

Infineon technologies HiRel Discrete & MW Semiconductors	ESCC Comp. No.: 520503104R	Page: 1
	Wafer Lot: VE602817	Rep.No.: VE602817TID Issue: Iss. 1, Aug 2021
	Total Dose Steady-State Irradiation Test Report BUY15CS45B-01(ES)	

§1 COVER SHEET

• Component and Test Identification

Comp. Type	BUY15CS45B-01(ES)
ESCC Comp. No.	520503104R
Lot Ident.	Wafer Lot No. VE602817
	Assembly Lot n.a.
	ESA Date Code n.a.
	Radiation Testing Level R: 100kRad
Test data	Test Plan TPIFX1827B
	Tested Sample Serial No.s 217-234
	Control Sample Serial No.s R156-R160

• 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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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 BUY15CS45B-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 VE602817 for type BUY15CS45B-01(ES) (ESCC detail specification No. 5205/031).

Test campaign TID 53 has been performed at the facility JS-9000 in Germany on the 16.06.2020.

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 varies from 91.4% to 105.7% which is in the +/-10% allowed window. Samples are placed such that the dose rate variation across the field of interest is between 94.2% and 105.7%.

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

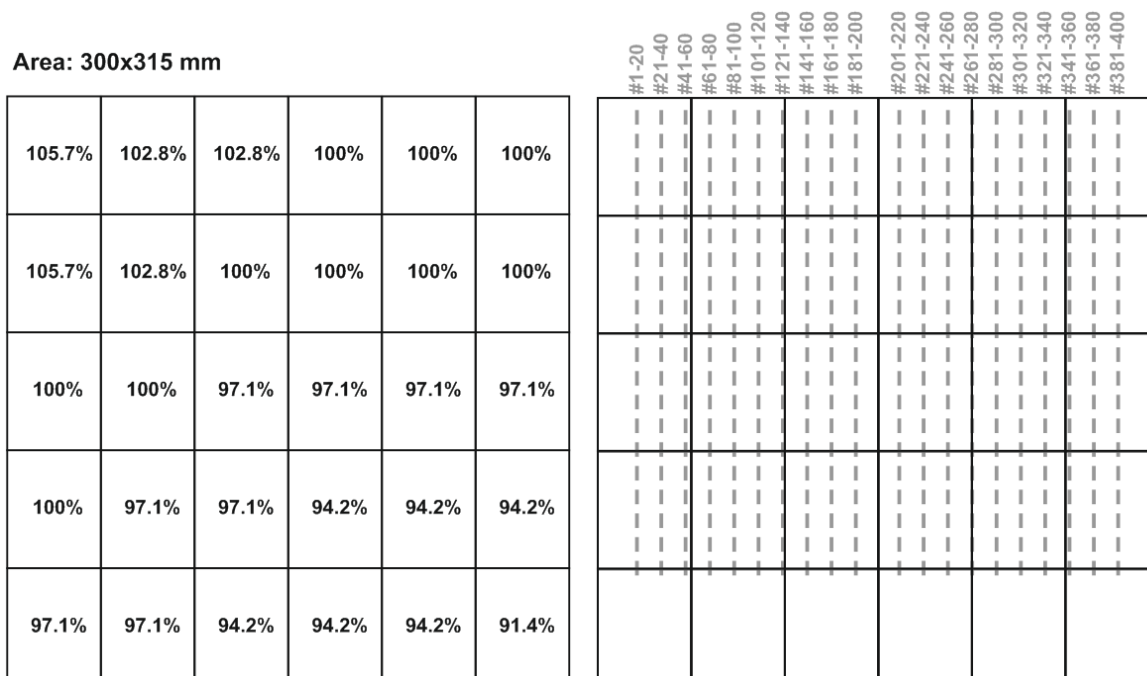


Fig. 1: Left: Gamma intensity within the container. Right: sample positions #1-400 with respect to the characterized irradiation plane.

