STEREO IMPACT

PROBLEM REPORT
PR-2006
LET Upside-down
5/2/2005

PR Numbers: 1xxx=UCB, 2xxx=Caltech/JPL, 3xxx=UMd, 4xxx=GSFC/SEP, 5xxx=GSFC/Mag, 6xxx=CESR, 7xxx=Keil, 8xxx=ESTEC, 9xxx=MPAe

Assembly: SEP	**SubAssembly: LET**
Component/Part Number:	**Serial Number: FM1**
Originator: Branislav Kecman	**Organization: Caltech**
Phone: (626) 395-4264	**Email: kecman@srl.caltech.edu**

Failure Occurred During (Check one √)

□ Functional test √ Qualification test □ S/C Integration □ Launch operations

Environment when failure occurred:

□ Ambient √ Vibration □ Shock □ Acoustic
□ Thermal □ Vacuum □ Thermal-Vacuum □ EMI/EMC

Problem Description

In preparation for Thermal Balance test while installing thermo-couples on the FM1 LET/HET/SEP Central the unit was hung upside-down from the cleanroom crane hook for bottom TC installation, and left in that position overnight under power. From the playback data it is evident that something happened just about the time the unit was turned upside-down, causing very high LET leakage currents on all channels. LET stopped producing pulsed ADC-only events and its rates were low as in a quiet state. After a while leakage currents became non-uniform, some were in red limits and some quite low. The main current was normal before the instrument was left for the night (0.228 A @ 28 V). The following day (Sunday) the problem was discovered through HK telemetry where LET leakage currents were all over the place. The main current was down, at exactly the same level as if LET were not booted (0.200 A @ 28 V), although it had been booted and was responding to commands. The unit recovered when it was returned right side up.

Analyses Performed to Determine Cause

(Reference the following page for a complete description and pictures.)
Four 0-80 screws holding down the shield had backed out and were loose inside LET. One of them had lodged between two test points for GND and +13V and was responsible for the short. The screws in the SEP/HET/LET assembly screws were torqued (but this is unverified). All of the screws in LET and HET were not staked. The screws in SEP Central were staked at the heads. There is no other locking feature on the screws used in this assembly. The 0-80 screws were torqued to 2 in-lb.

Corrective Action/ Resolution

√ Rework □ Repair □ Use As Is □ Scrap

1. Completed a visual inspection of the unit and all four loose screws were accounted for.
2. Stress analysis was performed and 27.4-ohm filter resistor R104 in LET FM1 (P/N D55342K07B27D4S) was replaced with the same P/N. UCB reviewed the LVPS design and believes it was not stressed. (email dated 5/5/2005 from D.C.)
3. Disassembled and replaced all of the screws in SEP Central, HET and LET. Reference assembly procedures: LETAssemblyProcPartial_revB.doc, SEP-fastener-replace-proc.doc, HETAssemblyProcParital.doc
    a. Applied a locking feature (Poly-Lok) to all of the hardware.
    b. Through analysis and test determined the proper torque value to use for the new hardware.
    c. When possible, staked the threads of all of the screws with EC2216. (Reference procedure to the screws that were not staked.)
    d. Carefully reassembled, following a detailed procedure, which included the documentation and verification of each screw in the all of the assemblies. The “buddy system” was required during all assembly.
4. Continue with thermal vacuum testing. Acoustic tests do not need to be repeated. Retest needed for vibration. Recommended – 3 axis vibe, which was successfully completed during 7/12/05-7/13/05.

STEREO IMPACT

Date Action Taken:_5/1/05-5/8/05 **Retest Results**:__success_____

Corrective Action Required/Performed on other Units √ Serial Number(s):

Only the Loose Screw Corrective Action applies to the other units.

- FM2 SEP/HET/LET (This corrective action will be performed under PFR 2007)
- FM1/FM2 SIT (decision to perform corrective action will be made after the flight units are opened for PFR 3010 and 3014 and the screws are inspected. If the screws inspected have retained their torque then the SIT flight units will be left as is.)

