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**DRAFT**

Gamma-ray Large Area Space Telescope (GLAST)  
Large Area Telescope (LAT)  
Integration and Test Subsystem (I&T)  
Testing Requirements Document

**CHANGE HISTORY LOG**

<b>Revision</b>	<b>Effective Date</b>	<b>Description of Changes</b>
01	January 13, 2004	Initial draft distributed to subsystems for their input
02	March 11, 2004	Added CAL contributions received thus far
03	May 5, 2004	Added ACD and TKR contributions received thus far

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## 1. Purpose

This document outlines the testing requirements to be carried out by the GLAST LAT I&T subsystem.

## 2. Scope

The scope of this document covers EM-2 and LAT integration. The goal is to have a comprehensive set of scripts ready for LAT integration after the end of EM-2. This document covers both *functional tests* and *calibration procedures* that are run on-line using *LATTE*. Offline calibration procedures are covered under a separate document (LAT-TD-??). Both individual *subsystem* tests as well as *system* level tests are covered.

## 3. Definitions

### 3.1. Acronyms

ACD	Anti-coincidence subsystem
AEM	ACD Electronics Module
API	Application Program Interface
CAL	Calorimeter subsystem
COMM	Communications Module
cPCI	Compact PCI
EEPROM	Electrically Erasable Programmable Read Only Memory
EGSE	Electronic Ground Support Equipment
ELX	Electronics subsystem
EM	Engineering Model
EPU	Event Processor Unit
FITS	Flexible Image Transport System
FSW	Flight software
FU	Flight Unit
GUI	Graphical User Interface
I&T	Integration and Test
IDL	Interactive Data Language
ISOC	Instrument Science Operations Center
LAN	Local Area Network
LAT	Large Area Telescope
LATTE	LAT Test Executive

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LCB	LAT Communications Board
MB	Mega bytes
NFS	Network File System
ODBC	Open DataBase Connectivity
PCI	Peripheral Communications Interface
PPC	Power PC
PSA	Power Supply Assembly
QU	Qualification Unit
RAM	Random Access Memory
ROOT	Rene's (?) Object Oriented Tool
RTE	Real Time Engine
SBC	Single Board Computer
SCL	Spacecraft Control Language
TBR	To Be Reviewed
TKR	Tracker subsystem
TCP/IP	Transmission Control Protocol/Internet Protocol
TEM	Tower Electronics Module
VME	Versa Module Eurocard

### 3.2. Definitions

Flash Memory	A type of memory that retains its contents when powered off. It is normally read only but can be written by a special software procedure.
Functional test	A test that produces a go/no-go result.
Calibration procedure	A procedure whose product is a set of constants.
Subsystem	One of ACD, CAL, TKR, ELX or FSW
System	Something that crosses subsystem boundaries
Test-stand	The combination of a workstation, embedded system, electronics and sensor under test, with corresponding software
Single Contributor	A single contributor system, includes integrated TKR, CAL, TEM, PSA
Multi-contributor	Can include any subset of entire LAT system

### 4. Applicable Documents

- LAT-MD-00408 LAT Program Instrument Performance Verification Plan
- LAT-TD-00191 Tracker Tower Electrical Tests
- LAT-SS-00231 Calorimeter Performance Acceptance Standard and Tests

- LAT-TD-01112 ACD Functional Test Plans
- LAT-TD-00786 LAT Flight Software Test Plan
- LAT-MD-00676 LAT Assembly Sequence
- LAT-MD-00466 LAT I&T SVAC Plan
- LAT-MD-00440 LAT Beam Test Plan
- LAT-MD-01055 LAT Electrical Performance Test Plan
- LAT-SS-00XXX-XX LAT Electrical Ground Support Equipment Level 3 Specification
- LAT-SS-00586 Online Software Validation and Verification

## 5. Description

This document describes testing to be carried out as LAT components are received by I&T from the subsystems. In many cases, corresponding test software will also be received. This software is used by the subsystem to carry out the pre-ship testing and by a combination of the subsystem and I&T to determine the acceptance of the component by I&T.

The delivered software will undergo scrutiny by I&T before being accepted, version controlled and released into the I&T repertoire of tests to be carried out during integration. If it follows I&T requirements, the test is to be listed in this document. If it doesn't, and I&T and the subsystem cannot agree on making a common test, I&T will develop its own version of the test. The project should strive to avoid the latter situation to prevent having to resolve discrepancies between the results of the subsystem's version and I&T's version of the test. As well, handling the divergence of the independent development and maintenance paths is potentially difficult.

I&T will be the main source of the system level tests, in collaboration with the System Engineering department.

## 6. Necessary infrastructure

- Certified Test Stand (LAT-TD-00861).  
I&T will certify, validate and establish a pedigree of the test stand hardware and the associated flight software. These will be maintained under configuration control.
- Certified version of LATTE (LAT-SS-00586).  
I&T will certify LATTE using the LAT Test Bed. LATTE core software is version controlled and released.

## 7. Test Scripts

Each test listed in this section is described on an integer number of pages (usually one). The test descriptions are formatted in the form of a table. The table contains:

- The test script's name
- The test's TEST ID
- The test's SVAC ID, if applicable

- Any aliases the test script goes by
- Test script(s) this script supercedes, if any
- Category, from:
  - Electronics - Component name (e.g., Power supplies, TEM, PSA, etc.)
  - ACD
  - Calorimeter
  - Tracker
  - I&T
- Short description (synopsis)
- Author. May be useful if a question occurs and contact with the original author is desired to find the intention of something.
- Owner/maintainer. Likely to change with time or involve multiple people and won't be updated in this document.
- Test description version number.
- Motivation (e.g. answers a requirement in some LAT document)
- Prerequisites: Script(s) that must be run before this one can be expected to succeed (e.g., to generate some input file for this script)
- Required EGSE
- Required input data/files
  - Type, e.g., calibration, configuration...
  - Format, e.g., XML, FITS...
- Generated output data/files
  - Type, e.g., event data, calibration...
  - Format, e.g., XML, FITS...
- Possible completion statuses, e.g., PASSED, FAILED, other
- Long description of the test
- Additional comments, perhaps to list quirks or observations?

A subsection is devoted to each test script table.

**7.1. TKR (WBS 4.1.4)*****7.1.1. Tracker Power Consumption***

NAME TkrPowerConsumptionTest	TEST ID TKR101	SVAC ID
ALIASES TE101	SUPERCEDES None	CATEGORY TKR
SYNOPSIS		
AUTHOR TBD		OWNER/MAINTAINER/CONTACT PERSON TBD
MOTIVATION Measure the Tracker readout-electronics power consumption		
PREREQUISITES Testing of TEM and power supplies before mating to flight hardware. Individual trays tested by TKR subsystem before tower assembly.		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file		GENERATED OUTPUT FILES Test report
COMPLETION STATUSES		
DESCRIPTION The digital power (2.5 V), analog high (2.5 V), and analog low (1.5 V) supplies are successively turned on, and a clock is supplied to the Tower by the TEM. The resulting current draw and power-supply voltages are checked to be within specifications and are recorded. The current and voltage measurements are made using the monitoring built into the TEM and supplies. Following the measurement with clock only (no commands) the data mask is loaded such that all channels are disabled. Trigger-acknowledge signals, followed by readout, are sent at a rate of 1 kHz, and the power measurement is repeated.		
COMMENTS TO BE REVIEWED – TEM V and I monitors functionalities need to be assessed		

**7.1.2. *Tracker Temperature***

NAME	TEST ID TKR102	SVAC ID
ALIASES TE102	SUPERCEDES None	CATEGORY TKR
SYNOPSIS		
AUTHOR TBD	OWNER/MAINTAINER/CONTACT PERSON TBD	
MOTIVATION Verify that the Tracker built-in temperature sensors work.		
PREREQUISITES TKR101		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file	GENERATED OUTPUT FILES Test Report	
COMPLETION STATUSES		
DESCRIPTION All supplies, except the SSD bias voltage, are turned on and delivered to the tower module. The temperature from each of the 16 sensors is recorded at 5-minute intervals for an hour. A plot of temperature versus time is made for each sensor.		
COMMENTS Tower-level test		

**7.1.3. Tracker Leakage Current**

NAME	TEST ID TKR103	SVAC ID
ALIASES TE103	SUPERCEDES None	CATEGORY TKR
SYNOPSIS		
AUTHOR TBD	OWNER/MAINTAINER/CONTACT PERSON TBD	
MOTIVATION Measure the Tracker SSD bias current and monitor the Tracker internal temperature with SSD biased.		
PREREQUISITES TKR102		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file	GENERATED OUTPUT FILES Test Report	
COMPLETION STATUSES		
DESCRIPTION With the Tracker module powered and clocked, the SSD bias supply is turned on and ramped step by step (5 V steps) to a voltage sufficient to deplete all SSDs in the tower module (according to information from the tower module assembly database) and within the specified maximum range. The Tracker temperature is monitored and recorded (from the internal sensors), as is the room temperature. The supply current is recorded at each step, and a plot of current versus voltage is made. The measurement is made with room lights on and off, to verify the light shielding. The results are compared with the sum of leakage current measurements of the trays from which the tower module was assembled.		
COMMENTS TO BE REVIEWED – TEM V and I monitors functionalities need to be assessed		

**7.1.4. GTRC configuration**

NAME TkrGTRCConfiguration	TEST ID TKR201	SVAC ID
ALIASES TE201	SUPERCEDES None	CATEGORY TKR
SYNOPSIS		
AUTHOR TBD	OWNER/MAINTAINER/CONTACT PERSON TBD	
MOTIVATION Test loading and readback of the controller-chip configuration register, including broadcast mode		
PREREQUISITES TKR101		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file	GENERATED OUTPUT FILES Test Report	
COMPLETION STATUSES Pass/fail		
DESCRIPTION The GTRC chips are sequentially addressed and their configuration registers loaded with a bit pattern. Each time the register is read back and checked for errors. The test is repeated with the complement of the bit pattern. The test then is repeated with a broadcast address for writing the register, followed by sequential readback.		
COMMENTS Functional test applied to each single layer		

**7.1.5. GTFE registers load and read-back**

NAME TkrGTFECheck	TEST ID TKR202	SVAC ID
ALIASES TE202	SUPERCEDES None	CATEGORY TKR
SYNOPSIS		
AUTHOR TBD	OWNER/MAINTAINER/CONTACT PERSON TBD	
MOTIVATION Test loading and readback of the 5 readout-chip configuration registers, including broadcast mode		
PREREQUISITES TKR201		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file	GENERATED OUTPUT FILES Test Report	
COMPLETION STATUSES Pass/fail		
DESCRIPTION The GTFE chips are sequentially addressed via the low-side GTRC and their mask (TRIGGER, DATA, CALIB) and DAC registers are sequentially loaded with a bit pattern. In each case the register then is read back and checked for errors. The MODE register then is loaded to switch the chips to the high-side controller and the MODE register is read back via the right GTRC. The MASK and DAC registers then are loaded with the complement bit pattern and read back via the right GTRC and checked. The GTFE MODE registers are set to split them equally between the two sides in each layer. GTFE MASK and DAC registers are simultaneously loaded with bit patterns via a broadcast command, and then sequentially read back and checked.		
COMMENTS Functional test applied to each single layer		

**7.1.6. GTFE split configuration**

NAME TkrReadingConfigurationTest	TEST ID TKR203	SVAC ID
ALIASES TE203	SUPERCEDES None	CATEGORY TKR
SYNOPSIS		
AUTHOR TBD	OWNER/MAINTAINER/CONTACT PERSON TBD	
MOTIVATION Test redundancy of layer readout configurations, test charge injection system and data path		
PREREQUISITES TKR202		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file	GENERATED OUTPUT FILES Test Report	
COMPLETION STATUSES Pass/fail		
DESCRIPTION The redundancy of the readout configuration is tested by running the same test of the charge injection system for three layer configurations, i.e. i) all GTFEs readout on the low-side GTRC, ii) all GTFEs readout on the high-side GTRC, iii) default configuration with 12 GTFEs on each side. In each configuration all the channels in the layer are enabled for data taking and triggering, and the signal threshold is set high enough to cut out noise; two random channels per GTFE are pulsed with enough charge to cross the threshold. The layer is readout and the channels above threshold are compared with the pulsed one. In case the default configuration is not working, all possible configurations with any number of GTFE on each side are scanned in order to define the optimal split point, which is the one that minimizes the number of GTFEs isolated from the readout.		
COMMENTS Functional test applied to each single layer		

**7.1.7. Tracker Gain and Noise**

NAME TkrNoiseAndGain	TEST ID TKR301	SVAC ID
ALIASES TE301	SUPERCEDES None	CATEGORY TKR
SYNOPSIS		
AUTHOR TBD		OWNER/MAINTAINER/CONTACT PERSON TBD
MOTIVATION Secondary calibration of the noise performance and threshold stability.		
PREREQUISITES TKR203		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file		GENERATED OUTPUT FILES Test Report. Data files with gain and noise for each channel and list of dead channels (both amplifiers and disconnected strips)
COMPLETION STATUSES		
DESCRIPTION The GTFEs mode registers and the GTRCs control register are set according to the optimal split point from test TKR203 (see 7.1.6). The calibration DAC is set in each chip to about 1 fC injection, and the calibration and data masks are set to select in each layer a set of non-adjacent channels smaller in number than the GTRC buffer size. The threshold is scanned over a range about 1 fC, with about 100 events per setting taken. For each setting the occupancy is calculated, and the data are used to fit for each channel the gain and noise. Channels having too low a gain are listed as dead amplifiers, and channels with a noise comparable with the average noise level from a bare MCM are listed as disconnected strips. The procedure is repeated for different mask settings until all live channels are analyzed. The results are stored in a database. A list of gain and noise for each channel is generated, as well as a list of dead channels.		
COMMENTS Functional and performance test applied to each single layer		

**7.1.8. Tracker Threshold Scan**

NAME TkrTriggerRate	TEST ID TKR302	SVAC ID
ALIASES None	SUPERCEDES None	CATEGORY TKR
SYNOPSIS		
AUTHOR TBD	OWNER/MAINTAINER/CONTACT PERSON TBD	
MOTIVATION Test layer self trigger and GTFEs trigger lines		
PREREQUISITES TE301		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file	GENERATED OUTPUT FILES Test Report	
COMPLETION STATUSES Pass/fail		
DESCRIPTION The GTFEs mode registers and the GTRCs control register are set according to the optimal split point from test TKR203 (see 7.1.6). The calibration masks are all disabled. The trigger in the TEM is set to the standard 3-in-a-row self trigger, enabling the combination of layers that includes the tray under test; the other five missing silicon layers are faked by forcing the corresponding trigger lines in the combination to be always on. One GTFE at a time is enabled for triggering and data. The threshold DAC is set at a low value, the TEM LRS counters are monitored and each single FE must provide high rate trigger primitives at sufficiently low threshold. The threshold is increased in steps until while the trigger rate decreases to cosmic rays levels at a reasonably high threshold.		
COMMENTS Functional and performance test applied to each single layer		

**7.1.9. Tracker ToT Test with charge injection**

NAME TkrTotTest	TEST ID TKR303	SVAC ID C11, C12
ALIASES TE303	SUPERCEDES TKR206	CATEGORY TKR
SYNOPSIS		
AUTHOR TBD	OWNER/MAINTAINER/CONTACT PERSON TBD	
MOTIVATION Calibration of the TOT gain. Explore full range of calibration DAC		
PREREQUISITES TE302		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file	GENERATED OUTPUT FILES Test Report	
COMPLETION STATUSES Pass/fail, TOT time_vs_charge calibration factor		
DESCRIPTION The GTFEs mode registers and the GTRCs control register are set according to the optimal split point from test TKR203 (see 7.1.6). The calibration and data masks in each layer are set to enable a maximum of 30 channels randomly chosen for each GTRC to be strobed and readout. The threshold is fixed at a low value, and the calibration DAC is scanned over its whole range, with about 100 events per setting taken. The TOT value at both GTRC is read for each setting and the data are used to calibrate the TOT. The results are stored in the calibration database.		
COMMENTS Functional and performance test applied to each single layer		

**7.1.10. Tracker single strip noise occupancy**

NAME TkrNoiseOccupancy	TEST ID TKR304	SVAC ID C10
ALIASES TE304	SUPERCEDES TKR501	CATEGORY TKR
SYNOPSIS		
AUTHOR TBD	OWNER/MAINTAINER/CONTACT PERSON TBD	
MOTIVATION Noisy channel search		
PREREQUISITES None		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file	GENERATED OUTPUT FILES Test Report plus list of noisy channels	
COMPLETION STATUSES		
DESCRIPTION The GTFEs mode registers and the GTRCs control register are set according to the optimal splitting point from test TKR203 (see 7.1.6). The data and trigger masks in the layer are set to enable all channels to be readout. The threshold is fixed around a working point value (about ¼ MIP, THR_DAC = 35). 100,000 random triggers are issued and the single strip noise occupancy (hits/triggers) is recorded. Any channel with a noise occupancy larger than $10^{-3}$ is considered as noisy and recorded in a database.		
COMMENTS Functional and performance test applied to each single layer		

**7.1.11. Tracker layer noise occupancy**

NAME TkrLayerNoiseOccupancy	TEST ID TKR501	SVAC ID C10
ALIASES TE501	SUPERCEDES TKR502	CATEGORY TKR
SYNOPSIS		
AUTHOR TBD		OWNER/MAINTAINER/CONTACT PERSON TBD
MOTIVATION Check the noise performance and determine working point for data taking		
PREREQUISITES None		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file		GENERATED OUTPUT FILES Test Report
COMPLETION STATUSES		
DESCRIPTION The GTFEs mode registers and the GTRCs control register for all layers are set to the standard configuration for data taking (i.e. 12 FEs on each GTRC), unless otherwise specified as a result of test TKR203 (see 7.1.6). The data and trigger masks in the layer are set to enable all channels to be readout except the noisy channels, as from test TKR304 (see 7.1.10). Random triggers are issued at various threshold values, scanning the full range 0 of the threshold DAC register, and the strips above threshold are readout. At each data point the layer noise occupancy is calculated as the ratio of the number of strips above threshold divided by the number of strips enabled. The threshold gets incremented until a plateau is reached, which is the result of cosmic rays crossing the tower in accidental coincidence with random triggers. The average values expected are a few $10^{-4}$ for the occupancy plateau, occurring at a threshold DAC larger than ~30 (range 0). The threshold DAC corresponding to the requirements layer noise occupancy of $10^{-4}$ is extrapolated from the plot and is defined as the working point for that layer for subsequent tests. The efficiency at that threshold or higher will be evaluated in the efficiency scan.		
COMMENTS Functional and performance test applied to each single layer		

