

## OptiMOS<sup>®</sup> 3 Power-Transistor

### Features

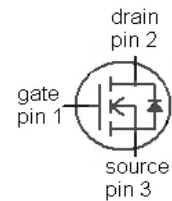
- N-channel, normal level
- Excellent gate charge x  $R_{DS(on)}$  product (FOM)
- Very low on-resistance  $R_{DS(on)}$
- 175 °C operating temperature
- Pb-free lead plating; RoHS compliant
- Qualified according to JEDEC<sup>1)</sup> for target application
- Ideal for high-frequency switching and synchronous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

### Product Summary

|                  |     |    |
|------------------|-----|----|
| $V_{DS}$         | 80  | V  |
| $R_{DS(on),max}$ | 2.8 | mΩ |
| $I_D$            | 100 | A  |

previous engineering  
sample codes:  
IPP02CN08N

| Type    | IPP028N08N3 G                                                                      | IPI028N08N3 G                                                                      |
|---------|------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|
|         |  |  |
| Package | PG-TO220-3                                                                         | PG-TO262-3                                                                         |
| Marking | 028N08N                                                                            | 028N08N                                                                            |



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

| Parameter                           | Symbol            | Conditions                                | Value       | Unit |
|-------------------------------------|-------------------|-------------------------------------------|-------------|------|
| Continuous drain current            | $I_D$             | $T_C=25\text{ °C}^{2)}$                   | 100         | A    |
|                                     |                   | $T_C=100\text{ °C}$                       | 100         |      |
| Pulsed drain current <sup>2)</sup>  | $I_{D,pulse}$     | $T_C=25\text{ °C}$                        | 400         |      |
| Avalanche energy, single pulse      | $E_{AS}$          | $I_D=100\text{ A}$ , $R_{GS}=25\text{ Ω}$ | 1430        | mJ   |
| Gate source voltage                 | $V_{GS}$          |                                           | ±20         | V    |
| Power dissipation                   | $P_{tot}$         | $T_C=25\text{ °C}$                        | 300         | W    |
| Operating and storage temperature   | $T_j$ , $T_{stg}$ |                                           | -55 ... 175 | °C   |
| IEC climatic category; DIN IEC 68-1 |                   |                                           | 55/175/56   |      |

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

#### Thermal characteristics

|                                           |            |                                              |   |   |     |     |
|-------------------------------------------|------------|----------------------------------------------|---|---|-----|-----|
| Thermal resistance, junction - case       | $R_{thJC}$ |                                              | - | - | 0.5 | K/W |
| Thermal resistance,<br>junction - ambient | $R_{thJA}$ | minimal footprint                            | - | - | 62  |     |
|                                           |            | 6 cm <sup>2</sup> cooling area <sup>3)</sup> | - | - | 40  |     |

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

#### Static characteristics

|                                  |               |                                                            |    |     |     |               |
|----------------------------------|---------------|------------------------------------------------------------|----|-----|-----|---------------|
| Drain-source breakdown voltage   | $V_{(BR)DSS}$ | $V_{GS}=0\text{ V}, I_D=1\text{ mA}$                       | 80 | -   | -   | V             |
| Gate threshold voltage           | $V_{GS(th)}$  | $V_{DS}=V_{GS}, I_D=270\text{ }\mu\text{A}$                | 2  | 2.8 | 3.5 |               |
| Zero gate voltage drain current  | $I_{DSS}$     | $V_{DS}=80\text{ V}, V_{GS}=0\text{ V}, T_j=25\text{ °C}$  | -  | 0.1 | 1   | $\mu\text{A}$ |
|                                  |               | $V_{DS}=80\text{ V}, V_{GS}=0\text{ V}, T_j=125\text{ °C}$ | -  | 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 | $R_{DS(on)}$  | $V_{GS}=10\text{ V}, I_D=100\text{ A}$                     | -  | 2.4 | 2.8 | m $\Omega$    |
|                                  |               | $V_{GS}=6\text{ V}, I_D=50\text{ A}$                       | -  | 2.8 | 4.2 |               |
| Gate resistance                  | $R_G$         |                                                            | -  | 2.7 | -   | $\Omega$      |
| Transconductance                 | $g_{fs}$      | $ V_{DS} >2 I_D R_{DS(on)max}, I_D=100\text{ A}$           | 94 | 187 | -   | S             |

