

CoolMOS™ Power Transistor
Features

- Lowest figure-of-merit $R_{ON} \times Q_g$
- Extreme dv/dt rated
- High peak current capability
- Qualified according to JEDEC¹⁾ for target applications
- Pb-free lead plating; RoHS compliant; available in Halogen free mold compound^{a)}
- Ultra low gate charge

Product Summary

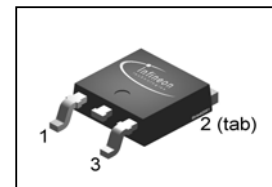
| | | |
|---|-----|----------|
| $V_{DS} @ T_J=25^\circ\text{C}$ | 900 | V |
| $R_{DS(on),max} @ T_J=25^\circ\text{C}$ | 1.2 | Ω |
| $Q_{g,typ}$ | 28 | nC |

CoolMOS™ 900V is designed for:

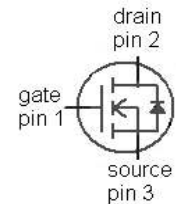
- Quasi Resonant Flyback / Forward topologies
- PC Silverbox and consumer applications
- Industrial SMPS



PG-TO252



| Type | Package | Marking |
|-------------|----------|---------|
| IPD90R1K2C3 | PG-TO252 | 9R1K2C |


Maximum ratings, at $T_J=25^\circ\text{C}$, unless otherwise specified

| Parameter | Symbol | Conditions | Value | Unit |
|---|----------------|---|-------------|------------------|
| Continuous drain current | I_D | $T_C=25^\circ\text{C}$ | 5.1 | A |
| | | $T_C=100^\circ\text{C}$ | 3.2 | |
| Pulsed drain current ²⁾ | $I_{D,pulse}$ | $T_C=25^\circ\text{C}$ | 10 | |
| Avalanche energy, single pulse | E_{AS} | $I_D=0.92\text{ A}, V_{DD}=50\text{ V}$ | 68 | mJ |
| Avalanche energy, repetitive t_{AR} ^{2),3)} | E_{AR} | $I_D=0.92\text{ A}, V_{DD}=50\text{ V}$ | 0.31 | |
| Avalanche current, repetitive t_{AR} ^{2),3)} | I_{AR} | | 0.92 | A |
| MOSFET dv/dt ruggedness | dv/dt | $V_{DS}=0\dots400\text{ V}$ | 50 | V/ns |
| Gate source voltage | V_{GS} | static | ± 20 | V |
| | | AC ($f>1\text{ Hz}$) | ± 30 | |
| Power dissipation | P_{tot} | $T_C=25^\circ\text{C}$ | 83 | W |
| Operating and storage temperature | T_J, T_{stg} | | -55 ... 150 | $^\circ\text{C}$ |

a) non-Halogen free (OPN: IPD90R1K2C3BT); Halogen free (OPN: IPD90R1K2C3AT)

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

| Parameter | Symbol | Conditions | Value | Unit |
|-----------------------------------|---------------|--------------------|-------|------|
| Continuous diode forward current | I_S | $T_C=25\text{ °C}$ | 2.8 | A |
| Diode pulse current ²⁾ | $I_{S,pulse}$ | | 11 | |
| Reverse diode dv/dt ⁴⁾ | dv/dt | | 4 | V/ns |

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

Thermal characteristics

| | | | | | | |
|--|------------|---------------------------------------|---|---|-----|-----|
| Thermal resistance, junction - case | R_{thJC} | | - | - | 1.5 | K/W |
| Thermal resistance, junction - ambient | R_{thJA} | leaded | - | - | 62 | |
| Soldering temperature, wavesoldering only allowed at leads | T_{sold} | 1.6 mm (0.063 in.) from case for 10 s | - | - | 260 | °C |

