

**OptiMOS™3 Power-Transistor**
**Features**

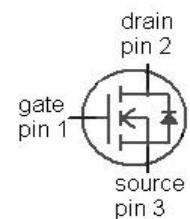
- N-channel, normal level
- Excellent gate charge x  $R_{DS(on)}$  product (FOM)
- Very low on-resistance  $R_{DS(on)}$
- 175 °C operating temperature
- Pb-free lead plating; RoHS compliant
- Qualified according to JEDEC<sup>1)</sup> for target application
- Ideal for high-frequency switching and synchronous rectification
- Halogen-free according to IEC61249-2-21

**Product Summary**

|                         |     |    |
|-------------------------|-----|----|
| $V_{DS}$                | 100 | V  |
| $R_{DS(on),max}$ TO-263 | 18  | mΩ |
| $I_D$                   | 43  | A  |



|                |               |
|----------------|---------------|
| <b>Type</b>    | IPD180N10N3 G |
|                |               |
| <b>Package</b> | PG-TO252-3    |
| <b>Marking</b> | 180N10N       |


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

| Parameter                           | Symbol         | Conditions                                    | Value       | Unit |
|-------------------------------------|----------------|---|-------------|------|
| Continuous drain current            | $I_D$          | $T_C=25\text{ °C}^{2)}$                       | 43          | A    |
|                                     |                | $T_C=100\text{ °C}$                           | 30          |      |
| Pulsed drain current <sup>2)</sup>  | $I_{D,pulse}$  | $T_C=25\text{ °C}$                            | 172         |      |
| Avalanche energy, single pulse      | $E_{AS}$       | $I_D=33\text{ A}$ , $R_{GS}=25\text{ }\Omega$ | 50          | mJ   |
| Gate source voltage                 | $V_{GS}$       |   | $\pm 20$    | V    |
| Power dissipation                   | $P_{tot}$      | $T_C=25\text{ °C}$                            | 71          | W    |
| Operating and storage temperature   | $T_j, T_{stg}$ |   | -55 ... 175 | °C   |
| IEC climatic category; DIN IEC 68-1 |                |   | 55/175/56   |      |

<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       | $R_{thJC}$ |  | - | - | 2.1 | K/W |
| Thermal resistance,<br>junction - ambient | $R_{thJA}$ | minimal footprint                            | - | - | 75  |     |
|   |            | 6 cm <sup>2</sup> cooling area <sup>3)</sup> | - | - | 50  |     |

**Electrical characteristics, at  $T_j=25\text{ °C}$ , unless otherwise specified**
**Static characteristics**

|                                  |               |   |     |      |     |               |
|----------------------------------|---------------|---|-----|------|-----|---------------|
| Drain-source breakdown voltage   | $V_{(BR)DSS}$ | $V_{GS}=0\text{ V}, I_D=1\text{ mA}$                        | 100 | -    | -   | V             |
| Gate threshold voltage           | $V_{GS(th)}$  | $V_{DS}=V_{GS}, I_D=33\text{ }\mu\text{A}$                  | 2   | 2.7  | 3.5 |               |
| Zero gate voltage drain current  | $I_{DSS}$     | $V_{DS}=100\text{ V}, V_{GS}=0\text{ V}, T_j=25\text{ °C}$  | -   | 0.1  | 1   | $\mu\text{A}$ |
|                                  |               | $V_{DS}=100\text{ V}, V_{GS}=0\text{ V}, T_j=125\text{ °C}$ | -   | 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 | $R_{DS(on)}$  | $V_{GS}=10\text{ V}, I_D=33\text{ A}$                       | -   | 14.7 | 18  | m $\Omega$    |
|                                  |               | $V_{GS}=6\text{ V}, I_D=16\text{ A}$                        | -   | 18.4 | 33  |               |
| Gate resistance                  | $R_G$         |   | -   | 1.4  | -   | $\Omega$      |
| Transconductance                 | $g_{fs}$      | $ V_{DS} >2 I_D R_{DS(on)max}, I_D=33\text{ A}$             | 20  | 40   | -   | 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            | $C_{iss}$    | $V_{GS}=0\text{ V}, V_{DS}=50\text{ V},$<br>$f=1\text{ MHz}$                          | - | 1350 | 1800 | pF |
| Output capacitance           | $C_{oss}$    |   | - | 237  | 315  |    |
| Reverse transfer capacitance | $C_{rss}$    |   | - | 11   | -    |    |
| Turn-on delay time           | $t_{d(on)}$  | $V_{DD}=50\text{ V}, V_{GS}=10\text{ V},$<br>$I_D=33\text{ A}, R_{G,ext}=1.6\ \Omega$ | - | 12   | -    | ns |
| Rise time                    | $t_r$        |   | - | 12   | -    |    |
| Turn-off delay time          | $t_{d(off)}$ |   | - | 19   | -    |    |
| Fall time                    | $t_f$        |   | - | 5    | -    |    |

