EV12AD550B - Mask VO02A – TID&SEE Test Report – November 2018

Revision date :	**26/11/2018**
Author :	**BONNET OLIVIER**
Scope :	**BUSINESS UNIT BMS**

Last revision approved by :

Approved by	Approbation Status	Date
Bonnet Olivier	OK	26/11/2018

1. DOCUMENT AMENDMENT RECORD

Author	Issue	Date	Reason for change
BONNET Olivier	A		Creation
BONNET Olivier	B		Reference correction

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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

In Graphs:

- Minimum: Minimum value of each part (except reference parts)
- Maximum: Maximum value of each part (except reference parts)
- Mean: Mean value of each part (except reference parts)
- Median: Median value of each part (except reference parts), half of the devices are above this limit, half are under

3. INTRODUCTION

This document is a preliminary report which summarizes the radiation tests performed on EV12AD550B Dual 12bits 1.6GSps ADC Space Grade.

- Total dose tests
- Heavy ion tests

4. APPLICABLE AND REFERENCE DOCUMENTS

AD01	EV12AD550B Dual 12bits 1.6GSps ADC Space Grade Preliminary Datasheet
AD02	ESA ESCC Specifications 25100 – SEE Test Method and Guidelines, issue 1, October 2002
AD03	JESD57 – Test Procedure for the management of SEE in Semiconductor Devices from Heavy-Ion Irradiation, December 1996
AD04	ASTM F1192-11 – Standard Guide for the Measurement of Single Event Phenomena (SEP) Induced by Heavy Ions Irradiation of Semiconductor Devices
AD05	ESA ESCC Specification 22900 – Total Dose Steady-State Irradiation Test Method
AD06	MIL-STD-883J Method 1019.9 – Ionizing Radiation (Total Dose) Test Procedure
AD07	ASTM 1892-12 – Standard Guide for ionizing Radiation (Total Dose) Effect Testing of Semiconductors Devices
AD08	LGA-323(1156VC)-1.0-04-00.pdf – Burn-In socket description
AD09	Spécification technique des cartes d'évaluation EV12AD5x0 Dual ADC 12-bit 1.5Gsps EV12AD5x0 Series
AD10	NE 13S 213682(B.1) - EV12AD550 - Mask VN80A - Radiation test report

5. EXECUTIVE SUMMARY

5.1 Lot description

Reference	EV12AD550B
Package	Ceramic Column Grid Array CCGA323 21mmx21mm
Function	Dual 12bits 1.5GSps ADC
Technology	BiCMOS9
Lot No.	J703EVW
Mfr. No.	EV12AD550BGC
Mask Lot	VO02A
Front End Date Code	17A1731
Manufacturer	E2V

5.2 Total dose

It was concluded that the device under test (P/N EV12AD550B) had neither functional failure nor parameter drift up to 150 Krad (Si). Static and Dynamic results are satisfactory for all parameters.

A total of ten devices (5 Bias ON, 5 Bias OFF) were tested at 3GHz Clock frequency.

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 component is not sensitive to 150 Krad with low dose rate (36 rad / hr).

5.3 Heavy ions

The main objective of this test was to evaluate the sensitivity of the EV12AD550B, an Analog to Digital Converter, to Single Event Latch up (SEL) and Single Event Effects (SEU, SEFI, SET).
The irradiation was performed at TAMU with a maximum LET at 82.8 MeV.cm²/mg.

The EV12AD550B SEE shows similar results with the EV12AD550A.

No SEL on VCCD was detected with a LET of 82.8 MeV.cm²/mg.
No SEL on VCCA was detected with a LET of 82.8 MeV.cm²/mg.
No SEL on VCCIO was detected with a LET of 82.8 MeV.cm²/mg.

In dynamic configuration and demux 1:1 mode
SEU were observed during the irradiation up to the Nitrogen Heavy Ion (LET= 1.3 MeV.cm²/mg).
SET were observed during the irradiation up to the Neon Heavy Ion (LET= 2.6 MeV.cm²/mg).
Clock Tree Event were observed during the irradiation up to the Neon Heavy Ion (LET= 2.6 MeV.cm²/mg).
No SEFI was detected with a LET of 82.8 MeV.cm²/mg.

In dynamic configuration and demux 1:2 mode
SEU were observed during the irradiation up to the Nitrogen Heavy Ion (LET= 1.3 MeV.cm²/mg).
SET were observed during the irradiation up to the Neon Heavy Ion (LET= 2.6 MeV.cm²/mg).
Clock Tree Event were observed during the irradiation up to the Neon Heavy Ion (LET= 2.6 MeV.cm²/mg).
No SEFI was detected with a LET of 82.8 MeV.cm²/mg.

In static middle configuration and demux 1:1 mode
SEU were observed during the irradiation up to the Helium Heavy Ion (LET= 0.11 MeV.cm²/mg).
SET were observed during the irradiation up to the Nitrogen Heavy Ion (LET= 1.3 MeV.cm²/mg).
No SEFI was detected with a LET of 82.8 MeV.cm²/mg.

In static middle configuration and demux 1:2 mode
SEU were observed during the irradiation up to the Helium Heavy Ion (LET= 0.11 MeV.cm²/mg).
SET were observed during the irradiation up to the Neon Heavy Ion (LET= 2.6 MeV.cm²/mg).
No SEFI was detected with a LET of 82.8 MeV.cm²/mg.

In static high configuration and demux 1:1 mode
SEU were observed during the irradiation up to the Nitrogen Heavy Ion (LET= 1.3 MeV.cm²/mg).
SET were observed during the irradiation up to the Nitrogen Heavy Ion (LET= 1.3 MeV.cm²/mg).
No SEFI was detected with a LET of 82.8 MeV.cm²/mg.

In static low configuration and demux 1:1 mode
SEU were observed during the irradiation up to the Nitrogen Heavy Ion (LET= 1.3 MeV.cm²/mg).
SET were observed during the irradiation up to the Neon Heavy Ion (LET= 2.6 MeV.cm²/mg).
No SEFI was detected with a LET of 82.8 MeV.cm²/mg.

6. TOTAL DOSE TESTS

6.1 Part references

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

Serial number	Device(s) irradiated									
Irradiation position	36-3(E2V)			36-2(E2V)		36-1(E2V)				
Mark	007	009	011	013	017	018	019	021	023	024
Bias mode	ON					OFF				

6.2 Bias conditions

	DC Voltage (V)
VCCA	3.55V
VCCIO	3.55V
VCCD	3.55V
Inupt Clock Frequency	F = 1GHz; +10dBm
Input AIN & BIN	F = 10MHz; 1Vpp

6.3 Dosimetry and irradiation facility

Gamma irradiations are performed with Cobalt 60 source. Gamma emitted radiation energies are 1.17 and 1.33 MeV provided by a panoramic Cobalt 60 source of 14.8 TBq (04/09/2015). The useful irradiation volume is about 45 m3. The Gamma ray beam dose rate is from 10rad/h to 4 krad/h (3 mrad/s to 1 rad/s).

Irradiation source	^{60}Co
Source location	TRAD, Toulouse
Irradiation equipment	GAMRAY
Dosimetry equipment	PTW

Dose rate measurement is performed with a PTW ionization chamber. This equipment is calibrated each year by PTW company (https://www.ptw.de/) which is DAkkS (https://www.dakks.de/) accredited.

6.4 Target Dose 150KRad

Total dose limit (krad)	153					
Levels for parts biased ON measurements (krad)	0	17	30	77	106	153
Levels for parts biased OFF measurements (krad)	0	17	30	77	106	153
Irradiation facility Temperature (°C)	20	21	20	20	20	19
Dose rate (rad/h)	36					

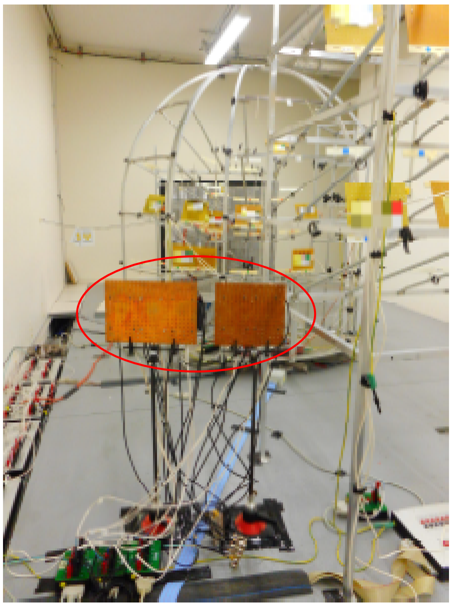
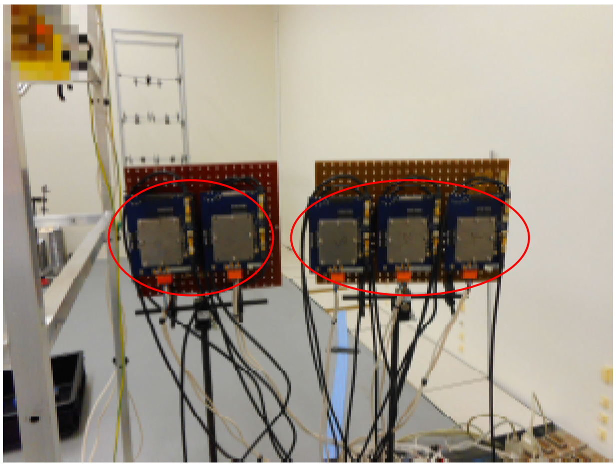
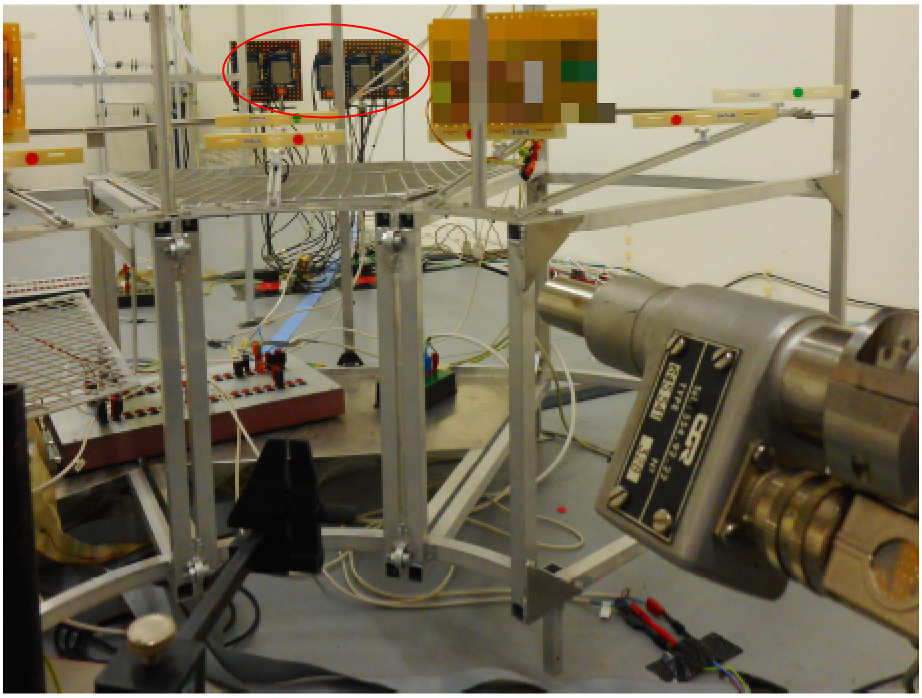
The test devices shall be exposed to within 10% of the specified radiation dose level(s). A Co_{60} irradiation certificate is provided in Appendix A.

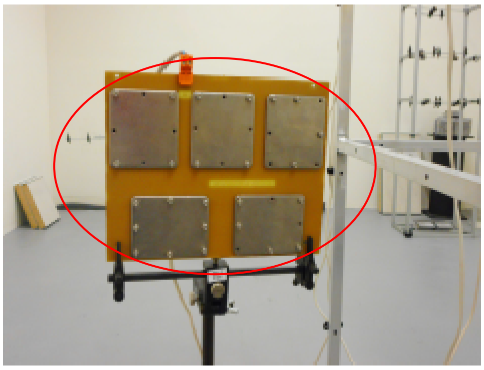
6.5 Annealing

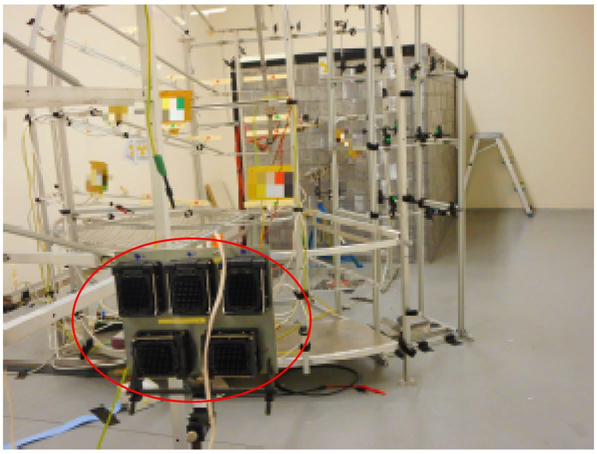
Annealing at 25°C	24h
Annealing at 100°C	168h

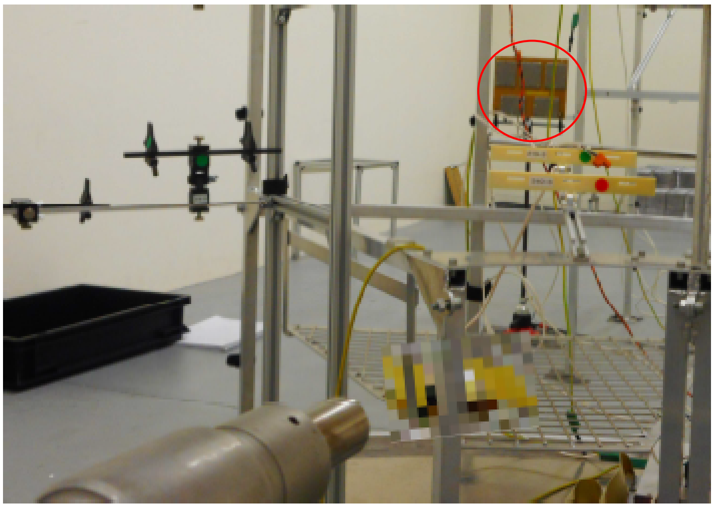
6.6 GAMRAY setup

Pictures below show the elements inside the GAMRAY bunker before the irradiation:







6.7 Intermediate measurements

Conditions:

- Ambient temperature
- Socketed Evaluation board
- Nominal power supplies

Measures:

- Measure of Analog input impedance
- Currents & Power calculation
- Leakage current on pin CMIREF
- Vol & Voh
- FFT on both core

Fclock	3GHz	3GHz
Pclock	+1dBm	+1dBm
Fin	1480MHz	2980MHz
Pin	-1 & -8dBFs	-1 & -8dBFs
Demux	1:1	1:2
Bandwidth	Nominal	Extented

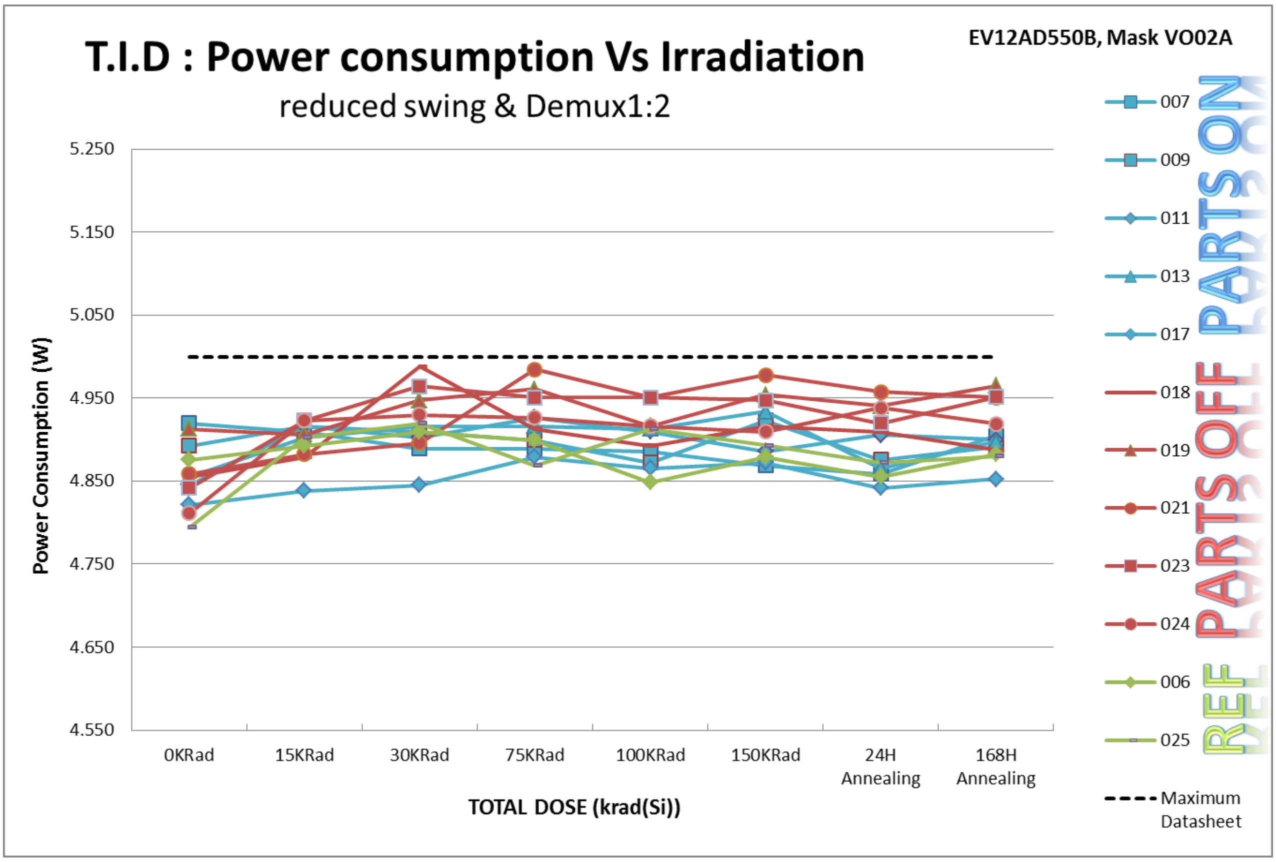
In the following tables, some results can be missing, the consequence of board test problems. In this case, a N/A has been substitute to the value in the table.

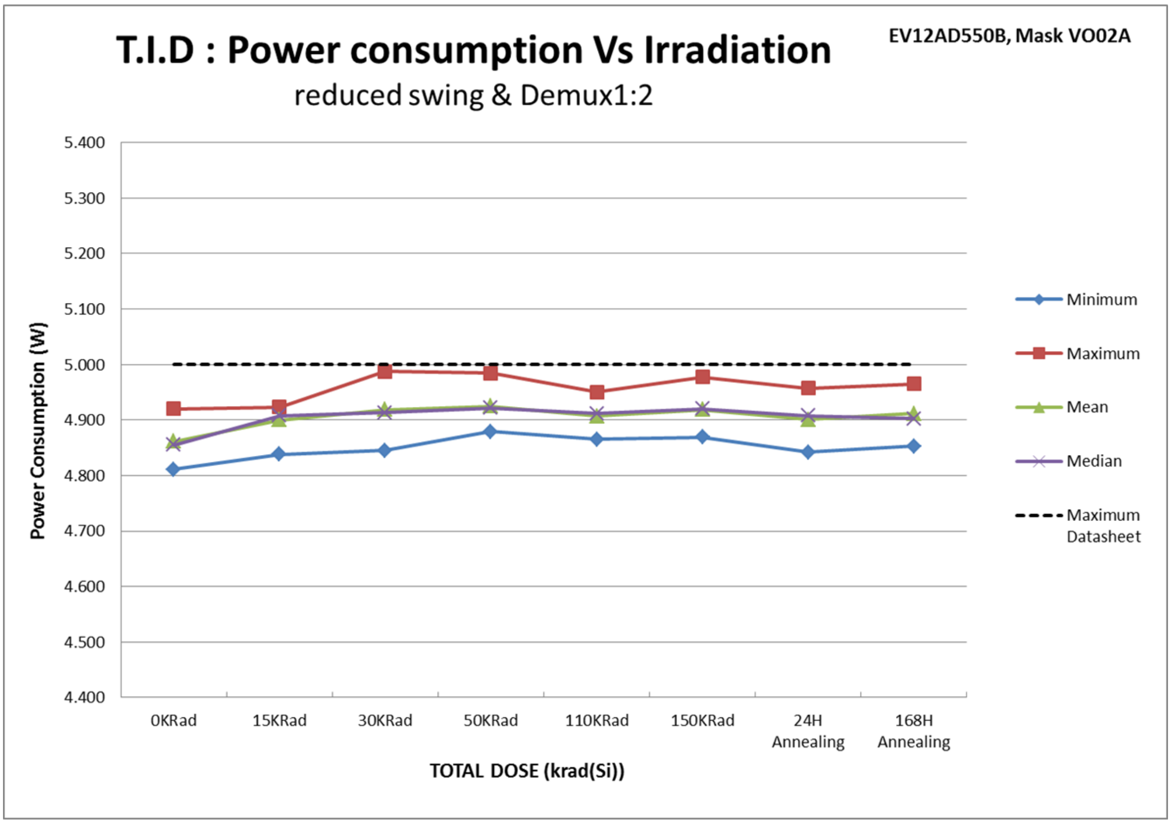
7. TOTAL DOSE RESULTS

7.1 Power Consumption

Table 1: Power Consumption (W)

Part	Current (A) & Power (W)	Dose&Annealing							
		0KRad	15KRad	30KRad	75KRad	100KRad	150KRad	24H Annealing	168H Annealing
007	VccA	1.039	1.039	1.040	1.040	1.034	1.037	1.037	1.042
	VccD	0.165	0.162	0.157	0.158	0.143	0.138	0.143	0.143
	VccIO1	0.148	0.148	0.146	0.144	0.164	0.160	0.155	0.162
	VccIO2	0.095	0.095	0.095	0.096	0.096	0.097	0.094	0.096
	Power	4.920	4.910	4.889	4.889	4.886	4.869	4.859	4.905
009	VccA	1.037	1.040	1.037	1.040	1.037	1.037	1.035	1.044
	VccD	0.161	0.149	0.166	0.164	0.161	0.147	0.143	0.140
	VccIO1	0.146	0.162	0.146	0.142	0.140	0.168	0.160	0.159
	VccIO2	0.095	0.095	0.095	0.095	0.095	0.096	0.096	0.096
	Power	4.893	4.916	4.910	4.899	4.872	4.923	4.876	4.891
011	VccA	1.045	1.045	1.045	1.048	1.046	1.045	1.047	1.043
	VccD	0.138	0.143	0.157	0.162	0.144	0.138	0.141	0.143
	VccIO1	0.148	0.164	0.146	0.144	0.159	0.159	0.160	0.160
	VccIO2	0.094	0.094	0.094	0.095	0.095	0.095	0.095	0.094
	Power	4.845	4.916	4.903	4.927	4.910	4.886	4.905	4.900
013	VccA	1.043	1.043	1.043	1.048	1.047	1.046	1.039	1.051
	VccD	0.136	0.138	0.158	0.156	0.148	0.147	0.138	0.133
	VccIO1	0.154	0.166	0.150	0.146	0.154	0.161	0.160	0.165
	VccIO2	0.095	0.095	0.095	0.096	0.096	0.097	0.094	0.092
	Power	4.855	4.903	4.916	4.916	4.913	4.933	4.865	4.898
017	VccA	1.034	1.039	1.039	1.044	1.043	1.040	1.038	1.041
	VccD	0.137	0.123	0.143	0.149	0.130	0.145	0.126	0.130
	VccIO1	0.152	0.166	0.148	0.146	0.162	0.151	0.164	0.162
	VccIO2	0.095	0.095	0.095	0.096	0.096	0.097	0.096	0.095
	Power	4.821	4.838	4.845	4.879	4.865	4.872	4.842	4.852
018	VccA	1.032	1.040	1.060	1.037	1.039	1.039	1.043	1.040
	VccD	0.146	0.147	0.162	0.163	0.136	0.144	0.141	0.139
	VccIO1	0.154	0.152	0.148	0.148	0.168	0.166	0.164	0.162
	VccIO2	0.096	0.096	0.097	0.097	0.096	0.097	0.096	0.096
	Power	4.855	4.879	4.988	4.913	4.893	4.916	4.910	4.887
019	VccA	1.042	1.048	1.054	1.048	1.048	1.048	1.051	1.061
	VccD	0.154	0.133	0.154	0.166	0.133	0.147	0.144	0.143
	VccIO1	0.154	0.166	0.150	0.148	0.168	0.165	0.162	0.158
	VccIO2	0.095	0.096	0.097	0.097	0.097	0.097	0.096	0.098
	Power	4.913	4.906	4.947	4.961	4.916	4.954	4.940	4.965
021	VccA	1.047	1.055	1.059	1.055	1.053	1.056	1.054	1.053
	VccD	0.136	0.137	0.137	0.168	0.141	0.149	0.145	0.147
	VccIO1	0.150	0.148	0.148	0.146	0.165	0.162	0.162	0.159
	VccIO2	0.096	0.096	0.096	0.097	0.097	0.097	0.097	0.097
	Power	4.859	4.882	4.896	4.984	4.950	4.978	4.957	4.951
023	VccA	1.040	1.051	1.053	1.050	1.052	1.051	1.049	1.053
	VccD	0.138	0.137	0.165	0.165	0.145	0.147	0.140	0.147
	VccIO1	0.150	0.164	0.146	0.144	0.162	0.159	0.162	0.159
	VccIO2	0.096	0.096	0.096	0.097	0.097	0.098	0.096	0.097
	Power	4.842	4.923	4.964	4.950	4.950	4.947	4.920	4.951
024	VccA	1.040	1.049	1.053	1.048	1.053	1.050	1.052	1.050
	VccD	0.132	0.142	0.156	0.162	0.137	0.138	0.143	0.145
	VccIO1	0.148	0.162	0.146	0.144	0.160	0.160	0.160	0.157
	VccIO2	0.095	0.095	0.095	0.095	0.096	0.096	0.097	0.095
	Power	4.811	4.923	4.930	4.927	4.916	4.910	4.938	4.919
006	VccA	1.037	1.039	1.043	1.043	1.035	1.038	1.040	1.042
	VccD	0.155	0.144	0.160	0.159	0.134	0.144	0.133	0.142
	VccIO1	0.148	0.162	0.146	0.144	0.163	0.158	0.160	0.158
	VccIO2	0.094	0.094	0.095	0.095	0.094	0.095	0.095	0.094
	Power	4.876	4.893	4.910	4.899	4.848	4.879	4.855	4.882
025	VccA	1.029	1.037	1.040	1.029	1.045	1.039	1.040	1.040
	VccD	0.138	0.146	0.166	0.162	0.146	0.146	0.138	0.140
	VccIO1	0.148	0.164	0.146	0.146	0.158	0.159	0.160	0.160
	VccIO2	0.095	0.095	0.095	0.095	0.096	0.096	0.095	0.096
	Power	4.794	4.903	4.920	4.869	4.913	4.893	4.872	4.880



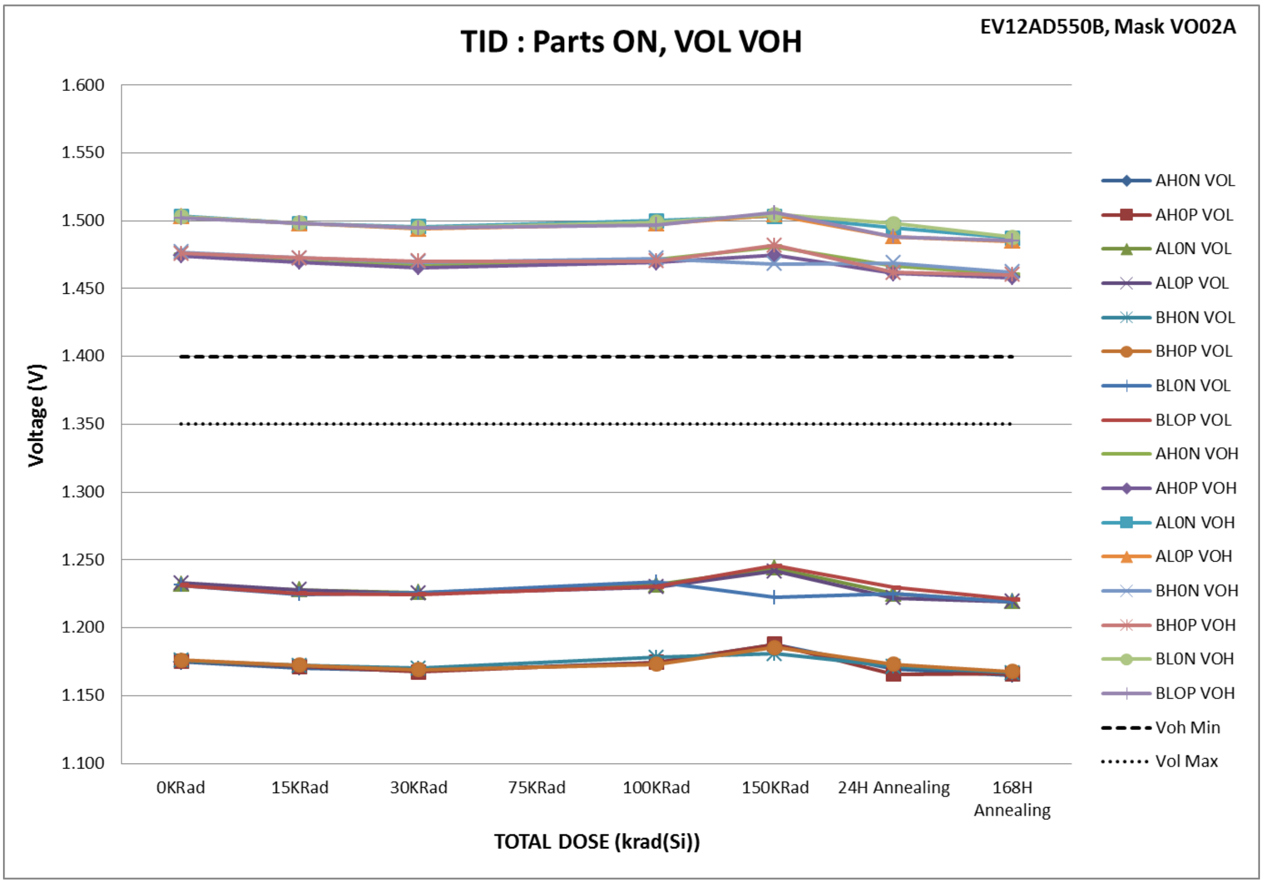


Conclusion:

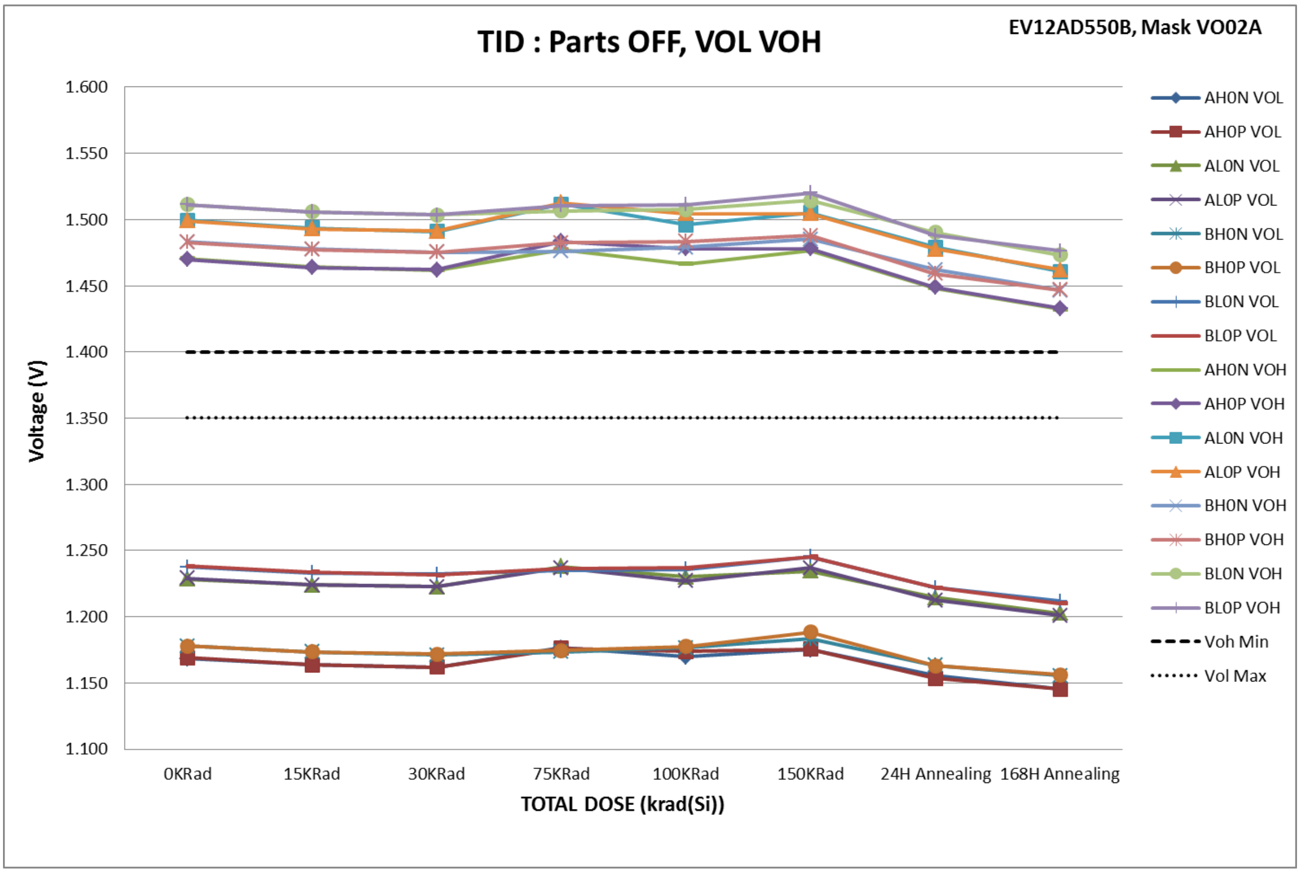
There is no impact of TID on the power consumption.