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

| | | | | | | |
|----------------------------------|---------------|---|-----|------|-----|---------------|
| Drain-source breakdown voltage | $V_{(BR)DSS}$ | $V_{GS}=0\text{ V}$, $I_D=250\text{ }\mu\text{A}$ | 900 | - | - | V |
| Gate threshold voltage | $V_{GS(th)}$ | $V_{DS}=V_{GS}$, $I_D=0.31\text{ mA}$ | 2.5 | 3 | 3.5 | |
| Zero gate voltage drain current | I_{DSS} | $V_{DS}=900\text{ V}$, $V_{GS}=0\text{ V}$, $T_J=25\text{ °C}$ | - | - | 1 | μA |
| | | $V_{DS}=900\text{ V}$, $V_{GS}=0\text{ V}$, $T_J=150\text{ °C}$ | - | 10 | - | |
| Gate-source leakage current | I_{GSS} | $V_{GS}=20\text{ V}$, $V_{DS}=0\text{ V}$ | - | - | 100 | nA |
| Drain-source on-state resistance | $R_{DS(on)}$ | $V_{GS}=10\text{ V}$, $I_D=2.8\text{ A}$, $T_J=25\text{ °C}$ | - | 0.94 | 1.2 | Ω |
| | | $V_{GS}=10\text{ V}$, $I_D=2.8\text{ A}$, $T_J=150\text{ °C}$ | - | 2.5 | - | |
| Gate resistance | R_G | $f=1\text{ MHz}$, open drain | - | 1.3 | - | Ω |

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

Dynamic characteristics

| | | | | | | |
|--|--------------|---|---|-----|---|----|
| Input capacitance | C_{iss} | $V_{GS}=0\text{ V}, V_{DS}=100\text{ V},$ $f=1\text{ MHz}$ | - | 710 | - | pF |
| Output capacitance | C_{oss} | | - | 35 | - | |
| Effective output capacitance, energy related ⁵⁾ | $C_{o(er)}$ | $V_{GS}=0\text{ V}, V_{DS}=0\text{ V}$ to 500 V | - | 23 | - | |
| Effective output capacitance, time related ⁶⁾ | $C_{o(tr)}$ | | - | 86 | - | |
| Turn-on delay time | $t_{d(on)}$ | $V_{DD}=400\text{ V},$ $V_{GS}=10\text{ V}, I_D=2.8\text{ A},$ $R_G=81.3\ \Omega$ | - | 70 | - | ns |
| Rise time | t_r | | - | 20 | - | |
| Turn-off delay time | $t_{d(off)}$ | | - | 400 | - | |
| Fall time | t_f | | - | 40 | - | |

Gate Charge Characteristics

| | | | | | | |
|-----------------------|---------------|--|---|-----|-----|----|
| Gate to source charge | Q_{gs} | $V_{DD}=400\text{ V}, I_D=2.8\text{ A},$ $V_{GS}=0\text{ to }10\text{ V}$ | - | 3.2 | - | nC |
| Gate to drain charge | Q_{gd} | | - | 12 | - | |
| Gate charge total | Q_g | | - | 28 | tbd | |
| Gate plateau voltage | $V_{plateau}$ | | - | 4.6 | - | V |

Reverse Diode

| | | | | | | |
|-------------------------------|-----------|--|---|-----|-----|---------------|
| Diode forward voltage | V_{SD} | $V_{GS}=0\text{ V}, I_F=2.8\text{ A},$ $T_j=25\text{ }^\circ\text{C}$ | - | 0.8 | 1.2 | V |
| Reverse recovery time | t_{rr} | $V_R=400\text{ V}, I_F=I_S,$ $di_F/dt=100\text{ A}/\mu\text{s}$ | - | 310 | - | ns |
| Reverse recovery charge | Q_{rr} | | - | 3.7 | - | μC |
| Peak reverse recovery current | I_{rrm} | | - | 19 | - | A |

¹⁾ J-STD20 and JESD22

²⁾ Pulse width t_p limited by $T_{J,max}$

³⁾ Repetitive avalanche causes additional power losses that can be calculated as $P_{AV}=E_{AR} \cdot f$.