**Gate Charge Characteristics<sup>6)</sup>**

|                       |               |  |   |     |    |    |
|-----------------------|---------------|--|---|-----|----|----|
| Gate to source charge | $Q_{gs}$      | $V_{DD}=50\text{ V}, I_D=33\text{ A},$<br>$V_{GS}=0\text{ to }10\text{ V}$ | - | 7   | -  | nC |
| Gate to drain charge  | $Q_{gd}$      |  | - | 4   | -  |    |
| Switching charge      | $Q_{sw}$      |  | - | 6   | -  |    |
| Gate charge total     | $Q_g$         |  | - | 19  | 25 |    |
| Gate plateau voltage  | $V_{plateau}$ |  | - | 4.9 | -  |    |
| Output charge         | $Q_{oss}$     | $V_{DD}=50\text{ V}, V_{GS}=0\text{ V}$                                    | - | 25  | 33 | nC |

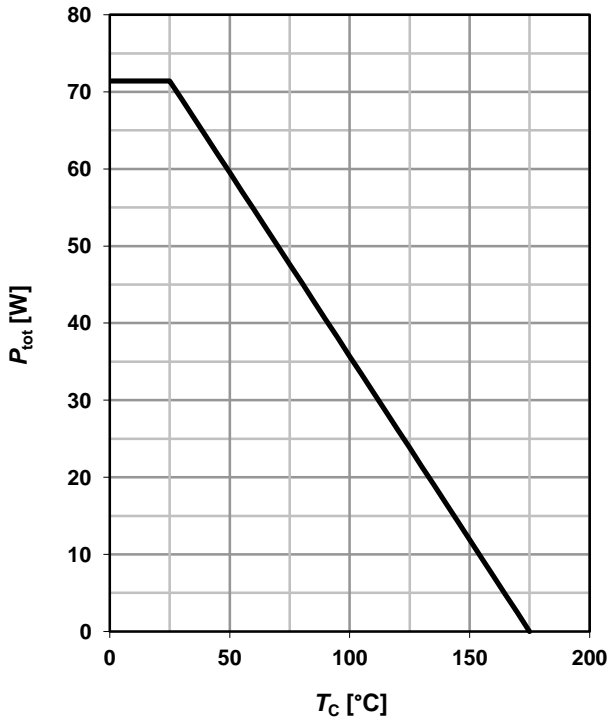
**Reverse Diode**

|                                  |               |   |   |    |     |    |
|----------------------------------|---------------|---|---|----|-----|----|
| Diode continuous forward current | $I_S$         | $T_C=25\text{ }^\circ\text{C}$  | - | -  | 43  | A  |
| Diode pulse current              | $I_{S,pulse}$ |   | - | -  | 172 |    |
| Diode forward voltage            | $V_{SD}$      | $V_{GS}=0\text{ V}, I_F=33\text{ A},$<br>$T_j=25\text{ }^\circ\text{C}$   | - | 1  | 1.2 | V  |
| Reverse recovery time            | $t_{rr}$      | $V_R=15\text{ V}, I_F=33\text{ A},$<br>$di_F/dt=100\text{ A}/\mu\text{s}$ | - | 55 | -   | ns |
| Reverse recovery charge          | $Q_{rr}$      |   | - | 92 | -   | nC |

