GLAST LAT LEVEL 3 SUBSYSTEM SPECIFICATION	Document # LAT-SS-00136-P	Date Effective Draft 8/3/01
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Document Title LAT Power Supply System - Level III Specification		

Gamma-ray Large Area Space Telescope (GLAST)

Large Area Telescope (LAT)

LAT Electrical Power System Level 3 Specification

PRELIMINARY

CHANGE HISTORY LOG

Revision	Effective Date	Description of Changes	DCN #
1		Initial Release	

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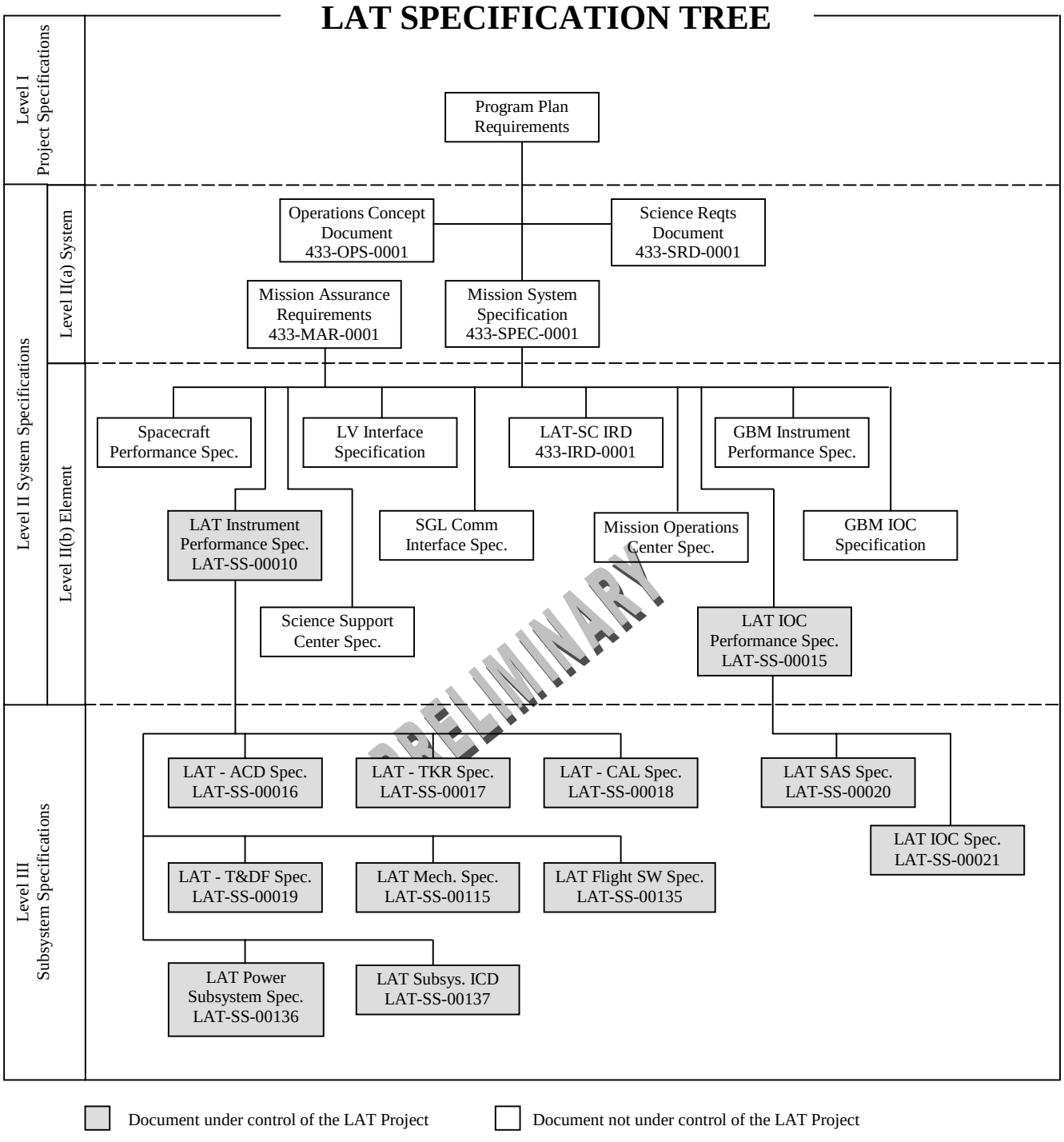
1 PURPOSE

This document defines level 3 subsystem requirements for the GLAST LAT electrical power system.

