

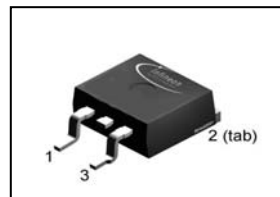
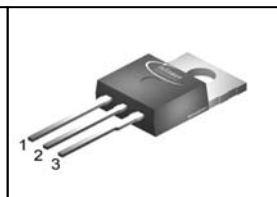
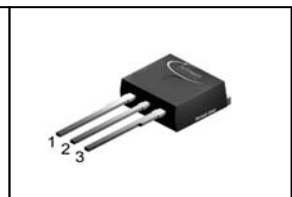
## OptiMOS® Power-Transistor

### Features

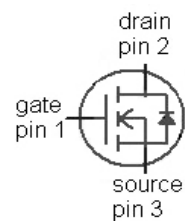
- N-channel - Enhancement mode
- Automotive AEC Q101 qualified
- MSL1 up to 260°C peak reflow
- 175°C operating temperature
- **Green package (lead free)**
- Ultra low  $R_{DS(on)}$
- 100% Avalanche tested

### Product Summary

|                                |     |    |
|--------------------------------|-----|----|
| $V_{DS}$                       | 40  | V  |
| $R_{DS(on),max}$ (SMD version) | 3.4 | mΩ |
| $I_D$                          | 80  | A  |

**PG-TO263-3-2**

**PG-TO220-3-1**

**PG-TO262-3-1**


| Type          | Package      | Ordering Code | Marking |
|---------------|--------------|---------------|---------|
| IPB80N04S2-04 | PG-TO263-3-2 | SP0002-18154  | 2N0404  |
| IPP80N04S2-04 | PG-TO220-3-1 | SP0002-19054  | 2N0404  |
| IPI80N04S2-04 | PG-TO262-3-1 | SP0002-19058  | 2N0404  |



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

| Parameter                                    | Symbol            | Conditions                                         | Value        | Unit |
|----------------------------------------------|-------------------|----------------------------------------------------|--------------|------|
| Continuous drain current <sup>1)</sup>       | $I_D$             | $T_C=25\text{ °C}$ , $V_{GS}=10\text{ V}$          | 80           | A    |
|                                              |                   | $T_C=100\text{ °C}$ ,<br>$V_{GS}=10\text{ V}^{2)}$ | 80           |      |
| Pulsed drain current <sup>2)</sup>           | $I_{D,pulse}$     | $T_C=25\text{ °C}$                                 | 320          |      |
| Avalanche energy, single pulse <sup>2)</sup> | $E_{AS}$          | $I_D=80\text{ A}$                                  | 810          | mJ   |
| Gate source voltage <sup>4)</sup>            | $V_{GS}$          |                                                    | ±20          | V    |
| Power dissipation                            | $P_{tot}$         | $T_C=25\text{ °C}$                                 | 300          | 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            | $R_{thJC}$ |                                              | -      | -    | 0.5  | 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   | $V_{(BR)DSS}$ | $V_{GS}=0\text{ V}, I_D=1\text{ mA}$                            | 40  | -    | -   | V                |
| Gate threshold voltage           | $V_{GS(th)}$  | $V_{DS}=V_{GS}, I_D=250\text{ }\mu\text{A}$                     | 2.1 | 3.0  | 4.0 |                  |
| Zero gate voltage drain current  | $I_{DSS}$     | $V_{DS}=40\text{ V}, V_{GS}=0\text{ V}, T_j=25\text{ °C}$       | -   | 0.01 | 1   | $\mu\text{A}$    |
|                                  |               | $V_{DS}=40\text{ V}, V_{GS}=0\text{ V}, T_j=125\text{ °C}^{2)}$ | -   | 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 | $R_{DS(on)}$  | $V_{GS}=10\text{ V}, I_D=80\text{ A},$                          | -   | 2.9  | 3.7 | $\text{m}\Omega$ |
|                                  |               | $V_{GS}=10\text{ V}, I_D=80\text{ A},$<br>SMD version           | -   | 2.6  | 3.4 |                  |

