§1 COVER SHEET

- **Component and Test Identification**

Comp. Type		BUY25CS12J-01(ES)
ESCC Comp. No.		520502601R
Lot Ident.	Wafer Lot No.	VE617411
	Assembly Lot	n.a.
	ESA Date Code	n.a.
	Radiation Testing Level	R: 100kRad
Test data	Test Plan	TPIFX1827B
	Tested Sample Serial No.s	241-258
	Control Sample Serial No.s	R25-R29

- **Applicable Documents**

Detail Specification	ESCC 5205/026 Issue 2, Apr 2014
Generic Specification	ESCC 5000 Issue 10, Feb. 2021
Process Identification Document	A63500-L5491-P000_Detail_PID_BUY25CS_9
Irradiation Specification	ESCC Basic Specification No. 22900 Iss. 5, June 2016

- **Manufacturer / Facility**

Silicon Die	Infineon Technologies Austria AG Siemensstrasse 2, 9500 Villach, Austria
Assembly & Testing	Infineon Technologies AG Am Campeon 1-15, D 85579 Neubiberg, Germany

- **Report Issue, Date / Manufacturers Signatures**

Iss. 1, Aug 2021 Total Number of Pages: 10 plus Appendix

Process	Department	Name	Signatures
Chip Assembly	PSS RFS D HIR	M. Hildebrandt	
Test Management	PSS RFS D HIR	D. Schwertberger	
Project Management	PSS RFS D HIR	Dr. T. Chirila	
HiRel Management	PSS RFS D HIR	Dr. B. Eisener	

§2 DOCUMENT INFORMATION

§2.1 CHANGE DESCRIPTION SHEET

Issue	Page	Para	Description
1	All	All	Initial Issue

§2.2 TABLE OF CONTENTS

§3 SCOPE AND TEST INFORMATION

This Test Report describes Total Dose Steady-State Irradiation (TID) tests and results of radiation-hardened power MOSFETs from Infineon Technologies, types BUY25CS12J-01(ES), in accordance to Chart F2 - Production Control Para. 5.2.5 in ESCC Generic Specification 5000.

This report contains the Total Dose Steady-State Irradiation Test results of wafer lot VE617411 for type BUY25CS12J-01(ES) (ESCC detail specification No. 5205/026).

Test campaign TID 56 has been performed at the facility JS-9000 in Germany on the 7.4.2021.

The read and record data from the electrical measurements of the tested and control samples is given in §7.2 of this report.

§4 IRRADIATION FACILITY – JS-9000

The JS-9000 irradiator is a pallet facility designed to irradiate large volumes of palletized products. The irradiation source is Co60.

For irradiations in this facility the samples are placed in an aluminium-lead container as recommended in ESCC 22900 §4.1.2. The irradiation field in the container has been determined by means of dose mapping. Dose rate across the field where the samples are placed varies from 97% to 102.6% which is in the +/-10% allowed window.

Total Dose performance is measured during the test with alanine dosimeters and recorded in the test report. Irradiation takes place at room temperature.

