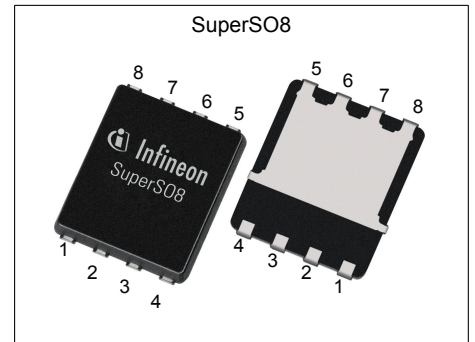


# MOSFET

## OptiMOS™ 5 Power-Transistor, 150 V

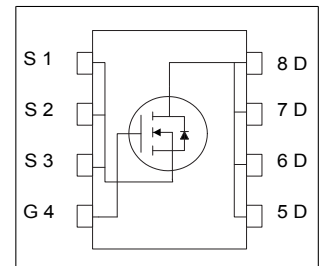
### Features

- N-channel, normal level
- Excellent gate charge x  $R_{DS(on)}$  product (FOM)
- Very low on-resistance  $R_{DS(on)}$
- Very low reverse recovery charge (Qrr)
- 150 °C operating temperature
- Pb-free lead plating; RoHS compliant
- Qualified according to JEDEC<sup>1)</sup> for target application
- Ideal for high-frequency switching and synchronous rectification



**Table 1 Key Performance Parameters**

| Parameter        | Value | Unit |
|------------------|-------|------|
| $V_{DS}$         | 150   | V    |
| $R_{DS(on),max}$ | 9.3   | mΩ   |
| $I_D$            | 87    | A    |
| $Q_{rr}$         | 58    | nC   |



| Type / Ordering Code | Package    | Marking  | Related Links |
|----------------------|------------|----------|---------------|
| BSC093N15NS5         | PG-TDSON-8 | 093N15NS | -             |

<sup>1)</sup> J-STD20 and JESD22

## Table of Contents

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## 1 Maximum ratings

at  $T_A=25\text{ °C}$ , unless otherwise specified

**Table 2 Maximum ratings**

| Parameter                                    | Symbol            | Values |      |          | Unit | Note / Test Condition                             |
|--|-------------------|--------|------|----------|------|---|
|  |                   | Min.   | Typ. | Max.     |      |   |
| Continuous drain current                     | $I_D$             | -      | -    | 87<br>55 | A    | $T_C=25\text{ °C}$<br>$T_C=100\text{ °C}$         |
| Pulsed drain current <sup>1)</sup>           | $I_{D,pulse}$     | -      | -    | 348      | A    | $T_C=25\text{ °C}$                                |
| Avalanche energy, single pulse <sup>2)</sup> | $E_{AS}$          | -      | -    | 130      | mJ   | $I_D=50\text{ A}$ , $R_{GS}=25\text{ }\Omega$     |
| Gate source voltage                          | $V_{GS}$          | -20    | -    | 20       | V    | -   |
| Power dissipation                            | $P_{tot}$         | -      | -    | 139      | W    | $T_C=25\text{ °C}$                                |
| Operating and storage temperature            | $T_j$ , $T_{stg}$ | -55    | -    | 150      | °C   | IEC climatic category;<br>DIN IEC 68-1: 55/150/56 |

## 2 Thermal characteristics

**Table 3 Thermal characteristics**

| Parameter  | Symbol     | Values |      |      | Unit | Note / Test Condition |
|--|------------|--------|------|------|------|-----------------------|
|  |            | Min.   | Typ. | Max. |      |                       |
| Thermal resistance, junction - case  | $R_{thJC}$ | -      | 0.54 | 0.9  | K/W  | -                     |
| Thermal resistance, junction - ambient, 6 cm <sup>2</sup> cooling area <sup>3)</sup> | $R_{thJA}$ | -      | -    | 50   | K/W  | -                     |

## 3 Electrical characteristics

**Table 4 Static characteristics**

| Parameter                        | Symbol        | Values |            |             | Unit          | Note / Test Condition   |
|----------------------------------|---------------|--------|------------|-------------|---------------|---|
|                                  |               | Min.   | Typ.       | Max.        |               |   |
| Drain-source breakdown voltage   | $V_{(BR)DSS}$ | 150    | -          | -           | V             | $V_{GS}=0\text{ V}$ , $I_D=1\text{ mA}$   |
| Gate threshold voltage           | $V_{GS(th)}$  | 3.0    | 3.8        | 4.6         | V             | $V_{DS}=V_{GS}$ , $I_D=107\text{ }\mu\text{A}$  |
| Zero gate voltage drain current  | $I_{DSS}$     | -      | 0.1<br>10  | 1<br>100    | $\mu\text{A}$ | $V_{DS}=120\text{ V}$ , $V_{GS}=0\text{ V}$ , $T_j=25\text{ °C}$<br>$V_{DS}=120\text{ V}$ , $V_{GS}=0\text{ V}$ , $T_j=125\text{ °C}$ |
| Gate-source leakage current      | $I_{GSS}$     | -      | 1          | 100         | nA            | $V_{GS}=20\text{ V}$ , $V_{DS}=0\text{ V}$  |
| Drain-source on-state resistance | $R_{DS(on)}$  | -      | 7.9<br>8.7 | 9.3<br>10.5 | m $\Omega$    | $V_{GS}=10\text{ V}$ , $I_D=44\text{ A}$<br>$V_{GS}=8\text{ V}$ , $I_D=22\text{ A}$   |
| Gate resistance <sup>4)</sup>    | $R_G$         | -      | 0.9        | 1.4         | $\Omega$      | -   |
| Transconductance                 | $g_{fs}$      | 34     | 67         | -           | S             | $ V_{DS} >2 I_D R_{DS(on)max}$ , $I_D=44\text{ A}$  |

<sup>1)</sup> See Diagram 3 for more detailed information

<sup>2)</sup> See Diagram 13 for more detailed information

<sup>3)</sup> Device on 40 mm x 40 mm x 1.5 mm epoxy PCB FR4 with 6 cm<sup>2</sup> (one layer, 70  $\mu\text{m}$  thick) copper area for drain connection. PCB is vertical in still air.

