EV12DS480AZP - VN62A - RU516515 - TID Report - Nov2019Nov2019

Revision date :	**19/11/2019**
Author :	**BONNET OLIVIER**
Scope :	**BUSINESS UNIT BMS**

Last revision approved by :

Approved by	Approbation Status	Date
NIKITINE Carine	Oui	19/11/2019

1. DOCUMENT AMENDMENT RECORD

Author	Issue	Date	Reason for change
BONNET Olivier	A	19/11/2019	Creation

INDEX

2. GLOSSARY

CRÈME	Cosmic Ray Effects on Micro-Electronics
DAC	Digital-to-Analog Converter
DC	Direct Current
DSP	Digital Signal Processor
DUT	Device Under Test
HF	High Frequency
HIF	Heavy Ions Facility
IUCM	Input Under Clocking Mode
LED	Light-Emitting Diode
LET	Linear Energy Transfer
MTBF	Mean Time Between Failure
MUX	MUltipleXer
NRTZ	Narrow Return To Zero
NRZ	Non Return to Zero
OCDS	Output Clock Division Select Function
OMERE	Modelization tool for extern radiative environment
PSS	Phase Shift Select Function
RADEF	RADiation Effects Facility (Jyväskylä University laboratory, Finland)
RF	Radio Frequency
RTZ	Return To Zero
SEE	Single Event Effect
SEFI	Single Event Functional Interrupt
SEL	Single Event Latchup
SET	Single Event Transient

3. INTRODUCTION

This report describes the tests performed on the device EV12DS480AMZP (Infineon B7HF200 technology, mask VN62A) to determine its sensitivity to the total ionizing dose (TID) at 150Krad with a low dose rate of 36rad/h (10mrad/s).

4. APPLICABLE AND REFERENCE DOCUMENTS

[AD01]	EV12DS480AZP Low power 12-bit 8GSps Digital to Analog Converter with 4/2:1 Multiplexer Datasheet DS 60S 217580 rev A.1
[AD02]	ESA ESCC Specification 22900 – Total Dose Steady-State Irradiation Test Method
[AD03]	MIL-STD-883J Method 1019.9 – Ionizing Radiation (Total Dose) Test Procedure
[AD04]	ASTM 1892-12 – Standard Guide for ionizing Radiation (Total Dose) Effect Testing of Semiconductors Devices
[AD05]	TRAD RADIATION ASSISTANCE TEST REPORT TRAD/ATR/EV12DS480/XXX2/EDV/MF/1904

5. IRRADIATION FACILITY

The tests have been performed at TRAD (Toulouse) by using a Co60 source.

The Co60 irradiation certificate is available in the Annex 1 of this document.

6. EXECUTIVE SUMMARY

6.1 Lot description

Reference	EV12DS480AZP
Package	FpBGA
Function	Low power 12-bit 8GSps Digital to Analog Converter
Technology	Infineon B7HF200
Lot No.	RU516515
Mfr. No.	EV12DS480AMZP-N1
Mask Lot	VN62A
Front End Date Code	1527
Manufacturer	Teledyne E2V

6.2 Total dose

Ten devices, five ON, five OFF, were tested, with a dose rate of 36rad/h and up to a total dose of 150Krad(Si).

The total irradiation test program was followed by a 24 hr. annealing process at ambient temperature, followed by a 168 hr. annealing at 100°C as per ESCC 22900.

The device under test (P/N EV12DS480AMZP-N1) had neither functional failure nor parameter drift up to 150 Krad (Si) with a dose rate of 36rad/h (10mrad/s).

7. TOTAL DOSE TESTS

7.1 Part references

12 parts have been used for these tests, 5 part biased ON, 5 parts biased OFF and 2 reference parts.

Serial number	63	66	67	73	74	75	78	80	154	156	3	9
Bias mode	ON					OFF					REF	

7.2 Bias conditions

Vcca5	5V
Vccd	3.3V
Vcca3	3.3V
Input Clock Frequency	400MHz
Port A&C	101010101010
Port B&D	010101010101

7.3 Dosimetry and irradiation facility

Irradiation Source	^{60}Co
Source Location	Labège (TRAD, France)
Irradiation equipment	GAMRAY
Dosimetry equipment	PTW

7.4 Target Dose 150KRad

Total Dose Limit (KRad(Si))	150KRad					
Total Dose Steps	0	18	35	75	100	150
Dose rate (Rad(Si)/h)	36Rad/H					

7.5 Annealing

24h at room temperature and 168h at 100°c.

7.6 Intermediate measurements

Conditions:

- Ambient temperature
- Socketed Evaluation board
- Nominal power supplies

Measurements:

- Power consumption
- Leakage current
- Dynamic measurements

SFDR:

Index	Mode	Fclock (MHz)	MUX	Fout (MHz)	IUCM
1	RF	8000	4	8020	4
2	RF	8000	4	8980	4
3	RF	8500	4	8521,25	4
4	RF	8500	4	9541,25	4
5	NRZ	6400	4	64	1
6	NRTZ	6400	4	6336	1
7	RTZ	6400	4	6336	1
8	RF	6400	4	9664	1

NPR:

Index	Mode	Fclock (MHz)	MUX	Start (MHz)	End (MHz)	IUCM
1	RF	8000	4	8020	9980	2
2	RF	8500	4	8521,25	10603,75	2
3	RF	8000	4	8010	8990	4
4	RF	8500	4	8510,625	9551,875	4
5	NRTZ	6400	4	8510,625	9551,875	1

8. TOTAL DOSE RESULTS

8.1 Power Consomption

		Steps							
Part	Current(A) & Power(W)	0 Krad	15 Krad	30 Krad	75 Krad	100 Krad	150 Krad	24H Annealing	168H Annealing
3	Vcca5	100	100	100	100	(✕)	100	100	100
	Vcca3	408	408	407	409	(✕)	406	405	406
	VccD	204	203	200	204	(✕)	203	203	201
	Consumption	2,520	2,516	2,503	2,523	(✕)	2,510	2,506	2,503
9	Vcca5	99	99	99	99	99	99	99	99
	Vcca3	408	409	409	409	407	409	408	407
	VccD	200	200	200	200	200	201	201	201
	Consumption	2,501	2,505	2,505	2,505	2,498	2,508	2,505	2,501
63	Vcca5	100	100	100	100	100	100	100	101
	Vcca3	411	414	408	406	405	406	407	418
	VccD	197	200	197	197	197	197	198	202
	Consumption	2,506	2,526	2,497	2,490	2,487	2,490	2,497	2,551
66	Vcca5	100	100	100	99	100	99	100	101
	Vcca3	410	409	407	406	404	405	405	417
	VccD	198	198	197	197	198	198	199	202
	Consumption	2,506	2,503	2,493	2,485	2,487	2,485	2,493	2,548
67	Vcca5	99	99	99	99	99	99	99	100
	Vcca3	407	406	405	405	403	406	406	417
	VccD	202	201	200	201	202	203	203	207
	Consumption	2,505	2,498	2,492	2,495	2,492	2,505	2,505	2,559
73	Vcca5	100	100	100	100	100	100	100	101
	Vcca3	407	405	406	405	404	406	406	418
	VccD	198	198	199	199	200	201	201	205
	Consumption	2,497	2,490	2,497	2,493	2,493	2,503	2,503	2,561
74	Vcca5	99	99	99	99	99	99	99	100
	Vcca3	407	406	408	405	401	405	402	417
	VccD	200	199	201	199	198	200	200	205
	Consumption	2,498	2,492	2,505	2,488	2,472	2,492	2,482	2,553
75	Vcca5	100	100	100	100	100	100	100	100
	Vcca3	403	401	400	399	397	399	398	400
	VccD	196	196	196	196	195	196	196	196
	Consumption	2,477	2,470	2,467	2,464	2,454	2,464	2,460	2,467
78	Vcca5	100	100	100	100	99	100	100	100
	Vcca3	407	404	404	404	401	405	401	401
	VccD	196	195	195	195	194	196	194	195
	Consumption	2,490	2,477	2,477	2,477	2,459	2,483	2,464	2,467
80	Vcca5	100	99	99	99	99	99	99	99
	Vcca3	400	400	399	400	395	396	395	396
	VccD	201	201	201	201	200	200	200	200
	Consumption	2,483	2,478	2,475	2,478	2,459	2,462	2,459	2,462
154	Vcca5	99	99	99	99	99	99	99	100
	Vcca3	405	404	404	402	400	401	400	401
	VccD	196	196	195	195	195	195	195	195
	Consumption	2,478	2,475	2,472	2,465	2,459	2,462	2,459	2,467
156	Vcca5	99	99	99	99	99	99	99	100
	Vcca3	411	411	410	409	407	408	405	408
	VccD	198	198	198	197	197	197	197	198
	Consumption	2,505	2,505	2,501	2,495	2,488	2,492	2,482	2,500

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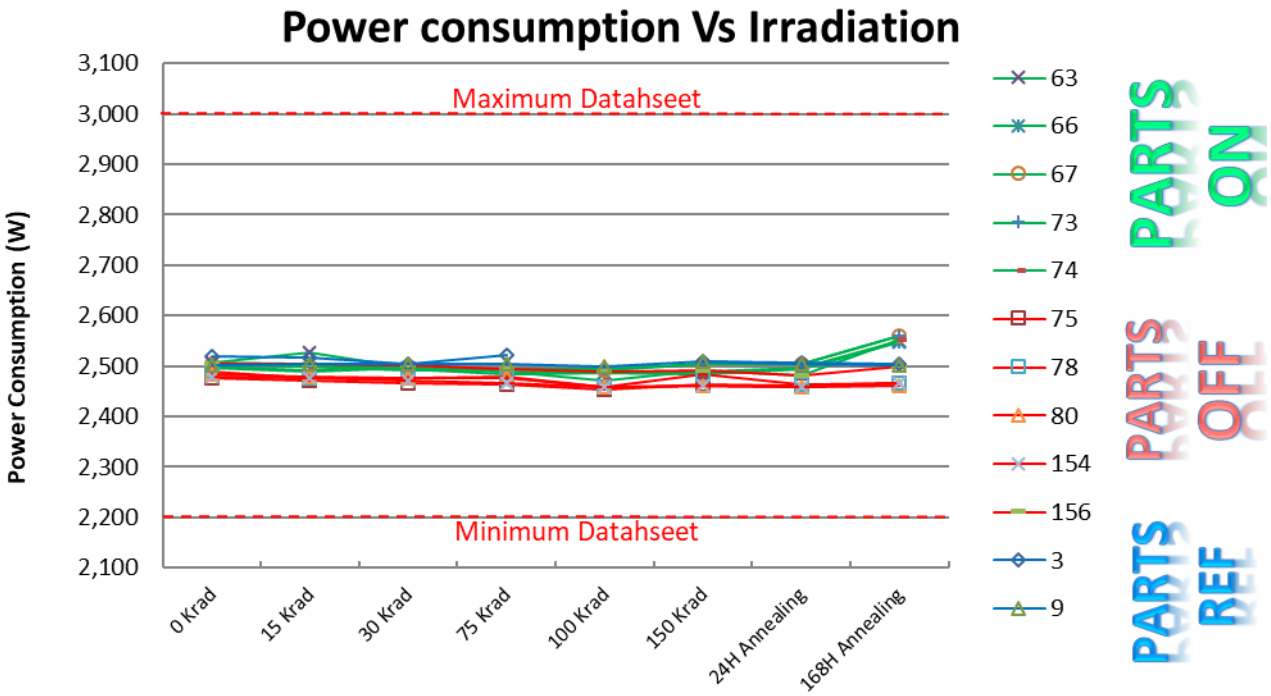


