

## OptiMOS® -P2 Power-Transistor



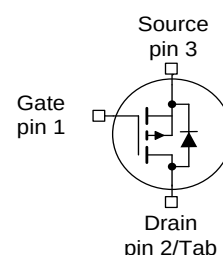
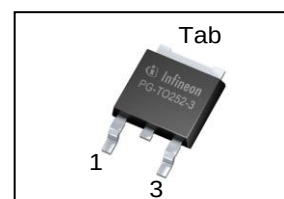
### Features

- P-channel - Logic 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  |
| $R_{DS(on)}$ | 7.8 | mΩ |
| $I_D$        | -70 | A  |

PG-TO252-3-313



| Type           | Package        | Marking |
|----------------|----------------|---------|
| IPD70P04P4L-08 | PG-TO252-3-313 | 4P04L08 |

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

| Parameter                                    | Symbol         | Conditions   | Value        | Unit |
|--|----------------|--|--------------|------|
| Continuous drain current                     | $I_D$          | $T_C=25\text{ °C}$ ,<br>$V_{GS}=-10\text{V}$       | -70          | A    |
|  |                | $T_C=100\text{ °C}$ ,<br>$V_{GS}=-10\text{V}^{1)}$ | -55          |      |
| Pulsed drain current <sup>1)</sup>           | $I_{D,pulse}$  | $T_C=25\text{ °C}$                                 | -280         |      |
| Avalanche energy, single pulse <sup>1)</sup> | $E_{AS}$       | $I_D=-35\text{A}$                                  | 24           | mJ   |
| Avalanche current, single pulse              | $I_{AS}$       | -  | -70          | A    |
| Gate source voltage                          | $V_{GS}$       | -  | +5/-16       | 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>1)</sup>

|                                     |            |  |   |   |     |     |
|-------------------------------------|------------|--|---|---|-----|-----|
| Thermal resistance, junction - case | $R_{thJC}$ | -  | - | - | 2.0 | K/W |
| SMD version, device on PCB          | $R_{thJA}$ | minimal footprint                            | - | - | 62  |     |
|                                     |            | 6 cm <sup>2</sup> cooling area <sup>2)</sup> | - | - | 40  |     |

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

#### Static characteristics

|                                  |               |  |      |       |      |            |
|----------------------------------|---------------|--|------|-------|------|------------|
| Drain-source breakdown voltage   | $V_{(BR)DSS}$ | $V_{GS}=0V, I_D=-1mA$                                  | -40  | -     | -    | V          |
| Gate threshold voltage           | $V_{GS(th)}$  | $V_{DS}=V_{GS}, I_D=-120\mu A$                         | -1.2 | -1.7  | -2.2 |            |
| Zero gate voltage drain current  | $I_{DSS}$     | $V_{DS}=-32V, V_{GS}=0V, T_j=25^{\circ}\text{C}$       | -    | -0.05 | -1   | $\mu A$    |
|                                  |               | $V_{DS}=-32V, V_{GS}=0V, T_j=125^{\circ}\text{C}^{1)}$ | -    | -20   | -200 |            |
| Gate-source leakage current      | $I_{GSS}$     | $V_{GS}=-16V, V_{DS}=0V$                               | -    | -     | -100 | nA         |
| Drain-source on-state resistance | $R_{DS(on)}$  | $V_{GS}=-4.5V, I_D=-40A$                               | -    | 9.5   | 12.9 | m $\Omega$ |
|                                  |               | $V_{GS}=-10V, I_D=-70A$                                | -    | 6.4   | 7.8  |            |

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

### Dynamic characteristics<sup>1)</sup>

|                              |              |   |   |      |      |    |
|------------------------------|--------------|---|---|------|------|----|
| Input capacitance            | $C_{iss}$    | $V_{GS}=0V, V_{DS}=-25V,$<br>$f=1MHz$                               | - | 4177 | 5430 | pF |
| Output capacitance           | $C_{oss}$    |   | - | 1185 | 1778 |    |
| Reverse transfer capacitance | $C_{rss}$    |   | - | 45   | 90   |    |
| Turn-on delay time           | $t_{d(on)}$  | $V_{DD}=-20V,$<br>$V_{GS}=-10V, I_D=-70A,$<br>$R_{G,ext}=3.5\Omega$ | - | 12   | -    | ns |
| Rise time                    | $t_r$        |   | - | 10   | -    |    |
| Turn-off delay time          | $t_{d(off)}$ |   | - | 50   | -    |    |
| Fall time                    | $t_f$        |   | - | 41   | -    |    |

