Series/Reflight Assessment
For the STS-134/ULF-6
Alpha Magnetic Spectrometer-02
(AMS-02)
ISS Digital Data Recording System
(ISS DDRS)
Equipment Delivery by Shuttle

February, 2011

Prepared by

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ESCG/L. Hill

Approved By

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ESCG\D. Nguyen

The following Series/Reflight Assessment for the transport to the ISS of the Alpha Magnetic Spectrometer-02 (AMS-02) ISS Digital Data Recording System (DDRS) covers the transport of the second grouping of the ISS DDRS equipment to the ISS in preparation for use with the AMS-02 payload which will be going up on STS-134/ULF-6.

The first group of hardware will be/was sent up on STS-133/ULF-5 to preposition essential hardware for the AMS-02 operations prior to its arrival on STS-134. Stowage obligations for STS-133 precluded sending up all alternate and spare components on that flight. This assessment covers the transportation of the second grouping of hardware. This shipment will complete the ISS DDRS delivery to orbit.

For STS-133 the following components were/will be transported and transferred to the ISS US Laboratory Module:

SEG39136090-301	S/N 1001	AMS Xmtr Adapter
SEG39136090-302	S/N 1003	AMS Rcvr Adapter
SEG39136091-301	S/N 1001	AMS HRDL Cable
SEG39137981-301	S/N 1001, 1002	AMS USB Cable
SEG39137974-301	S/N 1001-1007	AMS 500GB HD
SEG39137974-302	S/N 1011-1013	AMS 750GB HD
SJG39137982-301	S/N 1001	AMS HD Bag
SEG39137984-301	S/N 1001	AMS Network Jack
SEG39138002-301	S/N 1001	AMS Network Cable-10ft

For STS-134 the following components will be transported and transferred to the ISS US Laboratory Module:

SEG39136090-301	S/N 1002	AMS Xmtr Adapter
SEG39136090-302	S/N 1004	AMS Rcvr Adapter
SEG39136091-301	S/N 1002	AMS HRDL Cable
SEG39138002-301	S/N 1002	AMS Network Cable-10ft
SEG39138002-301	S/N 1003	AMS Network Cable-40ft
SEG39137984-301	S/N 1002	AMS Network Jack
SEG39137981-301	S/N 1003, 1004	AMS USB Cable
SEG39138001-301	S/N 1001, 1002	AMS Short Extension Cable
SEG39138001-302	S/N 1003, 1004	AMS Long Extension Cable

The baseline safety analysis of the ISS DDRS documented in JSC 65944A covers both flights, with the only exception that the sharp edge inspection for the STS-134 grouping of hardware will be conducted prior to or coincident with final packing for flight. This verification remains to be validated for this continued flight of ISS DDRS hardware.

REFLOWN AND SERIES PAYLOAD HARDWARE REFLIGHT ASSESSMENT REPORTING SHEET

Demonstration of Compliance with NSTS/ISS 13830C, Section 9 DATE: 02-15-2011

Payload Name: AMS-02 ISS Digital Data Recording System | Payload Acronym: ISS DDRS | Applicable Mission/Increment: STS-134/ULF-6

A(1). Payload/Payload Element/GSE	Previous Flight(s)	Baseline Safety Document Reference No.	Baseline Safety Document Title	Baseline Safety Document Date	B. Same Use/ Application?
ISS DDRS Components	STS-133	JSC65944	Flight Safety Data Package for the AMS-02 ISS Digital Data Recording System (ISS DDRS)	10/2010	Yes ☒ No ☐
					Yes ☐ No ☐
					Yes ☐ No ☐
					Yes ☐ No ☐

If more space is required for section A(1), attach additional sheet(s), denote attachment with designator A(1). If response in column B for any item is answered "No", attach description of new usage, denote as attachment B. In the context of this form "Baseline" is the most up to date compilation of data and hazard reports that have been approved by the PSRP.

All applicable items in columns II and III must be completed. If any items in column III are indicated columns IV and V must be completed. Column V should be checked for obligatory actions.

I.	II	III	IV.	V.
A(2). Use of Toxic Materials/ Chemicals	☒ Not Applicable ☐ No Changes In use of Toxic Materials	☐ Payload has altered use of toxic materials/ chemicals	☐ New Items ☐ Deleted Items ☐ Quantity Change ☐ Concentration Change	Attach complete list of Toxic Materials/ Chemical per JSC 27472, denote as attachment A(2). Applicable for any use of toxic materials.
C(1). Changes in Hardware/ Software Design, Operations	☒ No Changes in Payload from Previous Usage	☐ Changes exist in Payload from Previous flight ☐ Changes affect Flight Safety	☐ Hardware Changes ☐ Software Changes ☐ Operational Changes ☐ Configuration Changes	Describe changes made to payload in as attachment C(1). If changes affect flight safety of the payload, provide a description of these impacts.
C(2). Applicability of Previously Approved Hazard Reports	☒ No Change in applicability, content, or acceptance rationale of previously approved hazard reports	☐ Modifications required in previously approved hazard reports ☐ HR no longer applicable to payload ☐ HR not applicable in this application	☐ Hazard Report Revision ☐ Support Data Revision ☐ Hazard Report Applicability Change ☐ Design modification to remove hazard source	Attach revisions, additions, or description of applicability changes to this form; denote these attachments with the designator C(2).
C(3). New Hazard Reports	☒ No new hazard reports required for this payload	☐ New hazard report required	-	Attach all new hazard reports and supporting data. Denote as attachment C(3)

D. Attach a hardcopy of the baseline Hazard Reports.

All applicable items in columns II and III must be completed. If any items in column III are indicated columns IV and V must be completed. Column V should be checked for obligatory actions.

I.	II	III	IV.	V.
E. Safety Verifications	☒ All verifications are complete as of the submittal of this reflight form ☐ No Verification Reopened for Reflight	☐ Verifications remain open as of the time of the submittal of this Reflight form	Type of verifications open: ☐ Testing of Hardware ☐ Inspection of Hardware ☐ Assembly of Hardware ☐ Procedure Development ☐ Analysis of Hardware	Attach a current copy of the verification tracking log (VTL) identifying all verifications that are necessary for reflight, indicating clearly those that remain open. Indicate estimated completion date for all open items. Denote as attachment E.
F. Non-compliances to Safety Requirements	☒ Payload has no non-compliances to the safety requirements	☐ Payload has non-compliances to the safety requirements Quantity of Non-compliance Reports	☐ Non-compliances pending approval for reflight ☐ Non-compliances are approved for reflight	Attach Non-compliance reports (approved and/or pending approval) to this form in an attachment denoted as attachment F.
G. Limited Life Items	☒ Payload has no limited life items	☐ Payload has limited life items. ☐ Limited life items are safety critical	☐ Limited life items are limited by number of missions/increments ☐ Limited life parts are limited by service/shelf life	Provide an attachment that lists all limited life parts. Indicate which are safety critical, remaining life and any critical limits that may be approached during this mission. Designate this attachment G.
H. Maintenance, Refurbishment, Structural Inspections	☒ Payload has had no maintenance, refurbishment, or structural inspections performed since last flight	☐ Payload has had maintenance, refurbishment, or structural inspections performed since last flight	☐ All maintenance tracked on VTL ☐ All refurbishment tracked on VTL ☐ All structural inspections tracked on VTL ☐ Items exist that are not tracked on VTL	For any items of maintenance, refurbishment or structural inspection not tracked on the VTL provide an attachment describing the procedure and the results. Denote this attachment H.
I. Anomalies from Testing, Ground Processing and Previous Mission (Increment or Flight)	☒ Payload has suffered **no** anomalies during testing, ground processing or the previous mission	☐ Anomalies exist	☐ Testing anomalies occurred ☐ Ground processing anomalies occurred ☐ Flight anomalies occurred on previous mission	If any anomalies occurred attach a summary of all anomalies, indicating if they were safety related or not. If they were safety related, indicate the cause of the anomaly, and the corrective action taken to preclude recurrence, or the rationale to accept continued use. Denote this attachment I.
J(1). Pyrotechnic Initiators	☒ Payload has no pyrotechnic systems	☐ Payload has pyrotechnic systems	☐ Use of NASA Standard Initiator (NSI) only ☐ Use of non-NSI	Provide the part number, lot number and serial number of all initiators utilized, with an identification of the function of each initiator. Denote this attachment J.
J(2). Pressure Vessels (KSC processed only)	☒ Payload has no pressure vessels ☐ Payload is not processed through KSC	☐ Payload has pressure vessels to be processed through KSC	☐ Pressure vessels are tracked in a pressure vessel logbook	Provide a reference to the pressure vessel logbook such that KSC safety can verify that it is being maintained.

All applicable items in columns II and III must be completed. If any items in column III are indicated columns IV and V must be completed. Column V should be checked for obligatory actions.

I.	II	III	IV.	V.
K(1). Ionizing radiation	☒ Payload/GSE produces no ionizing radiation ☐ Payload has no radioactive materials	☐ Payload/GSE has radioactive materials ☐ Payload/GSE generates ionizing radiation (radioactivity)	☐ JSC Form 44 has been reviewed and approved for this specific flight ☐ JSC Form 44 is pending approval for this specific flight	Attach approved or pending JSC Form 44 and acceptance letter from Radiation Constraints Working Group. Denote this attachment K(1). If the JSC Form 44 is not yet approved, indicate the VTL item that is tracking its open status:
K(2). Non-Ionizing Radiation	☐ Payload/GSE produces no non-ionizing radiation	☐ Payload/GSE contains a RF transmitter ☒ Payload/GSE generates EMI	☐ RF/EMI Sources have not yet been approved ☒ RF/EMI sources have been reviewed and approved for all applicable vehicles	If RF/EMI sources have been approved, provide a reference to the acceptance memorandum: EV5-10-EMC-019R, 8/31/2010 If the RF/EMI sources have approval pending, provide a reference to the VTL item that is tracking the open status:
L. Vehicle Applicability	☒ Payload is stowed and/or operated on the same vehicle (Shuttle or ISS) as previous mission certification ☒ Payload is certified previously for both Shuttle and ISS operations	☐ Payload previously stowed and/or operated on Shuttle and will be stowed and/or operated on ISS ☐ Payload previously stowed and/or operated on the ISS and will be stowed and/or operated on the Shuttle	☐ Payload has been reassessed for applicable ISS requirements and environments ☐ Payload has been reassessed for applicable Shuttle requirements and environments	Attach all additional assessment summaries, and denote as attachment L, that demonstrate compliance with appropriate requirements and environments. Any new or updated hazard reports should be reflected in section C(2) and C(3) above, new or reopened verifications should be reflected in attachment E.
M. Ground Processing (KSC)	☐ Payload is not processed at KSC facilities ☒ Payload has no procedures involved with processing at KSC facilities	☐ Payload has procedures for processing at KSC facilities	☐ Ground processing procedures have been developed ☐ Ground processing procedures have not been developed	Attach a list of all ground processing procedures; denote this as attachment M.

N. Certificate of Safety Compliance: Attach signed certificate of safety compliance to this package.

Approval Signatures:	Signature	Date
Payload Organization Program Manager (or designee)		

FLIGHT PAYLOAD STANDARDIZED HAZARD CONTROL REPORT	A. NUMBER	B. PHASE	C. DATE 10-20-2010 LDH
	STD- ISS-DDRS-01	I/II/III	
D. PAYLOAD, DTO, DSO or RME *(Include Part Number(s), if applicable)*	HAZARD TITLE		E. VEHICLE
ISS Digital Data Recording System (DDRS)	STANDARD HAZARDS		***Shuttle Delivery to ISS ULF5***

F. DESCRIPTION OF HAZARD:	G. HAZARD CONTROLS: *(complies with)*	H. APP.	I. VERIFICATION METHOD, REFERENCE, AND STATUS:
1. Structural Failure	Designed to meet the applicable requirements for standard locker or soft-stowed items for launch/landing as defined in SSP 57008 or equivalent IDD NSTS 21000-IDD-MDK.	☒	1.1.1 SVM: Inspection of As Built Design 1.1.1STATUS: Closed. ESCG Memorandum ESCG-4510-10-SES-MEMO-0026, "AMS-02 ISS DDRS Hazard Controls," dated September 30, 2010
2. Structural Failure of Sealed Containers	Sealed containers must be compliant with a) and b) in <u>all</u> cases: a) Be a single, independent container containing a non-hazardous substance. b) Contain less than 14,240 foot-pounds (19,310 Joules) of stored energy due to pressure. *AND* Additionally, one of either c), d) or e) must be met, depending on the MDP and verification method. c) Have a maximum delta pressure of 1.5 atmospheres (22 psia, 1.5 bars). *OR* d) Have an MDP greater than 1.5 atm (22 psia, 1.5 bars), but less than 6.81 atm (100 psia, 6.9 bars) <u>and</u> analysis or test showing minimum safety factor for the design is 2.5 X MDP. *OR* e) Have an MDP greater than 1.5 atm (22 psia, 1.5 bars), but less than 6.81 atm (100 psia, 6.9 bars) <u>and</u> each flight unit pass a proof test to 1.5 X MDP.	☐ ☐ ☐ ☐ ☐	N/A

APPROVAL	PAYLOAD ORGANIZATION	SSP/ISS
PHASE I		
PHASE II		
PHASE III	TREVI MARTIN 10/20/10	Michael R. Lindsey 10/22/10

FLIGHT PAYLOAD STANDARDIZED HAZARD CONTROL REPORT		A. NUMBER	B. PHASE	C. DATE
		STD- ISS-DDRS-01	I/II/III	
D. PAYLOAD, DTO, DSO or RME *(Include Part Number(s), if applicable)*		HAZARD TITLE		E. VEHICLE
ISS Digital Data Recording System (DDRS)		STANDARD HAZARDS		***Shuttle Delivery to ISS ULF5***
F. DESCRIPTION OF HAZARD:	**G. HAZARD CONTROLS:** *(complies with)*	**H. APP.**	**I. VERIFICATION METHOD, REFERENCE, AND STATUS:**	
2. Structural Failure of Vented Containers	Vented enclosures are not intentionally-sealed and will not create a hazard in the event of depressurization or repressurization of the surrounding volume as verified by at least one of the following: a) Contains less than 3,063 foot-pounds (4,152 J) of stored energy due to pressure in the event of vent(s) failure *Note: Calculation of the stored energy potential can be found in NASA-HDBK-5010, Appendix. G.* b) Vents are sized to maintain a minimum FOS of 1.5 for pressure loads when assessed against depressurization/repressurization rates in SSP 57000, SSP 57008, or the equivalent ICD/IDD_____) c) Provides an internal volume to effective vent area ratio that results in a differential pressure loading of no greater than 0.01 psid. *Note: Maximum Effective Vent Ratio (MEVR) for a 0.01 psid pressure differential is defined as:* $MEVR = \left(\frac{Internal\ volume\ (in^2)}{Effective\ vent\ area\ (in^2)} \right) \leq 2000 in$	☒ ☐ ☐	3.a.1 SVM: Analysis of ISS DDRS enclosures for energy storage capability in excess of 3063 ft lbs 3.a.1 STATUS: Closed, Analysis of energy content attached to hazard report *Note: Include a listing of the vented container(s) as an attachment.*	

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		STD- ISS-DDRS-01	I/II/III	
D. PAYLOAD, DTO, DSO or RME *(Include Part Number(s), if applicable)*		HAZARD TITLE		E. VEHICLE
ISS Digital Data Recording System (DDRS)		STANDARD HAZARDS		***Shuttle Delivery to ISS ULF5***
F. DESCRIPTION OF HAZARD:	**G. HAZARD CONTROLS:** *(complies with)*	**H. APP.**	**I. VERIFICATION METHOD, REFERENCE, AND STATUS:**	
3. Sharp Edges, Corners, and/or Protrusions	Meets the intent of one or more of the following: a) NASA-STD-3000 / SSP 50005. b) NSTS 07700 Volume 14, Appendix 7 (EVA hardware). c) NSTS 07700 Volume 14, Appendix 7(IVA hardware)/ SSP 57000. d) SSP 41163, Paragraph 3.3.6.12.3 (EVA)/ SSP 41163, Paragraph 3.3.6.12.4 (IVA).	☒ ☐ ☐ ☐	4.a.1 SVM: Sharp Edge, Corners and/or Protrusion inspection of as built hardware 4.a.1 STATUS: Closed. Human Factors Implementation Team (HFIT) Hardware Certificate of Compliance for AMS-02 ISS DDRS, 10/6/2010	
5. Shatterable Material Release	Meets all that apply: a) All materials are contained. b) Optical glass (i.e. lenses, filters, etc.) components of crew cabin experiment hardware that are non-stressed (no delta pressure) and have passed both a vibration test at flight levels and a post-test visual inspection. c) Shuttle payload bay hardware shatterable material components that weigh less than 0.25 lb (113g) and are non-stressed (no delta pressure) or non-structural.	☒ ☐ ☐	5.a.1 SVM: Inspection, all fiber optic cables and interfaces contained per TPS Build 5.a.1 STATUS: Closed. JSC TPS No 2A1020182, "Fabricate HRDL Cable Assembly P/N SEG39136091-301 S/N 1001 (CI)," 9/20/2010, JSC TPS 2A1020183, "Fabricate HRDL Cable Assembly SEG39136091-301 S/N 1002 (CI)," 9/23/2010, JSC TPS 2A1020148, "Fabricate Extension Cable Assemblies P/N SEG3913800-301 S/N 1001 (CI) and 1002 (CI)," 9/28/10, JSC TPS 2A1020149, "Fabricate Extension Cable Assemblies P/N SEG39138001-302 S/N 1003 (CI) and 1004 (CI)," 10/5/2010 *Note: Include a listing and figure(s) of shatterable material(s) as an attachment.*	
6. Flammable Materials	Meets one or more of the following: a) A-rated materials selected from MAPTIS or applicable IP materials process. b) Flammability assessment per NSTS 22648, JSC 29353, or applicable International Partner materials process.	☐ ☒	6.b.1 SVM: JSC/ES4 approval of materials usage 6.b.1 STATUS: Closed. MATL-10-065A, "Alpha Magnetic Spectrometer (AMS-02) ISS Digital Data Recording System (DDRS)," dated 10/15/2010	

