## CoolMOS™ Power Transistor

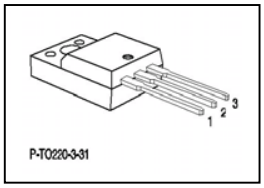
### Features

- Lowest figure of merit $R_{ON}$ x $Q_g$
- Ultra low gate charge
- Extreme dv/dt rated
- High peak current capability
- Pb-free lead plating; RoHS compliant; Halogen free for mold compound
- Qualified for industrial grade applications according to JEDEC[0)]

### Product Summary

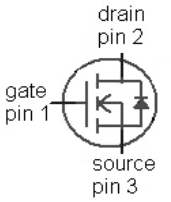
| | | |
|---|---|---|
| $V_{DS}$ @$T_{jmax}$ | 550 | V |
| $R_{DS(on),max}$ | 0.250 | Ω |
| $Q_{g,typ}$ | 27 | nC |

TO220 FP




### CoolMOS CP is designed for:

- Hard- & Softswitching SMPS topologies
- CCM PFC for ATX, Notebookadapter, PDP and LCD TV
- PWM for ATX, Notebookadapter, PDP and LCD TV




| Type | Package | Marking |
|---|---|---|
| IPA50R250CP | PG-TO220FP | 5R250P |

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

| Parameter | Symbol | Conditions | Value | Unit |
|---|---|---|---|---|
| Continuous drain current[1)] | $I_D$ | $T_C$=25 °C | 13 | A |
| | | $T_C$=100 °C | 9 | |
| Pulsed drain current[2)] | $I_{D,pulse}$ | $T_C$=25 °C | 31 | |
| 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...400 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 | 33 | W |
| Operating and storage temperature | $T_j$, $T_{stg}$ | | -55 ... 150 | °C |
| Mounting torque | | M2.5 screws | 60 | Ncm |

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

| Parameter | Symbol | Conditions | Value | Unit |
|---|---|---|---|---|
| Continuous diode forward current[1)] | $I_S$ | $T_C$=25 °C | 7.8 | A |
| Diode pulse current[2)] | $I_{S,pulse}$ | | 31 | |
| 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 | $R_{thJC}$ | | - | - | 3.75 | 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 | 500 | - | - | V |
| Gate threshold voltage | $V_{GS(th)}$ | $V_{DS}$=$V_{GS}$, $I_D$=0.52 mA | 2.5 | 3 | 3.5 | |
| Zero gate voltage drain current | $I_{DSS}$ | $V_{DS}$=500 V, $V_{GS}$=0 V, $T_j$=25 °C | - | - | 1 | µA |
| | | $V_{DS}$=500 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 | - | 0.54 | - | |
| Gate resistance | $R_G$ | $f$=1 MHz, open drain | - | 2.2 | - | 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 | - | 1420 | - | pF |
| Output capacitance | $C_{oss}$ | | - | 63 | - | |
| Effective output capacitance, energy related[5)] | $C_{o(er)}$ | $V_{GS}$=0 V, $V_{DS}$=0 V to 400 V | - | 60 | - | |
| Effective output capacitance, time related[6)] | $C_{o(tr)}$ | | - | 130 | - | |
| 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 | - | 35 | - | ns |
| Rise time | $t_r$ | | - | 14 | - | |
| Turn-off delay time | $t_{d(off)}$ | | - | 80 | - | |
| Fall time | $t_f$ | | - | 11.0 | - | |
| 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 | $Q_g$ | | - | 27 | 36 | |
| Gate plateau voltage | $V_{plateau}$ | | - | 5.2 | - | 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, $I_F$=$I_S$, d$i_F$/d$t$=100 A/µs | - | 300 | - | ns |
| Reverse recovery charge | $Q_{rr}$ | | - | 3.1 | - | µC |
| Peak reverse recovery current | $I_{rrm}$ | | - | 23 | - | A |

