

MOSFET

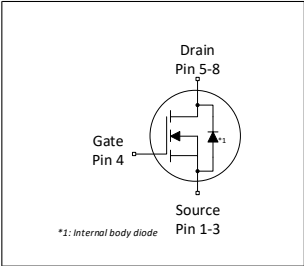
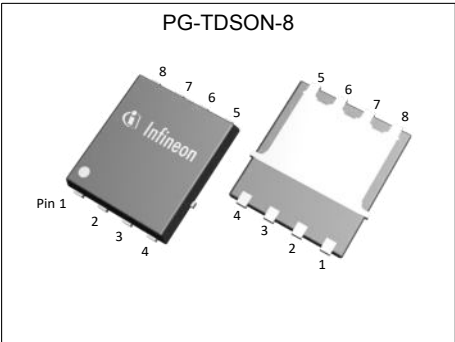
OptiMOS™ 3 Power-Transistor, 200 V

Features

- N-channel, normal level
- Excellent gate charge x  $R_{DS(on)}$  product (FOM)
- Very low on-resistance  $R_{DS(on)}$
- Pb-free lead plating; RoHS compliant
- Qualified according to JEDEC<sup>1)</sup> for target application
- Halogen-free according to IEC61249-2-21
- Ideal for high-frequency switching and synchronous rectification

Table 1 Key Performance Parameters

| Parameter        | Value | Unit |
|------------------|-------|------|
| $V_{DS}$         | 200   | V    |
| $R_{DS(on),max}$ | 50    | mΩ   |
| $I_D$            | 24    | A    |



| Type / Ordering Code | Package    | Marking  | Related Links |
|----------------------|------------|----------|---------------|
| BSC500N20NS3 G       | PG-TDSON-8 | 500N20NS | -             |

<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           | $I_D$             | -      | -    | 24<br>17 | A           | $T_C=25\text{ °C}$<br>$T_C=100\text{ °C}$         |
| Pulsed drain current <sup>1)</sup> | $I_{D,pulse}$     | -      | -    | 97       | A           | $T_C=25\text{ °C}$                                |
| Avalanche energy, single pulse     | $E_{AS}$          | -      | -    | 120      | mJ          | $I_D=22\text{ A}$ , $R_{GS}=25\text{ }\Omega$     |
| Reverse diode dv/dt                | dv/dt             | -      | -    | 50       | kV/ $\mu$ s | -                                                 |
| Gate source voltage                | $V_{GS}$          | -20    | -    | 20       | V           | -                                                 |
| Power dissipation                  | $P_{tot}$         | -      | -    | 96       | 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                                                  | $R_{thJC}$ | -      | -    | 1.3  | K/W  | -                     |
| Thermal resistance, junction - ambient, minimal footprint                            | $R_{thJA}$ | -      | -    | 75   | K/W  | -                     |
| Thermal resistance, junction - ambient, 6 cm <sup>2</sup> cooling area <sup>2)</sup> | $R_{thJA}$ | -      | -    | 50   | K/W  | -                     |

<sup>1)</sup> See figure 3

<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  $\mu$ m thick) copper area for drain connection. PCB is vertical in still air.

### 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   | $V_{(BR)DSS}$ | 200    | -         | -        | V             | $V_{GS}=0\text{ V}$ , $I_D=1\text{ mA}$                                                                                               |
| Gate threshold voltage           | $V_{GS(th)}$  | 2      | 3         | 4        | V             | $V_{DS}=V_{GS}$ , $I_D=60\text{ }\mu\text{A}$                                                                                         |
| Zero gate voltage drain current  | $I_{DSS}$     | -      | 0.1<br>10 | 1<br>100 | $\mu\text{A}$ | $V_{DS}=160\text{ V}$ , $V_{GS}=0\text{ V}$ , $T_j=25\text{ °C}$<br>$V_{DS}=160\text{ V}$ , $V_{GS}=0\text{ V}$ , $T_j=125\text{ °C}$ |
| Gate-source leakage current      | $I_{GSS}$     | -      | 1         | 100      | nA            | $V_{GS}=20\text{ V}$ , $V_{DS}=0\text{ V}$                                                                                            |
| Drain-source on-state resistance | $R_{DS(on)}$  | -      | 42        | 50       | m $\Omega$    | $V_{GS}=10\text{ V}$ , $I_D=22\text{ A}$                                                                                              |
| Gate resistance                  | $R_G$         | -      | 1.9       | -        | $\Omega$      | -                                                                                                                                     |
| Transconductance                 | $g_{fs}$      | 19     | 37        | -        | S             | $ V_{DS} >2 I_D R_{DS(on)max}$ , $I_D=22\text{ A}$                                                                                    |

