

MOSFET

Metal Oxide Semiconductor Field Effect Transistor

OptiMOS™ Power-Transistor, 120V

OptiMOS™ 3 Power-Transistor
IPD_S110N12N3 G

Data Sheet

Rev. 2.4
Final

Industrial & Multimarket

OptiMOS™3 Power-Transistor
Features

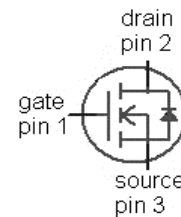
- N-channel, normal level
- Excellent gate charge x $R_{DS(on)}$ product (FOM)
- Very low on-resistance $R_{DS(on)}$
- 175 °C operating temperature
- Pb-free lead plating; RoHS compliant
- Qualified according to JEDEC¹⁾ for target application
- Halogen free according to IEC61249-2-21 *
- Ideal for high-frequency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

Product Summary

| | | |
|------------------|-----|----|
| V_{DS} | 120 | V |
| $R_{DS(on),max}$ | 11 | mΩ |
| I_D | 75 | A |



| Type | IPS110N12N3 G | IPD110N12N3 G |
|----------------|---------------|---------------|
| | | |
| Package | PG-TO251-3 | PG-TO252-3 |
| Marking | 110N12N | 110N12N |


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

| Parameter | Symbol | Conditions | Value | Unit |
|-------------------------------------|----------------|--|-------------|------|
| Continuous drain current | I_D | $T_C=25\text{ °C}$ | 75 | A |
| | | $T_C=100\text{ °C}$ | 54 | |
| Pulsed drain current ²⁾ | $I_{D,pulse}$ | $T_C=25\text{ °C}$ | 300 | |
| Avalanche energy, single pulse | E_{AS} | $I_D=75\text{ A}, R_{GS}=25\text{ }\Omega$ | 120 | mJ |
| Gate source voltage ³⁾ | V_{GS} | | ± 20 | V |
| | P_{tot} | $T_C=25\text{ °C}$ | 136 | 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

³⁾ $T_{jmax}=150\text{ °C}$ and duty cycle $D=0.01$ for $V_{gs}<-5V$

* Except package TO251-3

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

Thermal characteristics

| | | | | | | |
|--|------------|--|---|---|-----|-----|
| Thermal resistance, junction - case | R_{thJC} | | - | - | 1.1 | K/W |
| Thermal resistance, junction - ambient | R_{thJA} | minimal footprint | - | - | 75 | |
| | | 6 cm ² cooling area ⁴⁾ | - | - | 50 | |

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

| | | | | | | |
|----------------------------------|---------------|---|-----|-----|-----|---------------|
| Drain-source breakdown voltage | $V_{(BR)DSS}$ | $V_{GS}=0\text{ V}, I_D=1\text{ mA}$ | 120 | - | - | V |
| Gate threshold voltage | $V_{GS(th)}$ | $V_{DS}=V_{GS}, I_D=83\text{ }\mu\text{A}$ | 2 | 3 | 4 | |
| Zero gate voltage drain current | I_{DSS} | $V_{DS}=100\text{ V}, V_{GS}=0\text{ V}, T_j=25\text{ °C}$ | - | 0.1 | 1 | μA |
| | | $V_{DS}=100\text{ V}, V_{GS}=0\text{ V}, T_j=125\text{ °C}$ | - | 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 | $R_{DS(on)}$ | $V_{GS}=10\text{ V}, I_D=75\text{ A}$ | - | 9.2 | 11 | m Ω |
| Gate resistance | R_G | | - | 1.5 | - | Ω |
| Transconductance | g_{fs} | $ V_{DS} >2 I_D R_{DS(on)max}, I_D=75\text{ A}$ | 42 | 83 | - | S |

⁴⁾ 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 characteristics⁶⁾

| | | | | | | |
|------------------------------|--------------|---|---|------|------|----|
| Input capacitance | C_{iss} | $V_{GS}=0\text{ V}, V_{DS}=60\text{ V},$ $f=1\text{ MHz}$ | - | 3240 | 4310 | pF |
| Output capacitance | C_{oss} | | - | 408 | 543 | |
| Reverse transfer capacitance | C_{rss} | | - | 22 | - | |
| Turn-on delay time | $t_{d(on)}$ | $V_{DD}=60\text{ V}, V_{GS}=10\text{ V},$ $I_D=75\text{ A}, R_{G,ext}=1.6\ \Omega$ | - | 16 | - | ns |
| Rise time | t_r | | - | 16 | - | |
| Turn-off delay time | $t_{d(off)}$ | | - | 24 | - | |
| Fall time | t_f | | - | 8 | - | |

