

# MOSFET

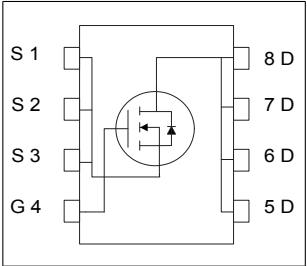
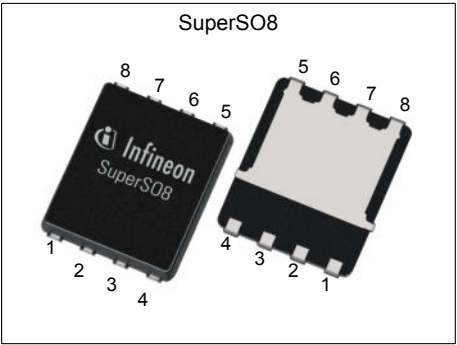
## OptiMOS™3 Power-Transistor, 40 V

### Features

- Fast switching MOSFET for SMPS
- Optimized technology for DC/DC converters
- Qualified according to JEDEC<sup>1)</sup> for target applications
- N-channel; Normal level
- Excellent gate charge x  $R_{DS(on)}$  product (FOM)
- Very low on-resistance  $R_{DS(on)}$
- Superior thermal resistance
- 100% Avalanche tested
- Pb-free plating; RoHS compliant
- Halogen-free according to IEC61249-2-21

Table 1 Key Performance Parameters

| Parameter        | Value | Unit |
|------------------|-------|------|
| $V_{DS}$         | 40    | V    |
| $R_{DS(on),max}$ | 1.9   | mΩ   |
| $I_D$            | 204   | A    |



| Type / Ordering Code | Package    | Marking  | Related Links |
|----------------------|------------|----------|---------------|
| BSC019N04NS G        | PG-TDSON-8 | 019N04NS | -             |

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

**Table of Contents**

Description ..... 1

Maximum ratings ..... 3

Thermal characteristics ..... 3

Electrical characteristics ..... 4

Electrical characteristics diagrams ..... 6

Package Outlines ..... 10

Revision History ..... 12

Trademarks ..... 12

Disclaimer ..... 12

## 1 Maximum ratings

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

**Table 2 Maximum ratings**

| Parameter                                     | Symbol            | Values |      |                  | Unit | Note / Test Condition                                                                                                                                              |
|-----------------------------------------------|-------------------|--------|------|------------------|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                               |                   | Min.   | Typ. | Max.             |      |                                                                                                                                                                    |
| Continuous drain current <sup>1)</sup>        | $I_D$             | -      | -    | 204<br>129<br>29 | A    | $V_{GS}=10\text{ V}$ , $T_C=25\text{ °C}$<br>$V_{GS}=10\text{ V}$ , $T_C=100\text{ °C}$<br>$V_{GS}=10\text{ V}$ , $T_A=25\text{ °C}$ , $R_{thJA}=50\text{ K/W}^2)$ |
| Pulsed drain current <sup>3)</sup>            | $I_{D,pulse}$     | -      | -    | 816              | 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                | $E_{AS}$          | -      | -    | 295              | mJ   | $I_D=50\text{ A}$ , $R_{GS}=25\text{ }\Omega$                                                                                                                      |
| Gate source voltage                           | $V_{GS}$          | -20    | -    | 20               | V    | -                                                                                                                                                                  |
| Power dissipation                             | $P_{tot}$         | -      | -    | 125<br>2.5       | W    | $T_C=25\text{ °C}$<br>$T_A=25\text{ °C}$ , $R_{thJA}=50\text{ K/W}^2)$                                                                                             |
| 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, bottom                 | $R_{thJC}$ | -      | -    | 1    | K/W  | -                     |
| Thermal resistance, junction - case, top                    | $R_{thJC}$ | -      | -    | 18   | 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   | $V_{(BR)DSS}$ | 40     | -         | -        | V             | $V_{GS}=0\text{ V}$ , $I_D=1\text{ mA}$                                                                                             |
| Gate threshold voltage           | $V_{GS(th)}$  | 2      | -         | 4        | V             | $V_{DS}=V_{GS}$ , $I_D=85\text{ }\mu\text{A}$                                                                                       |
| Zero gate voltage drain current  | $I_{DSS}$     | -      | 0.1<br>10 | 1<br>100 | $\mu\text{A}$ | $V_{DS}=40\text{ V}$ , $V_{GS}=0\text{ V}$ , $T_j=25\text{ °C}$<br>$V_{DS}=40\text{ V}$ , $V_{GS}=0\text{ V}$ , $T_j=125\text{ °C}$ |
| Gate-source leakage current      | $I_{GSS}$     | -      | -         | 100      | nA            | $V_{GS}=20\text{ V}$ , $V_{DS}=0\text{ V}$                                                                                          |
| Drain-source on-state resistance | $R_{DS(on)}$  | -      | 1.6       | 1.9      | m $\Omega$    | $V_{GS}=10\text{ V}$ , $I_D=50\text{ A}$                                                                                            |
| Gate resistance                  | $R_G$         | -      | 1.3       | -        | $\Omega$      | -                                                                                                                                   |
| Transconductance                 | $g_{fs}$      | 60     | 120       | -        | S             | $ V_{DS} >2 I_D R_{DS(on)max}$ , $I_D=50\text{ A}$                                                                                  |

