

## OptiMOS<sup>®</sup> -P2 Power-Transistor

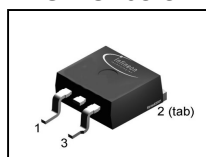
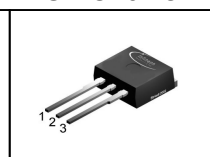
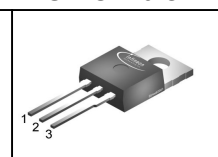


### Features

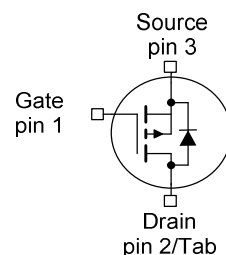
- P-channel - Normal Level - Enhancement mode
- AEC qualified
- MSL1 up to 260°C peak reflow
- 175°C operating temperature
- Green package (RoHS compliant)
- 100% Avalanche tested

### Product Summary

|                            |     |    |
|----------------------------|-----|----|
| $V_{DS}$                   | -40 | V  |
| $R_{DS(on)}$ (SMD Version) | 9.1 | mΩ |
| $I_D$                      | -70 | A  |

**PG-TO263-3-2**

**PG-TO262-3-1**

**PG-TO220-3-1**


| Type          | Package      | Marking |
|---------------|--------------|---------|
| IPB70P04P4-09 | PG-TO263-3-2 | 4P0409  |
| IPI70P04P4-09 | PG-TO262-3-1 | 4P0409  |
| IPP70P04P4-09 | PG-TO220-3-1 | 4P0409  |



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

| Parameter                              | Symbol         | Conditions                                    | Value        | Unit |
|----------------------------------------|----------------|-----------------------------------------------|--------------|------|
| Continuous drain current <sup>1)</sup> | $I_D$          | $T_C=25\text{ °C}$ ,<br>$V_{GS}=-10\text{V}$  | -72          | A    |
|                                        |                | $T_C=100\text{ °C}$ ,<br>$V_{GS}=-10\text{V}$ | -50          |      |
| Pulsed drain current <sup>2)</sup>     | $I_{D,pulse}$  | $T_C=25\text{ °C}$                            | -288         |      |
| Avalanche energy, single pulse         | $E_{AS}$       | $I_D=-36\text{A}$                             | 24           | mJ   |
| Avalanche current, single pulse        | $I_{AS}$       | -                                             | -72          | A    |
| Gate source voltage                    | $V_{GS}$       | -                                             | ±20          | V    |
| Power dissipation                      | $P_{tot}$      | $T_C=25\text{ °C}$                            | 75           | 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  | 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>2)</sup> | - | - | 40 |     |

### Electrical characteristics, at $T_j=25^\circ\text{C}$ , unless otherwise specified

#### Static characteristics

|                                  |               |                                                      |      |       |      |            |
|----------------------------------|---------------|------------------------------------------------------|------|-------|------|------------|
| Drain-source breakdown voltage   | $V_{(BR)DSS}$ | $V_{GS}=0V, I_D=-1mA$                                | -40  | -     | -    | V          |
| Gate threshold voltage           | $V_{GS(th)}$  | $V_{DS}=V_{GS}, I_D=-120\mu A$                       | -2.0 | -3.0  | -4.0 |            |
| Zero gate voltage drain current  | $I_{DSS}$     | $V_{DS}=-32V, V_{GS}=0V, T_j=25^\circ\text{C}$       | -    | -0.05 | -1   | $\mu A$    |
|                                  |               | $V_{DS}=-32V, V_{GS}=0V, T_j=125^\circ\text{C}^{2)}$ | -    | -20   | -200 |            |
| Gate-source leakage current      | $I_{GSS}$     | $V_{GS}=-20V, V_{DS}=0V$                             | -    | -     | -100 | nA         |
| Drain-source on-state resistance | $R_{DS(on)}$  | $V_{GS}=-10V, I_D=-70A$                              | -    | 6.9   | 9.4  | m $\Omega$ |
|                                  |               | $V_{GS}=-10V, I_D=-70A, \text{SMD version}$          | -    | 6.6   | 9.1  |            |

