

OptiMOS™3 Power-Transistor
Features

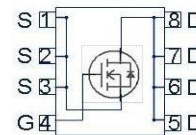
- N-channel, normal level
- Excellent gate charge x $R_{DS(on)}$ product (FOM)
- Very low on-resistance $R_{DS(on)}$
- Pb-free lead plating; RoHS compliant
- Qualified according to JEDEC¹⁾ for target application
- Halogen-free according to IEC61249-2-21
- Ideal for high-frequency switching and synchronous rectification

Product Summary

| | | |
|------------------|-----|----|
| V_{DS} | 200 | V |
| $R_{DS(on),max}$ | 50 | mΩ |
| I_D | 24 | A |



| | |
|---------|--------------|
| Type | BSC500N20NS3 |
| | |
| Package | PG-TDSON-8 |
| Marking | 500N20NS |


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

| Parameter | Symbol | Conditions | Value | Unit |
|-------------------------------------|----------------|--|-------------|-------------|
| Continuous drain current | I_D | $T_C=25\text{ °C}$ | 24 | A |
| | | $T_C=100\text{ °C}$ | 17 | |
| Pulsed drain current ²⁾ | $I_{D,pulse}$ | $T_C=25\text{ °C}$ | 97 | |
| Avalanche energy, single pulse | E_{AS} | $I_D=22\text{ A}, R_{GS}=25\text{ }\Omega$ | 120 | mJ |
| Reverse diode dv/dt | dv/dt | | 50 | kV/ μ s |
| Gate source voltage | V_{GS} | | ± 20 | V |
| Power dissipation | P_{tot} | $T_C=25\text{ °C}$ | 96 | W |
| Operating and storage temperature | T_j, T_{stg} | | -55 ... 150 | °C |
| IEC climatic category; DIN IEC 68-1 | | | 55/150/56 | |

¹⁾J-STD20 and JESD22

²⁾ See figure 3

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

Thermal characteristics

| | | | | | | |
|--|------------|--|---|---|-----|-----|
| Thermal resistance, junction - case | R_{thJC} | | - | - | 1.3 | K/W |
| Thermal resistance, junction - ambient | R_{thJA} | minimal footprint | - | - | 75 | |
| | | 6 cm ² cooling area ³⁾ | - | - | 50 | |

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

| | | | | | | |
|----------------------------------|---------------|---|-----|-----|-----|---------------|
| Drain-source breakdown voltage | $V_{(BR)DSS}$ | $V_{GS}=0\text{ V}, I_D=1\text{ mA}$ | 200 | - | - | V |
| Gate threshold voltage | $V_{GS(th)}$ | $V_{DS}=V_{GS}, I_D=60\text{ }\mu\text{A}$ | 2 | 3 | 4 | |
| Zero gate voltage drain current | I_{DSS} | $V_{DS}=160\text{ V}, V_{GS}=0\text{ V}, T_j=25\text{ °C}$ | - | 0.1 | 1 | μA |
| | | $V_{DS}=160\text{ V}, V_{GS}=0\text{ V}, T_j=125\text{ °C}$ | - | 10 | 100 | |
| Gate-source leakage current | I_{GSS} | $V_{GS}=20\text{ V}, V_{DS}=0\text{ V}$ | - | 1 | 100 | nA |
| Drain-source on-state resistance | $R_{DS(on)}$ | $V_{GS}=10\text{ V}, I_D=22\text{ A}$ | - | 42 | 50 | m Ω |
| Gate resistance | R_G | | - | 1.9 | - | Ω |
| Transconductance | g_{fs} | $ V_{DS} >2 I_D R_{DS(on)max}, I_D=22\text{ A}$ | 19 | 37 | - | S |

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.

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

Dynamic characteristics

| | | | | | | |
|------------------------------|--------------|---|---|------|------|----|
| Input capacitance | C_{iss} | $V_{GS}=0\text{ V}, V_{DS}=100\text{ V},$ $f=1\text{ MHz}$ | - | 1190 | 1580 | pF |
| Output capacitance | C_{oss} | | - | 90 | 120 | |
| Reverse transfer capacitance | C_{rss} | | - | 5 | - | |
| Turn-on delay time | $t_{d(on)}$ | $V_{DD}=100\text{ V},$ $V_{GS}=10\text{ V}, I_D=12\text{ A},$ $R_{G,ext}=6\ \Omega$ | - | 14 | - | ns |
| Rise time | t_r | | - | 5 | - | |
| Turn-off delay time | $t_{d(off)}$ | | - | 28 | - | |
| Fall time | t_f | | - | 7 | - | |

