



**THE DATASHEET OF
IPB039N10N3GATMA1**




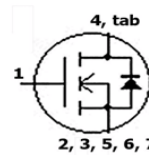
OptiMOS™ 3 Power-Transistor
Features

- N-channel, normal level
- Excellent gate charge x $R_{DS(on)}$ product (FOM)
- Very low on-resistance $R_{DS(on)}$
- High current capability
- 175 °C operating temperature
- Pb-free lead plating; RoHS compliant
- Qualified according to JEDEC¹⁾ for target application
- Halogen-free according to IEC61249-2-21

Product Summary

| | | |
|------------------|-----|------------|
| V_{DS} | 100 | V |
| $R_{DS(on),max}$ | 3.9 | m Ω |
| I_D | 160 | A |

| | |
|----------------|---|
| Type | IPB039N10N3 G |
| |  |
| Package | PG-TO263-7 |
| Marking | 039N10N |



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

| Parameter | Symbol | Conditions | Value | Unit |
|-------------------------------------|-------------------|--|-------------|------|
| Continuous drain current | I_D | $T_C=25\text{ °C}^{2)}$ | 160 | A |
| | | $T_C=100\text{ °C}$ | 113 | |
| Pulsed drain current ²⁾ | $I_{D,pulse}$ | $T_C=25\text{ °C}$ | 640 | |
| Avalanche energy, single pulse | E_{AS} | $I_D=100\text{ A}$, $R_{GS}=25\ \Omega$ | 340 | mJ |
| Gate source voltage | V_{GS} | | ± 20 | V |
| Power dissipation | P_{tot} | $T_C=25\text{ °C}$ | 214 | W |
| Operating and storage temperature | T_j , T_{stg} | | -55 ... 175 | °C |
| IEC climatic category; DIN IEC 68-1 | | | 55/175/56 | |

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} | | - | - | 0.7 | K/W |
| Thermal resistance, junction - ambient | R_{thJA} | minimal footprint | - | - | 62 | |
| | | 6 cm ² cooling area ³⁾ | - | - | 40 | |

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

| | | | | | | |
|----------------------------------|---------------|---|-----|-----|-----|---------------|
| Drain-source breakdown voltage | $V_{(BR)DSS}$ | $V_{GS}=0\text{ V}, I_D=1\text{ mA}$ | 100 | - | - | V |
| Gate threshold voltage | $V_{GS(th)}$ | $V_{DS}=V_{GS}, I_D=160\text{ }\mu\text{A}$ | 2 | 2.7 | 3.5 | |
| Zero gate voltage drain current | I_{DSS} | $V_{DS}=100\text{ V}, V_{GS}=0\text{ V}, T_j=25\text{ }^\circ\text{C}$ | - | 0.1 | 1 | μA |
| | | $V_{DS}=100\text{ V}, V_{GS}=0\text{ V}, T_j=125\text{ }^\circ\text{C}$ | - | 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 | $R_{DS(on)}$ | $V_{GS}=10\text{ V}, I_D=100\text{ A}$ | - | 3.3 | 3.9 | m Ω |
| | | $V_{GS}=6\text{ V}, I_D=50\text{ A}$ | - | 4.1 | 7.1 | |
| Gate resistance | R_G | | - | 1.4 | - | Ω |
| Transconductance | g_{fs} | $ V_{DS} >2 I_D R_{DS(on)max}, I_D=100\text{ A}$ | 76 | 152 | - | 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} | $V_{GS}=0\text{ V}, V_{DS}=50\text{ V},$ $f=1\text{ MHz}$ | - | 6320 | 8410 | pF |
| Output capacitance | C_{oss} | | - | 1210 | 1610 | |
| Reverse transfer capacitance | C_{rss} | | - | 41 | - | |
| Turn-on delay time | $t_{d(on)}$ | $V_{DD}=50\text{ V}, V_{GS}=10\text{ V},$ $I_D=100\text{ A}, R_G=1.6\ \Omega$ | - | 27 | - | ns |
| Rise time | t_r | | - | 59 | - | |
| Turn-off delay time | $t_{d(off)}$ | | - | 48 | - | |
| Fall time | t_f | | - | 14 | - | |

