



IPB016N06L3 G

## OptiMOS™3 Power-Transistor

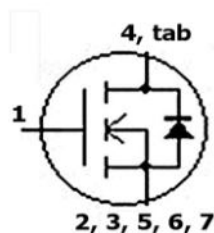
### Features

- Ideal for high frequency switching and sync. rec.
- Optimized technology for DC/DC converters
- Excellent gate charge  $\times R_{DS(on)}$  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
- Halogen-free according to IEC61249-2-21

|         |                                                                                     |
|---------|-------------------------------------------------------------------------------------|
| Type    | IPB016N06L3 G                                                                       |
|         |  |
| Package | PG-TO-263-7                                                                         |
| Marking | 016N06L                                                                             |

### Product Summary

|                  |     |    |
|------------------|-----|----|
| $V_{DS}$         | 60  | V  |
| $R_{DS(on),max}$ | 1.6 | mΩ |
| $I_D$            | 180 | A  |



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

| Parameter                                    | Symbol            | Conditions                                | Value       | Unit |
|----------------------------------------------|-------------------|-------------------------------------------|-------------|------|
| Continuous drain current                     | $I_D$             | $T_C=25\text{ °C}^{2)}$                   | 180         | A    |
|                                              |                   | $T_C=100\text{ °C}$                       | 180         |      |
|                                              |                   |                                           |             |      |
| Pulsed drain current <sup>3)</sup>           | $I_{D,pulse}$     | $T_C=25\text{ °C}$                        | 720         |      |
| Avalanche energy, single pulse <sup>4)</sup> | $E_{AS}$          | $I_D=100\text{ A}$ , $R_{GS}=25\text{ Ω}$ | 634         | mJ   |
| Gate source voltage                          | $V_{GS}$          |                                           | ±20         | V    |
| Power dissipation                            | $P_{tot}$         | $T_C=25\text{ °C}$                        | 250         | 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  $R_{thJC}=0.6\text{ K/W}$  the chip is able to carry 293 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       | $R_{thJC}$ |                                              | - | - | 0.6 | 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           | $V_{GS(th)}$  | $V_{DS}=V_{GS}, I_D=196\text{ }\mu\text{A}$                | 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 | 3   | $\mu\text{A}$ |
|                                  |               | $V_{DS}=60\text{ V}, V_{GS}=0\text{ V}, T_j=125\text{ °C}$ | -   | 30  | 300 |               |
| Gate-source leakage current      | $I_{GSS}$     | $V_{GS}=20\text{ V}, V_{DS}=0\text{ V}$                    | -   | 1   | 100 | nA            |
| Drain-source on-state resistance | $R_{DS(on)}$  | $V_{GS}=10\text{ V}, I_D=100\text{ A}$                     | -   | 1.2 | 1.6 | m $\Omega$    |
|                                  |               | $V_{GS}=4.5\text{ V}, I_D=50\text{ A}$                     | -   | 1.6 | 2.7 |               |
| Gate resistance                  | $R_G$         |                                                            | -   | 1.3 | -   | $\Omega$      |
| Transconductance                 | $g_{fs}$      | $ V_{DS} >2 I_D R_{DS(on)max}, I_D=100\text{ A}$           | 124 | 248 | -   | 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.



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| 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>$f=1\text{ MHz}$                     | - | 21000 | 28000 | pF |
| Output capacitance           | $C_{oss}$    |                                                                                  | - | 3300  | 4400  |    |
| Reverse transfer capacitance | $C_{rss}$    |                                                                                  | - | 140   | -     |    |
| Turn-on delay time           | $t_{d(on)}$  | $V_{DD}=30\text{ V}, V_{GS}=10\text{ V},$<br>$I_D=100\text{ A}, R_G=1.6\ \Omega$ | - | 35    | -     | ns |
| Rise time                    | $t_r$        |                                                                                  | - | 79    | -     |    |
| Turn-off delay time          | $t_{d(off)}$ |                                                                                  | - | 131   | -     |    |
| Fall time                    | $t_f$        |                                                                                  | - | 38    | -     |    |

