

## OptiMOS™3 Power-Transistor

### Features

- Optimized for dc-dc conversion
- N-channel, normal level
- Excellent gate charge  $\times R_{DS(on)}$  product (FOM)
- Low on-resistance  $R_{DS(on)}$
- 150 °C operating temperature
- Pb-free lead plating; RoHS compliant
- Qualified according to JEDEC<sup>1)</sup> for target application
- Halogen-free according to IEC61249-2-21



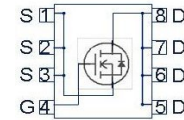
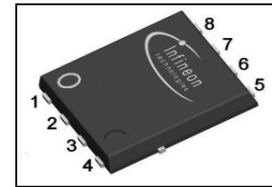
Halogen-Free

| Type           | Package    | Marking  |
|----------------|------------|----------|
| BSC12DN20NS3 G | PG-TDSON-8 | 12DN20NS |

### Product Summary

|                  |      |    |
|------------------|------|----|
| $V_{DS}$         | 200  | V  |
| $R_{DS(on),max}$ | 125  | mΩ |
| $I_D$            | 11.3 | A  |

PG-TDSON-8



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

| Parameter                           | Symbol            | Conditions                                | Value       | Unit  |
|-------------------------------------|-------------------|-------------------------------------------|-------------|-------|
| Continuous drain current            | $I_D$             | $T_C=25\text{ °C}$                        | 11.3        | A     |
|                                     |                   | $T_C=100\text{ °C}$                       | 8.0         |       |
| Pulsed drain current <sup>2)</sup>  | $I_{D,pulse}$     | $T_C=25\text{ °C}$                        | 45          |       |
| Avalanche energy, single pulse      | $E_{AS}$          | $I_D=5.7\text{ A}$ , $R_{GS}=25\text{ Ω}$ | 60          | mJ    |
| Reverse diode $dv/dt$               | $dv/dt$           |                                           | 10          | kV/μs |
| Gate source voltage                 | $V_{GS}$          |                                           | ±20         | V     |
| Power dissipation                   | $P_{tot}$         | $T_C=25\text{ °C}$                        | 50          | W     |
| Operating and storage temperature   | $T_j$ , $T_{stg}$ |                                           | -55 ... 150 | °C    |
| IEC climatic category; DIN IEC 68-1 |                   |                                           | 55/150/56   |       |

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

<sup>2)</sup> see figure 3

| Parameter | Symbol | Conditions | Values |      |      | Unit |
|-----------|--------|------------|--------|------|------|------|
|           |        |            | min.   | typ. | max. |      |

#### Thermal characteristics

|                                        |            |                                              |   |   |     |     |
|----------------------------------------|------------|----------------------------------------------|---|---|-----|-----|
| Thermal resistance, junction - case    | $R_{thJC}$ |                                              | - | - | 2.5 | K/W |
| Thermal resistance, junction - ambient | $R_{thJA}$ | 6 cm <sup>2</sup> cooling area <sup>3)</sup> | - | - | 50  |     |

#### Electrical characteristics, at $T_j=25\text{ }^{\circ}\text{C}$ , unless otherwise specified

#### Static characteristics

|                                  |               |                                                                                 |     |     |     |               |
|----------------------------------|---------------|---------------------------------------------------------------------------------|-----|-----|-----|---------------|
| Drain-source breakdown voltage   | $V_{(BR)DSS}$ | $V_{GS}=0\text{ V}$ , $I_D=1\text{ mA}$                                         | 200 | -   | -   | V             |
| Gate threshold voltage           | $V_{GS(th)}$  | $V_{DS}=V_{GS}$ , $I_D=25\text{ }\mu\text{A}$                                   | 2   | 3   | 4   |               |
| Zero gate voltage drain current  | $I_{DSS}$     | $V_{DS}=160\text{ V}$ , $V_{GS}=0\text{ V}$ , $T_j=25\text{ }^{\circ}\text{C}$  | -   | 0.1 | 1   | $\mu\text{A}$ |
|                                  |               | $V_{DS}=160\text{ V}$ , $V_{GS}=0\text{ V}$ , $T_j=125\text{ }^{\circ}\text{C}$ | -   | 10  | 100 |               |
| Gate-source leakage current      | $I_{GSS}$     | $V_{GS}=20\text{ V}$ , $V_{DS}=0\text{ V}$                                      | -   | 1   | 100 | nA            |
| Drain-source on-state resistance | $R_{DS(on)}$  | $V_{GS}=10\text{ V}$ , $I_D=5.7\text{ A}$                                       | -   | 108 | 125 | m $\Omega$    |
| Gate resistance                  | $R_G$         |                                                                                 | -   | 1.9 | -   | $\Omega$      |
| Transconductance                 | $g_{fs}$      | $ V_{DS} >2 I_D R_{DS(on)max}$ , $I_D=5.7\text{ A}$                             | 6   | 12  | -   | S             |