[0)] J-STD20 and JESD22

[1)] Limited only by $T_{j,max}$

[2)] Pulse width $t_p$ limited by $T_{j,max}$

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

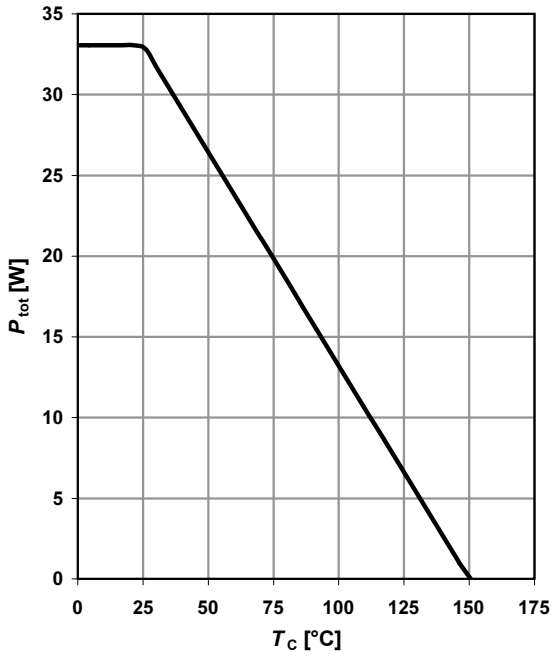
[4)] $I_{SD}$≤$I_D$, d$i$/d$t$≤200A/µs, $V_{DClink}$=400V, $V_{peak}$<$V_{(BR)DSS}$, $T_j$<$T_{jmax}$, identical low and high side switch

