

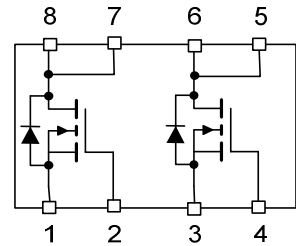
**OptiMOS™-T2 Power-Transistor**

**Product Summary**

|                       |     |    |
|-----------------------|-----|----|
| $V_{DS}$              | 40  | V  |
| $R_{DS(on),max}^{4)}$ | 8.6 | mΩ |
| $I_D$                 | 20  | A  |

**Features**

- Dual N-channel Normal Level - Enhancement mode
- AEC Q101 qualified
- MSL1 up to 260°C peak reflow
- 175°C operating temperature
- Green Product (RoHS compliant)
- 100% Avalanche tested
- Feasible for automatic optical inspection (AOI)

**PG-TDSON-8**


| Type           | Package    | Marking |
|----------------|------------|---------|
| IPG20N04S4-09A | PG-TDSON-8 | 4N0409  |

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

| Parameter  | Symbol         | Conditions   | Value        | Unit |
|--|----------------|--|--------------|------|
| Continuous drain current<br>one channel active           | $I_D$          | $T_C=25\text{ °C}$ , $V_{GS}=10\text{ V}^{1)}$     | 20           | A    |
|  |                | $T_C=100\text{ °C}$ ,<br>$V_{GS}=10\text{ V}^{2)}$ | 20           |      |
| Pulsed drain current <sup>2)</sup><br>one channel active | $I_{D,pulse}$  | -  | 80           |      |
| Avalanche energy, single pulse <sup>2, 4)</sup>          | $E_{AS}$       | $I_D=10\text{ A}$                                  | 145          | mJ   |
| Avalanche current, single pulse <sup>4)</sup>            | $I_{AS}$       | -  | 15           | A    |
| Gate source voltage                                      | $V_{GS}$       | -  | $\pm 20$     | V    |
| Power dissipation<br>one channel active                  | $P_{tot}$      | $T_C=25\text{ °C}$                                 | 54           | 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 | $R_{thJC}$ | -  | - | -   | 2.8 | K/W |
| SMD version, device on PCB          | $R_{thJA}$ | minimal footprint                            | - | 100 | -   |     |
|                                     |            | 6 cm <sup>2</sup> cooling area <sup>3)</sup> | - | 60  | -   |     |

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

|  |               |   |     |      |     |               |
|--|---------------|---|-----|------|-----|---------------|
| Drain-source breakdown voltage                 | $V_{(BR)DSS}$ | $V_{GS}=0\text{ V}$ , $I_D=1\text{ mA}$                               | 40  | -    | -   | V             |
| Gate threshold voltage                         | $V_{GS(th)}$  | $V_{DS}=V_{GS}$ , $I_D=22\mu\text{A}$                                 | 2.0 | 3.0  | 4.0 |               |
| Zero gate voltage drain current <sup>4)</sup>  | $I_{DSS}$     | $V_{DS}=40\text{ V}$ , $V_{GS}=0\text{ V}$ ,<br>$T_j=25\text{ °C}$    | -   | 0.01 | 1   | $\mu\text{A}$ |
|  |               | $V_{DS}=18\text{ V}$ , $V_{GS}=0\text{ V}$ ,<br>$T_j=85\text{ °C}^2)$ | -   | 1    | 100 |               |
| Gate-source leakage current <sup>4)</sup>      | $I_{GSS}$     | $V_{GS}=20\text{ V}$ , $V_{DS}=0\text{ V}$                            | -   | -    | 100 | nA            |
| Drain-source on-state resistance <sup>4)</sup> | $R_{DS(on)}$  | $V_{GS}=10\text{ V}$ , $I_D=17\text{ A}$                              | -   | 7.9  | 8.6 | m $\Omega$    |

