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PAYLOAD FLIGHT HAZARD REPORT		a. NO:	AMS-02-F12
b. PAYLOAD	Alpha Magnetic Spectrometer-02 (AMS-02)		c. PHASE: III
d. SUBSYSTEM:	Electrical, Integration	e. HAZARD GROUP:	Injury/Illness, Damage to Hardware
g. HAZARD TITLE: Mate/Demate of Connectors		f. DATE:	August 4, 2010
		i. HAZARD CATEGORY:	CATASTROPHIC X CRITICAL
h. APPLICABLE SAFETY REQUIREMENTS:		NSTS 1700.7B, ISS Addendum: 200.1, 200.1b	
j. DESCRIPTION OF HAZARD:		<p>The mating/demating of connectors associated with the exterior elements of the AMS-02 can result in the damage to integration hardware, payload hardware, the generation of molten debris, electrical shock and loss of system capabilities. The following are the connectors that will be mated/disconnected during the course of the AMS-02 Mission. ROEU, UMA, PVGF, AMS-02 EVA Connector.</p>	
k. CAUSES		<p>1. Mate/Demate with power in connection. 2. Connector mismatch. (list) 3. Bent pin shorting</p>	
o. APPROVAL	PAYLOAD ORGANIZATION	SSP/ISS	
PHASE I			
PHASE II			
PHASE III	<i>Trent Martin 8/4/10</i>	<i>Michael R. Lumb 8/6/10</i>	

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PAYLOAD FLIGHT HAZARD REPORT		a. NO:	AMS-02-F12
b. PAYLOAD	Alpha Magnetic Spectrometer-02 (AMS-02)	c. PHASE:	III
1. HAZARD CONTROL (CONTROL), m. SAFETY VERIFICATION METHODS (SVM), n. STATUS OF VERIFICATIONS (STATUS)			OPS CONTROL
1. CAUSE: Mate/Demate with power in connection.			
<p>1.1 CONTROL: A contingency EVA operation is provided for in the AMS-02 design to be able to switch the routing of power to the AMS-02 to swap the internal AMS-02 buses between the two ISS supplies. To accomplish this EVA task and provide the required two upstream inhibits to preclude arcing/sparking during connector demate/mate power provided by Utility Rail S3 2B3A 3A (DDCU P1-3A) and Utility Rail S3 1A4B 4B (DDCU S1-4B) must be inhibited. Each of these power sources is routed through RPCMs to control power to the individual PAS locations. The power will be switched (on/off) at RPCM S3-3A-E(A2) and RPCM S3-4B-E (A9) (respective) to inhibit power availability to the AMS-02. The second inhibit will involve the remote retraction of the UMA connection to provide physical isolation of the AMS-02 from the ISS power sources. AMS-02 does not have the means of removing or limiting downstream loads to meet the low power option of MA2-98-170.</p> <p style="margin-left: 20px;">1.1.1 SVM: OCAD for demating UMA prior to EVA connector swap (Including power removal). (OCAD 67860)</p> <p style="margin-left: 20px;">1.1.2 SVM: <Deleted></p> <p style="margin-left: 20px;">1.1.1 STATUS: Closed to SVTL</p> <p style="margin-left: 20px;">1.1.2 STATUS: <Deleted></p>			I
<p>NOTE: Remote operation of program provided connectors (ROEU, SSRMS, UMA) will be controlled by the nominal operating procedures of the vehicles supporting the remote operations. Generically this involves isolating the power and then operating the remote connection. No EVA crew are involved with this nominal operation.</p> <p>In the event of remotely operated connectors failing either to mate or demate, EVA capability has been designed into the remotely operated devices to fulfill the automated operation. AMS-02 does not have the capability to reduce loads or eliminate the consumption of power to meet the low power option of MA2-98-170, thus the vehicle must provide additional inhibits to power to satisfy the requirements for EVA mate/demate of connectors for any contingency procedure where EVA operations on the automated connectors are performed.</p>			
<p>1.2 CONTROL: AMS-02 EVA Accessible connectors are an EVA compatible design, are of a scoop proof design and keyed to require a specific orientation for connection. The EVA connection has the “hot” side terminated in sockets and not pins. The EVA connectors used are compliant with NASA SSQ-21635, “General Specification For Connectors And Accessories, Electrical, Circular, Miniature, IVA/EVA Compatible, Space Quality”.</p>			