7.2 VOL VOH

			0KRad	15KRad	30KRad	75KRad	100KRad	150KRad	24H Annealing	168H Annealing
Parts ON	VOL (V)	AHON VOL	1.175	1.170	1.168	#N/A	1.174	1.188	1.170	1.165
		AHOP VOL	1.175	1.171	1.167	#N/A	1.175	1.188	1.166	1.166
		ALON VOL	1.232	1.228	1.226	#N/A	1.232	1.244	1.225	1.219
		ALOP VOL	1.233	1.228	1.225	#N/A	1.230	1.242	1.222	1.219
		BHON VOL	1.176	1.172	1.170	#N/A	1.178	1.181	1.171	1.167
		BHOP VOL	1.176	1.173	1.169	#N/A	1.173	1.185	1.173	1.168
		BLON VOL	1.231	1.225	1.226	#N/A	1.234	1.222	1.225	1.219
		BLOP VOL	1.231	1.225	1.225	#N/A	1.230	1.246	1.230	1.221
	VOH (V)	AHON VOH	1.475	1.470	1.467	#N/A	1.471	1.481	1.466	1.460
		AHOP VOH	1.474	1.469	1.465	#N/A	1.469	1.475	1.461	1.458
		ALON VOH	1.503	1.498	1.496	#N/A	1.500	1.503	1.495	1.487
		ALOP VOH	1.503	1.498	1.494	#N/A	1.498	1.504	1.488	1.485
		BHON VOH	1.477	1.473	1.469	#N/A	1.472	1.468	1.469	1.462
		BHOP VOH	1.476	1.472	1.470	#N/A	1.470	1.482	1.462	1.460
		BLON VOH	1.503	1.498	1.495	#N/A	1.499	1.505	1.498	1.488
		BLOP VOH	1.502	1.498	1.495	#N/A	1.497	1.506	1.488	1.485



			0KRad	15KRad	30KRad	75KRad	100KRad	150KRad	24H Annealing	168H Annealing
Parts OFF	VOL (V)	AH0N VOL	1.168	1.164	1.162	1.177	1.170	1.175	1.156	1.146
		AH0P VOL	1.169	1.164	1.162	1.176	1.174	1.176	1.153	1.145
		AL0N VOL	1.228	1.224	1.223	1.238	1.230	1.234	1.214	1.203
		AL0P VOL	1.229	1.224	1.223	1.237	1.227	1.237	1.213	1.201
		BH0N VOL	1.178	1.174	1.171	1.174	1.176	1.183	1.163	1.155
		BH0P VOL	1.178	1.174	1.172	1.175	1.178	1.188	1.163	1.156
		BL0N VOL	1.237	1.233	1.232	1.235	1.236	1.245	1.222	1.212
		BL0P VOL	1.238	1.234	1.232	1.237	1.237	1.245	1.222	1.210
	VOH (V)	AH0N VOH	1.471	1.464	1.462	1.478	1.467	1.477	1.448	1.432
		AH0P VOH	1.470	1.464	1.462	1.484	1.478	1.478	1.449	1.433
		AL0N VOH	1.499	1.494	1.491	1.512	1.496	1.505	1.479	1.461
		AL0P VOH	1.499	1.493	1.491	1.513	1.504	1.505	1.478	1.462
		BH0N VOH	1.483	1.478	1.475	1.476	1.479	1.485	1.462	1.446
		BH0P VOH	1.483	1.477	1.475	1.483	1.483	1.488	1.459	1.447
		BL0N VOH	1.511	1.506	1.504	1.507	1.508	1.514	1.490	1.473
		BL0P VOH	1.511	1.506	1.504	1.511	1.511	1.520	1.488	1.476



Reference parts:

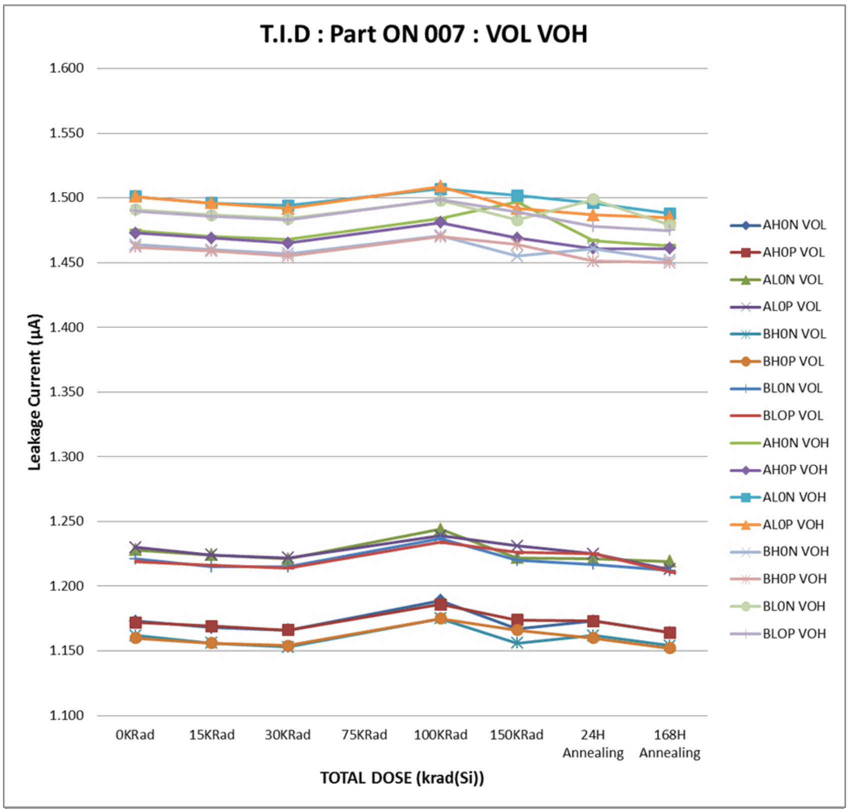
Part	Voltage measured		0KRad	15KRad	30KRad	75KRad	100KRad	150KRad	24H Annealing	168H Annealing
006	VOL (V)	AH0N VOL	1.177	1.166	1.165	1.183	1.160	1.158	1.159	1.152
		AH0P VOL	1.179	1.166	1.167	1.179	1.161	1.163	1.161	1.154
		AL0N VOL	1.241	1.230	1.231	1.246	1.223	1.222	1.232	1.210
		AL0P VOL	1.243	1.231	1.231	1.246	1.224	1.222	1.225	1.213
		BH0N VOL	1.179	1.177	1.177	1.192	1.172	1.169	1.182	1.167
		BH0P VOL	1.182	1.178	1.176	1.192	1.173	1.169	1.186	1.163
		BL0N VOL	1.248	1.235	1.235	1.252	1.231	1.225	1.232	1.223
		BL0P VOL	1.247	1.236	1.235	1.251	1.231	1.227	1.236	1.217
	VOH (V)	AH0N VOH	1.476	1.462	1.461	1.476	1.449	1.446	1.450	1.440
		AH0P VOH	1.474	1.461	1.461	1.475	1.451	1.447	1.462	1.444
		AL0N VOH	1.504	1.492	1.491	1.507	1.480	1.476	1.501	1.469
		AL0P VOH	1.504	1.491	1.492	1.505	1.481	1.476	1.468	1.472
		BH0N VOH	1.480	1.476	1.474	1.493	1.467	1.457	1.467	1.452
		BH0P VOH	1.478	1.475	1.475	1.491	1.466	1.459	1.462	1.456
		BL0N VOH	1.515	1.503	1.502	1.519	1.494	1.485	1.485	1.479
		BL0P VOH	1.516	1.502	1.502	1.517	1.494	1.487	1.492	1.484
Part	Voltage measured		0KRad	15KRad	30KRad	75.KRad	100KRad	150KRad	24H Annealing	168H Annealing
025	VOL (V)	AH0N	1.176	1.175	1.172	1.183	1.165	1.172	1.167	1.156
		AH0P	1.177	1.176	1.172	1.191	1.167	1.161	1.180	1.155
		AL0N	1.241	1.240	1.237	1.246	1.226	1.247	1.239	1.213
		AL0P	1.241	1.241	1.237	1.257	1.228	1.224	1.211	1.212
		BH0N	1.179	1.179	1.175	1.188	1.166	1.188	1.169	1.157
		BH0P	1.180	1.180	1.174	1.188	1.166	1.193	1.168	1.156
		BL0N	1.231	1.231	1.227	1.241	1.219	1.292	1.215	1.205
		BL0P	1.230	1.230	1.228	1.240	1.218	1.254	1.232	1.206
	VOH (V)	AH0N	1.480	1.479	1.474	1.489	1.461	1.468	1.452	1.442
		AH0P	1.480	1.478	1.473	1.495	1.462	1.478	1.459	1.443
		AL0N	1.510	1.509	1.503	1.513	1.489	1.500	1.495	1.471
		AL0P	1.510	1.508	1.504	1.522	1.489	1.480	1.491	1.472
		BH0N	1.475	1.475	1.469	1.481	1.454	1.477	1.462	1.437
		BH0P	1.475	1.476	1.470	1.493	1.454	1.462	1.457	1.437
		BL0N	1.501	1.501	1.497	1.506	1.481	1.472	1.479	1.463
		BL0P	1.501	1.501	1.495	1.518	1.480	1.477	1.472	1.463

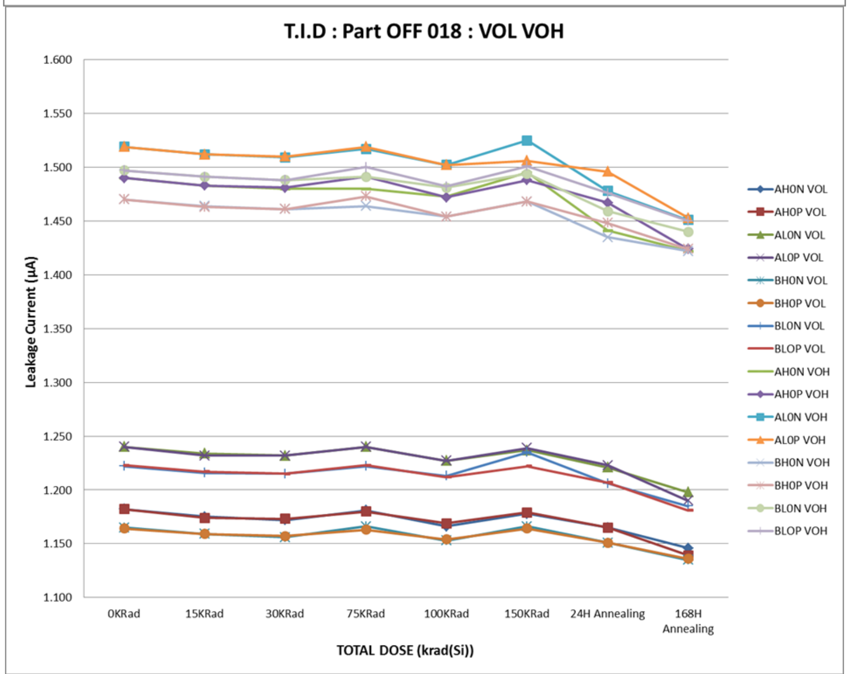
Parts ON:

Part	Voltage measured		0KRad	15KRad	30KRad	75KRad	100KRad	150KRad	24H Annealing	168H Annealing
007	VOL (V)	AHON	1.173	1.168	1.166	#N/A	1.189	1.167	1.173	1.164
		AHOP	1.172	1.169	1.166	#N/A	1.186	1.174	1.173	1.164
		ALON	1.228	1.224	1.221	#N/A	1.244	1.222	1.221	1.219
		ALOP	1.230	1.224	1.222	#N/A	1.239	1.231	1.225	1.213
		BHON	1.162	1.156	1.153	#N/A	1.175	1.156	1.162	1.154
		BHOP	1.160	1.156	1.154	#N/A	1.175	1.166	1.160	1.152
		BLON	1.221	1.215	1.215	#N/A	1.237	1.220	1.217	1.212
		BLOP	1.219	1.216	1.214	#N/A	1.234	1.226	1.225	1.211
	VOH (V)	AHON	1.475	1.470	1.468	#N/A	1.484	1.497	1.467	1.463
		AHOP	1.473	1.469	1.465	#N/A	1.481	1.469	1.461	1.461
		ALON	1.501	1.496	1.494	#N/A	1.507	1.502	1.496	1.488
		ALOP	1.501	1.496	1.492	#N/A	1.509	1.492	1.487	1.485
		BHON	1.464	1.460	1.457	#N/A	1.471	1.455	1.461	1.452
		BHOP	1.462	1.459	1.455	#N/A	1.470	1.464	1.451	1.450
		BLON	1.491	1.487	1.484	#N/A	1.498	1.483	1.499	1.479
		BLOP	1.490	1.486	1.483	#N/A	1.499	1.489	1.478	1.475
009	VOL (V)	AHON	1.180	1.175	1.174	#N/A	1.182	1.222	1.190	1.167
		AHOP	1.181	1.176	1.171	#N/A	1.188	1.215	1.191	1.168
		ALON	1.232	1.226	1.229	#N/A	1.237	1.271	1.243	1.218
		ALOP	1.234	1.229	1.224	#N/A	1.237	1.248	1.246	1.217
		BHON	1.172	1.167	1.165	#N/A	1.187	1.187	1.184	1.161
		BHOP	1.174	1.169	1.164	#N/A	1.166	1.186	1.184	1.159
		BLON	1.228	1.222	1.222	#N/A	1.242	1.165	1.240	1.215
		BLOP	1.230	1.224	1.220	#N/A	1.228	1.262	1.242	1.212
	VOH (V)	AHON	1.477	1.471	1.467	#N/A	1.485	1.502	1.483	1.457
		AHOP	1.476	1.471	1.465	#N/A	1.476	1.478	1.483	1.456
		ALON	1.503	1.498	1.491	#N/A	1.516	1.520	1.510	1.480
		ALOP	1.503	1.497	1.492	#N/A	1.502	1.520	1.509	1.481
		BHON	1.470	1.464	1.459	#N/A	1.472	1.486	1.475	1.447
		BHOP	1.470	1.464	1.459	#N/A	1.463	1.498	1.474	1.447
		BLON	1.498	1.490	1.485	#N/A	1.501	1.533	1.503	1.473
		BLOP	1.496	1.492	1.487	#N/A	1.491	1.525	1.502	1.474
011	VOL (V)	AHON	1.177	1.173	1.170	#N/A	1.171	1.215	1.166	1.169
		AHOP	1.179	1.175	1.169	#N/A	1.170	1.218	1.131	1.165
		ALON	1.233	1.229	1.225	#N/A	1.227	1.272	1.224	1.222
		ALOP	1.234	1.229	1.226	#N/A	1.225	1.276	1.186	1.215
		BHON	1.183	1.181	1.177	#N/A	1.179	1.215	1.175	1.177
		BHOP	1.183	1.181	1.177	#N/A	1.177	1.222	1.173	1.177
		BLON	1.237	1.223	1.232	#N/A	1.233	1.271	1.228	1.230
		BLOP	1.238	1.224	1.231	#N/A	1.233	1.280	1.227	1.229
	VOH (V)	AHON	1.474	1.469	1.463	#N/A	1.461	1.483	1.457	1.459
		AHOP	1.473	1.467	1.464	#N/A	1.462	1.498	1.455	1.459
		ALON	1.502	1.496	1.491	#N/A	1.490	1.512	1.483	1.485
		ALOP	1.501	1.495	1.491	#N/A	1.490	1.522	1.481	1.486
		BHON	1.482	1.478	1.473	#N/A	1.472	1.488	1.467	1.470
		BHOP	1.481	1.478	1.479	#N/A	1.472	1.506	1.462	1.469
		BLON	1.508	1.503	1.499	#N/A	1.498	1.514	1.496	1.495
		BLOP	1.506	1.503	1.500	#N/A	1.497	1.525	1.487	1.495
013	VOL (V)	AHON	1.165	1.163	1.161	#N/A	1.159	1.162	1.150	1.157
		AHOP	1.165	1.162	1.160	#N/A	1.158	1.163	1.161	1.160
		ALON	1.237	1.235	1.234	#N/A	1.228	1.234	1.215	1.224
		ALOP	1.238	1.235	1.232	#N/A	1.230	1.234	1.232	1.229
		BHON	1.196	1.195	1.196	#N/A	1.190	1.191	1.177	1.188
		BHOP	1.197	1.196	1.192	#N/A	1.189	1.191	1.191	1.191
		BLON	1.253	1.251	1.251	#N/A	1.247	1.250	1.229	1.238
		BLOP	1.254	1.252	1.248	#N/A	1.248	1.248	1.248	1.244
	VOH (V)	AHON	1.467	1.465	1.466	#N/A	1.456	1.461	1.458	1.452
		AHOP	1.468	1.465	1.462	#N/A	1.457	1.461	1.439	1.452
		ALON	1.503	1.500	1.505	#N/A	1.491	1.496	1.492	1.487
		ALOP	1.502	1.500	1.497	#N/A	1.491	1.496	1.471	1.485
		BHON	1.503	1.501	1.502	#N/A	1.491	1.461	1.491	1.490
		BHOP	1.502	1.501	1.501	#N/A	1.490	1.493	1.471	1.487
		BLON	1.529	1.529	1.526	#N/A	1.518	1.519	1.518	1.517
		BLOP	1.529	1.527	1.523	#N/A	1.519	1.520	1.500	1.513
017	VOL (V)	AHON	1.179	1.173	1.171	#N/A	1.170	1.172	1.170	1.169
		AHOP	1.180	1.175	1.171	#N/A	1.171	1.169	1.172	1.173
		ALON	1.230	1.225	1.221	#N/A	1.222	1.221	1.222	1.214
		ALOP	1.229	1.223	1.223	#N/A	1.219	1.220	1.220	1.222
		BHON	1.166	1.162	1.159	#N/A	1.160	1.155	1.159	1.154
		BHOP	1.166	1.161	1.159	#N/A	1.158	1.162	1.157	1.159
		BLON	1.217	1.212	1.208	#N/A	1.210	1.206	1.210	1.202
		BLOP	1.215	1.210	1.210	#N/A	1.208	1.213	1.207	1.209
	VOH (V)	AHON	1.481	1.475	1.471	#N/A	1.469	1.462	1.467	1.471
		AHOP	1.481	1.475	1.471	#N/A	1.470	1.467	1.467	1.463
		ALON	1.507	1.500	1.497	#N/A	1.495	1.486	1.493	1.496
		ALOP	1.507	1.501	1.497	#N/A	1.496	1.491	1.493	1.487
		BHON	1.465	1.460	1.456	#N/A	1.455	1.450	1.450	1.452
		BHOP	1.465	1.460	1.457	#N/A	1.456	1.448	1.451	1.447
		BLON	1.488	1.483	1.480	#N/A	1.479	1.474	1.474	1.475
		BLOP	1.488	1.483	1.480	#N/A	1.479	1.471	1.474	1.469

Parts OFF:

Part	Voltage measured		0KRad	15KRad	30KRad	75KRad	100KRad	150KRad	24H Annealing	168H Annealing
018	VOL (V)	AHON	1.182	1.175	1.172	1.181	1.166	1.178	1.165	1.146
		AHOP	1.182	1.174	1.173	1.180	1.169	1.179	1.165	1.139
		ALON	1.240	1.234	1.232	1.240	1.227	1.237	1.221	1.198
		ALOP	1.240	1.232	1.232	1.240	1.227	1.239	1.223	1.190
		BHON	1.165	1.159	1.156	1.166	1.153	1.166	1.151	1.135
		BHOP	1.164	1.159	1.157	1.163	1.154	1.164	1.151	1.136
		BLON	1.222	1.216	1.215	1.222	1.213	1.235	1.206	1.185
		BLOP	1.223	1.217	1.215	1.223	1.212	1.222	1.207	1.181
	VOH (V)	AHON	1.490	1.483	1.480	1.480	1.473	1.495	1.441	1.422
		AHOP	1.490	1.483	1.481	1.491	1.472	1.488	1.467	1.424
		ALON	1.519	1.512	1.509	1.517	1.502	1.525	1.478	1.451
		ALOP	1.519	1.512	1.510	1.519	1.502	1.506	1.496	1.453
		BHON	1.470	1.464	1.461	1.464	1.454	1.468	1.435	1.422
		BHOP	1.470	1.463	1.461	1.473	1.454	1.468	1.448	1.424
		BLON	1.497	1.491	1.488	1.491	1.481	1.494	1.459	1.440
		BLOP	1.497	1.491	1.488	1.500	1.482	1.501	1.476	1.450
019	VOL (V)	AHON	1.166	1.163	1.162	1.172	1.159	1.183	1.146	1.143
		AHOP	1.166	1.163	1.161	1.172	1.159	1.206	1.132	1.142
		ALON	1.230	1.227	1.226	1.236	1.222	1.247	1.204	1.201
		ALOP	1.231	1.228	1.226	1.234	1.223	1.275	1.190	1.199
		BHON	1.176	1.174	1.172	1.181	1.169	1.205	1.148	1.151
		BHOP	1.177	1.175	1.172	1.186	1.169	1.241	1.148	1.151
		BLON	1.243	1.240	1.238	1.248	1.236	1.271	1.209	1.210
		BLOP	1.243	1.240	1.239	1.250	1.236	1.281	1.206	1.210
	VOH (V)	AHON	1.472	1.467	1.464	1.475	1.460	1.506	1.451	1.432
		AHOP	1.471	1.466	1.465	1.476	1.460	1.509	1.429	1.431
		ALON	1.502	1.499	1.496	1.506	1.491	1.533	1.483	1.461
		ALOP	1.502	1.498	1.497	1.506	1.492	1.538	1.457	1.462
		BHON	1.485	1.481	1.479	1.488	1.478	1.510	1.464	1.441
		BHOP	1.484	1.480	1.479	1.492	1.474	1.511	1.436	1.441
		BLON	1.515	1.512	1.510	1.522	1.506	1.545	1.495	1.472
		BLOP	1.515	1.512	1.510	1.521	1.505	1.538	1.467	1.472
021	VOL (V)	AHON	1.168	1.160	1.159	#N/A	1.195	1.194	1.154	1.152
		AHOP	1.169	1.160	1.159	#N/A	1.179	1.173	1.154	1.153
		ALON	1.222	1.214	1.212	#N/A	1.250	1.236	1.209	1.204
		ALOP	1.221	1.212	1.214	#N/A	1.234	1.226	1.208	1.208
		BHON	1.184	1.174	1.173	#N/A	1.192	1.187	1.168	1.165
		BHOP	1.184	1.174	1.174	#N/A	1.205	1.185	1.167	1.167
		BLON	1.243	1.234	1.233	#N/A	1.248	1.246	1.228	1.226
		BLOP	1.243	1.234	1.233	#N/A	1.268	1.246	1.228	1.226
	VOH (V)	AHON	1.465	1.453	1.452	#N/A	1.479	1.466	1.445	1.443
		AHOP	1.463	1.453	1.453	#N/A	1.525	1.480	1.445	1.443
		ALON	1.491	1.481	1.479	#N/A	1.506	1.493	1.472	1.471
		ALOP	1.491	1.480	1.479	#N/A	1.534	1.506	1.472	1.471
		BHON	1.492	1.481	1.479	#N/A	1.501	1.495	1.469	1.466
		BHOP	1.491	1.480	1.479	#N/A	1.496	1.508	1.468	1.466
		BLON	1.519	1.508	1.507	#N/A	1.528	1.520	1.496	1.496
		BLOP	1.519	1.508	1.506	#N/A	1.524	1.551	1.496	1.495
023	VOL (V)	AHON	1.157	1.154	1.151	#N/A	1.165	1.156	1.164	1.144
		AHOP	1.157	1.153	1.152	#N/A	1.187	1.154	1.167	1.143
		ALON	1.222	1.219	1.218	#N/A	1.228	1.227	1.224	1.207
		ALOP	1.224	1.220	1.217	#N/A	1.227	1.219	1.226	1.202
		BHON	1.181	1.179	1.176	#N/A	1.188	1.180	1.178	1.165
		BHOP	1.181	1.178	1.177	#N/A	1.184	1.173	1.179	1.163
		BLON	1.238	1.236	1.235	#N/A	1.246	1.237	1.237	1.222
		BLOP	1.239	1.237	1.234	#N/A	1.244	1.239	1.238	1.217
	VOH (V)	AHON	1.459	1.454	1.453	#N/A	1.464	1.456	1.459	1.431
		AHOP	1.459	1.454	1.451	#N/A	1.476	1.455	1.458	1.436
		ALON	1.489	1.484	1.482	#N/A	1.494	1.486	1.487	1.459
		ALOP	1.489	1.484	1.482	#N/A	1.508	1.486	1.487	1.466
		BHON	1.484	1.480	1.478	#N/A	1.491	1.479	1.475	1.457
		BHOP	1.484	1.481	1.477	#N/A	1.516	1.478	1.475	1.457
		BLON	1.512	1.508	1.506	#N/A	1.519	1.507	1.504	1.486
		BLOP	1.512	1.508	1.506	#N/A	1.542	1.507	1.504	1.488
024	VOL (V)	AHON	1.169	1.166	1.165	#N/A	1.164	1.165	1.149	1.143
		AHOP	1.171	1.168	1.165	#N/A	1.175	1.166	1.149	1.150
		ALON	1.228	1.226	1.225	#N/A	1.224	1.225	1.214	1.203
		ALOP	1.229	1.228	1.224	#N/A	1.224	1.225	1.216	1.206
		BHON	1.184	1.182	1.179	#N/A	1.180	1.179	1.172	1.161
		BHOP	1.184	1.182	1.179	#N/A	1.176	1.178	1.170	1.163
		BLON	1.241	1.239	1.239	#N/A	1.237	1.238	1.229	1.216
		BLOP	1.243	1.241	1.237	#N/A	1.224	1.238	1.230	1.216
	VOH (V)	AHON	1.467	1.463	1.460	#N/A	1.457	1.460	1.445	1.433
		AHOP	1.467	1.463	1.460	#N/A	1.457	1.459	1.446	1.431
		ALON	1.496	1.492	1.488	#N/A	1.487	1.489	1.476	1.461
		ALOP	1.495	1.491	1.489	#N/A	1.486	1.487	1.476	1.459
		BHON	1.485	1.482	1.479	#N/A	1.472	1.474	1.468	1.446
		BHOP	1.485	1.482	1.480	#N/A	1.477	1.475	1.469	1.447
		BLON	1.513	1.510	1.507	#N/A	1.504	1.506	1.497	1.473
		BLOP	1.513	1.510	1.508	#N/A	1.504	1.504	1.497	1.476



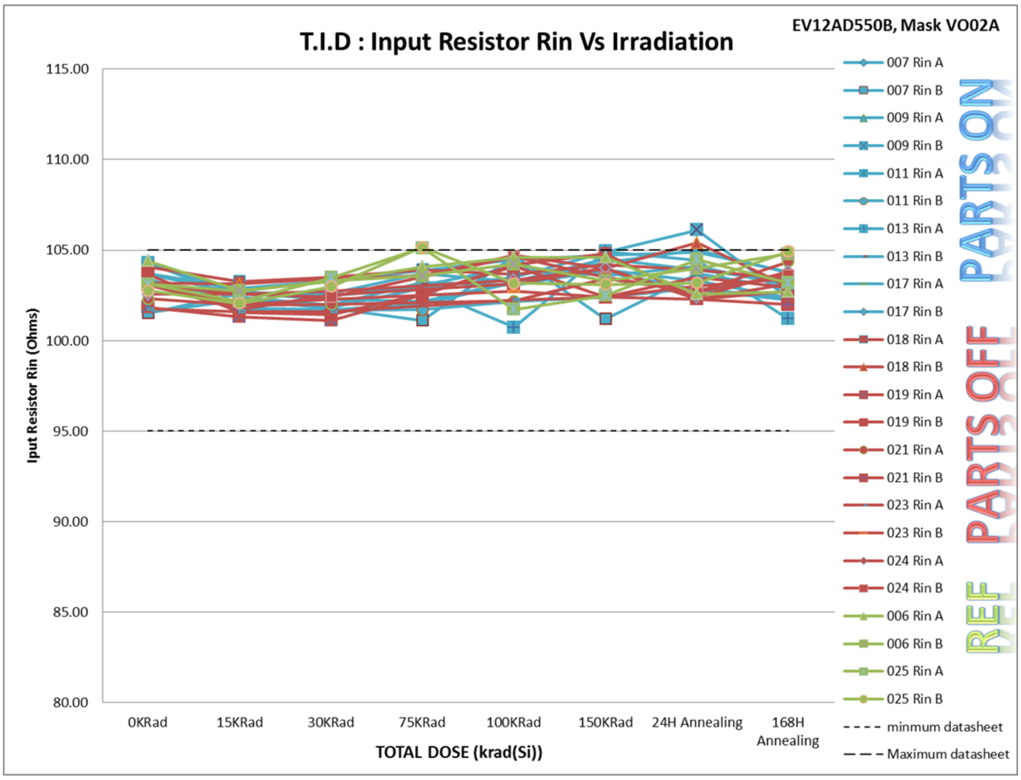


Conclusion:

There is no impact of TID on the VOL&VOH.

7.3 Input Resistor

Part	Input Resistance	Dose&Annealing							
		0KRad	15KRad	30KRad	75KRad	100KRad	150KRad	24H Annealing	168H Annealing
007	Rin A (ohms)	101.53	102.60	102.27	102.17	103.27	104.30	105.00	103.75
	Rin B (ohms)	101.54	102.24	101.78	101.11	104.67	101.20	103.70	102.86
009	Rin A (ohms)	103.17	102.40	101.96	103.20	103.07	103.90	103.30	102.37
	Rin B (ohms)	104.31	102.33	101.85	102.88	103.49	104.90	106.10	102.38
011	Rin A (ohms)	103.42	101.81	101.73	102.01	103.22	103.80	102.80	102.26
	Rin B (ohms)	103.10	101.75	101.68	101.70	102.15	102.40	102.90	102.34
013	Rin A (ohms)	104.27	102.68	102.49	102.88	100.73	104.92	104.45	101.20
	Rin B (ohms)	104.32	102.60	102.50	103.06	104.07	103.60	104.10	103.02
017	Rin A (ohms)	103.65	102.59	102.60	103.70	103.26	104.50	103.90	103.25
	Rin B (ohms)	103.72	102.91	103.28	103.88	104.46	104.70	104.90	103.79
018	Rin A (ohms)	104.05	103.27	103.51	103.91	103.65	104.20	103.90	103.43
	Rin B (ohms)	103.18	103.12	103.42	103.57	104.70	104.00	105.40	102.97
019	Rin A (ohms)	101.84	101.32	101.11	102.52	104.20	104.80	102.30	103.12
	Rin B (ohms)	103.67	101.57	101.42	102.56	104.13	102.40	102.30	102.72
021	Rin A (ohms)	102.32	101.95	102.01	#N/A	102.19	103.40	102.70	104.36
	Rin B (ohms)	103.09	101.70	102.53	#N/A	103.12	104.00	102.30	101.99
023	Rin A (ohms)	101.74	101.61	101.61	#N/A	102.26	102.40	103.50	102.92
	Rin B (ohms)	103.06	101.98	102.29	#N/A	102.72	102.40	103.00	103.40
024	Rin A (ohms)	102.55	102.58	102.75	#N/A	103.35	104.00	102.40	103.81
	Rin B (ohms)	103.09	102.56	102.42	#N/A	104.62	103.50	102.70	103.62
006	Rin A (ohms)	104.40	102.78	103.26	104.08	104.61	104.60	102.58	102.70
	Rin B (ohms)	103.13	102.73	103.31	103.57	104.22	103.30	103.97	104.80
025	Rin A (ohms)	103.13	102.18	103.47	105.12	101.73	102.50	104.49	103.19
	Rin B (ohms)	102.76	102.06	102.98	105.16	103.16	103.10	103.18	104.94



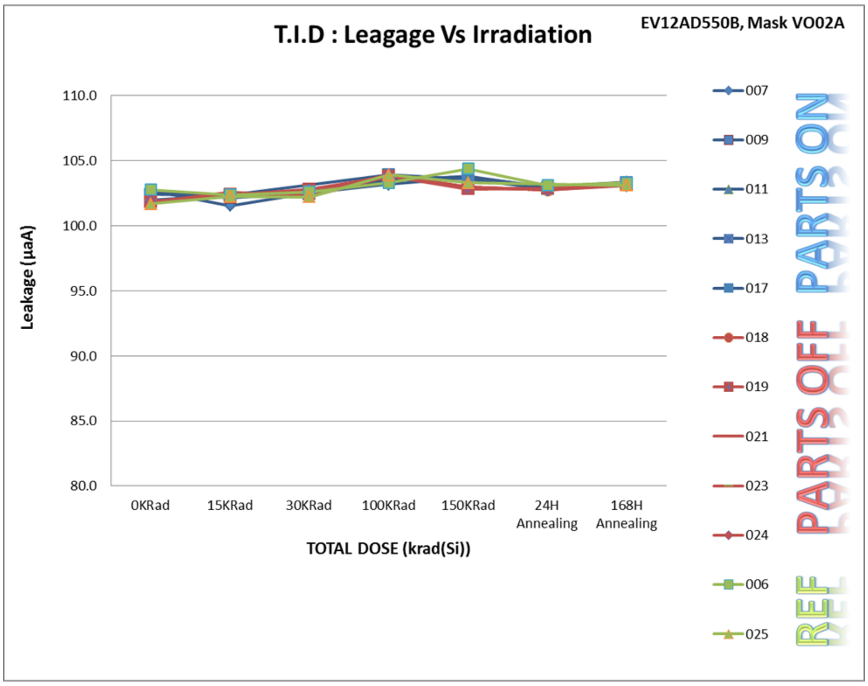
<u>Conclusion:</u>

There is no significant impact of TID on the input resistor.

7.4 Leakage Current (µA)

Part	Dose&Annealing						
	0KRad	15KRad	30KRad	100KRad	150KRad	24H Annealing	168H Annealing
007	102.7	101.5	102.5	103.2	103.7	102.9	103.2
009	102.6	102.2	102.5	103.5	103.8	102.9	103.3
011	102.5	102.3	102.6	103.6	103.7	103.0	103.4
013	102.4	102.3	102.5	103.6	103.7	102.9	103.3
017	102.0	102.4	#N/A	103.9	103.6	102.8	103.3
018	101.9	102.4	102.3	103.8	103.0	102.7	103.3
019	101.9	102.4	102.8	103.8	102.8	102.9	103.2
021	101.8	102.6	102.3	103.8	102.9	102.8	103.2
023	101.9	102.4	102.5	103.9	103.0	102.8	103.2
024	101.9	102.4	102.6	103.9	103.0	102.7	103.1
006	102.8	102.4	102.6	103.3	104.4	103.1	103.3
025	101.7	102.2	102.2	103.9	103.3	#N/A	103.1

	Dose&Annealing						
	0KRad	15KRad	30KRad	100KRad	150KRad	24H Annealing	168H Annealing
Minimum	101.7	101.5	102.2	103.2	102.8	102.7	103.1
Maximum	102.8	102.6	102.8	103.9	104.4	103.1	103.4
Mean	102.2	102.3	102.5	103.7	103.4	102.9	103.2
Median	101.9	102.4	102.5	103.8	103.5	102.9	103.2

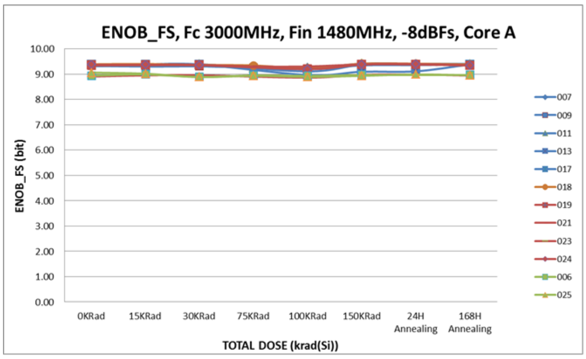


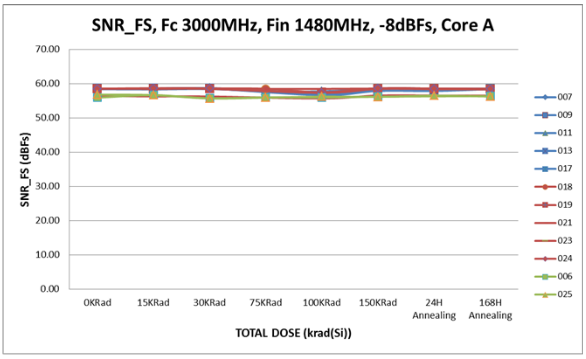
Conclusion:

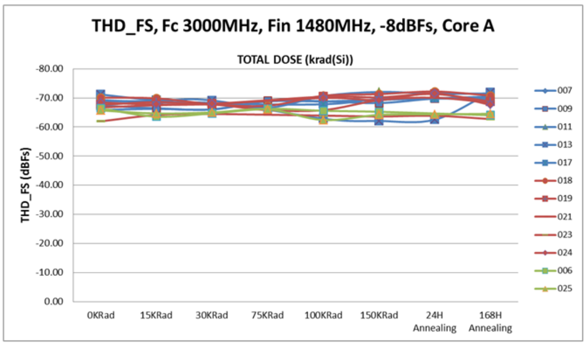
There is no impact of TID on the leakage.

