## CoolMOS$^{TM}$ Power Transistor

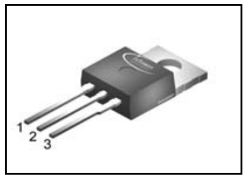
**Product Summary**

| | | |
|---|---|---|
| $V_{DS}$ @ $T_{j,max}$ | 650 | V |
| $R_{DS(on),max}$ | 0.125 | Ω |
| $Q_{g,typ}$ | 53 | nC |

### Features

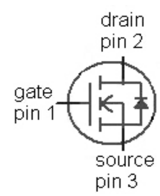
- Lowest figure-of-merit $R_{ON}$x$Q_g$
- Ultra low gate charge
- Extreme dv/dt rated
- High peak current capability
- Qualified for industrial grade applications according to JEDEC[1)]
- Pb-free lead plating; RoHS compliant; Halogen free mold compound

PG-TO220




### CoolMOS CP is specially designed for:

- Hard switching topologies, for Server and Telecom




| Type | Package | Ordering Code | Marking |
|---|---|---|---|
| IPP60R125CP | PG-TO220 | SP000088488 | 6R125P |

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

| Parameter | Symbol | Conditions | Value | Unit |
|---|---|---|---|---|
| Continuous drain current | $I_D$ | $T_C$=25 °C | 25 | A |
| | | $T_C$=100 °C | 16 | |
| Pulsed drain current[2)] | $I_{D,pulse}$ | $T_C$=25 °C | 82 | |
| Avalanche energy, single pulse | $E_{AS}$ | $I_D$=11 A, $V_{DD}$=50 V | 708 | mJ |
| Avalanche energy, repetitive $t_{AR}$[2),3)] | $E_{AR}$ | $I_D$=11 A, $V_{DD}$=50 V | 1.2 | |
| Avalanche current, repetitive $t_{AR}$[2),3)] | $I_{AR}$ | | 11 | 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 | 208 | W |
| Operating and storage temperature | $T_j$, $T_{stg}$ | | -55 ... 150 | °C |
| Mounting torque | | M3 and M3.5 screws | 60 | Ncm |

**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 | 16 | A |
| Diode pulse current[2)] | $I_{S,pulse}$ | | 82 | |
| 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 | $R_{thJC}$ | | - | - | 0.6 | 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 | $V_{GS(th)}$ | $V_{DS}$=$V_{GS}$, $I_D$=1.1 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 | - | - | 2 | µA |
| | | $V_{DS}$=600 V, $V_{GS}$=0 V, $T_j$=150 °C | - | 20 | - | |
| 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, $I_D$=16 A, $T_j$=25 °C | - | 0.11 | 0.125 | Ω |
| | | $V_{GS}$=10 V, $I_D$=16 A, $T_j$=150 °C | - | 0.30 | - | |
| Gate resistance | $R_G$ | $f$=1 MHz, open drain | - | 2.1 | - | 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 | - | 2500 | - | pF |
| Output capacitance | $C_{oss}$ | | - | 120 | - | |
| Effective output capacitance, energy related[5)] | $C_{o(er)}$ | $V_{GS}$=0 V, $V_{DS}$=0 V to 480 V | - | 110 | - | |
| Effective output capacitance, time related[6)] | $C_{o(tr)}$ | | - | 300 | - | |
| Turn-on delay time | $t_{d(on)}$ | $V_{DD}$=400 V, $V_{GS}$=10 V, $I_D$=16 A, $R_G$=3.3 Ω | - | 15 | - | ns |
| Rise time | $t_r$ | | - | 5 | - | |
| Turn-off delay time | $t_{d(off)}$ | | - | 50 | - | |
| Fall time | $t_f$ | | - | 5 | - | |
| Gate Charge Characteristics | | | | | | |
| Gate to source charge | $Q_{gs}$ | $V_{DD}$=400 V, $I_D$=16 A, $V_{GS}$=0 to 10 V | - | 12 | - | nC |
| Gate to drain charge | $Q_{gd}$ | | - | 18 | - | |
| Gate charge total | $Q_g$ | | - | 53 | 70 | |
| Gate plateau voltage | $V_{plateau}$ | | - | 5.0 | - | V |
| **Reverse Diode** | | | | | | |
| Diode forward voltage | $V_{SD}$ | $V_{GS}$=0 V, $I_F$=16 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 | - | 430 | - | ns |
| Reverse recovery charge | $Q_{rr}$ | | - | 9 | - | μC |
| Peak reverse recovery current | $I_{rrm}$ | | - | 42 | - | 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 $P_{AV}$=$E_{AR}$*$f$.