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

|                       |               |                                                                              |   |     |     |    |
|-----------------------|---------------|------------------------------------------------------------------------------|---|-----|-----|----|
| Gate to source charge | $Q_{gs}$      | $V_{DD}=30\text{ V}, I_D=100\text{ A},$<br>$V_{GS}=0\text{ to }4.5\text{ V}$ | - | 65  | -   | nC |
| Gate to drain charge  | $Q_{gd}$      |                                                                              | - | 21  | -   |    |
| Switching charge      | $Q_{sw}$      |                                                                              | - | 50  | -   |    |
| Gate charge total     | $Q_g$         |                                                                              | - | 125 | 166 |    |
| Gate plateau voltage  | $V_{plateau}$ |                                                                              | - | 3.1 | -   | V  |
| Output charge         | $Q_{oss}$     | $V_{DD}=30\text{ V}, V_{GS}=0\text{ V}$                                      | - | 165 | 219 | nC |

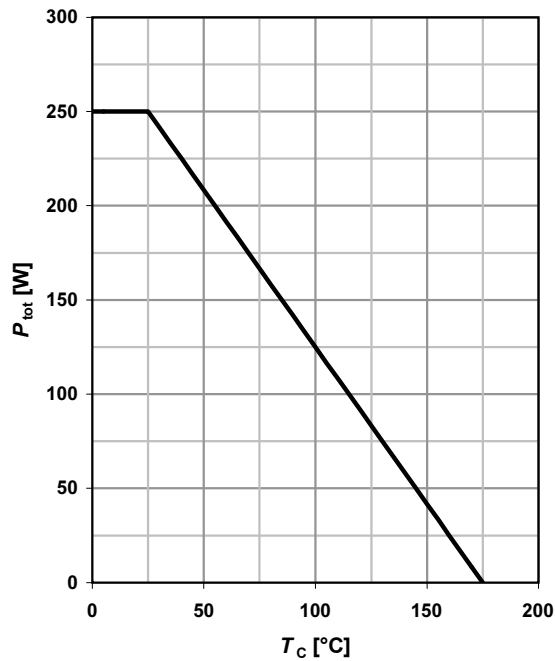
#### Reverse Diode

|                                  |               |                                                                            |   |     |     |    |
|----------------------------------|---------------|----------------------------------------------------------------------------|---|-----|-----|----|
| Diode continuous forward current | $I_S$         | $T_C=25\text{ °C}$                                                         | - | -   | 180 | A  |
| Diode pulse current              | $I_{S,pulse}$ |                                                                            | - | -   | 720 |    |
| Diode forward voltage            | $V_{SD}$      | $V_{GS}=0\text{ V}, I_F=100\text{ A},$<br>$T_j=25\text{ °C}$               | - | 0.9 | 1.2 | V  |
| Reverse recovery time            | $t_{rr}$      | $V_R=30\text{ V}, I_F=100\text{ A},$<br>$di_F/dt=100\text{ A}/\mu\text{s}$ | - | 71  | -   | ns |
| Reverse recovery charge          | $Q_{rr}$      |                                                                            | - | 87  | -   | nC |

