

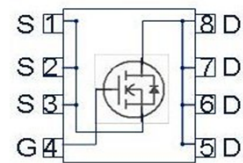
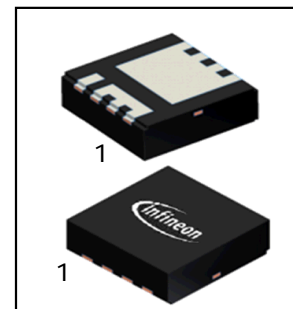
**OptiMOS™ -5 Power-Transistor**

**Product Summary**

|                  |     |    |
|------------------|-----|----|
| $V_{DS}$         | 40  | V  |
| $R_{DS(on),max}$ | 3.1 | mΩ |
| $I_D$            | 40  | A  |

**Features**

- OptiMOS™ - power MOSFET for automotive applications
- N-channel - Enhancement mode - Normal Level
- AEC Q101 qualified
- MSL1 up to 260°C peak reflow
- 175°C operating temperature
- Green Product (RoHS compliant)
- 100% Avalanche tested

**PG-TSDSON-8-33**


| Type           | Package        | Marking |
|----------------|----------------|---------|
| IPZ40N04S5-3R1 | PG-TSDSON-8-33 | 5N0431  |

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

| Parameter                                    | Symbol         | Conditions                                     | Value        | Unit |
|--|----------------|--|--------------|------|
| Continuous drain current <sup>1)</sup>       | $I_D$          | $T_C=25\text{ °C}$ , $V_{GS}=10\text{V}$       | 40           | A    |
|  |                | $T_C=100\text{ °C}$ , $V_{GS}=10\text{V}^{2)}$ | 40           |      |
| Pulsed drain current <sup>2)</sup>           | $I_{D,pulse}$  | $T_C=25\text{ °C}$                             | 160          |      |
| Avalanche energy, single pulse <sup>2)</sup> | $E_{AS}$       | $I_D=20\text{A}$                               | 140          | mJ   |
| Avalanche current, single pulse              | $I_{AS}$       | -  | 40           | A    |
| Gate source voltage                          | $V_{GS}$       | -  | ±20          | V    |
| Power dissipation                            | $P_{tot}$      | $T_C=25\text{ °C}$                             | 71           | W    |
| Operating and storage temperature            | $T_j, T_{stg}$ | -  | -55 ... +175 | °C   |

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

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

|  |            |  |   |   |     |     |
|--|------------|--|---|---|-----|-----|
| Thermal resistance, junction - case    | $R_{thJC}$ | -  | - | - | 2.1 | K/W |
| Thermal resistance, junction - ambient | $R_{thJA}$ | 6 cm <sup>2</sup> cooling area <sup>3)</sup> | - | - | 60  |     |

**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           | $V_{GS(th)}$  | $V_{DS}=V_{GS}, I_D=30\mu\text{A}$                  | 2.2 | 2.8 | 3.4 |               |
| Zero gate voltage drain current  | $I_{DSS}$     | $V_{DS}=40V, V_{GS}=0V, T_j=25^\circ\text{C}$       | -   | -   | 1   | $\mu\text{A}$ |
|                                  |               | $V_{DS}=40V, V_{GS}=0V, T_j=125^\circ\text{C}^{2)}$ | -   | -   | 100 |               |
| Gate-source leakage current      | $I_{GSS}$     | $V_{GS}=20V, V_{DS}=0V$                             | -   | -   | 100 | nA            |
| Drain-source on-state resistance | $R_{DS(on)}$  | $V_{GS}=7V, I_D=20A$                                | -   | 3.0 | 3.6 | m $\Omega$    |
|                                  |               | $V_{GS}=10V, I_D=20A$                               | -   | 2.5 | 3.1 |               |