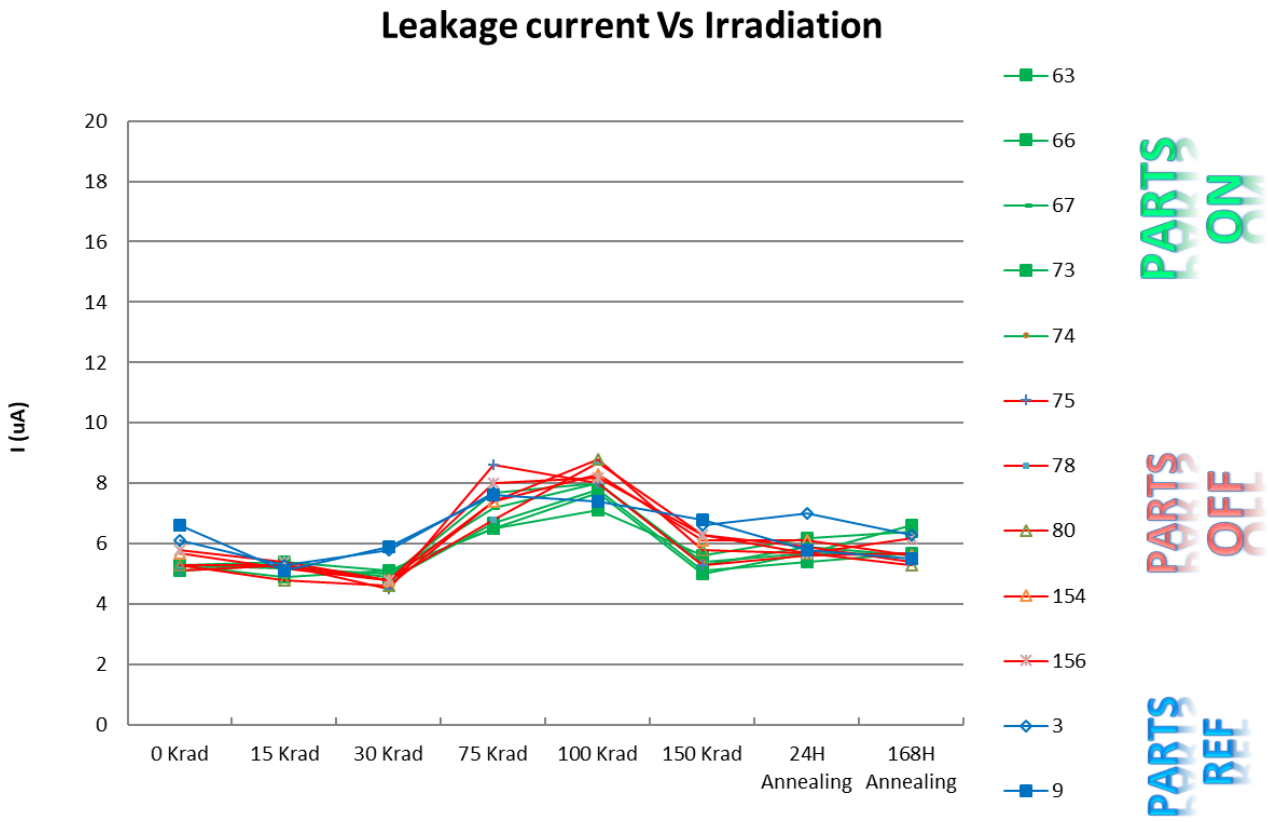
Conclusion:

There is no impact of TID on the power consumption up to 150Krad.

8.2 Leakage Current

Part	Leakage Current	Steps							
		0 Krad	15 Krad	30 Krad	75 Krad	100 Krad	150 Krad	24H Annealing	168H Annealing
3	PSS (uA)	6,1	5,30	5,80	7,70	(✗)	6,60	7,00	6,30
9	PSS (uA)	6,6	5,10	5,90	7,60	7,40	6,80	5,80	5,50
63	PSS (uA)	5,3	5,40	5,10	6,50	7,10	5,60	6,20	6,40
66	PSS (uA)	5,3	4,90	5,10	6,50	7,70	5,00	5,70	6,60
67	PSS (uA)	5,3	5,20	5,00	7,20	8,00	5,30	5,90	5,60
73	PSS (uA)	5,1	5,30	4,80	6,70	7,80	5,10	5,40	5,70
74	PSS (uA)	5,3	5,30	4,90	7,70	8,00	5,40	5,70	5,70
75	PSS (uA)	5,1	5,30	4,50	8,60	8,00	5,30	5,60	5,70
78	PSS (uA)	5,3	5,30	4,80	6,80	8,70	6,30	5,90	5,40
80	PSS (uA)	5,3	4,80	4,60	7,40	8,80	5,80	5,70	5,30
154	PSS (uA)	5,7	5,20	4,80	7,40	8,30	6,10	6,10	5,60
156	PSS (uA)	5,8	5,40	4,80	8,00	8,20	6,30	5,70	6,20

(✗) Data not available



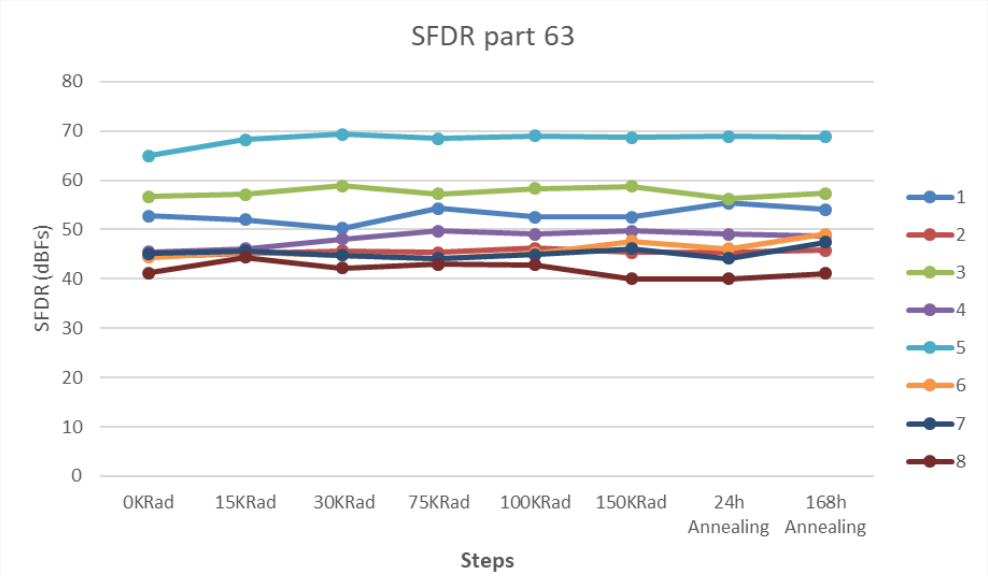
Conclusion:

The small variation is visible on the reference parts too, so there is no impact of TID on the leakage current up to 150KRad.

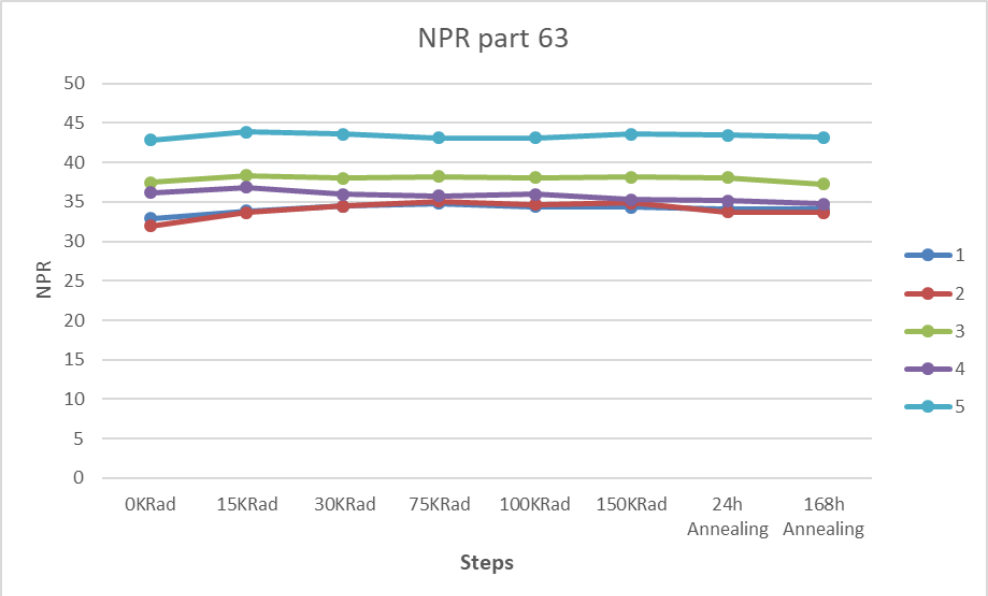
8.3 FFT Results

8.3.1 Part 63 (Part ON)

Index	Mode	Flock	MUX	Fout	IUCM	0KRad	15KRad	30KRad	75KRad	100KRad	150KRad	24h Annealing	168h Annealing
1	RF	8000	4	8020	4	52,77	51,97	50,26	54,32	52,57	52,52	55,35	54,02
2	RF	8000	4	8980	4	44,62	45,12	45,63	45,3	46,19	45,4	45,42	45,84
3	RF	8500	4	8521,25	4	56,67	57,1	58,85	57,24	58,27	58,74	56,23	57,35
4	RF	8500	4	9541,25	4	45,5	46,12	48,1	49,72	49,02	49,74	49,04	48,73
5	NRZ	6400	4	64	1	65,01	68,21	69,3	68,47	69,01	68,68	68,86	68,83
6	NRTZ	6400	4	6336	1	44,32	45,32	44,84	44	45,23	47,65	46,14	49,11
7	RTZ	6400	4	6336	1	45,16	45,63	44,79	44,18	44,9	46,15	44,17	47,46
8	RF	6400	4	9664	1	41,16	44,41	42,2	42,95	42,85	40,03	39,96	41,08

