

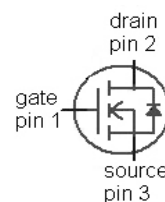
## OptiMOS™ 3 Power-Transistor

### Features

- Fast switching MOSFET for SMPS
- Optimized technology for DC/DC converters
- Qualified according to JEDEC<sup>1)</sup> for target applications
- N-channel, logic level
- Excellent gate charge x  $R_{DS(on)}$  product (FOM)
- Very low on-resistance  $R_{DS(on)}$
- Avalanche rated
- Pb-free plating; RoHS compliant
- Halogen-free according to IEC61249-2-21 \*

### Product Summary

|                  |    |    |
|------------------|----|----|
| $V_{DS}$         | 30 | V  |
| $R_{DS(on),max}$ | 9  | mΩ |
| $I_D$            | 40 | A  |



| Type    | IPD090N03L G                                                                        | IPF090N03L G                                                                        | IPS090N03L G                                                                         | IPU090N03L G                                                                          |
|---------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
|         |  |  |  |  |
| Package | PG-TO252-3                                                                          | PG-TO252-3-23                                                                       | PG-TO251-3-11                                                                        | PG-TO251-3                                                                            |
| Marking | 090N03L                                                                             | 090N03L                                                                             | 090N03L                                                                              | 090N03L                                                                               |

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

| Parameter                                     | Symbol        | Conditions                                                                            | Value | Unit  |
|-----------------------------------------------|---------------|---------------------------------------------------------------------------------------|-------|-------|
| Continuous drain current                      | $I_D$         | $V_{GS}=10\text{ V}, T_C=25\text{ °C}$                                                | 40    | A     |
|                                               |               | $V_{GS}=10\text{ V}, T_C=100\text{ °C}$                                               | 37    |       |
|                                               |               | $V_{GS}=4.5\text{ V}, T_C=25\text{ °C}$                                               | 40    |       |
|                                               |               | $V_{GS}=4.5\text{ V}, T_C=100\text{ °C}$                                              | 30    |       |
| Pulsed drain current <sup>2)</sup>            | $I_{D,pulse}$ | $T_C=25\text{ °C}$                                                                    | 280   |       |
| Avalanche current, single pulse <sup>3)</sup> | $I_{AS}$      | $T_C=25\text{ °C}$                                                                    | 40    |       |
| Avalanche energy, single pulse                | $E_{AS}$      | $I_D=3.5\text{ A}, R_{GS}=25\text{ Ω}$                                                | 70    | mJ    |
| Reverse diode $dv/dt$                         | $dv/dt$       | $I_D=40\text{ A}, V_{DS}=24\text{ V}, di/dt=200\text{ A/μs}, T_{j,max}=175\text{ °C}$ | 6     | kV/μs |
| Gate source voltage                           | $V_{GS}$      |                                                                                       | ±20   | V     |

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

\* IPD090N03L G HF available with SP000680636 only in Malacca, Malaysia  
IPS090N03L G available in HF

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

| Parameter                           | Symbol                | Conditions         | Value       | Unit |
|-------------------------------------|-----------------------|--------------------|-------------|------|
| Power dissipation                   | $P_{\text{tot}}$      | $T_c=25\text{ °C}$ | 42          | W    |
| Operating and storage temperature   | $T_j, T_{\text{stg}}$ |                    | -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 | $R_{\text{thJC}}$ |                                              | - | - | 3.6 | K/W |
| SMD version, device on PCB          | $R_{\text{thJA}}$ | 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                 | $V_{(\text{BR})\text{DSS}}$ | $V_{\text{GS}}=0\text{ V}, I_{\text{D}}=1\text{ mA}$                            | 30 | -    | -    | V             |
| Gate threshold voltage                         | $V_{\text{GS(th)}}$         | $V_{\text{DS}}=V_{\text{GS}}, I_{\text{D}}=250\text{ }\mu\text{A}$              | 1  | -    | 2.2  |               |
| Zero gate voltage drain current                | $I_{\text{DSS}}$            | $V_{\text{DS}}=30\text{ V}, V_{\text{GS}}=0\text{ V}, T_j=25\text{ °C}$         | -  | 0.1  | 1    | $\mu\text{A}$ |
|                                                |                             | $V_{\text{DS}}=30\text{ V}, V_{\text{GS}}=0\text{ V}, T_j=125\text{ °C}$        | -  | 10   | 100  |               |
| Gate-source leakage current                    | $I_{\text{GSS}}$            | $V_{\text{GS}}=20\text{ V}, V_{\text{DS}}=0\text{ V}$                           | -  | 10   | 100  | nA            |
| Drain-source on-state resistance <sup>5)</sup> | $R_{\text{DS(on)}}$         | $V_{\text{GS}}=4.5\text{ V}, I_{\text{D}}=30\text{ A}$                          | -  | 10.8 | 13.5 | m $\Omega$    |
|                                                |                             | $V_{\text{GS}}=10\text{ V}, I_{\text{D}}=30\text{ A}$                           | -  | 7.5  | 9    |               |
| Gate resistance                                | $R_{\text{G}}$              |                                                                                 | -  | 1.1  | -    | $\Omega$      |
| Transconductance                               | $g_{\text{fs}}$             | $ V_{\text{DS}} >2 I_{\text{D}} R_{\text{DS(on)max}}, I_{\text{D}}=30\text{ A}$ | 28 | 55   | -    | S             |

<sup>2)</sup> See figure 3 for more detailed information

<sup>3)</sup> See figure 13 for more detailed information

<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.

