ISOCOM® LTD

Total Dose Test Report on IS49 Optocouplers

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Package: TO-5 Metal Can

Optocouplers

Isocom Limited

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1.0 INTRODUCTION

The main objective of this assessment of the ISOCOM Optocouplers IS49 Series Products is to determine the susceptibility of the devices to Total Dose Gamma Radiation.

The result of this assessment will form the baseline for Displacement Damage testing during the evaluation and qualification phase of ESA Contract No.20466/06/NL/PM.

Total Dose Radiation Testing can severely degrade the performance and characterisation of optocouplers. Ionisation radiation causes bulk ionization of all materials resulting in the creation of non-radioactive trapped charges in the diffusion region of the devices with a resultant loss in efficiency. The degradation normally relates to Current Transfer Ratio (CTR) defined as the ratio of Output Current (IC) to the Input Current (IF).

This Total Dose Test Report details the work carried out on a sample of ISOCOM IS49 optocouplers in accordance with the ESA Contract covering Radiation Testing of 4N49 equivalent Optocouplers to:

i) Characterise optocoupler degradation under gamma irradiation in the framework requirements of Total Dose Steady State Irradiation Specification ESA/SCC 22900.

ii) Compare radiation sensitivity with 4N49 devices available on the market for space applications.

The Report focuses on:

i) Parameter shifts in Current Transfer Ratio (CTR) created by the build up of trapped charges; and

ii) Testing with different Bias Conditions to establish their influence on CTR degradation and the worse case damage condition of radiation on optocouplers.

Unbiased, 1mA and 10mA biased devices were irradiated at the European Space Research and Technology Centre (“ESTEC”) in Noordwijk in The Netherlands up to a total dose fluency of approximately 150krad(Si).

A complete set of electrical measurements, including CTR, Vce, If and IR, together with graphs of measured parameters with respect to the total Ionisation dose received are provided in **Appendix A** for all the samples delivered to ESTEC by Isocom Limited. All tests were conducted at ESTEC by ESA and Isocom Limited.

2.0 TEST PROCEDURES

2.1 Applicable and reference documents

Applicable documents for this test are ESA/SCC Basic Specification No.22900 Issue No.4 and MIL- STD -883C Method 1019.7.

2.2 The ESTEC Co-60 facility at Noordwijk in The Netherlands

A Cobalt-60 (Co-60) source is the agreed standard for the Total Ionising Dose characterisation of optocoupler devices.

CO-60 Ionisation testing was carried out at ESTEC in the Netherlands to establish the effect of dose rate dependent degradation mechanisms on the sample ISOCOM optocouplers. Further information on Co-60 is provided in **Appendix B**.

The Co-60 source at ESTEC is housed in a double welded stainless steel capsule approximately 60mm long and 30mm in diameter as shown in **Figure 1** below. Nominal source activity during the test was 1681 Ci (62TBq).

The average dose rate (water) of 20 Rad(Si)/min was achieved by:

i) Placing the devices an average 128.4 cms (per Table 2 below) from the Cobalt 60 source exit window shown in **Figure 1** below; and

ii) Using the control system in **Figure 2** to maintain the dose rate during the test.

Figure 1: Cobalt-60 radiation source

Figure 2: Control System

The ESTEC Co-60 facility at Noordwijk in The Netherlands (continued)

Testing was carried out in the ESTEC Cobalt 60 Radiation Chamber shown in **Figure 3** below.

Figure 3: ESTEC Cobalt 60 Radiation Chamber

The optocouplers were prepared for testing in the Radiation Chamber as shown in **Figure 4** below.

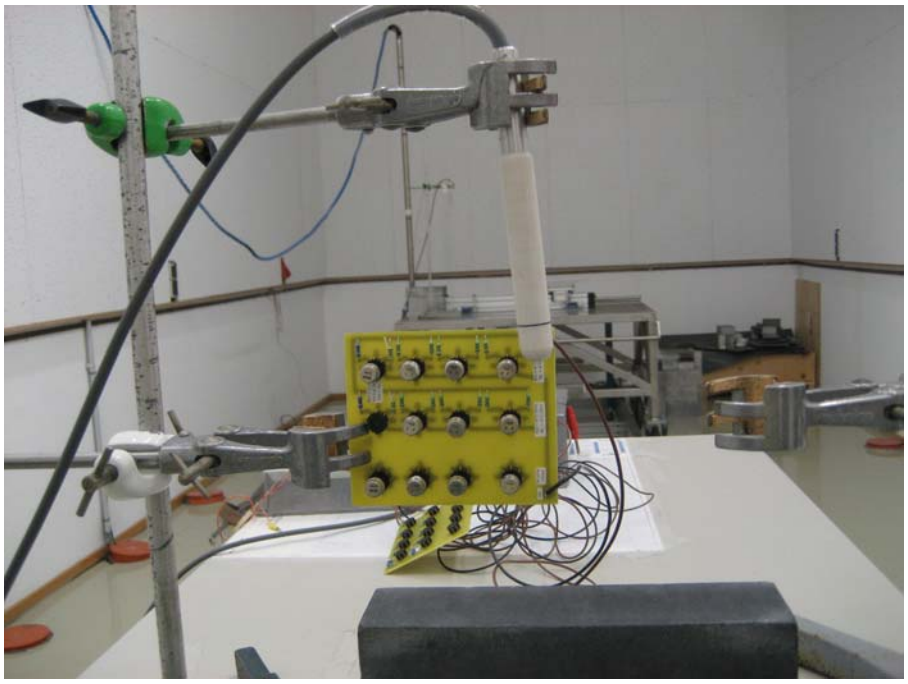


Figure 4: Test sample in the Radiation Chamber

2.3 TID sample and bias conditions

Total dose radiation tests were performed on a sample of ten IS49 (4N49) at an average dose rate of 20 Rad(Si)/min under the bias conditions shown in **Table 1** below. A sample of two high gain optocouplers were also tested but these are not the subject of this report.

		Bias condition:			Irradiated	Control	Total
		(If forward current)			sample	sample	sample
	Type of device	1mA	10mA	Off			
		No.	No.	No.	No.	No.	No.
	IS49 (4N49) devices	3	3	3	9	1	10
Note 1	Extra High Speed/High Gain devices	1	-	1	2	-	2
	Total	4	3	4	11	1	12

Note 1: These parts are not the subject of this report

Table 1: TID sample size and bias conditions

The primary electrical parameters were measured before irradiation and all tests were performed at ambient temperature.

The ten IS49 optocouplers were allocated sequential serial numbers (s/n) from 1 to 10 with No.10 being the reference sample.

The specification of the IS49 (4N49) optocouplers is as follows:

Product type:
Metal Can 6 Pin IS49 (4N49) Type Transistor output

Part no.
IS49

Date code
Per product specification Batch 20 dated 18 August 2009 (Numbered 1E to 10E).

Temperature Range:
25+-2°C

Technology:
LED GaAlAs (Wavelength: 850 nm) and Silicon Phototransistor

Detail Specification:
Per IS49 (4N49) data sheet supplied by ESA

TID sample and bias conditions (continued)

The Optocouplers were mounted onto an Isocom Radiation Test Board shown in **Figure 5** below.

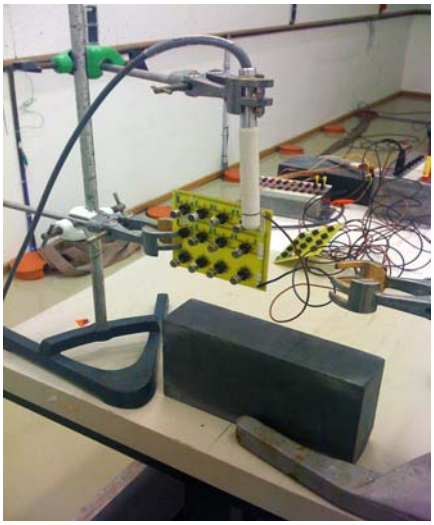
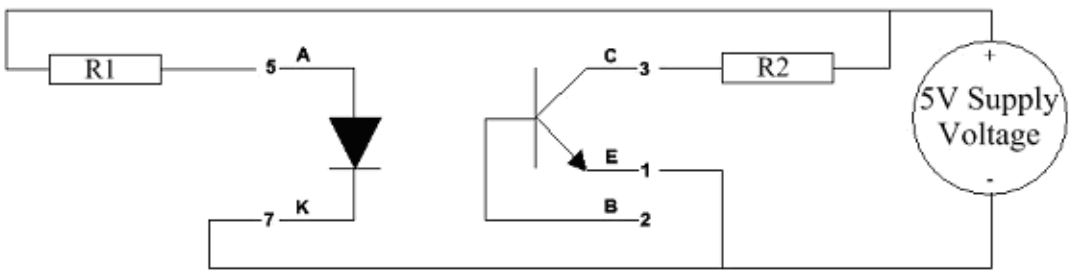


Figure 5: Photograph of the Radiation Test Board

The Radiation Test Board was set-up for Biased and Unbiased Conditions as shown in **Figures 6 and 7** below**.**



R1 = 470Ω; R2 = 4.7kΩ (I_{fwd} = 1mA) or 470Ω (I_{fwd} = 10mA)

Figure 6: Biasing conditions in Static ON Mode

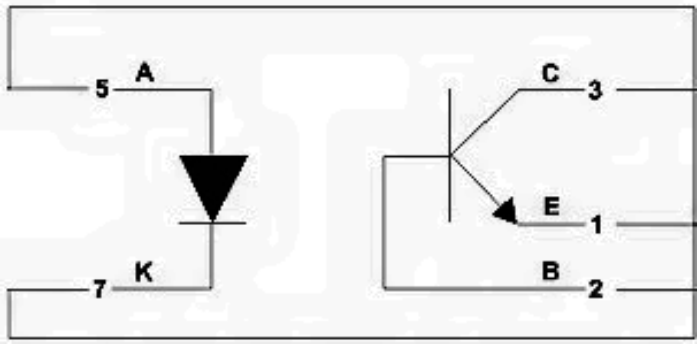


Figure 7 Un Biasing conditions in Static OFF Mode

TID sample and bias conditions (continued)

In the unbiased condition (OFF mode) all pins are grounded together as shown in the Radiation Test Board circuit layout in **Figure 8** below. This is the worst case damage condition for optocouplers under radiation test.

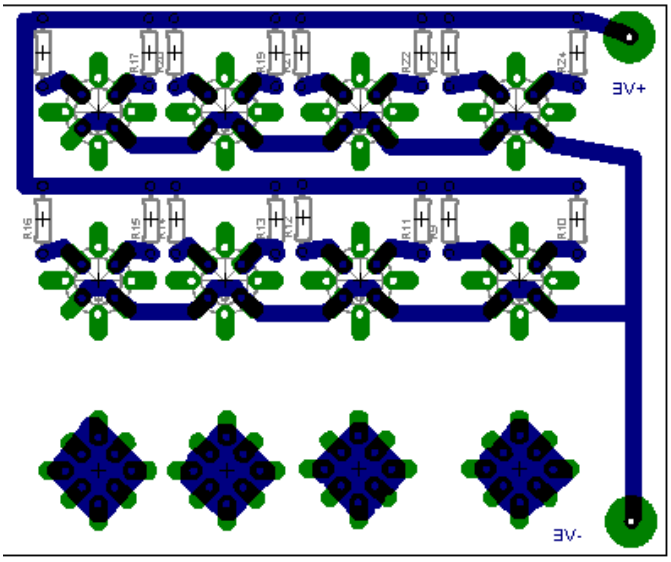


Figure 8: Radiation Test Board circuit layout

Each row was supplied with Bias constant current of 1mA (Optocouplers s/n 1-3) and 10mA (Optocouplers s/n 4-6). The remaining devices (optocouplers s/n 7-9) were unbiased meaning that all the leads are connected together.

Two samples of the Extra High Speed and High Gain optocouplers were also mounted on the same radiation test board in a 1mA and Unbiased condition as shown in **Figure 9** below. These parts are not the subject of this report.

Figure 9: Test sample mounted on the Radiation Test Board

2.4 Irradiation test sequence

A total dose of 150krad(Si) was reached at the ESTEC Co-60 facility in 7 dose steps of 4krad, 16krad, 8krad, 17krad, 7krad, 70krad and 28krad respectively in accordance with the irradiation test sequence shown in **Table 2** below.

Run	Date	Start time	Stop time	Run time	Distance from source	Dose rate	TID rads	Cum dose	**Cum dose**
						(water)	(water)	(water)	**(Si)**
No.	(d/m/yr)	(h.min)	(h.min)	(mins)	(cms)	(rad/min)	(krad)	(krad)	**(krad)**
1	22/10/08	13.27	17.11	224	128.1	20.1	4.5024	4.50	4.05
	22/10/08	17.45							
2	23/10/08		8.46	901	127.5	20.3	18.2723	22.77	20.50
3	23/10/08	9.26	17.00	454	128.1	20.1	9.1254	31.90	28.71
	23/10/08	17.32							
4	24/10/08		9.20	948	129.0	19.8	18.7704	50.67	45.60
5	24/10/08	10.18	17.03	405	129.0	19.8	8.0069	58.68	52.81
	24/10/08	18.03							
6	27/10/08		9.30	3807	127.4	20.3	77.2821	135.96	122.36
	27/10/08	10.52							
7	28/10/08		13.24	1592	129.7	19.6	31.1395	167.10	**150.39**
	Total			8331	mins	20.1	average dose rate		
				5.8	days				

Table 2: Irradiation Test Sequence & Total Dose

Commencing 22 October 2008, the irradiation tests were conducted over a period of six days. The average dose rate was 20 Rad(Si)/min and the total dose of 150Krad(Si) exceeded the original target standard dose of up to 100Krad(Si).

The optocouplers were electrically tested to space requirement specification within one hour of leaving the radiation chamber after each step run. The test results were recorded and are summarised in **Appendix A**.

The electrical control system for ionisation was setup to provide a 5 Volt supply to the printed circuit board. Resistors on the printed circuit board provided a constant current of 1mA to the first row of devices and 10mA to the second row in **Figures 8 and 9** . The third row was unbiased in the OFF condition and all the input and output leads of the optocouplers were connected to the ground.

The control system in **Figure 2** above shows if there is any sudden change in performance of the devices by an increase in current supplied to the PC board. The control system supplied 5 Volts and the total current was monitored during irradiation.

The control system showed that the total current consumed by the components on the printed circuit board throughout the test remained under 70mA.

2.5 Annealing

Post radiation the devices were left at 25°C under bias conditions for 24 hours as a recovery process.

After the recovery process, the devices were subject to accelerated ageing under bias conditions at an oven temperature of 100°C for 168 hours.

The results are shown on line 8 (24 hour recovery process) and line 9 (accelerated ageing process) of the test data in **Appendix A.**

2.6 Electrical test equipment

The Optocouplers were characterized pre and post irradiation using an Agilent 4156C shown in **Figure 10** below.

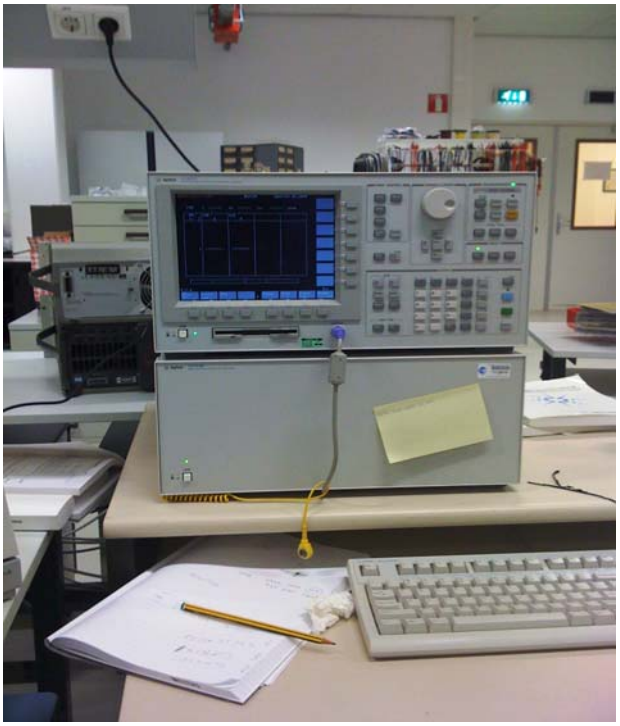


Figure 10: Agilent 4156C test equipment

Electrical measurements are monitored by an external PC for statistical and graphical analysis of each of the parameters tested.

The data storage and subsequent statistical analysis was performed by the ESTEC computer system interfacing with the Test System shown above in **Figure 10** via an RS232 interface.

2.7 Electrical measurement

The optocoupler test conditions and limits for the 29 electrical test parameters in Appendix A, numbered 0 to 28, are shown in **Table 3** below.

			LIMITS (change if needed)			
	Parameter	**Unit**	min	max	min%	max%
0	0- Ir	[pA]	-10,000,000	0	-100%	100%
1	1- Vf	[V]	0.8	1.5	-100%	100%
2	2- VCE Brkdwn	[V]	40	9999	-100%	100%
3	3- VCB Brkdwn	[V]	45	9999	-100%	100%
4	4- VBE Brkdwn	[V]	-9999	-7	-100%	100%
5	5- Ic Off	[pA]	0	100,000	-100%	100%
6	6- CTR	[%]	200	1000	-100%	100%
7	7- VCE saturation	[mV]	10	300	-100%	100%
8	8- Photosensitivity	[uA]	-100	-5	-100%	100%
9	9- Ic On	[mA]	2	10	-100%	100%
10	10- VCE sat 1	[mV]	10	300	-100%	100%
11	11- VCE sat 2	[mV]	10	300	-100%	100%
12	CTR @If 1mA (Vce 5V)	[%]	200	1000	-100%	100%
13	CTR @If 2mA (Vce 5V)	[%]	200	1000	-100%	100%
14	CTR @If 5mA (Vce 5V)	[%]	200	1000	-100%	100%
15	CTR @If 10mA (Vce 5V)	[%]	200	1000	-100%	100%
16	CTR @If 20mA (Vce 5V)	[%]	200	1000	-100%	100%
17	CTR @If 1mA (Vce 10V)	[%]	200	1000	-100%	100%
18	CTR @If 2mA (Vce 10V)	[%]	200	1000	-100%	100%
19	CTR @If 5mA (Vce 10V)	[%]	200	1000	-100%	100%
20	CTR @If 10mA (Vce 10V)	[%]	200	1000	-100%	100%
21	CTR @If 20mA (Vce 10V)	[%]	200	1000	-100%	100%
22	Hfe @Ib 1uA	[---]	50	1000	-100%	100%
23	Hfe @Ib 5uA	[---]	50	1000	-100%	100%
24	Hfe @Ib 10uA	[---]	50	1000	-100%	100%
25	Hfe @Ib 20uA	[---]	50	1000	-100%	100%
26	Hfe @Ib 40uA	[---]	50	1000	-100%	100%
27	Hfe @Ib 50uA	[---]	50	1000	-100%	100%
28	Hfe @Ib 80uA	[---]	50	1000	-100%	100%

Table 3: Test Conditions

The parameters were monitored during each radiation step and a record was taken of each parametric characterisation of the sample optocouplers. Measurements were taken immediately after each step in accordance with the one hour maximum duration prescribed in Specification ESA/SCC 22900.

During each step the radiation control equipment was monitored before and after electrical measurement.

The same test conditions applied for the ageing process of the optocouplers.

The test data for parameters 0 to 28 is shown in **Appendix A**.

3.0 TEST DATA

3.1 Parameter 0 to 28 test data (Appendix A)

Parameter measurements were recorded on the tests summarised in **Figure 11** below.

The test data on parameters 0 to 28 are shown in **Appendix A**. Data on parameter No.29 is displayed separately in **Figure 12** below.

No.	Parameter
0	Ir, LED reverse current Ir @ Vr = - 2 V [A]
1	Vf, LED forward voltage Vfw @ Ifw = 10mA [B]
2	VCE Brkdwn, Collector Emitter breakdown voltage Vce @ Ice=1mA (Ib=0) [Vce max limited at 100V] [N]
3	VCB Brkdwn, Collector Base breakdown voltage Vcb @ Icb=100uA (Ieb=0A)[VCb max limited at 60V] [L]
4	VBE Brkdwn, Base Emitter Breakdown Voltage Vbe @ Ibe = -100uA [Veb max limited at 10V] [M]
5	Ic off, Off State collector current Ioh @ Ifw = 0A (Vce = 20V) [D]
6	CTR, Current Transfer Ratio CTR @ Ifw = 1mA (Vce = 5V) [C]
7	Vce sat @ Ifw = 2mA (Ice= 2mA) [F]
8	Photosensitivity, Ib @ Ifw = 1mA (Vce = 0V) [I]
9	IC on, On State collector current Ion @ Ifw = 1mA (Vce = 5V) [E]
10	Vce sat1 @ Ifw = 30mA (Ice= 1mA) [G]
11	Vce sat2 @ Ifw = 6mA (Ice= 1mA) [H]
12	CTR @If 1mA (Vce 5V) [K]
13	CTR @If 2mA (Vce 5V)
14	CTR @If 5mA (Vce 5V)
15	CTR @If 10mA (Vce 5V)
16	CTR @If 20mA (Vce 5V)
17	CTR @If 1mA (Vce 10V)
18	CTR @If 2mA (Vce 10V)
19	CTR @If 5mA (Vce 10V)
20	CTR @If 10mA (Vce 10V)
21	CTR @If 20mA (Vce 10V)
22	Hfe @Ib 1uA (Vce = 5 V) [J]
23	Hfe @Ib 5uA (Vce = 5 V)
24	Hfe @Ib 10uA (Vce = 5 V)
25	Hfe @Ib 20uA (Vce = 5 V)
26	Hfe @Ib 40uA (Vce = 5 V)
27	Hfe @Ib 50uA (Vce = 5 V)
28	Hfe @Ib 80uA (Vce = 5 V)
29	CTR v Ifwd,Vce before and after 150Krad(si) TID at a dose rate of 20rad/min

Figure 11: List of electrical parameters tested

There are two schedules of test data for each parameter 0 to 28 in Appendix A.
- Schedule 1 of 2 records the individual device data and the min/max/average/standard deviation/median of the nine irradiated samples at each dose step (data rows 1 to 7) and after 24 hours and 168 hours annealing (data rows 8 and 9)
- Schedule 2 of 2 records the percentage change in parameter values.

Measurement values for reference device no.10 are also included in the test data.

3.2 Parameter 29 graphical data

This test monitors the CTR and Forward current (If) with respect to the Collector Emitter Voltage (Vce).

S/n 7 device was selected for this test as the unbiased condition would provide a worst case degradation condition.

The graphical analysis of the test data in **Figure 12** below shows the degree of CTR degradation in respect of Vce of 5 volts and 10 Volts and the shift in CTR before and after gamma irradiation.

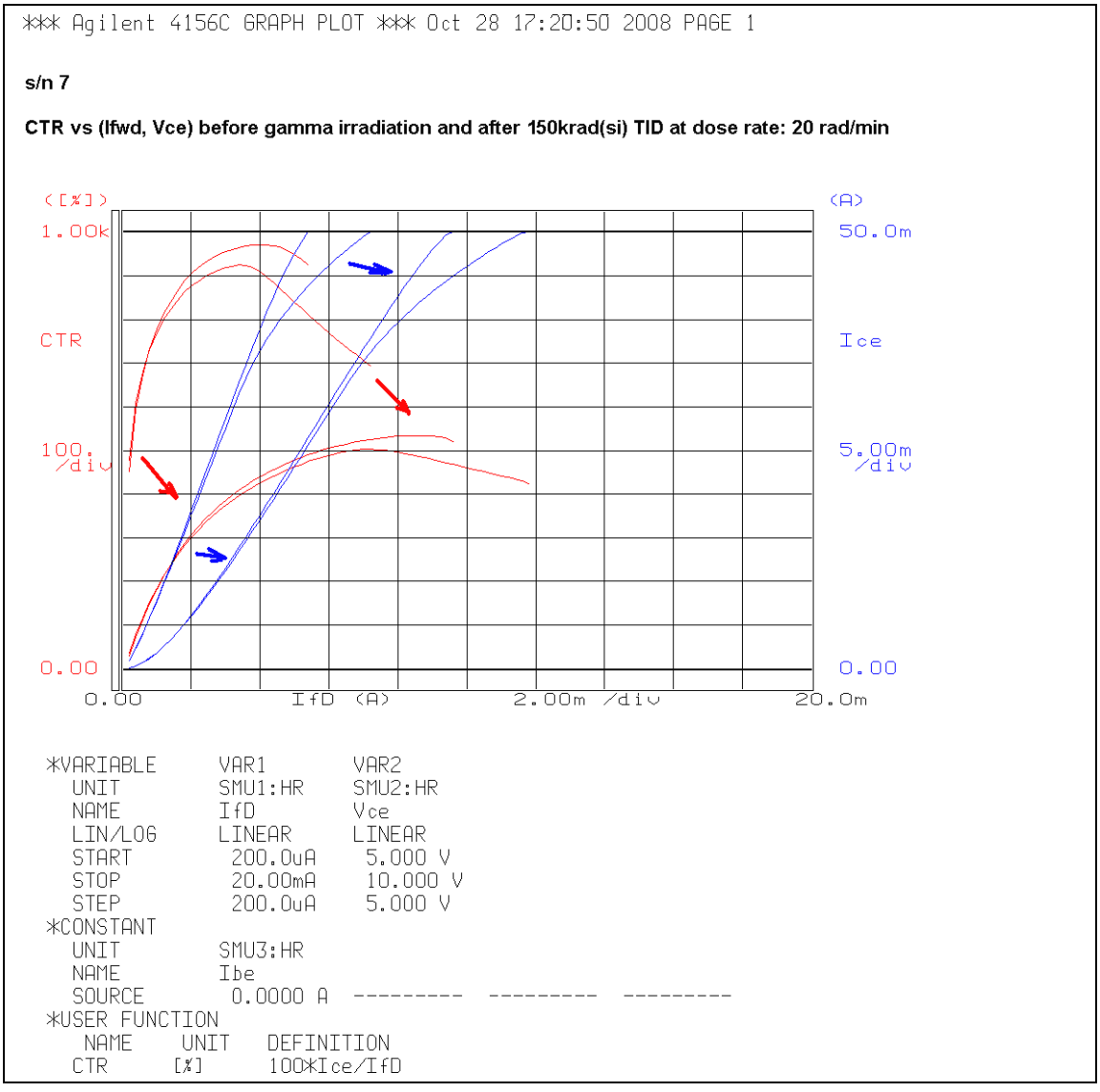


Figure 12: Parameter 29 Graphical data

4.0 TEST RESULTS

4.1 Summary of test results by parameter

The results of the tests on electrical parameters 0 to 29 are summarised below by parameter.

Current Transfer Ratio (CTR): Parameter Nos. 6, 12 - 21 and 29

The current transfer ratio, CTR was tested with forward current of 1mA, 2mA, 5mA, 10mA, and 20mA at Vce of 5 Volts and 10 Volts.

During the measurement of parameters 12 to 21 the CTR was tested and the worst condition was shown when the optocouplers are unbiased during irradiation.

CTR of the sample cptocouplers showed variations of between 500% to 1,000%. These are related to a combination of the emitter, LED, detector and construction of the optocouplers.

The test data derives from 9 devices in various conditions and an increasing total dose to 150krad(Si). 3 samples are tested at 1mA If; 3 samples are tested at 10mA If and 3 samples are unbiased. Performance is consistent in each condition with the worst performance in unbiased conditions.

The results, however, are still within specification except for one device with an initial CTR of 522.06% which fell below 200% at 130.56%. This, however, occurred at a total dose of 150krad(Si).

Overall, the test results show that the Isocom optocouplers are radiation hard to 150krad(Si) with little sign of further degradation

Reverse current (IR): Parameter No.0

The sample performed within IR limits at al times and emitter LED deviations were minimal during the test at each dose step to 150krad(Si).

Forward voltage (VF): Parameter No.1

The sample performed consistently with minimal emitter LED degradation.

Breakdown Voltage (BV): Parameter Nos.2 to 4

The breakdown voltage of the optocouplers were within specification and consistent without any optocoupler degradation at 99 volts. BV could not be measured further due to the limitation of the test equipment to measure 100 volts or more.

Leakage current (Ioh): Parameter Nos.5

The performance of the detector under all conditions is well within specification and leakage is low.

Summary of test results by parameter (continued)

Voltage collector emitter saturation (Vce): Parameter Nos.7, 10 and 11

Vce Sat is stable and within specification at currents of If of 2mA and 30mA and Collector emitter Current of 2mA and 1mA.

Photosensitivity Parameter No.8

Detector photosensitivity exhibits very little change at each irradiation dose step to 150Krad(Si). Measurements are stable and within specification.

Gain (Hfe) Parameter Nos.22 to 28

Whilst the Transistor gain measurements show signs of some degradation within the detector, particularly in the Unbiased condition, none of the sample optocouplers failed.

Standard Deviation

The pre-irradiation means and standard deviations were calculated for Devices 1 to 9.

Post irradiation analysis was performed by calculating the means and standard deviations of the ratio of post/pre irradiation values for the parameter measurements of each sample.

Appendix A gives the pre-irradiation mean and standard deviations for each parameter measured and shows the degradation ratio of the mean and standard deviations of the post irradiation parameter measurements.

The tables also include a column with the heading, "limit ratio". This is the ratio by which the pre-irradiation mean measurement is within the maximum or minimum parameter limit, as defined in the Electrical Characteristics of ESAs comparison data sheets. This ratio gives an easy reference to determine where a parameter has degraded beyond the manufacturer's limits, although it must be considered that the pre-irradiation measurement and the post irradiation ratios are the mean values of a number of samples.

Annealing results

The electrical measurements after 24 hours produced a slight recovery.

After 168 hours accelerated ageing, however, the optocouplers exhibited a significant recovery to almost 85% of the original conditions with no failures.

5.0 CONCLUSION

The sample ISOCOM IS49 optocouplers are radiation hard to a dose level of up to 150krad(Si) and are performing well within ESA's requirements for European Space Applications.

The detailed test results in **Appendix A** show the individual parameter characterization with respect to emitter performance, detector performance and performance of the optocoupler as a whole.

APPENDIX A

TOTAL DOSE TEST RESULTS
FOR PARAMETERS 0 TO 28

Test	Page
0 - Ir, LED reverse current Ir @ Vr = - 2 V [A]	1
1 -Vf, LED forward voltage Vfw @ Ifw = 10mA [B]	3
2 - VCE Brkdwn, Collector Emitter breakdown voltage Vce @ Ice=1mA (Ib=0) [Vce max limited at 100V] [N]	5
3 - VCB Brkdwn, Collector Base breakdown voltage Vcb @ Icb=100uA (Ieb=0A)[VCb max limited at 60V] [L]	7
4 - VBE Brkdwn, Base Emitter Breakdown Voltage Vbe @ Ibe = -100uA [Veb max limited at 10V] [M]	9
5 - Ic off, Off State collector current Ioh @ Ifw = 0A (Vce = 20V) [D]	11
6 - CTR, Current Transfer Ratio CTR @ Ifw = 1mA (Vce = 5V) [C]	13
7 - Vce sat @ Ifw = 2mA (Ice= 2mA) [F]	15
8 - Photosensitivity, Ib @ Ifw = 1mA (Vce = 0V) [I]	17
9 - IC on, On State collector current Ion @ Ifw = 1mA (Vce = 5V) [E]	19
10 - Vce sat1 @ Ifw = 30mA (Ice= 1mA) [G]	21
11 - Vce sat2 @ Ifw = 6mA (Ice= 1mA) [H]	23
12 - CTR @If 1mA (Vce 5V) [K]	25
13 - CTR @If 2mA (Vce 5V)	27
14 - CTR @If 5mA (Vce 5V)	29
15 - CTR @If 10mA (Vce 5V)	31
16 - CTR @If 20mA (Vce 5V)	33
17 - CTR @If 1mA (Vce 10V)	35
18 - CTR @If 2mA (Vce 10V)	37
19 - CTR @If 5mA (Vce 10V)	39
20 - CTR @If 10mA (Vce 10V)	41
21 - CTR @If 20mA (Vce 10V)	43
22 - Hfe @Ib 1uA (Vce = 5 V) [J]	45
23 - Hfe @Ib 5uA (Vce = 5 V)	47
24 - Hfe @Ib 10uA (Vce = 5 V)	49
25 - Hfe @Ib 20uA (Vce = 5 V)	51
26 - Hfe @Ib 40uA (Vce = 5 V)	53
27 - Hfe @Ib 50uA (Vce = 5 V)	55
28 - Hfe @Ib 80uA (Vce = 5 V)	57

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			Issue:	01
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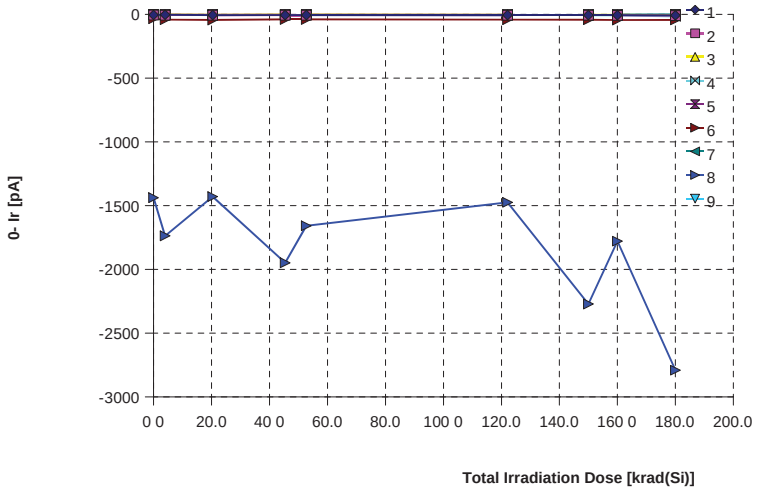
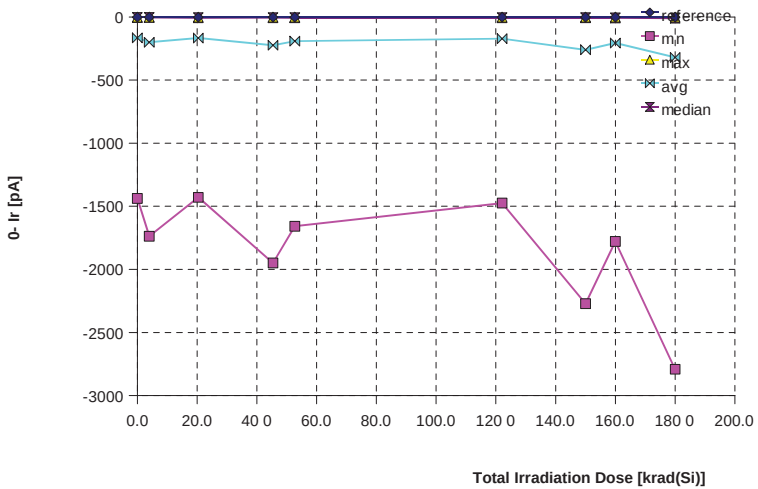
Parameter No: 0 : Ir, LED reverse current Ir @ Vr = - 2 V [A] Schedule: 1 of 2	APPENDIX A

0- Ir	s/n	1	2	3	4	5	6	7	8	9	10	min	max	avg	st dev	median
[pA]	krad(Si)	If=1mA	If=1mA	If=1mA	If=10mA	If=10mA	If=10mA	unbiased	unbiased	unbiased	reference					
	0.0	-4.57	-5.62	-0.89	-3 9	-1.08	-34.66	-1.09	-1438.19	-1.39	-1.49	-1438.19	-0.89	-165.71	477.3	-3.9
	4.0	-3.43	-7.15	-1.84	-5.79	-1.67	-41.48	-1.06	-1737.4	-1.73	-1 5	-1737.4	-1.06	-200.17	576.6	-3.43
	20.4	-5.72	-7.08	-2 9	-6.79	-2.35	-44.02	-1.17	-1429.55	-1.78	-1 8	-1429.55	-1.17	-166.82	473.71	-5.72
	45.4	-5.56	-6.76	-2.07	-5.67	-2.07	-39.71	-1.01	-1948.7	-1.68	-1.39	-1948.7	-1.01	-223.69	646.99	-5.56
	52.7	-5.85	-6.76	-1.95	-5.75	-2.17	-39.76	-0.97	-1658.09	-1.56	-1.73	-1658.09	-0.97	-191.43	550.13	-5.75
	122.1	-6.06	-7.21	-2 2	-7.37	-3.08	-41.31	-1	-1474.57	-1.72	-1.44	-1474.57	-1	-171.61	488.77	-6.06
	150.0	-6.11	-6.98	-2.41	-6.99	-3.36	-41.86	-0.93	-2271.36	-1.95	-1.65	-2271.36	-0.93	-260.22	754.29	-6.11
		-6.67	-7.82	-2.7	-8.64	-3.73	-44.42	-1.18	-1779.04	-1.68	-1.57	-1779.04	-1.18	-206.21	589.96	-6.67
Annealing		-7.62	-10.02	-5.59	-16.14	-8.88	-43.65	-0.76	-2791.1	-1.11	-1.44	-2791.1	-0.76	-320.54	926.55	-8.88
	min	-7.62	-10.02	-5.59	-16.14	-8.88	-44.42	-1.18	-2791.1	-1.95	-1.800					
	max	-3.43	-5.62	-0.89	-3.9	-1.08	-34.66	-0.76	-1429.55	-1.11	-1.390					
	avg	-5.73	-7.27	-2.51	-7.45	-3.15	-41.21	-1.02	-1836.44	-1.62	-1.557					
	st dev	1.19	1.19	1.29	3.52	2.3	3	0.13	449.05	0.25	0.142					
	median	-5.85	-7.08	-2 2	-6.79	-2.35	-41.48	-1.01	-1737.4	-1.68	-1.500					

Lim min -10,000,000.00 [pA]
Lim max 0.00 [pA]