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

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

|  |              |  |   |      |      |    |
|--|--------------|--|---|------|------|----|
| Input capacitance <sup>4)</sup>            | $C_{iss}$    | $V_{GS}=0\text{ V}, V_{DS}=25\text{ V},$<br>$f=1\text{ MHz}$                   | - | 1730 | 2250 | pF |
| Output capacitance <sup>4)</sup>           | $C_{oss}$    |  | - | 440  | 570  |    |
| Reverse transfer capacitance <sup>4)</sup> | $C_{rss}$    |  | - | 13   | 30   |    |
| Turn-on delay time                         | $t_{d(on)}$  | $V_{DD}=20\text{ V}, V_{GS}=10\text{ V},$<br>$I_D=20\text{ A}, R_G=11\ \Omega$ | - | 12   | -    | ns |
| Rise time                                  | $t_r$        |  | - | 3    | -    |    |
| Turn-off delay time                        | $t_{d(off)}$ |  | - | 15   | -    |    |
| Fall time                                  | $t_f$        |  | - | 10   | -    |    |

**Gate Charge Characteristics<sup>2, 4)</sup>**

|                       |               |  |   |      |     |    |
|-----------------------|---------------|--|---|------|-----|----|
| Gate to source charge | $Q_{gs}$      | $V_{DD}=32\text{ V}, I_D=20\text{ A},$<br>$V_{GS}=0\text{ to }10\text{ V}$ | - | 9.1  | 12  | nC |
| Gate to drain charge  | $Q_{gd}$      |  | - | 2.9  | 6.7 |    |
| Gate charge total     | $Q_g$         |  | - | 21.7 | 28  |    |
| Gate plateau voltage  | $V_{plateau}$ |  | - | 5.3  | -   | V  |

**Reverse Diode**

|  |               |   |   |     |     |    |
|--|---------------|---|---|-----|-----|----|
| Diode continuous forward current <sup>2)</sup><br>one channel active | $I_S$         | $T_C=25\text{ }^\circ\text{C}$  | - | -   | 20  | A  |
| Diode pulse current <sup>2)</sup><br>one channel active              | $I_{S,pulse}$ |   | - | -   | 80  |    |
| Diode forward voltage  | $V_{SD}$      | $V_{GS}=0\text{ V}, I_F=17\text{ A},$<br>$T_j=25\text{ }^\circ\text{C}$ | - | 0.9 | 1.3 | V  |
| Reverse recovery time <sup>2)</sup>                                  | $t_{rr}$      | $V_R=20\text{ V}, I_F=I_S,$<br>$di_F/dt=100\text{ A}/\mu\text{s}$       | - | 34  | -   | ns |
| Reverse recovery charge <sup>2, 4)</sup>                             | $Q_{rr}$      |   | - | 30  | -   | nC |

<sup>1)</sup> Current is limited by bondwire; with an  $R_{thJC}=2.8\text{ K/W}$  the chip is able to carry 61A at 25°C.

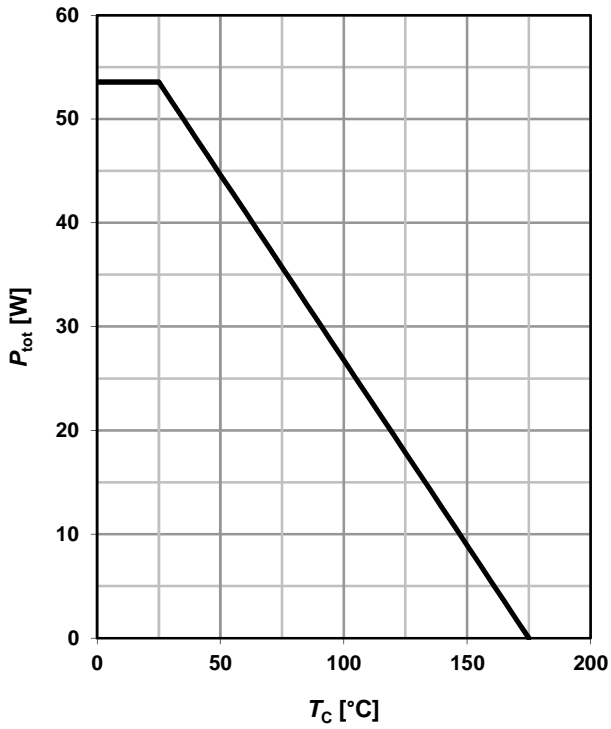
<sup>2)</sup> Specified by design. Not subject to production test.