**Table 5 Dynamic characteristics**

| Parameter                    | Symbol       | Values |      |      | Unit | Note / Test Condition                                                                        |
|------------------------------|--------------|--------|------|------|------|----------------------------------------------------------------------------------------------|
|                              |              | Min.   | Typ. | Max. |      |                                                                                              |
| Input capacitance            | $C_{iss}$    | -      | 6600 | 8800 | pF   | $V_{GS}=0\text{ V}$ , $V_{DS}=20\text{ V}$ , $f=1\text{ MHz}$                                |
| Output capacitance           | $C_{oss}$    | -      | 1800 | 2400 | pF   | $V_{GS}=0\text{ V}$ , $V_{DS}=20\text{ V}$ , $f=1\text{ MHz}$                                |
| Reverse transfer capacitance | $C_{rss}$    | -      | 70   | -    | pF   | $V_{GS}=0\text{ V}$ , $V_{DS}=20\text{ V}$ , $f=1\text{ MHz}$                                |
| Turn-on delay time           | $t_{d(on)}$  | -      | 22   | -    | ns   | $V_{DD}=20\text{ V}$ , $V_{GS}=10\text{ V}$ , $I_D=30\text{ A}$ ,<br>$R_G=1.6\text{ }\Omega$ |
| Rise time                    | $t_r$        | -      | 5.6  | -    | ns   | $V_{DD}=20\text{ V}$ , $V_{GS}=10\text{ V}$ , $I_D=30\text{ A}$ ,<br>$R_G=1.6\text{ }\Omega$ |
| Turn-off delay time          | $t_{d(off)}$ | -      | 33   | -    | ns   | $V_{DD}=20\text{ V}$ , $V_{GS}=10\text{ V}$ , $I_D=30\text{ A}$ ,<br>$R_G=1.6\text{ }\Omega$ |
| Fall time                    | $t_f$        | -      | 6.6  | -    | ns   | $V_{DD}=20\text{ V}$ , $V_{GS}=10\text{ V}$ , $I_D=30\text{ A}$ ,<br>$R_G=1.6\text{ }\Omega$ |