Gate Charge Characteristics⁵⁾

| | | | | | | |
|---------------------------------|---------------|--|---|-----|----|----|
| Gate to source charge | Q_{gs} | $V_{DD}=60\text{ V}, I_D=75\text{ A},$ $V_{GS}=0\text{ to }10\text{ V}$ | - | 18 | - | nC |
| Gate to drain charge | Q_{gd} | | - | 12 | - | |
| Switching charge | Q_{sw} | | - | 20 | - | |
| Gate charge total ⁶⁾ | Q_g | | - | 49 | 65 | |
| Gate plateau voltage | $V_{plateau}$ | | - | 5.6 | - | V |
| Output charge ⁶⁾ | Q_{oss} | $V_{DD}=60\text{ V}, V_{GS}=0\text{ V}$ | - | 56 | 75 | nC |

Reverse Diode

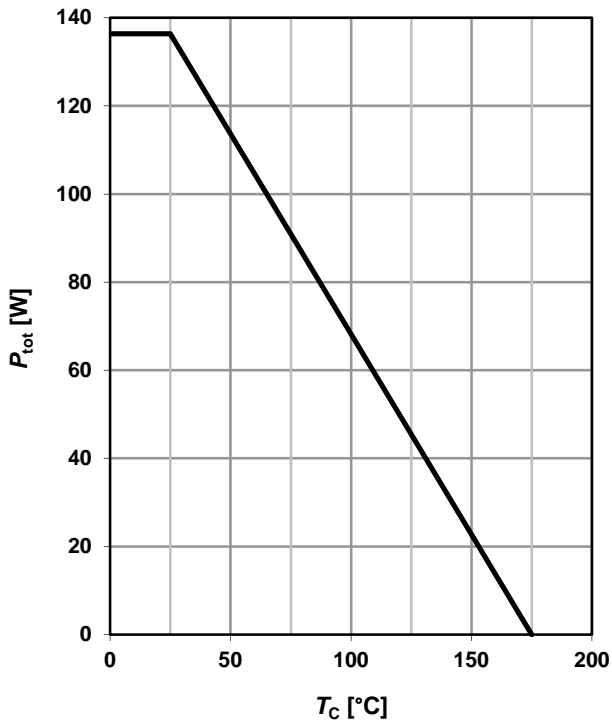
| | | | | | | |
|----------------------------------|---------------|---|---|-----|-----|----|
| Diode continuous forward current | I_S | $T_C=25\text{ }^\circ\text{C}$ | - | - | 75 | A |
| Diode pulse current | $I_{S,pulse}$ | | - | - | 300 | |
| Diode forward voltage | V_{SD} | $V_{GS}=0\text{ V}, I_F=75\text{ A},$ $T_J=25\text{ }^\circ\text{C}$ | - | 1 | 1.2 | V |
| Reverse recovery charge | t_{rr} | $V_R=60\text{ V}, I_F=I_S,$ $di_F/dt=100\text{ A}/\mu\text{s}$ | - | 90 | | ns |
| | Q_{rr} | | - | 249 | | nC |