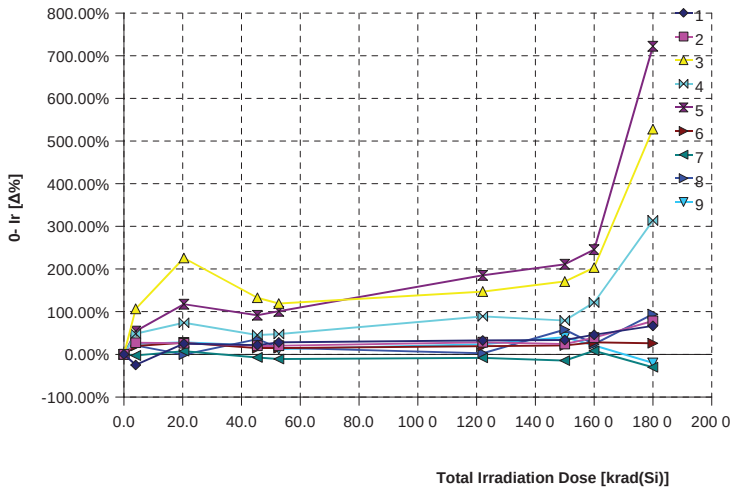


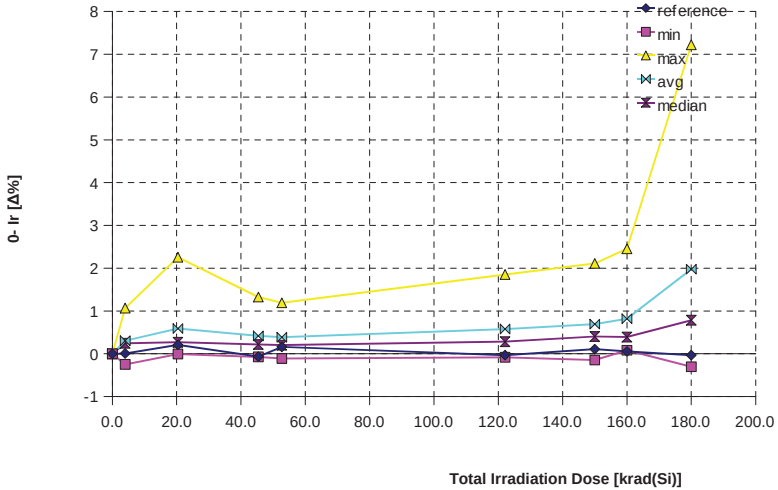
estimated uncertainty ± *0.09 [pA]*



Parameter No: 0 : Ir, LED reverse current Ir @ Vr = - 2 V [A] Schedule: 2 of 2	APPENDIX A

0- Ir [Δ%]	s/n krad(Si)	1 If=1mA	2 If=1mA	3 If=1mA	4 If=10mA	5 If=10mA	6 If=10mA	7 unbiased	8 unbiased	9 unbiased	10 reference	min	max	avg	st dev	median
	0.0	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0	0
	4.0	-24.95%	27.22%	106.74%	48.46%	54.63%	19.68%	-2.75%	20.80%	24.46%	0.67%	-24.95%	106.74%	30.48%	37.34%	24.46%
	20.4	25.16%	25.98%	225.84%	74.10%	117.59%	27.01%	7.34%	-0.60%	28.06%	20.81%	-0.60%	225.84%	58.94%	72.40%	27.01%
	45.4	21.66%	20.28%	132.58%	45.38%	91.67%	14.57%	-7.34%	35.50%	20.86%	-6.71%	-7.34%	132.58%	41.69%	43.65%	21.66%
	52.7	28.01%	20.28%	119.10%	47.44%	100.93%	14.71%	-11.01%	15.29%	12.23%	16.11%	-11.01%	119.10%	38.55%	43.53%	20.28%
	122.1	32.60%	28.29%	147.19%	88.97%	185.19%	19.19%	-8.26%	2.53%	23.74%	-3.36%	-8.26%	185.19%	57.72%	67.79%	28.29%
	150.0	33.70%	24.20%	170.79%	79.23%	211.11%	20.77%	-14.68%	57.93%	40.29%	10.74%	-14.68%	211.11%	69.26%	74.32%	40.29%
		45.95%	39.15%	203.37%	121.54%	245.37%	28.16%	8.26%	23.70%	20.86%	5.37%	8.26%	245.37%	81.82%	87.74%	39.15%
		66.74%	78.29%	528.09%	313.85%	722.22%	25.94%	-30.28%	94.07%	-20.14%	-3.36%	-30.28%	722.22%	197.64%	266.66%	78.29%
	min	-24.95%	0.00%	0.00%	0.00%	0.00%	0.00%	-30.28%	-0.60%	-20.14%	-6.71%					
	max	66.74%	78.29%	528.09%	313.85%	722.22%	28.16%	8.26%	94.07%	40.29%	20.81%					
	avg	25.43%	29.30%	181.52%	91.00%	192.08%	18.89%	-6.52%	27.69%	16.71%	4.47%					
	st dev	26.11%	21.10%	145.21%	90.20%	213.32%	8.65%	11.84%	31.22%	17.63%	9.52%					
	median	28.01%	25.98%	147.19%	74.10%	117.59%	19.68%	-7.34%	20.80%	20.86%	0.67%					
	Lim min	-100.00%														
	Lim max	100.00%														



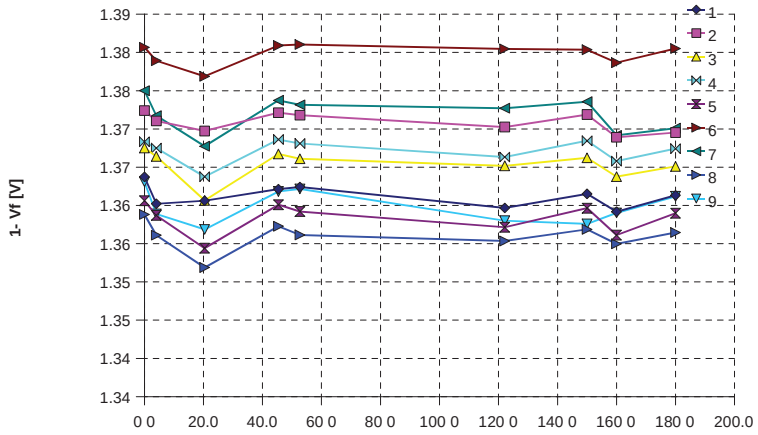


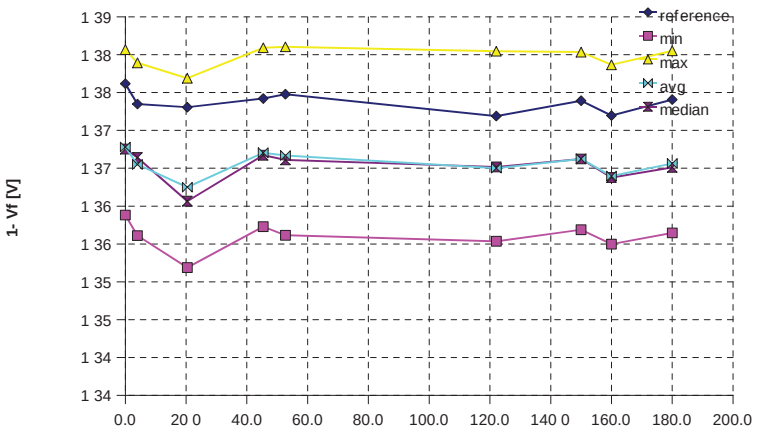
Parameter No: 1 : Vf, LED forward voltage Vfw @ Ifw = 10mA [B] Schedule: 1 of 2	APPENDIX A

1- Vf	s/n	1	2	3	4	5	6	7	8	9	10	min	max	avg	st dev	median
[V]	krad(Si)	If=1mA	If=1mA	If=1mA	If=10mA	If=10mA	If=10mA	unbiased	unbiased	unbiased	reference					
	0.0	1.36	1.37	1.37	1.37	1.36	1.38	1.38	1.36	1.36	1.38	1.36	1.38	1.37	0.01	1.37
	4.0	1.36	1.37	1.37	1.37	1.36	1.38	1.37	1.36	1.36	1.37	1.36	1.38	1.37	0.01	1.37
	20.4	1.36	1.37	1.36	1.36	1.35	1.38	1.37	1.35	1.36	1.37	1.35	1.38	1.36	0.01	1.36
	45.4	1.36	1.37	1.37	1.37	1.36	1.38	1.37	1.36	1.36	1.37	1.36	1.38	1.37	0.01	1.37
	52.7	1.36	1.37	1.37	1.37	1.36	1.38	1.37	1.36	1.36	1.37	1.36	1.38	1.37	0.01	1.37
	122.1	1.36	1.37	1.37	1.37	1.36	1.38	1.37	1.36	1.36	1.37	1.36	1.38	1.37	0.01	1.37
	150.0	1.36	1.37	1.37	1.37	1.36	1.38	1.37	1.36	1.36	1.37	1.36	1.38	1.37	0.01	1.37
		1.36	1.37	1.36	1.37	1.36	1.38	1.37	1.35	1.36	1.37	1.35	1.38	1.36	0.01	1.36
Annealing		1.36	1.37	1.37	1.37	1.36	1.38	1.37	1.36	1.36	1.37	1.36	1.38	1.37	0.01	1.37
	min	1.36	1.37	1.36	1.36	1.35	1.38	1.37	1.35	1.36	1.372					
	max	1.36	1.37	1.37	1.37	1.36	1.38	1.38	1.36	1.36	1.376					
	avg	1.36	1.37	1.37	1.37	1.36	1.38	1.37	1.36	1.36	1.374					
	st dev	0	0	0	0	0	0	0	0	0	0.001					
	median	1.36	1.37	1.37	1.37	1.36	1.38	1.37	1.36	1.36	1.374					

Lim min 0.80 [V]
Lim max 1.50 [V]

estimated uncertainty ± *0 [V]*

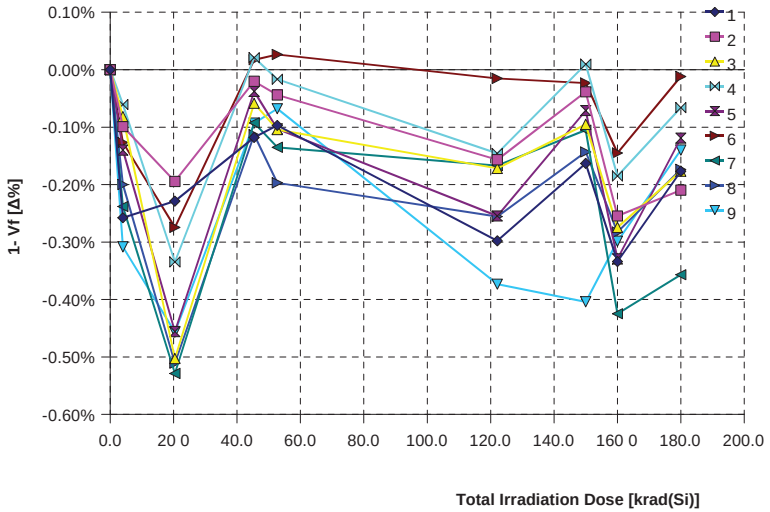


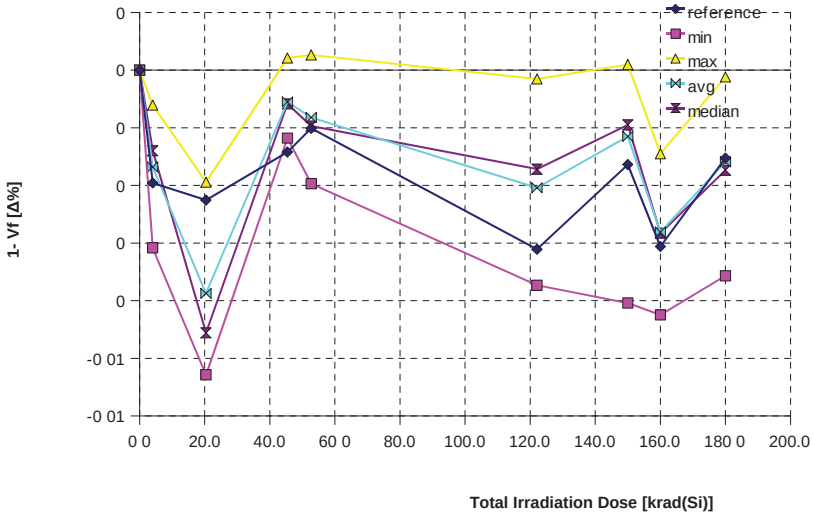


Parameter No: 1 : Vf, LED forward voltage Vfw @ Ifw = 10mA [B] Schedule: 2 of 2	APPENDIX A

0.0	0 00%	0.00%	0.00%	0 00%	0.00%	0.00%	0.00%	0 00%	0.00%	0.00%	**0.00%**	**0.00%**	**0.00%**	**0**	**0**
4.0	-0.26%	-0.10%	-0.08%	-0 06%	-0.14%	-0.13%	-0.24%	-0 20%	-0.31%	-0.20%	**-0.31%**	**-0.06%**	**-0.17%**	**0.09%**	**-0.14%**
20.4	-0.23%	-0.19%	-0.50%	-0 33%	-0.46%	-0.27%	-0.53%	-0 51%	-0.46%	-0.23%	**-0.53%**	**-0.19%**	**-0.39%**	**0.13%**	**-0.46%**
45.4	-0.12%	-0.02%	-0.06%	0 02%	-0.04%	0.02%	-0.09%	-0.11%	-0.09%	-0.14%	**-0.12%**	**0.02%**	**-0.05%**	**0.05%**	**-0.06%**
52.7	-0.10%	-0.04%	-0.10%	-0 02%	-0.10%	0.03%	-0.14%	-0 20%	-0.07%	-0.10%	**-0.20%**	**0.03%**	**-0.08%**	**0.07%**	**-0.10%**
122.1	-0.30%	-0.16%	-0.17%	-0.15%	-0.25%	-0.02%	-0.17%	-0 26%	-0.37%	-0.31%	**-0.37%**	**-0.02%**	**-0.20%**	**0.10%**	**-0.17%**
150.0	-0.16%	-0.04%	-0.10%	0 01%	-0.07%	-0.02%	-0.11%	-0.14%	-0.40%	-0.16%	**-0.40%**	**0.01%**	**-0.11%**	**0.12%**	**-0.10%**
	-0.33%	-0.25%	-0.27%	-0.19%	-0 33%	-0.15%	-0.42%	-0 28%	-0 30%	-0.31%	**-0.42%**	**-0.15%**	**-0.28%**	**0.08%**	**-0.28%**
	-0.18%	-0.21%	-0.18%	-0 07%	-0.12%	-0.01%	-0.36%	-0.17%	-0.14%	-0.15%	**-0.36%**	**-0.01%**	**-0.16%**	**0.10%**	**-0.17%**
min	-0.33%	-0.25%	-0.50%	-0 33%	-0.46%	-0.27%	-0.53%	-0 51%	-0.46%	**-0.31%**					
max	0.00%	0.00%	0.00%	0 02%	0.00%	0.03%	0.00%	0 00%	0.00%	**0.00%**					
avg	-0.19%	-0.11%	-0.16%	-0 09%	-0.17%	-0.06%	-0.23%	-0 21%	-0.24%	**-0.18%**					
st dev	0.11%	0.09%	0.15%	0.12%	0.15%	0.10%	0.17%	0.14%	0.17%	**0.10%**					
median	-0.18%	-0.10%	-0.10%	-0 06%	-0.12%	-0.02%	-0.17%	-0 20%	-0.30%	**-0.16%**					

Lim min	**-100.00%**
Lim max	**100.00%**



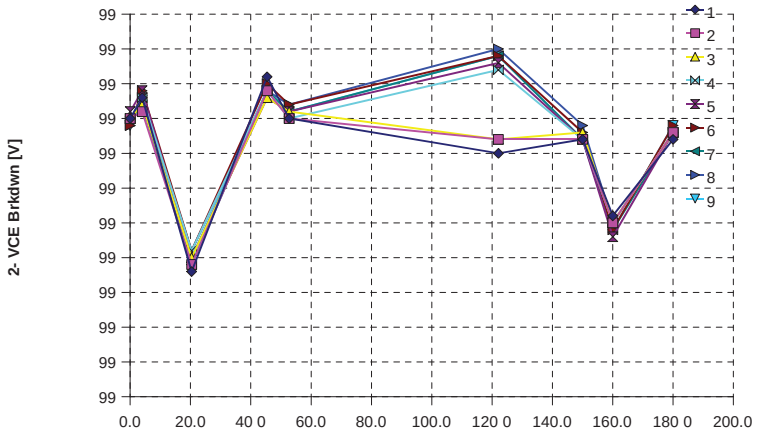


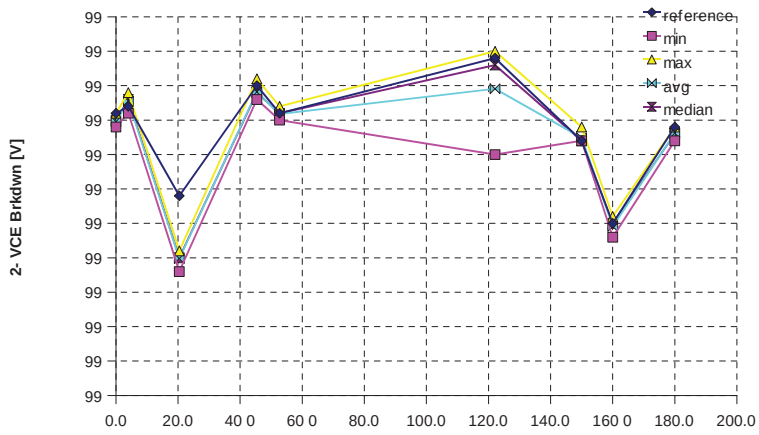
Parameter No: 2 : VCE Brkdwn, Collector Emitter breakdown voltage Vce @ Ice=1mA (Ib=0) [Vce max limited at 100V] [N] Schedule: 1 of 2	APPENDIX A

2- VCE Brkdwn [V]	s/n	1	2	3	4	5	6	7	8	9	10	min	max	avg	st dev	median
	krad(Si)	If=1mA	If=1mA	If=1mA	If=10mA	If=10mA	If=10mA	unbiased	unbiased	unbiased	reference					
	0.0	99	99	99	99	99	99	99	99	99	99	99	99	99	0	99
	4.0	99	99	99	99	99	99	99	99	99	99	99	99	99	0	99
	20.4	99	99	99	99	99	99	99	99	99	99	99	99	99	0	99
	45.4	99	99	99	99	99	99	99	99	99	99	99	99	99	0	99
	52.7	99	99	99	99	99	99	99	99	99	99	99	99	99	0	99
	122.1	99	99	99	99	99	99	99	99	99	99	99	99	99	0	99
	150.0	99	99	99	99	99	99	99	99	99	99	99	99	99	0	99
		99	99	99	99	99	99	99	99	99	99	99	99	99	0	99
Annealing		99	99	99	99	99	99	99	99	99	99	99	99	99	0	99
	min	99	99	99	99	99	99	99	99	99	98.998					
	max	99	99	99	99	99	99	99	99	99	99.000					
	avg	99	99	99	99	99	99	99	99	99	98.999					
	st dev	0	0	0	0	0	0	0	0	0	0.001					
	median	99	99	99	99	99	99	99	99	99	99.000					

Lim min 40.00 [V]
Lim max 9,999.00 [V]

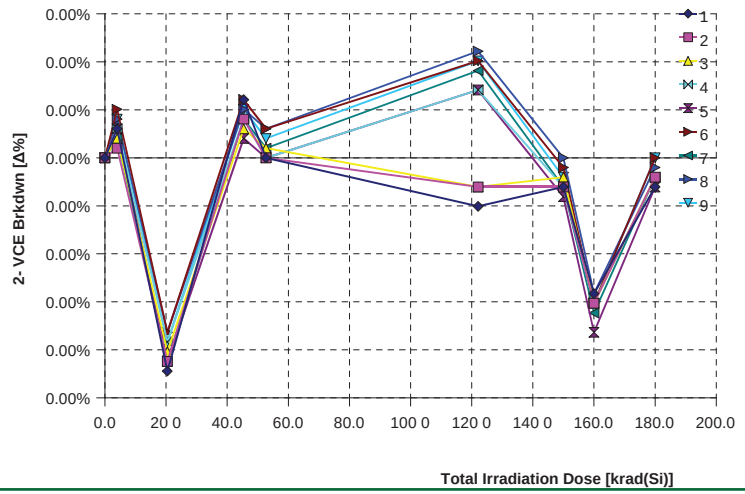
estimated uncertainty ± *0 [V]*

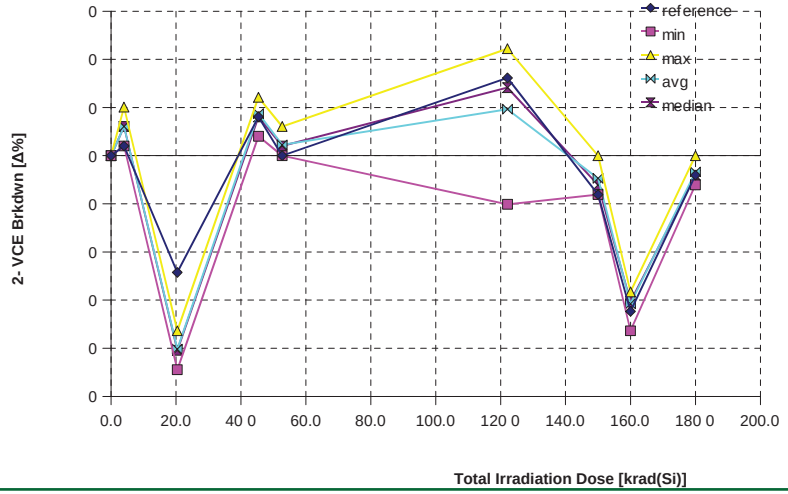




Parameter No: 2 : VCE Brkdwn, Collector Emitter breakdown voltage Vce @ Ice=1mA (Ib=0) [Vce max limited at 100V] [N] Schedule: 2 of 2	APPENDIX A

2- VCE Brkdwn [Δ%]	s/n	1	2	3	4	5	6	7	8	9	10	min	max	avg	st dev	median
	krad(Si)	If=1mA	If=1mA	If=1mA	If=10mA	If=10mA	If=10mA	unbiased	unbiased	unbiased	reference					
	0.0	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0.00%	0.00%	0.00%	0	0
	4.0	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0.00%	0.00%	0.00%	0.00%	0.00%
	20.4	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0.00%	0.00%	0.00%	0.00%	0.00%
	45.4	0 00%	0 00%	0 00%	0 00%	0.00%	0 00%	0 00%	0 00%	0 00%	0 00%	0.00%	0.00%	0.00%	0.00%	0.00%
	52.7	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	122.1	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0.00%	0.00%	0.00%	0.00%	0.00%
	150.0	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0.00%	0.00%	0.00%	0.00%	0.00%
		0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0.00%	0.00%	0.00%	0.00%	0.00%
		0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0.00%	0.00%	0.00%	0.00%	0.00%
	min	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0.00%					
	max	0.00%	0 00%	0 00%	0 00%	0.00%	0.00%	0.00%	0 00%	0 00%	0.00%					
	avg	0.00%	0.00%	0.00%	0.00%	0.00%	0 00%	0 00%	0 00%	0 00%	0.00%					
	st dev	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0.00%					
	median	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0.00%					
	Lim min	-100.00%														
	Lim max	100.00%														



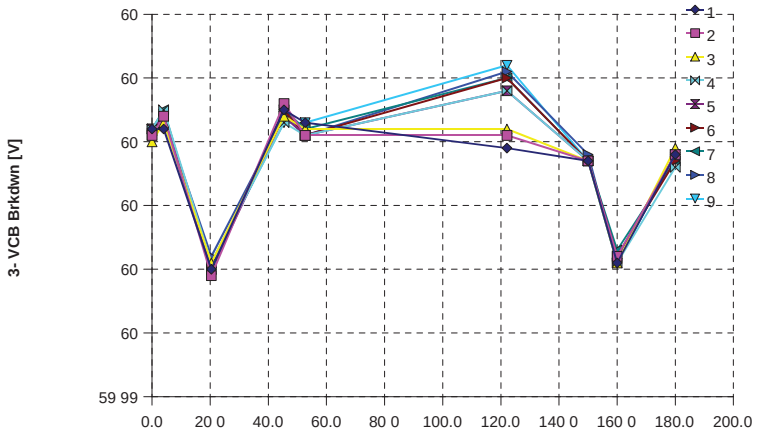


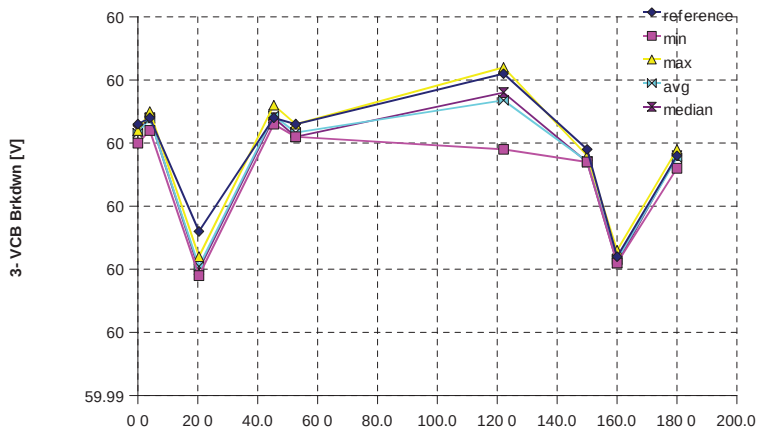
Parameter No: 3 : VCB Brkdwn, Collector Base breakdown voltage Vcb @ Icb=100uA (Ieb=0A) [VCb max limited at 60V] [L] Schedule: 1 of 2	APPENDIX A

3- VCB Brkdwn [V]	s/n krad(Si)	1 If=1mA	2 If=1mA	3 If=1mA	4 If=10mA	5 If=10mA	6 If=10mA	7 unbiased	8 unbiased	9 unbiased	10 reference	min	max	avg	st dev	median
	0.0	60	60	60	60	60	60	60	60	60	60	60	60	60	0	60
	4.0	60	60	60	60	60	60	60	60	60	60	60	60	60	0	60
	20.4	60	60	60	60	60	60	60	60	60	60	60	60	60	0	60
	45.4	60	60	60	60	60	60	60	60	60	60	60	60	60	0	60
	52.7	60	60	60	60	60	60	60	60	60	60	60	60	60	0	60
	122.1	60	60	60	60	60	60	60	60	60	60	60	60	60	0	60
	150.0	60	60	60	60	60	60	60	60	60	60	60	60	60	0	60
		60	60	60	60	60	60	60	60	60	60	60	60	60	0	60
Annealing		60	60	60	60	60	60	60	60	60	60	60	60	60	0	60
	min	60	60	60	60	60	60	60	60	60	59.996					
	max	60	60	60	60	60	60	60	60	60	59.999					
	avg	60	60	60	60	60	60	60	60	60	59.998					
	st dev	0	0	0	0	0	0	0	0	0	0.001					
	median	60	60	60	60	60	60	60	60	60	59.998					

Lim min	45.00 [V]
Lim max	9,999.00 [V]

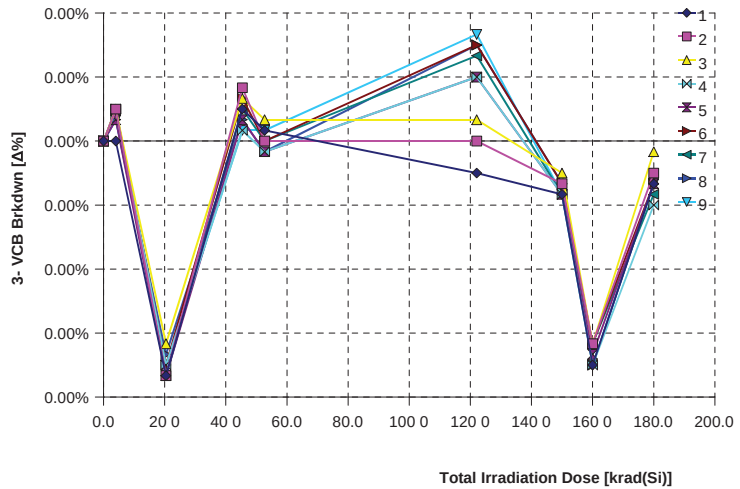
estimated uncertainty ± *0 [V]*

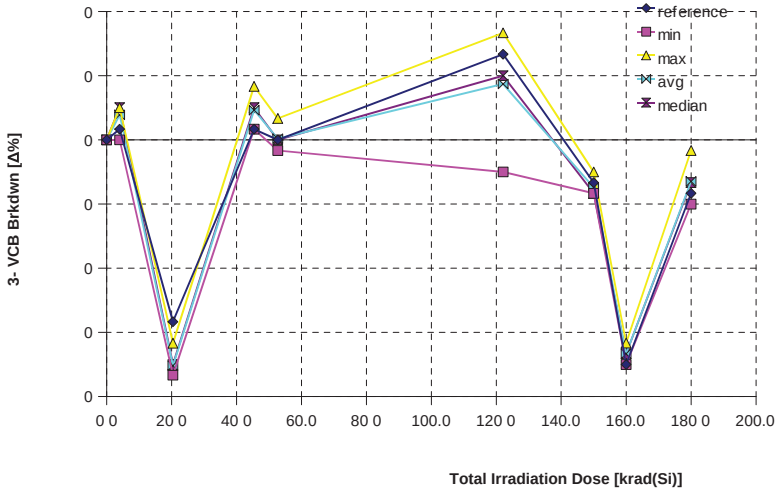




Parameter No: 3 : VCB Brkdwn, Collector Base breakdown voltage Vcb @ Icb=100uA (Ieb=0A) [VCb max limited at 60V] [L] Schedule: 2 of 2	APPENDIX A

3- VCB Brkdwn [Δ%]	s/n	1	2	3	4	5	6	7	8	9	10	min	max	avg	st dev	median
	krad(Si)	If=1mA	If=1mA	If=1mA	If=10mA	If=10mA	If=10mA	unbiased	unbiased	unbiased	reference					
	0.0	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0.00%	0.00%	0.00%	0	0
	4.0	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0.00%	0.00%	0.00%	0.00%	0.00%
	20.4	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0.00%	0.00%	0.00%	0.00%	0.00%
	45.4	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0.00%	0.00%	0.00%	0.00%	0.00%
	52.7	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0.00%	0.00%	0.00%	0.00%	0.00%
	122.1	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0.00%	0.00%	0.00%	0.00%	0.00%
	150.0	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0.00%	0.00%	0.00%	0.00%	0.00%
		0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0.00%	0.00%	0.00%	0.00%	0.00%
		0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0.00%	0.00%	0.00%	0.00%	0.00%
	min	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0.00%					
	max	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0.00%					
	avg	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0.00%					
	st dev	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0.00%	0.00%					
	median	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0.00%					
	Lim min	-100.00%														
	Lim max	100.00%														



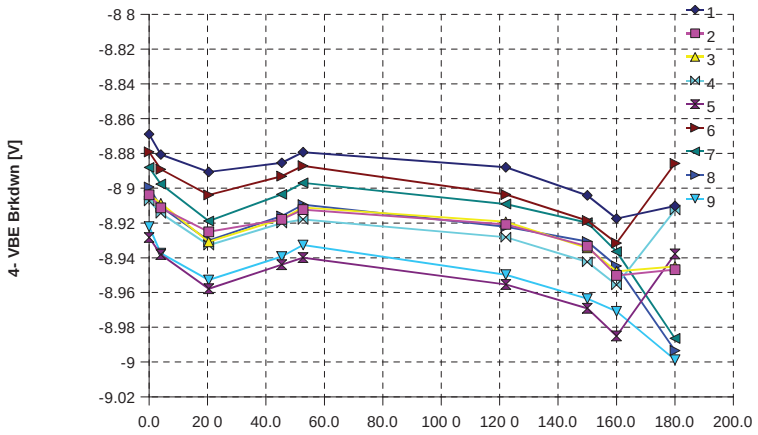


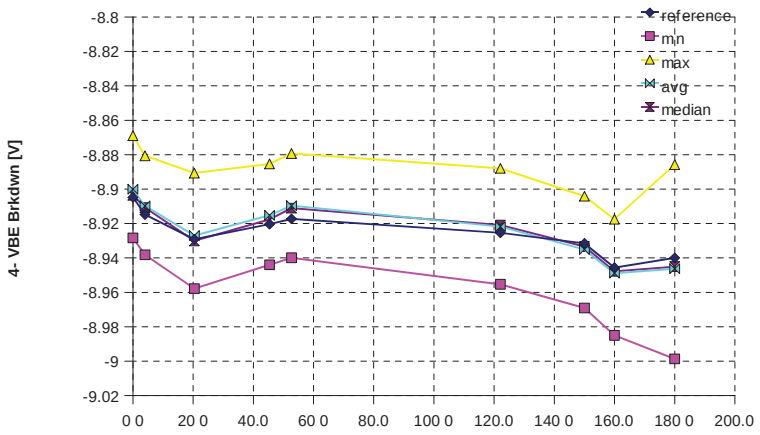
Parameter No: 4 : VBE Brkdwn, Base Emitter Breakdown Voltage Vbe @ Ibe = -100uA [Veb max limited at 10V] [M] Schedule: 1 of 2	APPENDIX A

4- VBE Brkdwn	s/n	1	2	3	4	5	6	7	8	9	10	min	max	avg	st dev	median
[V]	krad(Si)	If=1mA	If=1mA	If=1mA	If=10mA	If=10mA	If=10mA	unbiased	unbiased	unbiased	reference					
	0.0	-8.87	-8 9	-8 9	-8.91	-8.93	-8.88	-8.89	-8 9	-8.92	-8 9	-8.93	-8.87	-8.9	0.02	-8.9
	4.0	-8.88	-8.91	-8.91	-8.91	-8.94	-8.89	-8 9	-8.91	-8.94	-8.91	-8.94	-8.88	-8.91	0.02	-8.91
	20.4	-8.89	-8.93	-8.93	-8.93	-8.96	-8 9	-8.92	-8.93	-8.95	-8.93	-8.96	-8.89	-8.93	0.02	-8.93
	45.4	-8.89	-8.92	-8.92	-8.92	-8.94	-8.89	-8.9	-8.92	-8.94	-8.92	-8.94	-8.89	-8.92	0.02	-8.92
	52.7	-8.88	-8.91	-8.91	-8.92	-8.94	-8.89	-8.9	-8.91	-8.93	-8.92	-8.94	-8.88	-8.91	0.02	-8.91
	122.1	-8.89	-8.92	-8.92	-8.93	-8.96	-8 9	-8.91	-8.92	-8.95	-8.93	-8.96	-8.89	-8.92	0.02	-8.92
	150.0	-8 9	-8.93	-8.93	-8.94	-8.97	-8.92	-8.92	-8.93	-8.96	-8.93	-8.97	-8.9	-8.94	0.02	-8.93
		-8.92	-8.95	-8.95	-8.96	-8.98	-8.93	-8.94	-8.94	-8.97	-8.95	-8.98	-8.92	-8.95	0.02	-8.95
Annealing		-8.91	-8.95	-8.95	-8.91	-8.94	-8.89	-8.99	-8.99	-9	-8.94	-9	-8.89	-8.95	0.04	-8.95
	min	-8.92	-8.95	-8.95	-8.96	-8.98	-8.93	-8.99	-8.99	-9	-8.946					
	max	-8.87	-8.9	-8.9	-8.91	-8.93	-8.88	-8.89	-8.9	-8.92	-8.905					
	avg	-8.89	-8.92	-8.92	-8.93	-8.95	-8 9	-8.92	-8.93	-8.95	-8.925					
	st dev	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.02	0.013					
	median	-8.89	-8.92	-8.92	-8.92	-8.94	-8.89	-8.91	-8.92	-8.95	-8.925					

Lim min	-9,999.00 [V]
Lim max	-7.00 [V]

estimated uncertainty ± *0.01 [V]*

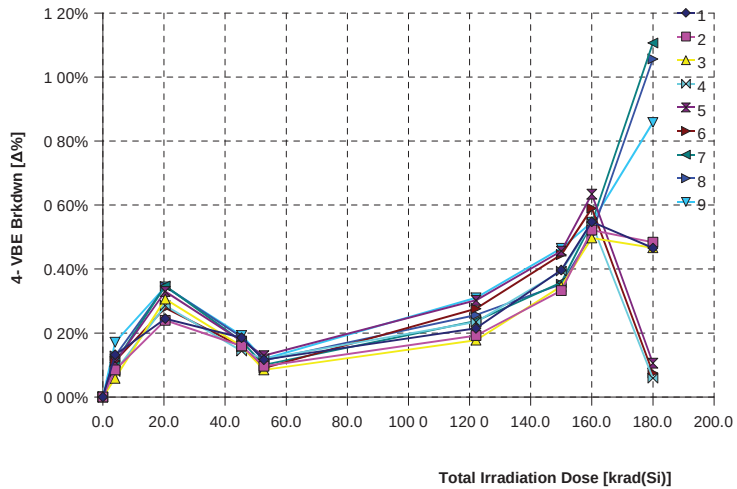


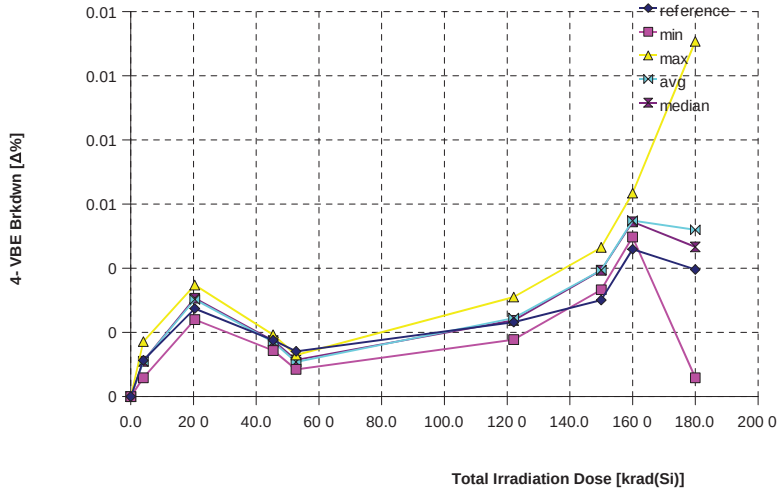


Parameter No: 4 : VBE Brkdwn, Base Emitter Breakdown Voltage Vbe @ Ibe = -100uA [Veb max limited at 10V] [M] Schedule: 2 of 2	APPENDIX A