| 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>$f=1\text{ MHz}$                    | - | 5300 | - | pF |
| Output capacitance           | $C_{oss}$    |                                                                                 | - | 2200 | - |    |
| Reverse transfer capacitance | $C_{rss}$    |                                                                                 | - | 580  | - |    |
| Turn-on delay time           | $t_{d(on)}$  | $V_{DD}=20\text{ V}, V_{GS}=10\text{ V},$<br>$I_D=80\text{ A}, R_G=2.2\ \Omega$ | - | 26   | - | ns |
| Rise time                    | $t_r$        |                                                                                 | - | 45   | - |    |
| Turn-off delay time          | $t_{d(off)}$ |                                                                                 | - | 56   | - |    |
| Fall time                    | $t_f$        |                                                                                 | - | 32   | - |    |

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

|                       |               |                                                                            |   |     |     |    |
|-----------------------|---------------|----------------------------------------------------------------------------|---|-----|-----|----|
| Gate to source charge | $Q_{gs}$      | $V_{DD}=32\text{ V}, I_D=80\text{ A},$<br>$V_{GS}=0\text{ to }10\text{ V}$ | - | 25  | 35  | nC |
| Gate to drain charge  | $Q_{gd}$      |                                                                            | - | 47  | 75  |    |
| Gate charge total     | $Q_g$         |                                                                            | - | 127 | 170 |    |
| Gate plateau voltage  | $V_{plateau}$ |                                                                            | - | 4.9 | -   | V  |

### Reverse Diode

|                                                |               |                                                                   |   |     |     |    |
|------------------------------------------------|---------------|-------------------------------------------------------------------|---|-----|-----|----|
| Diode continuous forward current <sup>2)</sup> | $I_S$         | $T_C=25\text{ °C}$                                                | - | -   | 80  | A  |
| Diode pulse current <sup>2)</sup>              | $I_{S,pulse}$ |                                                                   | - | -   | 320 |    |
| Diode forward voltage                          | $V_{SD}$      | $V_{GS}=0\text{ V}, I_F=80\text{ A},$<br>$T_J=25\text{ °C}$       | - | 0.9 | 1.3 | V  |
| Reverse recovery time <sup>2)</sup>            | $t_{rr}$      | $V_R=20\text{ V}, I_F=I_S,$<br>$di_F/dt=100\text{ A}/\mu\text{s}$ | - | 53  | 75  | ns |
| Reverse recovery charge <sup>2)</sup>          | $Q_{rr}$      | $V_R=20\text{ V}, I_F=I_S,$<br>$di_F/dt=100\text{ A}/\mu\text{s}$ | - | 85  | 125 | nC |

<sup>1)</sup> Current is limited by bondwire; with an  $R_{thJC} = 0.5\text{K/W}$  the chip is able to carry 208A at 25°C. For detailed information see Application Note ANPS071E at [www.infineon.com/optimos](http://www.infineon.com/optimos)

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

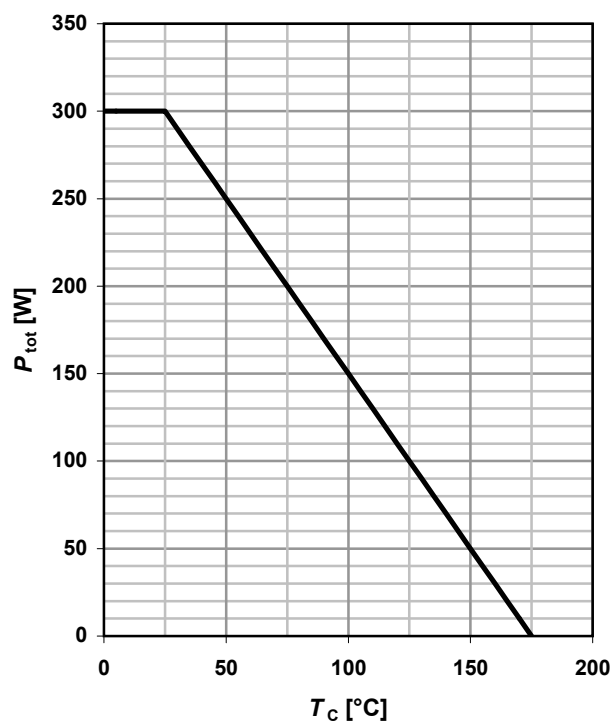
<sup>3)</sup> See diagram 13.

