

Infineon technologies HiRel Discrete & MW Semiconductors	ESCC Comp. No.: 520503102R	Page: 1
	Wafer Lot: VE831125	Rep.No.: VE831125TID Issue: Iss. 1, Dec. 2021
	Total Dose Steady-State Irradiation Test Report BUY15CS57A-01(ES)	

§1 COVER SHEET

• Component and Test Identification

Comp. Type	BUY15CS57A-01(ES)
ESCC Comp. No.	520503102R
Lot Ident.	Wafer Lot No. VE831125
	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 R76-R80

• 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_9a
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, Dec. 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	

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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 BUY15CS57A-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 VE831125 for type BUY15CS57A-01(ES) (ESCC detail specification No. 5205/031).

Test campaign TID 60 has been performed at the facility JS-9000 in Germany on the 29.9.2021.

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.

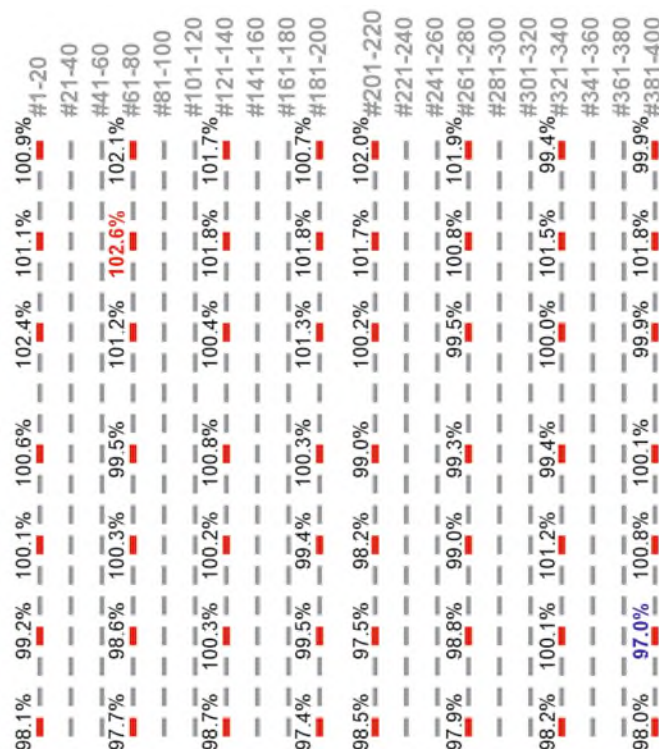


Fig. 1: Measured gamma intensity within the container at marked sample positions. Maximum and minimum measured intensities are marked – 102.6% and 97.0%.

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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.

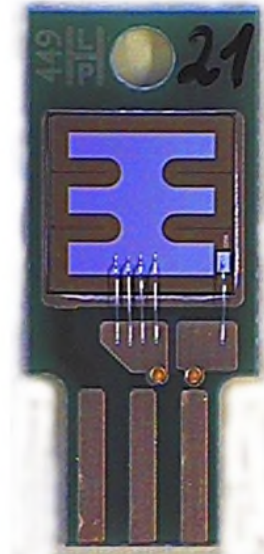


Fig. 2: Die mounted on PCB for TID testing – soldered and wire-bonded

§6 IRRADIATION CONDITIONS

The irradiation step had a duration of 4h 19 min at a dose rate of 45 krad/h which yields a total ionizing dose of 188 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

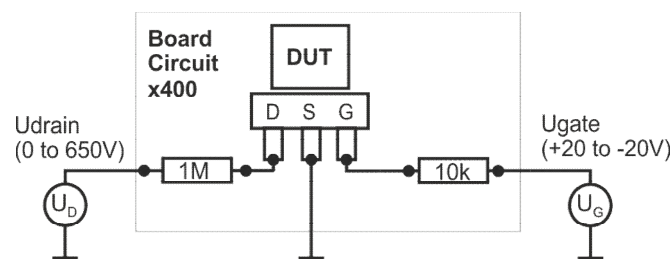


Fig. 3 Bias circuit for TID tests

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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
BUY15CS57A-01(ES) silicon chips used for C1 condition	6	C1	#115,118,121,124,127,130
BUY15CS57A-01(ES) silicon chips used for C2 condition	6	C2	#116,119,122,125,128,131
BUY15CS57A-01(ES) silicon chips used for C3 condition	6	C3	#117,120,123,126,129,132
BUY15CS57A-01(ES) silicon chips used as control samples (not irradiated, not annealed)	5	control	#R76-R80

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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.

