



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-07153	Date effective 08/17/05
	Author(s) Igor Volobouev Mark Arndt	Supersedes
	Subsystem/Office Electronics & DAQ Subsystem	
Document Title LAT FSW Qualification Test Procedure: FECALB_002: Charge Injection Calibration – TKR Threshold and Charge Scans		

CHANGE HISTORY LOG

Revision	Effective Date	Description of Changes
01	08/17/05	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

FECALB

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 *FECALB_002* belongs in the Test Suite *FECALB* under the *FST* Project.

1.2 Test ID

FECALB_002

Test *FECALB_002* contains one main test script, *FECALB_002*, which can be run when the SIU and EPU are operating in Application Mode.

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
5.3.12.2.1	Threshold Scan Measurements	The FSW shall collect such data as is necessary to determine the data capture efficiency for each channel for several threshold points at a fixed calibration DAC value. Note that one channel per GTFE can be pulsed at the same time (24 channels per layer).
5.3.12.2.2	Threshold Scan Parameters Stored in File	The number of threshold points and their threshold DAC values, the number of samples for each data point, and the calibration DAC value for each GTFE shall be given by a file or files that can be updated via a command from the ground.

Requirement Number	Requirement Name	Requirement
5.3.12.2.4	Charge Scan Measurements	The FSW shall collect such data as is necessary to determine the data capture efficiency for each channel for several calibration charge points at a nominal threshold DAC value. Note that one channel per GTFE can be pulsed at the same time (24 channels per layer).
5.3.12.2.5	Charge Scan Parameters Stored in File	The number of calibration DAC settings, the number of samples for each data point, and the calibration DAC values for each GTFE shall be given by a file or files that can be updated via a command from the ground.
5.3.12.2.6	TKR Scan Number of Points Minimum	The FSW shall permit gathering data for 5 points or less.
5.3.12.2.7	TKR Scan Number of Points Maximum	FSW shall permit gathering data for at least 25 points.
5.3.12.2.8	TKR Scan Number of Samples	FSW shall permit at least 50 samples to be gathered at each data point.

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:

2.1Definitions

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

2.2Acronyms

CAL	Calorimeter
EGSE	Electrical Ground Support Equipment
FOV	Field of View
GASU	Global trigger Anti-collision Spacecraft Unit
GBM	Gamma-ray Burst Monitor
GRB	Gamma Ray Bust
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:

3.1Applicable 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)
LAT-SS-00010-1	GLAST LAT Performance Specification - Level II(b) Specification
LAT-TD-00169	GTFE Specification
 <u>PROCEDURES</u>	
 <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 Flight Software Management Plan
 <u>DRAWINGS</u>	
 <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.

5.1Hardware Setup

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

Hardware Unit	Manufacturer	GLAT Number	Firmware Version (where applicable)
Front End Simulator (FES): 1	SLAC		
Virtual Spacecraft (VSC): 1	SLAC		
Spacecraft Interface Unit (SIU): 1	SLAC		
Event Processing Unit (EPU): 2	SLAC		
Tower Electronics Module (TEM): 16	SLAC		
Global Trigger AEM Signal distribution unit (GASU): 1	SLAC		
Power Distribution Unit (PDU):1	SLAC		
Unix or Linux host Establishes connection between VSC and the terminal from which the test is run.			

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.