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

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

<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            | $C_{iss}$    | $V_{GS}=0\text{ V}, V_{DS}=40\text{ V},$<br>$f=1\text{ MHz}$                     | - | 10700 | 14200 | pF |
| Output capacitance           | $C_{oss}$    |                                                                                  | - | 2890  | 3840  |    |
| Reverse transfer capacitance | $C_{rss}$    |                                                                                  | - | 100   | 150   |    |
| Turn-on delay time           | $t_{d(on)}$  | $V_{DD}=40\text{ V}, V_{GS}=10\text{ V},$<br>$I_D=100\text{ A}, R_G=1.6\ \Omega$ | - | 28    | -     | ns |
| Rise time                    | $t_r$        |                                                                                  | - | 73    | -     |    |
| Turn-off delay time          | $t_{d(off)}$ |                                                                                  | - | 86    | -     |    |
| Fall time                    | $t_f$        |                                                                                  | - | 33    | -     |    |

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

|                       |               |                                                                             |   |     |     |    |
|-----------------------|---------------|-----------------------------------------------------------------------------|---|-----|-----|----|
| Gate to source charge | $Q_{gs}$      | $V_{DD}=40\text{ V}, I_D=100\text{ A},$<br>$V_{GS}=0\text{ to }10\text{ V}$ | - | 50  | 67  | nC |
| Gate to drain charge  | $Q_{gd}$      |                                                                             | - | 30  | 45  |    |
| Switching charge      | $Q_{sw}$      |                                                                             | - | 50  | 72  |    |
| Gate charge total     | $Q_g$         |                                                                             | - | 155 | 206 |    |
| Gate plateau voltage  | $V_{plateau}$ |                                                                             | - | 4.7 | -   | V  |
| Output charge         | $Q_{oss}$     | $V_{DD}=40\text{ V}, V_{GS}=0\text{ V}$                                     | - | 210 | 279 | nC |

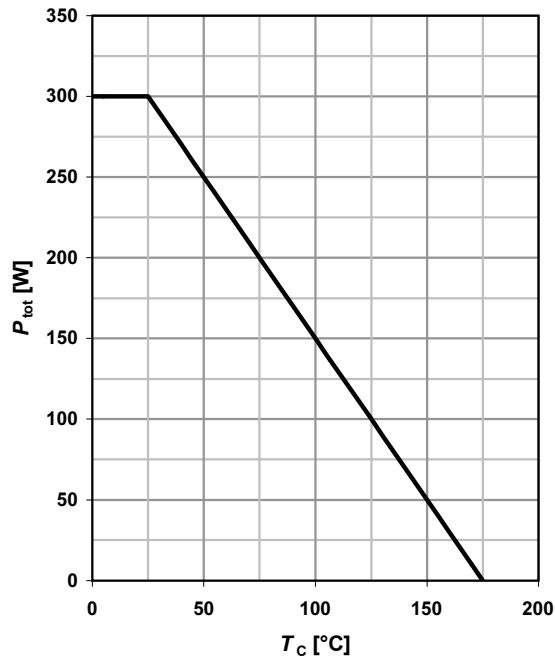
#### Reverse Diode

|                                  |               |                                                                   |   |     |     |    |
|----------------------------------|---------------|-------------------------------------------------------------------|---|-----|-----|----|
| Diode continuous forward current | $I_S$         | $T_C=25\text{ °C}$                                                | - | -   | 100 | A  |
| Diode pulse current              | $I_{S,pulse}$ |                                                                   | - | -   | 400 |    |
| Diode forward voltage            | $V_{SD}$      | $V_{GS}=0\text{ V}, I_F=100\text{ A},$<br>$T_j=25\text{ °C}$      | - | 1.0 | 1.2 | V  |
| Reverse recovery time            | $t_{rr}$      | $V_R=40\text{ V}, I_F=I_S,$<br>$di_F/dt=100\text{ A}/\mu\text{s}$ | - | 113 | -   | ns |
| Reverse recovery charge          | $Q_{rr}$      |                                                                   | - | 317 | -   | nC |