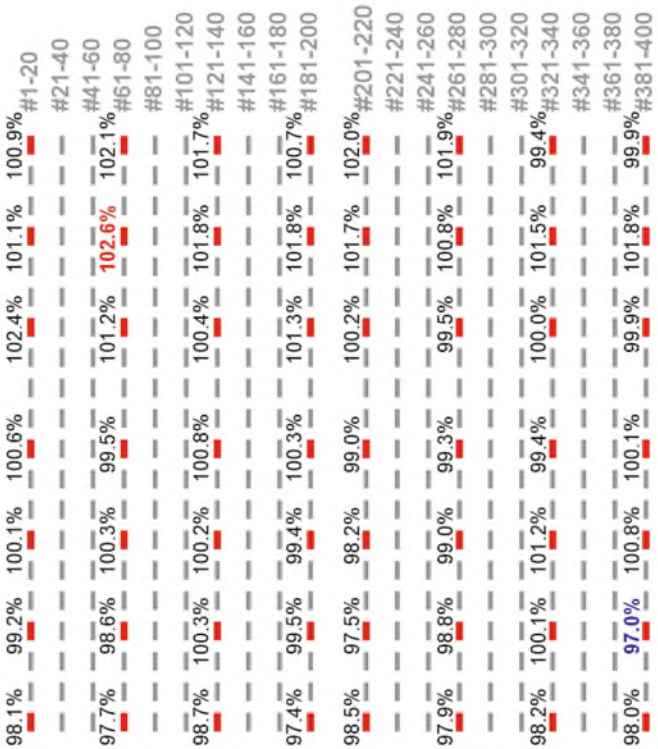


Fig. 1: Measured gamma intensity within the container at marked sample positions. Maximum and minimum measured intensities are marked – 102.6% and 97.0%.

§5 DEVICES MARKINGS AND SAMPLE PREPARATION

In order to contact devices with the test sockets on bias boards, chips have been soldered with AuZn solder material and bonded with 125µm Al wires to respective 3-pin PCB-TO-adapter boards to connect Gate/Drain/Source contacts of the MOSFETs.

Devices' numbers are written on the PCB with a permanent marker. The number correlates in the sample list to the lot and wafer number.

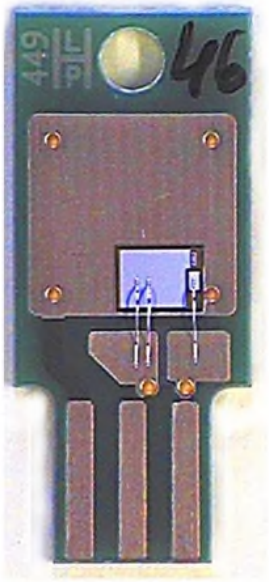


Fig. 2: Die mounted on PCB for TID testing – soldered and wire-bonded

§6 IRRADIATION CONDITIONS

The irradiation step had a duration of 4h 20 min at a dose rate of 42 krad/h which yields a total ionizing dose of 182 krad.

The tested devices were electrically biased according to the table below (remote test):

Electrical Bias Condition	Bias Circuit	Supply voltages		
		Gate	Drain	Source
C1	Fig. 3	+20 V	0 V	0 V
C2	Fig. 3	-20 V	0 V	0 V
C3	Fig. 3	0 V	250 V	0 V

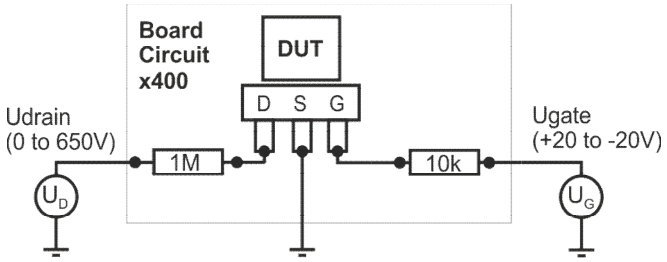


Fig. 3 Bias circuit for TID tests

§7 IRRADIATION TEST SEQUENCE

Irradiation- anneal- and electrical measurement steps follow the FLOW CHART FOR QUALIFICATION AND LOT ACCEPTANCE TESTING of Basic Specifications ESCC22900.

The test data is documented in an Infineon internal data package. It includes a summary listing total submitted and rejected numbers of components to the performed processes and tests.

The following table certifies which tests have been actually performed and certifies the availability of data.

