# CoolMOS™ Power Transistor

**Features**

• Lowest figure-of-merit $R_{ON}xQ_g$

• Ultra low gate charge

• Extreme dv/dt rated

• High peak current capability

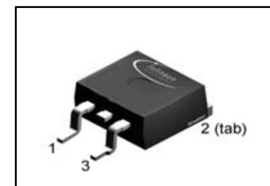
• Qualified according to JEDEC[1] for target applications

• Pb-free lead plating; RoHS compliant

**Product Summary**

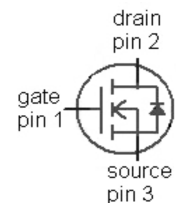
| | | |
|---|---|---|
| $V_{DS}$ @ $T_{j,max}$ | 650 | V |
| $R_{DS(on),max}$ | 0.250 | Ω |
| $Q_{g,typ}$ | 26 | nC |

P-TO263-3




**CoolMOS is designed for:**

Hard switching SMPS topologies




| Type | Package | Marking |
|---|---|---|
| IPB60R250CP | P-TO263 | 60R250P |

**Maximum ratings,** at $T_j$=25 °C, unless otherwise specified

| Parameter | Symbol | Conditions | Value | Unit |
|---|---|---|---|---|
| Continuous drain current | $I_D$ | $T_C$=25 °C | 12 | A |
| | | $T_C$=100 °C | 8 | |
| Pulsed drain current[2] | $I_{D,pulse}$ | $T_C$=25 °C | 40 | |
| Avalanche energy, single pulse | $E_{AS}$ | $I_D$=5.2 A, $V_{DD}$=50 V | 345 | mJ |
| Avalanche energy, repetitive $t_{AR}$[2),3)] | $E_{AR}$ | $I_D$=5.2 A, $V_{DD}$=50 V | 0.52 | |
| Avalanche current, repetitive $t_{AR}$[2),3)] | $I_{AR}$ | | 5.2 | A |
| MOSFET d$v$/d$t$ ruggedness | d$v$/d$t$ | $V_{DS}$=0...480 V | 50 | V/ns |
| Gate source voltage | $V_{GS}$ | static | ±20 | V |
| | | AC ($f$>1 Hz) | ±30 | |
| Power dissipation | $P_{tot}$ | $T_C$=25 °C | 104 | W |
| Operating and storage temperature | $T_j$, $T_{stg}$ | | -55 ... 150 | °C |

**Maximum ratings,** at $T_j$=25 °C, unless otherwise specified

| Parameter | Symbol | Conditions | Value | Unit |
|---|---|---|---|---|
| Continuous diode forward current | $I_S$ | $T_C$=25 °C | 7.8 | A |
| Diode pulse current[2)] | $I_{S,pulse}$ | | 40 | |
| Reverse diode d$v$/d$t$[4)] | d$v$/d$t$ | | 15 | V/ns |

| Parameter | Symbol | Conditions | Values | | | Unit |
|---|---|---|---|---|---|---|
| | | | min. | typ. | max. | |
| **Thermal characteristics** | | | | | | |
| Thermal resistance, junction - case | $R_{thJC}$ | | - | - | 1.2 | 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 °C, unless otherwise specified | | | | | | |
| **Static characteristics** | | | | | | |
| Drain-source breakdown voltage | $V_{(BR)DSS}$ | $V_{GS}$=0 V, $I_D$=250 µA | 600 | - | - | V |
| Gate threshold voltage | $V_{GS(th)}$ | $V_{DS}$=$V_{GS}$, $I_D$=0,44 mA | 2.5 | 3 | 3.5 | |
| Zero gate voltage drain current | $I_{DSS}$ | $V_{DS}$=600 V, $V_{GS}$=0 V, $T_j$=25 °C | - | - | 1 | µA |
| | | $V_{DS}$=600 V, $V_{GS}$=0 V, $T_j$=150 °C | - | 10 | - | |
| Gate-source leakage current | $I_{GSS}$ | $V_{GS}$=20 V, $V_{DS}$=0 V | - | - | 100 | nA |
| Drain-source on-state resistance | $R_{DS(on)}$ | $V_{GS}$=10 V, $I_D$=7.8 A, $T_j$=25 °C | - | 0.22 | 0.25 | Ω |
| | | $V_{GS}$=10 V, $I_D$=7.8 A, $T_j$=150 °C | - | 0.59 | - | |
| Gate resistance | $R_G$ | $f$=1 MHz, open drain | - | 1.3 | - | Ω |