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

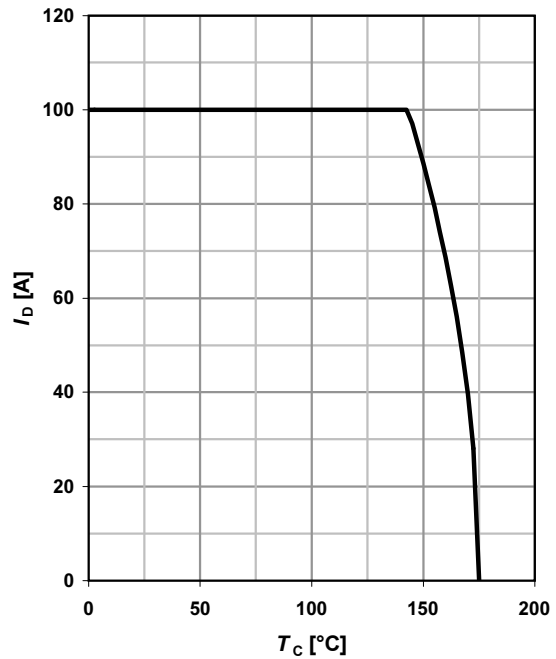
## 1 Power dissipation

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



## 2 Drain current

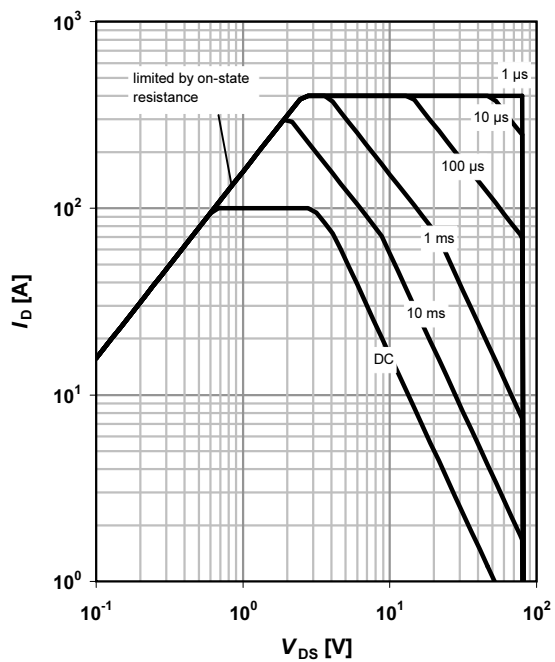
$$I_D = f(T_C); V_{GS} \geq 10 \text{ V}$$



