



IPD50N10S3L-16

## OptiMOS™-T Power-Transistor



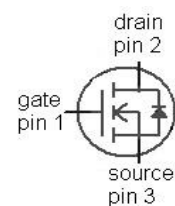
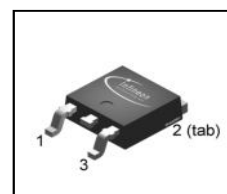
### Features

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

### Product Summary

|                  |     |    |
|------------------|-----|----|
| $V_{DS}$         | 100 | V  |
| $R_{DS(on),max}$ | 15  | mΩ |
| $I_D$            | 50  | A  |

PG-TO252-3-11



| Type           | Package       | Marking |
|----------------|---------------|---------|
| IPD50N10S3L-16 | PG-TO252-3-11 | QN10L16 |

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

| Parameter                                    | Symbol         | Conditions                                     | Value        | Unit |
|----------------------------------------------|----------------|------------------------------------------------|--------------|------|
| Continuous drain current                     | $I_D$          | $T_C=25\text{ °C}$ , $V_{GS}=10\text{V}$       | 50           | A    |
|                                              |                | $T_C=100\text{ °C}$ , $V_{GS}=10\text{V}^{1)}$ | 38           |      |
| Pulsed drain current <sup>1)</sup>           | $I_{D,pulse}$  | $T_C=25\text{ °C}$                             | 200          |      |
| Avalanche energy, single pulse <sup>1)</sup> | $E_{AS}$       | $I_D=25\text{A}$                               | 330          | mJ   |
| Avalanche current, single pulse              | $I_{AS}$       | -                                              | 50           | A    |
| Gate source voltage <sup>2)</sup>            | $V_{GS}$       | -                                              | ±20          | V    |
| Power dissipation                            | $P_{tot}$      | $T_C=25\text{ °C}$                             | 100          | W    |
| Operating and storage temperature            | $T_j, T_{stg}$ | -                                              | -55 ... +175 | °C   |

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

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

|                                     |            |                                              |   |   |     |     |
|-------------------------------------|------------|----------------------------------------------|---|---|-----|-----|
| Thermal resistance, junction - case | $R_{thJC}$ | -                                            | - | - | 1.5 | K/W |
| SMD version, device on PCB          | $R_{thJA}$ | minimal footprint                            | - | - | 62  |     |
|                                     |            | 6 cm <sup>2</sup> cooling area <sup>3)</sup> | - | - | 40  |     |

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

#### Static characteristics

|                                  |               |                                                     |     |      |      |            |
|----------------------------------|---------------|-----------------------------------------------------|-----|------|------|------------|
| Drain-source breakdown voltage   | $V_{(Br)DSS}$ | $V_{GS}=0V, I_D=1mA$                                | 100 | -    | -    | V          |
| Gate threshold voltage           | $V_{GS(th)}$  | $V_{DS}=V_{GS}, I_D=60\mu A$                        | 1.2 | 1.7  | 2.4  |            |
| Zero gate voltage drain current  | $I_{DSS}$     | $V_{DS}=80V, V_{GS}=0V, T_j=25^\circ\text{C}$       | -   | 0.01 | 0.1  | $\mu A$    |
|                                  |               | $V_{DS}=80V, V_{GS}=0V, T_j=125^\circ\text{C}^{1)}$ | -   | 0.1  | 10   |            |
| Gate-source leakage current      | $I_{GSS}$     | $V_{GS}=16V, V_{DS}=0V$                             | -   | -    | 100  | nA         |
| Drain-source on-state resistance | $R_{DS(on)}$  | $V_{GS}=4.5V, I_D=50A$                              | -   | 15.3 | 19.9 | m $\Omega$ |
|                                  |               | $V_{GS}=10V, I_D=50A$                               | -   | 12.5 | 15.0 |            |



