

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

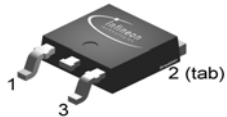
### Features

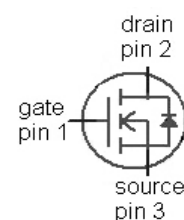
- For fast switching converters and sync. rectification
- N-channel enhancement - logic level
- 175 °C operating temperature
- Avalanche rated
- Pb-free lead plating, RoHS compliant



### Product Summary

|                  |    |    |
|------------------|----|----|
| $V_{DS}$         | 60 | V  |
| $R_{DS(on),max}$ | 35 | mΩ |
| $I_D$            | 29 | A  |

|                |                                                                                    |
|----------------|------------------------------------------------------------------------------------|
| <b>Type</b>    | IPD350N06L G                                                                       |
|                |  |
| <b>Package</b> | PG-TO252-3                                                                         |
| <b>Marking</b> | 350N06L                                                                            |



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

| Parameter                           | Symbol            | Conditions                                                                                           | Value       | Unit  |
|-------------------------------------|-------------------|------------------------------------------------------------------------------------------------------|-------------|-------|
| Continuous drain current            | $I_D$             | $T_C=25\text{ °C}$                                                                                   | 29          | A     |
|                                     |                   | $T_C=100\text{ °C}$                                                                                  | 20          |       |
| Pulsed drain current                | $I_{D,pulse}$     | $T_C=25\text{ °C}^{1)}$                                                                              | 116         |       |
| Avalanche energy, single pulse      | $E_{AS}$          | $I_D=29\text{ A}$ , $R_{GS}=25\text{ Ω}$                                                             | 80          | mJ    |
| Reverse diode $dv/dt$               | $dv/dt$           | $I_D=29\text{ A}$ , $V_{DS}=48\text{ V}$ ,<br>$di/dt=200\text{ A/μs}$ ,<br>$T_{j,max}=175\text{ °C}$ | 6           | kV/μs |
| Gate source voltage                 | $V_{GS}$          |                                                                                                      | ±20         | V     |
| Power dissipation                   | $P_{tot}$         | $T_C=25\text{ °C}$                                                                                   | 68          | 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> See figure 3

| Parameter                           | Symbol     | Conditions                                   | Values |      |      | Unit |
|-------------------------------------|------------|----------------------------------------------|--------|------|------|------|
|                                     |            |                                              | min.   | typ. | max. |      |
| Thermal characteristics             |            |                                              |        |      |      |      |
| Thermal resistance, junction - case | $R_{thJC}$ |                                              | -      | -    | 2.2  | K/W  |
| SMD version, device on PCB          | $R_{thJA}$ | minimal footprint                            | -      | -    | 75   |      |
|                                     |            | 6 cm <sup>2</sup> cooling area <sup>2)</sup> | -      | -    | 50   |      |

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

#### Static characteristics

|                                  |               |                                                                     |     |      |     |               |
|----------------------------------|---------------|---------------------------------------------------------------------|-----|------|-----|---------------|
| Drain-source breakdown voltage   | $V_{(BR)DSS}$ | $V_{GS}=0\text{ V}$ , $I_D=1\text{ mA}$                             | 60  | -    | -   | V             |
| Gate threshold voltage           | $V_{GS(th)}$  | $V_{DS}=V_{GS}$ , $I_D=28\text{ }\mu\text{A}$                       | 1.2 | 1.6  | 2   |               |
| Zero gate voltage drain current  | $I_{DSS}$     | $V_{DS}=60\text{ V}$ , $V_{GS}=0\text{ V}$ ,<br>$T_j=25\text{ °C}$  | -   | 0.01 | 1   | $\mu\text{A}$ |
|                                  |               | $V_{DS}=60\text{ V}$ , $V_{GS}=0\text{ V}$ ,<br>$T_j=125\text{ °C}$ | -   | 1    | 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 | $R_{DS(on)}$  | $V_{GS}=10\text{ V}$ , $I_D=29\text{ A}$                            | -   | 27   | 35  | m $\Omega$    |
|                                  |               | $V_{GS}=4.5\text{ V}$ , $I_D=19\text{ A}$                           | -   | 36   | 47  |               |
| Gate resistance                  | $R_G$         |                                                                     | -   | 1.4  | -   | $\Omega$      |
| Transconductance                 | $g_{fs}$      | $ V_{DS} >2 I_D R_{DS(on)max}$ ,<br>$I_D=29\text{ A}$               | 16  | 32   | -   | S             |