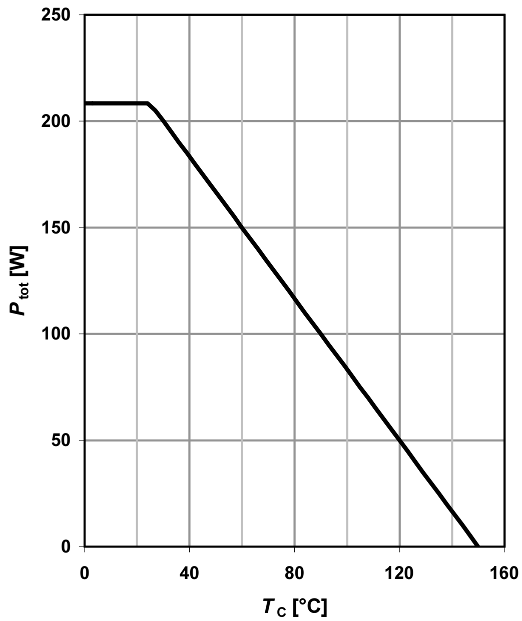
4) $I_{SD}$=$I_D$, di/dt<=200A/μs, $V_{DClink}$=400V, $V_{peak}$<$V_{(BR)DSS}$, $T_j$<$T_{jmax}$, identical low side and high side switch.

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**

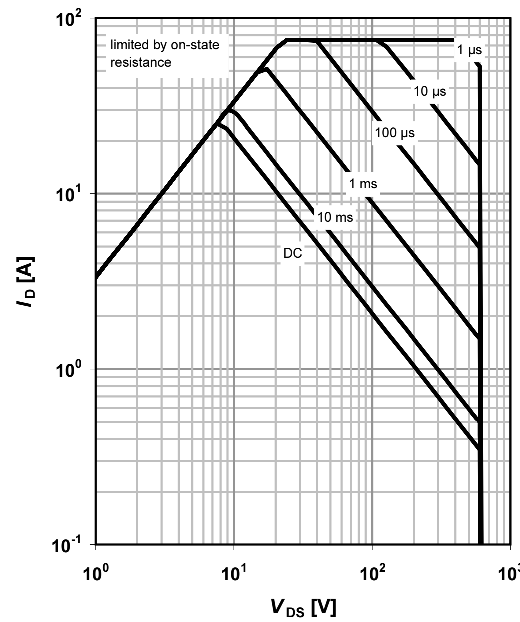
$P_{tot}$=f($T_C$)




