

**OptiMOS<sup>®</sup> -T2 Power-Transistor**

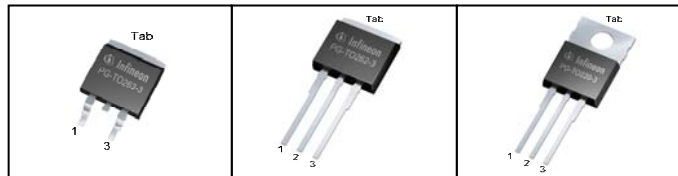
**Product Summary**

|                                |     |            |
|--------------------------------|-----|------------|
| $V_{DS}$                       | 60  | V          |
| $R_{DS(on),max}$ (SMD version) | 3.4 | m $\Omega$ |
| $I_D$                          | 90  | A          |

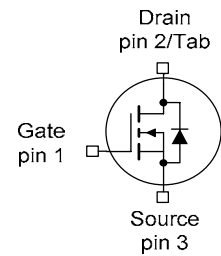
**Features**

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

PG-TO263-3-2      PG-TO262-3-1      PG-TO220-3-1



| Type           | Package      | Marking |
|----------------|--------------|---------|
| IPB90N06S4L-04 | PG-TO263-3-2 | 4N06L04 |
| IPI90N06S4L-04 | PG-TO262-3-1 | 4N06L04 |
| IPP90N06S4L-04 | PG-TO220-3-1 | 4N06L04 |


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

| Parameter                                    | Symbol         | Conditions   | Value        | Unit             |
|--|----------------|--|--------------|------------------|
| Continuous drain current <sup>1)</sup>       | $I_D$          | $T_C=25^\circ\text{C}$ , $V_{GS}=10\text{V}$       | 90           | A                |
|  |                | $T_C=100^\circ\text{C}$ , $V_{GS}=10\text{V}^{2)}$ | 90           |                  |
| Pulsed drain current <sup>2)</sup>           | $I_{D,pulse}$  | $T_C=25^\circ\text{C}$                             | 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                          | $V_{GS}$       | -  | $\pm 16$     | V                |
| Power dissipation                            | $P_{tot}$      | $T_C=25^\circ\text{C}$                             | 150          | W                |
| Operating and storage temperature            | $T_j, T_{stg}$ | -  | -55 ... +175 | $^\circ\text{C}$ |
| IEC climatic category; DIN IEC 68-1          | -              | -  | 55/175/56    |                  |

| Parameter                                      | Symbol     | Conditions                                   | Values |      |      | Unit |
|--|------------|--|--------|------|------|------|
|  |            |  | min.   | typ. | max. |      |
| <b>Thermal characteristics<sup>2)</sup></b>    |            |  |        |      |      |      |
| Thermal resistance, junction - case            | $R_{thJC}$ | -  | -      | -    | 1.0  | 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>3)</sup> | -      | -    | 40   |      |

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

**Static characteristics**

|                                  |               |   |     |      |     |                  |
|----------------------------------|---------------|---|-----|------|-----|------------------|
| Drain-source breakdown voltage   | $V_{(BR)DSS}$ | $V_{GS}=0V, I_D=1\text{mA}$                         | 60  | -    | -   | V                |
| Gate threshold voltage           | $V_{GS(th)}$  | $V_{DS}=V_{GS}, I_D=90\mu\text{A}$                  | 1.2 | 1.7  | 2.2 |                  |
| Zero gate voltage drain current  | $I_{DSS}$     | $V_{DS}=60V, V_{GS}=0V$                             | -   | 0.01 | 1   | $\mu\text{A}$    |
|                                  |               | $V_{DS}=60V, V_{GS}=0V, T_j=125^\circ\text{C}^{2)}$ | -   | 5    | 100 |                  |
| Gate-source leakage current      | $I_{GSS}$     | $V_{GS}=16V, V_{DS}=0V$                             | -   | -    | 100 | nA               |
| Drain-source on-state resistance | $R_{DS(on)}$  | $V_{GS}=4.5V, I_D=45A$                              | -   | 3.9  | 5.9 | $\text{m}\Omega$ |
|                                  |               | $V_{GS}=4.5V, I_D=45A, \text{SMD version}$          | -   | 3.6  | 5.6 |                  |
|                                  |               | $V_{GS}=10V, I_D=90A$                               | -   | 3.0  | 3.7 |                  |
|                                  |               | $V_{GS}=10V, I_D=90A, \text{SMD version}$           | -   | 2.7  | 3.4 |                  |

| 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>$V_{GS}=0$ 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 |