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

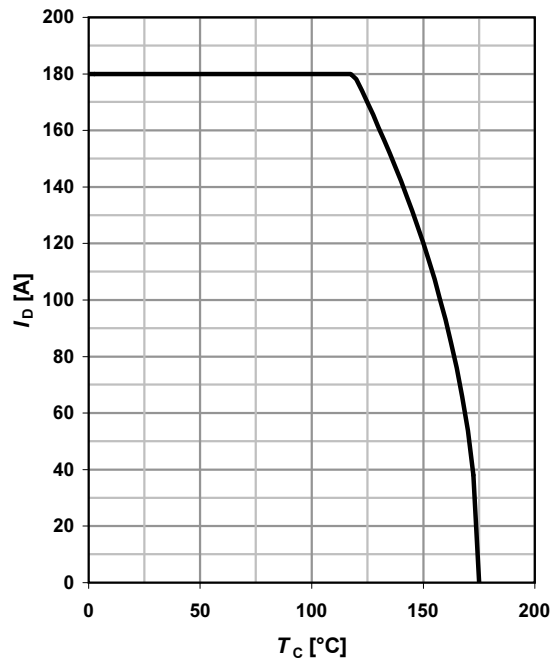
### 1 Power dissipation

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



### 2 Drain current

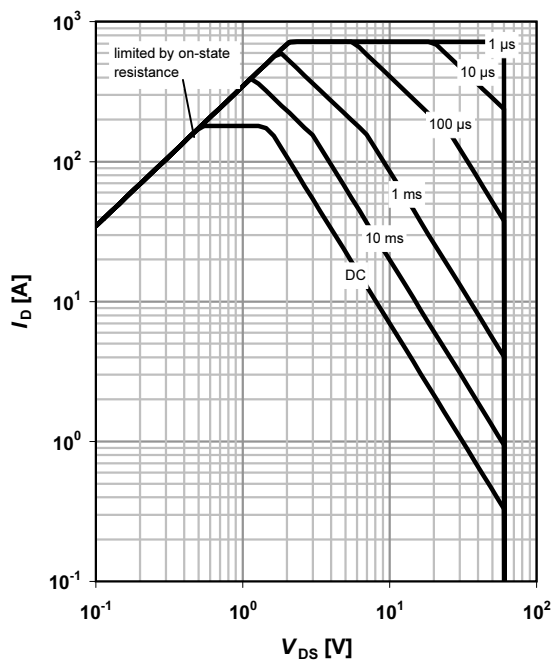
$$I_D = f(T_C); V_{GS} \geq 10 \text{ V}$$



