

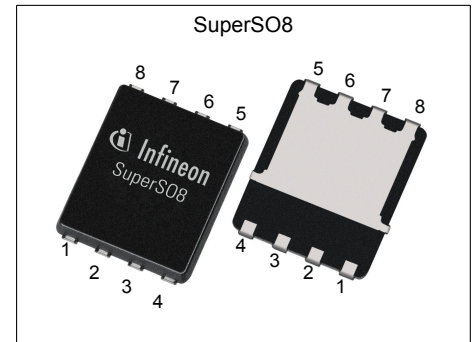


# MOSFET

## OptiMOS™ 5 Power-MOSFET, 25 V

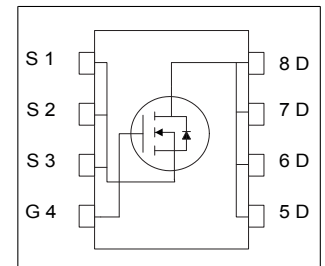
### Features

- Optimized for high performance buck converters
- Monolithic integrated Schottky like diode
- Very low on-resistance  $R_{DS(on)}$  @  $V_{GS}=4.5$  V
- 100% avalanche tested
- N-channel
- Qualified according to JEDEC<sup>1)</sup> for target applications
- Pb-free lead plating; RoHS compliant
- Halogen-free according to IEC61249-2-21



**Table 1 Key Performance Parameters**

| Parameter        | Value | Unit       |
|------------------|-------|------------|
| $V_{DS}$         | 25    | V          |
| $R_{DS(on),max}$ | 0.95  | m $\Omega$ |
| $I_D$            | 217   | A          |
| $Q_{OSS}$        | 27    | nC         |
| $Q_G(0V..4.5V)$  | 17    | nC         |



RoHS

| Type / Ordering Code | Package    | Marking  | Related Links |
|----------------------|------------|----------|---------------|
| BSC009NE2LS5I        | PG-TDSON-8 | 09NE2L5I | -             |

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

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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 <sup>1)</sup>        | $I_D$             | -      | -    | 217  | A    | $V_{GS}=10\text{ V}$ , $T_C=25\text{ °C}$<br>$V_{GS}=10\text{ V}$ , $T_C=100\text{ °C}$<br>$V_{GS}=4.5\text{ V}$ , $T_C=25\text{ °C}$<br>$V_{GS}=4.5\text{ V}$ , $T_C=100\text{ °C}$<br>$V_{GS}=10\text{ V}$ , $T_A=25\text{ °C}$ , $R_{thJA}=50\text{ K/W}^2)$ |
|   |                   | -      | -    | 137  |      |   |
|   |                   | -      | -    | 182  |      |   |
|   |                   | -      | -    | 115  |      |   |
|   |                   | -      | -    | 40   |      |   |
| Pulsed drain current <sup>3)</sup>            | $I_{D,pulse}$     | -      | -    | 868  | A    | $T_C=25\text{ °C}$  |
| Avalanche current, single pulse <sup>4)</sup> | $I_{AS}$          | -      | -    | 50   | A    | $T_C=25\text{ °C}$  |
| Avalanche energy, single pulse                | $E_{AS}$          | -      | -    | 50   | mJ   | $I_D=50\text{ A}$ , $R_{GS}=25\text{ }\Omega$   |
| Gate source voltage                           | $V_{GS}$          | -16    | -    | 16   | V    | -   |
| Power dissipation                             | $P_{tot}$         | -      | -    | 74   | W    | $T_C=25\text{ °C}$<br>$T_A=25\text{ °C}$ , $R_{thJA}=50\text{ K/W}^2)$  |
|   |                   | -      | -    | 2.5  |      |   |
| 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                         | $R_{thJC}$ | -      | -    | 1.7  | K/W  | -                     |
| Thermal resistance, junction - case, top                    | $R_{thJC}$ | -      | -    | 20   | K/W  | -                     |
| Device on PCB, 6 cm <sup>2</sup> cooling area <sup>2)</sup> | $R_{thJA}$ | -      | -    | 50   | K/W  | -                     |

<sup>1)</sup> Rating refers to the product only with datasheet specified absolute maximum values, maintaining case temperature at 25°C. For higher case temperature please refer to Diagram 2. De-rating will be required based on the actual environmental conditions.

<sup>2)</sup> Device on 40 mm x 40 mm x 1.5 mm epoxy PCB FR4 with 6 cm<sup>2</sup> (one layer, 70 µm thick) copper area for drain connection. PCB is vertical in still air.