| Parameter | Symbol | Conditions | Values | | | Unit |
|---|---|---|---|---|---|---|
| | | | min. | typ. | max. | |
| **Dynamic characteristics** | | | | | | |
| Input capacitance | $C_{iss}$ | $V_{GS}$=0 V, $V_{DS}$=100 V, $f$=1 MHz | - | 1200 | - | pF |
| Output capacitance | $C_{oss}$ | | - | 54 | - | |
| Effective output capacitance, energy related[5] | $C_{o(er)}$ | $V_{GS}$=0 V, $V_{DS}$=0 V to 480 V | - | 55 | - | |
| Effective output capacitance, time related[6] | $C_{o(tr)}$ | | - | 150 | - | |
| Turn-on delay time | $t_{d(on)}$ | $V_{DD}$=400 V, $V_{GS}$=10 V, $I_D$=7.8 A, $R_G$=23.1 Ω | - | 40 | - | ns |
| Rise time | $t_r$ | | - | 17 | - | |
| Turn-off delay time | $t_{d(off)}$ | | - | 110 | - | |
| Fall time | $t_f$ | | - | 12 | - | |
| Gate Charge Characteristics | | | | | | |
| Gate to source charge | $Q_{gs}$ | $V_{DD}$=400 V, $I_D$=7.8 A, $V_{GS}$=0 to 10 V | - | 6 | - | nC |
| Gate to drain charge | $Q_{gd}$ | | - | 9 | - | |
| Gate charge total | $Q_g$ | | - | 26 | 35 | |
| Gate plateau voltage | $V_{plateau}$ | | - | 5.0 | - | V |
| **Reverse Diode** | | | | | | |
| Diode forward voltage | $V_{SD}$ | $V_{GS}$=0 V, $I_F$=7.8 A, $T_j$=25 °C | - | 0.9 | 1.2 | V |
| Reverse recovery time | $t_{rr}$ | $V_R$=400 V, $I_F$=$I_S$, $di_F/dt$=100 A/μs | - | 330 | - | ns |
| Reverse recovery charge | $Q_{rr}$ | | - | 4.5 | - | μC |
| Peak reverse recovery current | $I_{rrm}$ | | - | 27 | - | 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 $P_{AV}=E_{AR}*f$.

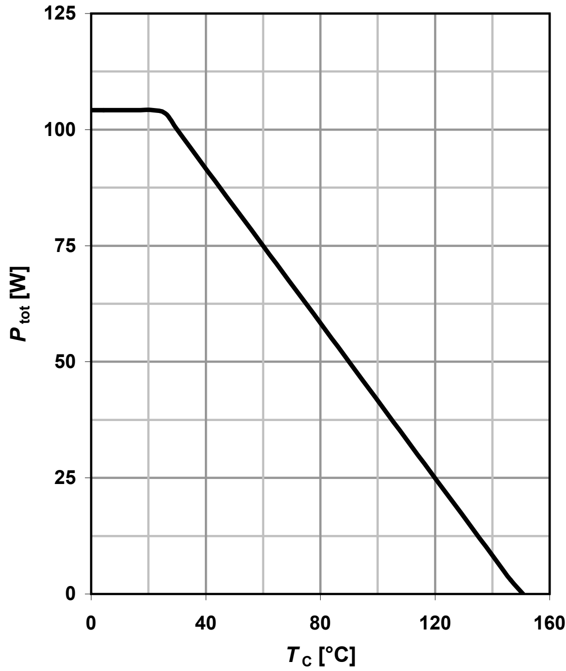
[4] $I_{SD} \leq I_D$, di/dt≤200A/μs, $V_{DClink}$=400V, $V_{peak}<V_{(BR)DSS}$, $T_j<T_{jmax}$, identical low side and high side switch.

[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 80% $V_{DSS}$.

[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 80% $V_{DSS}$.

