

# MOSFET

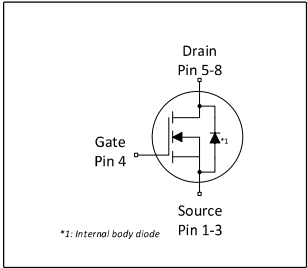
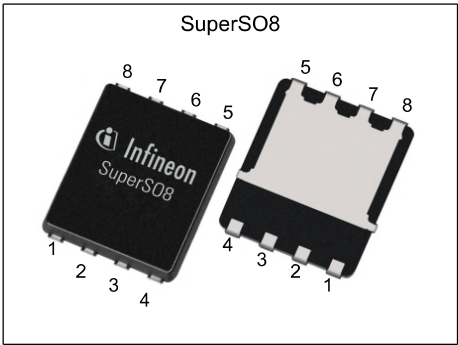
## OptiMOS™ 3 Power-Transistor, 60 V

### Features

- Ideal for high frequency switching and sync. rec.
- Optimized technology for DC/DC converters
- Excellent gate charge x  $R_{DS(on)}$  product (FOM)
- Very low on-resistance  $R_{DS(on)}$
- Superior thermal resistance
- N-channel, normal level
- 100% avalanche tested
- Pb-free plating; RoHS compliant
- Qualified according to JEDEC<sup>1)</sup> for target applications
- Halogen-free according to IEC61249-2-21

Table 1 Key Performance Parameters

| Parameter        | Value | Unit |
|------------------|-------|------|
| $V_{DS}$         | 60    | V    |
| $R_{DS(on),max}$ | 3.1   | mΩ   |
| $I_D$            | 165   | A    |



RoHS

| Type / Ordering Code | Package    | Marking  | Related Links |
|----------------------|------------|----------|---------------|
| BSC031N06NS3 G       | PG-TDSON-8 | 031N06NS | -             |

<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>       | $I_D$             | -      | -    | 165<br>105<br>22 | A    | $V_{GS}=10\text{ V}$ , $T_C=25\text{ °C}$<br>$V_{GS}=10\text{ V}$ , $T_C=100\text{ °C}$<br>$V_{GS}=10\text{ V}$ , $T_C=25\text{ °C}$ , $R_{thJA}=50\text{ K/W}^{2)}$ |
| Pulsed drain current <sup>3)</sup>           | $I_{D,pulse}$     | -      | -    | 660              | A    | $T_C=25\text{ °C}$                                                                                                                                                   |
| Avalanche energy, single pulse <sup>4)</sup> | $E_{AS}$          | -      | -    | 298              | mJ   | $I_D=50\text{ A}$ , $R_{GS}=25\text{ }\Omega$                                                                                                                        |
| Gate source voltage                          | $V_{GS}$          | -20    | -    | 20               | V    | -                                                                                                                                                                    |
| Power dissipation                            | $P_{tot}$         | -      | -    | 139<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                            | $R_{thJC}$ | -      | -    | 0.9  | K/W  | -                     |
| Device on PCB,<br>minimal footprint                            | $R_{thJA}$ | -      | -    | 62   | K/W  | -                     |
| Device on PCB,<br>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 as specified. For other case temperatures 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   | $V_{(BR)DSS}$ | 60     | -         | -          | V             | $V_{GS}=0\text{ V}$ , $I_D=1\text{ mA}$                                                                                             |
| Gate threshold voltage           | $V_{GS(th)}$  | 2.0    | 3.0       | 4.0        | V             | $V_{DS}=V_{GS}$ , $I_D=93\text{ }\mu\text{A}$                                                                                       |
| Zero gate voltage drain current  | $I_{DSS}$     | -      | 0.1<br>10 | 1.0<br>100 | $\mu\text{A}$ | $V_{DS}=60\text{ V}$ , $V_{GS}=0\text{ V}$ , $T_j=25\text{ °C}$<br>$V_{DS}=60\text{ V}$ , $V_{GS}=0\text{ V}$ , $T_j=125\text{ °C}$ |
| Gate-source leakage current      | $I_{GSS}$     | -      | 10        | 100        | nA            | $V_{GS}=20\text{ V}$ , $V_{DS}=0\text{ V}$                                                                                          |
| Drain-source on-state resistance | $R_{DS(on)}$  | -      | 2.5       | 3.1        | m $\Omega$    | $V_{GS}=10\text{ V}$ , $I_D=50\text{ A}$                                                                                            |
| Gate resistance                  | $R_G$         | -      | 1.3       | -          | $\Omega$      | -                                                                                                                                   |
| Transconductance                 | $g_{fs}$      | 50     | 99        | -          | 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 <sup>1)</sup>  | $C_{iss}$    | -      | 8000 | 11000 | pF   | $V_{GS}=0\text{ V}$ , $V_{DS}=30\text{ V}$ , $f=1\text{ MHz}$                              |
| Output capacitance <sup>1)</sup> | $C_{oss}$    | -      | 1700 | 2300  | pF   | $V_{GS}=0\text{ V}$ , $V_{DS}=30\text{ V}$ , $f=1\text{ MHz}$                              |
| Reverse transfer capacitance     | $C_{rss}$    | -      | 58   | -     | pF   | $V_{GS}=0\text{ V}$ , $V_{DS}=30\text{ V}$ , $f=1\text{ MHz}$                              |
| Turn-on delay time               | $t_{d(on)}$  | -      | 38   | -     | ns   | $V_{DD}=30\text{ V}$ , $V_{GS}=10\text{ V}$ , $I_D=90\text{ A}$ ,<br>$R_G=3\text{ }\Omega$ |
| Rise time                        | $t_r$        | -      | 161  | -     | ns   | $V_{DD}=30\text{ V}$ , $V_{GS}=10\text{ V}$ , $I_D=90\text{ A}$ ,<br>$R_G=3\text{ }\Omega$ |
| Turn-off delay time              | $t_{d(off)}$ | -      | 63   | -     | ns   | $V_{DD}=30\text{ V}$ , $V_{GS}=10\text{ V}$ , $I_D=90\text{ A}$ ,<br>$R_G=3\text{ }\Omega$ |
| Fall time                        | $t_f$        | -      | 16   | -     | ns   | $V_{DD}=30\text{ V}$ , $V_{GS}=10\text{ V}$ , $I_D=90\text{ A}$ ,<br>$R_G=3\text{ }\Omega$ |