**7.1.12. Efficiency, resolution and alignment**

NAME TkrDetectionEfficiency	TEST ID TKR503	SVAC ID ?
ALIASES TE503	SUPERCEDES None	CATEGORY TKR
SYNOPSIS		
AUTHOR TBD		OWNER/MAINTAINER/CONTACT PERSON TBD
MOTIVATION Verification of the single layer detection and trigger efficiency, spatial resolution, and tower alignment requirements.		
PREREQUISITES None		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file		GENERATED OUTPUT FILES Test Report. Efficiency scans for all layers, alignment constants, single-hit resolution for all layers
COMPLETION STATUSES		
DESCRIPTION The mode-registers, masks, and threshold DACs are set as determined by test TKR501 (see 7.1.11). The trigger is set to the standard 3-in-a-row and all combinations are enabled. Detection efficiency is studied for each layer independently: the trigger line from the layer under study is forced to 1 and cosmic ray data are taken for at least 12 hours. The data are analyzed as follows. Tracks are found and fit to straight lines with the layer under study omitted from the pattern recognition. Events are selected with a single, good-quality track that passes through all the other tracker layers. The projection of the track onto the selected layer is calculated, and a search is made for a hit cluster close to the track, if the extrapolation shows that the particle, to high confidence, passed through a live detector region. The efficiency for finding a hit cluster is calculated from the full data set and recorded for each of the 16 SSDs in the layer. The threshold DAC is then varied and the efficiency measurement is repeated until the threshold range 0 has been explored. The same measurement is then repeated for all the layers in the tracker tower. For each trigger in the above procedure, the status of all Layer-ORs is recorded, and the efficiency of each Layer-OR is calculated in the same manner as for the data readout. During the same procedure, when a cluster is found close to the track in the selected layer, its distance from the track intersection is calculated and a histogram of that residual is made on a layer-by-layer basis. The width of the distribution is a measure of the resolution (with some bias from the track fit), and the mean of the distribution gives an indication of the alignment quality. The number of triggers registered in every combination of 3 x-y- layers is recorded as to check that every combination works with good efficiency.		
COMMENTS Performance test applied to tower only		

**7.1.13. Tracker Muon Scan**

NAME	TEST ID TKR504	SVAC ID C9
ALIASES None	SUPERCEDES TKR503	CATEGORY TKR
SYNOPSIS		
AUTHOR TBD		OWNER/MAINTAINER/CONTACT PERSON TBD
MOTIVATION Exercise the system in working conditions for medium-long term periods		
PREREQUISITES None		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file		GENERATED OUTPUT FILES Test Report
COMPLETION STATUSES		
DESCRIPTION		
COMMENTS		

## 7.2. CAL (WBS 4.1.5)

### 7.2.1. CAL Power Consumption

Below is a draft of the CAL power consumption procedures. It relies heavily upon LATTE's rule capability and RunControl's Environmental Monitor and Housekeeping capabilities. Please review it and let me know if it's the way to go or if there is a better way. I not very familiar with rules so please correct any mistakes or misconceptions. I plan to implement temperature monitoring in a similar manner.

NAME	TEST ID CAL	SVAC ID
ALIASES None	SUPERCEDES None	CATEGORY CAL
SYNOPSIS Monitor CAL Power Consumption		
AUTHOR NRL/Code 7650/B. Leas		OWNER/MAINTAINER/CONTACT PERSON NRL/Code 7650/B. Leas
MOTIVATION TBD		
PREREQUISITES Environmental Monitoring "enabled" HouseKeeping enabled		
REQUIRED EGSE LATTE (latest?) SciPy package Dislin package (if hardcopy plots are desired) LAT TestStand (includes TEM?) Calorimeter Schema describing Calorimeter (\$CAL_ROOT\FMx\Configurations\FMx_schema.xml)		
REQUIRED INPUT DATA OR FILES Schema describing Calorimeter voltage/current monitor rules and limit settings which could vary by TEM (see description) : \$CAL_ROOT\FMx\Configurations\calvcMonConfig.xml		GENERATED OUTPUT FILES Housekeeping File: Session Log: Alarms Display: (Not an output file but don't know where else to put it)
COMPLETION STATUSES Red/Yellow ALARMS		
DESCRIPTION <?xml version='1.0' encoding='UTF-8'?> <configuration name='CAL current/voltage Monitoring Rules' version='1.0'> <rules> <rule name='voltageMonitor'>		

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```
<class>gRule.GruleAlarms</class>
<parameters>
  <name>voltageMonitor</name>
  <subsystem>CAL</subsystem>
  <category>voltage</category>
  <enabled>1</enabled>
  <continuous>1</continuous>
  <yellowLowerLimit>TBD</yellowLowerLimit>
  <yellowUpperLimit>TBD</yellowUpperLimit>
  <yellowAction>None</yellowAction>
  <redLowerLimit>TBD</redLowerLimit>
  <redUpperLimit>TBD</redUpperLimit>
  <redAction>disablePower</redAction>
</parameters>
```

```
</rule>
```

```
<rule name='currentMonitor'>
```

```
<class>gRule.GruleAlarms</class>
<parameters>
  <name>currentMonitor</name>
  <subsystem>CAL</subsystem>
  <category>current</category>
  <enabled>1</enabled>
  <continuous>1</continuous>
  <yellowLowerLimit>TBD</yellowLowerLimit>
  <yellowUpperLimit>TBD</yellowUpperLimit>
  <yellowAction>None</yellowAction>
  <redLowerLimit>TBD</redLowerLimit>
  <redUpperLimit>TBD</redUpperLimit>
  <redAction>disablePower</redAction>
</parameters>
```

```
</rule>
```

```
<rule name='bias VoltageMonitor'>
```

```
<class>gRule.GruleAlarms</class>
<parameters>
  <name>voltageMonitor</name>
  <subsystem>CAL</subsystem>
  <category>voltage</category>
  <enabled>1</enabled>
  <continuous>1</continuous>
  <yellowLowerLimit>TBD</yellowLowerLimit>
  <yellowUpperLimit>TBD</yellowUpperLimit>
  <yellowAction>None</yellowAction>
  <redLowerLimit>TBD</redLowerLimit>
  <redUpperLimit>TBD</redUpperLimit>
  <redAction>disableHV</redAction>
</parameters>
```

```
</rule>
```

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```

<rule name='biasCurrentMonitor'>
  <class>gRule.GruleAlarms</class>
  <parameters>
    <name>currentMonitor</name>
    <subsystem>CAL</subsystem>
    <category>current</category>
    <enabled>1</enabled>
    <continuous>1</continuous>
    <yellowLowerLimit>TBD</yellowLowerLimit>
    <yellowUpperLimit>TBD</yellowUpperLimit>
    <yellowAction>None</yellowAction>
    <redLowerLimit>TBD</redLowerLimit>
    <redUpperLimit>TBD</redUpperLimit>
    <redAction>disablePower</redAction>
  </parameters>
</rule>
</rules>
<GLAT>
<GTEM ID=0-15>
<GTIC>
  <adc_cal_digital_3_3v egu="CAL Digital 3.3 Voltage",rule="voltageMonitor"/>
  <adc_cal_digital_3_3i egu="CAL Digital 3.3 Current",rule="currentMonitor"/>
  <adc_cal_analog_3_3v egu="CAL Analog 3.3 Voltage",rule="voltageMonitor"/>
  <adc_cal_analog_3_3i egu="CAL Analog 3.3 Current",rule="currentMonitor"/>
  <adc_cal_bias_v egu="CAL Bias Voltage",rule="biasVoltageMonitor"/>
  <adc_cal_bias_i egu="CAL Bias Current",rule="biasCurrentMonitor"/>
  <adc_tkr_c7_t1 egu="Temperature"/>
</GTIC>
</GTEM>
</GLAT>
</configuration>

```

#### COMMENTS

The objective is to use RunControl provided capabilities to monitor power consumption and take appropriate action. The RunControl capabilities to be used are:

1. Rule definition and assignment to telemetry items
2. Environmental monitoring
3. Housekeeping

It would be convenient if uniform limits could be applied across all TEMs, however, this is dependent upon the capabilities of the TEM current/voltage monitoring circuitry and will require some analysis before actual limits can be determined.

### 7.2.2. CAL Temperature

Below is a draft of the CAL temperatures procedure. Same comments are with CAL power consumption description.

NAME	TEST ID CAL	SVAC ID
ALIASES None	SUPERCEDES None	CATEGORY CAL
SYNOPSIS Monitor CAL Temperatures		
AUTHOR NRL/Code 7650/B. Leas		OWNER/MAINTAINER/CONTACT PERSON NRL/Code 7650/B.Leas
MOTIVATION TBD		
PREREQUISITES Environmental Monitoring "enabled" HouseKeeping enabled		
REQUIRED EGSE LATTE (latest?) SciPy package Dislin package (if hardcopy plots are desired) LAT TestStand (includes TEM?) Calorimeter Schema describing Calorimeter (\$CAL_ROOT\FMx\Configurations\FMx_schema.xml)		
REQUIRED INPUT DATA OR FILES Schema describing Calorimeter temperature monitor rules and limit settings which could vary by TEM (see description) : \$CAL_ROOT\FMx\Configurations\calvcMonConfig.xml		GENERATED OUTPUT FILES Housekeeping File: Session Log: Alarms Display: (Not an output file but don't know where else to put it)
COMPLETION STATUSES Red/Yellow ALARMS		
DESCRIPTION <?xml version='1.0' encoding='UTF-8'?> <configuration name='CAL Temperature Monitoring Rules' version='1.0'> <rules> <rule name='temperatureMonitor'> <class>gRule.GruleAlarms</class> <parameters> <name>temperatureMonitor</name> <subsystem>CAL</subsystem> <category>temperature</category>		

