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Document Title

LAT FSW Qualification Test Procedure:

CMDFNC_002: Initiating EPU and SIU Secondary Boot

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CHANGE HISTORY LOG

Revision	Effective Date	Description of Changes
01	XXXXX	Original

TABLE OF CONTENTS

1. SCOPE

This document describes the procedure followed for qualification testing of the LAT FSW. This Qualification Test Procedure document describes one of the qualification tests executed to verify compliance with the requirements defined in the "Flight Software Specification – Level III" (LAT-SS-00399).

1.1 Test Suite

CMDFNC

The Test Suite is a logical grouping of a set of tests based on common functionalities and can be executed as a suite of tests in some order when the pre-conditions and post-conditions for each test within the suite have been met successfully.

This test procedure *CMDFNC_002* belongs in the Test Suite *CMDFNC* under the *FST* Project.

The CMDFNC tests verify that all LAT commands are executed through the 1553 interface with command execution and completion status reported in telemetry when command verification features are switched on. These tests also verify that the SIU FSW validates commands and command parameters prior to command execution.

1.1.1 Relationship of CMDFNC_002 to Other Test Suites

Responsibility for verifying 1553 interface and telecommand validation and processing requirements is shared between the CMDFNC_002 test and the CMDFNC_003 test. In particular, CMDFNC_002 verifies that the secondary boot telecommand has the correct format, can be received over the 1553 interface and processed, and that a valid secondary boot telecommand addressed to the SIU, EPU0, or EPU1 is correctly processed. By contrast, the CMDFNC_003 test tests the secondary boot telecommand when packet structures and parameters are *invalid*. The specific requirements shared between these test suites are identified in Section 1.3 below. See the CMDFNC_003 test procedure document for a complete discussion of how responsibility for testing the entire telecommand and telemetry interface is mapped among various qualification test suites.

The following PBC telecommands and PBC telemetry are used in this test.

PBC Telecommands

APID	FC	Cmd. Packet (L)	Description (L)
0x640	3	LBTRTOSEXEC	Boot RTOS

PBC Telemetry

APID	Tlm. Packet (L)	Description (L)
0x200	LBTHKP	Boot housekeeping telemetry
0x261	LBTEPU0HKP	EPU 0 Boot Housekeeping Telemetry
0x262	LBTEPU1HKP	EPU 1 Boot Housekeeping Telemetry

1.2 Test ID

CMDFNC_002

Test *CMDFNC_002* contains one main script, CMDFNC_002.py, which can be run when the SIU or an EPU is in the Boot Mode. This test verifies that at the end of primary boot, the EPUs and the SIU are commandable to perform the secondary boot.

1.3 Requirement(s) Tested

The Qualification Test Procedure described herein is performed to verify that the FSW satisfies the following requirement(s), quoted from the Flight Software Specification – Level III.

The following requirements are fully verified in CMDFNC_002.

Requirement Number	Requirement Name	Requirement	Level of Requirements Verification in This Test
5.3.1.10.1	Initiating EPU Secondary Boot	At the conclusion of the primary boot, the EPU shall be commandable by the SIU to perform the secondary boot. This command may be issued by the ground and implemented via the SIU.	Full
5.3.1.10.2	Initiating SIU Secondary Boot	At the conclusion of the primary boot, the SIU shall be commandable from the ground to perform the secondary boot.	Full

This test also shares verification of requirements with the CMDFNC_003 test. The requirements partially verified in this test are listed below.

Requirement Number	Requirement Name	Requirement	Level of Requirements Verification in This Test
5.2.2.1.1	Command, Telemetry, and Data Bus Protocol – SC	[2] (3.2.5.1.1) [3] (5.3.4) [4] (5.3.1) The SIU FSW shall exchange commands, low rate telemetry, time messages, and ancillary data with the SC C&DH across a MIL-STD-1553B bus, using the MIL-STD-1553B physical layer protocol.	Partial (Also see the CMDFNC_003 test)
5.2.2.1.3	Data Format	[1] (3.1.2.5.1.1) [2] (3.2.5.4.6) All data exchanged across the CTDB interface shall be formatted as CCSDS telecommand or telemetry packets, as specified in [7].	Partial (Also see the CMDFNC_003 test)
5.3.3.5	Command Format	[Derived] The FSW shall be able to process commands of the format described in [9].	Partial (Also see the CMDFNC_003 test)
5.3.3.9.1	Data Integrity Errors	[Derived] To reduce the chance of executing a corrupted command, the FSW shall validate commands prior to execution.	Partial (Also see the CMDFNC_003 test)
5.3.3.9.2	Parameter Validation	[Derived] The SIU FSW shall validate command parameters prior to execution.	Partial (Also see the CMDFNC_003 test)

If the requirement(s) quoted above cite external documents (e.g., "…Further details are provided in [11]"), consult LAT-SS-00399 for the list of citations.

