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RADIATION TEST REPORT FOR ANALOG DEVICES ADG713 (COMMERCIAL DEVICES)

PROJECT STEREO

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Test Report Number	ESA_QCA0308T_I
Project	STEREO
SCC Component no.	
Component Designation	CMOS low voltage 4 Ω quad SPST Switch (ADG713)
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 +5V 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	Yes Yes +5V 132 hours at 20 ± 3 ^{o}C.

1 INTRODUCTION

The following document contains the Radiation Test Report for ADG713 CMOS low voltage 4 Ω, quad SPST Switch for the STEREO project.

2 APPLICABLE DOCUMENTS

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

3 TEST DESCRIPTION

Five (5) AD713, 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 4.6 rad(Si)/min. Post irradiation room temperature annealing measurements were also performed on the devices.

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). All switching control inputs of the devices were connected to ground. In this configuration switches 2 and 3 are closed while switches 1 and 4 are open. 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.

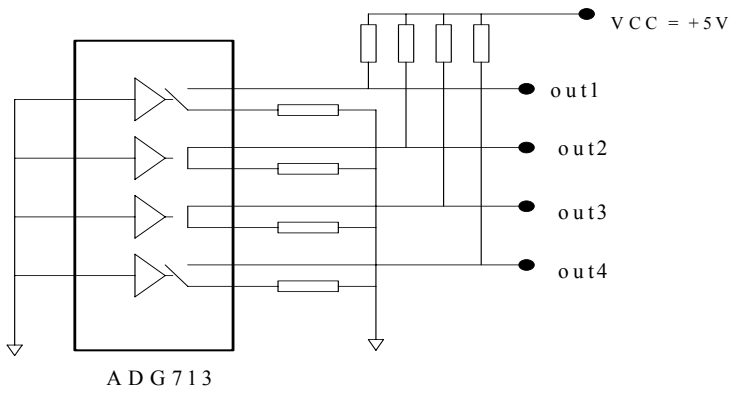

Figure 1 Simplified schematic diagram of the ADG713 irradiation biasing board.

Parameter	Ref. Dev.	Dev1	Dev2	Dev3	Dev4
Bias During Irradiation	NA	+5V	+5V	+5V	+5V
Dose Rate	NA	4.6rad(Si)/min	4.6rad(Si)/min	4.6rad(Si)/min	4.6rad(Si)/min
Irradiation Temperature	20 ± 3 ^{o}C	20 ± 3 ^{o}C	20 ± 3 ^{o}C	20 ± 3 ^{o}C	20 ± 3 ^{o}C

Table 1 Irradiation Test Conditions

3.1 Measurement set-up

- Only parametric measurements were performed at regular intervals as indicated in table 3, no real time measurements were performed 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 2 list all parametric measurements performed and their limit values.

Test Parameter	Limit
Supply Current	Upper 100nA
ON resistance	Upper 4ohm
Delta RON	Upper 0.2ohm
Input Current	Upper 100nA lower –100nA

Table 2 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. 4 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 3 illustrates the irradiation and measurement history.

Irradiation steps	Ref. Dev.	Dev1	Dev2	Dev3	Dev4
Pre-rad. Par. measurements	Yes	Yes	Yes	Yes	Yes
6.4 krad(Si)	NA	NA	NA	NA	NA
Par. measurements	NA	Yes	Yes	Yes	Yes
13 krad(Si)	NA	NA	NA	NA	NA
par. measurements	NA	Yes	Yes	Yes	Yes

21.7 krad(Si)	NA	NA	NA	NA	NA
par. measurements	NA	Yes	Yes	Yes	Yes
26 krad(Si)	NA	NA	NA	NA	NA
Par. measurements	Yes	Yes	Yes	Yes	Yes

Table 3 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

Figures 2 to 5 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.

Following figure5, a discussion of the results is presented.

