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DOCUMENT

RA0618 CO60 TID Test Results on Part Type BFY640

RA0618

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Reference	**RA0618**
Issue	**1**
Revision	**1**
Date of Issue	**25 February 2013**
Status	**Issued**
Document Type	**Test Report**
Distribution	**ESCIES Library**

European Space Agency
Agence spatiale européenne

APPROVAL

Title RA0618 CO60 TID Test Results on Part Type BFY640	
Issue 1	**Revision** 1
Author	**Date**
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CHANGE LOG

Reason for change	Issue	Revision	Date
Draft release	1	0	10 January 2013
Final release	1	1	25 February 2013

CHANGE RECORD

Issue 1	**Revision** 1		
Reason for change	**Date**	**Pages**	**Paragraph(s)**
Statement that tested parts were previously un-screened	19 February	4	5.2.1

Table of contents:

1 ACRONYMS

TID Total Irradiation Dose

2 REFERENCES

REF1 ESA/SCC 22900 “Total Dose Steady-State Irradiation Test Method”, issue 3
REF2 IFX Detail SpecificationA63500-T1580B-D11E
REF3 IFX Detail SpecificationA63500-T580B-D11E
REF4 IFX Detail SpecificationA63500-T1592B-D11E

3 PURPOSE

The purpose of this test report is to describe the TID test performed according to REF1 on the devices below specified.

4 SCOPE

This documents reports the test results obtained on Silicon-Germanium RF transistors, based on part type BFY640, manufactured by Infineon.

5 TEST DESCRIPTION

5.1 Facility and Dosimetry

The ESTEC Co-60 facility comprises of a Nordion Gammabeam 150C irradiator containing a nominal 85.2 TBq (2300 Ci) Co-60 source at the last reload date in October 2011. the irradiation room is monitored for temperature, relative humidity and pressure.

The dosimetry system is based on Farmer type 2571A 0.6 cc air ionisation chambers linked to Farmer 2670 electrometer. The dosimetry system is compensated against temperature and pressure environmental fluctuations.

All irradiations and measurements were performed at room temperature (22.5 ± 3 °C).

5.2 Devices Under Test

A total of twenty one devices, were received from Infineon Germany. A test fixture for the DC measurements to be performed, was also received from the manufacturer.

5.2.1 Part description

Manufacturer	Infineon - Hirel Discrete & MW Semiconductor
Family	RF NPN transistor
Group	Silicon-Germanium
Package	µX
Component Designation	BFY640
Component Specification	ESCC 5611/009
Part Identification Number	BFY640(SAM)
Diffusion Lot	4485/15
Delivery Lot	1226.53
Device serial numbers	from 1 to 11 (identified by the individual position in the primary package).

All received devices were not preliminary submitted to any screening by the manufacturer but just measured before the delivery for the TID test campaign.

The devices from s/n 6 to s/n 10 were irradiated with bias applied according to the schematic in Figure 1 .

The devices from s/n's: 1 to 5 were irradiated with all the pins grounded (un-biased).
The device s/n 11 was retained as control sample and measured at the completion of each irradiation step.

Table 1 summarize the sample usage

Table 1 received samples and their usage.

S/n's	Description
1, 2, 3, 4 and 5	Unbiased during ^{60}Co irradiation, anneal and ageing
6, 7, 8, 9 and 10	Biased during ^{60}Co irradiation, anneal and ageing
11	Reference device (not irradiated) - Electrically tested before and after each intermediate measurement run at irradiation step completion.
12, 13, 14, 15, 16, 17, 18, 19, 20	Nor Irradiated/kept for future use.

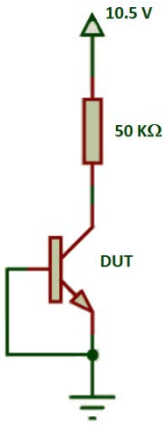

Figure 1 Biasing circuit

5.3 Radiation Test Plan

The actual radiation test steps are reported in Table 2.

Table 2 Irradiation Test Plan

Step	Step Dose krad (to water)	Total Dose krad (to water)	Dose Rate rad/min (to water)
(Pre irradiation) 0	==		==
Irradiation step # 1	47.75	47.75	6.62
Irradiation step # 2	63.88	111.6	6.54
Irradiation step # 3	83.54	195.2	6.53
Irradiation step # 4	166.9	362.1	6.50

At the completion of each of the above irradiation steps, intermediate electrical measurements were carried out according to the next paragraph.

At the end of the final irradiation run, all devices were electrically measured and annealed for 45 hours at room temperature and subsequently aged at 100°C (for 168 hrs in total), maintaining the same bias conditions applied during the TID test.
Table 3 reports the annealing/ageing sequence detail.

Table 3 Anneal/ageing sequence

Step	Temperature	Duration
Anneal	Room temperature	45 hours
Ageing	100 °C	168 hours

Again, at the completion of each anneal/ageing step, all devices were electrically tested.

5.4 Measurement Set-up

No in-situ measurements were performed during irradiation.
Electrical measurements were performed according to Table 2 of the relevant detail specification.

In the following, the Table 2 from the detail specification is reported.

Table 4 Measured Parameters, Min-Max Limits and Test conditions

BFY640 – DC Parameters from Table 2 of ESCC 5611/009:

NO.	CHARACTERISTIC	SYMB	TEST FIG.	TEST CONDITION	LIMITS		UNIT
					MIN.	MAX.	
1	Collector Cut-off Current, Base shorted (high voltage)	I_{CESH}	4(a)	V_{CE} = 13 V, V_{BE} = 0 V	-	1000	nA
2	Collector Cut-off Current, Base shorted (medium voltage)	I_{CESM}	4(a)	V_{CE} = 10.5 V, V_{BE} = 0 V	-	100	nA
3	Emitter Cut-off Current (high voltage)	I_{EB0H}	4(a)	V_{EB} = 1.2 V, I_C = 0 mA	-	5	µA
4	Collector-Emitter Cut-off Current (high voltage)	I_{CEXH}	4(a)	V_{CE} = 4 V , I_B = 100 nA (Note 1)	20	100	µA
5	DC Forward Current Transfer Ratio (medium current)	h_{FE}	4(a)	V_{CE} = 3 V, I_C = 30 mA	135	250	
6	Base-Emitter Forward Voltage	V_{FBE}	4(a)	I_B = 12 mA, I_C = 0 (Note 2)	-	0.96	V

