

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

### Features

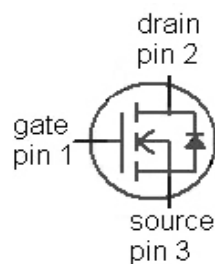
- Ideal for high frequency switching and sync. rec.
- Optimized technology for DC/DC converters
- Excellent gate charge x  $R_{DS(on)}$  product (FOM)
- Very low on-resistance  $R_{DS(on)}$
- N-channel, logic level
- 100% avalanche tested
- Pb-free plating; RoHS compliant
- Qualified according to JEDEC<sup>1)</sup> for target applications

### Product Summary

|                  |     |    |
|------------------|-----|----|
| $V_{DS}$         | 60  | V  |
| $R_{DS(on),max}$ | 3.5 | mΩ |
| $I_D$            | 90  | A  |



|         |                                                                                    |
|---------|------------------------------------------------------------------------------------|
| Type    | IPD035N06L3 G                                                                      |
|         |  |
| Package | PG-TO-252-3                                                                        |
| Marking | 035N06L                                                                            |



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

| Parameter                                    | Symbol            | Conditions                               | Value       | Unit |
|----------------------------------------------|-------------------|------------------------------------------|-------------|------|
| Continuous drain current                     | $I_D$             | $T_C=25\text{ °C}^{2)}$                  | 90          | A    |
|                                              |                   | $T_C=100\text{ °C}$                      | 90          |      |
| Pulsed drain current <sup>3)</sup>           | $I_{D,pulse}$     | $T_C=25\text{ °C}$                       | 360         |      |
| Avalanche energy, single pulse <sup>4)</sup> | $E_{AS}$          | $I_D=90\text{ A}$ , $R_{GS}=25\text{ Ω}$ | 165         | mJ   |
| Gate source voltage                          | $V_{GS}$          |                                          | ±20         | V    |
| Power dissipation                            | $P_{tot}$         | $T_C=25\text{ °C}$                       | 167         | 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> Current is limited by bondwire; with an  $R_{thJC}=0.9\text{ K/W}$  the chip is able to carry 162 A.

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

<sup>4)</sup> See figure 13 for more detailed information

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

#### Thermal characteristics

|                                           |            |                                              |   |   |     |     |
|-------------------------------------------|------------|----------------------------------------------|---|---|-----|-----|
| Thermal resistance, junction - case       | $R_{thJC}$ |                                              | - | - | 0.9 | K/W |
| Thermal resistance,<br>junction - ambient | $R_{thJA}$ | 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   | $V_{(BR)DSS}$ | $V_{GS}=0\text{ V}, I_D=1\text{ mA}$                       | 60  | -   | -   | V             |
| Gate threshold voltage           | $V_{GS(th)}$  | $V_{DS}=V_{GS}, I_D=93\text{ }\mu\text{A}$                 | 1.2 | 1.7 | 2.2 |               |
| Zero gate voltage drain current  | $I_{DSS}$     | $V_{DS}=60\text{ V}, V_{GS}=0\text{ V}, T_j=25\text{ °C}$  | -   | 0.1 | 1   | $\mu\text{A}$ |
|                                  |               | $V_{DS}=60\text{ V}, V_{GS}=0\text{ V}, T_j=125\text{ °C}$ | -   | 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 | $R_{DS(on)}$  | $V_{GS}=10\text{ V}, I_D=90\text{ A}$                      | -   | 2.7 | 3.5 | m $\Omega$    |
|                                  |               | $V_{GS}=4.5\text{ V}, I_D=45\text{ A}$                     | -   | 3.7 | 5.5 |               |
| Gate resistance                  | $R_G$         |                                                            | -   | 1.3 | -   | $\Omega$      |
| Transconductance                 | $g_{fs}$      | $ V_{DS} >2 I_D R_{DS(on)max}, I_D=90\text{ A}$            | 76  | 151 | -   | S             |

<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            | $C_{iss}$    | $V_{GS}=0\text{ V}, V_{DS}=30\text{ V},$<br>$f=1\text{ MHz}$                    | - | 10000 | 13000 | pF |
| Output capacitance           | $C_{oss}$    |                                                                                 | - | 1700  | 2300  |    |
| Reverse transfer capacitance | $C_{rss}$    |                                                                                 | - | 58    | -     |    |
| Turn-on delay time           | $t_{d(on)}$  | $V_{DD}=30\text{ V}, V_{GS}=10\text{ V},$<br>$I_D=90\text{ A}, R_G=1.6\ \Omega$ | - | 25    | -     | ns |
| Rise time                    | $t_r$        |                                                                                 | - | 78    | -     |    |
| Turn-off delay time          | $t_{d(off)}$ |                                                                                 | - | 64    | -     |    |
| Fall time                    | $t_f$        |                                                                                 | - | 13    | -     |    |

