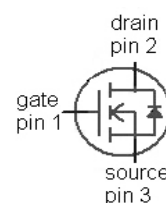
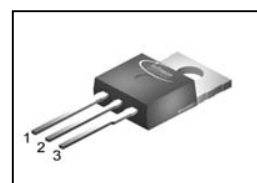


**OptiMOS<sup>®</sup> 2 Power-Transistor**
**Features**

- Ideal for high-frequency dc/dc converters
- Qualified according to JEDEC<sup>1)</sup> for target application
- N-channel - Logic level
- Excellent gate charge x  $R_{DS(on)}$  product (FOM)
- Very low on-resistance  $R_{DS(on)}$
- Superior thermal resistance
- 175 °C operating temperature
- $dv/dt$  rated
- Pb-free lead plating; RoHS compliant

**Product Summary**

|                  |     |    |
|------------------|-----|----|
| $V_{DS}$         | 30  | V  |
| $R_{DS(on),max}$ | 3.8 | mΩ |
| $I_D$            | 80  | A  |

**PG-TO220-3-1**


| Type         | Package      | Marking |
|--------------|--------------|---------|
| IPP04N03LB G | PG-TO220-3-1 | 04N03LB |

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

| Parameter                           | Symbol            | Conditions                                                                                           | Value       | Unit  |
|-------------------------------------|-------------------|------------------------------------------------------------------------------------------------------|-------------|-------|
| Continuous drain current            | $I_D$             | $T_C=25\text{ °C}^{2)}$                                                                              | 80          | A     |
|                                     |                   | $T_C=100\text{ °C}$                                                                                  | 80          |       |
| Pulsed drain current                | $I_{D,pulse}$     | $T_C=25\text{ °C}^{3)}$                                                                              | 320         |       |
| Avalanche energy, single pulse      | $E_{AS}$          | $I_D=80\text{ A}$ , $R_{GS}=25\text{ Ω}$                                                             | 270         | mJ    |
| Reverse diode $dv/dt$               | $dv/dt$           | $I_D=80\text{ A}$ , $V_{DS}=20\text{ V}$ ,<br>$di/dt=200\text{ A/μs}$ ,<br>$T_{j,max}=175\text{ °C}$ | 6           | kV/μs |
| Gate source voltage <sup>4)</sup>   | $V_{GS}$          |                                                                                                      | ±20         | V     |
| Power dissipation                   | $P_{tot}$         | $T_C=25\text{ °C}$                                                                                   | 107         | 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

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

**Thermal characteristics**

|                                     |            |                                              |   |   |     |     |
|-------------------------------------|------------|----------------------------------------------|---|---|-----|-----|
| Thermal resistance, junction - case | $R_{thJC}$ |                                              | - | - | 1.4 | K/W |
| SMD version, device on PCB          | $R_{thJA}$ | minimal footprint                            | - | - | 62  |     |
|                                     |            | 6 cm <sup>2</sup> cooling area <sup>5)</sup> | - | - | 40  |     |

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

|                                  |               |                                                            |     |     |     |               |
|----------------------------------|---------------|------------------------------------------------------------|-----|-----|-----|---------------|
| Drain-source breakdown voltage   | $V_{(BR)DSS}$ | $V_{GS}=0\text{ V}, I_D=1\text{ mA}$                       | 30  | -   | -   | V             |
| Gate threshold voltage           | $V_{GS(th)}$  | $V_{DS}=V_{GS}, I_D=70\text{ }\mu\text{A}$                 | 1.2 | 1.6 | 2   |               |
| Zero gate voltage drain current  | $I_{DSS}$     | $V_{DS}=30\text{ V}, V_{GS}=0\text{ V}, T_j=25\text{ °C}$  | -   | 0.1 | 1   | $\mu\text{A}$ |
|                                  |               | $V_{DS}=30\text{ V}, V_{GS}=0\text{ V}, T_j=125\text{ °C}$ | -   | 10  | 100 |               |
| Gate-source leakage current      | $I_{GSS}$     | $V_{GS}=20\text{ V}, V_{DS}=0\text{ V}$                    | -   | 10  | 100 | nA            |
| Drain-source on-state resistance | $R_{DS(on)}$  | $V_{GS}=4.5\text{ V}, I_D=55\text{ A}$                     | -   | 4.3 | 5.4 | m $\Omega$    |
|                                  |               | $V_{GS}=10\text{ V}, I_D=55\text{ A}$                      | -   | 3.2 | 3.8 |               |
| Gate resistance                  | $R_G$         |                                                            | -   | 1.1 | -   | $\Omega$      |
| Transconductance                 | $g_{fs}$      | $ V_{DS} >2 I_D R_{DS(on)max}, I_D=55\text{ A}$            | -   | 113 | -   | S             |

<sup>2)</sup> Current is limited by bondwire; with an  $R_{thJC}=1.4\text{ K/W}$  the chip is able to carry 125 A.