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```
<enabled>1</enabled>
<continuous>1</continuous>
<yellowLowerLimit>TBD</yellowLowerLimit>
<yellowUpperLimit>TBD</yellowUpperLimit>
<yellowAction>None</yellowAction>
<redLowerLimit>TBD</redLowerLimit>
<redUpperLimit>TBD</redUpperLimit>
<redAction>disablePower</redAction>
</parameters>
</rules>
<GLAT>
<GTEM ID=0-15>
<GTIC>
<adc_afee0_t0 egu="Temperature",rule="temperatureMonitor"/>
<adc_afee0_t1 egu="Temperature",rule="temperatureMonitor"/>
<adc_afee1_t0 egu="Temperature",rule="temperatureMonitor"/>
<adc_afee1_t1 egu="Temperature",rule="temperatureMonitor"/>
<adc_afee2_t0 egu="Temperature",rule="temperatureMonitor"/>
<adc_afee2_t1 egu="Temperature",rule="temperatureMonitor"/>
<adc_afee3_t0 egu="Temperature",rule="temperatureMonitor"/>
<adc_afee3_t1 egu="Temperature",rule="temperatureMonitor"/>
</GTIC>
</GTEM>
</GLAT>
</configuration>
```

**COMMENTS**

The objective is to use RunControl provided capabilities to monitor CAL temperatures and take appropriate action. The RunControl capabilities to be used are:

4. Rule definition and assignment to telemetry items
5. Environmental monitoring
6. Housekeeping

It would be convenient if uniform limits could be applied across all TEMs, however, this is dependent upon the capabilities of the TEM current/voltage monitoring circuitry and will require some analysis before actual limits can be determined.

**7.2.3. GCRC configuration**

See AFEE Configuration, Section 7.2.5

**7.2.4. GCFE configuration**

See AFEE Configuration, Section 7.2.5

**7.2.5. AFE configuration**

NAME Calu_init	TEST ID CAL	SVAC ID
ALIASES None	SUPERCEDES None	CATEGORY CAL
SYNOPSIS		
AUTHOR NRL/Code 7650/B. Leas		OWNER/MAINTAINER/CONTACT PERSON NRL/Code 7650/B.Leas
MOTIVATION TBD		
PREREQUISITES TEMPowerUp		
REQUIRED EGSE LATTE (latest?) SciPy package Dislin package (if hardcopy plots are desired) LAT TestStand (includes TEM?) Calorimeter Schema describing Calorimeter (\$CAL_ROOT\FMx\Configurations\FMx_schema.xml)		
REQUIRED INPUT DATA OR FILES Configuration file		GENERATED OUTPUT FILES Test Report: yymmddhhmss_FMx_calu_init.html Register Snapshot: yymmddhhmss_FMx_calu_init.xml
COMPLETION STATUSES PASS IPASS (Incomplete Pass - partial system...only applicable to development phase) FAIL ABORT		
DESCRIPTION <b>Procedure</b> <i>Init:</i> Read CAL parameters configuration file Obtain Calorimeter unit identifier: try configuration file first else use runControl preferences instrumentype value. Update default runControl Preferences paths with calorimeter unit identifier (assumes subdirectories already exist) Turn of Schema reuse flag (can be overridden from a test suite) <i>Setup:</i> (runControl.rcSetup does schema processing) Turn on schema reuse flag (all following application runs use this schema) Set power up flag based on whether "all" calorimeters defined in schema are powered up Set current configuration parameter values which include: TBD If interactive mode: Display current configuration parameter values Prompt operator for configuration parameters Else if batch		

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Update CAL configuration parameters with batch values

**startRun:**

Initialize report structure  
Disable triggers  
Set trigger mask to no triggers

**Running:**

Set PDU registers based on configuration values  
Set HV bias DAC value  
Power Calorimeters  
Wait for HV to settle  
Initialize GCCCs  
Initialize GCRCs with configuration values  
Initialize GCFEs with configuration values  
Initialize FLE,FHE,LAC,ULD DACs from tables contained in files if available  
Take register configuration snapshot and save filename to be used by all following application runs as the initial instrument state.

**Report:**

TBD

Comment [MSOffice1]: OBE when TEMPowerUp is implemented

COMMENTS

**7.2.6. CAL reset**

See AFEE Configuration, Section 7.2.5

**7.2.7. CAL Pedestals**

NAME CALU PEDESTALS CI	TEST ID CAL	SVAC ID C18
ALIASES None	SUPERCEDES None	CATEGORY CAL
SYNOPSIS Determine CAL Noise Pedestals		
AUTHOR NRL/Code 7650/B. Leas		OWNER/MAINTAINER/CONTACT PERSON NRL/Code 7650/B.Leas
MOTIVATION <b>Level IV: 9.1.14.1</b> The equivalent noise (RMS) on the low energy slow shaped signal paths (LEX8, LEX1) shall be less than 2000 e-. <b>Level IV: 9.1.14.2</b> The equivalent noise (RMS) on the high energy slow shaped signal paths (HEX8, HEX1) shall be less than 2000 e-.		
PREREQUISITES Estimate of electrons per ADC bin for LEX and HEX slow shaping circuits (see TBD). <b>Note: Tests can be run without the above mentioned information, but requirements for absolute noise cannot be tested.</b>		
REQUIRED EGSE LATTE (latest?) SciPy package Dislin package (if hardcopy plots are desired) LAT TestStand (includes TEM?) Calorimeter Schema describing Calorimeter (\$CAL_ROOT\FMx\Configurations\FMx_schema.xml)		
REQUIRED INPUT DATA OR FILES Schema describing Calorimeter: \$CAL_ROOT\FMx\Configurations\FMx_schema.xml  CAL Configuration file: \$CAL_ROOT\FMx\Configurations\calParams.cfg	GENERATED OUTPUT FILES Test Report: yymmddhhmss_FMx_calu_collect_ci.html Register Snapshot: yymmddhhmss_FMx_calu_collect_ci.xml Noise Pedestals Table: yymmddhhmss_FMx_pedestals.fits Noise Pedestal Statistics: yymmddhhmss_FMx_pedestal_stats.csv	
COMPLETION STATUSES PASS IPASS (Incomplete Pass - partial system...only applicable to development)		

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<p>phase)</p> <p>FAIL</p> <p>ABORT</p>
<p>DESCRIPTION</p> <p><b>Algorithm</b></p> <p><b>Setup:</b></p> <p>Nominal with the following changes:</p> <p>Tack Delay setting = CI_TIMED_PEAK</p> <p>Disable calibration injection to all FEs (config_1 = 0x80)</p> <p><b>Collect noise data</b></p> <p>For each operational gain setting plus the muon gain setting, <math>gainidx = 0</math> to 8 (9 settings)</p> <p>For N samples (default = 1000)</p> <p>Use GLT self trigger to inject charge (FEs accept no charge however), delay, and read 4 range event data</p> <p>Compute Mode for each component and energy range, mode[<math>gainidx</math>, 4,8,2,12]</p> <p>Compute Mean for each component and energy range, mean[<math>gainidx</math>, 4,8,2,12]</p> <p>Compute standard deviation for each component and energy range, std[<math>gainidx</math>,4,8,2,12]</p> <p>Save Pedestals table, mode[9,4,8,2,12], in FITS format to file</p> <p><b>Histogram noise samples and fit gaussian</b></p> <p>For each gain, <math>gainidx = 0</math> to 8</p> <p>For LEX8 and HEX8 ranges, <math>rangeidx = 1,3</math> (LEX1 and HEX1 range data does not have enough points to fit curve)</p> <p>For each layer, <math>layeridx = 0</math> to 7 (SLAC numbering 0-3=X layers, 4-7=Y layers)</p> <p>For each logend, <math>eidx = 0</math> to 1</p> <p>For each log, <math>logidx=0</math> to 11</p> <p>Histogram noise ADC settings using mode[<math>gainidx</math>,<math>rangeidx</math>,<math>layerid</math>,<math>eidx</math>,<math>logidx</math>]</p> <p>+/- offset (default = 30) as histogram lower/upper boundaries.</p> <p>Fit gaussian to histogram</p> <p>Find Peak[<math>gainidx</math>,<math>rangeidx</math>,<math>layeridx</math>,<math>eidx</math>,<math>logidx</math>]</p> <p>Compute Centroid[<math>gainidx</math>,<math>rangeidx</math>,<math>layeridx</math>,<math>eidx</math>,<math>logidx</math>]</p> <p>Compute FWHM[<math>gainidx</math>,<math>rangeidx</math>,<math>layeridx</math>,<math>eidx</math>,<math>logidx</math>]</p> <p>Compute Area[<math>gainidx</math>,<math>rangeidx</math>,<math>layeridx</math>,<math>eidx</math>,<math>logidx</math>]</p> <p>Save pedestals statistics, mode, peak, centroid, fwhm, area in FITS file format (to support utilities needing noise threshold data, low and high trigger DAC settings, data suppression DAC settings).</p> <p>Save pedestals statistics, mode, peak, centroid, fwhm, area in CSV file format suitable for database entry (trend analysis support)</p> <p><b>Requirements checks/sanity checks</b></p> <p>If Area[...] does not equal 80 to 100% of N samples then PASS[...] = FALSE (failed check)</p>
<p>COMMENTS</p>

**7.2.8. CAL Electronic Gain**

Attached is a draft of the CAL Electronic Gain procedures. It consists of 2 procedures; calf\_gain\_p01 to characterize evaluate the selectable Low and High Energy gain settings. calf\_gain\_p02 to characterize and evaluate the "times 8" and "times 1" gain ratios for both low and high energy.

**7.2.8.1. CAL Electronic Gain 1**

NAME Calf_gain_p01	TEST ID CAL	SVAC ID C19
ALIASES None	SUPERCEDES None	CATEGORY CAL
SYNOPSIS Characterize and evaluate CAL charge amplifier gain capabilities		
AUTHOR NRL/Code 7650/B. Leas		OWNER/MAINTAINER/CONTACT PERSON NRL/Code 7650/B.Leas
MOTIVATION <p>Level IV: 9.1.1.6      The gain of the low energy channels shall be adjustable by <b>a)</b> at least a factor of 2 <b>b)</b> in steps of approximately 10%-25%.</p> <p>Level IV: 9.1.2.5      The gain of the high energy channels shall be adjustable by <b>a)</b> at least a factor of 2 <b>b)</b> in steps of approximately 10%-25%. <b>c)</b> An additional gain setting shall be used for ground liveness testing.</p> <p>Level IV: 9.1.11.4     The high energy charge amplifier shall provide a test gain to be used in ground aliveness test with cosmic muons. The test gain shall increase the nominal gain by a factor of approximately 10. The test gain configuration is pre-selected by command input to the ASIC.</p>		
PREREQUISITES Calu_init		
REQUIRED EGSE LATTE (latest?) SciPy package Dislin package (if hardcopy plots are desired) LAT TestStand (includes TEM?) Calorimeter Schema describing Calorimeter (\$CAL_ROOT\FMx\Configurations\FMx_schema.xml)		
REQUIRED INPUT DATA OR FILES Schema describing Calorimeter: \$CAL_ROOT\FMx\Configurations\FMx_schema.xml  CAL Configuration file: \$CAL_ROOT\FMx\Configurations\calParams.cfg		GENERATED OUTPUT FILES Test Report: yymmddhhmss_FMx_calf_gain_p01.html  Register Snapshot: yymmddhhmss_FMx_calf_gain_p01.xml Events File: yymmddhhmss_FMx_calf_gain_p01.fits  relative gain Table:

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	yymmddhhmss_FMx_relgain.fits
<p>COMPLETION STATUSES</p> <p>PASS</p> <p>IPASS (Incomplete Pass - partial system...only applicable to development phase)</p> <p>FAIL</p> <p>ABORT</p>	
<p>DESCRIPTION</p> <p><b>Algorithm</b></p> <p><i>Setup:</i> Nominal with the following changes: Tack Delay setting = CI_TIMED_PEAK</p> <p><b>Collect gain data</b> For each energy range, <i>rangeidx = 0 to 3</i> <b>Find minimum globally useable DAC setting</b> <b>Find maximum globally useable DAC setting</b> Using mid DAC setting For each operational gain setting plus the muon gain setting, <i>gainidx = 0 to 8 (9 settings)</i></p> <p>For N samples, default = 1000 Use GLT self trigger to inject charge, delay, and read 4 range event data</p> <p>Compute Mean for each component and energy range, <math>\text{mean}[\text{gainidx}, 4, 8, 2, 12]</math> Compute standard deviation for each component and energy range, <math>\text{std}[\text{gainidx}, 4, 8, 2, 12]</math></p> <p><b>Calculate relative gains wrt nominal gain setting</b> For each gain setting, <i>gainidx = 0 to 8</i> Compute relative gain at gain setting <i>gainidx</i> as ratio of value at gain setting <i>gainidx</i> over value at nominal, <math>\text{relGain} = \frac{\text{mean}[\text{gainidx}, \dots]}{\text{mean}[5, \dots]}</math> Save relative gain table, <math>\text{relgain}[9, 4, 8, 2, 12]</math>, in FITS format to file For relative gains 7 to 1 If ratio between previous relative gain and current relative gain is not between 10 to 25% then fail component If relative gain 0 is not 2 times greater than relative gain 7 then fail component If relative gain 8 is not 10 times greater than relative gain 7 for the HEX1 range then fail component</p>	
<p>COMMENTS</p> <ol style="list-style-type: none"> <li>While this test supports subsets of the LAT hardware, it expects the existent TEMs to have identical configurations. In LAT systems where the existing TEMs are not identical, groups of identical TEMs should be identified and individual tests run on each identical TEM subgroup (see Test Preparation)</li> <li>It is sufficient to use for each ranges, one Charge Injection value for relative gain testing if chosen appropriately. For each range, this test will find the minimum and maximum Charge Injection value that produces ADC results above pedestal and below saturation respectively and choose the middle value from this interval as the Charge Injection value for relative gain testing.</li> <li>Nominal gain setting for the LEX8/LEX1 ranges is gain setting 5.</li> </ol>	

4. Nominal gain setting for the HEX8/HEX1 ranges is gain setting 13.
5. "steps of approximately 10%-25%." referred to in requirements Level IV 9.1.1.6 and 9.1.2.5 will be interpreted for testing purposes to be 9% to 27.5% i.e. 10% tolerance assigned to approximately.

**7.2.8.2. CAL Electronic Gain 2**

NAME Calf_gain_p02	TEST ID CAL	SVAC ID C19
ALIASES None	SUPERCEDES None	CATEGORY CAL
SYNOPSIS Characterize and evaluate the “times 8” to “times 1” gain ratios for both the Low and High Energy Paths		
AUTHOR NRL/Code 7650/B. Leas		OWNER/MAINTAINER/CONTACT PERSON NRL/Code 7650/B.Leas
MOTIVATION <p>Level IV: 9.1.3.6      The LEX1 amplifier of the low energy channel shall process the entire low energy charge amplifier range, i.e. nominally 1.6 GeV maximum energy.</p> <p>Level IV: 9.1.3.7      The LEX8 amplifier of the low energy channel shall process the lowest eighth of the low energy charge amplifier range, i.e. nominally 200 MeV maximum energy.</p> <p>Level IV: 9.1.3.8      The HEX1 amplifier of the high energy channel shall process the entire high energy charge amplifier range, i.e. nominally 100 GeV maximum energy.</p> <p>Level IV: 9.1.3.9      The HEX8 amplifier of the high energy channel shall process the lowest eighth of the high energy charge amplifier range, i.e. nominally 12.5 GeV maximum energy.</p>		
PREREQUISITES Calu_collect_ci		
REQUIRED EGSE LATTE (latest?) SciPy package Dislin package (if hardcopy plots are desired) LAT TestStand (includes TEM?) Calorimeter Schema describing Calorimeter (\$CAL_ROOT\FMx\Configurations\FMx_schema.xml)		
REQUIRED INPUT DATA OR FILES Schema describing Calorimeter: \$CAL_ROOT\FMx\Configurations\FMx_schema.xml 1  CAL Configuration file: \$CAL_ROOT\FMx\Configurations\calParams.cfg		GENERATED OUTPUT FILES Test Report: yymmddhhmmss_FMx_calf_gain_p02.htm 1
COMPLETION STATUSES		

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PASS IPASS (Incomplete Pass - partial system...only applicable to development phase) FAIL ABORT
DESCRIPTION <b>Algorithm</b> TBD
COMMENTS

**7.2.9. CAL Integral non-linearity**

Below is a draft of the CAL Integral non-linearity test procedures. It consists of 3 procedures;

Calu\_collect\_single16 to collect charge injected event data by column.

calf\_adc\_p02 to evaluate integral non-linearity, noise, and range coverage by channel.

calf\_adc\_p05 to evaluate droop

**7.2.9.1. CAL Integral non-linearity 1**

NAME calu_collect_ci_single16	TEST ID CAL	SVAC ID C20
ALIASES None	SUPERCEDES None	CATEGORY CAL
SYNOPSIS Collect event data generated using		
AUTHOR NRL/Code 7650/B. Leas		OWNER/MAINTAINER/CONTACT PERSON NRL/Code 7650/B. Leas
MOTIVATION Prerequisite for calf_adc procedures		
PREREQUISITES calu_init		
REQUIRED EGSE LATTE (latest?) SciPy package Dislin package (if hardcopy plots are desired) LAT TestStand (includes TEM?) Calorimeter Schema describing Calorimeter (\$CAL_ROOT\FMx\Configurations\FMx_schema.xml)		
REQUIRED INPUT DATA OR FILES	GENERATED OUTPUT FILES Test Report: yymmddhhmmss_FMx_calu_collect_ci_singlex16.html Register Snapshot: yymmddhhmmss_FMx_calu_collect_ci_singlex16.xml Events File: yymmddhhmmss_FMx_calu_collect_ci_single16.fits	
COMPLETION STATUSES PASS IPASS (Incomplete Pass - partial system...only applicable to development phase) FAIL ABORT		

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## DESCRIPTION

**Algorithm****Setup**

Obtain collection parameters (range order, channel columns, charge Injection DAC sequence, number of samples, gains)

**Collect data**

For each range order, (default ridx = 0)

For each column, (default colIdx = 0,11)

For each Charge Injection (CI) setting; cidx = bDAC, eDAC,iDAC (default cidx = 0,4096,16)

For N samples, sidx=0,199 (default = 200)

Use GLT self trigger to inject charge, delay, and read 4 range event data

Archive event

## COMMENTS

Charge Injection is done one column at a time to better simulate the operational environment. Events from simultaneous charge injection to multiple channels in a layer shows some dependency on number of channels injected.

**7.2.9.2. CAL Integral non-linearity 2**

NAME calf_adc_p02	TEST ID CAL	SVAC ID C20
ALIASES None	SUPERCEDES None	CATEGORY CAL
SYNOPSIS Evaluate channel integral non-linearity, noise, and energy range.		
