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Document Title

LAT FSW Qualification Test Procedure:

TIMPRC_001: LAT Time Services

CHANGE HISTORY LOG

Revision	Effective Date	Description of Changes
01	XXXXX	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

TIMPRC

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 *TIMPRC_001* belongs in the Test Suite *TIMPRC* under the *FST* Project.

The TIMPRC tests verify the capability of FSW to receive, process, and correlate time received from the spacecraft via the GPS time hack.

1.2 Test ID

TIMPRC_001

TIMPRC_001 verifies that SIU FSW receives and processes a 1 Hz GPS "time hack" on a discrete signal line, generating a correlation between the GPS time hack and the LAT internal 20 MHz clock. The test also verifies the SIU FSW receives and processes a 1 Hz GPS time message delivered by the SC via the CTDB between 500 ms and 800 ms before the GPS time hack. Finally, the test verifies that SIU FSW processing generates a mapping of external time to the LAT internal 20 MHz clock, in order to accurately time stamp event data.

1.3 Requirement(s) Tested

The Qualification Test Procedure described herein is performed to verify that the FSW satisfies the following requirement(s), quoted from the Flight Software Specification – Level III:

Requirement Number	Requirement Name	Requirement	Level of Requirements Verification in This Test
5.3.4.1	GPS Time Hack from SC	The LAT shall receive and process a 1 Hz GPS "time hack" on a discrete signal line, generating a correlation between the GPS time hack and the LAT internal 20 MHz clock. .	Full
5.3.4.2	GPS Time Hack Integrity Check	The LAT FSW shall perform an internal integrity check of the input GPS time hack to verify consistency with the expected internal clock behavior, reporting inconsistency to the ground.	Full
5.3.4.3	GPS Message from SC	Between 500 msec and 800 msec before the GPS time hack, the SIU FSW shall receive and process a 1 Hz GPS time message from the SC, via the CTDB. Processing this message provides information on the relationship between the GPS time hack and external time (UTC).	Full
5.3.4.4	LAT Clock Correlation	The SIU FSW processing shall generate a mapping of external time to the LAT internal 20 MHz clock, in order to accurately time stamp event data.	Full
5.3.4.5	Time Stamp Accuracy	The accuracy of event timestamps shall be better than 10 μsec relative to spacecraft time. The goal is to achieve time accuracy of better than 2 μsec relative to spacecraft time.	Full

Requirement Number	Requirement Name	Requirement	Level of Requirements Verification in This Test
5.3.14.3	GPS Status	The FSW shall record GPS status information contained in the Ancillary Data message from the SC with event data to aid in problem detection on the ground in case of GPS errors.	Full

If the requirement(s) quoted above cite external documents (e.g., "…Further details are provided in [11]"), consult LAT-SS-00399 for the list of citations.

2. DEFINITIONS AND ACRONYMS

The following terms, abbreviations, and acronyms are used in this document:

2.1 Definitions

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

2.2 Acronyms

CAL	Calorimeter
EGSE	Electrical Ground Support Equipment
GASU	Global trigger Anti-collision Spacecraft Unit
PTR	Post Test Review
TEM	Tower Electronics Module
TKR	Tracker
TPS	Tower Power Supply
TRR	Test Readiness Review
QAE	Quality Assurance Engineer
TE	Test Engineer
1 PPS	One Pulse per Second

3. REFERENCES

The list below provides documents that are to be used as references for this procedure:

3.1 Applicable Documents

Document Number	Description
SPECIFICATIONS	
LAT-SS-00399	LAT Flight Software Level III Specification
1196 EI-S46310-000	GLAST 1553 Bus Protocol Interface Control
LAT-TD-02659	LAT Flight Software Telecommand and Telemetry Formats
LAT-TD-0561	The Virtual Spacecraft (VSC)
PROCEDURES	
N/A	
PLANS	
LAT-MD-00039	Performance Assurance Implementation Plan
LAT-MD-00078	GLAST LAT System Safety Program Plan
LAT-MD-00404	LAT Contamination Control Plan
LAT-MD-00408	LAT Program Instrument Performance Verification Plan
LAT-SS-00296	T & DF Test Plan
LAT-TD-00297	LAT Electronics Test Plan
LAT-TD-00786	LAT Flight Software Test Plan
DRAWINGS	
N/A	
OTHER	
LAT-MD-00091	GLAST Quality Manual
LAT-MD-00471	Control of Nonconforming Product
LAT-MD-00472	Corrective and Preventative Action

4. REQUIREMENTS

This section lists the requirements that shall be followed during the LAT FSW Qualification Testing process.