<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.

<sup>4)</sup> Per channel

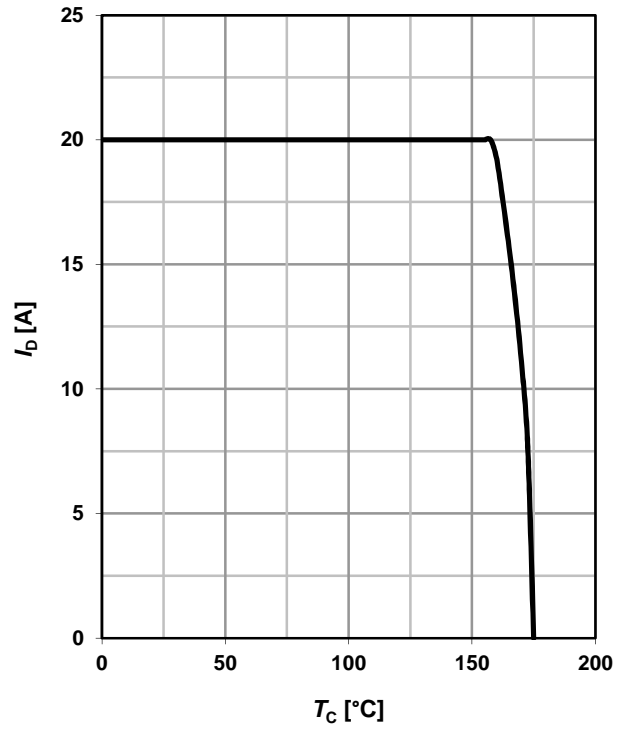
**1 Power dissipation**

$P_{tot} = f(T_C)$ ;  $V_{GS} = 10V$ ; one channel active



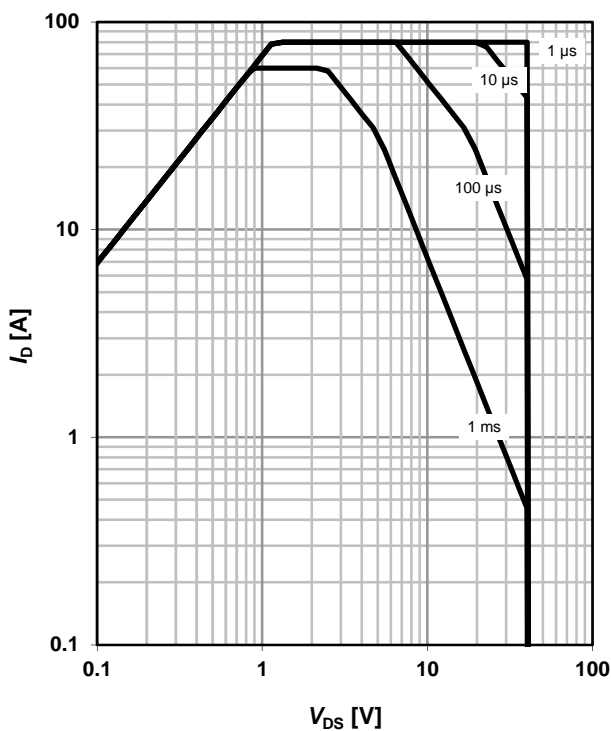
**2 Drain current**

$I_D = f(T_C)$ ;  $V_{GS} = 10 V$ ; one channel active