2. DEFINITIONS AND ACRONYMS

The following terms, abbreviations, and acronyms are used in this document:

2.1 Definitions

Hz	Hertz, unit of frequency
V	Volt
W	Watt
s, sec	seconds

2.2 Acronyms

CAL	Calorimeter
EGSE	Electrical Ground Support Equipment
GASU	Global trigger Anti-collision Spacecraft Unit
PTR	Post Test Review
TEM	Tower Electronics Module
TKR	Tracker
TPS	Tower Power Supply
TRR	Test Readiness Review
QAE	Quality Assurance Engineer
TE	Test Engineer

3. REFERENCES

The list below provides documents that are to be used as references for this procedure:

3.1 Applicable Documents

Document Number	Description
SPECIFICATIONS	
LAT-SS-00399	LAT Flight Software Level III Specification
1196 EI-S46310-000	GLAST 1553 Bus Protocol Interface Control
LAT-TD-02659	LAT Flight Software Telecommand and Telemetry Formats
LAT-TD-0561	The Virtual Spacecraft (VSC)
PROCEDURES	
LAT-TD-TBD	CMDFNC_003: 1553 Interface and Command Functional Verification
PLANS	
LAT-MD-00039	Performance Assurance Implementation Plan
LAT-MD-00078	GLAST LAT System Safety Program Plan
LAT-MD-00404	LAT Contamination Control Plan
LAT-MD-00408	LAT Program Instrument Performance Verification Plan
LAT-SS-00296	T & DF Test Plan
LAT-TD-00297	LAT Electronics Test Plan
LAT-TD-00786	LAT Flight Software Test Plan
DRAWINGS	
N/A	
OTHER	
LAT-MD-00091	GLAST Quality Manual
LAT-MD-00471	Control of Nonconforming Product
LAT-MD-00472	Corrective and Preventative Action

4. REQUIREMENTS

This section lists the requirements that shall be followed during the LAT FSW Qualification Testing process.

The Performance Assurance Implementation Plan, LAT-MD-00039, shall be utilized to ensure that the products produced by the GLAST LAT project intended for design qualification, flight and critical ground support equipment usage meet the required levels of quality and functionality for their intended purposes.

The LAT Program Instrument Performance Verification Plan, LAT-MD-00408, shall be utilized to address the testing to be performed at the unit/subsystem and instrument level for flight qualification, proto-flight and acceptance testing phases. Also included are the necessary processes/procedures and systems assurance activities.

4.1 Test Data, Equipment and Software

This procedure shall follow the requirements found in the Control of Nonconforming Product, LAT-MD-00471. This document establishes the method to identify and control nonconforming product developed by the LAT project team.

4.2 Quality Assurance

This procedure shall follow the requirements found in the Corrective and Preventative Action document, LAT-MD-00472 and the GLAST Quality Manual, LAT-MD-00091.

The Corrective and Preventative Action document establishes the method to be used to initiate, implement, evaluate and record corrective and preventive actions. The GLAST Quality Manual defines the methods implemented by the GLAST LAT project to ensure consistent quality of all processes for procurement, design, development and production of flight hardware, flight software and all associated ground support equipment interfacing with flight hardware and software.

4.3 Safety

This procedure shall follow the requirements found in the GLAST LAT System Safety Program Plan, LAT-MD-00078. This document defines all phases of the LAT program including: design, development, fabrication, handling, transportation, storage, test, assembly and operation.

WARNING: When high voltages are present extreme care should be exercised.

4.4 Warnings, Cautions, and Notes

The following SAFETY ALERTS are intended to create awareness of the potential safety hazards and the steps that must be taken to avoid accidents. These same alerts are used throughout this document to identify specific hazards that may endanger personnel and/or equipment.

Identification of every conceivable hazardous situation is impossible. Therefore, all personnel have the responsibility to diligently exercise safe practices whenever exposed to this equipment.

WARNING: Indicates a potential hazardous situation which, if not avoided, could result in death or injury.