**Table 5 Dynamic characteristics**

| Parameter                        | Symbol       | Values |      |      | Unit | Note / Test Condition                                                                             |
|----------------------------------|--------------|--------|------|------|------|---------------------------------------------------------------------------------------------------|
|                                  |              | Min.   | Typ. | Max. |      |                                                                                                   |
| Input capacitance <sup>1)</sup>  | $C_{iss}$    | -      | 1190 | 1580 | pF   | $V_{GS}=0\text{ V}$ , $V_{DS}=100\text{ V}$ , $f=1\text{ MHz}$                                    |
| Output capacitance <sup>1)</sup> | $C_{oss}$    | -      | 90   | 120  | pF   | $V_{GS}=0\text{ V}$ , $V_{DS}=100\text{ V}$ , $f=1\text{ MHz}$                                    |
| Reverse transfer capacitance     | $C_{rss}$    | -      | 5    | -    | pF   | $V_{GS}=0\text{ V}$ , $V_{DS}=100\text{ V}$ , $f=1\text{ MHz}$                                    |
| Turn-on delay time               | $t_{d(on)}$  | -      | 14   | -    | ns   | $V_{DD}=100\text{ V}$ , $V_{GS}=10\text{ V}$ , $I_D=12\text{ A}$ ,<br>$R_{G,ext}=6\text{ }\Omega$ |
| Rise time                        | $t_r$        | -      | 5    | -    | ns   | $V_{DD}=100\text{ V}$ , $V_{GS}=10\text{ V}$ , $I_D=12\text{ A}$ ,<br>$R_{G,ext}=6\text{ }\Omega$ |
| Turn-off delay time              | $t_{d(off)}$ | -      | 28   | -    | ns   | $V_{DD}=100\text{ V}$ , $V_{GS}=10\text{ V}$ , $I_D=12\text{ A}$ ,<br>$R_{G,ext}=6\text{ }\Omega$ |
| Fall time                        | $t_f$        | -      | 7    | -    | ns   | $V_{DD}=100\text{ V}$ , $V_{GS}=10\text{ V}$ , $I_D=12\text{ A}$ ,<br>$R_{G,ext}=6\text{ }\Omega$ |

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

| Parameter                       | Symbol        | Values |      |      | Unit | Note / Test Condition                                                        |
|---------------------------------|---------------|--------|------|------|------|------------------------------------------------------------------------------|
|                                 |               | Min.   | Typ. | Max. |      |                                                                              |
| Gate to source charge           | $Q_{gs}$      | -      | 5    | -    | nC   | $V_{DD}=100\text{ V}$ , $I_D=12\text{ A}$ , $V_{GS}=0\text{ to }10\text{ V}$ |
| Gate to drain charge            | $Q_{gd}$      | -      | 2    | -    | nC   | $V_{DD}=100\text{ V}$ , $I_D=12\text{ A}$ , $V_{GS}=0\text{ to }10\text{ V}$ |
| Switching charge                | $Q_{sw}$      | -      | 4    | -    | nC   | $V_{DD}=100\text{ V}$ , $I_D=12\text{ A}$ , $V_{GS}=0\text{ to }10\text{ V}$ |
| Gate charge total <sup>1)</sup> | $Q_g$         | -      | 15   | 20   | nC   | $V_{DD}=100\text{ V}$ , $I_D=12\text{ A}$ , $V_{GS}=0\text{ to }10\text{ V}$ |
| Gate plateau voltage            | $V_{plateau}$ | -      | 4.4  | -    | V    | $V_{DD}=100\text{ V}$ , $I_D=12\text{ A}$ , $V_{GS}=0\text{ to }10\text{ V}$ |
| Output charge <sup>1)</sup>     | $Q_{oss}$     | -      | 35   | 47   | nC   | $V_{DD}=100\text{ V}$ , $V_{GS}=0\text{ V}$                                  |

