

## OptiMOS™3 Power-Transistor

### Features

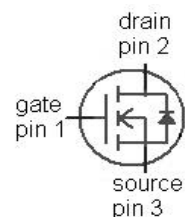
- N-channel, normal level
- Excellent gate charge x  $R_{DS(on)}$  product (FOM)
- Very low on-resistance  $R_{DS(on)}$
- 175 °C operating temperature
- Pb-free lead plating; RoHS compliant
- Qualified according to JEDEC<sup>1)</sup> for target application
- Ideal for high-frequency switching and synchronous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

### Product Summary

|                  |     |    |
|------------------|-----|----|
| $V_{DS}$         | 100 | V  |
| $R_{DS(on),max}$ | 18  | mΩ |
| $I_D$            | 28  | A  |



|         |                                                                                    |
|---------|------------------------------------------------------------------------------------|
| Type    | IPA180N10N3 G                                                                      |
|         |  |
| Package | PG-TO220-FP                                                                        |
| Marking | 180N10N                                                                            |



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

| Parameter                           | Symbol            | Conditions                               | Value       | Unit |
|-------------------------------------|-------------------|------------------------------------------|-------------|------|
| Continuous drain current            | $I_D$             | $T_C=25\text{ °C}^{2)}$                  | 28          | A    |
|                                     |                   | $T_C=100\text{ °C}$                      | 20          |      |
| Pulsed drain current <sup>2)</sup>  | $I_{D,pulse}$     | $T_C=25\text{ °C}$                       | 112         |      |
| Avalanche energy, single pulse      | $E_{AS}$          | $I_D=28\text{ A}$ , $R_{GS}=25\text{ Ω}$ | 59          | mJ   |
| Gate source voltage                 | $V_{GS}$          |                                          | ±20         | V    |
| Power dissipation                   | $P_{tot}$         | $T_C=25\text{ °C}$                       | 30          | 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 | $R_{thJC}$ |  | - | - | 5 | K/W |
|-------------------------------------|------------|--|---|---|---|-----|

### 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           | $V_{GS(th)}$  | $V_{DS}=V_{GS}$ , $I_D=35\text{ }\mu\text{A}$                        | 2   | 2.7  | 3.5 |                  |
| Zero gate voltage drain current  | $I_{DSS}$     | $V_{DS}=100\text{ V}$ , $V_{GS}=0\text{ V}$ ,<br>$T_j=25\text{ °C}$  | -   | 0.1  | 1   | $\mu\text{A}$    |
|                                  |               | $V_{DS}=100\text{ V}$ , $V_{GS}=0\text{ V}$ ,<br>$T_j=125\text{ °C}$ | -   | 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 | $R_{DS(on)}$  | $V_{GS}=10\text{ V}$ , $I_D=28\text{ A}$                             | -   | 15.5 | 18  | $\text{m}\Omega$ |
|                                  |               | $V_{GS}=6\text{ V}$ , $I_D=14\text{ A}$                              | -   | 19.2 | 33  |                  |
| Gate resistance                  | $R_G$         |                                                                      | -   | 1.4  | -   | $\Omega$         |
| Transconductance                 | $g_{fs}$      | $ V_{DS} >2 I_D R_{DS(on)max}$ ,<br>$I_D=28\text{ A}$                | 19  | 37   | -   | 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>$I_D=28\text{ A}, R_{G,ext}=1.6\ \Omega$ | - | 11   | -    | ns |
| Rise time                    | $t_r$        |                                                                                       | - | 5    | -    |    |
| Turn-off delay time          | $t_{d(off)}$ |                                                                                       | - | 18   | -    |    |
| Fall time                    | $t_f$        |                                                                                       | - | 3    | -    |    |

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

|                       |               |                                                                            |   |     |    |    |
|-----------------------|---------------|----------------------------------------------------------------------------|---|-----|----|----|
| Gate to source charge | $Q_{gs}$      | $V_{DD}=50\text{ V}, I_D=28\text{ A},$<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  | $V_{plateau}$ |                                                                            | - | 4.8 | -  | V  |
| Output charge         | $Q_{oss}$     | $V_{DD}=50\text{ V}, V_{GS}=0\text{ V}$                                    | - | 25  | 33 | nC |