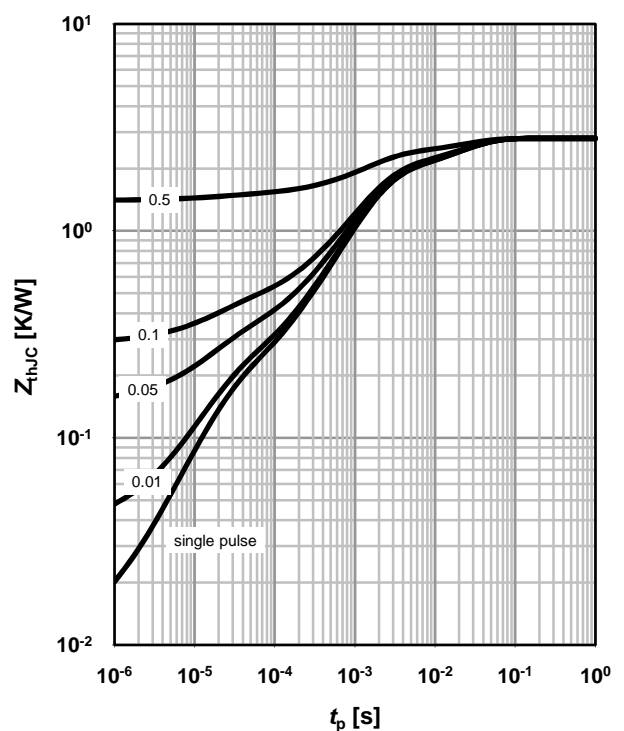
**3 Safe operating area**

$I_D = f(V_{DS})$ ;  $T_C = 25°C$ ;  $D = 0$ ; one channel active  
parameter:  $t_p$



**4 Max. transient thermal impedance**

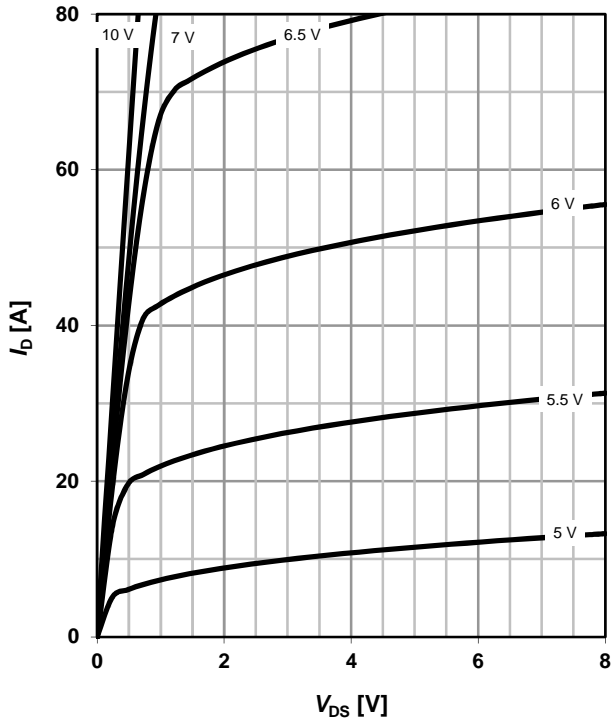
$Z_{thJC} = f(t_p)$   
parameter:  $D = t_p/T$



