Space Station Grounding Requirements

International Space Station

Revision D

31 July 2002

NASDA

National Space Development Agency of Japan

esa

european space agency

agenzia spaziale italiana
(Italian Space Agency)

Canadian Space Agency

Agence spatiale canadienne

National Aeronautics and Space Administration
Space Station Program Office
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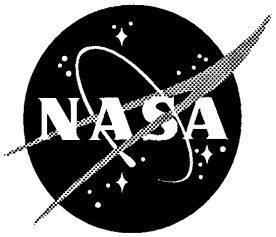
Houston, Texas



REVISION AND HISTORY PAGE

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–	Draft Revision B: SDR Version	03–22–94
B	Revision B (Reference SSCBD 000008 R1, Eff. 6–03–94) Revised to transition from Freedom program to ISSA. Changes include extensive simplification of requirements and scope.	09–30–94
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PREFACE

This document defines the requirements for primary power grounds, secondary power grounds, signal reference grounds, signal return grounds, grounds for user–conditioned power returns/references, and the grounding electrode system for the International Space Station (ISS) Program equipment and structures. The Space Station Grounding Requirements shall be implemented on all ISS Program contractual and internal activities and shall be included in any existing contracts. This document is under the control of the Space Station Control Board.

SPACE STATION PROGRAM OFFICE

SPACE STATION GROUNDING REQUIREMENTS

31 JULY 2002

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INTERNATIONAL SPACE STATION PROGRAM

SPACE STATION GROUNDING REQUIREMENTS

31 JULY 2002

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ESA Concurrence:
Reference SSP 50019 Joint Management Plan and
JESA 30000, Section 3, Appendix B

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SPACE STATION GROUNDING REQUIREMENTS

LIST OF CHANGES

31 JULY 2002

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

SSCBD	ENTRY DATE	CHANGE	PARAGRAPH(S)
3282	7/31/02	3.2.2.1	Signal Circuit Return Grounding
		3.2.2.6	Returns, Signals Below Four Megahertz
Editorial	7/31/02	Appendix A	Abbreviations and Acronyms
			TABLES
	7/31/02		None
			FIGURES
	7/31/02		None

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FIGURES

1.0 GENERAL

1.1 INTRODUCTION

This document defines the requirements for Space Station grounding including primary power grounds, secondary power grounds, signal reference grounds, signal return grounds and grounds for user–conditioned power return/references. These requirements are in accordance with the specifications in SSP 30243.

1.2 PURPOSE

These requirements are intended to provide assurance of successful on–orbit integration and operation of the diverse segments of the Space Station. These requirements support modularity, growth, replacement, and configuration independence.

1.3 OBJECTIVE

The objectives of the grounding requirements are crew safety, proper operation of fault avoidance/detection and electromagnetic interference reduction. The Space Station configuration consists of many electrically parallel components that provide conductive paths between flight elements, systems, subsystems, and equipment. The parallel conductive paths provide the opportunity for ground loops and spurious common impedance sources for noise coupling. Ground loops capture and circulate induced, multifrequency signals of varying levels, referred to as noise. Noise represents a varying, uncontrolled, and detrimental contribution to the performance of electrical, electronic, and electromechanical equipment. The grounding strategy represented in this document is designed to preclude the effects of the configuration and environment effects such as V x B that cause structure potential differences.

1.4 INTENDED USE

The requirements in this document apply to Space Station segments, subsystems, assembly elements, and equipment including the primary electrical power distribution, secondary electrical power distribution, signal circuits, signal references, primary structure, secondary structure, and interfaces. The requirements of this document also apply to all flight support equipment, orbital support equipment, and to the interface between the ground support equipment and flight hardware. Requirements for bonding are given in SSP 30245.

1.5 PRECEDENCE

SSP 41000 defines the design and performance requirements for the Space Station Program and invokes SSP 30243. This document is invoked by SSP 30243 for grounding requirements. If there is any conflict, SSP 30243 shall take precedence.

2.0 APPLICABLE DOCUMENTS

The following documents of exact issue shown in the current issue of SSP 50257 form a part of this document to the extent specified herein.

DOCUMENT NO.	TITLE
SSP 30245	Space Station Electrical Bonding Requirements Reference paragraph 3.2.3
SSP 41173	Space Station Quality Assurance Requirements Reference paragraph 4.0

2.1 REFERENCE DOCUMENTS

The following documents are cited as references to guide the user in the application of this standard.

