

## OptiMOS<sup>®</sup> -T2 Power-Transistor

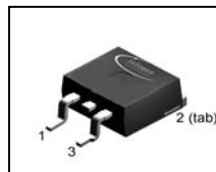
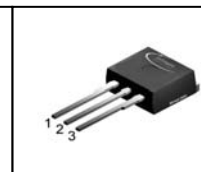
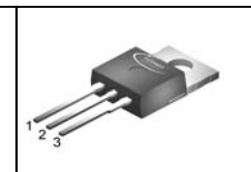


### Features

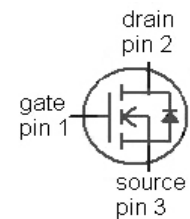
- N-channel - Enhancement mode
- Automotive AEC Q101 qualified
- MSL1 up to 260°C peak reflow
- 175°C operating temperature
- Green product (RoHS compliant)
- 100% Avalanche tested

### Product Summary

|                                |      |    |
|--------------------------------|------|----|
| $V_{DS}$                       | 55   | V  |
| $R_{DS(on),max}$ (SMD version) | 15.4 | mΩ |
| $I_D$                          | 45   | A  |

**PG-TO263-3-2**

**PG-TO262-3-1**

**PG-TO220-3-1**


| Type          | Package      | Marking |
|---------------|--------------|---------|
| IPB45N06S3-16 | PG-TO263-3-2 | 3N0616  |
| IPI45N06S3-16 | PG-TO262-3-1 | 3N0616  |
| IPP45N06S3-16 | PG-TO220-3-1 | 3N0616  |



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

| Parameter                                    | Symbol            | Conditions                                         | Value        | Unit |
|----------------------------------------------|-------------------|----------------------------------------------------|--------------|------|
| Continuous drain current <sup>1)</sup>       | $I_D$             | $T_C=25\text{ °C}$ , $V_{GS}=10\text{ V}$          | 45           | A    |
|                                              |                   | $T_C=100\text{ °C}$ ,<br>$V_{GS}=10\text{ V}^{2)}$ | 33           |      |
| Pulsed drain current <sup>2)</sup>           | $I_{D,pulse}$     | $T_C=25\text{ °C}$                                 | 90           |      |
| Avalanche energy, single pulse <sup>2)</sup> | $E_{AS}$          | $I_D=22.5\text{ A}$                                | 145          | mJ   |
| Avalanche current, single pulse              | $I_{AS}$          |                                                    | 45           | A    |
| Gate source voltage <sup>3)</sup>            | $V_{GS}$          |                                                    | ±20          | V    |
| Power dissipation                            | $P_{tot}$         | $T_C=25\text{ °C}$                                 | 65           | W    |
| Operating and storage temperature            | $T_J$ , $T_{stg}$ |                                                    | -55 ... +175 | °C   |
| IEC climatic category; DIN IEC 68-1          |                   |                                                    | 55/175/56    |      |

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

**Thermal characteristics<sup>2)</sup>**

|                                                |            |                                              |   |   |     |     |
|------------------------------------------------|------------|----------------------------------------------|---|---|-----|-----|
| Thermal resistance, junction - case            | $R_{thJC}$ |                                              | - | - | 2.3 | K/W |
| Thermal resistance, junction - ambient, leaded | $R_{thJA}$ |                                              | - | - | 62  |     |
| SMD version, device on PCB                     | $R_{thJA}$ | 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   | $V_{(BR)DSS}$ | $V_{GS}=0\text{ V}, I_D=250\text{ }\mu\text{A}$                 | 55  | -    | -    | V             |
| Gate threshold voltage           | $V_{GS(th)}$  | $V_{DS}=V_{GS}, I_D=30\text{ }\mu\text{A}$                      | 2.1 | 3    | 4    |               |
| Zero gate voltage drain current  | $I_{DSS}$     | $V_{DS}=25\text{ V}, V_{GS}=0\text{ V}, T_j=25\text{ °C}$       | -   | 0.1  | 1    | $\mu\text{A}$ |
|                                  |               | $V_{DS}=25\text{ V}, V_{GS}=0\text{ V}, T_j=125\text{ °C}^{1)}$ | -   | 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 | $R_{DS(on)}$  | $V_{GS}=10\text{ V}, I_D=23\text{ A}$                           | -   | 13.5 | 15.7 | m $\Omega$    |
|                                  |               | $V_{GS}=10\text{ V}, I_D=23\text{ A},$<br>SMD version           | -   | 13.2 | 15.4 |               |

