

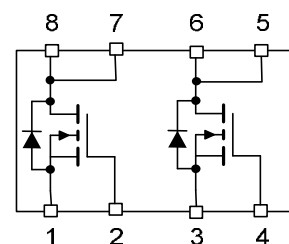
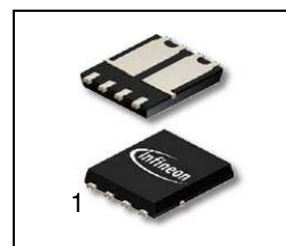
OptiMOS™-T2 Power-Transistor

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)

Product Summary

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

PG-TDSON-8-10


| Type | Package | Marking |
|----------------|---------------|---------|
| IPG20N04S4-09A | PG-TDSON-8-10 | 4N0409 |

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

| Parameter | Symbol | Conditions | Value | Unit |
|--|----------------|--|--------------|------|
| Continuous drain current one channel active | I_D | $T_C=25\text{ °C}$, $V_{GS}=10\text{ V}^{1)}$ | 20 | A |
| | | $T_C=100\text{ °C}$, $V_{GS}=10\text{ V}^{2)}$ | 20 | |
| Pulsed drain current ²⁾ one channel active | $I_{D,pulse}$ | - | 80 | |
| Avalanche energy, single pulse ^{2, 4)} | E_{AS} | $I_D=10\text{ A}$ | 145 | mJ |
| Avalanche current, single pulse ⁴⁾ | I_{AS} | - | 15 | A |
| Gate source voltage | V_{GS} | - | ±20 | V |
| Power dissipation 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 characteristics²⁾

| | | | | | | |
|-------------------------------------|------------|--|---|-----|-----|-----|
| Thermal resistance, junction - case | R_{thJC} | - | - | - | 2.8 | K/W |
| SMD version, device on PCB | R_{thJA} | minimal footprint | - | 100 | - | |
| | | 6 cm ² cooling area ³⁾ | - | 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 ⁴⁾ | I_{DSS} | $V_{DS}=40\text{ V}, V_{GS}=0\text{ V}, T_j=25\text{ °C}$ | - | 0.01 | 1 | μA |
| | | $V_{DS}=18\text{ V}, V_{GS}=0\text{ V}, T_j=85\text{ °C}^{2)}$ | - | 1 | 100 | |
| Gate-source leakage current ⁴⁾ | I_{GSS} | $V_{GS}=20\text{ V}, V_{DS}=0\text{ V}$ | - | - | 100 | nA |
| Drain-source on-state resistance ⁴⁾ | $R_{DS(on)}$ | $V_{GS}=10\text{ V}, I_D=17\text{ A}$ | - | 7.9 | 8.6 | m Ω |

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

Dynamic characteristics²⁾

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

Gate Charge Characteristics^{2, 4)}

| | | | | | | |
|-----------------------|---------------|--|---|------|-----|----|
| Gate to source charge | Q_{gs} | $V_{DD}=32\text{ V}, I_D=20\text{ A},$ $V_{GS}=0\text{ to }10\text{ V}$ | - | 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 ²⁾ one channel active | I_S | $T_C=25\text{ °C}$ | - | - | 20 | A |
| Diode pulse current ²⁾ one channel active | $I_{S,pulse}$ | | - | - | 80 | |
| Diode forward voltage | V_{SD} | $V_{GS}=0\text{ V}, I_F=17\text{ A},$ $T_j=25\text{ °C}$ | - | 0.9 | 1.3 | V |
| Reverse recovery time ²⁾ | t_{rr} | $V_R=20\text{ V}, I_F=I_S,$ $di_F/dt=100\text{ A}/\mu\text{s}$ | - | 34 | - | ns |
| Reverse recovery charge ^{2, 4)} | Q_{rr} | | - | 30 | - | |