[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

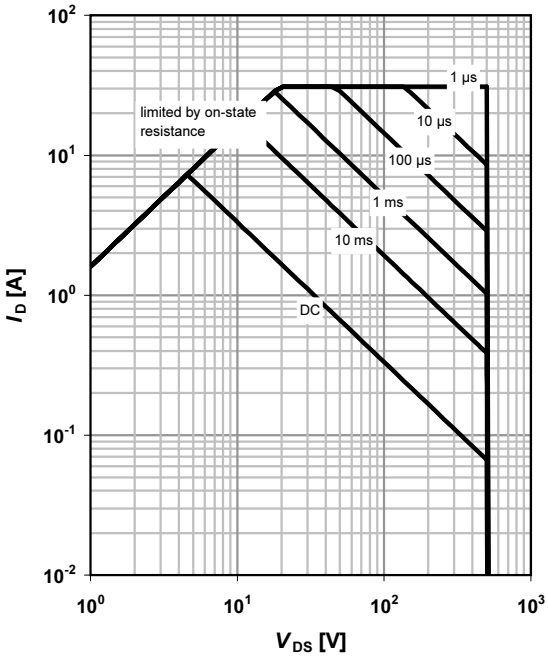
$P_{tot}=f(T_C)$




### 2 Safe operating area

$I_D=f(V_{DS})$; $T_C=25$ °C; $D=0$

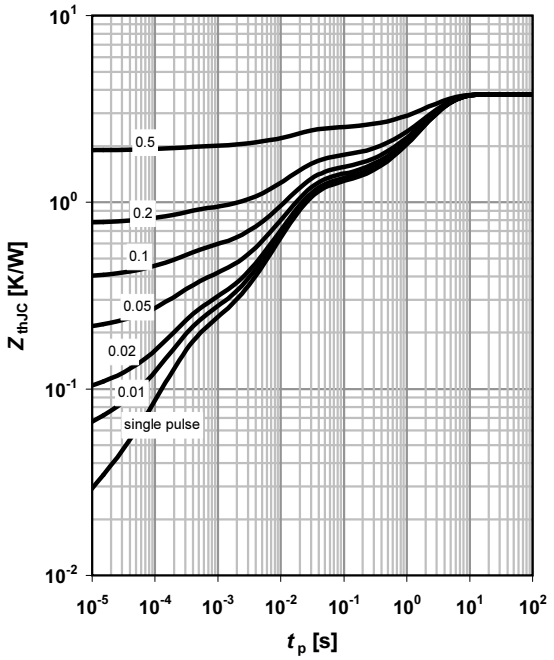
parameter: $t_p$




### 3 Max. transient thermal impedance

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

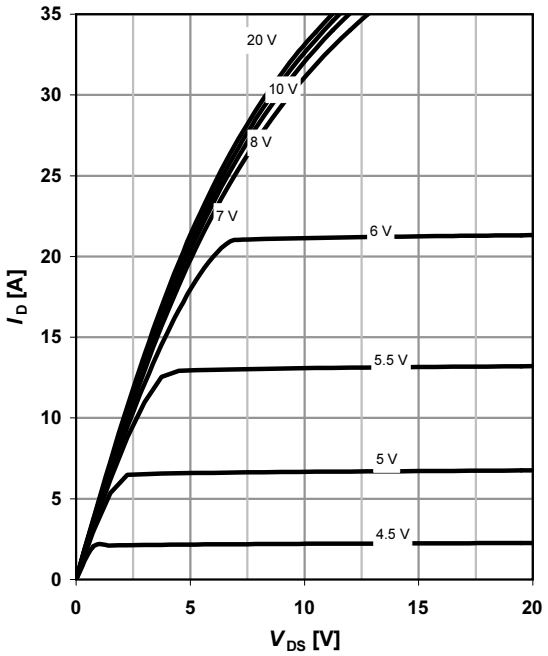
parameter: $D=t_p/T$




### 4 Typ. output characteristics

$I_D=f(V_{DS})$; $T_j=25$ °C

