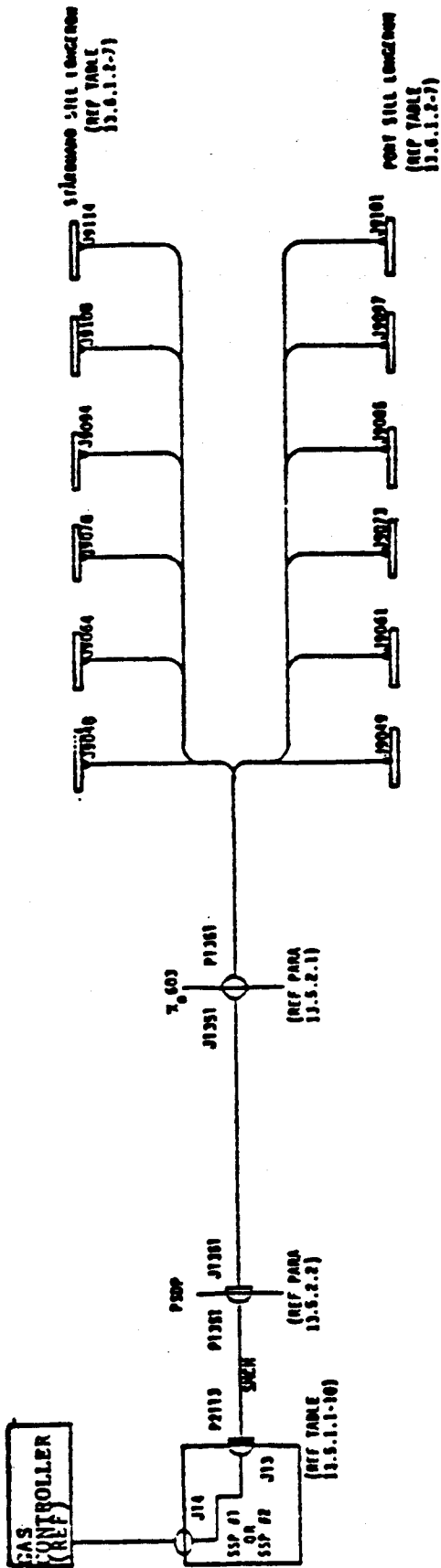


FIGURE 13.3.1.4-1 INTERFACE SCHEMATIC FOR GAS CONNECTORS

- STANDARD CARGO INTERFACE (PARA 13.2.1.1)
- NON-STANDARD CARGO INTERFACE, RELATIVE TO SUCH (PARA 13.2.1.2)
- NON-STANDARD CARGO INTERFACE, INDEPENDENT OF SUCH (PARA 13.2.1.3)
- NON-INTERFACE





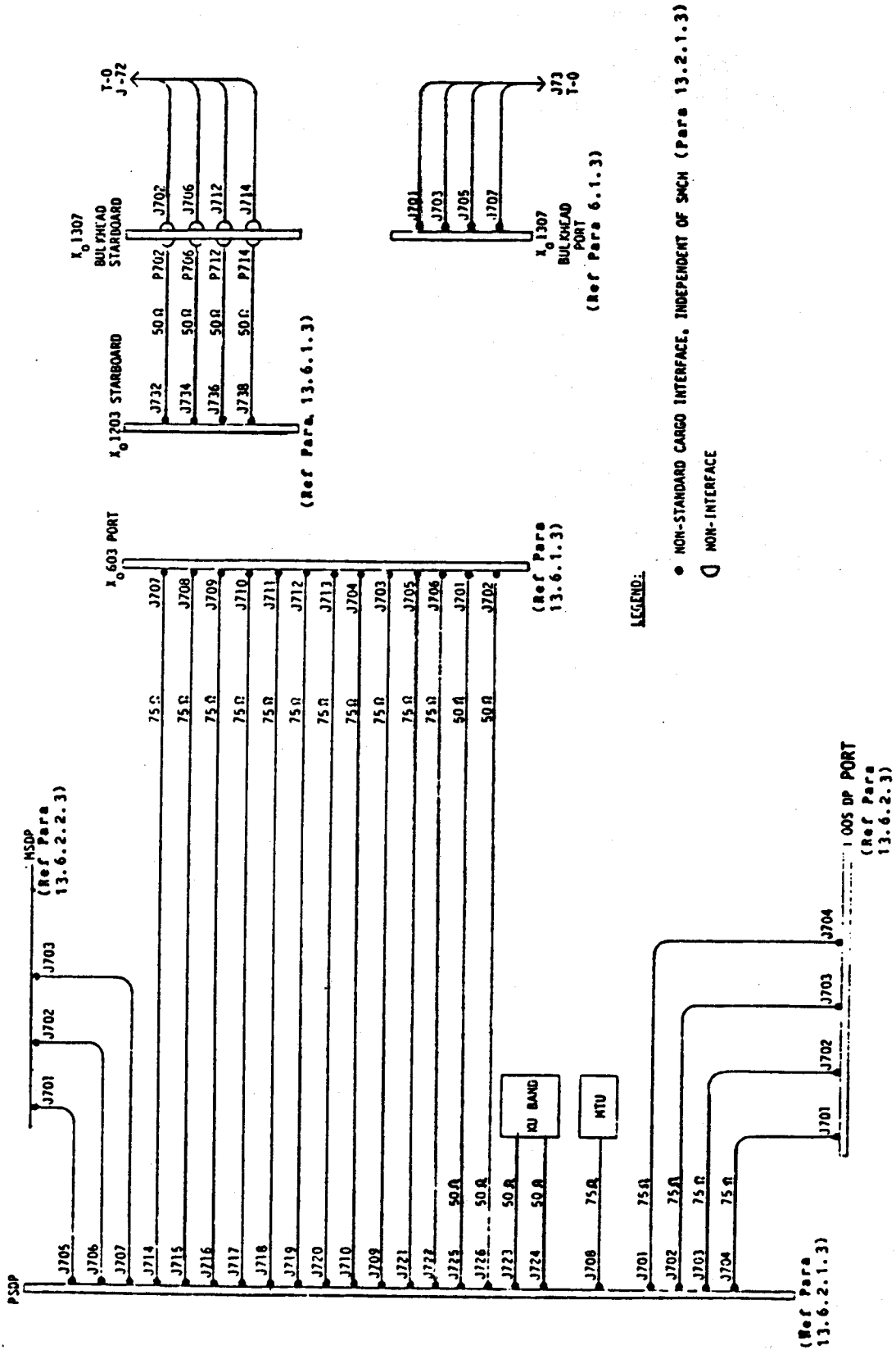
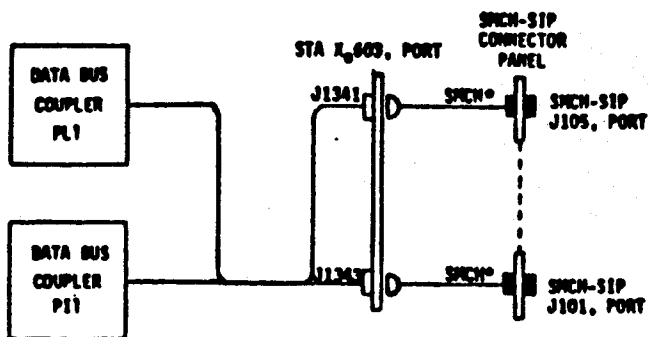
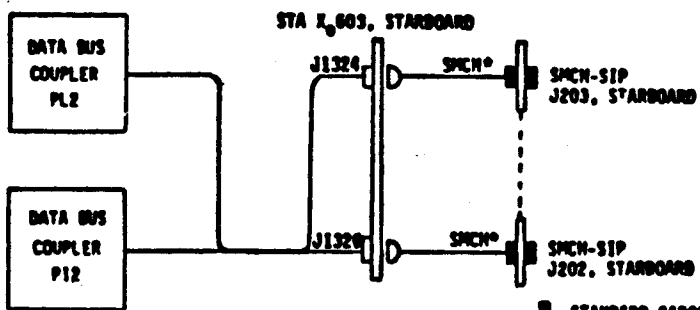


FIGURE 13.3.3-1 INTERFACE SCHEMATIC FOR COAX CONNECTORS



\*SMCN CABLES P1484 OR P1485  
OR P1486 OR P1487  
(INTERCHANGEABLE  
REF PARA 13.5.1.3)



- STANDARD CARGO INTERFACE (PARA 13.2.1.2)
- NON-STANDARD CARGO INTERFACE, RELATING TO SMCN (PARA 13.2.1.1)
- NON-INTERFACE

FIGURE 13.3.4-1 INTERFACE SCHEMATIC FOR DATA BUS CONNECTORS (RF)

#### 13.4 STANDARD PAYLOAD DISPLAY AND CONTROL INTERFACE (SPDCI).

13.4.1 CCTV Monitoring. The SPDCI shall provide monitoring of Closed Circuit TV (CCTV) for cargo element use. Performance characteristics of the CCTV monitor (number 3) mounted on the Television Monitor Panel (TVMP) are defined in Paragraph 8.2.8.

13.4.2 Standard Switch Panel (SSP). The SPDCI shall provide two Standard Switch Panels (SSP) for cargo element use. Each SSP shall provide switching, circuit breakers, fusing and statusing for cargo element use, limited capability for controlling conduct of experiments, and power control for pallets. SSP payload switching and statusing interface schematics are shown in Figures 13.4.2-1 and 13.4.2-2, respectively. Also identified, for reference purposes, are the connector/pin terminations at the cargo end of the standard mixed cargo harness in the AFD. The round-trip circuit resistance between the SSP and the cargo element interface shall not exceed 4.0 ohms (1.0 ohms when four parallel wires are used). All wire within the SSP is 22AWG unless otherwise noted. SSP component characteristics shall be as shown in Tables 13.4.2- 1, 13.4.2-2, 13.4.2-3 and the following specifications:

Toggle Switch	ME452-0102
Circuit Breaker	MC454-0026
Fuse	ME451-0018
Event Indication	MC432-0222

13.4.3 Cargo Element Deployment and Pointing. The SPDCI shall provide for cargo element deployment and cargo element manual pointing by means of a Deployment Panel and an attached Manual Pointing Controller (MPC) which operates in conjunction with it. The cargo element interface schematic is shown in Figure 13.4.3-1.

13.4.3.1 Manual Pointing Controller (MPC). A portable hand-held MPC shall be available to crew members in various AFD locations for initiating pointing commands to an Orbiter cargo element. The MPC shall provide an LED Power ON-OFF indication capability, toggle switches for varying control characteristics, a two-axis, force-operated joystick which produces continuously variable outputs and two push-button switches for roll access control.

13.4.3.2 Deployment/Pointing Panel. The Deployment/Pointing Panel shall provide (1) selection, arming and firing switch functions for pyrotechnic devices, and (2) signal conditioning interfaces between the attached MPC and Orbiter circuits. The characteristics of the rotary switches and the toggle switches shall be as specified in specifications ME452-0093 and ME452-0102, respectively. Signal characteristics of the pointing output functions are defined in Table 13.4.3.2-1.

TABLE 13.4.2-1 SSP TOGGLE SWITCH CHARACTERISTICS

Switch Ident.	No. of Poles	No. of Pos.	Operations	Volt Rating	Amp Rating
S1,S2,S5,S9,S13 S14,S17,S21	2	3	momentary ON maintained OFF momentary ON	32 VDC	5
S10,S22	2	2	maintained ON maintained ON	32 VDC	5 (10*)
S3,S4,S6,S7,S8, S11,S15,S16,S18, S19,S20,S23	2	2	maintained ON maintained ON	32 VDC	5
S12,S24	2	3	maintained ON maintained OFF maintained ON	32 VDC	5

\* Up to 10 amperes for 2 seconds maximum with unique harness required

Ref. Figure 13.4.2-1

TABLE 13.4.2-2 SSP PAYLOAD STATUS INDICATOR  
CHARACTERISTICS

Indicator Identification	Type	VDC	Input Impedance Kilohms
DS1, DS2, DS13, DS14	3 position(1)	28 VDC	35.3+3.3
DS3 to DS12, DS15 to DS24	2 Position(2)	28 VDC	28+3

Ref. Figure 13.4.2-2

- (1) Full ON indication given (up or down) for greater than 18 VDC applied.  
Full OFF indication given (center position) for zero volts applied.
- (2) Full ON indication given for greater than 18 VDC applied.  
Full OFF indication given for less than 5 VDC applied.

TABLE 13.4.3.2-1 SIGNAL CHARACTERISTICS OF POINTING  
CONTROLLER OUTPUT FUNCTIONS

Parameter	Dimension	Characteristics	Notes
Roll	Volts DC (discrete)	HI: $+5 \pm 1.0$	Compatible with MDM
Mode		LO: $0 \pm 0.5$	
Gain			
MPC On			
Pitch	Volts DC (analog)	Balanced	
Yaw		Differential $+5.11$ to $-5.12$	

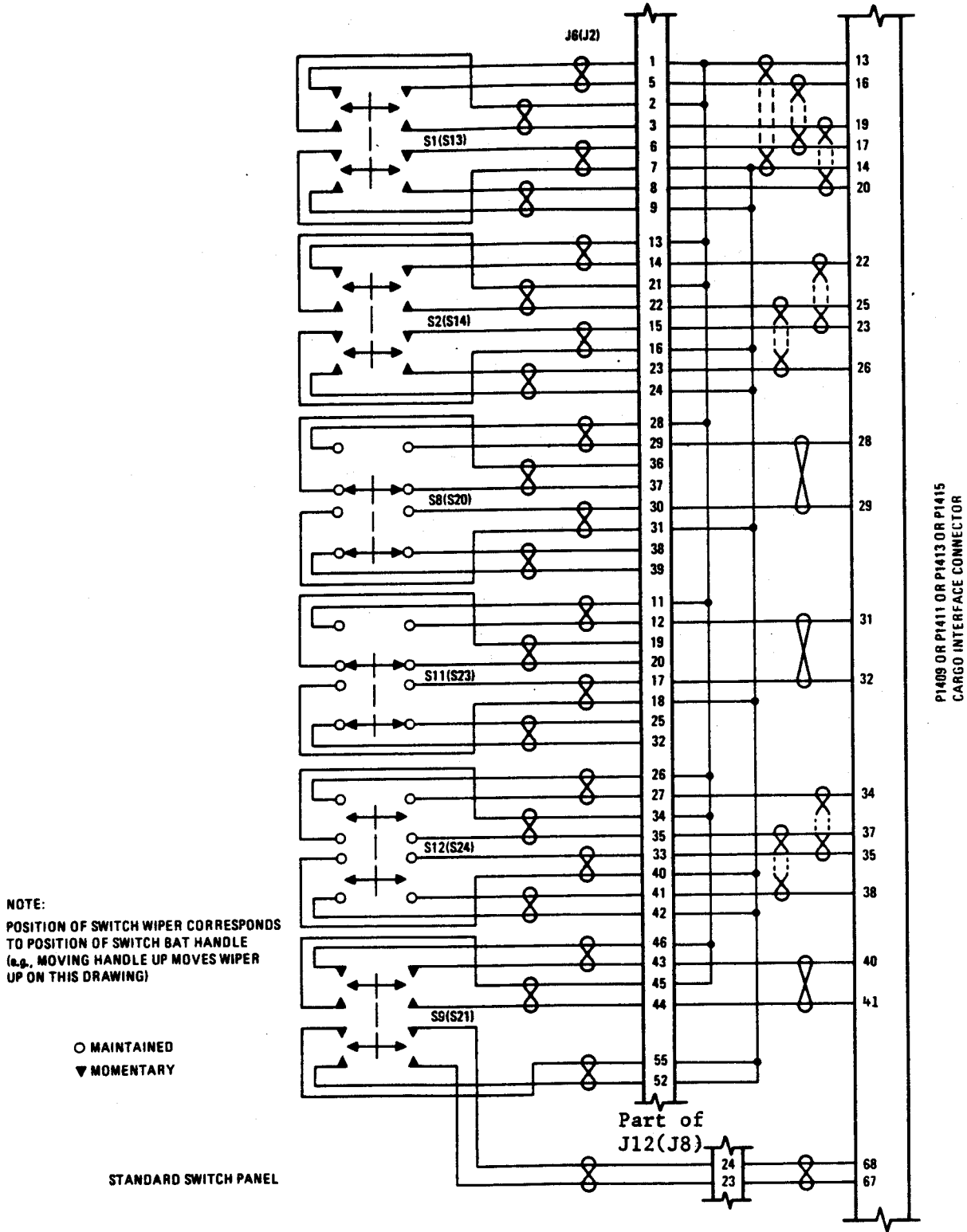


Figure 13.4.2-1 SSP Cargo Element Switching And Fusing Interface Schematic (Sheet 1 Of 2)



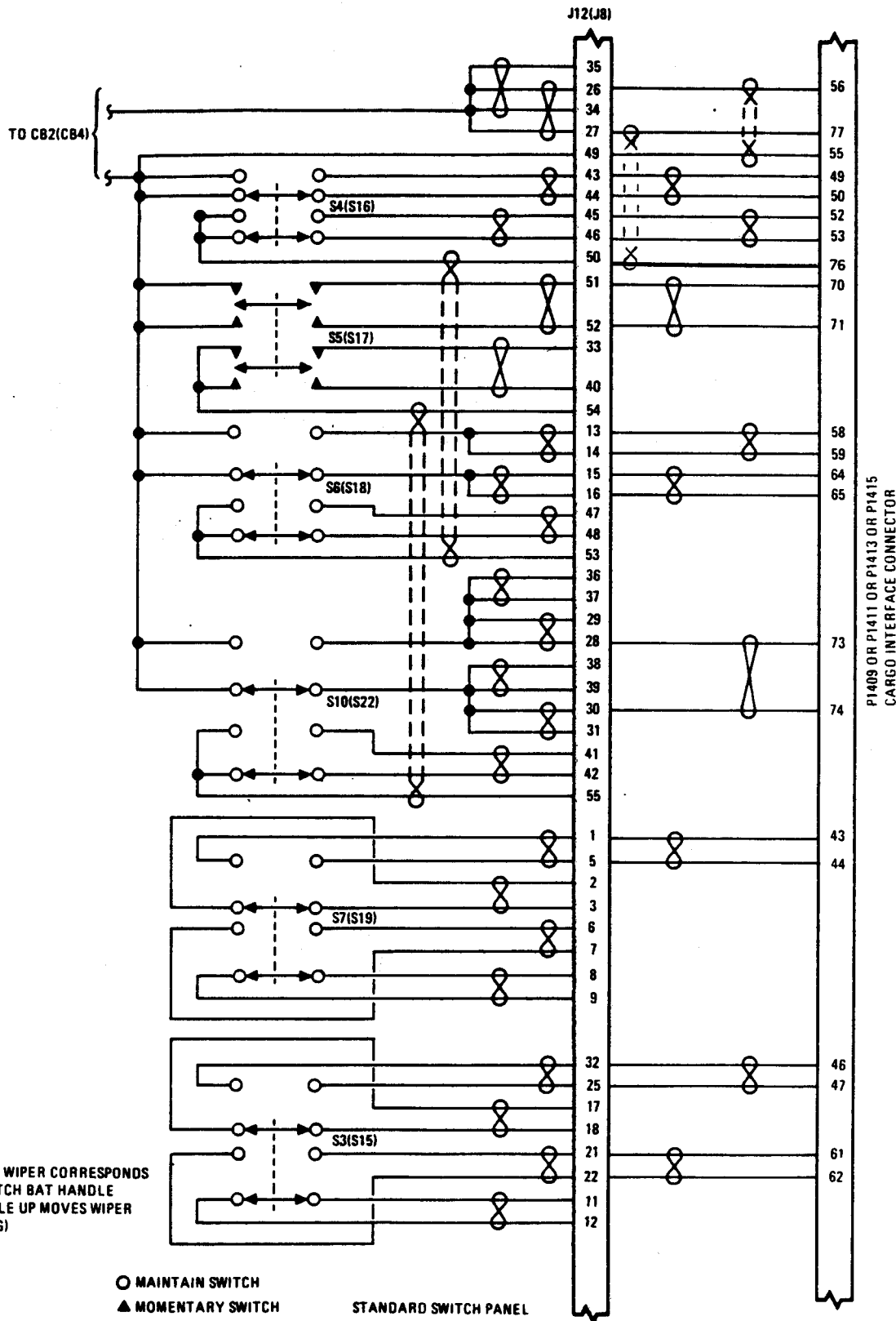


Figure 13.4.2-1 SSP Cargo Element Switching And Fusing Interface Schematic (Sheet 2 Of 2)

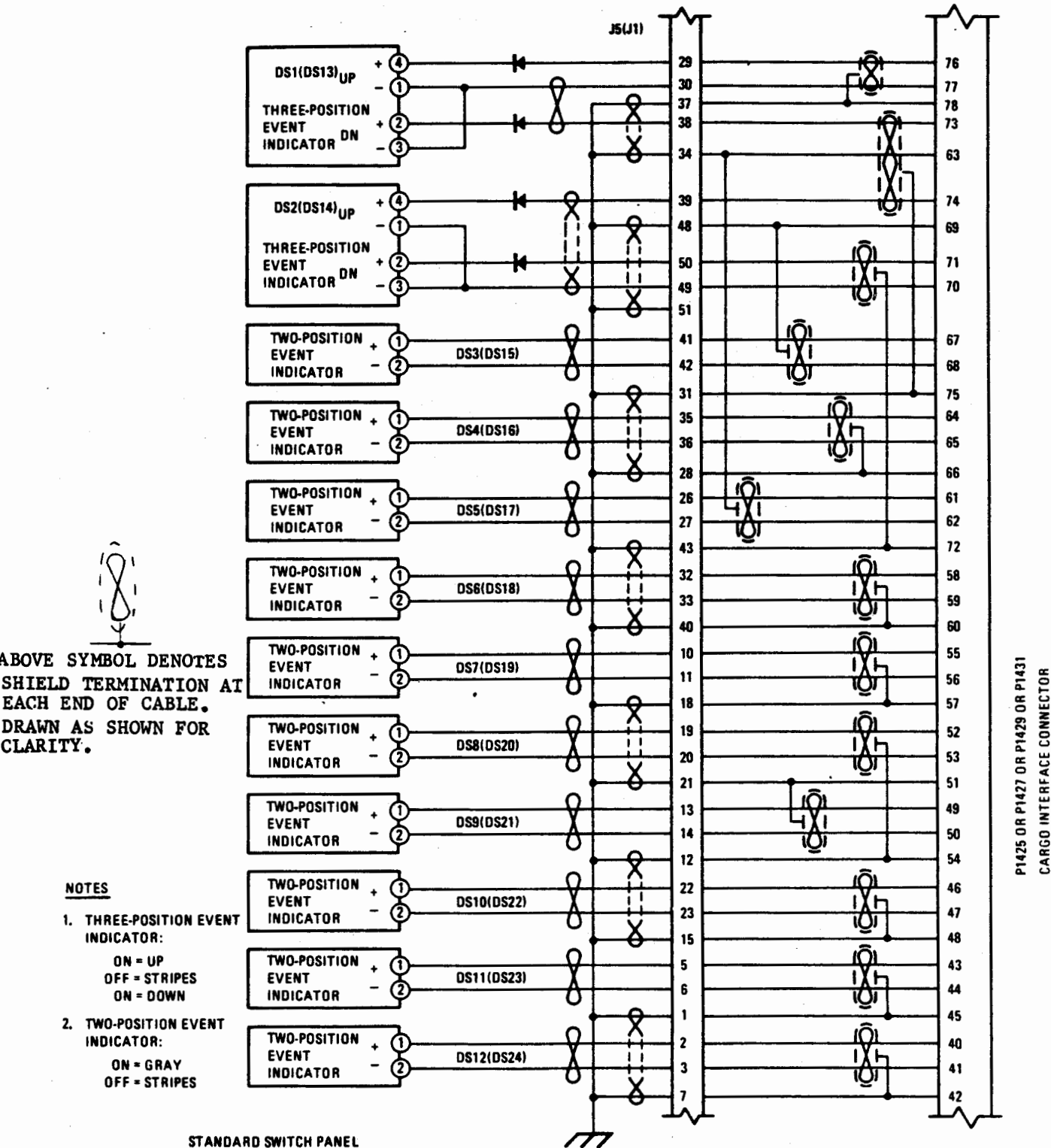


Figure 13.4.2-2 SSP Cargo Element Indicator Interface Schematic

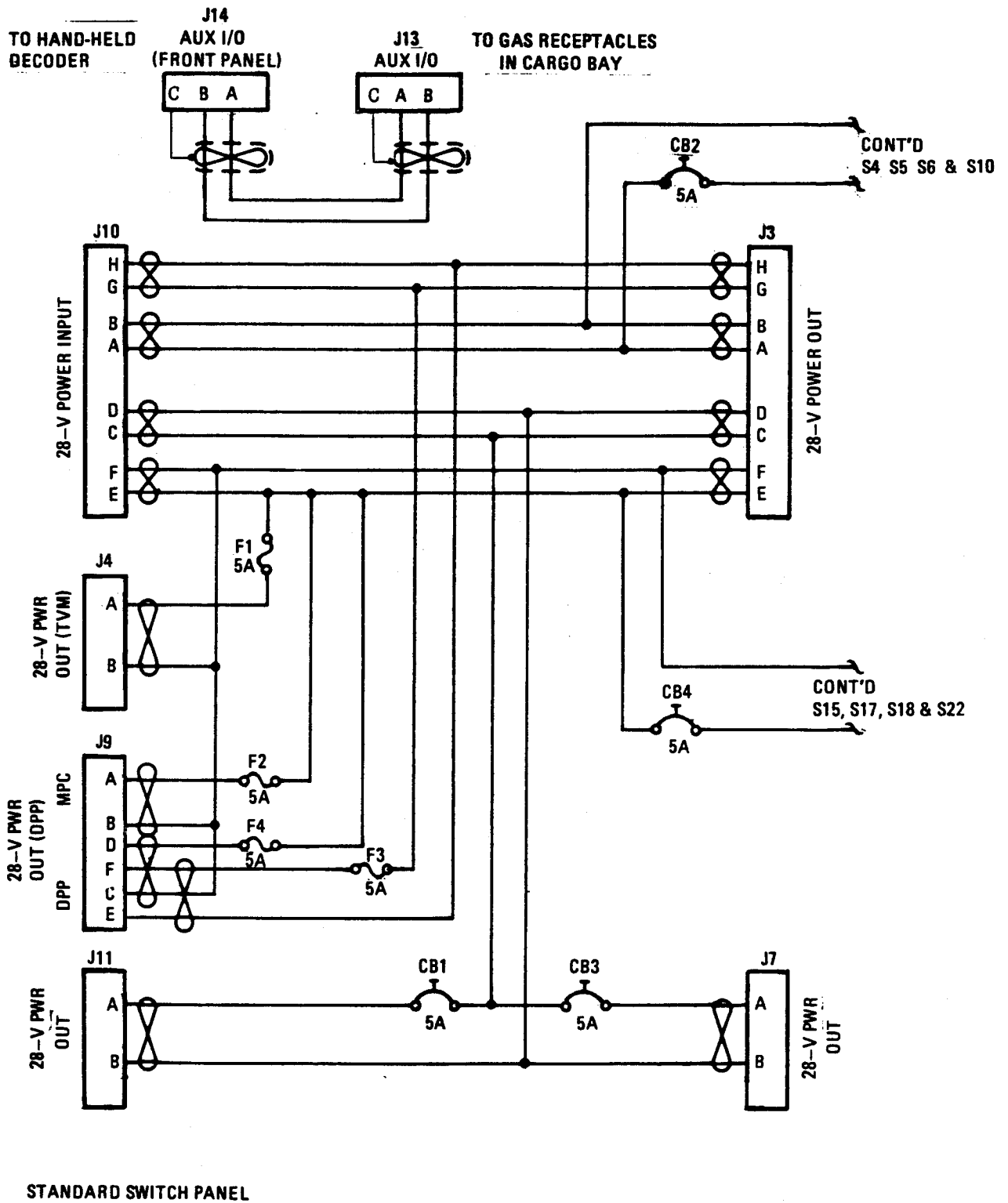


Figure 13.4.2-3 SSP Power And Auxillary I/O Interfaces

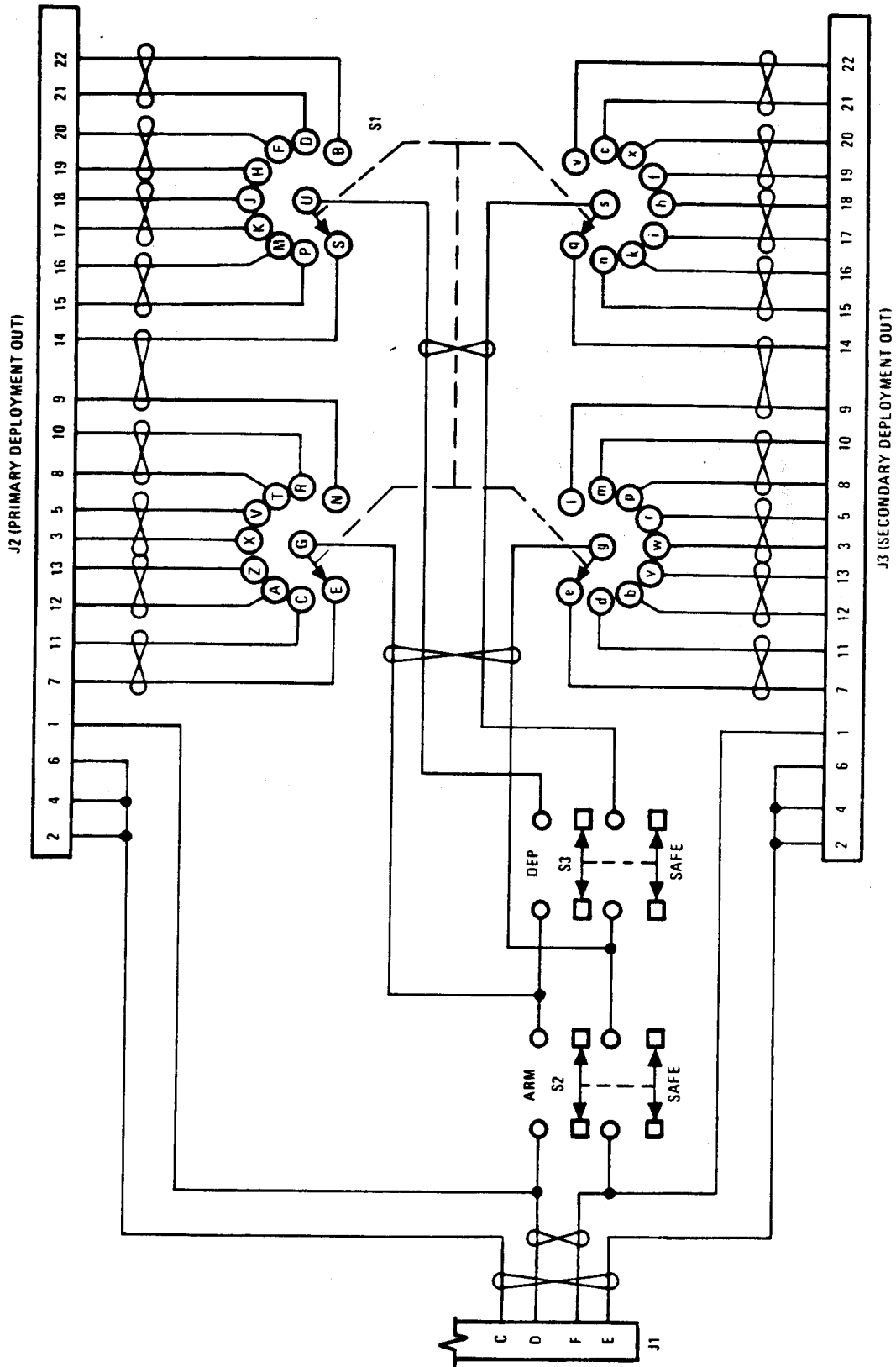
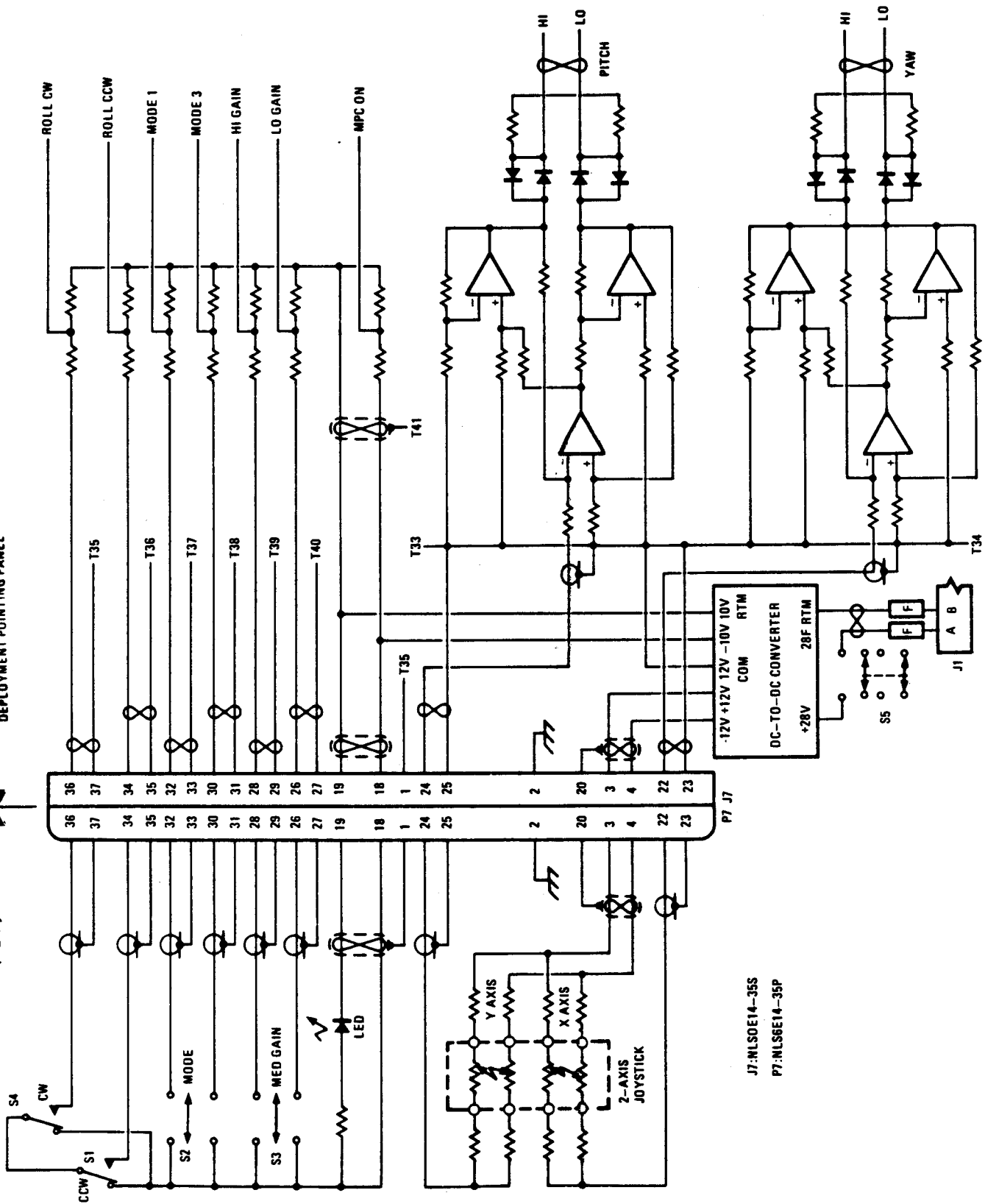
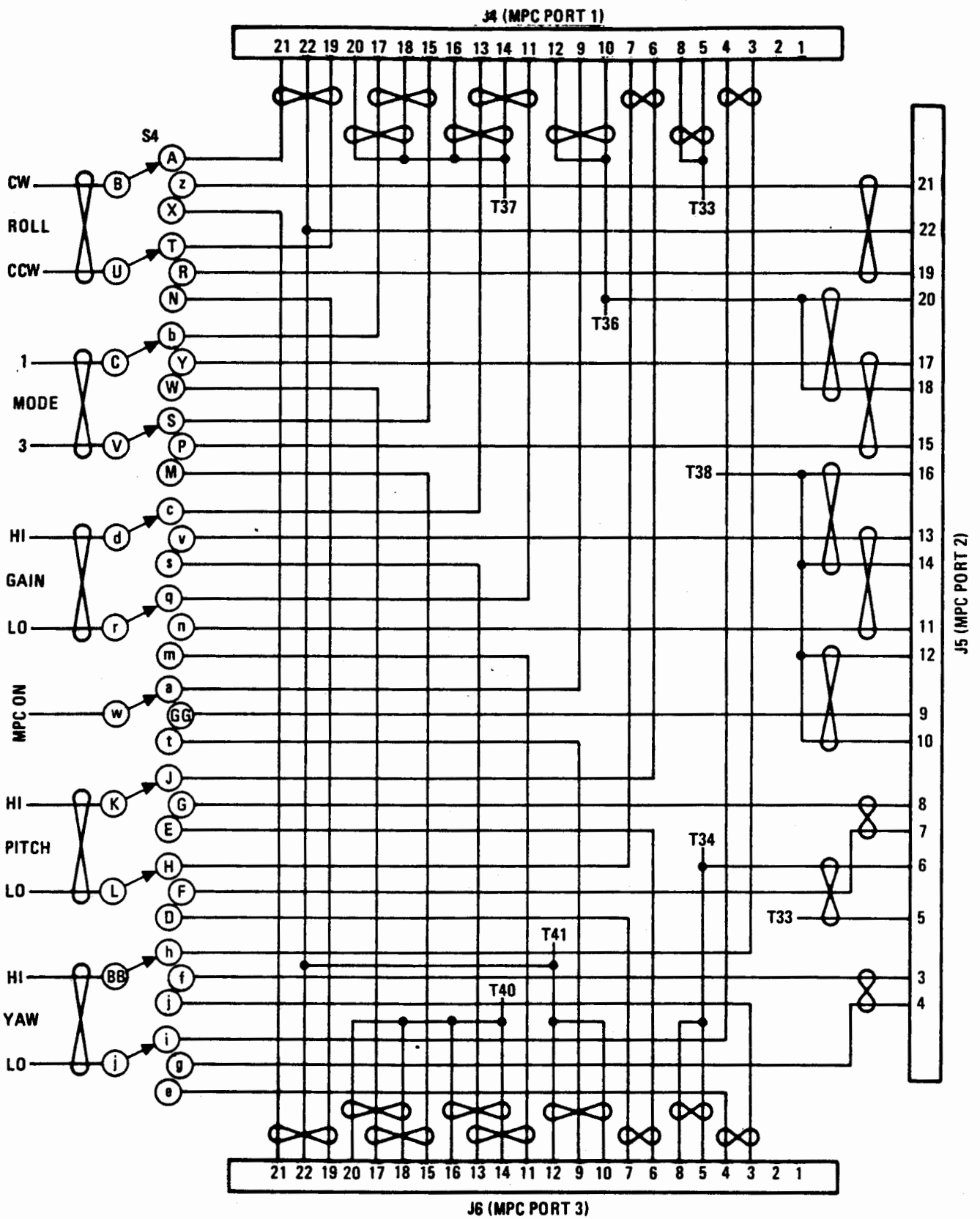


Figure 13.4.3-1 Deployment/Pointint Panel Interface Schematic (Sheet 1 Of 3)



J7: NLSOE14-35S  
 P7: NLSGE14-35P

Figure 13.4.3-1 Deployment/Pointing Panel Interface Schematic  
 (Sheet 2 Of 3)



DEPLOYMENT POINTING PANEL

Figure 13.4.3-1 Deployment/Pointing Panel Interface Schematic (Sheet 3 Of 3)

## 13.5 CONNECTOR/PIN INTERFACES ASSOCIATED WITH SMCH AND SMCH-SIP CONFIGURATION.

13.5.1 Standard Cargo Connector/Pin Interfaces in the Cargo Bay. Table 13.5.1-1 lists the SMCH cables and SMCH-SIP connectors, groups them according to interchangeability, and indicates the table in which the common pin assignments for signal functions are defined within each group.

13.5.1.1 Signal And Control. Signal and control connector/pin assignments are defined in Tables 13.5.1.1-1 through 13.5.1.1-10.

13.5.1.2 Electrical Power. Electrical power connector/pin assignments are defined in Tables 13.5.1.2-1 through 13.5.1.2-6.

13.5.1.3 Data Bus. Data bus connector/pin assignments are defined in Table 13.5.1.3-1.

13.5.1.4 (Deleted).

13.5.2 Non-Standard Cargo Interfaces (Relating to SMCH). Cargo use of non-standard cargo electrical interfaces (accessible when SMCH cables are removed) identified in the sub-paragraphs below shall be possible only as defined in Cargo-Element ICD's. Connector/pin assignments for connectors allocated to cargo use shall be defined in the Cargo-Element ICD's.

13.5.2.1 Connectors In Cargo Bay. Table 13.5.2.1-1 summarizes panel-mounted receptacles, normally terminations for SMCH cables in the Cargo Bay, which can be made available by negotiation as alternate electrical interfaces for cargo use.

13.5.2.2 Connectors in Aft Flight Deck. Table 13.5.2.2-1 summarizes PSDP receptacles, normally termination for SMCH cables in the AFD, which can be made available by negotiation as alternate electrical interfaces for cargo use.

TABLE 13.5.1-1 SMCH-SIP CONNECTOR INTERCHANGEABILITY MATRIX

SMCH CABLE IDENTIFIER	SMCH-SIP CONNECTOR IDENTIFIER	CABLE FUNCTION			SEE TABLE	SMCH CABLES INTERFACE CONNECTOR PART NUMBERS		SMCH - SIP INTERFACE CONNECTOR PART NUMBERS	
		EMC CLASS	SIGNL CNTRL	ELEC. POWER BUS		DATA BUS	ORBITER	CARGO ELEMENT	ORBITER
P1401/P1403/P1405/P1407	J107	RF	X		13.5.1.1-1	NLS6GT20-35P	NLSOT20-35S	ME414-0630-4002	NLS6GT20-35S
P1409/P1411/P1413/P1415	J103	HO	X		13.5.1.1-3	NLS6GT20-35PA	NLSOT20-35SA	ME414-0630-4003	NLS6GT20-35SA
P1425/P1427/P1429/P1431	J108	ML	X		13.5.1.1-2	NLS6GT20-35PB	NLSOT20-35SB	ME414-0630-4004	NLS6GT20-35SB
P1461/P1462/P1463/P1464	J206/201	HO		X	13.5.1.2-1	ME414-0235-7226	ME414-0234-7222	ME414-0630-2006	ME414-0235-7229
P1482/P1484/P1486/P1488	J202	RF		X	13.5.1.3-1	NLS6GT12-35P	NLSOT12-35S	ME414-0630-4001	NLS6GT12-35S
P1481/P1483/P1485/P1487 P1439/P1441/P1445/P1451 P1455	J101	RF		X	13.5.1.3-1	NLS6GT12-35P	NLSOT12-35S	ME414-0630-4001	NLS6GT12-35S
P1494/P1496	J203 CONTINUING	RF		X	13.5.1.3-2	NLS6GT12-35P	NLSOT12-35S	ME414-0630-4001	NLS6GT12-35S
P1495/P1497/P1341/P1443 P1447/P1345/P1457	J105 CONTINUING	RF		X	13.5.1.3-2	NLS6GT12-35P	NLSOT12-35S	ME414-0630-4001	NLS6GT12-35S
P1	J203 TERMINATING	RF		X	13.5.1.3-3	NLS6GT12-35P	NLSOT12-35S	ME414-0630-4001	NLS6GT12-35S
P1	J105 TERMINATING	RF		X	13.5.1.3-3	NLS6GT12-35P	NLSOT12-35S	ME414-0630-4001	NLS6GT12-35S
P1501/P1503/P1505/P1507	J106	RF	X		13.5.1.1-5	NB6GE14-19PNT3	NBOE14-19SNT3	ME414-0630-3001	NB6GE14-19SNT3
P1502/P1504	SEE NOTE BELOW	HO		X	13.5.1.2-2	NB6GE18-8PNT3	NBOE18-8SNT3		
P1506/P1508/P1509/P1511	J102	HO	X		13.5.1.1-4	NB6GE18-32PNT3	NBOE18-32SNT3	ME414-0630-3003	NB6GE18-32SNT3
P1510/P1512/P1513/P1515	J104	ML	X		13.5.1.1-6	NLS6GT20-35PB	NLSOT20-35SB	ME414-0630-4004	NLS6GT20-35SB
P2101/P2105/P2201/P2205		ML	X		13.5.1.1-7	NLS6GT16-35PB	NLSOE16-35SB		
P2102/P2106/P2202/P2206		HO	X		13.5.1.1-8	NLS6GT16-35PA	NLSOE16-35SA		
P2103		HO		X	13.5.1.2-3	NB6GE18-8PNT3	NBOE18-8SNT3		
P2107		HO		X	13.5.1.2-5	NB6GE10-6PNT3	NBOE10-6SNT3		
P2108/P2112/P2208/P2212		HO	X		13.5.1.1-9	NLS6GT16-35P	NLSOE16-35S		
P2110		HO		X	13.5.1.2-4	NB6GE18-8PNT3	NBOE18-8SNT3		
P2113		ML	X		13.5.1.1-10	NB6GE10-6PNT3	NBOE10-6SNT3		
P2210		HO		X	13.5.1.2-6	NB6GE18-8PNT3	NBOE18-8SNT3		

NOTE : SMCH CABLES P1502/P1504 DO NOT INTERFACE WITH STANDARD SMCH-SIP CONNECTOR PANEL.



TABLE 13.5.1.1-1 PIN ASSIGNMENTS FOR SMCH CONNECTOR SECTION 1 - P1401, SECTION 2 - P1403, SECTION 3 - P1405, SECTION 4 - P1407 AND SMCH-SIP CONNECTOR J107

EMC CLASS.	PIN FUNCT.	CABLE DESC.	PIN #	MDM PF-1 FUNCTIONS AND SSP FUNCTIONS	REFERENCE PARAGRAPH	P1401 SECTION 1	P1403 SECTION 2	P1405 SECTION 3	P1407 SECTION 4
			1	NOT WIRED					
			2	NOT WIRED					
			3	NOT WIRED					
			4	NOT WIRED					
			5	NOT WIRED					
			6	NOT WIRED					
			7	NOT WIRED					
			8	NOT WIRED					
			9	NOT WIRED					
RF	SIG	2S22	10	SPARE		To Xo 603 J1301-10	To Xo 603 J1303-10	NOT WIRED	NOT WIRED
RF	RTN	2S22	11	SPARE		To Xo 603 J1301-11	To Xo 603 J1303-11	NOT WIRED	NOT WIRED
RF	SIG	2S23	12	SPARE		To Xo 603 J1301-13	To Xo 603 J1303-13	To Xo 603 J1305-13	To Xo 603 J1307-13
RF	RTN	2S23	13	SPARE		To Xo 603 J1301-14	To Xo 603 J1303-14	To Xo 603 J1305-14	To Xo 603 J1307-14
RF	SIG	2S1	14	SPARE					
RF	RTN	2S1	15	NOT WIRED					
RF	SIG	2S1	16	SPARE		To PSDP J1301-36	To PSDP J1303-36	To PSDP J1305-36	To Xo 603 J1307-16
RF	RTN	2S1	17	SPARE		To PSDP J1301-37	To PSDP J1303-37	To PSDP J1305-37	To Xo 603 J1307-17
RF	SIG	2S2	18	NOT WIRED					
RF	RTN	2S2	19	SPARE		To PSDP J1301-34	To PSDP J1303-34	To PSDP J1305-34	To PSDP J1307-34
RF	SIG	2S2	20	SPARE		To PSDP J1301-35	To PSDP J1303-35	To PSDP J1305-35	To PSDP J1307-35
RF	SIG	2S3	21	NOT WIRED					
RF	RTN	2S3	22	SPARE		To PSDP J1301-32	To PSDP J1303-32	To PSDP J1305-32	To PSDP J1307-32
RF	SIG	2S3	23	SPARE		To PSDP J1301-33	To PSDP J1303-33	To PSDP J1305-33	To PSDP J1307-33
RF	SIG	2S4	24	NOT WIRED					
RF	RTN	2S4	25	SPARE		To PSDP J1301-30	To PSDP J1303-30	To PSDP J1305-30	To PSDP J1307-30
RF	SIG	2S4	26	SPARE		To PSDP J1301-31	To PSDP J1303-31	To PSDP J1305-31	To PSDP J1307-31
RF	SIG	2S5	27	NOT WIRED					
RF	RTN	2S5	28	SPARE		To PSDP J1301-28	To PSDP J1303-28	To PSDP J1305-28	To PSDP J1307-28
RF	SIG	2S5	29	SPARE		To PSDP J1301-29	To PSDP J1303-29	To PSDP J1305-29	To PSDP J1307-29
RF	SIG	2S6	30	NOT WIRED					
RF	RTN	2S6	31	SPARE		To PSDP J1301-26	To PSDP J1303-26	To PSDP J1305-26	To PSDP J1307-26
RF	SIG	2S6	32	SPARE		To PSDP J1301-27	To PSDP J1303-27	To PSDP J1305-27	To PSDP J1307-27
RF	SIG	2S7	33	NOT WIRED					
RF	RTN	2S7	34	SPARE		To PSDP J1301-24	To PSDP J1303-24	To PSDP J1305-24	To PSDP J1307-24
RF	SIG	2S7	35	SPARE		To PSDP J1301-25	To PSDP J1303-25	To PSDP J1305-25	To PSDP J1307-25
RF	SIG	2S8	36	NOT WIRED					
RF	RTN	2S8	37	SPARE		To PSDP J1301-22	To PSDP J1303-22	To PSDP J1305-22	To PSDP J1307-22
RF	SIG	2S8	38	SPARE		To PSDP J1301-23	To PSDP J1303-23	To PSDP J1305-23	To PSDP J1307-23
RF	SIG	2S9	39	NOT WIRED					
RF	RTN	2S9	40	SPARE		To PSDP J1301-20	To PSDP J1303-20	To PSDP J1305-20	To PSDP J1307-20
RF	SIG	2S9	41	SPARE		To PSDP J1301-21	To PSDP J1303-21	To PSDP J1305-21	To PSDP J1307-21
RF	SIG	2S10	42	NOT WIRED					
RF	RTN	2S10	43	SPARE		To PSDP J1301-18	To PSDP J1303-18	To PSDP J1305-18	To PSDP J1307-18
RF	SIG	2S10	44	SPARE		To PSDP J1301-19	To PSDP J1303-19	To PSDP J1305-19	To PSDP J1307-19
RF	SIG	2S10	45	NOT WIRED					

TABLE 13.5.1.1-1 PIN ASSIGNMENTS FOR SMCH CONNECTOR SECTION 1 - P1401, SECTION 2 - P1403, SECTION 3 - P1405, SECTION 4 - P1407 AND SMCH-SIP CONNECTOR J107

EMC CLASS.	PIN FUNCT.	CABLE DESC.	PIN #	MDM PF-1 FUNCTIONS AND SSP FUNCTIONS	REFERENCE PARAGRAPH	P1401 SECTION 1	P1403 SECTION 2	P1405 SECTION 3	P1407 SECTION 4
RF	SIG RTN	2S11	46	SPARE		To PSDP J1301-16	To PSDP J1303-16	To PSDP J1305-16	To PSDP J1307-16
RF	RTN	2S11	47	SPARE		To PSDP J1301-17	To PSDP J1303-17	To PSDP J1305-17	To PSDP J1307-17
RF	SIG RTN	2S12	48	NOT WIRED	8.2.3	ANALOG TRACK 9	ANALOG TRACK 10	ANALOG TRACK 11	ANALOG TRACK 12
RF	RTN	2S12	49	P/L RECORDER ANALOG					
RF	SIG RTN	2S13	50	P/L RECORDER ANALOG RETURN					
RF	RTN	2S13	51	NOT WIRED	8.2.3	DIGITAL TRACK 1	DIGITAL TRACK 3	DIGITAL TRACK 5	DIGITAL TRACK 7
RF	SIG RTN	2S14	52	P/L RECORDER DIGITAL					
RF	RTN	2S14	53	P/L RECORDER DIGITAL RETURN					
RF	SIG RTN	2S15	54	NOT WIRED	8.2.3	DIGITAL TRACK 2	DIGITAL TRACK 4	DIGITAL TRACK 6	DIGITAL TRACK 8
RF	RTN	2S15	55	P/L RECORDER DIGITAL RETURN					
RF	SIG RTN	2S16	56	NOT WIRED	8.2.1	TELEMETRY PORT 1	TELEMETRY PORT 2	TELEMETRY PORT 3	TELEMETRY PORT 4
RF	RTN	2S16	57	PDI INPUT TELEMETRY					
RF	SIG RTN	2S17	58	PDI INPUT TELEMETRY RETURN					
RF	RTN	2S17	59	NOT WIRED	8.2.1	TELEMETRY CLOCK 1	TELEMETRY CLOCK 2	TELEMETRY CLOCK 3	TELEMETRY CLOCK 4
RF	SIG RTN	2S18	60	PDI INPUT CLOCK					
RF	RTN	2S18	61	PDI INPUT CLOCK RETURN					
RF	SIG RTN	2S19	62	NOT WIRED	8.2.5	16 KHZ COMMAND OUT 1	16 KHZ COMMAND OUT 2	16 KHZ COMMAND OUT 3	16 KHZ COMMAND OUT 4
RF	RTN	2S19	63	NOT WIRED					
RF	SIG RTN	2S20	64	PSP # 1 OUTPUT					
RF	RTN	2S20	65	PSP # 1 OUTPUT RETURN					
RF	SIG RTN	2S21	66	NOT WIRED	8.2.10	GMT 1	GMT 3	GMT 5	GMT 7
RF	RTN	2S21	67	PSP # 2 OUTPUT					
RF	SIG RTN	2S22	68	PSP # 2 OUTPUT RETURN					
RF	RTN	2S22	69	NOT WIRED	8.2.10	GMT 2	GMT 4	GMT 6	GMT 8
RF	SIG RTN	2S23	70	PAYLOAD TIMING BUFFER					
RF	RTN	2S23	71	PAYLOAD TIMING BUFFER RETURN					
RF	SIG RTN	2S24	72	NOT WIRED	8.2.10	MET 1	MET 2	MET 3	MET 4
RF	RTN	2S24	73	PAYLOAD TIMING BUFFER					
RF	SIG RTN	2S25	74	PAYLOAD TIMING BUFFER RETURN					
RF	RTN	2S25	75	NOT WIRED					
RF	SIG RTN	2S26	76	PAYLOAD TIMING BUFFER					
RF	RTN	2S26	77	PAYLOAD TIMING BUFFER RETURN					
RF	SIG RTN	2S27	78	NOT WIRED					
RF	RTN	2S27	79	NOT WIRED					

TABLE 13.5.1.1-2 PIN ASSIGNMENTS FOR SMCH CONNECTOR SECTION 1 - P1431, SECTION 2 - P1429, SECTION 3 - P1427, SECTION 4 - P1425 AND SMCH-SIP CONNECTOR J108

EMC CLASS.	PIN FUNCT.	CABLE DESC.	PIN #	MDM PF-1 FUNCTIONS AND SSP FUNCTIONS	REFERENCE PARAGRAPH	P1431 SECTION 1			P1429 SECTION 2			P1427 SECTION 3			P1425 SECTION 4		
						CARD LOCATION	CHANNEL NUMBER	START BIT	CARD LOCATION	CHANNEL NUMBER	START BIT	CARD LOCATION	CHANNEL NUMBER	START BIT	CARD LOCATION	CHANNEL NUMBER	START BIT
ML	SIG	256	1	SPARE		To X0 603 J1331	02	08	To X0 603 J1329	02	08	To X0 603 J1327	02	To X0 603 J1325	01	08	
ML	SIG	256	2	SPARE	8.2.2.1	To X0 603 J1331	02	09	To X0 603 J1329	02	09	To X0 603 J1327	02	To X0 603 J1325	01	09	
ML	SIG	256	3	SPARE	8.2.2.1	To X0 603 J1331	02	10	To X0 603 J1329	02	10	To X0 603 J1327	02	To X0 603 J1325	01	10	
ML	SIG	256	4	SPARE	8.2.2.1	To X0 603 J1331	02	11	To X0 603 J1329	02	11	To X0 603 J1327	02	To X0 603 J1325	01	11	
ML	RIN	256	5	SPARE	8.2.2.1	To X0 603 J1331	02	---	To X0 603 J1329	02	---	To X0 603 J1327	02	To X0 603 J1325	01	---	
ML	RIN	256	6	TERMINATE		To X0 603 J1331	02	---	To X0 603 J1329	02	---	To X0 603 J1327	02	To X0 603 J1325	01	---	
ML	SHD	256	7	TERMINATE		To X0 603 J1331	02	12	To X0 603 J1329	02	12	To X0 603 J1327	02	To X0 603 J1325	01	12	
ML	SIG	2516	8	SPARE	8.2.2.1	To X0 603 J1331	02	13	To X0 603 J1329	02	13	To X0 603 J1327	02	To X0 603 J1325	01	13	
ML	RIN	2516	9	SPARE	8.2.2.1	To X0 603 J1331	02	14	To X0 603 J1329	02	14	To X0 603 J1327	02	To X0 603 J1325	01	14	
ML	SHD	2516	9	TERMINATE	8.2.2.1	To X0 603 J1331	02	15	To X0 603 J1329	02	15	To X0 603 J1327	02	To X0 603 J1325	01	15	
ML	SIG	551	10	P/L COMMAND (DOL 1)	8.2.2.3	IOM-10	02	08	IOM-10	02	08	IOM-10	02	IOM-00	01	08	
ML	SIG	551	11	P/L COMMAND (DOL 2)	8.2.2.3	IOM-10	02	09	IOM-10	02	09	IOM-10	02	IOM-00	01	09	
ML	SIG	551	12	P/L COMMAND (DOL 3)	8.2.2.3	IOM-10	02	10	IOM-10	02	10	IOM-10	02	IOM-00	01	10	
ML	SIG	551	13	P/L COMMAND (DOL 4)	8.2.2.3	IOM-10	02	11	IOM-10	02	11	IOM-10	02	IOM-00	01	11	
ML	RIN	551	14	DOL 1-4 RETURN	8.2.2.3	IOM-10	02	---	IOM-10	02	---	IOM-10	02	IOM-00	01	---	
ML	SHD	551	15	TERMINATE		IOM-10	02	---	IOM-10	02	---	IOM-10	02	IOM-00	01	---	
ML	SIG	552	16	P/L COMMAND (DOL 5)	8.2.2.3	IOM-10	02	12	IOM-10	02	12	IOM-10	02	IOM-00	01	12	
ML	SIG	552	17	P/L COMMAND (DOL 6)	8.2.2.3	IOM-10	02	13	IOM-10	02	13	IOM-10	02	IOM-00	01	13	
ML	SIG	552	18	P/L COMMAND (DOL 7)	8.2.2.3	IOM-10	02	14	IOM-10	02	14	IOM-10	02	IOM-00	01	14	
ML	SIG	552	19	P/L COMMAND (DOL 8)	8.2.2.3	IOM-10	02	15	IOM-10	02	15	IOM-10	02	IOM-00	01	15	
ML	RIN	552	20	DOL 5-8 RETURN	8.2.2.3	IOM-10	02	---	IOM-10	02	---	IOM-10	02	IOM-00	01	---	
ML	SHD	552	21	TERMINATE		IOM-10	02	---	IOM-10	02	---	IOM-10	02	IOM-00	01	---	
ML	SIG	554	22	P/L MONITOR (DIL 1)	8.2.2.3	IOM-5	01	08	IOM-13	02	08	IOM-13	02	IOM-5	02	08	
ML	SIG	554	23	P/L MONITOR (DIL 2)	8.2.2.3	IOM-5	01	09	IOM-13	02	09	IOM-13	02	IOM-5	02	09	
ML	SIG	554	24	P/L MONITOR (DIL 3)	8.2.2.3	IOM-5	01	10	IOM-13	02	10	IOM-13	02	IOM-5	02	10	
ML	SIG	554	25	P/L MONITOR (DIL 4)	8.2.2.3	IOM-5	01	11	IOM-13	02	11	IOM-13	02	IOM-5	02	11	
ML	RIN	554	26	DIL 1-4 RETURN	8.2.2.3	IOM-5	01	---	IOM-13	02	---	IOM-13	02	IOM-5	02	---	
ML	SHD	554	27	TERMINATE		IOM-5	01	---	IOM-13	02	---	IOM-13	02	IOM-5	02	---	
ML	SIG	555	28	P/L MONITOR (DIL 5)	8.2.2.3	IOM-5	01	12	IOM-13	02	12	IOM-13	02	IOM-5	02	12	
ML	SIG	555	29	P/L MONITOR (DIL 6)	8.2.2.3	IOM-5	01	13	IOM-13	02	13	IOM-13	02	IOM-5	02	13	
ML	SIG	555	30	P/L MONITOR (DIL 7)	8.2.2.3	IOM-5	01	14	IOM-13	02	14	IOM-13	02	IOM-5	02	14	
ML	SIG	555	31	P/L MONITOR (DIL 8)	8.2.2.3	IOM-5	01	15	IOM-13	02	15	IOM-13	02	IOM-5	02	15	
ML	RIN	555	32	DIL 5-8 RETURN	8.2.2.3	IOM-5	01	---	IOM-13	02	---	IOM-13	02	IOM-5	02	---	
ML	SHD	555	33	TERMINATE		IOM-5	01	---	IOM-13	02	---	IOM-13	02	IOM-5	02	---	
ML	SIG	251	34	P/L MONITOR (AID 1)	8.2.2.4	IOM-11	06-HI	---	IOM-11	04-HI	---	IOM-11	02-HI	IOM-11	00-HI	---	
ML	RIN	251	35	AID 1 RETURN	8.2.2.4	IOM-11	06-LO	---	IOM-11	04-LO	---	IOM-11	02-LO	IOM-11	00-LO	---	
ML	SHD	251	36	TERMINATE		IOM-11	07-HI	---	IOM-11	05-HI	---	IOM-11	03-HI	IOM-11	01-HI	---	
ML	SIG	252	37	P/L MONITOR (AID 2)	8.2.2.4	IOM-11	07-LO	---	IOM-11	05-LO	---	IOM-11	03-LO	IOM-11	01-LO	---	
ML	RIN	252	38	AID 2 RETURN		IOM-11	07-LO	---	IOM-11	05-LO	---	IOM-11	03-LO	IOM-11	01-LO	---	
ML	SHD	252	39	TERMINATE		IOM-11	07-LO	---	IOM-11	05-LO	---	IOM-11	03-LO	IOM-11	01-LO	---	
ML	SIG	2515	40	DS24/DS12	13.4.2	SSP 1A - DS24			SSP 1B - DS12			SSP 2A - DS24		SSP 2B - DS12			
ML	RIN	2515	41	DS24/DS12 RETURN		SSP 1A - DS24			SSP 1B - DS12			SSP 2A - DS24		SSP 2B - DS12			
ML	SHD	2514	42	TERMINATE		SSP 1A - DS24			SSP 1B - DS12			SSP 2A - DS24		SSP 2B - DS12			

TABLE 13.5.1.1-2 PIN ASSIGNMENTS FOR SMCH CONNECTOR SECTION 1 - P1431, SECTION 2 - P1429, SECTION 3 - P1427, SECTION 4 - P1425 AND SMCH-SIP CONNECTOR J108

EMC CLASS.	PIN FUNC.	CABLE DESCR.	PIN #	MDM PF-1 FUNCTIONS AND SSP FUNCTIONS	REFERENCE PARAGRAPH	P1431 SECTION 1	P1429 SECTION 2	P1427 SECTION 3	P1425 SECTION 4
ML	SIG	2514	43	DS23/DS11	13.4.2	SSP IA - DS23	SSP IB - DS11	SSP 2A - DS23	SSP 2B - DS11
ML	RTN	2514	44	DS23/DS11 RETURN	13.4.2	SSP IA - DS23 RETURN	SSP IB - DS11 RETURN	SSP 2A - DS23 RETURN	SSP 2B - DS11 RETURN
ML	SHD	2515	45	TERMINATE					
ML	SIG	2513	46	DS22/DS10	13.4.2	SSP IA - DS22	SSP IB - DS10	SSP 2A - DS22	SSP 2B - DS10
ML	RTN	2513	47	DS22/DS10 RETURN	13.4.2	SSP IA - DS22 RETURN	SSP IB - DS10 RETURN	SSP 2A - DS22 RETURN	SSP 2B - DS10 RETURN
ML	SHD	2513	48	TERMINATE					
ML	SIG	2512	49	DS21/DS9	13.4.2	SSP IA - DS21	SSP IB - DS9	SSP 2A - DS21	SSP 2B - DS9
ML	RTN	2512	50	DS21/DS9 RETURN	13.4.2	SSP IA - DS21 RETURN	SSP IB - DS9 RETURN	SSP 2A - DS21 RETURN	SSP 2B - DS9 RETURN
ML	SHD	2512	51	TERMINATE					
ML	SIG	2511	52	DS20/DS8	13.4.2	SSP IA - DS20	SSP IB - DS8	SSP 2A - DS20	SSP 2B - DS8
ML	RTN	2511	53	DS20/DS8 RETURN	13.4.2	SSP IA - DS20 RETURN	SSP IB - DS8 RETURN	SSP 2A - DS20 RETURN	SSP 2B - DS8 RETURN
ML	SHD	2511	54	TERMINATE					
ML	SIG	2510	55	DS19/DS7	13.4.2	SSP IA - DS19	SSP IB - DS7	SSP 2A - DS19	SSP 2B - DS7
ML	RTN	2510	56	DS19/DS7 RETURN	13.4.2	SSP IA - DS19 RETURN	SSP IB - DS7 RETURN	SSP 2A - DS19 RETURN	SSP 2B - DS7 RETURN
ML	SHD	2510	57	TERMINATE					
ML	SIG	259	58	DS18/DS6	13.4.2	SSP IA - DS18	SSP IB - DS6	SSP 2A - DS18	SSP 2B - DS6
ML	RTN	259	59	DS18/DS6 RETURN	13.4.2	SSP IA - DS18 RETURN	SSP IB - DS6 RETURN	SSP 2A - DS18 RETURN	SSP 2B - DS6 RETURN
ML	SHD	259	60	TERMINATE					
ML	SIG	258	61	DS17/DS5	13.4.2	SSP IA - DS17	SSP IB - DS5	SSP 2A - DS17	SSP 2B - DS5
ML	RTN	258	62	DS17/DS5 RETURN	13.4.2	SSP IA - DS17 RETURN	SSP IB - DS5 RETURN	SSP 2A - DS17 RETURN	SSP 2B - DS5 RETURN
ML	SHD	258	63	TERMINATE					
ML	SIG	257	64	DS16/DS4	13.4.2	SSP IA - DS16	SSP IB - DS4	SSP 2A - DS16	SSP 2B - DS4
ML	RTN	257	65	DS16/DS4 RETURN	13.4.2	SSP IA - DS16 RETURN	SSP IB - DS4 RETURN	SSP 2A - DS16 RETURN	SSP 2B - DS4 RETURN
ML	SHD	257	66	TERMINATE					
ML	SIG	256	67	DS15/DS3	13.4.2	SSP IA - DS15	SSP IB - DS3	SSP 2A - DS15	SSP 2B - DS3
ML	RTN	256	68	DS15/DS3 RETURN	13.4.2	SSP IA - DS15 RETURN	SSP IB - DS3 RETURN	SSP 2A - DS15 RETURN	SSP 2B - DS3 RETURN
ML	SHD	256	69	TERMINATE					
ML	RTN	255	70	DS14/DS2	13.4.2	SSP IA - DS14	SSP IB - DS2	SSP 2A - DS14	SSP 2B - DS2
ML	SIG	255	71	DS14/DS2 RETURN	13.4.2	SSP IA - DS14 RETURN	SSP IB - DS2 RETURN	SSP 2A - DS14 RETURN	SSP 2B - DS2 RETURN
ML	SHD	255	72	TERMINATE					
ML	SIG	254	73	DS13/DS1	13.4.2	SSP IA - DS13	SSP IB - DS1	SSP 2A - DS13	SSP 2B - DS1
ML	SIG	254	74	DS14/DS2	13.4.2	SSP IA - DS14	SSP IB - DS2	SSP 2A - DS14	SSP 2B - DS2
ML	SHD	254	75	TERMINATE					
ML	SIG	253	76	DS13/DS1	13.4.2	SSP IA - DS13	SSP IB - DS1	SSP 2A - DS13	SSP 2B - DS1
ML	RTN	253	77	DS13/DS1 RETURN	13.4.2	SSP IA - DS13 RETURN	SSP IB - DS1 RETURN	SSP 2A - DS13 RETURN	SSP 2B - DS1 RETURN
ML	SHD	253	78	TERMINATE					
ML	SHD	253	79	NOT WIRED					

TABLE 13.5.1.1-3 PIN ASSIGNMENTS FOR SMCH CONNECTOR SECTION 1 - P1415, SECTION 2 - P1413, SECTION 3 - P1409, SECTION 4 - P1411 AND SMCH-SIP CONNECTOR J103

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	MDM PF-1 COMMANDS AND SSP FUNCTIONS	REFERENCE PARAGRAPH	P1415 SECTION 1			P1413 SECTION 2			P1409 SECTION 3			P1411 SECTION 4		
						CARD LOCATION	CHANNEL NUMBER	START BIT	CARD LOCATION	CHANNEL NUMBER	START BIT	CARD LOCATION	CHANNEL NUMBER	START BIT	CARD LOCATION	CHANNEL NUMBER	START BIT
			1	P/L CMD (DOH 1)	8.2.2.2	IOM-14	02	08	IOM-02	02	12	IOM-02	02	04	IOM-02	02	08
HO	SIG	5T1	2	P/L CMD (DOH 2)	8.2.2.2	IOM-14	02	09	IOM-02	02	13	IOM-02	02	05	IOM-02	02	09
HO	SIG	5T1	3	P/L CMD (DOH 3)	8.2.2.2	IOM-14	02	10	IOM-02	02	14	IOM-02	02	06	IOM-02	02	10
HO	SIG	5T1	4	P/L CMD (DOH 4)	8.2.2.2	IOM-14	02	11	IOM-02	02	15	IOM-02	02	07	IOM-02	02	11
HO	RTN	5T1	5	DOH 1-4 RETURN													
HO	SIG	2T1	6	NOT WIRED													
HO	SIG	2T1	7	SPARE		To Xo 603 J1315	7		To Xo 603 J1313	7		To Xo 603 J1309	7		To Xo 603 J1311	7	
HO	RTN	2T1	8	SPARE		To Xo 603 J1315	8		To Xo 603 J1313	8		To Xo 603 J1309	8		To Xo 603 J1311	8	
HO	SIG	2T4	9	NOT WIRED													
HO	SIG	2T4	10	SPARE		To Xo 603 J1315	10		To Xo 603 J1313	10		To PSDP J1309	9		To PSDP J1311	9	
HO	RTN	2T4	11	SPARE		To Xo 603 J1315	11		To Xo 603 J1313	11		To PSDP J1309	16		To PSDP J1311	16	
HO	SIG	2T5	12	NOT WIRED	13.4.2	SSP 1A	S13		SSP 1B	S1		SSP 2A	S13		SSP 2B	S1	
HO	SIG	2T5	13	S13/S1	13.4.2	SSP 1A	S13		SSP 1B	S1		SSP 2A	S13		SSP 2B	S1	
HO	SIG	2T5	14	S13/S1		SSP 1A	S13		SSP 1B	S1		SSP 2A	S13		SSP 2B	S1	
HO	SIG	2T5	15	NOT WIRED		SSP 1A	S13		SSP 1B	S1		SSP 2A	S13		SSP 2B	S1	
HO	SIG	2T6	16	S13/S1		SSP 1A	S13		SSP 1B	S1		SSP 2A	S13		SSP 2B	S1	
HO	SIG	2T6	17	S13/S1		SSP 1A	S13		SSP 1B	S1		SSP 2A	S13		SSP 2B	S1	
HO	SIG	2T7	18	NOT WIRED	13.4.2	SSP 1A	S13		SSP 1B	S1		SSP 2A	S13		SSP 2B	S1	
HO	SIG	2T7	19	S13/S1	13.4.2	SSP 1A	S13		SSP 1B	S1		SSP 2A	S13		SSP 2B	S1	
HO	SIG	2T7	20	S13/S1		SSP 1A	S13		SSP 1B	S1		SSP 2A	S13		SSP 2B	S1	
HO	SIG	2T7	21	NOT WIRED		SSP 1A	S13		SSP 1B	S1		SSP 2A	S13		SSP 2B	S1	
HO	SIG	2T8	22	S14/S2	13.4.2	SSP 1A	S14		SSP 1B	S2		SSP 2A	S14		SSP 2B	S2	
HO	SIG	2T8	23	S14/S2	13.4.2	SSP 1A	S14		SSP 1B	S2		SSP 2A	S14		SSP 2B	S2	
HO	SIG	2T8	24	NOT WIRED		SSP 1A	S14		SSP 1B	S2		SSP 2A	S14		SSP 2B	S2	
HO	SIG	2T9	25	S14/S2	13.4.2	SSP 1A	S14		SSP 1B	S2		SSP 2A	S14		SSP 2B	S2	
HO	SIG	2T9	26	S14/S2	13.4.2	SSP 1A	S14		SSP 1B	S2		SSP 2A	S14		SSP 2B	S2	
HO	SIG	2T9	27	NOT WIRED		SSP 1A	S14		SSP 1B	S2		SSP 2A	S14		SSP 2B	S2	
HO	SIG	2T10	28	S20/S8	13.4.2	SSP 1A	S20		SSP 1B	S8		SSP 2A	S20		SSP 2B	S8	
HO	SIG	2T10	29	S20/S8	13.4.2	SSP 1A	S20		SSP 1B	S8		SSP 2A	S20		SSP 2B	S8	
HO	SIG	2T10	30	NOT WIRED		SSP 1A	S20		SSP 1B	S8		SSP 2A	S20		SSP 2B	S8	
HO	SIG	2T11	31	S23/S11	13.4.2	SSP 1A	S23		SSP 1B	S11		SSP 2A	S23		SSP 2B	S11	
HO	SIG	2T11	32	S23/S11	13.4.2	SSP 1A	S23		SSP 1B	S11		SSP 2A	S23		SSP 2B	S11	
HO	SIG	2T11	33	NOT WIRED		SSP 1A	S23		SSP 1B	S11		SSP 2A	S23		SSP 2B	S11	
HO	SIG	2T12	34	S24/S12	13.4.2	SSP 1A	S24		SSP 1B	S12		SSP 2A	S24		SSP 2B	S12	
HO	SIG	2T12	35	S24/S12	13.4.2	SSP 1A	S24		SSP 1B	S12		SSP 2A	S24		SSP 2B	S12	
HO	SIG	2T12	36	NOT WIRED		SSP 1A	S24		SSP 1B	S12		SSP 2A	S24		SSP 2B	S12	
HO	SIG	2T13	37	S24/S12	13.4.2	SSP 1A	S24		SSP 1B	S12		SSP 2A	S24		SSP 2B	S12	
HO	SIG	2T13	38	S24/S12	13.4.2	SSP 1A	S24		SSP 1B	S12		SSP 2A	S24		SSP 2B	S12	
HO	SIG	2T13	39	NOT WIRED		SSP 1A	S24		SSP 1B	S12		SSP 2A	S24		SSP 2B	S12	
HO	SIG	2T14	40	S21/S9	13.4.2	SSP 1A	S21		SSP 1B	S9		SSP 2A	S21		SSP 2B	S9	
HO	SIG	2T14	41	S21/S9	13.4.2	SSP 1A	S21		SSP 1B	S9		SSP 2A	S21		SSP 2B	S9	
HO	SIG	2T14	42	NOT WIRED		SSP 1A	S21		SSP 1B	S9		SSP 2A	S21		SSP 2B	S9	

TABLE 13.5.1.1-3 PIN ASSIGNMENTS FOR SMCH CONNECTOR SECTION 1 - P1415, SECTION 2 - P1413, SECTION 3 - P1409, SECTION 4 - P1411 AND SMCH-SIP CONNECTOR J103

EMC CLASS.	PIN FUNCT.	CABLE DESC.	PIN #	MDM PF-1 COMMANDS AND SSP FUNCTIONS	REFERENCE PARAGRAPH	P1415 SECTION 1	P1413 SECTION 2	P1409 SECTION 3	P1411 SECTION 4
HO	SIG	2T15	43	S19/S7	13.4.2	SSP 1A - S19	SSP 1B - S7	SSP 2A - S19	SSP 2B - S7
HO	SIG	2T15	44	S19/S7	13.4.2	SSP 1A - S19	SSP 1B - S7	SSP 2A - S19	SSP 2B - S7
HO	SIG	2T16	45	NOT WIRED					
HO	SIG	2T16	46	S15/S3	13.4.2	SSP 1A - S15	SSP 1B - S3	SSP 2A - S15	SSP 2B - S3
HO	SIG	2T16	47	S15/S3	13.4.2	SSP 1A - S15	SSP 1B - S3	SSP 2A - S15	SSP 2B - S3
HO	SIG	2T17	48	NOT WIRED					
HO	SIG	2T17	49	S16/S4	13.4.2	SSP 1A - S16	SSP 1B - S4	SSP 2A - S16	SSP 2B - S4
HO	SIG	2T17	50	S16/S4	13.4.2	SSP 1A - S16	SSP 1B - S4	SSP 2A - S16	SSP 2B - S4
HO	SIG	2T18	51	NOT WIRED					
HO	SIG	2T18	52	S16/S4	13.4.2	SSP 1A - S16	SSP 1B - S4	SSP 2A - S16	SSP 2B - S4
HO	SIG	2T18	53	S16/S4	13.4.2	SSP 1A - S16	SSP 1B - S4	SSP 2A - S16	SSP 2B - S4
HO	SIG	2T19	54	NOT WIRED					
HO	SIG	2T19	55	28 VDC (CB 2 / CB4)	13.4.2	SSP 1A - CB4	SSP 1B - CB2	SSP 2A - CB4	SSP 2B - CB2
HO	RTN	2T19	56	28 VDC RETURN		SSP 1A - CB4 RETURN	SSP 1B - CB2 RETURN	SSP 2A - CB4 RETURN	SSP 2B - CB2 RETURN
HO	SIG	2T20	57	NOT WIRED					
HO	SIG	2T20	58	S18/S6	13.4.2	SSP 1A - S18	SSP 1B - S6	SSP 2A - S18	SSP 2B - S6
HO	SIG	2T20	59	S18/S6	13.4.2	SSP 1A - S18	SSP 1B - S6	SSP 2A - S18	SSP 2B - S6
HO	SIG	2T21	60	NOT WIRED					
HO	SIG	2T21	61	S15/S3	13.4.2	SSP 1A - S15	SSP 1B - S3	SSP 2A - S15	SSP 2B - S3
HO	SIG	2T21	62	S15/S3	13.4.2	SSP 1A - S15	SSP 1B - S3	SSP 2A - S15	SSP 2B - S3
HO	SIG	2T22	63	NOT WIRED					
HO	SIG	2T22	64	S18/S6	13.4.2	SSP 1A - S18	SSP 1B - S6	SSP 2A - S18	SSP 2B - S6
HO	SIG	2T22	65	S18/S6	13.4.2	SSP 1A - S18	SSP 1B - S6	SSP 2A - S18	SSP 2B - S6
HO	SIG	2T23	66	NOT WIRED					
HO	SIG	2T23	67	S21/S9	13.4.2	SSP 1A - S21	SSP 1B - S9	SSP 2A - S21	SSP 2B - S9
HO	SIG	2T23	68	S21/S9	13.4.2	SSP 1A - S21	SSP 1B - S9	SSP 2A - S21	SSP 2B - S9
HO	SIG	2T24	69	NOT WIRED					
HO	SIG	2T24	70	S17/S5	13.4.2	SSP 1A - S17	SSP 1B - S5	SSP 2A - S17	SSP 2B - S5
HO	SIG	2T24	71	S17/S5	13.4.2	SSP 1A - S17	SSP 1B - S5	SSP 2A - S17	SSP 2B - S5
HO	SIG	2T2	72	NOT WIRED					
HO	SIG	2T2	73	S22/S10	13.4.2	SSP 1A - S22	SSP 1B - S10	SSP 2A - S22	SSP 2B - S10
HO	SIG	2T2	74	S22/S10	13.4.2	SSP 1A - S22	SSP 1B - S10	SSP 2A - S22	SSP 2B - S10
HO	SIG	2T3	75	NOT WIRED					
HO	SIG	2T3	76	S16/S4	13.4.2	SSP 1A - S16	SSP 1B - S4	SSP 2A - S16	SSP 2B - S4
HO	RTN	2T3	77	28 VDC RETURN					
HO	RTN	2T3	78	NOT WIRED					
HO	RTN	2T3	79	NOT WIRED					

NOTE : SIGNALS ON PINS 1-5 IN ALL FOUR SMCH SECTIONS ARE ALSO SPLICED TO Xo 603 J1337

TABLE 13.5.1.1-4 PIN ASSIGNMENTS FOR SMCH CONNECTOR SECTION 1 - P1506, SECTION 2 - P1508, SECTION 3 - P1509, SECTION 4 - P1511 AND SMCH-SIP CONNECTOR J102

EMC CLASS.	PIN FUNCT.	CABLE DESCOR.	PIN #	T-O CONNECTOR PIN ASSIGNMENT				REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
				J58	P1506	P1508	P1509		
HO	SIG		A	(1)	(1)	(1)	(1)		
HO	RIN		B	(1)	(1)	(1)	(1)		
HO	SIG	2T1	C	f	f	f	f		
HO	RIN	2T11	D	e	e	e	e		
HO	SIG	2T12	E	x	x	x	x		
HO	RIN	2T13	F	w	w	w	w		NOT WIRED
HO	SIG	2T13	G	c	c	c	c		NOT WIRED
HO	RIN	2T2	H	u	u	u	u		NOT WIRED
HO	SIG	2T2	I	b	b	b	b		
HO	RIN	2T2	J	a	a	a	a		
HO	SIG	2T3	K	y	y	y	y		
HO	RIN	2T3	L	z	z	z	z		
HO	SIG	2T4	M	j	j	j	j		
HO	RIN	2T4	N	m	m	m	m		
HO	SIG	2T5	O	k	k	k	k		
HO	RIN	2T5	P	n	n	n	n		
HO	SIG	2T6	Q	p	p	p	p		
HO	RIN	2T6	R	q	q	q	q		
HO	SIG	2T7	S	s	s	s	s		
HO	RIN	2T7	T	cc	cc	cc	cc		
HO	SIG	2T8	U	t	t	t	t		
HO	RIN	2T8	V	dd	dd	dd	dd		
HO	SIG	2T9	W	w	w	w	w		
HO	RIN	2T9	X	v	v	v	v		
HO	SIG	2T10	Y	aa	aa	aa	aa		
HO	RIN	2T10	Z	bb	bb	bb	bb		
HO	SIG	2T11	a	ff	ff	ff	ff		
HO	RIN	2T11	b	ee	ee	ee	ee		
HO	SIG	2T11	c	gg	gg	gg	gg		
HO	RIN	2T11	d	hh	hh	hh	hh		
HO	SIG	2T11	e						
HO	RIN	2T11	f						
HO	SIG	2T11	g						
HO	RIN	2T11	h						
HO	SIG	2T11	i						
HO	RIN	2T11	j						

(1) SPARE-- WIRED ONLY TO Xo 1203





TABLE 13.5.1.1-6 PIN ASSIGNMENTS FOR SMCH CONNECTOR SECTION 1 - P1510, SECTION 2 - P1512, SECTION 3 - P1513, SECTION 4 - P1515 AND SMCH-SIP CONNECTOR J104

EMC CLASS.	PIN FUNCT.	CABLE DESC.	PIN #	T-O CONNECTOR PIN ASSIGNMENT				REFERENCE PARAGRAPH	ORBITTER COMPONENT INTERFACE AND/OR NOTES
				J69	J67	J69	J67		
			1	P1510	P1512	P1513	P1515	7.3.6	
ML	SIG	2S1	51	(1)	(1)	(1)	(1)		PINS 1 THROUGH 51 NOT WIRED
ML	RTN	2S1	52	(1)	(1)	(1)	(1)		
ML	SHD	2S1	53	(1)	(1)	(1)	(1)		
ML	SIG	2S2	54	(1)	L	(1)	(1)		
ML	RTN	2S2	55	(1)	M	(1)	(1)		
ML	SHD	2S2	56	(1)	N	(1)	(1)		
ML	SIG	2S3	57	(1)	P	(1)	(1)		
ML	RTN	2S3	58	m	R	m	(1)		
ML	SHD	2S3	59	n	S	n	(1)		
ML	SIG	2S4	60	p	T	p	(1)		
ML	RTN	2S4	61	q	U	q	(1)		
ML	SHD	2S4	62	r	V	r	(1)		
ML	SIG	2S5	63	s	W	s	(1)		
ML	RTN	2S5	64	t	X	t	(1)		
ML	SHD	2S5	65	u	Y	u	(1)		
ML	SIG	2S6	66	v	Z	v	(1)		
ML	RTN	2S6	67	w	a	w	(1)		
ML	SHD	2S6	68	x	b	x	(1)		
ML	SIG	2S7	69	y	c	y	(1)		
ML	RTN	2S7	70	z	d	z	(1)		
ML	SHD	2S7	71	AA	e	AA	(1)		
ML	SIG	2S8	72	BB	f	BB	(1)		
ML	RTN	2S8	73	CC	g	CC	(1)		
ML	SHD	2S8	74	DD	h	DD	(1)		
ML	SIG	2S9	75	EE	i	EE	(1)		
ML	RTN	2S9	76	FF	j	FF	(1)		
ML	SHD	2S9	77	GG	k	GG	(1)		
ML			78	HH		HH			
ML			79						TERMINATE NOT WIRED

(1) SPARE- WIRED ONLY TO Xo 1203

TABLE 13.5.1.1-7 PIN ASSIGNMENTS FOR AFD SMCH SECTION 1 - P2101, SECTION 2 - P2105, SECTION 3 - P2201, AND SECTION 4 - P2205

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	MDM PF-1 FUNCTIONS AND SSP FUNCTIONS	REFERENCE PARAGRAPH	P2101 SECTION 1	P2105 SECTION 2	P2201 SECTION 3	P2205 SECTION 4
ML	SHD	2512	1	TERMINATE	13.4.2	SSP 1A - DS24	SSP 1B - DS12	SSP 2A - DS24	SSP 2B - DS12
ML	SIG	2513	2	DS24/DS12 RETURN		SSP 1A - DS24	SSP 1B - DS12	SSP 2A - DS24	SSP 2B - DS12
ML	RTN	2513	3	NOT WIRED					
ML	SIG	2512	5	DS23/DS11	13.4.2	SSP 1A - DS23	SSP 1B - DS11	SSP 2A - DS23	SSP 2B - DS11
ML	RTN	2512	6	DS23/DS11 RETURN		SSP 1A - DS23	SSP 1B - DS11	SSP 2A - DS23	SSP 2B - DS11
ML	SHD	2513	7	TERMINATE					
			8	NOT WIRED					
			9	NOT WIRED					
ML	SIG	258	10	DS19/DS12	13.4.2	SSP 1A - DS19	SSP 1B - DS7	SSP 2A - DS19	SSP 2B - DS7
ML	RTN	258	11	DS19/DS12 RETURN		SSP 1A - DS19	SSP 1B - DS7	SSP 2A - DS19	SSP 2B - DS7
ML	SHD	259	12	TERMINATE					
ML	SIG	2510	13	DS21/DS9	13.4.2	SSP 1A - DS21	SSP 1B - DS9	SSP 2A - DS21	SSP 2B - DS9
ML	RTN	2510	14	DS21/DS9 RETURN		SSP 1A - DS21	SSP 1B - DS9	SSP 2A - DS21	SSP 2B - DS9
ML	SHD	2511	15	TERMINATE					
			16	NOT WIRED					
			17	NOT WIRED					
			18	TERMINATE					
ML	SHD	258	19	DS20/DS8	13.4.2	SSP 1A - DS20	SSP 1B - DS8	SSP 2A - DS20	SSP 2B - DS8
ML	SIG	259	20	DS20/DS8 RETURN		SSP 1A - DS20	SSP 1B - DS8	SSP 2A - DS20	SSP 2B - DS8
ML	RTN	259	21	TERMINATE					
ML	SHD	2510	22	DS22/DS10	13.4.2	SSP 1A - DS22	SSP 1B - DS10	SSP 2A - DS22	SSP 2B - DS10
ML	SIG	2511	23	DS22/DS10 RETURN		SSP 1A - DS22	SSP 1B - DS10	SSP 2A - DS22	SSP 2B - DS10
ML	RTN	2511	24	NOT WIRED					
			25	NOT WIRED					
ML	SIG	256	26	DS17/DS5	13.4.2	SSP 1A - DS17	SSP 1B - DS5	SSP 2A - DS17	SSP 2B - DS5
ML	RTN	256	27	DS17/DS5 RETURN		SSP 1A - DS17	SSP 1B - DS5	SSP 2A - DS17	SSP 2B - DS5
ML	SHD	255	28	TERMINATE					
ML	SIG	251	29	DS13/DS1	13.4.2	SSP 1A - DS13	SSP 1B - DS1	SSP 2A - DS13	SSP 2B - DS1
ML	RTN	251	30	DS13/DS1 RETURN		SSP 1A - DS13	SSP 1B - DS1	SSP 2A - DS13	SSP 2B - DS1
ML	SHD	252	31	TERMINATE					
ML	SIG	257	32	DS18/DS6	13.4.2	SSP 1A - DS18	SSP 1B - DS6	SSP 2A - DS18	SSP 2B - DS6
ML	RTN	257	33	DS18/DS6 RETURN		SSP 1A - DS18	SSP 1B - DS6	SSP 2A - DS18	SSP 2B - DS6
ML	SHD	256	34	TERMINATE					
ML	SIG	255	35	DS16/DS4	13.4.2	SSP 1A - DS16	SSP 1B - DS4	SSP 2A - DS16	SSP 2B - DS4
ML	RTN	255	36	DS16/DS4 RETURN		SSP 1A - DS16	SSP 1B - DS4	SSP 2A - DS16	SSP 2B - DS4
ML	SHD	255	37	TERMINATE					
ML	SIG	251	38	DS13/DS1	13.4.2	SSP 1A - DS13	SSP 1B - DS1	SSP 2A - DS13	SSP 2B - DS1
ML	RTN	252	39	DS14/DS2		SSP 1A - DS14	SSP 1B - DS2	SSP 2A - DS14	SSP 2B - DS2
ML	SIG	252	40	TERMINATE					
ML	SHD	257	41	DS15/DS3	13.4.2	SSP 1A - DS15	SSP 1B - DS3	SSP 2A - DS15	SSP 2B - DS3
ML	SIG	254	42	DS15/DS3 RETURN		SSP 1A - DS15	SSP 1B - DS3	SSP 2A - DS15	SSP 2B - DS3
ML	RTN	254	43	TERMINATE					
ML	SHD	253	44	NOT WIRED					
			45	NOT WIRED					

TABLE 13.5.1.1-7 PIN ASSIGNMENTS FOR AFD SMCH SECTION 1 - P2101, SECTION 2 - P2105,  
SECTION 3 - P2201, AND SECTION 4 - P2205

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	MDM PF-1 FUNCTIONS AND SSP FUNCTIONS	REFERENCE PARAGRAPH	P2101 SECTION 1	P2105 SECTION 2	P2201 SECTION 3	P2205 SECTION 4
ML	SHD	254	46	NOT WIRED					
ML	RIN	253	47	NOT WIRED					
ML	SIG	253	48	TERMINATE					
			49	DS14/DS2		SSP 1A - DS14	SSP 1B - DS2	SSP 2A - DS14	SSP 2B - DS2
			50	DS14/DS2 RETURN	13.4.2	SSP 1A - DS14	SSP 1B - DS2	SSP 2A - DS14	SSP 2B - DS2
			51	NOT WIRED					
			52	NOT WIRED					
			53	NOT WIRED					
			54	NOT WIRED					
			55	NOT WIRED					

TABLE 13.5.1.1-8 PIN ASSIGNMENTS FOR AFD SMCH SECTION 1 - P2102, SECTION 2 - P2106, SECTION 3 - P2202, AND SECTION 4 - P2206