**1 Power dissipation**

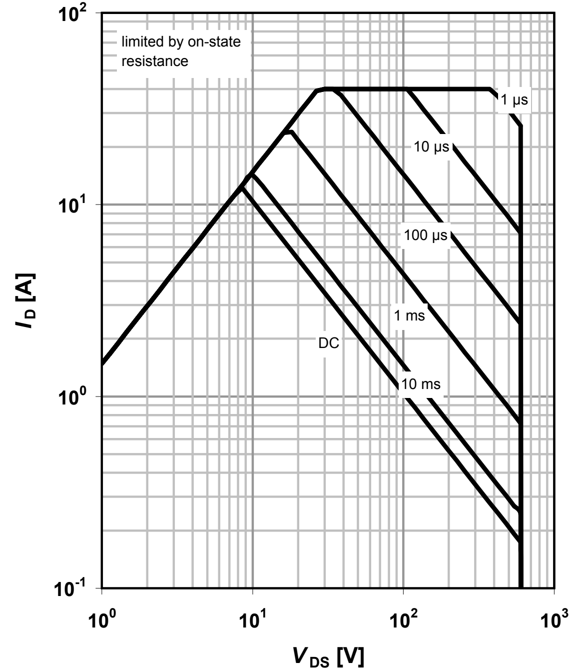
$P_{tot}$=f($T_C$)