<sup>2)</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            | $C_{iss}$    | $V_{GS}=0\text{ V}, V_{DS}=30\text{ V},$<br>$f=1\text{ MHz}$                   | - | 600 | 800 | pF |
| Output capacitance           | $C_{oss}$    |                                                                                | - | 150 | 200 |    |
| Reverse transfer capacitance | $C_{rss}$    |                                                                                | - | 40  | 60  |    |
| Turn-on delay time           | $t_{d(on)}$  | $V_{DD}=30\text{ V}, V_{GS}=10\text{ V},$<br>$I_D=29\text{ A}, R_G=11\ \Omega$ | - | 6   | 9   | ns |
| Rise time                    | $t_r$        |                                                                                | - | 21  | 32  |    |
| Turn-off delay time          | $t_{d(off)}$ |                                                                                | - | 29  | 44  |    |
| Fall time                    | $t_f$        |                                                                                | - | 20  | 30  |    |

### Gate Charge Characteristics<sup>3)</sup>

|                          |               |                                                                           |   |     |     |    |
|--------------------------|---------------|---------------------------------------------------------------------------|---|-----|-----|----|
| Gate to source charge    | $Q_{gs}$      | $V_{DD}=30\text{ V}, I_D=29\text{ A},$<br>$V_{GS}=0\text{ to }5\text{ V}$ | - | 2   | 3   | nC |
| Gate charge at threshold | $Q_{g(th)}$   |                                                                           | - | 1   | 1.3 |    |
| Gate to drain charge     | $Q_{gd}$      |                                                                           | - | 6   | 9   |    |
| Switching charge         | $Q_{sw}$      |                                                                           | - | 8   | 11  |    |
| Gate charge total        | $Q_g$         |                                                                           | - | 10  | 13  |    |
| Gate plateau voltage     | $V_{plateau}$ |                                                                           | - | 4.2 | -   | V  |
| Output charge            | $Q_{oss}$     | $V_{DD}=30\text{ V}, V_{GS}=0\text{ V}$                                   | - | 6   | 7   |    |

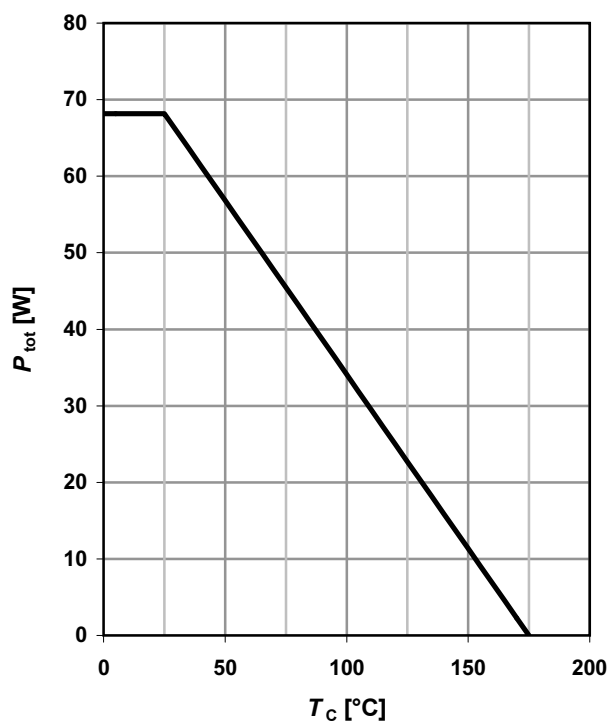
### Reverse Diode

|                                  |               |                                                                   |   |      |     |    |
|----------------------------------|---------------|-------------------------------------------------------------------|---|------|-----|----|
| Diode continuous forward current | $I_S$         | $T_C=25\text{ °C}$                                                | - | -    | 29  | A  |
| Diode pulse current              | $I_{S,pulse}$ |                                                                   | - | -    | 116 |    |
| Diode forward voltage            | $V_{SD}$      | $V_{GS}=0\text{ V}, I_F=29\text{ A},$<br>$T_J=25\text{ °C}$       | - | 0.98 | 1.3 | V  |
| Reverse recovery time            | $t_{rr}$      | $V_R=30\text{ V}, I_F=I_S,$<br>$di_F/dt=100\text{ A}/\mu\text{s}$ | - | 40   | 50  | ns |
| Reverse recovery charge          | $Q_{rr}$      |                                                                   | - | 36   | 45  | nC |