2 SCOPE

This specification captures the GLAST LAT requirements for the instrument electrical power system. This specification is identified in the specification tree of Figure 1.

Figure 1 LAT Specification Tree



3 DEFINITIONS

3.1 Acronyms

A
ACD Anticoincidence Detector

C
CAL Calorimeter

D
DAQ-EM Data Acquisition System – Electronics Module
DC Direct Current

E
EMC Electromagnetic Compatibility
EMI Electromagnetic Interference
EOL End of Life
EPE Event Processor Electronics

G
GEVS General Environmental Verification Specification
GLAST Gamma-ray Large Area Space Telescope
GRB Gamma Ray Burst
GTE Global Trigger Electronics

I
IRD Interface Requirements Document

L
LAT Large Area Telescope

M
MAR Mission Assurance Requirements

P
PIN Positive Intrinsic Negative
PMT Photo Multiplier Tube

S
SC Spacecraft
SE System Engineering

SI	Science Instrument
SIU	Spacecraft Interface Unit
SRD	Science Requirements Document

T

TBD	To Be Determined
TBR	To Be Revised
T/C PS	TKR/CAL Power Supply
TEM	Tower Electronics Module
TKR	Tracker

3.2 Definitions

A

A	Analog
Acc	Accuracy
adj	adjustable
Analysis Platform	Toolkit for doing analysis, such as IDL and Root
Arcmin	A measure of arc length. One arcmin is 1/60 °
Arcsec	A measure of arc length. One arcsec is 1/60 arcmin

B

Back Response	Response as measured in the thick layers of the TKR
Beam Test	Test conducted with high energy particle beams
cm	centimeter

D

D	Digital
Dead Time	Time during which the instrument does not sense and/or record gamma ray events during normal operations
Demonstration	To prove or show, usually without measurement of instrumentation, that the project/product complies with requirements by observation of results

E

Eff	Efficiency
eV	Electron Volt

F

Field of View	Integral of effective area over solid angle divided by peak effective area
Front Response	Response as measured in the thin layers of the Tracker

G

g	acceleration due to gravity, 9.81 m/s^2
Geometric Factor	Field of View times Effective Area

GeV	Giga electron Volt, 10^9 eV
I	
Inspection	To examine visually or use simple physical measurement techniques to verify conformance to specified requirements
M	
m	meter
MeV	Million electron Volts, 10^6 eV
P	
ph	photons
p-p	peak-to-peak
S	
s, sec	seconds
Simulation	To examine through model analysis or modeling techniques to verify conformance to specified requirements
sr	steradian: the solid (3D) angle formed when an area on the surface of a sphere is equal to the square of the radius of the sphere. There are 4π steradians in a sphere
T	
Testing	A measurement to prove or show, usually with precision measurements or instrumentation, that the project/product complies with requirements
V	
V	Volt
Validation	Process used to assure the requirement set is complete and consistent, and that each requirement is achievable
Verification	Process used to ensure that the selected solutions meet specified requirements and properly integrate with interfacing products
W	
W	Watt

4 APPLICABLE DOCUMENTS

Documents relevant to the development of the LAT electrical power system level 3 specification include the following:

LAT-SS-00010, “GLAST LAT Performance Specification”, August 2000

GSFC 433-IRD-0001, “GLAST Science Instrument – Spacecraft Interface Requirements Document”, Draft July 14, 2000

GSFC 433-MAR-0001, “Mission Assurance Requirements (MAR) for Gamma-Ray Large Area Telescope (GLAST) Large Area Telescope (LAT)”

GSFC-433-RQMT-0005, “EMC Requirements”

LAT-SP-00010, “Environmental Conditions”

TBD, “LAT Grounding Specification”

LAT-SS-TBR, “LAT Mechanical Performance Specification”

5 REQUIREMENTS

LAT requires a switched redundant source of Direct Current (DC) power from the spacecraft bus to support the operation of the LAT instrument and its subsystems.

5.1 Design References

5.1.1 Input Power

5.1.1.1 Voltage

The LAT primary power input design reference is 28 Volts (V) DC ±6 V, unregulated.

5.1.1.2 Current

The LAT current draw is not to exceed 46 Amps (A) at a bus voltage of 22 V DC at End of Life (EOL).

5.1.1.3 Power

The LAT will draw < 1000 Watts (W) peak power at EOL. The Average power is to be 650W on a daily orbital average.