<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.

| Parameter | Symbol | Conditions | Values |      |      | Unit |
|-----------|--------|------------|--------|------|------|------|
|           |        |            | min.   | typ. | max. |      |

#### Dynamic characteristics

|                              |              |                                                                                        |   |     |     |    |
|------------------------------|--------------|----------------------------------------------------------------------------------------|---|-----|-----|----|
| Input capacitance            | $C_{iss}$    | $V_{GS}=0\text{ V}, V_{DS}=100\text{ V},$<br>$f=1\text{ MHz}$                          | - | 510 | 680 | pF |
| Output capacitance           | $C_{oss}$    |                                                                                        | - | 39  | 52  |    |
| Reverse transfer capacitance | $C_{rss}$    |                                                                                        | - | 5.1 | -   |    |
| Turn-on delay time           | $t_{d(on)}$  | $V_{DD}=100\text{ V},$<br>$V_{GS}=10\text{ V}, I_D=5.7\text{ A},$<br>$R_G=1.6\ \Omega$ | - | 6   | -   | ns |
| Rise time                    | $t_r$        |                                                                                        | - | 4   | -   |    |
| Turn-off delay time          | $t_{d(off)}$ |                                                                                        | - | 10  | -   |    |
| Fall time                    | $t_f$        |                                                                                        | - | 3   | -   |    |

#### Gate Charge Characteristics<sup>4)</sup>

|                       |               |                                                                              |   |     |     |    |
|-----------------------|---------------|------------------------------------------------------------------------------|---|-----|-----|----|
| Gate to source charge | $Q_{gs}$      | $V_{DD}=100\text{ V}, I_D=5.7\text{ A},$<br>$V_{GS}=0\text{ to }10\text{ V}$ | - | 2.3 | -   | nC |
| Gate to drain charge  | $Q_{gd}$      |                                                                              | - | 1.1 | -   |    |
| Switching charge      | $Q_{sw}$      |                                                                              | - | 1.8 | -   |    |
| Gate charge total     | $Q_g$         |                                                                              | - | 6.5 | 8.7 |    |
| Gate plateau voltage  | $V_{plateau}$ |                                                                              | - | 4.5 | -   | V  |
| Output charge         | $Q_{oss}$     | $V_{DD}=100\text{ V}, V_{GS}=0\text{ V}$                                     | - | 14  | 19  | nC |