## 3 Safe operating area

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

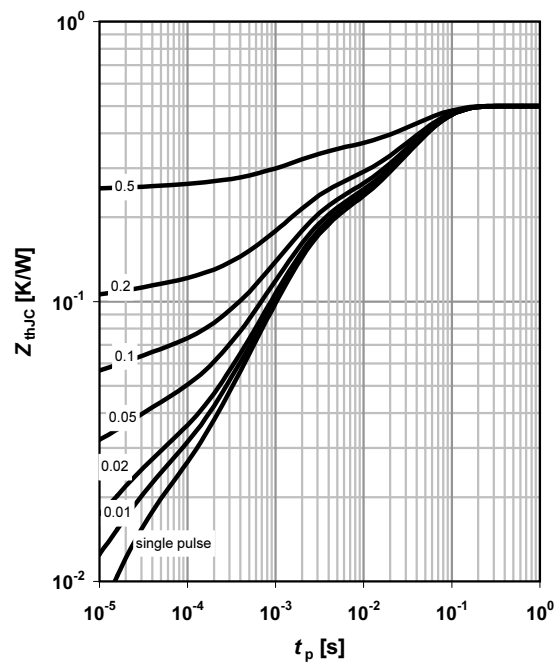
parameter:  $t_p$



## 4 Max. transient thermal impedance

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

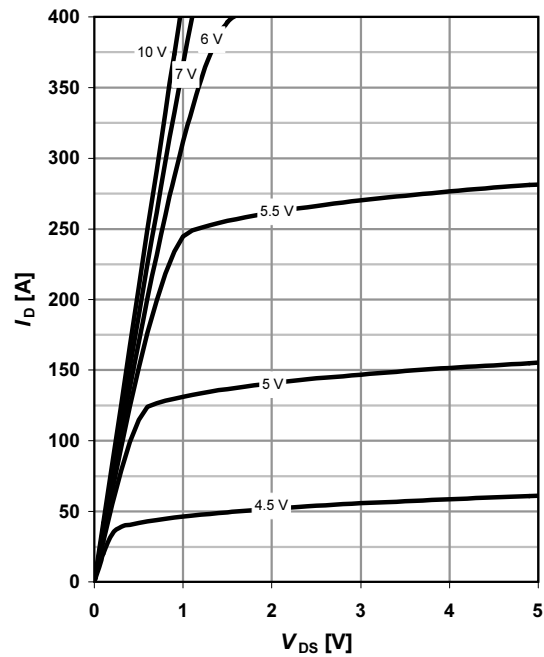
parameter:  $D = t_p/T$



### 5 Typ. output characteristics

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

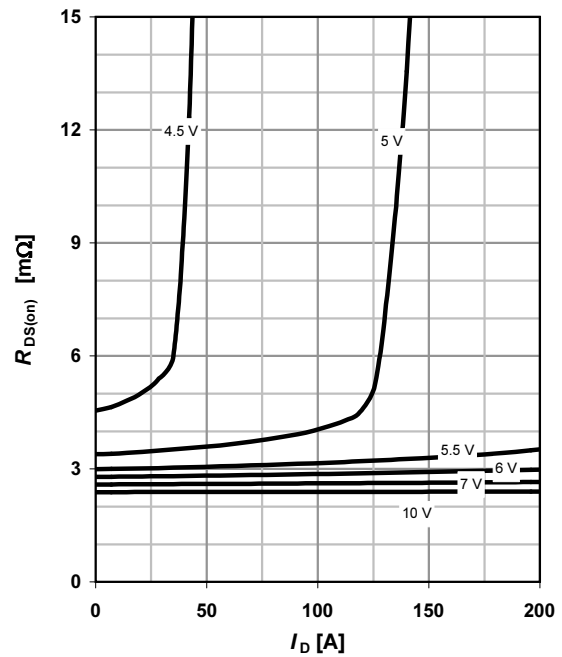
parameter:  $V_{GS}$



### 6 Typ. drain-source on resistance

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

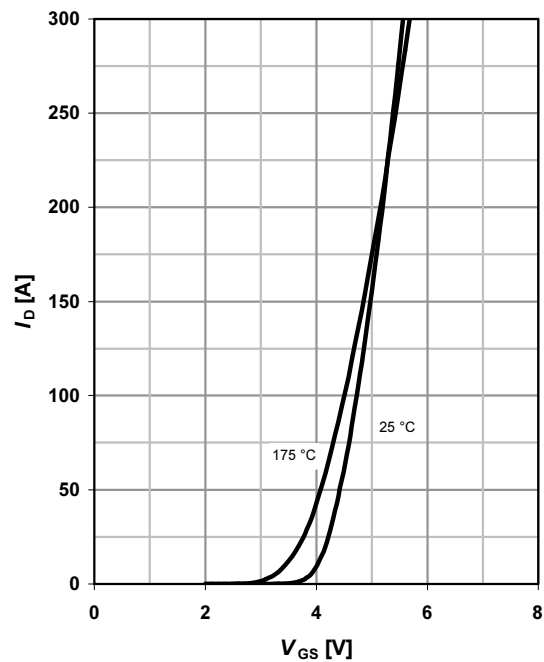
parameter:  $V_{GS}$



### 7 Typ. transfer characteristics

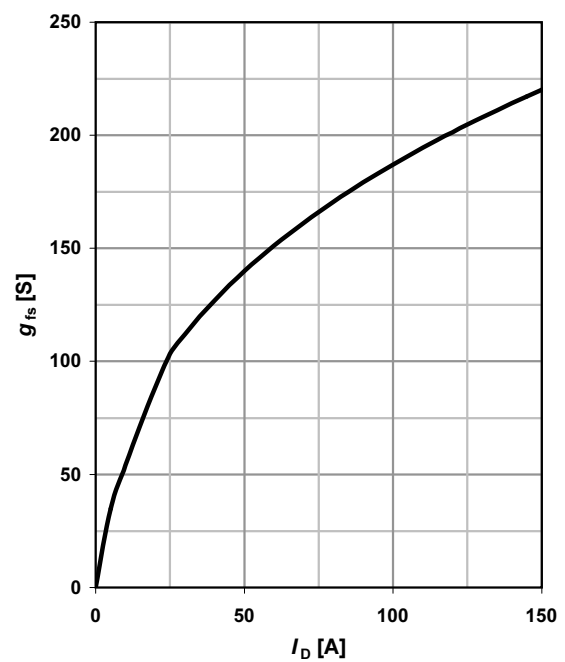
$$I_D = f(V_{GS}); |V_{DS}| > 2|I_D|R_{DS(on)max}$$