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

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

|                              |              |                                                               |   |      |      |    |
|------------------------------|--------------|---------------------------------------------------------------|---|------|------|----|
| Input capacitance            | $C_{iss}$    | $V_{GS}=0V, V_{DS}=-25V,$<br>$f=1MHz$                         | - | 3700 | 4810 | pF |
| Output capacitance           | $C_{oss}$    |                                                               | - | 1400 | 1820 |    |
| Reverse transfer capacitance | $C_{rss}$    |                                                               | - | 40   | 80   |    |
| Turn-on delay time           | $t_{d(on)}$  | $V_{DD}=-20V,$<br>$V_{GS}=-10V, I_D=-70A,$<br>$R_G=3.5\Omega$ | - | 19   | -    | ns |
| Rise time                    | $t_r$        |                                                               | - | 15   | -    |    |
| Turn-off delay time          | $t_{d(off)}$ |                                                               | - | 24   | -    |    |
| Fall time                    | $t_f$        |                                                               | - | 31   | -    |    |

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

|                       |               |                                                         |   |      |    |    |
|-----------------------|---------------|---------------------------------------------------------|---|------|----|----|
| Gate to source charge | $Q_{gs}$      | $V_{DD}=-32V, I_D=-70A,$<br>$V_{GS}=0 \text{ to } -10V$ | - | 20   | 26 | nC |
| Gate to drain charge  | $Q_{gd}$      |                                                         | - | 10   | 20 |    |
| Gate charge total     | $Q_g$         |                                                         | - | 54   | 70 |    |
| Gate plateau voltage  | $V_{plateau}$ |                                                         | - | -5.4 | -  | V  |

### Reverse Diode

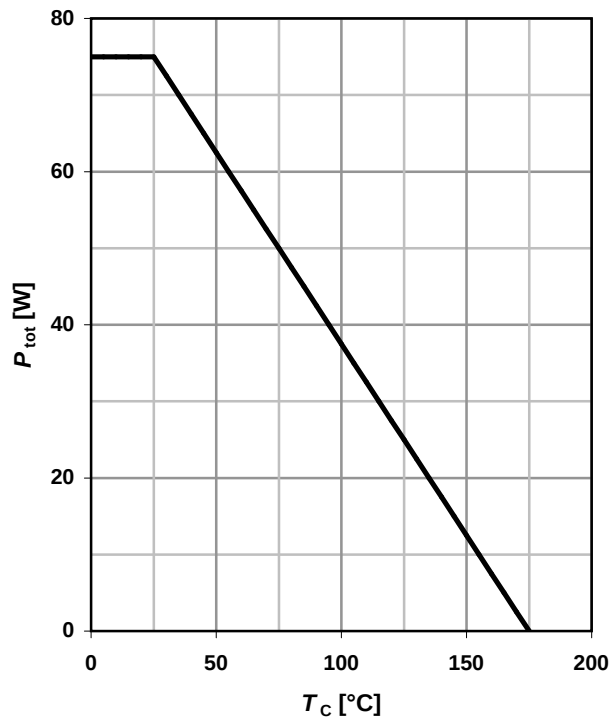
|                                                |               |                                                |   |      |      |    |
|------------------------------------------------|---------------|------------------------------------------------|---|------|------|----|
| Diode continuous forward current <sup>2)</sup> | $I_S$         | $T_C=25^\circ C$                               | - | -    | -72  | A  |
| Diode pulse current <sup>2)</sup>              | $I_{S,pulse}$ |                                                | - | -    | -288 |    |
| Diode forward voltage                          | $V_{SD}$      | $V_{GS}=0V, I_F=-70A,$<br>$T_j=25^\circ C$     | - | -1.0 | -1.3 | V  |
| Reverse recovery time <sup>2)</sup>            | $t_{rr}$      | $V_R=-20V, I_F=-50A,$<br>$di_F/dt=-100A/\mu s$ | - | 50   | -    | ns |
| Reverse recovery charge <sup>2)</sup>          | $Q_{rr}$      |                                                | - | 50   | -    | nC |

<sup>1)</sup> Defined by design. Not subject to production test.

<sup>2)</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.

