

**OptiMOS®-T2 Power-Transistor**

**Features**

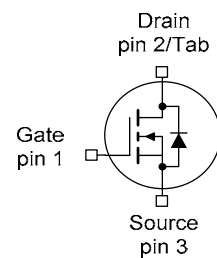
- N-channel - Enhancement mode
- AEC qualified
- MSL1 up to 260°C peak reflow
- 175°C operating temperature
- Green Product (RoHS compliant)
- 100% Avalanche tested

**Product Summary**

|                  |     |    |
|------------------|-----|----|
| $V_{DS}$         | 40  | V  |
| $R_{DS(on),max}$ | 3.2 | mΩ |
| $I_D$            | 90  | A  |

**PG-TO252-3-313**


| Type          | Package        | Marking |
|---------------|----------------|---------|
| IPD90N04S4-03 | PG-TO252-3-313 | 4N0403  |


**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    |
|  |                | $T_C=100\text{ °C}, V_{GS}=10\text{V}^{2)}$ | 90           |      |
| Pulsed drain current <sup>2)</sup>           | $I_{D,pulse}$  | $T_C=25\text{ °C}$                          | 360          |      |
| Avalanche energy, single pulse <sup>2)</sup> | $E_{AS}$       | $I_D=45\text{A}$                            | 185          | mJ   |
| Avalanche current, single pulse              | $I_{AS}$       | -   | 90           | A    |
| Gate source voltage                          | $V_{GS}$       | -   | ±20          | V    |
| Power dissipation                            | $P_{tot}$      | $T_C=25\text{ °C}$                          | 94           | 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. |      |
| <b>Thermal characteristics<sup>2)</sup></b>    |            |  |        |      |      |      |
| Thermal resistance, junction - case            | $R_{thJC}$ | -  | -      | -    | 1.6  | 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   | $V_{(BR)DSS}$ | $V_{GS}=0V, I_D=1\text{mA}$                        | 40  | -    | -   | V             |
| Gate threshold voltage           | $V_{GS(th)}$  | $V_{DS}=V_{GS}, I_D=53\mu\text{A}$                 | 2.0 | 3.0  | 4.0 |               |
| Zero gate voltage drain current  | $I_{DSS}$     | $V_{DS}=40V, V_{GS}=0V, T_j=25^\circ\text{C}$      | -   | 0.03 | 1   | $\mu\text{A}$ |
|                                  |               | $V_{DS}=18V, V_{GS}=0V, T_j=85^\circ\text{C}^{2)}$ | -   | 1    | 20  |               |
| Gate-source leakage current      | $I_{GSS}$     | $V_{GS}=20V, V_{DS}=0V$                            | -   | -    | 100 | nA            |
| Drain-source on-state resistance | $R_{DS(on)}$  | $V_{GS}=10V, I_D=90A$                              | -   | 2.7  | 3.2 | m $\Omega$    |

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

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

|                              |              |  |   |      |      |    |
|------------------------------|--------------|--|---|------|------|----|
| Input capacitance            | $C_{iss}$    | $V_{GS}=0\text{ V}, V_{DS}=25\text{ V},$<br>$f=1\text{ MHz}$               | - | 4050 | 5260 | pF |
| Output capacitance           | $C_{oss}$    |  | - | 950  | 1230 |    |
| Reverse transfer capacitance | $C_{rss}$    |  | - | 31   | 71   |    |
| Turn-on delay time           | $t_{d(on)}$  | $V_{DD}=20\text{V}, V_{GS}=10\text{V},$<br>$I_D=90\text{A}, R_G=3.5\Omega$ | - | 14   | -    | ns |
| Rise time                    | $t_r$        |  | - | 11   | -    |    |
| Turn-off delay time          | $t_{d(off)}$ |  | - | 14   | -    |    |
| Fall time                    | $t_f$        |  | - | 15   | -    |    |

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

|                       |               |   |   |     |    |    |
|-----------------------|---------------|---|---|-----|----|----|
| Gate to source charge | $Q_{gs}$      | $V_{DD}=32\text{V}, I_D=90\text{A},$<br>$V_{GS}=0\text{ to }10\text{V}$ | - | 24  | 31 | nC |
| Gate to drain charge  | $Q_{gd}$      |   | - | 7   | 17 |    |
| Gate charge total     | $Q_g$         |   | - | 51  | 66 |    |
| Gate plateau voltage  | $V_{plateau}$ |   | - | 5.8 | -  | V  |