<sup>4)</sup> Defined by design. Not subject to production test

**Table 5 Dynamic characteristics**

| Parameter                                  | Symbol       | Values |      |      | Unit | Note / Test Condition  |
|--|--------------|--------|------|------|------|--|
|  |              | Min.   | Typ. | Max. |      |  |
| Input capacitance <sup>1)</sup>            | $C_{iss}$    | -      | 2430 | 3230 | pF   | $V_{GS}=0\text{ V}$ , $V_{DS}=75\text{ V}$ , $f=1\text{ MHz}$                              |
| Output capacitance <sup>1)</sup>           | $C_{oss}$    | -      | 604  | 803  | pF   | $V_{GS}=0\text{ V}$ , $V_{DS}=75\text{ V}$ , $f=1\text{ MHz}$                              |
| Reverse transfer capacitance <sup>1)</sup> | $C_{rss}$    | -      | 15   | 26   | pF   | $V_{GS}=0\text{ V}$ , $V_{DS}=75\text{ V}$ , $f=1\text{ MHz}$                              |
| Turn-on delay time                         | $t_{d(on)}$  | -      | 14   | -    | ns   | $V_{DD}=75\text{ V}$ , $V_{GS}=10\text{ V}$ , $I_D=44\text{ A}$ ,<br>$R_{G,ext}=3\ \Omega$ |
| Rise time                                  | $t_r$        | -      | 4.3  | -    | ns   | $V_{DD}=75\text{ V}$ , $V_{GS}=10\text{ V}$ , $I_D=44\text{ A}$ ,<br>$R_{G,ext}=3\ \Omega$ |
| Turn-off delay time                        | $t_{d(off)}$ | -      | 14.4 | -    | ns   | $V_{DD}=75\text{ V}$ , $V_{GS}=10\text{ V}$ , $I_D=44\text{ A}$ ,<br>$R_{G,ext}=3\ \Omega$ |
| Fall time                                  | $t_f$        | -      | 3.8  | -    | ns   | $V_{DD}=75\text{ V}$ , $V_{GS}=10\text{ V}$ , $I_D=44\text{ A}$ ,<br>$R_{G,ext}=3\ \Omega$ |

**Table 6 Gate charge characteristics<sup>2)</sup>**

| Parameter                          | Symbol        | Values |      |      | Unit | Note / Test Condition   |
|------------------------------------|---------------|--------|------|------|------|---|
|                                    |               | Min.   | Typ. | Max. |      |   |
| Gate to source charge              | $Q_{gs}$      | -      | 14   | -    | nC   | $V_{DD}=75\text{ V}$ , $I_D=44\text{ A}$ , $V_{GS}=0\text{ to }10\text{ V}$ |
| Gate to drain charge <sup>1)</sup> | $Q_{gd}$      | -      | 6.8  | 10.2 | nC   | $V_{DD}=75\text{ V}$ , $I_D=44\text{ A}$ , $V_{GS}=0\text{ to }10\text{ V}$ |
| Switching charge                   | $Q_{sw}$      | -      | 13.4 | -    | nC   | $V_{DD}=75\text{ V}$ , $I_D=44\text{ A}$ , $V_{GS}=0\text{ to }10\text{ V}$ |
| Gate charge total <sup>1)</sup>    | $Q_g$         | -      | 33   | 40.7 | nC   | $V_{DD}=75\text{ V}$ , $I_D=44\text{ A}$ , $V_{GS}=0\text{ to }10\text{ V}$ |
| Gate plateau voltage               | $V_{plateau}$ | -      | 5.7  | -    | V    | $V_{DD}=75\text{ V}$ , $I_D=44\text{ A}$ , $V_{GS}=0\text{ to }10\text{ V}$ |
| Output charge <sup>1)</sup>        | $Q_{oss}$     | -      | 91   | 121  | nC   | $V_{DD}=75\text{ V}$ , $V_{GS}=0\text{ V}$                                  |

**Table 7 Reverse diode**

| Parameter                             | Symbol        | Values |      |      | Unit | Note / Test Condition   |
|---------------------------------------|---------------|--------|------|------|------|---|
|                                       |               | Min.   | Typ. | Max. |      |   |
| Diode continuous forward current      | $I_S$         | -      | -    | 87   | A    | $T_C=25\text{ °C}$  |
| Diode pulse current                   | $I_{S,pulse}$ | -      | -    | 348  | A    | $T_C=25\text{ °C}$  |
| Diode forward voltage                 | $V_{SD}$      | -      | 0.88 | 1.2  | V    | $V_{GS}=0\text{ V}$ , $I_F=44\text{ A}$ , $T_J=25\text{ °C}$      |
| Reverse recovery time <sup>1)</sup>   | $t_{rr}$      | -      | 49   | 98   | ns   | $V_R=75\text{ V}$ , $I_F=44$ , $di_F/dt=100\text{ A}/\mu\text{s}$ |
| Reverse recovery charge <sup>1)</sup> | $Q_{rr}$      | -      | 58   | 116  | nC   | $V_R=75\text{ V}$ , $I_F=44$ , $di_F/dt=100\text{ A}/\mu\text{s}$ |

