


**Gamma-ray Large  
Area Space  
Telescope**



## **GLAST Large Area Telescope**

### **Instrument to Spacecraft Interface Simulator (ISIS) Test Readiness Review**

**15 December 2004**

**Jana Thayer  
Eric Hansen  
Stanford Linear Accelerator Center**

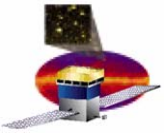
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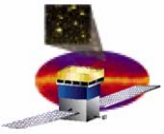
**[http://www-glast.slac.stanford.edu/Elec\\_DAQ/ELX\\_test/content/isis\\_documentation.htm](http://www-glast.slac.stanford.edu/Elec_DAQ/ELX_test/content/isis_documentation.htm)**



# ISIS TRR - Agenda

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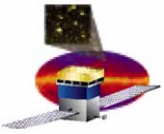
- **Overview**
- **Requirements**
- **Test Plan**
- **Tests**
- **Outstanding Issues**
- **Closure Plan**
- **Summary**



# ISIS Overview

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- Overview
  - **ISIS**
  - **Purpose**
  - **Schedule**
  - **Document Status**
- Requirements
- Test Plan
- Tests
- Outstanding Issues
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# ISIS

**Connections to SC Simulator:  
1553, SSR, and Discretes**

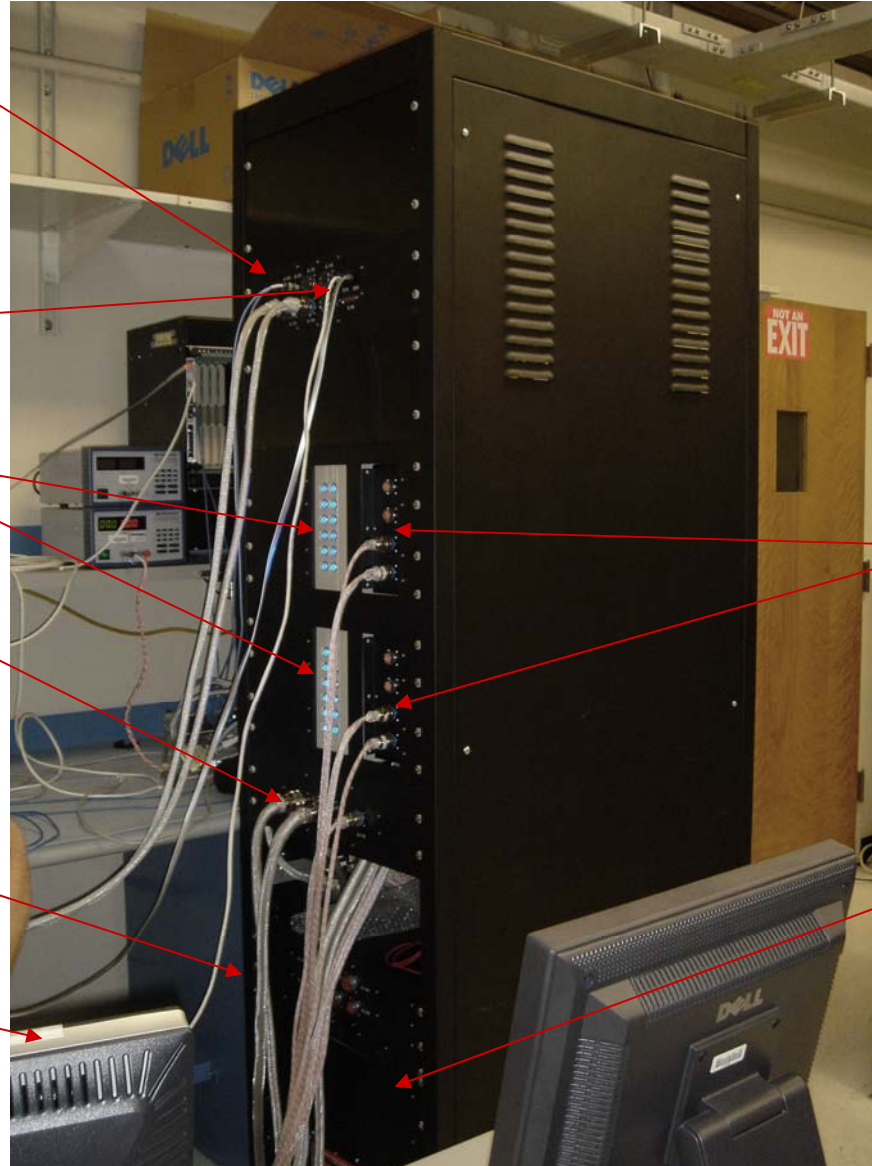
**Ethernet and Serial  
Connections**

**Heater Loads**

**Power feeds (SIU, PDU)**

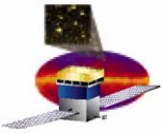
**Environmental  
Simulator**

**PC running  
AstroRT**



**Heater  
Controls**

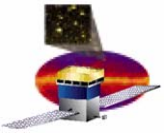
**PDU Load Box**



# Purpose

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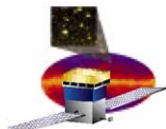
- **ISIS**
  - Assist the development of electrical interfaces and LAT-Spacecraft (SC) interaction
  - Provide a high-fidelity simulator of the primary-side LAT instrument
  - Present a flight-like hardware and FSW interface for testing and integration of the spacecraft
- **Testing**
  - Establish that it is safe to connect to the ISIS
  - Demonstrate that ISIS simulates the LAT effectively
    - Power, loads, temperature/voltage monitoring