TID Test Overview

Process / Test	Perfor-med	Data Avail.	Remarks / Notes
Serialisation	x	x	
Initial electrical measurements – pre-TID	x	x	Acc. Table 2, DC in ESCC Det. Spec.
Irradiation in one step	x	x	Conditions specified in §6
Parameter Drift Values – post-TID	x	x	Acc. §2.10.2 in ESCC Det. Spec.
Room temperature anneal for 24 hours	x	x	Same bias as during irradiation
Parameter Drift Values – 24h@RT	x	x	Acc. §2.10.2 in ESCC Det. Spec.
Accelerated aging: 168 hours at 100°C	x	x	Same bias as during irradiation
Parameter Drift Values – 168h@100°C	x	x	Acc. §2.10.2 in ESCC Det. Spec.
Check for Lot Failure	x	x	

§7.1 ATTRIBUTES RECORD OF MEASUREMENTS, TESTS AND INSPECTIONS

The following table gives the results of the total dose steady-state irradiation tests actually performed in terms of total quantity to test, rejected quantity in test, pass quantity in test.

Attributes Record of Measurements, Tests and Inspections Performed

Process / Test	to Test	Fail.	Pass	Data	Remarks / Notes, S/Ns of Failures and WDs
Initial Measurements	23	0	23	avail.	5 control samples included
Irradiation / Drift Value	23	0	23	avail.	5 control samples included
24h @ RT anneal / Drift Value	23	0	23	avail.	5 control samples included
168h @ 100°C / Drift Value	23	0	23	avail.	5 control samples included

Sample distribution within the bias conditions

Item	Qty	Part Notation in R&R Tables	
		Subgroup	Part SG S/Ns
BUY25CS12J-01(ES) silicon chips used for C1 condition	6	C1	#241,244,247,250 ,253,256
BUY25CS12J-01(ES) silicon chips used for C2 condition	6	C2	#242,245,248,251 ,254,257
BUY25CS12J-01(ES) silicon chips used for C3 condition	6	C3	#243,246,249,252 ,255,258
BUY25CS12J-01(ES) silicon chips used as control samples (not irradiated, not annealed)	5	control	#R25-R29

§7.2 READ AND RECORD DATA OF ELECTRICAL MEASUREMENTS

This documentation contains the data from all tested parts and control samples.

§7.2.1 INITIAL MEASUREMENTS (TABLE 2, DC)

S/N	V(BR)DSS [V]	VGS(th) [V]	IGSS [nA]	IGSS- [nA]	IDSS [uA]	RDS(ON) [mOhm]	VSD [V]	WaferLot/WaferNo.
min	250	2						
max		4	100	100	25	130	1.2	
241	290	3.24	0.5	0.9	0.002	120	0.958	VE617411 #11
242	290	3.25	0.5	0.9	0.002	120	0.958	VE617411 #11
243	291	3.24	0.6	0.9	0.002	121	0.956	VE617411 #11
244	291	3.21	0.5	0.8	0.002	121	0.952	VE617411 #11
245	292	3.21	0.5	0.9	0.002	121	0.952	VE617411 #11
246	292	3.23	0.6	0.8	0.002	122	0.955	VE617411 #11
247	297	3.20	0.5	0.9	0.002	129	0.957	VE617411 #13
248	296	3.20	0.6	0.9	0.002	129	0.958	VE617411 #13
249	297	3.19	0.5	0.8	0.002	129	0.955	VE617411 #13
250	292	3.22	0.6	0.9	0.002	123	0.954	VE617411 #13
251	292	3.22	0.5	0.8	0.002	123	0.956	VE617411 #13
252	292	3.25	0.6	0.9	0.002	123	0.957	VE617411 #13
253	293	3.10	0.5	0.8	0.002	121	0.956	VE617411 #39
254	293	3.11	0.6	0.9	0.002	120	0.954	VE617411 #39
255	293	3.12	0.6	0.9	0.002	121	0.954	VE617411 #39
256	294	3.17	0.6	0.9	0.002	122	0.956	VE617411 #39
257	294	3.18	0.5	0.8	0.002	122	0.956	VE617411 #39
258	294	3.18	0.6	0.9	0.002	122	0.953	VE617411 #39
R25	297	3.16	0.6	0.9	0.002	122	0.951	
R26	297	3.16	0.5	0.8	0.002	123	0.951	
R27	293	3.15	0.5	0.9	0.002	121	0.951	
R28	293	3.17	0.5	0.8	0.002	121	0.952	
R29	294	3.13	0.6	0.9	0.002	122	0.952	