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

|                       |               |                                                                             |   |     |     |    |
|-----------------------|---------------|-----------------------------------------------------------------------------|---|-----|-----|----|
| Gate to source charge | $Q_{gs}$      | $V_{DD}=30\text{ V}, I_D=90\text{ A},$<br>$V_{GS}=0\text{ to }4.5\text{ V}$ | - | 34  | -   | nC |
| Gate to drain charge  | $Q_{gd}$      |                                                                             | - | 11  | -   |    |
| Switching charge      | $Q_{sw}$      |                                                                             | - | 29  | -   |    |
| Gate charge total     | $Q_g$         |                                                                             | - | 59  | 79  |    |
| Gate plateau voltage  | $V_{plateau}$ |                                                                             | - | 3.4 | -   | V  |
| Output charge         | $Q_{oss}$     | $V_{DD}=30\text{ V}, V_{GS}=0\text{ V}$                                     | - | 83  | 110 | nC |

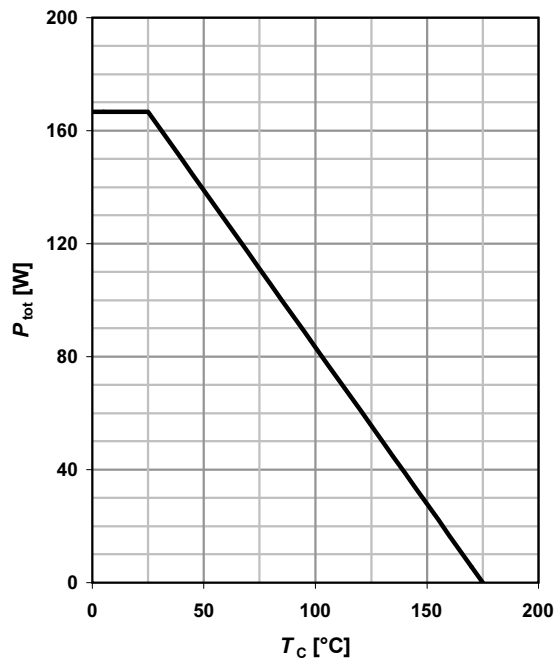
#### Reverse Diode

|                                  |               |                                                                         |   |      |     |    |
|----------------------------------|---------------|-------------------------------------------------------------------------|---|------|-----|----|
| Diode continuous forward current | $I_S$         | $T_C=25\text{ }^\circ\text{C}$                                          | - | -    | 90  | A  |
| Diode pulse current              | $I_{S,pulse}$ |                                                                         | - | -    | 360 |    |
| Diode forward voltage            | $V_{SD}$      | $V_{GS}=0\text{ V}, I_F=90\text{ A},$<br>$T_j=25\text{ }^\circ\text{C}$ | - | 0.95 | 1.2 | V  |
| Reverse recovery time            | $t_{rr}$      | $V_R=30\text{ V}, I_F=I_S,$<br>$di_F/dt=100\text{ A}/\mu\text{s}$       | - | 44   | -   | ns |
| Reverse recovery charge          | $Q_{rr}$      |                                                                         | - | 66   | -   | nC |