<sup>3)</sup> See figure 16 for gate charge parameter definition

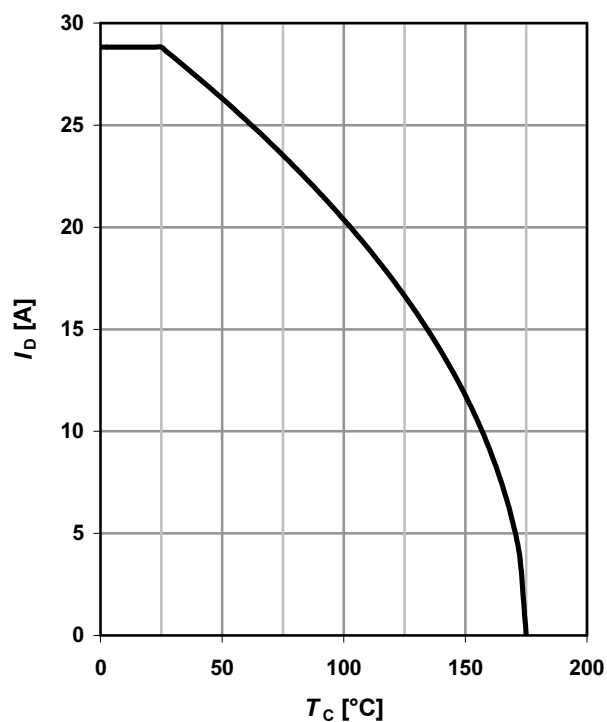
### 1 Power dissipation

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



### 2 Drain current

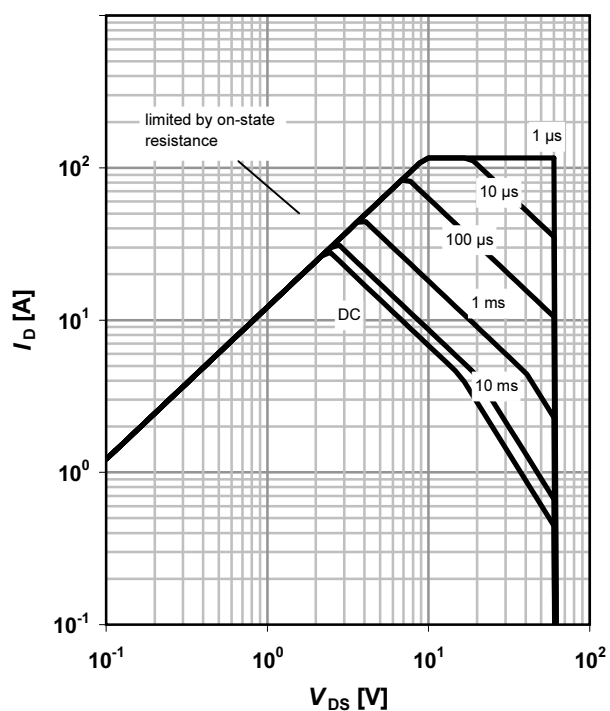
$$I_D = f(T_C); V_{GS} \geq 10 \text{ V}$$



