



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 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: <input checked="" type="checkbox"/> Subsystem <input type="checkbox"/> LAT IPO <input type="checkbox"/> GLAST Project	

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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 # LAT-TD-07130-01	Date effective
	Author(s) Shantha Condamoor	Supersedes
	Subsystem/Office Electronics & DAQ Subsystem	
Document Title LAT FSW Qualification Test Procedure: NBTLMV_002: Diagnostic Telemetry Verification		

CHANGE HISTORY LOG

Revision	Effective Date	Description of Changes
01	August 16, 2005	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**

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_002* belongs in the Test Suite *NBTLMV* under the *FST* Project.

The NBTLMV tests verify the capability of FSW to send diagnostics and demand telemetry upon request.

1.2 **Test ID**

NBTLMV_002

Test *NBTLMV_002* contains one main script, *NBTLMV_002*, which can be run when the SIU is in the Application Mode. This test primarily verifies that FSW sends diagnostics and demand telemetry upon request over the narrowband CTDB interface. Diagnostics telemetry sent over the wideband telemetry channel are verified elsewhere.

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
5.3.5.1.8	Demand Telemetry	Upon request, the FSW shall provide the ability to schedule a specified housekeeping telemetry packet up to four times per second.
5.3.5.2	Diagnostic Telemetry	<p>The FSW shall send diagnostic telemetry messages, as defined in [9], to the SC via the CTDB.</p> <p>Diagnostic telemetry is sent in response to a command and downlinked immediately while the SC is in contact with the ground. If not in contact, the telemetry is written to the solid-state recorder on the spacecraft.</p>
5.3.19.13	TCS Telemetry	<p>At least once every 10 seconds, a telemetry packet shall be composed to monitor the TCS, including:</p> <p>identification of active sensors, identification of active heaters, status for each heat pipe (ok primary sensor bad secondary sensor bad both bad), input temperatures, and algorithm results.</p>

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	[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)
<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
<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.

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

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	<p>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.</p> <p>This test does not alter the state of the CPU. It leaves the CPU in Boot mode.</p>		
secondary_boot_test.py	<p>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</p> <ul style="list-style-type: none"> • The RTOS has been loaded, • All FSW Application Software Packages have been loaded, • All tasks initialized and started. <p>This test does not alter the state of the CPU. It leaves the CPU in Application mode.</p>		

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_002.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

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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	
LTC	

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 002

6.1 Test Objective

This test verifies that FSW sends diagnostics and demand telemetry in response to a command over the narrowband CTDB interface as listed in the Requirement(s) Tested section. Diagnostics telemetry sent over the wideband telemetry channel are verified elsewhere.

Diagnostics Telemetry is generated by all the following FSW packages in response to commands. The reception and verification of the various Diagnostics packets are covered under different tests.

ITC

APID	Tlm. Packet (L)	Description (L)	Verified in Test
0x2D0	CmdConfirm	Response to command from spacecraft	CMDFNC_003

LCM

APID	Tlm. Packet (L)	Description (L)	Verified in Test
0x2D1	LLCMMODLIST	Module Status Dump	CMDFNC_003
0x2D2	LLCMTASKLIST	Task Status Dump	CMDFNC_003
0x2D3	LLCMPCIERR	RAD750 PCI Error Report	CMDFNC_003

[0x2D4](#) LLCMMEMERR RAD750 MEM Error Report [CMDFNC_003](#)

LFS

APIID	Tlm. Packet (L)	Description (L)	Verified in Test
0x318	LLFSDIRLIST	Directory Listing Report	FILMGT_001
0x319	LLFSROOTLIST	Root Listing Report	FILMGT_001
0x31A	LLFSSYSLIST	File System Status Report	FILMGT_001
0x31B	LLFSDUMPCTDB	File Dump Data CTDB	FILMGT_001

