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RADIATION TEST REPORT

LM158

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CHANGE RECORD

Issue: 1 Revision: 1

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Test Report Number	ESA_QCA0704T_I
Project	
SCC Component no.	
Component Designation	Dual Op. Amp
Irradiation Spec. no.	
Family	Linear
Group	Silicon
Package	DIL
Component Specification	
Test House Name	ESA / ESTEC
Irradiation Test Plan Number	
Manufacturer name	Nat semi
Application type of Acceptance	
Serial Number of samples	Four (4) samples serialised as 1,2,3 & 4 (Ref)
Manufacturing Date Code	0411
Irradiation Measurement Interval: Biased Unbiased: Circuit Reference: Supply Voltage: Temp ^{o}C: Duration:	 Yes (2 parts –1 & 2) Yes (1 part – 3) +60V Room temperature 20 ± 3

Electrical Measurement Parameters	IOS, IB-, IB+, IS+, IS-, AVO, VO+, VO-, SR+, SR- &VOS
Facility Source: Energy: Dose Rate: Absorbed Material: Thickness: Temperature ^{o}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^{o}C No Yes

1 INTRODUCTION

The following document contains the TID Radiation Test Report for LM158 op amp for the project.

2 APPLICABLE DOCUMENTS

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

3 TEST DESCRIPTION

Four (4) LM158, 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 (4) while, three were serialised for radiation exposure (1 & 2 biased and 3 unbiased). After each exposure-step the components were removed and tested on the SZ-test system for parametric measurements. Each irradiation test-board accommodated the biased and unbiased LM158 devices. The biasing scheme of the op. amps 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.

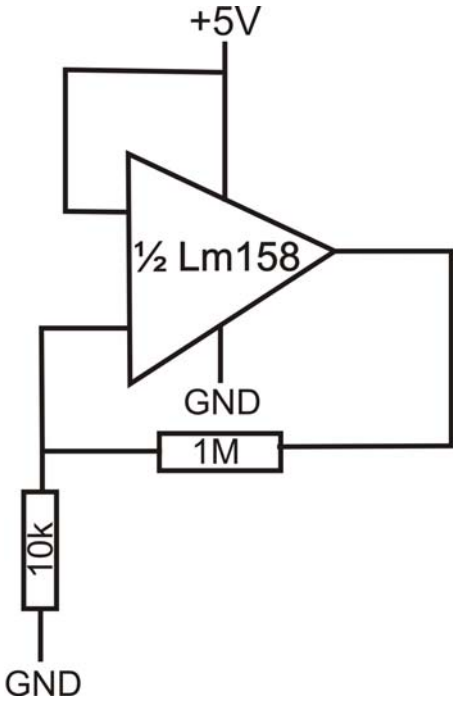

Figure 1: LM158 irradiation biasing conditions

Figure 2 LM158 package

Table 1: irradiation Test Conditions

Parameter	Ref	Dev1	Dev2	Dev3
Bias During Irradiation	NA	+5V	+5V	0V
Dose Rate	NA	0.5rad(Si)/min	0.5rad(Si)/min	0.5rad(Si)/min
Irradiation Temperature	NA	20 ± 3 ^{o}C	20 ± 3 ^{o}C	20 ± 3 ^{o}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	UL
Ios - Input Offset Curre	nA		1
Ib - Input Bias Current	nA		50
Ib+ - Input Bias Current	nA		50
Is+ - Positive Supply Cu	mA	0	2.9
Is- - Negative Supply Cu	mA	0	2.9
Avo - Large Signal Volt.	dB	73	
Vo+ - Output Voltage Swi	V	12	
Vo- - Output Voltage Swi	V		-12
SR+ - Slew Rate	V/us	0.05	
SR- - Slew Rate	V/us	0.05	
VOS - Input Offset Volta	mV		50

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
13.3krads(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

3.2 Thermal conditions

All irradiations and measurements were performed at room temperature (20 ± 3 ^{o}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 LM158 are presented in **Error! Reference source not found.** to **Error! Reference source not found.**13