**2 Safe operating area**

$I_D$=f($V_{DS}$); $T_C$=25 °C; $D$=0

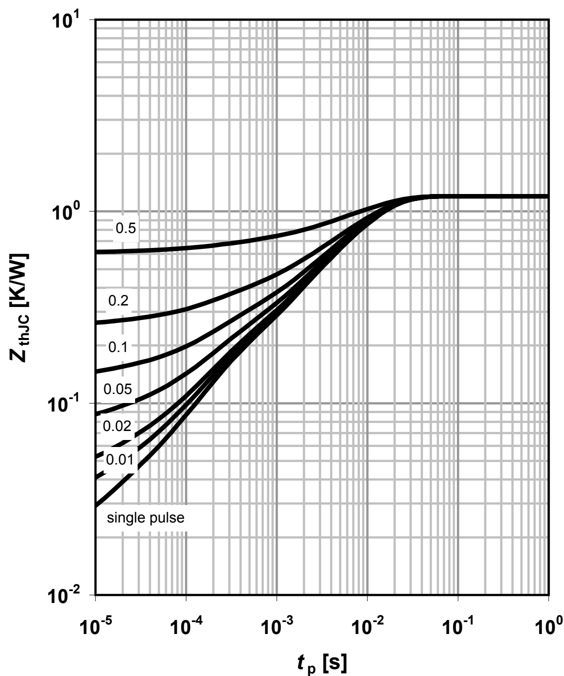
parameter: $t_p$




**3 Max. transient thermal impedance**

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

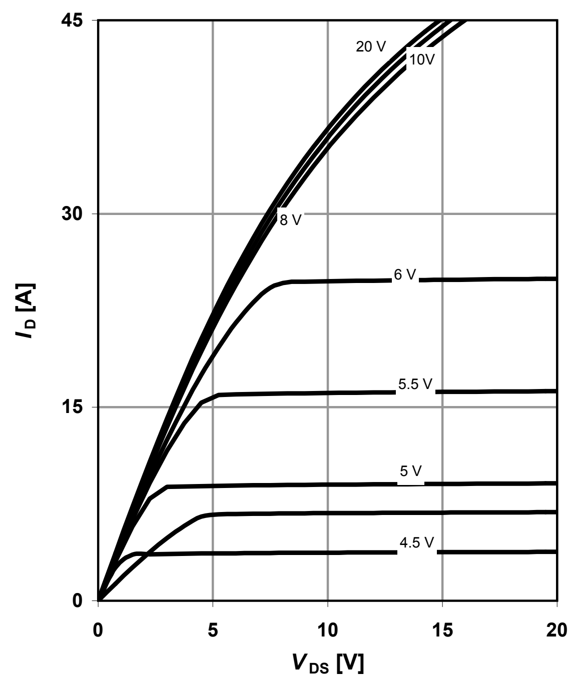
parameter: $D$=$t_p$/$T$




**4 Typ. output characteristics**

$I_D$=f($V_{DS}$); $T_j$=25 °C

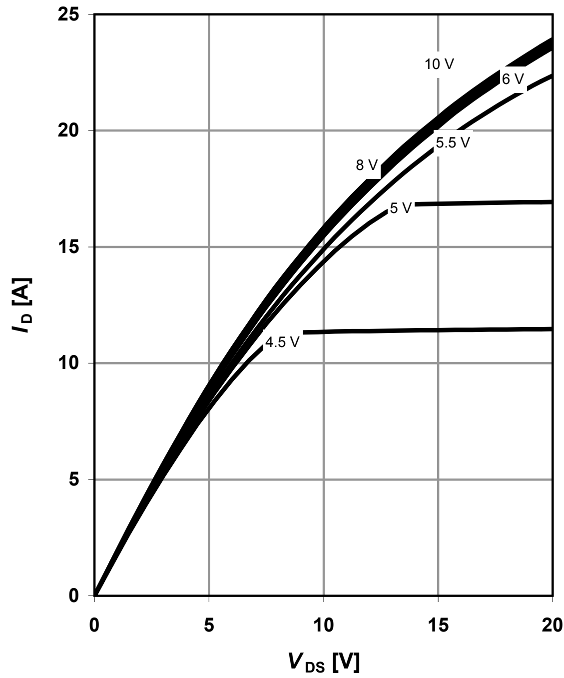
parameter: $V_{GS}$