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

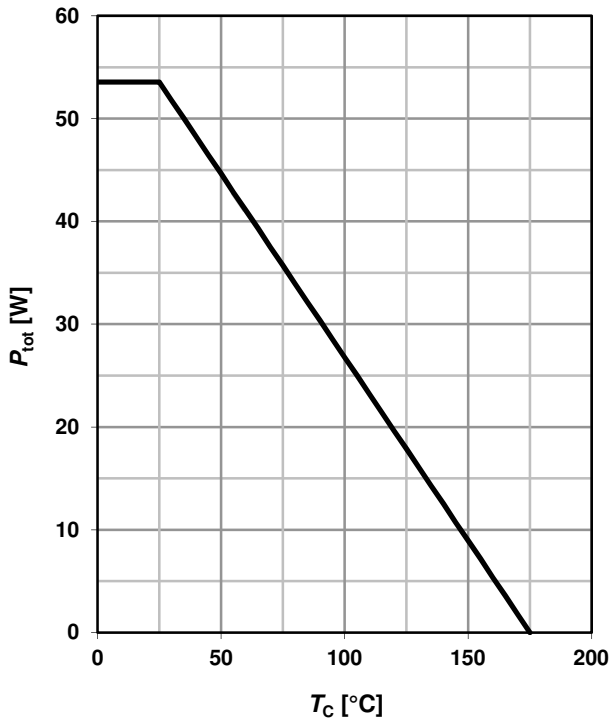
²⁾ Specified by design. Not subject to production test.

³⁾ Device on 40 mm x 40 mm x 1.5 mm epoxy PCB FR4 with 6 cm² (one layer, 70 μm thick) copper area for drain connection. PCB is vertical in still air.