    - LAT/SC interface (discretes, science data)
    - Commands and telemetry



# Schedule

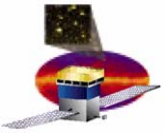
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- **Test Readiness Review (TRR) - December 15**
  - **Confirm readiness for Acceptance Testing**
    - **Safe Connection Procedure (LAT-TD-03541)**
    - **Acceptance Test Procedure (LAT-TD-05398)**
- **Close all required action items**
- **Acceptance Testing**
  - **Run Safe Connection Procedure - December 16**
  - **Run Acceptance Test Procedure - January 7**
- **Post Acceptance Test Review (PATR)**
  - **Held within 10 working days after last qualification test session**
  - **Confirm tests successfully completed (or specify what is required for completion)**
- **Delivery (ASAP after completion of acceptance tests)**



# Document Status

<i>Documents</i>	<i>Rev</i>	<i>Draft</i>	<i>LATDocs</i>	<i>Internal Review</i>	<i>CCB Approved</i>	<i>Signed Off</i>
LAT-SS-03975 LAT ISIS Requirements Specification	2	✓	✓	✓	✓	
LAT-MD-04086 LAT ISIS Acceptance Test Plan	2	✓	✓	✓	✓	
LAT-TD-03541 ISIS Safe Connection Procedure	1	✓	✓	✓	NA	
LAT-TD-05398 LAT ISIS Acceptance Test Procedure	1	*	✓	*		
LAT-TD-05426 ISIS FSW Build Description	1	✓	✓	✓	NA	
LAT-TD-02659 FSW Telecommand and Telemetry Formats	1	✓	✓	✓	NA	
LAT-DS-05244 ISIS Enclosure Assembly EGSE	2	✓	✓	✓	NA	✓
LAT-DS-05297 ISIS Grounding Diagram	1	✓	✓	✓	NA	
LAT-DS-04439 ISIS DAQ Hardware Mounting Plate	1	✓	✓	✓	NA	
LAT-DS-04440 ISIS GASU Mounting Rail	1	✓	✓	✓	NA	
LAT-DS-04441 ISIS PDU Mounting Rail	2	✓	✓	✓	NA	
LAT-DS-04461 ISIS +X Connector Panel	1	✓	✓	✓	NA	
LAT-DS-04489 ISIS -X Connector Panel	1	✓	✓	✓	NA	
LAT-DS-04593 ISIS Temperature Sensor Enclosure	1	✓	✓	✓	NA	
LAT-DS-04594 ISIS PDU Test Box Front Panel	1	✓	✓	✓	NA	
LAT-DS-04610 ISIS Heater Ctrl Box, VHCP Load Box Mounting and Front Panels	1	✓	✓	✓	NA	
LAT-DS-05147 ISIS SIU Adapter Plate EGSE	1	✓	✓	✓	NA	✓
LAT-DS-05235 ISIS Enclosure Blank Panel EGSE	1	✓	✓	✓	NA	✓
LAT-DS-05245 ISIS Enclosure Panel Temp Monitor EGSE	1	✓	✓	✓	NA	✓