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

| Parameter                       | Symbol        | Values |      |      | Unit | Note / Test Condition                                                       |
|---------------------------------|---------------|--------|------|------|------|-----------------------------------------------------------------------------|
|                                 |               | Min.   | Typ. | Max. |      |                                                                             |
| Gate to source charge           | $Q_{gs}$      | -      | 39   | -    | nC   | $V_{DD}=30\text{ V}$ , $I_D=50\text{ A}$ , $V_{GS}=0\text{ to }10\text{ V}$ |
| Gate charge at threshold        | $Q_{g(th)}$   | -      | 24   | -    | nC   | $V_{DD}=30\text{ V}$ , $I_D=50\text{ A}$ , $V_{GS}=0\text{ to }10\text{ V}$ |
| Gate to drain charge            | $Q_{gd}$      | -      | 8    | -    | nC   | $V_{DD}=30\text{ V}$ , $I_D=50\text{ A}$ , $V_{GS}=0\text{ to }10\text{ V}$ |
| Switching charge                | $Q_{sw}$      | -      | 23   | -    | nC   | $V_{DD}=30\text{ V}$ , $I_D=50\text{ A}$ , $V_{GS}=0\text{ to }10\text{ V}$ |
| Gate charge total <sup>1)</sup> | $Q_g$         | -      | 98   | 130  | nC   | $V_{DD}=30\text{ V}$ , $I_D=50\text{ A}$ , $V_{GS}=0\text{ to }10\text{ V}$ |
| Gate plateau voltage            | $V_{plateau}$ | -      | 4.9  | -    | V    | $V_{DD}=30\text{ V}$ , $I_D=50\text{ A}$ , $V_{GS}=0\text{ to }10\text{ V}$ |
| Output charge <sup>1)</sup>     | $Q_{oss}$     | -      | 79   | 105  | -    | $V_{DD}=30\text{ V}$ , $V_{GS}=0\text{ V}$                                  |

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

<sup>2)</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 | $I_S$         | -      | -    | 104  | A    | $T_C=25\text{ °C}$                                                         |
| Diode pulse current              | $I_{S,pulse}$ | -      | -    | 660  | A    | $T_C=25\text{ °C}$                                                         |
| Diode forward voltage            | $V_{SD}$      | -      | 0.86 | 1.2  | V    | $V_{GS}=0\text{ V}$ , $I_F=50\text{ A}$ , $T_j=25\text{ °C}$               |
| Reverse recovery time            | $t_{rr}$      | -      | 48   | -    | ns   | $V_R=30\text{ V}$ , $I_F=90\text{ A}$ , $di_F/dt=100\text{ A}/\mu\text{s}$ |
| Reverse recovery charge          | $Q_{rr}$      | -      | 73   | -    | nC   | $V_R=30\text{ V}$ , $I_F=90\text{ A}$ , $di_F/dt=100\text{ A}/\mu\text{s}$ |