§7.2.2 ELECTRICAL MEASUREMENTS AFTER IRRADIATION

	Drift Deltas post irradiation						Absolute Values post irradiation							Bias Cond.
S/N	$BV_{(DSS)}$ [%]	$VGS_{(th)}$ [%]	IGSS [nA]	IGSS- [nA]	$RDS_{(ON)}$ [%]	V_{SD} [%]	$BV_{(DSS)}$ [V]	$VGS_{(th)}$ [V]	IGSS [nA]	IGSS- [nA]	IDSS [uA]	$RDS_{(ON)}$ [mOhm]	V_{SD} [V]	
min	-20%	-50%	-20nA	-20nA	-20%	-10%	250	2						
max	+20%	+10%	+20nA	+20nA	+20%	+10%		4	100	100	25	130	1.2	
241	-0.1	-19.3	-0.0	0.1	-3.2	-0.2	290	2.62	0.5	1.0	1.534	116	0.956	C1
242	-0.0	-26.4	0.0	0.0	-1.2	-0.0	290	2.39	0.6	0.9	0.007	119	0.958	C2
243	-0.1	-26.6	-0.0	-0.1	-0.5	-0.4	291	2.38	0.5	0.8	0.009	120	0.952	C3
244	-0.1	-20.5	-0.0	0.1	-3.1	-0.2	291	2.55	0.5	0.9	2.371	117	0.950	C1
245	-0.1	-30.4	0.1	0.0	-1.2	0.0	291	2.23	0.6	0.9	0.007	120	0.953	C2
246	-0.1	-27.2	-0.0	0.1	-0.6	-0.4	292	2.35	0.6	0.9	0.009	121	0.951	C3
247	-0.0	-21.5	0.0	0.1	-3.2	-0.3	297	2.51	0.5	0.9	2.314	125	0.954	C1
248	-0.0	-25.1	-0.0	-0.0	-1.3	-0.1	296	2.40	0.6	0.9	0.007	128	0.957	C2
249	-0.1	-28.3	-0.1	-0.0	-0.6	-0.4	297	2.28	0.5	0.8	0.009	128	0.952	C3
250	-0.1	-20.5	-0.0	0.0	-3.2	-0.3	292	2.56	0.6	0.9	2.198	119	0.952	C1
251	-0.1	-28.1	0.0	0.1	-1.2	-0.0	292	2.32	0.5	0.9	0.007	122	0.956	C2
252	-0.1	-27.3	0.0	-0.0	-0.7	-0.4	292	2.36	0.6	0.8	0.009	122	0.953	C3
253	-0.1	-18.0	0.1	0.2	-3.3	-0.3	293	2.54	0.6	1.1	1.189	117	0.954	C1

	Drift Deltas post irradiation						Absolute Values post irradiation							Bias Cond.
S/N	$BV_{(DSS)}$ [%]	$VGS_{(th)}$ [%]	IGSS [nA]	IGSS- [nA]	$RDS_{(ON)}$ [%]	V_{SD} [%]	$BV_{(DSS)}$ [V]	$VGS_{(th)}$ [V]	IGSS [nA]	IGSS- [nA]	IDSS [uA]	$RDS_{(ON)}$ [mOhm]	V_{SD} [V]	
254	-0.1	-35.6	0.0	0.1	-1.3	0.0	293	2.00	0.6	1.0	0.008	119	0.954	C2
255	-0.1	-25.4	0.0	0.0	-0.7	-0.4	293	2.32	0.6	0.9	0.009	120	0.951	C3
256	-0.1	-18.1	0.0	0.2	-3.2	-0.2	293	2.60	0.6	1.0	0.747	118	0.954	C1
257	-0.1	-30.1	0.1	0.1	-1.4	0.0	294	2.22	0.6	1.0	0.007	120	0.956	C2
258	-0.1	-25.4	0.0	0.1	-0.5	-0.4	294	2.37	0.6	1.0	0.009	121	0.949	C3
R25	-0.0	0.3	-0.0	-0.0	-0.1	0.1	297	3.17	0.5	0.8	0.003	122	0.951	Control
R26	-0.0	0.3	0.0	0.0	0.2	-0.0	297	3.17	0.5	0.8	0.003	123	0.951	Control
R27	0.1	0.1	0.0	-0.1	0.4	-0.1	294	3.16	0.6	0.8	0.003	121	0.950	Control
R28	-0.0	0.4	0.0	0.0	-0.0	0.0	293	3.18	0.5	0.9	0.003	121	0.952	Control
R29	-0.0	0.4	-0.0	-0.0	-0.1	-0.2	294	3.14	0.6	0.9	0.003	122	0.951	Control