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

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

|                              |              |                                                       |   |      |      |    |
|------------------------------|--------------|-------------------------------------------------------|---|------|------|----|
| Input capacitance            | $C_{iss}$    | $V_{GS}=0V, V_{DS}=25V,$<br>$f=1MHz$                  | - | 3215 | 4180 | pF |
| Output capacitance           | $C_{oss}$    |                                                       | - | 730  | 950  |    |
| Reverse transfer capacitance | $C_{rss}$    |                                                       | - | 63   | 95   |    |
| Turn-on delay time           | $t_{d(on)}$  | $V_{DD}=20V, V_{GS}=10V,$<br>$I_D=50A, R_G=3.5\Omega$ | - | 10   | -    | ns |
| Rise time                    | $t_r$        |                                                       | - | 5    | -    |    |
| Turn-off delay time          | $t_{d(off)}$ |                                                       | - | 29   | -    |    |
| Fall time                    | $t_f$        |                                                       | - | 5    | -    |    |

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

|                       |               |                                                      |   |     |    |    |
|-----------------------|---------------|------------------------------------------------------|---|-----|----|----|
| Gate to source charge | $Q_{gs}$      | $V_{DD}=80V, I_D=50A,$<br>$V_{GS}=0 \text{ to } 10V$ | - | 9   | 12 | nC |
| Gate to drain charge  | $Q_{gd}$      |                                                      | - | 8   | 12 |    |
| Gate charge total     | $Q_g$         |                                                      | - | 49  | 64 |    |
| Gate plateau voltage  | $V_{plateau}$ |                                                      | - | 3.7 | -  | V  |

**Reverse Diode**

|                                                |               |                                             |     |     |     |    |
|------------------------------------------------|---------------|---------------------------------------------|-----|-----|-----|----|
| Diode continuous forward current <sup>1)</sup> | $I_S$         | $T_C=25^\circ C$                            | -   | -   | 50  | A  |
| Diode pulse current <sup>1)</sup>              | $I_{S,pulse}$ |                                             | -   | -   | 200 |    |
| Diode forward voltage                          | $V_{SD}$      | $V_{GS}=0V, I_F=50A,$<br>$T_j=25^\circ C$   | 0.6 | 1   | 1.2 | V  |
| Reverse recovery time <sup>1)</sup>            | $t_{rr}$      | $V_R=50V, I_F=I_S,$<br>$di_F/dt=100A/\mu s$ | -   | 97  | -   | ns |
| Reverse recovery charge <sup>1)</sup>          | $Q_{rr}$      |                                             | -   | 178 | -   |    |

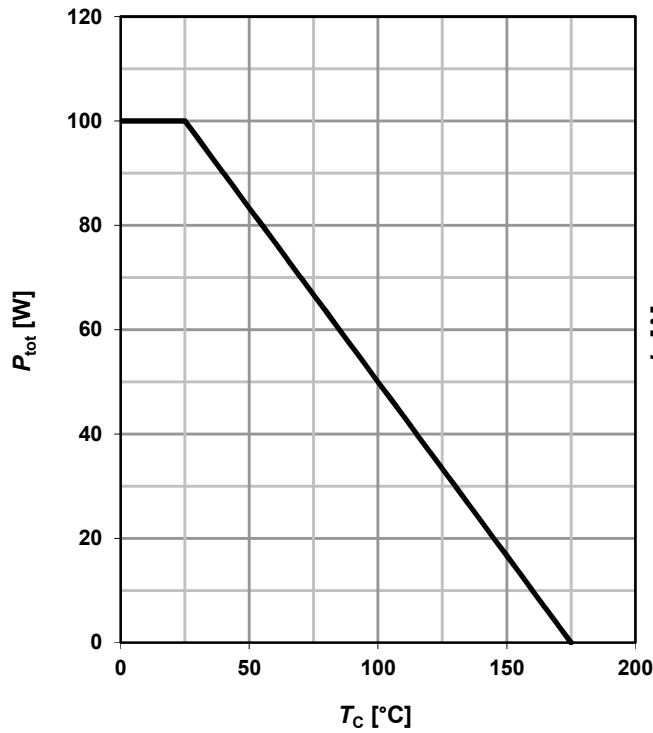
<sup>1)</sup> Defined by design. Not subject to production test.

<sup>2)</sup> -5V to -20V for max. 168 non-consecutive hours.

