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RADIATION TEST REPORT

2N3810

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CHANGE LOG

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Test Report Number	ESA_QCA0702T_I
Project	
SCC Component no.	
Component Designation	Dual PNP Transistor
Irradiation Spec. no.	
Family	Transistors
Group	Silicon
Package	Supplied as Surface mount on DIL adapter
Component Specification	
Test House Name	ESA / ESTEC
Irradiation Test Plan Number	
Manufacturer name	
Application type of Acceptance	
Serial Number of samples	Four (4) samples serialised as 1, 2, 3 and 4 (Ref)
Manufacturing Date Code	0325
Irradiation Measurement Interval: Biased Unbiased: Circuit Reference: Supply Voltage: Temp °C: Duration:	Yes (3 parts) No -24V Room temperature 20 ± 3
Electrical Measurement Parameters	VCE (BR), ICB0, IEB0, VCE (sat), hfe1 (DC) & VBE (on)
Facility Source: Energy: Dose Rate: Absorbed Material: Thickness: Temperature °C:	60Co 0.5 rad(Si)/min N/A N/A 20 ± 3
Dosimetry / Calibration method.	A calibrated NE2571, 0.6cc air ionisation chamber read by a calibrated Farmer 2670 dosimeter.
Anneal Test Biased Unbiased Bias Circuit Reference Supply Voltage Duration	Yes 168h at 80°C No Yes

1 INTRODUCTION

The following document contains the TID Radiation Test Report for 2N3810 dual pnp transistor.

2 APPLICABLE DOCUMENTS

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

3 TEST DESCRIPTION

Four (4) 2N3810, devices were selected for TID irradiation testing at the ESTEC ^{60}Co facility. Irradiations were performed at a dose rate of 0.5rad(Si)/min. Post irradiation annealing measurements were also performed on the devices.

Of the selected devices, one was assigned as a reference device (serialised as 4) while, three were serialised for radiation exposure (all three biased). After each exposure-step the components were removed and tested on the SZ-test system for parametric measurements. Each irradiation test-board accommodated and biased three 2N3810 devices. The biasing scheme of the dual transistors is illustrated in Figure 1, Figure 2 illustrates the device package. The operating conditions during irradiation were provided by the project. The device operating conditions, temperature conditions and applied dose rates are listed in Table 1.

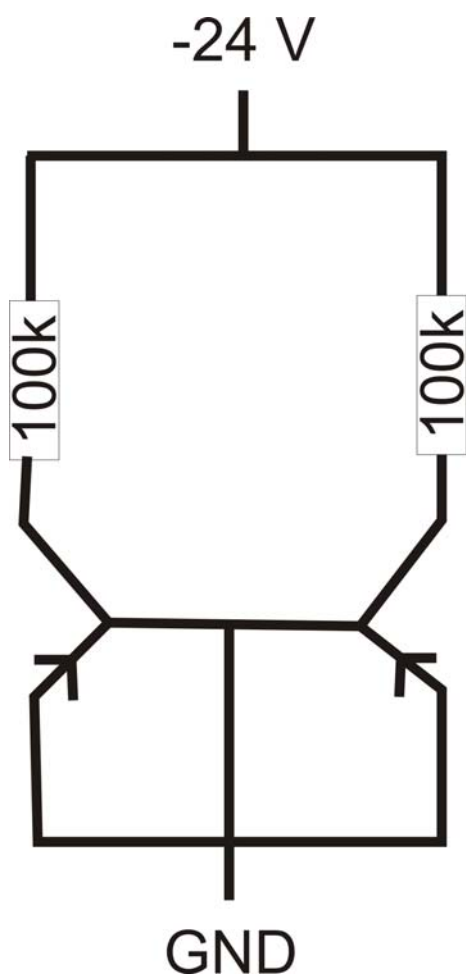


Figure 1: 2N3810 irradiation biasing conditions



Figure 2 2N3810 package

Table 1: irradiation Test Conditions

Parameter	Ref	Dev1	Dev2	Dev3
Bias During Irradiation	NA	-24V	-24V	-24V
Dose Rate	NA	0.5rad(Si)/min	0.5rad(Si)/min	0.5rad(Si)/min
Irradiation Temperature	NA	20 ± 3 °C	20 ± 3 °C	20 ± 3 °C