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

<sup>4)</sup>  $T_{j,max}=150\text{ °C}$  and duty cycle  $D<0.25$  for  $V_{GS}<-5\text{ V}$

<sup>5)</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            | $C_{iss}$    | $V_{GS}=0\text{ V}, V_{DS}=15\text{ V},$<br>$f=1\text{ MHz}$                    | - | 3912 | 5203 | pF |
| Output capacitance           | $C_{oss}$    |                                                                                 | - | 1391 | 1850 |    |
| Reverse transfer capacitance | $C_{rss}$    |                                                                                 | - | 177  | 265  |    |
| Turn-on delay time           | $t_{d(on)}$  | $V_{DD}=15\text{ V}, V_{GS}=10\text{ V},$<br>$I_D=20\text{ A}, R_G=2.7\ \Omega$ | - | 11   | 16   | ns |
| Rise time                    | $t_r$        |                                                                                 | - | 9    | 13   |    |
| Turn-off delay time          | $t_{d(off)}$ |                                                                                 | - | 39   | 59   |    |
| Fall time                    | $t_f$        |                                                                                 | - | 6.0  | 9.0  |    |

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

|                              |               |                                                                           |   |      |      |    |
|------------------------------|---------------|---------------------------------------------------------------------------|---|------|------|----|
| Gate to source charge        | $Q_{gs}$      | $V_{DD}=15\text{ V}, I_D=40\text{ A},$<br>$V_{GS}=0\text{ to }5\text{ V}$ | - | 12.1 | 16   | nC |
| Gate charge at threshold     | $Q_{g(th)}$   |                                                                           | - | 6.3  | 8.3  |    |
| Gate to drain charge         | $Q_{gd}$      |                                                                           | - | 7.8  | 11.7 |    |
| Switching charge             | $Q_{sw}$      |                                                                           | - | 14   | 19   |    |
| Gate charge total            | $Q_g$         |                                                                           | - | 30   | 40   |    |
| Gate plateau voltage         | $V_{plateau}$ |                                                                           | - | 3.1  | -    | V  |
| Gate charge total, sync. FET | $Q_{g(sync)}$ | $V_{DS}=0.1\text{ V},$<br>$V_{GS}=0\text{ to }5\text{ V}$                 | - | 27   | 35   | nC |
| Output charge                | $Q_{oss}$     | $V_{DD}=15\text{ V}, V_{GS}=0\text{ V}$                                   | - | 31   | 42   |    |