Gate Charge Characteristics⁴⁾

| | | | | | | |
|-----------------------|---------------|---|---|-----|-----|----|
| Gate to source charge | Q_{gs} | $V_{DD}=50\text{ V}, I_D=100\text{ A},$ $V_{GS}=0\text{ to }10\text{ V}$ | - | 29 | 39 | nC |
| Gate to drain charge | Q_{gd} | | - | 16 | - | |
| Switching charge | Q_{sw} | | - | 26 | - | |
| Gate charge total | Q_g | | - | 88 | 117 | |
| Gate plateau voltage | $V_{plateau}$ | | - | 4.6 | - | V |
| Output charge | Q_{oss} | $V_{DD}=50\text{ V}, V_{GS}=0\text{ V}$ | - | 122 | 162 | nC |

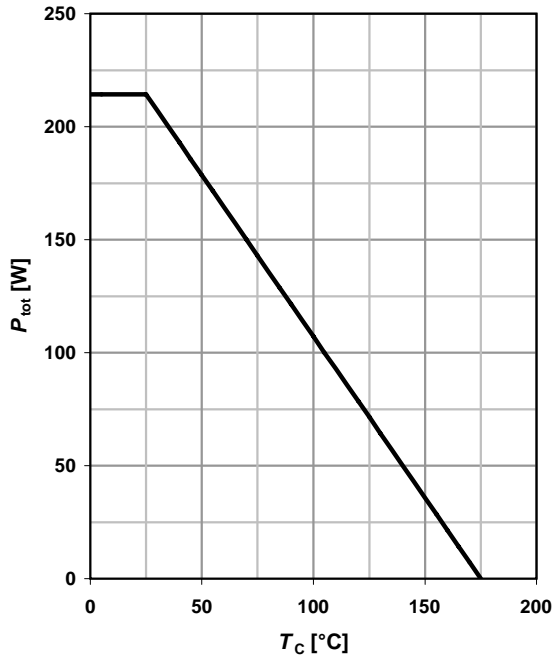
Reverse Diode

| | | | | | | |
|----------------------------------|---------------|--|---|-----|-----|----|
| Diode continuous forward current | I_S | $T_C=25\text{ }^\circ\text{C}$ | - | - | 160 | A |
| Diode pulse current | $I_{S,pulse}$ | | - | - | 640 | |
| Diode forward voltage | V_{SD} | $V_{GS}=0\text{ V}, I_F=100\text{ A},$ $T_j=25\text{ }^\circ\text{C}$ | - | 1 | 1.2 | V |
| Reverse recovery time | t_{rr} | $V_R=50\text{ V}, I_F=100\text{ A},$ $di_F/dt=100\text{ A}/\mu\text{s}$ | - | 68 | - | ns |
| Reverse recovery charge | Q_{rr} | | - | 135 | - | nC |

