

<b>Infineon</b> technologies  <b>HiRel Discrete &amp; MW Semiconductors</b>	ESCC Comp. No.: 520502602R	Page: 1
	Wafer Lot: VE507720	Rep.No.: VE507720TID Issue: Iss. 1, Dec. 2021
	<b>Total Dose Steady-State Irradiation Test Report</b> <b>BUY25CS04J-01(ES)</b>	

## §1 COVER SHEET

### • Component and Test Identification

<b>Comp. Type</b>	BUY25CS04J-01(ES)
<b>ESCC Comp. No.</b>	520502602R
<b>Lot Ident.</b>	Wafer Lot No. VE507720
	Assembly Lot n.a.
	ESA Date Code n.a.
	Radiation Testing Level R: 100kRad
<b>Test data</b>	Test Plan TPIFX1827B
	Tested Sample Serial No.s 245-256
	Control Sample Serial No.s R1-R5

### • Applicable Documents

<b>Detail Specification</b>	ESCC 5205/026 Issue 3, Jul 2016
<b>Generic Specification</b>	ESCC 5000 Issue 10, Feb. 2021
<b>Process Identification Document</b>	A63500-L5491-P000_Detail_PID_BUY25CS_9a
<b>Irradiation Specification</b>	ESCC Basic Specification No. 22900 Iss. 5, June 2016

### • Manufacturer / Facility

<b>Silicon Die</b>	Infineon Technologies Austria AG Siemensstrasse 2, 9500 Villach, Austria
<b>Assembly &amp; Testing</b>	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

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<b>Infineon</b> technologies  <b>HiRel Discrete &amp; MW</b> Semiconductors	ESCC Comp. No.: 520502602R	Page: 3
	Wafer Lot: VE507720	Rep.No.: VE507720TID Issue: Iss. 1, Dec. 2021
	<b>Total Dose Steady-State Irradiation Test</b> <b>Report</b> <b>BUY25CS04J-01(ES)</b>	

## §2.2 TABLE OF CONTENTS

<b>§1</b>	<b>COVER SHEET .....</b>	<b>1</b>
<b>§2</b>	<b>DOCUMENT INFORMATION .....</b>	<b>2</b>
§2.1	CHANGE DESCRIPTION SHEET.....	2
§2.2	TABLE OF CONTENTS .....	3
<b>§3</b>	<b>SCOPE AND TEST INFORMATION .....</b>	<b>4</b>
<b>§4</b>	<b>IRRADIATION FACILITY – JS-9000 .....</b>	<b>4</b>
<b>§5</b>	<b>DEVICES MARKINGS AND SAMPLE PREPARATION .....</b>	<b>5</b>
<b>§6</b>	<b>IRRADIATION CONDITIONS .....</b>	<b>5</b>
<b>§7</b>	<b>IRRADIATION TEST SEQUENCE .....</b>	<b>6</b>
§7.1	ATTRIBUTES RECORD OF MEASUREMENTS, TESTS AND INSPECTIONS .....	6
§7.2	READ AND RECORD DATA OF ELECTRICAL MEASUREMENTS .....	7
§7.2.1	<i>Initial Measurements (Table 2, DC).....</i>	7
§7.2.2	<i>Electrical Measurements after Irradiation.....</i>	7
§7.2.3	<i>Electrical Measurements after 24 hours anneal at room temperature.....</i>	8
§7.2.4	<i>Electrical Measurements after 168 hours anneal at 100°C .....</i>	8
§7.3	GRAPHICAL REPRESENTATION OF ELECTRICAL MEASUREMENTS .....	9
<b>§8</b>	<b>TOTAL IONIZING DOSE TESTING RESULT SUMMARY / CHECK FOR LOT FAILURE....</b>	<b>10</b>

<b>Infineon</b> technologies  <b>HiRel Discrete &amp; MW</b> Semiconductors	ESCC Comp. No.: 520502602R	Page: 4
	Wafer Lot: VE507720	Rep.No.: VE507720TID Issue: Iss. 1, Dec. 2021
	<b>Total Dose Steady-State Irradiation Test</b> <b>Report</b> <b>BUY25CS04J-01(ES)</b>	

### §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 BUY25CS04J-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 VE507720 for type BUY25CS04J-01(ES) (ESCC detail specification No. 5205/026).