parameter:  $T_J$



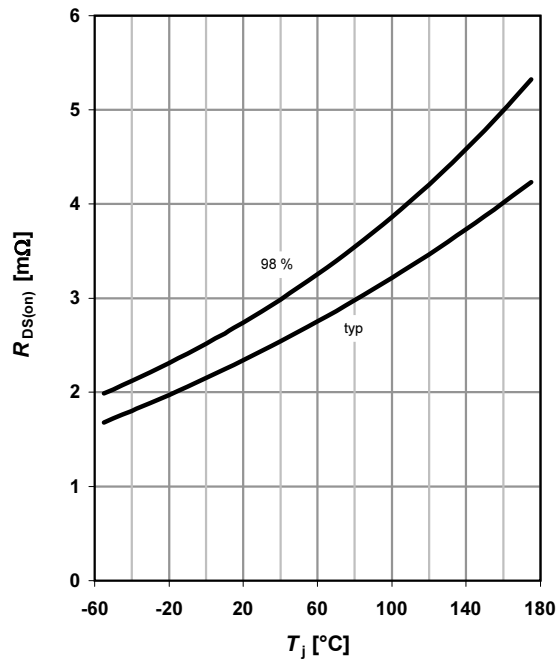
### 8 Typ. forward transconductance

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



### 9 Drain-source on-state resistance

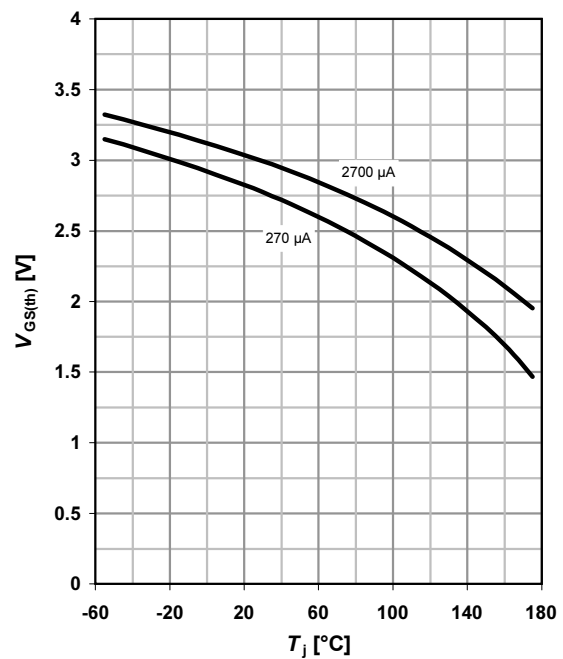
$$R_{DS(on)} = f(T_j); I_D = 100 \text{ A}; V_{GS} = 10 \text{ V}$$



### 10 Typ. gate threshold voltage

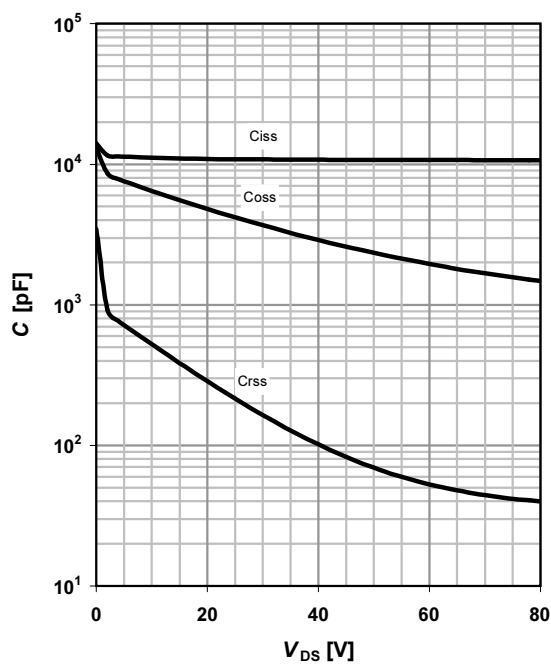
$$V_{GS(th)} = f(T_j); V_{GS} = V_{DS}$$