§5 DEVICES MARKINGS AND SAMPLE PREPARATION

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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.

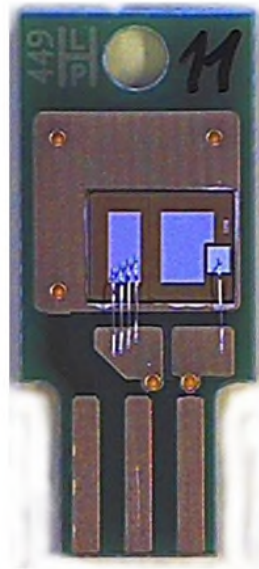


Fig. 2: Die mounted on PCB for TID testing – soldered and wire-bonded

§6 IRRADIATION CONDITIONS

The irradiation step had a duration of 5h 18 min at a dose rate of 33.5 krad/h which yields a total ionizing dose of 177.5 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

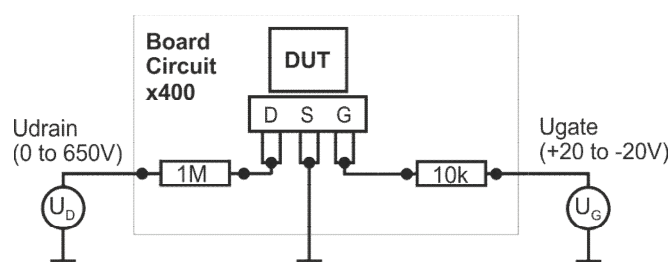


Fig. 3 Bias circuit for TID tests

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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
BUY15CS45B-01(ES) silicon chips used for C1 condition	6	C1	#217,220,223,226,229,232
BUY15CS45B-01(ES) silicon chips used for C2 condition	6	C2	#218,221,224,227,230,233
BUY15CS45B-01(ES) silicon chips used for C3 condition	6	C3	#219,222,225,228,231,234
BUY15CS45B-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	150	2						
max	4	100	100	25	27	1.4		
217	173	3.12	0.4	1.0	0.004	21	1.101	VE602817 #17
218	172	3.06	0.5	0.9	0.004	21	1.099	VE602817 #17
219	174	3.10	0.4	1.0	0.004	21	1.101	VE602817 #17
220	173	3.11	0.3	1.0	0.004	21	1.097	VE602817 #17
221	174	3.13	0.4	1.0	0.004	21	1.101	VE602817 #17
222	177	3.13	0.5	0.9	0.004	21	1.093	VE602817 #17
223	177	3.11	0.5	0.9	0.004	21	1.098	VE602817 #18
224	175	3.06	0.4	0.9	0.004	21	1.101	VE602817 #18
225	169	3.08	0.4	0.9	0.004	21	1.099	VE602817 #18
226	174	3.11	0.5	0.9	0.004	21	1.098	VE602817 #18
227	172	3.11	0.5	1.0	0.004	21	1.097	VE602817 #18
228	171	3.12	0.5	1.0	0.004	21	1.094	VE602817 #18
229	170	3.11	0.5	0.9	0.004	21	1.102	VE602817 #19
230	168	3.08	0.4	1.0	0.004	21	1.098	VE602817 #19
231	165	3.10	0.5	1.0	0.004	21	1.096	VE602817 #19
232	169	3.14	0.4	0.9	0.004	21	1.095	VE602817 #19
233	173	3.13	0.5	1.0	0.004	21	1.094	VE602817 #19
234	172	3.13	0.4	1.0	0.005	21	1.096	VE602817 #19
R156	176	2.97	0.4	0.9	0.005	21	1.093	
R157	179	2.99	0.5	0.9	0.005	21	1.091	
R158	176	2.96	0.4	0.9	0.004	21	1.089	
R159	178	2.99	0.4	0.9	0.005	21	1.093	
R160	174	2.99	0.5	0.9	0.005	21	1.091	