10	Collector Cut-off Current, Base shorted (low voltage)	I_{CESL}	4(a)	V_{CE} = 5 V, V_{BE} = 0 V	-	20	nA
11	Emitter Cut-off Current (low voltage)	I_{EB0L}	4(a)	V_{EB} = 0.5 V, I_C = 0 mA	-	100	nA
12	DC Forward Current Transfer Ratio (low current)	h_{FEL}	4(a)	V_{CE} = 3 V, I_C = 20 µA	150	300	

NOTES:

1. Regarding upper limit, this is an alternative method of establishing $V_{(BR)CEO}$ and assures that $V_{(BR)CEO}$ is > 4 V, if the stated base current is not exceeded. Lower limits result from current gain at low Ib.
2. Pulsed measurement: Pulse Duration < 1 second. For the purpose of V_{FBE} measurement, $I_{B,max}$ may be exceeded during a pulsed measurement provided that the pulse length duration < 1 second and I_C = 0 mA.

All the above parameters have been measured by using the following equipment:

DC Source Monitor Unit: Keithley model KE2612A s/n1259457.
Test Jig: Infineon proprietary
Test Program: CLY_inf.vi (Labview© based sw)

5.5 Measurement Set-up Calibration

After the test campaign, the DC source monitor was sent out for calibration. According to the calibration certificate (number NL000161 from Fluke Nederland B.V. dated 28 Nov 2012), the current measurements taken on channel A (connected to DUT collector) on ranges:

a) 0.101µA – 1.02µA
b) 1.01µA-10.1 µA

were affected by a systematic error of 15.7nA for I_C values ranging from 0.1µA to 19 µA.

In particular, all the reported collector current measurements falling in the above range, must be corrected by increasing the figures accordingly.

6 TEST RESULTS ON BFY640

All measurement results are reported from Table 5 to Table 13. Test ended with a registered Total Dose of 362.1 krad(water).
At the end of the last irradiation step, electrical measurements were performed. The devices were tested again after 45 hours annealing at room temperature.
After the annealing, the samples went through accelerated ageing, with final measurement performed after 168 hrs at 100°C.
During the entire annealing/ageing, the irradiated devices were biased employing the same test board.

Electrical Measurement uncertainty values, reported in the relevant table header, were estimated by combining the instrument uncertainty for the measured parameter (from the manufacturer specification) and the variations of the same parameter in the reference device (s/n 11), observed during the entire test campaign.

Significant data from tables have also been plotted from Figure 2 to Figure 10.

Table 5 Collector cut-off current, base shorted (high voltage) - I_{CESH}

	Pre-irradiation	47.5 [krad]	111.6 [krad]	195.2 [krad]	362.1 [krad]	Anneal @R.T. 45 h	Ageing @100'C 168 h
1	92.51	145.55	165.26	174.81	194.72	185.52	189.66
2	113.13	168.26	180.36	195.44	215.69	193.97	197.27
3	104.28	154.58	169.58	181.49	203.91	192.56	207.76
4	92.57	138.42	152.66	166.90	174.12	163.31	175.22
5	107.24	217.73	179.54	195.93	208.34	199.03	203.13
6	96.64	153.39	163.89	403.20	446.08	425.40	370.38
7	103.36	156.63	224.21	427.48	456.21	376.18	273.45
8	104.93	158.26	363.90	501.31	487.41	452.75	395.86
9	108.17	280.35	323.07	456.29	454.08	346.50	228.90
10	110.73	252.40	196.92	506.06	505.15	505.63	420.05
11	98.94	95.40	92.49	90.73	91.20	93.25	87.85

