

Infineon technologies HiRel Discrete & MW Semiconductors	ESCC Comp. No.: 520503101R	Page: 1
	Wafer Lot: VE106849	Rep.No.: VE106849TID Issue: Iss. 1, Aug. 2021
	Total Dose Steady-State Irradiation Test Report BUY15CS23J-01(ES)	Confidential Report

§1 COVER SHEET

• Component and Test Identification

Comp. Type	BUY15CS23J-01(ES)
ESCC Comp. No.	520503101R
Lot Ident.	Wafer Lot No. VE106849
	Assembly Lot n.a.
	ESA Date Code n.a.
	Radiation Testing Level R: 100kRad
Test data	Test Plan TPIFX1827B
	Tested Sample Serial No.s 115-132
	Control Sample Serial No.s R174-R178

• Applicability of Test Results

Comp. Types	BUY15CS23J-01(ES) BUY15CS23K-01(ES)
ESCC Comp. Nos.	520503101R 520503103R

• Applicable Documents

Detail Specification	ESCC 5205/031 Issue 1, May 2016
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
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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	

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§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 BUY15CS23J-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 VE106849 for type BUY15CS23J-01(ES) (ESCC detail specification No. 5205/031). This report is applicable for type BUY15CS23K-01(ES) as well, since the two types share the same chip type.

Test campaign TID 58 has been performed at the facility JS-9000 in Germany on the 6.7.2021.

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.

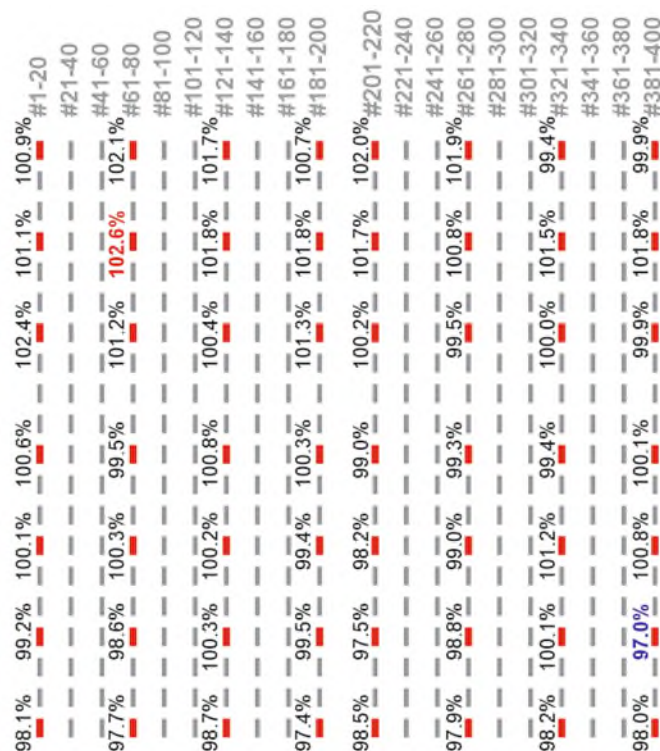


Fig. 1: Measured gamma intensity within the container at marked sample positions. Maximum and minimum measured intensities are marked – 102.6% and 97.0%.

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§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-adaptor 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.

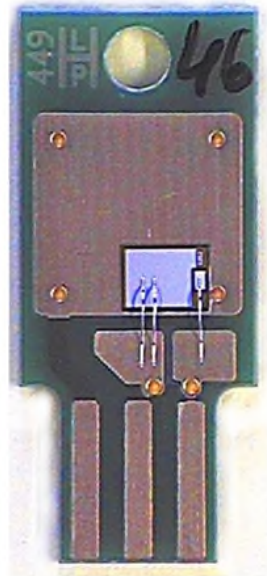


Fig. 2: Die mounted on PCB for TID testing – soldered and wire-bonded

§6 IRRADIATION CONDITIONS

The irradiation step had a duration of 3h 55 min at a dose rate of 41.3 krad/h which yields a total ionizing dose of 162 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	150 V	0 V

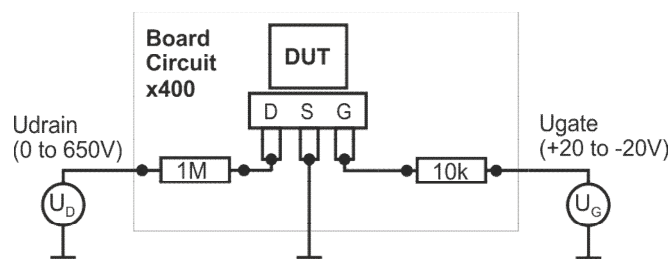


Fig. 3 Bias circuit for TID tests

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§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
BUY15CS23J-01(ES) silicon chips used for C1 condition	6	C1	#115,118,121,124,127,130
BUY15CS23J-01(ES) silicon chips used for C2 condition	6	C2	#116,119,122,125,128,131
BUY15CS23J-01(ES) silicon chips used for C3 condition	6	C3	#117,120,123,126,129,132
BUY15CS23J-01(ES) silicon chips used as control samples (not irradiated, not annealed)	5	control	#R174-R178