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

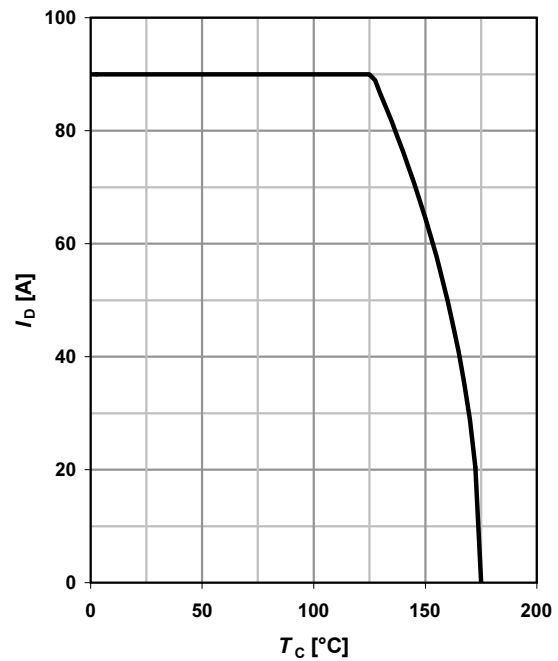
## 1 Power dissipation

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



## 2 Drain current

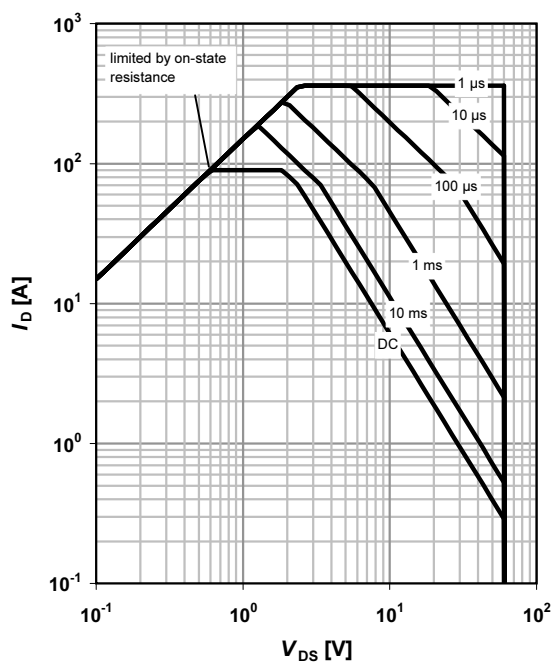
$$I_D = f(T_C); V_{GS} \geq 10 \text{ V}$$



