



IPD90N06S4L-03

## 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
- Ultra low  $R_{DS(on)}$

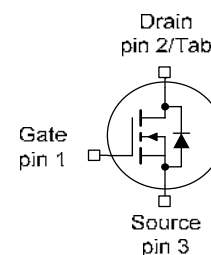
### Product Summary

|                  |     |    |
|------------------|-----|----|
| $V_{DS}$         | 60  | V  |
| $R_{DS(on),max}$ | 3.5 | mΩ |
| $I_D$            | 90  | A  |

PG-TO252-3-11



| Type           | Package       | Marking |
|----------------|---------------|---------|
| IPD90N06S4L-03 | PG-TO252-3-11 | 4N06L03 |



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

| Parameter                                    | Symbol            | Conditions                                               | Value        | Unit |
|----------------------------------------------|-------------------|----------------------------------------------------------|--------------|------|
| Continuous drain current <sup>1)</sup>       | $I_D$             | $T_C=25\text{ °C}$ , $V_{GS}=10\text{ V}$                | 90           | A    |
|                                              |                   | $T_C=100\text{ °C}$ , $V_{GS}=10\text{ V}$ <sup>2)</sup> | 90           |      |
| Pulsed drain current <sup>2)</sup>           | $I_{D,pulse}$     | $T_C=25\text{ °C}$                                       | 360          |      |
| Avalanche energy, single pulse <sup>2)</sup> | $E_{AS}$          | $I_D=45\text{ A}$                                        | 331          | mJ   |
| Avalanche current, single pulse              | $I_{AS}$          | -                                                        | 90           | A    |
| Gate source voltage                          | $V_{GS}$          | -                                                        | ±16          | V    |
| Power dissipation                            | $P_{tot}$         | $T_C=25\text{ °C}$                                       | 150          | 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 | $R_{thJC}$ | -                                            | - | - | 1.0 | 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   | $V_{(BR)DSS}$ | $V_{GS}=0V, I_D=1mA$                                | 60  | -    | -   | V          |
| Gate threshold voltage           | $V_{GS(th)}$  | $V_{DS}=V_{GS}, I_D=90\mu A$                        | 1.2 | 1.7  | 2.2 |            |
| Zero gate voltage drain current  | $I_{DSS}$     | $V_{DS}=60V, V_{GS}=0V, T_j=25^\circ\text{C}$       | -   | 0.01 | 1   | $\mu A$    |
|                                  |               | $V_{DS}=60V, V_{GS}=0V, T_j=125^\circ\text{C}^{2)}$ | -   | 5    | 100 |            |
| Gate-source leakage current      | $I_{GSS}$     | $V_{GS}=16V, V_{DS}=0V$                             | -   | -    | 100 | nA         |
| Drain-source on-state resistance | $R_{DS(on)}$  | $V_{GS}=4.5V, I_D=45A$                              | -   | 3.7  | 5.5 | m $\Omega$ |
|                                  |               | $V_{GS}=10V, I_D=90A$                               | -   | 2.7  | 3.5 |            |



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

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

|                              |              |                                                       |   |       |       |    |
|------------------------------|--------------|-------------------------------------------------------|---|-------|-------|----|
| Input capacitance            | $C_{iss}$    | $V_{GS}=0V, V_{DS}=25V,$<br>$f=1MHz$                  | - | 10000 | 13000 | pF |
| Output capacitance           | $C_{oss}$    |                                                       | - | 2060  | 2680  |    |
| Reverse transfer capacitance | $C_{rss}$    |                                                       | - | 90    | 180   |    |
| Turn-on delay time           | $t_{d(on)}$  | $V_{DD}=30V, V_{GS}=10V,$<br>$I_D=90A, R_G=3.5\Omega$ | - | 21    | -     | ns |
| Rise time                    | $t_r$        |                                                       | - | 6     | -     |    |
| Turn-off delay time          | $t_{d(off)}$ |                                                       | - | 140   | -     |    |
| Fall time                    | $t_f$        |                                                       | - | 20    | -     |    |

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

|                       |               |                                                      |   |     |     |    |
|-----------------------|---------------|------------------------------------------------------|---|-----|-----|----|
| Gate to source charge | $Q_{gs}$      | $V_{DD}=48V, I_D=90A,$<br>$V_{GS}=0 \text{ to } 10V$ | - | 34  | 45  | nC |
| Gate to drain charge  | $Q_{gd}$      |                                                      | - | 12  | 24  |    |
| Gate charge total     | $Q_g$         |                                                      | - | 133 | 170 |    |
| Gate plateau voltage  | $V_{plateau}$ |                                                      | - | 3.4 | -   | V  |