<sup>1)</sup> Defined by design. Not subject to production test

<sup>2)</sup> See "Gate charge waveforms" for parameter definition

### 4 Electrical characteristics diagrams

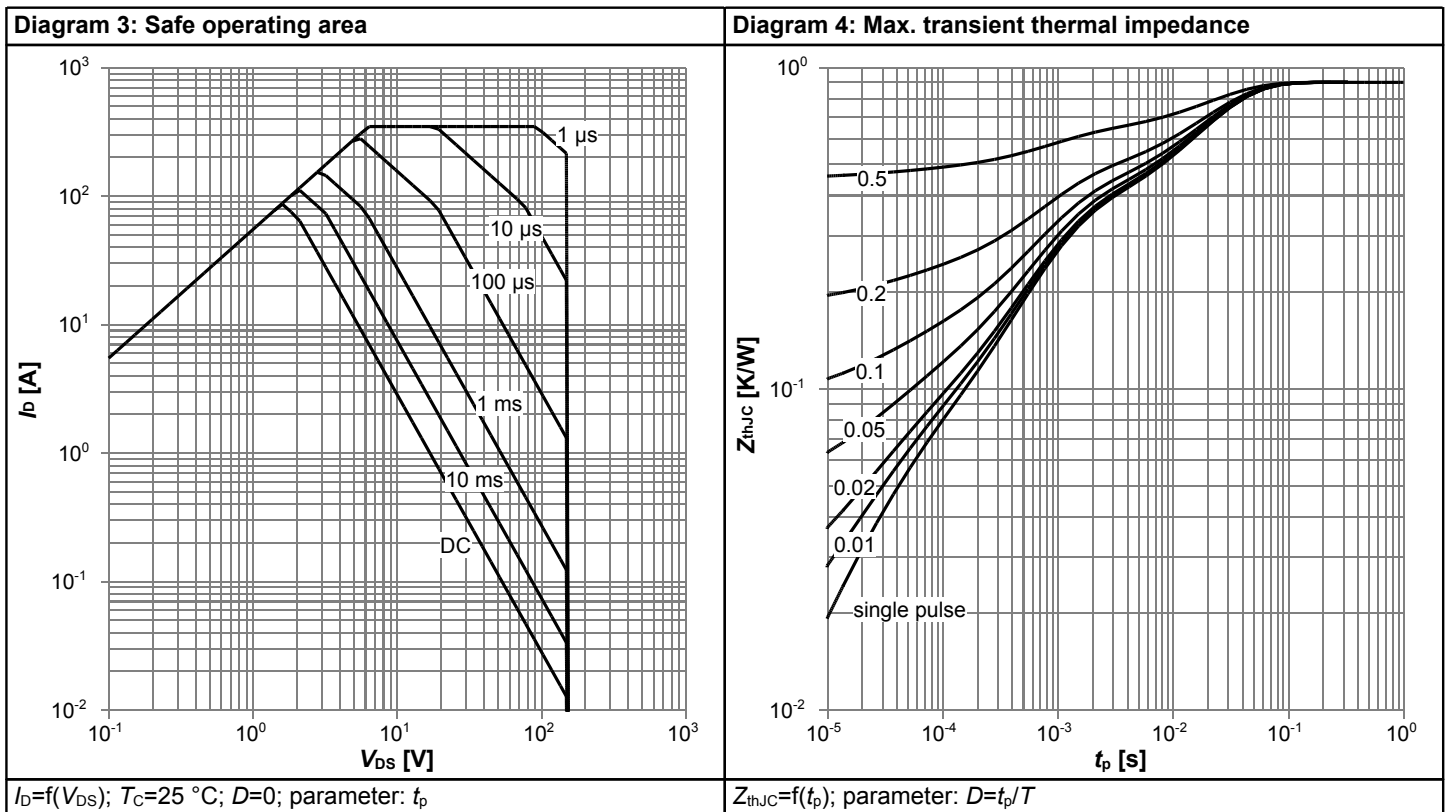
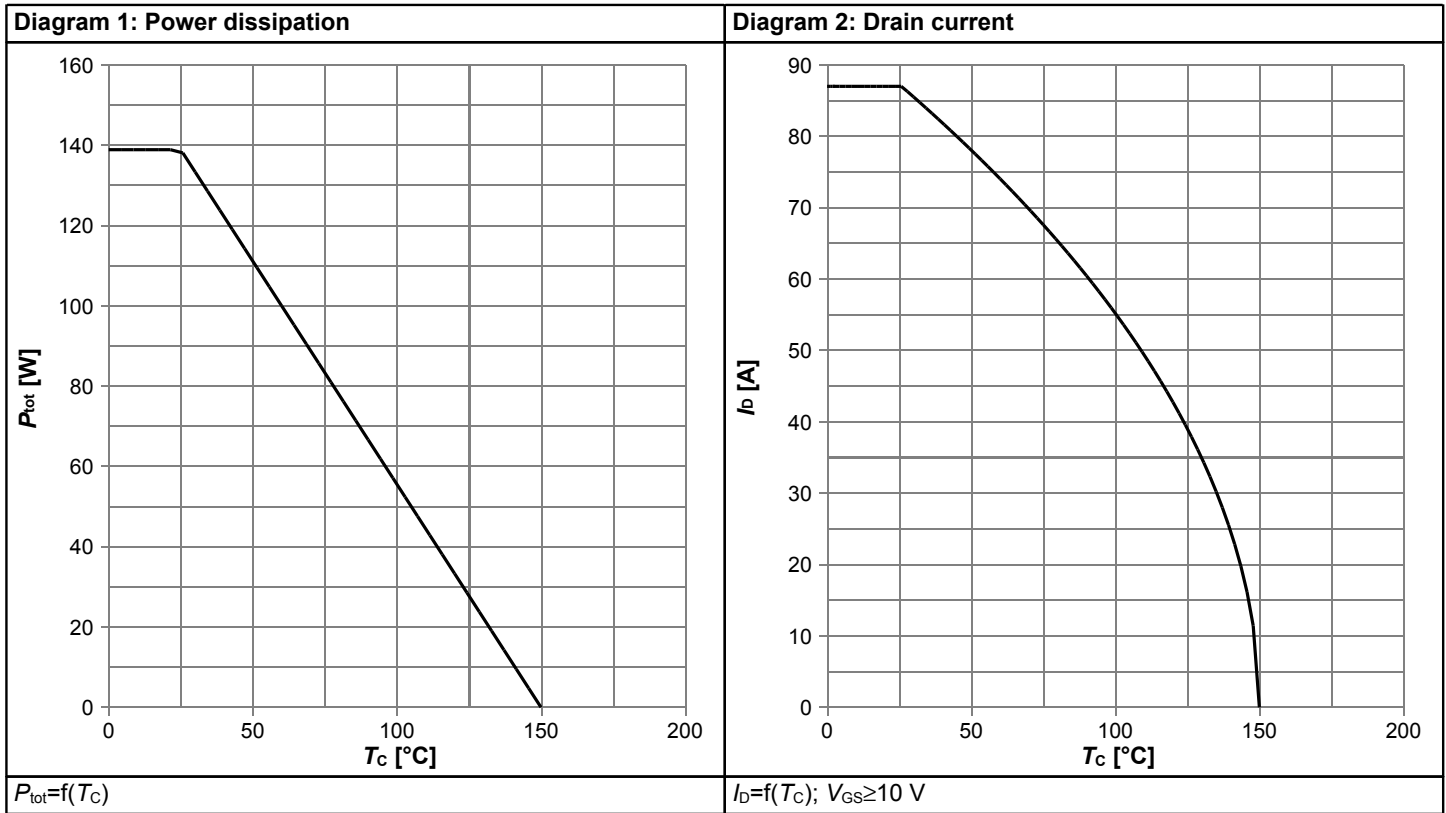
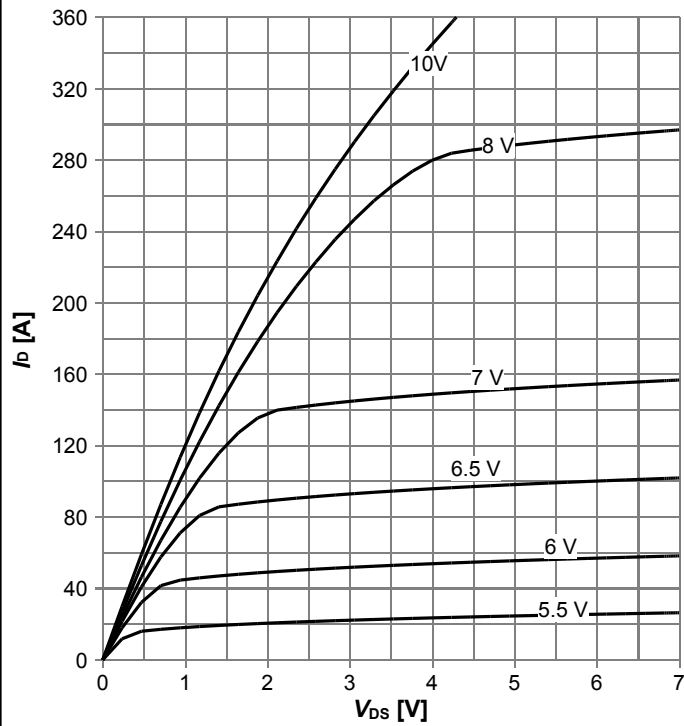
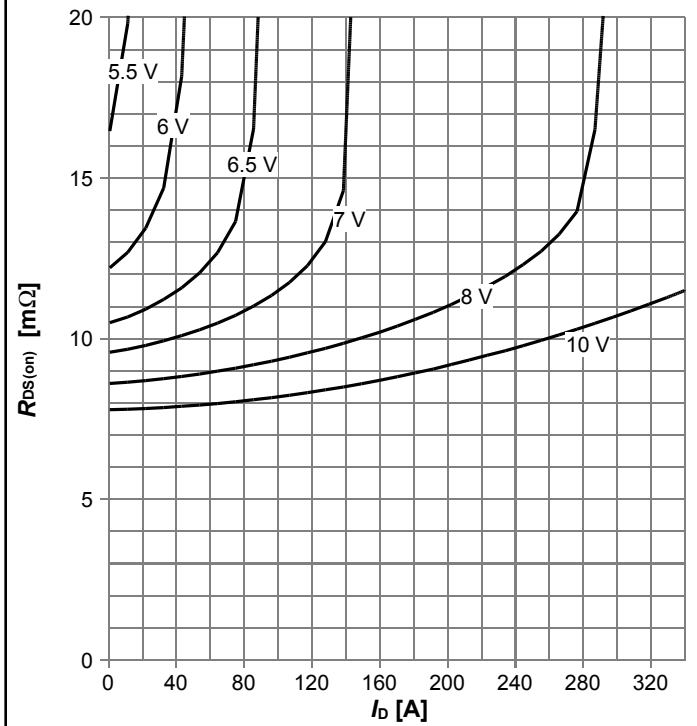