<sup>5)</sup> Measured from drain tab to source pin

| 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>$f=1\text{ MHz}$                    | - | 1200 | 1600 | pF |
| Output capacitance           | $C_{oss}$    |                                                                                 | - | 500  | 660  |    |
| Reverse transfer capacitance | $C_{rss}$    |                                                                                 | - | 24   | -    |    |
| Turn-on delay time           | $t_{d(on)}$  | $V_{DD}=15\text{ V}, V_{GS}=10\text{ V},$<br>$I_D=30\text{ A}, R_G=1.6\ \Omega$ | - | 4.0  | -    | ns |
| Rise time                    | $t_r$        |                                                                                 | - | 3    | -    |    |
| Turn-off delay time          | $t_{d(off)}$ |                                                                                 | - | 15   | -    |    |
| Fall time                    | $t_f$        |                                                                                 | - | 2.6  | -    |    |

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

|                              |               |                                                                             |   |     |     |    |
|------------------------------|---------------|-----------------------------------------------------------------------------|---|-----|-----|----|
| Gate to source charge        | $Q_{gs}$      | $V_{DD}=15\text{ V}, I_D=30\text{ A},$<br>$V_{GS}=0\text{ to }4.5\text{ V}$ | - | 4.0 | -   | nC |
| Gate charge at threshold     | $Q_{g(th)}$   |                                                                             | - | 1.9 | -   |    |
| Gate to drain charge         | $Q_{gd}$      |                                                                             | - | 1.8 | -   |    |
| Switching charge             | $Q_{sw}$      |                                                                             | - | 3.9 | -   |    |
| Gate charge total            | $Q_g$         |                                                                             | - | 7.4 | 9.8 |    |
| Gate plateau voltage         | $V_{plateau}$ |                                                                             | - | 3.4 | -   |    |
| Gate charge total            | $Q_g$         | $V_{DD}=15\text{ V}, I_D=30\text{ A},$<br>$V_{GS}=0\text{ to }10\text{ V}$  | - | 15  | -   | nC |
| Gate charge total, sync. FET | $Q_{g(sync)}$ | $V_{DS}=0.1\text{ V},$<br>$V_{GS}=0\text{ to }4.5\text{ V}$                 | - | 6.4 | 8.5 |    |
| Output charge                | $Q_{oss}$     | $V_{DD}=15\text{ V}, V_{GS}=0\text{ V}$                                     | - | 13  | -   |    |

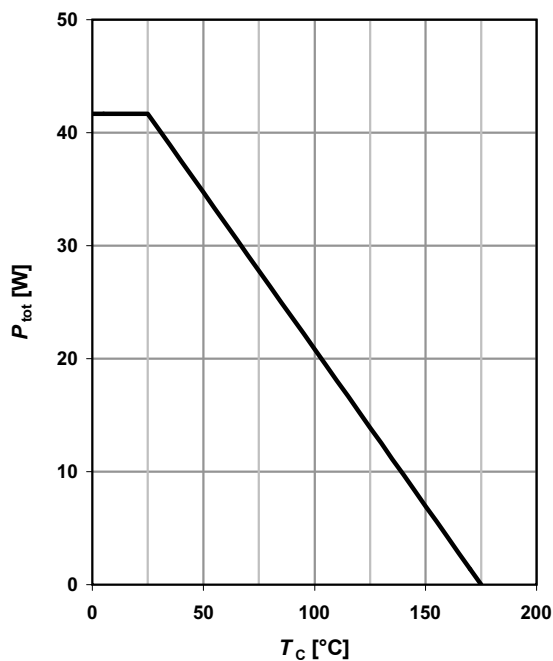
#### Reverse Diode

|                                  |               |                                                                   |   |      |     |    |
|----------------------------------|---------------|-------------------------------------------------------------------|---|------|-----|----|
| Diode continuous forward current | $I_S$         | $T_C=25\text{ °C}$                                                | - | -    | 37  | A  |
| Diode pulse current              | $I_{S,pulse}$ |                                                                   | - | -    | 280 |    |
| Diode forward voltage            | $V_{SD}$      | $V_{GS}=0\text{ V}, I_F=30\text{ A},$<br>$T_j=25\text{ °C}$       | - | 0.91 | 1.1 | V  |
| Reverse recovery charge          | $Q_{rr}$      | $V_R=15\text{ V}, I_F=I_S,$<br>$di_F/dt=400\text{ A}/\mu\text{s}$ | - | -    | 10  | nC |