**Reverse Diode**

|                                                |               |                                             |     |      |     |    |
|------------------------------------------------|---------------|---------------------------------------------|-----|------|-----|----|
| Diode continuous forward current <sup>2)</sup> | $I_S$         | $T_C=25^\circ C$                            | -   | -    | 90  | A  |
| Diode pulse current <sup>2)</sup>              | $I_{S,pulse}$ |                                             | -   | -    | 360 |    |
| Diode forward voltage                          | $V_{SD}$      | $V_{GS}=0V, I_F=90A,$<br>$T_j=25^\circ C$   | 0.6 | 0.95 | 1.3 | V  |
| Reverse recovery time <sup>2)</sup>            | $t_{rr}$      | $V_R=30V, I_F=90A,$<br>$di_F/dt=100A/\mu s$ | -   | 50   | -   | ns |
| Reverse recovery charge <sup>2)</sup>          | $Q_{rr}$      |                                             | -   | 80   | -   | nC |

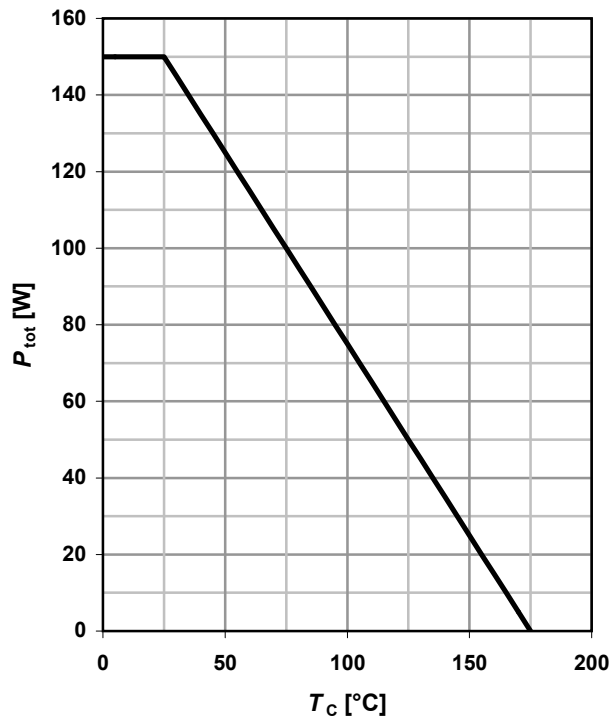
<sup>1)</sup> Current is limited by bondwire; with an  $R_{thJC} = 1.0K/W$  the chip is able to carry A at 25°C.

