esa

DOCUMENT

document title/ titre du document

RADIATION TEST REPORT FOR ANALOG DEVICES ADG704 (COMMERCIAL DEVICES)

PROJECT STEREO

prepared by/*préparé par*	ESA_QCA0307T_I
reference/*réference*	
issue/*édition*	1
revision/*révision*	0
date of issue/*date d'édition*	
status/*état*	
Document type/*type de document*	Radiation Test Report
Distribution/*distribution*	

European Space Agency
Agence spatiale européenne

ESTEC
Keplerlaan 1 - 2201 AZ Noordwijk - The Netherlands
Tel. (31) 71 5656565 - Fax (31) 71 5656040

APPROVAL

Title *titre*	issue 1 *issue*	revision 0 *revision*

author *auteur*	date *date*

approved by *approuvé by*	date *date*

CHANGE LOG

reason for change /*raison du changement*	issue/*issue*	revision/*revision*	date/*date*

CHANGE RECORD

Issue: 1 Revision: 0

reason for change/*raison du changement*	page(s)/*page(s)*	paragraph(s)/*paragraph(s)*

TABLE OF CONTENTS

Test Report Number	ESA_QCA0307T_I
Project	STEREO
SCC Component no.	
Component Designation	CMOS 4-Ω, 4-channel Multiplexer (ADG704)
Irradiation Spec. no.	
Family	Integrated Circuits
Group	Silicon Monolithic
Package	Plastic DIP/SO
Component Specification	
Test House Name	ESA / ESTEC
Irradiation Test Plan Number	
Manufacturer name	Analog Devices
Application type of Acceptance	
Serial Number of samples	Five (5) samples serialised as Ref, 1, 2, 3 and 4
Manufacturing Date Code	
Irradiation Measurement Interval: Biased Unbiased: Circuit Reference: Supply Voltage: Temp ^{o}C: Duration:	 Yes No +6V Room temperature 20 ± 3
Electrical Measurement Parameters	
Facility Source: Energy: Dose Rate: Absorbed Material: Thickness: Temperature ^{o}C:	 60Co 4.6 rad/min N/A N/A 20 ± 3
Dosimetry / Calibration method.	A calibrated NE2571, 0.66cc air ionisation chamber read by a calibrated Farmer 2670 dosimeter.
Anneal Test Biased Unbiased Bias Circuit Reference Supply Voltage Duration	NO

1 INTRODUCTION

The following document contains the Radiation Test Report for ADG704 CMOS 4-Ω, 4-channel Multiplexer for the STEREO project.

2 APPLICABLE DOCUMENTS

AD1- ESA/SCC 22900 "Total Dose Steady-State Irradiation Test Method"

3 TEST DESCRIPTION

Five (5) AD704, Flight Lot, Analog Devices components were selected for TID irradiation testing at the ESTEC ^{60}Co facility. Irradiations were performed at a dose rate of 4.6rad(Si)/min.

Of the selected devices, one was employed as a reference device while, four were serialised for radiation exposure. All devices were of the Small Outline (SO) type and for ease of measurements were soldered on special adapter boards. These adapter boards were mounted on the irradiation test-boards during exposure. After each exposure-step the adapter boards were removed and mounted on the SZ-test system for parametric measurements. The irradiation test-board can accommodate and bias four adapter boards (four devices). Inputs S1 and S3 of all devices were connected to VCC via a 10kohm resistor, the remaining two inputs were connected to ground. The enable line of all devices were set and connected to VCC. Input select pins of all devices were connected to ground hence selecting input S1, as illustrated in figure 1. The irradiation test operating conditions were provided by the STEREO project. The device operating conditions, temperature conditions and applied dose rates are listed in table1.