Note: All values are in nA

Part type: BFY640

limits		
min:	max:	unit
-	1000	nA

Expanded uncertainty (k=2)	2.9	%

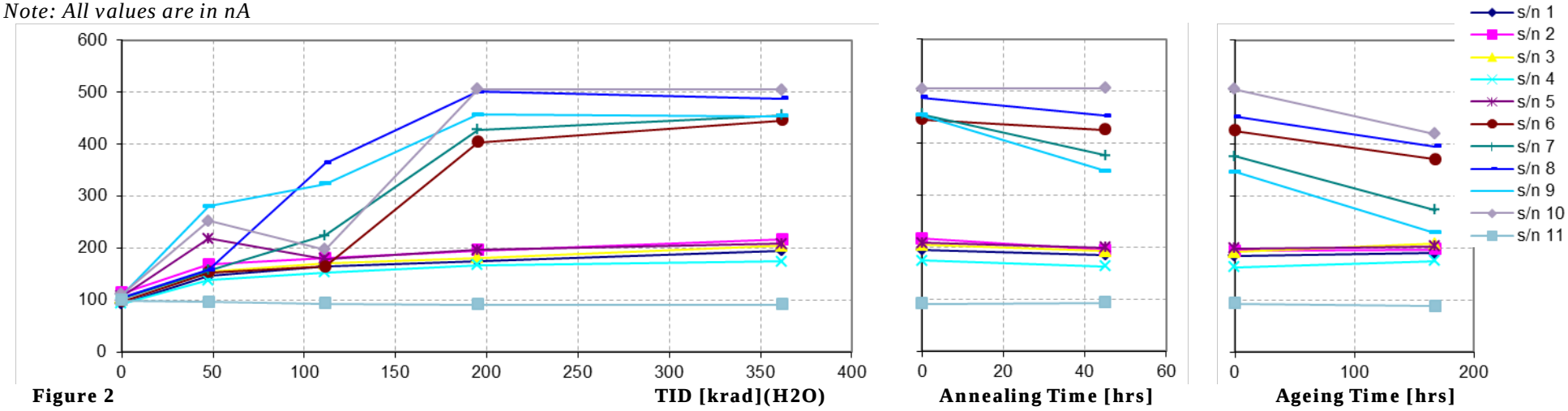

Figure 2

Table 6 Collector Cut-off Current, Base shorted (medium voltage) - I_{CESM}

	Pre-irradiation	47.5 [krad]	111.6 [krad]	195.2 [krad]	362.1 [krad]	Anneal @R.T. 45 h	Ageing @100'C 168 h
1	6.08	9.48	10.69	11.59	12.99	12.77	13.56
2	8.61	12.41	13.41	14.53	15.89	14.32	15.11
3	7.48	11.01	11.92	12.65	14.43	14.01	15.10
4	6.44	9.41	10.39	11.37	12.14	11.27	12.78
5	7.66	15.41	12.87	14.14	15.22	14.83	15.20
6	6.57	10.31	11.22	26.76	30.40	29.63	27.01
7	7.19	10.56	15.53	28.64	31.69	26.42	18.61
8	7.51	11.13	24.50	35.32	34.13	31.46	28.32
9	7.34	18.66	20.64	30.45	30.86	23.05	14.54
10	7.52	16.67	13.42	33.41	34.44	34.75	29.80
11	6.54	6.45	6.09	5.97	5.93	5.91	5.73

Note: All values are in nA

Part type: BFY640

limits		
min:	max:	unit
-	100	nA

Expanded uncertainty (k=2)	3.7	%

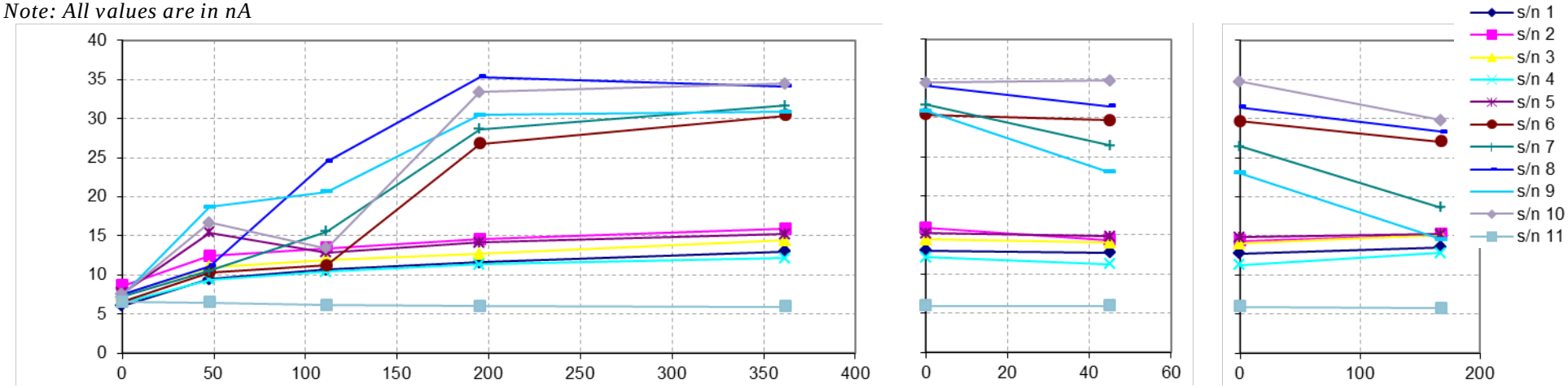

Figure 3

Table 7 Emitter Cut-off Current(high voltage) - I_{EB0H}

	Pre-irradiation	47.5 [krad]	111.6 [krad]	195.2 [krad]	362.1 [krad]	Anneal @R.T. 45 h	Ageing @100'C 168 h
1	49.44	49.17	50.42	51.62	49.09	50.61	49.95
2	46.37	45.95	47.01	46.78	44.29	44.59	44.47
3	42.61	42.75	48.05	46.17	43.16	46.46	45.97
4	45.98	45.34	46.52	47.70	46.67	46.74	46.66
5	45.38	44.07	49.71	46.70	43.89	45.05	45.25
6	42.35	41.33	42.48	41.87	40.14	40.91	41.64
7	49.05	48.33	46.57	43.99	43.79	43.99	43.91
8	45.20	43.99	46.20	44.67	44.82	45.19	45.21
9	45.74	44.68	47.55	46.50	47.18	47.48	47.45
10	47.74	46.62	46.22	44.79	44.40	45.17	44.86
11	48.82	48.82	48.83	48.79	48.71	48.66	48.73