**5 Typ. output characteristics**

$I_D$=f($V_{DS}$); $T_j$=150 °C

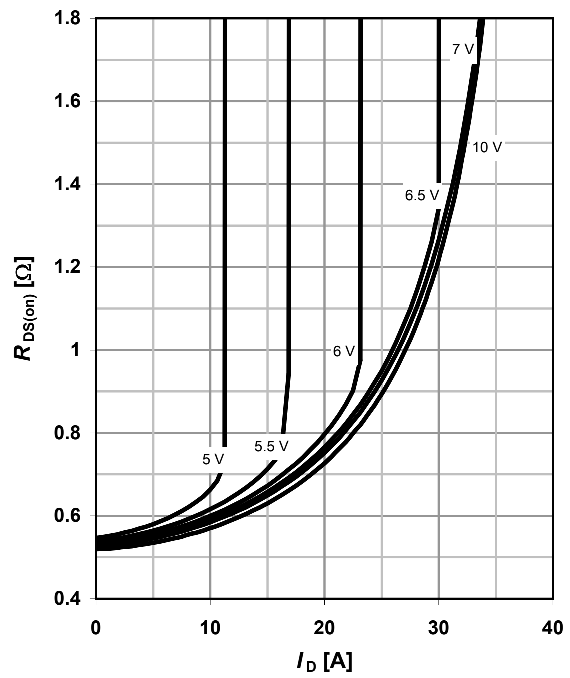
parameter: $V_{GS}$




**6 Typ. drain-source on-state resistance**

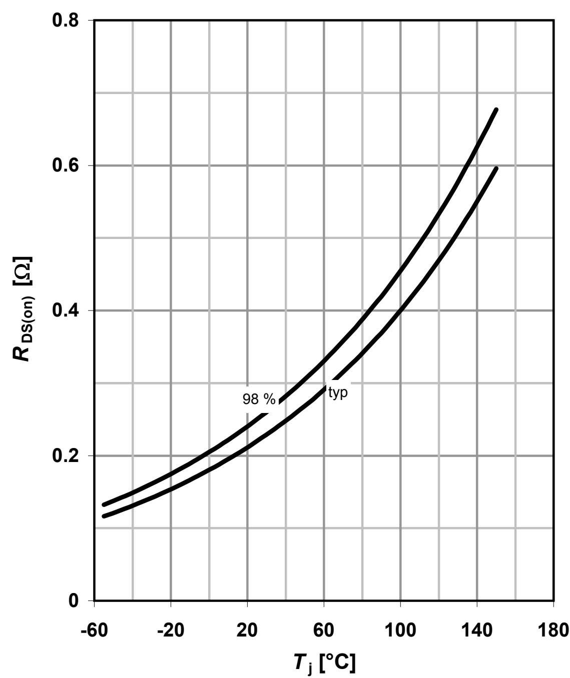
$R_{DS(on)}$=f($I_D$); $T_j$=150 °C

parameter: $V_{GS}$




**7 Drain-source on-state resistance**

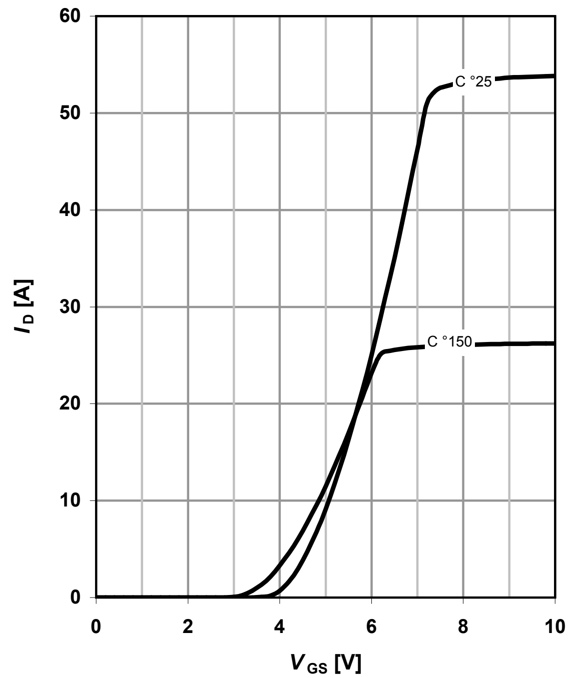
$R_{DS(on)}$=f($T_j$); $I_D$=7.8 A; $V_{GS}$=10 V