Gate Charge Characteristics⁴⁾

| | | | | | | |
|-----------------------|---------------|---|---|-----|----|----|
| Gate to source charge | Q_{gs} | $V_{DD}=100\text{ V}, I_D=12\text{ A},$ $V_{GS}=0\text{ to }10\text{ V}$ | - | 5 | - | nC |
| Gate to drain charge | Q_{gd} | | - | 2 | - | |
| Switching charge | Q_{sw} | | - | 4 | - | |
| Gate charge total | Q_g | | - | 15 | 20 | |
| Gate plateau voltage | $V_{plateau}$ | | - | 4.4 | - | |
| Output charge | Q_{oss} | $V_{DD}=100\text{ V}, V_{GS}=0\text{ V}$ | - | 35 | 47 | nC |

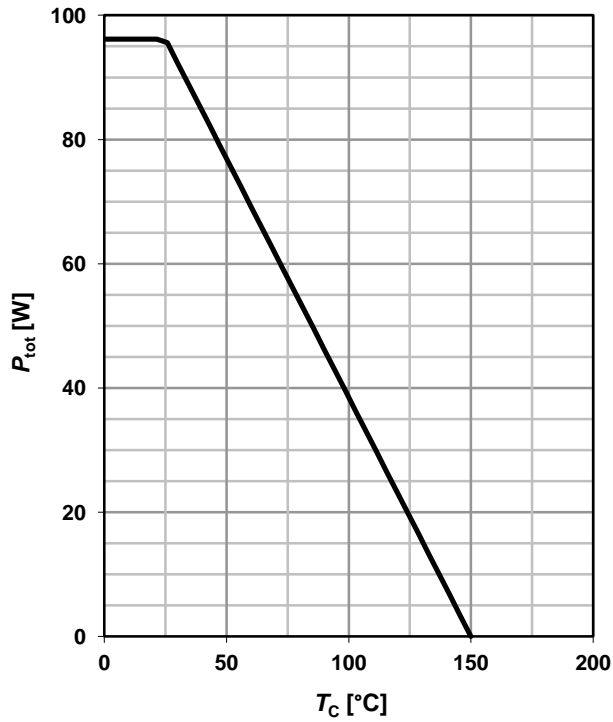
Reverse Diode

| | | | | | | |
|----------------------------------|---------------|--|---|-----|-----|----|
| Diode continuous forward current | I_S | $T_C=25\text{ }^\circ\text{C}$ | - | - | 24 | A |
| Diode pulse current | $I_{S,pulse}$ | | - | - | 97 | |
| Diode forward voltage | V_{SD} | $V_{GS}=0\text{ V}, I_F=22\text{ A},$ $T_j=25\text{ }^\circ\text{C}$ | - | 0.9 | 1.2 | V |
| Reverse recovery time | t_{rr} | $V_R=100\text{ V}, I_F=12\text{ A},$ $di_F/dt=100\text{ A}/\mu\text{s}$ | - | 110 | - | ns |
| Reverse recovery charge | Q_{rr} | | - | 399 | - | nC |