Diagram 5: Typ. output characteristics



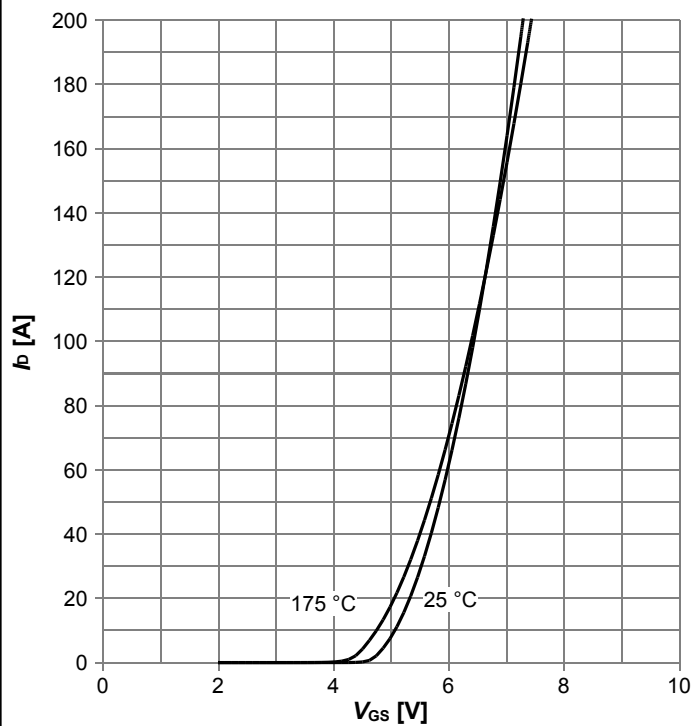
$I_D = f(V_{DS}); T_j = 25\text{ °C};$  parameter:  $V_{GS}$

Diagram 6: Typ. drain-source on resistance



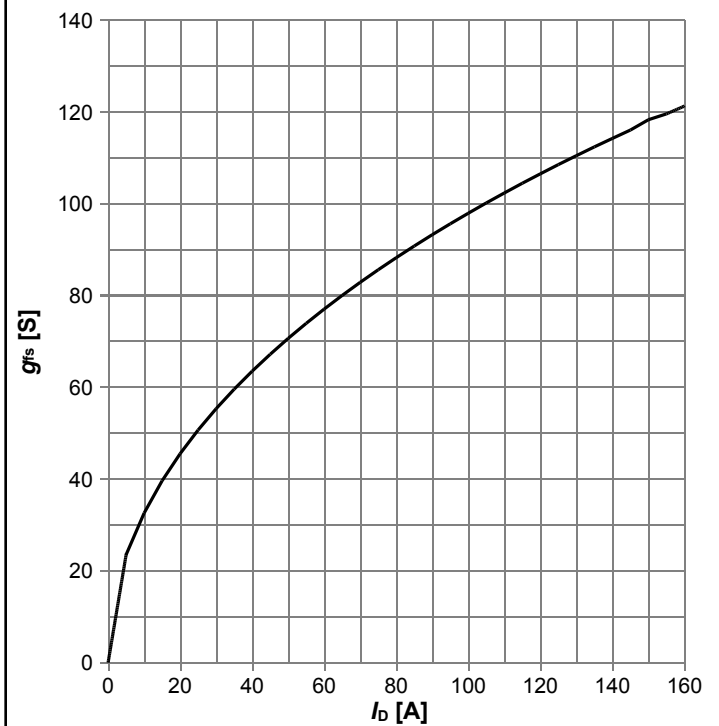
$R_{DS(on)} = f(I_D); T_j = 25\text{ °C};$  parameter:  $V_{GS}$

Diagram 7: Typ. transfer characteristics



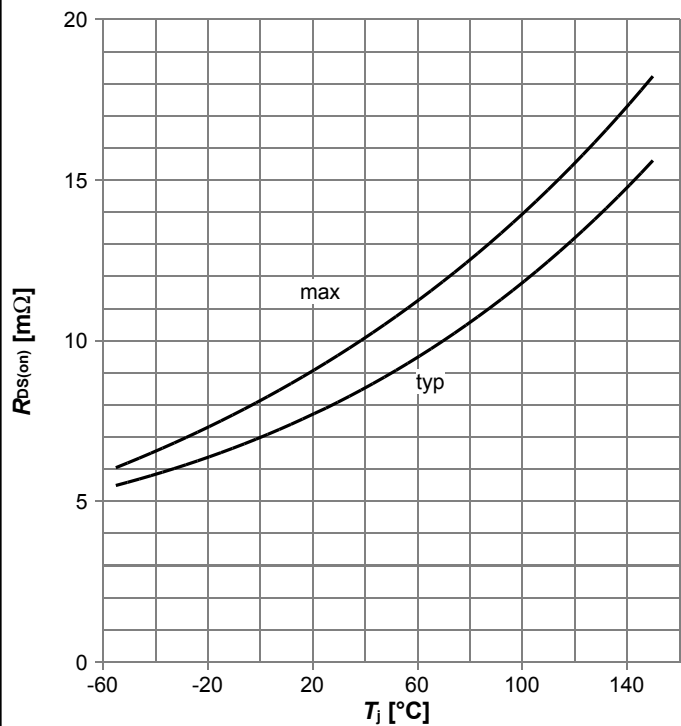
$I_D = f(V_{GS}); |V_{DS}| > 2 I_D R_{DS(on)max};$  parameter:  $T_j$