## 3 Safe operating area

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

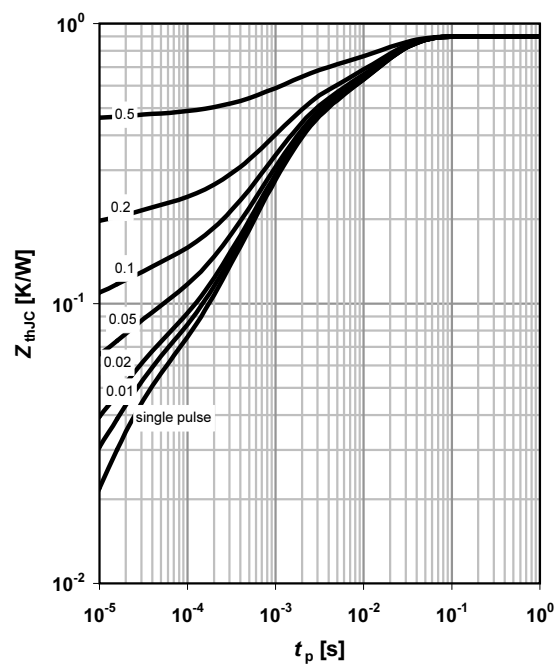
parameter:  $t_p$



## 4 Max. transient thermal impedance

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

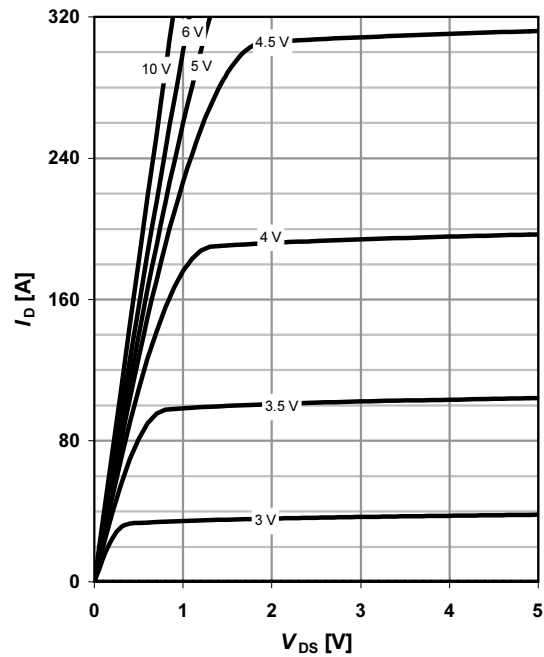
parameter:  $D = t_p/T$



### 5 Typ. output characteristics

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

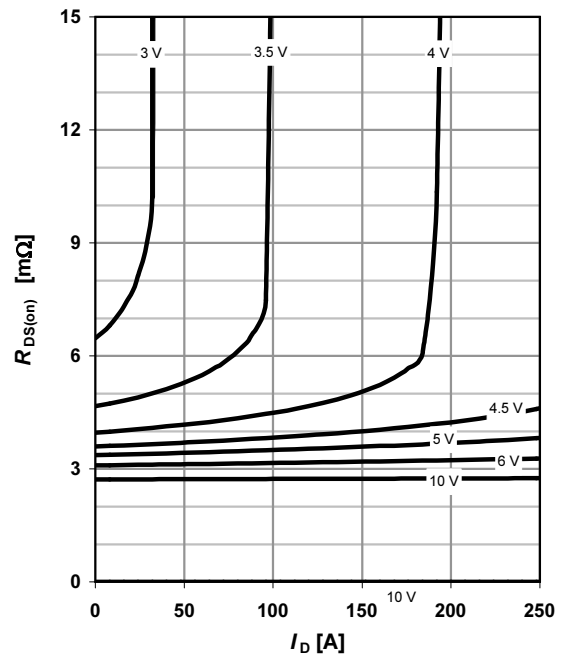
parameter:  $V_{GS}$



### 6 Typ. drain-source on resistance

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

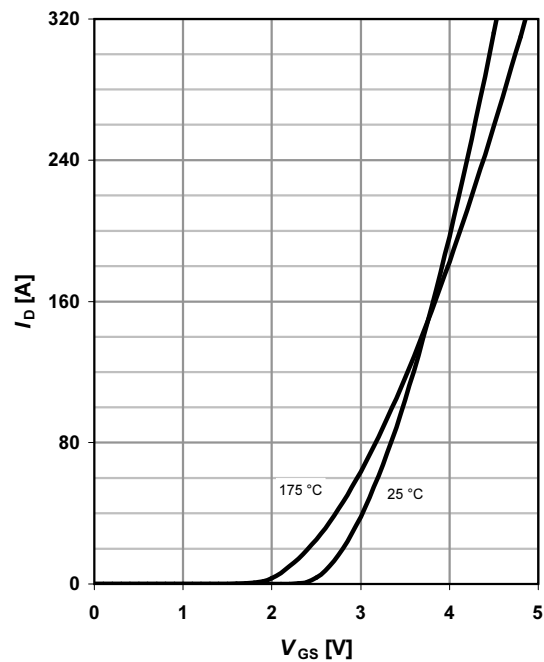
parameter:  $V_{GS}$



### 7 Typ. transfer characteristics

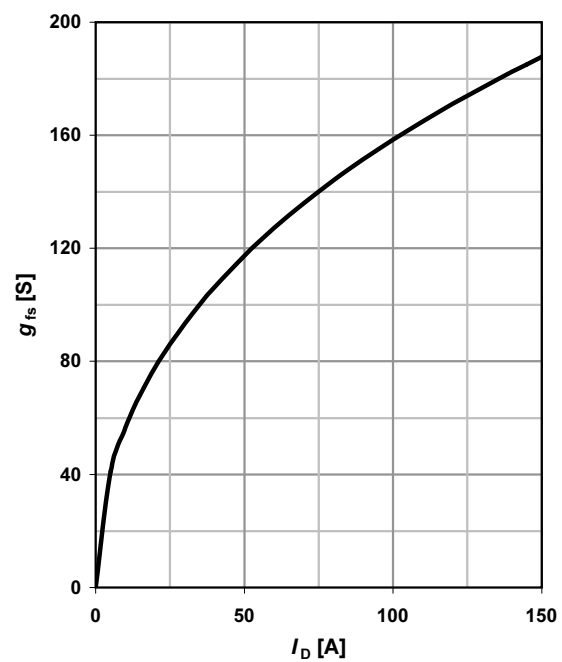
$$I_D = f(V_{GS}); |V_{DS}| > 2|I_D|R_{DS(on)max}$$