The Performance Assurance Implementation Plan, LAT-MD-00039, shall be utilized to ensure that the products produced by the GLAST LAT project intended for design qualification, flight and critical ground support equipment usage meet the required levels of quality and functionality for their intended purposes.

The LAT Program Instrument Performance Verification Plan, LAT-MD-00408, shall be utilized to address the testing to be performed at the unit/subsystem and instrument level for flight qualification, proto-flight and acceptance testing phases. Also included are the necessary processes/procedures and systems assurance activities.

4.1 Test Data, Equipment and Software

This procedure shall follow the requirements found in the Control of Nonconforming Product, LAT-MD-00471. This document establishes the method to identify and control nonconforming product developed by the LAT project team.

4.2 Quality Assurance

This procedure shall follow the requirements found in the Corrective and Preventative Action document, LAT-MD-00472 and the GLAST Quality Manual, LAT-MD-00091.

The Corrective and Preventative Action document establishes the method to be used to initiate, implement, evaluate and record corrective and preventive actions. The GLAST Quality Manual defines the methods implemented by the GLAST LAT project to ensure consistent quality of all processes for procurement, design, development and production of flight hardware, flight software and all associated ground support equipment interfacing with flight hardware and software.

4.3 Safety

This procedure shall follow the requirements found in the GLAST LAT System Safety Program Plan, LAT-MD-00078. This document defines all phases of the LAT program including: design, development, fabrication, handling, transportation, storage, test, assembly and operation.

WARNING: When high voltages are present extreme care should be exercised.

4.4 Warnings, Cautions, and Notes

The following SAFETY ALERTS are intended to create awareness of the potential safety hazards and the steps that must be taken to avoid accidents. These same alerts are used throughout this document to identify specific hazards that may endanger personnel and/or equipment.

Identification of every conceivable hazardous situation is impossible. Therefore, all personnel have the responsibility to diligently exercise safe practices whenever exposed to this equipment.

WARNING: Indicates a potential hazardous situation which, if not avoided, could result in death or injury.

CAUTION: Indicates a potential hazardous situation which, if not avoided, could result in damage to equipment.

Note: Indicates a notification of information that is important, but not hazard related.

4.5 General Instructions

This qualification test procedure shall be conducted on a formal basis to its latest approved and released version. The designated Software QAE shall be notified 24 hours prior to the start of this procedure. Software QAE may monitor the execution of all or part of this procedure should they elect to do so.

The Test Engineer conducting this test shall read this document in its entirety and resolve any apparent ambiguities before beginning the procedures described herein.

Deviations from the procedures described in this document and breaks in hardware or software configuration can only be initiated by the Test Engineer, must be approved by QA, and must be documented in Appendix A.

Any nonconformance/defect/anomaly is to be reported in JIRA. Refer to the LAT Flight Software Test Plan LAT-TD-00786 for guidance. Do not alter or break configuration if a failure occurs. Notify Software Quality Assurance.

All success conditions for a test must be met for the test to pass.

5. SETUP

This section describes the hardware and software configuration used for the qualification test described later in this document. Any break from configuration or deviation from a particular procedure must be authorized by the Quality Assurance Engineer and documented in Appendix A.

5.1 Hardware Setup

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

Hardware Unit	Manufacturer	GLAT Number (and Hardware Sub-Units by GLAT Number)	Firmware Version (where applicable)
Virtual Spacecraft (VSC)	SLAC		
Spacecraft Interface Unit (SIU)	SLAC		
Event Processing Unit (EPU): 2 (EPU0 and EPU1)	SLAC		
Global trigger, ACD, DAQ, and Signal distribution unit (GASU)	SLAC		
Power Distribution Unit (PDU)	SLAC		
1553 cables and couplers	SLAC		
Unix or Linux Host Establishes connection between VSC and the terminal from which the test is run.			
Power supply for SIU	SLAC		

The Figure below depicts the Testbed on which this qualification test is performed. The particular hardware units utilized in this test are itemized by GLAT number and firmware version in the

preceding table.