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

<sup>4)</sup> See Diagram 13 for more detailed information

### 3 Electrical characteristics

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

**Table 4 Static characteristics**

| Parameter                                 | Symbol              | Values |      |      | Unit       | Note / Test Condition  |
|---|---------------------|--------|------|------|------------|--|
|   |                     | Min.   | Typ. | Max. |            |  |
| Drain-source breakdown voltage            | $V_{(BR)DSS}$       | 25     | -    | -    | V          | $V_{GS}=0\text{ V}$ , $I_D=1\text{ mA}$                          |
| Breakdown voltage temperature coefficient | $dV_{(BR)DSS}/dT_j$ | -      | 15   | -    | mV/K       | $I_D=10\text{ mA}$ , referenced to $25\text{ °C}$                |
| Gate threshold voltage                    | $V_{GS(th)}$        | 1.2    | 1.6  | 2    | V          | $V_{DS}=V_{GS}$ , $I_D=250\text{ }\mu\text{A}$                   |
| Zero gate voltage drain current           | $I_{DSS}$           | -      | -    | 0.5  | mA         | $V_{DS}=20\text{ V}$ , $V_{GS}=0\text{ V}$ , $T_j=25\text{ °C}$  |
|   |                     | -      | 3    | -    |            | $V_{DS}=20\text{ V}$ , $V_{GS}=0\text{ V}$ , $T_j=125\text{ °C}$ |
| Gate-source leakage current               | $I_{GSS}$           | -      | 10   | 100  | nA         | $V_{GS}=20\text{ V}$ , $V_{DS}=0\text{ V}$                       |
| Drain-source on-state resistance          | $R_{DS(on)}$        | -      | 1.05 | 1.35 | m $\Omega$ | $V_{GS}=4.5\text{ V}$ , $I_D=30\text{ A}$                        |
|   |                     | -      | 0.80 | 0.95 |            | $V_{GS}=10\text{ V}$ , $I_D=30\text{ A}$                         |
| Gate resistance                           | $R_G$               | -      | 1.1  | 1.8  | $\Omega$   | -  |
| Transconductance                          | $g_{fs}$            | 75     | 150  | -    | S          | $ V_{DS} >2 I_D R_{DS(on)max}$ , $I_D=30\text{ A}$               |

**Table 5 Dynamic characteristics**

| Parameter                        | Symbol       | Values |      |      | Unit | Note / Test Condition  |
|----------------------------------|--------------|--------|------|------|------|--|
|                                  |              | Min.   | Typ. | Max. |      |  |
| Input capacitance <sup>1)</sup>  | $C_{iss}$    | -      | 2400 | 3200 | pF   | $V_{GS}=0\text{ V}$ , $V_{DS}=12\text{ V}$ , $f=1\text{ MHz}$                                      |
| Output capacitance <sup>1)</sup> | $C_{oss}$    | -      | 1400 | 1900 | pF   | $V_{GS}=0\text{ V}$ , $V_{DS}=12\text{ V}$ , $f=1\text{ MHz}$                                      |
| Reverse transfer capacitance     | $C_{rss}$    | -      | 130  | -    | pF   | $V_{GS}=0\text{ V}$ , $V_{DS}=12\text{ V}$ , $f=1\text{ MHz}$                                      |
| Turn-on delay time               | $t_{d(on)}$  | -      | 5    | -    | ns   | $V_{DD}=12\text{ V}$ , $V_{GS}=10\text{ V}$ , $I_D=30\text{ A}$ ,<br>$R_{G,ext}=1.6\text{ }\Omega$ |
| Rise time                        | $t_r$        | -      | 5    | -    | ns   | $V_{DD}=12\text{ V}$ , $V_{GS}=10\text{ V}$ , $I_D=30\text{ A}$ ,<br>$R_{G,ext}=1.6\text{ }\Omega$ |
| Turn-off delay time              | $t_{d(off)}$ | -      | 27   | -    | ns   | $V_{DD}=12\text{ V}$ , $V_{GS}=10\text{ V}$ , $I_D=30\text{ A}$ ,<br>$R_{G,ext}=1.6\text{ }\Omega$ |
| Fall time                        | $t_f$        | -      | 4    | -    | ns   | $V_{DD}=12\text{ V}$ , $V_{GS}=10\text{ V}$ , $I_D=30\text{ A}$ ,<br>$R_{G,ext}=1.6\text{ }\Omega$ |

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

**Table 6 Gate charge characteristics<sup>1)</sup>**

| Parameter                       | Symbol        | Values |      |      | Unit | Note / Test Condition  |
|---------------------------------|---------------|--------|------|------|------|--|
|                                 |               | Min.   | Typ. | Max. |      |  |
| Gate to source charge           | $Q_{gs}$      | -      | 5.7  | -    | nC   | $V_{DD}=12\text{ V}$ , $I_D=30\text{ A}$ , $V_{GS}=0\text{ to }4.5\text{ V}$ |
| Gate charge at threshold        | $Q_{g(th)}$   | -      | 3.9  | -    | nC   | $V_{DD}=12\text{ V}$ , $I_D=30\text{ A}$ , $V_{GS}=0\text{ to }4.5\text{ V}$ |
| Gate to drain charge            | $Q_{gd}$      | -      | 4.3  | -    | nC   | $V_{DD}=12\text{ V}$ , $I_D=30\text{ A}$ , $V_{GS}=0\text{ to }4.5\text{ V}$ |
| Switching charge                | $Q_{sw}$      | -      | 6.1  | -    | nC   | $V_{DD}=12\text{ V}$ , $I_D=30\text{ A}$ , $V_{GS}=0\text{ to }4.5\text{ V}$ |
| Gate charge total <sup>2)</sup> | $Q_g$         | -      | 17   | 23   | nC   | $V_{DD}=12\text{ V}$ , $I_D=30\text{ A}$ , $V_{GS}=0\text{ to }4.5\text{ V}$ |
| Gate plateau voltage            | $V_{plateau}$ | -      | 2.3  | -    | V    | $V_{DD}=12\text{ V}$ , $I_D=30\text{ A}$ , $V_{GS}=0\text{ to }4.5\text{ V}$ |
| Gate charge total <sup>2)</sup> | $Q_g$         | -      | 36   | 49   | nC   | $V_{DD}=12\text{ V}$ , $I_D=30\text{ A}$ , $V_{GS}=0\text{ to }10\text{ V}$  |
| Gate charge total, sync. FET    | $Q_{g(sync)}$ | -      | 15   | -    | nC   | $V_{DS}=0.1\text{ V}$ , $V_{GS}=0\text{ to }4.5\text{ V}$                    |
| Output charge                   | $Q_{oss}$     | -      | 27   | -    | nC   | $V_{DD}=12\text{ V}$ , $V_{GS}=0\text{ V}$                                   |