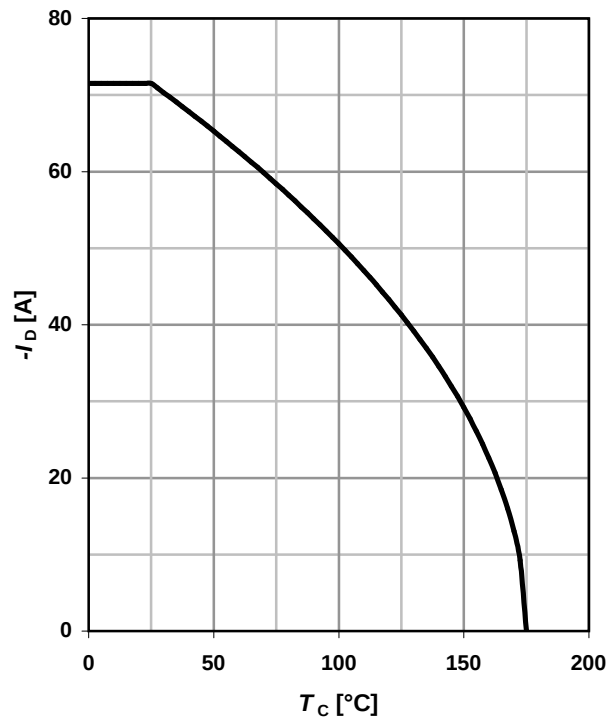
### 1 Power dissipation

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



### 2 Drain current

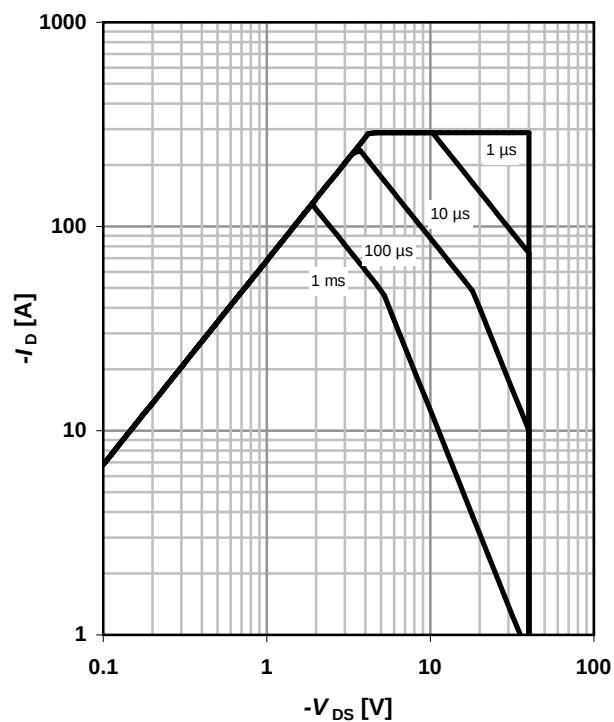
$$I_D = f(T_C); V_{\text{GS}} \leq -6\text{V}; \text{SMD}$$