DOCUMENT NO.	TITLE
SSP 30242	Space Station Cable/Wire Design and Control Requirements for Electromagnetic Compatibility Reference paragraph 3.2.2.6

3.0 REQUIREMENTS

3.1 DEFINITION OF OVERALL GROUNDING CONCEPT

System design shall prevent intentional electrical current from flowing in ground references except under fault conditions. Space Station segments, flight elements, subsystems, equipment metallic components, surfaces, and electrical and electronic parts generally will be referenced to the Space Station conductive structure. The electrical design shall be such that the electromagnetic environment due to grounding is not configuration dependent. Equipment external electrical signal and power grounds shall be dc isolated from each other at the Orbital Replaceable Unit (ORU) level. Each separately derived electrical power source shall be electrically connected to structure at no more than one point. Analog and digital signal grounds external to a system, subsystem, or equipment shall be electrically isolated from each other at the ORU level. Grounding within electrical or electronic equipment is at the discretion of the designer as long as the external power and external signal return isolation requirements are met.

3.1.1 BONDING

To ensure the integrity of the interconnected conductive elements that will function as the electrical power system fault return path and ground reference, the Space Station systems, assembly elements, flight elements, subsystems, and equipment complies with the electrical bonding requirements of SSP 30245. The chassis and/or structure of all equipment, assembly elements, flight elements, systems, and subsystems operating from a common power source shall be bonded such that maximum electrical fault currents can be conducted without creating a thermal or electrical hazard. Electrical bonds between all components of equipment, subsystems, systems, flight elements, and assembly elements shall be designed to control potential differences.

3.1.2 CABLE/WIRE GROUNDING TREATMENT

The wire treatment grounding and shielding procedures and requirements of SSP 30242 applies to all flight elements, systems, and equipment to control electromagnetic effects and reduce electromagnetic interference. SSP 30242 defines the requirements to isolate sensitive circuits and minimize radiated and conductive coupling by wire cable bundling, routing, separation, shielding, and grounding based on the circuit classifications. Requirements for wire and cable shield terminations are also included in SSP 30242.

3.2 CHARACTERISTICS

3.2.1 ELECTRICAL POWER

3.2.1.1 PRIMARY ELECTRICAL POWER

The Space Station primary electrical power system shall be distributed single point grounded. Users of power shall be direct current (dc) isolated such that the primary electrical power ground configuration is not dependent on the presence or absence of flight elements, systems, subsystems, equipment, or users. Primary electrical power shall be dc isolated from chassis, structure, equipment conditioned power return/reference, and signal returns by a minimum of 1 megohm, individually, when grounds are not terminated to chassis or structure. See appendix C for exception (Electromagnetic Effects Control Board (EMECB) TIA–0148) to this paragraph.

3.2.1.2 SECONDARY AND TERTIARY ELECTRICAL POWER

Secondary and tertiary electrical power shall be single point grounded. Secondary electrical power shall be dc isolated from chassis, structure, equipment conditioned power return/reference, and signal circuits by a minimum of 1 megohm, individually, when all grounds are not terminated to chassis or structure. See appendix C for the exception (Electromagnetic Effects Control Panel (EMEP) TIA–0273) to this paragraph.

3.2.1.3 CONTROL POWER BUS RETURN

The dc power control bus shall be independent of the primary electrical power and shall be referenced to the system reference at a single location.

3.2.1.4 ISOLATED ELECTRICAL POWER WITHIN EQUIPMENT

Within equipment, conditioned electrical power shall be dc isolated from chassis and structure except at no more than one electrically conductive common point. Where termination is desired, the equipment designer has the option of either bringing the single point reference external to the equipment for termination to the nearest structure ground or, of terminating the reference point to the chassis internal to the equipment; both methods may be used simultaneously. See appendix C for the exception (EMEP TIA–0273) to this paragraph.

3.2.1.5 ISOLATED ELECTRICAL POWER BETWEEN EQUIPMENT

Where equipment further conditions and isolates electrical power, e.g., for external channel to channel isolation or external signal to signal isolation, each secondary conditioned power reference shall be treated individually in the same manner as in 3.2.1.4. See appendix C for the exception (EMEP TIA–0273) to this paragraph.