⁵⁾ See figure 16 for gate charge parameter definition

⁶⁾ Defined by design. Not subject to production test

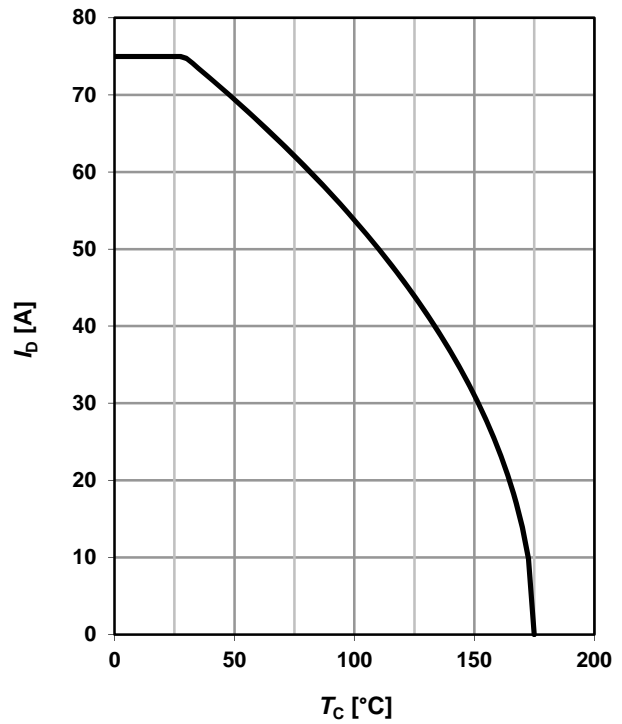
1 Power dissipation

$$P_{tot}=f(T_C)$$



2 Drain current

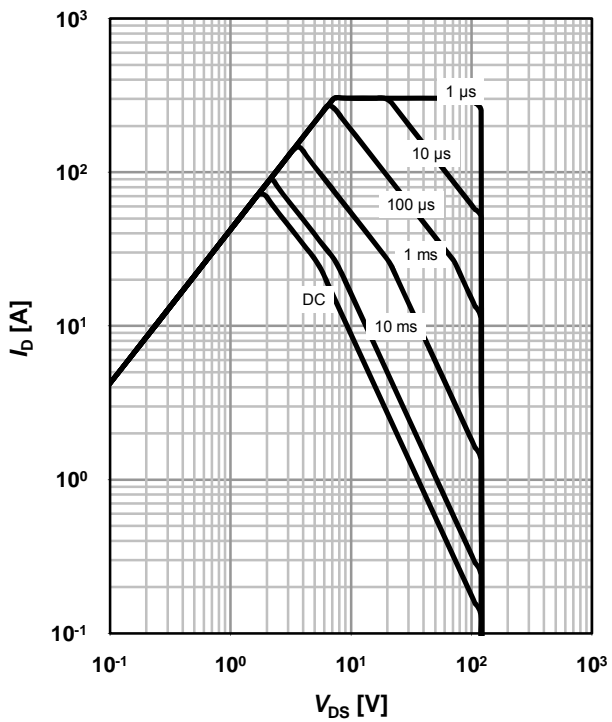
$$I_D=f(T_C); V_{GS} \geq 10 \text{ V}$$