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

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

|                              |              |   |   |      |      |    |
|------------------------------|--------------|---|---|------|------|----|
| Input capacitance            | $C_{iss}$    | $V_{GS}=0V, V_{DS}=25V,$<br>$f=1MHz$                  | - | 1740 | 2310 | pF |
| Output capacitance           | $C_{oss}$    |   | - | 490  | 650  |    |
| Reverse transfer capacitance | $C_{rss}$    |   | - | 35   | 55   |    |
| Turn-on delay time           | $t_{d(on)}$  | $V_{DD}=20V, V_{GS}=10V,$<br>$I_D=40A, R_G=3.5\Omega$ | - | 6    | -    | ns |
| Rise time                    | $t_r$        |   | - | 3    | -    |    |
| Turn-off delay time          | $t_{d(off)}$ |   | - | 11   | -    |    |
| Fall time                    | $t_f$        |   | - | 7    | -    |    |

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

|                       |               |   |   |     |      |    |
|-----------------------|---------------|---|---|-----|------|----|
| Gate to source charge | $Q_{gs}$      | $V_{DD}=32V, I_D=40A,$<br>$V_{GS}=0$ to 10V | - | 7.7 | 10.2 | nC |
| Gate to drain charge  | $Q_{gd}$      |   | - | 7.1 | 10.6 |    |
| Gate charge total     | $Q_g$         |   | - | 31  | 41   |    |
| Gate plateau voltage  | $V_{plateau}$ |   | - | 4.4 | -    | V  |

**Reverse Diode**

|  |               |   |   |     |     |    |
|--|---------------|---|---|-----|-----|----|
| Diode continuous forward current <sup>2)</sup> | $I_S$         | $T_C=25^\circ C$                            | - | -   | 40  | A  |
| Diode pulse current <sup>1)</sup>              | $I_{S,pulse}$ |   | - | -   | 160 |    |
| Diode forward voltage                          | $V_{SD}$      | $V_{GS}=0V, I_F=20A,$<br>$T_j=25^\circ C$   | - | 0.8 | 1.1 | V  |
| Reverse recovery time <sup>1)</sup>            | $t_{rr}$      | $V_R=20V, I_F=40A,$<br>$di_F/dt=100A/\mu s$ | - | 40  | -   | ns |
| Reverse recovery charge <sup>1)</sup>          | $Q_{rr}$      |   | - | 30  | -   | nC |

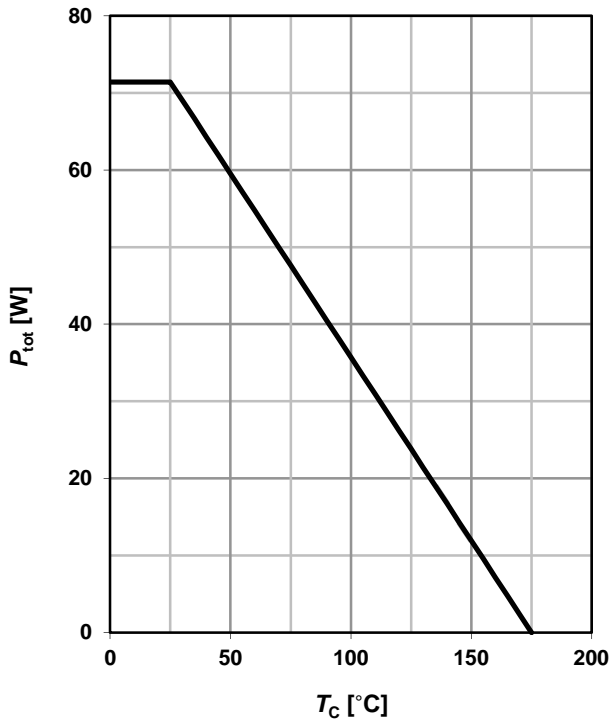
<sup>1)</sup> Current is limited by package; with an  $R_{thJC} = 2.1K/W$  the chip is able to carry 112A at 25°C.

<sup>2)</sup> The parameter is not subject to production test- verified by design/characterization.

<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.

