LAT PROJECT DOCUMENT CHANGE NOTICE (DCN)

DCN No. LAT-XR-07131-01

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 Verificaiton	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		
DCC RELEASE: Natalie Cramar (signature on file)	8/16/05	Doc. Control Level: ☒ Subsystem ☐ LAT IPO ☐ GLAST Project	

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 #	Date effective
	**LAT-TD-07129-01**	
	Author(s) Shantha Condamoor	Supersedes
	Subsystem/Office Electronics & DAQ Subsystem	

Document Title

LAT FSW Qualification Test Procedure:

NBTLMV_001: Narrowband Telemetry Housekeeping and Low-rate Science Data Verification

CHANGE HISTORY LOG

Revision	Effective Date	Description of Changes
01	August 16, 2005	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

NBTLMV

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 *NBTLMV_001* belongs in the Test Suite *NBTLMV* under the *FST* Project.

The NBTLMV tests verify the capability of FSW to acquire health and environmental data from the LAT PDU, CAL, TKR, ACD, and T&DF subsystems and report these statistics as Housekeeping Data. It also verifies the capability of FSW to acquire low-rate science counters from these subsystems.

1.2 Test ID

NBTLMV_001

Test *NBTLMV_001* contains one main script, *NBTLMV_001*, which can be run when the SIU is in the Application Mode. This test primarily verifies that FSW provides health statistics in the Housekeeping data stream and low-rate science counters data.

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
5.3.5.1	Housekeeping	

Requirement Number	Requirement Name	Requirement
5.3.5.1.1	LAT Housekeeping Data to SC	The SIU FSW shall provide housekeeping data to the SC, via the CTDB, on a schedule defined in [7]
5.3.5.1.2	LAT Housekeeping Data Set	The contents of this data set shall be as defined in [9]. Note: Additional information is available in [31], LAT Instrumentation Plan.
5.3.5.1.3	Housekeeping	The SIU FSW shall acquire and report health and environmental data, as defined in [9], from the LAT power distribution subsystem and the CAL, TKR, ACD, and T&DF subsystems. Note: See [24] for additional information.
5.3.5.1.7	Low Rate Science	The SIU FSW shall acquire low-rate science data (rate counters) from the CAL, TKR, ACD, and T&DF subsystems for transmission to the ground via telemetry.

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

Document Number	Description
SPECIFICATIONS	
LAT-SS-00399	LAT Flight Software Level III Specification
1196 EI-S46310-000	[7] GLAST 1553 Bus Protocol Interface Control
LAT-TD-02659	[9] LAT Flight Software Telecommand and Telemetry Formats
LAT-TD-0561	The Virtual Spacecraft (VSC)
PROCEDURES	
N/A	
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		
Front End Simulator (FES)	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.