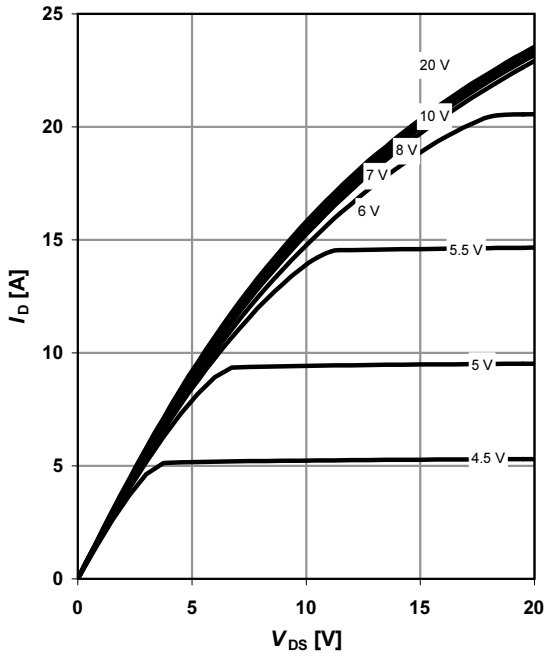
parameter: $V_{GS}$



### 5 Typ. output characteristics

$I_D$=f($V_{DS}$); $T_j$=150 °C

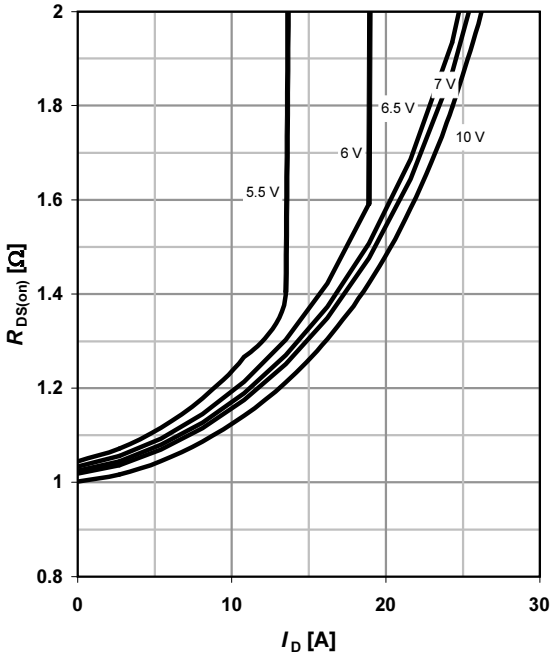
parameter: $V_{GS}$




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

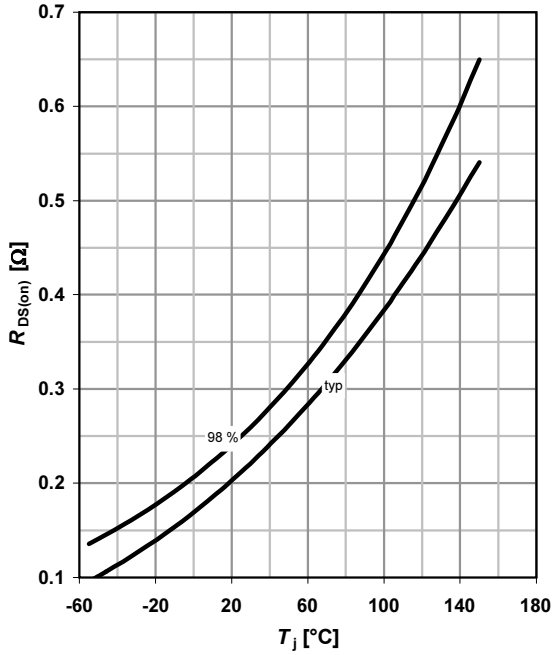
$R_{DS(on)}$=f($I_D$); $T_j$=150 °C

parameter: $V_{GS}$




### 7 Drain-source on-state resistance

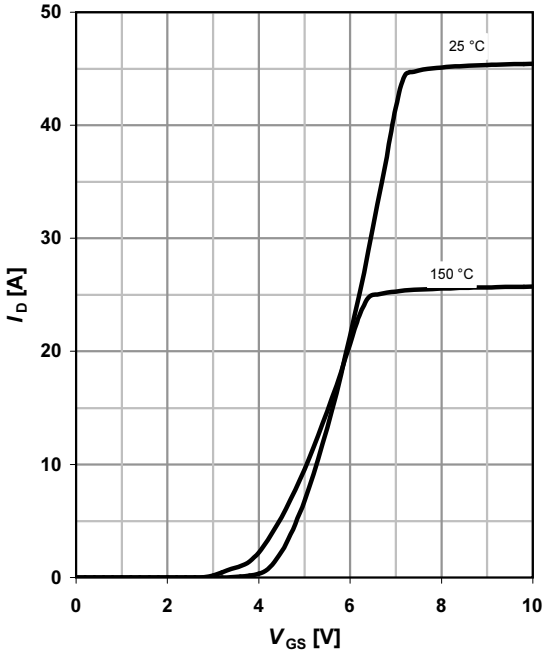
$R_{DS(on)}$=f($T_j$); $I_D$=7.8 A; $V_{GS}$=10 V