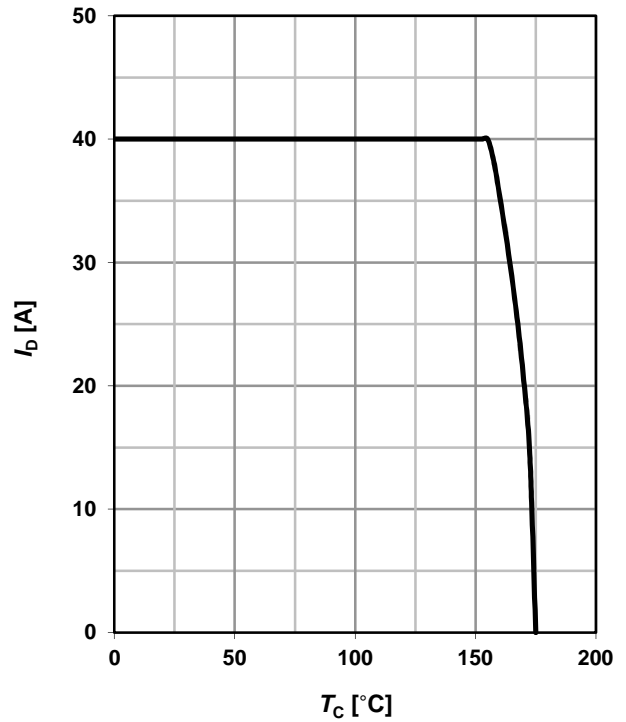
**1 Power dissipation**

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



**2 Drain current**

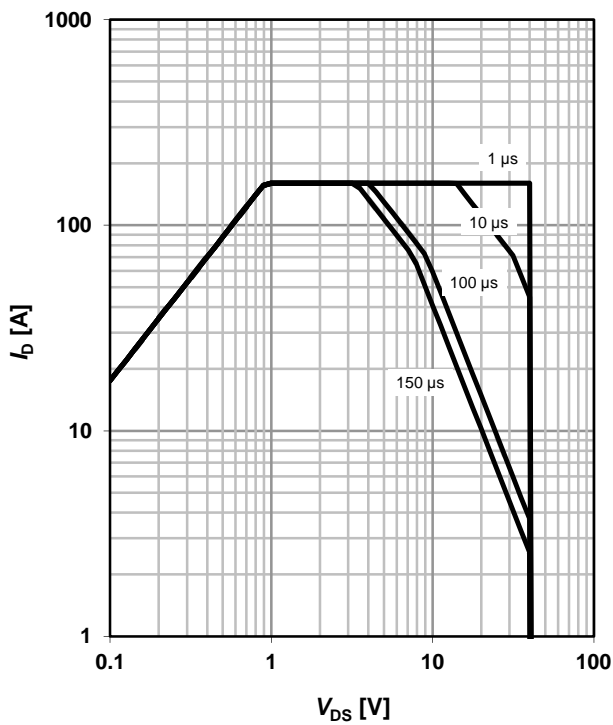
$I_D = f(T_C); V_{GS} = 10\text{ V}$



**3 Safe operating area**

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

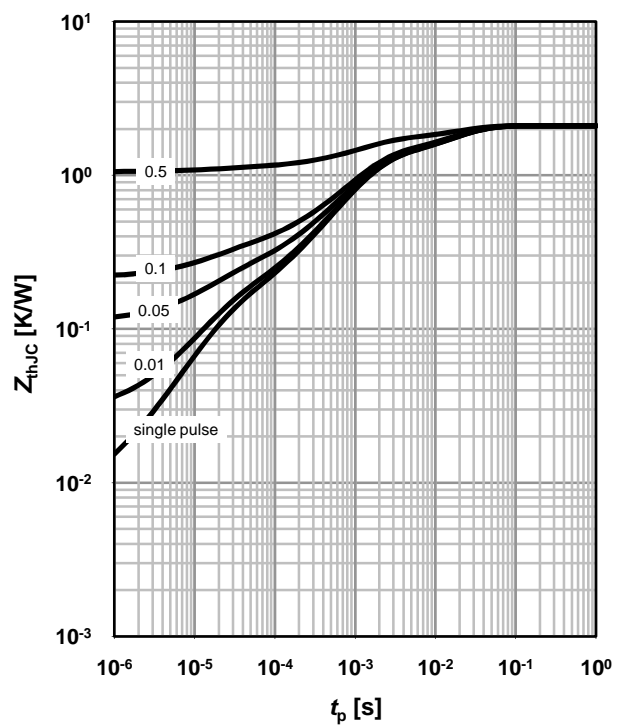
parameter:  $t_p$