**8 Typ. transfer characteristics**

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

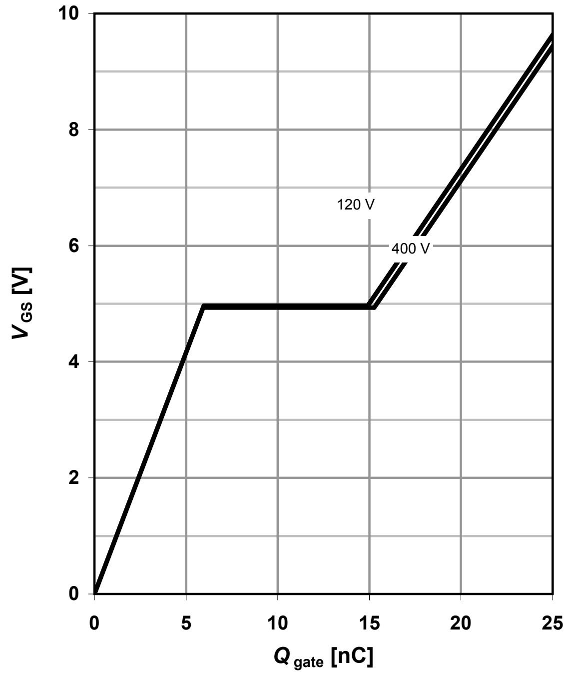
parameter: $T_j$



**9 Typ. gate charge**

$V_{GS}$=f($Q_{gate}$); $I_D$=7.8 A pulsed

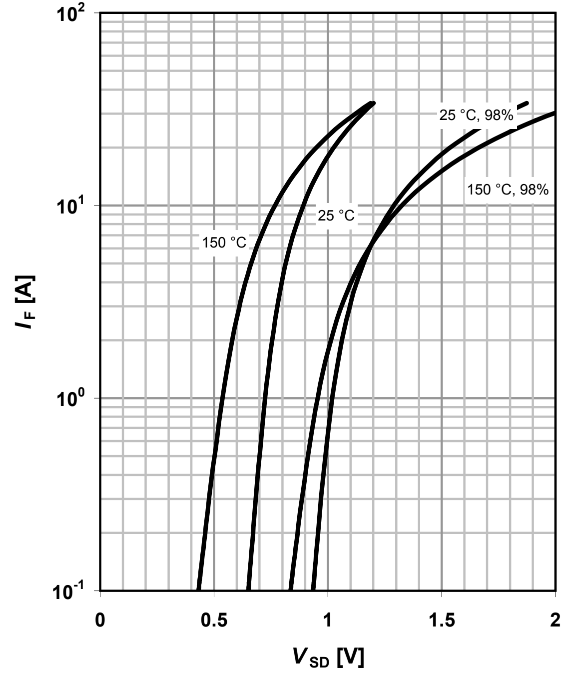
parameter: $V_{DD}$




**10 Forward characteristics of reverse diode**

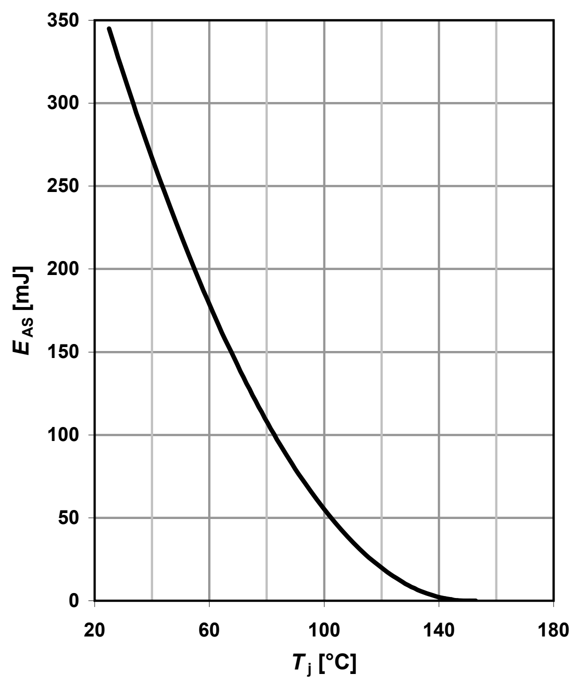
$I_F$=f($V_{SD}$)