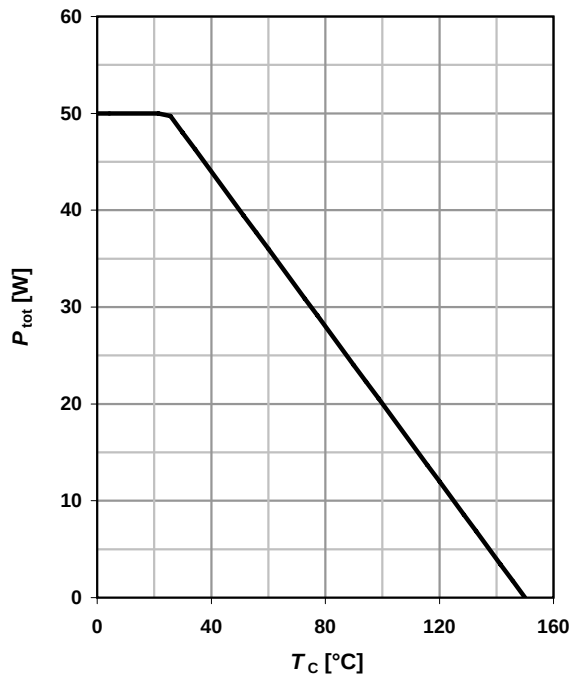
#### Reverse Diode

|                                  |               |                                                                    |   |     |      |    |
|----------------------------------|---------------|--------------------------------------------------------------------|---|-----|------|----|
| Diode continuous forward current | $I_S$         | $T_C=25\text{ °C}$                                                 | - | -   | 11.3 | A  |
| Diode pulse current              | $I_{S,pulse}$ |                                                                    | - | -   | 45   |    |
| Diode forward voltage            | $V_{SD}$      | $V_{GS}=0\text{ V}, I_F=11.3\text{ A},$<br>$T_j=25\text{ °C}$      | - | 1   | 1.2  | V  |
| Reverse recovery time            | $t_{rr}$      | $V_R=100\text{ V}, I_F=I_S,$<br>$di_F/dt=100\text{ A}/\mu\text{s}$ | - | 74  | -    | ns |
| Reverse recovery charge          | $Q_{rr}$      |                                                                    | - | 208 | -    | nC |

<sup>4)</sup> See figure 16 for gate charge parameter definition

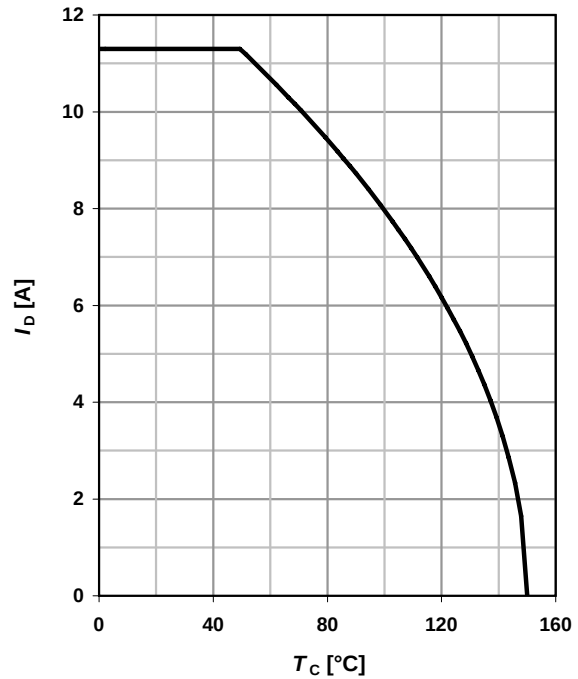
### 1 Power dissipation

$$P_{\text{tot}} = f(T_C)$$



### 2 Drain current

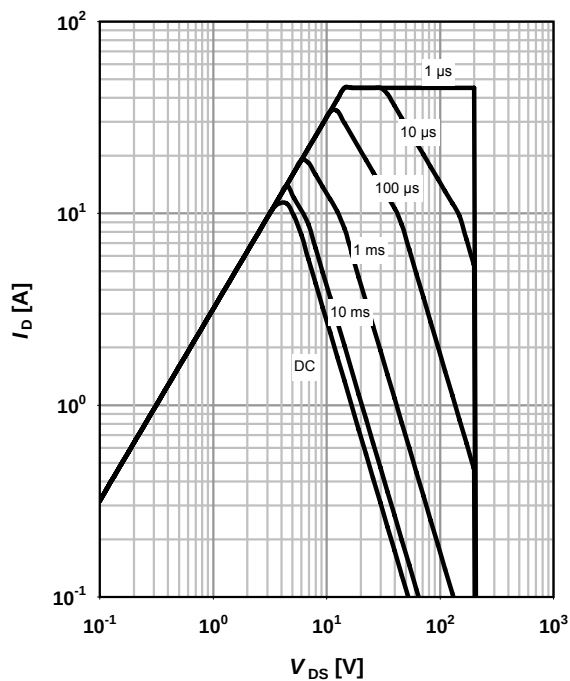
$$I_D = f(T_C); V_{GS} \geq 10 \text{ V}$$