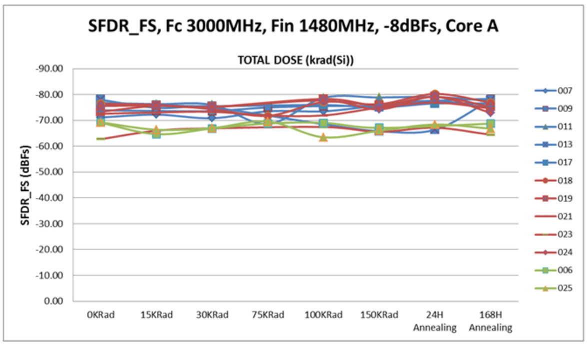
7.5 FFT Results

7.5.1 Fclock 3000MHz, Fin 1480MHz, Pin -8dBFs, Core A

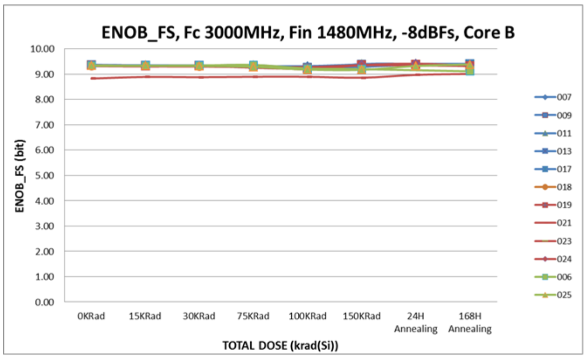


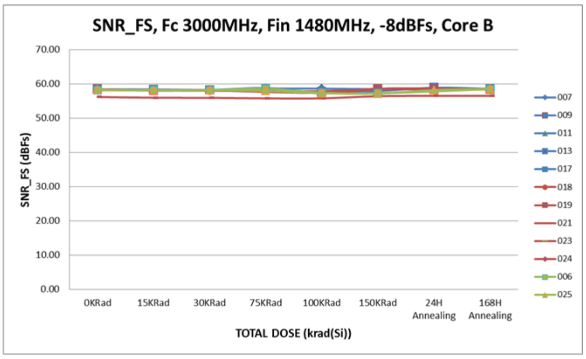


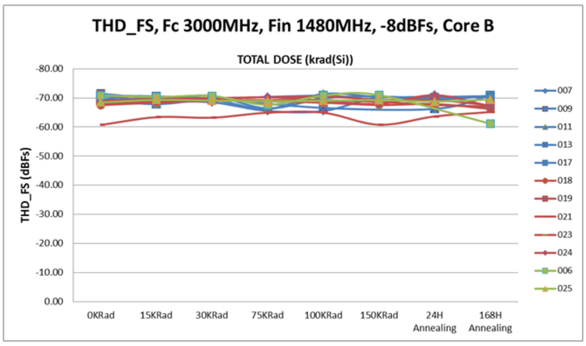


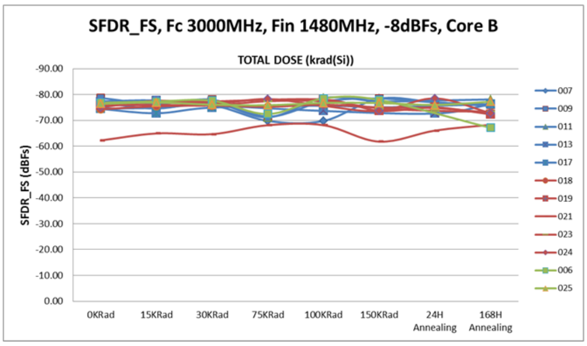


7.5.2 Fclock 3000MHz, Fin 1480MHz, Pin -8dBFs, Core B

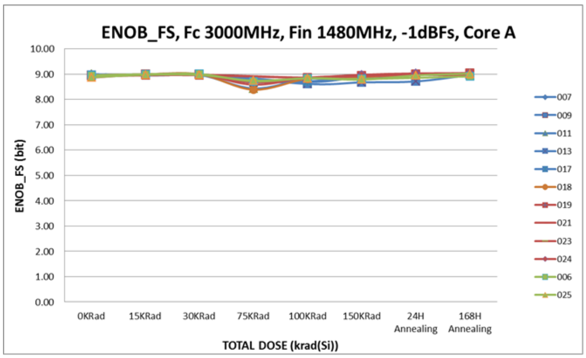


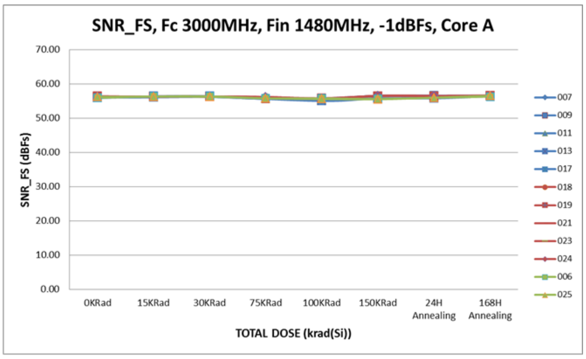


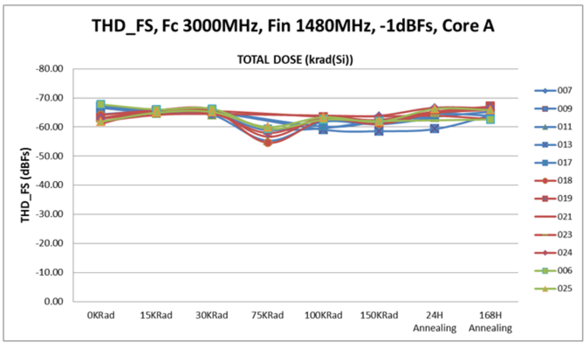


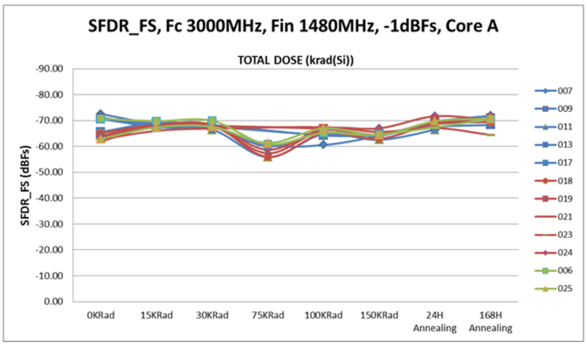


7.5.3 Fclock 3000MHz, Fin 1480MHz, Pin -1dBFs, Core A

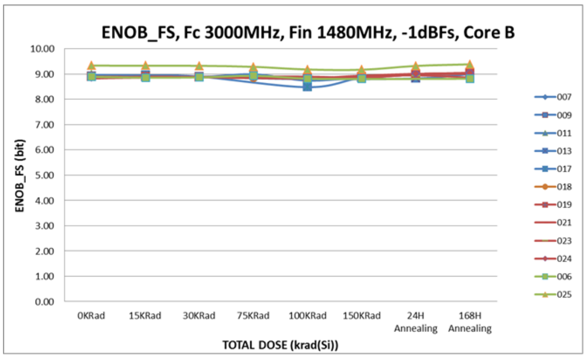


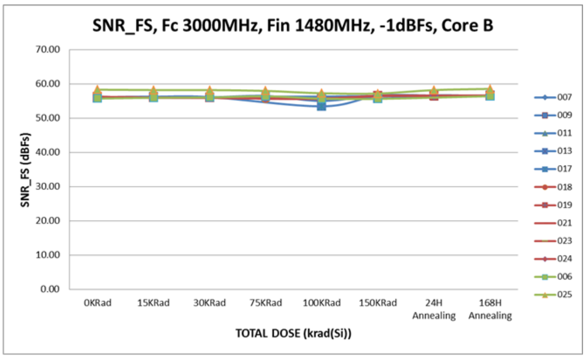


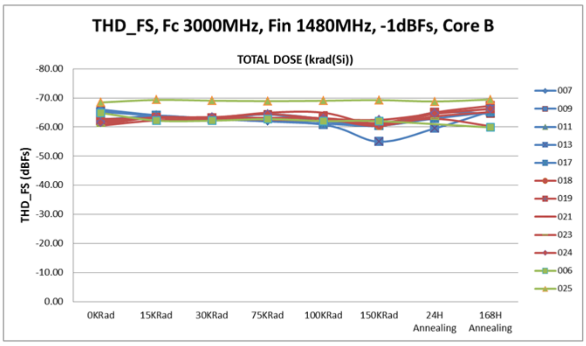


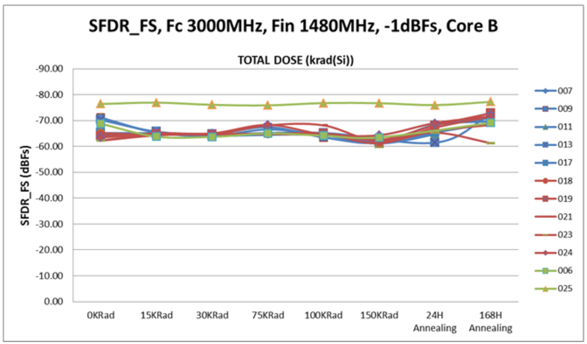


7.5.4 Fclock 3000MHz, Fin 1480MHz, Pin -1dBFs, Core B

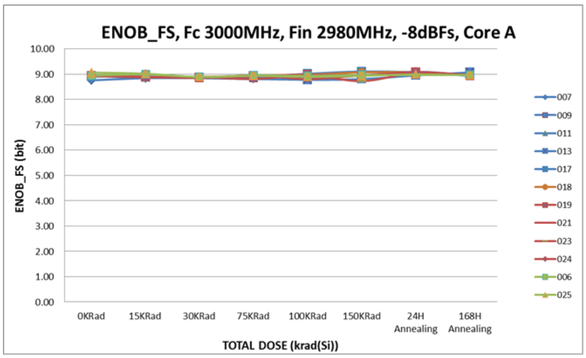


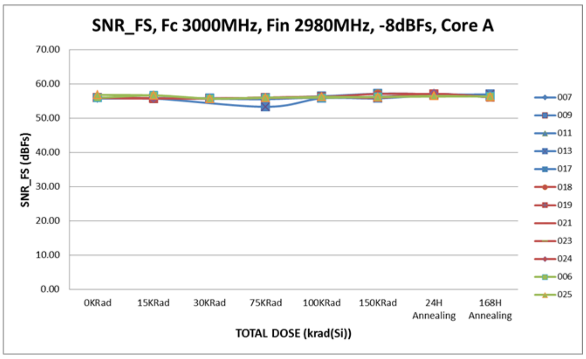


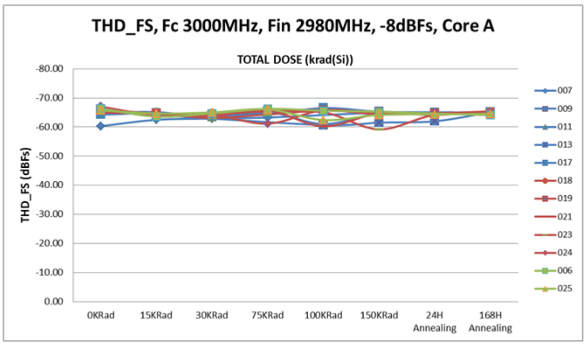


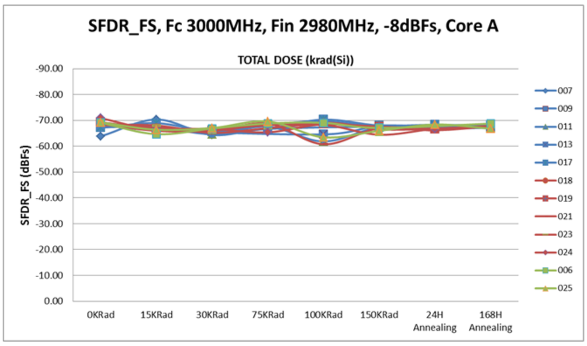


7.5.5 Fclock 3000MHz, Fin 2980MHz, Pin -8dBFs, Core A

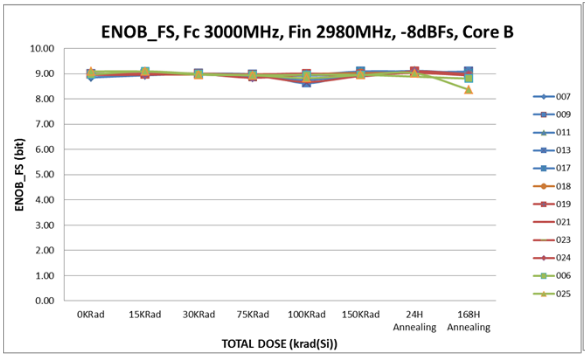


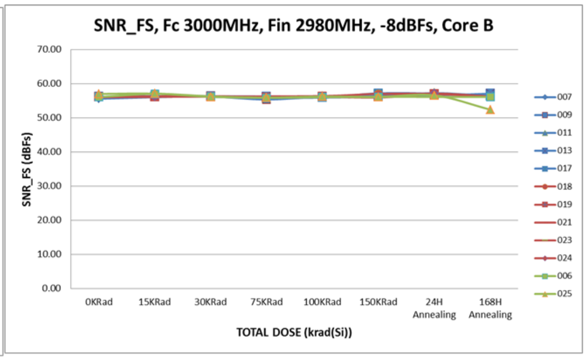


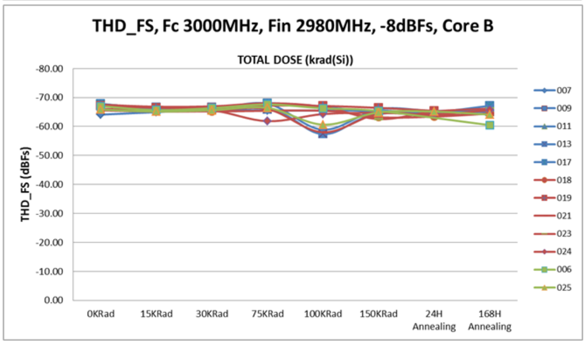


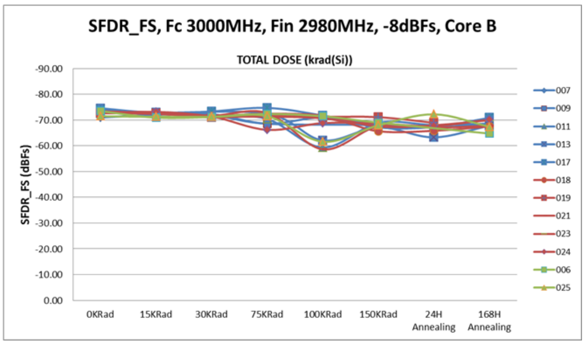


7.5.6 Fclock 3000MHz, Fin 2980MHz, Pin -8dBFs, Core B

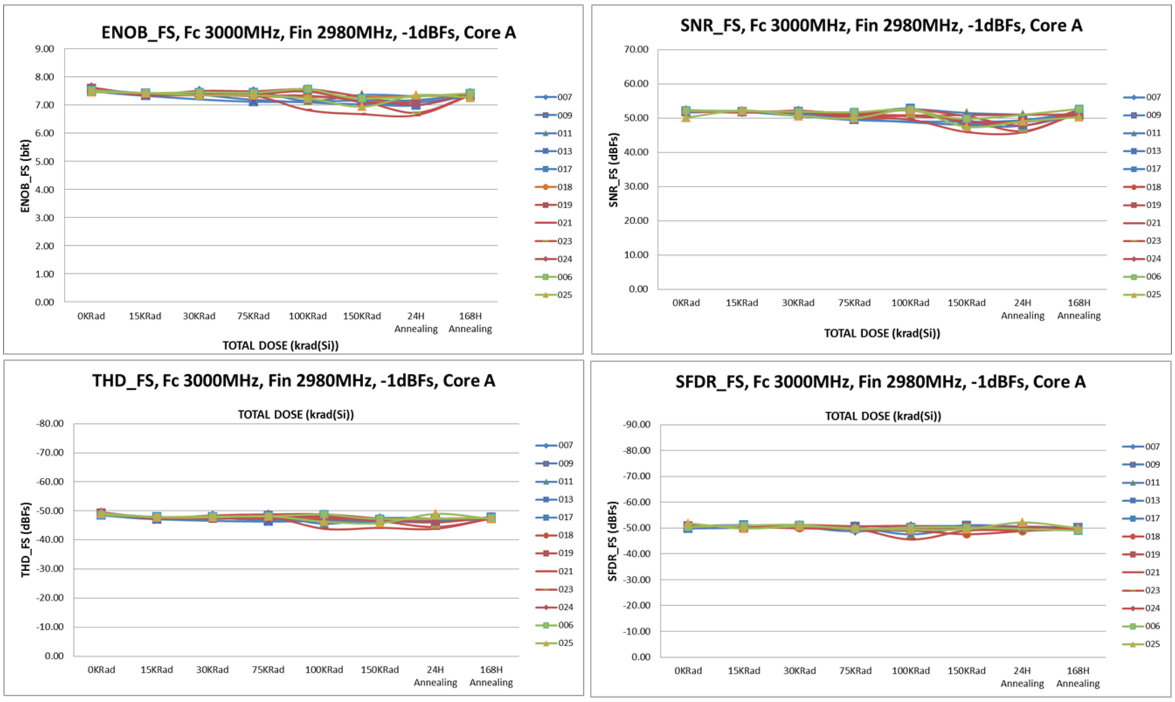




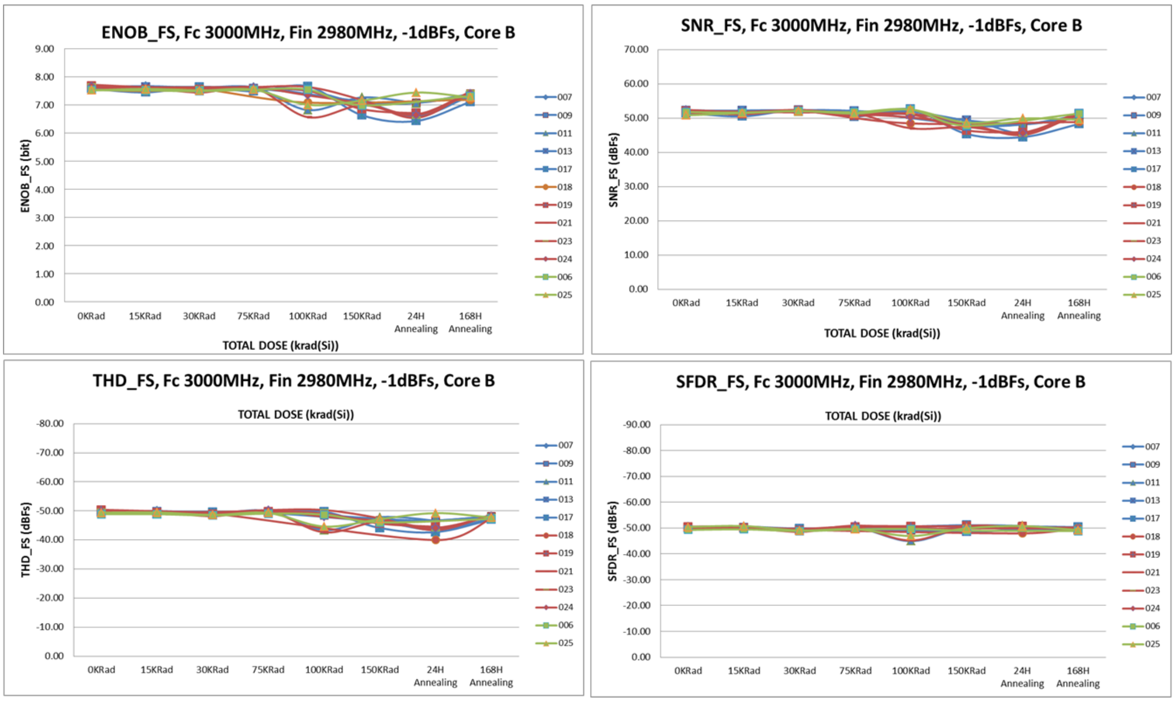




7.5.7 Fclock 3000MHz, Fin 2980MHz, Pin -1dBFs, Core A



7.5.8 Fclock 3000MHz, Fin 2980MHz, Pin -1dBFs, Core B



7.6 FFT conclusion

No relative significant drift have been observed on the performances due to Total Ionization dose.

8. TOTAL DOSE CONCLUSION

It was concluded that the device under test (P/N EV12AD550B) had neither functional failure nor parameter drift up to 150 Krad (Si). Static and Dynamic results are satisfactory for all parameters.

A total of ten devices (5 Bias ON, 5 Bias OFF) were tested at 3GHz Clock frequency.

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 component is not sensitive to 150 Krad with low dose rate (36 rad / hr).

9. HEAVY IONS TEST

9.1 External view

The component is assembled thanks to the flip chip technology, so the irradiation has been done through the backside of the die.
In order to have an acceptable beam penetration range, parts without lid, have been thinned at 60µm (S064, SO66, SO67).

The Figure 1 shows an external view of the parts. The left picture is the top view of the package and the right picture shows a bottom view of the part.
No marking were observed on the bottom of the package.

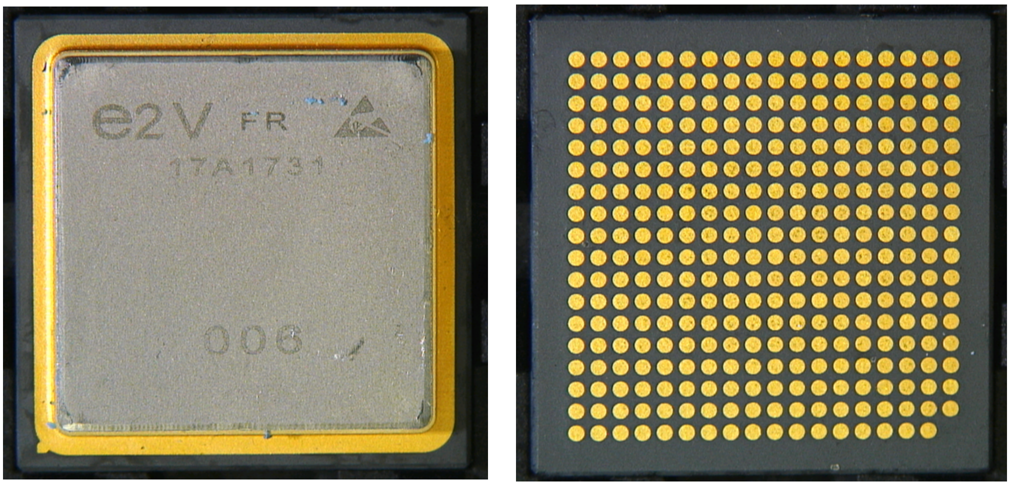


Figure 1: Package, front with the lid (left), LGA back (right)

9.2 Internal view

The following picture gives an overview of the die.

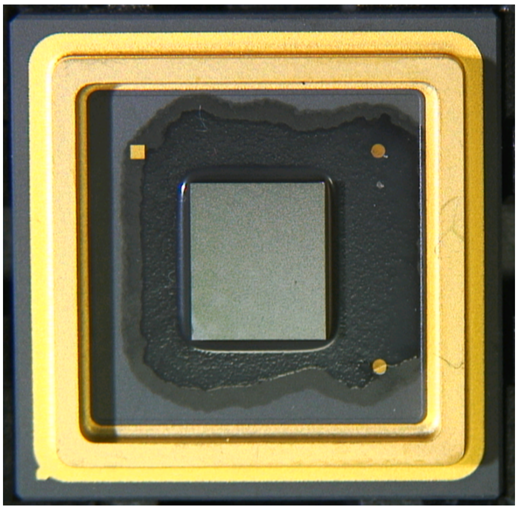
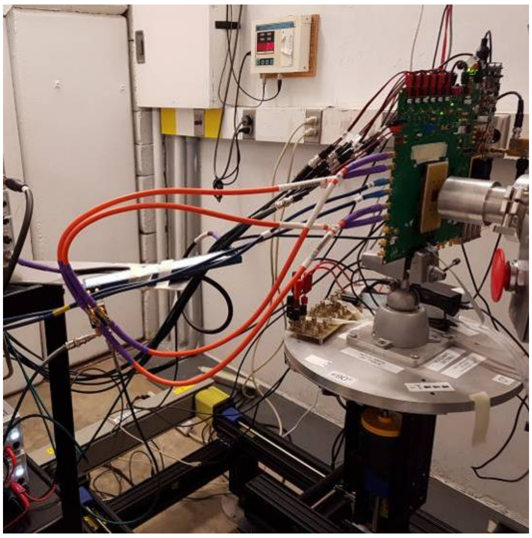


Figure 2: Internal overall view (without lid + thinned at 60µm)

9.3 Dosimetry and Irradiation Facilities

The test performed at TAMU (Texas A&M University, USA) on August 31st, September 01st and September 02nd, 2018

9.3.1 Heavy ion facility



The Cyclotron Institute is located on the campus of Texas A&M University (TAMU) in College Station, Texas (USA).

Various ion beams have been developed specifically for the Radiation Effects Facility. These beams provide for a wide scope of LET with high energies for deep part penetration.

Testing may be conducted in either vacuum chamber or with convenient in-air positioning system. Both provide precise positioning in x, y, and z as well as rotations up to 60 degrees.
Test presented in these report were performed using the In-Air Station.
Target position verification is provided by the means of a CCD camera aligned with the beam path. a narrow laser beam attached to an electronic scale is used to determine the air gap distance between exit window and target

9.3.2 Dosimetry

The beam uniformity and flux are determined using an array of five particle detectors. Each detector is made up with a plastic scintillator coupled to photo-multiplier tubes. Four of the detectors are fixed in position and set up to measure beam particle counting rates continuously at four characteristic points 1.64 inches (4.71 mm) away from the beam axis. The fifth scintillator can be optionally put in to measure the beam particle counting rate right at the beam axis. The sensitive area of each detector is defined by a 0.1 cm² aperture, while the intrinsic efficiency is 100% for all practical purposes. The beam uniformity parameter (ranging from 0 to 100%), the axial gain (%), and the beam flux (in particles/cm²/s) are determined by the control software based on the detector counting rates. The results are displayed and updated once every second.

9.3.3 Beam characteristics

The beam flux is variable between a few particles / s cm² and $1 \cdot 10^4$part. / s cm². On special request, the users have the possibility to increase the flux up to 10^6part/s cm². Heavy ion cocktail used for this test campaign are highlighted and their characteristics are listed in Table 2:

Ion	Energy (MeV)	Range (µm(Si))	LET (MeV.cm².mg^{-1})
^{4}He	60	1423	0.11
^{14}N	210	428	1.3
^{20}Ne	300	316	2.6
^{40}Ar	599	229	8
^{63}Cu	944	172	18.7
^{84}Kr	1259	170	26.6
^{109}Ag	1634	156	40.3
^{129}Xe	1934	156	49.3
^{141}Pr	2114	154	56
^{165}Ho	2474	156	66.7
^{181}Ta	2714	155	74.8
^{197}Au	2954	155	82.8

Table 2: Available ions 15MeV cocktail

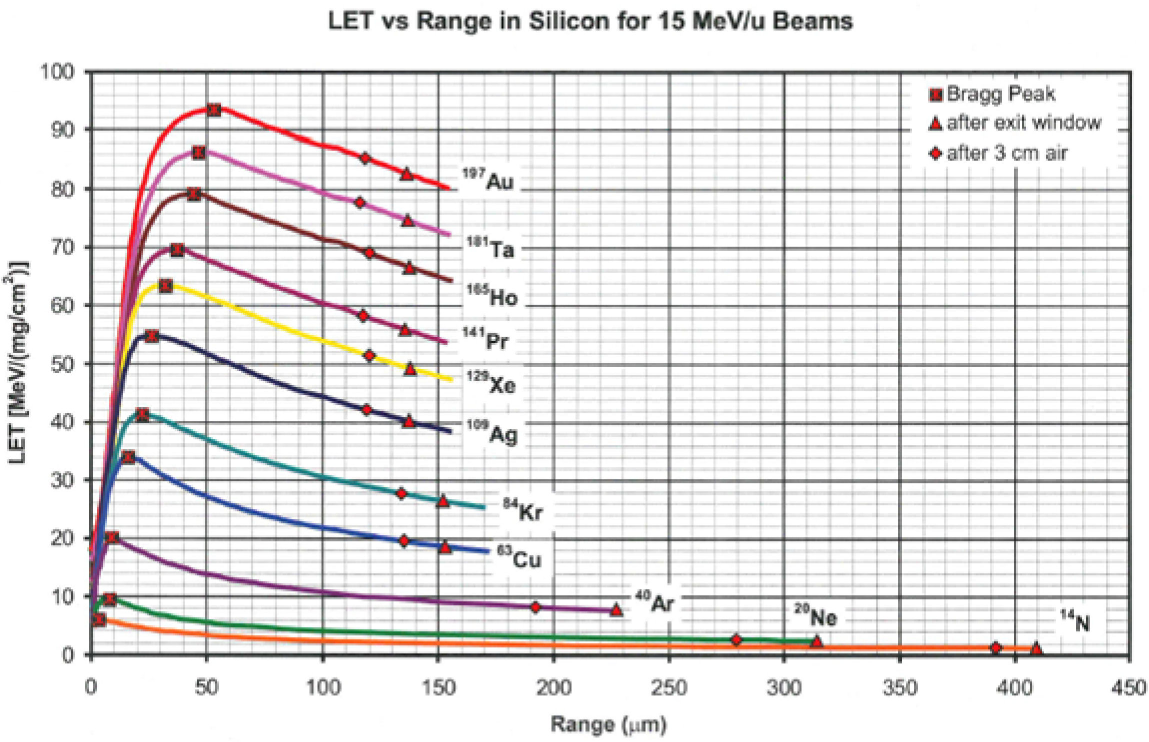


Figure 3: Let Vs Range

9.4 Test procedure and setup

9.4.1 Description of the test method

The test was divided in two parts, with respect to reference or applicable documents:
- Runs were performed up to a fluence of 10^7 particles.cm^{-2} with only SEL monitoring. This configuration allowed us to verify the latchup sensitivity of the device.
- Runs were performed up to a fluence to 10^6 particles.cm^{-2} for the SET, SEU, and SEFI detection. A latchup monitoring was used during these tests in order to protect the component. This configuration allowed us to verify the SET, SEU, SEFI.

The test is stopped when the maximum fluence is reached or when we get about a hundred events.

9.4.2 SEL test principle

The SEL test has been performed in dynamic mode with 1:2 DEMUX Ratio.
Hereunder are described the configuration used in SEL test:
- Maximum temperature: 125°C
- Maximum operating voltage V_{CCD}= +3.55V; V_{CCA}= +3.55V; V_{CCIO}= +3.55V
- No Gain or offset adjustment
- EXTRA_SE_Protect activated
- Default Fuses
- Clock input configuration:
  - Differential signal is applied on CLK pins with an RF generator
  - Clock level = 5dBm and Clock Frequency=3.2 GHz
- Analog input configuration: Fin= 1. 60012433980 GHz

Our sub-contractor has developed a specific equipment, the GUARD system (Graphical Universal AutoRange Delatcher) to perform SEL characterization. Its operation is as follows.
- The power supply is applied to the DUT through the GUARD system which protects the DUT against over consumption. Indeed the GUARD system continuously monitors the current consumption.
- If it exceeds the threshold current, set slightly above its nominal value, a SEL is counted. When a SEL occurs the power supply is maintained during a defined “hold time” then switched off during a defined “off time”.
- Then the power supply is switched ON again with the nominal current consumption expected.
- The waveform of the SEL is recorded using an oscilloscope.

The following figure shows a common SEL characteristic, with and without the GUARD system protection.

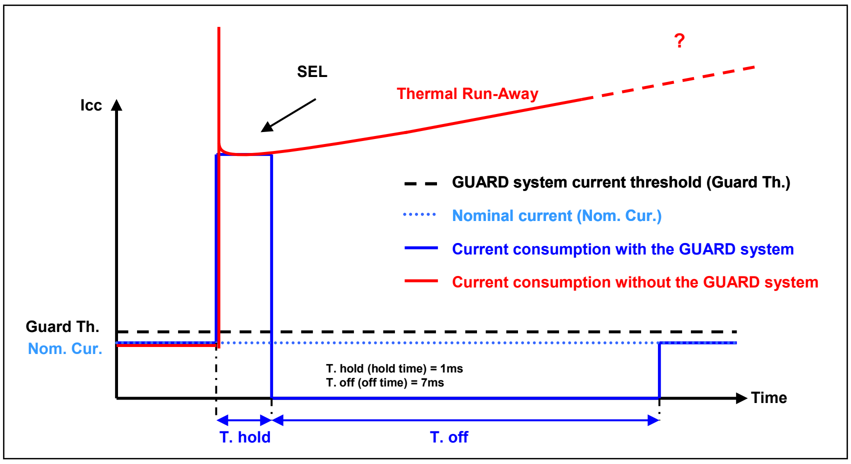


Figure 4: Common SEL characteristic

9.4.3 SEU, SET and SEFI test principle

The GUARD SYSTEM was used to protect the device under test.
The SEE test has been performed in dynamic and static modes in 1:2 and 1:1 DEMUX Ratio.
Hereunder are described the common configuration used in all these mode:

- Ambient temperature
- Nominal power supplies V_{CCD}= +3.4V; V_{CCA}= +3.4V; V_{CCIO}= +3.4V
- No Gain or offset adjustment
- EXTRA_SE_Protect activated
- Default Fuses
- Clock input configuration:
  - Differential signal is applied on CLK pins with an RF generator
  - Dynamic mode: Clock level=5dBm and Clock Frequency=2.4GHz
  - Static mode: Clock level=5dBm and Clock Frequency=3.2GHz
- Analog input configuration:
  - Differential signals are applied on analog pins using an RF generator thru 1 T-bias on each input for dynamic mode with frequency= 1.20009325485GHz

The following schematic presents an overview of this test setup.

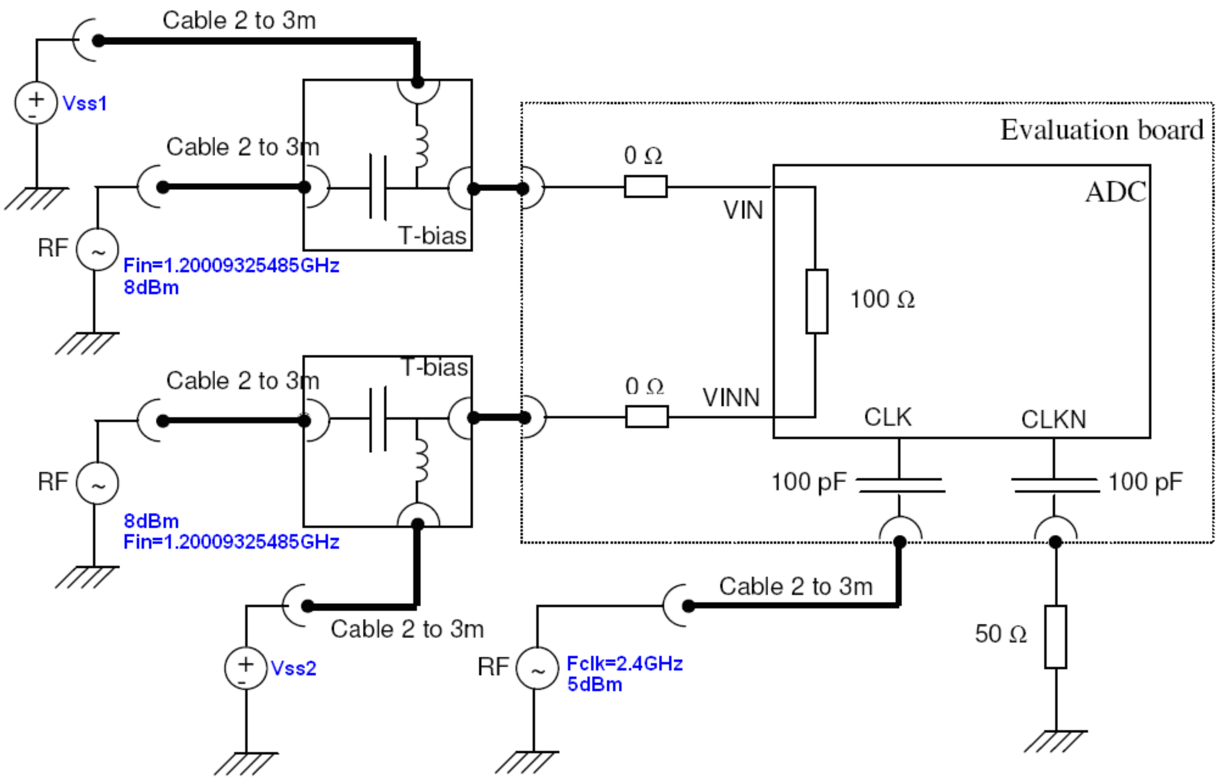


Figure 4: SEE Test Setup

9.4.3.1 Static mode

Static test was performed with a constant input signal applied on analog inputs AIN and BIN. Three configurations were experimented for static pattern:

Static high
AIN = BIN = Full scale+ (in order to have FFF on ADC outputs). Vss1=+2.6V and Vss2=+2V.
Static middle
AIN = BIN = Mid-scale (in order to have 7FF on ADC outputs).
Due to noisy environment, the tolerance to detect an upset was ±20LSB. Vss1= Vss2=0V.
Static low
AIN = BIN = Full scale - (in order to have 000 on ADC outputs). Vss1=+2V and Vss2=+2.6V.

The full SEE characterisation has been performed in static middle configuration and the configurations static high and low were performed in 1:2 DEMUX ratio.

9.4.3.2 Dynamic mode

For the dynamic test, a differential signal is applied on the analog pin with a RF generator, two T-bias are connected on analog inputs to apply the common mode voltage.

The dynamic test was done with a sine wave input applied on VIN (which is the AC coupled input on E2V evaluation board). No filter is mandatory after the RF generator because the linearity of the ADC is not a concern for heavy ion test.

Test was done at 2.4GHz with Fin=1.20009325485GHz, the difference between two successive codes will not exceed 1 LSB. The input frequency required to get 1 LSB change per clock cycle can be calculated by the following equation: $$\frac{Fs}{2^{12} \times \pi}$$

In this case with the sampling frequency set at 1.2 GHz for the two ADCs, the input frequency was set at 1.20009325485GHz, for a beat frequency and output of 93.25485 kHz.

This method enables to detect upsets.

Due to noisy environment, the tolerance to detect an upset was ±60LSB.

The DUT was set with Demux 1:1 and 1:2. Fclk and Fin RF generators were synchronized for coherence issue. The DC supply of T-Bias was not use.

In case of SEE detection 50 conversions before the event and 1000 conversions after are saved to allow post treatment if necessary.

9.4.3.3 Acquisition method

In both modes, static and dynamic, the two cores are tested simultaneously, their outputs being saved separately.
Depending of the test, the results of the two cores are presented separately or added.

9.4.4 Register configuration and records during SEE test

The following table shows the registers read at beginning and at the end of each run thru the microcontroller embedded on the E2V evolution board. These registers are also read before and after each SEFI for further post treatment analysis.

Address	Register	Description
0x01	CHIP_ID	Chip ID
0x02	S_N	Chip serial number
0x04	CHIP_CTRL	Chip control
0x1E	A_CMIREF	Input common mode trimming for channel A
0x1F	A_RIN	Input impedance trimming for channel A
0x20	A_SDA_CTRL	SDA for channel A
0x21	A_GAIN_CAL	Interleaving gain calibration for channel A
0x22	A_PHASE_CAL	Interleaving phase calibration for channel A
0x23	A_OFFSET_CAL	Interleaving offset calibration for channel A
0x3D	B_CMIREF	Input common mode trimming for channel B
0x3E	B_RIN	Input impedance trimming for channel B
0x3F	B_SDA_CTRL	SDA for channel B
0x40	B_GAIN_CAL	Interleaving gain calibration for channel B
0x41	B_PHASE_CAL	Interleaving phase calibration for channel B
0x42	B_OFFSET_CAL	Interleaving offset calibration for channel B
0x62	STDBY	Standby
0x63	LVDS_PRBS_CTRL	PRBS on LVDS output
0x64	CTRL_BIT_CFG	XFU1&2 selection
0x66	TEST_MODE	Test Mode
0x67	FLASH_RST_LENGTH	Number of clock cycle when data ready is driven low after a SYNC
0x68	OUT_SEL	DEMUX selection
0x69	A_CALC_CRC	CRC value for channel A
0x6A	B_CALC_CRC	CRC value for channel B
0x74	SYNC_CTRL	Edge selection for SYNC recovery
0x76	A_CAL_CRC1	CRC channel A low & Ambient temperature calibration
0x77	A_CAL_CRC2	CRC channel A high temperature calibration set 1
0x78	B_CAL_CRC1	CRC channel B low & Ambient temperature calibration
0x79	B_CAL_CRC2	CRC channel B high temperature calibration set 1

Table 3: The list of read register during the irradiation

The registers are initialized in default values when the microcontroller is reset. The DEMUX ratio is set at the beginning of run by writing the OUT_SEL register value. The single event protection is activated by writing ‘1’ in EXTRA_SE_PROTECT register. The ambient temperature calibration was chosen. To choose this factory temperature calibration, bit 3 of register CHIP_CTRL is written to ‘0’, next the calibration is loaded through writing ‘1’ in bit 0 of register LOAD_CAL .