Note: All values are in nA

Part type: BFY640

limits		
min:	max:	unit
-	5000	nA

Expanded uncertainty (k=2)	0.1	%

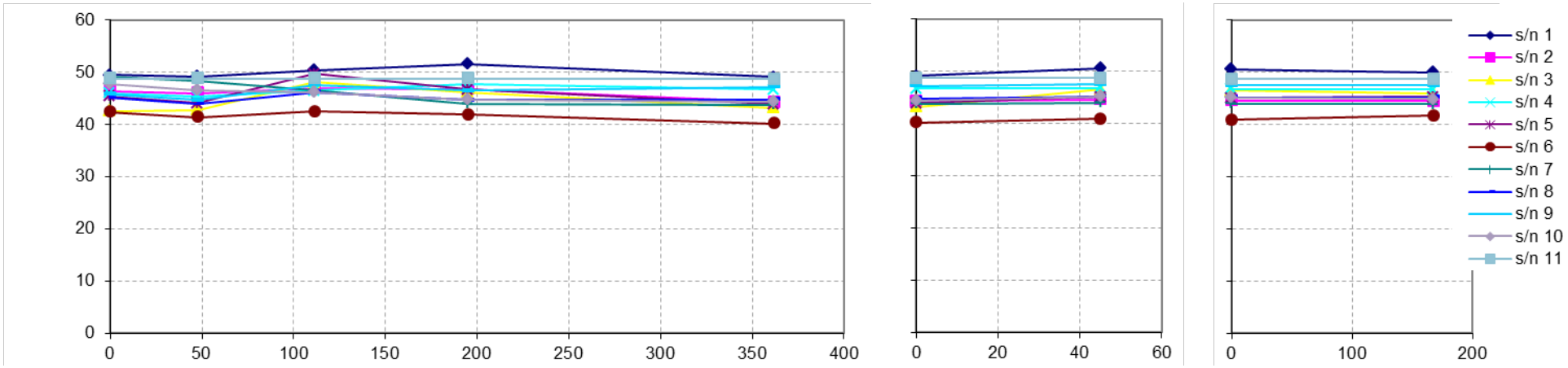

Figure 4

Table 8 **Collector-Emitter Cut-off Current (high voltage) - I_{CEXH}**

	Pre-irradiation	47.5 [krad]	111.6 [krad]	195.2 [krad]	362.1 [krad]	Anneal @R.T. 45 h	Ageing @100'C 168 h
1	39.00	35.94	27.70	21.91	22.36	21.97	28.02
2	25.68	26.30	21.84	**(*) 19.89**	**(*) 19.78**	20.61	25.08
3	43.35	39.97	**13.30**	**18.78**	**19.32**	**12.14**	20.43
4	33.07	32.17	**14.16**	**17.93**	**17.76**	**19.38**	24.36
5	34.46	34.69	**12.97**	**15.71**	**15.96**	**18.57**	23.17
6	38.75	38.56	32.96	32.43	29.27	29.54	32.23
7	44.59	42.61	20.98	24.08	21.30	22.41	31.12
8	31.68	32.62	31.98	31.60	26.81	27.63	30.75
9	37.36	38.50	43.18	40.29	34.25	35.50	39.14
10	25.61	23.48	23.02	23.01	21.23	21.59	23.78
11	41.20	43.27	43.33	43.09	43.27	43.43	43.30

Part type: BFY640

limits		
min:	max:	unit
20	100	µA

Expanded uncertainty (k=2)	1.4	%

Note: All values are in µA. *In dark red values below the min limits. (*)Some failures can still considered within the limits due to the relevant uncertainty*

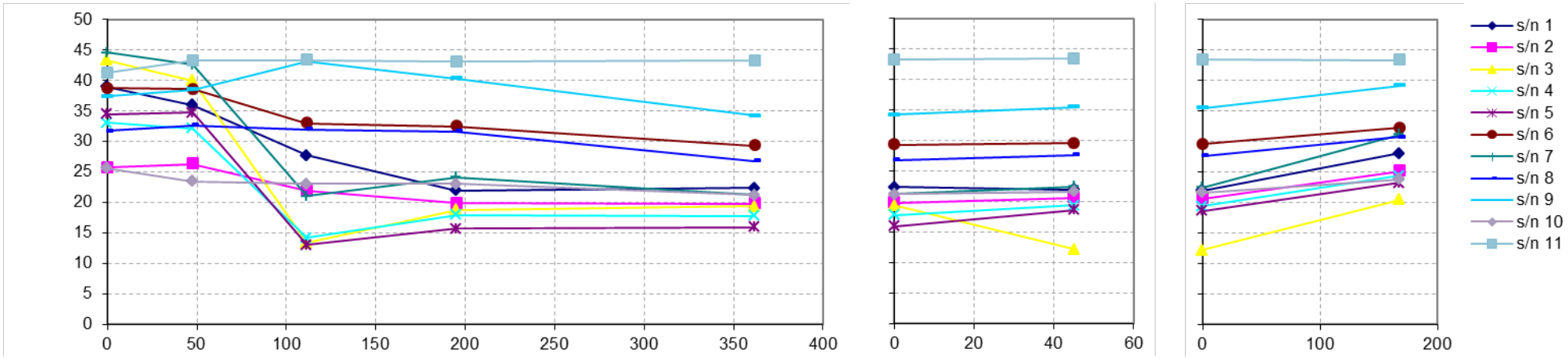

Figure 5

Table 9 **DC Forward Current Transfer Ratio (medium current) - h_{FE}**

	Pre-irradiation	47.5 [krad]	111.6 [krad]	195.2 [krad]	362.1 [krad]	Anneal @R.T. 45 h	Ageing @100'C 168 h
1	143.19	142.87	141.49	141.34	141.39	141.10	141.46
2	140.18	139.94	138.74	139.19	139.03	138.98	139.33
3	142.55	142.11	137.96	138.89	139.51	137.48	137.90
4	142.85	142.40	139.86	140.09	140.51	140.34	140.51
5	140.56	140.11	136.00	137.49	137.44	139.37	139.61
6	142.41	142.04	141.05	140.60	140.80	140.84	140.86
7	146.61	146.11	139.33	139.67	139.80	139.69	140.19
8	141.65	141.30	138.93	139.06	139.10	139.04	138.97
9	140.39	140.04	145.49	145.39	145.62	145.19	145.34
10	139.96	141.36	140.30	140.31	140.37	140.22	139.82
11	143.41	143.59	143.64	143.65	143.73	143.74	143.73