**5 Typ. output characteristics<sup>4)</sup>**

$I_D = f(V_{DS}); T_j = 25\text{ °C}$

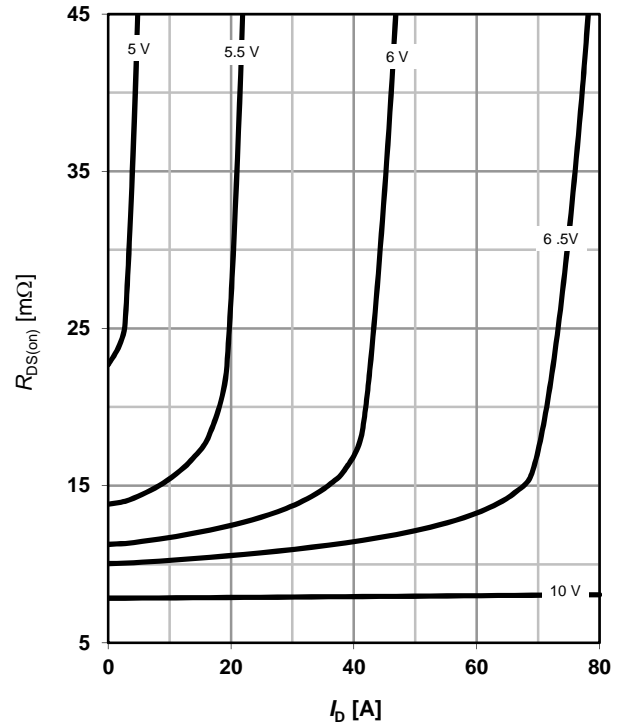
parameter:  $V_{GS}$



**6 Typ. drain-source on-state resistance<sup>4)</sup>**

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

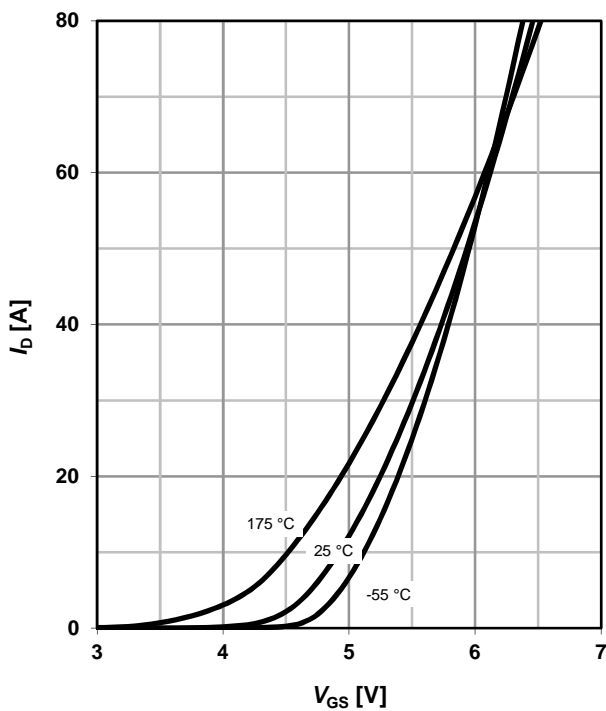
parameter:  $V_{GS}$



**7 Typ. transfer characteristics<sup>4)</sup>**

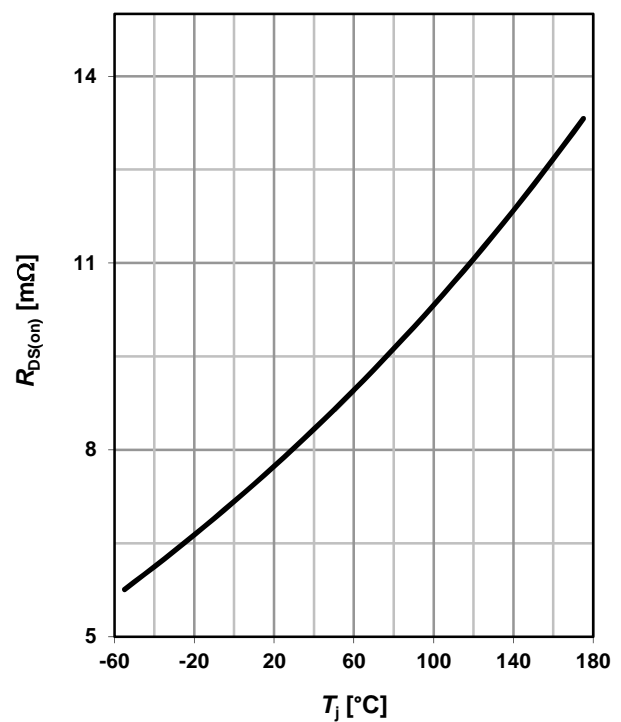
$I_D = f(V_{GS}); V_{DS} = 6\text{ V}$