### 8 Typ. transfer characteristics

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

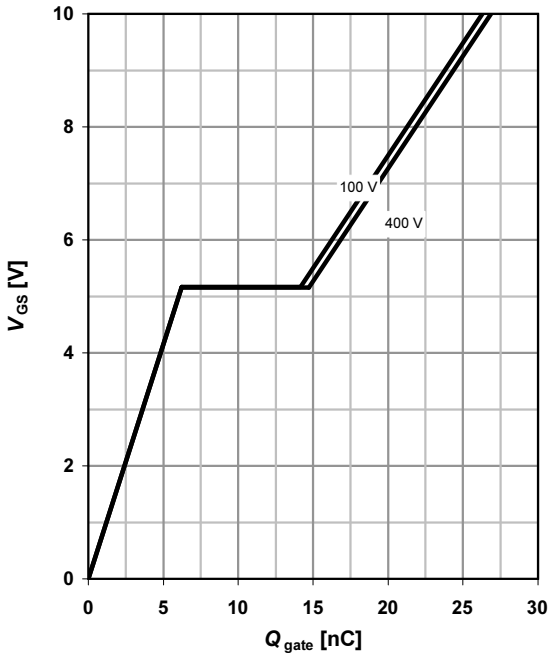
parameter: $T_j$



### 9 Typ. gate charge

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

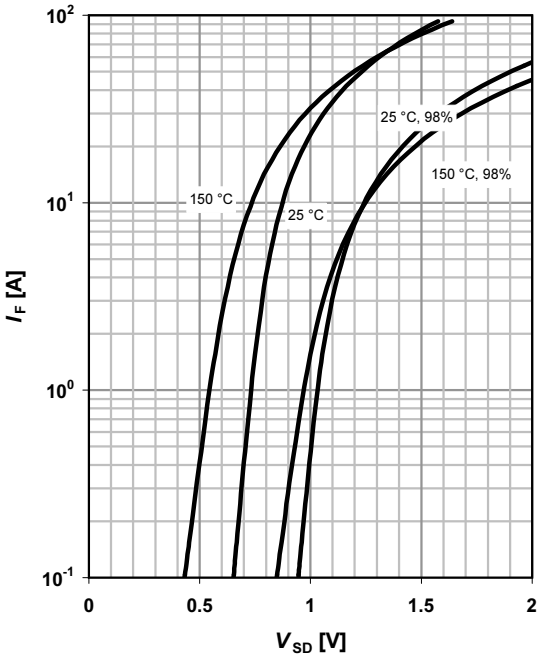
parameter: $V_{DD}$




### 10 Forward characteristics of reverse diode

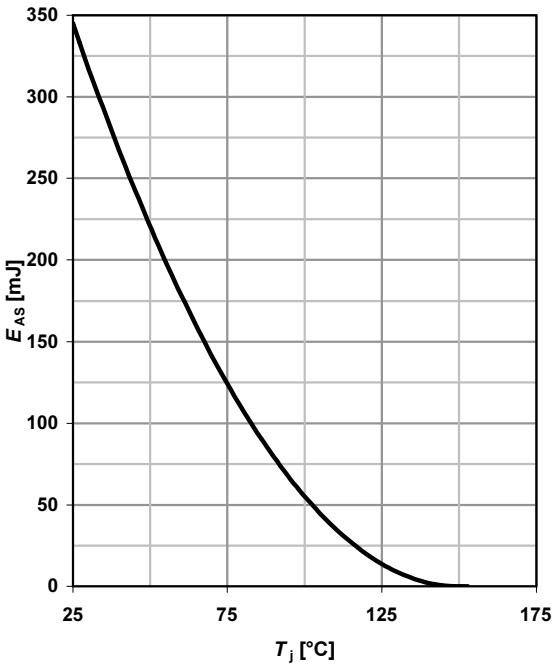
$I_F$=f($V_{SD}$)

