


|                                                                                                                                                                |                                                 |                |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------|----------------|
|                                                                               | Document #<br><b>LAT-TD-XXXX</b>                | Date effective |
|                                                                                                                                                                | Author(s)<br>Igor Volobouev<br>Mark Arndt       | Supersedes     |
|                                                                                                                                                                | Subsystem/Office<br>Electronics & DAQ Subsystem |                |
| Document Title<br><b>LAT FSW Qualification Test Procedure:</b><br><b>EVTPMO_001: Event Performance Monitoring and Verification – Software-Related Deadtime</b> |                                                 |                |

**CHANGE HISTORY LOG**

| Revision | Effective Date | Description of Changes |
|----------|----------------|------------------------|
| 01       | XXXXX          | Original               |
|          |                |                        |
|          |                |                        |
|          |                |                        |

**TABLE OF CONTENTS**

|                                                 |    |
|-------------------------------------------------|----|
| 1.Scope.....                                    | 4  |
| 1.1Test Suite.....                              | 4  |
| 1.2Test ID.....                                 | 4  |
| 1.3Requirement(s) Tested.....                   | 4  |
| 2.DEFINITIONS AND ACRONYMS.....                 | 5  |
| 2.1Definitions.....                             | 5  |
| 2.2Acronyms.....                                | 5  |
| 3.REFERENCES.....                               | 6  |
| 3.1Applicable Documents.....                    | 6  |
| 4.REQUIREMENTS.....                             | 7  |
| 4.1Test Data, Equipment and Software.....       | 7  |
| 4.2Quality Assurance.....                       | 7  |
| 4.3Safety.....                                  | 7  |
| 4.4Warnings, Cautions, and Notes.....           | 8  |
| 4.5General Instructions.....                    | 8  |
| 5.SETUP.....                                    | 9  |
| 5.1Hardware Setup.....                          | 9  |
| 5.2Software Setup.....                          | 10 |
| 5.3Setup Validation.....                        | 12 |
| 6.TEST PROCEDURE FOR EVTPMO_001.....            | 13 |
| 6.1Test Objective.....                          | 13 |
| 6.2Test Input Files.....                        | 13 |
| 6.3Test Output Files.....                       | 14 |
| 6.4Test Preparation.....                        | 14 |
| 6.5Test Procedure.....                          | 15 |
| 7.TEST POST-CONDITIONS AND OVERALL OUTCOME..... | 16 |
| 7.1Test Post-Conditions.....                    | 16 |
| 7.2Overall Outcome of EVTPMO_001.....           | 16 |
| 8.CERTIFICATION.....                            | 18 |

## **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**

#### ***EVTPMO***

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 *EVTPMO\_001* belongs in the Test Suite *EVTPMO* under the *FST* Project. The *EVTPMO* tests verify the ability of LAT flight software to collect and transmit to the ground a set of statistics related to in-flight performance of the detector subsystems and data acquisition.

### **1.2 Test ID**

#### ***EVTPMO\_001***

Test *EVTPMO\_001* contains one main test script, *evtpmo\_001.py*, 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                                                                                                                                                                                                                                                                                                 |
|--------------------|-----------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 5.3.6.1            | Deadtime During Normal Operations | The SIU FSW shall contribute less than 0.5% to the deadtime at trigger rates less than 1 kHz and less than 5% at trigger rates greater than 1 kHz and less than 10 kHz. (During normal operations, the trigger rate is dominated by background events, with the gamma ray component being less than 10 Hz). |
| 5.3.6.2            | Deadtime During Gamma Ray Bursts  | The SIU FSW shall contribute less than 25% additional deadtime over that for normal operations for bursts of less than 1 K gamma events within 1 second.                                                                                                                                                    |

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          |
| LAT-SS-00019           | LAT Trigger & Dataflow Subsystem Specification       |
| LAT-TD-05601           | The Virtual Spacecraft (VSC)                         |
| LAT-SS-00010           | LAT Performance 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                        |
| <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, ACD, DAQ, and Signal distribution unit (GASU): 1                                      | SLAC         |             |                                     |
| Power Distribution Unit (PDU):1                                                                       | SLAC         |             |                                     |
| Unix or Linux host<br>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.



| Software     | Description of Software             | Software Version Number (or Specify Attachment Number) | Path to Attachment (If Applicable) |
|--------------|-------------------------------------|--------------------------------------------------------|------------------------------------|
| 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) |
|-----------------------|-------------------------------------------------------------|------------------------------------------------------|------------------------------------|
| evtpmo_001.py         | Main LTX qualification test execution script for EVTPMO_001 |                                                      |                                    |
| evtpmo_001.xml        | LTX test description file for EVTPMO_001                    |                                                      |                                    |
| evtpmo_001_analyze.py | Test data/results analysis script for EVTPMO_001            |                                                      |                                    |

### 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) |
|-------------|----------------|
| EFC         | TBD            |
| EDS         | 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



---

Date

Time

Test Engineer

QAE

## **6. TEST PROCEDURE FOR EVTPMO\_001**

### **6.1 Test Objective**

Deadtime is the time during which the instrument does not sense and/or record gamma ray events during normal operations. In this document additional deadtime is defined as the deadtime added in relation to a 100% instrument up-time and not as a percentage of the deadtime due to other systems (same definition as in LAT-SS-00019). For example, 0.5% additional deadtime at 1 kHz background event rate translates into additional 5  $\mu$ s per background event, and 25% additional deadtime for 1 kHz additional gamma rate means additional 250  $\mu$ s per gamma event.