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	MDM PF-1 FUNCTIONS AND SSP FUNCTIONS	REFERENCE PARAGRAPH	P2102 SECTION 1	P2106 SECTION 2	P2202 SECTION 3	P2206 SECTION 4
HO	SIG	SC	1	S13/S1	13.4.2	SSP 1A - S13	SSP 1B - S1	SSP 2A - S13	SSP 2B - S1
HO	SIG	SC	2	S13/S1	13.4.2	SSP 1A - S13	SSP 1B - S1	SSP 2A - S13	SSP 2B - S1
HO	SIG	SC	3	S13/S1	13.4.2	SSP 1A - S13	SSP 1B - S1	SSP 2A - S13	SSP 2B - S1
HO	SIG	SC	4	NOT WIRED					
HO	SIG	SC	5	S13/S1	13.4.2	SSP 1A - S13	SSP 1B - S1	SSP 2A - S13	SSP 2B - S1
HO	RTN	SC	6	S13/S1 RETURN		SSP 1A - S13	SSP 1B - S1	SSP 2A - S13	SSP 2B - S1
HO	RTN	SC	7	S13/S1 RETURN		SSP 1A - S13	SSP 1B - S1	SSP 2A - S13	SSP 2B - S1
HO	RTN	SC	8	S13/S1 RETURN		SSP 1A - S13	SSP 1B - S1	SSP 2A - S13	SSP 2B - S1
HO	RTN	SC	9	S13/S1 RETURN		SSP 1A - S13	SSP 1B - S1	SSP 2A - S13	SSP 2B - S1
HO	RTN	SC	10	NOT WIRED					
HO	SIG	SC	11	S23/S11	13.4.2	SSP 1A - S23	SSP 1B - S11	SSP 2A - S23	SSP 2B - S11
HO	SIG	SC	12	S23/S11	13.4.2	SSP 1A - S23	SSP 1B - S11	SSP 2A - S23	SSP 2B - S11
HO	SIG	SC	13	S14/S2	13.4.2	SSP 1A - S14	SSP 1B - S2	SSP 2A - S14	SSP 2B - S2
HO	SIG	SC	14	S14/S2	13.4.2	SSP 1A - S14	SSP 1B - S2	SSP 2A - S14	SSP 2B - S2
HO	RTN	SC	15	S14/S2 RETURN		SSP 1A - S14	SSP 1B - S2	SSP 2A - S14	SSP 2B - S2
HO	RTN	SC	16	S14/S2 RETURN		SSP 1A - S14	SSP 1B - S2	SSP 2A - S14	SSP 2B - S2
HO	RTN	SC	17	S23/S11 RETURN		SSP 1A - S23	SSP 1B - S11	SSP 2A - S23	SSP 2B - S11
HO	RTN	SC	18	S23/S11 RETURN		SSP 1A - S23	SSP 1B - S11	SSP 2A - S23	SSP 2B - S11
HO	RTN	SC	19	NOT WIRED					
HO	RTN	SC	20	NOT WIRED					
HO	SIG	SC	21	S14/S2	13.4.2	SSP 1A - S14	SSP 1B - S2	SSP 2A - S14	SSP 2B - S2
HO	SIG	SC	22	S14/S2	13.4.2	SSP 1A - S14	SSP 1B - S2	SSP 2A - S14	SSP 2B - S2
HO	RTN	SC	23	S14/S2 RETURN		SSP 1A - S14	SSP 1B - S2	SSP 2A - S14	SSP 2B - S2
HO	RTN	SC	24	S14/S2 RETURN		SSP 1A - S14	SSP 1B - S2	SSP 2A - S14	SSP 2B - S2
HO	RTN	SC	25	NOT WIRED					
HO	SIG	SC	26	S24/S12	13.4.2	SSP 1A - S24	SSP 1B - S12	SSP 2A - S24	SSP 2B - S12
HO	SIG	SC	27	S24/S12	13.4.2	SSP 1A - S24	SSP 1B - S12	SSP 2A - S24	SSP 2B - S12
HO	SIG	SC	28	S20/S8	13.4.2	SSP 1A - S20	SSP 1B - S8	SSP 2A - S20	SSP 2B - S8
HO	SIG	SC	29	S20/S8	13.4.2	SSP 1A - S20	SSP 1B - S8	SSP 2A - S20	SSP 2B - S8
HO	RTN	SC	30	S20/S8 RETURN		SSP 1A - S20	SSP 1B - S8	SSP 2A - S20	SSP 2B - S8
HO	RTN	SC	31	S20/S8 RETURN		SSP 1A - S20	SSP 1B - S8	SSP 2A - S20	SSP 2B - S8
HO	RTN	SC	32	NOT WIRED					
HO	RTN	SC	33	S24/S12 RETURN		SSP 1A - S24	SSP 1B - S12	SSP 2A - S24	SSP 2B - S12
HO	SIG	SC	34	S24/S12	13.4.2	SSP 1A - S24	SSP 1B - S12	SSP 2A - S24	SSP 2B - S12
HO	SIG	SC	35	S24/S12	13.4.2	SSP 1A - S24	SSP 1B - S12	SSP 2A - S24	SSP 2B - S12
HO	SIG	SC	36	NOT WIRED					
HO	SIG	SC	37	NOT WIRED					
HO	SIG	SC	38	NOT WIRED					
HO	SIG	SC	39	NOT WIRED					
HO	RTN	SC	40	S24/S12 RETURN		SSP 1A - S24	SSP 1B - S12	SSP 2A - S24	SSP 2B - S12
HO	RTN	SC	41	S24/S12 RETURN		SSP 1A - S24	SSP 1B - S12	SSP 2A - S24	SSP 2B - S12
HO	RTN	SC	42	S24/S12 RETURN		SSP 1A - S24	SSP 1B - S12	SSP 2A - S24	SSP 2B - S12
HO	SIG	SC	43	S21/S9	13.4.2	SSP 1A - S21	SSP 1B - S9	SSP 2A - S21	SSP 2B - S9
HO	RTN	SC	44	S21/S9 RETURN		SSP 1A - S21	SSP 1B - S9	SSP 2A - S21	SSP 2B - S9
HO	SIG	SC	45	S21/S9	13.4.2	SSP 1A - S21	SSP 1B - S9	SSP 2A - S21	SSP 2B - S9

TABLE 13.5.1.1-8 PIN ASSIGNMENTS FOR AFD SMCH SECTION 1 - P2102, SECTION 2 - P2106,  
SECTION 3 - P2202, AND SECTION 4 - P2206

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	MDM PF-1 FUNCTIONS AND SSP FUNCTIONS	REFERENCE PARAGRAPH	P2102 SECTION 1	P2106 SECTION 2	P2202 SECTION 3	P2206 SECTION 4	
HO	SIG	SC	46	S21/S9	13.4.2	SSP 1A - S21	SSP 1B - S9	SSP 2A - S21	SSP 2B - S9	
			47	NOT WIRED						
			48	NOT WIRED						
			49	NOT WIRED						
			50	NOT WIRED						
			51	NOT WIRED						
HO	RTN	SC	52	S21/S9 RETURN		SSP 1A - S21	SSP 1B - S9	SSP 2A - S21	SSP 2B - S9	
			53	NOT WIRED						
			54	NOT WIRED						
HO	RTN	SC	55	S21/S9 RETURN		SSP 1A - S21	SSP 1B - S9	SSP 2A - S21	SSP 2B - S9	

TABLE 13.5.A.1-3 SECTION 1 - P2108, SECTION 2 - P2112, SECTION 3 - P2208, AND SECTION 4 - P2212

EMC CLASS.	PIN FUNCT.	CABLE DESC.	PIN #	MDM PE-1 FUNCTIONS AND SSP FUNCTIONS	REFERENCE PARAGRAPH	P2108 SECTION 1	P2112 SECTION 2	P2208 SECTION 3	P2212 SECTION 4
HO	SIG	2T1	1	S19/S7	13.4.2	SSP 1A - S19	SSP 1B - S7	SSP 2A - S19	SSP 2B - S7
			2	NOT WIRED					
			3	NOT WIRED					
			4	NOT WIRED					
HO	RTN	2T1	5	S19/S7 RETURN		SSP 1A - S19	SSP 1B - S7	SSP 2A - S19	SSP 2B - S7
			6	NOT WIRED					
			7	NOT WIRED					
			8	NOT WIRED					
			9	NOT WIRED					
			10	NOT WIRED					
			11	NOT WIRED					
			12	NOT WIRED					
HO	SIG	2T10	13	S18/S6	13.4.2	SSP 1A - S18	SSP 1B - S6	SSP 2A - S18	SSP 2B - S6
HO	RTN	2T10	14	S18/S6 RETURN		SSP 1A - S18	SSP 1B - S6	SSP 2A - S18	SSP 2B - S6
HO	SIG	2T8	15	S18/S6	13.4.2	SSP 1A - S18	SSP 1B - S6	SSP 2A - S18	SSP 2B - S6
HO	RTN	2T8	16	S18/S6 RETURN		SSP 1A - S18	SSP 1B - S6	SSP 2A - S18	SSP 2B - S6
			17	NOT WIRED					
			18	NOT WIRED					
			19	NOT WIRED					
			20	NOT WIRED					
HO	SIG	2T9	21	S15/S3	13.4.2	SSP 1A - S15	SSP 1B - S3	SSP 2A - S15	SSP 2B - S3
HO	RTN	2T9	22	S15/S3 RETURN		SSP 1A - S15	SSP 1B - S3	SSP 2A - S15	SSP 2B - S3
HO	SIG	2T7	23	S21/S9	13.4.2	SSP 1A - S21	SSP 1B - S9	SSP 2A - S21	SSP 2B - S9
HO	RTN	2T7	24	S21/S9 RETURN		SSP 1A - S21	SSP 1B - S9	SSP 2A - S21	SSP 2B - S9
HO	RTN	2T2	25	S15/S3 RETURN		SSP 1A - S15	SSP 1B - S3	SSP 2A - S15	SSP 2B - S3
HO	RTN	2T4	26	SSP 28V RETURN		SSP 1A - RETURN	SSP 1B - RETURN	SSP 2A - RETURN	SSP 2B - RETURN
HO	RTN	2T3	27	SSP 28V RETURN		SSP 1A - RETURN	SSP 1B - RETURN	SSP 2A - RETURN	SSP 2B - RETURN
HO	SIG	2T6	28	S22/S10	13.4.2	SSP 1A - S22	SSP 1B - S10	SSP 2A - S22	SSP 2B - S10
			29	NOT WIRED					
HO	RTN	2T6	30	S22/S10 RETURN		SSP 1A - S22	SSP 1B - S10	SSP 2A - S22	SSP 2B - S10
			31	NOT WIRED					
HO	SIG	2T2	32	S15/S3	13.4.2	SSP 1A - S15	SSP 1B - S3	SSP 2A - S15	SSP 2B - S3
			33	NOT WIRED					
			34	NOT WIRED					
			35	NOT WIRED					
			36	NOT WIRED					
			37	NOT WIRED					
			38	NOT WIRED					
			39	NOT WIRED					
			40	NOT WIRED					
			41	NOT WIRED					
			42	NOT WIRED					
HO	SIG	2T12	43	S16/S4	13.4.2	SSP 1A - S16	SSP 1B - S4	SSP 2A - S16	SSP 2B - S4
HO	RTN	2T12	44	S16/S4 RETURN		SSP 1A - S16	SSP 1B - S4	SSP 2A - S16	SSP 2B - S4
HO	SIG	2T5	45	S16/S4	13.4.2	SSP 1A - S16	SSP 1B - S4	SSP 2A - S16	SSP 2B - S4

TABLE 13.5.1.1-9 PIN ASSIGNMENTS FOR AFD SMCH SECTION 1 - P2108, SECTION 2 - P2112,  
SECTION 3 - P2208, AND SECTION 4 - P2212

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	MDM PF-1 FUNCTIONS AND SSP FUNCTIONS	REFERENCE PARAGRAPH	P2101 SECTION 1	P2105 SECTION 2	P2201 SECTION 3	P2205 SECTION 4
HO	RTN	2T5	46	S16/S4 RETURN		SSP 1A - S16	SSP 1B - S4	SSP 2A - S16	SSP 2B - S4
			47	NOT WIRED					
HO	SIG	2T4	49	SSP 28V - CB4/CB2	13.4.2	SSP 1A - CB4	SSP 1B - CB2	SSP 2A - CB4	SSP 2B - CB2
HO	SIG	2T3	50	S16/S4	13.4.2	SSP 1A - S16	SSP 1B - S4	SSP 2A - S16	SSP 2B - S4
HO	SIG	2T11	51	S17/S5	13.4.2	SSP 1A - S17	SSP 1B - S5	SSP 2A - S17	SSP 2B - S5
HO	RTN	2T11	52	S17/S5 RETURN		SSP 1A - S17	SSP 1B - S5	SSP 2A - S17	SSP 2B - S5
			53	NOT WIRED					
			54	NOT WIRED					
			55	NOT WIRED					

TABLE 13.5.1.1-10 PIN ASSIGNMENTS FOR AFD SMCH P2113

EMC CLASS.	PIN FUNCT.	CABLE DESC.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #		REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
				GAS CODE	GAS CODE RETURN		
ML	SIG	251	A	(1)		3.3.3	SSP 1 OR SSP 2 (AUX I/O) TERMINATED AT CONNECTOR BACKSHELL
ML	RIN	251	B				
ML	SHD	251	C				

(1) PORT ELECTRICAL INTERFACES FOR GAS PAYLOADS ARE J9049/61/73/85/97, & J9101  
STARBOARD ELECTRICAL INTERFACES FOR GAS PAYLOADS ARE J9048/64/78/94, & J9108/14



TABLE 13.5.1.2-1 PIN ASSIGNMENTS FOR SMCH CONNECTOR J206/J201 SECTION 1 - P1461, SECTION 2 - P1462, SECTION 3 - P1464, AND SECTION 4 - P1463

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
HO	PWR	2T1	A	MAIN DC POWER	7.3.2	MPCA # 2 AND # 3 NOT WIRED
HO	RTN	2T1	B	MAIN DC POWER RETURN FAULT BOND		
HO	GND		C			
			D			

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	J74 T-O PIN ASSIGNMENTS		REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
				FROM P1502	FROM P1504		
HO	PMR	2T1	A	K	A	7.3.6	NOT WIRED NOT WIRED
HO	RTN	2T1	B	L	B		
HO	PMR	2T2	C	M	D		
HO	RTN	2T2	D	J	C		
HO	PMR	2T3	E	H	E		
HO	RTN	2T3	F	G	F		

TABLE 13.5.1.2-3 PIN ASSIGNMENTS FOR AFD SMCH CONNECTOR P2103

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
HO	PMR	2T1	A	CABIN 1 POWER TO SSP 2	7.3.3	MPCA 1 OR 2
HO	RTN	2T1	B	CABIN 1 POWER RETURN		GROUND
HO	PMR	2T2	C	CABIN 2 POWER TO SSP 2	7.3.3	MPCA 1 OR 2
HO	RTN	2T2	D	CABIN 2 POWER RETURN		GROUND
HO	PMR	2T3	E	CABIN 3 POWER TO SSP 2	7.3.3	MPCA 1 OR 2
HO	RTN	2T3	F	CABIN 3 POWER RETURN		GROUND
HO	PMR	2T4	G	AUX B POWER TO SSP 2	7.3.4	MPCA 2
HO	RTN	2T4	H	AUX B POWER RETURN		GROUND

TABLE 5.1.3.1 CONNECTOR P2110

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
HO	PWR	2T1	A	CABIN 1 POWER TO SSP 1	7.3.3	MPCA 1 OR 2
HO	RTN	2T1	B	CABIN 1 POWER RETURN		GROUND
HO	PWR	2T2	C	CABIN 2 POWER TO SSP 1	7.3.3	MPCA 1 OR 2
HO	RTN	2T2	D	CABIN 2 POWER RETURN		GROUND
HO	PWR	2T3	E	CABIN 3 POWER TO SSP 1	7.3.3	MPCA 1 OR 2
HO	RTN	2T3	F	CABIN 3 POWER RETURN		GROUND
HO	PWR	2T4	G	AUX B POWER TO SSP 1	7.3.4	MPCA 2
HO	RTN	2T4	H	AUX B POWER RETURN		GROUND

TABLE 13.5.1.2-5 PIN ASSIGNMENTS FOR AFD SMCH CONNECTOR P2107

EMC CLASS.	PIN FUNCT.	CABLE DESC.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
HO	PWR	2T1	A	CABIN 2 POWER TO PTB	7.3.3	MPCA 1 OR 2
HO	RTN	2T1	B	CABIN 2 POWER RETURN		
HO	PWR	2T2	C	SPARE		
HO	RTN	2T2	D	SPARE		
			E			
			F			

TABLE 13.5.1.2-6 PIN ASSIGNMENTS FOR AFD SMCH CONNECTOR P2210

EMC CLASS.	PIN FUNCT.	CABLE DESC.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
HO	PWR	2T1	A	CABIN 1 POWER INTO SSP 2	7.3.3	SSP 1
HO	RTN	2T1	B	CABIN 1 POWER RETURN		
HO	PWR	2T2	C	CABIN 2 POWER INTO SSP 2	7.3.3	SSP 1
HO	RTN	2T2	D	CABIN 2 POWER RETURN		
HO	PWR	2T3	E	CABIN 3 POWER INTO SSP 2	7.3.3	SSP 1
HO	RTN	2T3	F	CABIN 3 POWER RETURN		
HO	PWR	2T4	G	AUX B POWER INTO SSP 2	7.3.4	SSP 1
HO	RTN	2T4	H	AUX B POWER RETURN		

TABLE 13.5.1.3-1 PIN ASSIGNMENTS FOR SMCH CONNECTOR (SEE NOTE 1)  
AND SMCH-SIP CONNECTOR J101 (PORT) AND J202 (STBD)

EMC CLASS.	PIN FUNCT.	CABLE DESC.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
			1			NOT WIRED
			2			NOT WIRED
			3			NOT WIRED
			4			NOT WIRED
			5			NOT WIRED
			6			NOT WIRED
			7			NOT WIRED
			8			NOT WIRED
RF	SIG	2S2	9	SPARE		NOT WIRED
RF	RIN	2S2	10	SPARE		NOT WIRED
			11			NOT WIRED
			12			NOT WIRED
			13			NOT WIRED
			14			NOT WIRED
RF	RIN	2S1	15	DATA BUS PL1/PL2 INPUT - LO		ORBITER DATA BUS INPUT TO CARGO ELEMENT
RF	SIG	2S1	16	DATA BUS PL1/PL2 INPUT - HI	8.2.12	NOT WIRED
			17			NOT WIRED
			18			NOT WIRED
			19			NOT WIRED
			20			NOT WIRED
			21			NOT WIRED
			22			NOT WIRED

(1) PORT STARBOARD

- P1481
- P1483
- P1485
- P1487
- P1439
- P1441
- P1445
- P1455
- P1451
- P1482
- P1484
- P1486
- P1488

TABLE 13.5.1.3-2 PIN ASSIGNMENTS FOR SMCH CONNECTOR (SEE NOTE 1)  
AND SMCH-SIP CONNECTOR J105 (PORT) AND J203 (SIBD) (CONTINUING)

EMC CLASS.	PIN FUNCT.	CABLE DESC.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
			1			NOT WIRED
			2			NOT WIRED
			3			NOT WIRED
			4			NOT WIRED
			5			NOT WIRED
			6			NOT WIRED
			7			NOT WIRED
			8			NOT WIRED
RF	SIG	2S2	9	SPARE		NOT WIRED
RF	RTN	2S2	10	SPARE		NOT WIRED
			11			NOT WIRED
			12			NOT WIRED
			13			NOT WIRED
			14			NOT WIRED
RF	RTN	2S1	15	DATA BUS PL1/PL2 OUTPUT - LO		ORBITER DATA BUS OUTPUT TO CARGO ELEMENT
RF	SIG	2S1	16	DATA BUS PL1/PL2 OUTPUT - HI	8.2.12	NOT WIRED
			17			NOT WIRED
			18			NOT WIRED
			19			NOT WIRED
			20			NOT WIRED
			21			NOT WIRED
			22			NOT WIRED

(1) PORT STARBOARD

- P1495
- P1497
- P1499
- P1496

- P1495
- P1497
- P1341
- P1443
- P1447
- P1345
- P1457



TABLE 13.5.1.3-3 PIN ASSIGNMENTS FOR SMCH CONNECTOR P1 AND SMCH-SIP CONNECTOR J105 (PORT) AND J203 (STBD) (TERMINATING)

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
			1			NOT WIRED
			2			NOT WIRED
			3			NOT WIRED
			4			NOT WIRED
			5			NOT WIRED
			6			NOT WIRED
			7			NOT WIRED
			8			NOT WIRED
			9			NOT WIRED
			10			NOT WIRED
RF	RTN	2S1	11	DATA BUS TERMINATION		ORBITER DATA BUS TERMINATING JUMPER
RF	SIG	2S1	12	DATA BUS TERMINATION		NOT WIRED
			13			NOT WIRED
			14			
RF	RTN	2S5	15	DATA BUS PL1/PL2 OUTPUT - LO		ORBITER DATA BUS OUTPUT TO CARGO ELEMENT
RF	SIG	2S5	16	DATA BUS PL1/PL2 OUTPUT - HI	8.2.12	NOT WIRED
			17			NOT WIRED
			18			NOT WIRED
			19			NOT WIRED
			20			NOT WIRED
			21			NOT WIRED
			22			NOT WIRED

TABLE 13.5.2.1-1 SUMMARY OF NON-STANDARD PANEL MOUNTED CONNECTORS (RELATING TO SMCH)

ORBITER CONNECTOR IDENTIFIER	CABLE DEFINITION			SEE TABLE	ORBITER INTERFACE CONNECTOR PART NO.	CARGO INTERFACE CONNECTOR PART NO.	PANEL AND LOCATION THE CONNECTOR IS MOUNTED ON
	NO CIRCT	WIRE TYPE	EMC CLASS				
J1035	2	TP	HO	13.5.2.1-2	ME414-0234-1222	ME414-0234-1226	STARBOARD PANEL, Xo 645
J1036	2	TP	HO	13.5.2.1-3	ME414-0234-1222	ME414-0234-1226	STARBOARD PANEL, Xo 645
J1301	21	TSP	RF	13.5.2.1-4	NLS0T20-35S	NLS6GT20-35P	PORT PANEL, Xo 603
J1303	21	TSP	RF	13.5.2.1-5	NLS0T20-35S	NLS6GT20-35P	PORT PANEL, Xo 603
J1305	21	TSP	RF	13.5.2.1-6	NLS0T20-35S	NLS6GT20-35P	PORT PANEL, Xo 603
J1307	20	TSP	RF	13.5.2.1-7	NLS0T20-35S	NLS6GT20-35P	PORT PANEL, Xo 603
J1309	23	TP	HO	13.5.2.1-8	NLS0T20-35SA	NLS6GT20-35PA	PORT PANEL, Xo 603
J1311	23	TP	HO	13.5.2.1-9	NLS0T20-35SA	NLS6GT20-35PA	PORT PANEL, Xo 603
J1313	22	TP	HO	13.5.2.1-10	NLS0T20-35SA	NLS6GT20-35PA	PORT PANEL, Xo 603
J1315	22	TP	HO	13.5.2.1-11	NLS0T20-35SA	NLS6GT20-35PA	PORT PANEL, Xo 603
J1324	3	TSP	RF	13.5.2.1-12	NLS0T12-35S	NLS6GT12-35P	STARBOARD PANEL, Xo 603
J1325	15	TSP	ML	13.5.2.1-13	NLS0T20-35SB	NLS6GT20-35PB	PORT PANEL, Xo 603
J1326	4	TS5C	ML	13.5.2.1-14	NLS0T12-35S	NLS6GT12-35P	STARBOARD PANEL, Xo 603
J1327	15	TSP	ML	13.5.2.1-15	NLS0T20-35SB	NLS6GT20-35PB	PORT PANEL, Xo 603
J1329	15	TSP	ML	13.5.2.1-16	NLS0T20-35SB	NLS6GT20-35PB	PORT PANEL, Xo 603
J1331	4	TS5C	ML	13.5.2.1-17	NLS0T20-35SB	NLS6GT20-35PB	PORT PANEL, Xo 603
J1341	3	TSP	RF	13.5.2.1-18	NLS0T12-35S	NLS6GT12-35P	PORT PANEL, Xo 603
J1343	3	TSP	RF	13.5.2.1-19	NLS0T12-35S	NLS6GT12-35P	PORT PANEL, Xo 603
J1601	7	TSP	RF	13.5.2.1-20	NBOE 14-19SNT3	NB6GE14-19PNT3	STARBOARD PANEL, Xo 1203
J1602	3	TP	HO	13.5.2.1-21	NBOE 18-8SNT3	NB6GE18-8PNT3	PORT PANEL, Xo 1203
J1603	6	TSP	RF	13.5.2.1-22	NBOE 14-19SNT3	NB6GE14-19PNT3	STARBOARD PANEL, Xo 1203
J1604	3	TP	HO	13.5.2.1-23	NBOE 18-8SNT3	NB6GE18-8PNT3	PORT PANEL, Xo 1203
J1605	6	TSP	RF	13.5.2.1-24	NBOE 14-19SNT3	NB6GE14-19PNT3	STARBOARD PANEL, Xo 1203
J1606	12	TP	HO	13.5.2.1-25	NBOE 18-32SNT3	NB6GE18-32PNT3	PORT PANEL, Xo 1203
J1607	6	TSP	RF	13.5.2.1-26	NBOE 14-19SNT3	NB6GE14-19PNT3	STARBOARD PANEL, Xo 1203
J1608	13	TP	HO	13.5.2.1-27	NBOE 18-32SNT3	NB6GE18-32PNT3	PORT PANEL, Xo 1203
J1609	12	TP	HO	13.5.2.1-28	NBOE 18-32SNT3	NB6GE18-32PNT3	PORT PANEL, Xo 1203
J1610	7	TSP	ML	13.5.2.1-29	NLS0T20-35SB	NLS6GT20-35PB	PORT PANEL, Xo 1203
J1611	13	TP	HO	13.5.2.1-30	NBOE 18-32SNT3	NB6GE18-32PNT3	PORT PANEL, Xo 1203
J1612	8	TSP	ML	13.5.2.1-31	NLS0T20-35SB	NLS6GT20-35PB	PORT PANEL, Xo 1203
J1613	7	TSP	ML	13.5.2.1-32	NLS0T20-35SB	NLS6GT20-35PB	PORT PANEL, Xo 1203
J1615	8	TSP	ML	13.5.2.1-33	NLS0T20-35SB	NLS6GT20-35PB	PORT PANEL, Xo 1203

TABLE 13.5.2.1-2 PIN ASSIGNMENTS FOR NON-STANDARD Xo 645 CONNECTOR J1035 (RELATING TO SMCH)

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPHS	ORBITER COMPONENT INTERFACE AND/OR NOTES
HO	PWR	2T1	A	MAIN DC POWER	1.3.2	MDA # 3
HO	PWR	2T2	B	MAIN DC POWER	1.3.2	MDA # 3
HO	RTN	2T1	C	MAIN DC POWER RETURN		
HO	RTN	2T2	D	MAIN DC POWER RETURN		

TABLE 13.5.2.1-3 PIN ASSIGNMENTS FOR NON-STANDARD Xo 645 CONNECTOR J1036 (RELATING TO SMCH)

EMC CLASS.	PIN FUNCT.	CABLE DESC.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
HO	PMR	2T1	A	MAIN DC POWER	7.3.2	MDA # 3
HO	PMR	2T2	B	MAIN DC POWER	7.3.2	MDA # 3
HO	RTN	2T1	C	MAIN DC POWER RETURN		
HO	RTN	2T2	D	MAIN DC POWER RETURN		

TABLE 13.5.2.1-4 PIN ASSIGNMENTS FOR NON-STANDARD Xo 603 CONNECTOR J1301 (RELATING TO SMCH)

EMC CLASS.	PIN FUNCT.	CABLE DESC.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITTER COMPONENT INTERFACE AND/OR NOTES
			1			NOT WIRED
			2			NOT WIRED
			3			NOT WIRED
			4			NOT WIRED
			5			NOT WIRED
			6			NOT WIRED
			7			NOT WIRED
			8			NOT WIRED
			9			NOT WIRED
			10			NOT WIRED
			11			NOT WIRED
			12			NOT WIRED
			13			NOT WIRED
			14			NOT WIRED
			15			NOT WIRED
			16			NOT WIRED
RF	SIG	2S19	16	SPARE		From PSDP J1301-36
RF	RTN	2S19	17	SPARE		From PSDP J1301-37
			18			NOT WIRED
RF	SIG	2S20	19	SPARE		From PSDP J1301-34
RF	RTN	2S20	20	SPARE		From PSDP J1301-35
			21			NOT WIRED
RF	SIG	2S21	22	SPARE		From PSDP J1301-32
RF	RTN	2S21	23	SPARE		From PSDP J1301-33
			24			NOT WIRED
			25			From PSDP J1301-30
RF	SIG	2S1	25	SPARE		From PSDP J1301-30
RF	RTN	2S1	26	SPARE		From PSDP J1301-31
			27			NOT WIRED
RF	SIG	2S2	28	SPARE		From PSDP J1301-28
RF	RTN	2S2	29	SPARE		From PSDP J1301-29
			30			NOT WIRED
RF	SIG	2S3	31	SPARE		From PSDP J1301-26
RF	RTN	2S3	32	SPARE		From PSDP J1301-27
			33			NOT WIRED
RF	SIG	2S4	34	SPARE		From PSDP J1301-24
RF	RTN	2S4	35	SPARE		From PSDP J1301-25
			36			NOT WIRED
RF	SIG	2S5	37	SPARE		From PSDP J1301-22
RF	RTN	2S5	38	SPARE		From PSDP J1301-23
			39			NOT WIRED
RF	SIG	2S6	40	SPARE		From PSDP J1301-20
RF	RTN	2S6	41	SPARE		From PSDP J1301-21
			42			NOT WIRED
RF	SIG	2S7	43	SPARE		From PSDP J1301-18
RF	RTN	2S7	44	SPARE		From PSDP J1301-19
			45			NOT WIRED

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL TERMINATION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
RF	SIG	2S8	46	SPARE		From PSDP J1301-16
RF	RTN	2S8	47	SPARE		From PSDP J1301-17
RF	SIG	2S9	49	P/L RECORDER ANALOG	8.2.3	NOT WIRED
RF	RTN	2S9	50	P/L RECORDER ANALOG RETURN		ANALOG TRACK 9
RF	SIG	2S10	51	P/L RECORDER DIGITAL	8.2.3	NOT WIRED
RF	RTN	2S10	52	P/L RECORDER DIGITAL RETURN		DIGITAL TRACK 1
RF	SIG	2S11	53	P/L RECORDER DIGITAL	8.2.3	NOT WIRED
RF	RTN	2S11	54	P/L RECORDER DIGITAL RETURN		DIGITAL TRACK 2
RF	SIG	2S12	55	PDI INPUT TELEMETRY	8.2.1	NOT WIRED
RF	RTN	2S12	56	PDI INPUT TELEMETRY RETURN		TELEMETRY PORT 1
RF	SIG	2S13	57	PDI INPUT CLOCK	8.2.1	NOT WIRED
RF	RTN	2S13	58	PDI INPUT CLOCK RETURN		TELEMETRY CLOCK 1
RF	SIG	2S14	59	PSP # 1 OUTPUT	8.2.5	NOT WIRED
RF	RTN	2S14	60	PSP # 1 OUTPUT RETURN		16 KHZ COMMAND OUT 1
RF	SIG	2S15	61	PSP # 2 OUTPUT	8.2.5	NOT WIRED
RF	RTN	2S15	62	PSP # 2 OUTPUT RETURN		16 KHZ COMMAND OUT 1
RF	SIG	2S16	63	PAYLOAD TIMING BUFFER	8.2.10	NOT WIRED
RF	RTN	2S16	64	PAYLOAD TIMING BUFFER RETURN		GMT 1
RF	SIG	2S17	65	PAYLOAD TIMING BUFFER	8.2.10	NOT WIRED
RF	RTN	2S17	66	PAYLOAD TIMING BUFFER RETURN		GMT 2
RF	SIG	2S18	67	PAYLOAD TIMING BUFFER	8.2.10	NOT WIRED
RF	RTN	2S18	68	PAYLOAD TIMING BUFFER RETURN		MET 1
RF	SIG	2S18	69	PAYLOAD TIMING BUFFER		NOT WIRED
RF	RTN	2S18	70	PAYLOAD TIMING BUFFER RETURN		NOT WIRED
RF	SIG	2S18	71	PAYLOAD TIMING BUFFER		NOT WIRED
RF	RTN	2S18	72	PAYLOAD TIMING BUFFER RETURN		NOT WIRED
RF	SIG	2S18	73	PAYLOAD TIMING BUFFER		NOT WIRED
RF	RTN	2S18	74	PAYLOAD TIMING BUFFER RETURN		NOT WIRED
RF	SIG	2S18	75	PAYLOAD TIMING BUFFER		NOT WIRED
RF	RTN	2S18	76	PAYLOAD TIMING BUFFER RETURN		NOT WIRED
RF	SIG	2S18	77	PAYLOAD TIMING BUFFER		NOT WIRED
RF	RTN	2S18	78	PAYLOAD TIMING BUFFER RETURN		NOT WIRED
RF	SIG	2S18	79	PAYLOAD TIMING BUFFER		NOT WIRED
RF	RTN	2S18	80	PAYLOAD TIMING BUFFER RETURN		NOT WIRED

TABLE 13.5.2.1-5 PIN ASSIGNMENTS FOR NON-STANDARD Xo 603 CONNECTOR J1303 (RELATING TO SMCH)

EMC CLASS.	PIN FUNCT.	CABLE DESC.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE   PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
			1			NOT WIRED
			2			NOT WIRED
			3			NOT WIRED
			4			NOT WIRED
			5			NOT WIRED
			6			NOT WIRED
			7			NOT WIRED
			8			NOT WIRED
			9			NOT WIRED
			10			NOT WIRED
			11			NOT WIRED
			12			NOT WIRED
			13			NOT WIRED
			14			NOT WIRED
			15			NOT WIRED
RF	SIG	251	16	SPARE		J1303-36
RF	RTN	251	17	SPARE		From PSDP J1303-37
RF	SIG	252	19	SPARE		J1303-34
RF	RTN	252	20	SPARE		J1303-35
RF	SIG	253	22	SPARE		J1303-32
RF	RTN	253	23	SPARE		J1303-33
RF	SIG	254	25	SPARE		J1303-30
RF	RTN	254	26	SPARE		From PSDP J1303-31
RF	SIG	255	28	SPARE		J1303-28
RF	RTN	255	29	SPARE		J1303-29
RF	SIG	256	31	SPARE		J1303-26
RF	RTN	256	32	SPARE		From PSDP J1303-27
RF	SIG	257	34	SPARE		J1303-24
RF	RTN	257	35	SPARE		From PSDP J1303-25
RF	SIG	258	37	SPARE		J1303-22
RF	RTN	258	38	SPARE		From PSDP J1303-23
RF	SIG	259	40	SPARE		J1303-20
RF	RTN	259	41	SPARE		From PSDP J1303-21
RF	SIG	2510	43	SPARE		J1303-18
RF	RTN	2510	44	SPARE		From PSDP J1303-19
			45			NOT WIRED

TABLE 13.5.2.1-5 PIN ASSIGNMENTS FOR NON-STANDARD Xo 603 CONNECTOR J1303 (RELATING TO SMCH)

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
RF	SIG RTN	2S11	46	SPARE		From PSDP J1303-16
RF	SIG RTN	2S11	47	SPARE		From PSDP J1303-17
RF	SIG RTN	2S12	48	P/L RECORDER ANALOG	8.2.3	NOT WIRED
RF	SIG RTN	2S12	49	P/L RECORDER ANALOG RETURN		ANALOG TRACK 10
RF	SIG RTN	2S13	51	P/L RECORDER DIGITAL	8.2.3	NOT WIRED
RF	SIG RTN	2S13	52	P/L RECORDER DIGITAL RETURN		DIGITAL TRACK 3
RF	SIG RTN	2S14	53	P/L RECORDER DIGITAL	8.2.3	NOT WIRED
RF	SIG RTN	2S14	54	P/L RECORDER DIGITAL RETURN		DIGITAL TRACK 4
RF	SIG RTN	2S14	55	P/L RECORDER DIGITAL		NOT WIRED
RF	SIG RTN	2S14	56	P/L RECORDER DIGITAL RETURN		TELEMETRY PORT 2
RF	SIG RTN	2S15	57	PDI INPUT TELEMETRY	8.2.1	NOT WIRED
RF	SIG RTN	2S15	58	PDI INPUT TELEMETRY RETURN		TELEMETRY CLOCK 2
RF	SIG RTN	2S16	59	PDI INPUT CLOCK	8.2.1	NOT WIRED
RF	SIG RTN	2S16	60	PDI INPUT CLOCK RETURN		TELEMETRY CLOCK 2
RF	SIG RTN	2S17	61	PSP # 1 OUTPUT	8.2.5	NOT WIRED
RF	SIG RTN	2S17	62	PSP # 1 OUTPUT RETURN		16 KHZ COMMAND OUT 2
RF	SIG RTN	2S17	63	PSP # 2 OUTPUT	8.2.5	NOT WIRED
RF	SIG RTN	2S17	64	PSP # 2 OUTPUT RETURN		16 KHZ COMMAND OUT 2
RF	SIG RTN	2S18	65	PAYLOAD TIMING BUFFER	8.2.10	NOT WIRED
RF	SIG RTN	2S18	66	PAYLOAD TIMING BUFFER RETURN		GMT 3
RF	SIG RTN	2S19	67	PAYLOAD TIMING BUFFER	8.2.10	NOT WIRED
RF	SIG RTN	2S19	68	PAYLOAD TIMING BUFFER RETURN		GMT 4
RF	SIG RTN	2S20	69	PAYLOAD TIMING BUFFER	8.2.10	NOT WIRED
RF	SIG RTN	2S20	70	PAYLOAD TIMING BUFFER RETURN		MET 2
RF	SIG RTN	2S21	71	PAYLOAD TIMING BUFFER	8.2.10	NOT WIRED
RF	SIG RTN	2S21	72	PAYLOAD TIMING BUFFER RETURN		NOT WIRED
RF	SIG RTN	2S21	73	PAYLOAD TIMING BUFFER		NOT WIRED
RF	SIG RTN	2S21	74	PAYLOAD TIMING BUFFER RETURN		NOT WIRED
RF	SIG RTN	2S21	75	PAYLOAD TIMING BUFFER		NOT WIRED
RF	SIG RTN	2S21	76	PAYLOAD TIMING BUFFER RETURN		NOT WIRED
RF	SIG RTN	2S21	77	PAYLOAD TIMING BUFFER		NOT WIRED
RF	SIG RTN	2S21	78	PAYLOAD TIMING BUFFER RETURN		NOT WIRED
RF	SIG RTN	2S21	79	PAYLOAD TIMING BUFFER RETURN		NOT WIRED





TABLE 13.5.2.1-6 PIN ASSIGNMENTS FOR NON-STANDARD Xo 603 CONNECTOR J1305 (RELATING TO SMCH)

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
RF	SIG	2S11	46	SPARE		From PSDP J1305-16
RF	RTN	2S11	47	SPARE		From PSDP J1305-17
RF	SIG	2S12	49	P/L RECORDER ANALOG	8.2.3	NOT WIRED
RF	RTN	2S12	50	P/L RECORDER ANALOG RETURN		ANALOG TRACK 11
RF	SIG	2S13	52	P/L RECORDER DIGITAL	8.2.3	NOT WIRED
RF	RTN	2S13	53	P/L RECORDER DIGITAL RETURN		DIGITAL TRACK 5
RF	SIG	2S14	54	P/L RECORDER DIGITAL	8.2.3	NOT WIRED
RF	RTN	2S14	55	P/L RECORDER DIGITAL RETURN		DIGITAL TRACK 6
RF	SIG	2S15	58	PDI INPUT TELEMETRY	8.2.1	NOT WIRED
RF	RTN	2S15	59	PDI INPUT TELEMETRY RETURN		TELEMETRY PORT 3
RF	SIG	2S16	61	PDI INPUT CLOCK	8.2.1	NOT WIRED
RF	RTN	2S16	62	PDI INPUT CLOCK RETURN		TELEMETRY CLOCK 3
RF	SIG	2S17	64	PSP # 1 OUTPUT	8.2.5	NOT WIRED
RF	RTN	2S17	65	PSP # 1 OUTPUT RETURN		16 KHZ COMMAND OUT 3
RF	SIG	2S18	67	PSP # 2 OUTPUT	8.2.5	NOT WIRED
RF	RTN	2S18	68	PSP # 2 OUTPUT RETURN		16 KHZ COMMAND OUT 3
RF	SIG	2S19	70	PAYLOAD TIMING BUFFER	8.2.10	NOT WIRED
RF	RTN	2S19	71	PAYLOAD TIMING BUFFER RETURN		GMT 5
RF	SIG	2S20	73	PAYLOAD TIMING BUFFER	8.2.10	NOT WIRED
RF	RTN	2S20	74	PAYLOAD TIMING BUFFER RETURN		GMT 6
RF	SIG	2S21	75	PAYLOAD TIMING BUFFER	8.2.10	NOT WIRED
RF	RTN	2S21	76	PAYLOAD TIMING BUFFER RETURN		MET 3
RF	SIG	2S21	77	PAYLOAD TIMING BUFFER		NOT WIRED
RF	RTN	2S21	78	PAYLOAD TIMING BUFFER RETURN		NOT WIRED
			79			

TABLE 13.5.2.1-7 PIN ASSIGNMENTS FOR NON-STANDARD Xo 603 CONNECTOR J1307 (RELATING TO SMCH)

EMC CLASS.	PIN FUNCT.	CABLE DESC.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
			1			NOT WIRED
			2			NOT WIRED
			3			NOT WIRED
			4			NOT WIRED
			5			NOT WIRED
			6			NOT WIRED
			7			NOT WIRED
			8			NOT WIRED
			9			NOT WIRED
			10			NOT WIRED
			11			NOT WIRED
			12			NOT WIRED
			13			NOT WIRED
			14			NOT WIRED
			15			NOT WIRED
			16			NOT WIRED
			17			NOT WIRED
			18			NOT WIRED
			19	SPARE		From PSDP J1307-34
RF	SIG	251	20	SPARE		From PSDP J1307-35
RF	RTN	251	21			NOT WIRED
			22	SPARE		From PSDP J1307-32
RF	SIG	252	23	SPARE		From PSDP J1307-33
RF	RTN	252	24			NOT WIRED
			25	SPARE		From PSDP J1307-30
RF	SIG	253	26	SPARE		From PSDP J1307-31
RF	RTN	253	27			NOT WIRED
			28	SPARE		From PSDP J1307-28
RF	SIG	254	29	SPARE		From PSDP J1307-29
RF	RTN	254	30			NOT WIRED
			31	SPARE		From PSDP J1307-26
RF	SIG	255	32	SPARE		From PSDP J1307-27
RF	RTN	255	33			NOT WIRED
			34	SPARE		From PSDP J1307-24
RF	SIG	256	35	SPARE		From PSDP J1307-25
RF	RTN	256	36			NOT WIRED
			37	SPARE		From PSDP J1307-22
RF	SIG	257	38	SPARE		From PSDP J1307-23
RF	RTN	257	39			NOT WIRED
			40	SPARE		From PSDP J1307-20
RF	SIG	258	41	SPARE		From PSDP J1307-21
RF	RTN	258	42			NOT WIRED
			43	SPARE		From PSDP J1307-18
RF	SIG	259	44	SPARE		From PSDP J1307-19
RF	RTN	259	45			NOT WIRED

TABLE 13.5.2.1-7 PIN ASSIGNMENTS FOR NON-STANDARD Xo 603 CONNECTOR J1307 (RELATING TO SMCH)

EMC CLASS.	PIN FUNCT.	CABLE DESC.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
RF	SIG	2S10	46	SPARE		From PSDP J1307-16
RF	RTN	2S10	47	SPARE		From PSDP J1307-17
RF	SIG	2S11	48	P/L RECORDER ANALOG	8.2.3	NOT WIRED
RF	RTN	2S11	49	P/L RECORDER ANALOG RETURN		ANALOG TRACK 12
RF	SIG	2S12	50	P/L RECORDER DIGITAL	8.2.3	NOT WIRED
RF	RTN	2S12	51	P/L RECORDER DIGITAL RETURN		DIGITAL TRACK 7
RF	SIG	2S13	52	P/L RECORDER DIGITAL	8.2.3	NOT WIRED
RF	RTN	2S13	53	P/L RECORDER DIGITAL RETURN		DIGITAL TRACK 8
RF	SIG	2S14	54	PDI INPUT TELEMETRY	8.2.1	NOT WIRED
RF	RTN	2S14	55	PDI INPUT TELEMETRY RETURN		TELEMETRY PORT 4
RF	SIG	2S15	56	PDI INPUT CLOCK	8.2.1	NOT WIRED
RF	RTN	2S15	57	PDI INPUT CLOCK RETURN		TELEMETRY CLOCK 4
RF	SIG	2S16	58	PSP # 1 OUTPUT	8.2.5	NOT WIRED
RF	RTN	2S16	59	PSP # 1 OUTPUT RETURN		16 KHZ COMMAND OUT 4
RF	SIG	2S17	60	PSP # 2 OUTPUT	8.2.5	NOT WIRED
RF	RTN	2S17	61	PSP # 2 OUTPUT RETURN		16 KHZ COMMAND OUT 4
RF	SIG	2S18	62	PAYLOAD TIMING BUFFER	8.2.10	NOT WIRED
RF	RTN	2S18	63	PAYLOAD TIMING BUFFER RETURN		GMT 7
RF	SIG	2S19	64	PAYLOAD TIMING BUFFER	8.2.10	NOT WIRED
RF	RTN	2S19	65	PAYLOAD TIMING BUFFER RETURN		GMT 8
RF	SIG	2S20	66	PAYLOAD TIMING BUFFER	8.2.10	NOT WIRED
RF	RTN	2S20	67	PAYLOAD TIMING BUFFER RETURN		MET 4
RF	SIG	2S20	68	PAYLOAD TIMING BUFFER		NOT WIRED
RF	RTN	2S20	69	PAYLOAD TIMING BUFFER RETURN		NOT WIRED
RF	SIG	2S20	70	PAYLOAD TIMING BUFFER		NOT WIRED
RF	RTN	2S20	71	PAYLOAD TIMING BUFFER RETURN		NOT WIRED
RF	SIG	2S20	72	PAYLOAD TIMING BUFFER		NOT WIRED
RF	RTN	2S20	73	PAYLOAD TIMING BUFFER RETURN		NOT WIRED
RF	SIG	2S20	74	PAYLOAD TIMING BUFFER		NOT WIRED
RF	RTN	2S20	75	PAYLOAD TIMING BUFFER RETURN		NOT WIRED
RF	SIG	2S20	76	PAYLOAD TIMING BUFFER		NOT WIRED
RF	RTN	2S20	77	PAYLOAD TIMING BUFFER RETURN		NOT WIRED
RF	SIG	2S20	78	PAYLOAD TIMING BUFFER		NOT WIRED
RF	RTN	2S20	79	PAYLOAD TIMING BUFFER RETURN		NOT WIRED

TABLE 13.5.2.1-8 PIN ASSIGNMENTS FOR NON-STANDARD Xo 603 CONNECTOR J1309 (RELATING TO SMCH)

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
HO	SIG	5T1	1	P/L CMD (DOH 19)	8.2.2.2	MDM PF-1
HO	SIG	5T1	2	P/L CMD (DOH 20)	8.2.2.2	MDM PF-1
HO	SIG	5T1	3	P/L CMD (DOH 21)	8.2.2.2	MDM PF-1
HO	SIG	5T1	4	P/L CMD (DOH 22)	8.2.2.2	MDM PF-1
HO	RTN	5T1	5	DOH 19-22 RETURN		
			6			NOT WIRED
			7			NOT WIRED
			8			NOT WIRED
			9			NOT WIRED
HO	SIG	2T21	10	SPARE		From PSDP J1309 - 9
HO	RTN	2T21	11	SPARE		From PSDP J1309 - 16
			12			NOT WIRED
HO	SIG	2T20	13	S13	13.4.2	NOT WIRED
HO	SIG	2T20	14	S13	13.4.2	SSP 2A
			15			NOT WIRED
HO	SIG	2T19	16	S13	13.4.2	SSP 2A
HO	SIG	2T19	17	S13	13.4.2	SSP 2A
			18			NOT WIRED
HO	SIG	2T18	19	S13	13.4.2	SSP 2A
HO	SIG	2T18	20	S13	13.4.2	SSP 2A
			21			NOT WIRED
HO	SIG	2T17	22	S14	13.4.2	SSP 2A
HO	SIG	2T17	23	S14	13.4.2	SSP 2A
			24			NOT WIRED
HO	SIG	2T16	25	S14	13.4.2	SSP 2A
HO	SIG	2T16	26	S14	13.4.2	SSP 2A
			27			NOT WIRED
HO	SIG	2T15	28	S20	13.4.2	SSP 2A
HO	SIG	2T15	29	S20	13.4.2	SSP 2A
			30			NOT WIRED
HO	SIG	2T14	31	S23	13.4.2	SSP 2A
HO	SIG	2T14	32	S23	13.4.2	SSP 2A
			33			NOT WIRED
HO	SIG	2T13	34	S24	13.4.2	SSP 2A
HO	SIG	2T13	35	S24	13.4.2	SSP 2A
			36			NOT WIRED
HO	SIG	2T12	37	S24	13.4.2	SSP 2A
HO	SIG	2T12	38	S24	13.4.2	SSP 2A
			39			NOT WIRED
HO	SIG	2T11	40	S21	13.4.2	SSP 2A
HO	SIG	2T11	41	S21	13.4.2	SSP 2A
			42			NOT WIRED
HO	SIG	2T10	43	S19	13.4.2	SSP 2A
HO	SIG	2T10	44	S19	13.4.2	SSP 2A
			45			NOT WIRED

TABLE 13.5.2.1-8 PIN ASSIGNMENTS FOR NON-STANDARD Xo 603 CONNECTOR J1309 (RELATING TO SMCH)

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
HO	SIG	2T9	46	S15	13.4.2	SSP 2A
HO	SIG	2T9	47	S15	13.4.2	SSP 2A
HO	SIG	2T8	48			NOT WIRED
HO	SIG	2T8	49	S16	13.4.2	SSP 2A
HO	SIG	2T8	50	S16	13.4.2	SSP 2A
HO	SIG	2T7	51	S16		NOT WIRED
HO	SIG	2T7	52	S16	13.4.2	SSP 2A
HO	SIG	2T7	53	S16	13.4.2	SSP 2A
HO	SIG	2T6	54			NOT WIRED
HO	SIG	2T6	55	28 VDC (CB4)	13.4.2	SSP 2A
HO	RIN	2T6	56	28 VDC RETURN		SSP 2A
HO	SIG	2T5	57			NOT WIRED
HO	SIG	2T5	58	S18	13.4.2	SSP 2A
HO	SIG	2T5	59	S18	13.4.2	SSP 2A
HO	SIG	2T4	60			NOT WIRED
HO	SIG	2T4	61	S15	13.4.2	SSP 2A
HO	SIG	2T4	62	S15	13.4.2	SSP 2A
HO	SIG	2T3	63			NOT WIRED
HO	SIG	2T3	64	S18	13.4.2	SSP 2A
HO	SIG	2T3	65	S18	13.4.2	SSP 2A
HO	SIG	2T2	66			NOT WIRED
HO	SIG	2T2	67	S21	13.4.2	SSP 2A
HO	SIG	2T2	68	S21	13.4.2	SSP 2A
HO	SIG	2T1	69			NOT WIRED
HO	SIG	2T1	70	S17	13.4.2	SSP 2A
HO	SIG	2T1	71	S17	13.4.2	SSP 2A
HO	SIG	2T23	72			NOT WIRED
HO	SIG	2T23	73	S22	13.4.2	SSP 2A
HO	SIG	2T23	74	S22	13.4.2	SSP 2A
HO	SIG	2T22	75			NOT WIRED
HO	SIG	2T22	76	S16	13.4.2	SSP 2A
HO	RIN	2T22	77	28 VDC RETURN		SSP 2A
HO			78			NOT WIRED
HO			79			NOT WIRED

NOTE : SIGNALS ON PINS 1-5 ARE ALSO SPLICED TO Xo 603 J1337

TABLE 13.5.2.1-9 PIN ASSIGNMENTS FOR NON-STANDARD Xo 603 CONNECTOR J1311 (RELATING TO SMCH)

EMC CLASS.	PIN FUNCT.	CABLE DESC.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
HO	SIG	5T1	1	P/L CMD (DOH 1)	8.2.2.2	MDM PF-1
HO	SIG	5T1	2	P/L CMD (DOH 2)	8.2.2.2	MDM PF-1
HO	SIG	5T1	3	P/L CMD (DOH 3)	8.2.2.2	MDM PF-1
HO	SIG	5T1	4	P/L CMD (DOH 4)	8.2.2.2	MDM PF-1
HO	RTN	5T1	5	DOH 1-4 RETURN		
HO	SIG	2T1	6			NOT WIRED
HO	RTN	2T1	7			NOT WIRED
HO	RTN	2T1	8			NOT WIRED
HO	SIG	2T4	9			NOT WIRED
HO	RTN	2T4	10			NOT WIRED
HO	SIG	2T5	11			NOT WIRED
HO	SIG	2T5	12			NOT WIRED
HO	SIG	2T5	13	S13/S1	13.4.2	SSP 2B - S1
HO	SIG	2T5	14	S13/S1	13.4.2	SSP 2B - S1
HO	SIG	2T6	15			NOT WIRED
HO	SIG	2T6	16	S13/S1	13.4.2	SSP 2B - S1
HO	SIG	2T6	17	S13/S1	13.4.2	SSP 2B - S1
HO	SIG	2T7	18			NOT WIRED
HO	SIG	2T7	19	S13/S1	13.4.2	SSP 2B - S1
HO	SIG	2T7	20	S13/S1	13.4.2	SSP 2B - S1
HO	SIG	2T8	21			NOT WIRED
HO	SIG	2T8	22	S14/S2	13.4.2	SSP 2B - S2
HO	SIG	2T8	23	S14/S2	13.4.2	SSP 2B - S2
HO	SIG	2T9	24			NOT WIRED
HO	SIG	2T9	25	S14/S2	13.4.2	SSP 2B - S2
HO	SIG	2T9	26	S14/S2	13.4.2	SSP 2B - S2
HO	SIG	2T10	27			NOT WIRED
HO	SIG	2T10	28	S20/S8	13.4.2	SSP 2B - S8
HO	SIG	2T10	29	S20/S8	13.4.2	SSP 2B - S8
HO	SIG	2T11	30			NOT WIRED
HO	SIG	2T11	31	S23/S11	13.4.2	SSP 2B - S11
HO	SIG	2T11	32	S23/S11	13.4.2	SSP 2B - S11
HO	SIG	2T12	33			NOT WIRED
HO	SIG	2T12	34	S24/S12	13.4.2	SSP 2B - S12
HO	SIG	2T12	35	S24/S12	13.4.2	SSP 2B - S12
HO	SIG	2T13	36			NOT WIRED
HO	SIG	2T13	37	S24/S12	13.4.2	SSP 2B - S12
HO	SIG	2T13	38	S24/S12	13.4.2	SSP 2B - S12
HO	SIG	2T14	39			NOT WIRED
HO	SIG	2T14	40	S21/S9	13.4.2	SSP 2B - S9
HO	SIG	2T14	41	S21/S9	13.4.2	SSP 2B - S9
HO	SIG	2T15	42			NOT WIRED
HO	SIG	2T15	43	S19/S7	13.4.2	SSP 2B - S7
HO	SIG	2T15	44	S19/S7	13.4.2	SSP 2B - S7
HO	SIG	2T15	45			NOT WIRED

TABLE 13.5.2.1-9 PIN ASSIGNMENTS FOR NON-STANDARD Xo 603 CONNECTOR J1311 (RELATING TO SMCH)

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
HO	SIG	2T16	46	S15/S3	13.4.2	SSP 2B - S3
HO	SIG	2T16	47	S15/S3	13.4.2	SSP 2B - S3
HO	SIG	2T17	48	S16/S4	13.4.2	NOT WIRED
HO	SIG	2T17	49	S16/S4	13.4.2	SSP 2B - S4
HO	SIG	2T17	50	S16/S4	13.4.2	SSP 2B - S4
HO	SIG	2T18	51	S16/S4	13.4.2	NOT WIRED
HO	SIG	2T18	52	S16/S4	13.4.2	SSP 2B - S4
HO	SIG	2T18	53	S16/S4	13.4.2	SSP 2B - S4
HO	SIG	2T18	54	S16/S4	13.4.2	NOT WIRED
HO	SIG	2T19	55	28 VDC (CB 2 / CB4)	13.4.2	SSP 2B - CB2
HO	RTN	2T19	56	28 VDC RETURN	13.4.2	SSP 2B - CB2 RETURN
HO	SIG	2T20	57			NOT WIRED
HO	SIG	2T20	58	S18/S6	13.4.2	SSP 2B - S6
HO	SIG	2T20	59	S18/S6	13.4.2	SSP 2B - S6
HO	SIG	2T21	60			NOT WIRED
HO	SIG	2T21	61	S15/S3	13.4.2	SSP 2B - S3
HO	SIG	2T21	62	S15/S3	13.4.2	SSP 2B - S3
HO	SIG	2T22	63	S18/S6	13.4.2	NOT WIRED
HO	SIG	2T22	64	S18/S6	13.4.2	SSP 2B - S6
HO	SIG	2T22	65	S18/S6	13.4.2	SSP 2B - S6
HO	SIG	2T23	66			NOT WIRED
HO	SIG	2T23	67	S21/S9	13.4.2	SSP 2B - S9
HO	SIG	2T23	68	S21/S9	13.4.2	SSP 2B - S9
HO	SIG	2T24	69			NOT WIRED
HO	SIG	2T24	70	S17/S5	13.4.2	SSP 2B - S5
HO	SIG	2T24	71	S17/S5	13.4.2	SSP 2B - S5
HO	SIG	2T2	72	S22/S10	13.4.2	NOT WIRED
HO	SIG	2T2	73	S22/S10	13.4.2	SSP 2B - S10
HO	SIG	2T2	74	S22/S10	13.4.2	SSP 2B - S10
HO	SIG	2T3	75			NOT WIRED
HO	SIG	2T3	76	S16/S4	13.4.2	SSP 2B - S4
HO	RTN	2T3	77	28 VDC RETURN		NOT WIRED
HO			78			NOT WIRED
HO			79			NOT WIRED

NOTE : SIGNALS ON PINS 1-5 IN ALL FOUR SMCH SECTIONS ARE ALSO SPLICED TO Xo 603 J1337



TABLE 13.5.2.1-10 PIN ASSIGNMENTS FOR NON-STANDARD X0 603 CONNECTOR J1313 (RELATING TO SMCH)

EMC CLASS.	PIN FUNCT.	CABLE DESC.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
HO	SIG	5T1	1	P/L CMD (DOH 27)	8.2.2.2	MDM PF-1
HO	SIG	5T1	2	P/L CMD (DOH 28)	8.2.2.2	MDM PF-1
HO	SIG	5T1	3	P/L CMD (DOH 29)	8.2.2.2	MDM PF-1
HO	SIG	5T1	4	P/L CMD (DOH 30)	8.2.2.2	MDM PF-1
HO	RTN	5T1	5	DOH 27-30 RETURN		
			6			NOT WIRED
			7			NOT WIRED
			8			NOT WIRED
			9			NOT WIRED
			10			NOT WIRED
			11			NOT WIRED
			12			NOT WIRED
HO	SIG	2T22	13	S1	13.4.2	SSP 1B
HO	SIG	2T22	14	S1	13.4.2	SSP 1B
HO	SIG	2T21	16	S1	13.4.2	NOT WIRED
HO	SIG	2T21	17	S1	13.4.2	SSP 1B
HO	SIG	2T20	19	S1	13.4.2	NOT WIRED
HO	SIG	2T20	20	S1	13.4.2	SSP 1B
HO	SIG	2T19	22	S2	13.4.2	NOT WIRED
HO	SIG	2T19	23	S2	13.4.2	SSP 1B
HO	SIG	2T18	25	S2	13.4.2	NOT WIRED
HO	SIG	2T18	26	S2	13.4.2	SSP 1B
HO	SIG	2T17	28	S8	13.4.2	NOT WIRED
HO	SIG	2T17	29	S8	13.4.2	SSP 1B
HO	SIG	2T16	31	S11	13.4.2	NOT WIRED
HO	SIG	2T16	32	S11	13.4.2	SSP 1B
HO	SIG	2T15	34	S12	13.4.2	NOT WIRED
HO	SIG	2T15	35	S12	13.4.2	SSP 1B
HO	SIG	2T14	37	S12	13.4.2	NOT WIRED
HO	SIG	2T14	38	S12	13.4.2	SSP 1B
HO	SIG	2T13	40	S9	13.4.2	NOT WIRED
HO	SIG	2T13	41	S9	13.4.2	SSP 1B
HO	SIG	2T12	43	S7	13.4.2	NOT WIRED
HO	SIG	2T12	44	S7	13.4.2	SSP 1B
			45			NOT WIRED

TABLE 13.5.2.1-10 PIN ASSIGNMENTS FOR NON-STANDARD Xo 603 CONNECTOR J1313 (RELATING TO SMCH)

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
HO	SIG	2T11	46	S3	13.4.2	SSP 1B
HO	SIG	2T11	47	S3	13.4.2	SSP 1B
HO	SIG	2T10	48			NOT WIRED
HO	SIG	2T10	49	S4	13.4.2	SSP 1B
HO	SIG	2T10	50	S4	13.4.2	SSP 1B
HO	SIG	2T9	51			NOT WIRED
HO	SIG	2T9	52	S4	13.4.2	SSP 1B
HO	SIG	2T9	53	S4	13.4.2	SSP 1B
HO	SIG	2T8	54			NOT WIRED
HO	RTN	2T8	55	28 VDC (CB 2)	13.4.2	SSP 1B
HO	SIG	2T7	56	28 VDC RETURN		NOT WIRED
HO	SIG	2T7	57			SSP 1B
HO	SIG	2T6	58	S6	13.4.2	SSP 1B
HO	SIG	2T6	59	S6	13.4.2	SSP 1B
HO	SIG	2T6	60			NOT WIRED
HO	SIG	2T5	61	S3	13.4.2	SSP 1B
HO	SIG	2T5	62	S3	13.4.2	SSP 1B
HO	SIG	2T5	63			NOT WIRED
HO	SIG	2T5	64	S6	13.4.2	SSP 1B
HO	SIG	2T5	65	S6	13.4.2	SSP 1B
HO	SIG	2T4	66			NOT WIRED
HO	SIG	2T4	67	S9	13.4.2	SSP 1B
HO	SIG	2T4	68	S9	13.4.2	SSP 1B
HO	SIG	2T3	69			NOT WIRED
HO	SIG	2T3	70	S5	13.4.2	SSP 1B
HO	SIG	2T3	71	S5	13.4.2	SSP 1B
HO	SIG	2T2	72			NOT WIRED
HO	SIG	2T2	73	S10	13.4.2	SSP 1B
HO	SIG	2T2	74	S10	13.4.2	SSP 1B
HO	SIG	2T1	75			NOT WIRED
HO	RTN	2T1	76	S4	13.4.2	SSP 1B
HO	RTN	2T1	77	28 VDC RETURN		NOT WIRED
HO	RTN	2T1	78			NOT WIRED
HO	RTN	2T1	79			NOT WIRED

NOTE : SIGNALS ON PINS 1-5 ARE ALSO SPLICED TO Xo 603 J1337

TABLE 13.5.2.1-11 PIN ASSIGNMENTS FOR NON-STANDARD Xo 603 CONNECTOR J1315 (RELATING TO SMCH)

EMC CLASS.	PIN FUNCT.	CABLE DESC.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
HO	SIG	5T1	1	P/L CMD (DOH 31)	8.2.2.2	MDM PF-1
HO	SIG	5T1	2	P/L CMD (DOH 32)	8.2.2.2	MDM PF-1
HO	SIG	5T1	3	P/L CMD (DOH 33)	8.2.2.2	MDM PF-1
HO	SIG	5T1	4	P/L CMD (DOH 34)	8.2.2.2	MDM PF-1
HO	RTN	5T1	5	DOH 31-34 RETURN		
			6			
			7			
			8			
			9			
			10			
			11			
			12			
HO	SIG	2T22	13	S13	13.4.2	NOT WIRED
HO	SIG	2T22	14	S13	13.4.2	SSP 1A
			15			SSP 1A
HO	SIG	2T21	16	S13	13.4.2	NOT WIRED
HO	SIG	2T21	17	S13	13.4.2	SSP 1A
			18			SSP 1A
HO	SIG	2T20	19	S13	13.4.2	NOT WIRED
HO	SIG	2T20	20	S13	13.4.2	SSP 1A
			21			SSP 1A
HO	SIG	2T19	22	S14	13.4.2	NOT WIRED
HO	SIG	2T19	23	S14	13.4.2	SSP 1A
			24			SSP 1A
HO	SIG	2T18	25	S14	13.4.2	NOT WIRED
HO	SIG	2T18	26	S14	13.4.2	SSP 1A
			27			SSP 1A
HO	SIG	2T17	28	S20	13.4.2	NOT WIRED
HO	SIG	2T17	29	S20	13.4.2	SSP 1A
			30			SSP 1A
HO	SIG	2T16	31	S23	13.4.2	NOT WIRED
HO	SIG	2T16	32	S23	13.4.2	SSP 1A
			33			SSP 1A
HO	SIG	2T15	34	S24	13.4.2	NOT WIRED
HO	SIG	2T15	35	S24	13.4.2	SSP 1A
			36			SSP 1A
HO	SIG	2T14	37	S24	13.4.2	NOT WIRED
HO	SIG	2T14	38	S24	13.4.2	SSP 1A
			39			SSP 1A
HO	SIG	2T13	40	S21	13.4.2	NOT WIRED
HO	SIG	2T13	41	S21	13.4.2	SSP 1A
			42			SSP 1A
HO	SIG	2T12	43	S19	13.4.2	NOT WIRED
HO	SIG	2T12	44	S19	13.4.2	SSP 1A
			45			SSP 1A

TABLE 13.5.2.1-11 PIN ASSIGNMENTS FOR NON-STANDARD Xo 603 CONNECTOR J1315 (RELATING TO SMCH)

EMC CLASS.	PIN FUNCT.	CABLE DESC.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
HO	SIG	2T11	46	S15	13.4.2	SSP 1A
HO	SIG	2T11	47	S15	13.4.2	SSP 1A
HO	SIG	2T10	48	S16	13.4.2	NOT WIRED
HO	SIG	2T10	49	S16	13.4.2	SSP 1A
HO	SIG	2T10	50	S16	13.4.2	SSP 1A
HO	SIG	2T9	51	S16	13.4.2	NOT WIRED
HO	SIG	2T9	52	S16	13.4.2	SSP 1A
HO	SIG	2T9	53	S16	13.4.2	SSP 1A
HO	SIG	2T8	54	28 VDC (CB4)	13.4.2	NOT WIRED
HO	RTN	2T8	55	28 VDC RETURN	13.4.2	SSP 1A
HO	SIG	2T7	56	S18	13.4.2	NOT WIRED
HO	SIG	2T7	57	S18	13.4.2	SSP 1A
HO	SIG	2T6	58	S15	13.4.2	NOT WIRED
HO	SIG	2T6	59	S15	13.4.2	SSP 1A
HO	SIG	2T5	60	S18	13.4.2	NOT WIRED
HO	SIG	2T5	61	S18	13.4.2	SSP 1A
HO	SIG	2T4	62	S21	13.4.2	NOT WIRED
HO	SIG	2T4	63	S21	13.4.2	SSP 1A
HO	SIG	2T3	64	S17	13.4.2	NOT WIRED
HO	SIG	2T3	65	S17	13.4.2	SSP 1A
HO	SIG	2T2	66	S22	13.4.2	NOT WIRED
HO	SIG	2T2	67	S22	13.4.2	SSP 1A
HO	SIG	2T1	68	S16	13.4.2	NOT WIRED
HO	RTN	2T1	69	28 VDC RETURN	13.4.2	SSP 1A
HO			70			
HO			71			
HO			72			
HO			73			
HO			74			
HO			75			
HO			76			
HO			77			
HO			78			
HO			79			

NOTE : SIGNALS ON PINS 1-5 ARE ALSO SPLICED TO Xo 603 J1337

TABLE 13.5.2.1-12 PIN ASSIGNMENTS FOR NON-STANDARD Xo 603 CONNECTOR J1324 (RELATING TO SHCH)

EMC CLASS.	PIN FUNCT.	CABLE DESC.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
			1			NOT WIRED
			2			NOT WIRED
			3			NOT WIRED
			4			NOT WIRED
			5			NOT WIRED
			6			NOT WIRED
			7			NOT WIRED
			8			NOT WIRED
			9			NOT WIRED
			10			NOT WIRED
RF	SIG	2S2	11	DATA BUS TERMINATION		ORBITER DATA BUS TERMINATION JUMPER
RF	RTN	2S2	12	DATA BUS TERMINATION RETURN		
RF	SIG	2S3	13	DATA BUS PL2 INPUT - LO		
RF	RTN	2S3	14	DATA BUS PL2 INPUT - HI	8.2.12	ORBITER DATA BUS INPUT TO CARGO ELEMENT
RF	RTN	2S1	15	DATA BUS TERMINATION RETURN		
RF	SIG	2S1	16	DATA BUS TERMINATION		ORBITER DATA BUS TERMINATION JUMPER
			17			NOT WIRED
			18			NOT WIRED
			19			NOT WIRED
			20			NOT WIRED
			21			NOT WIRED
			22			NOT WIRED

TABLE 13.5.2.1-13 PIN ASSIGNMENTS FOR NON-STANDARD Xo 603 CONNECTOR J1325 (RELATING TO SMCH)

EMC CLASS.	PIN FUNCT.	CABLE DESCOR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
			1			NOT WIRED
			2			NOT WIRED
			3			NOT WIRED
			4			NOT WIRED
			5			NOT WIRED
			6			NOT WIRED
			7			NOT WIRED
			8			NOT WIRED
			9			NOT WIRED
ML	SIG	5S1	10	P/L COMMAND (DOL 33)	8.2.2.1	MDM-PF1
ML	SIG	5S1	11	P/L COMMAND (DOL 34)	8.2.2.1	MDM-PF1
ML	SIG	5S1	12	P/L COMMAND (DOL 35)	8.2.2.1	MDM-PF1
ML	SIG	5S1	13	P/L COMMAND (DOL 36)	8.2.2.1	MDM-PF1
ML	RTN	5S1	14	DOL 33-36 RETURN		
ML	SHD	5S1	15			
ML	SIG	5S2	16	P/L COMMAND (DOL 37)	8.2.2.1	TERMINATE
ML	SIG	5S2	17	P/L COMMAND (DOL 38)	8.2.2.1	MDM-PF1
ML	SIG	5S2	18	P/L COMMAND (DOL 39)	8.2.2.1	MDM-PF1
ML	SIG	5S2	19	P/L COMMAND (DOL 40)	8.2.2.1	MDM-PF1
ML	RTN	5S2	20	DOL 37-40 RETURN		
ML	SHD	5S2	21			
ML	SIG	5S3	22	P/L MONITOR (DIL 25)	8.2.2.3	TERMINATE
ML	SIG	5S3	23	P/L MONITOR (DIL 26)	8.2.2.3	MDM-PF1
ML	SIG	5S3	24	P/L MONITOR (DIL 27)	8.2.2.3	MDM-PF1
ML	SIG	5S3	25	P/L MONITOR (DIL 28)	8.2.2.3	MDM-PF1
ML	RTN	5S3	26	DIL 25-28 RETURN		
ML	SHD	5S3	27			
ML	SIG	5S4	28	P/L MONITOR (DIL 29)	8.2.2.3	TERMINATE
ML	SIG	5S4	29	P/L MONITOR (DIL 30)	8.2.2.3	MDM-PF1
ML	SIG	5S4	30	P/L MONITOR (DIL 31)	8.2.2.3	MDM-PF1
ML	SIG	5S4	31	P/L MONITOR (DIL 32)	8.2.2.3	MDM-PF1
ML	RTN	5S4	32	DIL 29-32 RETURN		
ML	SHD	5S4	33			
ML	SIG	2S1	34	P/L MONITOR (AID 56)	8.2.2.4	TERMINATE
ML	SIG	2S1	35	AID 56 RETURN		MDM-PF1
ML	SHD	2S1	36			
ML	SIG	2S2	37	P/L MONITOR (AID 57)	8.2.2.4	TERMINATE
ML	RTN	2S2	38	AID 57 RETURN		MDM-PF1
ML	SHD	2S2	39			
ML	SIG	2S3	40	DS12	13.4.2	TERMINATE
ML	RTN	2S3	41	DS12 RETURN		SSP 2B
ML	SHD	2S3	42			
ML	SIG	2S4	43	DS11	13.4.2	TERMINATE
ML	RTN	2S4	44	DS11 RETURN		SSP 2B
ML	SHD	2S4	45			TERMINATE

TABLE 13.5.2.1-13 PIN ASSIGNMENTS FOR NON-STANDARD Xo 603 CONNECTOR J1325 (RELATING TO SMCH)

EMC CLASS.	PIN FUNCT.	CABLE DESC.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
ML	SIG	2S5	46	DS10	13.4.2	SSP 2B
ML	RTN	2S5	47	DS10 RETURN		
ML	SHD	2S5	48			TERMINATE SSP 2B
ML	SIG	2S6	49	DS9	13.4.2	TERMINATE SSP 2B
ML	RTN	2S6	50	DS9 RETURN		
ML	SHD	2S6	51			TERMINATE SSP 2B
ML	SIG	2S7	52	DS8	13.4.2	TERMINATE SSP 2B
ML	RTN	2S7	53	DS8 RETURN		
ML	SHD	2S7	54			TERMINATE SSP 2B
ML	SIG	2S8	55	DS7	13.4.2	TERMINATE SSP 2B
ML	RTN	2S8	56	DS7 RETURN		
ML	SHD	2S8	57			TERMINATE SSP 2B
ML	SIG	2S9	58	DS6	13.4.2	TERMINATE SSP 2B
ML	RTN	2S9	59	DS6 RETURN		
ML	SHD	2S9	60			TERMINATE SSP 2B
ML	SIG	2S10	61	DS5	13.4.2	TERMINATE SSP 2B
ML	RTN	2S10	62	DS5 RETURN		
ML	SHD	2S10	63			TERMINATE SSP 2B
ML	SIG	2S11	64	DS4	13.4.2	TERMINATE SSP 2B
ML	RTN	2S11	65	DS4 RETURN		
ML	SHD	2S11	66			TERMINATE SSP 2B
ML	SIG	2S12	67	DS3	13.4.2	TERMINATE SSP 2B
ML	RTN	2S12	68	DS3 RETURN		
ML	SHD	2S12	69			TERMINATE SSP 2B
ML	RTN	2S13	70	DS2	13.4.2	TERMINATE SSP 2B
ML	SIG	2S13	71	DS2		
ML	SHD	2S13	72			TERMINATE SSP 2B
ML	SIG	2S15	73	DS1	13.4.2	TERMINATE SSP 2B
ML	SIG	2S15	74	DS2	13.4.2	TERMINATE SSP 2B
ML	SHD	2S15	75			TERMINATE SSP 2B
ML	SIG	2S14	76	DS1	13.4.2	TERMINATE SSP 2B
ML	RTN	2S14	77	DS1 RETURN		
ML	SHD	2S14	78			TERMINATE NOT WIRED
ML		2S14	79			

TABLE 13.5.2.1-14 PIN ASSIGNMENTS FOR NON-STANDARD X0 603 CONNECTOR J1326 (RELATING TO SMCH)

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
			1			NOT WIRED
			2			NOT WIRED
			3			NOT WIRED
			4			NOT WIRED
			5			NOT WIRED
			6			NOT WIRED
			7			NOT WIRED
			8			NOT WIRED
			9			NOT WIRED
			10			ORBITER DATA BUS TERMINATION JUMPER
RF	SIG	2S2	11	DATA BUS TERMINATION		
RF	RTN	2S2	12	DATA BUS TERMINATION RETURN		
RF	SIG	2S3	13	DATA BUS PI2 INPUT - LO		
RF	RTN	2S3	14	DATA BUS PI2 INPUT - HI		
RF	RTN	2S1	15	DATA BUS TERMINATION RETURN	8.2.12	ORBITER DATA BUS INPUT TO CARGO ELEMENT
RF	SIG	2S1	16	DATA BUS TERMINATION		
			17			ORBITER DATA BUS TERMINATION JUMPER
			18			NOT WIRED
			19			NOT WIRED
			20			NOT WIRED
			21			NOT WIRED
			22			NOT WIRED



TABLE 13.5.2. 1-15 PIN ASSIGNMENTS FOR NON-STANDARD Xo 603 CONNECTOR J1327 (RELATING TO SMCH)

EMC CLASS.	PIN FUNCT.	CABLE DESCOR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
			1			NOT WIRED
			2			NOT WIRED
			3			NOT WIRED
			4			NOT WIRED
			5			NOT WIRED
			6			NOT WIRED
			7			NOT WIRED
			8			NOT WIRED
			9			NOT WIRED
ML	SIG	5S1	10	P/L COMMAND (DOL 41)	8.2.2.1	NOT WIRED
ML	SIG	5S1	11	P/L COMMAND (DOL 42)	8.2.2.1	MDM-PF1
ML	SIG	5S1	12	P/L COMMAND (DOL 43)	8.2.2.1	MDM-PF1
ML	SIG	5S1	13	P/L COMMAND (DOL 44)	8.2.2.1	MDM-PF1
ML	RTN	5S1	14	DOL 41-44 RETURN		TERMINATE
ML	SHD	5S1	15			MDM-PF1
ML	SIG	5S2	16	P/L COMMAND (DOL 45)	8.2.2.1	MDM-PF1
ML	SIG	5S2	17	P/L COMMAND (DOL 46)	8.2.2.1	MDM-PF1
ML	SIG	5S2	18	P/L COMMAND (DOL 47)	8.2.2.1	MDM-PF1
ML	SIG	5S2	19	P/L COMMAND (DOL 48)	8.2.2.1	MDM-PF1
ML	RTN	5S2	20	DOL 45-48 RETURN		TERMINATE
ML	SHD	5S2	21			MDM-PF1
ML	SIG	5S3	22	P/L MONITOR (DIL 33)	8.2.2.3	TERMINATE
ML	SIG	5S3	23	P/L MONITOR (DIL 34)	8.2.2.3	MDM-PF1
ML	SIG	5S3	24	P/L MONITOR (DIL 35)	8.2.2.3	MDM-PF1
ML	SIG	5S3	25	P/L MONITOR (DIL 36)	8.2.2.3	MDM-PF1
ML	RTN	5S3	26	DIL 33-36 RETURN		TERMINATE
ML	SHD	5S3	27			MDM-PF1
ML	SIG	5S4	28	P/L MONITOR (DIL 37)	8.2.2.3	TERMINATE
ML	SIG	5S4	29	P/L MONITOR (DIL 38)	8.2.2.3	MDM-PF1
ML	SIG	5S4	30	P/L MONITOR (DIL 39)	8.2.2.3	MDM-PF1
ML	SIG	5S4	31	P/L MONITOR (DIL 40)	8.2.2.3	MDM-PF1
ML	RTN	5S4	32	DIL 37-40 RETURN		TERMINATE
ML	SHD	5S4	33			MDM-PF1
ML	SIG	2S1	34	P/L MONITOR (AID 58)	8.2.2.4	TERMINATE
ML	RTN	2S1	35	AID 58 RETURN		MDM-PF1
ML	SHD	2S1	36			TERMINATE
ML	SIG	2S2	37	P/L MONITOR (AID 59)	8.2.2.4	MDM-PF1
ML	RTN	2S2	38	AID 59 RETURN		TERMINATE
ML	SHD	2S2	39			SSP 2A
ML	SIG	2S15	40	DS24	13.4.2	TERMINATE
ML	RTN	2S15	41	DS24 RETURN		SSP 2A
ML	SHD	2S15	42			TERMINATE
ML	SIG	2S14	43	DS23	13.4.2	TERMINATE
ML	RTN	2S14	44	DS23 RETURN		SSP 2A
ML	SHD	2S14	45			TERMINATE

TABLE 13.5.2.1-15 PIN ASSIGNMENTS FOR NON-STANDARD Xo 603 CONNECTOR J1327 (RELATING TO SMCH)

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
ML	SIG	2S13	46	DS22	13.4.2	SSP 2A
ML	RTN	2S13	47	DS22 RETURN		
ML	SHD	2S13	48			
ML	SIG	2S12	49	DS21	13.4.2	TERMINATE SSP 2A
ML	RTN	2S12	50	DS21 RETURN		
ML	SHD	2S12	51			
ML	SIG	2S11	52	DS20	13.4.2	TERMINATE SSP 2A
ML	RTN	2S11	53	DS20 RETURN		
ML	SHD	2S11	54			
ML	SIG	2S10	55	DS19	13.4.2	TERMINATE SSP 2A
ML	RTN	2S10	56	DS19 RETURN		
ML	SHD	2S10	57			
ML	SIG	2S9	58	DS18	13.4.2	TERMINATE SSP 2A
ML	RTN	2S9	59	DS18 RETURN		
ML	SHD	2S9	60			
ML	SIG	2S8	61	DS17	13.4.2	TERMINATE SSP 2A
ML	RTN	2S8	62	DS17 RETURN		
ML	SHD	2S8	63			
ML	SIG	2S7	64	DS16	13.4.2	TERMINATE SSP 2A
ML	RTN	2S7	65	DS16 RETURN		
ML	SHD	2S7	66			
ML	SIG	2S6	67	DS15	13.4.2	TERMINATE SSP 2A
ML	RTN	2S6	68	DS15 RETURN		
ML	SHD	2S6	69			
ML	RTN	2S5	70	DS14	13.4.2	TERMINATE SSP 2A
ML	SIG	2S5	71	DS14 RETURN		
ML	SHD	2S5	72	DS14		
ML	SIG	2S4	73	DS13	13.4.2	TERMINATE SSP 2A
ML	SIG	2S4	74	DS14	13.4.2	SSP 2A
ML	SHD	2S4	75			TERMINATE SSP 2A
ML	SIG	2S3	76	DS13	13.4.2	TERMINATE SSP 2A
ML	RTN	2S3	77	DS13 RETURN		
ML	SHD	2S3	78			TERMINATE NOT WIRED
			79			

TABLE 13.5.2.1-16 PIN ASSIGNMENTS FOR NON-STANDARD Xc 603 CONNECTOR JT1329 (RELATING TO SMCH)

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
			1			NOT WIRED
			2			NOT WIRED
			3			NOT WIRED
			4			NOT WIRED
			5			NOT WIRED
			6			NOT WIRED
			7			NOT WIRED
			8			NOT WIRED
			9			NOT WIRED
ML	SIG	5S1	10	P/L COMMAND (DOL 49)	8.2.2.1	NOT WIRED
ML	SIG	5S1	11	P/L COMMAND (DOL 50)	8.2.2.1	NOT WIRED
ML	SIG	5S1	12	P/L COMMAND (DOL 51)	8.2.2.1	MDM-PF1
ML	SIG	5S1	13	P/L COMMAND (DOL 52)	8.2.2.1	MDM-PF1
ML	RTN	5S1	14	DOL 49-52 RETURN	8.2.2.1	MDM-PF1
ML	SHD	5S1	15			TERMINATE
ML	SIG	5S2	16	P/L COMMAND (DOL 53)	8.2.2.1	MDM-PF1
ML	SIG	5S2	17	P/L COMMAND (DOL 54)	8.2.2.1	MDM-PF1
ML	SIG	5S2	18	P/L COMMAND (DOL 55)	8.2.2.1	MDM-PF1
ML	SIG	5S2	19	P/L COMMAND (DOL 56)	8.2.2.1	MDM-PF1
ML	RTN	5S2	20	DOL 53-56 RETURN		TERMINATE
ML	SHD	5S2	21			MDM-PF1
ML	SIG	5S3	22	P/L MONITOR (DIL 41)	8.2.2.3	TERMINATE
ML	SIG	5S3	23	P/L MONITOR (DIL 42)	8.2.2.3	MDM-PF1
ML	SIG	5S3	24	P/L MONITOR (DIL 43)	8.2.2.3	MDM-PF1
ML	SIG	5S3	25	P/L MONITOR (DIL 44)	8.2.2.3	MDM-PF1
ML	RTN	5S3	26	DIL 41-44 RETURN		TERMINATE
ML	SHD	5S3	27			MDM-PF1
ML	SIG	5S4	28	P/L MONITOR (DIL 45)	8.2.2.3	TERMINATE
ML	SIG	5S4	29	P/L MONITOR (DIL 46)	8.2.2.3	MDM-PF1
ML	SIG	5S4	30	P/L MONITOR (DIL 47)	8.2.2.3	MDM-PF1
ML	SIG	5S4	31	P/L MONITOR (DIL 48)	8.2.2.3	MDM-PF1
ML	RTN	5S4	32	DIL 45-48 RETURN		TERMINATE
ML	SHD	5S4	33			MDM-PF1
ML	SIG	2S1	34	P/L MONITOR (AID 60)	8.2.2.4	TERMINATE
ML	RTN	2S1	35	AID 60 RETURN		MDM-PF1
ML	SHD	2S1	36			TERMINATE
ML	SIG	2S2	37	P/L MONITOR (AID 61)	8.2.2.4	MDM-PF1
ML	RTN	2S2	38	AID 61 RETURN		TERMINATE
ML	SHD	2S2	39			SSP 1B
ML	SIG	2S15	40	DS12	13.4.2	TERMINATE
ML	RTN	2S15	41	DS12 RETURN		SSP 1B
ML	SHD	2S15	42			TERMINATE
ML	SIG	2S14	43	DS11	13.4.2	TERMINATE
ML	RTN	2S14	44	DS11 RETURN		SSP 1B
ML	SHD	2S14	45			TERMINATE

TABLE 13.5.2.1-16 PIN ASSIGNMENTS FOR NON-STANDARD Xo 603 CONNECTOR J1329 (RELATING TO SMCH)

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
ML	SIG	2S13	46	DS10	13.4.2	SSP 1B
ML	RTN	2S13	47	DS10 RETURN		
ML	SHD	2S13	48			TERMINATE
ML	SIG	2S12	49	DS9	13.4.2	SSP 1B
ML	RTN	2S12	50	DS9 RETURN		
ML	SHD	2S12	51			TERMINATE
ML	SIG	2S10	52	DS8	13.4.2	SSP 1B
ML	RTN	2S10	53	DS8 RETURN		
ML	SHD	2S10	54			TERMINATE
ML	SIG	2S9	55	DS7	13.4.2	SSP 1B
ML	RTN	2S9	56	DS7 RETURN		
ML	SHD	2S9	57			TERMINATE
ML	SIG	2S8	58	DS6	13.4.2	SSP 1B
ML	RTN	2S8	59	DS6 RETURN		
ML	SHD	2S8	60			TERMINATE
ML	SIG	2S7	61	DS5	13.4.2	SSP 1B
ML	RTN	2S7	62	DS5 RETURN		
ML	SHD	2S7	63			TERMINATE
ML	SIG	2S6	64	DS4	13.4.2	SSP 1B
ML	RTN	2S6	65	DS4 RETURN		
ML	SHD	2S6	66			TERMINATE
ML	SIG	2S5	67	DS3	13.4.2	SSP 1B
ML	RTN	2S5	68	DS3 RETURN		
ML	SHD	2S5	69			TERMINATE
ML	RTN	2S4	70	DS2 RETURN		
ML	SIG	2S4	71	DS2	13.4.2	SSP 1B
ML	SHD	2S4	72			TERMINATE
ML	SIG	2S3	73	DS1	13.4.2	SSP 1B
ML	SIG	2S3	74	DS2	13.4.2	SSP 1B
ML	SHD	2S3	75			TERMINATE
ML	SIG	2S11	76	DS1	13.4.2	SSP 1B
ML	RTN	2S11	77	DS1 RETURN		
ML	SHD	2S11	78			TERMINATE
ML			79			NOT WIRED

TABLE 13.5.2.1-17 PIN ASSIGNMENTS FOR NON-STANDARD Xo 603 CONNECTOR J1331 (RELATING TO SMCH)

EMC CLASS.	PIN FUNCT.	CABLE DESC.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
			1			NOT WIRED
			2			NOT WIRED
			3			NOT WIRED
			4			NOT WIRED
			5			NOT WIRED
			6			NOT WIRED
			7			NOT WIRED
			8			NOT WIRED
			9			NOT WIRED
ML	SIG	553	10	P/L COMMAND (DOL 57)	8.2.2.1	MDM-PF1
ML	SIG	553	11	P/L COMMAND (DOL 58)	8.2.2.1	MDM-PF1
ML	SIG	553	12	P/L COMMAND (DOL 59)	8.2.2.1	MDM-PF1
ML	SIG	553	13	P/L COMMAND (DOL 60)	8.2.2.1	MDM-PF1
ML	RTN	553	14	DOL 57-60 RETURN		
ML	SHD	553	15			
ML	SIG	554	16	P/L COMMAND (DOL 61)	8.2.2.1	TERMINATE
ML	SIG	554	17	P/L COMMAND (DOL 62)	8.2.2.1	MDM-PF1
ML	SIG	554	18	P/L COMMAND (DOL 63)	8.2.2.1	MDM-PF1
ML	SIG	554	19	P/L COMMAND (DOL 64)	8.2.2.1	MDM-PF1
ML	RTN	554	20	DOL 61-64 RETURN		
ML	SHD	554	21			
ML	SIG	551	22	P/L MONITOR (DIL 38)	8.2.2.3	TERMINATE
ML	SIG	551	23	P/L MONITOR (DIL 39)	8.2.2.3	MDM-PF1
ML	SIG	551	24	P/L MONITOR (DIL 40)	8.2.2.3	MDM-PF1
ML	SIG	551	25	P/L MONITOR (DIL 41)	8.2.2.3	MDM-PF1
ML	RTN	551	26	DIL 38-41 RETURN		
ML	SHD	551	27			
ML	SIG	552	28	P/L MONITOR (DIL 42)	8.2.2.3	TERMINATE
ML	SIG	552	29	P/L MONITOR (DIL 43)	8.2.2.3	MDM-PF1
ML	SIG	552	30	P/L MONITOR (DIL 44)	8.2.2.3	MDM-PF1
ML	SIG	552	31	P/L MONITOR (DIL 45)	8.2.2.3	MDM-PF1
ML	RTN	552	32	DIL 42-45 RETURN		
ML	SHD	552	33			
ML	SIG	251	34	P/L MONITOR (AID 62)	8.2.2.4	TERMINATE
ML	RTN	251	35	AID 62 RETURN		MDM-PF1
ML	SHD	251	36			
ML	SIG	252	37	P/L MONITOR (AID 63)	8.2.2.4	TERMINATE
ML	RTN	252	38	AID 63 RETURN		MDM-PF1
ML	SHD	252	39			
ML	SIG	253	40	DS24	13.4.2	TERMINATE
ML	RTN	253	41	DS24 RETURN		SSP 1A
ML	SHD	253	42			
ML	SIG	2515	43	DS23	13.4.2	TERMINATE
ML	RTN	2515	44	DS23 RETURN		SSP 1A
ML	SHD	2515	45			TERMINATE

TABLE 13.5.2.1-17 PIN ASSIGNMENTS FOR NON-STANDARD Xo 603 CONNECTOR J1331 (RELATING TO SMCH)

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
ML	SIG	257	46	DS22	13.4.2	SSP 1A
ML	RTN	257	47	DS22 RETURN		TERMINATE
ML	SHD	257	48			SSP 1A
ML	SIG	258	49	DS21	13.4.2	TERMINATE
ML	RTN	258	50	DS21 RETURN		SSP 1A
ML	SHD	258	51			SSP 1A
ML	SIG	259	52	DS20	13.4.2	TERMINATE
ML	RTN	259	53	DS20 RETURN		SSP 1A
ML	SHD	259	54			SSP 1A
ML	SIG	2514	55	DS19	13.4.2	TERMINATE
ML	RTN	2514	56	DS19 RETURN		SSP 1A
ML	SHD	2514	57			SSP 1A
ML	SIG	2511	58	DS18	13.4.2	TERMINATE
ML	RTN	2511	59	DS18 RETURN		SSP 1A
ML	SHD	2511	60			SSP 1A
ML	SIG	2512	61	DS17	13.4.2	TERMINATE
ML	RTN	2512	62	DS17 RETURN		SSP 1A
ML	SHD	2512	63			SSP 1A
ML	SIG	2513	64	DS16	13.4.2	TERMINATE
ML	RTN	2513	65	DS16 RETURN		SSP 1A
ML	SHD	2513	66			SSP 1A
ML	SIG	2510	67	DS15	13.4.2	TERMINATE
ML	RTN	2510	68	DS15 RETURN		SSP 1A
ML	SHD	2510	69			SSP 1A
ML	SIG	256	70	DS14	13.4.2	TERMINATE
ML	RTN	256	71	DS14 RETURN		SSP 1A
ML	SHD	256	72			SSP 1A
ML	SIG	255	73	DS13	13.4.2	TERMINATE
ML	SIG	255	74	DS14	13.4.2	SSP 1A
ML	SHD	255	75			SSP 1A
ML	SIG	254	76	DS13	13.4.2	TERMINATE
ML	RTN	254	77	DS13 RETURN		SSP 1A
ML	SHD	254	78			SSP 1A
ML		254	79			TERMINATE NOT WIRED

TABLE 13.5.2.1-18 PIN ASSIGNMENTS FOR NON-STANDARD Xo 603 CONNECTOR J1341 (RELATING TO SMCH)

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
			1			NOT WIRED
			2			NOT WIRED
			3			NOT WIRED
			4			NOT WIRED
			5			NOT WIRED
			6			NOT WIRED
			7			NOT WIRED
			8			NOT WIRED
			9			NOT WIRED
			10			NOT WIRED
RF	SIG	2S2	11	DATA BUS TERMINATION		ORBITER DATA BUS TERMINATION JUMPER
RF	RTN	2S2	12	DATA BUS TERMINATION RETURN		
RF	SIG	2S3	13	DATA BUS PL1 INPUT - LO		
RF	RTN	2S3	14	DATA BUS PL1 INPUT - HI		
RF	RTN	2S1	15	DATA BUS TERMINATION RETURN	8.2.12	ORBITER DATA BUS INPUT TO CARGO ELEMENT
RF	SIG	2S1	16	DATA BUS TERMINATION		ORBITER DATA BUS TERMINATION JUMPER
			17			NOT WIRED
			18			NOT WIRED
			19			NOT WIRED
			20			NOT WIRED
			21			NOT WIRED
			22			NOT WIRED

TABLE 13.5.2.1-19 PIN ASSIGNMENTS FOR NON-STANDARD Xo 603 CONNECTOR J1343 (RELATING TO SMCH)

EMC CLASS.	PIN FUNCT.	CABLE #	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
			1			NOT WIRED
			2			NOT WIRED
			3			NOT WIRED
			4			NOT WIRED
			5			NOT WIRED
			6			NOT WIRED
			7			NOT WIRED
			8			NOT WIRED
			9			NOT WIRED
			10			NOT WIRED
RF	SIG	252	11	DATA BUS TERMINATION		ORBITER DATA BUS TERMINATION JUMPER
RF	RTN	252	12	DATA BUS TERMINATION RETURN		
RF	SIG	253	13	DATA BUS P11 INPUT - LO		
RF	RTN	253	14	DATA BUS P11 INPUT - HI	8.2.12	ORBITER DATA BUS INPUT TO CARGO ELEMENT
RF	RTN	251	15	DATA BUS TERMINATION RETURN		
RF	SIG	251	16	DATA BUS TERMINATION		ORBITER DATA BUS TERMINATION JUMPER
			17			NOT WIRED
			18			NOT WIRED
			19			NOT WIRED
			20			NOT WIRED
			21			NOT WIRED
			22			NOT WIRED



TABLE 13.5.2.1-20 PIN ASSIGNMENTS FOR NON-STANDARD Xo 1203 CONNECTOR J1601 (RELATING TO SMCH)

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
			A		7.3.6	NOT WIRED
			B			NOT WIRED
			C			NOT WIRED
			D			NOT WIRED
RF	SIG	251	E	To P1501 - E		From J59 - B
RF	RTN	251	F	To P1501 - F		From J59 - A
RF	SIG	252	G	To P1501 - G		From J59 - Y
RF	RTN	252	H	To P1501 - H		From J59 - D
RF	SIG	253	J	To P1501 - J		From J59 - Z
RF	RTN	253	K	To P1501 - K		From J59 - E
RF	SIG	254	L	To P1501 - L		From J59 - a
RF	RTN	254	M	To P1501 - M		From J59 - F
RF	SIG	255	N	To P1501 - N		From J59 - H
RF	RTN	255	P	To P1501 - P		From J59 - d
RF	SIG	256	R	To P1501 - R	From J59 - K	
RF	RTN	256	S	To P1501 - S	From J59 - L	
RF	SIG	257	T	To P1501 - T	From J59 - 9	
RF	RTN	257	U	To P1501 - U	From J59 - M	
			V		NOT WIRED	

TABLE 13.5.2.1-21 PIN ASSIGNMENTS FOR NON-STANDARD Xo 1203 CONNECTOR J1602 (RELATING TO SMCH)

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
HO	PWR	2T1	A	To P1502 - A	7.3.6	From J74 - K
HO	RTN	2T1	B	To P1502 - B		From J74 - L
HO	PWR	2T2	C	To P1502 - C		From J74 - M
HO	RTN	2T2	D	To P1502 - D		From J74 - J
HO	PWR	2T3	E	To P1502 - E		From J74 - H
HO	RTN	2T3	F	To P1502 - F		From J74 - G
			G			NOT WIRED
			H			NOT WIRED