3.2.1.6 LOAD CONVERSION

Where load conversion is done to supply any form of conditioned power to several devices or functions, that conversion shall re–establish a single point reference for the serviced equipment or functions.

3.2.2 RETURNS

3.2.2.1 SIGNAL CIRCUIT RETURN GROUNDING

Signal Circuit conductors shall be dc isolated from chassis, structure, and equipment conditioned power return/reference, by a minimum of 1 megohm, individually, when not terminated by the signal circuit's single point ground/reference. The 1 megohm requirement will be verified with only one termination lifted at a time. An exception to the 1 megohm requirement for balanced circuits is found in 3.2.2.6. An exception for RF signals on coaxial cable is found in 3.2.2.7. Under no circumstances shall separate flight elements, assembly elements, systems, subsystems, or equipment depend on other equipment for signal reference or signal return grounding unless they are also dependent upon the other equipment for power. See appendix C for the exceptions (EMEP TIA–0271 and EMEP TIA–0273) to this paragraph.

The intent of this requirement is to assure that equipment which requires a ground cannot be operated in flight without that ground being in place. If an equipment depends upon another equipment for signal reference or return grounding, provisions should be made to ensure the dependent equipment cannot be operated in flight without the independent equipment's ground in place.

3.2.2.2 ALTERNATING CURRENT POWER RETURN

A neutral return wire shall accompany the alternating current input wires to individual equipment loads in the distribution of power.

3.2.2.3 ANALOG, DIFFERENTIAL CIRCUIT RETURN

Each differential analog circuit shall employ a separate return.

3.2.2.4 DISCRETE RETURNS

Low level discrete signals shall use individual returns. See appendix C for the exceptions (EMEP TIA–0271 and EMEP TIA–0273) to this paragraph.

3.2.2.5 PULSE OR CLOCK CIRCUIT RETURNS

All digital, pulse, or clock circuits that do not use fiber optic cabling shall use individual returns. See appendix C for the exceptions (EMEP TIA–0271 and EMEP TIA–0273) to this paragraph.

3.2.2.6 RETURNS, SIGNALS BELOW FOUR MEGAHERTZ

Signal circuits external to equipment with frequency content below four megahertz shall be balanced and shall be isolated from chassis, structure, and user conditioned power return/reference by a minimum of 6000 ohms, individually (i.e., measured per connection, pin, wire, etc.). Otherwise external signals shall be isolated through optical isolators, transformers, etc. All references for circuits with frequencies below 4 MHz shall be single point grounded to conductive structure. Shield connections shall be made to either connector shells or to connector pins that are grounded when mated. Shield treatment is specified in SSP 30242. See appendix C for the exceptions (EMEP TIA–0271, EMEP TIA–0273, and EMEP TIA–0306) to this paragraph.

The intent of this paragraph is to reduce low frequency ground currents, and to reduce signal circuit upset by ground currents. This paragraph is not intended to require low frequency circuits to be balanced. It just allows an exception to the 1 megohm isolation requirements of 3.2.2.1 for those circuits that are balanced. "Balanced circuits" include those with balanced impedance from signal circuit high and low, plus and minus, or signal and complement to ground at the source and at the receiver. This requirement is intended to be interpreted to include relaxation for those circuits with a balanced receiver and very low source impedance. A line driver and receiver pair is an example of the latter. Circuits meeting the "balanced circuit" definition should be isolated from their chassis by at least 6000 ohms at the balanced receiver end. Unbalanced circuits still must meet the 1 megohm requirement of 3.2.2.1

3.2.2.7 SIGNALS EQUAL TO AND ABOVE FOUR MEGAHERTZ

Signals circuits with frequency components equal to or above four megahertz shall use controlled impedance transmission and reception media such as shielded twisted 72 ohm cable, "twin ax" cable, "triax" cable, or "coax" cable. Circuits using "twin ax" cable shall be balanced and referenced to primary structure at a single point. "Triax" cable shall use the center and inner shield conductors for unbalanced transmission, referenced to primary structure at a single point with the outer shield multipoint grounded as an "overshield". DC isolated, single–ended circuits coupled by coaxial cable with the shield terminated 360 degrees at each end and at available intermediate point, shall be permitted for signals with the lowest frequency component equal to or above 4 MHz. See appendix C for exceptions (EMECB TIA–00166 and EMEP TIA–0273) to this paragraph.