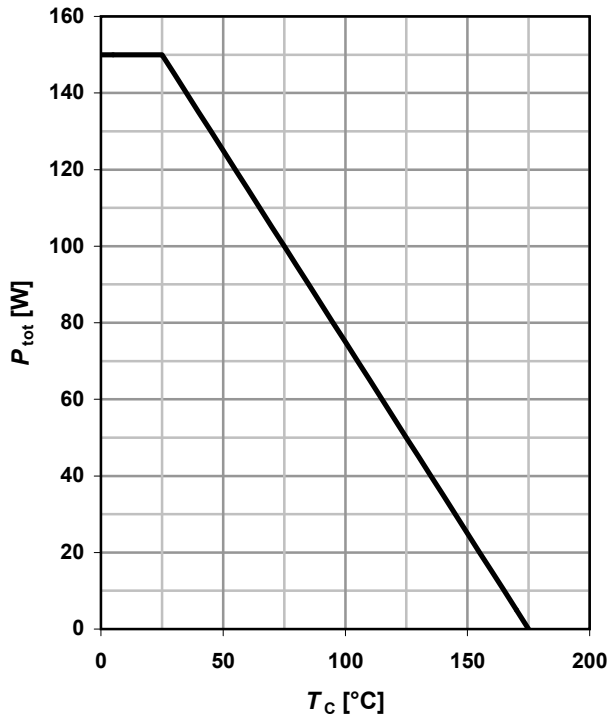
<sup>1)</sup> Current is limited by bondwire; with an  $R_{thJC} = 1.0K/W$  the chip is able to carry 157A at 25°C.

<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.