In order to verify the compliance of the FSW with the requirements 5.3.6.1 and 5.3.6.2, the test measures the contribution of the FSW into the data acquisition deadtime. The measurement is performed as follows. First, a sample of simulated background events is run through the Front-End Simulator with fully configured system and flight software using default system settings. The deadtime is estimated by extracting the values of GEM livetime and trigger time counters from the events which pass the filter. The filter is then replaced with a simple software prescale – the code which runs very quickly and accepts every N<sup>th</sup> event (N is a large TBD number selected so that the livetime counter does not roll over more than once between accepted events). It is assumed that the software contribution to the system deadtime in this configuration is negligible. The same event sample is rerun, and the difference between deadtime measurements in the two testbed runs is used to estimate the FSW deadtime contribution. Two sets of measurements are performed: at 1 kHz and at 10 kHz. At both frequencies event timing is driven by the FES using its exponential event interval feature.

The test also estimates the deadtime increase in GRB mode using default system settings. The same background sample is used in two runs. The first time the background sample is used as is, and the second time a set of short GRB signals is embedded into the sample. In these two runs the event rate is driven by the simulated event time stamps (so that background event rate corresponds to orbit average) rather than by the FES configuration. The deadtime is estimated and compared only for the periods of GRB activity which are known in advance.

The Test Objective is broken down into the following Test Sub-Objective(s).

| Number | Test Sub-Objective                                                                 |
|--------|------------------------------------------------------------------------------------|
| 1      | Take the four simulated data runs with the standard filter                         |
| 2      | Take the two simulated data runs with the filter replaced by the software prescale |
| 3      | Estimate deadtime increase between corresponding runs                              |

## 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) |
|------------|--------------------------------------------------------------------------------|----------------------------------------------------------|------------------------------------|
| TBD        | Simulated orbit data file                                                      |                                                          |                                    |
| TBD        | FES file simulating cosmic ray background data                                 |                                                          |                                    |
| TBD        | FES file simulating cosmic ray background data with embedded short GRB signals |                                                          |                                    |
| TBD        | Software prescale code                                                         |                                                          |                                    |
| TBD        | Software prescale configuration file                                           |                                                          |                                    |

## 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 from the testbed run with the standard filter at 1 kHz background rate  |                               |                    |
| TBD         | Science data telemetry, LDF format file from the testbed run with the standard filter at 10 kHz background rate |                               |                    |

| Output File | Description of Output File                                                                                                          | Output File Attachment Number | Path to Attachment |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|--------------------|
| TBD         | Science data telemetry, LDF format file from the testbed run with the standard filter at orbit average background rate              |                               |                    |
| TBD         | Science data telemetry, LDF format file from the testbed run with the standard filter on the event sample with embedded GRB signals |                               |                    |
| TBD         | Science data telemetry, LDF format file from the testbed run with the software prescale at 1 kHz background rate                    |                               |                    |
| TBD         | Science data telemetry, LDF format file from the testbed run with the software prescale at 10 kHz background rate                   |                               |                    |

## 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:<br>-- The power LED on all FES computers (lat-ent1, lat-ent2, ..., lat-ent11) should be on.<br>-- The voltage indicator on the Xantrex power supply marked "FES-FEED" should display $48 \pm 0.5V$ , and the current should be above 5A.<br>-- The state indicators on all FES electronic boards should be flashing.                                                                                                                                                                           | Complete/<br>Not Complete |
| 2        | Boot the Front End Simulator control nodes.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Complete/<br>Not Complete |
| 3        | Load simulated science data files to the FES nodes.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Complete/<br>Not Complete |
| 4        | Boot and initialize the Virtual Spacecraft.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Complete/<br>Not Complete |
| 5        | Confirm that the SIU and the GASU are powered up:<br>-- The voltage indicator on the SIU/GASU Xantrex power supply should display $28 \pm 0.2V$ .<br>-- 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<br>-- 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/<br>Not Complete |
| 6        | Execute Primary Boot and Secondary Boot on the SIU crate.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Complete/<br>Not Complete |