⁴⁾ Per channel

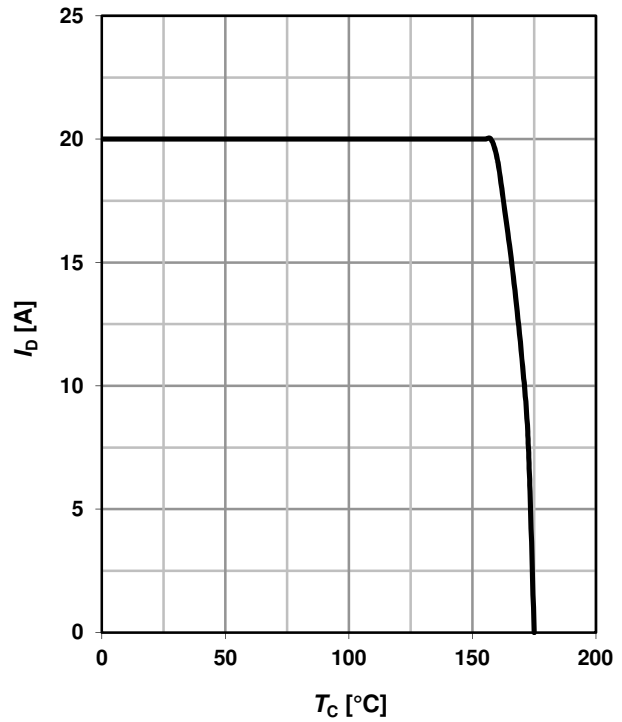
1 Power dissipation

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



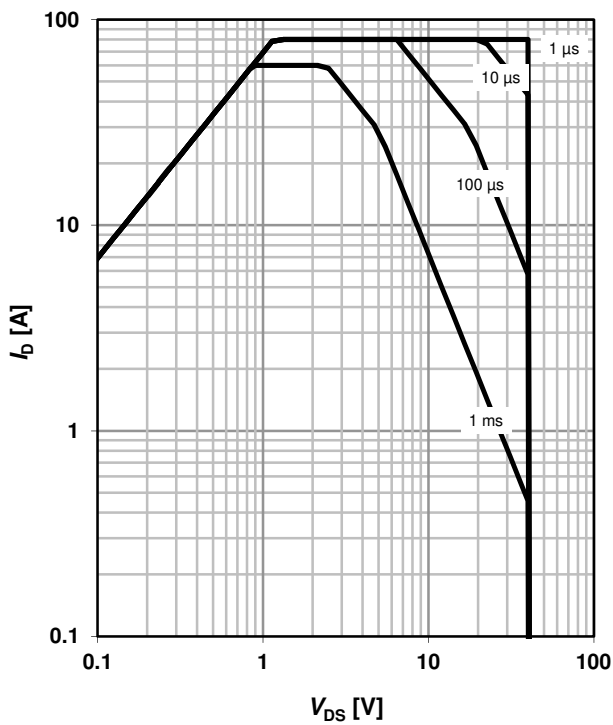
2 Drain current

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



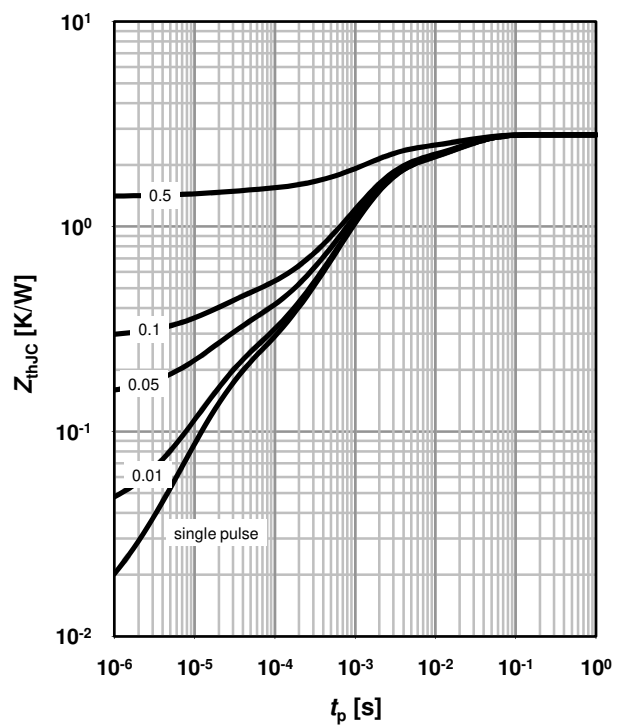
3 Safe operating area

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



4 Max. transient thermal impedance

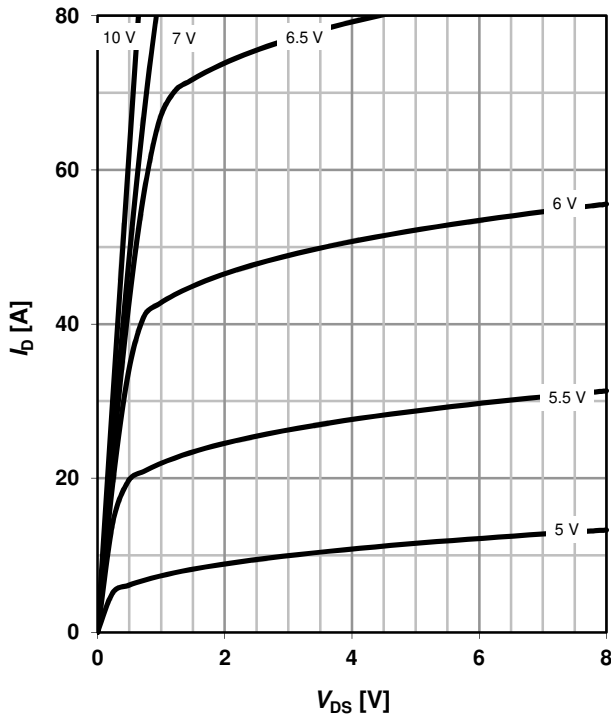
$Z_{thJC} = f(t_p)$
parameter: $D = t_p/T$



