ACD-RPT-0000xx

Responsible Office: GSFC / Code 661 / GLAST ACD

Title: TDA-PMT-Resistor Network End-to-End Thermal-Vacuum Test Report

1. Purpose

This report describes the results of the Engineering Tests performed on two Tile Detector Assemblies (TDAs) and Photo Multiplier Tube (PMT)/Resistor Network Assemblies in a thermal vacuum chamber for the Gamma-ray Large Area Space Telescope (GLAST) AntiCoincidence Detector (ACD).

2. Scope

This report describes the procedures, data, and results, of test which were performed to verify the design of the TDA, Clear Fiber, and PMT assembly) under thermal-vacuum conditions, including high temperature operational & survival, low temperature operational & survival, and thermal cycling.

3. Acronyms

ACD – AntiCoincidence Detector
GLAST – Gamma-ray Large Area Space Telescope
TDA – Tile Detector Assembly
T-Vac – Thermal Vacuum
TTA – Triggering Tile Assembly
PMT Photo multiplier Tube
RN- Resistor Network

4. Applicable Documents

This test required that the following documents implemented.

Tile Detector Assembly (TDA) TEST B PROCEDURE
Tile Detector Assembly (TDA) TEST A PROCEDURE
Tile Detector Assembly (TDA) Thermal Vacuum Test Procedure
PMT/Resistor Network Test Procedure

5. Test Equipment Used

High Voltage Power Supply	Tennelec TC 952
Digital Multi-Meter	Fluke
High Voltage Probe	Fluke 80K-40 HV Probe
Thermal Vacuum Chamber	Building 4
TDA Signal Pre Processor Rack	LeCroy
VME Box	Data Design Corp., SCICrate
PC, monitor, keyboard, printer	TBS
High Resistance Tester	Hewlett Packard HP 4329A
TDAs with Clear Fiber	Fermi Labs S/N 01,02, 03
Low Voltage Power Supply	Topwood 6302A
Oscilloscope	Tectronic TDS754C

Test Fixtures

Support for TDA under test	Figure 2
Support for TTA Tiles	Figure 2
Test Cables	TestbCab.doc

6. Test Location

This Thermal Vacuum Test was conducted the Thermal Engineering Branch's 36-inch vacuum chamber located in Building 4. Room 191 at GSFC.

