

## OptiMOS™3 Power-Transistor

### Features

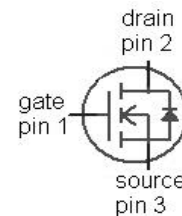
- N-channel, normal level
- Excellent gate charge x  $R_{DS(on)}$  product (FOM)
- Very low on-resistance  $R_{DS(on)}$
- 175 °C operating temperature
- Pb-free lead plating; RoHS compliant; halogen free
- Qualified according to JEDEC<sup>1)</sup> for target application
- Halogen free according to IEC61249-2-21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

### Product Summary

|                  |     |    |
|------------------|-----|----|
| $V_{DS}$         | 120 | V  |
| $R_{DS(on) max}$ | 11  | mΩ |
| $I_D$            | 75  | A  |



| Type    | IPS110N12N3 G                                                                      | IPD110N12N3 G                                                                      |
|---------|------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|
|         |  |  |
| Package | PG-TO251-3                                                                         | PG-TO252-3                                                                         |
| Marking | 110N12N                                                                            | 110N12N                                                                            |



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

| Parameter                           | Symbol            | Conditions                               | Value       | Unit |
|-------------------------------------|-------------------|------------------------------------------|-------------|------|
| Continuous drain current            | $I_D$             | $T_C=25\text{ °C}$                       | 75          | A    |
|                                     |                   | $T_C=100\text{ °C}$                      | 54          |      |
| Pulsed drain current <sup>2)</sup>  | $I_{D,pulse}$     | $T_C=25\text{ °C}$                       | 300         |      |
| Avalanche energy, single pulse      | $E_{AS}$          | $I_D=75\text{ A}$ , $R_{GS}=25\text{ Ω}$ | 120         | mJ   |
| Gate source voltage <sup>3)</sup>   | $V_{GS}$          |                                          | ±20         | V    |
| Power dissipation                   | $P_{tot}$         | $T_C=25\text{ °C}$                       | 136         | 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

<sup>3)</sup>  $T_{jmax}=150\text{ °C}$  and duty cycle  $D=0.01$  for  $V_{gs}<-5\text{ V}$

\* Except package TO251-3

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

### Thermal characteristics

|                                        |            |                                              |   |   |     |     |
|----------------------------------------|------------|----------------------------------------------|---|---|-----|-----|
| Thermal resistance, junction - case    | $R_{thJC}$ |                                              | - | - | 1.1 | K/W |
| Thermal resistance, junction - ambient | $R_{thJA}$ | minimal footprint                            | - | - | 75  |     |
|                                        |            | 6 cm <sup>2</sup> cooling area <sup>4)</sup> | - | - | 50  |     |

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

### Static characteristics

|                                  |               |                                                                      |     |     |     |               |
|----------------------------------|---------------|----------------------------------------------------------------------|-----|-----|-----|---------------|
| Drain-source breakdown voltage   | $V_{(BR)DSS}$ | $V_{GS}=0\text{ V}$ , $I_D=1\text{ mA}$                              | 120 | -   | -   | V             |
| Gate threshold voltage           | $V_{GS(th)}$  | $V_{DS}=V_{GS}$ , $I_D=83\text{ }\mu\text{A}$                        |     | 3   |     |               |
| 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 | $R_{DS(on)}$  | $V_{GS}=10\text{ V}$ , $I_D=75\text{ A}$                             | -   | 9.2 | 11  | m $\Omega$    |
| Gate resistance                  | $R_G$         |                                                                      | -   | 1.5 | -   | $\Omega$      |
| Transconductance                 | $g_{fs}$      | $ V_{DS} >2 I_D R_{DS(on)max}$ ,<br>$I_D=75\text{ A}$                | 42  | 83  | -   | S             |

<sup>4)</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            | $C_{iss}$    | $V_{GS}=0\text{ V}, V_{DS}=60\text{ V},$<br>$f=1\text{ MHz}$                          | - | 3240 | 4310 | pF |
| Output capacitance           | $C_{oss}$    |                                                                                       | - | 408  | 543  |    |
| Reverse transfer capacitance | $C_{rss}$    |                                                                                       | - | 22   | -    |    |
| Turn-on delay time           | $t_{d(on)}$  | $V_{DD}=60\text{ V}, V_{GS}=10\text{ V},$<br>$I_D=75\text{ A}, R_{G,ext}=1.6\ \Omega$ | - | 16   | -    | ns |
| Rise time                    | $t_r$        |                                                                                       | - | 16   | -    |    |
| Turn-off delay time          | $t_{d(off)}$ |                                                                                       | - | 24   | -    |    |
| Fall time                    | $t_f$        |                                                                                       | - | 8    | -    |    |