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

### Dynamic characteristics<sup>2)</sup>

|                              |              |                                                                                       |   |      |   |    |
|------------------------------|--------------|---------------------------------------------------------------------------------------|---|------|---|----|
| Input capacitance            | $C_{iss}$    | $V_{GS}=0\text{ V}, V_{DS}=25\text{ V},$<br>$f=1\text{ MHz}$                          | - | 2980 | - | pF |
| Output capacitance           | $C_{oss}$    |                                                                                       | - | 450  | - |    |
| Reverse transfer capacitance | $C_{rss}$    |                                                                                       | - | 430  | - |    |
| Turn-on delay time           | $t_{d(on)}$  | $V_{DD}=27.5\text{ V},$<br>$V_{GS}=10\text{ V}, I_D=45\text{ A},$<br>$R_G=22\ \Omega$ | - | 28   | - | ns |
| Rise time                    | $t_r$        |                                                                                       | - | 61   | - |    |
| Turn-off delay time          | $t_{d(off)}$ |                                                                                       | - | 26   | - |    |
| Fall time                    | $t_f$        |                                                                                       | - | 68   | - |    |

### Gate Charge Characteristics<sup>2)</sup>

|                       |               |                                                                            |   |     |    |    |
|-----------------------|---------------|----------------------------------------------------------------------------|---|-----|----|----|
| Gate to source charge | $Q_{gs}$      | $V_{DD}=11\text{ V}, I_D=45\text{ A},$<br>$V_{GS}=0\text{ to }10\text{ V}$ | - | 23  | -  | nC |
| Gate to drain charge  | $Q_{gd}$      |                                                                            | - | 10  | -  |    |
| Gate charge total     | $Q_g$         |                                                                            | - | 43  | 57 |    |
| Gate plateau voltage  | $V_{plateau}$ |                                                                            | - | 7.2 | -  | V  |

### Reverse Diode

|                                       |               |                                                                     |   |     |     |    |
|---------------------------------------|---------------|---------------------------------------------------------------------|---|-----|-----|----|
| Diode continuous forward current      | $I_S$         | $T_C=25\text{ °C}$                                                  | - | -   | 45  | A  |
| Diode pulse current <sup>2)</sup>     | $I_{S,pulse}$ |                                                                     | - | -   | 90  |    |
| Diode forward voltage <sup>2)</sup>   | $V_{SD}$      | $V_{GS}=0\text{ V}, I_F=45\text{ A},$<br>$T_j=25\text{ °C}$         | - | 1.1 | 1.3 | V  |
| Reverse recovery time <sup>2)</sup>   | $t_{rr}$      | $V_R=27.5\text{ V}, I_F=I_S,$<br>$di_F/dt=100\text{ A}/\mu\text{s}$ | - | 20  | -   | ns |
| Reverse recovery charge <sup>2)</sup> | $Q_{rr}$      |                                                                     | - | 25  | -   | nC |

<sup>1)</sup> Current is limited by bondwire; with an  $R_{thJC} = 2.3\text{ K/W}$  the chip is able to carry 46A at 25°C. For detailed information see Application Note ANPS071E

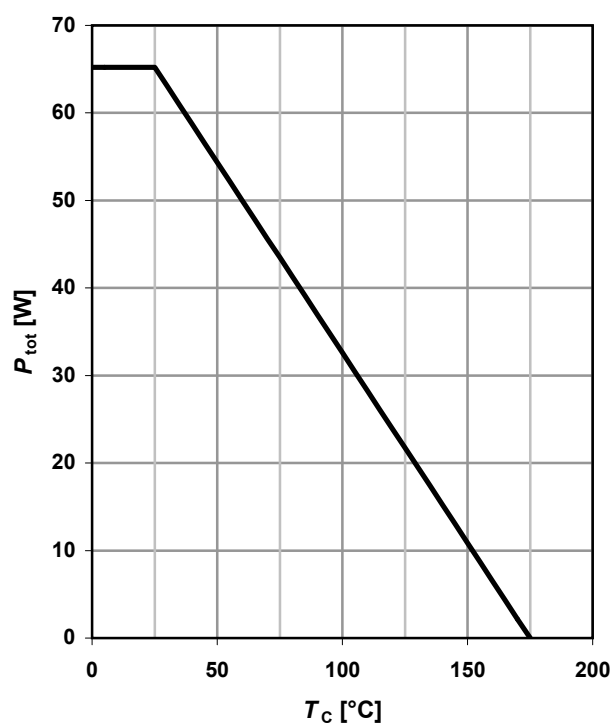
<sup>2)</sup> Defined by design. Not subject to production test.