4- VBE Brkdwn [Δ%]	s/n krad(Si)	1 If=1mA	2 If=1mA	3 If=1mA	4 If=10mA	5 If=10mA	6 If=10mA	7 unbiased	8 unbiased	9 unbiased	10 reference	min	max	avg	st dev	median
	0.0	0 00%	0 00%	0 00%	0 00%	0.00%	0.00%	0.00%	0.00%	0 00%	0 00%	0.00%	0.00%	0.00%	0	0
	4.0	0.13%	0 08%	0 06%	0 08%	0.11%	0.11%	0.11%	0.13%	0.17%	0.11%	0.06%	0.17%	0.11%	0.03%	0.11%
	20.4	0 24%	0 24%	0 31%	0 29%	0.33%	0.28%	0.35%	0.35%	0.34%	0.27%	0.24%	0.35%	0.30%	0.04%	0.31%
	45.4	0.19%	0.16%	0.16%	0.14%	0.17%	0.16%	0.17%	0.19%	0.19%	0.18%	0.14%	0.19%	0.17%	0.02%	0.17%
	52.7	0.12%	0.10%	0.08%	0.12%	0.13%	0.09%	0.10%	0.11%	0.12%	0.14%	0.08%	0.13%	0.11%	0.02%	0.11%
	122.1	0 21%	0.19%	0.18%	0 23%	0 30%	0 28%	0 24%	0 26%	0 31%	0 23%	0.18%	0.31%	0.24%	0.05%	0.24%
	150.0	0.40%	0 33%	0 35%	0 39%	0.46%	0.44%	0.36%	0.35%	0.46%	0.30%	0.33%	0.46%	0.39%	0.05%	0.39%
		0 55%	0 52%	0 50%	0 54%	0.63%	0.59%	0.54%	0.51%	0.55%	0.46%	0.50%	0.63%	0.55%	0.04%	0.54%
		0.47%	0.48%	0.47%	0 06%	0.11%	0.07%	1.11%	1.06%	0.86%	0.40%	0.06%	1.11%	0.52%	0.41%	0.47%
	min	0.00%	0 00%	0 00%	0 00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%					
	max	0 55%	0 52%	0 50%	0 54%	0.63%	0.59%	1.11%	1.06%	0.86%	0.46%					
	avg	0 26%	0 23%	0 23%	0 21%	0 25%	0 22%	0 33%	0 33%	0 33%	0.23%					
	st dev	0.18%	0.18%	0.18%	0.18%	0 20%	0.19%	0 33%	0 31%	0.26%	0.14%					
	median	0 21%	0.19%	0.18%	0.14%	0.17%	0.16%	0.24%	0 26%	0 31%	0.23%					

Lim min	-100.00%
Lim max	100.00%

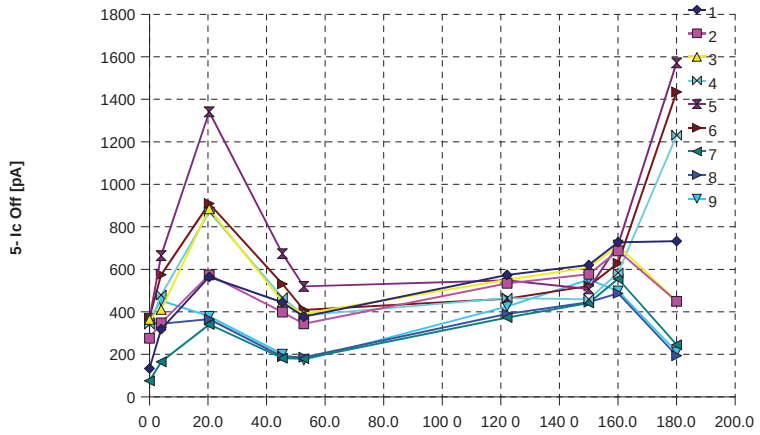




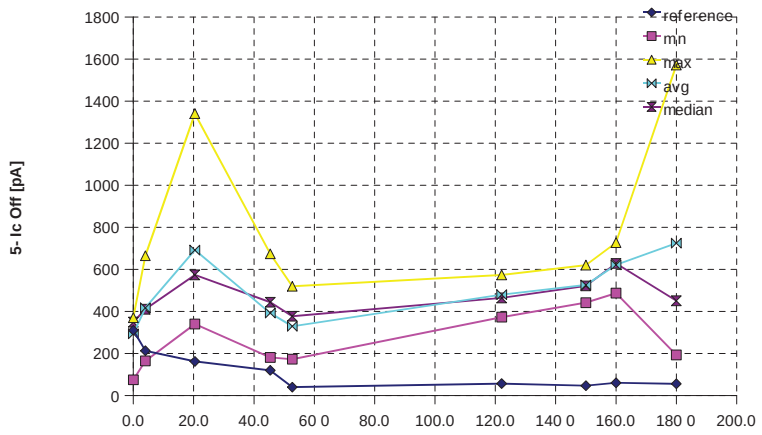
Parameter No: 5 : Ic off, Off State collector current Ioh @ Ifw = 0A (Vce = 20V) [D] Schedule: 1 of 2	APPENDIX A

5- Ic Off [pA]	s/n	1	2	3	4	5	6	7	8	9	10	min	max	avg	st dev	median
	krad(Si)	If=1mA	If=1mA	If=1mA	If=10mA	If=10mA	If=10mA	unbiased	unbiased	unbiased	reference					
	0.0	132 84	275 97	364.11	341.88	369.46	370.26	75.24	349.21	364.1	310.73	75.24	370.26	293.67	112.27	349.21
	4.0	317.87	348.29	410.94	478 8	664.64	574.59	164.77	343.62	452 2	213.29	164.77	664.64	417.3	147.82	410.94
	20.4	564.48	573 9	885.06	870.64	1341.34	909 3	340.47	365.53	379.16	162.35	340.47	1341.34	692.21	334.72	573.9
	45.4	444.12	398.36	445.91	466.91	673.93	530.93	181.33	189.13	201.23	120.13	181.33	673.93	392.43	170.29	444.12
	52.7	377.31	343.72	390.74	383.79	519.81	409.25	179.65	186.04	172.92	40.11	172.92	519.81	329.25	122.13	377.31
	122.1	573.77	534 06	550.81	464.59	548.09	461.53	372.89	390.17	424.96	57.01	372.89	573.77	480.1	74.6	464.59
	150.0	620.32	576.85	608.65	459.05	507.41	521.58	441.85	445.14	552.01	47.19	441.85	620.32	525.87	68.43	521.58
		727.43	686.86	710.67	583.47	714.49	628.43	555.4	487.29	498.5	61.03	487.29	727.43	621.39	94.27	628.43
Annealing		732.84	449.65	451.05	1230.65	1571.63	1434.35	244.64	193.57	211.22	56.11	193.57	1571.63	724.4	548.14	451.05
	min	132.84	275.97	364.11	341.88	369.46	370.26	75.24	186.04	172.92	40.110					
	max	732.84	686.86	885.06	1230.65	1571.63	1434.35	555.4	487.29	552.01	310.730					
	avg	499	465 3	535.33	586.64	767.87	648.91	284.03	327.74	361.81	118.661					
	st dev	198 8	135 6	173.01	285.83	408.29	333.73	154.29	113.23	137 6	93.588					
	median	564.48	449.65	451.05	466.91	664.64	530.93	244.64	349.21	379.16	61.030					

Lim min 0.00 [pA]
Lim max 100,000.00 [pA]

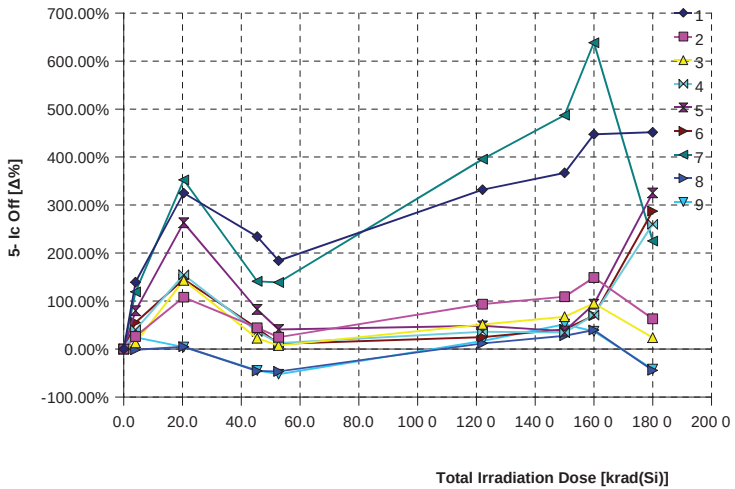


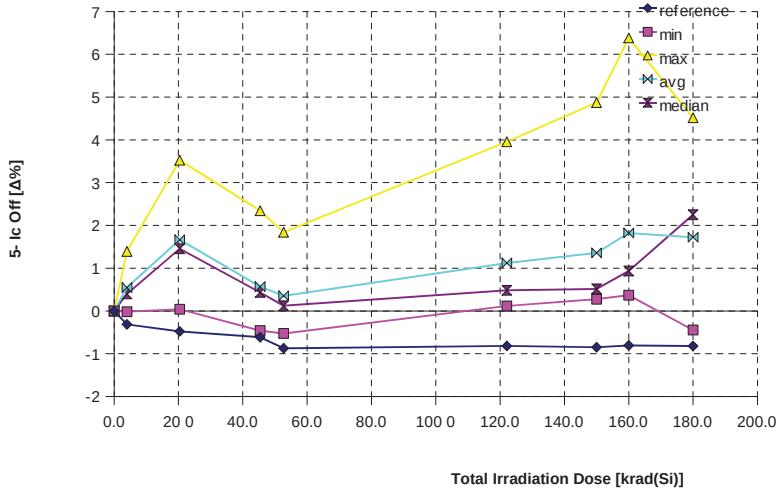
estimated uncertainty ± *60.31 [pA]*



Parameter No: 5 : Ic off, Off State collector current Ioh @ Ifw = 0A (Vce = 20V) [D] Schedule: 2 of 2	APPENDIX A

5- Ic Off [Δ%]	s/n	1	2	3	4	5	6	7	8	9	10	min	max	avg	st dev	median
	krad(Si)	If=1mA	If=1mA	If=1mA	If=10mA	If=10mA	If=10mA	unbiased	unbiased	unbiased	reference					
	0.0	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0	0
	4.0	139.29%	26.21%	12.86%	40.05%	79.89%	55.19%	118.99%	-1.60%	24.20%	-31.36%	-1.60%	139.29%	55.01%	48.48%	40.05%
	20.4	324.93%	107.96%	143.07%	154.66%	263.05%	145.58%	352.51%	4.67%	4.14%	-47.75%	4.14%	352.51%	166.73%	125.56%	145.58%
	45.4	234.33%	44.35%	22.47%	36.57%	82.41%	43.39%	141.00%	-45.84%	-44.73%	-61.34%	-45.84%	234.33%	57.11%	88.05%	43.39%
	52.7	184.03%	24.55%	7.31%	12.26%	40.69%	10.53%	138.77%	-46.73%	-52.51%	-87.09%	-52.51%	184.03%	35.44%	78.53%	12.26%
	122.1	331.93%	93.52%	51.28%	35.89%	48.35%	24.65%	395.60%	11.73%	16.72%	-81.65%	11.73%	395.60%	112.18%	145.53%	48.35%
	150.0	366.97%	109.03%	67.16%	34.27%	37.34%	40.87%	487.25%	27.47%	51.61%	-84.81%	27.47%	487.25%	135.77%	169.64%	51.61%
		447.60%	148.89%	95.18%	70.67%	93.39%	69.73%	638.17%	39.54%	36.91%	-80.36%	36.91%	638.17%	182.23%	212.56%	93.39%
		451.67%	62.93%	23.88%	259.97%	325.39%	287.39%	225.15%	-44.57%	-41.99%	-81.94%	-44.57%	451.67%	172.20%	177.53%	225.15%
	min	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	-46.73%	-52.51%	-87.09%					
	max	451.67%	148.89%	143.07%	259.97%	325.39%	287.39%	638.17%	39.54%	51.61%	0.00%					
	avg	275.64%	68.60%	47.02%	71.59%	107.83%	75.26%	277.49%	-6.15%	-0.63%	-61.81%					
	st dev	149.65%	49.14%	47.52%	83.61%	110.51%	90.13%	205.06%	32.43%	37.79%	30.12%					
	median	324.93%	62.93%	23.88%	36.57%	79.89%	43.39%	225.15%	0.00%	4.14%	-80.36%					
	Lim min	-100.00%														
	Lim max	100.00%														



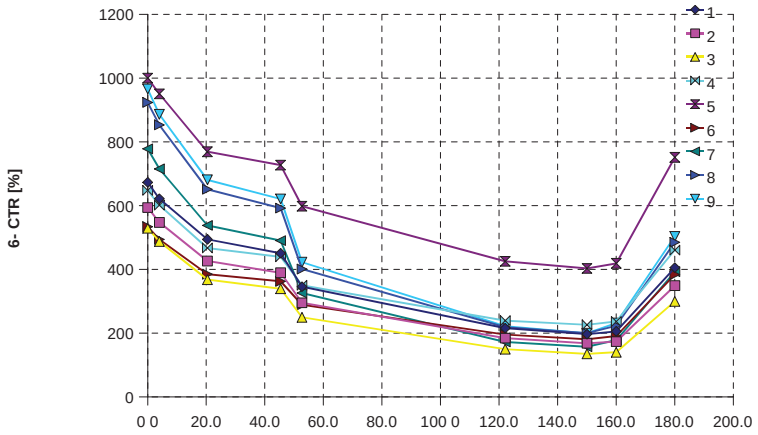


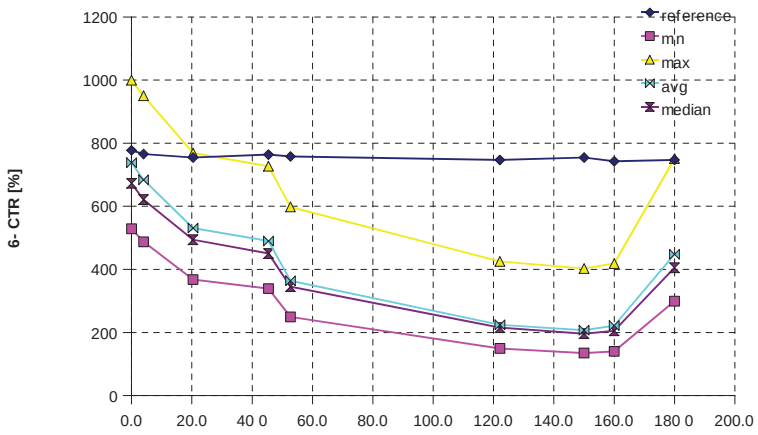
Parameter No: 6 : CTR, Current Transfer Ratio CTR @ Ifw = 1mA (Vce = 5V) [C] Schedule: 1 of 2	APPENDIX A

6- CTR [%]	s/n	1	2	3	4	5	6	7	8	9	10	min	max	avg	st dev	median
	krad(Si)	If=1mA	If=1mA	If=1mA	If=10mA	If=10mA	If=10mA	unbiased	unbiased	unbiased	reference					
	0.0	672.95	593.83	528.91	647.61	999.94	533.74	778.06	923.64	965.91	777.43	528.91	999.94	738.29	185.49	672.95
	4.0	621.39	547.25	487.59	601.29	950.69	493.83	715.29	853.12	886.41	765.74	487.59	950.69	684.09	175.31	621.39
	20.4	494.17	426.32	367.77	466.86	769.11	384.63	537.94	651.13	680.86	754.63	367.77	769.11	530.98	140.59	494.17
	45.4	450.52	389.18	339.14	439.35	727.04	362.38	490.38	592.18	620.81	763.99	339.14	727.04	490.11	130.9	450.52
	52.7	345 6	295.01	249.41	350.04	598.19	288.94	325.66	400.96	422.44	757.93	249.41	598.19	364.03	103.17	345.6
	122.1	215 5	184.17	149.47	239.25	425.29	195.26	171.97	218.67	221.36	746.91	149.47	425.29	224.55	80.26	215.5
	150.0	196.43	167.94	134.86	226.05	402.86	180.58	157.26	199.85	199.43	754.66	134.86	402.86	207.25	78.14	196.43
		205.43	173.19	140.07	236.36	418.8	190.69	177.93	223.1	231.4	742.82	140.07	418.8	221.88	80.09	205.43
Annealing		405.25	348.77	299.55	460.6	751.33	383.89	392.8	484.82	503.17	747.23	299.55	751.33	447.8	131.07	405.25
	min	196.43	167.94	134.86	226.05	402.86	180.58	157.26	199.85	199.43	742.818					
	max	672.95	593.83	528.91	647.61	999.94	533.74	778.06	923.64	965.91	777.430					
	avg	400.8	347.3	299.64	407.49	671.47	334.88	416.36	505.27	525.75	756.816					
	st dev	177.22	158.34	146.54	156.68	225.51	130.69	232.63	271.85	285.89	10.913					
	median	405.25	348.77	299.55	439.35	727.04	362.38	392.8	484.82	503.17	754.659					

Lim min	200.00 [%]
Lim max	1,000.00 [%]

estimated uncertainty ± *7.03 [%]*

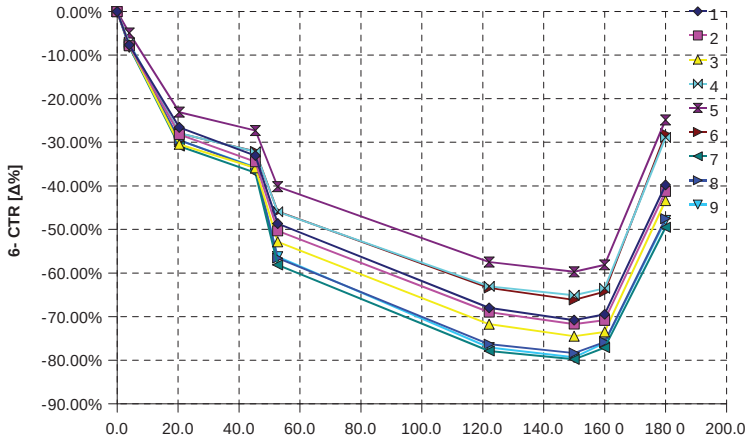


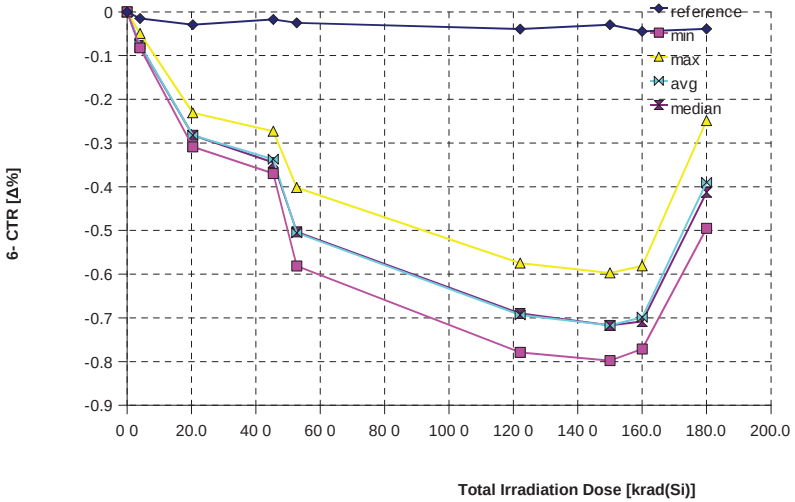


Parameter No: 6 : CTR, Current Transfer Ratio CTR @ Ifw = 1mA (Vce = 5V) [C] Schedule: 2 of 2	APPENDIX A

[Δ%] krad(Si)	If=1mA	If=1mA	If=1mA	If=10mA	If=10mA	If=10mA	unbiased	unbiased	unbiased	reference					
0.0	0.00%	0.00%	0.00%	0 00%	0.00%	0.00%	0.00%	0.00%	0 00%	0.00%	**0.00%**	**0.00%**	**0.00%**	**0**	**0**
4.0	-7.66%	-7.84%	-7.81%	-7.15%	-4.93%	-7.48%	-8.07%	-7.64%	-8 23%	-1 50%	**-8.23%**	**-4.93%**	**-7.42%**	**0.99%**	**-7.66%**
20.4	-26.57%	-28.21%	-30.47%	-27 91%	-23.09%	-27.94%	-30.86%	-29 50%	-29.51%	-2.93%	**-30.86%**	**-23.09%**	**-28.23%**	**2.36%**	**-28.21%**
45.4	-33.05%	-34.46%	-35 88%	-32.16%	-27.29%	-32.10%	-36.97%	-35 89%	-35.73%	-1.73%	**-36.97%**	**-27.29%**	**-33.73%**	**2.99%**	**-34.46%**
52.7	-48.64%	-50.32%	-52 84%	-45.95%	-40.18%	-45.87%	-58.15%	-56 59%	-56.27%	-2.51%	**-58.15%**	**-40.18%**	**-50.53%**	**5.98%**	**-50.32%**
122.1	-67.98%	-68.99%	-71.74%	-63 06%	-57.47%	-63.42%	-77.90%	-76 32%	-77 08%	-3.93%	**-77.90%**	**-57.47%**	**-69.33%**	**7.12%**	**-68.99%**
150.0	-70.81%	-71.72%	-74.50%	-65 09%	-59.71%	-66.17%	-79.79%	-78 36%	-79.35%	-2.93%	**-79.79%**	**-59.71%**	**-71.72%**	**7.03%**	**-71.72%**
	-69.47%	-70.84%	-73 52%	-63 50%	-58.12%	-64.27%	-77.13%	-75 85%	-76.04%	-4.45%	**-77.13%**	**-58.12%**	**-69.86%**	**6.62%**	**-70.84%**
	-39.78%	-41.27%	-43 36%	-28 88%	-24.86%	-28.07%	-49.52%	-47 51%	-47.91%	-3.88%	**-49.52%**	**-24.86%**	**-39.02%**	**9.41%**	**-41.27%**
min	-70.81%	-71.72%	-74.50%	-65 09%	-59.71%	-66.17%	-79.79%	-78 36%	-79 35%	**-4.45%**					
max	0.00%	0.00%	0.00%	0 00%	0.00%	0.00%	0.00%	0 00%	0 00%	**0.00%**					
avg	-40.44%	-41.52%	-43 35%	-37 08%	-32.85%	-37.26%	-46.49%	-45 30%	-45.57%	**-2.65%**					
st dev	26.33%	26.67%	27.71%	24.19%	22.55%	24.49%	29.90%	29.43%	29 60%	**1.40%**					
median	-39.78%	-41.27%	-43.36%	-32.16%	-27.29%	-32.10%	-49.52%	-47 51%	-47.91%	**-2.93%**					

Lim min	-100.00%
Lim max	100.00%



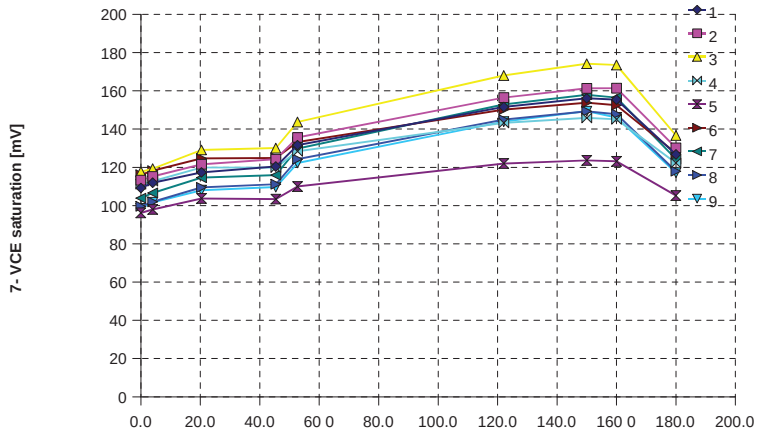


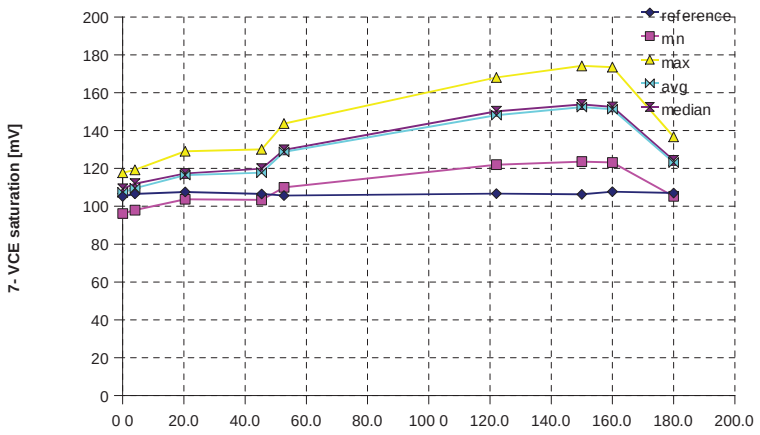
Parameter No: 7 : Vce sat @ Ifw = 2mA (Ice= 2mA) [F] Schedule: 1 of 2	APPENDIX A

7- VCE saturation [mV]	s/n krad(Si)	1 If=1mA	2 If=1mA	3 If=1mA	4 If=10mA	5 If=10mA	6 If=10mA	7 unbiased	8 unbiased	9 unbiased	10 reference	min	max	avg	st dev	median
	0.0	109.22	113.27	117.69	111.11	96.19	116.07	103.86	99 6	98.59	105 2	**96.19**	**117.69**	**107.29**	**7.98**	**109.22**
	4.0	111.95	115.26	119.28	112.77	97.97	118.26	106.62	101.97	101.7	106.56	**97.97**	**119.28**	**109.53**	**7.75**	**111.95**
	20.4	117.33	121.6	129.07	119.91	103.72	124.68	114.62	109.49	108.05	107.56	**103.72**	**129.07**	**116.5**	**8.3**	**117.33**
	45.4	120.43	124.27	130.07	119.88	103.38	124.92	115.91	111.18	109.7	106.51	**103.38**	**130.07**	**117.75**	**8.48**	**119.88**
	52.7	131.61	135.61	143.7	128.35	109.99	133.26	129.78	124.29	122.24	105.67	**109.99**	**143.7**	**128.76**	**9.45**	**129.78**
	122.1	151.56	156.46	168.05	143.24	121.99	150.19	152.86	144.94	143.9	106.7	**121.99**	**168.05**	**148.13**	**12.45**	**150.19**
	150.0	156.11	161.29	174.17	145.85	123.62	153.8	157.95	149.3	149.35	106.3	**123.62**	**174.17**	**152.38**	**13.65**	**153.8**
		155.42	161.38	173.54	145.11	123.14	152.52	156.46	147.81	146.11	107.7	**123.14**	**173.54**	**151.28**	**13.75**	**152.52**
Annealing		126.73	130.21	136.71	122.27	105.25	127.4	124.27	117.98	117.22	107	**105.25**	**136.71**	**123.12**	**9.01**	**124.27**
	min	109.22	113.27	117.69	111.11	96.19	116.07	103.86	99.6	98.59	**105.198**					
	max	156.11	161.38	174.17	145.85	123.62	153.8	157.95	149.3	149.35	**107.704**					
	avg	131.15	135.48	143.59	127.61	109.47	133.45	129.15	122.95	121.87	**106.578**					
	st dev	18.72	19.45	22.73	13 8	10.84	14.9	21.49	19.77	19.81	**0.809**					
	median	126.73	130.21	136.71	122.27	105.25	127.4	124.27	117.98	117.22	**106.560**					

Lim min **10.00** [mV]
Lim max **300.00** [mV]

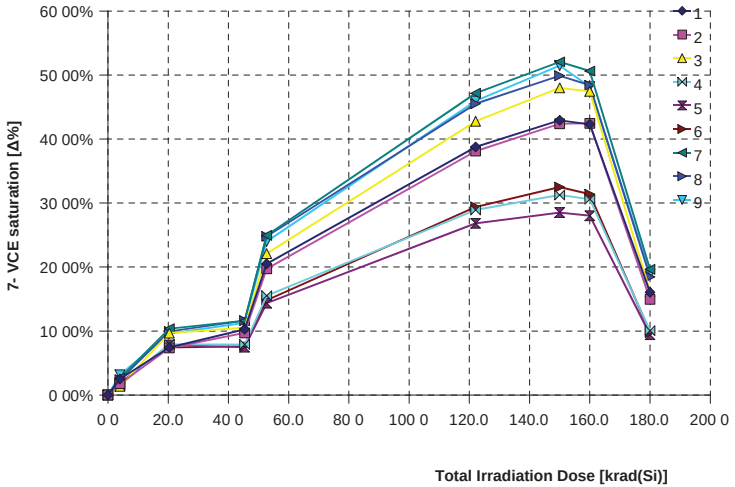
estimated uncertainty ± *0.52 [mV]*

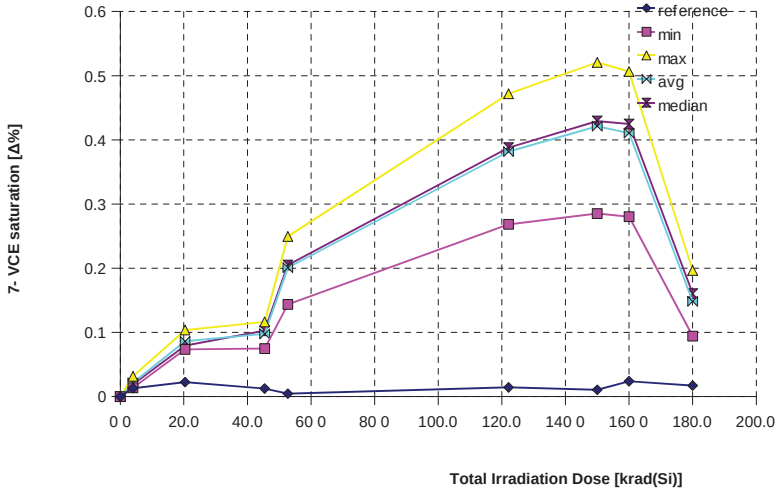




Parameter No: 7 : Vce sat @ Ifw = 2mA (Ice= 2mA) [F] Schedule: 2 of 2	APPENDIX A

7- VCE saturation [Δ%]	s/n	1	2	3	4	5	6	7	8	9	10	min	max	avg	st dev	median
	krad(Si)	If=1mA	If=1mA	If=1mA	If=10mA	If=10mA	If=10mA	unbiased	unbiased	unbiased	reference					
	0.0	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0	0
	4.0	2.51%	1.76%	1.35%	1.50%	1.86%	1.89%	2.66%	2.39%	3.16%	1.29%	1.35%	3.16%	2.12%	0.59%	1.89%
	20.4	7.43%	7.35%	9.67%	7.92%	7.83%	7.42%	10.36%	9.94%	9.60%	2.24%	7.35%	10.36%	8.61%	1.25%	7.92%
	45.4	10.26%	9.71%	10.52%	7.89%	7.48%	7.62%	11.60%	11.63%	11.27%	1.25%	7.48%	11.63%	9.78%	1.71%	10.26%
	52.7	20.50%	19.72%	22.10%	15.52%	14.35%	14.81%	24.95%	24.79%	23.99%	0.45%	14.35%	24.95%	20.08%	4.29%	20.50%
	122.1	38.77%	38.12%	42.79%	28.92%	26.83%	29.39%	47.18%	45.53%	45.96%	1.43%	26.83%	47.18%	38.17%	7.98%	38.77%
	150.0	42.94%	42.39%	48.00%	31.27%	28.52%	32.50%	52.07%	49.91%	51.49%	1.05%	28.52%	52.07%	42.12%	9.21%	42.94%
		42.31%	42.47%	47.46%	30.60%	28.02%	31.40%	50.64%	48.41%	48.20%	2.38%	28.02%	50.64%	41.06%	8.76%	42.47%
		16.04%	14.95%	16.16%	10.05%	9.43%	9.76%	19.64%	18.46%	18.90%	1.71%	9.43%	19.64%	14.82%	4.09%	16.04%
	min	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%					
	max	42.94%	42.47%	48.00%	31.27%	28.52%	32.50%	52.07%	49.91%	51.49%	2.38%					
	avg	20.08%	19.61%	22.01%	14.85%	13.81%	14.98%	24.34%	23.45%	23.62%	1.31%					
	st dev	17.14%	17.17%	19.31%	12.42%	11.27%	12.84%	20.69%	19.85%	20.09%	0.77%					
	median	16.04%	14.95%	16.16%	10.05%	9.43%	9.76%	19.64%	18.46%	18.90%	1.29%					
	Lim min	-100.00%														
	Lim max	100.00%														



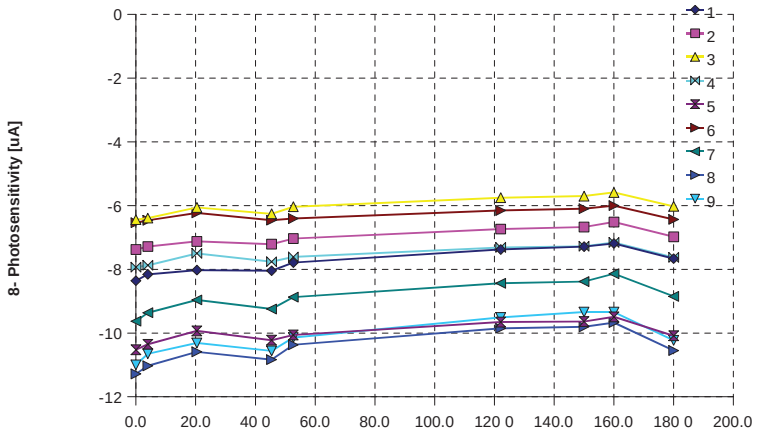


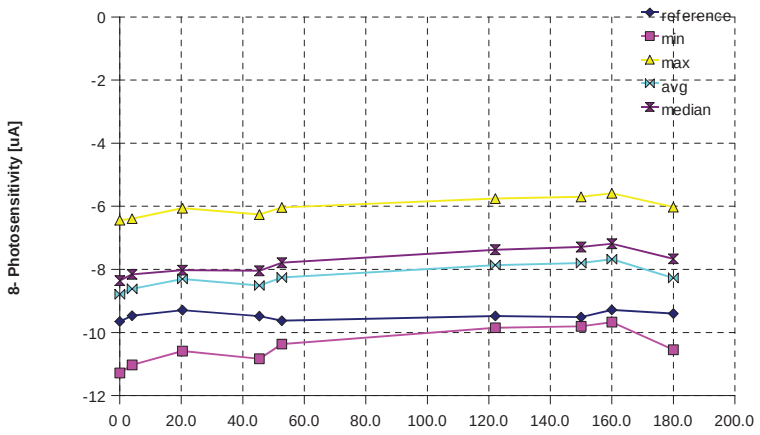
Parameter No: 8 : Photosensitivity, Ib @ Ifw = 1mA (Vce = 0V) [I] Schedule: 1 of 2	APPENDIX A

8- Photosensitivity	s/n	1	2	3	4	5	6	7	8	9	10	min	max	avg	st dev	median
[uA]	krad(Si)	If=1mA	If=1mA	If=1mA	If=10mA	If=10mA	If=10mA	unbiased	unbiased	unbiased	reference					
	0.0	-8.36	-7.38	-6.44	-7.93	-10.52	-6.54	-9.63	-11.28	-11	-9.65	**-11.28**	**-6.44**	**-8.79**	**1.88**	**-8.36**
	4.0	-8.16	-7.29	-6.39	-7.87	-10.35	-6.46	-9.36	-11.03	-10.65	-9.47	**-11.03**	**-6.39**	**-8.62**	**1.79**	**-8.16**
	20.4	-8.02	-7.12	-6.06	-7.5	-9.93	-6.23	-8.96	-10.59	-10.31	-9.29	**-10.59**	**-6.06**	**-8.3**	**1.72**	**-8.02**
	45.4	-8.04	-7.21	-6.26	-7.76	-10.22	-6.46	-9.25	-10.83	-10.56	-9.48	**-10.83**	**-6.26**	**-8.51**	**1.76**	**-8.04**
	52.7	-7.79	-7.03	-6.04	-7.61	-10.06	-6.41	-8.87	-10.37	-10.14	-9 63	**-10.37**	**-6.04**	**-8.26**	**1.66**	**-7.79**
	122.1	-7.38	-6.74	-5.75	-7.31	-9.66	-6.15	-8.44	-9.85	-9.51	-9.48	**-9.85**	**-5.75**	**-7.87**	**1.56**	**-7.38**
	150.0	-7.29	-6.67	-5.7	-7.28	-9.64	-6.1	-8.38	-9.81	-9.34	-9.51	**-9.81**	**-5.7**	**-7.8**	**1.55**	**-7.29**
		-7.19	-6.52	-5.59	-7.16	-9.49	-6	-8.14	-9.67	-9.34	-9.28	**-9.67**	**-5.59**	**-7.68**	**1.55**	**-7.19**
Annealing		-7.66	-6.98	-6.02	-7.62	-10.09	-6.44	-8.85	-10.55	-10.23	-9.4	**-10.55**	**-6.02**	**-8.27**	**1.71**	**-7.66**
	min	-8.36	-7.38	-6.44	-7.93	-10.52	-6.54	-9.63	-11.28	-11	**-9.651**					
	max	-7.19	-6.52	-5.59	-7.16	-9.49	-6	-8.14	-9.67	-9.34	**-9.282**					
	avg	-7.77	-6.99	-6.03	-7.56	-10	-6.31	-8.88	-10.44	-10.12	**-9.465**					
	st dev	0.41	0 3	0 3	0.27	0.35	0.19	0.49	0.57	0 6	**0.128**					
	median	-7.79	-7.03	-6.04	-7.61	-10.06	-6.41	-8.87	-10.55	-10.23	**-9.476**					

Lim min	-100.00 [uA]
Lim max	-5.00 [uA]

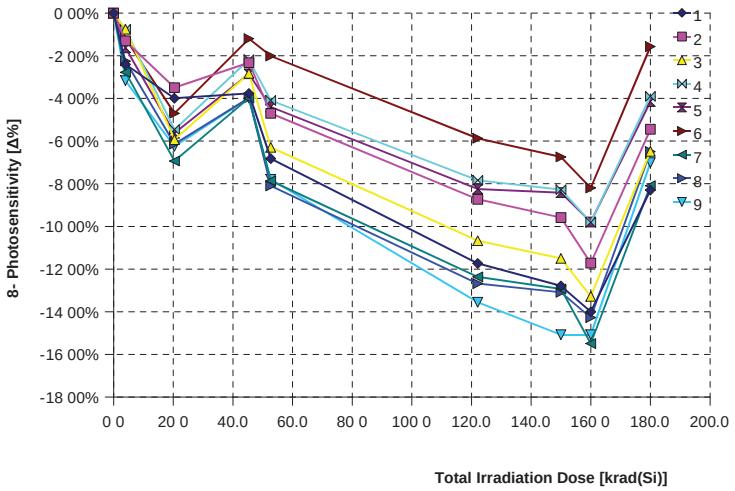
estimated uncertainty ± *0.08 [uA]*

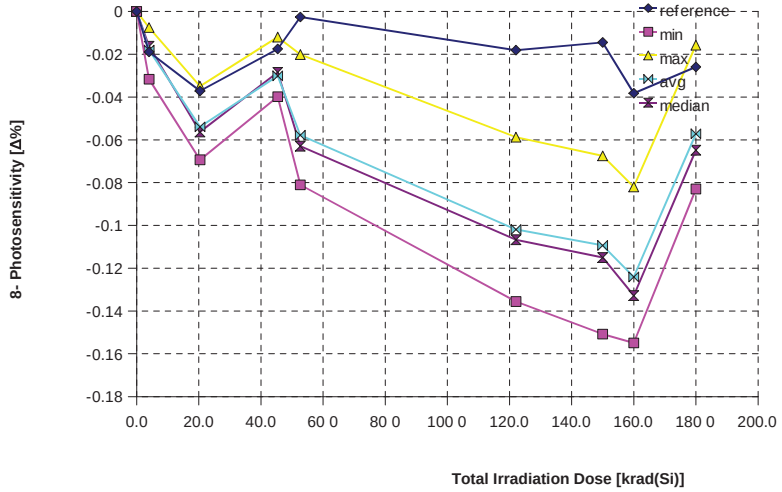




Parameter No: 8 : Photosensitivity, Ib @ Ifw = 1mA (Vce = 0V) [I] Schedule: 2 of 2	APPENDIX A