## 4 Electrical characteristics diagrams

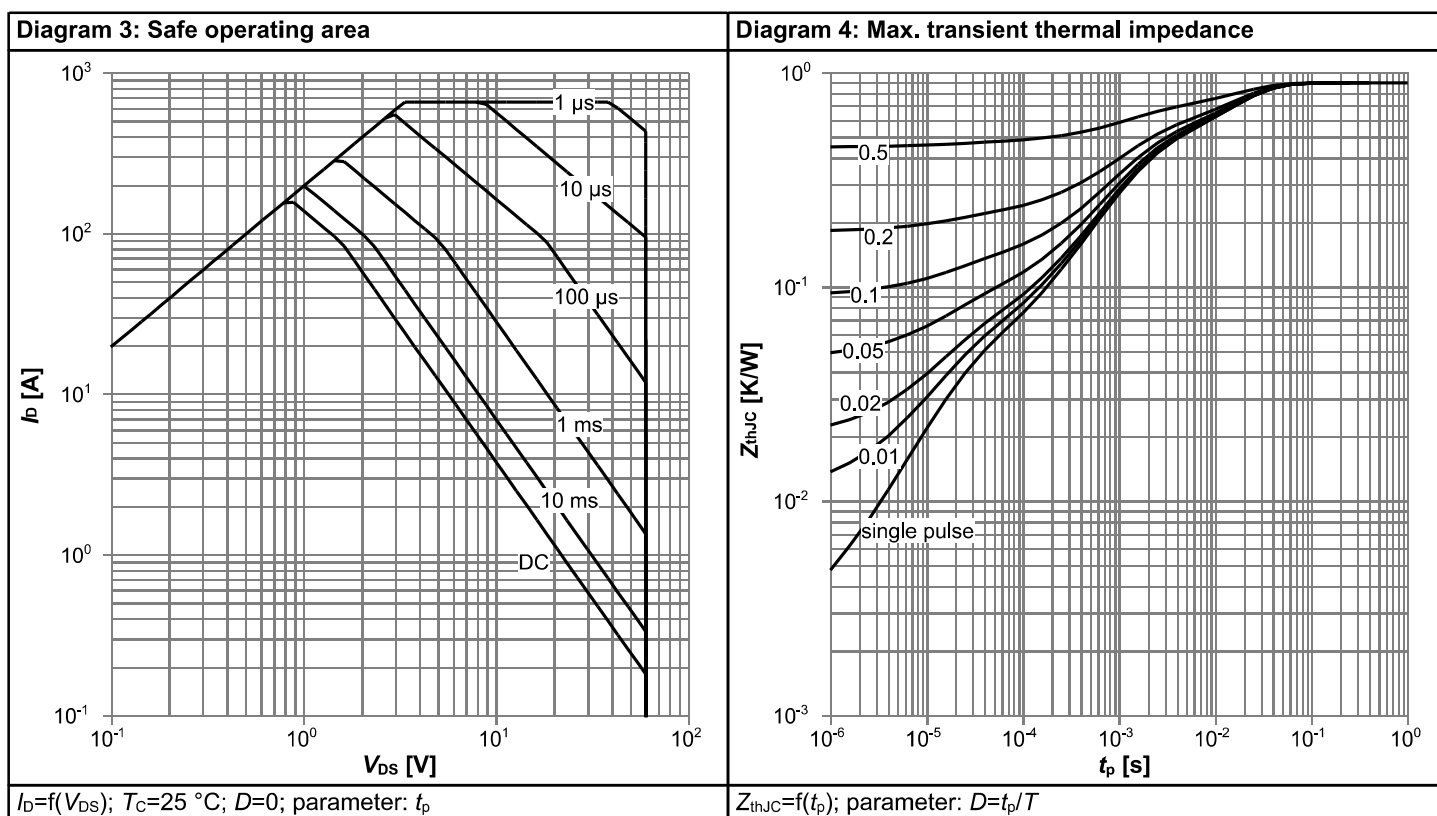
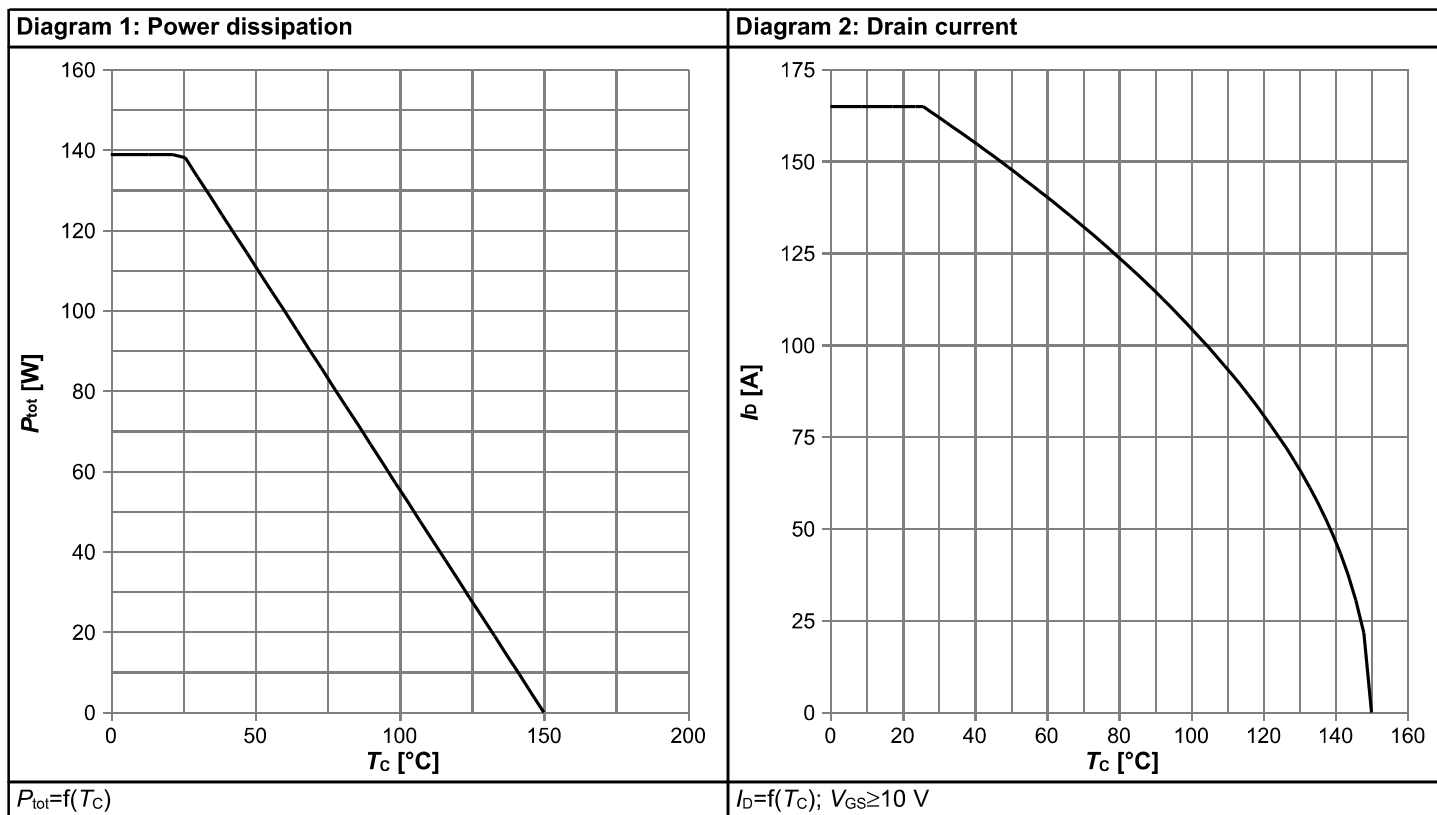
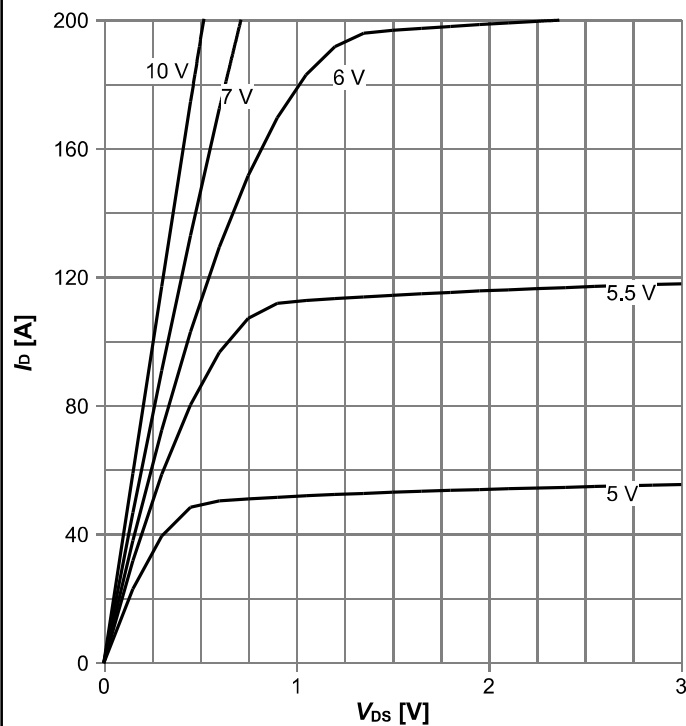
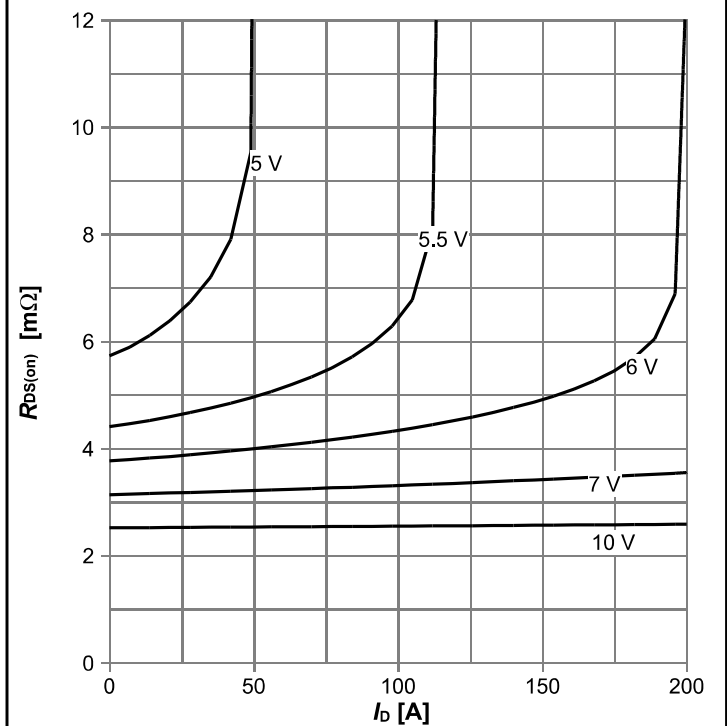


