53rd IAA SYMPOSIUM ON SAFETY, QUALITY AND KNOWLEDGE MANAGEMENT IN SPACE ACTIVITIES (D5)
Space Environment and Effects on Space Missions (3)

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SOFTWARE FOR TESTING AND MITIGATING RADIATION-INDUCED EFFECTS IN COMMERCIALLY AVAILABLE INTEGRATED CIRCUITS

Abstract

Testing electronic components for the radiation environment they will encounter in space has long been an important part of spacecraft engineering. As small satellites increasingly rely on non-redundant, tightly integrated electronic components with smaller semiconductor feature sizes, understanding the radiation-induced effects on individual components is becoming increasingly important. Even on short-duration nanosatellite missions where little component degradation may occur, the single-event effects on memories, real-time clocks, and processors can have large impacts on mission operations if they are not taken into account.

The ORCASat Command and Data Handling team has performed radiation testing on commercial off-the-shelf real-time clocks, non-volatile memory, and microcontroller components. The procedure undergone for testing these components is presented, alongside a description of how software can be developed to gain useful results during radiation testing. The results of the testing are also presented and the mission impacts of observed single-event effects in selected components are discussed. Emphasis is placed on how the functional implications of single-event effects are tested for, and how flight software can be designed to tolerate them, once they are understood.