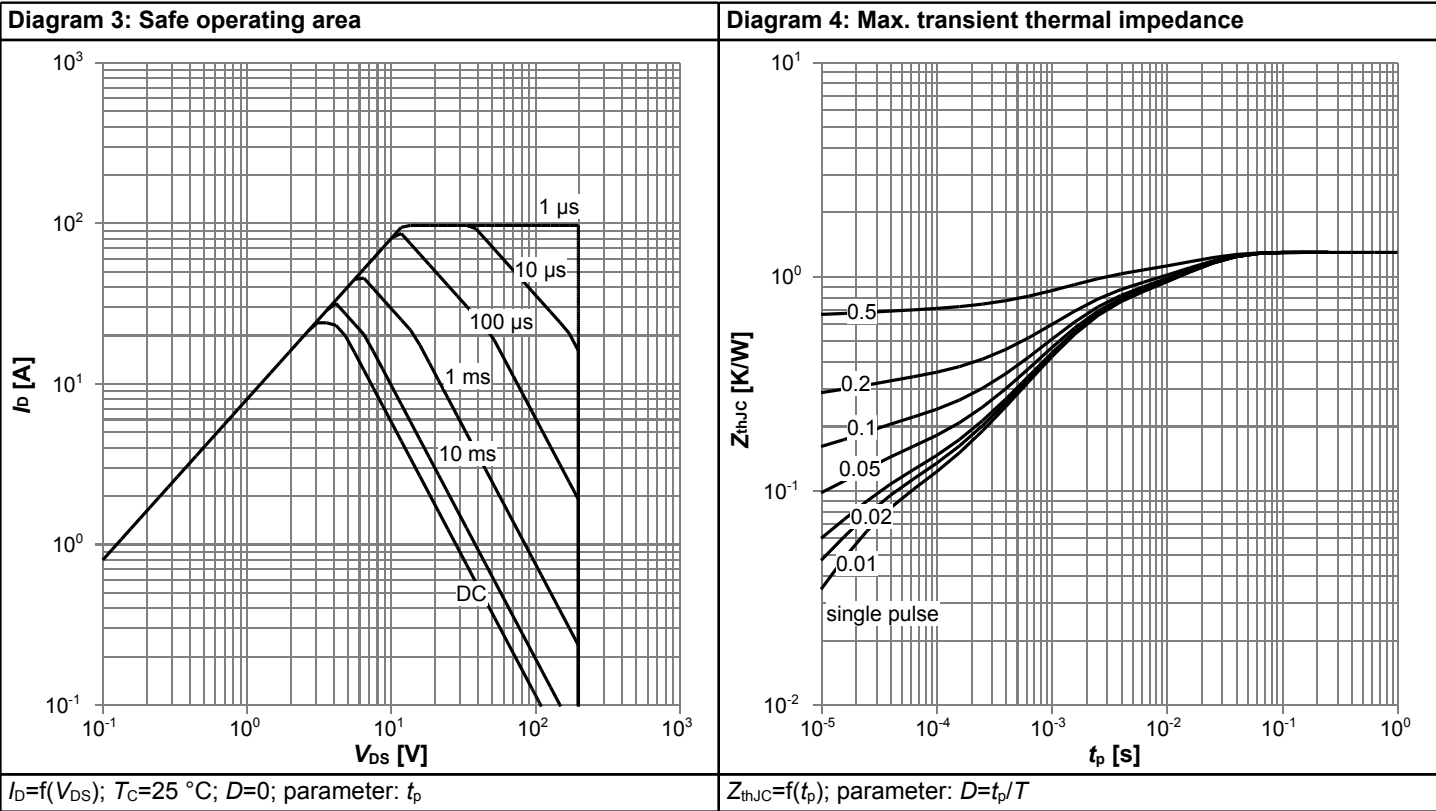
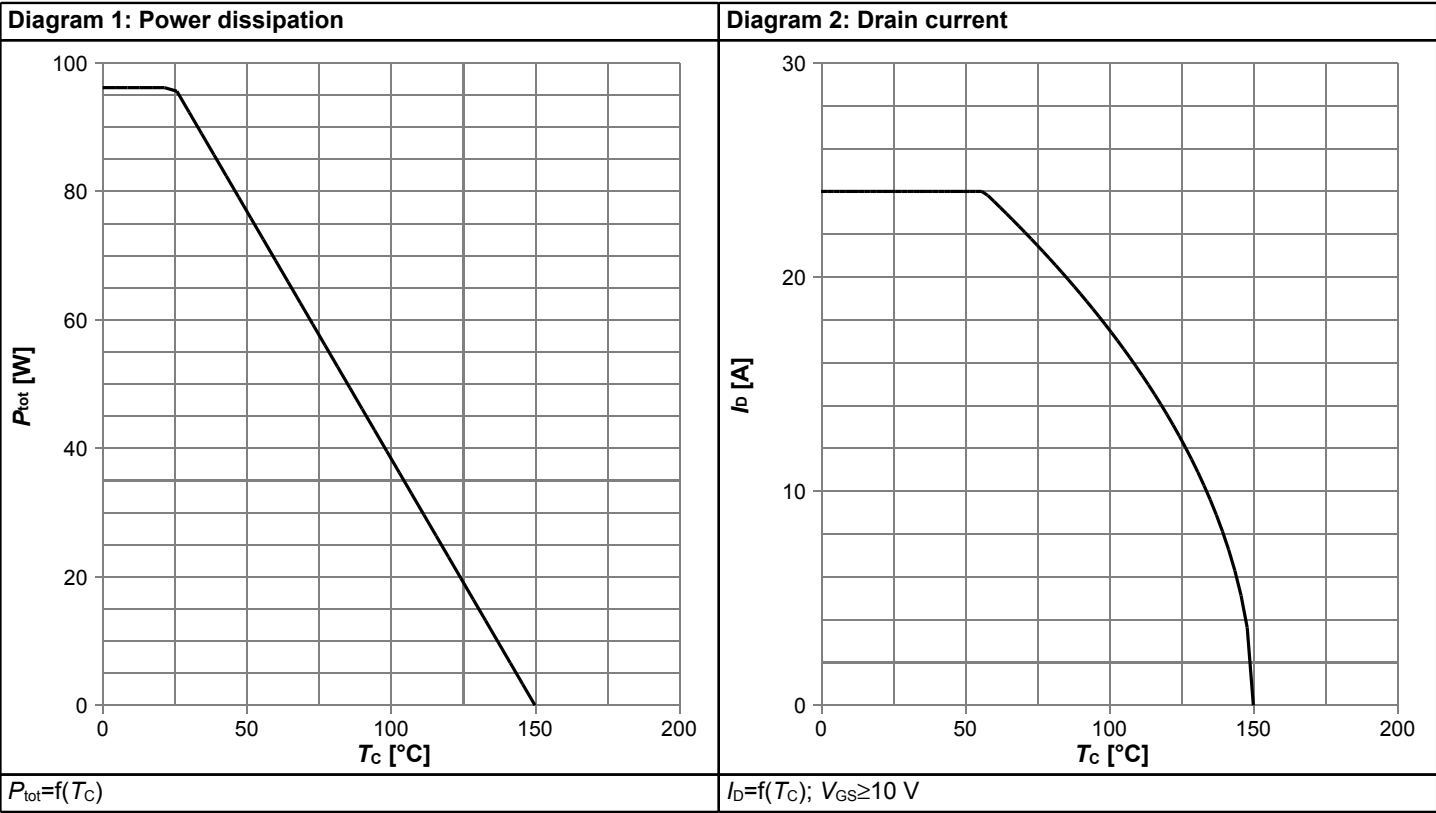
<sup>1)</sup> Defined by design. Not subject to production test

