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| <b>Infineon</b><br>technologies<br><b>HiRel Discrete &amp; MW Semiconductors</b> | ESCC Comp. No.: 520503202R                                      | Page: 1                                       |
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## §1 COVER SHEET

### • Component and Test Identification

|                                 |                         |
|---------------------------------|-------------------------|
| <b>Comp. Type</b>               | BUY06CS80A-01(ES)       |
| <b>ESCC Comp. No.</b>           | 520503202R              |
| <b>Lot Ident.</b> Wafer Lot No. | VE834923                |
| Radiation Testing Level         | R: 100kRad              |
| <b>Test data</b> Test Plan      | TPIFX1522A              |
| Tested Sample Serial No.s       | 203,204,207-209,213-217 |
| Control Sample Serial No.s      | R211,R218,R219          |

### • Applicability of Test Results

|                    |  |
|--------------------|--|
| <b>Comp. Types</b> | BUY06CS35J-01(ES)<br>BUY06CS80A-01(ES)<br>BUY06CS23K-01(ES)<br>BUY06CS45B-01(ES) |
|--------------------|--|

|                        |  |
|------------------------|--|
| <b>ESCC Comp. Nos.</b> | 520503201R<br>520503202R<br>520503203R<br>520503204R |
|------------------------|--|

### • Applicable Documents

|  |   |
|--|---|
| <b>Detail Specification</b>            | ESCC 5205/032 Issue 1, Sep. 2019        |
| <b>Generic Specification</b>           | ESCC 5000 Issue 8, Jun. 2019            |
| <b>Process Identification Document</b> | A63500-L5491-P000_Detail_PID_BUY25CS_9a |

|                                  |   |
|----------------------------------|---|
| <b>Irradiation Specification</b> | ESCC Basic Specification No. 25100 Iss. 2, Oct 2014 |
|----------------------------------|---|

### • Manufacturer / Facility

|                               |   |
|-------------------------------|---|
| <b>Silicon Die</b>            | Infineon Technologies Austria AG<br>Siemensstrasse 2, 9500 Villach, Austria |
| <b>Assembly &amp; Testing</b> | Infineon Technologies AG<br>Am Campeon 1-15, D 85579 Neubiberg, Germany     |

### • Report Issue, Date / Manufacturers Signatures

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Total Number of Pages:

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| 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 Single Event Effects (SEE) tests and results of radiation-hardened power MOSFETs from Infineon Technologies, types BUY06CS80A-01(ES). This test report applies to all BUY06CS power MOSFET family.

Test campaign SEE 3 has been performed at the facility CYCLONE in Louvain-la-Neuve, Belgium on the 3-5.12.2018.

Read and record data from the electrical measurements of the tested and control samples is given in §7.5 of this report.

### §4 HEAVY ION IRRADIATION FACILITY

CYCLONE at UCL Louvain-la-Neuve is a cyclotron capable of providing a “cocktail” of heavy ions with about the same M/Q ratio. From a HIF cocktail  $^{124}\text{Xe}$  (35+ charge state) are selected with an energy of 995 MeV yielding in silicon an LET = 62.5 MeVcm<sup>2</sup>/mg and a stopping range of 73.1 µm (which is more than the depth of the active area <50 µm).

The test boards are mounted within a vacuum chamber with feedthroughs for electrical bias and signals. The ion beam is positioned on the device under test.

The homogeneity is ± 10 % on a 25 mm diameter. Control of beam homogeneity and dosimetry as well as beam operation is the responsibility of ion beam provider.

### §5 DEVICES MARKINGS AND SAMPLE PREPARATION

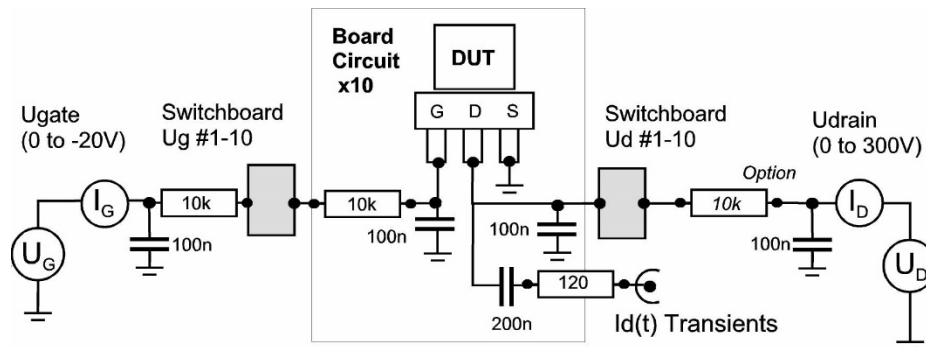
In order to contact devices with the test sockets on bias boards, chips have been soldered with AuZn solder material and bonded with 125µm Al wires to respective 3-pin PCB-TO-adaptor boards to connect Gate/Drain/Source contacts of the MOSFETs.