⁴⁾ See figure 16 for gate charge parameter definition

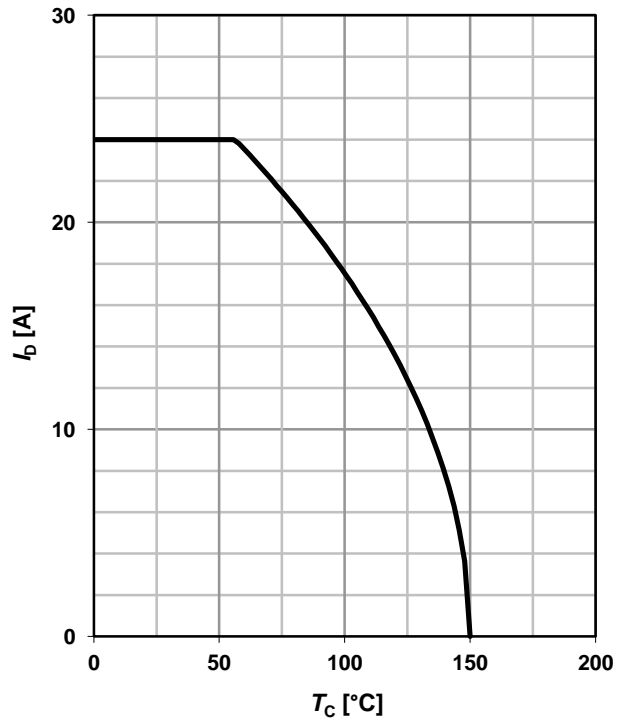
1 Power dissipation

$P_{tot}=f(T_C)$



2 Drain current

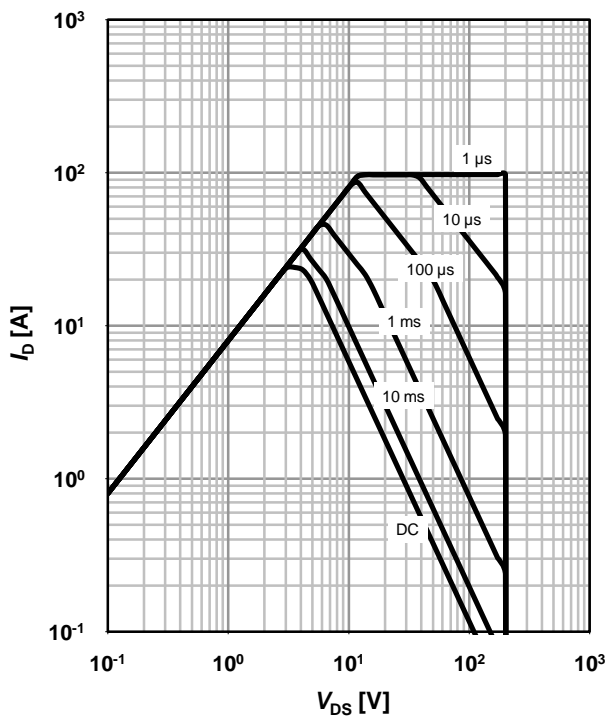
$I_D=f(T_C); V_{GS} \geq 10\text{ V}$



3 Safe operating area

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

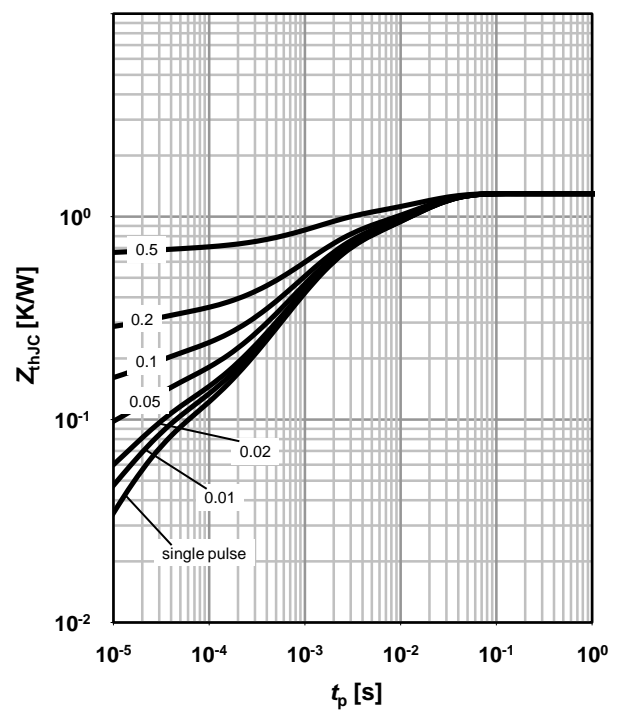
parameter: t_p



4 Max. transient thermal impedance

$Z_{thJC}=f(t_p)$

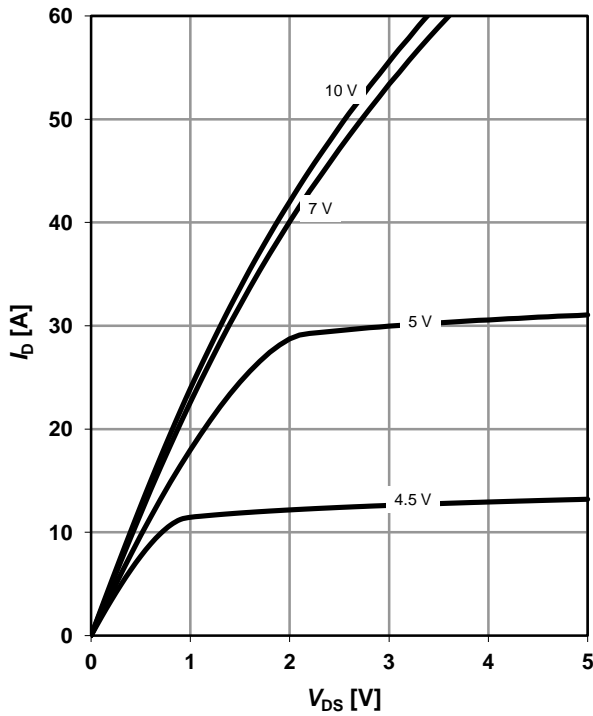