5.1.1.4 Impedance

The LAT power input impedance will conform to GSFC 433-IRD-0001, "GLAST Science Instrument – Spacecraft Interface Requirements".

5.1.1.5 Circuits

The LAT is to have a primary and redundant input power source for each circuit provided. These circuits are referred to as LAT Bus A (primary) and LAT Bus B (redundant). Each primary power circuit is to be isolated to prevent a power subsystem failure within the LAT from rendering any primary power bus inoperable.

5.1.1.6 Circuit Protection

The bus Power Control Unit (PCU) or Power Distribution Unit (PDU) is to provide primary input power circuit protection for each circuit.

5.1.1.7 Switching

Each primary power circuit is to be independently switched. Only one circuit source, A or B, is to be powered on at a time.

5.1.1.8 Control

The spacecraft bus will control selection of the primary bus, powered either A or B. The spacecraft bus will provide control of the LAT input power circuits. Each of the input circuit feeds may be switched ON and OFF by the bus. The LAT will control activation and primary bus selection of the LAT internal power busses. The LAT will control equipment ON/OFF on all power busses except the LAT Essential Bus.

5.1.1.9 LAT Distributed Output Power

The LAT will provide power distribution and control to LAT subsystems. The LAT will distribute and control the 28±6 V DC unregulated from the primary power source.

5.1.1.10 Redundancy

The LAT will provide for redundant power distribution and control capability within the LAT.

5.2 Primary Power

5.2.1 Primary Circuits

The LAT will accept power from 8 primary power circuits (TBR), 4 prime (TBR) and 4 redundant. Each circuit pair is to be capable of 14 A of current. Each circuit pair will correspond to a LAT internal power bus that will power specific subsystems of the LAT. The 4 LAT power busses and their subsystem components are listed in Table 5-1.

Table 5-1 LAT Internal Power Bus Structure

Bus #	Bus Name	Equipment	Power Required (W)	
1	LAT Essential	SIU, Housekeeping & LAT Heaters	127	
2	PROC Farm	Processor Farm, Global Trigger and ACD	140	
3	TEM Even	Even numbered TEMs	180	
4	TEM Odd	Odd numbered TEMs	180	
5	Survival Heaters	Survival Heaters	150	*
		TOTAL Power Consumption	627	

**NOTE: Not powered when LAT is powered so it is not included in Total LAT Power Consumption. These heaters are not part of this system and are here for information only.*

An example of LAT power distribution and control is shown in Figure 2.