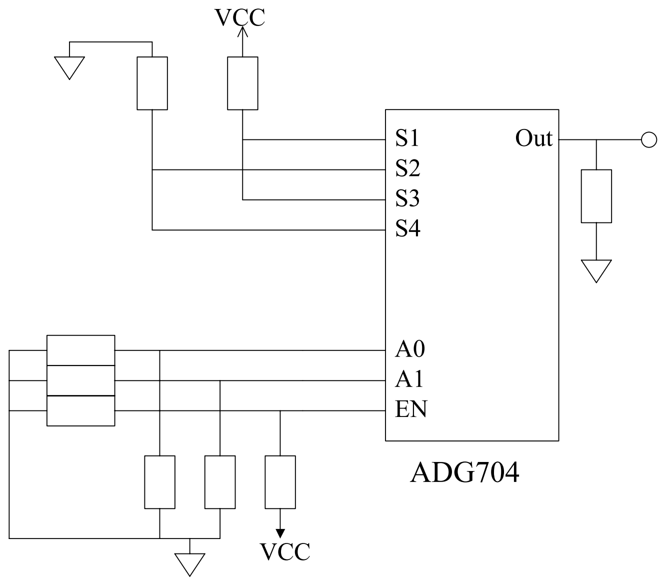

Figure 1 Simplified schematic diagram of the ADG704 irradiation biasing scheme.

Parameter	Ref. Dev.	Dev1	Dev2	Dev3	Dev4
Bias During Irradiation	NA	+6V	+6V	+6V	+6V
Dose Rate	NA	4.6rad(Si)/min	4.6rad(Si)/min	4.6rad(Si)/min	4.6rad(Si)/min
Irradiation Temperature	$20 \pm 3\ ^{o}C$	$20 \pm 3\ ^{o}C$	$20 \pm 3\ ^{o}C$	$20 \pm 3\ ^{o}C$	$20 \pm 3\ ^{o}C$

Table 1 Irradiation Test Conditions

3.1 Measurement set-up

Two sets of measurements were performed one set of continuous measurements during the irradiation runs and one set of parametric measurement at regular intervals between irradiation steps. Continuous measurements (performed during irradiation at 10 min intervals) were performed employing a HP-VEE system consisting of:

- HP 6626A System DC Power Supply
- HP 34970A Data Acquisition / Switch Unit

Measurement number	Devices 1,2,3 and 4
1	Device Output Voltage S1

Table 2 Continuous measurements for each device during irradiation.

Parametric measurements were performed employing a SZ parametric tests system:

- SZ M3000 Test Station Sm02B
- M3000 TA09B Test Adapter
- Software UTS-Version 2.3.3

Table 3 list all parametric measurements performed and their limit values.

Test Parameter	Limit
Supply Current	Upper 1µA
RON S1, S2, S3 and S4	Upper 5 ohm
Min. leakage current	Lower –0.1nA
Max. leakage current	Upper 0.1nA
AO (address line) leakage	Lower –100nA, upper 100nA
S1, S2, S3 and S4 leakage	Lower –0.1nA, upper 0.1nA
EN leakage	Lower –100nA, upper 100nA

Table 3 Parameters measured by the SZ parametric Test System

The time between irradiation stop, performing parametric measurements and starting irradiation for all irradiation steps were less than 60min. 5 irradiation steps were performed and parametric measurements performed after each step (parametric also performed for the reference device). Pre-irradiation measurements were performed on all devices. Table 4 illustrates the irradiation and measurement history.

Irradiation steps	Ref. Dev.	Dev1	Dev2	Dev3	Dev4
Pre-rad. Par. measurements	Yes	Yes	Yes	Yes	Yes
1.79 krad(Si)	NA	Yes	Yes	Yes	Yes
par. measurements	Yes	Yes	Yes	Yes	Yes
6.36 krad(Si)	NA	Yes	Yes	Yes	Yes
par. measurements	Yes	Yes	Yes	Yes	Yes
7.97 krad(Si)	NA	Yes	Yes	Yes	Yes
par. measurements	Yes	Yes	Yes	Yes	Yes
12.1 krad(Si)	NA	Yes	Yes	Yes	Yes
Par. measurements	Yes	Yes	Yes	Yes	Yes
18.36 krad(Si)	NA	Yes	Yes	Yes	Yes
Par. measurements	Yes	Yes	Yes	Yes	Yes

Table 4 Irradiation and measurement history

3.2 Thermal conditions

All irradiations and measurements were performed at room temperature (20 ± 3 ^{o}C).

3.3 Dosimetry

A calibrated NE2571, 0.66cc air ionisation chamber read by a calibrated Farmer 2670 dosimeter was used to measure the Total Ionising Dose.