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

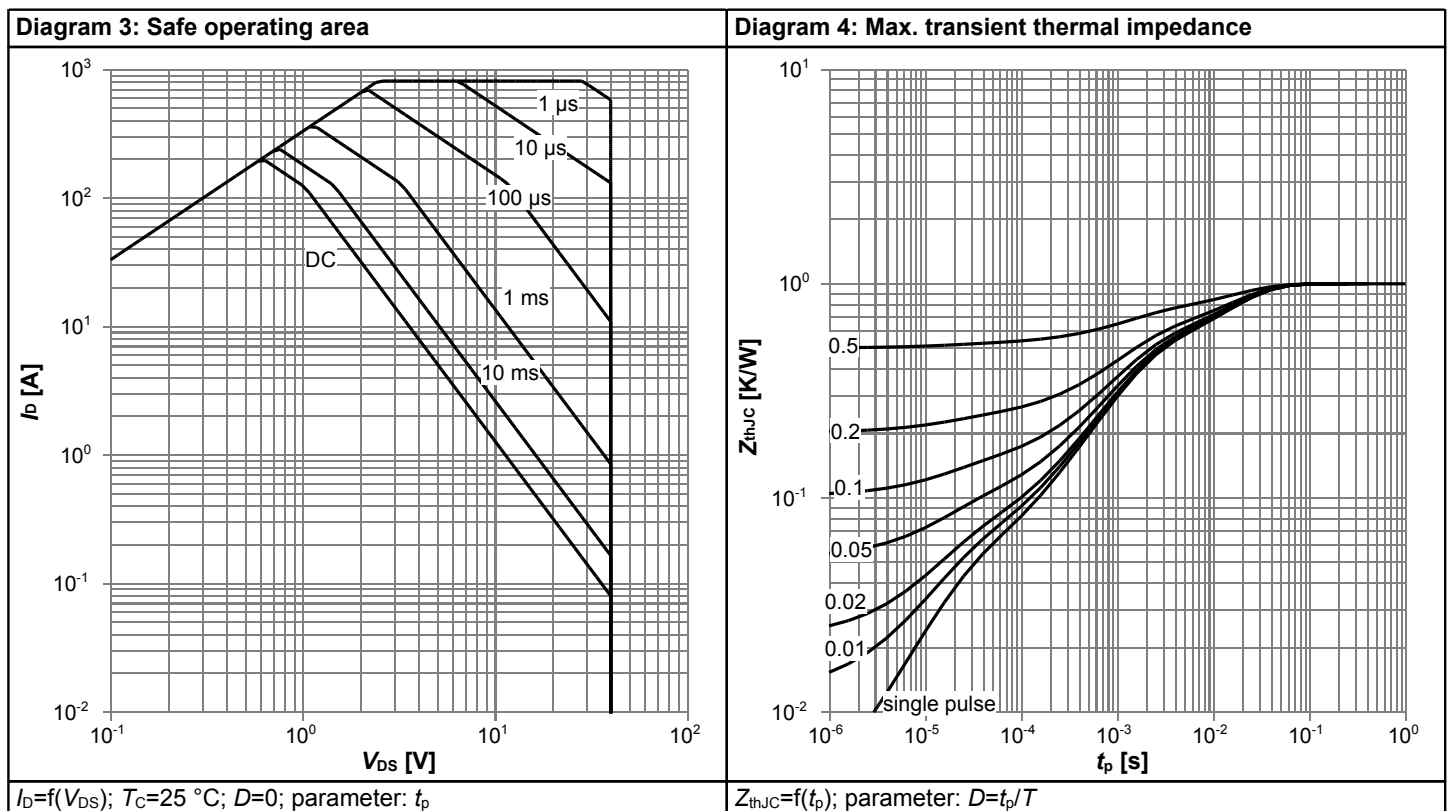
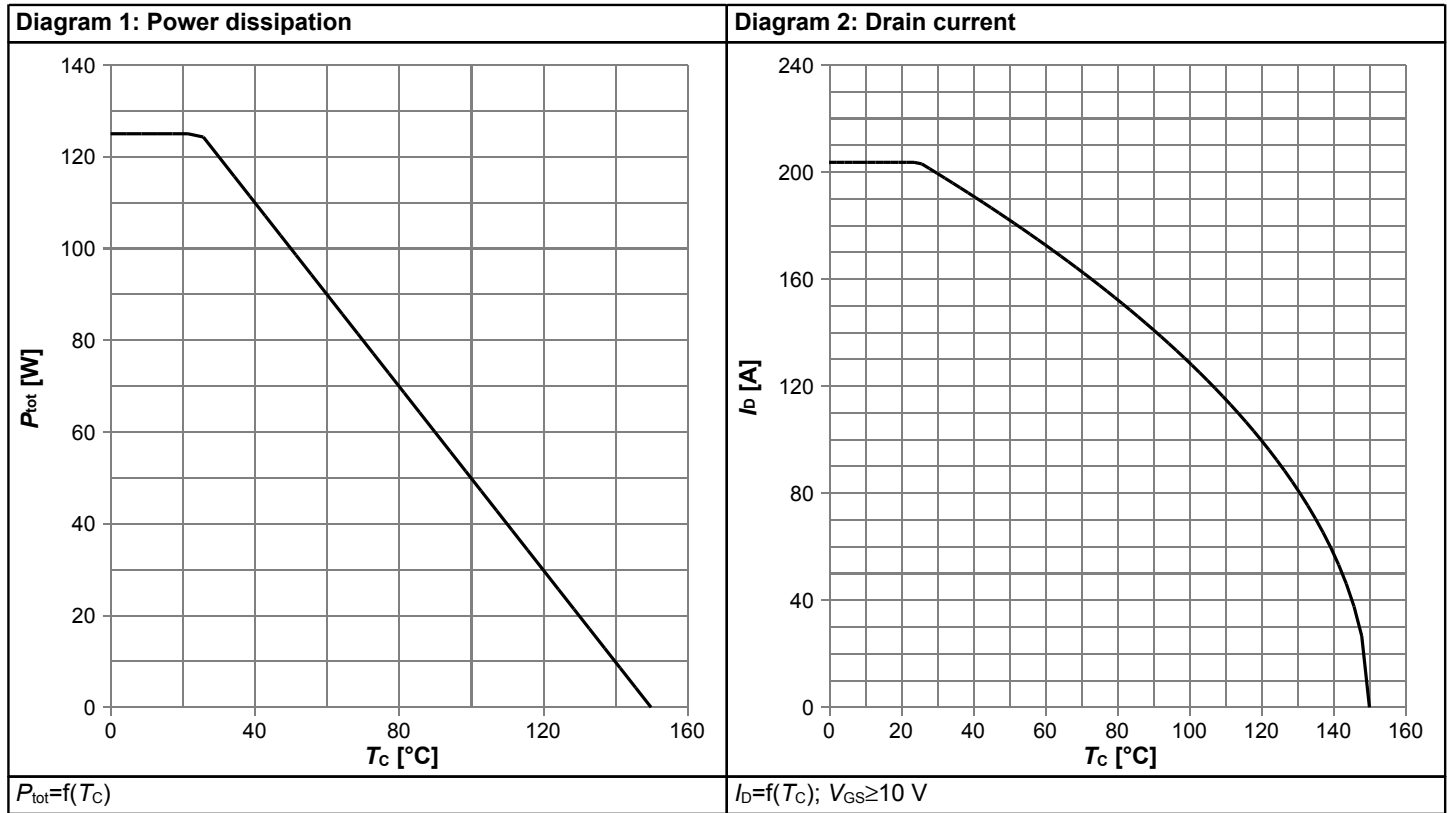
| Parameter                    | Symbol        | Values |      |      | Unit | Note / Test Condition                                                       |
|------------------------------|---------------|--------|------|------|------|-----------------------------------------------------------------------------|
|                              |               | Min.   | Typ. | Max. |      |                                                                             |
| Gate to source charge        | $Q_{gs}$      | -      | 32   | -    | nC   | $V_{DD}=20\text{ V}$ , $I_D=30\text{ A}$ , $V_{GS}=0\text{ to }10\text{ V}$ |
| Gate charge at threshold     | $Q_{g(th)}$   | -      | 20   | -    | nC   | $V_{DD}=20\text{ V}$ , $I_D=30\text{ A}$ , $V_{GS}=0\text{ to }10\text{ V}$ |
| Gate to drain charge         | $Q_{gd}$      | -      | 10   | -    | nC   | $V_{DD}=20\text{ V}$ , $I_D=30\text{ A}$ , $V_{GS}=0\text{ to }10\text{ V}$ |
| Switching charge             | $Q_{sw}$      | -      | 22   | -    | nC   | $V_{DD}=20\text{ V}$ , $I_D=30\text{ A}$ , $V_{GS}=0\text{ to }10\text{ V}$ |
| Gate charge total            | $Q_g$         | -      | 81   | 108  | nC   | $V_{DD}=20\text{ V}$ , $I_D=30\text{ A}$ , $V_{GS}=0\text{ to }10\text{ V}$ |
| Gate plateau voltage         | $V_{plateau}$ | -      | 4.9  | -    | V    | $V_{DD}=20\text{ V}$ , $I_D=30\text{ A}$ , $V_{GS}=0\text{ to }10\text{ V}$ |
| Gate charge total, sync. FET | $Q_{g(sync)}$ | -      | 77   | -    | nC   | $V_{DS}=0.1\text{ V}$ , $V_{GS}=0\text{ to }10\text{ V}$                    |
| Output charge                | $Q_{oss}$     | -      | 66   | -    | nC   | $V_{DD}=20\text{ V}$ , $V_{GS}=0\text{ V}$                                  |