5 Typ. output characteristics⁴⁾

$I_D = f(V_{DS}); T_j = 25\text{ °C}$

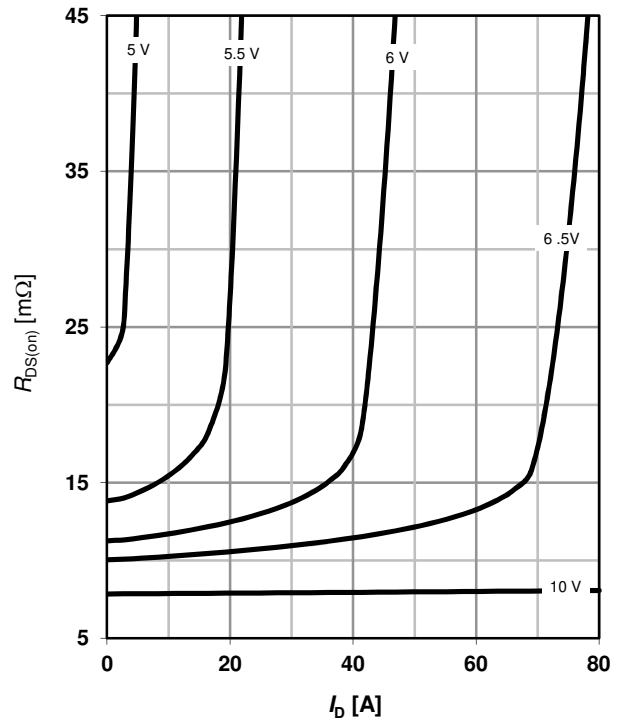
parameter: V_{GS}



6 Typ. drain-source on-state resistance⁴⁾

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

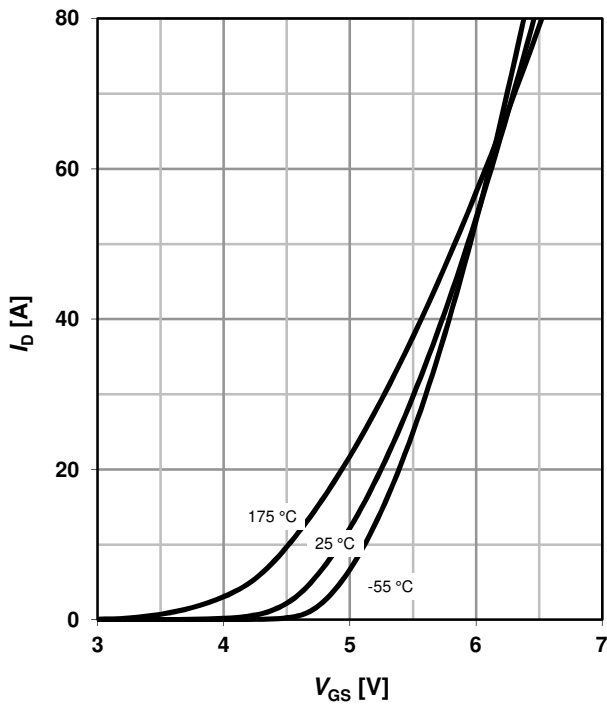
parameter: V_{GS}



7 Typ. transfer characteristics⁴⁾

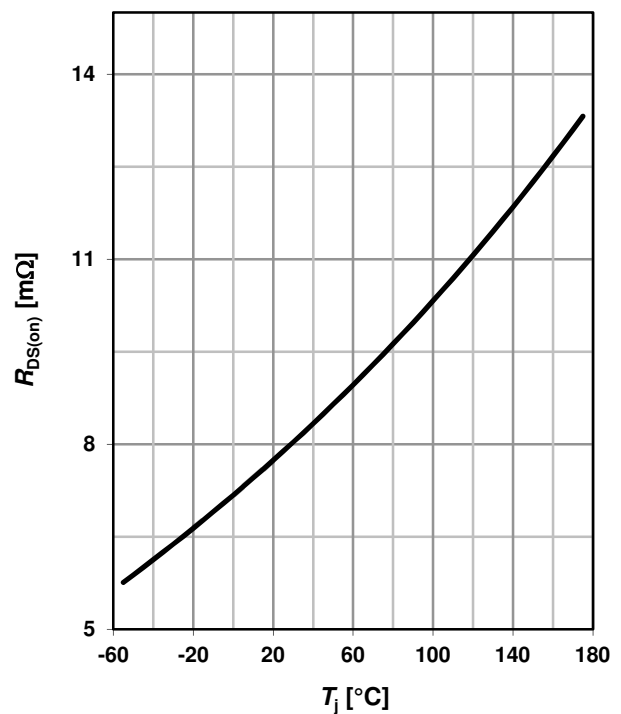
$I_D = f(V_{GS}); V_{DS} = 6\text{ V}$