3.4 Test Results

Figure2 illustrates the real-time measurements of the output voltage for S1 during irradiation. Figures 3 to 14 illustrate the parametric results. The limit for which a parameter is considered out of specification is provided in the vertical axis legend of all graphs except graph1.

Following figure18, a discussion of the results is presented.

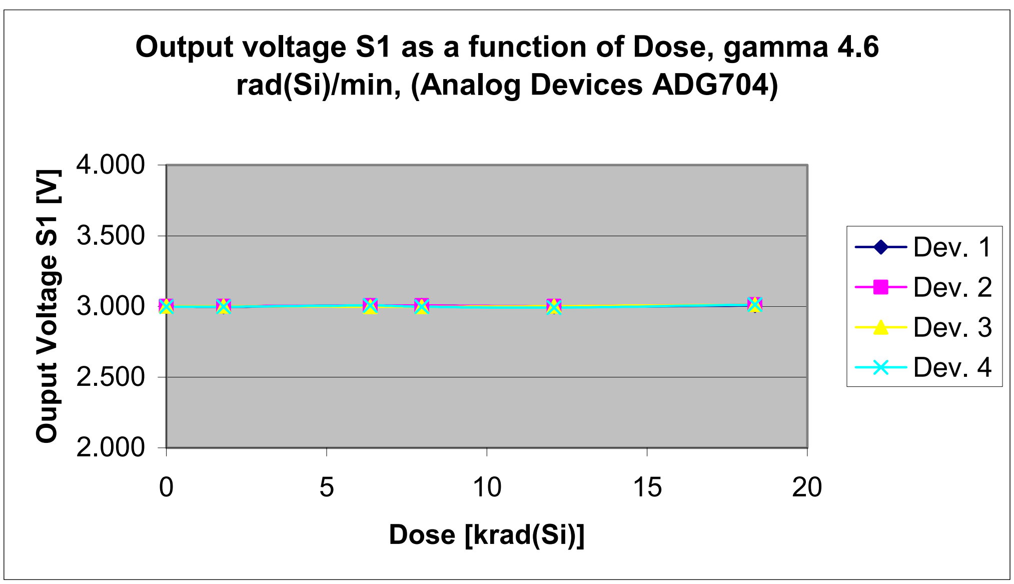

Figure 2 Output Voltage S1 as a function of Dose, gamma 4.6 rad(Si)/min.

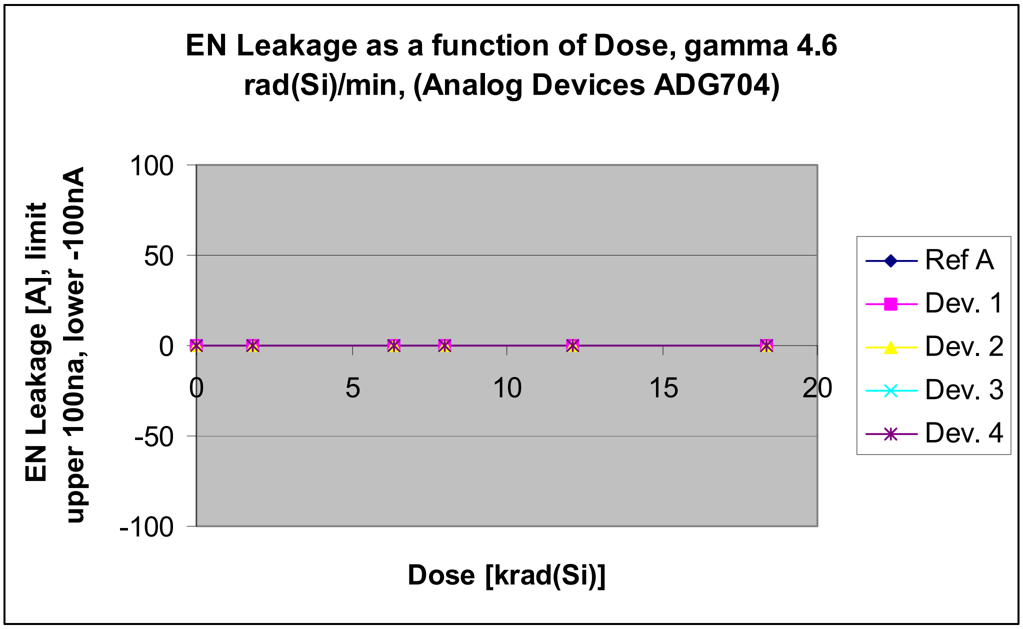

Figure 3 EN leakage as a function of Dose, gamma 4.6 rad(Si)/min.