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

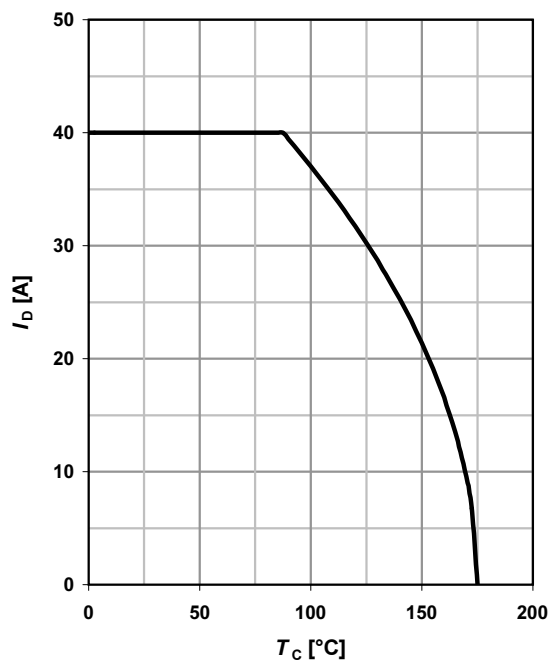
## 1 Power dissipation

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



## 2 Drain current

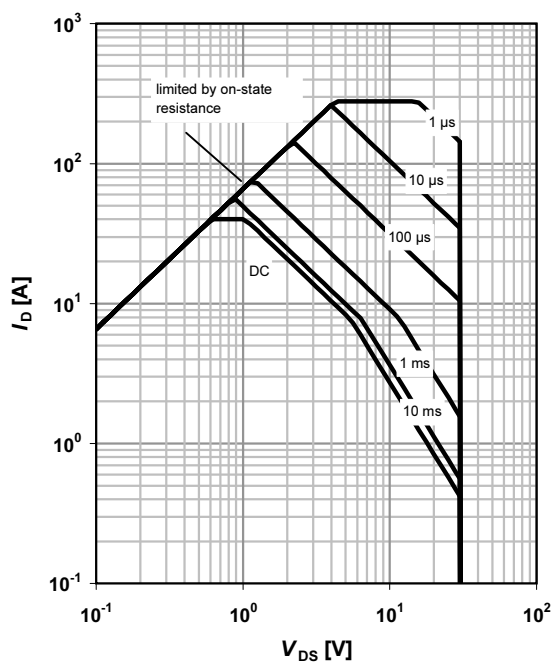
$$I_D = f(T_C); V_{GS} \geq 10 \text{ V}$$