<sup>4)</sup> Qualified at -20V and +20V.

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

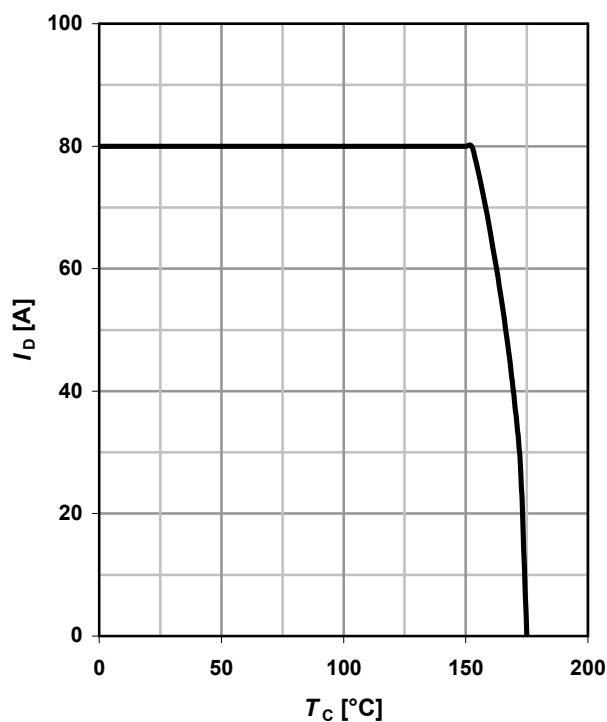
## 1 Power dissipation

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



## 2 Drain current

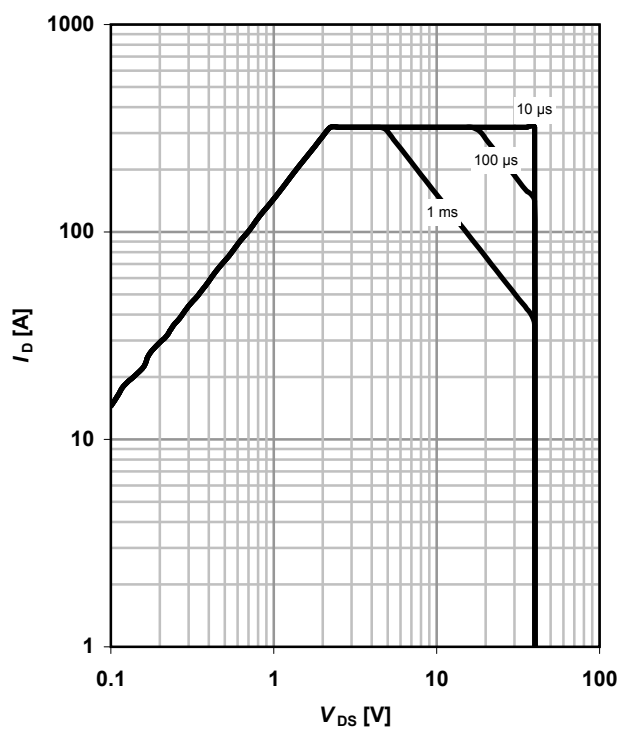
$$I_D = f(T_C); V_{\text{GS}} \geq 10 \text{ V}$$