Diagram 5: Typ. output characteristics



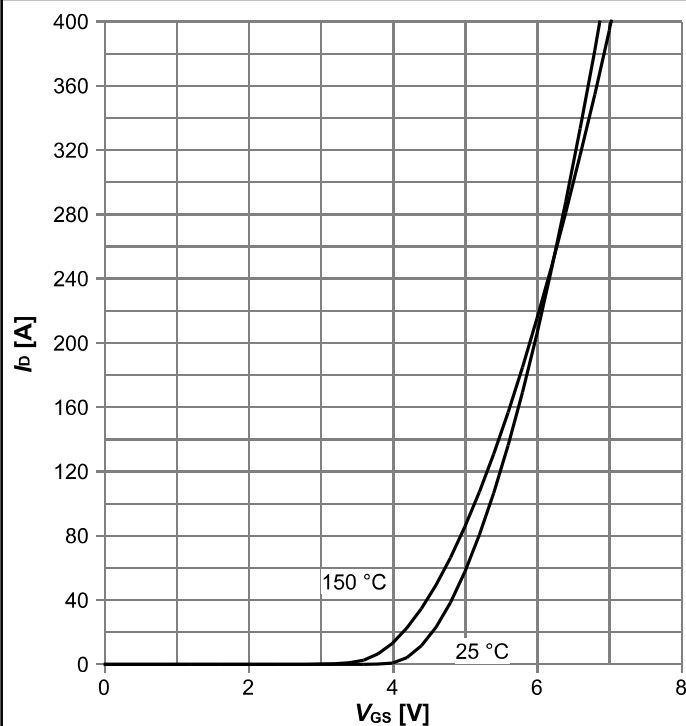
$I_D = f(V_{DS})$ ;  $T_J = 25^\circ\text{C}$ ; parameter:  $V_{GS}$

