

Infineon technologies HiRel Discrete & MW Semiconductors	ESCC Comp. No.: 520502701R	Page: 1
	Wafer Lot: VE633218	Rep.No.: VE633218TID Issue: Iss. 1, Aug 2021
	Total Dose Steady-State Irradiation Test Report BUY25CS54A-01(ES)	

§1 COVER SHEET

• Component and Test Identification

Comp. Type	BUY25CS54A-01(ES)
ESCC Comp. No.	520502701R
Lot Ident.	Wafer Lot No. VE633218
	Assembly Lot n.a.
	ESA Date Code n.a.
	Radiation Testing Level R: 100kRad
Test data	Test Plan TPIFX1827B
	Tested Sample Serial No.s 283-300
	Control Sample Serial No.s R19-R23

• Applicable Documents

Detail Specification	ESCC 5205/027 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	

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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 BUY25CS54A-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 VE633218 for type BUY25CS54A-01(ES) (ESCC detail specification No. 5205/027).

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.

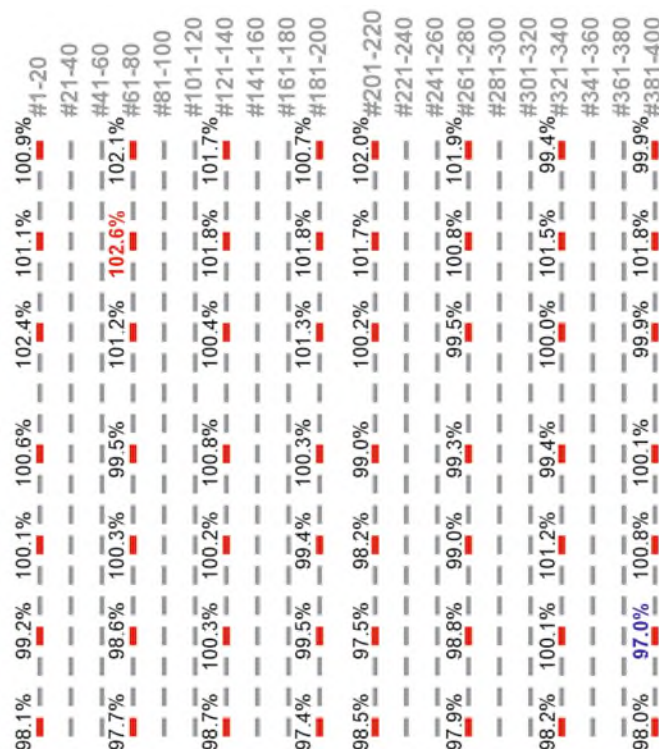


Fig. 1: Measured gamma intensity within the container at marked sample positions. Maximum and minimum measured intensities are marked – 102.6% and 97.0%.

§5 DEVICES MARKINGS AND SAMPLE PREPARATION

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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.

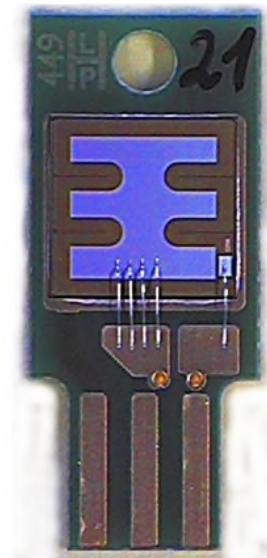


Fig. 2: Die mounted on PCB for TID testing – soldered and wire-bonded

§6 IRRADIATION CONDITIONS

The irradiation step had a duration of 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

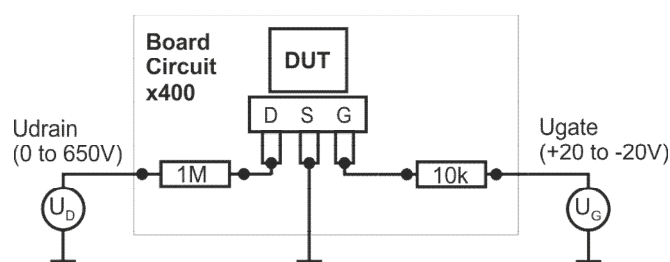


Fig. 3 Bias circuit for TID tests

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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
BUY25CS54A-01(ES) silicon chips used for C1 condition	6	C1	#283,286,289,292,295,298
BUY25CS54A-01(ES) silicon chips used for C2 condition	6	C2	#284,287,290,293,296,299
BUY25CS54A-01(ES) silicon chips used for C3 condition	6	C3	#285,288,291,294,297,300
BUY25CS54A-01(ES) silicon chips used as control samples (not irradiated, not annealed)	5	control	#R19-R23