parameter: $T_j$



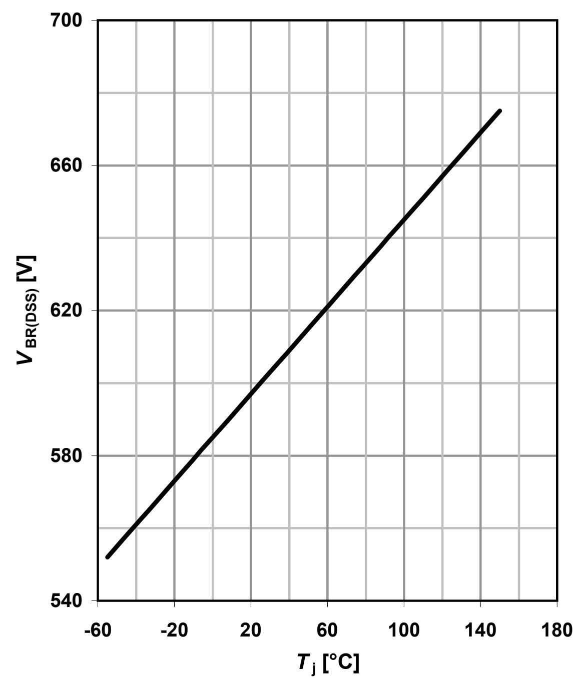

**11 Avalanche energy**

$E_{AS}$=f($T_j$); $I_D$=5.2 A; $V_{DD}$=50 V



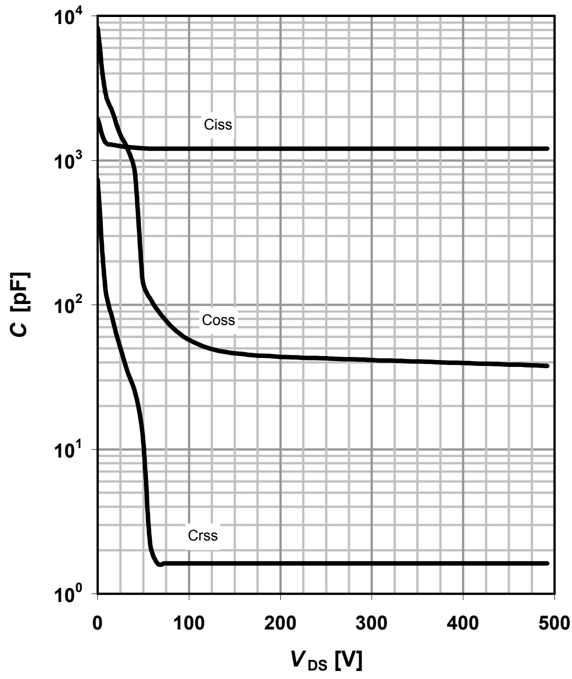

**12 Drain-source breakdown voltage**

$V_{BR(DSS)}$=f($T_j$); $I_D$=0.25 mA



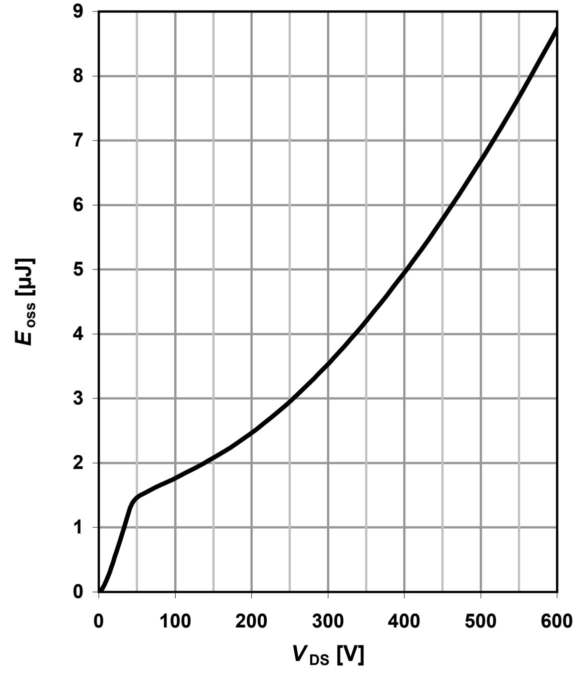
**13 Typ. capacitances**

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

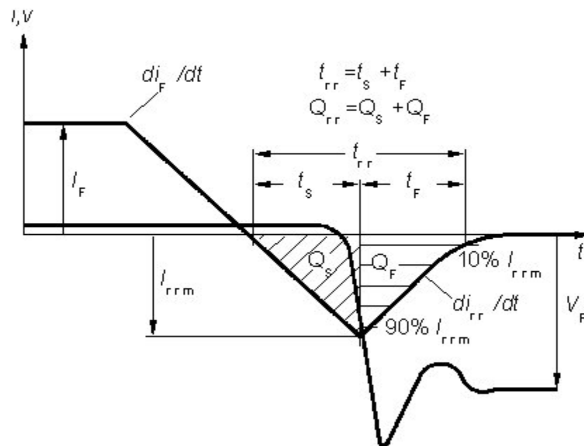



**14 Typ. Coss stored energy**

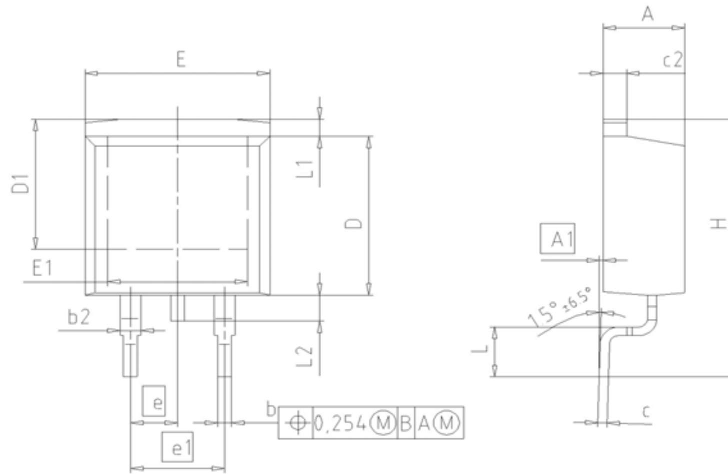
$E_{oss}$=f($V_{DS}$)



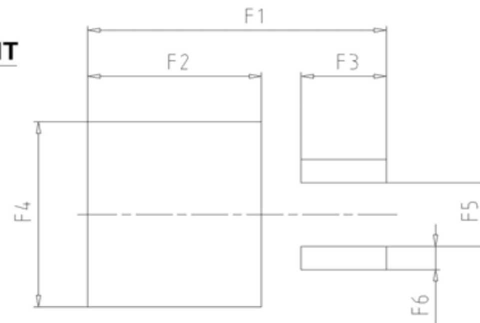
**Definition of diode switching characteristics**



**PG-TO263-3-2: Outline**




**FOOTPRINT**




| 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 | 0.65 | 0.85 | 0.026 | 0.033 |
| b2 | 0.95 | 1.15 | 0.037 | 0.045 |
| 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 | 7.10 | 7.90 | 0.280 | 0.311 |
| E | 9.80 | 10.31 | 0.386 | 0.406 |
| E1 | 6.50 | 8.60 | 0.256 | 0.339 |
| e | 2.54 | | 0.100 | |
| e1 | 5.08 | | 0.200 | |
| N | 2 | | 2 | |
| 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 | 3.65 | 3.85 | 0.144 | 0.152 |
| F6 | 1.25 | 1.45 | 0.049 | 0.057 |

| DOCUMENT NO. Z8B00003324 |
|---|
| SCALE 0 5 0 5 7.5mm |
| EUROPEAN PROJECTION |
| ISSUE DATE 30-08-2007 |
| REVISION 01 |

Dimensions in mm/inches

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