**Reverse Diode**

|  |               |  |   |     |     |    |
|--|---------------|--|---|-----|-----|----|
| Diode continuous forward current <sup>2)</sup> | $I_S$         | $T_C=25^\circ\text{C}$   | - | -   | 90  | A  |
| Diode pulse current <sup>2)</sup>              | $I_{S,pulse}$ |  | - | -   | 360 |    |
| Diode forward voltage                          | $V_{SD}$      | $V_{GS}=0\text{V}, I_F=90\text{A},$<br>$T_j=25^\circ\text{C}$          | - | 0.9 | 1.3 | V  |
| Reverse recovery time <sup>2)</sup>            | $t_{rr}$      | $V_R=20\text{V}, I_F=50\text{A},$<br>$di_F/dt=100\text{A}/\mu\text{s}$ | - | 43  | -   | ns |
| Reverse recovery charge <sup>2)</sup>          | $Q_{rr}$      |  | - | 44  | -   | nC |

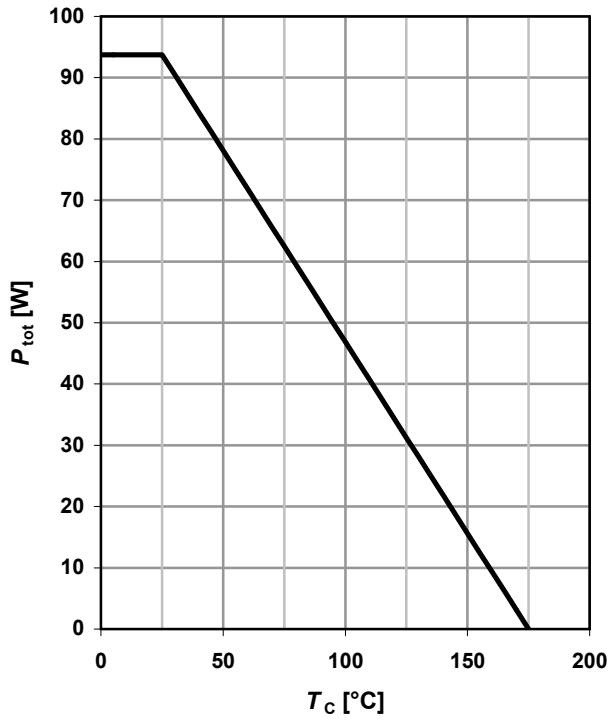
<sup>1)</sup> Current is limited by bondwire; with an  $R_{thJC} = 1.6\text{K/W}$  the chip is able to carry 130A at 25°C.

<sup>2)</sup> Defined 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.