### 3 Safe operating area

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

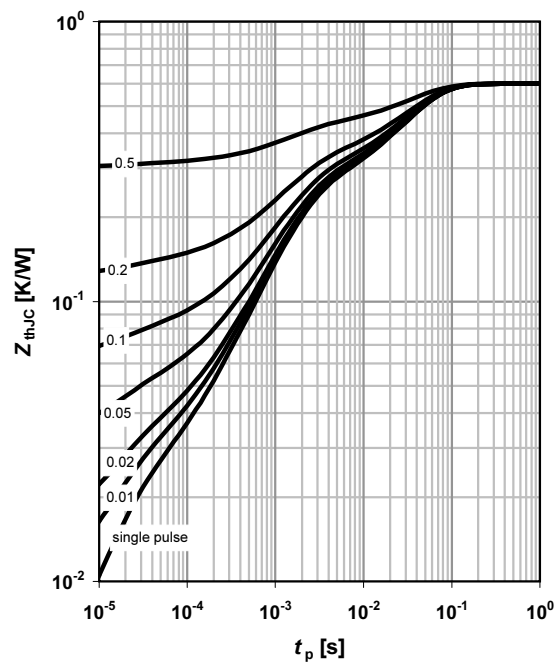
parameter:  $t_p$



### 4 Max. transient thermal impedance

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

parameter:  $D = t_p/T$



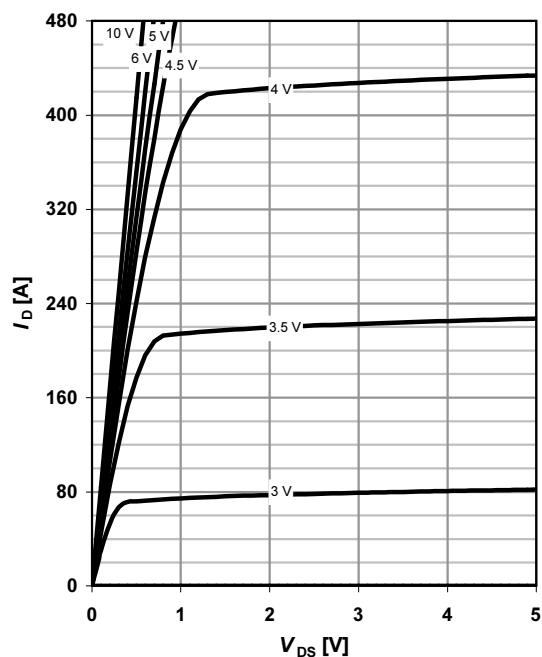


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### 5 Typ. output characteristics