**Table 7 Reverse diode**

| Parameter                        | Symbol        | Values |      |      | Unit | Note / Test Condition  |
|----------------------------------|---------------|--------|------|------|------|--|
|                                  |               | Min.   | Typ. | Max. |      |  |
| Diode continuous forward current | $I_S$         | -      | -    | 74   | A    | $T_C=25\text{ °C}$   |
| Diode pulse current              | $I_{S,pulse}$ | -      | -    | 868  | A    | $T_C=25\text{ °C}$   |
| Diode forward voltage            | $V_{SD}$      | -      | 0.48 | 0.62 | V    | $V_{GS}=0\text{ V}$ , $I_F=11\text{ A}$ , $T_j=25\text{ °C}$               |
| Reverse recovery charge          | $Q_{rr}$      | -      | 5    | -    | nC   | $V_R=15\text{ V}$ , $I_F=12\text{ A}$ , $di_F/dt=400\text{ A}/\mu\text{s}$ |

<sup>1)</sup> See "Gate charge waveforms" for parameter definition

<sup>2)</sup> Defined by design. Not subject to production test

### 4 Electrical characteristics diagrams

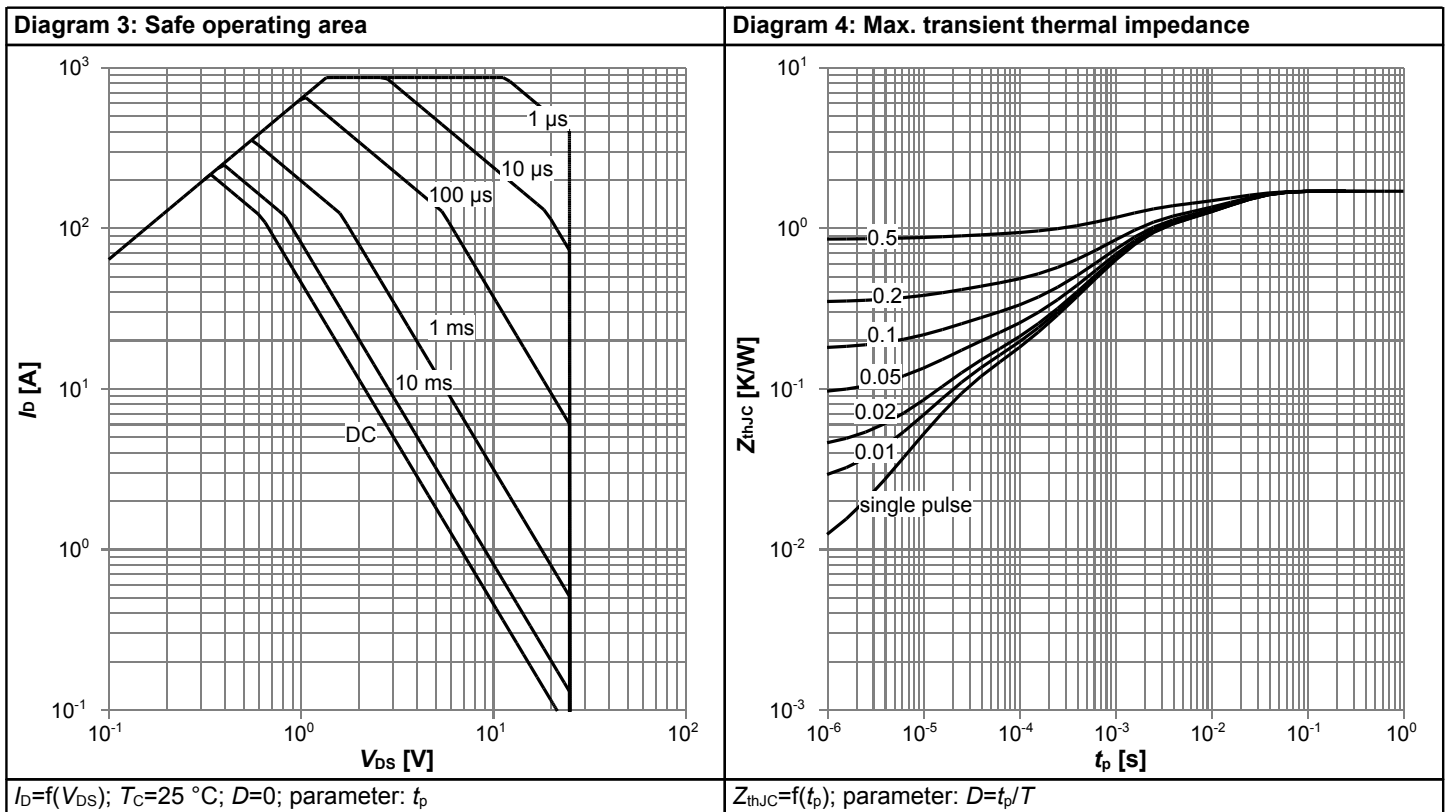
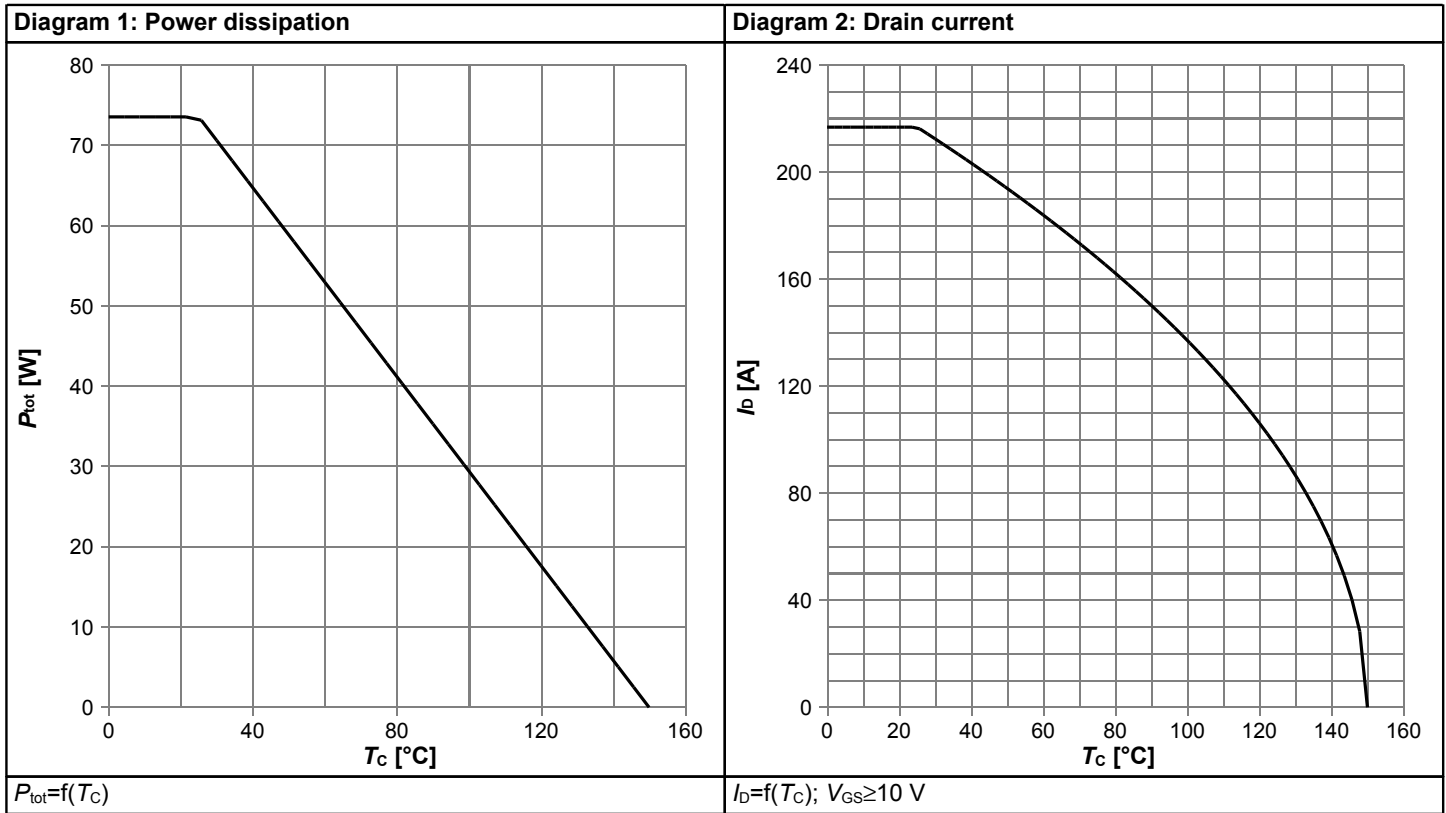
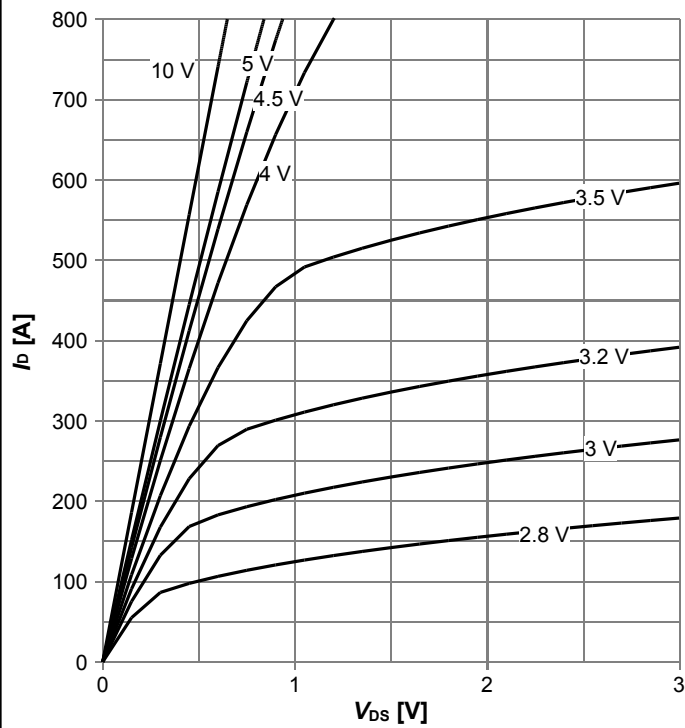
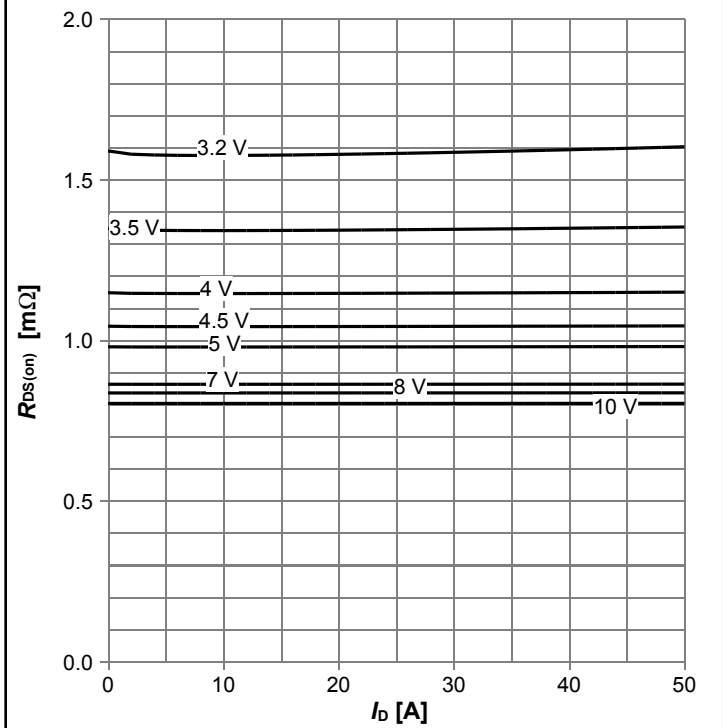