<sup>3)</sup> Device on 40 mm x 40 mm x 1.5 mm epoxy PCB FR4 with 6 cm<sup>2</sup> (one layer, 70  $\mu m$  thick) copper area for drain connection. PCB is vertical in still air.

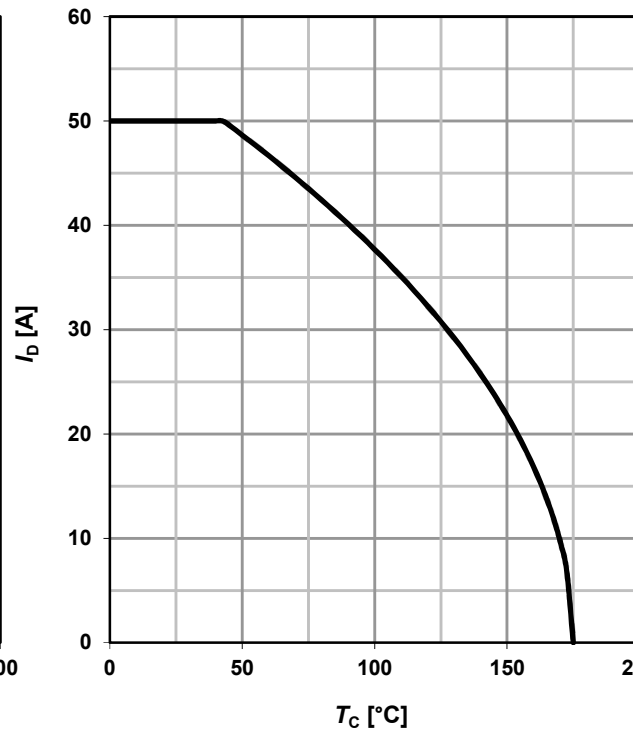
### 1 Power dissipation

$$P_{\text{tot}} = f(T_C); V_{\text{GS}} = 10 \text{ V}$$



### 2 Drain current

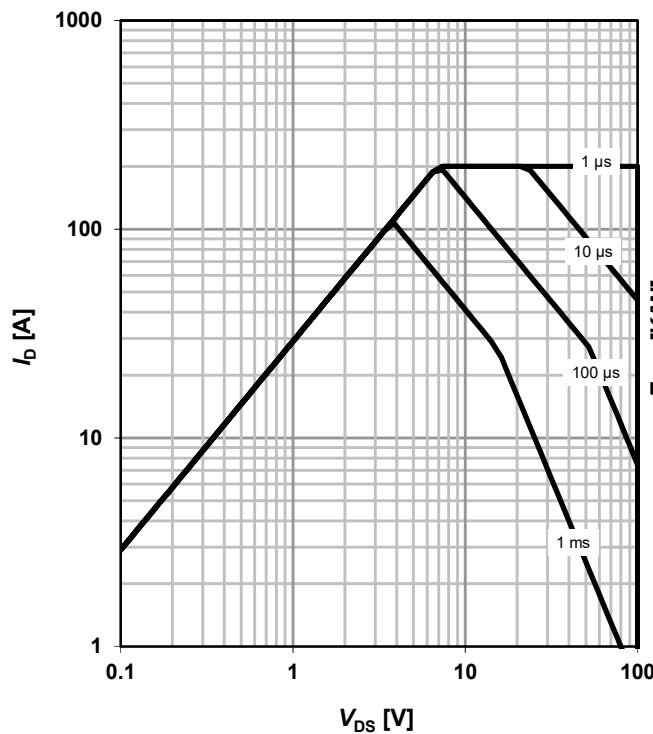
$$I_D = f(T_C); V_{\text{GS}} = 10 \text{ V}$$