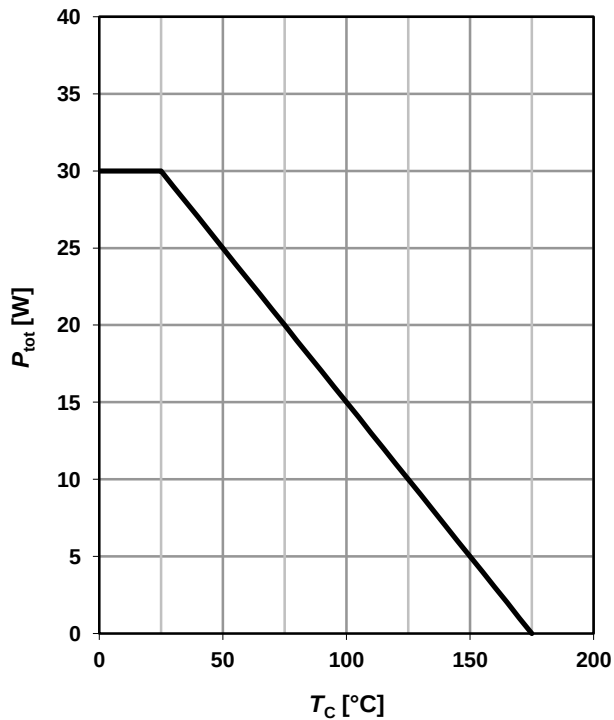
**Reverse Diode**

|                                  |               |                                                                           |   |     |     |    |
|----------------------------------|---------------|---------------------------------------------------------------------------|---|-----|-----|----|
| Diode continuous forward current | $I_S$         | $T_C=25\text{ °C}$                                                        | - | -   | 28  | A  |
| Diode pulse current              | $I_{S,pulse}$ |                                                                           | - | -   | 112 |    |
| Diode forward voltage            | $V_{SD}$      | $V_{GS}=0\text{ V}, I_F=28\text{ A},$<br>$T_J=25\text{ °C}$               | - | 0.9 | 1.2 | V  |
| Reverse recovery time            | $t_{rr}$      | $V_R=50\text{ V}, I_F=28\text{ A},$<br>$di_F/dt=100\text{ A}/\mu\text{s}$ | - | 57  | -   | ns |
| Reverse recovery charge          | $Q_{rr}$      |                                                                           | - | 94  | -   | nC |