7. Test Setup

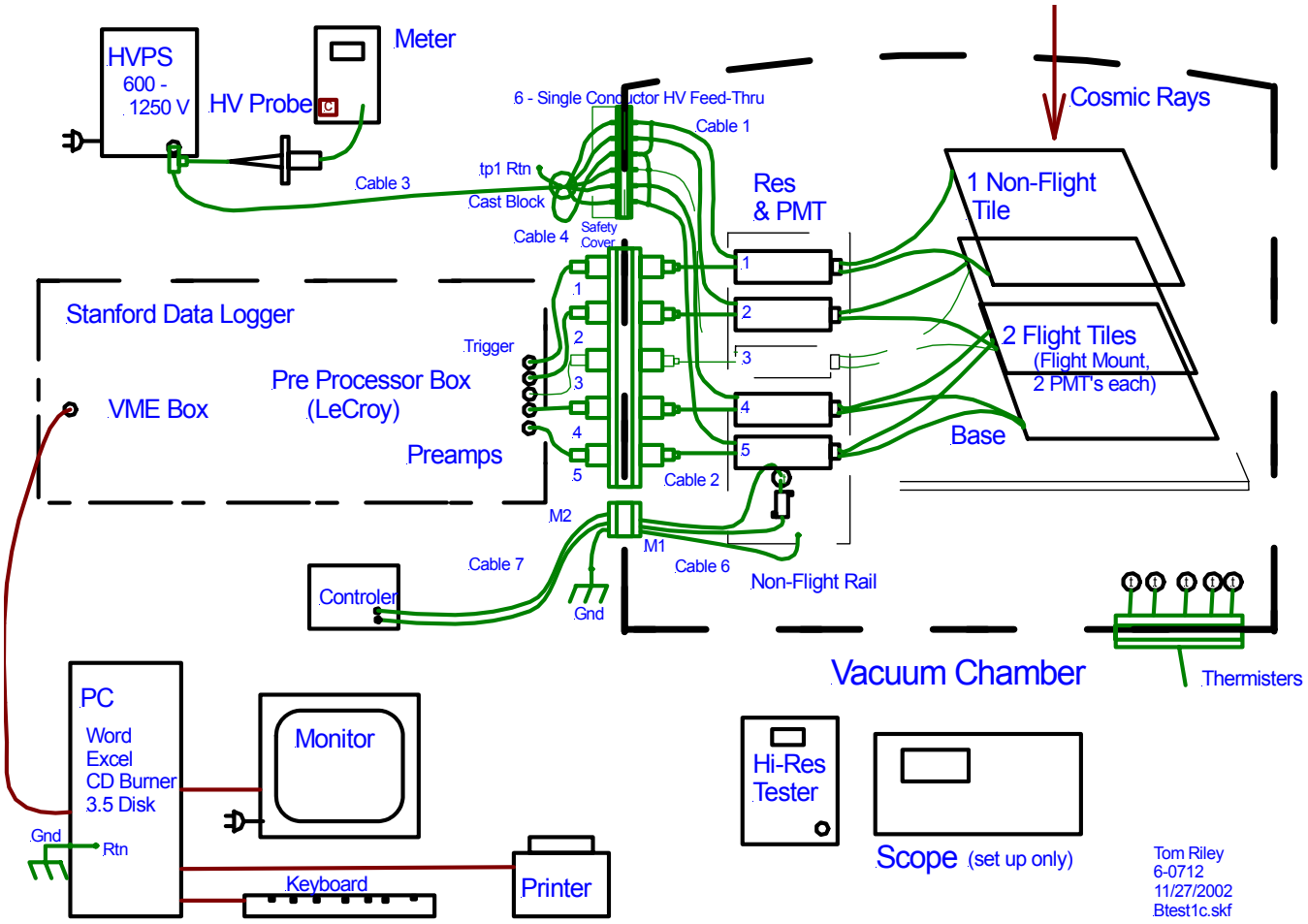

Figure 1 -- Engineering "B" Test Configuration

8. As Tested Configuration

TDA/PMT High Voltage Connections

Tile Serial Number	Internal HV Cable Number	PMT Serial Number	Feed-thru Clock Position
001	1	610	1
001	1	875 or 879	2
002	1	880	3
003 (TTA)	1	883	4

		GND	Center conductor

TDA/ PMT Signal Connections

Tile Serial Number	PMT Serial Number	Internal Cable	External Cable	Preamp Input
001	610	2	4	1
001	875 or 879	2	4	2
002	880	2	4	3
003	883	2	4	4

8. Thermocouple Locations

Thermocouples were attached to test hardware at locations designated below. The temperature at these location was monitored and recorded continuously throughout the test.

Thermocouple #	Location	Detail
1	PMT 1	On PMT
2	PMT 2	On PMT
3	PMT 3	On PMT
4	PMT 4	On PMT
5	TDT Connector Bundle	Near Shroud
6	TDA Connector Bundle	Middle
7	TDA Connector Bundle	Toward TDA
8	Support Frame	Rear left
9	Platen	
10	Shroud	
11	Coldfinger	
62	Coldfinger	
63	PMT Bracket	Rear Left
64	PMT Bracket	Front
65	Top Test Tile	Front
66	Top Test Tile	Side
67	Trigger Tile	Middle
68	Honeycomb Panel	Front
69	Bottom Test Tile	
70	Bottom Test Tile	Right side
71	Honeycomb Panel	Left
72	Support Frame Vertical	Front Left

73	Honeycomb Panel Right Rear	Underside

9.0 High Resistance Tests

Using the PMT/Resistor Network Test Procedure, attempts were made to measure the resistance between the high voltage + input and high voltage return (shield for high voltage connectors), for each PMT/ Resistor Network. However due to the grounding configuration of the chamber and fault protection in the High Voltage Meter, all readings inaccurately designated the resistance looking into the Resistor Network input as an open circuit.

10.0 Vacuum Chamber –Vacuum Pressure

This step was performed by Code 545 personnel. The target pressure for this test was1x10-6 torr. Throughout the test, there were periods, particularly during Hot Soaks, when the chamber pressure rose above 5 x 10-5 torr, due to minor outgassing. However the pressure inside the chamber consistently returned to below 1 x 10-6 torr prior to applying the high voltage to the PMTs for Test B.

11.0 Thermal Cycling

The thermal cycling phase of the test was conducted following the profile in Figure 3. During the temperature cycling, at the end of each operation plateau (Hot or Cold Soaks), the hardware was subject to a functional test (Test B), the procedure for which is located in the appendix A. Additionally the hardware inside the chamber was subject to 3 cycles Survival Soaks, and then retested using the same functional test (Test B).