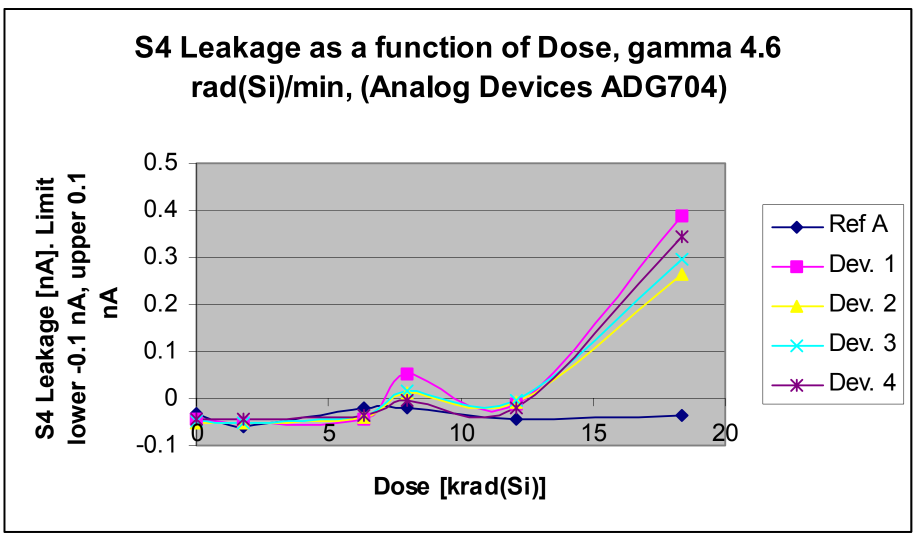

Figure 4 S4 leakage as a function of Dose, gamma 4.6 rad(Si)/min.

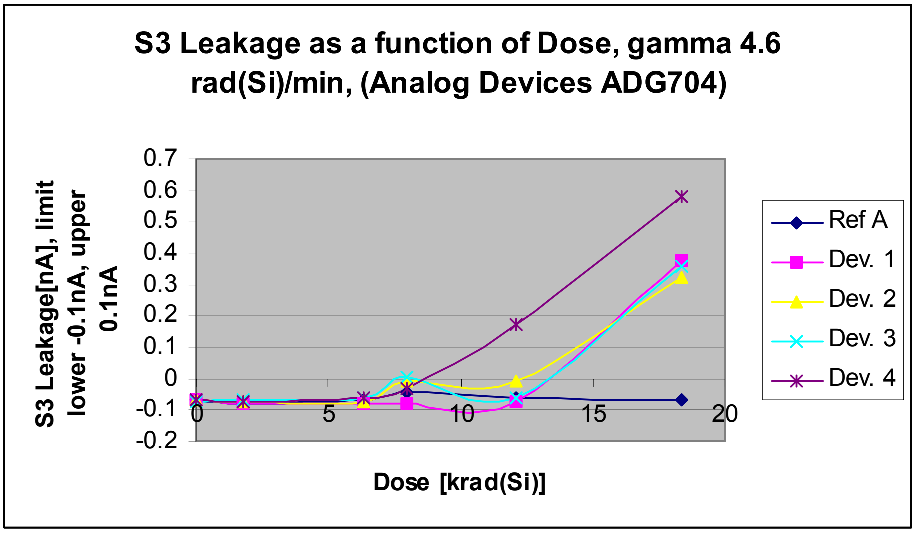

Figure 5 S3 leakage as a function of Dose, gamma 4.6 rad(Si)/min.