⁴⁾ See figure 16 for gate charge parameter definition

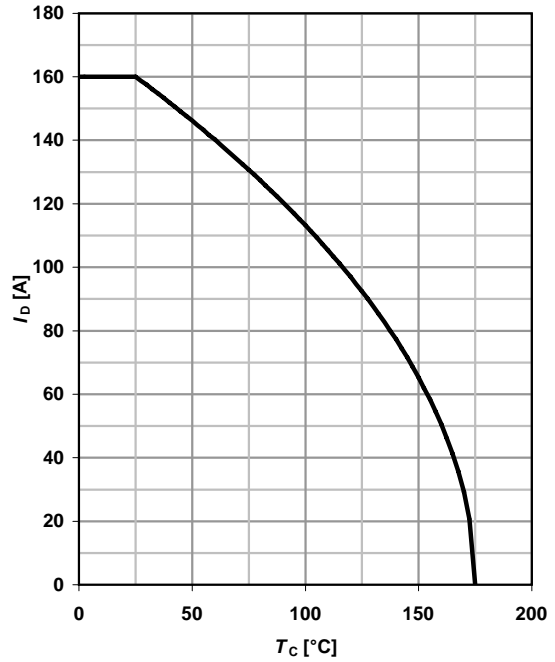
1 Power dissipation

$P_{tot}=f(T_C)$



2 Drain current

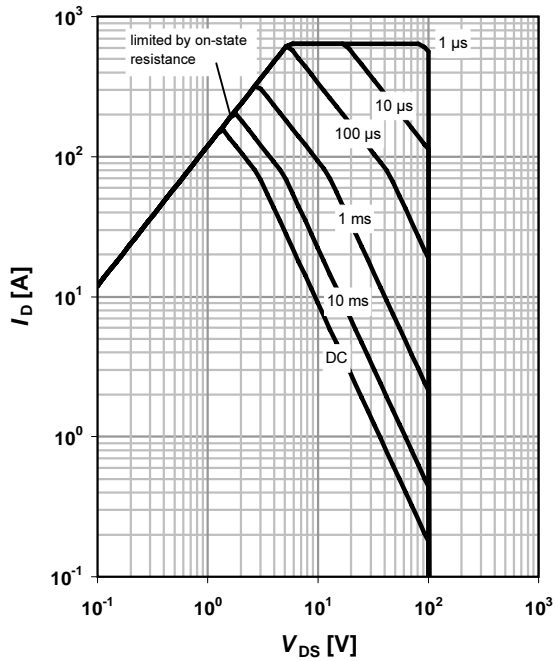
$I_D=f(T_C); V_{GS} \geq 10\text{ V}$



3 Safe operating area

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

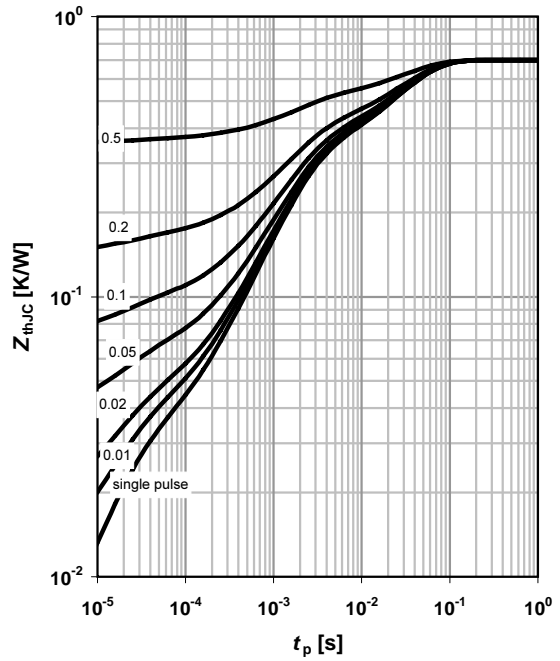
parameter: t_p



4 Max. transient thermal impedance

$Z_{thJC}=f(t_p)$

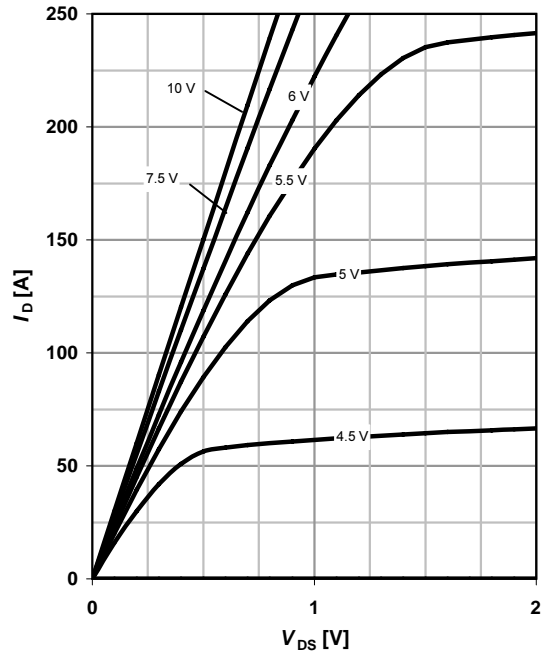