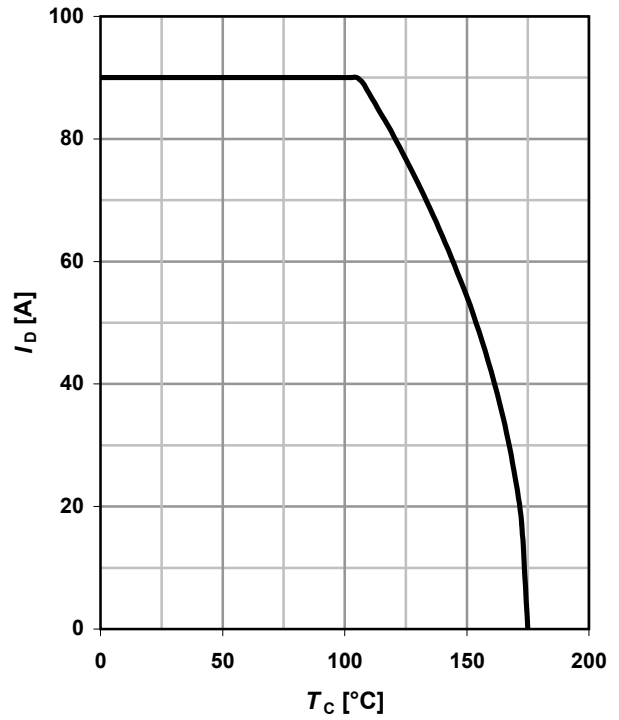
**1 Power dissipation**

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



**2 Drain current**

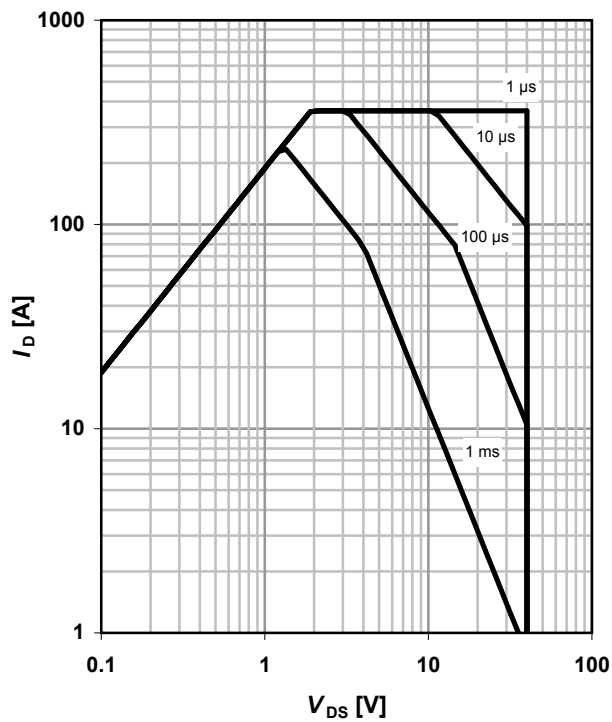
$I_D = f(T_C); V_{GS} \geq 6 V$



**3 Safe operating area**

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

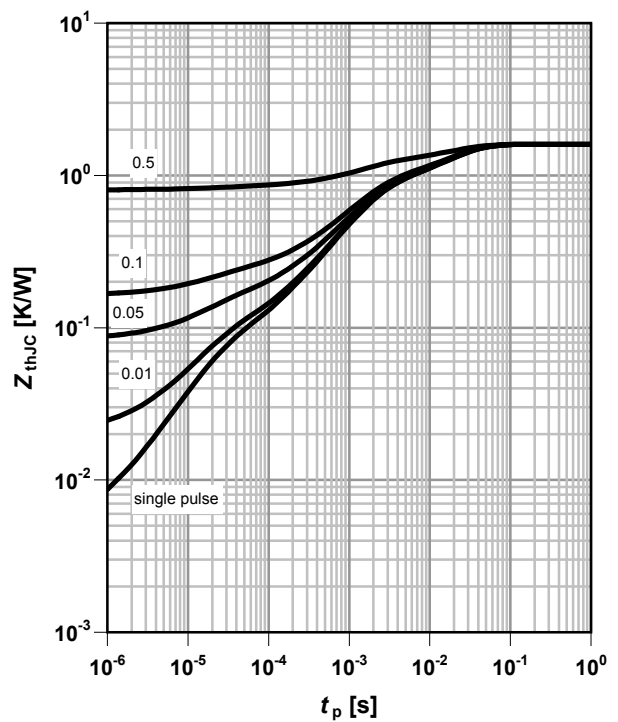
parameter:  $t_p$



