



DCN No.
LAT-XR-05891-01

LAT PROJECT DOCUMENT CHANGE NOTICE (DCN)

SHEET 1 OF 1

ORIGINATOR: Martin Nordby		PHONE: 650-926-3415	DATE: 2/18/05
CHANGE TITLE: DCN for TEM/TPS Mass Properties Measurement Procedure		ORG.:	
DOCUMENT NUMBER	TITLE	NEW REV.	
LAT-PS-05598	TEM/TPS Mass Properties Measurement Procedure	02	

CHANGE DESCRIPTION (FROM/TO):
Please see LAT-XR-05892-01 for changes to this document

REASON FOR CHANGE:

ACTION TAKEN: Change(s) included in new release DCN attached to document(s), changes to be included in next revision
 Other (specify):


DISPOSITION OF HARDWARE (IDENTIFY SERIAL NUMBERS):	DCN DISTRIBUTION:
<input checked="" type="checkbox"/> No hardware affected (record change only)	
<input type="checkbox"/> List S/Ns which comply already:	
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<input type="checkbox"/> List S/Ns to be built with this change:	
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SAFETY, COST, SCHEDULE, REQUIREMENTS IMPACT? YES NO
If yes, CCB approval is required. Enter change request number:

APPROVALS	DATE	OTHER APPROVALS (specify):	DATE
ORIGINATOR: M. Nordby (signature on file)	2/18/05		
ORG. MANAGER: G. Haller (signature on file)	2/18/05		
PSA- Darren Marsh (signature on file)	2/18/05		
CO-Author- A. Ortega (signature on file)	2/18/05		
DCC RELEASE: Natalie Cramar (signature on file)	2/18/05	Doc. Control Level: <input checked="" type="checkbox"/> Subsystem <input type="checkbox"/> LAT IPO <input type="checkbox"/> GLAST Project	

DCN No: LAT-XR-05891-01

TEM/TPS Mass Properties Measurement Procedure

 GLAST LAT PROCEDURE	Document # LAT-PS-05598-02	Date effective 2/17/05
	Author(s) Arturo Ortega Martin Nordby	Supersedes LAT-PS-05598-01
	Subsystem/Office Electronics & DAQ / Systems Integration	
Document Title TEM/TPS Mass Properties Measurement Procedure		

CHANGE HISTORY LOG

Revision	Effective Date	Description of Changes
01	01/26/05	Initial Release
2	17 Feb 2005	Section 4.6: clarified definition of UVW-Coordinate System; step 8: changed allowed spread on mass from 10 grams to 40 grams. Data Sheet: changed Data Table to embedded MS Excel worksheet with built-in formulas;

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1. SCOPE

This document describes the procedure required to measure the mass properties (weight and center of gravity) of the LAT Tower Electronics module (TEM)/Tower Power Supply (TPS) assembly figure 1.