## 3 Safe operating area

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

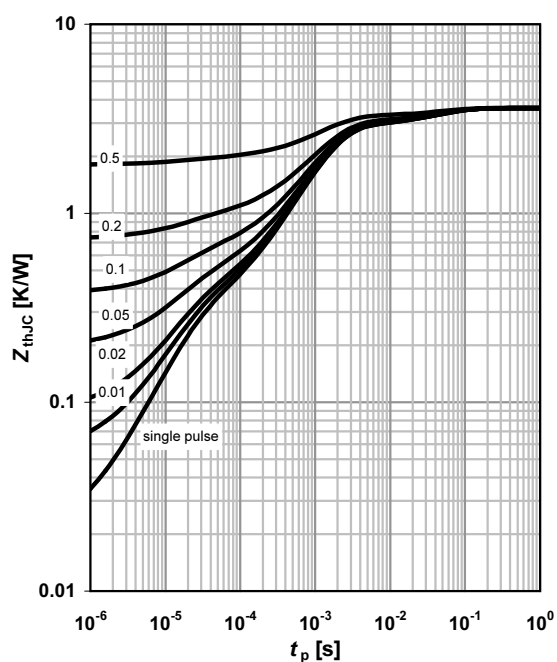
parameter:  $t_p$



## 4 Max. transient thermal impedance

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

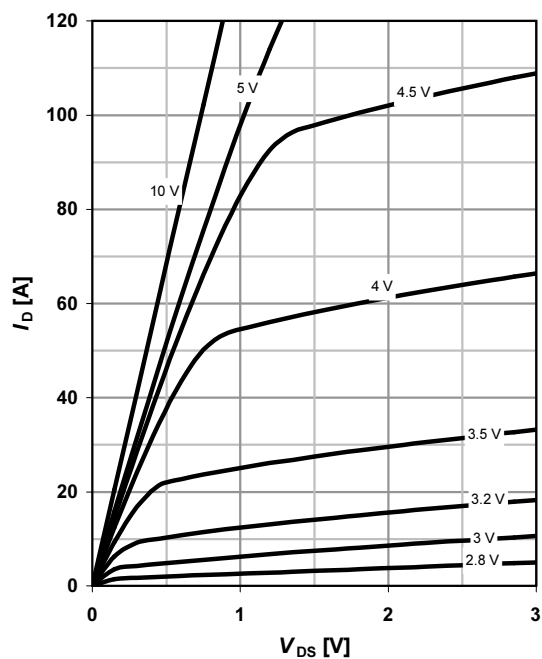
parameter:  $D = t_p/T$



### 5 Typ. output characteristics

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

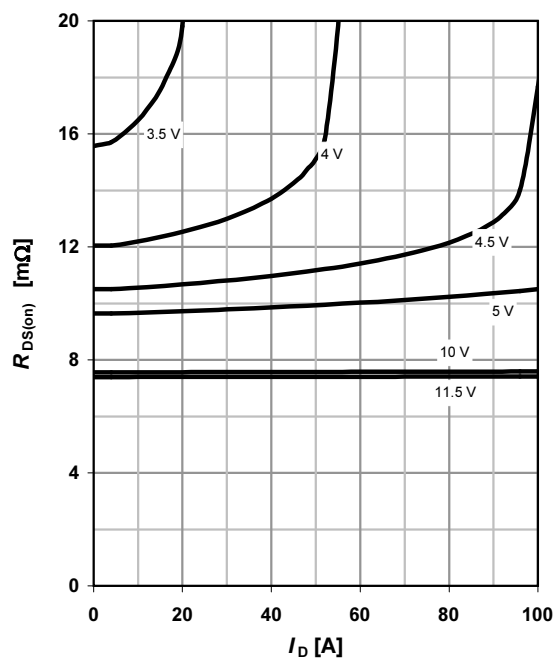
parameter:  $V_{GS}$



### 6 Typ. drain-source on resistance

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

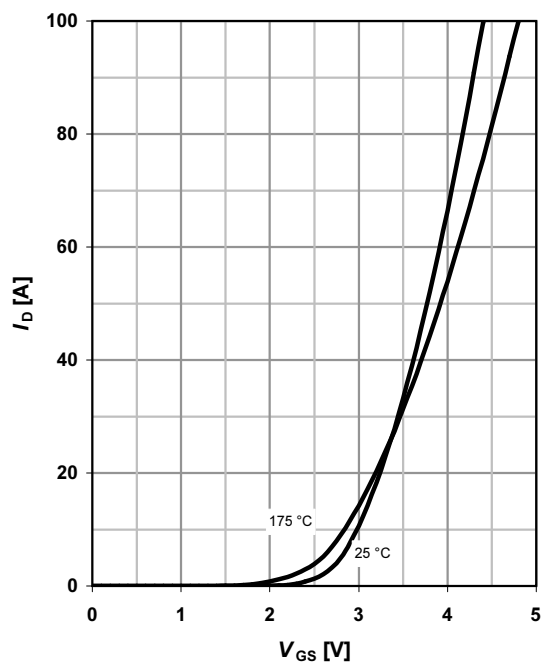
parameter:  $V_{GS}$



### 7 Typ. transfer characteristics

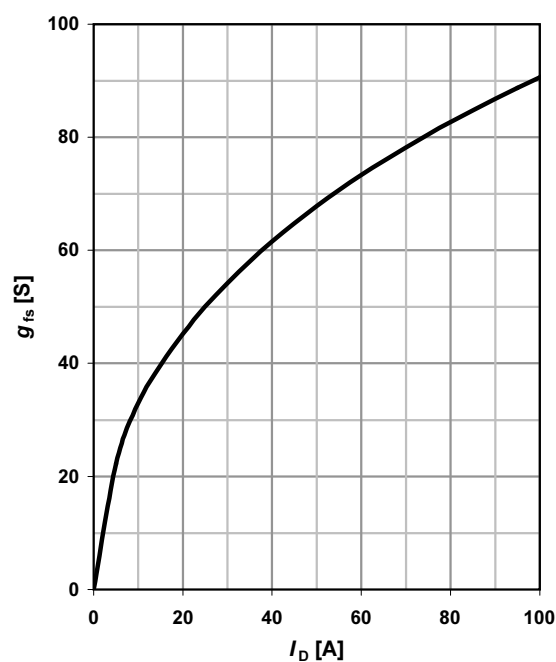
$$I_D = f(V_{GS}); |V_{DS}| > 2|I_D|R_{DS(on)max}$$