<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 | $I_S$         | -      | -    | 24   | A    | $T_C=25\text{ °C}$                                                          |
| Diode pulse current              | $I_{S,pulse}$ | -      | -    | 97   | A    | $T_C=25\text{ °C}$                                                          |
| Diode forward voltage            | $V_{SD}$      | -      | 0.9  | 1.2  | V    | $V_{GS}=0\text{ V}$ , $I_F=22\text{ A}$ , $T_j=25\text{ °C}$                |
| Reverse recovery time            | $t_{rr}$      | -      | 110  | -    | ns   | $V_R=100\text{ V}$ , $I_F=12\text{ A}$ , $di_F/dt=100\text{ A}/\mu\text{s}$ |
| Reverse recovery charge          | $Q_{rr}$      | -      | 399  | -    | nC   | $V_R=100\text{ V}$ , $I_F=12\text{ A}$ , $di_F/dt=100\text{ A}/\mu\text{s}$ |

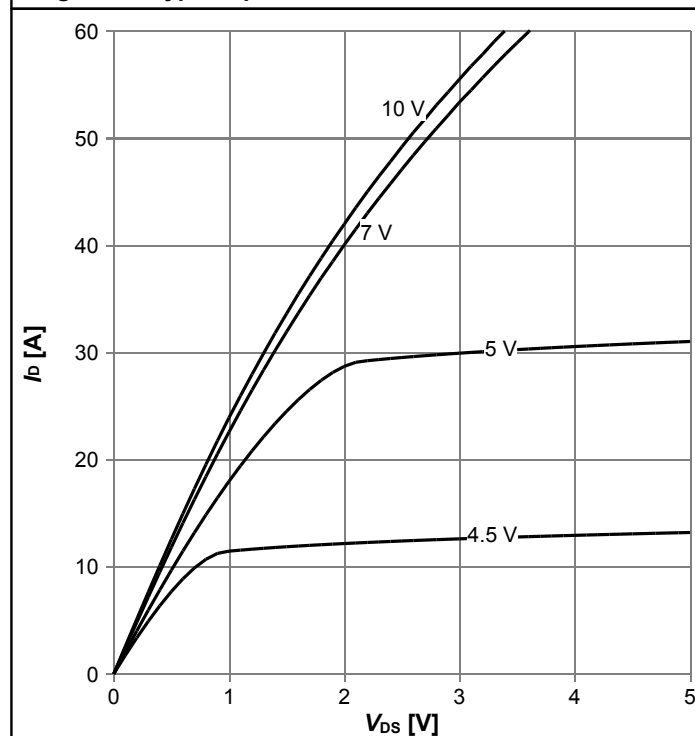
### 4 Electrical characteristics diagrams



# OptiMOS™ 3 Power-Transistor, 200 V

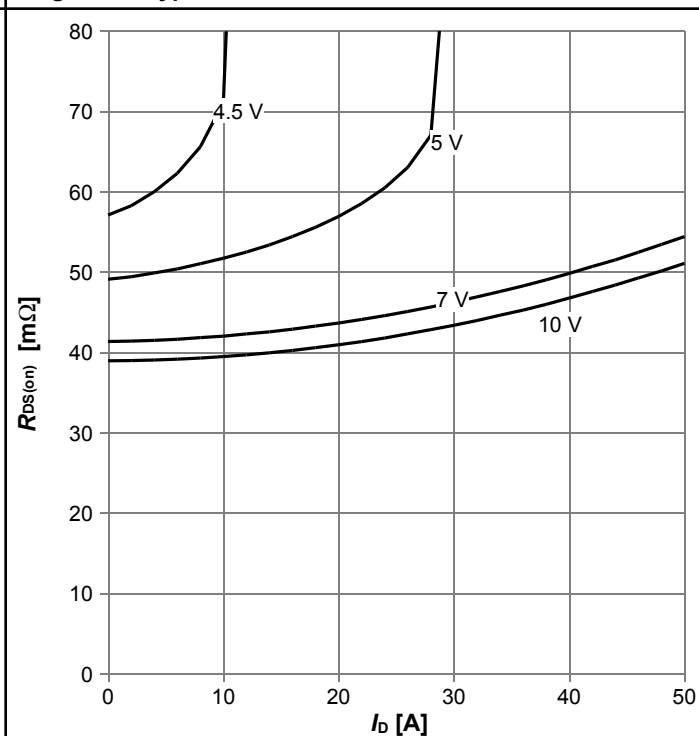
## BSC500N20NS3 G

Diagram 5: Typ. output characteristics



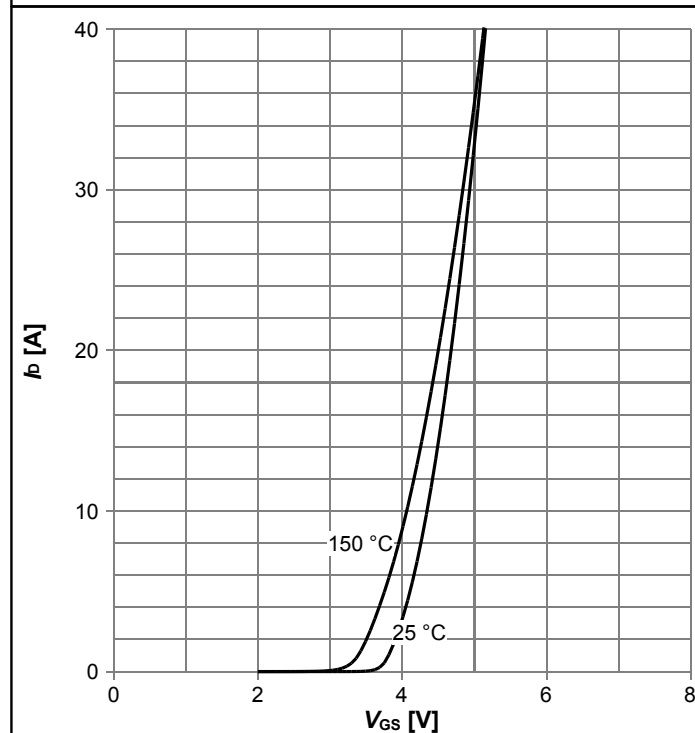
$I_D=f(V_{DS})$ ;  $T_j=25\text{ °C}$ ; parameter:  $V_{GS}$