Diagram 5: Typ. output characteristics



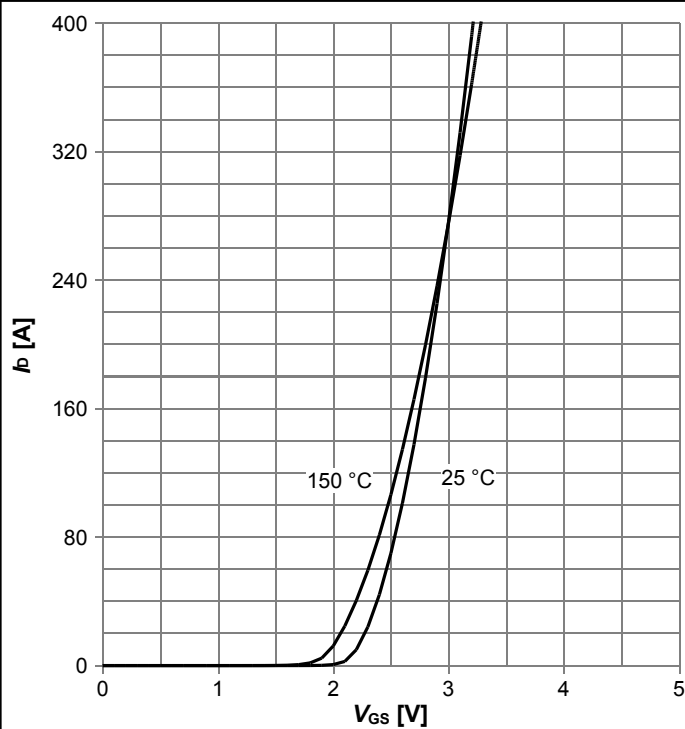
$I_D = f(V_{DS}); T_j = 25\text{ °C};$  parameter:  $V_{GS}$

Diagram 6: Typ. drain-source on resistance



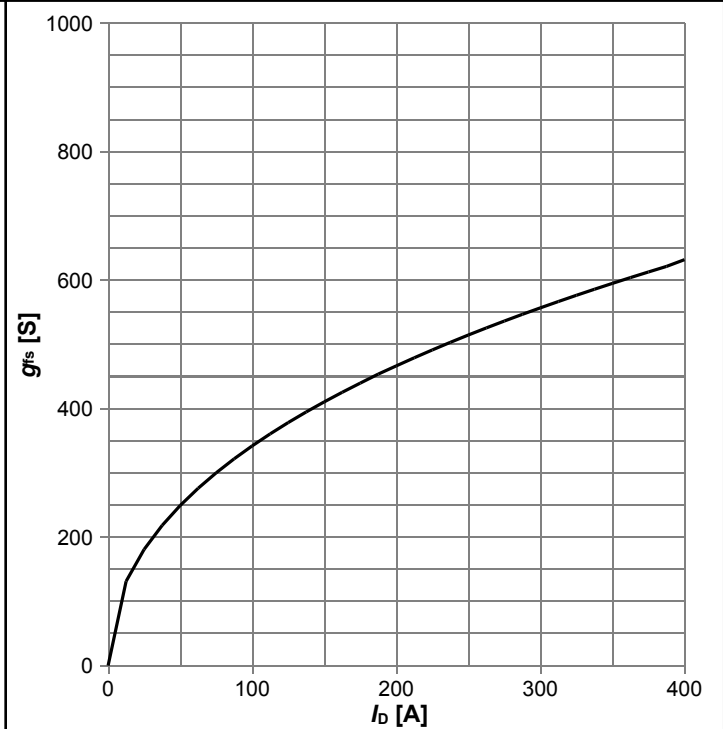
$R_{DS(on)} = f(I_D); T_j = 25\text{ °C};$  parameter:  $V_{GS}$