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§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	150	2						
max	4	100	100	25	60	1.2		
115	165	3.31	0.5	0.9	0.002	54.9	1.085	VE106849 #1
116	167	3.31	0.5	0.9	0.002	55.0	1.090	VE106849 #1
117	170	3.29	0.5	0.9	0.001	55.8	1.087	VE106849 #1
118	169	3.29	0.5	0.9	0.002	55.3	1.084	VE106849 #1
119	170	3.29	0.5	0.8	0.002	55.5	1.082	VE106849 #1
120	169	3.29	0.5	0.8	0.002	55.6	1.087	VE106849 #1
121	166	3.31	0.5	0.9	0.002	54.8	1.091	VE106849 #2
122	165	3.25	0.5	0.8	0.001	54.8	1.089	VE106849 #2
123	167	3.29	0.6	0.9	0.002	55.3	1.089	VE106849 #2
124	167	3.28	0.5	0.8	0.002	55.5	1.089	VE106849 #2
125	168	3.28	0.6	0.9	0.002	55.6	1.092	VE106849 #2
126	167	3.27	0.5	0.9	0.002	56.0	1.092	VE106849 #2
127	167	3.30	0.6	0.8	0.002	55.2	1.093	VE106849 #3
128	168	3.27	0.6	0.9	0.001	55.7	1.095	VE106849 #3
129	171	3.30	0.5	0.8	0.001	55.7	1.090	VE106849 #3
130	169	3.31	0.6	0.8	0.002	56.0	1.090	VE106849 #3
131	169	3.31	0.5	0.8	0.002	56.0	1.088	VE106849 #3
132	169	3.30	0.6	0.9	0.002	56.1	1.089	VE106849 #3
R174	164	3.20	0.5	0.9	0.002	52.9	1.070	
R175	165	3.20	0.5	0.9	0.002	53.0	1.068	
R176	165	3.20	0.5	0.9	0.002	53.2	1.072	
R177	165	3.21	0.5	0.9	0.002	52.6	1.068	
R178	166	3.21	0.5	0.9	0.002	52.6	1.069	

§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%	150	2						
max	+20%	+10%	+20nA	+20nA	+20%	+10%		4	100	100	25	60	1.2	
115	-5.0	-20.4	0.0	0.1	-3.6	-0.3	156	2.64	0.6	1.0	1.224	52.9	1.081	C1
116	-0.2	-7.6	-0.0	-0.0	-0.7	-0.1	166	3.05	0.5	0.9	0.007	54.6	1.088	C2
117	-0.1	-28.4	0.0	0.0	-0.3	-0.4	170	2.36	0.5	0.9	0.008	55.6	1.082	C3
118	-4.3	-20.9	-0.0	0.2	-3.3	-0.4	162	2.60	0.5	1.1	1.664	53.5	1.079	C1
119	-0.2	-6.9	-0.0	0.1	-1.0	-0.1	169	3.07	0.5	0.9	0.007	55.0	1.081	C2
120	-0.1	-28.7	-0.0	0.1	-0.3	-0.4	169	2.34	0.5	0.9	0.008	55.5	1.082	C3
121	-4.7	-20.1	0.0	0.2	-3.1	-0.4	158	2.64	0.5	1.0	0.805	53.1	1.087	C1
122	-0.2	-8.3	-0.0	0.1	-0.5	-0.3	165	2.98	0.5	0.9	0.007	54.6	1.086	C2
123	-0.2	-28.7	-0.1	0.0	-0.4	-0.4	167	2.34	0.5	0.9	0.008	55.1	1.084	C3
124	-4.7	-20.8	0.0	0.3	-3.4	-0.4	160	2.60	0.5	1.1	2.268	53.6	1.085	C1
125	-0.2	-7.4	0.0	0.1	-0.7	-0.1	167	3.04	0.6	0.9	0.007	55.2	1.090	C2
126	-0.2	-28.5	0.0	0.0	-0.5	-0.4	167	2.34	0.5	0.9	0.008	55.7	1.088	C3
127	-4.7	-20.1	-0.0	0.2	-3.4	-0.4	159	2.64	0.5	1.0	0.629	53.3	1.089	C1