parameter:  $T_J$



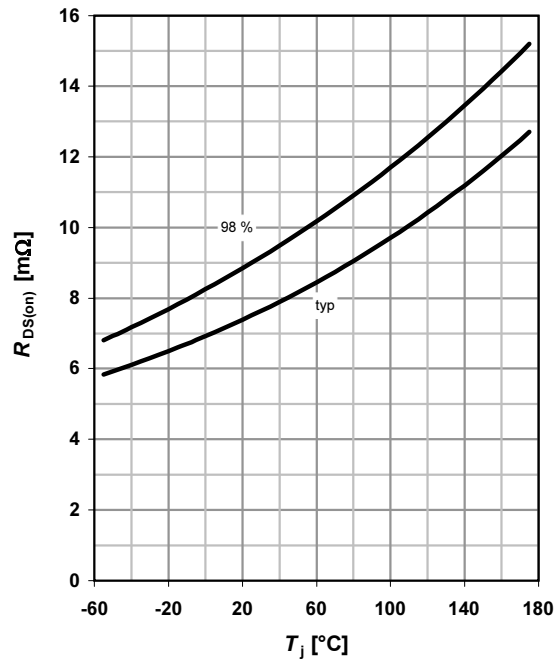
### 8 Typ. forward transconductance

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



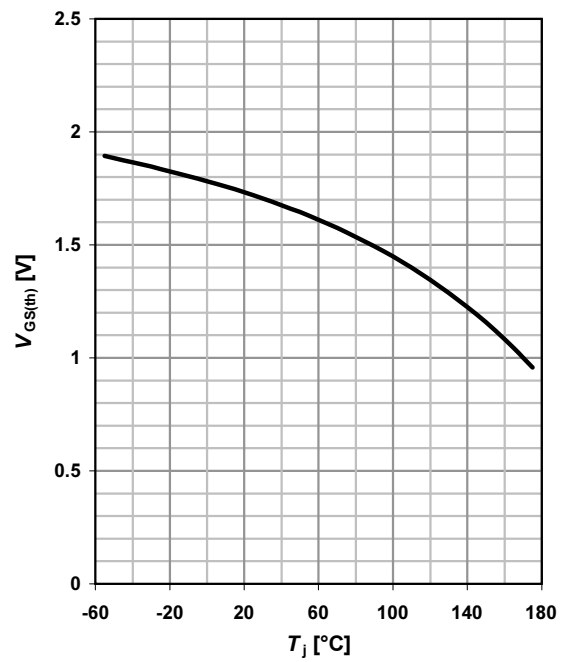
### 9 Drain-source on-state resistance

$$R_{DS(on)} = f(T_j); I_D = 30 \text{ A}; V_{GS} = 10 \text{ V}$$



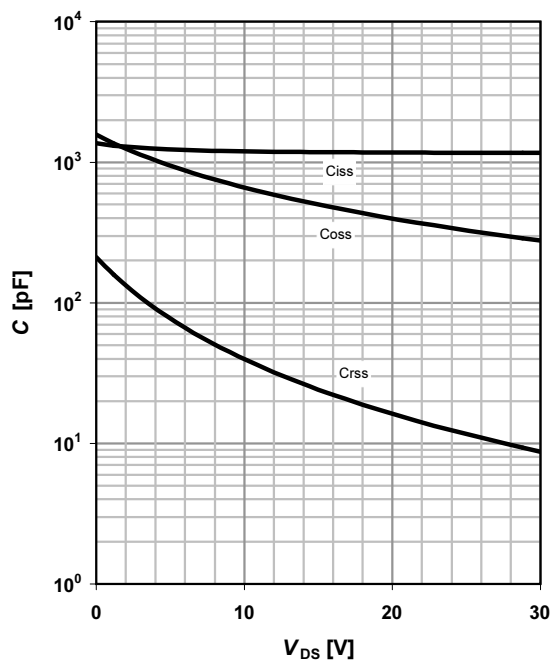
### 10 Typ. gate threshold voltage

$$V_{GS(th)} = f(T_j); V_{GS} = V_{DS}; I_D = 250 \text{ } \mu\text{A}$$



### 11 Typ. capacitances

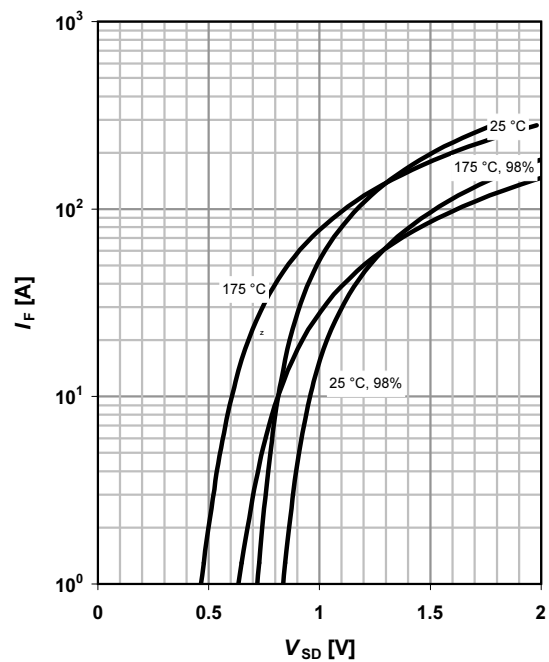
$$C = f(V_{DS}); V_{GS} = 0 \text{ V}; f = 1 \text{ MHz}$$