Diagram 6: Typ. drain-source on resistance



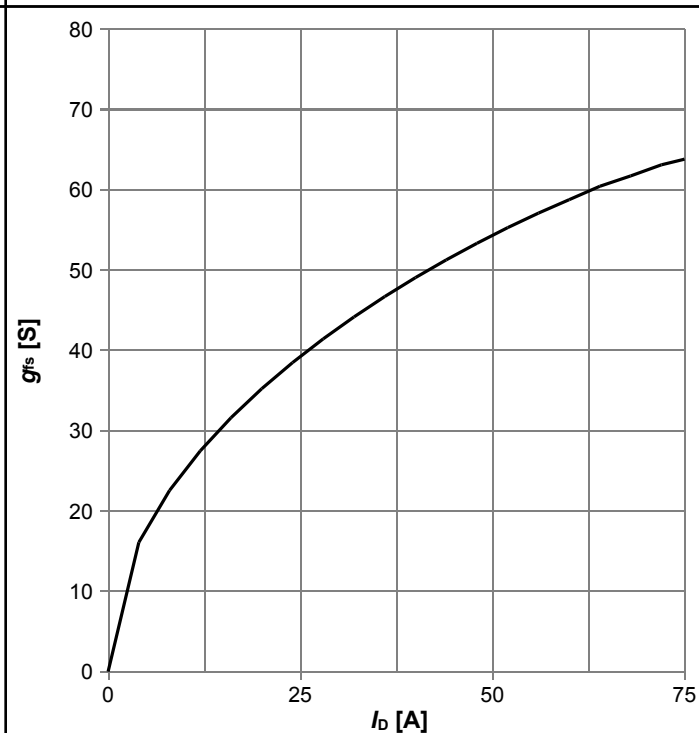
$R_{DS(on)}=f(I_D)$ ;  $T_j=25\text{ °C}$ ; parameter:  $V_{GS}$

Diagram 7: Typ. transfer characteristics



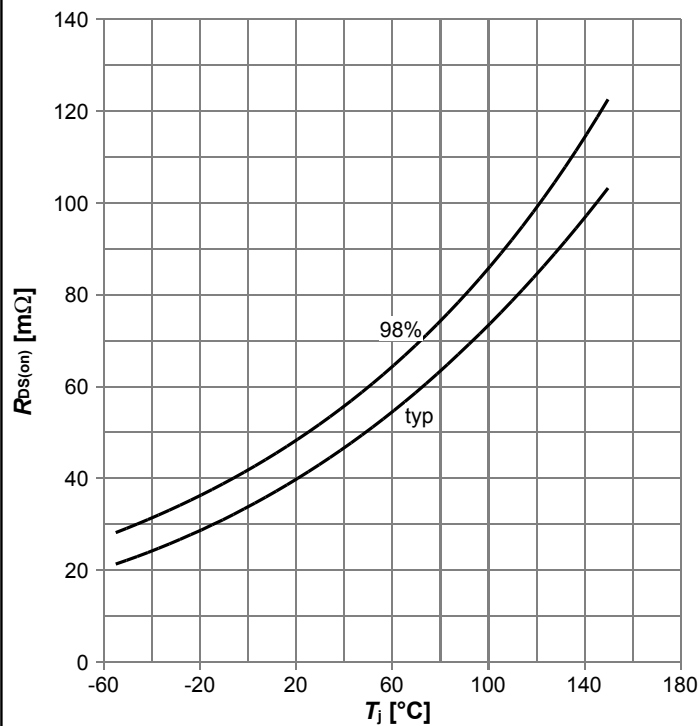
$I_D=f(V_{GS})$ ;  $|V_{DS}|>2|I_D|R_{DS(on)max}$ ; parameter:  $T_j$