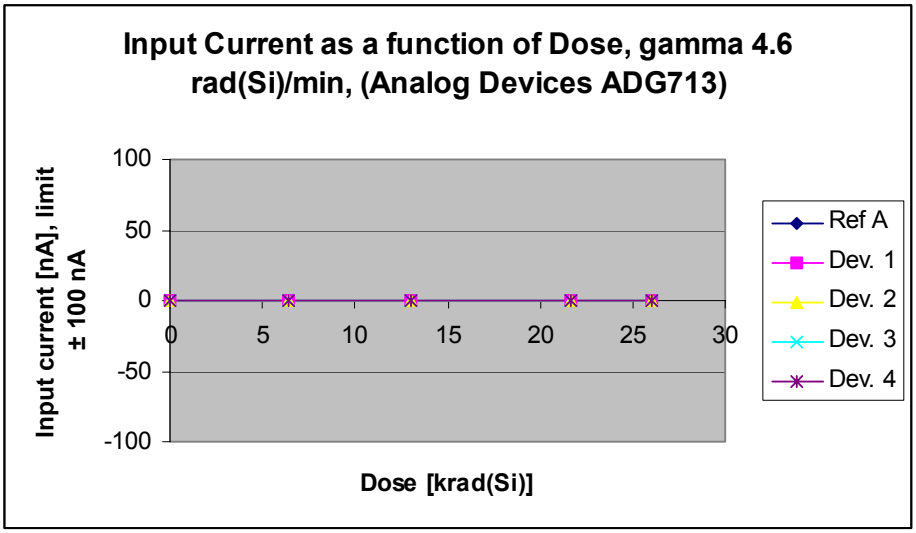

Figure 2 Input current as a function of Dose, gamma 4.6 rad(Si)/min.

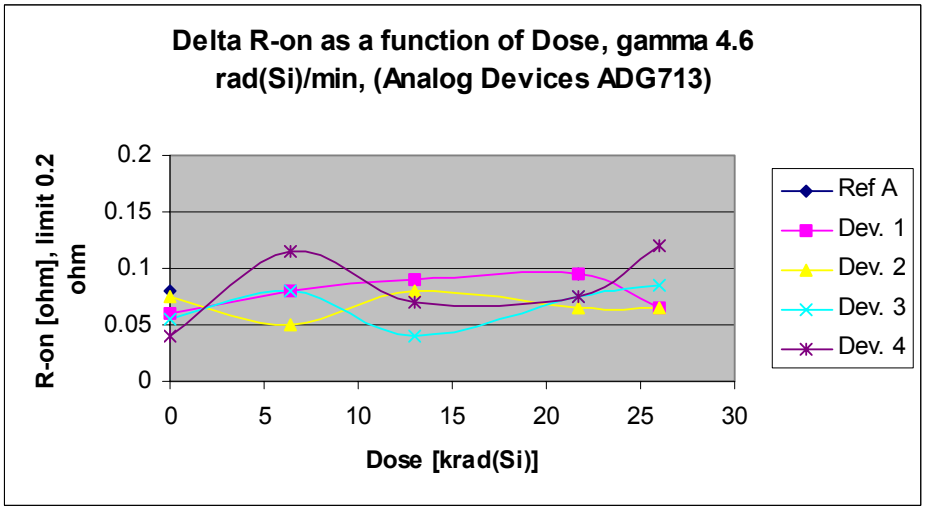

Figure 3 Delta R-on as a function of Dose, gamma 4.6 rad(Si)/min.