parameter: $D=t_p/T$



5 Typ. output characteristics

$I_D = f(V_{DS}); T_j = 25\text{ °C}$

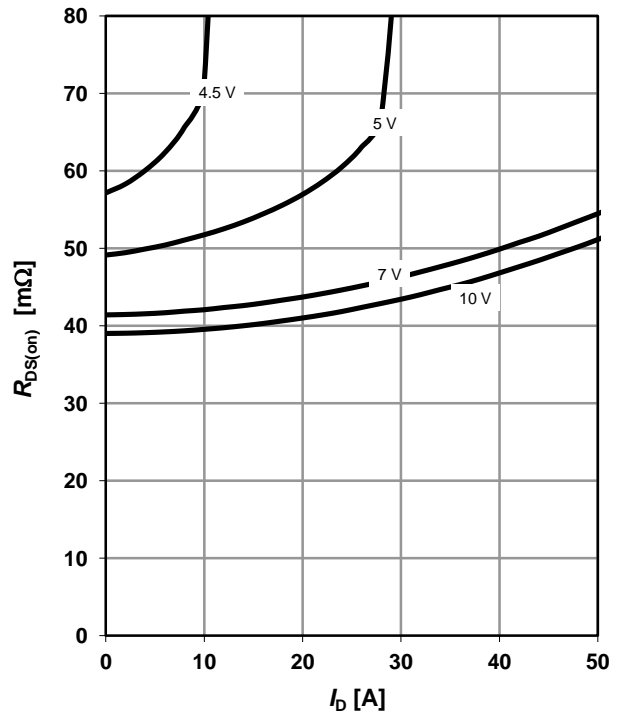
parameter: V_{GS}



6 Typ. drain-source on resistance

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

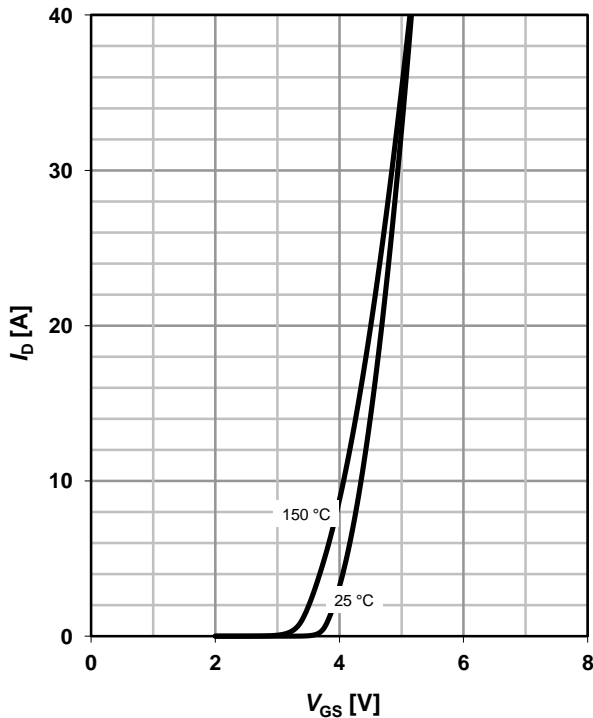
parameter: V_{GS}



7 Typ. transfer characteristics

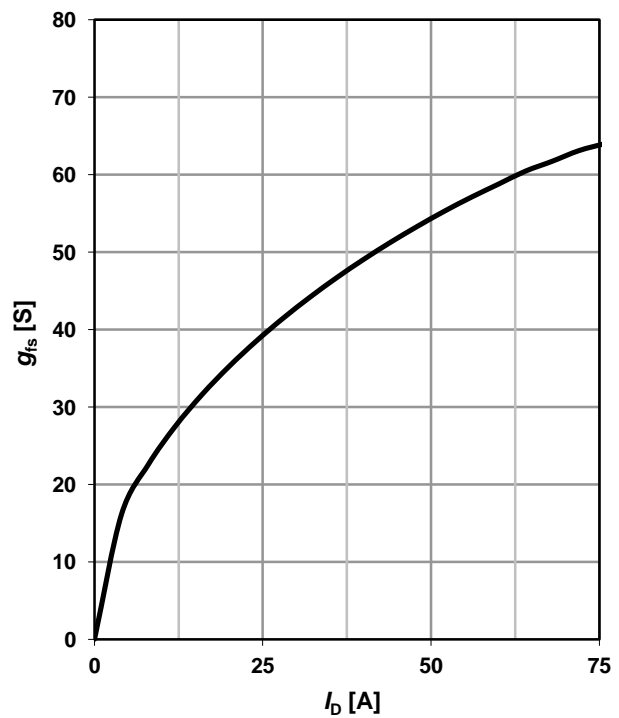
$I_D = f(V_{GS}); |V_{DS}| > 2|I_D|R_{DS(on)max}$