3.2.2.8 BRIDGE WIRE ACTUATED DEVICE GROUNDING

To preclude adverse electromagnetic effects, Bridge Wire Actuated Device (BWAD) firing circuits, including electroexplosive device firing circuits, shall be isolated from other electrical

circuits and from each other by a minimum of 1 megohm. Each actuating or firing circuit shall be routed as a shielded twisted pair. Each firing circuit shall be returned to the firing power source and shall be isolated from ground by a minimum of 20 kohms. The firing power source shall be isolated so that current cannot be conducted through chassis or structure by the ionized conductive path formed when a BWAD is fired. For electrostatic protection, the firing circuit shall be balanced and referenced to conductive structure ground by more than 20 kohms and less than 1 megohm. In addition, in a "safe" condition, BWAD leads shall be shorted together.

3.2.3 GROUNDING TO EQUIPMENT/VEHICLE NOT PERMANENTLY ATTACHED TO THE SPACE STATION

Structures shall be grounded first before crew contact or other electrical connections are made. Temporary interface power shall be separately derived power (using a dc isolating transformer) with only one connection to structure ground either on the ISS or on the interfacing system. Signal interfaces shall be fiber optic, differential, or isolated return conductor type. Docked or berthed bonding shall correspond to a Class H/R bond in accordance with SSP 30245. End effectors making contact with structures isolated from Space Station ground shall have provisions to bond at first contact through a 10,000–ohm resistance to limit current in the Electrostatic Discharge between the end effector and that structure. See appendix C for exception (EMECB TIA–69 and EMEP TIA–210) to this paragraph.

4.0 QUALITY ASSURANCE PROVISIONS

All quality assurance provisions shall be in accordance with the Space Station Program Quality Assurance Program Requirements as specified in SSP 41173 or equivalent document for International Partner (IP) agencies.

4.1 RESPONSIBILITY FOR INSPECTION

Unless otherwise specified, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified, the supplier may use his own facilities or any other commercial laboratory acceptable to NASA or responsible IP agency. NASA or responsible IP agency reserves the right to perform any of the inspections set forth in the requirements document where such inspections are deemed necessary to assure supplies and/or services conform with prescribed requirements.

APPENDIX A ABBREVIATIONS AND ACRONYMS

BWAD	Bridge Wire Actuated Device
CCAA	Common Cabin Air Assembly
CI	Configuration Item
CID	Circuit Interrupt Device
dc	direct current
EMECB	Electromagnetic Effects Control Board
EMEP	Electromagnetic Effects Control Panel
EME	Electromagnetic Effects
FRGF	Flight Releasable Grapple Fixture
FSEGF	Flight Support Equipment Grapple Fixture
IP	International Partner
ISS	International Space Station
LEE	Local End Effector
MDM	Multiplex/Demultiplex
MHz	megahertz
NASA	National Aeronautics and Space Administration
ORU	Orbital Replaceable Unit
PDGF	Power Data Grapple Fixture
PN	part number
SSRMS	Space Station Remote Manipulator System
SRMS	Shuttle Remote Manipulator System
VTR	Video Tape Recorder

APPENDIX B GLOSSARY

ASSEMBLY ELEMENT

A part of a flight element that requires no assembly on orbit and has a functional purpose to which resources may be assigned.

BALANCED CIRCUIT

A circuit with balanced impedance from signal circuit high and low, plus and minus, or signal and complement to ground at the source and at the receiver.

BOND (NOUN)

Any fixed union existing between two objects that results in electrical conductivity between the objects. Such union occurs either from physical contact between conductive surfaces of the objects, or from the addition of a firm electrical connection between the objects.

BONDING OR TO BOND

The act of connecting objects to obtain electrical conductivity between them.

CHASSIS OR STRUCTURE GROUND

Conducting connection, whether intentional or accidental, between an electrical circuit or equipment and the structure ground.

CIRCUIT REFERENCE

The collection of bonded circuit and conductive structural elements.

CIRCUIT REFERENCE/COMMON CONNECTION (POWER OR SIGNAL)

A return path or physical tie point usually at a potential of zero volts.

DISTRIBUTED SINGLE POINT GROUND

A system of multiple, isolated system ground points common to an isolated set of equipment (i.e. single point ground), referenced to a common, large, conductive structure (e.g. equipotential “islands”).