TABLE 13.5.2.1-22 PIN ASSIGNMENTS FOR NON-STANDARD Xo 1203 CONNECTOR J1603 (RELATING TO SMCH)

EMC CLASS.	PIN FUNCT.	PIN DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
			A		7.3.6	NOT WIRED
			B			NOT WIRED
			C			NOT WIRED
			D			NOT WIRED
			E			NOT WIRED
			F			NOT WIRED
	SIG	2S1	G	To P1503 - G		From J59 - P
RF	RTN	2S1	H	To P1503 - H		From J59 - R
RF	SIG	2S2	J	To P1503 - J		From J59 - T
RF	RTN	2S2	K	To P1503 - K		From J59 - S
RF	SIG	2S3	L	To P1503 - L		From J59 - U
RF	RTN	2S3	M	To P1503 - M		From J59 - V
RF	SIG	2S4	N	To P1503 - N		From J59 - X
RF	RTN	2S4	P	To P1503 - P		From J59 - W
RF	SIG	2S5	R	To P1503 - R	From J59 - C	
RF	RTN	2S5	S	To P1503 - S	From J59 - u	
RF	SIG	2S6	T	To P1503 - T	From J59 - f	
RF	RTN	2S6	U	To P1503 - U	From J59 - e	
			V		NOT WIRED	

TABLE 13.5.2.1-23 PIN ASSIGNMENTS FOR NON-STANDARD Xo I203 CONNECTOR J1604 (RELATING TO SMCH)

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
HO	PWR	2T1	A	To P1504 - A	7.3.6	From J74 - A
HO	RTN	2T1	B	To P1504 - B		From J74 - B
HO	PWR	2T2	C	To P1504 - C		From J74 - D
HO	RTN	2T2	D	To P1504 - D		From J74 - C
HO	PWR	2T3	E	To P1504 - E		From J74 - E
HO	RTN	2T3	F	To P1504 - F		From J74 - F
			G			NOT WIRED
			H			NOT WIRED

TABLE 13.5.2.1-24 PIN ASSIGNMENTS FOR NON-STANDARD Xo 1203 CONNECTOR J1605 (RELATING TO SMCH)

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
			A		7.3.6	NOT WIRED
			B			NOT WIRED
			C			NOT WIRED
			D			NOT WIRED
			E			NOT WIRED
			F			NOT WIRED
RF	SIG	2S1	G	To P1505 - G		From J59 - Y
RF	RTN	2S1	H	To P1505 - H		From J59 - Y
RF	SIG	2S2	J	To P1505 - J		From J59 - Z
RF	RTN	2S2	K	To P1505 - K		From J59 - Z
RF	SIG	2S3	L	To P1505 - L		From J59 - J
RF	RTN	2S3	M	To P1505 - M		From J59 - m
RF	SIG	2S4	N	To P1505 - N		From J59 - k
RF	RTN	2S4	P	To P1505 - P		From J59 - n
RF	SIG	2S5	R	To P1505 - R		From J59 - p
RF	RTN	2S5	S	To P1505 - S		From J59 - r
RF	SIG	2S6	T	To P1505 - T	From J59 - q	
RF	RTN	2S6	U	To P1505 - U	From J59 - s	
			V		From J59 - CC	
					NOT WIRED	

TABLE 13.5.2.1-25 PIN ASSIGNMENTS FOR NON-STANDARD Xo 1203 CONNECTOR J1606 (RELATING TO SMCH)

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
			A		7.3.6	NOT WIRED
			B			NOT WIRED
			C			NOT WIRED
			D			NOT WIRED
			E			NOT WIRED
			F			NOT WIRED
			G			NOT WIRED
			H			NOT WIRED
			J	To P1506 - J		From J58 - X
HO	SIG	2T11	K	To P1506 - K		From J58 - W
HO	RTN	2T11	L	To P1506 - L		From J58 - C
HO	SIG	2T12	M	To P1506 - M		From J58 - U
HO	RTN	2T12	N	To P1506 - N		From J58 - B
HO	SIG	2T1	P	To P1506 - P		From J58 - A
HO	RTN	2T1	R	To P1506 - R		From J58 - Y
HO	SIG	2T2	S	To P1506 - S		From J58 - D
HO	RTN	2T2	T	To P1506 - T		From J58 - Z
HO	SIG	2T3	U	To P1506 - U		From J58 - E
HO	RTN	2T3	V	To P1506 - V		From J58 - a
HO	SIG	2T4	W	To P1506 - W		From J58 - F
HO	RTN	2T4	X	To P1506 - X	From J58 - H	
HO	SIG	2T5	Y	To P1506 - Y	From J58 - d	
HO	RTN	2T5	Z	To P1506 - Z	From J58 - K	
HO	SIG	2T6	a	To P1506 - a	From J58 - L	
HO	RTN	2T6	b	To P1506 - b	From J58 - g	
HO	SIG	2T7	c	To P1506 - c	From J58 - M	
HO	RTN	2T7	d	To P1506 - d	From J58 - P	
HO	SIG	2T8	e	To P1506 - e	From J58 - R	
HO	RTN	2T8	f	To P1506 - f	From J58 - T	
HO	SIG	2T9	g	To P1506 - g	From J58 - S	
HO	RTN	2T9	h	To P1506 - h	From J58 - U	
HO	SIG	2T10	i	To P1506 - i	From J58 - V	
HO	RTN	2T10	j	To P1506 - j	From J58 - V	

TABLE 13.5.2.1-26 PIN ASSIGNMENTS FOR NON-STANDARD Xo 1203 CONNECTOR J1607 (RELATING TO SMCH)

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
			A		7.3.6	NOT WIRED
			B			NOT WIRED
			C			NOT WIRED
			D			NOT WIRED
			E			NOT WIRED
			F			NOT WIRED
			G	To P1507 - G		From J59 - t
RF	SIG	2S1	H	To P1507 - H		From J59 - DD
RF	RTN	2S1	I	To P1507 - I		From J59 - w
RF	SIG	2S2	J	To P1507 - J		From J59 - v
RF	RTN	2S2	K	To P1507 - K		From J59 - AA
RF	SIG	2S3	L	To P1507 - L		From J59 - BB
RF	RTN	2S3	M	To P1507 - M		From J59 - FF
RF	SIG	2S4	N	To P1507 - N		From J59 - EE
RF	RTN	2S4	P	To P1507 - P		From J59 - GG
RF	SIG	2S5	R	To P1507 - R		From J59 - HH
RF	RTN	2S5	S	To P1507 - S	From J59 - x	
RF	SIG	2S6	T	To P1507 - T	From J59 - h	
RF	RTN	2S6	U	To P1507 - U	NOT WIRED	
			V			

TABLE 13.5.2.1-27 PIN ASSIGNMENTS FOR NON-STANDARD Xo 1203 CONNECTOR J1608 (RELATING TO SMCH)

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
			A		7.3.6	NOT WIRED
			B			NOT WIRED
			C			NOT WIRED
			D			NOT WIRED
			E			NOT WIRED
			F			NOT WIRED
			G	To P1508 - G		From J58 - f
HO	SIG	2T1	H	To P1508 - H		From J58 - e
HO	RTN	2T1	I	To P1508 - I		From J58 - x
HO	SIG	2T2	J	To P1508 - J		From J58 - h
HO	RTN	2T2	K	To P1508 - K		From J58 - y
HO	SIG	2T3	L	To P1508 - L		From J58 - i
HO	RTN	2T3	M	To P1508 - M		From J58 - z
HO	SIG	2T4	N	To P1508 - N		From J58 - j
HO	RTN	2T4	P	To P1508 - P		From J58 - m
HO	SIG	2T5	R	To P1508 - R		From J58 - k
HO	RTN	2T5	S	To P1508 - S		From J58 - n
HO	SIG	2T6	T	To P1508 - T		From J58 - p
HO	RTN	2T6	U	To P1508 - U		From J58 - r
HO	SIG	2T7	V	To P1508 - V		From J58 - q
HO	RTN	2T7	W	To P1508 - W		From J58 - s
HO	SIG	2T8	X	To P1508 - X		From J58 - CC
HO	RTN	2T8	Y	To P1508 - Y		From J58 - t
HO	SIG	2T9	Z	To P1508 - Z		From J58 - DD
HO	RTN	2T9	a	To P1508 - a		From J58 - v
HO	SIG	2T10	b	To P1508 - b		From J58 - w
HO	RTN	2T10	c	To P1508 - c	From J58 - AA	
HO	SIG	2T11	d	To P1508 - d	From J58 - BB	
HO	RTN	2T11	e	To P1508 - e	From J58 - FF	
HO	SIG	2T12	f	To P1508 - f	From J58 - EE	
HO	RTN	2T12	g	To P1508 - g	From J58 - GG	
HO	SIG	2T13	h	To P1508 - h	From J58 - HH	
HO	RTN	2T13	j	To P1508 - j		



TABLE 13.5.2.1-28 PIN ASSIGNMENTS FOR NON-STANDARD Xo 1203 CONNECTOR J1609 (RELATING TO SMCH)

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITTER COMPONENT INTERFACE AND/OR NOTES
			A		7.3.6	NOT WIRED
			B			NOT WIRED
			C			NOT WIRED
			D			NOT WIRED
			E			NOT WIRED
			F			NOT WIRED
			G			NOT WIRED
			H			NOT WIRED
			J			From J55 - X
HO	SIG	2T11	K	To P1509 - J		From J55 - W
HO	RTN	2T11	L	To P1509 - K		From J55 - C
HO	SIG	2T12	M	To P1509 - L		From J55 - U
HO	RTN	2T12	N	To P1509 - M		From J55 - B
HO	SIG	2T1	P	To P1509 - N		From J55 - A
HO	RTN	2T1	R	To P1509 - P		From J55 - Y
HO	SIG	2T2	S	To P1509 - R		From J55 - D
HO	RTN	2T2	T	To P1509 - S		From J55 - Z
HO	SIG	2T3	U	To P1509 - T		From J55 - E
HO	RTN	2T3	V	To P1509 - U		From J55 - a
HO	SIG	2T4	W	To P1509 - V		From J55 - F
HO	RTN	2T4	X	To P1509 - W	From J55 - H	
HO	SIG	2T5	Y	To P1509 - X	From J55 - d	
HO	RTN	2T5	Z	To P1509 - Y	From J55 - K	
HO	SIG	2T6	a	To P1509 - Z	From J55 - L	
HO	RTN	2T6	b	To P1509 - a	From J55 - g	
HO	SIG	2T7	c	To P1509 - b	From J55 - M	
HO	RTN	2T7	d	To P1509 - c	From J55 - P	
HO	SIG	2T8	e	To P1509 - d	From J55 - R	
HO	RTN	2T8	f	To P1509 - e	From J55 - T	
HO	SIG	2T9	g	To P1509 - f	From J55 - S	
HO	RTN	2T9	h	To P1509 - g	From J55 - U	
HO	SIG	2T10	i	To P1509 - h	From J55 - V	
HO	RTN	2T10	j	To P1509 - j		

TABLE 13.5.2.1-29 PIN ASSIGNMENTS FOR NON-STANDARD Xo 1203 CONNECTOR J1610 (RELATING TO SMCH)

EMC CLASS.	PIN FUNCT.	CABLE DESCOR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
			1		7.3.6	PINS 1 THROUGH 57 NOT WIRED
			57			PINS 1 THROUGH 57 NOT WIRED
ML	SIG	2S1	58	To P1510 - 58		From J69 - m
ML	RTN	2S1	59	To P1510 - 59		From J69 - n
ML	SHD	2S1	60	To P1510 - 60		TERMINATE
ML	SIG	2S2	61	To P1510 - 61		From J69 - p
ML	RTN	2S2	62	To P1510 - 62		From J69 - q
ML	SHD	2S2	63	To P1510 - 63		From J69 - r
ML	SIG	2S3	64	To P1510 - 64		From J69 - s
ML	RTN	2S3	65	To P1510 - 65		From J69 - t
ML	SHD	2S3	66	To P1510 - 66		From J69 - u
ML	SIG	2S4	67	To P1510 - 67		From J69 - v
ML	RTN	2S4	68	To P1510 - 68		From J69 - w
ML	SHD	2S4	69	To P1510 - 69		From J69 - x
ML	SIG	2S5	70	To P1510 - 70		From J69 - y
ML	RTN	2S5	71	To P1510 - 71		From J69 - z
ML	SHD	2S5	72	To P1510 - 72		From J69 - AA
ML	SIG	2S6	73	To P1510 - 73		From J69 - BB
ML	RTN	2S6	74	To P1510 - 74		From J69 - CC
ML	SHD	2S6	75	To P1510 - 75		From J69 - DD
ML	SIG	2S7	76	To P1510 - 76		From J69 - EE
ML	RTN	2S7	77	To P1510 - 77		From J69 - FF
ML	SHD	2S7	78	To P1510 - 78		From J69 - GG
			79			From J69 - HH
						NOT WIRED

TABLE 13.5.2.1-30 PIN ASSIGNMENTS FOR NON-STANDARD Xo 1203 CONNECTOR J1611 (RELATING TO SMCH)

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PAMEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
			A		7.3.6	NOT WIRED
			B			NOT WIRED
			C			NOT WIRED
			D			NOT WIRED
			E			NOT WIRED
			F			NOT WIRED
HO	SIG	2T1	G	To P1511 - G		From J55 - f
HO	RTN	2T1	H	To P1511 - H		From J55 - e
HO	SIG	2T2	J	To P1511 - J		From J55 - x
HO	RTN	2T2	K	To P1511 - K		From J55 - h
HO	SIG	2T3	L	To P1511 - L		From J55 - y
HO	RTN	2T3	M	To P1511 - M		From J55 - i
HO	SIG	2T4	N	To P1511 - N		From J55 - z
HO	RTN	2T4	P	To P1511 - P		From J55 - j
HO	SIG	2T7	R	To P1511 - R		From J55 - m
HO	RTN	2T7	S	To P1511 - S		From J55 - k
HO	SIG	2T8	T	To P1511 - T		From J55 - n
HO	RTN	2T8	U	To P1511 - U		From J55 - p
HO	SIG	2T9	V	To P1511 - V		From J55 - r
HO	RTN	2T9	W	To P1511 - W		From J55 - q
HO	SIG	2T10	X	To P1511 - X		From J55 - s
HO	RTN	2T10	Y	To P1511 - Y		From J55 - CC
HO	SIG	2T11	Z	To P1511 - Z		From J55 - t
HO	RTN	2T11	a	To P1511 - a		From J55 - DD
HO	SIG	2T12	b	To P1511 - b		From J55 - w
HO	RTN	2T12	c	To P1511 - c		From J55 - v
HO	SIG	2T5	d	To P1511 - d	From J55 - AA	
HO	RTN	2T5	e	To P1511 - e	From J55 - BB	
HO	SIG	2T6	f	To P1511 - f	From J55 - FF	
HO	RTN	2T6	g	To P1511 - g	From J55 - EE	
HO	SIG	2T13	h	To P1511 - h	From J55 - GG	
HO	RTN	2T13	j	To P1511 - j	From J55 - HH	

TABLE 13.5.2.1-31 PIN ASSIGNMENTS FOR NON-STANDARD Xo 1203 CONNECTOR J1612 (RELATING TO SMCH)

EMC CLASS.	PIN FUNCT.	CABLE PIN DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
			1		7.3.6	PINS 1 THROUGH 54 NOT WIRED
			54			PINS 1 THROUGH 54 NOT WIRED
ML	SIG	251	55	To P1512 - 55		From J69 - L
ML	RTN	251	56	To P1512 - 56		From J69 - M
ML	SHD	251	57	To P1512 - 57		TERMINATE
ML	SIG	252	58	To P1512 - 58		From J69 - N
ML	RTN	252	59	To P1512 - 59		From J69 - P
ML	SHD	252	60	To P1512 - 60		From J69 - R
ML	SIG	253	61	To P1512 - 61		From J69 - S
ML	RTN	253	62	To P1512 - 62		From J69 - T
ML	SHD	253	63	To P1512 - 63		From J69 - U
ML	SIG	254	64	To P1512 - 64		From J69 - V
ML	RTN	254	65	To P1512 - 65		From J69 - W
ML	SHD	254	66	To P1512 - 66		From J69 - X
ML	SIG	255	67	To P1512 - 67		From J69 - Y
ML	RTN	255	68	To P1512 - 68		From J69 - Z
ML	SHD	255	69	To P1512 - 69		From J69 - a
ML	SIG	256	70	To P1512 - 70		From J69 - b
ML	RTN	256	71	To P1512 - 71		From J69 - c
ML	SHD	256	72	To P1512 - 72		From J69 - d
ML	SIG	257	73	To P1512 - 73		From J69 - e
ML	RTN	257	74	To P1512 - 74		From J69 - f
ML	SHD	257	75	To P1512 - 75		From J69 - g
ML	SIG	258	76	To P1512 - 76		From J69 - h
ML	RTN	258	77	To P1512 - 77		From J69 - i
ML	SHD	258	78	To P1512 - 78		From J69 - j
			79			From J69 - k NOT WIRED

TABLE 13.5.2.1-32 PIN ASSIGNMENTS FOR NON-STANDARD Xo 1203 CONNECTOR J1613 (RELATING TO SMCH)

EMC CLASS.	PIN FUNCT.	CABLE DESC.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
			1		7.3.6	PINS 1 THROUGH 57 NOT WIRED
			57			PINS 1 THROUGH 57 NOT WIRED
ML	SIG	2S1	58	To P1513 - 58		From J67 - m
ML	RTN	2S1	59	To P1513 - 59		From J67 - n
ML	SHD	2S1	60	To P1513 - 60		TERMINATE
ML	SIG	2S2	61	To P1513 - 61		From J67 - p
ML	RTN	2S2	62	To P1513 - 62		From J67 - q
ML	SHD	2S2	63	To P1513 - 63		From J67 - r
ML	SIG	2S3	64	To P1513 - 64		From J67 - s
ML	RTN	2S3	65	To P1513 - 65		From J67 - t
ML	SHD	2S3	66	To P1513 - 66		From J67 - u
ML	SIG	2S4	67	To P1513 - 67		From J67 - v
ML	RTN	2S4	68	To P1513 - 68		From J67 - w
ML	SHD	2S4	69	To P1513 - 69		From J67 - x
ML	SIG	2S5	70	To P1513 - 70		From J67 - y
ML	RTN	2S5	71	To P1513 - 71		From J67 - z
ML	SHD	2S5	72	To P1513 - 72		From J67 - AA
ML	SIG	2S6	73	To P1513 - 73		From J67 - BB
ML	RTN	2S6	74	To P1513 - 74		From J67 - CC
ML	SHD	2S6	75	To P1513 - 75		From J67 - DD
ML	SIG	2S7	76	To P1513 - 76		From J67 - EE
ML	RTN	2S7	77	To P1513 - 77		From J67 - FF
ML	SHD	2S7	78	To P1513 - 78		From J67 - GG
			79			From J67 - HH NOT WIRED

TABLE 13.5.2.1-33 PIN ASSIGNMENTS FOR NON-STANDARD Xo 1203 CONNECTOR J1615 (RELATING TO SMCH)

EMC CLASS.	PIN FUNCT.	CABLE DESCOR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
			1		7.3.6	PINS 1 THROUGH 54 NOT WIRED
			54			PINS 1 THROUGH 54 NOT WIRED
ML	SIG	2S1	55	To P1515 - 55		From J67 - L
ML	RTN	2S1	56	To P1515 - 56		From J67 - M
ML	SHD	2S1	57	To P1515 - 57		TERMINATE
ML	SIG	2S2	58	To P1515 - 58		From J67 - N
ML	RTN	2S2	59	To P1515 - 59		From J67 - P
ML	SHD	2S2	60	To P1515 - 60		From J67 - R
ML	SIG	2S3	61	To P1515 - 61		From J67 - S
ML	RTN	2S3	62	To P1515 - 62		From J67 - T
ML	SHD	2S3	63	To P1515 - 63		From J67 - U
ML	SIG	2S4	64	To P1515 - 64		From J67 - V
ML	RTN	2S4	65	To P1515 - 65		From J67 - W
ML	SHD	2S4	66	To P1515 - 66		From J67 - X
ML	SIG	2S5	67	To P1515 - 67		From J67 - Y
ML	RTN	2S5	68	To P1515 - 68		From J67 - Z
ML	SHD	2S5	69	To P1515 - 69		From J67 - a
ML	SIG	2S6	70	To P1515 - 70		From J67 - b
ML	RTN	2S6	71	To P1515 - 71		From J67 - c
ML	SHD	2S6	72	To P1515 - 72		From J67 - d
ML	SIG	2S7	73	To P1515 - 73		From J67 - e
ML	RTN	2S7	74	To P1515 - 74		From J67 - f
ML	SHD	2S7	75	To P1515 - 75		From J67 - g
ML	SIG	2S8	76	To P1515 - 76		From J67 - h
ML	RTN	2S8	77	To P1515 - 77		From J67 - i
ML	SHD	2S8	78	To P1515 - 78		From J67 - j
			79			From J67 - k
						NOT WIRED

TABLE 13.5.2.2-1 SUMMARY OF NON-STANDARD PSDP CONNECTORS (RELATING TO SMCH)

ORBITER CONNECTOR IDENTIFIER	CABLE DEFINITION			SEE TABLE	ORBITER INTERFACE CONNECTOR PART NO.	CARGO INTERFACE CONNECTOR PART NO.
	NO CIRCT	WIRE TYPE	EMC CLASS			
PSDP-J11	4	TSP	RF	5	NLS0T10-35S	NLS6GT10-35P
PSDP-J13	32	TSP	RF	2	NLS0T18-35S	NLS6GT18-35P
PSDP-J29	4	TP	HO	0	NB0E18-8SNT2	NB6GE18-8PNT2
PSDP-J53	8	TSP	RF	6	NLS0T12-35SA	NLS6GT12-35PA
PSDP-J63	14	TSP	RF	9	NLS0T14-35SB	NLS6GT14-35PB
PSDP-J1309	23	TP	HO	9	NLS0T16-35SB	NLS6GT16-35PB
PSDP-J1311	23	TP	HO	9	NLS0T16-35SB	NLS6GT16-35PB
PSDP-J1313	22	TP	HO	11	NLS0T16-35SB	NLS6GT16-35PB
PSDP-J1315	22	TP	HO	11	NLS0T16-35SB	NLS6GT16-35PB
PSDP-J1325	13	TSP	ML	16	NLS0T16-35SC	NLS6GT16-35PC
PSDP-J1327	13	TSP	ML	16	NLS0T16-35SC	NLS6GT16-35PC
PSDP-J1329	13	TSP	ML	16	NLS0T16-35SC	NLS6GT16-35PC
PSDP-J1331	13	TSP	ML	16	NLS0T16-35SC	NLS6GT16-35PC
PSDP-J1351	1	TSP	ML	10	NLS0T10-35SA	NLS6GT10-35PA
PSDP-J1391	20	TSP	RF	15	NLS0T16-35S	NLS6GT16-35P
PSDP-J1393	20	TSP	RF	15	NLS0T16-35S	NLS6GT16-35P
PSDP-J1395	20	TSP	RF	15	NLS0T16-35S	NLS6GT16-35P
PSDP-J1397	20	TSP	RF	15	NLS0T16-35S	NLS6GT16-35P

TABLE 13.5.2.2-2 PIN ASSIGNMENTS FOR NON-STANDARD PSDP CONNECTOR J11 (RELATING TO SMCH)

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
			1			NOT WIRED
			2			NOT WIRED
			3			NOT WIRED
			4			NOT WIRED
			5			NOT WIRED
RF	SIG	2S4	6	GNT INPUT TO PTB	8.2.10	BUS CONNECTED (P2) AT PSDP J11
RF	RTN	2S4	7	GNT INPUT TO PTB RETURN		
RF	SIG	2S3	8	MET INPUT TO PTB	8.2.10	BUS CONNECTED (P2) AT PSDP J11
RF	RTN	2S3	9	MET INPUT TO PTB RETURN		
RF	RTN	2S1	10	MET INPUT FROM MTU RETURN		
RF	SIG	2S1	11	MET INPUT FROM MTU	8.2.10	BUS CONNECTED (P2) AT PSDP J11
RF	SIG	2S2	12	GNT INPUT FROM MTU	8.2.10	BUS CONNECTED (P2) AT PSDP J11
RF	RTN	2S2	13	GNT INPUT FROM MTU RETURN		



TABLE 13.5.2.2-3 PIN ASSIGNMENTS FOR NON-STANDARD PSDP CONNECTOR J13 (RELATING TO SMCH)

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
RF	SIG	251	1	B SERIAL OUTPUT	8.2.3	PAYLOAD RECORDER PLAYBACK
RF	RTN	251	2	B SERIAL OUTPUT RETURN		
RF	SIG	2533	3	MET (CAMERAS)		Xo 576 A3J2
RF	RTN	2528	4	TRACK 11 OUTPUT RETURN		
RF	SIG	2532	5	B SERIAL OUTPUT (BUS CONNECTED)	8.2.3	PAYLOAD RECORDER I-0 INTERFACE
RF	RTN	2532	6	B SERIAL OUTPUT RETURN		
RF	SIG	2517	7	GMT (RECORDER)		Xo 576 A3J2
RF	RTN	2517	8	GMT (RECORDER) RETURN		
RF	RTN	2533	9	MET (CAMERAS) RETURN		
RF	SIG	2528	10	TRACK 11 OUTPUT	8.2.3	PAYLOAD RECORDER PLAYBACK
RF	SIG	2529	11	TRACK 12 OUTPUT	8.2.3	PAYLOAD RECORDER PLAYBACK
RF	RTN	2529	12	TRACK 12 OUTPUT RETURN		
RF	SIG	2531	13	TRACK 13 OUTPUT	8.2.3	PAYLOAD RECORDER PLAYBACK
RF	RTN	2531	14	TRACK 13 OUTPUT RETURN		
RF	SIG	2530	15	TRACK 14 OUTPUT	8.2.3	PAYLOAD RECORDER PLAYBACK
RF	RTN	2530	16	TRACK 14 OUTPUT RETURN		
RF	SIG	252	17	TRACK 11 OUTPUT (BUS CONNECTED)	8.2.3	PAYLOAD RECORDER I-0 INTERFACE
RF	RTN	252	18	TRACK 11 OUTPUT RETURN		
RF	SIG	253	19	TRACK 12 OUTPUT (BUS CONNECTED)	8.2.3	PAYLOAD RECORDER I-0 INTERFACE
RF	RTN	253	20	TRACK 12 OUTPUT RETURN		
RF	SIG	254	21	TRACK 13 OUTPUT (BUS CONNECTED)	8.2.3	PAYLOAD RECORDER I-0 INTERFACE
RF	RTN	254	22	TRACK 13 OUTPUT RETURN		
RF	SIG	255	23	TRACK 14 OUTPUT (BUS CONNECTED)	8.2.3	PAYLOAD RECORDER I-0 INTERFACE
RF	RTN	255	24	TRACK 14 OUTPUT RETURN		
RF	SIG	2518	25	TRACK 1 OUTPUT	8.2.3	PAYLOAD RECORDER PLAYBACK
RF	RTN	2518	26	TRACK 1 OUTPUT RETURN		
RF	SIG	2519	27	TRACK 2 OUTPUT	8.2.3	PAYLOAD RECORDER PLAYBACK
RF	RTN	2519	28	TRACK 2 OUTPUT RETURN		
RF	SIG	2520	29	TRACK 3 OUTPUT	8.2.3	PAYLOAD RECORDER PLAYBACK
RF	RTN	2520	30	TRACK 3 OUTPUT RETURN		
RF	SIG	2521	31	TRACK 4 OUTPUT	8.2.3	PAYLOAD RECORDER PLAYBACK
RF	RTN	2521	32	TRACK 4 OUTPUT RETURN		
RF	SIG	256	33	TRACK 1 OUTPUT (BUS CONNECTED)	8.2.3	NOT WIRED
RF	RTN	256	34	TRACK 1 OUTPUT RETURN		PAYLOAD RECORDER I-0 INTERFACE
RF	SIG	257	35	TRACK 2 OUTPUT (BUS CONNECTED)	8.2.3	PAYLOAD RECORDER I-0 INTERFACE
RF	RTN	257	36	TRACK 2 OUTPUT RETURN		
RF	SIG	258	37	TRACK 3 OUTPUT (BUS CONNECTED)	8.2.3	PAYLOAD RECORDER I-0 INTERFACE
RF	RTN	258	38	TRACK 3 OUTPUT RETURN		
RF	SIG	258	39	TRACK 4 OUTPUT (BUS CONNECTED)	8.2.3	PAYLOAD RECORDER I-0 INTERFACE
RF	RTN	258	40	TRACK 4 OUTPUT RETURN		
RF	SIG	259	41	TRACK 5 OUTPUT (BUS CONNECTED)	8.2.3	NOT WIRED
RF	RTN	259	42	TRACK 5 OUTPUT RETURN		PAYLOAD RECORDER I-0 INTERFACE
RF	SIG	2510	43	TRACK 6 OUTPUT (BUS CONNECTED)	8.2.3	PAYLOAD RECORDER I-0 INTERFACE
RF	RTN	2510	44	TRACK 6 OUTPUT RETURN		
RF	SIG	2511	45	TRACK 6 OUTPUT (BUS CONNECTED)	8.2.3	PAYLOAD RECORDER I-0 INTERFACE

TABLE 13.5.2.2-3 PIN ASSIGNMENTS FOR NON-STANDARD PSDP CONNECTOR J13 (RELATING TO SMCH)

EMC CLASS.	PIN FUNCT.	CABLE DESC.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
RF	RTN	2S11	46	TRACK 6 OUTPUT RETURN		
RF	SIG	2S12	47	TRACK 7 OUTPUT (BUS CONNECTED)	8.2.3	PAYLOAD RECORDER T-0 INTERFACE
RF	RTN	2S12	48	TRACK 7 OUTPUT RETURN		
RF	SIG	2S13	49	TRACK 8 OUTPUT (BUS CONNECTED)	8.2.3	PAYLOAD RECORDER T-0 INTERFACE
RF	RTN	2S13	50	TRACK 8 OUTPUT RETURN		
RF	SIG	2S22	51	TRACK 5 OUTPUT	8.2.3	PAYLOAD RECORDER PLAYBACK
RF	SIG	2S23	52	TRACK 6 OUTPUT	8.2.3	PAYLOAD RECORDER PLAYBACK
RF	RTN	2S23	53	TRACK 6 OUTPUT RETURN		
RF	SIG	2S24	54	TRACK 7 OUTPUT	8.2.3	PAYLOAD RECORDER PLAYBACK
RF	RTN	2S24	55	TRACK 7 OUTPUT RETURN		
RF	SIG	2S25	56	TRACK 8 OUTPUT	8.2.3	PAYLOAD RECORDER PLAYBACK
RF	RTN	2S25	57	TRACK 8 OUTPUT RETURN		
RF	RTN	2S22	58	TRACK 5 OUTPUT		
RF	SIG	2S14	59	TRACK 9 OUTPUT (BUS CONNECTED)	8.2.3	PAYLOAD RECORDER T-0 INTERFACE
RF	RTN	2S14	60	TRACK 9 OUTPUT RETURN		
RF	SIG	2S15	61	TRACK 10 OUTPUT (BUS CONNECTED)	8.2.3	PAYLOAD RECORDER T-0 INTERFACE
RF	RTN	2S15	62	TRACK 10 OUTPUT RETURN		
RF	RTN	2S27	63	TRACK 10 OUTPUT RETURN		
RF	SIG	2S26	64	TRACK 9 OUTPUT	8.2.3	PAYLOAD RECORDER PLAYBACK
RF	RTN	2S26	65	TRACK 9 OUTPUT RETURN		
RF	SIG	2S27	66	TRACK 10 OUTPUT	8.2.3	PAYLOAD RECORDER PLAYBACK

TABLE 13.5.2.2-4 PIN ASSIGNMENTS FOR NON-STANDARD PSDP CONNECTOR J29 (RELATING TO SMCH)

EMC CLASS.	PIN FUNCT.	CABLE DESCOR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
HO	SIG	2T1	A	CABIN 1 PAYLOAD POWER	7.3.3	MPCA # 1 & # 2
HO	RIN	2T1	B	CABIN 1 PAYLOAD POWER RETURN		
HO	SIG	2T2	C	CABIN 2 PAYLOAD POWER	7.3.3	MPCA # 1 & # 2
HO	RIN	2T2	D	CABIN 2 PAYLOAD POWER RETURN		
HO	SIG	2T3	E	CABIN 3 PAYLOAD POWER	7.3.3	MPCA # 1 & # 2
HO	RIN	2T3	F	CABIN 3 PAYLOAD POWER RETURN		
HO	SIG	2T4	G	AUX BUS B POWER	7.3.4	MPCA # 2
HO	RIN	2T4	H	AUX BUS B POWER RETURN		

TABLE 13.5.2.2-5 PIN ASSIGNMENTS FOR NON-STANDARD PSDP CONNECTOR J53 (RELATING TO SMCH)

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	PAYLOAD RECORDER TRACK SELECTION OPTIONS	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
			1			NOT WIRED
			2			NOT WIRED
			3			NOT WIRED
			4			NOT WIRED
			5			NOT WIRED
			6			NOT WIRED
RF	RTN	2529	7	ID # 8 RETURN		
RF	SIG	2529	8	DIGITAL RECORDING ID # 8	8.2.3	PAYLOAD RECORDER (# OF DIGITAL TRACKS)
RF	RTN	2528	9	ID # 4 RETURN		
RF	SIG	2528	10	DIGITAL RECORDING ID # 4	8.2.3	PAYLOAD RECORDER (# OF DIGITAL TRACKS)
RF	RTN	2527	11	ID # 2 RETURN		
RF	SIG	2527	12	DIGITAL RECORDING ID # 2	8.2.3	PAYLOAD RECORDER (# OF DIGITAL TRACKS)
RF	RTN	2526	13	ID # 1 RETURN		
RF	SIG	2526	14	DIGITAL RECORDING ID # 1	8.2.3	PAYLOAD RECORDER (# OF DIGITAL TRACKS)
RF	RTN	2510	15	ID # 8 RETURN		
RF	SIG	2510	16	DIGITAL RECORDING ID # 8	8.2.3	PAYLOAD RECORDER (# OF TOTAL TRACKS)
RF	RTN	259	17	ID # 4 RETURN		
RF	SIG	259	18	DIGITAL RECORDING ID # 4	8.2.3	PAYLOAD RECORDER (# OF TOTAL TRACKS)
RF	RTN	258	19	ID # 2 RETURN		
RF	SIG	258	20	DIGITAL RECORDING ID # 2	8.2.3	PAYLOAD RECORDER (# OF TOTAL TRACKS)
RF	RTN	257	21	ID # 1 RETURN		
RF	SIG	257	22	DIGITAL RECORDING ID # 1	8.2.3	PAYLOAD RECORDER (# OF TOTAL TRACKS)

TABLE 13.5.2.2-6 PIN ASSIGNMENTS FOR NON-STANDARD PSDP CONNECTOR J63 (RELATING TO SMCH)

EMC CLASS.	PIN FUNCT.	CABLE DESCOR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
			1			NOT WIRED
			2			NOT WIRED
			3			NOT WIRED
			4			NOT WIRED
			5			NOT WIRED
			6			NOT WIRED
			7			NOT WIRED
			8			NOT WIRED
			9			NOT WIRED
RF	SIG	2S1	10	MET # 4 OUTPUT	8.2.10	PAYLOAD TIMING BUFFER
RF	RTN	2S1	11	MET # 3 OUTPUT RETURN		
RF	SIG	2S2	12	MET # 4 OUTPUT	8.2.10	PAYLOAD TIMING BUFFER
RF	RTN	2S2	13	MET # 3 OUTPUT RETURN		
RF	SIG	2S3	14	MET # 2 OUTPUT	8.2.10	PAYLOAD TIMING BUFFER
RF	RTN	2S3	15	MET # 2 OUTPUT RETURN		
RF	SIG	2S4	16	MET # 1 OUTPUT	8.2.10	PAYLOAD TIMING BUFFER
RF	RTN	2S4	17	MET # 1 OUTPUT RETURN		
RF	SIG	2S5	18	MET # 8 OUTPUT	8.2.10	PAYLOAD TIMING BUFFER
RF	RTN	2S5	19	GMT # 8 OUTPUT RETURN		
RF	SIG	2S6	20	GMT # 7 OUTPUT	8.2.10	PAYLOAD TIMING BUFFER
RF	RTN	2S6	21	GMT # 7 OUTPUT RETURN		
RF	SIG	2S7	22	GMT # 6 OUTPUT	8.2.10	PAYLOAD TIMING BUFFER
RF	RTN	2S7	23	GMT # 6 OUTPUT RETURN		
RF	SIG	2S8	24	GMT # 5 OUTPUT	8.2.10	PAYLOAD TIMING BUFFER
RF	RTN	2S8	25	GMT # 5 OUTPUT RETURN		
RF	SIG	2S9	26	GMT # 4 OUTPUT	8.2.10	PAYLOAD TIMING BUFFER
RF	RTN	2S9	27	GMT # 4 OUTPUT RETURN		
RF	SIG	2S10	28	GMT # 3 OUTPUT	8.2.10	PAYLOAD TIMING BUFFER
RF	RTN	2S10	29	GMT # 3 OUTPUT RETURN		
RF	SIG	2S11	30	GMT # 2 OUTPUT	8.2.10	PAYLOAD TIMING BUFFER
RF	RTN	2S11	31	GMT # 2 OUTPUT RETURN		
RF	SIG	2S12	32	GMT # 1 OUTPUT	8.2.10	PAYLOAD TIMING BUFFER
RF	RTN	2S12	33	GMT # 1 OUTPUT RETURN		
RF	SIG	2S13	34	MET INPUT	8.2.10	MASTER TIMING UNIT
RF	RTN	2S13	35	MET INPUT RETURN		
RF	SIG	2S14	36	GMT INPUT	8.2.10	MASTER TIMING UNIT
RF	RTN	2S14	37	GMT INPUT RETURN		

TABLE 13.5.2.2-7 PIN ASSIGNMENTS FOR NON-STANDARD PSDP CONNECTOR J1309 (RELATING TO SMCH)

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	MDM PF-1 FUNCTIONS AND SSP FUNCTIONS	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
HO	SIG	2T34	1			NOT WIRED
HO	SIG	2T34	2			NOT WIRED
HO	SIG	2T35	3			NOT WIRED
HO	SIG	2T35	4	S13	13.4.2	SSP # 2A
HO	SIG	2T35	5	S13	13.4.2	SSP # 2A
HO	SIG	2T35	6	S13	13.4.2	SSP # 2A
HO	SIG	2T35	7	S13	13.4.2	SSP # 2A
HO	SIG	2T36	8	SPARE		NOT WIRED
HO	SIG	2T36	9	S14	13.4.2	P1409 - 10
HO	SIG	2T31	10	S14	13.4.2	SSP # 2A
HO	SIG	2T31	11	S14	13.4.2	SSP # 2A
HO	SIG	2T32	12	S14	13.4.2	SSP # 2A
HO	SIG	2T32	13	S14	13.4.2	SSP # 2A
HO	SIG	2T33	14	S13	13.4.2	SSP # 2A
HO	SIG	2T33	15	S13	13.4.2	SSP # 2A
HO	RTN	2T36	16	SPARE		P1409 - 11
HO	SIG	2T37	17	S16	13.4.2	SSP # 2A
HO	RTN	2T37	18	28 VDC RETURN		
HO	SIG	2T38	19	S22	13.4.2	SSP # 2A
HO	SIG	2T38	20	S22	13.4.2	SSP # 2A
HO	SIG	2T1	21	S17	13.4.2	SSP # 2A
HO	SIG	2T1	22	S17	13.4.2	SSP # 2A
HO	SIG	2T2	23	S21	13.4.2	SSP # 2A
HO	SIG	2T2	24	S21	13.4.2	SSP # 2A
HO	SIG	2T3	25	S18	13.4.2	SSP # 2A
HO	SIG	2T3	26	S18	13.4.2	SSP # 2A
HO	SIG	2T4	27	S15	13.4.2	SSP # 2A
HO	SIG	2T4	28	S15	13.4.2	SSP # 2A
HO	SIG	2T5	29	S18	13.4.2	SSP # 2A
HO	SIG	2T5	30	S18	13.4.2	SSP # 2A
HO	SIG	2T6	31	28 VDC		
HO	SIG	2T7	32	S16	13.4.2	SSP # 2A
HO	SIG	2T7	33	S16	13.4.2	SSP # 2A
HO	SIG	2T23	34	S16	13.4.2	SSP # 2A
HO	SIG	2T23	35	S16	13.4.2	SSP # 2A
HO	SIG	2T24	36	S15	13.4.2	SSP # 2A
HO	SIG	2T24	37	S15	13.4.2	SSP # 2A
HO	SIG	2T25	38	S19	13.4.2	SSP # 2A
HO	RTN	2T6	39	28 VDC RETURN		
HO	SIG	2T26	40	S21	13.4.2	SSP # 2A
HO	SIG	2T26	41	S21	13.4.2	SSP # 2A
HO	SIG	2T27	42	S24	13.4.2	SSP # 2A
HO	SIG	2T27	43	S24	13.4.2	SSP # 2A
HO	SIG	2T28	44	S24	13.4.2	SSP # 2A
HO	SIG	2T28	45	S24	13.4.2	SSP # 2A

TABLE 13.5.2.2-7 PIN ASSIGNMENTS FOR NON-STANDARD PSDP CONNECTOR J1309 (RELATING TO SMCH)

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	MDM PF-1 FUNCTIONS AND SSP FUNCTIONS	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
HO	SIG	2T25	46	S19	13.4.2	SSP # 2A
HO	SIG	2T29	47	S23	13.4.2	SSP # 2A
HO	SIG	2T29	48	S23	13.4.2	SSP # 2A
HO	SIG	2T30	49	S20	13.4.2	SSP # 2A
HO	SIG	2T30	50	S20	13.4.2	SSP # 2A
			51			NOT WIRED
			52			NOT WIRED
			53			NOT WIRED
			54			NOT WIRED
			55			NOT WIRED

TABLE 13.5.2.2-8 PIN ASSIGNMENTS FOR NON-STANDARD PSDP CONNECTOR J1311 (RELATING TO SMCH)

EMC CLASS.	PIN FUNCT.	CABLE DESC.	PIN #	MDM PF - 1 FUNCTIONS AND SSP FUNCTIONS	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
			1			NOT WIRED
			2			NOT WIRED
			3			NOT WIRED
HO	SIG	2T10	4	S1	13.4.2	SSP # 2B
HO	SIG	2T10	5	S1	13.4.2	SSP # 2B
HO	SIG	2T11	6	S1	13.4.2	SSP # 2B
HO	SIG	2T11	7	S1	13.4.2	SSP # 2B
			8			NOT WIRED
HO	SIG	2T12	9	SPARE		P1411 - 10
HO	SIG	2T17	10	S2	13.4.2	SSP # 2B
HO	SIG	2T17	11	S2	13.4.2	SSP # 2B
HO	SIG	2T18	12	S2	13.4.2	SSP # 2B
HO	SIG	2T18	13	S2	13.4.2	SSP # 2B
HO	SIG	2T19	14	S1	13.4.2	SSP # 2B
HO	SIG	2T19	15	S1	13.4.2	SSP # 2B
HO	RTN	2T12	16	SPARE		P1411 - 11
HO	SIG	2T23	17	S4	13.4.2	SSP # 2B
HO	RTN	2T23	18	28 VDC RETURN		
HO	SIG	2T22	19	S10	13.4.2	SSP # 2B
HO	SIG	2T22	20	S10	13.4.2	SSP # 2B
HO	SIG	2T21	21	S5	13.4.2	SSP # 2B
HO	SIG	2T21	22	S5	13.4.2	SSP # 2B
HO	SIG	2T20	23	S9	13.4.2	SSP # 2B
HO	SIG	2T20	24	S9	13.4.2	SSP # 2B
HO	SIG	2T19	25	S6	13.4.2	SSP # 2B
HO	SIG	2T19	26	S6	13.4.2	SSP # 2B
HO	SIG	2T18	27	S3	13.4.2	SSP # 2B
HO	SIG	2T18	28	S3	13.4.2	SSP # 2B
HO	SIG	2T17	29	S6	13.4.2	SSP # 2B
HO	SIG	2T17	30	S6	13.4.2	SSP # 2B
HO	SIG	2T16	31	28 VDC		
HO	SIG	2T15	32	S4	13.4.2	SSP # 2B
HO	SIG	2T15	33	S4	13.4.2	SSP # 2B
HO	SIG	2T14	34	S4	13.4.2	SSP # 2B
HO	SIG	2T14	35	S4	13.4.2	SSP # 2B
HO	SIG	2T13	36	S3	13.4.2	SSP # 2B
HO	SIG	2T13	37	S3	13.4.2	SSP # 2B
HO	SIG	2T11	38	S7	13.4.2	SSP # 2B
HO	RTN	2T16	39	28 VDC RETURN		
HO	SIG	2T2	40	S9	13.4.2	SSP # 2B
HO	SIG	2T2	41	S9	13.4.2	SSP # 2B
HO	SIG	2T3	42	S12	13.4.2	SSP # 2B
HO	SIG	2T3	43	S12	13.4.2	SSP # 2B
HO	SIG	2T4	44	S12	13.4.2	SSP # 2B
HO	SIG	2T4	45	S12	13.4.2	SSP # 2B



TABLE 13.5.2.2-8 PIN ASSIGNMENTS FOR NON-STANDARD PSDP CONNECTOR J1311 (RELATING TO SMCH)

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	MDM PF-1 FUNCTIONS AND SSP FUNCTIONS	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
HO	SIG	2T1	46	S7	13.4.2	SSP # 2B
HO	SIG	2T5	47	S11	13.4.2	SSP # 2B
HO	SIG	2T5	48	S11	13.4.2	SSP # 2B
HO	SIG	2T6	49	S8	13.4.2	SSP # 2B
HO	SIG	2T6	50	S8	13.4.2	SSP # 2B
			51			NOT WIRED
			52			NOT WIRED
			53			NOT WIRED
			54			NOT WIRED
			55			NOT WIRED

TABLE 13.5.2.2-9 PIN ASSIGNMENTS FOR NON-STANDARD PSDP CONNECTOR J1313 (RELATING TO SMCH)

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	MDM PF-1 FUNCTIONS AND SSP FUNCTIONS	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
			1			NOT WIRED
			2			NOT WIRED
			3			NOT WIRED
HO	SIG	2T1	4	S1	13.4.2	SSP # 1B
HO	SIG	2T1	5	S1	13.4.2	SSP # 1B
HO	SIG	2T24	6	S1	13.4.2	SSP # 1B
HO	SIG	2T24	7	S1	13.4.2	SSP # 1B
			8			NOT WIRED
			9			NOT WIRED
HO	SIG	2T4	10	S2	13.4.2	SSP # 1B
HO	SIG	2T4	11	S2	13.4.2	SSP # 1B
HO	SIG	2T3	12	S2	13.4.2	SSP # 1B
HO	SIG	2T3	13	S2	13.4.2	SSP # 1B
HO	SIG	2T2	14	S1	13.4.2	SSP # 1B
HO	SIG	2T2	15	S1	13.4.2	SSP # 1B
			16			NOT WIRED
HO	SIG	2T21	17	S4	13.4.2	SSP # 1B
HO	RTN	2T21	18	28 VDC RETURN		
HO	SIG	2T20	19	S10	13.4.2	SSP # 1B
HO	SIG	2T20	20	S10	13.4.2	SSP # 1B
HO	SIG	2T19	21	S5	13.4.2	SSP # 1B
HO	SIG	2T19	22	S5	13.4.2	SSP # 1B
HO	SIG	2T18	23	S9	13.4.2	SSP # 1B
HO	SIG	2T18	24	S9	13.4.2	SSP # 1B
HO	SIG	2T17	25	S6	13.4.2	SSP # 1B
HO	SIG	2T17	26	S6	13.4.2	SSP # 1B
HO	SIG	2T16	27	S3	13.4.2	SSP # 1B
HO	SIG	2T16	28	S3	13.4.2	SSP # 1B
HO	SIG	2T15	29	S6	13.4.2	SSP # 1B
HO	SIG	2T15	30	S6	13.4.2	SSP # 1B
HO	SIG	2T14	31	28 VDC	13.4.2	SSP # 1B
HO	SIG	2T13	32	S4	13.4.2	SSP # 1B
HO	SIG	2T13	33	S4	13.4.2	SSP # 1B
HO	SIG	2T12	34	S4	13.4.2	SSP # 1B
HO	SIG	2T12	35	S4	13.4.2	SSP # 1B
HO	SIG	2T11	36	S3	13.4.2	SSP # 1B
HO	SIG	2T11	37	S3	13.4.2	SSP # 1B
HO	SIG	2T10	38	S7	13.4.2	SSP # 1B
HO	RTN	2T14	39	28 VDC RETURN		
HO	SIG	2T9	40	S9	13.4.2	SSP # 1B
HO	SIG	2T9	41	S9	13.4.2	SSP # 1B
HO	SIG	2T8	42	S12	13.4.2	SSP # 1B
HO	SIG	2T8	43	S12	13.4.2	SSP # 1B
HO	SIG	2T7	44	S12	13.4.2	SSP # 1B
HO	SIG	2T7	45	S12	13.4.2	SSP # 1B

TABLE 13.5.2.2-9 PIN ASSIGNMENTS FOR NON-STANDARD PSDP CONNECTOR J1313 (RELATING TO SMCH)

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	MDM PF-1 FUNCTIONS AND SSP FUNCTIONS	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
HO	SIG	2T10	46	S7	13.4.2	SSP # 1B
HO	SIG	2T6	47	S11	13.4.2	SSP # 1B
HO	SIG	2T6	48	S11	13.4.2	SSP # 1B
HO	SIG	2T5	49	S8	13.4.2	SSP # 1B
HO	SIG	2T5	50	S8	13.4.2	SSP # 1B
			51			NOT WIRED
			52			NOT WIRED
			53			NOT WIRED
			54			NOT WIRED
			55			NOT WIRED

TABLE 13.5.2.2-10 PIN ASSIGNMENTS FOR NON-STANDARD PSDP CONNECTOR J1315 (RELATING TO SMCH)

EMC CLASS.	PIN FUNCT.	CABLE DESC.	PIN #	MDM PF-1 FUNCTIONS AND SSP FUNCTIONS	REFERENCE PARAGRAPH	ORBITTER COMPONENT INTERFACE AND/OR NOTES
			1			NOT WIRED
			2			NOT WIRED
			3			NOT WIRED
HO	SIG	2T23	4	S13	13.4.2	SSP # 1A
HO	SIG	2T23	5	S13	13.4.2	SSP # 1A
HO	SIG	2T22	6	S13	13.4.2	SSP # 1A
HO	SIG	2T22	7	S13	13.4.2	SSP # 1A
			8			NOT WIRED
			9			NOT WIRED
HO	SIG	2T26	10	S14	13.4.2	SSP # 1A
HO	SIG	2T26	11	S14	13.4.2	SSP # 1A
HO	SIG	2T25	12	S14	13.4.2	SSP # 1A
HO	SIG	2T25	13	S14	13.4.2	SSP # 1A
HO	SIG	2T24	14	S13	13.4.2	SSP # 1A
HO	SIG	2T24	15	S13	13.4.2	SSP # 1A
			16			NOT WIRED
HO	SIG	2T43	17	S16	13.4.2	SSP # 1A
HO	RTN	2T43	18	28 VDC RETURN		
HO	SIG	2T42	19	S22	13.4.2	SSP # 1A
HO	SIG	2T42	20	S22	13.4.2	SSP # 1A
HO	SIG	2T41	21	S17	13.4.2	SSP # 1A
HO	SIG	2T41	22	S17	13.4.2	SSP # 1A
HO	SIG	2T40	23	S21	13.4.2	SSP # 1A
HO	SIG	2T40	24	S21	13.4.2	SSP # 1A
HO	SIG	2T39	25	S18	13.4.2	SSP # 1A
HO	SIG	2T39	26	S18	13.4.2	SSP # 1A
HO	SIG	2T38	27	S15	13.4.2	SSP # 1A
HO	SIG	2T38	28	S15	13.4.2	SSP # 1A
HO	SIG	2T37	29	S18	13.4.2	SSP # 1A
HO	SIG	2T37	30	S18	13.4.2	SSP # 1A
HO	SIG	2T36	31	28 VDC		
HO	SIG	2T35	32	S16	13.4.2	SSP # 1A
HO	SIG	2T35	33	S16	13.4.2	SSP # 1A
HO	SIG	2T34	34	S16	13.4.2	SSP # 1A
HO	SIG	2T34	35	S16	13.4.2	SSP # 1A
HO	SIG	2T33	36	S15	13.4.2	SSP # 1A
HO	SIG	2T33	37	S15	13.4.2	SSP # 1A
HO	SIG	2T32	38	S19	13.4.2	SSP # 1A
			39	28 VDC RETURN		
HO	RTN	2T36	40	S21	13.4.2	SSP # 1A
HO	SIG	2T31	41	S21	13.4.2	SSP # 1A
HO	SIG	2T30	42	S24	13.4.2	SSP # 1A
HO	SIG	2T30	43	S24	13.4.2	SSP # 1A
HO	SIG	2T29	44	S24	13.4.2	SSP # 1A
HO	SIG	2T29	45	S24	13.4.2	SSP # 1A

TABLE 13.5.2.2-10 PIN ASSIGNMENTS FOR NON-STANDARD PSDP CONNECTOR J1315 (RELATING TO SMCH)

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	MDM PF-1 FUNCTIONS AND SSP FUNCTIONS	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
HO	SIG	2T32	46	S19	13.4.2	SSP # 1A
HO	SIG	2T28	47	S23	13.4.2	SSP # 1A
HO	SIG	2T28	48	S23	13.4.2	SSP # 1A
HO	SIG	2T27	49	S20	13.4.2	SSP # 1A
HO	SIG	2T27	50	S20	13.4.2	SSP # 1A
			51			NOT WIRED
			52			NOT WIRED
			53			NOT WIRED
			54			NOT WIRED
			55			NOT WIRED

TABLE 13.5.2.2-11 PIN ASSIGNMENTS FOR NON-STANDARD PSDP CONNECTOR J1325 (RELATING TO SMCH)

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	MDM PF-1 FUNCTIONS AND SSP FUNCTIONS	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
			1			NOT WIRED
			2			NOT WIRED
			3			NOT WIRED
			4			NOT WIRED
			5			NOT WIRED
			6			NOT WIRED
			7			NOT WIRED
			8			NOT WIRED
			9			NOT WIRED
			10			NOT WIRED
ML	SHD	2S9	11			TERMINATE
ML	SIG	2S9	12		13.4.2	TERMINATE
ML	RTN	2S9	13	DS4 RETURN		SSP # 2B
ML	SIG	2S6	14	DS7		SSP # 2B
ML	RTN	2S6	15	DS7 RETURN	13.4.2	TERMINATE
ML	SHD	2S6	16			TERMINATE
ML	SHD	2S3	17			TERMINATE
ML	SHD	2S13	18			TERMINATE
ML	SIG	2S13	19	DS1	13.4.2	SSP # 2B
ML	SIG	2S13	20	DS2 RETURN	13.4.2	SSP # 2B
ML	RTN	2S11	21	DS2		SSP # 2B
ML	SIG	2S11	22		13.4.2	TERMINATE
ML	SHD	2S11	23	DS10		SSP # 2B
ML	SIG	2S3	24	DS10 RETURN	13.4.2	TERMINATE
ML	RTN	2S3	25			SSP # 2B
ML	SHD	2S1	26			TERMINATE
ML	SIG	2S1	27	DS12 RETURN	13.4.2	SSP # 2B
ML	RTN	2S1	28	DS1		SSP # 2B
ML	SIG	2S12	29	DS1 RETURN	13.4.2	TERMINATE
ML	RTN	2S12	30			TERMINATE
ML	SHD	2S4	31			TERMINATE
ML	SHD	2S5	32			TERMINATE
ML	SIG	2S5	33	DS8 RETURN	13.4.2	TERMINATE
ML	RTN	2S5	34	DS8 RETURN		SSP # 2B
ML	SIG	2S5	35	DS3	13.4.2	SSP # 2B
ML	SIG	2S10	36	DS3 RETURN		SSP # 2B
ML	RTN	2S10	37		13.4.2	TERMINATE
ML	SHD	2S10	38			SSP # 2B
ML	SIG	2S4	39	DS9 RETURN	13.4.2	TERMINATE
ML	RTN	2S4	40	DS9 RETURN		SSP # 2B
ML	SHD	2S7	41			TERMINATE
ML	SIG	2S7	42	DS6 RETURN	13.4.2	SSP # 2B
ML	RTN	2S7	43	DS5		SSP # 2B
ML	SIG	2S8	44	DS5 RETURN	13.4.2	TERMINATE
ML	RTN	2S8	45			TERMINATE

TABLE 13.5.2.2-11 PIN ASSIGNMENTS FOR NON-STANDARD PSDP CONNECTOR J1325 (RELATING TO SMCH)

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	MDM PF-1 FUNCTIONS AND SSP FUNCTIONS	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
ML	SHD	2S2	46			TERMINATE
			47			NOT WIRED
			48			NOT WIRED
			49			NOT WIRED
			50			NOT WIRED
ML	STG	2S2	51	DS11	13.4.2	NOT WIRED
ML	RTN	2S2	52	DS11 RETURN		SSP # 2B
			53			NOT WIRED
			54			NOT WIRED
			55			NOT WIRED

TABLE 13.5.2.2-12 PIN ASSIGNMENTS FOR NON-STANDARD PSDP CONNECTOR J1327 (RELATING TO SMCH)

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	MDM PF-1 FUNCTIONS AND SSP FUNCTIONS	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
			1			NOT WIRED
			2			NOT WIRED
			3			NOT WIRED
			4			NOT WIRED
			5			NOT WIRED
			6			NOT WIRED
			7			NOT WIRED
			8			NOT WIRED
			9			NOT WIRED
ML	SHD	255	10			TERMINATE
ML	SIG	255	11		13.4.2	SSP # 2A
ML	RTN	255	12	DS16 RETURN		SSP # 2A
ML	SIG	258	13	DS16	13.4.2	TERMINATE
ML	RTN	258	14	DS19 RETURN		TERMINATE
ML	SHD	258	15			SIG # 2A
ML	SHD	2511	16			SIG # 2A
ML	SHD	252	17			TERMINATE
ML	SIG	252	18	DS13	13.4.2	TERMINATE
ML	SIG	252	19	DS14	13.4.2	SIG # 2A
ML	RTN	253	20	DS14 RETURN		SIG # 2A
ML	SIG	253	21	DS14	13.4.2	SIG # 2A
ML	SHD	253	22			TERMINATE
ML	SIG	2511	23	DS22	13.4.2	SIG # 2A
ML	RTN	2511	24	DS22 RETURN		SIG # 2A
ML	SHD	2513	25			TERMINATE
ML	SIG	2513	26	DS24	13.4.2	SIG # 2A
ML	RTN	2513	27	DS24 RETURN		SIG # 2A
ML	SIG	251	28	DS13	13.4.2	SIG # 2A
ML	RTN	251	29	DS13 RETURN		SIG # 2A
ML	SHD	251	30			TERMINATE
ML	SHD	2510	31			TERMINATE
ML	SHD	259	32			TERMINATE
ML	SIG	259	33			TERMINATE
ML	RTN	259	34	DS20 RETURN	13.4.2	SIG # 2A
ML	SIG	254	35	DS15	13.4.2	SIG # 2A
ML	RTN	254	36	DS15 RETURN		SIG # 2A
ML	SHD	254	37			TERMINATE
ML	SIG	2510	38	DS21	13.4.2	SIG # 2A
ML	RTN	2510	39	DS21 RETURN		SIG # 2A
ML	SHD	257	40			TERMINATE
ML	SIG	257	41	DS18	13.4.2	SIG # 2A
ML	RTN	257	42	DS18 RETURN		SIG # 2A
ML	SIG	256	43	DS17	13.4.2	SIG # 2A
ML	RTN	256	44	DS17 RETURN		SIG # 2A
ML	SHD	256	45			TERMINATE



TABLE 13.5.2.2-12 PIN ASSIGNMENTS FOR NON-STANDARD PSDP CONNECTOR J1327 (RELATING TO SMCH)

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	MDM PF-1 FUNCTIONS AND SSP FUNCTIONS	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
ML	SHD	2S12	46			TERMINATE
			47			NOT WIRED
			48			NOT WIRED
			49			NOT WIRED
ML	SIG RTN	2S12	50	DS23 RETURN	13.4.2	NOT WIRED
ML		2S12	51			NOT WIRED
			52			NOT WIRED
			53			NOT WIRED
			54			NOT WIRED
			55			NOT WIRED

TABLE 13.5.2.2-13 PIN ASSIGNMENTS FOR NON-STANDARD PSDP CONNECTOR J1329 (RELATING TO SMCH)

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	MDM PF-1 FUNCTIONS AND SSP FUNCTIONS	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
			1			NOT WIRED
			2			NOT WIRED
			3			NOT WIRED
			4			NOT WIRED
			5			NOT WIRED
			6			NOT WIRED
			7			NOT WIRED
			8			NOT WIRED
			9			NOT WIRED
ML	SHD	255	10			TERMINATE
ML	SIG	255	11		13.4.2	SSP # 1B
ML	RTN	255	12	DS4 RETURN		
ML	SIG	258	13	DS7	13.4.2	SSP # 1B
ML	RTN	258	14	DS7 RETURN		
ML	SHD	258	15			TERMINATE
ML	SHD	2513	16			TERMINATE
ML	SHD	252	17			TERMINATE
ML	SIG	252	18	DS1	13.4.2	SSP # 1B
ML	SIG	252	19	DS2	13.4.2	SSP # 1B
ML	RTN	253	20	DS2 RETURN		
ML	SIG	253	21	DS2	13.4.2	SSP # 1B
ML	SHD	253	22			TERMINATE
ML	SIG	2513	23	DS10	13.4.2	SSP # 1B
ML	RTN	2513	24	DS10 RETURN		
ML	SHD	2510	25			TERMINATE
ML	SIG	2510	26	DS12	13.4.2	SSP # 1B
ML	RTN	2510	27	DS12 RETURN		
ML	SIG	251	28	DS1	13.4.2	SSP # 1B
ML	RTN	251	29	DS1 RETURN		
ML	SHD	251	30			TERMINATE
ML	SHD	2512	31			TERMINATE
ML	SHD	259	32			TERMINATE
ML	SIG	259	33			TERMINATE
ML	RTN	259	34	DS8 RETURN	13.4.2	SSP # 1B
ML	SIG	254	35	DS3	13.4.2	SSP # 1B
ML	RTN	254	36	DS3 RETURN		
ML	SHD	254	37			TERMINATE
ML	SIG	2512	38	DS9	13.4.2	SSP # 1B
ML	RTN	2512	39	DS9 RETURN		
ML	SHD	257	40			TERMINATE
ML	SIG	257	41	DS6	13.4.2	SSP # 1B
ML	RTN	257	42	DS6 RETURN		
ML	SIG	256	43	DS5	13.4.2	SSP # 1B
ML	RTN	256	44	DS5 RETURN		
ML	SHD	256	45			TERMINATE

TABLE 13.5.2.2-13 PIN ASSIGNMENTS FOR NON-STANDARD PSDP CONNECTOR J1329 (RELATING TO SMCH)

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	MDM PF-1 FUNCTIONS AND SSP FUNCTIONS	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
ML	SHD	2S11	46			TERMINATE
			47			NOT WIRED
			48			NOT WIRED
ML ML	SIG RTN	2S11 2S11	49			NOT WIRED
			50			NOT WIRED
			51	DS11	13.4.2	NOT WIRED
			52	DS11 RETURN		SSP # 1B
			53			NOT WIRED
			54			NOT WIRED
			55			NOT WIRED

TABLE 13.5.2.2-14 PIN ASSIGNMENTS FOR NON-STANDARD PSDP CONNECTOR J1331 (RELATING TO SMCH)

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	MDM PF-1 FUNCTIONS AND SSP FUNCTIONS	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
			1			NOT WIRED
			2			NOT WIRED
			3			NOT WIRED
			4			NOT WIRED
			5			NOT WIRED
			6			NOT WIRED
			7			NOT WIRED
			8			NOT WIRED
			9			NOT WIRED
			10			TERMINATE
ML	SHD	2S11	11	DS16	13.4.2	SSP # 1A
ML	SIG	2S11	12	DS16 RETURN	13.4.2	SSP # 1A
ML	RTN	2S11	13	DS19		TERMINATE
ML	SIG	2S12	14	DS19 RETURN		TERMINATE
ML	RTN	2S12	15			SSP # 1A
ML	SHD	2S5	16			SSP # 1A
ML	SHD	2S3	17			TERMINATE
ML	SIG	2S3	18	DS13		TERMINATE
ML	SIG	2S3	19	DS14	13.4.2	SSP # 1A
ML	RTN	2S4	20	DS14 RETURN	13.4.2	SSP # 1A
ML	SIG	2S4	21	DS14		SSP # 1A
ML	SHD	2S4	22			SSP # 1A
ML	SIG	2S5	23	DS22	13.4.2	SSP # 1A
ML	RTN	2S5	24	DS22 RETURN		TERMINATE
ML	SHD	2S1	25		13.4.2	SSP # 1A
ML	SIG	2S1	26	DS24		SSP # 1A
ML	RTN	2S1	27	DS24 RETURN	13.4.2	TERMINATE
ML	SIG	2S2	28	DS13		SSP # 1A
ML	RTN	2S2	29	DS13 RETURN		TERMINATE
ML	SHD	2S2	30			TERMINATE
ML	SHD	2S6	31			SSP # 1A
ML	SHD	2S7	32			TERMINATE
ML	SIG	2S7	33	DS20	13.4.2	TERMINATE
ML	RTN	2S7	34	DS20 RETURN	13.4.2	SSP # 1A
ML	SIG	2S8	35	DS15		SSP # 1A
ML	RTN	2S8	36	DS15 RETURN		TERMINATE
ML	SHD	2S8	37		13.4.2	SSP # 1A
ML	SIG	2S6	38	DS21		TERMINATE
ML	RTN	2S6	39	DS21 RETURN		SSP # 1A
ML	SHD	2S9	40			TERMINATE
ML	SIG	2S9	41	DS18	13.4.2	SSP # 1A
ML	RTN	2S9	42	DS18 RETURN		SSP # 1A
ML	SIG	2S10	43	DS17	13.4.2	SSP # 1A
ML	RTN	2S10	44	DS17 RETURN		TERMINATE
ML	SHD	2S10	45			TERMINATE

TABLE 13.5.2.2-14 PIN ASSIGNMENTS FOR NON-STANDARD PSDP CONNECTOR J1331 (RELATING TO SMCH)

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	MDM PF-1 FUNCTIONS AND SSP FUNCTIONS	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
ML	SHD	2S13	46			TERMINATE
			47			NOT WIRED
			48			NOT WIRED
			49			NOT WIRED
ML	SIG	2S13	50	DS23		NOT WIRED
ML	RTN	2S13	51	DS23 RETURN	13.4.2	SSP # 1A
			52			NOT WIRED
			53			NOT WIRED
			54			NOT WIRED
			55			NOT WIRED

TABLE 13.5.2.2-15 PIN ASSIGNMENTS FOR NON-STANDARD PSDP CONNECTOR J1351 (RELATING TO SMCH)

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
ML	SIG	2S1	1	GAS CAN INPUT	13.3.1.4	SSP 1 or 2 (J13)
ML	RTN	2S1	2	GAS CAN INPUT RETURN		TERMINATE
ML	SHD	2S1	3			NOT WIRED
			4			NOT WIRED
			5			NOT WIRED
			6			NOT WIRED
			7			NOT WIRED
			8			NOT WIRED
			9			NOT WIRED
			10			NOT WIRED
			11			NOT WIRED
			12			NOT WIRED
			13			NOT WIRED

TABLE 13.5.2.2-16 PIN ASSIGNMENTS FOR NON-STANDARD PSDP CONNECTOR J1391 (RELATING TO SMCH)

EMC CLASS.	PIN FUNCT.	CABLE DESC.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
			1			
			2			NOT WIRED
			3			NOT WIRED
RF	SIG	2S18	4	GMT 1	8.2.10	PAYLOAD TIMING BUFFER
RF	RTN	2S18	5	GMT 1 RETURN		
RF	SIG	2S19	6	GMT 2	8.2.10	PAYLOAD TIMING BUFFER
RF	RTN	2S19	7	GMT 2 RETURN		
RF	SIG	2S20	8	MET 1	8.2.10	PAYLOAD TIMING BUFFER
RF	RTN	2S20	9	MET 1 RETURN		
RF	SIG	2S1	10	GMT 1 (BUS CONNECTED)	8.2.10	PAYLOAD TIMING BUFFER (BUS P1)
RF	RTN	2S1	11	GMT 1 RETURN		
RF	SIG	2S2	12	GMT 2 (BUS CONNECTED)	8.2.10	PAYLOAD TIMING BUFFER (BUS P1)
RF	RTN	2S2	13	GMT 2 RETURN		
RF	SIG	2S3	14	MET 1 (BUS CONNECTED)	8.2.10	PAYLOAD TIMING BUFFER (BUS P1)
RF	RTN	2S3	15	MET 1 RETURN		
			16			NOT WIRED
			17			NOT WIRED
RF	SIG	2S4	18	16 KHZ OUTPUT # 1 (BUS CONNECTED)	8.2.5	PAYLOAD SIGNAL PROCESSOR # 1 (BUS P1)
RF	RTN	2S4	19	16 KHZ OUTPUT # 1 RETURN		
RF	SIG	2S5	20	16 KHZ OUTPUT # 1 (BUS CONNECTED)	8.2.5	PAYLOAD SIGNAL PROCESSOR # 2 (BUS P1)
RF	RTN	2S5	21	16 KHZ OUTPUT # 1 RETURN		
RF	SIG	2S6	22	TRACK 9 ANALOG (BUS CONNECTED)	8.2.3	PAYLOAD RECORDER (BUS P1)
RF	RTN	2S6	23	TRACK 9 ANALOG RETURN		
			24			NOT WIRED
			25			NOT WIRED
RF	SIG	2S14	26	16 KHZ OUTPUT # 1	8.2.5	PAYLOAD SIGNAL PROCESSOR # 1
RF	RTN	2S14	27	16 KHZ OUTPUT # 1 RETURN		
RF	SIG	2S11	28	16 KHZ OUTPUT # 1	8.2.5	PAYLOAD SIGNAL PROCESSOR # 2
RF	RTN	2S11	29	16 KHZ OUTPUT # 1 RETURN		
RF	SIG	2S17	30	TRACK 9 ANALOG	8.2.3	PAYLOAD RECORDER
RF	RTN	2S17	31	TRACK 9 ANALOG RETURN		
RF	SIG	2S15	32	TRACK 1 DIGITAL	8.2.3	PAYLOAD RECORDER
RF	RTN	2S15	33	TRACK 1 DIGITAL RETURN		
RF	SIG	2S16	34	TRACK 2 DIGITAL	8.2.3	PAYLOAD RECORDER
RF	RTN	2S16	35	TRACK 2 DIGITAL RETURN		
RF	SIG	2S12	36	TELEMETRY PORT 1	8.2.1	PAYLOAD DATA INTERLEAVER
RF	RTN	2S12	37	TELEMETRY PORT 1 RETURN		
			38			NOT WIRED
			39			NOT WIRED
RF	SIG	2S7	40	TRACK 1 DIGITAL (BUS CONNECTED)	8.2.3	PAYLOAD RECORDER (BUS P1)
RF	RTN	2S7	41	TRACK 1 DIGITAL RETURN		
RF	SIG	2S8	42	TRACK 2 DIGITAL (BUS CONNECTED)	8.2.3	PAYLOAD RECORDER (BUS P1)
RF	RTN	2S8	43	TRACK 2 DIGITAL RETURN		
RF	SIG	2S9	44	TELEMETRY PORT 1 (BUS CONNECTED)	8.2.1	PAYLOAD DATA INTERLEAVER (BUS P1)
RF	RTN	2S9	45	TELEMETRY PORT 1 RETURN		

TABLE 13.5.2.2-16 PIN ASSIGNMENTS FOR NON-STANDARD PSDP CONNECTOR J1391 (RELATING TO SMCH)

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES	
RF	SIG	2S13	46	TELEMETRY CLOCK 1 TELEMETRY CLOCK 1 RETURN	8.2.1	NOT WIRED	
RF	RTN	2S13	47			NOT WIRED	
			48			PAYLOAD DATA INTERLEAVER	
			49				
			50				
			51			NOT WIRED	
			52			NOT WIRED	
RF	SIG	2S10	53	TELEMETRY CLOCK 1 (BUS CONNECTED)	8.2.1	PAYLOAD DATA INTERLEAVER (BUS P1)	
RF	RTN	2S10	54	TELEMETRY CLOCK 1 RETURN			
			55				NOT WIRED



TABLE 13.5.2.2-17 PIN ASSIGNMENTS FOR NON-STANDARD PSDP CONNECTOR J1393 (RELATING TO SMCH)

EMC CLASS.	PIN FUNCT.	CABLE DESC.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
			1			NOT WIRED
			2			NOT WIRED
RF	SIG	2S18	3	GMT 3	8.2.10	PAYLOAD TIMING BUFFER
RF	RTN	2S18	4	GMT 3 RETURN		
RF	SIG	2S19	5	GMT 4	8.2.10	PAYLOAD TIMING BUFFER
RF	RTN	2S19	6	GMT 4 RETURN		
RF	SIG	2S20	7	MET 2	8.2.10	PAYLOAD TIMING BUFFER
RF	RTN	2S20	8	MET 2 RETURN		
RF	SIG	2S21	9	GMT 3 (BUS CONNECTED)	8.2.10	PAYLOAD TIMING BUFFER (BUS P1)
RF	RTN	2S21	10	GMT 3 RETURN		
RF	SIG	2S22	11	GMT 4 (BUS CONNECTED)	8.2.10	PAYLOAD TIMING BUFFER (BUS P1)
RF	RTN	2S22	12	GMT 4 RETURN		
RF	SIG	2S23	13	GMT 2 (BUS CONNECTED)	8.2.10	PAYLOAD TIMING BUFFER (BUS P1)
RF	RTN	2S23	14	GMT 2 RETURN		
RF	SIG	2S3	15			NOT WIRED
RF	RTN	2S3	16			NOT WIRED
RF	SIG	2S4	17	16 KHZ OUTPUT # 2 (BUS CONNECTED)	8.2.5	PAYLOAD SIGNAL PROCESSOR # 1 (BUS P1)
RF	RTN	2S4	18	16 KHZ OUTPUT # 2 RETURN		
RF	SIG	2S5	19	16 KHZ OUTPUT # 2 (BUS CONNECTED)	8.2.5	PAYLOAD SIGNAL PROCESSOR # 2 (BUS P1)
RF	RTN	2S5	20	16 KHZ OUTPUT # 2 RETURN		
RF	SIG	2S6	21	TRACK 10 ANALOG (BUS CONNECTED)	8.2.3	PAYLOAD RECORDER (BUS P1)
RF	RTN	2S6	22	TRACK 10 ANALOG RETURN		
RF	SIG	2S14	23			NOT WIRED
RF	RTN	2S14	24			NOT WIRED
RF	SIG	2S14	25	16 KHZ OUTPUT # 2	8.2.5	PAYLOAD SIGNAL PROCESSOR # 1
RF	RTN	2S14	26	16 KHZ OUTPUT # 2 RETURN		
RF	SIG	2S13	27	16 KHZ OUTPUT # 2	8.2.5	PAYLOAD SIGNAL PROCESSOR # 2
RF	RTN	2S13	28	16 KHZ OUTPUT # 2 RETURN		
RF	SIG	2S17	29	TRACK 10 ANALOG	8.2.3	PAYLOAD RECORDER
RF	RTN	2S17	30	TRACK 10 ANALOG RETURN		
RF	SIG	2S15	31	TRACK 3 DIGITAL	8.2.3	PAYLOAD RECORDER
RF	RTN	2S15	32	TRACK 3 DIGITAL RETURN		
RF	SIG	2S16	33	TRACK 4 DIGITAL	8.2.3	PAYLOAD RECORDER
RF	RTN	2S16	34	TRACK 4 DIGITAL RETURN		
RF	SIG	2S16	35	TRACK 4 DIGITAL RETURN	8.2.1	PAYLOAD DATA INTERLEAVER
RF	RTN	2S11	36	TELEMETRY PORT 2		
RF	SIG	2S11	37	TELEMETRY PORT 2 RETURN		
RF	RTN	2S11	38			NOT WIRED
RF	SIG	2S10	39	TRACK 3 DIGITAL (BUS CONNECTED)	8.2.3	PAYLOAD RECORDER (BUS P1)
RF	RTN	2S10	40	TRACK 3 DIGITAL RETURN		
RF	SIG	2S7	41	TRACK 4 DIGITAL (BUS CONNECTED)	8.2.3	PAYLOAD RECORDER (BUS P1)
RF	RTN	2S7	42	TRACK 4 DIGITAL RETURN		
RF	SIG	2S8	43	TELEMETRY PORT 2 (BUS CONNECTED)	8.2.1	PAYLOAD DATA INTERLEAVER (BUS P1)
RF	RTN	2S8	44	TELEMETRY PORT 2 RETURN		
RF	SIG	2S8	45	TELEMETRY PORT 2 RETURN		
RF	RTN	2S8	45			

TABLE 13.5.2.2-17 PIN ASSIGNMENTS FOR NON-STANDARD PSDP CONNECTOR J1393 (RELATING TO SMCH)

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
			46			NOT WIRED
			47			NOT WIRED
RF	SIG	2S12	48	TELEMETRY CLOCK 2	8.2.1	PAYLOAD DATA INTERLEAVER
RF	RTN	2S12	49	TELEMETRY CLOCK 2 RETURN		
			50			NOT WIRED
			51			NOT WIRED
RF	SIG	2S9	53	TELEMETRY CLOCK 2 (BUS CONNECTED)	8.2.1	PAYLOAD DATA INTERLEAVER (BUS P1)
RF	RTN	2S9	54	TELEMETRY CLOCK 2 RETURN		
			55			NOT WIRED

TABLE 13.5.2.2-18 PIN ASSIGNMENTS FOR NON-STANDARD PSDP CONNECTOR J1395 (RELATING TO SMCH)

EMC CLASS.	PIN FUNCT.	CABLE DESC.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
			1			NOT WIRED
			2			NOT WIRED
			3			NOT WIRED
RF	SIG	2520	4	GMT 5	8.2.10	PAYLOAD TIMING BUFFER
RF	RTN	2520	5	GMT 5 RETURN		
RF	SIG	2519	6	GMT 6	8.2.10	PAYLOAD TIMING BUFFER
RF	RTN	2519	7	GMT 6 RETURN		
RF	SIG	2518	8	MET 3	8.2.10	PAYLOAD TIMING BUFFER
RF	RTN	2518	9	MET 3 RETURN		
RF	SIG	258	10	GMT 5 (BUS CONNECTED)	8.2.10	PAYLOAD TIMING BUFFER (BUS P1)
RF	RTN	258	11	GMT 5 RETURN		
RF	SIG	259	12	GMT 6 (BUS CONNECTED)	8.2.10	PAYLOAD TIMING BUFFER (BUS P1)
RF	RTN	259	13	GMT 6 RETURN		
RF	SIG	2510	14	MET 3 (BUS CONNECTED)	8.2.10	PAYLOAD TIMING BUFFER (BUS P1)
RF	RTN	2510	15	MET 3 RETURN		
			16			NOT WIRED
			17			NOT WIRED
RF	SIG	253	18	16 KHZ OUTPUT # 3 (BUS CONNECTED)	8.2.5	PAYLOAD SIGNAL PROCESSOR # 1 (BUS P1)
RF	RTN	253	19	16 KHZ OUTPUT # 3 RETURN		
RF	SIG	254	20	16 KHZ OUTPUT # 3 (BUS CONNECTED)	8.2.5	PAYLOAD SIGNAL PROCESSOR # 2 (BUS P1)
RF	RTN	254	21	16 KHZ OUTPUT # 3 RETURN		
RF	SIG	251	22	TRACK 11 ANALOG (BUS CONNECTED)	8.2.3	PAYLOAD RECORDER (BUS P1)
RF	RTN	251	23	TRACK 11 ANALOG RETURN		
			24			NOT WIRED
			25			NOT WIRED
RF	SIG	2516	26	16 KHZ OUTPUT # 3	8.2.5	PAYLOAD SIGNAL PROCESSOR # 1
RF	RTN	2516	27	16 KHZ OUTPUT # 3 RETURN		
RF	SIG	2513	28	16 KHZ OUTPUT # 3	8.2.5	PAYLOAD SIGNAL PROCESSOR # 2
RF	RTN	2513	29	16 KHZ OUTPUT # 3 RETURN		
RF	SIG	2517	30	TRACK 11 ANALOG	8.2.3	PAYLOAD RECORDER
RF	RTN	2517	31	TRACK 11 ANALOG RETURN		
RF	SIG	2514	32	TRACK 5 DIGITAL	8.2.3	PAYLOAD RECORDER
RF	RTN	2514	33	TRACK 5 DIGITAL RETURN		
RF	SIG	2515	34	TRACK 6 DIGITAL	8.2.3	PAYLOAD RECORDER
RF	RTN	2515	35	TRACK 6 DIGITAL RETURN		
RF	SIG	2511	36	TELEMETRY PORT 3	8.2.1	PAYLOAD DATA INTERLEAVER
RF	RTN	2511	37	TELEMETRY PORT 3 RETURN		
			38			NOT WIRED
			39			NOT WIRED
RF	SIG	252	40	TRACK 5 DIGITAL (BUS CONNECTED)	8.2.3	PAYLOAD RECORDER (BUS P1)
RF	RTN	252	41	TRACK 5 DIGITAL RETURN		
RF	SIG	255	42	TRACK 6 DIGITAL (BUS CONNECTED)	8.2.3	PAYLOAD RECORDER (BUS P1)
RF	RTN	255	43	TRACK 6 DIGITAL RETURN		
RF	SIG	256	44	TELEMETRY PORT 3 (BUS CONNECTED)	8.2.1	PAYLOAD DATA INTERLEAVER (BUS P1)
RF	RTN	256	45	TELEMETRY PORT 3 RETURN		

TABLE 13.5.2.2-18 PIN ASSIGNMENTS FOR NON-STANDARD PSDP CONNECTOR J1395 (RELATING TO SMCH)

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
			46			NOT WIRED
			47			NOT WIRED
RF	SIG	2512	48	TELEMETRY CLOCK 3	8.2.1	PAYLOAD DATA INTERLEAVER
RF	RTN	2512	49	TELEMETRY CLOCK 3 RETURN		
			50			NOT WIRED
			51			NOT WIRED
			52			NOT WIRED
RF	SIG	257	53	TELEMETRY CLOCK 3 (BUS CONNECTED)	8.2.1	PAYLOAD DATA INTERLEAVER (BUS P1)
RF	RTN	257	54	TELEMETRY CLOCK 3 RETURN		
			55			NOT WIRED

TABLE 13.5.2.2-19 PIN ASSIGNMENTS FOR NON-STANDARD PSDP CONNECTOR J1397 (RELATING TO SMCH)

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
			1			NOT WIRED
			2			NOT WIRED
			3			NOT WIRED
RF	SIG	2S20	4	GMT 7 RETURN	8.2.10	PAYLOAD TIMING BUFFER
RF	RTN	2S20	5	GMT 7 RETURN		
RF	SIG	2S19	6	GMT 8 RETURN	8.2.10	PAYLOAD TIMING BUFFER
RF	RTN	2S19	7	GMT 8 RETURN		
RF	SIG	2S18	8	MET 4 RETURN	8.2.10	PAYLOAD TIMING BUFFER
RF	RTN	2S18	9	MET 4 RETURN		
RF	SIG	2S21	10	GMT 7 (BUS CONNECTED)	8.2.10	PAYLOAD TIMING BUFFER (BUS P1)
RF	RTN	2S21	11	GMT 7 RETURN		
RF	SIG	2S22	12	GMT 8 (BUS CONNECTED)	8.2.10	PAYLOAD TIMING BUFFER (BUS P1)
RF	RTN	2S22	13	GMT 8 RETURN		
RF	SIG	2S23	14	MET 4 (BUS CONNECTED)	8.2.10	PAYLOAD TIMING BUFFER (BUS P1)
RF	RTN	2S23	15	MET 4 RETURN		
			16			NOT WIRED
			17			NOT WIRED
RF	SIG	2S4	18	16 KHZ OUTPUT # 4 (BUS CONNECTED)	8.2.5	PAYLOAD SIGNAL PROCESSOR # 1 (BUS P1)
RF	RTN	2S4	19	16 KHZ OUTPUT # 4 RETURN		
RF	SIG	2S5	20	16 KHZ OUTPUT # 4 (BUS CONNECTED)	8.2.5	PAYLOAD SIGNAL PROCESSOR # 2 (BUS P1)
RF	RTN	2S5	21	16 KHZ OUTPUT # 4 RETURN		
RF	SIG	2S6	22	TRACK 12 ANALOG (BUS CONNECTED)	8.2.3	PAYLOAD RECORDER (BUS P1)
RF	RTN	2S6	23	TRACK 12 ANALOG RETURN		
			24			NOT WIRED
			25			NOT WIRED
RF	SIG	2S17	26	16 KHZ OUTPUT # 4	8.2.5	PAYLOAD SIGNAL PROCESSOR # 1
RF	RTN	2S17	27	16 KHZ OUTPUT # 4 RETURN		
RF	SIG	2S13	28	16 KHZ OUTPUT # 4	8.2.5	PAYLOAD SIGNAL PROCESSOR # 2
RF	RTN	2S13	29	16 KHZ OUTPUT # 4 RETURN		
RF	SIG	2S16	30	TRACK 12 ANALOG	8.2.3	PAYLOAD RECORDER
RF	RTN	2S16	31	TRACK 12 ANALOG RETURN		
RF	SIG	2S14	32	TRACK 7 DIGITAL	8.2.3	PAYLOAD RECORDER
RF	RTN	2S14	33	TRACK 7 DIGITAL RETURN		
RF	SIG	2S15	34	TRACK 8 DIGITAL	8.2.3	PAYLOAD RECORDER
RF	RTN	2S15	35	TRACK 8 DIGITAL RETURN		
RF	SIG	2S11	36	TELEMETRY PORT 4	8.2.1	PAYLOAD DATA INTERLEAVER
RF	RTN	2S11	37	TELEMETRY PORT 4 RETURN		
			38			NOT WIRED
			39			NOT WIRED
RF	SIG	2S7	40	TRACK 7 DIGITAL (BUS CONNECTED)	8.2.3	PAYLOAD RECORDER (BUS P1)
RF	RTN	2S7	41	TRACK 7 DIGITAL RETURN		
RF	SIG	2S8	42	TRACK 8 DIGITAL (BUS CONNECTED)	8.2.3	PAYLOAD RECORDER (BUS P1)
RF	RTN	2S8	43	TRACK 8 DIGITAL RETURN		
RF	SIG	2S9	44	TELEMETRY PORT 4 (BUS CONNECTED)	8.2.1	PAYLOAD DATA INTERLEAVER (BUS P1)
RF	RTN	2S9	45	TELEMETRY PORT 4 RETURN		

TABLE 13.5.2.2-19 PIN ASSIGNMENTS FOR NON-STANDARD PSDP CONNECTOR J1397 (RELATING TO SMCH)

ENC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
RF	SIG	2S12	46	TELEMETRY CLOCK 4 TELEMETRY CLOCK 4 RETURN	8.2.1	NOT WIRED
RF	RTN	2S12	47			NOT WIRED
RF	SIG	2S10	48	TELEMETRY CLOCK 4 (BUS CONNECTED) TELEMETRY CLOCK 4 RETURN	8.2.1	PAYLOAD DATA INTERLEAVER
RF	RTN	2S10	49			NOT WIRED
			50			NOT WIRED
			51			NOT WIRED
			52			PAYLOAD DATA INTERLEAVER (BUS P1)
			53			NOT WIRED
			54			PAYLOAD DATA INTERLEAVER (BUS P1)
			55			NOT WIRED

NON-STANDARD ELECTRICAL INTERFACES  
INDEPENDENT OF SMCH

## 13.6 NON-STANDARD CARGO INTERFACES (INDEPENDENT OF SMCH).

13.6.1 Connectors In Cargo Bay. The non-standard cargo electrical interfaces (independent of SMCH) in the Cargo Bay are summarized in Table 13.6.1-1. Also included is the indication of the table in which pin assignments for each connector are defined.

13.6.1.1 Signal and Control. Signal and control connector/pin assignments are defined in Tables 13.6.1.1-1 through 13.6.1.1-9 (starboard side) and Tables 13.6.1.2-10 through 13.6.1.1-17 (port side).

13.6.1.2 Electrical Power. Electrical power connector/pin assignments are defined in Tables 13.6.1.2-1 through 13.6.1.2-7.

13.6.1.3 Coaxial. Coaxial connectors are defined in Table 13.6.1-1.

13.6.1.4 RMS End Effector. Pin assignments for RMS end effector/cargo element interface are defined in Table 13.6.1.4-1.

13.6.1.5 *Get-Away-Special (GAS).* Connector and pin assignments for GAS interfaces in the cargo bay are defined in Table 13.6.1.2-7.

### 13.6.2 Connectors In Aft Flight Deck.

13.6.2.1 Connectors On Payload Station Distribution Panel (PSDP). Non-standard cargo electrical interfaces (independent of SMCH) of the connectors on the PSDP are summarized in Table 13.6.2.1-1. Also included is the indication of the table in which the remaining pin assignments for each connector are defined. Each table includes only those pin assignments which have not already been defined in Paragraph 13.5.1, and its sub-paragraphs, or in Paragraph 13.6.1, and its sub-paragraphs.

13.6.2.1.1 Signal and Control. PSDP signal and control connector/pin assignments are defined in Tables 13.6.2.1.1-2 through 13.6.2.1.1-21.

13.6.2.1.2 Electrical Power. PSDP electrical power connector/pin assignments are defined in Tables 13.6.2.1.2-2 through 13.6.2.1.2-4.

13.6.2.1.3 Coaxial. PSDP coaxial connectors are identified in Table 13.6.2.1-1. Pin assignment tables are not required.

13.6.2.1.4 Timing Buffer. PSDP connector/pin assignments are defined in Table 13.6.2.1.4-1.

13.6.2.1.5 *Get-Away Special.* Connector and pin assignments for Aft Flight Deck GAS interfaces on the SSP are defined in Figure 13.4.2-3.

13.6.2.2 Connectors On Mission Station Distribution Panel (MSDP). The non-standard cargo electrical interfaces (independent of SMCH) of the connectors on the MSDP are summarized in Table 13.6.2.2-1. Also included is the indication of the table in which the remaining pin assignments for each connector are defined. Each table includes only those pin assignments which have not already been defined in Paragraph 13.5.1, and its sub paragraphs, or Paragraph 13.6.1, and its sub-paragraphs, or Paragraph 13.6.2.1, and its sub paragraphs.



13.6.2.2.1 Signal and Control. MSDP signal and control connector/pin assignments are defined in Tables 13.6.2.2.1-1 through 13.6.2.2.1-15.

13.6.2.2.2 Electrical Power. MSDP electrical power connector/pin assignments are defined in Tables 13.6.2.2.2-1 through 13.6.2.2.2-3.

13.6.2.2.3 Coaxial. MSDP Coaxial connectors are identified in Table 13.6.2.2-1. Pin assignment tables are not required.

13.6.2.3 Connectors On Starboard On-Orbit Station Distribution Panel (OOSDP). The non-standard cargo electrical interfaces (independent of SMCH) of the connectors on the starboard OOSDP are summarized in Table 13.6.2.3-1 *and defined in Tables 13.6.2.3-2 through 13.6.2.3-5*. Also included is the indication of the table in which the remaining pin assignments for each connector are defined. Each table includes only those pin assignments which have not already been defined in Paragraphs 13.5.1, and its sub-paragraphs, or 13.6.2.1, and its sub-paragraphs, or 13.6.2.2, and its sub-paragraphs.

13.6.2.4 Connectors On Port On-Orbit Station Distribution Panel. The non-standard cargo electrical interfaces (independent of SMCH) of the connectors on the port OOSDP are summarized in Table 13.6.2.4-1 *and defined in Tables 13.6.2.4-2 through 13.6.2.4-5*. Also included is the indication of the Table in which the remaining pin assignments for each connector are defined. Each table includes only those pin assignments which have not already been defined in Paragraphs 13.5.1, and its sub-paragraphs, or 13.6.2.1, and its sub-paragraphs, or 13.6.2.2, and its sub-paragraphs.