parameter: T_j



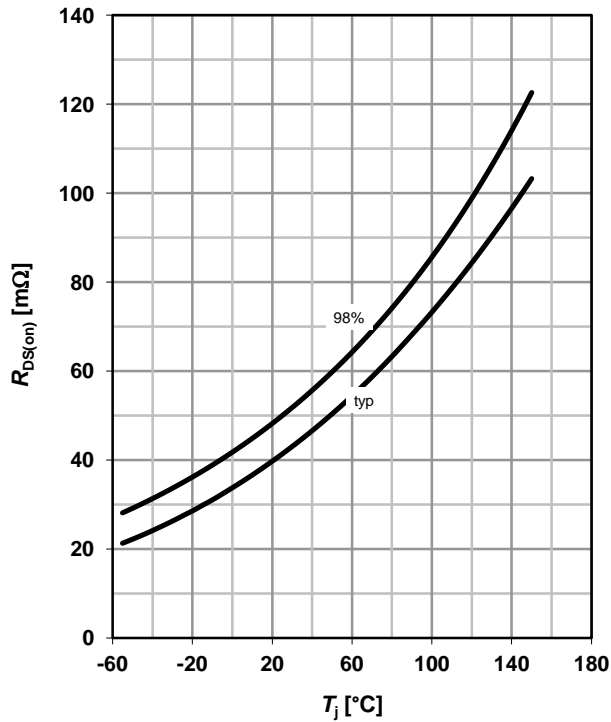
8 Typ. forward transconductance

$g_{fs} = f(I_D); T_j = 25\text{ °C}$



9 Drain-source on-state resistance

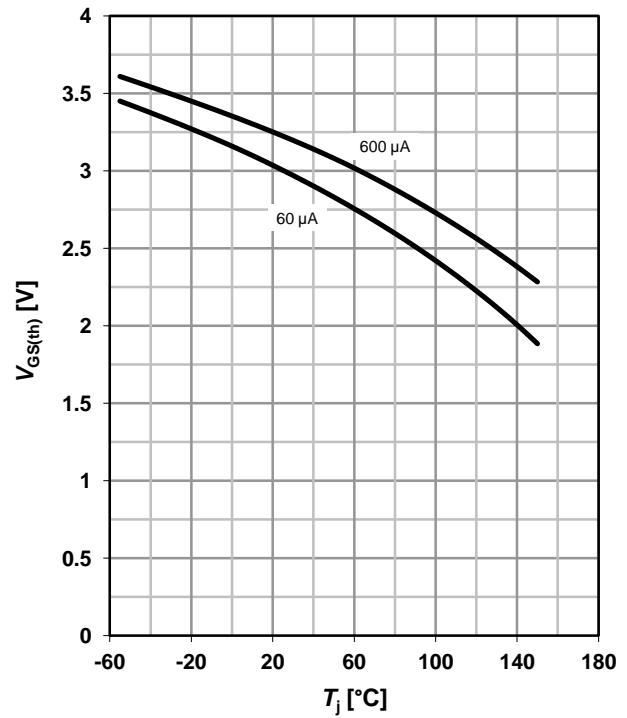
$R_{DS(on)}=f(T_j); I_D=22\text{ A}; V_{GS}=10\text{ V}$