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

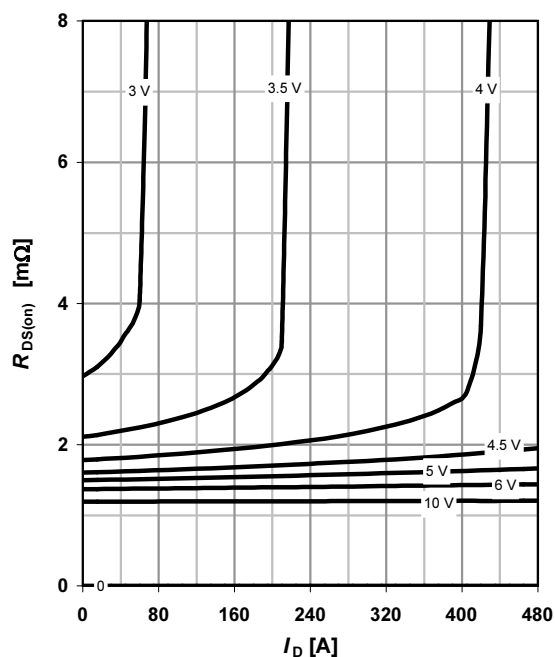
parameter:  $V_{GS}$



### 6 Typ. drain-source on resistance

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

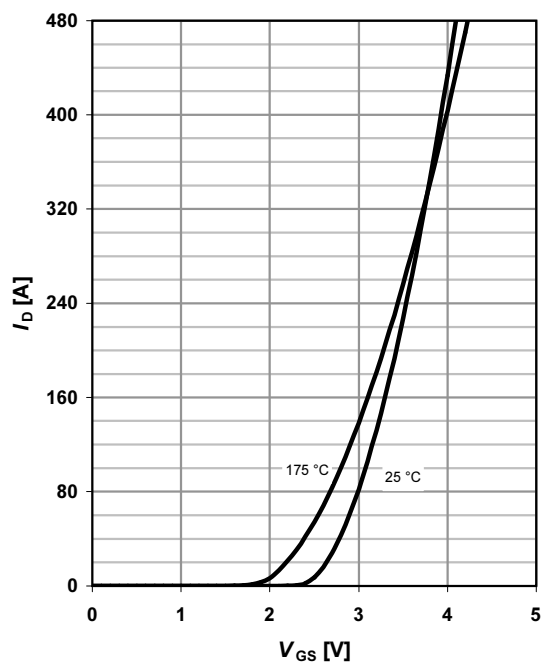
parameter:  $V_{GS}$



### 7 Typ. transfer characteristics

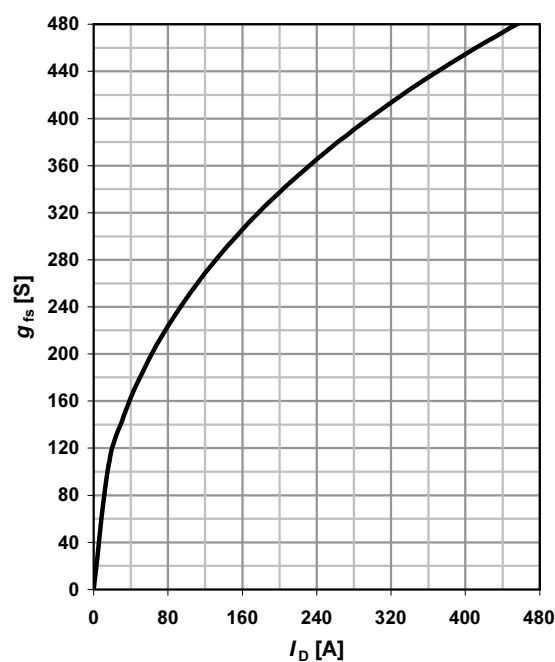
$$I_D = f(V_{GS}); |V_{DS}| > 2|I_D|R_{DS(on)max}$$

parameter:  $T_J$



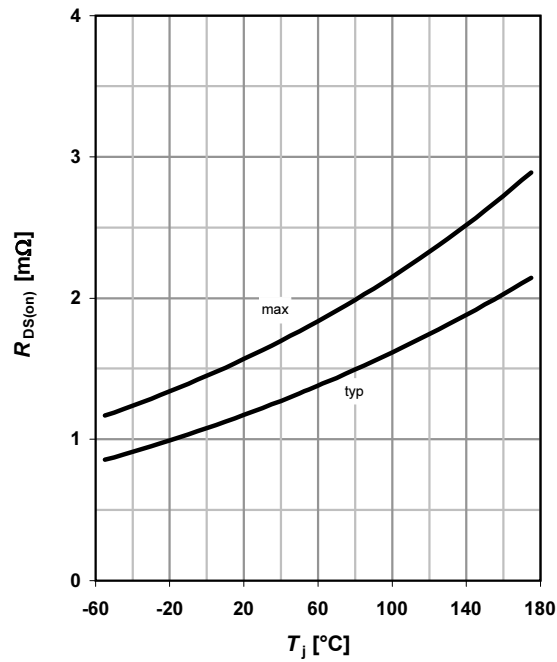
### 8 Typ. forward transconductance

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



### 9 Drain-source on-state resistance

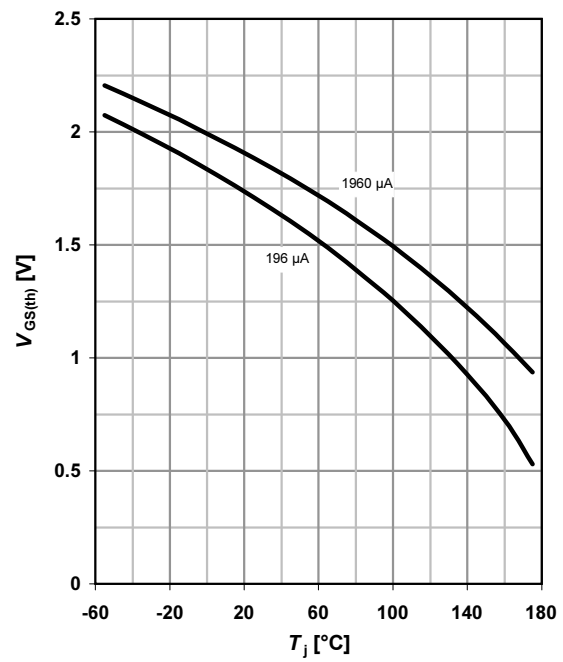
$$R_{DS(on)} = f(T_j); I_D = 100 \text{ A}; V_{GS} = 10 \text{ V}$$