### 3 Safe operating area

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

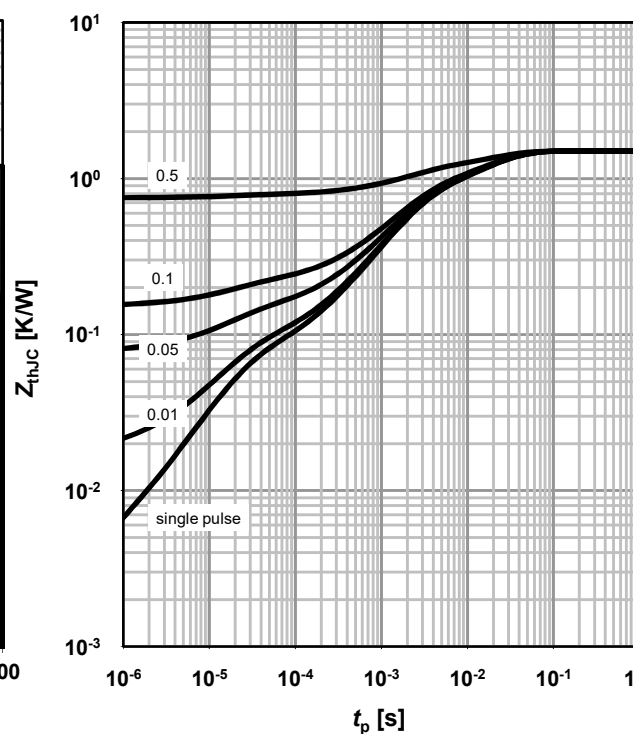
parameter:  $t_p$



### 4 Max. transient thermal impedance

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

parameter:  $D = t_p/T$

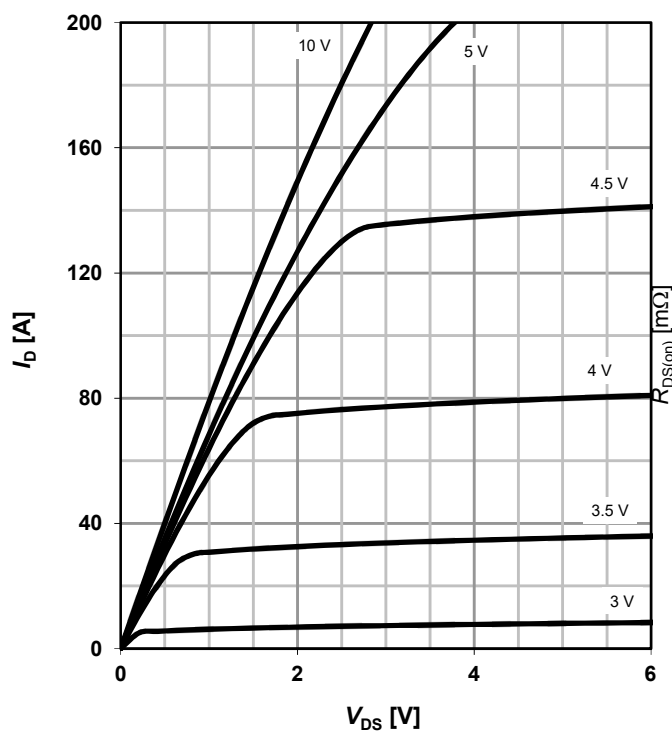




## 5 Typ. output characteristics

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

