



DCN No.  
LAT-XR-07131-01

# LAT PROJECT DOCUMENT CHANGE NOTICE (DCN)

SHEET 1 OF 2

ORIGINATOR: Mike DeKlotz      PHONE: 650-926-4752      DATE: 8/16/05

CHANGE TITLE: DCN for LAT Flight Software Test Procedures      ORG.:

DOCUMENT NUMBER	TITLE	NEW REV.
LAT-TD-07126	LAT FSW Qualification Test Procedure: DCMODE_001: ACD Diagnostics & Calibration	01
LAT-TD-07127	LAT FSW Qualification Test Procedure: DCMODE_002: ACD Diagnostics & Calibration	01
LAT-TD-07128	LAT FSW Qualification Test Procedure: DCMODE_003: TKR Diagnostics & Calibration	01
LAT-TD-07129	LAT FSW Qualification Test Procedure: NBTLMV_001: Narrowband Telemetry Housekeeping & Low-rate Science Data Verificaion	01
LAT-TD-07130	LAT FSW Qualification Test Procedure: NBTLMV_002: Diagnostic Telemetry Verification	01

**CHANGE DESCRIPTION (FROM/TO):**

LAT-TD-07132-01- LAT FSW Qualification Test Procedure: FSWINI\_001: FSW Initialization-SIU Primary Boot  
 LAT-TD-07133-01- LAT FSW Qualification Test Procedure: FSWINI\_002: FSW & LAT Initialization- Boot Self-Test & Boot Housekeeping Telemetry  
 LAT-TD-07134-01- LAT FSW Qualification Test Procedure: FSWINI\_003: FSW & LAT Initialization- Multiple Boot Images  
 LAT-TD-07135-01- LAT FSW Qualification Test Procedure: FSWINI\_004: FSW & LAT Initialization- SIU Hardware Reboot in response to the Signal on the Discrete Lines  
 LAT-TD-07136-01- LAT FSW Qualification Test Procedure: FSWINI\_005: FSW Initialization- EPU Primary Boot  
 LAT-TD-07137-01- LAT FSW Qualification Test Procedure: FSWINI\_006: FSW & LAT initialization- Reset Source  
 LAT-TD-07138-01- LAT FSW Qualification Test Procedure: FSWINI\_007: FSW & LAT Initialization- Storage & Retrieval of System Errors During SIU Primary Boot  
 LAT-TD-07139-01- LAT FSW Qualification Test Procedure: FSWINI\_008: FSW & LAT Initialization- Storage & Retrieval of System Errors During EPU Primary Boot  
 LAT-TD-07140-01- LAT FSW Qualification Test Procedure: FSWINI\_009: FSW & LAT Initialization- SIU Boot Status on Discrete Lines & SISU Boot Housekeeping Telemetry  
 LAT-TD-07141-01- LAT FSW Qualification Test Procedure: FSWINI\_010: FSW & LAT Initialization- SIU & EPU Secondary Boot  
 LAT-TD-07142-01- LAT FSW Qualification Test Procedure: FSWINI\_011: FSW & LAT Initialization- SIU & EPU Secondary Boot Error Mitigation  
 LAT-TD-07143-01- LAT FSW Qualification Test Procedure: FSWINI\_012: FSW & LAT Initialization- LAT SEU Protection  
 LAT-TD-07144-01- LAT FSW Qualification Test Procedure: FSWINI\_013: FSW & LAT Initialization- LAT Memory Scrubbing  
 LAT-TD-07145-01- LAT FSW Qualification Test Procedure: FSWINI\_014: FSW & LAT Initialization- Watchdog Management During Boot  
 LAT-TD-07146-01- LAT FSW Qualification Test Procedure: FSWINI\_015: FSW & LAT Initialization- Soft Reset  
 LAT-TD-07152-01 - LAT FSW Qualification Test Procedure:FECALB\_001: Charge Injection Calibration – TOT Measurements  
 LAT-TD-07153-01- LAT FSW Qualification Test Procedure:FECALB\_002: Charge Injection Calibration – TKR Threshold and Charge Scans  
 LAT-TD-07154-01- LAT FSW Qualification Test Procedure: FECALB\_003: Charge Injection Calibration – TKR Trigger Check  
 LAT-TD-07155-01- LAT FSW Qualification Test Procedure: FECALB\_004: Charge Injection Calibration – ACD Charge Injection  
 LAT-TD-07156-01- LAT FSW Qualification Test Procedure: FECALB\_005: Charge Injection Calibration – CAL Charge Injection  
 LAT-TD-07157-01- LAT FSW Qualification Test Procedure: WBTLMV\_001: Wideband Telemetry Verification – Science Data Format and Volume