Diagram 6: Typ. drain-source on resistance



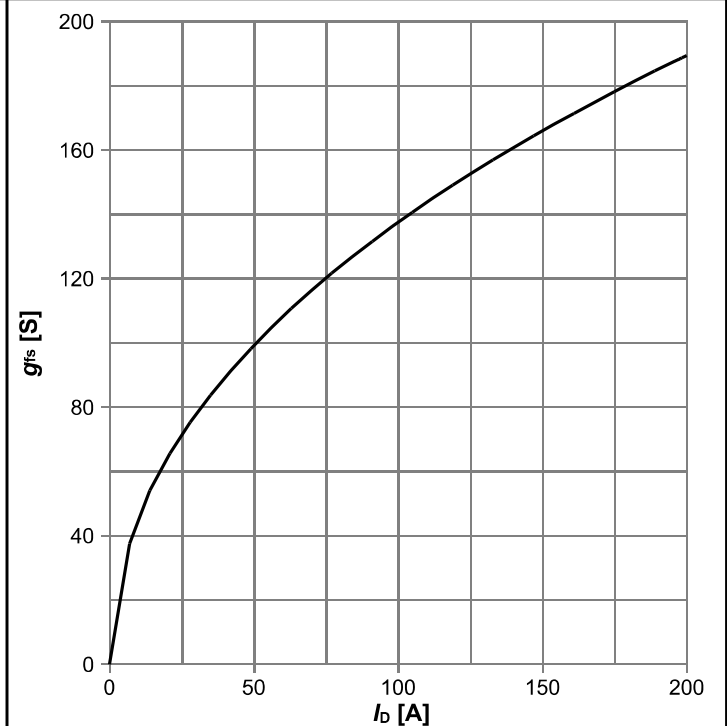
$R_{DS(on)} = f(I_D)$ ;  $T_J = 25^\circ\text{C}$ ; parameter:  $V_{GS}$

Diagram 7: Typ. transfer characteristics



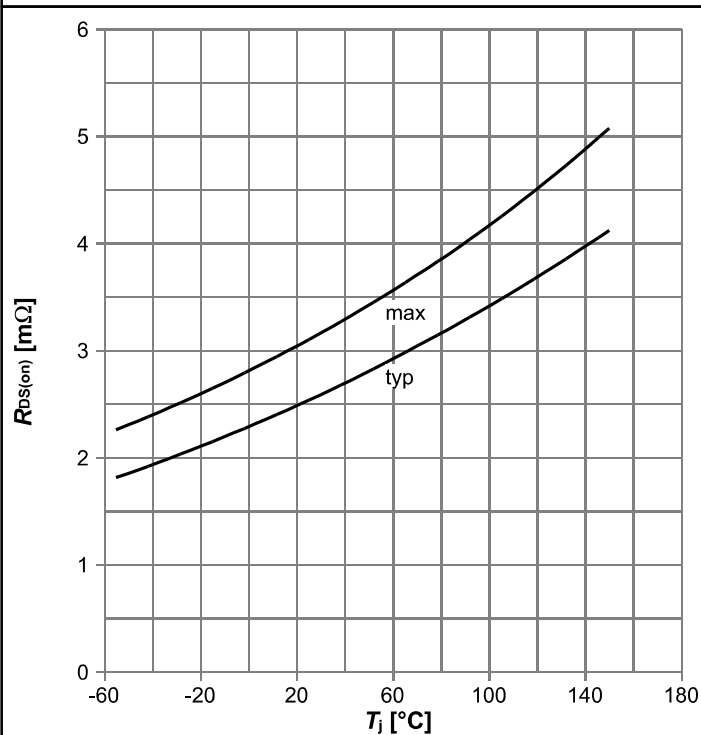
$I_D = f(V_{GS})$ ;  $|V_{DS}| > 2|I_D|R_{DS(on)max}$ ; parameter:  $T_J$

Diagram 8: Typ. forward transconductance



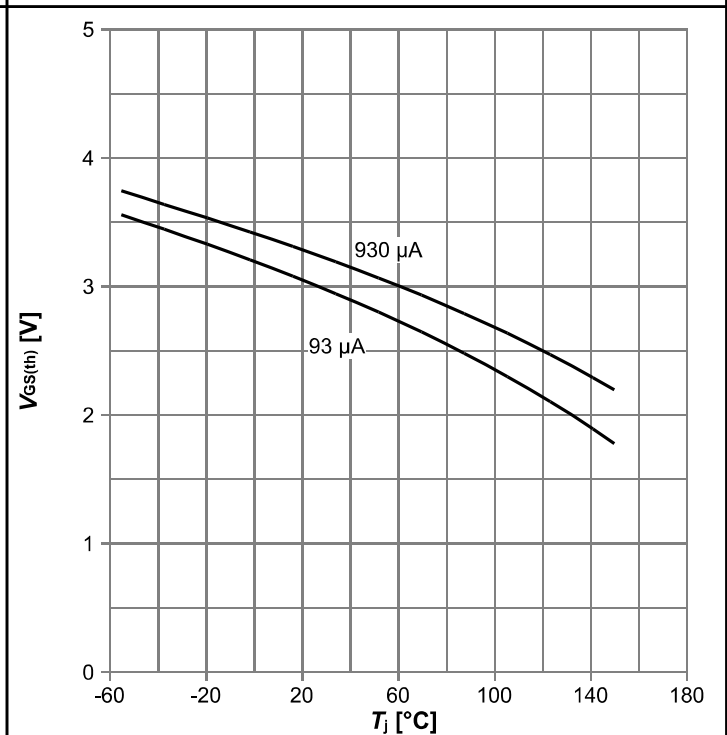
$g_{fs} = f(I_D)$ ;  $T_J = 25^\circ\text{C}$