3 Safe operating area

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

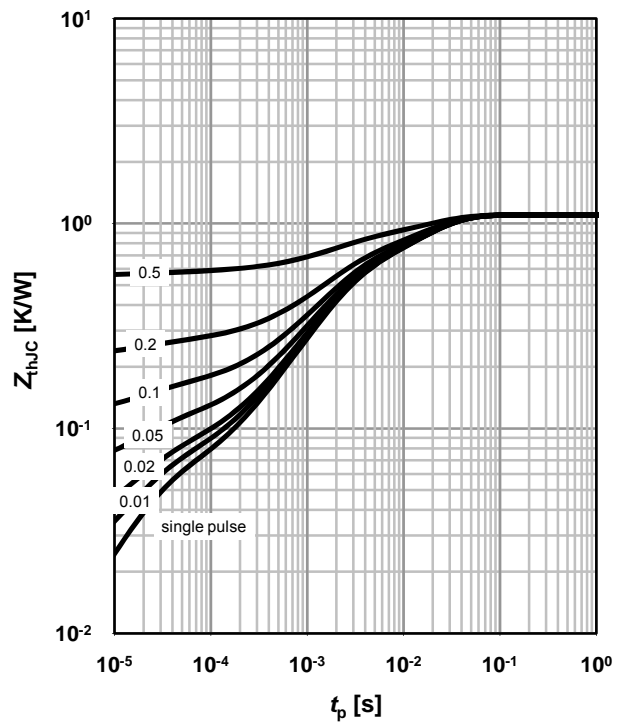
parameter: t_p



4 Max. transient thermal impedance

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

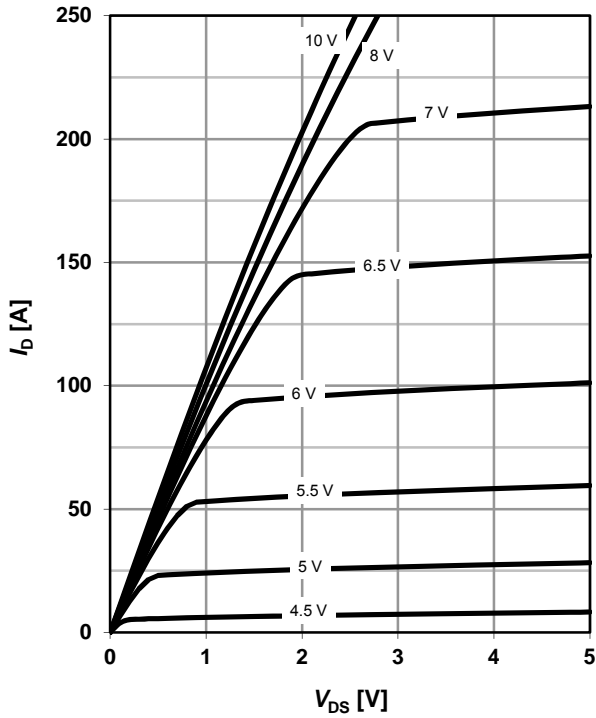
parameter: $D=t_p/T$



5 Typ. output characteristics

$I_D = f(V_{DS}); T_j = 25\text{ °C}$

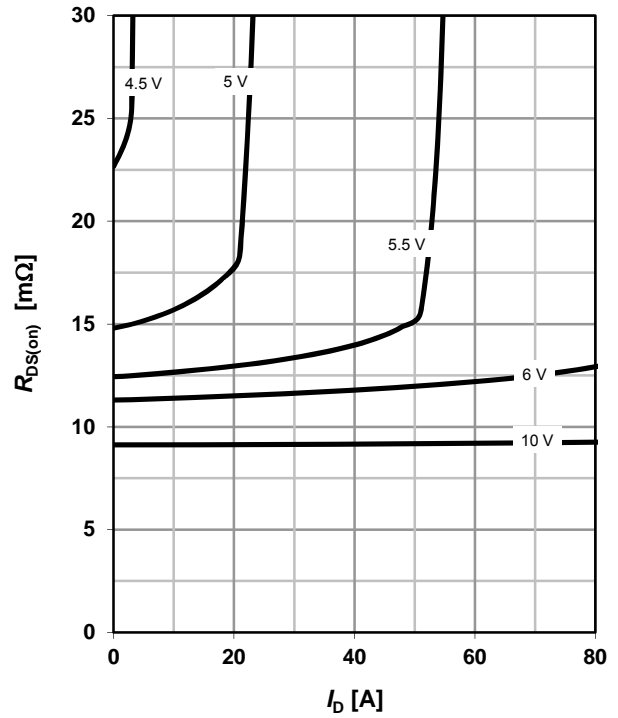
parameter: V_{GS}



6 Typ. drain-source on resistance

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

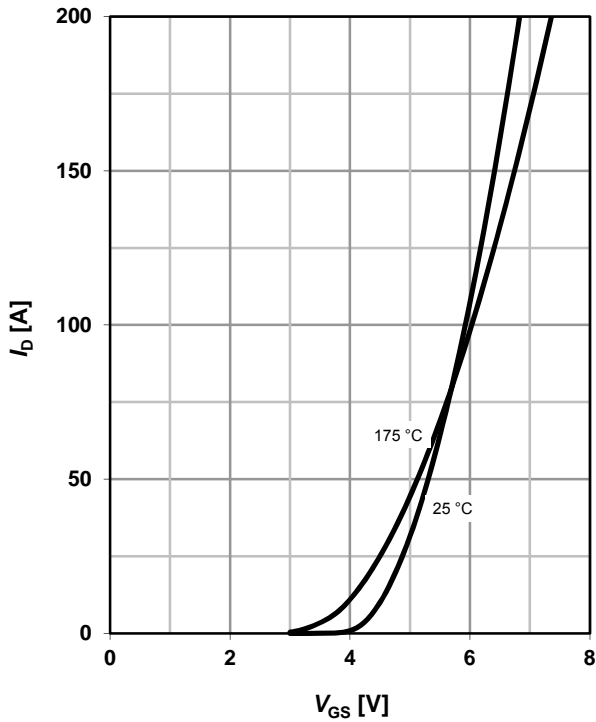
parameter: V_{GS}



7 Typ. transfer characteristics

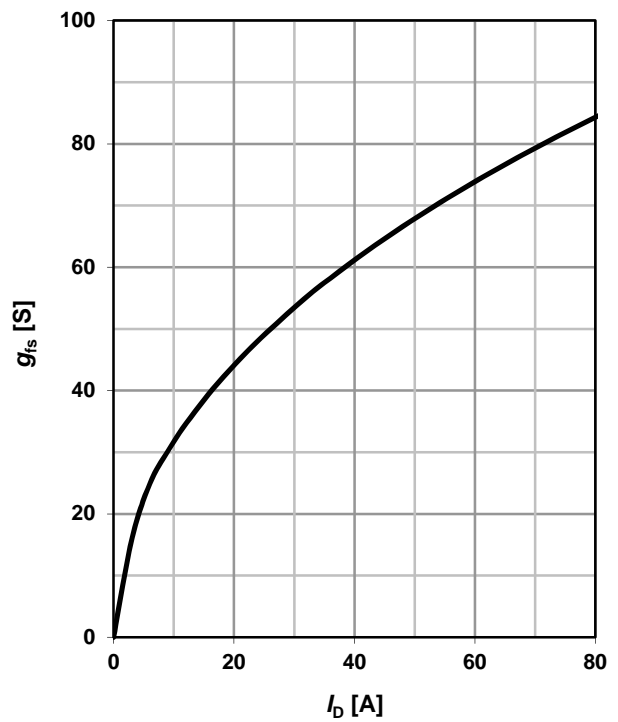
$I_D = f(V_{GS}); |V_{DS}| > 2|I_D|R_{DS(on)max}$