**REASON FOR CHANGE:**

ACTION TAKEN:  Change(s) included in new release     DCN attached to document(s), changes to be included in next revision  
 Other (specify):

**DISPOSITION OF HARDWARE (IDENTIFY SERIAL NUMBERS):**

**DCN DISTRIBUTION:**

No hardware affected (record change only)

List S/Ns which comply already:

List S/Ns to be reworked or scrapped:

List S/Ns to be built with this change:

List S/Ns to be retested per this change:

SAFETY, COST, SCHEDULE, REQUIREMENTS IMPACT?     YES     NO

If yes, CCB approval is required. Enter change request number:

APPROVALS	DATE	OTHER APPROVALS (specify):	DATE
ORIGINATOR: M. DeKlotz (signature on file)	8/16/05		
ORG. MANAGER: D. Horn (signature on file)	8/16/05		
PSA- K. Burlingham (signature on file)	8/16/05		
DCN RELEASE: Natalie Cramar (signature on file)	8/16/05	Doc. Control Level: <input checked="" type="checkbox"/> Subsystem <input type="checkbox"/> LAT IPO <input type="checkbox"/> GLAST Project	

DCN No: LAT-XR-07131-01




DCN No.  
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## LAT PROJECT DOCUMENT CHANGE NOTICE

SHEET 2 OF 2

### Continuation:

LAT-TD-07158-01- LAT FSW Qualification Test Procedure: FILMGT\_001: File Management Verification  
LAT-TD-07159-01- LAT FSW Qualification Test Procedure: MEMMGT\_002: Memory Load Data  
LAT-TD-07160-01- LAT FSW Qualification Test Procedure: NBTLMV\_003: ACD HSK Anomaly Response and Alert Telemetry Verification  
LAT-TD-07161-01- LAT FSW Qualification Test Procedure: OPMODE\_001: LAT Operational Mode Control  
LAT-TD-07162-01- LAT FSW Qualification Test Procedure: THRMCS\_001: LAT Thermal Control System  
LAT-TD-07163-01- LAT FSW Qualification Test Procedure: VSGIFV\_001: Discrete Signal Interfaces  
LAT-TD-07164-01- LAT FSW Qualification Test Procedure: CMDFNC\_003: 1553 Interface and Command Functional Verification  
LAT-TD-07054-01- LAT FSW Qualification Test Procedure: EVTPMO\_001: Event Performance Monitoring and Verification – Software-Related Deadtime  
LAT-TD-07055-01- LAT FSW Qualification Test Procedure: EVTPMO\_002: Event Performance Monitoring and Verification –Acquisition of VETO Rates from the GEM  
LAT-TD-07056-01- LAT FSW Qualification Test Procedure: EVTPMO\_003: Event Performance Monitoring and Verification – Level 1 Trigger Rates  
LAT-TD-07057-01- LAT FSW Qualification Test Procedure: EVTPMO\_004: Event Performance Monitoring and Verification – Monitor CNO Rates  
LAT-TD-07112-01- LAT FSW Qualification Test Procedure: EVTFIL\_001: Event Filtering – Interface from the Event Builder  
LAT-TD-07113-01- LAT FSW Qualification Test Procedure: EVTFIL\_002: Event Filtering – Event Filter Rates and Capacity  
LAT-TD-07114-01- LAT FSW Qualification Test Procedure: EVTFIL\_003: Event Filtering – Event Filter Reprogramming  
LAT-TD-07115-01- LAT FSW Qualification Test Procedure: EVTFIL\_004: Event Filtering – Event Filter Bypass

	Document # <b>LAT-TD-07159-01</b>	Date effective 8/16/05
	Author(s) Shantha Condamoor Mark Arndt	Supersedes
	Subsystem/Office Electronics & DAQ Subsystem	
Document Title <b>LAT FSW Qualification Test Procedure:</b> <b>MEMMGT_002: Memory Load Data</b>		

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**CHANGE HISTORY LOG**

Revision	Effective Date	Description of Changes
01	8/16/05	Original

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## 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**

#### ***MEMMGT***

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 *MEMMGT\_002* belongs in the Test Suite *MEMMGT* under the *FST* Project.