Address	Register	Description
0x04	CHIP_CTRL	Chip control
0x68	OUT_SEL	DEMUX selection
0x7E	LOAD_CAL	Load calibration when written 1
0x7F	EXTRA_SE_PROTECT	SE protect

Table 4: Registers write for DUT initialization

9.4.5 Test bench description

9.4.5.1 Test Bench description

Figure 5: Test system description

9.4.5.2 Test equipment identification

TRAD TEST BOARD	TRAD/CT1/I/EV12AS550A/XXX/ELG/0416 TRAD/TA1/I/EV12AS550/XXX/ELG/0416
E2V TEST BOARD	XILINX - VC709-1 – SN: 31798041418 Evaluation board 3 SN: BRD4X-470-0
EQUIPMENT	ME-53; SM-86; SM-87; ME-16; Agilent E4426B
TEST PROGRAM	EV12AD550A_FA.vi Demux_1_1.vhd Demux_1_2.vhd

Figure 6: Test equipment identification

9.4.5.3 Device setup and test conditions

Trigger threshold for SEL test is defined in the following table:

Number of DUT	3
Power Supply	Maximum
Temperature	Tj=125°C
Clock Frequency	Differential signal. Clock level = 5dBm Clock Frequency=3.2 GHz
Analog input configuration	Fin= ~1.6 GHz
To monitor	All Power Supplies
DUT Config	• No Gain • No offset adjustment • EXTRA_SE_Protect Activated • Default Fuses

Figure 7: SEL detection threshold and input configuration

Configurations for SEE test are defined in the following tables:

Number of DUT	2+1
Power Supply	Typical
Temperature	Tj=Room Temperature
Clock Frequency	Differential signal. Clock level = 5dBm Clock Frequency = 2.4&3.2GHz
Analog input configuration	Fin= ~1.6 GHz or static
To monitor	Digitals Outputs & Registers
DUT Config	• No Gain • No offset adjustment • EXTRA_SE_Protect Activated • Default Fuses

Figure 8: General configuration for SEE test

Figure 9: Tolerance for SEU detection

*unless otherwise specified in results tables

9.5 Summary of configuration

Config	Type	Input	FClock (GHz)	Demux	T° (Tj)	LET	Comment
1	SEL	Dynamic	3.2	1:2	125	80	Power Supply Maximum, Temperature 125°C
2	SEE	Dynamic	2.4	1:2	RT	80	
3	SEE	Static Hight	3.2	1:2	RT	80	
4	SEE	Static Middle	3.2	1:2	RT	80	
5	SEE	Static Low	3.2	1:2	RT	80	
6	SEE	Dynamic	2.4	1:1	RT	80	
7	SEE	Static Middle	3.2	1:1	RT	80	
8	SEE	Dynamic	2.4	1:2	RT	80	No EXTRA_SE_ Protect
9	SEE	Dynamic	2.4	1:2	RT	80	Maximum power Supply
10	SEE	Dynamic	2.4	1:2	RT	80	Minimum power Supply

9.5.1 Single Event Effect definition on each Core (Core A and Core B)

Single Event Upset (SEU): is recorded when a conversion or successive conversions are outside the tolerance specified in results table.

Single Event Transient (SET): is recorded when the internal PLL unlock during the test (ADR and BDR signals).

Single Event Functional Interrupt 1 (SEFI1): is recorded if 800 successive conversions have the same value (in dynamic mode only).
Then the registers values are read and stored for post treatment analysis and a reset is applied then the DUT shall recover after this reset.

Single Event Functional Interrupt 2 (SEFI2): is recorded when the reset applied after the SEFI 1 detection does not recover the nominal operation. Then a power supplies cycle off/on is performed to reboot the device properly.

Single Event Functional Interrupt 3 (SEFI3): is recorded when an SET (on DR signal) duration of more than 1ms is detected. Then the registers values are read and stored for post treatment analysis and a reset is applied and after the DUT shall recover.

Single Event Functional Interrupt 4 (SEFI4): is recorded when the reset applied after the SEFI 3 detection does not recover the nominal operation. Then a power supplies cycle off/on is performed to reboot the device properly.

Clock tree event: has been identified during the post irradiation SEE analysis. It can be detected in dynamic mode only.

Figure 10 shows an example of clock tree event. This is a phase shifting on conversion sequence. In practical in the test bench configuration, the DUT is sampling the signal on Core A input in first then on Core B input, this sampling sequence is inherent in the operation of the DUT.
Under irradiation it appeared that this sequence can be inverted by ions effect. When a clock tree event occurs Core B input is sampled before Core A input. At the exact moment of this event, a "jump" on the converted signals is observed.
The event is due of a SEE on the clock tree resulting a phase shifting by 180° of internal clock and disturbing the sampling sequence.

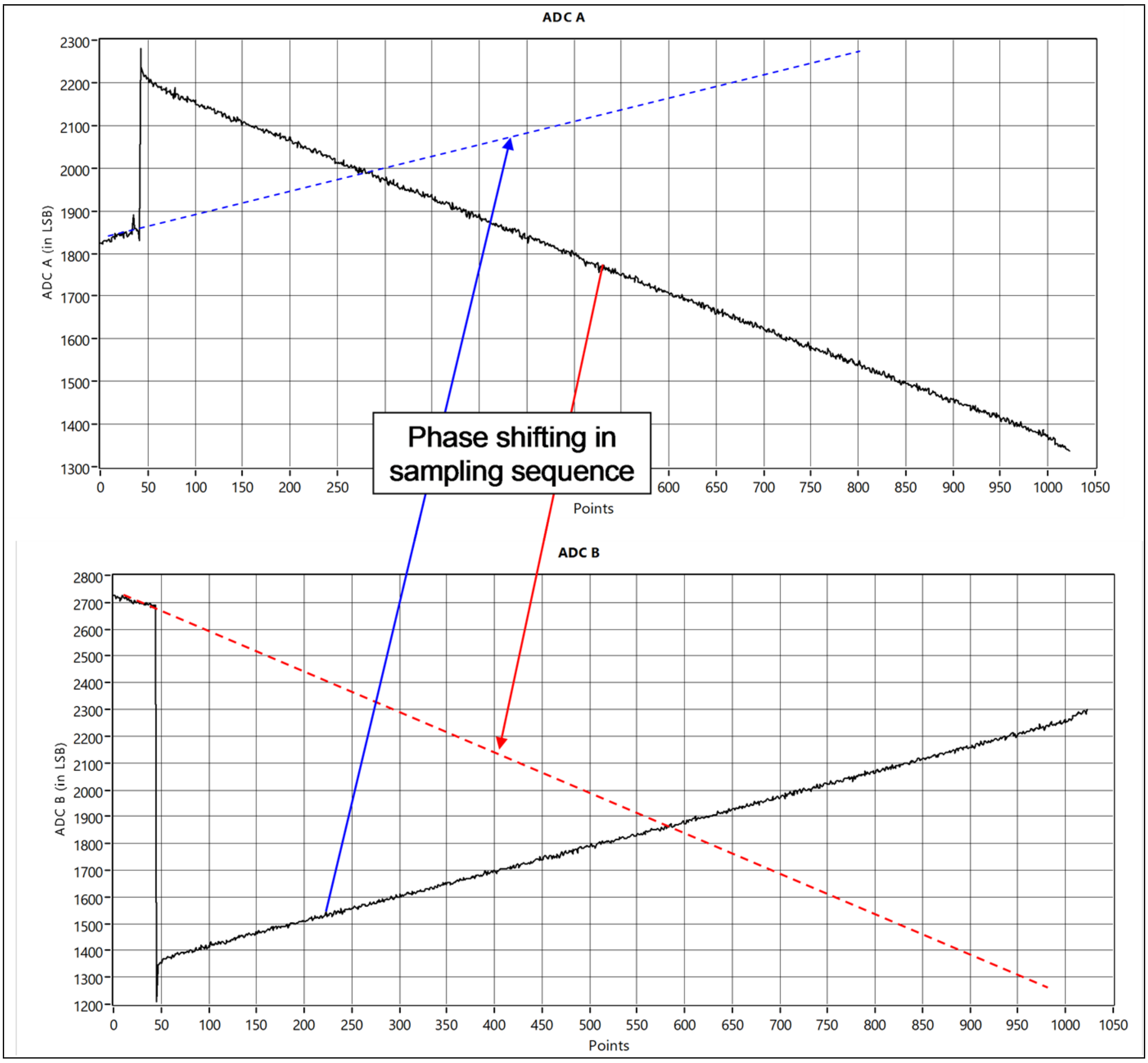


Figure 10: Clock Tree Event example

The consequence of the clock tree event is a phase shifting of a half period of the acquisition.

10. HEAVY IONS RESULTS

Here above, the device under test was described, the irradiation facility was presented and finally the overall view of the test bench and a test description was performed. This chapter will present the results obtained during the campaign.

10.1 Summary of runs

Hereafter you will find the runs performed during this campaign sorted by test type, test mode, ions and parts.

EV12AS550B - SEL test in dynamic configuration VCCD = VCCA = VCCIO = 3.55 V / Tj = 125°C Clock Frequency = 3.2 GHz / Input Frequency = 1.6001243398 GHz Tilt = 0°											Single Event Effect	
Run	DEMUX	Part	Ion	Eff. LET (MeV/mg/cm²)	Eff. Range (µm Si)	Flux (φ) ($cm^{-2}.s^{-1}$)	Time (s)	Run Fluence (cm^{-2})	Run Dose (krad)	Cumulated Dose (krad)	SEL	Cross Section (cm²)
1	**1:2**	**S064**	**197 Au**	82.8	155.0	6.76E+04	**148**	**1.00E+07**	13.25	12.83	**0**	<1.00E-07
19		**S066**	**197 Au**	82.8	155.0	1.06E+04	**946**	**1.00E+07**	13.25	15.14	**0**	<1.00E-07
20	**1:1**	**S066**	**197 Au**	82.8	155.0	1.05E+04	**955**	**1.00E+07**	13.25	27.97	**0**	<1.00E-07
21		**S067**	**197 Au**	82.8	155.0	9.31E+03	**1074**	**1.00E+07**	13.25	12.83	**0**	<1.00E-07
22	**1:2**	**S067**	**197 Au**	82.8	155.0	1.23E+04	**814**	**1.00E+07**	13.25	25.66	**0**	<1.00E-07

Table 5: EV12AS550B Single Event Latchup test runs

EV12AS550B - SEE test in dynamic configuration at ambient temperature Input Frequency = 1.20009325485 GHz Tilt = 0° / SEU Tolerance = ±60LSB												Single Event Effect													
Run	Part	VCCA VCCD VCCIO	DEMUX	SE_protected_ena register	Ion	Eff. LET (MeV/mg/cm²)	Eff. Range (µm Si)	Flux (φ) (cm^{-2}.s^{-1})	Time (s)	Run Fluence (cm^{-2})	Run Dose (krad)	Cumulated Dose (krad)	SEFI1 SEFI2 SEFI3 SEFI4	Cross Section (cm²)	SET Core A	Cross Section (cm²)	SET Core B	Cross Section (cm²)	SEU Core A	Cross Section (cm²)	SEU Core B	Cross Section (cm²)	SEL	Cross Section (cm²)	Clk Tree Event Core A&B	Cross Section (cm²)
2	S064	3.4V	1:2	ON	197 Au	82.8	155.0	6.34E+02	350	2.22E+05	0.29	13.12	0	<4.50E-06	12	5.41E-05	14	6.31E-05	101	4.55E-04	103	4.64E-04	0	<4.50E-06	0	<4.50E-06
15	S066				197 Au	82.8	155.0	8.86E+02	271	2.40E+05	0.32	0.89	0	<4.17E-06	20	8.33E-05	9	3.75E-05	97	4.04E-04	113	4.71E-04	0	<4.17E-06	0	<4.17E-06
94	S067				197 Au	82.8	155.0	8.80E+02	434	3.82E+05	0.51	30.03	0	<2.62E-06	21	5.50E-05	10	2.62E-05	150	3.93E-04	175	4.58E-04	0	<2.62E-06	2	5.24E-06
23	S064				84 Kr	26.6	170.0	2.14E+03	197	4.21E+05	0.18	16.40	0	<2.38E-06	10	2.38E-05	10	2.38E-05	115	2.73E-04	121	2.87E-04	0	<2.38E-06	0	<2.38E-06
24	S066				84 Kr	26.6	170.0	1.76E+03	312	5.48E+05	0.23	28.19	0	<1.82E-06	11	2.01E-05	16	2.92E-05	145	2.65E-04	165	3.01E-04	0	<1.82E-06	3	5.47E-06
36	S064				40 Ar	8.0	229.0	3.17E+03	315	1.00E+06	0.13	17.70	0	<1.00E-06	0	<1.00E-06	0	<1.00E-06	116	1.16E-04	129	1.29E-04	0	<1.00E-06	2	2.00E-06
44	S066				40 Ar	8.0	229.0	3.13E+03	319	1.00E+06	0.13	29.76	0	<1.00E-06	2	2.00E-06	2	2.00E-06	99	9.90E-05	94	9.40E-05	0	<1.00E-06	1	1.00E-06
51	S066				20 Ne	2.6	316.0	5.41E+03	185	1.00E+06	0.04	30.29	0	<1.00E-06	0	<1.00E-06	0	<1.00E-06	15	1.50E-05	20	2.00E-05	0	<1.00E-06	1	1.00E-06
56	S064				20 Ne	2.6	316.0	8.55E+03	117	1.00E+06	0.04	18.43	0	<1.00E-06	1	1.00E-06	0	<1.00E-06	14	1.40E-05	10	1.00E-05	0	<1.00E-06	0	<1.00E-06
61	S064				14 N	1.3	428.0	1.10E+04	91	1.00E+06	0.02	18.53	0	<1.00E-06	0	<1.00E-06	0	<1.00E-06	11	1.10E-05	9	9.00E-06	0	<1.00E-06	0	<1.00E-06
68	S066				14 N	1.3	428.0	1.14E+04	88	1.00E+06	0.02	30.43	0	<1.00E-06	0	<1.00E-06	0	<1.00E-06	7	7.00E-06	6	6.00E-06	0	<1.00E-06	0	<1.00E-06
73	S066				4 He	0.11	1423.0	1.01E+04	99	1.00E+06	0.00	30.51	0	<1.00E-06	0	<1.00E-06	0	<1.00E-06	0	<1.00E-06	0	<1.00E-06	0	<1.00E-06	0	<1.00E-06
81	S064				4 He	0.11	1423.0	1.04E+04	96	1.00E+06	0.00	18.62	0	<1.00E-06	0	<1.00E-06	0	<1.00E-06	0	<1.00E-06	0	<1.00E-06	0	<1.00E-06	0	<1.00E-06
86	S067			OFF	197 Au	82.8	155.0	7.49E+02	403	3.02E+05	0.40	26.80	0	<3.31E-06	24	7.95E-05	3	9.93E-06	146	4.83E-04	128	4.24E-04	0	<3.31E-06	2	6.62E-06
95	S066				197 Au	82.8	155.0	1.09E+03	249	2.72E+05	0.36	30.87	0	<3.68E-06	19	6.99E-05	10	3.68E-05	109	4.01E-04	110	4.04E-04	0	<3.68E-06	0	<3.68E-06
92	S067	3.25V		ON	197 Au	82.8	155.0	1.47E+03	157	2.31E+05	0.31	29.13	0	<4.33E-06	12	5.19E-05	13	5.63E-05	105	4.55E-04	115	4.98E-04	0	<4.33E-06	0	<4.33E-06
93	S067	3.55V			197 Au	82.8	155.0	9.38E+02	338	3.17E+05	0.42	29.54	0	<3.15E-06	10	3.15E-05	10	3.15E-05	161	5.08E-04	155	4.89E-04	0	<3.15E-06	0	<3.15E-06
7	S064	3.4V	1:1	ON	197 Au	82.8	155.0	6.96E+02	399	2.38E+05	0.32	16.05	0	<4.20E-06	0	<4.20E-06	1	4.20E-06	114	4.79E-04	101	4.24E-04	0	<4.20E-06	2	8.40E-06
12	S064				197 Au	82.8	155.0	7.47E+02	344	2.57E+05	0.34	16.22	0	<3.89E-06	16	6.23E-05	17	6.61E-05	101	3.93E-04	117	4.55E-04	0	<3.89E-06	0	<3.89E-06
13	S066				197 Au	82.8	155.0	6.72E+02	375	2.52E+05	0.33	0.32	0	<3.97E-06	10	3.97E-05	8	3.17E-05	98	3.89E-04	115	4.56E-04	0	<3.97E-06	0	<3.97E-06
28	S066				84 Kr	26.6	170.0	2.31E+03	220	5.09E+05	0.22	29.25	0	<1.96E-06	12	2.36E-05	9	1.77E-05	120	2.36E-04	157	3.08E-04	0	<1.96E-06	4	7.86E-06
30	S064				84 Kr	26.6	170.0	2.12E+03	245	5.19E+05	0.22	16.61	0	<1.93E-06	10	1.93E-05	12	2.31E-05	133	2.56E-04	126	2.43E-04	0	<1.93E-06	3	5.78E-06
39	S064				40 Ar	8.0	229.0	2.93E+03	341	1.00E+06	0.13	18.07	0	<1.00E-06	2	2.00E-06	3	3.00E-06	119	1.19E-04	96	9.60E-05	0	<1.00E-06	1	1.00E-06
43	S066				40 Ar	8.0	229.0	3.02E+03	331	1.00E+06	0.13	29.63	0	<1.00E-06	1	1.00E-06	2	2.00E-06	111	1.11E-04	133	1.33E-04	0	<1.00E-06	0	<1.00E-06
52	S066				20 Ne	2.6	316.0	5.21E+03	192	1.00E+06	0.04	30.33	0	<1.00E-06	0	<1.00E-06	0	<1.00E-06	18	1.80E-05	9	9.00E-06	0	<1.00E-06	0	<1.00E-06
55	S064				20 Ne	2.6	316.0	8.33E+03	120	1.00E+06	0.04	18.39	0	<1.00E-06	0	<1.00E-06	2	2.00E-06	22	2.20E-05	23	2.30E-05	0	<1.00E-06	1	1.00E-06
64	S064				14 N	1.3	428.0	1.16E+04	86	1.00E+06	0.02	18.60	0	<1.00E-06	0	<1.00E-06	0	<1.00E-06	9	9.00E-06	10	1.00E-05	0	<1.00E-06	0	<1.00E-06
67	S066				14 N	1.3	428.0	1.16E+04	86	1.00E+06	0.02	30.41	0	<1.00E-06	0	<1.00E-06	0	<1.00E-06	6	6.00E-06	5	5.00E-06	0	<1.00E-06	0	<1.00E-06
77	S066				4 He	0.11	1423.0	8.00E+03	125	1.00E+06	0.00	30.52	0	<1.00E-06	0	<1.00E-06	0	<1.00E-06	0	<1.00E-06	0	<1.00E-06	0	<1.00E-06	0	<1.00E-06
80	S064				4 He	0.11	1423.0	9.01E+03	111	1.00E+06	0.00	18.62	0	<1.00E-06	0	<1.00E-06	0	<1.00E-06	0	<1.00E-06	0	<1.00E-06	0	<1.00E-06	0	<1.00E-06
90	S067			OFF	197 Au	82.8	155.0	1.52E+03	252	3.84E+05	0.51	28.60	0	<2.60E-06	19	4.95E-05	10	2.60E-05	150	3.91E-04	143	3.72E-04	0	<2.60E-06	0	<2.60E-06
98	S066				197 Au	82.8	155.0	1.21E+03	327	3.95E+05	0.52	32.34	0	<2.53E-06	22	5.57E-05	10	2.53E-05	150	3.80E-04	128	3.24E-04	0	<2.53E-06	1	2.53E-06

Table 6: EV12AS550B SEE run in Dynamic configuration Core A & Core B detailed results

▨ Run not taken into account

EV12AS550B - SEL test in dynamic configuration VCCD = VCCA = VCCIO = 3.55 V / Tj = 125°C Tilt = 0° / SEU Tolerance = ±60LSB													Single Event Effect										
Run	**Part**	**VCCA VCCD VCCIO**	**DEMUX**	**SE_protected_ena register**	**Ion**	**Eff. LET (MeV/mg/cm²)**	**Eff. Range (µm Si)**	**Flux (φ) (cm^{-2}.s^{-1})**	**Time (s)**	**Run Fluence (cm^{-2})**	**Run Dose (krad)**	**Cumulated Dose (krad)**	**SEFI1 SEFI2 SEFI3 SEFI4**	**Cross Section (cm²)**	**SET Core A&B**	**Cross Section (cm²)**	**SEU Core A&B**	**Cross Section (cm²)**	**SEL**	**Cross Section (cm²)**	**Clk Tree Event Core A&B**	**Cross Section (cm²)**
2	**S064**	**3.4V**	**1:2**	**ON**	**197 Au**	82.8	155.0	6.34E+02	**350**	**2.22E+05**	0.29	13.12	**0**	<4.50E-06	**26**	1.17E-04	**204**	9.19E-04	**0**	<4.50E-06	**0**	<4.50E-06
15	**S066**				**197 Au**	82.8	155.0	8.86E+02	**271**	**2.40E+05**	0.32	0.89	**0**	<4.17E-06	**29**	1.21E-04	**210**	8.75E-04	**0**	<4.17E-06	**0**	<4.17E-06
94	**S067**				**197 Au**	82.8	155.0	8.80E+02	**434**	**3.82E+05**	0.51	30.03	**0**	<2.62E-06	**31**	8.12E-05	**325**	8.51E-04	**0**	<2.62E-06	**2**	5.24E-06
23	**S064**				**84 Kr**	26.6	170.0	2.14E+03	**197**	**4.21E+05**	0.18	16.40	**0**	<2.38E-06	**20**	4.75E-05	**236**	5.61E-04	**0**	<2.38E-06	**0**	<2.38E-06
24	**S066**				**84 Kr**	26.6	170.0	1.76E+03	**312**	**5.48E+05**	0.23	28.19	**0**	<1.82E-06	**27**	4.93E-05	**310**	5.66E-04	**0**	<1.82E-06	**3**	5.47E-06
36	**S064**				**40 Ar**	8.0	229.0	3.17E+03	**315**	**1.00E+06**	0.13	17.70	**0**	<1.00E-06	**0**	<1.00E-06	**245**	2.45E-04	**0**	<1.00E-06	**2**	2.00E-06
44	**S066**				**40 Ar**	8.0	229.0	3.13E+03	**319**	**1.00E+06**	0.13	29.76	**0**	<1.00E-06	**4**	4.00E-06	**193**	1.93E-04	**0**	<1.00E-06	**1**	1.00E-06
51	**S066**				**20 Ne**	2.6	316.0	5.41E+03	**185**	**1.00E+06**	0.04	30.29	**0**	<1.00E-06	**0**	<1.00E-06	**35**	3.50E-05	**0**	<1.00E-06	**1**	1.00E-06
56	**S064**				**20 Ne**	2.6	316.0	8.55E+03	**117**	**1.00E+06**	0.04	18.43	**0**	<1.00E-06	**1**	1.00E-06	**24**	2.40E-05	**0**	<1.00E-06	**0**	<1.00E-06
61	**S064**				**14 N**	1.3	428.0	1.10E+04	**91**	**1.00E+06**	0.02	18.53	**0**	<1.00E-06	**0**	<1.00E-06	**20**	2.00E-05	**0**	<1.00E-06	**0**	<1.00E-06
68	**S066**				**14 N**	1.3	428.0	1.14E+04	**88**	**1.00E+06**	0.02	30.43	**0**	<1.00E-06	**0**	<1.00E-06	**13**	1.30E-05	**0**	<1.00E-06	**0**	<1.00E-06
73	**S066**				**4 He**	0.11	1423.0	1.01E+04	**99**	**1.00E+06**	0.00	30.51	**0**	<1.00E-06	**0**	<1.00E-06	**0**	<1.00E-06	**0**	<1.00E-06	**0**	<1.00E-06
81	**S064**				**4 He**	0.11	1423.0	1.04E+04	**96**	**1.00E+06**	0.00	18.62	**0**	<1.00E-06	**0**	<1.00E-06	**0**	<1.00E-06	**0**	<1.00E-06	**0**	<1.00E-06
86	**S067**			**OFF**	**197 Au**	82.8	155.0	7.49E+02	**403**	**3.02E+05**	0.40	26.80	**0**	<3.31E-06	**27**	8.94E-05	**274**	9.07E-04	**0**	<3.31E-06	**2**	6.62E-06
95	**S066**				**197 Au**	82.8	155.0	1.09E+03	**249**	**2.72E+05**	0.36	30.87	**0**	<3.68E-06	**29**	1.07E-04	**219**	8.05E-04	**0**	<3.68E-06	**0**	<3.68E-06
92	**S067**	**3.25V**		**ON**	**197 Au**	82.8	155.0	1.47E+03	**157**	**2.31E+05**	0.31	29.13	**0**	<4.33E-06	**25**	1.08E-04	**220**	9.52E-04	**0**	<4.33E-06	**0**	<4.33E-06
93	**S067**	**3.55V**			**197 Au**	82.8	155.0	9.38E+02	**338**	**3.17E+05**	0.42	29.54	**0**	<3.15E-06	**20**	6.31E-05	**316**	9.97E-04	**0**	<3.15E-06	**0**	<3.15E-06
7	**S064**	**3.4V**	**1:1**	**ON**	**197 Au**	82.8	155.0	5.96E+02	**399**	**2.38E+05**	0.32	15.05	**0**	<4.20E-06	**1**	4.20E-06	**215**	9.03E-04	**0**	<4.20E-06	**2**	8.40E-06
12	**S064**				**197 Au**	82.8	155.0	7.47E+02	**344**	**2.57E+05**	0.34	16.22	**0**	<3.89E-06	**33**	1.28E-04	**218**	8.48E-04	**0**	<3.89E-06	**0**	<3.89E-06
13	**S066**				**197 Au**	82.8	155.0	6.72E+02	**375**	**2.52E+05**	0.33	0.32	**0**	<3.97E-06	**18**	7.14E-05	**213**	8.45E-04	**0**	<3.97E-06	**0**	<3.97E-06
28	**S066**				**84 Kr**	26.6	170.0	2.31E+03	**220**	**5.09E+05**	0.22	29.25	**0**	<1.96E-06	**21**	4.13E-05	**277**	5.44E-04	**0**	<1.96E-06	**4**	7.86E-06
30	**S064**				**84 Kr**	26.6	170.0	2.12E+03	**245**	**5.19E+05**	0.22	16.61	**0**	<1.93E-06	**22**	4.24E-05	**259**	4.99E-04	**0**	<1.93E-06	**3**	5.78E-06
39	**S064**				**40 Ar**	8.0	229.0	2.93E+03	**341**	**1.00E+06**	0.13	18.07	**0**	<1.00E-06	**5**	5.00E-06	**215**	2.15E-04	**0**	<1.00E-06	**1**	1.00E-06
43	**S066**				**40 Ar**	8.0	229.0	3.02E+03	**331**	**1.00E+06**	0.13	29.63	**0**	<1.00E-06	**3**	3.00E-06	**244**	2.44E-04	**0**	<1.00E-06	**0**	<1.00E-06
52	**S066**				**20 Ne**	2.6	316.0	5.21E+03	**192**	**1.00E+06**	0.04	30.33	**0**	<1.00E-06	**0**	<1.00E-06	**27**	2.70E-05	**0**	<1.00E-06	**0**	<1.00E-06
55	**S064**				**20 Ne**	2.6	316.0	8.33E+03	**120**	**1.00E+06**	0.04	18.39	**0**	<1.00E-06	**2**	2.00E-06	**45**	4.50E-05	**0**	<1.00E-06	**1**	1.00E-06
64	**S064**				**14 N**	1.3	428.0	1.16E+04	**86**	**1.00E+06**	0.02	18.60	**0**	<1.00E-06	**0**	<1.00E-06	**19**	1.90E-05	**0**	<1.00E-06	**0**	<1.00E-06
67	**S066**				**14 N**	1.3	428.0	1.16E+04	**86**	**1.00E+06**	0.02	30.41	**0**	<1.00E-06	**0**	<1.00E-06	**11**	1.10E-05	**0**	<1.00E-06	**0**	<1.00E-06
77	**S066**				**4 He**	0.11	1423.0	8.00E+03	**125**	**1.00E+06**	0.00	30.52	**0**	<1.00E-06	**0**	<1.00E-06	**0**	<1.00E-06	**0**	<1.00E-06	**0**	<1.00E-06
80	**S064**				**4 He**	0.11	1423.0	9.01E+03	**111**	**1.00E+06**	0.00	18.62	**0**	<1.00E-06	**0**	<1.00E-06	**0**	<1.00E-06	**0**	<1.00E-06	**0**	<1.00E-06
90	**S067**			**OFF**	**197 Au**	82.8	155.0	1.52E+03	**252**	**3.84E+05**	0.51	28.60	**0**	<2.60E-06	**29**	7.55E-05	**293**	7.63E-04	**0**	<2.60E-06	**0**	<2.60E-06
98	**S066**				**197 Au**	82.8	155.0	1.21E+03	**327**	**3.95E+05**	0.52	32.34	**0**	<2.53E-06	**32**	8.10E-05	**278**	7.04E-04	**0**	<2.53E-06	**1**	2.53E-06

Table 7: EV12AS550B SEE run in Dynamic configuration Core A & Core B cumulated results

▨ Run not taken into account

EV12AS550B - SEE test in static middle configuration at ambient temperature VCCD = VCCA = VCCIO = 3.4 V Clock Frequency = 3.2 GHz / SEU Tolerance ± 20 LSB Tilt = 0°												Single Event Effect											
Run	Part	DEMUX	SE_protected_ena register	Ion	Eff. LET (MeV/mg/cm²)	Eff. Range (µm Si)	Flux (φ) ($cm^{-2}.s^{-1}$)	Time (s)	Run Fluence (cm^{-2})	Run Dose (krad)	Cumulated Dose (krad)	SEFI1 SEFI2 SEFI3 SEFI4	Cross Section (cm²)	SET Core A	Cross Section (cm²)	SET Core B	Cross Section (cm²)	SEU Core A	Cross Section (cm²)	SEU Core B	Cross Section (cm²)	SEL	Cross Section (cm²)
5	S064	1:2	ON	197 Au	82.8	155.0	1.56E+03	131	2.04E+05	0.27	14.51	0	<4.90E-06	17	8.33E-05	16	7.84E-05	105	5.14E-04	104	5.09E-04	0	<4.90E-06
6	S064			197 Au	82.8	155.0	8.57E+02	210	1.80E+05	0.24	14.75	0	<5.56E-06	10	5.56E-05	4	2.22E-05	106	5.89E-04	97	5.39E-04	0	<5.56E-06
9	S064			197 Au	82.8	155.0	1.03E+03	185	1.91E+05	0.25	15.37	0	<5.24E-06	22	1.15E-04	5	2.62E-05	113	5.92E-04	105	5.50E-04	0	<5.24E-06
16	S066			197 Au	82.8	155.0	9.40E+02	216	2.03E+05	0.27	1.15	0	<4.93E-06	13	6.40E-05	13	6.40E-05	105	5.17E-04	102	5.02E-04	0	<4.93E-06
85	S067			197 Au	82.8	155.0	5.67E+02	492	2.79E+05	0.37	26.41	0	<3.58E-06	16	5.73E-05	10	3.58E-05	145	5.20E-04	149	5.34E-04	0	<3.58E-06
87	S067			197 Au	82.8	155.0	7.66E+02	282	2.16E+05	0.29	27.08	0	<4.63E-06	18	8.33E-05	10	4.63E-05	104	4.81E-04	122	5.65E-04	0	<4.63E-06
25	S066			84 Kr	26.6	170.0	2.14E+03	139	2.97E+05	0.13	28.31	0	<3.37E-06	11	3.70E-05	11	3.70E-05	102	3.43E-04	112	3.77E-04	0	<3.37E-06
34	S067			84 Kr	26.6	170.0	2.27E+03	220	5.00E+05	0.21	25.87	0	<2.00E-06	15	3.00E-05	8	1.60E-05	161	3.22E-04	189	3.78E-04	0	<2.00E-06
35	S067			40 Ar	8.0	229.0	2.09E+03	479	1.00E+06	0.13	25.99	0	<1.00E-06	7	7.00E-06	11	1.10E-05	120	1.20E-04	137	1.37E-04	0	<1.00E-06
45	S066			40 Ar	8.0	229.0	3.21E+03	312	1.00E+06	0.13	29.88	0	<1.00E-06	4	4.00E-06	9	9.00E-06	146	1.46E-04	163	1.63E-04	0	<1.00E-06
50	S066			20 Ne	2.6	316.0	5.41E+03	185	1.00E+06	0.04	30.25	0	<1.00E-06	0	<1.00E-06	1	1.00E-06	44	4.40E-05	52	5.20E-05	0	<1.00E-06
59	S067			20 Ne	2.6	316.0	8.47E+03	118	1.00E+06	0.04	26.03	0	<1.00E-06	1	1.00E-06	0	<1.00E-06	52	5.20E-05	61	6.10E-05	0	<1.00E-06
60	S067			14 N	1.3	428.0	1.02E+04	98	1.00E+06	0.02	26.05	0	<1.00E-06	0	<1.00E-06	0	<1.00E-06	18	1.80E-05	23	2.30E-05	0	<1.00E-06
69	S066			14 N	1.3	428.0	1.14E+04	88	1.00E+06	0.02	30.45	0	<1.00E-06	0	<1.00E-06	0	<1.00E-06	14	1.40E-05	13	1.30E-05	0	<1.00E-06
70	S066			14 N	1.3	428.0	1.19E+04	84	1.00E+06	0.02	30.47	0	<1.00E-06	0	<1.00E-06	0	<1.00E-06	8	8.00E-06	17	1.70E-05	0	<1.00E-06
74	S066			4 He	0.11	1423.0	1.08E+04	93	1.00E+06	0.00	30.52	0	<1.00E-06	0	<1.00E-06	0	<1.00E-06	1	1.00E-06	0	<1.00E-06	0	<1.00E-06
84	S067			4 He	0.11	1423.0	1.09E+04	92	1.00E+06	0.00	26.05	0	<1.00E-06	0	<1.00E-06	0	<1.00E-06	0	<1.00E-06	0	<1.00E-06	0	<1.00E-06
88	S067		OFF	197 Au	82.8	155.0	1.51E+03	200	3.01E+05	0.40	27.46	0	<3.32E-06	22	7.31E-05	17	5.65E-05	166	5.51E-04	179	5.95E-04	0	<3.32E-06
96	S066			197 Au	82.8	155.0	1.23E+03	196	2.41E+05	0.32	31.18	0	<4.15E-06	21	8.71E-05	16	6.64E-05	118	4.90E-04	101	4.19E-04	0	<4.15E-06
8	S064	1:1	ON	197 Au	82.8	155.0	1.12E+03	48	5.38E+04	0.07	15.12	0	<1.86E-05	0	<1.86E-05	3	5.58E-05	32	5.95E-04	23	4.28E-04	0	<1.86E-05
10	S064			197 Au	82.8	155.0	7.48E+02	270	2.02E+05	0.27	15.62	0	<4.95E-06	0	<4.95E-06	17	8.42E-05	116	5.74E-04	104	5.15E-04	0	<4.95E-06
11	S064			197 Au	82.8	155.0	7.67E+02	275	2.11E+05	0.28	15.89	0	<4.74E-06	24	1.14E-04	15	7.11E-05	102	4.83E-04	112	5.31E-04	0	<4.74E-06
14	S066			197 Au	82.8	155.0	6.69E+02	302	2.02E+05	0.27	0.58	0	<4.95E-06	15	7.43E-05	12	5.94E-05	96	4.75E-04	106	5.25E-04	0	<4.95E-06
29	S066			84 Kr	26.6	170.0	2.32E+03	147	3.41E+05	0.15	29.39	0	<2.93E-06	12	3.52E-05	12	3.52E-05	100	2.93E-04	107	3.14E-04	0	<2.93E-06
31	S064			84 Kr	26.6	170.0	1.81E+03	211	3.81E+05	0.16	16.76	0	<2.62E-06	12	3.15E-05	13	3.41E-05	106	2.78E-04	110	2.89E-04	0	<2.62E-06
40	S064			40 Ar	8.0	229.0	2.56E+03	390	1.00E+06	0.13	18.19	0	<1.00E-06	3	3.00E-06	4	4.00E-06	133	1.33E-04	131	1.31E-04	0	<1.00E-06
41	S064			40 Ar	8.0	229.0	1.99E+03	502	1.00E+06	0.13	18.31	0	<1.00E-06	8	8.00E-06	5	5.00E-06	130	1.30E-04	120	1.20E-04	0	<1.00E-06
42	S066			40 Ar	8.0	229.0	3.01E+03	332	1.00E+06	0.13	29.51	0	<1.00E-06	8	8.00E-06	10	1.00E-05	128	1.28E-04	127	1.27E-04	0	<1.00E-06
53	S066			20 Ne	2.6	316.0	5.10E+03	196	1.00E+06	0.04	30.37	0	<1.00E-06	0	<1.00E-06	0	<1.00E-06	48	4.80E-05	42	4.20E-05	0	<1.00E-06
54	S064			20 Ne	2.6	316.0	8.33E+03	120	1.00E+06	0.04	18.35	0	<1.00E-06	0	<1.00E-06	0	<1.00E-06	43	4.30E-05	35	3.50E-05	0	<1.00E-06
65	S064			14 N	1.3	428.0	1.14E+04	88	1.00E+06	0.02	18.62	0	<1.00E-06	1	1.00E-06	0	<1.00E-06	23	2.30E-05	16	1.60E-05	0	<1.00E-06
66	S066			14 N	1.3	428.0	1.19E+04	84	1.00E+06	0.02	30.39	0	<1.00E-06	0	<1.00E-06	0	<1.00E-06	15	1.50E-05	21	2.10E-05	0	<1.00E-06
78	S066			4 He	0.11	1423.0	8.00E+03	125	1.00E+06	0.00	30.52	0	<1.00E-06	0	<1.00E-06	0	<1.00E-06	0	<1.00E-06	1	1.00E-06	0	<1.00E-06
79	S064			4 He	0.11	1423.0	8.55E+03	117	1.00E+06	0.00	18.62	0	<1.00E-06	0	<1.00E-06	0	<1.00E-06	0	<1.00E-06	0	<1.00E-06	0	<1.00E-06
91	S067		OFF	197 Au	82.8	155.0	1.67E+03	110	1.84E+05	0.24	28.83	0	<5.43E-06	15	8.15E-05	14	7.61E-05	110	5.98E-04	109	5.92E-04	0	<5.43E-06
99	S066			197 Au	82.8	155.0	1.35E+03	175	2.37E+05	0.31	32.64	0	<4.22E-06	16	6.75E-05	13	5.49E-05	94	3.97E-04	96	4.05E-04	0	<4.22E-06
100	S066			197 Au	82.8	155.0	1.42E+03	48	6.80E+04	0.09	32.73	-	-	-	-	-	-	-	-	-	-	-	-
101	S066			197 Au	82.8	155.0	1.36E+03	189	2.57E+05	0.34	33.06	0	<3.89E-06	15	5.84E-05	12	4.67E-05	101	3.93E-04	108	4.20E-04	0	<3.89E-06

Table 8: EV12AS550B SEE run in Static middle configuration Core A and Core B detailed results