Part type: BFY640

limits		
min:	max:	unit
100	250	-

Expanded uncertainty (k=2)	0.1	%

Note: none

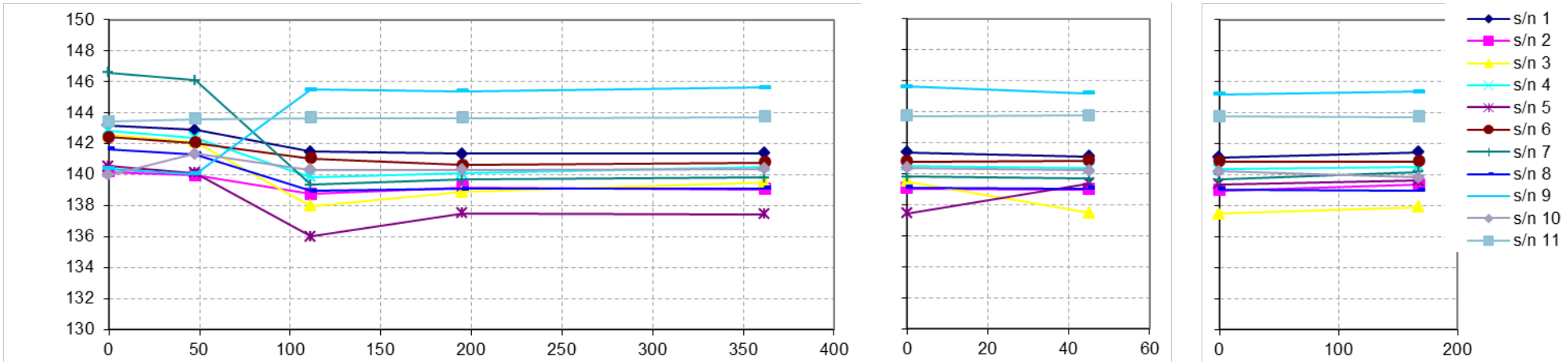

Figure 6

Table 10 **Base-Emitter Forward Voltage - V_{FBE}**

	Pre-irradiation	47.5 [krad]	111.6 [krad]	195.2 [krad]	362.1 [krad]	Anneal @R.T. 45 h	Ageing @100'C 168 h
1	937.2	937.5	937.1	936.2	936.4	936.4	936.6
2	936.8	936.9	935.7	935.7	937.3	935.4	935.6
3	937.1	937.1	937.8	936.6	937.3	936.6	936.7
4	936.3	936.7	937.5	936.1	935.6	935.8	935.6
5	936.8	937.1	936.6	936.0	937.1	935.7	935.2
6	936.7	936.6	935.4	936.0	935.3	935.6	935.5
7	936.5	936.1	935.4	935.3	936.3	935.9	935.6
8	937.0	936.7	936.1	935.9	936.4	935.8	936.1
9	937.5	937.2	935.0	934.7	935.0	934.3	935.1
10	937.4	937.1	935.9	935.7	936.8	936.2	936.0
11	937.1	937.2	937.2	937.2	937.4	937.5	937.4

Note: All values are in mV

Part type: BFY640

limits		
min:	max:	unit
-	960	mV

Expanded uncertainty (k=2)	0.1	%

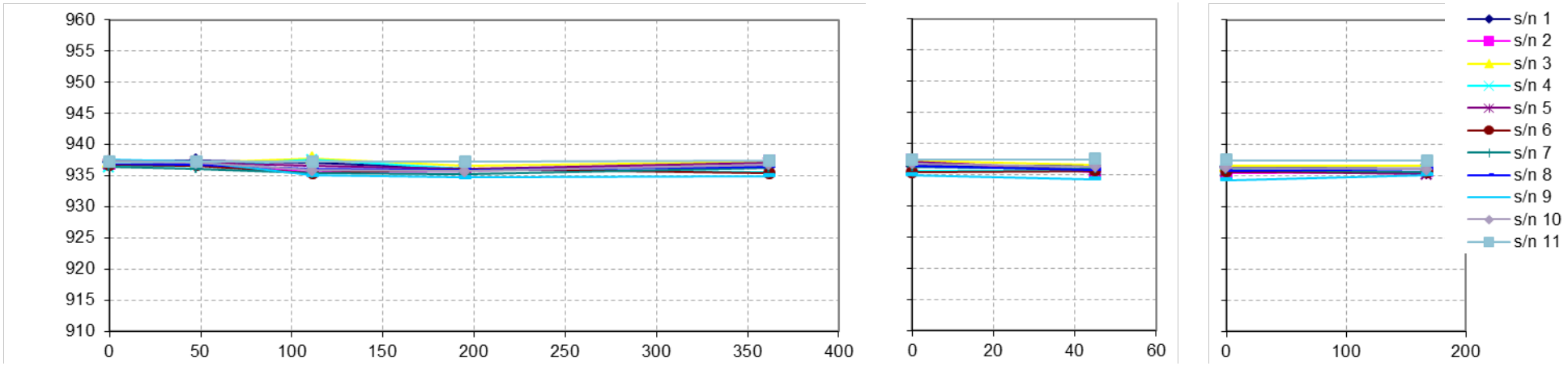

Figure 7

Table 11 **Collector Cut-off Current, Base shorted (low voltage) - I_{CESL}**

	Pre-irradiation	47.5 [krad]	111.6 [krad]	195.2 [krad]	362.1 [krad]	Anneal @R.T. 45 h	Ageing @100'C 168 h
1	22.4	26.5	30.6	32.6	36.6	36.2	32.9
2	22.9	29.8	33.8	35.9	39.6	38.1	33.5
3	22.6	28.7	33.0	35.6	38.3	39.5	34.0
4	23.3	29.8	42.7	36.9	39.5	39.1	35.4
5	23.3	37.7	34.7	35.8	40.1	37.0	35.0
6	22.7	30.6	32.9	73.7	97.1	95.3	74.7
7	21.7	27.1	43.9	82.7	99.3	86.6	68.2
8	23.9	30.7	61.1	79.3	88.6	88.8	79.0
9	23.0	44.7	52.3	75.1	86.6	76.8	46.8
10	23.2	42.9	59.7	76.4	92.8	90.5	82.7
11	21.9	22.7	22.3	21.9	21.9	21.8	20.8