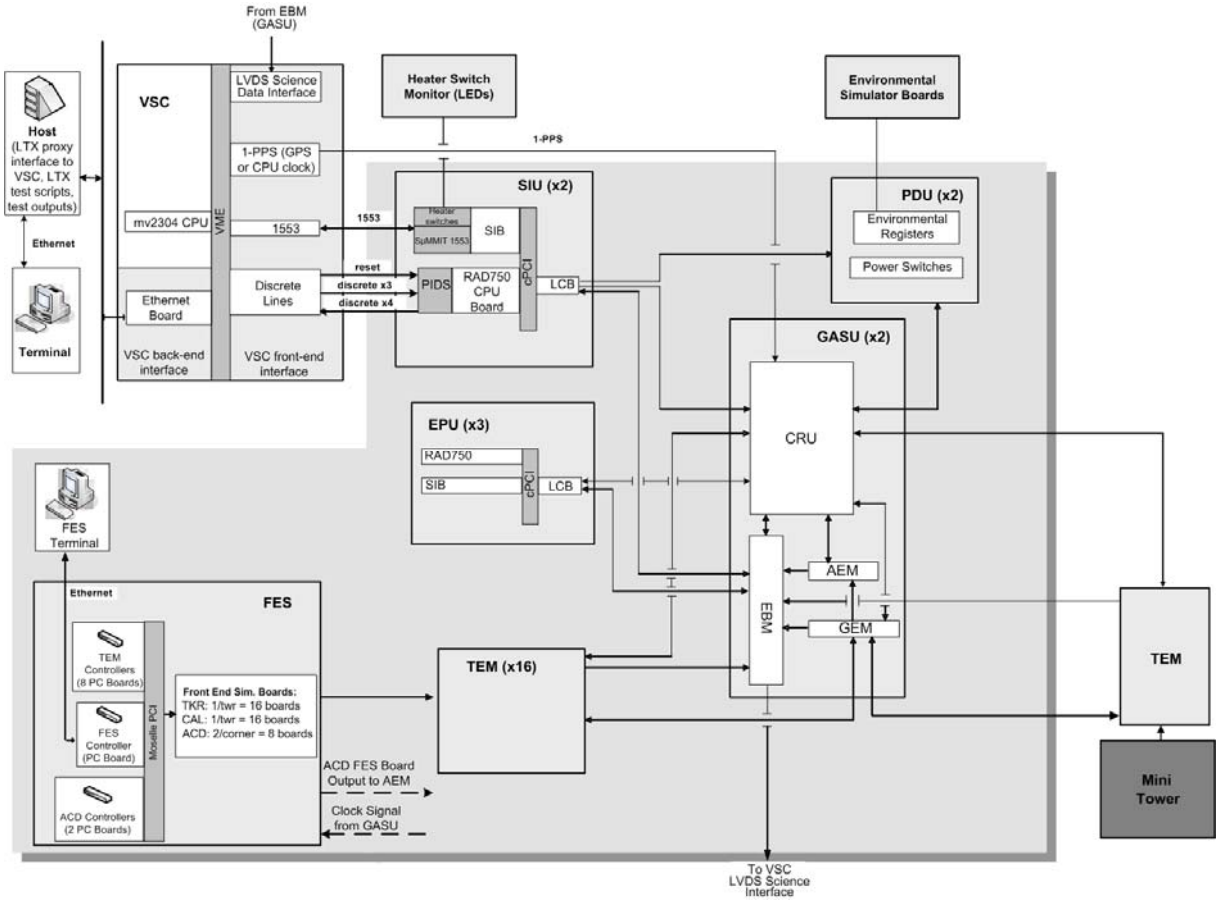

Figure 1. FSW Testbed

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)
primary_boot_test.py	This script must be run after the RAD750 crate has undergone Primary Boot (COLD, COMMANDED etc.) but not Secondary Boot. This script verifies the pre-conditions for some tests that need to be conducted in the PBC mode only. This test does not alter the state of the CPU. It leaves the CPU in Boot mode.		
secondary_boot_test.py	This script must be run after the RAD750 crate has undergone Secondary Boot. This script verifies the pre-conditions for some tests that need to be conducted in the SBC mode where • The RTOS has been loaded, • All FSW Application Software Packages have been loaded, • All tasks initialized and started. This test does not alter the state of the CPU. It leaves the CPU in Application mode.		

Test Script	Description of Test Script	Script Version Number (or Specify Attachment Number)	Path to Attachment (If Applicable)
version_test.py	This script must be run after primary_boot_test or secondary_boot_test to verify the version numbers of the currently loaded FSW packages.		
primary_boot.py	This script must be run if the pre-condition for a test necessitates that the RAD750 crate must be in the PBC mode. This script performs a hardware reset on the CPU through the Reset line of the VSC. It waits till the Primary Boot is completed and the Boot Housekeeping Telemetry starts coming in.		
secondary_boot.py	This script must be run after the primary_boot_test to advance the RAD750 crate to Secondary Boot. This script meets the pre-conditions for some tests that need to be conducted in the Application Mode. In this mode, the CPU is ready to accept telecommands issued from the S/C that can be processed only in the Application Mode. It may also start sending Housekeeping and other telemetry.		
NBTLMV.cfg	This is a configuration script for the NBTLMV suite. It contains information such as Current Mode (Boot or Application), LATUNITS used by this test (SIU, EPU0, EPU1) etc. and other parameters that are altered during the running of various scripts.		
NBTLMV_001.py	This script must be run in the Application Mode. The test requires SIU and EPUs to be in application mode and the FES simulating data.		