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

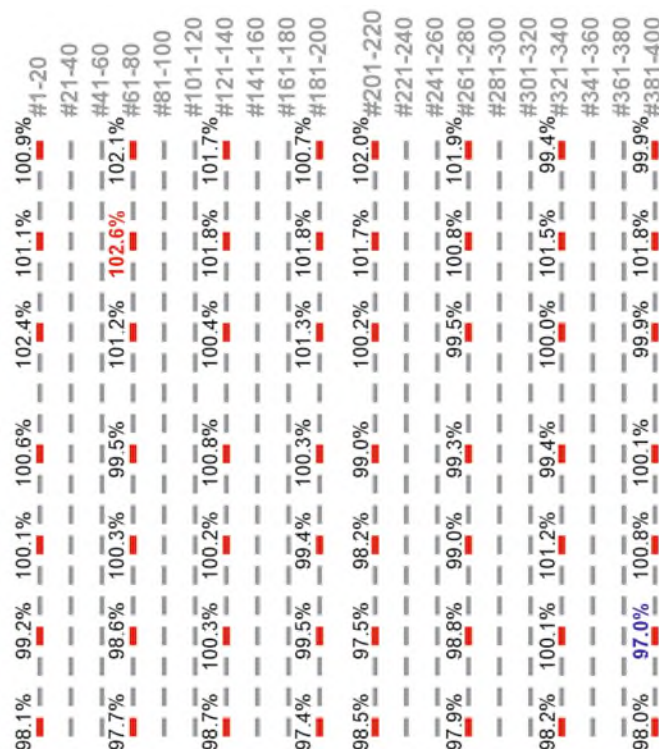
The read and record data from the electrical measurements of the tested and control samples is given in §7.2 of this report.

### §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%.

<b>Infineon</b> technologies <b>HiRel Discrete &amp; MW Semiconductors</b>	ESCC Comp. No.: 520502602R	Page: 5
	Wafer Lot: VE507720	Rep.No.: VE507720TID Issue: Iss. 1, Dec. 2021
	<b>Total Dose Steady-State Irradiation Test Report</b> <b>BUY25CS04J-01(ES)</b>	

## §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.

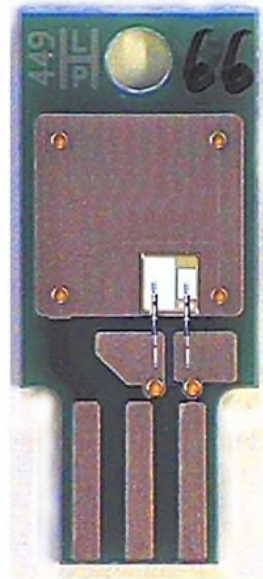


Fig. 2: Die mounted on PCB for TID testing – soldered and wire-bonded

## §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	250 V	0 V

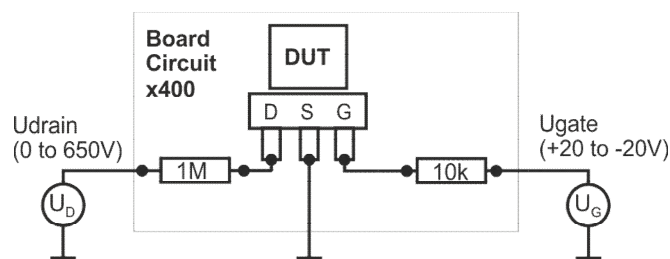


Fig. 3 Bias circuit for TID tests

<b>Infineon</b> technologies <b>HiRel Discrete &amp; MW Semiconductors</b>	ESCC Comp. No.: 520502602R	Page: 6
	Wafer Lot: VE507720	Rep.No.: VE507720TID Issue: Iss. 1, Dec. 2021
	<b>Total Dose Steady-State Irradiation Test Report</b> <b>BUY25CS04J-01(ES)</b>	

## §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	17	0	17	avail.	5 control samples included
Irradiation / Drift Value	17	0	17	avail.	5 control samples included
24h @ RT anneal / Drift Value	17	0	17	avail.	5 control samples included
168h @ 100°C / Drift Value	17	0	17	avail.	5 control samples included