The MEMMGT tests verify the capability of FSW, on command, to successfully upload data into a specified block of SIU or EPU memory and dump the contents of specific blocks of SIU or EPU memory.

### 1.2 **Test ID**

#### ***MEMMGT\_002***

Test *MEMMGT\_002* contains one main script, *MEMMGT\_002.py*, which can be run when the SIU or an EPU is in the Boot Mode. This test verifies Memory Write telecommand sequences are capable of writing software loads to the RAM and EEPROM on SIU and EPUs. *Since we want to limit the number of times we write to the EEPROM, however, this test should be run only on non-flight boards and just once or twice on flight boards.*

### 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:

Requirement Number	Requirement Name	Requirement	Level of Requirements Verification in This Test
5.3.7.12.6	Memory Load Data	Load data shall include telecommand packet sequences that contain software loads.	Full

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
s, sec	seconds
V	Volt
W	Watt

### 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

<u>Document Number</u>	<u>Description</u>
<u>SPECIFICATIONS</u>	
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)
<u>PROCEDURES</u>	
N/A	
<u>PLANS</u>	
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
LAT-MD-00104	LAT FSW Management Plan
<u>DRAWINGS</u>	
N/A	
<u>OTHER</u>	
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.

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**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, AEM 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



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)
MEMMGT_002.py	This script, the main test execution script, tests FSW operating in Boot Mode. It executes tests of SIU FSW, EPU0 FSW, and EPU1 FSW. The script controls the entire test process, detecting the state of the hardware and FSW and advancing SIU and EPU FSW through the different necessary operational modes required to execute 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 packages and constituents that are the focus of the test are listed below.

FSW Package	Constituent(s)
MEM	
PBC	

FSW Package	Constituent(s)

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
3	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 MEMMGT 002**

**6.1 Test Objective**

This test verifies that the SIU and EPU FSW is commandable by ground to perform Memory Management Operations listed in the Requirement(s) Tested section.

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

Number	Test Sub-Objective
1	Verify memory upload functionality on SIU, EPU0 and EPU1.
2	Verify upload functionality in the Boot Mode.
3	Verify that memory writes can be performed to load software to the SIU and EPUs.

Analysis of results is performed as and when data arrives in telemetry. Typically analysis includes verifying the telemetry values against expected values and tagging the sub-objectives as either “PASS” or “FAIL”.

**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)
TBD1.f	Corrupt secondary boot stage 1 (SSB1) software module, uploaded to the SIU in Boot Mode and designed to cause failure of SIU secondary boot process.		
TBD2.f	Corrupt secondary boot stage 1 (SSB1) software module, uploaded to the EPU0 and EPU1 in Boot Mode and designed to cause failure of EPU0 and EPU1 secondary boot process.		
TBD3.f	Valid SSB1 module for the SIU.		
TBD4.f	Valid SSB1 module for the EPU0 and EPU1.		

### 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 testing 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

## 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 MEMMGT\_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 both Boot Mode and Application 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 Boot Mode memory load data testing on the SIU.

Step No.	Description of Step	Step Outcome
1	At the test terminal, run the script <i>MEMMGT_002</i> under LTX through the VSC with the following command:  <b>\$ ltx run MEMMGT_002</b>	Complete/ Not Complete
2	The test script determines whether the SIU is powered on by checking whether SIU boot housekeeping telemetry is being transmitted. Regardless of the SIU’s current operational mode, the script sends the SIU the LPBCRESET telecommand to reboot the unit.  The script then checks whether the SIU FSW is operating in Boot Mode by detecting if boot housekeeping 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