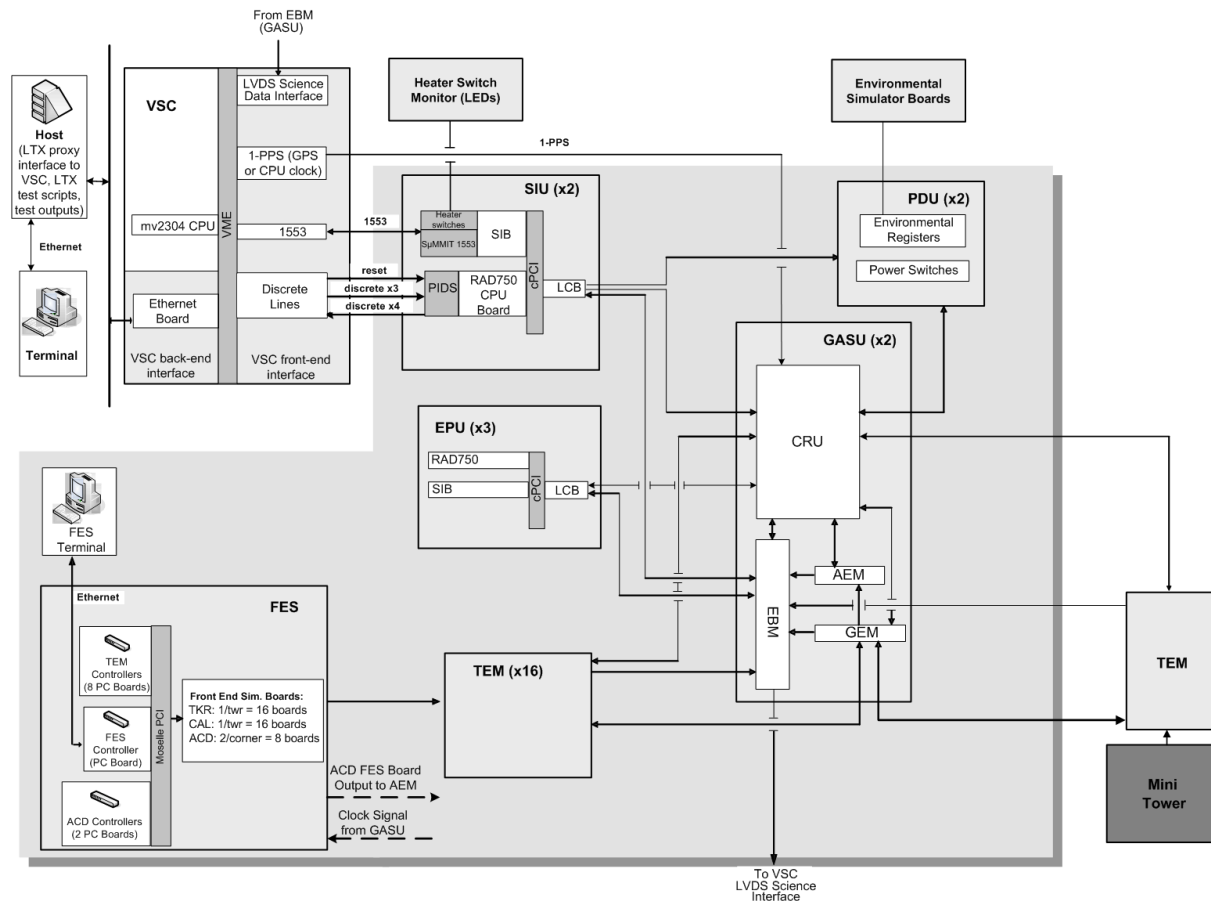


Figure 1. FSW Testbed

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		
FMX	File Management Extra		

Software	Description of Software	Software Version Number (or Specify Attachment Number)	Path to Attachment (If Applicable)
GLEAM	GLast Event Analysis Machine		
FES	Front End Simulator system software		
VSC	Virtual Spacecraft system software		
VPI	VSC Python/Proxy Interface		
(GLAST) ROOT	Data analysis toolkit		

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)
fecalb_002.py	Main LTX qualification test execution script for FECALB_002		
fecalb_002.xml	LTX test description file for FECALB_002		
fecalb_002_analyze.py	Test data/results analysis script for FECALB_002		

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)
LCI	TBD

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	Obtain version numbers of the test tools used to perform this qualification test by running the TBD script. Pick up and label the hardcopy report generated by the TBD script and attach it to this test procedure document. Record (1) the label for the attachment and (2) the directory location to which an electronic copy of the report was saved in Section 5.2.1.	Complete/ Not Complete
2	Obtain version numbers of the test scripts used to perform this qualification test by running the TBD script. Pick up and label the hardcopy report generated by the TBD script and attach it to this test procedure document. Record (1) the label for the attachment and (2) the directory location to which an electronic copy of the report was saved in Section 5.2.2.	Complete/ Not Complete
3	Obtain the versions of the FSW packages loaded on the targets by running the version_test script in the Application Mode. Pick up and label the hardcopy report generated by the version_test script and attach it to this test procedure document. Record (1) the label for the attachment and (2) the directory location to which an electronic copy of the report was saved 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 FECALB_002