Devices' numbers are written on the PCB with a permanent marker. The number correlates in the sample list to the lot and wafer number.

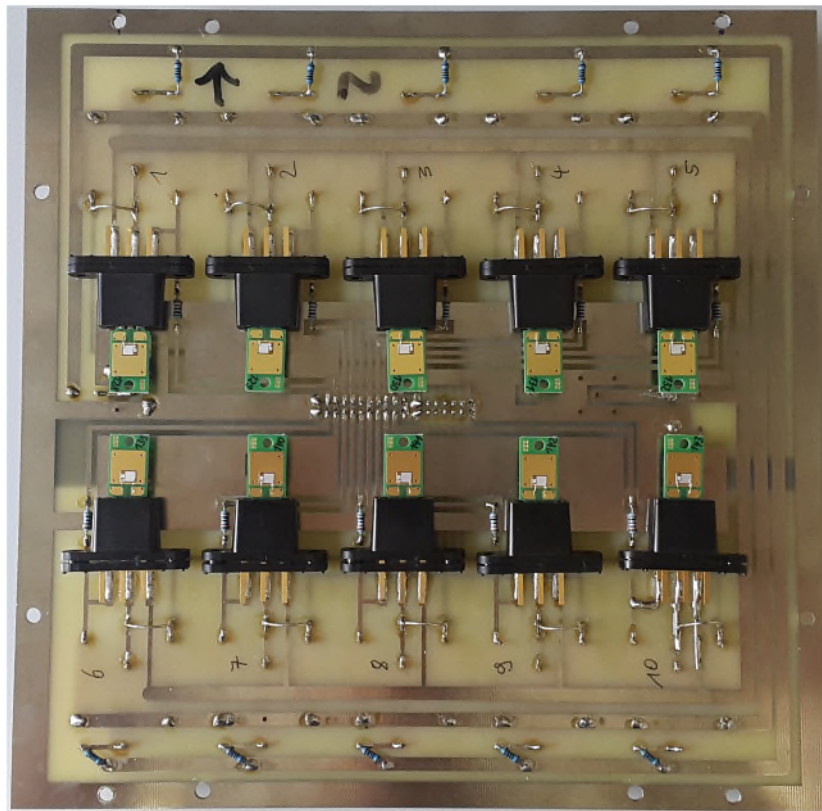
### §6 TEST SETUP

The test board was designed to accommodate up to 10 test samples, each consisting of an individual bias circuit (fig. 1). This test board (fig. 2) was fixed to the mechanical positioning stage provided at the Louvain/GANIL beam line. All voltages UDS and UGS were provided via a flat band cable from a switch board.

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**Fig. 1** Bias circuit for SEE tests



**Fig. 2:** Test-Board with 10 positions with TO test sockets. Separate bias of UDS and UGS for each device. Flat-band connector on back side.

As a voltage source for UDS and for ID current measurements a Keithley 237 High Voltage Measurement Unit has been employed. Gate voltage UGS and measurement of IG are provided by a Keithley 236 Source Measure Unit.

Voltages were set via computer software as were all recordings of run number, time, and sample number. All current readings, specifically PIGS currents, are logged.

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## §7 IRRADIATION TEST SEQUENCE

### §7.1 BEAM PARAMETERS AND TEST CRITERIA FOR ALL TESTS

- Ion Type  $^{124}\text{Xe}^{35+}$
- LET 62.5 MeVcm<sup>2</sup>/mg
- Flux 3E+3 ions/cm<sup>2</sup>/s
- Fluence 3E+5 ions/cm<sup>2</sup>
- Normal incidence of ion beam
- Destructive mode. FAIL current criteria: IDS>2 µA or IGS>100 nA.
- Required number of test samples per test case: 1(for FAIL)/3(for PASS)
- Post Irradiation Gate Stress (PIGS) test at any UDS (at respective UDS, UGS down to -25V, in steps of -5V). FAIL criteria: either IDS or IGS>100nA

### §7.2 TEST BIAS SEQUENCE FOR SEB-SOA

UGS: 0 V

UDS: Start at nominal maximum rated UDS. If *FAIL* occurs UDS is stepped-down by 10V until *PASS*.

### §7.3 TEST BIAS SEQUENCE FOR SEGR-SOA

UGS: negative, starting at -5 V and stepped down.

UDS: Start at maximum UDS at which *PASS* value was obtained for previous UGS-test sequence (or UGS=0V). If *FAIL* occurs UDS is stepped-down by 5V until *PASS*.