**2 Safe operating area**

$I_D$=f($V_{DS}$); $T_C$=25 °C; $D$=0

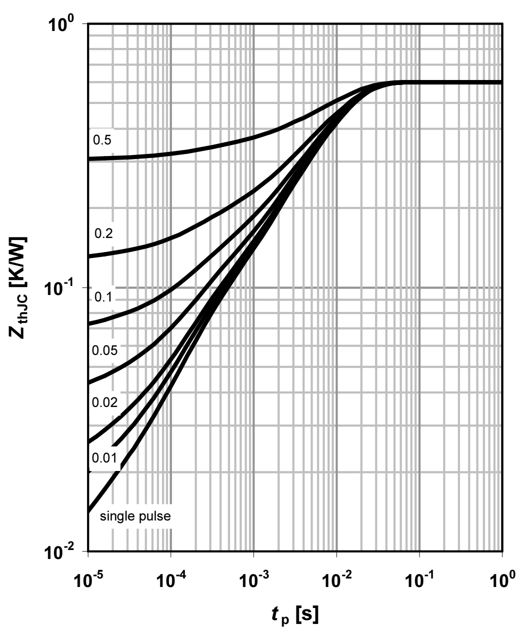
parameter: $t_p$




**3 Max. transient thermal impedance**

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

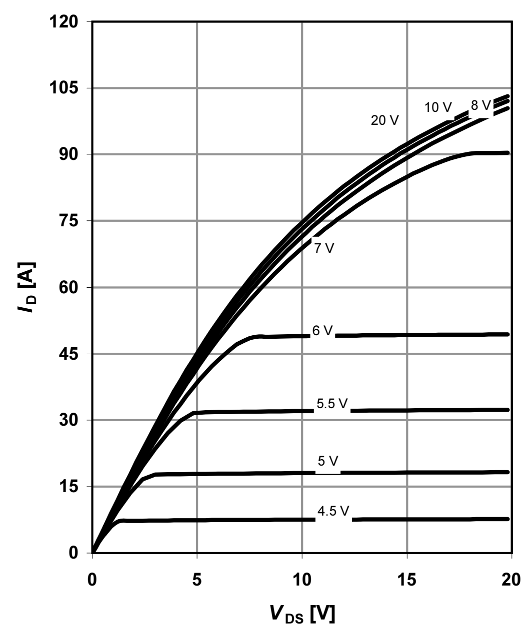
parameter: $D=t_p/T$




**4 Typ. output characteristics**

$I_D$=f($V_{DS}$); $T_j$=25 °C

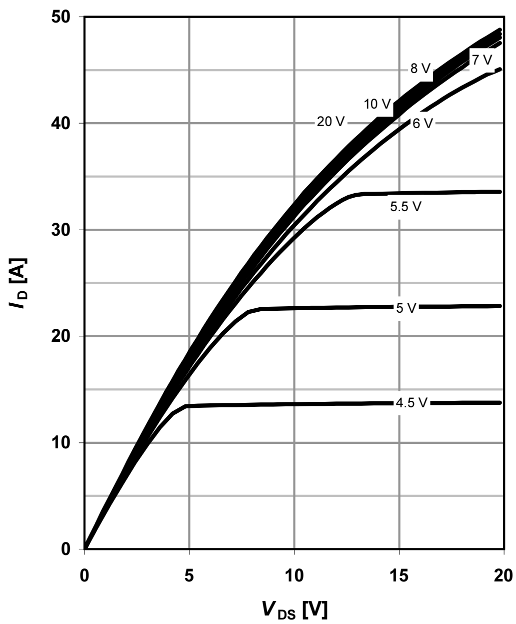
parameter: $V_{GS}$



**5 Typ. output characteristics**

$I_D$=f($V_{DS}$); $T_j$=150 °C

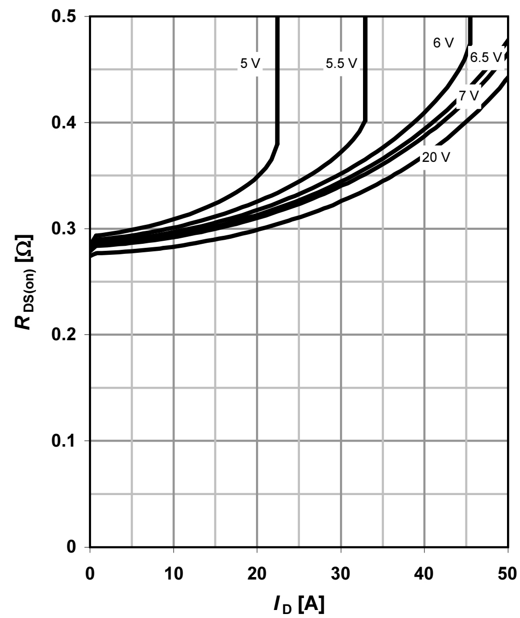
parameter: $V_{GS}$




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

