CONCLUSIONS

ANALYSIS METHODS

Presented in this body of work is a small summary of the ongoing testing the NASA-JSC Radiation Effects Group has tested over the past years. We frequently test many commercial microelectronic devices, boards and assemblies for short-term use in LEO applications and are tested using 200MeV protons as documented by [2].

The T61P Laptop was powered using a modified AC adapter cord that was connected to a Sorensen power supply, with the operating parameters set at 16V out and max current at 4.5A. With this modified AC adapter we were able to monitor current to the laptop and voltage at the power supply and going to the laptop.

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The following section will summarize Proton radiation testing on select COTS-NiCOTS hardware and individual electronic parts in a series of summary tables. Also a summary of the ISS Laptop testing will be also shown in this section along with a summarized table of the hardware tested.

A. PROTON TESTING

The majority of JSC hardware used for Shuttle and ISS is tested using 200MeV protons, at JSC. The proton beam passes through the detector and is then charged to about 11% of the initial energy. While the incident protons themselves usually do not cause direct device upsets, they do collide with the nuclei of atoms in the target device. This collision can fragment the nucleus and then generate a shower of high-energy secondary particles that can produce nuclear reactions in the surrounding atomic nuclei [2]. These high-energy secondary particles cause various electronic devices to upset. This upset is known as a single-event upset. The single-event upset is considered a low-energy upset, as it will deposit less than 14 keV/cm²mr in the sensitive volume. The low-energy upset is the dominant upset mechanism. In addition, the low-energy upset is the only upset mechanism that can occur. The low-energy upset is the only upset mechanism that can occur.

A. PROTON TESTING

The T61P 15.4" Wide Screen Lenovo ThinkPad Laptop is a commercial off-the-shelf (COTS) device that was tested in 2008. A series of selected hardware which consisted of SDRAM, Intel Dual Core Processors, and Hard Drives from different vendors was tested to determine the best hardware for a final flight laptop configuration. The T61P laptop was used as the test laptop for the ISS Shuttle Laptop on ISS. The test laptop was used for the last 10 years on orbit. In preparation for testing the candidate laptop was completely disassembled down to the motherboard in order to create a detailed parts list of the laptop and to determine the position of each component. Figure 1 shows the beam positions of the laptop on the motherboard. The major components of the laptop include the SDRAM, hard drive, north and south bridge processors, wireless communication chips and the power chip (the power chip) of the laptop were isolated in single beam positions to evaluate their potential SEE without multiple active parts being considered as well.

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