parameter: T_j



8 Typ. drain-source on-state resistance⁴⁾

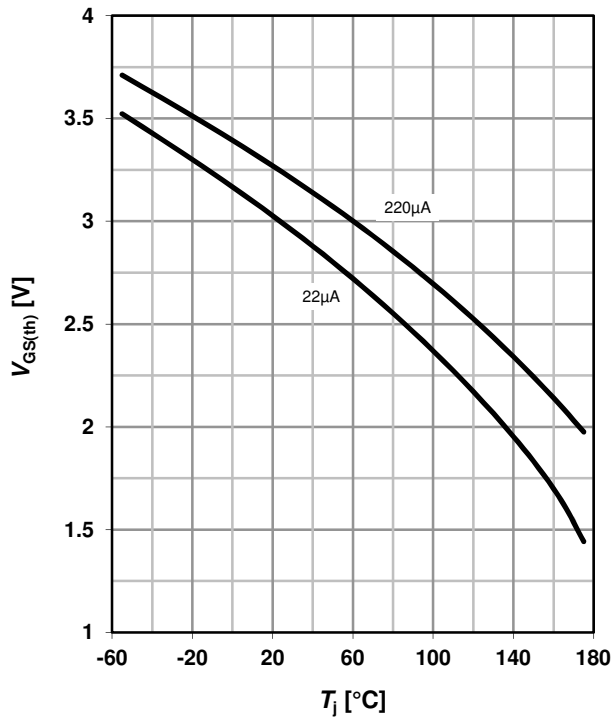
$R_{DS(on)} = f(T_j); I_D = 17\text{ A}; V_{GS} = 10\text{ V}$



9 Typ. gate threshold voltage

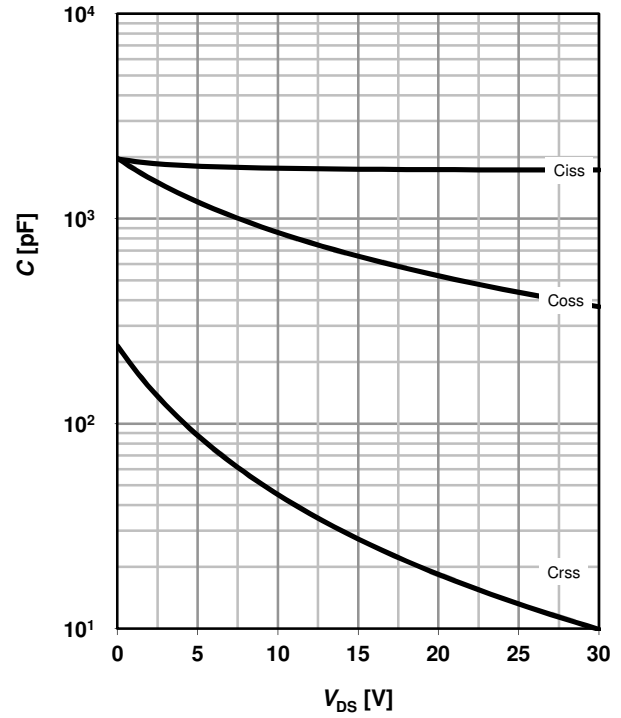
$V_{GS(th)} = f(T_j); V_{GS} = V_{DS}$

parameter: I_D



10 Typ. Capacitances⁴⁾

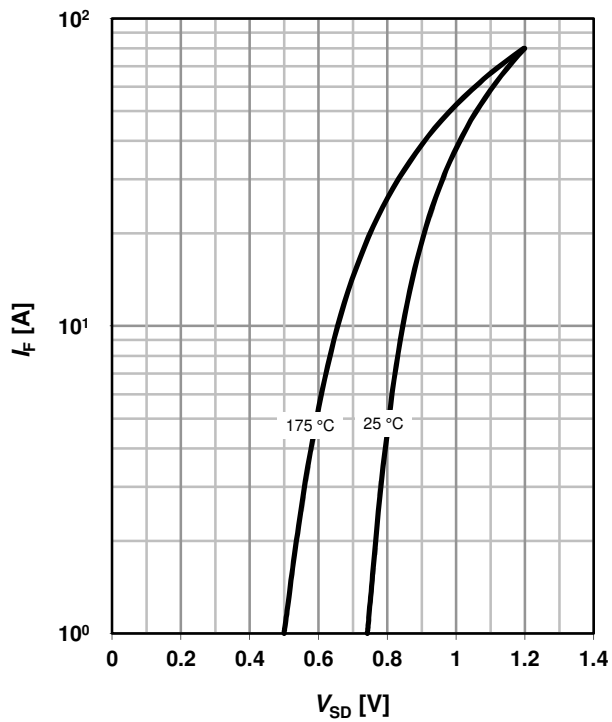
$C = f(V_{DS}); V_{GS} = 0 V; f = 1 MHz$



