

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

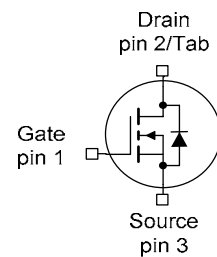
Product Summary

| | | |
|------------------|-----|----|
| V_{DS} | 40 | V |
| $R_{DS(on),max}$ | 3.8 | mΩ |
| I_D | 90 | A |

PG-TO252-3-313



| Type | Package | Marking |
|----------------|----------------|---------|
| IPD90N04S4L-04 | PG-TO252-3-313 | 4N04L04 |



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

| Parameter | Symbol | Conditions | Value | Unit |
|--|-------------------|--|--------------|------|
| Continuous drain current ¹⁾ | 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⁾ | 84 | |
| Pulsed drain current ²⁾ | $I_{D,pulse}$ | $T_C=25\text{ °C}$ | 360 | |
| Avalanche energy, single pulse ²⁾ | E_{AS} | $I_D=45\text{ A}$ | 95 | mJ |
| Avalanche current, single pulse | I_{AS} | - | 90 | A |
| Gate source voltage | V_{GS} | - | +20/-16 | V |
| Power dissipation | P_{tot} | $T_C=25\text{ °C}$ | 71 | 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. | |

Thermal characteristics²⁾

| | | | | | | |
|--|------------|--|---|---|-----|-----|
| Thermal resistance, junction - case | R_{thJC} | | - | - | 2.1 | K/W |
| Thermal resistance, junction - ambient, leaded | R_{thJA} | | - | - | 62 | |
| SMD version, device on PCB | R_{thJA} | minimal footprint | - | - | 62 | |
| | | 6 cm ² cooling area ³⁾ | - | - | 40 | |

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

Static characteristics

| | | | | | | |
|----------------------------------|---------------|--|-----|------|-----|------------|
| Drain-source breakdown voltage | $V_{(BR)DSS}$ | $V_{GS}=0V, I_D=1mA$ | 40 | - | - | V |
| Gate threshold voltage | $V_{GS(th)}$ | $V_{DS}=V_{GS}, I_D=35\mu A$ | 1.2 | 1.7 | 2.2 | |
| Zero gate voltage drain current | I_{DSS} | $V_{DS}=40V, V_{GS}=0V$ | - | 0.02 | 1 | μA |
| | | $V_{DS}=18V, V_{GS}=0V, T_j=85^\circ\text{C}^{2)}$ | - | 1 | 20 | |
| Gate-source leakage current | I_{GSS} | $V_{GS}=20V, V_{DS}=0V$ | - | - | 100 | nA |
| Drain-source on-state resistance | $R_{DS(on)}$ | $V_{GS}=4.5V, I_D=45A$ | - | 4.6 | 5.5 | m Ω |
| | | $V_{GS}=10V, I_D=90A$ | - | 3.2 | 3.8 | |

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

Dynamic characteristics²⁾

| | | | | | | |
|------------------------------|--------------|--|---|------|------|----|
| Input capacitance | C_{iss} | $V_{GS}=0\text{ V}, V_{DS}=25\text{ V},$ $f=1\text{ MHz}$ | - | 3610 | 4690 | pF |
| Output capacitance | C_{oss} | | - | 650 | 840 | |
| Reverse transfer capacitance | C_{rss} | | - | 30 | 69 | |
| Turn-on delay time | $t_{d(on)}$ | $V_{DD}=20\text{V}, V_{GS}=10\text{V},$ $I_D=90\text{A}, R_G=3.5\Omega$ | - | 7 | - | ns |
| Rise time | t_r | | - | 11 | - | |
| Turn-off delay time | $t_{d(off)}$ | | - | 22 | - | |
| Fall time | t_f | | - | 28 | - | |

Gate Charge Characteristics²⁾

| | | | | | | |
|-----------------------|---------------|---|---|-----|----|----|
| Gate to source charge | Q_{gs} | $V_{DD}=32\text{V}, I_D=90\text{A},$ $V_{GS}=0\text{ to }10\text{V}$ | - | 12 | 16 | nC |
| Gate to drain charge | Q_{gd} | | - | 5 | 12 | |
| Gate charge total | Q_g | | - | 46 | 60 | |
| Gate plateau voltage | $V_{plateau}$ | | - | 3.2 | - | V |