§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%	150	2						
max	+20%	+10%	+20nA	+20nA	+20%	+10%	4	100	100	25	27	1.4		
217	-4.4	-22.4	0.0	0.2	-4.0	-0.4	165	2.42	0.5	1.1	7.635	20	1.097	C1
218	-0.4	-9.4	0.0	1.2	-1.2	-0.0	171	2.78	0.5	2.2	0.017	21	1.098	C2
219	-0.3	-29.1	0.0	0.0	-0.8	-0.6	174	2.20	0.5	1.0	0.018	21	1.094	C3
220	-4.6	-22.2	0.2	0.2	-4.5	-0.3	166	2.42	0.5	1.2	5.929	20	1.093	C1
221	-0.3	-10.4	-0.0	1.2	-1.3	0.0	174	2.81	0.4	2.2	0.017	21	1.102	C2
222	-0.2	-28.4	-0.0	0.1	-0.8	-0.5	176	2.25	0.4	1.0	0.018	21	1.088	C3
223	-4.3	-22.4	0.0	0.2	-4.0	-0.4	170	2.42	0.5	1.1	6.136	20	1.093	C1
224	-0.4	-8.2	0.0	1.2	-1.3	0.1	174	2.81	0.5	2.1	0.017	21	1.103	C2
225	-0.3	-29.5	0.0	0.0	-0.8	-0.6	168	2.17	0.5	1.0	0.018	21	1.093	C3
226	-4.4	-22.4	0.0	0.2	-3.9	-0.5	166	2.41	0.5	1.2	7.205	21	1.093	C1
227	-0.3	-9.4	-0.1	1.1	-1.2	-0.0	171	2.82	0.5	2.1	0.017	21	1.097	C2
228	-0.3	-28.4	-0.1	0.0	-1.0	-0.5	170	2.24	0.5	1.0	0.018	21	1.089	C3
229	-4.5	-22.3	-0.1	0.2	-4.1	-0.4	162	2.42	0.4	1.1	6.997	20	1.097	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]	
230	-0.4	-7.8	0.1	1.3	-1.2	-0.0	167	2.84	0.5	2.3	0.017	20	1.097	C2
231	-0.4	-28.9	0.0	-0.0	-0.9	-0.5	164	2.20	0.5	1.0	0.018	21	1.090	C3
232	-4.4	-22.1	0.0	0.2	-3.8	-0.5	161	2.45	0.4	1.1	5.455	20	1.090	C1
233	-0.3	-9.0	0.0	1.4	-1.2	-0.1	173	2.85	0.5	2.3	0.017	21	1.093	C2
234	-0.3	-28.2	0.0	0.0	-0.7	-0.5	172	2.25	0.5	1.0	0.018	21	1.090	C3
R156	-0.0	-0.0	-0.0	0.0	-0.2	0.1	176	2.97	0.4	0.9	0.005	21	1.094	Control
R157	-0.0	0.0	-0.0	-0.0	-0.1	0.0	179	2.99	0.5	0.9	0.005	21	1.091	Control
R158	0.0	-0.1	0.0	-0.0	0.0	-0.1	176	2.96	0.5	0.9	0.005	21	1.088	Control
R159	-0.0	-0.1	-0.0	-0.0	0.0	0.0	178	2.99	0.4	0.9	0.005	21	1.093	Control
R160	0.0	-0.1	-0.0	-0.0	-0.1	-0.0	174	2.99	0.4	0.9	0.005	21	1.091	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	27	1.4	
217	-3.9	-17.3	0.1	0.0	-3.8	-0.3	166	2.58	0.5	1.0	0.122	20	1.098	C1
218	-0.4	-8.2	0.0	-0.0	-1.2	-0.1	171	2.81	0.5	0.9	0.016	21	1.098	C2
219	-0.3	-25.3	0.0	-0.1	-0.8	-0.4	174	2.31	0.5	0.9	0.015	21	1.097	C3
220	-4.1	-17.1	0.2	0.0	-4.3	-0.2	166	2.58	0.5	1.0	0.904	21	1.095	C1
221	-0.3	-9.1	0.1	0.0	-1.2	-0.0	174	2.85	0.5	1.0	0.016	21	1.101	C2
222	-0.2	-24.6	0.0	0.0	-0.8	-0.2	176	2.36	0.5	0.9	0.015	21	1.091	C3
223	-3.7	-17.3	0.0	0.1	-3.7	-0.2	171	2.57	0.5	1.0	0.118	20	1.095	C1
224	-0.4	-7.2	0.0	-0.0	-1.4	-0.1	174	2.84	0.5	0.9	0.016	21	1.100	C2
225	-0.3	-25.5	0.1	0.0	-0.8	-0.5	168	2.29	0.5	0.9	0.015	21	1.094	C3
226	-3.9	-17.3	0.0	0.1	-3.6	-0.3	167	2.57	0.5	1.0	0.481	21	1.095	C1
227	-0.4	-8.1	0.0	0.0	-1.3	0.0	171	2.86	0.6	1.0	0.016	21	1.097	C2
228	-0.3	-24.6	-0.0	-0.0	-0.8	-0.4	170	2.35	0.5	1.0	0.016	21	1.090	C3
229	-3.9	-17.2	0.0	0.0	-3.7	-0.3	163	2.58	0.5	0.9	0.363	20	1.098	C1
230	-0.4	-6.9	0.1	-0.1	-1.2	-0.1	167	2.87	0.5	0.9	0.016	20	1.097	C2
231	-0.3	-25.0	0.0	-0.1	-0.9	-0.5	164	2.32	0.5	0.9	0.015	21	1.091	C3
232	-3.8	-17.1	0.1	0.1	-3.6	-0.3	162	2.61	0.5	1.1	0.133	20	1.091	C1
233	-0.3	-7.8	0.1	0.1	-1.1	-0.1	173	2.89	0.5	1.0	0.016	21	1.093	C2
234	-0.3	-24.4	0.1	-0.0	-0.8	-0.4	172	2.37	0.5	1.0	0.016	21	1.092	C3
R156	0.1	-0.2	0.0	-0.0	0.4	-0.0	176	2.97	0.5	0.9	0.004	21	1.093	Control
R157	0.1	-0.2	-0.0	-0.0	0.4	0.0	179	2.99	0.5	0.9	0.004	21	1.091	Control
R158	0.1	-0.2	-0.0	0.0	0.7	-0.1	176	2.95	0.4	0.9	0.004	21	1.088	Control
R159	0.1	-0.3	0.1	-0.0	0.6	0.0	178	2.98	0.5	0.9	0.004	21	1.093	Control
R160	0.1	-0.2	0.0	0.0	0.6	-0.1	174	2.98	0.5	0.9	0.004	21	1.091	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	27	1.4	
217	-3.0	-13.9	0.1	0.1	-3.9	-0.4	167	2.68	0.6	1.1	0.100	20	1.097	C1
218	-0.3	-7.2	0.1	0.1	-2.0	-0.2	171	2.84	0.6	1.1	0.009	21	1.097	C2