Due to the mounting process for these tests and very high currents, $R_{DS(on)}$ (45A, 10V) absolute values are higher than specified in the Detail Specification – see also 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	14	1.2	
115	167	2.95	0.6	1.9	0.009	12.1	1.099	VE831125 #25
116	168	2.98	0.6	1.4	0.009	12.1	1.098	VE831125 #25
117	166	2.95	0.6	2.0	0.010	12.0	1.099	VE831125 #25
118	172	2.96	0.6	2.1	0.011	12.3	1.101	VE831125 #25
119	172	2.96	0.2	2.1	0.010	12.3	1.102	VE831125 #25
120	172	2.96	0.6	2.2	0.010	12.2	1.099	VE831125 #25
121	169	2.93	0.5	1.7	0.006	12.0	1.093	VE831125 #26
122	169	2.98	0.6	1.9	0.006	12.2	1.101	VE831125 #26
123	168	2.97	0.6	1.9	0.007	12.1	1.100	VE831125 #26
124	172	2.96	0.6	2.4	0.008	12.1	1.097	VE831125 #26
125	171	2.98	0.6	2.3	0.008	12.2	1.100	VE831125 #26
126	172	2.95	0.6	2.3	0.008	12.3	1.103	VE831125 #26
127	167	2.98	0.7	1.8	0.007	11.9	1.093	VE831125 #27
128	165	2.94	0.6	1.9	0.007	11.9	1.094	VE831125 #27
129	168	2.96	0.6	1.5	0.007	12.0	1.098	VE831125 #27
130	170	2.95	0.6	1.9	0.009	12.1	1.099	VE831125 #27
131	171	2.96	0.7	1.9	0.009	12.1	1.097	VE831125 #27
132	172	2.95	0.6	1.9	0.009	11.9	1.092	VE831125 #27
R76	168	2.87	0.6	1.7	0.008	12.7	1.118	
R77	170	2.89	0.5	1.7	0.006	12.7	1.121	
R78	167	2.90	0.5	1.7	0.006	12.5	1.114	
R79	165	2.87	0.5	1.5	0.006	12.5	1.115	
R80	165	2.88	0.5	1.7	0.006	12.6	1.120	