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PAYLOAD FLIGHT HAZARD REPORT		a. NO: AMS-02-F12
b. PAYLOAD Alpha Magnetic Spectrometer-02 (AMS-02)	c. PHASE: III	
<p>1.2.1 SVM: Review of design</p> <p>1.2.2 SVM: Inspection of as built hardware</p> <p>1.2.1 STATUS: Closed. ESCG Memorandum ESCG-4390-08-SP-MEMO-0022, "Mate/Demate of Connectors," dated 11 June 2008.</p> <p>1.2.2 STATUS: Closed to SVTL.</p>		
<p>1.3 CONTROL: AMS-02 EVA Connectors fully enclose the interconnecting pins and sockets prior to engagement. Engagement of the pins and sockets is externally controlled by use of EVA operated lever.</p> <p>1.3.1 SVM: Review of design</p> <p>1.3.2 SVM: Inspection of as built hardware</p> <p>1.3.1 STATUS: Closed. ESCG Memorandum ESCG-4390-08-SP-MEMO-0022, "Mate/Demate of Connectors," dated 11 June 2008.</p> <p>1.3.2 STATUS: Closed. TPS 2A0720181, completed 4/21/2008 verifies proper mating and connector type.</p>		
1.4 CONTROL: <Deleted. UPS Removed from AMS-02>		
<p>1.5 CONTROL: Nominally, the SSRMS will demate power connections from the AMS-02 prior to engaging the UMA in order to preclude power (high) lines from one power source on the ISS to be interconnected with the output of another power source. In the event of the situation where the SSRMS has delivered the AMS-02 to the PAS location and the UMA is connected while the SSRMS is still connected, power from the UMA (or the SSRMS) will be switched off and a diode protection included in the AMS-02 circuitry will prevent power, originating from the UMA, from being present in the PVGF. NOTE: Control of SSRMS power supply through the arm is a standard GFE procedure as indicated in preceding NOTE (following Control 1.1).</p> <p>1.5.1 SVM: Review of Design</p> <p>1.5.2 SVM: Testing of PVGF blocking diodes</p> <p>1.5.3 SVM: Requirement to physically separate SSRMS power path to the AMS-02 prior to engaging the UMA power connection to AMS-02 accepted by MOD through and OCAD. (OCAD 67861)</p> <p>1.5.1 STATUS: Closed. ESCG Memorandum ESCG-4175-09-REENTES-MEMO-0024, "Isolation between the UMA and PVGF," dated May 4, 2009.</p>		I

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<p>1.5.2 STATUS: Closed to SVTL.</p> <p>1.5.3 STATUS: Closed. OCAD Closure reported to AMS-02 Project on 6/4/2010 by JSC-DA8/B. O’Keeffe.</p>			
<p>1.6 CONTROL: The power supplied specifically for the AMS-02 through Shuttle T-0 connection will be depowered prior to 48 hours before launch.</p> <p>1.6.1 SVM: Review of OMRS for power shutdown procedure.</p> <p>1.6.1 STATUS: Closed. OMRSD File II, Volume 2 (P507 – ISS-ULF6 Baseline), requirement # P507KC.020 requires procedure for powering off AMS-02.</p>			
2. CAUSE: Connector Mismatch.			
<p>2.1 CONTROL: EVA connectors are keyed to only connect to compatible locations and in appropriate orientation. Each connector application uses different connectors with differing housing diameters and internal pin configurations. Attachment to hazard report provides technical detail of each connector application.</p> <p>2.1.1 SVM: Review of design</p> <p>2.1.2 SVM: Inspection of as built hardware</p> <p>2.1.1 STATUS: Closed. ESCG Memorandum ESCG-4390-08-SP-MEMO-0022, “Mate/Demate of Connectors,” dated 11 June 2008.</p> <p>2.1.2 STATUS: Closed to SVTL.</p>			
3. CAUSE: Bent Pin Shorting			
<p>3.1 CONTROL: The pin assignments within the AMS-02 EVA connectors will be assigned such that a bent pin will not short power to return.</p> <p>3.1.1 SVM: Bent Pin Analysis.</p> <p>3.1.1 STATUS: Closed. ESCG Memorandum ESCG-4390-08-SP-MEMO-0022, “Mate/Demate of Connectors,” dated 11 June 2008.</p>			
<p>3.2 CONTROL: Any potential contact between pins/bent pins will only occur when connector shells have already mated, containing any products of arcing/shorting.</p> <p>3.2.1 SVM: Review of connector design.</p>			