Diagram 9: Drain-source on-state resistance



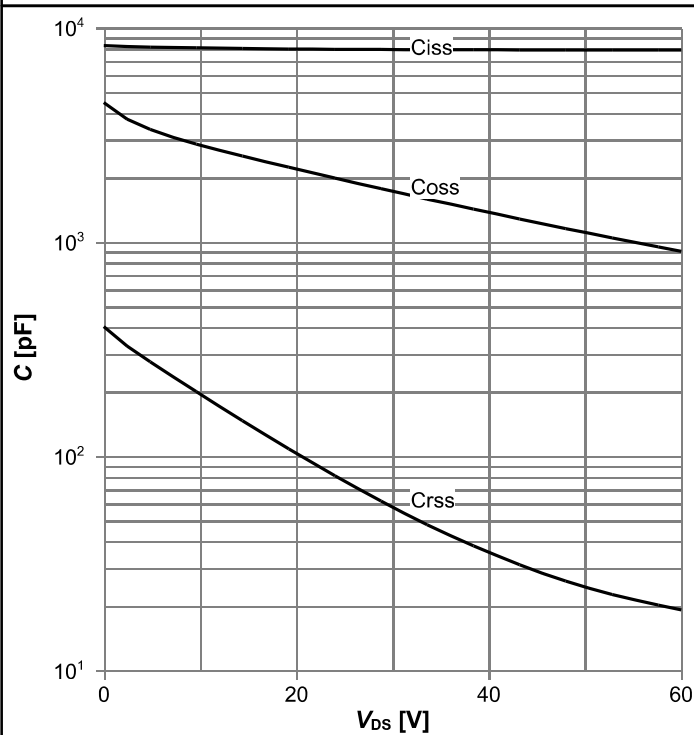
$R_{DS(on)}=f(T_j)$ ;  $I_D=50$  A;  $V_{GS}=10$  V

Diagram 10: Typ. gate threshold voltage



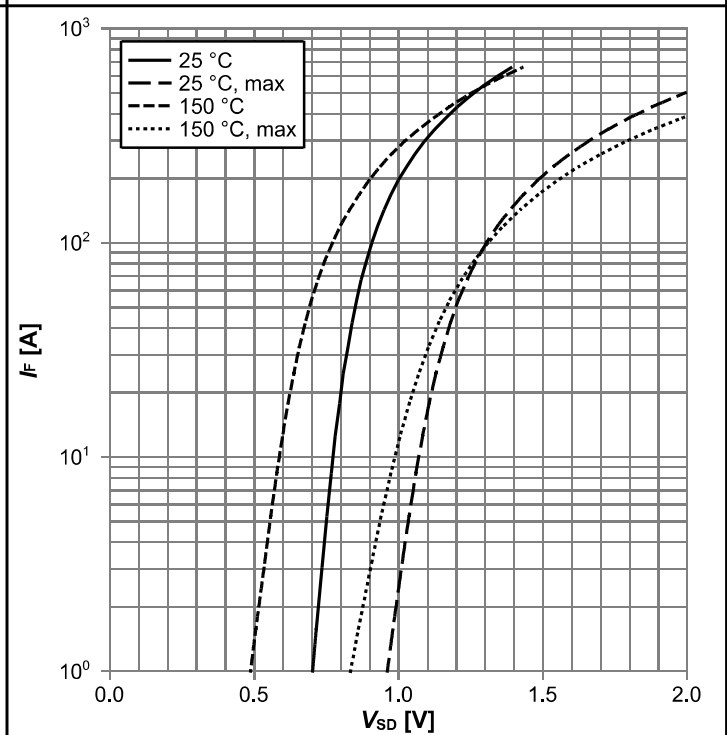
$V_{GS(th)}=f(T_j)$ ;  $V_{GS}=V_{DS}$

Diagram 11: Typ. capacitances



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

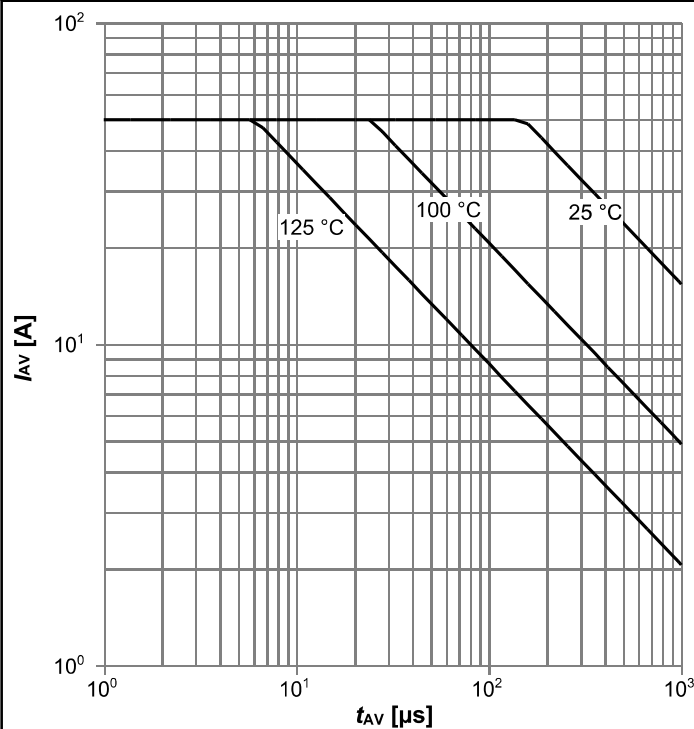
Diagram 12: Forward characteristics of reverse diode