Step No.	Description of Step	Step Outcome
3	With FSW on the SIU in Boot Mode, the test script writes to the Boot RAMdisk by sending a series of LMEMLOADMEM (Memory Write) telecommands containing the contents of the TBD1.f file (the corrupted SSB1 module).	N/A
4	The script sends an LMEMDUMPMEM command and checks the resulting telemetry to confirm that the data was correctly written into RAM.	N/A
5	Next, the script sends the LPBCRTOSEXEC telecommand to the SIU, causing the SIU FSW to read the uploaded SSB1 module from the RAM location and use that module, along with SSB0 and RTOS pre-burned into EEPROM, to begin the secondary boot process.	N/A
6	The secondary boot process is expected to fail. Failure is indicated by the absence of Application Mode (LHK) housekeeping telemetry. The script also confirms that secondary boot was unsuccessful by issuing the LLFSSYSSTATUS command to SIU, a command that is accepted and responded to by SIU FSW operating in Application Mode, and checking (1) that the expected LLFSSYSLIST telemetry packet was not received in response to the command and (2) the CmdConfirm telemetry packet is also not received.	N/A
7	The script sends LPBCRESET command to reboot the SIU.	N/A
8	Next, the test script writes a valid SSB1 module (TBD3.f) to the Boot RAMdisk by sending a series of LMEMLOADMEM (Memory Write) telecommands.	N/A
9	The script sends an LMEMDUMPMEM command and checks the resulting telemetry to confirm that the data was correctly written into RAM.	N/A
10	Next, the script sends the LPBCRTOSEXEC telecommand to the SIU, causing the SIU FSW to read the uploaded SSB1 module from the RAM location and use that module, along with SSB0 and RTOS pre-burned into EEPROM, to begin the secondary boot process.	N/A
11	The SIU should undergo a successful secondary boot and SIU FSW should reach Application Mode which is verified by the reception of LHK telemetry. The script also confirms that secondary boot was completed by issuing the LLFSSYSSTATUS command, a command that is accepted and responded to by SIU FSW operating in Application Mode, and checking (1) that the expected LLFSSYSLIST telemetry packets are received in response to the command and (2) that fields in CmdConfirm telemetry packets confirm the LLFSSYSSTATUS command was queued and processed	N/A
12	Next, the script sends the SIU the LPBCRESET telecommand to reboot the unit.  The script then checks whether the SIU FSW is operating in Boot Mode by detecting if boot housekeeping 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
13	With FSW on the SIU in Boot Mode, the test script writes to the SIB EEPROM by sending a series of LMEMLOADMEM (Memory Write) telecommands containing the contents of the TBD1.f file (the corrupted SSB1 module).	N/A
14	The script sends an LMEMDUMPMEM command and checks the resulting telemetry to confirm that the data was correctly written into SIB EEPROM.	N/A

Step No.	Description of Step	Step Outcome
15	Next, the script sends the LPBCRTOSEXEC telecommand to the SIU, causing the SIU FSW to read the uploaded SSB1 module from the EEPROM location and use that module, along with SSB0 and RTOS pre-burned into EEPROM, to begin the secondary boot process.	N/A
16	The secondary boot process is expected to fail. Failure is indicated by the absence of Application Mode (LHK) housekeeping telemetry.	N/A
17	The script sends LPBCRESET command to reboot the SIU.	N/A
18	Next, the test script writes a valid SSB1 module (TBD3.f) to the SIB EEPROM by sending a series of LMEMLOADMEM (Memory Write) telecommands.	N/A
19	The script sends an LMEMDUMPMEM command and checks the resulting telemetry to confirm that the data was correctly written into EEPROM.	N/A
20	Next, the script sends the LPBCRTOSEXEC telecommand to the SIU, causing the SIU FSW to read the uploaded SSB1 module from the EEPROM location and use that module, along with SSB0 and RTOS pre-burned into EEPROM, to begin the secondary boot process.	N/A
21	The SIU should undergo a successful secondary boot and SIU FSW should reach Application Mode which is verified by the reception of LHK telemetry. The script also confirms that secondary boot was completed by issuing the LLFSSYSSTATUS command, a command that is accepted and responded to by SIU FSW operating in Application Mode, and checking (1) that the expected LLFSSYSLIST telemetry packets are received in response to the command and (2) that fields in CmdConfirm telemetry packets confirm the LLFSSYSSTATUS command was queued and processed	N/A

## 6.4.2 Part 2: EPU0 Boot Mode Testing

The test continues with Boot Mode memory load data testing on EPU0. 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 memory management testing continues.