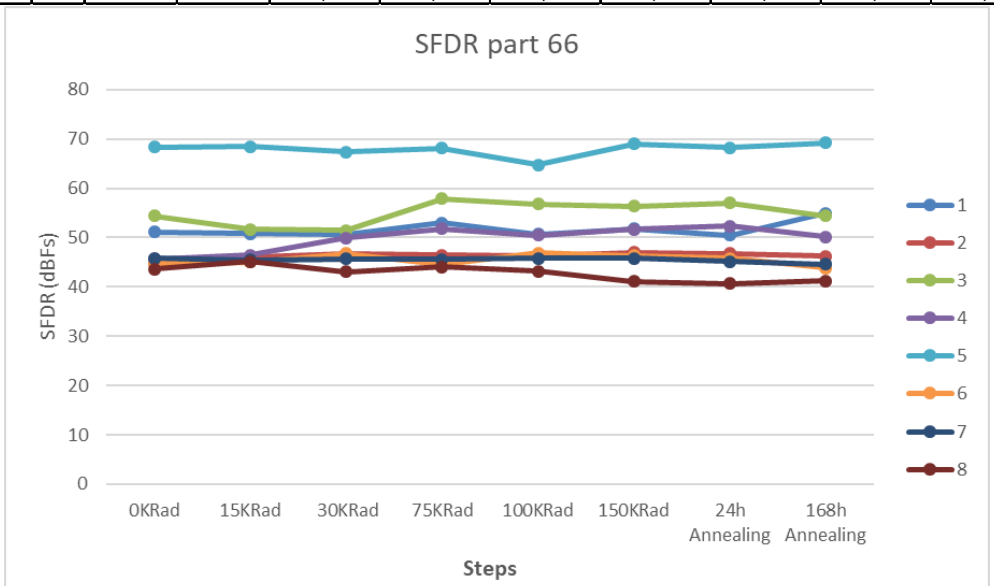


Index	Mode	Fclock	MUX	Start	End	IUCM	0KRad	15KRad	30KRad	75KRad	100KRad	150KRad	24h Annealing	168h Annealing
1	RF	8000	4	8020	9980	2	32,89	33,86	34,45	34,79	34,39	34,33	34,11	34,07
2	RF	8500	4	8521,25	10603,75	2	31,97	33,65	34,45	35,11	34,7	34,88	33,72	33,65
3	RF	8000	4	8010	8990	4	37,48	38,33	37,99	38,21	38,07	38,16	38,07	37,24
4	RF	8500	4	8510,625	9551,875	4	36,18	36,84	35,97	35,79	35,97	35,3	35,16	34,73
5	NRTZ	6400	4	8510,625	9551,875	1	42,88	43,84	43,6	43,11	43,15	43,58	43,45	43,16

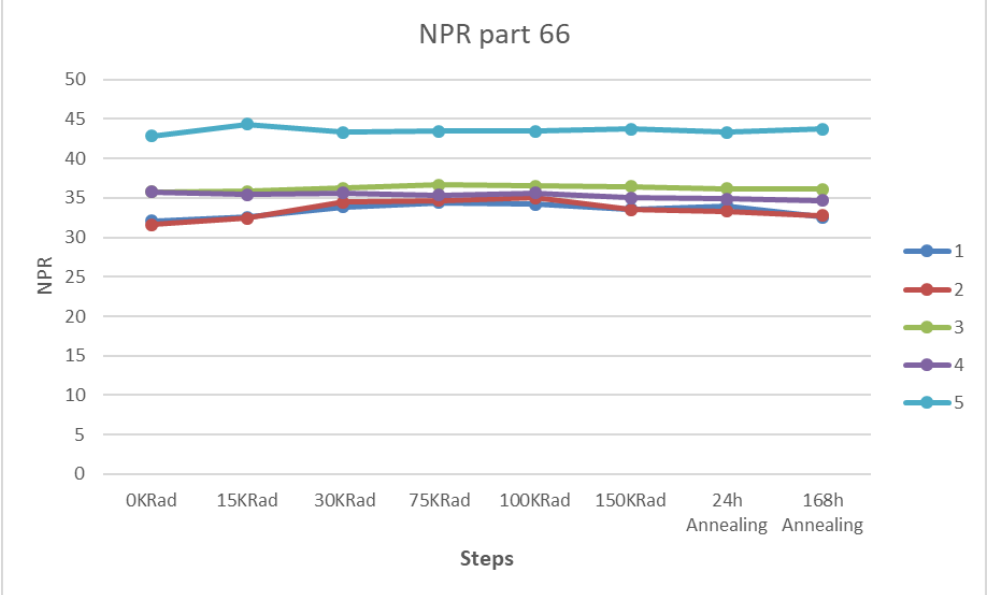


8.3.2 Part 66 (Part ON)

Index	Mode	Flock	MUX	Fout	IUCM	0KRad	15KRad	30KRad	75KRad	100KRad	150KRad	24h Annealing	168h Annealing
1	RF	8000	4	8020	4	51,11	50,78	50,71	53	50,67	51,73	50,45	54,91
2	RF	8000	4	8980	4	44,93	46,14	46,68	46,42	46,36	46,95	46,77	46,23
3	RF	8500	4	8521,25	4	54,39	51,69	51,48	57,84	56,84	56,37	56,97	54,39
4	RF	8500	4	9541,25	4	45,71	46,42	49,96	51,82	50,47	51,72	52,28	50,15
5	NRZ	6400	4	64	1	68,3	68,4	67,4	68,15	64,71	68,98	68,24	69,2
6	NRTZ	6400	4	6336	1	44,7	45,06	46,73	44,64	46,87	46,32	45,83	43,8
7	RTZ	6400	4	6336	1	45,76	45,46	45,69	45,59	45,84	45,78	45,1	44,64
8	RF	6400	4	9664	1	43,56	45,16	43,04	44,03	43,21	41,07	40,64	41,21

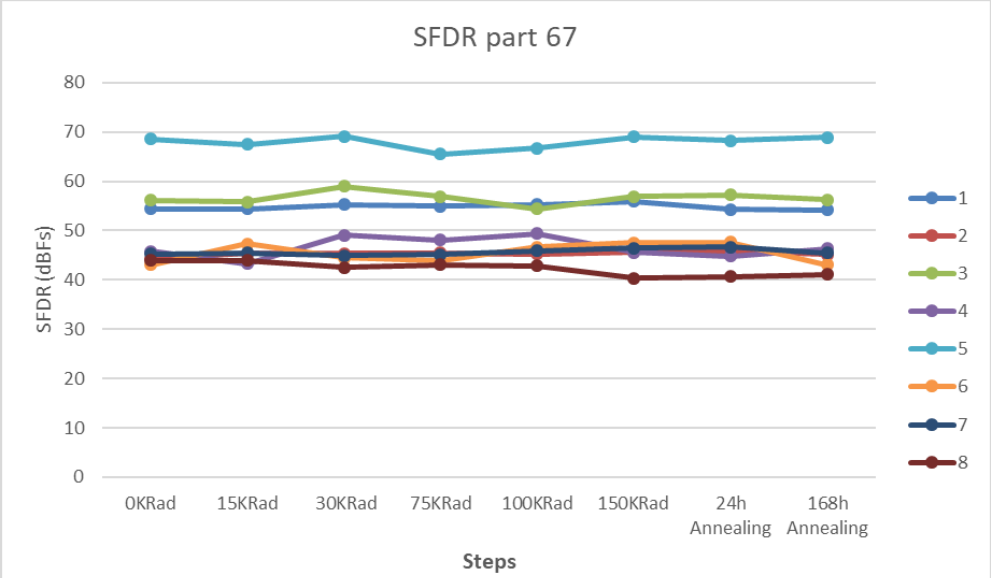


Index	Mode	Fclock	MUX	Start	End	IUCM	0KRad	15KRad	30KRad	75KRad	100KRad	150KRad	24h Annealing	168h Annealing
1	RF	8000	4	8020	9980	2	32,09	32,58	33,89	34,4	34,2	33,58	34	32,57
2	RF	8500	4	8521,25	10603,75	2	31,59	32,45	34,48	34,69	34,99	33,5	33,32	32,75
3	RF	8000	4	8010	8990	4	35,74	35,84	36,27	36,68	36,5	36,46	36,16	36,09
4	RF	8500	4	8510,625	9551,875	4	35,76	35,45	35,63	35,35	35,61	35,01	34,87	34,71
5	NRTZ	6400	4	8510,625	9551,875	1	42,84	44,33	43,36	43,47	43,48	43,75	43,3	43,77

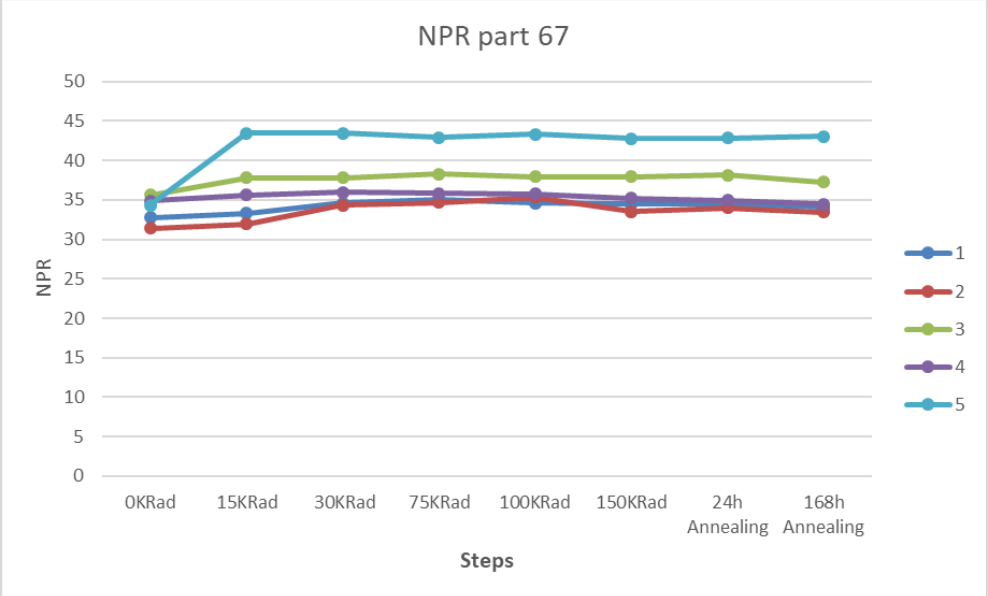


8.3.3 Part 67 (Part ON)

Index	Mode	Flock	MUX	Fout	IUCM	0KRad	15KRad	30KRad	75KRad	100KRad	150KRad	24h Annealing	168h Annealing
1	RF	8000	4	8020	4	54,39	54,41	55,31	54,97	55,23	55,95	54,31	54,18
2	RF	8000	4	8980	4	44,27	45,38	45,35	45,46	45,2	45,71	45,92	45,15
3	RF	8500	4	8521,25	4	56,13	55,76	59	56,9	54,4	56,93	57,19	56,27
4	RF	8500	4	9541,25	4	45,84	43,31	49,05	48,06	49,36	45,57	44,78	46,33
5	NRZ	6400	4	64	1	68,59	67,51	69,16	65,54	66,67	68,96	68,19	68,88
6	NRTZ	6400	4	6336	1	43,01	47,31	44,5	43,93	46,65	47,54	47,66	43,04
7	RTZ	6400	4	6336	1	45,21	45,41	44,87	45,14	45,86	46,39	46,63	45,51
8	RF	6400	4	9664	1	43,9	43,9	42,54	43,1	42,83	40,37	40,72	41,14