parameter: $D=t_p/T$



5 Typ. output characteristics

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

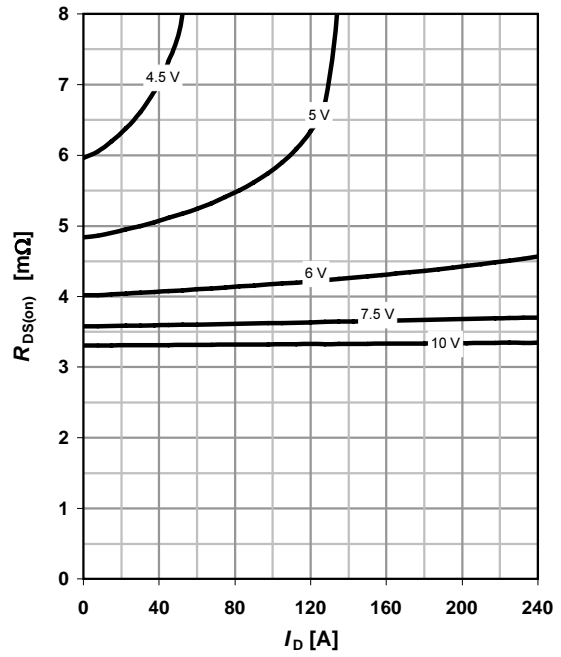
parameter: V_{GS}



6 Typ. drain-source on resistance

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

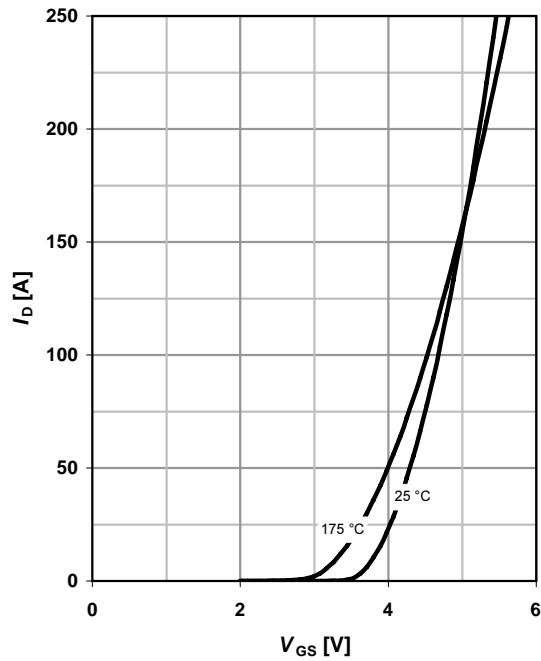
parameter: V_{GS}



7 Typ. transfer characteristics

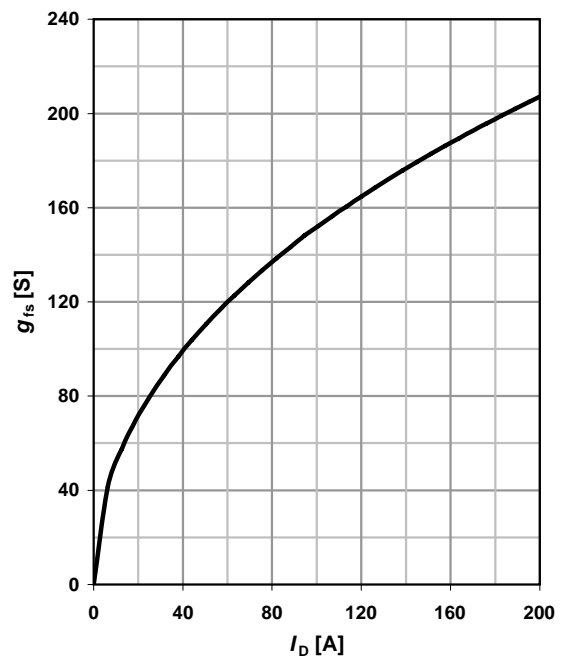
$I_D = f(V_{GS}); |V_{DS}| > 2|I_D|R_{DS(on)max}$