3.1 *Measurement set-up*

No in-situ measurements were performed during irradiation. Parametric measurements were performed with regular intervals as listed in Table 3. Parametric measurements were performed employing a SZ parametric tests system:

- SZ M3000 Test Station Sm02B
- M3000 TA07B Test Adapter
- Software UTS-Version 2.5.1

Table 2 lists all parametric measurements performed and their limit values.

Parameter	Unit	LL	HL
VCE0 (BR)	V	60	200
ICB0	nA		200
IEB0	nA		200
VCE (sat)	mV	0	200
hfe1 (DC)		1	900
VBE (on)	mV	0	700

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 45min. 9 irradiation steps were performed and parametric measurements taken 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.

Table 3: irradiation and measurement history

Irradiation steps	Ref	Dev 1	Dev 2	Dev 3
Pre-rad. Par. measurements	Yes	Yes	Yes	Yes
3.0 krad(Si)				
Par. measurements	Yes	Yes	Yes	Yes
5.8krad(Si)				
par. measurements	Yes	Yes	Yes	Yes
8.9krad(Si)				
par. measurements	Yes	Yes	Yes	Yes
19.1krad(Si)				
Par. Measurements	Yes	Yes	Yes	Yes
26.7krad(Si)				
Par Measurements	Yes	Yes	Yes	Yes
34.3krad(Si)				
par. measurements	Yes	Yes	Yes	Yes
44.5krad(Si)				
par. measurements	Yes	Yes	Yes	Yes
53.4krad(Si)				
par. measurements	Yes	Yes	Yes	Yes
62.3krad(Si)				
par. measurements	Yes	Yes	Yes	Yes

3.2 *Thermal conditions*

All irradiations and measurements were performed at room temperature (20 ± 3 °C).

3.3 *Dosimetry*

A calibrated NE2571, 0.6cc air ionisation chamber read by a calibrated Farmer 2670 dosimeter was used to measure the Total Ionising Dose.

3.4 *Test Results*

- The irradiation test results for 2N3810 are presented in **Error! Reference source not found.** to **Error! Reference source not found.**
- Device 1 contained transistors 1 & 2
- Device 2 contained transistors 3 & 4
- Device 3 contained transistors 5 & 6