parameter:  $T_j$



**8 Typ. drain-source on-state resistance<sup>4)</sup>**

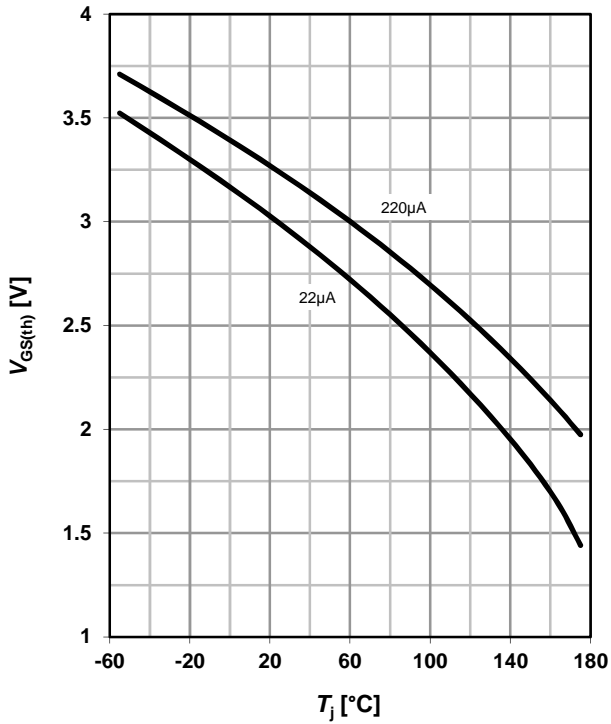
$R_{DS(on)} = f(T_j); I_D = 17\text{ A}; V_{GS} = 10\text{ V}$



**9 Typ. gate threshold voltage**

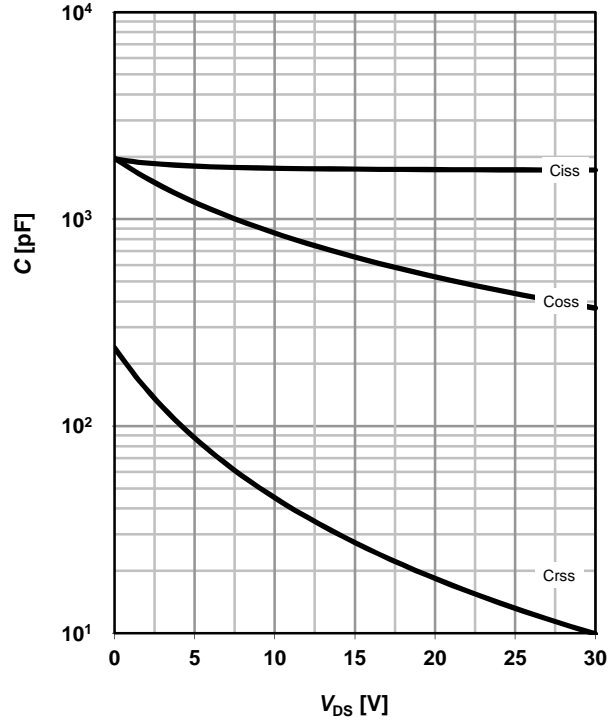
$V_{GS(th)} = f(T_j); V_{GS} = V_{DS}$

parameter:  $I_D$



**10 Typ. Capacitances<sup>4)</sup>**

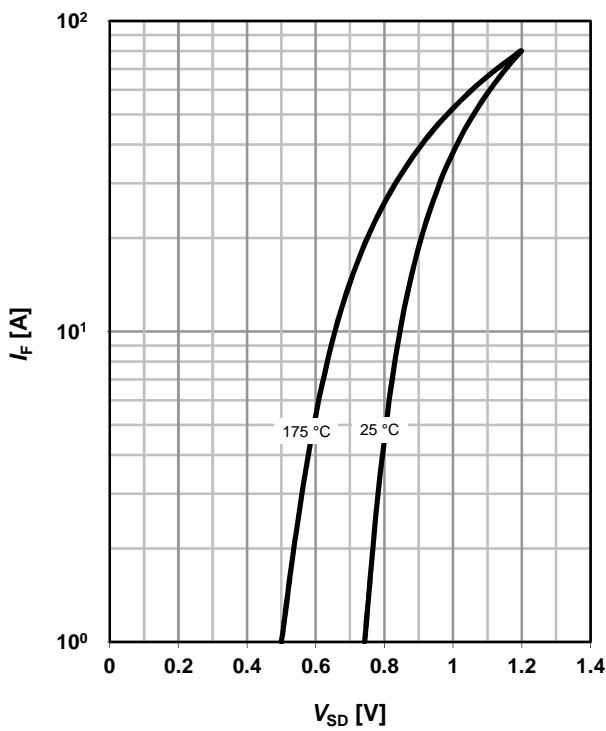
$C = f(V_{DS}); V_{GS} = 0 V; f = 1 MHz$