### Gate Charge Characteristics<sup>1)</sup>

|                       |               |   |   |      |    |    |
|-----------------------|---------------|---|---|------|----|----|
| Gate to source charge | $Q_{gs}$      | $V_{DD}=-32V, I_D=-70A,$<br>$V_{GS}=0 \text{ to } -10V$ | - | 14   | 18 | nC |
| Gate to drain charge  | $Q_{gd}$      |   | - | 10   | 20 |    |
| Gate charge total     | $Q_g$         |   | - | 71   | 92 |    |
| Gate plateau voltage  | $V_{plateau}$ |   | - | -3.5 | -  | V  |

### Reverse Diode

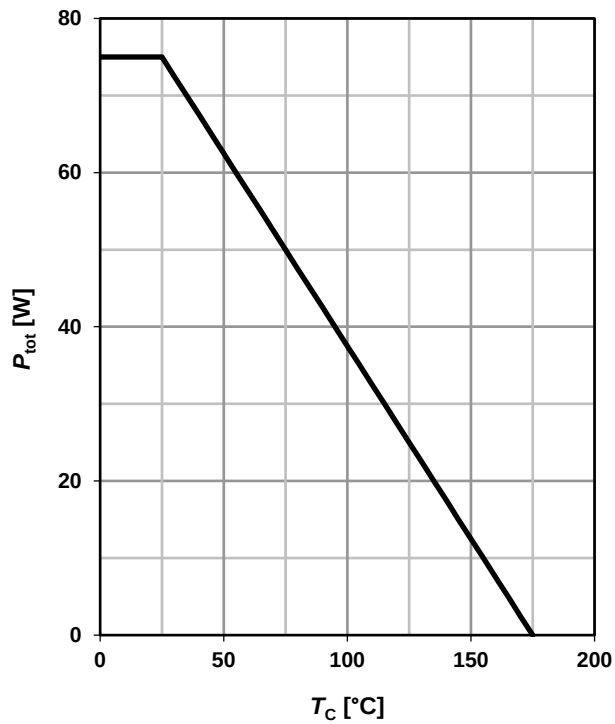
|  |               |  |   |    |      |    |
|--|---------------|--|---|----|------|----|
| Diode continuous forward current <sup>1)</sup> | $I_S$         | $T_C=25^\circ C$                               | - | -  | -70  | A  |
| Diode pulse current <sup>1)</sup>              | $I_{S,pulse}$ |  | - | -  | -280 |    |
| Diode forward voltage                          | $V_{SD}$      | $V_{GS}=0V, I_F=-70A,$<br>$T_J=25^\circ C$     | - | -1 | -1.3 | V  |
| Reverse recovery time <sup>1)</sup>            | $t_{rr}$      | $V_R=-20V, I_F=-50A,$<br>$di_F/dt=-100A/\mu s$ | - | 46 | -    | ns |
| Reverse recovery charge <sup>1)</sup>          | $Q_{rr}$      |  | - | 43 | -    | 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.