Diagram 7: Typ. transfer characteristics



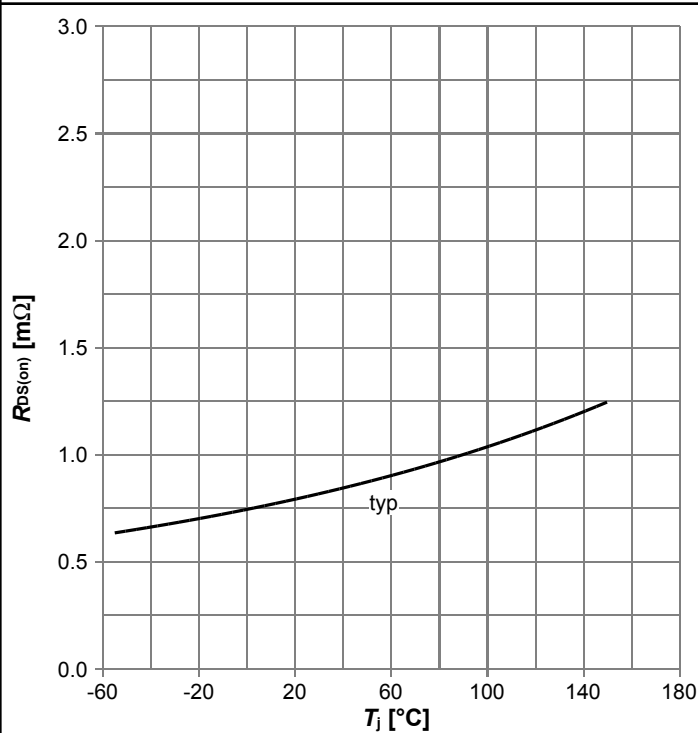
$I_D = f(V_{GS}); |V_{DS}| > 2 \cdot I_D \cdot R_{DS(on)max};$  parameter:  $T_j$

Diagram 8: Typ. forward transconductance



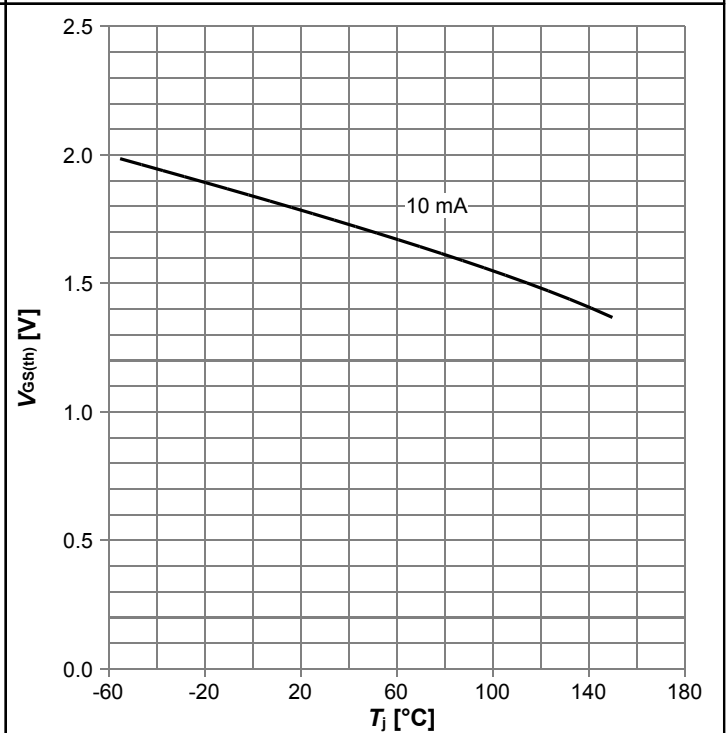
$g_{fs} = f(I_D); T_j = 25\text{ °C}$

Diagram 9: Drain-source on-state resistance



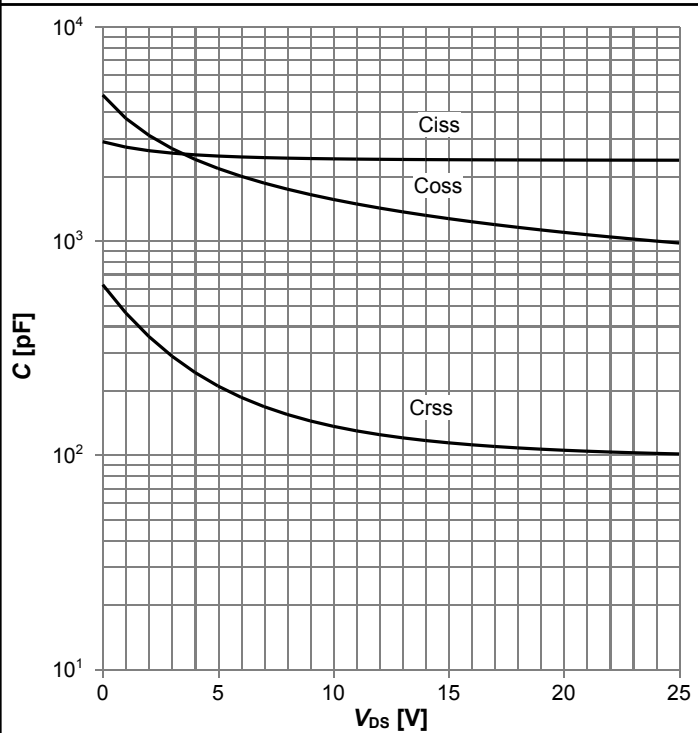
$R_{DS(on)}=f(T_j)$ ;  $I_D=30$  A;  $V_{GS}=10$  V