6.1Test Objective

This test verifies that:

- The FSW is capable of configuring front-end electronics and collecting data needed for charge injection and threshold calibration of each tracker strip.
- The charge injection and threshold calibration procedures can be configured by file uploading within the expected range of operational settings

This Test Objective is broken down into the following Test Sub-Objective(s) for each of the configurations tested:

Number	Test Sub-Objective
1	Download TKR charge injection calibration configuration file to the LAT.
2	Run the TKR charge injection calibration.
3	Collect the LCI status telemetry upon calibration completion.
4	Analyze the LDF file.

As the result of LDF file analysis for all configurations tested, the following objectives are achieved:

Number	Test Sub-Objective
5	The test verifies that the sequence of GTFE trigger mask settings generated by FSW results in collection of data from all silicon strips on each layer (1536 total), one strip at a time per GTFE chip, with the number of DAC settings and sample points determined by the calibration configuration file.
6	Verifies that the number of threshold DAC settings used in the threshold calibration can be set to 5, 25, 64
7	Verifies that the number of calibration DAC settings used in the charge injection calibration can be set to 5, 25, 64
8	Verifies that the number of samples collected per DAC settings can be set to 25, 50, 100
9	Verifies that the threshold and charge injection calibrations can be performed with several different layer readout splits between left and right cables (24/0, 12/12, 0/24) – due to hardware limitations, not more than 63 strips per layer should be read out simultaneously in any event and not more than 126 strips per cable.

The test script assumes that all changes in the hardware configuration are reported in the data stream (per FSW requirement 5.3.17.4).

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 .

Unless specifically mentioned in the table, nominal number of DAC settings, readout samples, and nominal layer readout split are used.

Input File	Description of Input File	Input File Version Number (or Specify Attachmnt Number)	Path to Attachment (If Applicable)
TBD	LATC hardware configuration file for TOT calibration		
TBD	TKR threshold calibration configuration file with nominal number of threshold DAC settings (64), readout samples (50), and layer readout split (12/12).		
TBD	TKR threshold calibration configuration file with 5 threshold DAC settings		
TBD	TKR threshold calibration configuration file with 25 threshold DAC settings		
TBD	TKR threshold calibration configuration file with 25 readout samples		
TBD	TKR threshold calibration configuration file with 100 readout samples		
TBD	TKR threshold calibration configuration file with 24/0 layer readout split		
TBD	TKR threshold calibration configuration file with 0/24 layer readout split		
TBD	TKR charge injection calibration configuration file with nominal number of calibration DAC settings (64), readout samples (50), and layer readout split (12/12).		
TBD	TKR charge injection calibration configuration file with 5 calibration DAC settings		

Input File	Description of Input File	Input File Version Number (or Specify Attachment Number)	Path to Attachment (If Applicable)
TBD	TKR charge injection calibration configuration file with 25 calibration DAC settings		
TBD	TKR charge injection calibration configuration file with 25 readout samples		
TBD	TKR charge injection calibration configuration file with 100 readout samples		
TBD	TKR charge injection calibration configuration file with 24/0 layer readout split		
TBD	TKR charge injection calibration configuration file with 0/24 layer readout split		
TBD	FES data file. This file will not be specially crafted to represent TKR calibration data. Rather, it will simply allow the FES to simulate the required number of triggers.		

6.3 Test Output Files

The following table identifies the log files, data dump files, and other output files generated by the test scripts executed during this qualification test. The “Output File Attachment Number” column identifies which attachment to this document is the hardcopy record of this script output data. The “Path to Attachment” column specifies where in the test repository an electronic copy of the hardcopy attachment has been saved.