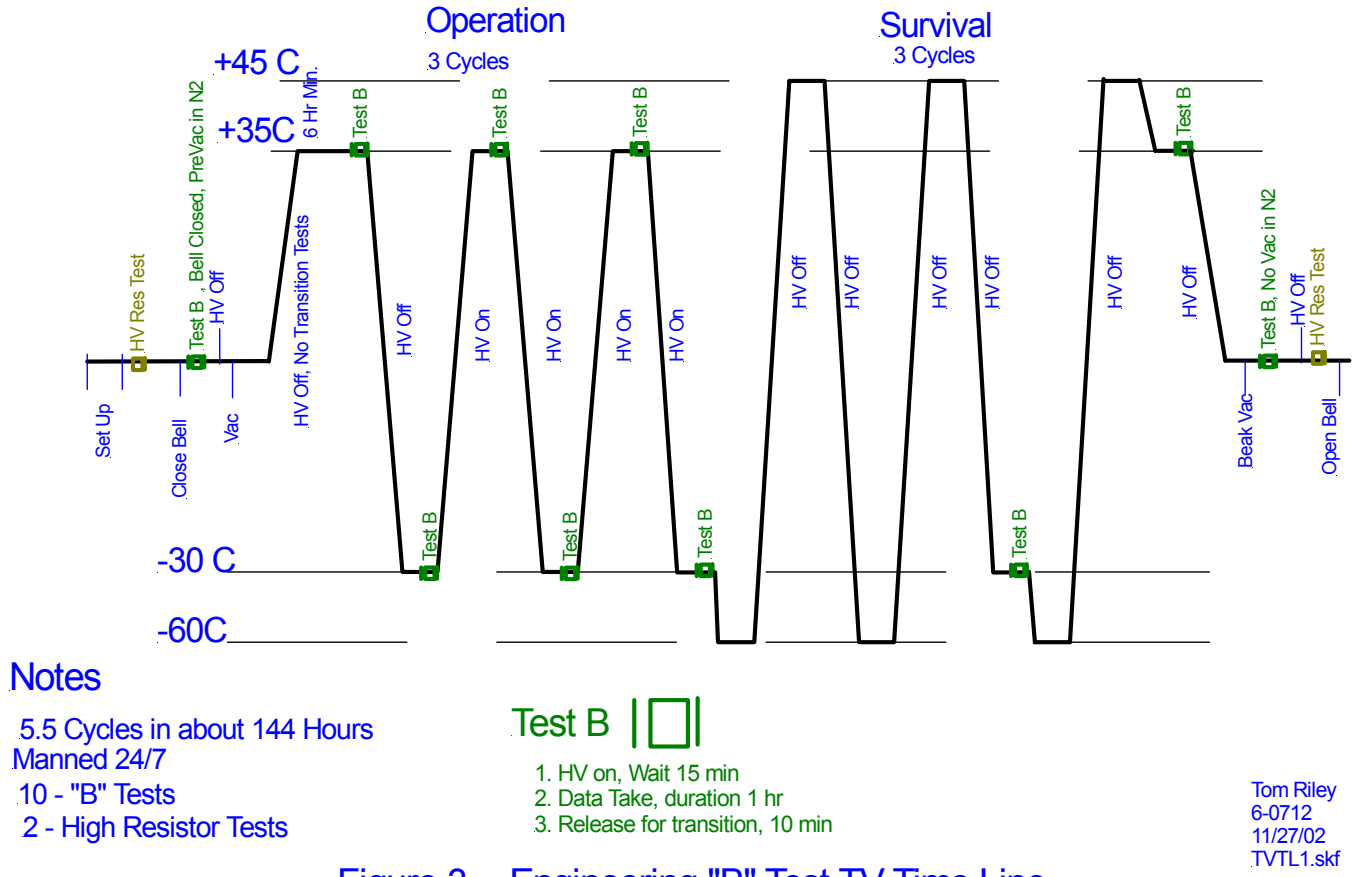

Figure 3 -- Engineering "B" Test TV Time Line

12.0 Results

The follow data represent the results of the Thermal Vacuum Test performed on the TDA/PMTs. These charts reflect the PMT light-yield/histogram data vs the average temperature, at the designated TC locations, during the various Test B's performed, as specified in figure 3.

