SYNOPSIS V1.0: Heavy Ion Latch-up Test Results for the Analog Devices ADG704 Multiplexer

Ray Ladbury[1], Robert Reed[2], Jim Forney[3], and Chris Palor[1]

1. Orbital Sciences Corp.
2. NASA/Goddard Space Flight Center, Greenbelt, Maryland 20771
3. Jackson and Tull Chartered Engineers

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I. INTRODUCTION

This study was undertaken to determine the radiation-induced latch-up sensitivities of the Analog Devices ADG704 multiplexer. The testing was done at Brookhaven National Laboratory's Single Event Upset Test Facility. The power supply current was monitored for large increase, and the device's functionality was verified after each single event latchup (SEL).

II. DEVICES TESTED

The Analog Devices ADG704 is a low-voltage (1.8 to 5 Volts) quad CMOS multiplexer fabricated in ADI's 0.6 µm process (Limerick, Ireland facility).

Two samples of the device were tested.

III. TEST FACILITY

Facility: Brookhaven National Laboratory Single Event Upset Test Facility.
Flux Range: 2×10^2 to 1.3×10^5 particles/cm^2/s.
Particles: linear energy transfer (LET)

Ion	LET (MeVcm^2/mg)
Cl	11.4
Br	37.4
I	59.8

IV. TEST METHODS

Temperature: ambient temperature

Test Hardware: An VXI-based custom test set was used to supply nominal input levels to the DUTs and monitor the bias supply current for changes resulting from the radiation exposure. Files were generated for each DUT to track changes the supply current with a measurement accuracy 100 pA (??). The current was measured and recorded at 10 ms intervals throughout the exposure. An oscilloscope was used to monitor DUT functionality during the irradiation.

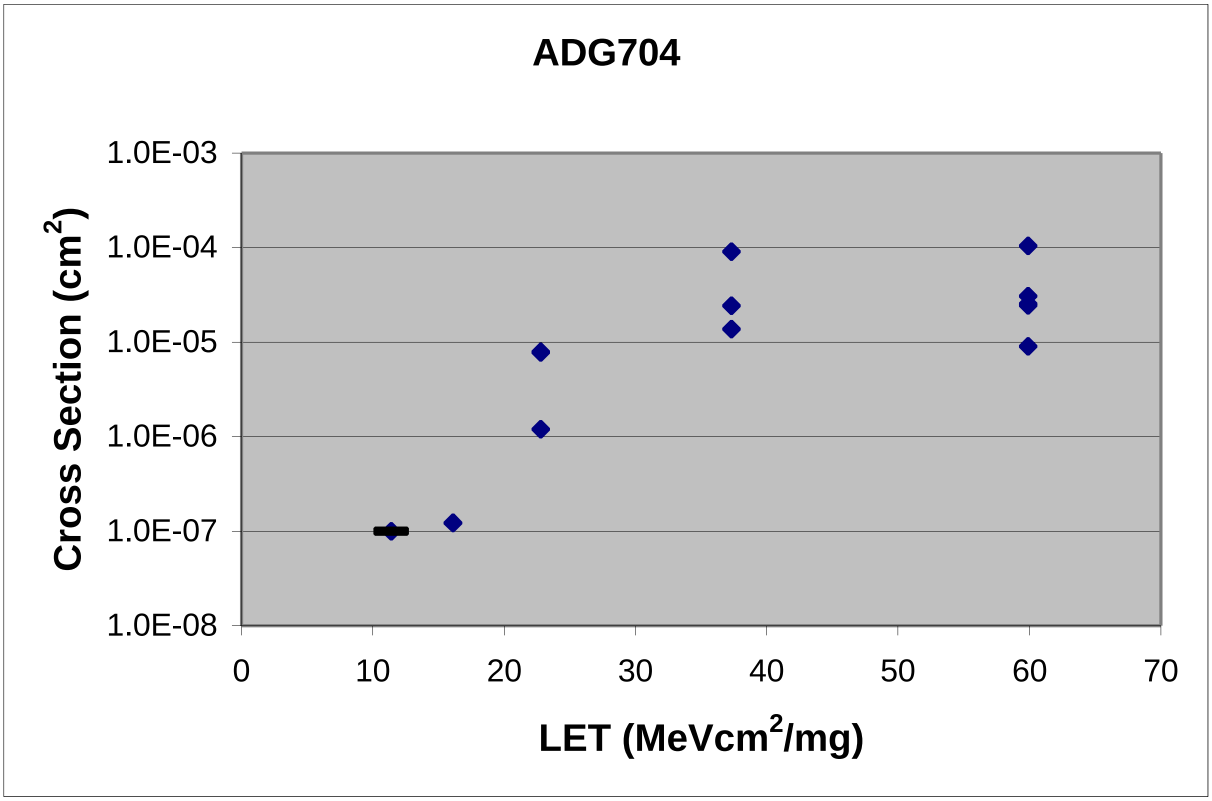
Software: Customized LABVIEW® software provided a user interface to control signals to the DUT. The software also automatically monitored supply currents and generated a file history. In the event that the supply current exceeded a predefined value, called the limiting current (I_L), the software automatically turned off the DUT power supply.

Test Techniques: Tests were performed to screen for susceptibility to latch-up and measure latch-up sensitivity as a function of supply voltage and particle LET. The parts were tested at room temperature, but at their worst case levels for the supply voltage (V_{cc} = 5.0 V). An equivalent normal-incidence fluence of at least $1x10^7$ ions/cm^2 was used at each test condition unless an SEL occurred. A beam flux range of $1x10^2$ to $1.3x10^5$ particles/cm^2/s resulted in individual exposures between 10 second and 10 minutes.

Device functionality was monitored by toggling the input to the chip and verifying that the output also changed. If the device current experienced a sudden increase larger than I_L, the power was cycled and the DUT was checked for functionality; we called this an SEL. The DUT functionality information was not saved to a file, but was recorded in the run log.

V. RESULTS

The figure below shows the device SEL cross section for the ADG704 at various effective LETs. LETs other than those in the table in Section III were obtained by changing the angle of incidence of the beam relative to the DUT. The data crossed by a solid horizontal line indicate that no latchup events where observed during the exposure, i.e. limiting cross section.



VI. COMMENTS AND RECOMMENDATIONS

In general, the REA group does not recommend the use of devices in space flight applications that experience an SEL at an LET less than or equal to 37 MeV cm^2 / mg. Significant error mitigation approaches capable of detecting an increase in current and responding to rapidly cycle power would be required if these devices are used in a space flight application. The extent of degradation of device lifetime and reliability due to an SEL are unknown.