## 3 Safe operating area

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

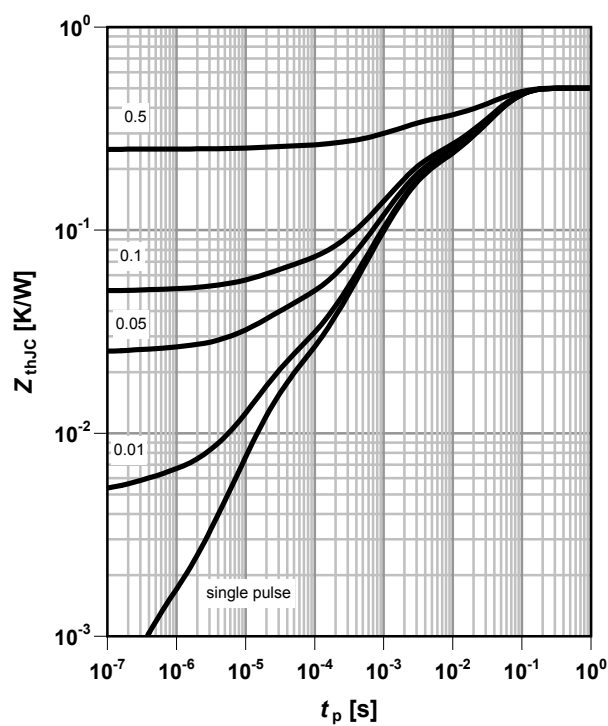
parameter:  $t_p$



## 4 Max. transient thermal impedance

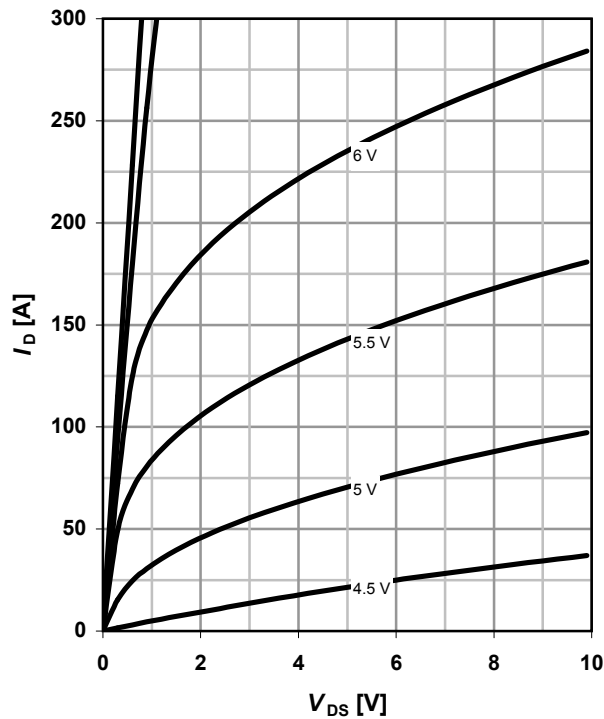
$$Z_{\text{thJC}} = f(t_p)$$

parameter:  $D = t_p/T$



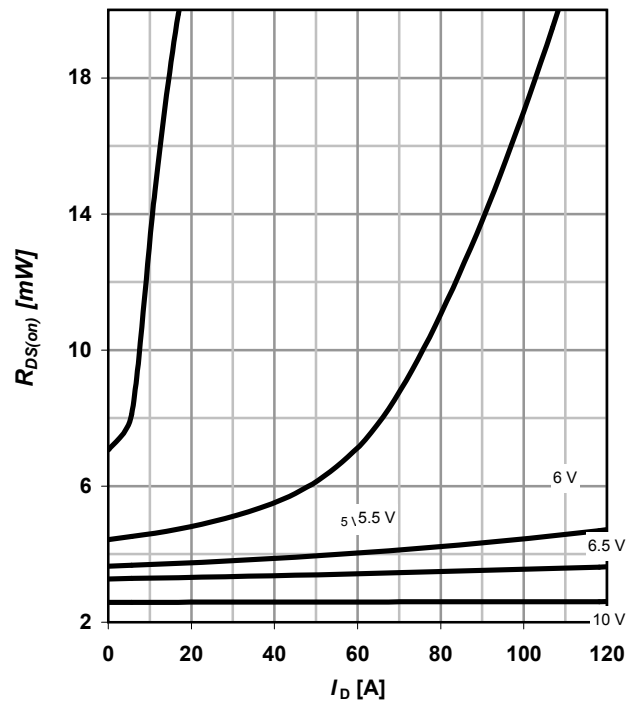
### 5 Typ. output characteristics

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

parameter:  $V_{GS}$ 


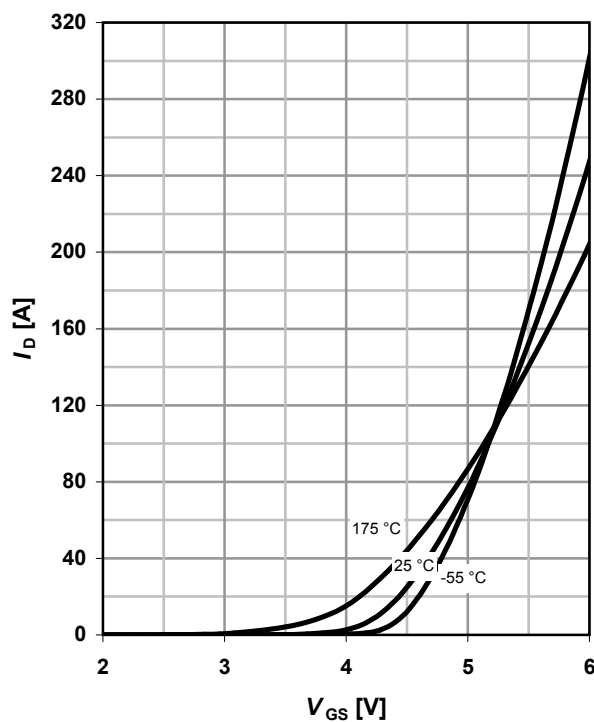
### 6 Typ. drain-source on-state resistance

