

Infineon technologies HiRel Discrete & MW Semiconductors	ESCC Comp. No.: 520503204R	Page: 1
	Wafer Lot: VE050903	Rep.No.: VE050903TID Issue: Iss. 1, Aug. 2021
	Total Dose Steady-State Irradiation Test Report BUY06CS45B-01(ES)	

§1 COVER SHEET

• Component and Test Identification

Comp. Type	BUY06CS45B-01(ES)
ESCC Comp. No.	520503204R
Lot Ident.	Wafer Lot No. VE050903
	Assembly Lot n.a.
	ESA Date Code n.a.
	Radiation Testing Level R: 100kRad
Test data	Test Plan TPIFX1827B
	Tested Sample Serial No.s 79-96
	Control Sample Serial No.s R156-R160

• Applicable Documents

Detail Specification	ESCC 5205/032 Issue 1, Sep. 2019
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 BUY06CS45B-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 VE050903 for type BUY06CS45B-01(ES) (ESCC detail specification No. 5205/032).

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.

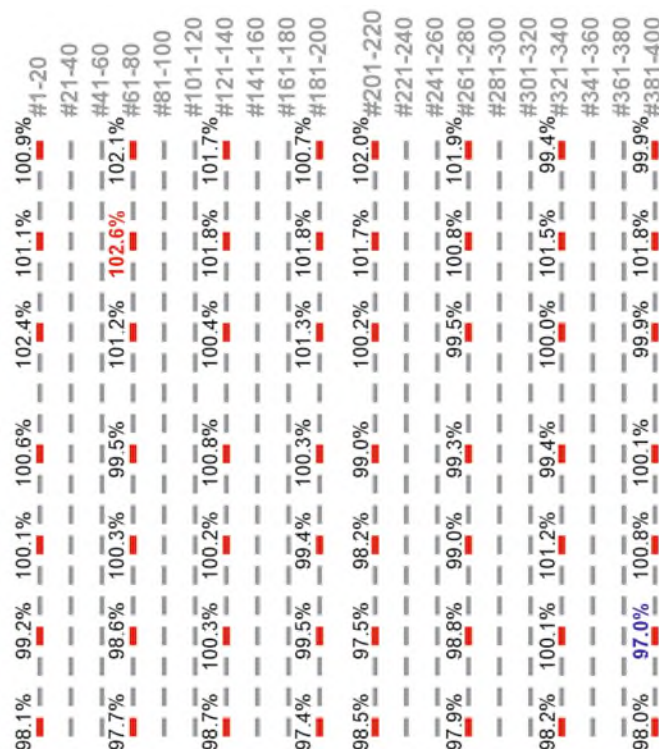


Fig. 1: Measured gamma intensity within the container at marked sample positions. Maximum and minimum measured intensities are marked – 102.6% and 97.0%.

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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.

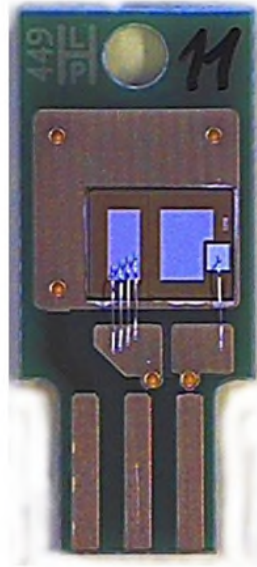


Fig. 2: Die mounted on PCB for TID testing – soldered and wire-bonded

§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	60 V	0 V

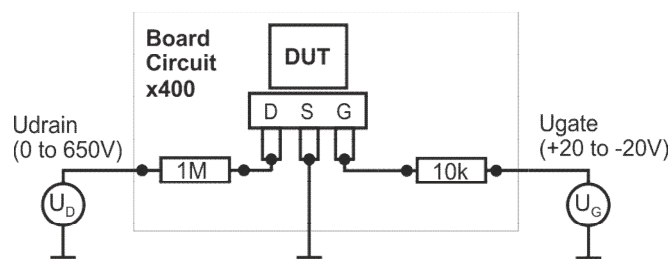


Fig. 3 Bias circuit for TID tests

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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
BUY06CS45B-01(ES) silicon chips used for C1 condition	6	C1	#79,82,85,88,91,94
BUY06CS45B-01(ES) silicon chips used for C2 condition	6	C2	#80,83,86,89,92,95
BUY06CS45B-01(ES) silicon chips used for C3 condition	6	C3	#81,84,87,90,93,96
BUY06CS45B-01(ES) silicon chips used as control samples (not irradiated, not annealed)	5	control	#R156-R160