### Gate Charge Characteristics<sup>5)</sup>

|                       |               |                                                                            |   |     |    |    |
|-----------------------|---------------|----------------------------------------------------------------------------|---|-----|----|----|
| Gate to source charge | $Q_{gs}$      | $V_{DD}=60\text{ V}, I_D=75\text{ A},$<br>$V_{GS}=0\text{ to }10\text{ V}$ | - | 18  | -  | nC |
| Gate to drain charge  | $Q_{gd}$      |                                                                            | - | 12  | -  |    |
| Switching charge      | $Q_{sw}$      |                                                                            | - | 20  | -  |    |
| Gate charge total     | $Q_g$         |                                                                            | - | 49  | 65 |    |
| Gate plateau voltage  | $V_{plateau}$ |                                                                            | - | 5.6 | -  | V  |
| Output charge         | $Q_{oss}$     | $V_{DD}=60\text{ V}, V_{GS}=0\text{ V}$                                    | - | 56  | 75 | nC |

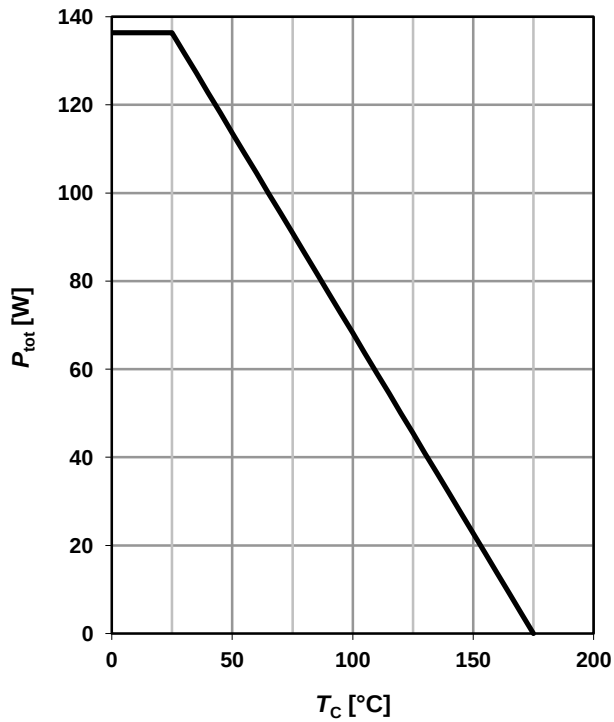
### Reverse Diode

|                                  |               |                                                                   |   |     |     |    |
|----------------------------------|---------------|-------------------------------------------------------------------|---|-----|-----|----|
| Diode continuous forward current | $I_S$         | $T_C=25\text{ °C}$                                                | - | -   | 75  | A  |
| Diode pulse current              | $I_{S,pulse}$ |                                                                   | - | -   | 300 |    |
| Diode forward voltage            | $V_{SD}$      | $V_{GS}=0\text{ V}, I_F=75\text{ A},$<br>$T_J=25\text{ °C}$       | - | 1   | 1.2 | V  |
| Reverse recovery time            | $t_{rr}$      | $V_R=60\text{ V}, I_F=I_S,$<br>$di_F/dt=100\text{ A}/\mu\text{s}$ | - | 90  |     | ns |
| Reverse recovery charge          | $Q_{rr}$      |                                                                   | - | 249 |     | nC |