parameter: T_j



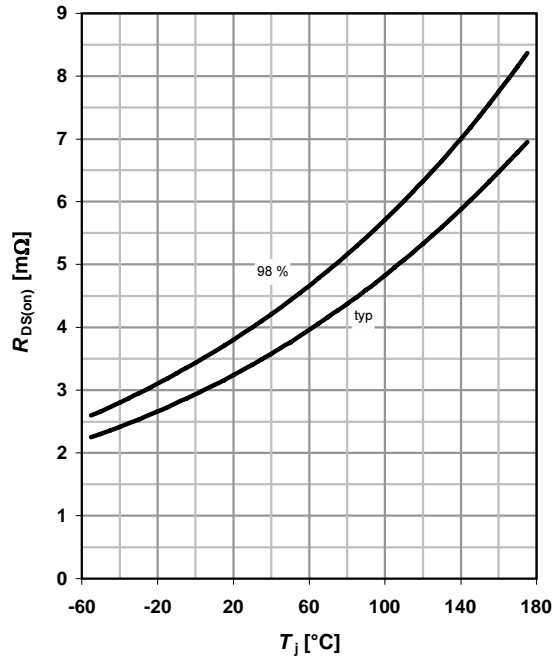
8 Typ. forward transconductance

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



9 Drain-source on-state resistance

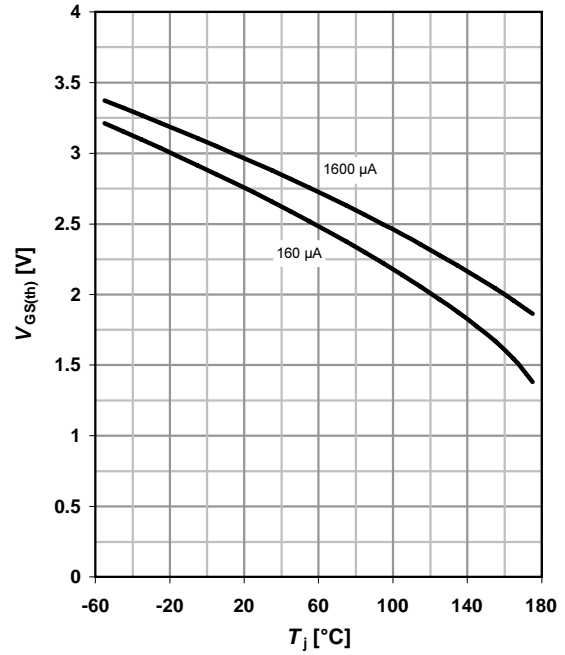
$$R_{DS(on)} = f(T_j); I_D = 100 \text{ A}; V_{GS} = 10 \text{ V}$$



10 Typ. gate threshold voltage

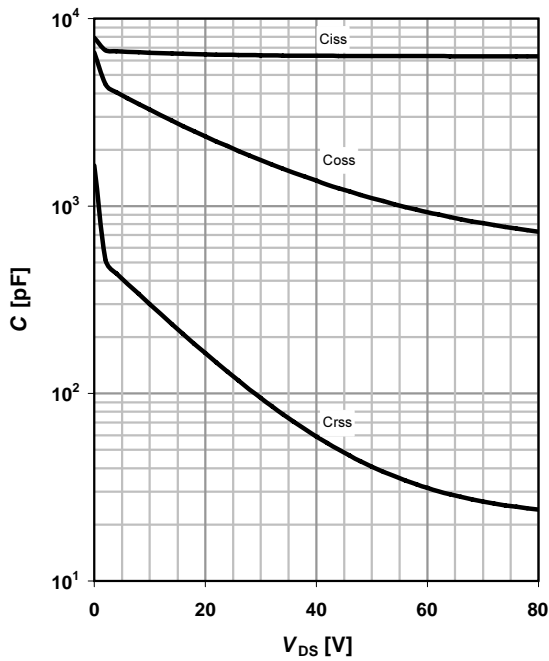
$$V_{GS(th)} = f(T_j); V_{GS} = V_{DS}$$

parameter: I_D



11 Typ. capacitances

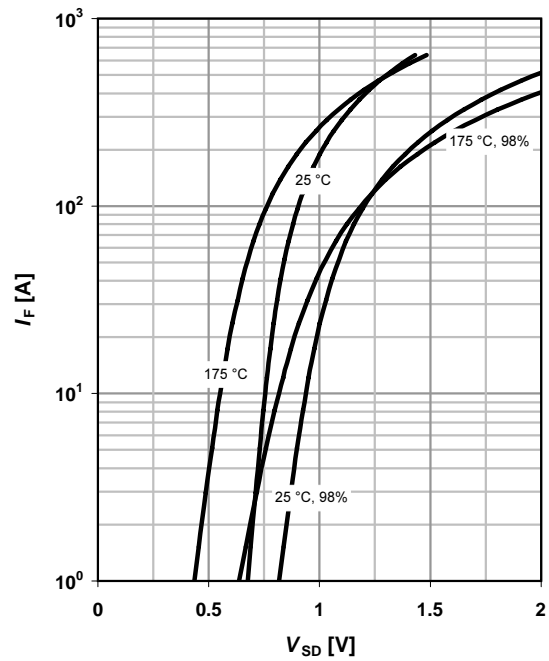
$$C = f(V_{DS}); V_{GS} = 0 \text{ V}; f = 1 \text{ MHz}$$