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

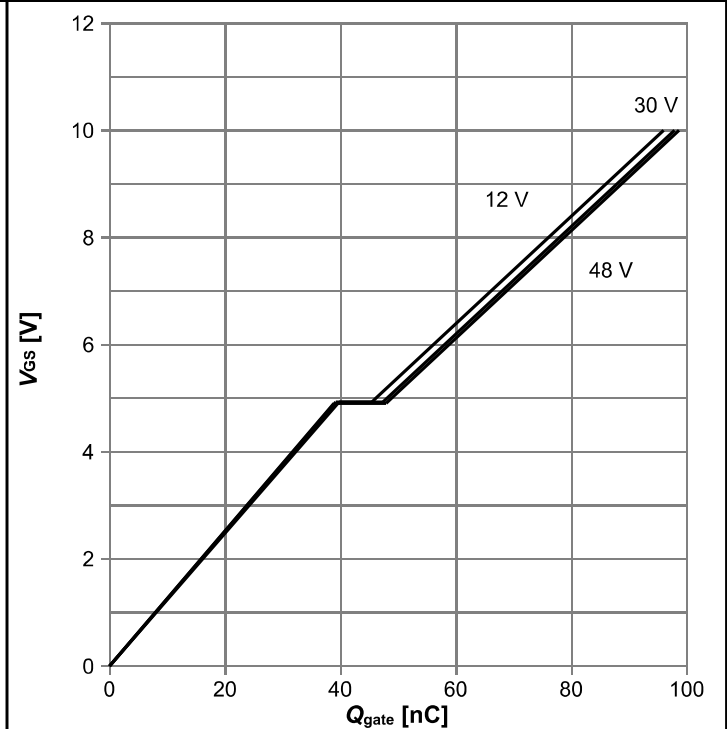


Diagram 13: Avalanche characteristics



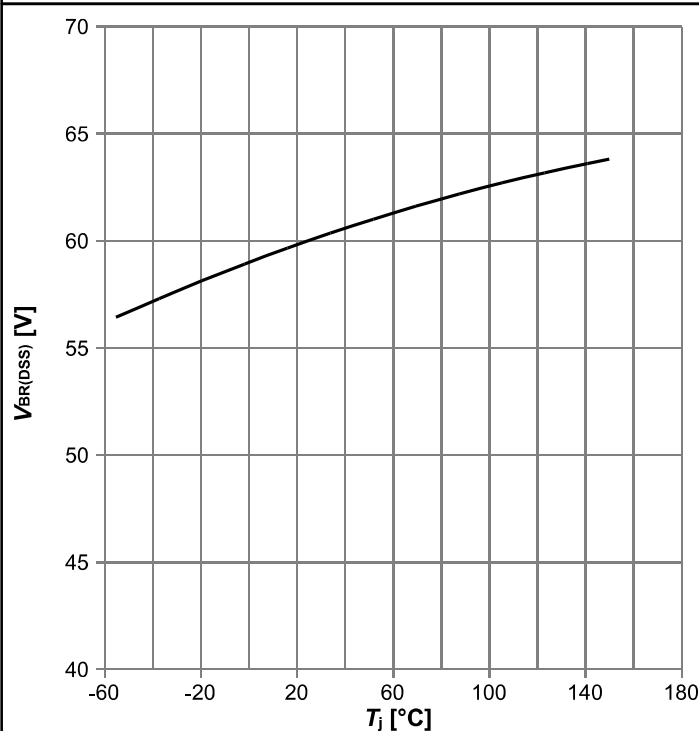
$I_{AS}=f(t_{AV})$ ;  $R_{GS}=25\ \Omega$ ; parameter:  $T_{j(start)}$

Diagram 14: Typ. gate charge



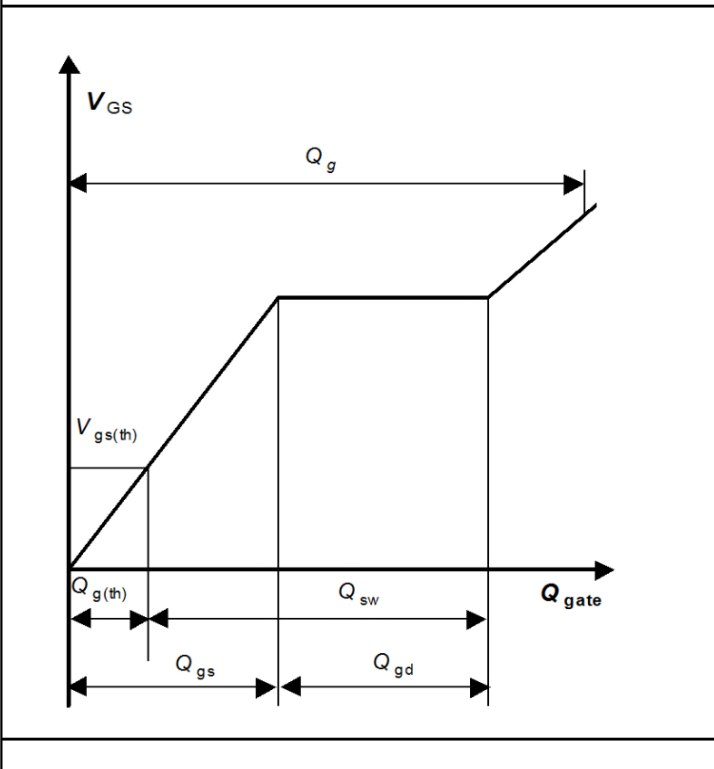
$V_{GS}=f(Q_{gate})$ ;  $I_D=50\text{ A}$  pulsed; parameter:  $V_{DD}$