CAUTION: Indicates a potential hazardous situation which, if not avoided, could result in damage to equipment.

Note: Indicates a notification of information that is important, but not hazard related.

4.5 General Instructions

This qualification test procedure shall be conducted on a formal basis to its latest approved and released version. The designated Software QAE shall be notified 24 hours prior to the start of this procedure. Software QAE may monitor the execution of all or part of this procedure should they elect to do so.

The Test Engineer conducting this test shall read this document in its entirety and resolve any apparent ambiguities before beginning the procedures described herein.

Deviations from the procedures described in this document and breaks in hardware or software configuration can only be initiated by the Test Engineer, must be approved by QA, and must be documented in Appendix A.

Any nonconformance/defect/anomaly is to be reported in JIRA. Refer to the LAT Flight Software Test Plan LAT-TD-00786 for guidance. Do not alter or break configuration if a failure occurs. Notify Software Quality Assurance.

All success conditions for a test must be met for the test to pass.

5. SETUP

This section describes the hardware and software configuration used for the qualification test described later in this document. Any break from configuration or deviation from a particular procedure must be authorized by the Quality Assurance Engineer and documented in Appendix A.

5.1 Hardware Setup

The list below indicates the equipment that is used to execute the tests described in this document.

Hardware Unit	Manufacturer	GLAT Number (and Hardware Sub-Units by GLAT Number)	Firmware Version (where applicable)
Virtual Spacecraft (VSC)	SLAC		
Spacecraft Interface Unit (SIU)	SLAC		
Event Processing Unit (EPU): 2 (EPU0 and EPU1)	SLAC		
Global trigger, ACD, DAQ, and Signal distribution unit (GASU)	SLAC		
Power Distribution Unit (PDU)	SLAC		
1553 cables and couplers	SLAC		
Unix or Linux Host Establishes connection between VSC and the terminal from which the test is run.			
Power supply for SIU	SLAC		

The Figure below depicts the Testbed on which this qualification test is performed. The particular hardware units utilized in this test are itemized by GLAT number and firmware version in the preceding table.