TABLE 13.6.1.1-1 SUMMARY OF CONNECTORS AVAILABLE AS NON-STANDARD ELECTRICAL INTERFACES (INDEPENDENT OF SMCH) IN THE CARGO BAY

ORBITER CONNECTOR IDENTIFIER	CABLE DEFINITION			SEE TABLE	ORBITER INTERFACE CONNECTOR PART NO.	CARGO INTERFACE CONNECTOR PART NO.	PANEL LOCATION
	NO CIRCT	WIRE TYPE	EMC CLASS				
J1/GAS	1	TQ	EO	13.6.1.2-7	NLS0T12-35S	NLS6GT12-35P	SEE TABLE 3.3.3-1
	1	TP	ML				
J2	4	SC	HO	13.6.1.2-7	NLS0T12-35SA	NLS6GT12-35PA	SEE TABLE 3.3.3-1
	1	TQ	EO				
J37	4	SC	HO	13.6.1.2-1	ME414-0234-7106	ME414-0235-7101	STA Xo 645, STBD
	1	TP	HO				
J38	1	SC	HO	13.6.1.2-2	ME414-0234-7106	ME414-0235-7101	STA Xo 645, STBD
	1	TP	HO				
J411	2	TSP	ML	13.6.1.4-1	5114001897-1	SG459/010-102	(2)
	26	T4C	HO				
J701	1	T54C	ML	(1)	ME414-0247-0306	ME414-0250-0306	STA Xo 603, PORT
	6	SC	HO				
J701	1	COAX	RF	(1)	ME414-0247-0306	ME414-0250-0306	BKHD Xo 1307, PORT
	1	COAX	RF				
J702	1	COAX	RF	(1)	ME414-0247-0306	ME414-0250-0306	STA Xo 603, PORT
	1	COAX	RF				
J703	1	COAX	RF	(1)	MC414-0614-0041	MC414-0614-0011	STA Xo 603, PORT
	1	COAX	RF				
J704	1	COAX	RF	(1)	ME414-0247-0306	ME414-0250-0306	BKHD Xo 1307, PORT
	1	COAX	RF				
J705	1	COAX	RF	(1)	MC414-0614-0041	MC414-0614-0011	STA Xo 603, PORT
	1	COAX	RF				
J705	1	COAX	RF	(1)	ME414-0247-0306	ME414-0250-0306	STA Xo 603, PORT
	1	COAX	RF				
J706	1	COAX	RF	(1)	MC414-0614-0041	MC414-0614-0011	BKHD Xo 1307, PORT
	1	COAX	RF				
J707	1	COAX	RF	(1)	ME414-0247-0306	ME414-0250-0306	STA Xo 603, PORT
	1	COAX	RF				
J708	1	COAX	RF	(1)	MC414-0247-0306	MC414-0614-0011	BKHD Xo 1307, PORT
	1	COAX	RF				
J709	1	COAX	RF	(1)	MC414-0614-0041	MC414-0614-0011	STA Xo 603, PORT
	1	COAX	RF				
J710	1	COAX	RF	(1)	MC414-0614-0041	MC414-0614-0011	STA Xo 603, PORT
	1	COAX	RF				
J711	1	COAX	RF	(1)	MC414-0614-0041	MC414-0614-0011	STA Xo 603, PORT
	1	COAX	RF				
J712	1	COAX	RF	(1)	MC414-0614-0041	MC414-0614-0011	STA Xo 603, PORT
	1	COAX	RF				
J713	1	COAX	RF	(1)	MC414-0614-0041	MC414-0614-0011	STA Xo 603, PORT
	1	COAX	RF				
J732	1	COAX	RF	(1)	ME414-0247-0306	ME414-0250-0306	STA Xo 1203, STBD
	1	COAX	RF				
J734	1	COAX	RF	(1)	ME414-0247-0306	ME414-0250-0306	STA Xo 1203, STBD
	1	COAX	RF				
J736	1	COAX	RF	(1)	ME414-0247-0306	ME414-0250-0306	STA Xo 1203, STBD
	1	COAX	RF				
J738	21	TSP	RF	13.6.1.1-1	NLS0T20-35S	NLS6GT20-35P	STA Xo 603, STBD
	1	COAX	RF				
J1302	16	TP	HO	13.6.1.1-8	NLS0T20-35SA	NLS6GT20-35PA	STA Xo 603, STBD
	1	TQ	EO				
J1304	16	TP	HO	13.6.1.2-5	NB0E14-19SNT3	NB6GE14-19PNT3	STA Xo 603, STBD
	1	TP	HO				
J1308	5	T5C	HO	13.6.1.1-9	NLS0T20-35SA	NLS6GT20-35PA	STA Xo 603, STBD
	1	TQ	EO				
J1310	15	EO	EO	13.6.1.2-6	NB0E14-19SNT3	NB6GE14-19PNT3	STA Xo 603, STBD
	1	TQ	EO				

TABLE 13.6.1-1 SUMMARY OF CONNECTORS AVAILABLE AS NON-STANDARD ELECTRICAL INTERFACES (INDEPENDENT OF SMCH) IN THE CARGO BAY

ORBITER CONNECTOR IDENTIFIER	CABLE DEFINITION			SEE TABLE	ORBITER INTERFACE CONNECTOR PART NO.	CARGO INTERFACE CONNECTOR PART NO.	PANEL LOCATION
	ORBITER CIRCT NO	WIRE TYPE	EMC CLASS				
J1312	13	TSP	ML	22	NLS0T20-35SB	NLS6GT20-35PB	STA X0 603, STBD
	3	TS5C	ML				
J1314	20	TSP	ML	19	NLS0T20-35SB	NLS6GT20-35PB	STA X0 603, STBD
J1316	21	TSP	ML	16	NLS0T20-35SB	NLS6GT20-35PB	STA X0 603, STBD
J1317	13	TSP	ML	40	NLS0T20-35SB	NLS6GT20-35PB	STA X0 603, PORT
J1318	21	TSP	ML	16	NLS0T20-35SB	NLS6GT20-35PB	STA X0 603, STBD
J1319	15	TSP	ML	28	NLS0T20-35SB	NLS6GT20-35PB	STA X0 603, PORT
	1	TS5C	ML				
J1320	6	TS5C	ML	43	NLS0T20-35SB	NLS6GT20-35PB	STA X0 603, STBD
J1321	13	TSP	ML	40	NLS0T20-35SB	NLS6GT20-35PB	STA X0 603, PORT
J1322	8	TS5C	ML	31	NLS0T20-35SB	NLS6GT20-35PB	STA X0 603, STBD
J1323	5	TSP	ML	64	NLS0T20-35SB	NLS6GT20-35PB	STA X0 603, PORT
J1333	5	T3C	HO	64	NLS0T20-35SA	NLS6GT20-35PA	STA X0 603, PORT
J1335	5	T3C	HO	64	NLS0T20-35SA	NLS6GT20-35PA	STA X0 603, PORT
J1337	5	T5C	HO	54	NLS0T20-35SA	NLS6GT20-35PA	STA X0 603, PORT
J1616	1	TP	HO	2	ME414-0234-7240	ME414-0235-7244	STA X0 1203, STBD
J1617	1	TP	HO	2	ME414-0234-7240	ME414-0235-7244	STA X0 1203, STBD

- (1) SIGNAL IS CARRIED CONVENTIONALLY ON CENTER CONDUCTOR FOR ALL ORBITER COAX CABLES. NO PIN ASSIGNMENT TABLES ARE REQUIRED. CIRCUIT TERMINATIONS ARE SHOWN IN FIGURE 13.3.3-1
- (2) CONNECTOR IS LOCATED ON THE END EFFECTOR OF THE RMS.

TABLE 13.6.1.1-1 PIN ASSIGNMENTS FOR STARBOARD Xo 603 CONNECTOR J1302

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
			1			NOT WIRED
			2			NOT WIRED
			3			NOT WIRED
			4			NOT WIRED
			5			NOT WIRED
			6			NOT WIRED
			7			NOT WIRED
			8			NOT WIRED
			9			NOT WIRED
			10			NOT WIRED
			11			NOT WIRED
			12			NOT WIRED
			13			NOT WIRED
			14			NOT WIRED
			15			NOT WIRED
RF	SIG	255	16	MSDP J40 - 26		NOT WIRED
RF	RTN	255	17	MSDP J40 - 25		NOT WIRED
RF	SIG	256	18			NOT WIRED
RF	RTN	256	19	MSDP J40 - 28		NOT WIRED
			20	MSDP J40 - 27		NOT WIRED
RF	SIG	257	21			NOT WIRED
RF	RTN	257	22	MSDP J40 - 30		NOT WIRED
			23	MSDP J40 - 29		NOT WIRED
			24			NOT WIRED
RF	SIG	258	25	MSDP J40 - 32		NOT WIRED
RF	RTN	258	26	MSDP J40 - 31		NOT WIRED
			27			NOT WIRED
RF	SIG	259	28	MSDP J40 - 35		NOT WIRED
RF	RTN	259	29	MSDP J40 - 34		NOT WIRED
			30			NOT WIRED
RF	SIG	2510	31	MSDP J40 - 37		NOT WIRED
RF	RTN	2510	32	MSDP J40 - 36		NOT WIRED
			33			NOT WIRED
RF	SIG	2511	34	MSDP J40 - 39		NOT WIRED
RF	RTN	2511	35	MSDP J40 - 38		NOT WIRED
			36			NOT WIRED
RF	SIG	2512	37	MSDP J40 - 41		NOT WIRED
RF	RTN	2512	38	MSDP J40 - 40		NOT WIRED
			39			NOT WIRED
RF	SIG	251	40	MSDP J40 - 65		NOT WIRED
RF	RTN	251	41	MSDP J40 - 64		NOT WIRED
			42			NOT WIRED
RF	SIG	252	43	MSDP J40 - 66		NOT WIRED
RF	RTN	252	44	MSDP J40 - 62		NOT WIRED
			45			NOT WIRED

TABLE 13.6.1.1-1 PIN ASSIGNMENTS FOR STARBOARD Xo 603 CONNECTOR J1302

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
RF	SIG	2S3	46	MSDP J40 - 61		
RF	RTN	2S3	47	MSDP J40 - 60		NOT WIRED
RF	SIG	2S4	48	MSDP J40 - 63		
RF	RTN	2S4	49	MSDP J40 - 57		NOT WIRED
RF	RTN	2S13	50	MSDP J40 - 57		
RF	SIG	2S13	51	MSDP J40 - 21		NOT WIRED
RF	RTN	2S13	52	MSDP J40 - 22		
RF	SIG	2S13	53	MSDP J40 - 22		NOT WIRED
RF	RTN	2S14	54	MSDP J40 - 19		
RF	SIG	2S14	55	MSDP J40 - 20		NOT WIRED
RF	RTN	2S15	56	MSDP J40 - 17		
RF	SIG	2S15	57	MSDP J40 - 18		NOT WIRED
RF	RTN	2S16	58	MSDP J40 - 15		
RF	SIG	2S16	59	MSDP J40 - 16		NOT WIRED
RF	RTN	2S17	60	SYNCHRONIZE	8.2.8	NOT WIRED
RF	SIG	2S17	61	SYNCHRONIZE RETURN	8.2.8	REMOTE CONTROL UNIT
RF	RTN	2S18	62	ORBITER TV	8.2.8	NOT WIRED
RF	SIG	2S18	63	ORBITER TV RETURN	8.2.8	VIDEO SWITCHING NETWORK
RF	RTN	2S19	64	PAYLOAD TV 3	8.2.8	NOT WIRED
RF	SIG	2S19	65	PAYLOAD TV 3 RETURN	8.2.8	VIDEO SWITCHING NETWORK
RF	RTN	2S20	66	PAYLOAD TV 1	8.2.8	NOT WIRED
RF	SIG	2S20	67	PAYLOAD TV 1 RETURN	8.2.8	VIDEO SWITCHING NETWORK
RF	RTN	2S21	68	PAYLOAD TV 2	8.2.8	NOT WIRED
RF	SIG	2S21	69	PAYLOAD TV 2 RETURN	8.2.8	VIDEO SWITCHING NETWORK
RF	RTN	2S22	70			NOT WIRED
RF	SIG	2S22	71			NOT WIRED
RF	RTN	2S22	72			NOT WIRED
RF	SIG	2S22	73			NOT WIRED
RF	RTN	2S22	74			NOT WIRED
RF	SIG	2S22	75			NOT WIRED
RF	RTN	2S22	76			NOT WIRED
RF	SIG	2S22	77			NOT WIRED
RF	RTN	2S22	78			NOT WIRED
RF	SIG	2S22	79			NOT WIRED

TABLE 13.6.1.1-2 PIN ASSIGNMENTS FOR STARBOARD Xo 603 CONNECTOR J1312

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
			1			NOT WIRED
			2			NOT WIRED
			3			NOT WIRED
			4			NOT WIRED
			5			NOT WIRED
			6			NOT WIRED
			7			NOT WIRED
			8			NOT WIRED
			9			NOT WIRED
			10			NOT WIRED
			11			NOT WIRED
			12			NOT WIRED
			13			NOT WIRED
			14			NOT WIRED
			15			NOT WIRED
			16			NOT WIRED
			17			NOT WIRED
			18			NOT WIRED
			19			NOT WIRED
			20			NOT WIRED
			21			NOT WIRED
			22	MSDP J32 - 43		TERMINATE
ML	SIG	251	22	MSDP J32 - 43		TERMINATE
ML	RTN	251	23	MSDP J32 - 41		TERMINATE
ML	SHD	251	24	MSDP J32 - 46		TERMINATE
ML	SIG	252	25	MSDP J32 - 45		TERMINATE
ML	RTN	252	26	MSDP J32 - 44		TERMINATE
ML	SHD	252	27	MSDP J32 - 49		TERMINATE
ML	SIG	253	28	MSDP J32 - 48		TERMINATE
ML	RTN	253	29	MSDP J32 - 47		TERMINATE
ML	SHD	254	30	MSDP J32 - 52		TERMINATE
ML	SIG	254	31	MSDP J32 - 51		TERMINATE
ML	RTN	254	32	MSDP J32 - 50		TERMINATE
ML	SHD	254	33	MSDP J32 - 55		TERMINATE
ML	SIG	255	34	MSDP J32 - 54		TERMINATE
ML	RTN	255	35	MSDP J32 - 53		TERMINATE
ML	SHD	255	36	MSDP J32 - 58		TERMINATE
ML	SIG	256	37	MSDP J32 - 57		TERMINATE
ML	RTN	256	38	MSDP J32 - 56		TERMINATE
ML	SHD	256	39	MSDP J32 - 61		TERMINATE
ML	SIG	257	40	MSDP J32 - 60		TERMINATE
ML	RTN	257	41	MSDP J32 - 59		TERMINATE
ML	SHD	257	42	MSDP J32 - 64		TERMINATE
ML	SIG	258	43	MSDP J32 - 63		TERMINATE
ML	RTN	258	44	MSDP J32 - 62		TERMINATE
ML	SHD	258	45	MSDP J32 - 62		TERMINATE

TABLE 13.6.1.1-2 PIN ASSIGNMENTS FOR STARBOARD Xo 603 CONNECTOR J1312

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
ML	SIG	259	46	MSDP J32 - 67		
ML	RTN	259	47	MSDP J32 - 66		
ML	SHD	259	48	MSDP J32 - 65		TERMINATE
ML	SIG	2510	49	MSDP J32 - 70		
ML	RTN	2510	50	MSDP J32 - 69		TERMINATE
ML	SHD	2510	51	MSDP J32 - 68		
ML	SIG	2511	52	MSDP J32 - 73		
ML	RTN	2511	53	MSDP J32 - 72		TERMINATE
ML	SHD	2511	54	MSDP J32 - 71		
ML	SIG	2512	55	MSDP J32 - 76		
ML	RTN	2512	56	MSDP J32 - 75		TERMINATE
ML	SHD	2512	57	MSDP J32 - 74		
ML	SIG	2513	58	MSDP J32 - 79		
ML	RTN	2513	59	MSDP J32 - 78		
ML	SHD	2513	60	MSDP J32 - 77		
ML	SIG	553	61	P01X5226Y DIL 26	8.2.2.3	TERMINATE
ML	SIG	553	62	P01X5227Y DIL 27	8.2.2.3	MDM-PF2 PAYLOAD CAUTION & WARNING
ML	SIG	553	63	P01X5228Y DIL 28	8.2.2.3	MDM-PF2 PAYLOAD CAUTION & WARNING
ML	SIG	553	64	P01X5229Y DIL 29	8.2.2.3	MDM-PF2 PAYLOAD CAUTION & WARNING
ML	RTN	553	65	RETURN		
ML	SHD	553	66			
ML	SIG	552	67	P01X5230Y DIL 30	8.2.2.3	TERMINATE
ML	SIG	552	68	P01X5231Y DIL 31	8.2.2.3	MDM-PF2 PAYLOAD CAUTION & WARNING
ML	SIG	552	69	P01X5232Y DIL 32	8.2.2.3	MDM-PF2 PAYLOAD CAUTION & WARNING
ML	SIG	552	70	P01X5233Y DIL 33	8.2.2.3	MDM-PF2 PAYLOAD CAUTION & WARNING
ML	RTN	552	71	RETURN		
ML	SHD	552	72			
ML	SIG	551	73	P01X5234Y DIL 34	8.2.2.3	TERMINATE
ML	SIG	551	74	P01X5235Y DIL 35	8.2.2.3	MDM-PF2 PAYLOAD CAUTION & WARNING
ML	SIG	551	75	P01X5236Y DIL 36	8.2.2.3	MDM-PF2 PAYLOAD CAUTION & WARNING
ML	SIG	551	76	P01X5237Y DIL 37	8.2.2.3	MDM-PF2 PAYLOAD CAUTION & WARNING
ML	RTN	551	77	RETURN		
ML	SHD	551	78			TERMINATE
ML		551	79			NOT WIRED





TABLE 13.6.1.1-3 PIN ASSIGNMENTS FOR STARBOARD Xo 603 CONNECTOR J1314

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
ML	SIG	2S17	46	MSDP J22 - 43		
ML	RTN	2S17	47	MSDP J22 - 42		
ML	SHD	2S17	48	MSDP J22 - 41		TERMINATE
ML	SIG	2S18	49	MSDP J22 - 73		
ML	RTN	2S18	50	MSDP J22 - 72		
ML	SHD	2S18	51	MSDP J22 - 71		TERMINATE
ML	SIG	2S19	52	MSDP J22 - 76		
ML	RTN	2S19	53	MSDP J22 - 75		
ML	SHD	2S19	54	MSDP J22 - 74		TERMINATE
ML	SIG	2S20	55	MSDP J22 - 77		
ML	RTN	2S20	56	MSDP J22 - 78		
ML	SHD	2S20	57	MSDP J22 - 79		TERMINATE
ML	SIG	2S1	58	MSDP J22 - 22		
ML	RTN	2S1	59	MSDP J22 - 21		
ML	SHD	2S1	60	MSDP J22 - 20		TERMINATE
ML	SIG	2S2	61	MSDP J22 - 25		
ML	RTN	2S2	62	MSDP J22 - 24		
ML	SHD	2S2	63	MSDP J22 - 23		TERMINATE
ML	SIG	2S3	64	MSDP J22 - 28		
ML	RTN	2S3	65	MSDP J22 - 27		
ML	SHD	2S3	66	MSDP J22 - 26		TERMINATE
ML	SIG	2S4	67	MSDP J22 - 31		
ML	RTN	2S4	68	MSDP J22 - 30		
ML	SHD	2S4	69	MSDP J22 - 29		TERMINATE
ML	SIG	2S5	70	MSDP J22 - 34		
ML	RTN	2S5	71	MSDP J22 - 33		
ML	SHD	2S5	72	MSDP J22 - 32		TERMINATE
ML	SIG	2S6	73	MSDP J22 - 37		
ML	RTN	2S6	74	MSDP J22 - 36		
ML	SHD	2S6	75	MSDP J22 - 35		TERMINATE
ML	SIG	2S7	76	MSDP J22 - 40		
ML	RTN	2S7	77	MSDP J22 - 39		
ML	SHD	2S7	78	MSDP J22 - 38		TERMINATE NOT WIRED
		2S7	79			

TABLE 13.6.1.1-4 PIN ASSIGNMENTS FOR STARBOARD Xo 603 CONNECTOR J1316

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION -- PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
			1			NOT WIRED
			2			NOT WIRED
			3			NOT WIRED
			4			NOT WIRED
			5			NOT WIRED
			6			NOT WIRED
			7			NOT WIRED
			8			NOT WIRED
			9			NOT WIRED
			10			NOT WIRED
			11			NOT WIRED
			12			NOT WIRED
			13			NOT WIRED
			14			NOT WIRED
			15			NOT WIRED
ML	SIG	2S13	16	PAYLOAD MASTER ALARM LIGHT	8.2.9.5	PANEL R13A1
ML	RTN	2S13	17	MASTER ALARM LIGHT RETURN		
ML	SHD	2S13	18			TERMINATE
ML	SIG	2S14	19	dP / dT EMERGENCY	8.2.9.5	PANEL R13A1
ML	RTN	2S14	20	dP / dT EMERGENCY RETURN		
ML	SHD	2S14	21			TERMINATE
ML	SIG	2S3	22	MSDP J18 - 47		
ML	RTN	2S3	23	MSDP J18 - 40		
ML	SHD	2S3	24	MSDP J18 - 41		TERMINATE
ML	SIG	2S2	25	MSDP J18 - 53		
ML	RTN	2S2	26	MSDP J18 - 49		
ML	SHD	2S2	27	MSDP J18 - 48		TERMINATE
ML	SIG	2S1	28	MSDP J18 - 54		
ML	RTN	2S1	29	MSDP J18 - 50		
ML	SHD	2S1	30	MSDP J18 - 55		TERMINATE
ML	SIG	2S4	31	MSDP J18 - 26		
ML	RTN	2S4	32	MSDP J18 - 19		
ML	SHD	2S4	33	MSDP J18 - 18		TERMINATE
ML	SIG	2S19	34	P01U6153V AID 53	8.2.2.4	MDM-PF2
ML	RTN	2S19	35	AID 53 RETURN		
ML	SHD	2S19	36			TERMINATE
ML	SIG	2S20	37	P01U6154V AID 54	8.2.2.4	MDM-PF2
ML	RTN	2S20	38	AID 54 RETURN		
ML	SHD	2S20	39			TERMINATE
ML	SIG	2S21	40	P01U6155V AID 55	8.2.2.4	MDM-PF2
ML	RTN	2S21	41	AID 55 RETURN		
ML	SHD	2S21	42			TERMINATE
ML	SIG	2S17	43	P01U6151V AID 51	8.2.2.4	MDM-PF2
ML	RTN	2S17	44	AID 51 RETURN		
ML	SHD	2S17	45			TERMINATE

TABLE 13.6.1.1-4 PIN ASSIGNMENTS FOR STARBOARD Xo 603 CONNECTOR J1316

EMC CLASS.	PIN FUNCT.	CABLE DESC.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
ML	SIG	2S16	46	POTU6150V AID 50	8.2.2.4	MDM-PF2
ML	RTN	2S16	47	AID 50 RETURN		
ML	SHD	2S16	48		8.2.2.4	TERMINATE MDM-PF2
ML	SIG	2S15	49	POTU6149V AID 49		
ML	RTN	2S15	50	AID 49 RETURN		
ML	SHD	2S15	51		8.2.2.4	TERMINATE MDM-PF2
ML	SIG	2S18	52	POTU6152V AID 52		
ML	RTN	2S18	53	AID 52 RETURN		TERMINATE
ML	SHD	2S18	54			TERMINATE
ML	SIG	2S5	55	MSDP J18 - 27		TERMINATE
ML	RTN	2S5	56	MSDP J18 - 20		TERMINATE
ML	SHD	2S5	57	MSDP J18 - 28		TERMINATE
ML	SIG	2S6	58	MSDP J18 - 13		TERMINATE
ML	RTN	2S6	59	MSDP J18 - 14		TERMINATE
ML	SHD	2S6	60	MSDP J18 - 21		TERMINATE
ML	SIG	2S7	61	MSDP J18 - 23		TERMINATE
ML	RTN	2S7	62	MSDP J18 - 15		TERMINATE
ML	SHD	2S7	63	MSDP J18 - 22		TERMINATE
ML	SIG	2S8	64	MSDP J18 - 37		TERMINATE
ML	RTN	2S8	65	MSDP J18 - 30		TERMINATE
ML	SHD	2S8	66	MSDP J18 - 29		TERMINATE
ML	SIG	2S9	67	MSDP J18 - 46		TERMINATE
ML	RTN	2S9	68	MSDP J18 - 39		TERMINATE
ML	SHD	2S9	69	MSDP J18 - 38		TERMINATE
ML	SIG	2S10	70	MSDP J18 - 51		TERMINATE
ML	RTN	2S10	71	MSDP J18 - 45		TERMINATE
ML	SHD	2S10	72	MSDP J18 - 52		TERMINATE
ML	SIG	2S11	73	MSDP J18 - 43		TERMINATE
ML	RTN	2S11	74	MSDP J18 - 44		TERMINATE
ML	SHD	2S11	75	MSDP J18 - 36		TERMINATE
ML	SIG	2S12	76	MSDP J18 - 42		TERMINATE
ML	RTN	2S12	77	MSDP J18 - 34		TERMINATE
ML	SHD	2S12	78	MSDP J18 - 35		TERMINATE NOT WIRED
ML			79			

TABLE 13.6.1.1-5 PIN ASSIGNMENTS FOR STARBOARD Xo 603 CONNECTOR J1318

EMC CLASS.	PIN FUNCT.	CABLE DESCOR.	PIN #	SIGNAL FUNCTION OR PANNEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
			1			NOT WIRED
			2			NOT WIRED
			3			NOT WIRED
			4			NOT WIRED
			5			NOT WIRED
			6			NOT WIRED
			7			NOT WIRED
			8			NOT WIRED
			9			NOT WIRED
			10			NOT WIRED
			11			NOT WIRED
			12			NOT WIRED
			13			NOT WIRED
			14			NOT WIRED
			15			NOT WIRED
ML	SIG	2S21	16	MSDP J34 - 19		TERMINATE
ML	RTN	2S21	17	MSDP J34 - 18		TERMINATE
ML	SHD	2S21	18	MSDP J34 - 17		TERMINATE
ML	SIG	2S20	19	MSDP J34 - 22		TERMINATE
ML	RTN	2S20	20	MSDP J34 - 21		TERMINATE
ML	SHD	2S20	21	MSDP J34 - 20		TERMINATE
ML	SIG	2S19	22	MSDP J34 - 25		TERMINATE
ML	RTN	2S19	23	MSDP J34 - 24		TERMINATE
ML	SHD	2S19	24	MSDP J34 - 23		TERMINATE
ML	SIG	2S18	25	MSDP J34 - 28		TERMINATE
ML	RTN	2S18	26	MSDP J34 - 27		TERMINATE
ML	SHD	2S18	27	MSDP J34 - 26		TERMINATE
ML	SIG	2S17	28	MSDP J34 - 31		TERMINATE
ML	RTN	2S17	29	MSDP J34 - 30		TERMINATE
ML	SHD	2S17	30	MSDP J34 - 29		TERMINATE
ML	SIG	2S16	31	MSDP J34 - 34		TERMINATE
ML	RTN	2S16	32	MSDP J34 - 33		TERMINATE
ML	SHD	2S16	33	MSDP J34 - 32		TERMINATE
ML	SIG	2S15	34	MSDP J34 - 37		TERMINATE
ML	RTN	2S15	35	MSDP J34 - 36		TERMINATE
ML	SHD	2S15	36	MSDP J34 - 35		TERMINATE
ML	SIG	2S14	37	MSDP J34 - 40		TERMINATE
ML	RTN	2S14	38	MSDP J34 - 39		TERMINATE
ML	SHD	2S14	39	MSDP J34 - 38		TERMINATE
ML	SIG	2S13	40	MSDP J34 - 43		TERMINATE
ML	RTN	2S13	41	MSDP J34 - 42		TERMINATE
ML	SHD	2S13	42	MSDP J34 - 41		TERMINATE
ML	SIG	2S12	43	MSDP J34 - 46		TERMINATE
ML	RTN	2S12	44	MSDP J34 - 45		TERMINATE
ML	SHD	2S12	45	MSDP J34 - 44		TERMINATE

TABLE 13.6.1.1-5 PIN ASSIGNMENTS FOR STARBOARD Xo 603 CONNECTOR J1318

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
ML	SIG	2S11	46	MSDP J34 - 49		
ML	RTN	2S11	47	MSDP J34 - 48		
ML	SHD	2S11	48	MSDP J34 - 47		TERMINATE
ML	SIG	2S10	49	MSDP J34 - 52		
ML	RTN	2S10	50	MSDP J34 - 51		
ML	SHD	2S10	51	MSDP J34 - 50		TERMINATE
ML	SIG	2S9	52	MSDP J34 - 55		
ML	RTN	2S9	53	MSDP J34 - 54		
ML	SHD	2S9	54	MSDP J34 - 53		TERMINATE
ML	SIG	2S8	55	MSDP J34 - 58		
ML	RTN	2S8	56	MSDP J34 - 57		
ML	SHD	2S8	57	MSDP J34 - 56		TERMINATE
ML	SIG	2S7	58	MSDP J34 - 61		
ML	RTN	2S7	59	MSDP J34 - 60		
ML	SHD	2S7	60	MSDP J34 - 59		TERMINATE
ML	SIG	2S6	61	MSDP J34 - 64		
ML	RTN	2S6	62	MSDP J34 - 63		
ML	SHD	2S6	63	MSDP J34 - 62		TERMINATE
ML	SIG	2S5	64	MSDP J34 - 67		
ML	RTN	2S5	65	MSDP J34 - 66		
ML	SHD	2S5	66	MSDP J34 - 65		TERMINATE
ML	SIG	2S4	67	MSDP J34 - 70		
ML	RTN	2S4	68	MSDP J34 - 69		
ML	SHD	2S4	69	MSDP J34 - 68		TERMINATE
ML	SIG	2S3	70	MSDP J34 - 73		
ML	RTN	2S3	71	MSDP J34 - 72		
ML	SHD	2S3	72	MSDP J34 - 71		TERMINATE
ML	SIG	2S2	73	MSDP J34 - 76		
ML	RTN	2S2	74	MSDP J34 - 75		
ML	SHD	2S2	75	MSDP J34 - 74		TERMINATE
ML	SIG	2S1	76	MSDP J34 - 79		
ML	RTN	2S1	77	MSDP J34 - 78		
ML	SHD	2S1	78	MSDP J34 - 77		TERMINATE NOT WIRED
ML		2S1	79	MSDP J34 - 77		

TABLE 13.6.1.1-6 PIN ASSIGNMENTS FOR STARBOARD Xo 603 CONNECTOR J1320

EMC CLASS.	PIN FUNCT.	CABLE DESC.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
			1			PINS 1-42 NOT WIRED
			42			PINS 1-42 NOT WIRED
ML	SIG	555	43	MSDP J26 - 21		
ML	SIG	555	44	MSDP J26 - 30		
ML	SIG	555	45	MSDP J26 - 19		
ML	SIG	555	46	MSDP J26 - 20		
ML	RTN	555	47	MSDP J26 - 29		
ML	SHD	555	48	MSDP J26 - 40		TERMINATE
ML	SIG	556	49	MSDP J26 - 43		
ML	SIG	556	50	MSDP J26 - 42		
ML	SIG	556	51	MSDP J26 - 22		
ML	SIG	556	52	MSDP J26 - 32		
ML	RTN	556	53	MSDP J26 - 31		
ML	SHD	556	54	MSDP J26 - 41		TERMINATE
ML	SIG	551	55	MSDP J26 - 48		
ML	SIG	551	56	MSDP J26 - 38		
ML	SIG	551	57	MSDP J26 - 28		
ML	SIG	551	58	MSDP J26 - 39		
ML	RTN	551	59	MSDP J26 - 49		TERMINATE
ML	SHD	551	60	MSDP J26 - 50		
ML	SIG	552	61	MSDP J26 - 58		
ML	SIG	552	62	MSDP J26 - 59		
ML	SIG	552	63	MSDP J26 - 79		
ML	SIG	552	64	MSDP J26 - 69		
ML	RTN	552	65	MSDP J26 - 70		
ML	SHD	552	66	MSDP J26 - 60		TERMINATE
ML	SIG	553	67	MSDP J26 - 80		
ML	SIG	553	68	MSDP J26 - 71		
ML	SIG	553	69	MSDP J26 - 82		
ML	SIG	553	70	MSDP J26 - 81		
ML	RTN	553	71	MSDP J26 - 72		
ML	SHD	553	72	MSDP J26 - 61		TERMINATE
ML	SIG	554	73	MSDP J26 - 73		
ML	SIG	554	74	MSDP J26 - 62		
ML	SIG	554	75	MSDP J26 - 53		
ML	SIG	554	76	MSDP J26 - 63		
ML	RTN	554	77	MSDP J26 - 52		TERMINATE
ML	SHD	554	78	MSDP J26 - 51		NOT WIRED
			79			

TABLE 13.6.1.1-7 PIN ASSIGNMENTS FOR STARBOARD Xo 603 CONNECTOR J1322

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
			1			NOT WIRED
			2			NOT WIRED
			3			NOT WIRED
			4			NOT WIRED
			5			NOT WIRED
			6			NOT WIRED
			7			NOT WIRED
			8			NOT WIRED
			9			NOT WIRED
			10			NOT WIRED
			11			NOT WIRED
			12			NOT WIRED
			13			NOT WIRED
			14			NOT WIRED
			15			NOT WIRED
			16			NOT WIRED
			17			NOT WIRED
			18			NOT WIRED
			19			NOT WIRED
			20			NOT WIRED
			21			NOT WIRED
			22			NOT WIRED
			23			NOT WIRED
			24			NOT WIRED
			25			NOT WIRED
			26			NOT WIRED
			27			NOT WIRED
			28			NOT WIRED
			29			NOT WIRED
			30			NOT WIRED
ML	SIG	551	31	MSDP J26 - 4		
ML	SIG	551	32	MSDP J26 - 3		
ML	SIG	551	33	MSDP J26 - 2		
ML	SIG	551	34	MSDP J26 - 1		
ML	RTN	551	35	MSDP J26 - 5		
ML	SHD	551	36	MSDP J26 - 6		
ML	SIG	552	37	MSDP J26 - 11		
ML	SIG	552	38	MSDP J26 - 10		
ML	SIG	552	39	MSDP J26 - 9		
ML	SIG	552	40	MSDP J26 - 8		
ML	RTN	552	41	MSDP J26 - 12		
ML	SHD	552	42	MSDP J26 - 13		
ML	SIG	553	43	MSDP J26 - 14		
ML	SIG	553	44	MSDP J26 - 7		
ML	SIG	553	45	MSDP J26 - 15		
						TERMINATE
						TERMINATE

TABLE 13.6.1.1-7 PIN ASSIGNMENTS FOR STARBOARD Xo 603 CONNECTOR J1322

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
ML	SIG	553	46	MSDP J26 - 24		
ML	RTN	553	47	MSDP J26 - 23		TERMINATE
ML	SHD	553	48	MSDP J26 - 33		
ML	SIG	554	49	MSDP J26 - 25		
ML	SIG	554	50	MSDP J26 - 16		
ML	SIG	554	51	MSDP J26 - 17		
ML	SIG	554	52	MSDP J26 - 18		
ML	RTN	554	53	MSDP J26 - 26		TERMINATE
ML	SHD	554	54	MSDP J26 - 27		
ML	SIG	555	55	MSDP J26 - 47		
ML	SIG	555	56	MSDP J26 - 37		
ML	SIG	555	57	MSDP J26 - 36		
ML	SIG	555	58	MSDP J26 - 35		
ML	RTN	555	59	MSDP J26 - 46		TERMINATE
ML	SHD	555	60	MSDP J26 - 56		
ML	SIG	556	61	MSDP J26 - 68		
ML	SIG	556	62	MSDP J26 - 57		
ML	SIG	556	63	MSDP J26 - 67		
ML	SIG	556	64	MSDP J26 - 77		
ML	RTN	556	65	MSDP J26 - 78		TERMINATE
ML	SHD	556	66	MSDP J26 - 86		
ML	SIG	557	67	MSDP J26 - 90		
ML	SIG	557	68	MSDP J26 - 89		
ML	SIG	557	69	MSDP J26 - 88		
ML	SIG	557	70	MSDP J26 - 87		
ML	RTN	557	71	MSDP J26 - 91		TERMINATE
ML	SHD	557	72	MSDP J26 - 92		
ML	SIG	558	73	MSDP J26 - 97		
ML	SIG	558	74	MSDP J26 - 96		
ML	SIG	558	75	MSDP J26 - 95		
ML	SIG	558	76	MSDP J26 - 94		
ML	RTN	558	77	MSDP J26 - 98		TERMINATE
ML	SHD	558	78	MSDP J26 - 99		NOT WIRED
			79			



TABLE 13.6.1.1-8 PIN ASSIGNMENTS FOR STARBOARD Xo 603 CONNECTOR J1304

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITTER COMPONENT INTERFACE AND/OR NOTES
			1			NOT WIRED
			2			NOT WIRED
			3			NOT WIRED
			4			NOT WIRED
			5			NOT WIRED
			6			NOT WIRED
			7			NOT WIRED
			8			NOT WIRED
			9			NOT WIRED
			10			NOT WIRED
			11			NOT WIRED
			12			NOT WIRED
			13			NOT WIRED
			14			NOT WIRED
			15			NOT WIRED
			16			NOT WIRED
			17			NOT WIRED
			18			NOT WIRED
			19			NOT WIRED
			20			NOT WIRED
			21			NOT WIRED
			22			NOT WIRED
			23			NOT WIRED
			24			NOT WIRED
			25			NOT WIRED
			26			NOT WIRED
			27			NOT WIRED
			28			NOT WIRED
			29			NOT WIRED
			30			NOT WIRED
ML	SIG	2T16	31	MSDP J12 - 78		NOT WIRED
ML	RTN	2T16	32	MSDP J12 - 79		NOT WIRED
ML	SIG	2T15	34	MSDP J12 - 49		NOT WIRED
ML	RTN	2T15	35	MSDP J12 - 48		NOT WIRED
ML	SIG	2T14	37	MSDP J12 - 51		NOT WIRED
ML	RTN	2T14	38	MSDP J12 - 50		NOT WIRED
ML	SIG	2T13	40	MSDP J12 - 53		NOT WIRED
ML	RTN	2T13	41	MSDP J12 - 54		NOT WIRED
ML	SIG	2T12	43	MSDP J12 - 55		NOT WIRED
ML	RTN	2T12	44	MSDP J12 - 54		NOT WIRED
			45			NOT WIRED

TABLE 13.6.1.1-8 PIN ASSIGNMENTS FOR STARBOARD Xo 603 CONNECTOR J1304

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
ML	SIG	2T11	46	MSDP J12 - 57		
ML	RTN	2T11	47	MSDP J12 - 56		NOT WIRED
			48			
ML	SIG	2T10	49	MSDP J12 - 59		
ML	RTN	2T10	50	MSDP J12 - 58		NOT WIRED
			51			
ML	SIG	2T9	52	MSDP J12 - 61		
ML	RTN	2T9	53	MSDP J12 - 60		NOT WIRED
			54			
ML	SIG	2T8	55	MSDP J12 - 63		
ML	RTN	2T8	56	MSDP J12 - 62		NOT WIRED
			57			
ML	SIG	2T7	58	MSDP J12 - 65		
ML	RTN	2T7	59	MSDP J12 - 64		NOT WIRED
			60			
ML	SIG	2T6	61	MSDP J12 - 67		
ML	RTN	2T6	62	MSDP J12 - 66		NOT WIRED
			63			
ML	SIG	2T5	64	MSDP J12 - 69		
ML	RTN	2T5	65	MSDP J12 - 68		NOT WIRED
			66			
ML	SIG	2T4	67	MSDP J12 - 71		
ML	RTN	2T4	68	MSDP J12 - 70		NOT WIRED
			69			
ML	SIG	2T3	70	MSDP J12 - 73		
ML	RTN	2T3	71	MSDP J12 - 72		NOT WIRED
			72			
ML	SIG	2T2	73	MSDP J12 - 75		
ML	RTN	2T2	74	MSDP J12 - 74		NOT WIRED
			75			
ML	SIG	2T1	76	MSDP J12 - 77		
ML	RTN	2T1	77	MSDP J12 - 76		NOT WIRED
			78			
			79			NOT WIRED

TABLE 13.6.1.1-9 PIN ASSIGNMENTS FOR STARBOARD Xo 603 CONNECTOR J1308

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
HO	SIG	2T16	1	MSDP J24 - 34		
HO	RTN	2T16	2	MSDP J24 - 56		NOT WIRED
HO	SIG	2T15	3			
HO	RTN	2T15	4	MSDP J24 - 63		
HO	SIG	2T15	5	MSDP J24 - 62		NOT WIRED
HO	RTN	2T15	6			
HO	SIG	2T14	7	MSDP J24 - 65		
HO	RTN	2T14	8	MSDP J24 - 64		NOT WIRED
HO	SIG	2T13	9			
HO	RTN	2T13	10	MSDP J24 - 67		
HO	SIG	2T13	11	MSDP J24 - 66		NOT WIRED
HO	RTN	2T13	12			
HO	SIG	2T12	13	MSDP J24 - 69		
HO	RTN	2T12	14	MSDP J24 - 68		NOT WIRED
HO	SIG	2T11	15			
HO	RTN	2T11	16	MSDP J24 - 71		
HO	SIG	2T11	17	MSDP J24 - 70		NOT WIRED
HO	RTN	2T11	18			
HO	SIG	2T10	19	MSDP J24 - 73		
HO	RTN	2T10	20	MSDP J24 - 72		NOT WIRED
HO	SIG	2T9	21			
HO	RTN	2T9	22	MSDP J24 - 75		
HO	SIG	2T9	23	MSDP J24 - 74		NOT WIRED
HO	RTN	2T9	24			
HO	SIG	2T8	25	MSDP J24 - 77		
HO	RTN	2T8	26	MSDP J24 - 76		NOT WIRED
HO	SIG	2T7	27			
HO	RTN	2T7	28	MSDP J24 - 79		
HO	SIG	2T7	29	MSDP J24 - 78		NOT WIRED
HO	RTN	2T7	30			
HO	SIG	2T6	31	MSDP J24 - 51		
HO	RTN	2T6	32	MSDP J24 - 50		NOT WIRED
HO	SIG	2T5	33			
HO	RTN	2T5	34	MSDP J24 - 53		
HO	SIG	2T5	35	MSDP J24 - 52		NOT WIRED
HO	RTN	2T5	36			
HO	SIG	2T4	37	MSDP J24 - 55		
HO	RTN	2T4	38	MSDP J24 - 54		NOT WIRED
HO	SIG	2T3	39			
HO	RTN	2T3	40	MSDP J24 - 29		
HO	SIG	2T3	41	MSDP J24 - 28		NOT WIRED
HO	RTN	2T3	42			
HO	SIG	2T2	43	MSDP J24 - 31		
HO	RTN	2T2	44	MSDP J24 - 30		NOT WIRED
HO	SIG	2T2	45			

TABLE 13.6.1.1-9 PIN ASSIGNMENTS FOR STARBOARD Xo 603 CONNECTOR J1308

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
HO	SIG	2T1	46	MSDP J24 - 2		NOT WIRED
HO	RTN	2T1	47	MSDP J24 - 1		HO AT Xo 603, ML AT MSDP
			48			HO AT Xo 603, ML AT MSDP
HO	SIG	5T1	49	MSDP J24 - 33		HO AT Xo 603, ML AT MSDP
HO	SIG	5T1	50	MSDP J24 - 6		HO AT Xo 603, ML AT MSDP
HO	SIG	5T1	51	MSDP J24 - 5		HO AT Xo 603, ML AT MSDP
HO	SIG	5T1	52	MSDP J24 - 4		HO AT Xo 603, ML AT MSDP
HO	RTN	5T1	53	MSDP J24 - 32		HO AT Xo 603, ML AT MSDP
			54			NOT WIRED
HO	SIG	5T2	55	MSDP J24 - 36		HO AT Xo 603, ML AT MSDP
HO	SIG	5T2	56	MSDP J24 - 9		HO AT Xo 603, ML AT MSDP
HO	SIG	5T2	57	MSDP J24 - 8		HO AT Xo 603, ML AT MSDP
HO	SIG	5T2	58	MSDP J24 - 7		HO AT Xo 603, ML AT MSDP
HO	RTN	5T2	59	MSDP J24 - 35		HO AT Xo 603, ML AT MSDP
			60			NOT WIRED
HO	SIG	5T3	61	MSDP J24 - 12		HO AT Xo 603, ML AT MSDP
HO	SIG	5T3	62	MSDP J24 - 11		HO AT Xo 603, ML AT MSDP
HO	SIG	5T3	63	MSDP J24 - 10		HO AT Xo 603, ML AT MSDP
HO	SIG	5T3	64	MSDP J24 - 37		HO AT Xo 603, ML AT MSDP
HO	RTN	5T3	65	MSDP J24 - 38		HO AT Xo 603, ML AT MSDP
			66			NOT WIRED
HO	SIG	5T4	67	MSDP J24 - 15		HO AT Xo 603, ML AT MSDP
HO	SIG	5T4	68	MSDP J24 - 14		HO AT Xo 603, ML AT MSDP
HO	SIG	5T4	69	MSDP J24 - 13		HO AT Xo 603, ML AT MSDP
HO	SIG	5T4	70	MSDP J24 - 39		HO AT Xo 603, ML AT MSDP
HO	RTN	5T4	71	MSDP J24 - 40		HO AT Xo 603, ML AT MSDP
			72			NOT WIRED
HO	SIG	5T5	73	MSDP J24 - 18		HO AT Xo 603, ML AT MSDP
HO	SIG	5T5	74	MSDP J24 - 17		HO AT Xo 603, ML AT MSDP
HO	SIG	5T5	75	MSDP J24 - 16		HO AT Xo 603, ML AT MSDP
HO	SIG	5T5	76	MSDP J24 - 41		HO AT Xo 603, ML AT MSDP
HO	RTN	5T5	77	MSDP J24 - 42		HO AT Xo 603, ML AT MSDP
			78			NOT WIRED
			79			NOT WIRED

TABLE 13.6.1.1-10 PIN ASSIGNMENTS FOR PORT Xo 603 CONNECTOR J1317

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
			1			PINS 1-39 NOT WIRED
			39			
ML	SIG	2S1	40	PSDP J1317 - 26		PINS 1-39 NOT WIRED
ML	RTN	2S1	41	PSDP J1317 - 27		
ML	SHD	2S1	42	PSDP J1317 - 25		
ML	SIG	2S2	43	PSDP J1317 - 51		TERMINATE
ML	RTN	2S2	44	PSDP J1317 - 52		
ML	SHD	2S2	45	PSDP J1317 - 46		TERMINATE
ML	SIG	2S3	46	PSDP J1317 - 23		
ML	RTN	2S3	47	PSDP J1317 - 24		TERMINATE
ML	SHD	2S3	48	PSDP J1317 - 16		
ML	SIG	2S4	49	PSDP J1317 - 38		TERMINATE
ML	RTN	2S4	50	PSDP J1317 - 39		
ML	SHD	2S4	51	PSDP J1317 - 31		TERMINATE
ML	SIG	2S5	52	PSDP J1317 - 33		
ML	RTN	2S5	53	PSDP J1317 - 34		TERMINATE
ML	SHD	2S5	54	PSDP J1317 - 32		
ML	SIG	2S6	55	PSDP J1317 - 13		TERMINATE
ML	RTN	2S6	56	PSDP J1317 - 14		
ML	SHD	2S6	57	PSDP J1317 - 15		TERMINATE
ML	SIG	2S7	58	PSDP J1317 - 41		
ML	RTN	2S7	59	PSDP J1317 - 42		TERMINATE
ML	SHD	2S7	60	PSDP J1317 - 40		
ML	SIG	2S8	61	PSDP J1317 - 43		TERMINATE
ML	RTN	2S8	62	PSDP J1317 - 44		
ML	SHD	2S8	63	PSDP J1317 - 45		TERMINATE
ML	SIG	2S9	64	PSDP J1317 - 11		
ML	RTN	2S9	65	PSDP J1317 - 12		TERMINATE
ML	SHD	2S9	66	PSDP J1317 - 10		
ML	SIG	2S10	67	PSDP J1317 - 35		TERMINATE
ML	RTN	2S10	68	PSDP J1317 - 36		
ML	SHD	2S10	69	PSDP J1317 - 37		TERMINATE
ML	SIG	2S11	70	PSDP J1317 - 20		
ML	RTN	2S11	71	PSDP J1317 - 21		TERMINATE
ML	SHD	2S11	72	PSDP J1317 - 22		
ML	SIG	2S12	73	PSDP J1317 - 18		TERMINATE
ML	RTN	2S12	74	PSDP J1317 - 19		
ML	SHD	2S12	75	PSDP J1317 - 17		TERMINATE
ML	SIG	2S13	76	PSDP J1317 - 28		
ML	RTN	2S13	77	PSDP J1317 - 29		TERMINATE
ML	SHD	2S13	78	PSDP J1317 - 30		TERMINATE NOT WIRED
			79			

TABLE 13.6.1.1-11 PIN ASSIGNMENTS FOR PORT Xo 603 CONNECTOR J1319

EMC CLASS.	PIN FUNCT.	CABLE DESC.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
			1			NOT WIRED
			2			NOT WIRED
			3			NOT WIRED
			4			NOT WIRED
			5			NOT WIRED
			6			NOT WIRED
			7			NOT WIRED
			8			NOT WIRED
			9			NOT WIRED
			10			NOT WIRED
			11			NOT WIRED
			12			NOT WIRED
			13			NOT WIRED
			14			NOT WIRED
			15			NOT WIRED
			16			NOT WIRED
			17			NOT WIRED
			18			NOT WIRED
			19			NOT WIRED
			20			NOT WIRED
			21			NOT WIRED
			22			NOT WIRED
			23			NOT WIRED
			24			NOT WIRED
			25			NOT WIRED
			26			NOT WIRED
			27			NOT WIRED
ML	SIG	5S1	28	P01X5246Y DIL 46	8.2.2.3	MDM-PF1
ML	SIG	5S1	29	P01X5247Y DIL 47	8.2.2.3	MDM-PF1
ML	SIG	5S1	30	P01X5248Y DIL 48	8.2.2.3	MDM-PF1
ML	SIG	5S1	31	P01X5249Y DIL 49	8.2.2.3	MDM-PF1
ML	RTN	5S1	32	DIL 46-49 RETURN		
ML	SHD	5S1	33			
ML	SIG	2S2	34	P01U6164V AID 64	8.2.2.4	TERMINATE
ML	RTN	2S2	35	AID 64 RETURN		MDM-PF1
ML	SHD	2S2	36			
ML	SIG	2S1	37	P01X5250Y DIL 50	8.2.2.3	TERMINATE
ML	RTN	2S1	38	DIL 50 RETURN		MDM-PF1
ML	SHD	2S1	39			
ML	SIG	2S15	40	PSDP J1319 - 26		TERMINATE
ML	RTN	2S15	41	PSDP J1319 - 27		
ML	SHD	2S15	42	PSDP J1319 - 25		
ML	SIG	2S14	43	PSDP J1319 - 51		TERMINATE
ML	RTN	2S14	44	PSDP J1319 - 52		
ML	SHD	2S14	45	PSDP J1319 - 46		TERMINATE

TABLE 13.6.1.1-11 PIN ASSIGNMENTS FOR PORT Xo 603 CONNECTOR J1319

EMC CLASS.	PIN FUNCT.	CABLE DESC.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
ML	SIG	2513	46	PSDP J1319 - 23		
ML	RTN	2513	47	PSDP J1319 - 24		TERMINATE
ML	SIG	2513	48	PSDP J1319 - 16		
ML	SHD	2512	49	PSDP J1319 - 38		
ML	RTN	2512	50	PSDP J1319 - 39		TERMINATE
ML	SHD	2512	51	PSDP J1319 - 31		
ML	SIG	2511	52	PSDP J1319 - 33		
ML	RTN	2511	53	PSDP J1319 - 34		TERMINATE
ML	SHD	2511	54	PSDP J1319 - 32		
ML	SIG	2510	55	PSDP J1319 - 13		
ML	RTN	2510	56	PSDP J1319 - 14		TERMINATE
ML	SHD	2510	57	PSDP J1319 - 15		
ML	SIG	259	58	PSDP J1319 - 41		
ML	RTN	259	59	PSDP J1319 - 42		TERMINATE
ML	SHD	259	60	PSDP J1319 - 40		
ML	SIG	258	61	PSDP J1319 - 43		
ML	RTN	258	62	PSDP J1319 - 44		TERMINATE
ML	SHD	258	63	PSDP J1319 - 45		
ML	SIG	257	64	PSDP J1319 - 11		
ML	RTN	257	65	PSDP J1319 - 12		TERMINATE
ML	SHD	257	66	PSDP J1319 - 10		
ML	SIG	256	67	PSDP J1319 - 35		
ML	RTN	256	68	PSDP J1319 - 36		TERMINATE
ML	SHD	256	69	PSDP J1319 - 37		
ML	SIG	255	70	PSDP J1319 - 20		
ML	RTN	255	71	PSDP J1319 - 21		TERMINATE
ML	SHD	255	72	PSDP J1319 - 22		
ML	SIG	254	73	PSDP J1319 - 18		
ML	RTN	254	74	PSDP J1319 - 19		TERMINATE
ML	SHD	254	75	PSDP J1319 - 17		
ML	SIG	253	76	PSDP J1319 - 28		
ML	RTN	253	77	PSDP J1319 - 29		TERMINATE
ML	SHD	253	78	PSDP J1319 - 30		NOT WIRED
			79			

TABLE 13.6.1.1-12 PIN ASSIGNMENTS FOR PORT Xo 603 CONNECTOR J1321

EMC CLASS.	PIN FUNCT.	CABLE DESC.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
			1			PINS 1-39 NOT WIRED
ML	SIG	2S10	39	PSDP J43 - 56		PINS 1-39 NOT WIRED
ML	RTN	2S10	40	PSDP J43 - 57		
ML	SHD	2S10	41	PSDP J43 - 58		TERMINATE
ML	SIG	2S9	42	PSDP J43 - 59		
ML	RTN	2S9	43	PSDP J43 - 60		TERMINATE
ML	SHD	2S9	44	PSDP J43 - 61		
ML	SIG	2S13	45	PSDP J43 - 46		TERMINATE
ML	RTN	2S13	46	PSDP J43 - 47		
ML	SHD	2S13	47	PSDP J43 - 48		TERMINATE
ML	SIG	2S12	48	PSDP J43 - 49		
ML	RTN	2S12	49	PSDP J43 - 50		TERMINATE
ML	SHD	2S12	50	PSDP J43 - 51		
ML	SIG	2S11	51	PSDP J43 - 52		TERMINATE
ML	RTN	2S11	52	PSDP J43 - 53		
ML	SHD	2S11	53	PSDP J43 - 54		TERMINATE
ML	SIG	2S8	54	PSDP J43 - 62		
ML	RTN	2S8	55	PSDP J43 - 63		TERMINATE
ML	SHD	2S8	56	PSDP J43 - 64		
ML	SIG	2S7	57	PSDP J43 - 65		TERMINATE
ML	RTN	2S7	58	PSDP J43 - 66		
ML	SHD	2S7	59	PSDP J43 - 67		TERMINATE
ML	SIG	2S6	60	PSDP J43 - 68		
ML	RTN	2S6	61	PSDP J43 - 69		TERMINATE
ML	SHD	2S6	62	PSDP J43 - 80		
ML	SIG	2S2	63	PSDP J43 - 81		TERMINATE
ML	RTN	2S2	64	PSDP J43 - 82		
ML	SHD	2S2	65	PSDP J43 - 83		TERMINATE
ML	SIG	2S1	66	PSDP J43 - 84		
ML	RTN	2S1	67	PSDP J43 - 92		TERMINATE
ML	SHD	2S1	68	PSDP J43 - 70		
ML	SIG	2S5	69	PSDP J43 - 71		TERMINATE
ML	RTN	2S5	70	PSDP J43 - 72		
ML	SHD	2S5	71	PSDP J43 - 73		TERMINATE
ML	SIG	2S4	72	PSDP J43 - 74		
ML	RTN	2S4	73	PSDP J43 - 75		TERMINATE
ML	SHD	2S4	74	PSDP J43 - 76		
ML	SIG	2S3	75	PSDP J43 - 85		TERMINATE
ML	RTN	2S3	76	PSDP J43 - 85		
ML	SHD	2S3	77	PSDP J43 - 93		TERMINATE NOT WIRED
ML			78			
ML			79			



TABLE 13.6.1.1-13 PIN ASSIGNMENTS FOR PORT Xo 603 CONNECTOR J1323

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
			1			PINS 1-51 NOT WIRED
ML	SIG	252	51	PAYLOAD WARNING (A), PARAM 55 PARAMETER 55 RETURN	8.2.9	PINS 1-51 NOT WIRED CAUTION & WARNING ELECTRONICS ASSEMBLY
ML	RTN	252	52			
ML	SHD	252	53			
			54			TERMINATE
			55			NOT WIRED
			56			NOT WIRED
			57			NOT WIRED
ML	SIG	255	58	PAYLOAD WARNING (B), PARAM 65 PARAMETER 65 RETURN	8.2.9	CAUTION & WARNING ELECTRONICS ASSEMBLY
ML	RTN	255	59			
ML	SHD	255	60			
			61			TERMINATE
			62			NOT WIRED
			63			NOT WIRED
ML	SIG	254	64	PAYLOAD WARNING (C), PARAM 75 PARAMETER 75 RETURN	8.2.9	CAUTION & WARNING ELECTRONICS ASSEMBLY
ML	RTN	254	65			
ML	SHD	254	66			
			67			TERMINATE
			68			NOT WIRED
			69			NOT WIRED
ML	SIG	253	70	PAYLOAD WARNING (D), PARAM 85 PARAMETER 85 RETURN	8.2.9	CAUTION & WARNING ELECTRONICS ASSEMBLY
ML	RTN	253	71			
ML	SHD	253	72			
			73			TERMINATE
			74			NOT WIRED
			75			NOT WIRED
			76			NOT WIRED
ML	SIG	251	77	PAYLOAD WARNING (E), PARAM 95 PARAMETER 95 RETURN	8.2.9	CAUTION & WARNING ELECTRONICS ASSEMBLY
ML	RTN	251	78			
ML	SHD	251	79			
						TERMINATE
						NOT WIRED

TABLE 13.6.1.1-14 PIN ASSIGNMENTS FOR PORT Xo 603 CONNECTOR J1333

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
			1			PINS 1-51 NOT WIRED
HO	SIG	3T1	51	PSDP J1333 - 20		PINS 1-51 NOT WIRED
HO	SIG	3T1	52	PSDP J1333 - 21		
HO	RIN	3T1	53	PSDP J1333 - 22		
			54			
			55			
			56			NOT WIRED
			57			NOT WIRED
HO	SIG	3T2	58	PSDP J1333 - 17		NOT WIRED
HO	SIG	3T2	59	PSDP J1333 - 18		NOT WIRED
HO	RIN	3T2	60	PSDP J1333 - 19		NOT WIRED
			61			
			62			
			63			
HO	SIG	3T3	64	PSDP J1333 - 14		
HO	SIG	3T3	65	PSDP J1333 - 15		
HO	RIN	3T3	66	PSDP J1333 - 16		
			67			NOT WIRED
			68			NOT WIRED
			69			NOT WIRED
HO	SIG	3T4	70	PSDP J1333 - 11		
HO	SIG	3T4	71	PSDP J1333 - 12		
HO	RIN	3T4	72	PSDP J1333 - 13		
			73			
			74			
			75			NOT WIRED
HO	SIG	3T5	76	PSDP J1333 - 40		NOT WIRED
HO	SIG	3T5	77	PSDP J1333 - 41		NOT WIRED
HO	RIN	3T5	78	PSDP J1333 - 42		NOT WIRED
			79			

TABLE 13.6.1.1-15 PIN ASSIGNMENTS FOR PORT Xo 603 CONNECTOR J1335

EMC CLASS.	PIN FUNCT. DESCR.	CABLE #	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
			1			PINS 1-51 NOT WIRED
HO	SIG	3T1	51	PSDP J1335 - 20		PINS 1-51 NOT WIRED
HO	SIG	3T1	52	PSDP J1335 - 21		
HO	RTN	3T1	53	PSDP J1335 - 22		
			54			NOT WIRED
			55			NOT WIRED
			56			NOT WIRED
HO	SIG	3T2	57	PSDP J1335 - 17		
HO	SIG	3T2	58	PSDP J1335 - 18		
HO	RTN	3T2	59	PSDP J1335 - 19		
			60			NOT WIRED
			61			NOT WIRED
			62			NOT WIRED
			63			NOT WIRED
HO	SIG	3T3	64	PSDP J1335 - 14		
HO	SIG	3T3	65	PSDP J1335 - 15		
HO	RTN	3T3	66	PSDP J1335 - 16		
			67			NOT WIRED
			68			NOT WIRED
			69			NOT WIRED
HO	SIG	3T4	70	PSDP J1335 - 11		
HO	SIG	3T4	71	PSDP J1335 - 12		
HO	RTN	3T4	72	PSDP J1335 - 13		
			73			NOT WIRED
			74			NOT WIRED
			75			NOT WIRED
			76			NOT WIRED
HO	SIG	3T5	77	PSDP J1335 - 40		
HO	SIG	3T5	78	PSDP J1335 - 41		
HO	RTN	3T5	79	PSDP J1335 - 42		

TABLE 13.6.1.1-16 PIN ASSIGNMENTS FOR PORT Xo 603 CONNECTOR J1337

EMC CLASS.	PIN FUNCT.	CABLE DESC.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
			1			PINS 1-48 NOT WIRED
HO	SIG	5T2	48			
HO	SIG	5T2	49	P01K4122Y DOH 22	8.2.2.2	PINS 1-48 NOT WIRED
HO	SIG	5T2	50	P01K4120Y DOH 20		MDM-PF1
HO	SIG	5T2	51	P01K4119Y DOH 19		MDM-PF1
HO	SIG	5T2	52	P01K4121Y DOH 21		MDM-PF1
HO	RTN	5T2	53	DOH 19-22 RETURN		
HO	SIG	5T3	54			NOT WIRED
HO	SIG	5T3	55	P01K4126Y DOH 26	8.2.2.2	MDM-PF1
HO	SIG	5T3	56	P01K4124Y DOH 24		MDM-PF1
HO	SIG	5T3	57	P01K4123Y DOH 23		MDM-PF1
HO	SIG	5T3	58	P01K4125Y DOH 25		MDM-PF1
HO	RTN	5T3	59	DOH 23-26 RETURN		
HO	SIG	5T4	60			NOT WIRED
HO	SIG	5T4	61	P01K4130Y DOH 30	8.2.2.2	MDM-PF1
HO	SIG	5T4	62	P01K4128Y DOH 28		MDM-PF1
HO	SIG	5T4	63	P01K4127Y DOH 27		MDM-PF1
HO	SIG	5T4	64	P01K4129Y DOH 29		MDM-PF1
HO	RTN	5T4	65	DOH 27-30 RETURN		
HO	SIG	5T5	66			NOT WIRED
HO	SIG	5T5	67	P01K4134Y DOH 34	8.2.2.2	MDM-PF1
HO	SIG	5T5	68	P01K4132Y DOH 32		MDM-PF1
HO	SIG	5T5	69	P01K4131Y DOH 31		MDM-PF1
HO	SIG	5T5	70	P01K4133Y DOH 33		MDM-PF1
HO	RTN	5T5	71	DOH 31-34 RETURN		
HO	SIG	5T1	72			NOT WIRED
HO	SIG	5T1	73	P01K4138Y DOH 38	8.2.2.2	MDM-PF1
HO	SIG	5T1	74	P01K4137Y DOH 37		MDM-PF1
HO	SIG	5T1	75	P01K4135Y DOH 35		MDM-PF1
HO	SIG	5T1	76	P01K4136Y DOH 36		MDM-PF1
HO	RTN	5T1	77	DOH 35-38 RETURN		
HO	SIG	5T1	78			NOT WIRED
HO	RTN	5T1	79			NOT WIRED

NOTE : 1) WIRES ARE HO TYPE AT Xo 603, ML TYPE AT Xo 576  
 2) PINS 49-72 ARE ALSO SPLICED TO SMCH P1409/11/13/15

TABLE 13.6.1.2-1 PIN ASSIGNMENTS FOR STARBOARD Xo 645 CONNECTOR J37

EMC CLASS.	PIN FUNCT.	CABLE DESC.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PTN #		REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
HO	SIG	15C	A	KILL POWER AUX BUS A RETURN		7.3.4	MPCA # 2 AND # 3
HO	RTN	2T1	B				
			C				
HO	PMR	2T1	D	AUX BUS A		7.3.4	NOT WIRED MPCA - 1

TABLE 13.6.1.1.2-2 PIN ASSIGNMENTS FOR STARBOARD Xo 645 CONNECTOR J38

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
HO	RTN	2T1	A	AUX BUS B RETURN	7.3.4	NOT WIRED
HO	PMR	2T1	B C D	AUX BUS B	7.3.4	NOT WIRED MPCA - 2

TABLE 13.6.1.2-3 PIN ASSIGNMENTS FOR STARBOARD Xo 1203 CONNECTOR J1616

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
HO	PMR	2T1	A	AFT PAYLOAD BUS B	7.3.5	AFT PCA # 2 (CONTROLLED BY PANEL R1A1) NOT WIRED GROUND NOT WIRED
HO	RTN	2T1	B	AFT PAYLOAD BUS B RETURN		
			C			
			D			

TABLE 13.6.1.2-4 PIN ASSIGNMENTS FOR STARBOARD Xo 1203 CONNECTOR 46J1617

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
HO	PWR	2T1	A	AFT PAYLOAD BUS C	7.3.5	AFT PCA # 3 (CONTROLLED BY PANEL R1A1)
HO	RTN	2T1	B	AFT PAYLOAD BUS C RETURN		NOT WIRED
			C			GROUND
			D			NOT WIRED



TABLE 13.6.1.2-5 PIN ASSIGNMENTS FOR STARBOARD Xo 603 CONNECTOR J1306

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
			A			NOT WIRED
			B			NOT WIRED
			C			NOT WIRED
			D			NOT WIRED
			E			NOT WIRED
			F			NOT WIRED
			G			NOT WIRED
			H			NOT WIRED
			J			NOT WIRED
			K			NOT WIRED
			L			NOT WIRED
			M			NOT WIRED
			N			NOT WIRED
			P			NOT WIRED
			R			NOT WIRED
EO	SIG	4T1	S	MSDP J36 - F		
EO	SIG	4T1	T	MSDP J36 - G		
EO	SIG	4T1	U	MSDP J36 - H		
EO	NTL	4T1	V	MSDP J36 - K		

TABLE 13.6.1.2-6 PIN ASSIGNMENTS FOR STARBOARD Xo 603 CONNECTOR J1310

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
			A			NOT WIRED
			B			NOT WIRED
			C			NOT WIRED
			D			NOT WIRED
			E			NOT WIRED
			F			NOT WIRED
			G			NOT WIRED
			H			NOT WIRED
			J			NOT WIRED
			K			NOT WIRED
			L			NOT WIRED
			M			NOT WIRED
			N			NOT WIRED
			P			NOT WIRED
			R			NOT WIRED
EO	SIG	4T1	S	MSDP J38 - F		
EO	SIG	4T1	T	MSDP J38 - G		
EO	SIG	4T1	U	MSDP J38 - H		
EO	NLT	4T1	V	MSDP J38 - K		

TABLE 13.6.1.2-7 PIN ASSIGNMENTS FOR PORT & STARBOARD SILL LONGERON RETENTION SYSTEM POWER CONNECTORS (1)

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PAMEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
EO	SIG	4T1	1	AC PHASE A	7.6.3	(2)
EO	SIG	4T1	2	AC PHASE B	7.6.3	(2)
EO	SIG	4T1	3	AC PHASE C	7.6.3	(2)
EO	NTL	4T1	4	AC NEUTRAL	7.6.3	(2)
			5			NOT WIRED
			6			NOT WIRED
			7			NOT WIRED
HO	SIG	SC	8	PRLA LATCHED	7.6.2	
HO	SIG	SC	9	PRLA RELEASED	7.6.2	
HO	SIG	SC	10	28 VOLTS	7.6.2	COMMON TO WIPERS OF PINS 8, 9, & 12
			11			NOT WIRED
HO	SIG	SC	12	PRLA READY TO LATCH	7.6.2	
HL	SIG	2S1	13	GAS CAN CONTROL	3.3.3	SSP 1 OR SSP 2, SMCH P2113 OR P1113 (3)(4)
ML	RTN	2S1	14	GAS CAN CONTROL RETURN		SSP 1 OR SSP 2, SMCH P2113 OR P1113 (3)(4)
			15			NOT WIRED
			16			NOT WIRED
			17			NOT WIRED
			18			NOT WIRED
			19			NOT WIRED
			20			NOT WIRED
			21			NOT WIRED
			22			NOT WIRED

NOTES :

- (1) SEE TABLE 3.3.3-1 FOR COMPLETE LIST OF RETENTION SYSTEM POWER CONNECTORS
- (2) AC BUS 1 APPLICABLE TO SYSTEM 1, AC BUS 2 APPLICABLE TO SYSTEM 2
- (3) THIS PIN IS NORMALLY ASSIGNED TO A GET AWAY SPECIAL INTERFACE AND ITS WIRING IS LIMITED TO THE RETENTION SYSTEM POWER CONNECTORS SHOWN IN FIGURE 13.3.1.4-1.
- (4) SHIELD IS GROUNDED AT THE CONNECTOR BACKSHELL.

TABLE 13.6.1.4-1 PIN ASSIGNMENTS FOR SPECIAL PURPOSE END EFFECTOR CONNECTOR J411 (2)

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	MAX (1) AMPS	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
			1				
			2				NOT WIRED
HO	PMR	2T1	3	28 VOLTS SPEE POWER	5.6	13.6.1.4	NOT WIRED
HO	RTN	2T1	4	SPEE POWER RETURN	5.6		
HO	PMR	2T2	5	28 VOLTS SPEE POWER	5.6	13.6.1.4	
ML	SHD	2S1	6				TERMINATE
ML	SIG	2S1	7	SPEE # 5	1.5	13.6.1.4	
			8				
			9				
			10				
			11				
HO	PMR	4T1	12	SPEE # 3 HEATER POWER	3.7	13.6.1.4	
HO	PMR	4T1	13	SPEE # 2 HEATER POWER	3.7	13.6.1.4	
HO	RTN	2T2	14	SPEE POWER RETURN	5.6		
	GND	1SC	15	STRUCTURE GROUND			
ML	SIG	4S1	16	SPEE # 9	1.5	13.6.1.4	
ML	SIG	2S1	17	SPEE # 6	1.5	13.6.1.4	
			18				
			19				
			20				
			21				
			22				
HO	RTN	4T1	23	SPEE # 4 HEATER POWER	3.7		
HO	RTN	4T1	24	SPEE # 1 HEATER POWER	3.7		
	GND	1SC	25	STRUCTURE GROUND			
ML	SIG	4S1	26	SPEE # 10	1.5	13.6.1.4	
ML	SIG	4S1	27	SPEE # 11	1.5	13.6.1.4	
			28				
			29				
			30				
			31				
			32				
HO	SIG	1SC	33	SPEE # 13	1.5	13.6.1.4	
			34				
			35				
ML	SHD	4S1	36				
ML	SIG	4S1	37	SPEE # 12	1.5	13.6.1.4	
ML	SIG	2S2	38	SPEE # 7	1.5	13.6.1.4	
			39				
			40				
			41				
			42				
			43				
HO	SIG	1SC	44	SPEE # 14	1.5	13.6.1.4	
HO	SIG	1SC	45	SPEE # 15	1.5	13.6.1.4	

TABLE 13.6.1.4-1 PIN ASSIGNMENTS FOR SPECIAL PURPOSE END EFFECTOR CONNECTOR J411 (2)

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	MAX (1) AMPS	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
HO	SIG	15C	46	SPEE # 16	1.5	13.6.1.4	TERMINATE
ML	SHD	252	47				NOT WIRED
ML	SIG	252	48	SPEE # 8	1.5	13.6.1.4	NOT WIRED
			49				NOT WIRED
			50				NOT WIRED
			51				NOT WIRED
			52				NOT WIRED
			53				NOT WIRED
			54				NOT WIRED
			55				NOT WIRED

NOTES :

- (1) MAXIMUM AMPS IMPOSED ON ORBITER WIRING
- (2) ADDITIONAL INTERFACE DATA AVAILABLE IN ICD-2-06001

TABLE 13.6.2.1-1 SUMMARY OF PSDP CONNECTORS AVAILABLE AS NON STANDARD ELECTRICAL INTERFACES (INDEPENDENT OF SMCH) IN THE AFD

ORBITER CONNECTOR IDENTIFIER	CABLE DEFINITION			SEE TABLE	ORBITER INTERFACE CONNECTOR PART NO.	CARGO INTERFACE CONNECTOR PART NO.
	NO CIRCT	WIRE TYPE	EMC CLASS			
PSDP-J17	15	TSP	HO	3	NLS0T14-35SC	NLS6GT14-35PC
PSDP-J19	2	TP	HO			
PSDP-J23	20	TSP	RF	15	NLS0T16-35SA	NLS6GT16-35PA
PSDP-J27	10	TSP	RF	2	NLS0T12-35S	NLS6GT12-35P
PSDP-J33	1	TP	HO	2	NLS0T12-35P	NLS6GT12-35S
PSDP-J35	34	TSP	RF	2	NBOE14-4SNT	NB6GE14-4PNT
PSDP-J37	1	TQ	EO	11	NLS0T20-35S	NLS6GT20-35P
PSDP-J39	1	TQ	EO	6	NBOE12-10SNT2	NB6GE12-10PNT3
PSDP-J43	26	TSP	ML	6	NBOE12-10SMT2	NB6GE12-10PMT3
PSDP-J45	21	TSP	ML	22	NLS0T22-35S	NLS6GT22-35P
PSDP-J51	22	TSP	ML	16	NLS0T20-35PA	NLS6GT20-35SA
PSDP-J55	3	TSP	RF	13	NLS0T20-35P	NLS6GT20-35S
PSDP-J100	1	T3C	HO	28	NLS0T14-35P	NLS6GT14-35S
PSDP-J701	1	COAX	RF	20	NLS0T12-35S	NLS6GT12-35P
PSDP-J702	1	COAX	RF	0	MC414-0614-0041	MC414-0614-0011
PSDP-J703	1	COAX	RF	0	MC414-0614-0041	MC414-0614-0011
PSDP-J704	1	COAX	RF	0	MC414-0614-0041	MC414-0614-0011
PSDP-J705	1	COAX	RF	0	MC414-0614-0041	MC414-0614-0011
PSDP-J706	1	COAX	RF	0	MC414-0614-0041	MC414-0614-0011
PSDP-J707	1	COAX	RF	0	MC414-0614-0041	MC414-0614-0011
PSDP-J708	1	COAX	RF	0	MC414-0614-0041	MC414-0614-0011
PSDP-J709	1	COAX	RF	0	MC414-0614-0041	MC414-0614-0011
PSDP-J710	1	COAX	RF	0	MC414-0614-0041	MC414-0614-0011
PSDP-J714	1	COAX	RF	0	MC414-0614-0041	MC414-0614-0011
PSDP-J715	1	COAX	RF	0	MC414-0614-0041	MC414-0614-0011
PSDP-J716	1	COAX	RF	0	MC414-0614-0041	MC414-0614-0011
PSDP-J717	1	COAX	RF	0	MC414-0614-0041	MC414-0614-0011
PSDP-J718	1	COAX	RF	0	MC414-0614-0041	MC414-0614-0011
PSDP-J719	1	COAX	RF	0	MC414-0614-0041	MC414-0614-0011
PSDP-J720	1	COAX	RF	0	MC414-0614-0041	MC414-0614-0011
PSDP-J721	1	COAX	RF	0	MC414-0614-0041	MC414-0614-0011
PSDP-J722	1	COAX	RF	0	MC414-0614-0041	MC414-0614-0011
PSDP-J723	1	COAX	RF	0	MC414-0614-0041	MC414-0614-0011
PSDP-J724	1	COAX	RF	0	ME414-0247-0306	ME414-0250-0306
PSDP-J725	1	COAX	RF	0	ME414-0247-0306	ME414-0250-0306
PSDP-J726	1	COAX	RF	0	ME414-0247-0306	ME414-0250-0306
PSDP-J1301	11	TSP	RF	15	NLS0T14-35S	NLS6GT14-35P
PSDP-J1303	11	TSP	RF	15	NLS0T14-35S	NLS6GT14-35P

TABLE 13.6.2.1-1 SUMMARY OF PSDP CONNECTORS AVAILABLE AS NON STANDARD ELECTRICAL INTERFACES (INDEPENDENT OF SMCH) IN THE AFD

ORBITER CONNECTOR IDENTIFIER	CABLE DEFINITION					SEE TABLE	ORBITER INTERFACE CONNECTOR PART NO.	CARGO INTERFACE CONNECTOR PART NO.
	NO CIRCT	WIRE TYPE	EMC CLASS	SPARE PINS				
PSDP-J1305	11	TSP	RF	15	SEE TABLE	NLS0T14-35S NLS0T14-35S NLS0T16-35SD NLS0T16-35SC NLS0T16-35S	NLS6GT14-35P NLS6GT14-35P NLS6GT16-35PD NLS6GT16-35PC NLS6GT16-35P	
PSDP-J1307	10	TSP	RF	17				
PSDP-J1317	13	TSP	ML	16				
PSDP-J1319	13	TSP	ML	16				
PSDP-J1333	10	T3C	HO	16				
	2	TSP	ML					
	5	SC	HO					
PSDP-J1335	10	T3C	HO	16	13.6.2.1.1-12	NLS0T16-35S	NLS6GT16-35P	
	1	TSP	HO					
	7	SC	HO					

(1) SIGNAL IS CARRIED CONVENTIONALLY ON CENTER CONDUCTOR FOR ALL ORBITER COAX CABLES. NO PIN ASSIGNMENT TABLES ARE REQUIRED. CIRCUIT TERMINATIONS ARE SHOWN IN FIGURE 13.3.3-1.

TABLE 13.6.2.1.1-2 PIN ASSIGNMENTS FOR PSDP - J19

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
			1			
			2			NOT WIRED
			3			NOT WIRED
			4			NOT WIRED
RF	SIG	2S20	5	DATA BUS HI	8.2.12	DATA BUS COUPLER - PI1
RF	RTN	2S20	6	DATA BUS LO		
			7			NOT WIRED
			8			NOT WIRED
			9			NOT WIRED
			10			MASTER TIMING UNIT
RF	SIG	2S1	11	TIMING 1024 KHZ	8.2.10.2.2	
RF	RTN	2S1	12	TIMING 1024 KHZ RETURN		
RF	SIG	2S2	13	TIMING 1 KHZ	8.2.10.2.3	
RF	RTN	2S2	14	TIMING 1 KHZ RETURN		
RF	SIG	2S3	15	TIMING 100 HZ	8.2.10.2.4	
RF	RTN	2S3	16	TIMING 100 HZ RETURN		
RF	SIG	2S4	17	NSP 2 OUT		NETWORK SIGNAL PROCESSOR 2
RF	RTN	2S4	18	NSP 2 OUT RETURN		
RF	SIG	2S5	19	NSP 2 OUT CLOCK		NETWORK SIGNAL PROCESSOR 2
RF	RTN	2S5	20	NSP 2 OUT CLOCK RETURN		
RF	SIG	2S6	21	NSP 2 IN		NETWORK SIGNAL PROCESSOR 2
RF	RTN	2S6	22	NSP 2 IN RETURN		
RF	SIG	2S7	23	NSP # 2 PSS TIMING		NETWORK SIGNAL PROCESSOR 2
RF	RTN	2S7	24	NSP # 2 PSS TIMING RETURN		
			25			NOT WIRED
RF	SIG	2S8	26	DOD CMDS FSK AM TERNARY TONES	8.3.1	PAYLOAD INTERROGATOR 2
RF	RTN	2S8	27	DOD CMDS RETURN		
RF	SIG	2S9	28	16 KHZ COMMAND OUT 5	8.2.5	PAYLOAD SIGNAL PROCESSOR 2
RF	RTN	2S9	29	16 KHZ COMMAND OUT 5 RETURN		
RF	SIG	2S10	30	NSP 2 IN CLOCK		NETWORK SIGNAL PROCESSOR 2
RF	RTN	2S10	31	NSP 2 IN CLOCK RETURN		
RF	SIG	2S11	32	NSP 1 OUT		NETWORK SIGNAL PROCESSOR 1
RF	RTN	2S11	33	NSP 1 OUT RETURN		
RF	SIG	2S12	34	DOD DATA (1.024 &/OR 1.7 MHZ)	8.3.1	PAYLOAD INTERROGATOR 2
RF	RTN	2S12	35	DOD DATA RETURN		
RF	SIG	2S13	36	PDI TELEMETRY 5	8.2.1	PAYLOAD DATA INTERLEAVER
RF	RTN	2S13	37	PDI TELEMETRY 5 RETURN		
RF	SIG	2S14	38	NSP # 1 PSS TIMING		NETWORK SIGNAL PROCESSOR 1
RF	RTN	2S14	39	NSP # 1 PSS TIMING RETURN		
RF	SIG	2S15	40	NSP 1 OUT CLOCK		NETWORK SIGNAL PROCESSOR 1
RF	RTN	2S15	41	NSP 1 IN		
RF	SIG	2S16	42	NSP 1 IN RETURN		NETWORK SIGNAL PROCESSOR 1
RF	RTN	2S16	43	NSP 1 IN CLOCK		
RF	SIG	2S17	44	NSP 1 IN CLOCK RETURN		NETWORK SIGNAL PROCESSOR 1
RF	RTN	2S17	45	TIMING 10 HZ	8.2.10.2.5	MASTER TIMING UNIT
RF	SIG	2S18				



TABLE 13.6.2.1.1-2 PIN ASSIGNMENTS FOR PSDP - J19

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
RF	RTN	2S18	46	TIMING 10 HZ RETURN NSP 1 OUT CLOCK RETURN PDI CLOCK 5 PDI CLOCK 5 RETURN	8.2.1	PAYLOAD DATA INTERLEAVER  NOT WIRED NOT WIRED NOT WIRED NOT WIRED NOT WIRED
RF	RTN	2S15	47			
RF	SIG	2S19	48			
RF	RTN	2S19	49			
			50			
			51			
			52			
			53			
			54			
			55			

TABLE 13.6.2.1.1-3 PIN ASSIGNMENTS FOR PSDP - J23

EMC CLASS.	PIN FUNCT.	CABLE DESC.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
			1			NOT WIRED
			2			NOT WIRED
RF	SIG	2S10	3	DATA BUS PI2 HI	8.2.2.12	DATA BUS COUPLER - PI2
RF	RTN	2S10	4	DATA BUS PI2 LO		
RF	SIG	2S11	5	DATA BUS DK2 HI	8.2.2.12	DATA BUS COUPLER - DK2
RF	RTN	2S11	6	DATA BUS DK2 LO		
RF	SIG	2S4	7	CLOCK 128 KBPS	8.2.4.1	KU-BAND SIGNAL PROCESSOR
RF	RTN	2S4	8	CLOCK 128 KBPS RETURN		
RF	SIG	2S3	9	FWD DATA LINK 128 KBPS	8.2.4.5	KU-BAND SIGNAL PROCESSOR
RF	RTN	2S3	10	FWD DATA LINK 128 KBPS RETURN		
RF	SIG	2S6	11	HDR P/L DIGITAL DATA	8.2.4.3	KU-BAND SIGNAL PROCESSOR
RF	RTN	2S6	12	HDR P/L DIGITAL DATA RETURN		
RF	SIG	2S5	13	HDR P/L ANALOG DATA	8.2.4.4	KU-BAND SIGNAL PROCESSOR
RF	RTN	2S5	14	HDR P/L ANALOG DATA RETURN		
RF	SIG	2S9	15	LDR P/L DIGITAL DATA	8.2.4.2	KU-BAND SIGNAL PROCESSOR
RF	RTN	2S9	16	LDR P/L DIGITAL DATA RETURN		
RF	SIG	2S2	17	DIGITAL P/L DATA ENCR	8.2.6.3	S-BAND FM SIGNAL PROCESSOR
RF	RTN	2S2	18	DIGITAL P/L DATA ENCR RETURN		
RF	SIG	2S8	19	W/B DIGITAL SIGNAL	8.2.6.2	S-BAND FM SIGNAL PROCESSOR
RF	RTN	2S8	20	W/B DIGITAL SIGNAL RETURN		
RF	SIG	2S7	21	W/B ANALOG SIGNAL	8.2.6.1	S-BAND FM SIGNAL PROCESSOR
RF	RTN	2S7	22	W/B ANALOG SIGNAL RETURN		

TABLE 13.6.2.1.1-4 PIN ASSIGNMENTS FOR PSDP - J35

EMC CLASS.	PIN FUNCT.	CABLE DESC.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
			1			NOT WIRED
			2			NOT WIRED
			3			NOT WIRED
			4			NOT WIRED
			5			NOT WIRED
			6			NOT WIRED
			7			NOT WIRED
			8			NOT WIRED
			9			NOT WIRED
			10			NOT WIRED
			11			NOT WIRED
			12	WORD ENBL DISCRETE	8.2.2.5	MDM-PF1 SIO
RF	SIG	2542	13	WORD ENBL DISCRETE RETURN		
RF	RIN	2543	14	MSDP J40 - 7		
RF	RIN	2543	15	MSDP J40 - 6		
RF	SIG	2544	16	MSDP J40 - 9		
RF	RIN	2544	17	MSDP J40 - 8		
RF	SIG	2545	18	MSDP J40 - 11		
RF	RIN	2545	19	MSDP J40 - 10		
RF	SIG	2546	20	MSDP J40 - 13		
RF	RIN	2546	21	MSDP J40 - 12		
RF	SIG	2534	22	1.024 &/OR 1.7 MHZ DATA SCO	8.3.1	PAYLOAD INTERROGATOR 1
RF	RIN	2534	23	1.024 &/OR 1.7 MHZ DATA RTN		
RF	SIG	2533	24	DOD CMDS FSK AM TERNARY TONES	8.3.1	PAYLOAD INTERROGATOR 1
RF	RIN	2533	25	DOD CMDS FSK AM TERNARY RETURN		
RF	SIG	2551	26	16 KHZ CMD OUT NO. 5	8.2.5	PAYLOAD SIGNAL PROCESSOR 1
RF	RIN	2551	27	16 KHZ CMD OUT NO. 5 RETURN		
RF	SIG	2541	28	MSG OUT DISCRETE	8.2.2.5	MDM-PF1 SIO
RF	RIN	2541	29	MSG OUT DISCRETE RETURN		
RF	SIG	2540	30	MSG IN DISCRETE	8.2.2.5	MDM-PF1 SIO
RF	RIN	2540	31	MSG IN DISCRETE RETURN		
RF	SIG	2539	32	POIM120J SIO 20	8.2.2.5	MDM-PF1 SIO PAYLOAD SENSOR
RF	RIN	2539	33	SIO 20 RETURN		
RF	SIG	2538	34	WORD ENBL DISCRETE	8.2.2.5	MDM-PF1 SIO
RF	RIN	2538	35	WORD ENBL DISCRETE RETURN		
RF	SIG	2537	36	MSG OUT DISCRETE	8.2.2.5	MDM-PF1 SIO
RF	RIN	2537	37	MSG OUT DISCRETE RETURN		
RF	SIG	2536	38	MSG IN DISCRETE	8.2.2.5	MDM-PF1 SIO
RF	RIN	2536	39	MSG IN DISCRETE RETURN		
RF	SIG	2535	40	POIM100J SIO 00	8.2.2.5	MDM-PF1 SIO PAYLOAD GN & C
RF	RIN	2535	41	SIO 00 RETURN		
RF	SIG	252	42	B1 SERIAL INPUT	8.2.3	PAYLOAD RECORDER
RF	RIN	252	43	B1 SERIAL RETURN		
RF	SIG	251	44	A2 SERIAL INPUT	8.2.3	PAYLOAD RECORDER
RF	RIN	251	45	A2 SERIAL RETURN		

TABLE 13.6.2.1.1-4 PIN ASSIGNMENTS FOR PSDP - J35

EMC CLASS.	PIN FUNCT.	CABLE DESC.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
RF	SIG	2S17	46	A1 SERIAL INPUT	8.2.3	PAYLOAD RECORDER
RF	RTN	2S17	47	A1 SERIAL RETURN		
RF	SIG	2S16	48	TRK 14 PARALLEL INPUT	8.2.3	PAYLOAD RECORDER
RF	RTN	2S16	49	TRK 14 PARALLEL RETURN		
RF	SIG	2S15	50	TRK 13 PARALLEL INPUT	8.2.3	PAYLOAD RECORDER
RF	RTN	2S15	51	TRK 13 PARALLEL RETURN		
RF	SIG	2S14	52	TRK 12 PARALLEL INPUT	8.2.3	PAYLOAD RECORDER
RF	RTN	2S14	53	TRK 12 PARALLEL RETURN		
RF	SIG	2S13	54	TRK 11 PARALLEL INPUT	8.2.3	PAYLOAD RECORDER
RF	RTN	2S13	55	TRK 11 PARALLEL RETURN		
RF	SIG	2S12	56	TRK 10 PARALLEL INPUT	8.2.3	PAYLOAD RECORDER
RF	RTN	2S12	57	TRK 10 PARALLEL RETURN		
RF	SIG	2S11	58	TRK 9 PARALLEL INPUT	8.2.3	PAYLOAD RECORDER
RF	RTN	2S11	59	TRK 9 PARALLEL RETURN		
RF	SIG	2S31	60	TRK 14 ANALOG INPUT	8.2.3	PAYLOAD RECORDER
RF	RTN	2S31	61	TRK 14 ANALOG RETURN		
RF	SIG	2S30	62	TRK 13 ANALOG INPUT	8.2.3	PAYLOAD RECORDER
RF	RTN	2S30	63	TRK 13 ANALOG RETURN		
RF	SIG	2S29	64	TRK 4 ANALOG INPUT	8.2.3	PAYLOAD RECORDER
RF	RTN	2S29	65	TRK 4 ANALOG RETURN		
RF	SIG	2S28	66	TRK 3 ANALOG INPUT	8.2.3	PAYLOAD RECORDER
RF	RTN	2S28	67	TRK 3 ANALOG RETURN		
RF	SIG	2S27	68	TRK 2 ANALOG INPUT	8.2.3	PAYLOAD RECORDER
RF	RTN	2S27	69	TRK 2 ANALOG RETURN		
RF	SIG	2S26	70	TRK 1 ANALOG INPUT	8.2.3	PAYLOAD RECORDER
RF	RTN	2S26	71	TRK 1 ANALOG RETURN		
RF	SIG	2S25	72	TRK 8 ANALOG INPUT	8.2.3	PAYLOAD RECORDER
RF	RTN	2S25	73	TRK 8 ANALOG RETURN		
RF	SIG	2S24	74	TRK 7 ANALOG INPUT	8.2.3	PAYLOAD RECORDER
RF	RTN	2S24	75	TRK 7 ANALOG RETURN		
RF	SIG	2S23	76	TRK 6 ANALOG INPUT	8.2.3	PAYLOAD RECORDER
RF	RTN	2S23	77	TRK 6 ANALOG RETURN		
RF	SIG	2S22	78	TRK 5 ANALOG INPUT	8.2.3	PAYLOAD RECORDER
RF	RTN	2S22	79	TRK 5 ANALOG RETURN		

TABLE 13.6.2.1.1-7 PIN ASSIGNMENTS FOR PSDP - J43

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
ML	SHD	2S24	1		8.2.7	TERMINATE
			2			NOT WIRED
			3			NOT WIRED
			4			NOT WIRED
			5			NOT WIRED
			6			NOT WIRED
			7			NOT WIRED
ML	SIG	2S24	8	AUDIO OUT EIC HI	8.2.7	AUDIO CENTRAL CONTROL UNIT
ML	RIN	2S24	9	AUDIO OUT EIC LO		
ML	SHD	5S25	10			TERMINATE
ML	SIG	5S25	11	AUDIO OUT PAGE HI	8.2.7	AUDIO CENTRAL CONTROL UNIT
ML	RIN	5S25	12	AUDIO OUT PAGE LO		
ML	SHD	5S26	13			TERMINATE
ML	SIG	5S26	14	P/L C/W TONE	8.2.7	AUDIO CENTRAL CONTROL UNIT
ML	RIN	5S26	15	P/L C/W TONE RETURN		
ML	SIG	5S21	16	AUDIO OUT AG2 HI	8.2.7	AUDIO CENTRAL CONTROL UNIT
ML	RIN	5S21	17	AUDIO OUT AG2 LO		
ML	SHD	5S21	18			TERMINATE
ML	SIG	5S22	19	AUDIO OUT AA HI	8.2.7	AUDIO CENTRAL CONTROL UNIT
ML	RIN	5S22	20	AUDIO OUT AA LO		
ML	SHD	5S22	21			TERMINATE
ML	SIG	5S23	22	AUDIO OUT OIC HI	8.2.7	AUDIO CENTRAL CONTROL UNIT
ML	RIN	5S23	23	AUDIO OUT OIC LO		
ML	SHD	5S23	24			TERMINATE
ML	SHD	5S18	25			TERMINATE
ML	SIG	5S18	26	AUDIO IN EIC HI	8.2.7	AUDIO CENTRAL CONTROL UNIT
ML	RIN	5S18	27	AUDIO IN EIC LO		
ML	SHD	5S19	28			TERMINATE
ML	SIG	5S19	29	AUDIO IN PAGE HI	8.2.7	AUDIO CENTRAL CONTROL UNIT
ML	RIN	5S19	30	AUDIO IN PAGE LO		
ML	SHD	5S20	31			TERMINATE
ML	SIG	5S20	32	AUDIO OUT AG1 HI	8.2.7	AUDIO CENTRAL CONTROL UNIT
ML	RIN	5S20	33	AUDIO OUT AG1 LO		
ML	SHD	2S17	34			TERMINATE
ML	SIG	2S14	35	AUDIO IN AG1 HI	8.2.7	AUDIO CENTRAL CONTROL UNIT
ML	RIN	2S14	36	AUDIO IN AG1 LO		
ML	SHD	2S14	37			TERMINATE
ML	SIG	2S15	38	AUDIO IN AG2 HI	8.2.7	AUDIO CENTRAL CONTROL UNIT
ML	RIN	2S15	39	AUDIO IN AG2 LO		
ML	SHD	2S15	40			TERMINATE
ML	SIG	2S16	41	AUDIO IN AA HI	8.2.7	AUDIO CENTRAL CONTROL UNIT
ML	RIN	2S16	42	AUDIO IN AA LO		
ML	SHD	2S16	43			TERMINATE
ML	SIG	2S17	44	AUDIO IN OIC HI	8.2.7	AUDIO CENTRAL CONTROL UNIT
ML	RIN	2S17	45	AUDIO IN OIC LO		

TABLE 13.6.2.1.1-7 PIN ASSIGNMENTS FOR PSDP - J43

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
ML	SIG	2S13	46	Xo 603 J1321 - 46		
ML	RTN	2S13	47	Xo 603 J1321 - 47		
ML	SHD	2S13	48	Xo 603 J1321 - 48		
ML	SIG	2S12	49	Xo 603 J1321 - 49		
ML	RTN	2S12	50	Xo 603 J1321 - 50		
ML	SHD	2S12	51	Xo 603 J1321 - 51		
ML	SIG	2S11	52	Xo 603 J1321 - 52		
ML	RTN	2S11	53	Xo 603 J1321 - 53		
ML	SHD	2S11	54	Xo 603 J1321 - 54		
ML	SHD	2S7	55	Xo 603 J1321 - 60		
ML	SIG	2S10	56	Xo 603 J1321 - 40		
ML	RTN	2S10	57	Xo 603 J1321 - 41		
ML	SHD	2S10	58	Xo 603 J1321 - 42		
ML	SIG	2S9	59	Xo 603 J1321 - 43		
ML	RTN	2S9	60	Xo 603 J1321 - 44		
ML	SHD	2S9	61	Xo 603 J1321 - 45		
ML	SIG	2S8	62	Xo 603 J1321 - 55		
ML	RTN	2S8	63	Xo 603 J1321 - 56		
ML	SHD	2S8	64	Xo 603 J1321 - 57		
ML	SIG	2S7	65	Xo 603 J1321 - 58		
ML	RTN	2S7	66	Xo 603 J1321 - 59		
ML	SIG	2S6	67	Xo 603 J1321 - 61		
ML	RTN	2S6	68	Xo 603 J1321 - 62		
ML	SHD	2S6	69	Xo 603 J1321 - 63		
ML	SIG	2S5	70	Xo 603 J1321 - 70		
ML	RTN	2S5	71	Xo 603 J1321 - 71		
ML	SHD	2S5	72	Xo 603 J1321 - 72		
ML	SIG	2S4	73	Xo 603 J1321 - 73		
ML	RTN	2S4	74	Xo 603 J1321 - 74		
ML	SHD	2S4	75	Xo 603 J1321 - 75		
ML	SIG	2S3	76	Xo 603 J1321 - 76		
			77			
			78			
			79			
ML	SIG	2S2	80	Xo 603 J1321 - 64		
ML	RTN	2S2	81	Xo 603 J1321 - 65		
ML	SHD	2S2	82	Xo 603 J1321 - 66		
ML	SIG	2S1	83	Xo 603 J1321 - 67		
ML	RTN	2S1	84	Xo 603 J1321 - 68		
ML	RTN	2S3	85	Xo 603 J1321 - 77		
			86			NOT WIRED
			87			NOT WIRED
			88			NOT WIRED
			89			NOT WIRED
			90			NOT WIRED