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

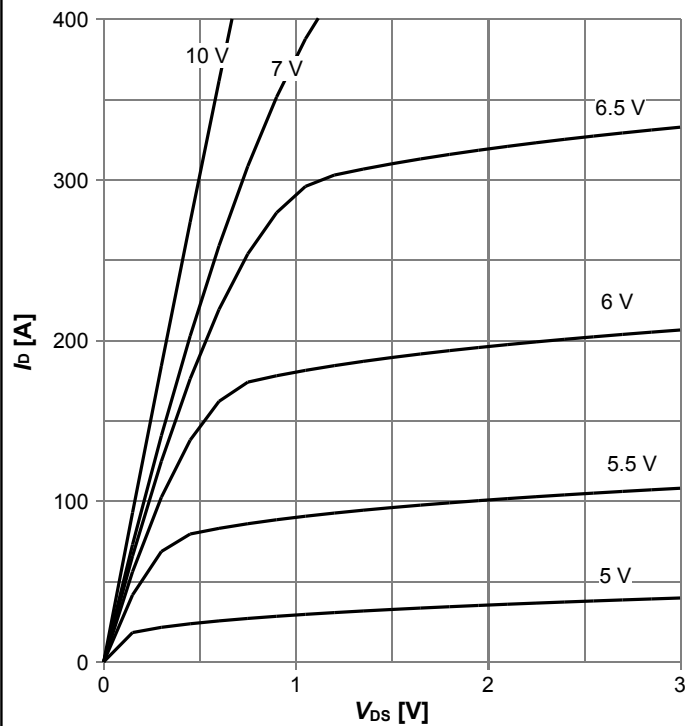
**Table 7 Reverse diode**

| Parameter                        | Symbol        | Values |      |      | Unit | Note / Test Condition                                              |
|----------------------------------|---------------|--------|------|------|------|--------------------------------------------------------------------|
|                                  |               | Min.   | Typ. | Max. |      |                                                                    |
| Diode continuous forward current | $I_S$         | -      | -    | 100  | A    | $T_C=25\text{ °C}$                                                 |
| Diode pulse current              | $I_{S,pulse}$ | -      | -    | 816  | A    | $T_C=25\text{ °C}$                                                 |
| Diode forward voltage            | $V_{SD}$      | -      | 0.85 | 1.2  | V    | $V_{GS}=0\text{ V}$ , $I_F=50\text{ A}$ , $T_j=25\text{ °C}$       |
| Reverse recovery charge          | $Q_{rr}$      | -      | 100  | -    | nC   | $V_R=20\text{ V}$ , $I_F=I_S$ , $di_F/dt=400\text{ A/}\mu\text{s}$ |