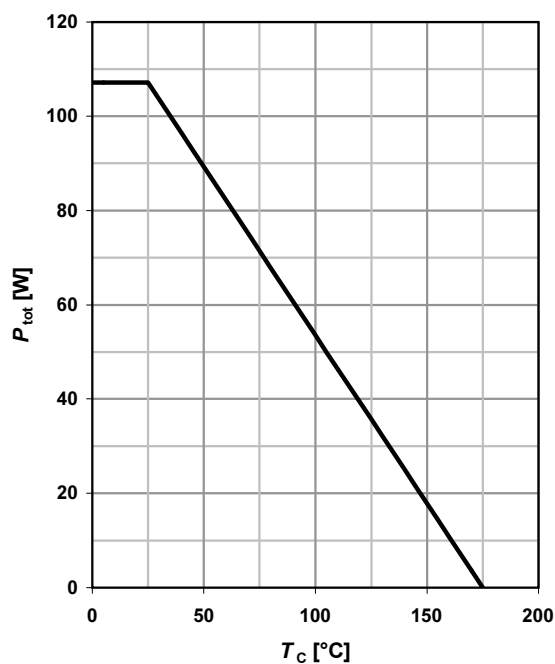
**Reverse Diode**

|                                  |               |                                                                   |   |      |     |    |
|----------------------------------|---------------|-------------------------------------------------------------------|---|------|-----|----|
| Diode continuous forward current | $I_S$         | $T_C=25\text{ °C}$                                                | - | -    | 78  | A  |
| Diode pulse current              | $I_{S,pulse}$ |                                                                   | - | -    | 320 |    |
| Diode forward voltage            | $V_{SD}$      | $V_{GS}=0\text{ V}, I_F=80\text{ A},$<br>$T_j=25\text{ °C}$       | - | 0.94 | 1.2 | V  |
| Reverse recovery charge          | $Q_{rr}$      | $V_R=15\text{ V}, I_F=I_S,$<br>$di_F/dt=400\text{ A}/\mu\text{s}$ | - | -    | 20  | nC |

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

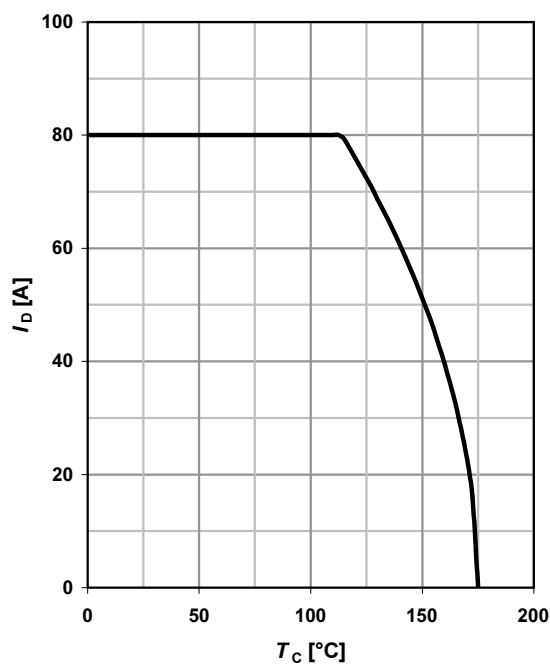
## 1 Power dissipation

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



## 2 Drain current

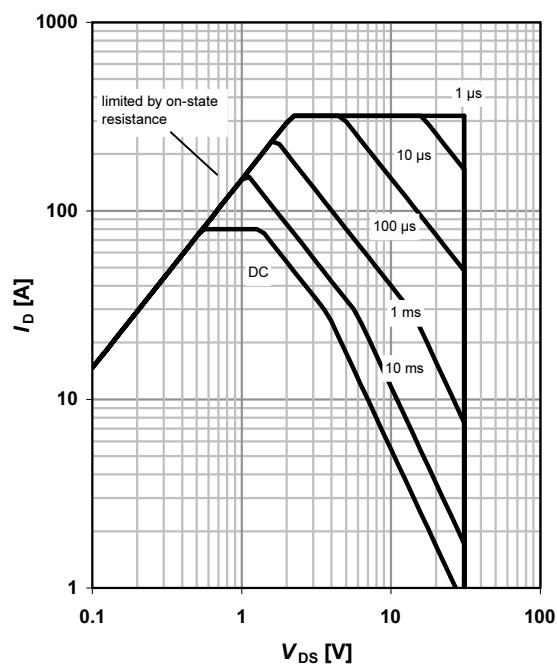
$$I_D = f(T_C); V_{GS} \geq 10 \text{ V}$$



