

Infineon technologies HiRel Discrete & MW Semiconductors	ESCC Comp. No.: 520503203R	Page: 1
	Wafer Lot: VE843932	Rep.No.: VE843932TID Issue: Iss. 1, Dec. 2019
	Total Dose Steady-State Irradiation Test Report BUY06CS23K-01(ES)	

§1 COVER SHEET

• Component and Test Identification

Comp. Type	BUY06CS23K-01(ES)
ESCC Comp. No.	520503203R
Lot Ident. Wafer Lot No.	VE843932
Assembly Lot	n.a.
ESA Date Code	n.a.
Radiation Testing Level	R: 100kRad
Test data Test Plan	TPIFX1827A
Tested Sample Serial No.s	153-170
Control Sample Serial No.s	R110,R112-R114

• Applicability of Test Results

Comp. Types	BUY06CS35J-01(ES) BUY06CS23K-01(ES)
ESCC Comp. Nos.	520503201R 520503203R

• Applicable Documents

Detail Specification	ESCC 5205/032 Issue 1, Sep. 2019
Generic Specification	ESCC 5000 Issue 8, Jun. 2019
Process Identification Document	A63500-L5491-P000_Detail_PID_BUY25CS_8
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. 2019

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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§2 DOCUMENT INFORMATION

§2.1 CHANGE DESCRIPTION SHEET

Issue	Page	Para	Description
1	All	All	Initial Issue

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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 BUY06CS23K-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 VE843932 for type BUY06CS23K-01(ES) (ESCC detail specification No. 5205/032). This report is applicable for type BUY06CS35J-01(ES) as well, since the two types share the same chip type.

Test campaign TID 50 has been performed at the facility JS-9000 in Germany on the 23.7.2019.

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.

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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.

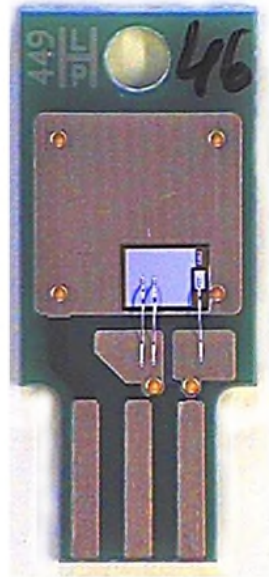


Fig. 2: Die mounted on PCB for TID testing – soldered and wire-bonded

§6 IRRADIATION CONDITIONS

The irradiation step had a duration of 3h 48 min at a dose rate of 33.2 krad/h which yields a total ionizing dose of 126 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

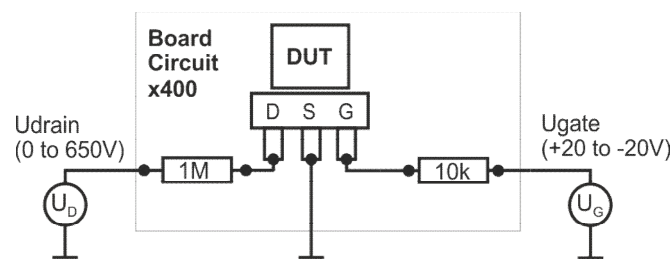


Fig. 3 Bias circuit for TID tests

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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	22	0	22	avail.	4 control samples included
Irradiation / Drift Value	22	0	22	avail.	4 control samples included
24h @ RT anneal / Drift Value	22	0	22	avail.	4 control samples included
168h @ 100°C / Drift Value	22	0	22	avail.	4 control samples included

Sample distribution within the bias conditions

Item	Qty	Part Notation in R&R Tables	
		Subgroup	Part SG S/Ns
BUY06CS23K-01(ES) silicon chips used for C1 condition	6	C1	#153,156,159,162,165,168
BUY06CS23K-01(ES) silicon chips used for C2 condition	6	C2	#154,157,160,163,166,169
BUY06CS23K-01(ES) silicon chips used for C3 condition	6	C3	#155,158,161,164,167,170
BUY06CS23K-01(ES) silicon chips used as control samples (not irradiated, not annealed)	4	control	#R110,R112-R114