<sup>5)</sup> See figure 16 for gate charge parameter definition

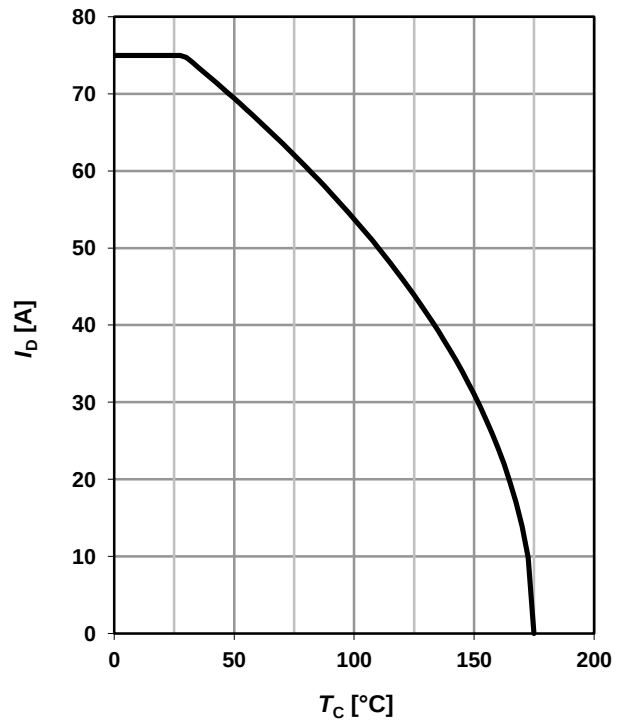
### 1 Power dissipation

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



### 2 Drain current

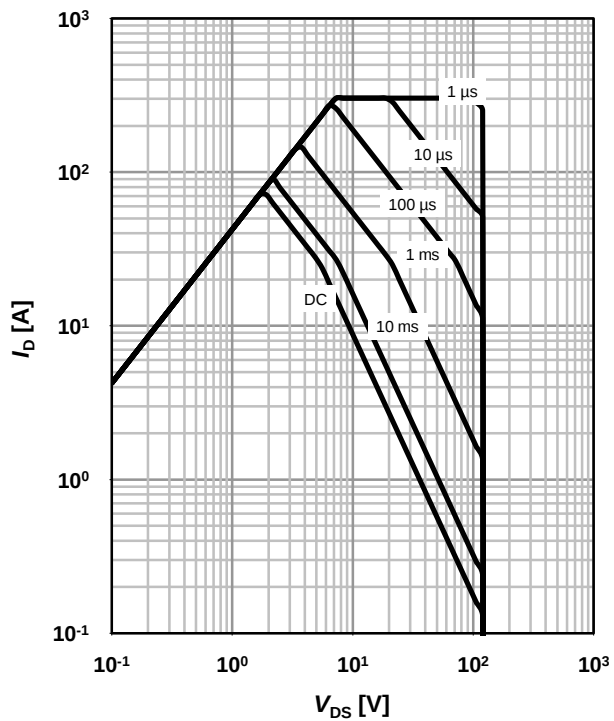
$$I_D = f(T_C); V_{GS} \geq 10 \text{ V}$$