### 3 Safe operating area

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

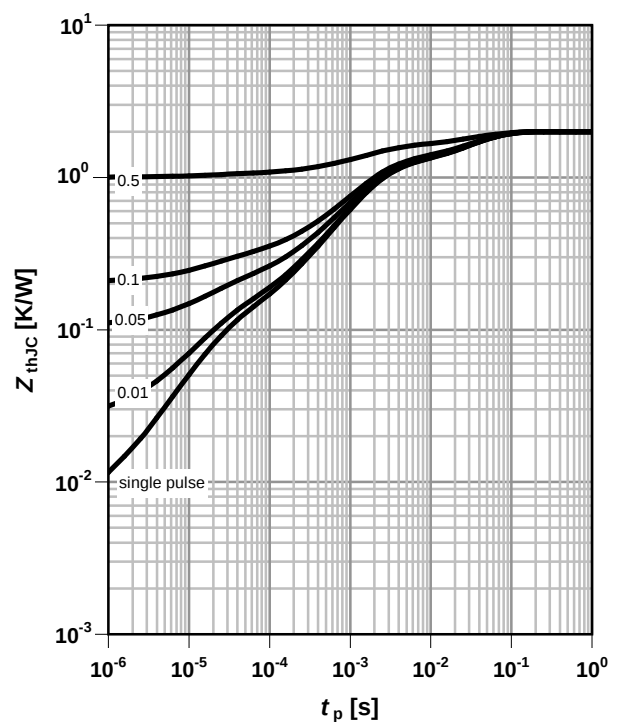
parameter:  $t_p$



### 4 Max. transient thermal impedance

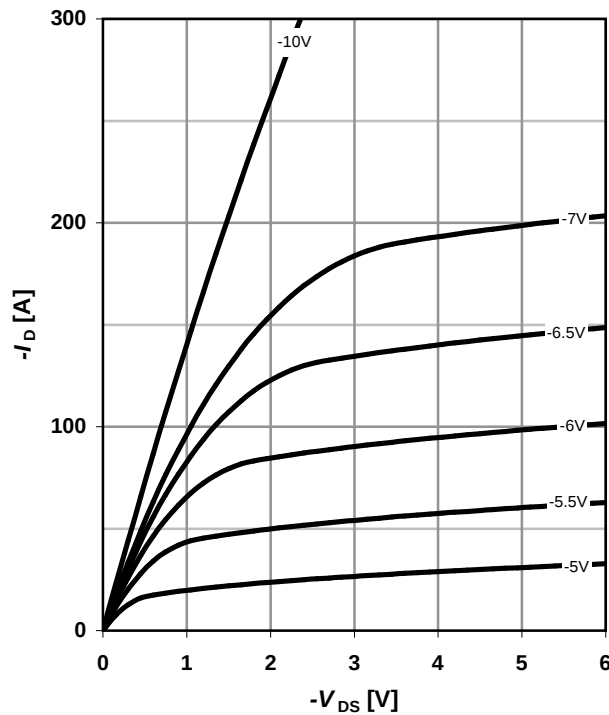
$$Z_{\text{thJC}} = f(t_p)$$

parameter:  $D = t_p/T$



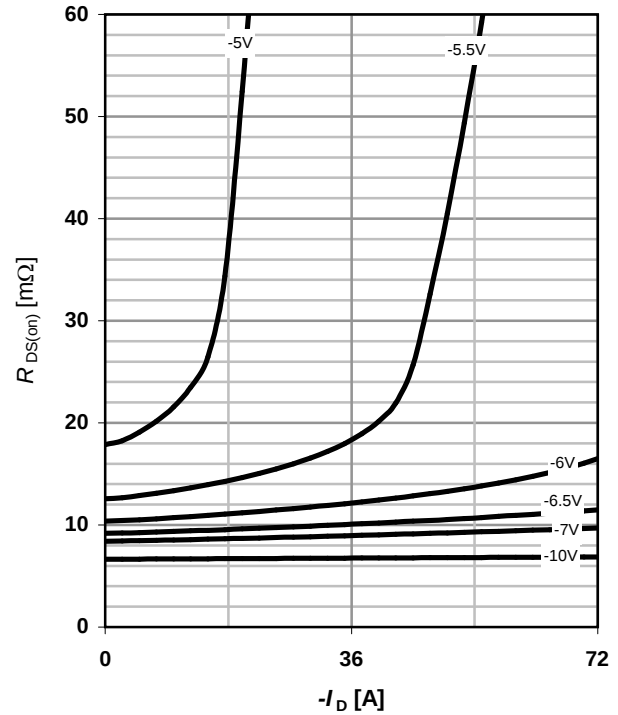
### 5 Typ. output characteristics

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

parameter:  $V_{GS}$ 


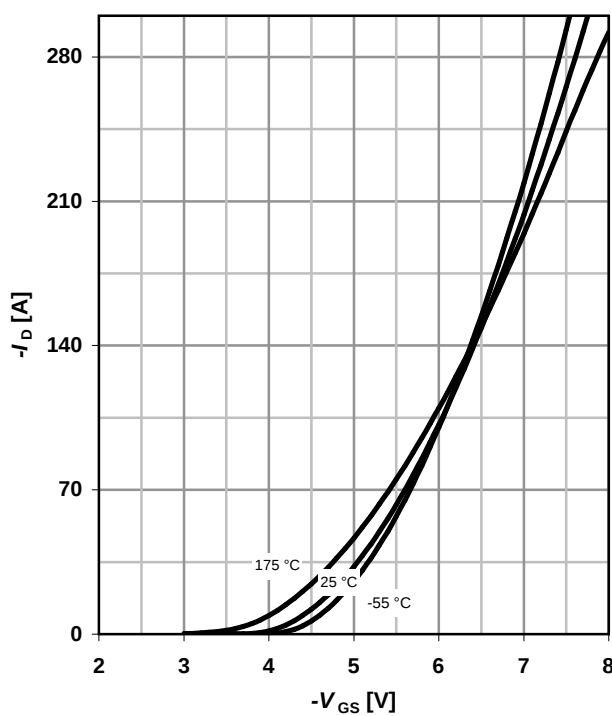
### 6 Typ. drain-source on-state resistance