### 12 Forward characteristics of reverse diode

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

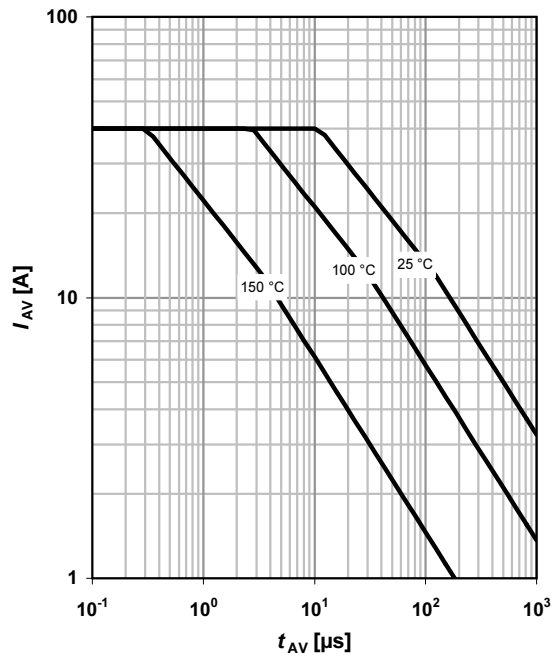
parameter:  $T_j$



### 13 Avalanche characteristics

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

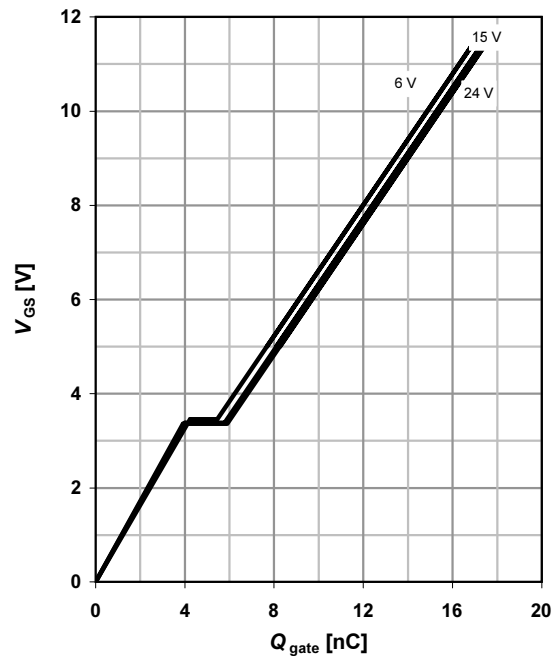
parameter:  $T_{j(\text{start})}$



### 14 Typ. gate charge

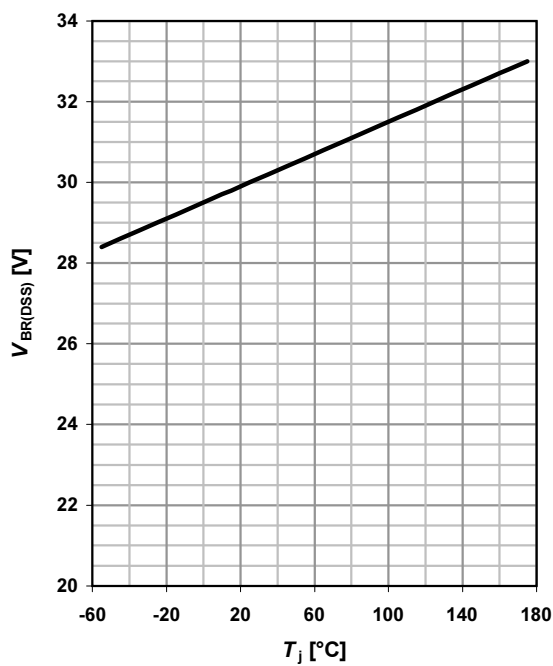
$$V_{GS}=f(Q_{\text{gate}}); I_D=30\ \text{A pulsed}$$