**4 Max. transient thermal impedance**

$Z_{thJC} = f(t_p)$

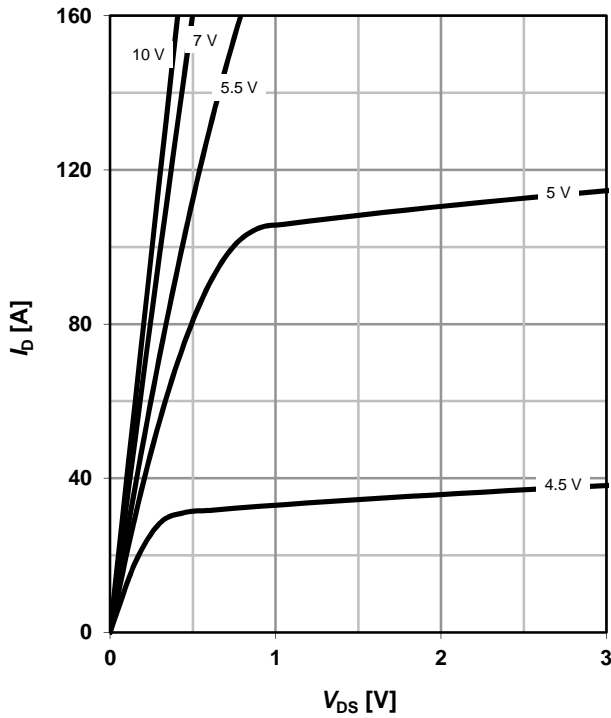
parameter:  $D = t_p/T$



**5 Typ. output characteristics**

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

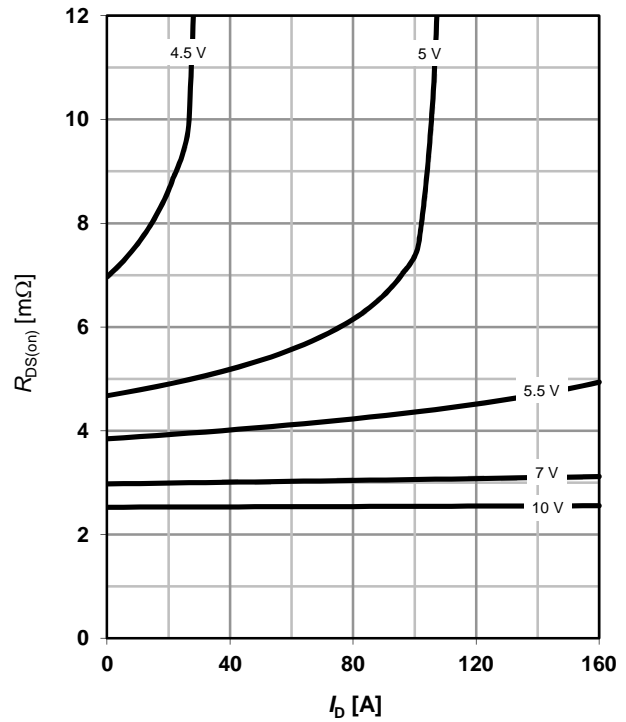
parameter:  $V_{GS}$



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

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