parameter: T_j



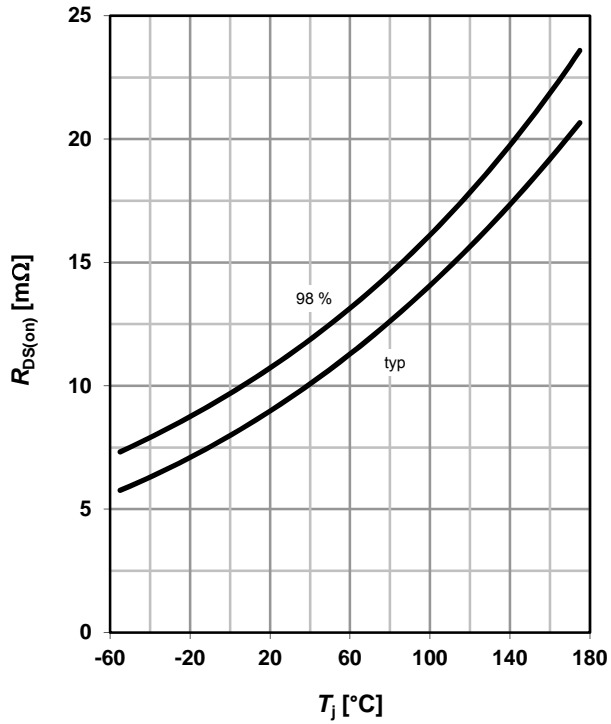
8 Typ. forward transconductance

$g_{fs} = f(I_D); T_j = 25\text{ °C}$



9 Drain-source on-state resistance

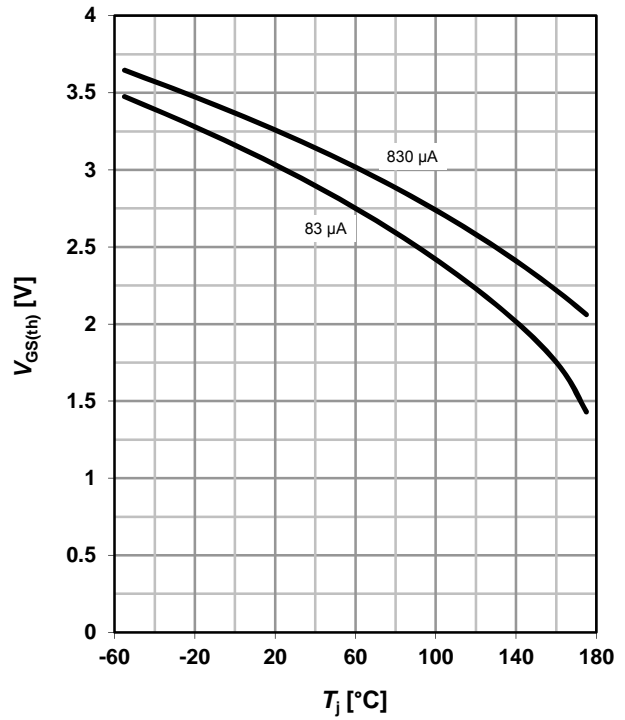
$R_{DS(on)}=f(T_j); I_D=75\text{ A}; V_{GS}=10\text{ V}$



10 Typ. gate threshold voltage

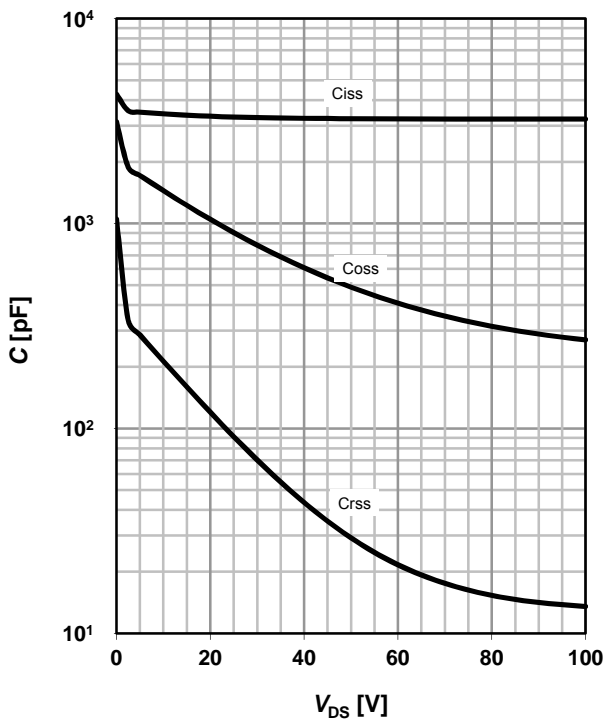
$V_{GS(th)}=f(T_j); V_{GS}=V_{DS}$

parameter: I_D



11 Typ. capacitances

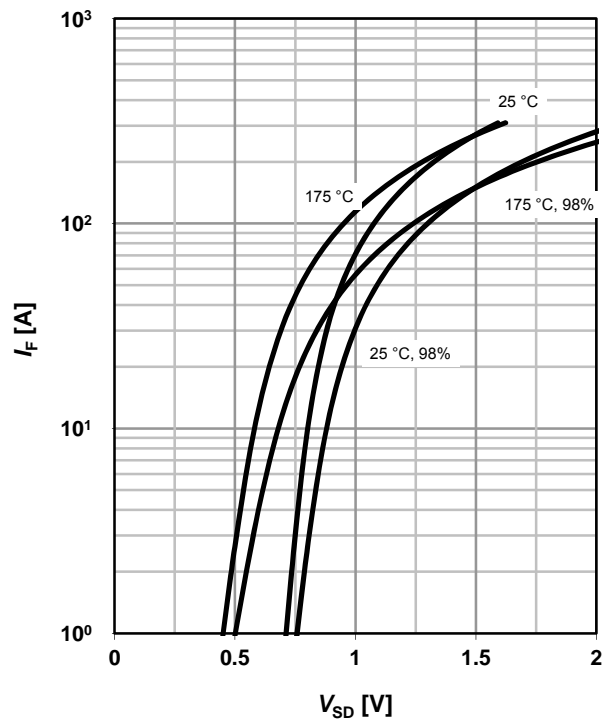
$C=f(V_{DS}); V_{GS}=0\text{ V}; f=1\text{ MHz}$