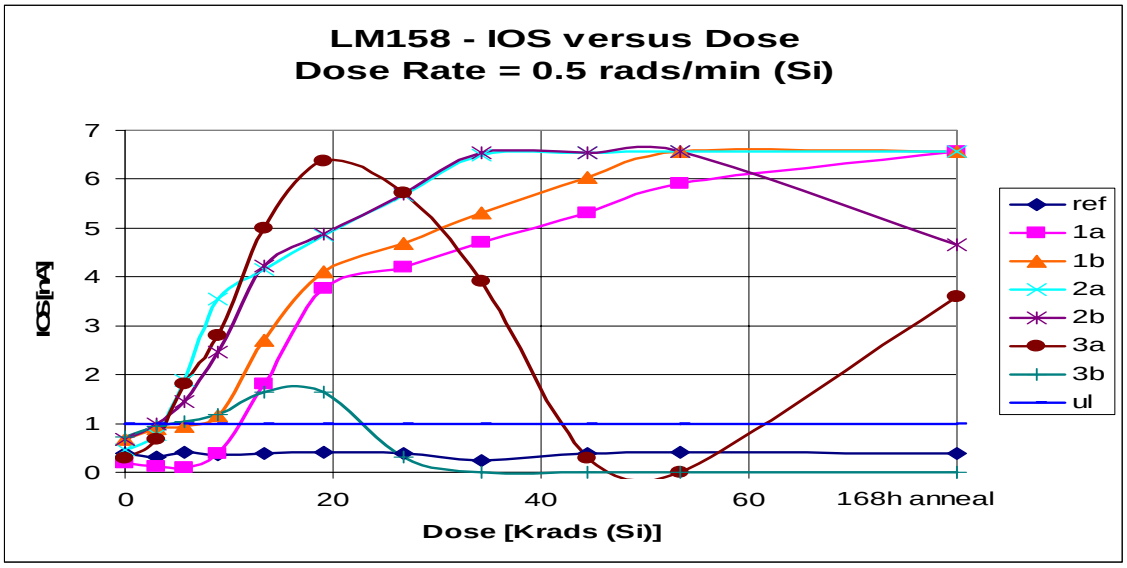

Fig 3. IOS versus Dose [Dose Rate=0.5 rads/min(Si)]

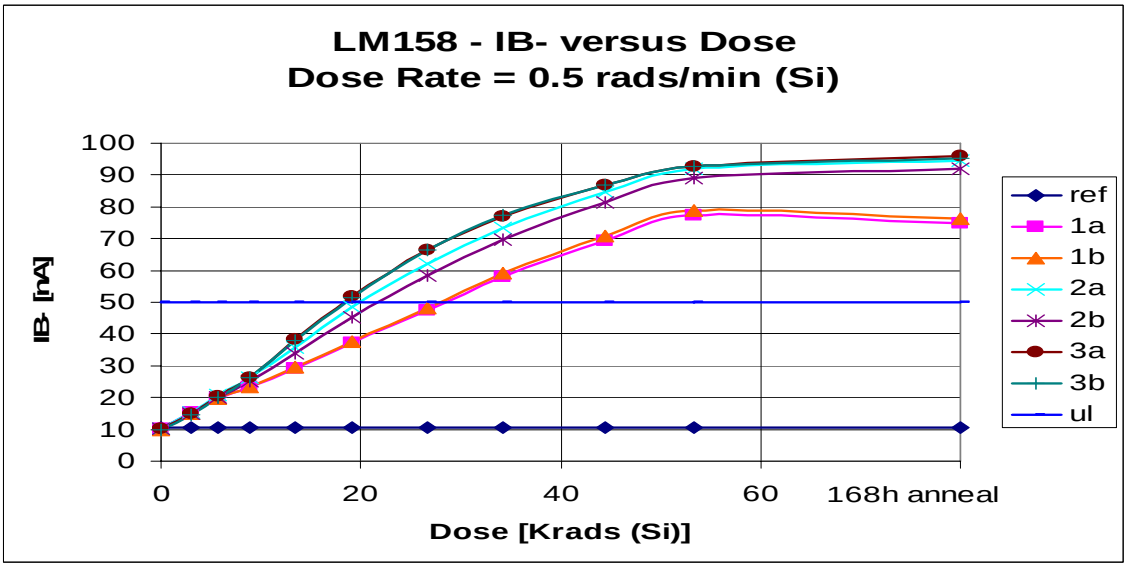

Fig 4. IB minus versus Dose [Dose Rate=0.5 rads/min(Si)]