parameter:  $V_{DD}$

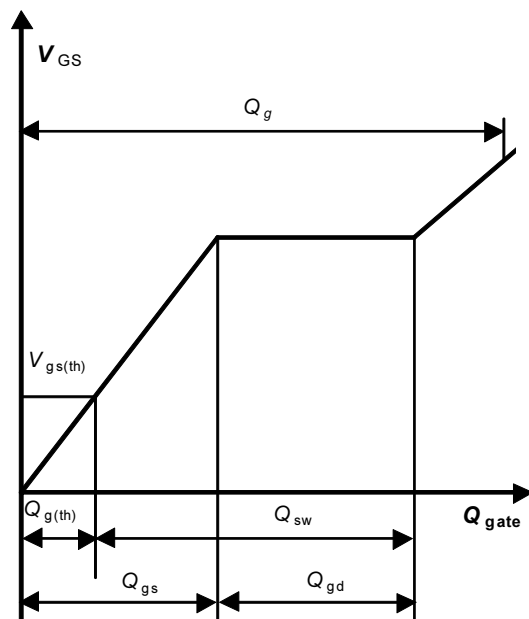


### 15 Drain-source breakdown voltage

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

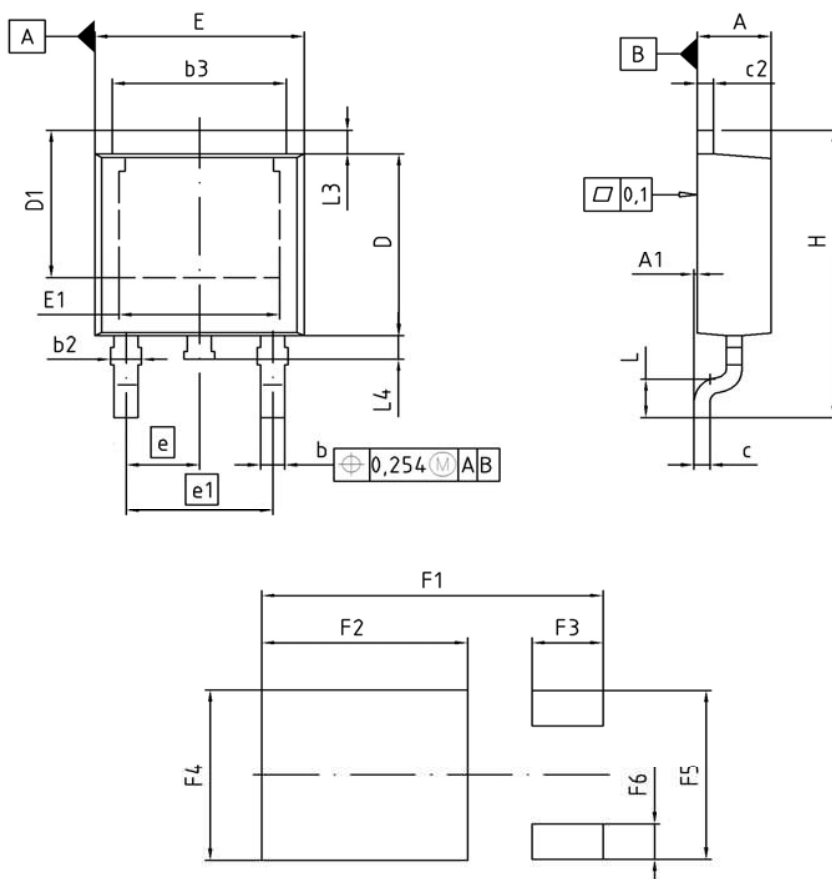


### 16 Gate charge waveforms

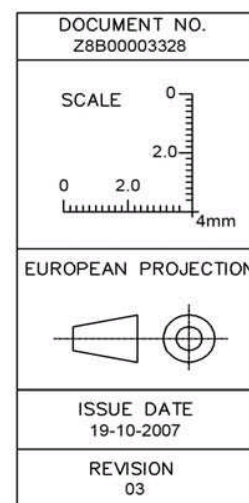


## Package Outline

## PG-TO252-3

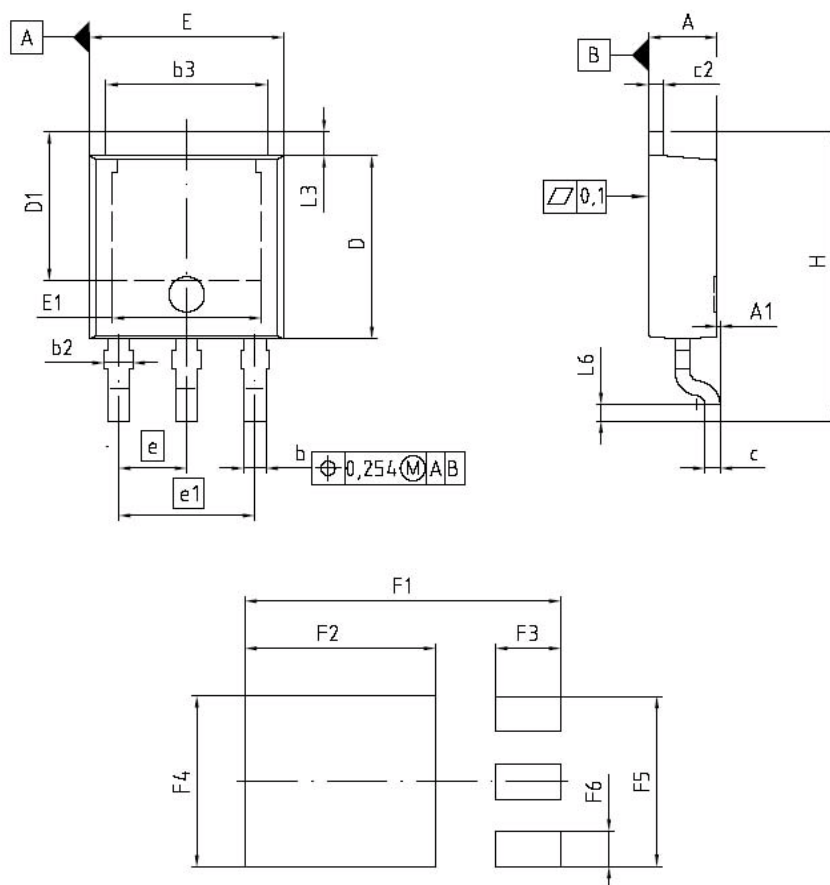


| DIM | MILLIMETERS |       | INCHES |       |
|-----|-------------|-------|--------|-------|
|     | MIN         | MAX   | MIN    | MAX   |
| A   | 2.16        | 2.41  | 0.085  | 0.095 |
| A1  | 0.00        | 0.15  | 0.000  | 0.006 |
| b   | 0.64        | 0.89  | 0.025  | 0.035 |
| b2  | 0.65        | 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 |

