LLIS Database Entry: 0348

Lesson Info

- **Lesson Number:** 0348
- **Lesson Date:** 25-oct-1994
- **Submitting Organization:** JPL
- **Submitted by:** J.L. Savino

Subject/Title/Topic(s):

Magellan AACS RAM Upset During SRM Pyrotechnic Initiation

Description of Driving Event:

On August 12, 1990, 7.3 seconds after the SRM separation pyros were activated on Magellan, erroneous alert codes were received by CDS. These alerts were caused by the failure of the AACS Memory B of at least 2K of the TCC244 RAM.

JPL was able to build a failure model which accurately matched the symptoms on the spacecraft. Through ground tests, it has been determined that by firing one or more NASA Standard Initiator (NSI) a short to the chassis ground could take place. The short path could be due to the direct contact between the unburned portion of the squib bridgewire with the chassis, or more likely, due to the presence of conductive gases/materials (plasma generated by detonation) between the squib bridgewire and chassis. When a short occurs, a large current can flow through the ground structure and thus a large differential voltage can be induced across the shorting path. Since the energy available during the short is very large (2.2 J), the intense source of electro magnetic interference can affect sensitive victim electronic circuits causing upsets or damages.

The shorting hypotheses are not unique to Magellan. The impact of NSI shorts on space systems is strongly dependent on grounding and cabling configurations of each spacecraft, with potential mission risks.

Additional Keyword(s): Shielding

Reference(s):

1. PFR 52235, ISA 8899
2. Magellan Anomaly Investigation, IOM 340-93-JLS 301, dated 12/9/93
3. Summarized Findings and Recommendations of the Mars Observer Investigation Groups, IOM GEC: 250-94-009, dated 1/28/94

4. Mars Observer Loss on Signal: Special Review Board Final Report; JPL Pub. 93-28

Lesson(s) Learned:

Based on Magellan analysis and test plus work recently performed in support of Mars Observer, the design for electro-explosive-device initiation may be inadequate.

Recommendation(s):

1. Reconsider induced chassis current mechanisms along with coupled voltage transients for all spacecraft designs being developed.
2. Consider eliminating the return path through the chassis back to the firing source (do not connect the firing source to the frame), thus isolating the firing source.
3. Consider reducing the NSI activation current - NSI spec.: 1 amp, no fire; 3.5 amps, all fire.
4. Consider locating the current limiting resistor in the "high-side" line.
5. Consider grounding the fire **CIRCUIT** shield at both ends.
6. Consider opening the enable relay for the initiators just fired, before firing of the next **PYRO** sequence devices (not between redundant pairs).

Evidence of Recurrence Control Effectiveness:

N/A

Applicable NASA Enterprise(s):

N/A

Applicable Crosscutting Process(es):

N/A

Additional Key Phrases:

- Energetic Materials - Explosive/Propellant/Pyrotechnic
- Energy

Approval Info:

- **Approval Date:** 30-nov-1994
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