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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	250	2						
max	4	100	100	25	30	1.2		
283	286	2.92	0.8	1.9	0.006	20.9	1.096	VE633218 #20
284	283	2.97	0.8	2.0	0.006	21.2	1.102	VE633218 #20
285	287	2.90	0.9	2.2	0.007	21.4	1.103	VE633218 #20
286	287	3.00	0.7	2.0	0.007	21.6	1.100	VE633218 #20
287	288	2.99	0.8	1.9	0.007	21.6	1.096	VE633218 #20
288	289	2.99	0.9	1.9	0.007	21.6	1.095	VE633218 #20
289	284	2.96	0.9	2.0	0.006	21.3	1.106	VE633218 #21
290	281	2.93	0.8	2.0	0.006	20.8	1.096	VE633218 #21
291	282	2.90	0.8	1.9	0.006	21.3	1.105	VE633218 #21
292	290	2.96	0.8	1.8	0.006	21.8	1.102	VE633218 #21
293	288	2.99	0.8	1.9	0.007	21.7	1.097	VE633218 #21
294	288	2.98	0.8	1.9	0.006	21.6	1.100	VE633218 #21
295	287	2.99	0.8	2.0	0.006	21.4	1.104	VE633218 #22
296	284	2.96	0.8	2.0	0.006	21.2	1.099	VE633218 #22
297	287	2.96	0.8	2.0	0.006	21.4	1.108	VE633218 #22
298	288	3.01	0.9	2.0	0.007	21.8	1.107	VE633218 #22
299	290	3.00	0.9	1.9	0.007	21.7	1.105	VE633218 #22
300	289	3.01	0.9	2.0	0.007	21.7	1.101	VE633218 #22
R19	291	2.98	0.8	1.9	0.007	21.7	1.101	
R20	289	2.90	0.8	1.9	0.006	21.4	1.109	
R21	288	2.97	0.8	1.9	0.006	21.7	1.108	
R22	290	2.91	0.8	1.9	0.006	21.4	1.108	
R23	290	2.94	0.8	1.8	0.007	21.4	1.105	