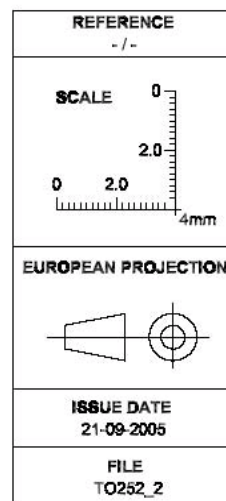


## Package Outline

## PG-TO252-3-23

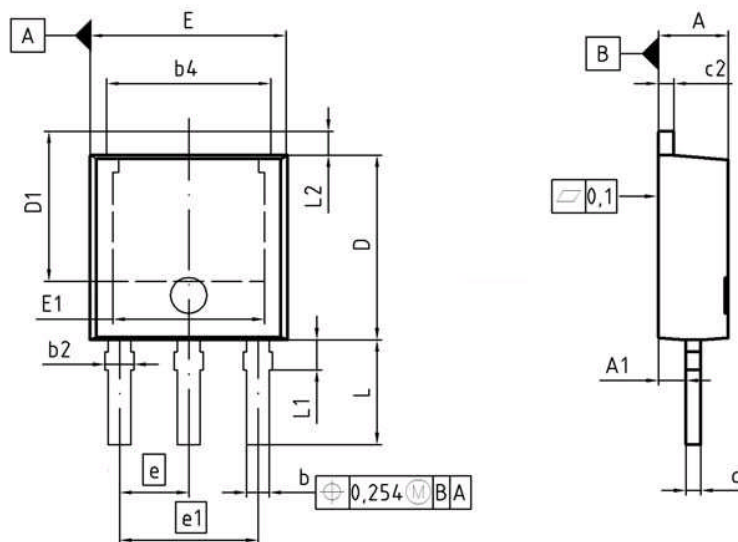


| DIM | MILLIMETERS |        | INCHES |       |
|-----|-------------|--------|--------|-------|
|     | MIN         | MAX    | MIN    | MAX   |
| A   | 2.159       | 2.413  | 0.085  | 0.095 |
| A1  | 0.000       | 0.150  | 0.000  | 0.006 |
| b   | 0.635       | 0.889  | 0.025  | 0.035 |
| b2  | 0.650       | 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 |

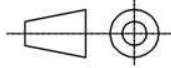


## Package Outline

## PG-TO251-3-11

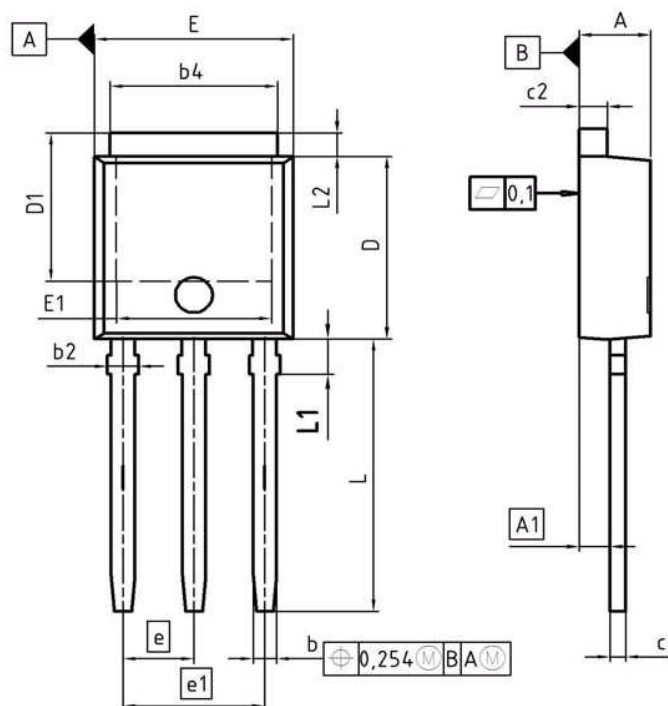


| DIM | MILLIMETERS |      | INCHES |       |
|-----|-------------|------|--------|-------|
|     | MIN         | MAX  | MIN    | MAX   |
| A   | 2.18        | 2.39 | 0.086  | 0.094 |
| A1  | 0.80        | 1.14 | 0.031  | 0.045 |
| b   | 0.64        | 0.89 | 0.025  | 0.035 |
| b2  | 0.65        | 1.15 | 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 |

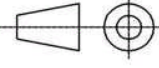
|                                                                                                              |
|--------------------------------------------------------------------------------------------------------------|
| DOCUMENT NO.<br>Z8B00003329                                             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

## Package Outline

## PG-TO251-3



| DIM | MILLIMETERS |      | INCHES |       |
|-----|-------------|------|--------|-------|
|     | MIN         | MAX  | MIN    | MAX   |
| A   | 2.16        | 2.41 | 0.085  | 0.095 |
| A1  | 0.90        | 1.14 | 0.035  | 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        | 0.60 | 0.018  | 0.024 |
| c2  | 0.46        | 0.89 | 0.018  | 0.035 |
| D   | 5.97        | 6.22 | 0.235  | 0.245 |
| D1  | 5.04        | 5.77 | 0.198  | 0.227 |
| E   | 6.35        | 6.73 | 0.250  | 0.265 |
| E1  | 4.70        | 5.21 | 0.185  | 0.205 |
| e   | 2.29        |      | 0.090  |       |
| e1  | 4.57        |      | 0.180  |       |
| N   | 3           |      | 3      |       |
| L   | 8.89        | 9.65 | 0.350  | 0.380 |
| L1  | 1.90        | 2.29 | 0.075  | 0.090 |
| L2  | 0.89        | 1.37 | 0.035  | 0.054 |

|                                                                                                              |
|--------------------------------------------------------------------------------------------------------------|
| DOCUMENT NO.<br>Z8B00003330                                                                                  |
| SCALE<br>0 2.0 4mm                                                                                           |
| EUROPEAN PROJECTION<br> |
| ISSUE DATE<br>19-03-2008                                                                                     |
| REVISION<br>03                                                                                               |



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