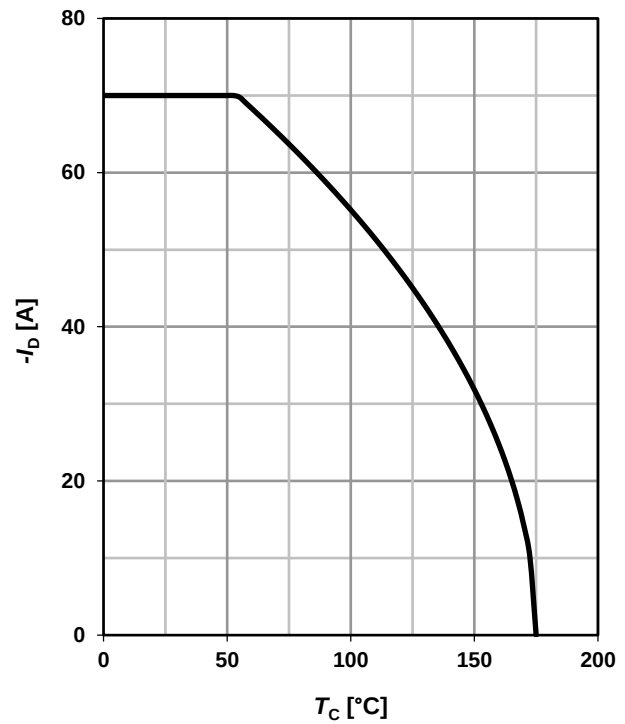
### 1 Power dissipation

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



### 2 Drain current

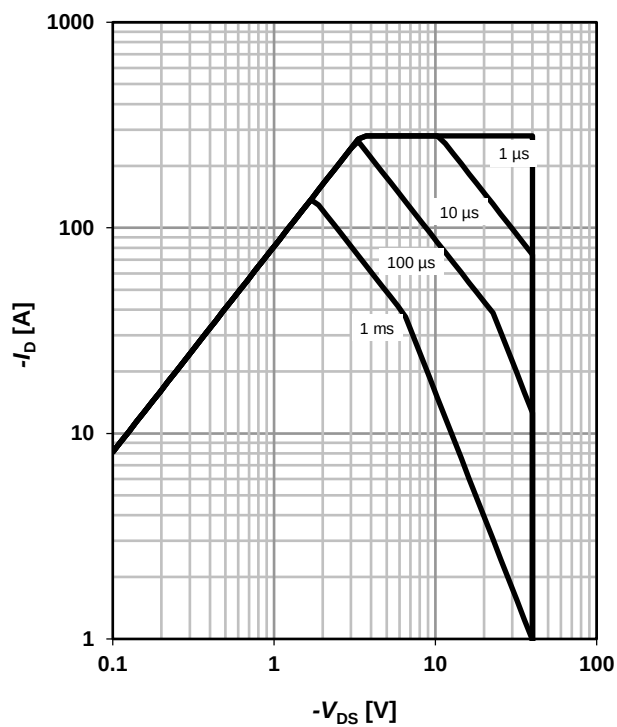
$$I_D = f(T_C); V_{\text{GS}} = -10\text{V}$$