<sup>6)</sup> See figure 16 for gate charge parameter definition

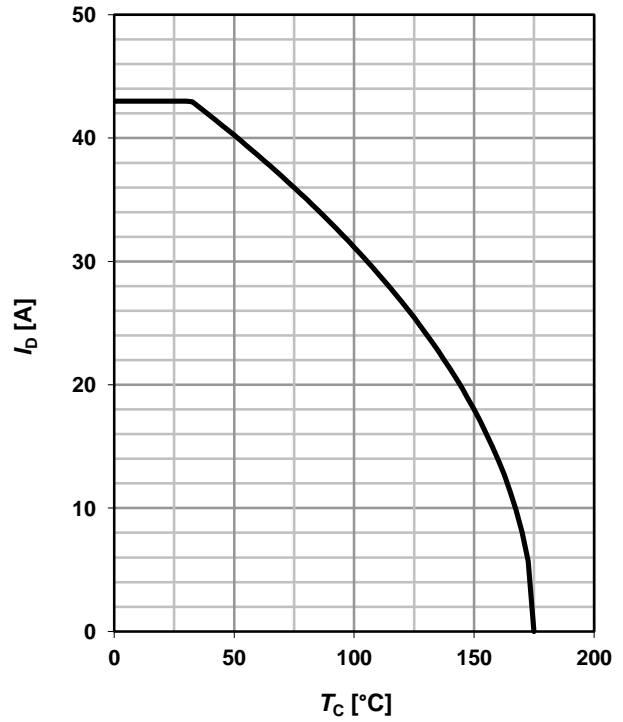
**1 Power dissipation**

$P_{tot}=f(T_C)$



**2 Drain current**

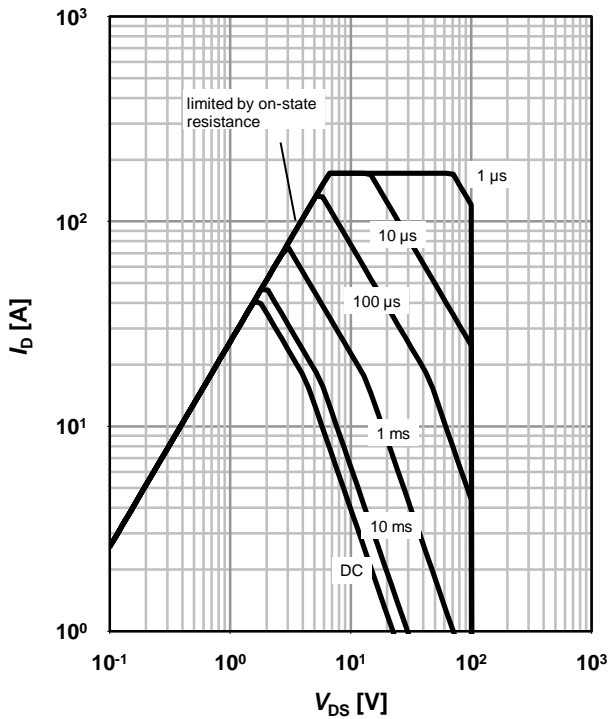
$I_D=f(T_C); V_{GS} \geq 10\text{ V}$



**3 Safe operating area**

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

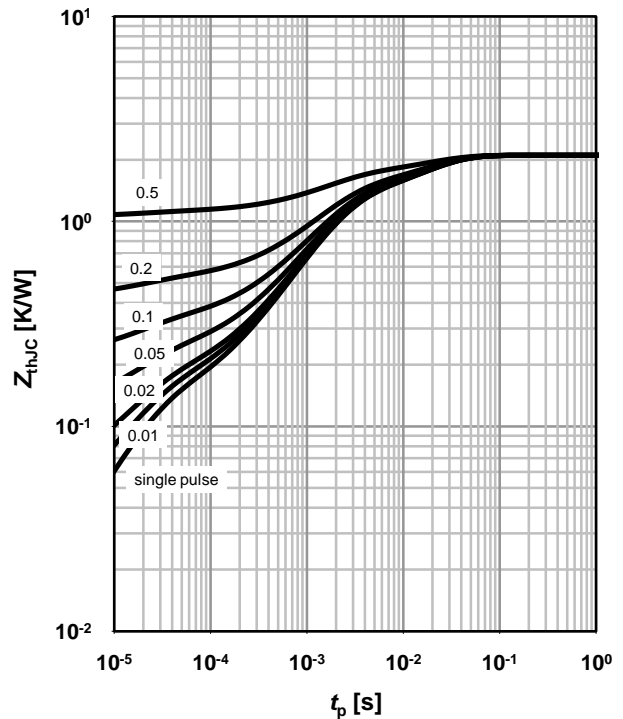
parameter:  $t_p$