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		STD- ISS-DDRS-01	I/II/III	
D. PAYLOAD, DTO, DSO or RME *(Include Part Number(s), if applicable)*		HAZARD TITLE		E. VEHICLE
ISS Digital Data Recording System (DDRS)		STANDARD HAZARDS		***Shuttle Delivery to ISS ULF5***
F. DESCRIPTION OF HAZARD:	**G. HAZARD CONTROLS:** *(complies with)*	**H. APP.**	**I. VERIFICATION METHOD, REFERENCE, AND STATUS:**	
7. Materials Offgassing	Meets one or more of the following: a) Offgassing tests of assembled article per NASA-STD-6001. b) Offgassing evaluation per: MSFC-HDBK-527/JSC or MAPTIS.	☒ ☒	7.a.1 SVM: Acceptance of offgassing test results for transmitter and receiver adapter boxes. 7.a.1 STATUS: Closed. MATL-10-065A, "Alpha Magnetic Spectrometer (AMS-02) ISS Digital Data Recording System (DDRS)," dated 10/15/2010 7.b.1 SVM: Acceptance of offgassing analysis for hardware other than transmitter and receiver adapter boxes. 7.b.1 STATUS Closed. MATL-10-065A, "Alpha Magnetic Spectrometer (AMS-02) ISS Digital Data Recording System (DDRS)," dated 10/15/2010	
8. Nonionizing Radiation 8.1 Non-transmitters	Meets all that apply: a) Meets ICD-2-19001, 10.7.3.2.2 EMI compatibility testing. *AND/OR* b) Meets SSP 30238 EMI compatibility testing.	☐ ☒	8.1.b.1 SVM: EMI Testing 8.1.b.1 STATUS: Closed. EV5-10-EMC-019R, "EMI/EMC Test Report Certification of the Alpha Magnetic Spectrometer (AMS) Transmitter and Receiver Adapters," dated August 31, 2010 *Note: Specify all ICD-2-19001, Section 20 and ISS/EMEP approved TIA exceedances in verification section.*	

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ISS Digital Data Recording System (DDRS)		STANDARD HAZARDS		***Shuttle Delivery to ISS ULF5***
F. DESCRIPTION OF HAZARD:	**G. HAZARD CONTROLS:** *(complies with)*	**H. APP.**	**I. VERIFICATION METHOD, REFERENCE, AND STATUS:**	
8.2 Lasers	Meets all that apply: a) Classified as as a Class 1 and/or Class 2 laser, as defined in ANSI Z136.1-2007 (as measured at the source). b) The radiant exposure, H, or irradiance, E, at the ISS crewmember's eye or on the crewmember's skin for laser source shall not exceed the maximum permissible exposure (MPE) as defined in ANSI Z136.1-2007. c) Optical magnification equipment on board ISS that could be used to view a laser source or its specular reflection shall be considered in any ocular hazard analysis.	☐ ☐ ☐	N/A *Note: Include the manufacturer laser data sheet(s) as an attachment.* *Note: Lasers operating at class 1M, 2M, 3R, 3B and 4 meeting ANSI Z136.1 -2007 and ANSI Z136.4-2005 shall be documented on a unique hazard report.*	
9. Battery Failure	Meets all that apply:		N/A	

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		STD- ISS-DDRS-01	I/II/III	
D. PAYLOAD, DTO, DSO or RME *(Include Part Number(s), if applicable)*		HAZARD TITLE		E. VEHICLE
ISS Digital Data Recording System (DDRS)		STANDARD HAZARDS		***Shuttle Delivery to ISS ULF5***
F. DESCRIPTION OF HAZARD:	**G. HAZARD CONTROLS:** *(complies with)*	**H. APP.**	**I. VERIFICATION METHOD, REFERENCE, AND STATUS:**	
9.1 Alkaline cells and batteries *Notes:* • *Up to 12 V* • *Up to 60 Watt-hours capacity* • *No potential charging source* • *Cells not in gas-tight compartment.*	Cells and batteries pass acceptance tests that include: a) Loaded and open circuit voltage measurements. b) Visual examination. c) Leakage check under vacuum (e.g. 6 hours at 0.1 psia).	☐	N/A *Note: Include confirmation of test completion and approval of Form-03 by JSC\EP5.*	
9.2 Primary button cells: e.g. - Li-(CF)x, Li-iodine, LiV_2O_5, $LiMnO_2$, Ag-Zn Rechargeable button cells: e.g. - LiV_2O_5, Li-ion, Ni-Cd, Ni-MH, Ag-Zn cells *Notes:* • *Battery capacity ≤ 300 mAh* • *Less than 3 cells per common circuit* • *Cells not in gas-tight compartment.*	Cells and batteries pass acceptance tests that include: a) Loaded and open circuit voltage measurements. b) Visual examination. *c)* Leakage check under vacuum (e.g. 6 hours at 0.1 psia). *Note: For button cells soldered to a circuit board, only a functional check of the battery in the equipment is required.*	☐	N/A *Note: Include confirmation of test completion and approval of Form-03 by JSC\EP5.*	

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D. PAYLOAD, DTO, DSO or RME *(Include Part Number(s), if applicable)*		HAZARD TITLE		E. VEHICLE
ISS Digital Data Recording System (DDRS)		STANDARD HAZARDS		***Shuttle Delivery to ISS ULF5***
F. DESCRIPTION OF HAZARD:	**G. HAZARD CONTROLS:** *(complies with)*	**H. APP.**	**I. VERIFICATION METHOD, REFERENCE, AND STATUS:**	
9.3 COTS Rechargeable NiMH, NiCd & Ag/Zn batteries *Note:* • *Batteries for IVA use up to 20 V and 60 Wh*	Batteries purchased in one lot and pass flight acceptance tests that include, as a minimum: a) Loaded and open circuit voltage measurements. b) Visual examination. c) Vibration to workmanship levels. d) Leakage check under vacuum. (e.g. 6 hours at 0.1 psia). e) Charge/discharge cycles before and after vibration and vacuum testing.	☐	N/A *Note: Include confirmation of test completion and approval of Form-03 by JSC\EP5.*	
9.4 COTS rechargeable Li-ion batteries *Note:* • *Batteries for IVA use up to 10 V and 60 Wh*	Batteries purchased in one lot and pass flight acceptance tests that include, as a minimum: a) Loaded and open circuit voltage measurements. b) Visual examination. c) Vibration to environment or 2X workmanship level, whichever is higher. d) Leakage check under vacuum (e.g. 6 hours at 0.1 psia). e) Functional check (i.e. charge/discharge cycles) before and after vibration and vacuum.	☐	N/A *Note: Include confirmation of test completion and approval of Form-03 by JSC\EP5.*	

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ISS Digital Data Recording System (DDRS)		STANDARD HAZARDS		***Shuttle Delivery to ISS ULF5***
F. DESCRIPTION OF HAZARD:	**G. HAZARD CONTROLS:** *(complies with)*	**H. APP.**	**I. VERIFICATION METHOD, REFERENCE, AND STATUS:**	
10. Touch Temperature	Meets all that apply, all payload accessible surfaces: a) Are within IVA touch temperature range of –18 Degrees C. (0 Degrees F) and 49 Degrees C (120 Degrees F). a1) For systems with active thermal management: Design contains a single fault tolerant design to not exceed touch temperature limits. a2) For systems with no active thermal management: Design is incapable of exceeding touch temperature limits. a3) For surfaces exceeding touch temperature limits: Acceptability of those higher temperatures has been determined using the formula within letter MA2-95-048 “Limits for Intravehicular Activity (IVA) Touch Temperatures”, which considers thermal properties of the involved materials. b) Meet EVA touch temperature criteria of NSTS 07700 Volume 14, Appendix 7.	☐ ☒ ☐ ☐	10.a2.1 SVM: Touch Temperature Anaylsis/Testing 10.a2.1 STATUS: Closed. ESCG Memorandum ESCG-4470-10-TEAN-DOC-0130, “Touch Temperature Analysis for Alpha Magnetic Spectrometer (AMS-02) ISS Digital Data Recording System (DDRS),” dated September 2, 2010	

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D. PAYLOAD, DTO, DSO or RME *(Include Part Number(s), if applicable)*		HAZARD TITLE		E. VEHICLE
ISS Digital Data Recording System (DDRS)		STANDARD HAZARDS		***Shuttle Delivery to ISS ULF5***
F. DESCRIPTION OF HAZARD:	**G. HAZARD CONTROLS:** *(complies with)*	**H. APP.**	**I. VERIFICATION METHOD, REFERENCE, AND STATUS:**	
11. Electrical Power Distribution	Meets all that apply: IVA Payloads: a) For Shuttle-powered payloads: Meets all circuit protection requirements of letter TA-92-038 and bonding and grounding requirements in NSTS 37330. b) For ISS-powered payloads: Meets station interface circuit protection requirements of SSP 57000 or applicable module ICD, payload circuit protection requirements of letter TA-92-038, and bonding and grounding requirements per SSP 30240 and SP 30245. EVA Payloads less than 32 volts: c) For Shuttle-powered payloads: Meets all circuit protection and wire sizing requirements of letter TA-92-038. d) For ISS-powered payloads: Meets station interface circuit protection requirements of SSP 57003 or applicable module ICD, payload circuit protection and wire sizing requirements of letter TA-92-038.	☐ ☒ ☐ ☐	11.b.1 SVM: Review of Design 11.b.1 STATUS: Closed. ESCG-4295-10-ADV SY-MEMO-0041, "AMS-02 ISS DDRS Electrical Power Distribution and Mating/Demating of Powered Connectors," dated September 21, 2010 *Note: Include circuit protection wire sizing, bonding and grounding diagrams as an attachment.* *Note: Payloads with voltages above 32 volts shall be documented on a unique hazard report.*	

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D. PAYLOAD, DTO, DSO or RME *(Include Part Number(s), if applicable)*		**HAZARD TITLE**		**E. VEHICLE**
ISS Digital Data Recording System (DDRS)		STANDARD HAZARDS		***Shuttle Delivery to ISS ULF5***
F. DESCRIPTION OF HAZARD:	**G. HAZARD CONTROLS:** *(complies with)*	**H. APP.**	**I. VERIFICATION METHOD, REFERENCE, AND STATUS:**	
12. Ignition of Flammable Atmospheres in Payload Bay	Meets the following for Shuttle launch, entry, landing, and post landing mission phases: a) Hardware is unpowered and all payload surfaces are below 352°F. *AND* b) Hardware MLI is grounded per ICD 2-19001.	☐ ☐	N/A	
13. Rotating Equipment	Rotating equipment meets both of the following: a) Enclosure has obvious containment capabilities. b) Rotating part does not exceed 8 inches (200 mm) in diameter and 8000 revolutions per minute (rpm) speed in all conditions. *OR* c) Computer Hard Disk Drive structure/enclosure is unmodified and HDDs are industry/safety certified (Example: UL, IEC, CE ratings).	☐ ☐ ☒	13.c.1 SVM: Inspection of Flight Hardware 13.c.1 STATUS: Closed. ESCG Memorandum ESCG=4530-10-GFESEI-MEMO-0025, "AMS-02 ISS DDRS Safety Data Pack: Hazard Verification 13.c.1 Rotating Equipment," dated September 22, 2010 *Note: Include listing of rotating equipment as an attachment.*	

FLIGHT PAYLOAD STANDARDIZED HAZARD CONTROL REPORT		A. NUMBER	B. PHASE	C. DATE
		STD- ISS-DDRS-01	I/II/III	
D. PAYLOAD, DTO, DSO or RME *(Include Part Number(s), if applicable)*		**HAZARD TITLE**		**E. VEHICLE**
ISS Digital Data Recording System (DDRS)		STANDARD HAZARDS		***Shuttle Delivery to ISS ULF5***
F. DESCRIPTION OF HAZARD:	**G. HAZARD CONTROLS:** *(complies with)*	**H. APP.**	**I. VERIFICATION METHOD, REFERENCE, AND STATUS:**	
14. Mating/demating powered connectors	Meets all that apply: a) Meets the low power criteria of letter MA2-99-170 (32V or less, and less than or equal to 3A maximum available upstream current) . *AND/OR* b) Meets the paragraph 1 criteria of letter MA2-99-170 (i.e., IVA only, greater than 3A and open circuit voltage no greater than 32 volts). *AND* c) Meets bonding and grounding requirements per NSTS 37330 and/or SSP 30240 & SSP 30245.	☒ ☐ ☐	14.a.1 SVM: Review of Design 14.a.1 STATUS: Closed. ESCG-4295-10-ADV SY-MEMO-0041, "AMS-02 ISS DDRS Electrical Power Distribution and Mating/Demating of Powered Connectors," dated September 21, 2010 Note; Demating and mating operational controls for GFE T61p interface to ExPRESS Rack addressed in hazard reports (ExPRESS) EXPR-11 and (T61p) T61p-0004, Cause 4, Control 5 *Note: Include bonding and grounding diagram for mating/demating connectors as an attachment.*	
15. Contingency Return and Rapid Safing	Meets all that apply: a) If payload is unstowed in Shuttle middeck: Can be stowed within 50 minutes. *Note: See paragraph 3 of letter MA2-96-190.* b) If payload is operated in the ISS: Design does not impede emergency IVA egress to the remaining adjacent pressurized volumes.	☐ ☒	15.b.1 SVM: Review of Design 15.b.1 STATUS: Closed. ISS PIRN 57206-NA-0006A, "ER-6 / MERLIN / PWD / ISSFW / CUCU / PS-28 / Condensate Transfer Pump / AMS Laptop Protrusion Exception for Stage ULF5 and Subsequent," dated 6/22/2010 approved 8/6/2010.	

FLIGHT PAYLOAD STANDARDIZED HAZARD CONTROL REPORT		A. NUMBER	B. PHASE	C. DATE
		STD- ISS-DDRS-01	I/II/III	
D. PAYLOAD, DTO, DSO or RME *(Include Part Number(s), if applicable)*		**HAZARD TITLE**		**E. VEHICLE**
ISS Digital Data Recording System (DDRS)		STANDARD HAZARDS		***Shuttle Delivery to ISS ULF5***
F. DESCRIPTION OF HAZARD:	**G. HAZARD CONTROLS:** *(complies with)*	**H. APP.**	**I. VERIFICATION METHOD, REFERENCE, AND STATUS:**	
16. Unintentional Release of Material	Hardware has been assessed for all planned transportation, stowage, and operation location(s), has a minimum of one (1) level of containment, and meets the following constraints: a) Maximum of Toxic Hazard Level 0 (THL-0) as classified by JSC 27472 *AND/OR* b) Maximum of Biological Safety Level 1 (BSL-1) as classified by JSC 63828 *AND* c) Release will have no impacts to Environmental Control and Life Support (ECLS)	☐ ☐ ☐	N/A *Note: Include Hazardous Material Summary Table (HMST) as an attachment.*	

SVM 1.1.1

Engineering and Science Contract Group

2224 Bay Area Boulevard
Houston, Texas 77058

ESCG-4510-10-SES-MEMO-0026
30 September 2010

TO: Leland Hill, Chris Tutt, Phil Mott, Tim Urban

FROM: George R. Brown

SUBJECT: AMS-02 ISS DDRS Hazard Controls

AMS-02 ISS DDRS deliverable components consist of cables, connectors, removable hard drives, and small extruded aluminum boxes(adapters) enclosing printed circuit boards(PCB). The control for this hazard is review of payload design to show it complies with the requirements of NSTS-21000-IDD-MDK. Review/inspection of the design and as-built hardware confirms that the hardware meets the requirements of NSTS-21000-IDD-MDK, "Middeck Interface Definition Document".

The payload that will be stowed in STS Standard Middeck Locker is referred to as the AMS ISS Digital Data Recording System (ISS DDRS) hardware (also known as AMS Laptop hardware). It will consist of the following hardware:

Item	P/N	S/N	Provider
AMS Network Cable-10FT	SEG39138002-301	1001, 1002	Jacobs
AMS Network Cable-40FT	SEG39138002-302	1001	Jacobs
AMS Network Jack	SEG39137984-301	1001, 1002	Jacobs
AMS Xmtr Adapter	SEG39137984-301	1001, 1002	Jacobs
AMS Rcvr Adapter	SEG39137984-302	1003, 1004	Jacobs
AMS USB Cable	SEG39137981-301	1001-1004	Jacobs
AMS HRDL Cable	SEG39136091-301	1001, 1002	Jacobs
AMS Short Extension Cable	SEG39138001-301	1001,1002	Jacobs
AMS Long Extension Cable	SEG39138001-302	1003, 1004	Jacobs
AMS HD Bag	SEG39137982-301	1001	Jacobs
AMS 500GB HD AMS 750GB HD	SEG39137974-301 SEG39137974-302	1001-1007 1011-1013	Jacobs

A review of ISS DDRS components design shows that:

1) None of the ISS DDRS components exceeds the stowage volume of standard Modular Stowage Locker.