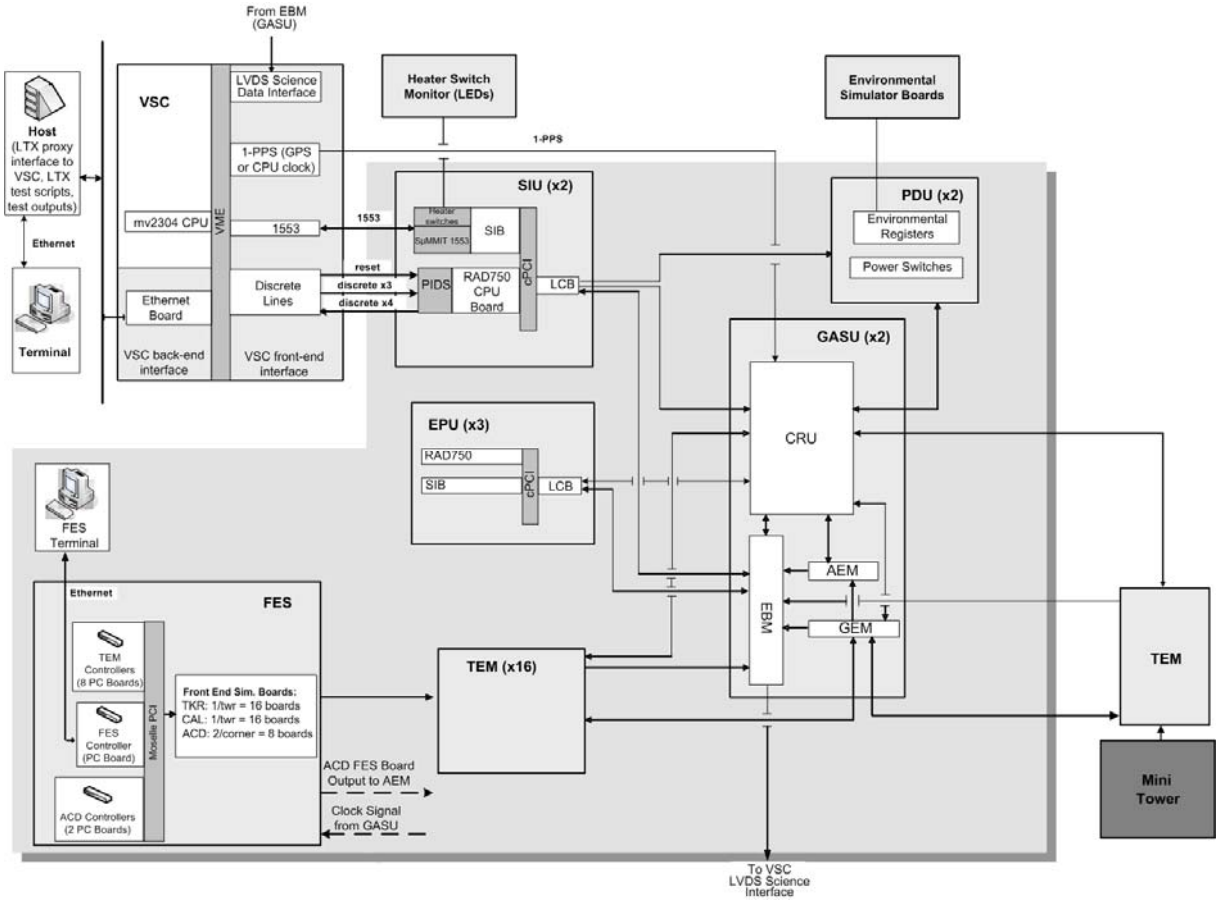

Figure 1. FSW Testbed

5.2 Software Setup

The software required to prepare for and execute the tests described in this Qualification Test Procedure document is itemized in this section.

5.2.1 Test Tools

The following table specifies the test executive used to run this qualification test, and identifies the other software tools used to support the execution of the test. The “Software Version Number” column identifies the version number of the test tool being used; alternatively, this column identifies the hardcopy attachment to this document that records the version of the tool being used (e.g., “Attachment 1”). The “Path to Attachment” column identifies the directory in which the electronic copy of any hardcopy attachment is saved (if applicable).