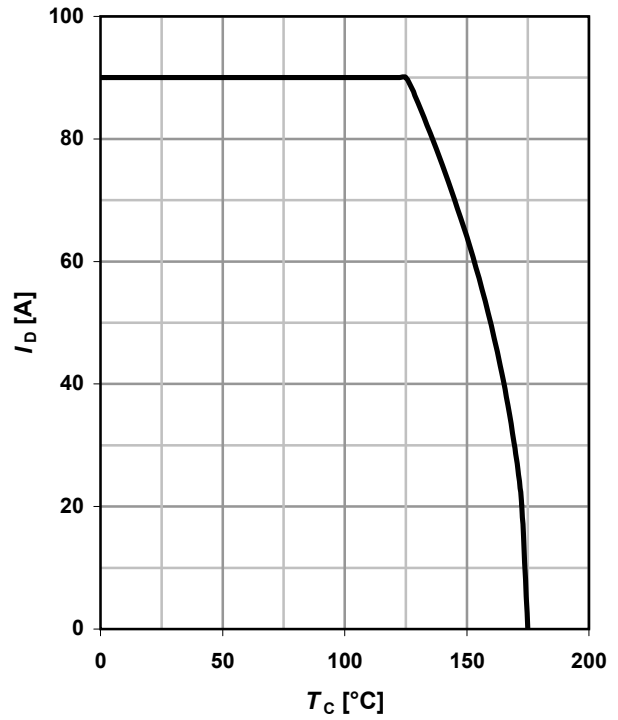
**1 Power dissipation**

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



**2 Drain current**

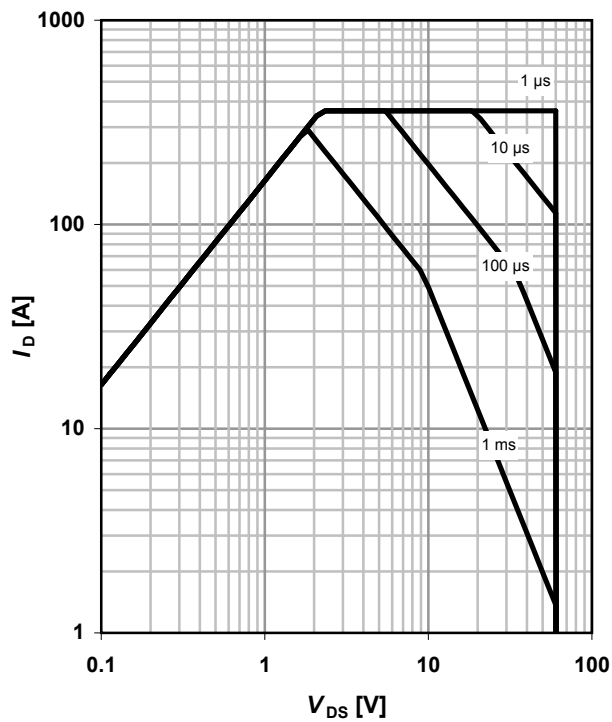
$I_D = f(T_C); V_{GS} \geq 6\text{ V}; \text{SMD}$