Diagram 15: Drain-source breakdown voltage

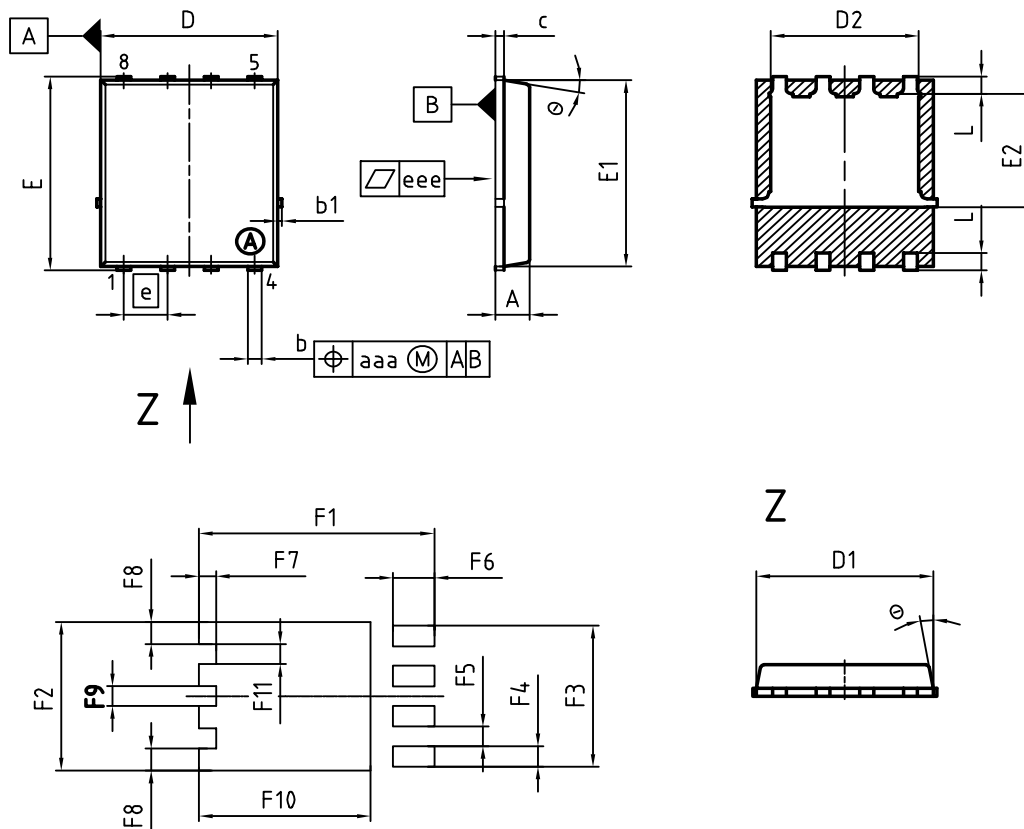


$V_{BR(DSS)}=f(T_j)$ ;  $I_D=1\text{ mA}$

Diagram Gate charge waveforms



## 5 Package Outlines



| DIM  | MILLIMETERS |       | INCHES |       |
|------|-------------|-------|--------|-------|
|      | MIN         | MAX   | MIN    | MAX   |
| A    | 0.90        | 1.10  | 0.035  | 0.043 |
| b    | 0.34        | 0.54  | 0.013  | 0.021 |
| b1   | 0.02        | 0.22  | 0.001  | 0.008 |
| c    | 0.15        | 0.35  | 0.006  | 0.014 |
| D=D1 | 4.95        | 5.35  | 0.195  | 0.211 |
| D2   | 4.20        | 4.40  | 0.165  | 0.173 |
| E    | 5.95        | 6.35  | 0.234  | 0.250 |
| E1   | 5.70        | 6.10  | 0.224  | 0.240 |
| E2   | 3.40        | 3.80  | 0.134  | 0.150 |
| e    | 1.27        |       | 0.050  |       |
| N    | 8           |       | 8      |       |
| L    | 0.45        | 0.65  | 0.018  | 0.026 |
| θ    | 8.5°        | 11.5° | 8.5°   | 11.5° |
| aaa  | 0.25        |       | 0.010  |       |
| eee  | 0.05        |       | 0.002  |       |
| F1   | 6.75        | 6.95  | 0.266  | 0.274 |
| F2   | 4.60        | 4.80  | 0.181  | 0.189 |
| F3   | 4.36        | 4.56  | 0.172  | 0.180 |
| F4   | 0.55        | 0.75  | 0.022  | 0.030 |
| F5   | 0.52        | 0.72  | 0.020  | 0.028 |
| F6   | 1.10        | 1.30  | 0.043  | 0.051 |
| F7   | 0.40        | 0.60  | 0.016  | 0.024 |
| F8   | 0.60        | 0.80  | 0.024  | 0.031 |
| F9   | 0.53        | 0.73  | 0.021  | 0.029 |
| F10  | 4.90        | 5.10  | 0.193  | 0.201 |
| F11  | 0.53        | 0.73  | 0.021  | 0.029 |

|                             |  |
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Figure 1 Outline PG-TDSON-8, dimensions in mm/inches

## Revision History

BSC031N06NS3 G

**Revision: 2021-04-29, Rev. 2.4**

Previous Revision

| Revision | Date       | Subjects (major changes since last revision) |
|----------|------------|----------------------------------------------|
| 2.4      | 2021-04-29 | Update current rating and footnotes          |

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