Note: All values are in pA unless differently noted

Part type: BFY640

limits		
min:	max:	unit
-	20E3	pA

Expanded uncertainty (k=2)	2.0	%

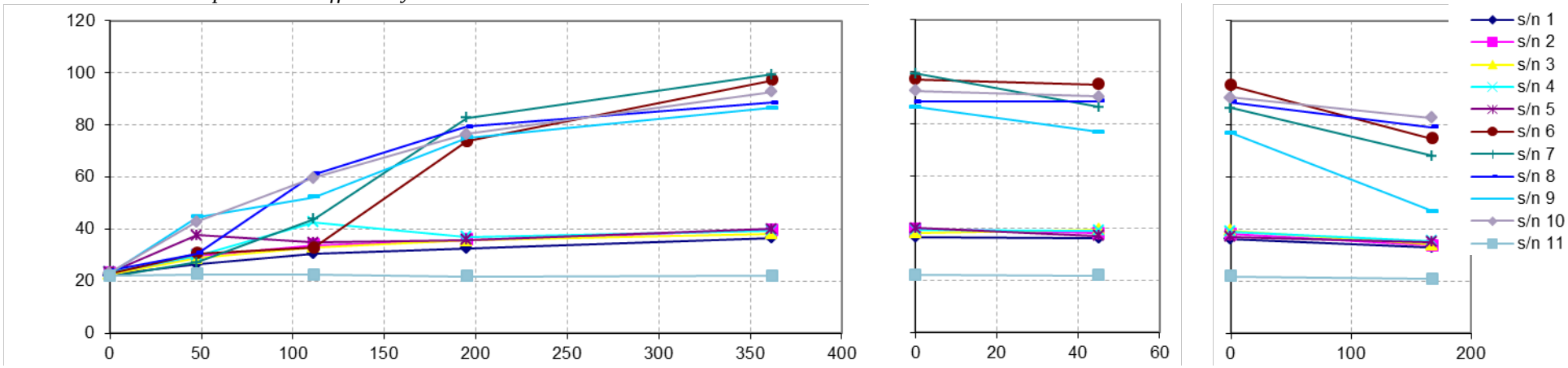

Figure 8

Table 12 **Emitter Cut-off Current (low voltage) - I_{EB0L}**

	Pre-irradiation	47.5 [krad]	111.6 [krad]	195.2 [krad]	362.1 [krad]		Anneal @R.T. 45 h	Ageing @100'C 168 h
1	82.8	81.7	88.0	94.8	90.0		95.1	86.7
2	90.7	88.9	97.2	93.9	83.8		86.0	82.1
3	63.8	65.1	93.6	83.8	73.9		89.0	84.1
4	84.3	82.6	99.9	101.8	97.6		97.8	93.0
5	79.2	74.5	105.7	92.9	81.2		78.4	76.1
6	65.4	62.0	66.1	64.9	61.0		62.8	63.8
7	79.3	77.6	96.9	89.0	88.9		88.4	84.0
8	90.2	85.3	77.0	72.7	75.4		76.1	73.6
9	73.9	71.3	75.6	72.8	76.9		76.7	75.0
10	102.8	86.5	84.0	80.2	78.1		80.5	79.1
11	82.2	78.7	78.3	78.5	78.7		79.0	77.5

Note: All values are in pA

Part type: BFY640

limits		
min:	max:	unit
-	100E3	pA

Expanded uncertainty (k=2)	1.5	%

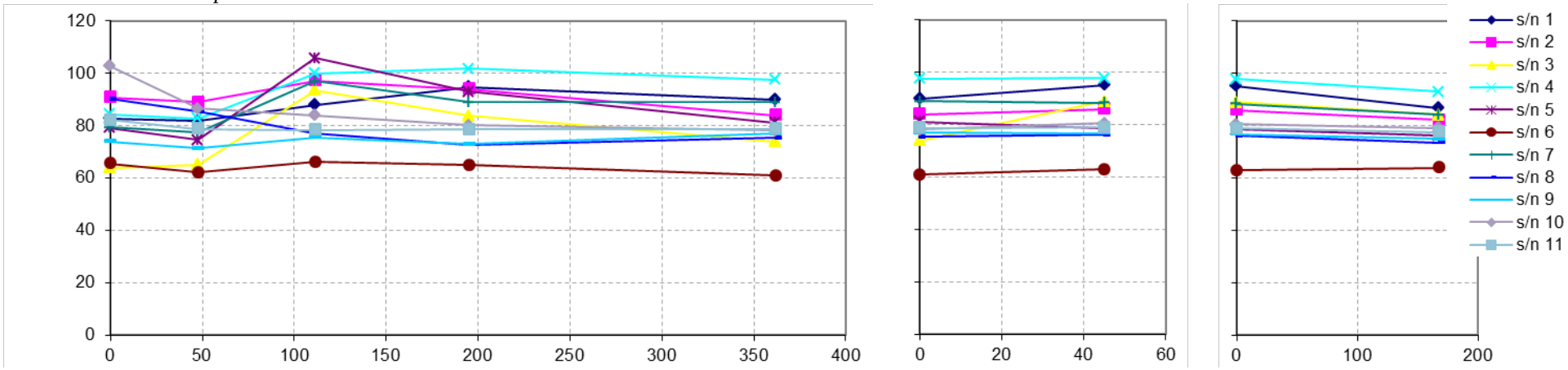

Figure 9

Table 13 **DC Forward Current Transfer Ratio (low current) - h_{FEL}**

	Pre-irradiation	47.5 [krad]	111.6 [krad]	195.2 [krad]	362.1 [krad]	Anneal @R.T. 45 h	Ageing @100'C 168 h
1	200.7	194.3	169.3	151.1	**146.5**	**146.1**	163.4
2	160.7	160.6	**(*) 147.6**	**141.8**	**139.4**	**139.4**	156.5
3	221.1	210.1	**133.0**	**136.1**	**135.0**	**121.4**	**138.4**
4	186.3	182.2	**141.6**	**135.9**	**134.6**	**135.9**	152.8
5	187.9	187.2	**129.7**	**123.2**	**123.7**	**133.8**	150.8
6	206.7	201.9	185.9	180.1	169.9	169.9	178.9
7	219.4	214.4	**(*) 149.4**	151.2	**144.4**	**144.6**	174.3
8	182.6	181.3	182.3	175.2	164.4	164.4	174.4
9	198.9	200.5	213.3	204.9	188.3	188.9	201.8
10	158.8	150.0	150.0	**(*) 147.8**	**141.8**	**143.5**	151.1
11	215.4	216.4	200.3	217.6	216.8	216.5	217.0

Part type: BFY640

limits		
min:	max:	unit
150	300	-

Expanded uncertainty (k=2)	2.2	%

This parameter is the most sensitive to TID.