Reverse Diode

| | | | | | | |
|--|---------------|--|---|-----|-----|----|
| Diode continuous forward current ²⁾ | I_S | $T_C=25^\circ\text{C}$ | - | - | 90 | A |
| Diode pulse current ²⁾ | $I_{S,pulse}$ | | - | - | 360 | |
| Diode forward voltage | V_{SD} | $V_{GS}=0\text{V}, I_F=90\text{A},$ $T_j=25^\circ\text{C}$ | - | 0.9 | 1.3 | V |
| Reverse recovery time ²⁾ | t_{rr} | $V_R=20\text{V}, I_F=50\text{A},$ $di_F/dt=100\text{A}/\mu\text{s}$ | - | 39 | - | ns |
| Reverse recovery charge ²⁾ | Q_{rr} | | - | 35 | - | nC |

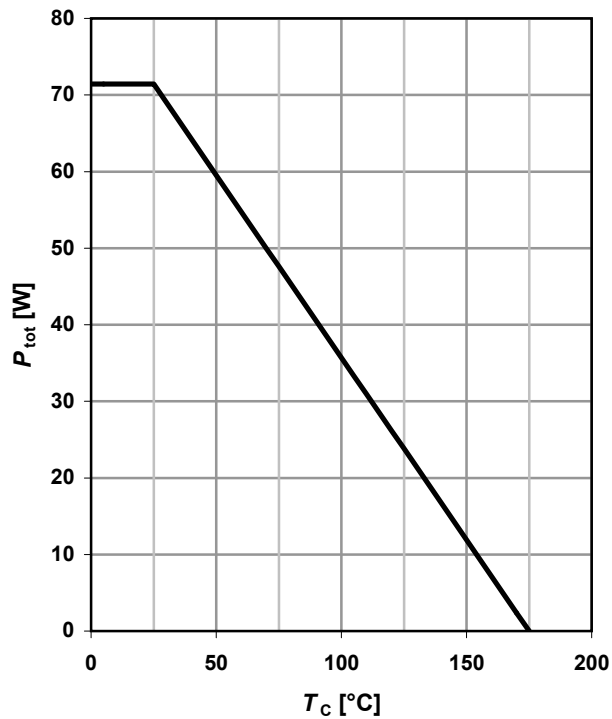
¹⁾ Current is limited by bondwire; with an $R_{thJC} = 2.1\text{K/W}$ the chip is able to carry 103A at 25°C.

²⁾ Defined 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.