### 3 Safe operating area

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

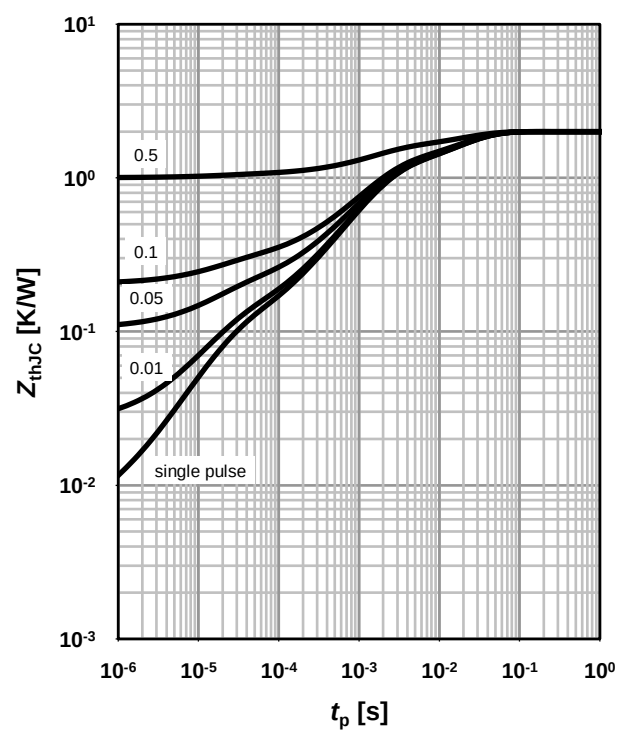
parameter:  $t_p$



### 4 Max. transient thermal impedance

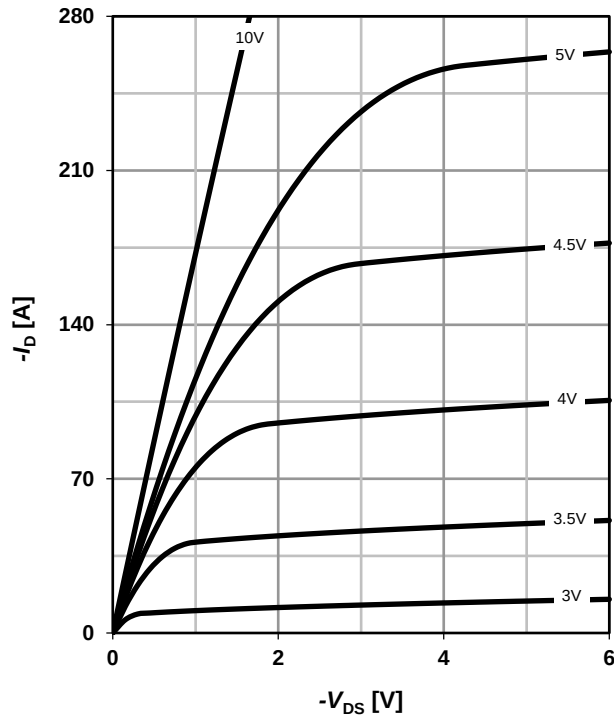
$$Z_{\text{thJC}} = f(t_p)$$

parameter:  $D = t_p/T$



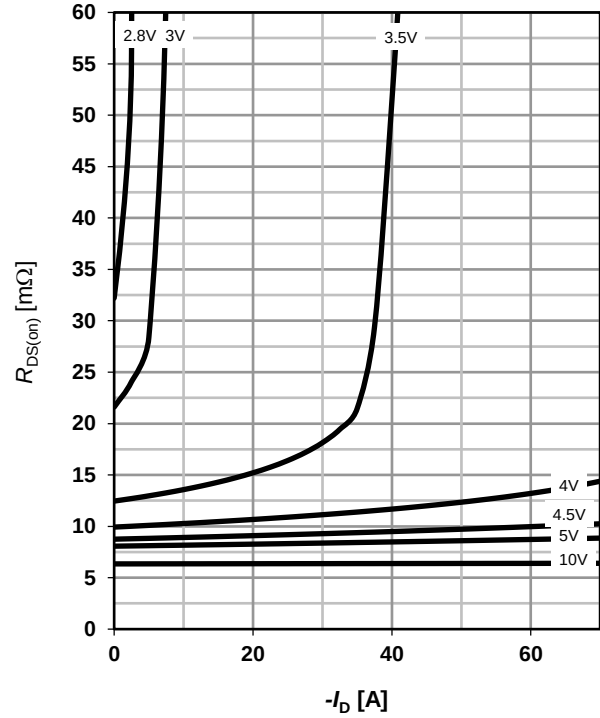
## 5 Typ. output characteristics

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

parameter:  $-V_{GS}$ 


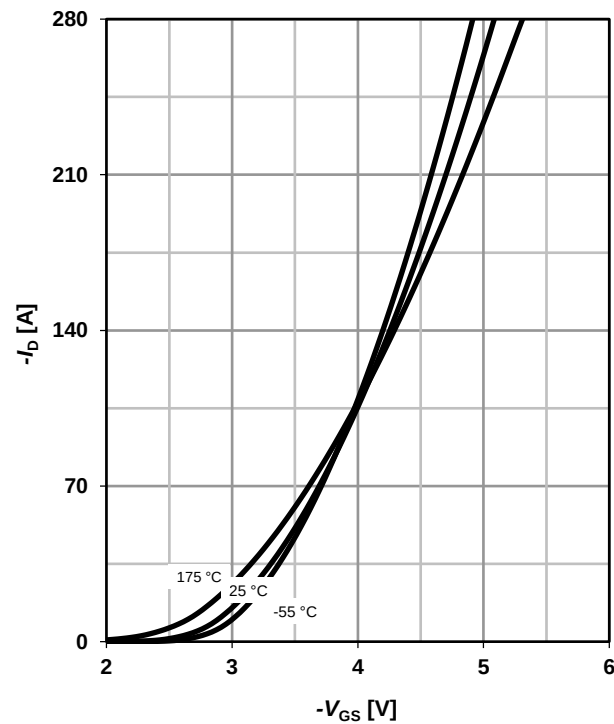
## 6 Typ. drain-source on-state resistance