Step No.	Description of Step	Step Outcome
22	The test script issues an LIMLOADSHED command. The SIU reboots and the GASU, PDU, EPU, and instrument power are turned off for a fresh test start.	N/A
23	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

Step No.	Description of Step	Step Outcome
24	<p>The test script advances the SIU FSW to Application Mode by sending the LPBCRTOSEXEC telecommand, which commands the SIU to perform a secondary boot.</p> <p>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.</p> <p>If the SIU FSW cannot be advanced to Application Mode, LTX prints an error message to the screen and exits, aborting the test.</p> <p>If the test is NOT aborted, mark "Complete" for the Step Outcome.</p>	Complete/ Not Complete
25	The script sends the LIMMAINFEEDON telecommand to power up the PDU and GASU.	N/A
26	<p>The script then sends the LIMPOWERON command to power up EPU0. In response to a power up, EPU0 should begin a primary boot.</p> <p>The test script determines whether EPU0 is operating in Boot Mode as a result of the power up and primary boot by detecting whether the EPU is transmitting boot housekeeping telemetry. If not, the script sends the LPBCRESET command to EPU0 and checks again.</p> <p>If the EPU0 FSW cannot be placed in Boot Mode, LTX prints an error message to the screen and exits, aborting the test.</p> <p>If the test is NOT aborted, mark "Complete" for the Step Outcome.</p>	Complete/ Not Complete
27	With FSW on EPU0 advanced to Boot Mode, the test script writes to the EPU Boot RAMdisk by sending a series of LMEMLOADMEM (Memory Write) telecommands containing the contents of the TBD2.f file (the corrupted SSB1 module).	N/A
28	The script sends an LMEMDUMPMEM command to EPU0 and checks the resulting telemetry to confirm that the file data was correctly written into RAM.	N/A
29	Next, the script sends the LPBCRTOSEXEC telecommand to EPU0, causing the FSW to read the uploaded SSB1 module from the RAM location and use that module, along with SSB0 and RTOS pre-burned into EEPROM, to begin the secondary boot process.	N/A
30	The secondary boot process is expected to fail. This is indicated by the absence of LHK statistics pertaining to EPU0 in the Application Mode housekeeping telemetry. The script also confirms that secondary boot was unsuccessful by issuing the LLFSSYSSTATUS command to EPU0, a command that is accepted and responded to by EPU FSW operating in Application Mode, and checking (1) that the expected LLFSSYSLIST telemetry packet was not received in response to the command and (2) that fields in CmdConfirm telemetry packet sent by SIU confirm that the LLFSSYSSTATUS command sent to EPU0 was unsuccessful,	N/A
31	The script sends LPBCRESET command to reboot the EPU0.	N/A
32	Next, the test script writes a valid SSB1 module (TBD4.f) to the EPU0 Boot RAMdisk by sending a series of LMEMLOADMEM (Memory Write) telecommands.	N/A
33	The script sends an LMEMDUMPMEM command and checks the resulting telemetry to confirm that the file data was correctly written into RAM.	N/A

Step No.	Description of Step	Step Outcome
34	Next, the script sends the LPBCRTOSEXEC telecommand to EPU0, causing the EPU FSW to read the uploaded SSB1 module from the RAM location and use that module, along with SSB0 and RTOS pre-burned into EEPROM, to begin the secondary boot process.	N/A
35	The EPU should undergo a successful secondary boot and EPU FSW should reach Application Mode which is verified by the reception of LHK telemetry. The script also confirms that secondary boot was completed by issuing the LLFSSYSSTATUS command to EPU0, a command that is accepted and responded to by EPU FSW operating in Application Mode, and checking (1) that the expected LLFSSYSLIST telemetry packets are received in response to the command and (2) that fields in CmdConfirm telemetry packets confirm the LLFSSYSSTATUS command was queued and processed	N/A
36	Next, the script sends the EPU0 the LPBCRESET telecommand to reboot the unit.  The script then checks whether the EPU0 FSW is operating in Boot Mode by detecting if boot housekeeping is being transmitted. 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
37	With FSW on the EPU0 in Boot Mode, the test script writes to the SIB EEPROM by sending a series of LMEMLOADMEM (Memory Write) telecommands containing the contents of the TBD2.f file (the corrupted SSB1 module).	N/A
38	The script sends an LMEMDUMPMEM command and checks the resulting telemetry to confirm that the data was correctly written into SIB EEPROM.	N/A
39	Next, the script sends the LPBCRTOSEXEC telecommand to the EPU0, causing the EPU0 FSW to read the uploaded SSB1 module from the EEPROM location and use that module, along with SSB0 and RTOS pre-burned into EEPROM, to begin the secondary boot process.	N/A
40	The secondary boot process is expected to fail. Failure is indicated by the absence of Application Mode (LHK) housekeeping telemetry. The script also confirms that secondary boot was unsuccessful by issuing the LLFSSYSSTATUS command to EPU0, a command that is accepted and responded to by EPU FSW operating in Application Mode, and checking (1) that the expected LLFSSYSLIST telemetry packet was not received in response to the command and (2) that fields in CmdConfirm telemetry packet sent by SIU confirm that the LLFSSYSSTATUS command sent to EPU0 was unsuccessful,	N/A
41	The script sends LPBCRESET command to reboot the SIU.	N/A
42	Next, the test script writes a valid SSB1 module (TBD4.f) to the SIB EEPROM by sending a series of LMEMLOADMEM (Memory Write) telecommands.	N/A
43	The script sends an LMEMDUMPMEM command and checks the resulting telemetry to confirm that the data was correctly written into EEPROM.	N/A
44	Next, the script sends the LPBCRTOSEXEC telecommand to the EPU0, causing the EPU0 FSW to read the uploaded SSB1 module from the EEPROM location and use that module, along with SSB0 and RTOS pre-burned into EEPROM, to begin the secondary boot process.	N/A