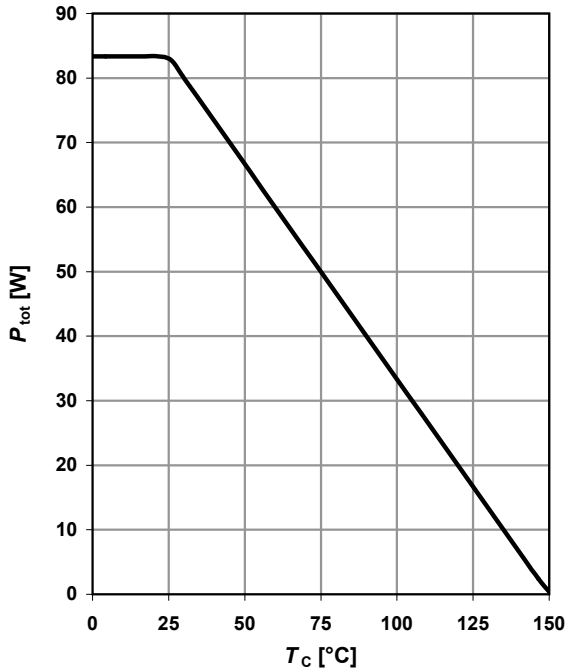
⁴⁾ $I_{SD} \leq I_D, di/dt \leq 200\text{ A}/\mu\text{s}, V_{DClink}=400\text{ V}, V_{peak} < V_{(BR)DSS}, T_J < T_{J,max}$, identical low side and high side switch

⁵⁾ $C_{o(er)}$ is a fixed capacitance that gives the same stored energy as C_{oss} while V_{DS} is rising from 0 to 50% V_{DSS} .

⁶⁾ $C_{o(tr)}$ is a fixed capacitance that gives the same charging time as C_{oss} while V_{DS} is rising from 0 to 50% V_{DSS} .