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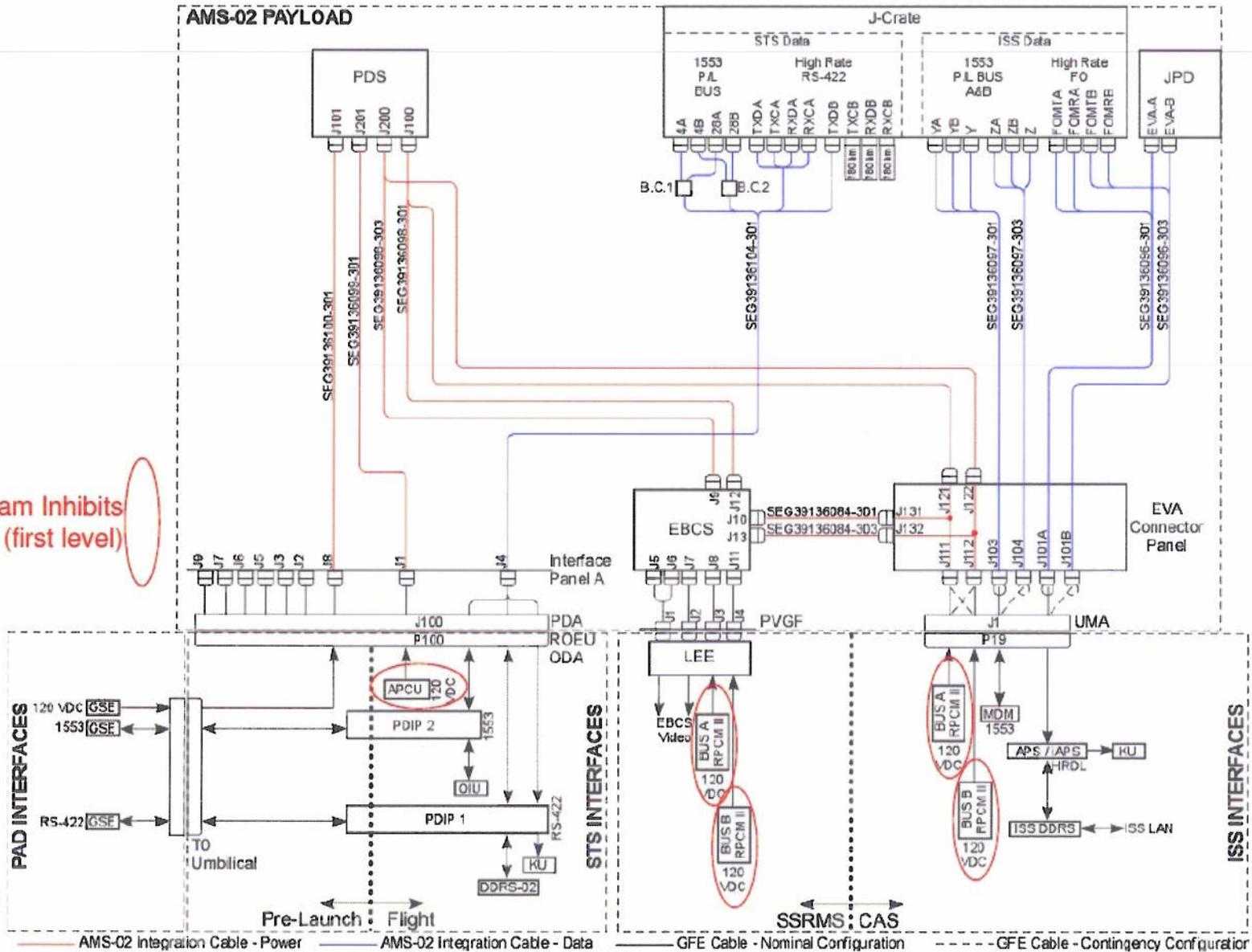
PAYLOAD FLIGHT HAZARD REPORT		a. NO:	AMS-02-F12
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3.2.1 STATUS: Closed. ESCG Memorandum ESCG-4390-08-SP-MEMO-0022, "Mate/Demate of Connectors," dated 11 June 2008.			
Notes:			