<sup>3)</sup> Qualified at -5V and +20V.

<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 µm thick) copper area for drain connection. PCB is vertical in still air.

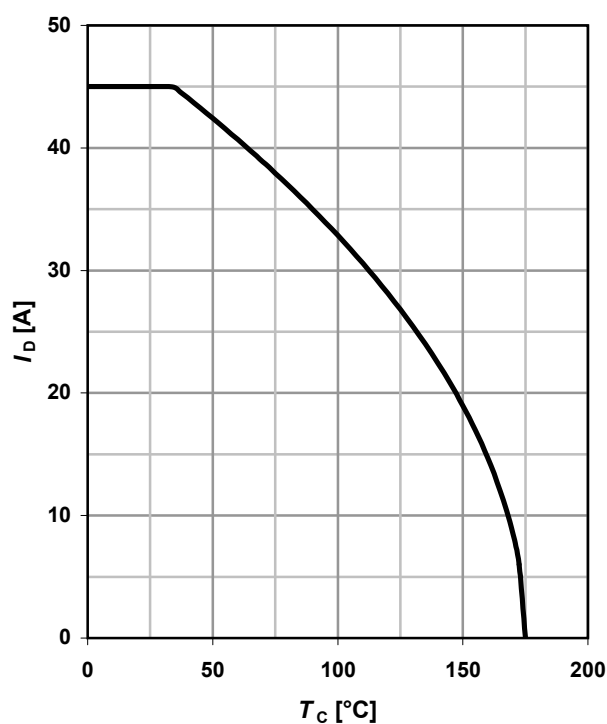
## 1 Power dissipation

$$P_{\text{tot}} = f(T_C); V_{\text{GS}} \geq 6 \text{ V}$$



## 2 Drain current

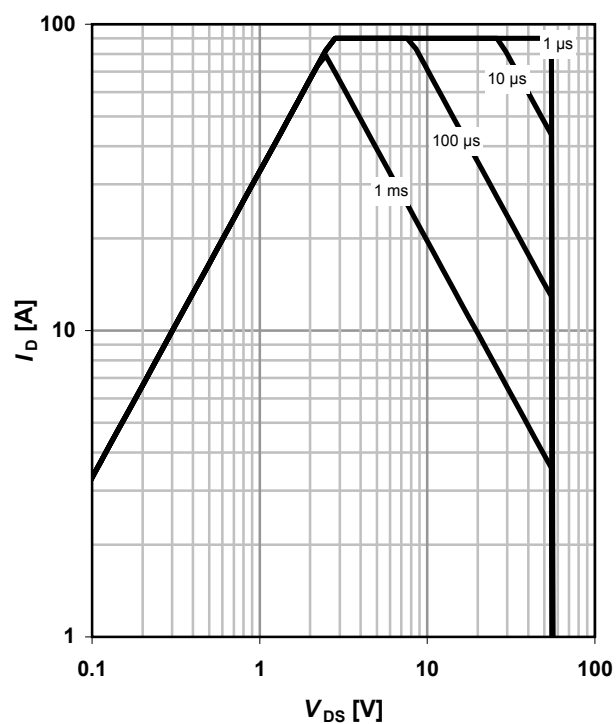
$$I_D = f(T_C); V_{\text{GS}} \geq 10 \text{ V}$$