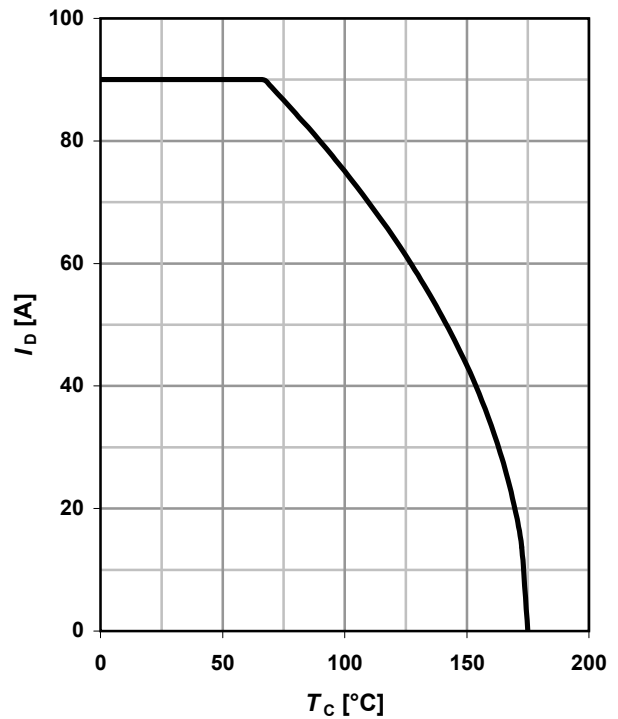
1 Power dissipation

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



2 Drain current

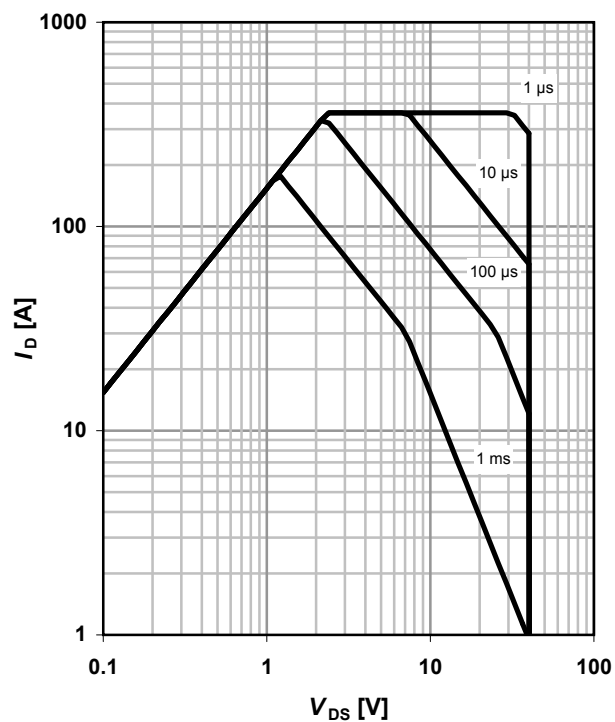
$$I_D = f(T_C); V_{\text{GS}} \geq 6 \text{ V}$$