LHK

APIID	Tlm. Packet (L)	Description (L)	Verified in Test
0x210	TemEnvPwr0	TEM Power Packet 0	NBTLMV_001
0x211	TemEnvPwr1	TEM Power Packet 1	NBTLMV_001
0x212	TemEnvPwr2	TEM Power Packet 2	NBTLMV_001
0x213	TemEnvPwr3	TEM Power Packet 3	NBTLMV_001
0x214	TemEnvPwr4	TEM Power Packet 4	NBTLMV_001
0x215	TemEnvPwr5	TEM Power Packet 5	NBTLMV_001
0x216	TemEnvTemp0	TEM Temperature Packet 0	NBTLMV_001
0x217	TemEnvTemp1	TEM Temperature Packet 1	NBTLMV_001
0x218	TemEnvTemp2	TEM Temperature Packet 2	NBTLMV_001
0x219	TemEnvTemp3	TEM Temperature Packet 3	NBTLMV_001
0x21A	TemEnvTemp4	TEM Temperature Packet 4	NBTLMV_001
0x21B	TemEnvTemp5	TEM Temperature Packet 5	NBTLMV_001
0x21C	TemEnvTemp6	TEM Temperature Packet 6	NBTLMV_001
0x21D	TemEnvTemp7	TEM Temperature Packet 7	NBTLMV_001

0x21E	PduEnv0	PDU Environmental Packet 0	NBTLMV_001
0x21F	PduEnv1	PDU Environmental Packet 1	NBTLMV_001
0x220	PduEnv2	PDU Environmental Packet 2	NBTLMV_001
0x221	PduEnv3	PDU Environmental Packet 3	NBTLMV_001
0x222	PduEnv4	PDU Environmental Packet 4	NBTLMV_001
0x223	PduEnv5	PDU Environmental Packet 5	NBTLMV_001
0x224	PduEnv6	PDU Environmental Packet 6	NBTLMV_001
0x225	PduEnv7	PDU Environmental Packet 7	NBTLMV_001
0x226	AemEnv0	AEM Environmental Monitor Packet 0	NBTLMV_001
0x227	Lrs0	Low-rate Science Packet	NBTLMV_001
0x228	CmdCnt0	Command Statistics Packet 0	NBTLMV_001
0x229	CmdCnt1	Command Statistics Packet 1	NBTLMV_001
0x22A	FileStats	File System Statistics Packet	NBTLMV_001
0x22B	CpuMetr	CPU Metrics	NBTLMV_001
0x22C	MemStats0	Memory Load/Dump Statistics	NBTLMV_001
0x22D	MemStats1	Memory Load/Dump Statistics	NBTLMV_001

LIM

APID	Tlm. Packet (L)	Description (L)	Verified in Test
0x30F	LLIMSTATE	Current LIM State	OPMODE

LMC

APID	Tlm. Packet (L)	Description (L)	Verified in Test
0x2C1	cal_cnt	CAL Low Rate Science Counters	NBTLMV_001

[0x2C2](#) tkr_cnt TKR Low Rate Science Counters [NBTLMV_001](#)

[0x2C3](#) acd_cnt ACD Tile Counters [NBTLMV_001](#)

MEM

APID	Tlm. Packet (L)	Description (L)	Verified in Test
0x311	LMEMPOOLDATA	Memory Pool Statistics Dump	MEMMGT_001
0x312	LMEMSYMVAL	Symbol Value Dump	MEMMGT_001
0x314	LMEMSIUDATA	SIU Memory Dump Data	MEMMGT_001
0x315	LMEMEPU0DATA	EPU 0 Memory Dump Data	MEMMGT_001
0x316	LMEMEPU1DATA	EPU 1 Memory Dump Data	MEMMGT_001
0x317	LMEMEPU2DATA	EPU 2 Memory Dump Data	MEMMGT_001

The following LHK-related and LTC_related diagnostics/demand telemetry are verified in this test, by issuing LHK /LTC Telecommands

LHK Telecommand

APID	FC Cmd. Packet (L)	Description (L)
0x650	0 ReqDiagPacket	Request a Housekeeping Diagnostic Packet
0x650	2 StopDiag	Stop Diagnostic Sample

LTC

APID	FC Cmd. Packet (L)	Description (L)
0x645	7 SetTlmFreq	Set LTC telemetry frequency, 0 is off.