11 Typical forward diode characteristics⁴⁾

$I_F = f(V_{SD})$

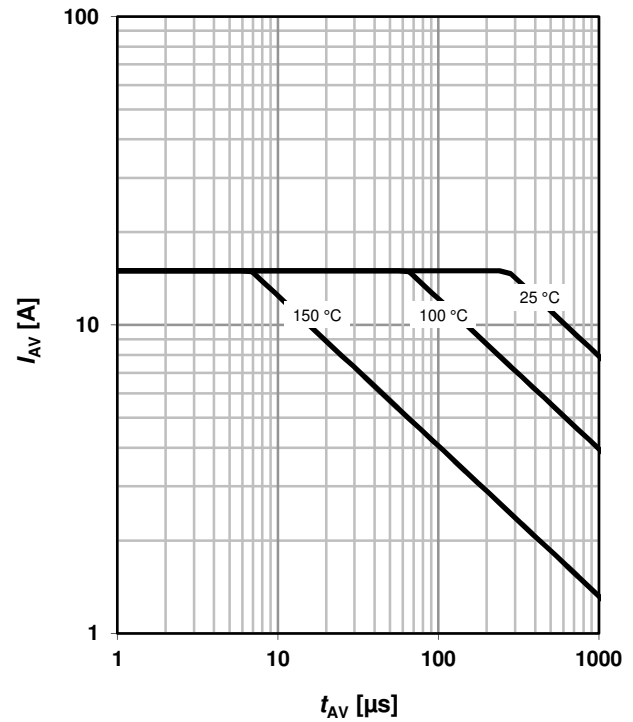
parameter: T_j



12 Avalanche characteristics⁴⁾

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

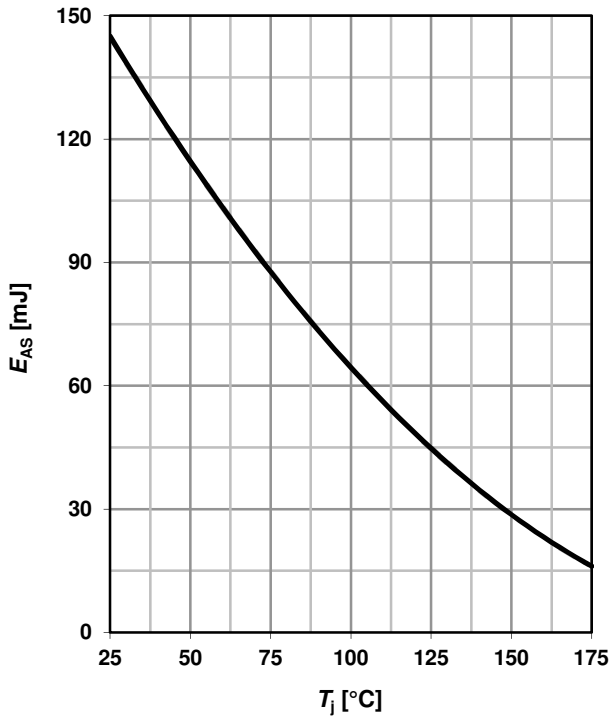
parameter: $T_{j(start)}$



13 Avalanche energy⁴⁾

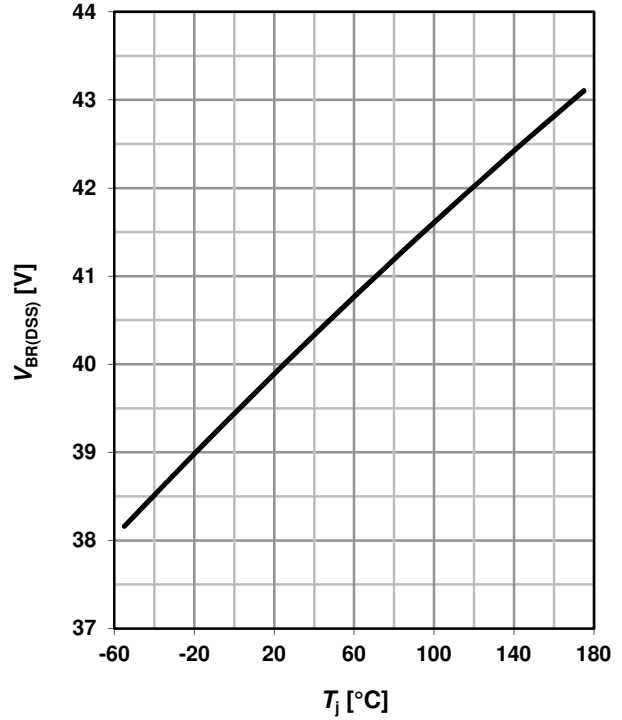