ESCG ENGINEERING & SCIENCE CONTRACT GROUP JACOBS ERC | Barrios | GeoControl | Hamilton Sundstrand | MEI

Memorandum
(Continued)
Page 2 of 2

For ULF5:

Item	P/N	S/N	Stowage Dimensions*	Volume (cu. Ft.)
AMS Network Cable-10FT	SEG39138002-301	1001	12x12x4	.33
AMS Network Jack	SEG39137984-301	1001	1.5x1.5x3	.004
AMS Xmtr Adapter	SEG39137984-301	1001, 1002	4x2.5x1 (2)	.01
AMS Rcvr Adapter	SEG39137984-302	1003, 1004	4x2.5x1 (2)	.01
AMS USB Cable	SEG39137984-301	1001-1002	6x6x1 (2)	.04
AMS HRDL Cable	SEG39137981-301	1001	14x14x4	.45
AMS HD Bag	SEG39137982-301	1001	10x7.5x3	.13

* inches

For ULF6:

Item	P/N	S/N	Stowage Dimensions*	Volume (cu. Ft.)
AMS Network Cable-10FT	SEG39138002-301	1002	12x12x4	.33
AMS Network Cable-40FT	SEG39138002-302	1001	14x14x4	.45
AMS Network Jack	SEG39137984-301	1002	1.5x1.5x3	.004
AMS USB Cable	SEG39137984-301	1003, 1004	6x6x1 (2)	.04
AMS HRDL Cable	SEG39137981-301	1002	14x14x4	.45
AMS Short Extension Cable	SEG39138001-301	1001,1002	12x12x2 (2)	.33
AMS Long Extension Cable	SEG39138001-302	1003, 1004	14x14x4 (2)	.9

* inches

2) Payload (excluding trays, foam, protective provisions) does not exceed the 54 pound limit referenced in IDD.

3) Payload does not require any special accommodations or power during storage.

4) Payload will utilize standard locker and attachment hardware provided by program.

5) Payload has been evaluated to meet the limit load factors encountered during lift off and landing.

This memo is submitted as formal closure of Safety Verification Method (SVM) 1.1.1 of Hazard Report (HR) Number STD-ISS-DDRS-F01. The review of the AMS ISS DDRS shows that payload is in compliance with requirements of NSTS-21000-IDD-MDK.

SVM 3.a.1:

Calculation of threshold Volume to exceed 4152 Joules of energy in a vented container used in habitable environment.

$$E = \left(\frac{P_i V}{k-1}\right)\left(1 - \left(\frac{P_e}{P_i}\right)^{\frac{k-1}{k}}\right)$$

E= Threshold Energy = 3063 ft lb_f = 4152 J = 36748.3 in lb_f

P_i= Internal Pressure = atmosphere = 14.7 psia

P_e= External Pressure = Vacuum = 0 psia

V = Volume Threshold

k = ratio of specific heat (air) = 1.4

$$E = \left(\frac{(14.7V)}{1.4-1}\right)\left(1 - \left(\frac{0}{14.7}\right)^{\frac{14-1}{14}}\right)$$

$$E = \left(\frac{14.7V}{0.4}\right)(1 - (0))$$

$$\frac{0.4E}{14.7} = V$$

$$\frac{(0.4)(36748.3)}{14.7} = V = 999.95 \; cubic \; inches$$

Therefore, any free volume under 999.95 cubic inches will not be a threat per JSC Form 1230, Hazard 3, Control 3a regardless of vent size, there simply cannot be sufficient energy to constitute a hazardous concern.

Outer dimensions of ISS DDRS Boxes:

Assume all interior volume is free for enclosures for first check.

Item	D1	D2	D3	Volume	(units - inches)
Hard Disk	3.96	2.76	0.374	4.09	<< 999.95 cubic inches – no potential for hazard
Transmitter Box/Receiver Box	4.85	2.13	0.906	9.34	<< 999.95 cubic inches – no potential for hazard

Dimensions shown are maximum exterior dimensions

As there is no potential for storing sufficient energy to create a hazard should any vents become blocked, no additional analysis will be performed.

SVM 6.b.1, 7.b.1:

JSC MATERIALS AND FRACTURE CONTROL CERTIFICATION

PROJECT/SUBSYSTEM MANAGER: T. Martin/EA321 | REF: MATL – **10 – 065A**

HARDWARE NAME: Alpha Magnetic Spectrometer (AMS-02) ISS Digital Data Recording System (DDRS) | PART NUMBER: See Attachment 2

APPLICABLE REQUIREMENTS:

Materials Requirements:

- ☒ JSC 27301F, Materials Control Plan for JSC Flight Hardware
- ☒ NASA-STD-6016, Standard Materials and Processes Requirements for Spacecraft
- ☒ NSTS 1700.7B, Safety Policy and Requirements for Payloads Using the Space Transportation System
- ☐ Other:

Fracture Control Requirements:

- ☐ JSC 25863B, Fracture Control Plan for JSC Space-Flight Hardware
- ☐ NASA-STD-5019, Fracture Control Requirements for Spaceflight Hardware
- ☐ Other:

SPECIFIC ASSESSMENTS:

- ☒ Flammability
- ☒ Toxicity
- ☒ Stress Corrosion Cracking
- ☒ General Corrosion
- ☐ Fracture Control (☒ Not Applicable; Concurrence: **M.S.**)
- ☒ Age Life ☐ Other:
- ☐ Atomic Oxygen/Ultraviolet
- ☐ Thermal Vacuum Stability
- ☐ Fluid Compatibility:
- ☒ Microbiological Resistance

LOCATION:

- ☒ Orbiter Crew Cabin
- ☐ Orbiter Payload Bay
- ☒ Progress
- ☒ Spacehab
- ☒ MPLM
- ☒ Soyuz
- ☒ ATV
- ☒ HTV
- ☒ Space Station: ☒ Internal ☐ External
- ☐ Other:

MATERIALS USAGE AGREEMENTS (MUAs):

- ☐ No MUAs
- ☒ MUA Number(s): **ESCG/ISS 281**

Deviation: Galvanic Corrosion

LIMITATIONS: ☐ No Limitations

- ☒ Materials: The AMS Adapter Assemblies shall be packaged with MIL-D-3464, Type II desiccant for transportation and storage.
- ☐ Fracture Control:

This JSC Materials and Fracture Control Certification is consistent with existing Materials or Fracture Control Reciprocal Agreements. Materials Certification to JSC 27301 or NASA-STD-6016 and Fracture Control Certifications to JSC 25863 or NASA-STD-5019 comply with applicable materials and processes and fracture control requirements in the following program-specific documents: SE-R-0006D, Space Shuttle System Requirements for Materials and Processes; SSP 30233G, Space Station Requirements for Materials and Processes; NASA-STD-5003, Fracture Control Requirements for Payloads Using the Space Shuttle; SSP 30558C, Fracture Control Requirements for Space Station; SSP 52005B, ISS Payload Flight Equipment Requirements and Guidelines for Safety-Critical Structures.

APPROVALS

M.D. Pedley	10/15/10	M.D. Pedley	10/15/10
Fracture Control Manager, S. Forth	Date	GFE Materials Control Manager, M. Pedley	Date

July 2009

MATL– 10 – 065A

ATTACHMENT 1

Hardware Acceptance Summary Report for Materials

Revision A of MATL-10-065 corrects the part number error for the hard drives and updates the toxicity assessment of the Transmitter and Receiver Adapters with the offgassing test results of the Transmitter Adapter. Except for the toxicity assessment update, there are no changes to the original materials assessment (MATL-10-065 released 9/21/10).

The Alpha Magnetic Spectrometer -02(AMS-02) ISS Digital Data Recording System (DDRS) consists of a GFE certified T61p Laptop, hard drives, Ethernet modified-Commercial Off The Shelf (COTS) cables, USB modified-COTS cables, fiber optic cables, fiber optic connectors, and adapter boxes with Printed Circuit Boards (PCBs) to convert Universal Serial Bus (USB) signals to Fiber Optic (FO) signals. The ISS DDRS will provide a means to buffer AMS-02 science data in case of a Ku-band outage and a means for the ISS crew to observe and command the AMS-02 payload.

The 36" long USB cable made of tinned copper wiring with polyolefin insulation has nickel-plated connectors and is wrapped with Teflon tape for flammability protection. The USB cables send and receive signals to/from the T61P laptop computer through the Receiver and Transmitter Adapters, which convert the USB signals to FO signals for transmission through the High Rate Data Link (HRDL) FO cables to/from the Universal Interface Panel (UIP) on the EXPRESS Rack and from there to /from the AMS-02 payload. The network (Ethernet) cables have polycarbonate plugs and flammable polyethylene jacket. Nonflammable Teflon tape is used to wrap the entire length of the network cables for flammability protection. The HRDL cable and HRDL extension cables are built from the already certified FO cable (SSQ21654E, General Specification for Space Qualify Multimode Single Fiber Cable) and connectors (CRES 303/316L or Ni-plated brass). Nonflammable Teflon tape is used to wrap the entire length of the flammable bend limiting FO tubing (polypropylene). The Network Jack consists of a 6061-T651 Al alloy shell and an electroless nickel plated plug connector (MS27467T15F35P). The hard drives (500GB and 750GB) are made of the same materials as the 160GB hard drive in the certified T61p Laptop. Seven Hitachi 500GB hard drives and three Western Digital 705GB hard drives will be stowed in a non-flammable Nomex bag (SEG39137983-701, AMS Hard Disk Drive (HDD) Bag). The AMS Hard Drive (HD) Bag (SJG39137982-301) consists of 10 hard drives stored in the AMS HDD bag, which is made of nonflammable Nomex HT90-40 fabric, Chemglass Stiffener, 10 mil Teflon film, and Nomex Velcro fasteners. The AMS Adapter Assembly (SEG39136090-301and -302) consists of an extruded 6063-T6 box enclosed on each end with 6063-T6 (or 6061-T6) end plate, and a USB/HRDL PCB coated with RTV 3140. The DDRS hardware will be soft stowed for launch and installed on-orbit in Express Rack, ISS Laboratory.

Stress Corrosion Cracking (SCC)
All metallic materials were evaluated for SCC and found acceptable.

General Corrosion:
All metallic materials have acceptable corrosion protection finishes. The gold-plated Cu/Invar/Cu gasket was attached to the 6063-T6 (or 6061-T6) end plate and the 6063-T6 adapter housing for electrical bonding and Electromagnetic Interference (EMI) shielding. This dissimilar metal coupling between the gold-plated copper and alodine 6063-T6 (or 6061-T6) is not acceptable because the electrical potential difference of this dissimilar metal coupling exceeds the 0.25 volts recommended for a permissible dissimilar metal couple. To mitigate the risk of galvanic corrosion at the gold-plated copper/alodine 6063-T6 interface, the AMS adapter assembly shall be placed in a packaging bag with MIL-D-3464, Type II desiccant for transportation and storage (Reference: MUA# ESCG\ISS-281).

Flammability:
All the flammable wiring/cable insulations are wrapped with nonflammable Teflon tapes for flammability protection. The flammable cable straps used in the HRDL and extension cables have a minimum separation distance of 2 inches. The hard drives have metallic enclosure and are not powered on by themselves. The hard drives are not flammable. The HDD bag is made of nonflammable Nomex fabrics. Other non-metallic materials are either nonflammable or used in non-flammable configurations by analysis.

Toxicity:
There will be no offgassing toxicity issue for the manifest of the seven Hitachi 500 GB and three Western Digital 750 GB hard drives on Shuttle and ISS based on the offgassing test results of a similar hard drive (Toxic Hazard Index (T-value) of 0.006/maximum allowable units of 83 hard drives for Shuttle and Toxic Hazard Index of 0.003/maximum allowable units of 166 hard drives for ISS, WSTF#95-29579). The Transmitter Adapter passed the offgassing test with the T-value of less than 0.001 for Shuttle and ISS (WSTF #10-44641). There will be no offgassing toxicity issue for the Transmitter Adapter because its T-value of <0.001 is much less than the acceptable value of 0.5. Since the Receiver Adapter and the Transmitter Adapter are identical except for a few EEE parts on the conformally coated PCB, there will also be no offgassing toxicity issue for the Receiver Adapter by analysis. Non-metallic materials of other ISS DDRS hardware are used in quantities below their maximum allowable limits for Shuttle and ISS per Materials and Processes Technical Information System (MAPTIS).

July 2009

Aging:
The ISS DDRS hardware was evaluated for aging and found acceptable. The hardware is replaceable as needed.

Microbiological Resistance:
The ISS DDRS hardware was evaluated for fungus resistance and found acceptable based on its accessibility for cleaning.

Conclusion:
The AMS Adapter Assemblies shall be packaged with MIL-D-3464, Type II desiccant for transportation and storage.

Chia Chang – MP, Mo Shoeb – FC, Certification Request Log Number 2212

ATTACHMENT 2

Attachment to MATL – **10 – 065A**

Hard Drive Assembly, AMS, 500 GB	SEG39137974-301
Hard Drive Assembly, AMS, 750 GB	SEG39137974-302
Hard Drive Assembly, AMS, 640 GB	SEG39137974-303
Cable Assembly, USB	SEG39137981-301
Cable Assembly, Network	SEG39138002-301 and -302
AMS Adapter Assembly	SEG39136090-301 and -302
Cable Assembly, AMS HRDL	SEG39136091-301
Network Jack Assembly	SEG39137984-301
Cable Assembly, Extension	SEG39138001-301 and -302
AMS HD Bag	SJG39137982-301

ISS MATERIALS USAGE AGREEMENT	USAGE AGREEMENT NO. ESCG/ISS-281	REV.	PAGE 1 OF 2

TITLE:	CATEGORY:	EFFECTIVITY:
AMS Transmitter Adapter and Receiver Adapter, Alpha Magnetic Spectrometer 02 (AMS-02)	2	STS-133/ULF5

TYPE OF DEVIATION:	REQUIREMENT DEVIATED:
☐ MATERIAL ☒ EQUIPMENT (NO. PER VEHICLE: 4)	☐ FLAMMABILITY ☐ TVS ☐ SCC ☐ OFFGASSING ☐ O_2 COMPATIBILITY ☒ OTHER Galvanic Corrosion

EQUIPMENT	PART NUMBER	MANUFACTURER
AMS Transmitter Adapter, and Receiver Adapter	SEG39136090-301, and -302	NASA/JSC

MATERIAL	TRADE NAME	SPECIFICATION	MANUFACTURER
6063 Al alloy box and end plate, Gold-plated Cu/Invar/Cu			

THICK (in.)	WEIGHT (lbs.)	AREA (in^2)	LOCATION	ENVIRONMENT		
				TEMPERATURE (°F)	PRESS (PSIA)	MEDIA
			☒ HABITABLE ☐ NONHABITABLE	65 F to 95 F	Ambient to 10.2 psia	30% oxygen worst case

APPLICATION (use second sheet if required)

The AMS Transmitter and Receiver Adapters convert High Rate Data Link (HRDL) signals from fiber optics to Universal Serial Bus (USB), to be processed by a T61p laptop computer for storage and later transmission to ground facilities. The initial construction of the housing for the adapters did not produce sufficient grounding to eliminate unwanted radiated emissions at the USB connector end of the Adapters. A fix was identified, adding a conductive 'gasket' that would ground the end plate to the USB connector and by extension then to the entire housing. Testing conducted at the developer's facility in CERN, Switzerland showed that this effectively eliminated the radiated emissions. The gaskets are being implemented in the Class 1 units to mitigate the EMI issue for the Adapters. In order to mitigate possible corrosion of the copper material in the gasket, the gaskets will be gold-plated. A concern was raised by ESCG Materials about dissimilar metal coupling (galvanic corrosion) between the gold-plating of the gaskets and the end plate and the adapter housing (6063-T6 Al alloy). The dissimilar metal coupling configuration is shown in Figure 1, Attachment 1.

RATIONALE (use second sheet if required)

1) The AMS HRDL/USB Adapters are not safety critical hardware.
2)The adapter assembly will be bagged and stored with MIL-D-3464E, Type II desiccant during transportation and stowage.
3) The galvanic corrosion between alodine 6063-T6 Al alloy and gold-plated gasket is not likely to occur in the non-condensable ISS pressurized environment.
4) Spare adapters are manifested and will replace the adapters that fail.
5) Failure of electrical grounding of the adapters due to galvanic corrosion does not affect any ISS system or equipment in any way.

APPROVALS

ORIGINATOR/ORGANIZATION	DATE	JSC MATERIALS AND PROCESSES TECHNOLOGY BRANCH	DATE
ESCG	8/10/10	M. D. Kelley	8/10/10
PROJECT MANAGER	DATE	PROGRAM MANAGER	DATE
Michael F. Fohey	8/17/10		

JSC Form 1466 (Rev June 93) NASA-JSC

Michael F. Fohey

ISS MATERIALS USAGE AGREEMENT	USAGE AGREEMENT NO. ESCG/ISS-281	REV.	PAGE 2 OF 2
TITLE: AMS Transmitter Adapter and Receiver Adapter, Alpha Magnetic Spectrometer 02 (AMS-02)	CATEGORY: 2	EFFECTIVITY: STS-134	

APPLICATION (Cont.):
This MUA provides rationale for accepting this dissimilar metal coupling configuration. AMS Project will provide appropriate controls to insure hardware is protected from exposure to excessive humidity.