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

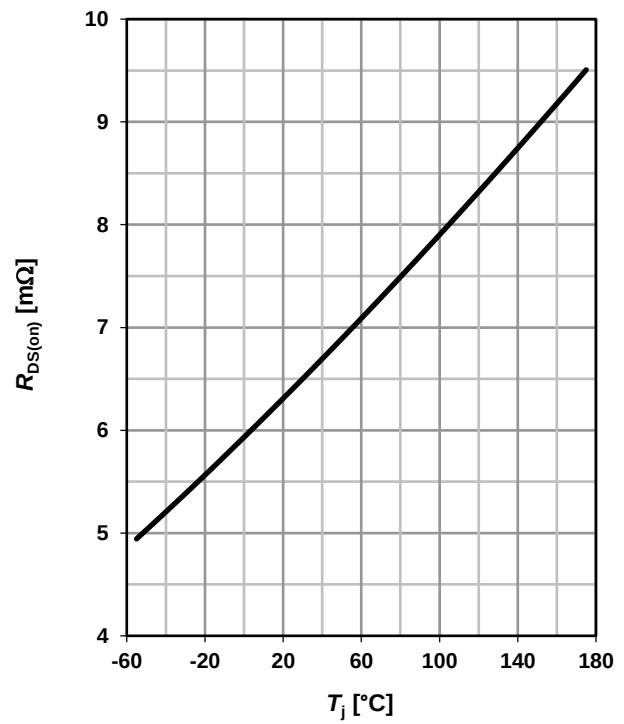
parameter:  $-V_{GS}$ 


## 7 Typ. transfer characteristics

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

parameter:  $T_j$ 


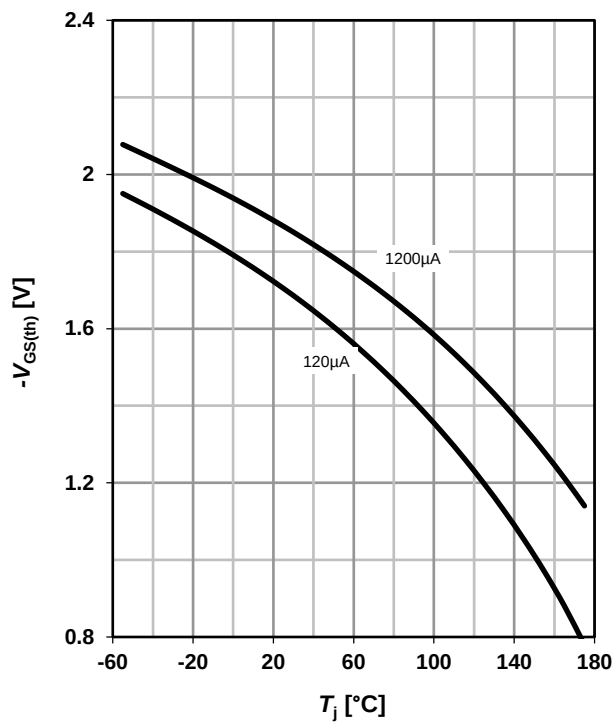
## 8 Typ. drain-source on-state resistance