**4 Max. transient thermal impedance**

$Z_{thJC} = f(t_p)$

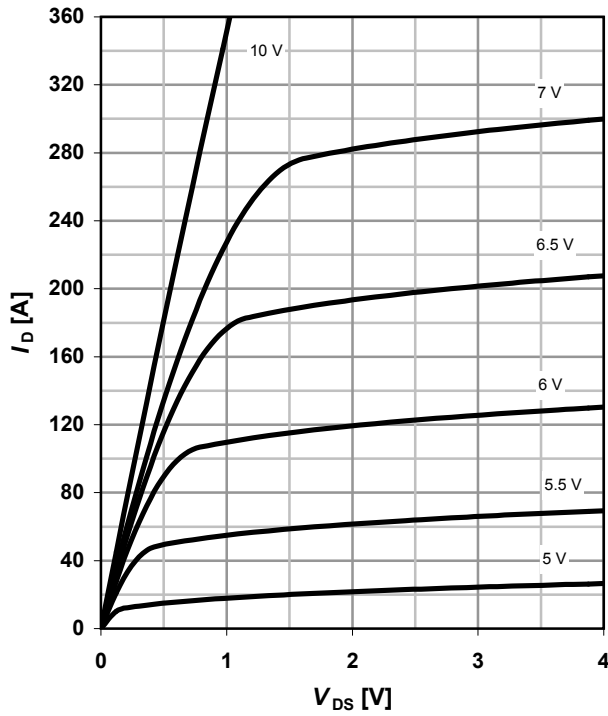
parameter:  $D = t_p/T$



**5 Typ. output characteristics**

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

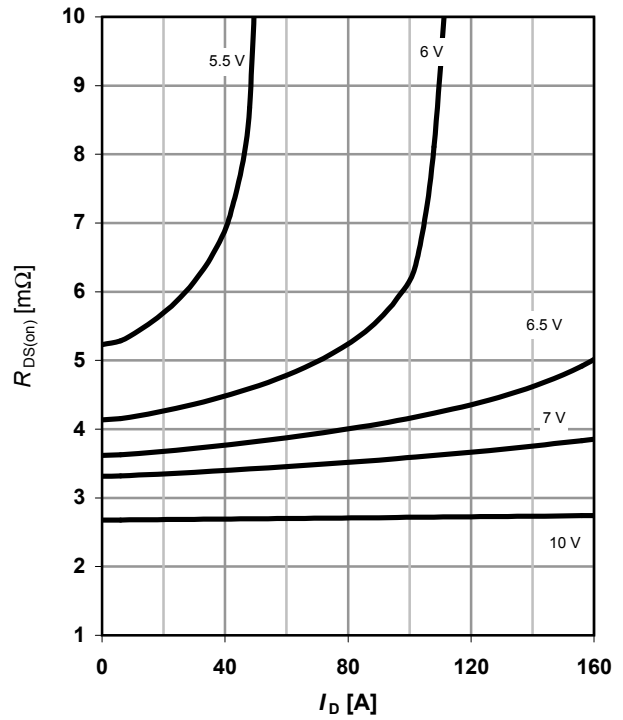
parameter:  $V_{GS}$



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

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