parameter: $T_j$



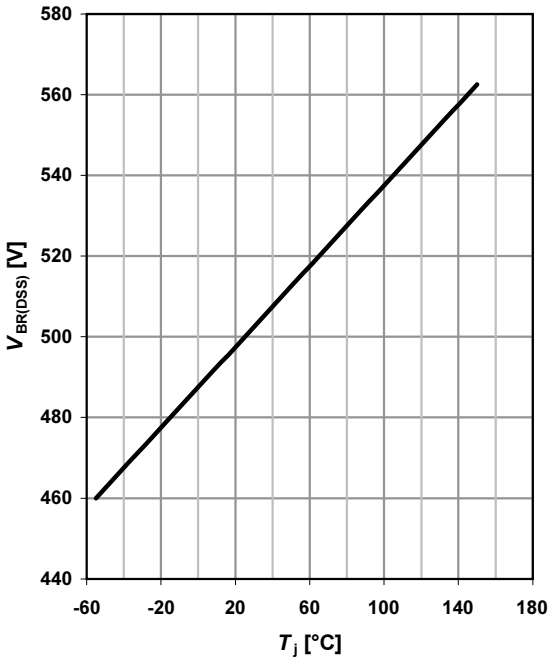

### 11 Avalanche energy

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



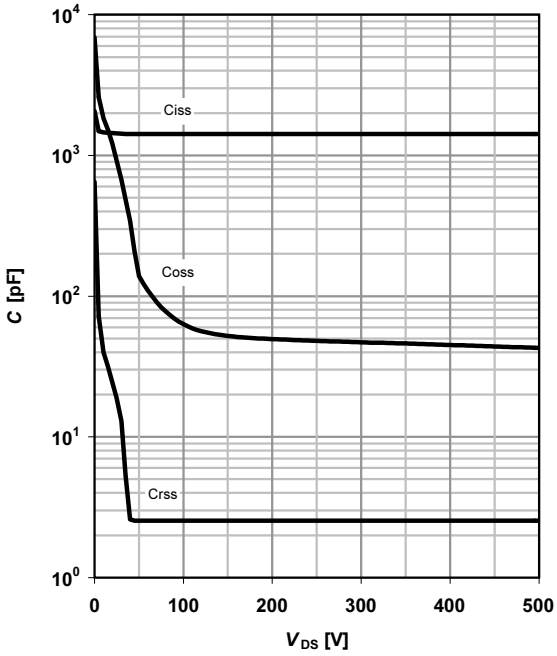

### 12 Drain-source breakdown voltage

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



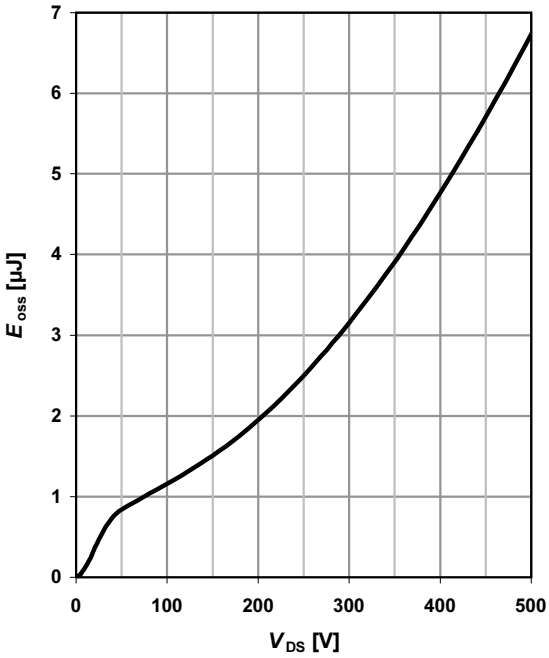
### 13 Typ. capacitances

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

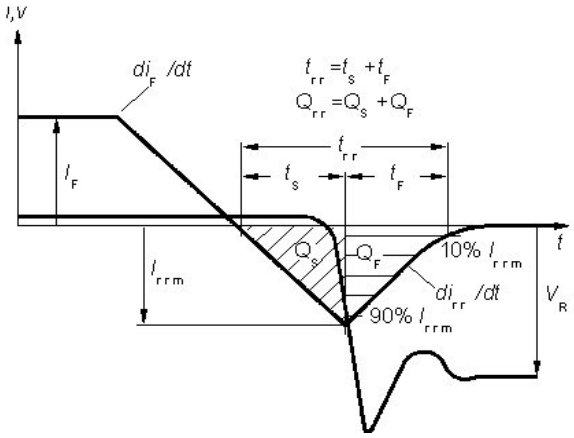



### 14 Typ. Coss stored energy

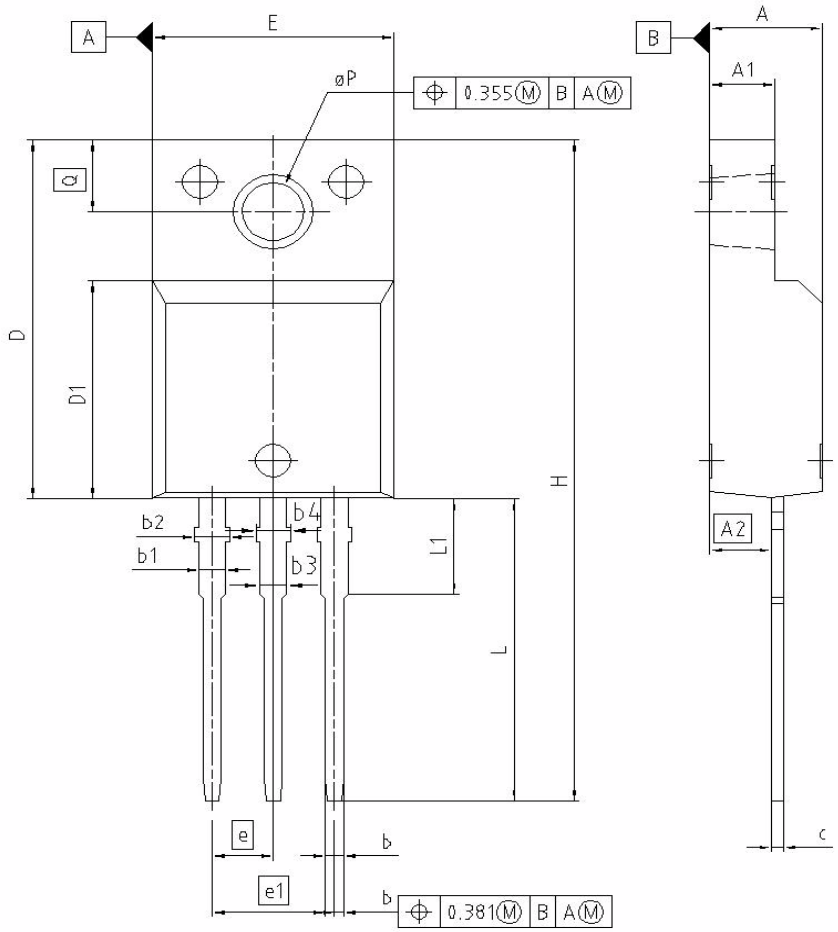
$E_{oss}$= f($V_{DS}$)



**Definition of diode switching characteristics**



**PG-TO220-3-31;-3-111: Outline / Fully isolated package (2500VAC; 1minute)**




| DIM | MILLIMETERS | | INCHES | |
|---|---|---|---|---|
| | MIN | MAX | MIN | MAX |
| A | 4.55 | 4.85 | 0.179 | 0.191 |
| A1 | 2.55 | 2.85 | 0.100 | 0.112 |