ACRONYMS

ACASS – Active Common Attach Site Simulator	PtP – Peak to Peak
AKA – Active Keel Assembly	PVGF – Power Video Grapple Fixture
AMS-02 – Alpha Magnetic Spectrometer - 02	QTY – Quantity
APS – Automated Payload Switch	RCV – Receive
BCS – Berthing Camera System	ROEU – Remotely Operated Electrical Umbilical
C&DH – Command and Data Handling	RPC – Remote Power Controller
DDCU - Direct Current-to-Direct Current Converter Unit	RPCM – Remote Power Control Module
DFMR – Design for Minimum Risk	SPDA – Secondary Power Distribution Assembly
EMU – Extravehicular Mobility Unit	SRMS – Shuttle Remote Manipulator System
EVA – Extravehicular Activity	SSRMS – Space Station Remote Manipulator System
HRDL – High Rate Data Link	SVM – Safety Verification Method
IVA – Intervehicular Activity	UMA – Umbilical Mating Assembly
MSWG – Mechanical Systems Working Group	UPS – Uninterruptible Power Supply
PAS – Payload Attach System, Payload Attach Site	VDC – Volts direct current
PRLA – Payload Retention Latch Assembly	XMT – Transmit

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Upstream Inhibits
(first level)



Connector	TYPE	Voltage	Max Current	Inhibit #1	Inhibit #2	Connector Type/Feature	EVA Automated
HIGH POWER CONNECTORS							
EVA Connector Power	AMS-02	120V DC (ISS)	~19 A	ISS RPC SPDA S3-1A4B, II 4B-E (A9), SPDA S3-3A, II03A-E(A2)	Demate UMA (Optional use of DDCU P1-3A and DDCU S1-4B)	NZGL06G2525LN 7SN	EVA
ROEU	GFE	120V DC (APCU)	~19 A	APCU OFF	APCU Power Source Off	GFE Provided	Auto/ EVA Capable
UMA	GFE	120V DC (ISS)	~19 A	ISS RPC SPDA S3-1A4B, II 4B-E (A9), SPDA S3-3A, II03A-E(A2)	<i>Vehicle Discretion as to location of second inhibit to power.</i>	GFE Provided	Auto/ EVA Capable
PVGF	GFE	120V DC (ISS)	~15 A	(depends on location on ISS)	<i>Vehicle Discretion as to location of second inhibit to power.</i>	GFE Provided	Auto/ EVA Capable
LOW POWER CONNECTORS							
EVA Connector Data – 1553	AMS-02	14V PtP (1553)	Very Small – Signal	ISS RPC SPDA S3-1A4B, II 4B-E (A9), SPDA S3-3A, II03A-E(A2)		NZGL06G1515N35 PA-1	EVA
Talkback		<=5 V DC	<<1 A				
EVA Connector Fiber Optic/Talk Back	AMS-02	<=5 V DC	<<1 A	ISS RPC SPDA S3-1A4B, II 4B-E (A9), SPDA S3-3A, II03A-E(A2)		NZGL06G1717N13 PN	EVA