**11 Typical forward diode characteristics<sup>4)</sup>**

$I_F = f(V_{SD})$

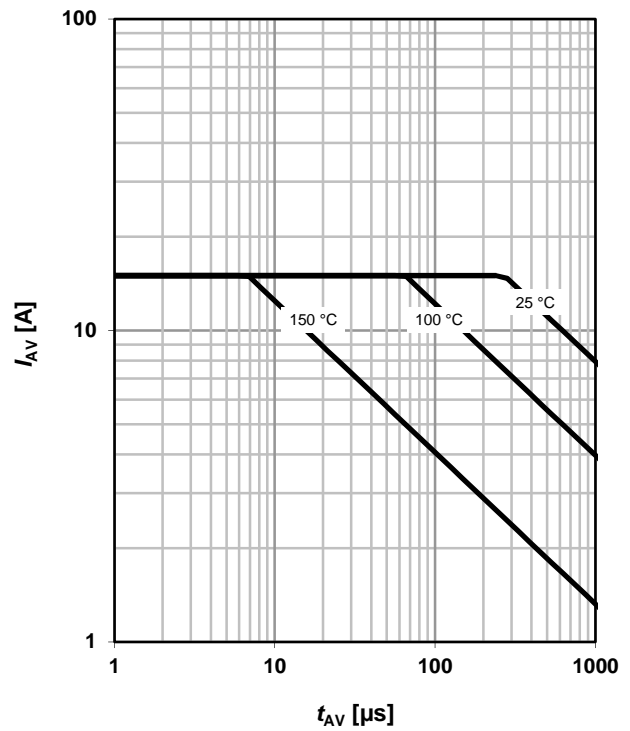
parameter:  $T_j$



**12 Avalanche characteristics<sup>4)</sup>**

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

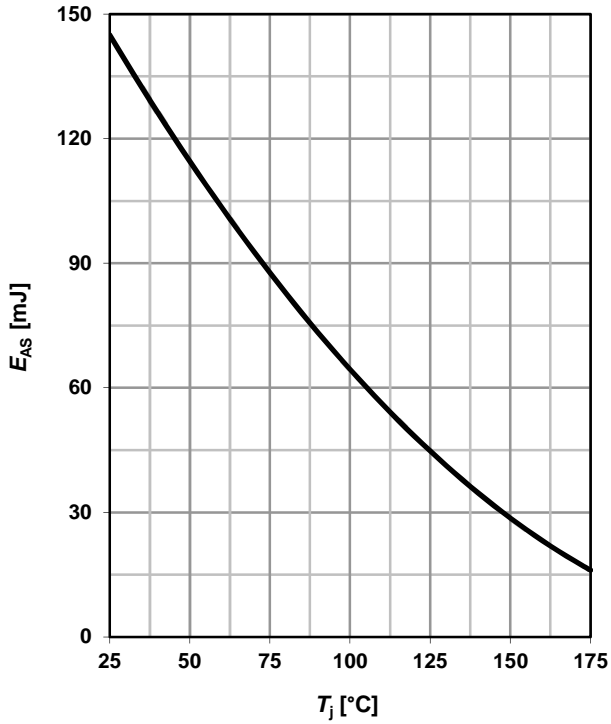
parameter:  $T_{j(start)}$



**13 Avalanche energy<sup>4)</sup>**

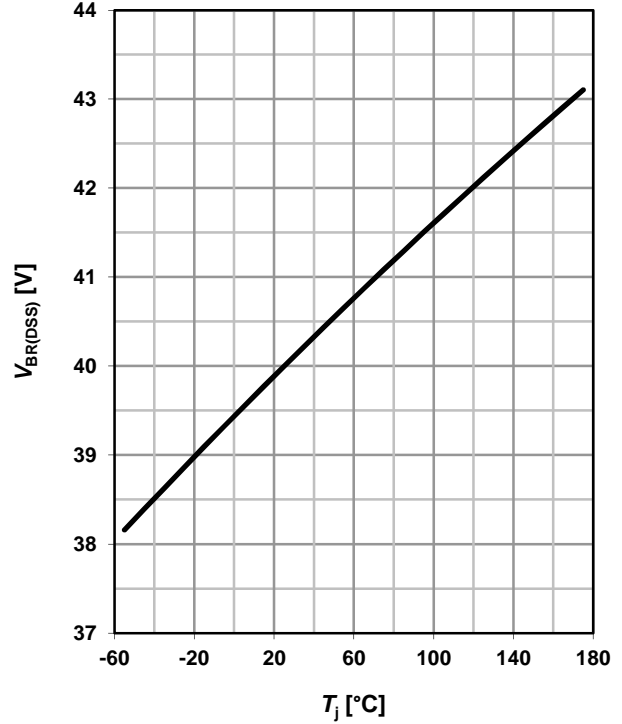
$E_{AS} = f(T_j)$

parameter:  $I_D$



**14 Drain-source breakdown voltage**

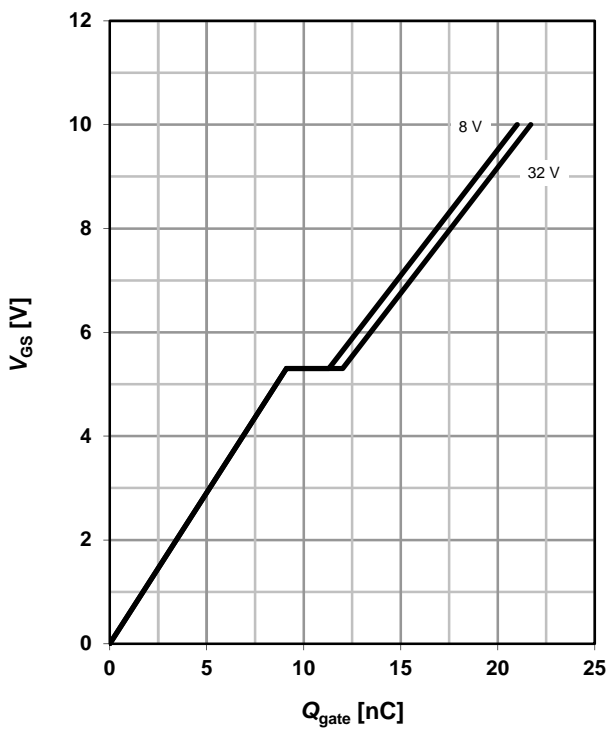