§7.2.2 ELECTRICAL MEASUREMENTS AFTER IRRADIATION

	Drift Deltas post irradiation						Absolute Values post irradiation							Bias Cond.
	BV(DSS)	VGS(TH)	IGSS	IGSS-	RDS(ON)	VSD	BV(DSS)	VGS(TH)	IGSS	IGSS-	IDSS	RDS(ON)	VSD	
S/N	[%]	[%]	[nA]	[nA]	[%]	[%]	[V]	[V]	[nA]	[nA]	[uA]	[mOhm]	[V]	
min	-20%	-50%	-20nA	-20nA	-20%	-10%	250	2						
max	+20%	+10%	+20nA	+20nA	+20%	+10%		4	100	100	25	30	1.2	
283	-0.2	-20.9	0.0	1.4	-2.8	-0.3	285	2.31	0.8	3.4	8.497	20.3	1.093	C1
284	-0.1	-30.4	0.0	0.1	-1.2	-0.1	282	2.07	0.8	2.1	0.029	20.9	1.101	C2
285	-0.1	-29.3	-0.1	-0.2	-0.8	-0.6	287	2.05	0.8	2.0	0.042	21.3	1.096	C3
286	-0.2	-20.7	0.1	1.6	-2.8	-0.4	286	2.38	0.8	3.5	5.768	21.0	1.096	C1
287	-0.1	-30.9	-0.1	0.2	-1.2	-0.1	288	2.07	0.8	2.1	0.029	21.3	1.095	C2
288	-0.1	-28.4	-0.0	-0.0	-0.8	-0.6	289	2.14	0.8	1.9	0.041	21.5	1.089	C3
289	-0.1	-22.4	-0.0	1.8	-2.7	-0.5	283	2.30	0.8	3.8	10.094	20.7	1.101	C1
290	-0.1	-29.5	0.0	0.1	-1.3	-0.0	281	2.06	0.8	2.1	0.028	20.6	1.096	C2
291	-0.1	-29.0	0.1	-0.0	-0.9	-0.7	282	2.06	0.9	1.9	0.041	21.1	1.097	C3
292	-0.2	-20.8	0.1	1.8	-2.9	-0.4	289	2.35	0.9	3.7	5.820	21.2	1.098	C1
293	-0.1	-32.7	0.0	0.2	-1.2	-0.1	288	2.01	0.8	2.1	0.029	21.4	1.096	C2
294	-0.1	-28.6	0.0	-0.0	-0.6	-0.6	288	2.13	0.8	1.9	0.041	21.5	1.094	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]	
295	-0.2	-21.8	0.0	1.9	-2.9	-0.3	287	2.34	0.8	3.9	8.414	20.8	1.100	C1
296	-0.1	-30.6	-0.0	0.2	-1.1	-0.0	284	2.06	0.8	2.2	0.029	21.0	1.098	C2
297	-0.1	-28.3	-0.0	-0.3	-0.7	-0.6	287	2.12	0.8	1.7	0.041	21.3	1.102	C3
298	-0.2	-20.2	0.0	1.9	-2.7	-0.4	287	2.40	0.9	3.9	4.570	21.2	1.102	C1
299	-0.1	-32.3	-0.0	0.1	-1.1	-0.1	290	2.03	0.8	2.0	0.029	21.5	1.104	C2
300	-0.1	-28.2	-0.0	-0.4	-0.6	-0.6	288	2.16	0.9	1.5	0.041	21.5	1.094	C3
R19	-0.0	0.0	0.1	0.1	0.0	-0.0	291	2.98	0.9	1.9	0.007	21.7	1.101	Control
R20	-0.0	0.1	0.0	-0.1	-0.4	-0.2	289	2.90	0.8	1.8	0.006	21.3	1.107	Control
R21	-0.0	0.1	-0.0	-0.0	-0.2	-0.0	288	2.98	0.8	1.9	0.006	21.7	1.108	Control
R22	-0.0	0.2	-0.1	0.0	-0.0	-0.1	290	2.91	0.7	1.9	0.006	21.3	1.107	Control
R23	-0.0	0.2	-0.0	0.2	-0.1	0.0	290	2.95	0.8	1.9	0.006	21.4	1.106	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	30	1.2	
283	-0.1	-16.4	0.0	0.4	-2.1	-0.3	285	2.44	0.9	2.3	0.453	20.5	1.093	C1
284	-0.0	-27.8	0.0	0.2	-0.8	-0.1	282	2.14	0.8	2.2	0.029	21.0	1.101	C2
285	-0.0	-25.3	-0.0	-0.2	-0.3	-0.5	287	2.17	0.8	2.0	0.039	21.4	1.097	C3
286	-0.1	-16.2	0.2	0.4	-2.2	-0.3	287	2.52	0.9	2.3	0.350	21.1	1.097	C1
287	-0.0	-28.3	0.0	-0.0	-0.9	-0.1	288	2.14	0.9	1.9	0.029	21.4	1.095	C2
288	-0.0	-24.5	-0.0	0.0	-0.3	-0.5	289	2.26	0.9	2.0	0.037	21.6	1.090	C3
289	-0.0	-17.6	-0.0	0.4	-1.9	-0.4	283	2.44	0.8	2.4	0.484	20.9	1.102	C1
290	-0.0	-26.9	-0.0	-0.1	-0.9	-0.1	281	2.14	0.8	1.9	0.029	20.7	1.096	C2
291	-0.1	-25.0	0.0	0.0	-0.4	-0.5	282	2.17	0.8	1.9	0.037	21.2	1.099	C3
292	-0.0	-16.3	0.0	0.5	-2.3	-0.3	290	2.48	0.9	2.4	0.347	21.3	1.099	C1
293	-0.0	-30.1	-0.0	-0.0	-1.0	-0.0	288	2.09	0.8	1.9	0.029	21.5	1.096	C2
294	-0.1	-24.6	0.0	0.0	-0.2	-0.4	288	2.25	0.8	1.9	0.038	21.6	1.095	C3
295	-0.1	-17.1	0.0	0.3	-2.3	-0.3	287	2.48	0.9	2.3	0.432	20.9	1.101	C1
296	-0.1	-28.1	-0.0	-0.1	-0.8	-0.0	284	2.13	0.8	1.9	0.029	21.1	1.099	C2
297	-0.0	-24.4	0.0	-0.0	-0.4	-0.4	287	2.24	0.9	1.9	0.037	21.3	1.103	C3
298	-0.1	-15.7	0.0	0.4	-2.1	-0.3	287	2.54	0.9	2.4	0.316	21.3	1.103	C1
299	-0.0	-29.6	0.0	-0.3	-0.8	-0.1	290	2.11	0.9	1.6	0.029	21.6	1.104	C2
300	-0.0	-24.3	0.0	0.0	-0.3	-0.5	288	2.28	0.9	2.0	0.037	21.6	1.095	C3
R19	0.0	0.1	-0.0	0.1	0.1	-0.0	291	2.99	0.8	2.0	0.008	21.7	1.101	Control
R20	0.0	0.1	0.0	-0.0	-0.0	-0.2	289	2.90	0.8	1.8	0.007	21.4	1.107	Control
R21	-0.0	0.2	-0.0	-0.1	-0.0	-0.0	288	2.98	0.8	1.9	0.007	21.7	1.108	Control
R22	-0.0	0.2	-0.0	-0.2	-0.1	-0.1	290	2.91	0.8	1.6	0.007	21.3	1.107	Control
R23	-0.0	0.2	-0.0	-0.1	-0.0	0.0	290	2.95	0.8	1.7	0.007	21.4	1.106	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	30	1.2	
283	-0.0	-11.8	0.0	-0.1	-2.5	-0.3	286	2.58	0.9	1.8	0.205	20.4	1.093	C1