parameter:  $I_D$



### 11 Typ. capacitances

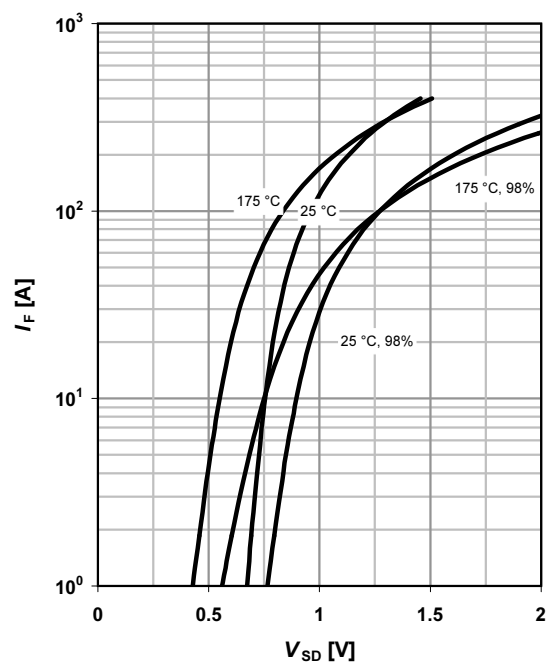
$$C = f(V_{DS}); V_{GS} = 0 \text{ V}; f = 1 \text{ MHz}$$