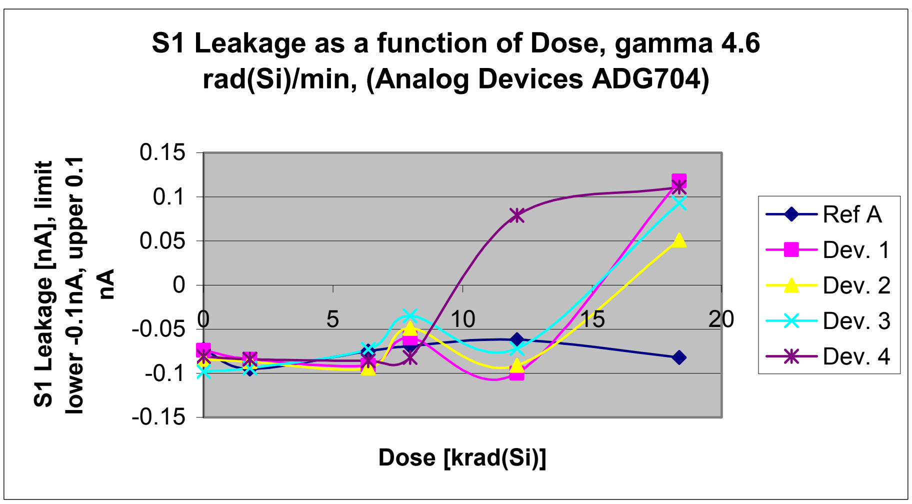

Figure 6 S1 leakage as a function of Dose, gamma 4.6 rad(Si)/min.

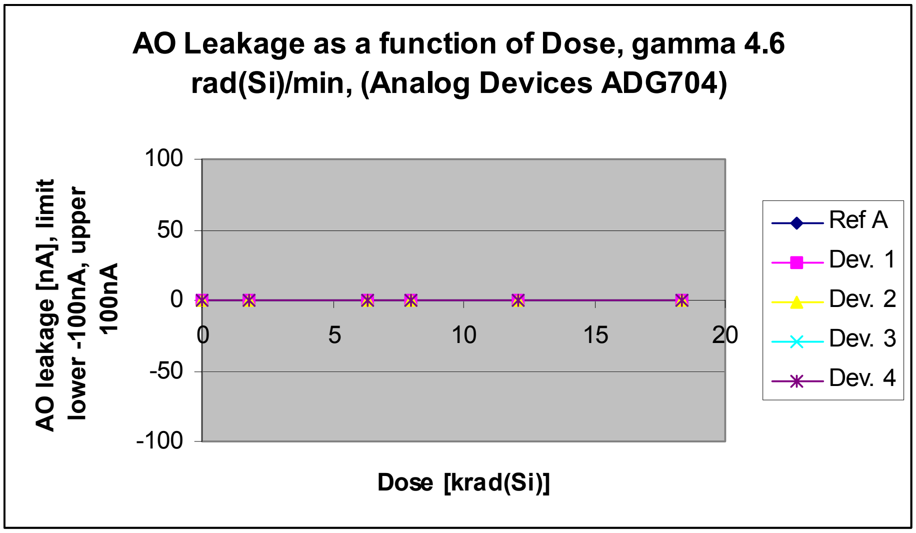

Figure 7 AO leakage as a function of Dose, gamma 4.6 rad(Si)/min.