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	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]	
128	-0.2	-8.0	-0.1	-0.0	-0.8	-0.1	168	3.01	0.5	0.9	0.007	55.3	1.094	C2
129	-0.2	-29.0	-0.0	0.1	-0.5	-0.4	170	2.34	0.5	0.9	0.008	55.4	1.086	C3
130	-4.6	-20.9	0.0	0.2	-3.4	-0.3	161	2.62	0.6	1.0	0.270	54.1	1.086	C1
131	-0.2	-7.3	-0.0	0.1	-0.8	-0.1	169	3.07	0.5	0.9	0.007	55.6	1.087	C2
132	-0.2	-28.7	-0.1	-0.0	-0.5	-0.4	169	2.36	0.5	0.8	0.008	55.9	1.085	C3
R174	0.1	-0.1	0.0	0.0	0.6	-0.0	164	3.20	0.5	0.9	0.002	53.2	1.070	Control
R175	0.1	-0.0	-0.0	-0.0	0.3	-0.0	165	3.20	0.5	0.8	0.002	53.2	1.067	Control
R176	0.1	-0.1	-0.0	0.0	0.3	-0.1	165	3.20	0.5	0.9	0.002	53.4	1.071	Control
R177	0.0	0.0	-0.1	-0.0	-0.0	0.0	165	3.21	0.5	0.8	0.002	52.6	1.068	Control
R178	0.1	-0.1	0.1	0.0	0.4	-0.0	166	3.20	0.6	0.9	0.002	52.8	1.069	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%	150	2						
max	+20%	+10%	+20nA	+20nA	+20%	+10%		4	100	100	25	60	1.2	
115	-4.7	-15.5	-0.0	-0.0	-4.9	-0.1	157	2.80	0.5	0.8	0.182	52.2	1.083	C1
116	-0.5	-6.3	-0.0	-0.1	-2.2	0.0	166	3.10	0.5	0.8	0.005	53.8	1.090	C2
117	-0.4	-24.1	0.0	-0.1	-1.6	-0.2	169	2.50	0.5	0.8	0.006	54.9	1.084	C3
118	-4.1	-15.9	-0.0	0.1	-4.5	-0.1	162	2.77	0.5	0.9	0.519	52.8	1.083	C1
119	-0.6	-5.6	-0.1	-0.0	-2.3	0.1	169	3.11	0.5	0.8	0.005	54.2	1.082	C2
120	-0.4	-24.4	0.0	-0.0	-1.9	-0.2	168	2.49	0.5	0.8	0.006	54.6	1.084	C3
121	-4.4	-15.3	0.0	0.0	-4.5	-0.1	158	2.80	0.5	0.9	0.243	52.4	1.089	C1
122	-0.5	-6.9	-0.0	0.0	-2.1	-0.1	164	3.02	0.5	0.8	0.005	53.7	1.088	C2
123	-0.5	-24.5	-0.0	-0.1	-1.7	-0.2	166	2.48	0.5	0.8	0.006	54.4	1.086	C3
124	-4.4	-15.8	-0.0	0.1	-4.7	-0.1	160	2.77	0.5	0.9	0.828	52.9	1.087	C1
125	-0.5	-6.1	-0.0	-0.0	-2.2	0.0	167	3.08	0.5	0.8	0.005	54.4	1.092	C2
126	-0.5	-24.3	0.0	-0.1	-1.7	-0.3	167	2.48	0.6	0.8	0.006	55.0	1.089	C3
127	-4.4	-15.3	0.0	-0.0	-4.5	-0.1	160	2.80	0.6	0.8	0.063	52.7	1.092	C1
128	-0.5	-6.6	-0.0	-0.1	-2.3	0.0	167	3.05	0.5	0.8	0.006	54.4	1.095	C2
129	-0.5	-24.7	-0.0	0.0	-1.7	-0.1	170	2.48	0.5	0.8	0.006	54.7	1.089	C3
130	-4.4	-15.9	-0.0	0.1	-4.7	-0.1	161	2.78	0.5	0.9	0.068	53.4	1.089	C1
131	-0.5	-5.9	-0.0	-0.1	-2.3	0.0	168	3.11	0.5	0.8	0.005	54.7	1.088	C2
132	-0.5	-24.4	-0.1	-0.1	-1.7	-0.1	169	2.50	0.5	0.8	0.006	55.2	1.088	C3
R174	-0.1	0.1	-0.0	-0.1	-0.0	0.0	164	3.20	0.5	0.8	0.002	52.9	1.071	Control
R175	-0.1	0.2	-0.0	-0.1	-0.5	0.1	165	3.21	0.5	0.8	0.002	52.7	1.068	Control
R176	-0.1	0.2	-0.0	-0.0	-0.5	0.0	165	3.20	0.5	0.8	0.002	52.9	1.072	Control
R177	-0.2	0.3	-0.1	-0.1	-0.6	0.1	165	3.22	0.5	0.8	0.002	52.3	1.069	Control
R178	-0.1	0.2	0.0	-0.1	-0.7	0.0	166	3.21	0.5	0.8	0.002	52.2	1.069	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%	150	2						
max	+20%	+10%	+20nA	+20nA	+20%	+10%		4	100	100	25	60	1.2	
115	-3.4	-12.7	0.0	0.0	-3.9	-0.3	159	2.89	0.5	0.9	0.060	52.8	1.081	C1
116	-0.4	-5.6	-0.1	-0.1	-2.0	-0.2	166	3.12	0.5	0.8	0.004	53.9	1.087	C2

