PROBLEM REPORT
PR-1028
FM1 SWEA Cold Start
2004-12-13

STEREO IMPACT

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

Assembly : SWEA/STE-D	**SubAssembly :**
Component/Part Number:	**Serial Number:** FM1
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Failure Occurred During (Check one √)

Functional test | v Qualification test | S/C Integration | Launch operations

Environment when failure occurred:

Ambient | Vibration | Shock | Acoustic
Thermal | Vacuum | v Thermal-Vacuum | EMI/EMC

Problem Description

During SWEA FM1 Thermal Balance test, the unit failed to start up correctly when cold (it had passed a CPT just prior to pump-down). The unit survival heater was on and maintaining a temperature between –21 and –29C. The primary power supply took ~150mA at 28V, somewhat more than usual. No messages were received by the IDPU, and the instrument did not respond to command. It would not start at 24V or 35V either. Impedance measurements on the data harness looked nominal, indicating it was connected correctly. The instrument was not left powered on for more than a few minutes at a time in this mode to avoid damage. The power-up sequence was repeated periodically as the instrument was warmed up. It failed to start at –25C and –22C, but started correctly at –16C and passed the CPT.

Analyses Performed to Determine Cause

While FM1 was still in thermal balance testing, the FM2 SWEA LVPS was tested in a thermal (not vacuum) chamber with a passive load. The supply started correctly down to temperatures of –40C. When the FM2 DAC/Shaper boards were put into the thermal chamber it was found that the 2.5V supply failed to come up at low temperatures if the current limit of the bench supply used was not high enough. We mapped this in-rush current amplitude as a function of temperature and found it ran from 140mA at room temperature to 380mA at –40C. It lasts ~5ms. This current is higher than the SWEA supply was designed to provide, and so it is browning out. Modifications need to be made on both the LVPS (to increase its transient current capability) and the DAC board (to change the Actel power sequencer to mitigate the turn-on current transient.) More on the next page.

Corrective Action/ Resolution

Rework | v Repair | Use As Is | Scrap

- Install a 47uF capacitor in parallel with C40 on the SWEA LVPS to delay the over-current cut-out on the SWEA supply so it can handle the Actel in-rush current.
- Change R504 on the DAC board from 300K to 68.9K to change the threshold at which the 5V supply comes on, which is found to decrease the Actel in-rush current amplitude.

Tested in the thermal chamber down to –45C (FM1 LVPS + DAC+ Shaper) which is well below the req't of –30C and all worked fine.

Date Action Taken: 2005-1-4 **Retest Results:** Success

Corrective Action Required/Performed on other Units v Serial Number(s): SWEA FM2

Closure Approvals

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

More Analysis and Test:

We added a 4.7uF capacitor in parallel with C40 on the ETU SWEA LVPS to slow down the response of the 5VD over-current detect to accommodate this transient. Tests with the modified ETU supply and the FM2 SWEA DAC/Shaper boards in a thermal chamber show that this solution works down to –35C (the instrument survival heater thermostat comes on at –29C, and the survival heater is close to the Actel, so the Actel should never be colder than that at turn-on). Below –35C the supply failed to start, with the same symptoms as before. It was found that the supply could be started by "pumping" it, turning the supply on and off a few times quickly. This worked down to –45C, which was as cold as we tested

After installing this fix on the FM1 SWEA LVPS it was found to have insufficient margin (could be made to fail cold). Increasing the capacitor in parallel with C40 in the SWEA LVPS was found to help. 22uF was adequate, 47uF is the closest larger value we have in flight stock. 47uF increases the over current delay to 50ms, which was determined to be safe. Also it was found that adjusting the threshold at which the Actel 5V supply came on decreased the in-rush transient (change R504 on the SWEA DAC board from 300K to 68.9K). Either of these two solutions was found to be adequate by itself. Both were implemented to provide additional margin. This worked down to –45C (no pumping required), which is as low as I tested (minimum SWEA operational temp is –25C, minimum survival is –30C, survival thermostat on point is –29C).

The circuit was analyzed and no parts were stressed due to this issue.