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

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

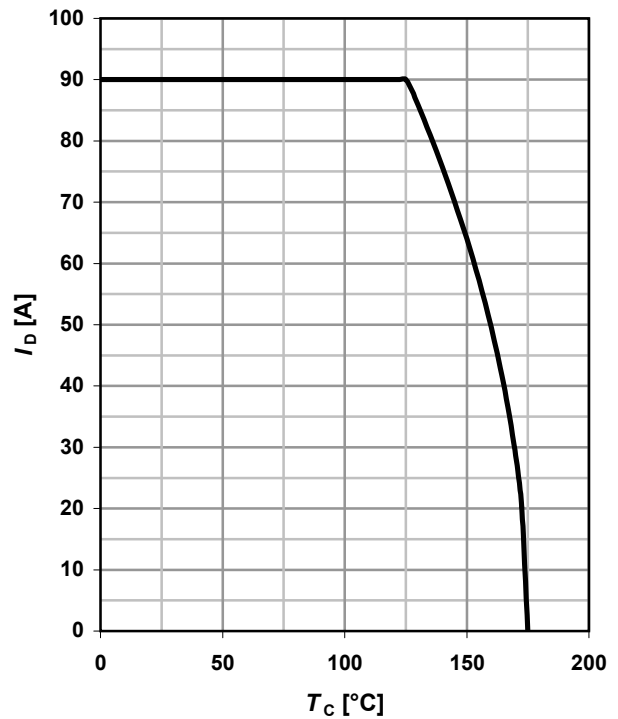
### 1 Power dissipation

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



### 2 Drain current

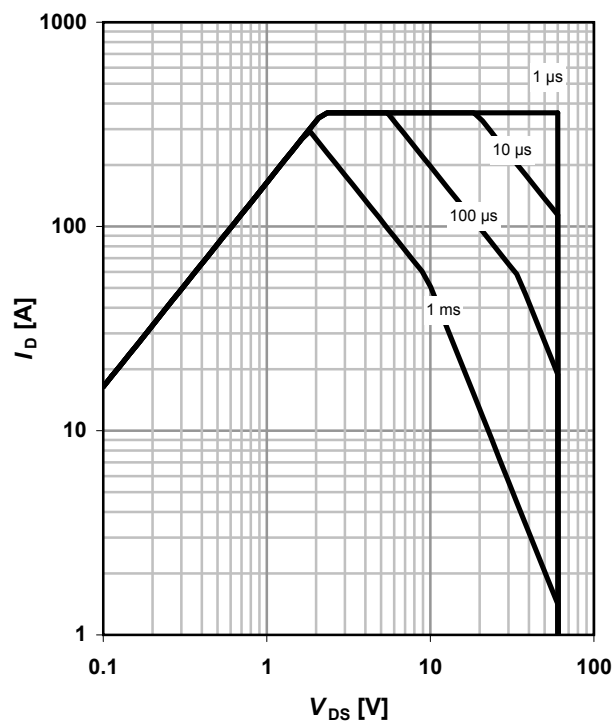
$$I_D = f(T_C); V_{\text{GS}} \geq 6 \text{ V}$$