**4 Max. transient thermal impedance**

$Z_{thJC}=f(t_p)$

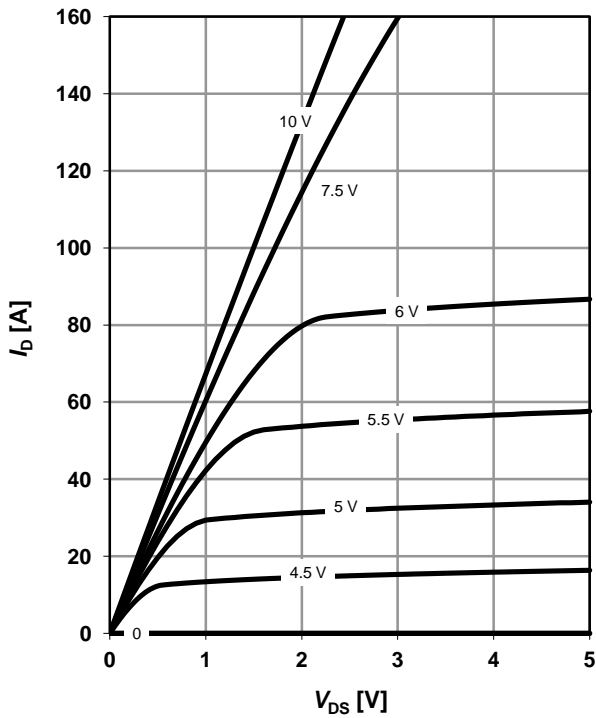
parameter:  $D=t_p/T$



**5 Typ. output characteristics**

$I_D = f(V_{DS}); T_j = 25\text{ °C}$

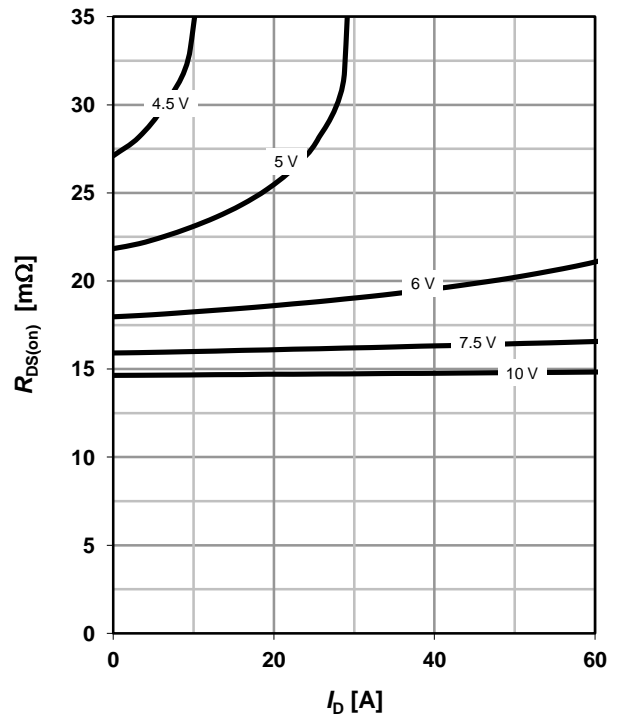
parameter:  $V_{GS}$



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

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

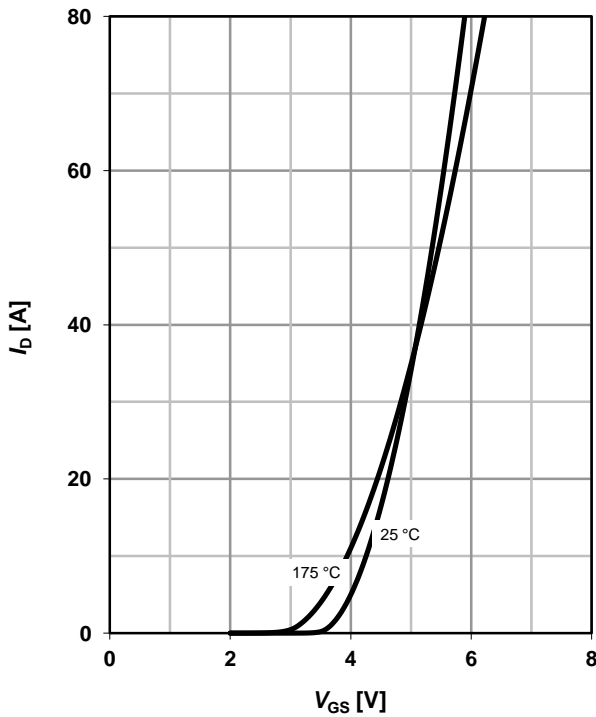
parameter:  $V_{GS}$