Diagram 8: Typ. forward transconductance



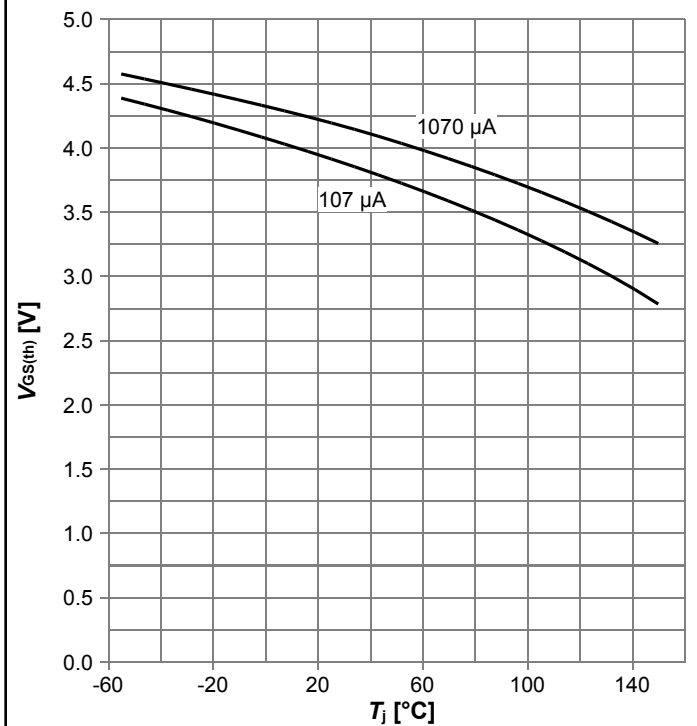
$g_{fs} = f(I_D); T_j = 25\text{ °C}$

Diagram 9: Drain-source on-state resistance



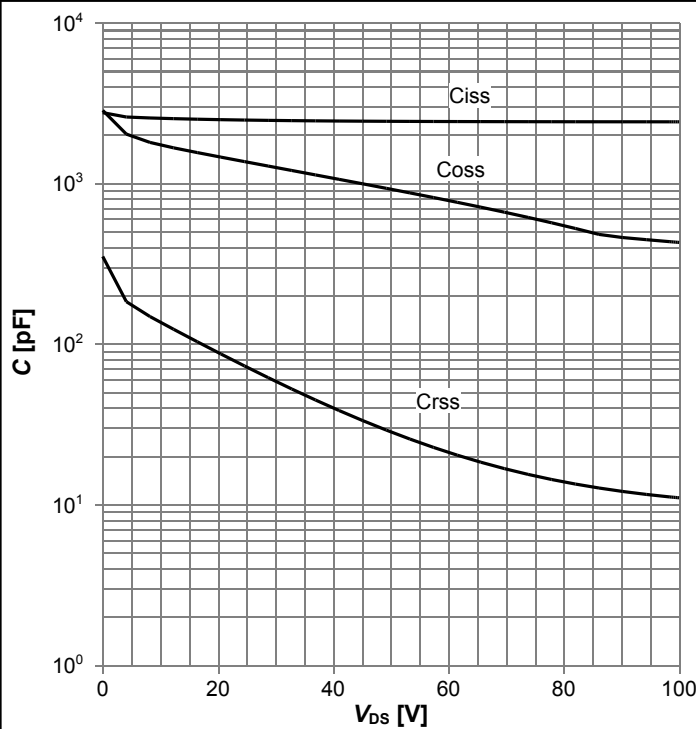
$R_{DS(on)}=f(T_j)$ ;  $I_D=44\text{ A}$ ;  $V_{GS}=10\text{ V}$

Diagram 10: Typ. gate threshold voltage



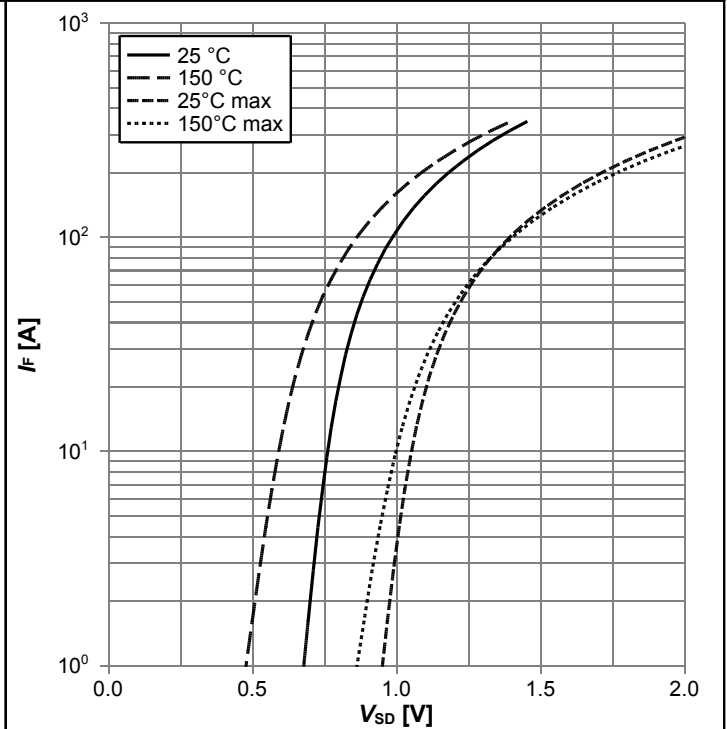
$V_{GS(th)}=f(T_j)$ ;  $V_{GS}=V_{DS}$ ; parameter:  $I_D$