10 Typ. gate threshold voltage

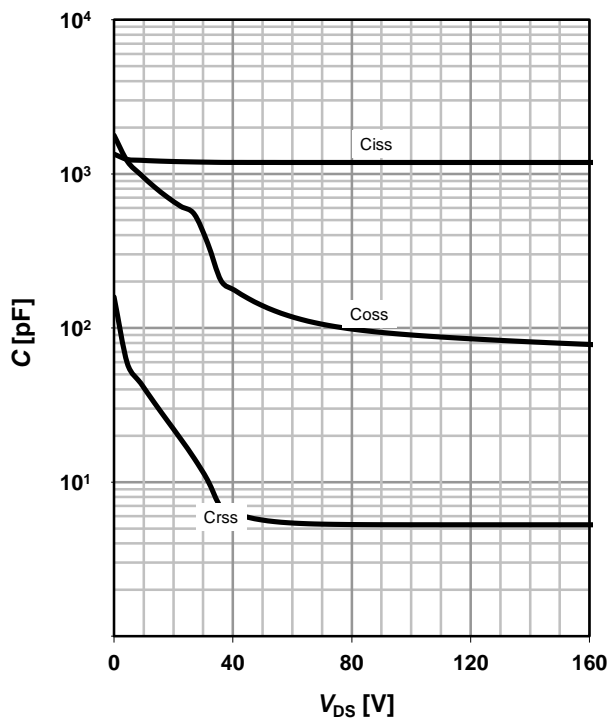
$V_{GS(th)}=f(T_j); V_{GS}=V_{DS}$

parameter: I_D



11 Typ. capacitances

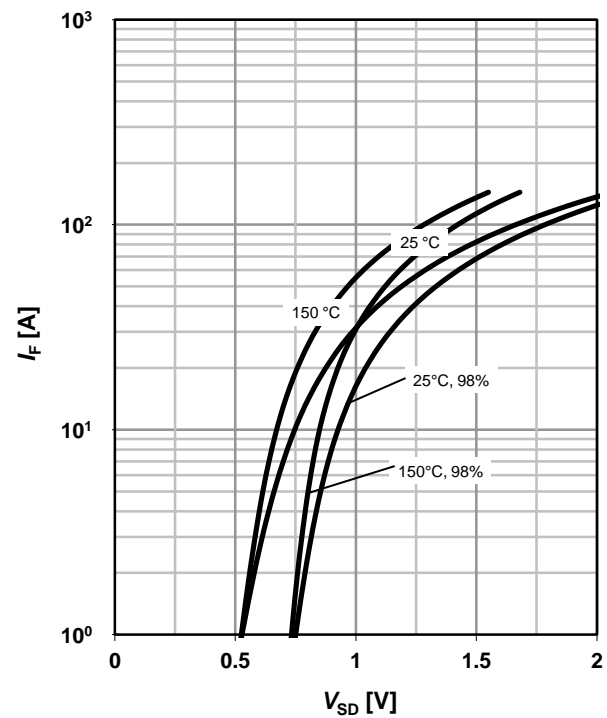
$C=f(V_{DS}); V_{GS}=0\text{ V}; f=1\text{ MHz}$