### 3 Safe operating area

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

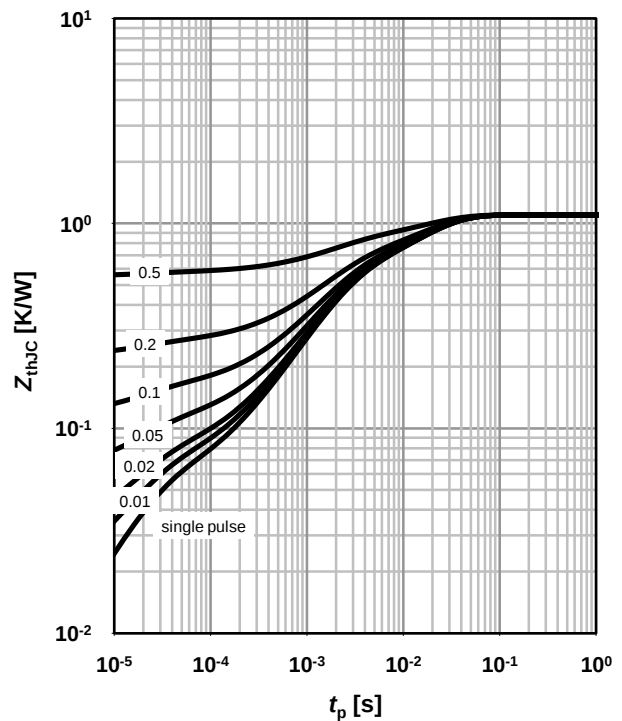
parameter:  $t_p$



### 4 Max. transient thermal impedance

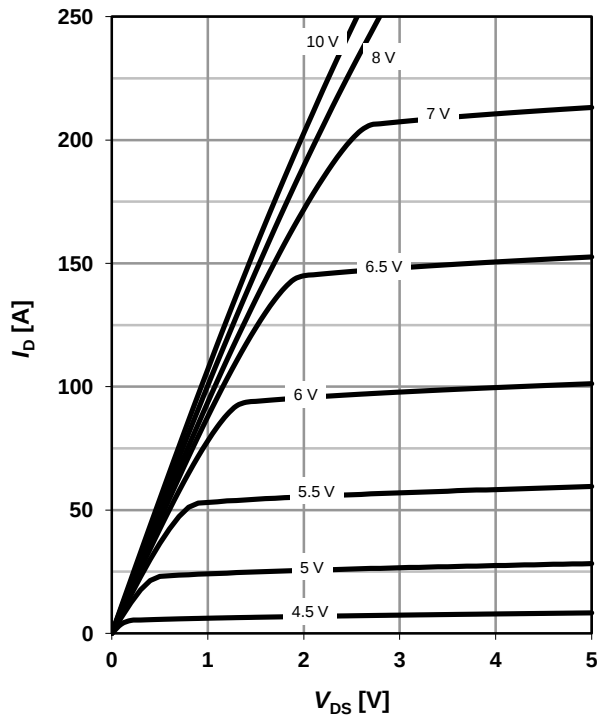
$$Z_{\text{thJC}} = f(t_p)$$

parameter:  $D = t_p/T$



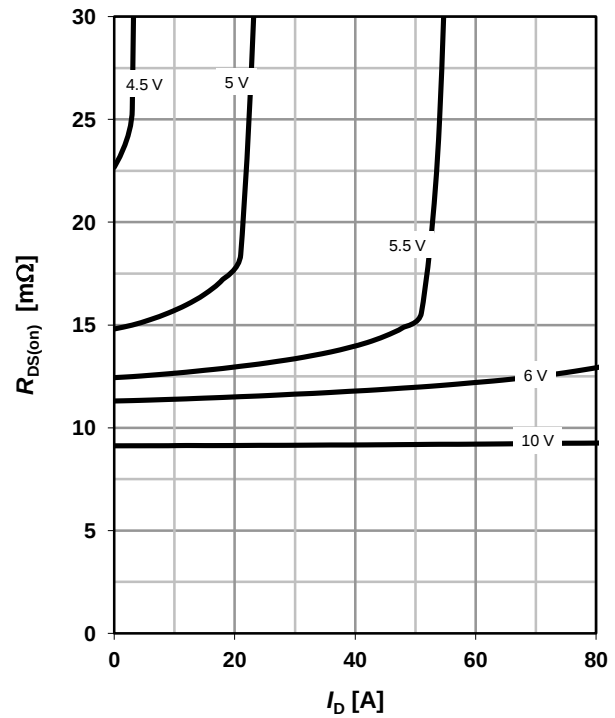
### 5 Typ. output characteristics

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

parameter:  $V_{GS}$ 


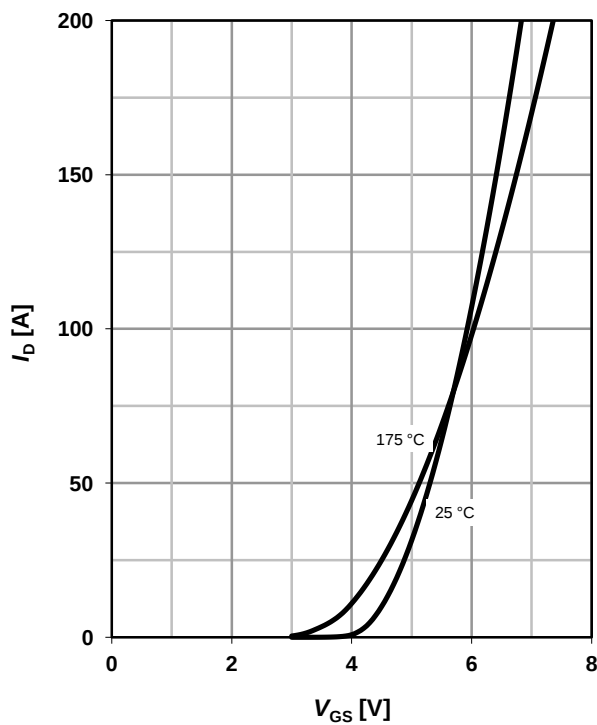
### 6 Typ. drain-source on resistance

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

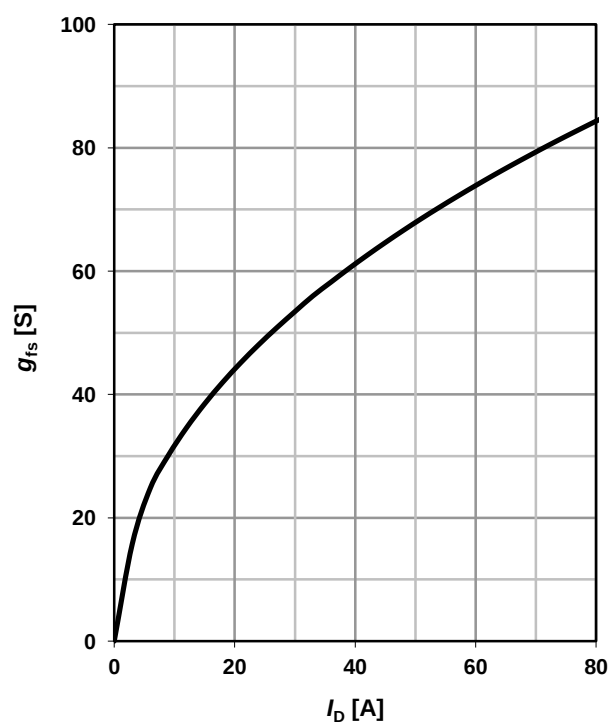
parameter:  $V_{GS}$ 


### 7 Typ. transfer characteristics

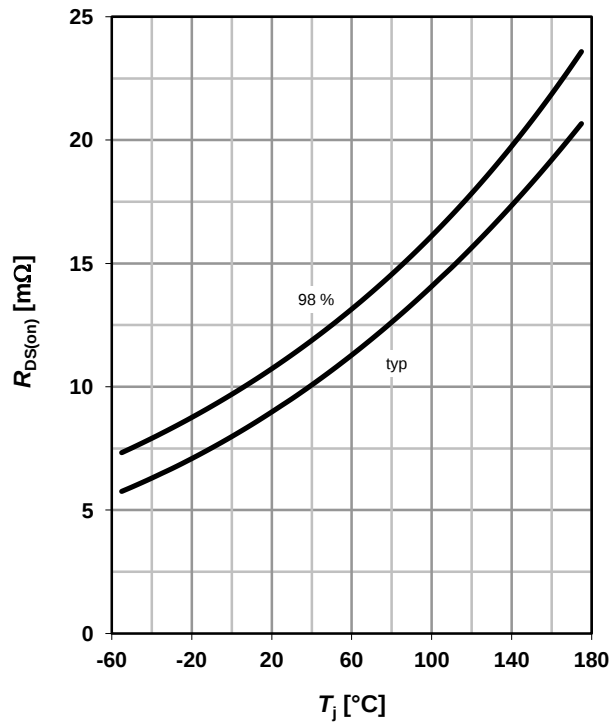
 $I_D = f(V_{GS}); |V_{DS}| > 2|I_D|R_{DS(on)max}$ 