JSC Form 1466 (Rev June 93) NASA-JSC

ATTACHMENT 1

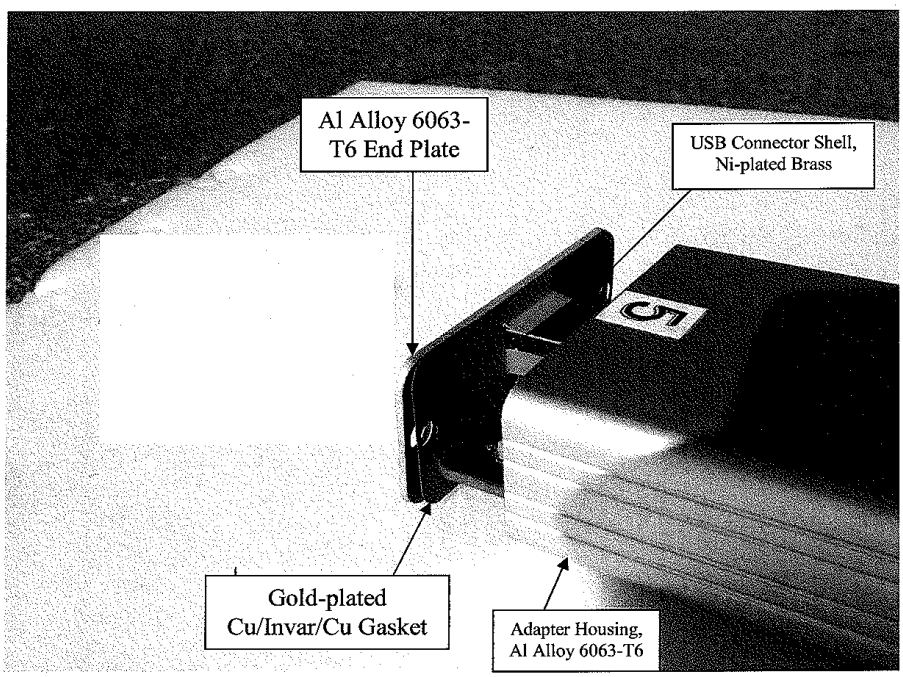


Figure 1: Photo of Unassembled Transmitter or Receiver Adapter Showing Dissimilar Metal Coupling Configuration

SVM 8.1.b.1:

National Aeronautics and Space Administration

Lyndon B. Johnson Space Center
2101 NASA Parkway
Houston, TX 77058

EVS-10-EMC-019R
August 31, 2010

EMI/EMC TEST REPORT
Certification of the Alpha Magnetic Spectrometer (AMS) Transmitter and Receiver Adapters

	NAME	PHONE	SIGNATURE/DATE
DISTRIBUTION	EA3/Trenton Martin	281-483-3296	9/8/10
WRITTEN BY	ESCG/ Charles Bautsch	281-483-0222	9/8/10
APPROVED BY	EV5/ Robert C. Scully	281-483-1499	for R. Scully 9/8/10

Table of Contents

List of Figures

List of Tables

Summary Information Sheet

TASK PERFORMANCE SHEET (TPS):	2A1020166
EQUIPMENT UNDER TEST:	AMS Transmitter Adapter : P/N SEG39136090-301, S/N 1001 AMS Receiver Adapter : P/N SEG39136090-302, S/N 1003
PROJECT MANAGER:	Wesley Gordon, 281-244-5688
TEST DATE:	August 19 – August 20, 2010
TEST LOCATION:	NASA, Johnson Space Center, Houston, TX Primary EMI Laboratory
EMC PROJECT ENGINEER:	Charlie Bautsch, 281-483-0222
NASA JSC EMC LEAD:	Robert C. Scully, 281-483-1499
TEST MANAGER:	Xiang Ni, 281-483-0186
TEST OPERATOR(S):	Cynthia Hightower, 281-483-4476 Charles Brooks, 281-483-8402

Test Report Summary

The Transceiver and Transmitter Adapters are part of the AMS02 ISS Digital Data Recorder System (DDRS). They convert between USB and HRDL fiber optic signals. There is one module for transmit (Tx) and one for receive (Rx). The DDRS ensures data integrity in the event of ISS data systems and/or payload outages. The following tests (RE02 and RS03) were performed for EMI/EMC certification of the Tx and Rx adapters per SSP 30237.

August 19, 2010

- RE02, Radiated Emissions, Electric Field (14 kHz–10 GHz, 13.5 GHz–15.5 GHz)
  - The AMS02 Tx and Rx Adapters meet the specified requirements for RE02.

August 20, 2010

- RS03, Radiated Susceptibility, Electric Field (discrete frequencies)
  - The AMS02 Tx and Rx Adapters meet the specified requirements for RS03.

The AMS02 Tx and Rx Adapters are in full compliance with SSP 30237 test requirements.

1.0 INTRODUCTION

This test report details the preparations for, and results of, the Electromagnetic Interference/Compatibility (EMI/EMC) testing accomplished for ISS certification of the Alpha Magnetic Spectrometer (AMS02) Transmitter and Receiver Adapters.

2.0 APPLICABLE DOCUMENTS

The following documents of the exact issue shown form a part of this Test Report to the extent specified herein. In the event of conflict between the documents referenced herein and the contents of this report, this document shall have precedence.

SSP 30237, Rev. R Dated: January 31, 2007	Space Station Electromagnetic Interference Emission and Susceptibility Requirements
ESCG-5132-06-BDL-DOC-0056 Dated August 2006	Electromagnetic Interference/Compatibility Laboratory Test Methods
JSC 27933, Rev B Dated March 05, 2004	EMI/EMC Laboratory Configuration Document

3.0 CONFIGURATION OF THE EQUIPMENT UNDER TEST

The AMS02 Tx and Rx Adapters are configured for testing as shown below. The adapter modules are powered by the T61 laptop computer's USB power source of 5 Vdc through the USB cables. A fiber optic cable is used to a provide loop-back for the HRDL signals at 6 Mbps.

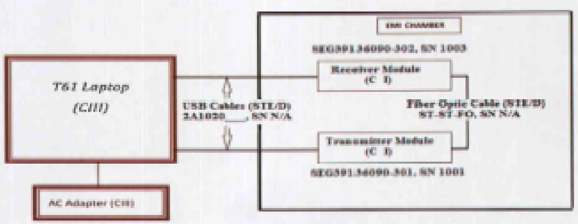


Fig. 3.1. General Test Configuration for the AMS02 Tx & Rx Adapters

EV5-10-EMC-019R
August 31, 2010

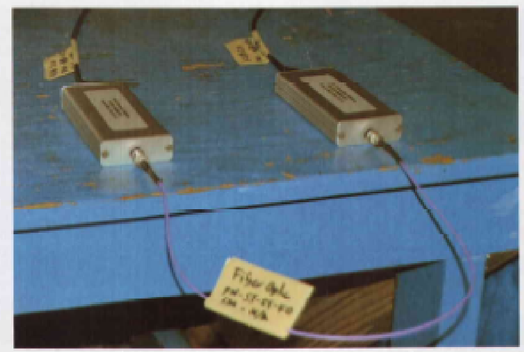


Fig. 3.2. AMS02 Tx and Rx Adapter Assemblies

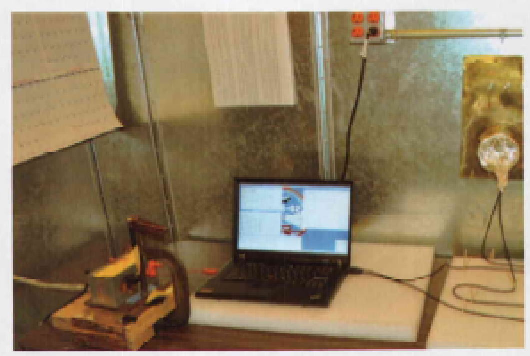


Fig. 3.3. Test Support Equipment for the AMS02 Tx and Rx Adapters

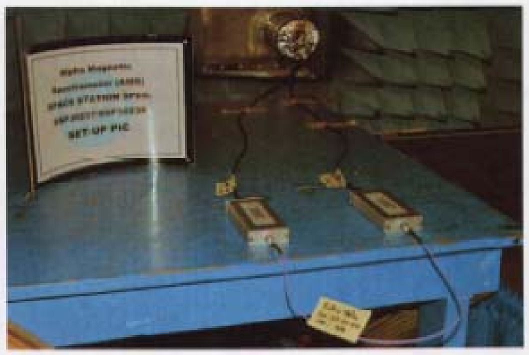


Fig. 3.4. Test Setup for the AMS02 Tx and Rx Adapters

4.0 TEST RESULTS

This section provides details of the tests performed per Space Station requirements. Test results indicate that the AMS02 Tx and Rx Adapters are in compliance with the requirements of SSP 30237, as shown in TABLE 4-1. The radiated susceptibility test, RS03, is evaluated at the discrete frequencies listed in TABLE 4-2. These frequencies and test levels are based on RF emitter sources located on the ISS.

TABLE 4-1
Test Results (SSP 30237)

EMI TEST	DESCRIPTION	COMPLY? Y/N
RE02	Radiated Emissions Electric Field 14 kHz-10 GHz, 13.5-15.5 GHz	Y
RS03	Radiated Susceptibility Electric Field Refer to TABLE 4-2	Y

TABLE 4-2
RS03 Discrete Frequencies and Test Levels

System Name	Frequency (MHz)	Required Levels V/m
ORLAN Korona VHF2 (EVA Voice)	121.125	5
ORLAN Korona VHF2 (EVA Voice)	121.75	5
FGB TORU (TOPY) - Dipole		
Progress TORU (A9)		
Soyuz VHF2 (A1)		
SM Voice (VHF-2) (EVA mode)	130.167	5
SM Voice (VHF-2) (Space to Ground)		
SM Voice (VHF-1)	143.625	5
FGB Sirius (ARISS) - VHF	145 - 148	5
SM ARISS - VHF		

TABLE 4-2 (continued)
RS03 Discrete Frequencies and Test Levels

System Name	Frequency (MHz)	Required Levels V/m
Progress Telemetry (A1)	166.15	5
Soyuz Telemetry (A2)		
UHF-ATC Antenna	243	5
ORLAN Transit Telemetry	247	5
UHF-ATC Antenna	259.7	5
UHF-ATC Antenna	296.8	5
SM GTS 1 (UHF)	400.1	30
WVS UHF Antenna (Spread Spectrum)	400.175 - 400.975	30
WVS (Command) Payload Bay		
SSCS Airlock Antenna	414.2	30
UHF SSCS External Antenna (Lab Module) High Power		
UHF SSCS External Antenna (Lab Module) Low Power		
UHF SSCS External Antenna (Port P1 Truss) High Power		
UHF SSCS External Antenna (Port P1 Truss) Low Power		
SSCS SSER		
SSO Airlock		
SSO UHF SSCS Payload Bay Antenna (High Power)		
SSO UHF SSCS Payload Bay Antenna (Low Power)		
SSCS Airlock Antenna	417.1	30
UHF SSCS External Antenna (Lab Module) High Power		
UHF SSCS External Antenna (Lab Module) Low Power		
UHF SSCS External Antenna (Port P1 Truss) High Power		
UHF SSCS External Antenna (Port P1 Truss) Low Power		
SSCS SSER		
SSO UHF SSCS Payload Bay Antenna (High Power)		
SSO UHF SSCS Payload Bay Antenna (Low Power)		
SM ARISS UHF	435 - 438	30
FGB Television (KL-108A)	463	5
FGB TORU (TOPY) - Slot		
DC1 A52 Television		
SM Television		
Progress Television (A2, A10)		
Soyuz Television (A13, A14)		
SM Telemetry	628	5
SM Telemetry	630	5
FGB Telemetry (BP-9TY)(БР-9ЦУ)	632	5

TABLE 4-2 (continued)
RS03 Discrete Frecuencies and Test Levels

System Name	Frequency (MHz)	Required Levels V/m
FGB Telemetry (BP-9TY)(БР-9ЦУ)	634	5
TVIS (Heart Monitor)	868.35	5
Instrumented EVA Worksite Interface (I-WIF)	902	5
External Wireless Instrumentation System (EWIS) Antenna	915	5
Wireless Instrumentation System (WIS) Antenna		
Wireless Instrumentation System (WIS) Antenna		
Aft Thrust Structure Micro-SGU	916.5	5
Micro TAU		
OMS Pod Micro-SGU		
SRMS Wireless Strain Gauge Instrumentation System (WSGIS)	916.7	5
SSO Wing Leading Edge		
Wide Band Micro TAU (WBMTAU)		
Progress Command(A3, A4, A7, A8)	922.76	5
Soyuz Command (A11, A12)		
Soyuz Command (A3, A4, A5, A6, A7, A8)		
SM Command (Regul) HGA	924.6	5
SM Command (Regul) LGA		
SSO TACAN	962 - 1213	25
SM GTS 2 (X-Dipole)	1428 - 1430	25
S-Band Payload Interrogator Antenna	2025 - 2120	25
JEM Prox (Aft Antenna) - High Power	2030.4	25
JEM Prox (Upper Antenna) - High Power		
JEM Prox (Forward Antenna) - High Power		
JEM Prox (Aft Antenna) - Low Power		
JEM Prox (Upper Antenna) - Low Power		
JEM Prox (Forward Antenna) - Low Power		
WAS SM --> ATV (WAS Ant) Forward SM to ATV	2030.43	25
WAL SM --> ATV (WAL Ant) Forward SM to ATV		
ATV Prox Ant (Return ATV to ISS)	2205	25
HTV PLS Zenith (High Power)		
HTV PLS Zenith (Low Power)		
HTV PLS Nadir (High Power)		
HTV PLS Nadir (Low Power)		

TABLE 4-2 (continued)
RS03 Discrete Frequencies and Test Levels

System Name	Frequency (MHz)	Required Levels V/m
S-Band Quad Antennas	2217.5	25
RokvISS (Robotic Komponent Verification on ISS)	2239.4	25
ACES - S-Band Downlink (ISS)	2248	25
S-Band Hemi Antenna	2250	25
S BD ACS High Gain Antenna	2265	25
S BD ACS Low Gain Antenna		
ATV TDRS Ant (Return ATV to TDRSS)	2287.5	25
HTV IOS Zenith (Nominal Operations)		
HTV IOS (Loss of Attitude-Zenith Antenna)		
HTV IOS (Loss of Attitude-Nadir Antenna)		
S-Band Quad Antennas		
FGB Komparus	2366.75	25
FGB Komparus	2367.063	25
802.11 Pre-N Access Point	2400 - 2482	25
802.11 Pre-N Laptop		
RFID		
802.11B Laptop		
Bluetooth Laptop		
Wireless LAN		
Wireless LAN		
WVS S-Band Antenna on EMU		
WVS S-Band Antenna on EMU		
WVS S-Band Antenna on EMU		
WVS S-Band Antenna on EMU		
3M Orbit Radio Tracking	2805	25
Progress Tracking (A5,A6)	2860	25
Soyuz Tracking (A9, A10)		
FGB Tracking (38G6)	2890	25
SM Kurs-P (2AP-BKA)	3230	25
SM Kurs-P (4AO-BKA)	3234	25
SM Kurs-P (AKP-BKA N3 & N4)	3240	25
SM Kurs-P (AP-BKA)		

TABLE 4-2 (continued)
RS03 Discrete Frecuencies and Test Levels

System Name	Frequency (MHz)	Required Levels V/m
FGB Kurs-P Dish (4A0-BKA)	3245	25
FGB Kurs-P Dish (AP-BKA)		
FGB Kurs-P Dish (2AP-BKA)		
FGB Kurs-P (AKP-BKA N3, N4)		
SM Kurs-P (AP-BKA)		
SM Kurs-P (AKP-BKA N3, N4)		
Progress KURS-A (2ASF1-N1, N2)	3294	25
Progress KURS-A (2AO-BKA)		
Soyuz KURS-A (2ASF-N1, N2)		
Soyuz KURS-A		
FGB Kurs-A (AC-BKA)	3294.2 - 3298.9	25
FGB Kurs-A (AKP-BKA N1, N2)		
DC1 KURS-A (AKP-BKA)		
Progress KURS-A (AKR-BKA & AKR-BKA(r))		
Soyuz KURS-A (AKR-BKA & AKR-BKA (z,r))		
Soyuz KURS-A (2AO)	3299	25
ATV KURS-KMTA 1		
ATV KURS-KMTA 2		
SSP 30237 specific callout	8500	20
ACES - Ku-Band Uplink (Ground)	13475	25
SSO Ku-Band Radar Antenna (High Power Mode)	13883	25
SSO Ku-Band Radar Antenna (Low Power Mode)		
SSO Ku-Band Radar Antenna (Medium Power Mode)		
ACES - Ku-Band Downlink (ISS)	14703.4	25
KU BD SGS (Failure mode)	15003.4	25
KU BD SGS (normal mode)		
SSO Ku-Band Antenna		
SM Ku-Band (Lira)	15155	25
SSO MSBLS	15460	25

4.1 RE02, Radiated Emissions, 14 kHz – 10 GHz; 13.5 – 15.5 GHz

The test data show in Fig. 4.1.1. indicates compliance of the AM302 Tx and Rx Adapters with RE02 test requirements. Fig. 4.1.2. through Fig. 4.1.13. show the test data and test setups for the applicable antenna frequency ranges, including horizontal and vertical polarizations as required in SSP 30237.