12 Forward characteristics of reverse diode

$I_F=f(V_{SD})$

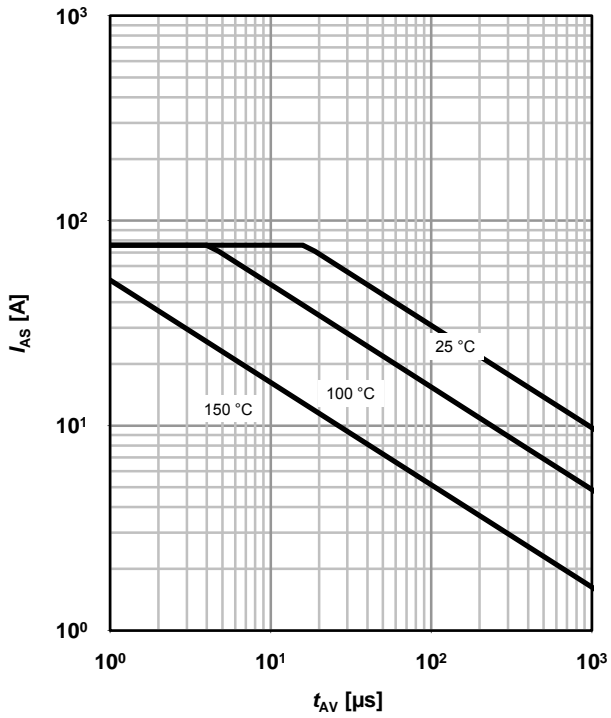
parameter: T_j



13 Avalanche characteristics

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

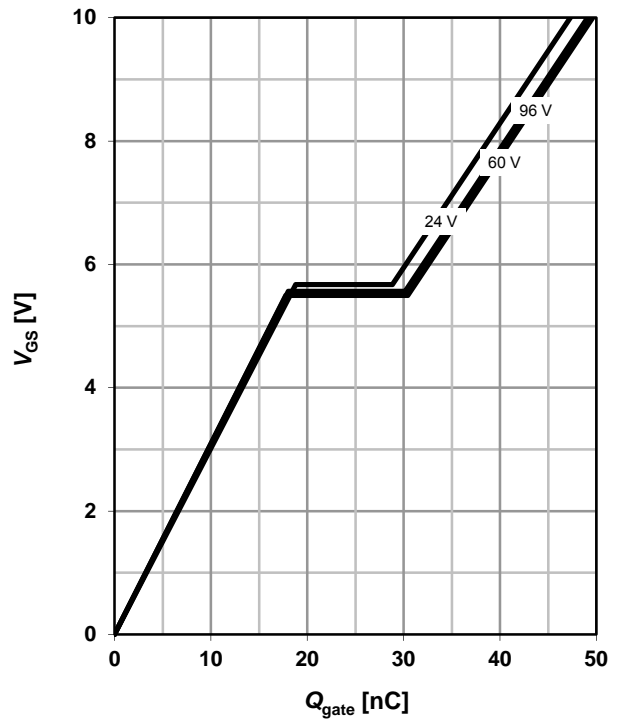
parameter: $T_{j(start)}$



14 Typ. gate charge

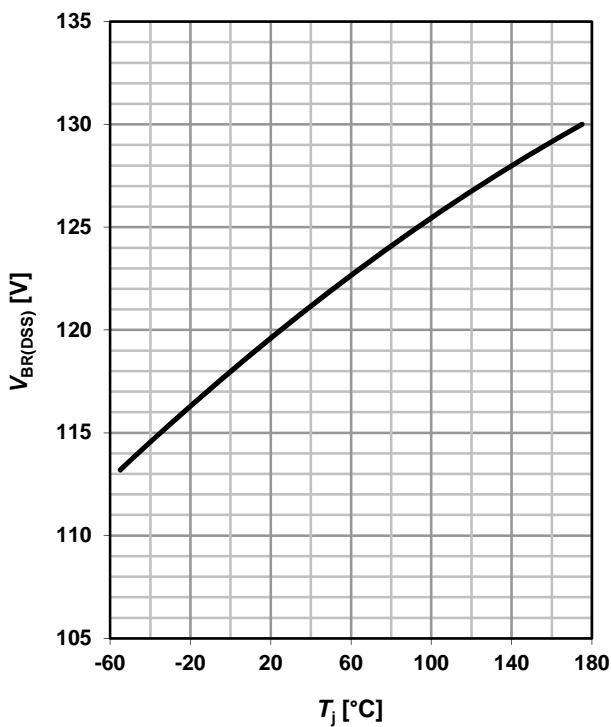
$V_{GS}=f(Q_{gate}); I_D=67 \text{ A pulsed}$