### 3 Safe operating area

$$I_D = f(V_{DS}); T_C = 25 \text{ °C}; D = 0$$

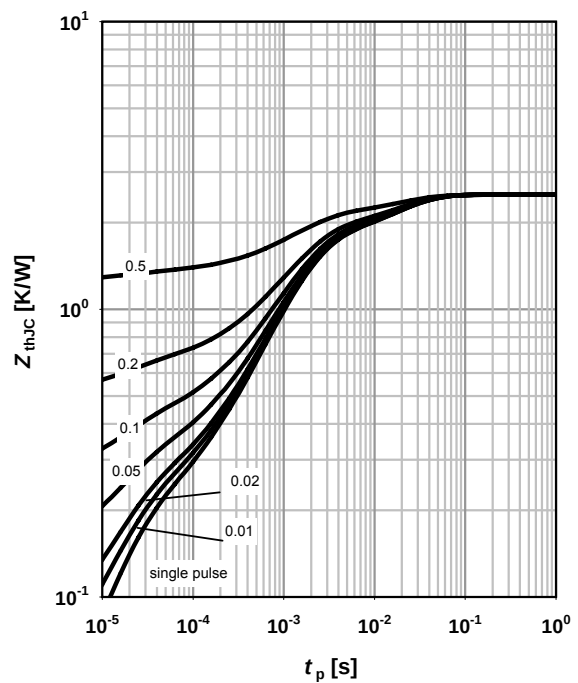
parameter:  $t_p$



### 4 Max. transient thermal impedance

$$Z_{\text{thJC}} = f(t_p)$$

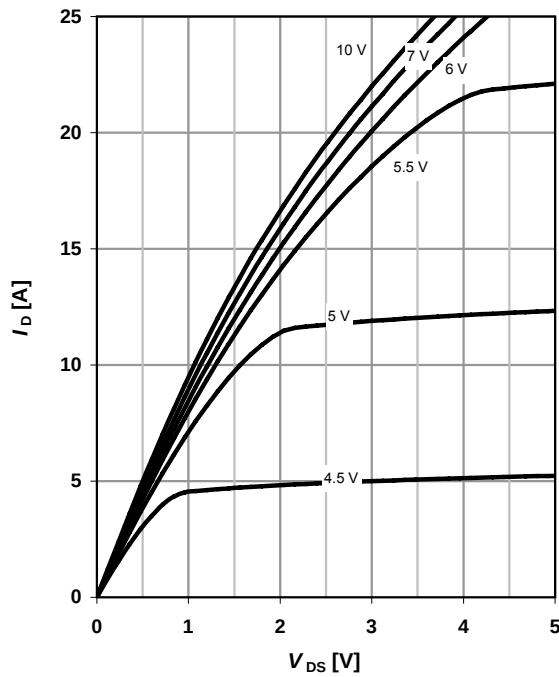
parameter:  $D = t_p / T$



### 5 Typ. output characteristics

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