### 10 Typ. gate threshold voltage

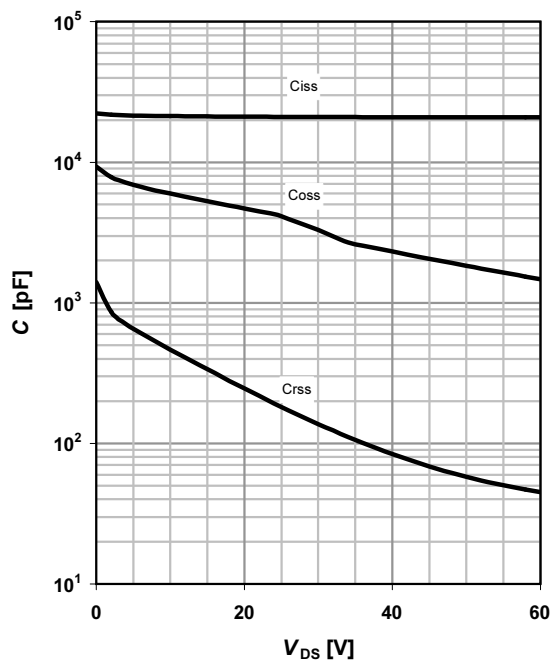
$$V_{GS(th)} = f(T_j); V_{GS} = V_{DS}$$

parameter:  $I_D$



### 11 Typ. capacitances

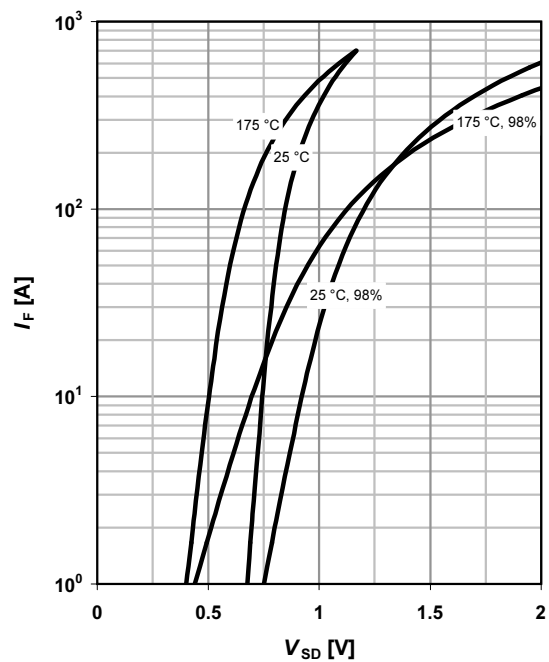
$$C = f(V_{DS}); V_{GS} = 0 \text{ V}; f = 1 \text{ MHz}$$



### 12 Forward characteristics of reverse diode

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

parameter:  $T_j$



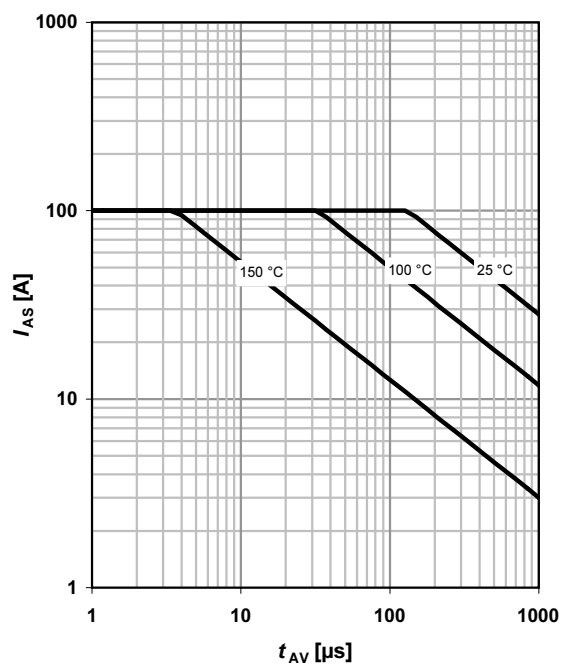


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### 13 Avalanche characteristics