### 3 Safe operating area

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

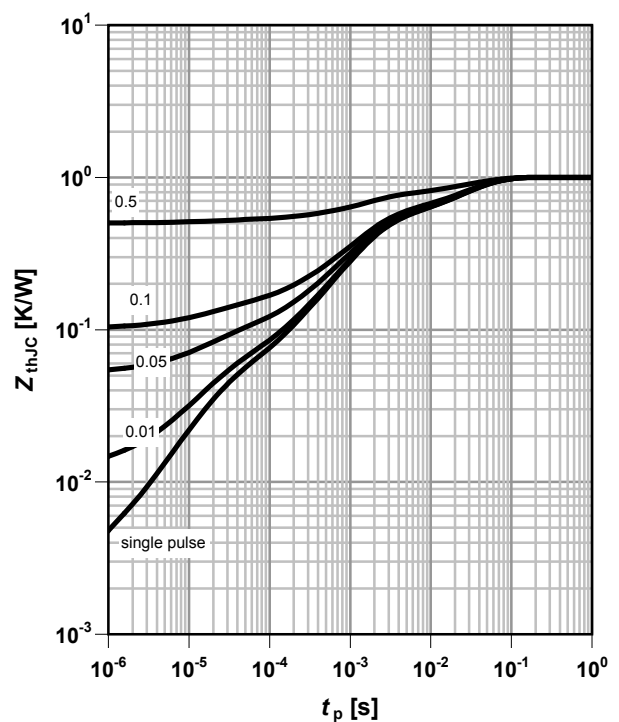
parameter:  $t_p$



### 4 Max. transient thermal impedance

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

parameter:  $D = t_p/T$

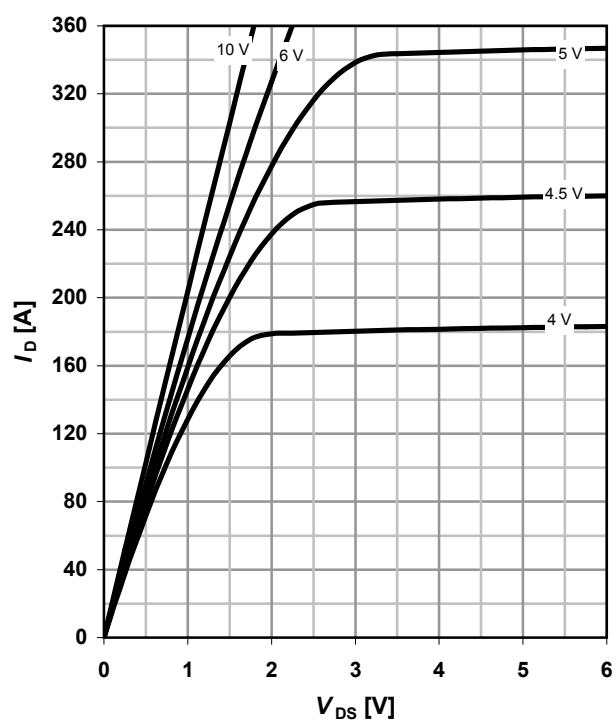




## 5 Typ. output characteristics

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

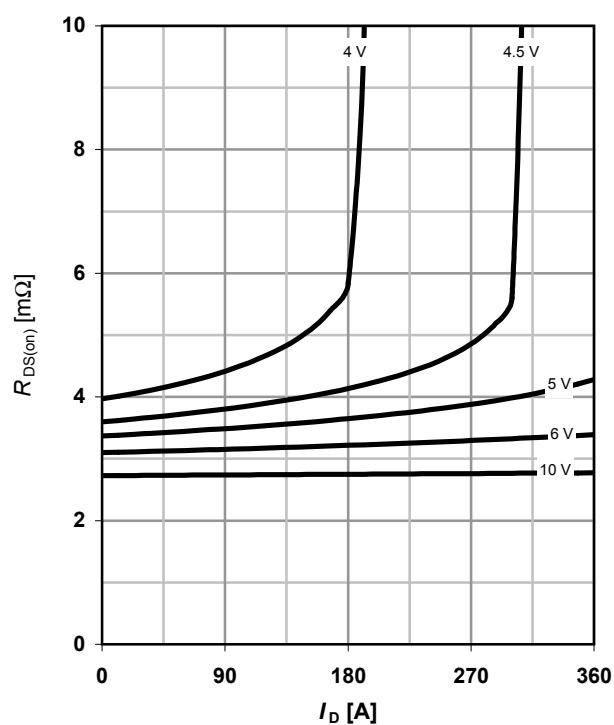
parameter:  $V_{GS}$



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

