STEREO IMPACT

PROBLEM REPORT
PR-3002
Waterman/Walpole
8/6/04

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

Assembly : Time of Flight Electronics	**SubAssembly : ATOF**
Component/Part Number: ATOF FM 2_1 (FM1 Instrument)	**Serial Number: 0344**
Originator: Waterman/Walpole	**Organization: UMd**
Phone : 301-405-4517	**Email : waterman@uleis.umd.edu**

Failure Occurred During (Check one √)

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

Environment when failure occurred:

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

Problem Description

The Start count rate from Time of Flight Electronics was zero.

Analyses Performed to Determine Cause

Tested the ATOF board for the Start signal. No Start signal output measured from the ATOF board. Verified that the signal was present on the base of Q1, AT41435, and that no signal output was present from the collector of Q1. Measured the dc resistance on the base of Q1 to ground. The measured resistance from the base of Q1 to ground was incorrect, lower than expected. We were unable to measure the front-end protection diodes in circuit on the PC board
A stress analysis was performed and the conclusion is that Q1 is bad and that the front end diodes, 1N5711, D1, D2 and D3 are most likely bad. See the attached Schematic. See Page 2 for more detail analyses.
The 500 V spike was more than sufficient to damage the ATOF Start signal front end.

Corrective Action/ Resolution

X Rework (flight board) **X** Repair (GSE) □ Use As Is □ Scrap

The start signal electronics, Q1 (AT41435), (1N5711) D1, D2 and D3 was replaced with new parts. To prevent this from occurring again, we have permanently added a 10K ohm termination resistor to ground to the both the Start and the Stop vacuum chamber BNC connectors (GSE). We then repeated the previous test using the 10K ohm termination resistor, except, this time leaving the 10K termination resistor connected. There was no measurable voltage observed.

Date Action Taken:_____8/7/2004_____ **Retest Results**:____Success, board level test. __
Corrective Action Required/Performed on other Units □ Serial Number(s): ____n/a___

Closure Approvals

Subsystem Lead: _____ Date:_____
IMPACT Project Manager: _____ Date _____
IMPACT QA: _____ Date:_____
NASA IMPACT Instrument Manager: _____ Date:_____

Analyses Performed to Determine Cause, Continued

Measured the discriminator output of the DTOF. The Stop signal was verified and there was no Start signal present. Injected a test signal of 300 mV to the ATOF Start input. No signal was present on the output of the Start discriminator circuit. Disassembled the SIT Electronics, FM1, and removed the ATOF board. Using a Multimeter measured R46 and verified that it was 51 ohms. We were unable to measure D1, D2 and D3 in circuit, because of R46. Measured R7 and verified that it was 1K. Measured the Base resistance of Q1 to ground, 660 ohms and 673 ohms, depending on the polarity of the measurement. The value should have measured 1K ohm. Measured the resistance of the Start input transistor, Q1B; Base to ground was 1K ohm.
Powered up the ATOF by itself, applied input signal to the Start input. Measured and verified that a signal was present at the Base of Q1. Attempted to measure a signal at the Collector of Q1, no signal present. Applied a signal to the Stop input. Measured and verified the correct signal at the Base and the Collector of Q1B.
Conclusion of troubleshooting, Q1 is bad and D1, D2 and D3 are most likely damaged.
Phoned the Max Planck Institute, the ATOF boards manufacture, to discuss our testing results and perform a stress analysis on the circuit. They concurred our conclusion to remove and replace Q1, D1, D2 and D3. Max Planck shipped us the replacement parts.

Investigation into the possible cause of the failure was the following.
One possible cause was that the Start input experienced an over-voltage from the test Pulser. The test Pulser was measured and verified that the output was 1V. This was expected and in the acceptable range. The signal output from the test Pulser is then attenuated by the test Attenuator. The test Attenuator output is connected to the Start input to the ATOF. The output of the test attenuator was measured to be 100mV. This was as expected and in the acceptable range.
Another possible cause of the failure could have been a high voltage pulse coming from the Start signal line from the Telescope. The Start signal from the Telescope is connected to the BNC connector on the Vacuum chamber bulkhead. The following was performed in order to determine if the there was a possible test configuration that could have caused a high voltage pulse. This testing involved using an oscilloscope and did not include any of the Time of Flight Electronics. The Start signal BNC connector had a 50 ohm termination resistor connected to it. The high voltage, 4KV, was then turned on to the Telescope. The 50 ohm termination resistor was disconnected and than the high voltage was ramped to 0 volts. Using an Oscilloscope, a 500 V negative voltage pulse was measured on the Start signal BNC connector
The conclusion is that the 500 V spike was more than sufficient to damage the ATOF Start signal front end. To prevent this from occurring again, we have permanently added a 10K ohm termination resistor to ground to the both the Start and the Stop vacuum chamber BNC connectors. We then repeated the previous test using the 10K ohm termination resistor, except, this time leaving the 10K termination resistor connected. There was no measurable voltage observed.

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