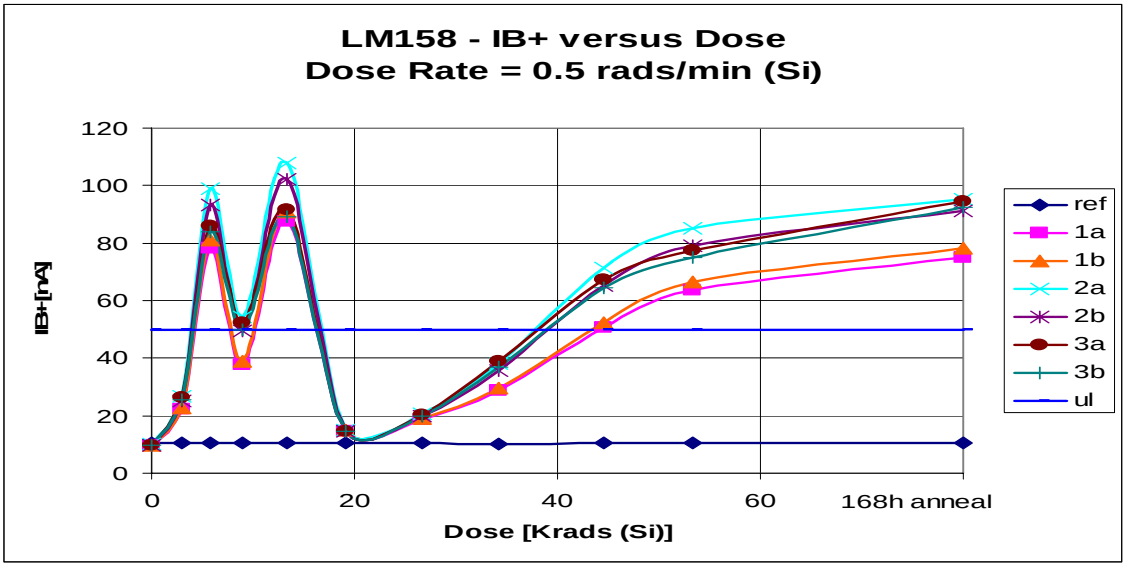

Fig 5.IB plus versus Dose [Dose Rate=0.5 rads/min(Si)]

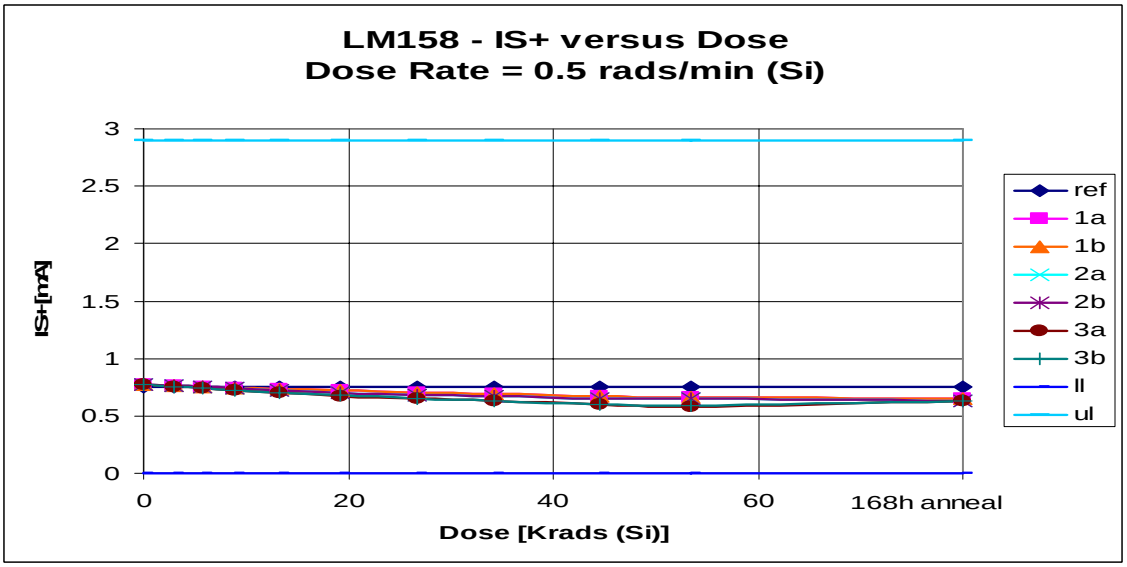

Fig 6.IS plus versus Dose [Dose Rate=0.5 rads/min(Si)]