Step No.	Description of Step	Step Outcome
45	The EPU0 should undergo a successful secondary boot and EPU0 FSW should reach Application Mode. The script confirms that secondary boot was completed by issuing the LLFSSYSTATUS command, a command that is accepted and responded to by EPU0 FSW operating in Application Mode, and checking (1) that the expected LLFSSYSLIST telemetry packets are received in response to the command and (2) that fields in CmdConfirm telemetry packets confirm the LLFSSYSSTATUS command was queued and processed.	N/A
46	The test script sends the LPBCRESET command to EPU0 to reboot that unit. It then powers down EPU0 by sending the LIMPOWEROFF command.	N/A

### 6.4.3 Part 3: EPU1 Boot Mode Testing

The test continues with Boot Mode memory load data testing on EPU1.

Step No.	Description of Step	Step Outcome
47	The script then sends the LIMPOWERON 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 to EPU1 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
48	With FSW on EPU1 in Boot Mode, the test script writes to the EPU Boot RAMdisk by sending a series of LMEMLOADMEM (Memory Write) telecommands containing the contents of the TBD2.f file (the corrupted SSB1 module).	N/A
49	The script sends an LMEMDUMPMEM command to EPU1 and checks the resulting telemetry to confirm that the file data was correctly written into RAM.	N/A
50	Next, the script sends the LPBCRTOSEXEC telecommand to the EPU, causing the FSW to read the uploaded SSB1 module from the RAM location and use that module, along with SSB0 and RTOS pre-burned into EEPROM, to begin the secondary boot process.	N/A
51	The secondary boot process is expected to fail. This is indicated by the absence of LHK Telemetry. The script also confirms that secondary boot was unsuccessful by issuing the LLFSSYSTATUS command to EPU1, a command that is accepted and responded to by EPU FSW operating in Application Mode, and checking (1) that the expected LLFSSYSLIST telemetry packet was not received in response to the command and (2) that fields in CmdConfirm telemetry packet sent by SIU confirm that the LLFSSYSSTATUS command sent to EPU1 was unsuccessful,	N/A
52	The script sends LPBCRESET command to reboot EPU1.	N/A