▨ Run not taken into account (rows 69, 8, 10, 99, 100 are hatched)

EV12AS550B - SEE test in static middle configuration at ambient temperature VCCD = VCCA = VCCIO = 3.4 V Clock Frequency = 3.2 GHz / SEU Tolerance ± 20 LSB Tilt = 0°												Single Event Effect							
Run	Part	DEMUX	SE_protected_ena register	Ion	Eff. LET (MeV/mg/cm²)	Eff. Range (µm Si)	Flux (φ) (cm⁻².s⁻¹)	Time (s)	Run Fluence (cm⁻²)	Run Dose (krad)	Cumulated Dose (krad)	SEFI1 SEFI2 SEFI3 SEFI4	Cross Section (cm²)	SET Core A&B	Cross Section (cm²)	SEU Core A&B	Cross Section (cm²)	SEL	Cross Section (cm²)
5	S064			197 Au	82.8	155.0	1.56E+03	131	2.04E+05	0.27	14.51	0	<4.90E-06	33	1.62E-04	209	1.02E-03	0	<4.90E-06
6	S064			197 Au	82.8	155.0	8.57E+02	210	1.80E+05	0.24	14.75	0	<5.56E-06	14	7.78E-05	203	1.13E-03	0	<5.56E-06
9	S064			197 Au	82.8	155.0	1.03E+03	185	1.91E+05	0.25	15.37	0	<5.24E-06	27	1.41E-04	218	1.14E-03	0	<5.24E-06
16	S066			197 Au	82.8	155.0	9.40E+02	216	2.03E+05	0.27	1.15	0	<4.93E-06	26	1.28E-04	207	1.02E-03	0	<4.93E-06
85	S067			197 Au	82.8	155.0	5.67E+02	492	2.79E+05	0.37	26.41	0	<3.58E-06	26	9.32E-05	294	1.05E-03	0	<3.58E-06
87	S067			197 Au	82.8	155.0	7.66E+02	282	2.16E+05	0.29	27.08	0	<4.63E-06	28	1.30E-04	226	1.05E-03	0	<4.63E-06
25	S066			84 Kr	26.6	170.0	2.14E+03	139	2.97E+05	0.13	28.31	0	<3.37E-06	22	7.41E-05	214	7.21E-04	0	<3.37E-06
34	S067			84 Kr	26.6	170.0	2.27E+03	220	5.00E+05	0.21	25.87	0	<2.00E-06	23	4.60E-05	350	7.00E-04	0	<2.00E-06
35	S067		ON	40 Ar	8.0	229.0	2.09E+03	479	1.00E+06	0.13	25.99	0	<1.00E-06	18	1.80E-05	257	2.57E-04	0	<1.00E-06
45	S066	1:2		40 Ar	8.0	229.0	3.21E+03	312	1.00E+06	0.13	29.88	0	<1.00E-06	13	1.30E-05	309	3.09E-04	0	<1.00E-06
50	S066			20 Ne	2.6	316.0	5.41E+03	185	1.00E+06	0.04	30.25	0	<1.00E-06	1	1.00E-06	96	9.60E-05	0	<1.00E-06
59	S067			20 Ne	2.6	316.0	8.47E+03	118	1.00E+06	0.04	26.03	0	<1.00E-06	1	1.00E-06	113	1.13E-04	0	<1.00E-06
60	S067			14 N	1.3	428.0	1.02E+04	98	1.00E+06	0.02	26.05	0	<1.00E-06	0	<1.00E-06	41	4.10E-05	0	<1.00E-06
69	S066			14 N	1.3	428.0	1.14E+04	88	1.00E+06	0.02	30.45	0	<1.00E-06	0	<1.00E-06	27	2.70E-05	0	<1.00E-06
70	S066			14 N	1.3	428.0	1.19E+04	84	1.00E+06	0.02	30.47	0	<1.00E-06	0	<1.00E-06	25	2.50E-05	0	<1.00E-06
74	S066			4 He	0.11	1423.0	1.08E+04	93	1.00E+06	0.00	30.52	0	<1.00E-06	0	<1.00E-06	1	1.00E-06	0	<1.00E-06
84	S067			4 He	0.11	1423.0	1.09E+04	92	1.00E+06	0.00	26.05	0	<1.00E-06	0	<1.00E-06	0	<1.00E-06	0	<1.00E-06
88	S067		OFF	197 Au	82.8	155.0	1.51E+03	200	3.01E+05	0.40	27.46	0	<3.32E-06	39	1.30E-04	345	1.15E-03	0	<3.32E-06
96	S066			197 Au	82.8	155.0	1.23E+03	196	2.41E+05	0.32	31.18	0	<4.15E-06	37	1.54E-04	219	9.09E-04	0	<4.15E-06
8	S064			197 Au	82.8	155.0	1.12E+03	48	5.38E+04	0.07	15.12	0	<1.86E-05	3	5.58E-05	55	1.02E-03	0	<1.86E-05
10	S064			197 Au	82.8	155.0	7.48E+02	270	2.02E+05	0.27	15.62	0	<4.95E-06	17	8.42E-05	220	1.09E-03	0	<4.95E-06
11	S064			197 Au	82.8	155.0	7.67E+02	275	2.11E+05	0.28	15.89	0	<4.74E-06	39	1.85E-04	214	1.01E-03	0	<4.74E-06
14	S066			197 Au	82.8	155.0	6.69E+02	302	2.02E+05	0.27	0.58	0	<4.95E-06	27	1.34E-04	202	1.00E-03	0	<4.95E-06
29	S066			84 Kr	26.6	170.0	2.32E+03	147	3.41E+05	0.15	29.39	0	<2.93E-06	24	7.04E-05	207	6.07E-04	0	<2.93E-06
31	S064			84 Kr	26.6	170.0	1.81E+03	211	3.81E+05	0.16	16.76	0	<2.62E-06	25	6.56E-05	216	5.67E-04	0	<2.62E-06
40	S064			40 Ar	8.0	229.0	2.56E+03	390	1.00E+06	0.13	18.19	0	<1.00E-06	7	7.00E-06	264	2.64E-04	0	<1.00E-06
41	S064		ON	40 Ar	8.0	229.0	1.99E+03	502	1.00E+06	0.13	18.31	0	<1.00E-06	13	1.30E-05	250	2.50E-04	0	<1.00E-06
42	S066			40 Ar	8.0	229.0	3.01E+03	332	1.00E+06	0.13	29.51	0	<1.00E-06	18	1.80E-05	255	2.55E-04	0	<1.00E-06
53	S066	1:1		20 Ne	2.6	316.0	5.10E+03	196	1.00E+06	0.04	30.37	0	<1.00E-06	0	<1.00E-06	90	9.00E-05	0	<1.00E-06
54	S064			20 Ne	2.6	316.0	8.33E+03	120	1.00E+06	0.04	18.35	0	<1.00E-06	0	<1.00E-06	78	7.80E-05	0	<1.00E-06
65	S064			14 N	1.3	428.0	1.14E+04	88	1.00E+06	0.02	18.62	0	<1.00E-06	1	1.00E-06	39	3.90E-05	0	<1.00E-06
66	S066			14 N	1.3	428.0	1.19E+04	84	1.00E+06	0.02	30.39	0	<1.00E-06	0	<1.00E-06	36	3.60E-05	0	<1.00E-06
78	S066			4 He	0.11	1423.0	8.00E+03	125	1.00E+06	0.00	30.52	0	<1.00E-06	0	<1.00E-06	1	1.00E-06	0	<1.00E-06
79	S064			4 He	0.11	1423.0	8.55E+03	117	1.00E+06	0.00	18.62	0	<1.00E-06	0	<1.00E-06	0	<1.00E-06	0	<1.00E-06
91	S067			197 Au	82.8	155.0	1.67E+03	110	1.84E+05	0.24	28.83	0	<5.43E-06	29	1.58E-04	219	1.19E-03	0	<5.43E-06
99	S066		OFF	197 Au	82.8	155.0	1.35E+03	175	2.37E+05	0.31	32.64	0	<4.22E-06	29	1.22E-04	190	8.02E-04	0	<4.22E-06
100	S066			197 Au	82.8	155.0	1.42E+03	48	6.80E+04	0.09	32.73	-	-	-	-	-	-	-	-
101	S066			197 Au	82.8	155.0	1.36E+03	189	2.57E+05	0.34	33.06	0	<3.89E-06	27	1.05E-04	209	8.13E-04	0	<3.89E-06

Table 9: EV12AS550B SEE run in Static middle configuration Core A & B cumulated results

▨ Run not taken into account

EV12AS550B - SEE test in static configuration at ambient temperature VCCD = VCCA = VCCIO = 3.4 V Clock Frequency = 3.2 GHz / SEU Tolerance ± 20 LSB / DEMUX 1:2 Tilt = 0°											Single Event Effect											
Run	Part	State	SE_protected_ena register	Ion	Eff. LET (MeV/mg/cm²)	Eff. Range (µm Si)	Flux (φ) ($cm^{-2}.s^{-1}$)	Time (s)	Run Fluence (cm^{-2})	Run Dose (krad)	Cumulated Dose (krad)	SEFI1 SEFI2 SEFI3 SEFI4	Cross Section (cm²)	SET Core A	Cross Section (cm²)	SET Core B	Cross Section (cm²)	SEU Core A	Cross Section (cm²)	SEU Core B	Cross Section (cm²)	SEL	Cross Section (cm²)
3	S064	High	ON	197 Au	82.8	155.0	1.32E+03	343	4.53E+05	0.60	13.70	0	<2.21E-06	40	8.83E-05	20	4.42E-05	101	2.23E-04	109	2.41E-04	0	<2.21E-06
17	S066			197 Au	82.8	155.0	1.52E+03	303	4.60E+05	0.61	1.74	0	<2.17E-06	26	5.65E-05	28	6.09E-05	118	2.57E-04	105	2.28E-04	0	<2.17E-06
26	S066			84 Kr	26.6	170.0	2.31E+03	346	8.00E+05	0.34	28.64	0	<1.25E-06	16	2.00E-05	35	4.38E-05	103	1.29E-04	101	1.26E-04	0	<1.25E-06
33	S064			84 Kr	26.6	170.0	2.11E+03	473	1.00E+06	0.43	17.57	0	<1.00E-06	30	3.00E-05	28	2.80E-05	87	8.70E-05	104	1.04E-04	0	<1.00E-06
38	S064			40 Ar	8.0	229.0	3.09E+03	324	1.00E+06	0.13	17.94	0	<1.00E-06	4	4.00E-06	6	6.00E-06	44	4.40E-05	49	4.90E-05	0	<1.00E-06
47	S066			40 Ar	8.0	229.0	5.38E+03	186	1.00E+06	0.13	30.13	0	<1.00E-06	5	5.00E-06	7	7.00E-06	49	4.90E-05	54	5.40E-05	0	<1.00E-06
48	S066			20 Ne	2.6	316.0	5.35E+03	187	1.00E+06	0.04	30.17	0	<1.00E-06	1	1.00E-06	1	1.00E-06	3	3.00E-06	8	8.00E-06	0	<1.00E-06
58	S064			20 Ne	2.6	316.0	8.62E+03	116	1.00E+06	0.04	18.51	0	<1.00E-06	2	2.00E-06	2	2.00E-06	15	1.50E-05	10	1.00E-05	0	<1.00E-06
63	S064			14 N	1.3	428.0	1.12E+04	89	1.00E+06	0.02	18.58	0	<1.00E-06	0	<1.00E-06	1	1.00E-06	7	7.00E-06	1	1.00E-06	0	<1.00E-06
72	S066			14 N	1.3	428.0	1.23E+04	81	1.00E+06	0.02	30.51	0	<1.00E-06	0	<1.00E-06	0	<1.00E-06	6	6.00E-06	3	3.00E-06	0	<1.00E-06
76	S066			4 He	0.11	1423.0	8.26E+03	121	1.00E+06	0.00	30.52	0	<1.00E-06	0	<1.00E-06	0	<1.00E-06	0	<1.00E-06	0	<1.00E-06	0	<1.00E-06
83	S064			4 He	0.11	1423.0	1.05E+04	95	1.00E+06	0.00	18.63	0	<1.00E-06	0	<1.00E-06	0	<1.00E-06	0	<1.00E-06	0	<1.00E-06	0	<1.00E-06
4	S064	Low	ON	197 Au	82.8	155.0	1.62E+03	266	4.32E+05	0.57	14.25	0	<2.31E-06	42	9.72E-05	19	4.40E-05	101	2.34E-04	108	2.50E-04	0	<2.31E-06
18	S066			197 Au	82.8	155.0	1.55E+03	283	4.38E+05	0.58	2.30	0	<2.28E-06	36	8.22E-05	33	7.53E-05	132	3.01E-04	102	2.33E-04	0	<2.28E-06
27	S066			84 Kr	26.6	170.0	2.31E+03	433	1.00E+06	0.43	29.04	0	<1.00E-06	27	2.70E-05	34	3.40E-05	134	1.34E-04	96	9.60E-05	0	<1.00E-06
32	S064			84 Kr	26.6	170.0	2.04E+03	491	1.00E+06	0.43	17.17	0	<1.00E-06	30	3.00E-05	28	2.80E-05	96	9.60E-05	114	1.14E-04	0	<1.00E-06
37	S064			40 Ar	8.0	229.0	3.05E+03	328	1.00E+06	0.13	17.82	0	<1.00E-06	3	3.00E-06	8	8.00E-06	27	2.70E-05	49	4.90E-05	0	<1.00E-06
46	S066			40 Ar	8.0	229.0	4.98E+03	201	1.00E+06	0.13	30.00	0	<1.00E-06	2	2.00E-06	3	3.00E-06	69	6.90E-05	52	5.20E-05	0	<1.00E-06
49	S066			20 Ne	2.6	316.0	5.41E+03	185	1.00E+06	0.04	30.21	0	<1.00E-06	0	<1.00E-06	1	1.00E-06	5	5.00E-06	11	1.10E-05	0	<1.00E-06
57	S064			20 Ne	2.6	316.0	8.47E+03	118	1.00E+06	0.04	18.47	0	<1.00E-06	1	1.00E-06	1	1.00E-06	11	1.10E-05	8	8.00E-06	0	<1.00E-06
62	S064			14 N	1.3	428.0	1.12E+04	89	1.00E+06	0.02	18.56	0	<1.00E-06	0	<1.00E-06	0	<1.00E-06	1	1.00E-06	4	4.00E-06	0	<1.00E-06
71	S066			14 N	1.3	428.0	1.19E+04	84	1.00E+06	0.02	30.49	0	<1.00E-06	0	<1.00E-06	0	<1.00E-06	7	7.00E-06	6	6.00E-06	0	<1.00E-06
75	S066			4 He	0.11	1423.0	1.01E+04	99	1.00E+06	0.00	30.52	0	<1.00E-06	0	<1.00E-06	0	<1.00E-06	0	<1.00E-06	0	<1.00E-06	0	<1.00E-06
82	S064			4 He	0.11	1423.0	1.01E+04	99	1.00E+06	0.00	18.62	0	<1.00E-06	0	<1.00E-06	0	<1.00E-06	0	<1.00E-06	0	<1.00E-06	0	<1.00E-06
89	S067		OFF	197 Au	82.8	155.0	1.19E+03	421	5.00E+05	0.66	28.10	0	<2.00E-06	43	8.60E-05	18	3.60E-05	126	2.52E-04	101	2.02E-04	0	<2.00E-06
97	S066			197 Au	82.8	155.0	1.36E+03	371	5.06E+05	0.67	31.83	0	<1.98E-06	26	5.14E-05	23	4.55E-05	120	2.37E-04	118	2.33E-04	0	<1.98E-06

Table 10: EV12AS550B SEE run in Static High and Low configuration Core A and Core B detailed results

EV12AS550B - SEE test in static configuration at ambient temperature VCCD = VCCA = VCCIO = 3.4 V Clock Frequency = 3.2 GHz / SEU Tolerance ± 20 LSB / DEMUX 1:2 Tilt = 0°												Single Event Effect							
Run	Part	State	SE_protected_ena register	Ion	Eff. LET (MeV/mg/cm²)	Eff. Range (µm Si)	Flux (φ) ($cm^{-2}.s^{-1}$)	Time (s)	Run Fluence (cm^{-2})	Run Dose (krad)	Cumulated Dose (krad)	SEFI1 SEFI2 SEFI3 SEFI4	Cross Section (cm²)	SET Core A&B	Cross Section (cm²)	SEU Core A&B	Cross Section (cm²)	SEL	Cross Section (cm²)
3	S064	High	ON	197 Au	82.8	155.0	1.32E+03	343	4.53E+05	0.60	13.70	0	<2.21E-06	60	1.32E-04	210	4.64E-04	0	<2.21E-06
17	S066			197 Au	82.8	155.0	1.52E+03	303	4.60E+05	0.61	1.74	0	<2.17E-06	54	1.17E-04	223	4.85E-04	0	<2.17E-06
26	S066			84 Kr	26.6	170.0	2.31E+03	346	8.00E+05	0.34	28.64	0	<1.25E-06	51	6.38E-05	204	2.55E-04	0	<1.25E-06
33	S064			84 Kr	26.6	170.0	2.11E+03	473	1.00E+06	0.43	17.57	0	<1.00E-06	58	5.80E-05	191	1.91E-04	0	<1.00E-06
38	S064			40 Ar	8.0	229.0	3.09E+03	324	1.00E+06	0.13	17.94	0	<1.00E-06	10	1.00E-05	93	9.30E-05	0	<1.00E-06
47	S066			40 Ar	8.0	229.0	5.38E+03	186	1.00E+06	0.13	30.13	0	<1.00E-06	12	1.20E-05	103	1.03E-04	0	<1.00E-06
48	S066			20 Ne	2.6	316.0	5.35E+03	187	1.00E+06	0.04	30.17	0	<1.00E-06	2	2.00E-06	11	1.10E-05	0	<1.00E-06
58	S064			20 Ne	2.6	316.0	8.62E+03	116	1.00E+06	0.04	18.51	0	<1.00E-06	4	4.00E-06	25	2.50E-05	0	<1.00E-06
63	S064			14 N	1.3	428.0	1.12E+04	89	1.00E+06	0.02	18.58	0	<1.00E-06	1	1.00E-06	8	8.00E-06	0	<1.00E-06
72	S066			14 N	1.3	428.0	1.23E+04	81	1.00E+06	0.02	30.51	0	<1.00E-06	0	<1.00E-06	9	9.00E-06	0	<1.00E-06
76	S066			4 He	0.11	1423.0	8.26E+03	121	1.00E+06	0.00	30.52	0	<1.00E-06	0	<1.00E-06	0	<1.00E-06	0	<1.00E-06
83	S064			4 He	0.11	1423.0	1.05E+04	95	1.00E+06	0.00	18.63	0	<1.00E-06	0	<1.00E-06	0	<1.00E-06	0	<1.00E-06
4	S064	Low	ON	197 Au	82.8	155.0	1.62E+03	266	4.32E+05	0.57	14.25	0	<2.31E-06	61	1.41E-04	209	4.84E-04	0	<2.31E-06
18	S066			197 Au	82.8	155.0	1.55E+03	283	4.38E+05	0.58	2.30	0	<2.28E-06	69	1.58E-04	234	5.34E-04	0	<2.28E-06
27	S066			84 Kr	26.6	170.0	2.31E+03	433	1.00E+06	0.43	29.04	0	<1.00E-06	61	6.10E-05	230	2.30E-04	0	<1.00E-06
32	S064			84 Kr	26.6	170.0	2.04E+03	491	1.00E+06	0.43	17.17	0	<1.00E-06	58	5.80E-05	210	2.10E-04	0	<1.00E-06
37	S064			40 Ar	8.0	229.0	3.05E+03	328	1.00E+06	0.13	17.82	0	<1.00E-06	11	1.10E-05	76	7.60E-05	0	<1.00E-06
46	S066			40 Ar	8.0	229.0	4.98E+03	201	1.00E+06	0.13	30.00	0	<1.00E-06	5	5.00E-06	121	1.21E-04	0	<1.00E-06
49	S066			20 Ne	2.6	316.0	5.41E+03	185	1.00E+06	0.04	30.21	0	<1.00E-06	1	1.00E-06	16	1.60E-05	0	<1.00E-06
57	S064			20 Ne	2.6	316.0	8.47E+03	118	1.00E+06	0.04	18.47	0	<1.00E-06	2	2.00E-06	19	1.90E-05	0	<1.00E-06
62	S064			14 N	1.3	428.0	1.12E+04	89	1.00E+06	0.02	18.56	0	<1.00E-06	0	<1.00E-06	5	5.00E-06	0	<1.00E-06
71	S066			14 N	1.3	428.0	1.19E+04	84	1.00E+06	0.02	30.49	0	<1.00E-06	0	<1.00E-06	13	1.30E-05	0	<1.00E-06
75	S066			4 He	0.11	1423.0	1.01E+04	99	1.00E+06	0.00	30.52	0	<1.00E-06	0	<1.00E-06	0	<1.00E-06	0	<1.00E-06
82	S064			4 He	0.11	1423.0	1.01E+04	99	1.00E+06	0.00	18.62	0	<1.00E-06	0	<1.00E-06	0	<1.00E-06	0	<1.00E-06
89	S067		OFF	197 Au	82.8	155.0	1.19E+03	421	5.00E+05	0.66	28.10	0	<2.00E-06	61	1.22E-04	227	4.54E-04	0	<2.00E-06
97	S066			197 Au	82.8	155.0	1.36E+03	371	5.06E+05	0.67	31.83	0	<1.98E-06	49	9.68E-05	238	4.70E-04	0	<1.98E-06

Table 11: EV12AS550B SEE run in Static High and Low configuration Core A & B cumulated results

10.2 SEL test results

The SEL test was performed at 125°C.
No SEL was observed during this test under Gold irradiation with a total fluence equal to 1E+7 cm^{-2}, with a particle angle of 0° (LET = 82.8 MeV.cm²/mg and range = 155.0µm).

The EV12AD550B is latch-Up free up to a LET of 82.8 MeV.cm²/mg.

10.2.1 SEU tests results

The SEU test was performed at ambient temperature.

In dynamic configuration and demux 1:1 mode
SEU were observed during the irradiation up to the Nitrogen Heavy Ion (LET= 1.3 MeV.cm²/mg).
In dynamic configuration and demux 1:2 mode
SEU were observed during the irradiation up to the Nitrogen Heavy Ion (LET= 1.3 MeV.cm²/mg).

In static middle configuration and demux 1:1 mode
SEU were observed during the irradiation up to the Helium Heavy Ion (LET= 0.11 MeV.cm²/mg).
In static middle configuration and demux 1:2 mode
SEU were observed during the irradiation up to the Helium Heavy Ion (LET= 0.11 MeV.cm²/mg).

In static high configuration and demux 1:2 mode
SEU were observed during the irradiation up to the Nitrogen Heavy Ion (LET= 1.3 MeV.cm²/mg).
In static low configuration and demux 1:2 mode
SEU were observed during the irradiation up to the Nitrogen Heavy Ion (LET= 1.3 MeV.cm²/mg).

	EV12AD550B SEU Cross Section (cm²) in static middle test configuration									
	DEMUX 1:1				DEMUX 1:2					
	Core A		Core B		Core A			Core B		
LET Eff (MeV/mg/cm²)	S064	S066	S064	S066	S064	S066	S067	S064	S066	S067
82.8	4.83E-04	4.75E-04	5.31E-04	5.25E-04	5.14E-04	5.17E-04	5.20E-04	5.09E-04	5.02E-04	5.34E-04
26.6	2.78E-04	2.93E-04	2.89E-04	3.14E-04	Not tested	3.43E-04	3.22E-04	Not tested	3.77E-04	3.78E-04
8.0	1.33E-04	1.28E-04	1.31E-04	1.27E-04	Not tested	1.46E-04	1.20E-04	Not tested	1.63E-04	1.37E-04
2.6	4.30E-05	4.80E-05	3.50E-05	4.20E-05	Not tested	4.40E-05	5.20E-05	Not tested	5.20E-05	6.10E-05
1.3	2.30E-05	1.50E-05	1.60E-05	2.10E-05	Not tested	8.00E-06	1.80E-05	Not tested	1.70E-05	2.30E-05
0.11	<1.00E-06	<1.00E-06	<1.00E-06	1.00E-06	Not tested	1.00E-06	<1.00E-06	Not tested	<1.00E-06	<1.00E-06

Table 12: SEU cross section Core A & Core B detailed results in static middle configuration

	EV12AD550B SEU Cross Section (cm²) in dynamic test configuration							
	DEMUX 1:1				DEMUX 1:2			
	Core A		Core B		Core A		Core B	
LET Eff (MeV/mg/cm²)	S064	S066	S064	S066	S064	S066	S064	S066
82.8	4.79E-04	3.89E-04	4.24E-04	4.56E-04	4.55E-04	4.04E-04	4.64E-04	4.71E-04
26.6	2.56E-04	2.36E-04	2.43E-04	3.08E-04	2.73E-04	2.65E-04	2.87E-04	3.01E-04
8.0	1.19E-04	1.11E-04	9.60E-05	1.33E-04	1.16E-04	9.90E-05	1.29E-04	9.40E-05
2.6	2.20E-05	1.80E-05	2.30E-05	9.00E-06	1.40E-05	1.50E-05	1.00E-05	2.00E-05
1.3	9.00E-06	6.00E-06	1.00E-05	5.00E-06	1.10E-05	7.00E-06	9.00E-06	6.00E-06
0.11	<1.00E-06	<1.00E-06	<1.00E-06	<1.00E-06	<1.00E-06	<1.00E-06	<1.00E-06	<1.00E-06

Table 13: SEU cross section Core A & Core B detailed results in dynamic configuration

	EV12AD550B SEU Cross Section (cm²) in static high test configuration			
	DEMUX 1:2			
	Core A		Core B	
LET Eff (MeV/mg/cm²)	**S064**	**S066**	**S064**	**S066**
82.8	2.23E-04	2.57E-04	2.41E-04	2.28E-04
26.6	8.70E-05	1.29E-04	1.04E-04	1.26E-04
8.0	4.40E-05	4.90E-05	4.90E-05	5.40E-05
2.6	1.50E-05	3.00E-06	1.00E-05	8.00E-06
1.3	7.00E-06	6.00E-06	1.00E-06	3.00E-06
0.11	<1.00E-06	<1.00E-06	<1.00E-06	<1.00E-06

Table 14: SEU cross section Core A & Core B detailed results in static high configuration

	EV12AD550B SEU Cross Section (cm²) in static low test configuration			
	DEMUX 1:2			
	Core A		Core B	
LET Eff (MeV/mg/cm²)	**S064**	**S066**	**S064**	**S066**
82.8	4.84E-04	5.34E-04	2.50E-04	2.33E-04
26.6	2.10E-04	2.30E-04	1.14E-04	9.60E-05
8.0	7.60E-05	1.21E-04	4.90E-05	5.20E-05
2.6	1.90E-05	1.60E-05	8.00E-06	1.10E-05
1.3	5.00E-06	1.30E-05	4.00E-06	6.00E-06
0.11	<1.00E-06	<1.00E-06	<1.00E-06	<1.00E-06

Table 15: SEU cross section Core A & Core B detailed results in static low configuration

	EV12AD550B SEU Cross Section (cm²)												
	Dynamic				Static middle					Static high		Static low	
	DEMUX 1:1		DEMUX 1:2		DEMUX 1:1		DEMUX 1:2			DEMUX 1:2			
LET Eff (MeV/mg/cm²)	**S064**	**S066**	**S064**	**S066**	**S064**	**S066**	**S064**	**S066**	**S067**	**S064**	**S066**	**S064**	**S066**
82.8	9.03E-04	8.45E-04	9.19E-04	8.75E-04	1.01E-03	1.00E-03	1.02E-03	1.02E-03	1.05E-03	4.64E-04	4.85E-04	4.84E-04	5.34E-04
26.6	4.99E-04	5.44E-04	5.61E-04	5.66E-04	5.67E-04	6.07E-04	Not tested	7.21E-04	7.00E-04	1.91E-04	2.55E-04	2.10E-04	2.30E-04
8.0	2.15E-04	2.44E-04	2.45E-04	1.93E-04	2.64E-04	2.55E-04	Not tested	3.09E-04	2.57E-04	9.30E-05	1.03E-04	7.60E-05	1.21E-04
2.6	4.50E-05	2.70E-05	2.40E-05	3.50E-05	7.80E-05	9.00E-05	Not tested	9.60E-05	1.13E-04	2.50E-05	1.10E-05	1.90E-05	1.60E-05
1.3	1.90E-05	1.10E-05	2.00E-05	1.30E-05	3.90E-05	3.60E-05	Not tested	2.50E-05	4.10E-05	8.00E-06	9.00E-06	5.00E-06	1.30E-05
0.11	<1.00E-06	<1.00E-06	<1.00E-06	<1.00E-06	<1.00E-06	1.00E-06	Not tested	1.00E-06	<1.00E-06	<1.00E-06	<1.00E-06	<1.00E-06	<1.00E-06

Table 16: SEU cross section Core A & Core B cumulated results

The following figures present **Core A & Core B cumulated cross section** for the SEU event on the EV12AS550B.

The evaluated cross section is then lower than 1.00 $10^{-6}cm^{-2}$, value corresponding to one event at maximum fluence.