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


## 9 Typ. gate threshold voltage

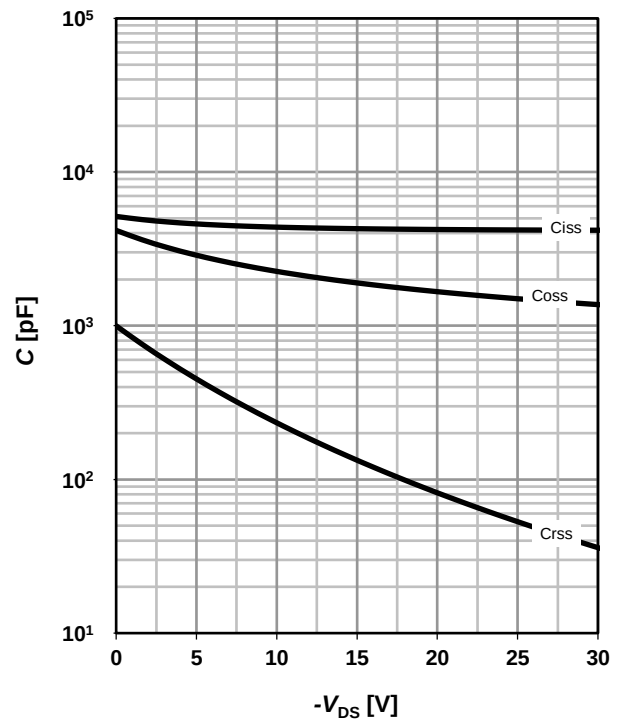
$$V_{GS(th)} = f(T_j); V_{GS} = V_{DS}$$

parameter:  $-I_D$



## 10 Typ. capacitances

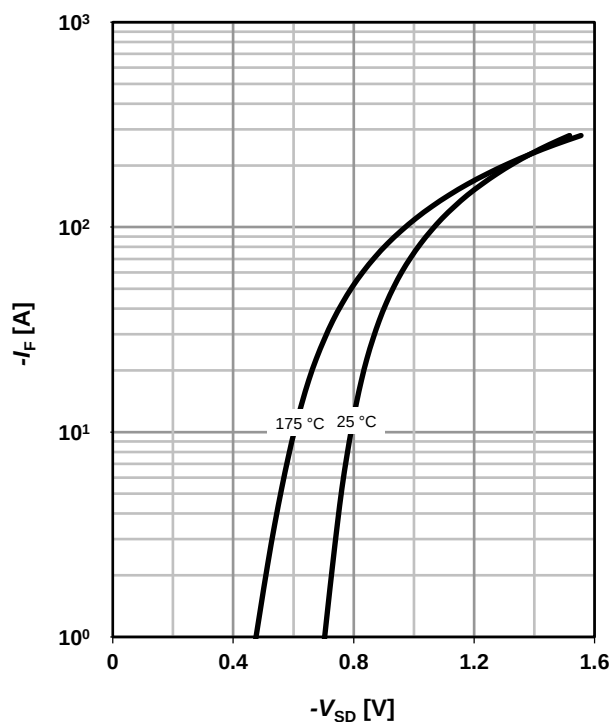
$$C = f(V_{DS}); V_{GS} = 0 V; f = 1 MHz$$