## 4 Electrical characteristics diagrams

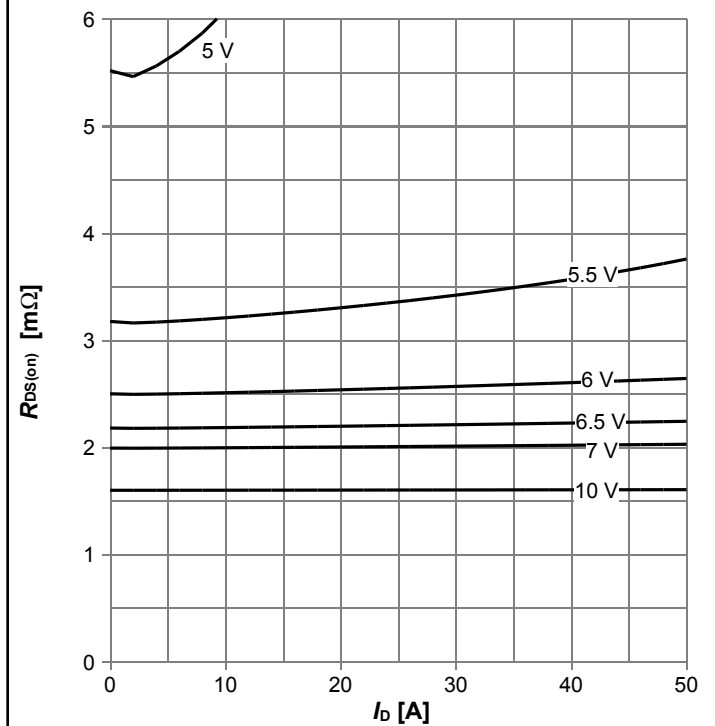


**Diagram 5: Typ. output characteristics**



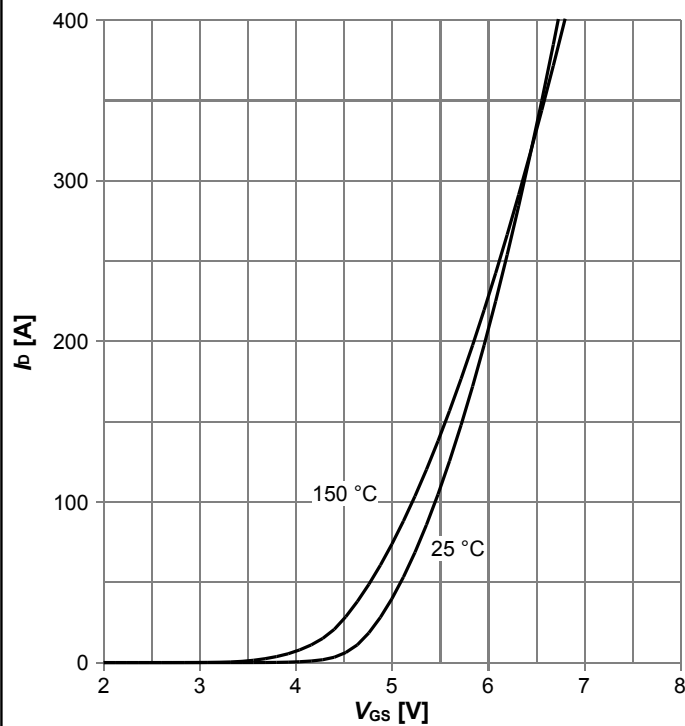
$I_D = f(V_{DS})$ ;  $T_j = 25^\circ\text{C}$ ; parameter:  $V_{GS}$

**Diagram 6: Typ. drain-source on resistance**



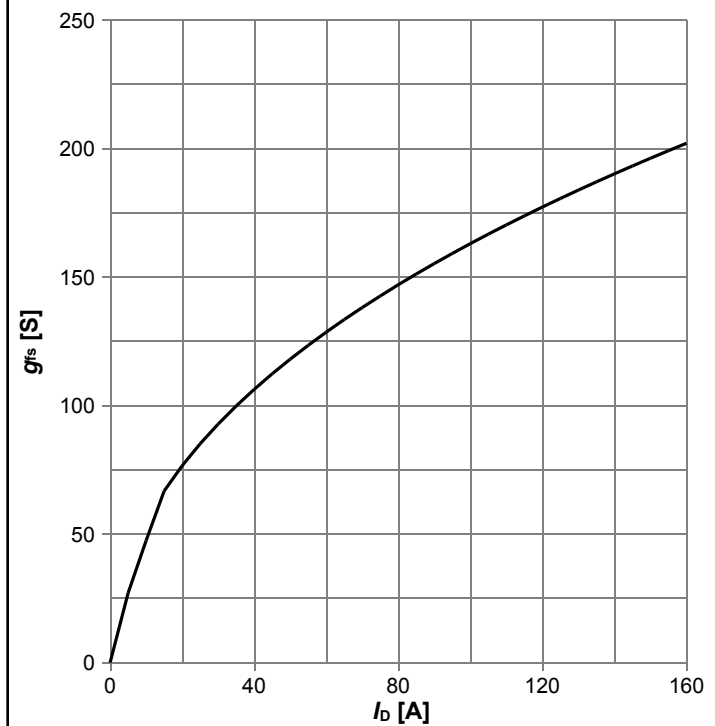
$R_{DS(on)} = f(I_D)$ ;  $T_j = 25^\circ\text{C}$ ; parameter:  $V_{GS}$

**Diagram 7: Typ. transfer characteristics**



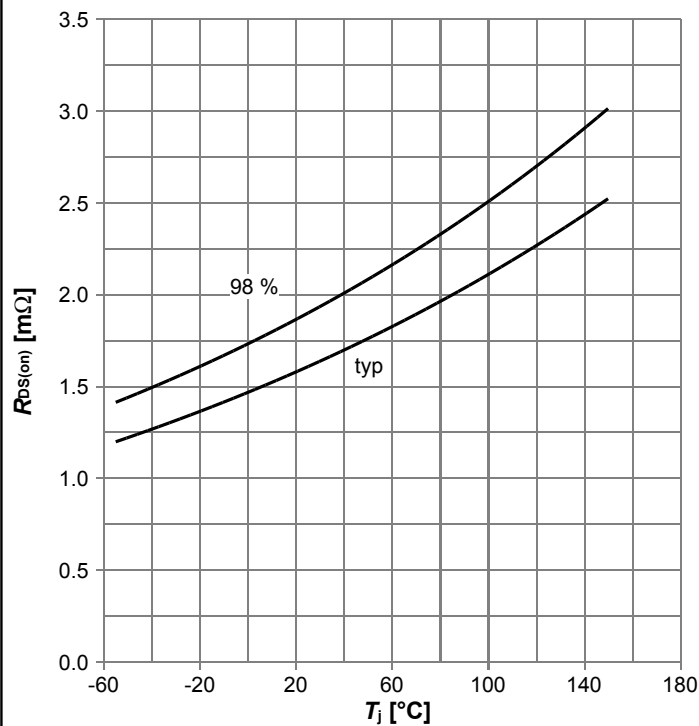
$I_D = f(V_{GS})$ ;  $|V_{DS}| > 2|I_D|R_{DS(on)max}$ ; parameter:  $T_j$