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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]	
284	-0.0	-24.2	0.1	0.2	-1.8	-0.2	283	2.25	0.9	2.2	0.024	20.8	1.099	C2
285	-0.0	-21.1	0.0	-0.3	-1.3	-0.6	287	2.29	0.9	2.0	0.024	21.1	1.096	C3
286	-0.0	-12.0	0.1	0.0	-2.6	-0.4	287	2.64	0.8	2.0	0.199	21.1	1.096	C1
287	-0.0	-25.1	0.0	0.0	-1.8	-0.2	288	2.24	0.8	2.0	0.022	21.2	1.094	C2
288	0.0	-20.5	-0.0	-0.0	-1.4	-0.6	289	2.38	0.8	1.9	0.023	21.3	1.089	C3
289	0.0	-13.2	-0.0	-0.1	-2.4	-0.5	284	2.57	0.8	1.9	0.200	20.8	1.101	C1
290	-0.0	-23.7	0.1	-0.0	-2.0	-0.2	281	2.23	0.9	2.0	0.023	20.4	1.094	C2
291	-0.1	-21.0	-0.1	0.0	-1.5	-0.6	282	2.29	0.7	1.9	0.023	20.9	1.098	C3
292	-0.0	-12.0	0.0	0.1	-2.9	-0.4	290	2.61	0.9	2.0	0.198	21.2	1.098	C1
293	-0.0	-26.4	0.0	-0.0	-1.9	-0.2	288	2.20	0.9	1.9	0.022	21.3	1.094	C2
294	-0.0	-20.5	0.0	-0.0	-1.3	-0.6	288	2.37	0.8	1.9	0.023	21.3	1.094	C3
295	-0.0	-12.6	0.0	-0.0	-2.8	-0.4	287	2.61	0.8	2.0	0.198	20.8	1.100	C1
296	-0.0	-24.4	-0.1	-0.0	-1.9	-0.2	284	2.24	0.8	2.0	0.024	20.8	1.097	C2
297	0.0	-20.3	-0.1	-0.0	-1.4	-0.7	287	2.36	0.8	2.0	0.024	21.1	1.101	C3
298	-0.1	-11.4	0.0	0.0	-2.6	-0.3	287	2.66	0.9	2.0	0.193	21.2	1.103	C1
299	-0.0	-25.7	0.0	-0.1	-1.8	-0.2	290	2.23	0.9	1.9	0.023	21.4	1.102	C2
300	0.0	-20.0	0.0	0.0	-1.4	-0.6	289	2.41	0.9	2.0	0.023	21.4	1.094	C3
R19	-0.1	0.1	0.0	0.1	-0.5	0.1	290	2.99	0.8	1.9	0.008	21.6	1.102	Control
R20	-0.1	0.3	-0.0	-0.0	-0.7	-0.1	289	2.91	0.8	1.9	0.007	21.3	1.108	Control
R21	-0.1	0.1	-0.0	-0.0	-0.7	0.0	288	2.98	0.8	1.9	0.007	21.6	1.109	Control
R22	-0.1	-0.0	-0.0	0.0	-0.5	0.0	290	2.91	0.8	1.9	0.007	21.2	1.108	Control
R23	-0.1	0.2	-0.1	0.1	-0.5	0.1	290	2.95	0.7	1.9	0.008	21.3	1.106	Control