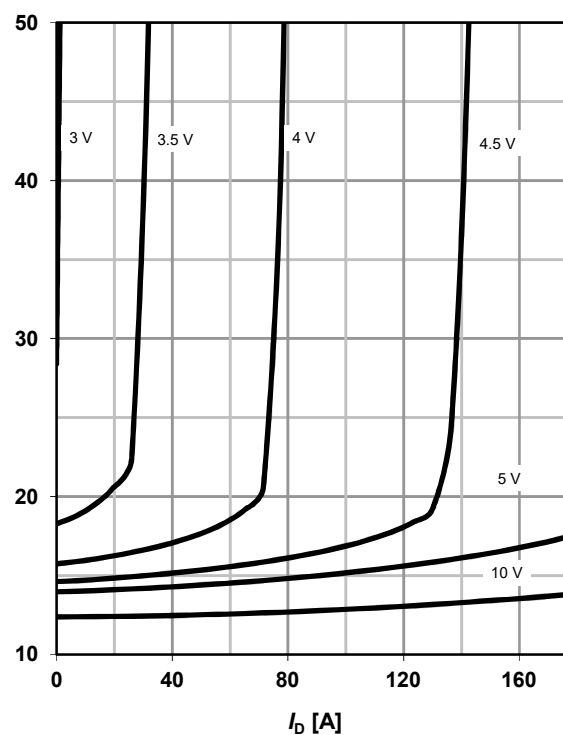
parameter:  $V_{GS}$



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

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

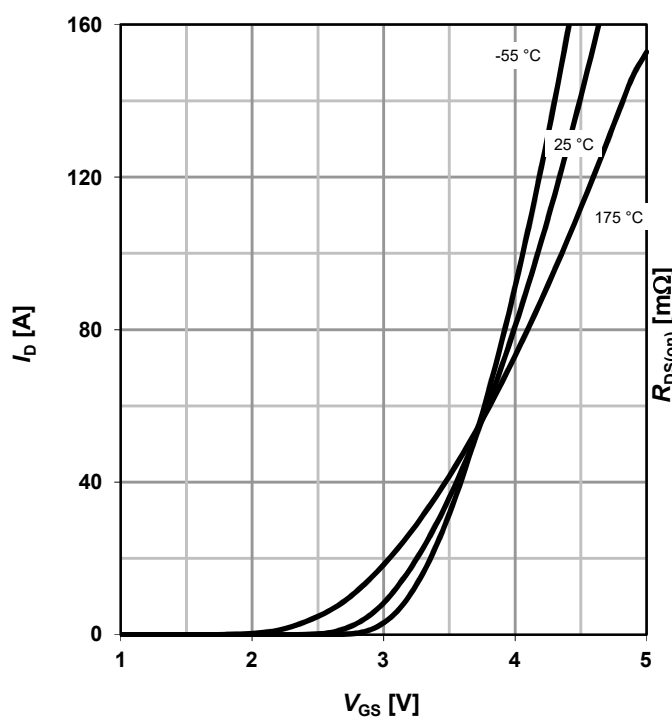
parameter:  $V_{GS}$



## 7 Typ. transfer characteristics

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

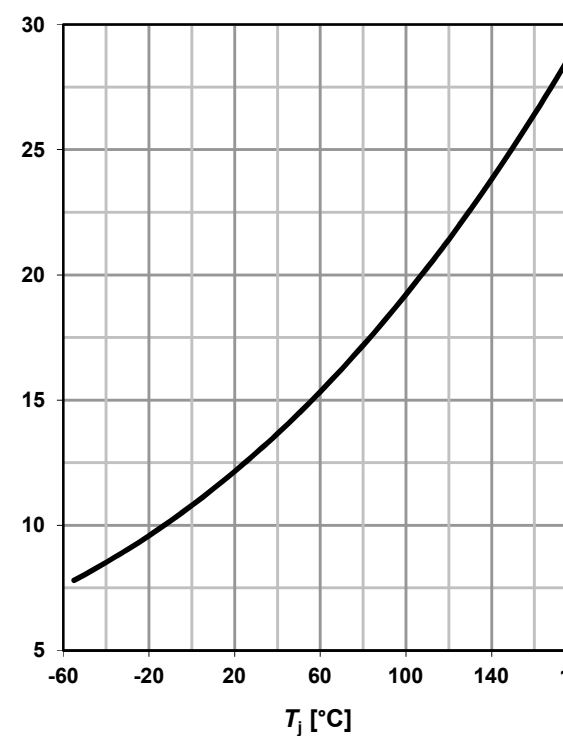
parameter:  $T_j$



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