$V_{BR(DSS)} = f(T_j); I_D = 1 \text{ mA}$



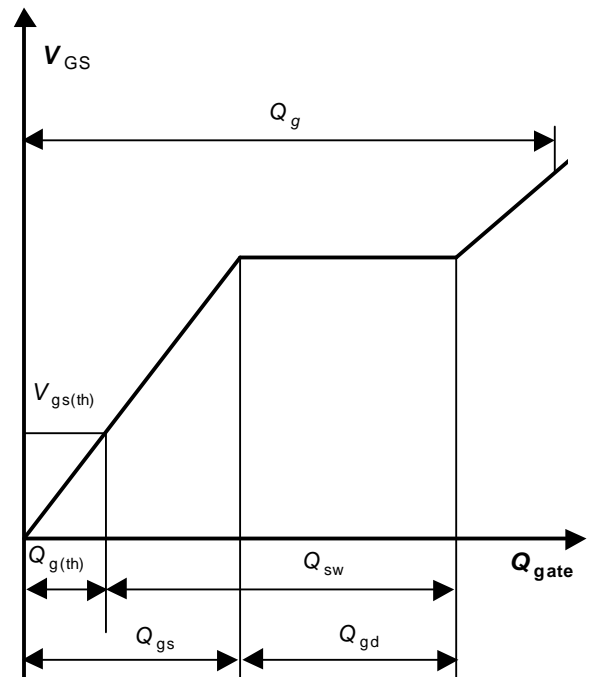
**15 Typ. gate charge<sup>4)</sup>**

$V_{GS} = f(Q_{gate}); I_D = 20 \text{ A pulsed}$

parameter:  $V_{DD}$



**16 Gate charge waveforms**



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## Revision History

| Version       | Date       | Changes                 |
|---------------|------------|-------------------------|
| Revision 1.0  | 03.05.2015 | Data Sheet revision 1.0 |
| Revision 1.01 | 31.05.2024 | Package naming updated  |