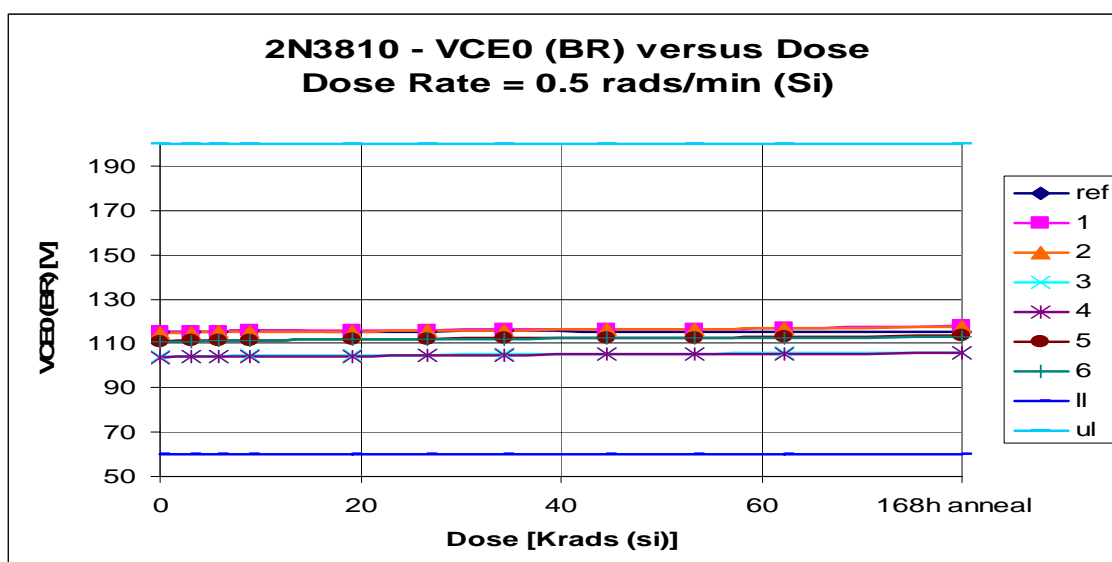


Fig 3. VCE0 (BR) versus Dose [Dose Rate=0.5 rads/min(Si)]

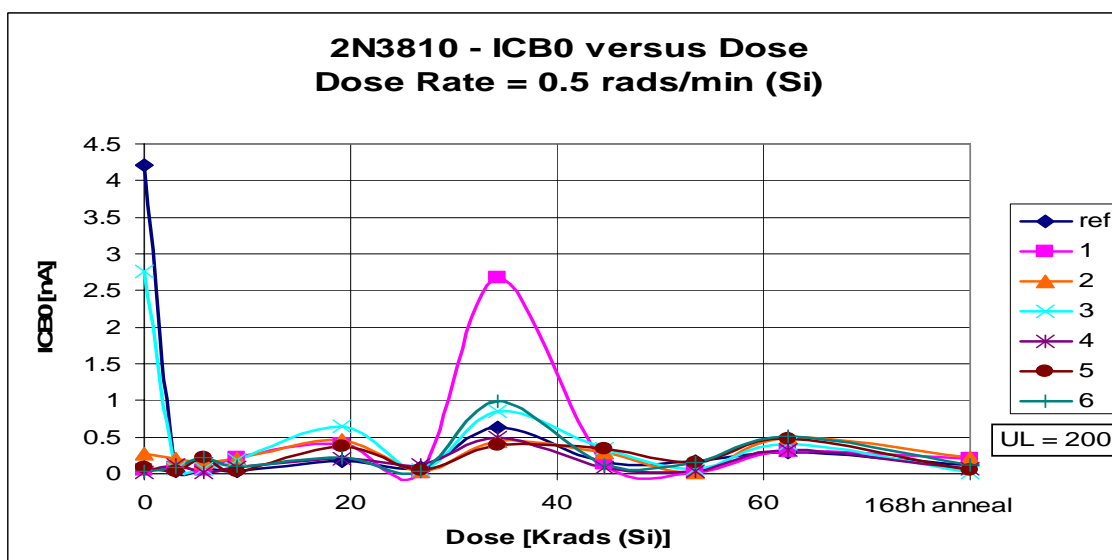


Fig 4. ICB0 versus Dose [Dose Rate=0.5 rads/min(Si)]