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

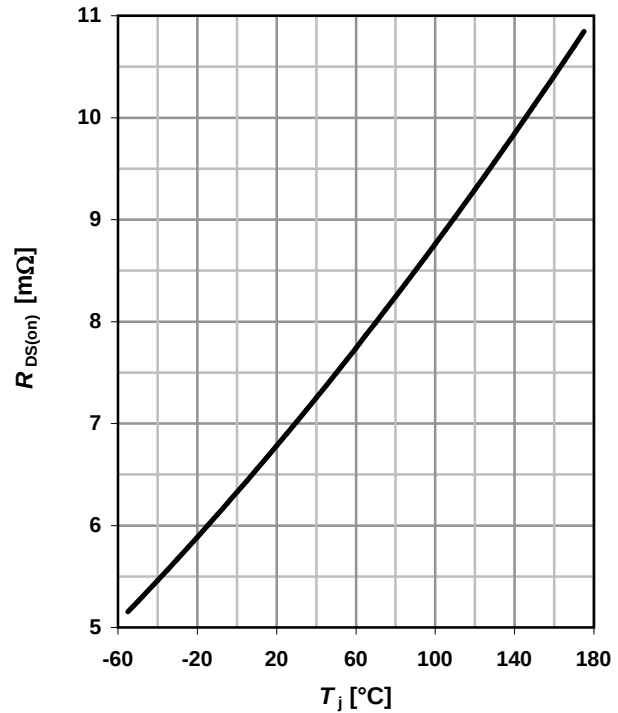
parameter:  $V_{GS}$ 


### 7 Typ. transfer characteristics

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

parameter:  $T_j$ 


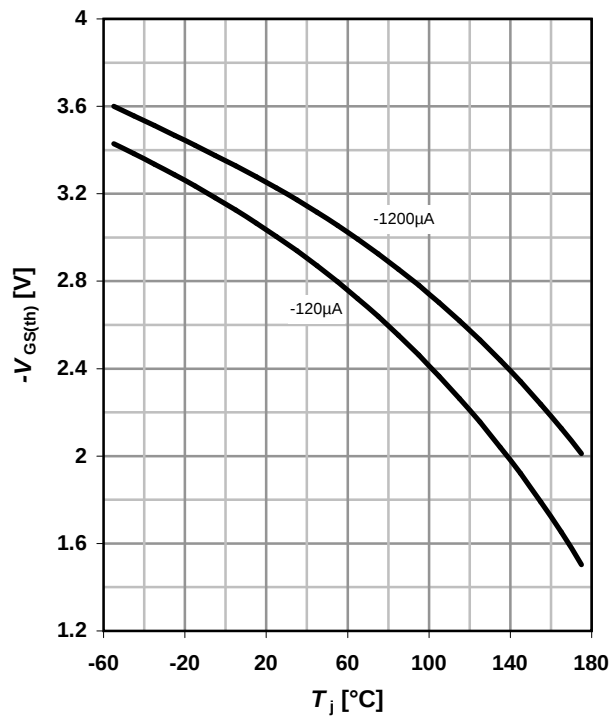
### 8 Typ. drain-source on-state resistance