Note: - ***In dark red values below the min limits. (*) Some failures can still considered within the limits due to the relevant uncertainty***

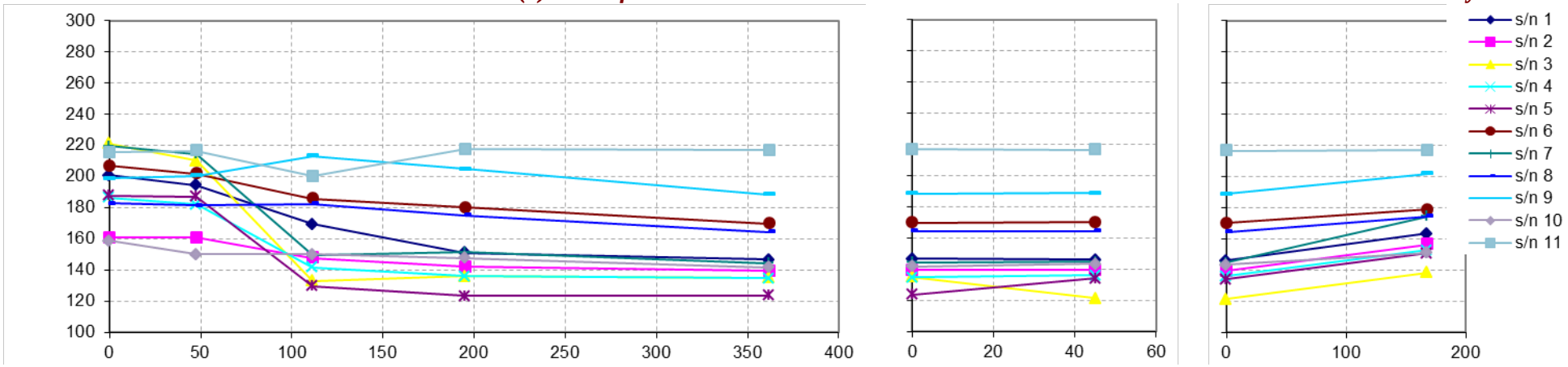

Figure 10

7 SUMMARY OF RESULT AND CONCLUSION ON BFY640

No catastrophic failures were observed during the entire test.
The parameter degradations induced by gamma radiation is summarized in: Table 14, Table 15 and Table 16.
Table 14 reports the total doses, recorded before and after the parameter *out of limit* per applied bias condition.

Table 14 TID levels, in [krad(H2O)], before and after the parameter out of limit, per different BIAS conditions

nr.	Parameter	Unbiased		Biased	
		pass	*fail*	*Pass*	*fail*
1	I_{CESH}	362	-	362	-
2	I_{CESM}	362	-	362	-
3	I_{EB0H}	362	-	362	-
4	I_{CEXH}	47.5	111.6	362	-
5	h_{FE}	362	-	362	-
6	V_{FBE}	362	-	362	-
7	I_{CESL}	362	-	362	-
8	I_{EB0L}	362	-	362	-
9	h_{FEL}	47.5	111.6	111.6	195.2

Table 15 Detail of Failures

nr.	Parameter	Bias conditions	Remarks	Ref. to
4	I_{CEXH}	unbiased	s/n's 03,04, and 05 failed at 111.61 krad(H_2O) and recoverd after the H.T. ageing. S/n 02 showed marginal failure (see note) after 195.2 krad(H_2O) and it recovered after the RT annealing.	Table 8
9	h_{FEL}	unbiased	S/n 01 failed after 362.1 krad(H_2O) and recovered after the R.T. annealing. S/n's 03,04, 05 and 02 (marginal –see note) failed after 111.6 krad(H_2O), S/n's 02, 04 and 05 recovered after the168 hrs H.T. ageing. S/n 3 did not recover after the 168hrs H.T. ageing.	Table 13
		biased	S/n's 07 and 10 failed after 362.1 krad(H_2O) and recovered after the R.T. annealing. The same s/n's showed marginal failure (see note) after 111.6 (s/n 07) and 195.2 (s/n 10) krad(H_2O) .	

Note: marginal failure means that the parameter could be still within the limits taking into account the relevant measurement uncertainty.

Table 16 Summary of TID test results

nr.	Parameter	Remarks	Ref. to
1	I_{CESH}	More sensitive to TID when biased.	Table 5
2	I_{CESM}	More sensitive to TID when biased.	Table 6
3	I_{EB0H}	Not significantly sensitive to TID up to 300krad (H_2O).	Table 7
4	I_{CEXH}	More sensitive to TID when unbiased.	Table 8
5	h_{FE}	Not significantly sensitive to TID up to 300krad (H_2O). No evidence of bias dependence.	Table 9
6	V_{FBE}	Not significantly sensitive to TID up to 300krad (H_2O).. No evidence of bias dependence.	Table 10
7	I_{CESL}	More sensitive to TID when biased.	Table 11
8	I_{EB0L}	Not significantly sensitive to TID up to 300krad (H_2O). No evidence of bias dependence.	Table 12
9	h_{FEL}	More sensitive to TID when unbiased. Most critical parameter showing the earliest out of spec condition. Selected for worst case estimation	Table 13

The worse performances were observed on unbiased devices.
The parameter h_{FEL} have been selected as representatives of worst case parameter performances as shown in **Table 17**.

NOTE that the remarks on the test equipment calibration status, (see chapter 5.5) did not substantially change the TID test report results.