LHK Telemetry

APID	Tlm. Packet (L)	Description (L)
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 Diagnosic 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

LTC

APID Tlm. Packet (L) Description (L)

- [0x2BC](#) DiagLTC LAT Thermal Control diagnostic telemetry

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

Number	Test Sub-Objective
1	Verify all operations in Application Mode only.
2	Verify reception of Demand Telemetry Verifies that upon request, the FSW provides the ability to schedule a specified housekeeping telemetry packet up to four times per second.
3	Verifies reception of Diagnostic Telemetry Verifies that Diagnostic telemetry is sent in response to a command.
4	Verifies TCS Diagnostics Telemetry Verifies that at least once every 10 seconds, a telemetry packet shall be composed to monitor the TCS, including: identification of active sensors, identification of active heaters, status for each heat pipe (ok primary sensor bad secondary sensor bad both bad), input temperatures, and algorithm results

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 LTC Telecommands and Telemetry exchanged across the 1553 Interface conform to CCSDS packet structure:
2	Verify that all supported valid LHK and LTC Telecommands issued by S/C with LAT as their destination are received

Number	Test Sub-Objective
	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 LTC 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 LTC 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”.

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 <i>primary_boot_SIU</i> script. The Primary Boot process takes a few seconds to complete.	Complete/ Not Complete
2	Run the <i>primary_boot_SIU_test</i> script to confirm that the SIU FSW is operating in Boot mode.	Complete/ Not Complete
3	<p>The <i>primary_boot_SIU_test</i> outputs a file named “PBC_SIU.log”. Retrieve the output file from the printer, label it, and attach it to this test procedure.</p> <p>Record the label written on the printed log file: _____</p> <p>Record the full path and filename of the soft copy of this output file: _____</p>	Complete/ Not Complete
4	Execute a Secondary Boot of the SIU through the <i>secondary_boot_SIU</i> script. The Secondary Boot process takes less than a minute.	Complete/ Not Complete
5	Run the <i>secondary_boot_SIU_test</i> script to confirm that the SIU FSW is operating in Application mode.	Complete/ Not Complete
6	<p>The <i>secondary_boot_SIU_test</i> outputs a file named “SBC_SIU.log”. Retrieve the output file from the printer, label it, and attach it to this test procedure.</p> <p>Record the label written on the printed log file: _____</p> <p>Record the full path and filename of the soft copy of this output file: _____</p>	Complete/ Not Complete
7	Execute a Secondary Boot of the EPU0 through the <i>secondary_boot_EPU0</i> script. The Secondary Boot process takes less than a minute.	Complete/ Not Complete
8	Run the <i>secondary_boot_EPU0_test</i> script to confirm that the EPU0 FSW is operating in Application mode.	Complete/ Not Complete
9	<p>The <i>secondary_boot_EPU0_test</i> outputs a file named “SBC_EPU0.log”. Retrieve the output file from the printer, label it, and attach it to this test procedure.</p> <p>Record the label written on the printed log file: _____</p> <p>Record the full path and filename of the soft copy of this output file: _____</p>	Complete/ Not Complete
10	Execute a Secondary Boot of the EPU1 through the <i>secondary_boot_EPU1</i> script. The Secondary Boot process takes less than a minute.	Complete/ Not Complete
11	Run the <i>secondary_boot_EPU1_test</i> script to confirm that the EPU1 FSW is operating in Application mode.	Complete/ Not Complete
12	<p>The <i>secondary_boot_EPU1_test</i> outputs a file named “SBC_EPU1.log”. Retrieve the output file from the printer, label it, and attach it to this test procedure.</p> <p>Record the label written on the printed log file: _____</p> <p>Record the full path and filename of the soft copy of this output file: _____</p>	Complete/ Not Complete

Step No.	Description of Step	Step Outcome
13	Load the files xxx on FES, initialize and start the FES	Complete/ Not Complete
14	Run the <i>start_fes</i> script to start the simulation of science data on the FES.	Complete/ Not Complete
15	Run the <i>fes_test</i> script to ensure that science data is coming in through the FES. The <i>fes_tests</i> 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_002. 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 EPU in Application Mode, using the data simulated by the FES.