12 Forward characteristics of reverse diode

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

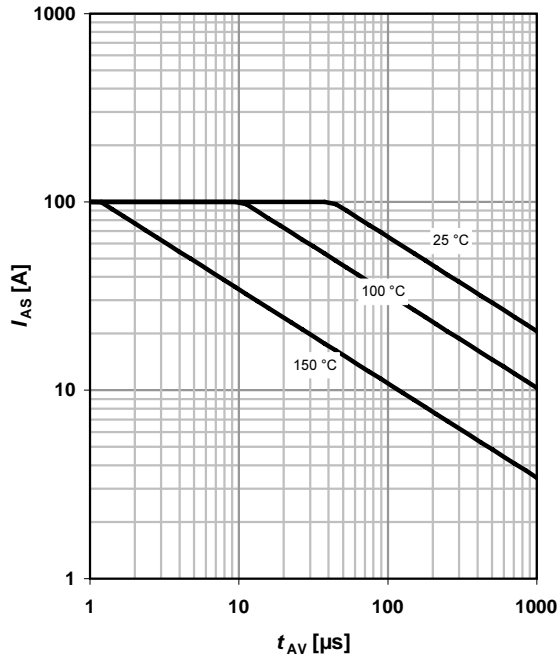
parameter: T_j



13 Avalanche characteristics

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

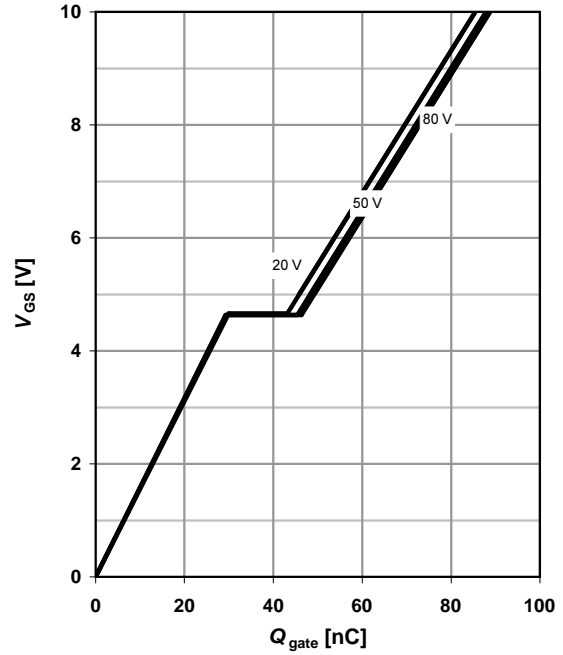
parameter: $T_{j(start)}$



14 Typ. gate charge

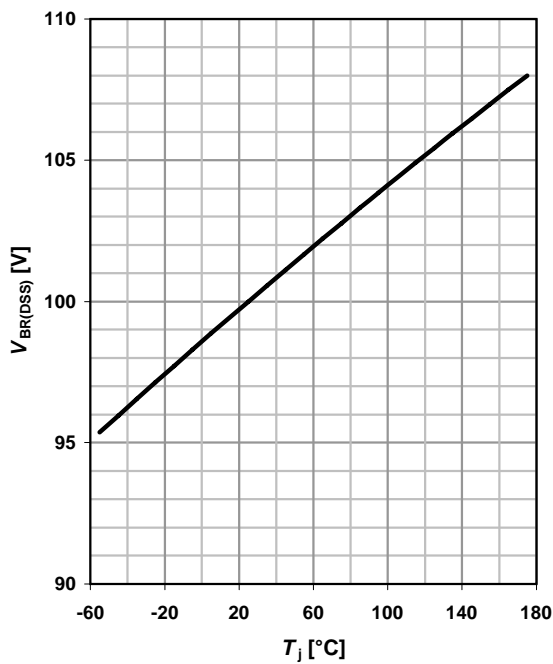
$V_{GS}=f(Q_{gate}); I_D=100 \text{ A pulsed}$