Diagram 8: Typ. forward transconductance



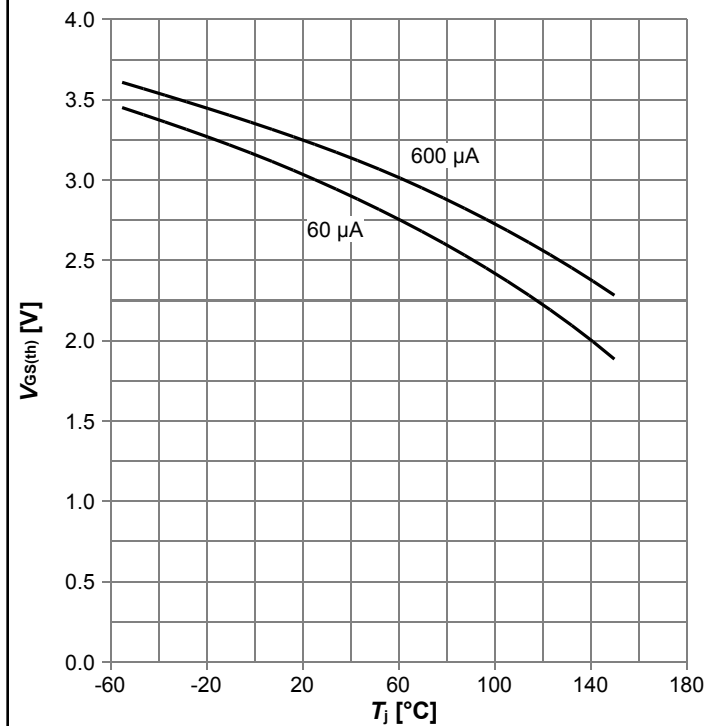
$g_{fs}=f(I_D)$ ;  $T_j=25\text{ °C}$

Diagram 9: Drain-source on-state resistance



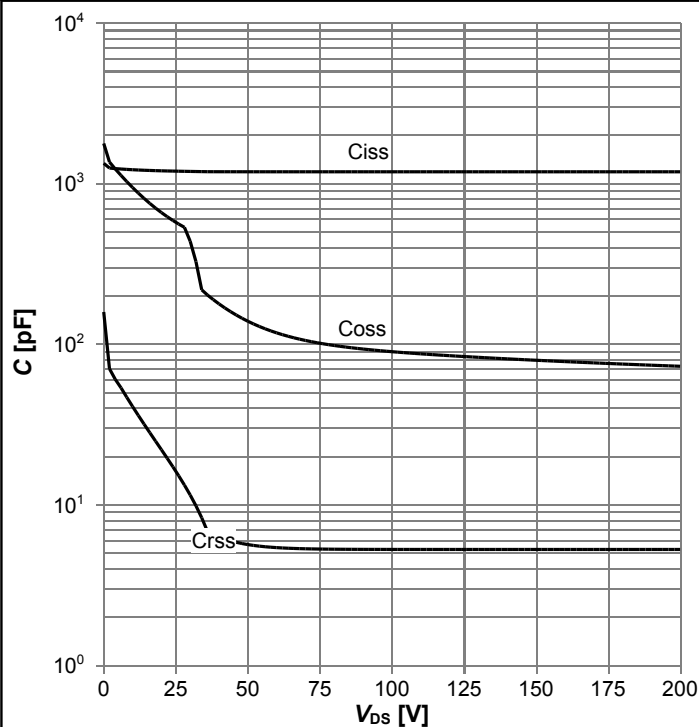
$R_{DS(on)} = f(T_j)$ ;  $I_D = 22$  A;  $V_{GS} = 10$  V

Diagram 10: Typ. gate threshold voltage



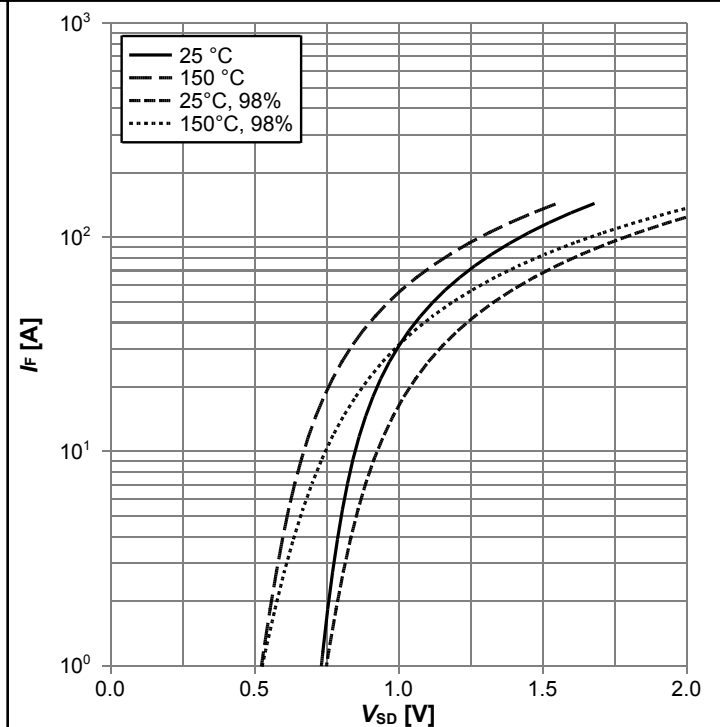
$V_{GS(th)} = f(T_j)$ ;  $V_{GS} = V_{DS}$ ; parameter:  $I_D$

Diagram 11: Typ. capacitances



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

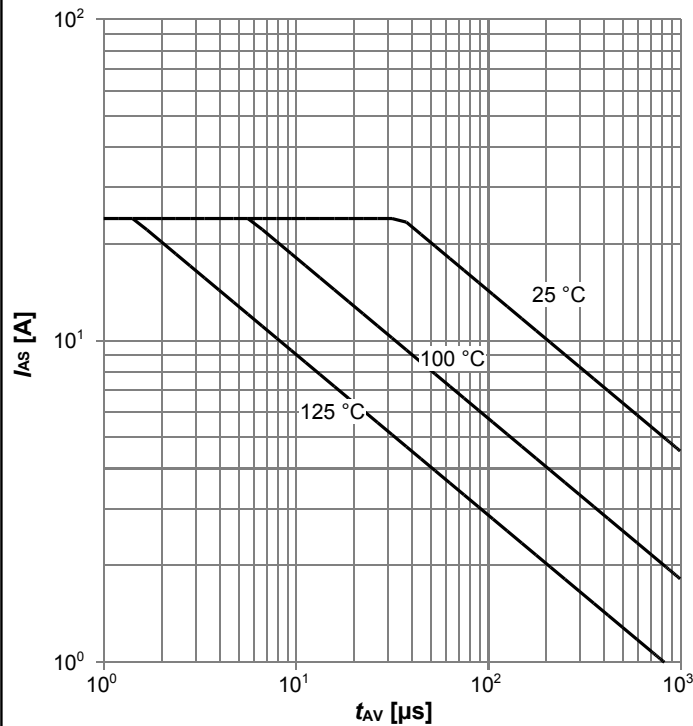
Diagram 12: Forward characteristics of reverse diode