TABLE 13.6.2.1.1-7 PIN ASSIGNMENTS FOR PSDP - J43

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
ML	SHD	2S1	91			NOT WIRED
ML	SHD	2S3	92	Xo 603 J1321 - 69		TERMINATE
			93	Xo 603 J1321 - 78		TERMINATE
			94			NOT WIRED
			95			NOT WIRED
			96			NOT WIRED
			97			NOT WIRED
			98			NOT WIRED
			99			NOT WIRED
			100			NOT WIRED

TABLE 13.6.2.1.1-8 PIN ASSIGNMENTS FOR PSDP - J45

EMC CLASS.	PIN FUNCT.	CABLE DESC.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
ML	SHD	2S9	1	OOSDP J61 - 54		TERMINATE
ML	SHD	2S16	2	OOSDP J61 - 57		TERMINATE
			3			NOT WIRED
			4			NOT WIRED
			5			NOT WIRED
			6			NOT WIRED
			7			NOT WIRED
ML	SIG	2S12	8	OOSDP J61 - 4		TERMINATE
ML	RTN	2S12	9	OOSDP J61 - 32		
ML	SHD	2S12	10	OOSDP J61 - 5		
ML	SIG	2S14	11	OOSDP J61 - 6		
ML	RTN	2S14	12	OOSDP J61 - 7		
ML	SIG	2S15	13	OOSDP J61 - 35		
ML	RTN	2S15	14	OOSDP J61 - 36		
ML	SHD	2S15	15	OOSDP J61 - 56		
			16			
			17			
ML	SIG	2S13	18	OOSDP J61 - 34		TERMINATE
ML	RTN	2S13	19	OOSDP J61 - 33		NOT WIRED
ML	SHD	2S13	20	OOSDP J61 - 55		NOT WIRED
ML	SHD	2S19	21	OOSDP J61 - 12		TERMINATE
			22			NOT WIRED
			23			NOT WIRED
			24			TERMINATE
ML	SHD	2S8	25	OOSDP J61 - 52		
ML	SIG	2S8	26	OOSDP J61 - 31		
ML	RTN	2S8	27	OOSDP J61 - 53		
ML	SIG	2S9	28	OOSDP J61 - 69		
ML	RTN	2S9	29	OOSDP J61 - 70		
ML	SIG	2S16	30	OOSDP J61 - 71		
ML	RTN	2S16	31	OOSDP J61 - 58		
ML	SIG	2S17	32	OOSDP J61 - 9		
ML	RTN	2S17	33	OOSDP J61 - 10		
ML	SHD	2S17	34	OOSDP J61 - 11		
ML	RTN	2S1	35	OOSDP J61 - 1		
ML	SIG	2S1	36	OOSDP J61 - 2		
ML	SHD	2S1	37	OOSDP J61 - 3		
ML	SHD	2S14	38	OOSDP J61 - 8		
			39			
			40			
ML	SIG	2S18	41	OOSDP J61 - 72		TERMINATE
ML	RTN	2S18	42	OOSDP J61 - 59		TERMINATE
ML	SHD	2S18	43	OOSDP J61 - 73		NOT WIRED
ML	SIG	2S19	44	OOSDP J61 - 37		TERMINATE
ML	RTN	2S19	45	OOSDP J61 - 38		



TABLE 13.6.2.1.1-8 PIN ASSIGNMENTS FOR PSDP - J45

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
ML	SIG	2S2	46	00SDP J61 - 29		
ML	RTN	2S2	47	00SDP J61 - 28		
ML	SIG	2S5	48	00SDP J61 - 51		
ML	RTN	2S5	49	00SDP J61 - 67		
ML	SIG	2S10	50	00SDP J61 - 77		
ML	RTN	2S10	51	00SDP J61 - 79		
ML	SHD	2S10	52	00SDP J61 - 78		TERMINATE
ML	SIG	2S20	53	00SDP J61 - 61		
ML	RTN	2S20	54	00SDP J61 - 62		
ML	SHD	2S20	55	00SDP J61 - 44		TERMINATE
ML	SIG	2S3	56	00SDP J61 - 50		
ML	RTN	2S3	57	00SDP J61 - 27		
ML	SHD	2S3	58	00SDP J61 - 26		TERMINATE
ML	SIG	2S6	59	00SDP J61 - 65		
ML	RTN	2S6	60	00SDP J61 - 64		
ML	SHD	2S6	61	00SDP J61 - 47		TERMINATE
ML	SIG	2S11	62	00SDP J61 - 75		
ML	RTN	2S11	63	00SDP J61 - 74		
ML	SHD	2S11	64	00SDP J61 - 76		TERMINATE
ML	SHD	2S2	65	00SDP J61 - 30		TERMINATE
ML	SHD	2S5	66	00SDP J61 - 68		TERMINATE
			67			NOT WIRED
ML	SIG	2S4	68	00SDP J61 - 49		
ML	RTN	2S4	69	00SDP J61 - 48		
ML	SHD	2S4	70	00SDP J61 - 66		TERMINATE
ML	SIG	2S7	71	00SDP J61 - 46		
ML	RTN	2S7	72	00SDP J61 - 45		
ML	SHD	2S7	73	00SDP J61 - 63		TERMINATE
ML	SIG	2S21	74	00SDP J61 - 42		
ML	RTN	2S21	75	00SDP J61 - 43		TERMINATE
ML	SHD	2S21	76	00SDP J61 - 60		TERMINATE
			77			NOT WIRED
			78			NOT WIRED
			79			NOT WIRED

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
			1			NOT WIRED
			2			NOT WIRED
			3			NOT WIRED
			4			NOT WIRED
			5			NOT WIRED
			6			NOT WIRED
			7			NOT WIRED
			8			NOT WIRED
			9			NOT WIRED
			10			NOT WIRED
			11			NOT WIRED
			12			NOT WIRED
			13			NOT WIRED
		2S2	14	00SDP J59 - 14		TERMINATE
ML	SIG	2S2	15	00SDP J59 - 15		TERMINATE
ML	RTN	2S2	16	00SDP J59 - 16		TERMINATE
ML	SHD	2S1	17	00SDP J59 - 17		TERMINATE
ML	SIG	2S1	18	00SDP J59 - 18		TERMINATE
ML	RTN	2S1	19	00SDP J59 - 19		TERMINATE
ML	SHD	2S1	20	00SDP J59 - 20		TERMINATE
ML	SIG	2S9	21	00SDP J59 - 21		TERMINATE
ML	RTN	2S9	22	00SDP J59 - 22		TERMINATE
ML	SHD	2S12	23	00SDP J59 - 23		TERMINATE
ML	SIG	2S12	24	00SDP J59 - 24		TERMINATE
ML	RTN	2S12	25	00SDP J59 - 25		TERMINATE
ML	SHD	2S14	26	00SDP J59 - 26		TERMINATE
ML	SIG	2S14	27	00SDP J59 - 27		TERMINATE
ML	RTN	2S14	28	00SDP J59 - 28		TERMINATE
ML	SHD	2S14	29	00SDP J59 - 29		TERMINATE
ML	SIG	2S15	30	00SDP J59 - 30		TERMINATE
ML	RTN	2S15	31	00SDP J59 - 31		TERMINATE
ML	SHD	2S15	32	00SDP J59 - 32		TERMINATE
ML	SIG	2S8	33	00SDP J59 - 33		TERMINATE
ML	RTN	2S8	34	00SDP J59 - 34		TERMINATE
ML	SHD	2S8	35	00SDP J59 - 35		TERMINATE
ML	SIG	2S7	36	00SDP J59 - 36		TERMINATE
ML	RTN	2S7	37	00SDP J59 - 37		TERMINATE
ML	SHD	2S7	38	00SDP J59 - 38		TERMINATE
ML	SIG	2S4	39	00SDP J59 - 39		TERMINATE
ML	RTN	2S4	40	00SDP J59 - 40		TERMINATE
ML	SHD	2S4	41	00SDP J59 - 41		TERMINATE
ML	SIG	2S3	42	00SDP J59 - 42		TERMINATE
ML	RTN	2S3	43	00SDP J59 - 43		TERMINATE
ML	SHD	2S3	44	00SDP J59 - 44		TERMINATE
ML	SIG	2S10	45	00SDP J59 - 45		TERMINATE
ML	RTN	2S10				

TABLE 13.6.2.1.1-9 PIN ASSIGNMENTS FOR PSDP - J51

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
ML	SHD	2S10	46	OOSDP J59 - 46		TERMINATE
ML	RTN	2S13	47	OOSDP J59 - 47		
ML	SIG	2S13	48	OOSDP J59 - 48		
ML	SHD	2S13	49	OOSDP J59 - 49		TERMINATE
ML	RTN	2S17	50	OOSDP J59 - 50		
ML	SIG	2S17	51	OOSDP J59 - 51		
ML	SHD	2S17	52	OOSDP J59 - 52		TERMINATE
ML	RTN	2S16	53	OOSDP J59 - 53		
ML	SIG	2S16	54	OOSDP J59 - 54		
ML	SHD	2S16	55	OOSDP J59 - 55		TERMINATE
ML	SIG	2S6	56	OOSDP J59 - 56		
ML	RTN	2S6	57	OOSDP J59 - 57		
ML	SHD	2S6	58	OOSDP J59 - 58		TERMINATE
ML	SIG	2S5	59	OOSDP J59 - 59		
ML	RTN	2S5	60	OOSDP J59 - 60		
ML	SHD	2S5	61	OOSDP J59 - 61		TERMINATE
ML	SIG	2S11	62	OOSDP J59 - 62		
ML	RTN	2S11	63	OOSDP J59 - 63		
ML	SHD	2S11	64	OOSDP J59 - 64		TERMINATE
ML	RTN	2S18	65	OOSDP J59 - 65		
ML	SIG	2S18	66	OOSDP J59 - 66		
ML	SHD	2S18	67	OOSDP J59 - 67		TERMINATE
ML	RTN	2S21	68	OOSDP J59 - 68		
ML	SIG	2S21	69	OOSDP J59 - 69		
ML	SHD	2S21	70	OOSDP J59 - 70		TERMINATE
ML	SIG	2S19	71	OOSDP J59 - 71		
ML	RTN	2S19	72	OOSDP J59 - 72		
ML	SHD	2S19	73	OOSDP J59 - 73		TERMINATE
ML	SIG	2S20	74	OOSDP J59 - 74		
ML	RTN	2S20	75	OOSDP J59 - 75		
ML	SHD	2S20	76	OOSDP J59 - 76		TERMINATE
ML	RTN	2S22	77	OOSDP J59 - 77		
ML	SIG	2S22	78	OOSDP J59 - 78		
ML	SHD	2S22	79	OOSDP J59 - 79		TERMINATE

TABLE 13.6.2.1.1-10 PIN ASSIGNMENTS FOR PSDP - J17

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
			1			
			2			
			3			
HO	SIG	2T39	4	PAGE KEY		
HO	RTN	2T39	5	PAGE KEY RETURN		
HO	SIG	2T40	6	PAGE KEY HI EVA		
HO	RTN	2T40	7	PTT OUT HI EVA		
HO	RTN	2T22	8	PTT OUT LO EVA		
HO	RTN	2T22	9	OOSDP J57 - 23	8.2.7	NOT WIRED
HO	SIG	2T21	10	OOSDP J57 - 24		NOT WIRED
HO	RTN	2T21	11	OOSDP J57 - 21		NOT WIRED
HO	SIG	2T20	12	OOSDP J57 - 22		
HO	SIG	2T20	13	OOSDP J57 - 19		
HO	RTN	2T19	14	OOSDP J57 - 20		
HO	SIG	2T19	15	OOSDP J57 - 17		
HO	RTN	2T18	16	OOSDP J57 - 18		
HO	SIG	2T18	17	OOSDP J57 - 45		
HO	SIG	2T17	18	OOSDP J57 - 46		
HO	SIG	2T17	19	OOSDP J57 - 43		
HO	RTN	2T16	20	OOSDP J57 - 44		
HO	SIG	2T16	21	OOSDP J57 - 41		
HO	RTN	2T15	22	OOSDP J57 - 42		
HO	SIG	2T15	23	OOSDP J57 - 38		
HO	RTN	2T14	24	OOSDP J57 - 39		
HO	SIG	2T14	25	OOSDP J57 - 36		
HO	RTN	2T13	26	OOSDP J57 - 37		
HO	SIG	2T13	27	OOSDP J57 - 34		
HO	RTN	2T12	28	OOSDP J57 - 35		
HO	SIG	2T12	29	OOSDP J57 - 40		
HO	RTN	2T11	30	OOSDP J57 - 33		
HO	SIG	2T11	31	OOSDP J57 - 30		
HO	RTN	2T10	32	OOSDP J57 - 31		
HO	SIG	2T10	33	OOSDP J57 - 28		
HO	RTN	2T10	34	OOSDP J57 - 29		
HO	SIG	2T9	35	OOSDP J57 - 26		
HO	RTN	2T9	36	OOSDP J57 - 27		
HO	SIG	2T8	37	OOSDP J57 - 32	8.2.7	SPLICED TO ACCU & UHF EVA/ATC XCVR
HO	RTN	2T8		OOSDP J57 - 25		

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
			1			
			2			
HO	SIG	SC	3	ACCU VOICE ENABLE		NOT WIRED
HO	SIG	SC	4	PS VOICE ENABLE		NOT WIRED
HO	SIG	SC	5	A1A3 VOICE ENABLE		NETWORK SIGNAL PROCESSOR # 1
HO	SIG	SC	6	28 VDC MAIN BUS B		NETWORK SIGNAL PROCESSOR # 1
HO	SIG	SC	7	DOD ENABLE		PANEL A1A3
			8			FORWARD LCA # 2
			9			PAYLOAD INTERROGATOR # 1
			10			NOT WIRED
			11	Xo 603 J1333 - 70		NOT WIRED
HO	SIG	3T4	12	Xo 603 J1333 - 71		
HO	RTN	3T4	13	Xo 603 J1333 - 72		
HO	SIG	3T3	14	Xo 603 J1333 - 64		
HO	SIG	3T3	15	Xo 603 J1333 - 65		
HO	RTN	3T3	16	Xo 603 J1333 - 66		
HO	SIG	3T2	17	Xo 603 J1333 - 58		
HO	SIG	3T2	18	Xo 603 J1333 - 59		
HO	RTN	3T2	19	Xo 603 J1333 - 60		
HO	SIG	3T1	20	Xo 603 J1333 - 52		
HO	SIG	3T1	21	Xo 603 J1333 - 53		
HO	RTN	3T1	22	Xo 603 J1333 - 54		
ML	SIG	2S2	23	ENCRYPTOR ZEROIZE	8.2.14	NOT WIRED
ML	RTN	2S2	24	ENCRYPTOR ZEROIZE RETURN		KGX-60 COMSEC
HO	SIG	3T8	25	ACTIVE 2A		
HO	RTN	3T8	26	COM 2A	8.2.9	PANEL C3A5 - PAYLOAD SAFING
HO	SIG	3T8	27	SAFE 2A		
HO	SIG	3T8	28	ACTIVE 3A	8.2.9	PANEL C3A5 - PAYLOAD SAFING
HO	SIG	3T9	29	ACTIVE 3A	8.2.9	PANEL C3A5 - PAYLOAD SAFING
HO	RTN	3T9	30	COM 3A		
HO	SIG	3T9	31	SAFE 3A	8.2.9	PANEL C3A5 - PAYLOAD SAFING
HO	SIG	3T10	32	ACTIVE 4A	8.2.9	PANEL C3A5 - PAYLOAD SAFING
HO	RTN	3T10	33	COM 4A		
HO	SIG	3T10	34	SAFE 4A	8.2.9	PANEL C3A5 - PAYLOAD SAFING
HO	SIG	3T6	35	ACTIVE 5A	8.2.9	PANEL C3A5 - PAYLOAD SAFING
HO	RTN	3T6	36	COM 5A		
HO	SIG	3T6	37	SAFE 5A	8.2.9	PANEL C3A5 - PAYLOAD SAFING
ML	SIG	2S1	38	ENCRYPTOR ZEROIZE	8.2.14	PANEL RT2A2
ML	RTN	2S1	39	ENCRYPTOR ZEROIZE RETURN		
HO	SIG	3T5	40	Xo 603 J1333 - 76		
HO	SIG	3T5	41	Xo 603 J1333 - 77		
HO	RTN	3T5	42	Xo 603 J1333 - 78		
HO	SIG	3T7	43	SAFE 1A	8.2.9	PANEL C3A5 - PAYLOAD SAFING
HO	RTN	3T7	44	ACTIVE 1A		
HO	SIG	3T7	45	COM 1A	8.2.9	PANEL C3A5 - PAYLOAD SAFING
ML			46			NOT WIRED
ML			47			NOT WIRED

TABLE 13.6.2.1.1-11 PIN ASSIGNMENTS FOR PSDP - J1333

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
			48			NOT WIRED
			49			NOT WIRED
			50			NOT WIRED
			51			NOT WIRED
			52			NOT WIRED
			53			NOT WIRED
			54			NOT WIRED
			55			NOT WIRED

TABLE 13.6.2.1.1-12 PIN ASSIGNMENTS FOR PSDP - J1335

EMC CLASS.	PIN FUNCT.	CABLE DESC.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
HO	SIG	SC	1	PS VOICE ENABLE		NETWORK SIGNAL PROCESSOR # 2
HO	SIG	SC	2	ACCU VOICE ENABLE		NETWORK SIGNAL PROCESSOR # 2
HO	SIG	SC	3	POWER ON DISCRETE FOR CRT 5		D&C PANEL C2A2
HO	SIG	SC	4	NSP # 1 VOICE ENABLE		MDM OF 4
HO	SIG	SC	5	A1A3 VOICE ENABLE		PANEL A1A3
HO	SIG	SC	6	28 VDC MAIN BUS C		FORWARD LCA # 3
HO	SIG	SC	7	DOD ENABLE		PAYLOAD INTERROGATOR # 2
			8			NOT WIRED
			9			NOT WIRED
			10			NOT WIRED
HO	SIG	3T4	11	Xo 603 J1335 - 70		
HO	SIG	3T4	12	Xo 603 J1335 - 71		
HO	RTN	3T4	13	Xo 603 J1335 - 72		
HO	SIG	3T3	14	Xo 603 J1335 - 64		
HO	SIG	3T3	15	Xo 603 J1335 - 65		
HO	RTN	3T3	16	Xo 603 J1335 - 66		
HO	SIG	3T2	17	Xo 603 J1335 - 58		
HO	SIG	3T2	18	Xo 603 J1335 - 59		
HO	RTN	3T2	19	Xo 603 J1335 - 60		
HO	SIG	3T1	20	Xo 603 J1335 - 52		
HO	SIG	3T1	21	Xo 603 J1335 - 53		
HO	RTN	3T1	22	Xo 603 J1335 - 54		
			23			NOT WIRED
			24			NOT WIRED
			25		8.2.9	PANEL C3A5 - PAYLOAD SAFING
HO	SIG	3T8	26	SAFE 2B		
HO	RTN	3T8	27	COM 2B		
HO	SIG	3T8	28	ACTIVE 2B	8.2.9	PANEL C3A5 - PAYLOAD SAFING
HO	SIG	3T9	29	SAFE 3B	8.2.9	PANEL C3A5 - PAYLOAD SAFING
HO	RTN	3T9	30	COM 3B		
HO	SIG	3T9	31	ACTIVE 3B	8.2.9	PANEL C3A5 - PAYLOAD SAFING
HO	SIG	3T10	32	SAFE 4B	8.2.9	PANEL C3A5 - PAYLOAD SAFING
HO	RTN	3T10	33	COM 4B		
HO	SIG	3T10	34	ACTIVE 4B	8.2.9	PANEL C3A5 - PAYLOAD SAFING
HO	SIG	3T6	35	SAFE 5B	8.2.9	PANEL C3A5 - PAYLOAD SAFING
HO	RTN	3T6	36	COM 5B		
HO	SIG	3T6	37	ACTIVE 5B	8.2.9	PANEL C3A5 - PAYLOAD SAFING
ML	RTN	2S1	38	ENCRYPTOR ZEROIZE RETURN	8.2.14	PANEL R12A2
ML	SIG	2S1	39	ENCRYPTOR ZEROIZE		
HO	SIG	3T5	40	Xo 603 J1335 - 77		
HO	SIG	3T5	41	Xo 603 J1335 - 78		
HO	RTN	3T5	42	Xo 603 J1335 - 79		
HO	SIG	3T7	43	SAFE 1B	8.2.9	PANEL C3A5 - PAYLOAD SAFING
HO	RTN	3T7	44	ACTIVE 1B		
HO	SIG	3T7	45	COM 1B	8.2.9	PANEL C3A5 - PAYLOAD SAFING
HO	SIG	3T7	46			NOT WIRED

TABLE 13.6.2.1.1-12 PIN ASSIGNMENTS FOR PSDP - J1335

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
			47			NOT WIRED
			48			NOT WIRED
			49			NOT WIRED
			50			NOT WIRED
			51			NOT WIRED
			52			NOT WIRED
			53			NOT WIRED
			54			NOT WIRED
			55			NOT WIRED



TABLE 13.6.2.1.1-14 PIN ASSIGNMENTS FOR PSDP - J1301

EMC CLASS.	PIN FUNCT.	CABLE DESC.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
			1			NOT WIRED
			2			NOT WIRED
			3			NOT WIRED
			4			NOT WIRED
			5			NOT WIRED
			6			NOT WIRED
			7			NOT WIRED
			8			NOT WIRED
			9			NOT WIRED
			10			NOT WIRED
			11			NOT WIRED
			12			NOT WIRED
			13			NOT WIRED
			14			NOT WIRED
			15			NOT WIRED
			16	P1401 - 46		SPARE
RF	SIG	2S11	17	P1401 - 47		SPARE
RF	RTN	2S11	18	P1401 - 43		SPARE
RF	SIG	2S10	19	P1401 - 44		SPARE
RF	RTN	2S10	20	P1401 - 40		SPARE
RF	SIG	2S9	21	P1401 - 41		SPARE
RF	RTN	2S9	22	P1401 - 37		SPARE
RF	SIG	2S8	23	P1401 - 38		SPARE
RF	RTN	2S8	24	P1401 - 34		SPARE
RF	SIG	2S7	25	P1401 - 35		SPARE
RF	RTN	2S7	26	P1401 - 31		SPARE
RF	SIG	2S6	27	P1401 - 32		SPARE
RF	RTN	2S6	28	P1401 - 28		SPARE
RF	SIG	2S5	29	P1401 - 29		SPARE
RF	RTN	2S5	30	P1401 - 25		SPARE
RF	SIG	2S4	31	P1401 - 26		SPARE
RF	RTN	2S4	32	P1401 - 22		SPARE
RF	SIG	2S3	33	P1401 - 23		SPARE
RF	RTN	2S3	34	P1401 - 19		SPARE
RF	SIG	2S2	35	P1401 - 20		SPARE
RF	RTN	2S2	36	P1401 - 16		SPARE
RF	SIG	2S1	37	P1401 - 17		SPARE
RF	RTN	2S1				

EMC CLASS.	PIN FUNCT.	CABLE DESC.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
			1			NOT WIRED
			2			NOT WIRED
			3			NOT WIRED
			4			NOT WIRED
			5			NOT WIRED
			6			NOT WIRED
			7			NOT WIRED
			8			NOT WIRED
			9			NOT WIRED
			10			NOT WIRED
			11			NOT WIRED
			12			NOT WIRED
			13			NOT WIRED
			14			NOT WIRED
			15			NOT WIRED
			16	P1403 - 46		SPARE
RF	SIG	2S11	17	P1403 - 47		SPARE
RF	RTN	2S11	18	P1403 - 43		SPARE
RF	SIG	2S10	19	P1403 - 44		SPARE
RF	RTN	2S10	20	P1403 - 40		SPARE
RF	SIG	2S9	21	P1403 - 41		SPARE
RF	RTN	2S9	22	P1403 - 37		SPARE
RF	SIG	2S8	23	P1403 - 38		SPARE
RF	RTN	2S8	24	P1403 - 34		SPARE
RF	SIG	2S7	25	P1403 - 35		SPARE
RF	RTN	2S7	26	P1403 - 31		SPARE
RF	SIG	2S6	27	P1403 - 32		SPARE
RF	RTN	2S6	28	P1403 - 28		SPARE
RF	SIG	2S5	29	P1403 - 29		SPARE
RF	RTN	2S5	30	P1403 - 25		SPARE
RF	SIG	2S4	31	P1403 - 26		SPARE
RF	RTN	2S4	32	P1403 - 22		SPARE
RF	SIG	2S3	33	P1403 - 23		SPARE
RF	RTN	2S3	34	P1403 - 19		SPARE
RF	SIG	2S2	35	P1403 - 20		SPARE
RF	RTN	2S2	36	P1403 - 16		SPARE
RF	SIG	2S1	37	P1403 - 17		SPARE
RF	RTN	2S1				

TABLE 13.6.2.1.1-16 PIN ASSIGNMENTS FOR PSDP - J1305

EMC CLASS.	PIN FUNCT.	CABLE DESCOR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
			1			NOT WIRED
			2			NOT WIRED
			3			NOT WIRED
			4			NOT WIRED
			5			NOT WIRED
			6			NOT WIRED
			7			NOT WIRED
			8			NOT WIRED
			9			NOT WIRED
			10			NOT WIRED
			11			NOT WIRED
			12			NOT WIRED
			13			NOT WIRED
			14			NOT WIRED
			15			NOT WIRED
			16	P1405 - 46		SPARE
RF	SIG	2S11	17	P1405 - 47		SPARE
RF	RTN	2S11	18	P1405 - 43		SPARE
RF	SIG	2S10	19	P1405 - 44		SPARE
RF	RTN	2S10	20	P1405 - 40		SPARE
RF	SIG	2S9	21	P1405 - 41		SPARE
RF	RTN	2S8	22	P1405 - 37		SPARE
RF	SIG	2S8	23	P1405 - 38		SPARE
RF	RTN	2S7	24	P1405 - 34		SPARE
RF	SIG	2S7	25	P1405 - 35		SPARE
RF	RTN	2S6	26	P1405 - 31		SPARE
RF	SIG	2S6	27	P1405 - 32		SPARE
RF	RTN	2S5	28	P1405 - 28		SPARE
RF	SIG	2S5	29	P1405 - 29		SPARE
RF	RTN	2S5	30	P1405 - 25		SPARE
RF	SIG	2S4	31	P1405 - 26		SPARE
RF	RTN	2S4	32	P1405 - 22		SPARE
RF	SIG	2S3	33	P1405 - 23		SPARE
RF	RTN	2S3	34	P1405 - 19		SPARE
RF	SIG	2S2	35	P1405 - 20		SPARE
RF	RTN	2S2	36	P1405 - 16		SPARE
RF	SIG	2S1	37	P1405 - 17		SPARE
RF	RTN	2S1				

TABLE 13.6.2.1.1-17 PIN ASSIGNMENTS FOR PSDP - J1307

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
			1			NOT WIRED
			2			NOT WIRED
			3			NOT WIRED
			4			NOT WIRED
			5			NOT WIRED
			6			NOT WIRED
			7			NOT WIRED
			8			NOT WIRED
			9			NOT WIRED
			10			NOT WIRED
			11			NOT WIRED
			12			NOT WIRED
			13			NOT WIRED
			14			NOT WIRED
			15			NOT WIRED
			16			SPARE
RF	SIG	2S11	16	P1407 - 46		SPARE
RF	RTN	2S11	17	P1407 - 47		SPARE
RF	SIG	2S10	18	P1407 - 43		SPARE
RF	RTN	2S10	19	P1407 - 44		SPARE
RF	SIG	2S9	20	P1407 - 40		SPARE
RF	RTN	2S9	21	P1407 - 41		SPARE
RF	SIG	2S8	22	P1407 - 37		SPARE
RF	RTN	2S8	23	P1407 - 38		SPARE
RF	SIG	2S7	24	P1407 - 34		SPARE
RF	RTN	2S7	25	P1407 - 35		SPARE
RF	SIG	2S6	26	P1407 - 31		SPARE
RF	RTN	2S6	27	P1407 - 32		SPARE
RF	SIG	2S5	28	P1407 - 28		SPARE
RF	RTN	2S5	29	P1407 - 29		SPARE
RF	SIG	2S4	30	P1407 - 25		SPARE
RF	RTN	2S4	31	P1407 - 26		SPARE
RF	SIG	2S3	32	P1407 - 22		SPARE
RF	RTN	2S3	33	P1407 - 23		SPARE
RF	SIG	2S2	34	P1407 - 19		SPARE
RF	RTN	2S2	35	P1407 - 20		NOT WIRED
			36			NOT WIRED
			37			NOT WIRED

TABLE 13.6.2.1.1-18 PIN ASSIGNMENTS FOR PSDP - J1317

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
			1			
			2			
			3			
			4			
			5			
			6			
			7			
			8			
			9			
ML	SHD	259	10	Xo 603 J1317 - 66		NOT WIRED
ML	SIG	259	11	Xo 603 J1317 - 64		NOT WIRED
ML	RTN	259	12	Xo 603 J1317 - 65		NOT WIRED
ML	SIG	256	13	Xo 603 J1317 - 55		NOT WIRED
ML	RTN	256	14	Xo 603 J1317 - 56		NOT WIRED
ML	SHD	256	15	Xo 603 J1317 - 57		NOT WIRED
ML	SHD	253	16	Xo 603 J1317 - 48		NOT WIRED
ML	SHD	2512	17	Xo 603 J1317 - 75		NOT WIRED
ML	SIG	2512	18	Xo 603 J1317 - 73		NOT WIRED
ML	RTN	2512	19	Xo 603 J1317 - 74		NOT WIRED
ML	SIG	2511	20	Xo 603 J1317 - 70		NOT WIRED
ML	RTN	2511	21	Xo 603 J1317 - 71		NOT WIRED
ML	SHD	2511	22	Xo 603 J1317 - 72		NOT WIRED
ML	SIG	253	23	Xo 603 J1317 - 46		NOT WIRED
ML	RTN	253	24	Xo 603 J1317 - 47		NOT WIRED
ML	SHD	251	25	Xo 603 J1317 - 42		TERMINATE
ML	SIG	251	26	Xo 603 J1317 - 40		TERMINATE
ML	RTN	251	27	Xo 603 J1317 - 41		TERMINATE
ML	SIG	2513	28	Xo 603 J1317 - 76		TERMINATE
ML	RTN	2513	29	Xo 603 J1317 - 77		TERMINATE
ML	SIG	2513	30	Xo 603 J1317 - 78		TERMINATE
ML	SHD	254	31	Xo 603 J1317 - 51		TERMINATE
ML	SHD	255	32	Xo 603 J1317 - 54		TERMINATE
ML	SIG	255	33	Xo 603 J1317 - 52		TERMINATE
ML	RTN	255	34	Xo 603 J1317 - 53		TERMINATE
ML	SIG	2510	35	Xo 603 J1317 - 67		TERMINATE
ML	RTN	2510	36	Xo 603 J1317 - 68		TERMINATE
ML	SHD	2510	37	Xo 603 J1317 - 69		TERMINATE
ML	SIG	254	38	Xo 603 J1317 - 49		TERMINATE
ML	RTN	254	39	Xo 603 J1317 - 50		TERMINATE
ML	SHD	257	40	Xo 603 J1317 - 60		TERMINATE
ML	SIG	257	41	Xo 603 J1317 - 58		TERMINATE
ML	RTN	257	42	Xo 603 J1317 - 59		TERMINATE
ML	SIG	258	43	Xo 603 J1317 - 61		TERMINATE
ML	RTN	258	44	Xo 603 J1317 - 62		TERMINATE
ML	SHD	258	45	Xo 603 J1317 - 63		TERMINATE

TABLE 13.6.2.1.1-18 PIN ASSIGNMENTS FOR PSDP - J1317

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
ML	SHD	2S2	46	Xo 603 J1317 - 45  Xo 603 J1317 - 43 Xo 603 J1317 - 44		TERMINATE
			47			NOT WIRED
			48			NOT WIRED
			49			NOT WIRED
			50			NOT WIRED
ML	SIG	2S2	51			
ML	RTN	2S2	52			
			53			NOT WIRED
			54			NOT WIRED
			55			NOT WIRED



TABLE 13.6.2.1.1-19 PIN ASSIGNMENTS FOR PSDP - J1319

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
ML	SHD	2S14	46	Xo 603 J1319 - 45		TERMINATE
			47			NOT WIRED
			48			NOT WIRED
			49			NOT WIRED
			50			NOT WIRED
ML	SIG	2S14	51	Xo 603 J1319 - 43		NOT WIRED
ML	RIN	2S14	52	Xo 603 J1319 - 44		NOT WIRED
			53			NOT WIRED
			54			NOT WIRED
			55			NOT WIRED



TABLE 13.6.2.1.1-20 PIN ASSIGNMENTS FOR PSDP - J27

EMC CLASS.	PIN FUNCT.	CABLE DESC.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
			1			
			2			
RF	SIG	2S1	3	MSDP J58 - 17		NOT WIRED
RF	RTN	2S1	4	MSDP J58 - 18		
RF	SIG	2S2	5	MSDP J58 - 19		
RF	RTN	2S2	6	MSDP J58 - 21		
RF	SIG	2S3	7	MSDP J58 - 22		
RF	RTN	2S3	8	MSDP J58 - 23		
RF	SIG	2S4	9	MSDP J58 - 24		
RF	RTN	2S4	10	MSDP J58 - 25		
RF	SIG	2S5	11	MSDP J58 - 26		
RF	RTN	2S5	12	MSDP J58 - 27		
RF	SIG	2S6	13	MSDP J58 - 28		
RF	RTN	2S6	14	MSDP J58 - 29		
RF	SIG	2S7	15	MSDP J58 - 30		
RF	RTN	2S7	16	MSDP J58 - 31		
RF	SIG	2S8	17	MSDP J58 - 32		
RF	RTN	2S8	18	MSDP J58 - 33		
RF	SIG	2S9	19	MSDP J58 - 34		
RF	RTN	2S9	20	MSDP J58 - 35		
RF	SIG	2S10	21	MSDP J58 - 36		
RF	RTN	2S10	22	MSDP J58 - 37		

TABLE 13.6.2.1.1-21 PIN ASSIGNMENTS FOR PSDP - J55

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
HO	SIG	3T1	1	CROSSHAIR DISABLE	8.2.8	VIDEO SWITCHING NETWORK
HO	SIG	3T1	2	DATA DISABLE	8.2.8	VIDEO SWITCHING NETWORK
HO	RTN	3T1	3	DATA DISABLE RETURN		
			4			NOT WIRED
			5			NOT WIRED
			6			NOT WIRED
			7			NOT WIRED
			8			NOT WIRED
			9			NOT WIRED
			10			NOT WIRED
			11			NOT WIRED
			12			NOT WIRED
			13			NOT WIRED
			14			NOT WIRED
			15			NOT WIRED
			16			NOT WIRED
			17			NOT WIRED
			18			NOT WIRED
			19			NOT WIRED
			20			NOT WIRED
			21			NOT WIRED
			22			NOT WIRED
			23			NOT WIRED
			24			NOT WIRED
			25			NOT WIRED
			26			NOT WIRED
			27			NOT WIRED
			28			NOT WIRED
			29			NOT WIRED
RF	SIG	2S7	30	VIDEO A+	8.2.8	VIDEO SWITCHING NETWORK
RF	RTN	2S7	31	VIDEO A-		
RF	SIG	2S2	32	VIDEO B+	8.2.8	VIDEO SWITCHING NETWORK
RF	RTN	2S2	33	VIDEO B-		
RF	SIG	2S3	34	SYNC TO MONITOR 3 POSITIVE	8.2.8	REMOTE CONTROL UNIT
RF	RTN	2S3	35	SYNC TO MONITOR 3 NEGATIVE		
			36			NOT WIRED
			37			NOT WIRED

TABLE 13.6.2.1.2-2 PIN ASSIGNMENTS FOR PSDP - J33

EMC CLASS.	PIN FUNCT.	CABLE DESC.	CABLE PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
RF	SIG	2T1	A	AUX DC POWER BUS A	7.3.4	M-PCA 1 NOT WIRED
RF	RTN	2T1	B	AUX DC POWER BUS A RETURN		GROUND NOT WIRED

TABLE 13.6.2.1.2-3 PIN ASSIGNMENTS FOR PSDP - J37

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
EO	SIG	4T1	A	AC BUS 2 PH A	7.4	PANEL MA73C
EO	SIG	4T1	B	AC BUS 2 PH B	7.4	PANEL MA73C
EO	SIG	4T1	C	AC BUS 2 PH C	7.4	PANEL MA73C
			D			NOT WIRED
			E			NOT WIRED
			F			NOT WIRED
			G			NOT WIRED
			H			NOT WIRED
			J			NOT WIRED
EO	NTL	4T1	K	AC BUS 2		PANEL MA73C
						NOT WIRED

TABLE 13.6.2.1.2-4 PIN ASSIGNMENTS FOR PSDP - J39

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
E0	SIG	4T1	A	AC BUS 3 PH A	7.4	PANEL MA73C
E0	SIG	4T1	B	AC BUS 3 PH B	7.4	PANEL MA73C
E0	SIG	4T1	C	AC BUS 3 PH C	7.4	PANEL MA73C
			D			NOT WIRED
			E			NOT WIRED
			F			NOT WIRED
			G			NOT WIRED
			H			NOT WIRED
			J			NOT WIRED
E0	NTL	4T1	K	AC BUS 3		PANEL MA73C
						NOT WIRED

TABLE 13.6.2.1.4-1 PIN ASSIGNMENTS FOR PSDP - J100

EMC CLASS.	PIN FUNCT.	CABLE DESC.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
			1			NOT WIRED
			2			NOT WIRED
			3			NOT WIRED
			4			NOT WIRED
			5			NOT WIRED
			6			NOT WIRED
RF	SIG	2S1	7	MET 2 HI	13.6.2.1.4	ORBITER TIMING BUFFER
RF	RTN	2S1	8	MET 2 LO		NOT WIRED
			9			NOT WIRED
			10			NOT WIRED
			11			NOT WIRED
			12			NOT WIRED
			13			NOT WIRED
			14			NOT WIRED
			15			NOT WIRED
			16			NOT WIRED
			17			NOT WIRED
			18			NOT WIRED
			19			NOT WIRED
			20			NOT WIRED
			21			NOT WIRED
			22			NOT WIRED

TABLE 13.6.2.2-1 SUMMARY OF MSDP CONNECTORS AVAILABLE AS NON-STANDARD ELECTRICAL INTERFACES (INDEPENDENT OF SMCH) IN THE AFD

ORBITER CONNECTOR IDENTIFIER	CABLE DEFINITION			SEE TABLE	ORBITER INTERFACE CONNECTOR PART NO.	CARGO INTERFACE CONNECTOR PART NO.
	NO CIRCT	WIRE TYPE	EMC CLASS			
MSDP-J10	9	TS5C	ML	10	NLS0T22-35PA	NLS6GT22-35SA
MSDP-J12	12	TSP	ML			
MSDP-J17	17	TP	HO	45	NLS0T20-35PA	NLS6GT20-35SA
MSDP-J14	21	TSP	ML	16	NLS0T20-35P	NLS6GT20-35S
MSDP-J16	2	TP	HO	0	NB0E14-4SNT2	NB6GE14-4PNT2
MSDP-J18	12	TSP	ML	13	NLS0T16-35P	NLS6GT16-35S
MSDP-J20	1	TS5C	ML	17	NLS0T20-35P	NLS6GT20-35S
MSDP-J22	5	TS5C	ML	19	NLS0T20-35PB	NLS6GT20-35SB
MSDP-J24	20	TSP	ML	17	NLS0T20-35PC	NLS6GT20-35SC
MSDP-J26	5	T5C	ML			
MSDP-J28	14	TS5C	ML	16	NLS0T22-35PB	NLS6GT22-35SB
MSDP-J30	22	TSP	ML	13	NLS0T20-35PC	NLS6GT20-35SC
MSDP-J32	14	TSP	ML	16	NLS0T22-35P	NLS6GT22-35S
MSDP-J34	7	TS5C	ML	34	NLS0T20-35PA	NLS6GT20-35SA
MSDP-J36	13	TSP	ML			
MSDP-J38	21	TS5C	ML	16	NLS0T20-35PD	NLS6GT20-35SD
MSDP-J40	2	TQ	EO	2	NB0E12-10SMT2	NB6GE12-10PNT2
MSDP-J42	2	TQ	EO	2	NB0E12-10SMT2	NB6GE12-10PNT2
MSDP-J52	32	TSP	RF	2	NLS0T18-35P	NLS6GT18-35S
MSDP-J54	1	TSP	RF	18	NLS0T10-35S	NLS6GT10-35P
MSDP-J56	2	TSP	RF	10	NLS0T10-35P	NLS6GT10-35S
MSDP-J58	4	TSP	RF	14	NLS0T12-35S	NLS6GT12-35P
MSDP-J701	2	TSP	HO	31	NLS0T14-35S	NLS6GT14-35P
MSDP-J702	2	SC	HO	17	NLS0T14-35P	NLS6GT14-35S
MSDP-J703	10	TSP	RF	0	MC414-0614-0041	MC414-0614-0011
	1	COAX	RF	0	MC414-0614-0041	MC414-0614-0011
	1	COAX	RF	0	MC414-0614-0041	MC414-0614-0011
	1	COAX	RF	0	MC414-0614-0041	MC414-0614-0011

(1) SIGNAL IS CARRIED CONVENTIONALLY ON CENTER CONDUCTOR FOR ALL ORBITER COAX CABLES. NO PIN ASSIGNMENT TABLES ARE REQUIRED. CIRCUIT TERMINATIONS ARE SHOWN IN FIGURE 13.3.3-1.

TABLE 13.6.2.2.1-1 PIN ASSIGNMENTS MSDP CONNECTOR J40

EMC CLASS.	PIN FUNCT.	CABLE DESC.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
RF	SIG	2S25	1	PO1M1140B HI DATA	8.2.2.5	MDM-FF1 (NOT AVAILABLE FOR PAYLOAD USE)
RF	RTN	2S25	2	LO DATA		
RF	SIG	2S25	3	MESSAGE IN HI	8.2.2.5	NOT WIRED MDM-FF1 (NOT AVAILABLE FOR PAYLOAD USE)
RF	RTN	2S25	4	MESSAGE IN LO		
RF	RTN	2S43	5	PSDP J35 - 15		
RF	SIG	2S43	6	PSDP J35 - 14		
RF	RTN	2S44	7	PSDP J35 - 17		
RF	RTN	2S44	8	PSDP J35 - 16		
RF	SIG	2S45	9	PSDP J35 - 19		
RF	RTN	2S45	10	PSDP J35 - 18		
RF	SIG	2S46	11	PSDP J35 - 21		
RF	RTN	2S46	12	PSDP J35 - 20		
RF	SIG	2S46	13	Xo 603 J1302 - 61		
RF	RTN	2S16	14	Xo 603 J1302 - 62		
RF	SIG	2S16	15	Xo 603 J1302 - 58		
RF	RTN	2S15	16	Xo 603 J1302 - 59		
RF	SIG	2S15	17	Xo 603 J1302 - 55		
RF	RTN	2S14	18	Xo 603 J1302 - 56		
RF	SIG	2S14	19	Xo 603 J1302 - 52		
RF	RTN	2S13	20	Xo 603 J1302 - 53		
RF	SIG	2S13	21	MESSAGE OUT HI		
RF	RTN	2S27	22	MESSAGE OUT LO		
RF	SIG	2S27	23	Xo 603 J1302 - 17		
RF	RTN	2S5	24	Xo 603 J1302 - 16		
RF	SIG	2S5	25	Xo 603 J1302 - 20		
RF	RTN	2S5	26	Xo 603 J1302 - 19		
RF	SIG	2S6	27	Xo 603 J1302 - 23		
RF	RTN	2S6	28	Xo 603 J1302 - 22		
RF	SIG	2S7	29	Xo 603 J1302 - 26		
RF	RTN	2S7	30	Xo 603 J1302 - 25		
RF	SIG	2S8	31	WORD DISCRETE HI		
RF	RTN	2S8	32	WORD DISCRETE LO		
RF	SIG	2S28	33	Xo 603 J1302 - 29		
RF	RTN	2S9	34	Xo 603 J1302 - 28		
RF	SIG	2S9	35	Xo 603 J1302 - 32		
RF	RTN	2S10	36	Xo 603 J1302 - 31		
RF	SIG	2S10	37	Xo 603 J1302 - 35		
RF	RTN	2S11	38	Xo 603 J1302 - 34		
RF	SIG	2S11	39	Xo 603 J1302 - 38		
RF	RTN	2S12	40	Xo 603 J1302 - 37		
RF	SIG	2S12	41	WORD DISCRETE LO		
RF	RTN	2S28	42	SIO 10 RETURN		
RF	SIG	2S17	43	PO1M110J SIO 10		
RF	RTN	2S17	44	MESSAGE IN DISCRETE RETURN		
RF	SIG	2S18	45			



TABLE 13.6.2.2.1-1 PIN ASSIGNMENTS MSDP CONNECTOR J40

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
RF	SIG	2518	46	MESSAGE IN DISCRETE	8.2.2.5	MDM-PF2 CHANNEL 0
RF	RTN	2519	47	MESSAGE OUT DISCRETE RETURN		
RF	SIG	2519	48	MESSAGE OUT DISCRETE	8.2.2.5	MDM-PF2 CHANNEL 0
RF	RTN	2520	49	WORD ENABLE DISCRETE RETURN		
RF	SIG	2520	50	WORD ENABLE DISCRETE	8.2.2.5	MDM-PF2 CHANNEL 0
RF	RTN	2521	51	SIO 30 RETURN		
RF	SIG	2521	52	P01H130J SIO 30	8.2.2.5	MDM-PF2 (PAYLOAD SENSOR)
RF	RTN	2522	53	MESSAGE IN DISCRETE RETURN		
RF	SIG	2522	54	MESSAGE IN DISCRETE	8.2.2.5	MDM-PF2 CHANNEL 1
RF	RTN	2523	55	MESSAGE OUT DISCRETE RETURN		
RF	SIG	2523	56	MESSAGE OUT DISCRETE	8.2.2.5	MDM-PF2 CHANNEL 1
RF	RTN	254	57	XO 603 J1302 - 50		
RF	RTN	2524	58	WORD ENABLE DISCRETE RETURN		
RF	SIG	2524	59	WORD ENABLE DISCRETE	8.2.2.5	MDM-PF2 CHANNEL 1
RF	RTN	253	60	XO 603 J1302 - 47		
RF	SIG	253	61	XO 603 J1302 - 46		
RF	RTN	252	62	XO 603 J1302 - 44		
RF	SIG	254	63	XO 603 J1302 - 49		
RF	RTN	251	64	XO 603 J1302 - 41		
RF	SIG	251	65	XO 603 J1302 - 40		
RF	SIG	252	66	XO 603 J1302 - 43		

TABLE 13.6.2.2.1-2 PIN ASSIGNMENTS FOR MSDP CONNECTOR J10

ENC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
ML	SHD	253	1	P01U5212V AID 12	8.2.2.4	TERMINATE
ML	SIG	254	2	AID 12 RETURN		MDM-PF2
ML	RTN	254	3			
ML	SHD	254	4	P01U5211V AID 11	8.2.2.4	TERMINATE
ML	SIG	255	5	AID 11 RETURN		MDM-PF2
ML	RTN	255	6			
ML	SHD	255	7			
ML	SHD	551	8	P01U5203V AID 03	8.2.2.4	TERMINATE
ML	SIG	253	9	AID 03 RETURN		MDM-PF2
ML	RTN	253	10			
ML	SIG	555	11	P01K4517Y DOL 17	8.2.2.1	MDM-PF2
ML	SIG	555	12	P01K4518Y DOL 18	8.2.2.1	MDM-PF2
ML	SIG	555	13	P01K4519Y DOL 19	8.2.2.1	MDM-PF2
ML	SIG	555	14	P01U5210V AID 10	8.2.2.4	MDM-PF2
ML	SIG	256	15	AID 10 RETURN		
ML	RTN	256	16			
ML	SHD	252	17	DOL 01-04 RETURN		TERMINATE
ML	RTN	551	18	P01K4501Y DOL 01	8.2.2.1	MDM-PF2
ML	SIG	551	19	P01K4511Y DOL 11	8.2.2.1	MDM-PF2
ML	SIG	553	20	DOL 17-20 RETURN		
ML	RTN	555	21	P01K4520Y DOL 20	8.2.2.1	MDM PF2
ML	SIG	255	22			TERMINATE
ML	SHD	256	23	P01U5209V AID 09	8.2.2.4	MDM-PF2
ML	SIG	257	24			TERMINATE
ML	SHD	257	25	P01U5202V AID 02	8.2.2.4	MDM-PF2
ML	SIG	252	26	P01K4504Y DOL 04	8.2.2.1	MDM-PF2
ML	SIG	551	27	P01K4502Y DOL 02	8.2.2.1	MDM-PF2
ML	SIG	551	28	P01K4510Y DOL 10	8.2.2.1	MDM-PF2
ML	SIG	553	29	P01K4512Y DOL 12	8.2.2.1	MDM-PF2
ML	SIG	555	30			TERMINATE
ML	SHD	557	31	P01K4525Y DOL 25	8.2.2.1	MDM-PF2
ML	SIG	557	32	AID 09 RETURN		
ML	RTN	557	33	P01U5208V AID 08	8.2.2.4	MDM-PF2
ML	SIG	258	34	AID 08 RETURN		
ML	RTN	258	35			TERMINATE
ML	SHD	251	36	AID 02 RETURN		
ML	RTN	252	37	P01K4503Y DOL 03	8.2.2.1	MDM-PF2
ML	SIG	551	38	P01K4509Y DOL 09	8.2.2.1	MDM-PF2
ML	SIG	553	39	DOL 09-12 RETURN		
ML	RTN	553	40			TERMINATE
ML	SHD	553	41	DOL 25-28 RETURN		
ML	RTN	557	42	P01K4526Y DOL 26	8.2.2.1	MDM-PF2
ML	SIG	557	43			TERMINATE
ML	SHD	258	44	P01U5207V AID 07	8.2.2.4	MDM-PF2
ML	SIG	259	45			TERMINATE
ML	SHD	257				

TABLE 13-0.2.2.1-2. PIN ASSIGNMENTS FOR HSDB COMBULATOR STD

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
ML	SIG	251	46	P01U5201V AID 01	8.2.2.4	MDM-PF2
ML	RTN	251	47	AID 01 RETURN		
ML	SIG	554	48	P01K4515Y DOL 15	8.2.2.1	MDM-PF2
ML	SIG	554	49	P01K4516Y DOL 16	8.2.2.1	MDM-PF2
ML	SHD	554	50			TERMINATE
ML	SHD	557	51			TERMINATE
ML	SIG	557	52	P01K4528Y DOL 28	8.2.2.1	MDM-PF2
ML	SIG	557	53	P01K4527Y DOL 27	8.2.2.1	MDM-PF2
ML	RTN	259	54	AID 07 RETURN		
ML	SIG	2510	55	P01U5206V AID 06	8.2.2.4	MDM-PF2
ML	SHD	2512	56			TERMINATE
ML	SIG	2512	57	P01U5204V AID 04	8.2.2.4	MDM-PF2
ML	SIG	552	58	P01K4505Y DOL 05	8.2.2.1	MDM-PF2
ML	SIG	554	59	P01K4514Y DOL 14	8.2.2.1	MDM-PF2
ML	RTN	554	60	DOL 13-16 RETURN		
ML	SHD	556	61			TERMINATE
ML	SHD	558	62			TERMINATE
ML	RTN	558	63	DOL 29-32 RETURN		
ML	SIG	558	64	P01K4529Y DOL 29	8.2.2.1	MDM-PF2
ML	SIG	2510	65	AID 06 RETURN		
ML	SHD	2510	66			TERMINATE
ML	RTN	2512	67	AID 04 RETURN		
ML	RTN	552	68	DOL 05-08 RETURN		
ML	SIG	552	69	P01K4506Y DOL 06	8.2.2.1	MDM-PF2
ML	SIG	554	70	P01K4513Y DOL 13	8.2.2.1	MDM-PF2
ML	SIG	556	71	P01K4524Y DOL 24	8.2.2.1	MDM-PF2
ML	RTN	556	72	DOL 21-24 RETURN		
ML	SIG	558	73	P01K4532Y DOL 32	8.2.2.1	MDM-PF2
ML	SIG	558	74	P01K4530Y DOL 30	8.2.2.1	MDM-PF2
ML	SIG	2511	75	P01U5205V AID 05	8.2.2.4	MDM-PF2
ML	RTN	2511	76	AID 05 RETURN		
ML	SHD	552	77			TERMINATE
ML	SIG	552	78	P01K4508Y DOL 08	8.2.2.1	MDM-PF2
ML	SIG	552	79	P01K4507Y DOL 07	8.2.2.1	MDM-PF2
ML	SIG	556	80	P01K4522Y DOL 22	8.2.2.1	MDM-PF2
ML	SIG	556	81	P01K4523Y DOL 23	8.2.2.1	MDM-PF2
ML	SIG	556	82	P01K4521Y DOL 21	8.2.2.1	MDM-PF2
ML	SIG	558	83	P01K4531Y DOL 31	8.2.2.1	MDM-PF2
ML			84			NOT WIRED
ML	SHD	2511	85			TERMINATE
ML	SIG	559	86	P01X5113Y DIH 13	8.2.2.7	MDM-PF2
ML	SIG	559	87	P01X5114Y DIH 14	8.2.2.7	MDM-PF2
ML	SIG	559	88	P01X5115Y DIH 15	8.2.2.7	MDM-PF2
ML	SIG	559	89	P01X5116Y DIH 16	8.2.2.7	MDM-PF2
ML	RTN	559	90	DIH 13-16 RETURN		
ML	SHD	559	91			TERMINATE

TABLE 13.6.2.2.1-2 PIN ASSIGNMENTS FOR MSDP CONNECTOR J10

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
			92			NOT WIRED
			93			NOT WIRED
			94			NOT WIRED
			95			NOT WIRED
			96			NOT WIRED
			97			NOT WIRED
			98			NOT WIRED
			99			NOT WIRED
			100			NOT WIRED

TABLE 13.6.2.2.1-3 PIN ASSIGNMENTS FOR MSDP CONNECTOR J14

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
			1			
			2			
			3			
			4			
			5			
			6			
			7			
			8			
			9			
			10			
			11			
			12			
			13			
			14			
			15			
			16			
			17			
ML	SIG	2S1	17	OOSDP J50 - 17		NOT WIRED
ML	RTN	2S1	18	OOSDP J50 - 18		NOT WIRED
ML	SHD	2S1	19	OOSDP J50 - 19		NOT WIRED
ML	RTN	2S2	20	OOSDP J50 - 20		NOT WIRED
ML	SIG	2S2	21	OOSDP J50 - 21		NOT WIRED
ML	SHD	2S2	22	OOSDP J50 - 22		NOT WIRED
ML	RTN	2S3	23	OOSDP J50 - 23		NOT WIRED
ML	SIG	2S3	24	OOSDP J50 - 24		NOT WIRED
ML	SHD	2S3	25	OOSDP J50 - 25		NOT WIRED
ML	RTN	2S4	26	OOSDP J50 - 26		NOT WIRED
ML	SIG	2S4	27	OOSDP J50 - 27		NOT WIRED
ML	SHD	2S4	28	OOSDP J50 - 28		NOT WIRED
ML	RTN	2S5	29	OOSDP J50 - 29		NOT WIRED
ML	SIG	2S5	30	OOSDP J50 - 30		NOT WIRED
ML	SHD	2S5	31	OOSDP J50 - 31		NOT WIRED
ML	RTN	2S6	32	OOSDP J50 - 32		NOT WIRED
ML	SIG	2S6	33	OOSDP J50 - 33		NOT WIRED
ML	SHD	2S6	34	OOSDP J50 - 34		NOT WIRED
ML	SIG	2S7	35	OOSDP J50 - 35		NOT WIRED
ML	RTN	2S7	36	OOSDP J50 - 36		NOT WIRED
ML	SHD	2S7	37	OOSDP J50 - 37		NOT WIRED
ML	SIG	2S8	38	OOSDP J50 - 38		NOT WIRED
ML	RTN	2S8	39	OOSDP J50 - 39		NOT WIRED
ML	SHD	2S8	40	OOSDP J50 - 40		NOT WIRED
ML	SIG	2S9	41	OOSDP J50 - 41		NOT WIRED
ML	RTN	2S9	42	OOSDP J50 - 42		NOT WIRED
ML	SHD	2S9	43	OOSDP J50 - 43		NOT WIRED
ML	SIG	2S10	44	OOSDP J50 - 44		NOT WIRED
ML	RTN	2S10	45	OOSDP J50 - 45		NOT WIRED
						TERMINATE
						TERMINATE
						TERMINATE
						TERMINATE
						TERMINATE
						TERMINATE
						TERMINATE
						TERMINATE
						TERMINATE
						TERMINATE
						TERMINATE
						TERMINATE
						TERMINATE

TABLE 13.6.2.2.1-3 PIN ASSIGNMENTS FOR MSDP CONNECTOR J14

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
ML	SHD	2S10	46	00SDP J50 - 46		TERMINATE
ML	RTN	2S11	47	00SDP J50 - 47		
ML	SIG	2S11	48	00SDP J50 - 48		TERMINATE
ML	SHD	2S11	49	00SDP J50 - 49		
ML	RTN	2S12	50	00SDP J50 - 50		
ML	SIG	2S12	51	00SDP J50 - 51		TERMINATE
ML	SHD	2S12	52	00SDP J50 - 52		
ML	RTN	2S13	53	00SDP J50 - 53		
ML	SIG	2S13	54	00SDP J50 - 54		TERMINATE
ML	SHD	2S13	55	00SDP J50 - 55		
ML	SIG	2S14	56	00SDP J50 - 56		
ML	RTN	2S14	57	00SDP J50 - 57		TERMINATE
ML	SHD	2S14	58	00SDP J50 - 58		
ML	SIG	2S15	59	00SDP J50 - 59		
ML	RTN	2S15	60	00SDP J50 - 60		TERMINATE
ML	SHD	2S15	61	00SDP J50 - 61		
ML	SIG	2S16	62	00SDP J50 - 62		TERMINATE
ML	RTN	2S16	63	00SDP J50 - 63		
ML	SHD	2S16	64	00SDP J50 - 64		
ML	RTN	2S17	65	00SDP J50 - 65		
ML	SIG	2S17	66	00SDP J50 - 66		TERMINATE
ML	SHD	2S17	67	00SDP J50 - 67		
ML	RTN	2S18	68	00SDP J50 - 68		
ML	SIG	2S18	69	00SDP J50 - 69		TERMINATE
ML	SHD	2S18	70	00SDP J50 - 70		
ML	SIG	2S19	71	00SDP J50 - 71		
ML	RTN	2S19	72	00SDP J50 - 72		TERMINATE
ML	SHD	2S19	73	00SDP J50 - 73		
ML	SIG	2S20	74	00SDP J50 - 74		
ML	RTN	2S20	75	00SDP J50 - 75		TERMINATE
ML	SHD	2S20	76	00SDP J50 - 76		
ML	RTN	2S22	77	00SDP J50 - 77		
ML	SIG	2S22	78	00SDP J50 - 78		TERMINATE
ML	SHD	2S22	79	00SDP J50 - 79		

TABLE 13.6.2.2.1-4 PIN ASSIGNMENTS FOR MSDP CONNECTOR J18

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
ML	SIG	551	1	P01X5112Y DIH 12	8.2.2.7	NOT WIRED
			2			NOT WIRED
			3			NOT WIRED
			4			MDM-PF2
			5			NOT WIRED
			6			NOT WIRED
			7			NOT WIRED
			8			NOT WIRED
			9			MDM-PF2
ML	SIG SHD	551 551	10	P01X5111Y DIH 11	8.2.2.7	TERMINATE
			11			NOT WIRED
			12			
			13			Xo 603 J1316 - 58
			14			Xo 603 J1316 - 59
			15			Xo 603 J1316 - 62
			16			
			17			P01X5110Y DIH 10
			18			Xo 603 J1316 - 33
ML	SIG SHD RTN	256 256 257	19	P01X5109Y DIH 09	8.2.2.7	NOT WIRED
			20			MDM-PF2
			21			TERMINATE
			22			TERMINATE
			23			NOT WIRED
			24			MDM-PF2
			25			
			26			
			27			
ML	SIG SHD RTN	255 255 258 258	28	DIH 09-12 RETURN	8.2.2.7	TERMINATE
			29			TERMINATE
			30			NOT WIRED
			31			NOT WIRED
			32			
			33			
			34			Xo 603 J1316 - 77
			35			Xo 603 J1316 - 78
			36			Xo 603 J1316 - 75
ML	SIG SHD RTN	258 259 259	37	DIH 09-12 RETURN	8.2.2.7	TERMINATE
			38			TERMINATE
			39			TERMINATE
			40			
			41			Xo 603 J1316 - 23
			42			Xo 603 J1316 - 24
			43			Xo 603 J1316 - 76
			44			Xo 603 J1316 - 73
			45			Xo 603 J1316 - 74
ML	SIG SHD RTN	2511 2510	46	DIH 09-12 RETURN	8.2.2.7	TERMINATE
			47			TERMINATE
			48			TERMINATE
			49			TERMINATE
			50			
			51			
			52			
			53			
			54			

TABLE 13.6.2.2.1-4 PIN ASSIGNMENTS FOR MSDP CONNECTOR J18

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
ML	SIG	2S9	46	Xo 603 J1316 - 67		
ML	SIG	2S3	47	Xo 603 J1316 - 22		
ML	SHD	2S2	48	Xo 603 J1316 - 27		TERMINATE
ML	RTN	2S2	49	Xo 603 J1316 - 26		
ML	RTN	2S1	50	Xo 603 J1316 - 29		
ML	SIG	2S10	51	Xo 603 J1316 - 70		
ML	SHD	2S10	52	Xo 603 J1316 - 72		TERMINATE
ML	SIG	2S2	53	Xo 603 J1316 - 25		
ML	SIG	2S1	54	Xo 603 J1316 - 28		
ML	SHD	2S1	55	Xo 603 J1316 - 30		TERMINATE





TABLE 13.6.2.2.1-5 PIN ASSIGNMENTS FOR MSDP CONNECTOR J28

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION -- PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
ML	SHD	2S11	46	00SDP J48 - 46		TERMINATE
ML	RTN	2S12	47	00SDP J48 - 47		
ML	SIG	2S12	48	00SDP J48 - 48		TERMINATE
ML	SHD	2S12	49	00SDP J48 - 49		
ML	RTN	2S13	50	00SDP J48 - 50		TERMINATE
ML	SIG	2S13	51	00SDP J48 - 51		
ML	SHD	2S13	52	00SDP J48 - 52		TERMINATE
ML	RTN	2S14	53	00SDP J48 - 53		
ML	SIG	2S14	54	00SDP J48 - 54		TERMINATE
ML	SHD	2S14	55	00SDP J48 - 55		
ML	SIG	2S15	56	00SDP J48 - 56		TERMINATE
ML	RTN	2S15	57	00SDP J48 - 57		
ML	SHD	2S15	58	00SDP J48 - 58		TERMINATE
ML	SIG	2S16	59	00SDP J48 - 59		
ML	RTN	2S16	60	00SDP J48 - 60		TERMINATE
ML	SHD	2S16	61	00SDP J48 - 61		
ML	SIG	2S17	62	00SDP J48 - 62		TERMINATE
ML	RTN	2S17	63	00SDP J48 - 63		
ML	SHD	2S17	64	00SDP J48 - 64		TERMINATE
ML	RTN	2S18	65	00SDP J48 - 65		
ML	SIG	2S18	66	00SDP J48 - 66		TERMINATE
ML	SHD	2S18	67	00SDP J48 - 67		
ML	RTN	2S19	68	00SDP J48 - 68		TERMINATE
ML	SIG	2S19	69	00SDP J48 - 69		
ML	SHD	2S19	70	00SDP J48 - 70		TERMINATE
ML	SIG	2S20	71	00SDP J48 - 71		
ML	RTN	2S20	72	00SDP J48 - 72		TERMINATE
ML	SHD	2S20	73	00SDP J48 - 73		
ML	SIG	2S21	74	00SDP J48 - 74		TERMINATE
ML	RTN	2S21	75	00SDP J48 - 75		
ML	SHD	2S21	76	00SDP J48 - 76		TERMINATE
ML	RTN	2S22	77	00SDP J48 - 77		
ML	SIG	2S22	78	00SDP J48 - 78		TERMINATE
ML	SHD	2S22	79	00SDP J48 - 79		

TABLE 13.6.2.2.1-6 PIN ASSIGNMENTS FOR MSDP CONNECTOR J30

EMC CLASS.	PIN FUNCT.	CABLE DESC.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
ML	RTN	2S9	1	AID 21 RETURN		
ML	SIG	2S9	2	P01U5221V AID 21	8.2.2.4	MDM-PF1 TERMINATE
ML	SHD	2S9	3			
ML	SIG	2S8	4	P01U5222V AID 22	8.2.2.4	MDM-PF1 TERMINATE
ML	SHD	2S8	5			
ML	SIG	2S7	6	P01U5223V AID 23	8.2.2.4	MDM-PF1 TERMINATE
ML	SIG	2S8	7	P01U5224V AID 24	8.2.2.4	MDM-PF1 TERMINATE
ML	SIG	2S11	8	P01U5219V AID 19	8.2.2.4	MDM-PF1 TERMINATE
ML	SHD	2S10	9			
ML	SIG	2S10	10	P01U5220V AID 20	8.2.2.4	MDM-PF1 TERMINATE
ML	RTN	2S8	11	AID 22 RETURN		
ML	SHD	2S7	12			
ML	RTN	2S7	13	AID 23 RETURN		
ML	RTN	2S6	14	AID 24 RETURN		
ML	SHD	2S6	15			
ML	RTN	2S11	16	AID 19 RETURN		TERMINATE
ML	SHD	2S11	17			
ML	RTN	2S10	18	AID 20 RETURN		TERMINATE
ML	SIG	5S1	19	P01X6103Y DIL 03	8.2.2.3	MDM-PF2
ML	SIG	5S1	20	P01X6104Y DIL 04	8.2.2.3	MDM-PF2
ML	SIG	5S1	21	P01X6101Y DIL 01	8.2.2.3	MDM-PF2
ML	SIG	5S2	22	P01X6107Y DIL 07	8.2.2.3	MDM-PF2
ML	SIG	2S5	23	P01U5225V AID 25	8.2.2.4	MDM-PF1 TERMINATE
ML	SHD	2S5	24			
ML	SIG	2S14	25	P01U5216V AID 16	8.2.2.4	MDM-PF1 TERMINATE
ML	SHD	2S12	26			
ML	SIG	2S12	27	P01U5218V AID 18	8.2.2.4	MDM-PF1 TERMINATE
ML	SIG	5S6	28	P01X6111Y DIL 11	8.2.2.3	MDM-PF2
ML	RTN	5S1	29	DIL 01-04 RETURN		
ML	SIG	5S1	30	P01X6102Y DIL 02	8.2.2.3	MDM-PF2
ML	RTN	5S2	31	DIL 05-08 RETURN		
ML	SIG	5S2	32	P01X6108Y DIL 08	8.2.2.3	MDM-PF2
ML	RTN	2S5	33	AID 25 RETURN		
ML	SIG	2S4	34	P01U5215V AID 15	8.2.2.4	MDM-PF1 TERMINATE
ML	RTN	2S14	35	AID 16 RETURN		
ML	SHD	2S14	36			
ML	RTN	2S12	37	AID 18 RETURN		TERMINATE
ML	SIG	5S6	38	P01X6110Y DIL 10	8.2.2.3	MDM-PF2
ML	SIG	5S6	39	P01X6112Y DIL 12	8.2.2.3	MDM-PF2
ML	SHD	5S1	40			
ML	SHD	5S2	41			
ML	SIG	5S2	42	P01X6106Y DIL 06	8.2.2.3	MDM-PF2
ML	SIG	5S2	43	P01X6105Y DIL 05	8.2.2.3	MDM-PF2
ML	SHD	2S4	44			
ML	RTN	2S12	45	AID 15 RETURN		TERMINATE

TABLE 13.6.2.2.1-6 PIN ASSIGNMENTS FOR MSDP CONNECTOR J30

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
ML	SHD	2S12	46	POIU5217V AID 17	8.2.2.4	TERMINATE
ML	SIG	2S12	47	POIX6109Y DIL 09	8.2.2.3	MDM-PF1
ML	SIG	5S6	48	DIL 09-12 RETURN		MDM-PF2
ML	RTN	5S6	49			
ML	SHD	5S3	50			TERMINATE
ML	SHD	5S3	51			TERMINATE
ML	RTN	5S3	52	DIL 21-24 RETURN		
ML	SIG	5S3	53	POIX6123Y DIL 23	8.2.2.3	MDM-PF2
ML	SIG	5S3	54	POIU5214V AID 14	8.2.2.4	MDM-PF1
ML	SHD	5S3	55			TERMINATE
ML	SHD	5S3	56			NOT WIRED
ML	RTN	2S13	57	AID 17 RETURN		
ML	SIG	5S5	58	POIX6113Y DIL 13	8.2.2.3	MDM-PF2
ML	SIG	5S5	59	POIX6114Y DIL 14	8.2.2.3	MDM-PF2
ML	SHD	5S5	60			TERMINATE
ML	SHD	5S4	61			TERMINATE
ML	SIG	5S3	62	POIX6122Y DIL 22	8.2.2.3	MDM-PF2
ML	SIG	5S3	63	POIX6124Y DIL 24	8.2.2.3	MDM-PF2
ML	SIG	2S1	64	V72X0001Y DOL	8.2.2.1	MDM-PF2
ML	RTN	2S3	65	AID 14 RETURN		
ML	SHD	2S2	66			TERMINATE
ML	SHD	2S2	67			NOT WIRED
ML	SHD	2S2	68			NOT WIRED
ML	SIG	5S5	69	POIX6116Y DIL 16	8.2.2.3	MDM-PF2
ML	RTN	5S5	70	DIL 13-16 RETURN		
ML	SIG	5S4	71	POIX6118Y DIL 18	8.2.2.3	MDM-PF2
ML	RTN	5S4	72	DIL 17-20 RETURN		
ML	SIG	5S3	73	POIX6121Y DIL 21	8.2.2.3	MDM-PF2
ML	RTN	2S1	74	DOL RETURN		
ML	SIG	2S2	75	POIU5213V AID 13	8.2.2.4	MDM-PF1
ML	RTN	2S2	76	AID 13 RETURN		
ML	RTN	2S2	77			NOT WIRED
ML	RTN	2S2	78			NOT WIRED
ML	SIG	5S5	79	POIX6115Y DIL 15	8.2.2.3	MDM-PF2
ML	SIG	5S4	80	POIX6117Y DIL 17	8.2.2.3	MDM-PF2
ML	SIG	5S4	81	POIX6120Y DIL 20	8.2.2.3	MDM-PF2
ML	SIG	5S4	82	POIX6119Y DIL 19	8.2.2.3	MDM-PF2
ML	SHD	2S1	83			TERMINATE
ML	SHD	5S7	84			TERMINATE
ML	RTN	5S7	85	DTH 01-04 RETURN		
ML	RTN	5S7	86			NOT WIRED
ML	RTN	5S7	87			NOT WIRED
ML	RTN	5S7	88			NOT WIRED
ML	RTN	5S7	89			NOT WIRED
ML	SIG	5S7	90	POIX5104Y DIH 04	8.2.2.4	MDM-PF1
ML	SIG	5S7	91	POIX5103Y DIH 03	8.2.2.4	MDM-PF1

TABLE 13.6.2.2.1-6 PIN ASSIGNMENTS FOR MSDP CONNECTOR J30

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
HL	SIG	5S7	92	P01X5102Y DIH 02	8.2.2.4	MDM-PF1
HL	SIG	5S7	93	P01X5101Y DIH 01	8.2.2.4	MDM-PF1
			94			NOT WIRED
			95			NOT WIRED
			96			NOT WIRED
			97			NOT WIRED
			98			NOT WIRED
			99			NOT WIRED
			100			NOT WIRED

TABLE 13.6.2.2.1-7 PIN ASSIGNMENTS FOR MSDP CONNECTOR J32

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
			1			NOT WIRED
			2			NOT WIRED
			3			NOT WIRED
			4			NOT WIRED
			5			NOT WIRED
			6			NOT WIRED
			7			NOT WIRED
			8			NOT WIRED
			9			NOT WIRED
			10			NOT WIRED
			11			NOT WIRED
			12			NOT WIRED
			13			NOT WIRED
			14			NOT WIRED
			15			NOT WIRED
			16			NOT WIRED
			17			NOT WIRED
			18			NOT WIRED
			19			NOT WIRED
			20			NOT WIRED
			21			NOT WIRED
			22			NOT WIRED
			23			NOT WIRED
			24			NOT WIRED
			25			NOT WIRED
			26			NOT WIRED
			27			NOT WIRED
			28			NOT WIRED
			29			NOT WIRED
			30			NOT WIRED
			31			NOT WIRED
			32			NOT WIRED
			33			NOT WIRED
			34			NOT WIRED
			35	P01X5105Y DIH 05	8.2.2.7	MDM-PF1
ML	SIG	551	36	P01X5108Y DIH 08	8.2.2.7	MDM-PF1
ML	SIG	551	37	P01X5107Y DIH 07	8.2.2.7	MDM-PF1
ML	SIG	551	38	P01X5106Y DIH 06	8.2.2.7	MDM-PF1
ML	RTN	551	39	DIH 05-08 RETURN		
ML	SHD	551	40			TERMINATE
ML	SHD	251	41	Xo 603 J1312 - 24		TERMINATE
ML	RTN	251	42	Xo 603 J1312 - 23		
ML	RTN	251	43	Xo 603 J1312 - 22		
ML	SIG	251	44	Xo 603 J1312 - 27		
ML	SHD	252	45	Xo 603 J1312 - 26		TERMINATE
ML	RTN	252				

TABLE 13.6.2.2.1-7 PIN ASSIGNMENTS FOR MSDP CONNECTOR J32

EMC CLASS.	PIN FUNCT.	CABLE DESC.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
ML	SIG	2S2	46	Xo 603 J1312 - 25		TERMINATE
ML	SHD	2S3	47	Xo 603 J1312 - 30		
ML	RTN	2S3	48	Xo 603 J1312 - 29		
ML	SIG	2S3	49	Xo 603 J1312 - 28		TERMINATE
ML	SHD	2S4	50	Xo 603 J1312 - 33		
ML	RTN	2S4	51	Xo 603 J1312 - 32		
ML	SIG	2S4	52	Xo 603 J1312 - 31		TERMINATE
ML	SHD	2S5	53	Xo 603 J1312 - 36		
ML	RTN	2S5	54	Xo 603 J1312 - 35		
ML	SIG	2S5	55	Xo 603 J1312 - 34		TERMINATE
ML	SHD	2S6	56	Xo 603 J1312 - 39		
ML	RTN	2S6	57	Xo 603 J1312 - 38		
ML	SIG	2S6	58	Xo 603 J1312 - 37		TERMINATE
ML	SHD	2S7	59	Xo 603 J1312 - 42		
ML	RTN	2S7	60	Xo 603 J1312 - 41		
ML	SIG	2S7	61	Xo 603 J1312 - 40		TERMINATE
ML	SHD	2S8	62	Xo 603 J1312 - 45		
ML	RTN	2S8	63	Xo 603 J1312 - 44		
ML	SIG	2S8	64	Xo 603 J1312 - 43		TERMINATE
ML	SHD	2S9	65	Xo 603 J1312 - 48		
ML	RTN	2S9	66	Xo 603 J1312 - 47		TERMINATE
ML	SIG	2S9	67	Xo 603 J1312 - 46		
ML	SHD	2S10	68	Xo 603 J1312 - 51		TERMINATE
ML	RTN	2S10	69	Xo 603 J1312 - 50		
ML	SIG	2S10	70	Xo 603 J1312 - 49		TERMINATE
ML	SHD	2S11	71	Xo 603 J1312 - 54		
ML	RTN	2S11	72	Xo 603 J1312 - 53		
ML	SIG	2S11	73	Xo 603 J1312 - 52		TERMINATE
ML	SHD	2S12	74	Xo 603 J1312 - 57		
ML	RTN	2S12	75	Xo 603 J1312 - 56		
ML	SIG	2S12	76	Xo 603 J1312 - 55		TERMINATE
ML	SHD	2S13	77	Xo 603 J1312 - 60		
ML	RTN	2S13	78	Xo 603 J1312 - 59		
ML	SIG	2S13	79	Xo 603 J1312 - 58		TERMINATE

TABLE 13.6.2.2.1-8 PIN ASSIGNMENTS FOR MSDP CONNECTOR J52

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
			1			NOT WIRED
			2			NOT WIRED
			3			NOT WIRED
			4			NOT WIRED
			5			NOT WIRED
			6			NOT WIRED
			7			NOT WIRED
			8			NOT WIRED
			9			NOT WIRED
			10			NOT WIRED
			11			TERMINATE
ML	SHD	2S1	11	PAYLOAD CAUTION RETURN		
ML	RTN	2S1	12	PAYLOAD CAUTION	8.2.9.3	CAUTION & WARNING ELECTRONICS UNIT
ML	SIG	2S1	13			



TABLE 13.6.2.2.1-9 PIN ASSIGNMENTS FOR MSDP CONNECTOR J12

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
HO	RTN	2T17	1	PAYLOAD SMOKE B RETURN		PANEL L1A1 / CAUTION & WARNING
			2			NOT WIRED
			3			NOT WIRED
			4			NOT WIRED
			5			NOT WIRED
			6			NOT WIRED
			7			NOT WIRED
			8			NOT WIRED
			9			NOT WIRED
			10			NOT WIRED
			11			NOT WIRED
			12			NOT WIRED
			13			NOT WIRED
			14			NOT WIRED
			15			NOT WIRED
			16			NOT WIRED
			17			NOT WIRED
			18			NOT WIRED
			19			NOT WIRED
			20			NOT WIRED
			21			NOT WIRED
			22			NOT WIRED
			23			NOT WIRED
			24			NOT WIRED
			25			NOT WIRED
			26			NOT WIRED
			27			NOT WIRED
			HO			SIG
29	NOT WIRED					
30	NOT WIRED					
31	NOT WIRED					
32	NOT WIRED					
33	NOT WIRED					
34	NOT WIRED					
35	NOT WIRED					
36	NOT WIRED					
37	NOT WIRED					
38	NOT WIRED					
39	NOT WIRED					
40	NOT WIRED					
41	NOT WIRED					
42	NOT WIRED					
43	NOT WIRED					
44	NOT WIRED					
45	NOT WIRED					

TABLE 13.6.2.2.1-9 PIN ASSIGNMENTS FOR MSDP CONNECTOR J12

EMC CLASS.	PIN FUNCT.	CABLE DESC.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
			46			
			47			
HO	RTN	2T15	48	Xo 603 J1304 - 35		
HO	SIG	2T15	49	Xo 603 J1304 - 34		
HO	RTN	2T14	50	Xo 603 J1304 - 38		
HO	SIG	2T14	51	Xo 603 J1304 - 37		
HO	RTN	2T13	52	Xo 603 J1304 - 41		
HO	SIG	2T13	53	Xo 603 J1304 - 40		
HO	RTN	2T12	54	Xo 603 J1304 - 44		
HO	SIG	2T12	55	Xo 603 J1304 - 43		
HO	RTN	2T11	56	Xo 603 J1304 - 47		
HO	SIG	2T11	57	Xo 603 J1304 - 46		
HO	RTN	2T10	58	Xo 603 J1304 - 50		
HO	SIG	2T10	59	Xo 603 J1304 - 49		
HO	RTN	2T9	60	Xo 603 J1304 - 53		
HO	SIG	2T9	61	Xo 603 J1304 - 52		
HO	RTN	2T8	62	Xo 603 J1304 - 56		
HO	SIG	2T8	63	Xo 603 J1304 - 55		
HO	RTN	2T7	64	Xo 603 J1304 - 59		
HO	SIG	2T7	65	Xo 603 J1304 - 58		
HO	RTN	2T6	66	Xo 603 J1304 - 62		
HO	SIG	2T6	67	Xo 603 J1304 - 61		
HO	RTN	2T5	68	Xo 603 J1304 - 65		
HO	SIG	2T5	69	Xo 603 J1304 - 64		
HO	RTN	2T4	70	Xo 603 J1304 - 68		
HO	SIG	2T4	71	Xo 603 J1304 - 67		
HO	RTN	2T3	72	Xo 603 J1304 - 71		
HO	SIG	2T3	73	Xo 603 J1304 - 70		
HO	RTN	2T2	74	Xo 603 J1304 - 74		
HO	SIG	2T2	75	Xo 603 J1304 - 73		
HO	RTN	2T1	76	Xo 603 J1304 - 77		
HO	SIG	2T1	77	Xo 603 J1304 - 76		
HO	SIG	2T16	78	Xo 603 J1304 - 31		
HO	RTN	2T16	79	Xo 603 J1304 - 32		

NOT WIRED  
NOT WIRED

TABLE 13.6.2.2.1-10 PIN ASSIGNMENTS FOR MSDP CONNECTOR J20

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
HO	RTN	2T16	1	PAYLOAD SMOKE A RETURN		
			2			NOT WIRED
			3			NOT WIRED
HO	RTN	2T2	4	OOSDP J44 - 35		
HO	SIG	2T2	5	OOSDP J44 - 34		
HO	SIG	2T5	6	OOSDP J44 - 36		
HO	RTN	2T5	7	OOSDP J44 - 37		
HO	SIG	2T8	8	OOSDP J44 - 38		
HO	RTN	2T8	9	OOSDP J44 - 39		
			10			NOT WIRED
			11			NOT WIRED
			12			NOT WIRED
			13			NOT WIRED
			14			NOT WIRED
			15			NOT WIRED
			16			NOT WIRED
			17			NOT WIRED
HO	RTN	2T11	18	OOSDP J44 - 15		
HO	SIG	2T11	19	OOSDP J44 - 14		
			20			NOT WIRED
			21			NOT WIRED
HO	RTN	2T12	22	OOSDP J44 - 13		
HO	SIG	2T12	23	OOSDP J44 - 12		
HO	RTN	2T13	24	OOSDP J44 - 11		
HO	SIG	2T13	25	OOSDP J44 - 10		
HO	RTN	2T15	26	OOSDP J44 - 17		
HO	SIG	2T15	27	OOSDP J44 - 25		
HO	SIG	2T16	28	PAYLOADSMOKE A	8.2.9.1	PANEL L1A1 / CAUTION & WARNING
HO	RTN	2T14	29	OOSDP J44 - 33		
HO	SIG	2T14	30	OOSDP J44 - 32		
HO	RTN	2T3	31	OOSDP J44 - 27		
HO	SIG	2T3	32	OOSDP J44 - 26		
HO	SIG	2T1	33	OOSDP J44 - 28		
HO	RTN	2T1	34	OOSDP J44 - 29		
HO	SIG	2T6	35	OOSDP J44 - 30		
HO	RTN	2T6	36	OOSDP J44 - 31		
			37			NOT WIRED
			38			NOT WIRED
			39			NOT WIRED
			40			NOT WIRED
			41			NOT WIRED
HO	RTN	2T10	42	OOSDP J44 - 16		
HO	SIG	2T10	43	OOSDP J44 - 24		
HO	RTN	2T7	44	OOSDP J44 - 23		
HO	SIG	2T7	45	OOSDP J44 - 22		

TABLE 13.6.2.2.1-10 PIN ASSIGNMENTS FOR MSDP CONNECTOR J20

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
HO	RTN	219	46	OOSDP J44 - 21		
HO	SIG	219	47	OOSDP J44 - 20		
HO	RTN	214	48	OOSDP J44 - 19		
HO	SIG	214	49	OOSDP J44 - 18		
ML	SHD	555	50			
ML	SIG	555	51	PO1K4103Y DOH 03	8.2.2.2	TERMINATE
ML	SIG	551	52	PO1K4117Y DOH 17	8.2.2.2	MDM-PF2
ML	SIG	551	53	PO1K4118Y DOH 18	8.2.2.2	MDM-PF2
ML	SIG	551	54	PO1K4139Y DOH 39	8.2.2.2	MDM-PF2
ML	SIG	552	55	PO1K4113Y DOH 13	8.2.2.2	MDM-PF2
ML	SIG	552	56	PO1K4114Y DOH 14	8.2.2.2	MDM-PF2
ML	SIG	552	57	PO1K4115Y DOH 15	8.2.2.2	MDM-PF2
ML	SIG	553	58	PO1K4109Y DOH 09	8.2.2.2	MDM-PF2
ML	SIG	553	59	PO1K4110Y DOH 10	8.2.2.2	MDM-PF2
ML	SIG	553	60	PO1K4111Y DOH 11	8.2.2.2	MDM-PF2
ML	SHD	553	61			TERMINATE
ML	SIG	554	62	PO1K4105Y DOH 05	8.2.2.2	MDM-PF2
ML	SIG	554	63	PO1K4106Y DOH 06	8.2.2.2	MDM-PF2
ML	SIG	554	64	PO1K4107Y DOH 07	8.2.2.2	MDM-PF2
ML	SIG	555	65	PO1K4101Y DOH 01	8.2.2.2	MDM-PF2
ML	SIG	555	66	PO1K4102Y DOH 02	8.2.2.2	MDM-PF2
ML	SIG	555	67	PO1K4104Y DOH 04	8.2.2.2	MDM-PF2
ML	RTN	551	68	DOH 17-18, 39-40 RETURN		
ML	SIG	551	69	PO1K4140Y DOH 40	8.2.2.2	MDM-PF2
ML	RTN	552	70	DOH 13-16 RETURN		
ML	SIG	552	71	PO1K4116Y DOH 16	8.2.2.2	MDM-PF2
ML	RTN	553	72	DOH 09-12 RETURN		
ML	SIG	553	73	PO1K4112Y DOH 12	8.2.2.2	MDM-PF2
ML	RTN	554	74	DOH 05-08 RETURN		
ML	SIG	554	75	PO1K4108Y DOH 08	8.2.2.2	MDM-PF2
ML	RTN	555	76	DOH 01-04 RETURN		
ML	SHD	551	77			TERMINATE
ML	SHD	552	78			TERMINATE
ML	SHD	554	79			TERMINATE

TABLE 13.6.2.2.1-11 PIN ASSIGNMENTS FOR MSDP CONNECTOR J22

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
			1			
			2			
			3			
			4			NOT WIRED
			5			NOT WIRED
			6			NOT WIRED
			7			NOT WIRED
			8			NOT WIRED
			9			NOT WIRED
			10			NOT WIRED
			11			NOT WIRED
			12			NOT WIRED
			13			NOT WIRED
			14			NOT WIRED
			15			NOT WIRED
			16			NOT WIRED
			17			NOT WIRED
			18			NOT WIRED
			19			NOT WIRED
			20	Xo 603 J1314 - 60		TERMINATE
ML	SHD	251	21	Xo 603 J1314 - 59		TERMINATE
ML	RTN	251	22	Xo 603 J1314 - 58		TERMINATE
ML	SIG	251	23	Xo 603 J1314 - 63		TERMINATE
ML	SHD	252	24	Xo 603 J1314 - 62		TERMINATE
ML	RTN	252	25	Xo 603 J1314 - 61		TERMINATE
ML	SIG	252	26	Xo 603 J1314 - 66		TERMINATE
ML	SHD	253	27	Xo 603 J1314 - 65		TERMINATE
ML	RTN	253	28	Xo 603 J1314 - 64		TERMINATE
ML	SIG	253	29	Xo 603 J1314 - 69		TERMINATE
ML	SHD	254	30	Xo 603 J1314 - 68		TERMINATE
ML	RTN	254	31	Xo 603 J1314 - 67		TERMINATE
ML	SIG	254	32	Xo 603 J1314 - 72		TERMINATE
ML	SHD	255	33	Xo 603 J1314 - 71		TERMINATE
ML	RTN	255	34	Xo 603 J1314 - 70		TERMINATE
ML	SIG	255	35	Xo 603 J1314 - 75		TERMINATE
ML	SHD	256	36	Xo 603 J1314 - 74		TERMINATE
ML	RTN	256	37	Xo 603 J1314 - 73		TERMINATE
ML	SIG	256	38	Xo 603 J1314 - 78		TERMINATE
ML	SHD	257	39	Xo 603 J1314 - 77		TERMINATE
ML	RTN	257	40	Xo 603 J1314 - 76		TERMINATE
ML	SIG	257	41	Xo 603 J1314 - 48		TERMINATE
ML	SHD	2517	42	Xo 603 J1314 - 47		TERMINATE
ML	RTN	2517	43	Xo 603 J1314 - 46		TERMINATE
ML	SIG	2517	44	Xo 603 J1314 - 45		TERMINATE
ML	SHD	2516	45	Xo 603 J1314 - 44		TERMINATE
ML	RTN	2516				

TABLE 13.6.2.2.1-11 PIN ASSIGNMENTS FOR MSDP CONNECTOR J22

EMC CLASS.	PIN FUNCT.	CABLE DESCOR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
ML	SIG	2S16	46	Xo 603 J1314 - 43		TERMINATE
ML	SHD	2S15	47	Xo 603 J1314 - 42		
ML	RTN	2S15	48	Xo 603 J1314 - 41		
ML	SIG	2S15	49	Xo 603 J1314 - 40		
ML	SHD	2S14	50	Xo 603 J1314 - 39		TERMINATE
ML	RTN	2S14	51	Xo 603 J1314 - 38		
ML	SIG	2S14	52	Xo 603 J1314 - 37		
ML	SHD	2S13	53	Xo 603 J1314 - 36		TERMINATE
ML	RTN	2S13	54	Xo 603 J1314 - 35		
ML	SIG	2S13	55	Xo 603 J1314 - 34		
ML	SHD	2S12	56	Xo 603 J1314 - 33		TERMINATE
ML	RTN	2S12	57	Xo 603 J1314 - 32		
ML	SIG	2S12	58	Xo 603 J1314 - 31		
ML	SHD	2S11	59	Xo 603 J1314 - 30		TERMINATE
ML	RTN	2S11	60	Xo 603 J1314 - 29		
ML	SIG	2S11	61	Xo 603 J1314 - 28		
ML	SHD	2S10	62	Xo 603 J1314 - 27		TERMINATE
ML	RTN	2S10	63	Xo 603 J1314 - 26		
ML	SIG	2S10	64	Xo 603 J1314 - 25		
ML	SHD	2S9	65	Xo 603 J1314 - 24		TERMINATE
ML	RTN	2S9	66	Xo 603 J1314 - 23		
ML	SIG	2S9	67	Xo 603 J1314 - 22		
ML	SHD	2S8	68	Xo 603 J1314 - 21		TERMINATE
ML	RTN	2S8	69	Xo 603 J1314 - 20		
ML	SIG	2S8	70	Xo 603 J1314 - 19		
ML	SHD	2S18	71	Xo 603 J1314 - 51		TERMINATE
ML	RTN	2S18	72	Xo 603 J1314 - 50		
ML	SIG	2S18	73	Xo 603 J1314 - 49		
ML	SHD	2S19	74	Xo 603 J1314 - 54		TERMINATE
ML	RTN	2S19	75	Xo 603 J1314 - 53		
ML	SIG	2S19	76	Xo 603 J1314 - 52		
ML	SIG	2S20	77	Xo 603 J1314 - 55		
ML	RTN	2S20	78	Xo 603 J1314 - 56		
ML	SHD	2S20	79	Xo 603 J1314 - 57		TERMINATE



TABLE 13.6.2.2.1-12 PIN ASSIGNMENTS FOR MSDP CONNECTOR J24

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
			46			
			47			NOT WIRED
			48			NOT WIRED
			49			NOT WIRED
			50	XO 603 J1308 - 32		
HO	RTN	2T6	51	XO 603 J1308 - 31		
HO	SIG	2T6	52	XO 603 J1308 - 35		
HO	RTN	2T5	53	XO 603 J1308 - 34		
HO	SIG	2T5	54	XO 603 J1308 - 38		
HO	RTN	2T4	55	XO 603 J1308 - 37		
HO	SIG	2T4	56	XO 603 J1308 - 2		
HO	RTN	2T16	57			TERMINATE
ML	SHD	5T2	58			TERMINATE
ML	SHD	5T3	59			TERMINATE
ML	SHD	5T4	60			NOT WIRED
			61			NOT WIRED
			62	XO 603 J1308 - 5		
HO	RTN	2T15	63	XO 603 J1308 - 4		
HO	SIG	2T15	64	XO 603 J1308 - 8		
HO	RTN	2T14	65	XO 603 J1308 - 7		
HO	SIG	2T14	66	XO 603 J1308 - 11		
HO	RTN	2T13	67	XO 603 J1308 - 10		
HO	SIG	2T13	68	XO 603 J1308 - 14		
HO	RTN	2T12	69	XO 603 J1308 - 13		
HO	SIG	2T12	70	XO 603 J1308 - 17		
HO	RTN	2T11	71	XO 603 J1308 - 16		
HO	SIG	2T11	72	XO 603 J1308 - 20		
HO	RTN	2T10	73	XO 603 J1308 - 19		
HO	SIG	2T10	74	XO 603 J1308 - 23		
HO	RTN	2T9	75	XO 603 J1308 - 22		
HO	SIG	2T9	76	XO 603 J1308 - 26		
HO	RTN	2T8	77	XO 603 J1308 - 25		
HO	SIG	2T8	78	XO 603 J1308 - 29		
HO	RTN	2T7	79	XO 603 J1308 - 28		
HO	SIG	2T7				



TABLE 13.6.2.2.1-13 PIN ASSIGNMENTS FOR MSDP CONNECTOR J26

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
ML	SIG	551	1	Xo 603 J1322 - 34		
ML	SIG	551	2	Xo 603 J1322 - 33		
ML	SIG	551	3	Xo 603 J1322 - 32		
ML	SIG	551	4	Xo 603 J1322 - 31		
ML	RTN	551	5	Xo 603 J1322 - 35		
ML	SHD	551	6	Xo 603 J1322 - 36		TERMINATE
ML	SIG	553	7	Xo 603 J1322 - 44		
ML	SIG	552	8	Xo 603 J1322 - 40		
ML	SIG	552	9	Xo 603 J1322 - 39		
ML	SIG	552	10	Xo 603 J1322 - 38		
ML	SIG	552	11	Xo 603 J1322 - 37		
ML	RTN	552	12	Xo 603 J1322 - 41		
ML	SHD	552	13	Xo 603 J1322 - 42		
ML	SIG	553	14	Xo 603 J1322 - 43		
ML	SIG	553	15	Xo 603 J1322 - 45		
ML	SIG	554	16	Xo 603 J1322 - 50		
ML	SIG	554	17	Xo 603 J1322 - 51		
ML	SIG	554	18	Xo 603 J1322 - 52		
ML	SIG	555	19	Xo 603 J1320 - 45		
ML	SIG	555	20	Xo 603 J1320 - 46		
ML	SIG	555	21	Xo 603 J1320 - 43		
ML	SIG	556	22	Xo 603 J1320 - 51		
ML	RTN	553	23	Xo 603 J1322 - 47		
ML	SIG	553	24	Xo 603 J1322 - 46		
ML	SIG	554	25	Xo 603 J1322 - 49		
ML	RTN	554	26	Xo 603 J1322 - 53		
ML	SHD	554	27	Xo 603 J1322 - 54		
ML	SIG	551	28	Xo 603 J1320 - 57		
ML	RTN	555	29	Xo 603 J1320 - 47		
ML	SIG	555	30	Xo 603 J1320 - 44		
ML	RTN	556	31	Xo 603 J1320 - 53		
ML	SIG	556	32	Xo 603 J1320 - 52		
ML	SHD	553	33	Xo 603 J1322 - 48		
			34			
ML	SIG	555	35	Xo 603 J1322 - 58		
ML	SIG	555	36	Xo 603 J1322 - 57		
ML	SIG	555	37	Xo 603 J1322 - 56		
ML	SIG	551	38	Xo 603 J1320 - 56		
ML	SIG	551	39	Xo 603 J1320 - 58		
ML	SHD	555	40	Xo 603 J1320 - 48		TERMINATE
ML	SHD	556	41	Xo 603 J1320 - 54		TERMINATE
ML	SIG	556	42	Xo 603 J1320 - 50		
ML	SIG	556	43	Xo 603 J1320 - 49		
			44			
			45			NOT WIRED NOT WIRED