1 Power dissipation

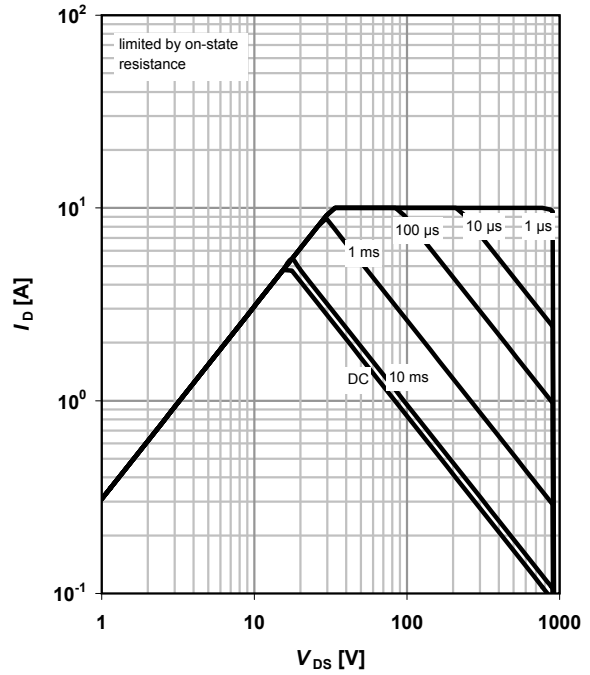
$$P_{tot} = f(T_C)$$



2 Safe operating area

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

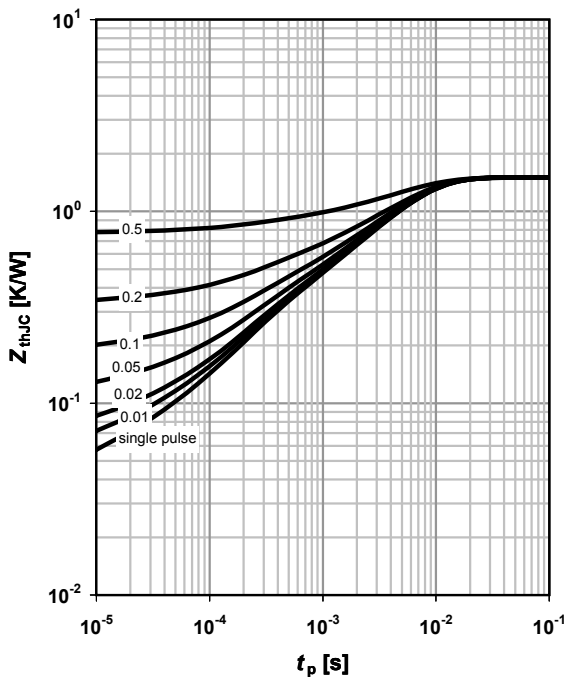
parameter: t_p



3 Max. transient thermal impedance

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

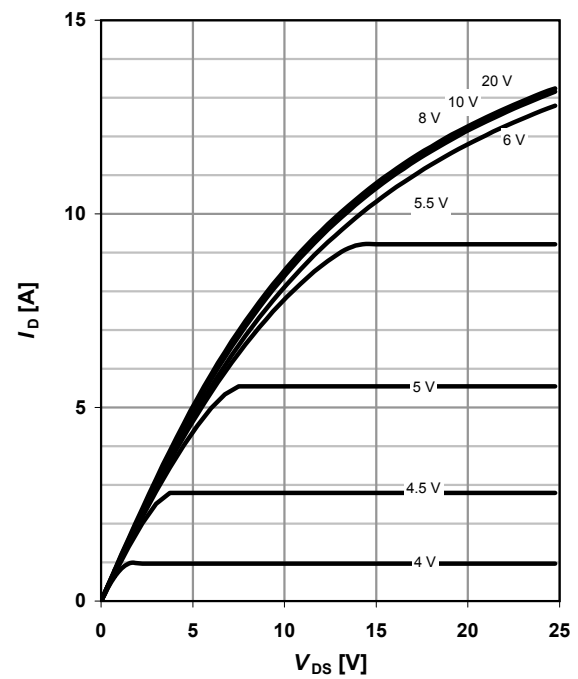
parameter: $D = t_p / T$



4 Typ. output characteristics

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