### 12 Forward characteristics of reverse diode

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

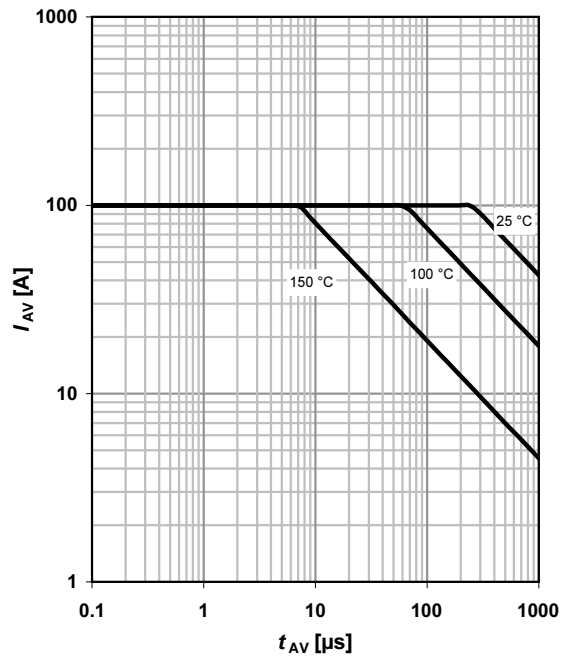
parameter:  $T_j$



### 13 Avalanche characteristics

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

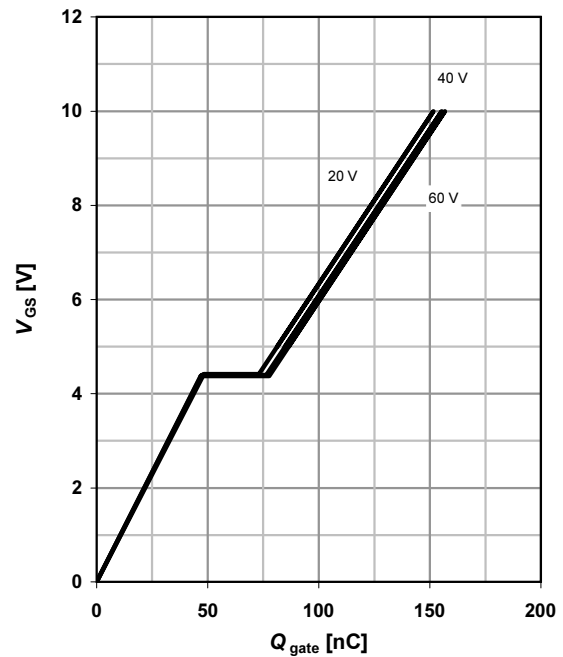
parameter:  $T_{j(\text{start})}$



### 14 Typ. gate charge

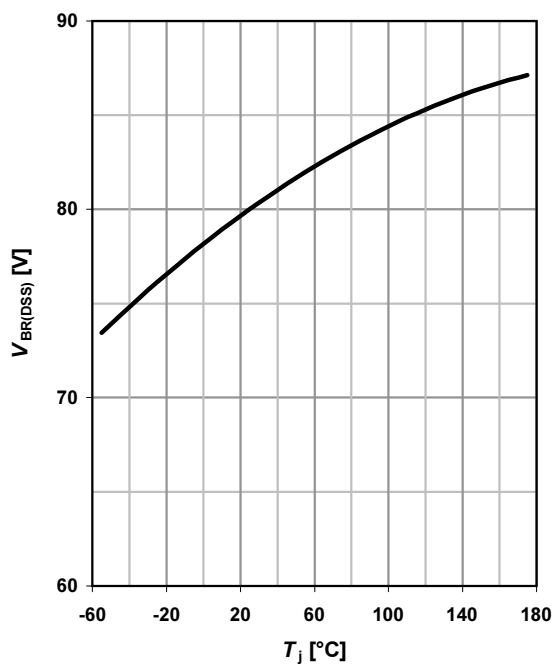
$$V_{GS}=f(Q_{\text{gate}}); I_D=50\ \text{A pulsed}$$