## 3 Safe operating area

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

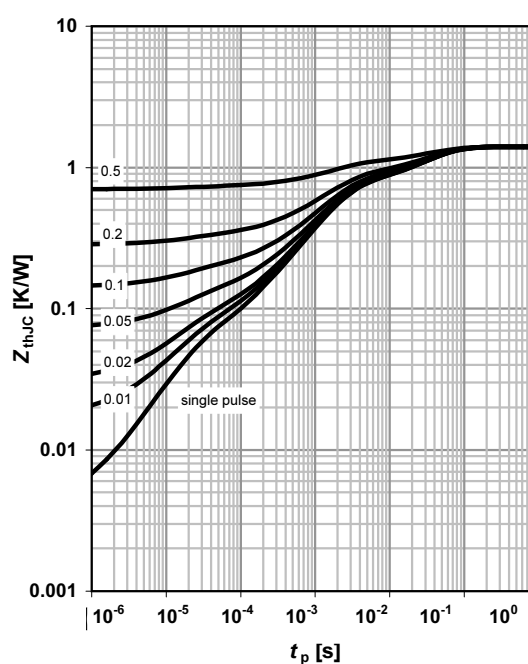
parameter:  $t_p$



## 4 Max. transient thermal impedance

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

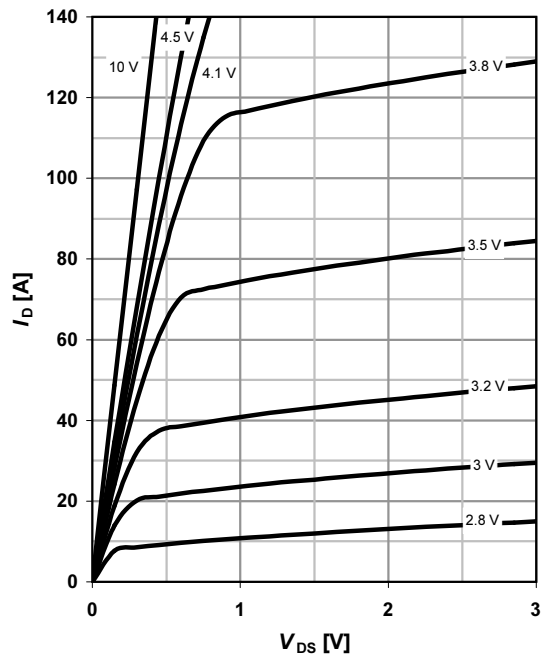
parameter:  $D = t_p/T$



### 5 Typ. output characteristics

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

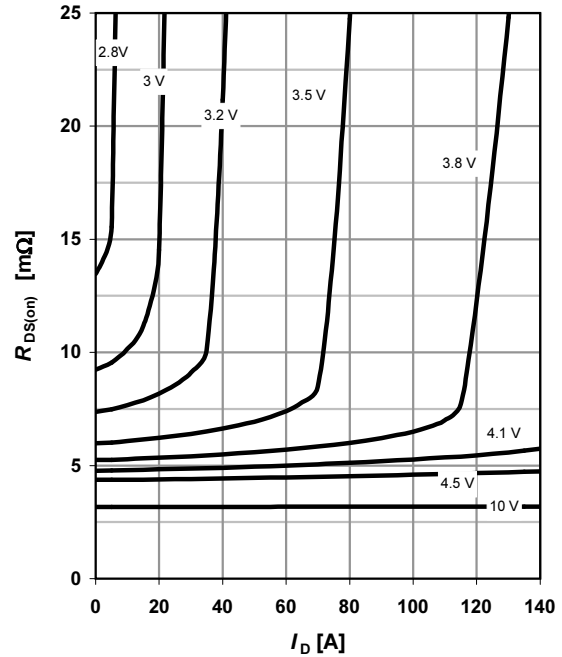
parameter:  $V_{GS}$



### 6 Typ. drain-source on resistance

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