Software	Description of Software	Software Version Number (or Specify Attachment Number)	Path to Attachment (If Applicable)
LTX	LAT Test Executive		
VSC	Virtual Spacecraft system software		
VPI	VSC Python/Proxy Interface		

5.2.2 Test Scripts

The following table identifies the test scripts that are run to execute this qualification test. The "Script Version Number" column identifies which version of the script is being used; alternatively, this column identifies the hardcopy attachment to this document that records the version of the script being used (e.g., "Attachment 1"). The "Path to Attachment" column identifies the directory in which the electronic copy of any hardcopy attachment is saved (if applicable).

Test Script	Description of Test Script	Script Version Number (or Specify Attachment Number)	Path to Attachment (If Applicable)
TIMPRC_001.py	This script, the main test execution script, tests FSW operating in Application Mode. It executes tests of SIU FSW, EPU0 FSW, and EPU1 FSW. The script controls the entire test process, detecting the state of the hardware and FSW and advancing SIU and EPU FSW through the different necessary operational modes required to execute the test.		

5.2.3 Flight Software

This qualification test is performed on a complete, integrated Candidate Release of FSW. All FSW libraries under test are final Flight Unit Candidate versions. The test described in this document is designed to evaluate the particular FSW packages and constituents listed in the following table; for clarity, only those packages and constituents that are the focus of the test are listed below.

FSW Package	Constituent(s)
LSM	
THS	

FSW Package	Constituent(s)

The Candidate Release into which these FSW constituents are integrated is identified in the following table. The "Candidate Release Build Number" column specifies the build number of the FSW Candidate Release under test (e.g., "B0-0-1"). The "Candidate Release Attachment Number" column identifies which hardcopy attachment to this document confirms the name and version number of the full set of FSW packages and constituents used in the test (e.g., "Attachment 2"). The "Path to Attachment" column specifies where in the test repository an electronic copy of the hardcopy attachment has been saved.

Candidate Release Build Number	Candidate Release Attachment Number	Path to Attachment

5.3 Setup Validation

5.3.1 Hardware Validation

The following signatures confirm that the Test Engineer and Quality Assurance Engineer have verified the GLAT numbers, firmware version numbers, and the proper connection of all hardware listed in the table in Section 5.1.

_____	_____	_____	_____
Date	Time	Test Engineer	QAE

5.3.2 Software Validation

The Test Engineer performs the following procedure to validate the software setup for this qualification test and records completion of the setup validation steps in the space provided.

Step No.	Description of Step	Step Outcome
1	Record the version numbers of all test tools used to perform this qualification test in the table in Section 5.2.1	Complete/ Not Complete

Step No.	Description of Step	Step Outcome
2	Record the version numbers of all test scripts used to perform this qualification test in the table in Section 5.2.2	Complete/ Not Complete
3	Record the version numbers of the FSW constituents and the Candidate Release on which this test is performed in Section 5.2.3.	Complete/ Not Complete

The following signatures confirm that, using the procedure described in the previous table, the Test Engineer and Quality Assurance Engineer have verified that all versions of test support software, test scripts, and FSW constituents match those identified in Section 5.2.

_____	_____	_____	_____
Date	Time	Test Engineer	QAE

6. TEST PROCEDURE FOR TIMPRC_001

6.1 Test Objective

At one second intervals, the spacecraft sends a so called “time tone” telecommand to the LAT. Each telecommand contains a spacecraft time value that will correspond to a discrete signal that is pulsed 500 to 800 ms after the telecommand was dispatched. The flight software catalogs each time tone telecommand received from the spacecraft, and upon the receipt of each 1 PPS signal, samples the GEM internal 20 Mhz clock and PPS counter. The data in this sample includes an index of PPS signals received, the value of the GEM 20Mhz clock at the last PPS signal, and the current GEM 20 Mhz timebase. A table of this data is kept in flight software memory for the last 127 PPS signals. Each index in the table correlates the value received in the time tone telecommand with the GEM clock data. If a PPS signal arrives at a time that is not consistent with the expected value at that index, an error message is generated and reported in diagnostic telemetry.