GLAST ACE Thermal Vacum Test Reduced Data

1. Average Counts

	Avg Temp	PMT 1	PMT 2	PMT 3	PMT 4	Temp 1	Temp 2	Temp 3	Temp 4
1. Amb 1	22.04	502.55	638.95	591.20	463.61	22.04	22.02	22.06	22.06
2. Hot 1	40.06	502.55	638.95	591.20	463.61	40.07	40.12	40.02	40.04
3. Cold 1	-30.41	715.18	952.12	855.96	636.75	-30.33	-30.33	-30.53	-30.46
4. Amb 2	26.71	449.22	685.08	607.64	462.80	26.68	26.73	26.72	26.71
5. Hot 2	39.50	407.95	561.49	562.64	435.97	39.34	39.43	39.59	39.61
6. Cold 2	-29.59	577.28	994.75	797.46	601.15	-29.73	-29.60	-29.57	-29.47
7. Hot 3	35.59	416.65	649.28	561.55	439.54	35.53	35.58	35.61	35.63
8. Cold 3	-38.35	588.91	1001.06	836.65	627.26	-38.31	-38.24	-38.47	-38.37

9. Amb	20.73	450.11	717.99	614.22	474.56	20.78	20.83	20.64	20.66
10. Cold 4	-32.16	587.53	1018.40	834.16	629.84	-32.87	-32.81	-31.52	-31.43
11. Hot 4	36.58	413.40		557.04		36.58	36.57	36.57	36.61
12. Amb 4	29.15	435.80	690.77	592.91	479.23	29.09	29.06	29.21	29.22