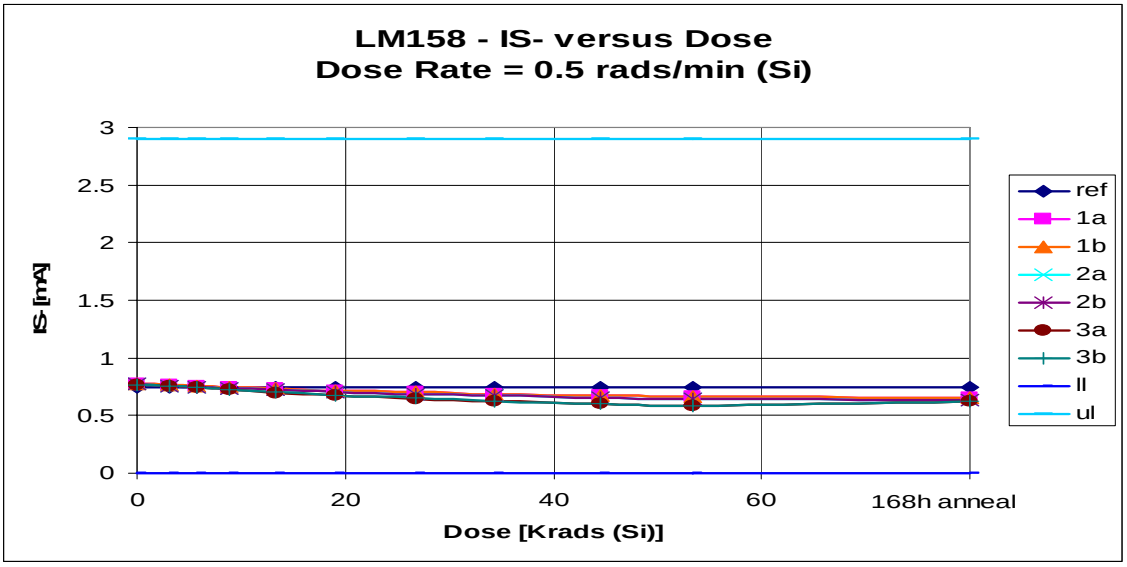

Fig 7. IS minus versus Dose [Dose Rate=0.5 rads/min(Si)]