Each event delivered to the SSR contains the aforementioned GEM timing register data, as well as a spacecraft timestamp. To verify that this event timestamp is consistent with the spacecraft timebase, one must be able to determine exactly when an event was triggered relative to spacecraft time. In order to accomplish this, a 1 PPS signal output on the VSC is routed to the GASU external trigger. Enabling the external trigger will cause an event to be triggered at precisely 1 second intervals, as determined by the spacecraft. The resulting event timestamp equates to spacecraft time plus or minus 10 μsec. Simply put, if an event is triggered at spacecraft time 232 seconds, then the event

timestamp will be 232 sec ± 10 μsec. Also, each event timestamp will be spaced exactly one second apart.

This test verifies that SIU FSW is able to perform the time services listed in the Requirement(s) Tested section.

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

Number	Test Sub-Objective
1	Verify GPS time hack receipt and processing on the SIU.
2	Verify GPS time hack integrity and inconsistency reporting.
3	Verify receipt and processing of spacecraft time tone 1553 telecommand message.
4	Verify generation of external time mapping to the LAT internal 20 Mhz clock.
5	Verify the accuracy of event timestamps to better than 10 μsec relative to spacecraft time.
6	Verify presence of GPS status in event data.

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

6.2 Test Input Files

The following table identifies all auxiliary files (e.g., Front End Simulator data files, GLEAM data files) used as inputs to this qualification test. Note that not all qualification tests use input data of this type. The "Input File Version Number" column identifies the version number of the auxiliary file being used; alternatively, this column identifies the hardcopy attachment to this document that records the version of the file being used (e.g., "Attachment 1"). The "Path to Attachment" column specifies where in the test repository an electronic copy of the hardcopy attachment has been saved.

Input File	Description of Input File	Input File Version Number (or Specify Attachment Number)	Path to Attachment (If Applicable)
TBD1.f	Filter configuration file with loose event selection criteria.		
TBD2.f	FES input file		

6.3 Test Output Files

The following table identifies all files used as outputs to this qualification test. Note that not all qualification tests use output data of this type. The "Output File Version Number" column identifies the version number of the auxiliary file being used; alternatively, this column identifies the hardcopy attachment to this document that records the version of the file being used (e.g., "Attachment 1"). The "Path to Attachment" column specifies where in the test repository an electronic copy of the hardcopy attachment has been saved.

Input File	Description of Input File	Input File Version Number (or Specify Attachment Number)	Path to Attachment (If Applicable)
TBD1.ldf	Science data telemetry, LDF format file for the background run with loose event selection criteria		

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 testing and records completion of the test preparation steps in the space provided.

Step No.	Description of Step	Step Outcome
1	Confirm that the VSC is powered up. Confirm that the VSC 1 PPS output signal is routed to the GASU external trigger.	Complete/ Not Complete
2	Confirm that the Front End Simulator is powered up and files loaded: The power LED on all FES computers (latent1,latent2, ..., latent11) should be on. The voltage indicator on the Xantrex power supply marked "FESFEED"should display 48 ± 0.5V, and the current should be above 5A.The state indicators on all FES electronic boards should be flashing. Load FES input file xxx and initialize run.	Complete/ Not Complete

Step No.	Description of Step	Step Outcome
3	Confirm that the SIU and the GASU are powered up: The voltage indicator on the SIU/GASU Xantrex power supply should display 28 ± 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 ± 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 ± 0.2V.	Complete/ Not Complete

6.5 Test Procedure

This section describes the step by step procedure performed once the test preparation is 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).

Step No.	Description of Step	Step Outcome
1	At the test terminal, run the script *TIMPRC_001* under LTX through the VSC with the following command: **$ ltx run TIMPRC_001**	Complete/ Not Complete
2	The test script determines whether the SIU is powered on by checking whether SIU boot housekeeping telemetry is being transmitted. Regardless of the SIU's current operational mode, the script sends the SIU the LPBCRESET telecommand to reboot the unit. The script then checks whether the SIU FSW is operating in Boot Mode by detecting if boot housekeeping is being transmitted. If not, the script sends the LPBCRESET command and checks again. If the SIU FSW cannot be placed in Boot Mode, LTX prints an error message to the screen and exits, aborting the test. If the test is NOT aborted, mark "Complete" for the Step Outcome.	Complete/ Not Complete
3	Initialize the VSC software and start proxy interface.	Complete/ Not Complete
4	With FSW on the SIU in Boot Mode, send PBCRTOSEXEC telecommand to advance to secondary boot.	Complete/ Not Complete
5	After completion of secondary boot, FSW modules are loaded and the SIU is placed in TERMINAL mode. Housekeeping telemetry LHKxxx shows LIM reporting terminal mode.	N/A
6	Send telecommand LIMMAINFEEDON to initialize the LCB, PDU, and GASU. Housekeeping telemetry LHKxxx reports LIM in QUIESCIENT mode. Send telecommand LIMPOWERON with parameters set to enable power of all TEMs, CAL, TKR, ACD and EPU electronics modules.	N/A