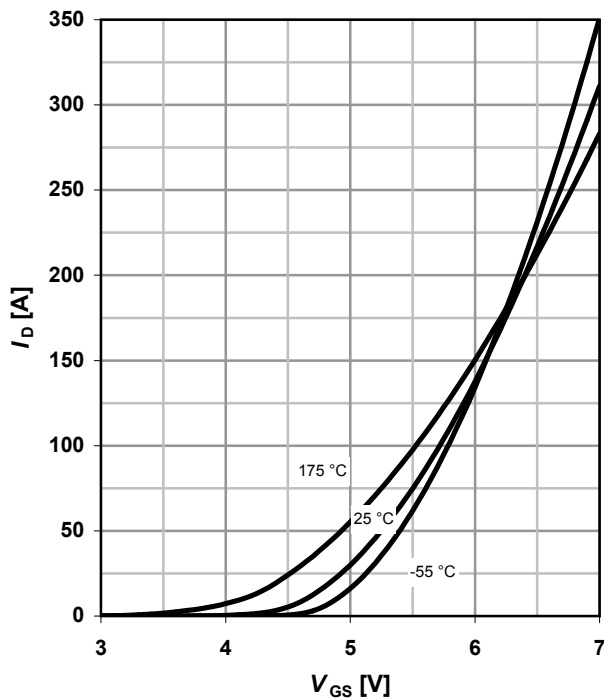
parameter:  $V_{GS}$



**7 Typ. transfer characteristics**

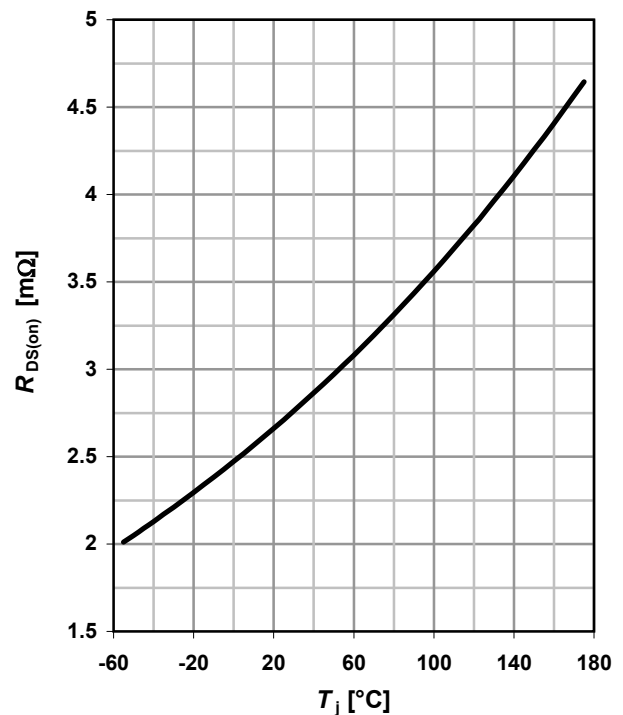
$I_D = f(V_{GS}); V_{DS} = 6\text{ V}$

parameter:  $T_j$



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

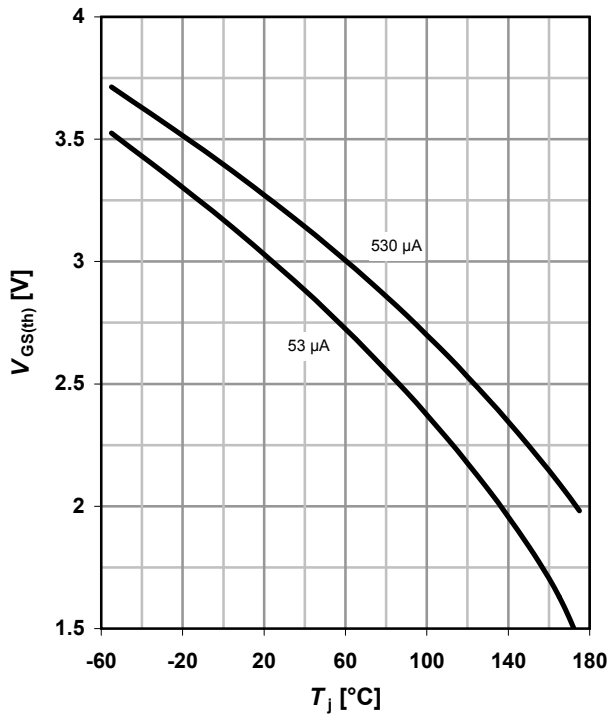
$R_{DS(on)} = f(T_j); I_D = 90\text{ A}; V_{GS} = 10\text{ V}$