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)
LHK	
LMC	

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
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 NBTLMV_001

6.1 Test Objective

This test verifies that the FSW report health and environmental statistics as Housekeeping Data and low rate science counters 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 LAT Housekeeping functionality on SIU, EPU0 and EPU1.
2	Verify all operations in Application Mode only.
3	Verifies the reception of housekeeping data stream at the rate of 4 Hz, via the CTDB. Verifies the reception of a complete cycle of Housekeeping data, i.e., reception of HK Telemetry packets ranging in APIDs from 0x210 through 0x22D.
4	Verifies that contents of this Housekeeping data contain instrument statistics. Verifies that the Housekeeping data contain health and environmental data from the LAT power distribution subsystem and the CAL, TKR, ACD, and T&DF subsystems.
5	Verifies the reception of low-rate science counters from the CAL, TKR, ACD, and T&DF subsystems

As part of 1553 Interface and Command Validation tests described in CMDFNC_003, the following are also listed as Test Objectives and verified in this test.

Number	Test Sub-Objective
1	Verify that the LHK and LMC Telecommands and Telemetry exchanged across the 1553 Interface conform to CCSDS packet structure:
2	Verify that all supported valid LHK and LMC Telecommands issued by S/C with LAT as their destination are received correctly and processed.
3	Verify that SIU FSW processes LAT commands from the SC in the order that they are received.
4	Verify that for all LHK and LMC commands from SC, the FSW is capable of generating time-tagged telemetry notification of their dispatch for execution.
5	Verifies that FSW is capable of generating time-tagged telemetry notification of command completion status (success or general cause of failure) for all LHK and LMC commands.

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".

The following LHK and LMC telecommands and LHK and LMC telemetry are used in this test.

LHK Telecommands

APID	FC	Cmd. Packet (L)	Description (L)
0x650	1	SysReset	System Reset

LMC Telecommands

APID	FC	Cmd. Packet (L)	Description (L)
0x69C	0	cal_lrs	CAL Low Rate Science Counters
0x69C	1	tkr_lrs	TKR Low Rate Science Counters
0x69C	2	acd_tile_pair	ACD Tile Counter (Pair)
0x69C	3	acd_tile_all	ACD Tile Counters (All)
0x69C	4	stop_count	Stop Active Counter

LHK Telemetry

APID	Tlm. Packet (L)	Description (L)
0x210	TemEnvPwr0	TEM Power Packet 0
0x211	TemEnvPwr1	TEM Power Packet 1
0x212	TemEnvPwr2	TEM Power Packet 2
0x213	TemEnvPwr3	TEM Power Packet 3
0x214	TemEnvPwr4	TEM Power Packet 4
0x215	TemEnvPwr5	TEM Power Packet 5
0x216	TemEnvTemp0	TEM Temperature Packet 0
0x217	TemEnvTemp1	TEM Temperature Packet 1
0x218	TemEnvTemp2	TEM Temperature Packet 2
0x219	TemEnvTemp3	TEM Temperature Packet 3
0x21A	TemEnvTemp4	TEM Temperature Packet 4
0x21B	TemEnvTemp5	TEM Temperature Packet 5
0x21C	TemEnvTemp6	TEM Temperature Packet 6
0x21D	TemEnvTemp7	TEM Temperature Packet 7
0x21E	PduEnv0	PDU Environmental Packet 0
0x21F	PduEnv1	PDU Environmental Packet 1
0x220	PduEnv2	PDU Environmental Packet 2
0x221	PduEnv3	PDU Environmental Packet 3
0x222	PduEnv4	PDU Environmental Packet 4
0x223	PduEnv5	PDU Environmental Packet 5
0x224	PduEnv6	PDU Environmental Packet 6
0x225	PduEnv7	PDU Environmental Packet 7
0x226	AemEnv0	AEM Environmental Monitor Packet 0