Step No.	Description of Step	Step Outcome
7	Enable external trigger by running vxworks script cfg-ext-trg.vx	Complete/ Not Complete
8	With the SIU in QUIESCIENT mode, send telecommand LPAxxx with filter configuration file ID xxx to start physics run. LHK telemetry reports LIM in PHYSICS mode.	N/A
9	Command the VSC to enable the 1 PPS signal and start sending the time tone telecommands.	N/A
	Immediately start FES run control using selected file to ensure capture of time indexing data in science telemetry.	Complete/ Not Complete
9	Collect event data for xxx minutes.	N/A
10	Disable the VSC 1 PPS for xxx seconds, then reenable the signal to force error reporting.	N/A
11	Command the VSC to vary the time tone message to force error reporting.	N/A
12	Command the VSC to set the GPS status bit in the time tone telecommand for xxx seconds.	N/A

Initial to confirm.

_____	_____	_____	_____
Date	Time	Test Engineer	QAE

6.6 Test Analysis

The analysis for each of the sub-objectives is conducted by the main analysis script TIMPRC_xxx. "Pass" or "Fail" is specified for steps involved in verifying completion of test objectives and sub-objectives.

Step No.	Description of Step	Step Outcome
1	At the test terminal, run the analysis script *TIMPRC_xxx* with the following command: **$ TIMPRC_xxx**	N/A
2	The analysis script loads the science data telemetry output file and diagnostic telemetry archive file.	N/A
3	The SSR telemetry stream is parsed for event records. Each event record is parsed for the GEM contribution 1 PPS index and 20 Mhz clock value corresponding to that index. Acquisition of the data by the event filter, and inclusion of this data in the event stream, partially verifies the PPS receipt and processing specified in sub-objective 1	Pass/ Fail
4	Diagnostic telemetry is parsed for MSG packets xxx apid 0xxxx containing error messages resulting from procedure steps 10 and 11. These errors are produced when a PPS signal does not arrive at the expected time contained in the mapping table, or the time tone message value is inconsistent. Receipt of these errors indicate that the flight software is processing the PPS signal, thus completing verification of sub-objective 1, and verifying sub-objective 2	Pass/ Fail

Step No.	Description of Step	Step Outcome
5	The SSR telemetry output is parsed for the presence of all time tone telecommand telemetry packets in apid 0xxxx, thus verifying the "receive" portion of sub-objective 3. All event timestamps are matched to the time tone telemetry messages, which demonstrate the "processing" of the time tone messages, and thus completing verification of sub-objective 3.	Pass/ Fail
6	Verification of the mapping of external spacecraft time to the internal 20 Mhz GEM clock is achieved by recreating the expected mapping and comparing its outputs to that which the flight software has produced. Each event record is extracted from the SSR stream, and the GEM contribution is located. The PPS index and clock values are used to create table entries. Each time tone message value is mapped to each PPS index. After the mapping is complete, each event is reparsed, and the GEM index value is used to find the corresponding time tone value in the recreated table. This value is then checked against the timestamp in the event header for consistency, thus verifying sub-objective 4.	Pass/ Fail
7	Event data is extracted from the SSR telemetry stream. Both the GEM timebase and spacecraft timestamp values are extracted from each event record. A delta is calculated between each consecutive timebase sample and timestamp. Since each event was triggered by the 1 PPS pulse, they are all separated by 1 second. The delta values do not exceed 1s ±10 µsec, thus verifying sub-objective 5.	Pass/ Fail
8	Event records are parsed for the GPS status bits that were set as a result of procedure step 12, thus verifying sub-objective 6.	Pass/ Fail

7. TEST POST_CONDITIONS AND OVERALL OUTCOME

7.1 Test Post-Conditions

The following post-conditions are analyzed and verified by the test script as described in "Test Procedure and Test Analysis":

No.	Post-Condition	Post-Condition Met? (Yes/No)
1	None	

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 TIMPRC_001

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