3 Safe operating area

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

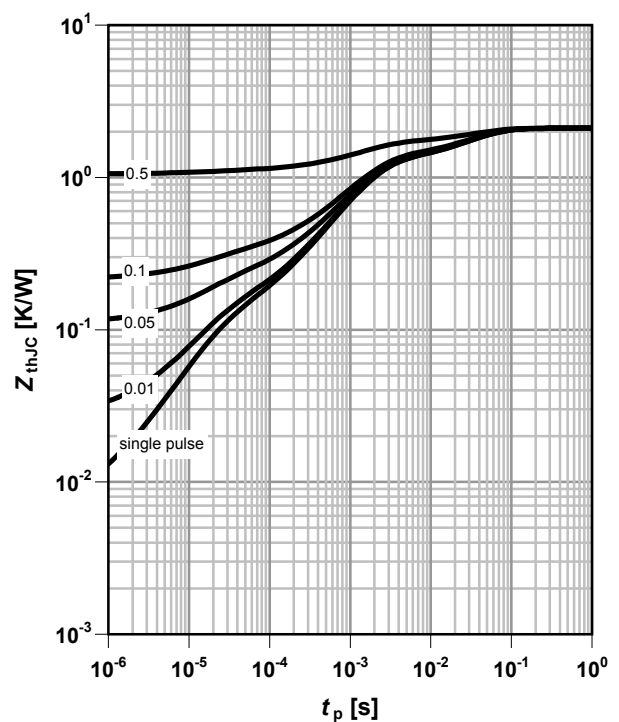
parameter: t_p



4 Max. transient thermal impedance

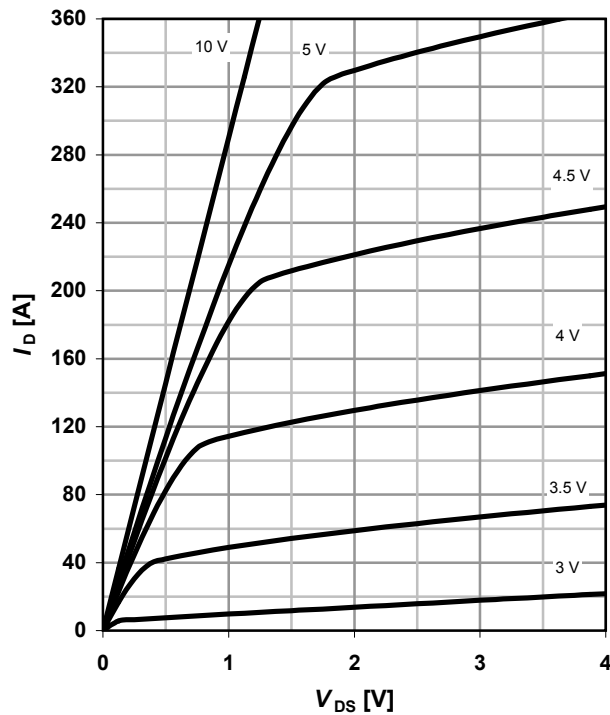
$$Z_{\text{thJC}} = f(t_p)$$

parameter: $D = t_p/T$



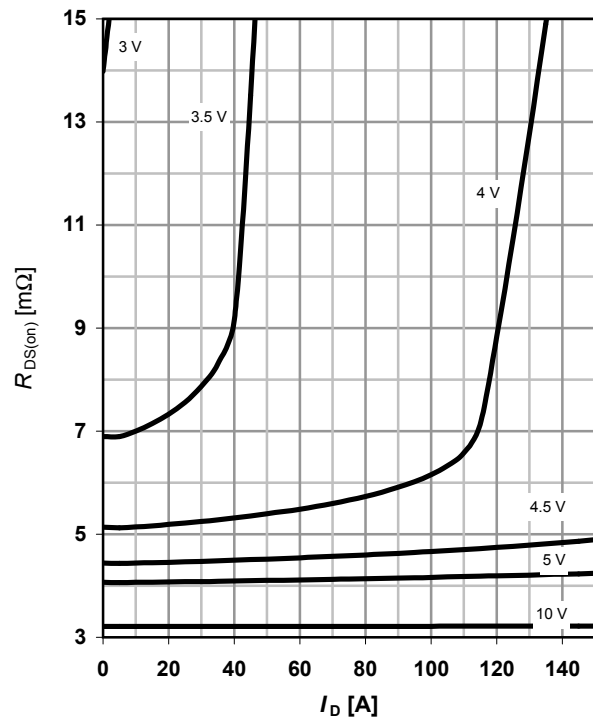
5 Typ. output characteristics

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

parameter: V_{GS}


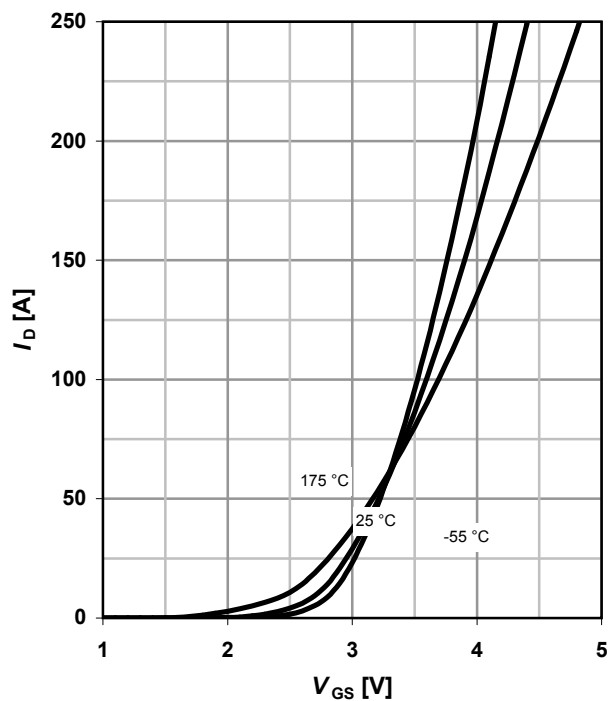
6 Typ. drain-source on-state resistance