**7 Typ. transfer characteristics**

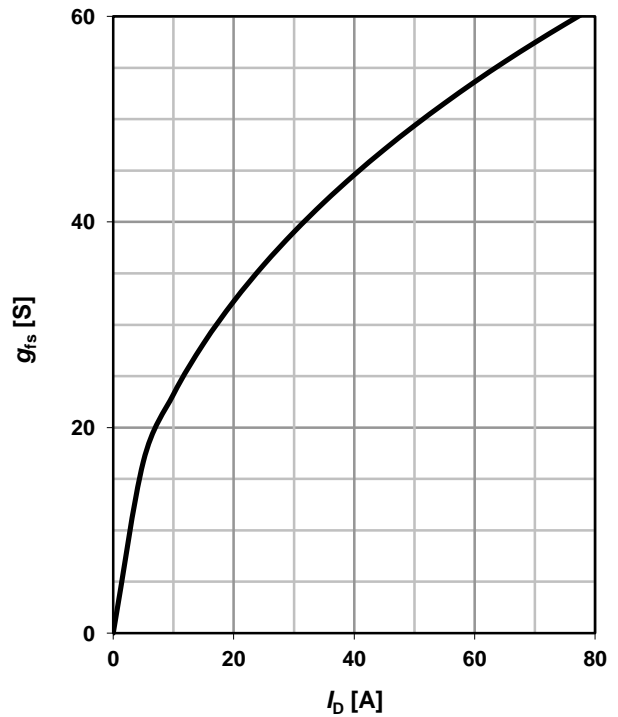
$I_D = f(V_{GS}); |V_{DS}| > 2|I_D|R_{DS(on)max}$

parameter:  $T_j$



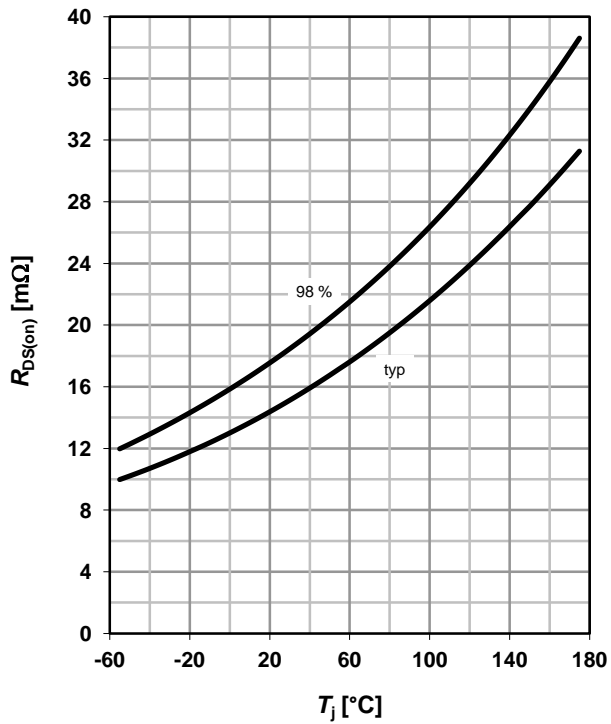
**8 Typ. forward transconductance**

$g_{fs} = f(I_D); T_j = 25\text{ °C}$



**9 Drain-source on-state resistance**

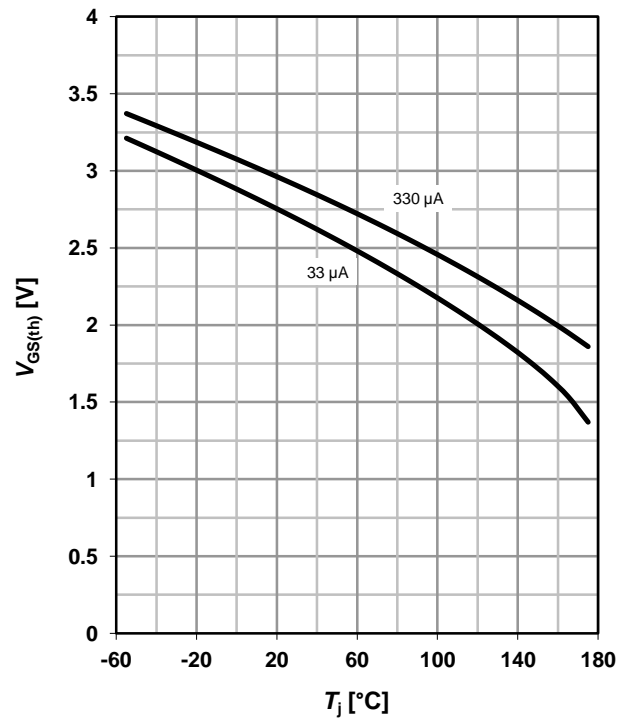
$R_{DS(on)}=f(T_j); I_D=33\text{ A}; V_{GS}=10\text{ V}$