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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]	
117	-0.3	-20.5	-0.0	-0.0	-1.8	-0.4	170	2.62	0.5	0.9	0.004	54.8	1.082	C3
118	-3.0	-12.9	-0.0	0.0	-3.8	-0.4	164	2.87	0.5	0.9	0.045	53.2	1.080	C1
119	-0.4	-5.1	0.0	-0.0	-2.1	-0.2	169	3.12	0.6	0.8	0.004	54.3	1.080	C2
120	-0.3	-20.7	0.0	-0.0	-1.7	-0.3	169	2.61	0.5	0.8	0.003	54.7	1.083	C3
121	-3.2	-12.4	0.0	0.0	-3.7	-0.3	160	2.90	0.5	0.9	0.050	52.8	1.087	C1
122	-0.3	-6.2	0.0	-0.0	-1.7	-0.3	165	3.05	0.6	0.8	0.004	53.9	1.085	C2
123	-0.3	-20.9	-0.0	-0.0	-2.0	-0.4	166	2.60	0.5	0.9	0.004	54.2	1.084	C3
124	-3.2	-12.8	-0.0	0.0	-3.9	-0.3	162	2.86	0.5	0.9	0.050	53.4	1.086	C1
125	-0.3	-5.5	-0.0	-0.0	-1.9	-0.2	167	3.11	0.5	0.9	0.004	54.6	1.090	C2
126	-0.3	-20.7	-0.0	0.0	-1.9	-0.4	167	2.60	0.5	0.9	0.004	54.9	1.088	C3
127	-3.2	-12.3	0.0	0.1	-3.7	-0.4	162	2.90	0.6	0.9	0.050	53.1	1.089	C1
128	-0.3	-5.9	-0.1	-0.0	-2.2	-0.2	167	3.08	0.5	0.9	0.004	54.5	1.093	C2
129	-0.3	-21.1	0.0	0.1	-1.9	-0.3	170	2.60	0.6	0.9	0.004	54.7	1.087	C3
130	-3.2	-13.0	-0.0	-0.0	-3.9	-0.3	163	2.88	0.5	0.8	0.050	53.8	1.087	C1
131	-0.4	-5.3	-0.0	-0.0	-2.1	-0.2	169	3.13	0.5	0.8	0.004	54.8	1.086	C2
132	-0.3	-20.8	-0.1	0.0	-1.7	-0.4	169	2.61	0.5	0.9	0.004	55.2	1.085	C3
R174	0.1	-0.1	0.0	-0.0	0.7	-0.0	164	3.19	0.5	0.8	0.002	53.3	1.070	Control
R175	0.0	0.1	-0.0	0.1	-0.0	-0.0	165	3.20	0.5	0.9	0.002	53.0	1.067	Control
R176	0.0	0.1	-0.1	0.0	-0.0	-0.0	165	3.20	0.5	0.9	0.002	53.2	1.072	Control
R177	-0.1	0.1	0.0	-0.0	-0.2	0.0	165	3.22	0.5	0.8	0.002	52.5	1.068	Control
R178	0.3	-0.4	0.0	-0.1	1.2	-0.1	166	3.19	0.6	0.8	0.002	53.2	1.067	Control