Step No.	Description of Step	Step Outcome
53	Next, the test script writes a valid SSB1 module (TBD4.f) to the EPU1 Boot RAMdisk by sending a series of LMEMLOADMEM (Memory Write) telecommands.	N/A
54	The script sends an LMEMDUMPMEM command and checks the resulting telemetry to confirm that the file data was correctly written into RAM.	N/A
55	Next, the script sends the LPBCRTOSEXEC telecommand to EPU1, causing the EPU FSW to read the uploaded SSB1 module from the RAM location and use that module, along with SSB0 and RTOS pre-burned into EEPROM, to begin the secondary boot process.	N/A
56	The EPU should undergo a successful secondary boot and EPU FSW should reach Application Mode which is verified by the reception of LHK telemetry. The script also confirms that secondary boot was completed by issuing the LLFSSYSSTATUS command to EPU1, a command that is accepted and responded to by EPU FSW operating in Application Mode, and checking (1) that the expected LLFSSYSLIST telemetry packets are received in response to the command and (2) that fields in CmdConfirm telemetry packets confirm the LLFSSYSSTATUS command was queued and processed	N/A
57	Next, the script sends the EPU1 the LPBCRESET telecommand to reboot the unit.  The script then checks whether the EPU1 FSW is operating in Boot Mode by detecting if boot housekeeping is being transmitted. 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
58	With FSW on the EPU1 in Boot Mode, the test script writes to the SIB EEPROM by sending a series of LMEMLOADMEM (Memory Write) telecommands containing the contents of the TBD2.f file (the corrupted SSB1 module).	N/A
59	The script sends an LMEMDUMPMEM command and checks the resulting telemetry to confirm that the data was correctly written into SIB EEPROM.	N/A
60	Next, the script sends the LPBCRTOSEXEC telecommand to the EPU1, causing the EPU1 FSW to read the uploaded SSB1 module from the EEPROM location and use that module, along with SSB0 and RTOS pre-burned into EEPROM, to begin the secondary boot process.	N/A
61	The secondary boot process is expected to fail. Failure is indicated by the absence of Application Mode (LHK) housekeeping telemetry. The script also confirms that secondary boot was unsuccessful by issuing the LLFSSYSSTATUS command to EPU1, a command that is accepted and responded to by EPU FSW operating in Application Mode, and checking (1) that the expected LLFSSYSLIST telemetry packet was not received in response to the command and (2) that fields in CmdConfirm telemetry packet sent by SIU confirm that the LLFSSYSSTATUS command sent to EPU1 was unsuccessful,	N/A
62	The script sends LPBCRESET command to reboot the SIU.	N/A
63	Next, the test script writes a valid SSB1 module (TBD4.f) to the SIB EEPROM by sending a series of LMEMLOADMEM (Memory Write) telecommands.	N/A
64	The script sends an LMEMDUMPMEM command and checks the resulting telemetry to confirm that the data was correctly written into EEPROM.	N/A

Step No.	Description of Step	Step Outcome
65	Next, the script sends the LPBCRTOSEXEC telecommand to the EPU1, causing the EPU1 FSW to read the uploaded SSB1 module from the EEPROM location and use that module, along with SSB0 and RTOS pre-burned into EEPROM, to begin the secondary boot process.	N/A
66	The EPU1 should undergo a successful secondary boot and EPU1 FSW should reach Application Mode. The script confirms that secondary boot was completed by issuing the LLFSSYSSTATUS command, a command that is accepted and responded to by EPU1 FSW operating in Application Mode, and checking (1) that the expected LLFSSYSLIST telemetry packets are received in response to the command and (2) that fields in CmdConfirm telemetry packets confirm the LLFSSYSSTATUS command was queued and processed.	N/A
67	The test script sends the LPBCRESET command to EPU1 to reboot that unit. It then powers down EPU1 by sending the LIMPOWEROFF command.	N/A
68	The script next sends the LIMLOADSHED telecommand to power off the GASU and PDU and reboot the SIU.	N/A
69	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 MEMMGT\_002 script output file and verification of PASS/FAIL criteria.

Step No.	Description of Step	Step Outcome
70	After the MEMMGT_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
71	<p>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</p> <p>The following log file entries appear interspersed through the log file, followed by “PASS” or “FAIL”.</p> <p><b>Boot Mode Memory Loads to SIU</b></p> <p><b>Boot Mode Memory Loads to EPU0</b></p> <p><b>Boot Mode Memory Loads to EPU1</b></p> <p><b>MEMMGT_002(1): Passed</b></p> <p>Confirm that each of the above entries appears in the log file with a “PASS” indication.</p> <p>Successful completion of this step verifies all test objectives and sub-objectives.</p>	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 as described in “Test Procedure and Test Analysis”:

No.	Post-Condition	Post-Condition Met? (Yes/No)
1	SIU operating in Boot Mode	
2	DAQ, PDU/GASU, and EPUs powered off.	

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

\_\_\_\_\_ Date \_\_\_\_\_ Time \_\_\_\_\_ Test Engineer \_\_\_\_\_ QAE

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## 7.2 Overall Outcome of MEMMGT\_002

Based on the analysis of the test results, the overall outcome of Test MEMMGT\_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

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Date

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Test Engineer

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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)

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**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).

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**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.

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**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., “MEMMGT\_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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