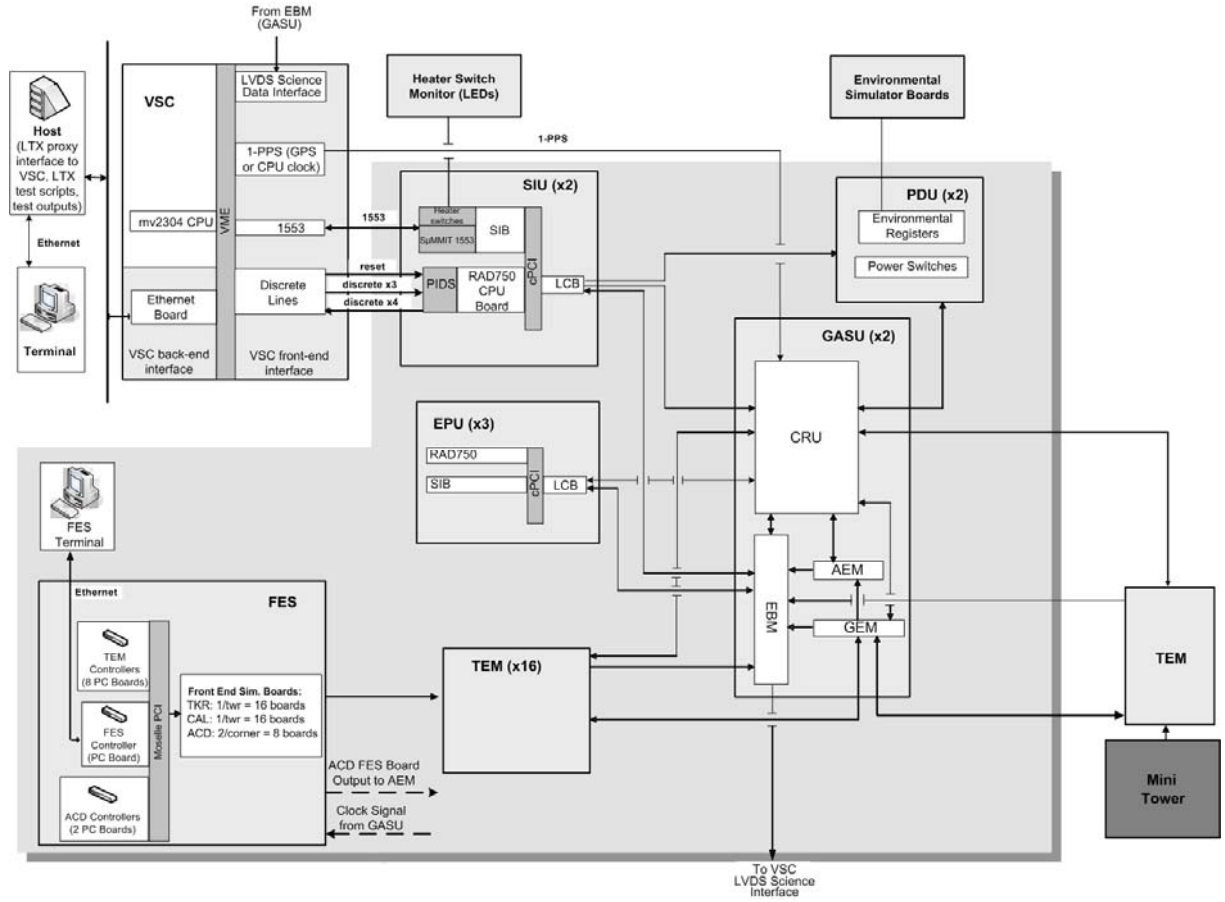

Figure 1. FSW Testbed

5.2 Software Setup

The software required to prepare for and execute the tests described in this Qualification Test Procedure document is itemized in this section.

5.2.1 Test Tools

The following table specifies the test executive used to run this qualification test, and identifies the other software tools used to support the execution of the test. The “Software Version Number” column identifies the version number of the test tool being used; alternatively, this column identifies the hardcopy attachment to this document that records the version of the tool being used (e.g., “Attachment 1”). The “Path to Attachment” column identifies the directory in which the electronic copy of any hardcopy attachment is saved (if applicable).

Software	Description of Software	Software Version Number (or Specify Attachment Number)	Path to Attachment (If Applicable)
LTX	LAT Test Executive		
VSC	Virtual Spacecraft system software		
VPI	VSC Python/Proxy Interface		

5.2.2 Test Scripts

The following table identifies the test scripts that are run to execute this qualification test. The "Script Version Number" column identifies which version of the script is being used; alternatively, this column identifies the hardcopy attachment to this document that records the version of the script being used (e.g., "Attachment 1"). The "Path to Attachment" column identifies the directory in which the electronic copy of any hardcopy attachment is saved (if applicable).

Test Script	Description of Test Script	Script Version Number (or Specify Attachment Number)	Path to Attachment (If Applicable)
CMDFNC_002.py	This script, the main test execution script, must be run when FSW is operating in Boot Mode. It executes tests of SIU and EPU FSW. The script controls the entire test process, detecting the state of the hardware and FSW and advancing the SIU and EPUs through the different operational modes covered during the test.		

5.2.3 Flight Software

This qualification test is performed on a complete, integrated Candidate Release of FSW. All FSW libraries under test are final Flight Unit Candidate versions. The test described in this document is designed to evaluate the particular FSW packages and constituents listed in the following table; for clarity, only those constituents that are the focus of the test are listed below.

FSW Package	Constituent(s)
PBC	

FSW Package	Constituent(s)
CTDB	

The Candidate Release into which these FSW constituents are integrated is identified in the following table. The "Candidate Release Build Number" column specifies the build number of the FSW Candidate Release under test (e.g., "B0-0-1"). The "Candidate Release Attachment Number" column identifies which hardcopy attachment to this document confirms the name and version number of the full set of FSW packages and constituents used in the test (e.g., "Attachment 2"). The "Path to Attachment" column specifies where in the test repository an electronic copy of the hardcopy attachment has been saved.

Candidate Release Build Number	Candidate Release Attachment Number	Path to Attachment

5.3 Setup Validation

5.3.1 Hardware Validation

The following signatures confirm that the Test Engineer and Quality Assurance Engineer have verified the GLAT numbers, firmware version numbers, and the proper connection of all hardware listed in the table in Section 5.1.

_____	_____	_____	_____
Date	Time	Test Engineer	QAE

5.3.2 Software Validation

The Test Engineer performs the following procedure to validate the software setup for this qualification test and records completion of the setup validation steps in the space provided.