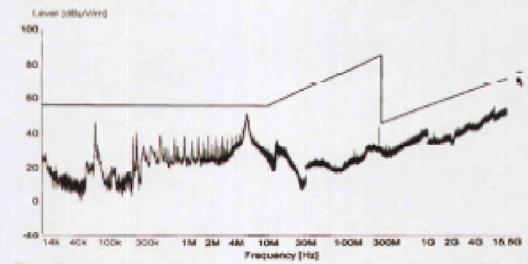
Test Date: 08/19/2010 Test Time: 4:05 pm - 4:36 pm
SECTION: 11.2 STEPS: 5-6 (RE02) (PASSED)

TPS 2A1020166 Page 37 of 50

EUT NAME:	Alpha Magnetic Spectrometer (AMS) Emitter & Receiver Adapter
TEST CLASSIFICATION:	Certification
PP.NO: PPD.NO:	EV5-10-EMC-019R 2A1020166
TEST SITE:	JSC B14A Rm. 1000
OPERATOR:	Cynthia Hightower, Charles Brooks
TEST SPECIFICATION:	Radiation Emissions Space Station Spec. SSP30237 Frequency Range 14 kHz -10 GHz 13.5-15.5 GHz

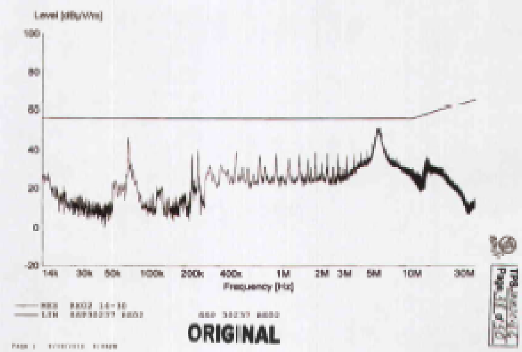
SCAN TABLE: "SSP30237 RE02"
Short Description: SSP30237 RE02

Start Frequency	Stop Frequency	Step Width	Detector	Meas. Time	IF Bandw.	Transducer
14.0 kHz	50.0 kHz	100.0 Hz	MaxPeak	10.0 ms	200 Hz	SAS-200/550-1 420
50.0 kHz	250.0 kHz	500.0 Hz	MaxPeak	10.0 ms	1 kHz	SAS-200/550-1 420
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
30.0 MHz	200.0 MHz	50.0 kHz	MaxPeak	5.0 ms	100 kHz	3104C 4708 4714
200.0 MHz	1.0 GHz	50.0 kHz	MaxPeak	5.0 ms	100 kHz	93490-1 1109 1110
1.0 GHz	10.0 GHz	500.0 kHz	MaxPeak	5.0 ms	1 MHz	3115 S/N 6059
13.5 GHz	15.5 GHz	5.0 MHz	MaxPeak	5.0 ms	10 MHz	3115 S/N 6059



ORIGINAL

Fig. 4.1.1. RE02 Test Data



ORIGINAL

Fig. 4.1.2. RE02 Test Data, Rod Antenna,
14 kHz -30 MHz

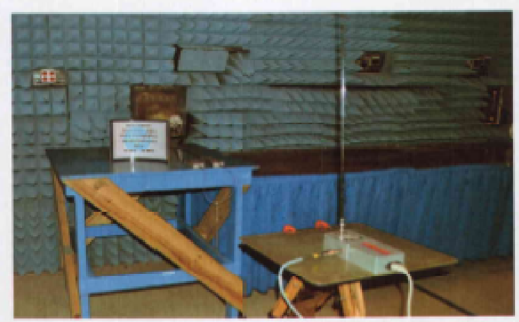


Fig. 4.1.3. RE02 Test Setup, Rod Antenna,
14 kHz -30 MHz

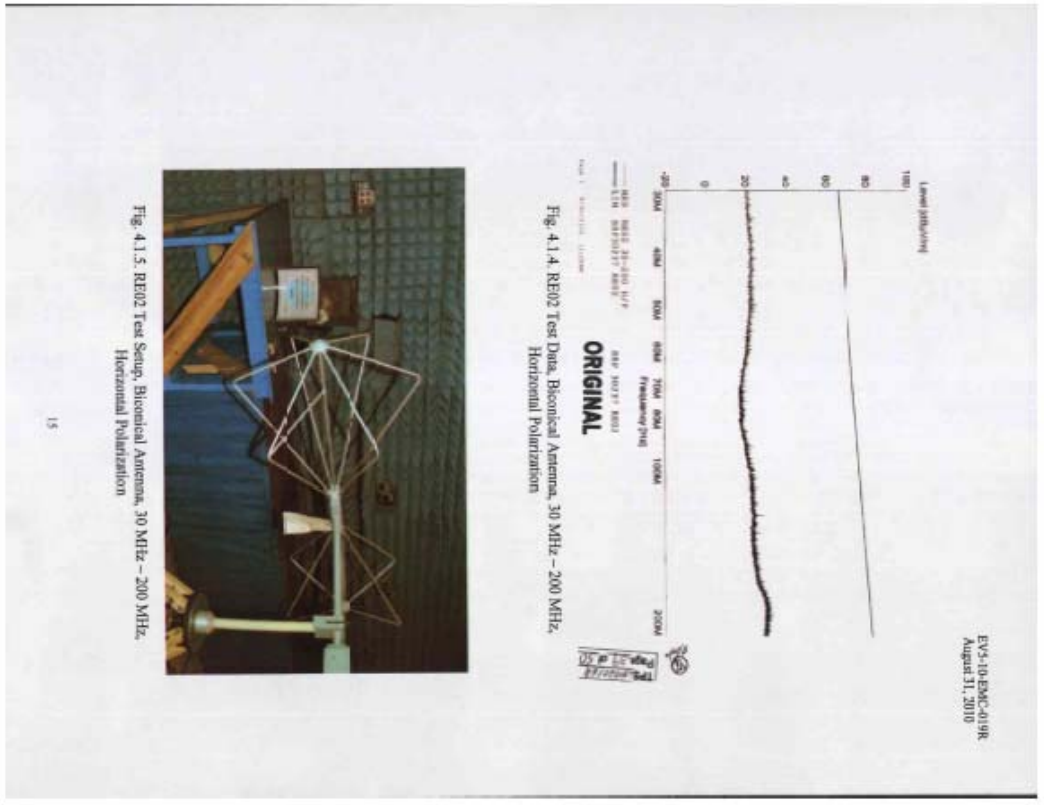


Fig. 4.1.4 RE02 Test Data, Biconical Antenna, 30 MHz – 200 MHz, Horizontal Polarization

Fig. 4.1.5 RE02 Test Setup, Biconical Antenna, 30 MHz – 200 MHz, Horizontal Polarization

15

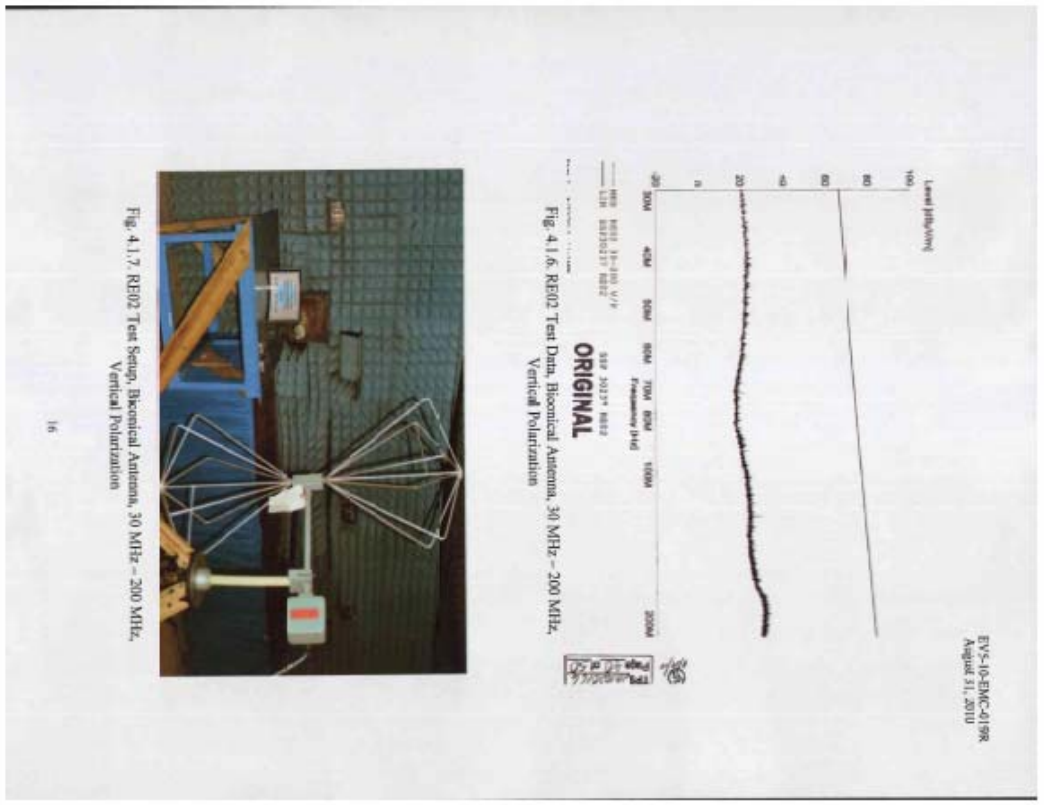


Fig. 4.1.6. RE02 Test Data, Biconical Antenna, 30 MHz – 200 MHz, Vertical Polarization

Fig. 4.1.7. RE02 Test Setup, Biconical Antenna, 30 MHz – 200 MHz, Vertical Polarization

16

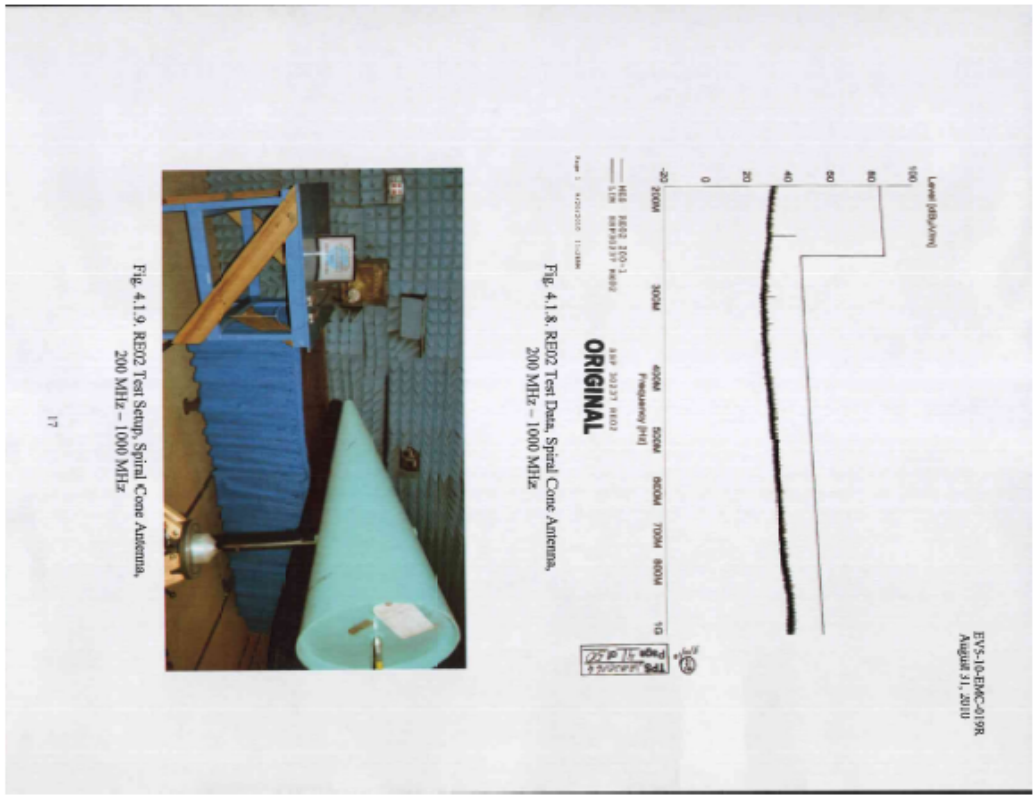


Fig. 4.1.8. RE02 Test Data, Spiral Cone Antenna, 200 MHz – 1000 MHz

Fig. 4.1.9. RE02 Test Setup, Spiral Cone Antenna, 200 MHz – 1000 MHz

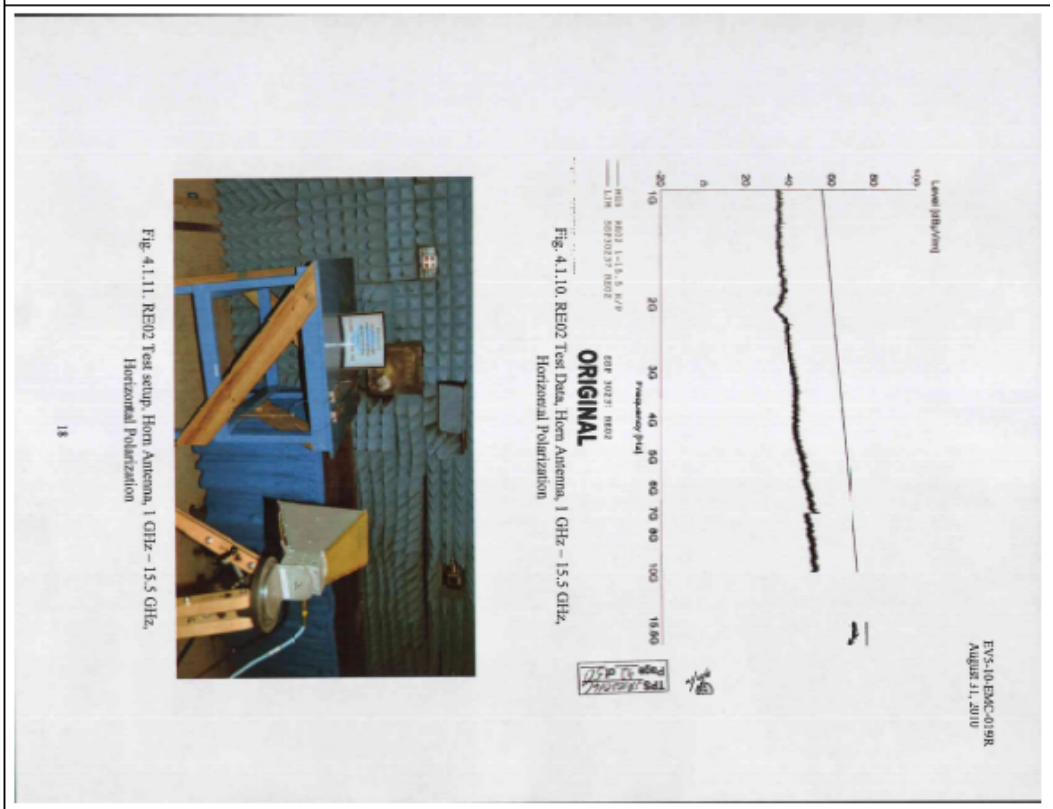


Fig. 4.1.10. RE02 Test Data, Horn Antenna, 1 GHz – 15.5 GHz, Horizontal Polarization

Fig. 4.1.11. RE02 Test setup, Horn Antenna, 1 GHz – 15.5 GHz, Horizontal Polarization

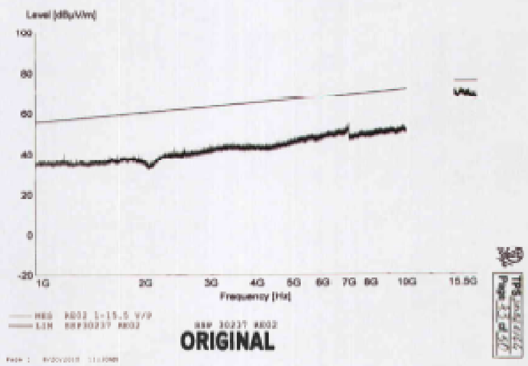


Fig. 4.1.12. RE02 Test Data, Horn Antenna, 1 GHz – 15.5 GHz, Vertical Polarization

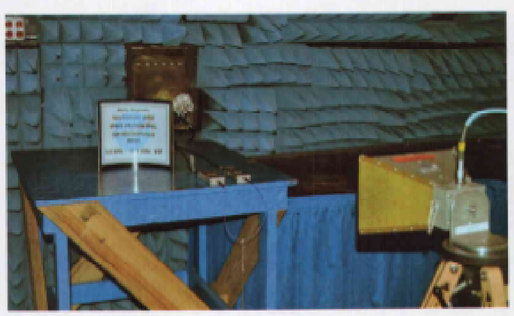


Fig. 4.1.13. RE02 Test Setup, Horn Antenna, 1 GHz – 15.5 GHz, Vertical Polarization

4.2 RS03, Radiated Susceptibility, Discrete Frequencies

The following test data shown for RS03 is based on the discrete ISS Emitter Frequencies listed in TABLE 4-2. The measured data shown in TABLE 4.2-1 is for horizontal antenna polarization. The measured data shown in TABLE 4.2-2 is for vertical antenna polarization. The test data demonstrates compliance of the AMS Tx and Rx Adapters with the RS03 test requirements. Fig. 4.2.1. through Fig. 4.2.6. show test set-ups for the applicable frequency ranges and antenna polarizations.