parameter:  $T_j$ 


### 8 Typ. forward transconductance

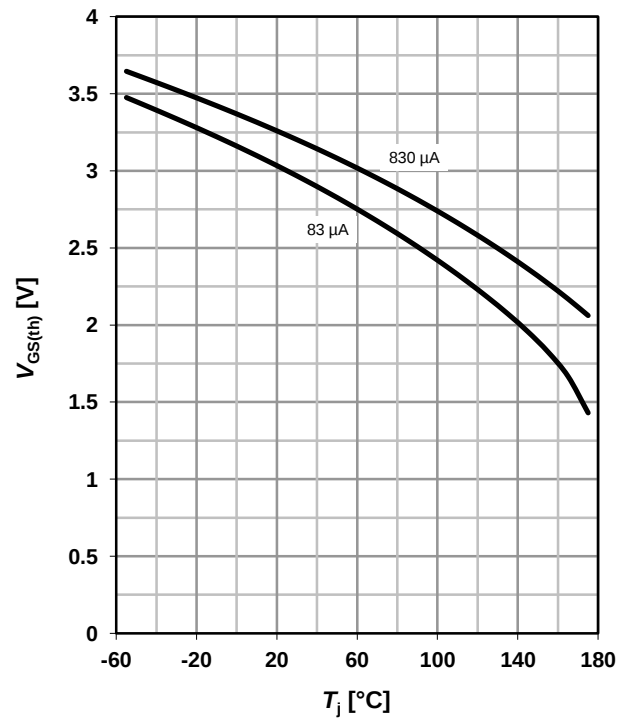
 $g_{fs} = f(I_D); T_j = 25^\circ\text{C}$ 


## 9 Drain-source on-state resistance

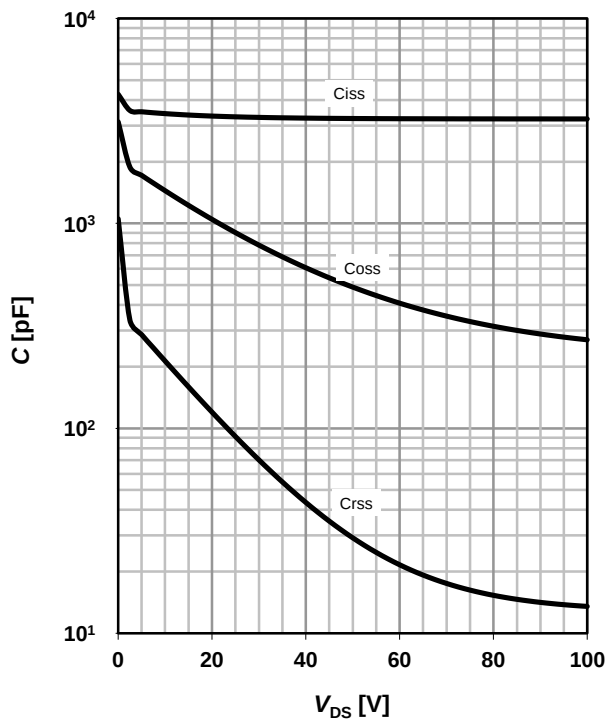
 $R_{DS(on)} = f(T_j); I_D = 75 \text{ A}; V_{GS} = 10 \text{ V}$ 