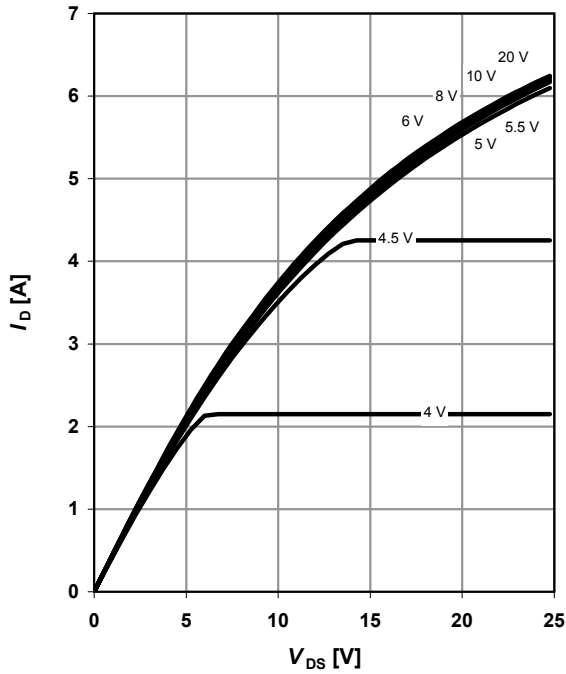
parameter: V_{GS}



5 Typ. output characteristics

$I_D = f(V_{DS}); T_J = 150\text{ }^\circ\text{C}$

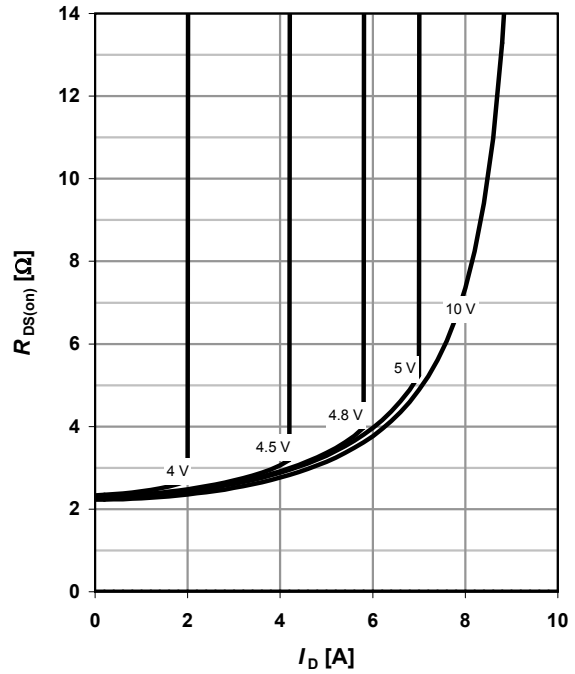
parameter: V_{GS}



6 Typ. drain-source on-state resistance

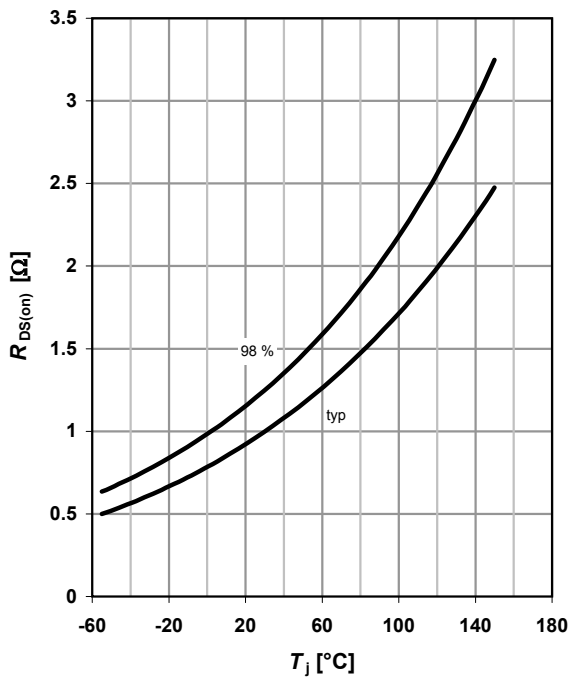
$R_{DS(on)} = f(I_D); T_J = 150\text{ }^\circ\text{C}$

parameter: V_{GS}



7 Drain-source on-state resistance

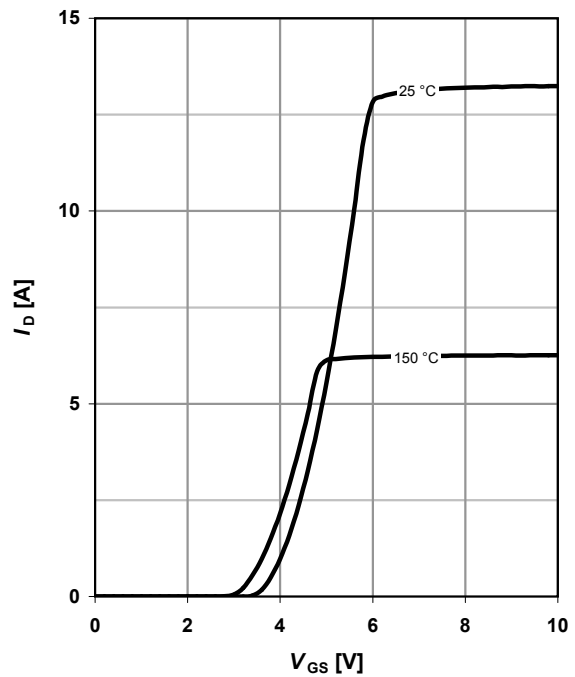
$R_{DS(on)} = f(T_J); I_D = 2.8\text{ A}; V_{GS} = 10\text{ V}$