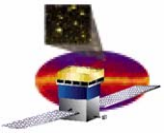


# Requirements

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- **1553 Bus Communication/LAT Telemetry**
  - Alert Telemetry
  - Spacecraft Commands
  - Routing of Commands
  - No-op Commands/Counting of No-op Commands
  - Ancillary Commands/Counting Ancillary Commands
  - Attitude Commands/Counting of Attitude Commands
  - Time Tone Commands/Counting of Time Tone Commands
  - Automatic Repoint Requests
  - GRB Signals
- **Discrete Control**
  - Output Discrete Lines
  - Input Discrete Lines
  - Reset Signal
- **Science Data Interface**
  - Hardware Interface
  - Science Data Patterns
  - Science Data Rate
  - Science Packet Length
  - Transmission Duration
- **CPU Boot Process**
- **Power**
  - Power Control/Power Draw
  - Analog Temperatures/Voltages

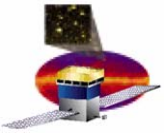




# Test Plan

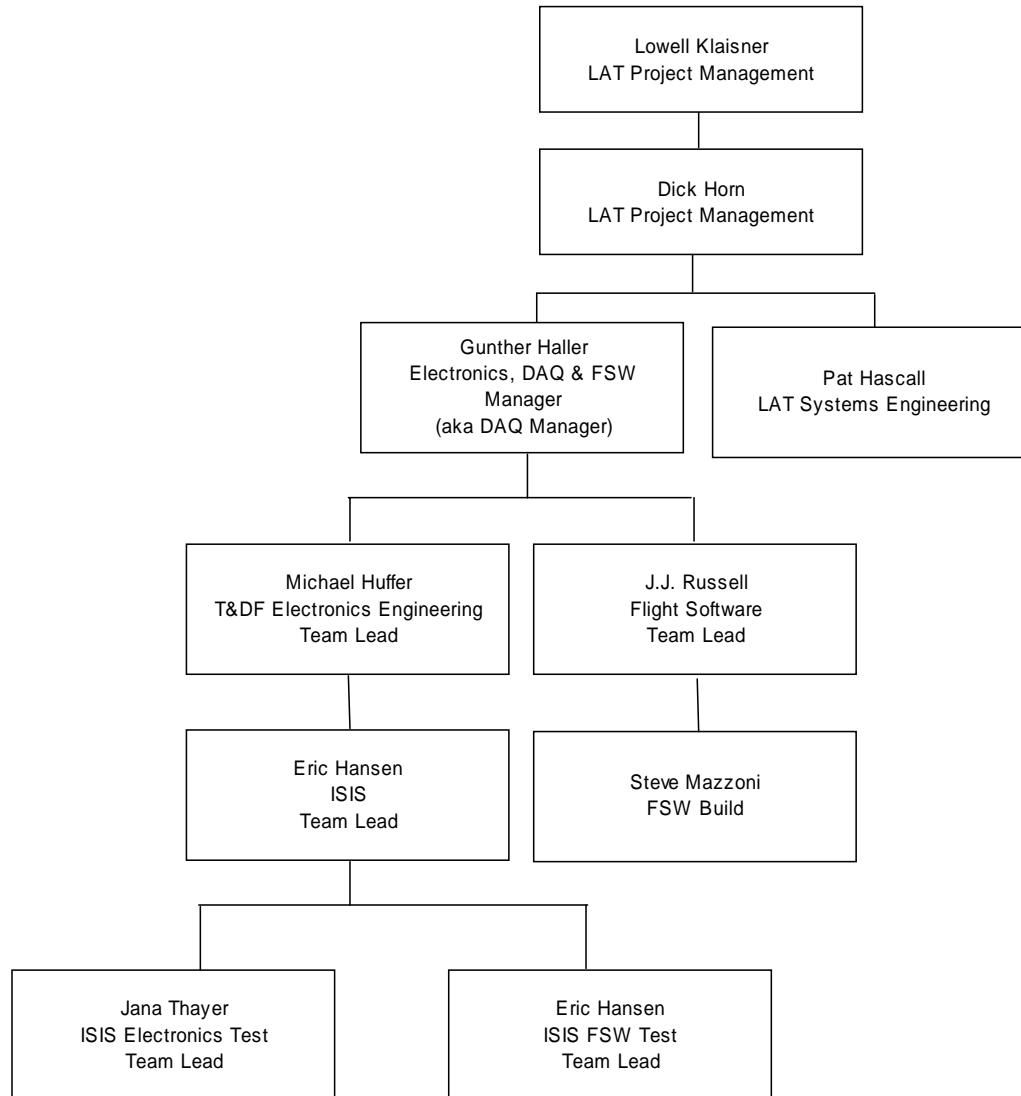
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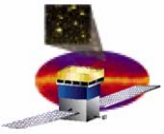
- Overview
- Requirements
- **Test Plan**
  - **Roles and Responsibilities**
  - **Test Execution**
  - **Configuration Management**
  - **Approach to Testing**
- Tests
- Outstanding Issues
- Closure Plan
- Summary