AUTHOR NRL/Code 7650/B. Leas		OWNER/MAINTAINER/CONTACT PERSON NRL/Code 7650/B.Leas
MOTIVATION		
Level IV: 9.1	<b>a)</b> The GCFE shall perform spectroscopic measurements over a range from 0.4 MeV to 100 GeV... <b>c)</b> The dynamic range shall be divided into two independent signal chains, one for low energy range, one for the high energy range.	
Level IV: 9.1.1.1	The low energy charge amplifier shall process energy depositions in the 2 MeV to 1.6 GeV range. The characteristics of the inputs to the low energy range are summarized in Table 9.3.	
Level IV: 9.1.2.1	The high energy charge amplifier shall process energy depositions in the 100 MeV to 100 GeV range. The characteristics of the inputs to the low energy range are summarized in Table 9.3.	
Level IV: 9.1.11	The GCFE ASIC shall accept a precision calibration voltage from an external DAC as a reference voltage for a calibration charge injection system.	
Level IV: 9.1.11.1	The test charge injection system shall be capable of testing the entire dynamic range of the GCFE ASIC.	
Level IV: 9.1.3.6	The LEX1 amplifier of the low energy channel shall process the entire low energy charge amplifier range, i.e. nominally 1.6 GeV maximum energy.	
Level IV: 9.1.3.7	The LEX8 amplifier of the low energy channel shall process the lowest eighth of the low energy charge amplifier range, i.e. nominally 200 MeV maximum energy.	
Level IV: 9.1.3.8	The HEX1 amplifier of the high energy channel shall process the entire high energy charge amplifier range, i.e. nominally 100 GeV maximum energy.	
Level IV: 9.1.3.9	The HEX8 amplifier of the high energy channel shall process the lowest eighth of the high energy charge amplifier range, i.e. nominally 12.5 GeV maximum energy.	
Level IV: 9.1.5	The maximum non-linearity in each of the four ranges: LEX8, LEX1, HEX8, and HEX1 shall be 1% of full range.	
Level IV: 9.1.14.3	<b>a)</b> The output of the buffer amplifier for each of the four amplifier ranges shall be monotonically increasing with charge input over the top 99.9% of the energy range. <b>b)</b> The integral non-linearity shall be less than +/- 0.5% of full scale. This is the deviation of the best fit	

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straight line from the measured amplitudes over the top 99% of the energy range.	
Level IV: 9.2.1.3	The maximum non-linearity of the ADC shall be 0.5% of full range.
PREREQUISITES calu_collect_ci_singlex16 with full four range readout	
REQUIRED EGSE LATTE (latest?) SciPy package Dislin package (if hardcopy plots are desired) LAT TestStand (includes TEM?) Calorimeter Schema describing Calorimeter (\$CAL_ROOT\FMx\Configurations\FMx_schema.xml)	
REQUIRED INPUT DATA OR FILES Events File: yymmddhhmmss_FMx_calu_collect_ci_singlex16.fits  <b>Note: Tests can be run without the following information, but characterization in energy terms cannot be performed</b>  ADC to Energy Conversion Table.  Pedestals Table  Relative Gain Table	GENERATED OUTPUT FILES Test Report: yymmddhhmmss_FMx_calf_adc_p02.html  Noise Pedestals Table: yymmddhhmmss_FMx_pedestals.fits Noise Pedestal Statistics: yymmddhhmmss_FMx_pedestals_stats.csv
COMPLETION STATUSES PASS IPASS (Incomplete Pass - partial system...only applicable to development phase) FAIL ABORT	
DESCRIPTION <b>Algorithm</b> <i>Setup</i>  <i>Collect data</i> For each Charge Injection (CI) setting; cidx = bDAC, eDAC, iDAC (default cidx = 0,4096,16) For N samples, sidx=0,199 (default = 200) read 4 range event data, data[4,8,2,12,sidx] Compute Mean for each component and energy range, mean[4,8,2,12,cidx] Compute standard deviation for each component and energy range, noise[4,8,2,12,cidx] Check for railed component, if data = 0xfff, then upper limit (ul) = previous cidx Check for plateaued component, if mean[...:cidx] - mean[...:cidx-1] < tolerance, upper limit (ul) = previous cidx  <i>Analyze</i> Using least squares method, fit line to mean Generate distribution of deviation of mean values to fitted line, non-linearity measurements	

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Extract max non-linearity and average non-linearity and compare to criteria

Extract max noise and average noise measures from the noise distribution and compare to criteria

If gain of the component at which the data was taken the lowest setting and if the ADC to energy conversion table is available, then compute maximum energy value for each range and compare against criteria

COMMENTS

*Assumptions?*

1. To minimize mean and noise statistic skewing, this test defines the upper ADC range limit for any FE to be the maximum ADC mean value for which none of the samples contributing to this mean are railed ADC values (4096). The result of this definition is that "noisy" FEs may be assigned a lower maximum ADC value that affects the maximum energy determination.
2. For some FE energy ranges, the maximum input analog (reference DAC or Charge Injection) does not rail the ADC but instead the ADC result "plateaus" after some input analog interval. To make non-linearity evaluation practical, this test defines the upper ADC range limit for FE energy range in this case to be the maximum ADC mean value which does not deviate more than 10% from a line obtained from a linear fit of all the previous ADC mean values. The method for determining an upper limit will be referred to as the ADC "plateau" method.
3. The test for Integral non-linearity is not gain specific. To test integral non-linearity for a given gain involves collecting event data at the requested gain and then applying the integral non-linearity test procedure to that data. A "suite" for testing integral non-linearity over one or more gains can be formed by "chaining" test procedure `calf_adc_p02` along with `calu_collect_ci` for each gain setting. The report from that test would reference the individual `calu_collect_ci` and `calf_adc_p02` reports.

**7.2.10. Evaluate channel droop**

NAME calf_adc_p05	TEST ID CAL	SVAC ID
ALIASES None	SUPERCEDES None	CATEGORY CAL
SYNOPSIS Evaluate channel droop.		
AUTHOR NRL/Code 7650/B. Leas		OWNER/MAINTAINER/CONTACT PERSON NRL/Code 7650/B.Leas
MOTIVATION Level IV: 9.1.4.3      The T&H circuit shall be capable of holding a constant signal amplitude for > 100 usec with less than 0.1% droop for a signal amplitude dynamic range of 500 (TBR).		
PREREQUISITES calu_collect_ci_singlex16 with full four range readout and all 4 range first combinations.		
REQUIRED EGSE LATTE (latest?) SciPy package Dislin package (if hardcopy plots are desired) LAT TestStand (includes TEM?) Calorimeter Schema describing Calorimeter (\$CAL_ROOT\FMx\Configurations\FMx_schema.xml)		
REQUIRED INPUT DATA OR FILES Events File: yymmddhhmss_FMx_calu_collect_ci_singlex16.fits  Note: Tests can be run without the following information, but characterization in energy terms cannot be performed  ADC to Energy Conversion Table.  Pedestals Table  Relative Gain Table		GENERATED OUTPUT FILES Test Report: yymmddhhmss_FMx_calf_adc_p03.html  Plots file: yymmddhhmss_FMx_calf_adc_p03.pdf
COMPLETION STATUSES PASS IPASS (Incomplete Pass - partial system...only applicable to development phase) FAIL ABORT		
DESCRIPTION <b>Algorithm Setup</b>		

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**Collect data**

For each Range order, ridx = 0,3

For each Charge Injection (CI) setting; cidx = bDAC, eDAC, iDAC (default cidx = 0,4096,16)

For N samples, sidx=0,199 (default = 200)

read 4 range event data, data[4,8,2,12,ridx,sidx]

Compute Mean for each component and energy range, mean[4,8,2,12,cidx]

Compute standard deviation for each component and energy range, noise[4,8,2,12,cidx]

Check for railed component, *if data = 0xffff, then upper limit (ul) = previous cidx*

Check for plateaued component, *if mean[...cidx] - mean[...cidx-1] < tolerance, upper limit (ul) = previous cidx*

**Analyze**

Normalize means.

Compare normalized range order mean value differences to criteria.

## COMMENTS

**Assumptions?**

1. Processing each range of a four range readout requires approximately 14 usec at a clock frequency of 20 Mhz. This time factor is assumed in the droop evaluation algorithm and means that a droop check over more than 56 usec with this test is not possible.

**7.2.11. CAL Noisy Channels**

NAME	TEST ID CAL	SVAC ID C22
ALIASES None	SUPERCEDES None	CATEGORY CAL
SYNOPSIS Manual procedure to generate/update CAL noisy channels list		
AUTHOR NRL/Code 7650/B. Leas		OWNER/MAINTAINER/CONTACT PERSON NRL/Code 7650/B.Leas
MOTIVATION SVAC C22		
PREREQUISITES Calf_adc_p02 Calf_trg_p03 Calf_supp_p01		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Yymmddhhmmss_FMx_calf_adc_p02.html Yymmddhhmmss_FMx_calf_supp_p01.html Yymmddhhmmss_FMx_calf_trg_p03.html		GENERATED OUTPUT FILES CAL Noisy Channel File: Yymmddhhmmss_calu_noisy_channel_list.xml (actual format TBD)
COMPLETION STATUSES Not Applicable (manual procedure)		
DESCRIPTION This is a manual procedure (for now) <ol style="list-style-type: none"> <li>1. Evaluate Yymmddhhmmss_FMx_calf_adc_p02.html reports for noisy channels and add them to noisy channel list</li> <li>2. Evaluate Yymmddhhmmss_FMx_calf_supp_p01.html reports for channels which do not suppress data over a required range and add them to the noisy channel list for at least the LEX8 energy channel and possibly more.</li> <li>3. Evaluate Yymmddhhmmss_FMx_calf_trg_p03.html reports for channels which do not trigger data over a required range and add them to the noisy channel list for at least the LEX8 energy channel and possibly more.</li> </ol>		
COMMENTS <ol style="list-style-type: none"> <li>1. CAL defines a channel to be one energy range from a crystal front end (FE). Therefore each crystal FE represents 4 channels for a total of 768 channels per Calorimeter (4 x 8 x 2 x 12).</li> <li>2. Format of CAL's contribution to the noisy channel file needs to be defined.</li> </ol>		

**7.2.12. CAL Dead Channels**

NAME	TEST ID CAL	SVAC ID C23
ALIASES None	SUPERCEDES None	CATEGORY CAL
SYNOPSIS Manual procedure to generate/update CAL dead channels list		
AUTHOR NRL/Code 7650/B. Leas		OWNER/MAINTAINER/CONTACT PERSON NRL/Code 7650/B.Leas
MOTIVATION SVAC C23		
PREREQUISITES Calf_adc_p02 Calf_exr_p01		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Yymmddhhmmss_FMX_calf_adc_p02.html Yymmddhhmmss_FMX_calf_exr_p01.html		GENERATED OUTPUT FILES CAL Dead Channel File: Yymmddhhmmss_calu_dead_channels_list.xml (actual format TBD)
COMPLETION STATUSES Not Applicable (manual procedure)		
DESCRIPTION This is a manual procedure (for now) 4. Evaluate Yymmddhhmmss_FMX_calf_adc_p02.html reports for unresponsive channels and add them to dead channel list 5. Evaluate Yymmddhhmmss_FMX_calf_exr_p01.html reports for commanding problems and add them to the dead channel list.		
COMMENTS 3. CAL defines a channel to be one energy range from a crystal front end (FE). Therefore each crystal FE represents 4 channels for a total of 768 channels per Calorimeter (4 x 8 x 2 x 12). 4. Format of CAL's contribution to the dead channel file needs to be defined.		

**7.2.13. CAL LO Discriminator**

Attached is a draft of the CAL LO Discriminator procedures. It consists of 5 procedures; cal\_f\_trg\_p03 to characterize the Low Energy Discriminator DAC calu\_genFleTable to use that characterization table to produce an FLE trigger threshold table cal\_f\_trg\_p05 to generate an FLE trigger threshold table based on noise pedestals cal\_f\_trg\_p01 to evaluate the independence of the trigger enable/disable logic cal\_f\_trg\_p04 to characterize and evaluate the trigger arrival time behavior

calu\_genLacTable is dependent on cal\_f\_supp\_p01 as stated in its prerequisites

The same issues that Eduardo had with the zero data-suppression procedures also exist with these procedures.

**7.2.13.1. CAL LO Discriminator 1**

NAME CALF_TRG_P03	TEST ID CAL	SVAC ID C24
ALIASES None	SUPERCEDES None	CATEGORY CAL
SYNOPSIS Characterize the CAL Low Energy Discriminator wrt ADC settings		
AUTHOR NRL/Code 7650/B. Leas		OWNER/MAINTAINER/CONTACT PERSON NRL/Code 7650/B.Leas
MOTIVATION  Level III: 5.9            Low Energy Trigger Signal: CAL to provide low energy trigger signal to the LAT trigger system..  Level IV: 9.1.10        The outputs of the two 0.5 usec shaping amplifiers (FHE and FLE) are connected to discriminators. The two outputs of the trigger discriminators logic are provided to external logic which forms the calorimeter trigger request inputs to the GLAST trigger system.  Level IV: 9.1.10.3     The low energy trigger (FLE) discriminator level shall be adjustable by command input to DACs inside the ASIC. Two adjustment ranges shall be provided: lowest energies (<~60 MeV) with ~ 1 MeV resolution and moderate energies (<~400 MeV) with ~ 5 MeV resolution.		
PREREQUISITES CALU_INIT		
REQUIRED EGSE LATTE (latest?) SciPy package Dislin package (if hardcopy plots are desired) LAT TestStand (includes TEM?) Calorimeter Schema describing Calorimeter (\$CAL_ROOT\FMx\Configurations\FMx_schema.xml)		
REQUIRED INPUT DATA OR FILES		GENERATED OUTPUT FILES Test Report:

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**7.2.13.2. CAL LO Discriminator 2**

NAME calu_genFleTable	TEST ID CAL	SVAC ID C26
ALIASES None	SUPERCEDES None	CATEGORY CAL
SYNOPSIS Generate an appropriate Low Energy Discriminator threshold Table given a "target" threshold energy using an appropriate FLE Discriminator Characterization Table		
AUTHOR NRL/Code 7650/B. Leas		OWNER/MAINTAINER/CONTACT PERSON NRL/Code 7650/B.Leas
MOTIVATION LAT-MD-0446-05 GLAST LAT Science Verification Analysis and Calibration (SVAC) Plan, section 5.3 SVAC Compliance, Table item C24		
PREREQUISITES CALF_TRG_P03		
REQUIRED EGSE LATTE (latest?) SciPy package Dislin package (if hardcopy plots are desired) LAT TestStand (includes TEM?) Calorimeter Schema describing Calorimeter (\$CAL_ROOT\FMx\Configurations\FMx_schema.xml)		
REQUIRED INPUT DATA OR FILES ADC to Energy Conversion Table.  Pedestals Table  Relative Gain Table  calParams.cfg (Calorimeter environment configuration file)		GENERATED OUTPUT FILES FLE Trigger Threshold Table: yymmddhhmmss_FMx_fle.xml
COMPLETION STATUSES PASS IPASS (Incomplete Pass - partial system...only applicable to development phase)  FAIL ABORT		
DESCRIPTION <b>Setup:</b> <b>Read fle2adc characterization table</b> Read ADC 2 Energy Conversion table Read relative gain table		

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Obtain (from operator?) energy (MeV) to use for data suppression threshold

Obtain (from operator?) LE gain to be used.

**Process:**

Using the relative gain table, adjust the fle2dac characterization values to the requested gain.

Using the relative gain table, adjust the Energy to ADC conversion table to reflect the requested gain.

Using the adjusted Energy to ADC conversion table, convert the fle2dac characterization table to anfle2nrg (FLE to Energy) characterization table.

For each FE, find the minimum FLE setting whose corresponding energy in the fle2nrg characterization table is above the request energy threshold (FLE trigger threshold table, FLEThreshold[4,8,2,12])

**Save FLE trigger threshold table**

Save threshold table, FLEThreshold[4,8,2,12], in xml format to file with appropriate documentation to include:

- Requested Energy Threshold
- Requested Gain
- FLE to ADC characterization table filename
- ADC to Energy conversion table filename
- Relative gain table filename
- Data generated
- Application Name "calu\_genFleTable"

COMMENTS

**7.2.13.3. CAL LO Discriminator 3**

NAME CALF_TRG_P01	TEST ID CAL	SVAC ID C24
ALIASES None	SUPERCEDES None	CATEGORY CAL
SYNOPSIS Test trigger enable/disables for functionality and independent operation.		
AUTHOR NRL/Code 7650/B. Leas		OWNER/MAINTAINER/CONTACT PERSON NRL/Code 7650/B.Leas
MOTIVATION Level III: 5.9      Low Energy Trigger Signal: CAL to provide low energy trigger signal to the LAT trigger system..  Level IV: 9.1.10.2      Each of the two trigger signals shall be individually enabled or disabled by command input to the ASIC.		
PREREQUISITES calu_init		
REQUIRED EGSE LATTE (latest?) SciPy package Dislin package (if hardcopy plots are desired) LAT TestStand (includes TEM?) Calorimeter Schema describing Calorimeter (\$CAL_ROOT\FMx\Configurations\FMx_schema.xml)		
REQUIRED INPUT DATA OR FILES	GENERATED OUTPUT FILES Test Report: yymmddhhmmss_FMx_calf_trg_p01.html Register Snapshot: yymmddhhmmss_FMx_calf_trg_p01.xml Trigger Enable Table: Yymmddhhmmss_FMx_calu_trg.xml	
COMPLETION STATUSES PASS IPASS (Incomplete Pass - partial system...only applicable to development phase) FAIL ABORT		
DESCRIPTION <b>Setup:</b> Nominal with the following changes: Tack Delay setting = CI_TIMED_PEAK GLT trigger mask = Disabled Enable LRS counting for everything (lrs_counter_mask = 0) <b>Process:</b>		

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Sequence thru each FE (all TEMs at once)