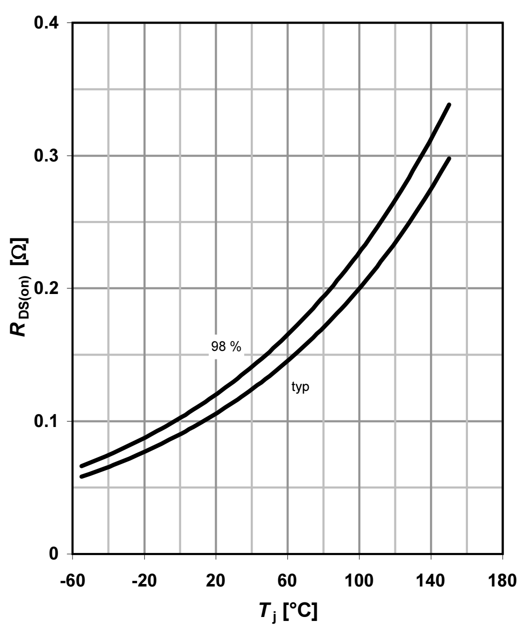
$R_{DS(on)}$=f($I_D$); $T_j$=150 °C

parameter: $V_{GS}$




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

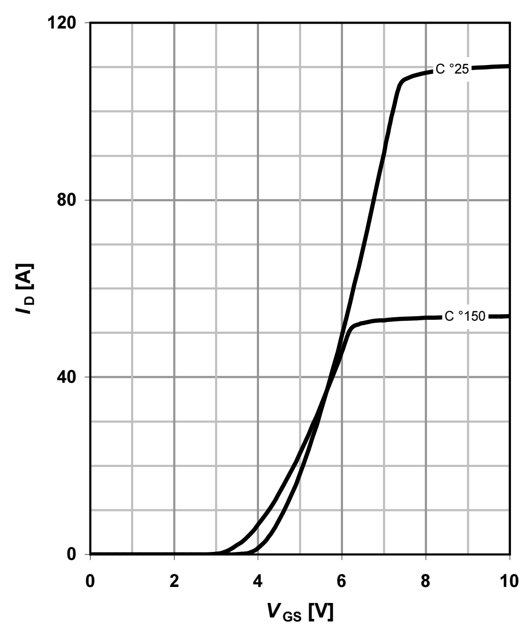
$R_{DS(on)}$=f($T_j$); $I_D$=16 A; $V_{GS}$=10 V




**8 Typ. transfer characteristics**

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

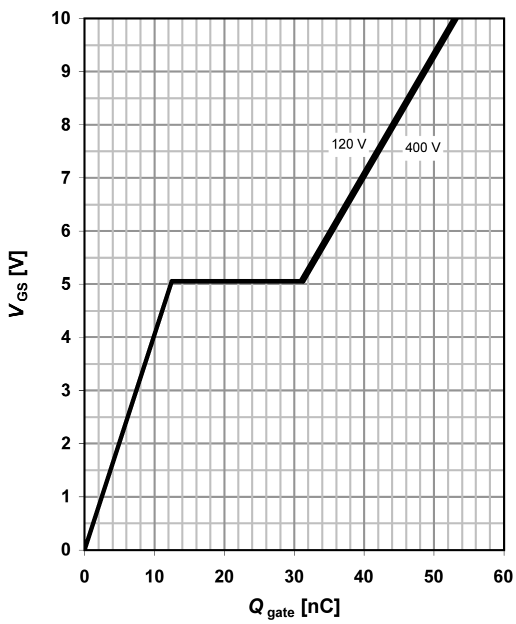
parameter: $T_j$



**9 Typ. gate charge**

$V_{GS}$=f($Q_{gate}$); $I_D$=16 A pulsed

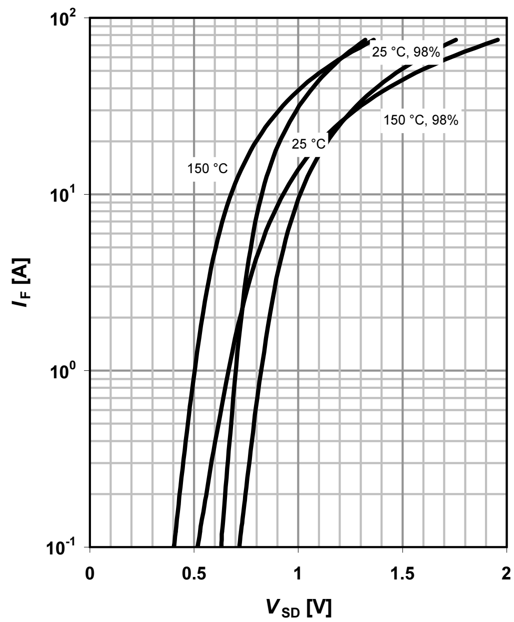
parameter: $V_{DD}$




**10 Forward characteristics of reverse diode**

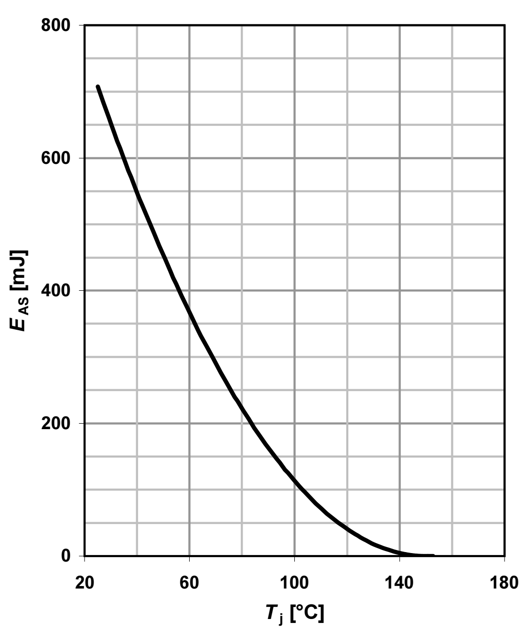
$I_F$=f($V_{SD}$)

