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Proton Single Event Effects testing of Xilinx Zynq-7010 System-on Chip

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The sensitivity to radiation is dramatically increasing with the decrease in transistor dimensions and operating voltages for modern integrated circuit (IC).The low energy proton also causes single event effects through direct ionization.The System-on Chip (SoC) contains complex circuit elements in a chip. Therefore,we provided a methodology and set up a test system to measure the proton single event effects for Xilinx Zynq-7010 SoC based on 28nm technology node.The sensitivities were measured individually for five comments of Xilinx Zynq-7010 System-on Chip that include D-Cache, arithmetic logical unit (ALU), float point unit (FPU), direct memory access (DMA) and programmable logic (PL). This methodology also was validated for a given application. The SEE sections of different blocks in different energy were calculated. The results demonstrated the D-Cache was more vulnerable than other components, such as DMA, FPU,PL and ALU for direct ionization from low energy proton. Furthermore, the cross sections of different blocks were increasing with the increase of energy except D-Cache block. The SRIM simulations provided insight into the mechanism involved.The LET values and ranges from proton and different heavy ions(Al,Mg, Na)in silicon, with an energy < 10 MeV, caculated with SRIM were given. The direct ionization form low energy leaded to upset the D-Cache, but other blocks were upset by nuclear reactions. Moreover, the experimental results were presented showing that single event functional interrupt(SEFI) was more serious than other types of single event effects.

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