Output File	Description of Output File	Output File Attachment Number	Path to Attachment
TBD	Science data telemetry, LDF format file, for nominal TKR threshold calibration configuration		
TBD	Science data telemetry, LDF format file, for TKR threshold calibration configuration with 5 threshold DAC settings		
TBD	Science data telemetry, LDF format file, for TKR threshold calibration configuration with 25 threshold DAC settings		

Output File	Description of Output File	Output File Attachment Number	Path to Attachment
TBD	Science data telemetry, LDF format file, for TKR threshold calibration configuration with 25 readout samples		
TBD	Science data telemetry, LDF format file, for TKR threshold calibration configuration with 100 readout samples		
TBD	Science data telemetry, LDF format file, for TKR threshold calibration configuration with 24/0 layer readout split		
TBD	Science data telemetry, LDF format file, for TKR threshold calibration configuration with 0/24 layer readout split		
TBD	Science data telemetry, LDF format file, for nominal TKR charge injection calibration configuration		
TBD	Science data telemetry, LDF format file, for TKR charge injection calibration configuration with 5 calibration DAC settings		
TBD	Science data telemetry, LDF format file, for TKR charge injection calibration configuration with 25 calibration DAC settings		
TBD	Science data telemetry, LDF format file, for TKR charge injection calibration configuration with 25 readout samples		
TBD	Science data telemetry, LDF format file, for TKR charge injection calibration configuration with 100 readout samples		
TBD	Science data telemetry, LDF format file, for TKR charge injection calibration configuration with 24/0 layer readout split		
TBD	Science data telemetry, LDF format file, for TKR charge injection calibration configuration with 0/24 layer readout split		

6.4 Test Preparation

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

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

Step No.	Description of Step	Step Outcome
1	Confirm that the Front End Simulator is powered up: -- The power LED on all FES computers (lat-ent1, lat-ent2, ..., lat-ent11) should be on. -- The voltage indicator on the Xantrex power supply marked "FES-FEED" should display $48 \pm 0.5V$, and the current should be above 5A. -- The state indicators on all FES electronic boards should be flashing.	Complete/ Not Complete
2	Boot the Front End Simulator control nodes.	Complete/ Not Complete
3	Boot and initialize the Virtual Spacecraft.	Complete/ Not Complete
4	Confirm that the SIU and the GASU are powered up: -- The voltage indicator on the SIU/GASU Xantrex power supply should display $28 \pm 0.2V$. -- The SIU feed "POWER ON" switch on the regulated feeds bus protection unit (BPU) should be flipped "ON". The SIU voltage indicator on the BPU should display $28 \pm 0.2V$. The SIU current as shown by the BPU indicator should be above 0.4A -- The DAQ feed "POWER ON" switch on the BPU should be flipped "ON". The DAQ voltage indicator on the BPU should display $28 \pm 0.2V$.	Complete/ Not Complete
5	Execute Primary Boot and Secondary Boot on the SIU crate.	Complete/ Not Complete
6	Confirm that FSW application modules have been loaded and that all FSW tasks have been initialized and are running. [[A script will be provided for this purpose.]]	Complete/ Not Complete

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

Date

Time

Test Engineer

QAE

6.5 Test Procedure

After the test setup has been validated, and test preparation steps are complete, 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).

Step No.	Description of Step	Step Outcome
1	Verify presence of the simulated science data on the FES nodes: [[Will be implemented using Owen Saxton's FES web server at http://lat-ent1/home.asp Support for file system browsing is not there yet.]]	Complete / Not Complete