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

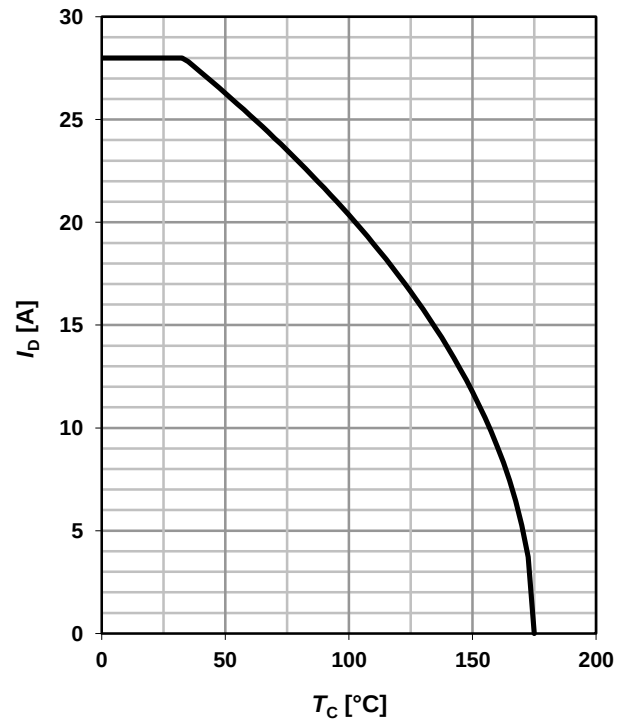
### 1 Power dissipation

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



### 2 Drain current

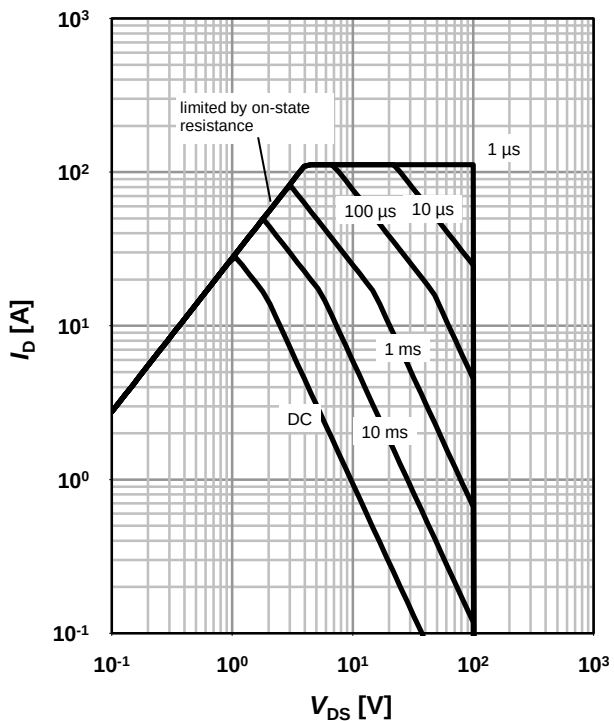
$$I_D = f(T_C); V_{GS} \geq 10 \text{ V}$$