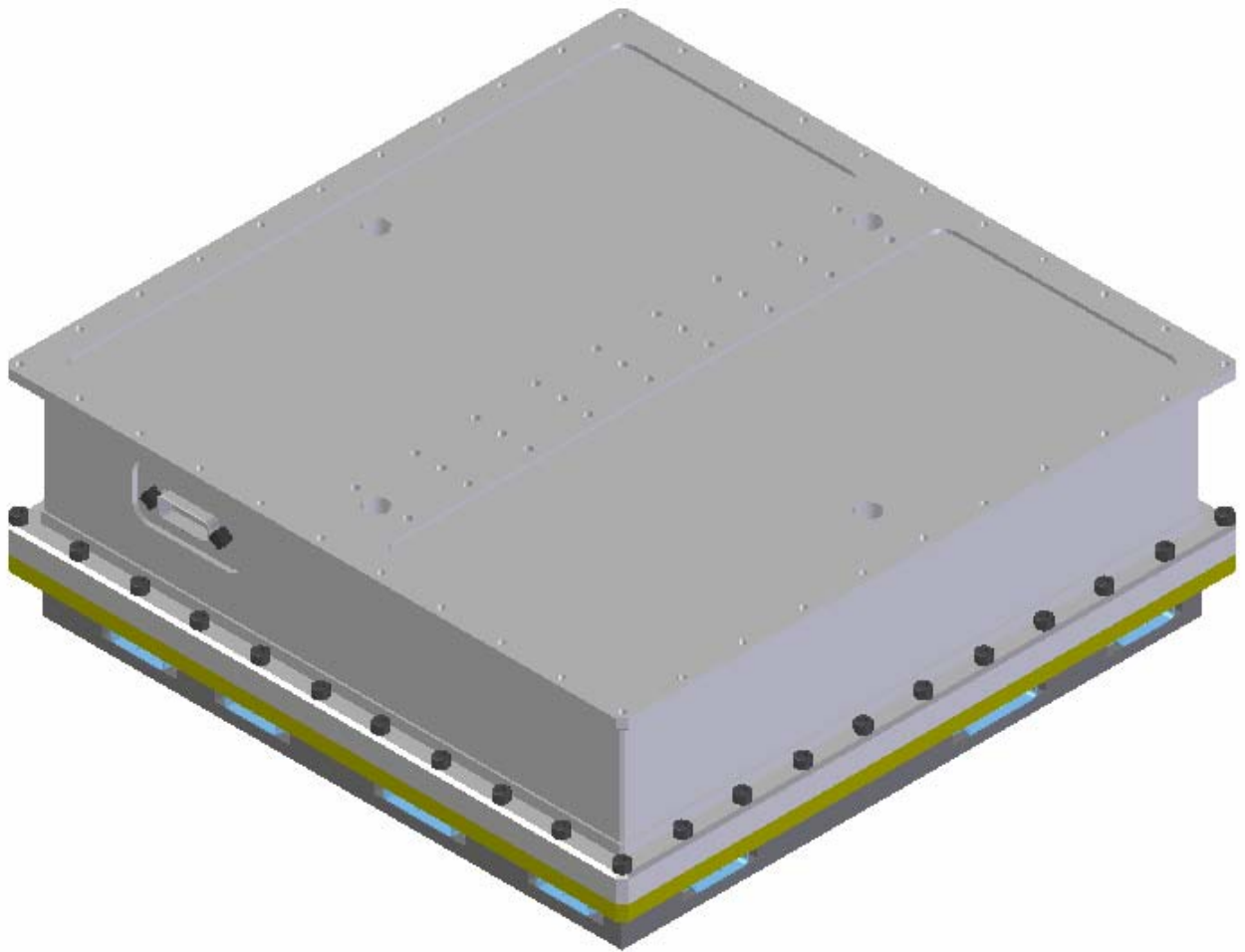


Figure 1 TEM/TPS ASSEMBLY LAT-DS-01643

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2. DEFINITIONS AND ACRONYMS

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

2.1 Definitions and Acronyms

GLAST	Gamma Ray Large Area Telescope
LAT	Large Area Telescope
TEM	Tower Electronics Module
TPS	Tower Power Supply
CG	Center of Gravity
CMM	Coordinate Measuring Machine

3. REFERENCES

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

3.1 Applicable Documents

Document Number	Description
LAT-DS-01643	TEM/TPS Assembly
LAT-DS-01481	TEM Assembly
LAT-DS-01482	TPS Assembly

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4. GENERAL REQUIREMENTS

4.1 MASS PROPERTIES

4.1.1 Mass

The maximum TEM/TPS assembly mass allocation is 8.46kg/18.68 lbs.

4.2 ENVIRONMENT

Weighing and CG operations shall be performed in the following environmental condition:

- Temperature: 20°C to 25°C

4.3 EQUIPMENT AND SUPPLIES

The following equipment and supplies are required for the procedure.

Test Equipment Description/Manufacturer	Model Number
Load Cell- 5lb capacity	Interface sm15 Load Cells
Load Cell Reader	Interface model 9820 Indicators
Weight Scale	
Mounting hardware	
Miscellaneous Hand Tools	
Coordinate Measuring Machine CMM	

4.4 PARTS LIST

This following assembly is required for the procedure.

Drawing Number	Part Description	Quantity
LAT-DS-01643	TEM/TPS Assembly	1

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4.5 WEIGHING OPERATION

All assemblies—qualification/protoflight and acceptance units—will be weighed per this section.

1. Verify that all connector savers have been removed from the boxes prior to weighing.
2. Setup and secure weight scale on a level surface. Slowly lower TEM/TPS assembly on to scale. Record weight and unit GLAT #.

4.6 MEASURING CENTER OF GRAVITY

Unit center of gravity will be measured for qualification and protoflight boxes, only. Follow-on unites do not need to be measured for center of gravity

1. Verify that all connector savers have been removed from the boxes prior to weighing.
2. Setup and secure three load cells on the load plate (see figure 2). Measure and record the location of each load cell in the plate coordinate system (X, Y, Z), as shown in figure 2.