EQUIPMENT

Any electrical, electronic, or electromechanical device or collection of devices intended to operate as a single unit and to perform a single function. As used herein, equipment includes but is not limited to the following: receivers, transmitters, transponders, power supplies, hand tools, processors, test apparatus, and test instruments.

FLIGHT ELEMENT

An assembly of Space Station hardware collected as one named group, e.g., segments.

GROUND

A stable sink capable of conducting large currents with little or no effect on potential differences, providing a reliable reference.

ISOLATED ELECTRICAL POWER

Secondary electrical power isolated from primary electrical power.

LEAKAGE CURRENT

Current flowing in a path between chassis and power single point ground.

POINT

A position or location, not intended to be limited to a single fastener (for example a golden rivet) but constitutes an equipotential ground reference.

PRIMARY ELECTRICAL POWER

Electrical power taken from power generation units without conditioning or isolation.

SECONDARY ELECTRICAL POWER

Electrical power in the Space Station that has been isolated from the primary electrical power before it is distributed to the modules, utility ports, and external payloads.

SEPARATELY DERIVED POWER

Power derived from a generator, a transformer, or a converter and with no direct electrical connection to conductors in another system.

SINGLE POINT GROUND

A common electrical connection to ground, used as a common reference (typically the common electrical connection is characterized by a minimum, or zero potential difference between each physical connection).

STRUCTURE BOND

An electrical connection between structure components or to structure intended to minimize potential differences.

TERTIARY POWER

Electrical power derived from secondary power.

APPENDIX C APPROVED TAILORING/INTERPRETATION AGREEMENTS

EMECB TIA–0069

C.3.2.3 GROUNDING TO EQUIPMENT/VEHICLE NOT PERMANENTLY ATTACHED TO THE SPACE STATION

Exception: This requirement is relaxed for the Local End Effector (LEE) (Part Number (PN) 51612–4000–1 N) and applied instead to the Power Data Grapple Fixture (PDGF) or Flight Support Equipment Grapple Fixture (FSEGF) of all free–flyers that the LEE is required to interface with, thus meeting the objective of the requirement. (Therefore the LEE will offer a low–impedance path to ground per the other station requirements.)

Rationale: All ORUs and payloads being moved by the Space Station Remote Manipulator System (SSRMS) on the station are already bonded to structure when picked up by the LEE. Thus the requirement only applied to free–flyers on first contact (and does not therefore apply to the Orbiter which is docked and grounded before arm–operations commence).

It is also highly doubtful whether this requirement is necessary even for free–flyers because the plasma contactor holds the station structure within 40 volts of the plasma potential, which is acquired by any free–flyer within less than a minute.

On the Shuttle Remote Manipulator System (SRMS), a similar requirement is satisfied as proposed in the tailoring/interpretation agreement presented above.

EMECB TIA–0148

C.3.2.1.1 PRIMARY ELECTRICAL POWER

Exception: The Circuit Interrupt Device (CID) (PNs LAB DDCU1A P301/J201, LAB DDCU1B P302/J202, LAB DDCU2B P316/J216, LAB DDCU3B P315/J215, Z1 CHANNEL2B P240/J440, Z1 CHANNEL4B P230/J430, S0 CHANNEL2B P488/J487, S0 CHANNEL4B P485/J484) is not required to meet the Class H bonding requirement of SSP 30245, paragraphs 3.2.1.1, 3.2.1.1.1, and 3.2.1.1.2.

Rationale: The CID is susceptible to hot to chassis faults which may cause fault currents that could create an electrical hazard. To protect against such an occurrence, the following precautions as shown in Figure C.3.2.1.1–1 will be taken:

1. A resistive bond wire is added between the switch box and the “T” box to prevent the fault current from traveling to the connector.

2. The switch box will be coated inside with a Halar coating to prevent the hot line from touching the switch box in the event of a failure.

3. Insulating material will be placed inside the “T” box to prevent the wires from moving in the event of a failure.

With these precautions, it is believed that the CID will be sufficiently isolated from the chassis, and the risk of causing an electrical hazard will be sufficiently reduced.