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

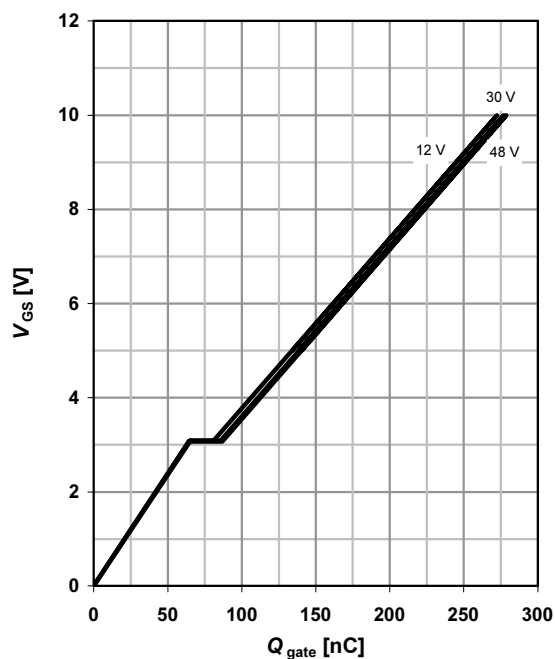
parameter:  $T_{j(\text{start})}$



### 14 Typ. gate charge

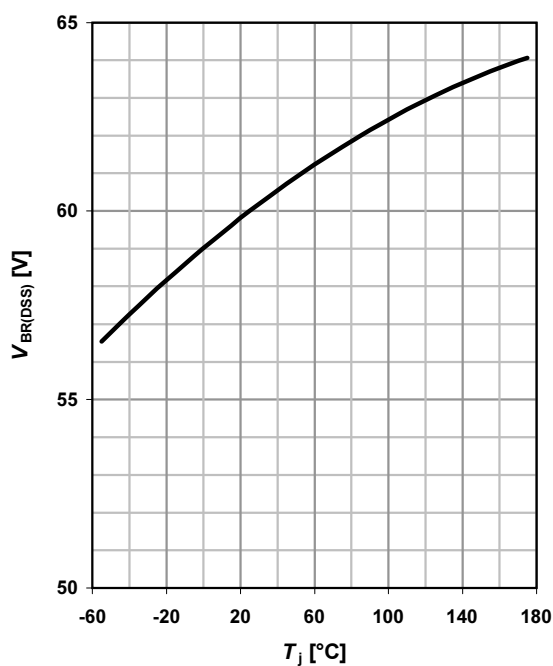
$$V_{GS}=f(Q_{\text{gate}}); I_D=100\ \text{A pulsed}$$