# Roles and Responsibilities

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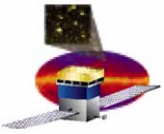




# Test Execution

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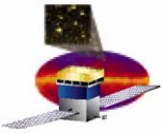
- **Safe Connection Procedure – Dec. 16**
  - **Test Director – Eric Hansen**
  - **Test Conductor – Jana Thayer**
  - **Quality Assurance Engineer - ?**
  
- **Acceptance Test Procedure – Jan. 6**
  - **Test Director**
    - **SW tests – Jana Thayer**
    - **HW tests – Eric Hansen**
  - **Test Conductor**
    - **SW tests – Eric Hansen**
    - **HW tests – Jana Thayer**
  - **Quality Assurance Engineer - ?**



# Configuration Management

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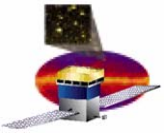
- **Hardware**
  - **Hardware database used to keep track of units/versions**
    - All hardware units are assigned a GLAT# (bar coded)
    - GLAT# recorded in LAT-DS-03541
  - **Each FPGA also has unique VHDL# (stored electronically)**
    - HW version info available in diagnostic telemetry packet
- **FSW**
  - **CMX**
  - **SW configuration info available in diagnostic telemetry packet**
- **Test scripts**
  - **CVS (CVSROOT = /afs/slac/g/glast/flight/fsw\_test/ISIS)**
- **Documents**
  - **LATDocs**



# Approach to Testing

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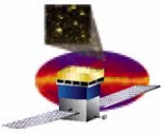
- **Hardware**
  - Each package has been unit tested prior to delivery
  - Mechanically, electronically, and for functionality
- **FSW**
  - Each package has been unit tested prior to delivery
- **ISIS integration**
  - ISIS hardware and software integrated since 9-21-04
  - Commissioning and debugging of HW/SW ongoing
  - Routinely used as test bench by FSW and FSW test
- **Acceptance Tests**
  - Perl scripts utilize AstroRT interface
    - Send commands to ISIS
    - Receive telemetry from ISIS
    - Toggle discrete lines using SDIS