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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	60	2						
max		4	100	100	25	15	1.2	
79	72	3.17	0.5	1.1	0.003	13.5	1.084	VE050903 #1
80	73	3.17	0.5	1.1	0.003	13.5	1.084	VE050903 #1
81	73	3.18	0.6	1.1	0.003	13.4	1.081	VE050903 #1
82	72	3.19	0.5	1.1	0.003	13.4	1.079	VE050903 #1
83	72	3.19	0.6	1.1	0.003	13.4	1.081	VE050903 #1
84	72	3.19	0.6	1.1	0.003	13.5	1.084	VE050903 #1
85	73	3.15	0.6	1.1	0.003	13.4	1.075	VE050903 #2
86	73	3.16	0.6	1.1	0.003	13.5	1.083	VE050903 #2
87	73	3.16	0.5	1.1	0.003	13.5	1.081	VE050903 #2
88	72	3.16	0.6	1.1	0.003	13.3	1.074	VE050903 #2
89	72	3.16	0.6	1.1	0.003	13.4	1.079	VE050903 #2
90	72	3.16	0.6	1.1	0.003	13.4	1.079	VE050903 #2
91	71	3.11	0.5	1.1	0.002	13.4	1.081	VE050903 #3
92	71	3.14	0.6	1.2	0.003	13.3	1.078	VE050903 #3
93	71	3.15	0.6	1.1	0.003	13.4	1.083	VE050903 #3
94	72	3.14	0.5	1.1	0.003	13.4	1.078	VE050903 #3
95	72	3.15	0.5	1.1	0.003	13.4	1.079	VE050903 #3
96	72	3.14	0.6	1.1	0.003	13.2	1.074	VE050903 #3
R156	74	3.13	0.4	1.1	0.003	14.0	1.107	
R157	74	3.12	0.5	1.1	0.003	14.4	1.113	
R158	73	3.12	0.5	1.1	0.002	14.0	1.108	
R159	71	3.11	0.5	1.1	0.003	14.2	1.111	
R160	75	3.16	0.5	1.1	0.002	14.1	1.112	

§7.2.2 ELECTRICAL MEASUREMENTS AFTER IRRADIATION

S/N	Drift Deltas post irradiation						Absolute Values post irradiation							Bias Cond.
	BV(DSS) [%]	VGS(th) [%]	IGSS [nA]	IGSS- [nA]	RDS(ON) [%]	VSD [%]	BV(DSS) [V]	VGS(th) [V]	IGSS [nA]	IGSS- [nA]	IDSS [uA]	RDS(ON) [mOhm]	VSD [V]	
min	-20%	-50%	-20nA	-20nA	-20%	-10%	60	2	100	100	25	15	1.2	
max	+20%	+10%	+20nA	+20nA	+20%	+10%		4						
79	-3.1	-20.6	-0.0	0.7	-3.6	-0.6	69	2.52	0.5	1.8	0.149	13.0	1.077	C1
80	0.0	-18.6	-0.0	0.1	-0.6	-0.3	73	2.58	0.5	1.2	0.012	13.4	1.082	C2
81	0.0	-29.0	-0.0	0.1	0.0	-0.7	73	2.26	0.6	1.2	0.016	13.4	1.074	C3
82	-3.0	-20.9	0.0	0.6	-4.0	-0.4	70	2.52	0.6	1.7	0.146	12.9	1.075	C1
83	-0.0	-17.9	-0.0	0.0	-0.6	-0.2	72	2.62	0.5	1.2	0.012	13.4	1.079	C2
84	0.1	-29.0	0.0	0.0	-0.1	-0.7	72	2.27	0.6	1.1	0.017	13.5	1.077	C3
85	-3.0	-20.5	0.1	0.7	-4.2	-0.6	71	2.51	0.7	1.8	0.146	12.8	1.069	C1
86	0.0	-18.2	-0.0	0.1	-0.7	-0.2	73	2.59	0.5	1.2	0.011	13.4	1.080	C2
87	0.1	-29.1	0.0	0.0	-0.2	-0.7	73	2.24	0.5	1.2	0.016	13.4	1.073	C3
88	-2.8	-20.3	-0.1	0.6	-4.1	-0.5	70	2.52	0.5	1.7	0.140	12.8	1.069	C1
89	0.0	-17.2	-0.0	0.1	-0.6	-0.2	73	2.62	0.6	1.2	0.012	13.4	1.078	C2
90	0.1	-28.9	-0.1	0.0	0.0	-0.8	72	2.25	0.5	1.1	0.016	13.4	1.070	C3