**Sample distribution within the bias conditions**

Item	Qty	Part Notation in R&R Tables	
		Subgroup	Part SG S/Ns
BUY25CS04J-01(ES) silicon chips used for C1 condition	4	C1	#245,248,251,254
BUY25CS04J-01(ES) silicon chips used for C2 condition	4	C2	#246,249,252,255
BUY25CS04J-01(ES) silicon chips used for C3 condition	4	C3	#247,250,253,256
BUY25CS04J-01(ES) silicon chips used as control samples (not irradiated, not annealed)	5	control	#R1-R5

<b>Infineon</b> technologies  <b>HiRel Discrete &amp; MW Semiconductors</b>	ESCC Comp. No.: 520502602R	Page: 7
	Wafer Lot: VE507720	Rep.No.: VE507720TID Issue: Iss. 1, Dec. 2021
	<b>Total Dose Steady-State Irradiation Test Report</b> <b>BUY25CS04J-01(ES)</b>	

## §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	400	1.2	
245	294	3.27	0.1	0.7	0.001	348	0.921	VE507720 #10
246	289	3.30	0.6	0.8	0.001	339	0.922	VE507720 #10
247	289	3.37	0.0	0.1	0.001	339	0.924	VE507720 #10
248	294	3.36	0.1	0.6	0.001	349	0.922	VE507720 #10
249	294	3.36	0.3	0.9	0.001	348	0.921	VE507720 #10
250	296	3.36	0.5	0.9	0.001	352	0.923	VE507720 #10
251	295	3.33	1.0	1.1	0.001	347	0.922	VE507720 #11
252	291	3.29	0.4	1.2	0.001	339	0.922	VE507720 #11
253	292	3.39	0.4	0.9	0.001	344	0.922	VE507720 #11
254	294	3.40	0.3	0.2	0.001	348	0.921	VE507720 #11
255	293	3.41	0.6	0.7	0.001	347	0.922	VE507720 #11
256	294	3.39	0.4	0.3	0.001	349	0.922	VE507720 #11
R1	294	3.39	0.3	0.3	0.001	350	0.923	
R2	294	3.35	0.4	0.8	0.001	348	0.921	
R3	294	3.38	0.1	0.6	0.001	348	0.922	
R4	294	3.38	0.8	1.2	0.001	346	0.924	
R5	294	3.36	0.7	0.7	0.001	348	0.923	

### §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%	250	2						
max	+20%	+10%	+20nA	+20nA	+20%	+10%		4	100	100	25	400	1.2	
245	0.1	-21.0	0.4	0.3	-2.6	-0.4	294	2.58	0.5	1.1	3.098	339	0.917	C1
246	0.1	-13.8	-0.3	-0.1	-0.6	-0.1	289	2.85	0.3	0.8	0.004	337	0.922	C2
247	0.0	-25.0	0.2	0.9	-0.2	-0.5	289	2.53	0.3	1.0	0.004	339	0.920	C3
248	0.1	-19.6	0.2	-0.3	-2.7	-0.5	294	2.70	0.4	0.3	1.397	340	0.918	C1
249	0.0	-12.6	-0.2	0.4	-0.7	-0.1	295	2.94	0.1	1.3	0.004	346	0.920	C2
250	-0.0	-25.5	0.2	-0.2	-0.4	-0.4	295	2.50	0.7	0.7	0.005	350	0.919	C3
251	0.1	-20.1	-0.7	-0.1	-2.6	-0.4	295	2.66	0.3	1.0	2.237	338	0.918	C1
252	0.1	-14.5	0.3	-0.9	-0.5	-0.1	291	2.81	0.7	0.4	0.004	337	0.921	C2
253	0.0	-25.0	0.0	-0.2	-0.4	-0.4	292	2.54	0.4	0.7	0.005	342	0.918	C3
254	0.0	-19.1	0.5	0.4	-2.5	-0.4	294	2.75	0.8	0.7	1.413	339	0.918	C1
255	0.0	-13.4	-0.3	0.3	-0.7	-0.2	293	2.95	0.4	1.1	0.004	345	0.920	C2
256	0.0	-25.5	-0.3	-0.1	-0.4	-0.5	294	2.53	0.1	0.2	0.005	348	0.918	C3
R1	0.1	0.1	0.2	0.5	0.7	-0.2	294	3.39	0.5	0.8	0.001	352	0.922	Control
R2	0.1	0.0	-0.4	0.1	0.9	-0.1	295	3.35	0.0	0.8	0.001	351	0.920	Control
R3	0.2	0.0	0.2	-0.1	0.9	-0.2	294	3.38	0.3	0.6	0.001	351	0.920	Control
R4	0.1	0.0	-0.7	-0.6	1.0	-0.1	294	3.38	0.1	0.6	0.001	350	0.923	Control
R5	0.1	0.0	-0.0	0.4	0.9	-0.2	294	3.36	0.7	1.1	0.001	351	0.921	Control

