Single Event Transients (SET) in linear devices - NASA/GSFC studies

Christian Poivey, Steve Buchner, Jim Howard, Ken LaBel, Christina Seidleck, Hak Kim, Jim Forney, Chris Palor
• SET studies started in 1999 with the objective to define a low cost conservative test methodology.
  – study on 139 voltage comparators from two vendors (NSC, Intersil) and LM124 operational amplifier from NSC under many operational conditions.
  – The results showed that the worst case test condition is specific for each device (2001NSREC paper).
• More data was collected to understand the effect of bias conditions and support Vanderbilt modeling effort.
• Lessons learned during testing have been used to define testing guidelines.
• Laser studies were performed.
Objectives of NASA-GSFC SET studies

- Collect SET data on common linear devices used in NASA missions.
- Issue of NASA guidelines for SET testing of linear devices.
- Collect broad beam and laser test data in support of Vanderbilt modeling effort.
- Evaluate the laser tool for Radiation Hardness Assurance of linear devices.
2002/2003 activities

• Broad beam testing
  – LM124, LMC6484, LT1128
  – Project testing: OP293, MAX494, SG1525,…
  – OP27, LM6144 (NAVSEA CRANE)

• Laser testing at NRL
  – LM124, LMC6484, OP27
    • LM124 paper submitted to RADECS
  – LM6144, OP293, SG1525,…

• Issue of SET test guidelines
Results – LM124

LM124 - SET

Let (MeV cm²/mg) vs. X section (cm²/amplifier)

0 event
Results – LM124
Results – LM124

- LM124 Voltage follower: Vin=5V, LET=2.8 MeVcm²/mg
- LM124 Voltage follower: Vin=5V, LET=53.9 MeVcm²/mg
- LM124 Voltage follower: Vin=5V, LET=53.9 MeVcm²/mg
Results – LM124

LM124 SET Voltage follower Vin=5V

Cross section (cm²/dev)

Effective LET (MeV.cm²/mg)
Results – LMC 6484

![Graph showing cross section vs LET for different conditions: follower, Vin=2V, Vin=5V, Vin=8V, ninv, Vin=1V, Vin=1.5V, Vin=2.5V. The x-axis represents LET in MeV cm²/mg, and the y-axis represents cross section in cm²/atom.](image)
Results – LMC 6484
Results – LMC 6484
Results – LMC 6484

LMC6484 Laser SET (590 nm)

11pF Scope Probe

RG174 Cable

10/09/02 Data
Results – OP293

The graph displays the transient magnitude (volts) over time (seconds). The x-axis represents time in seconds, ranging from 0.0E+00 to 2.0E-04. The y-axis shows the transient magnitude in volts, with values ranging from 0.0E+00 to 4.5. The data points indicate an exponential decay pattern.
Lessons learned

• Different bias conditions and applications give different responses. It is often difficult to define the worst-case condition based on a limited set of bias conditions
  – Test in the application condition
  – Laser testing
  – Modeling
• SET characteristics are significantly affected by test set-up conditions and irradiation conditions. -> see testing guidelines
• A detailed data analysis is very important to assess the impact in applications.
• Flight experiments would be very useful
Future work

• provide more accurate transient characteristics data to designers -> SET design book