```

temb = lat.allTEM()
For trgMode (0=LE triggers, 1 = HE trigger)
  For ccIdx=0 to 3
    cc = temb.downCCC(ccIdx)
    If cc is valid
      For rcIdx=0 to 3
        rc = cc.downCRC(rcIdx)
        If rc is valid
          For feIdx=0 to 3
            fe = rc.downCFE(feIdx)
            if fe is valid
              Clear lrs_counters (broadcast temb.gtic.lrs_counters=0)
              Verify counters are zeros
              For temIdx=0 to 15
                If lat.downTEM(temIdx).downTIC().lrs_counters <>0
                  Passflag[trgMode,[temIdx,ccIdx,rcIdx,feIdx]]=FAILED
              Enable trigger (fe.config_1 = 0x380 | trgMode <<1)
              Inject Charge (rc.calStrobe=1)
              Wait for fast shaper peak logic to complete (.01 seconds)
              Read and verify trigger counters
              For temIdx=0 to 15
                If lat.downTEM(temIdx).downTIC().lrs_counters <=0
                  Passflag[trgMode,temIdx,ccIdx,rcIdx,feIdx]=FAILED
                If lat.downTEM(temIdx).downTIC().lrs_counters >1
                  MultipleTriggerflag[trgMode,temIdx,ccIdx,rcIdx,feIdx]=TRUE
              Clear lrs_counters (broadcast temb.gtic.lrs_counters=0)
              Verify counters are zeros
              For temIdx=0 to 15
                If lat.downTEM(temIdx).downTIC().lrs_counters <>0
                  Passflag[trgMode,[temIdx,ccIdx,rcIdx,feIdx]]=FAILED
              Disable trigger (fe.config_1 = 0x380)
              Inject Charge (rc.calStrobe=1)
              Wait for fast shaper peak logic to complete (.01 seconds)
              Read and verify trigger counters
              For temIdx=0 to 15
                If lat.downTEM(temIdx).downTIC().lrs_counters >0
                  Passflag[trgMode,temIdx,ccIdx,rcIdx,feIdx]=FAILED

```

COMMENTS

**7.2.13.4. CAL LO Discriminator 4**

NAME CALF_TRG_P04	TEST ID CAL	SVAC ID C24
ALIASES None	SUPERCEDES None	CATEGORY CAL
SYNOPSIS Characterize trigger arrival time		
AUTHOR NRL/Code 7650/B. Leas		OWNER/MAINTAINER/CONTACT PERSON NRL/Code 7650/B.Leas
MOTIVATION Level III: 5.9      Low Energy Trigger Signal: CAL to provide low energy trigger signal to the LAT trigger system.. Level IV: 9.1.3.1      The low energy fast shaped signals shall peak at 0.5 +/- 0.2 usec. Level IV: 9.1.10.1      The variation in time of the leading edge of the trigger output from the time of energy deposition shall be less than +/- 0.2 usec.		
PREREQUISITES calu_init		
REQUIRED EGSE LATTE (latest?) SciPy package Dislin package (if hardcopy plots are desired) LAT TestStand (includes TEM?) Calorimeter Schema describing Calorimeter (\$CAL_ROOT\FMx\Configurations\FMx_schema.xml)		
REQUIRED INPUT DATA OR FILES CI_TIMED_TRIGGER (expected trigger primitive present Tack delay value for timed Charge Injection stimulus) <b>Note: Tests can be run without the above mentioned information, but characterization in energy terms cannot be performed</b>		GENERATED OUTPUT FILES Test Report: yymmddhhmmss_FMx_calf_trg_p04.html Register Snapshot: yymmddhhmmss_FMx_calf_trg_p04.xml Events File: yymmddhhmmss_FMx_calf_trg_p04.fits
COMPLETION STATUSES PASS IPASS (Incomplete Pass - partial system...only applicable to development phase) FAIL ABORT		
DESCRIPTION <b>Setup:</b> Nominal with the following changes:		

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Tack Delay setting = CI\_TIMED\_PEAK  
 Setup for trigger primitive acquisition  
 Use one range readout suppressed data mode

**Collect Data:**

For temIdx=0 to 15

For feIdx=0 to 11

Enable triggers for this "column" of FEs (lat.downTEM(temIdx).allCCC().allCRC(),downCFE(feIdx).config\_1=0x3E)

For tackDelaySetting = 0 to 255

Set tack delay (tem.cal\_trgSeq = tackDelaySetting)

For nsamples

Use Timed trigger to inject charge and acquire event data

Decom event data and get trigger primitive state

Count triggers (increment triggers[temIdx,trgIdx,ccIdx,rcIdx,endIdx,feIdx,tackDelaySetting])

**Process Data:**

Convert trigger count array into trigger percentage (trgPct=triggers[...]/nsamples)

Convert trgPct array to triggered array (trgd[...] = 1 if trgPct[...] > 90%)

Look for "dropouts"

Generate distribution of trigger tack delays (trgTime[...] = min(where trgd[...]>0])

Compute the mode of the triggered tack delay times (trgMode = stats.mode(trgTime))

Compare mode to expected value (if abs(trgMode - CI\_TIMED\_TRIGGER) > tolerance then FAILED)

Compare each FEs triggered time to trgMode (if abs(trgTime[...] - trgMode) > .2usec then FAILED)

Convert trgPct array to untriggered array (untrgd[...] = 1 if trgPct[...] < 10%)

Look for "dropouts"

Generate distribution of untrigger tack delays (untrgTime[...] = max(where untrgd[...]>1])

Generate distribution of trigger uncertainty times (diff = trgTime[] - untrgTime[])

Compute mean and standard deviation of trigger uncertainty time and evaluate individual FE responses based on these statistics

COMMENTS

**7.2.13.5. CAL LO Discriminator 5**

NAME CALF_TRG_P05	TEST ID CAL	SVAC ID C24
ALIASES None	SUPERCEDES None	CATEGORY CAL
SYNOPSIS Generate an FLE trigger discriminator table using noise pedestals as thresholds.		
AUTHOR NRL/Code 7650/B. Leas		OWNER/MAINTAINER/CONTACT PERSON NRL/Code 7650/B.Leas
MOTIVATION LAT-MD-0446-05 GLAST LAT Science Verification Analysis and Calibration (SVAC) Plan, section 5.3 SVAC Compliance, Table item C24		
PREREQUISITES calu_init		
REQUIRED EGSE LATTE (latest?) SciPy package Dislin package (if hardcopy plots are desired) LAT TestStand (includes TEM?) Calorimeter Schema describing Calorimeter (\$CAL_ROOT\FMx\Configurations\FMx_schema.xml)		
REQUIRED INPUT DATA OR FILES ADC to Energy Conversion Table.  Pedestals Table  Relative Gain Table  <b>Note: Tests can be run without the above mentioned information, but characterization in energy terms cannot be performed</b>		GENERATED OUTPUT FILES Test Report: yymmddhhmss_FMx_calf_trg_p05.html Register Snapshot: yymmddhhmss_FMx_calf_trg_p05.xml Events File: yymmddhhmss_FMx_calf_trg_p05.fits FLE Trigger Noise Pedestal Threshold Discriminator Table: yymmddhhmss_FMx_calu_fle.xml
COMPLETION STATUSES PASS IPASS (Incomplete Pass - partial system...only applicable to development phase)  FAIL ABORT		
DESCRIPTION TBD		

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COMMENTS
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### 7.2.14. CAL HI Discriminator

Below is a draft of the CAL HI Discriminator procedures. It consists of 5 procedures;  
 cal\_f\_trg\_p03 to characterize the High Energy Discriminator DAC  
 calu\_genFheTable to use that characterization table to produce an FHE trigger threshold table  
 cal\_f\_trg\_p05 to generate an FHE trigger threshold table based on noise pedestals  
 cal\_f\_trg\_p01 to evaluate the independence of the trigger enable/disable logic  
 cal\_f\_trg\_p04 to characterize and evaluate the trigger arrival time behavior

calu\_genFheTable is dependent on cal\_f\_trg\_p03 as stated in its prerequisites

As you can see, the same procedures are used for low and high energy trigger processing. The procedures are written to allow processing low and/or high triggers.

#### 7.2.14.1. CAL HI Discriminator 1

NAME CALF_TRG_P03	TEST ID CAL	SVAC ID C24
ALIASES None	SUPERCEDES None	CATEGORY CAL
SYNOPSIS Characterize the CAL High Energy Discriminator wrt ADC settings		
AUTHOR NRL/Code 7650/B. Leas		OWNER/MAINTAINER/CONTACT PERSON NRL/Code 7650/B.Leas
MOTIVATION <p>Level III: 5.10      High Energy Trigger Signal: CAL to provide high energy trigger signal to the LAT trigger system.</p> <p>Level IV: 9.1.10.4      The high energy trigger (FHE) discriminator level shall be adjustable by command input to DACs inside the ASIC. The range of adjustment shall include the lowest 25% of the high energy charge amplifier range (&lt;~25 GeV) and have ~ 200 MeV resolution.</p>		
PREREQUISITES CALU_INIT		
REQUIRED EGSE LATTE (latest?) SciPy package Dislin package (if hardcopy plots are desired) LAT TestStand (includes TEM?) Calorimeter Schema describing Calorimeter (\$CAL_ROOT\FMx\Configurations\FMx_schema.xml)		
REQUIRED INPUT DATA OR FILES ADC to Energy Conversion Table. Pedestals Table Relative Gain Table	GENERATED OUTPUT FILES Test Report: yymddhhmss_FMx_cal_f_trg_p03.html Register Snapshot: yymddhhmss_FMx_cal_f_trg_p03.xml FHE to ADC conversion Table: yymddhhmss_FMx_fhe2dac.fits	

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<p>Note: Tests can be run without the above mentioned information, but characterization in energy terms cannot be performed</p>	<p>FHE DAC characterization Plots: yymmddhhmmss_FMx_calf_trg_p03.pdf</p>
<p>COMPLETION STATUSES</p> <p>PASS</p> <p>IPASS (Incomplete Pass - partial system...only applicable to development phase)</p> <p>FAIL</p> <p>ABORT</p>	
<p>DESCRIPTION</p> <p><b>Setup:</b></p> <p>Nominal with the following changes:</p> <p>Tack Delay setting = CI_TIMED_PEAK</p> <p>GLT data suppress = TRUE</p> <p>Gain setting = Nominal</p> <p><b>Collect FLE/FHE DAC characterization data</b></p> <p>For each of 2 cases (case 0 = FLE DAC) (case 1 = FHE DAC)</p> <p>For each FST DAC setting, <i>fstDacidx</i> = 0 to 127 default</p> <p>For each column, <i>colidx</i> = 0 to 11</p> <p>For each charge injection (CI) setting, <i>cidx</i>=0 to 4095 and component are still suppressed</p> <p>For N samples, <i>sidx</i> = 0 to ? default = 0</p> <p>Use GLT self trigger to inject charge, delay, read event data with trigger primitive diagnostic data</p> <p>If 90% of the samples had triggers from a component and , <i>adc</i>[<i>fstDacidx</i>,4,8,2,12]=<i>adc</i></p> <p>Save FST to ADC conversion table, <i>adc</i>[128,4,8,2,12], in FITS format to file</p> <p><b>Validate FST DAC operation against criteria</b></p> <p>Check range and resolution against criteria (by using low energy lowest gain setting or by converting collected ADC data to lowest gain equivalent)</p> <p>Check linearity of DAC?</p>	
<p>COMMENTS</p>	

**7.2.14.2. CAL HI Discriminator 2**

NAME calu_genFheTable	TEST ID CAL	SVAC ID C26
ALIASES None	SUPERCEDES None	CATEGORY CAL
SYNOPSIS Generate an appropriate High Energy Discriminator threshold Table given a “target” threshold energy using an appropriate FHE Discriminator Characterization Table		
AUTHOR NRL/Code 7650/B. Leas		OWNER/MAINTAINER/CONTACT PERSON NRL/Code 7650/B.Leas
MOTIVATION LAT-MD-0446-05 GLAST LAT Science Verification Analysis and Calibration (SVAC) Plan, section 5.3 SVAC Compliance, Table item C24		
PREREQUISITES CALF_TRG_P03		
REQUIRED EGSE LATTE (latest?) SciPy package Dislin package (if hardcopy plots are desired) LAT TestStand (includes TEM?) Calorimeter Schema describing Calorimeter (\$CAL_ROOT\FMx\Configurations\FMx_schema.xml)		
REQUIRED INPUT DATA OR FILES ADC to Energy Conversion Table.  Pedestals Table  Relative Gain Table  calParams.cfg (Calorimeter environment configuration file)		GENERATED OUTPUT FILES FHE Trigger Threshold Table: yymmddhhmss_FMx_calu_fhe.xml
COMPLETION STATUSES PASS IPASS (Incomplete Pass - partial system...only applicable to development phase)  FAIL ABORT		
DESCRIPTION <i>Setup:</i> <b>Read fhe2adc characterization table</b> Read ADC 2 Energy Conversion table Read relative gain table		

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Obtain (from operator?) energy (MeV) to use for data suppression threshold

Obtain (from operator?) HE gain to be used.

**Process:**

Using the relative gain table, adjust the fhe2dac characterization values to the requested gain.

Using the relative gain table, adjust the Energy to ADC conversion table to reflect the requested gain.

Using the adjusted Energy to ADC conversion table, convert the fhe2dac characterization table to anfhe2nrg (FHE to Energy) characterization table.

For each FE, find the minimum FHE setting whose corresponding energy in the fhe2nrg characterization table is above the request energy threshold (FHE trigger threshold table, FHETHreshold[4,8,2,12])

**Save FHE trigger threshold table**

Save threshold table, FHETHreshold[4,8,2,12], in xml format to file with appropriate documentation to include:

- Requested Energy Threshold
- Requested Gain
- FHE to ADC characterization table filename
- ADC to Energy conversion table filename
- Relative gain table filename
- Data generated
- Application Name "calu\_genFheTable"

COMMENTS

**7.2.14.3. CAL HI Discriminator 3**

NAME CALF_TRG_P01	TEST ID CAL	SVAC ID C24
ALIASES None	SUPERCEDES None	CATEGORY CAL
SYNOPSIS Test trigger enable/disables for functionality and independent operation.		
AUTHOR NRL/Code 7650/B. Leas		OWNER/MAINTAINER/CONTACT PERSON NRL/Code 7650/B.Leas
MOTIVATION Level III: 5.10 High Energy Trigger Signal: CAL to provide high energy trigger signal to the LAT trigger system. Level IV: 9.1.10.2 Each of the two trigger signals shall be individually enabled or disabled by command input to the ASIC.		
PREREQUISITES calu_init		
REQUIRED EGSE LATTE (latest?) SciPy package Dislin package (if hardcopy plots are desired) LAT TestStand (includes TEM?) Calorimeter Schema describing Calorimeter (\$CAL_ROOT\FMx\Configurations\FMx_schema.xml)		
REQUIRED INPUT DATA OR FILES	GENERATED OUTPUT FILES Test Report: yymmddhhmmss_FMx_calf_trg_p01.html Register Snapshot: yymmddhhmmss_FMx_calf_trg_p01.xml Trigger Enable Table: Yymmddhhmmss_FMx_calu_trg.xml	
COMPLETION STATUSES PASS IPASS (Incomplete Pass - partial system...only applicable to development phase) FAIL ABORT		
DESCRIPTION <b>Setup:</b> Nominal with the following changes: Tack Delay setting = CI_TIMED_PEAK GLT trigger mask = Disabled Enable LRS counting for everything (lrs_counter_mask = 0) <b>Process:</b>		

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**Sequence thru each FE (all TEMs at once)**