Step No.	Description of Step	Step Outcome
1	Record the version numbers of all test tools used to perform this qualification test in the table in Section 5.2.1	Complete/ Not Complete

Step No.	Description of Step	Step Outcome
2	Record the version numbers of all test scripts used to perform this qualification test in the table in Section 5.2.2	Complete/ Not Complete
2	Record the version numbers of the FSW constituents and the Candidate Release on which this test is performed in Section 5.2.3.	Complete/ Not Complete

The following signatures confirm that, using the procedure described in the previous table, the Test Engineer and Quality Assurance Engineer have verified that all versions of test support software, test scripts, and FSW constituents match those identified in Section 5.2.

_____	_____	_____	_____
Date	Time	Test Engineer	QAE

6. TEST PROCEDURE FOR CMDFNC_002

6.1 Test Objective

The following are the objectives of this test when tested in the Boot or Application Modes.

This test verifies that at the end of primary boot, the EPUs and the SIU are commandable to perform the secondary boot.

This Test Objective is broken down into the following Test Sub-Objectives.

Number	Test Sub-Objective
1	Verify on SIU, EPU0 and EPU1.
2	Verify in the Boot Mode only.
3	Verify on both the Primary and Redundant SIU.
4	Verify that at the conclusion of the primary boot, the SIU is commandable from the ground to perform the secondary boot.
5	Verify that at the conclusion of the primary boot, the EPU is commandable by the SIU to perform the secondary boot.

As explained in Section 1, the CMDFNC_002 test is related to CMDFNC_003 test. CMDFNC_002 partially verifies some of the 1553 interface and command validation requirements, thus the following are also listed as Test Objectives and are verified in this test.

Number	Test Sub-Objective
6	Verify that the supported PBC Telecommands and Telemetry exchanged across the 1553 Interface conform to CCSDS packet structure:
7	Verify that the supported valid PBC Telecommands issued by S/C with LAT as their destination are received correctly and processed.

6.2 Test Input Files

The following table identifies all auxiliary files (e.g., Front End Simulator data files, GLEAM data files) used as inputs to this qualification test. Note that not all qualification tests use input data of this type. The "Input File Version Number" column identifies the version number of the auxiliary file being used; alternatively, this column identifies the hardcopy attachment to this document that records the version of the file being used (e.g., "Attachment 1"). The "Path to Attachment" column specifies where in the test repository an electronic copy of the hardcopy attachment has been saved.

Input File	Description of Input File	Input File Version Number (or Specify Attachment Number)	Path to Attachment (If Applicable)
N/A	N/A	N/A	N/A

6.3 Test Preparation

After the hardware and software setup has been validated, steps may be required to place the hardware and FSW in an operational mode in which the qualification test can be performed or otherwise complete preparations for the test to begin.

The Test Engineer carries out the following procedure to prepare for qualification tested and records completion of the test preparation steps in the space provided.

Step No.	Description of Step	Step Outcome
1	Confirm that the VSC is powered up.	Complete/ Not Complete
2	Confirm that the SIU is powered up.	Complete/ Not Complete

The Test Engineer and Quality Assurance Engineer verify that all test preparation steps are complete.

_____ Date	_____ Time	_____ Test Engineer	_____ QAE

6.4 Test Procedure and Test Analysis

This section describes the step by step procedure performed once the test preparation is complete. The test as well as analysis for each of the sub-objectives is conducted by the main test script CMDFNC_002.

The Test Engineer proceeds with the qualification test procedure itself, as described below, and records the outcome of each step during test execution. The outcome of each step is either "Complete" or "Not Complete" (for steps which involve no analysis or verification); or, "Pass" or "Fail" (for steps involved in verifying completion of test objectives and sub-objectives).

The test procedure is executed on the SIU and EPUs, in Boot Mode, in 4 major parts:

- SIU Boot Mode Testing
- EPU0 Boot Mode Testing
- EPU1 Boot Mode Testing
- Review of Test Outputs

6.4.1 Part 1: SIU Boot Mode Testing

This part of the test exercises the secondary boot telecommand handling functionality of SIU FSW while the SIU is operating in Boot Mode.