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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]	
91	-3.1	-20.8	-0.0	0.6	-4.2	-0.6	68	2.46	0.5	1.7	0.156	12.8	1.075	C1
92	0.0	-22.1	0.1	0.0	-0.6	-0.2	71	2.45	0.6	1.2	0.012	13.2	1.075	C2
93	0.0	-28.9	0.0	0.0	-0.1	-0.8	71	2.24	0.6	1.2	0.016	13.4	1.075	C3
94	-3.1	-21.1	-0.0	0.5	-3.7	-0.6	70	2.48	0.5	1.6	0.155	12.9	1.072	C1
95	-0.0	-21.6	-0.0	0.1	-0.6	-0.2	72	2.47	0.5	1.2	0.012	13.3	1.077	C2
96	0.1	-28.9	-0.1	-0.0	0.0	-0.8	72	2.24	0.6	1.1	0.016	13.2	1.065	C3
R156	0.1	-0.1	0.1	-0.0	0.2	0.0	74	3.12	0.5	1.1	0.002	14.1	1.107	Control
R157	0.0	-0.1	-0.1	-0.0	0.2	-0.1	74	3.12	0.5	1.1	0.003	14.4	1.112	Control
R158	0.0	-0.2	-0.0	0.0	0.2	-0.1	73	3.11	0.5	1.1	0.002	14.0	1.107	Control
R159	0.1	-0.2	-0.1	-0.1	0.2	-0.0	71	3.10	0.5	1.0	0.003	14.2	1.110	Control
R160	0.0	-0.2	-0.0	-0.1	0.2	-0.0	75	3.15	0.5	1.0	0.003	14.1	1.111	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%	60	2						
max	+20%	+10%	+20nA	+20nA	+20%	+10%		4	100	100	25	15	1.2	
79	-3.0	-15.6	0.0	0.2	-4.7	-0.4	70	2.68	0.5	1.3	0.085	12.8	1.080	C1
80	-0.3	-16.2	-0.0	-0.1	-2.1	-0.1	73	2.66	0.5	1.0	0.008	13.2	1.083	C2
81	-0.3	-24.4	-0.1	-0.0	-1.3	-0.4	73	2.40	0.5	1.1	0.011	13.3	1.077	C3
82	-2.9	-15.7	-0.0	0.1	-5.0	-0.2	70	2.69	0.5	1.2	0.085	12.7	1.077	C1
83	-0.4	-15.5	0.0	-0.1	-2.1	-0.0	72	2.70	0.6	1.0	0.008	13.1	1.081	C2
84	-0.3	-24.5	-0.1	-0.0	-1.4	-0.5	72	2.41	0.5	1.0	0.012	13.3	1.078	C3
85	-3.0	-15.5	-0.1	0.2	-5.2	-0.3	71	2.66	0.5	1.3	0.084	12.7	1.072	C1
86	-0.4	-15.8	0.1	-0.0	-2.2	0.0	73	2.66	0.7	1.1	0.008	13.2	1.083	C2
87	-0.3	-24.5	0.0	-0.0	-1.4	-0.4	73	2.39	0.5	1.1	0.011	13.3	1.076	C3
88	-2.8	-15.3	0.1	0.2	-5.0	-0.3	70	2.67	0.6	1.3	0.082	12.7	1.072	C1
89	-0.3	-14.8	-0.0	-0.1	-2.0	-0.0	72	2.69	0.5	1.0	0.008	13.2	1.079	C2
90	-0.3	-24.4	-0.0	-0.1	-1.4	-0.5	72	2.39	0.5	1.0	0.011	13.2	1.073	C3
91	-3.1	-15.6	0.0	0.1	-5.1	-0.3	69	2.63	0.5	1.3	0.090	12.7	1.078	C1
92	-0.4	-19.5	-0.0	-0.1	-2.2	-0.0	71	2.53	0.5	1.0	0.008	13.0	1.078	C2
93	-0.3	-24.4	-0.0	-0.1	-1.5	-0.4	71	2.38	0.5	1.0	0.011	13.2	1.078	C3
94	-3.1	-15.8	-0.0	0.1	-4.9	-0.2	70	2.65	0.5	1.2	0.089	12.8	1.076	C1
95	-0.4	-19.1	-0.0	-0.1	-2.1	-0.1	72	2.55	0.5	1.1	0.008	13.1	1.079	C2
96	-0.3	-24.4	-0.0	-0.1	-1.3	-0.4	72	2.38	0.6	1.0	0.011	13.1	1.069	C3
R156	-0.1	0.1	0.0	-0.1	-0.4	0.1	74	3.13	0.5	1.0	0.002	14.0	1.108	Control
R157	-0.1	0.1	0.0	-0.1	-0.4	-0.0	74	3.13	0.5	1.0	0.003	14.3	1.113	Control
R158	-0.1	0.1	0.1	-0.0	-0.4	-0.0	73	3.12	0.6	1.0	0.002	13.9	1.108	Control
R159	-0.1	0.1	-0.1	-0.1	-0.5	0.1	71	3.11	0.5	1.0	0.003	14.1	1.111	Control
R160	-0.1	0.1	0.0	-0.1	-0.4	0.1	75	3.16	0.6	1.0	0.002	14.0	1.112	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%	60	2						
max	+20%	+10%	+20nA	+20nA	+20%	+10%		4	100	100	25	15	1.2	
79	-2.2	-12.6	-0.1	0.1	-3.6	-0.5	70	2.77	0.5	1.1	0.081	13.0	1.079	C1