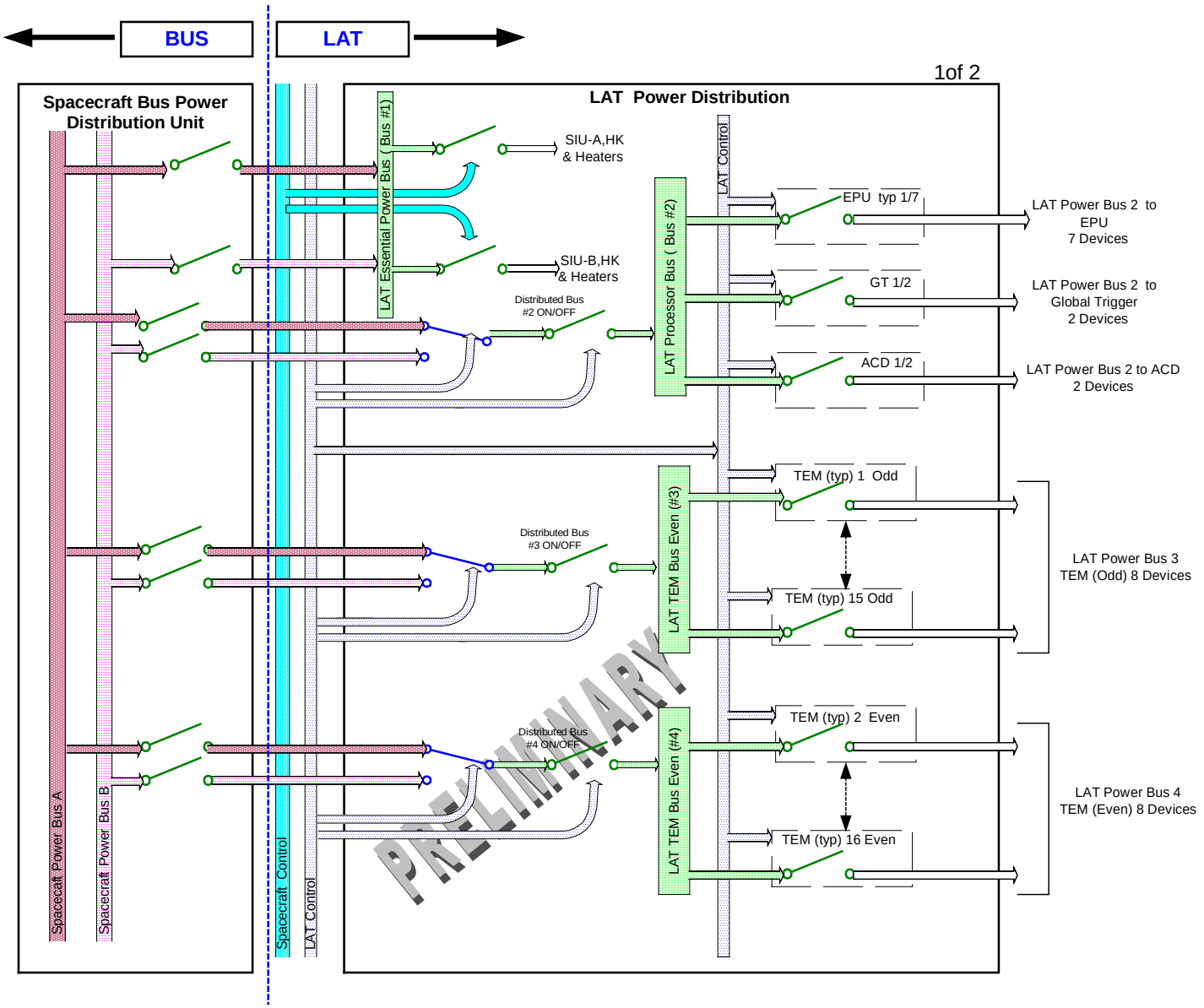
5.2.2 Survival Heaters

The spacecraft bus will provide power and control of the survival heaters. No accommodation for these heaters is provided within the LAT power system.

5.3 Secondary Power

The LAT will provide distributed power to each of the LAT internal power busses. The LAT internal power busses are listed in Table 5-1. A general block diagram of the LAT electrical power system is shown in Figure 3.

Figure 2 LAT Power Distribution & Control Example



5.3.1 Power Bus Control - General

Each of the secondary power busses is to be capable of being switched between primary and redundant power sources. Each subsystem equipment load is having its power controlled at the source.

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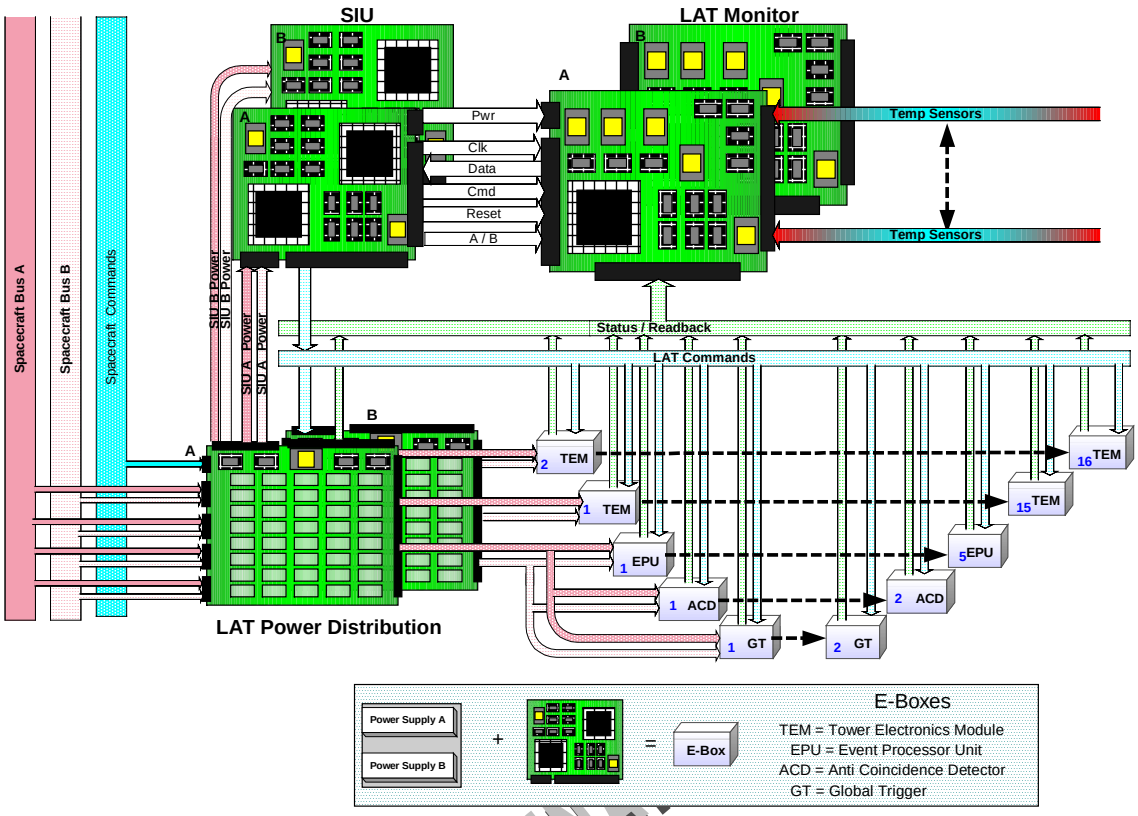
Figure 3 LAT Electrical Power System Block Diagram