Step No.	Description of Step	Step Outcome
1	At the test terminal, run the script CMDFNC_002 under LTX through the VSC with the following command: **$ ltx run CMDFNC_002**	Complete/ Not Complete

Step No.	Description of Step	Step Outcome
2	The test script determines whether the SIU FSW is currently operating in Boot Mode or Application Mode by detecting whether boot housekeeping or application housekeeping telemetry is being transmitted. Regardless of the SIU's current mode, the script sends the SIU the LBTRESET telecommand to reboot the unit. The script then checks whether the SIU FSW is now operating in Boot Mode by detecting if boot housekeeping is being transmitted. If not, the script sends the LBTRESET command and checks again. If the SIU FSW cannot be placed in Boot Mode, LTX prints an error message to the screen and exits, aborting the test. If the test is NOT aborted, mark "Complete" for the Step Outcome.	Complete/ Not Complete
3	With SIU FSW operating in Boot Mode, the test enters its Initiating SIU Secondary Boot phase. The script sends the LBTRTOSEXEC telecommand to the SIU. The script waits for few seconds, then checks whether Boot Mode housekeeping telemetry packets that are being transmitted from the SIU have stopped. The script also verifies that secondary boot was completed by issuing the LLFSDIRDUMP telecommand, a command that is accepted and responded to by SIU FSW running in Application Mode, and checking (1) that the expected LLFSROOTLIST telemetry packets are received and in response to the command (2) that fields in CmdConfirm telemetry packets confirm the LLFSDIRDUMP command was queued and processed.	N/A
4	Next, the script executes its Boot Mode Command Data Format and Integrity Errors phase. The script confirms that the boot housekeeping telemetry (LBTHKP) packets conform to the CCSDS standard. Note: In Step 3, the test verifies that the LBTRTOSEXEC telecommand has the proper data format and integrity, and conforms to the CCSDS standard, by implicit verification of successful secondary boot. The complete analysis of the format and integrity of the LBTRTOSEXEC command is recorded in the output log printed and reviewed at the end of the test.	N/A
5	The script next executes its Boot Mode PBC Command Format and Parameter Validation phase. Proper execution of an LBTRTOSEXEC telecommand that has the correct format and valid parameters is tested in Step 3 by implicit verification of successful secondary boot. The complete analysis of command parameter validation based on the results of Step 3 is recorded in the output log printed and reviewed at the end of the test.	N/A

6.4.2 Part 2: EPU0 Boot Mode Testing

Once SIU Boot Mode testing is complete, the test exercises the secondary boot telecommand handling functionality of EPU0 FSW while EPU0 is operating in Boot Mode. As described below, at this stage, the test procedure moves through a series of steps to place the GASU, PDU, EPUs, and instrument power in a "clean" state for testing. Once this is accomplished, the secondary boot command testing continues.

Step No.	Description of Step	Step Outcome
6	The test script issues an LLIMLOADSHED command. The SIU reboots and the GASU, PDU, EPU, and instrument power are turned off for a fresh test start.	N/A
7	The test script determines whether the SIU is now operating in Boot Mode as a result of the reboot by detecting whether boot housekeeping telemetry is being transmitted. If not, the script sends the LPBCRESET command and checks again. If the SIU FSW cannot be placed in Boot Mode, LTX prints an error message to the screen and exits, aborting the test. If the test is NOT aborted, mark "Complete" for the Step Outcome.	Complete/ Not Complete
8	The test script advances the SIU FSW to Application Mode by sending the LPBCRTOSEXEC telecommand, which commands the SIU to perform a secondary boot. The script checks that the SIU is operating in Application Mode by detecting whether Application Mode housekeeping telemetry is being transmitted. If not, the script sends the LPBCRTOSEXEC command and checks again. If the SIU FSW cannot be advanced to Application Mode, LTX prints an error message to the screen and exits, aborting the test. If the test is NOT aborted, mark "Complete" for the Step Outcome.	Complete/ Not Complete
9	The script sends the LLIMMAINFEEDON telecommand to power up the PDU and GASU.	N/A
10	The script then sends the LLIMPOWERON command to power up EPU0. In response to a powerup, EPU0 should begin a primary boot. The test script determines whether EPU0 is operating in Boot Mode as a result of the powerup and primary boot by detecting whether the EPU is transmitting boot housekeeping telemetry. If not, the script sends the LPBCRESET command and checks again. If the EPU0 FSW cannot be placed in Boot Mode, LTX prints an error message to the screen and exits, aborting the test. If the test is NOT aborted, mark "Complete" for the Step Outcome.	Complete/ Not Complete
11	With EPU0 FSW operating in Boot Mode, the test enters its Initiating EPU0 Secondary Boot phase. The script sends the LBTRTOSEXEC telecommand to the EPU0. The script waits for few seconds, then checks whether Boot Mode housekeeping telemetry packets that are being transmitted from the EPU0 have stopped. The script also verifies that secondary boot was completed by issuing the LLFSDIRDUMP telecommand, a command that is accepted and responded to by EPU0 FSW running in Application Mode, and checking (1) that the expected LLFSROOTLIST telemetry packets are received and in response to the command (2) that fields in CmdConfirm telemetry packets confirm the LLFSDIRDUMP command was queued and processed.	N/A