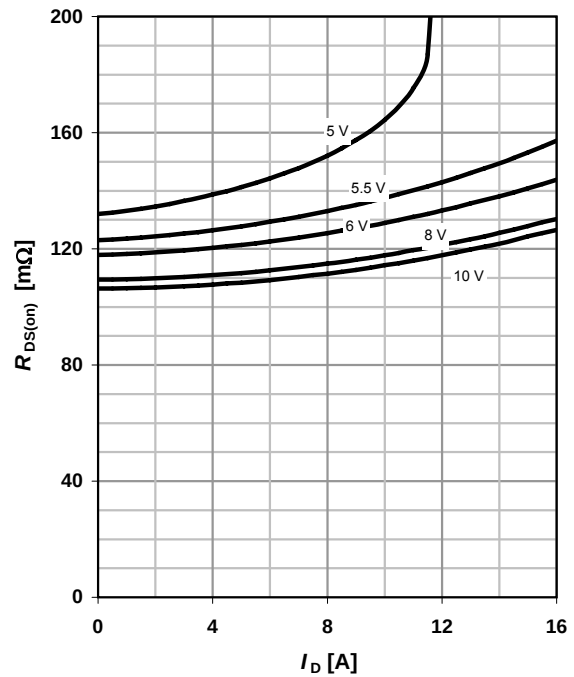
parameter:  $V_{GS}$



### 6 Typ. drain-source on resistance

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

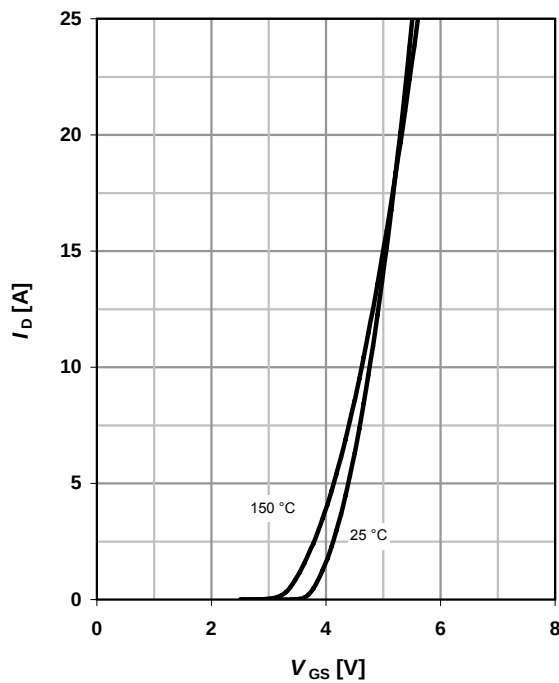
parameter:  $V_{GS}$



### 7 Typ. transfer characteristics

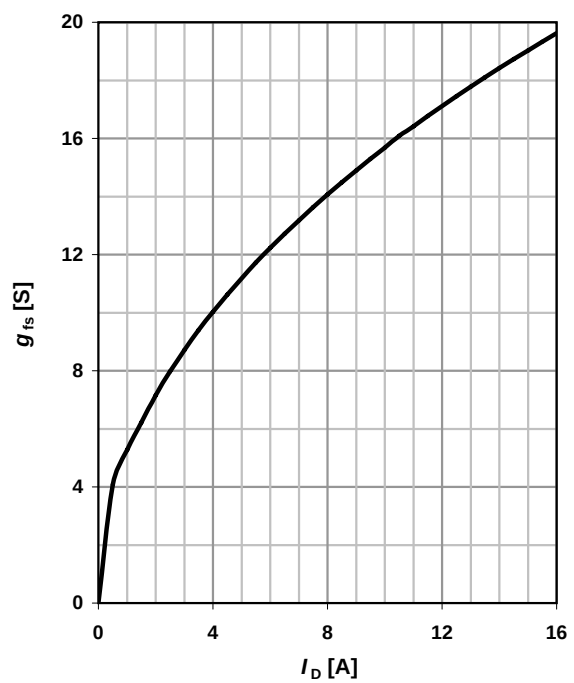
$$I_D = f(V_{GS}); |V_{DS}| > 2|I_D|R_{DS(on)max}$$