parameter: $T_j$



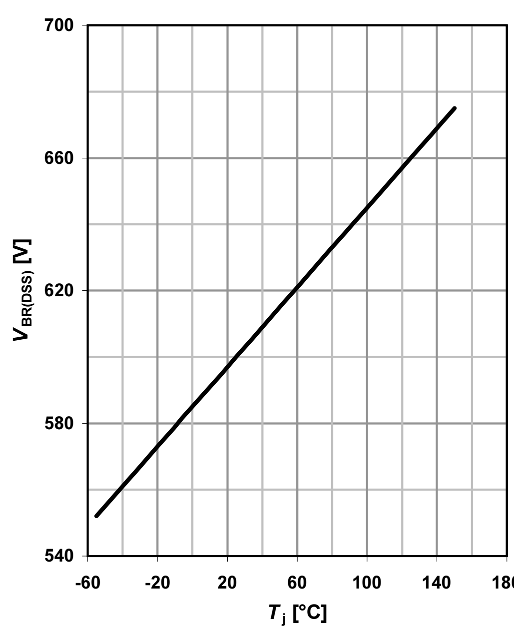

**11 Avalanche energy**

$E_{AS}$=f($T_j$); $I_D$=11 A; $V_{DD}$=50 V



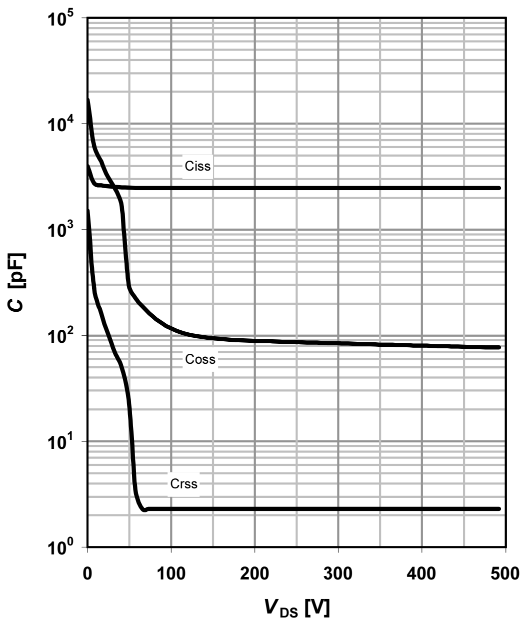

**12 Drain-source breakdown voltage**

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



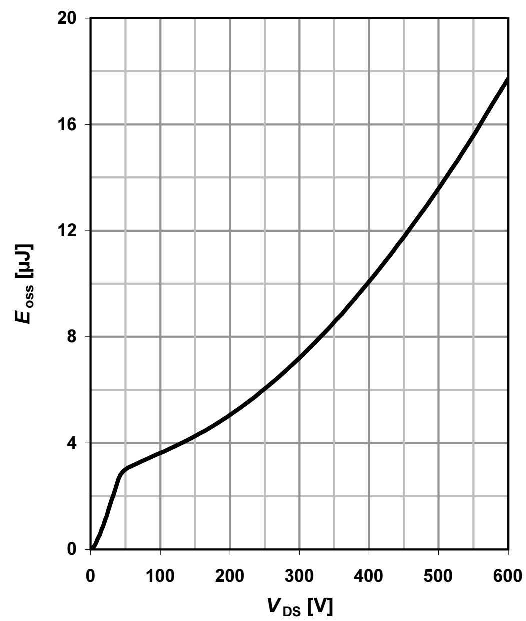
**13 Typ. capacitances**

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

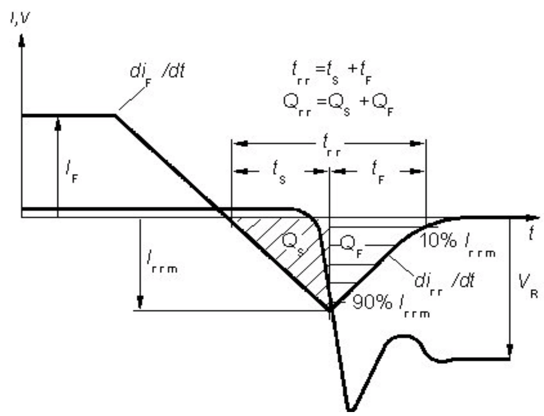



**14 Typ. Coss stored energy**

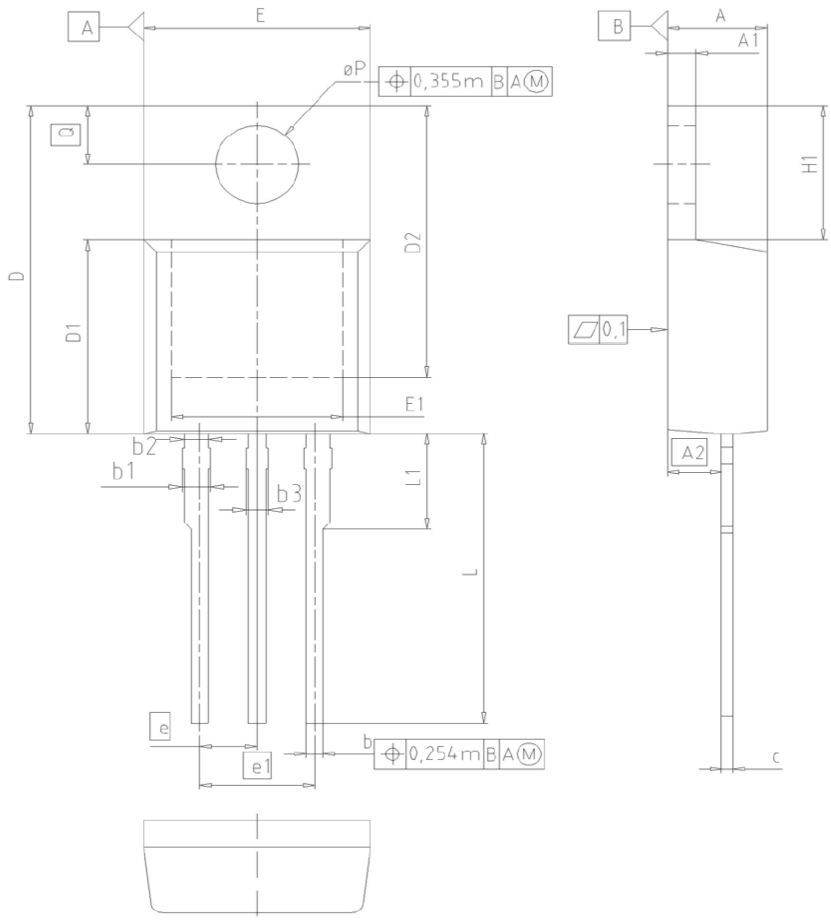
$E_{oss}$=f($V_{DS}$)



**Definition of diode switching characteristics**



**PG-TO220-3-1/TO-220-3-21: Outlines**




| DIM | MILLIMETERS | | INCHES | |
|---|---|---|---|---|
| | MIN | MAX | MIN | MAX |
| A | 4.30 | 4.57 | 0.169 | 0.180 |
| A1 | 1.17 | 1.40 | 0.046 | 0.055 |
| A2 | 2.15 | 2.72 | 0.085 | 0.107 |
| b | 0.65 | 0.86 | 0.026 | 0.034 |