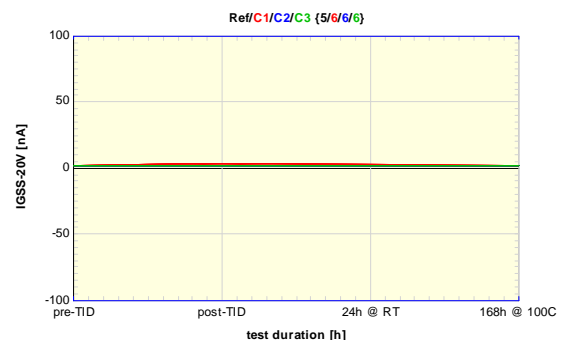
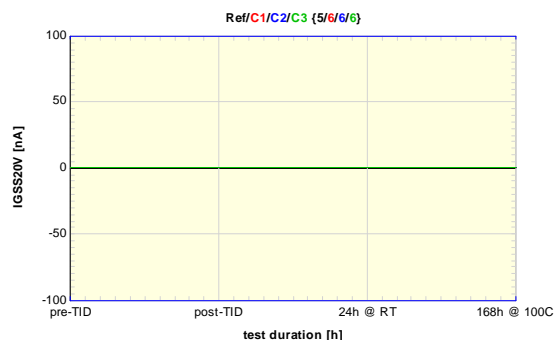
§7.3 GRAPHICAL REPRESENTATION OF ELECTRICAL MEASUREMENTS

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

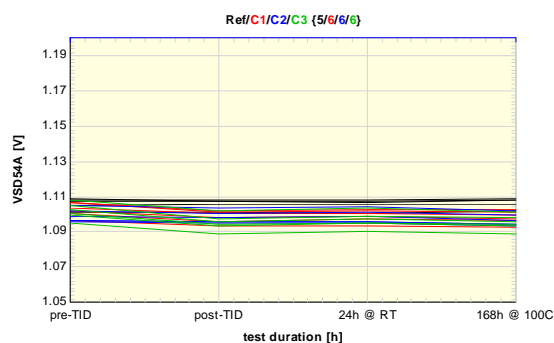
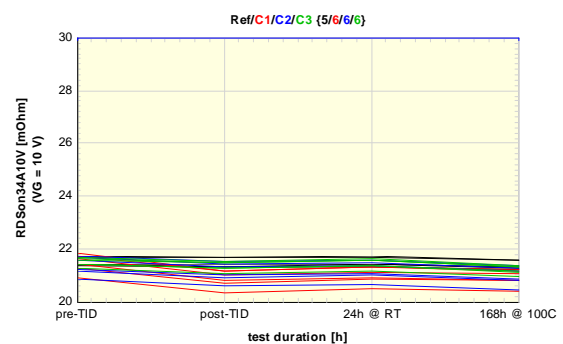
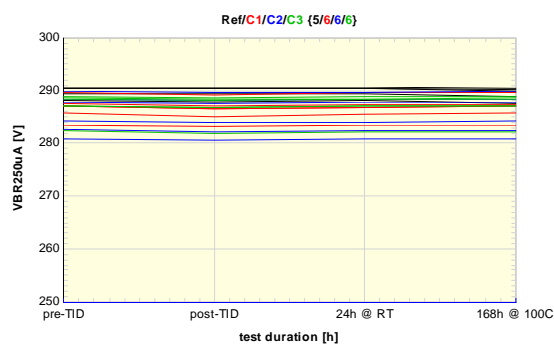
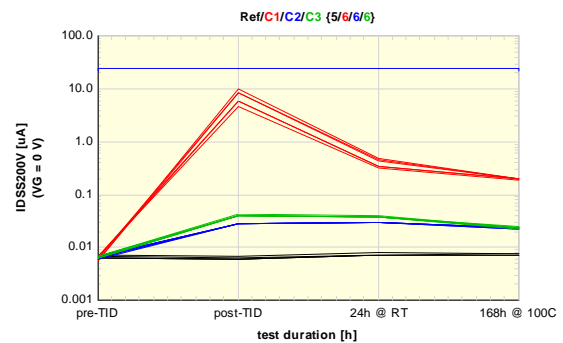
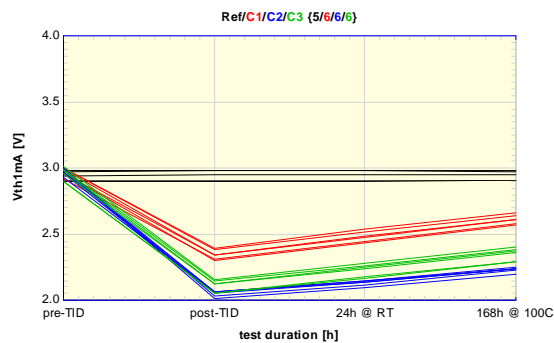
1. Prior to irradiation (pre-TID),
2. Post-irradiation (post-TID),
3. Posterior to room-temperature anneal of 24 hours (24h@RT),
4. Posterior to 168 hours of anneal at 100°C (168h@100°C) .

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 BUY25CS54A-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.