TABLE 4.2-1
RS03 Test Data, Discrete Frequencies, Horizontal Polarization

Horizontal Polarization (Discrete Frequencies)					
FREQUENCY (MHz)	SSP30237 Limit (V/m)	Injected Test Signal		Remarks	Test Sample Response
		Probe #1 Level (V/m)	Probe #2 Level (V/m)		
128.125	5.00	4.60	5.25	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
121.750	5.00	4.60	5.14	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
130.167	5.00	3.49	5.46	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
143.635	5.00	1.14	5.01	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
145.000	5.00	1.08	5.55	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
148.000	5.00	1.24	5.46	AMS Pass Maintain R.F. V/m Level @ Limit	↓

TABLE 4.2-1 (continued)
RS03 Test Data, Discrete Frequencies, Horizontal Polarization

Horizontal Polarization (Discrete Frequencies)

FREQUENCY (MHz)	SSP30237 Limit (V/m)	Injected Test Signal Probe #1 Level (V/m)	Injected Test Signal Probe #2 Level (V/m)	Remarks	Test Sample Response
[illegible]	5.00	3.50	5.18	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
243.000	5.00	4.23	5.18	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
247.000	5.00	4.23	5.15	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
259.720	5.00	4.06	5.43	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
298.800	5.00	4.61	5.28	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
400.150	30.50	28.31	30.84	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
400.175	30.00	27.56	30.40	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
400.275	30.00	28.10	30.40	AMS Pass Maintain R.F. V/m Level @ Limit	↓
414.200	30.00	24.20	30.50	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
417.100	30.00	19.79	30.10	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
435.200	30.00	23.17	30.50	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
436.300	30.00	24.71	30.10	AMS Pass Maintain R.F. V/m Level @ Limit	↓
482.500	5.00	4.31	5.55	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
528.500	5.00	4.30	5.33	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
530.000	5.00	4.18	5.08	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
532.000	5.00	4.67	4.97	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
534.000	5.00	4.80	5.18	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
888.350	5.00	5.63	4.49	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
902.000	5.00	4.46	5.39	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
915.000	5.00	4.31	5.51	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
916.500	5.00	4.27	5.45	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
916.700	5.00	4.32	5.61	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
922.780	5.00	4.60	5.50	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
924.500	5.00	4.46	5.17	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
962.000	25.00	25.49	24.85	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
1213.000	25.00	21.08	25.84	AMS Pass Maintain R.F. V/m Level @ Limit	↓
1428.000	25.00	24.87	25.38	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
1400.000	25.00	25.07	28.11	AMS Pass Maintain R.F. V/m Level @ Limit	↓
2025.000	25.00	20.33	25.21	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
2120.000	25.00	18.76	25.70	AMS Pass Maintain R.F. V/m Level @ Limit	↓
2200.600	25.00	22.77	25.56	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
2200.400	25.00	22.77	25.84	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
2205.000	25.00	24.61	26.22	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
2217.800	25.00	24.63	25.25	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
2235.400	25.00	22.28	25.57	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
2246.000	25.00	20.84	25.37	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
2250.000	25.00	20.92	25.71	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible

TABLE 4.2-1 (continued)
RS03 Test Data, Discrete Frequencies, Horizontal Polarization

Horizontal Polarization (Discrete Frequencies)

FREQUENCY (MHz)	SSP30237 Limit (V/m)	Injected Test Signal Probe #1 Level (V/m)	Injected Test Signal Probe #2 Level (V/m)	Remarks	Test Sample Response
2265.000	25.00	19.90	25.36	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
2287.500	25.50	25.40	26.09	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
2288.750	25.00	25.20	25.18	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
2287.083	25.00	25.27	25.18	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
2410.000	25.00	26.62	24.36	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
2480.000	25.00	22.23	25.86	AMS Pass Maintain R.F. V/m Level @ Limit	↓
2808.000	25.00	21.73	25.43	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
2860.000	25.00	25.46	25.43	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
2890.000	25.00	20.54	25.29	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
3230.000	25.00	23.02	25.26	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
3234.000	25.00	23.03	25.08	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
3240.000	25.00	23.87	25.98	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
3245.000	25.00	24.14	25.60	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
3284.000	25.00	20.47	25.60	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
3294.300	25.00	20.45	26.41	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
3298.900	25.00	20.47	25.87	AMS Pass Maintain R.F. V/m Level @ Limit	↓
3299.000	25.00	20.24	25.17	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
6900.000	20.00	20.73	19.29	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
13475.000	25.00	26.61	18.13	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
13860.000	25.00	25.22	15.42	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
14700.400	25.00	25.62	21.42	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
15000.000	25.00	25.66	21.57	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
15150.000	25.00	25.57	19.29	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
15480.000	25.00	22.08	25.13	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible

EV5-10-EMC-019R
August 31, 2010

TABLE 4.2-2
RS03 Test Data, Discrete Frequencies, Vertical Polarization

Vertical Polarization (Discrete Frequencies)

FREQUENCY (MHz)	SSP30237 Limit (V/m)	Injected Test Signal Probe #1 Level (V/m)	Injected Test Signal Probe #2 Level (V/m)	Remarks	Test Sample Response
125.125	5.00	5.18	4.18	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
121.790	5.00	5.38	4.24	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
136.187	5.00	5.07	5.07	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
143.025	5.00	5.38	4.45	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
145.000	5.00	5.74	4.53	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
148.000	5.00	5.18	4.58	AMS Pass Maintain R.F. V/m Level @ Limit	↓

EV5-10-EMC-019R
August 31, 2010

TABLE 4.2-2 (continued)
RS03 Test Data, Discrete Frequencies, Vertical Polarization

Vertical Polarization (Discrete Frequencies)

FREQUENCY (MHz)	SSP30237 Limit (V/m)	Injected Test Signal Probe #1 Level (V/m)	Injected Test Signal Probe #2 Level (V/m)	Remarks	Test Sample Response
196.100	5.00	5.81	5.43	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
243.000	5.00	5.57	4.27	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
247.000	5.00	5.69	4.30	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
259.700	5.00	5.71	4.30	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
[illegible]	5.00	[illegible]	4.35	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
400.150	30.00	30.20	22.98	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
400.175	30.00	30.90	22.71	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
400.875	30.00	30.70	22.66	AMS Pass Maintain R.F. V/m Level @ Limit	↓
414.200	30.00	30.78	27.71	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
417.100	30.00	30.80	29.48	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
440.000	30.00	30.10	27.40	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
456.000	30.00	30.10	24.70	AMS Pass Maintain R.F. V/m Level @ Limit	↓
463.000	5.00	6.18	5.49	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
526.000	5.00	6.79	5.46	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
530.000	5.00	6.29	5.05	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
532.000	5.00	6.90	5.21	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
534.000	5.00	6.27	4.76	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
568.250	5.00	6.05	5.04	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
902.000	5.00	6.86	4.77	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
915.000	5.00	5.54	4.81	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
916.000	5.00	5.82	4.92	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
918.700	5.00	5.84	4.59	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
922.760	5.00	6.10	4.46	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
984.000	5.00	5.16	4.90	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
992.000	20.00	20.84	22.98	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
1019.000	20.00	20.17	26.10	AMS Pass Maintain R.F. V/m Level @ Limit	↓
1428.000	20.00	21.46	26.85	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
1430.000	20.00	20.14	26.84	AMS Pass Maintain R.F. V/m Level @ Limit	↓
2025.000	20.00	21.96	26.81	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
2120.000	20.00	17.16	26.80	AMS Pass Maintain R.F. V/m Level @ Limit	↓
2200.800	20.00	21.11	26.75	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
2200.800	20.00	23.07	26.72	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
2205.000	20.00	21.94	26.24	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
2217.500	20.00	20.73	26.03	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
2238.400	20.00	20.06	25.10	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
2248.000	20.00	20.47	25.80	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
2250.000	20.00	20.03	26.21	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible

TABLE 4.2-2 (continued)
RS03 Test Data, Discrete Frequencies, Vertical Polarization

FREQUENCY (MHz)	SSP30237 Limit (V/m)	Injected Test Signal Probe #1 Level (V/m)	Probe #2 Level (V/m)	Remarks	Test Sample Response
2265.000	25.00	21.36	25.19	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
2287.500	25.00	25.05	23.13	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
2356.750	25.00	25.27	24.54	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
2387.063	25.00	25.32	24.97	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
2400.000	25.00	24.86	25.23	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
2482.000	25.00	23.10	25.12	AMS Pass Maintain R.F. V/m Level @ Limit	↓
2808.000	25.00	20.14	25.60	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
2860.000	25.00	25.15	20.83	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
2890.000	25.00	25.06	22.80	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
3230.000	25.00	19.11/25.34	25.26	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
3234.000	25.00	16.70	25.62	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
3240.000	25.00	25.02	25.60	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
3268.000	25.00	16.79	25.87	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
3294.000	25.00	18.02	25.09	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
3294.220	25.00	16.01	25.80	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
3296.500	25.00	14.89	26.30	AMS Pass Maintain R.F. V/m Level @ Limit	↓
3299.000	25.00	15.18	25.20	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
8500.000	20.00	20.49	20.55	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
13673.660	22.00	20.12	22.72	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
13663.000	21.00	20.01	17.06	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
14703.400	21.00	25.05	22.81	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
15003.400	22.00	20.91	18.33	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
15155.000	23.00	25.33	15.53	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible
18480.000	21.00	25.06	23.87	AMS Pass Maintain R.F. V/m Level @ Limit	Not Susceptible

Fig. 4.2.1. RS03 Test Setup, Biconical Antenna,
Horizontal Polarization, 30 MHz - 200 MHz

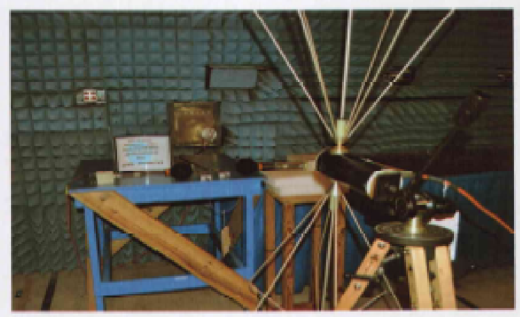


Fig. 4.2.2. RS03 Test Setup, Biconical Antenna,
Vertical Polarization, 30 MHz - 200 MHz

Fig. 4.2.4. RS03 Test Setup, Double Ridge Horn Antenna, Vertical Polarization, 200 MHz – 1000 MHz

Fig. 4.2.3. RS03 Test Setup, Double Ridge Horn Antenna, Horizontal Polarization, 200 MHz – 1000 MHz

Fig. 4.2.6. RS03 Test Setup, Small Double Ridge Horn Antenna, Vertical Polarization, 1 GHz – 15.5 GHz

Fig. 4.2.5. RS03 Test Setup, Small Double Ridge Horn Antenna, Horizontal Polarization, 1 GHz – 15.5 GHz

5.0 CONCLUSIONS

The EMI measured data indicates the AMS Transmitter Adapter, P/N 39136090-301, S/N 1001, and AMS Receiver Adapter, P/N 39136090-302, S/N 1003, are in full compliance with the test requirements specified in SSP 30237.

TABLE 5-1
Test Summary: AMS Tx and Rx Adapters

EMI Test	Description
RE02	Radiated Emissions, Electric Field, 14 kHz - 10 GHz, 13.5 GHz - 15.5 GHz. Passed RE02 on 8/19/2010.
RS03	Radiated Susceptibility, Electric Field, Discrete Frequencies per Table 4-2. Passed RS03 on 8/20/2010.

6.0 APPENDIX

This appendix contains copies of the following documents:

- Task Performance Sheets, 2A1020166
- TRR Checklist
- TRR Attendance Sheet
- Test Request – JSC Form 90
- Test Readiness Review Summary Sheet Form 1850
- Test Readiness Review Board – Form EA-005
- Test Facility Authorized Operators List
- EUT Certified Operators List
- Facility Readiness Statement Memo
- EMI Lab Safety Briefing Sheets
- EMI Lab Sign-In Sheets
- Test in Progress Authorized Personnel Sign
- Pre-Test Checklist
- Test Process Evaluation Sheet
- Test Plan, EV5-10-EMC-019P
- Measured Data
- Integrated Test Hazard Analysis Report

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SVM 10.a2.1

Engineering and Science Contract Group

2224 Bay Area Boulevard
Houston, Texas 77058

September 2, 2010
ESCG-4470-10-TEAN-DOC-0130

To: J. C. Tutt ESCG

Via: J. L. Cox ESCG

Reviewed by: M. R. Vogel ESCG

From: C. S. Clark ESCG

Subject: **Touch Temperature Analysis for Alpha Magnetic Spectrometer (AMS-02) ISS Digital Data Recording System (DDRS)**

The AMS-02 ISS Digital Data Recording System (DDRS) is used to record high rate data generated by the AMS-02 payload on the International Space Station (ISS). The DDRS consists of a T61p ISS Laptop, two USB/HRDL Adapter Assemblies and various interface cables. The DDRS will be mounted to a flexible arm on an ExPRESS Rack in the U.S. Lab section of ISS. This report will show that the DDRS meets the requirements for bare skin contact temperature.

The T61p ISS Laptop is standard ISS hardware that requires no additional analysis. The cables are passive and also require no touch temperature analysis. This analysis will focus on the USB/HRDL Adapter Boxes, which do dissipate heat.

Each USB/HRDL Adapter Box is a 4.7" x 2.1" x .9" clear anodized 6063 aluminum box containing electronics. The maximum power dissipation for one box is 2.5 watt. It is assumed that heat will be rejected via radiation and convection from 5 sides of the box (one of the 4.7 x 2.1" sides will be mounted using Velcro and is assumed to be perfectly insulated). Assumptions include an emissivity of 0.75 for the box surface, a radiation sink of 86°F, cabin air temperature of 82°F, and an airflow rate of 10 ft/min [1].

With these assumptions, the surface of the USB/HDRL Adapter Box reaches a maximum temperature of 119°F. This is below the 120°F limit specified for bare skin contact for metallic surfaces [2].

Craig S. Clark
Thermal and Environmental Analysis Section
Engineering and Science Contract Group

Engineering and Science Contract Group

2224 Bay Area Boulevard
Houston, Texas 77058

References

1) "EXpedite the PRocessing of Experiments to Space Station (EXPRESS) Rack Payloads Interface Definition Document", SSP 52000-IDD-ERP, Rev. H, International Space Station Program, September 2009.
2) "Interpretation of NSTS/ISS Payload Safety Requirements", NSTS/ISS 18798 Rev B, NASA- Lyndon B. Johnson Space Center, September 1997.

Distribution

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SVM 11.b.1:

Engineering and Science Contract Group

2224 Bay Area Boulevard
Houston, Texas 77058

ESCG-4295-10-ADV SY-MEMO-0041
21 September 2010

TO: Leland Hill, Chris Tutt, Phil Mott, Wes Gordon

FROM: Duong V. Nguyen

SUBJECT: AMS-02 ISS DDRS Electrical Power Distribution and Mating/Demating of Powered Connectors

When the Alpha Magnetic Spectrometer (AMS-02) payload is operated on the International Space Station (ISS); it will utilize the ISS Digital Data Recorder System (DDRS) as shown in Figure 1 below to:

- Provide recording (24/7) on-board the ISS for AMS-02 payload data
- Provide play-back capability to downlink lost or corrupted AMS-02 payload data
- Protect for ISS data systems, as well as AMS-02 payload, outages
- Allow for contingency crew monitoring of AMS-02 payload status
- Allow for contingency crew commanding of AMS-02 payload systems.

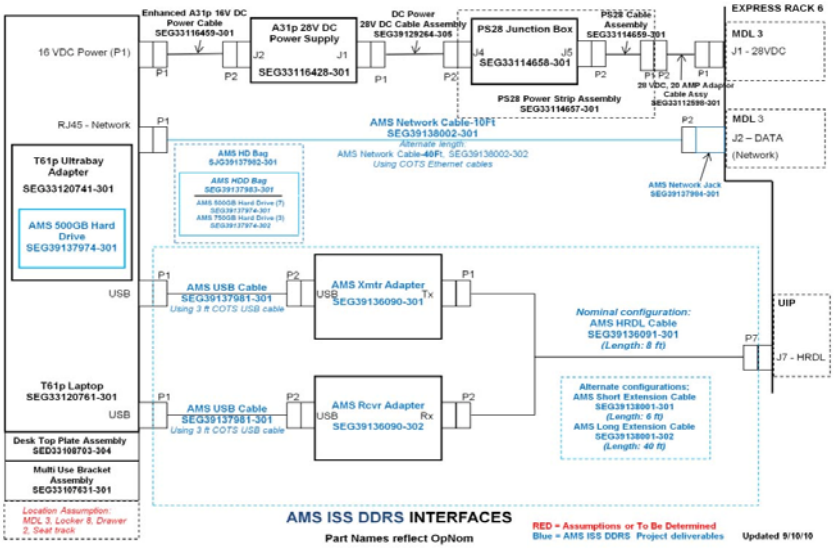


Figure 1. AMS-02 ISS DDRS System Block Diagram

Memorandum
(Continued)
Page 2 of 3

AMS-02 ISS DDRS System consists of:

Government Furnished Equipment

- T61p Laptop Assembly p/n SEG33120761-301
  T61p 160 GB Prime Hard Drive (installed) p/n SEG33120738-301
  T61p Internal Battery (installed) p/n SEG33120739-301
  T61p Ultrabay Adapter (installed) p/n SEG33120741-301
- Enhanced A31p 16VDC Power Cable p/n SEG33116459-301
- A31p 28VDC Power Supply p/n SEG33116428-301
- 28VDC Cable p/n SEG39129264-305
- PS28 Power Strip Assembly p/n SEG33114657-301
  PS28 Junction Box p/n SEG33114658-301
  PS28 Cable p/n SEG33114659-301
- 28VDC, 20A Adapter p/n SEG33112598-301
- Desk Top Plate p/n SED33108703-304
- Multi-Use Bracket p/n SEG33107631-301

AMS Project Furnished Equipment

- AMS Network Cable-10 FT p/n SEG39138002-301
- AMS Network Cable-40 FT p/n SEG39138002-302
- AMS Network Jack p/n SEG39137984-301
- AMS HRDL Cable p/n SEG39136091-301
- AMS USB Cable p/n SEG39137981-301
- AMS Xmtr Adapter p/n SEG39136090-301
- AMS Rcvr Adapter p/n SEG39136090-302
- AMS Short Extension Cable p/n SEG39138001-301
- AMS Long Extension Cable p/n SEG39138001-302
- AMS HD Bag Kit p/n SJG39137982-301
  AMS HDD Bag p/n SEG39137983-301
  AMS 500GB HD p/n SEG39137974-801
  AMS 750GB HD p/n SEG39137974-802

As shown in Figure 1 above, the GFE T61p laptop is powered by ISS Express Rack 28 VDC and will use a GFE power supply and cabling to directly interface with the ISS Express Rack power system. Mating and demating of the GFE power supply will be accomplished by the standard procedures associated with the GFE laptop. GFE hardware will be utilized in accordance with its' GFE certification and will be referenced to satisfy the requirement of Letter TA-92-03.