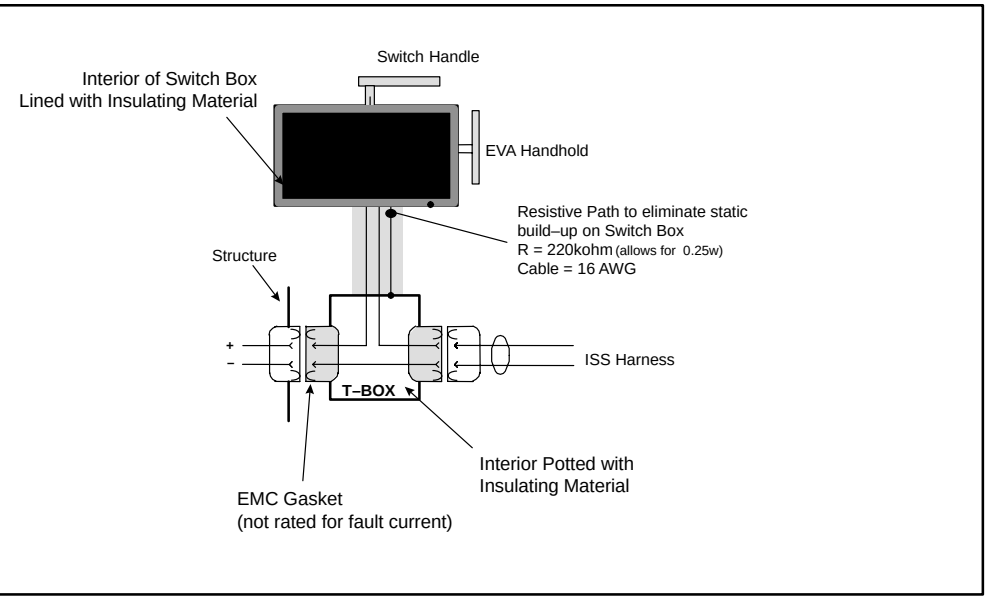

FIGURE TIA–0148–1 CID FAULT PREVENTION

EMECB TIA–0166

C.3.2.2.7 SIGNALS EQUAL TO AND ABOVE FOUR MEGAHERTZ

Exception: The SGANT (Configuration Item (CI) 222016A, PN 10033190–1) is allowed to exceed the SSP 30237, paragraph 3.2.3.1.2, RE02 requirements by 28 dB from 1 MHz to 7 MHz. The SGANT is permitted to not follow the SSP 30240, paragraph 3.2.2.7, requirement by not terminating the harness shield at both ends. The SGANT is allowed to not meet the SSP 30245, paragraph 3.2.1.2.1, Class R Bonding requirement at the titanium interfaces.

Rationale: 1) Currently there are no intended receiver systems in the noted frequency band, hence, low level signals would impose no impact on RF systems.

2) An emission level of 80 dB μV is 54 dB below the radiated susceptibility RS03 test level of 5 V/m in that frequency band. This level of incident field would not impose any threat to ORUs qualified to that RS03 level.

3) The data busses and power busses near to the SGANT that would be illuminated by the out–of–specification field have been thoroughly tested in both laboratory and installed vehicle environments. Neither have shown any susceptibility in the frequency range noted at fields much greater than those noted.

4) Assuming the SGANT emissions to be a plane wave, the field intensity would decrease as 1/r, hence, a 25 meter sphere would be considered as potentially illuminated by this field. The systems and ORUs within this sphere comprise the P6 assembly, all of which have been successfully tested at field strengths significantly higher than those noted.

5) The SGANT passed the RS03 tests.

EMEP TIA–0210

C.3.2.3 GROUNDING TO EQUIPMENT/VEHICLE NOT PERMANENTLY ATTACHED TO THE SPACE STATION

Exception: The Flight Releasable Grapple Fixture (FRGF) is allowed to meet the intent of the 3.2.3 requirement of first contact bond of 10,000 Ohms with a first contact bond of 5,000 Ohms.

Rationale: The intent of the requirement is so that any difference of potential between a structure that has been isolated from the station will be allowed a safe discharge path for any static built up as it is connected to the ISS. The requirement for 10,000 Ohms is an arbitrary number that will allow this safe discharge. Changing the value to 5,000 Ohms will not degrade the intent of the requirement.