8- Photosensitivity [Δ%]	s/n	1	2	3	4	5	6	7	8	9	10	min	max	avg	st dev	median
	krad(Si)	If=1mA	If=1mA	If=1mA	If=10mA	If=10mA	If=10mA	unbiased	unbiased	unbiased	reference					
	0.0	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0	0
	4.0	-2.41%	-1.30%	-0.75%	-0.76%	-1.63%	-1.18%	-2.77%	-2.25%	-3.17%	-1.89%	-3.17%	-0.75%	-1.80%	0.88%	-1.63%
	20.4	-3.99%	-3.50%	-5.93%	-5.46%	-5.63%	-4.70%	-6.93%	-6.14%	-6.25%	-3.72%	-6.93%	-3.50%	-5.39%	1.12%	-5.63%
	45.4	-3.76%	-2.32%	-2.83%	-2.18%	-2 85%	-1.20%	-3.98%	-3.98%	-3.98%	-1.75%	-3.98%	-1.20%	-3.01%	0.99%	-2.85%
	52.7	-6 82%	-4.70%	-6.29%	-4.09%	-4.40%	-2 01%	-7 86%	-8.10%	-7.80%	-0.26%	-8.10%	-2.01%	-5.79%	2.10%	-6.29%
	122.1	-11.74%	-8.73%	-10.67%	-7.84%	-8.25%	-5.87%	-12.37%	-12.68%	-13 56%	-1 81%	-13.56%	-5.87%	-10.19%	2.62%	-10.67%
	150.0	-12.79%	-9.58%	-11.50%	-8.27%	-8.42%	-6.75%	-12 93%	-13 09%	-15 08%	-1.45%	-15.08%	-6.75%	-10.93%	2.79%	-11.50%
		-14.00%	-11.72%	-13.28%	-9.81%	-9.79%	-8 20%	-15.49%	-14 28%	-15 08%	-3 82%	-15.49%	-8.20%	-12.41%	2.63%	-13.28%
		-8 30%	-5.45%	-6.48%	-3.90%	-4.15%	-1.57%	-8.09%	-6.50%	-7.01%	-2.59%	-8.30%	-1.57%	-5.72%	2.18%	-6.48%
	min	-14 00%	-11.72%	-13 28%	-9 81%	-9.79%	-8 20%	-15.49%	-14 28%	-15 08%	-3.82%					
	max	0 00%	0 00%	0 00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%					
	avg	-7.09%	-5.26%	-6.41%	-4.70%	-5.01%	-3.50%	-7.83%	-7.45%	-7.99%	-1.92%					
	st dev	4.95%	4.00%	4.71%	3.43%	3.31%	2.93%	5.10%	5.04%	5.46%	1.32%					
	median	-6.82%	-4.70%	-6.29%	-4.09%	-4.40%	-2.01%	-7.86%	-6.50%	-7.01%	-1.81%					
	Lim min	-100.00%														
	Lim max	100.00%														

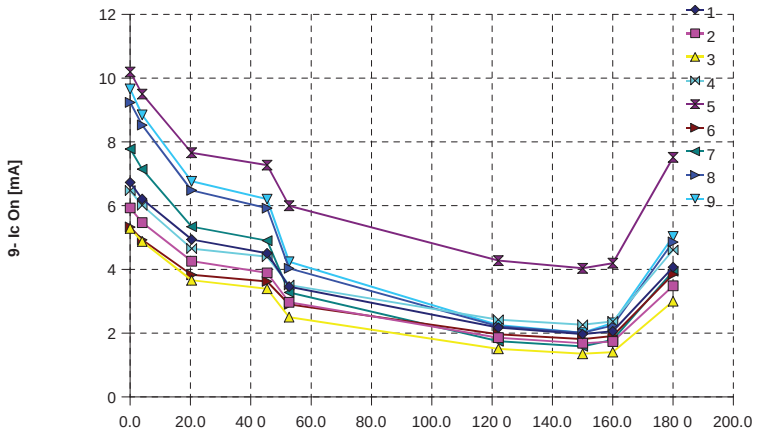




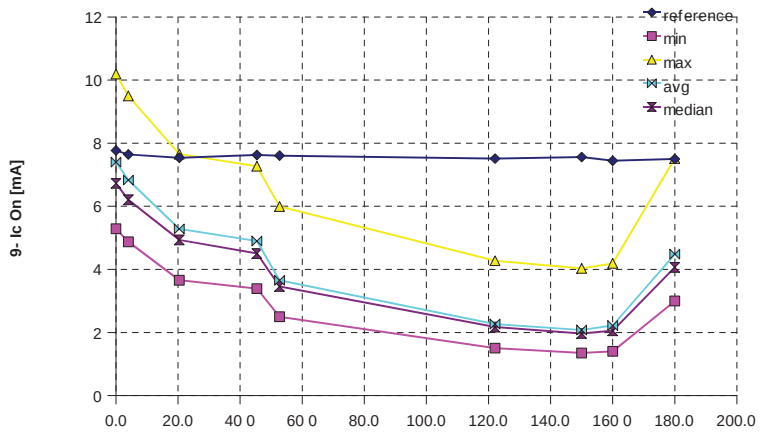
Parameter No: 9 : IC on, On State collector current Ion @ Ifw = 1mA (Vce = 5V) [E] Schedule: 1 of 2	APPENDIX A

9- Ic On	s/n	1	2	3	4	5	6	7	8	9	10	min	max	avg	st dev	median
[mA]	krad(Si)	If=1mA	If=1mA	If=1mA	If=10mA	If=10mA	If=10mA	unbiased	unbiased	unbiased	reference					
	0.0	6.73	5.92	5.29	6.47	10.19	5.33	7.78	9.24	9.66	7.77	5.29	10.19	7.4	1.89	6.73
	4.0	6.21	5.47	4.87	6.01	9 5	4.93	7.14	8.53	8.84	7 64	4.87	9.5	6.83	1.75	6.21
	20.4	4.94	4.25	3.66	4.65	7.66	3.83	5.34	6.48	6.76	7.54	3.66	7.66	5.28	1.4	4.94
	45.4	4 5	3.89	3.39	4.39	7.27	3.62	4.9	5.92	6.2	7.63	3.39	7.27	4.9	1.31	4.5
	52.7	3.46	2.97	2 5	3.51	6	2.9	3.28	4.03	4.24	7 6	2.5	6	3.65	1.03	3.46
	122.1	2.17	1.86	1.5	2.42	4.27	1.96	1.74	2.21	2.25	7 51	1.5	4.27	2.27	0.8	2.17
	150.0	1.97	1.68	1.35	2.26	4.03	1.81	1.58	2.01	2.01	7 56	1.35	4.03	2.08	0.78	1.97
		2.06	1.73	1.4	2.36	4.19	1.91	1.79	2.23	2.32	7.44	1.4	4.19	2.22	0.8	2.06
Annealing		4.07	3.48	3	4.61	7.52	3.84	3.94	4.86	5.03	7 5	3	7.52	4.48	1.31	4.07
	min	1.97	1.68	1.35	2.26	4.03	1.81	1.58	2.01	2.01	7.444					
	max	6.73	5.92	5.29	6.47	10.19	5.33	7.78	9.24	9.66	7.769					
	avg	4.01	3.47	3	4.08	6.74	3.35	4.17	5.06	5.26	7.577					
	st dev	1.77	1.58	1.46	1.56	2.28	1.3	2.31	2.71	2.84	0.097					
	median	4.07	3.48	3	4.39	7.27	3.62	3.94	4.86	5.03	7.561					

Lim min	2.00 [mA]
Lim max	10.00 [mA]

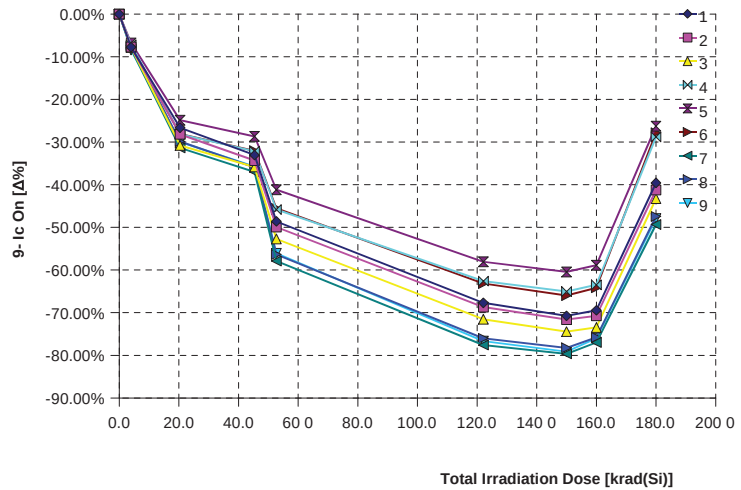


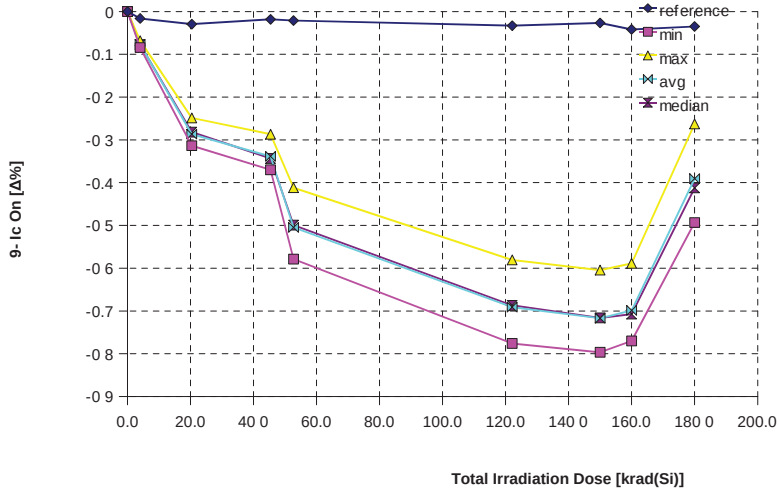
estimated uncertainty ± *0.06 [mA]*



Parameter No: 9 : IC on, On State collector current Ion @ Ifw = 1mA (Vce = 5V) [E] Schedule: 2 of 2	APPENDIX A

9- Ic On	s/n	1	2	3	4	5	6	7	8	9	10	min	max	avg	st dev	median
[Δ%]	krad(Si)	If=1mA	If=1mA	If=1mA	If=10mA	If=10mA	If=10mA	unbiased	unbiased	unbiased	reference					
	0.0	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0	0
	4.0	-7.76%	-7.73%	-7.80%	-7.19%	-6.80%	-7.51%	-8.17%	-7.70%	-8.41%	-1.62%	-8.41%	-6.80%	-7.68%	0.48%	-7.73%
	20.4	-26.64%	-28.19%	-30.78%	-28.15%	-24.88%	-28.12%	-31.36%	-29.87%	-29.97%	-2.96%	-31.36%	-24.88%	-28.66%	2.07%	-28.19%
	45.4	-33.05%	-34.33%	-35.85%	-32.12%	-28.68%	-32.05%	-37.00%	-35.93%	-35.77%	-1.84%	-37.00%	-28.68%	-33.86%	2.64%	-34.33%
	52.7	-48.60%	-49.92%	-52.72%	-45.81%	-41.18%	-45.53%	-57.87%	-56.35%	-56.09%	-2.12%	-57.87%	-41.18%	-50.45%	5.73%	-49.92%
	122.1	-67.70%	-68.68%	-71.54%	-62.60%	-58.07%	-63.15%	-77.59%	-76.02%	-76.67%	-3.32%	-77.59%	-58.07%	-69.12%	6.93%	-68.68%
	150.0	-70.75%	-71.62%	-74.43%	-65.04%	-60.44%	-65.99%	-79.66%	-78.25%	-79.15%	-2.68%	-79.66%	-60.44%	-71.70%	6.84%	-71.62%
		-69.43%	-70.74%	-73.46%	-63.47%	-58.87%	-64.16%	-76.99%	-75.80%	-75.98%	-4.19%	-76.99%	-58.87%	-69.88%	6.44%	-70.74%
		-39.57%	-41.24%	-43.26%	-28.81%	-26.26%	-27.83%	-49.32%	-47.43%	-47.91%	-3.49%	-49.32%	-26.26%	-39.07%	9.16%	-41.24%
	min	-70.75%	-71.62%	-74.43%	-65.04%	-60.44%	-65.99%	-79.66%	-78.25%	-79.15%	-4.19%					
	max	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%					
	avg	-40.39%	-41.38%	-43.32%	-37.02%	-33.91%	-37.15%	-46.44%	-45.26%	-45.55%	-2.47%					
	st dev	26.26%	26.61%	27.64%	24.10%	22.40%	24.39%	29.76%	29.32%	29.44%	1.24%					
	median	-39.57%	-41.24%	-43.26%	-32.12%	-28.68%	-32.05%	-49.32%	-47.43%	-47.91%	-2.68%					
	Lim min	-100.00%														
	Lim max	100.00%														



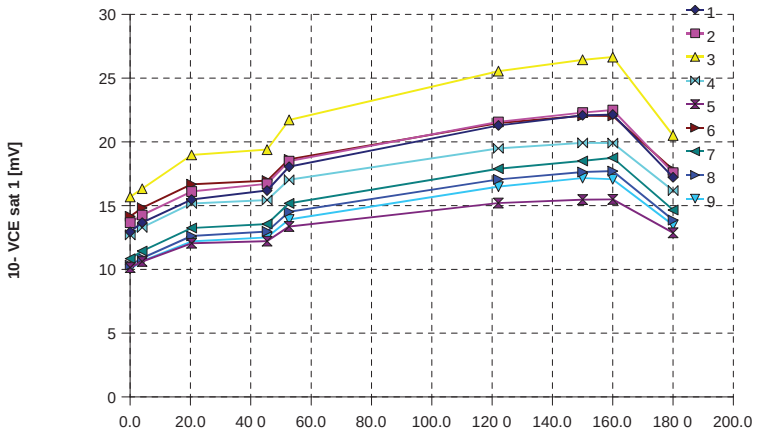


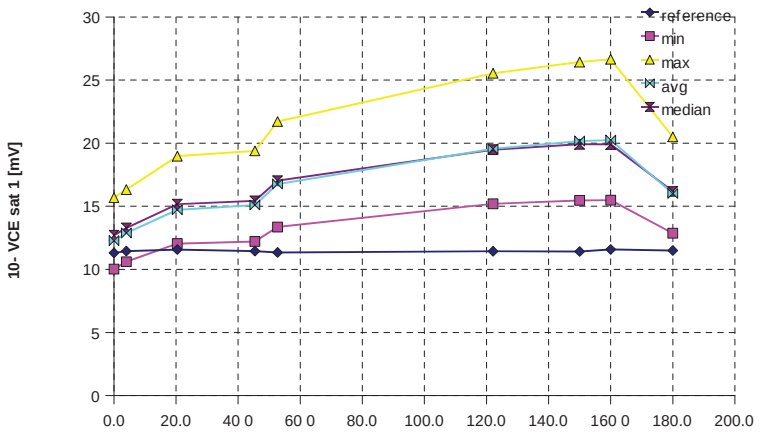
Parameter No: 10 : Vce sat1 @ Ifw = 30mA (Ice= 1mA) [G] Schedule: 1 of 2	APPENDIX A

10- VCE sat 1 [mV]	s/n	1	2	3	4	5	6	7	8	9	10	min	max	avg	st dev	median
	krad(Si)	If=1mA	If=1mA	If=1mA	If=10mA	If=10mA	If=10mA	unbiased	unbiased	unbiased	reference					
	0.0	12.94	13.67	15.69	12.7	10.14	14.16	10.84	10.33	10.02	11 3	10.02	15.69	12.28	2.04	12.7
	4.0	13.67	14.26	16.32	13.28	10.61	14.82	11.44	10.89	10.64	11.45	10.61	16.32	12.88	2.08	13.28
	20.4	15.47	16.11	18.97	15.17	12.04	16.67	13.24	12.62	12.19	11.57	12.04	18.97	14.72	2.36	15.17
	45.4	16.18	16.71	19.39	15.43	12.21	16.95	13.56	12.97	12.5	11.45	12.21	19.39	15.1	2.44	15.43
	52.7	18.05	18.49	21.72	17.03	13.36	18.62	15.17	14.51	13.91	11.34	13.36	21.72	16.76	2.74	17.03
	122.1	21.29	21.56	25.54	19.48	15 2	21.47	17.89	17.05	16.48	11.44	15.2	25.54	19.55	3.24	19.48
	150.0	22.07	22.29	26.43	19.92	15.47	22.04	18.5	17.63	17.16	11.42	15.47	26.43	20.17	3.38	19.92
		22.14	22 5	26.65	19.9	15.49	22.03	18.75	17.71	17.07	11.58	15.49	26.65	20.25	3.44	19.9
Annealing		17.21	17.58	20.5	16.18	12.86	17.8	14.66	13.86	13.48	11.49	12.86	20.5	16.01	2.5	16.18
	min	12.94	13.67	15.69	12.7	10.14	14.16	10.84	10.33	10.02	11.304					
	max	22.14	22.5	26.65	19.92	15.49	22.04	18.75	17.71	17.16	11.578					
	avg	17.67	18.13	21.25	16.57	13.04	18.28	14.89	14.17	13.72	11.450					
	st dev	3.5	3.35	4.17	2.74	2.02	3	2.96	2.79	2.69	0.091					
	median	17.21	17.58	20 5	16.18	12.86	17.8	14.66	13.86	13.48	11.452					

Lim min	10.00 [mV]
Lim max	300.00 [mV]

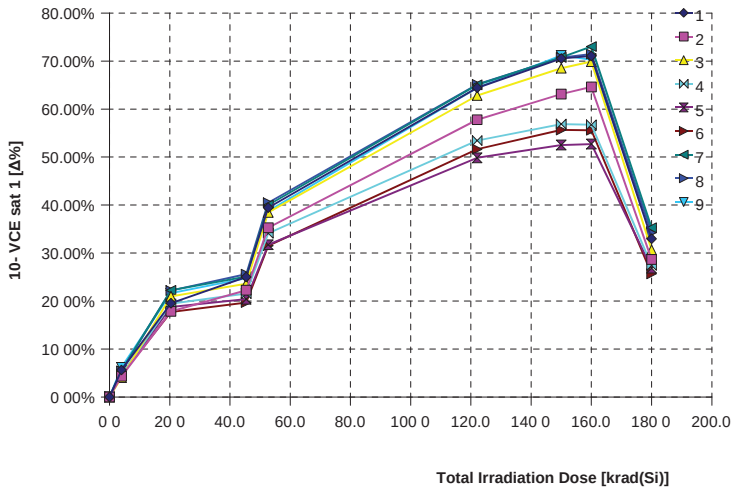
estimated uncertainty ± *0.06 [mV]*

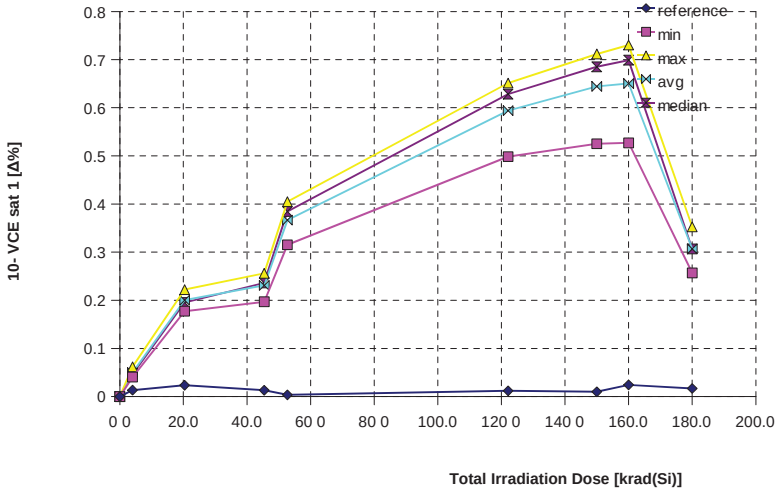




Parameter No: 10 : Vce sat1 @ Ifw = 30mA (Ice= 1mA) [G] Schedule: 2 of 2	APPENDIX A

10- VCE sat 1 [Δ%]	s/n	1	2	3	4	5	6	7	8	9	10	min	max	avg	st dev	median
	krad(Si)	If=1mA	If=1mA	If=1mA	If=10mA	If=10mA	If=10mA	unbiased	unbiased	unbiased	reference					
	0.0	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0	0
	4.0	5.62%	4.32%	4.04%	4.58%	4.63%	4.63%	5.54%	5.42%	6.17%	1.33%	4.04%	6.17%	5.00%	0.71%	4.63%
	20.4	19.53%	17.85%	20.96%	19.44%	18.75%	17.73%	22 22%	22.18%	21 63%	2 35%	17.73%	22.22%	20.03%	1.77%	19.53%
	45.4	25.02%	22.24%	23.60%	21.55%	20.39%	19 69%	25.10%	25 61%	24.74%	1 31%	19.69%	25.61%	23.10%	2.21%	23.60%
	52.7	39.46%	35.28%	38.47%	34.10%	31.73%	31.53%	40.01%	40.50%	38.75%	0.35%	31.53%	40.50%	36.65%	3.55%	38.47%
	122.1	64.45%	57.79%	62.83%	53.44%	49.85%	51.64%	65.06%	65.14%	64.45%	1.19%	49.85%	65.14%	59.41%	6.30%	62.83%
	150.0	70.53%	63.13%	68.52%	56.88%	52.51%	55 65%	70.76%	70.71%	71.17%	0 99%	52.51%	71.17%	64.43%	7.56%	68.52%
		71.06%	64.61%	69.90%	56.73%	52.71%	55 59%	73 03%	71.47%	70 27%	2.42%	52.71%	73.03%	65.04%	7.93%	69.90%
		32 97%	28 66%	30.68%	27.41%	26.84%	25 68%	35 27%	34 24%	34.48%	1 68%	25.68%	35.27%	30.69%	3.68%	30.68%
	min	0 00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	**0.00%**					
	max	71.06%	64.61%	69.90%	56.88%	52.71%	55.65%	73.03%	71.47%	71.17%	**2.42%**					
	avg	36.52%	32.66%	35.44%	30.46%	28.60%	29.13%	37.45%	37.25%	36 85%	**1.29%**					
	st dev	27.07%	24.50%	26.59%	21.61%	19.92%	21 20%	27 28%	27.05%	26.79%	**0.81%**					
	median	32.97%	28.66%	30.68%	27.41%	26.84%	25 68%	35 27%	34 24%	34.48%	**1.31%**					
	Lim min	-100.00%														
	Lim max	100.00%														



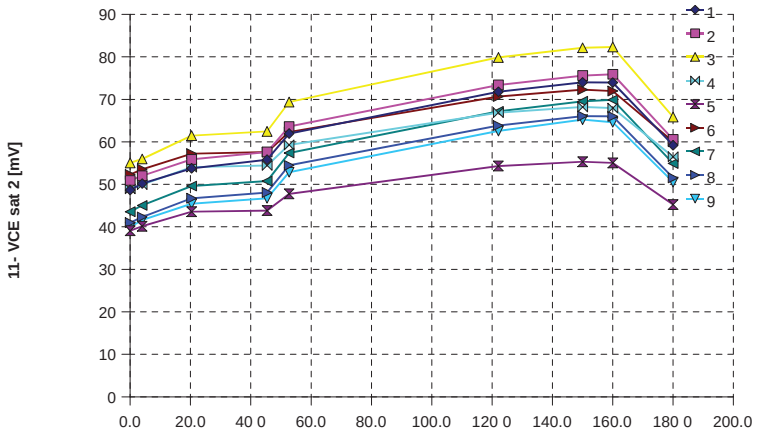


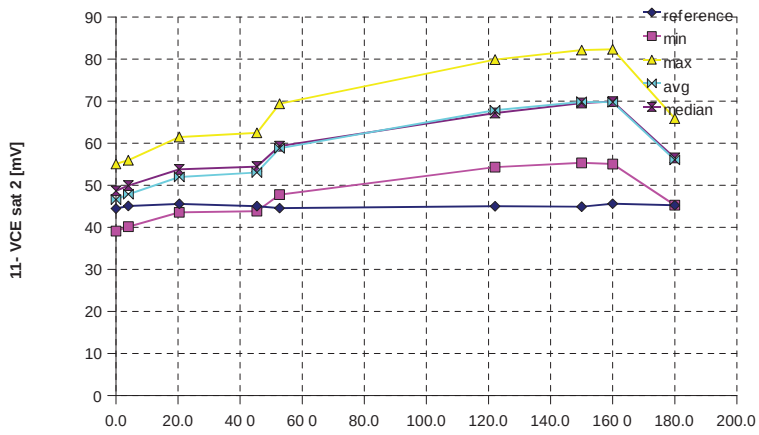
Parameter No: 11 : Vce sat2 @ Ifw = 6mA (Ice= 1mA) [H] Schedule: 1 of 2	APPENDIX A

11- VCE sat 2 [mV]	s/n	1	2	3	4	5	6	7	8	9	10	min	max	avg	st dev	median
	krad(Si)	If=1mA	If=1mA	If=1mA	If=10mA	If=10mA	If=10mA	unbiased	unbiased	unbiased	reference					
	0.0	48.66	50.92	55.06	48.92	39.11	52.31	43.56	40.98	39.94	44.46	39.11	55.06	46.61	5.85	48.66
	4.0	50.19	52.03	55.97	49.94	40.14	53.55	45.04	42.32	41.61	45.07	40.14	55.97	47.86	5.73	49.94
	20.4	53.78	55.87	61.47	54.06	43.57	57.22	49.61	46.72	45.45	45.58	43.57	61.47	51.97	5.99	53.78
	45.4	55.8	57.62	62.46	54.43	43.84	57.59	50.77	48.08	46.72	45.04	43.84	62.46	53.03	6.07	54.43
	52.7	61.95	63.62	69.38	59.3	47.77	62.33	57.39	54.48	52.86	44.56	47.77	69.38	58.79	6.47	59.3
	122.1	71.79	73.38	79.88	66.88	54.32	70.66	67.18	63.84	62.56	45.02	54.32	79.88	67.83	7.31	67.18
	150.0	74.02	75 6	82.14	68.22	55.33	72.3	69.55	66.06	65.23	44.91	55.33	82.14	69.83	7.56	69.55
		73.96	75.91	82.34	67.95	55.05	71.96	69.89	66.01	64.61	45.61	55.05	82.34	69.74	7.74	69.89
Annealing		59.21	60.57	65.86	56.5	45.26	60.04	54.93	51.52	50.55	45.24	45.26	65.86	56.05	6.24	56.5
	min	48.66	50.92	55.06	48.92	39.11	52.31	43.56	40.98	39.94	44.460					
	max	74.02	75.91	82.34	68.22	55.33	72.3	69.89	66.06	65.23	45.614					
	avg	61.04	62.83	68.28	58.47	47.15	61.99	56.44	53.33	52.17	45.054					
	st dev	10.04	9.91	10.83	7.58	6.35	7.84	10.28	9.89	9.83	0.394					
	median	59.21	60.57	65.86	56 5	45.26	60.04	54.93	51.52	50.55	45.036					

Lim min	10.00 [mV]
Lim max	300.00 [mV]

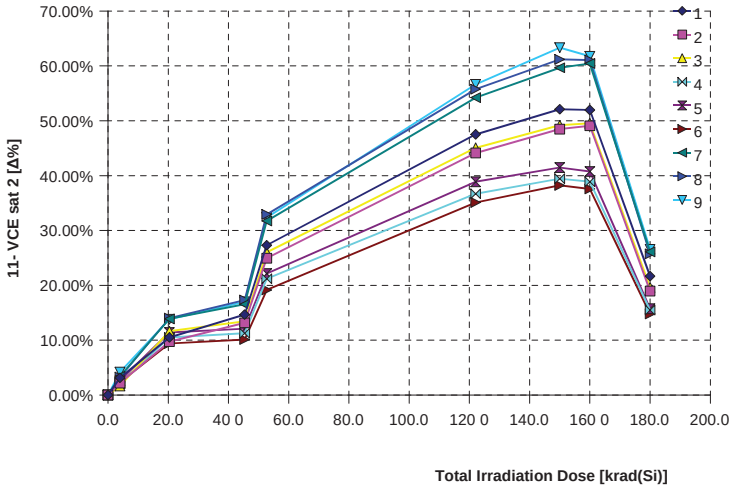
estimated uncertainty ± *0.25 [mV]*

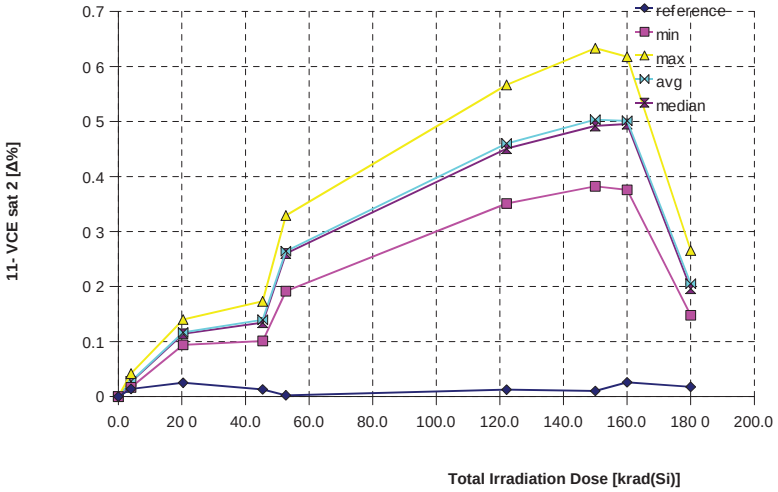




Parameter No: 11 : Vce sat2 @ Ifw = 6mA (Ice= 1mA) [H] Schedule: 2 of 2	APPENDIX A

11- VCE sat 2 [Δ%]	s/n	1	2	3	4	5	6	7	8	9	10	min	max	avg	st dev	median
	krad(Si)	If=1mA	If=1mA	If=1mA	If=10mA	If=10mA	If=10mA	unbiased	unbiased	unbiased	reference					
	0.0	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0	0
	4.0	3.14%	2.18%	1.66%	2.07%	2.64%	2.37%	3.40%	3.26%	4.18%	1.38%	1.66%	4.18%	2.77%	0.79%	2.64%
	20.4	10.50%	9.73%	11.65%	10.51%	11.40%	9.39%	13.88%	14.00%	13.81%	2.51%	9.39%	14.00%	11.65%	1.82%	11.40%
	45.4	14.66%	13.16%	13.44%	11.25%	12.08%	10.11%	16.54%	17.31%	16.99%	1.30%	10.11%	17.31%	13.95%	2.60%	13.44%
	52.7	27.31%	24.95%	26.01%	21.20%	22.15%	19.16%	31.74%	32.93%	32.37%	0.22%	19.16%	32.93%	26.42%	5.09%	26.01%
	122.1	47.53%	44.13%	45.08%	36.70%	38.89%	35.10%	54.23%	55.78%	56.65%	1.26%	35.10%	56.65%	46.01%	8.21%	45.08%
	150.0	52.10%	48.48%	49.20%	39.44%	41.47%	38.22%	59.66%	61.20%	63.33%	1.01%	38.22%	63.33%	50.34%	9.53%	49.20%
		51.98%	49.09%	49.55%	38.89%	40.76%	37.57%	60.45%	61.06%	61.77%	2.60%	37.57%	61.77%	50.12%	9.61%	49.55%
		21.66%	18.95%	19.62%	15.48%	15.72%	14.78%	26.09%	25.72%	26.56%	1.76%	14.78%	26.56%	20.51%	4.75%	19.62%
	min	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%					
	max	52.10%	49.09%	49.55%	39.44%	41.47%	38.22%	60.45%	61.20%	63.33%	2.60%					
	avg	25.43%	23.41%	24.02%	19.50%	20.57%	18.52%	29.56%	30.14%	30.63%	1.34%					
	st dev	20.63%	19.46%	19.67%	15.50%	16.23%	14.99%	23.61%	24.14%	24.60%	0.89%					
	median	21.66%	18.95%	19.62%	15.48%	15.72%	14.78%	26.09%	25.72%	26.56%	1.30%					
	Lim min	-100.00%														
	Lim max	100.00%														



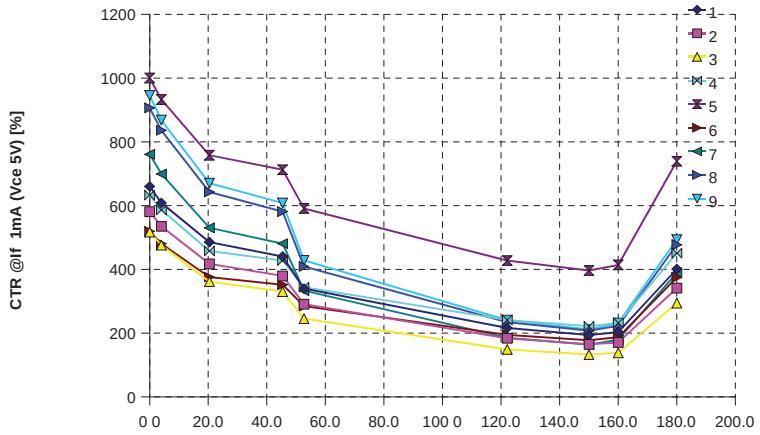


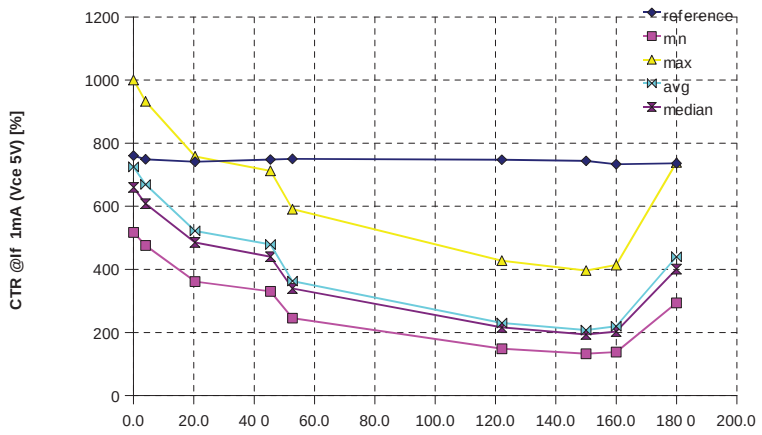
Parameter No: 12 : CTR @If 1mA (Vce 5V) [K] Schedule: 1 of 2	APPENDIX A

CTR @If 1mA (Vce 5V) [%]	s/n	1	2	3	4	5	6	7	8	9	10	min	max	avg	st dev	median
	krad(Si)	If=1mA	If=1mA	If=1mA	If=10mA	If=10mA	If=10mA	unbiased	unbiased	unbiased	reference					
	0.0	660.15	580.75	517.05	632.71	1000.4	519.08	761.06	906.67	945.84	760.62	517.05	1000.4	724.86	186.45	660.15
	4.0	608.33	534.73	475.92	586.56	932.79	480.65	699.38	836.2	868.25	749.03	475.92	932.79	669.2	173	608.33
	20.4	485.46	417.16	361.49	457.74	758.08	375.7	530.34	642.58	670.39	741.34	361.49	758.08	522.1	139.64	485.46
	45.4	440.35	379.22	330.47	427.83	712.56	351.8	480.53	581.1	608.05	748.27	330.47	712.56	479.1	129.39	440.35
	52.7	339 6	290.65	245.52	343.86	591.13	284.49	333.34	408.87	428.04	750.4	245.52	591.13	362.83	103.3	339.6
	122.1	216.05	183.55	148.58	241.16	427.58	194.43	185.47	233.96	240.62	747.66	148.58	427.58	230.15	80.25	216.05
	150.0	193.81	164.75	132.79	221.28	396.33	177.61	163.91	207.63	211.02	744.04	132.79	396.33	207.68	76.03	193.81
		202.85	170.5	138.06	232.09	413.87	186.94	179.3	222.82	231.22	733.33	138.06	413.87	219.74	79.11	202.85
Annealing		401	341.26	293.95	450.79	739.23	374.7	389.39	477.09	493.09	736.38	293.95	739.23	440.06	129.07	401
	min	193.81	164.75	132.79	221.28	396.33	177.61	163.91	207.63	211.02	733.334					
	max	660.15	580.75	517.05	632.71	1000.4	519.08	761.06	906.67	945.84	760.624					
	avg	394.18	340.29	293.76	399.33	663.55	327.27	413.63	501.88	521.84	745.674					
	st dev	172.69	154	142.54	151.72	222.96	126.04	222.72	261.54	273.64	8.122					
	median	401	341.26	293.95	427.83	712.56	351.8	389.39	477.09	493.09	747.661					

Lim min	200.00 [%]
Lim max	1,000.00 [%]