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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]	
80	-0.1	-14.2	0.0	-0.0	-1.2	-0.4	73	2.73	0.5	1.1	0.007	13.4	1.080	C2
81	-0.2	-20.5	-0.1	-0.0	-1.3	-0.6	73	2.53	0.5	1.1	0.006	13.3	1.075	C3
82	-2.1	-12.7	-0.0	-0.0	-4.0	-0.4	71	2.78	0.5	1.1	0.079	12.9	1.075	C1
83	-0.2	-13.4	-0.1	-0.0	-1.6	-0.2	72	2.77	0.5	1.1	0.007	13.2	1.079	C2
84	-0.1	-20.4	-0.0	0.0	-1.4	-0.6	72	2.54	0.6	1.1	0.007	13.3	1.078	C3
85	-2.1	-12.4	-0.1	-0.0	-4.2	-0.4	71	2.76	0.5	1.1	0.079	12.8	1.071	C1
86	-0.1	-13.7	-0.0	0.0	-1.7	-0.2	73	2.73	0.5	1.1	0.007	13.3	1.080	C2
87	-0.1	-20.6	-0.0	-0.0	-1.4	-0.6	73	2.51	0.5	1.1	0.006	13.3	1.075	C3
88	-2.0	-12.2	0.0	0.0	-4.2	-0.4	71	2.77	0.6	1.1	0.077	12.8	1.070	C1
89	-0.2	-12.8	-0.1	0.0	-1.7	-0.2	72	2.76	0.5	1.1	0.007	13.2	1.077	C2
90	-0.1	-20.3	0.0	0.0	-1.2	-0.6	72	2.52	0.6	1.1	0.006	13.2	1.072	C3
91	-2.3	-12.4	-0.0	-0.0	-4.2	-0.4	69	2.72	0.5	1.1	0.083	12.8	1.077	C1
92	-0.1	-17.1	-0.0	-0.0	-1.5	-0.3	71	2.61	0.5	1.1	0.007	13.1	1.075	C2
93	-0.1	-20.5	-0.0	-0.0	-1.6	-0.6	71	2.51	0.6	1.1	0.006	13.2	1.077	C3
94	-2.2	-12.7	-0.0	0.0	-3.9	-0.4	71	2.74	0.5	1.1	0.082	12.9	1.074	C1
95	-0.2	-16.6	-0.0	-0.1	-1.7	-0.3	72	2.63	0.5	1.1	0.007	13.2	1.076	C2
96	-0.1	-20.3	-0.1	-0.0	-1.1	-0.6	72	2.51	0.6	1.1	0.006	13.1	1.067	C3
R156	-0.0	0.0	-0.3	0.0	-0.0	0.1	74	3.13	0.1	1.2	0.002	14.0	1.108	Control
R157	-0.0	-0.0	-0.1	-0.1	0.0	-0.1	74	3.12	0.5	1.1	0.003	14.4	1.112	Control
R158	0.0	-0.1	-0.0	-0.0	0.1	-0.1	73	3.11	0.5	1.1	0.002	14.0	1.108	Control
R159	-0.0	-0.0	-0.0	-0.0	-0.1	-0.0	71	3.11	0.5	1.1	0.003	14.2	1.110	Control
R160	0.0	-0.1	-0.0	-0.0	-0.0	0.0	75	3.15	0.5	1.1	0.002	14.1	1.112	Control

