IRRADIATION TEST REPORT: 1228TR10

Total Induced Dose Characterization of Power MOSFETs **BUY15CS23K**

Dr. Martin Göllner	IFAG PMM RFS D HIR	
Dr. Bernd Eisener	IFAG PMM RFS D HIR	

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1. SCOPE

This Test Report describes Total Induced Dose (TID) tests and results of radiation-hardened power MOSFETs from Infineon Technologies, types BUY15CS23K, in accordance to ESCC Basic Spec 22900.

Tests have been performed at the facilities Gammacell 1 and Gammacell 2 of Helmholtz-Center, Department of Radiation Sciences, Munich-Neuherberg, Germany, week 48, 2015.

2 IRRADIATION FACILITIES

The Co60 Source "GAMMACELL 2" is a facility at the Helmholtz-Centre, Department of Radiation Sciences, Munich-Neuherberg, Germany.

Dose rate varies by +/-15 % within the irradiation chamber. However, sample placement is such that position-dependent dose rate variation is from 95 % to 100 %, therefore, stays within +/-5 % of nominal (fig. 4)

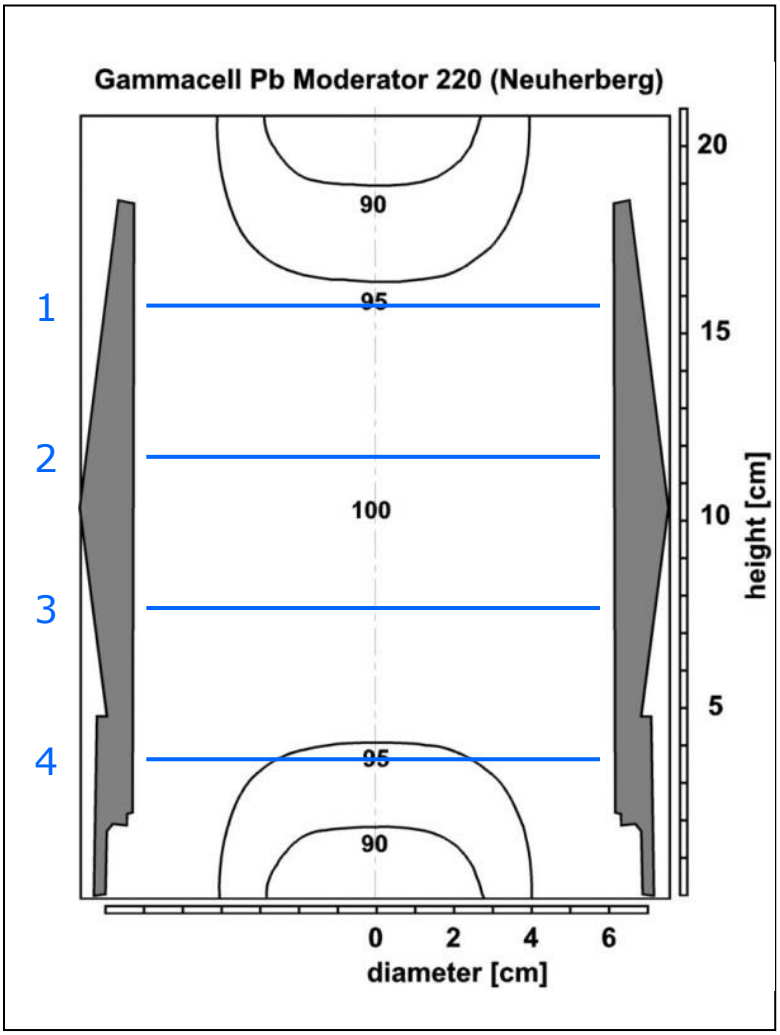

Fig. 1: Gamma intensity within Co60 irradiation chamber. Samples are positioned in levels 1-4 at defined locations.

3 EXPERIMENTAL DETAILS

3.1 Sample Placement and Sample Size

Tab. 1 shows the individual placement of the devices. Refer to fig. 4 for details of radiation exposure in Positions 1-8. The dies are mounted on a PCB.

3.2 Irradiation Conditions

Dose rate: 280 Gy/h (Nov 2015, see note 1)

TID: >1000 Gy on all parts (see note 2)

Bias: C1: UGS= +20 V; UDS = 0 V

C2: UGS= - 20 V; UDS = 0 V

C3: UGS= 0 V; UDS = +150 V

Notes:

1. Dose rate performance of the source is updated monthly and recorded in the test report.
2. Position-dependence of dose rate is accounted for to achieve target dose on all parts.