Diagram 10: Typ. gate threshold voltage



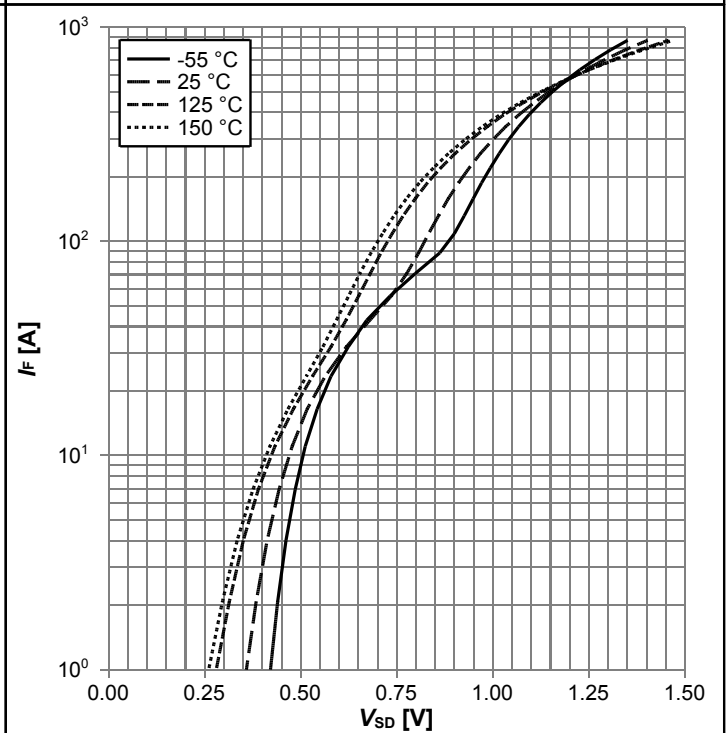
$V_{GS(th)}=f(T_j)$ ;  $V_{GS}=V_{DS}$

Diagram 11: Typ. capacitances



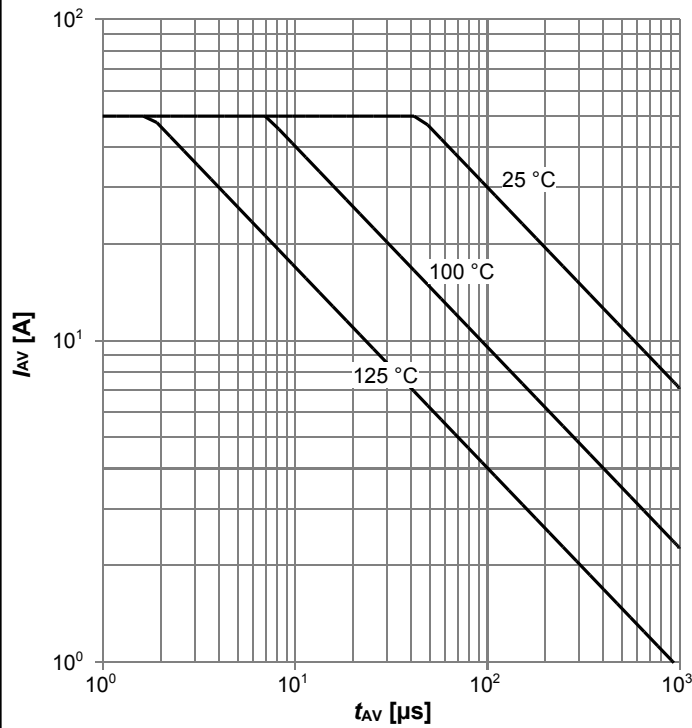
$C=f(V_{DS})$ ;  $V_{GS}=0$  V;  $f=1$  MHz