Diagram 11: Typ. capacitances



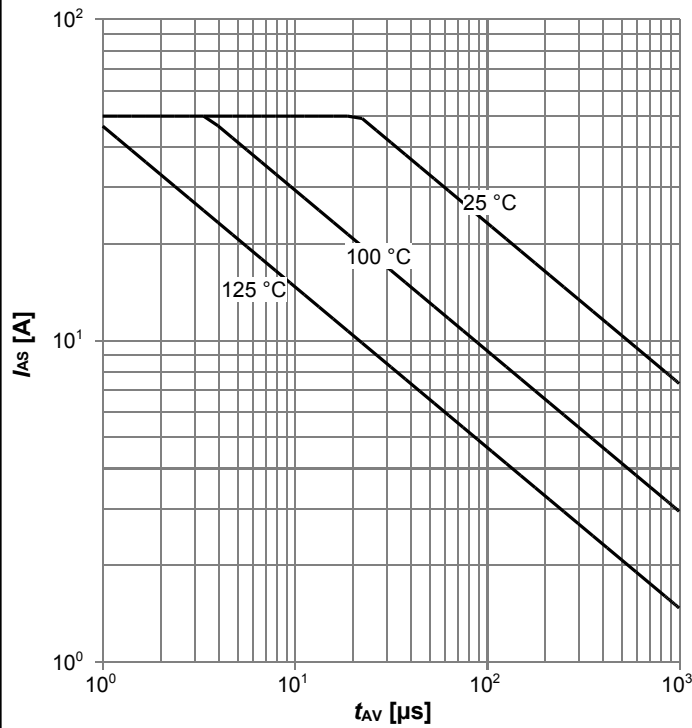
$C=f(V_{DS})$ ;  $V_{GS}=0\text{ V}$ ;  $f=1\text{ MHz}$

Diagram 12: Forward characteristics of reverse diode



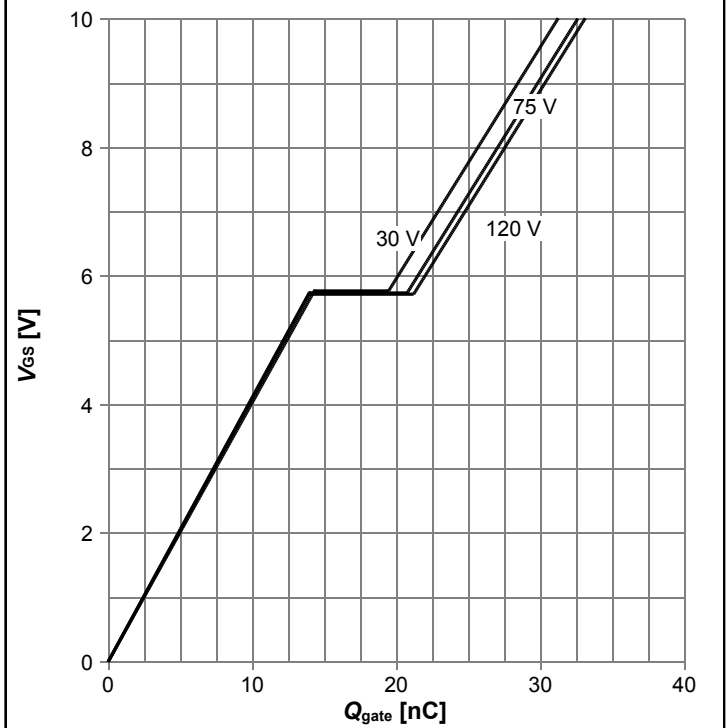
$I_F=f(V_{SD})$ ; parameter:  $T_j$

Diagram 13: Avalanche characteristics



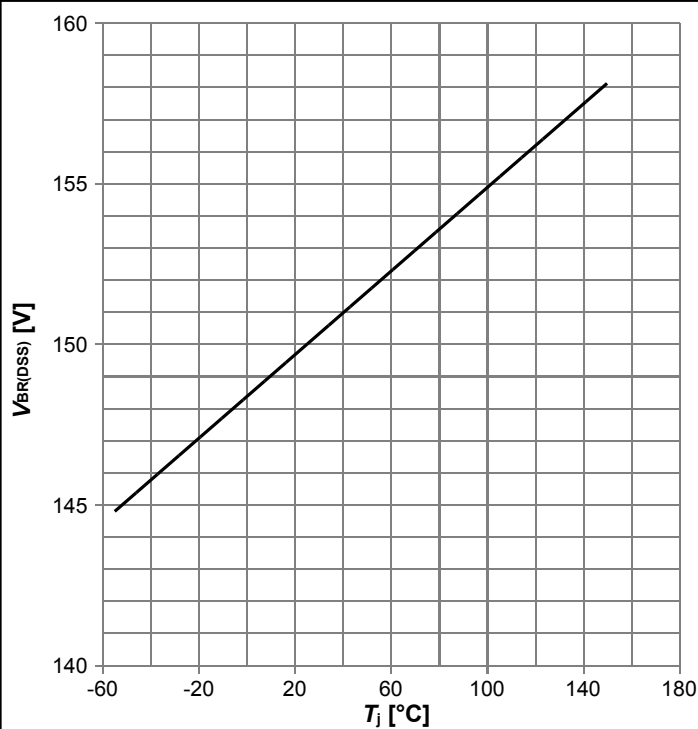
$I_{AS}=f(t_{AV}); R_{GS}=25 \Omega$ ; parameter:  $T_{j(start)}$