Step No.	Description of Step	Step Outcome
12	Next, the script executes its EPU0 Boot Mode Command Data Format and Integrity Errors phase. The script confirms that EPU0 boot housekeeping telemetry (LBTEPU0HKP) packets conform to the CCSDS standard. Note: In Step 11, the test verifies that the LBTRTOSEXEC telecommand has the proper data format and integrity, and conforms to the CCSDS standard, by implicit verification of successful secondary boot. The complete analysis of the format and integrity of the LBTRTOSEXEC command is recorded in the output log printed and reviewed at the end of the test.	N/A
13	The script next executes its Boot Mode PBC Command Format and Parameter Validation phase. Proper execution of an LBTRTOSEXEC telecommand that has the correct format and valid parameters is tested in Step 11 by implicit verification of successful secondary boot. The complete analysis of command parameter validation based on the results of Step 11 is recorded in the output log printed and reviewed at the end of the test.	N/A

6.4.3 Part 3: EPU1 Boot Mode Testing

The test continues with Boot Mode secondary boot command handling functionality on EPU1.

Step No.	Description of Step	Step Outcome
14	The script then sends the LLIMPOWERON command to power up EPU1. In response to a powerup, EPU1 should begin a primary boot. The test script determines whether EPU1 is operating in Boot Mode as a result of the powerup and primary boot by detecting whether EPU1 is transmitted boot housekeeping telemetry. If not, the script sends the LPBCRESET command and checks again. If the EPU1 FSW cannot be placed in Boot Mode, LTX prints an error message to the screen and exits, aborting the test. If the test is NOT aborted, mark “Complete” for the Step Outcome.	Complete/ Not Complete
15	With EPU1 FSW operating in Boot Mode, the test enters its Initiating EPU1 Secondary Boot phase. The script sends the LBTRTOSEXEC telecommand to the EPU1. The script waits for few seconds, then checks whether Boot Mode housekeeping telemetry packets that are being transmitted from the EPU1 have stopped. The script also verifies that secondary boot was completed by issuing the LLFSDIRDUMP telecommand, a command that is accepted and responded to by EPU1 FSW running in Application Mode, and checking (1) that the expected LLFSROOTLIST telemetry packets are received and in response to the command (2) that fields in CmdConfirm telemetry packets confirm the LLFSDIRDUMP command was queued and processed.	N/A

Step No.	Description of Step	Step Outcome
16	Next, the script executes its EPU1 Boot Mode Command Data Format and Integrity Errors phase. The script confirms that EPU1 boot housekeeping telemetry (LBTEPU1HKP) packets conform to the CCSDS standard. Note: In Step 15, the test verifies that the LBTRTOSEXEC telecommand has the proper data format and integrity, and conforms to the CCSDS standard, by implicit verification of successful secondary boot. The complete analysis of the format and integrity of the LBTRTOSEXEC command is recorded in the output log printed and reviewed at the end of the test.	N/A
17	The script next executes its Boot Mode PBC Command Format and Parameter Validation phase. Proper execution of an LBTRTOSEXEC telecommand that has the correct format and valid parameters is tested in Steps 15 by implicit verification of successful secondary boot. The complete analysis of command parameter validation based on the results of Step 15 is recorded in the output log printed and reviewed at the end of the test.	N/A
18	The test script sends the LPBCRESET command to EPU1 to reboot that unit. It then powers down EPU1 by sending the LLIMPOWEROFF command.	N/A
19	The test script sends the LPBCRESET command to EPU0 to reboot that unit. It then powers down EPU0 by sending the LLIMPOWEROFF command.	N/A
20	The script next sends the LLIMLOADSHED telecommand to power off the GASU and PDU.	N/A
21	The script sends the LPBCRESET command to the SIU perform a graceful exit. If the SIU FSW cannot be placed in Boot Mode, LTX prints an error message to the screen and exits. Confirm that the script has placed the SIU in Boot Mode ready for another test.	Complete/ Not Complete

6.4.4 Part 4: Review of Test Outputs

This final part of the test covers detailed review of the CMDFNC_002 script output file and verification of PASS/FAIL criteria.