### 3 Safe operating area

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

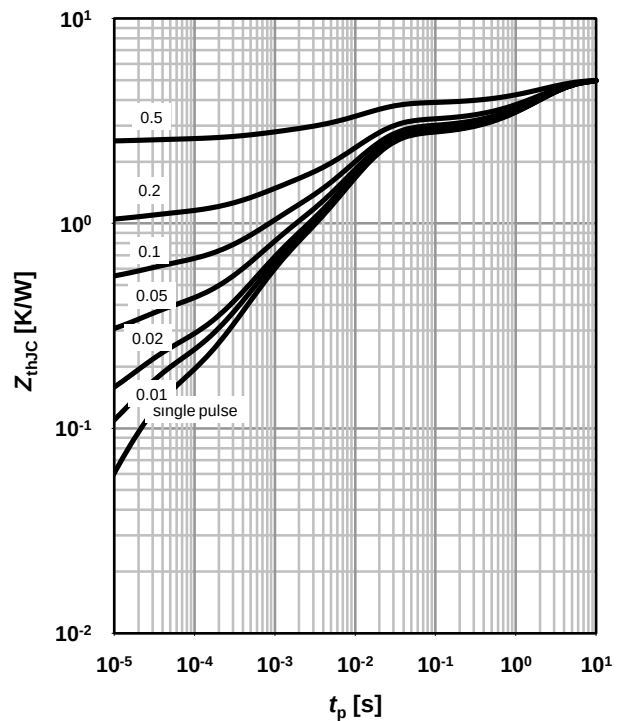
parameter:  $t_p$



### 4 Max. transient thermal impedance

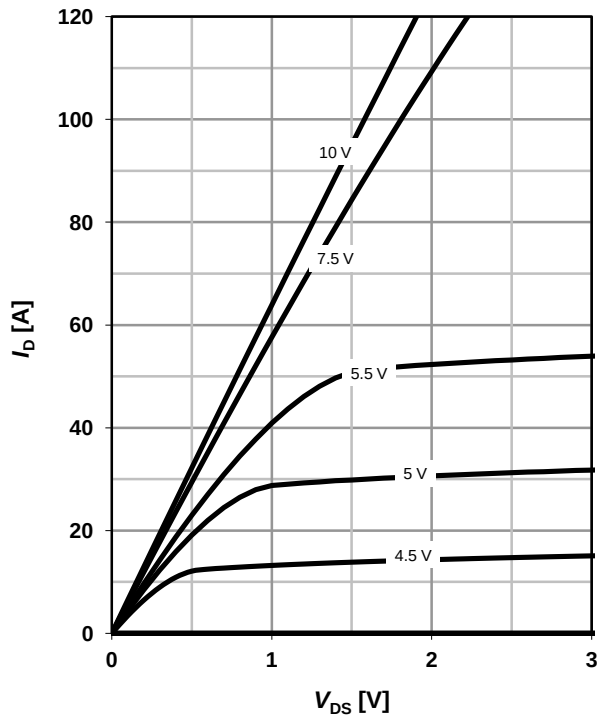
$$Z_{\text{thJC}} = f(t_p)$$

parameter:  $D = t_p/T$



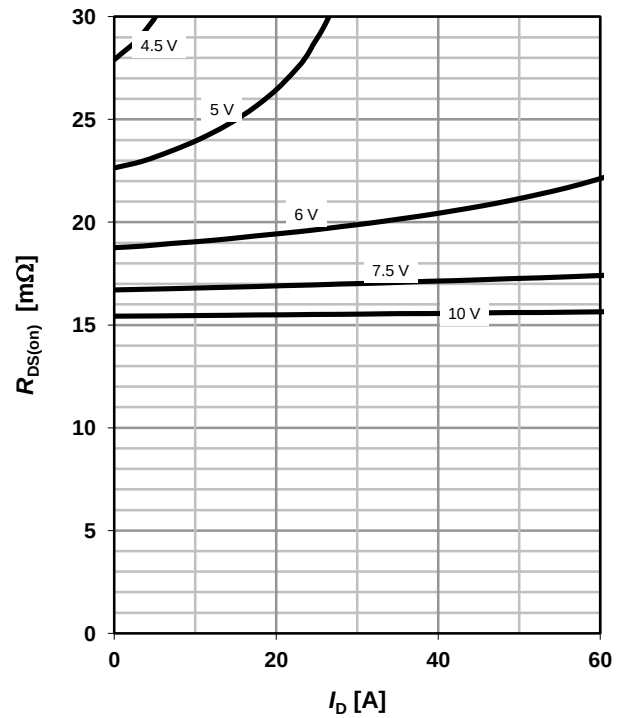