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

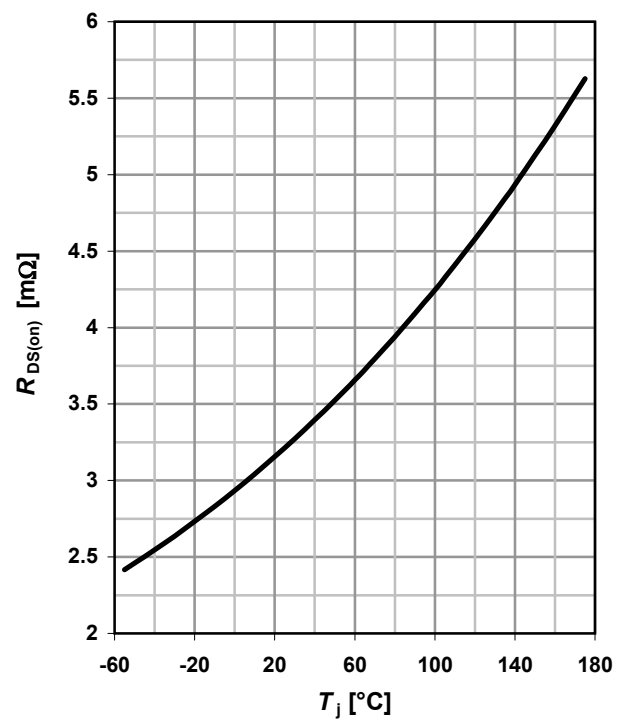
parameter: V_{GS}


7 Typ. transfer characteristics

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

parameter: T_j


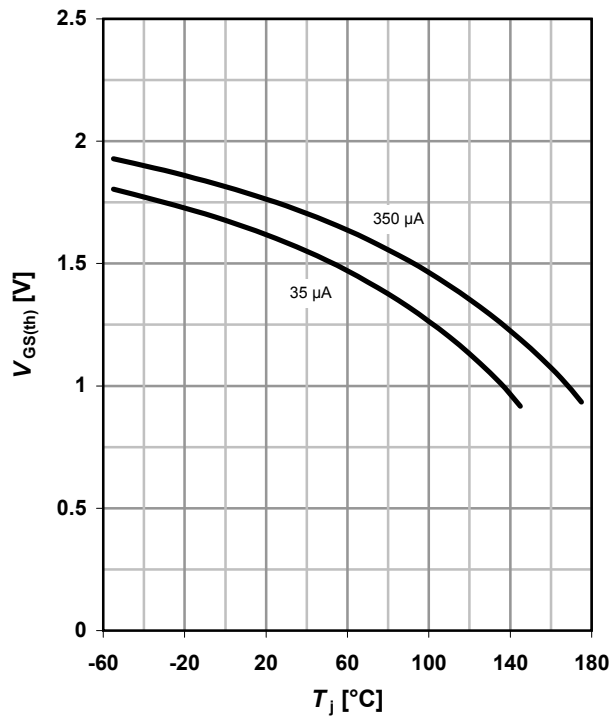
8 Typ. drain-source on-state resistance

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


9 Typ. gate threshold voltage

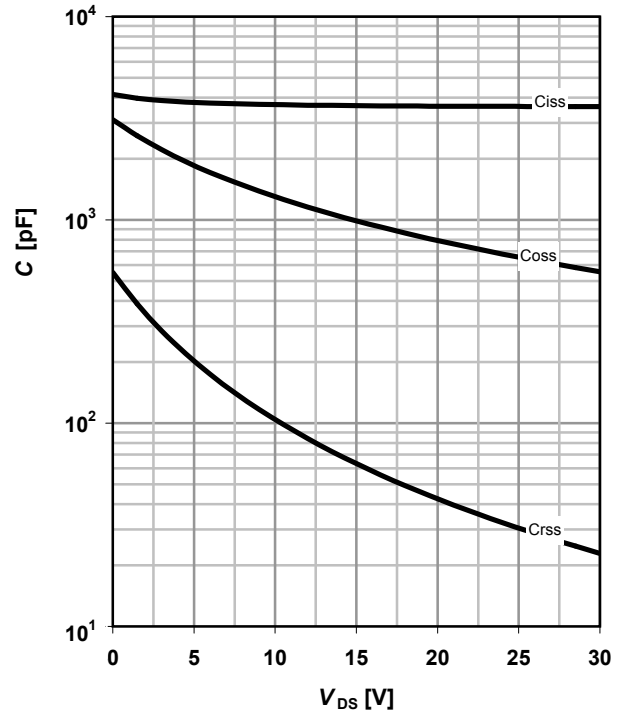
$$V_{GS(th)} = f(T_j); V_{GS} = V_{DS}$$