parameter:  $V_{DD}$

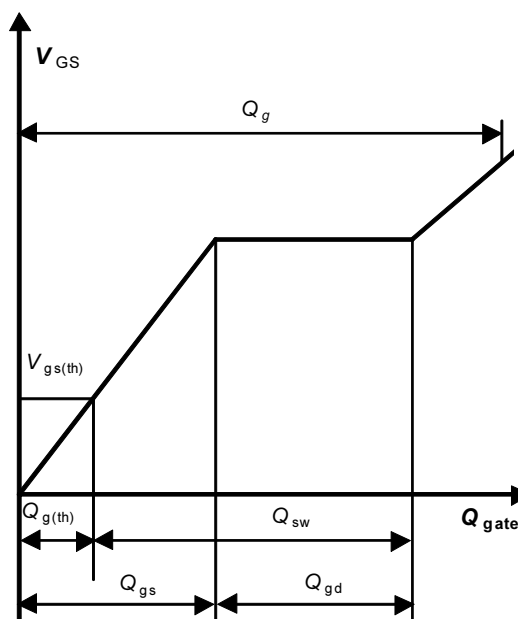


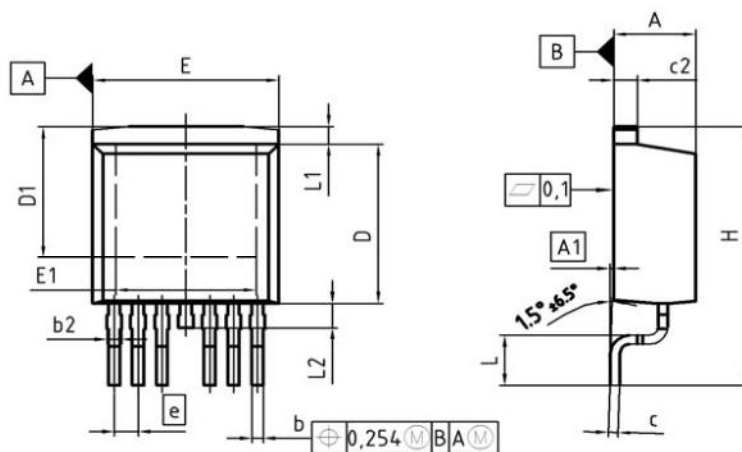
### 15 Drain-source breakdown voltage

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

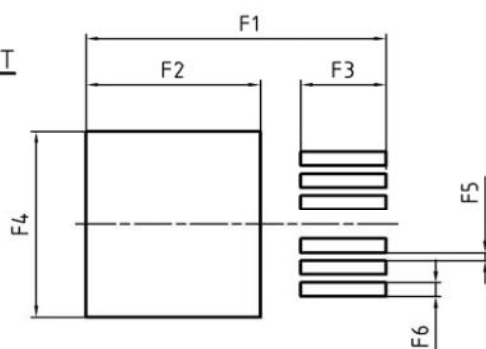


### 16 Gate charge waveforms

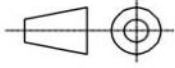


PG-TO-263-7 (D<sup>2</sup>-Pak 7pin)


## FOOTPRINT



| DIM | MILLIMETERS |       | INCHES |       |
|-----|-------------|-------|--------|-------|
|     | MIN         | MAX   | MIN    | MAX   |
| A   | 4.30        | 4.57  | 0.169  | 0.180 |
| A1  | 0.00        | 0.25  | 0.000  | 0.010 |
| b   | 0.50        | 0.70  | 0.020  | 0.028 |
| b2  | 0.50        | 1.00  | 0.020  | 0.039 |
| c   | 0.33        | 0.65  | 0.013  | 0.026 |
| c2  | 1.17        | 1.40  | 0.046  | 0.055 |
| D   | 8.51        | 9.45  | 0.335  | 0.372 |
| D1  | 6.90        | 7.90  | 0.272  | 0.311 |
| E   | 9.80        | 10.31 | 0.386  | 0.406 |
| E1  | 6.50        | 8.60  | 0.256  | 0.339 |
| e   | 1.27        |       | 0.050  |       |
| N   | 6           |       | 6      |       |
| H   | 14.61       | 15.88 | 0.575  | 0.625 |
| L   | 2.29        | 3.00  | 0.090  | 0.118 |
| L1  | 0.70        | 1.60  | 0.028  | 0.063 |
| L2  | 1.00        | 1.78  | 0.039  | 0.070 |
| F1  | 16.05       | 16.25 | 0.632  | 0.640 |
| F2  | 9.30        | 9.50  | 0.366  | 0.374 |
| F3  | 4.50        | 4.70  | 0.177  | 0.185 |
| F4  | 10.70       | 10.90 | 0.421  | 0.429 |
| F5  | 0.37        | 0.57  | 0.015  | 0.022 |
| F6  | 0.70        | 0.90  | 0.028  | 0.035 |

|                                                                                                              |
|--------------------------------------------------------------------------------------------------------------|
| DOCUMENT NO.<br>Z8B00134765                                                                                  |
| SCALE<br>0 5 5 7.5mm                                                                                         |
| EUROPEAN PROJECTION<br> |
| ISSUE DATE<br>05-11-2007                                                                                     |
| REVISION<br>01                                                                                               |





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