§7.2.3 ELECTRICAL MEASUREMENTS AFTER 24 HOURS ANNEAL AT ROOM TEMPERATURE

	Drift Deltas post 24h anneal at RT						Absolute Values post 24h anneal at RT							Bias Cond.
S/N	$BV_{(DSS)}$ [%]	$VGS_{(th)}$ [%]	IGSS [nA]	IGSS- [nA]	$RDS_{(ON)}$ [%]	V_{SD} [%]	$BV_{(DSS)}$ [V]	$VGS_{(th)}$ [V]	IGSS [nA]	IGSS- [nA]	IDSS [uA]	$RDS_{(ON)}$ [mOhm]	V_{SD} [V]	
min	-20%	-50%	-20nA	-20nA	-20%	-10%	250	2						
max	+20%	+10%	+20nA	+20nA	+20%	+10%		4	100	100	25	130	1.2	
241	-0.0	-15.2	0.0	0.0	-2.8	-0.2	290	2.75	0.6	0.9	0.080	117	0.957	C1
242	-0.0	-24.0	0.1	-0.1	-1.0	-0.0	290	2.47	0.6	0.8	0.006	119	0.958	C2
243	-0.0	-22.8	-0.1	-0.1	-0.4	-0.3	291	2.50	0.5	0.8	0.008	120	0.953	C3
244	-0.0	-16.2	-0.0	0.0	-2.7	-0.1	291	2.69	0.5	0.9	0.116	118	0.951	C1
245	-0.0	-27.6	0.1	-0.0	-1.1	-0.0	292	2.32	0.6	0.9	0.007	120	0.952	C2
246	-0.0	-23.6	0.1	0.0	-0.5	-0.3	292	2.47	0.6	0.9	0.008	122	0.952	C3
247	0.0	-17.1	0.0	0.1	-2.7	-0.2	297	2.65	0.5	0.9	0.141	126	0.955	C1
248	-0.0	-22.6	-0.0	-0.0	-1.3	-0.0	296	2.48	0.6	0.9	0.007	128	0.958	C2
249	-0.0	-24.3	0.1	-0.0	-0.5	-0.3	297	2.41	0.6	0.8	0.008	128	0.952	C3
250	-0.0	-16.2	-0.0	0.0	-2.7	-0.2	292	2.70	0.5	0.9	0.108	119	0.952	C1
251	-0.0	-25.5	0.0	0.0	-1.1	0.0	292	2.40	0.5	0.8	0.007	122	0.957	C2
252	-0.0	-23.7	-0.0	0.0	-0.5	-0.4	292	2.48	0.5	0.9	0.008	123	0.953	C3
253	-0.0	-14.0	-0.0	0.1	-2.7	-0.3	293	2.66	0.5	0.9	0.076	117	0.954	C1
254	-0.0	-32.7	0.0	0.1	-1.2	0.0	293	2.10	0.6	0.9	0.007	119	0.954	C2
255	-0.0	-21.7	-0.0	-0.0	-0.4	-0.4	293	2.44	0.6	0.9	0.008	121	0.951	C3
256	-0.1	-14.1	0.0	0.1	-2.7	-0.2	293	2.72	0.6	0.9	0.059	118	0.954	C1
257	-0.0	-27.6	0.1	0.1	-1.1	-0.0	294	2.30	0.6	0.9	0.007	120	0.956	C2
258	-0.0	-21.9	0.1	0.1	-0.4	-0.3	294	2.48	0.6	0.9	0.008	122	0.950	C3
R25	-0.0	0.3	0.0	-0.0	-0.3	0.1	297	3.17	0.6	0.9	0.002	122	0.951	Control
R26	0.1	0.2	0.1	0.1	0.5	-0.1	297	3.17	0.6	0.9	0.004	124	0.950	Control
R27	-0.1	0.3	0.0	-0.0	-0.3	0.0	293	3.17	0.6	0.9	0.002	121	0.951	Control
R28	-0.0	0.4	-0.0	0.0	-0.1	0.1	292	3.18	0.5	0.8	0.002	121	0.952	Control
R29	-0.0	0.4	-0.1	-0.1	-0.2	-0.2	294	3.14	0.5	0.8	0.002	122	0.951	Control