ESCG ENGINEERING & SCIENCE CONTRACT GROUP JACOBS
ERC | Barrios | GeoControl | Hamilton Sundstrand | MEI

Memorandum
(Continued)
Page 3 of 3

AMS Xmtr/Rcvr Adapters which provides in-line conversion of HRDL signal to a standard USB interface is powered by GFE T61p Laptop USB bus and connected via AMS USB Cables.

GFE T61p Laptop USB bus is rated at 5 +/- .25 VDC and current limited at 500 mA. Since power supply's open circuit voltage is not greater than 32 VDC and designed to limit current to 3 A or less; it meets the low-power connections criteria of letter MA2-99-170 and crew mating/demating of powered connectors of AMS USB Cables for payload operations is allowed.

This memo is submitted as formal closure of Safety Verification Method (SVM) 11.b.1 and 14.a.1 of Hazard Report (HR) Number STD-ISS-DDRS-01. It provides confirmation that ISS powered DDRS System meets circuit protection requirements of letter TA-92-038 and low power critieria of letter MA2-99-170.

SVM 13.c.1

Engineering and Science Contract Group
2224 Bay Area Boulevard
Houston, Texas 77058

ESCG-4530-10-GFESEI-MEMO-0025
22 September 2010

TO: Leland Hill, Chris Tutt, Phil Mott, Wes Gordon

FROM: George R. Brown

SUBJECT: AMS-02 ISS DDRS Safety Data Pack; Hazard Verification 13.c.1 Rotating Equipment

When the Alpha Magnetic Spectrometer (AMS-02) payload is operated on the International Space Station (ISS); it will utilize the ISS Digital Data Recorder System (DDRS) as shown in Figure 1 below to:

- Provide recording (24/7) on-board the ISS for AMS-02 payload data
- Provide play-back capability to downlink lost or corrupted AMS-02 payload data
- Protect for ISS data systems, as well as AMS-02 payload, outages
- Allow for contingency crew monitoring of AMS-02 payload status
- Allow for contingency crew commanding of AMS-02 payload systems.

The only ISS DDRS payload organization provided hardware that could be considered as "rotating equipment" would be the AMS Hard Drives. The two hard drives are the 500GB Hitachi HTS725050A9A364 COTS Serial Advanced Technology Attachment (SATA) drive and the 750GB Western Digital WD7500BPVT COTS SATA drive.

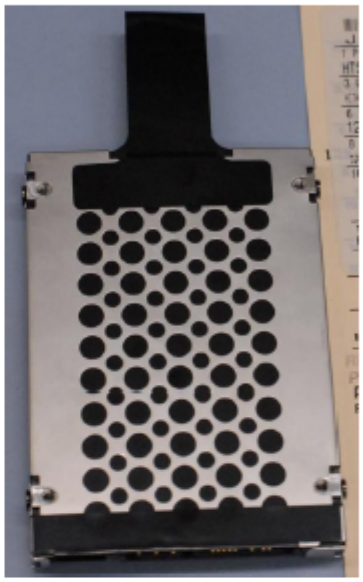
The 500GB Hitachi drive operates at 7200 revolutions per minute (RPM), operates on 5 VDC (±5%) and draws a maximum of 5.5 W peak at startup, 2.0 W during seeks, 1 W during active idle and 0.2 W during standby.

The 750 GB Western Digital drive drive operates at 5400 RPM, operates on 5 VDC (±10%) and draws 1.6 W during seeks, 0.65 W during active idle and 0.2 W during standby.

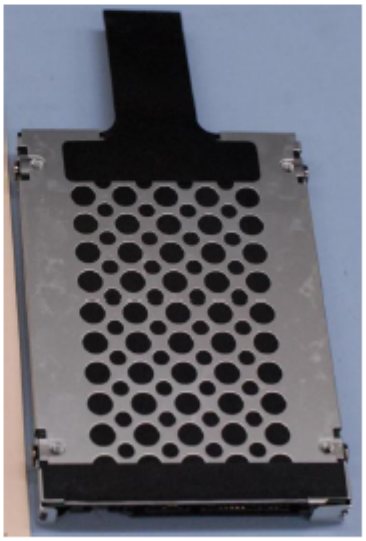
Both drives have received consumer protection certifications from a number of countries, the CE mark of the units indicate that they are approved for use by the European Commission. The Underwriters Laboratory Recognized Component logo for safety certification is visible on all units as well.

These markings along with the standardized size and operational speeds of the hard disks indicate that these units do not pose a unique uncontrolled hazard as rotating equipment and are safe for use on the ISS.

Memorandum
(Continued)
Page 2 of 2



Hitachi 500 GB Hard Disk Drive



Western Digital 750 GB Hard Disk Drive

SVM 15.b.1 (Excerpts)

DATE PREPARED: 5/20/2010 Revision A: 6/22/2010	**ISS PAYLOAD OFFICE PIRN/EXCEPTION FORM**	**PAGE 1 OF 29**

Doc. No., Rev. & Title: SSP 57206, SSP 53100, SSP 53109, SSP 53110, SSP 53111, SSP 57213
EXPRESS Rack Six Hardware Interface Control Document
EXPRESS Rack ICD for Microgravity Experiment Locker/Incubator (MERLIN)
EXPRESS Rack ICD for Potable Water Dispenser (PWD)
EXPRESS Rack ICD for International Space Station Food Warmer (ISSFW)
EXPRESS Rack ICD for Commercial Orbital Transport Services (COTS) Ultra High Frequency (UHF) Communication Unit (CUCU)
Alpha Magnetic Spectrometer-02 Hardware Interface Control Document (AMS)

PIRN No: **57206-NA-0006A**

TITLE: **ER-6 / MERLIN / PWD / ISSFW / CUCU / PS-28 / Condensate Transfer Pump / AMS Laptop Protrusion Exception for Stage ULF5 and Subsequent**

Originator: Name: **Rick Roth** Agency: **Payload Engineering Integration** Phone: **281-961-0464** Email: **James.R.Roth@boeing.com**	PIRN Type: ☐ Standard PIRN ☒ Exception	FAX Approval Signatures to this Number: **314-777-2866**
Utilization Change Engineer: Name: **Michael Maroon** Agency: **Payload Engineering Integration** Phone: **256-961-1139** Email: **Michael.r.maroon@boeing.com**	SSCN/CR/CEF:	RELATED PIRN No.: **57206-NA-0004A** **57206-NA-0005A**
Agency Tracking No.: **57206-0009**	SYSTEM/ELEMENT AFFECTED & STAGE EFFECTIVITY: **EXPRESS Rack 6 for Stage ULF5 and Subsequent****	

REASON FOR CHANGE OR REQUIREMENT(S) VIOLATION:

The EXPRESS Rack 6 (ER-6) does not meet the Protrusion requirements in SSP 57000, paragraphs 3.1.1.7A/B, 3.1.1.7.2B, 3.1.1.7.3A and 3.1.1.7.5; and SSP 52000, paragraph 3.6.2A/B, 3.6.2.2A, 3.6.2.3.A, and 3.6.2.5. The protrusions are a result of ER-6 subrack payloads (i.e., MERLIN and PWD) and the following Systems hardware in or connected to ER-6: the ISS Food Warmers (ISSFW), the CUCU and the PS-28 cable*. In addition, the AMS Laptop and supporting GFE are added to the ER-6 payload complement in violation of SSP 57000, requirement 3.1.1.7.3A and 3.3.8.1D limiting the rack to a single laptop.

NOTES:

*** This exception only addresses the lateral protrusions due to the power cables for the PS-28. Placement of the PS-28 will NOT be on ER-6 and is the responsibility of the Vehicle.**

**** If the ER-6 subrack complement changes the analysis will be re-performed and a new exception issued.**

Revision A: Amended analysis throughout to include the Condensate Transfer Pump; added exception summary bullets to Proposed Exceptions to SSP 57000 and SSP 52000 Requirements; Rationale for Acceptance: added references to Condensate Transfer Pump in paragraph 1 and protrusion summary paragraph to On-orbit Payload Protrusions (Lateral) summary; Replaced Figure 1 so as to include Pump protrusion and explanatory text in graphic; Section 3: deleted reference to EDV in item 2; added reference to Condensate Transfer Pump in item 5; corrected editorial error in item 6 and added text referring to crew preference placement of AMS Laptop on LAB1P4; corrected editorial error in item 8 and added statement about closure of AMS Laptop when not in use by the Crew; Operational Guidelines and Constraints: replaced 'must' with 'shall' in constraint #4; added constraint #9 regarding Condensate Transfer Pump placement; deleted ECLS MEs

AFFECTED INTERFACING PARTIES

	SIGNATURE & ORGANIZATION	DATE	SIGNATURE & ORGANIZATION	DATE	SIGNATURE & ORGANIZATION	DATE
CONCUR	/s/ Mike Miller/ OZ3	8/6/10	/s/ Tony Sapp/ IVCWG	6/28/10	/s/ Kevin Takada/ [illegible]	8/3/10
	/s/ Vic Sanders/ Boeing PEI	8/4/10	/s/ Richard Ellenberger/ NASA [illegible]	6/23/10	/s/ Trent Martin/ AMS PD	7/6/10
	/s/ Bill Bowers/ S&MA	6/27/10	/s/ Wayne Rast/ Crew	7/9/10	N/A OB	
	/s/ Dennis Toney/ EXPRESS [illegible]	6/25/10	/s/ Clif Jones/ POIF	7/3/10	/s/ Amin Rezapour/ ON/CUCU	7/19/10
	/s/ Lee Jordan/ EXPRESS [illegible]	7/6/10			/s/ Rod Jones/ PCB	8/6/10

THE INFORMATION CONTAINED IN THE EXPRESS RACK SIX HARDWARE INTERFACE CONTROL DOCUMENT IS INTERFACE DATA, WHICH IS CLASSIFIED AS EAR99 UNDER THE EXPORT ADMINISTRATION REGULATIONS (ear) (15 CFR 730 et.seq.) RE-EXPORT OR RE-TRANSMISSION IN VIOLATION OF U.S. EXPORT CONTROL LAWS AND REGULATIONS IS PROHIBITED.

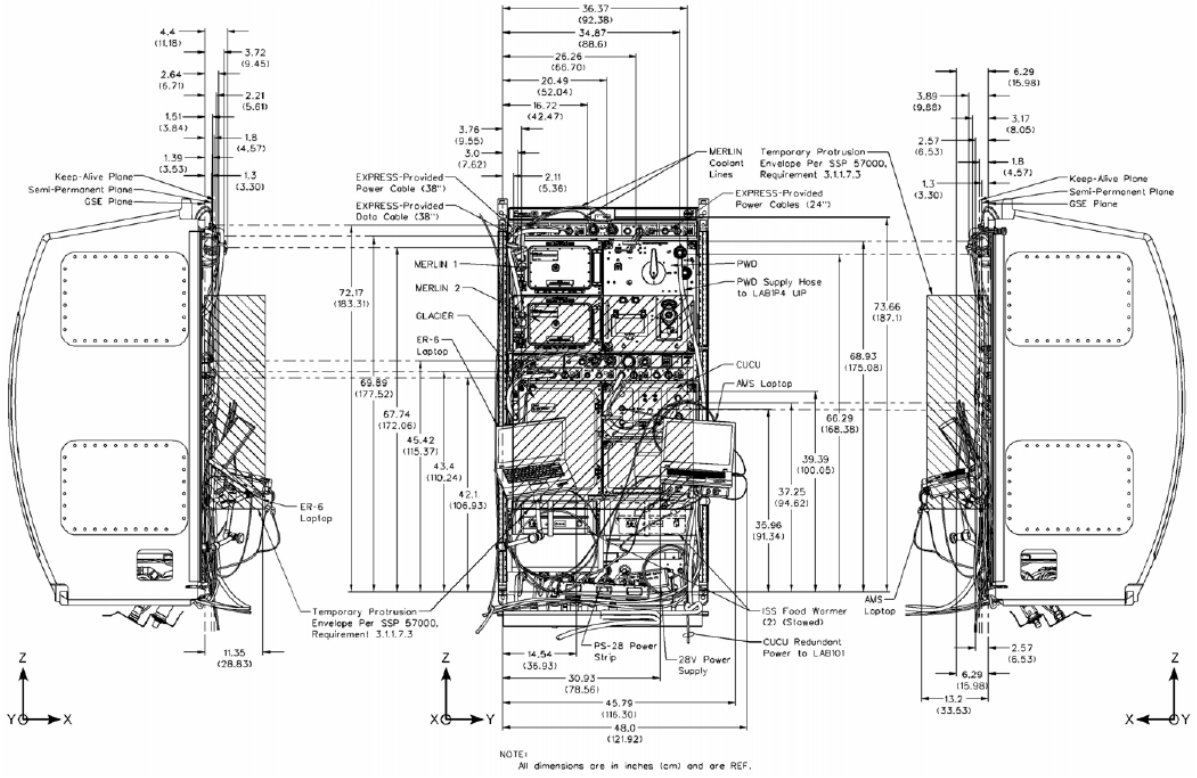


Figure 2 Integrated ER-6 (LAB1O4) Protrusions

4.2 INTRAVEHICULAR ACTIVITY EMERGENCY EGRESS PATH (ME-07)

Description

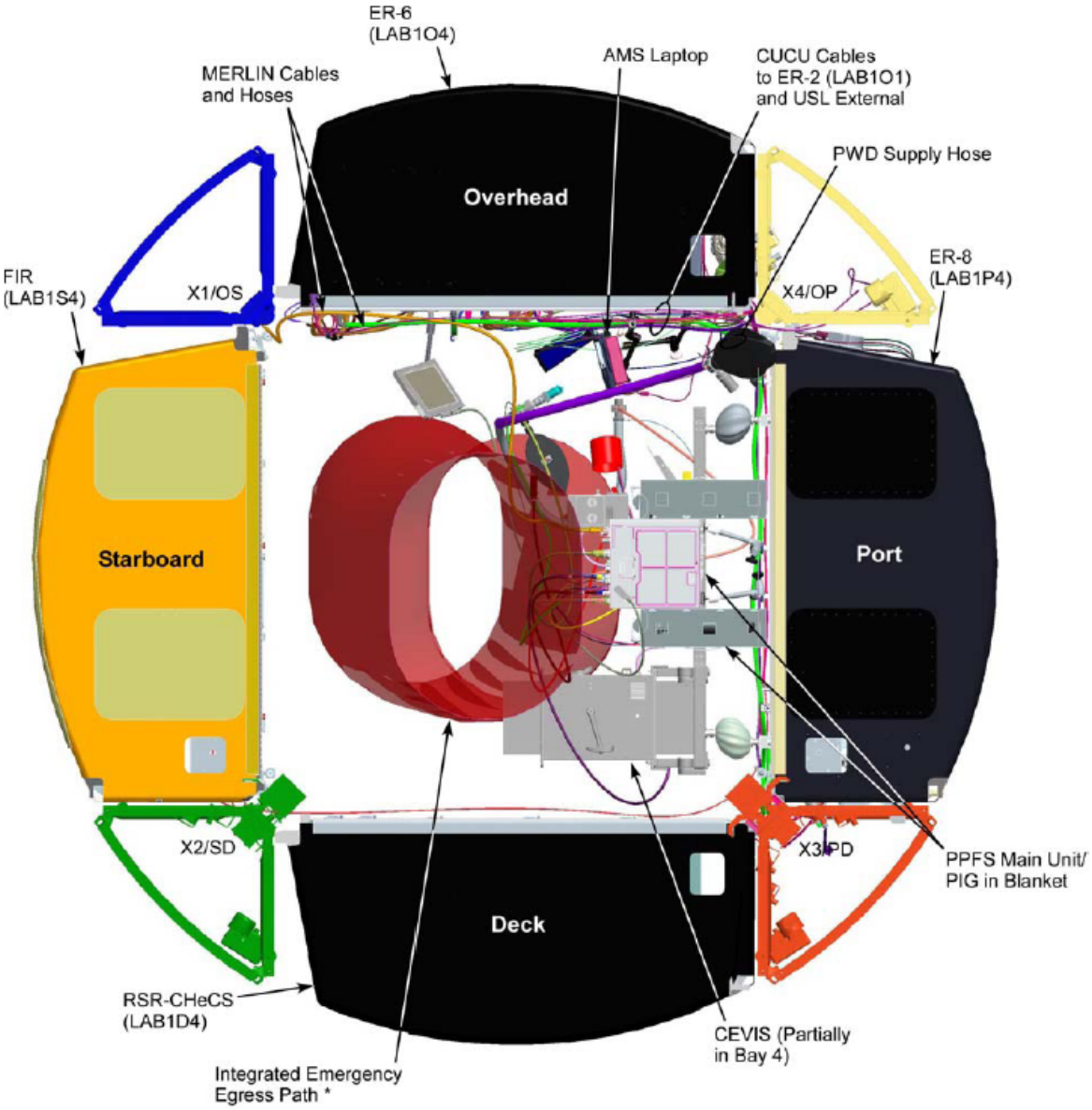
The purpose of the IVA Emergency Egress Path analysis is to ensure adequate clearance is available to provide crewmembers the capability to escape from the US Lab module in the event of a hazardous condition (e.g., fire, smoke, loss of pressure, atmospheric contamination, etc.). The IVA emergency egress path is a 45 by 32-inch (114.3 x 81.28-cm) rectangular path which may bend and curve through the length of the US Lab module. This path may be encroached upon only by operating volumes for crewmembers at worksites and by equipment in-transit. This analysis satisfies the IVA Emergency Egress Path requirements documented in SSP 57011, the Payload Verification Program Plan, CVDS (ME-07).

Results

There is no clear EEP if all Payload and Systems protrusions are deployed simultaneously to their maximum extent. Consequently, there are three possible paths depending on the Payload and Systems protrusions that are deployed as summarized in Table 4.2-1 and Figures 4.2-1, 4.2-2 and 4.2-3. ALL of these protrusions cannot be deployed simultaneously and maintain a clear EEP. As demonstrated by each figure, there are no ER-6-associated intrusions into the EEP in the depicted combinations. Therefore, no guidelines or constraints are required.