```

temb = lat.allTEM()
For trgMode (0=LE triggers, 1 = HE trigger)
  For ccIdx=0 to 3
    cc = temb.downCCC(ccIdx)
    If cc is valid
      For rcIdx=0 to 3
        rc = cc.downCRC(rcIdx)
        If rc is valid
          For feIdx=0 to 3
            fe = rc.downCFE(feIdx)
            if fe is valid
              Clear lrs_counters (broadcast temb.gtic.lrs_counters=0)
              Verify counters are zeros
              For temIdx=0 to 15
                If lat.downTEM(temIdx).downTIC().lrs_counters <>0
                  Passflag[trgMode,[temIdx,ccIdx,rcIdx,feIdx]]=FAILED
              Enable trigger (fe.config_1 = 0x380 | trgMode <<1)
              Inject Charge (rc.calStrobe=1)
              Wait for fast shaper peak logic to complete (.01 seconds)
              Read and verify trigger counters
              For temIdx=0 to 15
                If lat.downTEM(temIdx).downTIC().lrs_counters <=0
                  Passflag[trgMode,temIdx,ccIdx,rcIdx,feIdx]=FAILED
                If lat.downTEM(temIdx).downTIC().lrs_counters >1
                  MultipleTriggerflag[trgMode,temIdx,ccIdx,rcIdx,feIdx]=TRUE
              Clear lrs_counters (broadcast temb.gtic.lrs_counters=0)
              Verify counters are zeros
              For temIdx=0 to 15
                If lat.downTEM(temIdx).downTIC().lrs_counters <>0
                  Passflag[trgMode,[temIdx,ccIdx,rcIdx,feIdx]]=FAILED
              Disable trigger (fe.config_1 = 0x380)
              Inject Charge (rc.calStrobe=1)
              Wait for fast shaper peak logic to complete (.01 seconds)
              Read and verify trigger counters
              For temIdx=0 to 15
                If lat.downTEM(temIdx).downTIC().lrs_counters >0
                  Passflag[trgMode,temIdx,ccIdx,rcIdx,feIdx]=FAILED

```

COMMENTS

**7.2.14.4. CAL HI Discriminator 4**

NAME CALF_TRG_P04	TEST ID CAL	SVAC ID C24
ALIASES None	SUPERCEDES None	CATEGORY CAL
SYNOPSIS Characterize trigger arrival time		
AUTHOR NRL/Code 7650/B. Leas		OWNER/MAINTAINER/CONTACT PERSON NRL/Code 7650/B.Leas
MOTIVATION <p>Level IV: 9.1.3.3      The high energy fast shaped signals shall peak at 0.5 +/- 0.2 usec.</p> <p>Level IV: 9.1.10      The outputs of the two 0.5 usec shaping amplifiers (FHE and FLE) are connected to discriminators. The two outputs of the trigger discriminators logic are provided to external logic which forms the calorimeter trigger request inputs to the GLAST trigger system.</p> <p>Level IV: 9.1.10.1      The variation in time of the leading edge of the trigger output from the time of energy deposition shall be less than +/- 0.2 usec.</p> <p>Level IV: 9.5      The calorimeter shall provide a prompt (within 2 us of an event) high-energy trigger signal with a detection efficiency of 90% (TBR) for 50 GeV gamma rays entering the calorimeter from the LAT field of view with a trajectory which traverses at least 8 RL of Csl.</p>		
PREREQUISITES calu_init		
REQUIRED EGSE LATTE (latest?) SciPy package Dislin package (if hardcopy plots are desired) LAT TestStand (includes TEM?) Calorimeter Schema describing Calorimeter (\$CAL_ROOT\FMx\Configurations\FMx_schema.xml)		
REQUIRED INPUT DATA OR FILES CL_TIMED_TRIGGER (expected trigger primitive present Tack delay value for timed Charge Injection stimulus) <b>Note: Tests can be run without the above mentioned information, but characterization in energy terms cannot be performed</b>	GENERATED OUTPUT FILES Test Report: yymmddhhmmss_FMx_calf_trg_p04.html Register Snapshot: yymmddhhmmss_FMx_calf_trg_p04.xml Events File: yymmddhhmmss_FMx_calf_trg_p04.fits	
COMPLETION STATUSES PASS IPASS (Incomplete Pass - partial system...only applicable to development		

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<p>phase)</p> <p>FAIL</p> <p>ABORT</p>
<p>DESCRIPTION</p> <p><b>Setup:</b></p> <p>Nominal with the following changes:</p> <ul style="list-style-type: none"> <li>Tack Delay setting = CI_TIMED_PEAK</li> <li>Setup for trigger primitive acquisition</li> <li>Use one range readout suppressed data mode</li> </ul> <p><b>Collect Data:</b></p> <p>For temIdx=0 to 15</p> <p>For feIdx=0 to 11</p> <p>Enable triggers for this "column" of FEs (lat.downTEM(temIdx).allCCC().allCRC().downCFE(feIdx).config_1=0x3E)</p> <p>For tackDelaySetting = 0 to 255</p> <ul style="list-style-type: none"> <li>Set tack delay (tem.cal_trgSeq = tackDelaySetting)</li> </ul> <p>For nsamples</p> <ul style="list-style-type: none"> <li>Use Timed trigger to inject charge and acquire event data</li> <li>Decom event data and get trigger primitive state</li> <li>Count triggers (increment triggers[temIdx,trgIdx,ccIdx,rcIdx,endIdx,feIdx,tackDelaySetting])</li> </ul> <p><b>Process Data:</b></p> <p>Convert trigger count array into trigger percentage (trgPct=triggers[...]/nsamples)</p> <p>Convert trgPct array to triggered array ( trgd[...] = 1 if trgPct[...] &gt; 90%)</p> <p>Look for "dropouts"</p> <p>Generate distribution of trigger tack delays (trgTime[...] = min(where trgd[...]&gt;0])</p> <p>Compute the mode of the triggered tack delay times (trgMode =stats.mode(trgTime))</p> <p>Compare mode to expected value (if abs(trgMode -CI_TIMED_TRIGGER) &gt; tolerance then FAILED)</p> <p>Compare each FEs triggered time to trgMode (if abs(trgTime[...] -trgMode)&gt;.2usec then FAILED)</p> <p>Convert trgPct array to untriggered array(untrgd[...] = 1 if trgPct[...] &lt; 10%)</p> <p>Look for "dropouts"</p> <p>Generate distribution of untrigger tack delays (untrgTime[...] = max(where trgd[...]&gt;1])</p> <p>Generate distribution of trigger uncertainty times ( diff = trgTime[] -untrgTime[])</p> <p>Compute mean and standard deviation of trigger uncertainty time and evaluate individual FE responses based on these statistics</p>
<p>COMMENTS</p>

**7.2.14.5. CAL HI Discriminator 5**

NAME CALF_TRG_P05	TEST ID CAL	SVAC ID C24
ALIASES None	SUPERCEDES None	CATEGORY CAL
SYNOPSIS Generate an FHE trigger discriminator table using noise pedestals as thresholds.		
AUTHOR NRL/Code 7650/B. Leas		OWNER/MAINTAINER/CONTACT PERSON NRL/Code 7650/B.Leas
MOTIVATION LAT-MD-0446-05 GLAST LAT Science Verification Analysis and Calibration (SVAC) Plan, section 5.3 SVAC Compliance, Table item C24		
PREREQUISITES calu_init		
REQUIRED EGSE LATTE (latest?) SciPy package Dislin package (if hardcopy plots are desired) LAT TestStand (includes TEM?) Calorimeter Schema describing Calorimeter (\$CAL_ROOT\FMx\Configurations\FMx_schema.xml)		
REQUIRED INPUT DATA OR FILES ADC to Energy Conversion Table.  Pedestals Table  Relative Gain Table  <b>Note: Tests can be run without the above mentioned information, but characterization in energy terms cannot be performed</b>		GENERATED OUTPUT FILES Test Report: yymmddhhmss_FMx_calf_trg_p05.html Register Snapshot: yymmddhhmss_FMx_calf_trg_p05.xml Events File: yymmddhhmss_FMx_calf_trg_p05.fits FHE Trigger Noise Pedestal Threshold Discriminator Table: yymmddhhmss_FMx_calu_fhe.xml
COMPLETION STATUSES PASS IPASS (Incomplete Pass - partial system...only applicable to development phase) FAIL ABORT		
DESCRIPTION TBD		

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COMMENTS
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**7.2.15. CAL Zero-Suppress Thresh.**

Below is a draft of the CAL zero-suppress threshold procedures. It consists of 3 procedures; calf\_supp\_p01 to characterize the data suppress DAC  
calu\_genLacTable to use that characterization table to produce a threshold table  
calf\_supp\_p02 to generate a noise pedestal threshold table

calu\_genLacTable is dependent on calf\_supp\_p01 as stated in its prerequisites

**7.2.15.1. CAL Zero-Suppress Thresh. 1**

NAME CALF_SUPP_P01	TEST ID CAL	SVAC ID C26
ALIASES None	SUPERCEDES None	CATEGORY CAL
SYNOPSIS Characterize the Log Accept Discriminator wrt ADC settings		
AUTHOR NRL/Code 7650/B. Leas		OWNER/MAINTAINER/CONTACT PERSON NRL/Code 7650/B.Leas
MOTIVATION Level IV: 9.1.9.1 The amplitude of the LEX8 output shall be compared with a programmable threshold, the accept lower level discriminator, to identify CsI crystals with measurable energy depositions. This crystal-accept signal shall be transmitted to external logic for determination of crystals to be included in the event readout message. Level IV: 9.1.9.2 The accept discriminator level shall be adjustable by command to the ASIC a) with adjustment resolution of ~0.25 MeV b) over the lowest approximately 10% of the LEX8 energy range.		
PREREQUISITES CALU_INIT		
REQUIRED EGSE LATTE (latest?) SciPy package Dislin package (if hardcopy plots are desired) LAT TestStand (includes TEM?) Calorimeter Schema describing Calorimeter (\$CAL_ROOT\FMx\Configurations\FMx_schema.xml)		
REQUIRED INPUT DATA OR FILES  ADC to Energy Conversion Table.  Pedestals Table  Relative Gain Table  <b>Note: Tests can be run without the above mentioned information, but characterization in energy terms cannot be performed</b>	GENERATED OUTPUT FILES Test Report: yymmddhhmss_FMx_calf_supp_p01.htm 1 Register Snapshot: yymmddhhmss_FMx_calf_supp_p01.xml LAC 2 ADC conversion Table: yymmddhhmss_FMx_lac2dac.fits LAC DAC characterization Plots: yymmddhhmss_FMx_calf_supp_p01.pdf	

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<p>COMPLETION STATUSES</p> <p>PASS</p> <p>IPASS (Incomplete Pass - partial system...only applicable to development phase)</p> <p>FAIL</p> <p>ABORT</p>	
<p>DESCRIPTION</p> <p><b>Setup:</b>  Nominal with the following changes:  Tack Delay setting = CI_TIMED_PEAK  GLT data suppress = TRUE  Gain setting = Nominal</p> <p><b>Collect suppression data</b>  For each of 3 cases (case 0 = + LAC DACs set to maximum, - LAC DACs varied)  (case 1 = - LAC DACs set to maximum, + LAC DACs varied)  (case 2 = +/- LAC DACs varied; result should be equal to the lower threshold of cases 0 &amp; 1)</p> <p>For each LAC DAC setting, <i>lacDacidx = 0 to 127 default</i>  For each charge injection (CI) setting, <i>cidx=0 to 4095</i> and not all component thresholds found  For N samples, default = 10?  Use GLT self trigger to inject charge, delay, read event data  For each channel (FE), save the average ADC reading obtained from the first charge injection setting, <i>cidx</i>, that causes data from that channel to be present in the event readouts for 90% of the samples,  <code>adc[lacDacidx,4,8,3,12] = ADC</code>  Save LAC to ADC conversion table, <code>ADC[128,4,8,2,12]</code>, in FITS format to file.</p> <p><b>Validate LAC DAC operation against criteria</b>  Check range and resolution against criteria (by using low energy lowest gain setting or by converting collected ADC data to lowest gain equivalent?)  Verify case 2 results equal minimum of case0 and case 1 results.</p>	
COMMENTS	

**7.2.15.2. CAL Zero-Suppress Thresh. 2**

NAME calu_genLacTable	TEST ID CAL	SVAC ID C26
ALIASES None	SUPERCEDES None	CATEGORY CAL
SYNOPSIS Generate an appropriate Data Suppression Table for a specified energy given a LAC Discriminator Characterization Table and corresponding ADC to Energy Conversion Table		
AUTHOR NRL/Code 7650/B. Leas		OWNER/MAINTAINER/CONTACT PERSON NRL/Code 7650/B.Leas
MOTIVATION LAT-MD-0446-05 GLAST LAT Science Verification Analysis and Calibration (SVAC) Plan, section 5.3 SVAC Compliance, Table item C26		
PREREQUISITES CALF_SUPP_P01		
REQUIRED EGSE LATTE (latest?) SciPy package Dislin package (if hardcopy plots are desired) LAT TestStand (includes TEM?) Calorimeter Schema describing Calorimeter (\$CAL_ROOT\FMx\Configurations\FMx_schema.xml)		
REQUIRED INPUT DATA OR FILES ADC to Energy Conversion Table.  Pedestals Table  Relative Gain Table		GENERATED OUTPUT FILES LAC 2 ADC conversion Table: yymmddhhmss_FMx_lac.xml
COMPLETION STATUSES PASS IPASS (Incomplete Pass - partial system...only applicable to development phase) FAIL ABORT		
DESCRIPTION <b>Setup:</b> <b>Read Lac2ADC characterization</b> Read ADC 2 Energy Conversion table Read relative gain table Obtain (from operator?) energy (MeV) to use for data suppression threshold Obtain (from operator?) LE gain to be used. <b>Process:</b>		

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Using the relative gain table, adjust the lac2ADC characterization values to the requested gain.  
Using the relative gain table, adjust the Energy to ADC conversion table to reflect the requested gain.  
Using the adjusted Energy to ADC conversion table, convert the Lac2ADC characterization table to an Lac2NRG (LAC to Energy) characterization table.

For each FE, find the minimum LAC setting whose corresponding energy in the Lac2NRG characterization table is above the request energy threshold (LAC threshold table, LACThreshold[4,8,2,12])

***Save LAC threshold table***

Save threshold table, LACThreshold[4,8,2,12], in xml format to file with appropriate documentation to include:

- Requested Energy Threshold
- Requested Gain
- LAC to ADC characterization table filename
- ADC to Energy conversion table filename
- Relative gain table filename
- Data generated
- Application Name "calu\_genLacTable"

COMMENTS

**7.2.15.3. CAL Zero-Suppress Thresh. 3**

NAME CALF_SUPP_P02	TEST ID CAL	SVAC ID C26
ALIASES None	SUPERCEDES None	CATEGORY CAL
SYNOPSIS Generate a pedestal noise threshold Data Suppression Table.		
AUTHOR NRL/Code 7650/B. Leas		OWNER/MAINTAINER/CONTACT PERSON NRL/Code 7650/B.Leas
MOTIVATION LAT-MD-0446-05 GLAST LAT Science Verification Analysis and Calibration (SVAC) Plan, section 5.3 SVAC Compliance, Table item C26		
PREREQUISITES calu_init		
REQUIRED EGSE LATTE (latest?) SciPy package Dislin package (if hardcopy plots are desired) LAT TestStand (includes TEM?) Calorimeter Schema describing Calorimeter (\$CAL_ROOT\FMx\Configurations\FMx_schema.xml)		
REQUIRED INPUT DATA OR FILES ADC to Energy Conversion Table.  Pedestals Table  Relative Gain Table  <b>Note: Tests can be run without the above mentioned information, but characterization in energy terms cannot be performed</b>	GENERATED OUTPUT FILES Test Report: yymddhhmss_FMx_calf_supp_p02.htm 1 Register Snapshot: yymddhhmss_FMx_calf_supp_p02.xml Events File: yymddhhmss_FMx_calf_supp_p02.fits LAC Noise Pedestal Threshold Discriminator Table: yymddhhmss_FMx_lac.xml	
COMPLETION STATUSES PASS IPASS (Incomplete Pass - partial system...only applicable to development phase) FAIL ABORT		
DESCRIPTION <b>Setup:</b>		

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Nominal with the following changes:

Tack Delay setting = CI\_TIMED\_PEAK

GLT data suppress = TRUE

Gain setting = Nominal

Disable calibration enable bits (config\_1 = 0x80)

**Collect suppression data**

Initialize LACThreshold[4,8,2,12] = -1

For each of 2 cases (case 0 = + LAC DACs set to maximum, - LAC DACs varied)

(case 1 = - LAC DACs set to maximum, + LAC DACs varied)

For each LAC DAC setting, *lacDacidx* = 63 to 0

For N samples, default = 10?

Use GLT self trigger inject no charge, delay, read event data

For each channel (FE), save the LAC reading obtained from the first charge injection setting, *cidx*, that causes data from that channel to be present in the event readouts for 90% of the samples, LACThreshold[4,8,2,12] = *lacDacidx*

**Check against Criteria**

Flag channels with LACThreshold = -1 for not having a range low enough to allow the most-probable pedestal

**Save LAC noise pedestal threshold table**

Adjust LACThresholds for a minimum LAC setting of 0 (change -1 to 0)

Save LAC noise pedestal threshold table, LACThreshold[4,8,2,12], in xml format to file with appropriate documentation to include:

- Requested Energy Threshold
- Requested Gain
- LAC to ADC characterization table filename
- ADC to Energy conversion table filename
- Relative gain table filename
- Data generated
- Application Name "calf\_supp\_p02"

COMMENTS

***CAL High Rate Trigger***

NAME	TEST ID CAL	SVAC ID
ALIASES None	SUPERCEDES None	CATEGORY CAL
SYNOPSIS		
AUTHOR TBD	OWNER/MAINTAINER/CONTACT PERSON TBD	
MOTIVATION TBD		
PREREQUISITES None		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file	GENERATED OUTPUT FILES Test Report	
COMPLETION STATUSES		
DESCRIPTION		
COMMENTS		

### 7.3. ACD (WBS 4.1.6)

#### 7.3.1. *ACD Test Script Outline (This section from D. Thompson)*

ACD Functional Tests (not a single script) – **The following items must be set before starting this test: voltage (3.3V nominal), system clock frequency (20 MHz nominal).**

(Indentation indicates nested scripts – suites?)

Normal text – G2 script exists, not necessarily debugged; Underlined italics – Script outline exists;

**Underlined** text – Script does not exist

#### **ACD Comprehensive Performance Test**

ACD Short Functional (goal: 2 hours for this test)

##### **ACD Electronics Short Functional (12 iterations of the Chassis Short Functional)**

Chassis Short Functional (Unless otherwise noted, run with both A & B interfaces.)

- 1 Initial Current Measurements
  - GARC Registers Initial Reset Test
  - Initial GAFE Logic Reset Test (18)
- 2 Power Consumption Tests
  - GARC/GAFE Register Read/Write Tests (multiple small scripts)
  - Parity Error Detection by GARC
  - Maximum PHA Return Test
  - PHA Enable/Disable Test
  - PHA Threshold Test
  - GAFE Register Tests (18)
  - GAFE Broadcast Command Verification

##### **Characterization of GAFE chips (18, A interface only)**

GAFE BIAS DAC Calibration

GAFE Hold Delay Optimization using TCI

GAFE HitMap Delay Test

GAFE VETO Calibration (using GASU hardware scalers)

GAFE Noise Test (using GASU hardware scalers)

GAFE HLD Calibration (using GASU hardware scalers)

GAFE Discriminator Enable/Disable Test (using GASU hardware scalers)