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

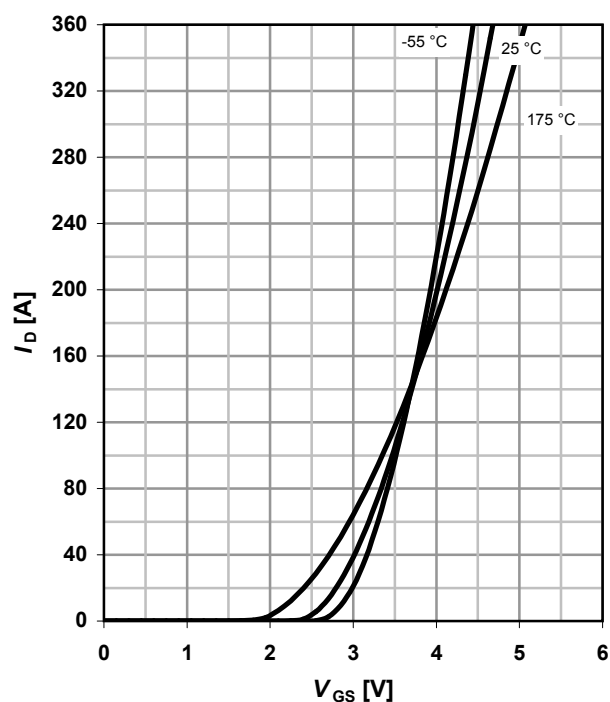
parameter:  $V_{GS}$



## 7 Typ. transfer characteristics

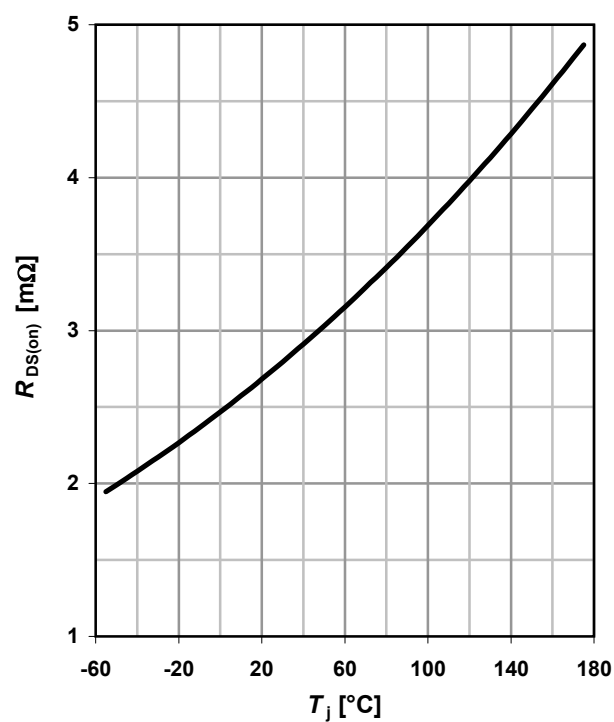
$I_D = f(V_{GS}); V_{DS} = 6\text{ V}$

parameter:  $T_j$



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

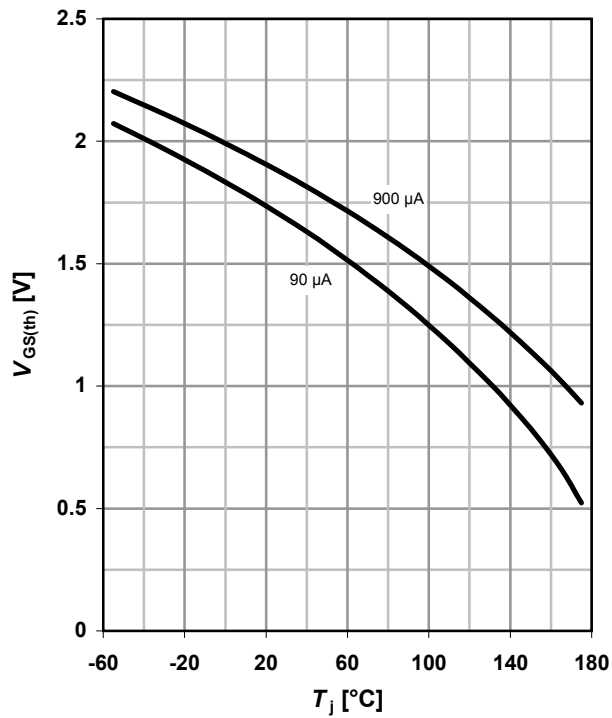
$R_{DS(on)} = f(T_j); I_D = 90\text{ A}; V_{GS} = 10\text{ V}$



## 9 Typ. gate threshold voltage

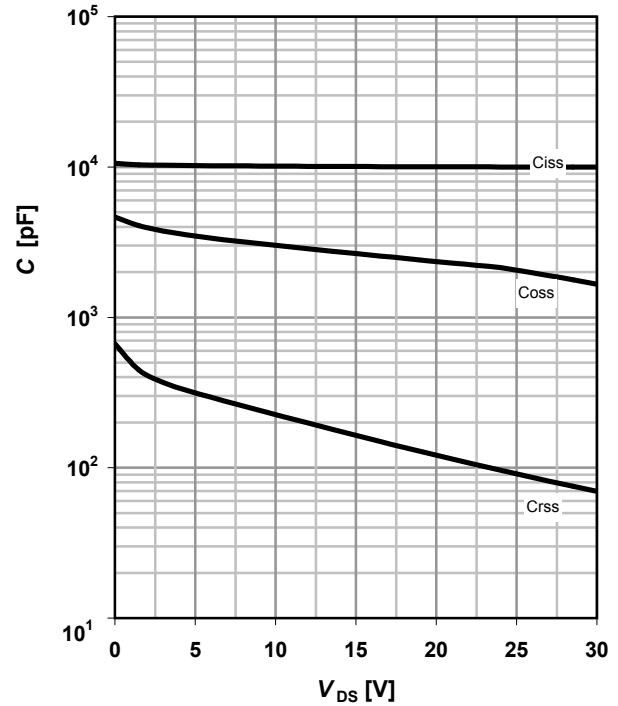
$$V_{GS(th)} = f(T_j); V_{GS} = V_{DS}$$