parameter:  $T_j$



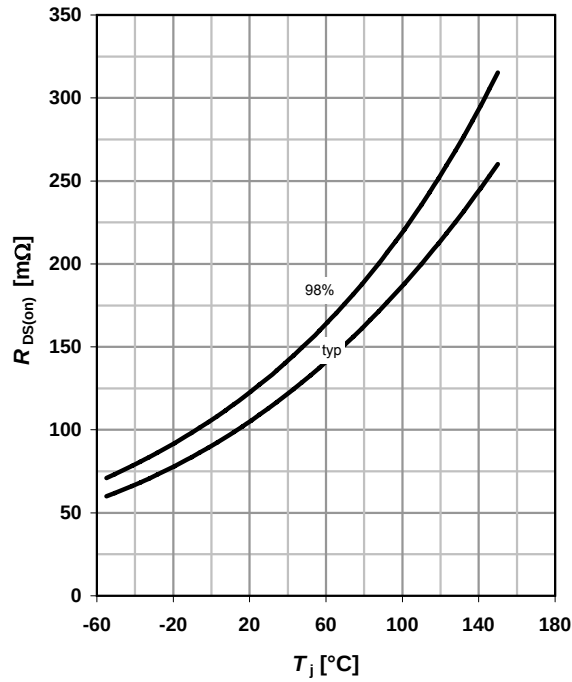
### 8 Typ. forward transconductance

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



## 9 Drain-source on-state resistance

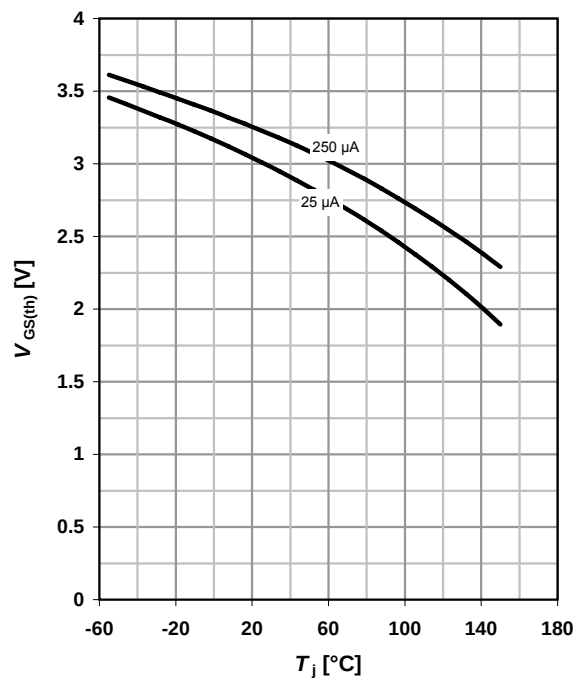
$$R_{DS(on)} = f(T_j); I_D = 5.7 \text{ A}; V_{GS} = 10 \text{ V}$$



## 10 Typ. gate threshold voltage

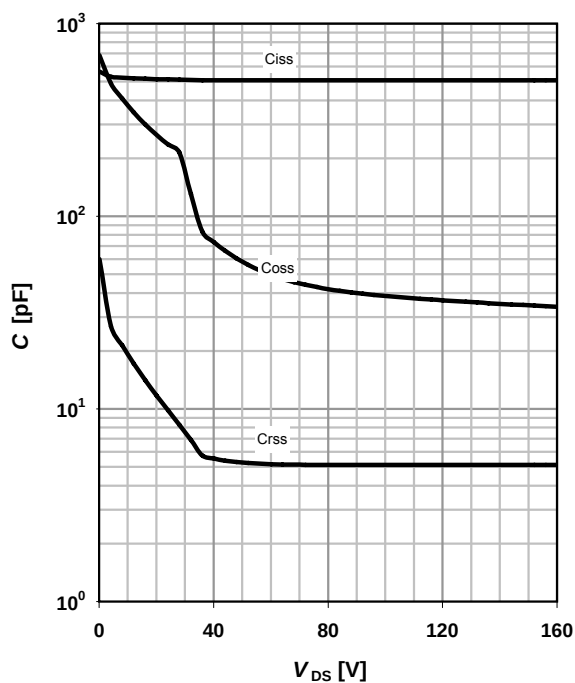
$$V_{GS(th)} = f(T_j); V_{GS} = V_{DS}$$

parameter:  $I_D$



## 11 Typ. capacitances

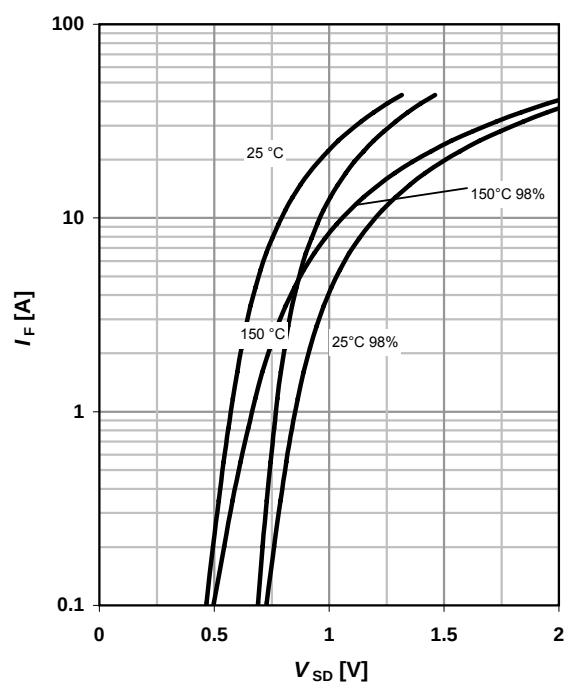
$$C = f(V_{DS}); V_{GS} = 0 \text{ V}; f = 1 \text{ MHz}$$