Step No.	Description of Step	Step Outcome
2	<p>Launch the data acquisition script. The expected run time for this script is TBD min:</p> <p>Itx run FECALB_002</p> <p>The data acquisition script uploads the LATC configuration file used with all TKR calibrations. Then it performs fourteen testbed runs using different LCI configuration files and generates fourteen LDF files listed in the table in Section 6.3. The following sequence of operations is performed for each testbed run:</p> <ol style="list-style-type: none"> 1) An LCI configuration file is uploaded to the LAT. The file upload procedure consists in sending the following sequence of telcommands: <ol style="list-style-type: none"> a) LFIUPLCANCEL (APID 0x641, function code 1) resets the file upload state machine to the “START” state. b) LFIUPLSTART (APID 0x641, function code 0) indicates the file size and changes the file upload state to “LOAD”. c) A series of LFIUPLDATA telecommands (APID 0x641, function code 3) transfer the file contents to the SIU memory. These commands do not generate command validation telemetry. d) LFIUPLCOMMIT (APID 0x641, function code 3) commits the file to the temporary file system in memory (ram disk). 2) The science telemetry stream is open on the VSC (operation description TBD). 3) The FES run is started using the VSC interface FES class “start” method. FES timing is determined by the calibration strobes. 4) The CALIBRATE telecommand (APID 0x67C) is sent to the spacecraft. This changes the LAT Instrument Manager operation mode from QUIESCENT to CALIBRATION and initiates data taking by the LAT. The ids of LATC and LCI configuration files are provided as the telecommand arguments. 5) The LLIMSTATE telemetry (APID 0x30f) is received. The LCI task state, as identified by the lci_state field, is required to be “Running”. The LIM operation mode, as identified by the op_mode field, is required to be CALIBRATION. The timeout for LLIMSTATE telemetry reception after the CALIBRATE telecommand is set to TBD seconds. 6) The CmdConfirm telemetry (APID 0x2d0) is received from the LCI task. The message severity level is required to be “SUCCESS”. The timeout for CmdConfirm telemetry reception after the CALIBRATE telecommand is set to TBD seconds. 7) The LLIMSTATE telemetry (APID 0x30f) is received. The LCI task state, as identified by the lci_state field, is required to be “Idle”. The LIM operation mode, as identified by the op_mode field, is required to be QUIESCENT. The timeout for LLIMSTATE telemetry reception after the CALIBRATE telecommand is set to TBD seconds. 8) The FES run is stopped using the VSC interface FES class “stop” method. 9) The science telemetry stream is closed on the VSC (operation description TBD). 	<p>Complete / Not Complete</p>

Step No.	Description of Step	Step Outcome
3	<p>Run the data analysis script. The expected run time for this script is TBD min:</p> <p>python \$HOME/FST/source/FECALB/test/FECALB_002/fecalb_002_analyze.py ???</p> <p>For each testbed run, the data analysis script collects the information about the changes in the system configuration from the LDF file (packet APID and data format TBD). The number of calibration events delivered in each configuration is used to check that the sequence of GTFE trigger mask settings generated by LAT flight software results in collection of data from all silicon strips on each layer (1536 total) with the number of DAC settings and sample points per DAC setting determined by the LCI calibration configuration file. The script also verifies that at no time more than 63 strips per layer or more than 126 strips per cable are enabled simultaneously. The script does not analyze the contents of collected events.</p>	<p>Complete/ Not Complete</p>
4	<p>Confirm the outputs of the data analysis script were saved to the repository. Record the directory location of the output as indicated in Section 6.3.</p>	<p>Complete/ Not Complete</p>
5	<p>Review the outputs of the data analysis script on the test terminal. The test passes if every line of the output contains the word "PASS". Successful completion of this step fulfills all test objectives and sub-objectives. Example data analysis script output is shown below:</p> <p>TKR threshold calibration configuration 0 : PASS</p> <p>TKR threshold calibration configuration 1 : PASS</p> <p>TKR threshold calibration configuration 2 : PASS</p> <p>TKR threshold calibration configuration 3 : PASS</p> <p>TKR threshold calibration configuration 4 : PASS</p> <p>TKR threshold calibration configuration 5 : PASS</p> <p>TKR threshold calibration configuration 6 : PASS</p> <p>TKR charge injection calibration configuration 0 : PASS</p> <p>TKR charge injection calibration configuration 1 : PASS</p> <p>TKR charge injection calibration configuration 2 : PASS</p> <p>TKR charge injection calibration configuration 3 : PASS</p> <p>TKR charge injection calibration configuration 4 : PASS</p> <p>TKR charge injection calibration configuration 5 : PASS</p> <p>TKR charge injection calibration configuration 6 : PASS</p>	<p>Pass/ Fail</p>

Initial to confirm.

Date Time Test Engineer QAE

7.TEST POST-CONDITIONS AND OVERALL OUTCOME

7.1Test Post-Conditions

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

No.	Post-Condition	Post-Condition Met? (Yes/No)
1	LIM task is in the QUIESCENT mode	

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

_____ Date _____ Time _____ Test Engineer _____ QAE

7.2 Overall Outcome of FECALB_002

Based on the analysis of the test results, the overall outcome of Test FECALB_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., “MEMMGT_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.