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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	40	1.3		
153	75	3.14	0.9	2.3	0.001	33	1.086	VE843932 #5
154	76	3.15	1.1	2.5	0.001	33	1.088	VE843932 #5
155	75	3.13	1.4	2.1	0.001	34	1.090	VE843932 #5
156	76	3.21	1.4	2.2	0.001	34	1.087	VE843932 #5
157	76	3.23	1.2	2.3	0.001	33	1.084	VE843932 #5
158	76	3.22	1.3	2.0	0.001	34	1.084	VE843932 #5
159	75	3.19	1.3	2.1	0.001	34	1.089	VE843932 #6
160	76	3.14	1.2	2.5	0.001	34	1.090	VE843932 #6
161	74	3.17	1.2	2.2	0.001	34	1.091	VE843932 #6
162	75	3.20	1.3	2.2	0.001	34	1.084	VE843932 #6
163	75	3.20	1.1	2.0	0.001	34	1.088	VE843932 #6
164	75	3.20	1.5	2.2	0.001	34	1.084	VE843932 #6
165	75	3.12	1.2	1.8	0.001	33	1.087	VE843932 #7
166	74	3.14	1.0	2.3	0.001	33	1.087	VE843932 #7
167	73	3.13	1.1	2.0	0.001	33	1.085	VE843932 #7
168	74	3.21	1.3	2.4	0.001	34	1.083	VE843932 #7
169	75	3.22	1.6	2.3	0.001	34	1.085	VE843932 #7
170	75	3.22	1.2	2.3	0.001	34	1.083	VE843932 #7
R110	75	3.11	1.2	2.1	0.001	33	1.084	
R112	75	3.12	1.2	1.8	0.001	33	1.082	
R113	76	3.10	1.3	2.1	0.001	33	1.082	
R114	76	3.12	1.1	2.2	0.001	34	1.082	

§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						
max	+20%	+10%	+20nA	+20nA	+20%	+10%	4	100	100	25	40	1.3		
153	-3.5	-20.9	-0.4	-1.3	-6.4	-0.2	73	2.48	0.5	1.0	0.058	31	1.084	C1
154	-0.2	-28.3	-0.6	-1.6	-2.0	-0.1	75	2.26	0.5	0.9	0.005	32	1.087	C2
155	-0.1	-27.3	-0.9	-1.3	-1.2	-0.5	75	2.28	0.5	0.8	0.006	33	1.085	C3
156	-3.2	-20.7	-0.9	-1.2	-6.1	-0.4	73	2.55	0.5	1.0	0.057	32	1.083	C1
157	-0.2	-27.2	-0.7	-1.4	-2.0	-0.1	76	2.35	0.5	0.9	0.005	33	1.082	C2
158	-0.1	-26.8	-0.8	-1.2	-1.2	-0.5	76	2.36	0.5	0.8	0.007	33	1.078	C3
159	-3.3	-21.0	-0.8	-1.1	-6.1	-0.3	72	2.52	0.5	1.0	0.061	31	1.085	C1
160	-0.2	-31.0	-0.7	-1.6	-2.1	-0.2	75	2.17	0.5	0.8	0.005	33	1.088	C2
161	-0.1	-27.3	-0.6	-1.3	-1.1	-0.5	74	2.30	0.5	0.9	0.006	34	1.086	C3
162	-2.9	-20.6	-0.8	-1.2	-6.0	-0.4	73	2.54	0.5	1.0	0.058	32	1.080	C1
163	-0.1	-28.6	-0.6	-1.2	-2.0	-0.2	75	2.28	0.5	0.8	0.005	33	1.086	C2
164	-0.1	-27.1	-1.0	-1.4	-1.1	-0.5	75	2.33	0.5	0.8	0.007	33	1.079	C3
165	-3.6	-21.8	-0.7	-0.8	-6.6	-0.6	72	2.44	0.5	1.0	0.062	31	1.081	C1
166	-0.2	-29.1	-0.5	-1.4	-2.1	-0.2	74	2.23	0.5	0.9	0.006	33	1.085	C2