Closure Approvals

Subsystem Lead:	_Branislav Kecman_____	Date:_8/31/05____
IMPACT Project Manager:	_____	Date _____
IMPACT QA:	_____	Date:_____
NASA IMPACT Instrument Manager:	_____	Date:_____

SUPPORTING MATERIAL:

Analysis Performed to Determine Cause:
5/3/2005 –

1. Carefully remove LET top cover, check the power supply voltages (all are accessible).
2. Probe selected signals using an oscilloscope. There is only one signal that seems likely to be the source of our trouble: CMD-DATA. This signal originates at the MISC ACTEL and can be probed there. The signal travels within the PCB to the flex circuit that connects the digital and detector boards and eventually makes its way to one of the PHASICs. Unfortunately, we will only be able to probe the signal near its source without further disassembly. There are two other signals that are related to CMD-DATA: CMD-CLK and CMD-STROBE. While it seems unlikely that these signals are at fault, we will also check them. Since all three of these signals originate at the ACTEL and drive a fair amount of capacitance on the way to the PHASICs, it may be possible to carefully observe the signal transient waveforms and infer whether or not one of them is currently driving a much reduced capacitive load (as might occur if there is an open circuit).

RESULTS: Opened up the lid of LET FM1. However, upon powering on and booting the instrument, LET FM1 came up in a normal state. It remained in this state overnight.

5.4/2005 –

1. Turn FM1 upside down again.

RESULTS: Turned FM1 upside down again and it almost immediately went into the lower current (200mA) state. It returned to the normal (228mA) state after being turned back. It was then turned upside down again and shaken. It stayed at the normal 228 mA. The LET was placed into the "robust" state and turned upside-down. After about a minute upside-down the current dipped to 200 mA and then returned to normal within a few seconds. After another few minutes the current went first to 204 mA then after a few seconds to 334 mA. A command (TIME.) was sent, which worked, and then the power supply was turned off.

5/5/2005 – Plan for further disassembly and measurements.

1. With LET partially opened, perform measurements to determine if the power supply voltages are ok. We will set up to make the measurements with power off, then briefly power on only long enough to make the measurements (10s of seconds).
2. Disconnect the LET connector (which will take special effort) to SEP Central and repeat a brief power on test just to measure total 28 V current. This should help determine whether the excess current was being drawn by LET or not.

RESULTS UPDATE: 5/5/2005 1:23 PM
Measurements of the power supply voltages within LET have revealed that the 13 Volt supply is shorted to ground (0.2 ohm). The short is within LET since the voltage measured on the LET side of the series filter resistor (27 ohm) is only 25mV, while the voltage on the other side is 9.73 V. The current through the filter resistor is then about 350 mA and the power is about 3.3 W.

1. Proceeding to demate the connector between LET and SEP Central to allow further inspection and debugging of LET and monitoring the short resistance from here out. (SEP Central seems off the hook for now.)

RESULTS UPDATE: 5/5/2005 5:02 PM

Four 0-80 screws holding down the shield had backed out and were loose inside LET. One of them had lodged between two test points for GND and +13V and was responsible for the short. All loose screws have been accounted for. We will need to replace the one filter resistor in LET FM1 that saw 350 mA and 3.3 W. (See attached pictures)

To get to this far, LET FM1 disassembly involved removal of the following:
- fourteen staked 0-80 screws from the top cover
- dozen staked 2-56 screws from each of the two side walls
- half dozen staked 0-80 screws from one side wall
- purge hose from one side wall
- dozen staked 2-56 screws from the base of LET bracket
- two non-staked 1-mm jack-screws
- one Nanonics connector
- LET bracket from SEP Central box
- fourteen non-staked 0-80 screws from the top board

There are more disassembly steps needed in order to inspect, re-torque and stake the remaining 0-80 screws within LET, some of which are behind the one-time use windows. L3B detector replacement will require some more disassembly too.

Inside SEP Central box all 2-56 screws holding boards had been staked except for HET board.