**3 Safe operating area**

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

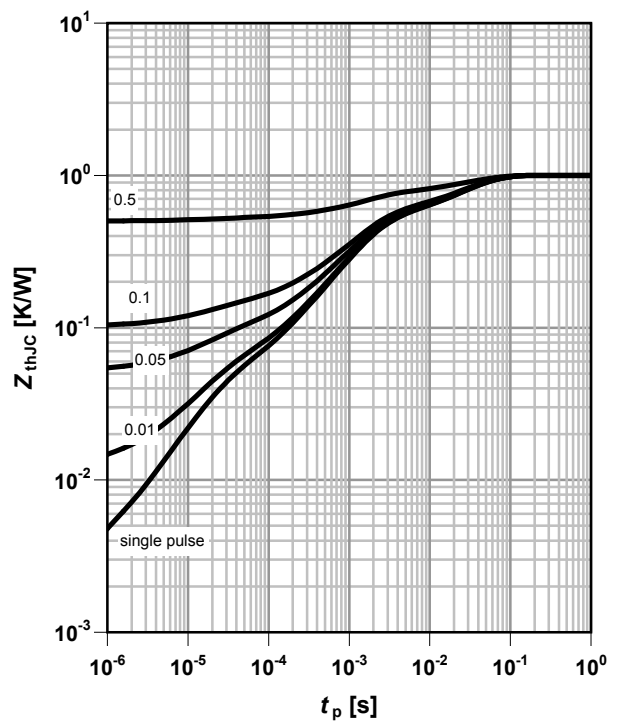
parameter:  $t_p$



**4 Max. transient thermal impedance**

$Z_{thJC} = f(t_p)$

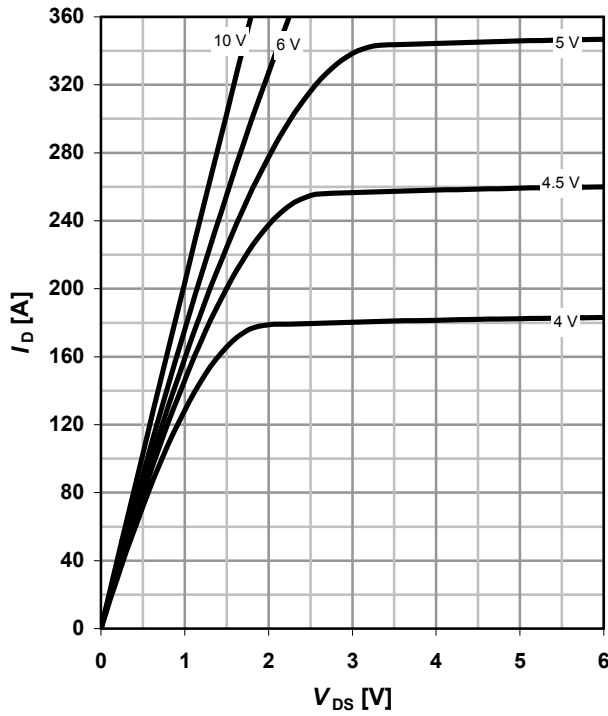
parameter:  $D = t_p/T$



**5 Typ. output characteristics**

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

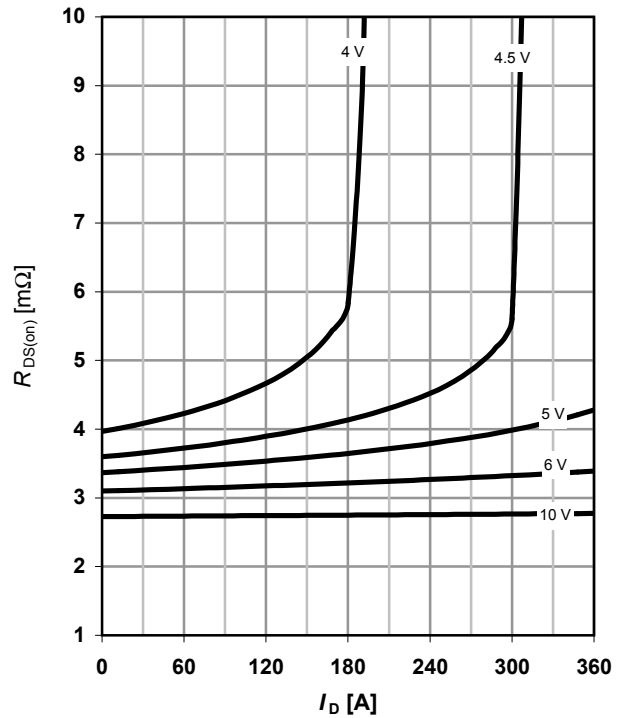
parameter:  $V_{GS}$



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