Diagram 12: Forward characteristics of reverse diode



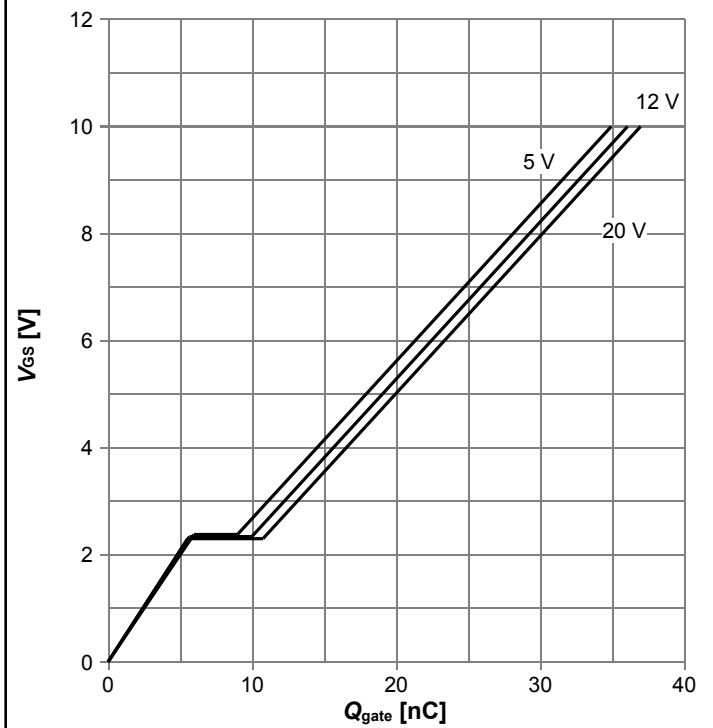
$I_F=f(V_{SD})$ ; parameter:  $T_j$

**Diagram 13: Avalanche characteristics**



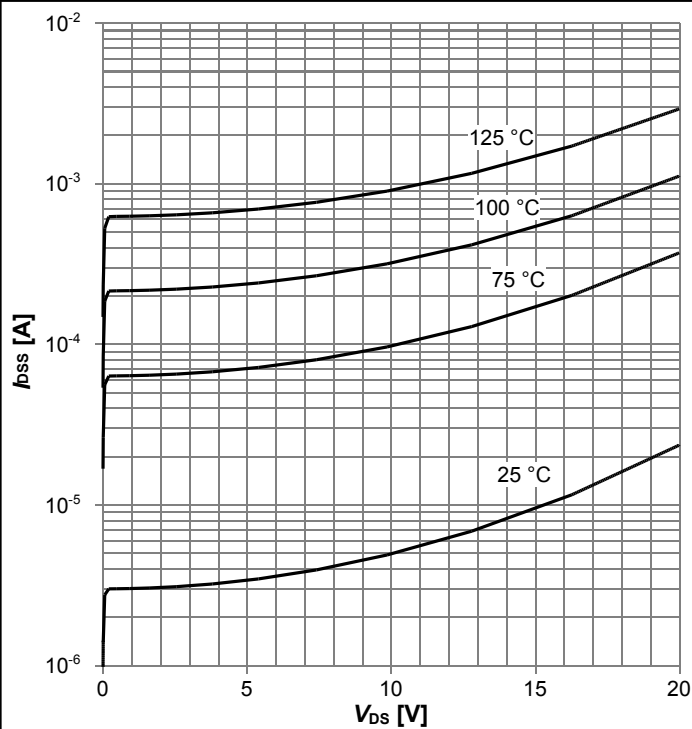
$I_{AS}=f(t_{AV}); R_{GS}=25 \Omega$ ; parameter:  $T_{j(start)}$

**Diagram 14: Typ. gate charge**



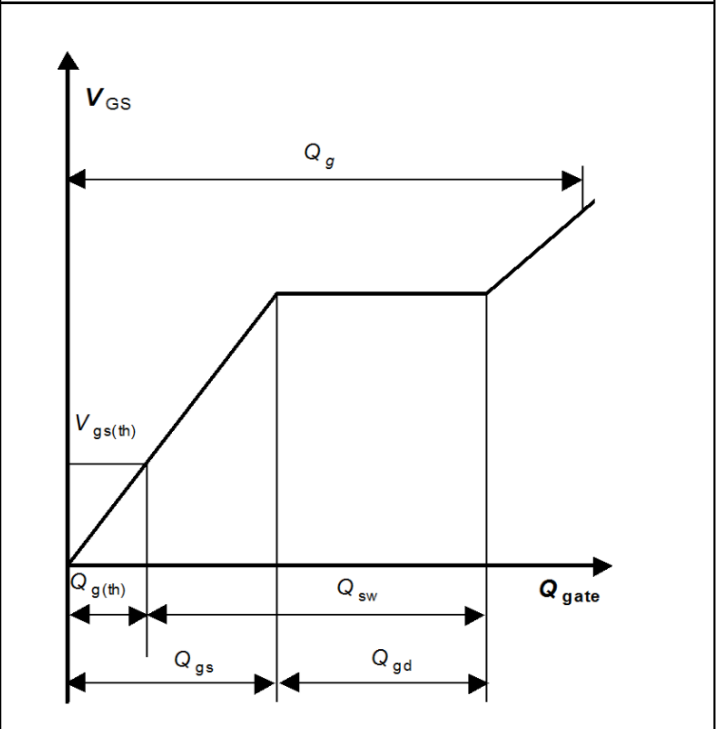
$V_{GS}=f(Q_{gate}); I_D=30 \text{ A pulsed}$ ; parameter:  $V_{DD}$

**Diagram 15: Typ. drain-source leakage current**

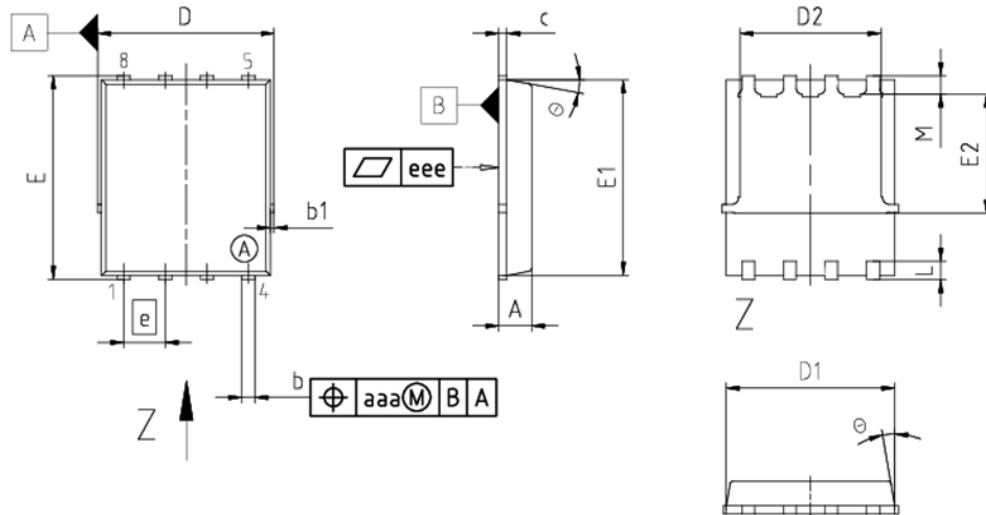


$I_{BSS}=f(V_{DS}); V_{GS}=0 \text{ V}$ ; parameter:  $T_j$

**Diagram 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        |      |

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04

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



## Revision History

BSC009NE2LS5I

**Revision: 2020-06-17, Rev. 2.1**

Previous Revision

| Revision | Date       | Subjects (major changes since last revision) |
|----------|------------|--|
| 2.0      | 2015-03-10 | Release of final version                     |
| 2.1      | 2020-06-17 | Update current rating and footnotes          |

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