§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	14	1.2	
115	-4.8	-21.6	0.1	2.8	-3.0	-0.6	159	2.31	0.7	4.7	1.110	11.8	1.093	C1
116	-0.5	-30.2	0.1	0.5	-1.4	-0.1	167	2.08	0.7	1.9	0.027	11.9	1.096	C2
117	-0.4	-28.3	0.2	0.1	-0.9	-0.6	166	2.12	0.8	2.2	0.036	11.9	1.092	C3
118	-4.3	-21.2	0.2	1.2	-2.5	-0.6	164	2.33	0.8	3.2	1.323	12.0	1.095	C1
119	-0.5	-28.3	0.5	0.4	-1.4	-0.1	171	2.13	0.8	2.5	0.028	12.1	1.101	C2
120	-0.4	-28.7	0.2	0.1	-0.8	-0.8	171	2.11	0.7	2.3	0.036	12.1	1.090	C3
121	-5.0	-22.2	0.3	2.3	-3.5	-0.6	160	2.28	0.8	4.0	0.870	11.6	1.086	C1
122	-0.5	-26.3	0.1	0.2	-1.4	-0.2	168	2.20	0.7	2.1	0.025	12.0	1.099	C2
123	-0.4	-28.5	0.2	0.1	-0.9	-0.7	167	2.12	0.7	2.0	0.032	12.0	1.092	C3
124	-4.4	-21.7	0.1	2.2	-3.1	-0.5	165	2.32	0.8	4.6	1.852	11.8	1.091	C1
125	-0.4	-25.5	0.2	0.3	-1.3	-0.1	170	2.22	0.7	2.6	0.027	12.0	1.098	C2
126	-0.4	-28.9	0.2	0.1	-0.9	-0.8	171	2.10	0.7	2.4	0.034	12.2	1.094	C3
127	-5.4	-22.0	0.1	2.7	-3.3	-0.6	158	2.32	0.7	4.5	0.502	11.5	1.087	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	-0.6	-30.2	0.1	0.4	-1.2	-0.1	164	2.05	0.7	2.3	0.026	11.7	1.093	C2
129	-0.4	-28.3	0.2	0.5	-0.8	-0.8	167	2.12	0.8	2.0	0.032	11.9	1.089	C3
130	-3.8	-22.0	0.2	1.2	-2.2	-0.6	163	2.30	0.7	3.0	1.462	11.8	1.092	C1
131	-0.1	-28.4	0.1	0.7	-1.4	-0.1	171	2.12	0.7	2.7	0.028	11.9	1.096	C2
132	-0.4	-29.0	0.2	0.2	-0.9	-0.8	171	2.09	0.8	2.1	0.035	11.8	1.083	C3
R76	-0.0	0.4	0.1	0.2	-0.1	-0.0	168	2.89	0.7	1.9	0.007	12.7	1.118	Control
R77	0.2	0.2	0.2	0.2	0.0	-0.0	171	2.89	0.7	1.9	0.005	12.7	1.120	Control
R78	0.1	0.1	0.1	0.1	0.1	-0.0	168	2.90	0.7	1.8	0.006	12.5	1.114	Control
R79	0.0	0.2	0.1	0.4	-0.0	-0.0	165	2.88	0.6	1.9	0.006	12.5	1.114	Control
R80	-0.0	0.2	0.1	0.1	-0.0	0.0	165	2.89	0.7	1.8	0.006	12.6	1.120	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	14	1.2	
115	-4.3	-16.7	0.2	0.9	-3.2	-0.4	160	2.46	0.8	2.7	0.555	11.8	1.095	C1
116	-0.5	-27.7	0.1	0.6	-1.2	-0.1	167	2.16	0.7	2.1	0.027	11.9	1.096	C2
117	-0.3	-24.5	0.1	0.2	-0.7	-0.6	166	2.23	0.7	2.3	0.033	12.0	1.092	C3
118	-4.0	-16.1	0.2	0.6	-2.9	-0.4	165	2.49	0.7	2.7	0.869	12.0	1.097	C1
119	-0.4	-25.9	0.5	0.1	-1.2	-0.1	171	2.20	0.7	2.2	0.028	12.1	1.101	C2
120	-0.3	-25.2	0.3	-0.3	-0.7	-0.6	172	2.22	0.8	1.9	0.034	12.1	1.092	C3
121	-4.3	-17.6	0.3	0.8	-3.0	-0.4	161	2.42	0.7	2.5	0.426	11.6	1.088	C1
122	-0.4	-24.1	-0.0	0.0	-1.1	-0.2	168	2.26	0.6	1.9	0.025	12.1	1.099	C2
123	-0.3	-24.8	0.1	0.1	-0.7	-0.5	167	2.24	0.7	2.0	0.030	12.0	1.094	C3
124	-3.8	-17.0	0.1	0.2	-2.8	-0.4	166	2.45	0.7	2.6	0.747	11.8	1.092	C1
125	-0.4	-23.3	0.2	0.2	-0.9	-0.1	170	2.29	0.8	2.5	0.026	12.1	1.098	C2
126	-0.6	-25.3	0.2	-0.2	-1.0	-0.7	171	2.21	0.8	2.1	0.032	12.2	1.096	C3
127	-4.7	-17.5	0.1	0.8	-2.5	-0.3	159	2.46	0.7	2.6	0.342	11.6	1.089	C1
128	-0.5	-27.7	0.1	0.2	-1.0	-0.1	164	2.13	0.8	2.0	0.025	11.7	1.093	C2
129	-0.3	-24.6	0.1	0.6	-0.5	-0.6	168	2.23	0.7	2.0	0.030	11.9	1.091	C3
130	-3.4	-16.8	0.2	0.3	-2.8	-0.4	164	2.45	0.8	2.2	1.175	11.8	1.094	C1
131	-0.2	-25.9	-0.0	0.2	-1.1	-0.1	170	2.19	0.6	2.1	0.028	11.9	1.096	C2
132	-0.4	-25.4	0.2	-0.3	-0.5	-0.7	171	2.20	0.8	1.6	0.032	11.9	1.084	C3
R76	-0.0	0.5	0.1	-0.0	-0.2	-0.0	168	2.89	0.7	1.7	0.007	12.7	1.118	Control
R77	0.2	0.3	0.2	0.1	-0.1	-0.0	171	2.90	0.7	1.8	0.005	12.7	1.121	Control
R78	0.1	0.2	0.2	0.1	-0.1	0.1	168	2.90	0.7	1.8	0.006	12.5	1.116	Control
R79	-0.0	0.3	0.2	0.3	-0.5	0.0	165	2.88	0.7	1.8	0.006	12.5	1.115	Control
R80	-0.1	0.3	0.2	0.2	-0.3	0.0	165	2.89	0.7	1.9	0.006	12.5	1.120	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	14	1.2	
115	-3.2	-12.7	0.2	0.3	-2.8	-0.3	162	2.57	0.8	2.2	0.264	11.8	1.097	C1
116	-0.2	-24.7	0.1	0.6	-1.1	-0.3	167	2.25	0.8	2.0	0.023	11.9	1.094	C2
117	-0.1	-20.6	0.2	-0.2	-1.3	-0.7	166	2.34	0.8	1.9	0.022	11.9	1.091	C3

