SPACE RADIATION ENVIRONMENTAL ANALYSIS OF CUBESAT AVIONICS COMPONENTS

BY JAMES M. BYRNE

In this paper we present the procedure, analysis, and results for a space radiation environment total ionizing dose (TID) test and verification of commonly-used Small Satellite avionics hardware, including industrial-grade Micro SD memory cards and several analog integrated circuits. TID testing was conducted using a Gammacell 220 device Cobalt-60 gamma radiation source. All industrial-grade Micro SD cards from manufacturers Delkin, San Disk, and Transcend showed sufficient tolerance up to 24krad TID to pass test criteria of: initialization, read accuracy, and write accuracy in both biased and unbiased states. Two different current-limit switches – MAX892L (Maxim) and FPF2000 (Fairchild) series – were tested at 8, 16, and 24krad TID and showed no signs of deterioration or variance from pre-irradiation characterization of voltage limit, current limit, on switch voltage, and on resistance. Similarly, a batch of SN65HVD30DR (Texas Instruments) RS-485 line transceivers were also shown to be radiation tolerant up to 24krad TID and maintained characteristic values of differential transmit voltage, common mode voltage, transmit rise time, transmit fall time, receive rise time, and receive fall time. The single failure was with the final tested component: an ADG452 (Analog Devices) single-pole single-throw (SPST) switch. It was tested pre- and post-irradiation like the other components and failed at 24krad when its propagation rise time exceeded characteristic values by two orders of magnitude. This failure is currently under investigation as to the cause. It is currently hypothesized to be attributed to the Linear Compatible CMOS (LC^2MOS) design which enables low power dissipation at high speed and low resistance.