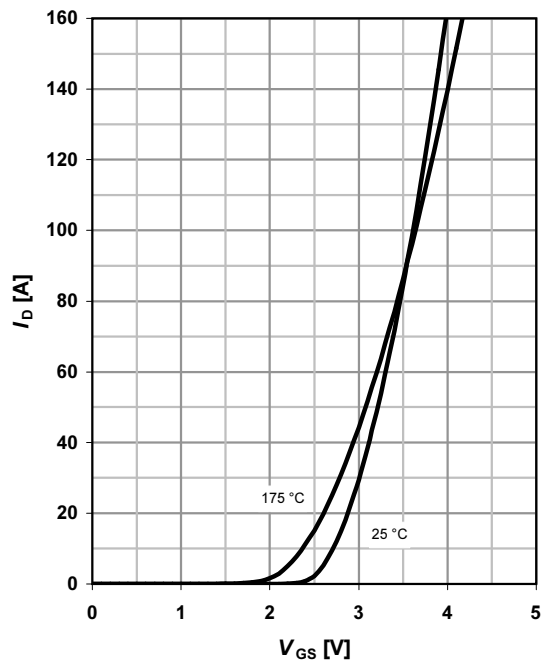
parameter:  $V_{GS}$



### 7 Typ. transfer characteristics

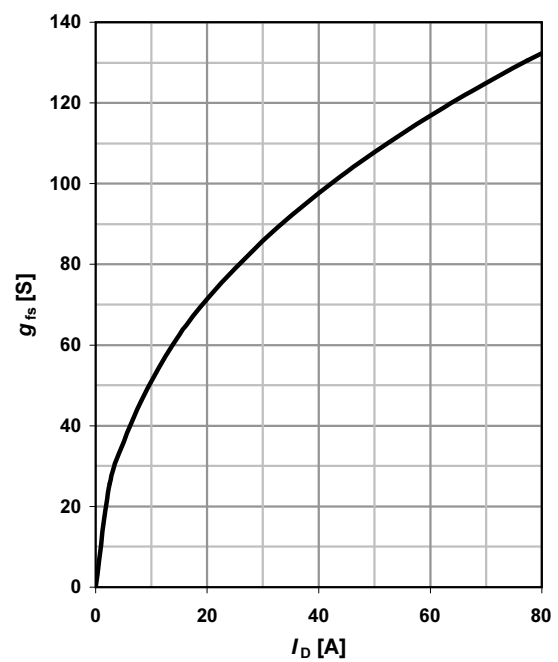
$$I_D = f(V_{GS}); |V_{DS}| > 2|I_D|R_{DS(on)max}$$

parameter:  $T_J$



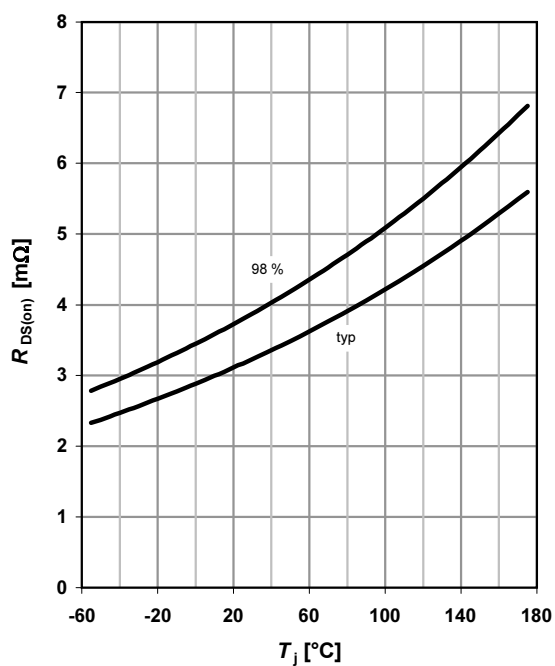
### 8 Typ. forward transconductance

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



### 9 Drain-source on-state resistance

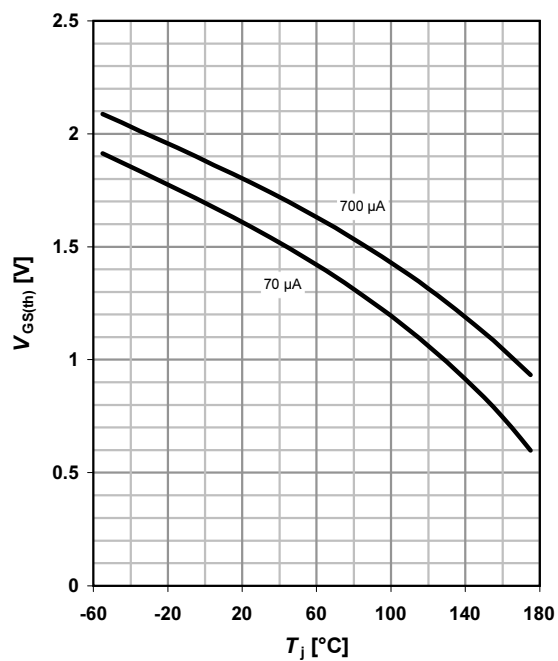
$$R_{DS(on)} = f(T_j); I_D = 55 \text{ A}; V_{GS} = 10 \text{ V}$$