### 3 Safe operating area

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

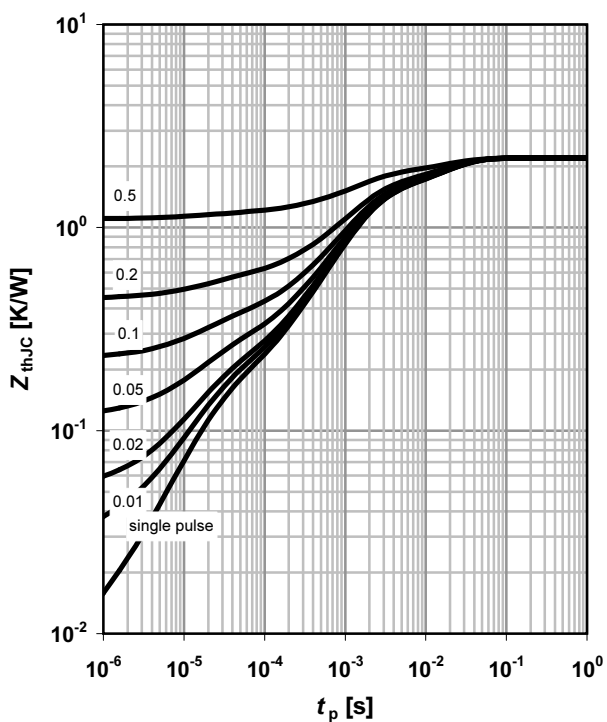
parameter:  $t_p$



### 4 Max. transient thermal impedance

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

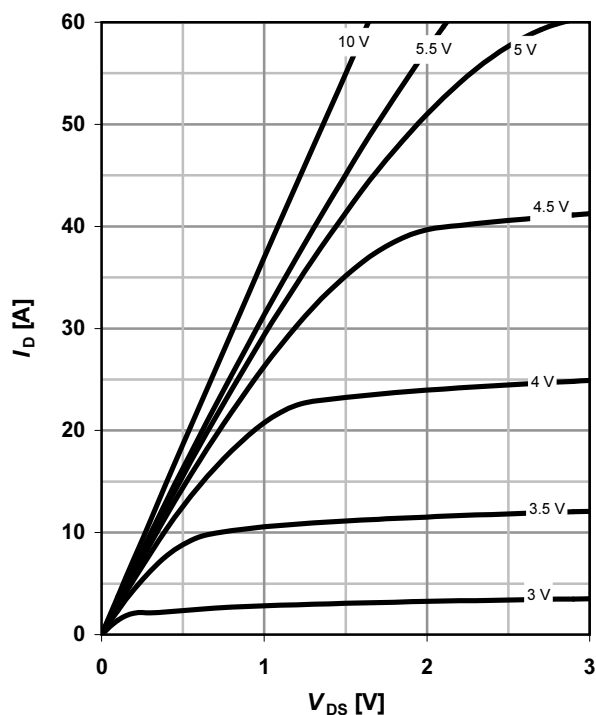
parameter:  $D = t_p/T$



### 5 Typ. output characteristics

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