§7.2.4 ELECTRICAL MEASUREMENTS AFTER 168 HOURS ANNEAL AT 100°C

	Drift Deltas post 168h anneal at 100°C						Absolute Values post 168h anneal at 100°C							Bias Cond.
S/N	$BV_{(DSS)}$ [%]	$VGS_{(th)}$ [%]	IGSS [nA]	IGSS- [nA]	$RDS_{(ON)}$ [%]	V_{SD} [%]	$BV_{(DSS)}$ [V]	$VGS_{(th)}$ [V]	IGSS [nA]	IGSS- [nA]	IDSS [uA]	$RDS_{(ON)}$ [mOhm]	V_{SD} [V]	
min	-20%	-50%	-20nA	-20nA	-20%	-10%	250	2						
max	+20%	+10%	+20nA	+20nA	+20%	+10%		4	100	100	25	130	1.2	
241	-0.0	-11.3	0.0	-0.1	-2.8	-0.3	290	2.88	0.6	0.8	0.035	117	0.956	C1
242	-0.1	-19.7	0.0	-0.1	-2.0	-0.2	290	2.61	0.6	0.8	0.005	118	0.957	C2

	Drift Deltas post 168h anneal at 100°C						Absolute Values post 168h anneal at 100°C							Bias Cond.
S/N	$BV_{(DSS)}$ [%]	$VGS_{(th)}$ [%]	IGSS [nA]	IGSS- [nA]	$RDS_{(ON)}$ [%]	V_{SD} [%]	$BV_{(DSS)}$ [V]	$VGS_{(th)}$ [V]	IGSS [nA]	IGSS- [nA]	IDSS [uA]	$RDS_{(ON)}$ [mOhm]	V_{SD} [V]	
243	-0.1	-19.4	-0.0	-0.1	-1.5	-0.4	291	2.62	0.6	0.8	0.005	119	0.952	C3
244	-0.0	-11.9	0.0	-0.0	-3.1	-0.2	291	2.83	0.5	0.8	0.036	118	0.950	C1
245	-0.1	-22.7	0.1	-0.0	-1.8	-0.1	291	2.48	0.5	0.8	0.005	119	0.951	C2
246	-0.1	-20.0	0.0	-0.0	-1.8	-0.5	292	2.59	0.6	0.8	0.005	120	0.950	C3
247	-0.0	-12.8	0.0	0.0	-2.7	-0.3	297	2.79	0.6	0.9	0.037	126	0.954	C1
248	-0.0	-18.7	-0.0	-0.1	-2.0	-0.1	296	2.60	0.6	0.8	0.005	127	0.956	C2