Table 17 **DC Forward Current Transfer Ratio (low current) - h_{FEL} - STATISTICS**

	Pre-irradiation	47.5 [krad]	111.6 [krad]	195.2 [krad]	362.1 [krad]	Anneal @R.T. 45 h	Ageing @100'C 168 h
Unbiased devices							
avg	191.3	186.9	144.2	137.6	135.8	135.3	152.4
min	160.7	160.6	129.7	123.2	123.7	121.4	138.4
max	221.1	210.1	169.3	151.1	146.5	146.1	163.4
σ	22.1	18.1	15.7	10.2	8.3	9.1	9.2
Biased devices							
avg	193.3	189.6	176.2	171.9	161.7	162.2	176.1
min	158.8	150.0	149.4	147.8	141.8	143.5	151.1
max	219.4	214.4	213.3	204.9	188.3	188.9	201.8
σ	23.4	25.1	27.0	23.3	19.2	19.0	18.0

Part type: BFY650B

limits		
min:	max:	unit
150	300	-

Note: Error bars -> ±2 σ(362.1krad)

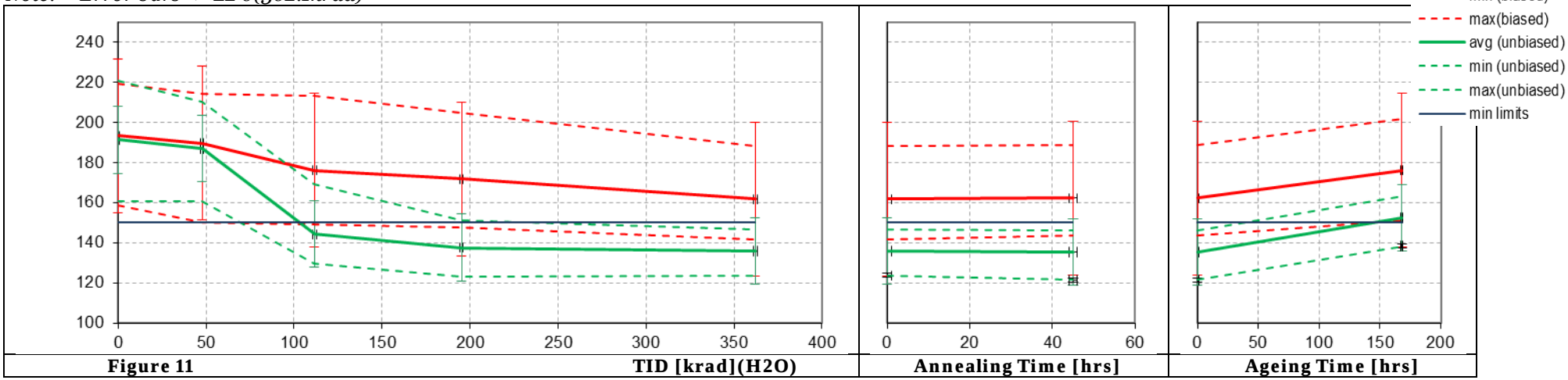

Figure 11 **TID [krad](H2O)** **Annealing Time [hrs]** **Ageing Time [hrs]**

APPENDIX A RADIATION SUMMARY

ESTEC ^{60}Co Facility

Keplerlaan, 1 2200AG Noordwijk Zh (NL)

RADIATION TEST SUMMARY

Irradiation Test Report Number : **20184** *Date :* **04-10-2012**

Test Requester :	*Name*	Infineon Technologies AG Am Campeon 1-12
	Address	85579 Neubiberg Germany
	Personnel present :	M Muschitiello, B Nickson
Project/Cost Code :		ECI
Devices/Components irradiated :		SiGe Transistors
Device/Component details : (conditions and identification)		BFY650B, BFY640B, BFY640 & BFY740B
Dosimetry Chain used :		C
Dosimeter :		Farmer model 2680 – s/n 491
Gas Ionisation Chamber :		NE Type 2571 – s/n 3611
Measured Dosimetry :		Total Ionising Dose in [Gy] (water)
Dosimetry Procedure :		ESCC 22900 section 4.1.1 TEC-QEC/PR001 - Appendix D ***(Total Ionising Dose accredited by RvA according to ISO/IEC 17025.2005 Certificate No. L517)***

(With the exception of the above specified dosimetry equipment, ESTEC ^{60}Co Facility does not assume any liability for the calibration status of any other equipment lent to the requester)

Irradiation Test Campaign Details

Source Activity : 75.3 TBq *on date :* 26-07-2012

	units	*Min.*	*Max.*	Time-weighted Average
Temperature	°C	*25.2*	*26.0*	25.74
Pressure	mbar	*1000.7*	*1027.5*	1014.22
Relative Humidity	%	*33.7*	*45.4*	41.02

Dosimeter position relative to ^{60}Co source		
X	cm	-28.0
Y	cm	225.0
Z	cm	5.0

Run	*Start Date & Time (CET)*	*End Date & Time (CET)*	*Total Ionising Dose [Gy] (water)*	*Dose Rate [Gy/h] (water)*
1	26/07/2012 13:32	31/07/2012 13:41	477.49	3.97
2	31/07/2012 16:31	06/08/2012 09:16	536.83	3.93
3	06/08/2012 10:56	07/08/2012 12:53	101.92	3.93
4	07/08/2012 15:54	16/08/2012 13:01	835.39	3.92

ESTEC ^{60}Co Facility

Keplerlaan, 1 2200AG Noordwijk Zh (NL)

Run	Start Date & Time (CET)	End Date & Time (CET)	Total Ionising Dose [Gy] (water)	Dose Rate [Gy/h] (water)
5	16/08/2012 15:49	17/08/2012 10:21	70.97	3.91
6	17/08/2012 10:36	22/08/2012 10:48	467.44	3.89
7	22/08/2012 10:53	22/08/2012 14:48	15.29	3.90
8	22/08/2012 14:52	24/08/2012 14:11	184.42	3.90
9	24/08/2012 14:16	03/09/2012 12:59	931.41	3.90

Note: *The uncertainty budgets (according to TEC-QEC/PR001 section 12) are: 4.2 % (k=2) for absorbed dose to water and 4.4% (k=2) for absorbed dose rate to water*

Notes: no remarks.

Bob Nickson/Michele Muschitiello
(TEC-QEC Radiation Test Engineer)

Ali Zadeh
(TEC-QEC Section Head)

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