12 Forward characteristics of reverse diode

$I_F=f(V_{SD})$

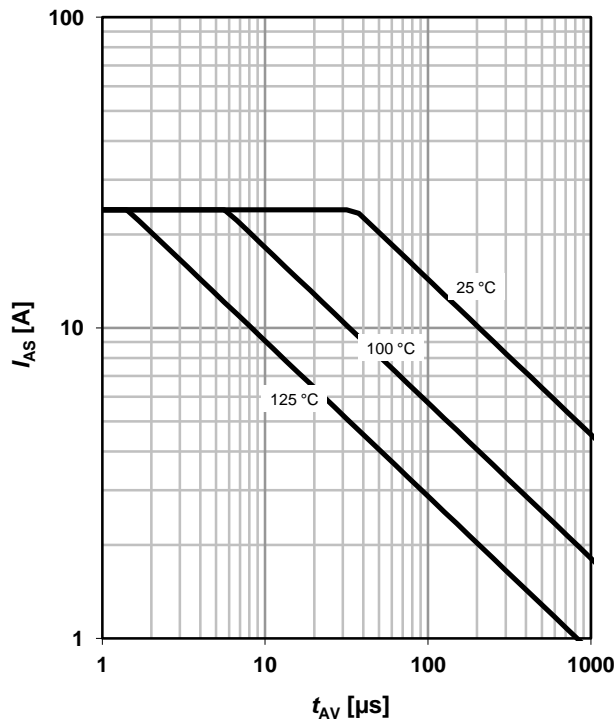
parameter: T_j



13 Avalanche characteristics

$I_{AS}=f(t_{AV}); R_{GS}=25 \Omega$

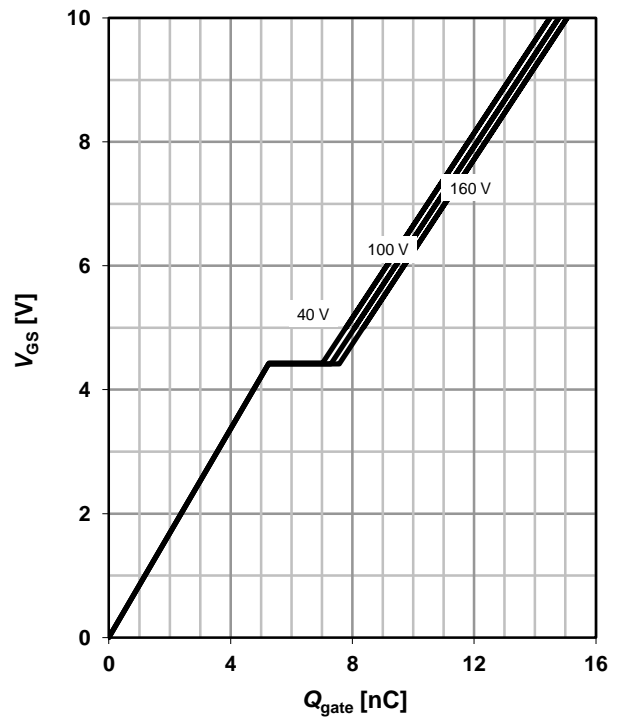
parameter: $T_{j(\text{start})}$



14 Typ. gate charge

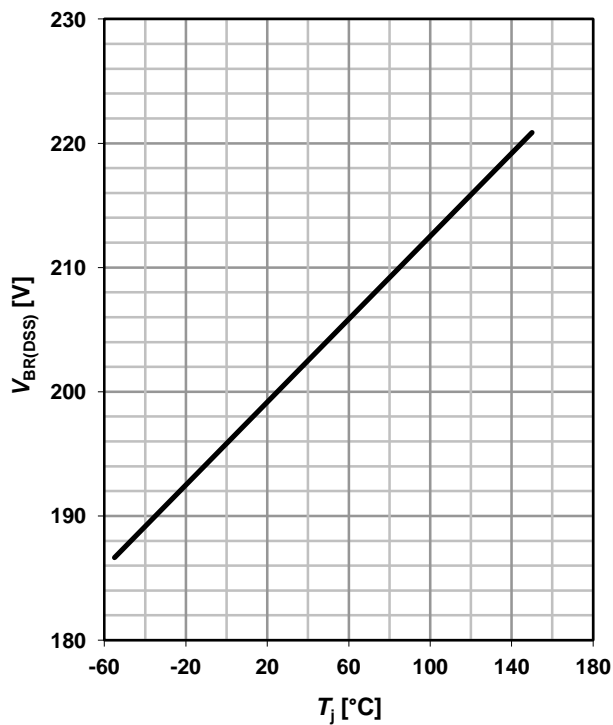
$V_{GS}=f(Q_{\text{gate}}); I_D=12 \text{ A pulsed}$