**9 Typ. gate threshold voltage**

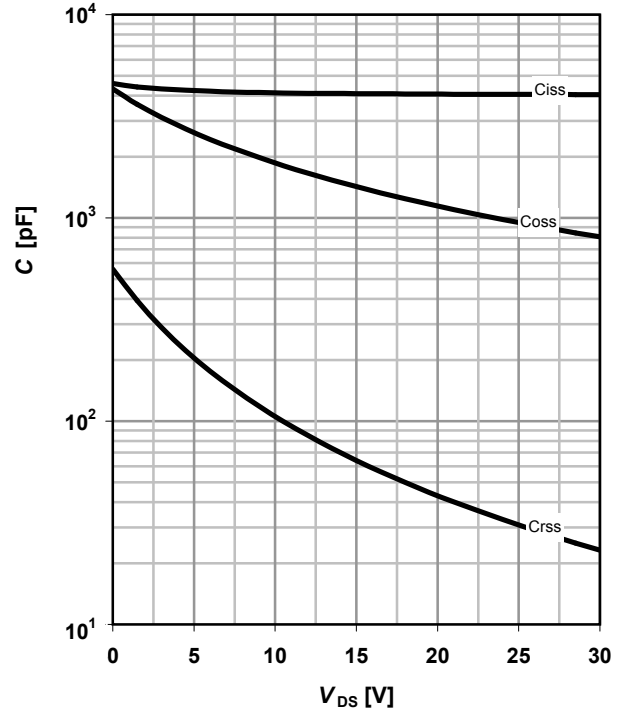
$V_{GS(th)} = f(T_j); V_{GS} = V_{DS}$

parameter:  $I_D$



**10 Typ. capacitances**

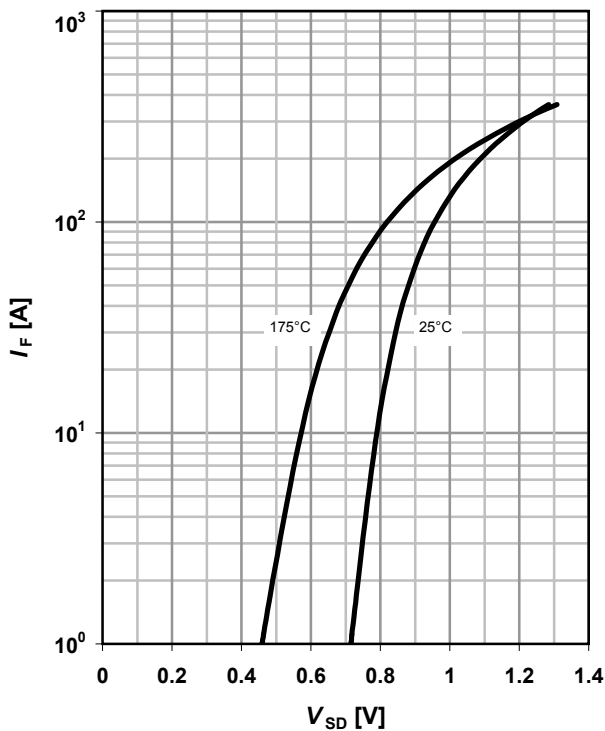
$C = f(V_{DS}); V_{GS} = 0 V; f = 1 MHz$