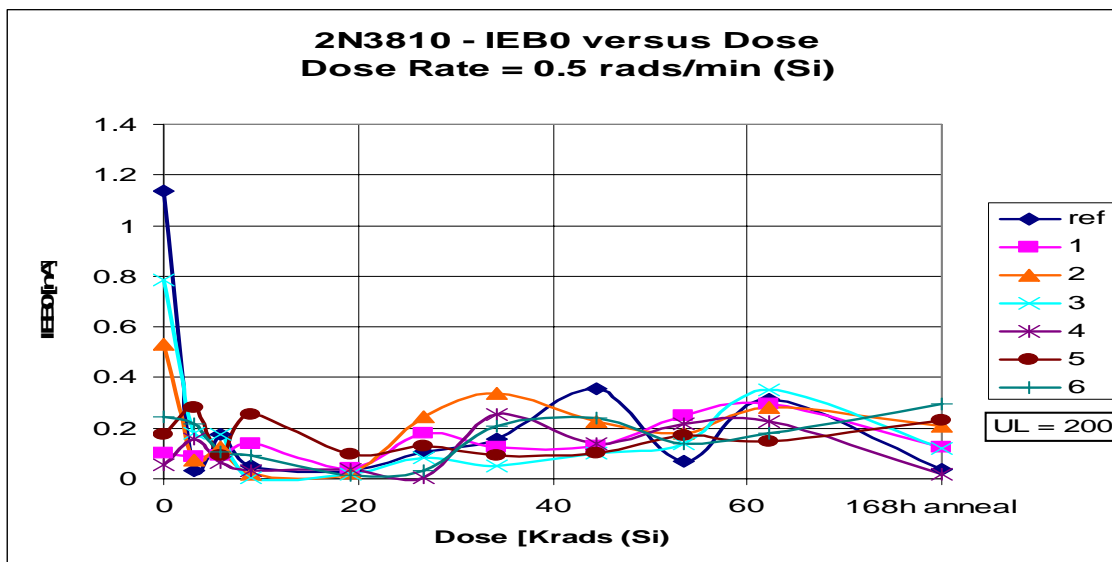


Fig 5. IEB0 versus Dose [Dose Rate=0.5 rads/min(Si)]

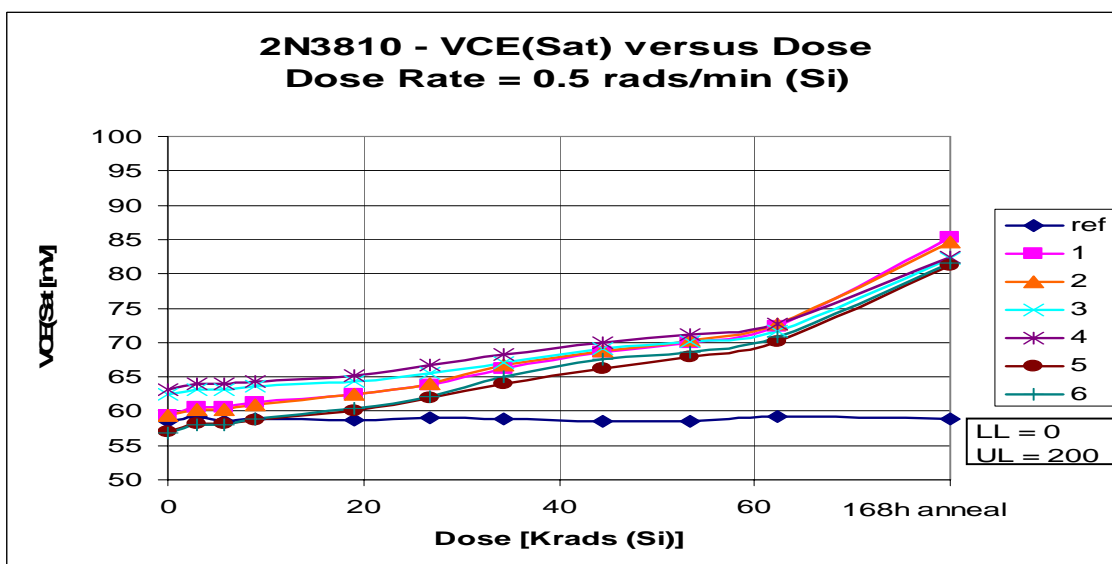


Fig 6. VCE (sat) versus Dose [Dose Rate=0.5 rads/min(Si)]