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

parameter:  $V_{GS}$ 


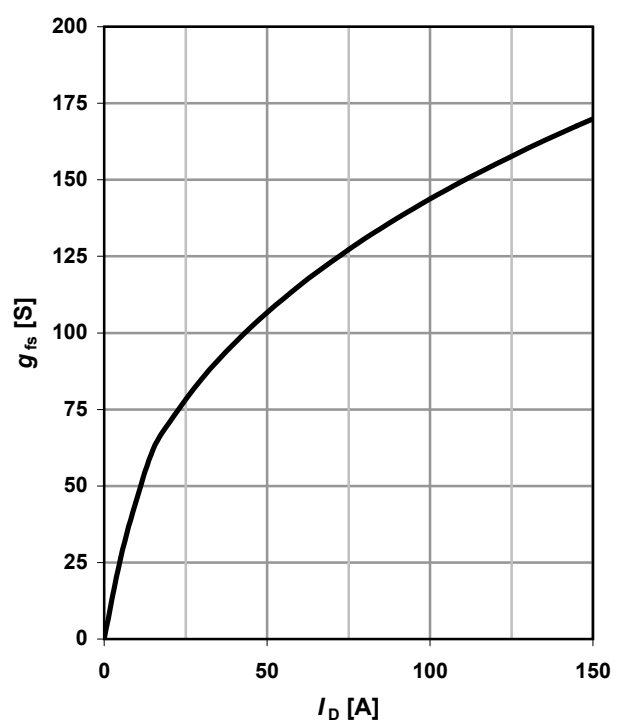
### 7 Typ. transfer characteristics

 $I_D = f(V_{GS}); V_{DS} = 6\text{ V}$ 

parameter:  $T_j$ 


### 8 Typ. Forward transconductance

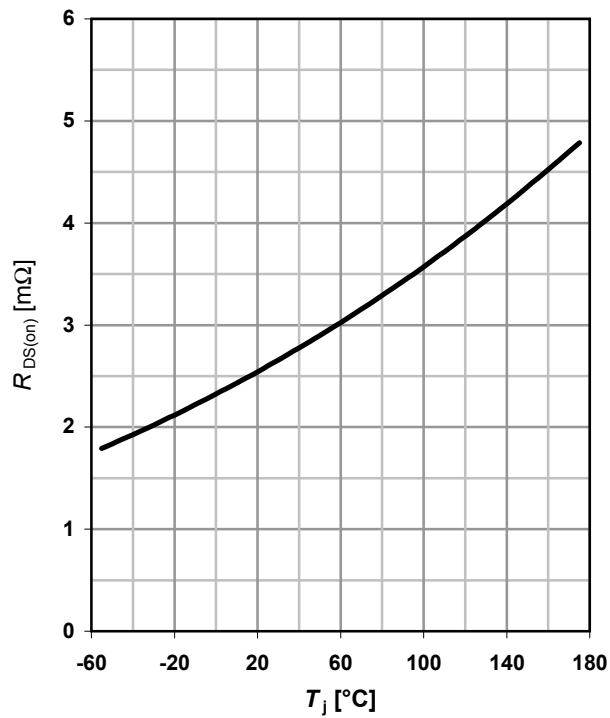
 $g_{fs} = f(I_D); T_j = 25^\circ\text{C}$ 