## 5 Typ. output characteristics

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

parameter:  $V_{GS}$ 


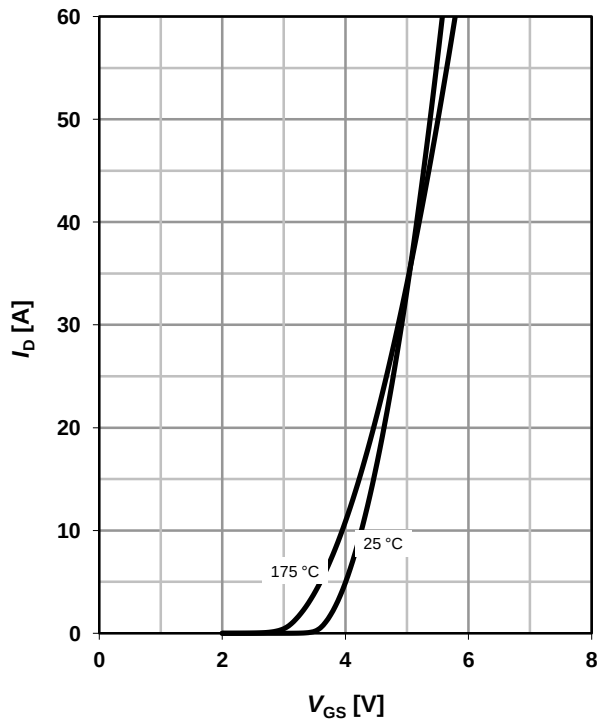
## 6 Typ. drain-source on resistance

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

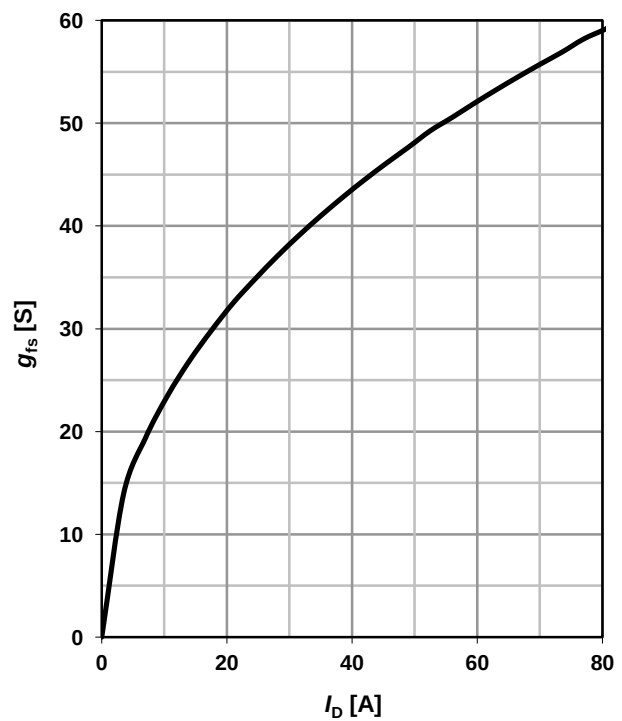
parameter:  $V_{GS}$ 


## 7 Typ. transfer characteristics

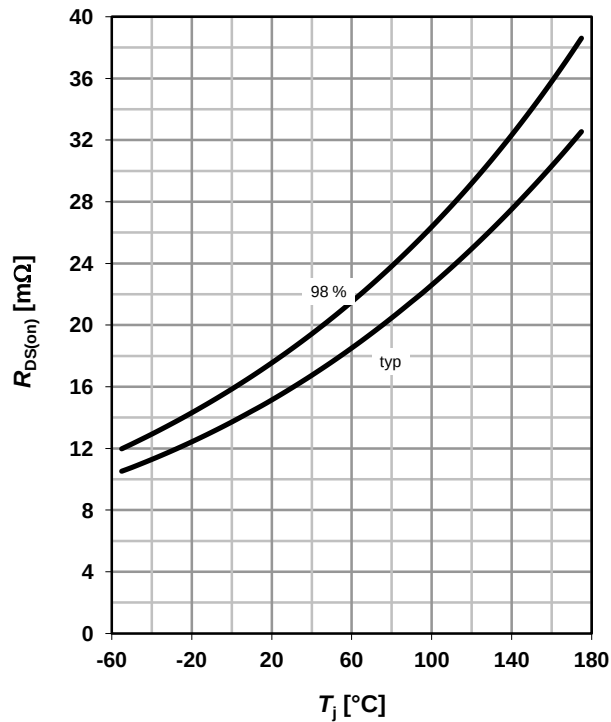