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

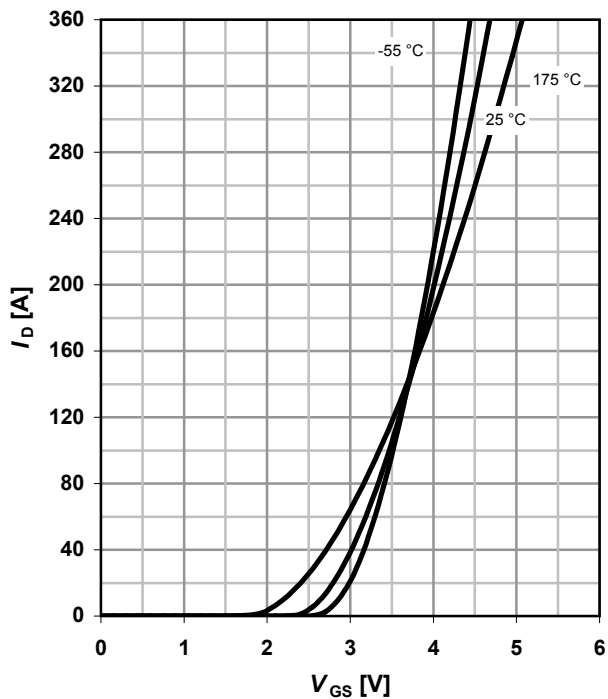
parameter:  $V_{GS}$



**7 Typ. transfer characteristics**

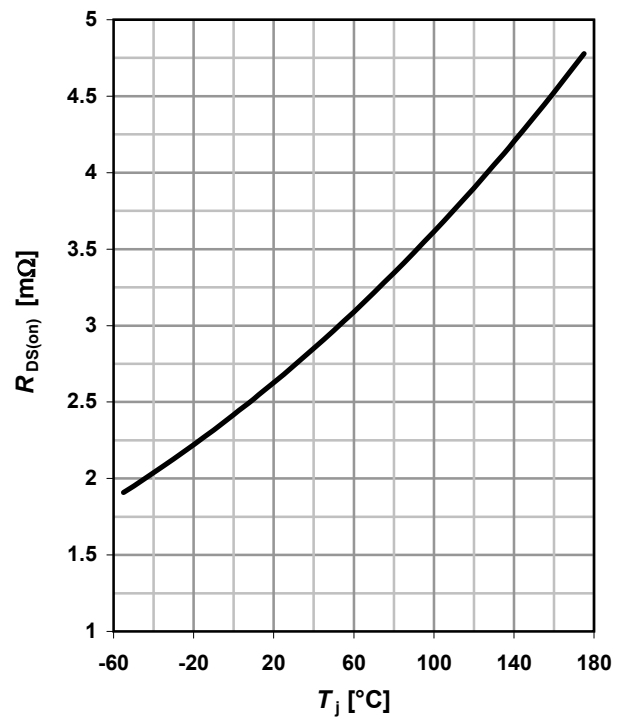
$I_D = f(V_{GS}); V_{DS} = 6\text{ V}$

parameter:  $T_j$



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

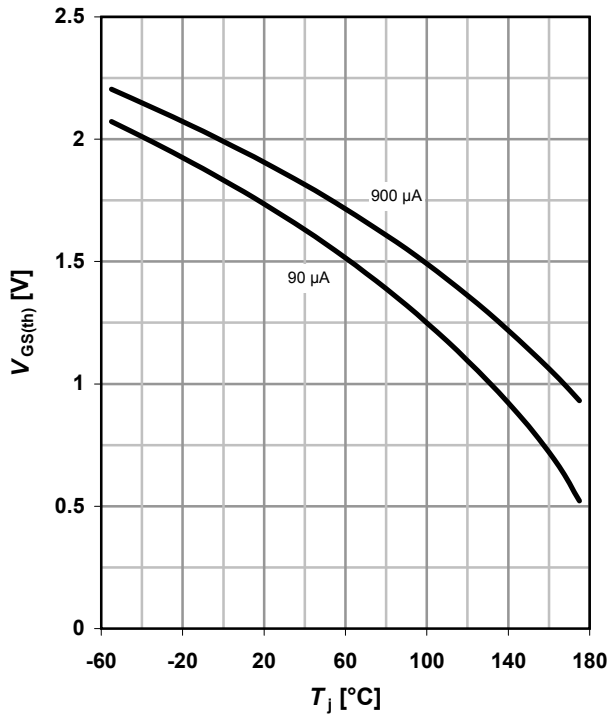
$R_{DS(on)} = f(T_j); I_D = 90\text{ A}; V_{GS} = 10\text{ V}; \text{SMD}$