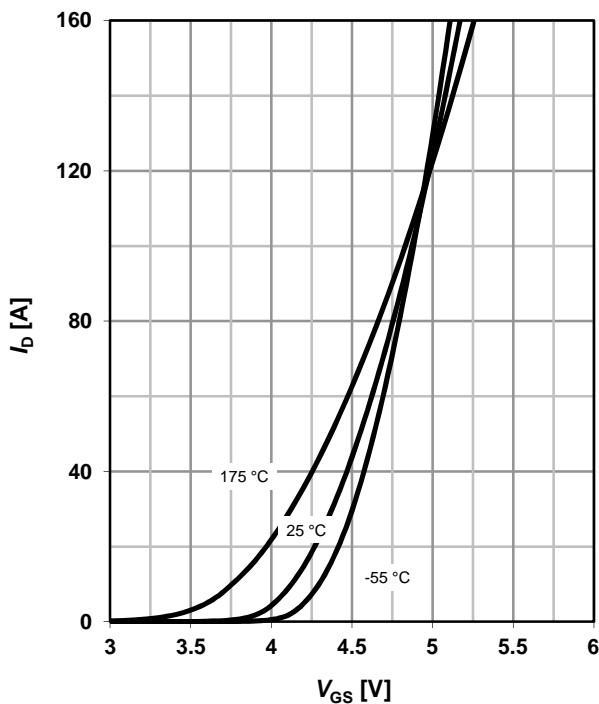
parameter:  $V_{GS}$



**7 Typ. transfer characteristics**

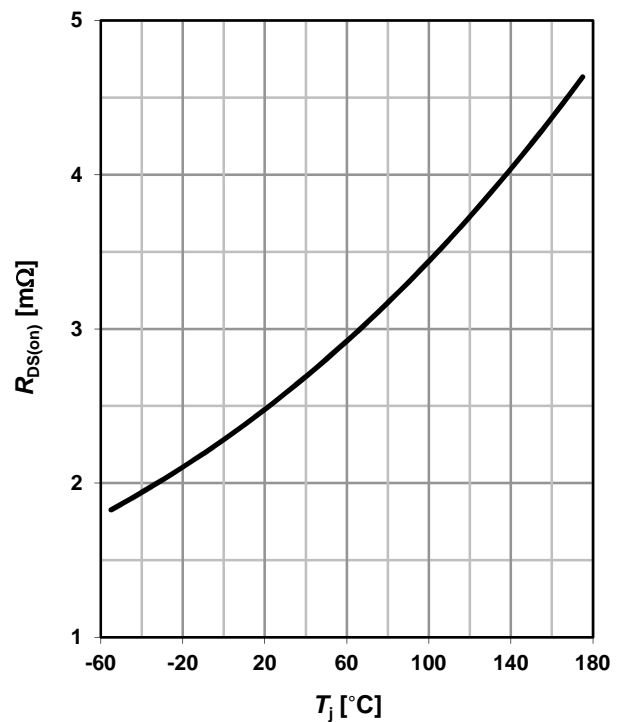
$I_D = f(V_{GS}); V_{DS} = 6\text{ V}$

parameter:  $T_j$



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

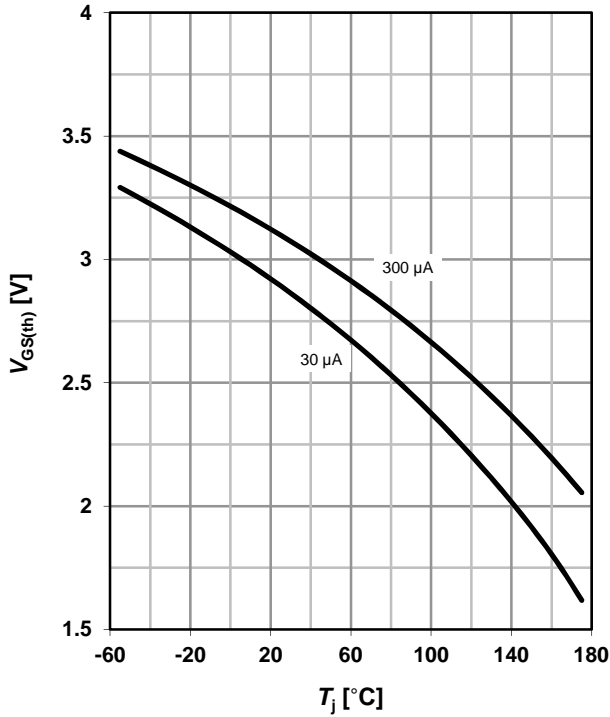
$R_{DS(on)} = f(T_j); I_D = 20\text{ A}; V_{GS} = 10\text{ V}$