 $I_D = f(V_{GS}); |V_{DS}| > 2|I_D|R_{DS(on)max}$ 

parameter:  $T_j$ 


## 8 Typ. forward transconductance

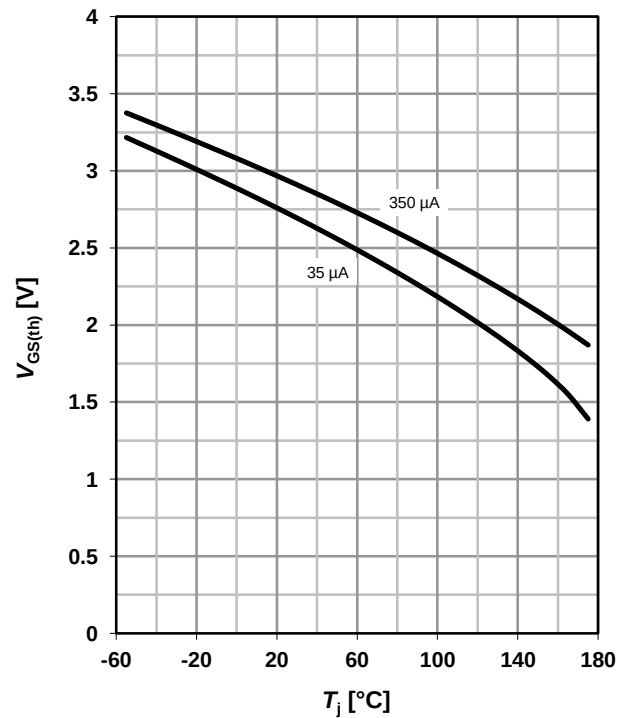
 $g_{fs} = f(I_D); T_j = 25^\circ\text{C}$ 


## 9 Drain-source on-state resistance

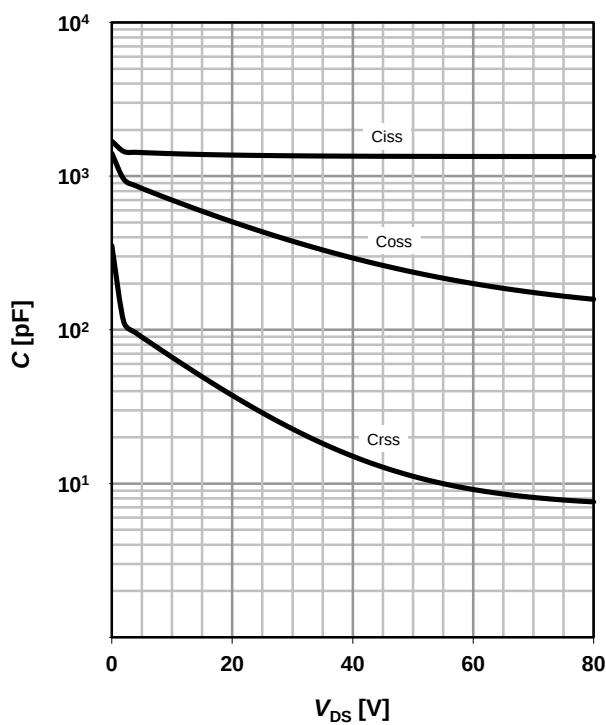
 $R_{DS(on)} = f(T_j); I_D = 28 \text{ A}; V_{GS} = 10 \text{ V}$ 