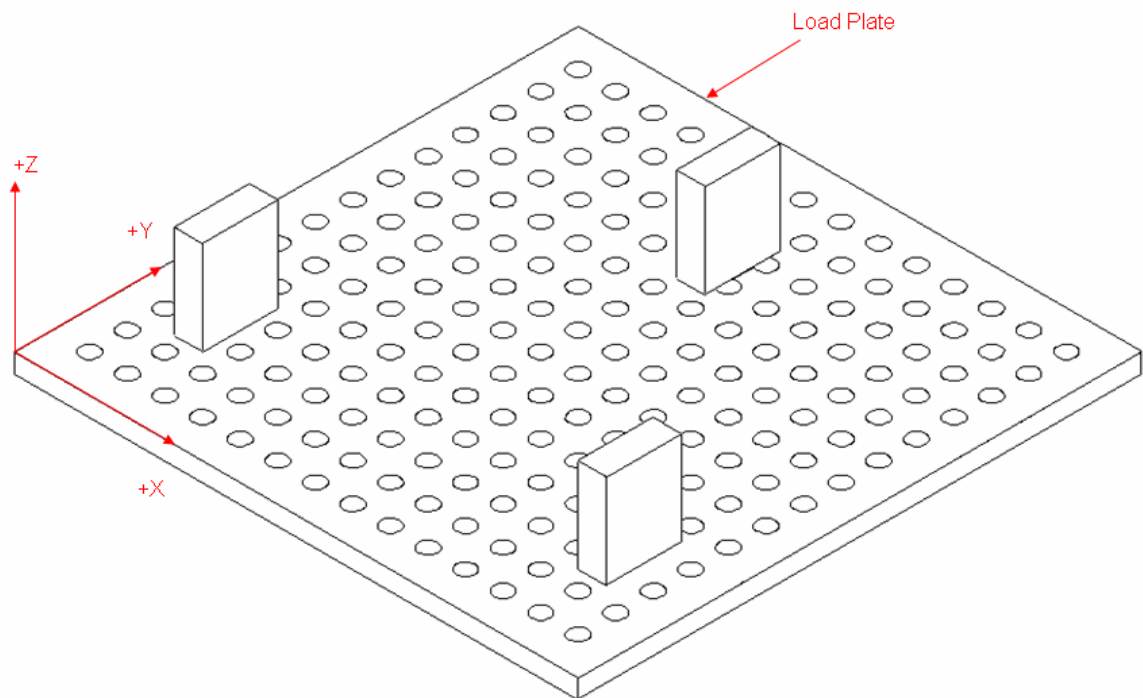


Figure 2. Load Plate/Load Cells

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3. Slowly place the TEM/TPS assembly onto the load cells (see figure 3). Set the unit down on the load cells in any orientation, keeping the geometric center of the box within the triangle defined by the 3 load cells.
4. Measure the location of the box in its as-mounted position by measuring the location of the auxiliary coordinate system (U,V,W) with the CMM using the U and V edges of the box and bottom surface, as defined in figures 3 and 4. Note that the UVW-Coordinate system is fixed with respect to the unit, and must be defined as shown in Figures 3 and 4. Since the unit will be measured in a static bag, take care to make sure the static bag is flat (no wrinkles) against the box when measurements are taken by the CMM. Record the rotation angle of the U-axis of the box coordinate system with respect to the X-axis of the plate coordinate system. Record in the Data Table.