**10 Typ. gate threshold voltage**

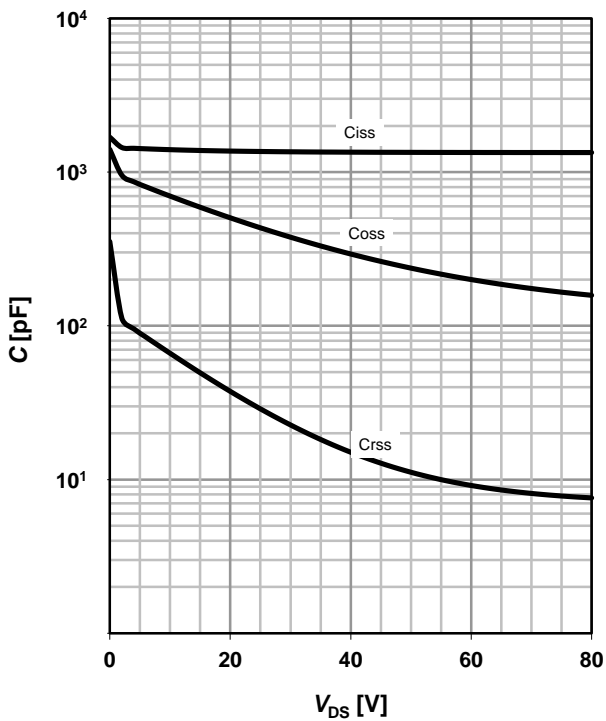
$V_{GS(th)}=f(T_j); V_{GS}=V_{DS}$

parameter:  $I_D$



**11 Typ. capacitances**

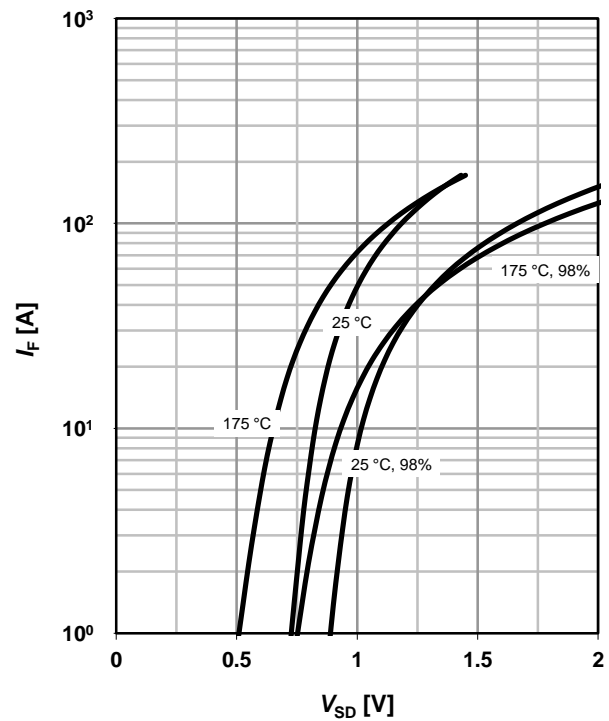
$C=f(V_{DS}); V_{GS}=0\text{ V}; f=1\text{ MHz}$