Step No.	Description of Step	Step Outcome
22	After the CMDFNC_002 test script has executed all parts of the test described in the previous sections, a dialogue box appears, reporting the directory location to which the test log output file is saved and instructing the test engineer to print the file for review. Print the log file, retrieve it from the printer, label it, and attach it to this test procedure. Record the label written on the printed log file: _____ Record the full path and filename of the soft copy of this output file: _____	Complete/ Not Complete

Step No.	Description of Step	Step Outcome
23	Review the log file. The file contains detailed outputs of the test script, with the names of telecommands being issued, telemetry packets being received, telemetry fields being examined, and status summaries of each major step in the test. The following log file entries appear interspersed through the log file, followed by "PASS" or "FAIL". **Initiating SIU Secondary Boot** **Initiating EPU Secondary Boot** **Boot Mode PBC command Data Format and Integrity Errors** **Boot Mode PBC Command Format and Parameter Validation** **CMDFNC_002(1): Passed** Confirm that each of the above entries appears in the log file with a "PASS" indication. Successful completion of this step verifies all test objectives and sub-objectives for Boot Mode.	Pass/ Fail

Initial to confirm.

_____ _____ _____ _____
Date Time Test Engineer QAE

7. TEST POST_CONDITIONS AND OVERALL OUTCOME

7.1 Test Post-Conditions

The following post-conditions are analyzed and verified by the test script:

No.	Post-Condition	Post-Condition Met? (Yes/No)
1	SIU in Boot Mode	

The Test Engineer and Quality Assurance Engineer verify that all test post-conditions are met.

_____ _____ _____ _____
Date Time Test Engineer QAE

7.2 Overall Outcome of CMDFNC_002

Based on the analysis of the test results as described in "Test Procedure and Test Analysis", the overall outcome of Test CMDFNC_002 is as follows:

☐ **Passed** - all of the expected outcomes for the test were confirmed

☐ **Failed** - one or more of the test outcomes were not confirmed

_____	_____	_____
Date	Test Engineer	QAE

8. CERTIFICATION

I certify that the information obtained under this test procedure is as represented and the information recorded in this document is complete and correct. Any deviations from test procedures described herein are identified in Appendix A.

_____	_____	_____
Date	Test Engineer (Print Name)	Test Engineer (Signature)

I certify that the information obtained through execution of this test procedure is as represented and the information recorded in this document is complete and correct. Execution of the test, storage of the results, and verification of outcomes were carried out in accordance with quality standards defined in the GLAST Quality Manual (LAT-MD-00091).

_____	_____	_____
Date	Software QA Engineer (Print Name)	Software QA Engineer (Sign)

I certify that the information obtained under this test procedure is as represented and the information recorded in this document is complete and correct. The test procedure, as designed and executed, does indeed verify that the FSW functionality under test satisfies the corresponding requirements from the Flight Software Specification – Level III.

_____	_____	_____
Date	FSW Manager (Print Name)	FSW Manager (Signature)

APPENDIX A: DEVIATIONS FROM THE QUALIFICATION TEST PROCEDURE

This section details any deviations from the hardware configuration, software configuration, or test procedure followed during the execution of the test or tests described in this Qualification Test Procedure document. All deviations from the approved procedure are agreed to by the Test Engineer and the Software Quality Engineer during the test execution session. All deviations must be reported during the Post Qualification Test Review, where their impact on the test results will be evaluated.

Hardware Deviations

Describe any deviations from the hardware configuration defined in Section 5.1. Name the hardware that was modified and describe the modifications. If hardware is *replaced* during execution of the test, name the replaced hardware, the manufacturer, and list an identification number (e.g., GLAT ID number).

Software Deviations

Describe any changes made to the software configuration under test or the software configuration used to support test execution, as defined in Section 5.2. Give version numbers of all FSW packages and test packages that were modified. Describe how the contents of the modified software load were verified. Describe these deviations for each test that was modified.

Procedural Deviations

Specify any deviations from the test procedure for the test being executed. If this document contains more than one test procedure, list the procedure by number (e.g., "CMDFNC_001"). List by number the steps modified or skipped. Provide a numbered sequence listing any added steps. Describe these deviations for each test that was modified.

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