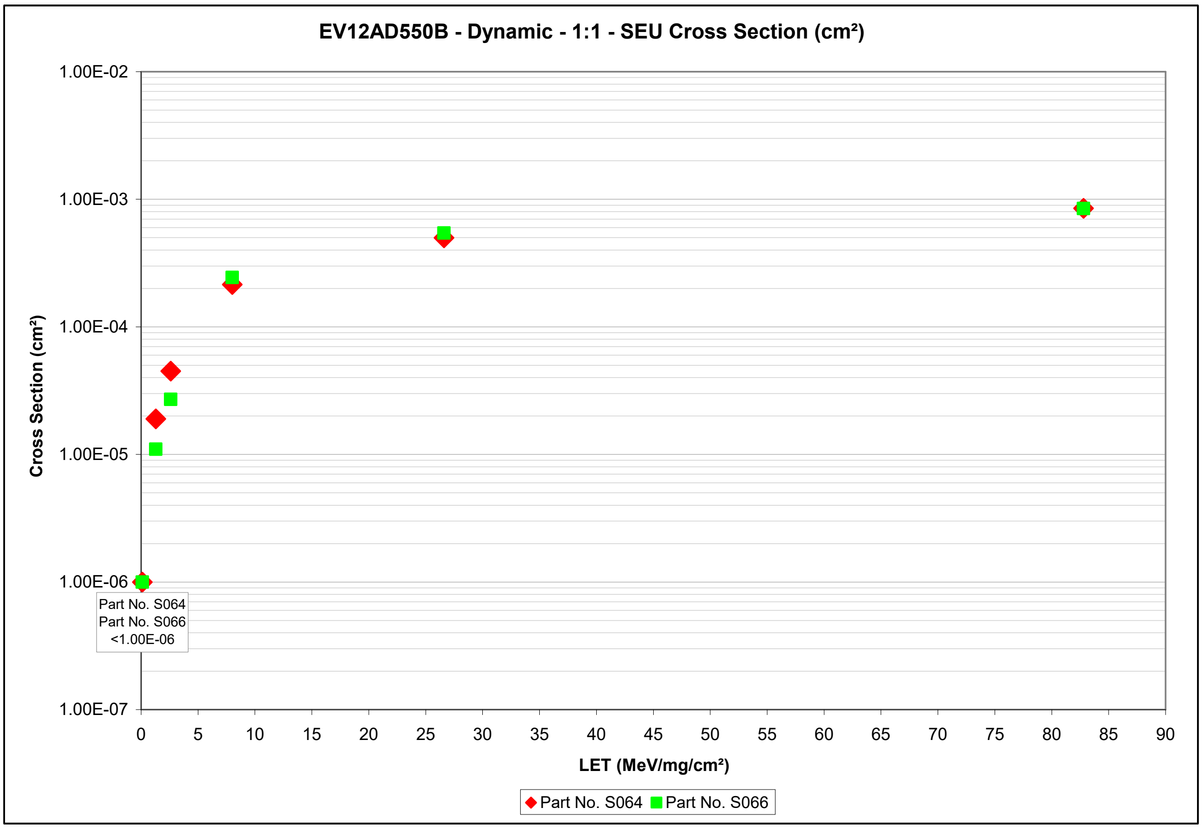


Figure 11: SEU cross section curve in dynamic and demux 1:1 configuration

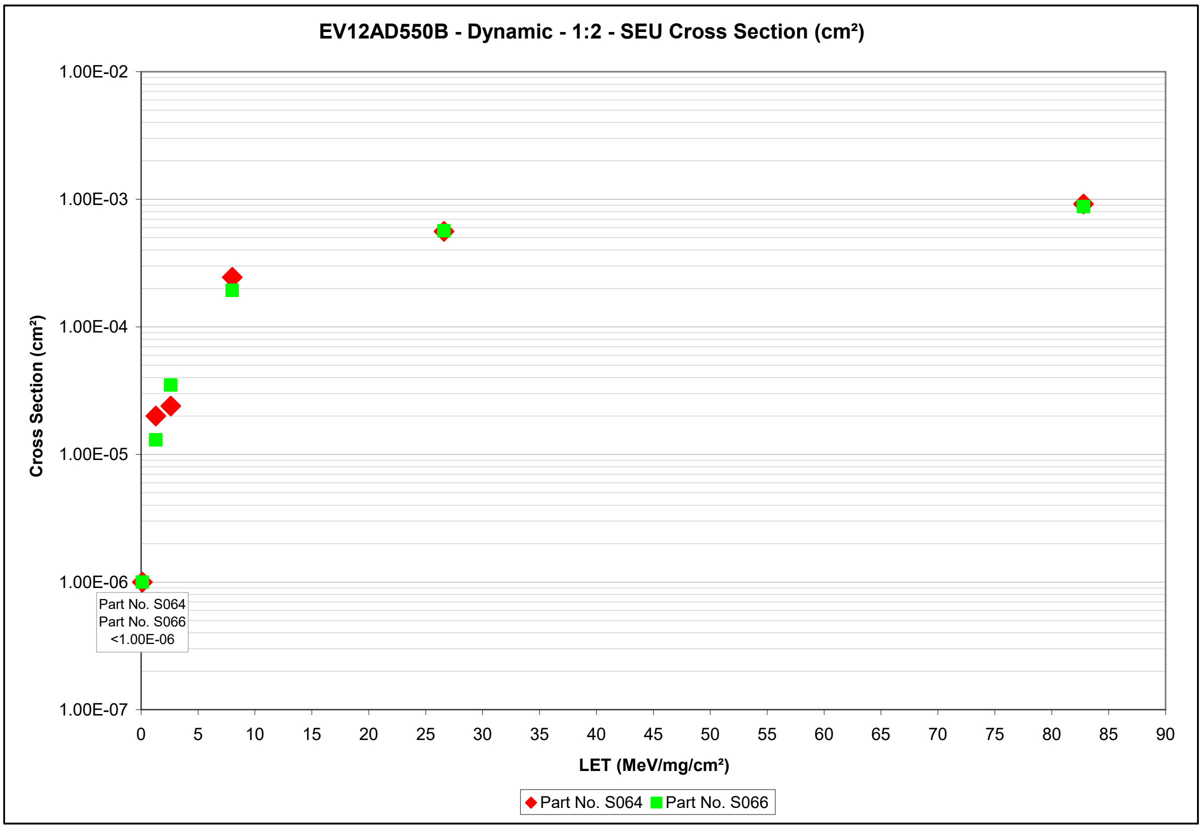


Figure 12: SEU cross section curve in dynamic and demux 1:2 configuration

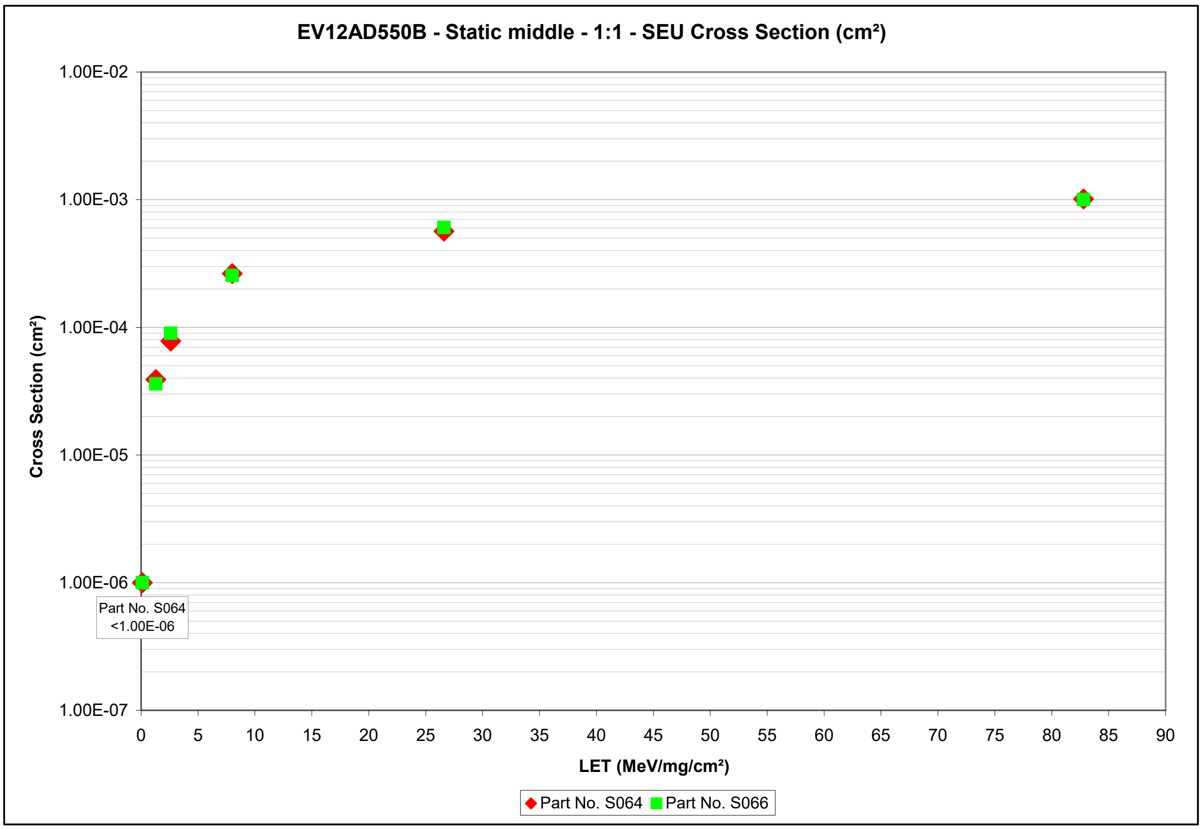


Figure 13: SEU cross section curve in static middle and demux 1:1 configuration

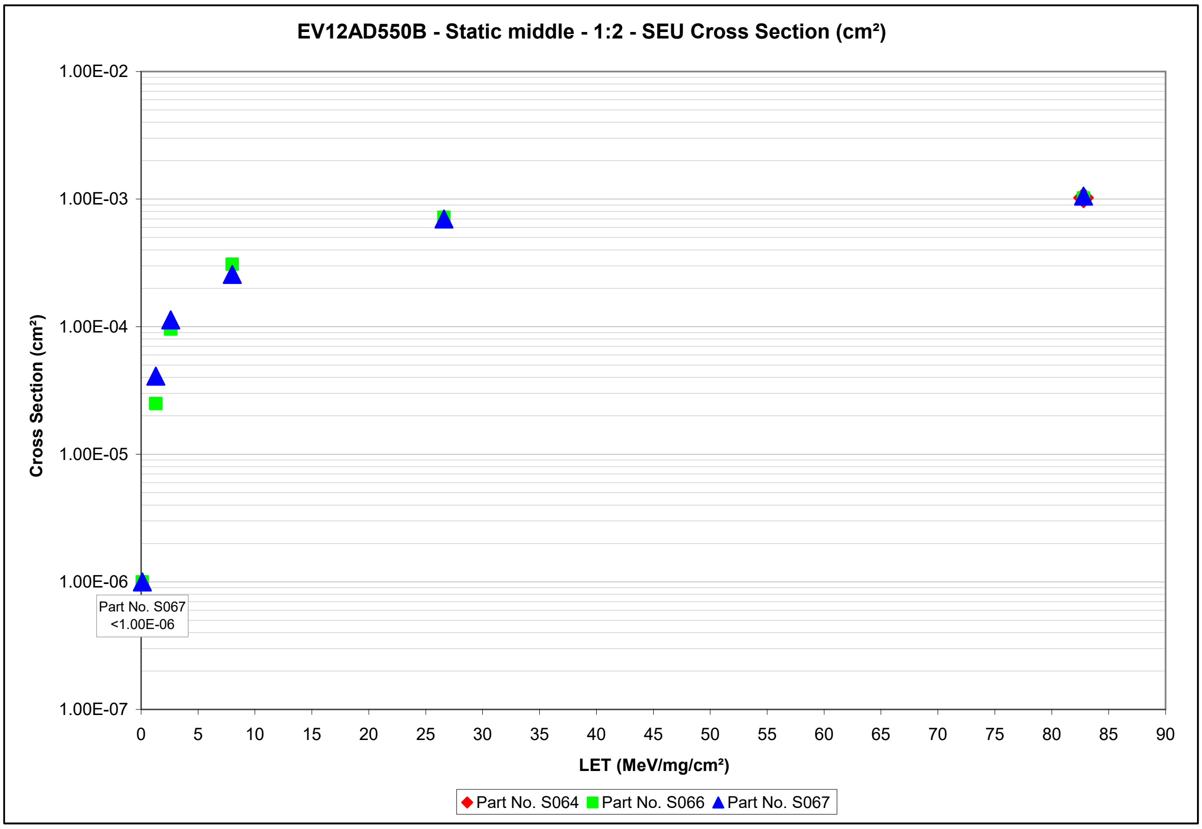


Figure 14: SEU cross section curve in static middle and demux 1:2 configuration

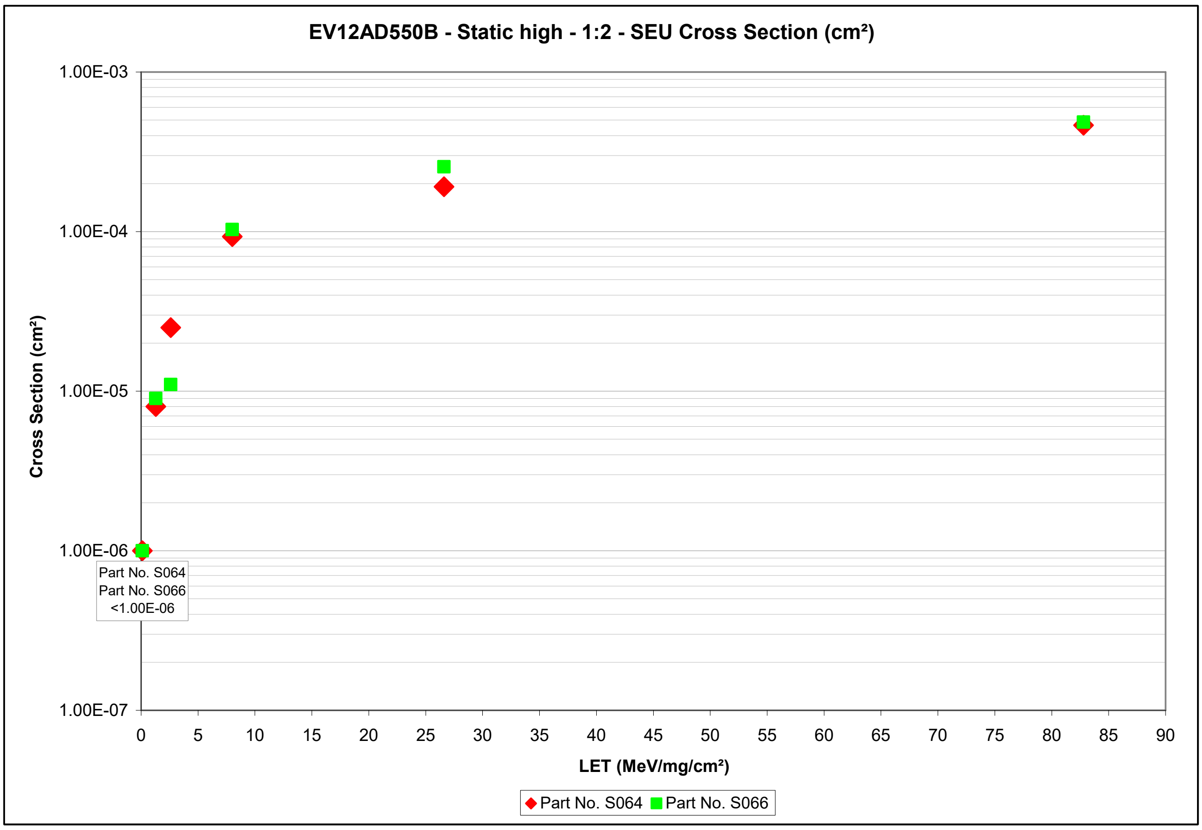


Figure 15: SEU cross section curve in static high and demux 1:2 configuration

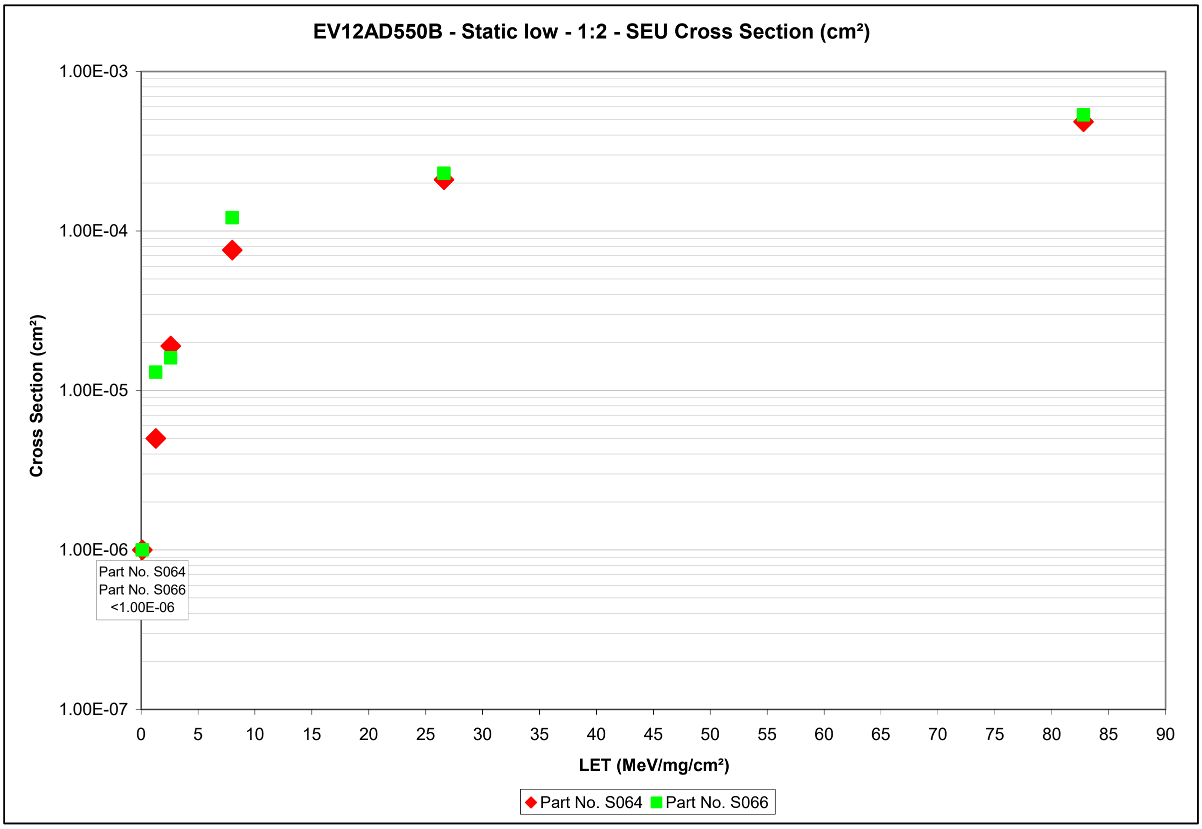


Figure 16: SEU cross section curve in static low and demux 1:2 configuration

10.2.2 SET Cross sections (internal PLL unlock)

In dynamic configuration and demux 1:1 mode

SET were observed during the irradiation up to the Neon Heavy Ion (LET= 2.6 MeV.cm²/mg).

In dynamic configuration and demux 1:2 mode

SET were observed during the irradiation up to the Neon Heavy Ion (LET= 2.6 MeV.cm²/mg).

In static middle configuration and demux 1:1 mode

SET were observed during the irradiation up to the Nitrogen Heavy Ion (LET= 1.3 MeV.cm²/mg).

In static middle configuration and demux 1:2 mode

SET were observed during the irradiation up to the Neon Heavy Ion (LET= 2.6 MeV.cm²/mg).

In static high configuration and demux 1:2 mode

SET were observed during the irradiation up to the Nitrogen Heavy Ion (LET= 1.3 MeV.cm²/mg).

In static low configuration and demux 1:2 mode

SET were observed during the irradiation up to the Neon Heavy Ion (LET= 2.6 MeV.cm²/mg).

	EV12AD550B SET Cross Section (cm²) in static middle test configuration									
	DEMUX 1:1				DEMUX 1:2					
	Core A		Core B		Core A			Core B		
LET Eff (MeV/mg/cm²)	S064	S066	S064	S066	S064	S066	S067	S064	S066	S067
82.8	1.14E-04	7.43E-05	7.11E-05	5.94E-05	8.33E-05	6.40E-05	5.73E-05	7.84E-05	6.40E-05	3.58E-05
26.6	3.15E-05	3.52E-05	3.41E-05	3.52E-05	Not tested	3.70E-05	3.00E-05	Not tested	3.70E-05	1.60E-05
8.0	3.00E-06	8.00E-06	4.00E-06	1.00E-05	Not tested	4.00E-06	7.00E-06	Not tested	9.00E-06	1.10E-05
2.6	<1.00E-06	<1.00E-06	<1.00E-06	<1.00E-06	Not tested	<1.00E-06	1.00E-06	Not tested	1.00E-06	<1.00E-06
1.3	1.00E-06	<1.00E-06	<1.00E-06	<1.00E-06	Not tested	<1.00E-06	<1.00E-06	Not tested	<1.00E-06	<1.00E-06
0.11	<1.00E-06	<1.00E-06	<1.00E-06	<1.00E-06	Not tested	<1.00E-06	<1.00E-06	Not tested	<1.00E-06	<1.00E-06

Table 17: SET cross section Core A & Core B detailed results in static middle configuration

	EV12AD550B SET Cross Section (cm²) in dynamic test configuration							
	DEMUX 1:1				DEMUX 1:2			
	Core A		Core B		Core A		Core B	
LET Eff (MeV/mg/cm²)	S064	S066	S064	S066	S064	S066	S064	S066
82.8	6.23E-05	3.97E-05	6.61E-05	3.17E-05	5.41E-05	8.33E-05	6.31E-05	3.75E-05
26.6	1.93E-05	2.36E-05	2.31E-05	1.77E-05	2.38E-05	2.01E-05	2.38E-05	2.92E-05
8.0	2.00E-06	1.00E-06	3.00E-06	2.00E-06	<1.00E-06	2.00E-06	<1.00E-06	2.00E-06
2.6	<1.00E-06	<1.00E-06	2.00E-06	<1.00E-06	1.00E-06	<1.00E-06	<1.00E-06	<1.00E-06
1.3	<1.00E-06	<1.00E-06	<1.00E-06	<1.00E-06	<1.00E-06	<1.00E-06	<1.00E-06	<1.00E-06
0.11	<1.00E-06	<1.00E-06	<1.00E-06	<1.00E-06	<1.00E-06	<1.00E-06	<1.00E-06	<1.00E-06

Table 18: SET cross section Core A & Core B detailed results in dynamic configuration

	EV12AD550B SET Cross Section (cm²) in static high test configuration			
	DEMUX 1:2			
	Core A		Core B	
LET Eff (MeV/mg/cm²)	S064	S066	S064	S066
82.8	8.83E-05	5.65E-05	4.42E-05	6.09E-05
26.6	3.00E-05	2.00E-05	2.80E-05	4.38E-05
8.0	4.00E-06	5.00E-06	6.00E-06	7.00E-06
2.6	2.00E-06	1.00E-06	2.00E-06	1.00E-06
1.3	<1.00E-06	<1.00E-06	1.00E-06	<1.00E-06
0.11	<1.00E-06	<1.00E-06	<1.00E-06	<1.00E-06

Table 19: SET cross section Core A & Core B detailed results in static high configuration

	EV12AD550B SET Cross Section (cm²) in static low test configuration			
	DEMUX 1:2			
	Core A		Core B	
LET Eff (MeV/mg/cm²)	S064	S066	S064	S066
82.8	9.72E-05	8.22E-05	4.40E-05	7.53E-05
26.6	3.00E-05	2.70E-05	2.80E-05	3.40E-05
8.0	3.00E-06	2.00E-06	8.00E-06	3.00E-06
2.6	1.00E-06	<1.00E-06	1.00E-06	1.00E-06
1.3	<1.00E-06	<1.00E-06	<1.00E-06	<1.00E-06
0.11	<1.00E-06	<1.00E-06	<1.00E-06	<1.00E-06

Table 20: SET cross section Core A & Core B detailed results in static low configuration

	EV12AD550B SET Cross Section (cm²)												
	Dynamic				Static middle					Static high		Static low	
	DEMUX 1:1		DEMUX 1:2		DEMUX 1:1		DEMUX 1:2			DEMUX 1:2			
LET Eff (MeV/mg/cm²)	S064	S066	S064	S066	S064	S066	S064	S066	S067	S064	S066	S064	S066
82.8	1.28E-04	7.14E-05	1.17E-04	1.21E-04	1.85E-04	1.34E-04	1.62E-04	1.28E-04	9.32E-05	1.32E-04	1.17E-04	1.41E-04	1.58E-04
26.6	4.24E-05	4.13E-05	4.75E-05	4.93E-05	6.56E-05	7.04E-05	Not tested	7.41E-05	4.60E-05	5.80E-05	6.38E-05	5.80E-05	6.10E-05
8.0	5.00E-06	3.00E-06	<1.00E-06	4.00E-06	7.00E-06	1.80E-05	Not tested	1.30E-05	1.80E-05	1.00E-05	1.20E-05	1.10E-05	5.00E-06
2.6	2.00E-06	<1.00E-06	1.00E-06	<1.00E-06	<1.00E-06	<1.00E-06	Not tested	1.00E-06	1.00E-06	4.00E-06	2.00E-06	2.00E-06	1.00E-06
1.3	<1.00E-06	<1.00E-06	<1.00E-06	<1.00E-06	1.00E-06	<1.00E-06	Not tested	<1.00E-06	<1.00E-06	1.00E-06	<1.00E-06	<1.00E-06	<1.00E-06
0.11	<1.00E-06	<1.00E-06	<1.00E-06	<1.00E-06	<1.00E-06	<1.00E-06	Not tested	<1.00E-06	<1.00E-06	<1.00E-06	<1.00E-06	<1.00E-06	<1.00E-06

Table 21: SET cross section Core A & Core B cumulated results

The following figures present **Core A & Core B cumulated cross section** for the SET event on the EV12AS550B.
The evaluated cross section is then lower than 1.00 $10^{-6}cm^{-2}$, value corresponding to one event at maximum fluence.

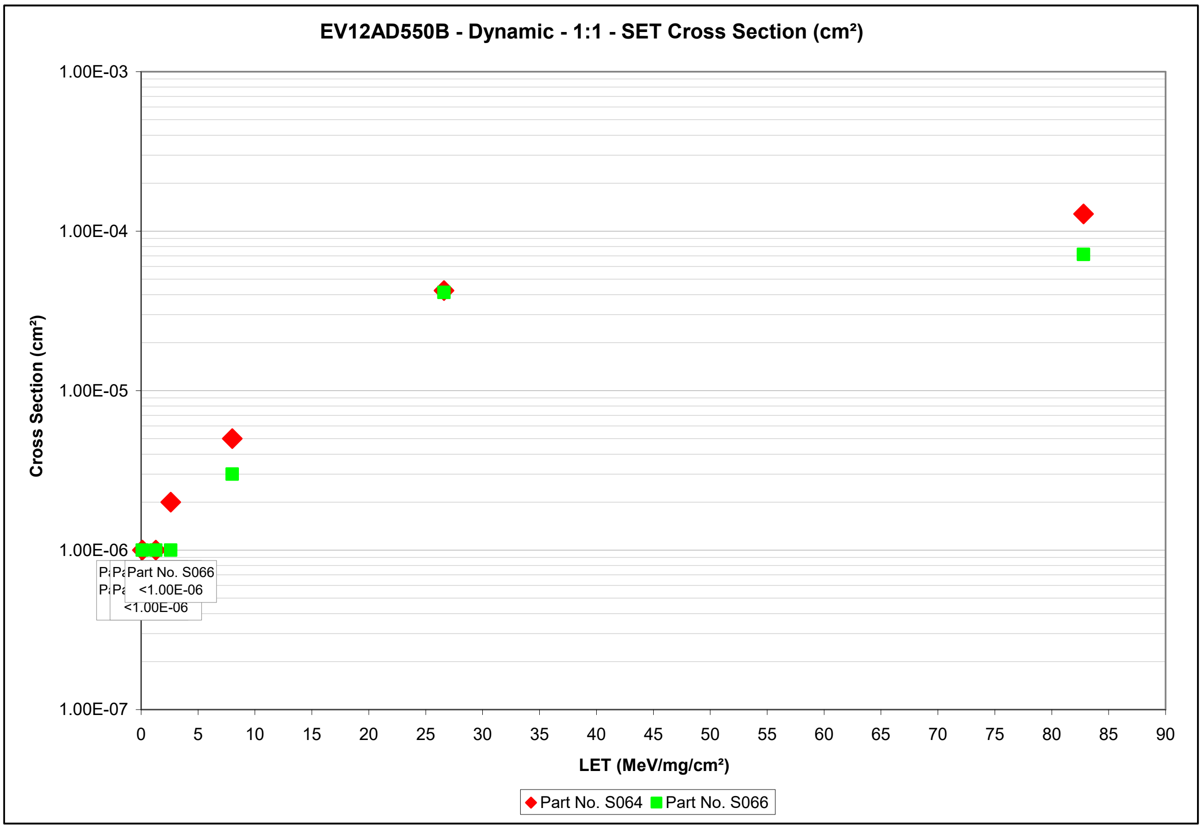


Figure 17: SET cross section curve in dynamic and demux 1:1 configuration

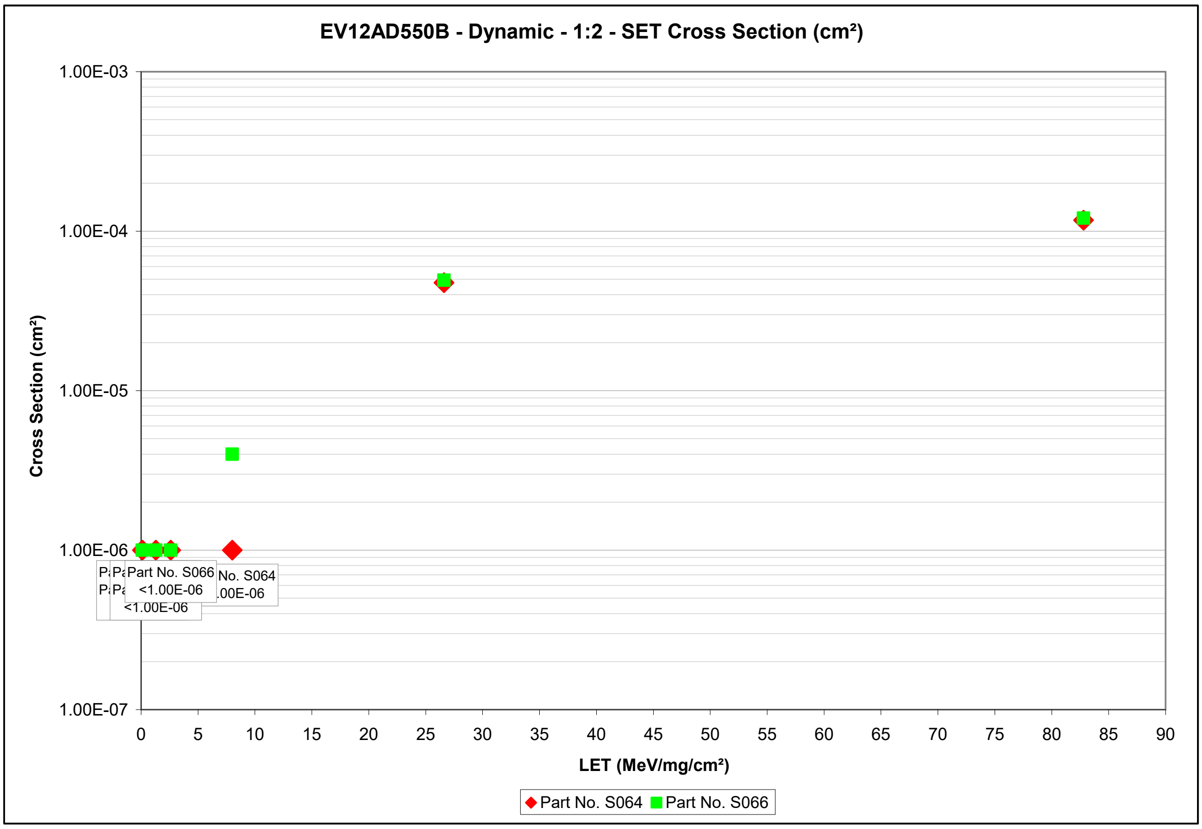


Figure 18: SET cross section curve in dynamic and demux 1:2 configuration

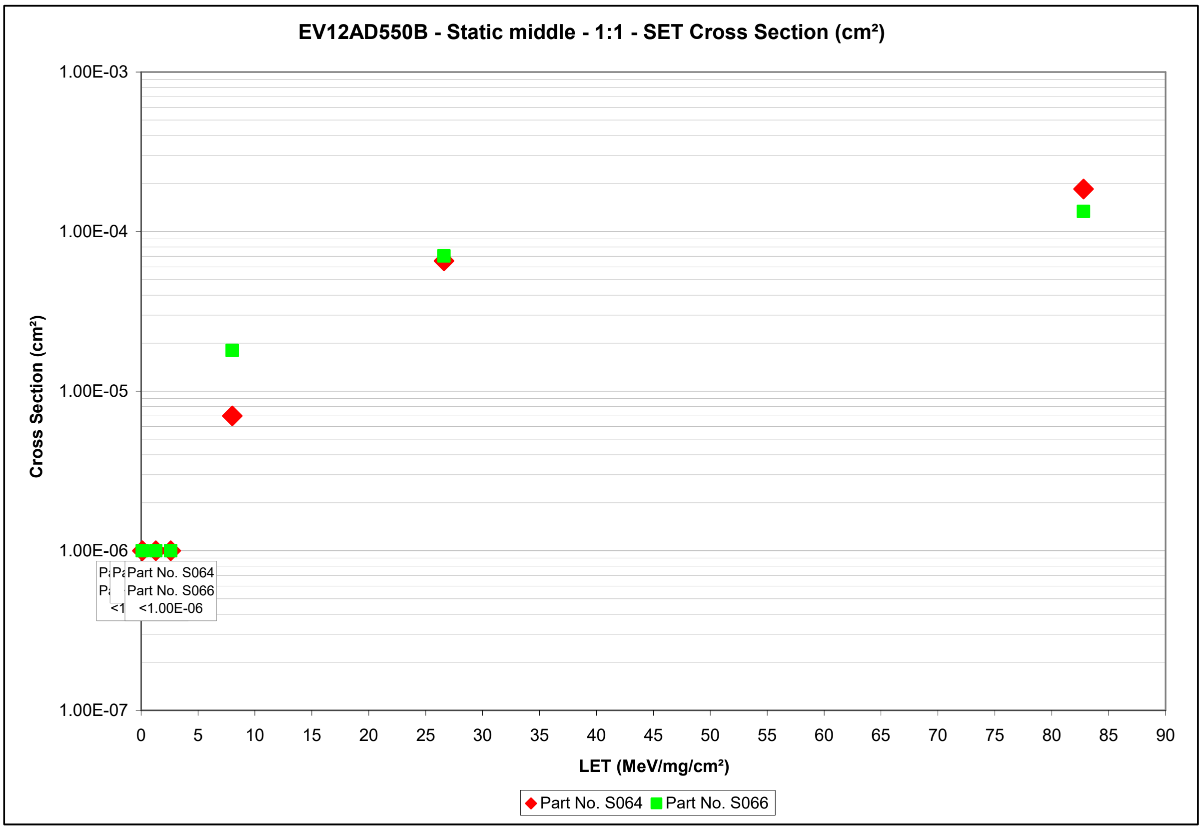


Figure 19: SET cross section curve in static middle and demux 1:1 configuration

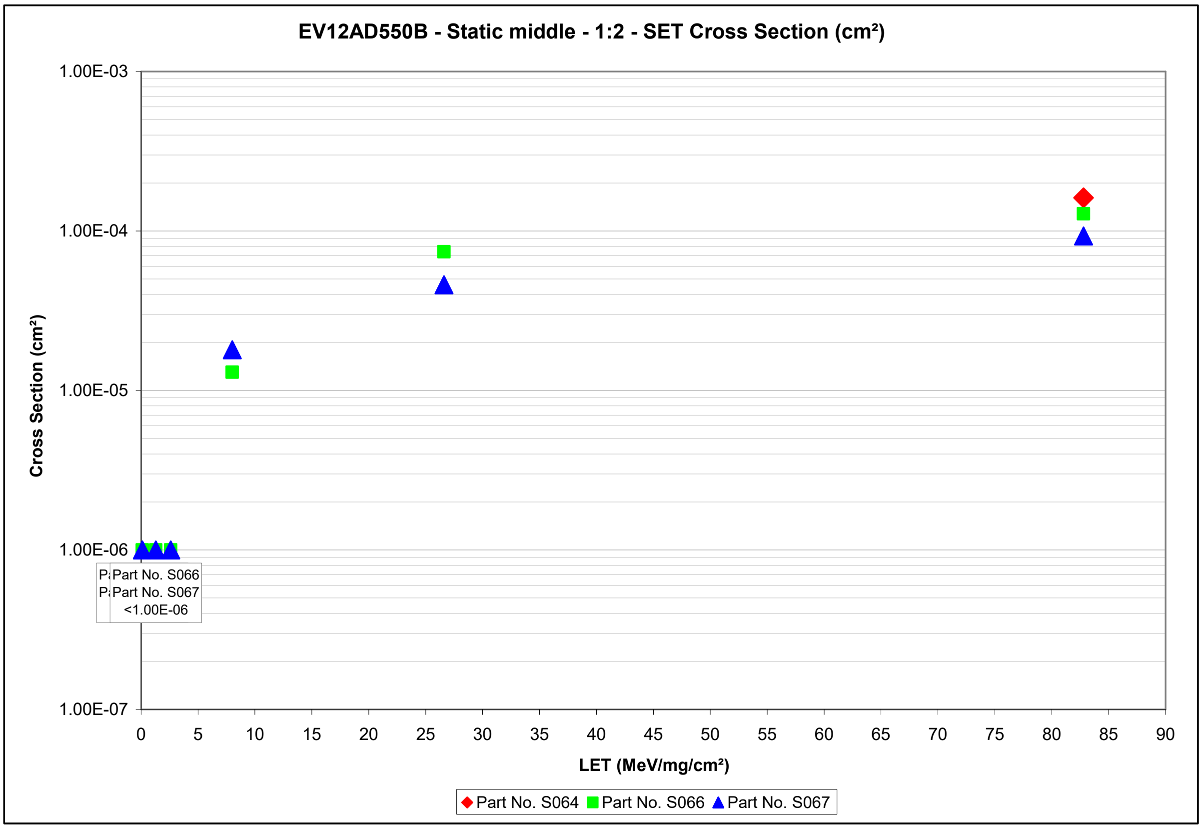


Figure 20: SET cross section curve in static middle and demux 1:2 configuration

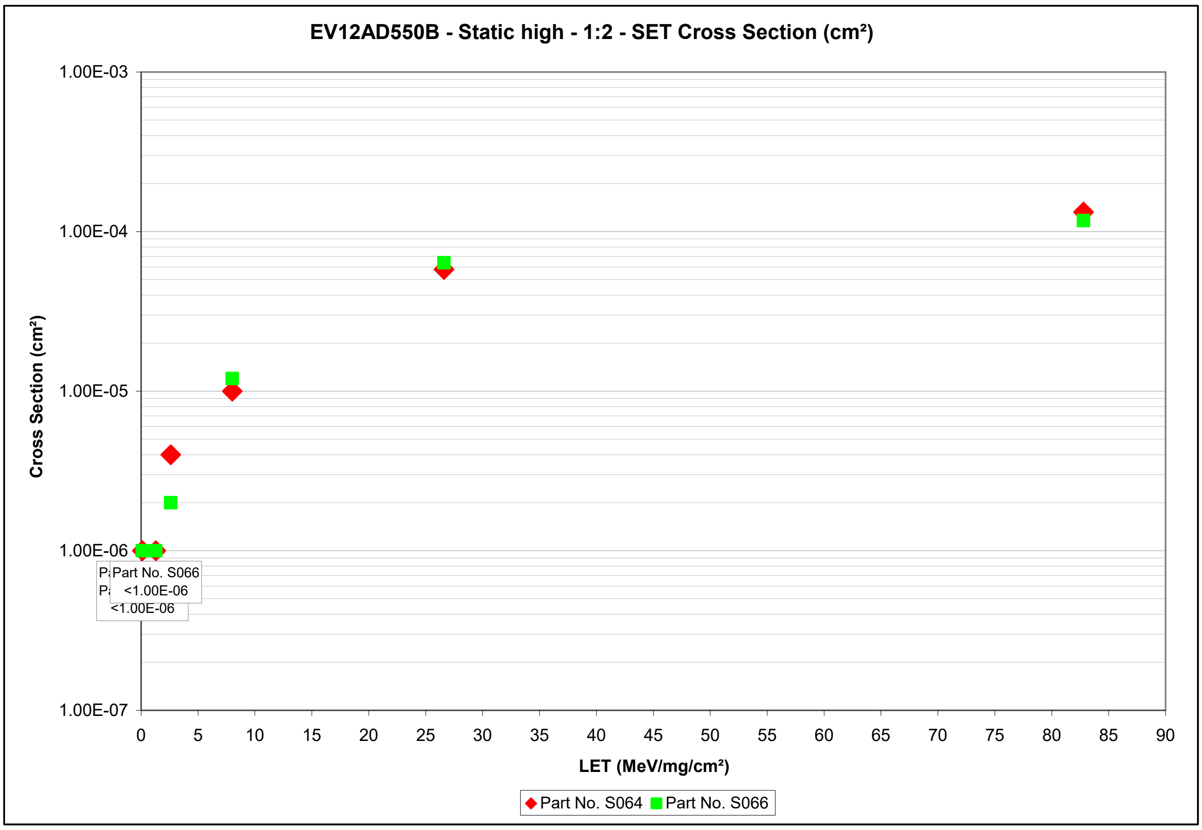


Figure 21: SET cross section curve in static high and demux 1:2 configuration

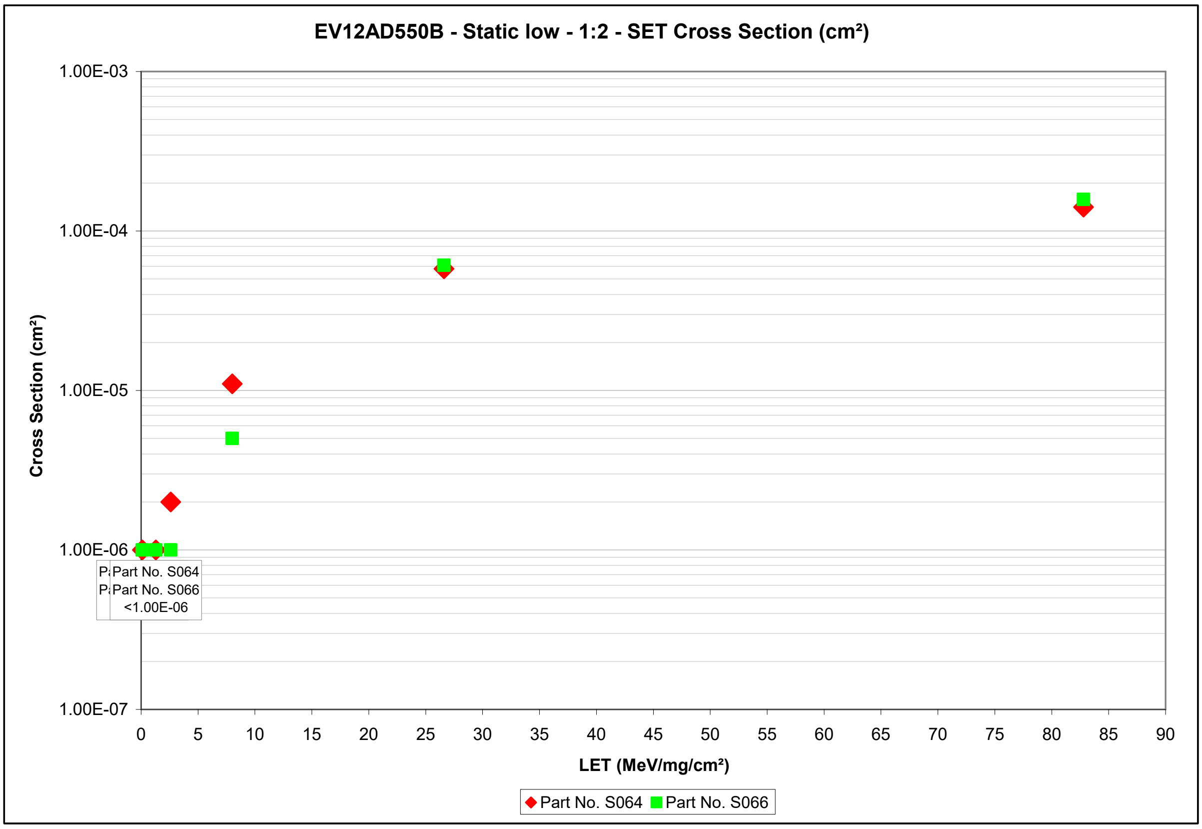


Figure 22: SET cross section curve in static low and demux 1:2 configuration

10.2.3 Clock Tree Event tests results

The Clock Tree Event test was performed at ambient temperature.
In dynamic configuration and demux 1:1 mode
Clock Tree Event were observed during the irradiation up to the Neon Heavy Ion (LET= 2.6 MeV.cm²/mg).
In dynamic configuration and demux 1:2 mode
Clock Tree Event were observed during the irradiation up to the Neon Heavy Ion (LET= 2.6 MeV.cm²/mg).

	EV12AD550B Clock Tree Even Cross Section (cm²) in dynamic test configuration			
	DEMUX 1:1		DEMUX 1:2	
LET Eff (MeV/mg/cm²)	**S064**	**S066**	**S064**	**S066**
82.8	<3.89E-06	<3.97E-06	<4.50E-06	<4.17E-06
26.6	5.78E-06	7.86E-06	<2.38E-06	5.47E-06
8.0	1.00E-06	<1.00E-06	2.00E-06	1.00E-06
2.6	1.00E-06	<1.00E-06	<1.00E-06	1.00E-06
1.3	<1.00E-06	<1.00E-06	<1.00E-06	<1.00E-06
0.11	<1.00E-06	<1.00E-06	<1.00E-06	<1.00E-06

Table 22: Clock Tree Event cross section Core A & Core B cumulated results

10.2.4 SEFI tests results

The SEFI test was performed at ambient temperature.
In dynamic configuration and demux 1:1 or 1:2 mode,
No SEFI were observed during this test under Gold irradiation with a particle angle of 0° (LET = 82.8 MeV.cm²/mg and range = 155µm).