3.3 Pre- and Post-Irradiation Tests

The following parameters will be measured for test sample type BUY15CS23K:

- IDSS(120 V),
- IGSS(+/-20 V),
- RDSON(15 A, Ugs=10 V),
- VSD(23 A),
- Vgs(th)(1 mA),
- BVDSS (0.25 mA).

4. RADIATION EXPOSURE AND TEST SEQUENCE

Irradiation- anneal- and characterization steps according to the *FLOW CHART FOR QUALIFICATION TESTING* of Basic Specifications ESCC22900.

1. Sample serialization
2. Electrical pre-test according to ***3.3***.
3. Irradiation with a dose rate of 280 Gy/h for a dose of >1000Gy, in one irradiation step,
4. Transport of samples, cooled to -23°C from irradiation site to electrical characterization site.
5. Parameter measurements according to ***3.3.***
6. Room temperature anneal for 24 hours under same bias conditions as during TID, followed by parameter measurements according to ***3.3***.
7. Accelerated aging under same bias conditions as during TID: 168 hours at 100°C.
8. Electrical post-rad/post anneal test, according to ***3.3***

5. TEST RESULTS

In the following, each of the electrically parameters listed in 3.3 is plotted for four points of the testing sequence (see Fig.2), i.e.

1. Prior to irradiation (pre-rad)
2. Post-irradiation (post-rad 1000Gy)
3. Posterior to room-temperature anneal of 24 hours under same bias conditions as during TID (anneal 24h)
4. Posterior to 168 hours of anneal at 100°C under same bias conditions as during TID (anneal 168h)

Due to the introduction of a new test setup, no unirradiated control (reference) were available to be measured. However, as all devices passed and behave as expected, no comparison to reference devices is necessary to confirm TID hardness.

Three groups of graphs are given coded by line-color (see Table 1):