<b>Infineon</b> technologies  <b>HiRel Discrete &amp; MW Semiconductors</b>	ESCC Comp. No.: 520502602R	Page: 8
	Wafer Lot: VE507720	Rep.No.: VE507720TID Issue: Iss. 1, Dec. 2021
<b>Total Dose Steady-State Irradiation Test Report</b> <b>BUY25CS04J-01(ES)</b>		

### §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 <sub>(DSS)</sub> [%]	VGS <sub>(th)</sub> [%]	IGSS [nA]	IGSS- [nA]	RDS <sub>(ON)</sub> [%]	V <sub>SD</sub> [%]	BV <sub>(DSS)</sub> [V]	VGS <sub>(th)</sub> [V]	IGSS [nA]	IGSS- [nA]	IDSS [uA]	RDS <sub>(ON)</sub> [mOhm]	V <sub>SD</sub> [V]	
min	-20%	-50%	-20nA	-20nA	-20%	-10%	250	2						
max	+20%	+10%	+20nA	+20nA	+20%	+10%		4	100	100	25	400	1.2	
245	0.1	-16.6	0.4	0.4	-2.4	-0.4	294	2.72	0.5	1.1	0.214	339	0.917	C1
246	0.1	-12.5	-0.4	0.8	-0.3	0.0	290	2.89	0.2	1.6	0.004	338	0.922	C2
247	0.1	-21.9	0.5	0.1	0.3	-0.5	290	2.63	0.5	0.3	0.004	340	0.920	C3
248	0.1	-15.4	0.1	0.1	-2.0	-0.4	294	2.84	0.2	0.7	0.061	342	0.918	C1
249	0.1	-11.4	0.2	0.1	-0.2	-0.1	295	2.98	0.4	1.0	0.004	347	0.921	C2
250	0.0	-22.4	0.3	-0.1	0.1	-0.5	296	2.60	0.8	0.8	0.004	352	0.918	C3
251	0.1	-16.0	-0.5	-0.1	-2.0	-0.5	295	2.80	0.5	1.0	0.131	340	0.918	C1
252	0.1	-13.0	0.5	-1.1	-0.3	-0.1	292	2.86	0.9	0.1	0.004	338	0.921	C2
253	0.1	-22.0	-0.3	0.4	-0.2	-0.4	292	2.65	0.1	1.3	0.004	343	0.919	C3
254	0.1	-15.0	-0.3	0.4	-1.9	-0.4	294	2.89	0.0	0.6	0.061	341	0.918	C1
255	0.1	-12.0	-0.1	-0.1	-0.3	-0.2	293	3.00	0.5	0.6	0.004	346	0.920	C2
256	0.1	-22.4	0.5	0.3	0.3	-0.5	295	2.63	0.8	0.6	0.004	350	0.917	C3
R1	0.1	0.0	0.2	0.5	0.8	-0.1	294	3.39	0.5	0.8	0.001	352	0.922	Control
R2	0.2	-0.0	0.2	-0.2	1.1	-0.2	295	3.35	0.6	0.5	0.001	351	0.920	Control
R3	0.1	0.0	0.8	-0.5	1.0	-0.1	294	3.38	0.9	0.2	0.001	351	0.921	Control