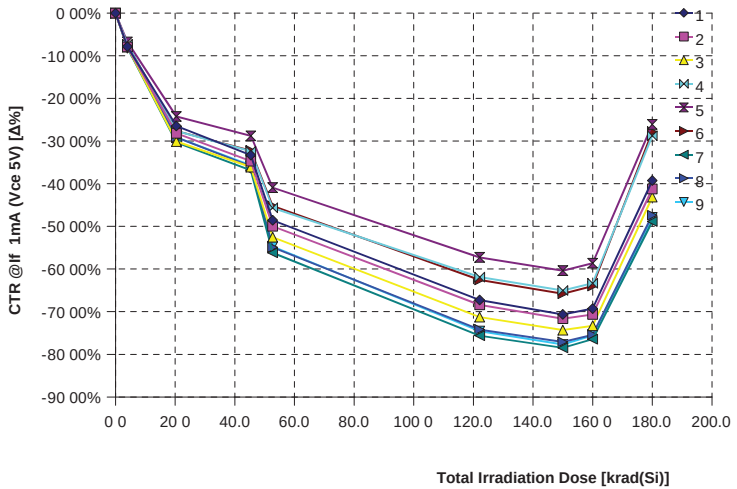
estimated uncertainty ± *5.23 [%]*

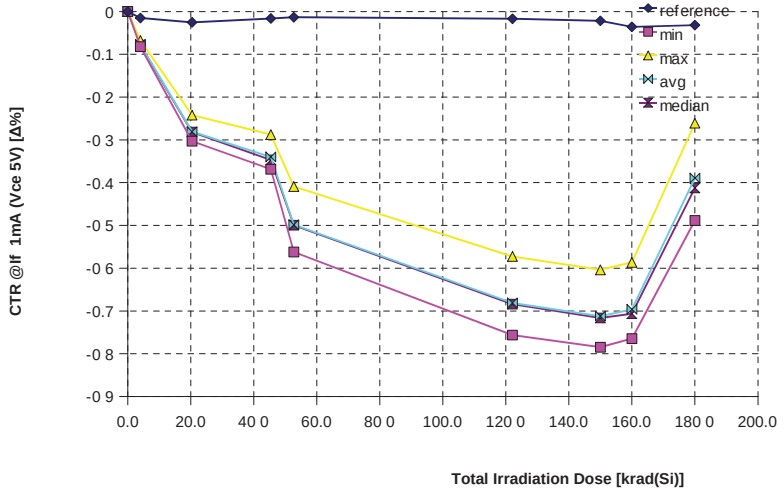




Parameter No: 12 : CTR @If 1mA (Vce 5V) [K] Schedule: 2 of 2	APPENDIX A

CTR @If 1mA (Vce 5V) [Δ%]	s/n	1	2	3	4	5	6	7	8	9	10	min	max	avg	st dev	median
	krad(Si)	If=1mA	If=1mA	If=1mA	If=10mA	If=10mA	If=10mA	unbiased	unbiased	unbiased	reference					
	0.0	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0	0
	4.0	-7.85%	-7.92%	-7.95%	-7.29%	-6.76%	-7.40%	-8.10%	-7.77%	-8.20%	-1.52%	-8.20%	-6.76%	-7.70%	0.46%	-7.85%
	20.4	-26.46%	-28.17%	-30.09%	-27.65%	-24.22%	-27.62%	-30 32%	-29.13%	-29.12%	-2 54%	-30.32%	-24.22%	-28.09%	1.91%	-28.17%
	45.4	-33.30%	-34.70%	-36.09%	-32.38%	-28.77%	-32 23%	-36 86%	-35 91%	-35.71%	-1 62%	-36.86%	-28.77%	-33.99%	2.58%	-34.70%
	52.7	-48.56%	-49.95%	-52.51%	-45.65%	-40.91%	-45.19%	-56.20%	-54 90%	-54.75%	-1 34%	-56.20%	-40.91%	-49.85%	5.22%	-49.95%
	122.1	-67.27%	-68.40%	-71.26%	-61.88%	-57.26%	-62.54%	-75.63%	-74 20%	-74 56%	-1.70%	-75.63%	-57.26%	-68.11%	6.46%	-68.40%
	150.0	-70.64%	-71.63%	-74.32%	-65.03%	-60 38%	-65.78%	-78.46%	-77.10%	-77 69%	-2.18%	-78.46%	-60.38%	-71.23%	6.37%	-71.63%
		-69.27%	-70.64%	-73.30%	-63.32%	-58 63%	-63 99%	-76.44%	-75.42%	-75 55%	-3 59%	-76.44%	-58.63%	-69.62%	6.35%	-70.64%
		-39.26%	-41.24%	-43.15%	-28.75%	-26.11%	-27.81%	-48.84%	-47.38%	-47.87%	-3.19%	-48.84%	-26.11%	-38.93%	9.11%	-41.24%
	min	-70.64%	-71.63%	-74.32%	-65.03%	-60.38%	-65.78%	-78.46%	-77.10%	-77 69%	**-3.59%**					
	max	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	**0.00%**					
	avg	-40.29%	-41.41%	-43.19%	-36.88%	-33.67%	-36.95%	-45.65%	-44 65%	-44 83%	**-1.97%**					
	st dev	26.16%	26.52%	27.57%	23.98%	22.29%	24.28%	29.26%	28.85%	28 93%	**1.07%**					
	median	-39.26%	-41.24%	-43.15%	-32.38%	-28.77%	-32 23%	-48 84%	-47 38%	-47 87%	**-1.70%**					
	Lim min	-100.00%														
	Lim max	100.00%														

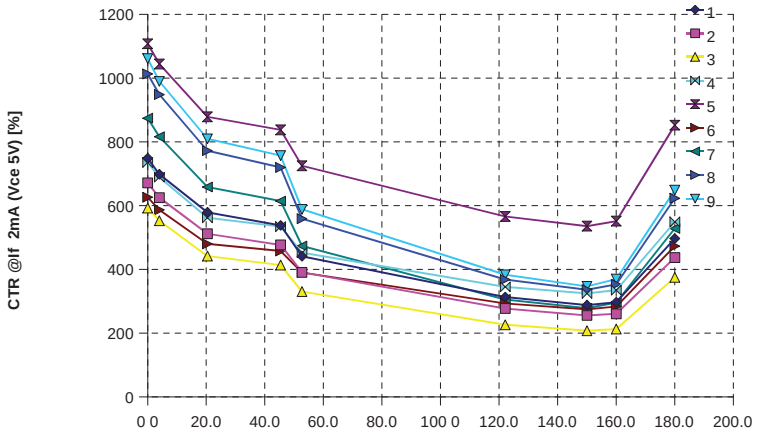




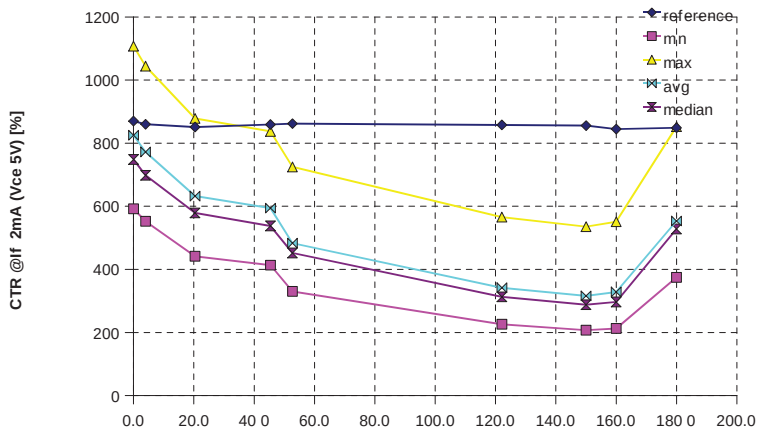
Parameter No: 13 : CTR @If 2mA (Vce 5V) Schedule: 1 of 2	APPENDIX A

CTR @If 2mA (Vce 5V) [%]	s/n	1	2	3	4	5	6	7	8	9	10	min	max	avg	st dev	median
	krad(Si)	If=1mA	If=1mA	If=1mA	If=10mA	If=10mA	If=10mA	unbiased	unbiased	unbiased	reference					
	0.0	748.64	671.28	592 3	735.38	1107.87	626.29	874.32	1013.15	1061.14	870.21	592.3	1107.87	825.59	195.17	748.64
	4.0	698.36	624.87	552.59	689.15	1044.38	586.51	816.15	948.46	989.82	860.07	552.59	1044.38	772.25	184.12	698.36
	20.4	579.01	511.72	441.71	561.92	878.56	479.99	658.44	772.36	809.77	851.34	441.71	878.56	632.61	155.84	579.01
	45.4	537.84	476.7	413.45	534.12	837.62	457.44	614.27	719.71	756.83	859.31	413.45	837.62	594.22	147.4	537.84
	52.7	441.01	390.47	330.22	452.19	724.98	389.89	473.28	558.78	588.33	862.16	330.22	724.98	483.24	121.84	452.19
	122.1	313.08	277.12	226.22	345.01	565.87	292.81	305.44	367.91	383.07	857.93	226.22	565.87	341.84	96.62	313.08
	150.0	288.07	255.13	207.43	324.24	535.58	274.29	278.09	335.81	346.63	855.88	207.43	535.58	316.14	92.91	288.07
		296.95	260.55	212.72	334.51	551.23	283.29	295.66	352.92	369.54	844.77	212.72	551.23	328.6	96.22	296.95
Annealing		496.75	436.82	374.93	549.09	852.4	473	528.23	623.01	648.5	849.06	374.93	852.4	553.64	141	528.23
	min	288.07	255.13	207.43	324.24	535.58	274.29	278.09	335.81	346.63	844.765					
	max	748.64	671.28	592.3	735.38	1107.87	626.29	874.32	1013.15	1061.14	870.205					
	avg	488.86	433.85	372.4	502.84	788.72	429.28	538.21	632.46	661.51	856.745					
	st dev	170.4	153.78	142.82	151.29	210.93	129.58	222.33	253.38	265.99	7.600					
	median	496.75	436.82	374.93	534.12	837.62	457.44	528.23	623.01	648.5	857.925					

Lim min	200.00 [%]
Lim max	1,000.00 [%]

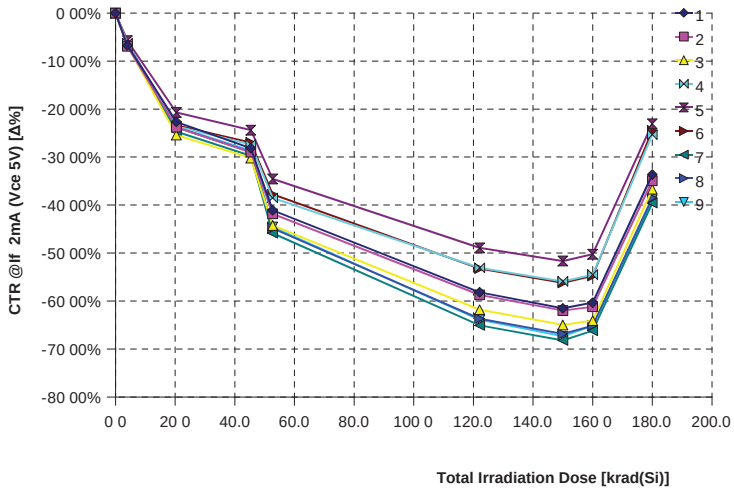


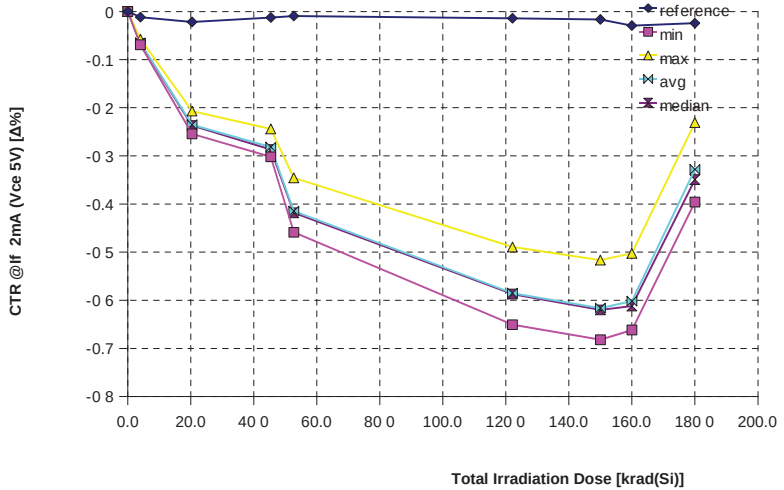
estimated uncertainty ± *4.9 [%]*



Parameter No: 13 : CTR @If 2mA (Vce 5V) Schedule: 2 of 2	APPENDIX A

CTR @If 2mA (Vce 5V) [Δ%]	s/n	1	2	3	4	5	6	7	8	9	10	min	max	avg	st dev	median
	krad(Si)	If=1mA	If=1mA	If=1mA	If=10mA	If=10mA	If=10mA	unbiased	unbiased	unbiased	reference					
	0.0	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0	0
	4.0	-6.72%	-6.91%	-6.70%	-6.29%	-5.73%	-6.35%	-6.65%	-6.39%	-6.72%	-1.16%	-6.91%	-5.73%	-6.50%	0.35%	-6.65%
	20.4	-22.66%	-23.77%	-25.42%	-23.59%	-20.70%	-23.36%	-24 69%	-23.77%	-23 69%	-2.17%	-25.42%	-20.70%	-23.52%	1.32%	-23.69%
	45.4	-28.16%	-28.99%	-30.20%	-27.37%	-24 39%	-26 96%	-29.74%	-28 96%	-28 68%	-1 25%	-30.20%	-24.39%	-28.16%	1.75%	-28.68%
	52.7	-41.09%	-41.83%	-44.25%	-38.51%	-34.56%	-37.74%	-45.87%	-44 85%	-44 56%	-0 92%	-45.87%	-34.56%	-41.47%	3.85%	-41.83%
	122.1	-58.18%	-58.72%	-61.81%	-53.08%	-48.92%	-53.25%	-65.06%	-63 69%	-63 90%	-1.41%	-65.06%	-48.92%	-58.51%	5.69%	-58.72%
	150.0	-61.52%	-61.99%	-64.98%	-55.91%	-51 66%	-56 20%	-68.19%	-66 86%	-67 33%	-1 65%	-68.19%	-51.66%	-61.63%	5.87%	-61.99%
		-60.33%	-61.19%	-64.09%	-54.51%	-50 24%	-54.77%	-66.18%	-65.17%	-65.18%	-2 92%	-66.18%	-50.24%	-60.18%	5.73%	-61.19%
		-33.65%	-34.93%	-36.70%	-25.33%	-23.06%	-24.47%	-39.58%	-38.51%	-38.89%	-2.43%	-39.58%	-23.06%	-32.79%	6.67%	-34.93%
	min	-61.52%	-61.99%	-64.98%	-55.91%	-51.66%	-56.20%	-68.19%	-66 86%	-67 33%	-2.92%					
	max	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%					
	avg	-34.70%	-35.37%	-37.13%	-31.62%	-28.81%	-31.46%	-38.44%	-37 58%	-37 66%	-1.55%					
	st dev	22.76%	22.91%	24.11%	20.57%	19.04%	20.69%	25.43%	25.01%	25 07%	0.87%					
	median	-33.65%	-34.93%	-36.70%	-27.37%	-24 39%	-26 96%	-39 58%	-38 51%	-38 89%	-1.41%					
	Lim min	-100.00%														
	Lim max	100.00%														



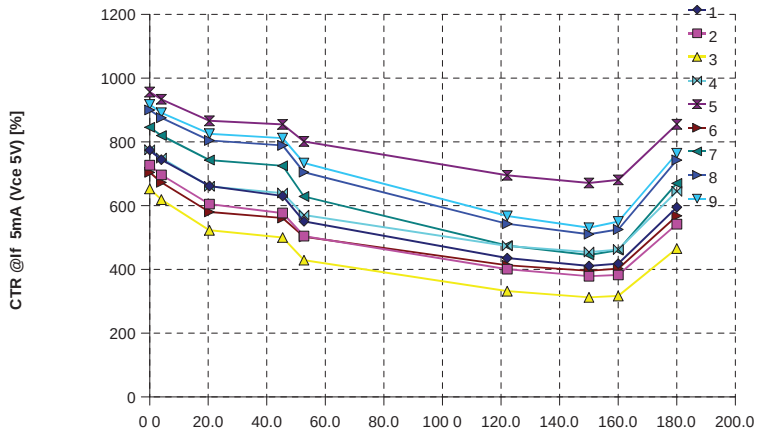


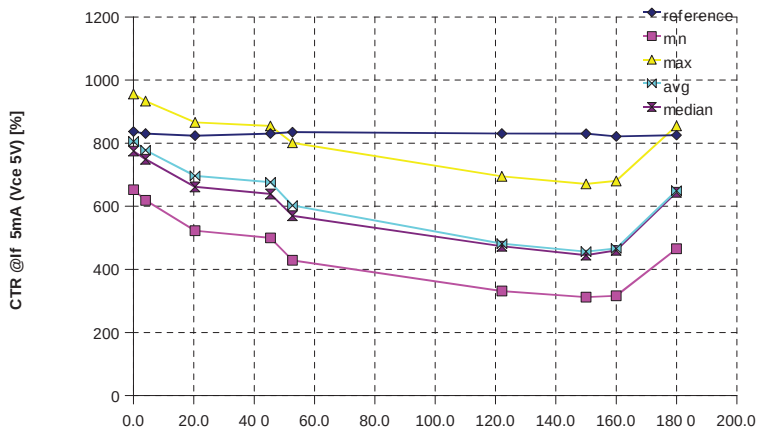
Parameter No: 14 : CTR @If 5mA (Vce 5V) Schedule: 1 of 2	APPENDIX A

CTR @If 5mA (Vce 5V) [%]	s/n	1	2	3	4	5	6	7	8	9	10	min	max	avg	st dev	median
	krad(Si)	If=1mA	If=1mA	If=1mA	If=10mA	If=10mA	If=10mA	unbiased	unbiased	unbiased	reference					
	0.0	774.04	726.93	652.71	775.1	956.24	704.53	845.88	899.96	917.59	836.96	652.71	956.24	805.89	104.56	775.1
	4.0	744.26	696.27	619.02	748.98	933.69	672.84	819.93	875.55	891.29	830.62	619.02	933.69	777.98	108.02	748.98
	20.4	661.6	604.75	522.71	660.36	866.11	580.14	742.87	804.54	825.45	823.88	522.71	866.11	696.5	119.32	661.6
	45.4	630.28	576.69	499.86	639.28	854.83	561.1	724.88	788.87	811.85	830.66	499.86	854.83	676.4	124.04	639.28
	52.7	550.63	504 3	428.88	570.15	801.33	502.22	628.63	704.75	733.56	835.16	428.88	801.33	602.72	123.2	570.15
	122.1	435.38	400.63	331.56	473.42	695.04	412.91	474.54	543.02	567.54	830.86	331.56	695.04	481.56	107.68	473.42
	150.0	410.84	378.42	312.22	454.19	671.05	395.32	445.2	510.25	530.68	830.28	312.22	671.05	456.46	104.46	445.2
		417.99	382.36	316.46	462.22	680.63	402.13	460.37	525.14	550.16	821.67	316.46	680.63	466.38	107.49	460.37
Annealing		594.94	541.68	465.36	644.64	855.03	567.87	669.86	742.94	763.98	825.74	465.36	855.03	649.59	122.32	644.64
	min	410.84	378.42	312.22	454.19	671.05	395.32	445.2	510.25	530.68	821.668					
	max	774.04	726.93	652.71	775.1	956.24	704.53	845.88	899.96	917.59	836.958					
	avg	579.99	534.67	460.98	603.15	812.66	533.23	645.79	710.56	732.45	829.535					
	st dev	137.24	130.53	126.43	120.99	107.9	114.38	154.46	150.71	148.57	4.996					
	median	594.94	541.68	465.36	639.28	854.83	561.1	669.86	742.94	763.98	830.622					

Lim min	200.00 [%]
Lim max	1,000.00 [%]

estimated uncertainty ± *3.22 [%]*



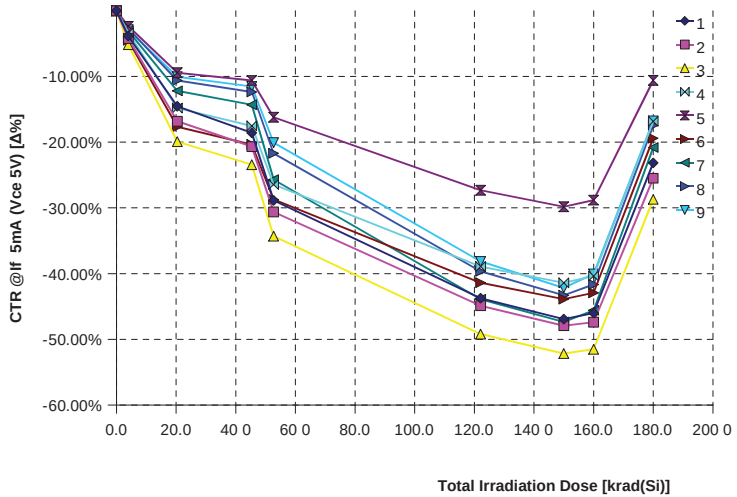


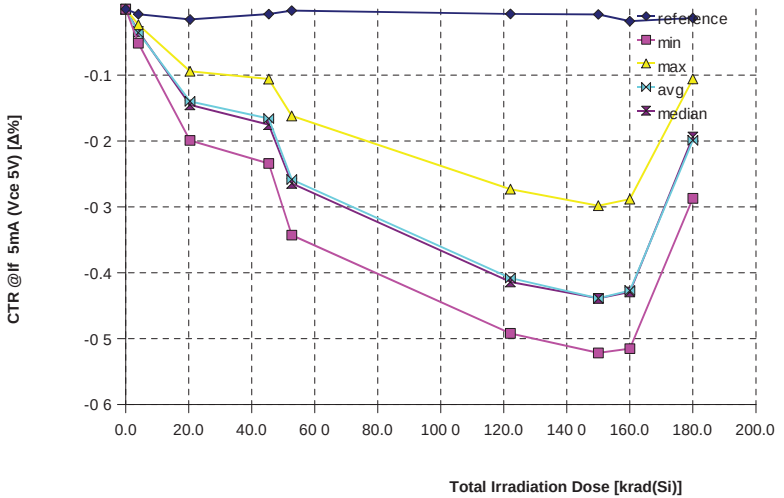
Parameter No: 14 : CTR @If 5mA (Vce 5V) Schedule: 2 of 2	APPENDIX A

CTR @If 5mA (Vce 5V) [Δ%]

s/n	1	2	3	4	5	6	7	8	9	10	min	max	avg	st dev	median
krad(Si)	If=1mA	If=1mA	If=1mA	If=10mA	If=10mA	If=10mA	unbiased	unbiased	unbiased	reference					
0.0	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0	0
4.0	-3.85%	-4.22%	-5.16%	-3.37%	-2.36%	-4.50%	-3.07%	-2.71%	-2.87%	-0.76%	-5.16%	-2.36%	-3.57%	0.93%	-3.37%
20.4	-14.53%	-16.81%	-19.92%	-14.80%	-9.43%	-17.66%	-12.18%	-10.60%	-10.04%	-1.56%	-19.92%	-9.43%	-14.00%	3.68%	-14.53%
45.4	-18.57%	-20.67%	-23.42%	-17.52%	-10.61%	-20.36%	-14.31%	-12.34%	-11.52%	-0.75%	-23.42%	-10.61%	-16.59%	4.57%	-17.52%
52.7	-28.86%	-30.63%	-34.29%	-26.44%	-16.20%	-28.72%	-25.68%	-21.69%	-20.06%	-0.22%	-34.29%	-16.20%	-25.84%	5.65%	-26.44%
122.1	-43.75%	-44.89%	-49.20%	-38.92%	-27.32%	-41.39%	-43.90%	-39.66%	-38.15%	-0.73%	-49.20%	-27.32%	-40.80%	6.12%	-41.39%
150.0	-46.92%	-47.94%	-52.17%	-41.40%	-29.82%	-43.89%	-47.37%	-43.30%	-42.17%	-0.80%	-52.17%	-29.82%	-43.89%	6.26%	-43.89%
	-46.00%	-47.40%	-51.52%	-40.37%	-28.82%	-42.92%	-45.58%	-41.65%	-40.04%	-1.83%	-51.52%	-28.82%	-42.70%	6.38%	-42.92%
	-23.14%	-25.48%	-28.70%	-16.83%	-10.58%	-19.40%	-20.81%	-17.45%	-16.74%	-1.34%	-28.70%	-10.58%	-19.90%	5.39%	-19.40%
min	-46.92%	-47.94%	-52.17%	-41.40%	-29.82%	-43.89%	-47.37%	-43.30%	-42.17%	-1.83%					
max	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%					
avg	-25.07%	-26.45%	-29.37%	-22.18%	-15.02%	-24.31%	-23.65%	-21.05%	-20.18%	-0.89%					
st dev	17.73%	17.96%	19.37%	15.61%	11.28%	16.23%	18.26%	16.75%	16.19%	0.60%					
median	-23.14%	-25.48%	-28.70%	-17.52%	-10.61%	-20.36%	-20.81%	-17.45%	-16.74%	-0.76%					

Lim min	-100.00%
Lim max	100.00%



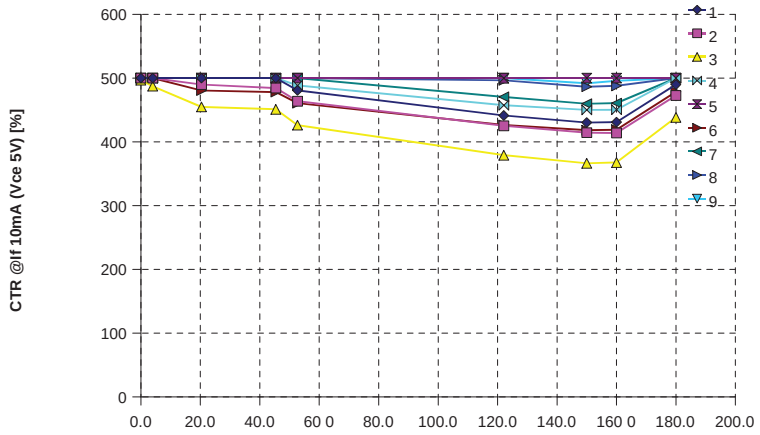


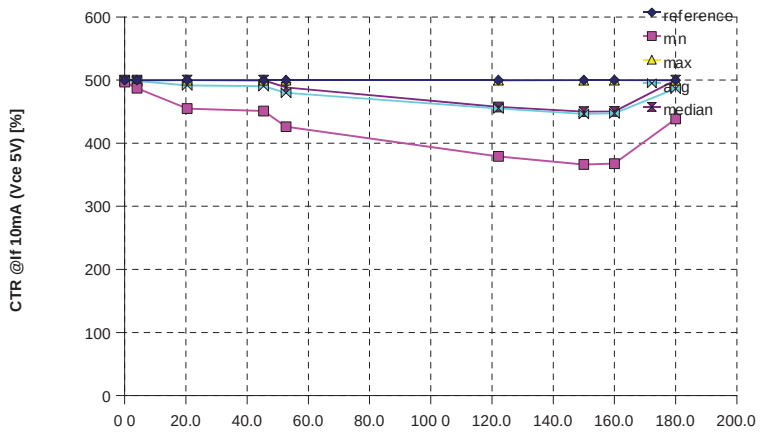
Parameter No: 15 : CTR @If 10mA (Vce 5V) Schedule: 1 of 2	APPENDIX A

CTR @If 10mA (Vce 5V) [%]	s/n	1	2	3	4	5	6	7	8	9	10	min	max	avg	st dev	median
	krad(Si)	If=1mA	If=1mA	If=1mA	If=10mA	If=10mA	If=10mA	unbiased	unbiased	unbiased	reference					
	0.0	499.99	499.99	496.91	499.99	499.99	499.99	499.99	499.99	499.99	499.99	496.91	499.99	499.65	1.03	499.99
	4.0	499.98	499.98	487 3	499.98	499.98	499.98	499.98	499.98	499.99	499.98	487.3	499.99	498.57	4.23	499.98
	20.4	500.02	489.92	454.83	500.02	500.02	480.55	500.01	500.01	500.01	500.02	454.83	500.02	491.71	15.42	500.01
	45.4	499.99	484.43	451.13	499.99	499.99	478.12	499.99	499.99	499.99	499.99	451.13	499.99	490.4	16.88	499.99
	52.7	480.86	463.78	426.21	488.48	499.99	460.67	499.99	499.99	499.99	499.99	426.21	499.99	479.99	25.5	488.48
	122.1	441.43	425.27	379.12	457 5	499.96	426.5	470.54	496.56	499.94	499.94	379.12	499.96	455.2	41.31	457.5
	150.0	430 3	414.46	366.4	450.15	500	418.34	459.82	486.43	491.83	500	366.4	500	446.42	43.59	450.15
		430.95	413.93	367.66	450.4	500.02	419.13	460.83	487.89	495.73	500.01	367.66	500.02	447.39	43.99	450.4
		489.9	472.82	438.43	499.99	499.99	478.58	499.99	500	500	500	438.43	500	486.63	20.86	499.99
Annealing																
	min	430 3	413.93	366.4	450.15	499.96	418.34	459.82	486.43	491.83	499.938					
	max	500.02	499.99	496.91	500.02	500.02	499.99	500.01	500.01	500.01	500.019					
	avg	474.83	462.73	429.78	482.95	499.99	462.43	487.91	496.76	498.61	499.992					
	st dev	31.27	35.71	49.28	23.09	0.02	33.11	18.37	5.57	2.91	0.023					
	median	489 9	472.82	438.43	499.98	499.99	478.12	499.99	499.99	499.99	499.994					

Lim min	200.00 [%]
Lim max	1,000.00 [%]

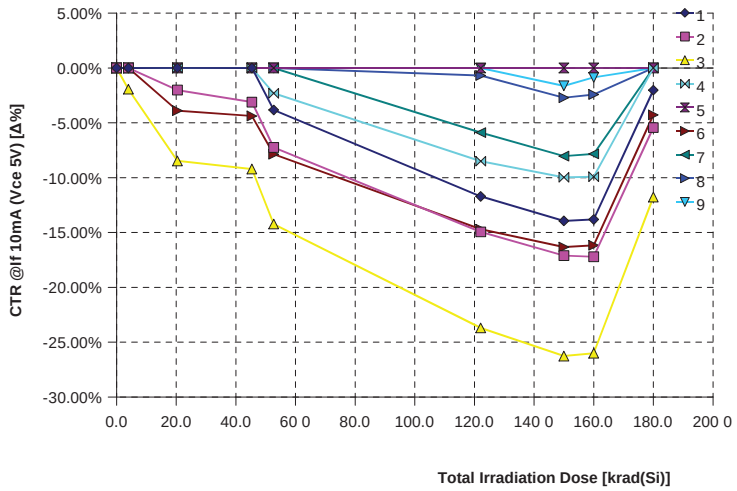
estimated uncertainty ± *0.01 [%]*

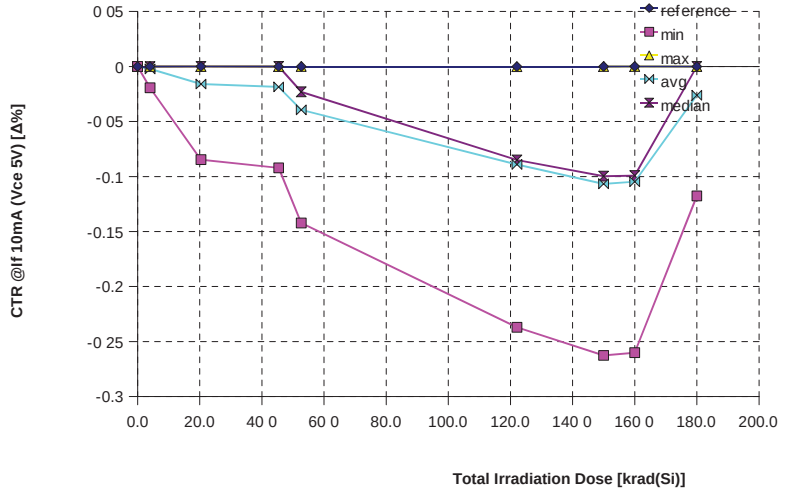




Parameter No: 15 : CTR @If 10mA (Vce 5V) Schedule: 2 of 2	APPENDIX A

CTR @If 10mA (Vce 5V) [Δ%]	s/n	1	2	3	4	5	6	7	8	9	10	min	max	avg	st dev	median
	krad(Si)	If=1mA	If=1mA	If=1mA	If=10mA	If=10mA	If=10mA	unbiased	unbiased	unbiased	reference					
	0.0	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0	0
	4.0	0.00%	0.00%	-1.93%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	-1.93%	0.00%	-0.22%	0.64%	0.00%
	20.4	0.01%	-2.01%	-8.47%	0.01%	0.01%	-3.89%	0.00%	0.00%	0.00%	0.01%	-8.47%	0.01%	-1.59%	2.92%	0.00%
	45.4	0.00%	-3.11%	-9.21%	0.00%	0.00%	-4.37%	0.00%	0.00%	0.00%	0.00%	-9.21%	0.00%	-1.86%	3.22%	0.00%
	52.7	-3.83%	-7.24%	-14.23%	-2.30%	0.00%	-7.86%	0.00%	0.00%	0.00%	0.00%	-14.23%	0.00%	-3.94%	4.96%	-2.30%
	122.1	-11.71%	-14.94%	-23.70%	-8.50%	-0.01%	-14.70%	-5.89%	-0.69%	-0.01%	-0.01%	-23.70%	-0.01%	-8.91%	8.15%	-8.50%
	150.0	-13.94%	-17.11%	-26.26%	-9.97%	0.00%	-16.33%	-8.03%	-2.71%	-1.63%	0.00%	-26.26%	0.00%	-10.66%	8.61%	-9.97%
		-13.81%	-17.21%	-26.01%	-9.92%	0.01%	-16.17%	-7.83%	-2.42%	-0.85%	0.00%	-26.01%	0.01%	-10.47%	8.70%	-9.92%
		-2.02%	-5.43%	-11.77%	0.00%	0.00%	-4.28%	0.00%	0.00%	0.00%	0.00%	-11.77%	0.00%	-2.61%	4.02%	0.00%
	min	-13.94%	-17.21%	-26.26%	-9.97%	-0.01%	-16.33%	-8.03%	-2.71%	-1.63%	-0.01%					
	max	0.01%	0.00%	0.00%	0.01%	0.01%	0.00%	0.00%	0.00%	0.00%	0.01%					
	avg	-5.03%	-7.45%	-13.51%	-3.41%	0.00%	-7.51%	-2.42%	-0.65%	-0.28%	0.00%					
	st dev	6.25%	7.14%	9.92%	4.62%	0.00%	6.62%	3.67%	1.11%	0.58%	0.00%					
	median	-2.02%	-5.43%	-11.77%	0.00%	0.00%	-4.37%	0.00%	0.00%	0.00%	0.00%					
	Lim min	-100.00%														
	Lim max	100.00%														

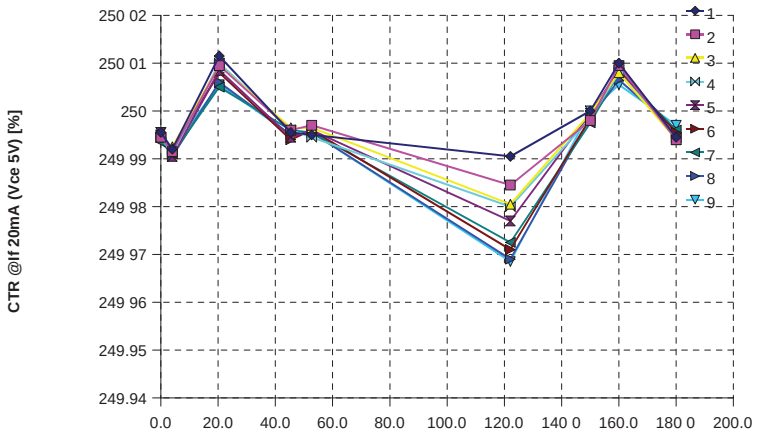




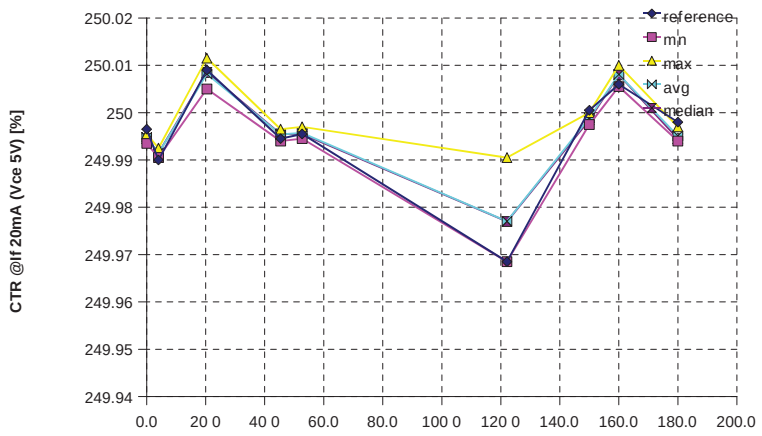
Parameter No: 16 : CTR @If 20mA (Vce 5V) Schedule: 1 of 2	APPENDIX A

CTR @If 20mA (Vce 5V) [%]	s/n	1	2	3	4	5	6	7	8	9	10	min	max	avg	st dev	median
	krad(Si)	If=1mA	If=1mA	If=1mA	If=10mA	If=10mA	If=10mA	unbiased	unbiased	unbiased	reference					
	0.0	250	249.99	249.99	249.99	250	249.99	249.99	250	250	250	249.99	250	249.99	0	249.99
	4.0	249.99	249.99	249.99	249.99	249.99	249.99	249.99	249.99	249.99	249.99	249.99	249.99	249.99	0	249.99
	20.4	250.01	250.01	250.01	250.01	250.01	250.01	250.01	250.01	250.01	250.01	250.01	250.01	250.01	0	250.01
	45.4	250	250	250	250	249.99	249.99	250	250	250	249.99	249.99	250	250	0	250
	52.7	250	250	250	249.99	250	250	250	250	250	250	249.99	250	250	0	250
	122.1	249.99	249.98	249.98	249.98	249.98	249.97	249.97	249.97	249.97	249.97	249.97	249.99	249.98	0.01	249.98
	150.0	250	250	250	250	250	250	250	250	250	250	250	250	250	0	250
		250.01	250.01	250.01	250.01	250.01	250.01	250.01	250.01	250.01	250.01	250.01	250.01	250.01	0	250.01
Annealing		249.99	249.99	249.99	249.99	249.99	250	250	250	250	250	249.99	250	250	0	249.99
	min	249.99	249.98	249.98	249.98	249.98	249.97	249.97	249.97	249.97	249.969					
	max	250.01	250.01	250.01	250.01	250.01	250.01	250.01	250.01	250.01	250.009					
	avg	250	250	250	250	250	250	250	249.99	249.99	249.995					
	st dev	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.012					
	median	250	250	250	249.99	250	250	250	250	250	249.997					

Lim min	200.00 [%]
Lim max	1,000.00 [%]