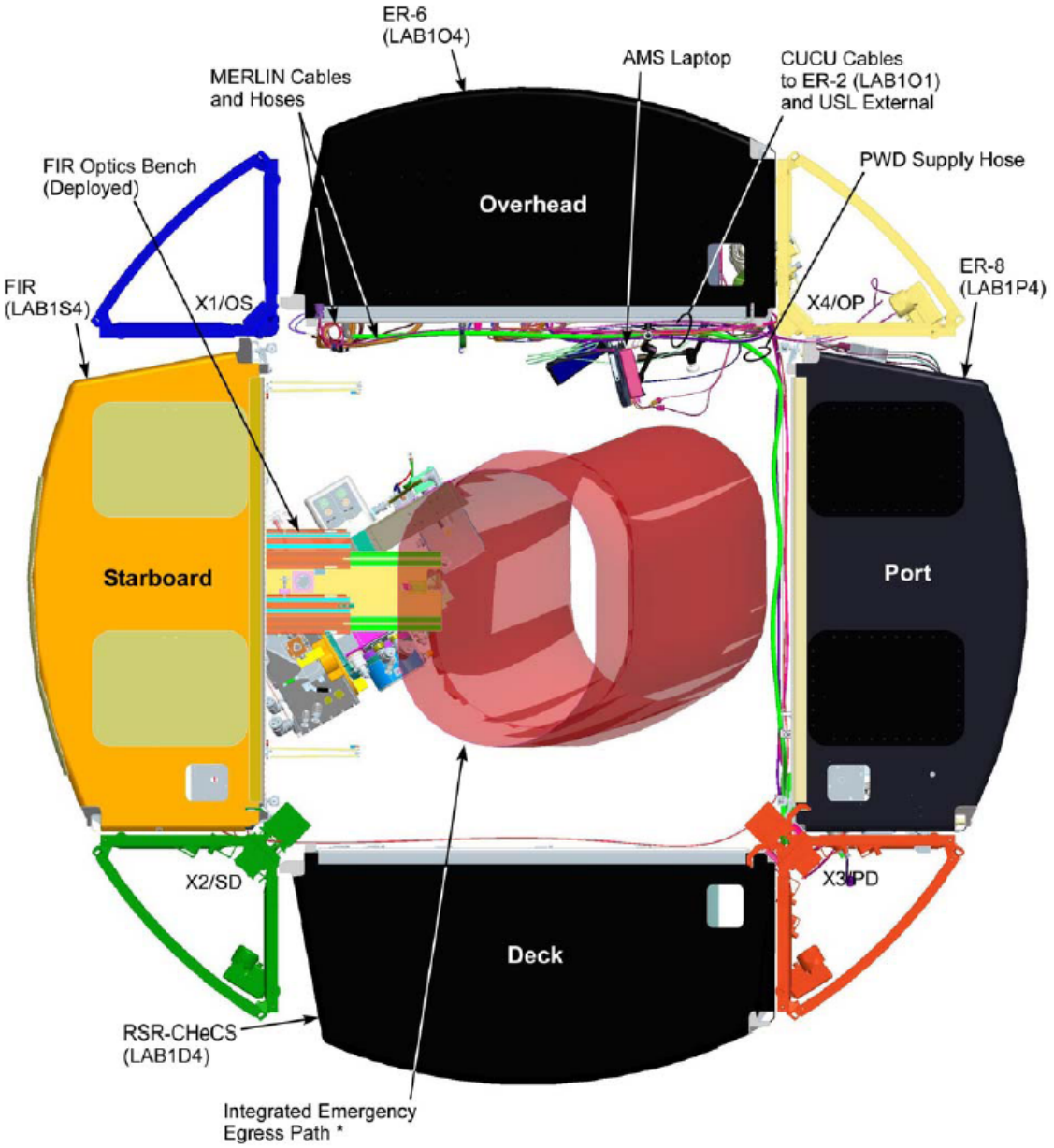
Table 4.2-1 Emergency Egress Path Summary for Multiple Protrusion Scenarios

Path No.	*System/Payload Protrusions Deployed*	*System/Payload Protrusions Stowed*	*Figure No.*	*Requirement Met?*
EEP 1	CEVIS/PPFS deployed	MELFI2 momentary protrusions and the CIR and FIR Optics Benches are stowed	4.2-1	Yes
EEP 2	MELFI2, CIR and FIR Optics Benches	CEVIS and PPFS	4.2-2	Yes
EEP 3	PPFS and FIR Optics Bench	MELFI2 and CIR Optics Bench	4.2-3	Yes



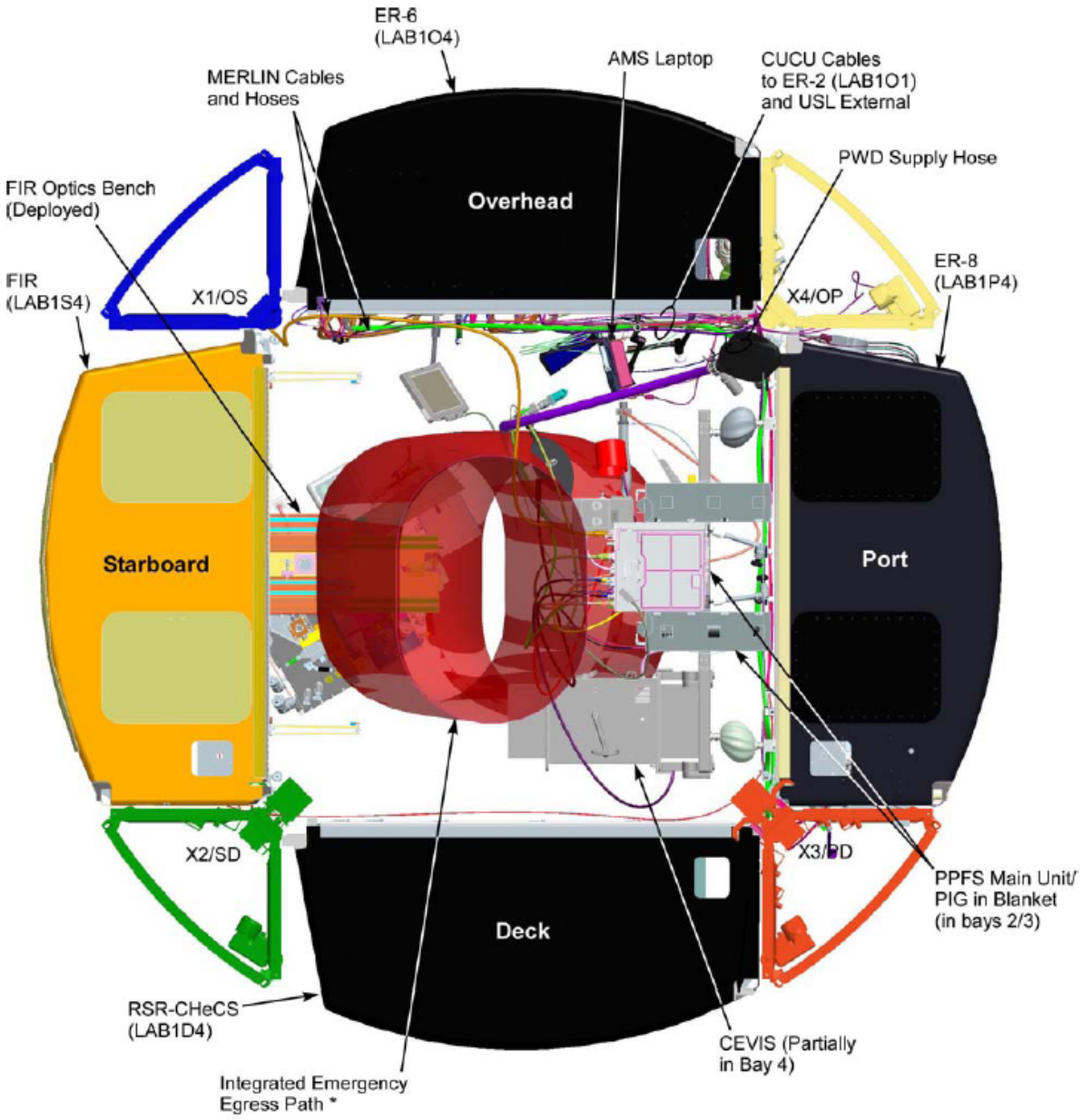
NOTE:
* The Integrated Emergency Egress Path shown is the available Path if the CEVIS and PPFS (not shown) are deployed simultaneously (CIR and FIR Optics Benches and MELFI-2 momentary protrusions are stowed).

Figure 4.2-1 ER-6 (LAB1O4) Protrusions and the Emergency Egress Path – View Looking Aft (Path if CEVIS/PPFS Deployed)



NOTE:
* The Integrated Emergency Egress Path shown is the available Path if the CIR and FIR Optics Benches and the MELFI2 momentary protrusions (not shown) are all deployed simultaneously (CEVIS/PPFS are stowed).

Figure 4.2-2 ER-6 (LAB1O4) Protrusions and the Emergency Egress Path – View Looking Aft (Path if MELFI2, CIR/FIR Optics Benches Deployed)



NOTE:
* The Integrated Emergency Egress Path shown is the available Path if the CEVIS/PPFS and FIR Optics Bench are deployed simultaneously (CIR Optics Bench and MELFI-2 momentary protrusions are stowed).

Figure 4.2-3 ER-6 (LAB1O4) Protrusions and the Emergency Egress Path – View Looking Aft (Path if CEVIS/PPFS and FIR Optics Bench Deployed)

ATTACHMENT E

NSTS/ISS PAYLOAD SAFETY VERIFICATION TRACKING LOG a. FLIGHT **X** GROUND

c. ISS Digital Data Recording System (DDRS)(AMS-02)STS-134/ULF-6 d. DATE: February 15, 2011

e. Log No.	f. Hazard Report Number	g. Safety Verification Number	h. Safety Verif. Method (Identify Procedures By Number and Title)	i. Ground Operation(s) Contrained	j. Independent Verification Required (Yes/No)	k. Scheduled Completion Date	j. Completion Date	m. Method of Closure (Comments)
1	STD-ISS DDRS-F01	4.a.1	Sharp Edge, Corners and/or Protrusion inspection of as built hardware	No	No	03/25/2011	2/16/2011	HFIT Inspection Certificate of Compliance issued 2/16/2011 by HFIT/R. Harper

Hardware PSRP Certificate of Compliance (COC)

I hereby certify compliance with the verification requirements as specified in **SSP 57313-ICD,** and SSP 57000 for the payload. I also certify that the identified as-built hardware was manufactured in accordance with the design drawings, parts lists, applicable waivers and deviations. All supporting data is valid, applicable, and complete. This data is maintained in the HFIT files and will be made available upon request. The hardware listed on attachment "A" is certified to **NSTS 1700.7 Addendum paragraph 222.1 and SSP51700 3.22**.1for the internal and external payload hardware.

Stage Effectivity ULF-6 and subsequent with no drawing changes.

SSP 57000	SSP 57000 IDD Requirement	Applicable and Verified	Method	Applicable Document / Rev. Date	Drawings, Parts Lists, Waivers, Deviations, Procedures, Etc. (Attach correlated list as needed)
3.12.9.2	Sharp Edges	X	I	SSP 57313	All parts listed in Attachment A listed HFIT ULF-6 ISS DDRS
3.12.9.8	Burrs	X			
3.11.3	Cleanliness	X			
3.12.7	Labeling	X			

Robert Harper 2-16-2011
Print Name/Signature/Date
HFIT - Responsible Person
Organization – HFIT

NEED HFIT INSPECTION TO CLOSE SVTL (ONLY THIS H/W)

~~Appendix~~ Attachment "A"

1/13/11

AMS DDRS	UFL-5 ISS DDRS			HFIT ULF-6 ISS DDRS ONLY				ULF-6 Shuttle DDRS - Sortie				
Name	Part Number	Serial Num	Mass (lbs)	Part Number	Serial Num	Mass (lbs)	IMS Label	Name	Part Number	Serial Num	Mass (lbs)	
Cable Assembly, Network, 10Ft	SEG39138002-301	1001	0.33	SEG39138002-301	1002	0.33	00139186J	Cable Assembly, AMS-02 RS422 T-0/PDIP	SED39136112-302	1001	0.38	OV pre-installed
Cable Assembly, Network, 40Ft	NA	NA	NA	SEG39138002-302	1003	1.98	00139188J	Cable Assembly, OCA Adapter	SED39137971-301	1001	0.33	OV pre-installed
Network Jack Assembly	SEG39137984-301	1001	0.20	SEG39137984-301 IR No Bar Code	1002	0.20	00143915J	Cable Assembly, Extension	SED39137973-301	1001	1.26	OV pre-installed
AMS HD Bag	SJG39137982-301	1001	2.93					Cable Assembly, DDRS-02 KU Adapter	SED39137930-301	1001	0.33	USA/FCE 12/23/10
Cable Assembly, USB	SEG39137981-301	1001	0.11	SEG39137981-301	1003	0.11	00139178J	DDRS-02 Assembly	SED39136116-301	1001	1.88	USA/FCE 12/23/10
Cable Assembly, USB	SEG39137981-301	1002	0.11	SEG39137981-301	1004	0.11	00139177J	• Cable Assembly, AMS-02 USB-422/PDIP	SED39136111-301	1001	(1.26)	
Adapter Assembly, AMS Transmitter	SEG39136090-301	1001	0.29	SEG39136090-301	1002	0.29	00139104J	• USB422 Assembly	SED39137921-301	1013	(0.51)	
Adapter Assembly, AMS Receiver	SEG39136090-302	1003	0.29	SEG39136090-302	1004	0.29	00139105J	• Cable Assembly, USB A/B	SED39136130-801	1001	(0.11)	
Cable Assembly, AMS HRDL (8Ft)	SEG39136091-301	1001	0.40	SEG39136091-301	1002	0.40	00139180J	DDRS-02 Assembly	SED39136116-301	1002	1.88	USA/FCE 12/23/10
Cable Assembly, Extension, 6Ft				SEG39138001-301	1001	0.15	00139183J	• Cable Assembly, AMS-02 USB-422/PDIP	SED39136111-301	1002	(1.26)	
Cable Assembly, Extension, 6Ft				SEG39138001-301	1002	0.15	00139182J	• USB422 Assembly	SED39137921-301	1015	(0.51)	
Cable Assembly, Extension, 40Ft				SEG39138001-302	1003	0.66	00139184J	• Cable Assembly, USB A/B	SED39136130-801	1002	(0.11)	
Cable Assembly, Extension, 40Ft				SEG39138001-302	1004	0.66	00139185J					
AMS DDRS Total Mass ISS or STS			**4.66 lbs**			**5.33 lbs**					**6.06 lbs**	
Station Multi Use Bracket and Desk Top Plat	PGSC Desk Plate Assy P/N SED33108703-304 S/N 5027 Multiuse Bracket Assy P/N SEG33107631-301 S/N 1095		**4.52 lbs**									
Total Mass to Station			**9.18 lbs**			**5.33 lbs**						

CERTIFICATE OF NSTS/ISS PAYLOAD SAFETY COMPLIANCE FOR

1) **Hardware addressed on this Certificate:**

a) Payload Name (Acronym): ISS Digital Data Recording System (ISS DDRS)

i) If multiple components identify here or add attachment: _____

b) Launch vehicle(s)/launch Carrier(s)*: STS-134

c) Return vehicle/hardware disposal*: ISS DDRS Stays with AMS-02 which stays with ISS through ISS End of Life

d) Hardware On-Orbit Operations (vehicle/ISS Segment): U. S. Laboratory Module

Note: This 1114A certification is for operations on the **Shuttle and ISS (excluding the Russian Segment). It also addresses **Shuttle** launch/return. Launch/**return**/disposal on other vehicles requires adherence to the unique certification process as dictated by the applicable vehicle/IP process requirements.*

2) **Certification Applicability:** applicable to

X Payload Design and Flight Operations

_____ Ground Support Equipment Design and Ground Operations

3) **The Payload Organization Hereby Certifies that:**

X For STS, the Payload Hardware Identified on this Form Complies with all Applicable Requirements of the NSTS 1700.7 (current issue), "Safety Policy and Requirements for Payloads Using the National Space Transportation System," and/or KHB 1700.7, "Space Shuttle Payload Ground Safety Handbook."

X For ISS, the Payload Hardware Identified on this Form Complies with all Applicable Requirements of the NSTS 1700.7 (current issue), "Safety Policy and Requirements for Payloads Using the National Space Transportation System," NSTS 1700.7 ISS Addendum (current issue), "Safety Policy and Requirements for Payloads Using the International Space Station," and/or KHB 1700.7, "Space Shuttle Payload Ground Safety Handbook."

1) The Safe Design Life is 11+ years (life of ISS, no safety issue with life identified) Failure/Operation does not result in safety risk from Launch(11/10) (date).
This is the time period the payload can be retained at or restored to a specified safe condition using prescribed resources and procedures. The limiting component(s) the determined this safe design life Is (are) Hard disk drive functional life (not safety critical) Multiple replacements are flown , which requires (recalibration, repair, replacement, etc). (Additional Analysis to extend life.)

2) The Safe Operational Life is 11+ years (life of ISS, no safety issue with life identified) Failure/Operation does not result in safety risk from Launch(11/10) (date). The limiting component(s) that determined this safe operational life is (are) Hard disk drive functional life (not safety critical) Multiple replacements are flown , which requires (recalibration, repair, replacement, etc).

4) **Approved Waivers/Deviations:** None

5) **Approved (Payload Organization Manager) and Date:**