5.3.2 LAT Internal Power Bus Control

5.3.2.1 Essential Bus

The LAT Essential Power Bus will be controlled by the spacecraft bus. This is the primary LAT power bus and will be the first LAT bus powered on when powering up the instrument

5.3.2.2 Processor Bus

The LAT will control power on the processor bus. The LAT will select either the primary or redundant input source to power the internal equipment bus.

5.3.2.3 TEM Even Bus

The TEM Even Bus will power the TEMs that occupy the even numbered positions on the grid. The LAT will control power on the TEM Even Bus. The LAT will select either the primary or redundant input source to power the internal equipment bus.

5.3.2.4 TEM Odd Bus

The TEM Odd Bus will power the TEMs that occupy the odd numbered positions on the grid. The LAT will control power on the TEM Odd Bus. The LAT will select either the primary or redundant input source to power the internal equipment bus.

5.3.3 Equipment Power Control

Each powered component of the LAT will have its power controlled for power bus source and equipment power ON/OFF. There are 52 (TBR) pieces of equipment that require ON/OFF control.

5.3.3.1 Essential Bus Equipment

The Essential Bus equipment will have its power supplies controlled by the spacecraft bus. There are 2 (TBR) pieces of equipment on the Essential Bus.

5.3.3.2 Processor Bus

All Processor Bus equipment power supplies will be controlled by the LAT. There are 11 (TBR) pieces of equipment on the Processor Bus.

5.3.3.3 TEM Even And Odd Power Bus Equipment

All TEM (Even and Odd) Bus equipment power supplies will be controlled by the LAT. There are 8 (TBR) pieces of equipment on each TEM Power Bus.

5.3.4 Power Conditioning

The LAT will provide noise filtering of the power distributed to the LAT internal equipment. No other power conditioning will be performed by the LAT directly. Distributed power is to conform to the power conditions specified in XXX-433.

5.3.5 Circuit Protection

The LAT will provide circuit protection for each internal bus and for each powered piece of equipment. No single piece of equipment or component is to be capable of disabling the LAT's ability to provide or control power.

5.3.6 Distribution

The LAT Electrical Power System will distribute power to all secondary LAT equipment power users.

5.4 Telemetry

The LAT will itself monitor the internal voltage, power and temperature conditions associated with the LAT and its equipment. This information is to be available for use in controlling the LAT and in ground link telemetry.

6 ENVIRONMENTAL

All LAT electrical power system components shall meet the structural and thermal environment requirements defined in the LAT Mechanical Performance Specification, LAT-SS-TBR.

7 GROUNDING

This must conform to recommendations in NASA-HDBK-4001, “Electrical Grounding Architecture To Unmanned Spacecraft”.

8 EMI

This must conform to GSFC-433-RQMT-0005, “EMC Requirements With Respect To Radiated Emissions And Conducted Susceptibility Of Noise”.

9 RELIABILITY

The probability that any of the electrical power system components will experience a complete loss of operation due to the failure of any of its components shall be less than TBD % in 5 years. No single failure is to bring the LAT below the science requirements.

10 SAFETY

This should be per Program Safety Policy (TBR).

11 APPENDIX A, TBD/TBR ITEMS