$$R_{DS(on)} = f(T_j); I_D = 50\text{ A}; V_{GS} = 10\text{ V}$$

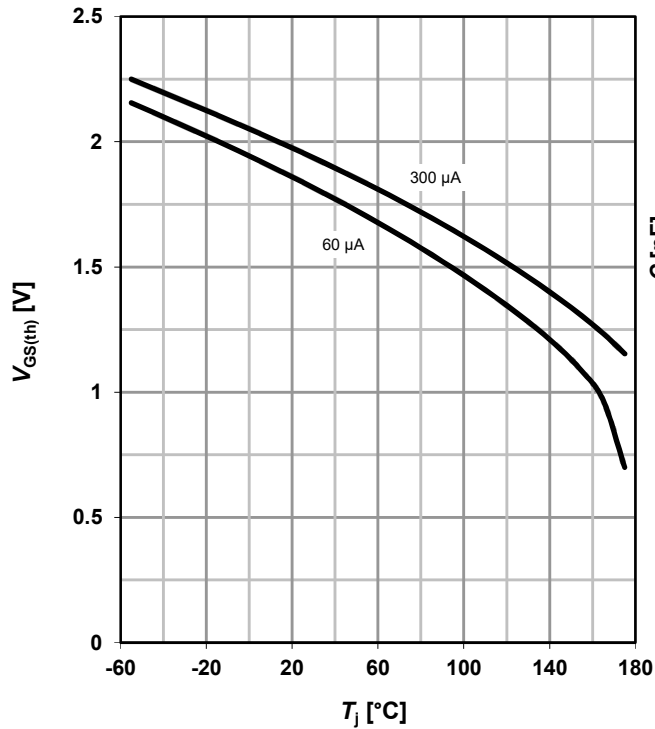
$\alpha = 0.56$



## 9 Typ. gate threshold voltage

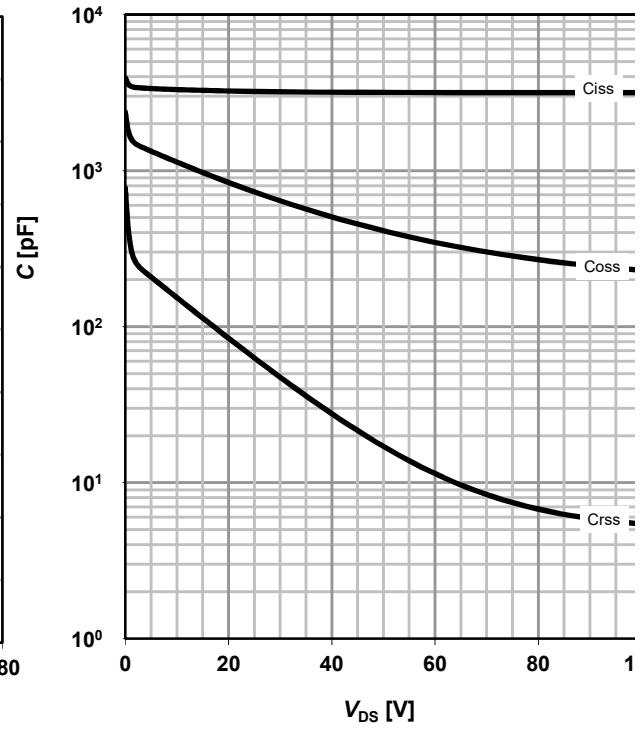
$$V_{GS(th)} = f(T_j); V_{GS} = V_{DS}$$

parameter:  $I_D$



## 10 Typ. capacitances

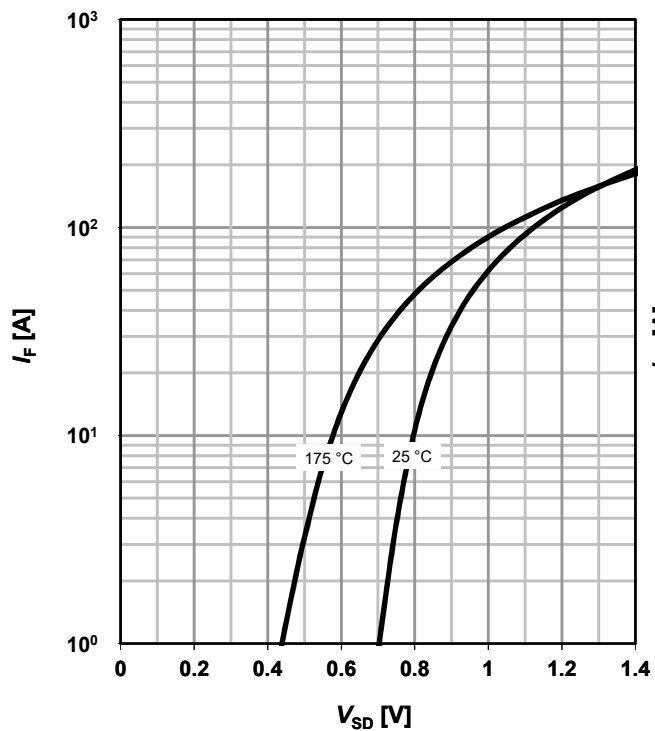
$$C = f(V_{DS}); V_{GS} = 0 \text{ V}; f = 1 \text{ MHz}$$