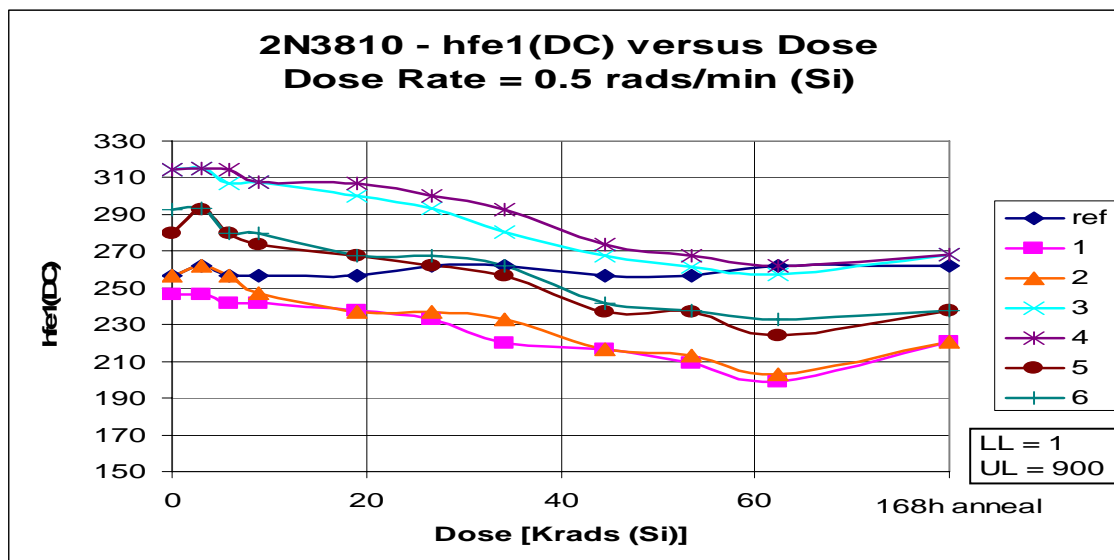


Fig 7. hfe1 (DC) versus Dose [Dose Rate=0.5 rads/min(Si)]

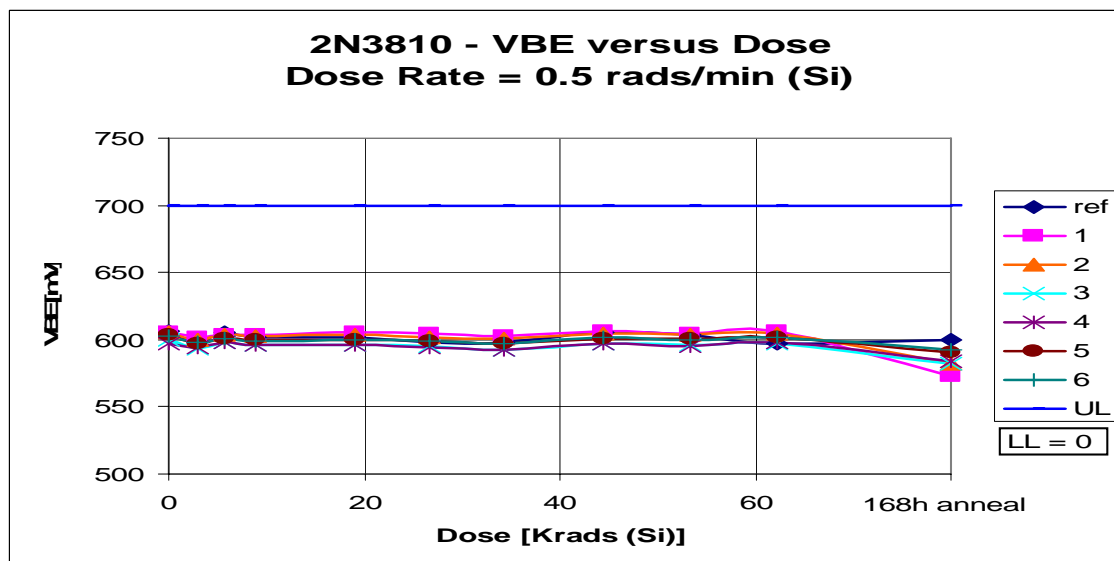


Fig 8.VBE (on) versus Dose [Dose Rate=0.5 rads/min(Si)]

4 CONCLUSION

Irradiation tests of the 2N3810 devices were performed to investigate the component's suitability for flight..

Although there was anomalous behaviour at 34Krad for parameter ICB0 it recovered to nominal by 44krads. Even though parameter drifting became evident at higher doses for VCE (sat) and hfe1 (DC) all devices remained well within their parametric limits to the maximum total dose tested [62Krad (Si)].