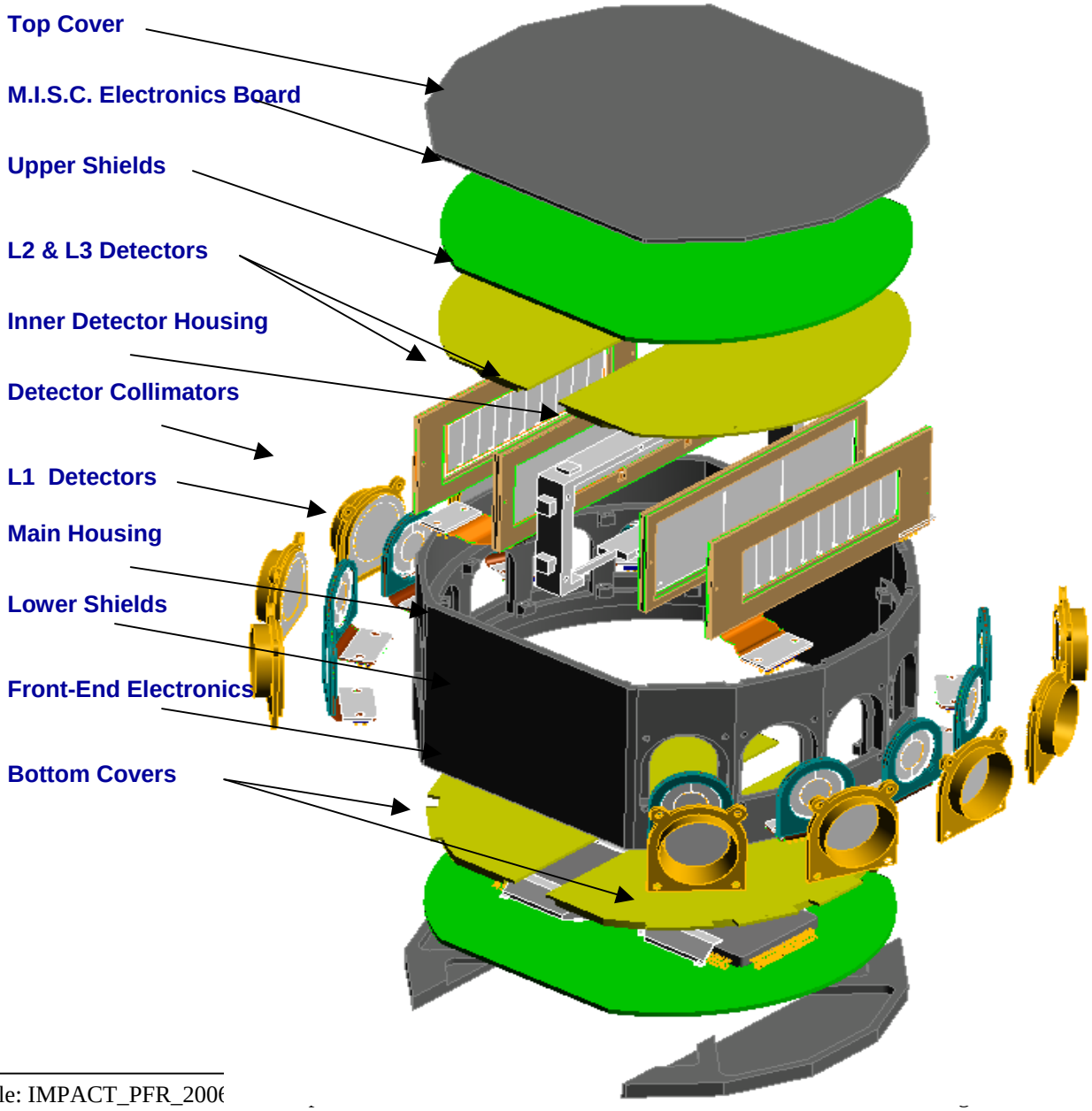
STEREO IMPACT

PLAN TO PROCEED:

1. Complete visual inspection .
2. Perform a stress analysis due to the short.
3. Determine why the screws backed out and develop a plan to proceed.

Alexia Lyons, 6/3/2005
I looked up the MIL-DTL-18240, the specification that defines the requirements for self locking fasteners, and it does not cover #0-80 fasteners. The smallest fastener called out is #4.

This doesn't change the direction we are going in for LET, but I would advocate applying the EC2216 to the threads as many places as possible (or Uralane 5753 if the threads are in spec).



STEREO IMPACT