6.4.1 Diagnostics and Demand Telemetry testing

For each of the LHK or LTC-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	<p>Once the Test Preparation is complete, run the script <i>NBTLMV_002</i> under LTX through the VSC with the following command:</p> <p style="text-align: center;">\$ ltx run <NBTLMV_002</p>	Complete/ Not Complete
2	<p>The script executes its Demand Telemetry reception verification</p> <p>The test script sends the LHKREQDIAGPKT telecommands to the SIU to start the collection of LHK Diagnostics packets for the APID range 0x210 through 0x22D. The Telemetry DiagTemEnvPwr0 – DiagMemStats1 in the corresponding range 0x270 – 0x28D are received and verified to contain information about the corresponding Housekeeping Telemetry. Then LHKSTOPDIAG telecommand is sent to stop the diagnostics.</p> <p>The script also verifies that up to 4 packets per second can be scheduled for these diagnostics packets.</p> <p>When the script is finished with this phase, it has been verified that upon reception of commands, FSW sends demand telemetry for up to 4 seconds; the script outputs XXXXX to the test terminal to signal that this phase of execution is complete.</p>	Complete/ Not Complete
3	<p>The script executes its Diagnostics Telemetry reception verification</p> <p>The test script sends the LHKREQDIAGPKT telecommand to the SIU requesting one LHK Diagnostics packet for the APID 0x210. The Telemetry DiagTemEnvPwr0 with APID 0x270 is received and verified to contain information about the corresponding Housekeeping Telemetry.</p> <p>When the script is finished with this phase, it has been verified that upon reception of command, FSW sends diagnostics telemetry; the script outputs XXXXX to the test terminal to signal that this phase of execution is complete.</p>	Complete/ Not Complete
4	<p>The script executes its Diagnostics TCS Telemetry reception verification</p> <p>The test script sends the LLTCSETTLMFREQ telecommand to the SIU setting the frequency to 10 seconds, requesting one LTC Diagnostics packet per 10 seconds. The Telemetry DiagLTC with APID 0x2BC is received and verified to contain information about identification of active sensors, identification of active heaters, status for each heat pipe (ok primary sensor bad secondary sensor bad both bad), input temperatures, and algorithm results.</p> <p>The test script resends the LLTCSETTLMFREQ to reset the frequency back to once per second default value.</p> <p>When the script is finished with this phase, it has been verified that upon reception of command, FSW sends LTC diagnostics telemetry once per ten seconds; the script outputs XXXXX to the test terminal to signal that this phase of execution is complete.</p>	Complete/ Not Complete

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	<p>After the NBTLMV_002 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.</p> <p>Record the label written on the printed log file: _____</p> <p>Record the full path and filename of the soft copy of this output file: _____</p>	Complete/ Not Complete
5	<p>Review the xxx log file and verify that the following entries appears followed by “PASS” or “FAIL”.</p> <p>Demand Telemetry</p> <p>Demand Telemetry rate</p> <p>Diagnostics Telemetry</p> <p>LTC Diagnostics Telemetry</p> <p>NBTLMV_002(1): Passed</p> <p>Successful completion of this step verifies all test 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 in Application Mode	

No.	Post-Condition	Post-Condition Met? (Yes/No)
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_002

Based on the analysis of the test results, the overall outcome of Test NBTLMV_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., “NBTLMV_002”). 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.