parameter:  $g_{fs}$ 


### 9 Typ. Drain-source on-state resistance

$$R_{DS(on)} = f(T_j)$$

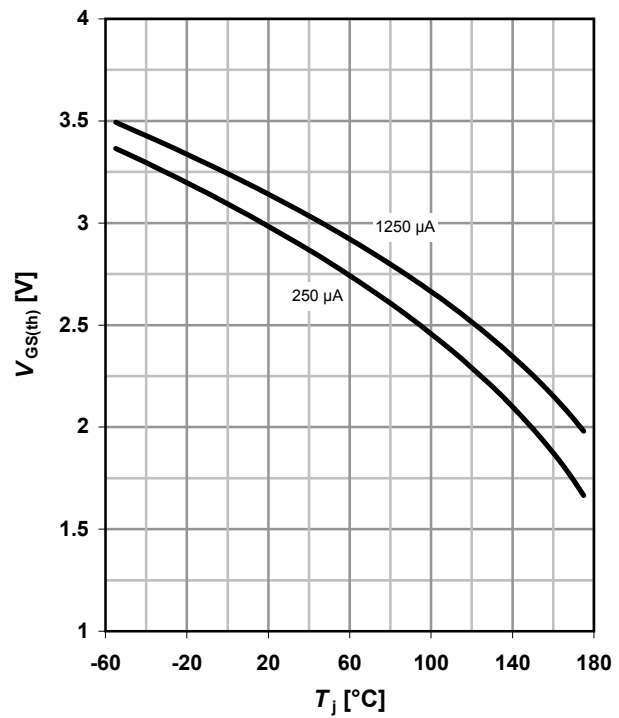
parameter:  $I_D = 80 \text{ A}$ ;  $V_{GS} = 10 \text{ V}$



### 10 Typ. gate threshold voltage

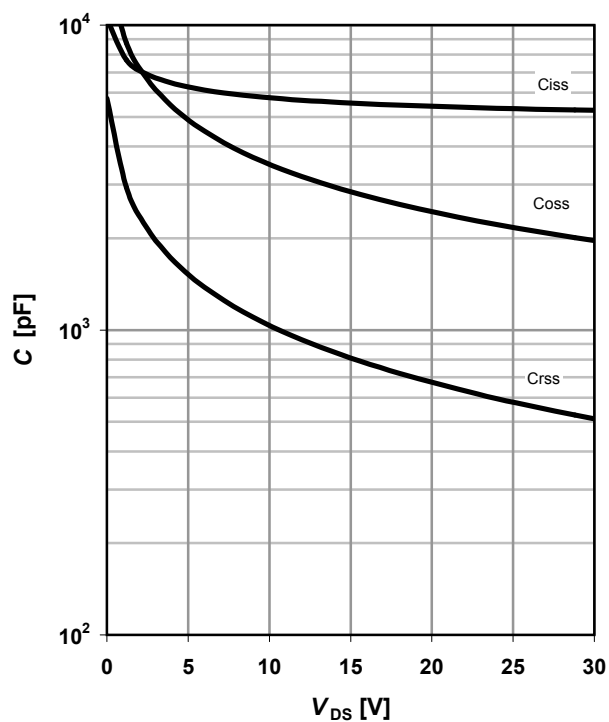
$$V_{GS(th)} = f(T_j); V_{GS} = V_{DS}$$