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	Drift Deltas post 168h anneal at 100°C						Absolute Values post 168h anneal at 100°C							Bias Cond.
	BV _(DSS)	VGS _(th)	IGSS	IGSS-	RDS _(ON)	V _{SD}	BV _(DSS)	VGS _(th)	IGSS	IGSS-	IDSS	RDS _(ON)	V _{SD}	
S/N	[%]	[%]	[nA]	[nA]	[%]	[%]	[V]	[V]	[nA]	[nA]	[uA]	[mOhm]	[V]	
219	-0.2	-21.6	0.1	0.1	-1.7	-0.6	174	2.43	0.6	1.1	0.008	21	1.095	C3
220	-3.2	-13.6	0.3	0.1	-4.5	-0.3	168	2.69	0.6	1.1	0.098	20	1.094	C1
221	-0.3	-7.9	0.2	0.1	-2.0	-0.2	174	2.89	0.6	1.1	0.009	21	1.100	C2
222	-0.2	-21.0	0.2	0.1	-1.6	-0.5	176	2.48	0.6	1.0	0.009	21	1.087	C3
223	-2.9	-13.8	0.1	0.1	-3.9	-0.4	172	2.68	0.6	1.1	0.099	20	1.094	C1
224	-0.3	-6.3	0.2	0.1	-2.1	-0.2	175	2.87	0.6	1.1	0.009	21	1.099	C2
225	-0.2	-21.6	0.1	0.2	-1.7	-0.6	168	2.41	0.6	1.1	0.008	21	1.093	C3
226	-3.0	-13.8	0.2	0.2	-3.8	-0.5	169	2.68	0.6	1.1	0.099	21	1.093	C1
227	-0.3	-7.0	0.1	0.1	-2.0	-0.2	171	2.89	0.6	1.1	0.010	21	1.095	C2
228	-0.2	-20.9	0.2	0.1	-1.7	-0.6	170	2.47	0.7	1.1	0.009	21	1.088	C3
229	-3.0	-13.7	0.1	0.1	-3.8	-0.5	165	2.68	0.6	1.1	0.107	20	1.097	C1
230	-0.3	-6.0	0.2	0.1	-1.8	-0.2	167	2.90	0.6	1.1	0.010	20	1.095	C2
231	-0.3	-21.3	0.2	0.1	-1.7	-0.6	164	2.44	0.6	1.1	0.008	20	1.090	C3
232	-3.0	-13.7	0.2	0.2	-3.8	-0.4	164	2.71	0.6	1.2	0.105	20	1.091	C1
233	-0.3	-6.8	0.1	0.1	-1.9	-0.2	173	2.92	0.6	1.0	0.010	20	1.091	C2
234	-0.2	-20.8	0.1	0.1	-1.7	-0.6	172	2.48	0.6	1.1	0.009	21	1.090	C3
R156	0.0	-0.3	0.1	0.1	-0.0	0.0	176	2.96	0.6	1.1	0.004	21	1.093	Control
R157	-0.0	-0.3	0.1	0.1	-0.1	0.1	179	2.98	0.6	1.0	0.004	21	1.092	Control
R158	0.0	-0.4	0.1	0.1	0.1	-0.0	176	2.95	0.6	1.0	0.004	21	1.088	Control
R159	0.0	-0.5	0.2	0.1	0.2	0.0	178	2.97	0.6	1.0	0.004	21	1.093	Control
R160	0.0	-0.3	0.1	0.1	0.2	-0.0	174	2.98	0.5	1.0	0.004	21	1.091	Control