| A2 | 2.42 | 2.72 | 0.095 | 0.107 |
| b | 0.65 | 0.85 | 0.026 | 0.033 |
| b1 | 0.95 | 1.33 | 0.037 | 0.052 |
| b2 | 0.95 | 1.51 | 0.037 | 0.059 |
| b3 | 0.65 | 1.33 | 0.026 | 0.052 |
| b4 | 0.65 | 1.51 | 0.026 | 0.059 |
| c | 0.40 | 0.63 | 0.016 | 0.025 |
| D | 15.85 | 16.15 | 0.624 | 0.636 |
| D1 | 9.53 | 9.83 | 0.375 | 0.387 |
| E | 10.35 | 10.65 | 0.407 | 0.419 |
| e | 2.54 | | 0.100 | |
| e1 | 5.08 | | 0.200 | |
| N | 3 | | 3 | |
| H | 29.45 | 29.75 | 1.159 | 1.171 |
| L | 13.45 | 13.75 | 0.530 | 0.541 |
| L1 | 3.15 | 3.45 | 0.124 | 0.136 |
| øP | 2.95 | 3.20 | 0.116 | 0.126 |
| Q | 3.15 | 3.50 | 0.124 | 0.138 |

| | |
|---|---|
| REFERENCE | ../.. |
| SCALE | 0, 2.5, 0, 2.5, 5mm |
| EUROPEAN PROJECTION | |
| ISSUE DATE | 08-01-2007 |
| FILE | TO220_2 |

Dimensions in mm/inches

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