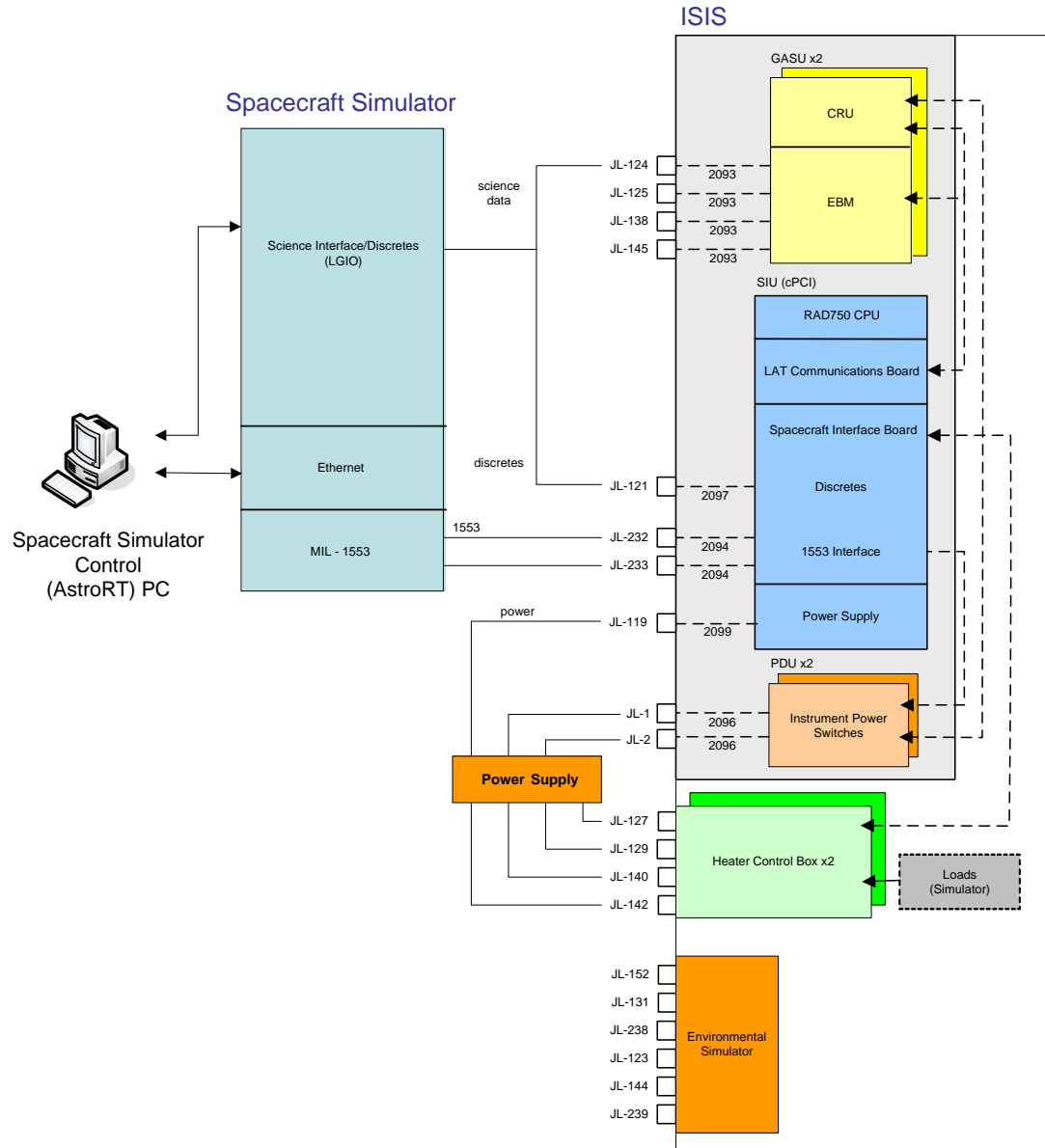
# Tests

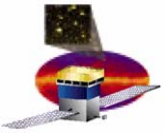
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- Overview
- Requirements
- Test Plan
- **Tests**
  - **Test Environment**
  - **Safe Connection**
  - **AstroRT**
  - **Verification Matrix**
- Outstanding Issues
- Closure Plan
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# Test Environment