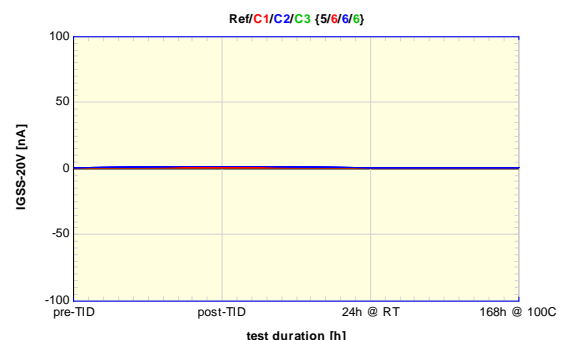
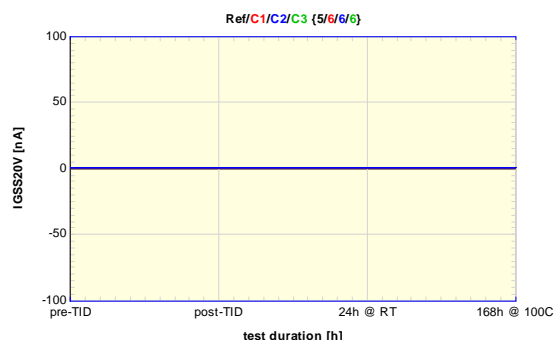
§7.3 GRAPHICAL REPRESENTATION OF ELECTRICAL MEASUREMENTS