**12 Forward characteristics of reverse diode**

$I_F=f(V_{SD})$

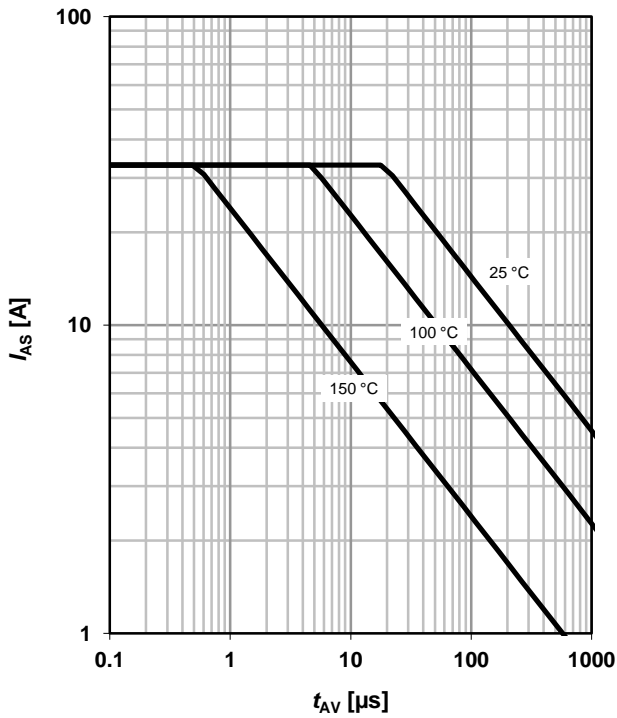
parameter:  $T_j$



**13 Avalanche characteristics**

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

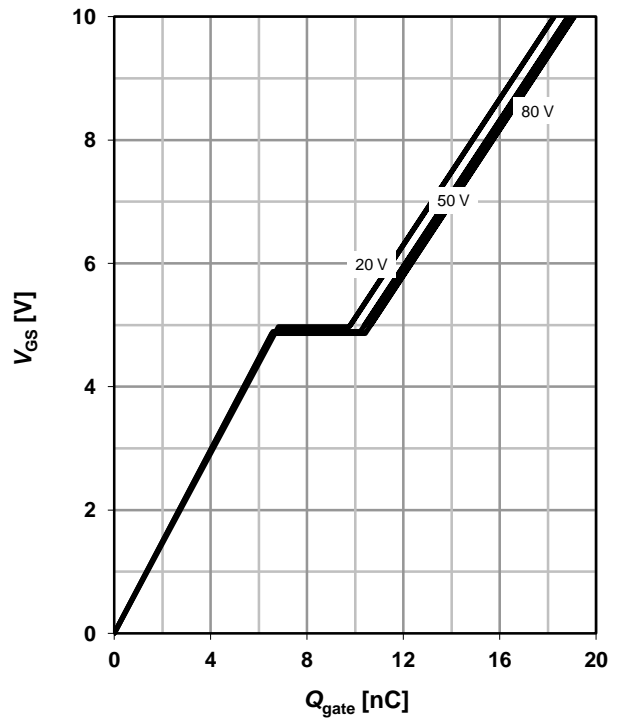
parameter:  $T_{j(\text{start})}$



**14 Typ. gate charge**

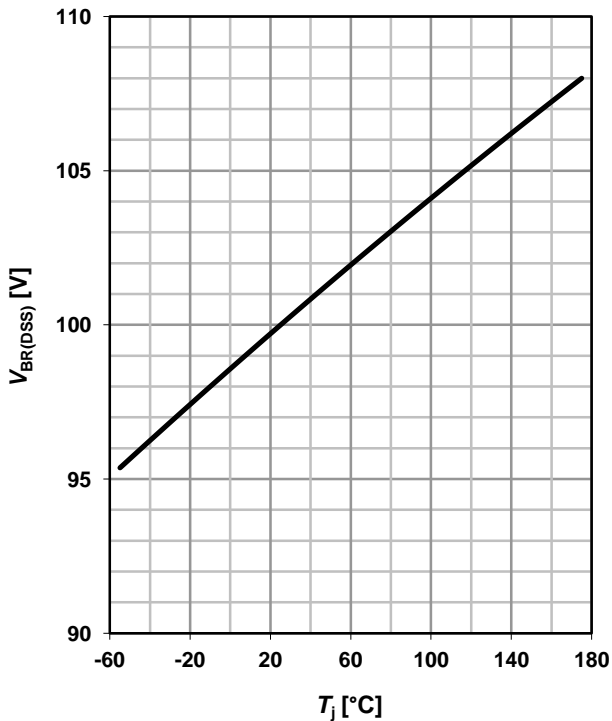
$V_{GS}=f(Q_{\text{gate}}); I_D=33 \text{ A pulsed}$