**9 Typ. gate threshold voltage**

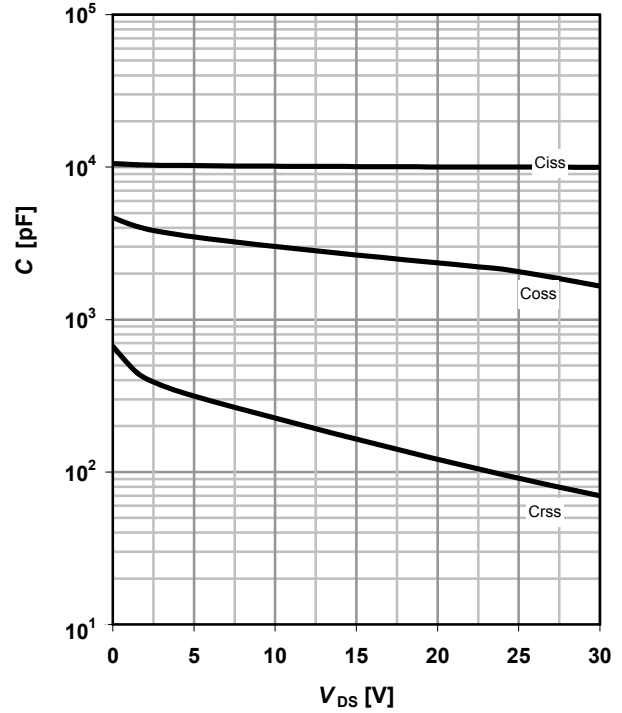
$V_{GS(th)} = f(T_j); V_{GS} = V_{DS}$

parameter:  $I_D$



**10 Typ. capacitances**

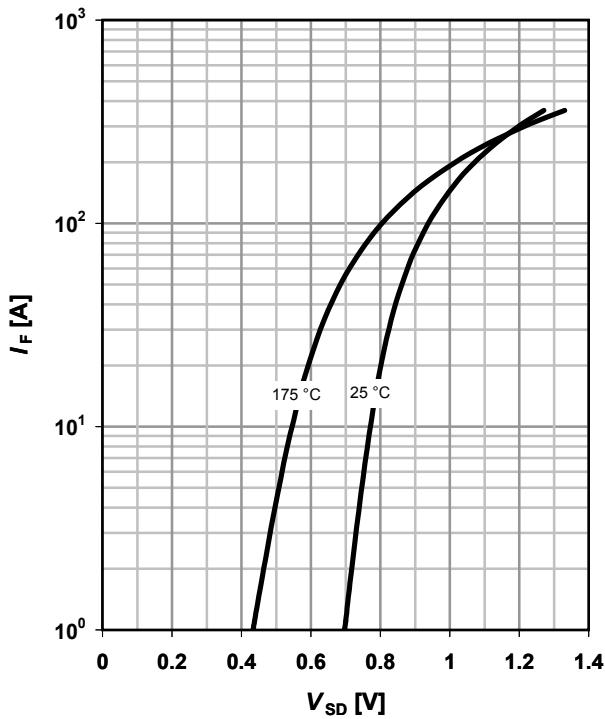
$C = f(V_{DS}); V_{GS} = 0 V; f = 1 MHz$