parameter: V_{DD}

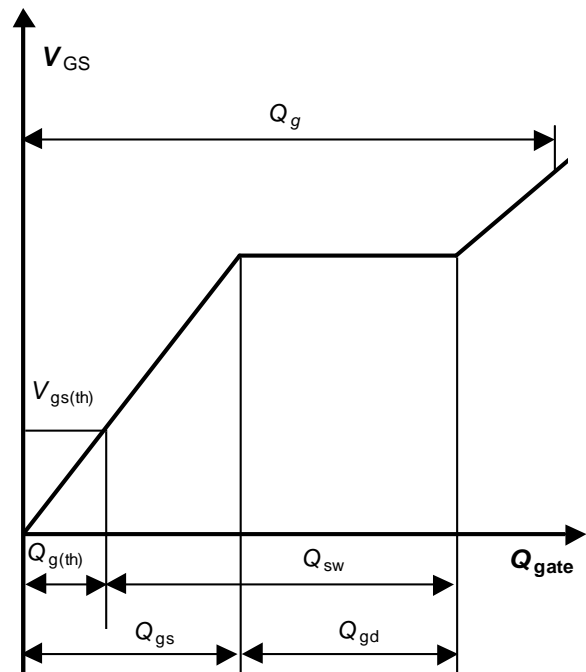


15 Drain-source breakdown voltage

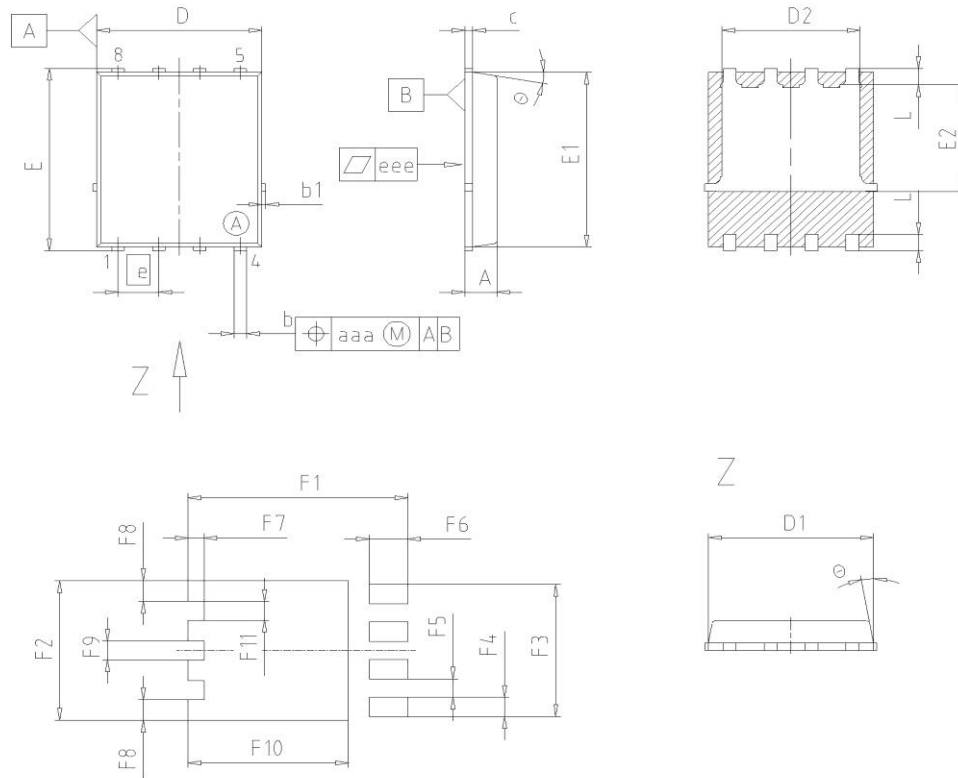
$V_{BR(DSS)}=f(T_j); I_D=1 \text{ mA}$



16 Gate charge waveforms



PG-TDSON-8: Outline



| DIM | MILLIMETERS | | INCHES | |
|------|-------------|-------|--------|-------|
| | MIN | MAX | MIN | MAX |
| A | 0.90 | 1.10 | 0.035 | 0.043 |
| b | 0.34 | 0.54 | 0.013 | 0.021 |
| b1 | 0.02 | 0.22 | 0.001 | 0.008 |
| c | 0.15 | 0.35 | 0.006 | 0.014 |
| D=D1 | 4.95 | 5.35 | 0.195 | 0.211 |
| D2 | 4.20 | 4.40 | 0.165 | 0.173 |
| E | 5.95 | 6.35 | 0.234 | 0.250 |
| E1 | 5.70 | 6.10 | 0.224 | 0.240 |
| E2 | 3.40 | 3.80 | 0.134 | 0.150 |
| e | 1.27 | | 0.050 | |
| N | 8 | | 8 | |
| L | 0.45 | 0.65 | 0.018 | 0.026 |
| □ | 8.5° | 11.5° | 8.5° | 11.5° |
| aaa | 0.25 | | 0.010 | |
| eee | 0.05 | | 0.002 | |
| F1 | 6.75 | 6.95 | 0.266 | 0.274 |
| F2 | 4.60 | 4.80 | 0.181 | 0.189 |
| F3 | 4.36 | 4.56 | 0.172 | 0.180 |
| F4 | 0.55 | 0.75 | 0.022 | 0.030 |
| F5 | 0.52 | 0.72 | 0.020 | 0.028 |
| F6 | 1.10 | 1.30 | 0.043 | 0.051 |
| F7 | 0.40 | 0.60 | 0.016 | 0.024 |
| F8 | 0.60 | 0.80 | 0.024 | 0.031 |
| F9 | 0.53 | 0.73 | 0.021 | 0.029 |
| F10 | 4.90 | 5.10 | 0.193 | 0.201 |
| F11 | 0.53 | 0.73 | 0.021 | 0.029 |

DOCUMENT NO.
Z8B00003332

SCALE 0 2.5 5mm

EUROPEAN PROJECTION

ISSUE DATE
08-03-2007

REVISION
03

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Infineon Technologies AG
81726 Munich, Germany
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