TABLE 13.6.2.2.1-13 PIN ASSIGNMENTS FOR MSDP CONNECTOR J26

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
ML	RTN	555	46	Xo 603 J1322 - 59		
ML	SIG	555	47	Xo 603 J1322 - 55		
ML	SIG	551	48	Xo 603 J1320 - 55		
ML	RTN	551	49	Xo 603 J1320 - 59		
ML	SHD	551	50	Xo 603 J1320 - 60		TERMINATE
ML	SHD	554	51	Xo 603 J1320 - 78		TERMINATE
ML	RTN	554	52	Xo 603 J1320 - 77		
ML	SIG	554	53	Xo 603 J1320 - 75		
			54			
			55			
ML	SHD	555	56	Xo 603 J1322 - 60		NOT WIRED
ML	SIG	556	57	Xo 603 J1322 - 62		NOT WIRED
ML	SIG	552	58	Xo 603 J1320 - 61		TERMINATE
ML	SIG	552	59	Xo 603 J1320 - 62		TERMINATE
ML	SHD	552	60	Xo 603 J1320 - 66		
ML	SHD	553	61	Xo 603 J1320 - 72		
ML	SIG	554	62	Xo 603 J1320 - 74		NOT WIRED
ML	SIG	554	63	Xo 603 J1320 - 76		NOT WIRED
			64			
			65			
			66			
ML	SIG	556	67	Xo 603 J1322 - 63		
ML	SIG	556	68	Xo 603 J1322 - 61		
ML	SIG	552	69	Xo 603 J1320 - 64		
ML	RTN	552	70	Xo 603 J1320 - 65		
ML	SIG	553	71	Xo 603 J1320 - 68		
ML	RTN	553	72	Xo 603 J1320 - 71		
ML	SIG	554	73	Xo 603 J1320 - 73		NOT WIRED
			74			NOT WIRED
			75			NOT WIRED
			76			
ML	SIG	556	77	Xo 603 J1322 - 64		
ML	RTN	556	78	Xo 603 J1322 - 65		
ML	SIG	552	79	Xo 603 J1320 - 63		
ML	SIG	553	80	Xo 603 J1320 - 67		
ML	SIG	553	81	Xo 603 J1320 - 70		
ML	SIG	553	82	Xo 603 J1320 - 69		
			83			
			84			
			85			
ML	SHD	556	86	Xo 603 J1322 - 66		NOT WIRED
ML	SIG	557	87	Xo 603 J1322 - 70		NOT WIRED
ML	SIG	557	88	Xo 603 J1322 - 69		TERMINATE
ML	SIG	557	89	Xo 603 J1322 - 68		
ML	SIG	557	90	Xo 603 J1322 - 67		
ML	RTN	557	91	Xo 603 J1322 - 71		

TABLE 13.6.2.2.1-13 PIN ASSIGNMENTS FOR MSDP CONNECTOR J26

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
ML	SHD	557	92	Xo 603 J1322 - 72		TERMINATE NOT WIRED
ML	SIG	558	93	Xo 603 J1322 - 76		
ML	SIG	558	94	Xo 603 J1322 - 75		
ML	SIG	558	95	Xo 603 J1322 - 74		
ML	SIG	558	96	Xo 603 J1322 - 73		
ML	RTN	558	97	Xo 603 J1322 - 77		
ML	SHD	558	98	Xo 603 J1322 - 78		TERMINATE NOT WIRED
ML	SHD	558	99	Xo 603 J1322 - 78		
			100			

TABLE 13.6.2.2.1-14 PIN ASSIGNMENTS FOR MSDP CONNECTOR J34

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
			1			NOT WIRED
			2			NOT WIRED
			3			NOT WIRED
			4			NOT WIRED
			5			NOT WIRED
			6			NOT WIRED
			7			NOT WIRED
			8			NOT WIRED
			9			NOT WIRED
			10			NOT WIRED
			11			NOT WIRED
			12			NOT WIRED
			13			NOT WIRED
			14			NOT WIRED
			15			NOT WIRED
			16			NOT WIRED
			17	Xo 603 J1318 - 18		TERMINATE
ML	SHD	2521	17	Xo 603 J1318 - 17		TERMINATE
ML	RTN	2521	18	Xo 603 J1318 - 16		TERMINATE
ML	SIG	2521	19	Xo 603 J1318 - 21		TERMINATE
ML	SHD	2520	20	Xo 603 J1318 - 20		TERMINATE
ML	RTN	2520	21	Xo 603 J1318 - 19		TERMINATE
ML	SIG	2520	22	Xo 603 J1318 - 24		TERMINATE
ML	SHD	2519	23	Xo 603 J1318 - 23		TERMINATE
ML	RTN	2519	24	Xo 603 J1318 - 22		TERMINATE
ML	SIG	2519	25	Xo 603 J1318 - 27		TERMINATE
ML	SHD	2518	26	Xo 603 J1318 - 26		TERMINATE
ML	RTN	2518	27	Xo 603 J1318 - 25		TERMINATE
ML	SIG	2518	28	Xo 603 J1318 - 30		TERMINATE
ML	SHD	2517	29	Xo 603 J1318 - 29		TERMINATE
ML	RTN	2517	30	Xo 603 J1318 - 28		TERMINATE
ML	SIG	2517	31	Xo 603 J1318 - 33		TERMINATE
ML	SHD	2516	32	Xo 603 J1318 - 32		TERMINATE
ML	RTN	2516	33	Xo 603 J1318 - 31		TERMINATE
ML	SIG	2516	34	Xo 603 J1318 - 36		TERMINATE
ML	SHD	2515	35	Xo 603 J1318 - 35		TERMINATE
ML	RTN	2515	36	Xo 603 J1318 - 34		TERMINATE
ML	SIG	2515	37	Xo 603 J1318 - 39		TERMINATE
ML	SHD	2514	38	Xo 603 J1318 - 38		TERMINATE
ML	RTN	2514	39	Xo 603 J1318 - 37		TERMINATE
ML	SIG	2514	40	Xo 603 J1318 - 42		TERMINATE
ML	SHD	2513	41	Xo 603 J1318 - 41		TERMINATE
ML	RTN	2513	42	Xo 603 J1318 - 40		TERMINATE
ML	SIG	2513	43	Xo 603 J1318 - 45		TERMINATE
ML	SHD	2512	44	Xo 603 J1318 - 44		TERMINATE
ML	RTN	2512	45	Xo 603 J1318 - 44		TERMINATE

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
ML	SIG	2S12	46	Xo 603 J1318 - 43		TERMINATE
ML	SHD	2S11	47	Xo 603 J1318 - 48		
ML	RTN	2S11	48	Xo 603 J1318 - 47		
ML	SIG	2S11	49	Xo 603 J1318 - 46		TERMINATE
ML	SHD	2S10	50	Xo 603 J1318 - 51		
ML	RTN	2S10	51	Xo 603 J1318 - 50		
ML	SIG	2S10	52	Xo 603 J1318 - 49		TERMINATE
ML	SHD	2S9	53	Xo 603 J1318 - 54		
ML	RTN	2S9	54	Xo 603 J1318 - 53		
ML	SIG	2S9	55	Xo 603 J1318 - 52		TERMINATE
ML	SHD	2S8	56	Xo 603 J1318 - 57		
ML	RTN	2S8	57	Xo 603 J1318 - 56		
ML	SIG	2S8	58	Xo 603 J1318 - 55		TERMINATE
ML	SHD	2S7	59	Xo 603 J1318 - 60		
ML	RTN	2S7	60	Xo 603 J1318 - 59		
ML	SIG	2S7	61	Xo 603 J1318 - 58		TERMINATE
ML	SHD	2S6	62	Xo 603 J1318 - 63		
ML	RTN	2S6	63	Xo 603 J1318 - 62		
ML	SIG	2S6	64	Xo 603 J1318 - 61		TERMINATE
ML	SHD	2S5	65	Xo 603 J1318 - 66		
ML	RTN	2S5	66	Xo 603 J1318 - 65		
ML	SIG	2S5	67	Xo 603 J1318 - 64		TERMINATE
ML	SHD	2S4	68	Xo 603 J1318 - 69		
ML	RTN	2S4	69	Xo 603 J1318 - 68		
ML	SIG	2S4	70	Xo 603 J1318 - 67		TERMINATE
ML	SHD	2S3	71	Xo 603 J1318 - 72		
ML	RTN	2S3	72	Xo 603 J1318 - 71		
ML	SIG	2S3	73	Xo 603 J1318 - 70		TERMINATE
ML	SHD	2S2	74	Xo 603 J1318 - 75		
ML	RTN	2S2	75	Xo 603 J1318 - 74		
ML	SIG	2S2	76	Xo 603 J1318 - 73		TERMINATE
ML	SHD	2S1	77	Xo 603 J1318 - 78		
ML	RTN	2S1	78	Xo 603 J1318 - 77		
ML	SIG	2S1	79	Xo 603 J1318 - 76		TERMINATE

TABLE 13.6.2.2.1-15 PIN ASSIGNMENTS FOR MSDP CONNECTOR J58

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
			1			
			2			
			3			
			4			
			5			
			6			
			7			
			8			
			9			
			10			
			11			
			12			
			13			
			14			
			15			
			16			
RF	SIG	251	17	PSDP J27 - 3		NOT WIRED
RF	RTN	251	18	PSDP J27 - 4		NOT WIRED
RF	SIG	252	19	PSDP J27 - 5		NOT WIRED
			20			
RF	RTN	252	21	PSDP J27 - 6		NOT WIRED
RF	SIG	253	22	PSDP J27 - 7		NOT WIRED
RF	RTN	253	23	PSDP J27 - 8		NOT WIRED
RF	SIG	254	24	PSDP J27 - 9		NOT WIRED
RF	RTN	254	25	PSDP J27 - 10		NOT WIRED
RF	SIG	255	26	PSDP J27 - 11		NOT WIRED
RF	RTN	255	27	PSDP J27 - 12		NOT WIRED
RF	SIG	256	28	PSDP J27 - 13		NOT WIRED
RF	RTN	256	29	PSDP J27 - 14		NOT WIRED
RF	SIG	257	30	PSDP J27 - 15		NOT WIRED
RF	RTN	257	31	PSDP J27 - 16		NOT WIRED
RF	SIG	258	32	PSDP J27 - 17		NOT WIRED
RF	RTN	258	33	PSDP J27 - 18		NOT WIRED
RF	SIG	259	34	PSDP J27 - 19		NOT WIRED
RF	RTN	259	35	PSDP J27 - 20		NOT WIRED
RF	SIG	2510	36	PSDP J27 - 21		NOT WIRED
RF	RTN	2510	37	PSDP J27 - 22		NOT WIRED

TABLE 13.6.2.2.2-1 PIN ASSIGNMENTS FOR MSDP CONNECTOR J16

EMC CLASS.	PIN FUNCT.	CABLE DESC.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
HO	SIG	2T1	A	CABIN 3 POWER	7.3.3	MPCA 1 OR 2
HO	RTN	2T1	B	CABIN 3 POWER RETURN		GROUND
HO	SIG	2T2	C	CABIN 2 POWER	7.3.3	MPCA 1 OR 2
HO	RTN	2T2	D	CABIN 2 POWER RETURN		GROUND

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
EO	SIG	4T1	A	AC 2 POWER, PHASE A	7.4	PANEL MA73C
EO	SIG	4T1	B	AC 2 POWER, PHASE B	7.4	PANEL MA73C
EO	SIG	4T1	C	AC 2 POWER, PHASE C	7.4	PANEL MA73C
			D			NOT WIRED
			E			NOT WIRED
EO	SIG	4T2	F	XO 603 J1306 - S		
EO	SIG	4T2	G	XO 603 J1306 - T		
EO	SIG	4T2	H	XO 603 J1306 - U		
EO	NTL	4T1	J	AC 2 POWER, NEUTRAL		
EO	NTL	4T2	K	XO 603 J1306 - V	7.4	PANEL MA73C



TABLE 13.6.2.2.2-3 PIN ASSIGNMENTS FOR MSDP CONNECTOR J38

ENC CLASS.	PIN FUNCT.	CABLE PIN DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
E0	SIG	4T1	A	AC 3 POWER, PHASE A	7.4	PANEL MA73C
E0	SIG	4T1	B	AC 3 POWER, PHASE B	7.4	PANEL MA73C
E0	SIG	4T1	C	AC 3 POWER, PHASE C	7.4	PANEL MA73C
			D			NOT WIRED
			E			NOT WIRED
E0	SIG	4T2	F	X0 603 J1310 - S		
E0	SIG	4T2	G	X0 603 J1310 - T		
E0	SIG	4T2	H	X0 603 J1310 - U		
E0	NTL	4T1	J	AC 3 POWER, NEUTRAL		
E0	NTL	4T2	K	X0 603 J1310 - V	7.4	PANEL MA73C

TABLE 13.6.2.2.2-4 PIN ASSIGNMENTS FOR MSDP - J42

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
			1			NOT WIRED
			2			NOT WIRED
			3			NOT WIRED
			4			NOT WIRED
			5			NOT WIRED
			6			NOT WIRED
RF	SIG RTN	2S2	7	CCTV VIDEO TO COMSEC +	8.2.8	KGX - 60 COMSEC
RF		2S2	8	CCTV VIDEO TO COMSEC -		
			9			NOT WIRED
			10			NOT WIRED
RF	SIG RTN	2S1	11	CCTV CLOCK TO COMSEC +	8.2.8	KGX - 60 COMSEC
RF		2S1	12	CCTV CLOCK TO COMSEC -		
			13			NOT WIRED
			14			NOT WIRED
			15			NOT WIRED
			16			NOT WIRED
			17			NOT WIRED
			18			NOT WIRED
			19			NOT WIRED
			20			NOT WIRED
			21			NOT WIRED
			22			NOT WIRED

TABLE 13.6.2.2-5 PIN ASSIGNMENTS FOR MSDP - J54

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
			1			NOT WIRED
			2			NOT WIRED
			3			NOT WIRED
			4			NOT WIRED
RF	SIG	252	5	VIDEO SPARE 1 +	8.2.8	VIDEO SWITCHING NETWORK
RF	RTN	252	6	VIDEO SPARE 1 -		
			7			NOT WIRED
			8			NOT WIRED
			9			NOT WIRED
			10			NOT WIRED
			11			NOT WIRED
			12			NOT WIRED
			13			NOT WIRED
			14			NOT WIRED
			15			NOT WIRED
			16			NOT WIRED
			17	CABIN CAMERA 4 SYNC +	8.2.8	REMOTE CONTROL UNIT
RF	SIG	251	18	CABIN CAMERA 4 SYNC -		
RF	RTN	251	19	CCTV VIDEO ADU +	8.2.8	KGX - 60 COMSEC
RF	SIG	253	20	CCTV VIDEO ADU -		
RF	RTN	253	21	CCTV CLOCK ADU +	8.2.8	KGX - 60 COMSEC
RF	SIG	254	22	CCTV CLOCK ADU -		
RF	RTN	254				



TABLE 13.6.2.3-1 SUMMARY OF STARBOARD OOSDP CONNECTORS AVAILABLE AS NON-STANDARD ELECTRICAL INTERFACES (INDEPENDENT OF SMCH) IN THE AFD

ORBITER CONNECTOR IDENTIFIER	CABLE DEFINITION				SEE TABLE	ORBITER INTERFACE CONNECTOR PART NO.	CARGO INTERFACE CONNECTOR PART NO.
	NO CIRCT	WIRE TYPE	EMC CLASS	SPARE PINS			
OOSDP-J44	15	TP	HO	25	13.6.2.3-5	MLS0T16-35P	MLS6GT16-35S
OOSDP-J46	1	TP	HO	2	13.6.2.3-4	MB0E14-4SNT2	MB6GE14-4PNT2
OOSDP-J48	22	TSP	ML	13	13.6.2.3-2	MLS0T20-35P	MLS6GT20-35S
OOSDP-J50	21	TSP	ML	16	13.6.2.3-3	MLS0T20-35PA	MLS6GT20-35SA

TABLE 13.6.2.3-2 PIN ASSIGNMENTS FOR OOSDP CONNECTOR J48

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
			1			NOT WIRED
			2			NOT WIRED
			3			NOT WIRED
			4			NOT WIRED
			5			NOT WIRED
			6			NOT WIRED
			7			NOT WIRED
			8			NOT WIRED
			9			NOT WIRED
			10			NOT WIRED
			11			NOT WIRED
			12			NOT WIRED
			13			NOT WIRED
			14	MSDP J28 - 14		TERMINATE
ML	SIG	251	15	MSDP J28 - 15		TERMINATE
ML	RTN	251	16	MSDP J28 - 16		TERMINATE
ML	SHD	251	17	MSDP J28 - 17		TERMINATE
ML	SIG	252	18	MSDP J28 - 18		TERMINATE
ML	RTN	252	19	MSDP J28 - 19		TERMINATE
ML	SHD	252	20	MSDP J28 - 20		TERMINATE
ML	SIG	253	21	MSDP J28 - 21		TERMINATE
ML	RTN	253	22	MSDP J28 - 22		TERMINATE
ML	SHD	253	23	MSDP J28 - 23		TERMINATE
ML	SIG	254	24	MSDP J28 - 24		TERMINATE
ML	RTN	254	25	MSDP J28 - 25		TERMINATE
ML	SHD	254	26	MSDP J28 - 26		TERMINATE
ML	SIG	255	27	MSDP J28 - 27		TERMINATE
ML	RTN	255	28	MSDP J28 - 28		TERMINATE
ML	SHD	255	29	MSDP J28 - 29		TERMINATE
ML	SIG	256	30	MSDP J28 - 30		TERMINATE
ML	RTN	256	31	MSDP J28 - 31		TERMINATE
ML	SHD	256	32	MSDP J28 - 32		TERMINATE
ML	SIG	257	33	MSDP J28 - 33		TERMINATE
ML	RTN	257	34	MSDP J28 - 34		TERMINATE
ML	SHD	257	35	MSDP J28 - 35		TERMINATE
ML	SIG	258	36	MSDP J28 - 36		TERMINATE
ML	RTN	258	37	MSDP J28 - 37		TERMINATE
ML	SHD	258	38	MSDP J28 - 38		TERMINATE
ML	SIG	259	39	MSDP J28 - 39		TERMINATE
ML	RTN	259	40	MSDP J28 - 40		TERMINATE
ML	SHD	259	41	MSDP J28 - 41		TERMINATE
ML	SIG	2510	42	MSDP J28 - 42		TERMINATE
ML	RTN	2510	43	MSDP J28 - 43		TERMINATE
ML	SHD	2510	44	MSDP J28 - 44		TERMINATE
ML	SIG	2511	45	MSDP J28 - 45		TERMINATE
ML	RTN	2511				

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
ML	SHD	2S11	46	MSDP J28 - 46		TERMINATE
ML	RTN	2S12	47	MSDP J28 - 47		
ML	SIG	2S12	48	MSDP J28 - 48		TERMINATE
ML	SHD	2S12	49	MSDP J28 - 49		
ML	RTN	2S13	50	MSDP J28 - 50		TERMINATE
ML	SIG	2S13	51	MSDP J28 - 51		
ML	SHD	2S13	52	MSDP J28 - 52		TERMINATE
ML	RTN	2S14	53	MSDP J28 - 53		
ML	SIG	2S14	54	MSDP J28 - 54		TERMINATE
ML	SHD	2S14	55	MSDP J28 - 55		
ML	SIG	2S15	56	MSDP J28 - 56		TERMINATE
ML	RTN	2S15	57	MSDP J28 - 57		
ML	SHD	2S15	58	MSDP J28 - 58		TERMINATE
ML	SIG	2S16	59	MSDP J28 - 59		
ML	RTN	2S16	60	MSDP J28 - 60		TERMINATE
ML	SHD	2S16	61	MSDP J28 - 61		
ML	SIG	2S17	62	MSDP J28 - 62		TERMINATE
ML	RTN	2S17	63	MSDP J28 - 63		
ML	SHD	2S17	64	MSDP J28 - 64		TERMINATE
ML	RTN	2S18	65	MSDP J28 - 65		
ML	SIG	2S18	66	MSDP J28 - 66		TERMINATE
ML	SHD	2S18	67	MSDP J28 - 67		
ML	RTN	2S19	68	MSDP J28 - 68		TERMINATE
ML	SIG	2S19	69	MSDP J28 - 69		
ML	SHD	2S19	70	MSDP J28 - 70		TERMINATE
ML	SIG	2S20	71	MSDP J28 - 71		
ML	RTN	2S20	72	MSDP J28 - 72		TERMINATE
ML	SHD	2S20	73	MSDP J28 - 73		
ML	SIG	2S21	74	MSDP J28 - 74		TERMINATE
ML	RTN	2S21	75	MSDP J28 - 75		
ML	SHD	2S21	76	MSDP J28 - 76		TERMINATE
ML	RTN	2S22	77	MSDP J28 - 77		
ML	SIG	2S22	78	MSDP J28 - 78		TERMINATE
ML	SHD	2S22	79	MSDP J28 - 79		

TABLE 13.6.2.3-3 PIN ASSIGNMENTS FOR OOSDP CONNECTOR J50

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
			1			NOT WIRED
			2			NOT WIRED
			3			NOT WIRED
			4			NOT WIRED
			5			NOT WIRED
			6			NOT WIRED
			7			NOT WIRED
			8			NOT WIRED
			9			NOT WIRED
			10			NOT WIRED
			11			NOT WIRED
			12			NOT WIRED
			13			NOT WIRED
			14			NOT WIRED
			15			NOT WIRED
			16			NOT WIRED
ML	SIG	251	17	MSDP J14 - 17		TERMINATE
ML	RTN	251	18	MSDP J14 - 18		TERMINATE
ML	SHD	251	19	MSDP J14 - 19		TERMINATE
ML	RTN	252	20	MSDP J14 - 20		TERMINATE
ML	SIG	252	21	MSDP J14 - 21		TERMINATE
ML	SHD	252	22	MSDP J14 - 22		TERMINATE
ML	RTN	253	23	MSDP J14 - 23		TERMINATE
ML	SIG	253	24	MSDP J14 - 24		TERMINATE
ML	SHD	253	25	MSDP J14 - 25		TERMINATE
ML	RTN	254	26	MSDP J14 - 26		TERMINATE
ML	SIG	254	27	MSDP J14 - 27		TERMINATE
ML	SHD	254	28	MSDP J14 - 28		TERMINATE
ML	RTN	255	29	MSDP J14 - 29		TERMINATE
ML	SIG	255	30	MSDP J14 - 30		TERMINATE
ML	SHD	255	31	MSDP J14 - 31		TERMINATE
ML	RTN	256	32	MSDP J14 - 32		TERMINATE
ML	SIG	256	33	MSDP J14 - 33		TERMINATE
ML	SHD	256	34	MSDP J14 - 34		TERMINATE
ML	SIG	257	35	MSDP J14 - 35		TERMINATE
ML	RTN	257	36	MSDP J14 - 36		TERMINATE
ML	SHD	257	37	MSDP J14 - 37		TERMINATE
ML	SIG	258	38	MSDP J14 - 38		TERMINATE
ML	RTN	258	39	MSDP J14 - 39		TERMINATE
ML	SHD	258	40	MSDP J14 - 40		TERMINATE
ML	SIG	259	41	MSDP J14 - 41		TERMINATE
ML	RTN	259	42	MSDP J14 - 42		TERMINATE
ML	SHD	259	43	MSDP J14 - 43		TERMINATE
ML	SIG	2510	44	MSDP J14 - 44		TERMINATE
ML	RTN	2510	45	MSDP J14 - 45		TERMINATE



TABLE 13.6.2.3-3 PIN ASSIGNMENTS FOR OOSDP CONNECTOR J50

EMC CLASS.	PIN FUNCT.	CABLE DESC.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
ML	SHD	2S10	46	MSDP J14 - 46		TERMINATE
ML	RTN	2S11	47	MSDP J14 - 47		
ML	SIG	2S11	48	MSDP J14 - 48		
ML	SHD	2S11	49	MSDP J14 - 49		TERMINATE
ML	RTN	2S12	50	MSDP J14 - 50		
ML	SIG	2S12	51	MSDP J14 - 51		
ML	SHD	2S12	52	MSDP J14 - 52		TERMINATE
ML	RTN	2S13	53	MSDP J14 - 53		
ML	SIG	2S13	54	MSDP J14 - 54		
ML	SHD	2S13	55	MSDP J14 - 55		TERMINATE
ML	SIG	2S14	56	MSDP J14 - 56		
ML	RTN	2S14	57	MSDP J14 - 57		
ML	SHD	2S14	58	MSDP J14 - 58		TERMINATE
ML	SIG	2S15	59	MSDP J14 - 59		
ML	RTN	2S15	60	MSDP J14 - 60		
ML	SHD	2S15	61	MSDP J14 - 61		TERMINATE
ML	SIG	2S16	62	MSDP J14 - 62		
ML	RTN	2S16	63	MSDP J14 - 63		
ML	SHD	2S16	64	MSDP J14 - 64		TERMINATE
ML	RTN	2S17	65	MSDP J14 - 65		
ML	SIG	2S17	66	MSDP J14 - 66		
ML	SHD	2S17	67	MSDP J14 - 67		TERMINATE
ML	RTN	2S18	68	MSDP J14 - 68		
ML	SIG	2S18	69	MSDP J14 - 69		
ML	SHD	2S18	70	MSDP J14 - 70		TERMINATE
ML	SIG	2S19	71	MSDP J14 - 71		
ML	RTN	2S19	72	MSDP J14 - 72		
ML	SHD	2S19	73	MSDP J14 - 73		TERMINATE
ML	SIG	2S20	74	MSDP J14 - 74		
ML	RTN	2S20	75	MSDP J14 - 75		
ML	SHD	2S20	76	MSDP J14 - 76		TERMINATE
ML	RTN	2S22	77	MSDP J14 - 77		
ML	SIG	2S22	78	MSDP J14 - 78		
ML	SHD	2S22	79	MSDP J14 - 79		TERMINATE

TABLE 13.6.2.3-4 PIN ASSIGNMENTS FOR OOSDP CONNECTOR J46

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
HO	SIG	2T1	A	CABIN 3 POWER	7.3.3	MPCA 1 OR 2 GROUND NOT WIRED NOT WIRED
HO	RTN	2T1	B	CABIN 3 POWER RETURN		
			C			
			D			

TABLE 13.6.2.3-5 PIN ASSIGNMENTS FOR OOSDP CONNECTOR J44

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
			1			NOT WIRED
			2			NOT WIRED
			3			NOT WIRED
			4			NOT WIRED
			5			NOT WIRED
			6			NOT WIRED
			7			NOT WIRED
			8			NOT WIRED
			9			NOT WIRED
HO	SIG	2T13	10	MSDP J20 - 25		
HO	RTN	2T13	11	MSDP J20 - 24		
HO	SIG	2T12	12	MSDP J20 - 23		
HO	RTN	2T12	13	MSDP J20 - 22		
HO	SIG	2T11	14	MSDP J20 - 19		
HO	RTN	2T11	15	MSDP J20 - 18		
HO	RTN	2T10	16	MSDP J20 - 42		
HO	RTN	2T15	17	MSDP J20 - 26		
HO	SIG	2T4	18	MSDP J20 - 49		
HO	RTN	2T4	19	MSDP J20 - 48		
HO	SIG	2T9	20	MSDP J20 - 47		
HO	RTN	2T9	21	MSDP J20 - 46		
HO	SIG	2T7	22	MSDP J20 - 45		
HO	RTN	2T7	23	MSDP J20 - 44		
HO	SIG	2T10	24	MSDP J20 - 43		
HO	SIG	2T15	25	MSDP J20 - 27		
HO	SIG	2T3	26	MSDP J20 - 32		
HO	RTN	2T3	27	MSDP J20 - 31		
HO	SIG	2T1	28	MSDP J20 - 33		
HO	RTN	2T1	29	MSDP J20 - 34		
HO	SIG	2T6	30	MSDP J20 - 35		
HO	RTN	2T6	31	MSDP J20 - 36		
HO	SIG	2T14	32	MSDP J20 - 30		
HO	RTN	2T14	33	MSDP J20 - 29		
HO	SIG	2T2	34	MSDP J20 - 5		
HO	RTN	2T2	35	MSDP J20 - 4		
HO	SIG	2T5	36	MSDP J20 - 6		
HO	RTN	2T5	37	MSDP J20 - 7		
HO	SIG	2T8	38	MSDP J20 - 8		
HO	RTN	2T8	39	MSDP J20 - 9		
			40			NOT WIRED
			41			NOT WIRED
			42			NOT WIRED
			43			NOT WIRED
			44			NOT WIRED
			45			NOT WIRED

TABLE 13.6.2.3-5 PIN ASSIGNMENTS FOR OOSDP CONNECTOR J44

EMC CLASS.	PIN FUNCT.	CABLE DESC.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
			46			NOT WIRED
			47			NOT WIRED
			48			NOT WIRED
			49			NOT WIRED
			50			NOT WIRED
			51			NOT WIRED
			52			NOT WIRED
			53			NOT WIRED
			54			NOT WIRED
			55			NOT WIRED

TABLE 13.6.2.4-1 SUMMARY OF PORT OODP CONNECTORS AVAILABLE AS NON-STANDARD ELECTRICAL INTERFACES (INDEPENDENT OF SMCH) IN THE AFD

ORBITER CONNECTOR IDENTIFIER	CABLE DEFINITION			SEE TABLE	ORBITER INTERFACE CONNECTOR PART NO.	CARGO INTERFACE CONNECTOR PART NO.
	NO CIRCT	WIRE TYPE	EMC CLASS			
005DP-J57	15	TP	HO	25	NLS0T16-35P	NLS6GT16-35S
005DP-J59	22	TSP	ML	13	NLS0T20-35P	NLS6GT20-35S
005DP-J61	21	TSP	ML	16	NLS0T20-35PA	NLS6GT20-35SA
005DP-J701	1	COAX	RF	0	MC414-0614-0041	MC414-0614-0011
005DP-J702	1	COAX	RF	0	MC414-0614-0041	MC414-0614-0011
005DP-J703	1	COAX	RF	0	MC414-0614-0041	MC414-0614-0011
005DP-J704	1	COAX	RF	0	MC414-0614-0041	MC414-0614-0011
005DP-J9575	4	TSP	ML	13	NB0E22-55SNT2	NB6GE22-55PNT2
	2	TS4C	ML			
	2	T4C	HO			
	12	SC	HO			

(1) SIGNAL IS CARRIED CONVENTIONALLY ON CENTER CONDUCTOR FOR ALL ORBITER COAX CABLES. NO PIN ASSIGNMENT TABLES ARE REQUIRED. CIRCUIT TERMINATIONS ARE SHOWN IN FIGURE 13.3.3-1.

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
			1			NOT WIRED
			2			NOT WIRED
			3			NOT WIRED
			4			NOT WIRED
			5			NOT WIRED
			6			NOT WIRED
			7			NOT WIRED
			8			NOT WIRED
			9			NOT WIRED
			10			NOT WIRED
			11			NOT WIRED
			12			NOT WIRED
			13			NOT WIRED
			14	PSDP J51 - 14		TERMINATE
ML	SIG	2S2	15	PSDP J51 - 15		TERMINATE
ML	RTN	2S2	16	PSDP J51 - 16		TERMINATE
ML	SHD	2S2	17	PSDP J51 - 17		TERMINATE
ML	SIG	2S1	18	PSDP J51 - 18		TERMINATE
ML	RTN	2S1	19	PSDP J51 - 19		TERMINATE
ML	SHD	2S1	20	PSDP J51 - 20		TERMINATE
ML	SIG	2S9	21	PSDP J51 - 21		TERMINATE
ML	RTN	2S9	22	PSDP J51 - 22		TERMINATE
ML	SHD	2S9	23	PSDP J51 - 23		TERMINATE
ML	SIG	2S12	24	PSDP J51 - 24		TERMINATE
ML	RTN	2S12	25	PSDP J51 - 25		TERMINATE
ML	SHD	2S12	26	PSDP J51 - 26		TERMINATE
ML	SIG	2S14	27	PSDP J51 - 27		TERMINATE
ML	RTN	2S14	28	PSDP J51 - 28		TERMINATE
ML	SHD	2S14	29	PSDP J51 - 29		TERMINATE
ML	SIG	2S15	30	PSDP J51 - 30		TERMINATE
ML	RTN	2S15	31	PSDP J51 - 31		TERMINATE
ML	SHD	2S15	32	PSDP J51 - 32		TERMINATE
ML	SIG	2S8	33	PSDP J51 - 33		TERMINATE
ML	RTN	2S8	34	PSDP J51 - 34		TERMINATE
ML	SHD	2S8	35	PSDP J51 - 35		TERMINATE
ML	SIG	2S7	36	PSDP J51 - 36		TERMINATE
ML	RTN	2S7	37	PSDP J51 - 37		TERMINATE
ML	SHD	2S7	38	PSDP J51 - 38		TERMINATE
ML	SIG	2S4	39	PSDP J51 - 39		TERMINATE
ML	RTN	2S4	40	PSDP J51 - 40		TERMINATE
ML	SHD	2S4	41	PSDP J51 - 41		TERMINATE
ML	SIG	2S3	42	PSDP J51 - 42		TERMINATE
ML	RTN	2S3	43	PSDP J51 - 43		TERMINATE
ML	SHD	2S3	44	PSDP J51 - 44		TERMINATE
ML	SIG	2S10	45	PSDP J51 - 45		TERMINATE
ML	RTN	2S10				

TABLE 13.6.2.4-2 PIN ASSIGNMENTS FOR OOSDP CONNECTOR J59

EMC CLASS.	PIN FUNCT.	CABLE DESC.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
ML	SHD	2S10	46	PSDP J51 - 46		TERMINATE
ML	RTN	2S13	47	PSDP J51 - 47		
ML	SIG	2S13	48	PSDP J51 - 48		
ML	SHD	2S13	49	PSDP J51 - 49		TERMINATE
ML	RTN	2S17	50	PSDP J51 - 50		
ML	SIG	2S17	51	PSDP J51 - 51		
ML	SHD	2S17	52	PSDP J51 - 52		TERMINATE
ML	RTN	2S16	53	PSDP J51 - 53		
ML	SIG	2S16	54	PSDP J51 - 54		
ML	SHD	2S16	55	PSDP J51 - 55		TERMINATE
ML	SIG	2S6	56	PSDP J51 - 56		
ML	RTN	2S6	57	PSDP J51 - 57		
ML	SHD	2S6	58	PSDP J51 - 58		TERMINATE
ML	SIG	2S5	59	PSDP J51 - 59		
ML	RTN	2S5	60	PSDP J51 - 60		
ML	SHD	2S5	61	PSDP J51 - 61		TERMINATE
ML	SIG	2S11	62	PSDP J51 - 62		
ML	RTN	2S11	63	PSDP J51 - 63		
ML	SHD	2S11	64	PSDP J51 - 64		TERMINATE
ML	RTN	2S18	65	PSDP J51 - 65		
ML	SIG	2S18	66	PSDP J51 - 66		
ML	SHD	2S18	67	PSDP J51 - 67		TERMINATE
ML	RTN	2S21	68	PSDP J51 - 68		
ML	SIG	2S21	69	PSDP J51 - 69		
ML	SHD	2S21	70	PSDP J51 - 70		TERMINATE
ML	SIG	2S19	71	PSDP J51 - 71		
ML	RTN	2S19	72	PSDP J51 - 72		
ML	SHD	2S19	73	PSDP J51 - 73		TERMINATE
ML	SIG	2S20	74	PSDP J51 - 74		
ML	RTN	2S20	75	PSDP J51 - 75		
ML	SHD	2S20	76	PSDP J51 - 76		TERMINATE
ML	RTN	2S22	77	PSDP J51 - 77		
ML	SIG	2S22	78	PSDP J51 - 78		
ML	SHD	2S22	79	PSDP J51 - 79		TERMINATE

TABLE 13.6.2.4-3 PIN ASSIGNMENTS FOR OOSDP CONNECTOR J61

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
ML	RTN	2S1	1	PSDP J45 - 35		TERMINATE
ML	SIG	2S1	2	PSDP J45 - 36		
ML	SHD	2S1	3	PSDP J45 - 37		TERMINATE
ML	SIG	2S12	4	PSDP J45 - 8		
ML	SHD	2S12	5	PSDP J45 - 10		TERMINATE
ML	SIG	2S14	6	PSDP J45 - 11		
ML	RTN	2S14	7	PSDP J45 - 12		
ML	SHD	2S14	8	PSDP J45 - 38		TERMINATE
ML	SIG	2S17	9	PSDP J45 - 32		TERMINATE
ML	RTN	2S17	10	PSDP J45 - 33		NOT WIRED
ML	SHD	2S17	11	PSDP J45 - 34		NOT WIRED
ML	SHD	2S19	12	PSDP J45 - 21		NOT WIRED
			13			TERMINATE
			14			
			15			NOT WIRED
			16			NOT WIRED
			17			NOT WIRED
			18			NOT WIRED
			19			NOT WIRED
			20			NOT WIRED
			21			NOT WIRED
			22			NOT WIRED
			23			NOT WIRED
			24			NOT WIRED
			25			NOT WIRED
			26	PSDP J45 - 58		TERMINATE
ML	SHD	2S3	26	PSDP J45 - 57		
ML	RTN	2S3	27	PSDP J45 - 47		
ML	SIG	2S2	28	PSDP J45 - 46		
ML	RTN	2S2	29	PSDP J45 - 65		
ML	SHD	2S2	30	PSDP J45 - 26		
ML	SIG	2S8	31	PSDP J45 - 9		
ML	RTN	2S12	32	PSDP J45 - 19		
ML	SIG	2S13	33	PSDP J45 - 18		
ML	RTN	2S13	34	PSDP J45 - 13		
ML	SIG	2S15	35	PSDP J45 - 14		
ML	RTN	2S15	36	PSDP J45 - 44		
ML	SIG	2S19	37	PSDP J45 - 45		
ML	RTN	2S19	38			NOT WIRED
			39			NOT WIRED
			40			NOT WIRED
			41			
ML	SIG	2S21	42	PSDP J45 - 74		TERMINATE
ML	RTN	2S21	43	PSDP J45 - 75		
ML	SHD	2S20	44	PSDP J45 - 55		
ML	RTN	2S7	45	PSDP J45 - 72		



EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
ML	SIG	257	46	PSDP J45 - 71		
ML	SHD	256	47	PSDP J45 - 61		TERMINATE
ML	RTN	254	48	PSDP J45 - 69		
ML	SIG	254	49	PSDP J45 - 68		
ML	SIG	253	50	PSDP J45 - 56		
ML	SIG	255	51	PSDP J45 - 48		
ML	SHD	258	52	PSDP J45 - 25		TERMINATE
ML	RTN	258	53	PSDP J45 - 27		
ML	SHD	259	54	PSDP J45 - 1		TERMINATE
ML	SHD	2513	55	PSDP J45 - 20		TERMINATE
ML	SHD	2515	56	PSDP J45 - 15		TERMINATE
ML	SHD	2516	57	PSDP J45 - 2		TERMINATE
ML	RTN	2516	58	PSDP J45 - 31		
ML	RTN	2518	59	PSDP J45 - 42		
ML	SHD	2521	60	PSDP J45 - 76		TERMINATE
ML	SIG	2520	61	PSDP J45 - 53		
ML	RTN	2520	62	PSDP J45 - 54		
ML	SHD	257	63	PSDP J45 - 73		TERMINATE
ML	RTN	256	64	PSDP J45 - 60		
ML	SIG	256	65	PSDP J45 - 59		
ML	SHD	254	66	PSDP J45 - 70		TERMINATE
ML	RTN	255	67	PSDP J45 - 49		
ML	SHD	255	68	PSDP J45 - 66		TERMINATE
ML	SIG	259	69	PSDP J45 - 28		
ML	RTN	259	70	PSDP J45 - 29		
ML	SIG	2516	71	PSDP J45 - 30		
ML	SIG	2518	72	PSDP J45 - 41		TERMINATE
ML	SHD	2518	73	PSDP J45 - 43		
ML	RTN	2511	74	PSDP J45 - 63		
ML	SIG	2511	75	PSDP J45 - 62		
ML	SHD	2511	76	PSDP J45 - 64		TERMINATE
ML	SIG	2510	77	PSDP J45 - 50		
ML	SHD	2510	78	PSDP J45 - 52		TERMINATE
ML	RTN	2510	79	PSDP J45 - 51		

TABLE 13.6.2.4-4 PIN ASSIGNMENTS FOR OOSDP CONNECTOR J57

EMC CLASS.	PIN FUNCT.	CABLE DESC.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
			1			NOT WIRED
			2			NOT WIRED
			3			NOT WIRED
			4			NOT WIRED
			5			NOT WIRED
			6			NOT WIRED
			7			NOT WIRED
			8			NOT WIRED
			9			NOT WIRED
			10			NOT WIRED
			11			NOT WIRED
			12			NOT WIRED
			13			NOT WIRED
			14			NOT WIRED
			15			NOT WIRED
			16			NOT WIRED
			17	PSDP J17 - 14		
HO	SIG	2T19	17	PSDP J17 - 15		
HO	RTN	2T19	18	PSDP J17 - 12		
HO	SIG	2T20	19	PSDP J17 - 13		
HO	RTN	2T20	20	PSDP J17 - 10		
HO	SIG	2T21	21	PSDP J17 - 11		
HO	RTN	2T21	22	PSDP J17 - 8		
HO	SIG	2T22	23	PSDP J17 - 9		
HO	RTN	2T22	24	PSDP J17 - 37		
HO	RTN	2T8	25	PSDP J17 - 34		
HO	SIG	2T9	26	PSDP J17 - 35		
HO	RTN	2T9	27	PSDP J17 - 32		
HO	SIG	2T10	28	PSDP J17 - 33		
HO	RTN	2T10	29	PSDP J17 - 30		
HO	SIG	2T11	30	PSDP J17 - 31		
HO	RTN	2T11	31	PSDP J17 - 36		
HO	SIG	2T8	32	PSDP J17 - 29		
HO	RTN	2T12	33	PSDP J17 - 26		
HO	SIG	2T13	34	PSDP J17 - 27		
HO	RTN	2T13	35	PSDP J17 - 24		
HO	SIG	2T14	36	PSDP J17 - 25		
HO	RTN	2T14	37	PSDP J17 - 22		
HO	SIG	2T15	38	PSDP J17 - 23		
HO	RTN	2T15	39	PSDP J17 - 28		
HO	SIG	2T12	40	PSDP J17 - 20		
HO	RTN	2T16	41	PSDP J17 - 21		
HO	SIG	2T16	42	PSDP J17 - 18		
HO	RTN	2T17	43	PSDP J17 - 19		
HO	SIG	2T17	44	PSDP J17 - 16		
HO	RTN	2T17	45			

TABLE 13.6.2.4-4 PIN ASSIGNMENTS FOR OOSDP CONNECTOR J57

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
H0	RTN	2T18	46	PSDP J17 - 17		NOT WIRED
			47			NOT WIRED
			48			NOT WIRED
			49			NOT WIRED
			50			NOT WIRED
			51			NOT WIRED
			52			NOT WIRED
			53	NOT WIRED		
			54	NOT WIRED		
			55	NOT WIRED		

TABLE 13.6.2.4-5 PIN ASSIGNMENTS FOR OOSDP CONNECTOR J9575

EMC CLASS.	PIN FUNCT.	CABLE DESC.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITTER COMPONENT INTERFACE AND/OR NOTES
			A			
			B			
			C			
HO	SIG	15C	D	END EFFECTOR # 16 (PORT)		NOT WIRED
HO	SIG	15C	E	END EFFECTOR # 15 (PORT)		NOT WIRED
HO	SIG	15C	F	END EFFECTOR # 14 (PORT)		NOT WIRED
ML	SIG	253	G	END EFFECTOR # 8 (PORT)		
ML	RTN	253	H	END EFFECTOR # 7 (PORT)		
ML	SHD	253	J			
ML	SIG	251	K	END EFFECTOR # 8 (STARBOARD)		TERMINATE
ML	RTN	251	L	END EFFECTOR # 7 (STARBOARD)		
ML	SHD	251	M			
HO	SIG	15C	N	END EFFECTOR # 14 (STARBOARD)		
HO	SIG	15C	P	END EFFECTOR # 15 (STARBOARD)		
HO	SIG	15C	R	END EFFECTOR # 16 (STARBOARD)		
			S			
			T			
			U			
			V			
ML	SIG	452	W	END EFFECTOR # 12 (PORT)		
ML	SIG	452	X	END EFFECTOR # 11 (PORT)		
HO	SIG	15C	Y	END EFFECTOR # 13 (PORT)		
HO	RTN	15C	Z	TRANSFER RELAY RETURN (PORT)		
HO	SIG	15C	a	TRANSFER RELAY (PORT)		
ML	SIG	254	b	END EFFECTOR # 6 (PORT)		NOT WIRED
ML	RTN	254	c	END EFFECTOR # 5 (PORT)		NOT WIRED
ML	SHD	254	d			NOT WIRED
			e			
ML	SIG	252	f	END EFFECTOR # 6 (STARBOARD)		TERMINATE
ML	RTN	252	g	END EFFECTOR # 5 (STARBOARD)		NOT WIRED
ML	SHD	252	h			
HO	SIG	15C	i	TRANSFER RELAY (STBD)		
HO	RTN	15C	j	TRANSFER RELAY RETURN (STBD)		
HO	SIG	15C	k	END EFFECTOR # 13 (STARBOARD)		
ML	SIG	451	m	END EFFECTOR # 11 (STARBOARD)		
ML	RTN	451	n	END EFFECTOR # 12 (STARBOARD)		
			p			
ML	SIG	452	q	END EFFECTOR # 10 (PORT)		NOT WIRED
ML	RTN	452	r	END EFFECTOR # 9 (PORT)		
HO	RTN	412	s	END EFFECTOR # 4 (PORT)		
HO	SIG	412	t	END EFFECTOR # 3 (PORT)		
HO	SIG	412	u	END EFFECTOR # 2 (PORT)		
			v			
HO	SIG	411	w	END EFFECTOR # 2 (STARBOARD)		NOT WIRED
HO	SIG	411	x	END EFFECTOR # 3 (STARBOARD)		

TABLE 13.6.2.4-5 PIN ASSIGNMENTS FOR OOSDP CONNECTOR J9575

EMC CLASS.	PIN FUNCT.	CABLE DESCR.	PIN #	SIGNAL FUNCTION OR PANEL TERMINATION - PIN #	REFERENCE PARAGRAPH	ORBITER COMPONENT INTERFACE AND/OR NOTES
HO	SIG	4T1	y	END EFFECTOR # 4 (STARBOARD)		
ML	SIG	4S1	z	END EFFECTOR # 9 (STARBOARD)		
ML	SIG	4S1	AA	END EFFECTOR # 10 (STARBOARD)		
ML	SHD	4S2	BB			NOT WIRED
HO	SIG	4T2	CC	END EFFECTOR # 1 (PORT)		TERMINATE
			DD			NOT WIRED
HO	RTN	4T1	EE			TERMINATE
ML	SHD	4S1	FF	END EFFECTOR # 1 (STARBOARD)		NOT WIRED
			GG			
			HH			

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## **14.0 Payload Deployment And Retrieval System**

### **14.1 Clearance Envelopes**

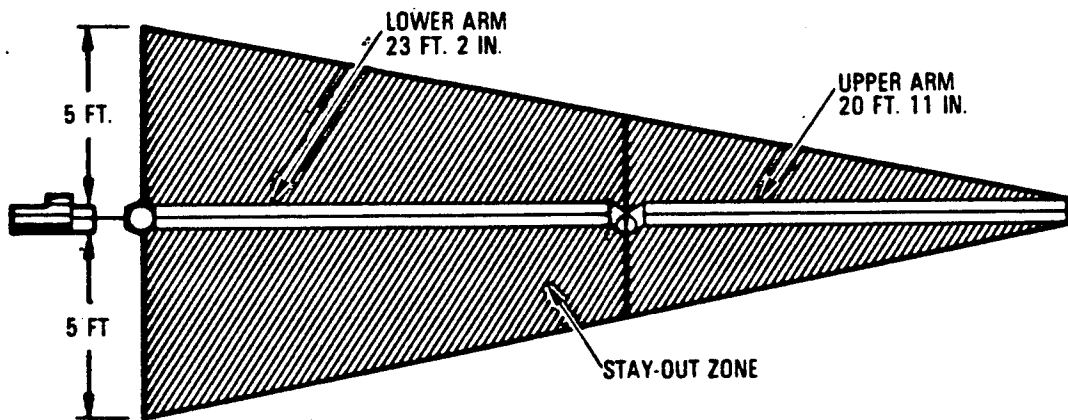
**14.1.1 Maximum RMS Deployable Payload Stowed-in-the-Bay Envelope.** The maximum envelope payload (reference Volume XV, Appendix 8) requires 24 inch guides, scuff plates, and 4 bulkhead CCTV cameras. Remote Manipulator System (RMS) elbow and Orbiter keel cameras may also be required, although these are evaluated on a mission specific basis.

**14.1.2 Clearances for RMS Payload Maneuvers.** Clearance of 2 feet shall be maintained between the payload and all other structures until the payload trunnions enter the guides.

The clearance (exclusive of the distance between the payload trunnions and guides) may then decrease uniformly to six inches just prior to when the trunnions are fully seated in the retention latches. The six inch clearance precludes contact between the payload and other structures should the payload rotate slightly during berthing/unberthing.

Paragraph 3.1.2.1.4 describes various payload bay protrusions that shall be considered for RMS deployable payloads.

**14.1.3 RMS Auto Trajectory Clearance Requirements.** Auto trajectories shall maintain a minimum of 5 feet clearance between the deployed payload and any part of the Orbiter (including other payloads in the bay) at all times. Clearance between the protective RMS boom envelope and any part of the Orbiter (including other payloads in the bay) shall also be maintained (figure 14.1.2-1).



*Figure 14.1.2-1 RMS Boom Envelope*



## 14.2 Payload Deployment Operations

14.2.1 Deployment Stabilization and Release Accuracy. An RMS deployed payload as large as the maximum stowed-in-the-bay envelope can be stabilized prior to release using the vernier reaction control system (VRCS) for Orbiter attitude control with the following accuracy when tight DAP control deadzones are used. Attainment of the quoted accuracy requires turning off the RMS brakes 120 seconds before Orbiter free drift and 15 to 120 seconds of Orbiter free drift (exact time is determined by NSJS) prior to release to allow RMS vibration settling.

- a. Attitude uncertainty of less than or equal to a total of 5 degrees, root-sum-square (rss) of all 3 axes, between the payload and desired inertial or LVLH reference.
- b. Angular rate uncertainty of less than or equal to 0.1 degrees/seconds, root-sum-square of all 3 axes, between the payload and the desired inertial or LVLH reference.
- c. Linear motion of less than or equal to 0.1 foot/second, relative to the RMS shoulder attach point.
- d. The total release accuracy can be computed by adding an additional uncertainty due to the tip-off/separation impulse. The worst case impulse is 1.5 lbf-seconds applied to the grapple fixture in any one direction.

## 14.3 Payload Retrieval Operations

14.3.1 Stabilization for Approach. Attitude error relative to the desired orientation in the inertial or Local Vertical/Local Horizontal (LVLH) reference frame is limited to  $\pm 20$  degrees total in all axes. For payloads having one or more unconstrained axes, the nominal payload orientation relative to the payload LVLH reference frame, during the planned retrieval sequence, shall be made known preflight.

14.3.2 Stabilization at Grapple. Angular rate relative to the inertial or LVLH reference frame is limited to  $\pm 0.1$  degree/second in each axis.

14.3.3 Attitude Control and Pointing. The grapple fixture location(s) shall be compatible with approach techniques. For payloads with multiple stable attitudes, grapple fixture location(s) shall be compatible for all stable attitudes.

14.3.4 Payloads with Active Control Systems. The RMS shall not grapple payloads having active attitude or translational control systems.

## 14.4 Grapple Fixture Interface

14.4.1 General Requirements. The location of the grapple fixture shall be compatible with the RMS reach capability for berthing and deployment.

14.4.1.1 EVA Release. EVA release capability is required for all grapple fixtures. Clearance requirements for the EVA crewman to perform the EVA release operations on any grapple fixture are shown in Figure 14.4.1.1-1.

**14.4.1.2 Grapple Fixture Tolerances.** The grapple fixture shall be installed in compliance with the installation instructions provided with each grapple fixture. The grapple fixture shall be located such that the perpendicular distance from the grapple fixture centerline to the payload CG is less than or equal to 11 feet and the total distance from the payload CG to grapple fixture base is less than 13 feet. If the grapple fixture centerline passes through or within 1 foot of the payload CG, the distance between the grapple fixture base and payload CG can be increased to 20 feet.

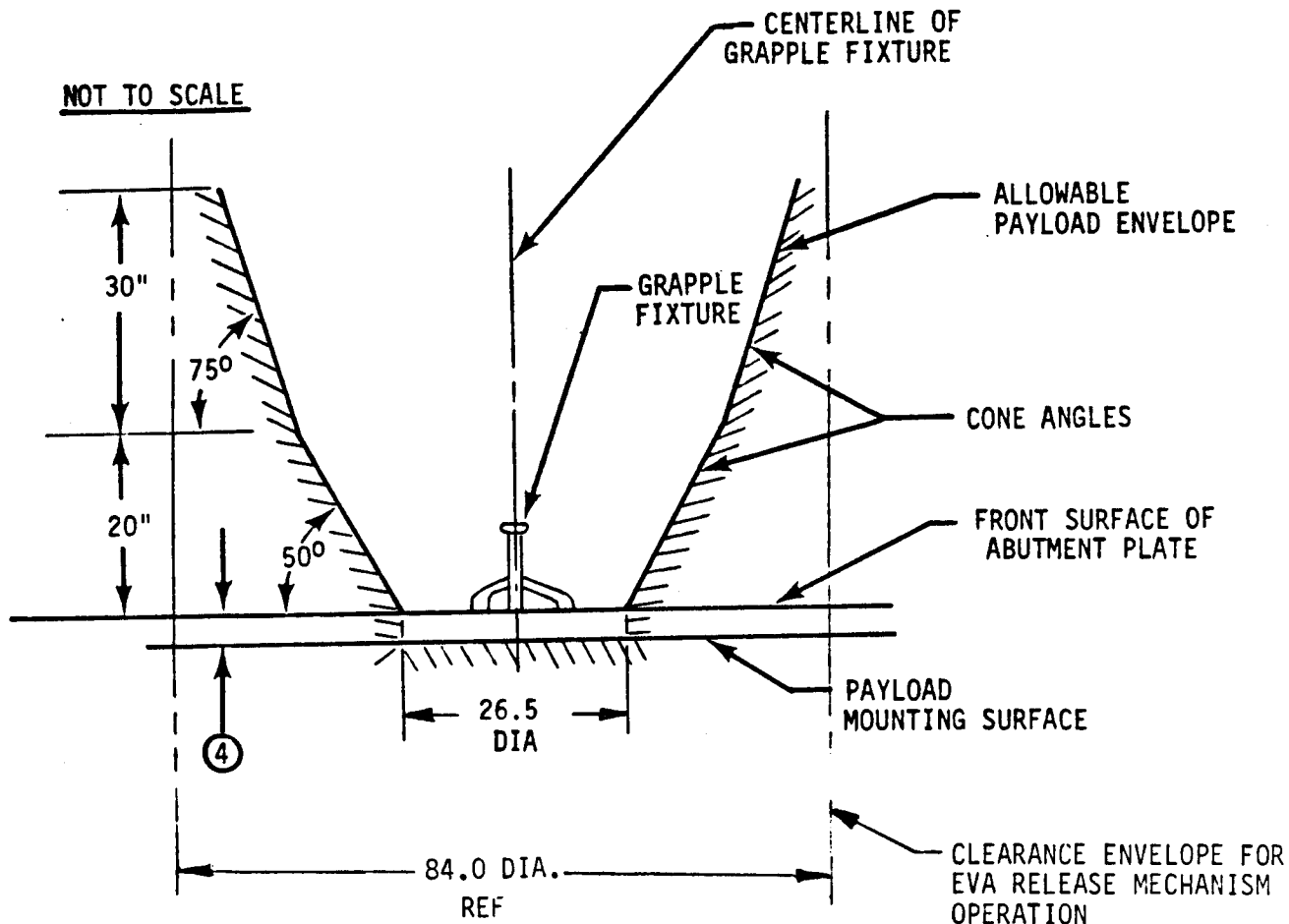
The alignment between the grapple fixture to end effector interface plane and the cargo element reference axes shall be known to within  $\pm 0.15$  degree in pitch, roll, and yaw; and to within  $\pm 0.25$  inch in X, Y, and Z.

The payload clearance envelope required to support RMS operations is shown in Figure 14.4.1.1-1. The RMS end effector-to-grapple fixture allowable misalignment at capture is shown in Figure 14.4.1.2-1.

**14.4.1.3 Electrical Bonding.** Grapple fixture to payload bonding shall be as specified in Paragraph 10.7.4.3.1. The RMS shall not be utilized in a manner that would allow electrical current to flow through the RMS structure. Payloads which reference Orbiter supplied power to their structure and which draw Orbiter power while grappled by the RMS shall utilize an electrically isolated grapple fixture. If an electrical connector is used at the RMS/payload interface, the structure electrical isolation shall not be compromised by wiring or shielding terminations, thermal blanket(s), or in any other way. The requirement for an electrically isolated grapple fixture may be met by insulating the grapple fixture mounting surface and hardware.

Static electrical bonding of the grapple fixture is a requirement. This requirement may be met for isolated grapple fixtures by connecting the grapple fixture to the payload structure through not less than 5000 ohms and not more than 10,000 ohms resistance.

**14.4.1.4 Roll Misalignments.** Under normal grappling conditions within the payload bay, roll misalignment at capture is less than 10 degrees and proper operation of the RSGJ and EJGJ shafts will occur. Grappling operations of a free-flying payload may occur with roll misalignments greater than 10 degrees and may result in premature cyclic operation (extension) of the RSGJ and EJGJ shafts during rigidization. The payload designer shall take this premature, momentary shaft extension into account when designing activation/deactivation logic. In the case of the EJGJ, the GJ electrical connector also extends. Damage to the mating electrical components may occur if the extension is held under a peak rigidization force.



**NOTES:**

- (1) CLEARANCE VOLUME CENTERED ON CENTERLINE OF GRAPPLE FIXTURE
- (2) CLEARANCES REQUIRED BEYOND 50 INCHES FROM THE ATTACHMENT PLANE WILL BE DEPENDENT ON THE PAYLOAD AND THE REQUIRED ARM CONFIGURATION
- (3) THE GRAPPLE FIXTURE/TARGET MOUNTING ORIENTATION ON THE PAYLOAD VIEWING REFERENCE FOR THE OPERATOR
- (4) DIMENSION DEPENDENT ON TYPE OF GRAPPLE FIXTURE INSTALLED

*Figure 14.4.1.1-1 Clearance Envelope For Grapple Fixture EVA Release Mechanism Operation And RMS Operations*

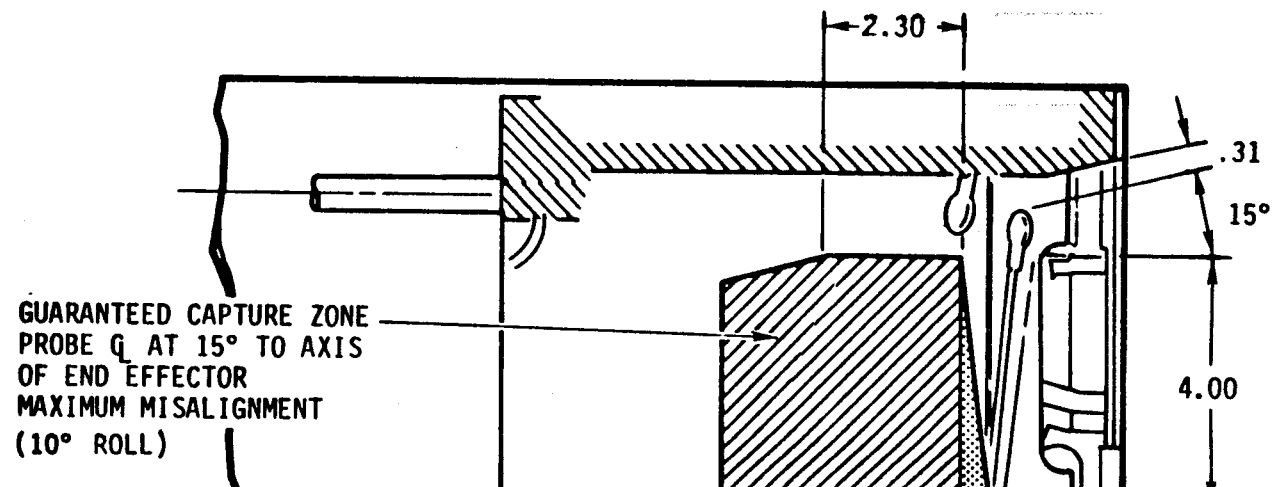


Figure 14.4.1.2-1 Precapit  
Sixtur

ICD-2-19001

**14.4.2 Flight Releasable Grapple Fixture.** The general configuration and interfacing provisions are shown in Figures 14.4.2-1 through 14.4.2-5. Thermal and electrical isolation between the FRGF and the payload are obtained by nonconductive washers and bushings as shown in Figure 14.4.2-3. Electrical bonding is established by a ground strap (Figure 14.4.2-5). The strap is 20 AWG, approximately 24 inches long and requires termination by the cargo element. All bushings and washers required for mounting are supplied with the FRGF. The cargo element is responsible for providing the attachment bolts as specified in Figure 14.4.2-3.

**14.4.3 Rigidize Sensing Grapple Fixture.** The RSGF is an adaptation of an FRGF that incorporates a movable grapple shaft which extend under end effector rigidization loads and retracts during derigidization. The shaft motion is available behind the backplate to actuate limit switches for initiating startup or shutdown sequences or for other purposes related to end effector operation subject to NSJS approval. The RSGF interface parameters are defined in Figures 14.4.3-1 and 14.4.3-2. Thermal and electrical isolation are provided in the same manner as described for the FRGF. Attachment bolts shall be provided by the cargo element and the attachment interface is the same as specified for the FRGF in Figure 14.4.2-3. A ground strap as described in Paragraph 14.4.2 is installed as shown in Figure 14.4.2-5.

**14.4.4 Electrical Flight Grapple Fixture.** The EFGF is an adaptation of an RSGF which uses the movable grapple shaft to extend and retract an electrical connector. The grapple fixture connector mates with the special purpose end effector (SPEE) electrical connector on the end effector. See Table 14.4.4-1 for pin assignments including amperage limits and fusing requirements. The location and orientation of the connector are as defined in Figure 14.4.4-1. Thermal and electrical isolation are provided in the same manner as described for the FRGF. A ground strap as described in 14.4.2 is installed as shown in Figure 14.4.2-5. Attachment bolts shall be provided by the cargo element and the attachment interface is the same as specified for the FRGF in Figure 14.4.2-3.



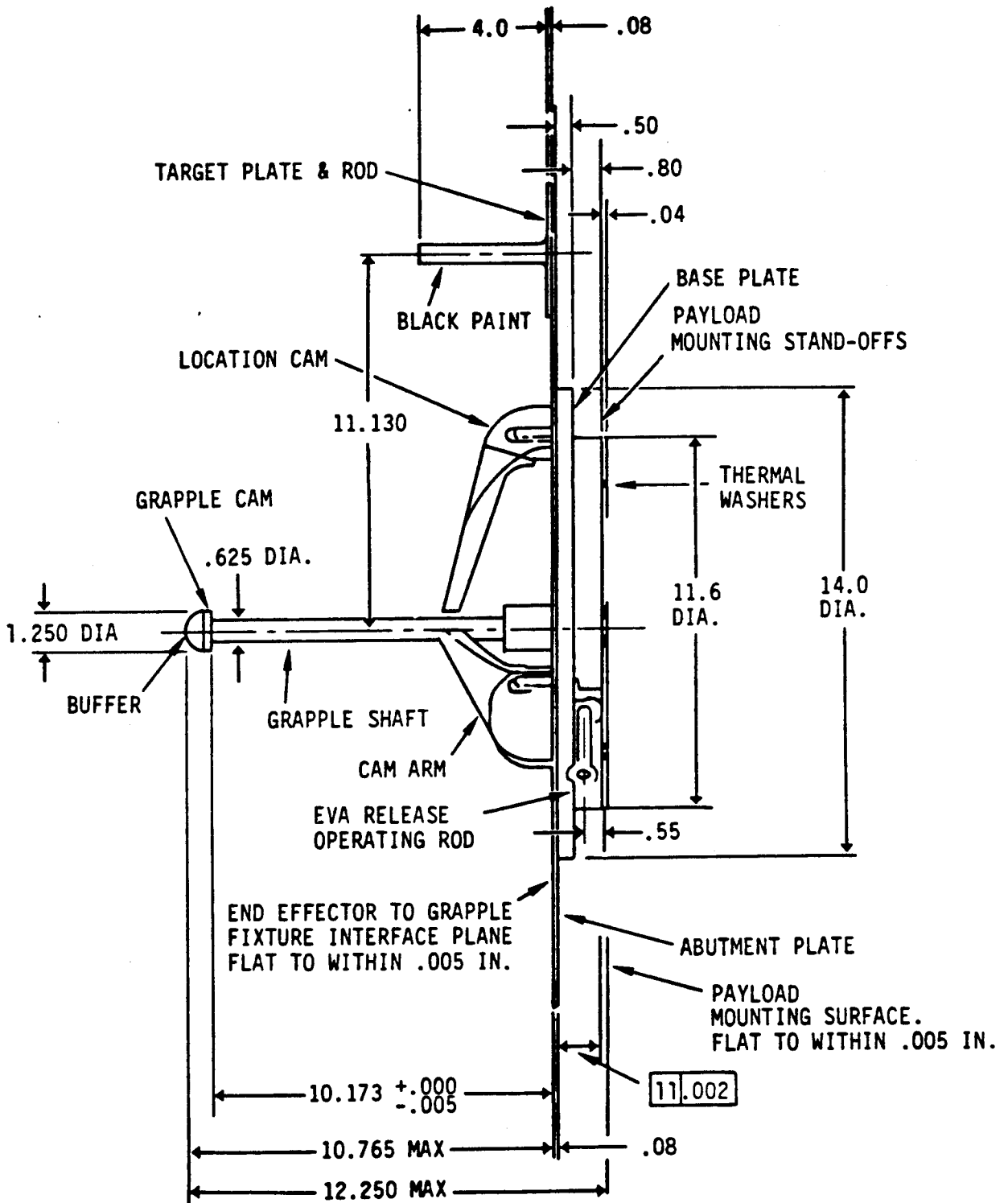


Figure 14.A.2-2 JRG3 Interface Parameters

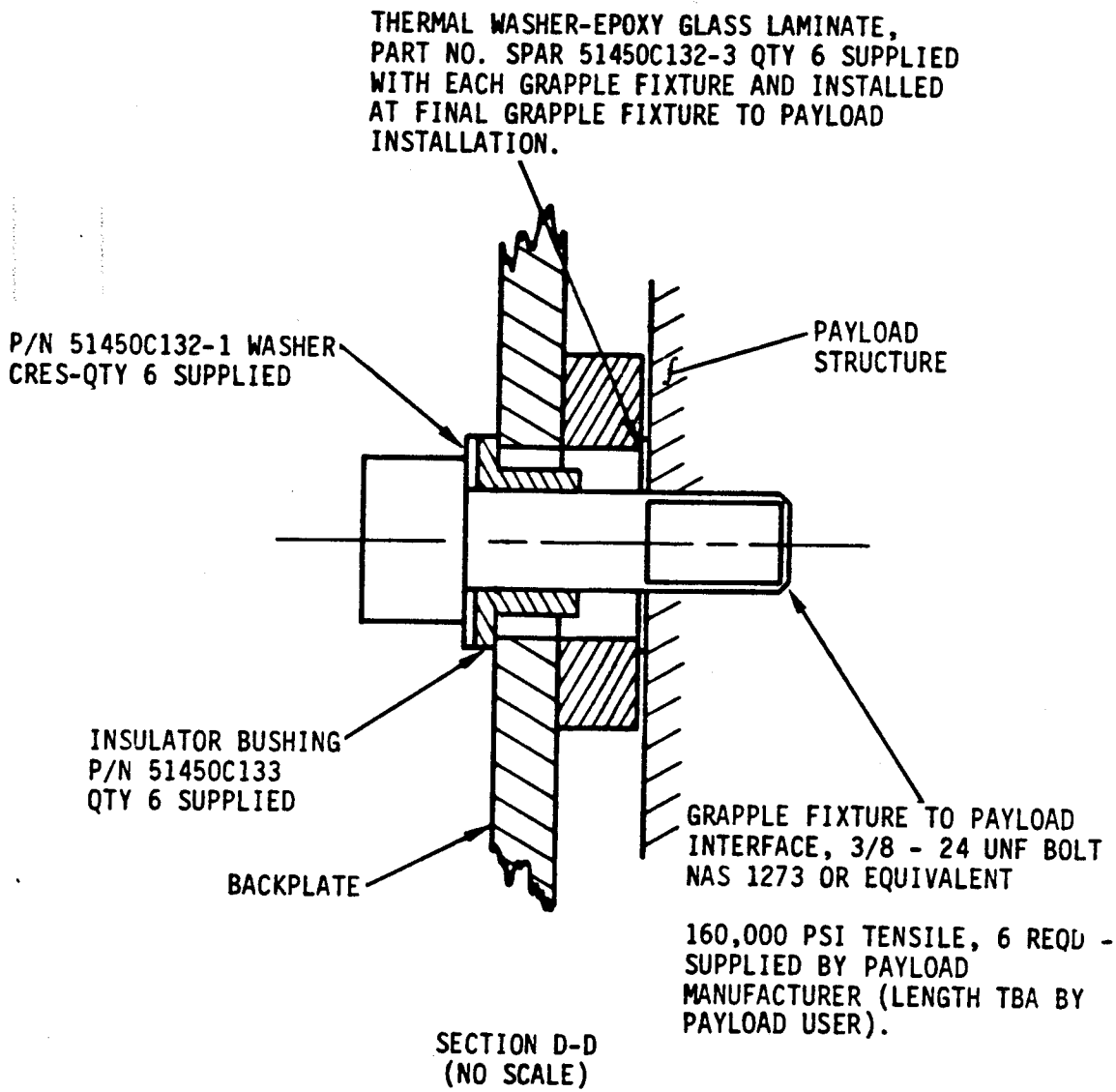
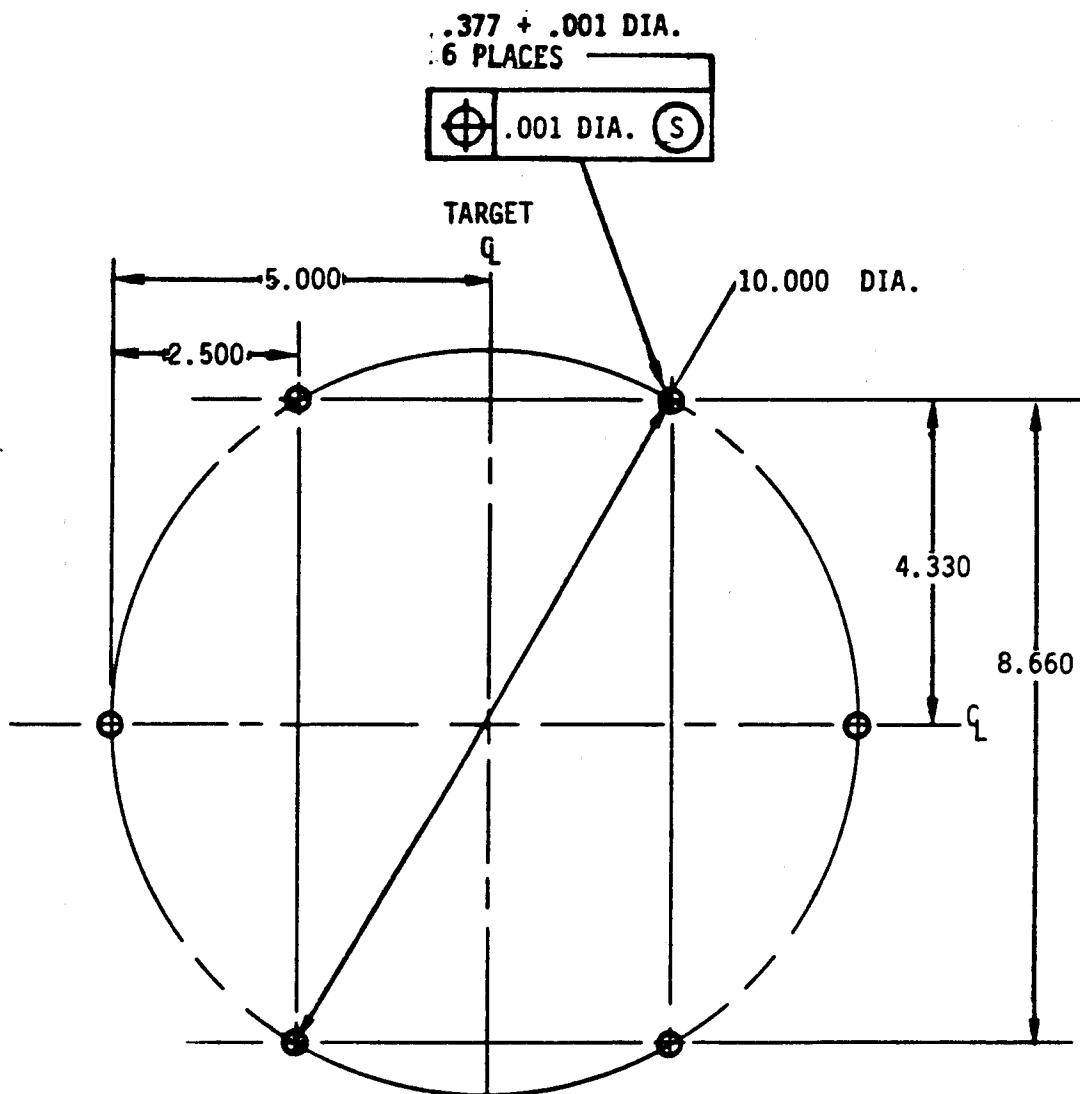


Figure 14.4.2-3 G3 Interface Parameters





DETAIL E-E  
 SCALE: NONE  
 INTERFACE BOLT PATTERN  
 PAYLOAD SIDE

NOTES:

1. USE THROUGH HOLES AND FLOATING NUTPLATES (SELF-LOCKING) OR EQUIV. FOR EVEN BOLT LOAD SHARING.
2. PAYLOAD MOUNTING SURFACE TO BE FLAT TO WITHIN .005 IN.
3. DRILLING TOOL AVAILABLE ON REQUEST.

Figure 14.4.2-4 G3 Interface Parameters

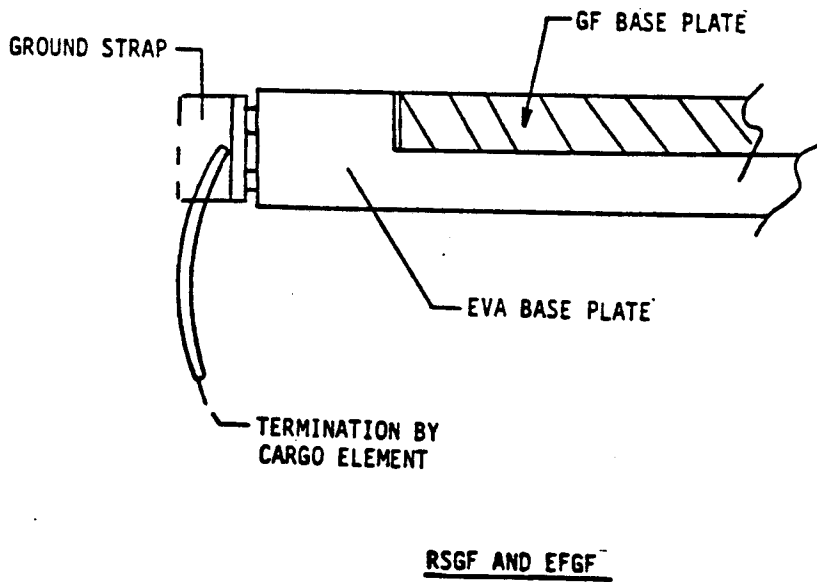
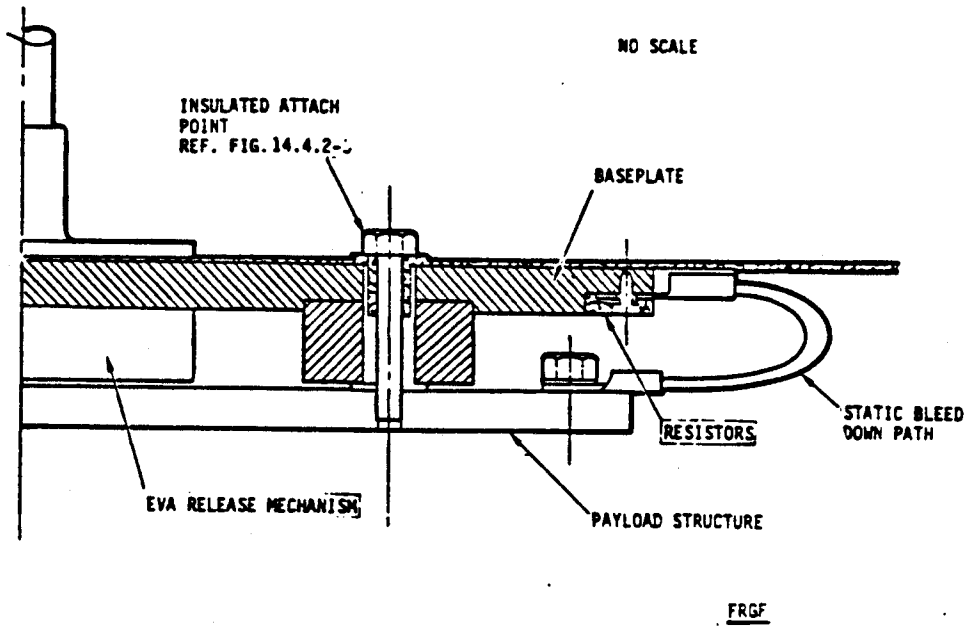
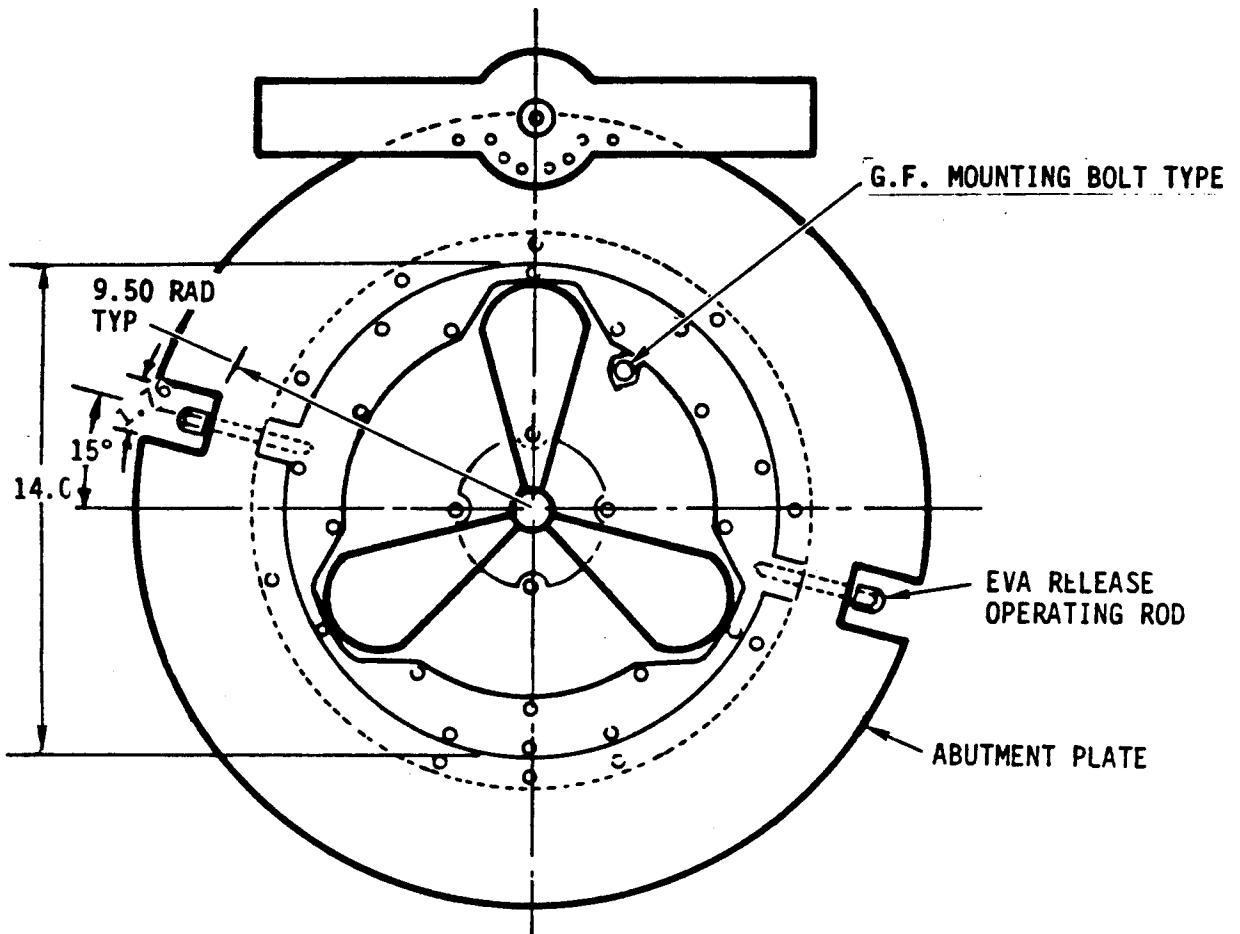


Figure 14.4.2-5 Ground Strap Installation



NOTES:

- ① EXCEPT AS NOTED ABOVE DIMENSIONS OF FIG. 14.4.2-1 APPLY
- ② RSGF WEIGHT - 42 LBS.

Figure 14.4.3-1 RSGF Interface Parameters

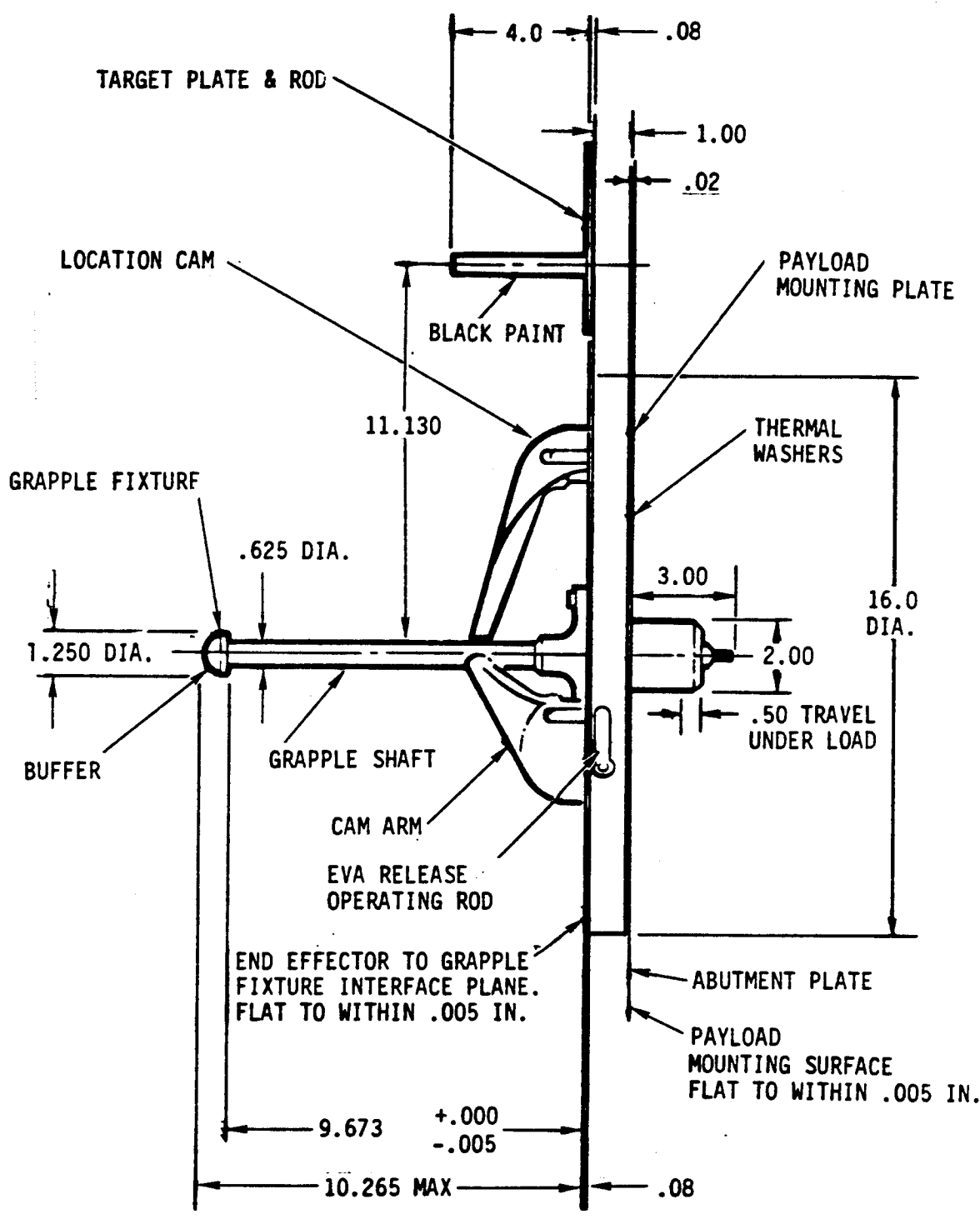


Figure 14.4.3-2 RSG3 Interface Parameters

TABLE 14.4.4-1 PIN ASSIGNMENTS FOR SPECIAL PURPOSE END EFFECTOR CONNECTOR J411

INTERFACING CARGO ELEMENT CONNECTOR IDENTIFIER: P411

LOCATION SEE FIG. 14.4.4-1

		CARGO TERMINATION INTERFACE				
C: L: E: M: C: S: N: T: I: E: C:	F: U: A: D: N: B: E: L: S: T: I: E: C:	IN: PIN: NO.	PANEL JUNCTION IDENTIF. NO.	SIGNAL FUNCTION	MAXIMUM LOAD AMPS	PARAGRAPH DEFINING PERFORMANCE
		1				
		2				
HO	2T1	3		+28VDC SPEE PWR	*	
HO	2T1	4		SPEE PWR RTN	*	
HO	2T2	5		+28VDC SPEE PWR	*	
ML	SHD	6		TERMINATE (SPEE SHLD)		
ML	2S1	7		SPEE NO. 5	1.5	
		8				
		9				
		10				
		11				
HO	4T1	12		SPEE NO. 3 HTR PWR	3.7	
HO	4T1	13		SPEE NO. 2 HTR PWR	3.7	
HO	2T2	14		SPEE PWR RTN	*	
	1COND	15		STRUCTURE GND		
ML	4S1	16		SPEE NO. 9	1.5	
ML	2S1	17		SPEE NO. 6	1.5	
		18				
		19				
		20				
		21				
		22				
HO	4T1	23		SPEE NO. 4 HTR PWR RTN	3.7	
HO	4T1	24		SPEE NO. 1 HTR PWR RTN	3.7	
	1COND	25		STRUCTURE GND		
ML	4S1	26		SPEE NO. 10	1.5	
ML	4S1	27		SPEE NO. 11	1.5	
		28				
		29				
		30				
		31				
		32				
HO	1COND	33		SPEE NO. 13	1.5	
		34				
		35				
ML	SHD	36		TERMINATE (SPEE SHLD)		
ML	4S1	37		SPEE NO. 12	1.5	
ML	2S2	38		SPEE NO. 7	1.5	
		39				
		40				
		41				
		42				
		43				
HO	1COND	44		SPEE NO. 14	1.5	
HO	1COND	45		SPEE NO. 15	1.5	
HO	1COND	46		SPEE NO. 16	1.5	
ML	SHD	47		TERMINATE (SPEE SHLD)		
ML	2S2	48		SPEE NO. 8	1.5	
		49				
		50				
		51				

\* NOTE: CARGO ELEMENTS USING THE ELECTRICAL FLIGHT GRAPPLE FIXTURE AND +28 VDC SPEE POWER MUST PROVIDE A 5 AMP FUSE ON EACH LINE OF THE CARGO ELEMENT SIDE OF THE INTERFACE. THE PAYLOAD MAY DRAW 5 AMPS FROM ONE OUTPUT AND ZERO FROM THE OTHER, BUT THE COMBINED TOTAL CURRENT DRAWN BY THE PAYLOAD MAY NOT EXCEED 5 AMPS.

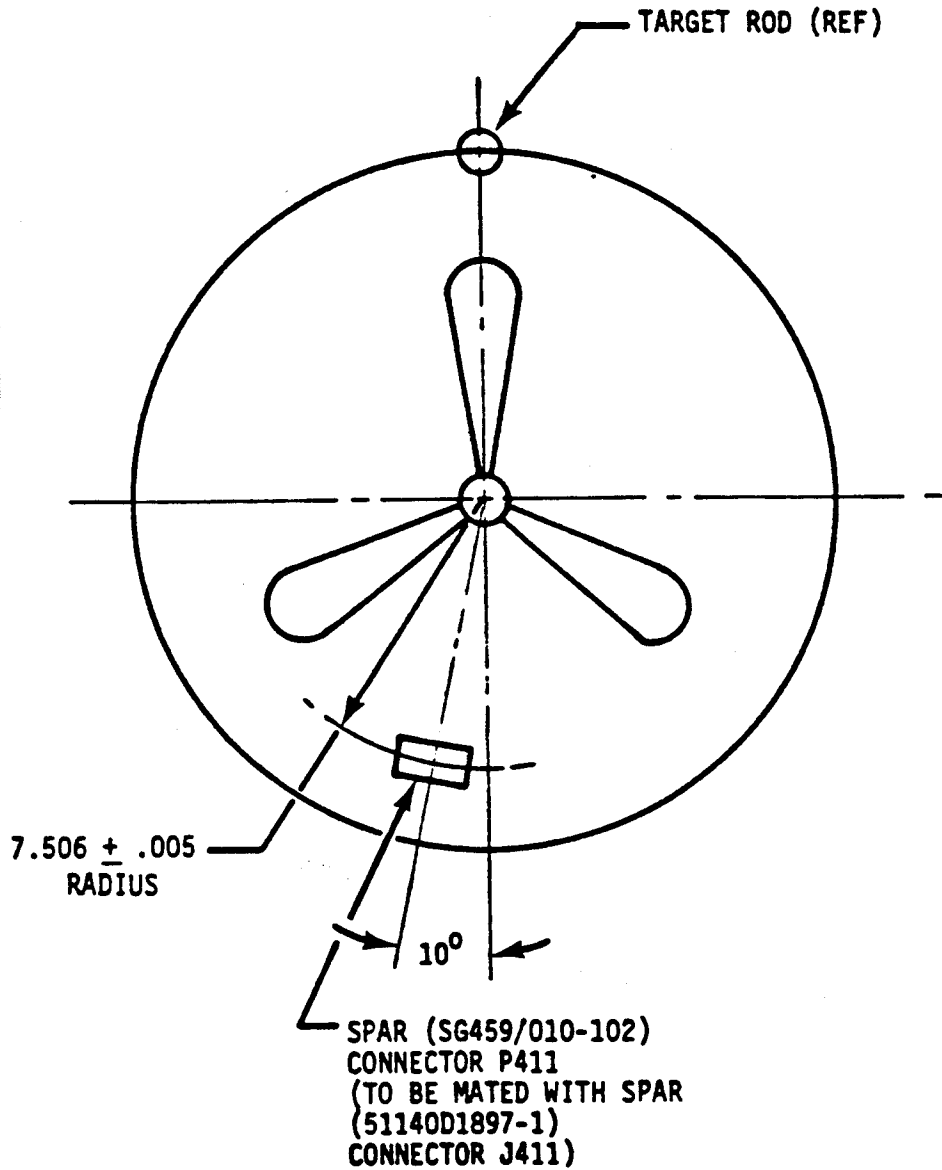


Figure 14.4.4-1 E3G3 Connector Alignment

#### 14.4.5 Structural Loads.

14.4.5.1 Grapple Fixture Loads. Following rigidization, the nominal tensile force exerted by the end effector on the grapple fixture shall be 740 - 1300 lbf. The grapple fixture shall distribute the reaction force between the end effector end ring and the grapple fixture baseplate uniformly over the annular contact area.

14.4.5.2 Design Limit Forces and Moments. After rigidization, the grapple fixture shall be able to transmit the following forces and moments between the end effector and the payload model. Case 1 shows the maximum torsional moment expected (700 ft-lbs) with its associated bending moment and shear force. Case 2 shows the maximum bending moment expected (1200 ft-lbs) with its associated torsional moment and shear force.

	<u>Case 1</u>	<u>Case 2</u>
a. Torsional moment about the longitudinal axis of the end effector.	700 ft-lb	450 ft-lb
b. Bending moment to end effector.	900 ft-lb	1200 ft-lb
c. Shear force associated with the bending moment of (b) above.	40 lbf	50 lbf

The maximum bending moment without end effector/grapple fixture separation is 350 ft-lbf. Separation shall not exceed 3 degrees during the loading conditions given above. Moments and shear forces shown shall be transferred at the 3 degrees angular separations. The tensile load in the grapple fixture shaft is 2215 lbf when the case 2 bending moment is applied.

The torsional moment and bending moment for either case will be applied simultaneously. Note the load cases should not be combined. The payload shall be designed to withstand both cases, one case at a time.

The actual forces and moments applied depend on arm configuration, the maneuver being performed, the rate of motion, and the arm control mode.