$$E_{AS} = f(T_j)$$

parameter: I_D



14 Drain-source breakdown voltage

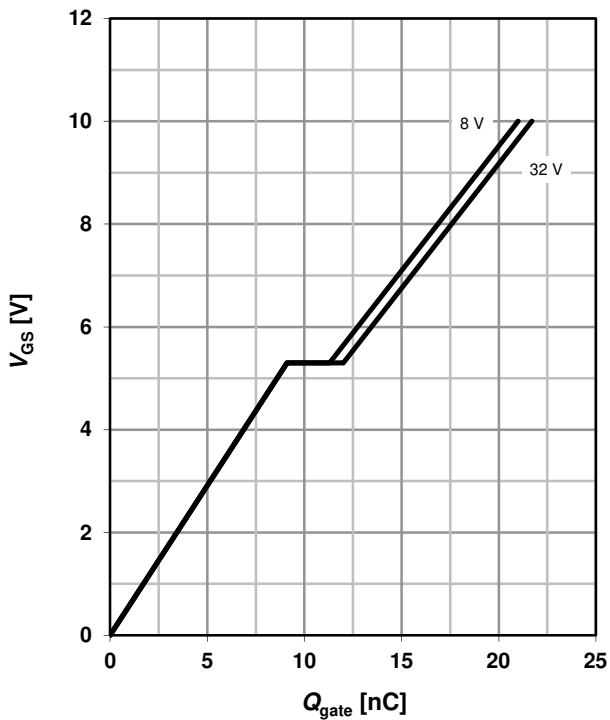
$$V_{BR(DSS)} = f(T_j); I_D = 1 \text{ mA}$$



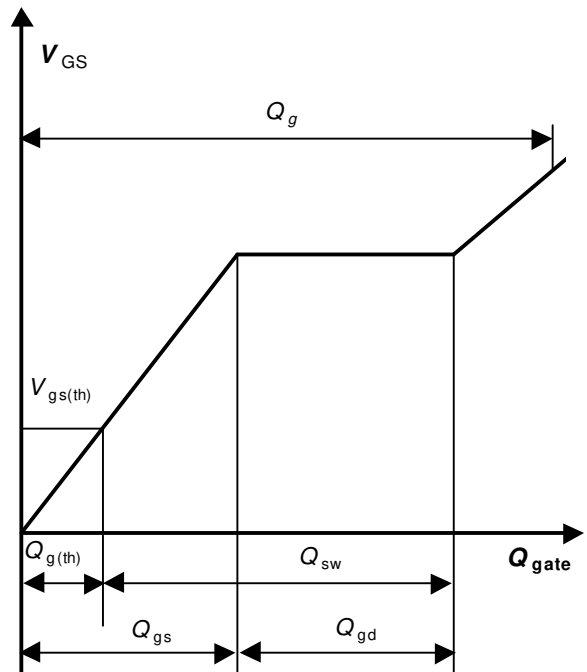
15 Typ. gate charge⁴⁾

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

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 |