GAFE TCI Regular Range Tests

GAFE TCI High Range Tests

##### **GAFE Parity Error Test**

**HitMap Width Test**

**HitMap Deadtime Stretch Test**

**VETO and ADC Crosstalk Test**

**ADC Start Time (TACQ) Test**

**TCI Comparison of VETO, Hitmap, and PHA**

**HVBS and PMT Aliveness**

HVBS DAC Commands and HV Monitor Differential Drivers

SAA/HV Normal Modes

**PMT Aliveness**

**Test of Look-At-Me Circuitry**

**7.3.2. *Power-on AEM electronics***

NAME	TEST ID ACD	SVAC ID
ALIASES None	SUPERCEDES None	CATEGORY ACD
SYNOPSIS		
AUTHOR TBD	OWNER/MAINTAINER/CONTACT PERSON TBD	
MOTIVATION TBD		
PREREQUISITES None		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file	GENERATED OUTPUT FILES Test Report	
COMPLETION STATUSES		
DESCRIPTION		
COMMENTS		

**7.3.3. *Power-on FREE cards***

NAME	TEST ID ACD	SVAC ID
ALIASES None	SUPERCEDES None	CATEGORY ACD
SYNOPSIS		
AUTHOR TBD		OWNER/MAINTAINER/CONTACT PERSON TBD
MOTIVATION TBD		
PREREQUISITES None		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file		GENERATED OUTPUT FILES Test Report
COMPLETION STATUSES		
DESCRIPTION		
COMMENTS		

**7.3.4. GAFE and GARC configure & readback**

NAME	TEST ID ACD	SVAC ID
ALIASES None	SUPERCEDES None	CATEGORY ACD
SYNOPSIS		
AUTHOR TBD	OWNER/MAINTAINER/CONTACT PERSON TBD	
MOTIVATION TBD		
PREREQUISITES None		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file	GENERATED OUTPUT FILES Test Report	
COMPLETION STATUSES		
DESCRIPTION		
COMMENTS		

**7.3.5. ACD pedestal readback**

NAME	TEST ID ACD	SVAC ID
ALIASES None	SUPERCEDES None	CATEGORY ACD
SYNOPSIS		
AUTHOR TBD	OWNER/MAINTAINER/CONTACT PERSON TBD	
MOTIVATION TBD		
PREREQUISITES None		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file	GENERATED OUTPUT FILES Test Report	
COMPLETION STATUSES		
DESCRIPTION		
COMMENTS		

**7.3.6. ACD Strobe**

NAME	TEST ID ACD	SVAC ID
ALIASES None	SUPERCEDES None	CATEGORY ACD
SYNOPSIS		
AUTHOR TBD	OWNER/MAINTAINER/CONTACT PERSON TBD	
MOTIVATION TBD		
PREREQUISITES None		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file	GENERATED OUTPUT FILES Test Report	
COMPLETION STATUSES		
DESCRIPTION		
COMMENTS		

**7.3.7. ACD Veto Threshold**

NAME	TEST ID ACD	SVAC ID
ALIASES None	SUPERCEDES None	CATEGORY ACD
SYNOPSIS		
AUTHOR TBD	OWNER/MAINTAINER/CONTACT PERSON TBD	
MOTIVATION TBD		
PREREQUISITES None		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file	GENERATED OUTPUT FILES Test Report	
COMPLETION STATUSES		
DESCRIPTION		
COMMENTS		

**7.3.8. ACD HLD Threshold**

NAME	TEST ID ACD	SVAC ID
ALIASES None	SUPERCEDES None	CATEGORY ACD
SYNOPSIS		
AUTHOR TBD	OWNER/MAINTAINER/CONTACT PERSON TBD	
MOTIVATION TBD		
PREREQUISITES None		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file	GENERATED OUTPUT FILES Test Report	
COMPLETION STATUSES		
DESCRIPTION		
COMMENTS		

**7.3.9. ACD Trigger**

NAME	TEST ID ACD	SVAC ID
ALIASES None	SUPERCEDES None	CATEGORY ACD
SYNOPSIS		
AUTHOR TBD	OWNER/MAINTAINER/CONTACT PERSON TBD	
MOTIVATION TBD		
PREREQUISITES None		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file	GENERATED OUTPUT FILES Test Report	
COMPLETION STATUSES		
DESCRIPTION		
COMMENTS		

**7.3.10. ACD Low Range PHA**

NAME	TEST ID ACD	SVAC ID
ALIASES None	SUPERCEDES None	CATEGORY ACD
SYNOPSIS		
AUTHOR TBD	OWNER/MAINTAINER/CONTACT PERSON TBD	
MOTIVATION TBD		
PREREQUISITES None		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file	GENERATED OUTPUT FILES Test Report	
COMPLETION STATUSES		
DESCRIPTION		
COMMENTS		

**7.3.11. ACD High Range PHA**

NAME	TEST ID ACD	SVAC ID
ALIASES None	SUPERCEDES None	CATEGORY ACD
SYNOPSIS		
AUTHOR TBD	OWNER/MAINTAINER/CONTACT PERSON TBD	
MOTIVATION TBD		
PREREQUISITES None		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file	GENERATED OUTPUT FILES Test Report	
COMPLETION STATUSES		
DESCRIPTION		
COMMENTS		

**7.3.12. ACD Zero-Suppress**

NAME	TEST ID ACD	SVAC ID
ALIASES None	SUPERCEDES None	CATEGORY ACD
SYNOPSIS		
AUTHOR TBD	OWNER/MAINTAINER/CONTACT PERSON TBD	
MOTIVATION TBD		
PREREQUISITES None		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file	GENERATED OUTPUT FILES Test Report	
COMPLETION STATUSES		
DESCRIPTION		
COMMENTS		

**7.3.13. ACD Non-linearity**

NAME	TEST ID ACD	SVAC ID
ALIASES None	SUPERCEDES None	CATEGORY ACD
SYNOPSIS		
AUTHOR TBD	OWNER/MAINTAINER/CONTACT PERSON TBD	
MOTIVATION TBD		
PREREQUISITES None		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file	GENERATED OUTPUT FILES Test Report	
COMPLETION STATUSES		
DESCRIPTION		
COMMENTS		

**7.3.14. ACD light tightness**

NAME	TEST ID ACD	SVAC ID
ALIASES None	SUPERCEDES None	CATEGORY ACD
SYNOPSIS		
AUTHOR TBD	OWNER/MAINTAINER/CONTACT PERSON TBD	
MOTIVATION TBD		
PREREQUISITES None		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file	GENERATED OUTPUT FILES Test Report	
COMPLETION STATUSES		
DESCRIPTION		
COMMENTS		

**7.3.15. ACD Power-On High Voltage**

NAME	TEST ID ACD	SVAC ID
ALIASES None	SUPERCEDES None	CATEGORY ACD
SYNOPSIS		
AUTHOR TBD	OWNER/MAINTAINER/CONTACT PERSON TBD	
MOTIVATION TBD		
PREREQUISITES None		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file	GENERATED OUTPUT FILES Test Report	
COMPLETION STATUSES		
DESCRIPTION		
COMMENTS		

**7.3.16. ACD Raise/Lower High Voltage**

NAME	TEST ID ACD	SVAC ID
ALIASES None	SUPERCEDES None	CATEGORY ACD
SYNOPSIS		
AUTHOR TBD	OWNER/MAINTAINER/CONTACT PERSON TBD	
MOTIVATION TBD		
PREREQUISITES None		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file	GENERATED OUTPUT FILES Test Report	
COMPLETION STATUSES		
DESCRIPTION		
COMMENTS		

**7.3.17. ACD pedestal calculation**

NAME	TEST ID ACD	SVAC ID
ALIASES None	SUPERCEDES None	CATEGORY ACD
SYNOPSIS		
AUTHOR TBD		OWNER/MAINTAINER/CONTACT PERSON TBD
MOTIVATION TBD		
PREREQUISITES None		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file		GENERATED OUTPUT FILES Test Report
COMPLETION STATUSES		
DESCRIPTION		
COMMENTS		

**7.3.18. ACD MIP threshold**

NAME	TEST ID ACD	SVAC ID
ALIASES None	SUPERCEDES None	CATEGORY ACD
SYNOPSIS		
AUTHOR TBD	OWNER/MAINTAINER/CONTACT PERSON TBD	
MOTIVATION TBD		
PREREQUISITES None		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file	GENERATED OUTPUT FILES Test Report	
COMPLETION STATUSES		
DESCRIPTION		
COMMENTS		

**7.3.19. ACD pedestal measurement**

NAME	TEST ID ACD	SVAC ID
ALIASES None	SUPERCEDES None	CATEGORY ACD
SYNOPSIS		
AUTHOR TBD	OWNER/MAINTAINER/CONTACT PERSON TBD	
MOTIVATION TBD		
PREREQUISITES None		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file	GENERATED OUTPUT FILES Test Report	
COMPLETION STATUSES		
DESCRIPTION		
COMMENTS		

**7.3.20. ACD False VETO**

NAME	TEST ID ACD	SVAC ID
ALIASES None	SUPERCEDES None	CATEGORY ACD
SYNOPSIS		
AUTHOR TBD	OWNER/MAINTAINER/CONTACT PERSON TBD	
MOTIVATION TBD		
PREREQUISITES None		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file	GENERATED OUTPUT FILES Test Report	
COMPLETION STATUSES		
DESCRIPTION		
COMMENTS		

**7.3.21. *ACD discriminator mask***

NAME	TEST ID ACD	SVAC ID
ALIASES None	SUPERCEDES None	CATEGORY ACD
SYNOPSIS		
AUTHOR TBD		OWNER/MAINTAINER/CONTACT PERSON TBD
MOTIVATION TBD		
PREREQUISITES None		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file		GENERATED OUTPUT FILES Test Report
COMPLETION STATUSES		
DESCRIPTION		
COMMENTS		

**7.3.22. ACD Limit Check**

NAME	TEST ID ACD	SVAC ID
ALIASES None	SUPERCEDES None	CATEGORY ACD
SYNOPSIS		
AUTHOR TBD	OWNER/MAINTAINER/CONTACT PERSON TBD	
MOTIVATION TBD		
PREREQUISITES None		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file	GENERATED OUTPUT FILES Test Report	
COMPLETION STATUSES		
DESCRIPTION		
COMMENTS		

**7.3.23. ACD Gain Calibration**

NAME	TEST ID ACD	SVAC ID
ALIASES None	SUPERCEDES None	CATEGORY ACD
SYNOPSIS		
AUTHOR TBD	OWNER/MAINTAINER/CONTACT PERSON TBD	
MOTIVATION TBD		
PREREQUISITES None		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file	GENERATED OUTPUT FILES Test Report	
COMPLETION STATUSES		
DESCRIPTION		
COMMENTS		

**7.3.24. ACD SAA Mode**

NAME	TEST ID ACD	SVAC ID
ALIASES None	SUPERCEDES None	CATEGORY ACD
SYNOPSIS		
AUTHOR TBD	OWNER/MAINTAINER/CONTACT PERSON TBD	
MOTIVATION TBD		
PREREQUISITES None		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file	GENERATED OUTPUT FILES Test Report	
COMPLETION STATUSES		
DESCRIPTION		
COMMENTS		

**7.3.25. ACD Operating Power Consumption**

NAME	TEST ID ACD	SVAC ID
ALIASES None	SUPERCEDES None	CATEGORY ACD
SYNOPSIS		
AUTHOR TBD	OWNER/MAINTAINER/CONTACT PERSON TBD	
MOTIVATION TBD		
PREREQUISITES None		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file	GENERATED OUTPUT FILES Test Report	
COMPLETION STATUSES		
DESCRIPTION		
COMMENTS		

**7.3.26. ACD Efficiency**

NAME	TEST ID ACD	SVAC ID
ALIASES None	SUPERCEDES None	CATEGORY ACD
SYNOPSIS		
AUTHOR TBD	OWNER/MAINTAINER/CONTACT PERSON TBD	
MOTIVATION TBD		
PREREQUISITES None		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file	GENERATED OUTPUT FILES Test Report	
COMPLETION STATUSES		
DESCRIPTION		
COMMENTS		

**7.3.27. ACD Timing**

NAME	TEST ID ACD	SVAC ID
ALIASES None	SUPERCEDES None	CATEGORY ACD
SYNOPSIS		
AUTHOR TBD	OWNER/MAINTAINER/CONTACT PERSON TBD	
MOTIVATION TBD		
PREREQUISITES None		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file	GENERATED OUTPUT FILES Test Report	
COMPLETION STATUSES		
DESCRIPTION		
COMMENTS		

**7.3.28. ACD High Rate Trigger**

NAME	TEST ID ACD	SVAC ID
ALIASES None	SUPERCEDES None	CATEGORY ACD
SYNOPSIS		
AUTHOR TBD	OWNER/MAINTAINER/CONTACT PERSON TBD	
MOTIVATION TBD		
PREREQUISITES None		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file	GENERATED OUTPUT FILES Test Report	
COMPLETION STATUSES		
DESCRIPTION		
COMMENTS		

**7.4. ELX (WBS 4.1.7)**

**7.4.1. Power Supply Assembly voltage measurement test**

NAME PSAtest.py	TEST ID ELX	SVAC ID
ALIASES None	SUPERCEDES None	CATEGORY Electronics – Power supplies
SYNOPSIS PSA voltage test		
AUTHOR TBD	OWNER/MAINTAINER/CONTACT PERSON TBD	
MOTIVATION TBD		
PREREQUISITE SUCCESSFULLY COMPLETED TEST SCRIPTS None		
REQUIRED EGSE <ul style="list-style-type: none"> <li>• GPIB</li> <li>• Model ??? DVM with GPIB option</li> <li>• Dummy load module</li> </ul>		
REQUIRED INPUT DATA OR FILES Configuration file	GENERATED OUTPUT FILES Test Report	
COMPLETION STATUSES <ul style="list-style-type: none"> <li>• PASSED</li> <li>• FAILED</li> </ul>		
DESCRIPTION <p>This test measures the voltages produced by the tower Power Supply Assembly using a calibrated GPIB readable DVM and compares the result with limit values found in the configuration file. If any of the values are found to be outside of the red limits, the test fails. Bias voltages are measured against their set points as given in the configuration file. [Perhaps we should consider ramping the bias voltages and testing against several set points?] This test must be carried out using an appropriate dummy load that mimics the TEM. [Should this test perform a single measurement and/or sample (randomly?) over a configurable time period?] Results of all voltages are reported in the test report. [How do we handle the input voltage from the spacecraft battery? Do we need to carry out margin testing by ramping the battery up and down or is that already guaranteed to be okay when the PSA is delivered from ELX to I&amp;T (e.g., by design)?]</p>		
COMMENTS <p>This test is normally carried out when a PSA unit is received by I&amp;T and before a PSA unit is to be integrated with a TEM unit.</p>		

The idea of this test is to qualify a PSA unit. As described below, it is done using a dummy load and a calibrated GPIB voltmeter. Possibly an alternative way to do it is to use a “standard” TEM, perhaps not fully functional, and use its environmental quantity measurement features to satisfy this test’s intention. Dummy loads would have to be applied to the TEM’s cable connectors to simulate the current draw of the front ends. The “standard” TEM would have to undergo some sort of certification procedure to ensure that its calibration is correct. What do we want to do?

**7.4.2. *Power Supply Assembly current limit test***

NAME	TEST ID ELX	SVAC ID
ALIASES None	SUPERCEDES None	CATEGORY Electronics – Power supplies
SYNOPSIS		
AUTHOR TBD		OWNER/MAINTAINER/CONTACT PERSON TBD
MOTIVATION TBD		
PREREQUISITES None		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file		GENERATED OUTPUT FILES Test Report
COMPLETION STATUSES		
DESCRIPTION		
COMMENTS		

**7.4.3. *Power Distribution Unit voltage measurement test***

NAME	TEST ID ELX	SVAC ID
ALIASES None	SUPERCEDES None	CATEGORY Electronics – Power supplies
SYNOPSIS		
AUTHOR TBD		OWNER/MAINTAINER/CONTACT PERSON TBD
MOTIVATION TBD		
PREREQUISITES None		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file		GENERATED OUTPUT FILES Test Report
COMPLETION STATUSES		
DESCRIPTION		
COMMENTS		

**7.4.4. *Power Distribution Unit current limit test***

NAME	TEST ID ELX	SVAC ID
ALIASES None	SUPERCEDES None	CATEGORY Electronics – Power supplies
SYNOPSIS		
AUTHOR TBD		OWNER/MAINTAINER/CONTACT PERSON TBD
MOTIVATION TBD		
PREREQUISITES None		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file		GENERATED OUTPUT FILES Test Report
COMPLETION STATUSES		
DESCRIPTION		
COMMENTS		

**7.4.5. *Power Distribution Unit voltage sequencing test***

NAME	TEST ID ELX	SVAC ID
ALIASES None	SUPERCEDES None	CATEGORY Electronics – Power supplies
SYNOPSIS		
AUTHOR TBD		OWNER/MAINTAINER/CONTACT PERSON TBD
MOTIVATION TBD		
PREREQUISITES None		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file		GENERATED OUTPUT FILES Test Report
COMPLETION STATUSES		
DESCRIPTION		
COMMENTS		

**7.4.6. Voltage margin test**

NAME	TEST ID ELX	SVAC ID
ALIASES None	SUPERCEDES None	CATEGORY Electronics – Power supplies
SYNOPSIS		
AUTHOR TBD		OWNER/MAINTAINER/CONTACT PERSON TBD
MOTIVATION TBD		
PREREQUISITES None		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file		GENERATED OUTPUT FILES Test Report
COMPLETION STATUSES		
DESCRIPTION		
COMMENTS		

Done by ELX? Determined by design, or needed for every component instance? Any component requiring a power supply for input voltages needs this test. List each one separately?

**7.4.7. SysClk margin test**

NAME	TEST ID ELX	SVAC ID
ALIASES None	SUPERCEDES None	CATEGORY Electronics
SYNOPSIS		
AUTHOR TBD		OWNER/MAINTAINER/CONTACT PERSON TBD
MOTIVATION TBD		
PREREQUISITES None		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file		GENERATED OUTPUT FILES Test Report
COMPLETION STATUSES		
DESCRIPTION		
COMMENTS		

Same comments as for voltage margin test. Also useful for each component because it can help shake out incorrect loading of electronic components like resistors, capacitors, etc.

**7.4.8. Environmental monitoring test**

NAME	TEST ID ELX	SVAC ID
ALIASES None	SUPERCEDES None	CATEGORY Electronics
SYNOPSIS		
AUTHOR TBD		OWNER/MAINTAINER/CONTACT PERSON TBD
MOTIVATION TBD		
PREREQUISITES None		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file		GENERATED OUTPUT FILES Test Report
COMPLETION STATUSES		
DESCRIPTION Vary measured item (voltage, current, temperature, etc) over range of device and verify digitized value matches. Checks constants for converting to engineering units as well. Probably this is design/layout dependent, but may be cabling dependent as well, so test cross talk with power glitches, other environmental quantities, command/event/trigger path activity? Test stability of each quantity over time. Also against environment temperature?		
COMMENTS		

**7.4.9. Writeable register test**

NAME	TEST ID ELX	SVAC ID
ALIASES None	SUPERCEDES None	CATEGORY Electronics
SYNOPSIS Test writeable registers		
AUTHOR TBD		OWNER/MAINTAINER/CONTACT PERSON TBD
MOTIVATION TBD		
PREREQUISITES None		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file		GENERATED OUTPUT FILES Test Report
COMPLETION STATUSES		
DESCRIPTION To be done for each component having writable registers: <ul style="list-style-type: none"> <li>• walking ones</li> <li>• walking zeros</li> <li>• 0's</li> <li>• f's</li> <li>• a's</li> <li>• 5's</li> <li>• addressing check</li> <li>• MBZ recognition check</li> <li>• Parity test</li> <li>• Other error testing</li> </ul>		
COMMENTS		

**7.4.10. Read-only register test**

NAME	TEST ID ELX	SVAC ID
ALIASES None	SUPERCEDES None	CATEGORY Electronics
SYNOPSIS Test readable registers		
AUTHOR TBD		OWNER/MAINTAINER/CONTACT PERSON TBD
MOTIVATION TBD		
PREREQUISITES None		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file		GENERATED OUTPUT FILES Test Report
COMPLETION STATUSES		
DESCRIPTION To be done for each component having read-only registers: <ul style="list-style-type: none"> <li>• Recognize MBZ fields</li> <li>• Verify response to stimuli</li> <li>• Parity test</li> <li>• Other error testing</li> </ul>		
COMMENTS		

**7.4.11. Dataless command tests**

NAME	TEST ID ELX	SVAC ID
ALIASES None	SUPERCEDES None	CATEGORY Electronics
SYNOPSIS		
AUTHOR TBD		OWNER/MAINTAINER/CONTACT PERSON TBD
MOTIVATION TBD		
PREREQUISITES None		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file		GENERATED OUTPUT FILES Test Report
COMPLETION STATUSES		
DESCRIPTION To be done for each component having dataless commands: <ul style="list-style-type: none"> <li>• Test whether corresponding effect is initiated</li> <li>• Parity test</li> <li>• Other error testing</li> </ul>		
COMMENTS		

**7.4.12. Event path tests**

NAME	TEST ID ELX	SVAC ID
ALIASES None	SUPERCEDES None	CATEGORY Electronics
SYNOPSIS		
AUTHOR TBD		OWNER/MAINTAINER/CONTACT PERSON TBD
MOTIVATION TBD		
PREREQUISITES None		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file		GENERATED OUTPUT FILES Test Report
COMPLETION STATUSES		