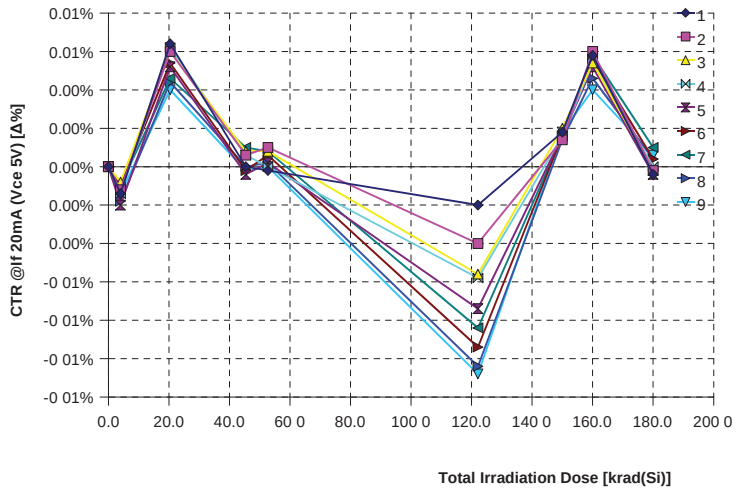


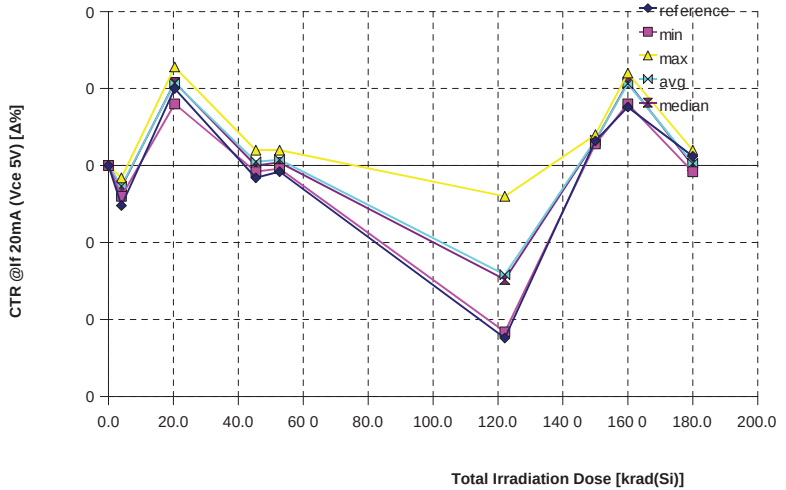
estimated uncertainty ± *0.01 [%]*



Parameter No: 16 : CTR @If 20mA (Vce 5V) Schedule: 2 of 2	APPENDIX A

CTR @If 20mA (Vce 5V) [Δ%]	s/n	1	2	3	4	5	6	7	8	9	10	min	max	avg	st dev	median
	krad(Si)	If=1mA	If=1mA	If=1mA	If=10mA	If=10mA	If=10mA	unbiased	unbiased	unbiased	reference					
	0.0	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0	0
	4.0	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	20.4	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.00%	0.00%	0.00%	0.01%	0.00%	0.01%	0.01%	0.00%	0.01%
	45.4	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	52.7	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	122.1	0.00%	0.00%	-0.01%	-0.01%	-0.01%	-0.01%	-0.01%	-0.01%	-0.01%	-0.01%	-0.01%	0.00%	-0.01%	0.00%	-0.01%
	150.0	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
		0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.00%	0.01%
		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	min	0.00%	0.00%	-0.01%	-0.01%	-0.01%	-0.01%	-0.01%	-0.01%	-0.01%	-0.01%					
	max	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.00%	0.00%	0.01%					
	avg	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%					
	st dev	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%					
	median	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%					
	Lim min	-100.00%														
	Lim max	100.00%														



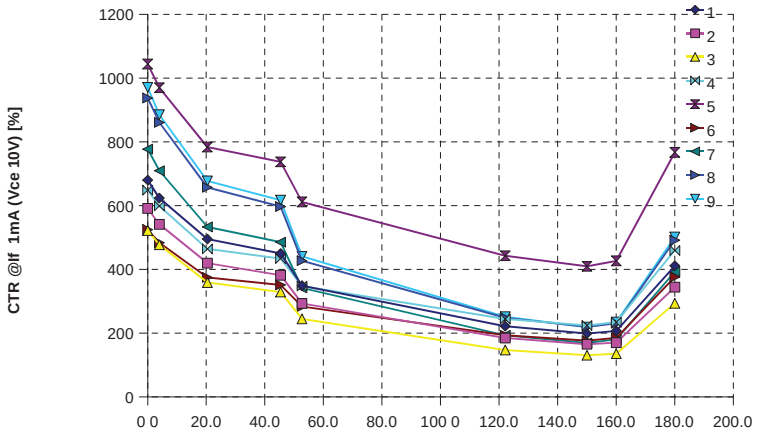


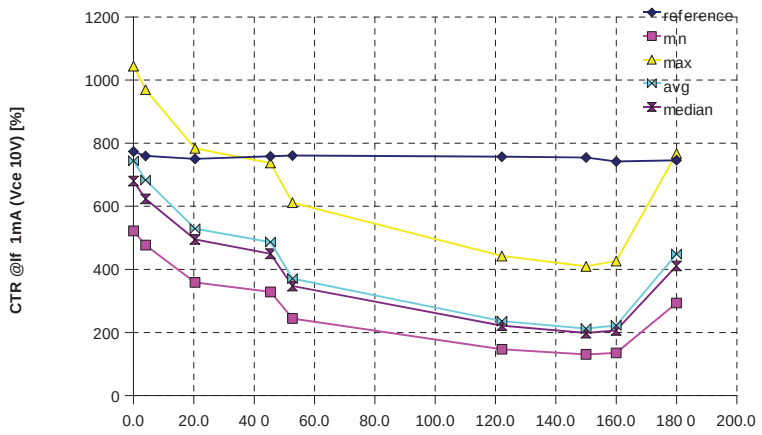
Parameter No: 17 : CTR @If 1mA (Vce 10V) Schedule: 1 of 2	APPENDIX A

CTR @If 1mA (Vce 10V) [%]	s/n	1	2	3	4	5	6	7	8	9	10	min	max	avg	st dev	median
	krad(Si)	If=1mA	If=1mA	If=1mA	If=10mA	If=10mA	If=10mA	unbiased	unbiased	unbiased	reference					
	0.0	680.09	591.19	522.06	648.53	1044.4	524.94	777.17	937.73	970.66	773.7	522.06	1044.4	744.08	198.13	680.09
	4.0	623.55	541 2	476.92	598.79	969.9	483.59	709.58	861.02	885.22	759.75	476.92	969.9	683.31	183.23	623.55
	20.4	494.94	419.46	358.7	464.08	783.64	374.69	533.28	657.16	677.45	750.49	358.7	783.64	529.26	147.27	494.94
	45.4	449.66	381.5	328.77	433.69	737.36	351.02	485.27	596.94	616.91	758.72	328.77	737.36	486.79	137.18	449.66
	52.7	348.86	292.82	244.55	347.46	611.57	283.34	341.73	427.02	440.87	760.92	244.55	611.57	370.91	110.44	347.46
	122.1	221.64	184.45	146.96	244.26	442.53	193.09	192.79	248.17	251.12	757.31	146.96	442.53	236.11	84.85	221.64
	150.0	198.52	164.83	130.56	223.84	409.66	176.12	169	219.45	218.76	754.66	130.56	409.66	212.3	80.22	198.52
		206.74	169.91	135.38	234	426.64	185	180.24	230.61	234.49	742.01	135.38	426.64	222.56	83.53	206.74
Annealing		411.15	344.25	293.64	459.34	767.16	376.08	392.81	491.27	501.32	746.08	293.64	767.16	448.56	137.33	411.15
	min	198.52	164.83	130.56	223.84	409.66	176.12	169	219.45	218.76	742.013					
	max	680.09	591.19	522.06	648.53	1044.4	524.94	777.17	937.73	970.66	773.697					
	avg	403.9	343.29	293.06	406	688.1	327.54	420.21	518.82	532.98	755.959					
	st dev	177.57	157.15	144.39	156.26	233.51	128.32	225.69	267.62	278.46	9.265					
	median	411.15	344.25	293.64	433.69	737.36	351.02	392.81	491.27	501.32	757.307					

Lim min	200.00 [%]
Lim max	1,000.00 [%]

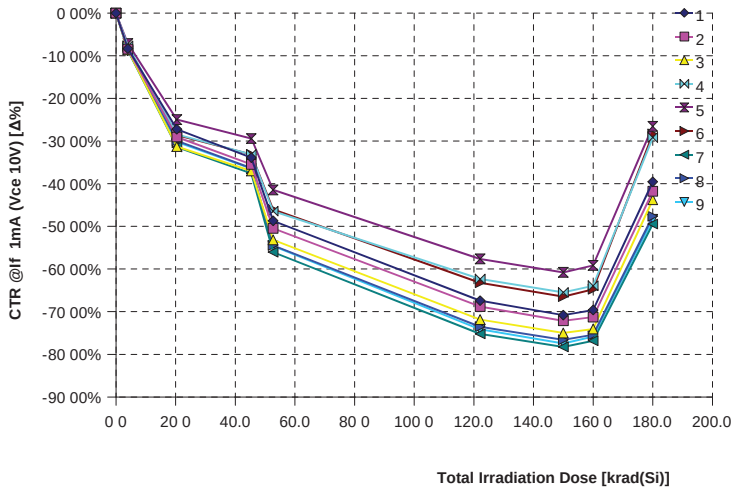
estimated uncertainty ± *5.97 [%]*

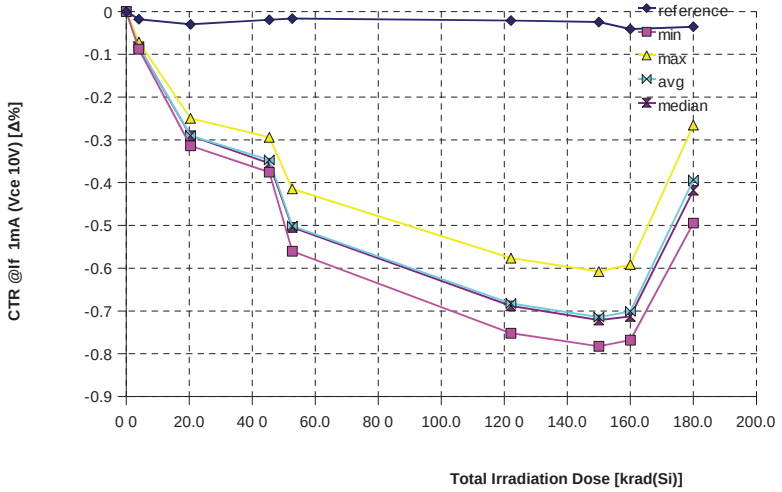




Parameter No: 17 : CTR @If 1mA (Vce 10V) Schedule: 2 of 2	APPENDIX A

CTR @If 1mA (Vce 10V) [Δ%]	s/n	1	2	3	4	5	6	7	8	9	10	min	max	avg	st dev	median
	krad(Si)	If=1mA	If=1mA	If=1mA	If=10mA	If=10mA	If=10mA	unbiased	unbiased	unbiased	reference					
	0.0	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0	0
	4.0	-8.31%	-8.46%	-8.65%	-7.67%	-7.13%	-7.88%	-8.70%	-8.18%	-8.80%	-1.80%	-8.80%	-7.13%	-8.20%	0.55%	-8.31%
	20.4	-27.22%	-29.05%	-31.29%	-28.44%	-24 97%	-28 62%	-31 38%	-29 92%	-30 21%	-3 00%	-31.38%	-24.97%	-29.01%	2.03%	-29.05%
	45.4	-33 88%	-35.47%	-37 03%	-33.13%	-29.40%	-33.13%	-37 56%	-36 34%	-36.44%	-1 94%	-37.56%	-29.40%	-34.71%	2.59%	-35.47%
	52.7	-48.70%	-50.47%	-53.16%	-46.42%	-41.44%	-46.03%	-56 03%	-54.46%	-54 58%	-1 65%	-56.03%	-41.44%	-50.14%	4.88%	-50.47%
	122.1	-67.41%	-68.80%	-71.85%	-62.34%	-57 63%	-63 22%	-75.19%	-73 54%	-74.13%	-2.12%	-75.19%	-57.63%	-68.23%	6.10%	-68.80%
	150.0	-70.81%	-72.12%	-74.99%	-65.48%	-60.78%	-66.45%	-78 25%	-76 60%	-77.46%	-2.46%	-78.25%	-60.78%	-71.44%	6.09%	-72.12%
		-69.60%	-71.26%	-74 07%	-63 92%	-59.15%	-64.76%	-76 81%	-75.41%	-75 84%	-4.10%	-76.81%	-59.15%	-70.09%	6.23%	-71.26%
		-39 54%	-41.77%	-43.75%	-29.17%	-26.55%	-28.36%	-49.46%	-47 61%	-48 35%	-3 57%	-49.46%	-26.55%	-39.40%	9.12%	-41.77%
	min	-70.81%	-72.12%	-74.99%	-65.48%	-60.78%	-66.45%	-78 25%	-76 60%	-77.46%	-4.10%					
	max	0.00%	0.00%	0.00%	0.00%	0 00%	0 00%	0 00%	0 00%	0 00%	0.00%					
	avg	-40.61%	-41.93%	-43.86%	-37.40%	-34.12%	-37 60%	-45 93%	-44 67%	-45 09%	-2.29%					
	st dev	26.11%	26.58%	27.66%	24.09%	22.36%	24.44%	29 04%	28 54%	28 69%	1.20%					
	median	-39 54%	-41.77%	-43.75%	-33.13%	-29.40%	-33.13%	-49.46%	-47 61%	-48 35%	-2.12%					
	Lim min	-100.00%														
	Lim max	100.00%														



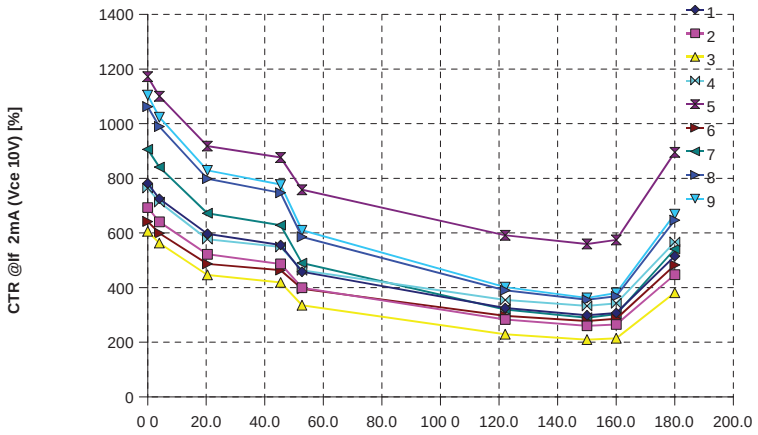


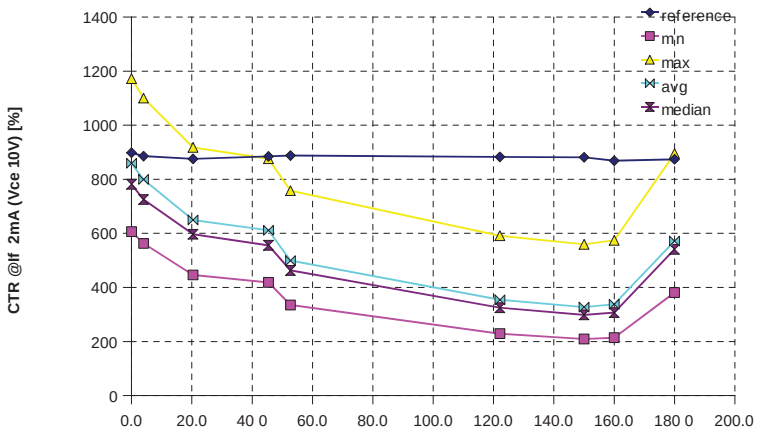
Parameter No: 18 : CTR @If 2mA (Vce 10V) Schedule: 1 of 2	APPENDIX A

CTR @If 2mA (Vce 10V) [%]	s/n	1	2	3	4	5	6	7	8	9	10	min	max	avg	st dev	median
	krad(Si)	If=1mA	If=1mA	If=1mA	If=10mA	If=10mA	If=10mA	unbiased	unbiased	unbiased	reference					
	0.0	781.62	692.82	606.1	763.98	1172.23	641.69	906.06	1062.25	1104.28	897.96	606.1	1172.23	859	210.83	781.62
	4.0	725.28	640.39	562.81	712.96	1100.22	598.79	840.85	989.38	1023.42	885.63	562.81	1100.22	799.34	197.79	725.28
	20.4	596.76	521.78	446.16	577	917.97	486.63	671.87	798.4	828.9	875.44	446.16	917.97	649.49	165.51	596.76
	45.4	555.82	486.44	418.69	548.52	876.13	463.96	628.25	746.8	777.08	884.79	418.69	876.13	611.3	157.19	555.82
	52.7	457.83	399.15	335.25	463.11	757.96	395.15	489.55	585.44	609.78	887.84	335.25	757.96	499.25	131.08	463.11
	122.1	325.06	283.03	229.13	354.48	591.22	296.5	319.57	389.98	401.54	882.59	229.13	591.22	354.5	103.55	325.06
	150.0	298.65	259.86	209.34	332.74	559.45	277.53	289.66	355.37	362.18	881.28	209.34	559.45	327.2	99.44	298.65
		306.82	264.6	214.2	342.39	574.52	286.07	302.63	368.07	380.28	868.46	214.2	574.52	337.73	102.64	306.82
Annealing		515.38	446.96	381.17	566.93	895.06	482.51	541.1	646.59	668.96	873.92	381.17	895.06	571.63	151.48	541.1
	min	298.65	259.86	209.34	332.74	559.45	277.53	289.66	355.37	362.18	868.455					
	max	781.62	692.82	606.1	763.98	1172.23	641.69	906.06	1062.25	1104.28	897.955					
	avg	507.02	443.89	378.09	518.01	827.19	436.54	554.39	660.25	684.05	881.988					
	st dev	177.68	159.04	146.53	158.21	224.95	133.71	228.57	263.07	274.51	8.676					
	median	515.38	446.96	381.17	548.52	876.13	463.96	541.1	646.59	668.96	882.585					

Lim min	200.00 [%]
Lim max	1,000.00 [%]

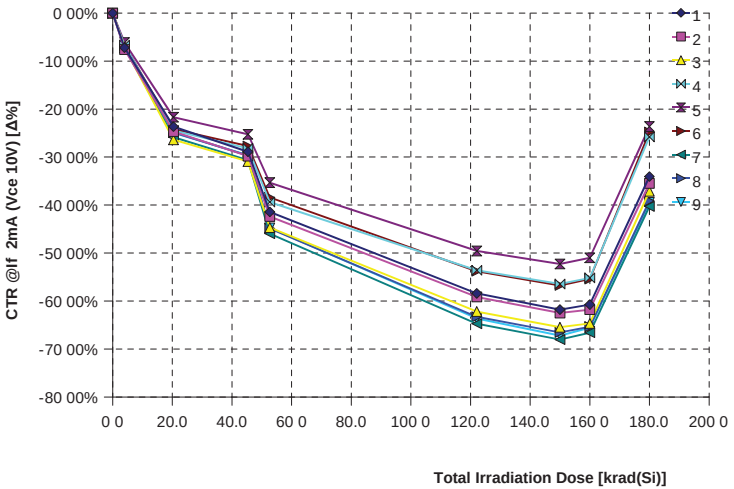
estimated uncertainty ± *5.59 [%]*

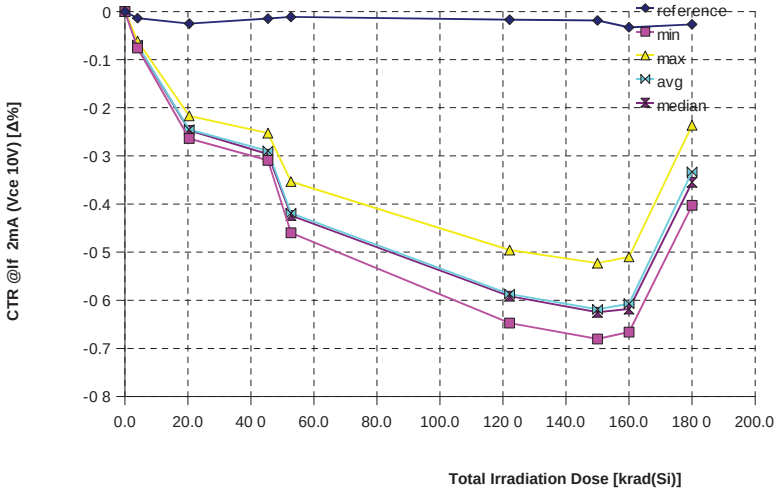




Parameter No: 18 : CTR @If 2mA (Vce 10V) Schedule: 2 of 2	APPENDIX A

CTR @If 2mA (Vce 10V) [Δ%]	s/n	1	2	3	4	5	6	7	8	9	10	min	max	avg	st dev	median
	krad(Si)	If=1mA	If=1mA	If=1mA	If=10mA	If=10mA	If=10mA	unbiased	unbiased	unbiased	reference					
0.0		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0	0
4.0		-7.21%	-7.57%	-7.14%	-6.68%	-6.14%	-6.68%	-7.20%	-6.86%	-7.32%	-1.37%	-7.57%	-6.14%	-6.98%	0.43%	-7.14%
20.4		-23.65%	-24.69%	-26.39%	-24.47%	-21.69%	-24.16%	-25.85%	-24 84%	-24 94%	-2 51%	-26.39%	-21.69%	-24.52%	1.34%	-24.69%
45.4		-28.89%	-29.79%	-30.92%	-28.20%	-25.26%	-27.70%	-30.66%	-29.70%	-29 63%	-1.47%	-30.92%	-25.26%	-28.97%	1.74%	-29.63%
52.7		-41.43%	-42.39%	-44.69%	-39.38%	-35.34%	-38.42%	-45.97%	-44.89%	-44.78%	-1.13%	-45.97%	-35.34%	-41.92%	3.60%	-42.39%
122.1		-58.41%	-59.15%	-62.20%	-53.60%	-49.56%	-53.79%	-64.73%	-63.29%	-63.64%	-1.71%	-64.73%	-49.56%	-58.71%	5.34%	-59.15%
150.0		-61.79%	-62.49%	-65.46%	-56.45%	-52.27%	-56.75%	-68.03%	-66 55%	-67 20%	-1 86%	-68.03%	-52.27%	-61.89%	5.58%	-62.49%
		-60.75%	-61.81%	-64.66%	-55.18%	-50.99%	-55.42%	-66.60%	-65 35%	-65 56%	-3 29%	-66.60%	-50.99%	-60.70%	5.59%	-61.81%
		-34.06%	-35.49%	-37.11%	-25.79%	-23 64%	-24 81%	-40.28%	-39.13%	-39.42%	-2.68%	-40.28%	-23.64%	-33.30%	6.73%	-35.49%
min		-61.79%	-62.49%	-65.46%	-56.45%	-52.27%	-56.75%	-68.03%	-66 55%	-67 20%	-3.29%					
max		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%					
avg		-35.13%	-35.93%	-37.62%	-32.20%	-29.43%	-31 97%	-38.81%	-37.84%	-38 05%	-1.78%					
st dev		22.73%	22.96%	24.18%	20.71%	19.19%	20.84%	25.23%	24.77%	24.86%	0.97%					
median		-34.06%	-35.49%	-37.11%	-28.20%	-25.26%	-27.70%	-40.28%	-39.13%	-39.42%	-1.71%					
Lim min		-100.00%														
Lim max		100.00%														



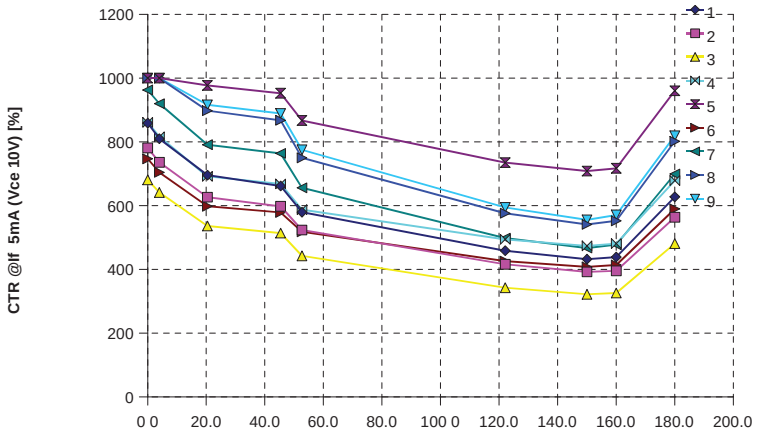


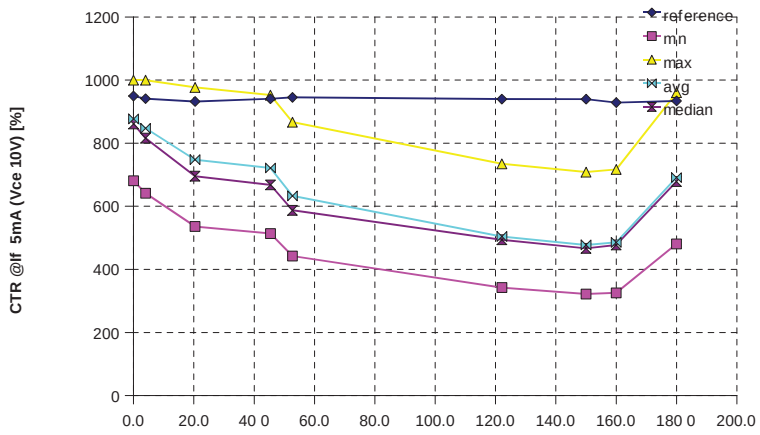
Parameter No: 19 : CTR @If 5mA (Vce 10V) Schedule: 1 of 2	APPENDIX A

CTR @If 5mA (Vce 10V) [%]	s/n	1	2	3	4	5	6	7	8	9	10	min	max	avg	st dev	median
	krad(Si)	If=1mA	If=1mA	If=1mA	If=10mA	If=10mA	If=10mA	unbiased	unbiased	unbiased	reference					
	0.0	858.91	780.86	681.14	861.06	999.99	746.83	962.89	999.98	999.98	949.55	681.14	999.99	876.85	121.39	861.06
	4.0	809.82	735.84	641.31	816.02	999.97	704.5	919.92	999.95	999.96	941.24	641.31	999.97	847.48	138.21	816.02
	20.4	695.54	626.54	536.04	691.73	977.13	598.09	791.15	897.88	916.3	932.39	536.04	977.13	747.82	155.41	695.54
	45.4	661.61	597.66	513.85	668.02	952.7	578.57	763.78	867.66	889.29	940.96	513.85	952.7	721.46	154.15	668.02
	52.7	579.19	523.29	442.33	587.48	866.98	517.71	655.77	749.84	774.9	945.39	442.33	866.98	633.05	139.51	587.48
	122.1	458 5	415.78	342.42	493.96	734.88	425.68	498.12	575.92	594.19	939.86	342.42	734.88	504.38	116.64	493.96
	150.0	432.05	392.06	321.96	473.58	708.5	407.46	466.69	540.95	555.24	939.72	321.96	708.5	477.61	112.93	466.69
		438.54	395.27	325.76	480.82	716.97	413.69	477.55	552.09	570.59	928.86	325.76	716.97	485.7	115.3	477.55
Annealing		627.38	563.53	480.96	678.7	960.27	589.62	699.2	801.56	818.99	934.11	480.96	960.27	691.14	148.33	678.7
	min	432.05	392.06	321.96	473.58	708.5	407.46	466.69	540.95	555.24	928.864					
	max	858.91	780.86	681.14	861.06	999.99	746.83	962.89	999.98	999.98	949.550					
	avg	617.95	558.98	476.2	639.04	879.71	553.57	692.79	776.2	791.05	939.120					
	st dev	156.75	142.76	132.17	142.27	126.08	123.79	185.75	183.82	179.11	6.447					
	median	627.38	563.53	480.96	668.02	952.7	578.57	699.2	801.56	818.99	939.864					

Lim min	200.00 [%]
Lim max	1,000.00 [%]

estimated uncertainty ± *4.15 [%]*



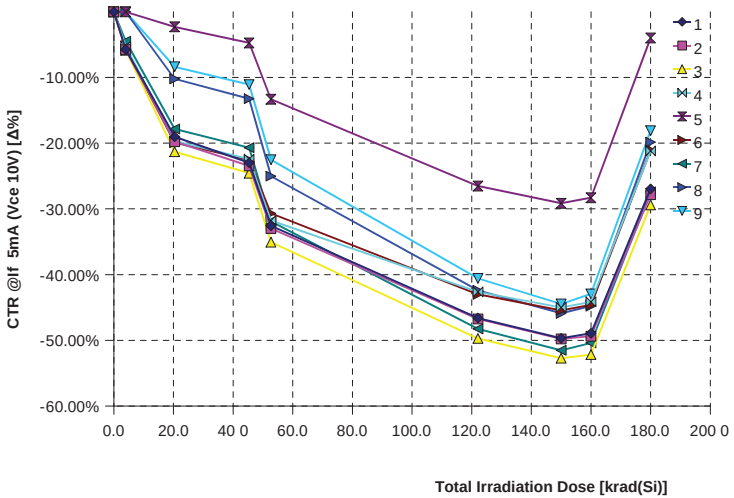


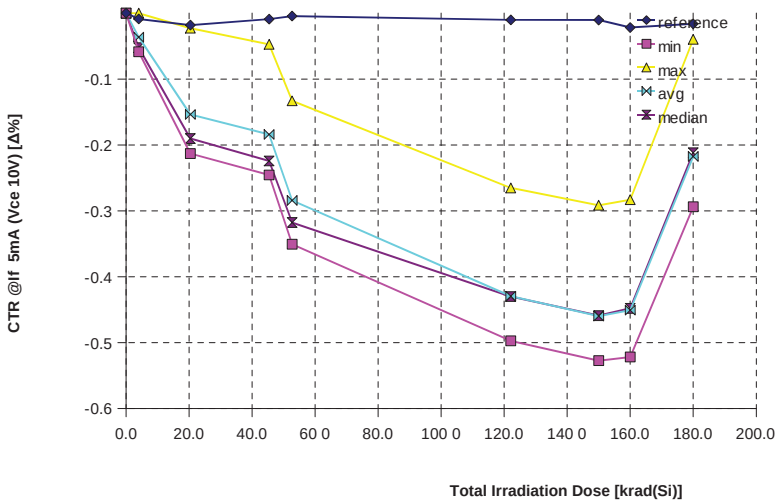
Parameter No: 19 : CTR @If 5mA (Vce 10V) Schedule: 2 of 2	APPENDIX A

CTR @If 5mA (Vce 10V) [Δ%]

s/n	1	2	3	4	5	6	7	8	9	10	min	max	avg	st dev	median
krad(Si)	If=1mA	If=1mA	If=1mA	If=10mA	If=10mA	If=10mA	unbiased	unbiased	unbiased	reference					
0.0	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0	0
4.0	-5.72%	-5.77%	-5.85%	-5.23%	0.00%	-5.67%	-4.46%	0.00%	0.00%	-0.88%	-5.85%	0.00%	-3.63%	2.75%	-5.23%
20.4	-19.02%	-19.76%	-21.30%	-19.67%	-2.29%	-19.92%	-17.84%	-10.21%	-8.37%	-1.81%	-21.30%	-2.29%	-15.37%	6.71%	-19.02%
45.4	-22.97%	-23.46%	-24.56%	-22.42%	-4.73%	-22.53%	-20.68%	-13.23%	-11.07%	-0.91%	-24.56%	-4.73%	-18.41%	6.98%	-22.42%
52.7	-32.57%	-32.99%	-35.06%	-31.77%	-13.30%	-30.68%	-31.90%	-25.01%	-22.51%	-0.44%	-35.06%	-13.30%	-28.42%	6.94%	-31.77%
122.1	-46.62%	-46.75%	-49.73%	-42.63%	-26.51%	-43.00%	-48.27%	-42.41%	-40.58%	-1.02%	-49.73%	-26.51%	-42.94%	6.88%	-43.00%
150.0	-49.70%	-49.79%	-52.73%	-45.00%	-29.15%	-45.44%	-51.53%	-45.90%	-44.48%	-1.04%	-52.73%	-29.15%	-45.97%	7.00%	-45.90%
	-48.94%	-49.38%	-52.17%	-44.16%	-28.30%	-44.61%	-50.40%	-44.79%	-42.94%	-2.18%	-52.17%	-28.30%	-45.08%	7.07%	-44.79%
	-26.96%	-27.83%	-29.39%	-21.18%	-3.97%	-21.05%	-27.38%	-19.84%	-18.10%	-1.63%	-29.39%	-3.97%	-21.74%	7.81%	-21.18%
min	-49.70%	-49.79%	-52.73%	-45.00%	-29.15%	-45.44%	-51.53%	-45.90%	-44.48%	-2.18%					
max	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%					
avg	-28.05%	-28.41%	-30.09%	-25.78%	-12.03%	-25.88%	-28.05%	-22.38%	-20.89%	-1.10%					
st dev	18.25%	18.28%	19.40%	16.52%	12.61%	16.58%	19.29%	18.38%	17.91%	0.68%					
median	-26.96%	-27.83%	-29.39%	-22.42%	-4.73%	-22.53%	-27.38%	-19.84%	-18.10%	-1.02%					

Lim min	-100.00%
Lim max	100.00%

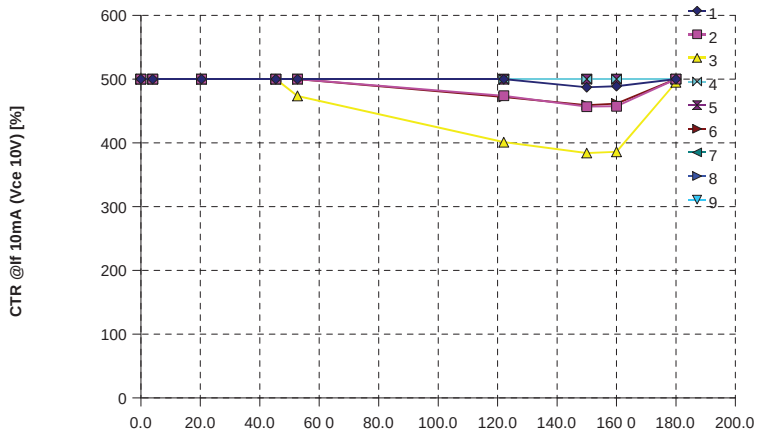




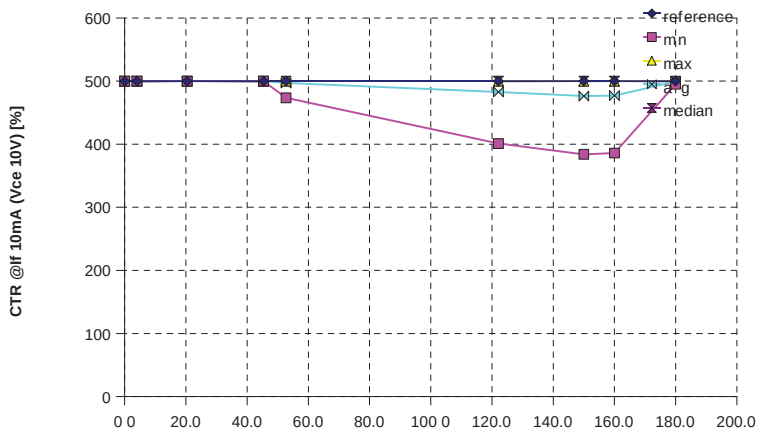
Parameter No: 20 : CTR @If 10mA (Vce 10V) Schedule: 1 of 2	APPENDIX A

CTR @If 10mA (Vce 10V) [%]	s/n	1	2	3	4	5	6	7	8	9	10	min	max	avg	st dev	median
	krad(Si)	If=1mA	If=1mA	If=1mA	If=10mA	If=10mA	If=10mA	unbiased	unbiased	unbiased	reference					
	0.0	499.99	499.99	499.99	499.99	499.99	499.99	499.99	499.99	499.99	499.99	499.99	499.99	499.99	0	499.99
	4.0	499.98	499.98	499.99	499.98	499.98	499.98	499.98	499.98	499.99	499.98	499.98	499.99	499.98	0	499.98
	20.4	500.03	500.02	500.02	500.02	500.02	500.02	500.01	500.01	500.01	500.02	500.01	500.03	500.02	0.01	500.02
	45.4	499.99	499.99	499.99	499.99	499.99	499.99	499.99	499.99	499.99	499.99	499.99	499.99	499.99	0	499.99
	52.7	499.99	500	473 6	499.99	499.99	499.99	499.99	499.99	499.99	499.99	473.6	500	497.06	8.8	499.99
	122.1	499.98	473.91	401.15	499.96	499.96	471.95	499.95	499.94	499.94	499.94	401.15	499.98	482.97	32.84	499.94
	150.0	487.21	456.86	384	500	500	459.16	500	500	500	500	384	500	476.36	38.92	500
		488.92	457.45	385.98	500.02	500.02	461.6	500.02	500.01	500.01	500.01	385.98	500.02	477.11	38.23	500.01
Annealing		499.99	499.99	495.01	499.99	499.99	499.99	499.99	499.99	499.99	500	495.01	499.99	499.44	1.66	499.99
	min	487.21	456.86	384	499.96	499.96	459.16	499.95	499.94	499.94	499.935					
	max	500.03	500.02	500.02	500.02	500.02	500.02	500.02	500.01	500.01	500.021					
	avg	497.34	487.58	459.97	499.99	499.99	488.08	499.99	499.99	499.99	499.991					
	st dev	5.28	19.25	53.07	0.02	0.02	18.2	0.02	0.02	0.02	0.024					
	median	499.99	499.99	495.01	499.99	499.99	499.99	499.99	499.99	499.99	499.994					

Lim min	200.00 [%]
Lim max	1,000.00 [%]

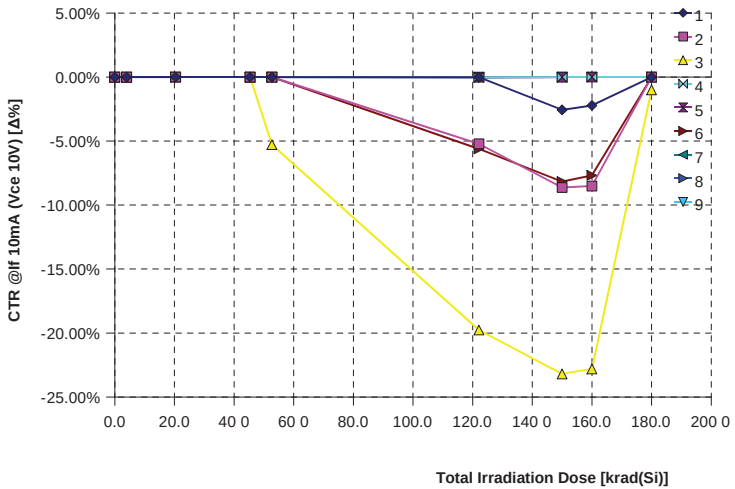


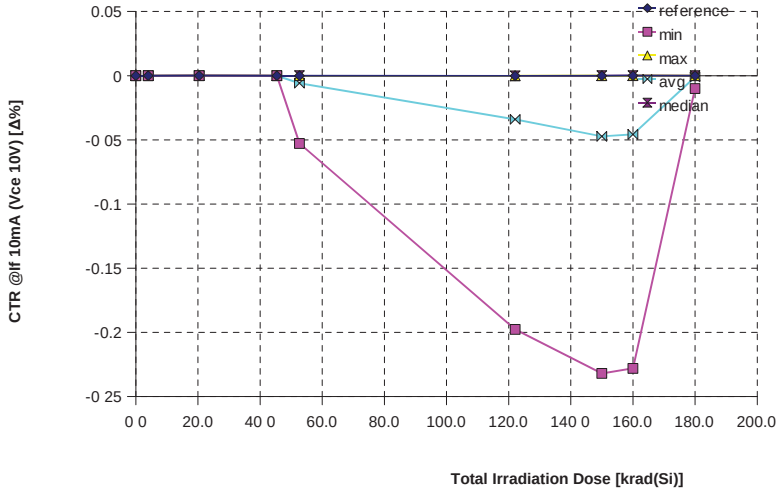
estimated uncertainty ± *0.02 [%]*



Parameter No: 20 : CTR @If 10mA (Vce 10V) Schedule: 2 of 2	APPENDIX A

CTR @If 10mA (Vce 10V) [Δ%]	s/n	1	2	3	4	5	6	7	8	9	10	min	max	avg	st dev	median
	krad(Si)	If=1mA	If=1mA	If=1mA	If=10mA	If=10mA	If=10mA	unbiased	unbiased	unbiased	reference					
	0.0	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0	0
	4.0	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	20.4	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.00%	0.00%	0.00%	0.01%	0.00%	0.01%	0.01%	0.00%	0.01%
	45.4	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	52.7	0.00%	0.00%	-5.28%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	-5.28%	0.00%	-0.59%	1.76%	0.00%
	122.1	0.00%	-5.22%	-19.77%	-0.01%	-0.01%	-5.61%	-0.01%	-0.01%	-0.01%	-0.01%	-19.77%	0.00%	-3.40%	6.57%	-0.01%
	150.0	-2.56%	-8.63%	-23.20%	0.00%	0.00%	-8.17%	0.00%	0.00%	0.00%	0.00%	-23.20%	0.00%	-4.73%	7.78%	0.00%
		-2.22%	-8.51%	-22.80%	0.01%	0.01%	-7.68%	0.01%	0.00%	0.00%	0.00%	-22.80%	0.01%	-4.58%	7.65%	0.00%
		0.00%	0.00%	-1.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	-1.00%	0.00%	-0.11%	0.33%	0.00%
	min	-2.56%	-8.63%	-23.20%	-0.01%	-0.01%	-8.17%	-0.01%	-0.01%	-0.01%	-0.01%					
	max	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.00%	0.00%	0.01%					
	avg	-0.53%	-2.48%	-8.00%	0.00%	0.00%	-2.38%	0.00%	0.00%	0.00%	0.00%					
	st dev	1.06%	3.85%	10.61%	0.00%	0.00%	3.64%	0.00%	0.00%	0.00%	0.00%					
	median	0.00%	0.00%	-1.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%					
	Lim min	-100.00%														
	Lim max	100.00%														