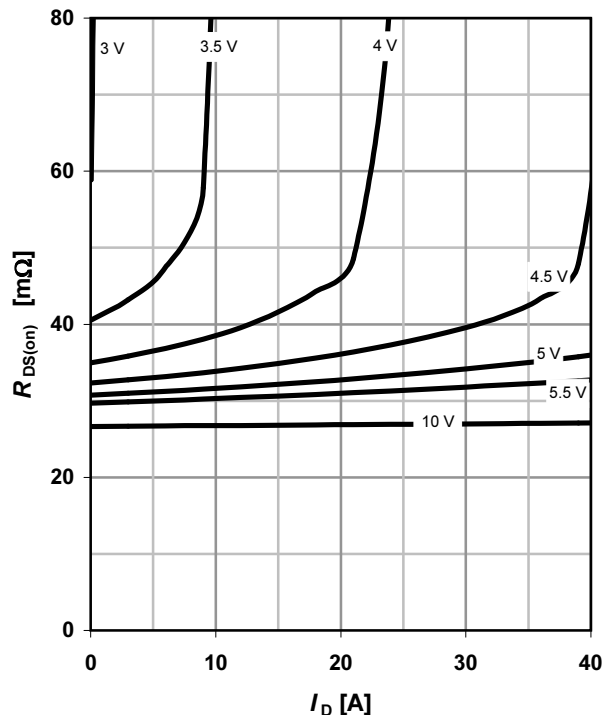
parameter:  $V_{GS}$



### 6 Typ. drain-source on resistance

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

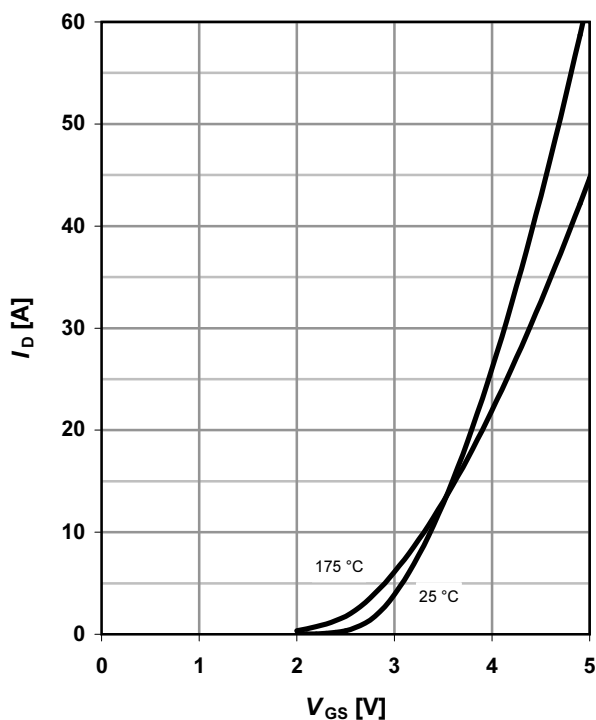
parameter:  $V_{GS}$



### 7 Typ. transfer characteristics

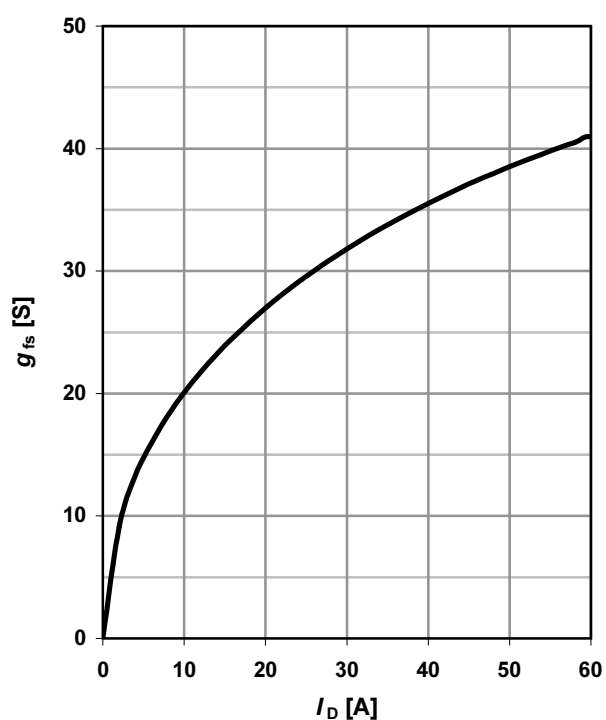
$$I_D = f(V_{GS}); |V_{DS}| > 2|I_D|R_{DS(on)\max}$$