0x227	Lrs0	Low-rate Science Packet
0x228	CmdCnt0	Command Statistics Packet 0
0x229	CmdCnt1	Command Statistics Packet 1
0x22A	FileStats	File System Statistics Packet
0x22B	CpuMetr	CPU Metrics
0x22C	MemStats0	Memory Load/Dump Statistics
0x22D	MemStats1	Memory Load/Dump Statistics
0x270	DiagTemEnvPwr0	Diagnostic TEM Power Packet 0
0x271	DiagTemEnvPwr1	Diagnostic TEM Power Packet 1
0x272	DiagTemEnvPwr2	Diagnostic TEM Power Packet 2
0x273	DiagTemEnvPwr3	Diagnostic TEM Power Packet 3
0x274	DiagTemEnvPwr4	Diagnostic TEM Power Packet 4
0x275	DiagTemEnvPwr5	Diagnostic TEM Power Packet 5
0x276	DiagTemEnvTemp0	Diagnostic TEM Temperature Packet 0
0x277	DiagTemEnvTemp1	Diagnostic TEM Temperature Packet 1
0x278	DiagTemEnvTemp2	Diagnostic TEM Temperature Packet 2
0x279	DiagTemEnvTemp3	Diagnostic TEM Temperature Packet 3
0x27A	DiagTemEnvTemp4	Diagnostic TEM Temperature Packet 4
0x27B	DiagTemEnvTemp5	Diagnostic TEM Temperature Packet 5
0x27C	DiagTemEnvTemp6	Diagnostic TEM Temperature Packet 6
0x27D	DiagTemEnvTemp7	Diagnostic TEM Temperature Packet 7
0x27E	DiagPduEnv0	Diagnostic PDU Environmental Packet 0
0x27F	DiagPduEnv1	Diagnostic PDU Environmental Packet 1
0x280	DiagPduEnv2	Diagnostic PDU Environmental Packet 2

0x281	DiagPduEnv3	Diagnostic PDU Environmental Packet 3
0x282	DiagPduEnv4	Diagnostic PDU Environmental Packet 4
0x283	DiagPduEnv5	Diagnostic PDU Environmental Packet 5
0x284	DiagPduEnv6	Diagnostic PDU Environmental Packet 6
0x285	DiagPduEnv7	Diagnostic PDU Environmental Packet 7
0x286	DiagAemEnv0	Diagnostic AEM Environmental Monitor Packet 0
0x287	DiagLrs0	Diagnostic Low-rate Science Packet
0x288	DiagCmdCnt0	Diagnostic Command Statistics Packet 0
0x289	DiagCmdCnt1	Diagnostic Command Statistics Packet 1
0x28A	DiagFileStats	Diagnositc File System Statistics Packet
0x28B	DiagCpuMetr	Diagnostic CPU Metrics
0x28C	DiagMemStats0	Diagnostic Memory Load/Dump Statistics
0x28D	DiagMemStats1	Diagnostic Memory Load/Dump Statistics
0x353	RedLimAlrt	Red Limit Alert Packet

LMC Telemetry

APID	Tlm. Packet (L)	Description (L)
0x2C1	cal_cnt	CAL Low Rate Science Counters
0x2C2	tkr_cnt	TKR Low Rate Science Counters
0x2C3	acd_cnt	ACD Tile Counters

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)
FES files			

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	Execute a Primary Boot of the SIU through the *primary_boot_SIU* script. The Primary Boot process takes a few seconds to complete.	Complete/ Not Complete
2	Run the *primary_boot_SIU_test* script to confirm that the SIU FSW is operating in Boot mode.	Complete/ Not Complete
3	The *primary_boot_SIU_test* outputs a file named "PBC_SIU.log". Retrieve the output file 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
4	Execute a Secondary Boot of the SIU through the *secondary_boot_SIU* script. The Secondary Boot process takes less than a minute.	Complete/ Not Complete
5	Run the *secondary_boot_SIU_test* script to confirm that the SIU FSW is operating in Application mode.	Complete/ Not Complete