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

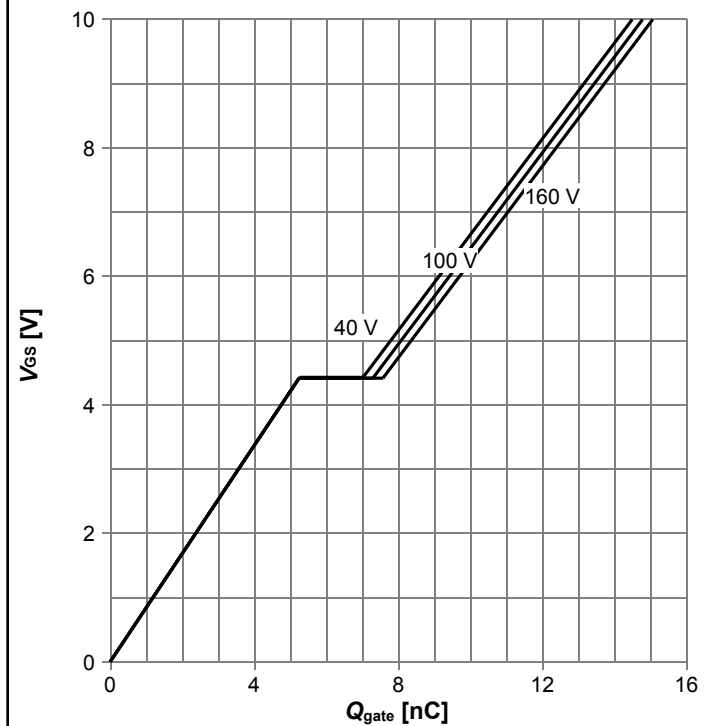


Diagram 13: Avalanche characteristics



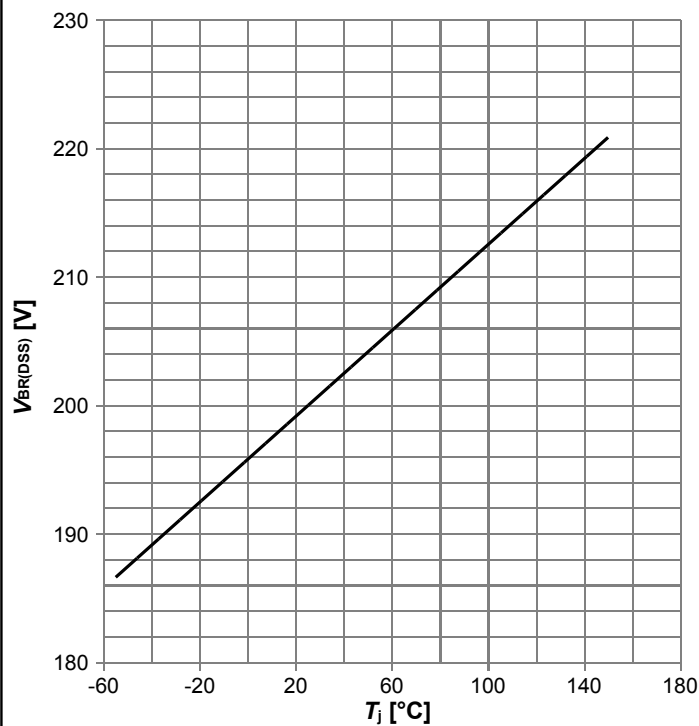
$I_{AS}=f(t_{AV})$ ;  $R_{GS}=25\ \Omega$ ; parameter:  $T_{j(start)}$

Diagram 14: Typ. gate charge



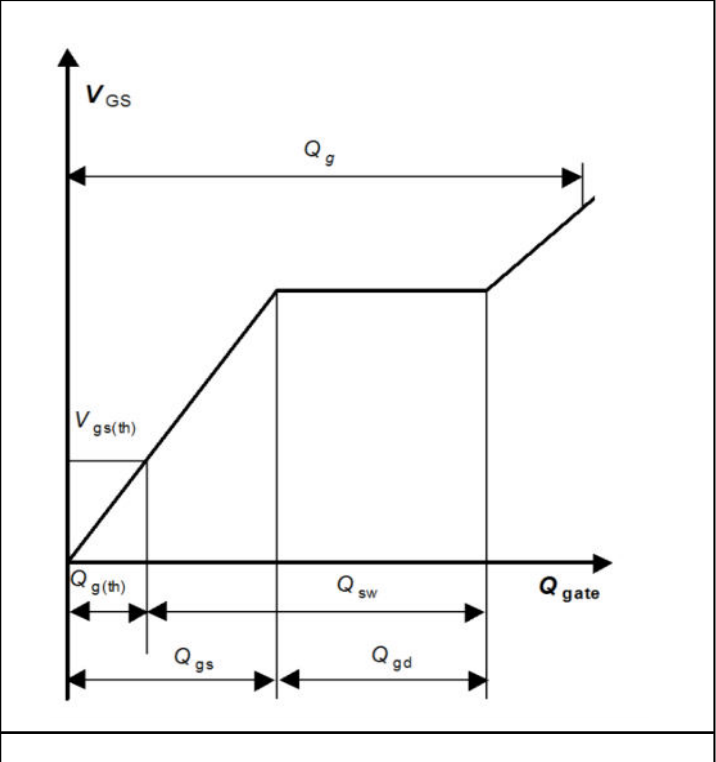
$V_{GS}=f(Q_{gate})$ ;  $I_D=12\text{ A}$  pulsed; parameter:  $V_{DD}$