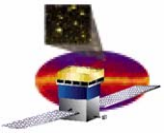


# Safe Connection

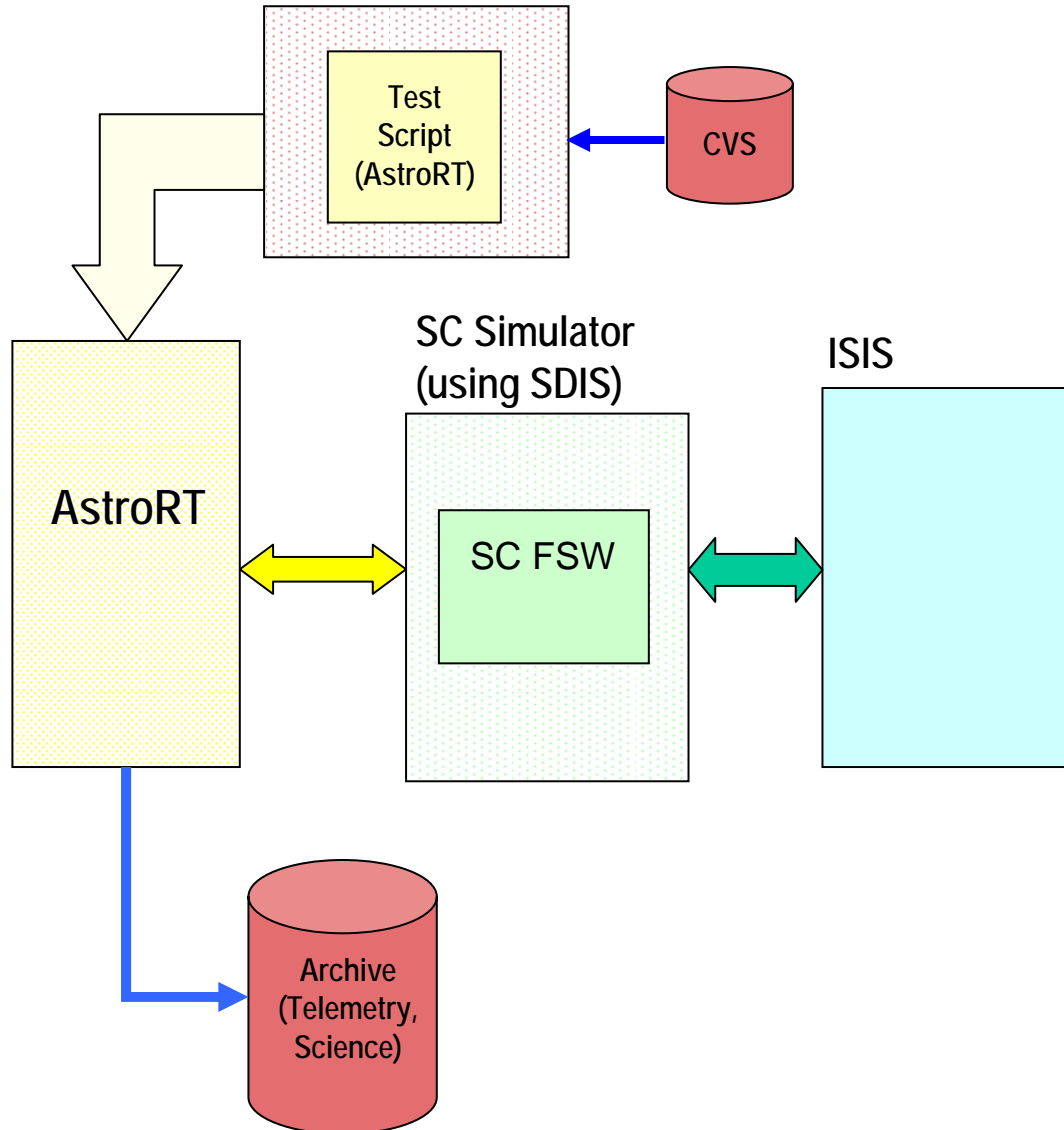
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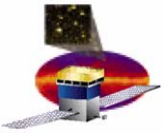
- **Every connector on front panel tested**
- **Four tests for each**
  - **Electrical Continuity Check, Power and Power-Return**
  - **Electrical Isolation Check, Power to Power-Return**
  - **Electrical Isolation, Signal Isolation from Power and Power-Return**
  - **Electrical Impedance, Signal-to-Signal (Resistance between Differential Pairs)**
- **Verifies**
  - **Can safely mate to connectors**
  - **All internal connections are good**
  - **Analog temperatures have correct values**





# AstroRT

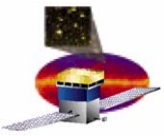




# Verification Matrix

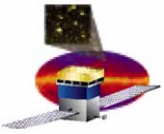
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ISIS Req't #	Requirement Title	Test Script
1	MIL-STD 1553B Communication	All
1.0.0	LAT Telemetry	All
1.0.0.0	Alert Telemetry	ISIS_Alert.pl
1.0.1	Spacecraft Commands	All
1.0.1.0	Routing of Commands	ISIS_Routing_Cmds.pl
1.0.1.1.1	Counting of No-op Commands	ISIS_Noop.pl
1.0.1.1.2	Reporting of No-op Command Counts	ISIS_Noop.pl
1.0.1.2	Ancillary Commands	ISIS_Magic7.pl
1.0.1.2.1	Reporting of Ancillary Command Counts	ISIS_Magic7.pl
1.0.1.3	Attitude Commands	ISIS_Magic7.pl
1.0.1.3.1	Reporting of Attitude Command Counts	ISIS_Magic7.pl



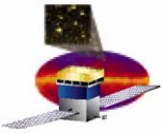
## Verification Matrix (continued)