**11 Typical forward diode characteristics**

$I_F = f(V_{SD})$

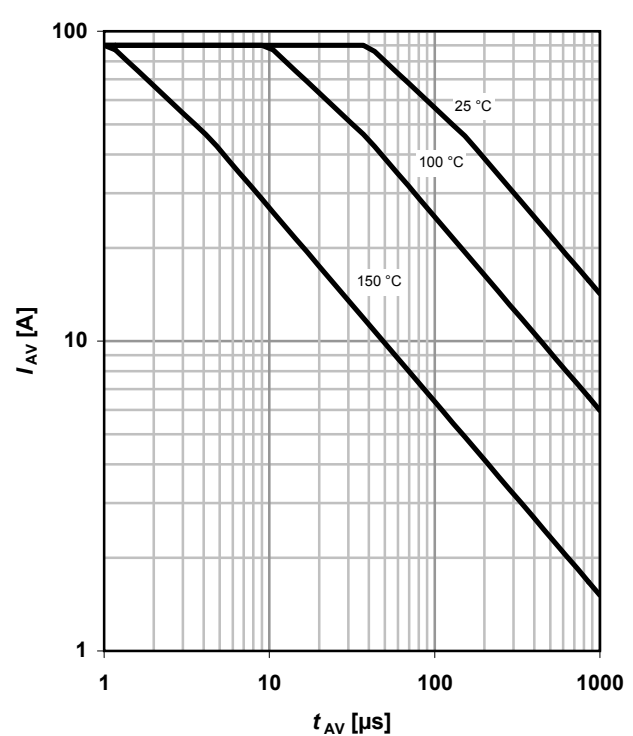
parameter:  $T_j$



**12 Avalanche characteristics**

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

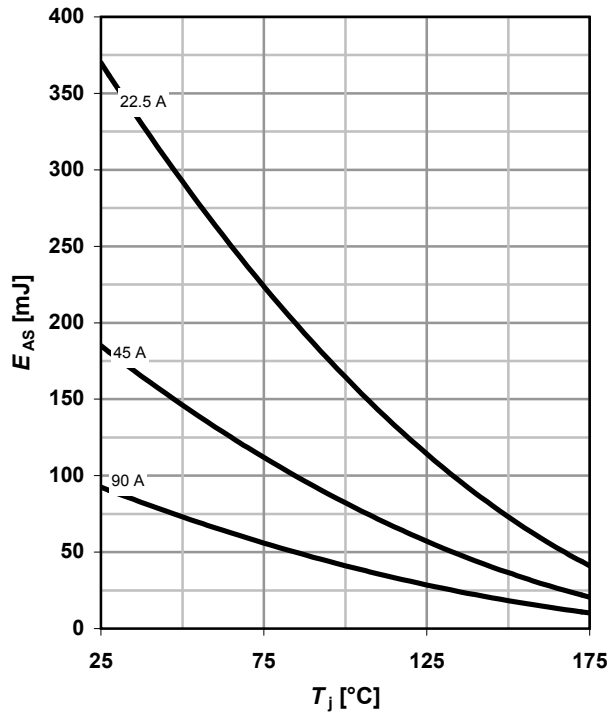
parameter:  $T_{j(start)}$



**13 Avalanche energy**

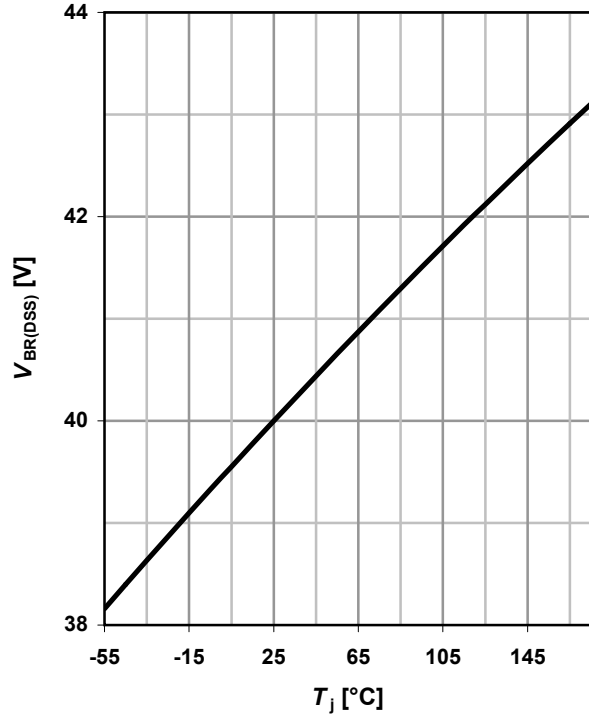
$E_{AS} = f(T_j)$

parameter:  $I_D$



**14 Drain-source breakdown voltage**

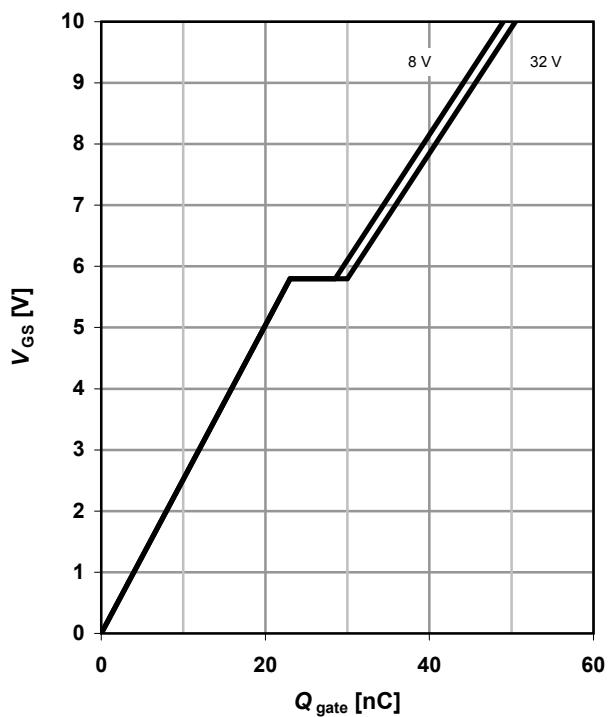
$V_{BR(DSS)} = f(T_j); I_D = 1 \text{ mA}$



**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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