## 3 Safe operating area

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

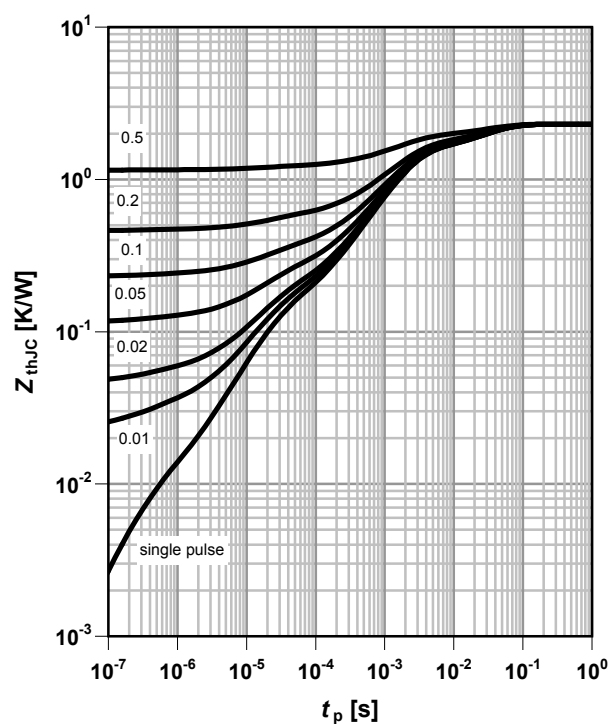
parameter:  $t_p$



## 4 Max. transient thermal impedance

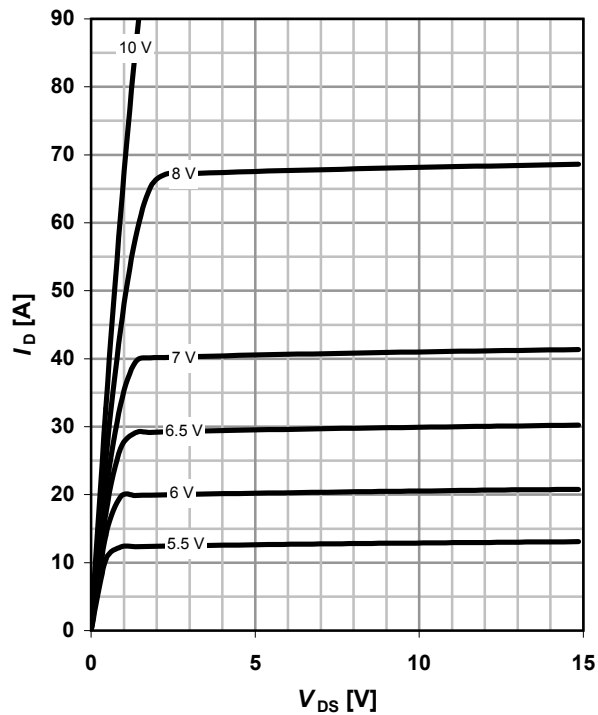
$$Z_{\text{thJC}} = f(t_p)$$

parameter:  $D = t_p / T$



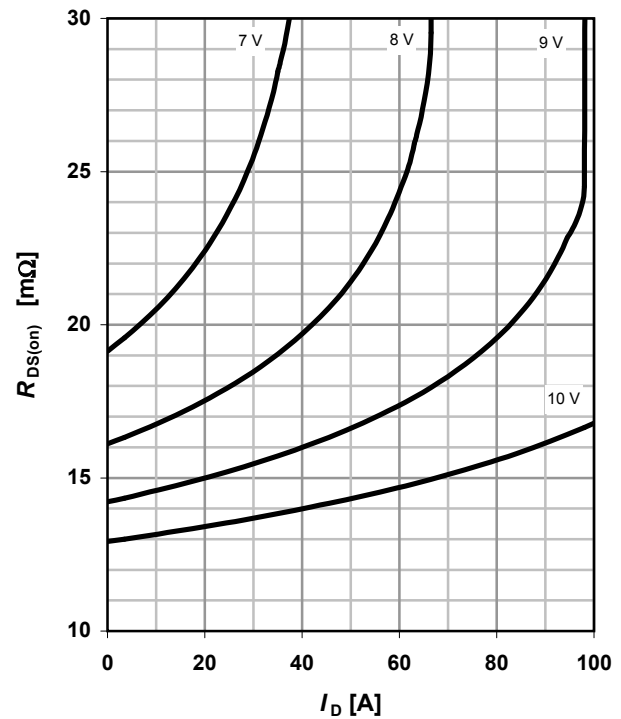
### 5 Typ. output characteristics

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

