STEREO IMPACT

PROBLEM REPORT
PR-7002
SEPT-Detector
2004-03-05

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

Assembly : SEPT-E FM1, SEPT-E FM2	**SubAssembly : Sensor**
Component/Part Number:	**Serial Number:** A195 SN1, A195 SN3
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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

There are 16 passivated implanted planar silicon (PIPS) detectors (Canberra Part # CD-STEREO-300-EB) installed in four SEPT units. The detectors are packed in stacks of 2. During TV cold soak (-40 °C), 3 detectors in 2 stacks (Serial # 51863 and # 51860) produced high leakage currents: SEPT-E FM1 detector 2 in cycle 1, SEPT-E FM2 detector 1 in cycle 1, SEPT-E FM2 detector 0 in cycle 2. The leakage current measurement shows saturation, time resolution of the measurement is 1 minute.
The onset of the failure is sudden like a switch: below a certain trigger temperature, the failure is continually present and absent above this temperature. The trigger temperature is different for the three detectors and is observed to move to higher temperatures in the course of the thermal cycling (e.g. from -35 °C to +9 °C).
Simultaneously the current on the -80 V bias supply switches from 4.3 µA to 22 µA in the case of a one-detector failure (FM1), and in a second step to 43 µA in the case of a two-detector failure (FM2), time resolution of the measurement is 1 second. Note: this is not detector leakage current which is in nA range!

Analyses Performed to Determine Cause

In the case of the SEPT-E FM1 failure, vacuum was broken, detector 2 disconnected from its electronics and connected via a chamber feedthrough to the EM electronics outside the chamber. During cold soak the failure signature could be reproduced, i.e. the origin could be located inside SEPT sensor. The suspected cause is the detector mount and/or wire-bonding which might lead to short-circuiting to analogue ground. (More attached)

Corrective Action/ Resolution

√ Rework □ Repair □ Use As Is □ Scrap

It became clear that all SEPT detectors might become affected. Even when the origin is identified, the existing detectors cannot be reused, as breaking the housing might afflict unnoticed damage not tolerable for flight-worthy detectors.

All eight detector stacks (not only the two failing ones) were disassembled, wire bonds removed, new wire bonds applied with maximum height of 0.6mm, detectors separated by 1.0 mm instead of 0.8 mm and mounted in new housing. All four sensor units were re-assembled and integrated with their associated electronics units. Nearly all of the detectors survived the openíng of the stacks unharmed and could be re-used.

Date Action Taken: AUG-04 **Retest Results**: All flight detector stacks passed TV (DEC-04)
Corrective Action Performed on other Units √ Serial Number(s): A201 SN2, A201 SN4

Closure Approvals

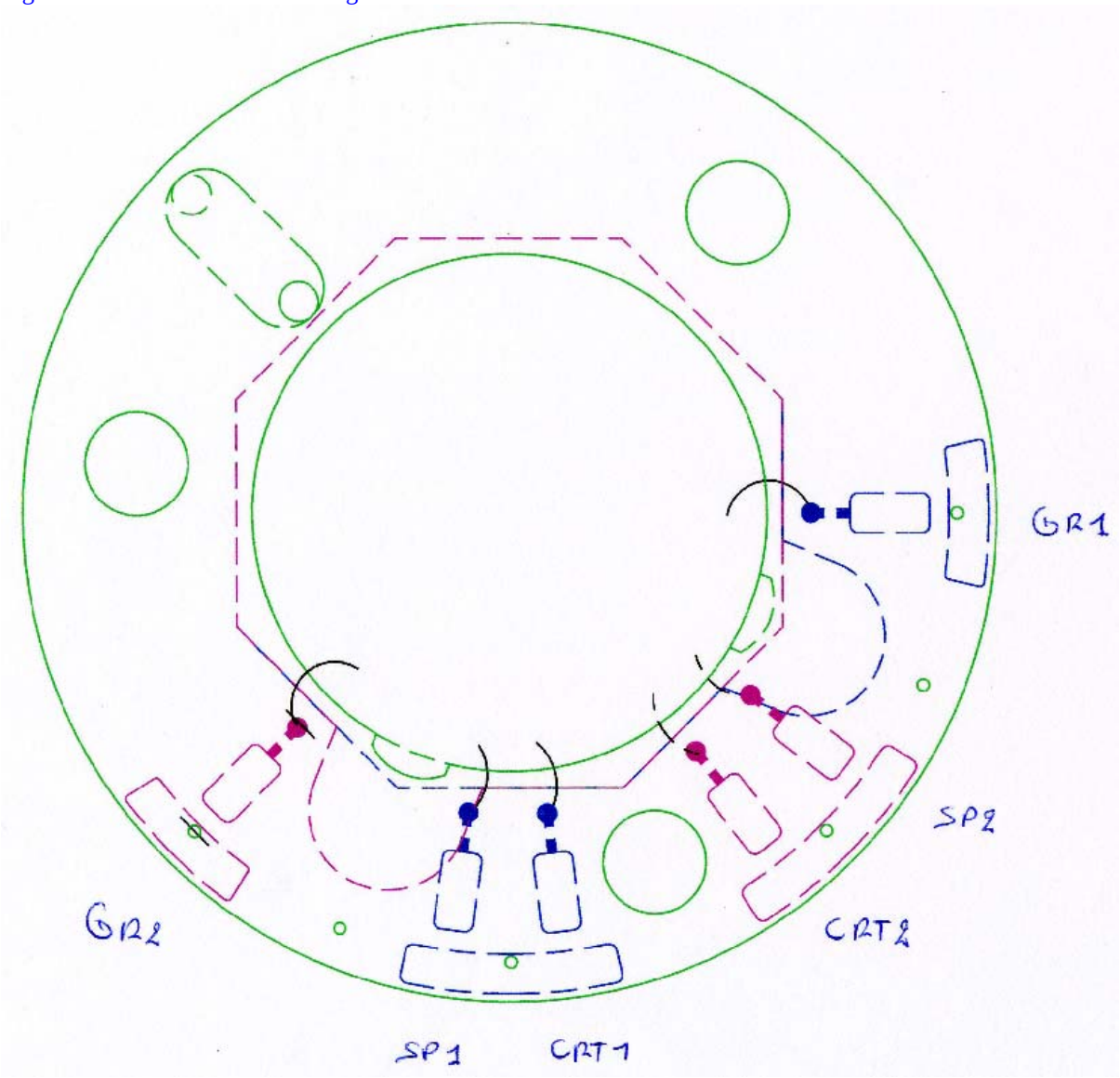
Subsystem Lead:	Reinhold Mueller-Mellin	Date: 07-DEC-04
IMPACT Project Manager:	_____	Date _____
IMPACT QA:	_____	Date:_____
NASA IMPACT Instrument Manager:	_____	Date:_____