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	Drift Deltas post irradiation						Absolute Values post irradiation							Bias Cond.
	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]	
167	-0.1	-27.1	-0.6	-1.2	-0.8	-0.4	73	2.28	0.5	0.8	0.006	33	1.080	C3
168	-3.2	-21.0	-0.7	-1.4	-6.5	-0.4	72	2.53	0.5	1.0	0.059	32	1.079	C1
169	-0.1	-27.3	-1.2	-1.5	-1.8	-0.2	74	2.34	0.5	0.8	0.005	33	1.082	C2
170	-0.1	-26.9	-0.7	-1.4	-1.1	-0.4	74	2.36	0.5	0.8	0.007	33	1.079	C3
R110	-0.1	0.2	-0.7	-1.3	-0.4	0.1	75	3.12	0.5	0.8	0.001	33	1.085	Control
R112	-0.1	0.2	-0.7	-1.1	-0.8	0.1	75	3.12	0.5	0.8	0.001	33	1.082	Control
R113	-0.1	0.2	-0.8	-1.2	-0.5	0.0	76	3.11	0.5	0.8	0.001	33	1.082	Control
R114	-0.1	0.2	-0.6	-1.4	-0.5	0.0	76	3.13	0.5	0.8	0.001	33	1.082	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	40	1.3	
153	-3.1	-16.4	-0.4	-1.4	-6.2	-0.1	73	2.63	0.4	0.9	0.036	31	1.085	C1
154	-0.3	-25.9	-0.7	-1.7	-2.4	-0.1	75	2.34	0.5	0.8	0.004	32	1.087	C2
155	-0.2	-24.4	-0.9	-1.3	-1.5	-0.3	75	2.37	0.5	0.8	0.005	33	1.086	C3
156	-2.9	-16.1	-0.9	-1.3	-6.0	-0.2	74	2.69	0.5	0.9	0.035	32	1.085	C1
157	-0.3	-24.8	-0.8	-1.5	-2.5	-0.1	76	2.43	0.5	0.8	0.004	33	1.083	C2
158	-0.2	-24.1	-0.8	-1.2	-1.5	-0.4	76	2.45	0.5	0.8	0.005	33	1.080	C3
159	-3.0	-16.4	-0.8	-1.2	-6.3	-0.2	73	2.67	0.5	0.9	0.037	31	1.087	C1
160	-0.3	-28.3	-0.7	-1.6	-2.5	0.1	75	2.25	0.5	0.8	0.004	33	1.091	C2
161	-0.2	-24.5	-0.7	-1.3	-1.5	-0.4	74	2.39	0.5	0.9	0.005	34	1.087	C3
162	-2.7	-15.9	-0.8	-1.2	-6.0	-0.2	73	2.69	0.5	1.0	0.035	32	1.082	C1
163	-0.3	-26.1	-0.6	-1.2	-2.5	-0.1	75	2.36	0.6	0.9	0.004	33	1.087	C2
164	-0.2	-24.3	-1.0	-1.3	-1.6	-0.4	75	2.42	0.5	0.8	0.005	33	1.080	C3
165	-3.3	-17.1	-0.7	-0.9	-6.8	-0.4	72	2.59	0.5	0.9	0.038	31	1.083	C1
166	-0.3	-26.6	-0.6	-1.4	-2.5	-0.1	74	2.31	0.5	0.9	0.004	32	1.086	C2
167	-0.2	-24.3	-0.7	-1.2	-1.2	-0.3	73	2.37	0.5	0.8	0.005	33	1.082	C3
168	-2.9	-16.4	-0.8	-1.5	-6.6	-0.0	72	2.68	0.5	0.9	0.035	31	1.083	C1
169	-0.3	-24.9	-1.1	-1.5	-2.6	-0.1	74	2.42	0.5	0.8	0.004	33	1.083	C2
170	-0.2	-24.1	-0.7	-1.4	-1.5	-0.3	74	2.45	0.5	0.9	0.005	33	1.080	C3
R110	0.0	-0.0	-0.7	-1.3	-0.0	0.0	75	3.11	0.5	0.8	0.001	33	1.084	Control
R112	-0.0	0.0	-0.6	-1.0	-0.3	0.0	75	3.12	0.5	0.8	0.001	33	1.082	Control
R113	-0.0	-0.0	-0.8	-1.3	-0.1	-0.0	76	3.10	0.5	0.8	0.001	33	1.081	Control
R114	0.0	-0.1	-0.6	-1.4	-0.0	0.0	76	3.12	0.5	0.8	0.001	33	1.082	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	40	1.3	
153	-2.4	-12.9	-0.5	-1.5	-5.3	-0.3	73	2.74	0.4	0.9	0.030	32	1.082	C1
154	-0.2	-22.4	-0.7	-1.7	-2.3	-0.1	75	2.45	0.5	0.8	0.003	32	1.086	C2
155	-0.2	-20.4	-0.9	-1.3	-2.0	-0.4	75	2.49	0.5	0.8	0.002	33	1.085	C3
156	-2.2	-12.7	-0.9	-1.4	-5.0	-0.3	74	2.80	0.5	0.8	0.030	32	1.084	C1
157	-0.2	-21.6	-0.7	-1.5	-2.2	-0.2	76	2.53	0.5	0.8	0.003	33	1.082	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]	
158	-0.2	-19.9	-0.8	-1.2	-2.4	-0.4	76	2.58	0.5	0.8	0.002	33	1.079	C3
159	-2.3	-12.9	-0.8	-1.3	-5.1	-0.2	73	2.77	0.5	0.8	0.031	32	1.086	C1
160	-0.3	-24.7	-0.7	-1.6	-2.6	-0.2	75	2.37	0.5	0.8	0.003	33	1.088	C2
161	-0.2	-20.4	-0.7	-1.4	-1.9	-0.4	74	2.52	0.5	0.8	0.002	33	1.087	C3
162	-2.0	-12.4	-0.9	-1.3	-5.0	-0.3	74	2.80	0.5	0.9	0.030	32	1.081	C1
163	-0.2	-22.7	-0.7	-1.2	-2.3	-0.2	75	2.47	0.5	0.8	0.003	33	1.085	C2
164	-0.1	-20.1	-1.0	-1.3	-2.0	-0.5	75	2.55	0.5	0.8	0.003	33	1.079	C3
165	-2.5	-13.4	-0.7	-1.0	-5.4	-0.5	73	2.70	0.5	0.8	0.032	32	1.082	C1
166	-0.3	-23.0	-0.6	-1.5	-2.6	-0.2	74	2.42	0.5	0.8	0.003	32	1.085	C2
167	-0.2	-20.3	-0.6	-1.2	-1.7	-0.3	73	2.49	0.5	0.8	0.002	33	1.081	C3
168	-2.2	-12.9	-0.7	-1.5	-5.6	-0.4	73	2.79	0.5	0.9	0.030	32	1.080	C1
169	-0.2	-21.6	-1.1	-1.5	-2.5	-0.1	74	2.53	0.5	0.8	0.003	33	1.084	C2
170	-0.2	-19.9	-0.7	-1.4	-1.9	-0.4	74	2.58	0.5	0.9	0.002	33	1.079	C3
R110	-0.1	0.1	-0.7	-1.8	-0.4	0.0	75	3.12	0.5	0.4	0.001	33	1.085	Control
R112	-0.1	0.2	-0.7	-1.1	-0.8	0.0	75	3.13	0.5	0.8	0.001	33	1.082	Control
R113	-0.1	0.2	-0.8	-1.3	-0.6	-0.0	76	3.11	0.5	0.8	0.001	33	1.081	Control
R114	-0.1	0.2	-0.6	-1.4	-0.5	0.1	76	3.13	0.5	0.8	0.001	33	1.083	Control