parameter:  $V_{GS}$ , pulsed


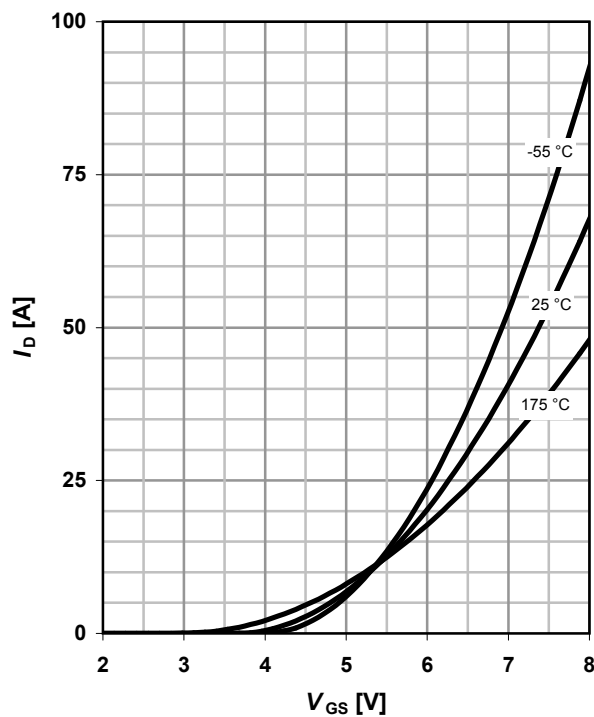
### 6 Typ. drain-source on resistance

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

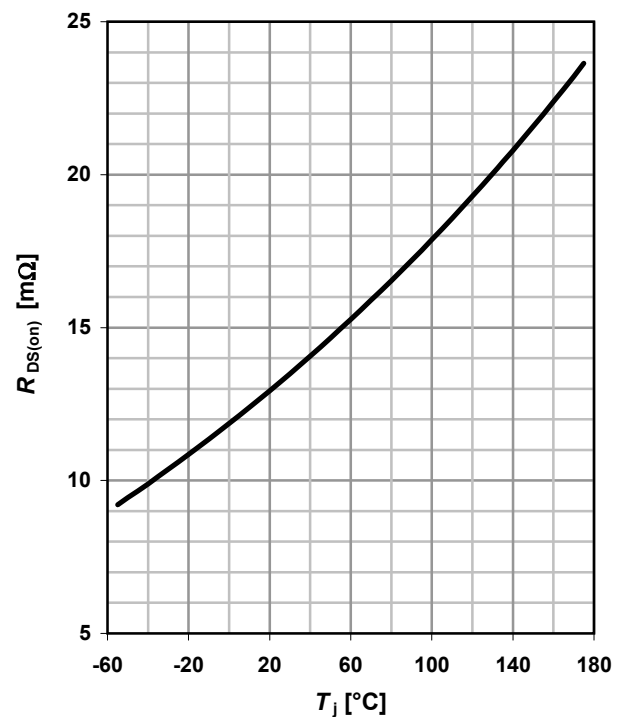
parameter:  $V_{GS}$ 


### 7 Typ. transfer characteristics

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

parameter:  $T_j$ 


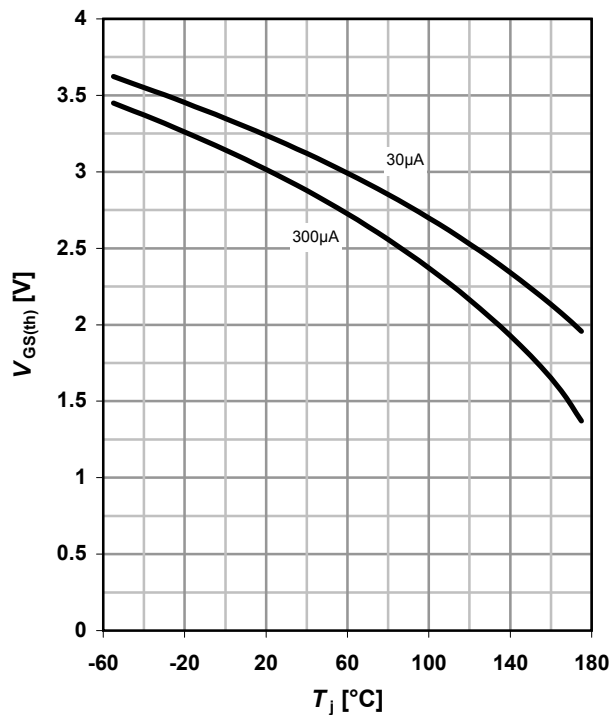