## 10 Typ. gate threshold voltage

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

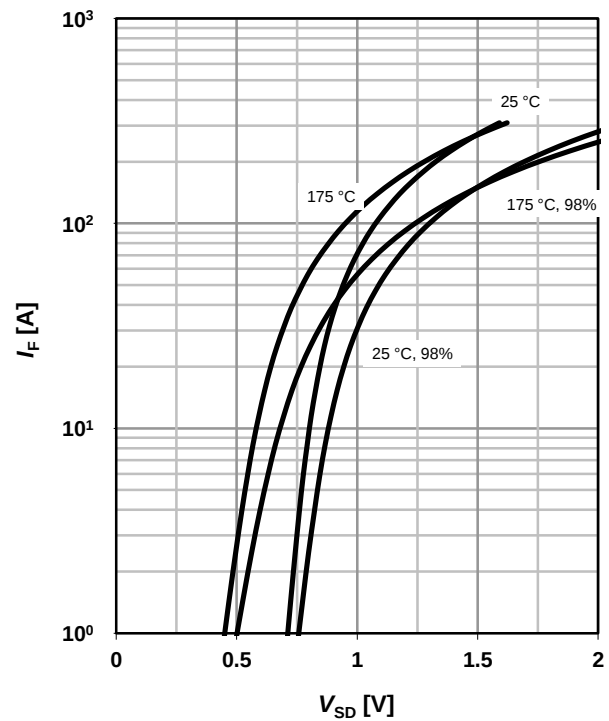
parameter:  $I_D$ 


## 11 Typ. capacitances

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


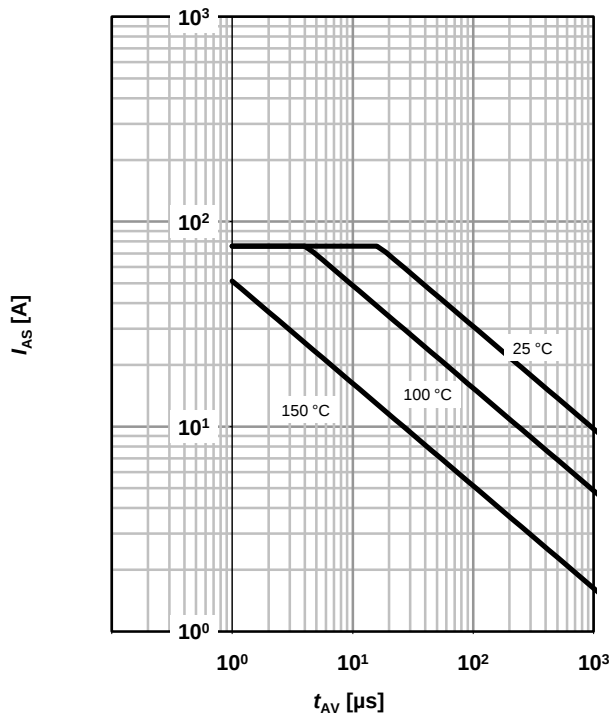
## 12 Forward characteristics of reverse diode