## 10 Typ. gate threshold voltage

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

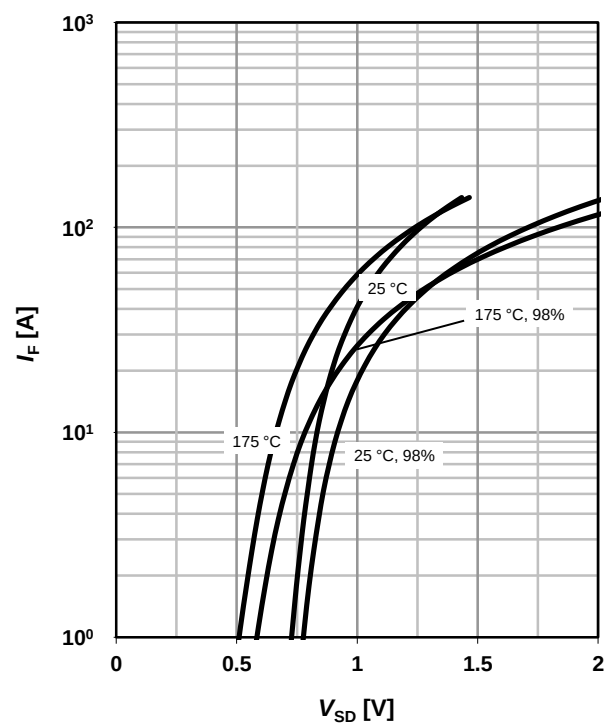
parameter:  $I_D$ 


## 11 Typ. capacitances

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


## 12 Forward characteristics of reverse diode

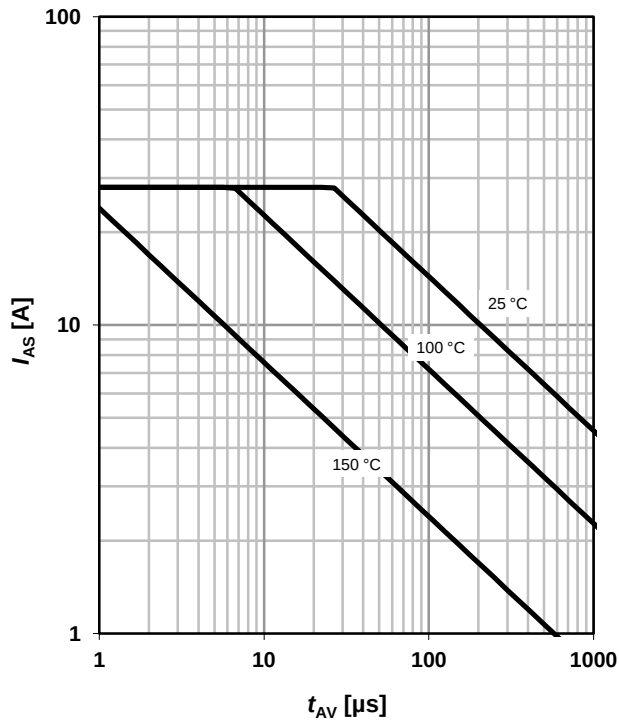
 $I_F = f(V_{SD})$ 

parameter:  $T_j$ 


### 13 Avalanche characteristics

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

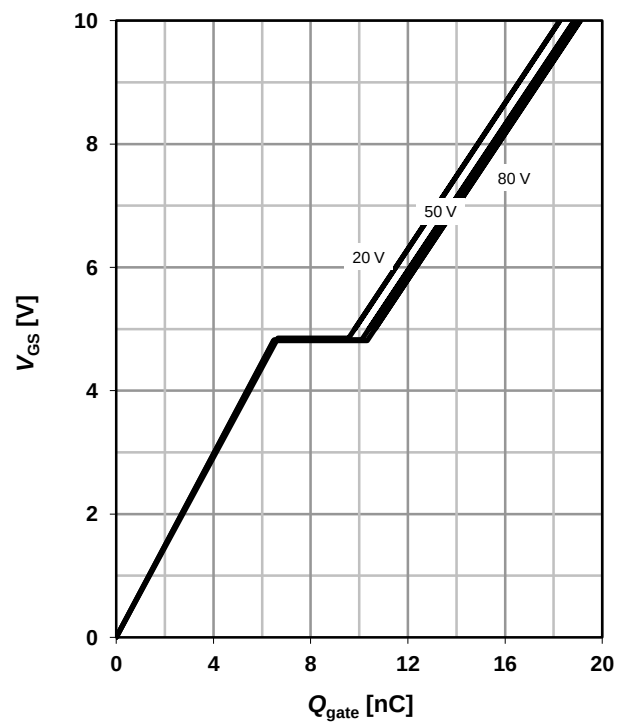
parameter:  $T_{j(\text{start})}$



### 14 Typ. gate charge

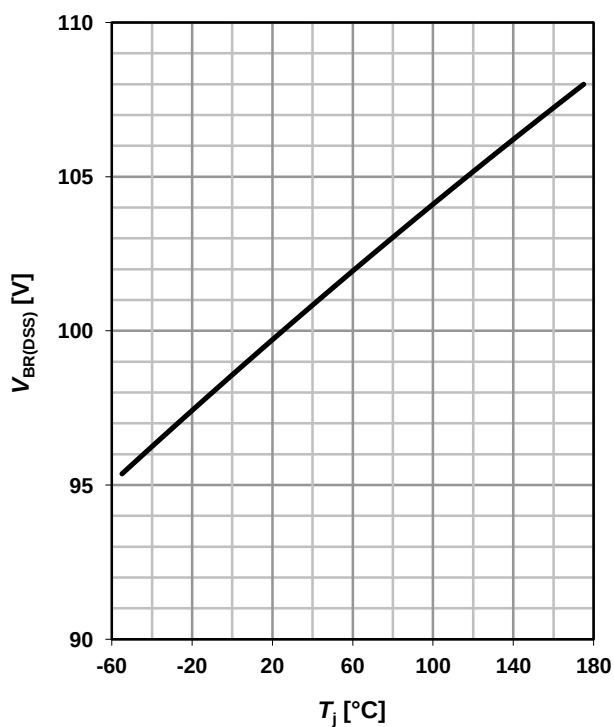
$$V_{GS}=f(Q_{\text{gate}}); I_D=28\ \text{A pulsed}$$