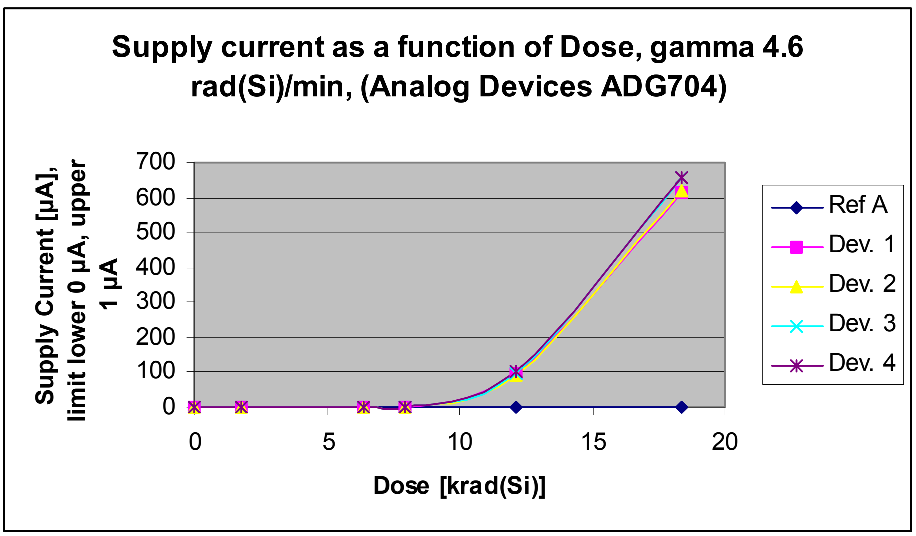

Figure 8 Supply current as a function of Dose, gamma 4.6 rad(Si)/min.

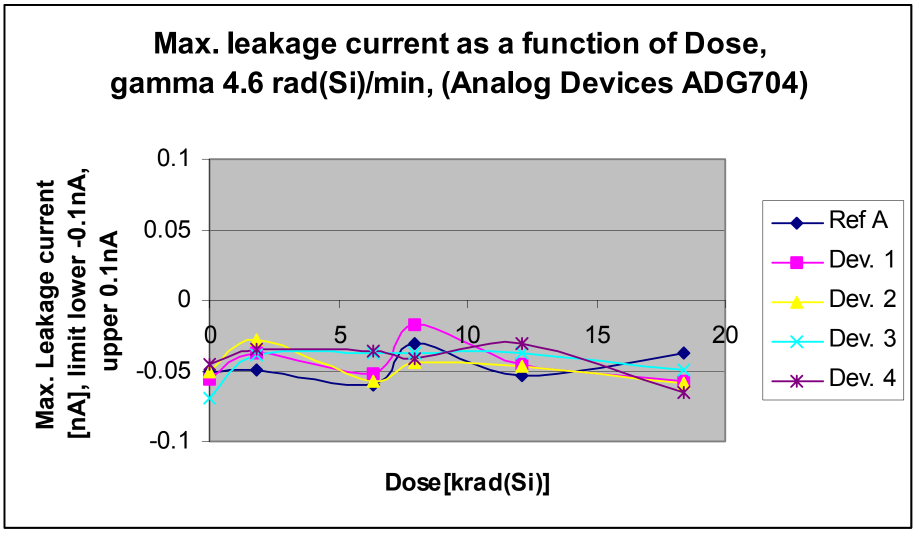

Figure 9 Max. leakage current as a function of Dose, gamma 4.6 rad(Si)/min.

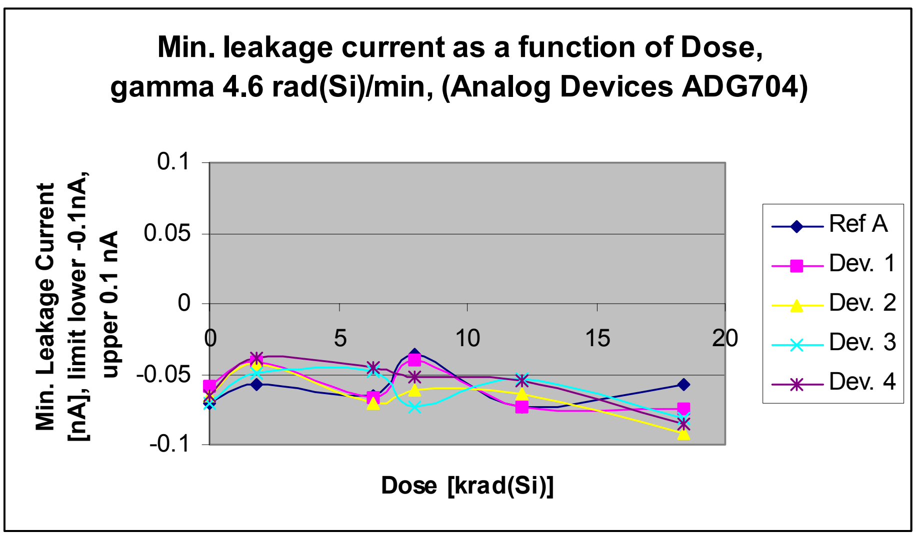

Figure 10 Min. leakage current as a function of Dose, gamma 4.6 rad(Si)/min.