| b1 | 0.95 | 1.40 | 0.037 | 0.055 |
| b2 | 0.95 | 1.15 | 0.037 | 0.045 |
| b3 | 0.65 | 1.15 | 0.026 | 0.045 |
| c | 0.33 | 0.60 | 0.013 | 0.024 |
| D | 14.81 | 15.95 | 0.583 | 0.628 |
| D1 | 8.51 | 9.45 | 0.335 | 0.372 |
| D2 | 12.19 | 13.10 | 0.480 | 0.516 |
| E | 9.70 | 10.36 | 0.382 | 0.408 |
| E1 | 6.50 | 8.60 | 0.256 | 0.339 |
| e | 2.54 | | 0.100 | |
| e1 | 5.08 | | 0.200 | |
| N | 3 | | 3 | |
| H1 | 5.90 | 6.90 | 0.232 | 0.272 |
| L | 13.00 | 14.00 | 0.512 | 0.551 |
| L1 | - | 4.80 | - | 0.189 |
| øP | 3.60 | 3.89 | 0.142 | 0.153 |
| Q | 2.60 | 3.00 | 0.102 | 0.118 |

**DOCUMENT NO.**
Z8B00003318

**SCALE**
0
2.5
0 2.5
5mm

**EUROPEAN PROJECTION**

**ISSUE DATE**
23-08-2007

**REVISION**
05

Dimensions in mm/inches:

Published by
Infineon Technologies AG
81726 München, Germany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