### §7.4 DETAILS OF TEST RUNS

| Date/Time        | Test Run No. | Board Position | Sample No. | Flux [1/cm <sup>2</sup> /s] | Fluence [1/cm <sup>2</sup> ] | Acc. Dose [krad] | UDS [V] | UGS [V] | PIGS pass/fail | Remarks                  |
|------------------|--------------|----------------|------------|-----------------------------|------------------------------|------------------|---------|---------|----------------|--------------------------|
| 05.12.2018 02:08 | 44           | 1              | 203        | 3000                        | 3.00E+05                     | 0.3              | 60      | 0       | pass           | SEGR after ~ 2.6E+5 ions |
| 05.12.2018 02:10 | 45           |                |            |                             |                              | 0.56             | 60      | -20     | fail           |                          |
| 05.12.2018 02:14 | 46           | 5              | 204        | 3000                        | 3.00E+05                     | 0.3              | 60      | 0       | pass           | SEGR after ~ 2.3E+5 ions |
| 05.12.2018 02:17 | 47           |                |            |                             |                              | 0.6              | 60      | -15     | pass           |                          |
| 05.12.2018 02:20 | 48           |                |            |                             |                              | 0.9              | 50      | -20     | pass           |                          |
| 05.12.2018 02:22 | 49           |                |            |                             |                              | 1.15             | 55      | -20     | fail           |                          |
| 05.12.2018 02:27 | 50           | 6              | 213        | 3000                        | 3.00E+05                     | 0.3              | 60      | 0       | pass           | SEGR after ~ 0.6E+5 ions |
| 05.12.2018 02:30 | 51           |                |            |                             |                              | 0.6              | 60      | -15     | pass           |                          |
| 05.12.2018 02:32 | 52           |                |            |                             |                              | 0.9              | 50      | -20     | pass           |                          |
| 05.12.2018 02:35 | 53           |                |            |                             |                              | 1.1              | 30      | -25     | fail           |                          |
| 05.12.2018 02:37 | 54           | 7              | 214        | 3000                        | 3.00E+05                     | 0.3              | 60      | 0       | pass           | SEGR after ~ 2.2E+5 ions |
| 05.12.2018 02:39 | 55           |                |            |                             |                              | 0.6              | 60      | -15     | pass           |                          |
| 05.12.2018 02:42 | 56           |                |            |                             |                              | 0.8              | 50      | -20     | fail           |                          |
| 05.12.2018 03:12 | 66           | 8              | 215        | 3000                        | 3.00E+05                     | 0.3              | 60      | 0       | pass           |                          |
| 05.12.2018 03:14 | 67           |                |            |                             |                              | 0.6              | 60      | -15     | pass           |                          |
| 05.12.2018 03:16 | 68           |                |            |                             |                              | 0.9              | 30      | -20     | pass           |                          |
| 05.12.2018 03:19 | 69           |                |            |                             |                              | 1.2              | 40      | -20     | pass           |                          |
| 05.12.2018 03:21 | 70           |                |            |                             |                              | 1.5              | 45      | -20     | pass           |                          |
| 05.12.2018 03:24 | 71           | 9              | 216        | 3000                        | 3.00E+05                     | 0.3              | 40      | -20     | pass           |                          |
| 05.12.2018 03:26 | 72           |                |            |                             |                              | 0.6              | 45      | -20     | pass           |                          |
| 05.12.2018 03:30 | 73           | 10             | 217        | 3000                        | 3.00E+05                     | 0.3              | 45      | -20     | pass           |                          |
| 05.12.2018 03:46 | 74           | 1              | 207        | 3000                        | 3.00E+05                     | 0.3              | 60      | 0       | pass           |                          |
| 05.12.2018 03:49 | 75           |                |            |                             |                              | 0.6              | 60      | -15     | pass           |                          |
| 05.12.2018 03:51 | 76           |                |            |                             |                              | 0.9              | 45      | -20     | pass           |                          |
| 05.12.2018 03:54 | 77           |                |            |                             |                              | 1.2              | 50      | -20     | pass           |                          |
| 05.12.2018 03:57 | 78           | 2              | 208        | 3000                        | 3.00E+05                     | 0.3              | 60      | -15     | pass           |                          |
| 05.12.2018 03:59 | 79           |                |            |                             |                              | 0.6              | 45      | -20     | pass           |                          |
| 05.12.2018 04:02 | 80           |                |            |                             |                              | 0.9              | 50      | -20     | pass           |                          |

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| Date/Time        | Test Run No. | Board Position | Sample No. | Flux [1/cm²/s] | Fluence [1/cm²] | Acc. Dose [krad] | UDS [V] | UGS [V] | PIGS pass/fail | Remarks |
|------------------|--------------|----------------|------------|----------------|-----------------|------------------|---------|---------|----------------|---------|
| 05.12.2018 04:05 | 81           | 3              | 209        | 3000           | 3.00E+05        | 0.3              | 45      | -20     | pass           |         |
| 05.12.2018 04:14 | 82           |                |            |                |                 | 0.6              | 50      | -20     | pass           |         |

## §7.5 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, RDSon (60A, 10V) and VSD (80A) absolute values are higher than specified in the Detail Specification – see also control samples and initial measurements.