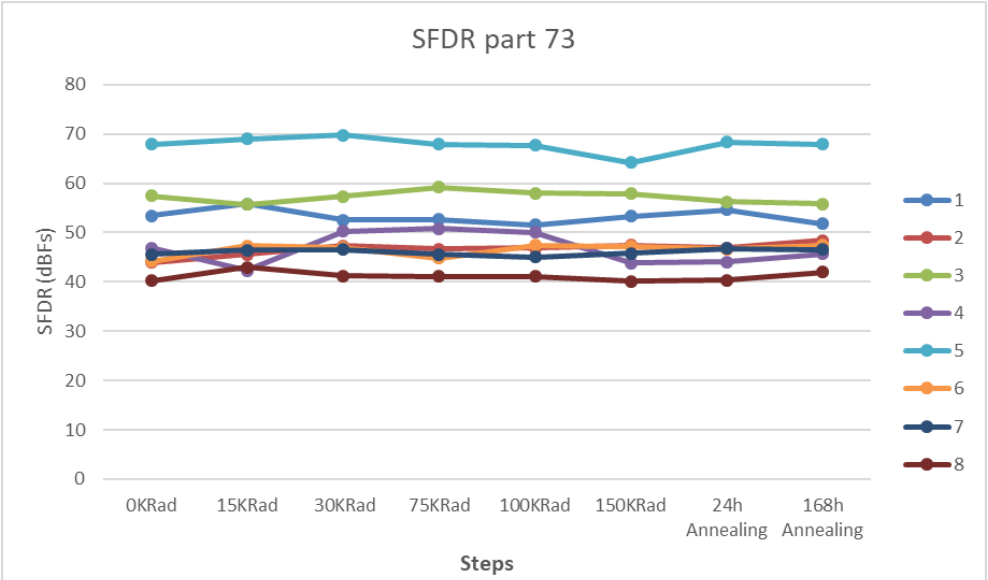


Index	Mode	Fclock	MUX	Start	End	IUCM	0KRad	15KRad	30KRad	75KRad	100KRad	150KRad	24h Annealing	168h Annealing
1	RF	8000	4	8020	9980	2	32,76	33,29	34,6	35,11	34,64	34,48	34,48	34,05
2	RF	8500	4	8521,25	10603,75	2	31,38	31,96	34,34	34,7	35,38	33,5	34,02	33,42
3	RF	8000	4	8010	8990	4	35,65	37,8	37,78	38,27	37,93	37,98	38,16	37,25
4	RF	8500	4	8510,625	9551,875	4	34,9	35,61	35,98	35,86	35,77	35,25	34,98	34,46
5	NRTZ	6400	4	8510,625	9551,875	1	34,33	43,46	43,45	42,92	43,36	42,78	42,84	43,06

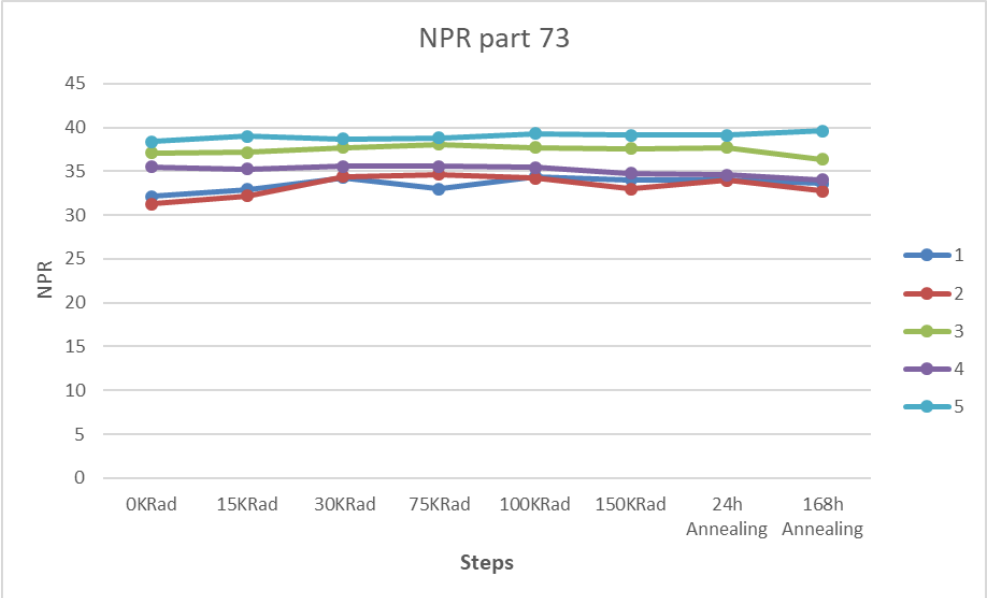


8.3.4 Part 73 (Part ON)

Index	Mode	Flock	MUX	Fout	IUCM	0KRad	15KRad	30KRad	75KRad	100KRad	150KRad	24h Annealing	168h Annealing
1	RF	8000	4	8020	4	53,47	55,77	52,52	52,6	51,57	53,34	54,6	51,83
2	RF	8000	4	8980	4	43,98	45,55	47,26	46,7	46,88	47,42	46,86	48,38
3	RF	8500	4	8521,25	4	57,46	55,7	57,32	59,17	57,95	57,92	56,24	55,84
4	RF	8500	4	9541,25	4	46,86	42,26	50,23	50,76	50,01	43,8	44,07	45,67
5	NRZ	6400	4	64	1	67,9	69,03	69,74	67,89	67,7	64,15	68,37	67,93
6	NRTZ	6400	4	6336	1	44,18	47,35	46,99	44,86	47,39	47,16	46,67	47,38
7	RTZ	6400	4	6336	1	45,52	46,47	46,6	45,55	45	45,77	46,77	46,56
8	RF	6400	4	9664	1	40,25	43	41,2	41,05	41,05	40,16	40,39	41,99

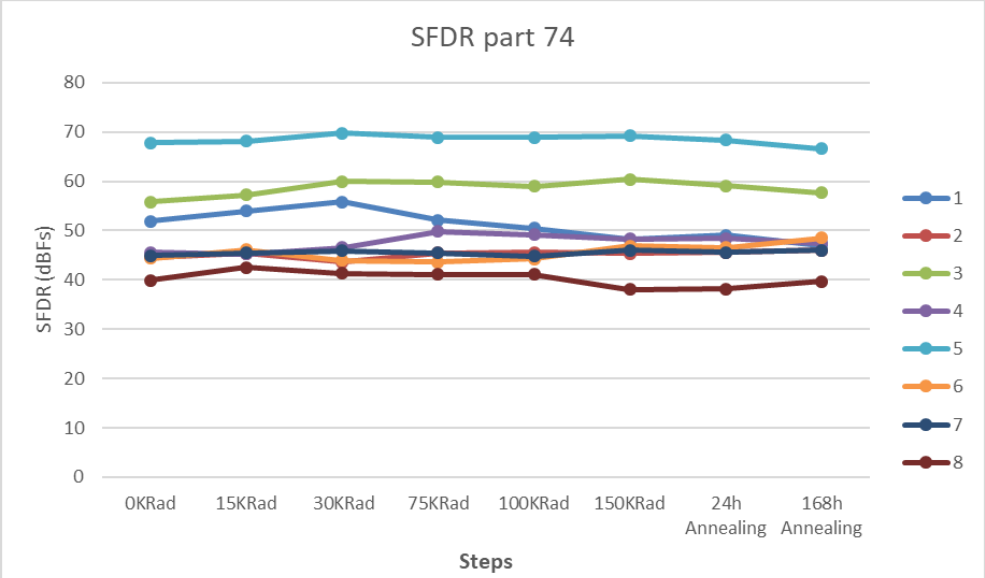


Index	Mode	Fclock	MUX	Start	End	IUCM	0KRad	15KRad	30KRad	75KRad	100KRad	150KRad	24h Annealing	168h Annealing
1	RF	8000	4	8020	9980	2	32,14	32,93	34,3	32,96	34,38	34,05	34,05	33,62
2	RF	8500	4	8521,25	10603,75	2	31,28	32,18	34,42	34,67	34,2	32,97	33,95	32,76
3	RF	8000	4	8010	8990	4	37,07	37,14	37,73	38,08	37,72	37,61	37,73	36,38
4	RF	8500	4	8510,625	9551,875	4	35,5	35,24	35,58	35,55	35,42	34,77	34,59	34,02
5	NRTZ	6400	4	8510,625	9551,875	1	38,39	39	38,71	38,82	39,31	39,11	39,1	39,61

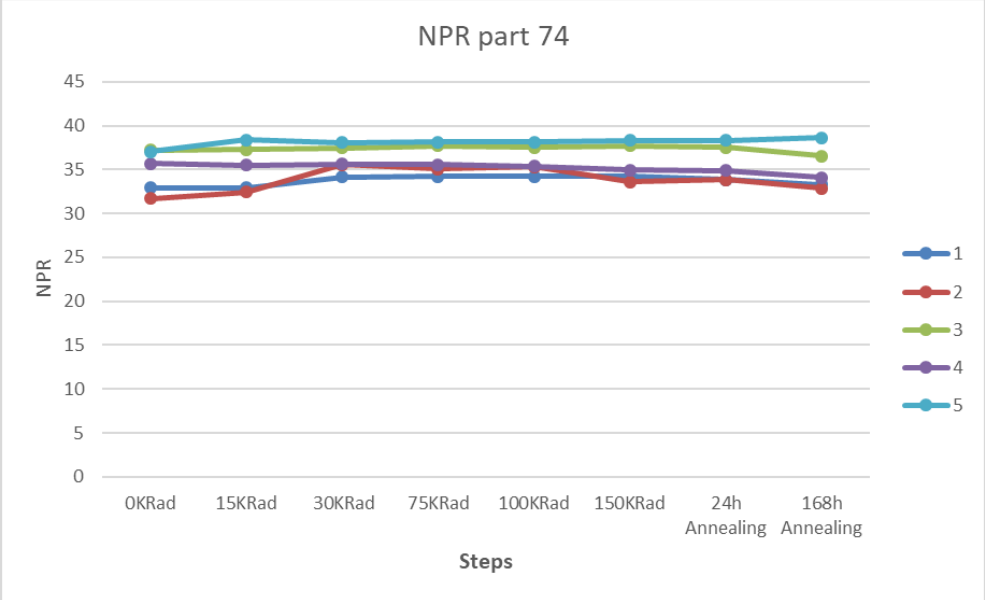


8.3.5 Part 74 (Part ON)

Index	Mode	Flock	MUX	Fout	IUCM	0KRad	15KRad	30KRad	75KRad	100KRad	150KRad	24h Annealing	168h Annealing
1	RF	8000	4	8020	4	51,84	53,98	55,78	52,15	50,5	48,18	49,03	47,04
2	RF	8000	4	8980	4	44,55	45,33	43,6	45,43	45,62	45,38	45,53	46,05
3	RF	8500	4	8521,25	4	55,82	57,2	59,95	59,86	58,96	60,37	59,04	57,72
4	RF	8500	4	9541,25	4	45,53	45,22	46,5	49,8	49,14	48,32	48,44	47,4
5	NRZ	6400	4	64	1	67,85	68,09	69,81	68,86	68,89	69,27	68,3	66,64
6	NRTZ	6400	4	6336	1	44,37	46,15	43,93	43,63	44,24	46,9	46,6	48,51
7	RTZ	6400	4	6336	1	44,87	45,46	45,94	45,48	44,82	46	45,55	46,04
8	RF	6400	4	9664	1	39,85	42,49	41,27	41,15	41,09	38,1	38,18	39,72