Diagram 14: Typ. gate charge



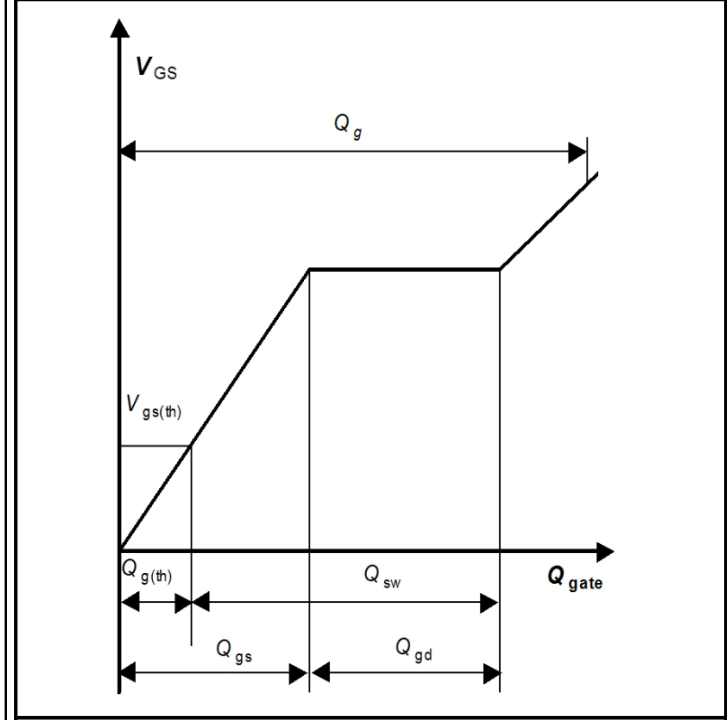
$V_{GS}=f(Q_{gate}); I_D=44A$  pulsed; parameter:  $V_{DD}$

Diagram 15: Drain-source breakdown voltage



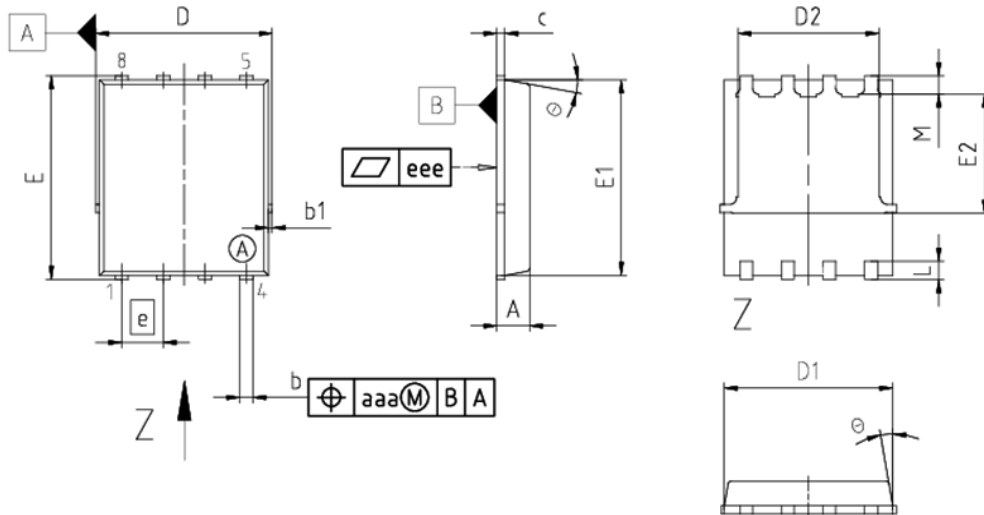
$V_{BR(DSS)}=f(T_j); I_D=1 \text{ mA}$

Gate charge waveforms





## 5 Package Outlines



| DIM   | MILLIMETERS |      |
|-------|-------------|------|
|       | MIN         | MAX  |
| A     | 0.90        | 1.10 |
| b     | 0.31        | 0.54 |
| b1    | 0.02        | 0.22 |
| c     | 0.15        | 0.35 |
| D     | 5.15        | 5.49 |
| D1    | 4.95        | 5.35 |
| D2    | 3.70        | 4.40 |
| E     | 5.95        | 6.35 |
| E1    | 5.70        | 6.10 |
| E2    | 3.40        | 3.80 |
| e     | 1.27        |      |
| N     | 8           |      |
| L     | 0.45        | 0.71 |
| M     | 0.45        | 0.75 |
| theta | 8.5°        | 12°  |
| aaa   | 0.25        |      |
| eee   | 0.08        |      |

**DOCUMENT NO.**  
Z8B00003332

**SCALE**

**EUROPEAN PROJECTION**

**ISSUE DATE**  
10-04-2013

**REVISION**  
04

Figure 1 Outline PG-TDSON-8, dimensions in mm

## Revision History

BSC093N15NS5

**Revision: 2016-06-10, Rev. 2.2**

Previous Revision

| Revision | Date       | Subjects (major changes since last revision) |
|----------|------------|--|
| 2.0      | 2015-10-09 | Release of final version                     |
| 2.1      | 2016-01-22 | Update diagram 13                            |
| 2.2      | 2016-06-10 | Update trr and Qrr                           |

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**Published by**  
**Infineon Technologies AG**  
**81726 München, Germany**  
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