parameter:  $T_J$



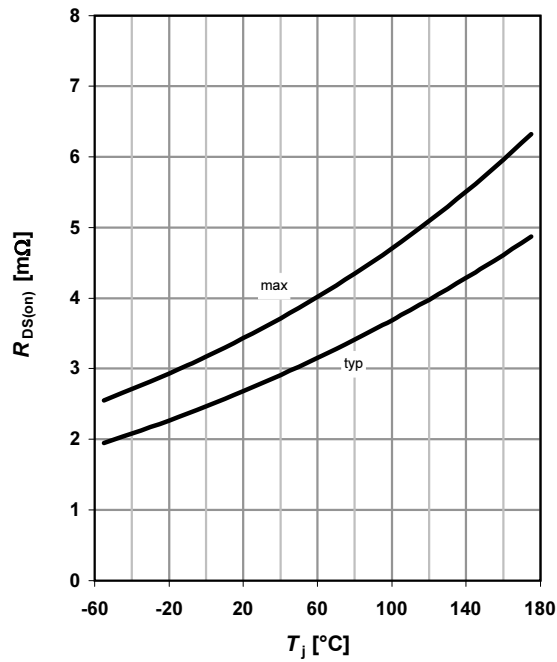
### 8 Typ. forward transconductance

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



### 9 Drain-source on-state resistance

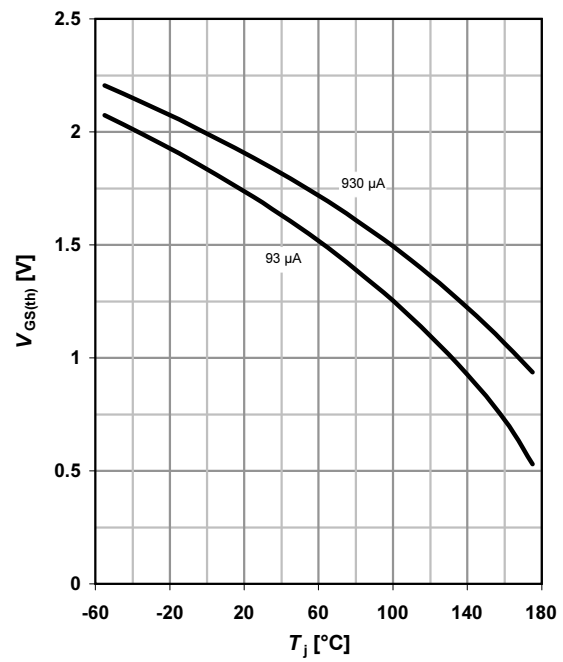
$$R_{DS(on)} = f(T_j); I_D = 90 \text{ A}; V_{GS} = 10 \text{ V}$$



### 10 Typ. gate threshold voltage

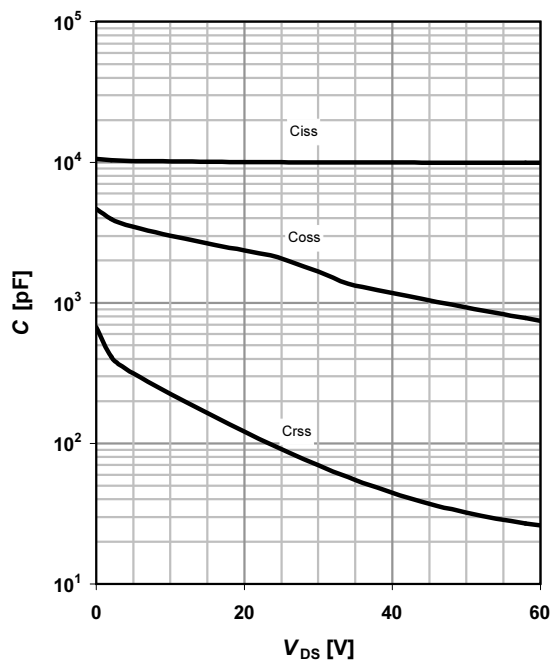
$$V_{GS(th)} = f(T_j); V_{GS} = V_{DS}$$

parameter:  $I_D$



### 11 Typ. capacitances

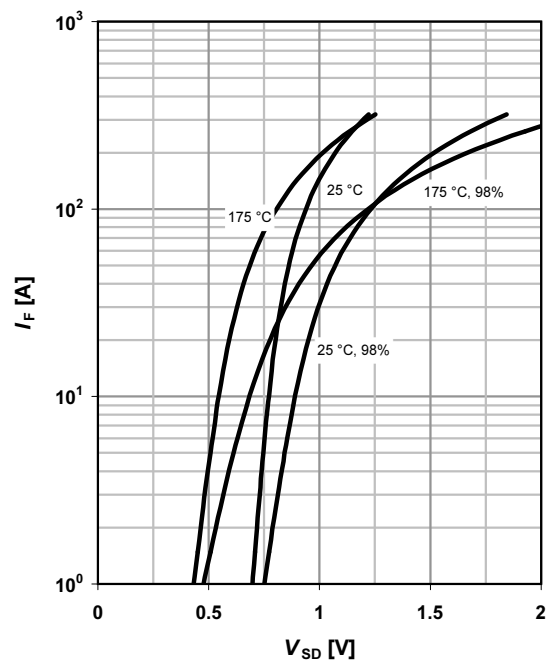
$$C = f(V_{DS}); V_{GS} = 0 \text{ V}; f = 1 \text{ MHz}$$