R4	0.1	0.0	-0.5	-0.7	0.9	-0.1	294	3.38	0.3	0.6	0.001	349	0.922	Control
R5	0.2	0.0	-0.1	0.0	0.9	0.1	294	3.36	0.6	0.8	0.001	351	0.924	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 <sub>(DSS)</sub> [%]	VGS <sub>(th)</sub> [%]	IGSS [nA]	IGSS- [nA]	RDS <sub>(ON)</sub> [%]	V <sub>SD</sub> [%]	BV <sub>(DSS)</sub> [V]	VGS <sub>(th)</sub> [V]	IGSS [nA]	IGSS- [nA]	IDSS [uA]	RDS <sub>(ON)</sub> [mOhm]	V <sub>SD</sub> [V]	
min	-20%	-50%	-20nA	-20nA	-20%	-10%	250	2						
max	+20%	+10%	+20nA	+20nA	+20%	+10%		4	100	100	25	400	1.2	
245	0.3	-12.8	0.4	0.5	-0.4	-0.5	295	2.85	0.5	1.3	0.023	346	0.916	C1
246	0.0	-10.6	0.1	0.4	-1.1	-0.0	289	2.95	0.8	1.2	0.002	336	0.922	C2
247	0.0	-18.7	-0.0	0.8	-0.6	-0.4	290	2.74	0.0	0.9	0.002	337	0.921	C3
248	0.3	-11.5	0.7	-0.1	-0.7	-0.6	295	2.97	0.8	0.5	0.019	346	0.916	C1
249	0.0	-9.7	0.8	-0.5	-1.1	-0.1	295	3.03	1.0	0.4	0.003	344	0.920	C2
250	-0.0	-19.3	0.4	-0.1	-0.9	-0.4	295	2.71	0.9	0.7	0.002	348	0.919	C3
251	0.3	-12.3	-1.0	-0.2	-0.8	-0.6	296	2.92	0.0	0.9	0.020	345	0.917	C1
252	0.1	-11.1	0.7	-0.0	-0.8	-0.2	291	2.92	1.1	1.2	0.002	336	0.920	C2
253	0.0	-18.7	-0.1	0.7	-0.6	-0.4	292	2.76	0.3	1.6	0.002	342	0.919	C3
254	0.2	-11.1	0.6	0.6	-0.9	-0.5	295	3.02	0.9	0.9	0.019	344	0.916	C1
255	0.0	-10.3	0.1	-0.4	-0.9	-0.2	293	3.06	0.8	0.3	0.003	344	0.920	C2
256	0.0	-19.3	0.4	0.2	-0.6	-0.5	294	2.74	0.8	0.5	0.002	347	0.918	C3
R1	0.1	0.1	0.2	0.5	0.4	-0.1	294	3.39	0.5	0.8	0.001	351	0.922	Control
R2	0.1	0.1	-0.0	0.0	0.7	-0.1	295	3.35	0.4	0.8	0.001	350	0.920	Control
R3	0.1	0.1	-0.0	0.1	0.6	-0.1	294	3.38	0.1	0.8	0.001	350	0.922	Control
R4	0.1	0.1	-0.2	-0.6	0.7	-0.1	294	3.38	0.6	0.7	0.001	349	0.923	Control
R5	0.1	0.1	0.1	-0.5	0.7	-0.1	294	3.36	0.7	0.2	0.001	350	0.922	Control