8 Typ. transfer characteristics

$I_D = f(V_{GS}); V_{DS} = 20\text{ V}$

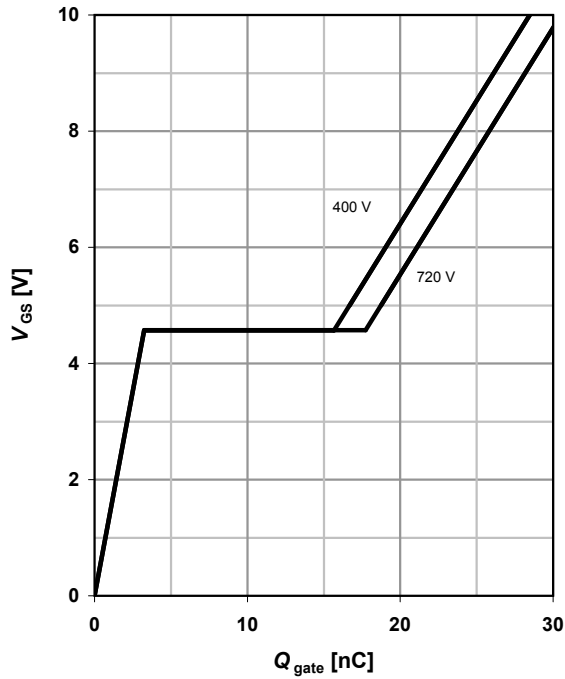
parameter: T_J



9 Typ. gate charge

$V_{GS}=f(Q_{gate}); I_D=2.8 \text{ A pulsed}$

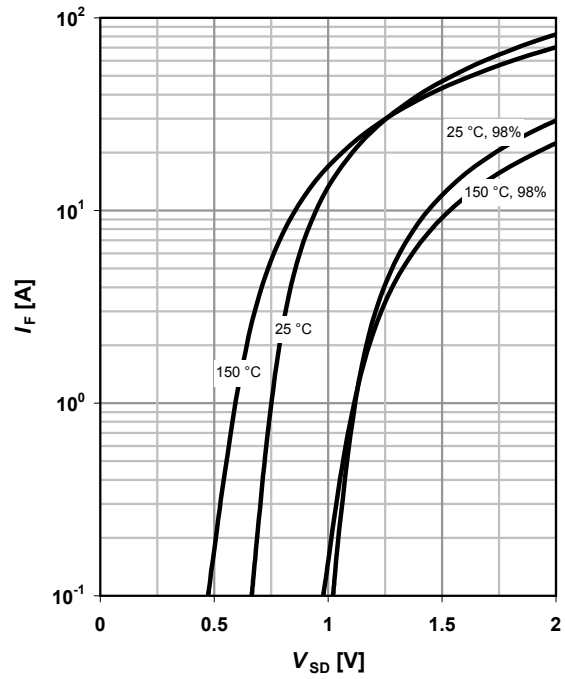
parameter: V_{DD}



10 Forward characteristics of reverse diode

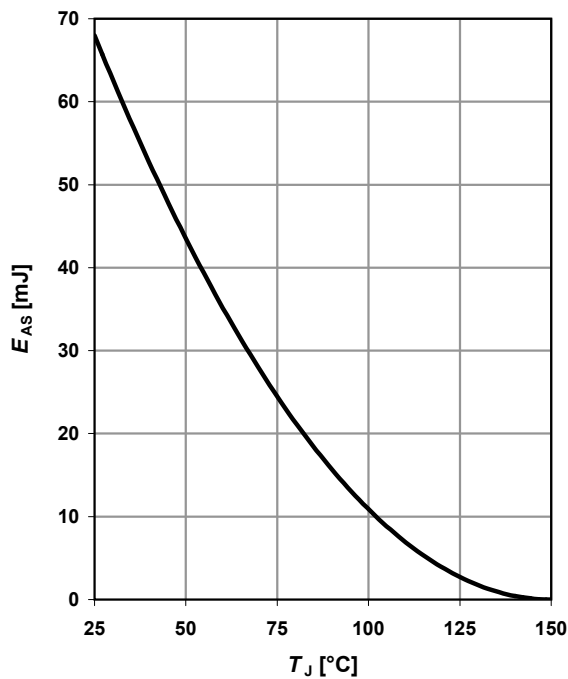
$I_F=f(V_{SD})$

parameter: T_J



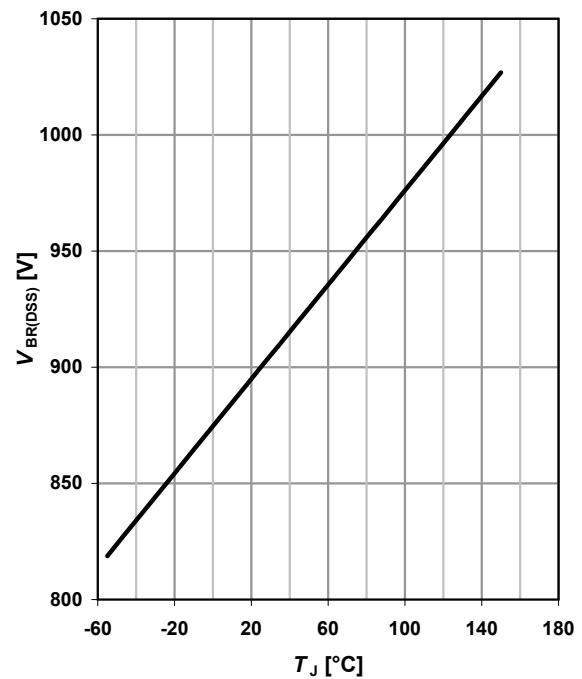
11 Avalanche energy

$E_{AS}=f(T_J); I_D=0.92 \text{ A}; V_{DD}=50 \text{ V}$



