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COTS ADC for the Accelerator Radiation Environment

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The analog to digital converter (ADC) is a component that is widely used in high energy physics. In recent years commercial off the shelf ADCs has become increasingly tolerant to ionizing radiation, likely a side effect of their implementation as a small feature size integrated circuit. In this presentation we report on recent irradiation results of COTS ADCs that can potentially be used in the detector readout electronics as well as for accelerator instrumentation. Two components, the ADS5272-SP and ADS52J90 were extensively tested and we report on the measurements performed.

Summary

The analog to digital converter (ADC) is a component that is widely used in high energy physics. Digitizing signals as close as possible to the detector or sensors is highly desirable to preserve signal integrity. In high energy physics experiments and accelerator instrumentation the implication is that the analog to digital converters (ADCs) must be located in regions with radiation. In the past years a number of commercial off the shelf (COTS) ADCs that are tolerant to ionizing radiation became available. The key feature of these ADCs are the small feature size that appears to have as a side effect increased resistance to ionizing radiation. The smaller feature size, however, makes these devices more prone to single event effects, induced by high energy hadrons from the background environment. In numbers, the majority of the single event effects are bit flips that results in corrupted data. The effects that requires mitigation are those where configuration bits are flipped resulting in functional changes. These need to be mitigated during operations. A most severe effect are cases that leads to a total inoperability of the component. Even if these happens infrequently for an individual part, it is the need of many thousands of components that makes them important to be detected and quantified. Previously we reported on tests of a COTS 12 bit ADC, the ADS5272, where a single event micro latch was reported. Since then, a new part, the ADS5272-SP became available by the same manufacturer where a hardening process eliminated the occurrence of micro-latches. We will report on the test results of these devices as well as on the results of the new ADC manufactured in 90 nm feature size, the AD52J90. This part is a 16 channel, 14 bit ADC that has low power consumption.

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