parameter: I_D



10 Typ. capacitances

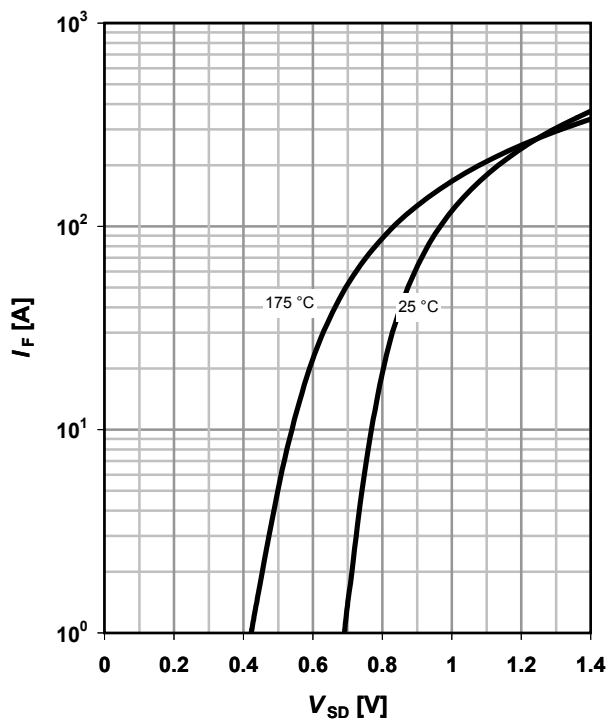
$$C = f(V_{DS}); V_{GS} = 0 \text{ V}; f = 1 \text{ MHz}$$