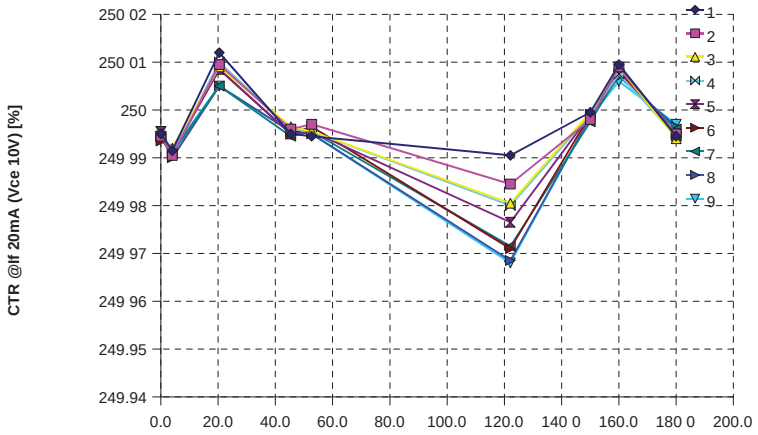




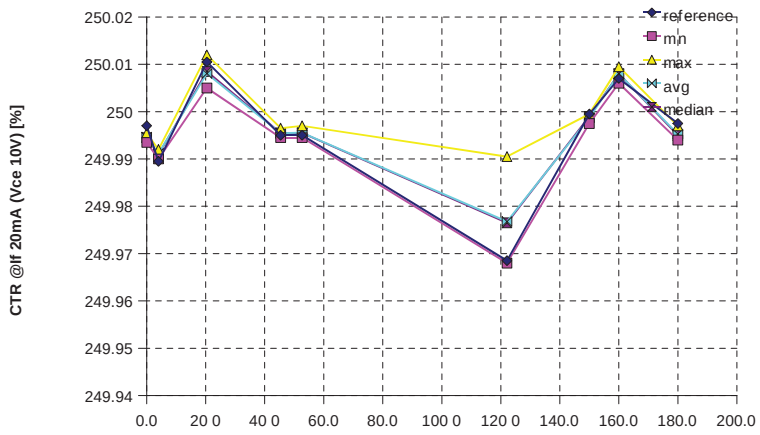
Parameter No: 21 : CTR @If 20mA (Vce 10V) Schedule: 1 of 2	APPENDIX A

CTR @If 20mA (Vce 10V) [%]	s/n	1	2	3	4	5	6	7	8	9	10	min	max	avg	st dev	median
	krad(Si)	If=1mA	If=1mA	If=1mA	If=10mA	If=10mA	If=10mA	unbiased	unbiased	unbiased	reference					
	0.0	250	249.99	249.99	249.99	250	249.99	249.99	249.99	250	250	249.99	250	249.99	0	249.99
	4.0	249.99	249.99	249.99	249.99	249.99	249.99	249.99	249.99	249.99	249.99	249.99	249.99	249.99	0	249.99
	20.4	250.01	250.01	250.01	250.01	250.01	250.01	250.01	250.01	250.01	250.01	250.01	250.01	250.01	0	250.01
	45.4	250	250	250	250	250	250	249.99	250	250	250	249.99	250	250	0	250
	52.7	249.99	250	250	250	250	250	250	250	250	250	249.99	250	250	0	250
	122.1	249.99	249.98	249.98	249.98	249.98	249.97	249.97	249.97	249.97	249.97	249.97	249.99	249.98	0.01	249.98
	150.0	250	250	250	250	250	250	250	250	250	250	250	250	250	0	250
		250.01	250.01	250.01	250.01	250.01	250.01	250.01	250.01	250.01	250.01	250.01	250.01	250.01	0	250.01
Annealing		249.99	250	249.99	249.99	250	250	250	250	250	250	249.99	250	250	0	250
	min	249.99	249.98	249.98	249.98	249.98	249.97	249.97	249.97	249.97	249.969					
	max	250.01	250.01	250.01	250.01	250.01	250.01	250.01	250.01	250.01	250.011					
	avg	250	250	250	250	250	250	249.99	249.99	249.99	249.996					
	st dev	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.012					
	median	250	250	250	250	250	250	250	250	250	249.997					

Lim min	200.00 [%]
Lim max	1,000.00 [%]



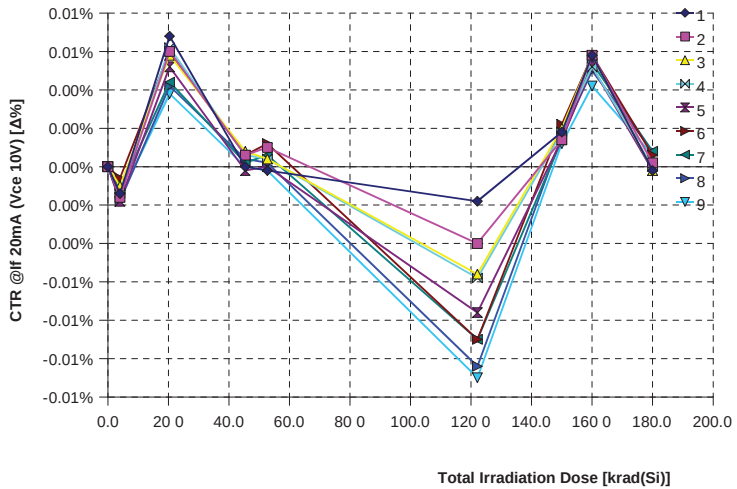
estimated uncertainty ± *0.01 [%]*

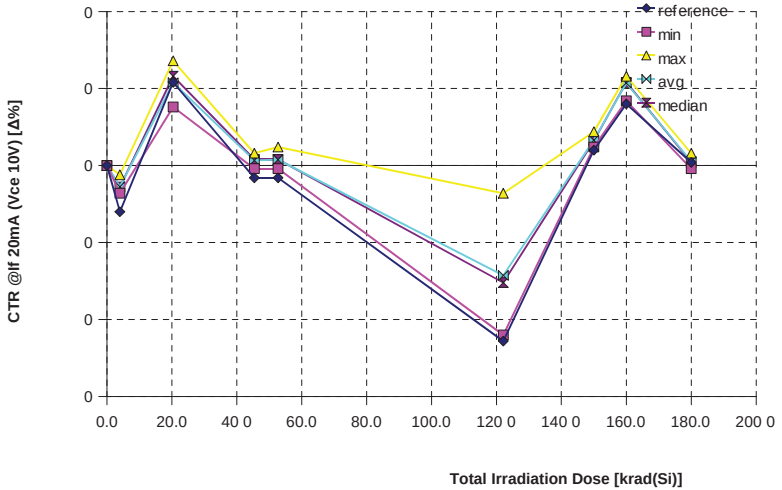


Parameter No: 21 : CTR @If 20mA (Vce 10V) Schedule: 2 of 2	APPENDIX A

CTR @If 20mA (Vce 10V) [Δ%]	s/n	1	2	3	4	5	6	7	8	9	10	min	max	avg	st dev	median
	krad(Si)	If=1mA	If=1mA	If=1mA	If=10mA	If=10mA	If=10mA	unbiased	unbiased	unbiased	reference					
	0.0	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0.00%	0.00%	0.00%	0	0
	4.0	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0.00%	0.00%	0.00%	0.00%	0.00%
	20.4	0 01%	0 01%	0 01%	0 01%	0 01%	0 01%	0 00%	0 00%	0 00%	0 01%	0.00%	0.01%	0.01%	0.00%	0.01%
	45.4	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0.00%	0.00%	0.00%	0.00%	0.00%
	52.7	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0.00%	0.00%	0.00%	0.00%	0.00%
	122.1	0 00%	0 00%	-0 01%	-0 01%	-0 01%	-0 01%	-0 01%	-0 01%	-0 01%	-0 01%	-0.01%	0.00%	-0.01%	0.00%	-0.01%
	150.0	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0.00%	0.00%	0.00%	0.00%	0.00%
		0 01%	0 01%	0 01%	0 01%	0 01%	0 01%	0 01%	0 01%	0 00%	0 00%	0.00%	0.01%	0.01%	0.00%	0.01%
		0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0.00%	0.00%	0.00%	0.00%	0.00%
	min	0 00%	0 00%	-0 01%	-0 01%	-0 01%	-0 01%	-0 01%	-0 01%	-0 01%	-0.01%					
	max	0 01%	0 01%	0 01%	0 01%	0 01%	0 01%	0 01%	0 01%	0 00%	0.01%					
	avg	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0.00%					
	st dev	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0.00%					
	median	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0.00%					

Lim min	-100.00%
Lim max	100.00%



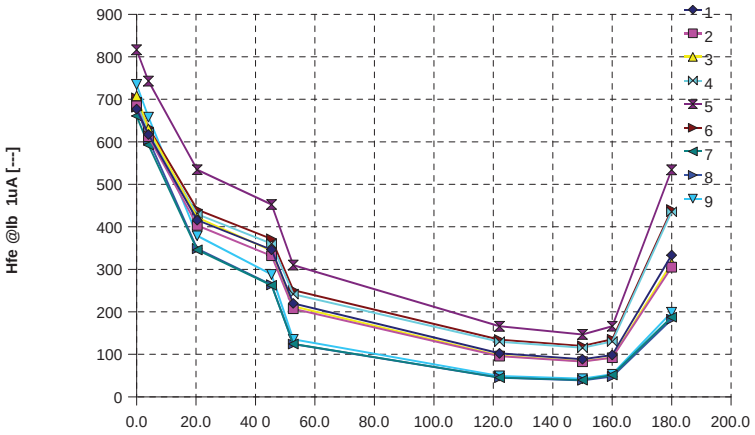


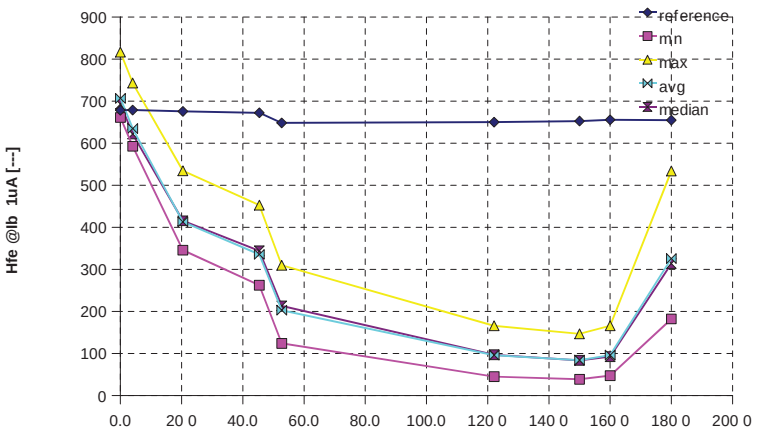
Parameter No: 22 : Hfe @Ib 1uA (Vce = 5 V) [J] Schedule: 1 of 2	APPENDIX A

Hfe @Ib 1uA	s/n	1	2	3	4	5	6	7	8	9	10	min	max	avg	st dev	median
[---]	krad(Si)	If=1mA	If=1mA	If=1mA	If=10mA	If=10mA	If=10mA	unbiased	unbiased	unbiased	reference					
	0.0	677.16	684.74	708.16	692 95	816 62	703 03	661.14	681.35	735.29	678.44	661.14	816.62	706.72	46.34	692.95
	4.0	617 36	612.18	630 64	621.86	742.95	633.67	592.67	605.17	658.18	678.78	592.67	742.95	634.96	44.58	621.86
	20.4	415.56	403.35	422.06	429.71	534.42	440.32	345.73	348.27	378.86	675.62	345.73	534.42	413.14	56.82	415.56
	45.4	346.17	331 9	343.98	360.39	452.65	371.48	262.29	263.71	288.04	672.15	262.29	452.65	335.62	59.8	343.98
	52.7	219 88	207 21	213 3	241.59	309.93	251.11	124.45	124.07	135.43	648.25	124.07	309.93	203	63.85	213.3
	122.1	102 35	95.72	96 96	129 58	165 95	134.4	45.27	45.1	49.16	650 06	45.1	165.95	96.05	43.15	96.96
	150.0	88 51	82 88	83.76	115.27	146.84	119.76	39.36	38.76	42.81	652 63	38.76	146.84	84.22	38.67	83.76
		98.45	91.98	92 5	130.11	166.07	135.35	51.39	47.45	53.01	655 67	47.45	166.07	96.26	41.61	92.5
Annealing		333.49	305	313.87	435.45	534.08	440.39	187.33	182.33	199.11	654.79	182.33	534.08	325.67	124.99	313.87
	min	88 51	82 88	83.76	115.27	146.84	119.76	39.36	38.76	42.81	648.250					
	max	677.16	684.74	708.16	692.95	816.62	703.03	661.14	681.35	735.29	678.781					
	avg	322.1	312.77	322 8	350.77	429.94	358.84	256.62	259.58	282.21	662.932					
	st dev	219.66	222 62	230 98	214.79	250.91	216.95	234.73	242 2	261.87	12.962					
	median	333.49	305	313 87	360.39	452.65	371.48	187.33	182.33	199.11	655.665					

Lim min	50.00 [---]
Lim max	1,000.00 [---]

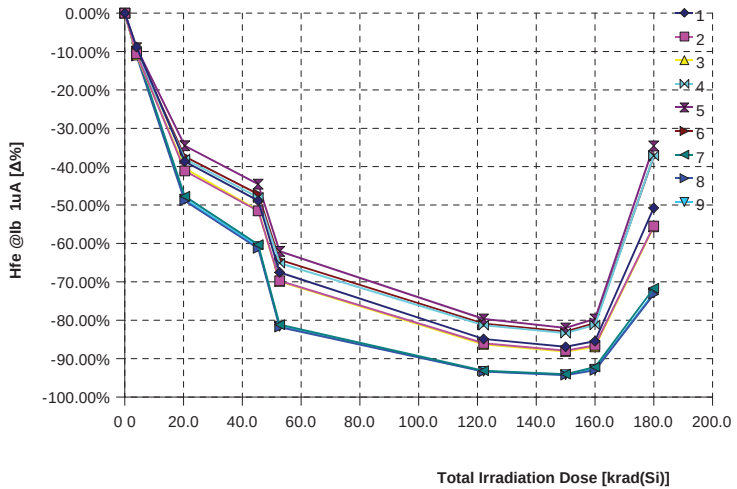
estimated uncertainty ± *8.35 [---]*

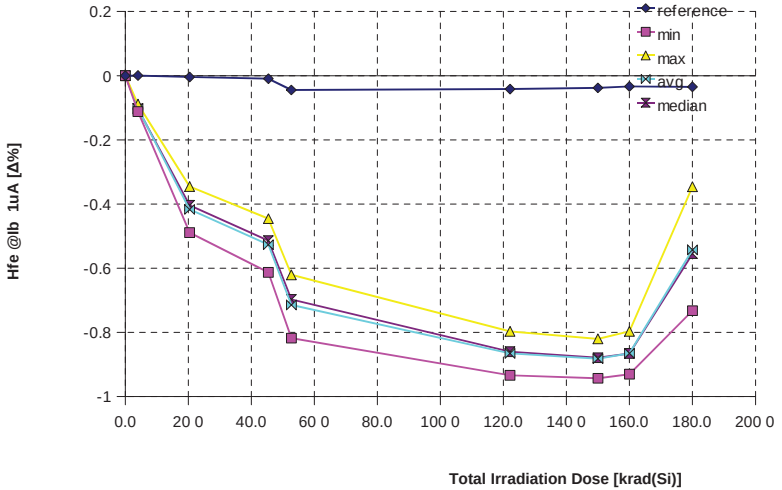




Parameter No: 22 : Hfe @Ib 1uA (Vce = 5 V) [J] Schedule: 2 of 2	APPENDIX A

Hfe @Ib 1uA	s/n	1	2	3	4	5	6	7	8	9	10	min	max	avg	st dev	median
[Δ%]	krad(Si)	If=1mA	If=1mA	If=1mA	If=10mA	If=10mA	If=10mA	unbiased	unbiased	unbiased	reference					
	0.0	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0	0
	4.0	-8.83%	-10.60%	-10.95%	-10.26%	-9.02%	-9.87%	-10.36%	-11.18%	-10.49%	0.05%	-11.18%	-8.83%	-10.17%	0.80%	-10.36%
	20.4	-38.63%	-41.09%	-40.40%	-37.99%	-34.56%	-37.37%	-47.71%	-48.89%	-48.48%	-0.42%	-48.89%	-34.56%	-41.68%	5.35%	-40.40%
	45.4	-48.88%	-51.53%	-51.43%	-47.99%	-44.57%	-47.16%	-60.33%	-61.30%	-60.83%	-0.93%	-61.30%	-44.57%	-52.67%	6.47%	-51.43%
	52.7	-67.53%	-69.74%	-69.88%	-65.14%	-62.05%	-64.28%	-81.18%	-81.79%	-81.58%	-4.45%	-81.79%	-62.05%	-71.46%	7.94%	-69.74%
	122.1	-84.89%	-86.02%	-86.31%	-81.30%	-79.68%	-80.88%	-93.15%	-93.38%	-93.31%	-4.18%	-93.38%	-79.68%	-86.55%	5.55%	-86.02%
	150.0	-86.93%	-87.90%	-88.17%	-83.37%	-82.02%	-82.96%	-94.05%	-94.31%	-94.18%	-3.80%	-94.31%	-82.02%	-88.21%	4.97%	-87.90%
		-85.46%	-86.57%	-86.94%	-81.22%	-79.66%	-80.75%	-92.23%	-93.04%	-92.79%	-3.36%	-93.04%	-79.66%	-86.52%	5.29%	-86.57%
		-50.75%	-55.46%	-55.68%	-37.16%	-34.60%	-37.36%	-71.67%	-73.24%	-72.92%	-3.49%	-73.24%	-34.60%	-54.31%	15.78%	-55.46%
	min	-86.93%	-87.90%	-88.17%	-83.37%	-82.02%	-82.96%	-94.05%	-94.31%	-94.18%	-4.45%					
	max	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.05%					
	avg	-52.43%	-54.32%	-54.42%	-49.38%	-47.35%	-48.96%	-61.18%	-61.90%	-61.62%	-2.29%					
	st dev	32.44%	32.51%	32.62%	31.00%	30.73%	30.86%	35.50%	35.55%	35.61%	1.91%					
	median	-50.75%	-55.46%	-55.68%	-47.99%	-44.57%	-47.16%	-71.67%	-73.24%	-72.92%	-3.36%					
	Lim min	-100.00%														
	Lim max	100.00%														



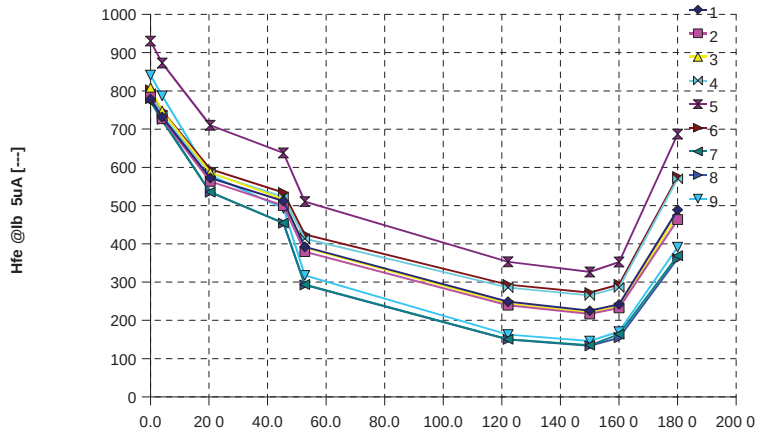


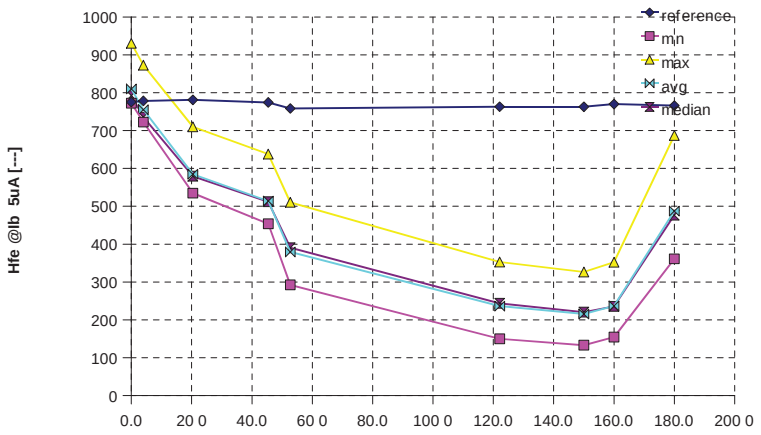
Parameter No: 23 : Hfe @Ib 5uA (Vce = 5 V) Schedule: 1 of 2	APPENDIX A

Hfe @Ib 5uA	s/n	1	2	3	4	5	6	7	8	9	10	min	max	avg	st dev	median
[---]	krad(Si)	If=1mA	If=1mA	If=1mA	If=10mA	If=10mA	If=10mA	unbiased	unbiased	unbiased	reference					
	0.0	778 34	783 85	808 28	792 33	930 31	802.41	772.49	779 68	841.11	775 27	772.49	930.31	809.87	49.79	792.33
	4.0	731 56	727 01	747 05	735 69	872 83	747.73	722.47	725.43	787.18	778 31	722.47	872.83	755.22	48.31	735.69
	20.4	572.46	563.44	586.71	585 02	710	595 32	535.43	534.74	579.49	781 05	534.74	710	584.73	51.68	579.49
	45.4	512 05	500.1	516.47	522.76	637.81	534.27	454.46	453.97	493.22	774.24	453.97	637.81	513.9	54.31	512.05
	52.7	392 28	379.45	390.46	413 51	510.46	424 58	293.76	292 39	317.71	758 51	292.39	510.46	379.4	70.16	390.46
	122.1	248.76	239 27	243.7	285.79	352 99	293 23	150 61	149 99	162.76	762 95	149.99	352.99	236.34	70.47	243.7
	150.0	225 29	216 64	220 34	265 24	326.49	272 36	134 83	133.16	145.96	762 81	133.16	326.49	215.59	67.33	220.34
		241 88	232.4	235.76	286	352.4	293.76	163.7	154 65	170 6	769 95	154.65	352.4	236.79	66.66	235.76
Annealing		488 87	463 39	476 69	570 3	687.11	575.81	369	361.26	391.41	765.98	361.26	687.11	487.09	108.63	476.69
	min	225 29	216 64	220 34	265 24	326.49	272 36	134 83	133.16	145.96	758.506					
	max	778 34	783 85	808 28	792 33	930 31	802.41	772.49	779 68	841.11	781.054					
	avg	465.72	456.17	469 5	495.18	597.82	504.39	399.64	398.36	432.16	769.898					
	st dev	207 02	210 53	218.45	196.14	226 32	197 31	241	244.46	263.72	7.800					
	median	488 87	463 39	476 69	522.76	637 81	534 27	369	361 26	391.41	769.954					

Lim min	50.00 [---]
Lim max	1,000.00 [---]

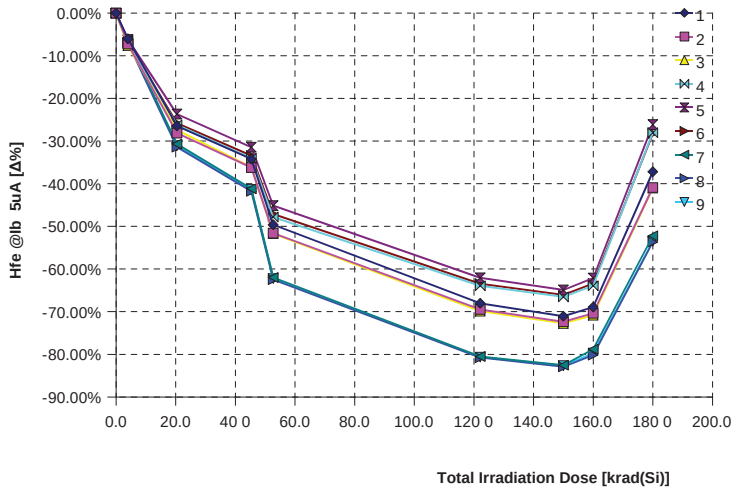
estimated uncertainty ± *5.03 [---]*

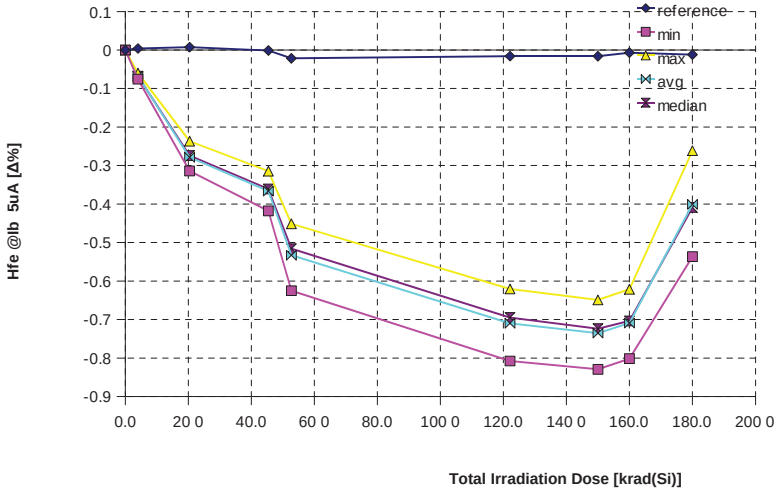




Parameter No: 23 : Hfe @Ib 5uA (Vce = 5 V) Schedule: 2 of 2	APPENDIX A

Hfe @Ib 5uA	s/n	1	2	3	4	5	6	7	8	9	10	min	max	avg	st dev	median
[Δ%]	krad(Si)	If=1mA	If=1mA	If=1mA	If=10mA	If=10mA	If=10mA	unbiased	unbiased	unbiased	reference					
	0.0	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0	0
	4.0	-6.01%	-7.25%	-7.58%	-7.15%	-6.18%	-6.81%	-6.47%	-6 96%	-6.41%	0 39%	-7.58%	-6.01%	-6.76%	0.52%	-6.81%
	20.4	-26.45%	-28.12%	-27.41%	-26.16%	-23.68%	-25.81%	-30.69%	-31.42%	-31.10%	0.75%	-31.42%	-23.68%	-27.87%	2.69%	-27.41%
	45.4	-34.21%	-36.20%	-36.10%	-34.02%	-31.44%	-33.42%	-41.17%	-41.78%	-41.36%	-0.13%	-41.78%	-31.44%	-36.63%	3.87%	-36.10%
	52.7	-49.60%	-51.59%	-51.69%	-47.81%	-45.13%	-47.09%	-61.97%	-62.50%	-62.23%	-2.16%	-62.50%	-45.13%	-53.29%	7.02%	-51.59%
	122.1	-68.04%	-69.47%	-69.85%	-63.93%	-62.06%	-63.46%	-80.50%	-80.76%	-80.65%	-1.59%	-80.76%	-62.06%	-70.97%	7.73%	-69.47%
	150.0	-71.06%	-72.36%	-72.74%	-66.52%	-64.90%	-66.06%	-82.55%	-82.92%	-82.65%	-1.61%	-82.92%	-64.90%	-73.53%	7.42%	-72.36%
		-68.92%	-70.35%	-70.83%	-63.90%	-62.12%	-63.39%	-78.81%	-80.16%	-79.72%	-0.69%	-80.16%	-62.12%	-70.91%	7.18%	-70.35%
		-37.19%	-40.88%	-41.02%	-28.02%	-26.14%	-28.24%	-52.23%	-53.67%	-53.47%	-1.20%	-53.67%	-26.14%	-40.10%	11.19%	-40.88%
	min	-71.06%	-72.36%	-72.74%	-66.52%	-64.90%	-66.06%	-82.55%	-82.92%	-82.65%	-2.16%					
	max	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.75%					
	avg	-40.17%	-41.80%	-41.91%	-37.50%	-35.74%	-37.14%	-48.27%	-48.91%	-48.62%	-0.69%					
	st dev	26.60%	26.86%	27.03%	24.75%	24.33%	24.59%	31.20%	31.35%	31.35%	1.01%					
	median	-37.19%	-40.88%	-41.02%	-34.02%	-31.44%	-33.42%	-52.23%	-53.67%	-53.47%	-0.69%					
	Lim min	-100.00%														
	Lim max	100.00%														





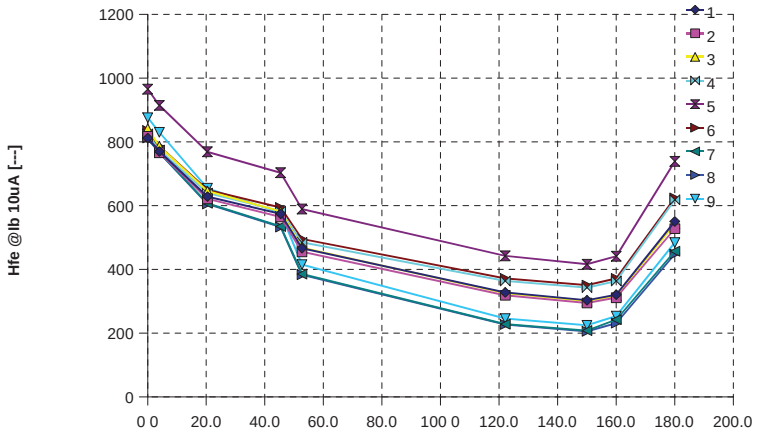
ISOCOM® LTD	Total Dose Test Report		Ref:	TID/IS0038
			Issue:	01
Part Type: IS49 (4N49)	Designation: Optocouplers	Specification: ESA/SCC No: 22900	Date:	21 November 2008
			Page:	49 of 58

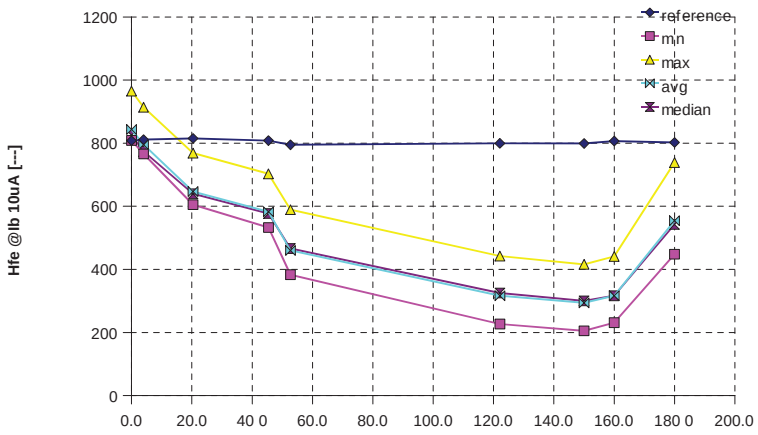
Parameter No: 24 : Hfe @Ib 10uA (Vce = 5 V) Schedule: 1 of 2	APPENDIX A

Hfe @Ib 10uA	s/n	1	2	3	4	5	6	7	8	9	10	min	max	avg	st dev	median
[---]	krad(Si)	If=1mA	If=1mA	If=1mA	If=10mA	If=10mA	If=10mA	unbiased	unbiased	unbiased	reference					
	0.0	811.84	817.07	841.23	825.38	965.54	835.04	809	812.19	875.81	807.94	809	965.54	843.68	50.27	825.38
	4.0	770.01	766.19	786.32	774.31	914.34	786.14	766.19	766.09	830.24	811.58	766.09	914.34	795.54	48.97	774.31
	20.4	628.17	621.21	645.52	639.67	768.86	649.53	607.45	605.19	654.44	815.37	605.19	768.86	646.67	49.11	639.67
	45.4	574.24	564.36	581.94	582.76	703.06	593.88	534.57	532.94	577.34	808.27	532.94	703.06	582.79	49.8	577.34
	52.7	466.25	455.13	468.18	484.55	589.4	495.38	385.28	383.17	415.04	795	383.17	589.4	460.26	63.48	466.25
	122.1	327.83	318 6	325.12	363.56	442.38	371.49	228.01	226.92	245.59	799.75	226.92	442.38	316.61	72.61	325.12
	150.0	303 2	294.46	300.35	342.76	416.02	350.56	207.85	205.43	224.3	799.23	205.43	416.02	293.88	71.34	300.35
		320.44	311.09	316.59	363.3	441.23	371.4	242.09	231.21	253.29	806.94	231.21	441.23	316.74	68.57	316.59
Annealing		550.3	527.75	542.62	618.15	738.92	623.8	457.01	448.08	483.92	802.6	448.08	738.92	554.5	93.24	542.62
	min	303 2	294.46	300.35	342.76	416.02	350.56	207.85	205.43	224.3	**794.995**					
	max	811.84	817.07	841.23	825.38	965.54	835.04	809	812.19	875.81	**815.365**					
	avg	528.03	519.54	534.21	554.94	664.42	564.13	470.83	467.91	506.66	**805.184**					
	st dev	190.16	193.78	200.84	179.07	205.41	179.94	227.01	229.42	247.19	**6.522**					
	median	550 3	527.75	542.62	582.76	703.06	593.88	457.01	448.08	483.92	**806.940**					

Lim min	50.00 [---]
Lim max	1,000.00 [---]

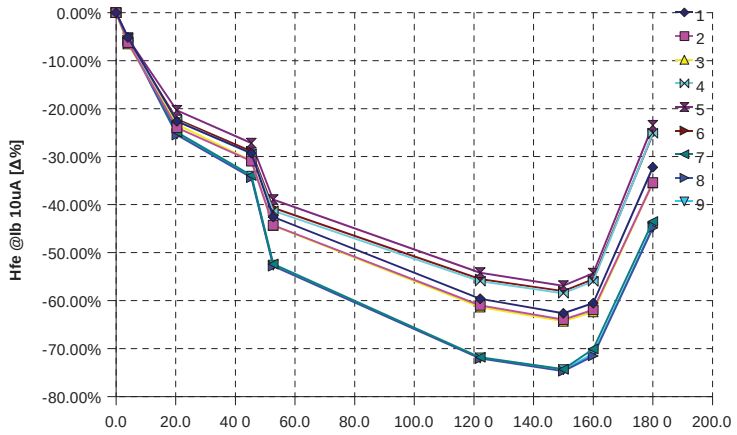
estimated uncertainty ± *4.2 [---]*

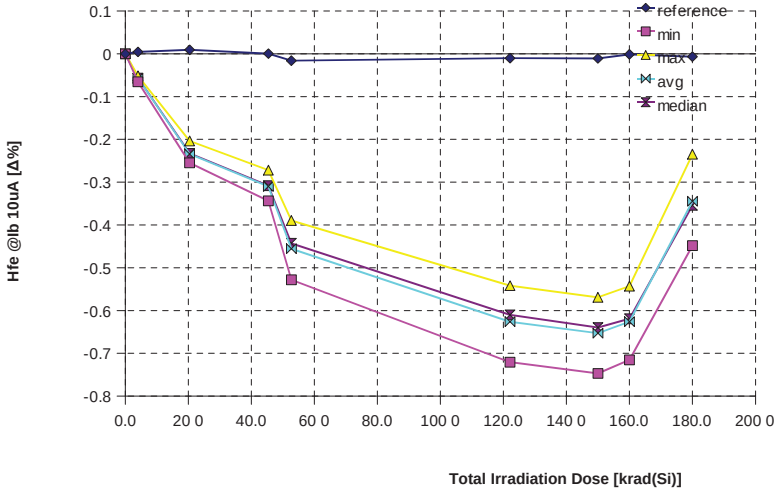




Parameter No: 24 : Hfe @Ib 10uA (Vce = 5 V) Schedule: 2 of 2	APPENDIX A

Hfe @Ib 10uA [Δ%]	s/n krad(Si)	1 If=1mA	2 If=1mA	3 If=1mA	4 If=10mA	5 If=10mA	6 If=10mA	7 unbiased	8 unbiased	9 unbiased	10 reference	min	max	avg	st dev	median
	0.0	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0	0
	4.0	-5.15%	-6.23%	-6.53%	-6.19%	-5.30%	-5.86%	-5.29%	-5.68%	-5.20%	0.45%	-6.53%	-5.15%	-5.71%	0.51%	-5.68%
	20.4	-22.62%	-23.97%	-23.26%	-22.50%	-20.37%	-22.22%	-24.91%	-25.49%	-25.28%	0.92%	-25.49%	-20.37%	-23.40%	1.68%	-23.26%
	45.4	-29.27%	-30.93%	-30.82%	-29.39%	-27.19%	-28.88%	-33.92%	-34.38%	-34.08%	0.04%	-34.38%	-27.19%	-30.99%	2.60%	-30.82%
	52.7	-42.57%	-44.30%	-44.35%	-41.29%	-38.96%	-40.68%	-52.38%	-52.82%	-52.61%	-1.60%	-52.82%	-38.96%	-45.55%	5.55%	-44.30%
	122.1	-59.62%	-61.01%	-61.35%	-55.95%	-54.18%	-55.51%	-71.82%	-72.06%	-71.96%	-1.01%	-72.06%	-54.18%	-62.61%	7.42%	-61.01%
	150.0	-62.65%	-63.96%	-64.30%	-58.47%	-56.91%	-58.02%	-74.31%	-74.71%	-74.39%	-1.08%	-74.71%	-56.91%	-65.30%	7.35%	-63.96%
		-60.53%	-61.93%	-62.37%	-55.98%	-54.30%	-55.52%	-70.08%	-71.53%	-71.08%	-0.12%	-71.53%	-54.30%	-62.59%	6.85%	-61.93%
		-32.22%	-35.41%	-35.50%	-25.11%	-23.47%	-25.30%	-43.51%	-44.83%	-44.75%	-0.66%	-44.83%	-23.47%	-34.45%	8.62%	-35.41%
	min	-62.65%	-63.96%	-64.30%	-58.47%	-56.91%	-58.02%	-74.31%	-74.71%	-74.39%	-1.60%					
	max	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.92%					
	avg	-34.96%	-36.41%	-36.50%	-32.77%	-31.19%	-32.44%	-41.80%	-42.39%	-42.15%	-0.34%					
	st dev	23.42%	23.72%	23.87%	21.70%	21.27%	21.55%	28.06%	28.25%	28.22%	0.81%					
	median	-32.22%	-35.41%	-35.50%	-29.39%	-27.19%	-28.88%	-43.51%	-44.83%	-44.75%	-0.12%					
	Lim min	-100.00%														
	Lim max	100.00%														