### §7.5.1 INITIAL MEASUREMENTS

| S/N  | V(BR)DSS [V] | VGS(th) [V] | IGSS [nA] | IGSS- [nA] | IDSS [uA] | RDS(ON) [mOhm] | VSD [V] | Remarks |
|------|--------------|-------------|-----------|------------|-----------|----------------|---------|---------|
| min  | 60           | 2           |           |            |           |                |         |         |
| max  |              | 4           | 100       | 100        | 25        | 20             | 1.9     |         |
| 203  | 74           | 2.97        | 0.8       | 2.2        | 0.006     | 13.8           | 1.360   |         |
| 204  | 75           | 2.95        | 0.9       | 2.0        | 0.005     | 12.4           | 1.255   |         |
| 207  | 74           | 2.98        | 0.6       | 2.3        | 0.006     | 15.5           | 1.380   |         |
| 208  | 74           | 2.95        | 1.0       | 2.4        | 0.006     | 16.9           | 1.601   |         |
| 209  | 73           | 2.97        | 0.5       | 2.6        | 0.005     | 12.8           | 1.284   |         |
| 213  | 75           | 2.93        | 0.0       | 1.4        | 0.005     | 19.4           | 1.657   |         |
| 214  | 75           | 2.94        | 0.7       | 1.7        | 0.005     | 16.2           | 1.520   |         |
| 215  | 75           | 2.95        | 1.2       | 1.9        | 0.005     | 13.5           | 1.328   |         |
| 216  | 76           | 2.94        | 0.9       | 1.5        | 0.005     | 16.9           | 1.517   |         |
| 217  | 76           | 2.94        | 0.8       | 1.6        | 0.005     | 15.3           | 1.468   |         |
| R211 | 75           | 2.95        | 0.5       | 1.6        | 0.006     | 14.5           | 1.387   |         |
| R218 | 76           | 2.94        | 0.4       | 1.1        | 0.006     | 15.3           | 1.459   |         |
| R219 | 74           | 2.94        | 0.6       | 1.3        | 0.005     | 18.0           | 1.693   |         |

### §7.5.2 ELECTRICAL MEASUREMENTS AFTER IRRADIATION

| S/N  | V(BR)DSS [V] | VGS(th) [V] | IGSS [nA] | IGSS- [nA] | IDSS [uA] | RDS(ON) [mOhm] | VSD [V] | Remarks. |
|------|--------------|-------------|-----------|------------|-----------|----------------|---------|----------|
| min  | 60           | 2           |           |            |           |                |         |          |
| max  |              | 4           | 100       | 100        | 25        | 20             | 1.9     |          |
| 203  | n.m.         | n.m.        | n.m.      | n.m.       | n.m.      | n.m.           | n.m.    |          |
| 204  | n.m.         | n.m.        | n.m.      | n.m.       | n.m.      | n.m.           | n.m.    |          |
| 207  | 74           | 2.98        | 0.8       | 1.7        | 0.006     | 15.4           | 1.592   |          |
| 208  | 74           | 2.96        | 0.8       | 1.9        | 0.006     | 16.0           | 1.808   |          |
| 209  | 73           | 2.98        | 0.7       | 2.1        | 0.005     | 12.7           | 1.483   |          |
| 213  | n.m.         | n.m.        | n.m.      | n.m.       | n.m.      | n.m.           | n.m.    |          |
| 214  | n.m.         | n.m.        | n.m.      | n.m.       | n.m.      | n.m.           | n.m.    |          |
| 215  | 75           | 2.95        | 0.8       | 2.4        | 0.006     | 13.2           | 1.523   |          |
| 216  | 76           | 2.94        | 0.8       | 2.5        | 0.005     | 16.5           | 1.722   |          |
| 217  | 76           | 2.95        | 0.7       | 2.2        | 0.005     | 13.5           | 1.565   |          |
| R211 | 75           | 2.96        | 0.7       | 2.1        | 0.006     | 14.2           | 1.598   |          |
| R218 | 75           | 2.95        | 0.8       | 2.0        | 0.005     | 13.4           | 1.575   |          |
| R219 | 74           | 2.94        | 0.8       | 2.2        | 0.005     | 16.8           | 1.809   |          |

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## §8 GRAPHICAL SEE-SOA