parameter:  $I_D$



## 10 Typ. capacitances

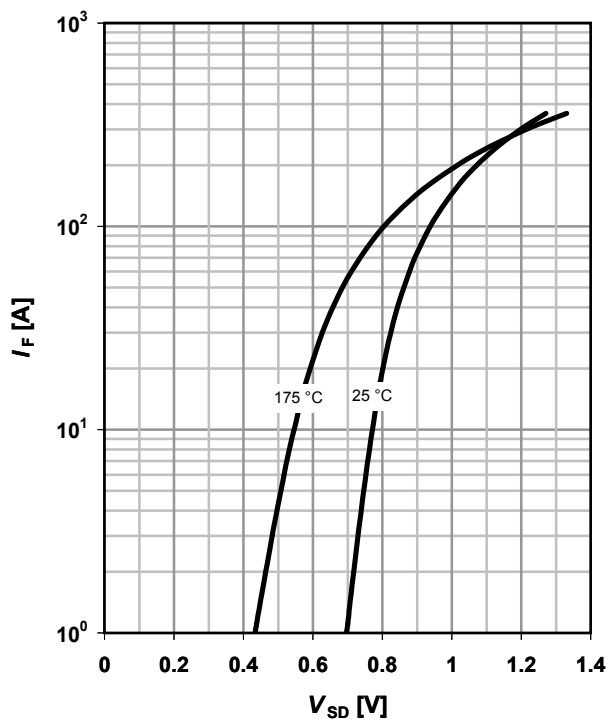
$$C = f(V_{DS}); V_{GS} = 0 \text{ V}; f = 1 \text{ MHz}$$