249	-0.1	-20.7	-0.0	0.0	-1.6	-0.4	297	2.53	0.5	0.9	0.005	127	0.951	C3
250	-0.0	-11.9	0.0	0.0	-2.9	-0.3	292	2.84	0.6	0.9	0.036	119	0.951	C1
251	-0.0	-21.1	0.1	0.1	-1.9	-0.1	292	2.54	0.6	0.9	0.005	121	0.955	C2
252	-0.1	-20.0	0.1	-0.0	-1.5	-0.4	292	2.60	0.6	0.8	0.005	122	0.953	C3
253	-0.0	-10.1	0.1	-0.0	-2.9	-0.3	293	2.78	0.6	0.8	0.036	117	0.954	C1
254	-0.0	-26.9	-0.0	0.0	-1.8	-0.1	293	2.27	0.6	0.9	0.005	118	0.953	C2
255	-0.1	-18.2	-0.0	-0.1	-1.5	-0.4	293	2.55	0.6	0.8	0.005	119	0.951	C3
256	-0.0	-10.2	0.0	0.0	-2.7	-0.2	293	2.85	0.6	0.9	0.035	118	0.954	C1
257	-0.0	-23.1	0.0	-0.0	-1.8	-0.1	294	2.45	0.6	0.8	0.005	119	0.954	C2
258	-0.0	-18.4	0.0	0.0	-1.5	-0.4	294	2.59	0.6	0.9	0.005	120	0.949	C3
R25	-0.2	0.5	-0.2	-0.5	-0.9	0.2	297	3.17	0.4	0.4	0.002	121	0.952	Control
R26	-0.1	0.6	0.0	0.0	-0.7	0.1	297	3.18	0.5	0.8	0.003	122	0.952	Control
R27	-0.1	0.5	-0.0	-0.1	-0.8	0.1	293	3.17	0.5	0.8	0.003	120	0.952	Control
R28	-0.1	0.6	-0.0	0.0	-0.6	0.1	292	3.18	0.5	0.8	0.003	120	0.953	Control
R29	-0.1	0.5	-0.1	-0.0	-0.8	-0.1	294	3.14	0.5	0.9	0.002	121	0.952	Control

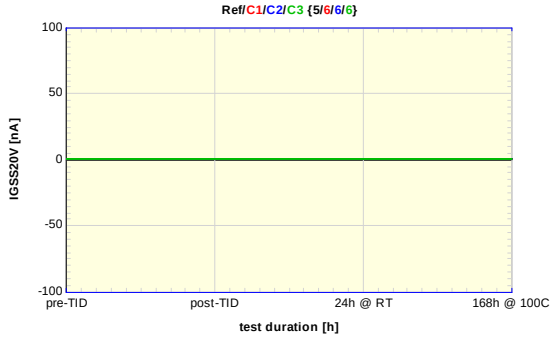
§7.3 GRAPHICAL REPRESENTATION OF ELECTRICAL MEASUREMENTS

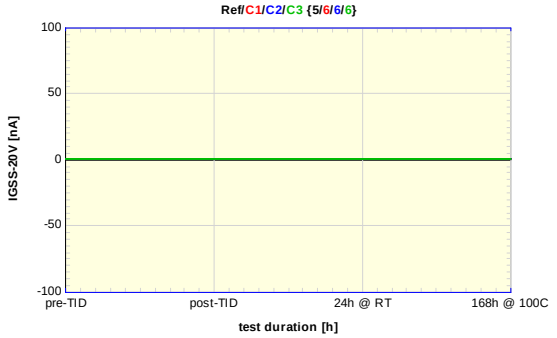
In the following, the electrical parameters listed in §7.2 are plotted for four points of the testing sequence, i.e.