11 Typical forward diode characteristics

$$I_F = f(V_{SD})$$

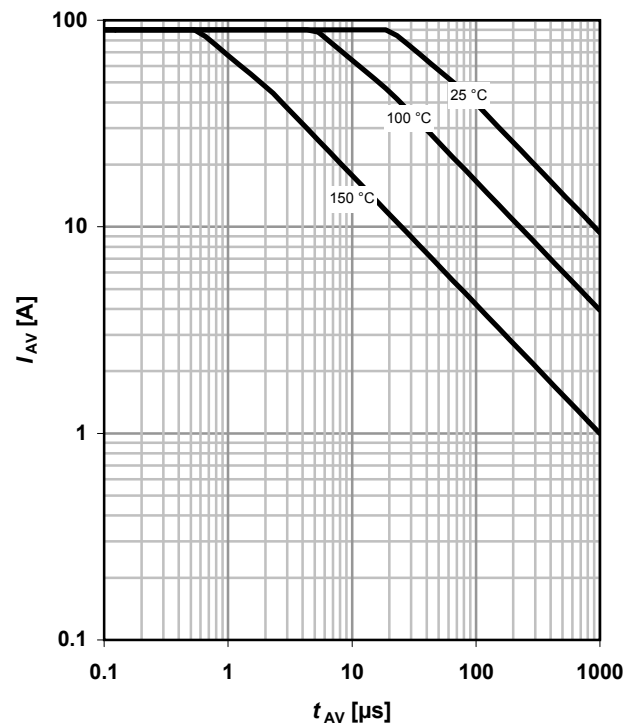
parameter: T_j



12 Avalanche characteristics

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

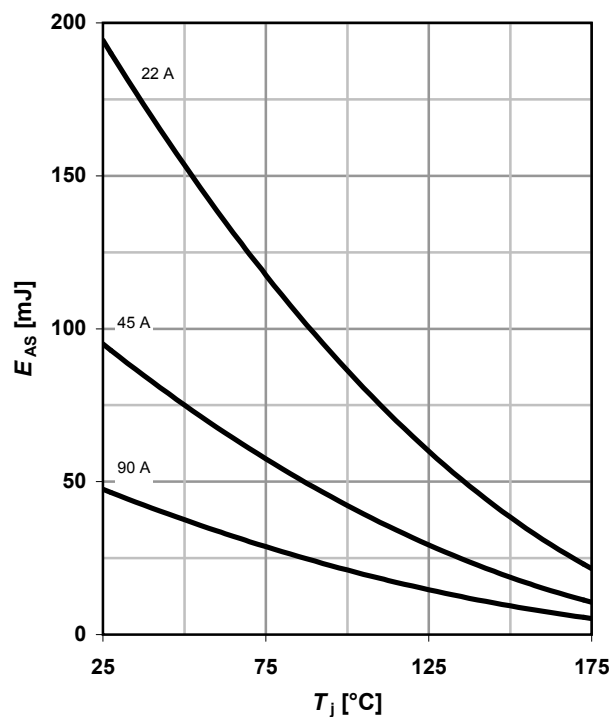
parameter: $T_{j(start)}$



13 Avalanche energy

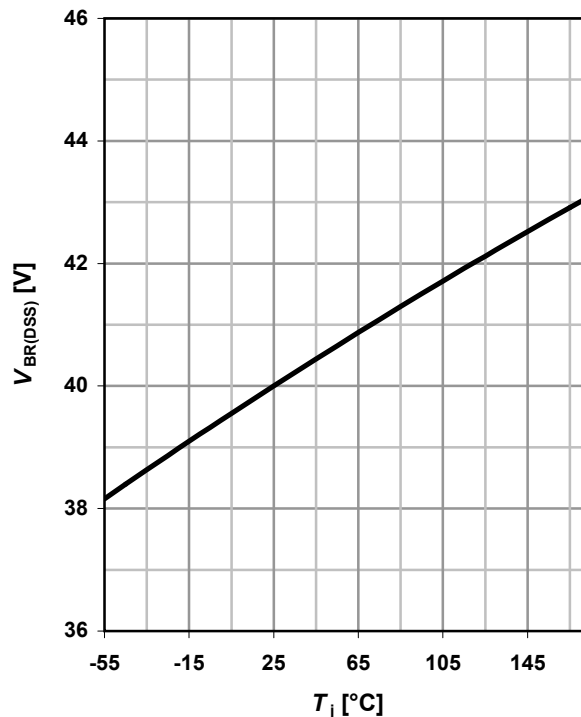
$$E_{AS} = f(T_j)$$

parameter: I_D



14 Drain-source breakdown voltage

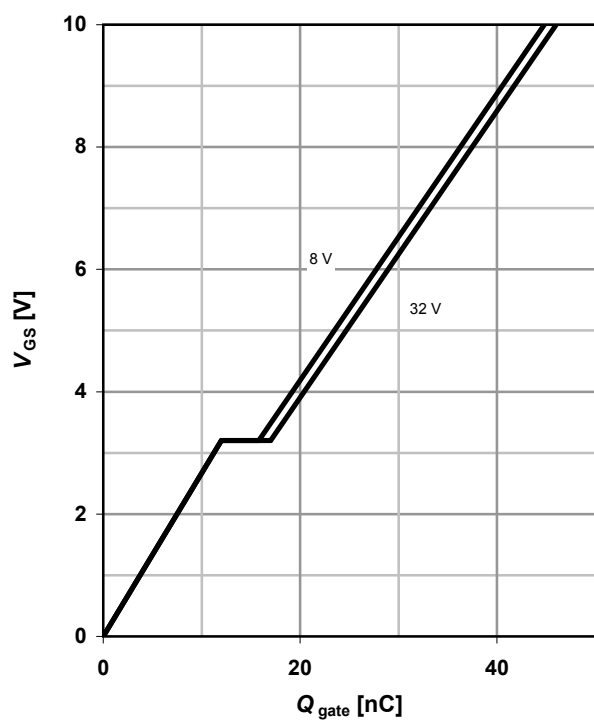
$$V_{BR(DSS)} = f(T_j); I_D = 1 \text{ mA}$$



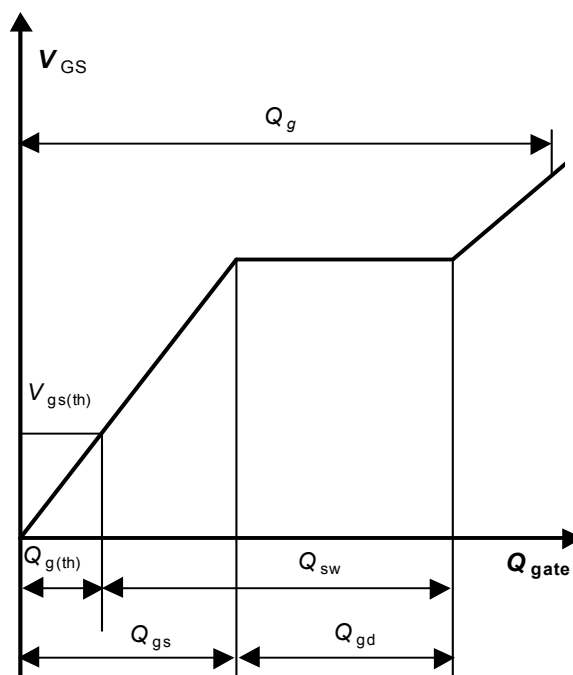
15 Typ. gate charge

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

parameter: V_{DD}



16 Gate charge waveforms



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Revision History

| Version | Date | Changes |
|--------------|------------|------------------|
| Revision 1.0 | 06.04.2010 | Final Data Sheet |
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