<b>Infineon</b> technologies <b>HiRel Discrete &amp; MW Semiconductors</b>	ESCC Comp. No.: 520502602R	Page: 9
	Wafer Lot: VE507720	Rep.No.: VE507720TID Issue: Iss. 1, Dec. 2021
	<b>Total Dose Steady-State Irradiation Test Report</b> <b>BUY25CS04J-01(ES)</b>	

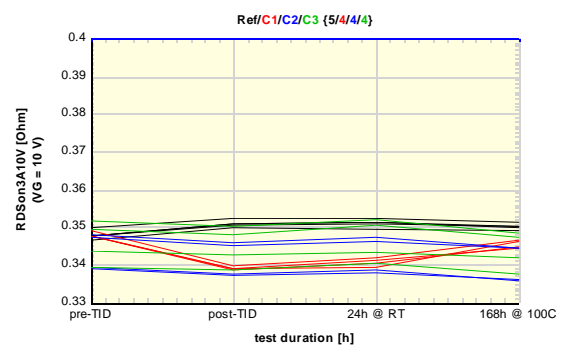
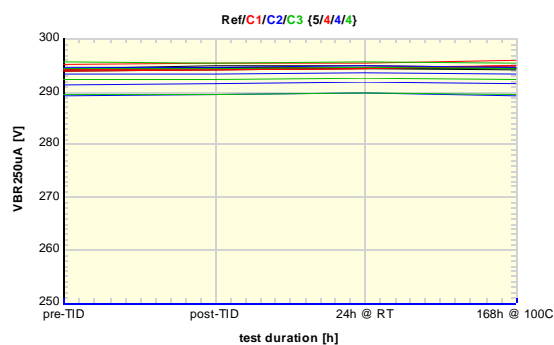
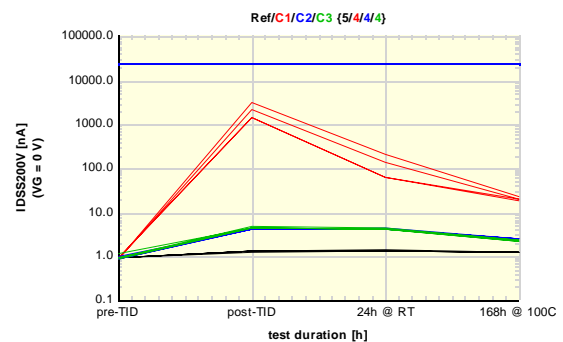
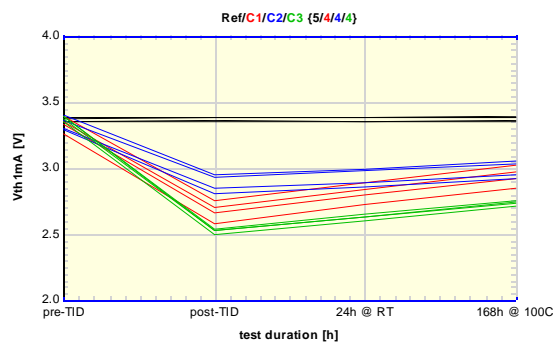
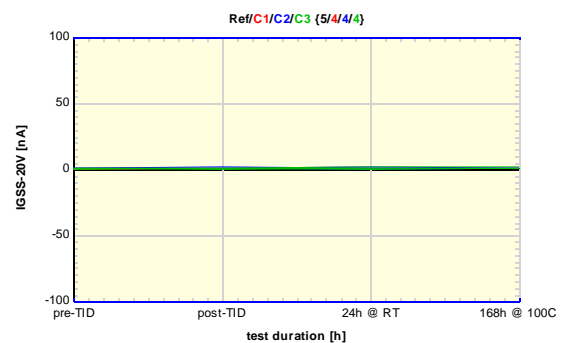
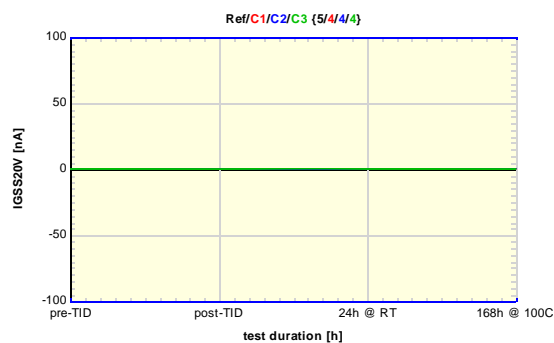
## §7.3 GRAPHICAL REPRESENTATION OF ELECTRICAL MEASUREMENTS

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

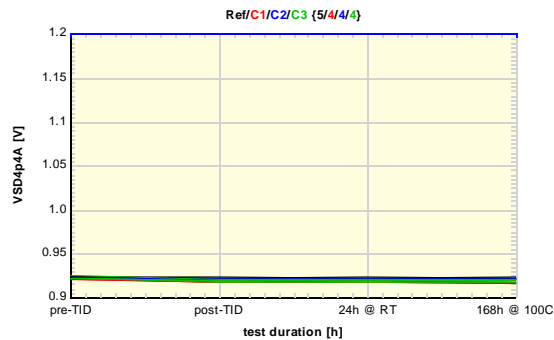
1. Prior to irradiation (pre-TID),
2. Post-irradiation (post-TID),
3. Posterior to room-temperature anneal of 24 hours (24h@RT),
4. Posterior to 168 hours of anneal at 100°C (168h@100°C).

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)



<b>Infineon</b> technologies <b>HiRel Discrete &amp; MW Semiconductors</b>	ESCC Comp. No.: 520502602R	Page: 10
	Wafer Lot: VE507720	Rep.No.: VE507720TID Issue: Iss. 1, Dec. 2021
	<b>Total Dose Steady-State Irradiation Test Report</b> <b>BUY25CS04J-01(ES)</b>	



## §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	4	4	0	0	yes
C2	4	4	0	0	yes
C3	4	4	0	0	yes
Complete TID Tests					passed

**The Wafer Lot passed the Total Dose Steady-State Irradiation Test.**