**Diagram 8: Typ. forward transconductance**



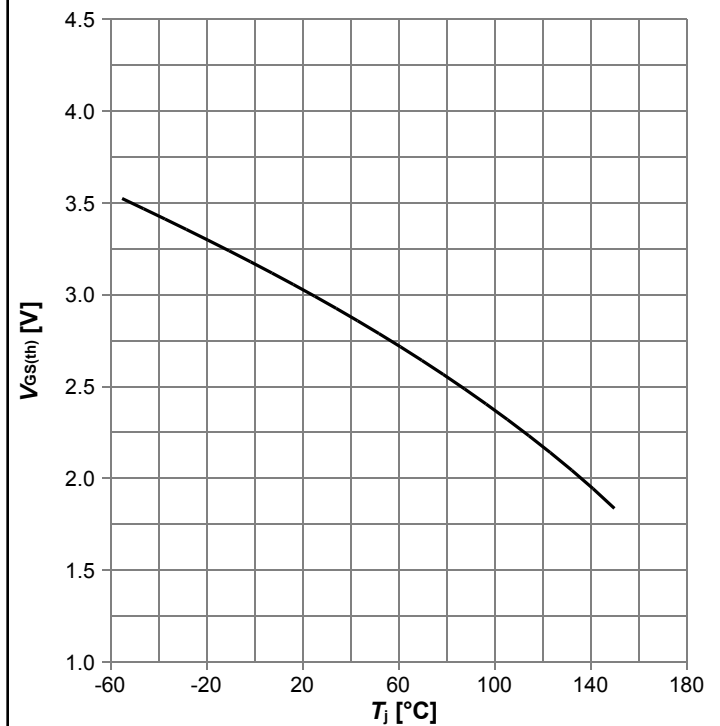
$g_{fs} = f(I_D)$ ;  $T_j = 25^\circ\text{C}$

Diagram 9: Drain-source on-state resistance



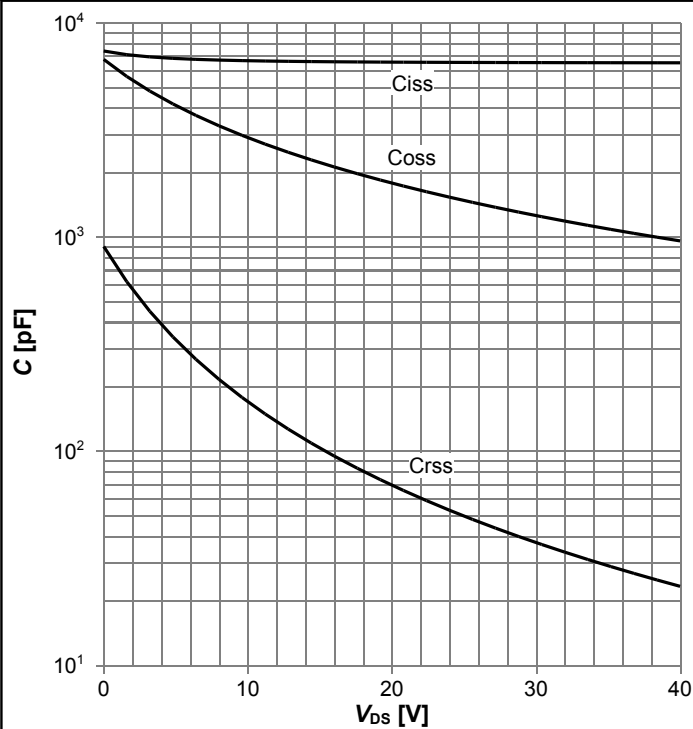
$R_{DS(on)} = f(T_j)$ ;  $I_D = 50$  A;  $V_{GS} = 10$  V

