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Space Environmental Effects and Spacecraft Protection (6)

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VOLTAGE REGULATOR RADIATION QUALIFICATION CASE STUDY

Abstract

Spacecrafts are subjected to harsh space environments that include exposure to various types of ionizing and non-ionizing radiation. In fact, the radiation environment in low earth orbit is complex due to a number of factors which include altitude, orbital inclination, solar cycle, mission lifetime, and shielding design. To determine the suitable electronics for a spacecraft, total ionizing dose (TID), thermal-vacuum, and vibration testing are performed. Charged particles and gamma rays create what is called total ionization dose (TID), which causes a degradation in the performance of the electronic circuits of the spacecraft. Radiation hardness assurance is a key to space mission success, especially for devices like a voltage regulator (VR), which ensures a steady constant voltage supply to sensitive elements like microprocessor, microcontroller, memory circuits, and FPGAs through all operational conditions. The qualification process of the non-RHA (radiation-hardened assurance) VR, implemented in this case study, went through two major stages. The first stage simulated the expected radiation environment in the lab on a number of replicated VR samples. The total dose steady-state irradiation lab test using gamma rays from Cobalt 60 source has been carried out with a TID up to 3.3 krad(Si) at low dose rate (36 rad(Si)/h). The second stage will be summarized in this paper, as we show results from an active LEO space mission that proves the effectiveness of the radiation qualification process of a non-RHA (radiation-hardened assurance) VR over a span of four years.