ISIS Req't #	Requirement Title	Test Script
1.0.1.4	Time Tone Commands	ISIS_Magic7.pl
1.0.1.4.1	Reporting of Time Tone Command Counts	ISIS_Magic7.pl
1.0.2	ISIS Automatic Repoint Requests (ARRs)	ISIS_AutoRepoint.pl
1.1.0	Output Discrete Lines	ISIS_DiscreteSet.pl
1.1.1	Input Discrete Lines	ISIS_DiscreteRead.pl
1.1.1.0	Reset Signal	ISIS_Reset.pl
1.2.0	Science Data Hardware Interface	LAT-TD-03541 ISIS Safe Connection Procedure
1.2.1	Pattern Initialization	ISIS_SciDataPatterns.pl
1.2.2	Transmission of Pattern Initialization Parameters	ISIS_SciDataPatterns.pl
1.2.3	Transmission of Science Data	ISIS_SciDataPatterns.pl
1.2.4.0	Selection of Science Data Patterns	ISIS_SciDataPatterns.pl
1.2.4.1	Seed for Random Data Pattern	ISIS_SciDataPatterns.pl



## Verification Matrix (continued)

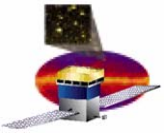
ISIS Req't #	Requirement Title	Test Script
1.2.5	Data Rate	ISIS_SciDataPatterns.pl
1.2.6	Transmission Duration	ISIS_SciDataPatterns.pl
1.2.6.0	Continuous Transmission Signal	ISIS_SciDataPatterns.pl
1.2.7.0	Packets of Defined Length	ISIS_SciDataPatterns.pl
1.2.7.1	Packets of Random Length	ISIS_SciDataPatterns.pl
1.3.0	GBM Signals	ISIS_GBM_Messages.pl
1.4	CPU Boot Process	ISIS_Boot.pl
1.5	Analog Temperatures	LAT-TD-03541ISIS Safe Connection Procedure
1.6	Analog Voltages	LAT Voltage Monitoring Test (no script)
1.7	Power	ISIS_Power.pl
		Power Draw Test (no script)
		Voltage Monitoring Test (no script)



# Outstanding Issues

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- **Hardware**
  - JL-2, pin 2 not connected
    - One of 20 28V\_HOT pins on redundant main feed
- **Software**
  - Upload ISIS FSW build to EEPROMs
  - Resolve occasional PCI master abort
- **Test Scripts**
  - Routing of commands
  - Ancillary, Attitude, and Time Tone Commands
  - Boot Process
  - Reset Signal
- **Documentation**
  - LAT-TD-05398 – ISIS Acceptance test procedure
    - Waiting on remaining test scripts
  - LAT-TD-03541 – ISIS Safe Connection procedure
    - Update GLAT# for heater load boxes
  - LAT-TD-05297 – ISIS Grounding diagram
    - Add chassis ground
    - Add temperature monitor panel ground



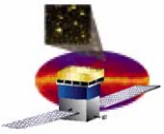
# Closure Plan

#	Description of problem	Responsible party	Due date
1	JL-2, pin 2 not connected	Patrick Young	12-16-04
2	Resolve PCI master abort	Steve Mazzoni/Ed Bacho	12-17-04
3	Upload ISIS FSW build*	Tony Waite	12-17-04
4	Test script: Routing of commands	Eric Hansen	12-17-04
5	Test script: Ancillary, Attitude and Time Tone Commands	Eric Hansen	12-16-04
6	Test script: Boot Process	Eric Hansen	12-17-04
7	Test script: Reset Signal	Eric Hansen	12-17-04
8	LAT-DS-05398 (Acceptance Test)**	Jana Thayer/Susan Becker	1-6-04
9	LAT-DS-03541 (Safe Connection)	Jana Thayer/Susan Becker	12-16-04
10	LAT-DS-05297 (Grounding diagram)	Jana Thayer/Susan Becker	12-17-04

\* Closure depends on #2 (resolution of PCI master abort)

\*\* Closure depends on #4 – #8 (test script completion)

(SLAC has a two week shutdown: 12/18/04 – 1/2/05)



# Summary

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- On schedule to ship ISIS in the 1<sup>st</sup> week of January
- Some minor issues to deal with affecting the following documents/items
  - Safe Connection Procedure - December 15
  - Test scripts - December 17
  - Update Acceptance Test Procedure - January 6

## MILESTONES

- Acceptance Testing
  - Run Safe Connection Procedure - December 16
  - Run Acceptance Test Procedure - January 7
- Post Acceptance Test Review (PATR)
  - Confirm tests successfully completed (or specify what is required for completion)
- Delivery (ASAP after completion of acceptance tests) – 1<sup>st</sup> week of January
  - After resolution of any required issues
  - ISIS shipped, accompanied by team from SLAC; training provided
  - Installed and verified with a subset of Acceptance Test
  - Settle on details after winter shutdown.