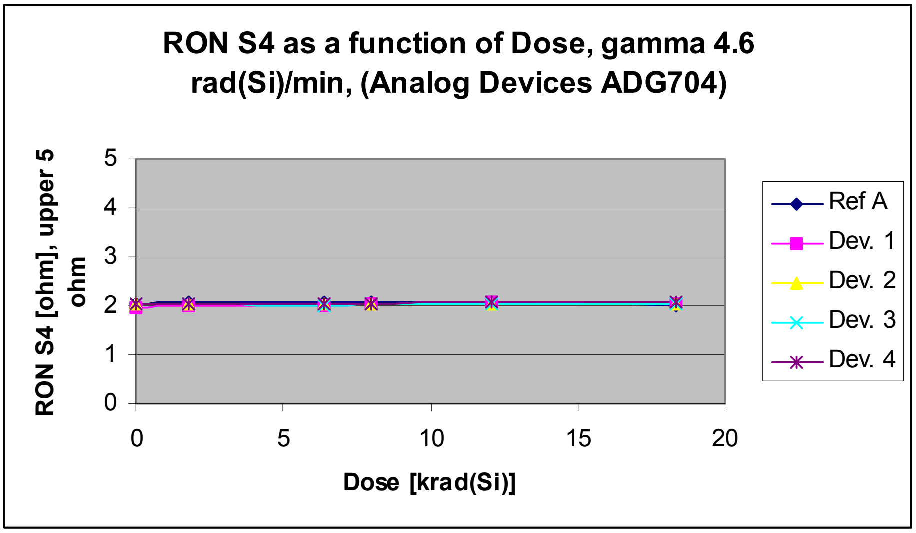

Figure 11 RON S4 as a function of Dose, gamma 4.6 rad(Si)/min.

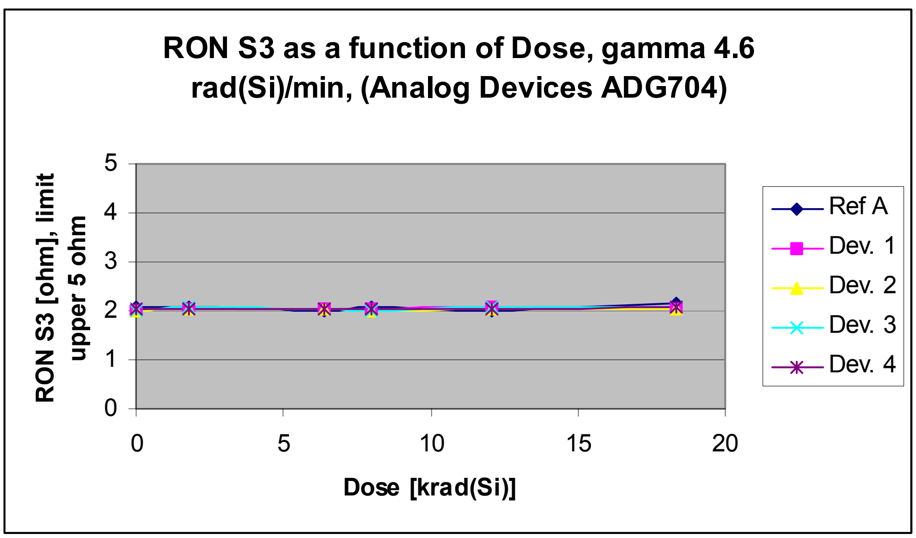

Figure 12 RON S3 as a function of Dose, gamma 4.6 rad(Si)/min.