parameter:  $T_j$



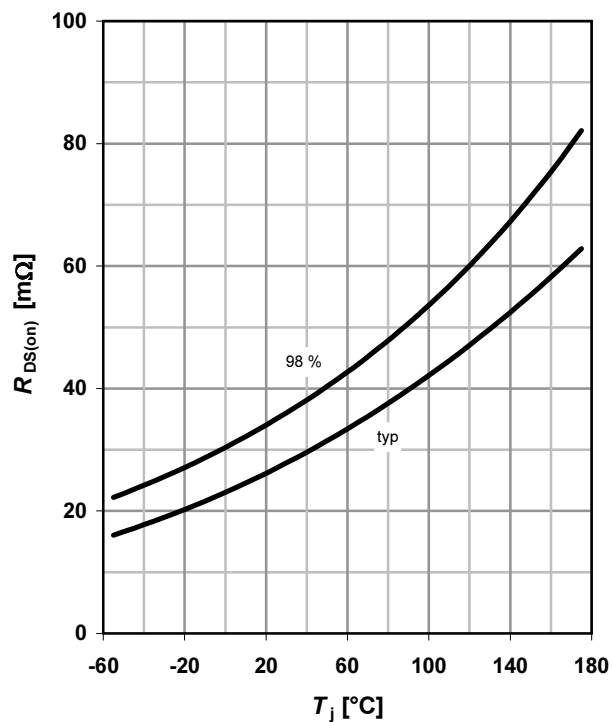
### 8 Typ. forward transconductance

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



## 9 Drain-source on-state resistance

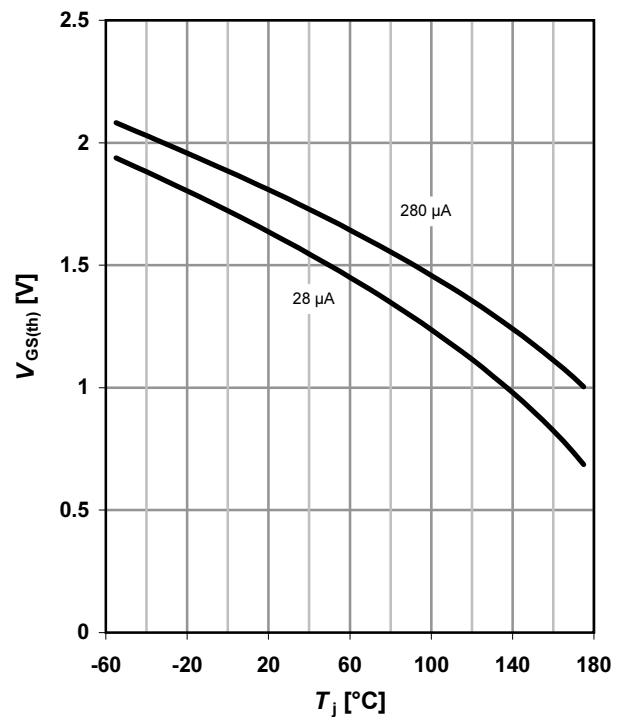
$$R_{DS(on)} = f(T_j); I_D = 29 \text{ A}; V_{GS} = 10 \text{ V}$$



## 10 Typ. gate threshold voltage

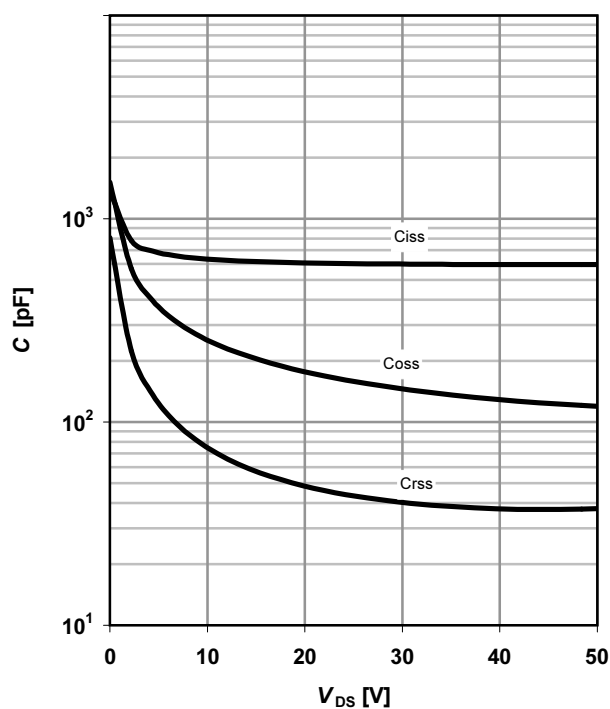
$$V_{GS(th)} = f(T_j); V_{GS} = V_{DS}$$

parameter:  $I_D$



## 11 Typ. capacitances

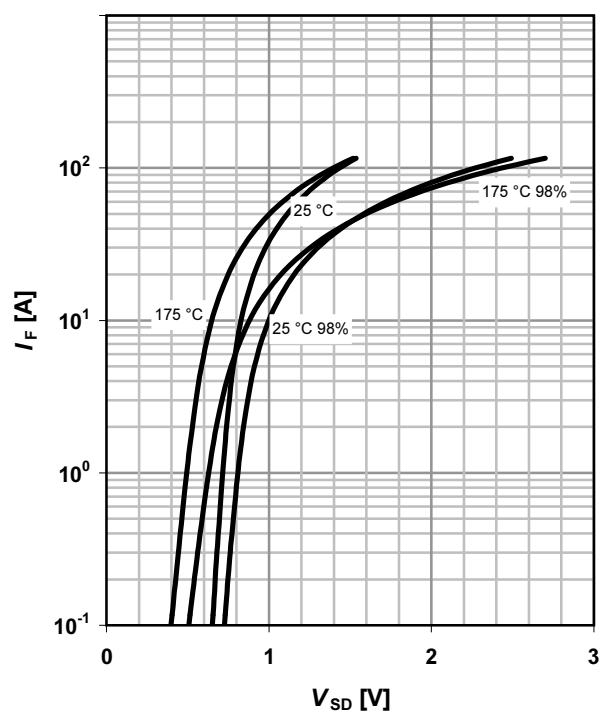
$$C = f(V_{DS}); V_{GS} = 0 \text{ V}; f = 1 \text{ MHz}$$