1. C1: UGS= +20 V; UDS = 0 V (black)
2. C2: UGS= - 20 V; UDS = 0 V (green)
3. C3: UGS= 0 V; UDS = +150 V (red)

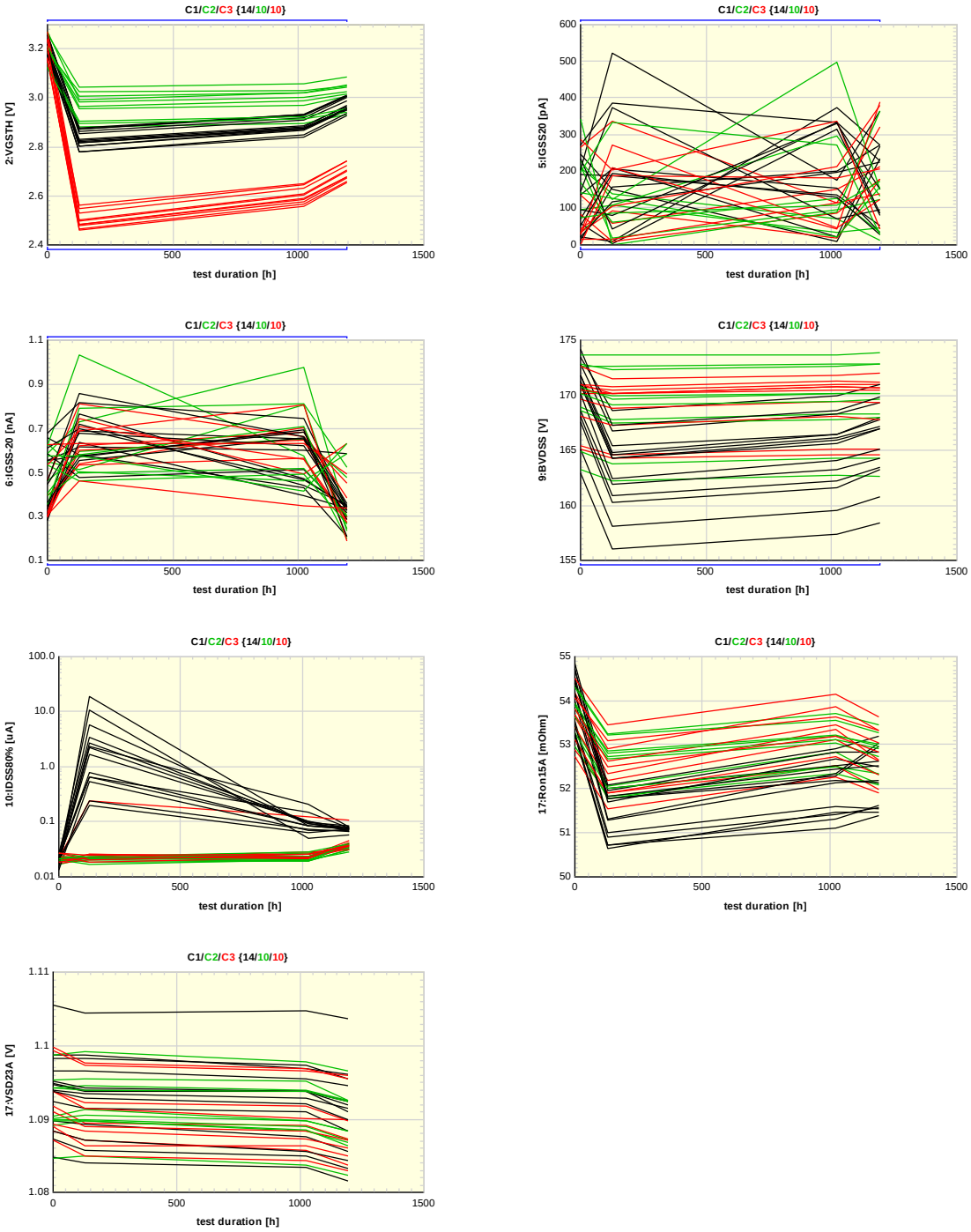

Fig. 2: Plot of TID test results for BUY15CS23K

6. SUMMARY

SN	FE Wafer Lot	Wafer	Bias Condition	VGS	VDS	Level	Intensitiy [%]	Result
1544AJ#103	VE540534	03	C1	+20	0	2	95-100	pass
1544AJ#104	VE540534	03	C2	-20	0	3	95-100	pass
1544AJ#105	VE540534	03	C3	0	150	1	95-100	pass
1544AJ#106	VE540534	03	C1	+20	0	2	95-100	pass
1544AJ#107	VE540534	03	C2	-20	0	3	95-100	pass
1544AJ#108	VE540534	03	C3	0	150	1	95-100	pass
1544AJ#151	VE532625	03	C1	+20	0	2	95-100	pass
1544AJ#152	VE532625	03	C1	+20	0	2	95-100	pass
1544AJ#153	VE532625	03	C2	-20	0	3	95-100	pass
1544AJ#154	VE532625	03	C3	0	150	1	95-100	pass
1544AJ#155	VE532625	03	C1	+20	0	2	95-100	pass
1544AJ#156	VE532625	03	C1	+20	0	2	95-100	pass
1544AJ#157	VE532625	03	C2	-20	0	3	95-100	pass
1544AJ#158	VE532625	03	C3	0	150	1	95-100	pass
1544AJ#159	VE532625	08	C1	+20	0	2	95-100	pass
1544AJ#160	VE532625	08	C1	+20	0	2	95-100	pass
1544AJ#161	VE532625	08	C2	-20	0	3	95-100	pass
1544AJ#162	VE532625	08	C3	0	150	1	95-100	pass
1544AJ#163	VE532625	08	C1	+20	0	2	95-100	pass
1544AJ#164	VE532625	08	C1	+20	0	2	95-100	pass
1544AJ#165	VE532625	08	C2	-20	0	3	95-100	pass
1544AJ#166	VE532625	08	C3	0	150	1	95-100	pass
1544AJ#167	VE532625	11	C1	+20	0	3	95-100	pass
1544AJ#168	VE532625	11	C2	-20	0	3	95-100	pass
1544AJ#169	VE532625	11	C3	0	150	1	95-100	pass
1544AJ#170	VE532625	11	C1	+20	0	3	95-100	pass
1544AJ#171	VE532625	11	C2	-20	0	3	95-100	pass
1544AJ#172	VE532625	11	C3	0	150	1	95-100	pass
1544AJ#173	VE532625	13	C1	+20	0	3	95-100	pass
1544AJ#174	VE532625	13	C2	-20	0	3	95-100	pass
1544AJ#175	VE532625	13	C3	0	150	1	95-100	pass
1544AJ#176	VE532625	13	C1	+20	0	3	95-100	pass
1544AJ#177	VE532625	13	C2	-20	0	3	95-100	pass
1544AJ#178	VE532625	13	C3	0	150	1	95-100	pass

Table 1: List of irradiated Devices