## 11 Typical forward diode characteristics

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

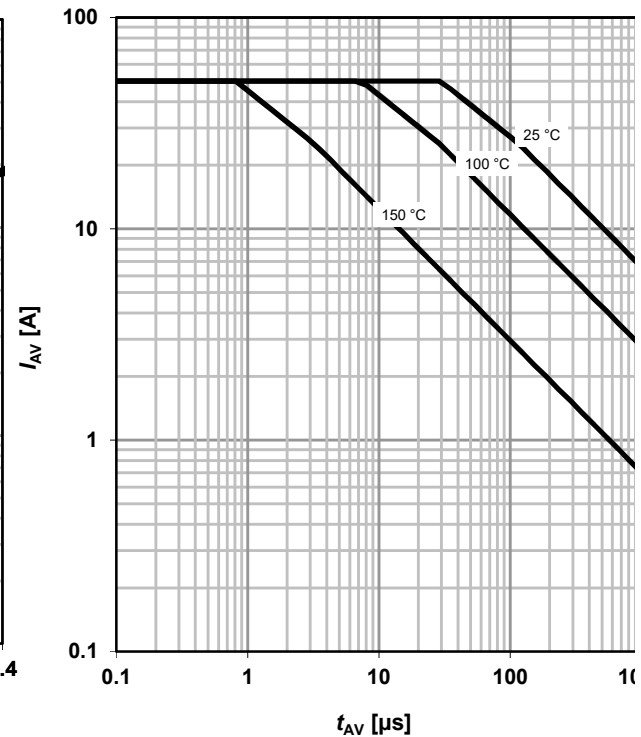
parameter:  $T_j$



## 12 Typ. avalanche characteristics

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

parameter:  $T_{j(start)}$



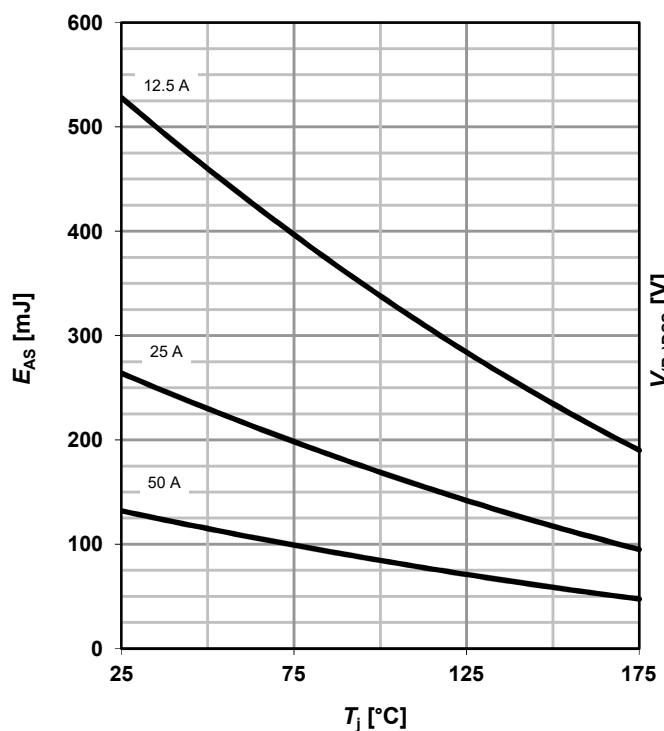


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### 13 Typical avalanche energy