parameter:  $I_D$



### 11 Typ. capacitances

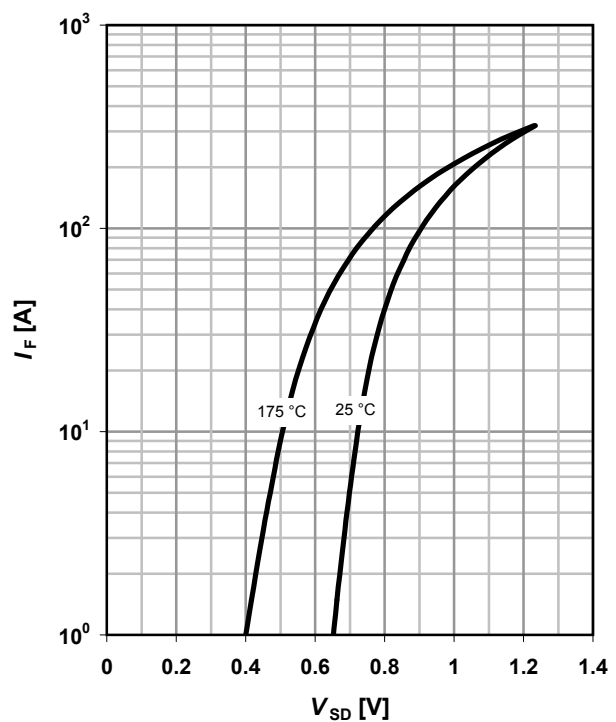
$$C = f(V_{DS}); V_{GS} = 0 \text{ V}; f = 1 \text{ MHz}$$