## 12 Forward characteristics of reverse diode

$$I_F = f(V_{SD})$$

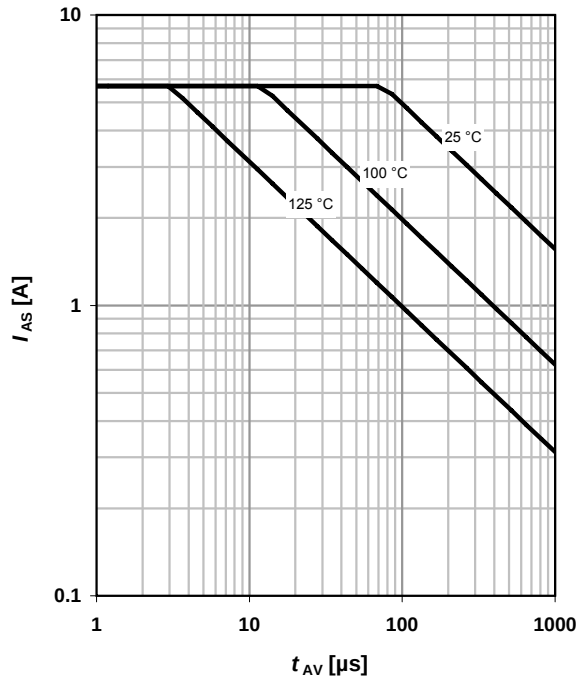
parameter:  $T_j$



### 13 Avalanche characteristics

$$I_{AS} = f(t_{AV}); R_{GS} = 25 \Omega$$

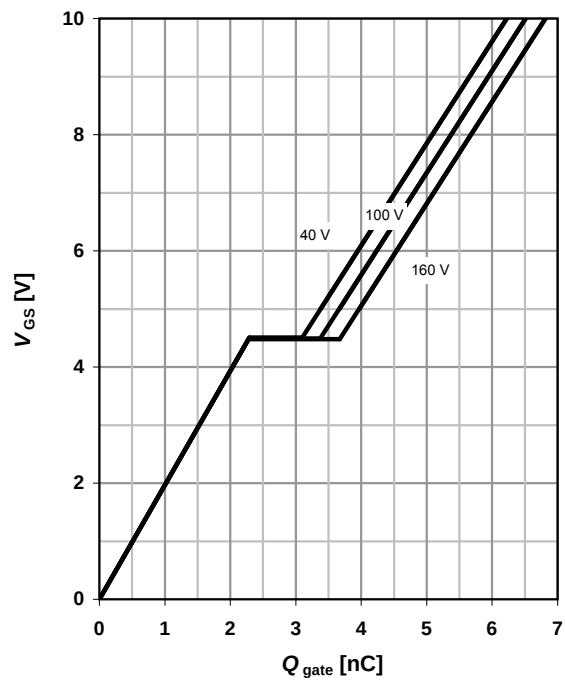
parameter:  $T_{j(\text{start})}$



### 14 Typ. gate charge

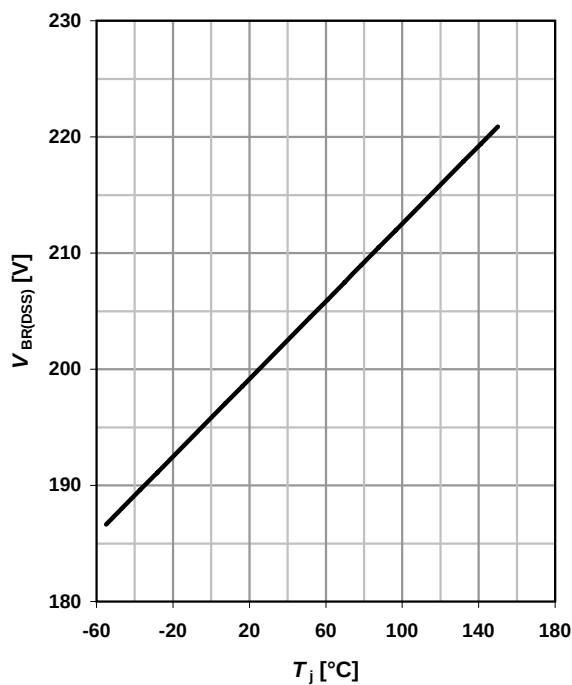
$$V_{GS} = f(Q_{\text{gate}}); I_D = 5.7 \text{ A pulsed}$$