### 10 Typ. gate threshold voltage

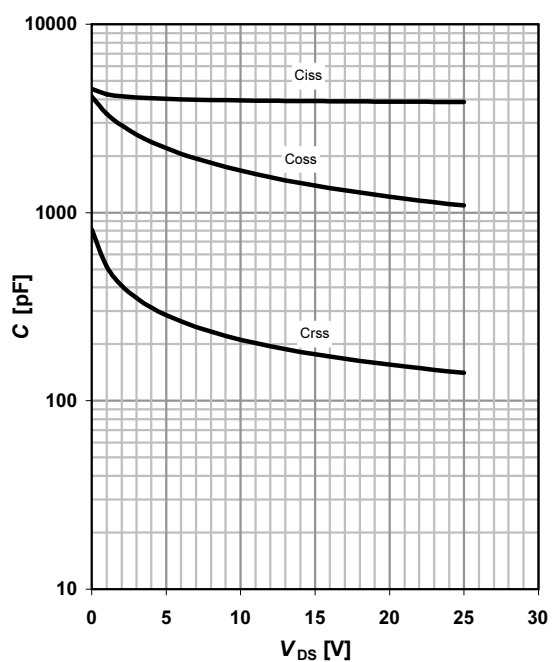
$$V_{GS(th)} = f(T_j); V_{GS} = V_{DS}$$

parameter:  $I_D$



### 11 Typ. Capacitances

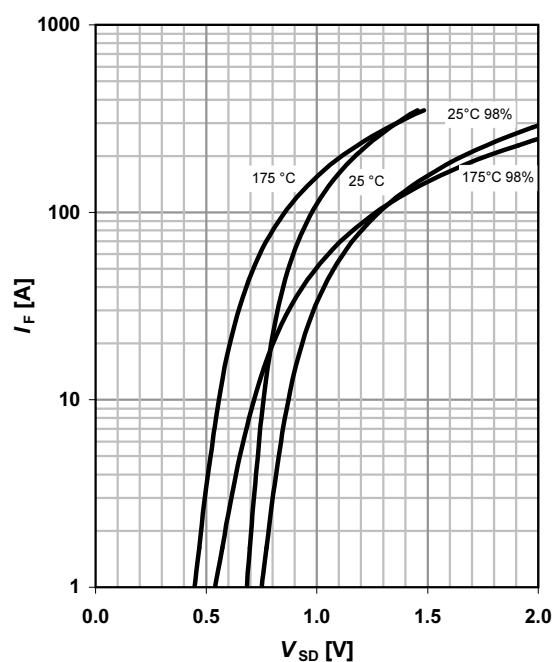
$$C = f(V_{DS}); V_{GS} = 0 \text{ V}; f = 1 \text{ MHz}$$