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

parameter:  $I_D$



### 14 Typ. drain-source breakdown voltage

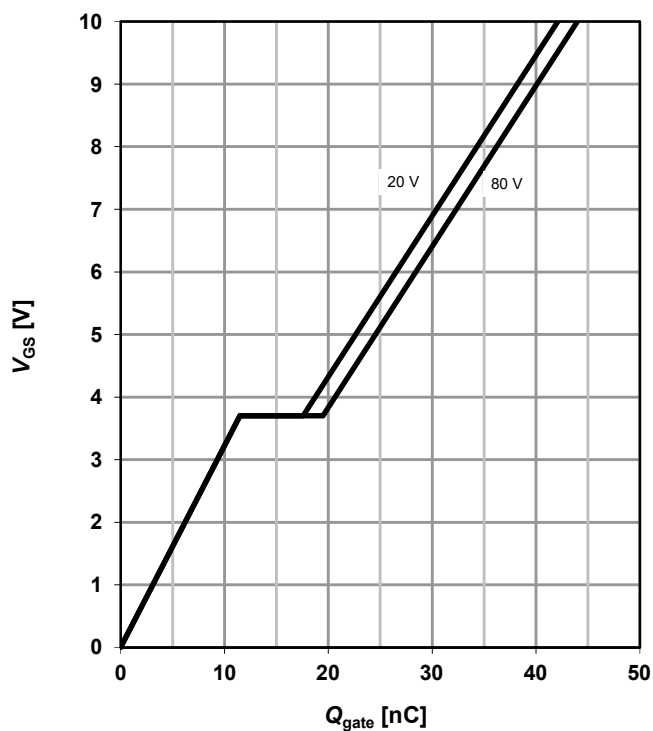
$$V_{(Br)DSS} = f(T_j); I_D = 1 \text{ mA}$$



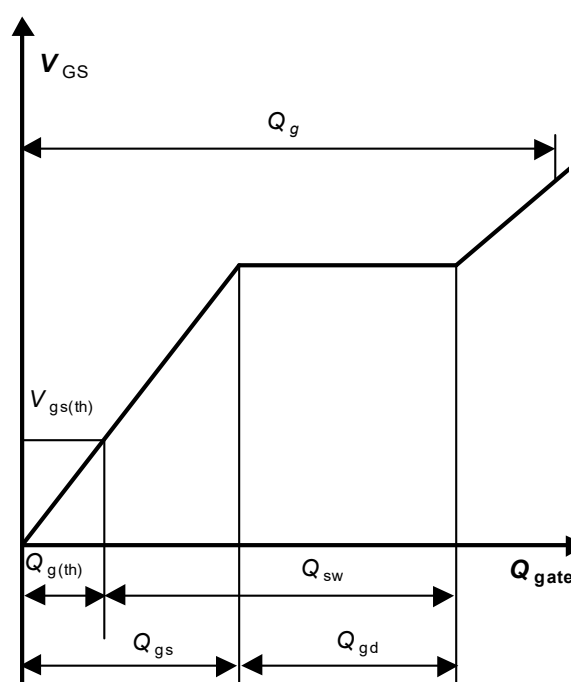
### 15 Typ. gate charge

$$V_{GS} = f(Q_{gate}); I_D = 50 \text{ A pulsed}$$

parameter:  $V_{DD}$



### 16 Gate charge waveforms



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## Revision History

| Version      | Date       | Changes                                                                        |
|--------------|------------|--------------------------------------------------------------------------------|
| Revision 1.1 | 2008-04-08 | Page 1: $V_{GS}$ changed from $\pm 16V$ to $\pm 20V$                           |
| Revision 1.1 | 2008-04-08 | Page 3: Footnote <sup>2)</sup> added                                           |
| Revision 1.1 | 2008-04-09 | Page 1: $E_{AS}$ changed from 264mJ to 330mJ                                   |
| Revision 1.2 | 2011-03-06 | $I_{DSS}$ typ changed from 1 $\mu A$ to 0.1 $\mu A$                            |
| Revision 1.3 | 2015-10-07 | Update of SOA diagram                                                          |
| Revision 1.4 | 2023-06-15 | Diagram 8 Typ. drain-source on-state resistance: used $\alpha$ value clarified |
| Revision 1.4 | 2023-06-15 | Ratings of Gate Source Voltage $V_{GS}$ refined in footnote <sup>2)</sup>      |
| Revision 1.4 | 2023-06-15 | Corrected diagram 3 safe operating area                                        |
| Revision 1.4 | 2023-06-15 | Corrected diagram 10 typical capacitances                                      |