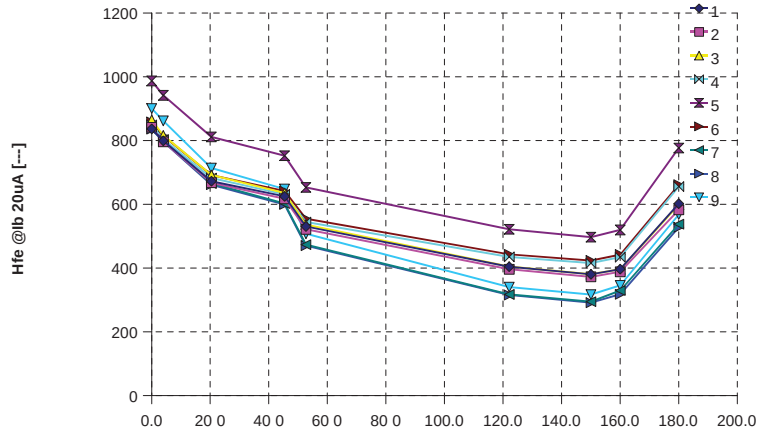


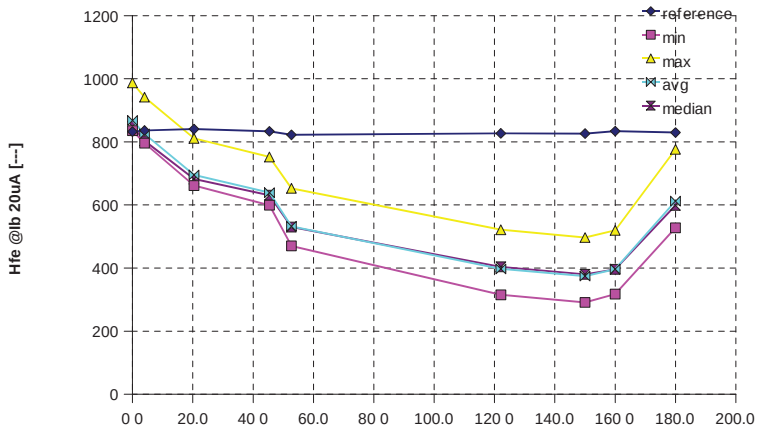
Parameter No: 25 : Hfe @Ib 20uA (Vce = 5 V) Schedule: 1 of 2	APPENDIX A

Hfe @Ib 20uA	s/n	1	2	3	4	5	6	7	8	9	10	min	max	avg	st dev	median
[---]	krad(Si)	If=1mA	If=1mA	If=1mA	If=10mA	If=10mA	If=10mA	unbiased	unbiased	unbiased	reference					
	0.0	836.58	841.63	864.91	849.22	987.04	858.32	836.29	835.72	900.65	832.47	835.72	987.04	867.81	49.27	849.22
	4.0	799.14	796.24	816.02	803.49	941.81	814.77	799.1	796.18	861.61	836.27	796.18	941.81	825.37	48.26	803.49
	20.4	672.34	667.59	692.06	682.41	811.38	691.69	665.36	661.58	713 66	840.54	661.58	811.38	695.34	46.54	682.41
	45.4	624.91	617.33	635.53	630 99	752.4	641 56	602 39	599.45	647 82	833 59	599.45	752.4	639.15	45.54	630.99
	52.7	530.24	521.49	536.07	544.48	652.9	554.79	473.25	470.21	507 54	822.42	470.21	652.9	532.33	53.95	530.24
	122.1	403.96	395.95	404.62	435.01	521.62	443	317.21	315.34	340.26	827.12	315.34	521.62	397.44	66.57	403.96
	150.0	380.2	372.31	380.52	415.39	497.02	423.41	294.47	291.19	316 53	826.37	291.19	497.02	374.56	66.95	380.2
		396.46	388.26	396.04	434.14	519.76	442.15	329 38	317 66	345 53	834 06	317.66	519.76	396.6	63.32	396.04
Annealing		601.95	582.51	598.9	655 67	776 57	661.4	537.76	527 63	568.18	829.73	527.63	776.57	612.28	76.75	598.9
	min	380.2	372.31	380.52	415.39	497.02	423.41	294.47	291.19	316 53	822.415					
	max	836.58	841.63	864.91	849.22	987.04	858.32	836.29	835.72	900 65	840.535					
	avg	582.86	575.92	591.63	605.64	717 83	614 56	539.47	534 99	577 97	831.394					
	st dev	170.25	173.68	179.58	160.46	182.6	161.11	204.1	205.55	221.3	5.560					
	median	601.95	582.51	598.9	630.99	752.4	641.56	537.76	527.63	568.18	832.465					

Lim min	50.00 [---]
Lim max	1,000.00 [---]

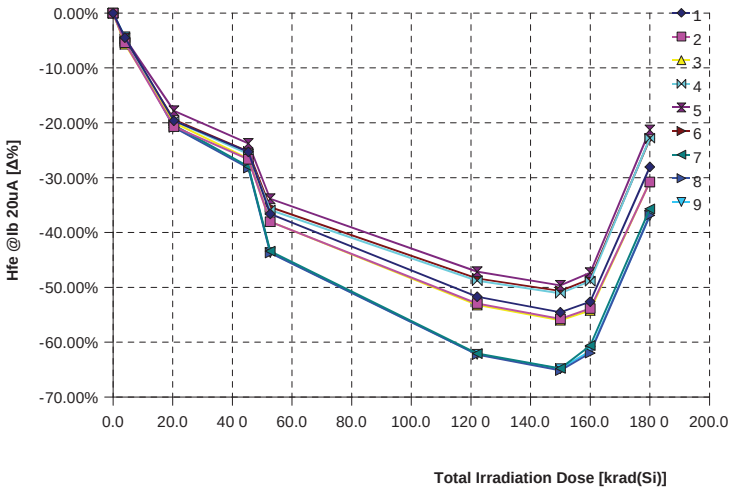
estimated uncertainty ± *3.58 [---]*

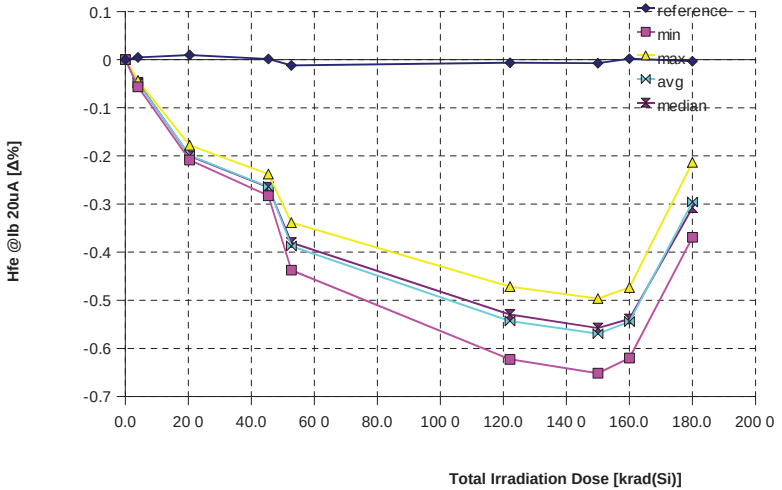




Parameter No: 25 : Hfe @Ib 20uA (Vce = 5 V) Schedule: 2 of 2	APPENDIX A

Hfe @Ib 20uA	s/n	1	2	3	4	5	6	7	8	9	10	min	max	avg	st dev	median
[Δ%]	krad(Si)	If=1mA	If=1mA	If=1mA	If=10mA	If=10mA	If=10mA	unbiased	unbiased	unbiased	reference					
	0.0	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0	0
	4.0	-4.48%	-5.39%	-5.65%	-5.38%	-4.58%	-5.07%	-4.45%	-4.73%	-4.33%	0.46%	-5.65%	-4.33%	-4.90%	0.49%	-4.73%
	20.4	-19.63%	-20.68%	-19.99%	-19.64%	-17.80%	-19.41%	-20.44%	-20.84%	-20.76%	0.97%	-20.84%	-17.80%	-19.91%	0.96%	-19.99%
	45.4	-25.30%	-26.65%	-26.52%	-25.70%	-23.77%	-25.25%	-27.97%	-28.27%	-28.07%	0.14%	-28.27%	-23.77%	-26.39%	1.53%	-26.52%
	52.7	-36.62%	-38.04%	-38.02%	-35.88%	-33.85%	-35.36%	-43.41%	-43.74%	-43.65%	-1.21%	-43.74%	-33.85%	-38.73%	3.87%	-38.02%
	122.1	-51.71%	-52.95%	-53.22%	-48.77%	-47.15%	-48.39%	-62.07%	-62.27%	-62.22%	-0.64%	-62.27%	-47.15%	-54.31%	6.25%	-52.95%
	150.0	-54.55%	-55.76%	-56.00%	-51.09%	-49.65%	-50.67%	-64.79%	-65.16%	-64.86%	-0.73%	-65.16%	-49.65%	-56.95%	6.39%	-55.76%
		-52.61%	-53.87%	-54.21%	-48.88%	-47.34%	-48.49%	-60.61%	-61.99%	-61.63%	0.19%	-61.99%	-47.34%	-54.40%	5.78%	-53.87%
		-28.05%	-30.79%	-30.76%	-22.79%	-21.32%	-22.94%	-35.70%	-36.86%	-36.91%	-0.33%	-36.91%	-21.32%	-29.57%	6.20%	-30.76%
	min	-54.55%	-55.76%	-56.00%	-51.09%	-49.65%	-50.67%	-64.79%	-65.16%	-64.86%	-1.21%					
	max	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.97%					
	avg	-30.33%	-31.57%	-31.60%	-28.68%	-27.27%	-28.40%	-35.49%	-35.98%	-35.83%	-0.13%					
	st dev	20.35%	20.64%	20.76%	18.89%	18.50%	18.77%	24.41%	24.60%	24.57%	0.67%					
	median	-28.05%	-30.79%	-30.76%	-25.70%	-23.77%	-25.25%	-35.70%	-36.86%	-36.91%	0.00%					
	Lim min	-100.00%														
	Lim max	100.00%														



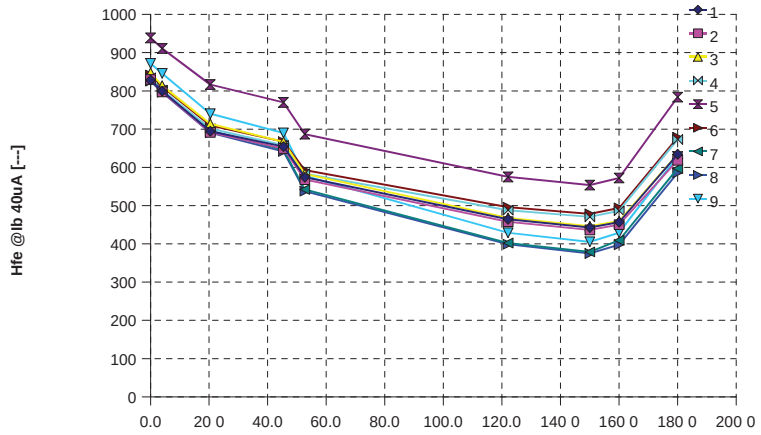


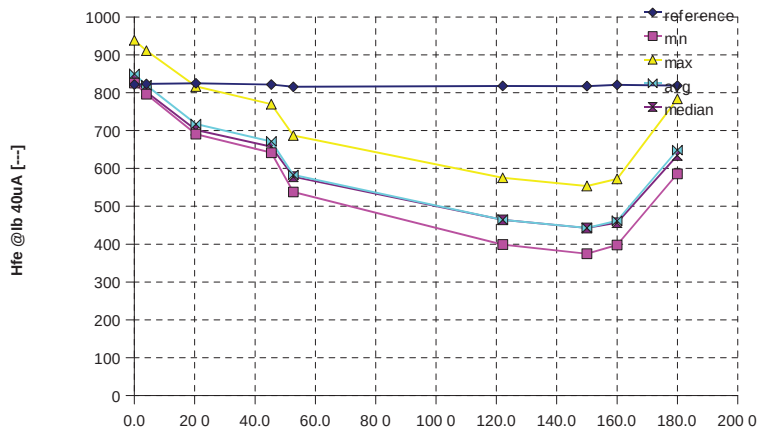
Parameter No: 26 : Hfe @Ib 40uA (Vce = 5 V) Schedule: 1 of 2	APPENDIX A

Hfe @Ib 40uA	s/n	1	2	3	4	5	6	7	8	9	10	min	max	avg	st dev	median
[---]	krad(Si)	If=1mA	If=1mA	If=1mA	If=10mA	If=10mA	If=10mA	unbiased	unbiased	unbiased	reference					
	0.0	827 98	829.9	847 09	834 35	938.71	841.45	828.16	825 34	871 81	821 66	825.34	938.71	849.42	36.47	834.35
	4.0	799.45	797 33	813 58	802	911	810.76	800 65	796 23	845 55	823.17	796.23	911	819.61	37.51	802
	20.4	694.43	691 64	713 63	701.43	816 64	709 8	695 88	690 57	740 38	824.74	690.57	816.64	717.15	40.43	701.43
	45.4	654 34	649 25	666 58	657.48	769.88	666.99	646 3	641.71	689.93	821.63	641.71	769.88	671.38	39.64	657.48
	52.7	574 23	568 04	583	583 37	686 92	592.78	542.18	537.73	578	815 59	537.73	686.92	582.91	43.21	578
	122.1	464 25	458 01	468.13	488.11	575 22	495.75	402 05	399 02	428 94	817 87	399.02	575.22	464.39	53.97	464.25
	150.0	442 68	436 36	446 28	470.48	553 59	478 23	378.9	374 69	405.14	817.4	374.69	553.59	442.93	55.33	442.68
		456 65	450 26	459 68	486 39	572 3	493 86	409 21	397.77	429 32	820.8	397.77	572.3	461.71	52.35	456.65
Annealing		634 22	618 92	635.11	673.02	783.7	678.57	597.06	585.88	628.29	818.88	585.88	783.7	648.31	59.18	634.22
	min	442 68	436 36	446 28	470.48	553 59	478 23	378.9	374 69	405.14	815.590					
	max	827 98	829.9	847 09	834 35	938.71	841.45	828.16	825 34	871 81	824.743					
	avg	616.47	611 08	625.9	632 96	734 22	640 91	588 93	583 21	624.15	820.193					
	st dev	144 37	146.74	150 09	135.71	145.75	135.73	169 69	170 59	178 31	2.963					
	median	634 22	618 92	635.11	657.48	769 88	666 99	597 06	585 88	628.29	820.795					

Lim min	50.00 [---]
Lim max	1,000.00 [---]

estimated uncertainty ± *1.91 [---]*

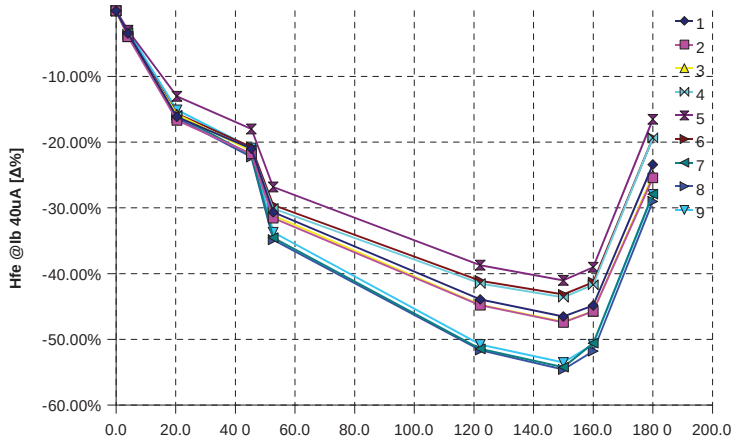


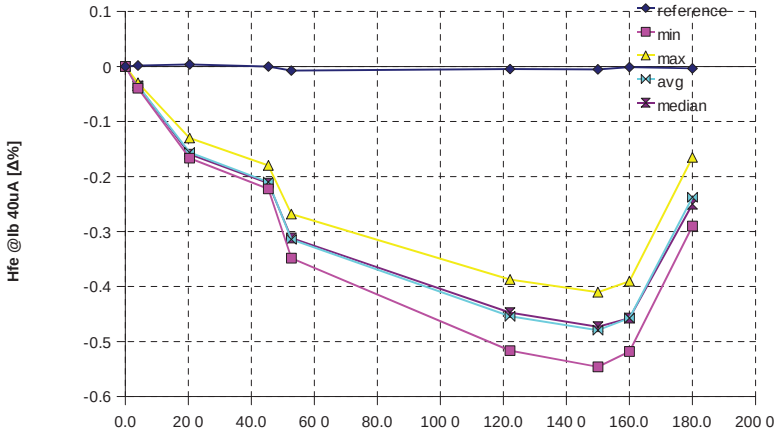


Parameter No: 26 : Hfe @Ib 40uA (Vce = 5 V) Schedule: 2 of 2	APPENDIX A

Hfe @Ib 40uA	s/n	1	2	3	4	5	6	7	8	9	10	min	max	avg	st dev	median
[Δ%]	krad(Si)	If=1mA	If=1mA	If=1mA	If=10mA	If=10mA	If=10mA	unbiased	unbiased	unbiased	reference					
	0.0	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0	0
	4.0	-3.45%	-3.92%	-3.96%	-3.88%	-2.95%	-3.65%	-3.32%	-3.53%	-3.01%	0.18%	-3.96%	-2.95%	-3.52%	0.37%	-3.53%
	20.4	-16.13%	-16.66%	-15.76%	-15.93%	-13.00%	-15.65%	-15.97%	-16.33%	-15.08%	0.37%	-16.66%	-13.00%	-15.61%	1.07%	-15.93%
	45.4	-20.97%	-21.77%	-21.31%	-21.20%	-17.99%	-20.73%	-21.96%	-22.25%	-20.86%	0.00%	-22.25%	-17.99%	-21.00%	1.24%	-21.20%
	52.7	-30.65%	-31.55%	-31.18%	-30.08%	-26.82%	-29.55%	-34.53%	-34.85%	-33.70%	-0.74%	-34.85%	-26.82%	-31.44%	2.59%	-31.18%
	122.1	-43.93%	-44.81%	-44.74%	-41.50%	-38.72%	-41.08%	-51.45%	-51.65%	-50.80%	-0.46%	-51.65%	-38.72%	-45.41%	4.83%	-44.74%
	150.0	-46.54%	-47.42%	-47.32%	-43.61%	-41.03%	-43.17%	-54.25%	-54.60%	-53.53%	-0.52%	-54.60%	-41.03%	-47.94%	5.09%	-47.32%
		-44.85%	-45.75%	-45.73%	-41.70%	-39.03%	-41.31%	-50.59%	-51.80%	-50.76%	-0.11%	-51.80%	-39.03%	-45.72%	4.57%	-45.73%
		-23.40%	-25.42%	-25.02%	-19.34%	-16.51%	-19.36%	-27.91%	-29.01%	-27.93%	-0.34%	-29.01%	-16.51%	-23.77%	4.45%	-25.02%
	min	-46.54%	-47.42%	-47.32%	-43.61%	-41.03%	-43.17%	-54.25%	-54.60%	-53.53%	-0.74%					
	max	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.37%					
	avg	-25.55%	-26.37%	-26.11%	-24.14%	-21.78%	-23.83%	-28.89%	-29.34%	-28.41%	-0.18%					
	st dev	17.44%	17.68%	17.72%	16.27%	15.53%	16.13%	20.49%	20.67%	20.45%	0.36%					
	median	-23.40%	-25.42%	-25.02%	-21.20%	-17.99%	-20.73%	-27.91%	-29.01%	-27.93%	-0.11%					

Lim min	-100.00%
Lim max	100.00%



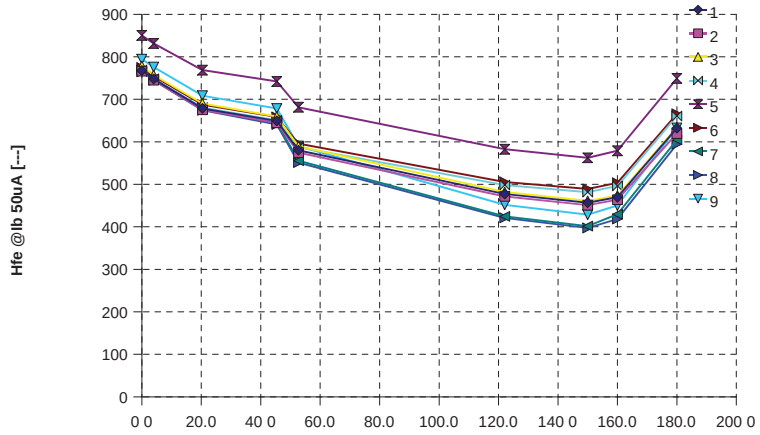


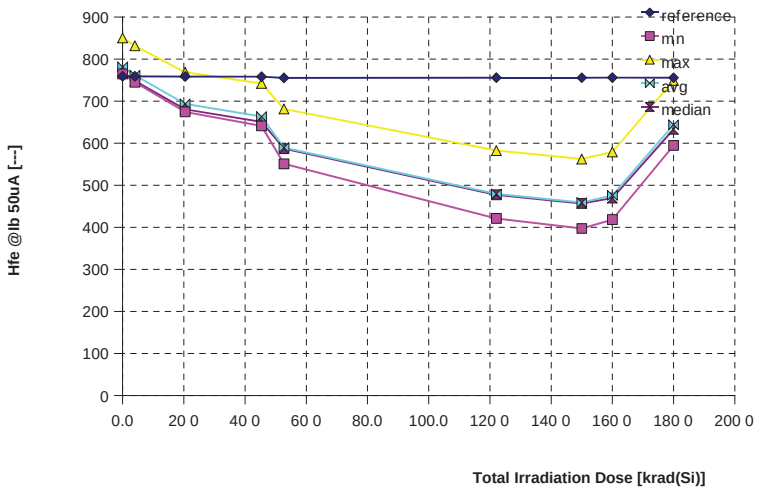
Parameter No: 27 : Hfe @Ib 50uA (Vce = 5 V) Schedule: 1 of 2	APPENDIX A

Hfe @Ib 50uA	s/n	1	2	3	4	5	6	7	8	9	10	min	max	avg	st dev	median
[---]	krad(Si)	If=1mA	If=1mA	If=1mA	If=10mA	If=10mA	If=10mA	unbiased	unbiased	unbiased	reference					
	0.0	767 63	766 22	778.47	769 05	850 29	774.71	765 84	764.48	794 61	759 22	764.48	850.29	781.26	27.56	769.05
	4.0	747 94	745.1	757.15	748.18	831 53	754 33	746 98	744.78	775 96	758 88	744.78	831.53	761.33	28.07	748.18
	20.4	678 68	675.41	690 22	680.53	768.77	687 6	677.96	674.43	708.61	758.47	674.43	768.77	693.58	30.12	680.53
	45.4	649 39	645	659.39	650.46	742.09	658 5	645	640.97	678.59	758.08	640.97	742.09	663.27	31.64	650.46
	52.7	580 06	574.75	589.44	587.14	681.46	595 95	555.79	551.06	590.11	755 39	551.06	681.46	589.53	37.79	587.14
	122.1	477 24	471.7	481 91	498 33	582 52	505 67	424 57	421.13	451 81	755.7	421.13	582.52	479.43	48.63	477.24
	150.0	456.7	450 99	461.14	481 58	562 39	489 05	401.73	397.24	428 5	755 59	397.24	562.39	458.81	50.25	456.7
		469 63	463 89	473.48	496.23	579.12	503.38	429.53	418.45	450.26	755.92	418.45	579.12	476	47.59	469.63
Annealing		632.16	619.55	634.18	660.58	749.19	665.91	605.01	594.61	632.89	755.65	594.61	749.19	643.79	45.74	632.89
	min	456.7	450 99	461.14	481 58	562 39	489 05	401.73	397.24	428 5	755.388					
	max	767 63	766 22	778.47	769.05	850.29	774.71	765.84	764.48	794.61	759.216					
	avg	606 6	601.4	613 93	619.12	705.26	626.12	583 6	578.57	612.37	756.986					
	st dev	118.46	119.68	120 93	109.11	109 69	108 51	139 6	141 24	141 6	1.622					
	median	632.16	619 55	634.18	650.46	742 09	658 5	605 01	594.61	632.89	755.918					

Lim min	50.00 [---]
Lim max	1,000.00 [---]

estimated uncertainty ± *1.05 [---]*

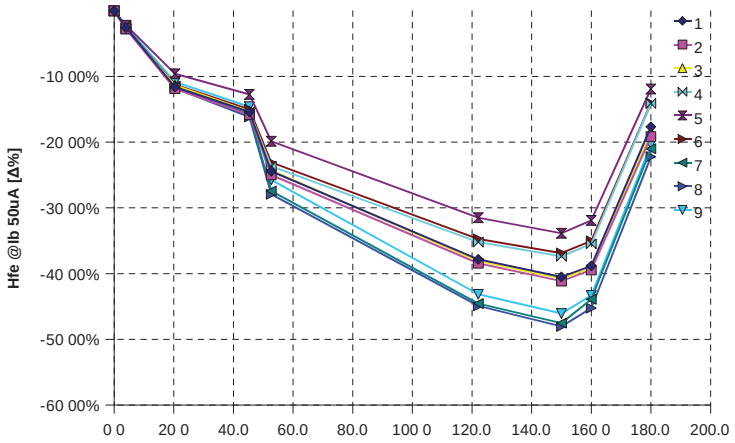


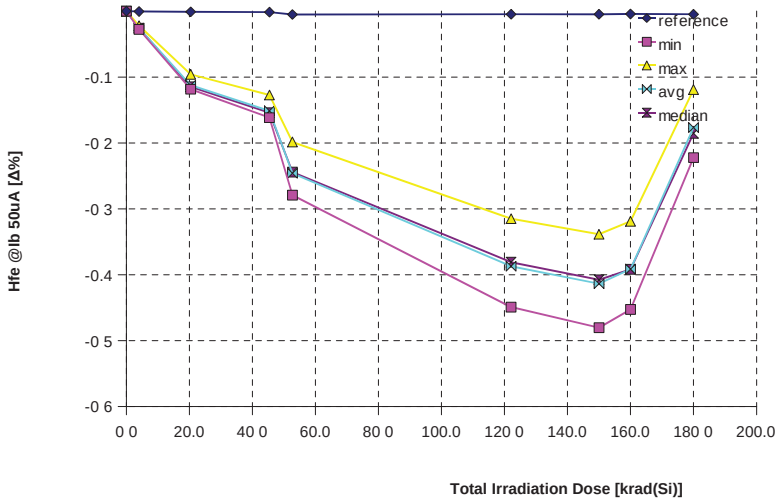


Parameter No: 27 : Hfe @Ib 50uA (Vce = 5 V) Schedule: 2 of 2	APPENDIX A

Hfe @Ib 50uA [Δ%]	s/n	1	2	3	4	5	6	7	8	9	10	min	max	avg	st dev	median
	krad(Si)	If=1mA	If=1mA	If=1mA	If=10mA	If=10mA	If=10mA	unbiased	unbiased	unbiased	reference					
	0.0	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0	0
	4.0	-2.56%	-2.76%	-2.74%	-2.71%	-2.21%	-2.63%	-2.46%	-2.58%	-2.35%	-0.04%	-2.76%	-2.21%	-2.56%	0.19%	-2.58%
	20.4	-11.59%	-11.85%	-11.34%	-11.51%	-9 59%	-11 24%	-11.47%	-11.78%	-10 82%	-0.10%	-11.85%	-9.59%	-11.24%	0.69%	-11.47%
	45.4	-15.40%	-15.82%	-15.30%	-15.42%	-12.73%	-15 00%	-15.78%	-16.16%	-14 60%	-0.15%	-16.16%	-12.73%	-15.13%	1.01%	-15.40%
	52.7	-24.43%	-24.99%	-24.28%	-23.65%	-19.86%	-23.07%	-27.43%	-27 92%	-25.74%	-0 50%	-27.92%	-19.86%	-24.60%	2.41%	-24.43%
	122.1	-37.83%	-38.44%	-38.10%	-35.20%	-31.49%	-34.73%	-44.56%	-44 91%	-43.14%	-0.46%	-44.91%	-31.49%	-38.71%	4.66%	-38.10%
	150.0	-40.50%	-41.14%	-40.76%	-37.38%	-33.86%	-36.87%	-47.54%	-48 04%	-46 07%	-0.48%	-48.04%	-33.86%	-41.35%	4.98%	-40.76%
		-38.82%	-39.46%	-39.18%	-35.48%	-31 89%	-35 02%	-43 91%	-45 26%	-43 34%	-0.43%	-45.26%	-31.89%	-39.15%	4.49%	-39.18%
		-17.65%	-19.14%	-18.54%	-14.10%	-11 89%	-14 04%	-21 00%	-22.22%	-20.35%	-0.47%	-22.22%	-11.89%	-17.66%	3.56%	-18.54%
	min	-40.50%	-41.14%	-40.76%	-37.38%	-33.86%	-36.87%	-47.54%	-48 04%	-46 07%	**-0.50%**					
	max	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	**0.00%**					
	avg	-20.98%	-21.51%	-21.14%	-19.50%	-17 06%	-19.18%	-23.80%	-24 32%	-22 93%	**-0.29%**					
	st dev	15.43%	15.62%	15.53%	14.19%	12.90%	14.01%	18.23%	18.48%	17 82%	**0.21%**					
	median	-17.65%	-19.14%	-18.54%	-15.42%	-12.73%	-15 00%	-21 00%	-22 22%	-20 35%	**-0.43%**					

Lim min	-100.00%
Lim max	100.00%



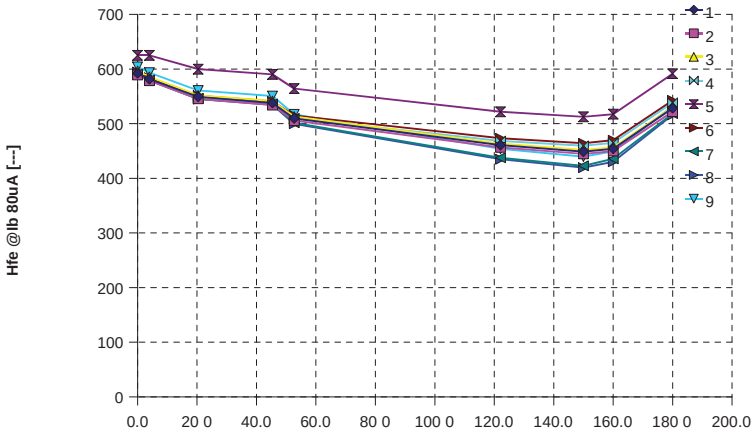


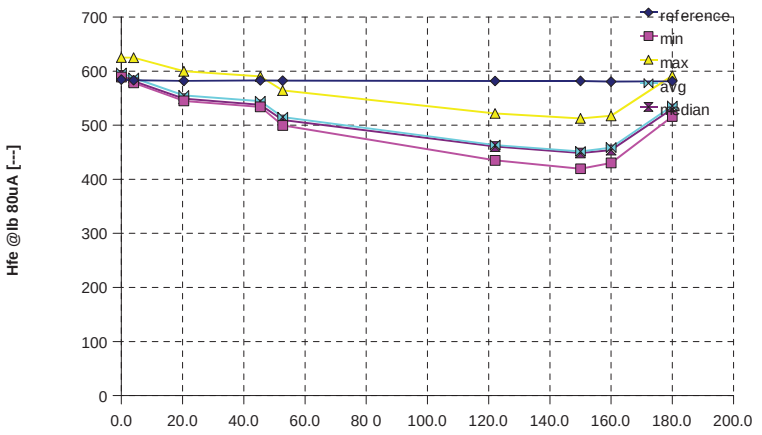
Parameter No: 28 : Hfe @Ib 80uA (Vce = 5 V) Schedule: 1 of 2	APPENDIX A

Hfe @Ib 80uA	s/n	1	2	3	4	5	6	7	8	9	10	min	max	avg	st dev	median
[---]	krad(Si)	If=1mA	If=1mA	If=1mA	If=10mA	If=10mA	If=10mA	unbiased	unbiased	unbiased	reference					
	0.0	592.13	589.09	596.07	590.56	624.99	594.52	589.29	589.37	603.8	584.26	589.09	624.99	596.65	11.62	592.13
	4.0	581.52	578.51	585.7	580.26	624.98	584.05	579.19	579.03	593.43	583.14	578.51	624.98	587.41	14.85	581.52
	20.4	549.14	545.39	551.78	546.48	599.74	551.25	545.75	544.87	560 67	581.9	544.87	599.74	555.01	17.48	549.14
	45.4	537.72	534.01	541.5	535 99	590 27	540 68	535.45	534.41	550.64	582.87	534.01	590.27	544.52	17.92	537.72
	52.7	509.63	505.55	512.98	509.59	564.23	514.96	501.56	499.7	517.12	582.41	499.7	564.23	515.04	19.35	509.63
	122.1	460.62	456.53	463.49	468.4	521.74	473.22	437.56	434.98	453.89	581.7	434.98	521.74	463.38	25.36	460.62
	150.0	448.65	444.65	451.83	459.52	512.57	464.21	422.77	419.43	439 58	581.84	419.43	512.57	451.47	27.4	448.65
		454.04	449.82	456.56	465 03	517 36	469.78	435 66	430.16	449 56	580.6	430.16	517.36	458.66	25.34	454.04
Annealing		528.34	521 95	530 23	538 38	591.49	542 56	518.35	516.1	531.87	581.22	516.1	591.49	535.47	22.75	530.23
	min	448.65	444.65	451.83	459.52	512.57	464.21	422.77	419.43	439 58	580.601					
	max	592.13	589.09	596.07	590.56	624.99	594.52	589.29	589 37	603.8	584.255					
	avg	517.98	513.94	521.13	521 58	571 93	526.13	507 28	505 34	522 28	582.215					
	st dev	53.92	54.26	54.29	49.16	45	48.83	62.71	64.25	62.16	1.095					
	median	528.34	521.95	530.23	535.99	590.27	540.68	518.35	516.1	531 87	581.903					

Lim min	50.00 [---]
Lim max	1,000.00 [---]

estimated uncertainty ± *0.71 [---]*





Parameter No: 28 : Hfe @Ib 80uA (Vce = 5 V) Schedule: 2 of 2	APPENDIX A

Hfe @Ib 80uA	s/n	1	2	3	4	5	6	7	8	9	10	min	max	avg	st dev	median
[Δ%]	krad(Si)	If=1mA	If=1mA	If=1mA	If=10mA	If=10mA	If=10mA	unbiased	unbiased	unbiased	reference					
	0.0	0.00%	0.00%	0.00%	0.00%	0 00%	0 00%	0 00%	0 00%	0 00%	0 00%	0.00%	0.00%	0.00%	0	0
	4.0	-1.79%	-1.79%	-1.74%	-1.74%	0 00%	-1.76%	-1.71%	-1.76%	-1.72%	-0.19%	-1.79%	0.00%	-1.56%	0.58%	-1.74%
	20.4	-7 26%	-7.42%	-7.43%	-7.46%	-4 04%	-7 28%	-7 39%	-7 55%	-7.14%	-0.40%	-7.55%	-4.04%	-7.00%	1.12%	-7.39%
	45.4	-9.19%	-9 35%	-9.16%	-9 24%	-5 56%	-9 06%	-9.14%	-9 33%	-8 80%	-0 24%	-9.35%	-5.56%	-8.76%	1.21%	-9.16%
	52.7	-13.93%	-14.18%	-13.94%	-13.71%	-9.72%	-13 38%	-14 89%	-15 22%	-14 35%	-0 32%	-15.22%	-9.72%	-13.70%	1.60%	-13.94%
	122.1	-22.21%	-22.50%	-22.24%	-20.69%	-16 52%	-20.40%	-25.75%	-26 20%	-24 83%	-0.44%	-26.20%	-16.52%	-22.37%	3.02%	-22.24%
	150.0	-24 23%	-24.52%	-24.20%	-22.19%	-17 99%	-21 92%	-28 26%	-28 83%	-27 20%	-0.41%	-28.83%	-17.99%	-24.37%	3.44%	-24.23%
		-23 32%	-23 64%	-23.41%	-21 26%	-17 22%	-20 98%	-26 07%	-27 01%	-25 55%	-0 63%	-27.01%	-17.22%	-23.16%	3.02%	-23.41%
		-10.77%	-11.40%	-11 05%	-8 84%	-5 36%	-8.74%	-12 04%	-12.43%	-11 91%	-0 52%	-12.43%	-5.36%	-10.28%	2.27%	-11.05%
	min	-24.23%	-24.52%	-24.20%	-22.19%	-17 99%	-21 92%	-28 26%	-28 83%	-27 20%	**-0.63%**					
	max	0.00%	0.00%	0.00%	0.00%	0 00%	0 00%	0 00%	0 00%	0 00%	**0.00%**					
	avg	-12 52%	-12.76%	-12 57%	-11 68%	-8.49%	-11 50%	-13 92%	-14 26%	-13 50%	**-0.35%**					
	st dev	9.11%	9 21%	9.11%	8 32%	7 20%	8 21%	10 64%	10 90%	10 29%	**0.19%**					
	median	-10.77%	-11.40%	-11 05%	-9 24%	-5 56%	-9 06%	-12 04%	-12.43%	-11 91%	**-0.40%**					
	Lim min	-100.00%														
	Lim max	100.00%