**9 Typ. gate threshold voltage**

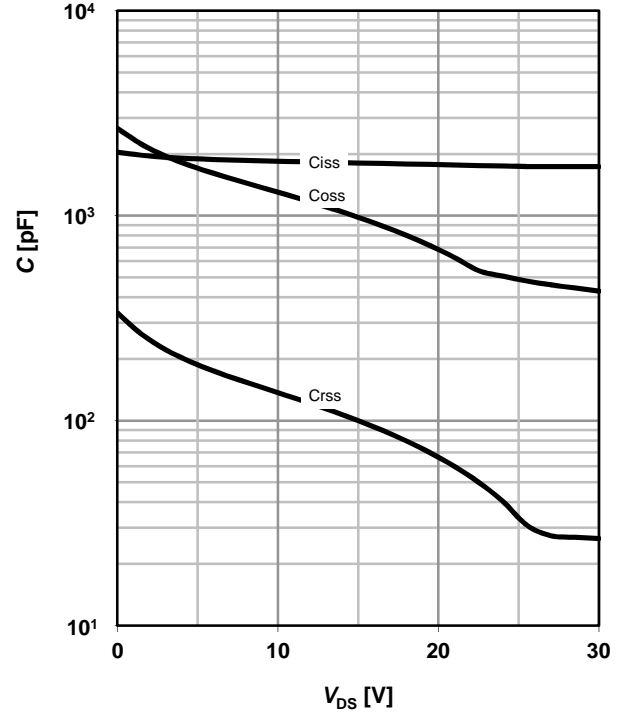
$V_{GS(th)} = f(T_j); V_{GS} = V_{DS}$

parameter:  $I_D$



**10 Typ. capacitances**

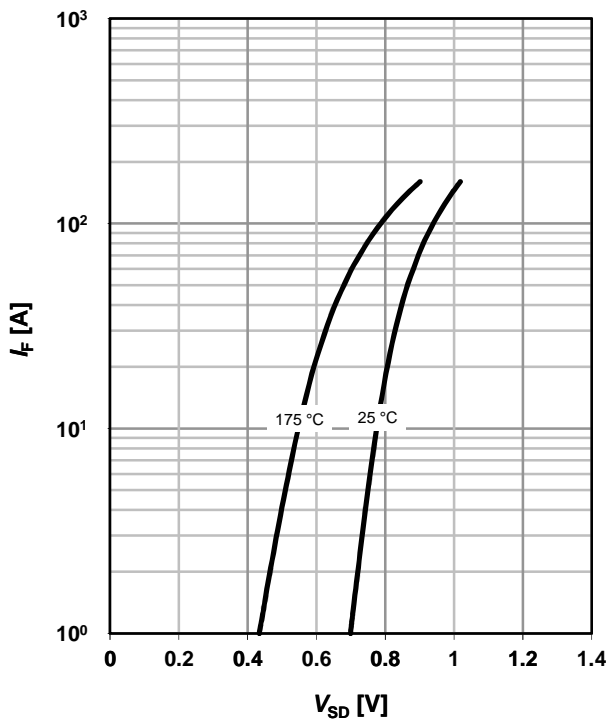
$C = f(V_{DS}); V_{GS} = 0 V; f = 1 MHz$