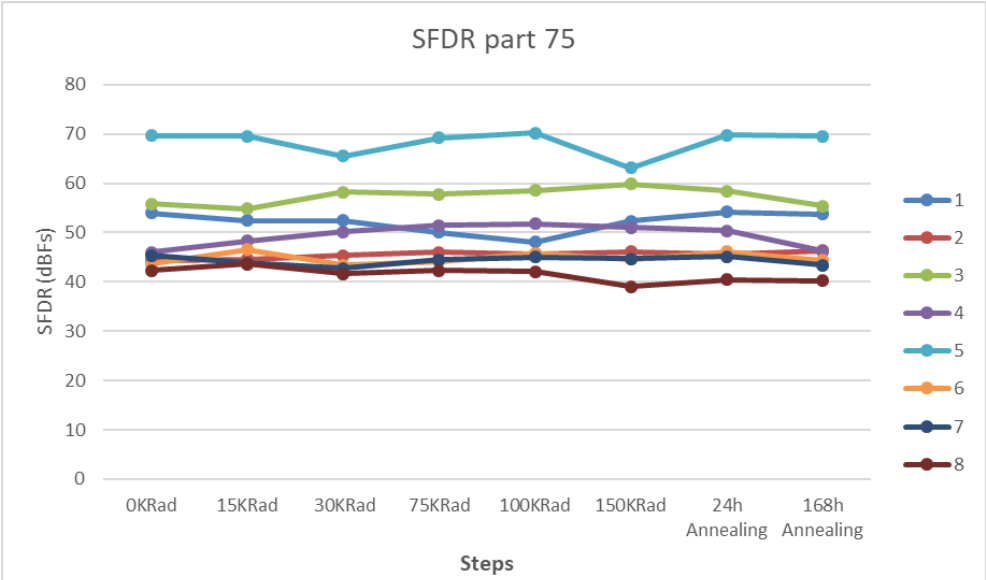


Index	Mode	Fclock	MUX	Start	End	IUCM	0KRad	15KRad	30KRad	75KRad	100KRad	150KRad	24h Annealing	168h Annealing
1	RF	8000	4	8020	9980	2	32,9	32,95	34,15	34,19	34,22	34,24	33,85	33,3
2	RF	8500	4	8521,25	10603,75	2	31,68	32,45	35,56	35,09	35,34	33,6	33,86	32,89
3	RF	8000	4	8010	8990	4	37,19	37,25	37,44	37,71	37,54	37,73	37,54	36,55
4	RF	8500	4	8510,625	9551,875	4	35,68	35,51	35,6	35,54	35,35	34,92	34,91	34,11
5	NRTZ	6400	4	8510,625	9551,875	1	37,02	38,41	38,09	38,12	38,13	38,33	38,3	38,6

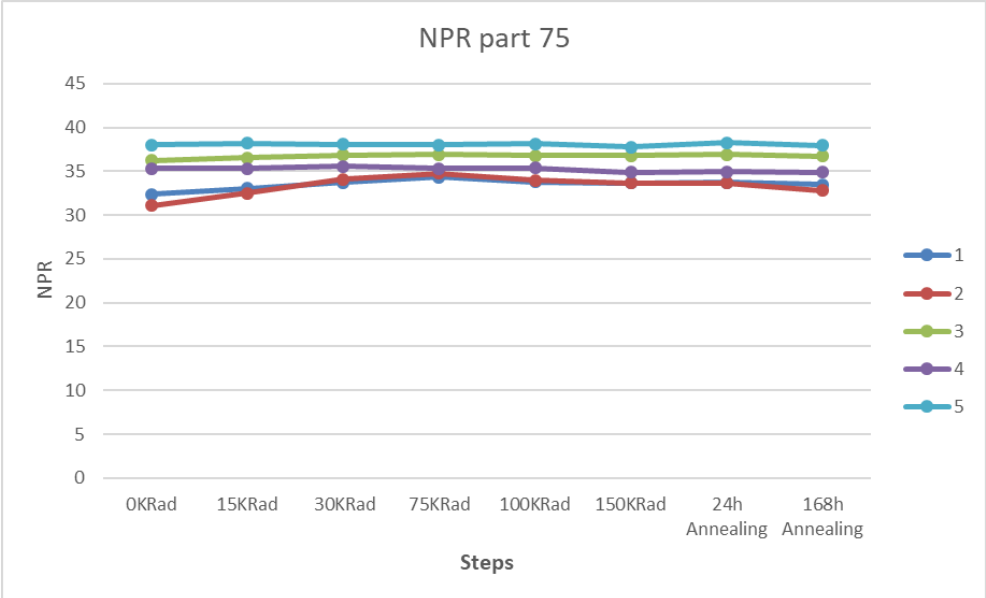


8.3.6 Part 75 (Part OFF)

Index	Mode	Flock	MUX	Fout	IUCM	0KRad	15KRad	30KRad	75KRad	100KRad	150KRad	24h Annealing	168h Annealing
1	RF	8000	4	8020	4	53,94	52,43	52,39	50	48,1	52,37	54,15	53,7
2	RF	8000	4	8980	4	44,29	44,63	45,34	45,96	45,65	46,08	45,52	46,37
3	RF	8500	4	8521,25	4	55,83	54,86	58,25	57,77	58,55	59,83	58,46	55,43
4	RF	8500	4	9541,25	4	45,96	48,31	50,15	51,45	51,8	51,02	50,37	46,19
5	NRZ	6400	4	64	1	69,62	69,56	65,47	69,21	70,24	63,14	69,71	69,56
6	NRTZ	6400	4	6336	1	43,62	46,55	43,43	44,16	45,84	44,56	46,09	44,38
7	RTZ	6400	4	6336	1	45,33	43,84	42,71	44,49	45,06	44,68	45,13	43,42
8	RF	6400	4	9664	1	42,27	43,66	41,6	42,29	42,05	39,07	40,45	40,22

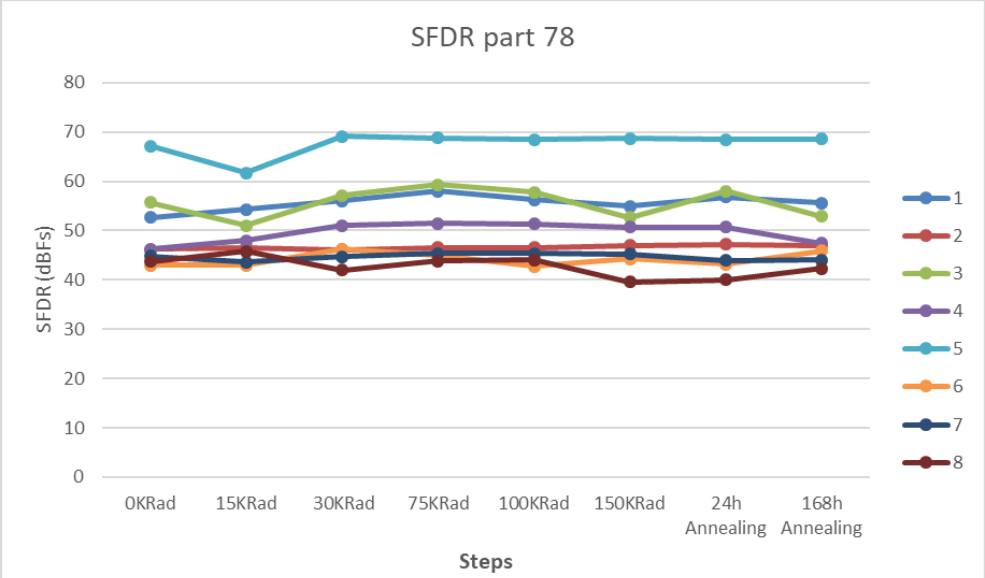


Index	Mode	Fclock	MUX	Start	End	IUCM	0KRad	15KRad	30KRad	75KRad	100KRad	150KRad	24h Annealing	168h Annealing
1	RF	8000	4	8020	9980	2	32,37	33,05	33,73	34,31	33,81	33,66	33,74	33,5
2	RF	8500	4	8521,25	10603,75	2	31,1	32,5	34,12	34,75	33,95	33,67	33,67	32,78
3	RF	8000	4	8010	8990	4	36,23	36,55	36,82	36,9	36,8	36,76	36,91	36,7
4	RF	8500	4	8510,625	9551,875	4	35,31	35,34	35,56	35,29	35,35	34,87	34,96	34,87
5	NRTZ	6400	4	8510,625	9551,875	1	37,99	38,18	38,09	37,99	38,13	37,77	38,23	37,94



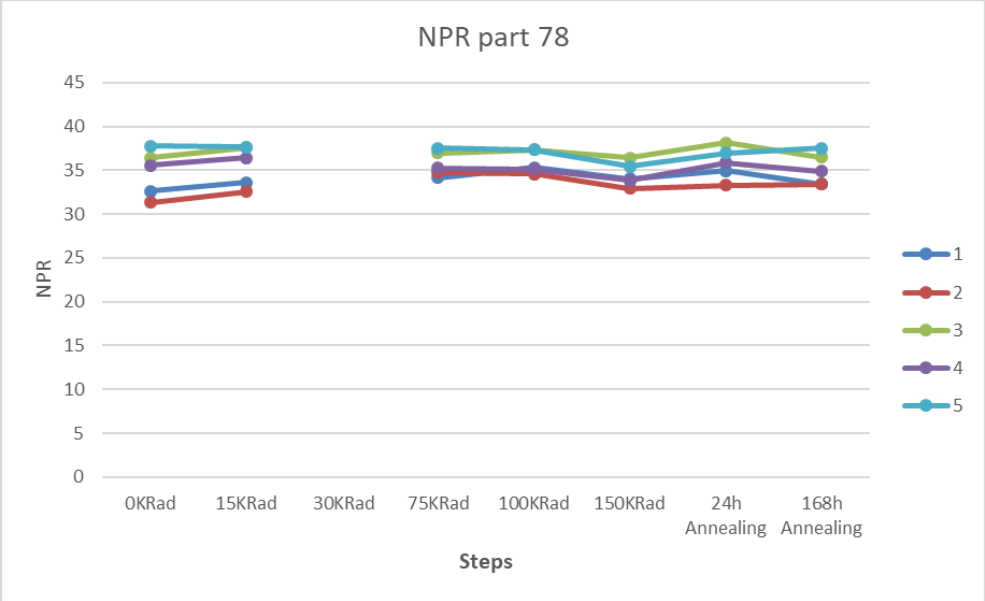
8.3.7 Part 78 (Part OFF)

Index	Mode	Flock	MUX	Fout	IUCM	0KRad	15KRad	30KRad	75KRad	100KRad	150KRad	24h Annealing	168h Annealing
1	RF	8000	4	8020	4	52,65	54,29	56,07	58,03	56,23	54,93	56,78	55,57
2	RF	8000	4	8980	4	46,21	46,59	46,07	46,51	46,52	47,03	47,19	47,02
3	RF	8500	4	8521,25	4	55,74	50,97	57,16	59,27	57,82	52,62	58,01	52,83
4	RF	8500	4	9541,25	4	46,2	47,98	50,99	51,48	51,32	50,74	50,67	47,4
5	NRZ	6400	4	64	1	67,18	61,69	69,14	68,74	68,43	68,63	68,5	68,57
6	NRTZ	6400	4	6336	1	42,91	42,99	46,21	44,98	42,69	44,24	43,18	45,88
7	RTZ	6400	4	6336	1	44,81	43,6	44,68	45,32	45,4	45,19	43,96	44
8	RF	6400	4	9664	1	43,74	45,75	42,01	43,82	44,08	39,61	40,01	42,33