EMEP TIA–0271

C.3.2.2.1 SIGNAL CIRCUIT RETURN GROUNDING,
C.3.2.2.4 DISCRETE RETURNS,
C.3.2.2.5 PULSE OR CLOCK CIRCUIT RETURNS, AND
C.3.2.2.6 RETURNS, SIGNALS BELOW FOUR MEGAHERTZ

Exception: The Common Cabin Air Assembly (CCAA) (PN SV806610–1 (CID SSF9610)), CCAA Inlet ORU (PN SV811840–2 (CID SSF9664)), CCAA TCCV (PN SV805626–1 (CID SSF9731)), CCAA Water Separator (PN SV813920–1 (CID SSF9706)), and Intermodule Vent Fan (PN SV809111–6 (CID SSF9619)) meet the intent of the ground isolation/signal return requirements of SSP 30240, paragraphs 3.2.2.1, 3.2.2.4, 3.2.2.5, and 3.2.2.6.

Rationale:

1. Electrical power isolation has been tested for these ORUs, and the ORUs meet the requirements.
2. Tertiary power and signal returns are intentionally grounded and cannot be lifted for testing.
3. Functional tests of the above units worked properly; therefore the system is self compatible.
4. All of the above units passed the EMI testing.
5. The MDM signal connections to these items are isolated.

EMEP TIA–0273

C.3.2.1.2 SECONDARY AND TERTIARY ELECTRICAL POWER,
C.3.2.1.4 ISOLATED ELECTRICAL POWER WITHIN EQUIPMENT,
C.3.2.1.5 ISOLATED ELECTRICAL POWER BETWEEN EQUIPMENT,
C.3.2.2.1 SIGNAL CIRCUIT RETURN GROUNDING,
C.3.2.2.4 DISCRETE RETURNS,
C.3.2.2.5 PULSE OR CLOCK CIRCUIT RETURNS,
C.3.2.2.6 RETURNS, SIGNALS BELOW FOUR MEGAHERTZ, AND
C.3.2.2.7 SIGNALS EQUAL TO AND ABOVE FOUR MEGAHERTZ

Exception: The Video Tape Recorder (VTR), TEAC V–80AB–F (IF–101A), (PN 683–51020, CI 683–138A) is not required to meet the ground isolation/signal return requirements in SSP 30240, paragraphs 3.2.1.2, 3.2.1.4, 3.2.1.5, 3.2.2.1, 3.2.2.4, 3.2.2.5, 3.2.2.6, and 3.2.2.7.

Rationale: Ground isolation/signal return: The TEAC COTS VTR Deck, associated Power Supply Card, and the Interface Control Card equipment drawings and schematics were reviewed by BHSV and found to be isolated as specified in SSP 30240. The COTS VTR tape deck's audio/video lines did not meet the 1 megohm isolation requirement. Since the referenced Power Supply Card and the Interface Control Card are the only ones being connected, the associated ground loops and corresponding noise voltages will be minimized externally to the VTR system. The VTR is a COTS item and standard practice throughout the industry precludes the 1 megohm isolation for the audio and video lines. This exception is not expected to result in any ground isolation problems. An EMI test is planned for the complete VTR system in the near future that should verify the VTR system is self compatible.

EMEP TIA–0306

C.3.2.2.6 RETURNS, SIGNALS BELOW FOUR MEGAHERTZ

Exception: The VTR (PN 683–51020, CI 683138A) is not required meet the 3.2.2.6 requirement to have less than 1000 ohms grounding isolation resistance between chassis ground and the RS–485 serial databus lines.

Rationale: The VTR provides approximately 700 ohms from each RS–485 serial databus "Command" line to chassis ground. Three "Command" and three "Status" RS–485 serial databus lines are used to connect each VTR to a MDM. For the USL these three sets of databus lines connect each VTR to the C&C–1, –2, and –3 MDMs. The primary contributor to the low resistance to chassis ground is the network of pull up and pull down resistors incorporated in the VTR for these data lines. These resistors are shown on drawing 683–51040 sheet 3. When the VTR is operating, these resistors provide pull up and pull down voltages to the RS–485 transceiver ICs. The 121 ohm load resistors also are incorporated for the "Command" lines in this network. The 121 ohm load resistors for the "Status" lines are incorporated into the cable assemblies near the MDM end. These design features comply with the technical specifications for the RS–485 databus standard and are necessary for the databus to operate properly in this implementation. Similar pull up and pull down voltage functions are provided in the MDM serial data card by diodes. The VTR operates properly and has passed EMI testing.