**11 Typical forward diode characteristics**

$I_F = f(V_{SD})$

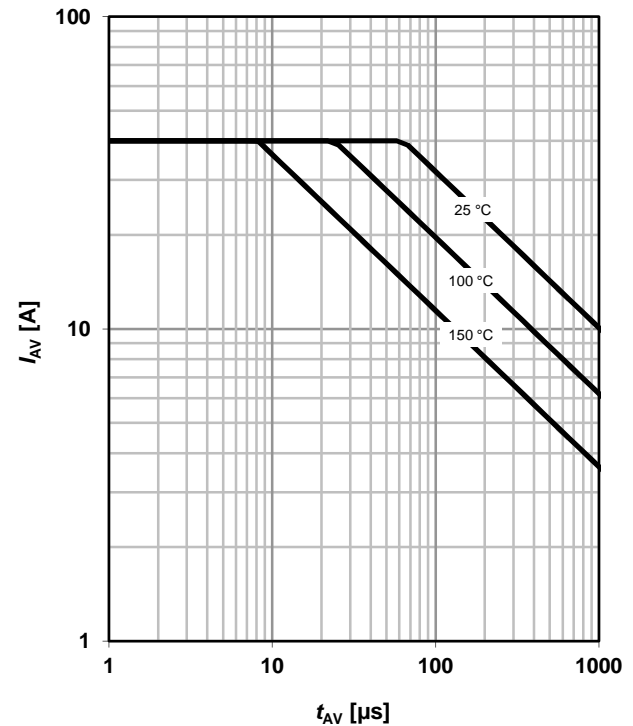
parameter:  $T_j$



**12 Avalanche characteristics**

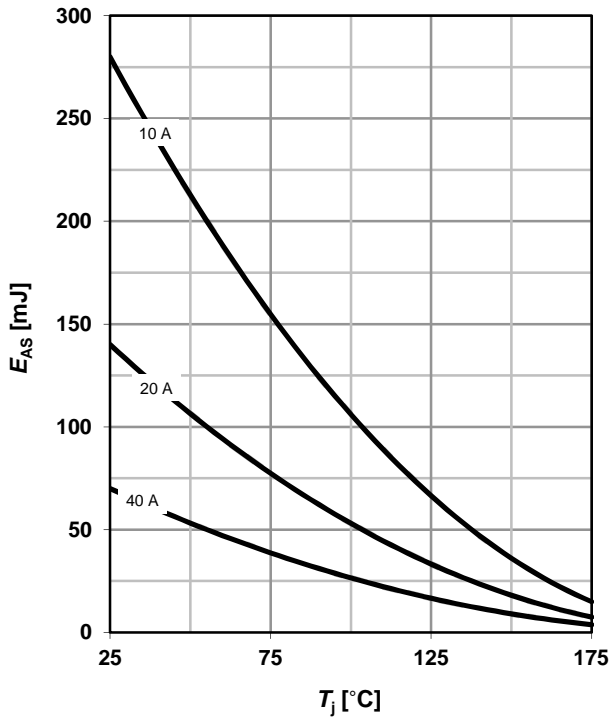
$I_{AS} = f(t_{AV})$

parameter:  $T_{j(start)}$



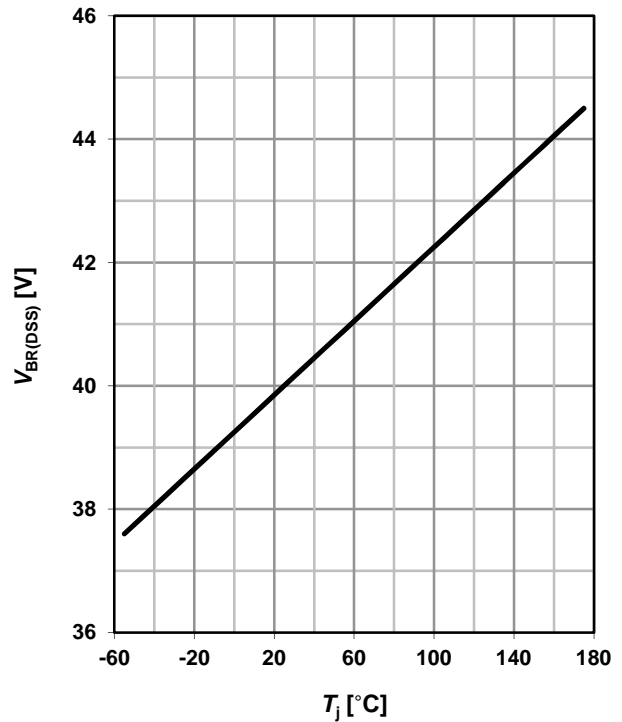
**13 Avalanche energy**

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



**14 Drain-source breakdown voltage**

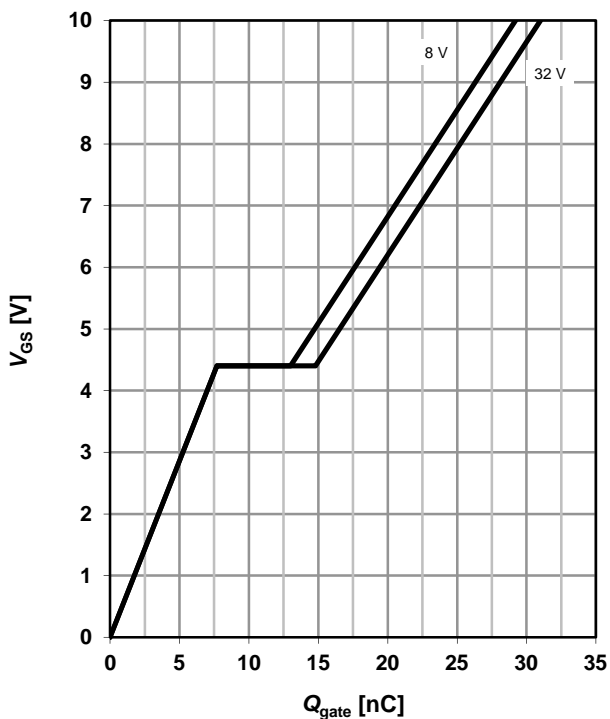
$$V_{BR(DSS)} = f(T_j); I_D = 1 \text{ mA}$$



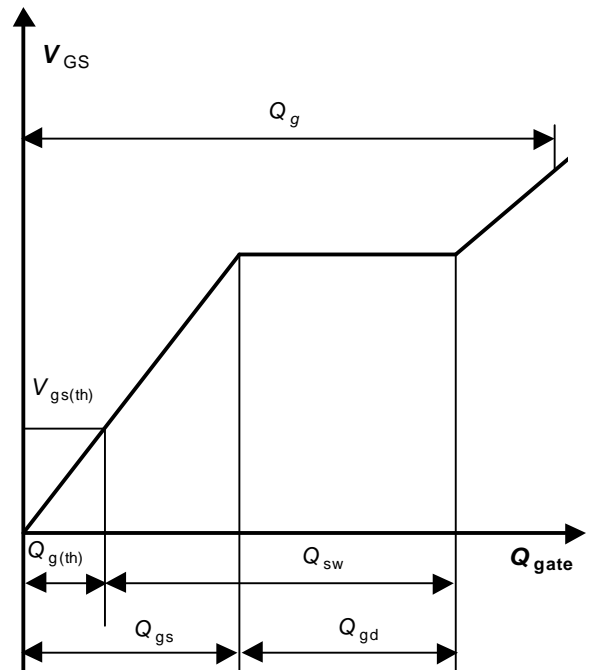
**15 Typ. gate charge**

$$V_{GS} = f(Q_{gate}); I_D = 40 \text{ A pulsed}$$

parameter:  $V_{DD}$



**16 Gate charge waveforms**



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## Revision History

| Version      | Date       | Changes                |
|--------------|------------|------------------------|
| Revision 1.0 | 2015-05-05 | Final Data Sheet       |
| Revision 1.1 | 2015-07-27 | Update of package name |
|              |            |                        |
|              |            |                        |
|              |            |                        |
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