Diagram 15: Drain-source breakdown voltage

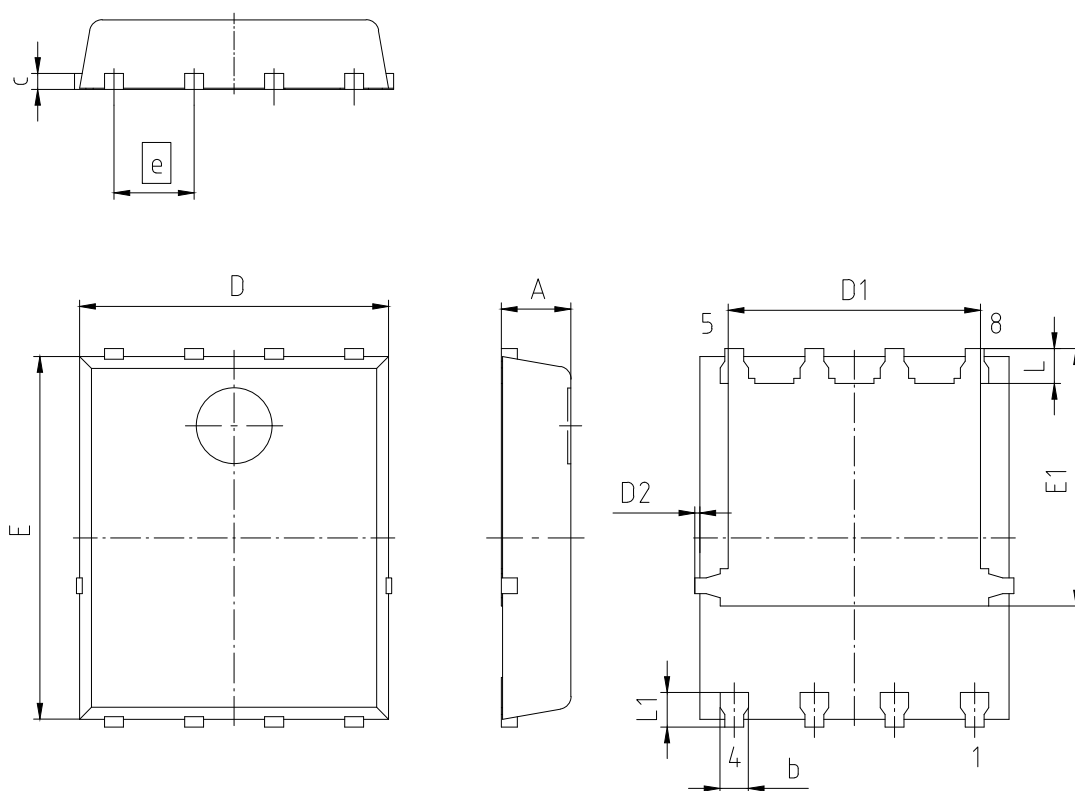


$V_{BR(DSS)}=f(T_j)$ ;  $I_D=1\text{ mA}$

Diagram Gate charge waveforms



## 5 Package Outlines



| PACKAGE - GROUP<br>NUMBER: <b>PG-TDSON-8-U08</b> |             |      |
|--------------------------------------------------|-------------|------|
| DIMENSIONS                                       | MILLIMETERS |      |
|                                                  | MIN.        | MAX. |
| <b>A</b>                                         | 0.90        | 1.20 |
| <b>b</b>                                         | 0.34        | 0.54 |
| <b>c</b>                                         | 0.15        | 0.35 |
| <b>D</b>                                         | 4.80        | 5.35 |
| <b>D1</b>                                        | 3.90        | 4.40 |
| <b>D2</b>                                        | 0.00        | 0.22 |
| <b>E</b>                                         | 5.70        | 6.10 |
| <b>E1</b>                                        | 4.05        | 4.25 |
| <b>e</b>                                         | 1.27        |      |
| <b>L</b>                                         | 0.45        | 0.65 |
| <b>L1</b>                                        | 0.45        | 0.65 |

- 1) EXCLUDING MOLD FLASH
- 2) REMOVAL ON MOLD GATE  
INTRUSION 0.1 MM  
PROTRUSION 0.1 MM
- 3) ALL METAL SURFACES ARE PLATED,  
EXCEPT AREA OF CUT

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

## Revision History

BSC500N20NS3 G

**Revision: 2023-05-31, Rev. 2.1**

Previous Revision

| Revision | Date       | Subjects (major changes since last revision) |
|----------|------------|----------------------------------------------|
| 2.1      | 2023-05-31 | Update POD and footnotes                     |

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