Diagram 10: Typ. gate threshold voltage



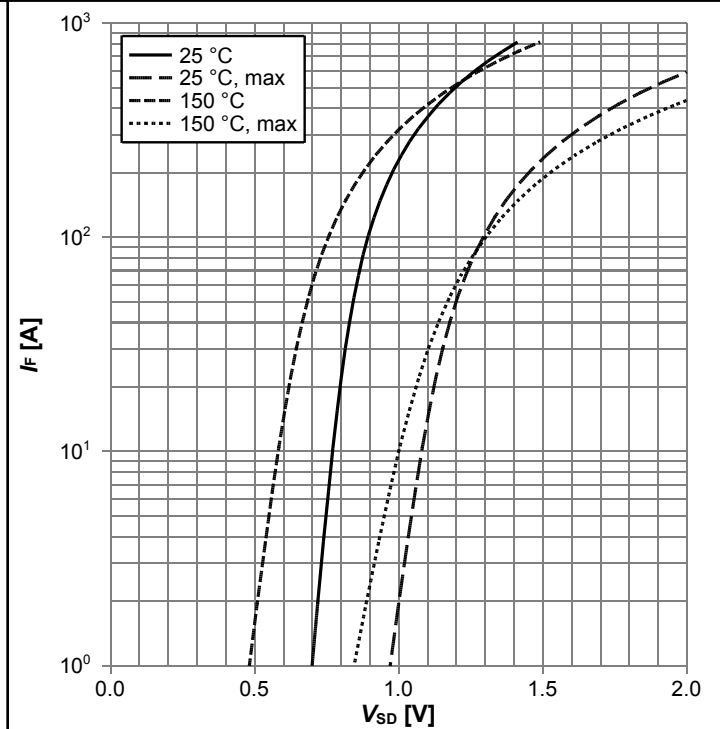
$V_{GS(th)} = f(T_j)$ ;  $V_{GS} = V_{DS}$ ;  $I_D = 85$   $\mu$ A

Diagram 11: Typ. capacitances



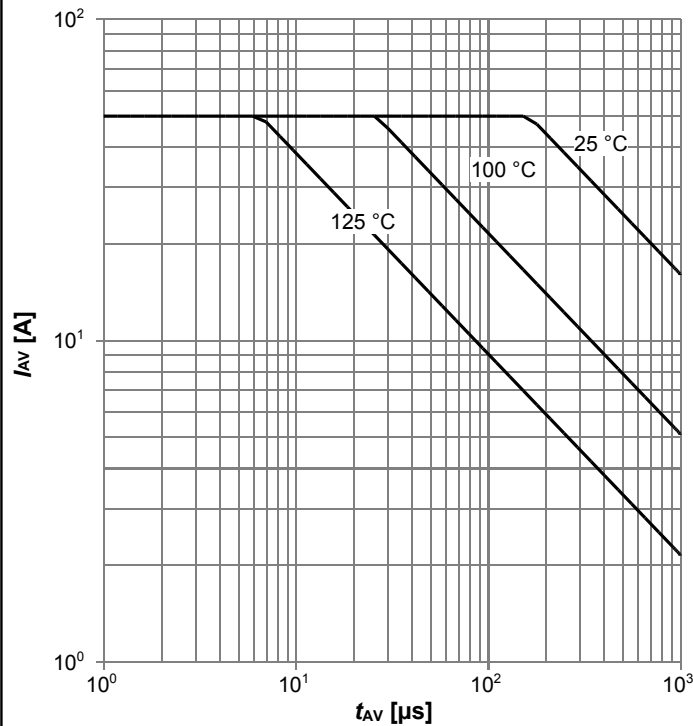
$C = f(V_{DS})$ ;  $V_{GS} = 0$  V;  $f = 1$  MHz