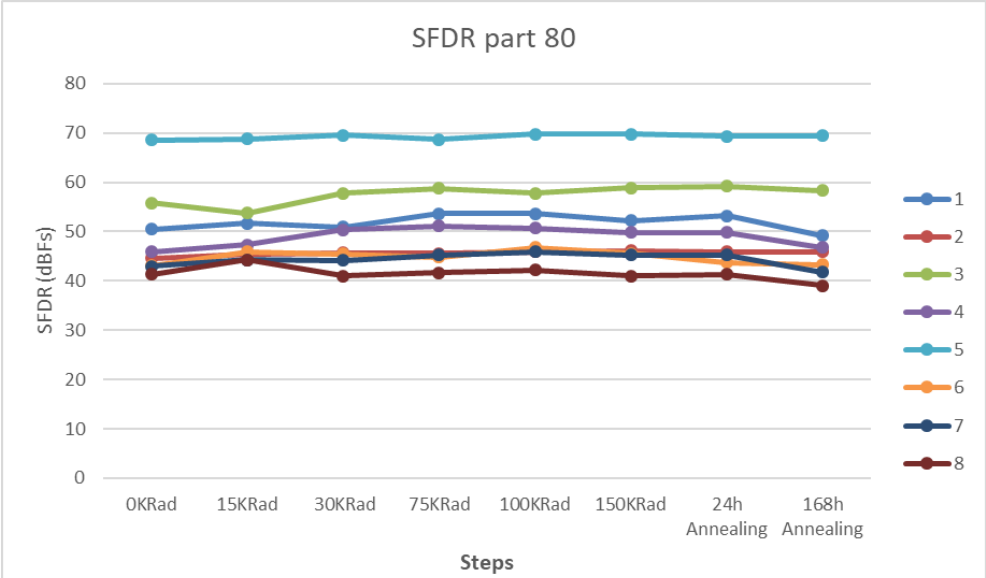
Index	Mode	Fclock	MUX	Start	End	IUCM	0KRad	15KRad	30KRad	75KRad	100KRad	150KRad	24h Annealing	168h Annealing
1	RF	8000	4	8020	9980	2	32,62	33,61	(✕)	34,16	35,31	34,04	34,95	33,4
2	RF	8500	4	8521,25	10603,75	2	31,36	32,55	(✕)	34,79	34,58	32,9	33,29	33,39
3	RF	8000	4	8010	8990	4	36,44	37,56	(✕)	37	37,33	36,45	38,14	36,5
4	RF	8500	4	8510,625	9551,875	4	35,56	36,45	(✕)	35,24	35,13	33,87	35,84	34,91
5	NRTZ	6400	4	8510,625	9551,875	1	37,8	37,67	(✕)	37,53	37,36	35,46	36,97	37,53

(✕) Data not available

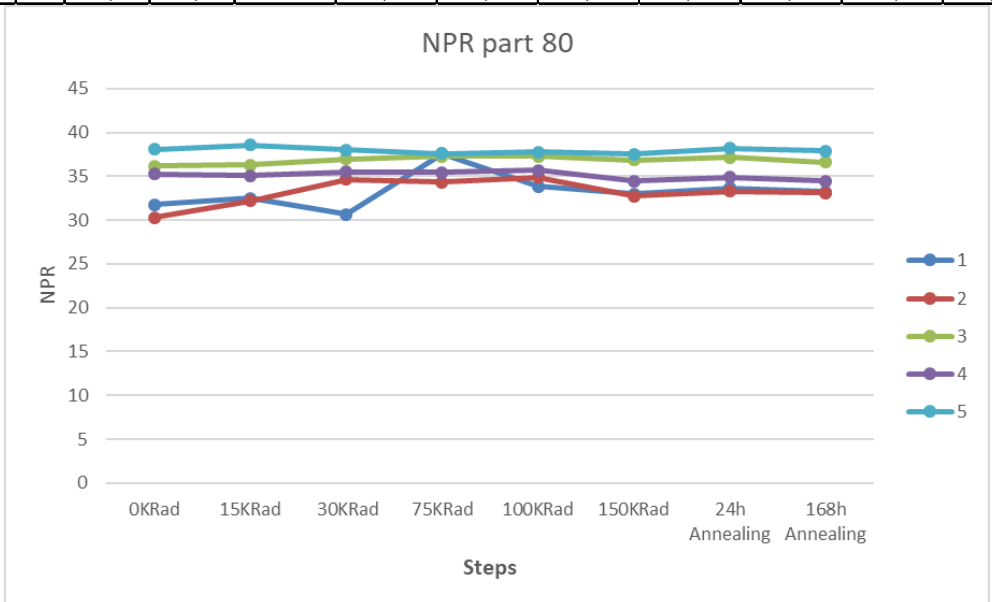


8.3.8 Part 80 (Part OFF)

Index	Mode	Flock	MUX	Fout	IUCM	0KRad	15KRad	30KRad	75KRad	100KRad	150KRad	24h Annealing	168h Annealing
1	RF	8000	4	8020	4	50,42	51,72	50,88	53,66	53,66	52,18	53,21	49,16
2	RF	8000	4	8980	4	44,56	45,31	45,71	45,53	45,86	46,13	45,87	45,86
3	RF	8500	4	8521,25	4	55,76	53,75	57,79	58,71	57,78	58,84	59,2	58,28
4	RF	8500	4	9541,25	4	45,9	47,26	50,41	51,14	50,7	49,85	49,77	46,74
5	NRZ	6400	4	64	1	68,58	68,75	69,58	68,62	69,73	69,75	69,3	69,46
6	NRTZ	6400	4	6336	1	43,04	45,93	45,49	44,86	46,76	45,61	43,73	43,31
7	RTZ	6400	4	6336	1	42,93	44,3	44,12	45,25	45,88	45,21	45,23	41,71
8	RF	6400	4	9664	1	41,27	44,31	41	41,61	42,17	40,97	41,37	39,07

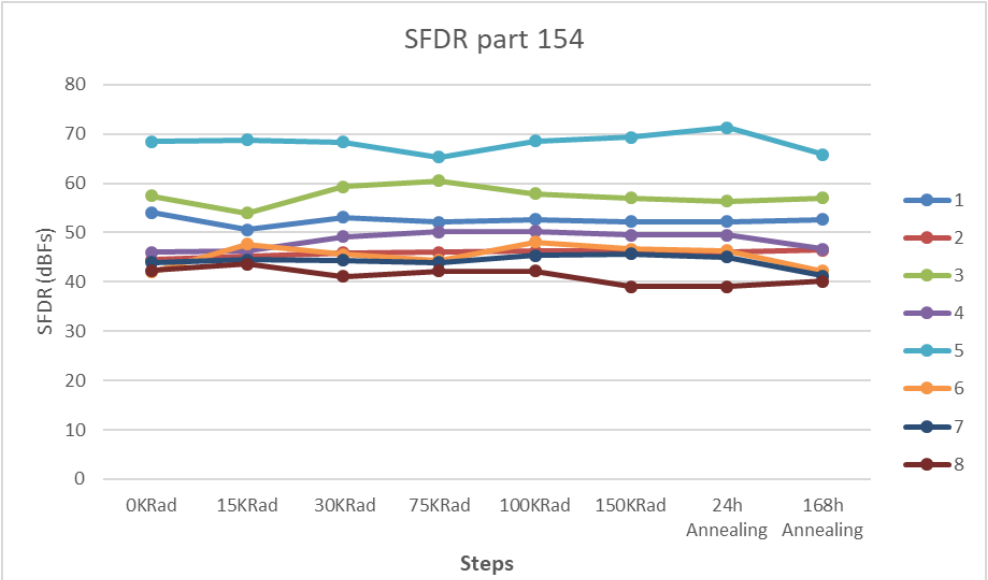


Index	Mode	Fclock	MUX	Start	End	IUCM	0KRad	15KRad	30KRad	75KRad	100KRad	150KRad	24h Annealing	168h Annealing
1	RF	8000	4	8020	9980	2	31,79	32,47	30,67	37,58	33,87	32,97	33,64	33,23
2	RF	8500	4	8521,25	10603,75	2	30,28	32,19	34,64	34,35	34,88	32,75	33,32	33,09
3	RF	8000	4	8010	8990	4	36,16	36,27	36,97	37,28	37,29	36,88	37,13	36,58
4	RF	8500	4	8510,625	9551,875	4	35,27	35,1	35,5	35,42	35,66	34,45	34,86	34,47
5	NRTZ	6400	4	8510,625	9551,875	1	38,08	38,56	37,99	37,58	37,79	37,5	38,17	37,88

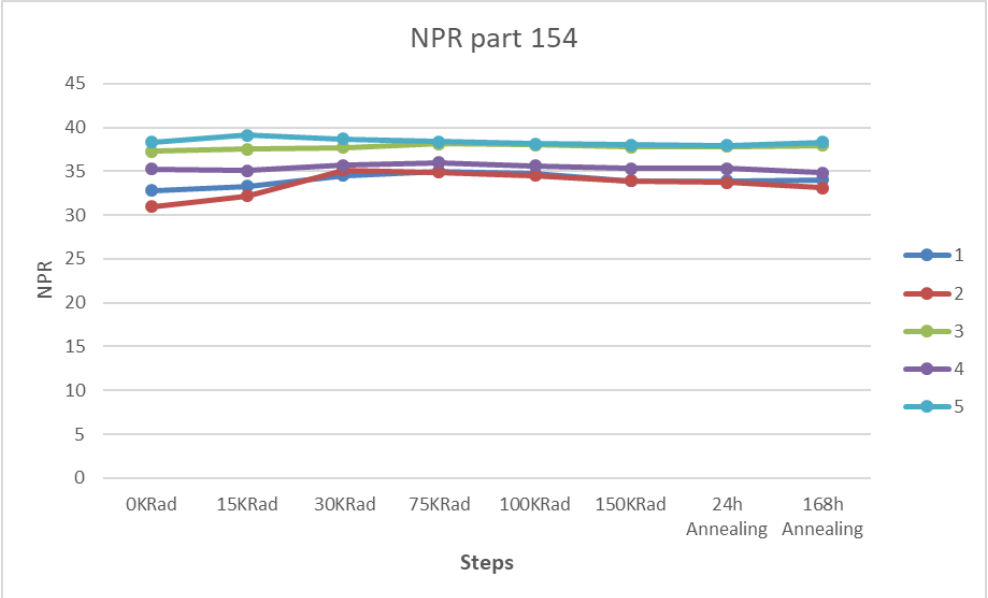


8.3.9 Part 154 (Part OFF)

Index	Mode	Flock	MUX	Fout	IUCM	0KRad	15KRad	30KRad	75KRad	100KRad	150KRad	24h Annealing	168h Annealing
1	RF	8000	4	8020	4	54,07	50,61	53,08	52,14	52,6	52,21	52,26	52,7
2	RF	8000	4	8980	4	44,52	45,21	45,94	45,97	46,26	46,2	45,97	46,49
3	RF	8500	4	8521,25	4	57,49	54,01	59,33	60,47	57,85	57,06	56,37	56,98
4	RF	8500	4	9541,25	4	46,04	46,21	49,13	50,15	50,21	49,44	49,49	46,64
5	NRZ	6400	4	64	1	68,42	68,83	68,31	65,31	68,58	69,3	71,24	65,85
6	NRTZ	6400	4	6336	1	41,94	47,65	45,54	44,32	48,12	46,66	46,31	42,23
7	RTZ	6400	4	6336	1	43,97	44,52	44,42	43,94	45,31	45,63	45,02	41,19
8	RF	6400	4	9664	1	42,28	43,62	41,1	42,2	42,22	39,08	39,01	40,11