14.4.5.3 Stiffness. The grapple shaft shall have the following stiffness characteristics:

a. Axial direction (along the axis of the grapple fixture shaft)	175,000 lb/in min.
b. Transverse direction (perpendicular to the axis of the grapple fixture shaft)	100 lb/in min. 725 lb/in max.

The stiffness defined above is with respect to the contact surface of the end effector/grapple fixture interface as defined in Figure 14.4.2-1. Only the contact surface is assumed fixed.

**14.4.5.4 Vibration Frequency.** The major structural vibration frequencies of a payload and its grapple fixture interface, when cantilevered from the grapple fixture, shall be greater than or equal to 0.2 Hz for payloads weighing less than or equal to 35K lbs and greater than or equal to 0.5 Hz for payloads weighing greater than 35K lbs. Details of the payload weight, RMS mode, grapple fixture interface frequency, deadzone size, and envelope size relationships are in Tables 14.9.1.1-1 and 14.9.1.2-1. Computation of the frequencies shall exclude the grapple fixture.

**14.4.5.5 Impact Loads.** During the grappling of the payload, there may be an impact between the end effector and the grapple fixture abutment plate. The resulting impulse which is ultimately imparted to the payload shall be a maximum of 10 pound-seconds. The payload shall be designed to withstand such impacts during grappling.

**14.4.6 RMS/Payload Thermal Interface.** The thermal isolation between the grapple fixture and payload is obtained by nonconductive washers and bushings as shown in Figure 14.4.2-3. Grapple fixture materials and thermo-optical surface properties for thermal analysis purposes are defined in Figure 14.4.6-1.

**14.6.6.1 End Effector/Grapple Fixture (EE/GF) Thermal Conductance.** The thermal conductance between the rigidized end effector and the payload grapple fixture shall be assumed infinite for thermal analysis purposes.

**14.4.6.2 Grapple Fixture/Payload Structure Thermal Conductance.** The heat transfer between the RMS and the payload is controlled by thermal isolators between the grapple fixture and the payload structure. The allowable thermal conductance as a function of payload average temperature is defined in Figure 14.4.6.2-1.



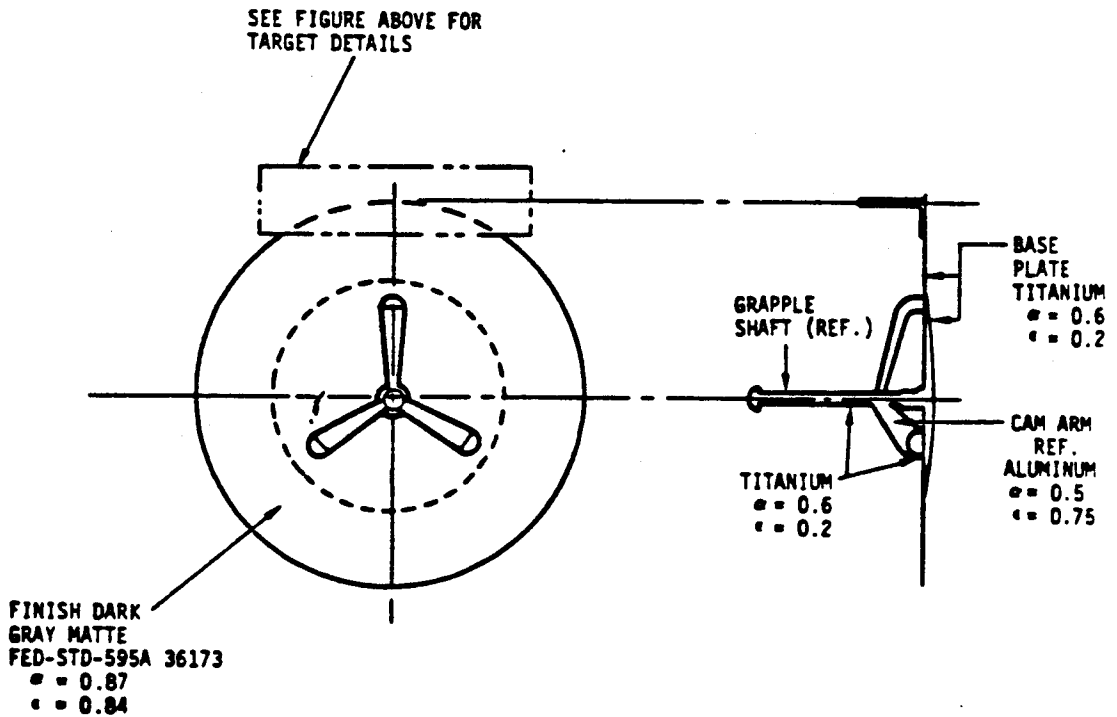
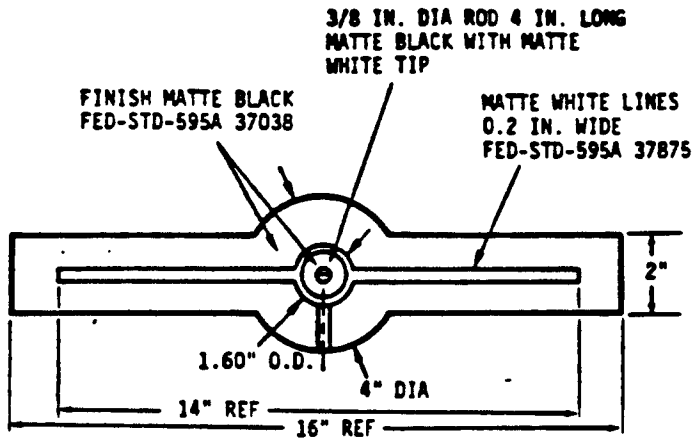


Figure 14.4.6-1 Grapple Fixture Target Emissivity Properties

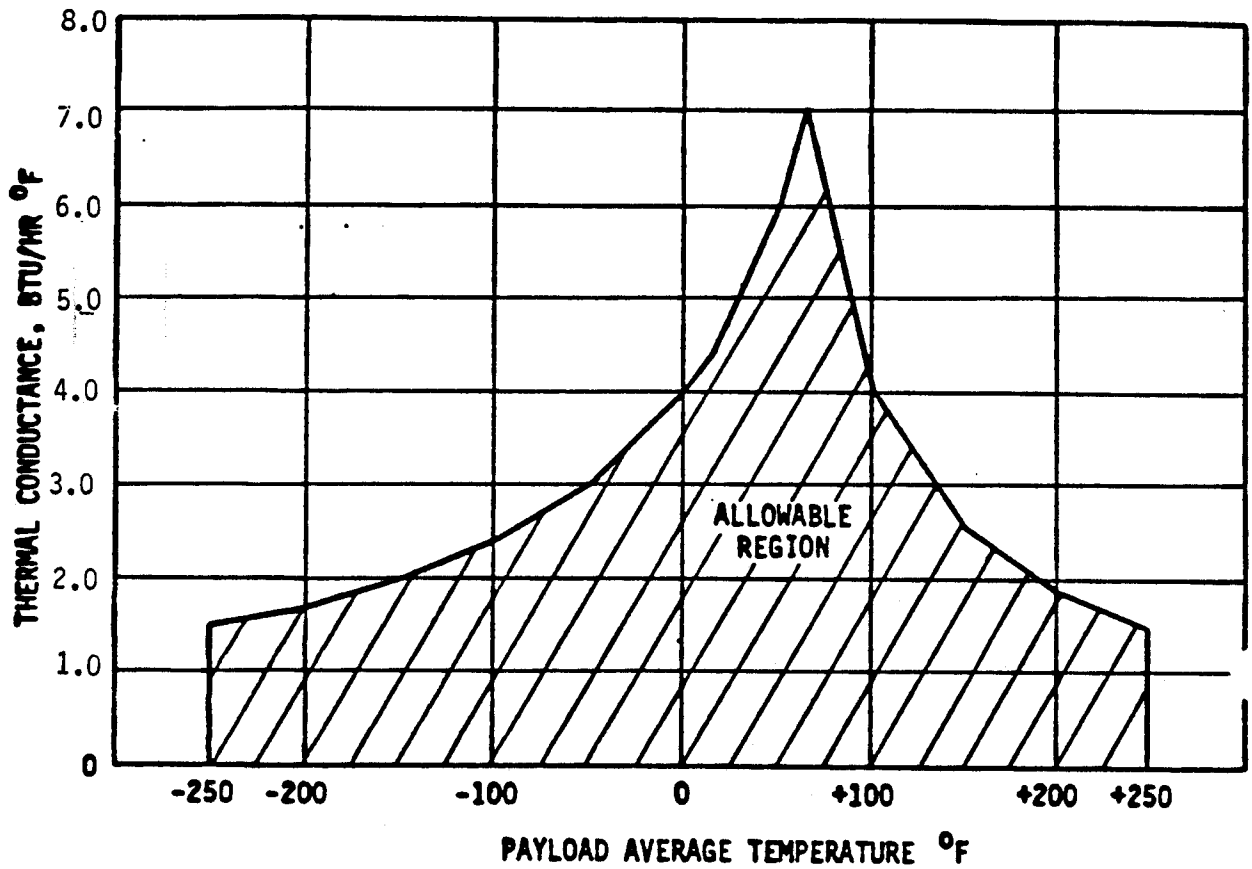


Figure 14.4.6.2-1 Allowable Payload Structure To Grapple Fixture  
 Thermal Conductance For Various Payload Temperatures  
 (Across the Area Of The G3 Baseplate)

**14.4.6.3 End Effector Temperature.** For use in calculations, the worst case hot temperature for the EE is 65 degrees C (149 degrees F), and the worst case cold temperature for the EE is -10 degrees C (14 degrees F).

**14.4.6.4 Grapple Fixture Temperatures.**

**14.4.6.4.1 Non-Operational.** The FRGF, RSGF, and GF shall not be exposed to temperatures outside the structural temperature range of -156 degrees C to +121 degrees C (+250 degrees F) at any time prior to intended use.

**14.4.6.4.2 Operational.**

**14.4.6.4.2.1 FRGF.** The FRGF shall function as designed if used within a operational temperature range of -76 degrees C to +68 degrees C (-105 degrees F to +154 degrees F).

**14.4.6.4.2.2 RSGF and EFGF.** The RSGF and EFGF grapple shaft mechanism shall function as designed if used within an operational temperature range of -57 degrees C to +88 degrees C (-70 degrees F to +190 degrees F). The EVA release mechanism and EE/GF interface shall function as designed within an operational temperature range of -76 degrees C to +68 degrees C (-105 degrees F to +154 degrees F).

**14.5 Visual Access Requirements.** Visual cues shall be provided on payloads to aid the RMS operator in berthing, deployment, and proximity operations. When a CCTV view is required, the target associated with it shall be aligned per standard RMS orientations. The trunnion and guide interfaces between the payload and the retention system shall be visually accessible to the RMS operator (either directly or via CCTV). These shall be negotiated with NSJS.

**14.6 Payload Unique Retention Systems.** Payloads requiring non-standard payload retention devices shall meet the Orbiter standards (i.e., thermal and safety constraints) and follow these guidelines for system compatibility with RMS operations.

- a. The total force required to place/remove a payload into/from the retention system shall not exceed 12 lbf.
- b. V-guides or other comparable alignment aids shall be provided to aid the berthing/unberthing process. The clearance requirements outlined in Paragraph 14.1.1 apply.
- c. The retention system latches require redundant ready-to-latch and latch cues and shall be compatible with the RMS capability of positioning the end effector, (not the Point of Reference (POR)), to within 2.0 inches and 1.0 degree with respect to the shoulder attach point.
- d. The RMS operator shall have sufficient information of payload position and attitude with respect to its retention system via visual access (either direct or CCTV) to perform berthing and deployment operations. Reference Paragraph 14.5.
- e. The retention system configuration shall consider in its design the complexity of RMS maneuvers (berthing) with single joint operations in the event of a loss of standard operating modes.

14.7 *Payload Berthing Systems.* If the payload provides a berthing system, then the berthing system shall accommodate the payload/RMS motions without contact of Orbiter or payload critical surfaces.

#### 14.8 *Scuff Plates And Bump Protection.*

- a. *The payload shall provide scuff plates to preclude excessive motion in the port/starboard direction during berthing/unberthing. Also, critical or hazardous payload elements (i.e., hydrazine storage tanks/lines, attitude control systems, cryogen tanks, and pyrotechnic devices) shall be shielded from inadvertent contact during RMS operations (Reference Volume X9U, Appendix 8).*
- b. *Payloads on the same pallet which are manifested within in 2 feet of pallet structure (reference clearances in Paragraph 14.1.2) or each other shall be constructed to withstand 1.1 feet/second contact velocities between components.*
- c. *If an Orbiter Replacement Unit (ORU) is to be changed out using the RMS, both the ORU and the host payload shall be able to withstand 1.1 feet/second contact velocities, tolerate end effector position uncertainty of  $\pm 2$  inches and 1 degree, and comply with the payload and EVA clearance envelopes for RMS operations (Figure 14.4.1.1-1).*

#### 14.9 *On-Orbit DAP Stability During RMS Operations*

14.9.1 *URCS Operations.* The following paragraphs specify the acceptable envelope of payload center of mass (CM) positions while attached to the RMS and under Orbiter URCS control, subject to constraints on payload grapple fixture stiffness, Digital Auto Pilot (DAP) deadzone parameters, and DAP g-loads. These constraints are designed to minimize the likelihood of sustained dynamic oscillations between the Orbiter and the payload during closed loop (auto, manual discrete rate, or manual LVLH) flight control operations.

14.9.1.1 *URCS Operations with the RMS Under Position Hold Control.* Closed-loop URCS control is available when the deployed payload CM position envelope and DAP deadzone parameters vs payload weight and lowest grapple fixture to payload center of mass interface frequency are shown in Table 14.9.1.1-1.

14.9.1.2 *URCS Operations with the RMS Brakes on.* Closed-loop URCS control is available when the deployed payload CM position envelope and DAP deadzone parameters vs payload weight and lowest grapple fixture to payload center of mass interface frequency are as shown in Table 14.9.1.2-1.

14.9.1.3 *URCS Operations with RMS/Payload Motion.* While the RMS is moving, Orbiter attitude can be simultaneously maintained using the URCS for payloads weighing up to 8,000 lbs (3630 kg) providing that the DAP attitude deadband is set to  $\geq 3$  degrees, the DAP rate deadband is set to  $\geq 0.2$  degrees/second, and the deployed payload CM position and lowest grapple fixture to payload center of mass interface frequency are within the bounds shown in Table 14.9.1.1-1. Orbiter free drift is required for payloads greater than 8,000 lbs while the RMS is moving.

14.9.1.4 Addition VRCS Control Constraints.

- a. All closed-loop operations for payloads weighing greater than 1,000 lbs must be done with the appropriate DAP g-loads. The g-loads (MAG-CONTROL-ACCEL and ANG-INCREMENTS) must be based upon the particular payload mass properties and positions.
- b. Closed-loop DAP attitude control with tight DAP deadzones when payloads are near the boundaries defined in Tables 14.9.1.1-1 and 14.9.1.2-1 will result in increased propellant usage and jet duty cycles.
- c. The DAP maneuver rate must be  $\leq 0.2$  degree/second if the rate deadband is  $\geq 0.02$  degree/second. The maneuver rate must be  $\leq 0.1$  degree/second if the rate deadband is  $< 0.02$  degree/second.

14.9.2 PRCS Operations. To preclude a loss of mission in the event that VRCS attitude control is lost, the payload must be designed to be compatible with PRCS auto attitude control.

Open loop, manual, minimum impulse PRCS can be used for short term attitude control for Orbiter safety purposes if preflight analyses (RMS configuration specific) confirm adequate margins of controllability.

PRCS DAP stability, PRCS-induced motion, and PRCS-induced loads shall be analyzed preflight for mission specific, stationary, RMS/payload configurations (i.e., a pre-release position). Using PRCS, deployment release uncertainties may exceed those quoted for VRCS.

For any RMS/payload motion, PRCS will normally be inhibited for payloads weighing greater than 1,000 lbs.

Table 14.9.1.1-1 Generic URCS DAP Stability Envelopes For Position Hold And RMS Motion

Permissible RMS deployed payload CM position envelope and DAP deadzone parameters vs. payload weight and lowest grapple fixture to payload CM interface frequency (End Effector Operating Frame, EE-OP for RMS in position hold or with commanded motion.)

Payload Weight (k pound)	RMS Mode	Grapple Fixture Interface Frequency (Hz)	Minimum Deadzone Size	Envelope Size (inches OCS)
$0 < w \leq 1$	P.H or M	$\geq 0.2$	$R_L \geq 0.01$ deg/sec for P.H without attached payload $\geq 0.2$ deg/sec for M with payload attached DB=Normal unloaded RMS restrictions for P.H or without payload = 3 deg for M with payload attached	Normal unloaded RMS Restrictions
$1 < w \leq 8$	P.H or M	$\geq 0.2$	$R_L \geq 0.01$ deg/sec for P.H $\geq 0.2$ deg/sec for M DB $\geq 0.5$ deg for P.H $\geq 3.0$ deg for M	$400 \leq x \leq 1300$ $-90 \leq y \leq 90$
$8 < w \leq 35$	P.H only	$\geq 0.2$	$R_L \geq 0.02$ deg/sec DB $\geq 1.0$ deg	$A1 \leq x \leq B1$ $C1 \leq y \leq D1$ $z \leq E1$
$8 < w \leq 35$	P.H only	$\geq 0.5$	$R_L \geq 0.01$ deg/sec DB $\geq 0.5$ deg	$A2 \leq x \leq B2$ $C2 \leq y \leq D2$ $z \leq E2$
$8 < w \leq 35$	P.H only	$\geq 0.5$	$R_L \geq 0.02$ deg/sse DB $\geq 1.0$ deg	$A3 \leq x \leq B3$ $C3 \leq y \leq D3$ $z \leq E3$
$35 < w \leq 65$		$\geq 0.5$	Payload specific assessment will be performed	

Note: P.H denotes position hold  
M denotes RMS motion allowed  
R.L denotes rate limit deadband  
DB denotes attitude deadband

Envelope limits are parameterized by payload weight W (in thousands of pounds) and payload X-Z c.g. position (orbiter coordinate system)

*Table 14.9.1.1-1 Generic VRCS DAP Stability Envelopes For  
Position Hold And RMS Motion (Continued)*

*A1 = The greatest of 400 and  $10w + 300$   
B1 = The least of 1200 and  $1557.0 - 5.0w - .857z$   
C1 = The greatest of -90 and  $3w - 150$   
D1 = The least of +90 and  $150 - 3w$   
E1 = The least of 900 and  $1817.0 - 1.167x - 5.833w$*

*A2 = The greatest of 400 and  $10w + 300$   
B2 = The least of 1200 and  $1557.0 - 5.0w - .857z$   
C2 = The greatest of -90 and  $3w - 150$   
D2 = The least of +90 and  $150 - 3w$   
E2 = The least of 900 and  $1817.0 - 1.167x - 5.833w$*

*A3 = The greatest of 400 and  $10w + 300$   
B3 = The least of 1200 and  $1657.0 - 5.0w - .857z$   
C3 = The greatest of -90 and  $3w - 150$   
D3 = The least of +90 and  $150 - 3w$   
E3 = The least of 950 and  $1933.0 - 1.167x - 5.833w$*

Table 14.9.1.2-1 Generic URCS DAP Stability Envelopes For Brakes On

Permissible RMS deployed payload CM position envelope and DAP deadzone parameters vs. payload weight for lowest grapple fixture to payload CM interface frequency (End Effector Operating Frame)  $\geq 0.2$  Hz and RMS with Brakes ON.

Payload Weight (k pound)	Minimum Deadzone Size	Envelope Size (inches OCS)
$0 < w \leq 1$	$RL \geq 0.01 \text{ deg/sec}$ $DB > \text{Normal unloaded RMS restrictions without attached payload}$	Normal unloaded RMS Restrictions
$1 < w \leq 8$	$RL \geq 0.02 \text{ deg/sec}$ $DB \geq 2 \text{ deg}$	$490 \leq x \leq 1040$ $-75 \leq y \leq 75$ $z \leq 610$
$1 < w \leq 8$	$RL \geq 0.04 \text{ deg/sec}$ $DB \geq 2 \text{ deg}$	$490 \leq x \leq G1$ $-75 \leq y \leq 75$ $z \leq H1$
$8 < w \leq 25$	$RL \geq 0.02 \text{ deg/sec}$ $DB \geq 2 \text{ deg}$	$F2 \leq x \leq G2$ $-75 \leq y \leq 75$ $z \leq H2$
$8 < w \leq 25$	$RL \geq 0.04 \text{ deg/sec}$ $DB \geq 2 \text{ deg}$	$F3 \leq x \leq G3$ $-75 \leq y \leq 75$ $z \leq H3$
$25 < w \leq 65$	Payload specific assessment will be performed	

NOTE: Table valid for all payloads with grapple fixture/payload interface frequencies  $\geq 0.2$  Hz.

RL denotes rate limit deadband

DB denotes attitude deadband

Envelope limits are parameterized by payload weight W (in klb) and payload X-Z center-of-mass position in OCS.

$$G1 = 1347.8 + 0.456Z$$

$$H1 = \text{The least of } 895 \text{ and } [2957.8 + (-2.194)X]$$

$$F2 = 467 + 3.33w$$

$$G2 = 1200 - 20w$$

$$H2 = 650 - 5w$$

$$F3 = 467 + 3.33w$$



Table 14.9.1.2-1 Generic VRCS DAP Stability Envelopes For Brakes On  
(Continued)

$$G_3 = \left( \frac{w + 10}{w - 47.5} \right) Z - \left[ \frac{(-10w^2 - 1175w + 62000)}{w - 47.5} \right]$$

$H_3 =$  The least of  $(975 - 10w)$  and

$$\left[ \left( \frac{w - 47.5}{w + 10} \right) X \right] + \left[ \frac{(10w^2 - 1175w + 62000)}{w + 10} \right]$$

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*Appendix A*  
*Abbreviations And Acronyms*

## APPENDIX A

### ABBREVIATIONS AND ACRONYMS

AA	Air to Air
AC	Alternating Current
ACCN	Audio Central Control Network
AF	Audio Frequency
AFD	Aft Flight Deck
AG	Air to Ground
AID	Analog Inputs, Differential
A/L	Airlock
AM	Amplitude Modulation
AOA	Abort Once Around
AOD	Analog Output, Differential
ARS	Atmospheric Revitalization System
ASE	Airborne Support Equipment
ATCS	Active Thermal Control System
AUX	Auxiliary
BCT	Bit Cell Time
BER	Bit Error Rate
BITE	Built-in Test Equipment
BOT	Beginning of Tape
bps	Bits per Second
BSR	BITE Status Request
BTU	Bus Terminal Unit
CCTV	Closed Circuit Television
CCW	Counter Clockwise
CPC	Cargo Processing Contractor
CDW	Command Data Word
CE	Cargo Element
CG	Center-of-Gravity
CMRR	Common Mode Rejection Ratio
CMV	Common Mode Voltage
COAX	Coaxial, Coaxial Cable
CRYO	Cryogenic
CW	Clockwise
CW	Command Word
CWEA	Caution and Warning Electronics Assembly
<i>DAP</i>	<i>Digital Autopilot</i>
D&C	Display and Control
dB	Decibels
DBC	Data Bus Coupler
DBIA	Data Bus Isolation Amplifier
DBS	Data Bus System
DC	Direct Current
DIH	Discrete Input, High Level
DIL	Discrete Inputs, Low Level
DOD	Department of Defense
DOH	Discrete Outputs, High Level
DOL	Discrete Outputs, Low Level

DP	Deployment Panel
DP	Double Precision Floating Point
DSN	Deep Space Network
EED	Electrical Explosive Device
EIRP	Effective Isotropic Radiated Power
EMC	Electromagnetic Compatibility
EMEC	Electromagnetic Effects Compatibility
EMI	Electromagnetic Interference
EMU	Extravehicular Mobility Unit
EOT	End of Tape
EPDS	Electrical Power Distribution System
ET	External Tank
ETR	Eastern Test Range
EU	Engineering Unit
EVA	Extravehicular Activity
<i>JCS</i>	<i>Flight Control System</i>
FM	Frequency Modulation
FPV	Flow Proportioning Valve
FS	Full Scale
FSK	Frequency Shift Keyed
GMT	Greenwich Mean Time
GN <sub>2</sub>	Gaseous Nitrogen
GN&C	Guidance, Navigation and Control
GND	Ground
GPC	General Purpose Computer
GSE	Ground Support Equipment
HE	Heat Exchanger
HEPA	High Efficiency Particle Arrestor
Hz	Hertz
I/CA	Intercom A
I/CB	Intercom B
I/F	Interface
I/O	Input/Output
I/OM	Input/Output Module
IPS	Inches per Second
IVA	Intravehicular Activity
JSC	Lyndon B. Johnson Space Center
kbps	Kilobits per Second
kg	Kilograms
klb	Kilopounds
KSC	Kennedy Space Center
kWh	Kilowatt Hours
LED	Light Emitting Diode
LHCP	Left Hand Circularly Polarized
L-L	Line-to-Line
LOS	Line of Sight

LPS	Launch Processing System
LRU	Line Replaceable Unit
<i>LV/LH</i>	<i>Local Vertical/Local Horizontal</i>
mbps	Million Bits per Second
MDM	Multiplexer/Demultiplexer
ME	Main Engine
MECO	Main Engine Cutoff
MET	Mission Elapsed Time
MHz	Megahertz
MIA	Multiplexer Interface Adapter
MML	Master Measurement List
MMU	Manned Maneuvering Unit
MPC	Manual Pointing Controller
M/S	Mission Station
MSB	Most Significant Bit
MSDP	Mission Station Distribution Panel
MTU	Master Timing Unit
MPG	Multiple Point Ground
N/A	Not Applicable
NM	Nautical Miles
N/m <sup>2</sup>	Newton per Square Meter
NRZ	Non-Return to Zero
OA	Overall
OMCF	Orbiter Maintenance and Checkout Facility
OMS	Orbital Maneuvering System
OOS	On-orbit Station
OOSDP	On-Orbit Station Distribution Panel
OPF	Orbit Processing Facility
OPR	Orbiter/Payload Recorder
PCM	Pulse Code Modulation
PCMMU	Pulse Code Modulation Master Unit
PCR	Payload Changeout Room
PDI	Payload Data Interleaver
PDRS	Payload Deployment and Retrieval System
PGHM	Payload Ground Handling Mechanism
P/L	Payload
PM	Pulse Modulated
P-P	Peak to Peak
PPS	Pulses per Second
PRCB	Program Requirements Control Board
PRCBD	Program Requirements Control Board Directive
<i>PRCS</i>	<i>Primary Reaction Control System</i>
<i>PR9</i>	<i>Primary</i>
<i>PROM</i>	<i>Programmable Read Only Memory</i>
PRSD	Power Reactant Storage and Distribution System
PS	Payload Station
PSDP	Payload Station Distribution Panel
PSK	Phase Shift Keyed
PSP	Payload Signal Processor
PTB	Payload Timing Buffer
PWR	Power

RAM	Random Access Memory
RCD	Record
RCS	Reaction Control System
RCVR	Receiver
<i>RDW</i>	<i>Response Data Word</i>
RF	Radio Frequency
RFI	Radio Frequency Interference
RHCP	Right Hand Circularly Polarized
RMS	Remote Manipulator System
rms	Root Mean Square
RPH	Revolutions per Hour
RSS	Rotating Service Structure
RTL5	Return to Launch Site
SAB	Shuttle Assembly Building
S/C	Subcarrier
SGLS	Space Ground Link Station
SIO	Serial Input/Output
SMCH	Standard Mixed Cargo Harness
SNR	Signal-to-Noise Ratio
SP	Single Precision, Floating Point
SPA	Signal Processor Assembly
SPDCI	Standard Payload Display and Control Interface
SPG	Single Point Ground
SRB	Solid Rocket Booster
SSP	Standard Switch Panel
STDN	Spaceflight Tracking and Data Network
STS	Space Transportation System
T-0	T minus Zero, Time of Launch
T-4	4 Hours Prior to Launch
TAEM	Terminal Approach Energy Management
TBD	To Be Determined
TDRS	Tracking and Data Relay Satellite
TDRSS	TDRS System
TEC	Time Executed Command
TOD	Greenwich True-of-Date Cartesian Coordinate
TSP	Twisted Shielded Pair
TTL	Transistor-to-Transistor Logic
TVMP	TV Monitor Panel
TW	Twisted
TWDS	Twisted Double Shielded
TWS	Twisted Shielded
VA	Volt-Amperes
VAB	Vehicle Assembly Building
VCM	Volatile Condensable Material
VRCS	Vernier RCS
WPS	Words per Second

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**APPENDIX B**

**GLOSSARY**

## APPENDIX B

### GLOSSARY

Aerospace Support Equipment	See Airborne Support Equipment.
Aft Flight Deck	That portion of the crew compartment upper deck dedicated to orbital operations including the Payload Station, Mission Station and On- Orbit Station.
Airborne Support Equipment	Airborne Support Equipment (ASE) refers to those payload-supplied on-board equipment items and systems required to permit operation of specific payloads during flight. As used in this document, this term is synonymous with Payload Support Equipment, Aerospace Support Equipment and Space Support Equipment.
Airlock	- A compartment, capable of being depressurized without depressurization of the cabin, used to transfer crewman and equipment.
Berthing	- The process of using the RMS to softly bring together an orbital element and the Orbiter, i.e., the positioning of a payload on the repair/maintenance support fixture in the payload bay.
Beta Angle	- The minimum angle between the earth-sun line and the plane of the orbit.
Cable	Two or more insulated conductors (wire) contained in a common covering; or, two or more insulated conductors twisted or moulded together without a common covering; or, one insulated conductor with a metallic covering, shield or outer conductor.
Cargo	- The total complement of payloads (one or more), including support equipment, carried on any one flight. In other words, everything contained in the Orbiter payload bay plus other equipment, hardware and consumables located elsewhere in the Orbiter which is user-unique and is not carried on board as part of the basic Orbiter.

Cargo Element	As used in this document, Cargo Element is synonymous with Payload.
Cargo Element Provided	- See Payload-provided
Caution	- Any out-of-limit condition or malfunction of a system that affects primary mission objectives or could result in loss of a system if not responded to in time. Crew action is required, although not immediately.
Commonality	- Commonality is the shared usage of technical or programmatic items among Shuttle System elements. Element requirements may permit common usage either in identical or similar configurations.
Cooperative Target	- A cooperative target is a three axis stabilized orbital element which has enhanced electro-magnetic reflection or signal characteristics.
Dead Band	- That attitude and rate control region in which no RCS or vernier correction forces are being generated.
Deployment	- The process of removing a orbital element from a stowed or berthed position in the payload bay and releasing the orbital element to a position that is free of the Orbiter.
Electrical Power	As used in this document, electrical power is that power which is available for use as required to perform payload-designated functions. This does not include electricity used for signals or dedicated functions such as operating latch mechanisms.

- Emergency - Any condition which can result in crew injury or threat to life and requires immediate corrective action, including predetermined crew response.
- Extravehicular Activity - Crewman activities conducted outside the spacecraft pressure hull or within the payload bay when the payload bay doors are open.
- Experiment - An instrument, or group of instruments and associated support equipment used to conduct research, or to perform useful tasks in space. Experiments are generally discipline oriented, as for example, astronomy, atmospheric and space physics, earth observations, communications, etc.
- Flight - That portion of a mission encompassing the period from launch to landing or launch to termination of the active life of a spacecraft. The term Shuttle "flight" means a single Shuttle round trip - its launch, orbital activity and return. One flight might deliver more than one payload. More than one flight might be required to accomplish one mission.
- Inclination - The maximum angle between the plane of the orbit and the equatorial plane.
- Instrument - An instrument is a mechanical, optical, electrical or electronic device used in conducting experiments or performing useful tasks in space. Such instruments observe, sense, or process materials and data, or manipulate other devices used for observation, sensing, and processing of data or materials.  
  
(Example: Camera, laser, telescope, furnace, etc.)
- Interorbital Transfer Vehicle - An interorbital transfer vehicle is a separable upper stage used, as required, to boost a spacecraft/satellite from the low energy orbit of the orbiter to a prescribed higher energy orbit.
- Intravehicular Activity - Crewman activities inside the spacecraft, within a payload module carried in the payload bay, or within the payload bay when the doors are closed. The term IVA is dependent upon where the activity is performed and is independent of local atmospheric pressure.

- Launch Pad - The pad area from which the Space Shuttle will be launched. The stacked Space Shuttle will undergo final prelaunch checkout and countdown at the launch pad.
- Launch Processing System (LPS) - A high speed digital computer operated checkout system used to support test, checkout, launch control and operational management of launch site ground operations at KSC.
- Mission - The performance of a coherent set of investigations or operations in space to achieve programs goals. (Example - Measure detailed structure of Sun's chromosphere; survey mineral resources of North America.)
- Mixed Cargo - The term mixed cargo is used in the case where more than one payload is carried in the Orbiter payload bay. These payloads are generally under the cognizance and control of more than one user or discipline, and no overall mission manager has been designated. Mixed cargoes include all associated user-provided ASE required to operate the payloads in space.
- Mobile Launch Platform - The elements of the Space Shuttle will be stacked upon the mobile launch platform while in the Vehicle Assembly Building (VAB). After stacking, it will be rolled out to the launch pad.
- Multi Mission Payload Support Equipment (MMPSE) - MMPSE is a class of ground and flight hardware provided by the Shuttle Transportation System operator as the interface between the elements of the STS and the payloads. It will transport, handle, accommodate and/or operate a wide range of science applications and technology payloads. It can be furnished more economically from a standard equipment inventory rather than by individual payload suppliers.
- Orbiter Processing Facility - This is a building at KSC with two bays in which the Orbiter undergoes post flight inspection, maintenance, pre-mate checkout prior to payload installation.
- Orbiter - Provided - Equipment or services provided by Rockwell International as part of the basic Shuttle Orbiter contract.

- Passive Target - A passive target is a three axis stabilized orbital element which is detected, acquired and tracked by means of electromagnetic energy reflected from the skin of the target.
- Payload - The total complement of specific instruments, space equipment, support hardware and consumables carried in the Orbiter (but not included as part of the basic Orbiter cargo element support) to accomplish a discrete activity in space. A payload is functionally independent of other payloads within a cargo.
- Payload Carrier - Payload carriers are defined as a special class of payload support equipment attached in the payload bay to provide support to, and/or deliver, one or more payloads for the accomplishment of objectives assigned to the payloads. Carriers are identified as habitable modules, such as Spacelab, and attached but uninhabitable modules such as pallets, free flyers, satellites, and propulsive stages.
- Payload Supplier Owner/operator of any Space Shuttle payload.
- Payload Support Equipment See Airborne Support Equipment.
- Payload - Provided Provided by the payload supplier, be it a private or government agency. This category includes items supplied by a sponsoring government agency as an adjunct to a specific payload.
- Prelaunch The time period during which the Shuttle vehicle is situated on the launch pad being prepared for launch and lasting until the start of the liftoff sequence.
- Reference Missions - Mission profiles to be used in conjunction with other specific systems requirements to size the space shuttle vehicle.
- Retrieval - The process of utilizing the RMS and/or other handling aids to return a captured orbital element to a stowed or berthed position. No orbital element is considered retrieved until it is fully stowed for safe return or berthed for repair/maintenacnce tasks.
- Rotating Service Structure This structure moves into position and seals around the Orbiter to provide an environmentally controlled work area adjacent to the payload bay on the launch pad.
- STS - Provided Provided by the NASA or one of its contractors to supplement the basic Shuttle Orbiter. This category does not include items supplied by a sponsoring government agency as an adjunct to a specific payload element.

Space Support Equipment	See Airborne Support Equipment.
Spacecraft/Satellite	Is the combination of mission equipment and a carrier spacecraft capable of autonomous operation in space.
Stability Rate	- The maximum angular rate error during steady state limit cycle operation.
STDN	- Is the Spaceflight Tracking and Data Network. It generally means a number of ground based systems (stations) having direct communications with NASA flight vehicles. Although technically incorrect, as used in this document, generally includes point-to-point circuits (NASCOM) between the remote sites (stations) and the Mission Control Center. Also, as herein used, <u>does not</u> include TDRSS, although GSFC intends that TDRSS become a part of STDN when operational.
Stowing	- The process of placing a payload or payload component in a retained position in the orbiter for ascent or return from orbit.
TDRS	- Is the Tracking and Data Relay Satellite to be used by NASA for communications between the flight vehicle and ground. As is, includes only the satellites, of which there are two (2) active planned, located at geosynchronous altitude, and separated in longitude by about 130°. When used with a second "S", (i.e. - TDRSS), it includes the ground system required to work with the satellites, (i.e. - Tracking and Data Relay Satellite System).
Vehicle Assembly Building (VAB)	- This is the building at KSC that has four high bays that is used for vertical storage of the external tanks and to stack the Shuttle elements onto the mobile launch platform.
Warning	- Any existing or impending condition or malfunction of a system that would adversely affect crew safety or compromise primary mission objectives. Immediate action by the crew is required.
Wire	- A single metallic conductor of solid, stranded, or woven construction designed to carry current in an electrical circuit. The wire may be bare or insulated, but does not have a metallic covering, sheath, or shield.

- Wire Harness - One or more wires or cables and their terminations, mechanically held together, routed, and installed as a unit.
- Wiring - Collectively, wiring shall mean wire and cable with their terminations.



APPENDIX C  
CHANNEL AND FREQUENCY ASSIGNMENTS

## APPENDIX C

### CHANNEL AND FREQUENCY ASSIGNMENTS

C.1 STDN CHANNEL AND FREQUENCY ASSIGNMENTS. Specific STDN channel and frequency assignments are listed in Table C.1-1. (Reference Paragraph 8.3.1)

TABLE C. 1-1 STDN CHANNEL & FREQUENCY ASSIGNMENT

CHANNEL	TRANSMIT		RECEIVE
	221/240	0.115104MHZ	0.125MHZ
1	2025.833333	2025.833400	2200.000
2	2025.948437	2025.948504	2200.125
3	2026.063542	2026.063608	2200.250
4	2026.178646	2026.178712	2200.375
5	2026.293750	2026.293816	2200.500
6	2026.408854	2026.408920	2200.625
7	2026.523958	2026.524024	2200.750
8	2026.639062	2026.639128	2200.875
9	2026.754167	2026.754232	2201.000
10	2026.869271	2026.869336	2201.125
11	2026.984375	2026.984440	2201.250
12	2027.099479	2027.099544	2201.375
13	2027.214583	2027.214648	2201.500
14	2027.329687	2027.329752	2201.625
15	2027.444792	2027.444856	2201.750
16	2027.559896	2027.559960	2201.875
17	2027.675000	2027.675064	2202.000
18	2027.790104	2027.790168	2202.125
19	2027.905208	2027.905272	2202.250
20	2028.020312	2028.020376	2202.375
21	2028.135417	2028.135480	2202.500
22	2028.250521	2028.250584	2202.625
23	2028.365625	2028.365688	2202.750
24	2028.480729	2028.480792	2202.875
25	2028.595833	2028.595896	2203.000
26	2028.710937	2028.711000	2203.125
27	2028.826042	2028.826104	2203.250
28	2028.941146	2028.941208	2203.375
29	2029.056250	2029.056312	2203.500
30	2029.171354	2029.171416	2203.625
31	2029.286458	2029.286520	2203.750
32	2029.401562	2029.401624	2203.875
33	2029.516667	2029.516728	2204.000
34	2029.631771	2029.631832	2204.125
35	2029.746875	2029.746936	2204.250
36	2029.861979	2029.862040	2204.375
37	2029.977083	2029.977144	2204.500
38	2030.092187	2030.092248	2204.625
39	2030.207292	2030.207352	2204.750
40	2030.322396	2030.322456	2204.875
41	2030.437500	2030.437560	2205.000
42	2030.552604	2030.552664	2205.125
43	2030.667708	2030.667768	2205.250
44	2030.782812	2030.782872	2205.375
45	2030.897917	2030.897976	2205.500

TABLE C. 1-1 STDN CHANNEL & FREQUENCY ASSIGNMENT

CHANNEL	TRANSMIT		RECEIVE
	221/240	0.115104MHZ	0.1251MHZ
46	2031.013021	2031.013080	2205.625
47	2031.128125	2031.128184	2205.750
48	2031.243229	2031.243288	2205.875
49	2031.358333	2031.358392	2206.000
50	2031.473437	2031.473496	2206.125
51	2031.588542	2031.588600	2206.250
52	2031.703646	2031.703704	2206.375
53	2031.818750	2031.818808	2206.500
54	2031.933854	2031.933912	2206.625
55	2032.048958	2032.049016	2206.750
56	2032.164062	2032.164120	2206.875
57	2032.279167	2032.279224	2207.000
58	2032.394271	2032.394328	2207.125
59	2032.509375	2032.509432	2207.250
60	2032.624479	2032.624536	2207.375
61	2032.739583	2032.739640	2207.500
62	2032.854687	2032.854744	2207.625
63	2032.969792	2032.969848	2207.750
64	2033.084896	2033.084952	2207.875
65	2033.200000	2033.200056	2208.000
66	2033.315104	2033.315160	2208.125
67	2033.430208	2033.430264	2208.250
68	2033.545312	2033.545368	2208.375
69	2033.660417	2033.660472	2208.500
70	2033.775521	2033.775576	2208.625
71	2033.890625	2033.890680	2208.750
72	2034.005729	2034.005784	2208.875
73	2034.120833	2034.120888	2209.000
74	2034.235937	2034.235992	2209.125
75	2034.351042	2034.351096	2209.250
76	2034.466146	2034.466200	2209.375
77	2034.581250	2034.581304	2209.500
78	2034.696354	2034.696408	2209.625
79	2034.811458	2034.811512	2209.750
80	2034.926562	2034.926616	2209.875
81	2035.041667	2035.041720	2210.000
82	2035.156771	2035.156824	2210.125
83	2035.271875	2035.271928	2210.250
84	2035.386979	2035.387032	2210.375
85	2035.502083	2035.502136	2210.500
86	2035.617187	2035.617240	2210.625
87	2035.732292	2035.732344	2210.750
88	2035.847396	2035.847448	2210.875
89	2035.962500	2035.962552	2211.000
90	2036.077604	2036.077656	2211.125

TABLE C. 1-1 STDN CHANNEL &amp; FREQUENCY ASSIGNMENT

CHANNEL	TRANSMIT		RECEIVE
	221/240	0.115104MHZ	0.125MHZ
91	2036.192708	2036.192760	2211.250
92	2036.307812	2036.307864	2211.375
93	2036.422917	2036.422968	2211.500
94	2036.538021	2036.538072	2211.625
95	2036.653125	2036.653176	2211.750
96	2036.768229	2036.768280	2211.875
97	2036.883333	2036.883384	2212.000
98	2036.998437	2036.998488	2212.125
99	2037.113542	2037.113592	2212.250
100	2037.228646	2037.228696	2212.375
101	2037.343750	2037.343800	2212.500
102	2037.458854	2037.458904	2212.625
103	2037.573958	2037.574008	2212.750
104	2037.689062	2037.689112	2212.875
105	2037.804167	2037.804216	2213.000
106	2037.919271	2037.919320	2213.125
107	2038.034375	2038.034424	2213.250
108	2038.149479	2038.149528	2213.375
109	2038.264583	2038.264632	2213.500
110	2038.379687	2038.379736	2213.625
111	2038.494792	2038.494840	2213.750
112	2038.609896	2038.609944	2213.875
113	2038.725000	2038.725048	2214.000
114	2038.840104	2038.840152	2214.125
115	2038.955208	2038.955256	2214.250
116	2039.070312	2039.070360	2214.375
117	2039.185417	2039.185464	2214.500
118	2039.300521	2039.300568	2214.625
119	2039.415625	2039.415672	2214.750
120	2039.530729	2039.530776	2214.875
121	2039.645833	2039.645880	2215.000
122	2039.760937	2039.760984	2215.125
123	2039.876042	2039.876088	2215.250
124	2039.991146	2039.991192	2215.375
125	2040.106250	2040.106296	2215.500
126	2040.221354	2040.221400	2215.625
127	2040.336458	2040.336504	2215.750
128	2040.451562	2040.451608	2215.875
129	2040.566667	2040.566712	2216.000
130	2040.681771	2040.681816	2216.125
131	2040.796875	2040.796920	2216.250
132	2040.911979	2040.912024	2216.375
133	2041.027083	2041.027128	2216.500
134	2041.142187	2041.142232	2216.625
135	2041.257292	2041.257336	2216.750

TABLE C. 1-1 STDN CHANNEL &amp; FREQUENCY ASSIGNMENT

CHANNEL	TRANSMIT		RECEIVE
	221/240	0.115104MHZ	0.125MHZ
136	2041.372396	2041.372440	2216.875
137	2041.487500	2041.487544	2217.000
138	2041.602604	2041.602648	2217.125
139	2041.717708	2041.717752	2217.250
140	2041.832812	2041.832856	2217.375
141	2041.947917	2041.947960	2217.500
142	2041.063021	2041.063064	2217.625
143	2042.178125	2042.178168	2217.750
144	2042.293229	2042.293272	2217.875
145	2042.408333	2042.408376	2218.000
146	2042.523437	2042.523480	2218.125
147	2042.638542	2042.638584	2218.250
148	2042.753646	2042.753688	2218.375
149	2042.868750	2042.868792	2218.500
150	2042.983854	2042.983896	2218.625
151	2043.098958	2043.099000	2218.750
152	2043.214062	2043.214104	2218.875
153	2043.329167	2043.329208	2219.000
154	2043.444271	2043.444312	2219.125
155	2043.559375	2043.559416	2219.250
156	2043.674479	2043.674520	2219.375
157	2043.789583	2043.789624	2219.500
158	2043.904687	2043.904728	2219.625
159	2044.019792	2044.019832	2219.750
160	2044.134896	2044.134936	2219.875
161	2044.250000	2044.250040	2220.000
162	2044.365104	2044.365144	2220.125
163	2044.480208	2044.480248	2220.250
164	2044.595312	2044.595352	2220.375
165	2044.710417	2044.710456	2220.500
166	2044.825521	2044.825560	2220.625
167	2044.940625	2044.940664	2220.750
168	2045.055729	2045.055768	2220.875
169	2045.170833	2045.170872	2221.000
170	2045.285937	2045.285976	2221.125
171	2045.401042	2045.401080	2221.250
172	2045.516146	2045.516184	2221.375
173	2045.631250	2045.631288	2221.500
174	2045.746354	2045.746392	2221.625
175	2045.861458	2045.861496	2221.750
176	2045.976562	2045.976600	2221.875
177	2046.091667	2046.091704	2222.000
178	2046.206771	2046.206808	2222.125
179	2046.321875	2046.321912	2222.250
180	2046.436979	2046.437016	2222.375

TABLE C. 1-1 STDN CHANNEL & FREQUENCY ASSIGNMENT

CHANNEL	TRANSMIT		RECEIVE
	221/240	0.115104MHZ	0.125MHZ
181	2046.552083	2046.552120	2222.500
182	2046.667187	2046.667224	2222.625
183	2046.782292	2046.782328	2222.750
184	2046.897396	2046.897432	2222.875
185	2047.012500	2047.012536	2223.000
186	2047.127604	2047.127640	2223.125
187	2047.242708	2047.242744	2223.250
188	2047.357812	2047.357848	2223.375
189	2047.472917	2047.472952	2223.500
190	2047.588021	2047.588056	2223.625
191	2047.703125	2047.703160	2223.750
192	2047.818229	2047.818264	2223.875
193	2047.933333	2047.933368	2224.000
194	2048.048437	2048.048472	2224.125
195	2048.163542	2048.163576	2224.250
196	2048.278646	2048.278680	2224.375
197	2048.393750	2048.393784	2224.500
198	2048.508854	2048.508888	2224.625
199	2048.623958	2048.623992	2224.750
200	2048.739062	2048.739096	2224.875
201	2048.854167	2048.854200	2225.000
202	2048.969271	2048.969304	2225.125
203	2049.084375	2049.084408	2225.250
204	2049.199479	2049.199512	2225.375
205	2049.314583	2049.314616	2225.500
206	2049.429687	2049.429720	2225.625
207	2049.544792	2049.544824	2225.750
208	2049.659896	2049.659928	2225.875
209	2049.775000	2049.775032	2226.000
210	2049.890104	2049.890136	2226.125
211	2050.005208	2050.005240	2226.250
212	2050.120312	2050.120344	2226.375
213	2050.235417	2050.235448	2226.500
214	2050.350521	2050.350552	2226.625
215	2050.465625	2050.465656	2226.750
216	2050.580729	2050.580760	2226.875
217	2050.695833	2050.695864	2227.000
218	2050.810937	2050.810968	2227.125
219	2050.926042	2050.926072	2227.250
220	2051.041146	2051.041176	2227.375
221	2051.156250	2051.156280	2227.500
222	2051.271354	2051.271384	2227.625
223	2051.386458	2051.386488	2227.750
224	2051.501562	2051.501592	2227.875
225	2051.616667	2051.616696	2228.000

TABLE C. 1-1 STDN CHANNEL & FREQUENCY ASSIGNMENT

CHANNEL	TRANSMIT		RECEIVE
	221/240	0.115104MHZ	0.125MHZ
226	2051.731771	2051.731800	2228.125
227	2051.846875	2051.846904	2228.250
228	2051.961979	2051.962008	2228.375
229	2052.077083	2052.077112	2228.500
230	2052.192187	2052.192216	2228.625
231	2052.307292	2052.307320	2228.750
232	2052.422396	2052.422424	2228.875
233	2052.537500	2052.537528	2229.000
234	2052.652604	2052.652632	2229.125
235	2052.767708	2052.767736	2229.250
236	2052.882812	2052.882840	2229.375
237	2052.997917	2052.997944	2229.500
238	2053.113021	2053.113048	2229.625
239	2053.228125	2053.228152	2229.750
240	2053.343229	2053.343256	2229.875
241	2053.458333	2053.458360	2230.000
242	2053.573437	2053.573464	2230.125
243	2053.688542	2053.688568	2230.250
244	2053.803646	2053.803672	2230.375
245	2053.918750	2053.918776	2230.500
246	2054.033854	2054.033880	2230.625
247	2054.148958	2054.148984	2230.750
248	2054.264062	2054.264088	2230.875
249	2054.379167	2054.379192	2231.000
250	2054.494271	2054.494296	2231.125
251	2054.609375	2054.609400	2231.250
252	2054.724479	2054.724504	2231.375
253	2054.839583	2054.839608	2231.500
254	2054.954687	2054.954712	2231.625
255	2055.069792	2055.069816	2231.750
256	2055.184896	2055.184920	2231.875
257	2055.300000	2055.300024	2232.000
258	2055.415104	2055.415128	2232.125
259	2055.530208	2055.530232	2232.250
260	2055.645312	2055.645336	2232.375
261	2055.760417	2055.760440	2232.500
262	2055.875521	2055.875544	2232.625
263	2055.990625	2055.990648	2232.750
264	2056.105729	2056.105752	2232.875
265	2056.220833	2056.220856	2233.000
266	2056.335937	2056.335960	2233.125
267	2056.451042	2056.451064	2233.250
268	2056.566146	2056.566168	2233.375
269	2056.681250	2056.681272	2233.500
270	2056.796354	2056.796376	2233.625



TABLE C. 1-1 STDN CHANNEL &amp; FREQUENCY ASSIGNMENT

CHANNEL	TRANSMIT		RECEIVE
	221/240	0.115104MHZ	0.125MHZ
271	2056.911458	2056.911480	2233.750
272	2057.026562	2057.026584	2233.875
273	2057.141667	2057.141688	2234.000
274	2057.256771	2057.256792	2234.125
275	2057.371875	2057.371896	2234.250
276	2057.486979	2057.487000	2234.375
277	2057.602083	2057.602104	2234.500
278	2057.717187	2057.717208	2234.625
279	2057.832292	2057.832312	2234.750
280	2057.947396	2057.947416	2234.875
281	2058.062500	2058.062520	2235.000
282	2058.177604	2058.177624	2235.125
283	2058.292708	2058.292728	2235.250
284	2058.407812	2058.407832	2235.375
285	2058.522917	2058.522936	2235.500
286	2058.638021	2058.638040	2235.625
287	2058.753125	2058.753144	2235.750
288	2058.868229	2058.868248	2235.875
289	2058.983333	2058.983352	2236.000
290	2059.098437	2059.098456	2236.125
291	2059.213542	2059.213560	2236.250
292	2059.328646	2059.328664	2236.375
293	2059.443750	2059.443768	2236.500
294	2059.558854	2059.558872	2236.625
295	2059.673958	2059.673976	2236.750
296	2059.789062	2059.789080	2236.875
297	2059.904167	2059.904184	2237.000
298	2060.019271	2060.019288	2237.125
299	2060.134375	2060.134392	2237.250
300	2060.249479	2060.249496	2237.375
301	2060.364583	2060.364600	2237.500
302	2060.479687	2060.479704	2237.625
303	2060.594792	2060.594808	2237.750
304	2060.709896	2060.709912	2237.875
305	2060.825000	2060.825016	2238.000
306	2060.940104	2060.940120	2238.125
307	2061.055208	2061.055224	2238.250
308	2061.170312	2061.170328	2238.375
309	2061.285417	2061.285432	2238.500
310	2061.400521	2061.400536	2238.625
311	2061.515625	2061.515640	2238.750
312	2061.630729	2061.630744	2238.875
313	2061.745833	2061.745848	2239.000
314	2061.860937	2061.860952	2239.125
315	2061.976042	2061.976056	2239.250

TABLE C. 1-1 STDN CHANNEL &amp; FREQUENCY ASSIGNMENT

CHANNEL	TRANSMIT		RECEIVE
	221/240	0.115104MHZ	0.125MHZ
316	2062.091146	2062.091160	2239.375
317	2062.206250	2062.206264	2239.500
318	2062.321354	2062.321368	2239.625
319	2062.436458	2062.436472	2239.750
320	2062.551562	2062.551576	2239.875
321	2062.666667	2062.666680	2240.000
322	2062.781771	2062.781784	2240.125
323	2062.896875	2062.896888	2240.250
324	2063.011979	2062.011992	2240.375
325	2063.127083	2062.127096	2240.500
326	2063.242187	2062.242200	2240.625
327	2063.357292	2062.357304	2240.750
328	2063.472396	2062.472408	2240.875
329	2063.587500	2062.587512	2241.000
330	2063.702604	2063.702616	2241.125
331	2063.817708	2063.817720	2241.250
332	2063.932812	2063.932824	2241.375
333	2064.047917	2064.047928	2241.500
334	2064.163021	2064.163032	2241.625
335	2064.278125	2064.278136	2241.750
336	2064.393229	2064.393240	2241.875
337	2064.508333	2064.508344	2242.000
338	2064.623437	2064.623448	2242.125
339	2064.738542	2064.738552	2242.250
340	2064.853646	2064.853656	2242.375
341	2064.968750	2064.968760	2242.500
342	2065.083854	2065.083864	2242.625
343	2065.198958	2065.198968	2242.750
344	2065.314062	2065.314072	2242.875
345	2065.429167	2065.429176	2243.000
346	2065.544271	2065.544280	2243.125
347	2065.659375	2065.659384	2243.250
348	2065.774479	2065.774488	2243.375
349	2065.889583	2065.889592	2243.500
350	2066.004687	2066.004696	2243.625
351	2066.119792	2066.119800	2243.750
352	2066.234896	2066.234904	2243.875
353	2066.350000	2066.350008	2244.000
354	2066.465104	2066.465112	2244.125
355	2066.580208	2066.580216	2244.250
356	2066.695312	2066.695320	2244.375
357	2066.810417	2066.810424	2244.500
358	2066.925521	2066.925528	2244.625
359	2067.040625	2067.040632	2244.750
360	2067.155729	2067.155736	2244.875

TABLE C. 1-1 STDN CHANNEL & FREQUENCY ASSIGNMENT

CHANNEL	TRANSMIT		RECEIVE
	221/240	0.115104MHZ	0.125MHZ
361	2067.270833	2067.270840	2245.000
362	2067.385937	2067.385944	2245.125
363	2067.501042	2067.501048	2245.250
364	2067.616146	2067.616152	2245.375
365	2067.731250	2067.731256	2245.500
366	2067.846354	2067.846360	2245.625
367	2067.961458	2067.961464	2245.750
368	2068.076562	2068.076568	2245.875
369	2068.191667	2068.191672	2246.000
370	2068.306771	2068.306776	2246.125
371	2068.421875	2068.421880	2246.250
372	2068.536979	2068.536984	2246.375
373	2068.652083	2068.652088	2246.500
374	2068.767187	2068.767192	2246.625
375	2068.882292	2068.882296	2246.750
376	2068.997396	2068.997400	2246.875
377	2069.112500	2069.112504	2247.000
378	2069.227604	2069.227608	2247.125
379	2069.342708	2069.342712	2247.250
380	2069.457812	2069.457816	2247.375
381	2069.572917	2069.572920	2247.500
382	2069.688021	2069.688024	2247.625
383	2069.803125	2069.803128	2247.750
384	2069.918229	2069.918232	2247.875
385	2070.033333	2070.033336	2248.000
386	2070.148437	2070.148440	2248.125
387	2070.263542	2070.263544	2248.250
388	2070.378646	2070.378648	2248.375
389	2070.493750	2070.493752	2248.500
390	2070.608854	2070.608856	2248.625
391	2070.723958	2070.723960	2248.750
392	2070.839062	2070.839064	2248.875
393	2070.954167	2070.954168	2249.000
394	2071.069271	2071.069272	2249.125
395	2071.184375	2071.184376	2249.250
396	2071.299479	2071.299480	2249.375
397	2071.414583	2071.414584	2249.500
398	2071.529687	2071.529688	2249.625
399	2071.644792	2071.644792	2249.750
400	2071.759896	2071.759896	2249.875
401	2071.875000	2071.875000	2250.000
402	2071.990104	2071.990104	2250.125
403	2072.105208	2072.105208	2250.250
404	2072.220312	2072.220312	2250.375
405	2072.335417	2072.335416	2250.500

TABLE C. 1-1 STDN CHANNEL &amp; FREQUENCY ASSIGNMENT

CHANNEL	TRANSMIT		RECEIVE
	221/240	0.115104MHZ	0.125MHZ
406	2071.450521	2071.450520	2250.625
407	2071.565625	2071.565624	2250.750
408	2072.680729	2072.680728	2250.875
409	2072.795833	2072.795832	2251.000
410	2072.910937	2072.910936	2251.125
411	2073.026042	2073.026040	2251.250
412	2073.141146	2073.141144	2251.375
413	2073.256250	2073.256248	2251.500
414	2073.371354	2073.371352	2251.625
415	2073.486458	2073.486456	2251.750
416	2073.601562	2073.601560	2251.875
417	2073.716667	2073.716664	2252.000
418	2073.831771	2073.831768	2252.125
419	2073.946875	2073.946872	2252.250
420	2074.061979	2074.061976	2252.375
421	2074.177083	2074.177080	2252.500
422	2074.292187	2074.292184	2252.625
423	2074.407292	2074.407288	2252.750
424	2074.522396	2074.522392	2252.875
425	2074.637500	2074.637496	2253.000
426	2074.752604	2074.752600	2253.125
427	2074.867708	2074.867704	2253.250
428	2074.982812	2074.982808	2253.375
429	2075.097917	2075.097912	2253.500
430	2075.213021	2075.213016	2253.625
431	2075.328125	2075.328120	2253.750
432	2075.443229	2075.443224	2253.875
433	2075.558333	2075.558328	2254.000
434	2075.673437	2075.673432	2254.125
435	2075.788542	2075.788536	2254.250
436	2075.903646	2075.903640	2254.375
437	2076.018750	2076.018744	2254.500
438	2076.133854	2076.133848	2254.625
439	2076.248958	2076.248952	2254.750
440	2076.364062	2076.364056	2254.875
441	2076.479167	2076.479160	2255.000
442	2076.594271	2076.594264	2255.125
443	2076.709375	2076.709368	2255.250
444	2076.824479	2076.824472	2255.375
445	2076.939583	2076.939576	2255.500
446	2077.054687	2077.054680	2255.625
447	2077.169792	2077.169784	2255.750
448	2077.284896	2077.284888	2255.875
449	2077.400000	2077.399992	2256.000
450	2077.515104	2077.515096	2256.125

TABLE C. 1-1 STDN CHANNEL & FREQUENCY ASSIGNMENT

CHANNEL	TRANSMIT		RECEIVE
	221/240	0.115104MHZ	0.125MHZ
451	2077.630208	2077.630200	2256.250
452	2077.745312	2077.745304	2256.375
453	2077.860417	2077.860408	2256.500
454	2077.975521	2077.975512	2256.625
455	2078.090625	2078.090616	2256.750
456	2078.205729	2078.205720	2256.875
457	2078.320833	2078.320824	2257.000
458	2078.435937	2078.435928	2257.125
459	2078.551042	2078.551032	2257.250
460	2078.666146	2078.666136	2257.375
461	2078.781250	2078.781240	2257.500
462	2078.896354	2078.896344	2257.625
463	2079.011458	2079.011448	2257.750
464	2079.126562	2079.126552	2257.875
465	2079.241667	2079.241656	2258.000
466	2079.356771	2079.356760	2258.125
467	2079.471875	2079.471864	2258.250
468	2079.586979	2079.586968	2258.375
469	2079.702083	2079.702072	2258.500
470	2079.817187	2079.817176	2258.625
471	2079.932292	2079.932280	2258.750
472	2080.047396	2080.047384	2258.875
473	2080.162500	2080.162488	2259.000
474	2080.277604	2080.277592	2259.125
475	2080.392708	2080.392696	2259.250
476	2080.507812	2080.507800	2259.375
477	2080.622917	2080.622904	2259.500
478	2080.738021	2080.738008	2259.625
479	2080.853125	2080.853112	2259.750
480	2080.968229	2080.968216	2259.875
481	2081.083333	2081.083320	2260.000
482	2081.198437	2081.198424	2260.125
483	2081.313542	2081.313528	2260.250
484	2081.428646	2081.428632	2260.375
485	2081.543750	2081.543736	2260.500
486	2081.658854	2081.658840	2260.625
487	2081.773958	2081.773944	2260.750
488	2081.889062	2081.889048	2260.875
489	2082.004167	2082.004152	2261.000
490	2082.119271	2082.119256	2261.125
491	2082.234375	2082.234360	2261.250
492	2082.349479	2082.349464	2261.375
493	2082.464583	2082.464568	2261.500
494	2082.579687	2082.579672	2261.625
495	2082.694792	2082.694776	2261.750

TABLE C. 1-1 STDN CHANNEL & FREQUENCY ASSIGNMENT

CHANNEL	TRANSMIT		RECEIVE
	221/240	0.115104MHZ	0.125MHZ
496	2082.809896	2082.809880	2261.875
497	2082.925000	2082.924984	2262.000
498	2083.040104	2083.040088	2262.125
499	2083.155208	2083.155192	2262.250
500	2083.270312	2083.270296	2262.375
501	2083.385417	2083.385400	2262.500
502	2083.500521	2083.500504	2262.625
503	2083.615625	2083.615608	2262.750
504	2083.730729	2083.730712	2262.875
505	2083.845833	2083.845816	2263.000
506	2083.960937	2083.960920	2263.125
507	2084.076042	2084.076024	2263.250
508	2084.191146	2084.191128	2263.375
509	2084.306250	2084.306232	2263.500
510	2084.421354	2084.421336	2263.625
511	2084.536458	2084.536440	2263.750
512	2084.651562	2084.651544	2263.875
513	2084.766667	2084.766648	2264.000
514	2084.881771	2084.881752	2264.125
515	2084.996875	2084.996856	2264.250
516	2085.111979	2085.111960	2264.375
517	2085.227083	2085.227064	2264.500
518	2085.342187	2085.342168	2264.625
519	2085.457292	2085.457272	2264.750
520	2085.572396	2085.572376	2264.875
521	2085.687500	2085.687480	2265.000
522	2085.802604	2085.802584	2265.125
523	2085.917708	2085.917688	2265.250
524	2086.032812	2086.032792	2265.375
525	2086.147917	2086.147896	2265.500
526	2086.263021	2086.263000	2265.625
527	2086.378125	2086.378104	2265.750
528	2086.493229	2086.493208	2265.875
529	2086.608333	2086.608312	2266.000
530	2086.723437	2086.723416	2266.125
531	2086.838542	2086.838520	2266.250
532	2086.953646	2086.953624	2266.375
533	2087.068750	2087.068728	2266.500
534	2087.183854	2087.183832	2266.625
535	2087.298958	2087.298936	2266.750
536	2087.414062	2087.414040	2266.875
537	2087.529167	2087.529144	2267.000
538	2087.644271	2087.644248	2267.125
539	2087.759375	2087.759352	2267.250
540	2087.874479	2087.874456	2267.375

TABLE C. 1-1 STDN CHANNEL &amp; FREQUENCY ASSIGNMENT

CHANNEL	TRANSMIT		RECEIVE
	221/240	0.115104MHZ	0.125MHZ
541	2087.989583	2087.989560	2267.500
542	2088.104687	2088.104664	2267.625
543	2088.219792	2088.219768	2267.750
544	2088.334896	2088.334872	2267.875
545	2088.450000	2088.449976	2268.000
546	2088.565104	2088.565080	2268.125
547	2088.680208	2088.680184	2268.250
548	2088.795312	2088.795288	2268.375
549	2088.910417	2088.910392	2268.500
550	2089.025521	2089.025496	2268.625
551	2089.140625	2089.140600	2268.750
552	2089.255729	2089.255704	2268.875
553	2089.370833	2089.370808	2269.000
554	2089.485937	2089.485912	2269.125
555	2089.601042	2089.601016	2269.250
556	2089.716146	2089.716120	2269.375
557	2089.831250	2089.831224	2269.500
558	2089.946354	2089.946328	2269.625
559	2090.061458	2090.061432	2269.750
560	2090.176562	2090.176536	2269.875
561	2090.291667	2090.291640	2270.000
562	2090.406771	2090.406744	2270.125
563	2090.521875	2090.521848	2270.250
564	2090.636979	2090.636952	2270.375
565	2090.752083	2090.752056	2270.500
566	2090.867187	2090.867160	2270.625
567	2090.982292	2090.982264	2270.750
568	2091.097396	2091.097368	2270.875
569	2091.212500	2091.212472	2271.000
570	2091.327604	2091.327576	2271.125
571	2091.442708	2091.442680	2271.250
572	2091.557812	2091.557784	2271.375
573	2091.672917	2091.672888	2271.500
574	2091.788021	2091.787992	2271.625
575	2091.903125	2091.903096	2271.750
576	2092.018229	2092.018200	2271.875
577	2092.133333	2092.133304	2272.000
578	2092.248437	2092.248408	2272.125
579	2092.363542	2092.363512	2272.250
580	2092.478646	2092.478616	2272.375
581	2092.593750	2092.593720	2272.500
582	2092.708854	2092.708824	2272.625
583	2092.823958	2092.823928	2272.750
584	2092.939062	2092.939032	2272.875
585	2093.054167	2093.054136	2273.000

TABLE C. 1-1 STDN CHANNEL & FREQUENCY ASSIGNMENT

CHANNEL	TRANSMIT		RECEIVE
	221/240	0.115104MHZ	0.125MHZ
586	2093.169271	2093.169240	2273.125
587	2093.284375	2093.284344	2273.250
588	2093.399479	2093.399448	2273.375
589	2093.514583	2093.514552	2273.500
590	2093.629687	2093.629656	2273.625
591	2093.744792	2093.744760	2273.750
592	2093.859896	2093.859864	2273.875
593	2093.975000	2093.974968	2274.000
594	2094.090104	2094.090072	2274.125
595	2094.205208	2094.205176	2274.250
596	2094.320312	2094.320280	2274.375
597	2094.435417	2094.435384	2274.500
598	2094.550521	2094.550488	2274.625
599	2094.665625	2094.665592	2274.750
600	2094.780729	2094.780696	2274.875
601	2094.895833	2094.895800	2275.000
602	2095.010937	2095.010904	2275.125
603	2095.126042	2095.126008	2275.250
604	2095.241146	2095.241112	2275.375
605	2095.356250	2095.356216	2275.500
606	2095.471354	2095.471320	2275.625
607	2095.586458	2095.586424	2275.750
608	2095.701562	2095.701528	2275.875
609	2095.816667	2095.816632	2276.000
610	2095.931771	2095.931736	2276.125
611	2096.046875	2096.046840	2276.250
612	2096.161979	2096.161944	2276.375
613	2096.277083	2096.277048	2276.500
614	2096.392187	2096.392152	2276.625
615	2096.507292	2096.507256	2276.750
616	2096.622396	2096.622360	2276.875
617	2096.737500	2096.737464	2277.000
618	2096.852604	2096.852568	2277.125
619	2096.967708	2096.967672	2277.250
620	2097.082812	2097.082776	2277.375
621	2097.197917	2097.197880	2277.500
622	2097.313021	2097.313984	2277.625
623	2097.428125	2097.428088	2277.750
624	2097.543229	2097.543192	2277.875
625	2097.658333	2097.658296	2278.000
626	2097.773437	2097.773400	2278.125
627	2097.888542	2097.888504	2278.250
628	2098.003646	2098.003608	2278.375
629	2098.118750	2098.118712	2278.500
630	2098.233854	2098.233816	2278.625



TABLE C. 1-1 STDN CHANNEL & FREQUENCY ASSIGNMENT

CHANNEL	TRANSMIT		RECEIVE
	221/240	0.115104MHZ	0.125MHZ
631	2098.348958	2098.348920	2278.750
632	2098.464062	2098.464024	2278.875
633	2098.579167	2098.579128	2279.000
634	2098.694271	2098.694232	2279.125
635	2098.809375	2098.809336	2279.250
636	2098.924479	2098.924440	2279.375
637	2099.039583	2099.039544	2279.500
638	2099.154687	2099.154648	2279.625
639	2099.269792	2099.269752	2279.750
640	2099.384896	2099.384856	2279.875
641	2099.500000	2099.499960	2280.000
642	2099.615104	2099.615064	2280.125
643	2099.730208	2099.730168	2280.250
644	2099.845312	2099.845272	2280.375
645	2099.960417	2099.960376	2280.500
646	2100.075521	2100.075480	2280.625
647	2100.190625	2100.190584	2280.750
648	2100.305729	2100.305688	2280.875
649*	2100.420833	2100.420792	2281.000
650*	2100.535937	2100.535896	2281.125
651*	2100.651042	2100.651000	2281.250
652*	2100.766146	2100.766104	2281.375
653*	2100.881250	2100.881208	2281.500
654	2100.996354	2100.996312	2281.625
655	2101.111458	2101.111416	2281.750
656	2101.226562	2101.226520	2281.875
657	2101.341667	2101.341624	2282.000
658	2101.456771	2101.456728	2282.125
659	2101.571875	2101.571832	2282.250
660	2101.686979	2101.686936	2282.375
661	2101.802083	2101.802040	2282.500
662	2101.917187	2101.917144	2282.625
663	2102.032292	2102.032248	2282.750
664	2102.147396	2102.147352	2282.875
665	2102.262500	2102.262456	2283.000
666	2102.377604	2102.377560	2283.125
667	2102.492708	2102.492664	2283.250
668	2102.607812	2102.607768	2283.375
669	2102.722917	2102.722872	2283.500
670	2102.838021	2102.838976	2283.625
671	2102.953125	2102.953080	2283.750
672	2103.068229	2103.068184	2283.875
673	2103.183333	2103.183288	2284.000
674	2103.298437	2103.298392	2284.125
675	2103.413542	2103.413496	2284.250

\*Channels 649, 650, 651, 652 and 653 are to be used in the Low Power Transmit Mode only.

TABLE C. 1-1 STDN CHANNEL & FREQUENCY ASSIGNMENT

CHANNEL	TRANSMIT		RECEIVE
	221/240	0.115104MHZ	0.125MHZ
676	2103.528646	2103.528600	2284.375
677	2103.643750	2103.643704	2284.500
678	2103.758854	2103.758808	2284.625
679	2103.873958	2103.873912	2284.750
680	2103.989062	2103.989016	2284.875
681	2104.104167	2104.104120	2285.000
682	2104.219271	2104.219224	2285.125
683	2104.334375	2104.334328	2285.250
684	2104.449479	2104.449432	2285.375
685	2104.564583	2104.564536	2285.500
686	2104.679687	2104.679640	2285.625
687	2104.794792	2104.794744	2285.750
688	2104.909896	2104.909848	2285.875
689	2105.025000	2105.024952	2286.000
690	2105.140104	2105.140056	2286.125
691	2105.255208	2105.255160	2286.250
692	2105.370312	2105.370264	2286.375
693	2105.485417	2105.485368	2286.500
694	2105.600521	2105.600472	2286.625
695	2105.715625	2105.715576	2286.750
696	2105.830729	2105.830680	2286.875
697	2105.945833	2105.945784	2287.000
698	2106.060937	2106.060888	2287.125
699	2106.176042	2106.175992	2287.250
700	2106.291146	2106.291096	2287.375
701	2106.406250	2106.406200	2287.500
702	2106.521354	2106.521304	2287.625
703	2106.636458	2106.636408	2287.750
704	2106.751562	2106.751512	2287.875
705	2106.866667	2106.866616	2288.000
706	2106.981771	2106.981720	2288.125
707	2107.096875	2107.096824	2288.250
708	2107.211979	2107.211928	2288.375
709	2107.327083	2107.327032	2288.500
710	2107.442187	2107.442136	2288.625
711	2107.557292	2107.557240	2288.750
712	2107.672396	2107.672344	2288.875
713	2107.787500	2107.787448	2289.000
714	2107.902604	2107.902552	2289.125
715	2108.017708	2108.017656	2289.250
716	2108.132812	2108.132760	2289.375
717	2108.247917	2108.247864	2289.500
718	2108.363021	2108.362968	2289.625
719	2108.478125	2108.478072	2289.750
720	2108.593229	2108.593176	2289.875

TABLE C. 1-1 STDN CHANNEL & FREQUENCY ASSIGNMENT

CHANNEL	TRANSMIT		RECEIVE
	221/240	0.115104MHZ	0.125MHZ
721	2108.708333	2108.708280	2290.000
722	2108.823437	2108.823384	2290.125
723	2108.938542	2108.938488	2290.250
724	2109.053646	2109.053592	2290.375
725	2109.168750	2109.168696	2290.500
726	2109.283854	2109.283800	2290.625
727	2109.398958	2109.398904	2290.750
728	2109.514062	2109.514008	2290.875
729	2109.629167	2109.629112	2291.000
730	2109.744271	2109.744216	2291.125
731	2109.859375	2109.859320	2291.250
732	2109.974479	2109.974424	2291.375
733	2110.089583	2110.089528	2291.500
734	2110.204687	2110.204632	2291.625
735	2110.319792	2110.319736	2291.750
736	2110.434896	2110.434840	2291.875
737	2110.550000	2110.549944	2292.000
738	2110.665104	2110.665048	2292.125
739	2110.780208	2110.780152	2292.250
740	2110.895312	2110.895256	2292.375
741	2111.010417	2111.010360	2292.500
742	2111.125521	2111.125464	2292.625
743	2111.240625	2111.240568	2292.750
744	2111.355729	2111.355672	2292.875
745	2111.470833	2111.470776	2293.000
746	2111.585937	2111.585880	2293.125
747	2111.701042	2111.700984	2293.250
748	2111.816146	2111.816088	2293.375
749	2111.931250	2111.931192	2293.500
750	2112.046354	2112.046296	2293.625
751	2112.161458	2112.161400	2293.750
752	2112.276562	2112.276504	2293.875
753	2112.391667	2112.391608	2294.000
754	2112.506771	2112.506712	2294.125
755	2112.621875	2112.621816	2294.250
756	2112.736979	2112.736920	2294.375
757	2112.852083	2112.852024	2294.500
758	2112.967187	2112.967128	2294.625
759	2113.082292	2113.082232	2294.750
760	2113.197396	2113.197336	2294.875
761	2113.312500	2113.312440	2295.000
762	2113.427604	2113.427544	2295.125
763	2113.542708	2113.542648	2295.250
764	2113.657812	2113.657752	2295.375
765	2113.772917	2113.772856	2295.500

TABLE C. 1-1 STDN CHANNEL & FREQUENCY ASSIGNMENT

CHANNEL	TRANSMIT		RECEIVE
	221/240	0.115104MHZ	0.125MHZ
766	2113.888021	2113.887960	2295.625
767	2114.003125	2114.003064	2295.750
768	2114.118229	2114.118168	2295.875
769	2114.233333	2114.233272	2296.000
770	2114.348437	2114.348376	2296.125
771	2114.463542	2114.463480	2296.250
772	2114.578646	2114.578584	2296.375
773	2114.693750	2114.693688	2296.500
774	2114.808854	2114.808792	2296.625
775	2114.923958	2114.923896	2296.750
776	2115.039062	2115.039000	2296.875
777	2115.154167	2115.154104	2297.000
778	2115.269271	2115.269208	2297.125
779	2115.384375	2115.384312	2297.250
780	2115.499479	2115.499416	2297.375
781	2115.614583	2115.614520	2297.500
782	2115.729687	2115.729624	2297.625
783	2115.844792	2115.844728	2297.750
784	2115.959896	2115.959832	2297.875
785	2116.075000	2116.074936	2298.000
786	2116.190104	2116.190040	2298.125
787	2116.305208	2116.305144	2298.250
788	2116.420312	2116.420248	2298.375
789	2116.535417	2116.535352	2298.500
790	2116.650521	2116.650456	2298.625
791	2116.765625	2116.765560	2298.750
792	2116.880729	2116.880664	2298.875
793	2116.995833	2116.995768	2299.000
794	2117.110937	2117.110872	2299.125
795	2117.226042	2117.225976	2299.250
796	2117.341146	2117.341080	2299.375
797	2117.456250	2117.456184	2299.500
798	2117.571354	2117.571288	2299.625
799	2117.686458	2117.686392	2299.750
800	2117.801562	2117.801496	2299.875
801	2117.916667	2117.916600	2300.000

UNASSIGNED CHANNELS: 000, 802-849

TABLE C.2-1 NASA/DSN CHANNEL & FREQUENCY ASSIGNMENTS

CHANNEL	TRANSMIT MHz	RECEIVE MHz
850		2290.185185
851		2290.555556
852		2290.925926
853		2291.296296
854	2110.243056	2291.666667
855	2110.584105	2292.037037
856	2110.925154	2292.407407
857	2111.266204	2292.777778
858	2111.607253	2293.148148
859	2111.948303	2293.518519
860	2112.289352	2293.888889
861	2112.630401	2294.259259
862	2112.971451	2294.629630
863	2113.312500	2295.000000
864	2113.653549	2295.370370
865	2113.994599	2295.740741
866	2114.335648	2296.111111
867	2114.676697	2296.481481
868	2115.017747	2296.851852
869	2115.358796	2297.222222
870	2115.699846	2297.592593
871	2116.040895	2297.962963
872	2116.381944	2298.333333
873	2116.722994	2298.703704
874	2117.064043	2299.074074
875	2117.405092	2299.444444
876	2117.746142	2299.814815
877	2118.087191	
878	2118.428241	
879	2118.769290	
880	2119.110339	
881	2119.451399	
882	2119.792438	

Unassigned Channels: 883-899  
 Transmit/Receive Ratio: 221/240

TABLE C.2-2 DOD/SGLS CHANNEL & FREQUENCY ASSIGNMENTS

CHANNEL	TRANSMIT ORBITER TO DOD PAYLOADS (MHz)	RECEIVE DOD PAYLOADS TO ORBITER (MHz)
900	1763.721	2202.500
901	1767.725	2207.500
902	1771.729	2212.500
903	1775.733	2217.500
904	1779.736	2222.500
905	1783.740	2227.500
906	1787.744	2232.500
907	1791.748	2237.500
908	1795.752	2242.500
909	1799.756	2247.500
910	1803.760	2252.500
911	1807.764	2257.500
912	1811.768	2262.500
913	1815.772	2267.500
914	1819.775	2272.500
915	1823.779	2277.500
916	1827.783	2282.500
917	1831.787	2287.500
918	1835.791	2292.500
919	1839.795	2297.500

Unassigned Channels: 920-999  
 Transmit/Receive Ratio: 205/256

APPENDIX I

PAYLOAD, ATTACH-POINT, STATIC LIMIT-LOAD CAPABILITY

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## I.1 INTRODUCTION

This appendix provides the payload designer with information required to determine the compatibility of payload-induced loads with the Orbiter static limit load capability.

Guidelines and equations are provided to determine the allowable loads for attach points on single bridges and on adjacent bridges. (A single bridge is defined as a longeron or keel bridge which does not share either of its mid-fuselage support frames with another longeron or keel bridge respectively). Table I.1-1 provides guidelines for the applicability of the equations provided in the following paragraphs. It is in essence an index correlating the load combinations with longeron or keel attach points and with single or adjacent bridges.

## I.2 ORBITER STATIC LIMIT LOAD CAPABILITY

Loads are transmitted from the payload trunnions through the payload attachment mechanisms to the longeron and keel bridges. The loads are then transmitted in turn from the bridges to the mid-fuselage frames. Positive X, Y, and Z loads are aft, right (looking forward), and up, respectively. Load capability data are provided in Tables I.2-1, I.2-2, and I.2-3.

Table 3.3.1.1-1 should be examined to determine which attach points can be used. Table I.2-1 provides the allowable limit load data defining for each attach point: (1) the allowable  $\pm Z$  and  $\pm Y$  loads at the longeron, where the Y load results from trunnion/bearing friction and/or bearing rotation (trunnion deflection), and (2) the allowable  $\pm Y$ ,  $\pm X$  and  $\pm Z$  loads at the keel, where the Z load results from friction or trunnion deflection, and the X load results from either friction or a keel (auxiliary) fitting which is restrained from movement in the X direction.

The transfer of X load from the longeron bridge to the longeron is not affected by the fore and aft location of the attach fitting on the bridge. Thus the X-load capability for all attach points on a given bridge is the same. Table I.2-2 presents tabular data defining the allowable X load for each bridge.

At landing, the payload imposed Z loads result in critical vertical shear loads in the mid-fuselage side skins. Table I.2-3 presents data defining the allowable limit load ( $Z_s$  load), at landing only, for each frame.

*Table 9.1-1 Paragraph Guidelines For Use Of Attachment Point Limit-Load Capabilities*

Longeron/Trunnion Bearing Friction Plus Bearing Rotation	Longeron Attach Points					
	Single Bridge		Adjacent Bridges			
	Applied Z and X Loads Primary Fitting	Applied Z Load Only Stabilizing Fitting	Pt.1,Primary Pt.2,Primary	Pt.1,Stabiliz. Pt.2,Stabiliz.	Pt.1,Primary Pt.2,Stabiliz.	Pt.1,Stabiliz. Pt.2,Primary
Yes	I.3.2.1.1	I.3.2.1.2	I.3.3.1.1	I.3.3.1.2	I.3.3.1.3	I.3.3.1.4

Keel Trunnion/Bearing Friction Plus Bearing Rotation	Keel Attach Points					
	Single Bridge		Adjacent Bridges			
	Applied Y Load Only Primary	Applied X and Y Loads Stabilizing	Applied Y Loads Only	Applied X and Y Loads	Pt.1,X and Y Loads Pt.2,Y Loads	Pt.1, Y Loads Pt.2, X and Y Loads
Z Friction Load	---	I.3.2.2.2	---	I.3.3.2.2	---	---
X and Z Friction Load	I.3.2.2.1	---	I.3.3.2.1	---	I.3.3.2.3	I.3.3.2.4

Longeron/Trunnion Bearing Friction Plus Bearing	Longeron Attach Points				
	Two Attach Points on One Bridge				
	Forward Primary and Aft Stabilizing	Forward and Aft Primary Fittings	Forward Stabilizing and Aft Fittings	Forward and Aft Stabilizing Fitting	
Yes	9.3.4.1	9.3.4.2	9.3.4.3	9.3.4.4	

Table 9.2-1 Payload Attachment Point Limit-Load Capability At Longerons And Keel For All Flight And Landing Conditions

ATTACH POINT, X O	LONGERON, 1000 LBS PER SIDE								KEEL, 1000 LBS							
	VERTICAL ± Z						LATERAL, ±Y		+ Y		± X K	±Z (X=0)		±R (X, Z=0)		
	+ Z		- Z		Z MODIFIERS				(ZERO FRICTION)			K		K		K
	Z	A	Z	A	K	A	±Y	±Y	±Y	±Y	(Z=0)	±Z	±Z	±R	±R	
F	A	F	A	F	A	LF	LA	F	A		KF	KA	KF	KA		
BRIDGE BETWEEN FRAMES Xo582 AND Xo636																
582.00	19.30	*	-19.30	*	-0.106	*	*	3.00	*	0.31	0.31	0.31	0.31	0.31		
612.73	*	*	*	*	*	*	*	6.96	24.60	0.90	0.71	2.44	0.71	0.90		
616.67	53.92	52.85	-53.92	-66.74	-0.297	0.166	5.8	6.8	8.38	21.81	0.90	0.86	2.16	0.86		
620.60	67.68	47.47	-67.68	-59.95	-0.373	0.149	7.2	6.2	10.52	19.58	0.90	1.08	1.94	1.08		
624.53	90.86	43.08	-90.86	-54.41	-0.501	0.135	9.4	5.5	14.12	17.78	0.90	1.45	1.76	1.45		
628.47	138.41	39.43	-138.41	-49.79	-0.764	0.124	13.9	4.9	*	*	*	*	*	*		
632.40	289.50	36.35	-289.50	-45.91	-1.597	0.114	28.2	4.4	*	*	*	*	*	*		
636.00		33.93		-42.85		0.106										
										14.00	0.90		1.39			
BRIDGE BETWEEN FRAMES Xo636 AND Xo693																
636.00	33.93		-46.29		-0.101			14.00			1.39		1.39			
644.20	39.63	183.67	-54.07	-290.49	-0.118	0.701	5.8	27.0	*	*	*	*	*	*		
648.13	43.10	124.20	-58.80	-196.38	-0.128	0.474	6.2	17.9	*	*	*	*	*	*		
652.07	47.25	93.75	-64.46	-148.23	-0.140	0.358	6.7	13.3	19.50	71.97	1.80	1.94	7.18	1.94		
656.00	52.27	75.33	-71.31	-119.10	-0.155	0.288	7.1	10.5	21.57	57.83	1.80	2.14	5.77	2.14		
659.93	58.48	62.95	-79.79	-99.54	-0.174	0.240	7.2	8.6	24.13	48.33	1.80	2.40	4.82	2.40		
663.86	*	*	*	*	*	*	*	*	27.39	41.51	1.80	2.72	4.14	2.72		
667.80	*	*	*	*	*	*	*	*	31.67	36.37	1.80	3.14	3.63	3.14		
671.73	*	*	*	*	*	*	*	*	37.52	32.37	1.80	3.72	3.23	3.72		
675.67	*	*	*	*	*	*	*	*	46.05	29.15	1.80	4.57	2.91	4.57		
679.60	*	*	*	*	*	*	*	*	59.55	26.53	1.80	5.91	2.65	5.91		
693.00		26.43		-41.79		0.101				20.29	1.80		2.03			

NOTES: 1. Before using this table see paragraph I.3 through I.3.3 for guidelines.

2. See Tables I.2-2 and I.2-3 for limit longitudinal loads and limit vertical side skin shear loads at landing.

\* Attach point not available at locations where asterisk appears.

Table 9.2-1 Payload Attachment Point Limit-Load Capability At Longeron And Keel For All Flight And Landing Conditions (Continued)

ATTACH POINT, X	LONGERON, 1000 LBS PER SIDE								KEEL, 1000 LBS							
	VERTICAL ± Z						LATERAL, ±Y		+ Y		± X K	±Z (X=0)		±R (X, Z=0)		
	+ Z		- Z		Z MODIFIERS				(ZERO FRICTION)			K		K		
	Z F	Z A	Z F	Z A	K F	K A	±Y LF	±Y LA	±Y F	±Y A	(Z=0)	±Z KF	±Z KA	±R KF	±R KA	
BRIDGE BETWEEN FRAMES Xo693 AND Xo750																
693.00!	26.43!		-41.79!		-0.101!					20.29!				2.03!		2.03!
699.27!	29.69!	329.91!	-46.96!	-400.00!	-0.113!	0.917!	4.7	36.1		*	*	*	*	*	*	*
703.20!	32.19!	202.80!	-50.90!	-245.88!	-0.123!	0.564!	5.1	22.2		*	*	*	*	*	*	*
707.13!	35.14!	146.39!	-55.56!	-177.49!	-0.134!	0.407!	5.6	16.0		*	*	*	*	*	*	*
711.07!	38.70!	114.47!	-61.19!	-138.79!	-0.148!	0.319!	6.1	12.5	29.71!	84.03!	3.30!	2.96!	8.40!	2.96!	2.96!	3.30!
715.00!	43.04!	94.02!	-68.06!	-114.00!	-0.164!	0.261!	6.8	10.2	33.04!	69.02!	3.30!	3.30!	6.90!	3.30!	3.30!	3.30!
718.93!	48.49!	79.77!	-76.67!	-96.72!	-0.185!	0.222!	7.2	8.8	42.63!	50.84!	3.30!	4.25!	5.08!	4.25!	3.30!	3.30!
722.87!	55.53!	69.25!	-87.80!	-83.96!	-0.212!	0.193!	8.1	7.9	37.22!	58.56!	3.30!	3.71!	5.85!	3.71!	3.30!	3.30!
726.80!	64.94!	61.20!	-102.67!	-74.20!	-0.248!	0.170!	9.2	7.1	42.63!	50.84!	3.30!	4.98!	4.49!	4.98!	3.20!	3.20!
730.73!	78.18!	54.82!	-123.61!	-66.47!	-0.298!	0.152!	10.9	6.2	49.85!	44.93!	3.30!	5.99!	4.02!	5.99!	3.00!	3.00!
734.67!	*	*	*	*	*	*	*	*	60.02!	40.25!	3.30!	5.99!	4.02!	5.99!	3.00!	3.00!
738.60!	*	*	*	*	*	*	*	*	75.44!	36.44!	3.30!	7.53!	3.64!	7.53!	2.90!	2.90!
742.53!	201.67!	41.76!	-318.88!	-50.64!	-0.770!	0.116!	25.7	4.3	101.45!	33.30!	3.30!	10.13!	3.33!	10.13!	2.70!	2.70!
746.47!	426.77!	38.68!	-674.80!	-46.90!	-1.629!	0.108!	52.3	3.9	*	*	*	*	*	*	*	*
750.00!		36.29!		-44.00!		0.101!										
BRIDGE BETWEEN FRAMES Xo750 AND Xo807																
750.00!	36.29!		-44.00!		-0.101!				26.64!			2.66!		2.66!		2.66!
758.27!	42.45!	236.82!	-51.47!	-280.11!	-0.118!	0.695!	5.2	26.7	*	*	*	*	*	*	*	*
762.20!	46.17!	160.53!	-55.98!	-189.88!	-0.128!	0.471!	5.7	18.1	*	*	*	*	*	*	*	*
766.13!	50.61!	121.42!	-61.37!	-143.61!	-0.141!	0.356!	6.2	13.6	37.15!	106.01!	4.60!	3.71!	10.60!	3.71!	4.60!	4.60!
770.07!	56.01!	97.58!	-67.91!	-115.42!	-0.156!	0.286!	6.8	10.9	41.12!	85.20!	4.60!	4.11!	8.52!	4.11!	4.40!	4.40!
774.00!	62.68!	81.61!	-76.00!	-96.52!	-0.174!	0.240!	7.6	9.1	46.01!	71.25!	4.60!	4.60!	7.13!	4.60!	4.20!	4.20!
777.93!	71.16!	70.12!	-86.27!	-82.94!	-0.198!	0.206!	8.0	7.8	52.24!	61.22!	4.60!	5.22!	6.12!	5.22!	3.90!	3.90!
781.87!	82.31!	61.45!	-99.80!	-72.69!	-0.229!	0.180!	8.8	7.2	60.42!	53.66!	4.60!	6.04!	5.37!	6.04!	3.70!	3.70!
785.80!	97.57!	54.71!	-118.30!	-64.71!	-0.271!	0.161!	10.2	6.2	71.63!	47.77!	4.60!	7.16!	4.78!	7.16!	3.50!	3.50!
789.73!	119.78!	49.30!	-145.22!	-58.31!	-0.333!	0.145!	12.2	5.5	87.93!	43.04!	4.60!	8.79!	4.30!	8.79!	3.30!	3.30!
793.67!	155.18!	44.85!	-188.15!	-53.05!	-0.431!	0.132!	15.3	4.8	113.91!	39.16!	4.60!	11.39!	3.92!	11.39!	3.10!	3.10!
797.60!	220.06!	41.15!	-266.81!	-48.67!	-0.612!	0.121!	21.0	4.3	*	*	*	*	*	*	*	*
801.53!	378.16!	38.01!	-458.50!	-44.95!	-1.051!	0.112!	34.6	3.8	*	*	*	*	*	*	*	*
807.00!		34.36!		-40.64!		0.101!										

- NOTES: 1. Before using this table see paragraphs I.3.0 through I.3.3 for guidelines.  
2. See Tables I.2-2 and I.2-3 for limit longitudinal loads and limit vertical side skin shear loads at landing.  
\* Attach point not available at locations where asterisk appears.