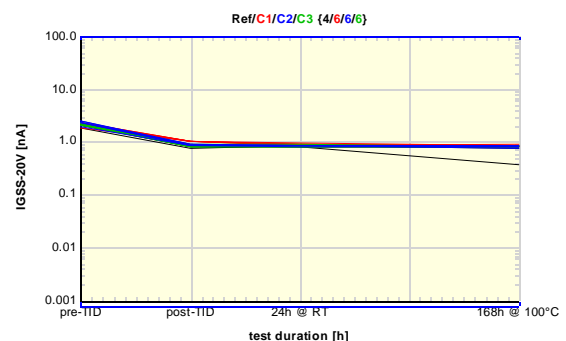
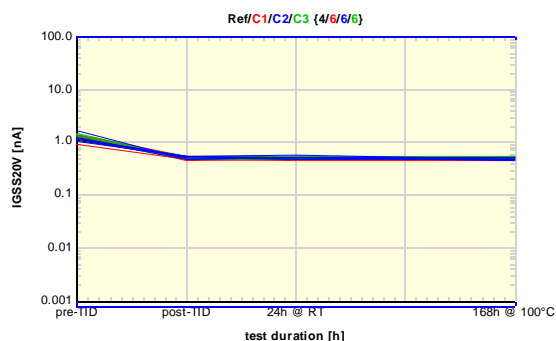
§7.3 GRAPHICAL REPRESENTATION OF ELECTRICAL MEASUREMENTS