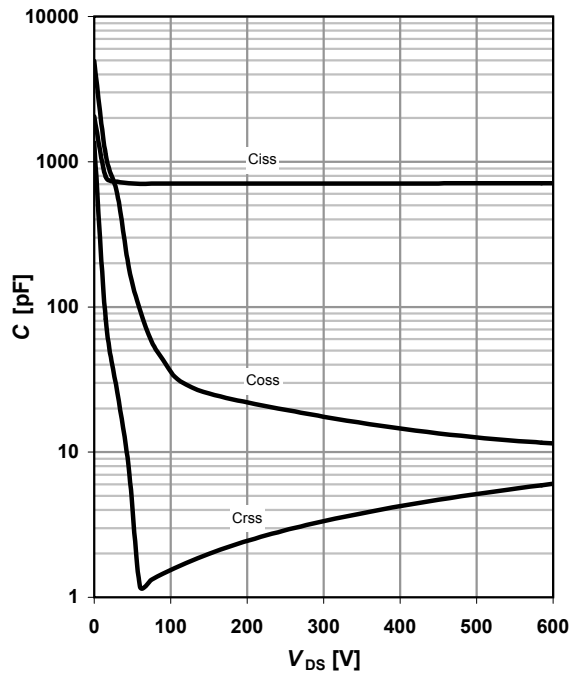
12 Drain-source breakdown voltage

$V_{BR(DSS)}=f(T_J); I_D=0.25 \text{ mA}$



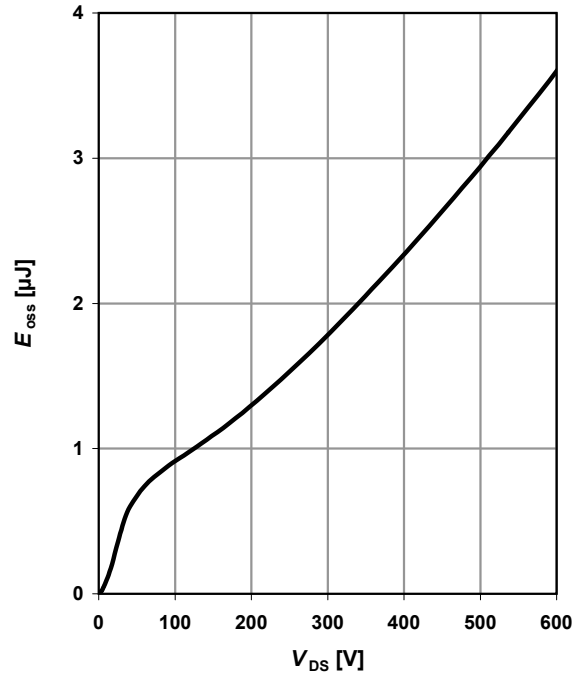
13 Typ. capacitances

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



14 Typ. C_{oss} stored energy

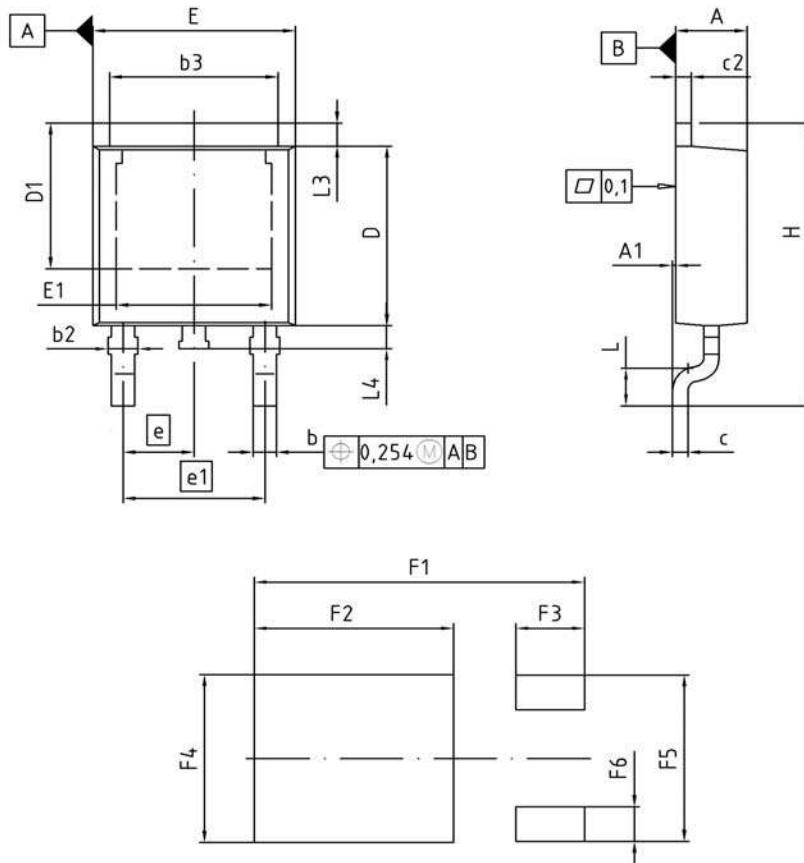
$E_{oss}=f(V_{DS})$



Definition of diode switching characteristics



PG-TO252 Outlines



| 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 | | 0.090 | |
| 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 | 10.50 | 10.70 | 0.413 | 0.421 |
| F2 | 6.30 | 6.50 | 0.248 | 0.256 |
| F3 | 2.10 | 2.30 | 0.083 | 0.091 |
| F4 | 5.70 | 5.90 | 0.224 | 0.232 |
| F5 | 5.66 | 5.86 | 0.223 | 0.231 |
| F6 | 1.10 | 1.30 | 0.043 | 0.051 |

DOCUMENT NO.
Z8B00003328

SCALE

EUROPEAN PROJECTION

ISSUE DATE
19-10-2007

REVISION
03

Dimensions in mm/inches

Published by
Infineon Technologies AG
81726 Munich, Germany
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