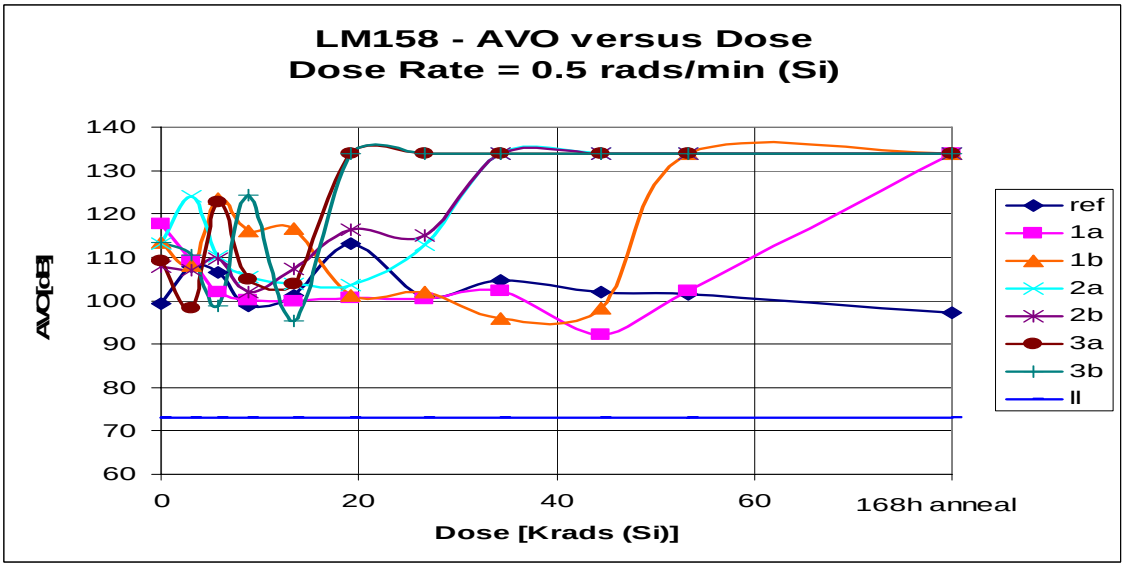

Fig 8. AVO versus Dose [Dose Rate=0.5 rads/min(Si)]

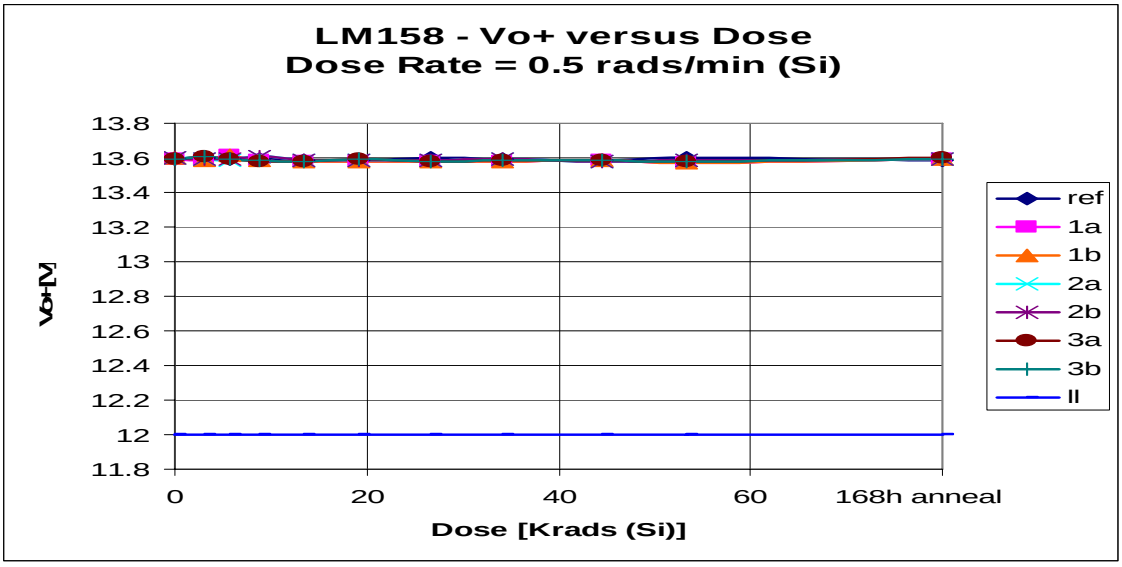

Fig 9. V0 plus versus Dose [Dose Rate=0.5 rads/min(Si)]