Diagram 12: Forward characteristics of reverse diode



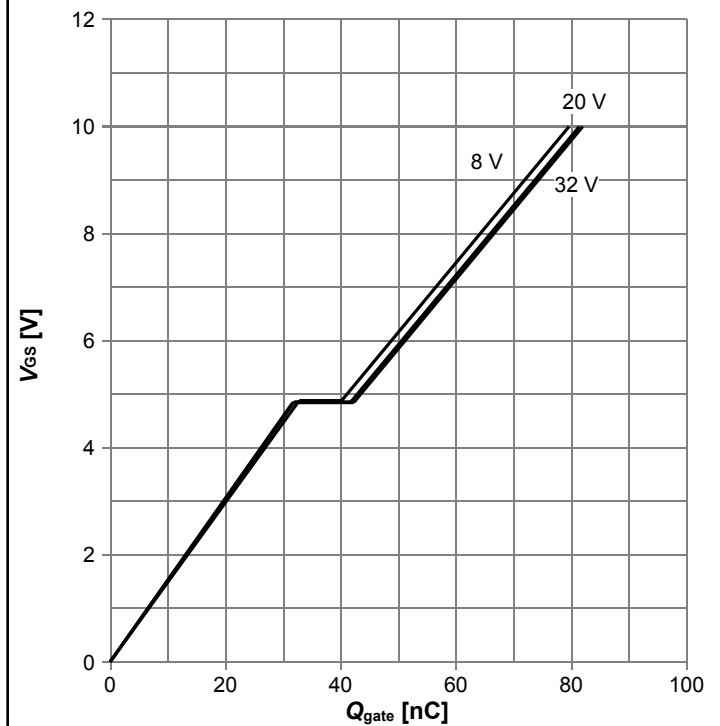
$I_F = f(V_{SD})$ ; parameter:  $T_j$

Diagram 13: Avalanche characteristics



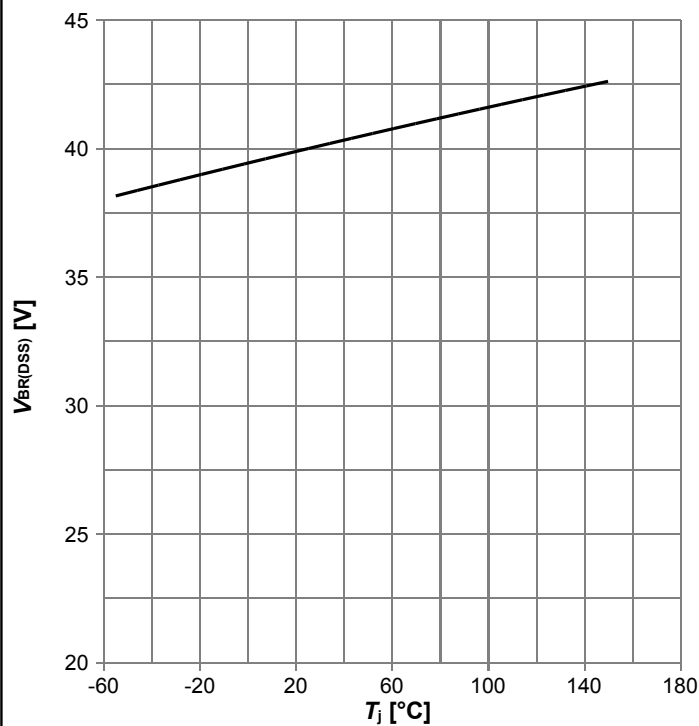
$I_{AS}=f(t_{AV})$ ;  $R_{GS}=25\ \Omega$ ; parameter:  $T_{j(start)}$

Diagram 14: Typ. gate charge



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

Diagram 15: Drain-source breakdown voltage



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

Diagram Gate charge waveforms



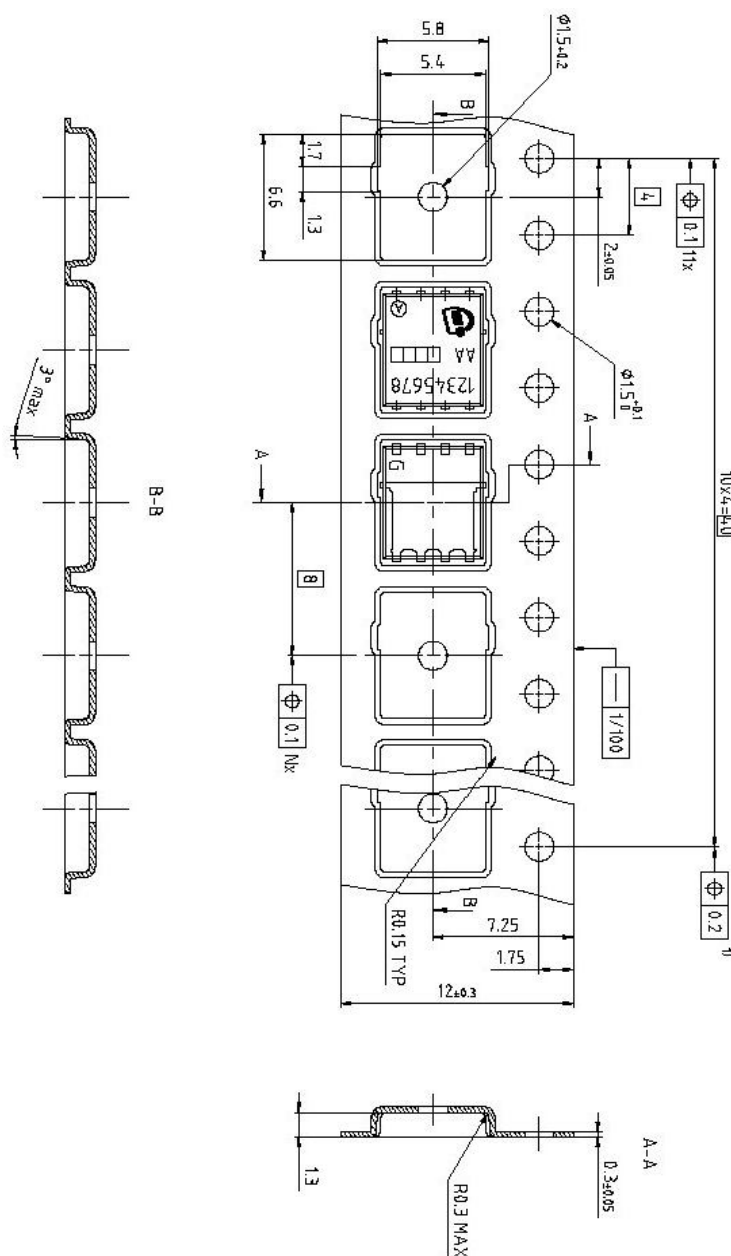
## 5 Package Outlines



| 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 |
| ø   | 8.5°        | 12°  |
| aaa | 0.25        |      |
| eee | 0.08        |      |

|                             |
|-----------------------------|
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| REVISION<br>04              |

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



Dimension in mm

Figure 2 Outline Tape (TDSON-8)

## Revision History

BSC019N04NS G

**Revision: 2020-03-17, Rev. 2.1**

Previous Revision

| Revision | Date       | Subjects (major changes since last revision) |
|----------|------------|----------------------------------------------|
| 2.0      | 2018-04-09 | Release of final version                     |
| 2.1      | 2020-03-17 | Update current rating                        |

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