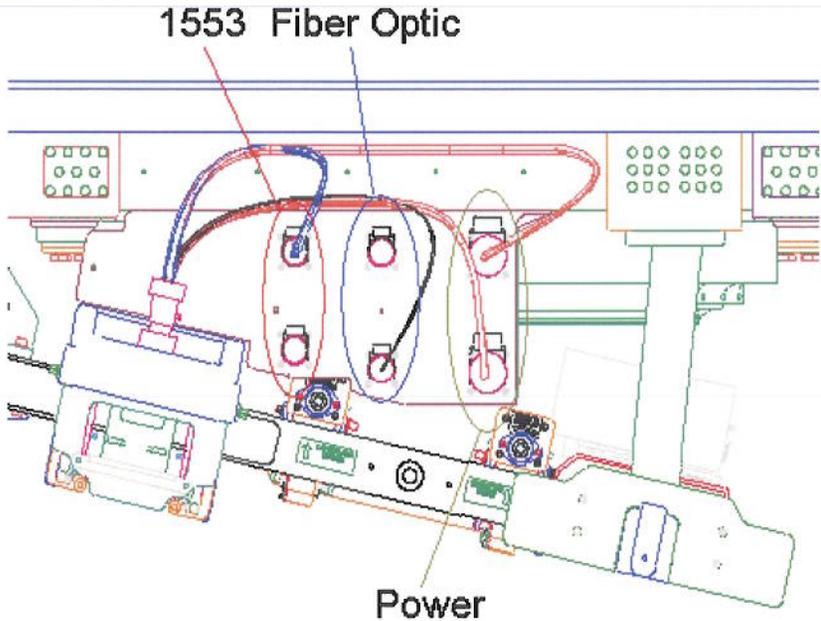
Highlighted elements are GFE hardware and controlled by the supporting vehicle programs.

CABLE CONNECTORS

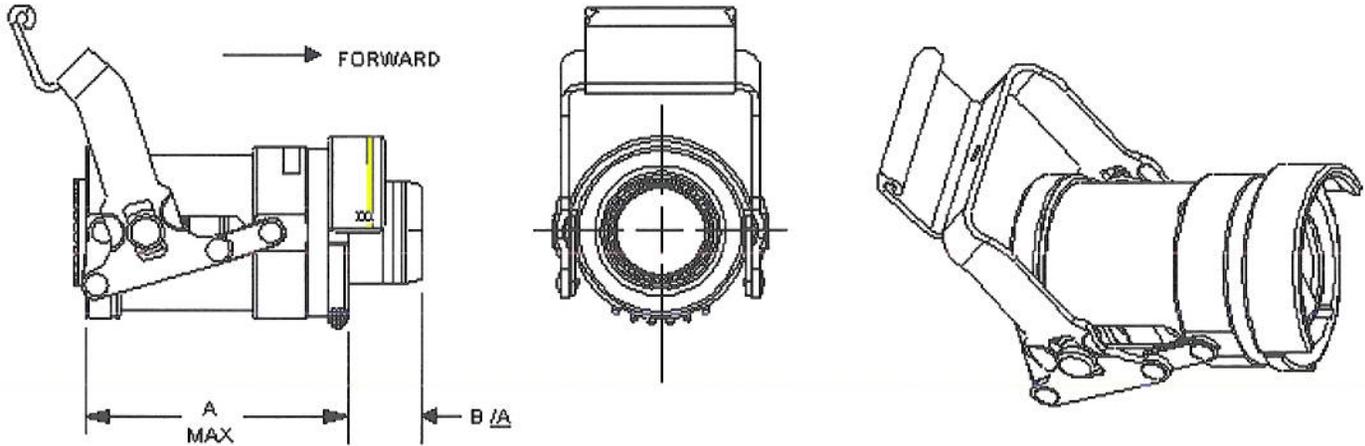
1553 – QTY: 1 EA P/N: NZGL06G1515N35PA-1
 Fiber Optic – QTY: 1 EA P/N: NZGL06G1717N13PN
 Power – QTY: 2 EA P/N: NZGL06G2525LN7SN
 (Matching panel mounted connector halves Qty 2 for each)

From NASA Spec SSQ21635:

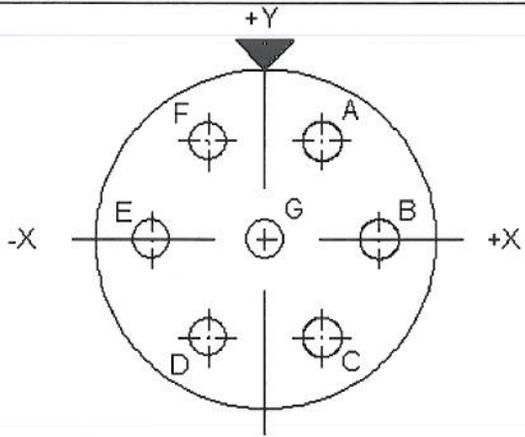
NZGL – NASA Zero-G Level Actuated
 06 – Plug, Lever Actuated
 G – Aluminum Shell, EMI Shielded, Environment Resisting
 15, 17, 25 – Housing Size
 15, 17, 25 – Insert Size
 L – Size 25 Long Housing, (blank) – All other sizes
 N – Electroless Nickel Finish
 35, 13, 7 – Insert Arrangement
 P – Pin, S- Socket
 A, N – Polarization