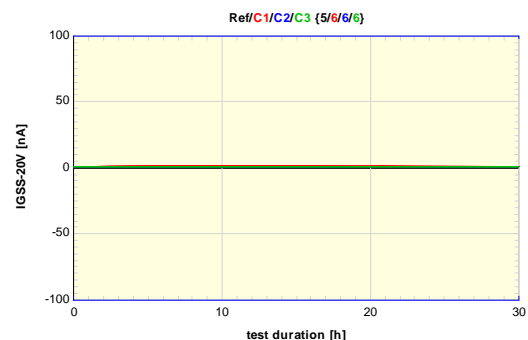
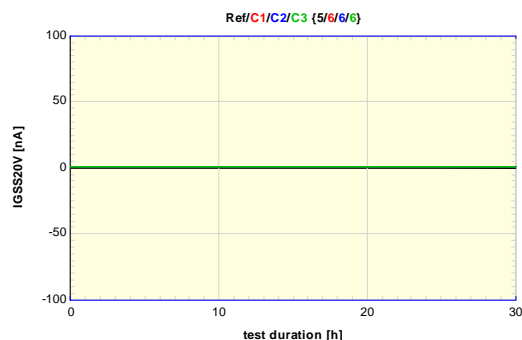
§7.3 GRAPHICAL REPRESENTATION OF ELECTRICAL MEASUREMENTS

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

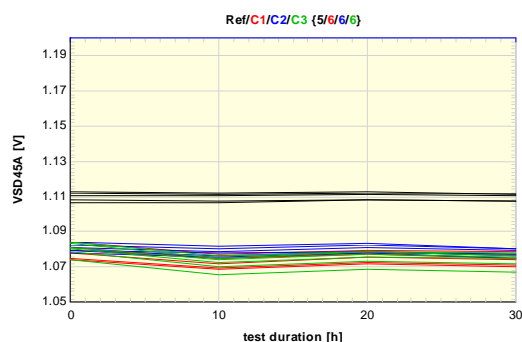
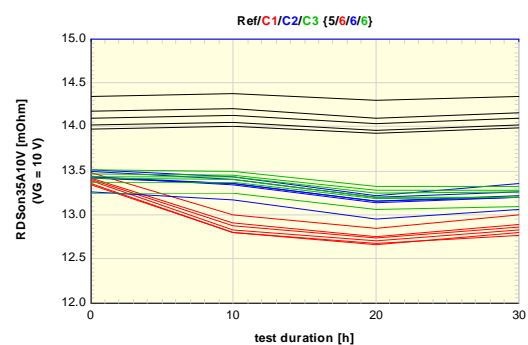
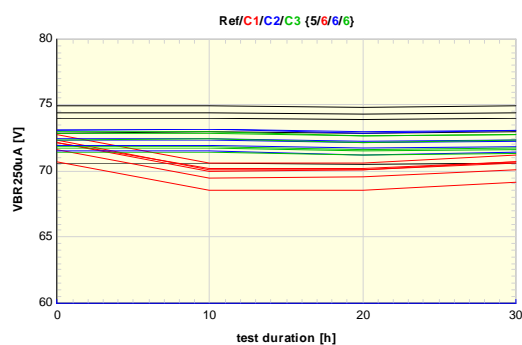
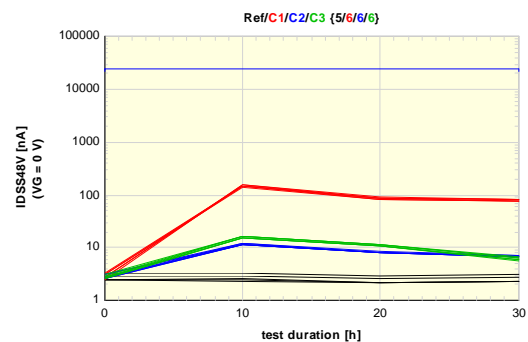
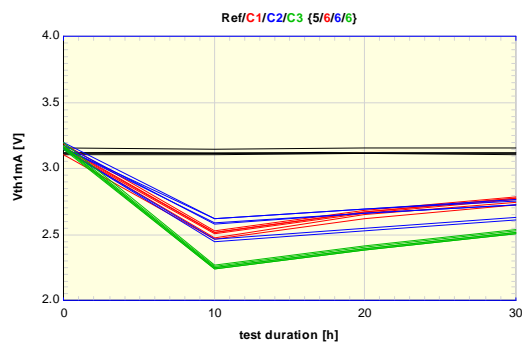
1. Prior to irradiation (pre-TID),
2. Post-irradiation (post-TID),
3. Posterior to room-temperature anneal of 24 hours (24h@RT),
4. Posterior to 168 hours of anneal at 100°C (168h@100°C) .

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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	Wafer Lot: VE050903	Rep.No.: VE050903TID Issue: Iss. 1, Aug. 2021
	Total Dose Steady-State Irradiation Test Report BUY06CS45B-01(ES)	



§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.