In static middle configuration and demux 1:1 or 1:2 mode
No SEFI were observed during this test under Gold irradiation with a particle angle of 0° (LET = 82.8 MeV.cm²/mg and range = 155µm).

In static high configuration and demux 1:2 mode
No SEFI were observed during this test under Gold irradiation with a particle angle of 0° (LET = 82.8 MeV.cm²/mg and range = 155µm).

In static low configuration and demux 1:2 mode
No SEFI were observed during this test under Gold irradiation with a particle angle of 0° (LET = 82.8 MeV.cm²/mg and range = 155µm).

The EV12AD550B is SEFI free up to a LET of 82.8 MeV.cm²/mg.

10.3 SEE observed shape analysis and characteristic

SEU in dynamic configuration

In demux 1:1 the worst cases can be found in run 12 and 90.

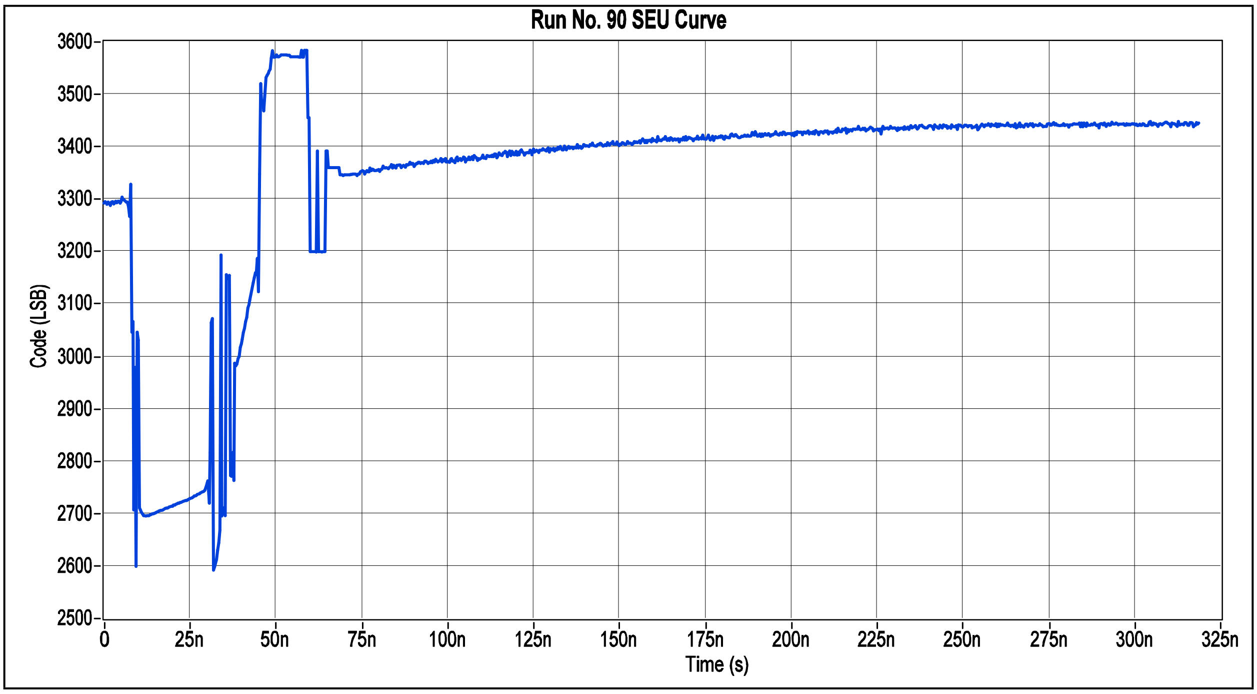


Figure 23: SEU worst curve in dynamic with demux 1:1, Ion Au, Part S067, ADC core A, Run No. 90, amplitude of 700 LSB, duration of 61ns

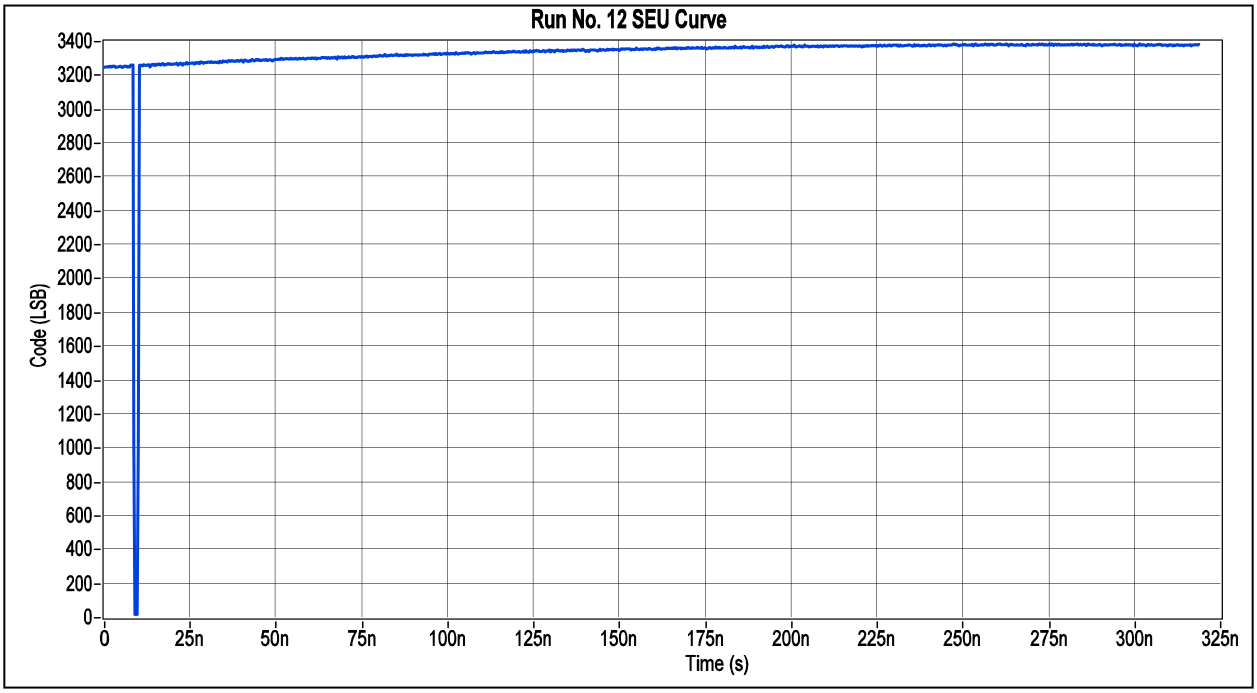


Figure 24: SEU worst curve in dynamic with demux 1:1, Ion Au, Part S064, ADC core B, Run No. 12, amplitude of 3230 LSB, duration of 2ns

In demux 1:2 the worst cases can be found in run 93 and 94.

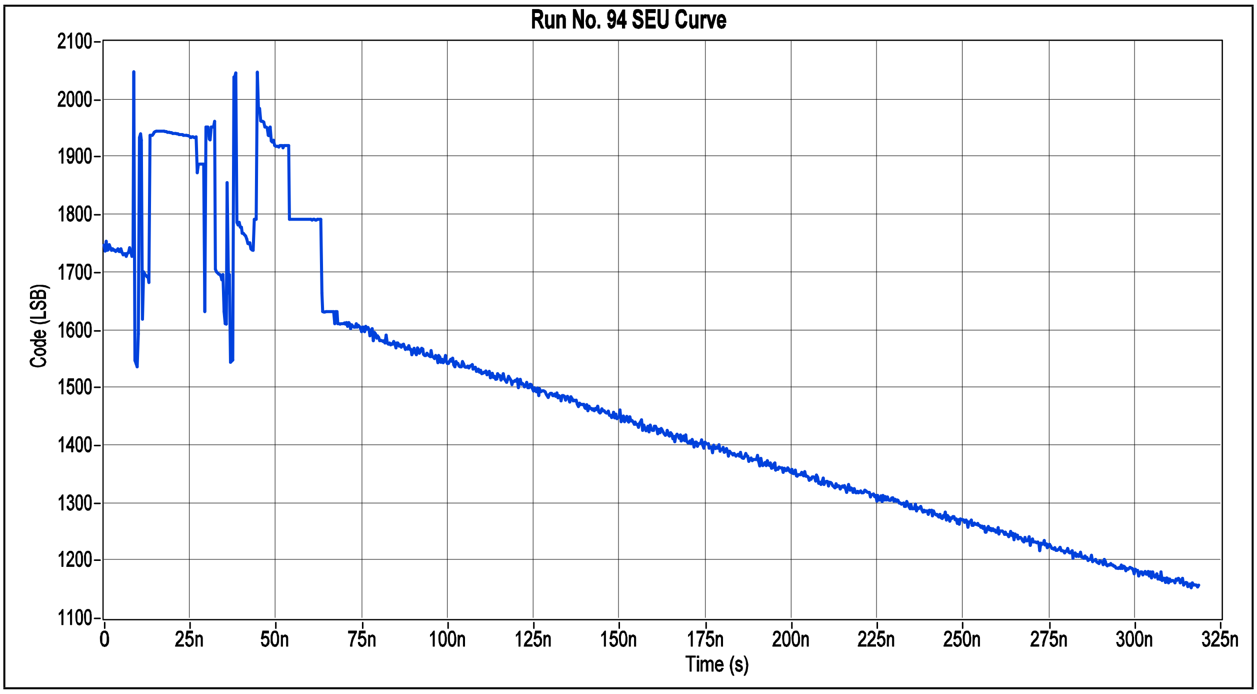


Figure 25: SEU worst curve in dynamic with demux 1:2, Ion Au, Part S067, ADC core A, Run No. 94, amplitude of 300 LSB, duration of 60ns

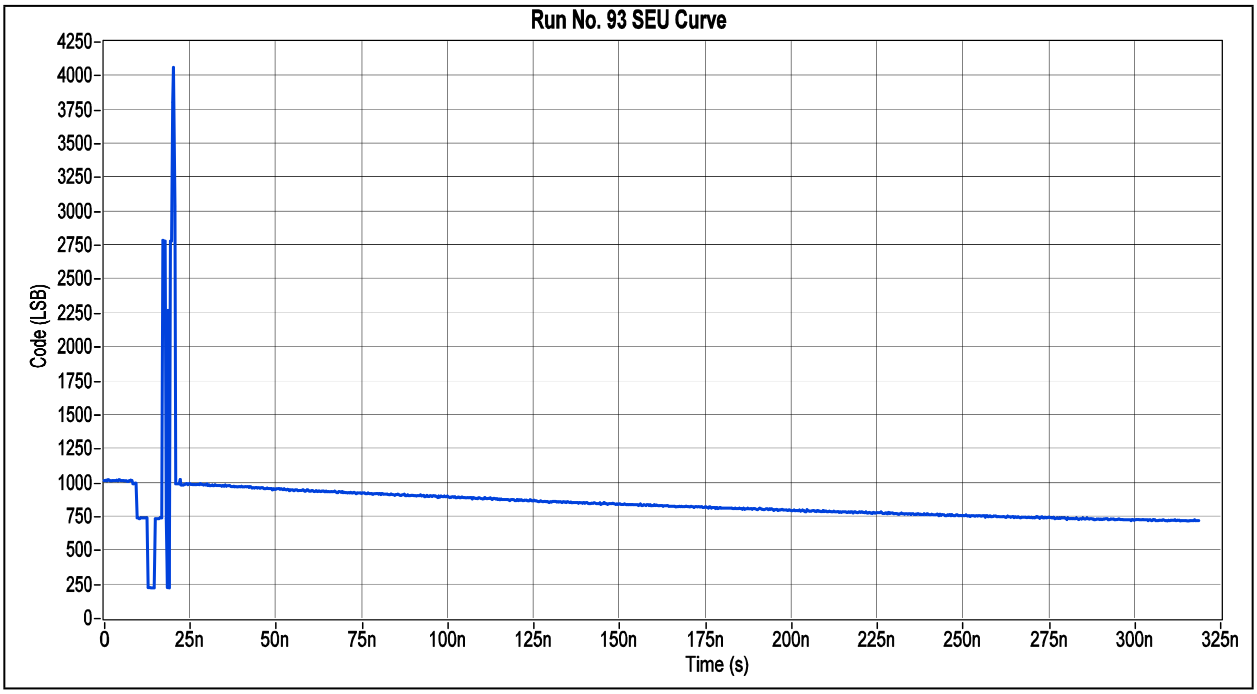


Figure 26: SEU worst curve in dynamic with demux 1:2, Ion Au, Part S067, ADC core B, Run No. 93, amplitude of 3048 LSB, duration of 12ns

SEU in static middle configuration

All events observed in static middle configuration for each run and their statistical distribution amplitude versus duration can be found in appendix A and B of this test report.

In demux 1:1 the worst cases can be found in run 11 and 14.

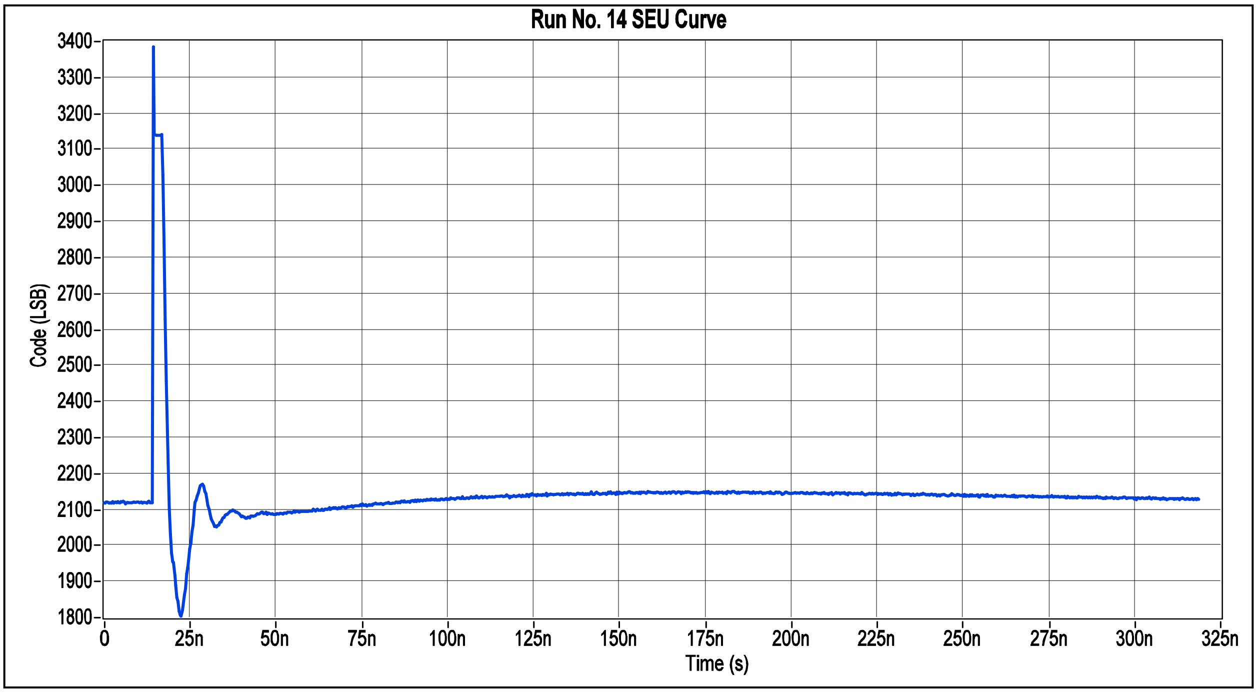


Figure 27: SEU worst curve in static middle with demux 1:1, Ion Au, Part S066, ADC core A, Run No. 14, amplitude of 1160 LSB, duration of 300ns

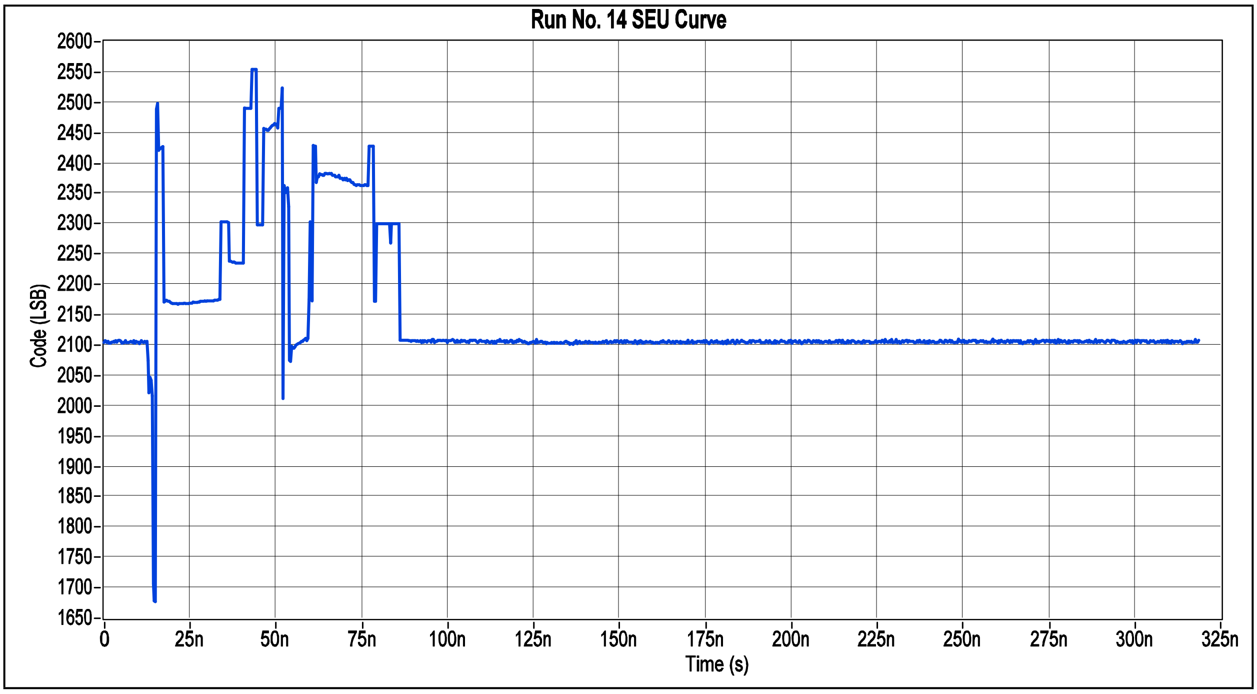


Figure 28: SEU worst curve in static middle with demux 1:1, Ion Au, Part S066, ADC core B, Run No. 14, amplitude of 464 LSB, duration of 73ns

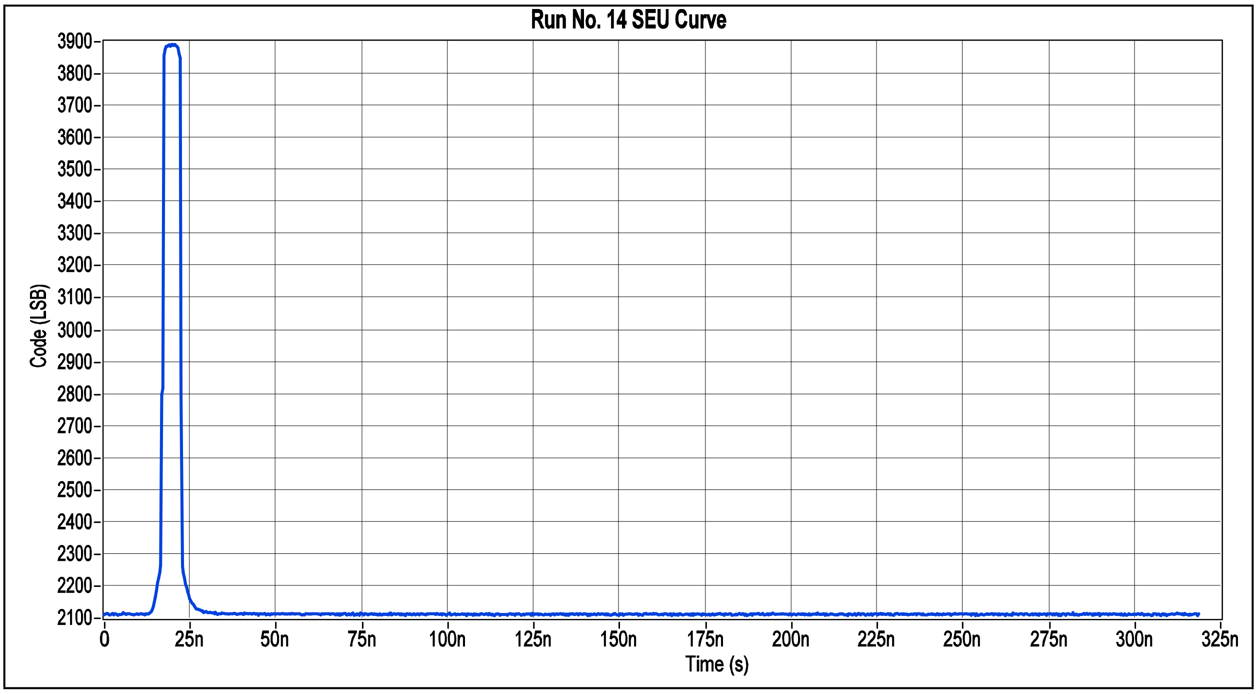


Figure 29: SEU worst curve in static middle with demux 1:1, Ion Au, Part S066, ADC core B, Run No. 14, amplitude of 1770 LSB, duration of 12.5ns

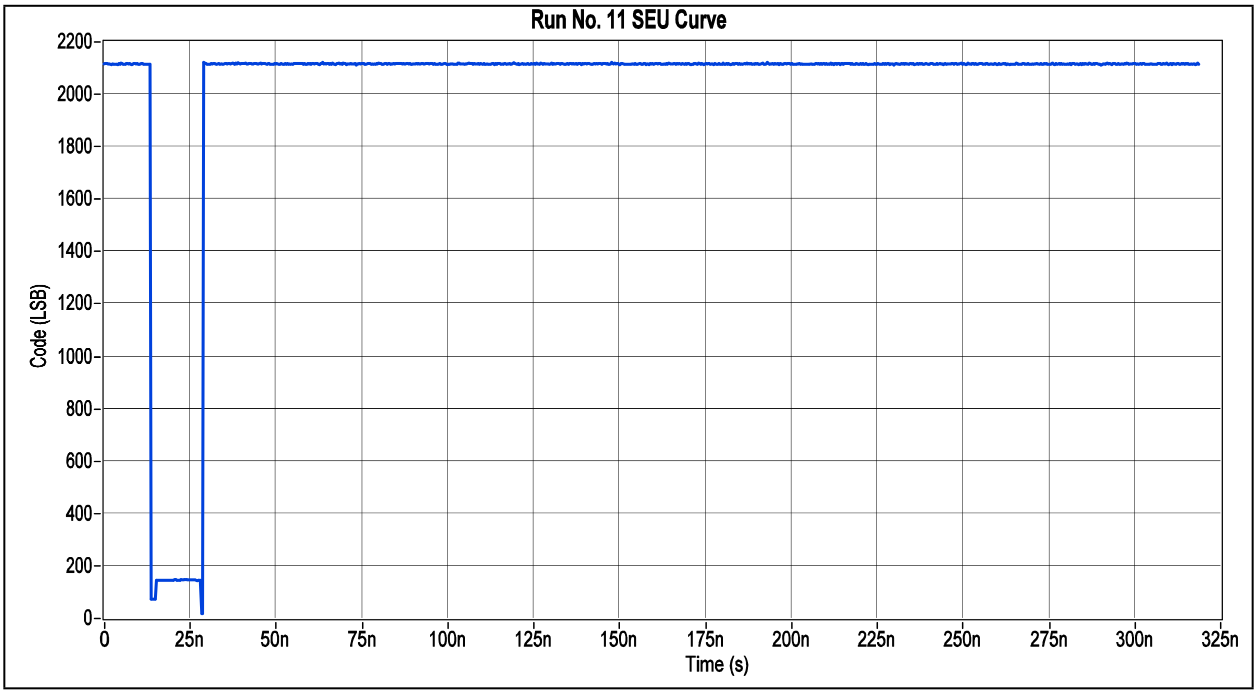


Figure 30: SEU worst curve in static middle with demux 1:1, Ion Au, Part S066, ADC core B, Run No. 11, amplitude of 2105 LSB, duration of 15.5ns

In demux 1:2 the worst case can be found in run 6.

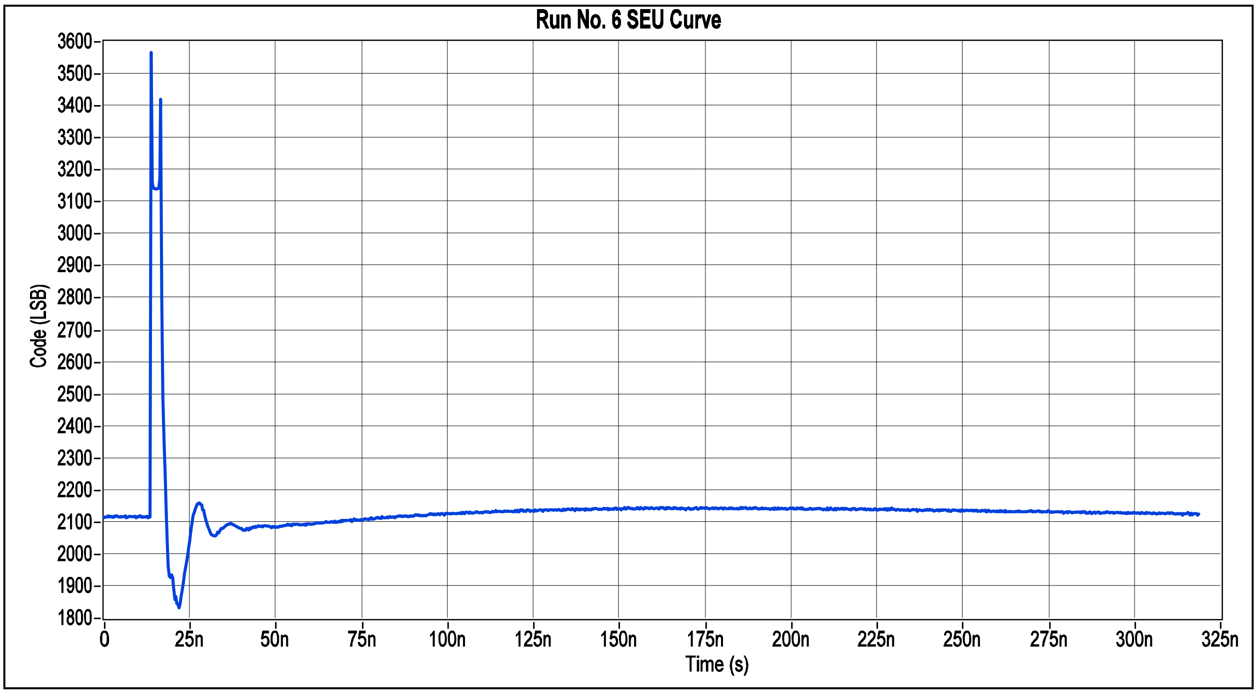


Figure 31: SEU worst curve in static middle with demux 1:2, Ion Au, Part S064, ADC core A, Run No. 6, amplitude of 1450 LSB, duration of 278ns

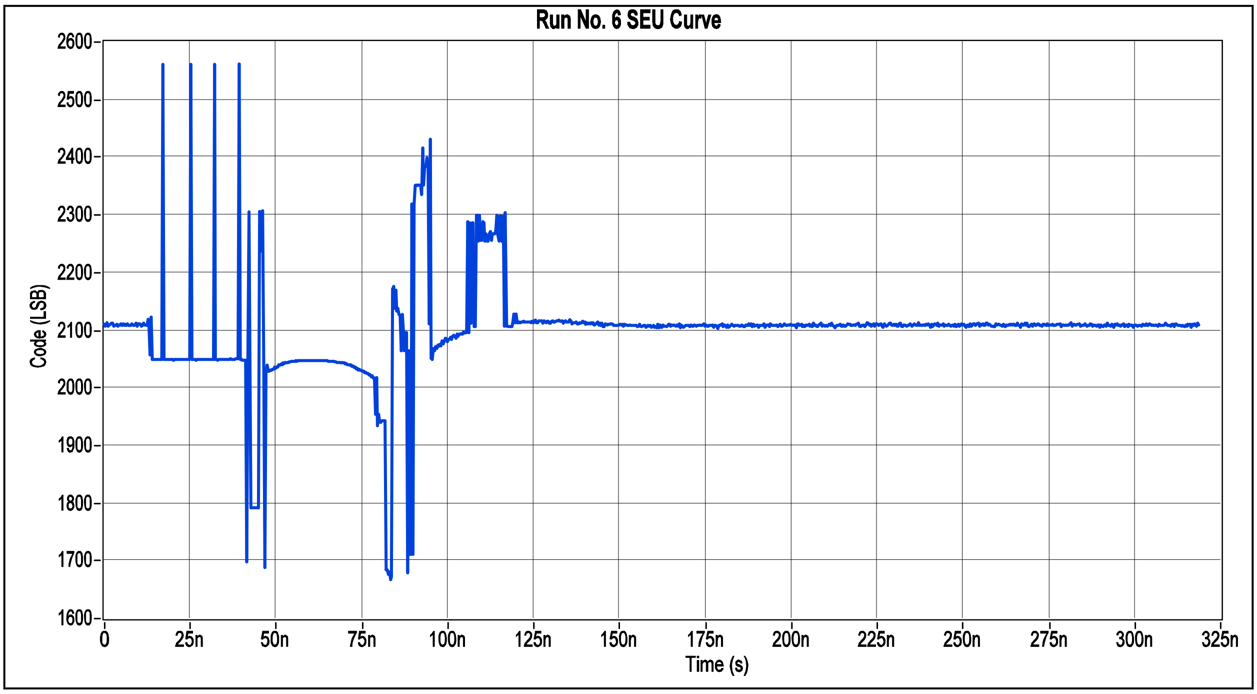


Figure 32: SEU worst curve in static middle with demux 1:2, Ion Au, Part S064, ADC core B, Run No. 6, amplitude of 440 LSB, duration of 278ns

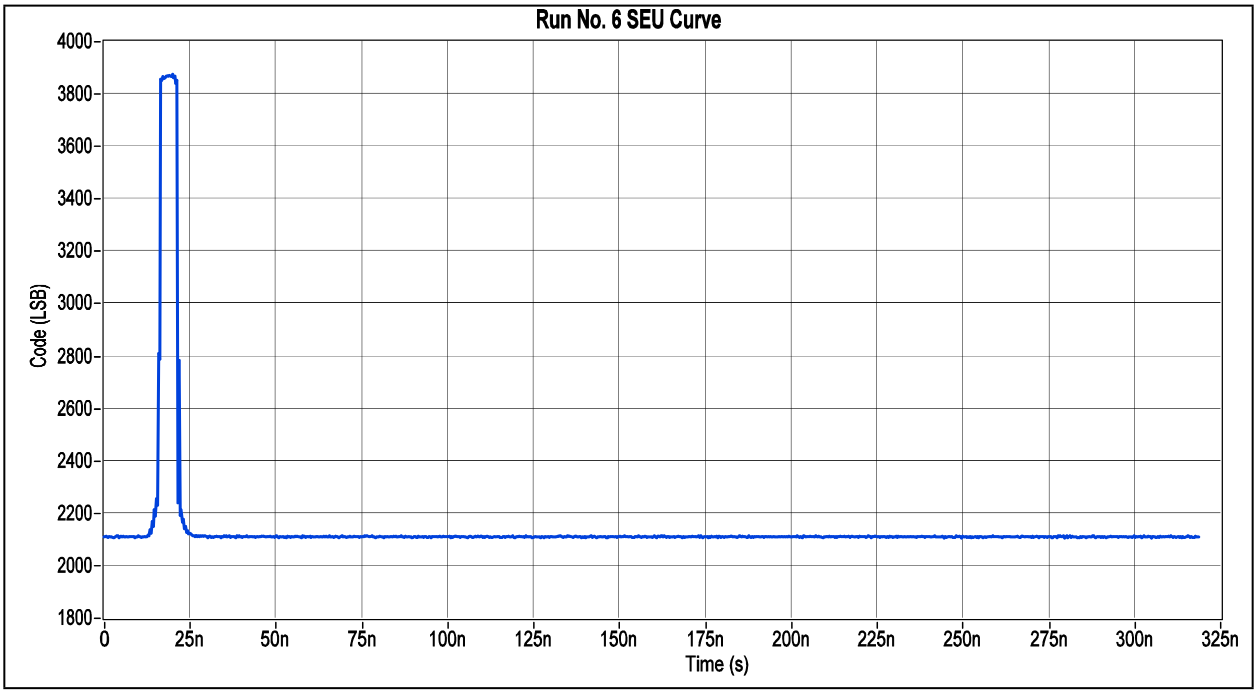


Figure 33: SEU worst curve in static middle with demux 1:2, Ion Au, Part S064, ADC core B, Run No. 6, amplitude of 1750 LSB, duration of 11ns

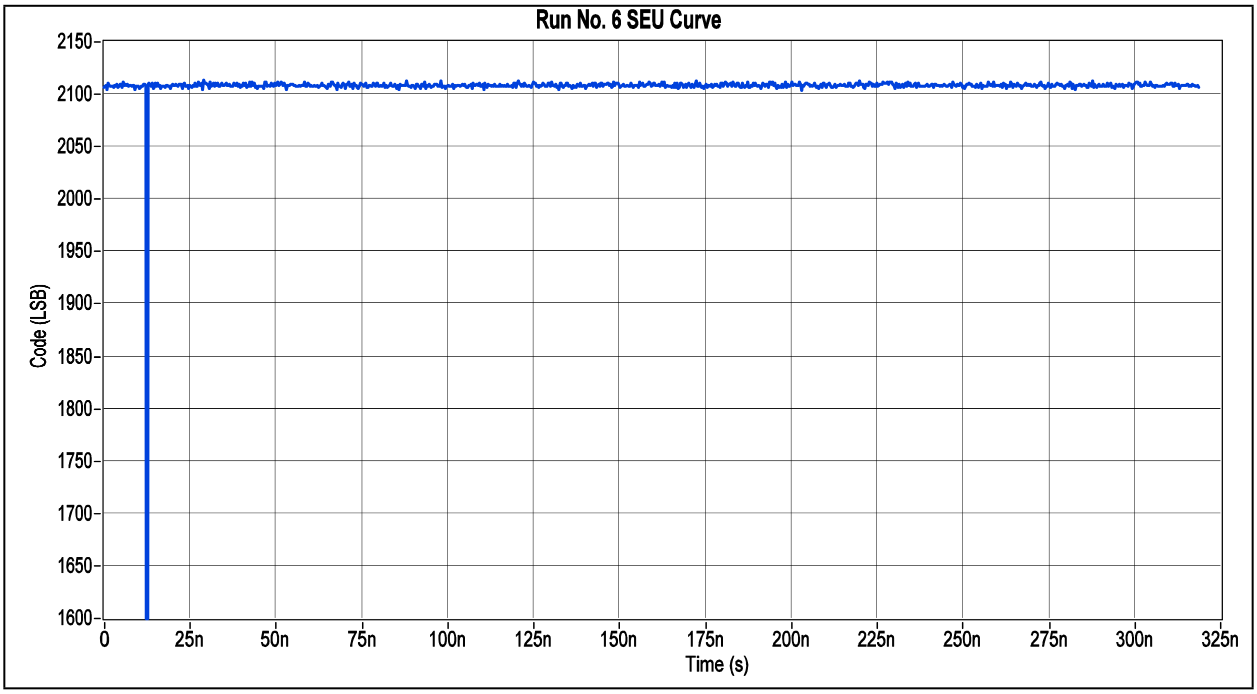


Figure 34: SEU worst curve in static middle with demux 1:2, Ion Au, Part S064, ADC core B, Run No. 6, amplitude of 2055 LSB, duration of 310ps

SEU in static high configuration

All events observed in static high configuration for each run and their statistical distribution amplitude versus duration can be found in appendix C of this test report.

The worst case can be found in run 17.