### 8 Drain-source on-state resistance

 $R_{DS(on)} = f(T_j); I_D = 20\text{ A}; V_{GS} = 10\text{ V}$ 


## 9 Typ. gate threshold voltage

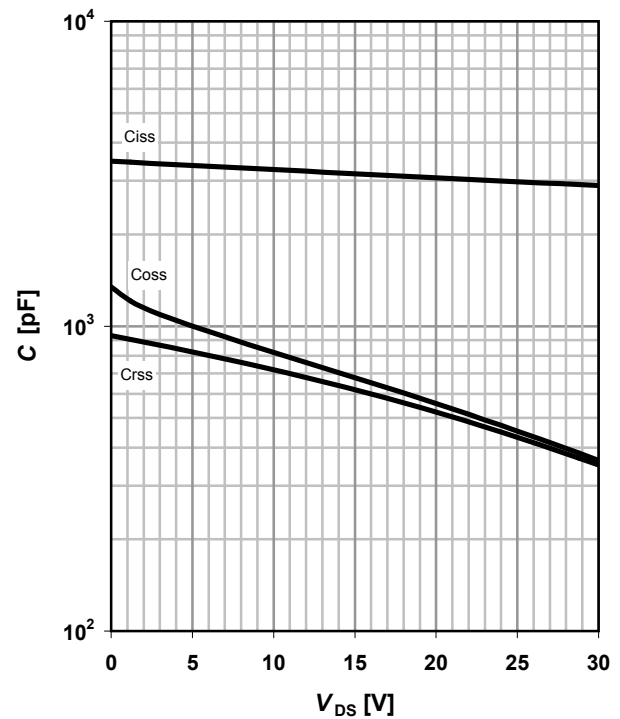
$$V_{GS(th)} = f(T_j); V_{GS} = V_{DS}$$

parameter:  $I_D$



## 10 Typ. capacitances

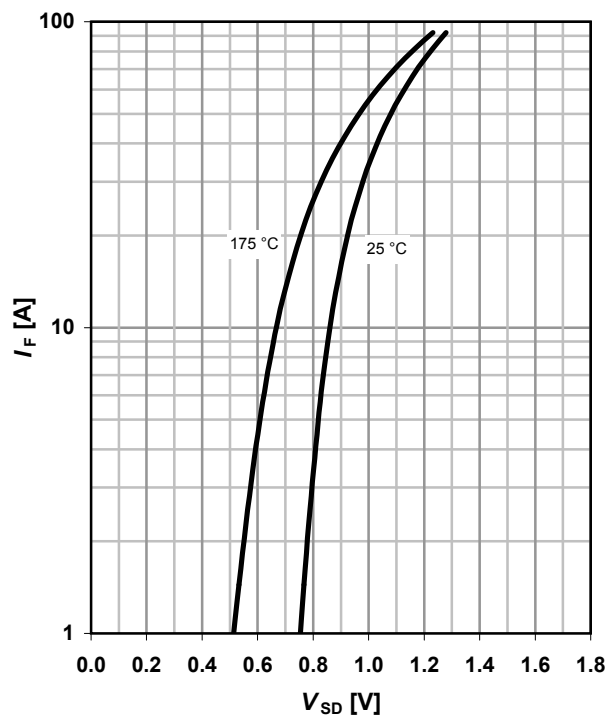
$$C = f(V_{DS}); V_{GS} = 0 \text{ V}; f = 1 \text{ MHz}$$