### 12 Forward characteristics of reverse diode

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

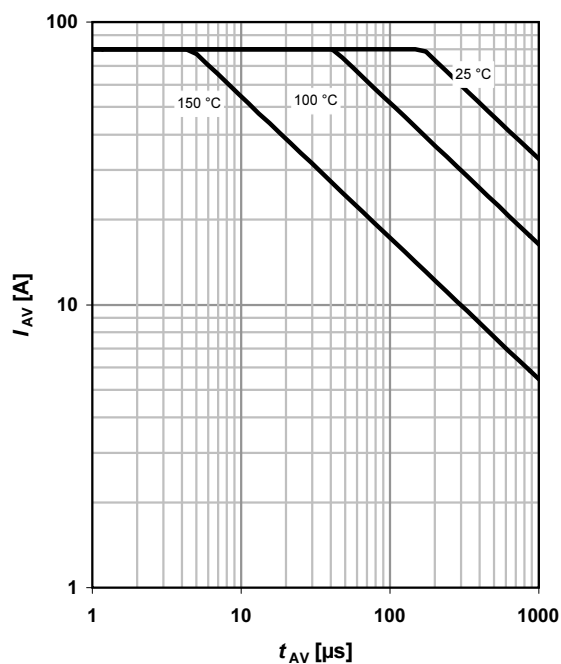
parameter:  $T_j$



### 13 Avalanche characteristics

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

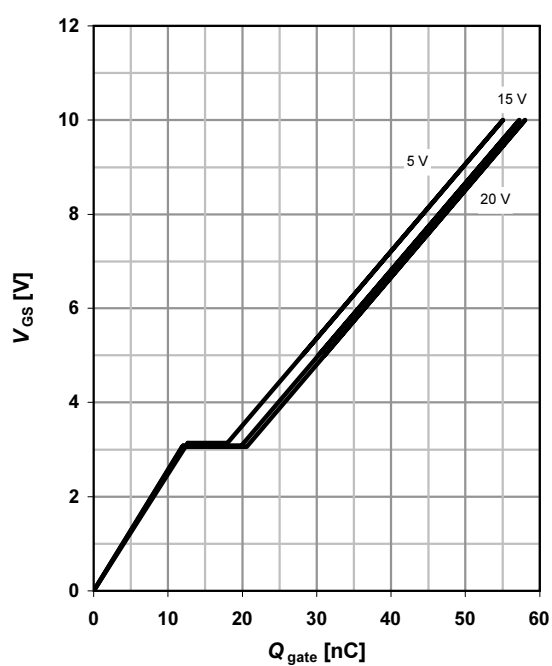
parameter:  $T_{j(\text{start})}$



### 14 Typ. gate charge

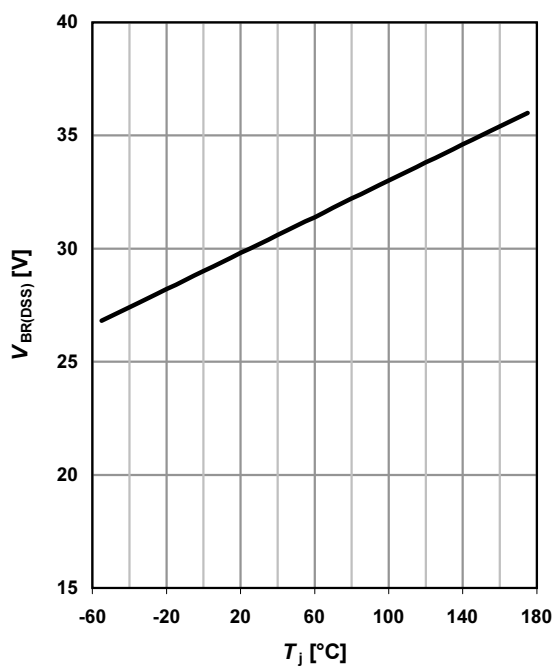
$$V_{GS}=f(Q_{\text{gate}}); I_D=40\ \text{A pulsed}$$