On 2004-03-30 an internal failure review board meeting with Canberra was held in Olen/Belgium. Two possible failure scenarios were identified:

- The detectors are glued with EPO-TEK E4110-LV (formerly EP110-LV) to PCB frames. Differences in thermal expansion coefficients between frame, glue, and silicon might exist. Kiel had never operated detectors below -30 °C and cannot test below -30 °C. Canberra/Belgium cannot test detectors below -10 °C.
- The 0.1 mm diameter aluminium wire-bonds might not have enough clearance (gap between the paired detectors: 700 µm). The DELRIN standoffs which define the gap might change with temperature.

Further temperature tests are scheduled to find the origin. A different glue (AMICON CE 8500) which stays more flexible at cold temperatures and a ceramics frame instead of PCB are possible options.

Figure: Junction side wire bonding



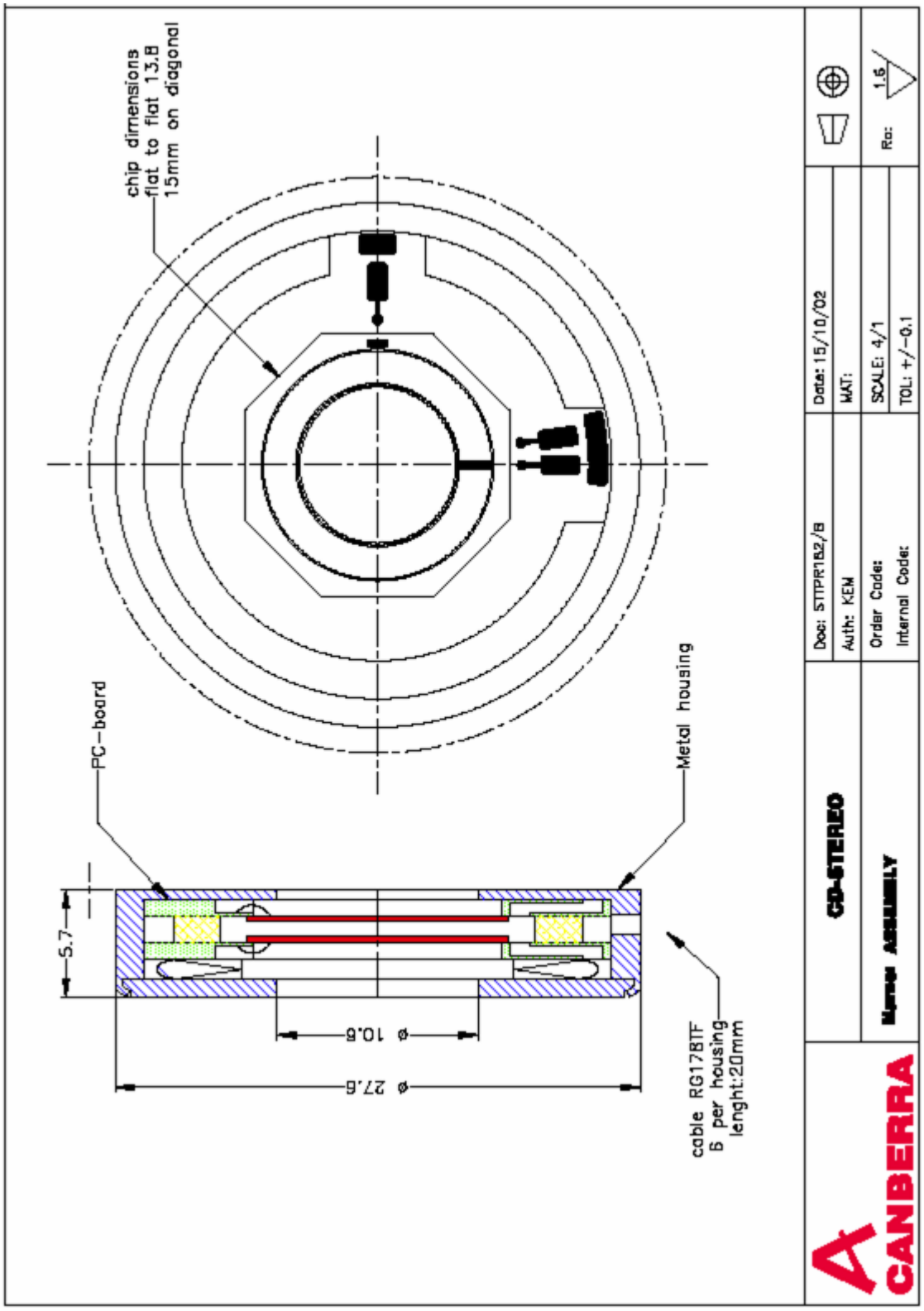
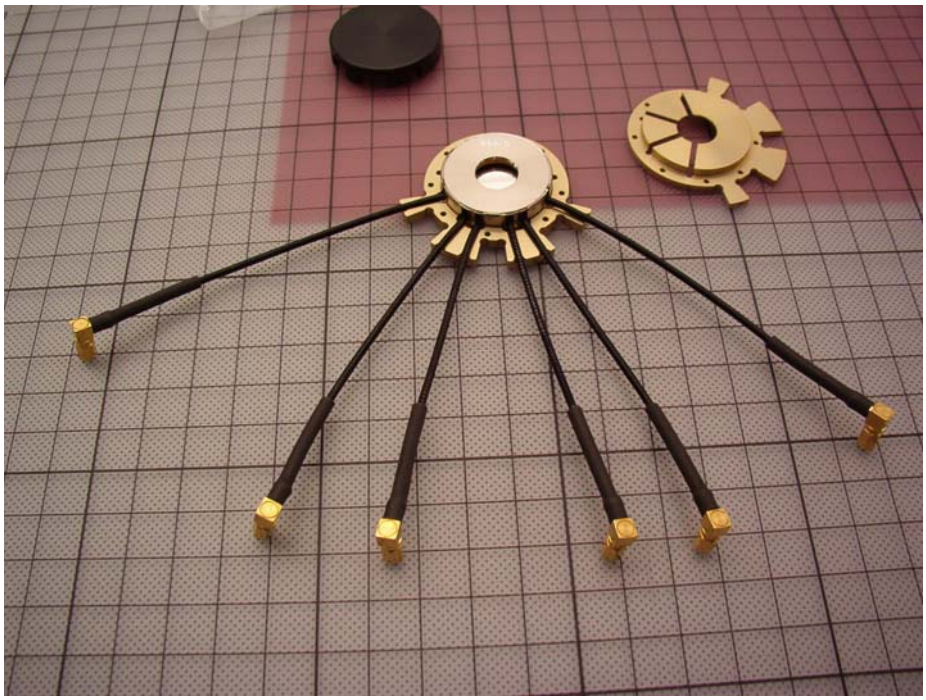

chip dimensions
flat to flat 13.8
15mm on diagonal
PC-board
Metal housing
5.7
ø 10.6
ø 27.6
cable RG178TF
6 per housing
lenght:20mm
CANBERRA
CD-STEREO
Manuf. ASSEMBLY
Doc: STTPR1852/B
Auth: KEN
Order Code:
Internal Code:
Date: 15/10/02
MAT:
SCALE: 4/1
TOL: +/-0.1
Ra: 1.6

Figure: Detector housing (Dural, aluminium, nickel plated) with 2 PCB frames (FR4), spring, and POM spacers (Delrin)

Figure: Final detector assembly



Rework completed (August 2004):

The tests at Canberra were successful in revealing the cause of the failure: the height of the arch suspended by the wire bonds is higher than the separation distance of the two detectors in the stack. All eight detector stacks (not only the two failing ones) were disassembled, wire bonds removed, new wire bonds applied with maximum height of 0.6 mm, detectors separated by 1.0 mm instead of 0.8 mm and mounted in new housing. All four sensor units were re-assembled and integrated with their associated electronics units.

Retest completed (December 2004):

The TV test was repeated from 25-NOV-04 through 01-DEC-04 and showed nominal detector performance for all four units.