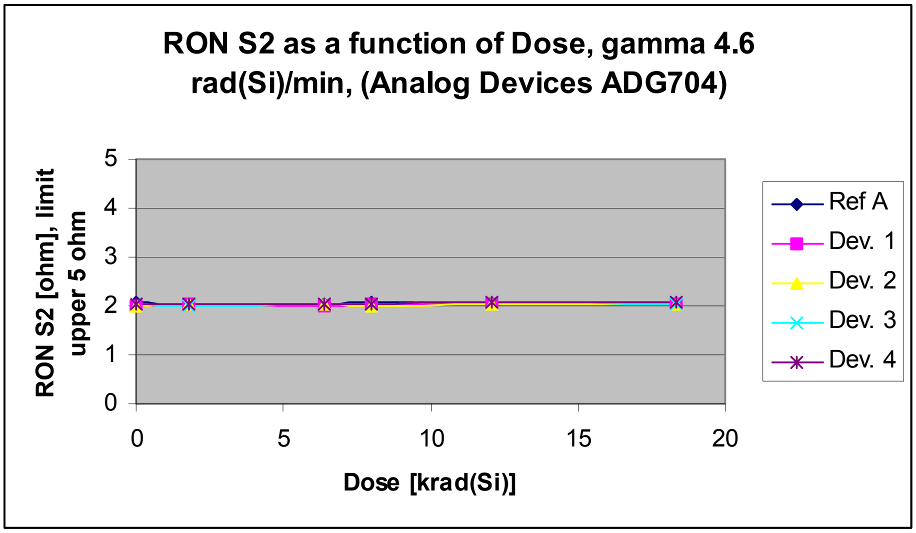

Figure 13 RON S2 as a function of Dose, gamma 4.6 rad(Si)/min.

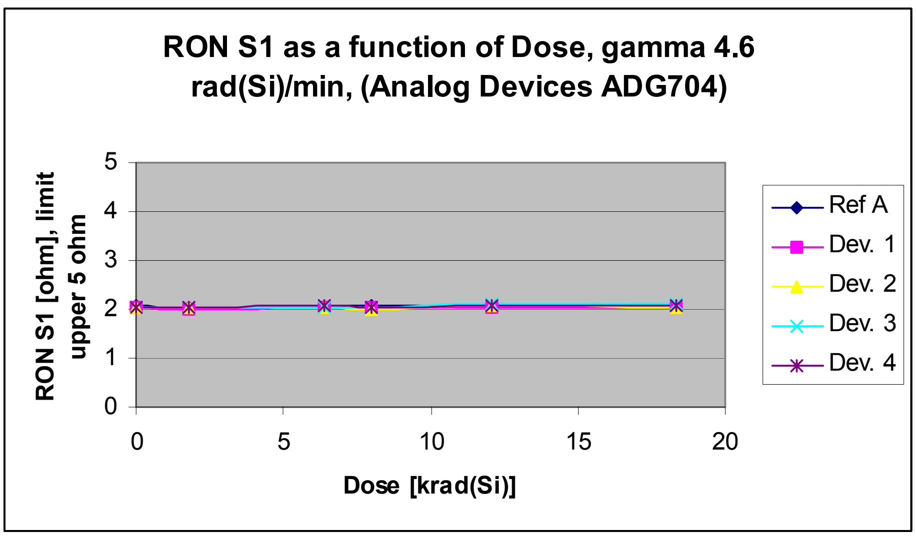

Figure 14 RON S1 as a function of Dose, gamma 4.6 rad(Si)/min.

Figure 2 illustrates the real-time measurement results for the device output. This voltage is three volts due to the voltage divider network as illustrated in figure 1. No measurable degradation of the output voltage is observed.

Figures 4 to 6 illustrate that the input signals S1 to S4 leakage current values increased above the maximum specified value between approximately 7 and 18krad(Si)

Figure 8 illustrate that the supply currents for all devices increased above the specified value for total doses above approximately 7krad(Si). At approximately 18krad(Si) the supply current was 600 times above specified upper limit of 1 µA.

All other parameters were within specified values to a total dose value of 18.36krad(Si).

3.5 Conclusion

The commercial ADG704 4-channel multiplexer irradiation test show that some parameters failed after total ionising dose levels above approximately 8krad(Si). The total ionising dose requirement set by the STEREO project is 15krad(Si) (including a margin of 2).

The STEREO project is required to critically assess the impact of the increased leakage currents and the significant increase in supply current on their system and long-term reliability. Considering the significant increase in supply current, this device is not recommended for use on the STEREO project before the impact of the increased supply current has been assessed.