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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]	
118	-3.0	-11.9	0.2	0.2	-3.2	-0.5	167	2.61	0.7	2.3	0.242	11.9	1.095	C1
119	-0.3	-22.8	0.5	0.2	-1.5	-0.3	171	2.29	0.7	2.2	0.022	12.1	1.099	C2
120	-0.2	-21.1	0.1	0.1	-1.2	-0.8	172	2.34	0.7	2.3	0.022	12.0	1.090	C3
121	-3.3	-13.1	0.2	0.4	-3.3	-0.4	163	2.55	0.7	2.1	0.244	11.6	1.088	C1
122	-0.4	-21.0	0.1	0.1	-2.0	-0.3	168	2.36	0.7	2.0	0.017	11.9	1.098	C2
123	-0.2	-20.9	0.2	0.1	-1.1	-0.6	168	2.35	0.8	2.0	0.018	12.0	1.093	C3
124	-2.9	-12.6	0.2	0.1	-3.0	-0.5	167	2.59	0.8	2.5	0.238	11.8	1.092	C1
125	-0.3	-20.4	0.0	-0.2	-1.8	-0.2	170	2.37	0.6	2.1	0.019	11.9	1.097	C2
126	-0.2	-21.1	0.2	0.1	-1.3	-0.7	171	2.33	0.7	2.3	0.019	12.2	1.095	C3
127	-3.4	-13.5	0.1	0.2	-2.7	-0.5	161	2.58	0.7	2.0	0.269	11.6	1.087	C1
128	-0.5	-24.5	0.1	0.5	-1.5	-0.2	164	2.22	0.7	2.3	0.019	11.7	1.091	C2
129	-0.3	-20.2	-0.0	0.5	-1.6	-0.7	168	2.36	0.6	2.0	0.017	11.8	1.090	C3
130	-2.2	-12.8	0.1	0.3	-2.5	-0.5	166	2.57	0.7	2.2	0.262	11.8	1.093	C1
131	0.1	-22.9	0.1	0.2	-1.5	-0.3	171	2.28	0.8	2.1	0.021	11.9	1.093	C2
132	-0.3	-21.0	0.2	0.3	-1.5	-0.7	171	2.33	0.8	2.2	0.019	11.8	1.084	C3
R76	-0.1	0.6	0.1	0.2	-0.4	-0.0	168	2.89	0.7	1.9	0.007	12.6	1.118	Control
R77	0.2	0.4	0.2	0.1	-0.3	0.1	171	2.90	0.7	1.8	0.005	12.7	1.122	Control
R78	0.0	0.3	0.1	0.2	-0.3	0.0	167	2.90	0.7	1.9	0.006	12.5	1.115	Control
R79	-0.1	0.4	0.2	0.4	-0.3	0.0	165	2.88	0.7	1.8	0.006	12.5	1.115	Control
R80	-0.1	0.5	0.1	0.2	-0.4	0.0	164	2.90	0.7	1.9	0.005	12.5	1.120	Control