### 12 Forward characteristics of reverse diode

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

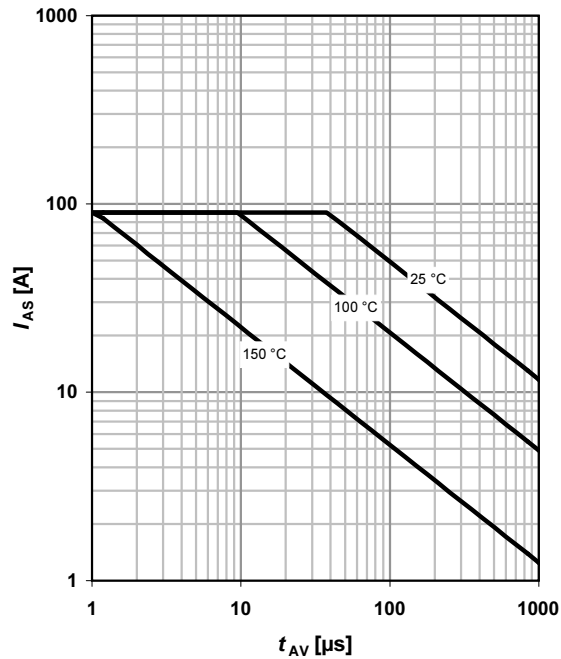
parameter:  $T_j$



### 13 Avalanche characteristics

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

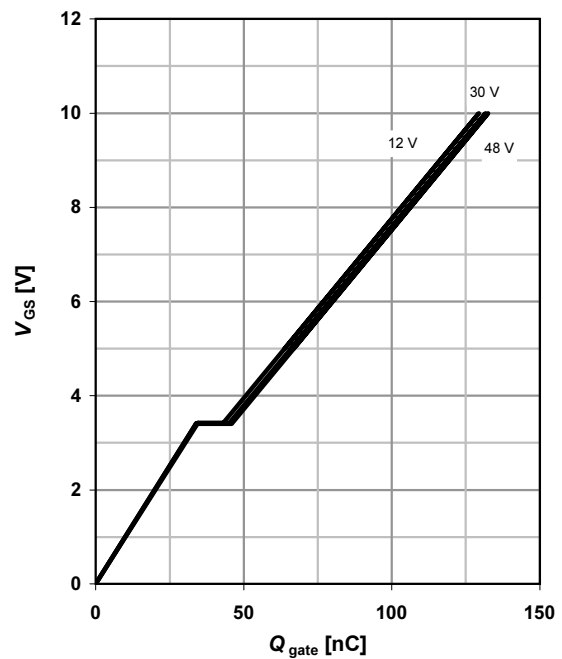
parameter:  $T_{j(\text{start})}$



### 14 Typ. gate charge

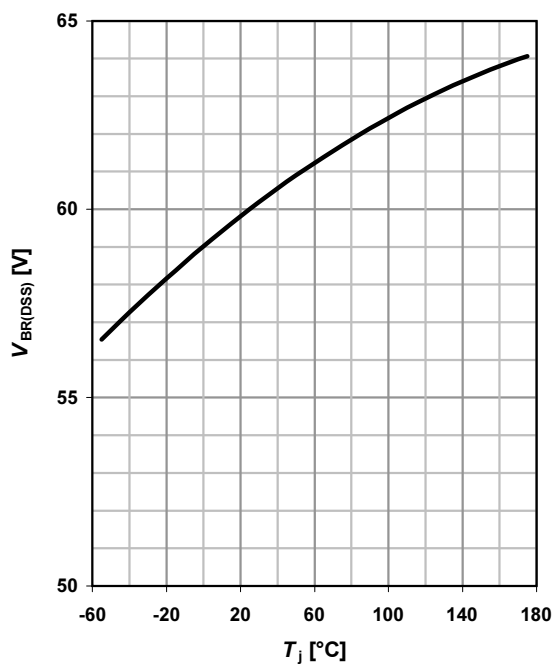
$$V_{GS}=f(Q_{\text{gate}}); I_D=90\ \text{A pulsed}$$