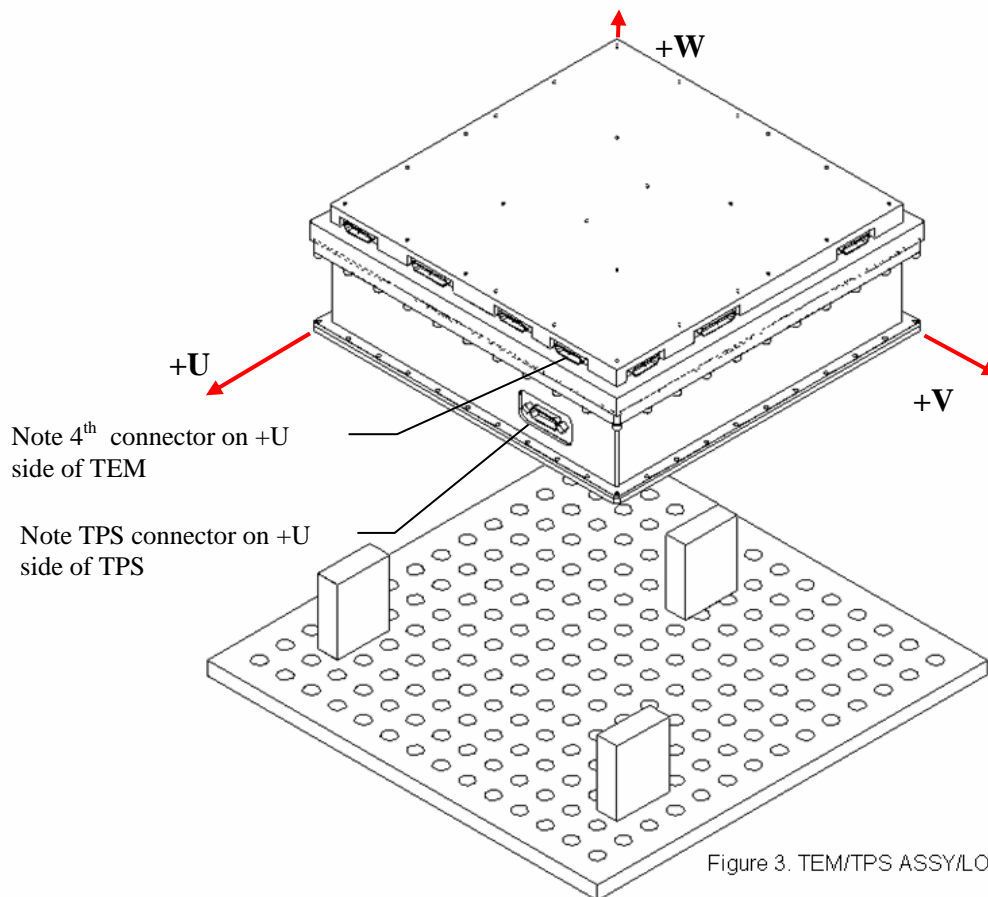


Figure 3. TEM/TPS ASSY/LOAD PLATE/LOAD CELLS

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5. In the CMM, transform the location of the load cells from the plate (X, Y, Z) to the box (U, V, W) coordinate system.
Record the (U, V, W) location of all 3 load cells in the Data Table.
Record the load reading for all 3 load cells in the Data Table.
6. Repeat steps 3-5 with the unit rotated 90 +/- 20 degrees from its initial orientation. Note that the UVW-Coordinate system is fixed with respect to the box, so it too rotates with respect to the XYZ-Coordinate system.
7. Repeat steps 3-5 with the unit rotated 180 +/- 20 degrees from its initial orientation.
8. Calculate the center of gravity and total weight for all 3 measurement orientations. Record results in the Data Table.
Verify that the center of gravity spread between the 3 measurements is less than 2 mm.
Verify that the weight spread between the 3 measurements is less than 40 grams.