parameter:  $V_{DD}$

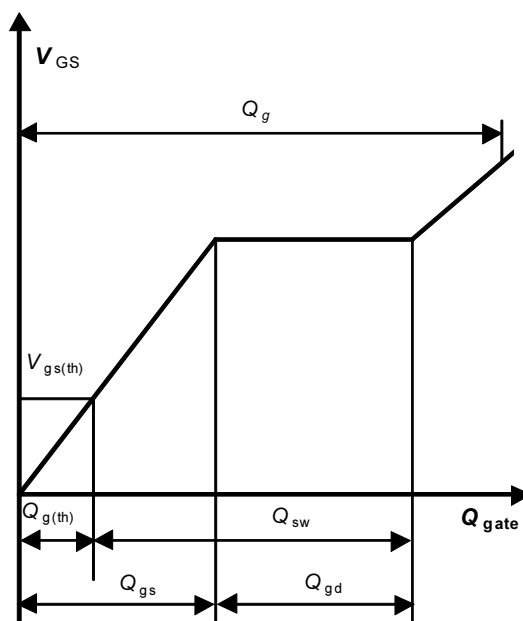


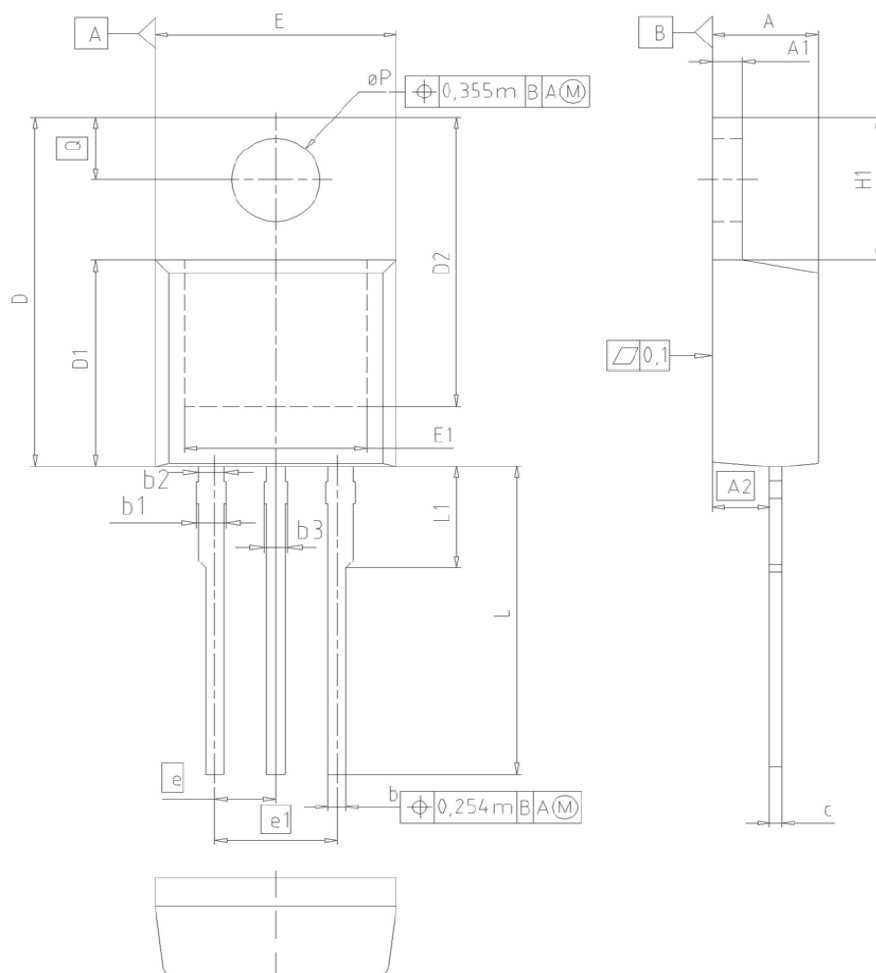
### 15 Drain-source breakdown voltage

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



### 16 Gate charge waveforms



**PG-TO220-3-1**


| DIM       | MILLIMETERS |       | INCHES |       |
|-----------|-------------|-------|--------|-------|
|           | MIN         | MAX   | MIN    | MAX   |
| <b>A</b>  | 4.30        | 4.57  | 0.169  | 0.180 |
| <b>A1</b> | 1.17        | 1.40  | 0.046  | 0.055 |
| <b>A2</b> | 2.15        | 2.72  | 0.085  | 0.107 |
| <b>b</b>  | 0.65        | 0.86  | 0.026  | 0.034 |
| <b>b1</b> | 0.95        | 1.40  | 0.037  | 0.055 |
| <b>b2</b> | 0.95        | 1.15  | 0.037  | 0.045 |
| <b>b3</b> | 0.65        | 1.15  | 0.026  | 0.045 |
| <b>c</b>  | 0.33        | 0.60  | 0.013  | 0.024 |
| <b>D</b>  | 14.81       | 15.95 | 0.583  | 0.628 |
| <b>D1</b> | 8.51        | 9.45  | 0.335  | 0.372 |
| <b>D2</b> | 12.19       | 13.10 | 0.480  | 0.516 |
| <b>E</b>  | 9.70        | 10.36 | 0.382  | 0.408 |
| <b>E1</b> | 6.50        | 8.60  | 0.256  | 0.339 |
| <b>e</b>  | 2.54        |       | 0.100  |       |
| <b>e1</b> | 5.08        |       | 0.200  |       |
| <b>N</b>  | 3           |       | 3      |       |
| <b>H1</b> | 5.90        | 6.90  | 0.232  | 0.272 |
| <b>L</b>  | 13.00       | 14.00 | 0.512  | 0.551 |
| <b>L1</b> | -           | 4.80  | -      | 0.189 |
| <b>øP</b> | 3.60        | 3.89  | 0.142  | 0.153 |
| <b>Q</b>  | 2.60        | 3.00  | 0.102  | 0.118 |

|                                                                                                                     |
|---------------------------------------------------------------------------------------------------------------------|
| <b>DOCUMENT NO.</b><br>Z8B00003318                                                                                  |
| <b>SCALE</b><br>0 2.5 5mm                                                                                           |
| <b>EUROPEAN PROJECTION</b><br> |
| <b>ISSUE DATE</b><br>23-08-2007                                                                                     |
| <b>REVISION</b><br>05                                                                                               |





**Published by**  
**Infineon Technologies AG**  
**81726 Munich, Germany**  
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