 $R_{DS(on)} = f(T_j); I_D = -70\text{ A}; V_{GS} = -10\text{ V}; \text{SMD}$ 


## 9 Typ. gate threshold voltage

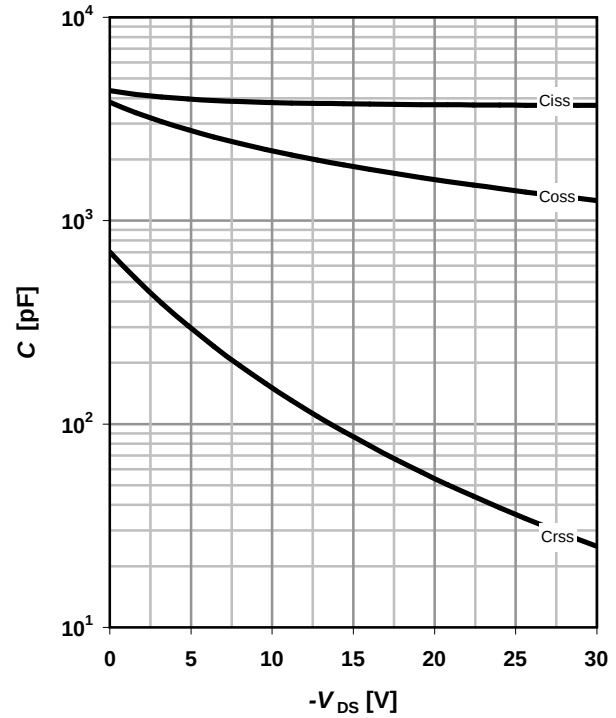
$$V_{GS(th)} = f(T_j); V_{GS} = V_{DS}$$

parameter:  $I_D$



## 10 Typ. capacitances

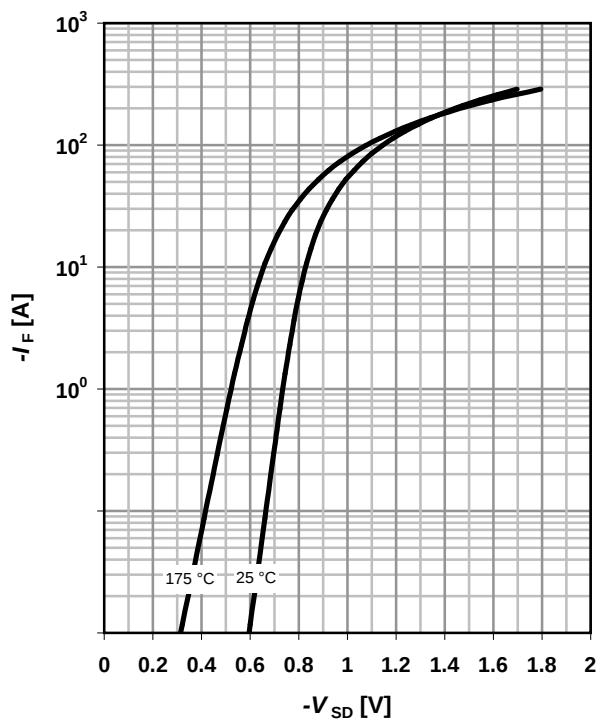
$$C = f(V_{DS}); V_{GS} = 0 V; f = 1 MHz$$