Step No.	Description of Step	Step Outcome
6	The *secondary_boot_SIU_test* outputs a file named "SBC_SIU.log". Retrieve the output file 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
7	Execute a Secondary Boot of the EPU0 through the *secondary_boot_EPU0* script. The Secondary Boot process takes less than a minute.	Complete/ Not Complete
8	Run the *secondary_boot_EPU0_test* script to confirm that the EPU0 FSW is operating in Application mode.	Complete/ Not Complete
9	The *secondary_boot_EPU0_test* outputs a file named "SBC_EPU0.log". Retrieve the output file 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
10	Execute a Secondary Boot of the EPU1 through the *secondary_boot_EPU1* script. The Secondary Boot process takes less than a minute.	Complete/ Not Complete
11	Run the *secondary_boot_EPU1_test* script to confirm that the EPU1 FSW is operating in Application mode.	Complete/ Not Complete
12	The *secondary_boot_EPU1_test* outputs a file named "SBC_EPU1.log". Retrieve the output file 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
13	Load the files xxx on FES, initialize and start the FES	Complete/ Not Complete
14	Run the *start_fes* script to start the simulation of science data on the FES.	Complete/ Not Complete
15	Run the fes_test script to ensure that science data is coming in through the FES. The *fes_tests* outputs a file named "FES.log". Retrieve the output file 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

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 setup has been validated. The test as well as analysis for each of the sub-objectives is conducted by the main test script NBTLMV_001. An indication of whether the step has been performed or not is provided as screen print statements followed by "PASS" or "FAIL".

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 Application Mode, using the data simulated by the FES.

6.4.1 Housekeeping and Low-rate Science Counters testing

LAT Housekeeping data is collected and analyzed.

For each of the LMC-related commands sent to the SIU during this part of the test, a Command Verification (CmdConfirm) telemetry packet is received, which is further analyzed to verify the status of the reception and execution of the commands. The test script examines the ITC_NodeID, ITC_TaskID, and Status fields in these packets, as well as the CmdHeader field (in which the CCSDS header of each LMC telecommand sent to SIU FSW is reflected).

Step No.	Description of Step	Step Outcome
1	Once the Test Preparation is complete, run the script *NBTLMV_001* under LTX through the VSC with the following command: **$ ltx run <NBTLMV_001**	Complete/ Not Complete

Step No.	Description of Step	Step Outcome
2	The test script begins collection of the Housekeeping Data packets phase. The test script collects one whole cycle of Housekeeping data packets ranging from the APIDs 0x210 through 0x22D and prints out all the payload information contained in these packets. These payload information is verified to contain health statistics about CAL, TKR, ACD, T&DF, PDU subsystems. The test script verifies that the Housekeeping packets arrive at 4 Hz rate. When the script is finished with this phase, LAT Housekeeping telemetry has been received from the SIU, the script outputs XXXX to the test terminal to signal that this phase of execution is complete.	N/A
3	Next, the script executes its Low-rate Science counter information collection verification. The test script sends the LMCALLRS telecommand to the SIU to start the collection of CAL low rate science counters. The Telemetry cal_cnt is received and verified to contain information about CAL low-rate science counters. Then LMCSTOPCOUNT telecommand is sent to stop the active counter. Next script sends LMTKRLRS telecommand to the SIU to start the collection of TKR low rate science counters. The Telemetry tkr_cnt is received and verified to contain information about TKR low-rate science counters. Then LMCSTOPCOUNT telecommand is sent to stop the active counter. Next script sends LMCACDTILEPAIR and LMCACDTILEALL telecommands to the SIU to start the collection of ACD tile counters. The Telemetry acd_cnt is received and verified to contain information about ACD low-rate science counters. Then LMCSTOPCOUNT telecommand is sent to stop the active counter. When the script is finished with this phase, and Low-rate science counter commands and telemetry have been exchanged with the SIU, the script outputs XXXX to the test terminal to signal that this phase of execution is complete.	N/A

6.4.2 Part 5: Data Analysis

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

Step No.	Description of Step	Step Outcome
4	After the NBTLMV_001 test script has executed all of the sub-tests described in the previous sections, and the final XXXX message appears at the end testing, the script sends a single, large log file to the printer. Retrieve the output file 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
5	Review the xxx log file and verify that the following entries appears followed by "PASS" or "FAIL". **LAT Housekeeping Data from PDU, CAL, TKR, ACD and T&DF** **LAT Housekeeping Data rate** **LAT Low-rate Science counters from CAL, TKR and ACD subsystems.** **NBTLMV_001(1): Passed** Successful completion of this step verifies all test objectives.	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 in Application Mode	
2	EPU0 and EPU1 in Application Mode	
3	FES running	

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 NBTLMV_001

Based on the analysis of the test results, the overall outcome of Test NBTLMV_001 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., “NBTLMV_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.