 $I_F = f(V_{SD})$ 

parameter:  $T_j$ 


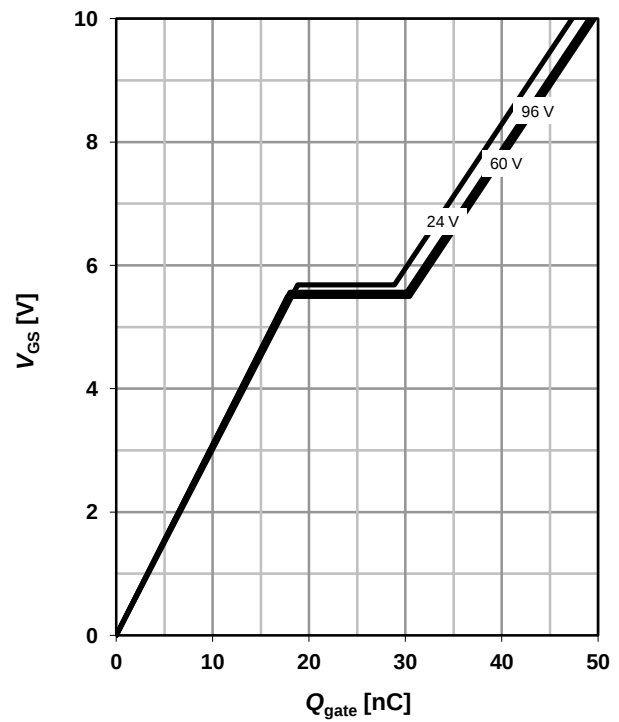
### 13 Avalanche characteristics

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

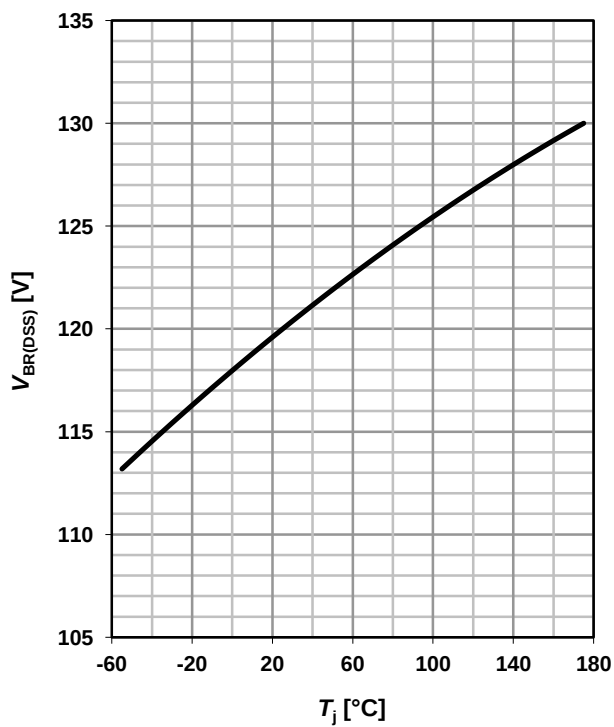
parameter:  $T_{j(\text{start})}$ 


### 14 Typ. gate charge

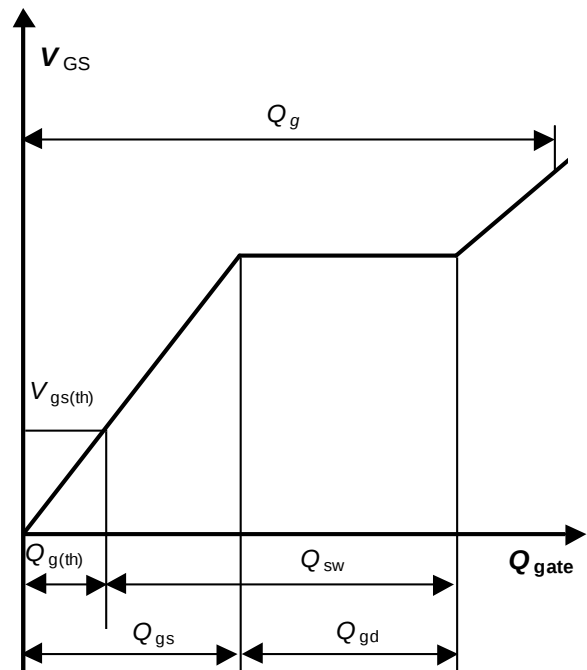
 $V_{GS}=f(Q_{gate}); I_D=67\ \text{A pulsed}$ 