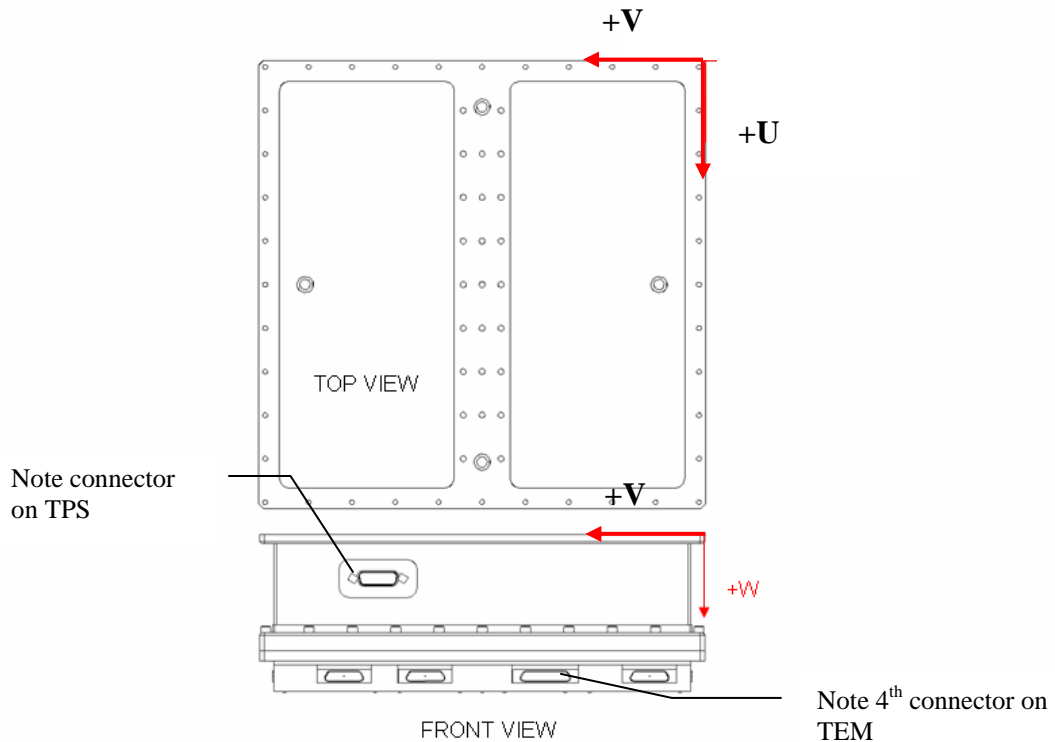


Figure 3. TEM/TPS Box Coordinates

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4.7 CALCULATION OF TEM/TPS CENTER OF GRAVITY

There are four values associated with each of the load cells 1, 2, and 3:

L1 = Load read by that load cell.

(U1, V1, W1) = the location of the load cell in box coordinates

Using the definitions listed above, find the box center of gravity (Ucg, Vcg) with the following formulae:

$$U_{cg} = (L1*U1 + L2*U2 + L3*U3) / (L1 + L2 + L3)$$

$$V_{cg} = (L1*V1 + L2*V2 + L3*V3) / (L1 + L2 + L3)$$

TEM/TPS Mass Properties Measurement Data Sheet

Procedure No. LAT-TD-05598-01

Page ___ of ___

Part Number: LAT-DS-01643

Test Type: TEM/TPS Mass Measurement

Test Operator (s):

Name: _____

Phone Number: _____

Calibration Record

Description	Serial #	Date of Last Calibration	Calibration Due Date
Weight Scale			

Procedure

Step/ Description: Section 4.1	Performed by/date:	Q.A.	Notes:
1. Verify that connector savers are all removed			
2. Weigh unit on scale			
Unit Serial #: _____ Mass: _____ kg			

Test Data Review and Approval:

Test Operator/Engineer: _____ Date: _____

Responsible Engineer: _____ Date: _____

Quality Engineer: _____ Date: _____

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TEM/TPS Mass Properties Measurement Data Sheet

Procedure No. LAT-TD-05598-01

Page ___ of ___

Part Number: LAT-DS-01643

Test Type: TEM/TPS CG Measurement

Test Operator (s):

Name: _____

Phone Number: _____

Calibration Record

Description	Serial #	Date of Last Calibration	Calibration Due Date
Load Cell 1			
Load Cell 2			
Load Cell 3			

Procedure

Step/ Description: Section 4.1	Performed by/date:	Q.A.	Notes:
1. Verify that connector savers are all removed			
2. Set up load cells and define plate coordinate system. Measure load cell location in plate coordinate system.			
<u>Measurement #1</u> 3. Set box on load cells			
4. Define box (U, V, W) coordinate system. Record offset of the box U-axis with respect to the plate X-axis in Data Table.			
5. Transform the load cell coordinates into the box (U, V, W) coordinate system. Record load cell locations and loads in the Data Table			

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Measurement #2 3. Set box on load cells rotated 90 +/- 20 degrees from original orientation 4. Define box (U, V, W) coord. system. Record offset of the box U-axis with respect to the plate X-axis in Data Table. 5. Transform the load cell coordinates into the box (U, V, W) coordinate system. Record locations, loads in the Data Table			
Measurement #3 3. Set box on load cells rotated 180 +/- 20 degrees from original orientation 4. Define box (U, V, W) coord. system. Record offset of the box U-axis with respect to the plate X-axis in Data Table. 5. Transform the load cell coordinates into the box (U, V, W) coordinate system. Record locations, loads in the Data Table			
8. Calculate center of gravity and total weight for all 3 measurements. Record results in Data Table Verify that spread is within allowables			

Data Table

#	Load Cell	U offset (degrees)	Load Cell Location/Reading				Box CG/Weight		
			U (mm)	V (mm)	W (mm)	Load (kg)	U (mm)	V (mm)	Weight (kg)
1	L1						0.000	0.000	0.000
	L2								
	L3								
2	L1						0.000	0.000	0.000
	L2								
	L3								
3	L1						0.000	0.000	0.000
	L2								
	L3								
Average:							0.000	0.000	0.000
Spread:							0.000	0.000	0.000

Test Data Review and Approval:

Test Operator/Engineer: _____ Date: _____

Responsible Engineer: _____ Date: _____

Quality Engineer: _____ Date: _____

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