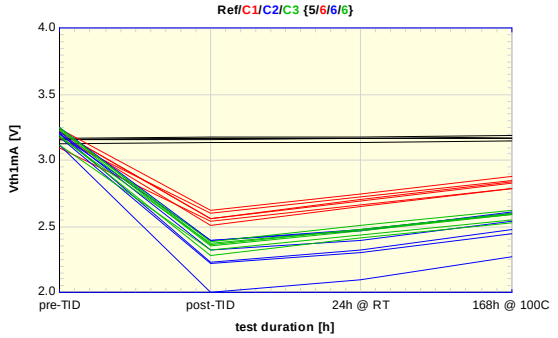
1. Prior to irradiation (pre-TID),
2. Post-irradiation (post-TID),
3. Posterior to room-temperature anneal of 24 hours (24h@RT),
4. Posterior to 168 hours of anneal at 100°C (168h@100°C) .

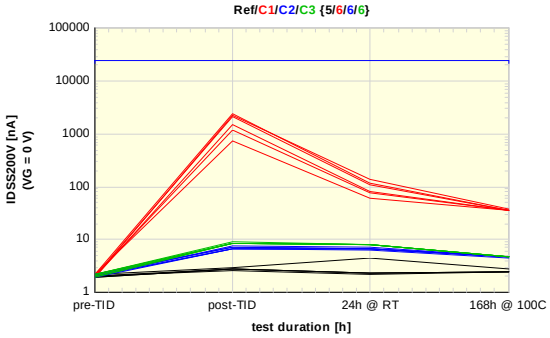
Four groups of samples are given coded by line-color:

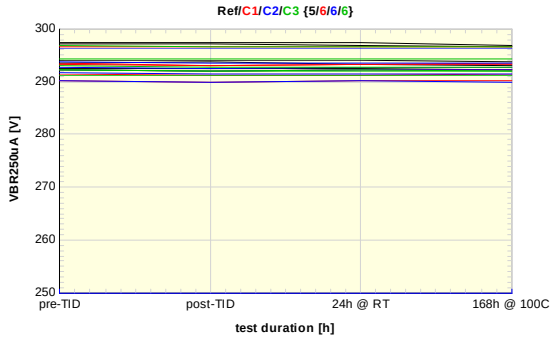
1. Unirradiated control (reference) devices (legend: Ref in BLACK)
2. Irradiated devices Bias Condition C1 (legend: C1 in RED)
3. Irradiated devices Bias Condition C2 (legend: C2 in BLUE)
4. Irradiated devices Bias Condition C3 (legend: C3 in GREEN)

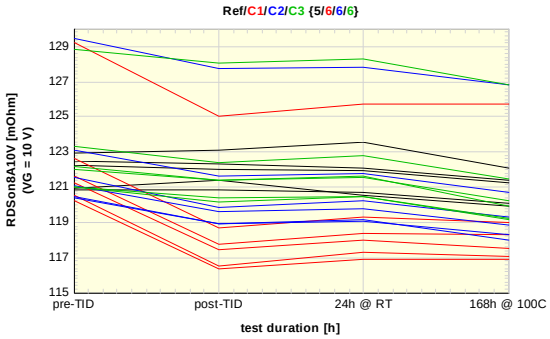


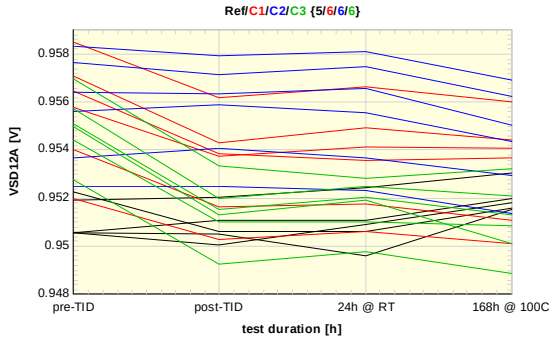












§8 TOTAL IONIZING DOSE TESTING RESULT SUMMARY / CHECK FOR LOT FAILURE

TID Bias Condition	Minimum Required	Total to Condition	Failures Allowed	Failures Occurred	Condition Passed
C1	5	6	0	0	yes
C2	5	6	0	0	yes
C3	5	6	0	0	yes
Complete TID Tests					passed

The Wafer Lot passed the Total Dose Steady-State Irradiation Test.