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

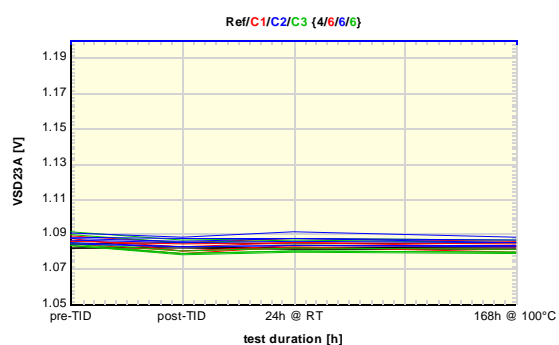
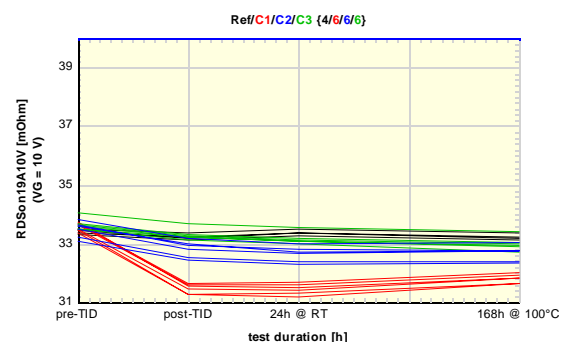
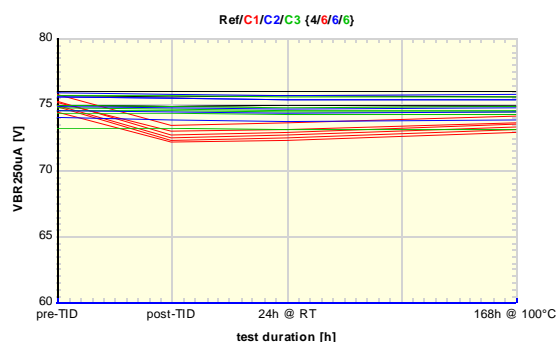
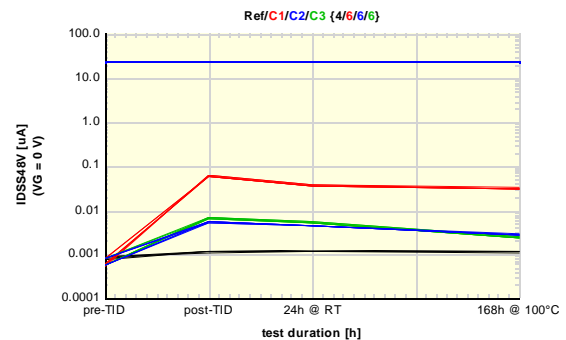
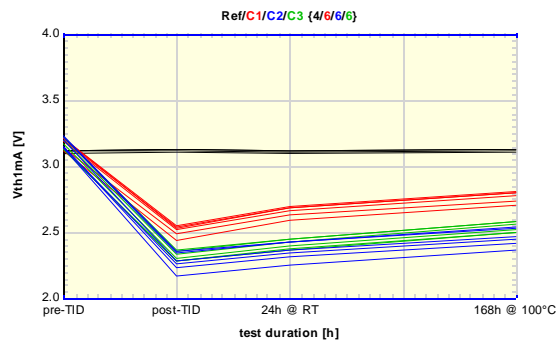
1. Prior to irradiation (pre-TID),
2. Post-irradiation (post-TID),
3. Posterior to room-temperature anneal of 24 hours (24h@RT),
4. Posterior to 168 hours of anneal at 100°C (168h@100°C) .

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 BUY06CS23K-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.