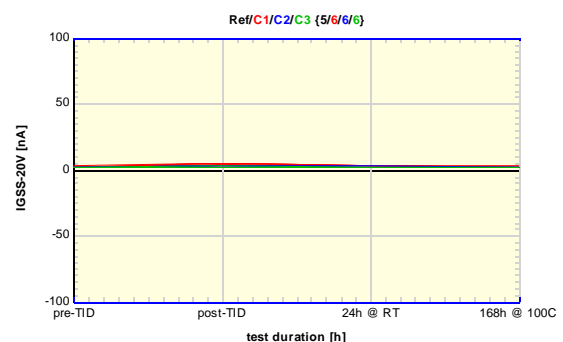
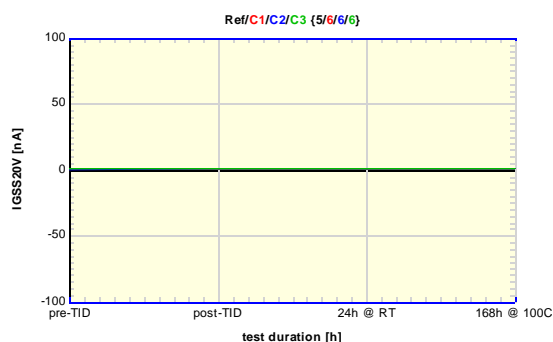
§7.3 GRAPHICAL REPRESENTATION OF ELECTRICAL MEASUREMENTS

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

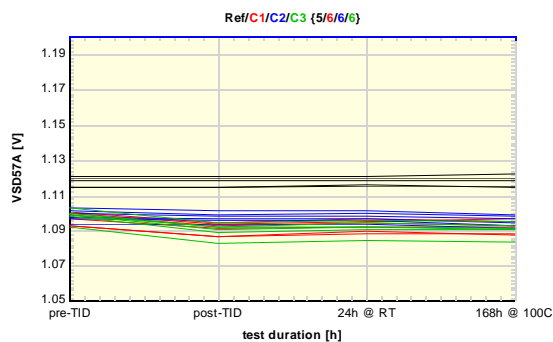
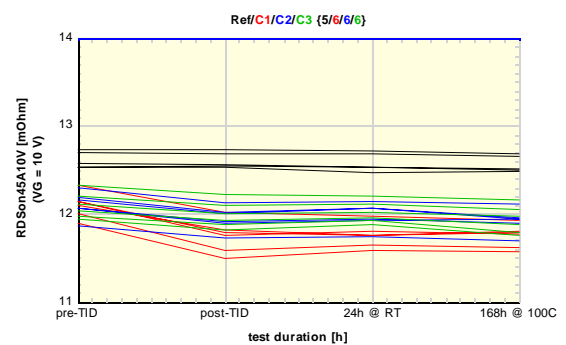
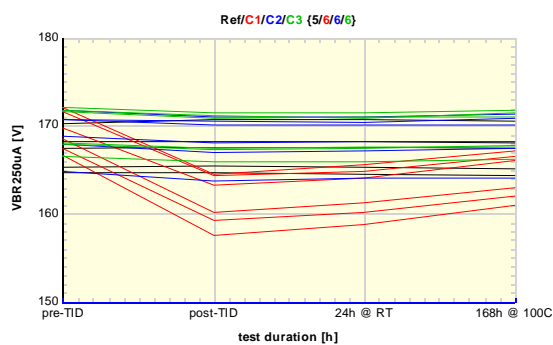
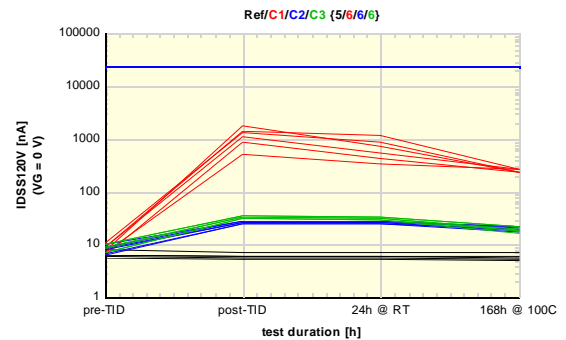
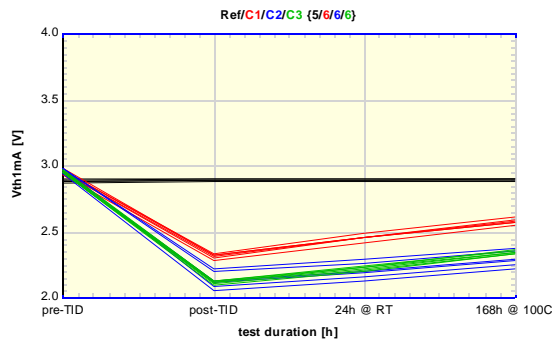
1. Prior to irradiation (pre-TID),
2. Post-irradiation (post-TID),
3. Posterior to room-temperature anneal of 24 hours (24h@RT),
4. Posterior to 168 hours of anneal at 100°C (168h@100°C) .

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 BUY15CS57A-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.