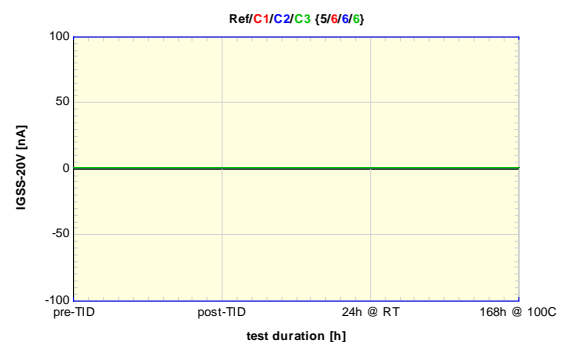
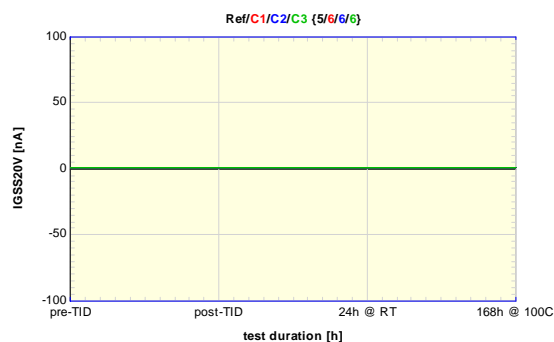
§7.3 GRAPHICAL REPRESENTATION OF ELECTRICAL MEASUREMENTS

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

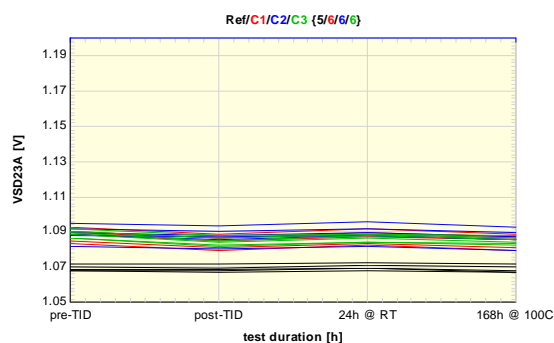
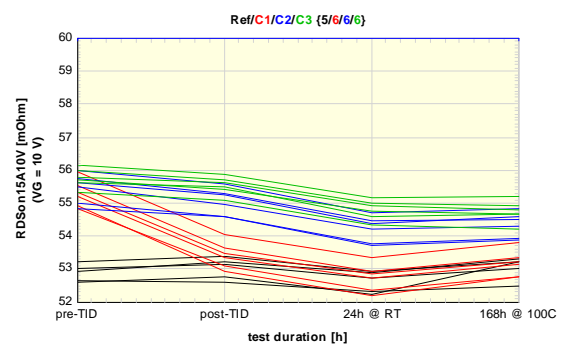
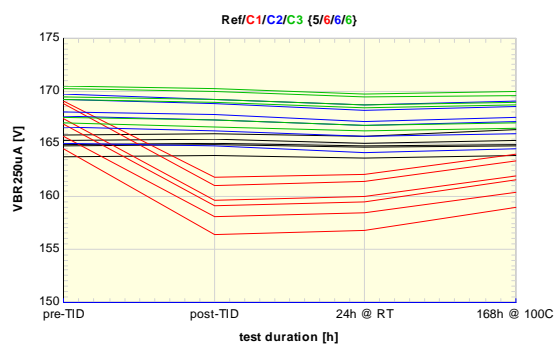
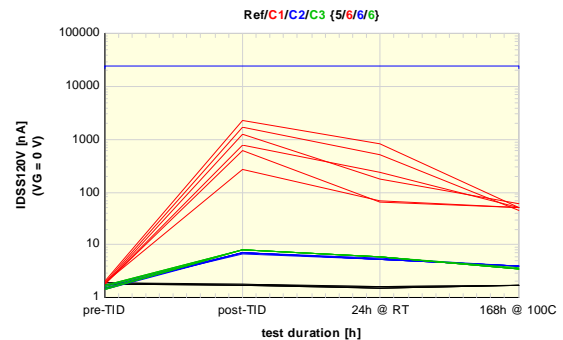
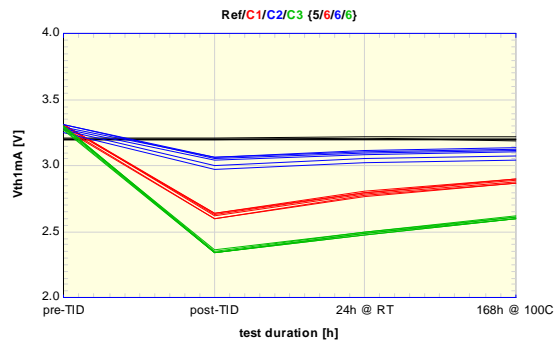
1. Prior to irradiation (pre-TID),
2. Post-irradiation (post-TID),
3. Posterior to room-temperature anneal of 24 hours (24h@RT),
4. Posterior to 168 hours of anneal at 100°C (168h@100°C) .

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)



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§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.