parameter: V_{DD}

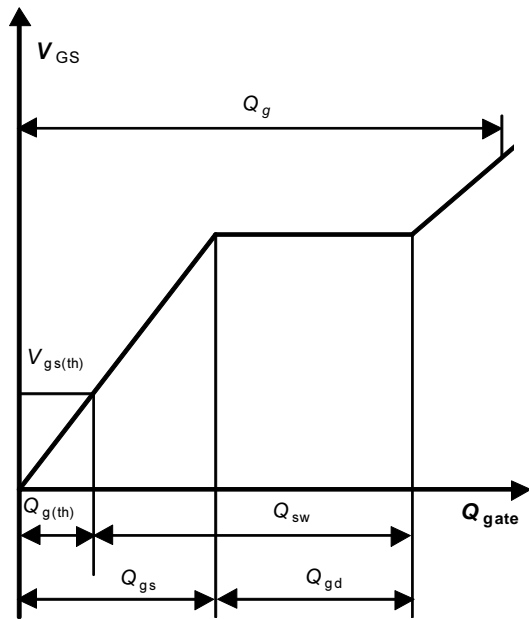


15 Drain-source breakdown voltage

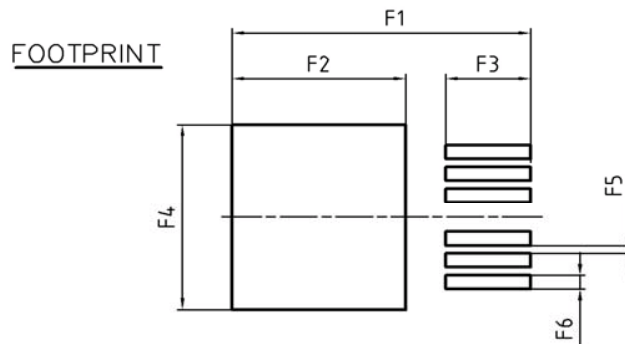
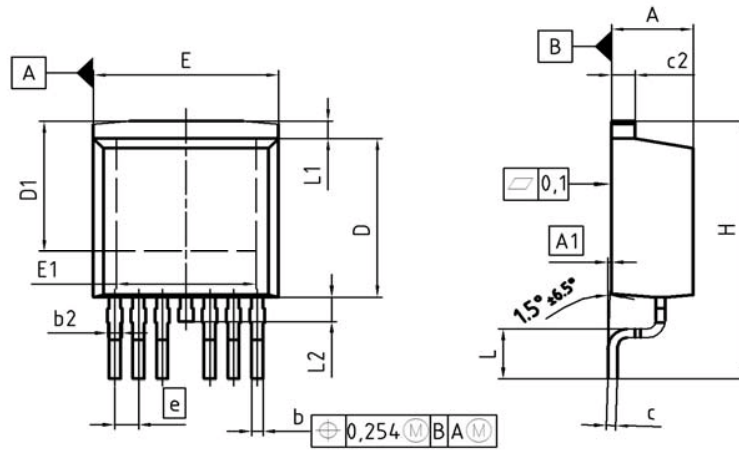
$V_{BR(DSS)}=f(T_j); I_D=1 \text{ mA}$



16 Gate charge waveforms



PG-TO263-3: Outline



| DIM | MILLIMETERS | | INCHES | |
|-----|-------------|-------|--------|-------|
| | MIN | MAX | MIN | MAX |
| A | 4.30 | 4.57 | 0.169 | 0.180 |
| A1 | 0.00 | 0.25 | 0.000 | 0.010 |
| b | 0.50 | 0.70 | 0.020 | 0.028 |
| b2 | 0.50 | 1.00 | 0.020 | 0.039 |
| c | 0.33 | 0.65 | 0.013 | 0.026 |
| c2 | 1.17 | 1.40 | 0.046 | 0.055 |
| D | 8.51 | 9.45 | 0.335 | 0.372 |
| D1 | 6.90 | 7.90 | 0.272 | 0.311 |
| E | 9.80 | 10.31 | 0.386 | 0.406 |
| E1 | 6.50 | 8.60 | 0.256 | 0.339 |
| e | 1.27 | | 0.050 | |
| N | 6 | | 6 | |
| H | 14.61 | 15.88 | 0.575 | 0.625 |
| L | 2.29 | 3.00 | 0.090 | 0.118 |
| L1 | 0.70 | 1.60 | 0.028 | 0.063 |
| L2 | 1.00 | 1.78 | 0.039 | 0.070 |
| F1 | 16.05 | 16.25 | 0.632 | 0.640 |
| F2 | 9.30 | 9.50 | 0.366 | 0.374 |
| F3 | 4.50 | 4.70 | 0.177 | 0.185 |
| F4 | 10.70 | 10.90 | 0.421 | 0.429 |
| F5 | 0.37 | 0.57 | 0.015 | 0.022 |
| F6 | 0.70 | 0.90 | 0.028 | 0.035 |

DOCUMENT NO.
Z8B00134765

SCALE

EUROPEAN PROJECTION

ISSUE DATE
05-11-2007

REVISION
01

Published by
Infineon Technologies AG
81726 Munich, Germany
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