parameter:  $V_{DD}$



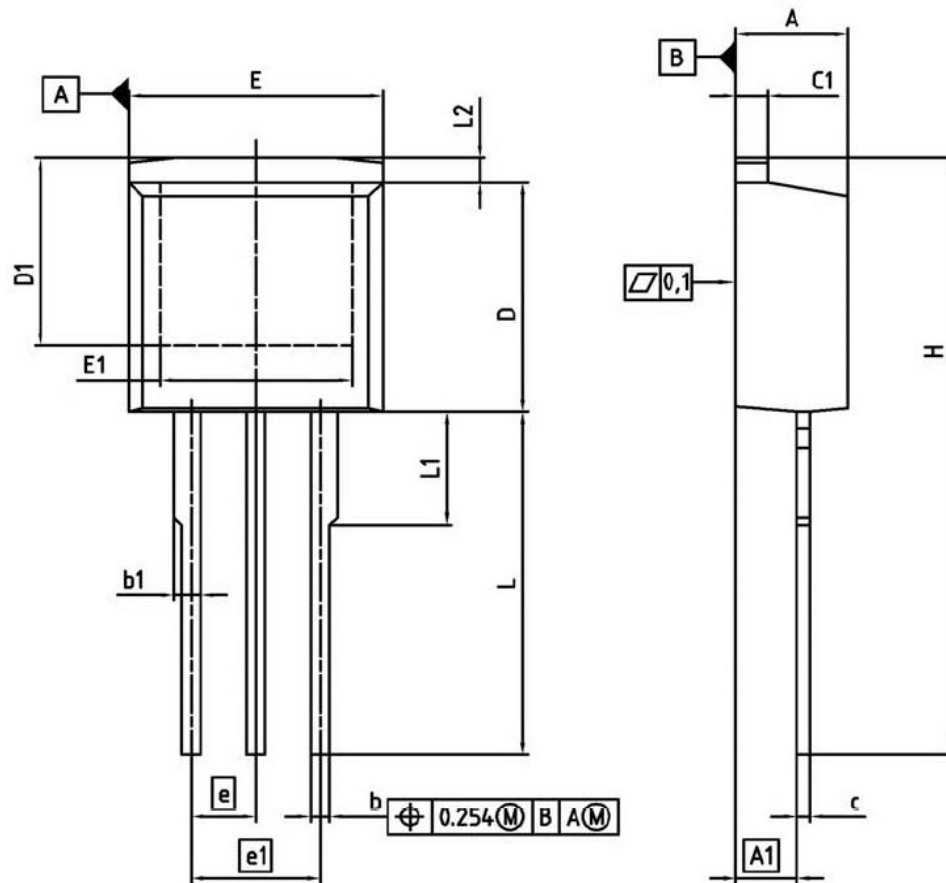
### 15 Drain-source breakdown voltage

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

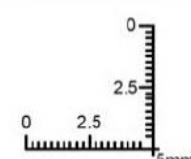


### 16 Gate charge waveforms

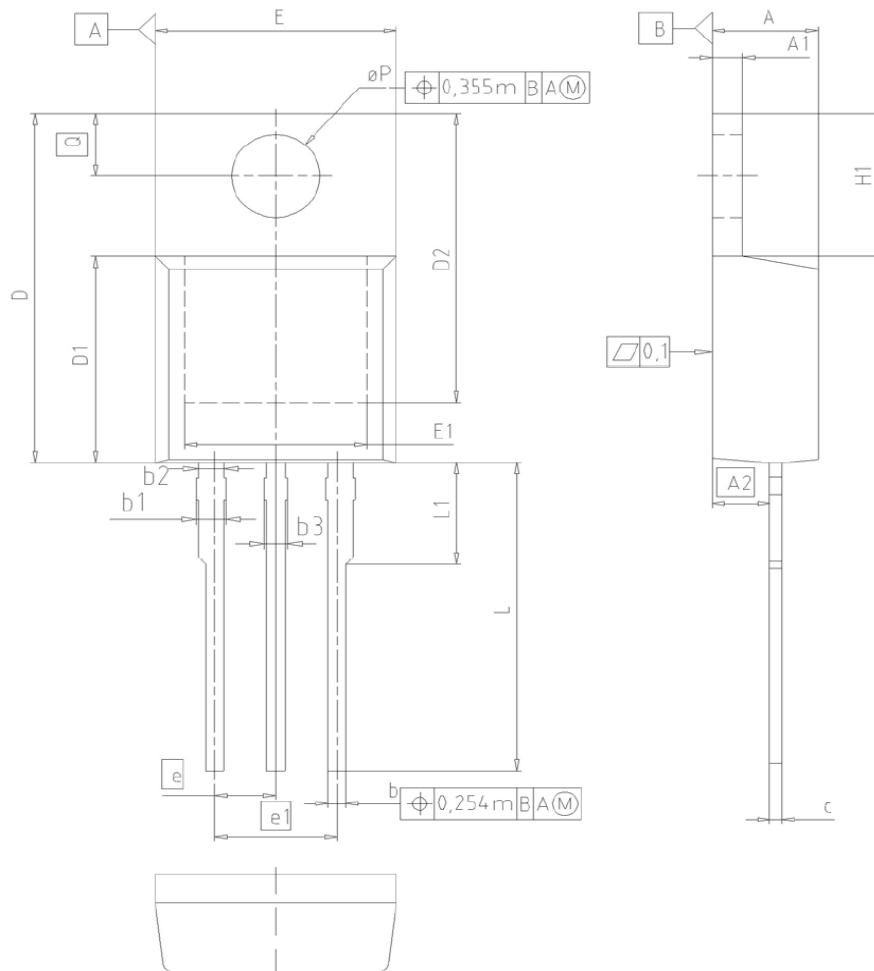


PG-TO262-3 (I<sup>2</sup>-Pak)


| DIM | MILLIMETERS |        | INCHES |       |
|-----|-------------|--------|--------|-------|
|     | MIN         | MAX    | MIN    | MAX   |
| A   | 4.300       | 4.572  | 0.169  | 0.180 |
| A1  | 2.150       | 2.718  | 0.085  | 0.107 |
| b   | 0.650       | 0.664  | 0.026  | 0.034 |
| b1  | 0.635       | 1.400  | 0.025  | 0.055 |
| c   | 0.330       | 0.600  | 0.013  | 0.024 |
| c1  | 1.170       | 1.400  | 0.046  | 0.055 |
| D   | 8.509       | 9.450  | 0.335  | 0.372 |
| D1  | 6.900       | -      | 0.272  | -     |
| E   | 9.700       | 10.363 | 0.382  | 0.408 |
| E1  | 6.500       | 8.600  | 0.256  | 0.339 |
| e   | 2.540       |        | 0.100  |       |
| e1  | 5.080       |        | 0.200  |       |
| N   | 3           |        | 3      |       |
| L   | 13.000      | 14.000 | 0.512  | 0.551 |
| L1  | -           | 4.800  | -      | 0.189 |
| L2  | -           | 1.727  | -      | 0.068 |

|                                                                                                              |
|--------------------------------------------------------------------------------------------------------------|
| REFERENCE<br>JEDEC TO262                                                                                     |
|                         |
| EUROPEAN PROJECTION<br> |
| ISSUE DATE<br>05-05-2006                                                                                     |
| FILE<br>TO262_1                                                                                              |

## PG-TO220-3



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

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