## 11 Typical forward diode characteristics

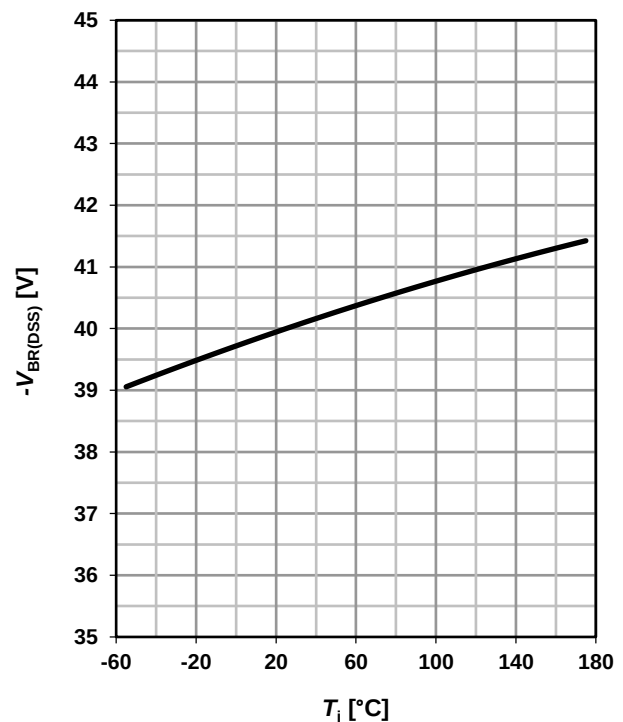
$$I_F = f(V_{SD})$$

parameter:  $T_j$



## 12 Drain-source breakdown voltage

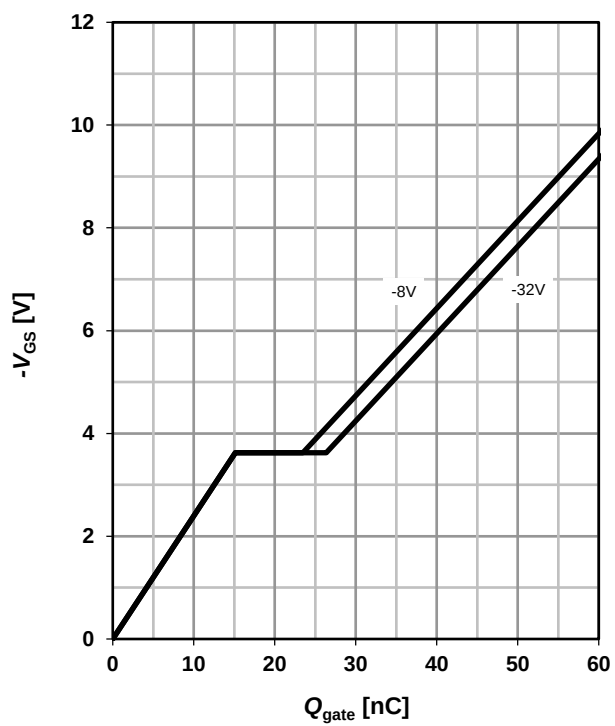
$$V_{BR(DSS)} = f(T_j); I_D = -1 mA$$



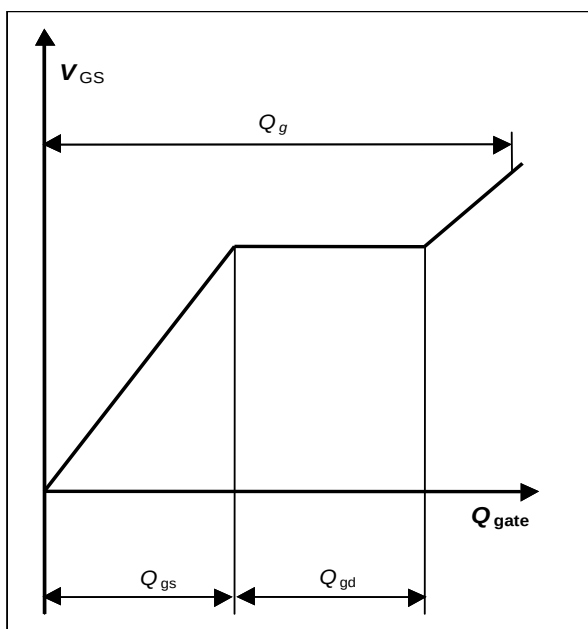
### 13 Typ. gate charge

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

parameter:  $V_{DD}$



### 14 Gate charge waveforms



**Published by**  
**Infineon Technologies AG**  
**81726 Munich, Germany**

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## Revision History

| Version | Date       | Changes                        |
|---------|------------|--------------------------------|
| 1.0     | 14.03.2011 | Final Data Sheet               |
| 1.1     | 21.12.2012 | Update of typical $R_{ds(on)}$ |
| 1.2     | 04.07.2019 | $V_{GS}$ changed               |
| 1.21    | 19.08.2021 | Editorial changes              |
|         |            |                                |
|         |            |                                |
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