## 11 Typical forward diode characteristics

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

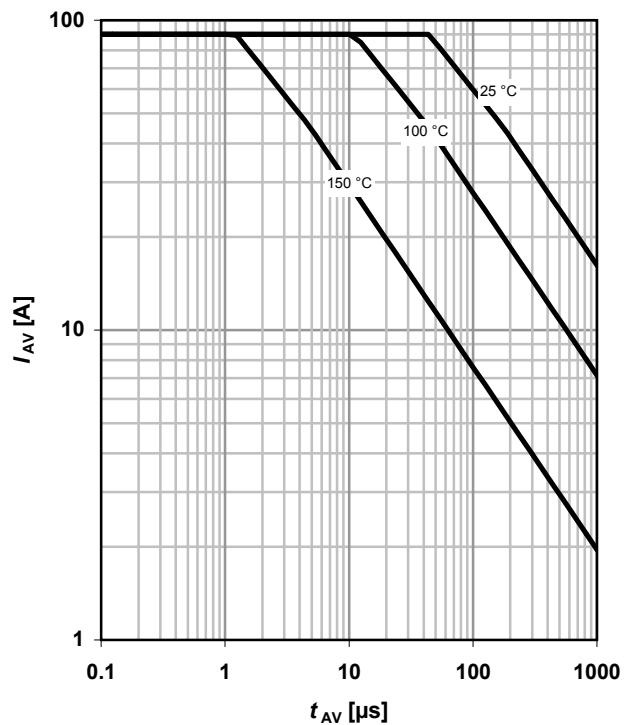
parameter:  $T_j$



## 12 Avalanche characteristics

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

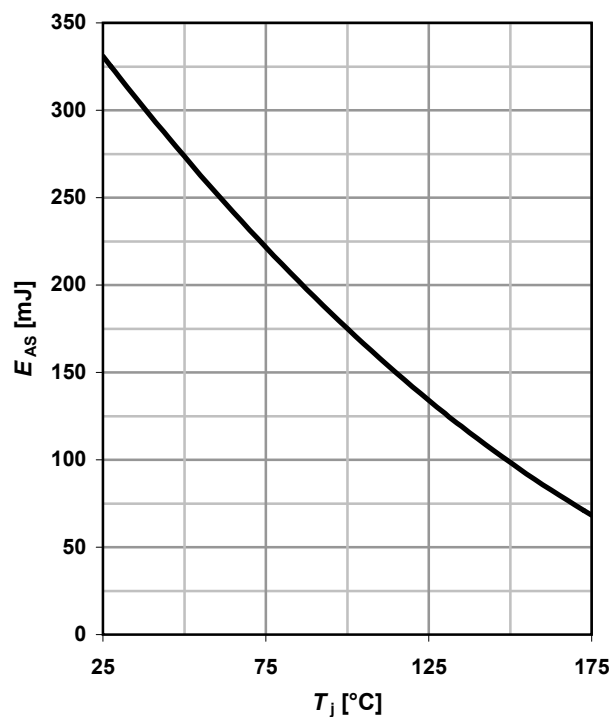
parameter:  $T_{j(start)}$





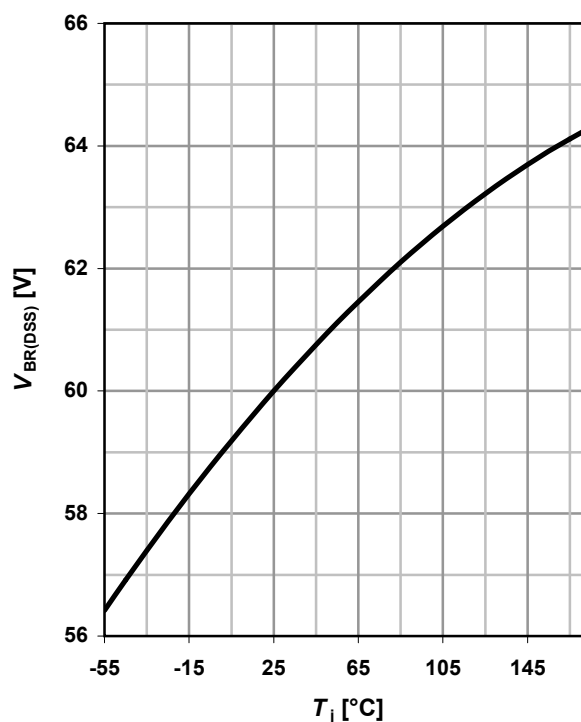
### 13 Avalanche energy

$$E_{AS} = f(T_j); I_D = 45 \text{ A}$$



### 14 Drain-source breakdown voltage

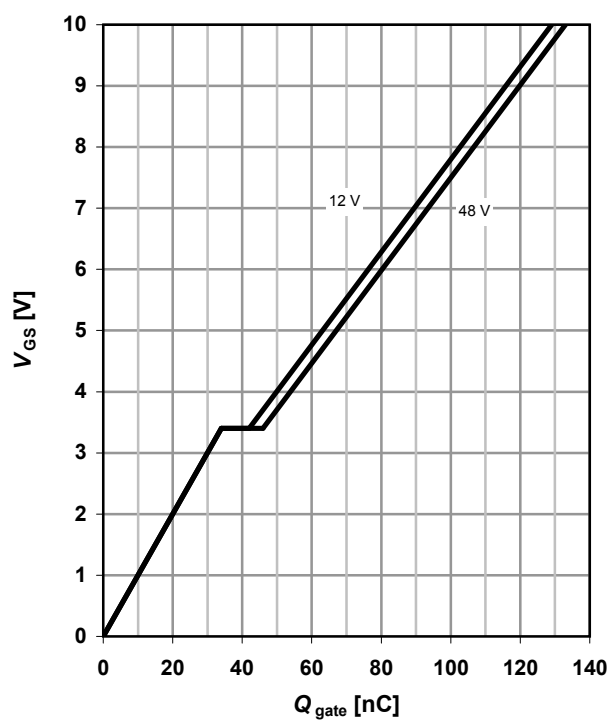
$$V_{BR(DSS)} = f(T_j); I_D = 1 \text{ mA}$$



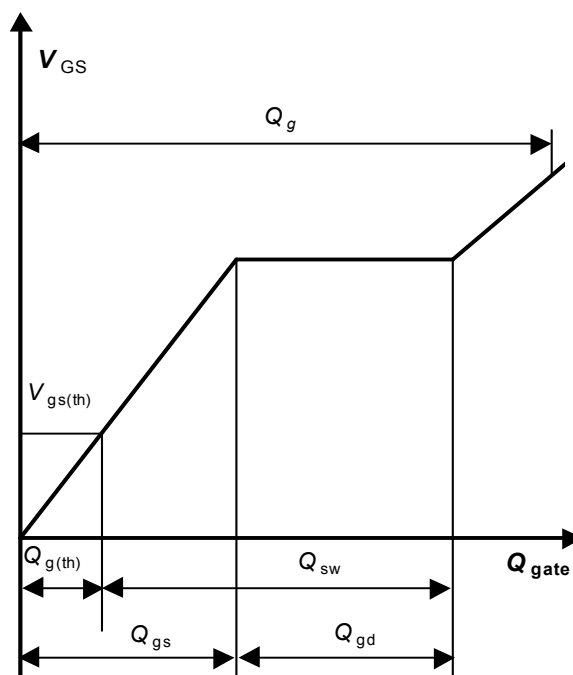
### 15 Typ. gate charge

$$V_{GS} = f(Q_{gate}); I_D = 90 \text{ A pulsed}$$

parameter:  $V_{DD}$



### 16 Gate charge waveforms



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Revision History

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| Version      | Date       | Changes          |
|--------------|------------|------------------|
| Revision 1.0 | 24.03.2009 | Final data sheet |