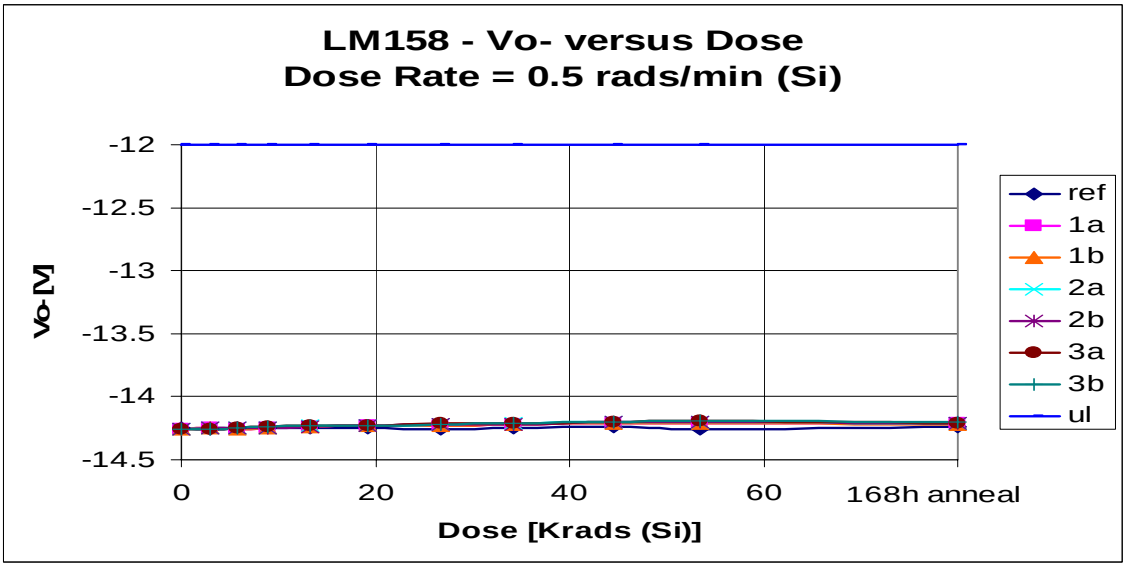

Fig10. V0 minus versus Dose [Dose Rate=0.5 rads/min(Si)]

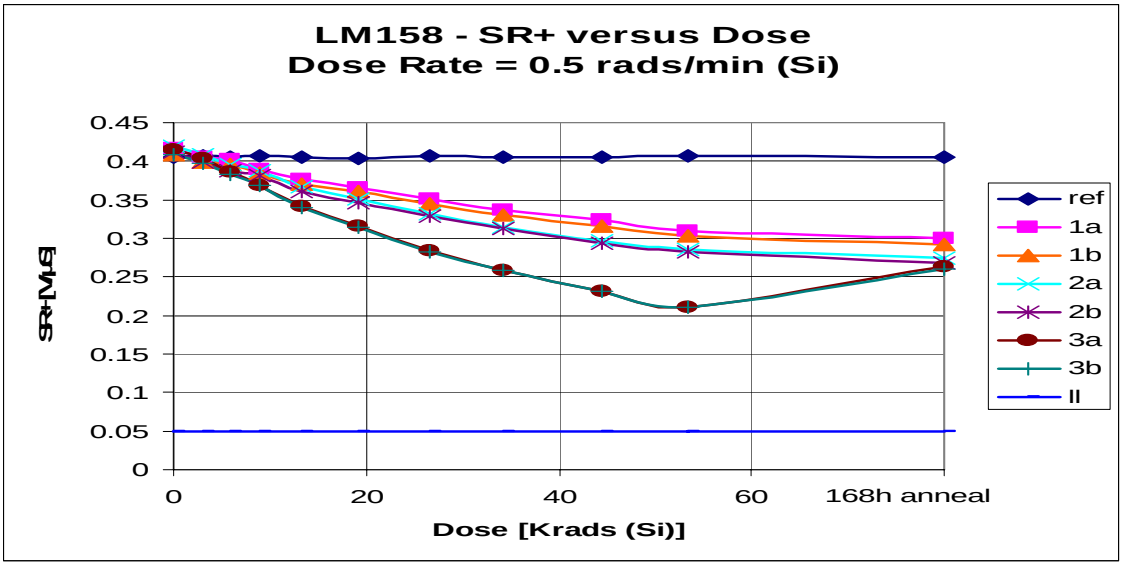

Fig 11. SR plus versus Dose [Dose Rate=0.5 rads/min(Si)]