parameter:  $V_{DD}$

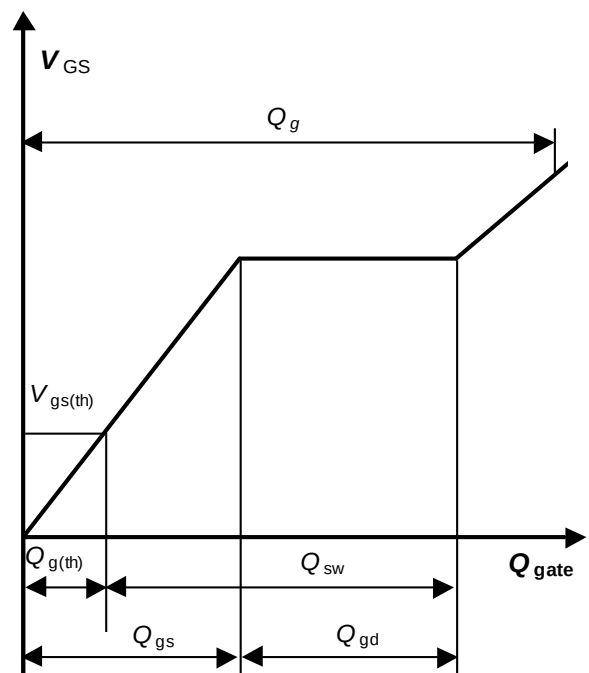


### 15 Drain-source breakdown voltage

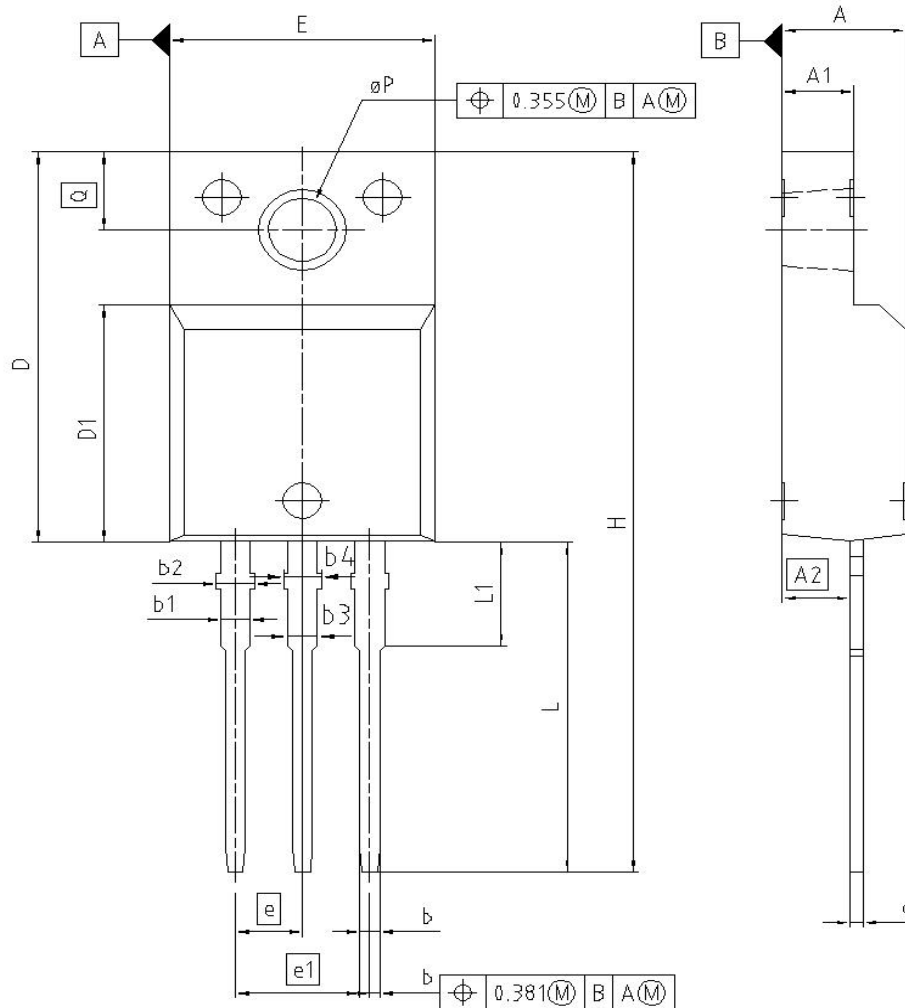
$$V_{BR(DSS)}=f(T_j); I_D=1\ \text{mA}$$



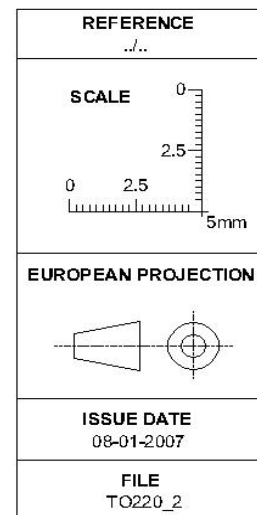
### 16 Gate charge waveforms



## PG-TO220-FP



| DIM | MILLIMETERS |       | INCHES |       |
|-----|-------------|-------|--------|-------|
|     | MIN         | MAX   | MIN    | MAX   |
| A   | 4.55        | 4.85  | 0.179  | 0.191 |
| A1  | 2.55        | 2.85  | 0.100  | 0.112 |
| A2  | 2.42        | 2.72  | 0.095  | 0.107 |
| b   | 0.65        | 0.85  | 0.026  | 0.033 |
| b1  | 0.95        | 1.33  | 0.037  | 0.052 |
| b2  | 0.95        | 1.51  | 0.037  | 0.059 |
| b3  | 0.65        | 1.33  | 0.026  | 0.052 |
| b4  | 0.65        | 1.51  | 0.026  | 0.059 |
| c   | 0.40        | 0.63  | 0.016  | 0.025 |
| D   | 15.85       | 16.15 | 0.624  | 0.636 |
| D1  | 9.53        | 9.83  | 0.375  | 0.387 |
| E   | 10.35       | 10.65 | 0.407  | 0.419 |
| e   | 2.54        |       | 0.100  |       |
| e1  | 5.08        |       | 0.200  |       |
| N   | 3           |       | 3      |       |
| H   | 29.45       | 29.75 | 1.159  | 1.171 |
| L   | 13.45       | 13.75 | 0.530  | 0.541 |
| L1  | 3.15        | 3.45  | 0.124  | 0.136 |
| øP  | 2.95        | 3.20  | 0.116  | 0.126 |
| Q   | 3.15        | 3.50  | 0.124  | 0.138 |





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