parameter:  $V_{DD}$

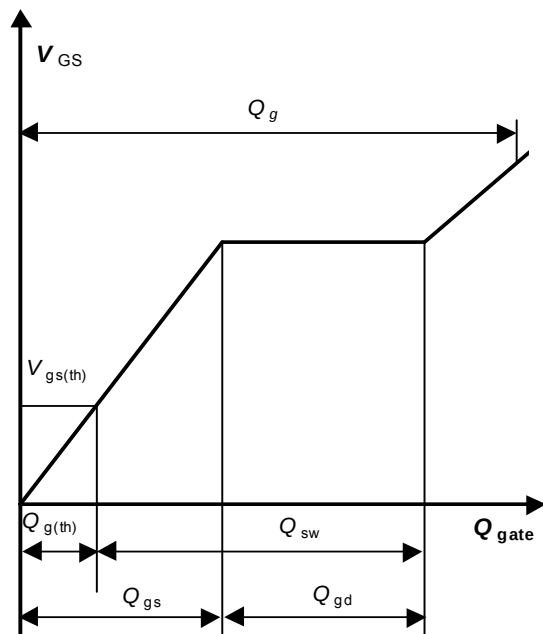


### 15 Drain-source breakdown voltage

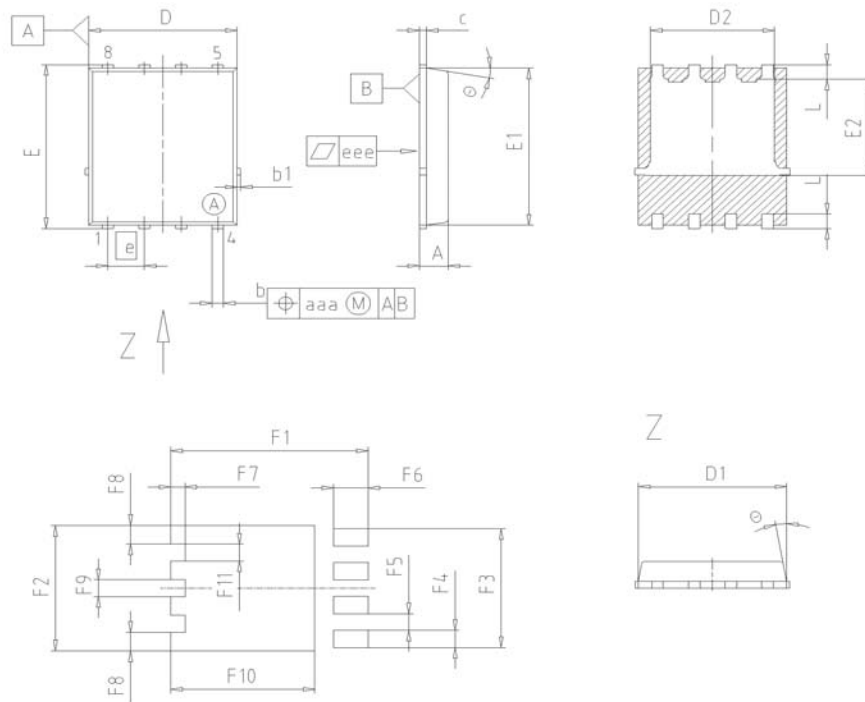
$$V_{BR(DSS)} = f(T_j); I_D = 1 \text{ mA}$$



### 16 Gate charge waveforms



## Package Outline:PG-TDSON-8



| 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 |
| □    | 8.5°        |      | 8.5°   |       |
| 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 |

|                                                                                       |                 |
|---------------------------------------------------------------------------------------|-----------------|
| <b>DOCUMENT NO.</b><br>Z8B00003332                                                    |                 |
| <b>SCALE</b>                                                                          | 0<br>2.5<br>5mm |
| <b>EUROPEAN PROJECTION</b>                                                            |                 |
|  |                 |
| <b>ISSUE DATE</b><br>08-03-2007                                                       |                 |
| <b>REVISION</b><br>03                                                                 |                 |



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