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

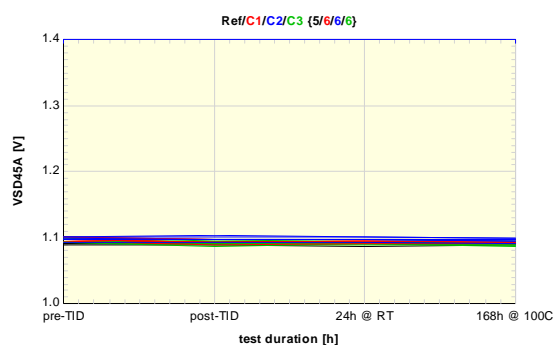
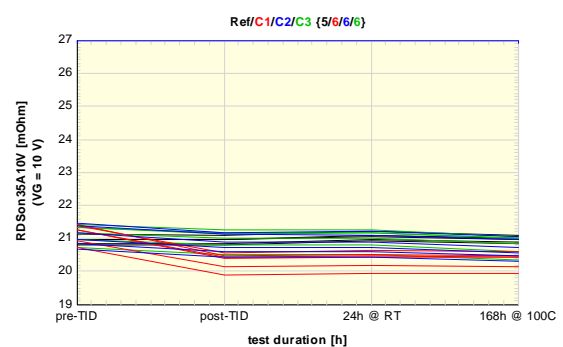
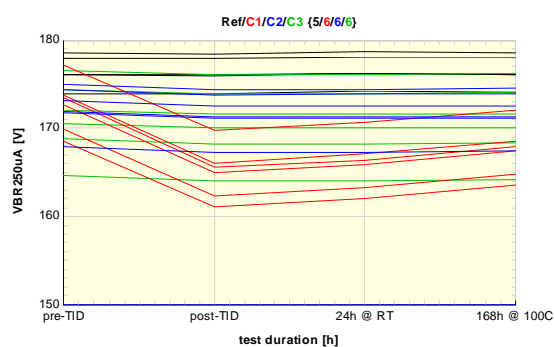
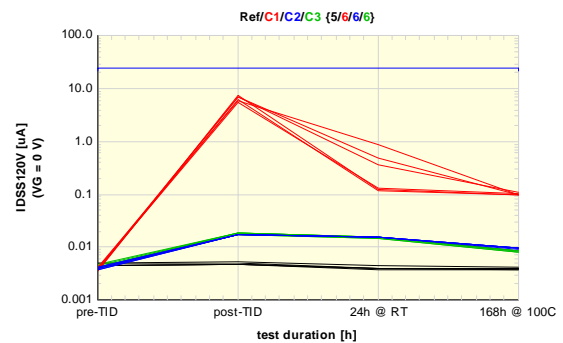
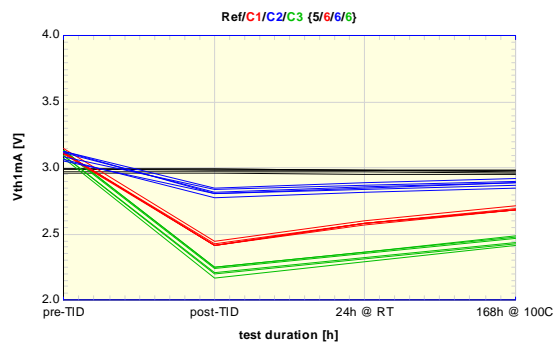
1. Prior to irradiation (pre-TID),
2. Post-irradiation (post-TID),
3. Posterior to room-temperature anneal of 24 hours (24h@RT),
4. Posterior to 168 hours of anneal at 100°C (168h@100°C) .

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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	Total Dose Steady-State Irradiation Test Report BUY15CS45B-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.