Table 9.2-1 Payload Attachment Point Limit-Load Capability At Longeron And Keel For All Flight And Landing Conditions (Continued)

ATTACH POINT	LONGERON, 1000 LBS PER SIDE								KEEL, 1000 LBS											
	VERTICAL ± Z								LATERAL, ±Y				±Y (ZERO FRICTION)		±X		±Z (X=0)		±R (X, Z=0)	
	+ Z		- Z		Z MODIFIERS															
	X	Z	Z	Z	K	K	±Y	±Y	±Y	±Y	±X	±Z	±Z	±R	±R	±Z	±Z	±R	±R	
O	F	A	F	A	F	A	LF	LA	F	A	(Z=0)	KF	KA	KF	KA	KF	KA	KF	KA	
BRIDGE BETWEEN FRAMES Xo807 AND Xo863																				
!807.00!	34.36!		-40.64!		-0.103!					30.00!				3.00!				3.00!		
!813.33!	38.74!	286.90!	-45.82!	-324.14!	-0.116!	0.908!	4.6	33.0	*	*	*	*	*	*	*	*	*	*	*	
!817.27!	42.08!	176.83!	-49.77!	-199.79!	-0.126!	0.560!	5.0	20.3	*	*	*	*	*	*	*	*	*	*	*	
!821.20!	46.03!	127.89!	-54.45!	-144.50!	-0.138!	0.405!	5.5	14.7	40.19!	108.45!	5.60!	4.02!	13.27!	4.02!	5.20!	4.02!	5.20!	4.02!	5.20!	
!825.13!	50.81!	100.17!	-60.10!	-113.17!	-0.152!	0.317!	6.1	11.5	44.36!	84.94!	5.60!	4.44!	10.39!	4.44!	5.94!	4.44!	5.94!	4.44!	5.94!	
!829.07!	56.71!	82.29!	-67.07!	-92.97!	-0.169!	0.261!	6.7	9.4	49.51!	69.78!	5.60!	4.95!	8.54!	4.95!	4.44!	4.95!	4.44!	4.95!	4.44!	
!833.00!	64.14!	69.85!	-75.86!	-78.92!	-0.192!	0.221!	7.6	8.0	56.00!	59.23!	5.60!	5.60!	7.25!	5.60!	5.60!	5.60!	7.25!	5.60!	5.60!	
!836.93!	73.81!	60.68!	-87.30!	-68.55!	-0.221!	0.192!	8.2	6.9	64.44!	51.45!	5.60!	6.44!	6.30!	6.44!	6.30!	6.44!	6.30!	6.44!	6.30!	
!840.87!	86.95!	53.62!	-102.84!	-60.58!	-0.260!	0.170!	9.4	5.9	75.92!	45.47!	5.60!	7.59!	5.56!	7.59!	5.56!	7.59!	5.56!	7.59!	5.56!	
!844.80!	105.72!	48.04!	-125.05!	-54.28!	-0.316!	0.152!	11.2	5.2	92.31!	40.74!	5.60!	9.23!	4.99!	9.23!	4.99!	9.23!	4.99!	9.23!	4.99!	
!848.73!	134.84!	43.52!	-159.48!	-49.17!	-0.403!	0.138!	13.8	4.6	117.73!	36.90!	5.60!	11.77!	4.52!	11.77!	4.52!	11.77!	4.52!	11.77!	4.52!	
!852.67!	186.27!	39.77!	-220.31!	-44.93!	-0.557!	0.126!	18.5	4.0	162.63!	33.72!	5.60!	16.26!	4.13!	16.26!	4.13!	16.26!	4.13!	16.26!	4.13!	
!856.60!	300.65!	36.61!	-355.60!	-41.37!	-0.898!	0.116!	28.7	3.6	*	*	*	*	*	*	*	*	*	*	*	
!860.53!	779.01!	33.93!	-921.39!	-38.33!	-2.328!	0.107!	71.0	3.2	*	*	*	*	*	*	*	*	*	*	*	
!863.00!		32.43!	-36.64!		0.103!					27.50!			3.37!				3.37!			
BRIDGE BETWEEN FRAMES Xo863 AND Xo919																				
!863.00!	32.43!		-36.64!		-0.103!					27.50!			3.37!				3.37!			
!872.33!	38.91!	186.07!	-43.96!	-236.24!	-0.123!	0.616!	4.5	23.8	*	*	*	*	*	*	*	*	*	*	*	
!876.27!	42.50!	130.82!	-48.02!	-166.10!	-0.135!	0.433!	4.9	16.7	*	*	*	*	*	*	*	*	*	*	*	
!880.20!	46.81!	100.93!	-52.88!	-128.15!	-0.148!	0.334!	5.4	12.9	39.69!	107.44!	5.70!	4.86!	10.71!	4.86!	5.03!	4.86!	5.03!	4.86!	5.03!	
!884.13!	52.08!	82.16!	-58.84!	-104.31!	-0.165!	0.272!	6.0	10.5	44.16!	87.46!	5.70!	5.40!	8.72!	5.40!	4.77!	5.40!	4.77!	5.40!	4.77!	
!888.07!	58.72!	69.25!	-66.34!	-87.92!	-0.186!	0.229!	6.7	8.8	49.79!	73.71!	5.70!	6.09!	7.35!	6.09!	4.51!	6.09!	4.51!	6.09!	4.51!	
!892.00!	67.26!	59.86!	-75.99!	-76.01!	-0.213!	0.198!	7.6	7.6	57.04!	63.72!	5.70!	6.98!	6.36!	6.98!	4.25!	6.98!	4.25!	6.98!	4.25!	
!895.93!	78.72!	52.72!	-88.94!	-66.93!	-0.249!	0.175!	8.8	6.5	66.75!	56.12!	5.70!	8.17!	5.60!	8.17!	3.99!	8.17!	3.99!	8.17!	3.99!	
!899.87!	*	*	*	*	*	*	*	*	*	80.50!	50.12!	5.70!	9.85!	5.00!	9.85!	3.76!	9.85!	3.76!	9.85!	3.76!
!903.80!	*	*	*	*	*	*	*	*	*	101.32!	45.29!	5.70!	12.40!	4.52!	12.40!	3.54!	12.40!	3.54!	12.40!	3.54!
!907.73!	*	*	*	*	*	*	*	*	*	136.65!	41.31!	5.70!	16.72!	4.12!	16.72!	3.34!	16.72!	3.34!	16.72!	3.34!
!919.00!		31.00!	-39.36!		0.103!					33.00!			3.29!				3.29!			

- NOTES: 1. Before using this table see paragraphs I.3.0 through I.3.3 for guidelines.  
 2. See Tables I.2-2 and I.2-3 for limit longitudinal loads and limit vertical side skin shear loads at landing.  
 \* Attach point not available at locations where asterisk appears.

Table 9.2-1 Payload Attachment Point Limit-Load Capability At Longeron And Keel For All Flight And Landing Conditions (Continued)

ATTACH POINT, X O	LONGERON, 1000 LBS PER SIDE								KEEL 1000 LBS										
	VERTICAL ± Z						LATERAL, ±Y		+ Y (ZERO FRICTION)		+ X K (Z=0)	±Z (X=0) K		±R (X, Z±0) K					
	+ Z		- Z		Z MODIFIERS							±Z KF	±Z KA	±R KF	±R KA				
	Z F	Z A	Z F	Z A	K F	K A	±Y LF	±Y LA	±Y F	±Y A	±Z KF					±Z KA	±R KF	±R KA	
BRIDGE BETWEEN FRAMES Xo919 AND Xo979.5																			
919.00!	31.00!		-39.36!		-0.095!					33.00!			3.29!		3.29!				
923.47!	33.47!	564.53!	-42.50!	-544.22!	-0.103!	1.286!	4.3	54.0		*	*	*	*	*	*	*	*	*	*
927.40!	36.00!	300.41!	-45.71!	-289.61!	-0.110!	0.685!	4.6	28.7		*	*	*	*	*	*	*	*	*	*
931.33!	38.94!	204.66!	-49.43!	-197.30!	-0.119!	0.466!	5.0	19.5		*	*	*	*	*	*	*	*	*	*
935.27!	42.40!	155.10!	-53.84!	-149.52!	-0.130!	0.353!	5.4	14.8		45.14!	148.74!	7.00!	4.50!	15.64!	4.50!	6.51!			
939.20!	46.54!	124.94!	-59.09!	-120.43!	-0.143!	0.285!	5.9	11.9		49.54!	119.80!	7.00!	4.94!	12.60!	4.94!	6.18!			
943.13!	51.57!	104.58!	-65.47!	-100.82!	-0.158!	0.238!	6.6	9.9		54.89!	100.29!	7.00!	5.47!	10.55!	5.47!	5.86!			
947.07!	57.83!	89.90!	-73.43!	-86.67!	-0.177!	0.205!	7.3	8.5		61.56!	86.21!	7.00!	6.14!	9.07!	6.14!	5.55!			
951.00!	65.83!	78.86!	-83.55!	-76.02!	-0.202!	0.180!	8.3	7.6		70.05!	75.63!	7.00!	6.99!	7.95!	6.99!	5.26!			
954.93!	76.33!	70.23!	-96.92!	-67.71!	-0.234!	0.160!	9.4	6.6		81.26!	67.35!	7.00!	8.10!	7.08!	8.10!	4.98!			
958.87!	90.91!	63.29!	-115.43!	-61.02!	-0.279!	0.144!	11.0	5.8		96.78!	60.70!	7.00!	9.65!	6.38!	9.65!	4.72!			
962.80!	*	*	*	*	*	*	*	*		119.55!	55.25!	7.00!	11.92!	5.81!	11.92!	4.47!			
966.73!	*	*	*	*	*	*	*	*		156.34!	50.70!	7.00!	15.59!	5.33!	15.59!	4.24!			
974.60!	382.76!	45.39!	-485.98!	-43.75!	-1.173!	0.103!	40.6	3.7		*	*	*	*	*	*	*			
979.50!		41.71!	-40.21!		0.095!								4.21!		4.21!				
BRIDGE BETWEEN FRAMES Xo979.5 AND Xo1040																			
979.50!	41.71!		-40.21!		-0.095!			40.00!		*	*	*	4.21!		4.21!				
986.40!	47.08!	311.27!	-45.39!	-345.73!	-0.107!	0.833!	4.6	34.4		*	*	*	*	*	*	*	*	*	*
990.33!	50.80!	198.31!	-48.98!	-220.27!	-0.116!	0.531!	5.0	21.9		*	*	*	*	*	*	*	*	*	*
994.27!	55.18!	145.41!	-53.20!	-161.51!	-0.126!	0.389!	5.4	16.0		52.92!	165.89!	8.00!	5.56!	24.69!	5.56!	7.69!			
998.20!	60.37!	114.85!	-58.20!	-127.57!	-0.138!	0.307!	5.9	12.6		57.89!	131.03!	8.00!	6.09!	19.50!	6.09!	7.43!			
1002.13!	66.63!	94.91!	-64.24!	-105.41!	-0.152!	0.254!	6.5	10.4		63.90!	108.24!	8.00!	6.72!	16.12!	6.72!	7.17!			
1006.07!	74.37!	80.83!	-71.70!	-89.78!	-0.169!	0.216!	7.2	8.9		71.32!	92.22!	8.00!	7.50!	13.73!	7.50!	6.91!			
1010.00!	84.12!	70.42!	-81.09!	-78.21!	-0.192!	0.189!	8.0	7.7		80.67!	80.37!	8.00!	8.48!	11.96!	8.48!	6.65!			
1013.93!	96.80!	62.38!	-93.31!	-69.29!	-0.221!	0.167!	9.0	6.7		92.83!	71.17!	8.00!	9.76!	10.59!	9.76!	6.39!			
1017.87!	114.03!	55.97!	-109.93!	-62.17!	-0.260!	0.150!	10.3	5.9		109.35!	63.86!	8.00!	11.50!	9.50!	11.50!	6.12!			
1021.80!	138.65!	50.77!	-133.67!	-56.40!	-0.316!	0.136!	12.3	5.2		132.97!	57.93!	8.00!	13.98!	8.62!	13.98!	5.87!			
1025.73!	176.84!	46.46!	-170.48!	-51.60!	-0.403!	0.124!	15.2	4.6		169.50!	53.00!	8.00!	17.83!	7.89!	17.83!	5.62!			
1029.67!	244.28!	42.81!	-235.50!	-47.55!	-0.557!	0.115!	20.3	4.1		234.27!	48.84!	8.00!	24.63!	7.27!	24.63!	5.38!			
1033.60!	394.29!	39.70!	-380.11!	-44.09!	-0.898!	0.106!	31.7	3.7		*	*	*	*	*	*	*			
1037.53!	1021.64!	37.01!	-984.90!	-41.11!	-2.328!	0.099!	78.6	3.3		*	*	*	*	*	*	*			
1040.00!		35.50!	-39.43!		0.095!								40.50!	8.00!	6.03!	4.82!			

- NOTES: 1. Before using this table see paragraphs I.3.0 through I.3.3 for guidelines.  
 2. See Tables I.2-2 and I.2-3 for limit longitudinal loads and limit vertical side skin shear loads at landing.  
 \* Attach point not available at locations where asterisk appears.

Table 9.2-1 Payload Attachment Point Limit-Load Capability At Longeron And Keel For All Flight And Landing Conditions (Continued)

ATTACH POINT, X	LONGERON, 1000 LBS PER SIDE								KEEL, 1000 LBS							
	VERTICAL ± Z						LATERAL, ±Y		+ Y		± X	±Z (X=0)		±R (X, Z=0)		
	+ Z		- Z		Z MODIFIERS				(ZERO FRICTION)			K	K		K	
	Z	Z	Z	Z	K	K	±Y	±Y	±Y	±Y	(Z=0)	±Z	±Z	±R	±R	
O	F	A	F	A	F	A	LF	LA	F	A		KF	KA	KF	KA	
BRIDGE BETWEEN FRAMES Xo1040 AND Xo1090.33																
1040.00!	35.50!		-39.43!		-0.114!	0.616!				40.50!			6.03!		6.03!	
1049.11!	43.58!	219.55!	-48.40!	-244.69!	-0.140!	0.433!	4.8	23.0	*	*	*	*	*	*	*	
1053.27!	48.21!	154.37!	-53.55!	-172.04!	-0.155!	0.334!	5.3	16.1	*	*	*	*	*	*	*	
1057.20!	53.93!	119.09!	-59.90!	-132.73!	-0.174!	0.272!	5.9	12.4	61.53!	134.81!	8.00!	9.16!	17.01!	9.16!	7.24	
1061.13!	61.19!	96.94!	-67.96!	-108.04!	-0.197!	0.229!	6.7	10.1	69.81!	109.74!	8.00!	10.39!	13.84!	10.39!	6.93	
1065.07!	70.73!	81.71!	-78.56!	-91.06!	-0.228!	0.198!	7.7	8.5	80.70!	92.49!	8.00!	12.01!	11.67!	12.01!	6.60	
1069.00!	83.77!	70.64!	-93.04!	-78.72!	-0.270!	0.175!	9.0	7.7	95.56!	79.96!	8.00!	14.22!	10.09!	14.22!	6.27	
1072.93!	102.68!	62.21!	-114.05!	-69.33!	-0.330!	0.156!	10.7	6.6	117.15!	70.41!	8.00!	17.44!	8.88!	17.44!	5.95	
1076.87!	132.74!	55.56!	-147.44!	-61.92!	-0.427!	0.141!	13.4	5.7	151.44!	62.89!	8.00!	22.54!	7.93!	22.54!	5.63	
1080.80!	187.48!	50.21!	-208.24!	-55.96!	-0.603!	0.114!	18.3	5.0	*	*	*	*	*	*	*	
1090.33!		40.70!		-45.36!						46.07!	8.00!		5.81!		4.70	
BRIDGE BETWEEN FRAMES Xo1090.33 AND Xo1140.67																
1090.33!	40.70!		-42.85!		-0.114!					46.07!			5.81!		5.81!	
1092.60!	42.62!	1337.00!	-44.87!	-1621.97!	-0.120!	2.533!	4.8	174.7	*	*	*	*	*	*	*	
1096.53!	46.42!	489.52!	-48.87!	-593.85!	-0.130!	0.927!	5.2	63.7	*	*	*	*	*	*	*	
1100.47!	50.97!	299.31!	-53.66!	-363.10!	-0.143!	0.567!	5.7	38.8	*	*	*	*	*	*	*	
1104.40!	56.49!	215.71!	-59.47!	-261.68!	-0.159!	0.409!	6.3	27.9	*	*	*	*	*	*	*	
1108.11!	63.35!	168.61!	-66.70!	-204.55!	-0.178!	0.319!	7.1	21.7	71.71!	151.66!	7.20!	9.05!	16.30!	9.05!	6.59	
1112.27!	72.14!	138.33!	-75.96!	-167.82!	-0.202!	0.262!	8.0	17.7	81.66!	124.43!	7.20!	10.30!	13.39!	10.30!	6.34	
1116.20!	83.73!	117.32!	-88.15!	-142.32!	-0.235!	0.222!	8.6	15.0	94.78!	105.53!	7.20!	11.96!	11.34!	11.96!	6.00	
1120.13!	99.75!	101.85!	-105.02!	-123.55!	-0.280!	0.193!	9.8	13.0	112.91!	91.61!	7.20!	14.24!	9.85!	14.24!	5.81	
1124.07!	123.42!	89.95!	-129.94!	-109.12!	-0.346!	0.170!	12.0	11.2	139.71!	80.91!	7.20!	17.63!	8.70!	17.63!	5.55	
1128.00!	161.71!	80.57!	-170.25!	-97.74!	-0.454!	0.153!	15.3	9.7	183.04!	72.47!	7.20!	23.09!	7.79!	23.09!	5.29	
1131.93!	234.42!	72.96!	-246.80!	-88.51!	-0.658!	0.138!	21.3	8.5	*	*	*	*	*	*	*	
1135.87!	426.84!	66.64!	-449.39!	-80.85!	-1.198!	0.126!	37.2	7.4	*	*	*	*	*	*	*	
1140.67!		60.29!		-73.14!		0.114!				54.23!	7.20!		5.83!		4.53	

- NOTES: 1. Before using this table see paragraphs I.3.0 through I.3.3 for guidelines.  
2. See Tables I.2-2 and I.2-3 for limit longitudinal loads and limit vertical side skin shear loads at landing.  
\* Attach point not available at locations where asterisk appears.

Table I.2-1 Payload Attachment Point Limit-Load Capability At Longeron And Keel For All Flight And Landing Conditions (Continued)

ATTACH POINT, X 0	LONGERON, 1000 LBS PER SIDE							KEEL, 1000 LBS								
	VERTICAL $\pm Z$							LATERAL, $\pm Y$		+ Y		$\pm X$ K (Z=0)	$\pm Z$ (X=0) K		$\pm R$ (X, Z=0) K	
	+ Z		- Z		Z MODIFIERS		(ZERO FRICTION)			$\pm Y$	$\pm Z$		$\pm Z$	$\pm R$	$\pm R$	
	Z F	Z A	Z F	Z A	K F	K A	$\pm Y$ LF	$\pm Y$ LA	$\pm Y$ F	$\pm Y$ A	$\pm Z$ KF	$\pm Z$ KA	$\pm R$ KF	$\pm R$ KA		
BRIDGE BETWEEN FRAMES Xo1140.67 AND Xo1191																
1140.67	60.29		-73.14		-0.114		10.3		54.23			5.83		5.83		
1151.60	77.02	424.60	-93.43	-478.57	-0.146	0.526	(10.3)	47.4	*	*	*	*	*	*		
1155.53	85.55	312.31	-103.78	-352.01	-0.162	0.387	(11.4)	34.7	76.95	185.10	6.80	8.27	23.71	8.27		
1159.47	96.24	246.86	-116.75	-278.23	-0.182	0.306	(12.8)	12.1	86.57	146.31	6.80	9.31	18.74	9.31		
1163.40	109.94	203.18	-133.37	-230.13	-0.208	0.253	(12.1)	22.5	98.89	121.01	6.80	10.63	15.50	10.63		
1167.33	128.20	174.00	-155.52	-196.20	-0.243	0.216	(14.6)	12.1	115.31	103.17	6.80	12.40	13.21	12.40		
1171.27	153.80	151.66	-186.58	-170.94	-0.291	0.188	(15.7)	12.1	138.34	89.89	6.80	14.87	11.51	14.87		
1175.20	192.05	134.40	-232.98	-151.49	-0.364	0.167	(17.5)	23.4	12.1	172.75	79.66	6.80	18.57	10.20		
1179.13	255.64	120.67	-310.12	-136.01	-0.484	0.150	(14.8)	30.1	12.1	229.94	71.52	6.80	24.72	9.16		
1181.00	*	*	*	*	*	*	*	*	*	272.94	67.09	6.80	29.34	8.74		
1183.07	382.65	109.46	-464.20	-123.37	-0.725	0.136	(12.9)	43.3	12.1	344.19	64.87	6.80	37.00	8.31		
1187.00	758.60	100.17	-920.28	-112.90	-1.438	0.124		81.9	11.3	*	*	*	*	*		
1190.93	43348.57	92.34	-52587.66	-104.07	-82.140	0.114	4430.3	9.8	*	*	*	*	*	*		
1191.00		92.21	-103.93			0.114				54.65	6.80		7.00	5.44		

- NOTES: 1. Before using this table see paragraphs I.3.0 through I.3.3 for guidelines.
2. See Tables I.2-2 and I.2-3 for limit longitudinal loads and limit vertical side skin shear loads at landing.
3. The value within parentheses indicates the lateral capability of the mid-fuselage with a special bridge and retention mechanism; the value outside parentheses indicates the capability of the current bridge concept.
4. If payload-required, a special, strong, heavier bridge and attach fitting can be developed to take advantage of the lateral load capability of the mid-fuselage.
- \* Attach point not available at locations where asterisk appears.

Table 9.2-1 Payload Attachment Point Limit-Load Capability At Longeron And Keel For All Flight And Landing Conditions (Continued)

ATTACH POINT, X 0	LONGERON, 1000 LBS PER SIDE								KEEL, 1000 LBS									
	VERTICAL ± Z				Z MODIFIERS				LATERAL, ±Y		± Y (ZERO FRICTION)		± X K		±Z (X=0) K		±R (X, Z=0) K	
	+ Z		- Z		Z	Z	K	K	±Y	±Y	±Y	±Y	(Z=0)		±Z	±Z	±R	±R
	Z	Z	Z	Z	F	A	F	A	LF	LA	F	A		KF	KA	KF	KA	
BRIDGE BETWEEN FRAMES Xo1191 AND Xo1249																		
1191.00	92.21		-103.93		-0.099				12.1		54.6			7.00		7.00		
1194.87	98.80	1305.97	-111.36	-1408.78	-0.106	1.486			(13.8)	101.9	*	*	*	*	*	*	*	*
1198.80	106.54	647.96	-120.08	-698.97	-0.115	0.737			(14.8)	50.3	*	*	*	*	*	*	*	*
1202.73	115.59	430.87	-130.28	-464.79	-0.124	0.490			(15.9)	33.3								
1206.67	126.34	322.53	-142.40	-347.93	-0.136	0.367			(17.3)	24.8								
1210.60	139.28	257.86	-156.98	-278.16	-0.150	0.293			(18.6)	19.7								
1214.53	155.15	214.79	-174.87	-231.70	-0.167	0.244			19.4	12.1	Allowable loads are defined in Paragraph 9.3.5							
1218.47	175.18	183.99	-197.44	-198.47	-0.188	0.209			(16.3)	20.3								
1222.40	201.06	160.96	-226.61	-173.63	-0.216	0.183			(13.9)	21.9								
1226.33	235.91	143.05	-265.90	-154.32	-0.254	0.163			(12.5)	11.8								
1230.27	285.54	128.70	-321.83	-138.83	-0.307	0.146			29.7	11.2	*	*	*	*	*	*	*	*
1234.20	361.36	116.99	-407.29	-126.20	-0.389	0.133			36.5	10.7	*	*	*	*	*	*	*	*
1238.13	492.01	107.24	-554.55	-115.68	-0.529	0.122			48.1	10.4	*	*	*	*	*	*	*	*
1242.07	771.74	98.96	-869.83	-106.76	-0.830	0.113			72.6	10.1	*	*	*	*	*	*	*	*
1246.00	1782.73	91.89	-2009.31	-99.13	-1.917	0.105			160.9	9.8	*	*	*	*	*	*	*	*
1249.00		87.14		-94.00		0.099								56.5	2.94	5.65		5.6

- NOTES: 1. Before using this table see paragraphs I.3.0 through I.3.3 for guidelines.
2. See Tables I.2-2 and I.2-3 for limit longitudinal loads and limit vertical side skin shear loads at landing.
3. The value within parentheses indicates the lateral capability of the mid-fuselage with a special bridge and retention mechanism; the value outside parentheses indicates the capability of the current bridge concept.
4. If payload-required, a special, strong, heavier bridge and attach fitting can be developed to take advantage of the lateral load capability of the mid-fuselage.
- \* Attach point not available at locations where asterisk appears.

**Table 9.2-1 Payload Attachment Point Limit-Load Capability At  
Longeron And Keel For All Flight And Landing Conditions (Continued)**

ATTACH POINT, X O	LONGERON, 1000 LBS PER SIDE								KEEL, 1000 LBS									
	VERTICAL ± Z								LATERAL, ±Y		+ Y (ZERO FRICTION)		± X K		±Z (X=0) K		±R (X, Z=0) K	
	+ Z		- Z		Z MODIFIERS		±Y											
	Z F	Z A	Z F	Z A	K F	K A	±Y LF	±Y LA	±Y F	±Y A	(Z=0)	±Z KF	±Z KA	±R KF	±R KA			
BRIDGE BETWEEN FRAME Xo1249 AND BRIDGE ATTACH PIN Xo1301.00																		
1249.00	87.14		-94.00		-0.111					56.5			5.65		5.65			
1269.60	144.31	167.36	-155.67	-167.36	-0.183	0.279	12.1	15.5										
							(13.0)											
1273.53	164.95	140.55	-177.94	-140.55	-0.209	0.234	13.9	12.1										
							(13.0)											
1277.47	192.57	121.10	-207.73	-121.10	-0.244	0.202	14.8	11.2										
1281.40	231.19	106.40	-249.39	-106.40	-0.293	0.177	16.9	10.3										
1303.00		66.30		-66.30		0.111												
No Keel Attach Points Available																		

- NOTE: 1. Before using this table see paragraphs I.3 through I.3.3 for guidelines.
2. See Tables I.2-2 and I.2-3 for limit longitudinal loads and limit vertical side skin shear loads at landing.
3. The value within parentheses indicates the lateral capability of the mid-fuselage with a special bridge and retention mechanism; the value outside parentheses indicates the capability of the current bridge concept.
4. *If payload-required, a special, stronger, heavier bridge and attach fitting can be developed to take advantage of the lateral load capability of the mid-fuselage.*

*Table 9.2-2 Limit Longitudinal Load Capability Per Vehicle  
Side For All Flight And Landing Conditions*

Bridge Span, Frame to Frame	Limit Longitudinal Load Capability X,1000Lbs			
	Ascent Mode (1)		Descent Mode (2)	
	SRB Post- Staging	Boost Max. and All Other Ascent Modes	TAEM Yaw Maneuver and Landing	TAEM Pitch-up Maneuver
582 - 636	5.9	17.0	+ 7.0	24.8
636 - 693	5.9	17.0	+ 7.0	24.8
693 - 750	5.9	17.0	+ 7.0	24.8
750 - 807	11.4	33.0	+15.0	26.3
807 - 863	11.8	34.0	+15.0	26.9
863 - 919	18.7	54.0	+19.0	46.9
919 - 979.5	19.0	55.0	+27.0	57.5
979.5 - 1040	19.7	57.0	+25.0	76.4
1040 - 1090.33	24.2	70.0	+33.0	90.0
1090.33 - 1140.67	36.0	104.0	+50.0	116.0
1140.67 - 1191	41.6	120.0	+76.0	120.0
1191 - 1249	41.6	120.0	+76.0	120.0
1249 - 1301	38.1	110.0	+50.0	110.0

**NOTE:**

- (1) During ascent, at post-SRB-staging (-1.10g), payload inertial loads combined with bending loads caused by thrust vector misalignment of the main engines result in critical longeron compression loading. At Orbiter maximum acceleration (-3.17g), payload inertial loads result in critical longeron compression loading. The noted limit load capability is applicable to any attach point on a particular bridge span. For single payloads, the noted capability applies. For multiple payloads or multiple attach points which react longitudinal loads, the +X-loads acting at each attach point are summed from front to rear in the payload bay to the aft most employed attach point. In addition the accumulation of +X loads cannot exceed the noted load capability at any intermediate attach point in the summation.
- (2) During descent, payload inertial loads combined with bending loads caused by thermal conditions, TAEM maneuvers and landing forces result in critical longeron loading. For single payloads, the noted capability applies. For multiple payloads or X-load attach points, the noted load capability at each X-load attach point applies also.

Table 9.2-3 Allowable Limit Vertical Load Capability  
Per Vehicle Side At Landing

MAIN FRAME Xo STATION	LIMIT VERTICAL LOAD -Zs, IN 1000 LBS(1)
582	- 19.3
636	- 57.2
693	- 59.5
750	- 67.9
807	- 73.9
863	- 73.9
919	- 83.2
979.5	- 90.5
1040	- 96.9
1090.33	-105.4
1140.67	-111.9
(2) -----1180	-----
1191	-103.9
1249	- 94.0
1307*	- 66.3

NOTES:

\* Last bridge is attached to fuselage structure at  
Xo 1301.00; loads are transmitted to Xo 1307 frame.

- (1) At landing, Orbiter side skins react payload-imposed vertical shear loads. The vertical loads are transmitted from the payload attach point to the side skins via the longeron bridge and bridge-to-main-frame attachment pins.
- (2) Fuselage Station Xo 1180 is the main landing gear station. Negative loads transmitted to the frames from payload-imposed landing loads at the primary and stabilizing attach points are accumulated aft from frame Xo 582 to frame Xo 1140.67, and forward from frame Xo 1307 to Frame Xo 1191. For single or multiple payloads, the sum of the loads cannot exceed the noted capability for that frame. For the bridge spanning the landing gear station (i.e., from frame Xo 1140.67 to frame Xo 1191) the payload-imposed load at Xo 1140.67 is summed with the aft accumulating loads; the load at Xo 1191 is summed with the forward accumulating loads. Only negative vertical loads are referenced to the main landing gear; positive vertical loads are limited to those values shown in Table I.2-1.



### I.3 *Guidelines/Equations For Use Of Attach Point Limit-Load Capability Data.*

The following paragraphs provide guidelines, equations, and symbol definitions for using Tables I.2-1 through I.2-3 in determining whether payload-imposed loads are within the attach point limit load capability. Paragraph I.3.2 presents the equations for determining the load capability of an attach point where only a single bridge is used (i.e., no other bridge is attached to either frame). In Paragraph I.3.3, equations are presented for determining the load capability of attach points which are mounted on adjacent bridges (i.e., the bridges are pinned to a common frame). *Paragraph 9.3.4 presents the equations for treating the allowable loads for two longeron attach points on one bridge. The equations specifically addressing the allowable keel loads for Bay 12 (X01191-1249) are presented in Paragraph 9.3.5.*

Before using the guidelines and capability data, the loads imposed by a payload at its attach points should be calculated based on the load factors presented in Section 4.0. Then, those applied loads can be checked against Orbiter capability presented herein.

#### I.3.1 DEFINITION OF TERMS.

The terms appearing in Paragraphs I.3.2, I.3.3, 9.3.4 and 9.3.5 and Tables I.2-1, I.2-2 and I.2-3 are defined below; *exclamation marks have been used in the formulas to denote the absolute value of the quantity enclosed by the marks, i.e., |x|:*

##### I.3.1.1 Longeron Attach Points.

- $Z$  = Applied vertical load at a single attach point on one bridge.
- $Z_1$  = Applied vertical load at the attach point on the forward bridge of an adjacent bridge pair, or the applied vertical load at the attach point on the forward attach point of a single bridge with two attach fittings.
- $Z_2$  = Applied vertical load at the attach point on the aft bridge of an adjacent bridge pair, or the applied vertical load at the attach point on the aft attach point of a single bridge with two attach fittings.
- $Z_F$  = Attach point Z-load capability as limited by forward frame strength of a bridge.
- $Z_A$  = Attach point Z-load capability as limited by aft frame strength of a bridge.
- $Z_{31}$  = Forward attach point Z-load capability as limited by the forward frame strength of the forward bridge of an adjacent bridge pair, or the forward attach point Z-load capability as limited by forward frame strength of a single bridge with two attach fittings.
- $Z_{32}$  = Aft attach point Z-load capability as limited by the forward frame strength of the aft bridge of an adjacent bridge pair, or the aft attach point Z-load capability as limited by forward frame strength of a single bridge with two attach fittings.

- $Z_{A1}$  = Forward attach point Z-load capability as limited by the aft frame strength of the forward bridge of an adjacent bridge pair, or the forward attach point Z-load capability as limited by aft frame strength of a single bridge with two attach fittings.
- $Z_{A2}$  = Aft attach point Z-load capability as limited by the aft frame strength of the aft bridge of an adjacent bridge pair, or the aft attach point Z-load capability as limited by aft frame strength of a single bridge with two attach fittings.
- $Z_s$  = Attach point Z-load capability at landing as limited by frame capability noted in Table I.2-3.
- $X$  = Applied longitudinal load, to be less than the values shown in Table I.2-2.
- $K_{Zi}$  = Modifier of  $Z_{Ai}$  to account for couple resulting from applied longitudinal load  $X$ , where  $i = 1$ , or  $2$ .
- $K_{Ai}$  = Modifier of  $Z_{Ai}$  to account for couple resulting from applied longitudinal load  $X$ , where  $i = 1$ , or  $2$ .
- $Y_{LF}$  = Attach point Y-load capability as limited by forward frame strength.
- $Y_{LA}$  = Attach point Y-load capability as limited by aft frame strength.
- $\mu_x$  = Coefficient of friction for X-direction friction loads on a single attach fitting of a single bridge.
- $\mu_y$  = Coefficient of friction for Y-direction friction loads on a single attach fitting of a single bridge.
- $\mu_z$  = Coefficient of friction for Z-direction friction loads on a single attach fitting of a single bridge.
- $\mu_{x1}$  = Coefficient of friction for X-direction friction loads on the forward bridge of an adjacent bridge pair, or the coefficient of friction for X-direction friction load on the forward attach point of a single bridge.
- $\mu_{y1}$  = Coefficient of friction for Y-direction friction loads on the forward bridge of an adjacent bridge pair, or the coefficient of friction for Y-direction friction load on the forward attach point of a single bridge.
- $\mu_{z1}$  = Coefficient of friction for Z-direction friction loads on the forward bridge of an adjacent bridge pair, or the coefficient of friction for Z-direction friction load on the forward attach fitting of a single bridge.
- $\mu_{x2}$  = Coefficient of friction for X-direction friction loads on the aft bridge of an adjacent bridge pair, or the coefficient of friction for X-direction friction load on the aft attach fitting of a single bridge.

- $\mu_{Y2}$  = *Coefficient of friction for Y-direction friction loads on the aft bridge of an adjacent bridge pair, or the coefficient of friction for Y-direction friction load on the aft attach fitting of a single bridge.*
- $\mu_{Z2}$  = *Coefficient of friction for Z-direction friction loads on the aft bridge of an adjacent bridge pair, or the coefficient of friction for Z-direction friction load on the aft attach fitting of a single bridge.*
- $\theta_i$  = *Angle (deg.) of bearing rotation due to trunnion deflection (See Figure 9.3.1.1-1). (i = 1 or 2) for 2 attach points on one bridge or 2 attach points on adjacent bridges.*

### I.3.1.2 Keel Attach Point

- $Y$  = *Applied lateral load for one fitting on a single bridge.*
- $Y_F$  = *Attach point Y-load capability as limited by forward frame strength.*
- $Y_A$  = *Attach point Y-load capability as limited by aft frame strength.*
- $Y_{F1}$  = *Forward attach point Y-load capability as limited by forward frame strength of the forward bridge for an adjacent bridge pair.*
- $Y_{F2}$  = *Aft attach point Y-load capability as limited by forward frame strength of the aft bridge for an adjacent bridge pair.*
- $Y_{A1}$  = *Forward attach point Y-load capability as limited by aft frame strength of the forward bridge for an adjacent bridge pair.*
- $Y_{A2}$  = *Aft attach point Y-load capability as limited by aft frame strength of the aft bridge for an adjacent bridge pair.*
- $X_{K1}$  = *Attach point X-load (i.e., imposed by friction or fixed-X fittings) capability on the forward bridge for an adjacent bridge pair.*
- $X_{K2}$  = *Attach point X-load (i.e., imposed by friction or fixed-X fittings) capability on the aft bridge for an adjacent bridge pair.*
- $Z_{KF}$  = *Attach point Z-load capability as limited by forward frame strength.*
- $Z_{KA}$  = *Attach point Z-load capability as limited by aft frame strength.*
- $Z_{KF1}$  = *Attach point Z-load capability as limited by forward frame strength of the forward bridge for an adjacent bridge pair.*
- $Z_{KF2}$  = *Attach point Z-load capability as limited by forward frame strength of the aft bridge for an adjacent bridge pair.*
- $Z_{KA1}$  = *Attach point Z-load capability as limited by aft frame strength of the forward bridge for an adjacent bridge pair.*

- $Z_{KA2}$  = *Attach point Z-load capability as limited by aft frame strength of the aft bridge for an adjacent bridge pair.*
- $R_{KF}$  = *Attach point combined X-Z friction load capability as limited by forward frame strength.*
- $R_{KA}$  = *Attach point combined X-Z friction load capability as limited by aft frame strength.*
- $R_{K31}$  = *Attach point combined X-Z friction load capability as limited by forward frame strength of the forward bridge for an adjacent bridge pair.*
- $R_{K32}$  = *Attach point combined X-Z friction load capability as limited by forward frame strength of the aft bridge for an adjacent bridge pair.*
- $R_{KA1}$  = *Attach point combined X-Z friction load capability as limited by aft frame strength of the forward bridge for an adjacent bridge pair.*
- $R_{KA2}$  = *Attach point combined X-Z friction load capability as limited by aft frame strength of the aft bridge for an adjacent bridge pair.*
- $\mu$  = *The definition of friction coefficient are the same as those in Paragraph 9.3.1.1, Longerons Attach Points.*
- $\theta_i$  = *Angle (deg.) of bearing rotation due to keel deflections (See Figure 9.3.1.2-1).  $i = 1, 2$  for adjacent bridge pairs.*

**I.3.2 ALLOWABLE LOADS FOR SINGLE BRIDGE.**

This paragraph outlines the procedure for deriving allowable payload attach point loads for a "single" longeron or keel bridge. A bridge is referred to as "single" when it does not share either of its mid-fuselage support frames with another longeron or keel bridge, respectively. Figure I.3.2-1 depicts such a configuration.

Paragraph I.3.2.1 is concerned with the derivation of allowable payload-induced loads at the longeron for all pertinent load combinations. Each load combination is treated separately. All equations applicable to a particular combination of loads must be satisfied. The equations compare absolute values of payload-induced loads and Orbiter capabilities. *If the sign of the sum inside the absolute value of the left hand side of the equation is positive, a positive  $Z_3$  or  $Z_A$  capability is compared. If the sign of the quantity is negative, a negative  $Z_3$  or  $Z_A$  value from Table 9.2-1 is compared.* The absolute value of a payload-induced load must be less than the absolute value of Orbiter capability. Similarly, Paragraph I.3.2.2 treats the allowable payload-induced loads at the keel.

**I.3.2.1 Allowable Loads at Longerons Attach Points.**

I.3.2.1.1 Attach Point Reacts Z- and X-loads with Trunnion/Bearing Friction and Bearing Rotation Loads.

$$\sqrt{X^2 + Z^2} (\mu_y + \tan \theta) \leq \text{Lower of } Y_{LF} \text{ and } Y_{LA} \text{ values}$$

$$Z - K_F X \leq Z_F \text{ and } Z - K_A X \leq Z_A$$

Z! ≤ Zs load capability, at landing, as shown in Table I.2-3!

X! ≤ X-load capability, for applicable flight conditions, as shown in Table I.2-2.!

For the above two equations, See Note (1) of Table I.2-2 and Note (2) of Table I.2-3 for load accumulation procedure.

I.3.2.1.2 Attach Point Reacts Z-Load with Trunnion/Bearing Friction and Bearing Rotation Loads.

$$Z! (\mu_y + \tan \theta) \leq \text{Lower of } Y_{LF} \text{ and } Y_{LA} \text{ values}$$

$$Z - K_F \mu_X Z! \leq Z_F \text{ and } Z + K_A \mu_X Z! \leq Z_A$$

Z! ≤ Zs load capability, at landing, as shown in Table I.2-3!

μ<sub>X</sub>Z! ≤ X-load capability shown in Table I.2-2 for applicable flight condition!

For the above two equations, see Note (1) of Table I.2-2 and Note (2) of Table I.2-3 for load accumulation procedure.

I.3.2.2 Allowable Loads at Keel Attach Points.

I.3.2.2.1 Attach Point Reacts Y-Loads, X-Friction Loads, and Z-Friction and Bearing Rotation Loads (X, Z ≠ 0).

$$Y! (\mu + \tan \theta) \leq \text{Lower of } R_{KF} \text{ and } R_{KA} \text{ values}$$

The μ value in the above equation should be μ<sub>X</sub> or μ<sub>Z</sub>, whichever is greater.

$$Y! \leq \text{Lower of } Y_F \text{ and } Y_A \text{ values}$$

I.3.2.2.2 Attach Point Reacts X- and Y-Loads (i.e., Keel Fitting Restrained from Movement in the X- Direction) and Z-Friction and Bearing Rotation Loads (X, Z ≠ 0).

$$\sqrt{X^2 [1 + (\mu_Z + \tan \theta)^2] + [Y^2 (\mu_Z + \tan \theta)^2]} \leq R_{KA}$$

$$\sqrt{X^2 + Y^2} (\mu_Z + \tan \theta) \leq R_{KF}$$

$$X! \leq X_K!$$

$$Y! \leq \text{Lower of } Y_F \text{ and } Y_A \text{ values.}$$

I.3.3 Allowable Loads for Adjacent Bridges. This paragraph outlines the procedure for deriving allowable payload attach point loads for "adjacent" longeron or keel bridges. Two bridges are "adjacent" when the aft end of the first bridge and the forward end of the second bridge are attached to the same mid-fuselage frame. This common frame reacts attach point loads transmitted to it by each bridge. Figure I.3.3-1 depicts such a configuration. Paragraph I.3.3.1 is concerned with the derivation of allowable payload-induced loads at attach points on adjacent longeron bridges for all pertinent load combinations. Each load combination is treated separately. For each particular load combination, all equations must be satisfied. The equations compare absolute values of payload-induced loads and Orbiter capabilities. The absolute value of payload-induced load must be less than the absolute value of Orbiter capability. Paragraph I.3.3.2 treats allowable payload-induced loads at attach points on adjacent keel bridges. These procedures must be repeated when more than two bridges are adjacent. Table I.1-1 correlates specific load combinations with the paragraphs below.

### I.3.3.1 Allowable Loads at Longeron Attach Points

I.3.3.1.1 Attach Points 1 and 2 React X-Loads and Z-Loads *with Trunnion/Bearing Friction and Bearing Rotation*.

$$\frac{\sqrt{X_1^2 + Z_1^2} (\mu_{y1} + \tan \theta_1)}{Y_{LA1}} + \frac{\sqrt{X_2^2 + Z_2^2} (\mu_{y2} + \tan \theta_2)}{Y_{LF2}} \leq 1$$

$$\frac{Z_1 - K_{A1} X_1}{Z_{A1}} + \frac{Z_2 - K_{F2} X_2}{Z_{F2}} \leq 1$$

$$\sqrt{X_1^2 + Z_1^2} (\mu_{y1} + \tan \theta_1) \leq Y_{LF1}$$

$$\sqrt{X_2^2 + Z_2^2} (\mu_{y2} + \tan \theta_2) \leq Y_{LA2}$$

$$Z_1 - K_{F1} X_1 \leq Z_{F1}$$

$$Z_2 - K_{A2} X_2 \leq Z_{A2}$$

$X_1$  and  $X_2 \leq$  X-load capability shown in Table I.2-2!

$Z_1$  and  $Z_2 \leq$  Zs load capability, *at landing only*, as shown in Table I.2-3!

For the previous two equations, see Note (1) of Table I.2-2 and Note (2) of Table I.2.3 for load accumulation procedures.

when  $Z_1$  and  $Z_2$  are in opposite directions, also check:

$$|Z_1 - K_{A1}X_1| \leq |Z_{A1}|$$

$$|Z_2 - K_{F2}X_2| \leq |Z_{F2}|$$

**I.3.3.1.2 Attach Points 1 and 2 React Z-Loads with Trunnion/Bearing Friction and Bearing Rotation Loads.**

$$\frac{|Z_1| (\mu_{y1} + \tan |\theta_1|)}{|Y_{LA1}|} + \frac{|Z_2| (\mu_{y2} + \tan |\theta_2|)}{|Y_{LF2}|} \leq 1$$

$$\frac{|Z_1 + K_{A1}\mu_{x1}Z_1|}{|Z_{A1}|} + \frac{|Z_2 - K_{F2}\mu_{x2}Z_2|}{|Z_{F2}|} \leq 1 ;$$

$$|Z_1| (\mu_{y1} + \tan |\theta_1|) \leq |Y_{LF1}|$$

$$|Z_2| (\mu_{y2} + \tan |\theta_2|) \leq |Y_{LA2}|$$

$$|Z_1 - K_{F1}\mu_{x1}Z_1| \leq |Z_{F1}|$$

$$|Z_2 + K_{A2}\mu_{x2}Z_2| \leq |Z_{A2}|$$

$|\mu_{x1}Z_1|$  and  $|\mu_{x2}Z_2| \leq$  X-load capability shown in Table I.2-2!

$|Z_1|$  and  $|Z_2| \leq$  Zs load capability shown in Table I.2-3 at landing only.!

For the above two equations, see Note (1) of Table I.2-2 and Note (2) of Table I.2-3 for load accumulation procedure.

when  $Z_1$  and  $Z_2$  are in opposite directions, also check:

$$|Z_1 + K_{A1}\mu_{x1}Z_1| \leq |Z_{A1}|$$

$$|Z_2 - K_{F2}\mu_{x2}Z_2| \leq |Z_{F2}|$$

**I.3.3.1.3 Attach Point 1 Reacts Z- and X-Loads and Attach Point 2 Reacts Z-Loads Only with Trunnion/Bearing Friction and Bearing Rotation.**

$$\frac{\sqrt{X_1^2 + Z_1^2} (\mu_{y1} + \tan |\theta_1|)}{|Y_{LA1}|} + \frac{|Z_2| (\mu_{y2} + \tan |\theta_2|)}{|Y_{LF2}|} \leq 1$$

$$\frac{|Z_1 - K_{A1}X_1|}{|Z_{A1}|} + \frac{|Z_2 - K_{F2}\mu_{x2}Z_2|}{|Z_{F2}|} \leq 1 ;$$

$$\sqrt{X_1^2 + Z_1^2} (\mu_{y1} + \tan |\theta_1|) \leq |Y_{LF1}|$$

$$|Z_2| (\mu_{y2} + \tan |\theta_2|) \leq |Y_{LA2}|$$

$$|Z_1 - K_{F1} X_1| \leq |Z_{F1}|$$

$$|Z_2 + K_{A2} \mu_{x2} Z_2| \leq |Z_{A2}|$$

$|X_1|$  and  $|\mu_{x2} Z_2| \leq$  X-load capability shown in Table I.2-2!

$|Z_1|$  and  $|Z_2| \leq$  Zs load capability shown in Table I.2-3 at landing only.!

For the above two equations, see Note (1) of Table I.2-2 and Note (2) of Table I.2.3 for load accumulation procedure.

when  $Z_1$  and  $Z_2$  are in opposite directions, also check:

$$|Z_1 - K_{A1} X_1| \leq |Z_{A1}|$$

$$|Z_2 - K_{F2} \mu_{x2} Z_2| \leq |Z_{F2}|$$

**I.3.3.1.4 Attach Point 1 Reacts Z-Loads Only and Attach Point 2 Reacts X- and Z-Loads with Trunnion/Bearing Friction and Bearing Rotation.**

$$\frac{|Z_1| (\mu_{y1} + \tan |\theta_1|)}{|Y_{LA1}|} + \frac{\sqrt{X_2^2 + Z_2^2} (\mu_{y2} + \tan |\theta_2|)}{|Y_{LF2}|} \leq 1$$

$$\frac{|Z_1 + K_{A1} \mu_{x1} Z_1|}{|Z_{A1}|} + \frac{|Z_2 - K_{F2} X_2|}{|Z_{F2}|} \leq 1 ;$$

$$|Z_1| (\mu_{y1} + \tan |\theta_1|) \leq |Y_{LF1}|$$

$$\sqrt{X_2^2 + Z_2^2} (\mu_{y2} + \tan |\theta_2|) \leq |Y_{LA2}|$$

$$|Z_1 - K_{F1} \mu_{x1} Z_1| \leq |Z_{F1}|$$

$$|Z_2 - K_{A2} X_2| \leq |Z_{A2}|$$

$|\mu_{x1} Z_1|$  and  $|X_2| \leq$  X-load capability shown in Table I.2-2!

$|Z_1|$  and  $|Z_2| \leq$  Zs load capability shown in Table I.2-3 at landing only.!

For the above two equations, see Note (1) of Table I.2-2 and Note (2) of Table I.2.3 for load accumulation procedure.

when  $Z_1$  and  $Z_2$  are in opposite directions, also check:

$$|Z_1 + K_{A1} \mu_{x1} Z_1| \leq |Z_{A1}|$$

$$|Z_2 - K_{F2} X_2| \leq |Z_{F2}|$$



### I.3.3.2 Allowable-Loads at Keel Attach Points.

I.3.3.2.1 Attach Points 1 and 2 React *Y-Loads, X-Friction Loads, and Z-Friction and Bearing Rotation Loads (X, Z ≠ 0).*

$$\frac{|Y_1| (\mu_1 + \tan |\theta_1|)}{|R_{KA1}|} + \frac{|Y_2| (\mu_2 + \tan |\theta_2|)}{|R_{KF2}|} \leq 1$$

$$|Y_1| (\mu_1 + \tan |\theta_1|) \leq |R_{KF1}|$$

$$|Y_2| (\mu_2 + \tan |\theta_2|) \leq |R_{KA2}|$$

The  $\mu_i$  value in the above three equations should be  $\mu_{xi}$  or  $\mu_{zi}$ , whichever is greater ( $i = 1, \text{ or } 2$ ).

$$\frac{|Y_1|}{|Y_{A1}|} + \frac{|Y_2|}{|Y_{F2}|} \leq 1$$

$$|Y_1| \leq |Y_{F1}|$$

$$|Y_2| \leq |Y_{A2}|$$

when  $Y_1$  and  $Y_2$  are in the opposite directions, also check:

$$|Y_1| \leq |Y_{A1}|$$

$$|Y_2| \leq |Y_{F2}|$$

I.3.3.2.2 Attach Points 1 and 2 React *Y- and X-Loads (i.e., Keel Fittings Restrained from Movement in the X-Direction) and Z-Friction and Bearing Rotation Loads.*

$$\frac{\sqrt{X_1^2 [1 + (\mu_{z1} + \tan |\theta_1|)^2] + [Y_1^2 (\mu_{z1} + \tan |\theta_1|)^2]}}{|R_{KA1}|} +$$

$$\frac{\sqrt{X_2^2 + Y_2^2 (\mu_{z2} + \tan |\theta_2|)}}{|R_{KF2}|} \leq 1$$

$$\sqrt{X_1^2 + Y_1^2 (\mu_{z1} + \tan |\theta_1|)} \leq |R_{KF1}|$$

$$\sqrt{X_2^2 [1 + (\mu_{z2} + \tan |\theta_2|)^2] + [Y_2^2 (\mu_{z2} + \tan |\theta_2|)^2]} \leq |R_{KA2}|$$

$$\frac{|Y_1|}{|Y_{A1}|} + \frac{|Y_2|}{|Y_{F2}|} \leq 1$$

$$|Y_1| \leq |Y_{F1}|$$

$$|Y_2| \leq |Y_{A2}|$$

when  $Y_1$  and  $Y_2$  are in the opposite directions, also check:

$$|Y_1| \leq |Y_{A1}|$$

$$|Y_2| \leq |Y_{F2}|$$

I.3.3.2.3 *Attach Points 1 Reacts Y- and X-Loads (i.e., Keel Fitting Restrained from Movement in the X-Direction) and Z-Friction and Bearing Rotation Loads. Attach Point 2 Reacts Y-Loads, X-Friction Loads, and Z-Friction and Bearing Rotation Loads.*

$$\frac{\sqrt{X_1^2 [1 + (\mu_{z1} + \tan \theta_1)^2] + [Y_1^2 (\mu_{z1} + \tan \theta_1)^2]}}{|R_{KA1}|} + \frac{|Y_2| (\mu_2 + \tan \theta_2)}{|R_{KF2}|} \leq 1$$

The  $\mu_2$  value in the above equations should be  $\mu_{x2}$  or  $\mu_{z2}$ , whichever is greater.

$$\sqrt{X_1^2 + Y_1^2} (\mu_{z1} + \tan \theta_1) \leq |R_{KF1}|$$

$$|Y_2| (\mu_2 + \tan \theta_2) \leq |R_{KA2}|$$

The  $\mu_2$  value in the above equations should be  $\mu_{x2}$  or  $\mu_{z2}$ , whichever is greater.

$$\frac{|Y_1|}{|Y_{A1}|} + \frac{|Y_2|}{|Y_{F2}|} \leq 1$$

$$|Y_1| \leq |Y_{F1}|$$

$$|Y_2| \leq |Y_{A2}|$$

when  $Y_1$  and  $Y_2$  are in opposite directions, also check:

$$|Y_1| \leq |Y_{A1}|$$

$$|Y_2| \leq |Y_{F2}|$$

I.3.3.2.4 *Attach Point 1 Reacts Y-Loads, X-Friction Loads, and Z-Friction and Bearing Rotation Loads. Attach Point 2 Reacts Y- and X-Loads (i.e., Keel Fitting Restrained from Movement in the X-Direction) and Z-Friction and Bearing Rotation Loads.*

$$\frac{|Y_1| (\mu_1 + \tan |\theta_1|)}{|R_{KA1}|} + \frac{\sqrt{\frac{X^2}{2} + \frac{Y^2}{2}} (\mu_{Z2} + \tan |\theta_2|)}{|R_{KF2}|} \leq 1$$

$$|Y_1| (\mu_1 + \tan |\theta_1|) \leq |R_{KF1}|$$

The  $\mu_1$  value in the above equations should be  $\mu_{X1}$  or  $\mu_{Z1}$ , whichever is greater.

$$\sqrt{\frac{X^2}{2} [1 + (\mu_{Z2} + \tan |\theta_2|)^2] + \frac{Y^2}{2} (\mu_{Z2} + \tan |\theta_2|)^2} \leq |R_{KA2}|$$

$$\frac{|Y_1|}{|Y_{A1}|} + \frac{|Y_2|}{|Y_{F2}|} \leq 1$$

$$|Y_1| \leq |Y_{F1}|$$

$$|Y_2| \leq |Y_{A2}|$$

when  $Y_1$  and  $Y_2$  are in opposite directions, also check:

$$|Y_1| \leq |Y_{A1}|$$

$$|Y_2| \leq |Y_{F2}|$$

### I.3.4 Allowable Loads For Two Longerons Attach Points On One Bridge.

This paragraph defines the allowable payload attach point loads when two longeron attach points are located on one bridge. Attach points 1 and 2 are the forward and aft longeron attach on the one bridge, respectively. These attachments may be primary fittings, i.e., each reacting both X and Z loads; stabilizing fittings, i.e., each reacting only Z load; or may be a combination of both, i.e., one primary and one stabilizing fitting. Figure 9.3.4-1 depicts such a configuration. The bridge shear capability equations should be checked under the stipulation: Use the +Z column from Table 9.2-1 if the sign of the value inside the absolute value sign on the left hand side of the  $Z_{J1}$  and  $Z_{A2}$  inequality equations is positive. If the value is negative use the -Z column.

I.3.4.1 *Forward Attach Point Reacts X- and Z-loads (i.e., primary fitting), Aft Attach Point Reacts Z-Loads Only (i.e., stabilizing fitting), with Trunnion/Bearing Friction and Bearing Rotations at Both Attach Points.*

Either + or - sign for the  $\mu_x$  term should be used such that the ratio of the absolute value on the left hand side to the absolute value on the right hand side of the following inequality equations will be maximized. Both positive and negative values of  $Z_{J1}$  and  $Z_{A1}$  may have to be assessed.

$$\begin{aligned} & \left[ \begin{array}{c} Z_1 + \left[ \begin{array}{c} K_{F1} \\ \hline K_{F2} \end{array} \right] (Z_2) \\ Z_1 + \left[ \begin{array}{c} K_{A1} \\ \hline K_{A2} \end{array} \right] (Z_2) \end{array} \right] - [(K_{F1}) (X_1 \pm \mu_{x2} Z_2)] \leq |Z_{F1}| \\ & \left[ \begin{array}{c} K_{F1} \\ \hline K_{F2} \end{array} \right] (Z_2) - [(K_{A1}) (X_1 \pm \mu_{x2} Z_2)] \leq |Z_{A1}| \end{aligned}$$

Note that the choice of  $Z_{F1}$  and  $Z_{A1}$  from Table I.2-1 shall be of the same sign as that of the value inside the absolute value symbol on the left hand side of the equations.

If  $Z_1$  and  $Z_2$  are of opposite signs, the shear load capability of the bridge fitting between attach point 1 and attach point 2 shall be assessed by using the following equations:

$$\begin{aligned} & \left[ \begin{array}{c} K_{F1} \\ \hline K_{A1} \end{array} \right] (Z_1) + \left[ \begin{array}{c} K_{F1} \\ \hline K_{F2} \end{array} \right] (Z_2) - [(K_{F1})(X_1 \pm \mu_{x2} Z_2)] \leq |Z_{F1}|, \text{ and} \\ & \left[ \begin{array}{c} K_{A2} \\ \hline K_{A1} \end{array} \right] (Z_1) + \left[ \begin{array}{c} K_{A2} \\ \hline K_{F2} \end{array} \right] (Z_2) - [(K_{A2})(X_1 \pm \mu_{x2} Z_2)] \leq |Z_{A2}| \end{aligned}$$

If trunnion/bearing friction and bearing rotation loads are not available from coupled loads analysis, use the following equations:

$$Y_1 = \sqrt{X_1^2 + Z_1^2} (\mu_{y1} + \tan \theta_1) \text{ and } Y_2 = |Z_2| (\mu_{y2} + \tan \theta_2)$$

For  $Y_1$  and  $Y_2$  of same sign,

$$\frac{Y_1}{Y_{LF1}} + \frac{Y_2}{Y_{LF2}} \leq 1 \text{ and } \frac{Y_1}{Y_{LA1}} + \frac{Y_2}{Y_{LA2}} \leq 1$$

For  $Y_1$  and  $Y_2$  of opposite signs (Not needed when  $Y_1$  and  $Y_2$  are computed with equations above)

$$\frac{Y_1}{Y_{LF1}} \leq 1, \frac{Y_2}{Y_{LF2}} \leq 1, \frac{Y_1}{Y_{LA1}} \leq 1, \text{ and } \frac{Y_2}{Y_{LA2}} \leq 1$$

$|X_1 \pm \mu_{x2} Z_2| \leq$  X load capability shown in Table I.2-2.!

$|Z_1 + Z_2| \leq$  Zs load capability shown in Table I.2-3 at landing only.!

For the above two equations, see Note (1) of Table I.2-2 and Note (2) of Table I.2-3 for load accumulation procedure.

**I.3.4.2 Forward and Aft Attach Points React X- and Z-Loads (i.e., primary fittings), with Trunnion/Bearing Friction and Bearing Rotations at both Attach Points.**

$$\begin{aligned} & \begin{matrix} \vdots \\ Z_1 + \left[ \begin{matrix} K_{F1} \\ K_{F2} \end{matrix} \right] Z_2 - [(K_{F1})(X_1 + X_2)] \\ \vdots \end{matrix} \leq |Z_{F1}| \\ & \begin{matrix} \vdots \\ Z_1 + \left[ \begin{matrix} K_{A1} \\ K_{A2} \end{matrix} \right] Z_2 - [(K_{A1})(X_1 + X_2)] \\ \vdots \end{matrix} \leq |Z_{A1}| \end{aligned}$$

Note that the choice of  $Z_{F1}$  and  $Z_{A1}$  from Table I.2-1 shall be of the same sign as that of the value inside the absolute value symbol on the left hand side of the equations.

If  $Z_1$  and  $Z_2$  are of opposite signs, the shear load capability of the bridge fitting between attach point 1 and attach point 2 shall be assessed by using the following equations:

$$\begin{aligned} & \begin{matrix} \vdots \\ \frac{K_{F1}}{K_{A1}} Z_1 + \frac{K_{F1}}{K_{F2}} Z_2 - [(K_{F1})(X_1 + X_2)] \\ \vdots \end{matrix} \leq |Z_{F1}| \\ \text{and} & \begin{matrix} \vdots \\ \frac{K_{A2}}{K_{A1}} Z_1 + \frac{K_{A2}}{K_{F2}} Z_2 - [(K_{A2})(X_1 + X_2)] \\ \vdots \end{matrix} \leq |Z_{A2}| \end{aligned}$$

If trunnion/bearing friction and bearing rotation loads are not available from coupled loads analysis, use the following equations:

$$Y_1 = \sqrt{X_1^2 + Z_1^2} (\mu_{y1} + \tan \theta_1!)$$

and

$$Y_2 = \sqrt{X_2^2 + Z_2^2} (\mu_{y2} + \tan \theta_2!)$$

For  $Y_1$  and  $Y_2$  of same sign,

$$\begin{matrix} \vdots \\ Y_1 \\ \vdots \end{matrix} + \begin{matrix} \vdots \\ Y_2 \\ \vdots \end{matrix} \leq 1 \text{ and } \begin{matrix} \vdots \\ Y_1 \\ \vdots \end{matrix} + \begin{matrix} \vdots \\ Y_2 \\ \vdots \end{matrix} \leq 1$$

$$\begin{matrix} \vdots \\ Y_{LF1} \\ \vdots \end{matrix} + \begin{matrix} \vdots \\ Y_{LF2} \\ \vdots \end{matrix} \leq 1 \text{ and } \begin{matrix} \vdots \\ Y_{LA1} \\ \vdots \end{matrix} + \begin{matrix} \vdots \\ Y_{LA2} \\ \vdots \end{matrix} \leq 1$$

For  $Y_1$  and  $Y_2$  of opposite signs (Not needed when  $Y_1$  and  $Y_2$  are computed with equations above),

$$\begin{matrix} \vdots \\ Y_1 \\ \vdots \end{matrix} \leq 1, \begin{matrix} \vdots \\ Y_2 \\ \vdots \end{matrix} \leq 1, \begin{matrix} \vdots \\ Y_1 \\ \vdots \end{matrix} \leq 1, \text{ and } \begin{matrix} \vdots \\ Y_2 \\ \vdots \end{matrix} \leq 1$$

$$\begin{matrix} \vdots \\ Y_{LF1} \\ \vdots \end{matrix} \leq 1, \begin{matrix} \vdots \\ Y_{LF2} \\ \vdots \end{matrix} \leq 1, \begin{matrix} \vdots \\ Y_{LA1} \\ \vdots \end{matrix} \leq 1, \text{ and } \begin{matrix} \vdots \\ Y_{LA2} \\ \vdots \end{matrix} \leq 1$$

$$|X_1 + X_2| \leq |X \text{ load capability shown in Table I.2-2.}|$$

$$|Z_1 + Z_2| \leq |Z_s \text{ load capability shown in Table I.2-3 at landing only.}|$$

For the above two equations, see Note (1) of Table I.2-2 and Note (2) of Table I.2-3 for load accumulation procedure.

**I.3.4.3 Forward Attach Point React Z-Loads only (i.e., stabilizing fitting) and the Aft Attach Point Reacts X- and Z-Loads (i.e., primary fitting), with Trunnion/Bearing Friction and Bearing Rotations at Both Attach Points.**

Either + or - sign for the  $\mu_x$  term should be used such that the ratio of the absolute value on the left hand side to the absolute value on the right hand side of the following inequality equations will be maximized. Both positive and negative values of  $Z_{F1}$  and  $Z_{A1}$  may have to be assessed.

$$\begin{array}{l} \vdots \\ \vdots \\ \vdots \end{array} \left[ \begin{array}{l} K_{F1} \\ \text{---} \\ K_{F2} \end{array} (Z_2) \right] - [(K_{F1}) (\pm \mu_x |Z_1 + X_2|)] \begin{array}{l} \vdots \\ \vdots \\ \vdots \end{array} \leq |Z_{F1}|$$

$$\begin{array}{l} \vdots \\ \vdots \\ \vdots \end{array} \left[ \begin{array}{l} K_{A1} \\ \text{---} \\ K_{A2} \end{array} (Z_2) \right] - [(K_{A1}) (\pm \mu_x |Z_1 + X_2|)] \begin{array}{l} \vdots \\ \vdots \\ \vdots \end{array} \leq |Z_{A1}|$$

Note that the choice of  $Z_{F1}$  and  $Z_{A1}$  from Table I.2-1 shall be of the same sign as that of the value inside the absolute value symbol on the left hand side of the equations.

If  $Z_1$  and  $Z_2$  are of opposite signs, the shear load capability of the bridge fitting between attach point 1 and attach point 2 shall be assessed by using the following equations:

$$\begin{array}{l} \vdots \\ \vdots \\ \vdots \end{array} \frac{K_{F1}}{K_{A1}} (Z_1) + \frac{K_{F1}}{K_{F2}} (Z_2) - [(K_{F1}) (\pm \mu_x |Z_1 + X_2|)] \begin{array}{l} \vdots \\ \vdots \\ \vdots \end{array} \leq |Z_{F1}|, \text{ and}$$

$$\begin{array}{l} \vdots \\ \vdots \\ \vdots \end{array} \frac{K_{A2}}{K_{A1}} (Z_1) + \frac{K_{A2}}{K_{F2}} (Z_2) - [(K_{A2}) (\pm \mu_x |Z_1 + X_2|)] \begin{array}{l} \vdots \\ \vdots \\ \vdots \end{array} \leq |Z_{A2}|$$

If trunnion/bearing friction and bearing rotation loads are not available from coupled loads analysis, use the following equations:

$$Y_1 = |Z_1| (\mu_{y1} + \tan |\theta_1|) \text{ and}$$

$$Y_2 = \sqrt{\frac{X_2^2 + Z_2^2}{2}} (\mu_{y2} + \tan |\theta_2|)$$

For  $Y_1$  and  $Y_2$  of same sign,

$$\frac{|Y_1|}{|Y_{LF1}|} + \frac{|Y_2|}{|Y_{LF2}|} \leq 1 \text{ and } \frac{|Y_1|}{|Y_{LA1}|} + \frac{|Y_2|}{|Y_{LA2}|} \leq 1$$

For  $Y_1$  and  $Y_2$  of opposite signs (Not needed when  $Y_1$  and  $Y_2$  are computed with equations above),

$$\left| \frac{Y_1}{Y_{LF1}} \right| \leq 1, \quad \left| \frac{Y_2}{Y_{LF2}} \right| \leq 1, \quad \left| \frac{Y_1}{Y_{LA1}} \right| \leq 1, \quad \text{and} \quad \left| \frac{Y_2}{Y_{LA2}} \right| \leq 1$$

$|\pm \mu_{x1}Z_1 + X_2| \leq |X|$  load capability shown in Table I.2-2.!

$|Z_1 + Z_2| \leq |Z_s|$  load capability shown in Table I.2-3 at landing only.!

**I.3.4.4 Forward and Aft Attach Points React only Z-Loads (i.e., stabilizing fittings), with Trunnion/Bearing Friction and Bearing Rotations at Both Attach Points.**

Either + or - sign for the  $\mu_x$  term should be used such that the ratio of the absolute value on the left hand side to the absolute value on the right hand side of the following inequality equations will be maximized. Both positive and negative values of  $Z_{F1}$  and  $Z_{A1}$  may have to be assessed.

$$\left| Z_1 + \frac{K_{F1}}{K_{F2}} Z_2 - [(K_{F1}) (\pm \mu_{x1}Z_1 + \mu_{x2}Z_2)] \right| \leq |Z_{F1}|$$

$$\left| Z_1 + \frac{K_{A1}}{K_{A2}} Z_2 - [(K_{A1}) (\pm \mu_{x1}Z_1 + \mu_{x2}Z_2)] \right| \leq |Z_{A1}|$$

Note that the choice of  $Z_{F1}$  and  $Z_{A1}$  from Table I.2-1 shall be of the same sign as that of the value inside the absolute value symbol on the left hand side of the equations.

If  $Z_1$  and  $Z_2$  are of opposite signs, the shear load capability of the bridge fitting between attach point 1 and attach point 2 shall be assessed by using the following equations:

$$\left| \frac{K_{F1}}{K_{A1}} (Z_1) + \frac{K_{F1}}{K_{F2}} (Z_2) - [(K_{F1}) (\pm \mu_{x1}Z_1 \pm \mu_{x2}Z_2)] \right| \leq |Z_{F1}|, \text{ and}$$

$$\left| \frac{K_{A2}}{K_{A1}} (Z_1) + \frac{K_{A2}}{K_{F2}} (Z_2) - [(K_{A2}) (\pm \mu_{x1}Z_1 \pm \mu_{x2}Z_2)] \right| \leq |Z_{A2}|$$

If trunnion/bearing friction and bearing rotation loads are not available from coupled loads analysis, use the following equations:

$$Y_1 = |Z_1| (\mu_{y1} + \tan |\theta_1|) \text{ and } Y_2 = |Z_2| (\mu_{y2} + \tan |\theta_2|)$$

For  $Y_1$  and  $Y_2$  of same sign,

$$\left| \frac{Y_1}{Y_{LF1}} + \frac{Y_2}{Y_{LF2}} \right| \leq 1 \text{ and } \left| \frac{Y_1}{Y_{LA1}} + \frac{Y_2}{Y_{LA2}} \right| \leq 1$$

For  $Y_1$  and  $Y_2$  of opposite signs (Not needed when  $Y_1$  and  $Y_2$  are computed with equations above)

$$\left| \frac{Y_1}{Y_{LF1}} \right| \leq 1, \quad \left| \frac{Y_2}{Y_{LF2}} \right| \leq 1, \quad \left| \frac{Y_1}{Y_{LA1}} \right| \leq 1, \quad \text{and} \quad \left| \frac{Y_2}{Y_{LA2}} \right| \leq 1$$

$|\mu_x Z_1 \pm \mu_x Z_2| \leq$  X load capability shown in Table I.2-2.

$|Z_1 + Z_2| \leq$  Zs load capability shown in Table I.2-3 at landing only.

For the above two equations, see Note (1) of Table I.2-2 and Note (2) of Table I.2-3 for load accumulation procedure.

### I.3.5 Allowable Loads at Bay 12 ( $X_0$ 1191-1249) Keel Attach Points.

!!NOTE!! The Bay 12 keel bridge  $X_0$  attachment is one inch forward of the frame station.

#### I.3.5.1 Attach Point Reacts Y-Loads, X-Friction Loads, and Z-Friction and Bearing Rotation Loads ( $X, Z \neq 0$ ).

$$\frac{\mu_x Y}{2937} + \left( \frac{1249 - X_0}{59} \right) \left( \frac{Y}{37908} \right) \leq 1$$

$$\left[ \left( \frac{1249 - X_0}{59} \right) Y \right] \left[ \frac{(\tan \theta + \mu_z) \sqrt{\left( \frac{\mu_x^2 + 1}{x} \right)}}{3018} \right] \leq 1$$

$$\left[ \left( \frac{X_0 - 1190}{59} \right) Y \right] \left[ \frac{(\tan \theta + \mu_z) \sqrt{\left( \frac{\mu_x^2 + 1}{x} \right)}}{2715} \right] \leq 1$$

#### I.3.5.2 Attach Point Reacts Y- and X- Loads (i.e. Keel Fitting Restrained from Movement in the X-Direction) and Z-Friction and Bearing Rotation Loads ( $X, Z \neq 0$ ).

$$\frac{X}{2937} + \left[ \frac{1249 - X_0}{59} \frac{Y}{37908} \right] \leq 1$$

$$\frac{X}{168119} + \left[ \frac{1249 - X_0}{59} \frac{Y}{36162} \right] + Z \left( \frac{1249 - X_0}{59} \right) \left( \frac{1}{14660} \right) + \left( \frac{X_0 - 1190}{59} \right) \left( \frac{1}{9544} \right) \leq 1$$

$$\left[ \frac{1249 - X_0}{59} \frac{Y}{21640} \right] \leq 1$$

$$\left[ \frac{X_0 - 1190}{59} \frac{Y}{27100} \right] \leq 1$$



$$\left[ \frac{1249 - X_0}{59} \quad \frac{|Z|}{3018} \right] \leq 1$$

$$\left[ \frac{X_0 - 1190}{59} \quad \frac{|Z|}{2715} \right] \leq 1$$

Where  $Z = (\tan \theta + \mu_z) \sqrt{X^2 + Y^2}$

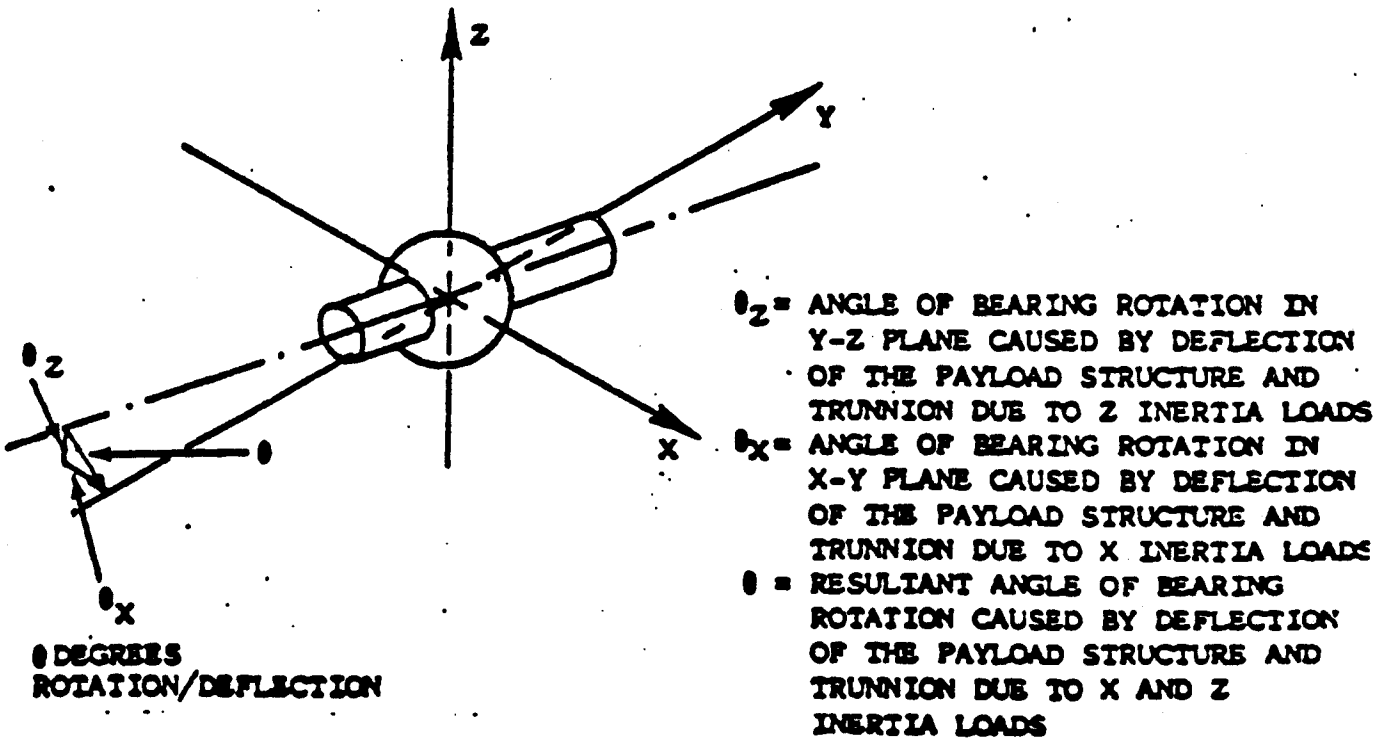
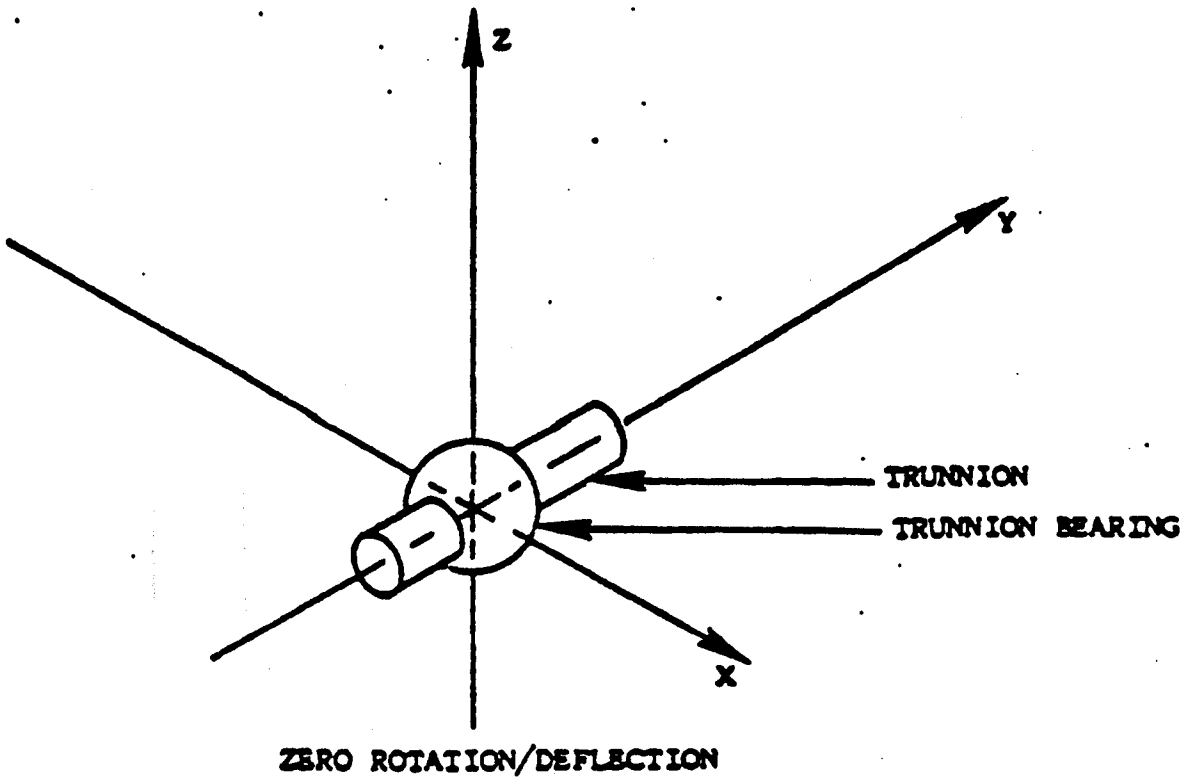
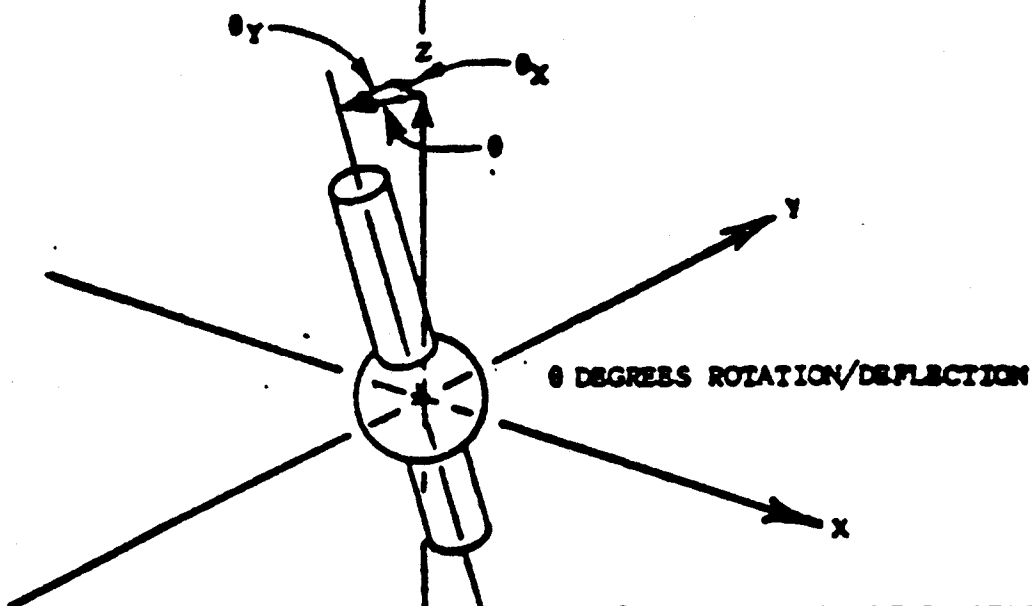
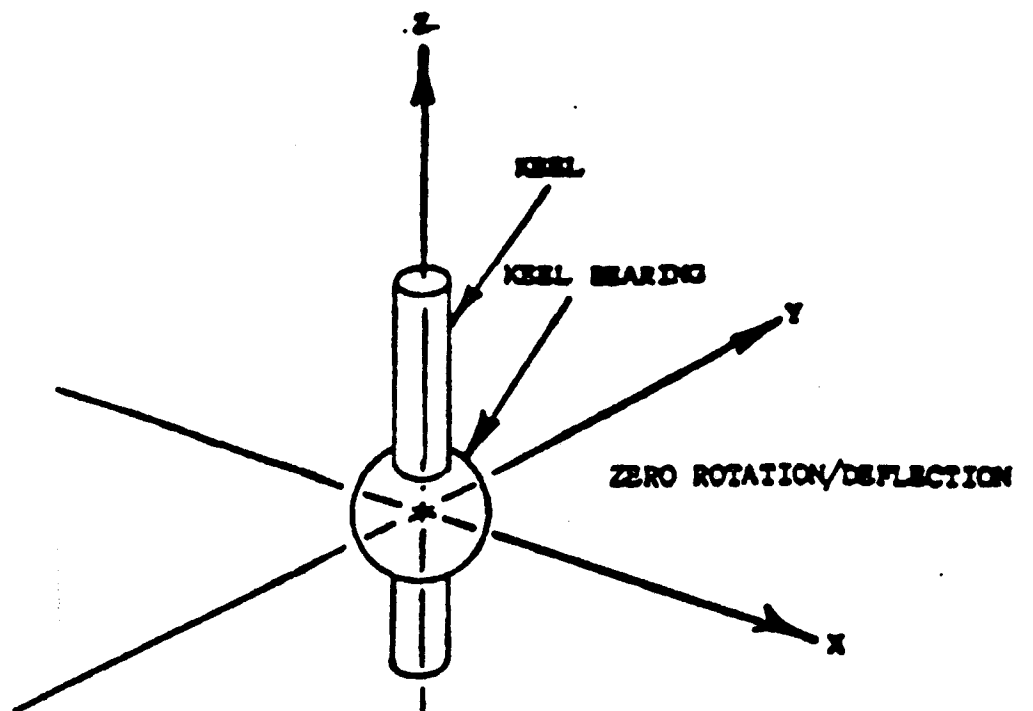


FIGURE I.3.1.1-1 ANGLE OF BEARING ROTATION/TRUNNION DEFLECTION,  $\theta$



$\theta_y$  = ANGLE OF BEARING ROTATION IN Y-Z PLANE CAUSED BY DEFLECTION OF THE PAYLOAD STRUCTURE AND KEEL DUE TO Y INERTIA LOADS  
 $\theta_x$  = ANGLE OF BEARING ROTATION IN X-Y PLANS CAUSED BY DEFLECTION OF THE PAYLOAD STRUCTURE AND KEEL DUE TO X INERTIA LOADS  
 $\theta$  = RESULTANT ANGLE OF BEARING ROTATION CAUSED BY DEFLECTION OF THE PAYLOAD STRUCTURE AND KEEL DUE TO X AND Y INERTIA LOADS

FIGURE I.3.1.2-1 ANGLE OF BEARING ROTATION/KEEL DEFLECTION,  $\theta$

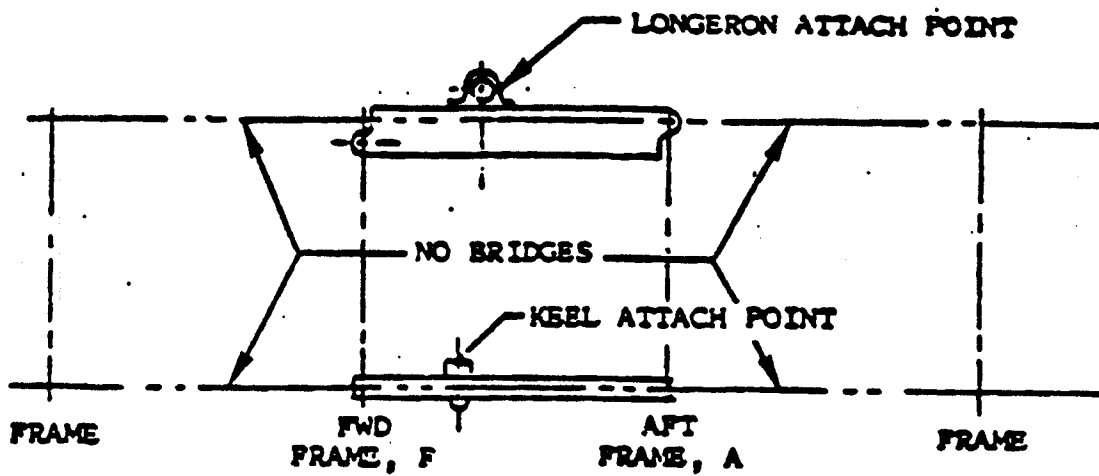


FIGURE I.3.2-1 SINGLE BRIDGE

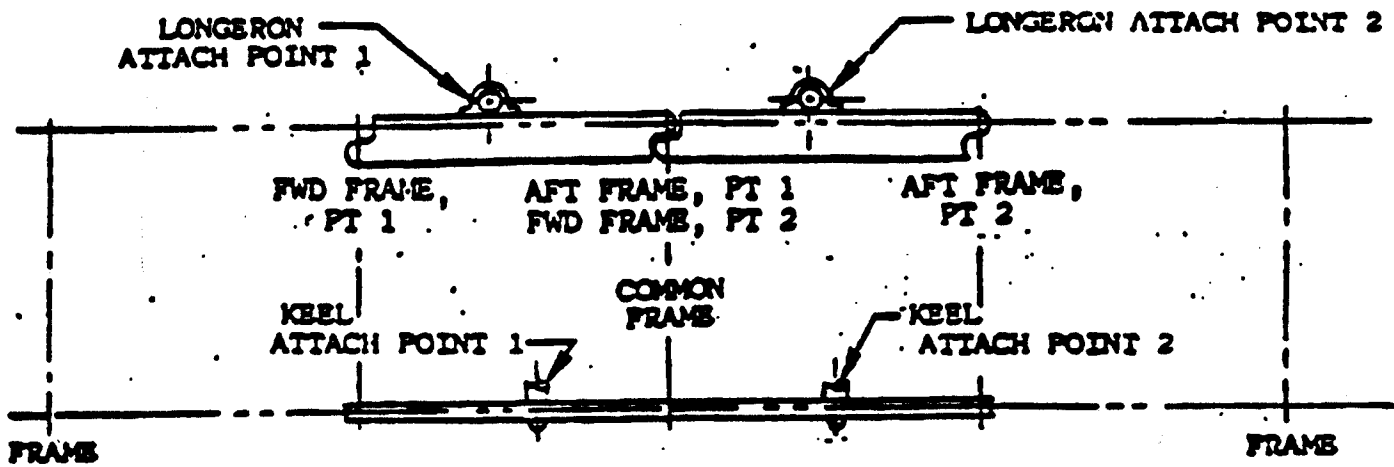


FIGURE I.3.3-1 ADJACENT BRIDGES

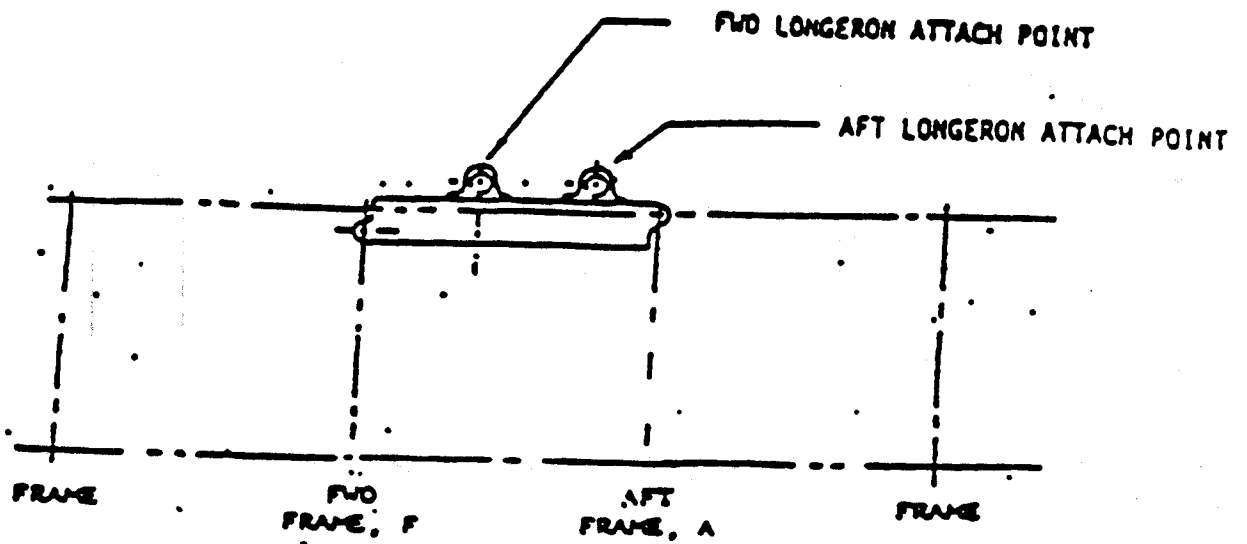


FIGURE I.3.4-1 TWO ATTACH POINTS ON ONE LONGERON BRIDGE

APPENDIX X  
ALTERNATE TRUNNION LENGTH SELECTION CRITERIA  
AND  
DEFLECTION DATA

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X.1 INTRODUCTION. Longeron trunnion lengths and attach points shall be selected to meet the following criteria:

- a. Minimum trunnion length shall be such that retraction of the end of the trunnion into the attach fitting bearing due to combined Payload/Orbiter deflection shall be precluded.
- b. Maximum trunnion length shall be such that the outboard end of the trunnion shall not contact Orbiter Structure or subsystems during combined cargo element/Orbiter 'together' deflection. The maximum stroke of the outboard end of the trunnion shall be limited to  $Y_0 \pm 101.25$  for most attach points. At all other locations, listed in Table X.1-1, trunnion  $Y_0$  travel shall be restricted as defined therein.

Keel trunnion lengths and attach points shall be selected to meet the following criteria:

- a. Minimum trunnion length shall be such that retraction of the end of the trunnion into the attach fitting bearing due to combined Payload/Orbiter deflection shall be precluded.
- b. Maximum trunnion length shall be such that the end of the cargo element keel trunnion shall not contact Orbiter structure during combined cargo element/Orbiter 'together' deflection. The maximum stroke of the end of the trunnion shall be limited to the  $Z_0$  values presented in Table X.1-1 for given keel attach points.

Payload preliminary design shall be based upon the deflection limits defined in Table X.1-2 for payload and Orbiter structure at the longeron and keel attach fittings. Payloads requiring larger portions of the total allowance must verify that no interference occurs between the payload and the Orbiter under dynamic conditions. Compatibility of the final payload design with Orbiter physical and structural capability shall be verified by Payload/Orbiter coupled dynamic and quasi-static deflection analyses. Deflection, as used here, includes thermal effects, the effects of mechanical loading and manufacturing tolerances.

TABLE X.1-1 LONGERON AND KEEL TRUNNION MAXIMUM PENETRATION LIMITS

ATTACH POINT	LONGERON $Y_0$ LIMIT (inches)	KEEL $Z_0$ LIMIT (inches)	ATTACH POINT	LONGERON $Y_0$ LIMIT (inches)	KEEL $Z_0$ Limit (inches)
155	*	299.95	198	99.50	295.00
156	101.25	297.00	199	99.50	295.00
157	100.75	298.87	200	101.25	295.00
158	101.25	300.75	201	101.15	295.00
159	101.25	*	202	101.25	*
160	101.25	*	203	101.25	*
163	101.25	*	206	101.25	*
164	101.25	*	207	101.25	*
165	100.00	295.00	208	101.25	320.50
166	100.00	295.00	209	101.25	298.25
167	100.00	295.00	210	100.75	296.00
168	*	295.00	211	101.25	295.00
169	*	295.00	212	99.50	295.00
170	*	296.25	213	99.50	295.00
171	*	298.00	214	101.25	298.75
172	*	299.95	215	99.50	299.00
177	101.25	*	216	99.50	299.00
178	100.75	*	217	101.25	*
179	101.25	*	218	101.25	*
180	101.25	298.75	221	100.75	*
181	101.25	295.00	222	101.25	*
182	101.25	295.00	223	101.25	298.50
183	101.25	295.00	224	101.25	296.00
184	101.25	295.00	225	101.25	295.00
185	101.25	295.00	226	100.75	295.00
186	*	295.00	227	101.25	295.00
187	*	295.00	228	*	295.00
188	101.25	*	229	*	295.00
189	101.25	*	230	*	295.00
192	101.25	*	234	101.25	*
193	101.25	*	235	101.25	*
194	101.25	299.62	236	99.50	*
195	101.25	297.50	237	99.50	299.38
196	100.75	295.25	238	101.25	299.00
197	101.25	295.00	239	101.25	299.00

\* Attach point not available at those locations where asterisk appears.

TABLE X.1-1 LONGERON AND KEEL TRUNNION MAXIMUM PENETRATION LIMITS  
CONCLUDED

ATTACH POINT	LONGERON Y <sub>0</sub> LIMIT (inches)	KEEL Z <sub>0</sub> LIMIT (inches)	ATTACH POINT	LONGERON Y <sub>0</sub> LIMIT (inches)	KEEL Z <sub>0</sub> Limit (inches)
240	101.25	299.00	283	101.25	295.00
241	100.75	299.00	284	100.75	295.00
242	99.50	299.00	285	101.25	295.00
243	99.50	299.00	286	101.25	295.00
244	*	299.00	287	101.25	*
245	*	299.00	288	101.25	*
247	101.25	*	292	101.25	*
250	101.25	*	293	101.25	298.25
251	100.75	*	294	101.25	295.00
252	101.25	300.00	295	101.25	295.00
253	101.25	297.75	296	100.75	295.00
254	101.25	295.37	297	101.25	295.00
255	101.25	295.00	298	101.25	295.00
256	100.75	295.00	299	101.25	298.37
257	101.25	295.00	304	99.50	*
258	101.25	295.00	305	99.50	*
259	101.25	295.00	306	99.50	305.18
260	101.25	295.00	307	101.25	305.26
261	99.50	295.00	308	101.25	305.34
262	99.50	*	309	100.75	305.42
263	101.25	*	310	101.25	305.50
266	101.25	*	311	101.25	305.58
267	101.25	*	312	101.25	*
268	101.25	297.25	313	100.75	*
269	100.75	295.00	314	101.25	*
270	101.25	295.00	315	101.25	*
271	101.25	295.00	316	101.25	*
272	101.25	295.00	322	101.25	*
273	100.75	298.00	323	101.25	*
274	101.25	*	324	100.75	*
277	101.25	*	325	101.25	*
278	99.50	*			
279	99.50	*			
280	99.50	*			
281	101.25	295.00			
282	101.25	295.00			

\* Attach point not available at those locations where asterisk appears.

TABLE X.1-2 PAYLOAD/ORBITER DEFLECTION LIMITS FOR  
PRELIMINARY DESIGN

INTERFACE LOCATION	DEFLECTION LIMITS -- INCHES					
	MOTION TOGETHER			MOTION APART		
	PAYLOAD	ORBITER	TOTAL	PAYLOAD	ORBITER	TOTAL
LONGERON TRUNNION SPACING $\leq$ 100 IN	0.93	2.07	3.00	0.74	0.76	1.50
LONGERON TRUNNION SPACING $>$ 100 IN	0.93	2.07	3.00	1.99	0.76	2.75
KEEL FITTING FWD OF $X_q$ 1191	1.32	1.18	2.50	0.95	1.42	2.37
KEEL FITTING AFT OF $X_o$ 1191	0.33	0.37	0.70	0.21	0.78	0.99

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