parameter: V_{DD}

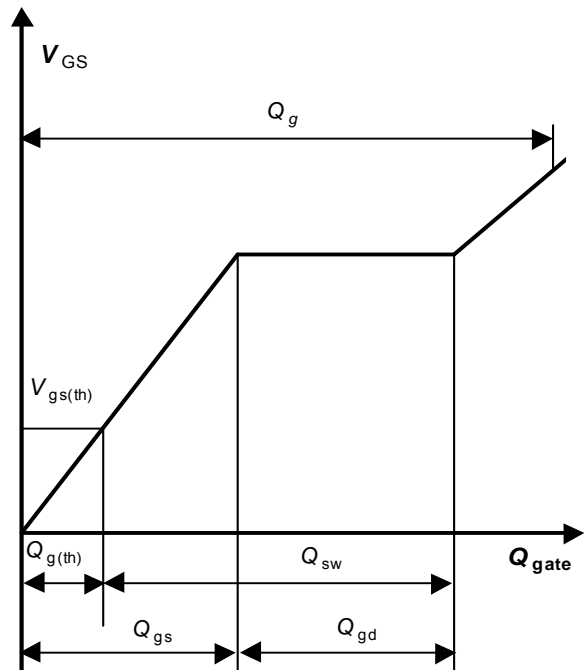


15 Drain-source breakdown voltage

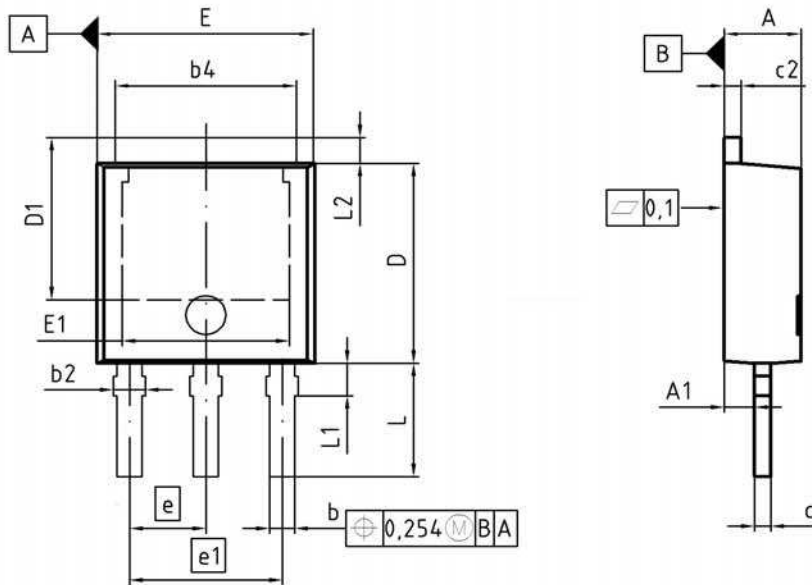
$V_{BR(DSS)}=f(T_j); I_D=1 \text{ mA}$



16 Gate charge waveforms



PG-TO-251SL : Outline



| DIM | MILLIMETERS | | INCHES | |
|-----|-------------|------|--------|-------|
| | MIN | MAX | MIN | MAX |
| A | 2.18 | 2.39 | 0.086 | 0.094 |
| A1 | 0.80 | 1.14 | 0.031 | 0.045 |
| b | 0.64 | 0.89 | 0.025 | 0.035 |
| b2 | 0.65 | 1.15 | 0.026 | 0.045 |
| b4 | 4.95 | 5.50 | 0.195 | 0.217 |
| c | 0.46 | 0.58 | 0.018 | 0.023 |
| c2 | 0.46 | 0.89 | 0.018 | 0.035 |
| D | 5.97 | 6.22 | 0.235 | 0.245 |
| D1 | 5.04 | 5.44 | 0.198 | 0.214 |
| E | 6.35 | 6.73 | 0.250 | 0.265 |
| E1 | 4.90 | 5.10 | 0.193 | 0.201 |
| e | 2.29 | | 0.090 | |
| e1 | 4.57 | | 0.180 | |
| N | 3 | | 3 | |
| L | 3.40 | 3.60 | 0.134 | 0.142 |
| L1 | 0.90 | 1.10 | 0.035 | 0.043 |
| L2 | 0.90 | 1.10 | 0.035 | 0.043 |