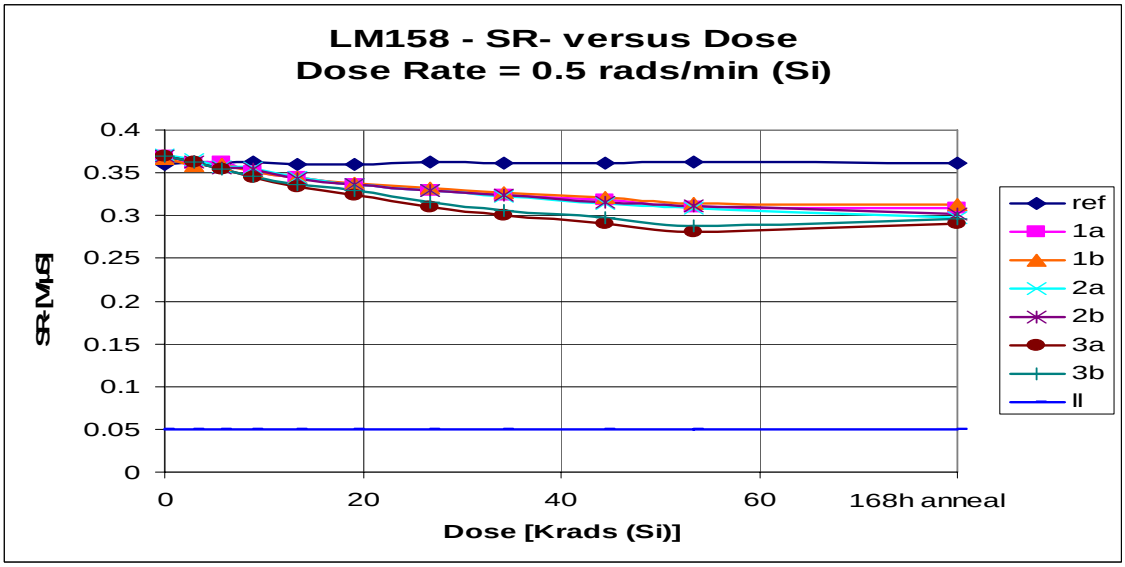

Fig 12. SR minus versus Dose [Dose Rate=0.5 rads/min(Si)]

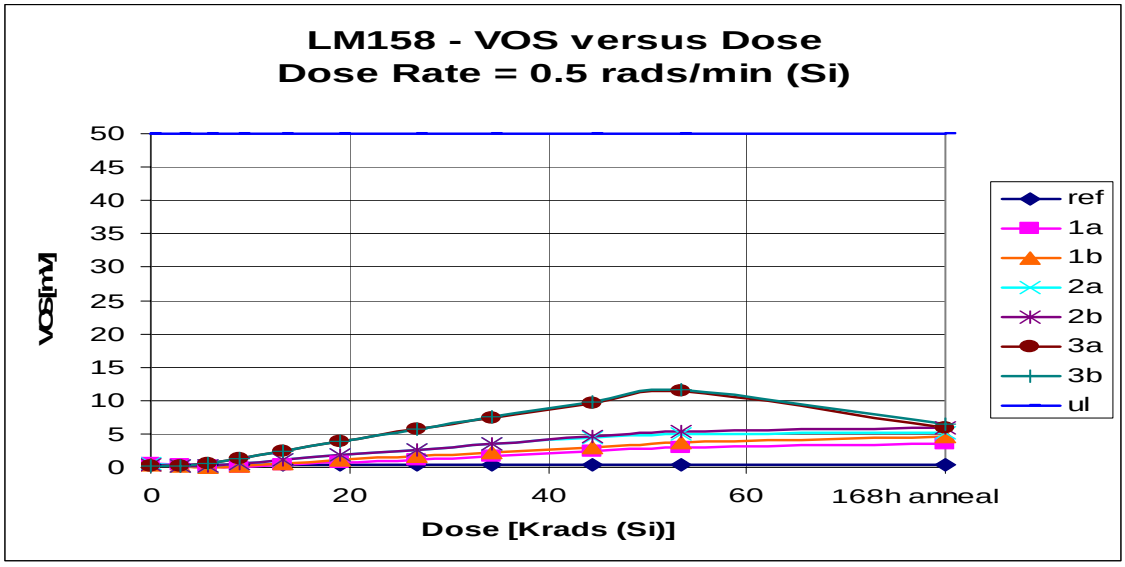

Fig 13. VOS versus Dose [Dose Rate=0.5 rads/min(Si)]

4 CONCLUSION

Irradiation tests of the LM158 devices were performed to investigate the component's suitability for flight.

For IOS, devices 2 & 3 are outside limits by 5.8krads and all devices outside by 13.3krads.
The unbiased device (3) fails between 34 and 44krads and no recovery is evident after annealing.

For IB minus all devices are outside limits by 30Krads.

For IB plus all devices exhibit strange behaviour between 5.8 and 13.3krads followed by a progressive increase in current until all devices are (again) outside limits by 44krads. No recovery is observed after annealing.

Otherwise all other parameters remain within limits until the test is stopped at 53.4krads.