DESCRIPTION <ul style="list-style-type: none"> <li>• Bit path liveness [verify all bits in the path work independently (no 0s, 1s, shorted together bits)]</li> <li>• Cross talking bits in the bit path? [Different from detector crosstalk test?]</li> <li>• Data bit liveness (PHAs, Log End values &amp; ranges, TOTs) [verify ADCs work]</li> <li>• Error reporting for each error type [can we induce each error type?]</li> <li>• Event path parity error test</li> <li>• Other error reporting</li> <li>• Diagnostic reporting [determine whether trigger primitives are being reported correctly; ensure all bits are working (all trigger primitive messages can be generated)]</li> <li>• FIFO and other memory tests</li> <li>• Backpressure/Rate tests</li> </ul>		
COMMENTS		

**7.4.13. Trigger path tests**

NAME	TEST ID ELX	SVAC ID
ALIASES None	SUPERCEDES None	CATEGORY Electronics
SYNOPSIS		
AUTHOR TBD		OWNER/MAINTAINER/CONTACT PERSON TBD
MOTIVATION TBD		
PREREQUISITES None		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file		GENERATED OUTPUT FILES Test Report
COMPLETION STATUSES		
DESCRIPTION <ul style="list-style-type: none"> <li>• Test of trigger types</li> <li>• Trigger type cross-talk test?</li> <li>• Veto cross-talk test?</li> <li>• Timing in (TACK delay, etc.) [also provides delay register values for configuration file]</li> <li>• Zero suppression test</li> <li>• Marker test</li> <li>• Other modes</li> </ul>		
COMMENTS		

**7.4.14. Detector (sensor?) tests**

NAME	TEST ID ELX	SVAC ID
ALIASES None	SUPERCEDES None	CATEGORY Electronics
SYNOPSIS		
AUTHOR TBD		OWNER/MAINTAINER/CONTACT PERSON TBD
MOTIVATION TBD		
PREREQUISITES None		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file		GENERATED OUTPUT FILES Test Report
COMPLETION STATUSES		
DESCRIPTION <ul style="list-style-type: none"> <li>• Dead channels [also supplies bad channel list]</li> <li>• Noisy channels [also supplies bad channel list]</li> <li>• Cross talking channels</li> <li>• Thresholds [also supplies threshold list]</li> <li>• Pedestals [also supplies pedestal list]</li> <li>• Linearity</li> <li>• Noise &amp; Gain</li> <li>• Inter-layer TKR alignment</li> <li>• Detection efficiency test</li> </ul>		
COMMENTS		

**7.5. FSW (WBS 4.1.7)****7.5.1. 1553 Interface Test**

NAME	TEST ID ELX	SVAC ID
ALIASES None	SUPERCEDES None	CATEGORY Flight Software
SYNOPSIS		
AUTHOR TBD	OWNER/MAINTAINER/CONTACT PERSON TBD	
MOTIVATION TBD		
PREREQUISITES None		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file	GENERATED OUTPUT FILES Test Report	
COMPLETION STATUSES		
DESCRIPTION <ul style="list-style-type: none"> <li>• Booting tests</li> </ul>		
COMMENTS		

**7.5.2. *Command Functional***

NAME	TEST ID ELX	SVAC ID
ALIASES None	SUPERCEDES None	CATEGORY Flight Software
SYNOPSIS		
AUTHOR TBD		OWNER/MAINTAINER/CONTACT PERSON TBD
MOTIVATION TBD		
PREREQUISITES None		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file		GENERATED OUTPUT FILES Test Report
COMPLETION STATUSES		
DESCRIPTION		
COMMENTS		

**7.5.3. Memory Upload and Dump**

NAME	TEST ID ELX	SVAC ID
ALIASES None	SUPERCEDES None	CATEGORY Flight Software
SYNOPSIS		
AUTHOR TBD	OWNER/MAINTAINER/CONTACT PERSON TBD	
MOTIVATION TBD		
PREREQUISITES None		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file	GENERATED OUTPUT FILES Test Report	
COMPLETION STATUSES		
DESCRIPTION		
COMMENTS		

**7.5.4. Narrowband Telemetry**

NAME	TEST ID ELX	SVAC ID
ALIASES None	SUPERCEDES None	CATEGORY Flight Software
SYNOPSIS		
AUTHOR TBD		OWNER/MAINTAINER/CONTACT PERSON TBD
MOTIVATION TBD		
PREREQUISITES None		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file		GENERATED OUTPUT FILES Test Report
COMPLETION STATUSES		
DESCRIPTION		
COMMENTS		

**7.5.5. Wideband Telemetry**

NAME	TEST ID ELX	SVAC ID
ALIASES None	SUPERCEDES None	CATEGORY Flight Software
SYNOPSIS		
AUTHOR TBD	OWNER/MAINTAINER/CONTACT PERSON TBD	
MOTIVATION TBD		
PREREQUISITES None		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file	GENERATED OUTPUT FILES Test Report	
COMPLETION STATUSES		
DESCRIPTION		
COMMENTS		

**7.5.6. *Vehicle Signals Interface***

NAME	TEST ID ELX	SVAC ID
ALIASES None	SUPERCEDES None	CATEGORY Flight Software
SYNOPSIS		
AUTHOR TBD	OWNER/MAINTAINER/CONTACT PERSON TBD	
MOTIVATION TBD		
PREREQUISITES None		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file	GENERATED OUTPUT FILES Test Report	
COMPLETION STATUSES		
DESCRIPTION		
COMMENTS		

**7.5.7. CPU-CPU Communications**

NAME	TEST ID ELX	SVAC ID
ALIASES None	SUPERCEDES None	CATEGORY Flight Software
SYNOPSIS		
AUTHOR TBD	OWNER/MAINTAINER/CONTACT PERSON TBD	
MOTIVATION TBD		
PREREQUISITES None		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file	GENERATED OUTPUT FILES Test Report	
COMPLETION STATUSES		
DESCRIPTION		
COMMENTS		

**7.5.8. EPU Internal Configuration**

NAME	TEST ID ELX	SVAC ID
ALIASES None	SUPERCEDES None	CATEGORY Flight Software
SYNOPSIS		
AUTHOR TBD		OWNER/MAINTAINER/CONTACT PERSON TBD
MOTIVATION TBD		
PREREQUISITES None		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file		GENERATED OUTPUT FILES Test Report
COMPLETION STATUSES		
DESCRIPTION		
COMMENTS		

**7.5.9. T&DF Internal Configuration**

NAME	TEST ID ELX	SVAC ID
ALIASES None	SUPERCEDES None	CATEGORY Flight Software
SYNOPSIS		
AUTHOR TBD	OWNER/MAINTAINER/CONTACT PERSON TBD	
MOTIVATION TBD		
PREREQUISITES None		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file	GENERATED OUTPUT FILES Test Report	
COMPLETION STATUSES		
DESCRIPTION		
COMMENTS		

**7.5.10. TKR Internal Configuration**

NAME	TEST ID ELX	SVAC ID
ALIASES None	SUPERCEDES None	CATEGORY Flight Software
SYNOPSIS		
AUTHOR TBD	OWNER/MAINTAINER/CONTACT PERSON TBD	
MOTIVATION TBD		
PREREQUISITES None		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file	GENERATED OUTPUT FILES Test Report	
COMPLETION STATUSES		
DESCRIPTION		
COMMENTS		

**7.5.11. CAL Internal Configuration**

NAME	TEST ID ELX	SVAC ID
ALIASES None	SUPERCEDES None	CATEGORY Flight Software
SYNOPSIS		
AUTHOR TBD	OWNER/MAINTAINER/CONTACT PERSON TBD	
MOTIVATION TBD		
PREREQUISITES None		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file	GENERATED OUTPUT FILES Test Report	
COMPLETION STATUSES		
DESCRIPTION		
COMMENTS		

**7.5.12. ACD Internal Configuration**

NAME	TEST ID ELX	SVAC ID
ALIASES None	SUPERCEDES None	CATEGORY Flight Software
SYNOPSIS		
AUTHOR TBD	OWNER/MAINTAINER/CONTACT PERSON TBD	
MOTIVATION TBD		
PREREQUISITES None		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file	GENERATED OUTPUT FILES Test Report	
COMPLETION STATUSES		
DESCRIPTION		
COMMENTS		

**7.5.13. Event Filtering**

NAME	TEST ID ELX	SVAC ID
ALIASES None	SUPERCEDES None	CATEGORY Flight Software
SYNOPSIS		
AUTHOR TBD	OWNER/MAINTAINER/CONTACT PERSON TBD	
MOTIVATION TBD		
PREREQUISITES None		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file	GENERATED OUTPUT FILES Test Report	
COMPLETION STATUSES		
DESCRIPTION		
COMMENTS		

**7.5.14. Electronic Calibration**

NAME	TEST ID ELX	SVAC ID
ALIASES None	SUPERCEDES None	CATEGORY Flight Software
SYNOPSIS		
AUTHOR TBD	OWNER/MAINTAINER/CONTACT PERSON TBD	
MOTIVATION TBD		
PREREQUISITES None		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file	GENERATED OUTPUT FILES Test Report	
COMPLETION STATUSES		
DESCRIPTION		
COMMENTS		

**7.5.15. FSW and LAT Initialization**

NAME	TEST ID ELX	SVAC ID
ALIASES None	SUPERCEDES None	CATEGORY Flight Software
SYNOPSIS		
AUTHOR TBD	OWNER/MAINTAINER/CONTACT PERSON TBD	
MOTIVATION TBD		
PREREQUISITES None		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file	GENERATED OUTPUT FILES Test Report	
COMPLETION STATUSES		
DESCRIPTION		
COMMENTS		

**7.5.16. FSW and LAT recovery**

NAME	TEST ID ELX	SVAC ID
ALIASES None	SUPERCEDES None	CATEGORY Flight Software
SYNOPSIS		
AUTHOR TBD	OWNER/MAINTAINER/CONTACT PERSON TBD	
MOTIVATION TBD		
PREREQUISITES None		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file	GENERATED OUTPUT FILES Test Report	
COMPLETION STATUSES		
DESCRIPTION		
COMMENTS		

**7.5.17. LAT Pointing Calculations**

NAME	TEST ID ELX	SVAC ID
ALIASES None	SUPERCEDES None	CATEGORY Flight Software
SYNOPSIS		
AUTHOR TBD		OWNER/MAINTAINER/CONTACT PERSON TBD
MOTIVATION TBD		
PREREQUISITES None		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file		GENERATED OUTPUT FILES Test Report
COMPLETION STATUSES		
DESCRIPTION		
COMMENTS		

**7.5.18. GRB Handling**

NAME	TEST ID ELX	SVAC ID
ALIASES None	SUPERCEDES None	CATEGORY Flight Software
SYNOPSIS		
AUTHOR TBD		OWNER/MAINTAINER/CONTACT PERSON TBD
MOTIVATION TBD		
PREREQUISITES None		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file		GENERATED OUTPUT FILES Test Report
COMPLETION STATUSES		
DESCRIPTION		
COMMENTS		

**7.5.19. GRB Detection**

NAME	TEST ID ELX	SVAC ID
ALIASES None	SUPERCEDES None	CATEGORY Flight Software
SYNOPSIS		
AUTHOR TBD	OWNER/MAINTAINER/CONTACT PERSON TBD	
MOTIVATION TBD		
PREREQUISITES None		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file	GENERATED OUTPUT FILES Test Report	
COMPLETION STATUSES		
DESCRIPTION		
COMMENTS		

**7.5.20. Repointing Logic**

NAME	TEST ID ELX	SVAC ID
ALIASES None	SUPERCEDES None	CATEGORY Flight Software
SYNOPSIS		
AUTHOR TBD	OWNER/MAINTAINER/CONTACT PERSON TBD	
MOTIVATION TBD		
PREREQUISITES None		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file	GENERATED OUTPUT FILES Test Report	
COMPLETION STATUSES		
DESCRIPTION		
COMMENTS		

**7.5.21. Safe Modes**

NAME	TEST ID ELX	SVAC ID
ALIASES None	SUPERCEDES None	CATEGORY Flight Software
SYNOPSIS		
AUTHOR TBD	OWNER/MAINTAINER/CONTACT PERSON TBD	
MOTIVATION TBD		
PREREQUISITES None		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file	GENERATED OUTPUT FILES Test Report	
COMPLETION STATUSES		
DESCRIPTION		
COMMENTS		

**7.5.22. Science Modes**

NAME	TEST ID ELX	SVAC ID
ALIASES None	SUPERCEDES None	CATEGORY Flight Software
SYNOPSIS		
AUTHOR TBD		OWNER/MAINTAINER/CONTACT PERSON TBD
MOTIVATION TBD		
PREREQUISITES None		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file		GENERATED OUTPUT FILES Test Report
COMPLETION STATUSES		
DESCRIPTION		
COMMENTS		

**7.5.23. Diagnostic and Calibration Modes**

NAME	TEST ID ELX	SVAC ID
ALIASES None	SUPERCEDES None	CATEGORY Flight Software
SYNOPSIS		
AUTHOR TBD		OWNER/MAINTAINER/CONTACT PERSON TBD
MOTIVATION TBD		
PREREQUISITES None		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file		GENERATED OUTPUT FILES Test Report
COMPLETION STATUSES		
DESCRIPTION		
COMMENTS		

**7.5.24. Thermal Control System**

NAME	TEST ID ELX	SVAC ID
ALIASES None	SUPERCEDES None	CATEGORY Flight Software
SYNOPSIS		
AUTHOR TBD	OWNER/MAINTAINER/CONTACT PERSON TBD	
MOTIVATION TBD		
PREREQUISITES None		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file	GENERATED OUTPUT FILES Test Report	
COMPLETION STATUSES		
DESCRIPTION		
COMMENTS		

**7.5.25. LAT On-Orbit Initialization**

NAME	TEST ID ELX	SVAC ID
ALIASES None	SUPERCEDES None	CATEGORY Flight Software
SYNOPSIS		
AUTHOR TBD		OWNER/MAINTAINER/CONTACT PERSON TBD
MOTIVATION TBD		
PREREQUISITES None		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file		GENERATED OUTPUT FILES Test Report
COMPLETION STATUSES		
DESCRIPTION		
COMMENTS		

**7.5.26. Sky Survey Mode**

NAME	TEST ID ELX	SVAC ID
ALIASES None	SUPERCEDES None	CATEGORY Flight Software
SYNOPSIS		
AUTHOR TBD	OWNER/MAINTAINER/CONTACT PERSON TBD	
MOTIVATION TBD		
PREREQUISITES None		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file	GENERATED OUTPUT FILES Test Report	
COMPLETION STATUSES		
DESCRIPTION		
COMMENTS		

**7.5.27. Pointed Observation Mode**

NAME	TEST ID ELX	SVAC ID
ALIASES None	SUPERCEDES None	CATEGORY Flight Software
SYNOPSIS		
AUTHOR TBD	OWNER/MAINTAINER/CONTACT PERSON TBD	
MOTIVATION TBD		
PREREQUISITES None		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file	GENERATED OUTPUT FILES Test Report	
COMPLETION STATUSES		
DESCRIPTION		
COMMENTS		

**7.5.28. LAT Performance Verification**

NAME	TEST ID ELX	SVAC ID
ALIASES None	SUPERCEDES None	CATEGORY Flight Software
SYNOPSIS		
AUTHOR TBD		OWNER/MAINTAINER/CONTACT PERSON TBD
MOTIVATION TBD		
PREREQUISITES None		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file		GENERATED OUTPUT FILES Test Report
COMPLETION STATUSES		
DESCRIPTION		
COMMENTS		

**7.5.29. LAT Airborne End-to-End Test**

NAME	TEST ID ELX	SVAC ID
ALIASES None	SUPERCEDES None	CATEGORY Flight Software
SYNOPSIS		
AUTHOR TBD	OWNER/MAINTAINER/CONTACT PERSON TBD	
MOTIVATION TBD		
PREREQUISITES None		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file	GENERATED OUTPUT FILES Test Report	
COMPLETION STATUSES		
DESCRIPTION		
COMMENTS		

**7.6. I&T (WBS 4.1.9) System level tests**

**7.6.1. Inter-subsystem timing-in script**

NAME	TEST ID INT	SVAC ID
ALIASES None	SUPERCEDES None	CATEGORY I&T
SYNOPSIS		
AUTHOR TBD	OWNER/MAINTAINER/CONTACT PERSON TBD	
MOTIVATION TBD		
PREREQUISITES None		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file	GENERATED OUTPUT FILES Test Report	
COMPLETION STATUSES		
DESCRIPTION		
COMMENTS		

**7.6.2. *Inter-subsystem cross talk test***

NAME	TEST ID INT	SVAC ID
ALIASES None	SUPERCEDES None	CATEGORY I&T
SYNOPSIS		
AUTHOR TBD	OWNER/MAINTAINER/CONTACT PERSON TBD	
MOTIVATION TBD		
PREREQUISITES None		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file	GENERATED OUTPUT FILES Test Report	
COMPLETION STATUSES		
DESCRIPTION		
COMMENTS		

**7.6.3. Data taking**

NAME	TEST ID INT	SVAC ID
ALIASES None	SUPERCEDES None	CATEGORY I&T
SYNOPSIS		
AUTHOR TBD		OWNER/MAINTAINER/CONTACT PERSON TBD
MOTIVATION TBD		
PREREQUISITES None		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file		GENERATED OUTPUT FILES Test Report
COMPLETION STATUSES		
DESCRIPTION		
COMMENTS		

- Muons
  - External trigger
  - External trigger with lead
- Van de Graaff

**7.6.4. Comprehensive test**

NAME	TEST ID INT	SVAC ID
ALIASES None	SUPERCEDES None	CATEGORY I&T
SYNOPSIS		
AUTHOR TBD	OWNER/MAINTAINER/CONTACT PERSON TBD	
MOTIVATION TBD		
PREREQUISITES None		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file	GENERATED OUTPUT FILES Test Report	
COMPLETION STATUSES		
DESCRIPTION		
COMMENTS		

**7.6.5. *Limited performance test***

NAME	TEST ID INT	SVAC ID
ALIASES None	SUPERCEDES None	CATEGORY I&T
SYNOPSIS		
AUTHOR TBD	OWNER/MAINTAINER/CONTACT PERSON TBD	
MOTIVATION TBD		
PREREQUISITES None		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file	GENERATED OUTPUT FILES Test Report	
COMPLETION STATUSES		
DESCRIPTION		
COMMENTS		

**7.6.6. Aliveness test**

NAME	TEST ID INT	SVAC ID
ALIASES None	SUPERCEDES None	CATEGORY I&T
SYNOPSIS		
AUTHOR TBD	OWNER/MAINTAINER/CONTACT PERSON TBD	
MOTIVATION TBD		
PREREQUISITES None		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file	GENERATED OUTPUT FILES Test Report	
COMPLETION STATUSES		
DESCRIPTION		
COMMENTS		

**7.6.7. Single contributor trigger**

NAME	TEST ID INT101	SVAC ID
ALIASES None	SUPERCEDES None	CATEGORY I&T
SYNOPSIS Check the relative efficiency of the 3-in-a-row trigger		
AUTHOR TBD	OWNER/MAINTAINER/CONTACT PERSON TBD	
MOTIVATION TBD		
PREREQUISITES None		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file	GENERATED OUTPUT FILES Test Report	
COMPLETION STATUSES		
DESCRIPTION		
COMMENTS		

**7.6.8. Single contributor synchronization**

NAME	TEST ID INT102	SVAC ID
ALIASES None	SUPERCEDES None	CATEGORY I&T
SYNOPSIS Check for integrity of the combined tracker and calorimeter data from a single tower		
AUTHOR TBD	OWNER/MAINTAINER/CONTACT PERSON TBD	
MOTIVATION TBD		
PREREQUISITES TKR504		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file	GENERATED OUTPUT FILES Test Report	
COMPLETION STATUSES		
DESCRIPTION		
COMMENTS		

**7.6.9. Single contributor muon survey**

NAME	TEST ID INT103	SVAC ID
ALIASES None	SUPERCEDES None	CATEGORY I&T
SYNOPSIS TKR tray-to-tray alignment and CDE performance		
AUTHOR TBD	OWNER/MAINTAINER/CONTACT PERSON TBD	
MOTIVATION TBD		
PREREQUISITES TKR503		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file	GENERATED OUTPUT FILES Test Report	
COMPLETION STATUSES		
DESCRIPTION		
COMMENTS		

**7.6.10. Multi-contributor synchronization**

NAME	TEST ID INT301	SVAC ID
ALIASES None	SUPERCEDES None	CATEGORY I&T
SYNOPSIS Check for synchronization of the event data		
AUTHOR TBD	OWNER/MAINTAINER/CONTACT PERSON TBD	
MOTIVATION TBD		
PREREQUISITES INT200 - INT215		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file	GENERATED OUTPUT FILES Test Report	
COMPLETION STATUSES		
DESCRIPTION		
COMMENTS		

**7.6.11. Multi-contributor high rate trigger**

NAME	TEST ID INT302	SVAC ID
ALIASES None	SUPERCEDES None	CATEGORY I&T
SYNOPSIS Check high rate trigger data integrity		
AUTHOR TBD		OWNER/MAINTAINER/CONTACT PERSON TBD
MOTIVATION TBD		
PREREQUISITES INT301		
REQUIRED EGSE		
REQUIRED INPUT DATA OR FILES Configuration file		GENERATED OUTPUT FILES Test Report
COMPLETION STATUSES		
DESCRIPTION		
COMMENTS		

## 8. File formats

Files used as input or generated as output will have well known formats. There are only two acceptable storage protocols: XML and FITS.

### 8.1. Schema and configuration files

Schema and configuration files are XML files. They contain several blocks denoted by XML tags:

- schema
- configuration
- engineering units conversion (egu)
- rules
- constraints

These files are shared with Flight Software.

### 8.2. Calibration files

#### 8.2.1. XML

- Dead tracker strips
- Noisy tracker strips
- Threshold data

#### 8.2.2. FITS binary tables

- Calorimeter pedestal data
- ACD pedestal data
- TKR ToT calibration constants

### 8.3. Event data files

Event data is a FITS file containing event data in binary images. The event data topology is described in LAT-TD-01546.