**11 Typical forward diode characteristics**

$I_F = f(V_{SD})$

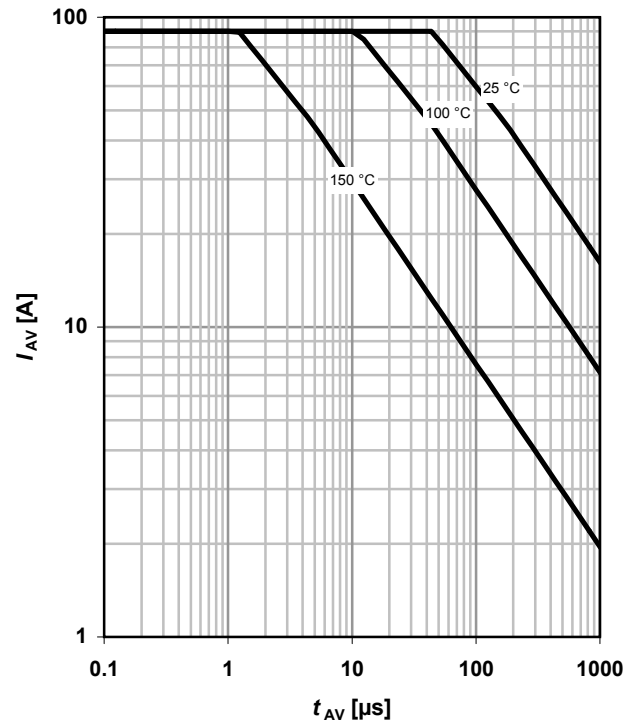
parameter:  $T_j$



**12 Avalanche characteristics**

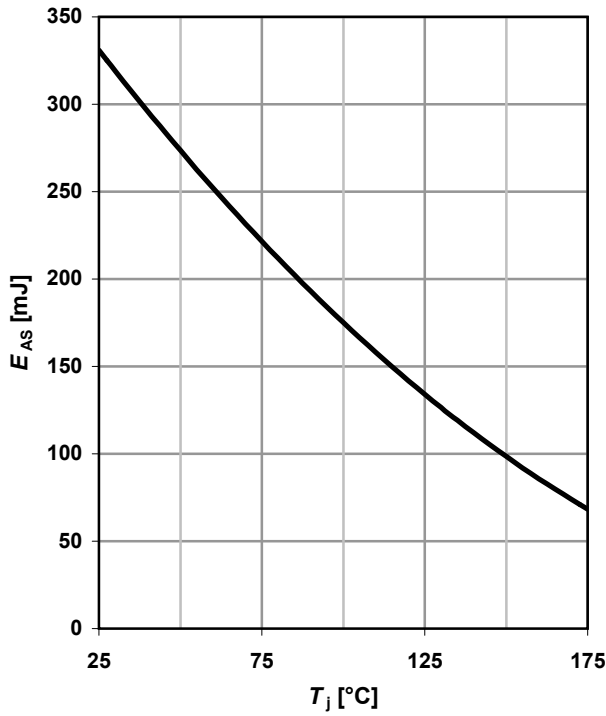
$I_{AS} = f(t_{AV})$

parameter:  $T_{j(start)}$



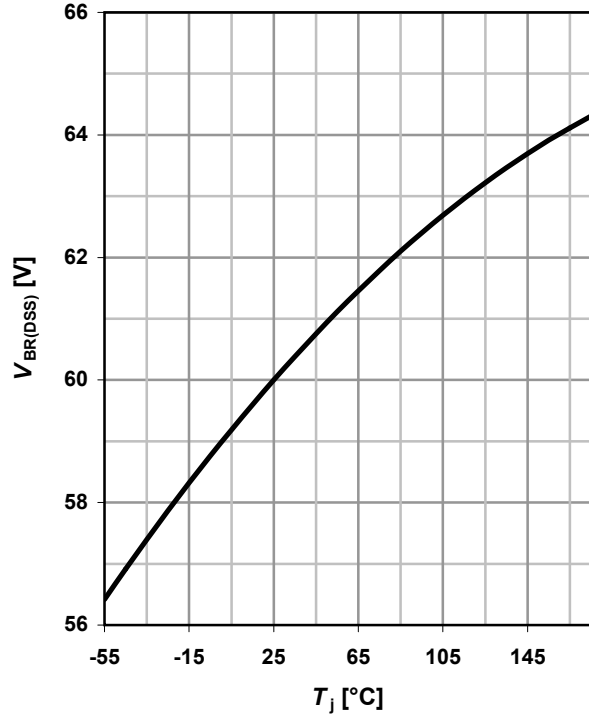
**13 Avalanche energy**

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



**14 Drain-source breakdown voltage**

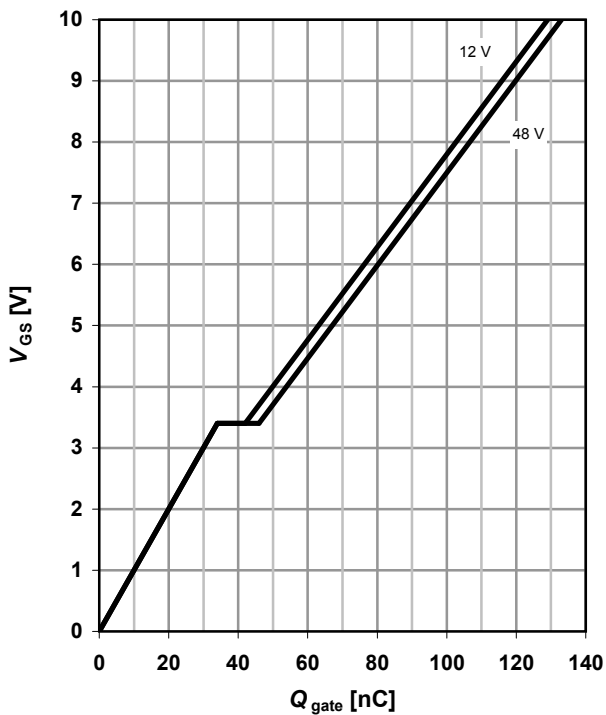
$V_{BR(DSS)} = f(T_j); I_D = 1 \text{ mA}$



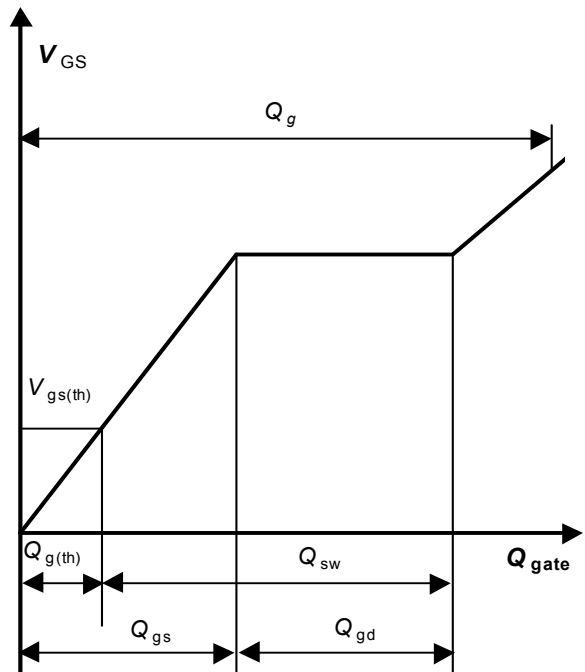
**15 Typ. gate charge**

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

parameter:  $V_{DD}$



**16 Gate charge waveforms**



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Revision History

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

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