## 12 Forward characteristics of reverse diode

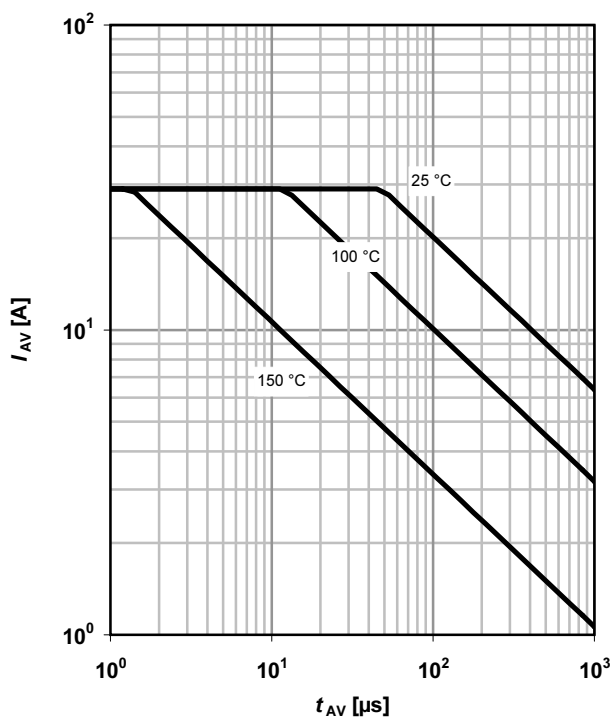
$$I_F = f(V_{SD})$$

parameter:  $T_j$



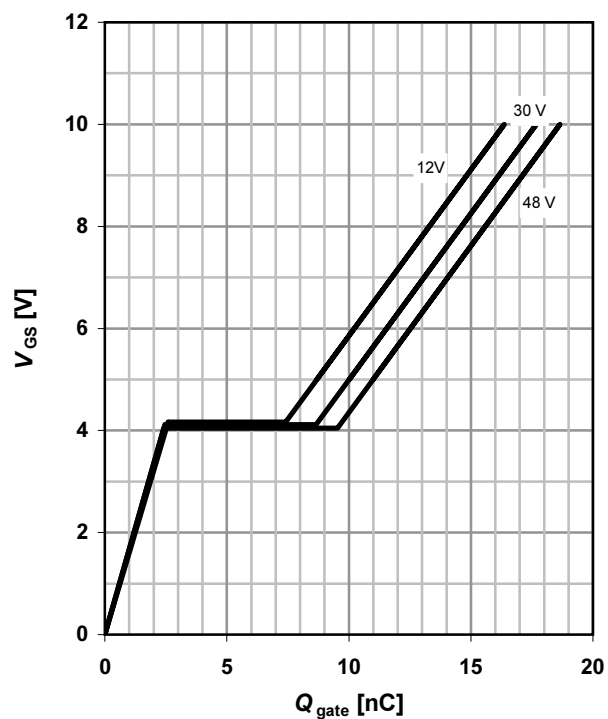
### 13 Avalanche characteristics

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

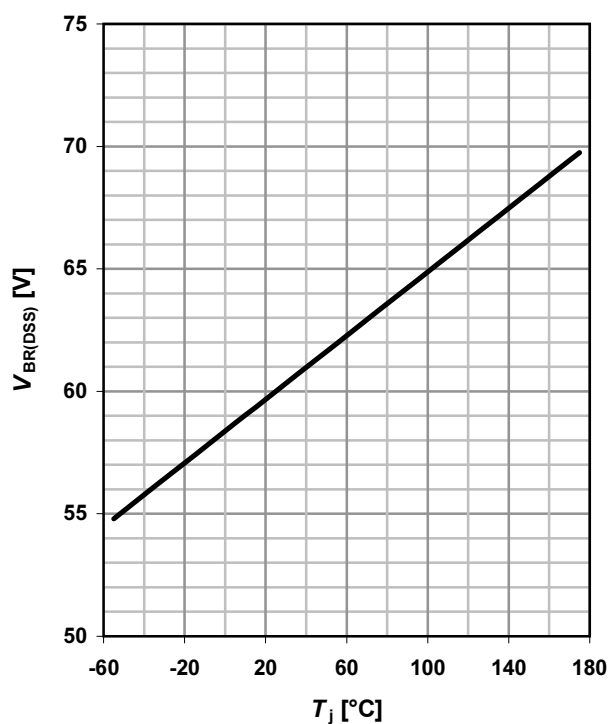
parameter:  $T_{j(start)}$ 


### 14 Typ. gate charge

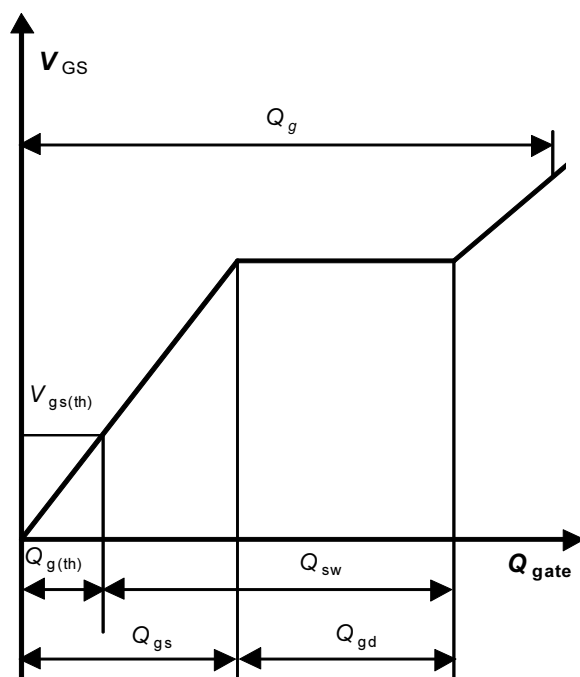
 $V_{GS}=f(Q_{gate}); I_D=29\text{ A pulsed}$ 

parameter:  $V_{DD}$ 


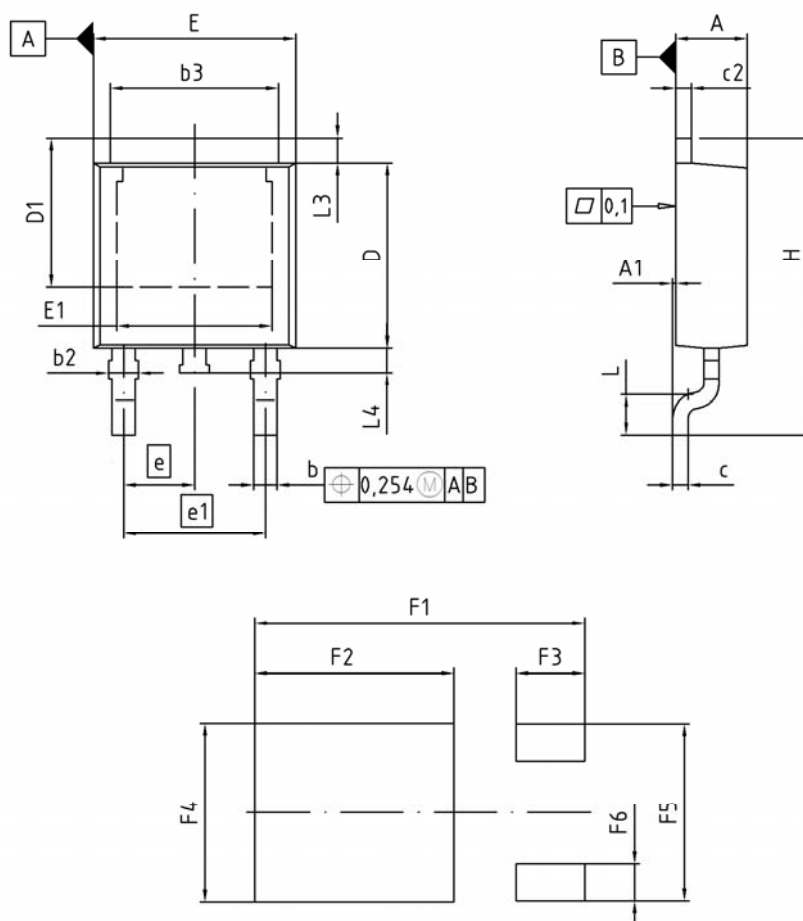
### 15 Drain-source breakdown voltage

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


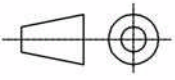
### 16 Gate charge waveforms



## PG-T0252-3: Outline



| 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 |

|                                                                                                              |
|--------------------------------------------------------------------------------------------------------------|
| DOCUMENT NO.<br>Z8B00003328                                                                                  |
| SCALE<br>0 2.0 4mm                                                                                           |
| EUROPEAN PROJECTION<br> |
| ISSUE DATE<br>19-10-2007                                                                                     |
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