parameter:  $V_{DD}$

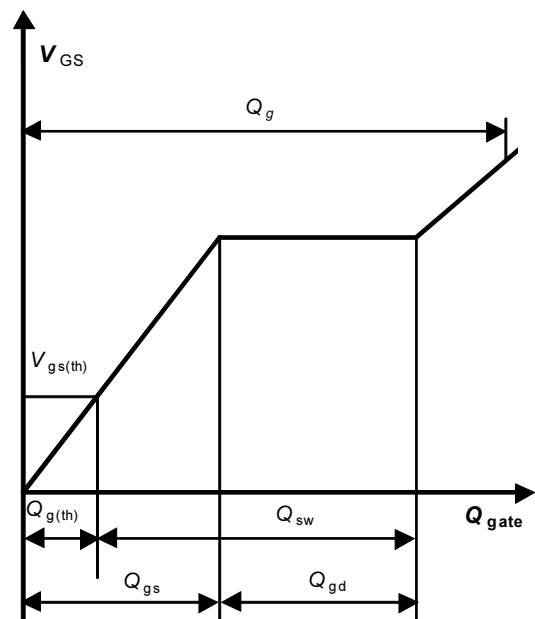


### 15 Drain-source breakdown voltage

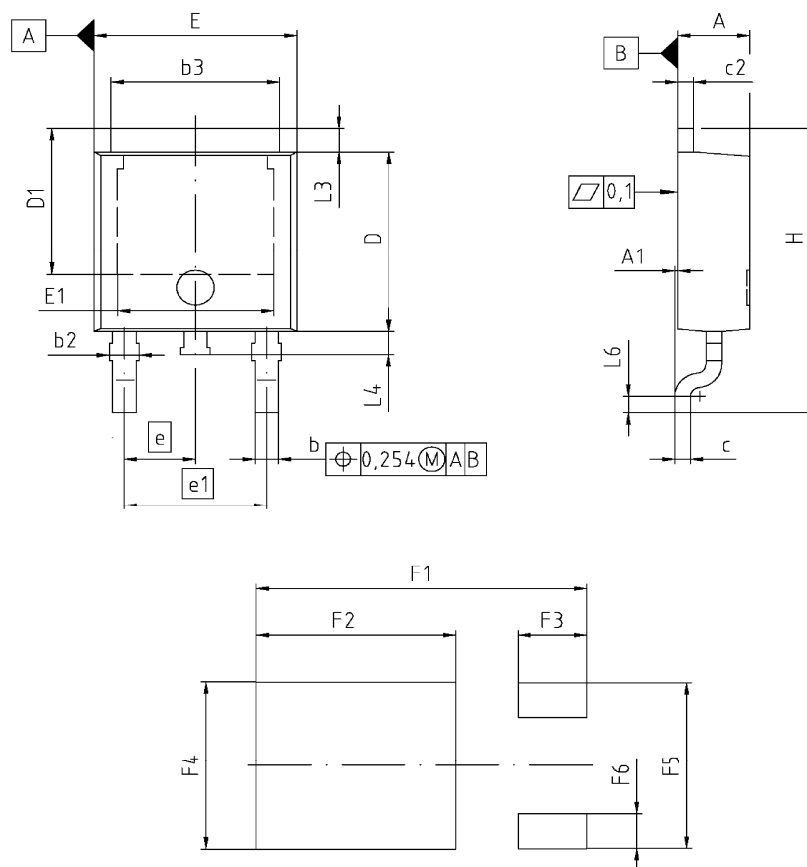
$$V_{BR(DSS)}=f(T_j); I_D=1\ \text{mA}$$



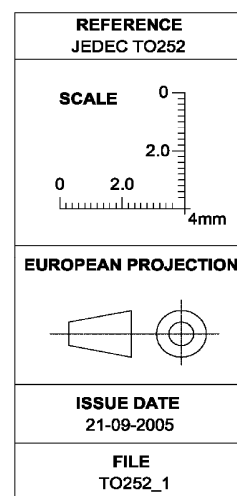
### 16 Gate charge waveforms



## PG-T0252-3



| 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 |



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