## 11 Forward characteristics of reverse diode

$$I_F = f(V_{SD}), \text{ pulsed}$$

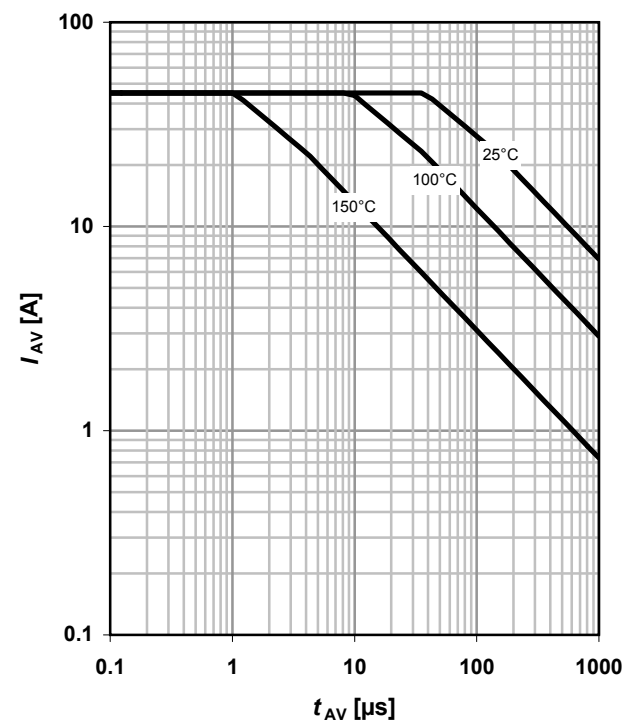
parameter:  $T_j$



## 12 Typ. avalanche characteristics

$$I_{AS} = f(t_{AV})$$

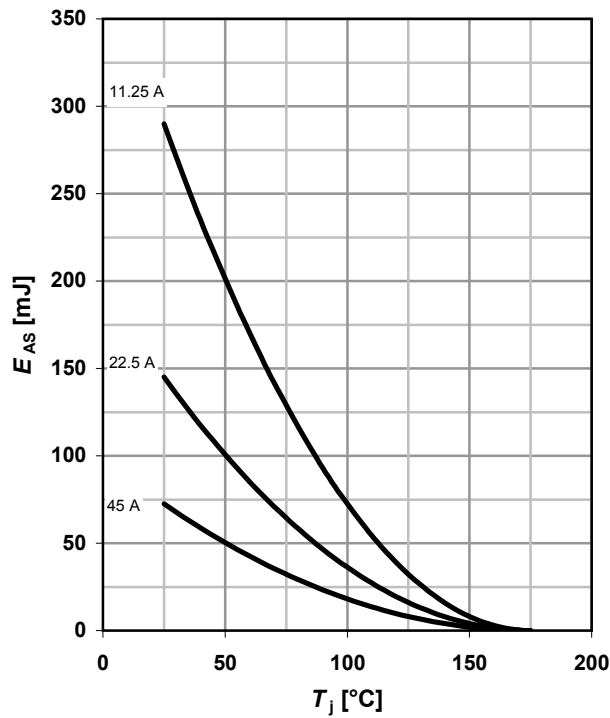
parameter:  $T_{j(start)}$



### 13 Typ. avalanche energy

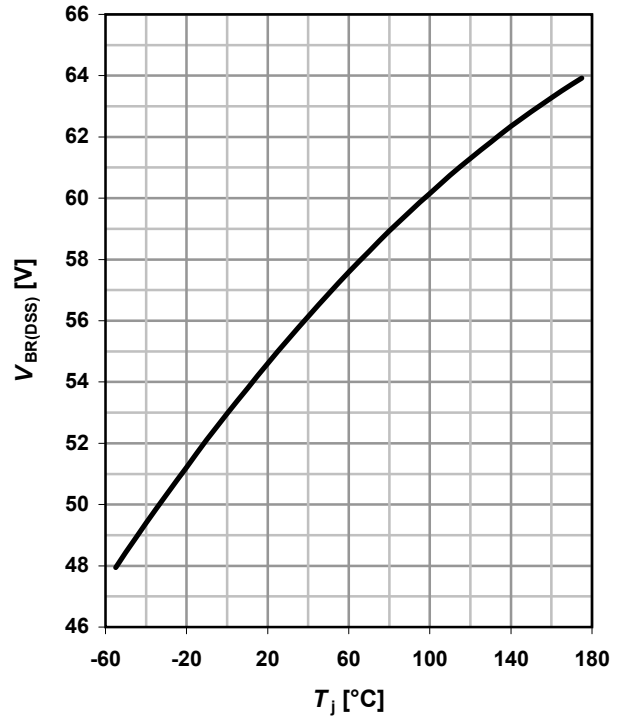
$$E_{AS}=f(T_j)$$

parameter:  $I_D$



### 15 Drain-source breakdown voltage

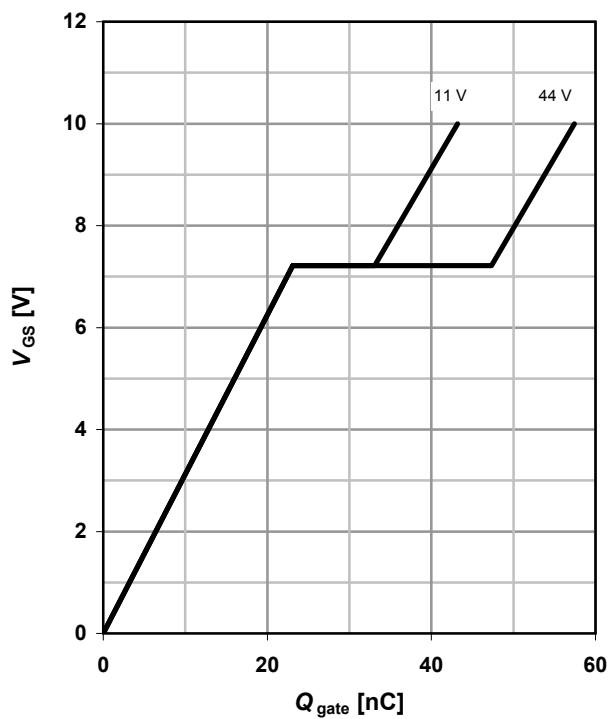
$$V_{BR(DSS)}=f(T_j); I_D=1 \text{ mA}$$



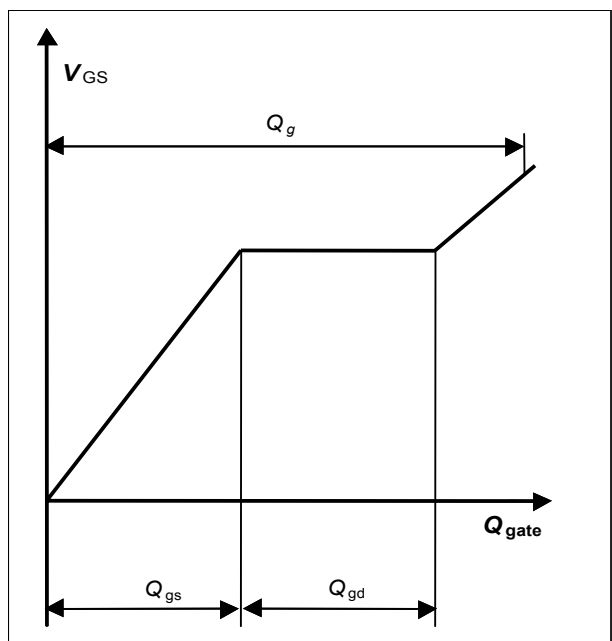
### 14 Typ. gate charge

$$V_{GS}=f(Q_{gate}); I_D=45 \text{ A pulsed}$$

parameter:  $V_{DD}$



### 16 Gate charge waveforms



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## Revision History

| Version        | Date       | Changes                                                     |
|----------------|------------|-------------------------------------------------------------|
| Data Sheet 2.1 | 15.12.2006 | Removal of ordering code                                    |
| Data Sheet 2.1 | 15.12.2006 | Implementation of avalanche current single pulse            |
| Data Sheet 2.1 | 15.12.2006 | Update of Infineon address                                  |
| Data Sheet 2.1 | 15.12.2006 | Removal of foot note 3, avalanche diagrams                  |
| Data Sheet 2.1 | 15.12.2006 | Implementation of Qrr and trr typ                           |
| Data Sheet 2.1 | 15.12.2006 | Pulse current rating from 180A to 90A                       |
| Data Sheet 2.1 | 15.12.2006 | Update of disclaimer                                        |
| Data Sheet 2.1 | 15.12.2006 | Implementation of RoHS and AEC logo, update of feature list |
| Data Sheet 1.1 | 07.11.2007 | Update of data sheet layout                                 |
| Data Sheet 1.1 | 07.11.2007 | Adaptation of Ias                                           |
| Data Sheet 1.1 | 07.11.2007 | implementation of footnote 2 for Eas specification          |
| Data Sheet 1.1 | 07.11.2007 | removal of Vdg specification from data sheet                |