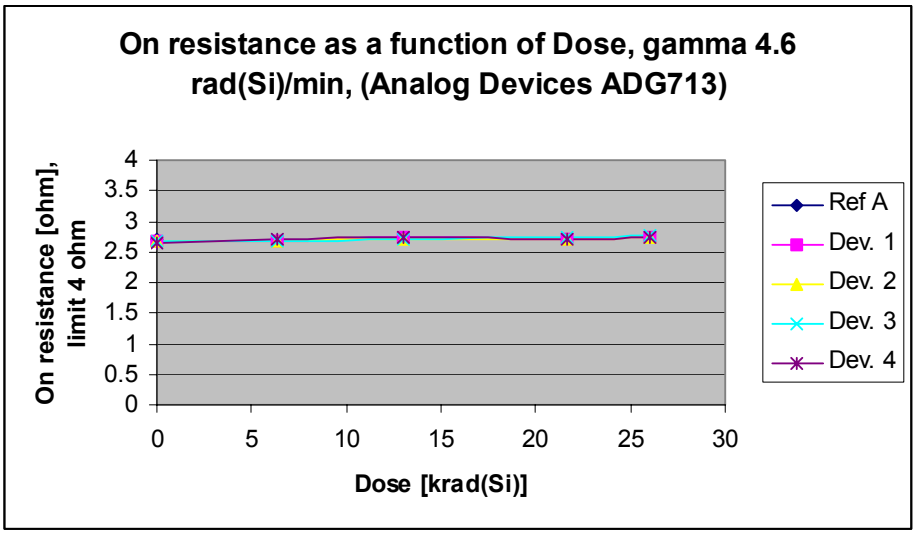

Figure 4 On resistance as a function of Dose, gamma 4.6 rad(Si)/min.

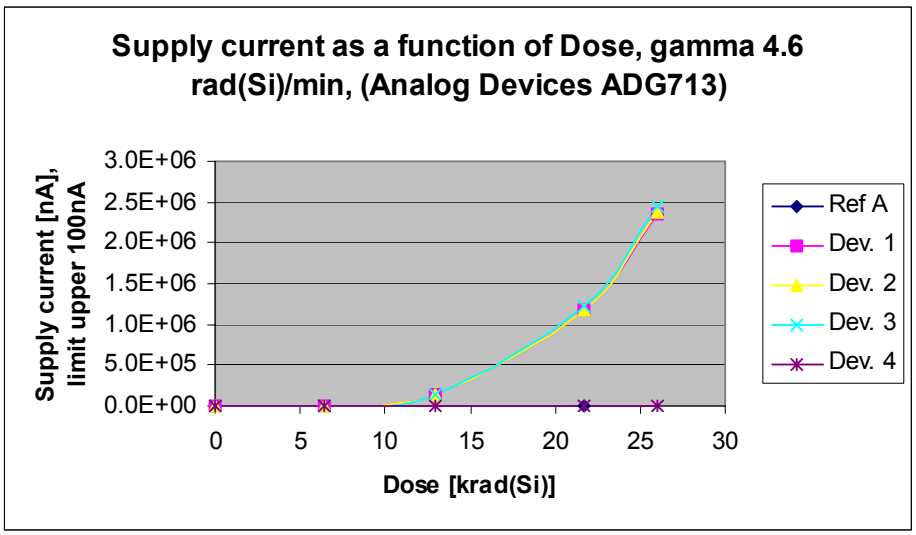

Figure 5 Supply current as a function of Dose, gamma 4.6 rad(Si)/min.

Figure 6 illustrate that the device supply current is out of specification for total doses above 6.4krad(Si). Parameter degradations for devices 1 to 3 are comparable while device 4 illustrates much lower degradation values (this may indicate that device 4 is from a different lot). At 13krad(Si) the supply current values for devices1 to 3 are approximately 3 orders of magnitude above the specified upper limit while the supply current for device 4 is only 3 times above the specified upper limit.

All other parameters were within specified values to a total dose value of 26krad(Si).

3.5 Annealing results

All devices were subjected to a 132-hour room temperature annealing test. The devices were biased during the annealing tests.

No significant changes to any parameters were observed.

3.6 Conclusion

The commercial ADG713 quad SPST switch tested here, show that the supply currents are out of specification at total dose levels above 6.4 krad(Si). The total ionising dose requirement set by the STEREO project is 15krad(Si) (including a margin of 2). No significant parameter changes were observed after 132-hour room temperature annealing.

The ADG713 devices were still functional at a total dose of 26krad(Si), however, the supply current increases significantly for total doses above 6.4krad(Si). The large increase observed is of great concern and should be critically reviewed for impact on long-term reliability of the devices.

Considering the significant increase in supply current observed with potential long-term reliability issues, it is not recommended to employ this device for the STEREO project.