## 11 Typical forward diode characteristics

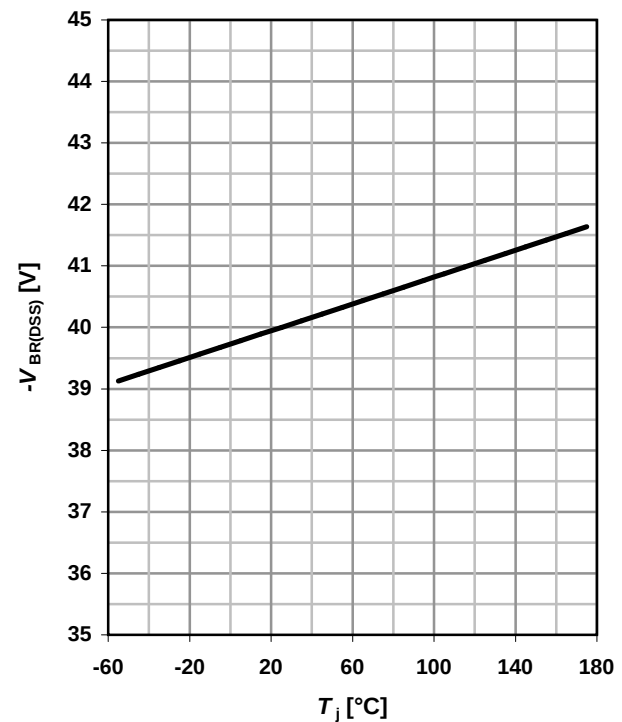
$$I_F = f(V_{SD})$$

parameter:  $T_j$



## 12 Drain-source breakdown voltage

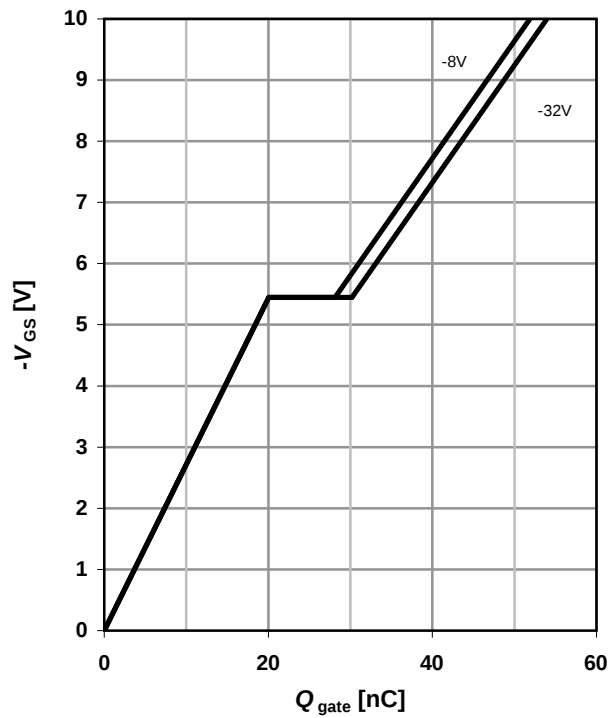
$$V_{BR(DSS)} = f(T_j); I_D = -1 mA$$



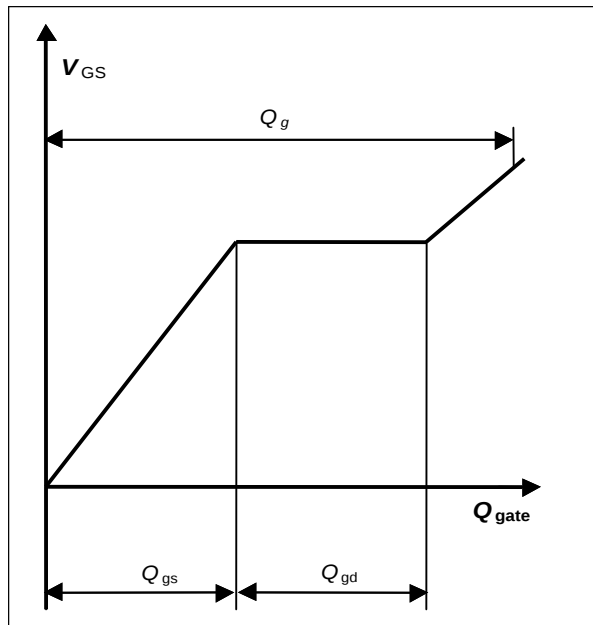
### 13 Typ. gate charge

$V_{GS} = f(Q_{gate}); I_D = -70 \text{ A pulsed}$

parameter:  $V_{DD}$



### 14 Gate charge waveforms



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**Revision History**

| <b>Version</b> | <b>Date</b> | <b>Changes</b>                        |
|----------------|-------------|---------------------------------------|
| 1.1            | 02.09.2009  | $V_{GS(th)}$ : $I_D$ changed to 116uA |
| 1.2            | 07.10.2009  | $V_{GS(th)}$ : $I_D$ changed to 120uA |
| 1.2            | 07.10.2009  | $R_{DS(on)}$ : $I_D$ changed to 70A   |
| 1.2            | 07.10.2009  | $V_{SD}$ : $I_D$ changed to 70A       |
| 1.2            | 07.10.2009  | $I_{GSS}$ : $V_{GS}$ changed to 20V   |
| 1.3            | 04.02.2011  | Final Data Sheet                      |
|                |             |                                       |
|                |             |                                       |
|                |             |                                       |
|                |             |                                       |
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