parameter:  $V_{DD}$ 


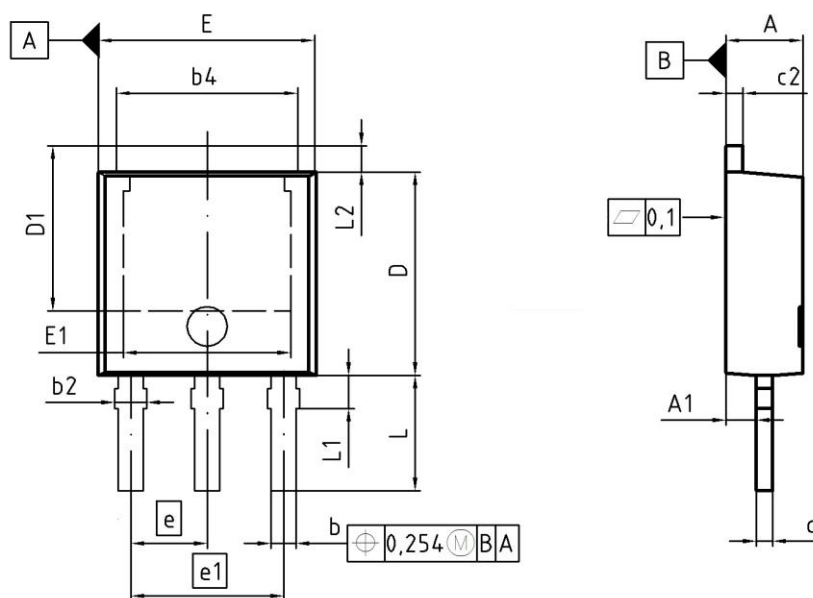
### 15 Drain-source breakdown voltage

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


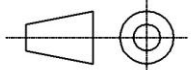
### 16 Gate charge waveforms



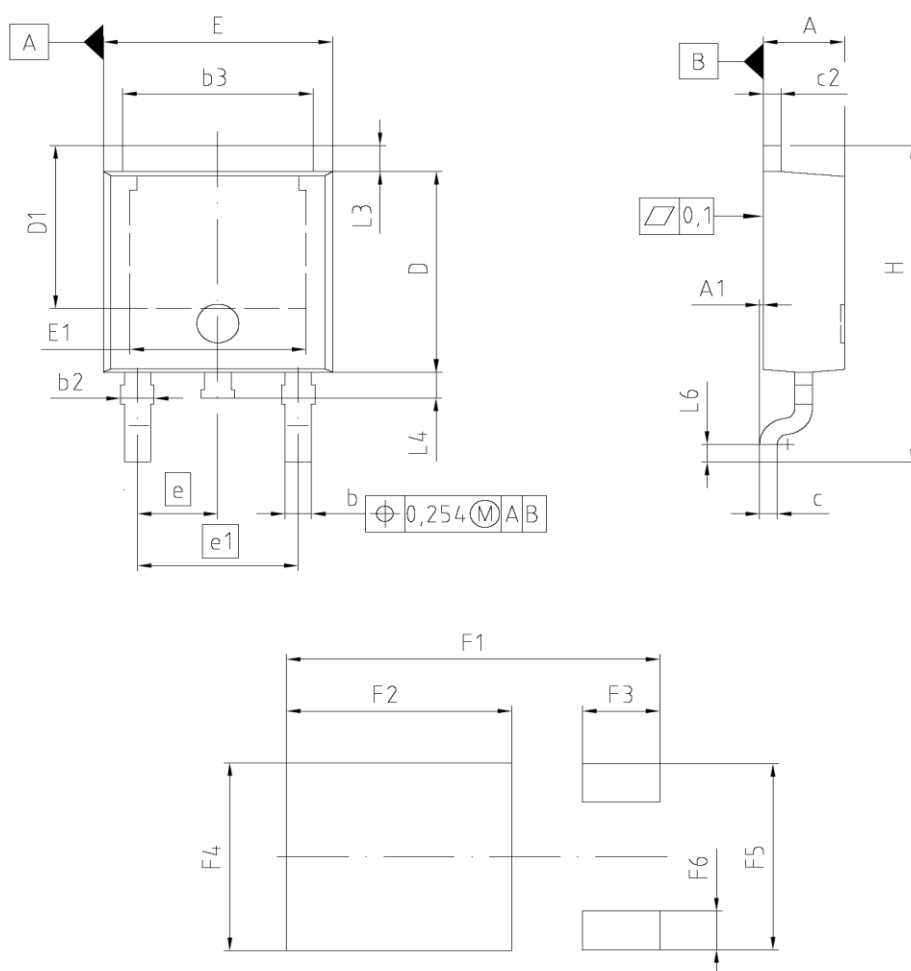
## PG-TO-251SL : Outline



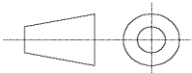
| DIM | MILLIMETERS |      | INCHES |       |
|-----|-------------|------|--------|-------|
|     | MIN         | MAX  | MIN    | MAX   |
| A   | 2.18        | 2.39 | 0.086  | 0.094 |
| A1  | 0.80        | 1.14 | 0.031  | 0.045 |
| b   | 0.64        | 0.89 | 0.025  | 0.035 |
| b2  | 0.65        | 1.15 | 0.026  | 0.045 |
| b4  | 4.95        | 5.50 | 0.195  | 0.217 |
| c   | 0.46        | 0.58 | 0.018  | 0.023 |
| c2  | 0.46        | 0.89 | 0.018  | 0.035 |
| D   | 5.97        | 6.22 | 0.235  | 0.245 |
| D1  | 5.04        | 5.44 | 0.198  | 0.214 |
| E   | 6.35        | 6.73 | 0.250  | 0.265 |
| E1  | 4.90        | 5.10 | 0.193  | 0.201 |
| e   | 2.29        |      | 0.090  |       |
| e1  | 4.57        |      | 0.180  |       |
| N   | 3           |      | 3      |       |
| L   | 3.40        | 3.60 | 0.134  | 0.142 |
| L1  | 0.90        | 1.10 | 0.035  | 0.043 |
| L2  | 0.90        | 1.10 | 0.035  | 0.043 |

|                                                                                                              |
|--------------------------------------------------------------------------------------------------------------|
| DOCUMENT NO.<br>Z8B00003329                                                                                  |
| SCALE<br>0 2.0 4mm                                                                                           |
| EUROPEAN PROJECTION<br> |
| ISSUE DATE<br>17-01-2008                                                                                     |
| REVISION<br>03                                                                                               |

## PG-TO252-3: Outline



| DIM | MILLIMETERS |        | INCHES |       |
|-----|-------------|--------|--------|-------|
|     | MIN         | MAX    | MIN    | MAX   |
| A   | 2.159       | 2.413  | 0.085  | 0.095 |
| A1  | 0.000       | 0.150  | 0.000  | 0.006 |
| b   | 0.635       | 0.889  | 0.025  | 0.035 |
| b2  | 0.650       | 1.150  | 0.026  | 0.045 |
| b3  | 5.004       | 5.500  | 0.197  | 0.217 |
| c   | 0.457       | 0.580  | 0.018  | 0.023 |
| c2  | 0.460       | 0.980  | 0.018  | 0.039 |
| D   | 5.969       | 6.223  | 0.235  | 0.245 |
| D1  | 5.020       | 5.842  | 0.198  | 0.230 |
| E   | 6.400       | 6.731  | 0.252  | 0.265 |
| E1  | 4.850       | 5.207  | 0.191  | 0.205 |
| e   | 2.286       |        | 0.090  |       |
| e1  | 4.572       |        | 0.180  |       |
| N   | 3           |        | 3      |       |
| H   | 9.400       | 10.480 | 0.370  | 0.413 |
| L3  | 0.900       | 1.143  | 0.035  | 0.045 |
| L4  | 0.584       | 0.950  | 0.023  | 0.037 |
| L6  | 0.510       | 0.686  | 0.020  | 0.027 |
| F1  | 10.500      | 10.700 | 0.413  | 0.421 |
| F2  | 6.300       | 6.500  | 0.248  | 0.256 |
| F3  | 2.100       | 2.300  | 0.083  | 0.091 |
| F4  | 5.700       | 5.900  | 0.224  | 0.232 |
| F5  | 5.660       | 5.860  | 0.222  | 0.231 |
| F6  | 1.100       | 1.300  | 0.043  | 0.051 |

|                                                                                       |                 |
|---------------------------------------------------------------------------------------|-----------------|
| REFERENCE<br>JEDEC TO252                                                              |                 |
| SCALE                                                                                 | 0<br>2.0<br>4mm |
| EUROPEAN PROJECTION                                                                   |                 |
|  |                 |
| ISSUE DATE<br>21-09-2005                                                              |                 |
| FILE<br>TO252_1                                                                       |                 |

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