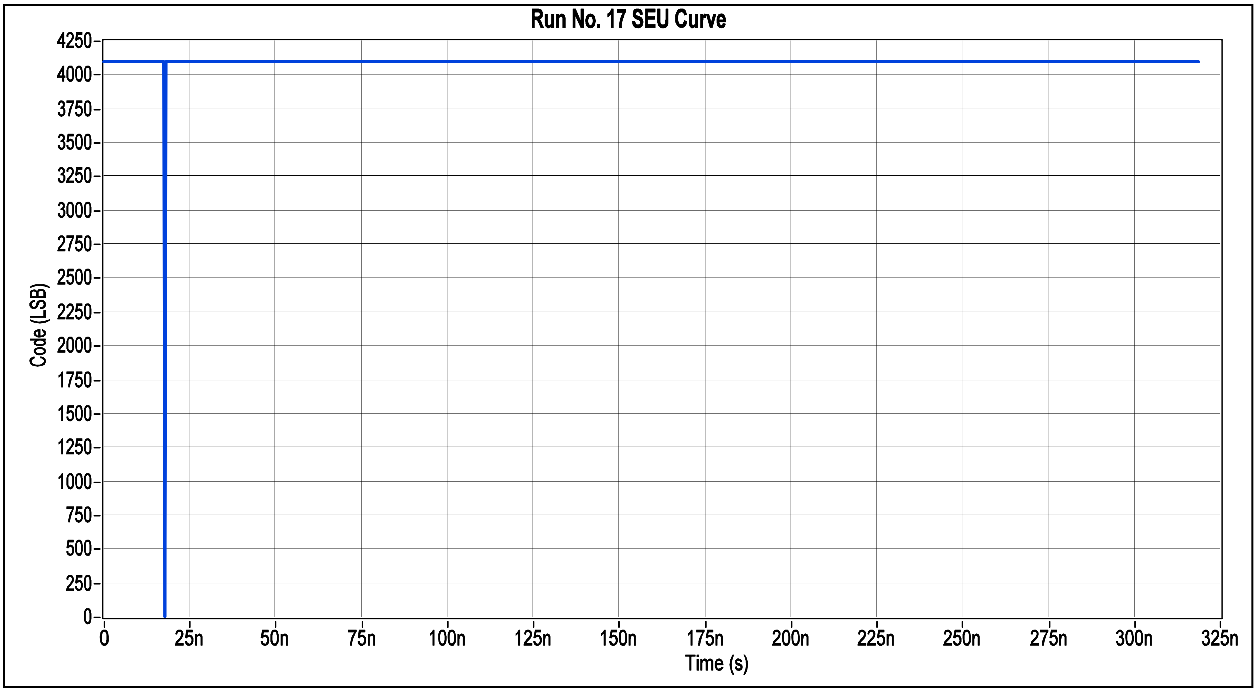


Figure 35: SEU worst curve in static high, Ion Au, Part S066, ADC core A, Run No. 17, amplitude of 4095 LSB, duration of 310ps

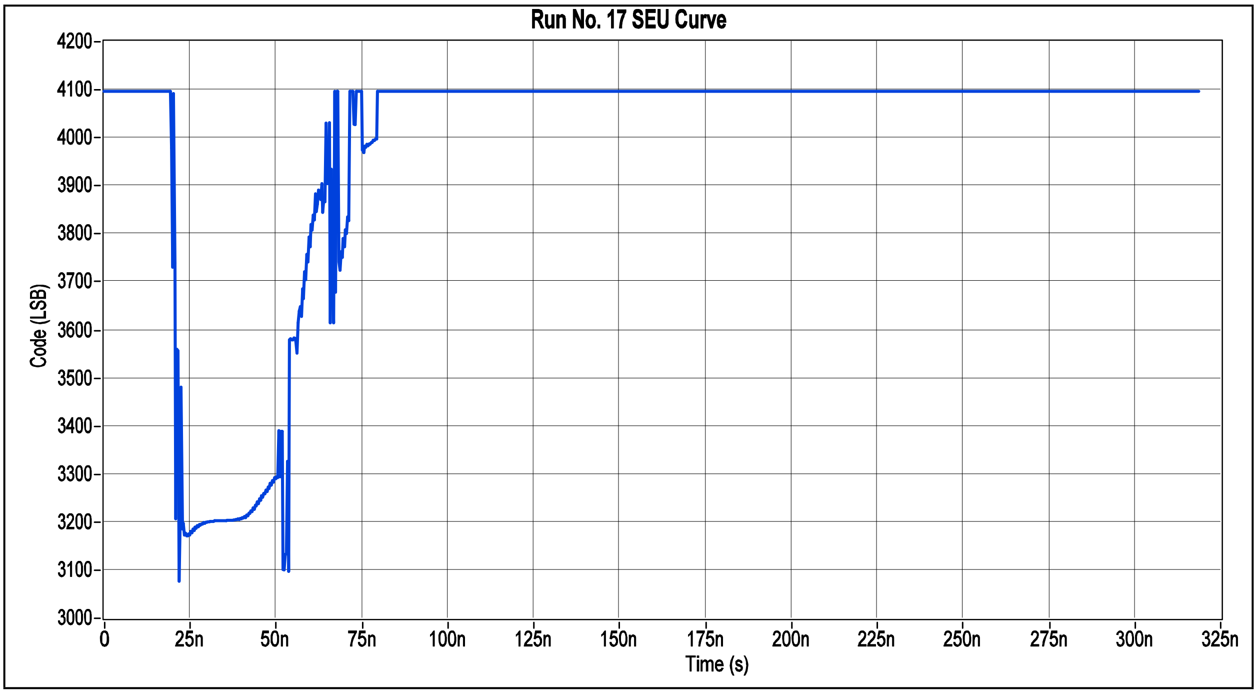


Figure 36: SEU worst curve in static high, Ion Au, Part S066, ADC core B, Run No. 17, amplitude of 900 LSB, duration of 60ns

SEU in static low configuration

All events observed in static low configuration for each run and their statistical distribution amplitude versus duration can be found in appendix D of this test report.

The worst case can be found in run 18 and 89.

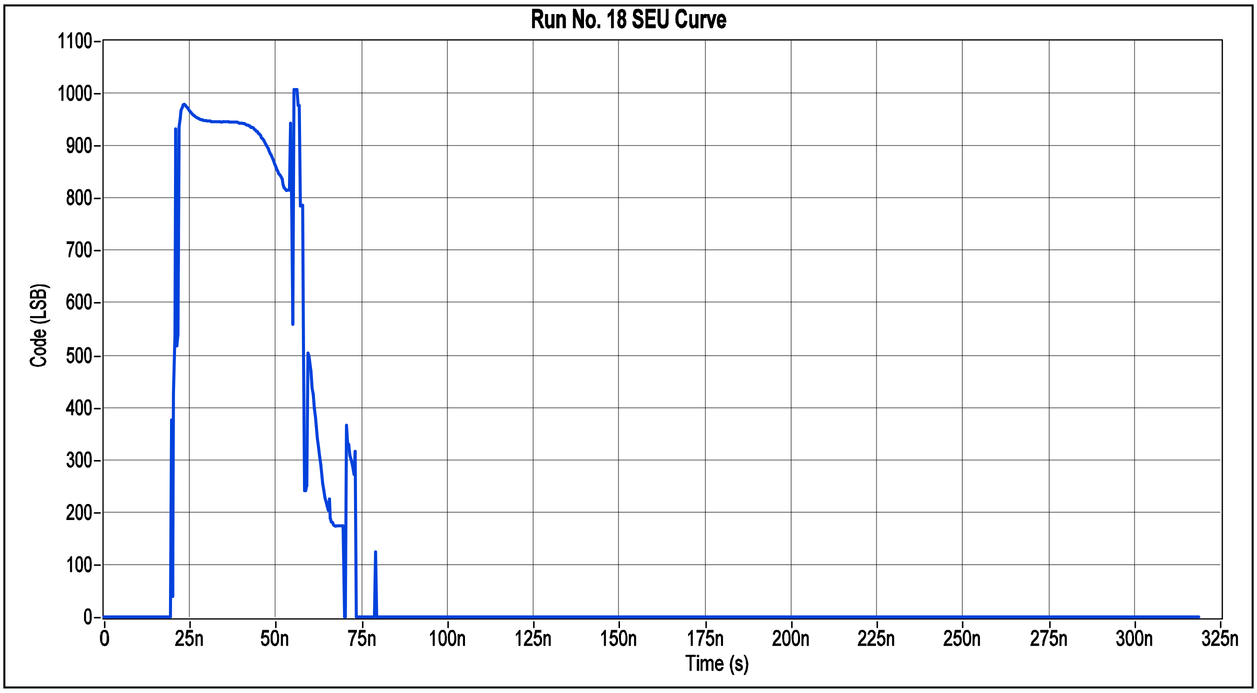


Figure 37: SEU worst curve in static low, Ion Au, Part S066, ADC core A, Run No. 17, amplitude of 1000 LSB, duration of 59ns

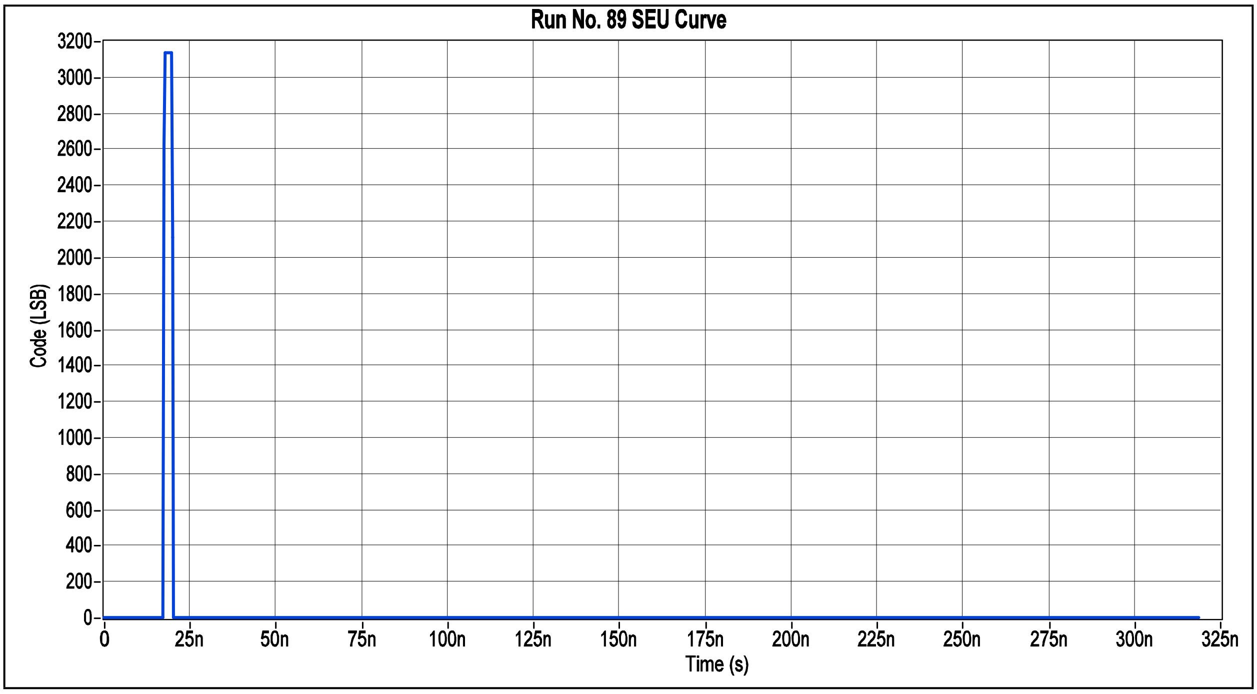


Figure 38: SEU worst curve in static low, Ion Au, Part S067, ADC core A, Run No. 89, amplitude of 3140 LSB, duration of 2.81ns

10.4 SEU Maximum duration

Configuration	Maximum Durations (ns)
Dynamic 1:2	60
Dynamic 1:1	61
Static Middle 1:2	278
Static Middle 1:1	300
Static Hight 1:2	60
Static Low 1:2	59

10.5 Weibull curve and rate calculation

Weibull curves were plotted by using OMERE 5.0.6.0 software. To perform SEE rate calculations GEO environment (alt. 35780 km) was taken into account:

- Galactic Cosmic Protons
  - Model: CREME 96 solar min
  - Elements: H to H
- Galactic Cosmic Heavy Ions
  - Model: CREME 96 solar min
  - Elements: He to U
- Solar Flare Protons
  - Model: CREME96 worst day
  - Elements: H to H
- Solar Flare Heavy Ions
  - Model: CREME96 worst day
  - Elements: He to U

All the SEE rate results presented here are calculated with OMERE 5.0.6.0 considering a sensitive volume thickness of 6 µm and an aluminium shielding of 3,705 mm (1 g/cm²). For SEU rates 24 sensitive cells were considered and for SET rates 1 sensitive cell was considered. As no proton test data are available, PROFIT method was used for proton contribution.

Results for SEE rates will be presented in the same way as Table 23. Heavy ion contributions and proton contributions will be separated, as well as *Under no-flare* and *Under flare* environments.
Rates provided during solar flares stand for a worst-case in extreme conditions. They are provided per day of flare and should not be considered for the whole mission.

	Error Rate **Under no-flare environment**	Error Rate **Under flare environment**
Heavy ion contribution	GCR Heavy Ions	GCR Heavy Ions + Solar Flare HI
Proton contribution	GCR Protons	GCR Protons + Solar Flare Protons
TOTAL Error Rate (/dev/day)	**GCR Heavy Ions + GCR Protons**	**GCR HI + Solar flare HI + GCR Protons + Solar Flare Protons**

Table 23 : Typical results for error rate calculations

10.5.1 SEU

10.5.1.1 Dynamic 1:1 - SEU

Figure 39 represents the SEU cross-section curve and Table 24 provides the used Weibull parameters.

LET_{th}	1 MeV.cm²/mg
σ_{sat}	9.6E-04 cm²/dev
W	27
S	0.9

Table 24 : Weibull Parameters – Dynamic 1:1 - SEU

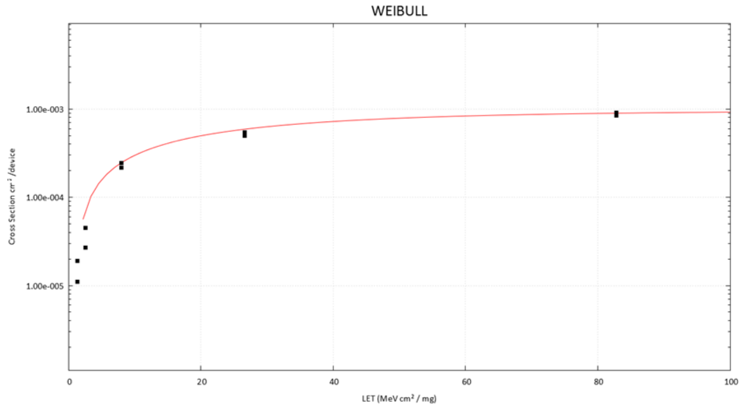


Figure 39: Dynamic 1:1 - SEU cross-section curve

	Error Rate **Under no-flare environment**	Error Rate **Under flare environment**
Heavy ion contribution	1.1E-02	4.4E+00
Proton contribution	9.4E-05	2.2E+00
TOTAL Error Rate (/dev/day)	1.1E-02	6.6E+00

Table 25 : Dynamic 1:1 - SEU Error Rate

10.5.1.2 Dynamic 1:2 - SEU

Figure 40 represents the SEU cross-section curve and Table 26 provides the used Weibull parameters.

LET_{th}	1 MeV.cm²/mg
σ_{sat}	9.6E-04 cm²/dev
W	26
S	0.9

Table 26 : Weibull Parameters – Dynamic 1:2 - SEU

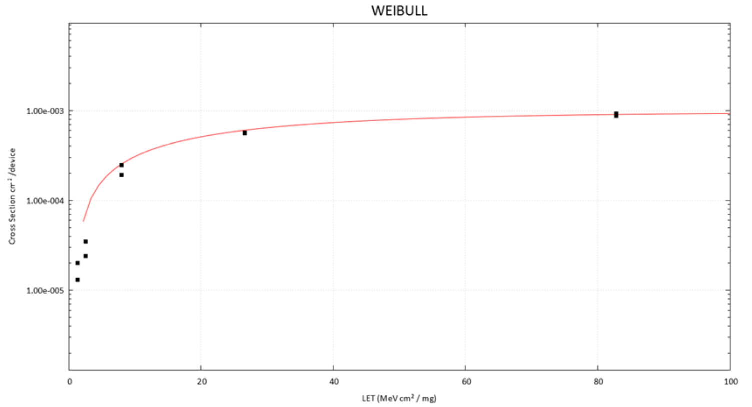


Figure 40: Dynamic 1:2 - SEU cross-section curve

	Error Rate **Under no-flare environment**	Error Rate **Under flare environment**
Heavy ion contribution	1.1E-02	4.5E+00
Proton contribution	9.6E-05	2.3E+00
TOTAL Error Rate (/dev/day)	1.1E-02	6.8E+00

Table 27 : Dynamic 1:2 - SEU Error Rate

10.5.1.3 Static middle 1:1 - SEU

Figure 41 represents the SEU cross-section curve and Table 28 provides the used Weibull parameters.

LET_{th}	0.1 MeV.cm²/mg
σ_{sat}	1.15E-03 cm²/dev
W	34
S	0.9

Table 28 : Weibull Parameters – Static middle 1:1 - SEU

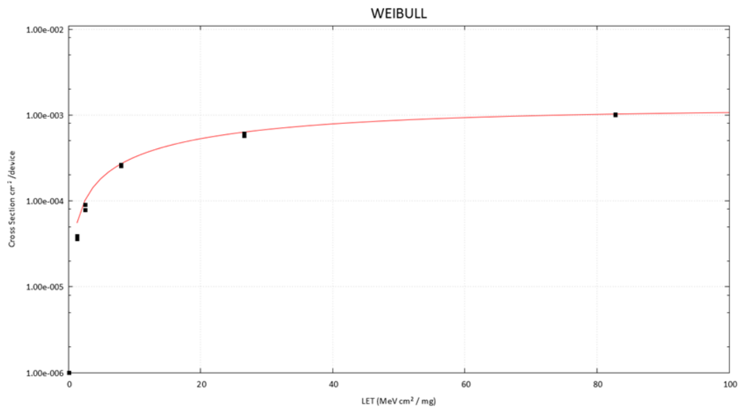


Figure 41: Static middle 1:1 - SEU cross-section curve

	Error Rate **Under no-flare environment**	Error Rate **Under flare environment**
Heavy ion contribution	2.7E-02	2.7E+01
Proton contribution	1.0E-04	2.6E+00
TOTAL Error Rate (/dev/day)	2.7E-02	2.9E+01

Table 29 : Static middle 1:1 - SEU Error Rate

10.5.1.4 Static middle 1:2 - SEU

Figure 42 represents the SEU cross-section curve and Table 30 provides the used Weibull parameters.

LET_{th}	0.1 MeV.cm²/mg
σ_{sat}	1.05E-03 cm²/dev
W	22
S	1

Table 30 : Weibull Parameters – Static middle 1:2 - SEU

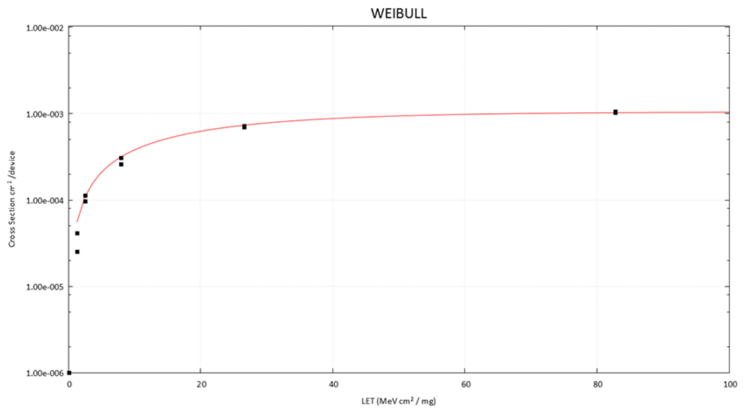


Figure 42: Static middle 1:2 - SEU cross-section curve

	Error Rate **Under no-flare environment**	Error Rate **Under flare environment**
Heavy ion contribution	2.8E-02	2.6E+01
Proton contribution	1.2E-04	3.0E+00
TOTAL Error Rate (/dev/day)	2.8E-02	2.9E+01

Table 31 : Static middle 1:2 - SEU Error Rate

10.5.1.5 Static high 1:2 - SEU

Figure 43 represents the SEU cross-section curve and Table 32 provides the used Weibull parameters.

LET_{th}	1 MeV.cm²/mg
σ_{sat}	5.2E-04 cm²/dev
W	32
S	1

Table 32 : Weibull Parameters – Static high 1:2 - SEU

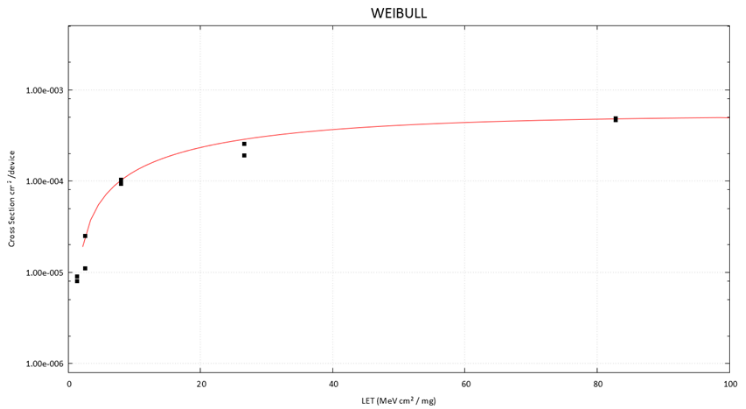


Figure 43: Static high 1:2 - SEU cross-section curve

	Error Rate **Under no-flare environment**	Error Rate **Under flare environment**
Heavy ion contribution	3.9E-03	1.4E+00
Proton contribution	4.1E-05	8.8E-01
TOTAL Error Rate (/dev/day)	3.9E-03	2.3E+00

Table 33 : Static high 1:1 - SEU Error Rate

10.5.1.6 Static low 1:2 - SEU

Figure 44 represents the SEU cross-section curve and Table 34 provides the used Weibull parameters.

LET_{th}	1 MeV.cm²/mg
σ_{sat}	5.6E-04 cm²/dev
W	28
S	1

Table 34 : Weibull Parameters – Static low 1:2 - SEU

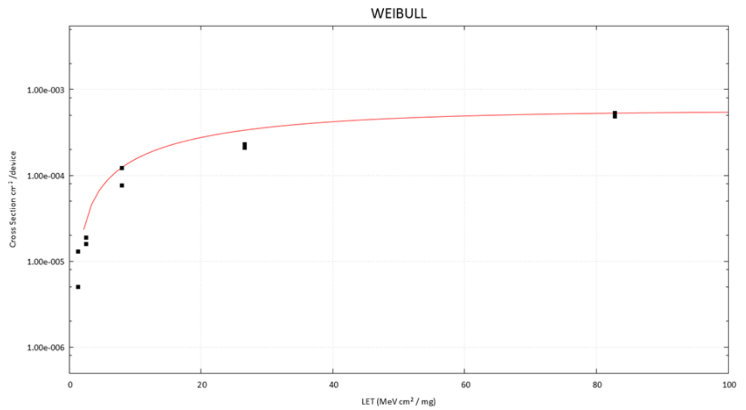


Figure 44: Static low 1:2 - SEU cross-section curve

	Error Rate **Under no-flare environment**	Error Rate **Under flare environment**
Heavy ion contribution	4.8E-03	1.8E+00
Proton contribution	5.0E-05	1.1E+00
TOTAL Error Rate (/dev/day)	4.8E-03	2.8E+00

Table 35 : Static low 1:1 - SEU Error Rate

1.1.1. SET

10.5.1.7 Dynamic 1:1 - SET

Figure 45 represents the SET cross-section curve and Table 36 provides the used Weibull parameters.

LET_{th}	1.3 MeV.cm²/mg
σ_{sat}	1.8E-04 cm²/dev
W	70
S	1.1

Table 36 : Weibull Parameters – Dynamic 1:1 - SET

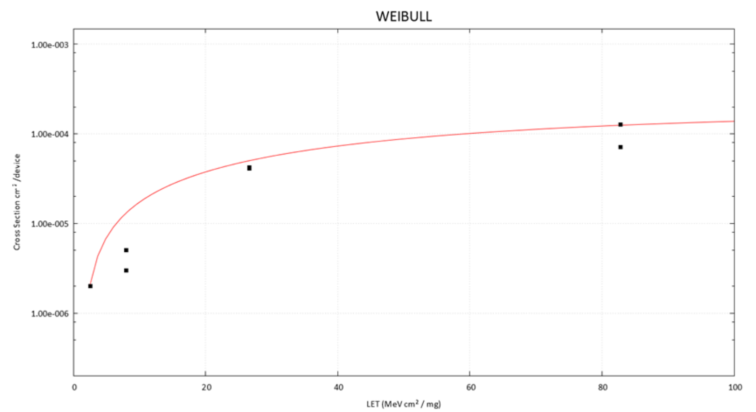


Figure 45: Dynamic 1:1 - SET cross-section curve

	Error Rate **Under no-flare environment**	Error Rate **Under flare environment**
Heavy ion contribution	4.6E-04	1.8E-01
Proton contribution	5.9E-06	1.1E-01
TOTAL Error Rate (/dev/day)	4.7E-04	2.9E-01

Table 37 : Dynamic 1:1 - SET Error Rate

10.5.1.8 Dynamic 1:2 - SET

Figure 46 represents the SET cross-section curve and Table 38 provides the used Weibull parameters.

LET_{th}	1.3 MeV.cm²/mg
σ_{sat}	1.3E-04 cm²/dev
W	42
S	1.4

Table 38 : Weibull Parameters – Dynamic 1:2 - SET

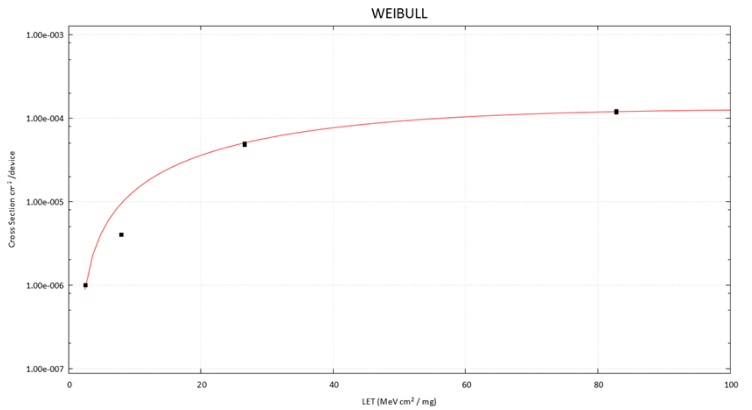


Figure 46: Dynamic 1:2 - SET cross-section curve

	Error Rate **Under no-flare environment**	Error Rate **Under flare environment**
Heavy ion contribution	3.1E-04	1.1E-01
Proton contribution	5.0E-06	7.6E-01
TOTAL Error Rate (/dev/day)	3.2E-04	1.8E-01

Table 39 : Dynamic 1:2 - SET Error Rate

10.5.1.9 Static middle 1:1 - SET

Figure 47 represents the SET cross-section curve and Table 40 provides the used Weibull parameters.

LET_{th}	1 MeV.cm²/mg
σ_{sat}	2.1E-04 cm²/dev
W	42
S	1.3

Table 40 : Weibull Parameters – Static middle 1:1 - SET

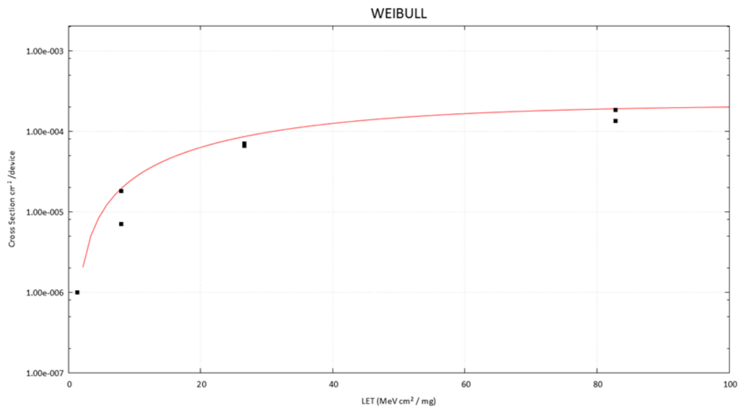


Figure 47: Static middle 1:1 - SET cross-section curve

	Error Rate **Under no-flare environment**	Error Rate **Under flare environment**
Heavy ion contribution	7.1E-04	2.9E-01
Proton contribution	9.4E-06	1.6E-01
TOTAL Error Rate (/dev/day)	7.2E-04	4.5E-01

Table 41 : Static middle 1:1 - SET Error Rate

10.5.1.10 Static middle 1:2 - SET

Figure 48 represents the SET cross-section curve and Table 42 provides the used Weibull parameters.

LET_{th}	1.3 MeV.cm²/mg
σ_{sat}	1.8E-04 cm²/dev
W	42
S	1.2

Table 42 : Weibull Parameters – Static middle 1:2 - SET

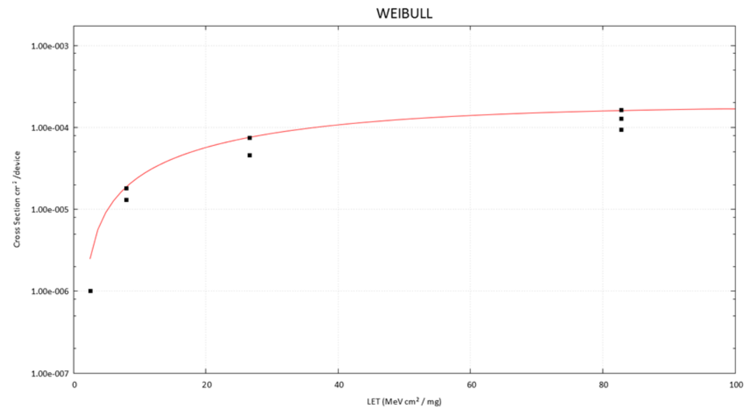


Figure 48: Static middle 1:2 - SET cross-section curve

	Error Rate **Under no-flare environment**	Error Rate **Under flare environment**
Heavy ion contribution	6.4E-04	2.5E-01
Proton contribution	8.8E-06	1.5E-01
TOTAL Error Rate (/dev/day)	6.4E-04	4.0E-01

Table 43 : Static middle 1:2 - SET Error Rate

10.5.1.11 Static high 1:2 - SET

Figure 49 represents the SET cross-section curve and Table 44 provides the used Weibull parameters.

LET_{th}	1 MeV.cm²/mg
σ_{sat}	1.5E-04 cm²/dev
W	42
S	1.1

Table 44 : Weibull Parameters – Static high 1:2 - SET

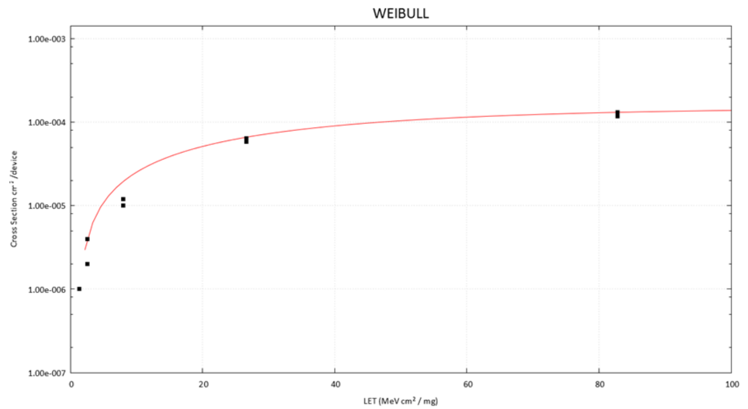


Figure 49: Static high 1:2 - SET cross-section curve

	Error Rate **Under no-flare environment**	Error Rate **Under flare environment**
Heavy ion contribution	7.6E-04	3.3E-01
Proton contribution	8.5E-06	1.6E-01
TOTAL Error Rate (/dev/day)	7.7E-04	4.9E-01

Table 45 : Static high 1:2 - SET Error Rate

10.5.1.12 Static low 1:2 - SET

Figure 50 represents the SET cross-section curve and Table 46 provides the used Weibull parameters.

LET_{th}	1 MeV.cm²/mg
σ_{sat}	2E-04 cm²/dev
W	55
S	1.3

Table 46 : Weibull Parameters – Static low 1:2 - SET

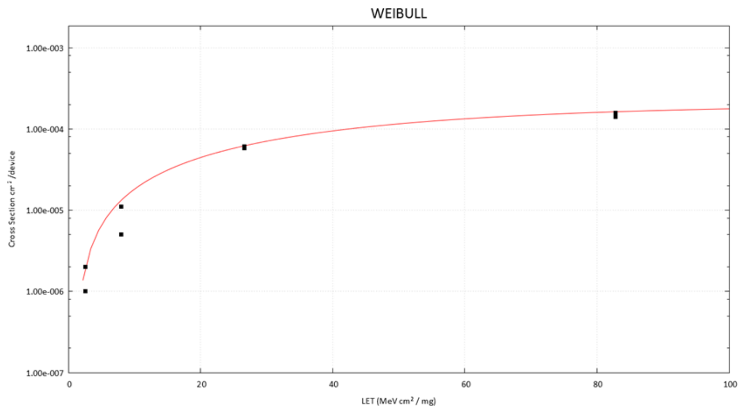


Figure 50: Static low 1:2 - SET cross-section curve

	Error Rate **Under no-flare environment**	Error Rate **Under flare environment**
Heavy ion contribution	4.9E-04	2.0E-01
Proton contribution	6.5E-06	1.1E-01
TOTAL Error Rate (/dev/day)	5.0E-04	3.0E-01

Table 47 : Static low 1:2 - SET Error Rate

10.5.2 Clock Tree Event

For Clock Tree, the saturation cross-section considered is close to the cross section at a LET of 26.6 MeV.cm^2/mg as not events were observed at higher LET. Sensitivity seems to be relatively small, so this approach may be considered as conservative.

10.5.2.1 Dynamic 1:1 – Clock Tree Event

Figure 51 represents the Clock Tree Event cross-section curve and Table 48 provides the used Weibull parameters.

LET_{th}	1.3 MeV.cm²/mg
σ_{sat}	8.9E-06 cm²/dev
W	10
S	0.8

Table 48 : Weibull Parameters – Dynamic 1:1 - CTE

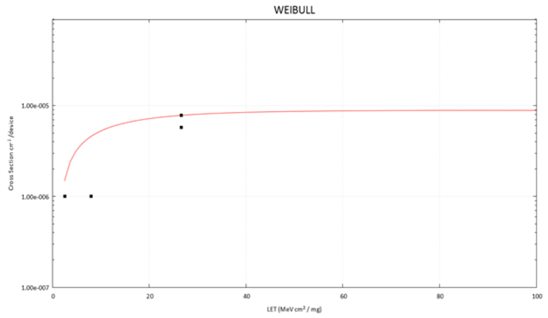


Figure 51: Dynamic 1:1 - CTE cross-section curve

	Error Rate **Under no-flare environment**	Error Rate **Under flare environment**
Heavy ion contribution	1.7E-04	5.3E-02
Proton contribution	1.6E-06	4.2E-02
TOTAL Error Rate (/dev/day)	1.7E-04	9.5E-02

Table 49 : Dynamic 1:1 - CTE Error Rate

10.5.2.2 Dynamic 1:2 – Clock Tree Event

Figure 52 represents the Clock Tree Event cross-section curve and Table 50 provides the used Weibull parameters.

LET_{th}	1.3 MeV.cm²/mg
σ_{sat}	6.3E-06 cm²/dev
W	10
S	0.8

Table 50 : Weibull Parameters – Dynamic 1:2 - CTE

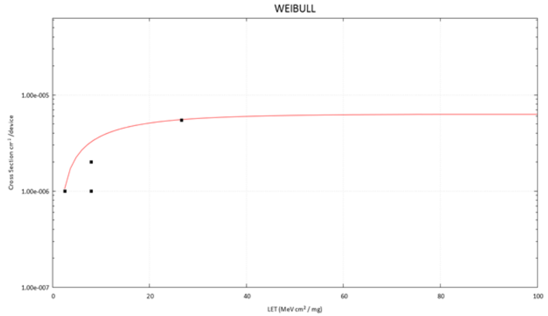


Figure 52: Dynamic 1:2 - CTE cross-section curve

	Error Rate **Under no-flare environment**	Error Rate **Under flare environment**
Heavy ion contribution	1.2E-04	3.5E-02
Proton contribution	1.1E-06	3.0E-02
TOTAL Error Rate (/dev/day)	1.2E-04	6.4E-02

Table 51 : Dynamic 1:2 - CTE Error Rate

11. HEAVY IONS CONCLUSION

The main objective of this test was to evaluate the sensitivity of the EV12AD550B, an Analog to Digital Converter, to Single Event Latch up (SEL) and Single Event Effects (SEU, SEFI, SET).
The irradiation was performed at TAMU with a maximum LET at 82.8 MeV.cm²/mg.

The EV12AD550B SEE shows similar results with the EV12AD550A.

No SEL on VCCD was detected with a LET of 82.8 MeV.cm²/mg.
No SEL on VCCA was detected with a LET of 82.8 MeV.cm²/mg.
No SEL on VCCIO was detected with a LET of 82.8 MeV.cm²/mg.

In dynamic configuration and demux 1:1 mode
SEU were observed during the irradiation up to the Nitrogen Heavy Ion (LET= 1.3 MeV.cm²/mg).
SET were observed during the irradiation up to the Neon Heavy Ion (LET= 2.6 MeV.cm²/mg).
Clock Tree Event were observed during the irradiation up to the Neon Heavy Ion (LET= 2.6 MeV.cm²/mg).
No SEFI was detected with a LET of 82.8 MeV.cm²/mg.

In dynamic configuration and demux 1:2 mode
SEU were observed during the irradiation up to the Nitrogen Heavy Ion (LET= 1.3 MeV.cm²/mg).
SET were observed during the irradiation up to the Neon Heavy Ion (LET= 2.6 MeV.cm²/mg).
Clock Tree Event were observed during the irradiation up to the Neon Heavy Ion (LET= 2.6 MeV.cm²/mg).
No SEFI was detected with a LET of 82.8 MeV.cm²/mg.

In static middle configuration and demux 1:1 mode
SEU were observed during the irradiation up to the Helium Heavy Ion (LET= 0.11 MeV.cm²/mg).
SET were observed during the irradiation up to the Nitrogen Heavy Ion (LET= 1.3 MeV.cm²/mg).
No SEFI was detected with a LET of 82.8 MeV.cm²/mg.

In static middle configuration and demux 1:2 mode
SEU were observed during the irradiation up to the Helium Heavy Ion (LET= 0.11 MeV.cm²/mg).
SET were observed during the irradiation up to the Neon Heavy Ion (LET= 2.6 MeV.cm²/mg).
No SEFI was detected with a LET of 82.8 MeV.cm²/mg.

In static high configuration and demux 1:1 mode
SEU were observed during the irradiation up to the Nitrogen Heavy Ion (LET= 1.3 MeV.cm²/mg).
SET were observed during the irradiation up to the Nitrogen Heavy Ion (LET= 1.3 MeV.cm²/mg).
No SEFI was detected with a LET of 82.8 MeV.cm²/mg.

In static low configuration and demux 1:1 mode
SEU were observed during the irradiation up to the Nitrogen Heavy Ion (LET= 1.3 MeV.cm²/mg).
SET were observed during the irradiation up to the Neon Heavy Ion (LET= 2.6 MeV.cm²/mg).
No SEFI was detected with a LET of 82.8 MeV.cm²/mg.

The EV12AD550B is SEL & SEFI free up to a LET of 82.8 MeV.cm²/mg.