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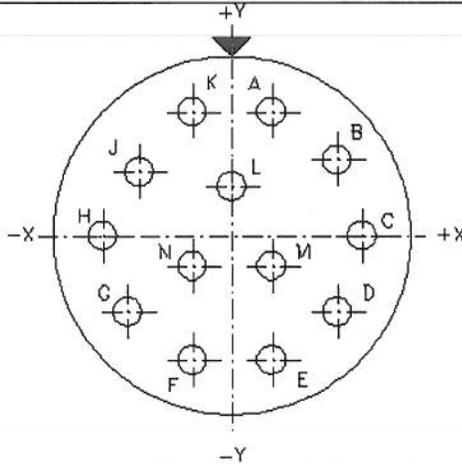
AMS-02 EVA Operable Connector



AMS-02 EVA CONNECTORS

Power Connector Pinout (Socket Side View)
(8 gauge pins/sockets)

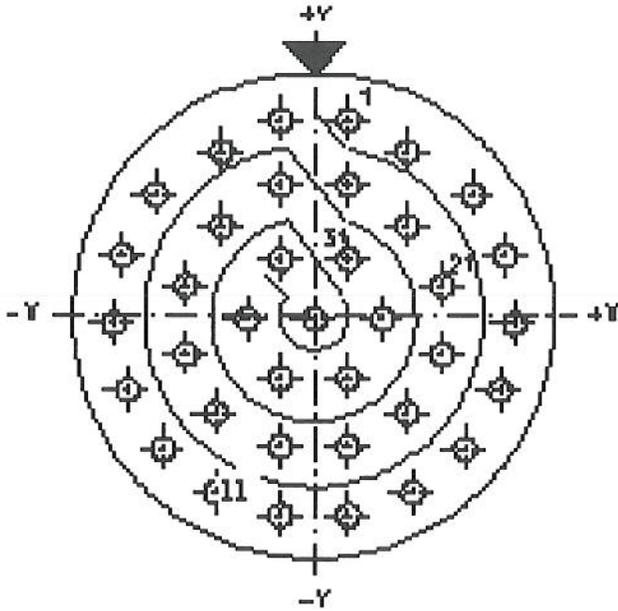
Pin/Socket	Assignment
A	Power 120 VDC (+)
C	Power Return
D	Ground



Fiber Optics Connector Pinout (Socket Side View)
(16 gauge pin/sockets)

Pin/Socket	Assignment
A	5.0 VDC Power
B	5.0 VDC Power
C	HRDL XMT TO APS
D	5.0 VDC Power Return
E	5.0 VDC Power Return
F	5.0 VDC Power Return
G	5.0 VDC Power Return
H	HRDL RCV FROM APS
K	5.0 VDC Power
J	5.0 VDC Power

Mil-Std-1553 Bus Connector (Socket Side View)
(22 gauge pin/sockets)



Pin/Socket	Assignment
1	1553 Bus A Hi
2	1553 Bus A Lo
3	AMS Address Bit 0
4	AMS Address Bit 0 Return
5	AMS Address Bit 1
6	AMS Address Bit 1 Return
7	AMS Address Bit 2
8	AMS Address Bit 2 Return
9	AMS Address Bit 3
10	AMS Address Bit 3 Return
11	AMS Address Bit 4
12	AMS Address Bit 4 Return
13	AMS Address Parity Bit
14	AMS Address Parity Bit Return
15	1553 Bus B Hi
16	1553 Bus B Lo
17 – 20	Unused
21	5 VDC Loop Back (22)
22	5 VDC Loop Back (21)
23	5 VDC Loop Back (24)
24	5 VDC Loop Back (23)
25	5 VDC Loop Back (26)
26	5 VDC Loop Back (25)
27	5 VDC Loop Back (28)
28	5 VDC Loop Back (27)
29 – 37	Unused

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