| Step No. | Description of Step                                                                                                                                                    | Step Outcome              |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|
| 7        | Execute Primary Boot and Secondary Boot on the EPU crates.                                                                                                             | Complete/<br>Not Complete |
| 8        | Confirm that FSW application modules have been loaded and that all FSW tasks have been initialized and are running.<br>[[A script will be provided for this purpose.]] | Complete/<br>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:<br>[[Will be implemented using Owen Saxton's FES web server at <a href="http://lat-ent1/home.asp">http://lat-ent1/home.asp</a><br>Support for file system browsing is not there yet.]] | Complete /<br>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><b>ltx run EVTPMO_001</b></p> <p>The data acquisition script performs six testbed runs using different Monte Carlo event samples and onboard filter configurations and generates six 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"> <li>1) A set of spacecraft timestamped coordinates and attitudes is scheduled for simulation on the VSC using the VSC interface M7 (“magic seven”) class. The simulated orbit file used for “magic seven” telecommand scheduling is the same as the orbit file used to produce the background simulation. The orbit file format is described at <a href="http://confluence.slac.stanford.edu/display/DC2/Orbit+and+Pointing+History">http://confluence.slac.stanford.edu/display/DC2/Orbit+and+Pointing+History</a></li> <li>2) The science telemetry stream is open on the VSC (operation description TBD).</li> <li>3) The Physics-Start telecommand (APID TBD) is sent to the spacecraft. This changes the LAT Instrument Manager operation mode from QUIESCENT to PHYSICS and initiates data taking by the LAT. The filter configuration number (an element of the LPA “working set”) is provided as the telecommand argument.</li> <li>4) The LLIMSTATE telemetry (APID 0x30f) is received. The LPA task state, as identified by the lpa_state field, is required to be “Running”. The LIM operation mode, as identified by the op_mode field, is required to be PHYSICS. The timeout for LLIMSTATE telemetry reception after the Physics-Start telecommand is set to TBD seconds.</li> <li>5) The FES run is started using the VSC interface FES class “start” method. FES timing is exponential for the runs with 1 kHz and 10 kHz background rates and determined by simulation for the runs with embedded GRBs.</li> <li>6) After a waiting period, the FES run is stopped using the VSC interface FES class “stop” method. For the 1kHz and 10 kHz runs, the length of the waiting period is set to the number of events in the sample times the average event interval. For the GRB samples the length of the waiting period is determined by the difference in the time of the first and last event in the sample.</li> <li>7) The Physics-Stop telecommand (APID TBD) is sent to the spacecraft.</li> <li>8) One or more LLIMSTATE telemetry packets is received, until the lpa_state field of the LLIMSTATE packet indicates that that the state of the LPA task is “Idle” and the op_mode field indicates that the instrument operation mode is QUIESCENT. The timeout for telemetry reception after the Physics-Stop telecommand is set to TBD seconds.</li> <li>9) The science telemetry stream is closed on the VSC (operation description TBD).</li> </ol> <p>Change in the filter code and configuration by uploading the software prescale code requires system reboot. When the alternative filter configuration file is uploaded, it must be added to the LPA task “working set”. This requires reconfiguration of the LPA task (details of the procedure TBD).</p> | <p>Complete /<br/>Not Complete</p> |

| Step No. | Description of Step                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Step Outcome              |
|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|
|          | <p>The file upload procedure consists in sending the following sequence of telcommands:</p> <p>1) LFILUPLCANCEL (APID 0x641, function code 1) resets the file upload state machine to the “START” state.</p> <p>2) LFILUPLSTART (APID 0x641, function code 0) indicates the file size and changes the file upload state to “LOAD”.</p> <p>3) A series of LFILUPLDATA telcommands (APID 0x641, function code 3) transfer the file contents to the SIU memory. These commands do not generate command validation telemetry.</p> <p>4) LFILUPLCOMMIT (APID 0x641, function code 3) commits the file to the permanent storage (EEPROM).</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                           |
| 3        | <p>Run the data analysis script. The expected run time for this script is TBD min:</p> <p><b>python \$HOME/FST/source/EVTPMO/test/EVTPMO_001/evtpmo_001_analyze.py ???</b></p> <p>The data analysis script extracts values of the trigger time counter and the livetime counter from the GEM event contributions. It keeps its own livetime and trigger time counters (python long integers) which never roll over. The initial values of the script counters are set from the first event in the LDF file. Trigger time and livetime counter rollovers in the GEM contributions are translated into the increase of script counters by <math>2^{25}</math> and <math>2^{24}</math>, respectively. For each LDF file, the total trigger time, <math>T_{trig}</math>, is estimated as the difference between the final and the initial values of the script trigger counter. The total livetime, <math>T_{live}</math>, is estimated as the difference between the final and the initial values of the script livetime counter. The fractional deadtime, <math>T_{dead}</math>, is estimated as <math>(T_{trig} - T_{live})/T_{trig}</math>. Once the deadtime for each testbed run is determined, the increase due to FSW is estimated from corresponding run pairs.</p> | Complete/<br>Not Complete |
| 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>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Complete/<br>Not Complete |
| 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><b>Deadtime increase for normal operation at 1 kHz trigger : 0.3 % : PASS</b></p> <p><b>Deadtime increase for normal operation at 10 kHz trigger : 3 % : PASS</b></p> <p><b>Deadtime increase for GRB operation : 10 % : PASS</b></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Pass/<br>Fail             |

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   | The system is configured to use software prescale instead of the standard filter code |                              |

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 EVTPMO\_001**

Based on the analysis of the test results, the overall outcome of Test EVTPMO\_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., “MEMMGT\_001”). List by number the steps modified or skipped. Provide a numbered sequence listing any added steps. Describe these deviations for each test that was modified.

---

---

---

---

---

---

---