DOCUMENT NO.
Z8B00003329

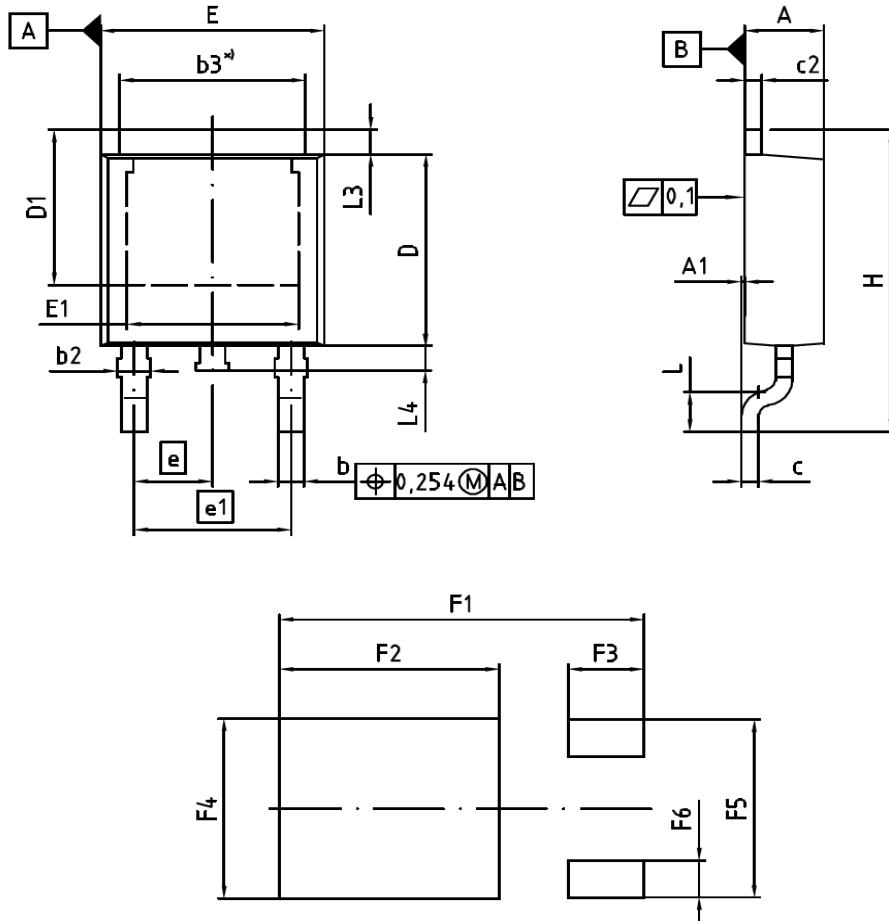
SCALE

EUROPEAN PROJECTION

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REVISION
03

PG-TO252-3: Outline



*) mold flash not included

| DIM | MILLIMETERS | | INCHES | |
|-----|-------------|-------|-------------|-------|
| | MIN | MAX | MIN | MAX |
| A | 2.16 | 2.41 | 0.085 | 0.095 |
| A1 | 0.00 | 0.15 | 0.000 | 0.006 |
| b | 0.64 | 0.89 | 0.025 | 0.035 |
| b2 | 0.65 | 1.15 | 0.026 | 0.045 |
| b3 | 5.00 | 5.50 | 0.197 | 0.217 |
| c | 0.46 | 0.60 | 0.018 | 0.024 |
| c2 | 0.46 | 0.98 | 0.018 | 0.039 |
| D | 5.97 | 6.22 | 0.235 | 0.245 |
| D1 | 5.02 | 5.84 | 0.198 | 0.230 |
| E | 6.40 | 6.73 | 0.252 | 0.265 |
| E1 | 4.70 | 5.21 | 0.185 | 0.205 |
| e | 2.29 (BSC) | | 0.090 (BSC) | |
| e1 | 4.57 | | 0.180 | |
| N | 3 | | 3 | |
| H | 9.40 | 10.48 | 0.370 | 0.413 |
| L | 1.18 | 1.70 | 0.046 | 0.067 |
| L3 | 0.90 | 1.25 | 0.035 | 0.049 |
| L4 | 0.51 | 1.00 | 0.020 | 0.039 |
| F1 | 10.60 | | 0.417 | |
| F2 | 6.40 | | 0.252 | |
| F3 | 2.20 | | 0.087 | |
| F4 | 5.80 | | 0.228 | |
| F5 | 5.76 | | 0.227 | |
| F6 | 1.20 | | 0.047 | |

| |
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| DOCUMENT NO. Z8B00003328 |
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| ISSUE DATE 16-02-2011 |
| REVISION 04 |

Revision History

IPD_S110N12N3 G

Revision: 2015-07-16, Rev. 2.4

Previous Revision

| Revision | Date | Subjects (major changes since last revision) |
|----------|------------|--|
| 2.4 | 2015-07-16 | Update VGS(th) and package outline TO252-3 |

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