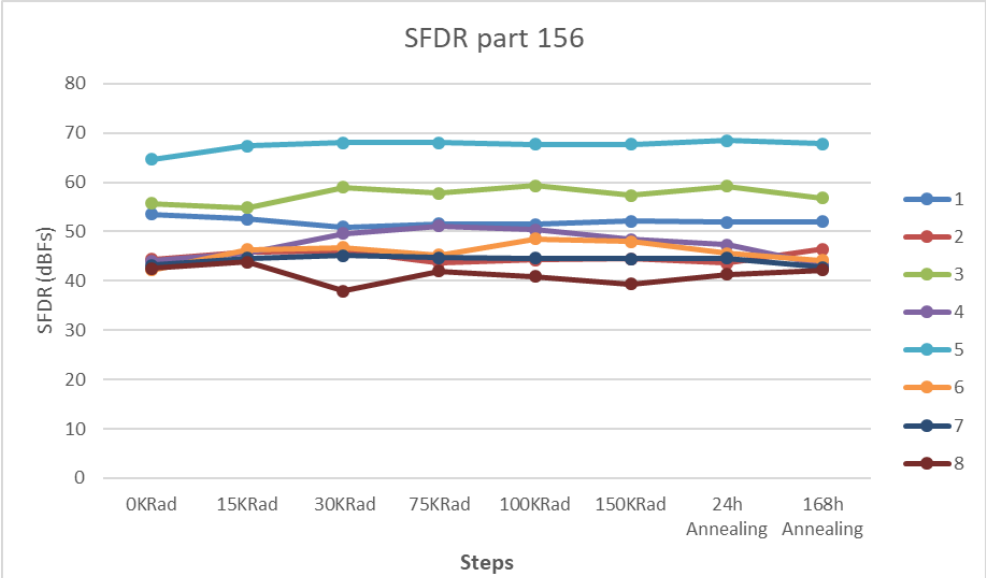


Index	Mode	Fclock	MUX	Start	End	IUCM	0KRad	15KRad	30KRad	75KRad	100KRad	150KRad	24h Annealing	168h Annealing
1	RF	8000	4	8020	9980	2	32,8	33,31	34,52	35,03	34,73	33,88	33,92	34,03
2	RF	8500	4	8521,25	10603,75	2	30,98	32,22	35,16	34,91	34,54	33,88	33,72	33,1
3	RF	8000	4	8010	8990	4	37,27	37,55	37,69	38,11	37,99	37,75	37,82	37,97
4	RF	8500	4	8510,625	9551,875	4	35,24	35,06	35,67	36	35,63	35,29	35,31	34,8
5	NRTZ	6400	4	8510,625	9551,875	1	38,31	39,1	38,67	38,39	38,15	38,01	37,97	38,32

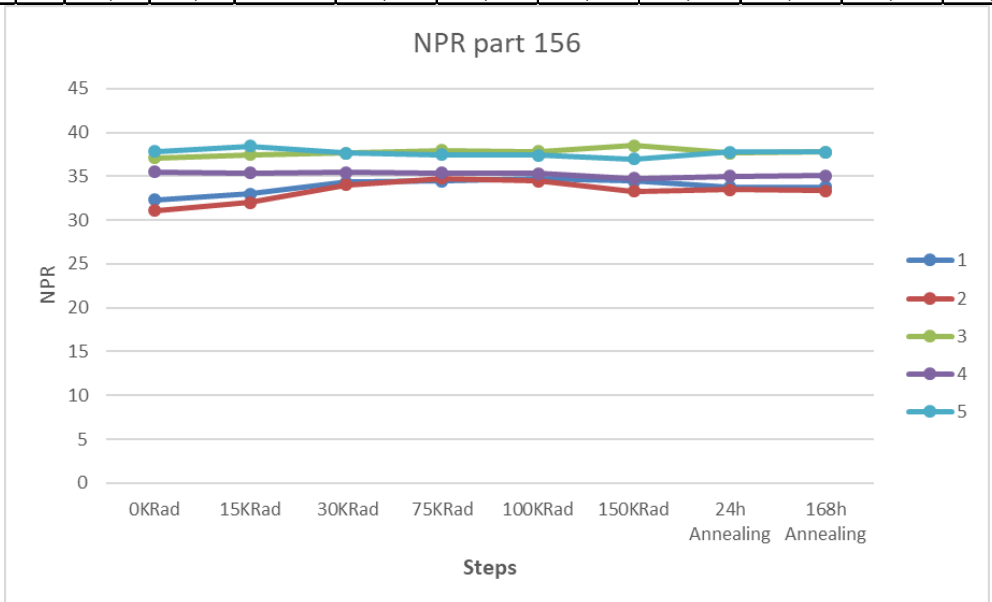


8.3.10 Part 156 (Part OFF)

Index	Mode	Flock	MUX	Fout	IUCM	0KRad	15KRad	30KRad	75KRad	100KRad	150KRad	24h Annealing	168h Annealing
1	RF	8000	4	8020	4	53,49	52,54	50,92	51,52	51,49	52,07	51,93	51,99
2	RF	8000	4	8980	4	44,33	45,88	46,15	43,74	44,3	44,51	43,66	46,43
3	RF	8500	4	8521,25	4	55,7	54,78	58,94	57,76	59,34	57,38	59,14	56,76
4	RF	8500	4	9541,25	4	44	45,69	49,61	51,11	50,35	48,42	47,26	43,23
5	NRZ	6400	4	64	1	64,6	67,31	68,02	68,05	67,65	67,66	68,46	67,84
6	NRTZ	6400	4	6336	1	42,18	46,31	46,78	45,29	48,46	47,95	45,53	44,14
7	RTZ	6400	4	6336	1	43,2	44,61	45,14	44,75	44,54	44,45	44,58	42,79
8	RF	6400	4	9664	1	42,52	43,84	37,99	41,93	40,9	39,31	41,29	42,19

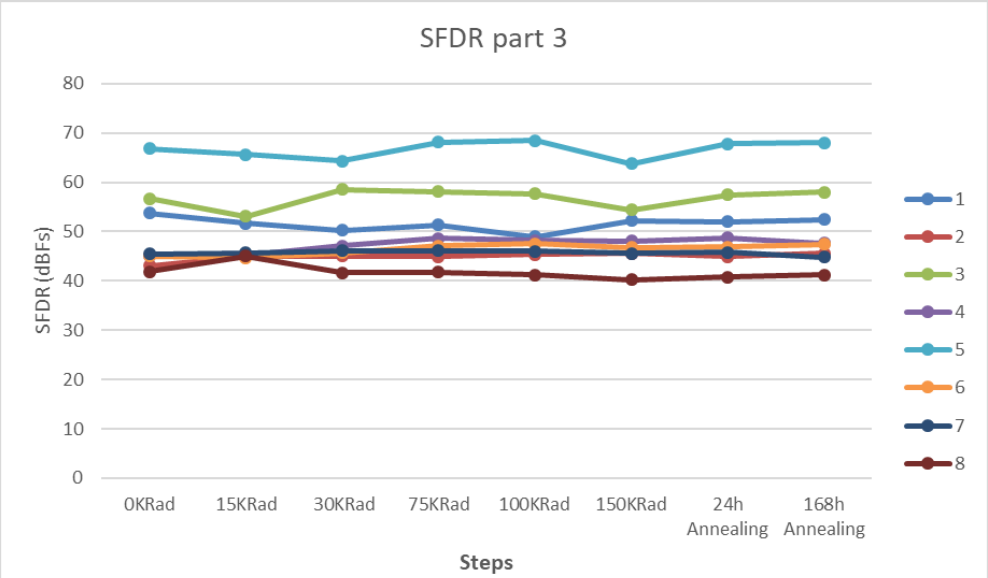


Index	Mode	Fclock	MUX	Start	End	IUCM	0KRad	15KRad	30KRad	75KRad	100KRad	150KRad	24h Annealing	168h Annealing
1	RF	8000	4	8020	9980	2	32,33	33,01	34,34	34,44	34,68	34,43	33,78	33,78
2	RF	8500	4	8521,25	10603,75	2	31,06	32,02	34,02	34,79	34,47	33,32	33,47	33,35
3	RF	8000	4	8010	8990	4	37,11	37,49	37,64	37,94	37,84	38,51	37,66	37,78
4	RF	8500	4	8510,625	9551,875	4	35,51	35,37	35,43	35,37	35,32	34,79	35,02	35,06
5	NRTZ	6400	4	8510,625	9551,875	1	37,83	38,43	37,66	37,47	37,42	36,99	37,77	37,8



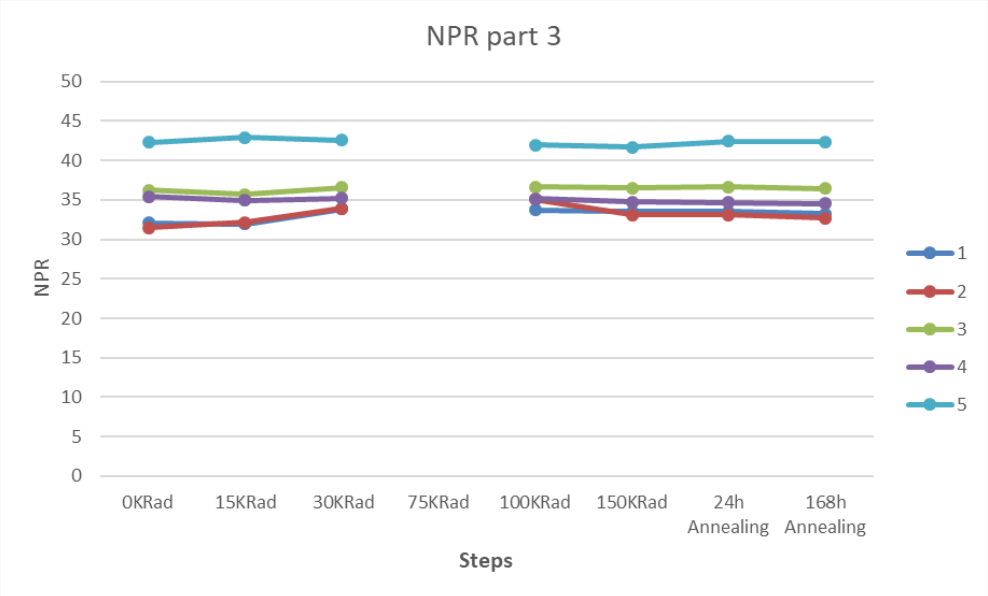
8.3.11 Part 3 (Part REF)

Index	Mode	Flock	MUX	Fout	IUCM	0KRad	15KRad	30KRad	75KRad	100KRad	150KRad	24h Annealing	168h Annealing
1	RF	8000	4	8020	4	53,79	51,68	50,31	51,4	48,96	52,2	51,95	52,46
2	RF	8000	4	8980	4	43,04	44,99	45	44,92	45,33	45,6	44,9	45,56
3	RF	8500	4	8521,25	4	56,65	53,04	58,5	58,06	57,71	54,45	57,42	58,01
4	RF	8500	4	9541,25	4	45,13	45,22	47,07	48,57	48,22	48,09	48,73	47,62
5	NRZ	6400	4	64	1	66,79	65,58	64,33	68,1	68,42	63,77	67,79	67,99
6	NRTZ	6400	4	6336	1	45,03	44,72	45,67	47,06	47,56	46,75	46,86	47,47
7	RTZ	6400	4	6336	1	45,5	45,65	46,15	46,11	46	45,59	45,8	44,82
8	RF	6400	4	9664	1	41,9	45,05	41,63	41,79	41,25	40,24	40,73	41,18



