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To be presented by Michael Campola at the 2016 Institute of Electrical and Electronics Engineers (IEEE) Nuclear and Space Radiation Effects Conference (NSREC), Portland, Oregon, July 11-15, 2016.

Abstract: Single event effect data is presented on the Analog Devices AD7984. The recent heavy-ion test results showcase application-specific results for the commercial part in its intended application.

Introduction
Radiation-induced upsets are a concern for microcircuit designs in the space environment. Charged particles that deposit energy within the sensitive node of a device may cause the output to fluctuate from expected values. Desirable single events such as single event latch up (SEL) are of particular concern with commercial-off-the-shelf (COTS) devices. Many data converters that have been tested have shown varied response to heavy ions [1-4]. The Analog Devices AD7984 is an 18-bit, successive approximation, analog-to-digital (ADC) that operates from a single power supply. It contains a low-power, high-speed, 18-bit sampling ADC and a versatile serial interface port [5].

Device Preparation
Device preparation for the facility requires that the commercial plastic encapsulant be removed such that the range of particles is sufficient through the semiconductor to penetrate through to the sensitive volumes within the device. Chemical etching was of particular concern because the parts were on a flight like board populated with other active devices and the traces on the PCBW could not be damaged if we were to retain functionality. The challenges associated with these tasks are in the same device family; this investigation radiation response of COTS devices is not easily performance of commercial alternatives. The testing was performed in air at the Texas A&M University Cyclotron Facility, Table 1 shows the Ion, angle, and effective LET that was used to experimentally determine the device response to heavy ion testing. Testing was performed in air at room temperature.

Test Facilities
Table 1: Ion used for heavy ion testing of the AD7984

<table>
<thead>
<tr>
<th>Angle</th>
<th>Ion and Linear Energy Transfer (MeV/cm)</th>
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<tbody>
<tr>
<td>45°</td>
<td>4.0 26.8 55.1</td>
</tr>
<tr>
<td>90°</td>
<td>4.0 26.8 55.1</td>
</tr>
<tr>
<td>12.2</td>
<td>40.8 75.1</td>
</tr>
<tr>
<td>17.2</td>
<td>57.6 106.2</td>
</tr>
<tr>
<td>45°</td>
<td>8.6 28.8 53.1</td>
</tr>
<tr>
<td>90°</td>
<td>8.6 28.8 53.1</td>
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<tr>
<td>45°</td>
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<td>17.2</td>
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Test Results and Discussion
The parts were tested for a given LET to a predetermined count of single events. For this test, a single event upset was defined as a data frame containing more than 10 pixels at least 10 standard deviations beyond the noise floor, data was then scaled to 100 frames and the results are presented in Figure 4. As shown in Figure 5, the data has an onset of 23.4 MeV/cm, the last ion LET where no upset was recorded, and an estimated saturation of 3x10^-4 cm^2/device.

For the given application there were two types of radiation responses: short output transients (glitches seen at the beginning and end of the rising edge) and large scale transients that correspond with false readings of saturation on the input. No destructive events were recorded. Supply voltage to the system was not varied from nominal application levels. Figure 5 shows digital output levels of the ADC following a single event heavy ion strike. The two curves shown are an upper and lower bound for the amplitude of the captured transient.

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References

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