parameter:  $V_{DD}$

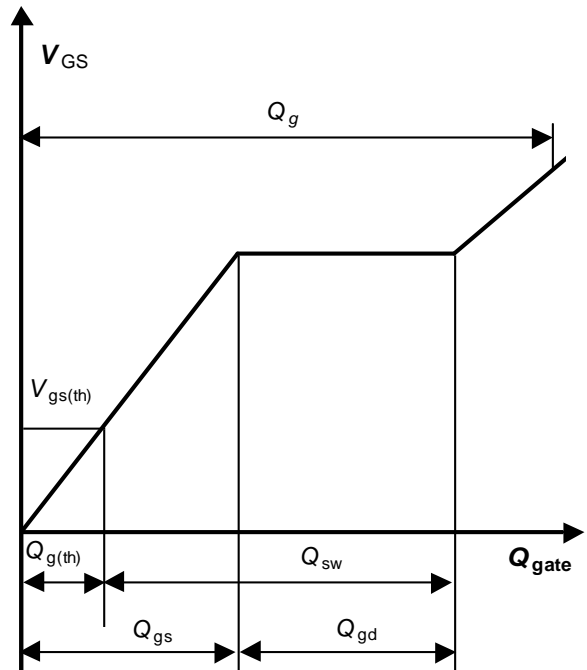


**15 Drain-source breakdown voltage**

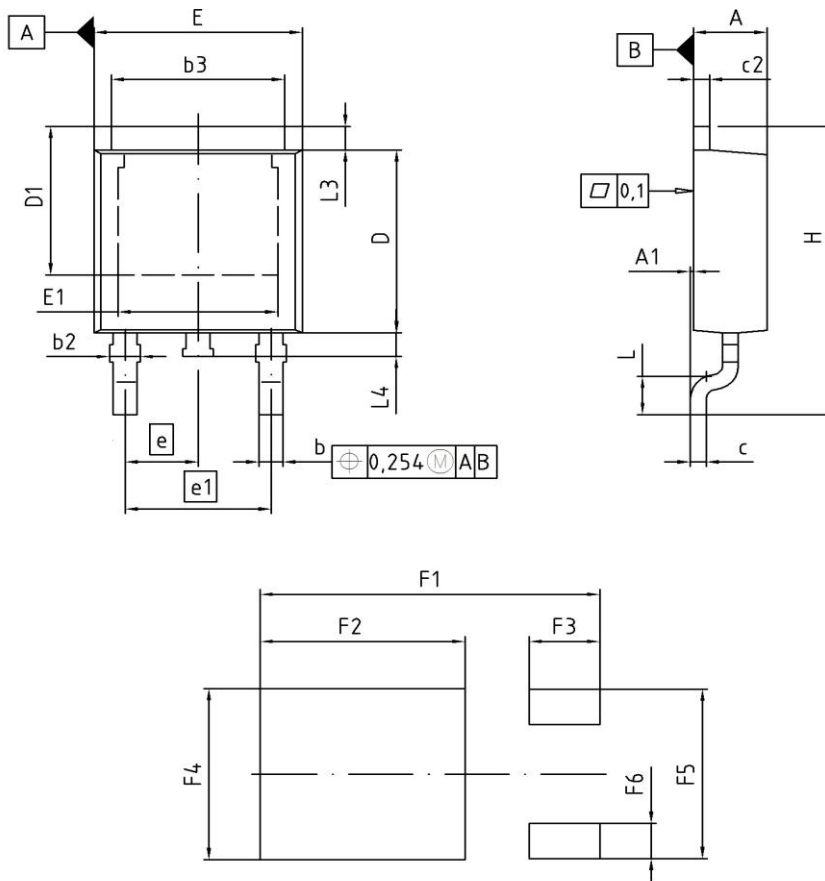
$V_{BR(DSS)}=f(T_j); I_D=1 \text{ mA}$



**16 Gate charge waveforms**



PG-TO-252



| DIM | MILLIMETERS |       | INCHES |       |
|-----|-------------|-------|--------|-------|
|     | MIN         | MAX   | MIN    | MAX   |
| A   | 2.16        | 2.41  | 0.085  | 0.095 |
| A1  | 0.00        | 0.15  | 0.000  | 0.006 |
| b   | 0.64        | 0.89  | 0.025  | 0.035 |
| b2  | 0.65        | 1.15  | 0.026  | 0.045 |
| b3  | 5.00        | 5.50  | 0.197  | 0.217 |
| c   | 0.46        | 0.60  | 0.018  | 0.024 |
| c2  | 0.46        | 0.98  | 0.018  | 0.039 |
| D   | 5.97        | 6.22  | 0.235  | 0.245 |
| D1  | 5.02        | 5.84  | 0.198  | 0.230 |
| E   | 6.40        | 6.73  | 0.252  | 0.265 |
| E1  | 4.70        | 5.21  | 0.185  | 0.205 |
| e   | 2.29        |       | 0.090  |       |
| e1  | 4.57        |       | 0.180  |       |
| N   | 3           |       | 3      |       |
| H   | 9.40        | 10.48 | 0.370  | 0.413 |
| L   | 1.18        | 1.70  | 0.046  | 0.067 |
| L3  | 0.90        | 1.25  | 0.035  | 0.049 |
| L4  | 0.51        | 1.00  | 0.020  | 0.039 |
| F1  | 10.50       | 10.70 | 0.413  | 0.421 |
| F2  | 6.30        | 6.50  | 0.248  | 0.256 |
| F3  | 2.10        | 2.30  | 0.083  | 0.091 |
| F4  | 5.70        | 5.90  | 0.224  | 0.232 |
| F5  | 5.66        | 5.86  | 0.223  | 0.231 |
| F6  | 1.10        | 1.30  | 0.043  | 0.051 |

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