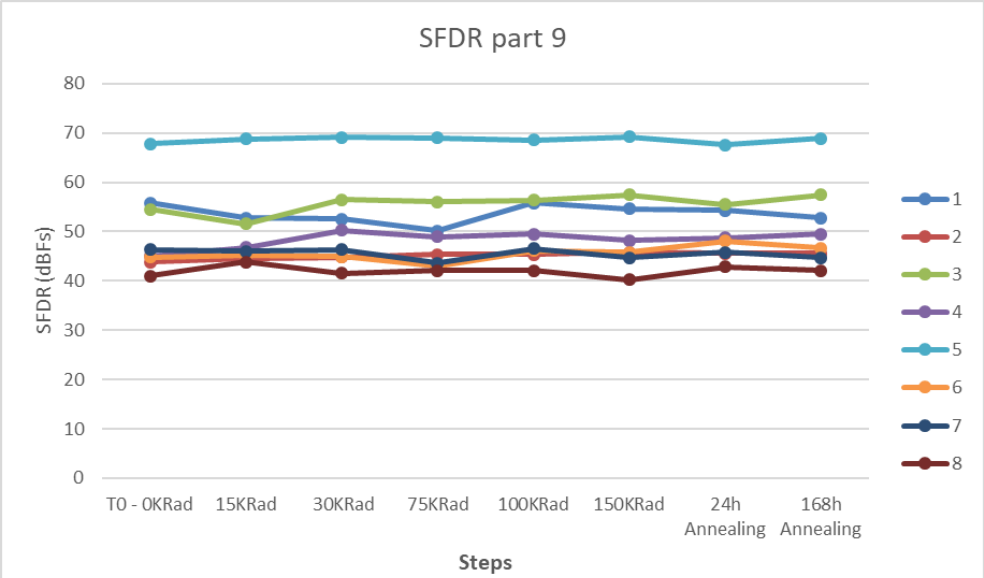
Index	Mode	Fclock	MUX	Start	End	IUCM	0KRad	15KRad	30KRad	75KRad	100KRad	150KRad	24h Annealing	168h Annealing
1	RF	8000	4	8020	9980	2	32,07	31,98	33,84	(✕)	33,74	33,52	33,51	33,23
2	RF	8500	4	8521,25	10603,75	2	31,45	32,15	33,92	(✕)	35,06	33,11	33,09	32,69
3	RF	8000	4	8010	8990	4	36,25	35,7	36,57	(✕)	36,64	36,55	36,63	36,42
4	RF	8500	4	8510,625	9551,875	4	35,46	34,93	35,22	(✕)	35,14	34,73	34,66	34,51
5	NRTZ	6400	4	8510,625	9551,875	1	42,33	42,92	42,57	(✕)	41,98	41,71	42,41	42,36

(✕) Data not available



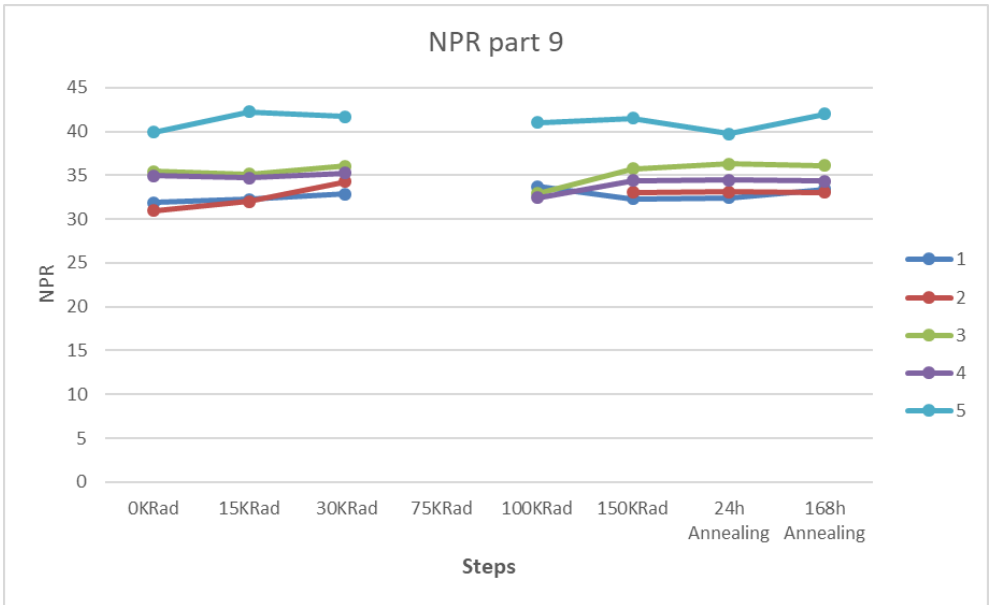
8.3.12 Part 9 (Part REF)

Index	Mode	Flock	MUX	Fout	IUCM	T0 - 0KRad	15KRad	30KRad	75KRad	100KRad	150KRad	24h Annealing	168h Annealing
1	RF	8000	4	8020	4	55,82	52,78	52,51	50,1	55,81	54,59	54,27	52,78
2	RF	8000	4	8980	4	43,8	44,55	44,83	45,3	45,31	45,81	45,52	45,57
3	RF	8500	4	8521,25	4	54,47	51,61	56,5	56,03	56,37	57,49	55,47	57,44
4	RF	8500	4	9541,25	4	45,03	46,8	50,24	48,94	49,53	48,24	48,72	49,5
5	NRZ	6400	4	64	1	67,79	68,82	69,09	69,01	68,6	69,19	67,6	68,86
6	NRTZ	6400	4	6336	1	44,86	45,14	44,9	43,1	46,1	45,75	48,1	46,7
7	RTZ	6400	4	6336	1	46,31	46	46,38	43,62	46,57	44,71	45,79	44,68
8	RF	6400	4	9664	1	41,04	43,85	41,49	42,12	42,06	40,18	42,81	42,09



Index	Mode	Fclock	MUX	Start	End	IUCM	0KRad	15KRad	30KRad	75KRad	100KRad	150KRad	24h Annealing	168h Annealing
1	RF	8000	4	8020	9980	2	31,88	32,27	32,85	(✕)	33,75	32,31	32,46	33,42
2	RF	8500	4	8521,25	10603,75	2	30,96	32	34,28	(✕)	0	33,02	33,09	33,06
3	RF	8000	4	8010	8990	4	35,41	35,11	36,08	(✕)	32,93	35,75	36,31	36,1
4	RF	8500	4	8510,625	9551,875	4	34,93	34,71	35,25	(✕)	32,46	34,4	34,47	34,35
5	NRTZ	6400	4	8510,625	9551,875	1	39,92	42,27	41,68	(✕)	40,99	41,5	39,71	41,97

(✕) Data not available



9. TOTAL DOSE CONCLUSION

Ten devices, five ON, five OFF, were tested, with a dose rate of 36rad/h and up to a total dose of 150Krad(Si).

The total irradiation test program was followed by a 24 hr. annealing process at ambient temperature, followed by a 168 hr. annealing at 100°C as per ESCC 22900.

The device under test (P/N EV12DS480AMZP-N1) had neither functional failure nor parameter drift up to 150 Krad (Si) with a dose rate of 36rad/h (10mrad/s).

10. ANNEX 1 : CO60 IRRADIATION CERTIFICATE

Co^{60} IRRADIATION CERTIFICATE

Customer: EDV Case followed up by: MF
FAO: Olivier BONNET

Source: Coblat-60 (Co60)	
Certificate	N° 36708 of 08/10/2015
Activity	14.8 TBq of 04/09/2015

Reference : PV/ATR/EV12DS480/XXX2/EDV/MF/1904 Rev: 0
Device irradiated : EV12DS480
Irradiation certificate applied only to the device subjected to the irradiation
In agreement with the quality procedure according ESCC 22900 (Pro.026 Rev. 5)

Irradiation environment

	Units	Min	Max	Time-weighted average
Temperature	°C	18.4	23.4	20.1
Relative humidity	%	33.9	68.9	54.4

Dose rate measurement

The instruments used for dose rate measurement is a PTW ionization chamber(TM30013) and universal dosimeter UNIDOS E which is controlled annually.

UNIDOS E	Serial number: 82253	Certificate number: 18D256	Date: 09/11/2018
TM30013	Serial number: 9314	Certificate number: 18D256	Date: 09/11/2018

The measurement unit of the international system for the dose rate is Gy/s. We commonly use rad/h (1 Gy/h = 100 rad/h).
The dose rate is measured at the center of the device.

TRAD position	Date	Dose rate [rad/h] (Kerma in the air)
36-A	23/04/2019	38.68
	25/09/2019	37.43
36-B	23/04/2019	37.49
	25/09/2019	37.51
36-C	23/04/2019	38.36
	25/09/2019	36.87
36-D	23/04/2019	37.64
	25/09/2019	36.75
36-E	23/04/2019	38.05
	25/09/2019	37.15
36-F	23/04/2019	37.72
	25/09/2019	37.92
36-G	23/04/2019	38.47
	25/09/2019	37.00
36-H	23/04/2019	38.22
	25/09/2019	36.70
36-10	23/04/2019	37.95
	25/09/2019	37.88
36-11	23/04/2019	38.13
	25/09/2019	37.64

Dosimetry

Each exit and input of Cobalt-60 source is logged in a digital file. We compute the dose at each step taking into account the source decay, the dose rate measured by the gamma probe and the downtime irradiation.

TRAD position	Date	Total ionizing dose [krad] (Kerma in the air)	Parts No. (If applicable)
36-A	25/04/2019	0	SN78
	16/05/2019	18.76	
	06/06/2019	37.35	
	25/07/2019	80.59	
	22/08/2019	105.05	
	23/10/2019	158.71	
36-B	25/04/2019	0	SN74
	16/05/2019	18.18	
	06/06/2019	36.20	
	25/07/2019	78.11	
	22/08/2019	101.82	
	23/10/2019	154.64	
36-C	25/04/2019	0	SN73
	16/05/2019	18.60	
	06/06/2019	37.05	
	25/07/2019	79.93	
	22/08/2019	104.18	
	23/10/2019	157.23	
36-D	25/04/2019	0	SN67
	16/05/2019	18.25	
	06/06/2019	36.35	
	25/07/2019	78.43	
	22/08/2019	102.22	
	23/10/2019	154.66	
36-E	25/04/2019	0	SN80
	16/05/2019	18.45	
	06/06/2019	36.75	
	25/07/2019	79.28	
	22/08/2019	103.34	
	23/10/2019	156.34	
36-F	25/04/2019	0	SN75
	16/05/2019	18.29	
	06/06/2019	36.43	
	25/07/2019	78.59	
	22/08/2019	102.44	
	23/10/2019	155.70	
36-G	25/04/2019	0.0	SN154
	16/05/2019	18.66	
	06/06/2019	37.15	
	25/07/2019	80.15	
	22/08/2019	104.48	
	23/10/2019	157.70	
36-H	25/04/2019	0	SN156
	16/05/2019	18.54	
	06/06/2019	36.91	
	25/07/2019	79.63	
	22/08/2019	103.80	
	23/10/2019	156.63	
36-10	25/04/2019	0	SN66
	16/05/2019	18.40	
	06/06/2019	36.65	
	25/07/2019	79.07	
	22/08/2019	103.07	
	23/10/2019	156.48	
36-11	25/04/2019	0	SN63
	16/05/2019	18.49	
	06/06/2019	36.82	
	25/07/2019	79.45	
	22/08/2019	103.55	
	23/10/2019	156.94	

Measurement uncertainty : 1.6% *The measurement uncertainty is expressed at two standard uncertainties (k=2).*

ESCC 22900: The dose at the device under test shall be measured to a resolution of better than 10%. The test devices shall be exposed to within 10% of the specified radiation dose level(s).

The gamma-ray dose rate of a Cobalt 60 source shall be calibrated in accordance with the requirements of ESCC Basic Specification No. 21500 to 5% or better. Dosimetry shall be traceable to national standards.

Written by	Quality control and Approved by
28/10/2019 M. FULLALOVE	05/11/2019 Y. PADIÉ

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