### 12 Typical forward diode characteristics

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

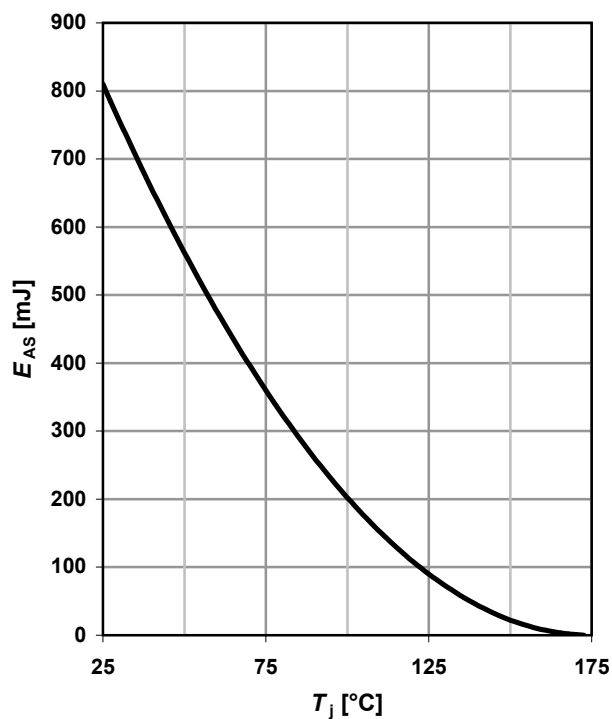
parameter:  $T_j$



### 13 Typical avalanche energy

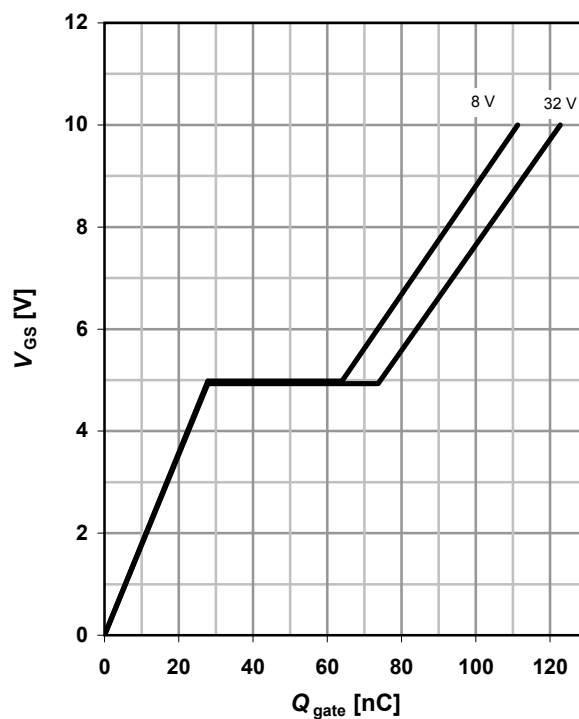
$$E_{AS} = f(T_j)$$

parameter:  $I_D = 80\text{ A}$



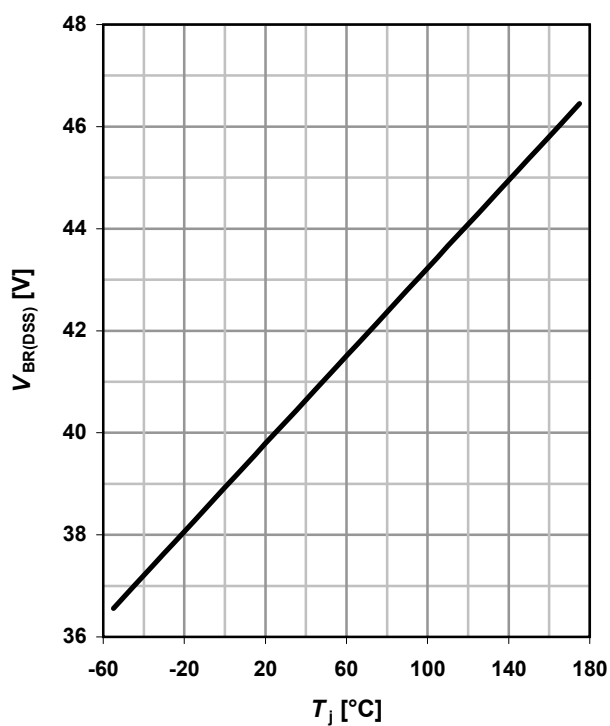
### 14 Typ. gate charge

$$V_{GS} = f(Q_{gate}); I_D = 80\text{ A pulsed}$$

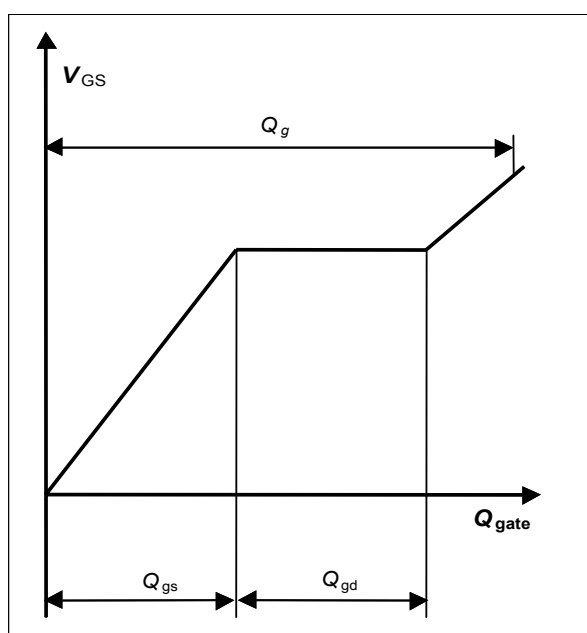


### 15 Typ. drain-source breakdown voltage

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



### 16 Gate charge waveforms



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