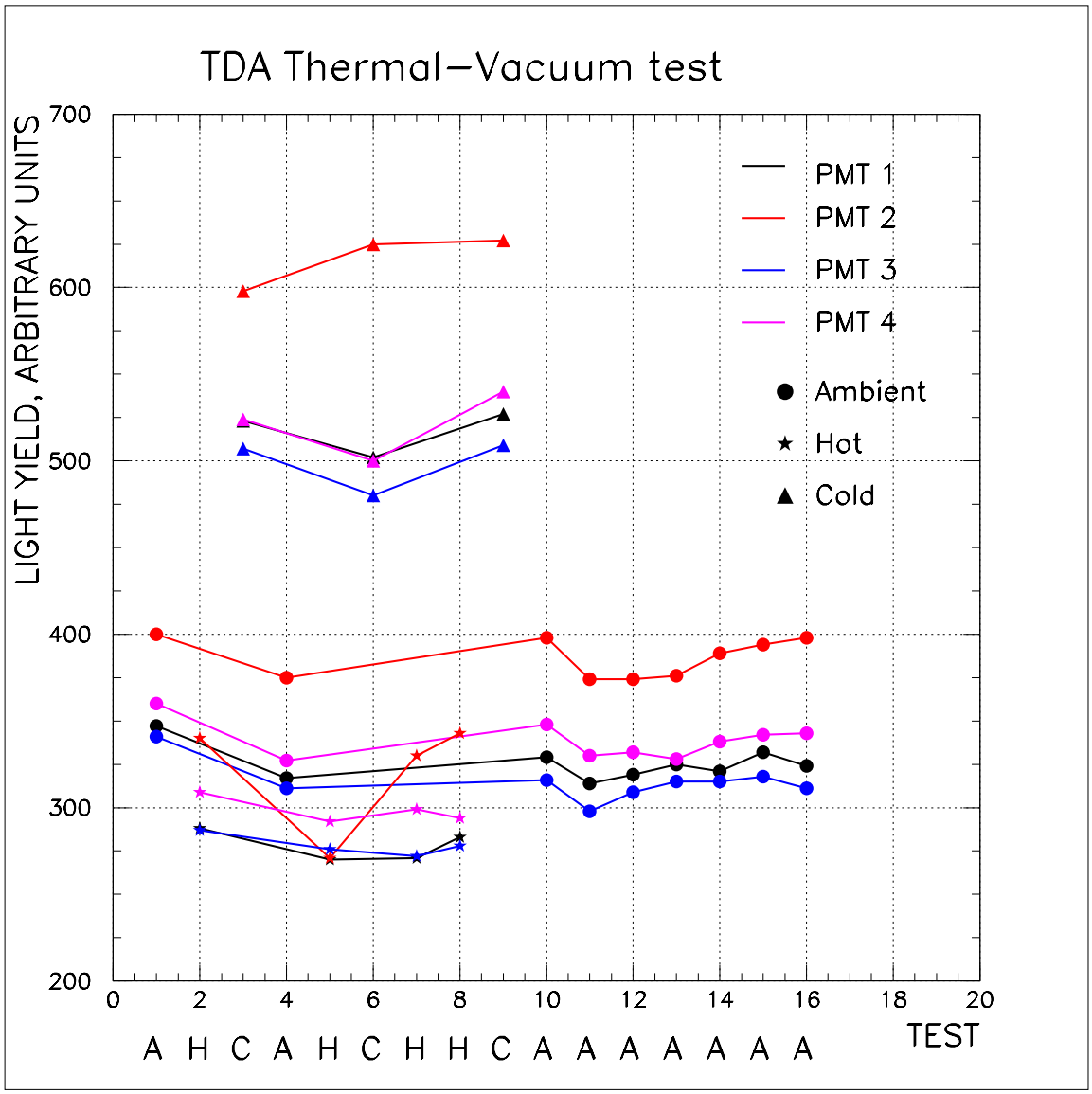

Fig. 2. Light yield from TDA as measured in thermal-vacuum test. Four colors (black, red, blue, and purple) stand for four PMTs . Three different marker styles stand for three temperatures (filled circle is for ambient temperature of +20C, stars are for hot of +35C, and triangles are for cold of –30C). 6 last measurements at the ambient temperature were made to determine the measurement precision.

13.0 Conclusions

1. Although there is a known performance change with temperature (the system has more light output when cold), for a given temperature the performance was constant. Within the measurements uncertainties, the performance of the tile Detector Assemblies was the same after the Thermal Vacuum test as before. This confirms that the temperature change within the operational range does not cause any degradation TDA degradation.
2. We observed the change of the most probable signal amplitude from single mip over the temperature range from –30C to +35C to be ~1% per degree of C. It increases with temperature decrease, so we can expect the increase of the signals by about 40% at operational temperature (-20C) in respect to the ambient temperature. Observed rate of signal change (1%/degree C) is slightly higher than we expected from our earlier TDA thermal test where we observed ~0.75 %/degree C
3. We believe that about half of the performance change (~0.4-0.5 %/degree C) comes from PMT. It agrees with data provided by Hamamatsu and with that measured by us in earlier TDA thermal test. The remaining half comes from fiber-to-fiber connector with some small (0.05-0.1 %/degree C) contribution from the scintillator.
4. Obtained results lead us to the necessity of correcting the VETO threshold values with the temperature with the steps of 5-8 C.

Appendix A

AM, 11/26/2002
Revised 12/02

TDA Test "B" Procedure

The purpose of this test is to measure the response of the TDA to the cosmic muons which produce the signals equivalent to that required from ACD to detect. The measurements should be performed during the thermal-vacuum tests and compared with each other. The change of the response (light yield) against the temperature is expected. The difference of the TDA response (light yield) between the measurements done at the same temperature should not differ by more than 10%.

1. Initialization step – all connections are done, NIM rack (with NIM modules), Low Voltage PS, PC are turned ON. HVPS's are in stand-by mode
2. Start LabView program by clicking the icon (needs to be done only once, or if any problem occurred and the PC has been re-booted)
3. Turn ON HVPS to +1100V (by knob). No waiting time is needed to start the measurements.
4. Make re-connections (if needed) in black box (delays). Connect Lemo cables as follows:
   Cable "1" - to C2-1 "IN"
   Cable "2" - to C2-6 "IN"
   Cable "3" – to C2-10 "IN"
   Cable "4" – to C2-14 "IN"
   This is a run "Test for PMT 3 and 4"
5. Insert the name of the file to be written in the box (second from the bottom) as C:\Data\Thermal_Vac\[myfile]. Click "enter" at the left upper corner of the screen
6. If box "Ignore PHA values below" is 200, change it to 0
7. Click "start" button (arrow) at the left upper corner. The borron next but one to it should become red. Look at the histograms started collecting in the windows (look at numbers 1 and 2). If they look reasonable, click the button next to the box with the name of the file to be written. It should get red.
8. Collect the data until the file reaches the size of 80-100K (approximately 15 –20 min.). Stop the file by clicking the red button at the left upper corner.
9. Check the shape of histograms #1 and #2 in the windows. If they look correct – this run is done.
10. Make re-connections in black box again:
    Cable "1" – to C2-10 "IN"
    Cable "2" – to C2-14 "IN"
    Cable "3" – to C2-1 "IN"
    Cable "4" – to c2-6 "IN"
    This is a run "Test of PMT 1 and 2"
11. Repeat steps 5, 7, 8, and 9
12. Put HVPS in stand-by mode.
13. Continue to the next test.