## CoolMOS® Power Transistor

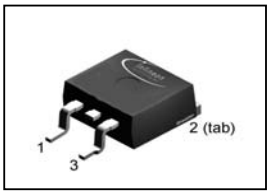
### Features

- 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

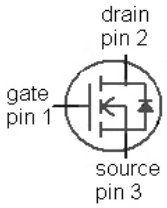
| | | |
|---|---|---|
| $V_{DS}$ @ $T_{j,max}$ | 650 | V |
| $R_{DS(on),max}$ | 0.165 | Ω |
| $Q_{g,typ}$ | 39 | nC |

PG-TO263




### CoolMOS CP is specially designed for:

- Hard switching topologies for Server and Telecom




| Type | Package | Ordering Code | Marking |
|---|---|---|---|
| IPB60R165CP | PG-TO263 | SP000096439 | 6R165P |

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

| Parameter | Symbol | Conditions | Value | Unit |
|---|---|---|---|---|
| Continuous drain current | $I_D$ | $T_C$=25 °C | 21 | A |
| | | $T_C$=100 °C | 13 | |
| Pulsed drain current[2)] | $I_{D,pulse}$ | $T_C$=25 °C | 61 | |
| Avalanche energy, single pulse | $E_{AS}$ | $I_D$=7.9 A, $V_{DD}$=50 V | 522 | mJ |
| Avalanche energy, repetitive $t_{AR}$[2),3)] | $E_{AR}$ | $I_D$=7.9 A, $V_{DD}$=50 V | 0.79 | |
| Avalanche current, repetitive $t_{AR}$[2),3)] | $I_{AR}$ | | 7.9 | A |
| MOSFET $dv/dt$ ruggedness | $dv/dt$ | $V_{DS}$=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 | 192 | 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 | 12 | A |
| Diode pulse current[2] | $I_{S,pulse}$ | | 61 | |
| 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 | $R_{thJC}$ | | - | - | 0.65 | K/W |
| Thermal resistance, junction - ambient | $R_{thJA}$ | SMD version, device on PCB, minimal footprint | -- | | 62 | |
| | | SMD version, device on PCB, 6 cm$^2$ cooling area[5] | | 35 | | |
| Soldering temperature, reflowsoldering | $T_{sold}$ | reflow MSL 1 | - | - | 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 | $V_{GS(th)}$ | $V_{DS}$=$V_{GS}$, $I_D$=0.79 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 | -1 | 0- | | |
| 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, $I_D$=12 A, $T_j$=25 °C | - | 0.15 | 0.165 | Ω |
| | | $V_{GS}$=10 V, $I_D$=12 A, $T_j$=150 °C | - | 0.40 | - | |
| Gate resistance | $R_G$ | $f$=1 MHz, open drain | - | 1.9 | - | 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 | - | 2000 | - | pF |
| Output capacitance | $C_{oss}$ | | - | 100 | - | |
| Effective output capacitance, energy related[6)] | $C_{o(er)}$ | $V_{GS}$=0 V, $V_{DS}$=0 V to 480 V | - | 83 | - | |
| Effective output capacitance, time related[7)] | $C_{o(tr)}$ | | - | 220 | - | |
| Turn-on delay time | $t_{d(on)}$ | $V_{DD}$=400 V, $V_{GS}$=10 V, $I_D$=12 A, $R_G$=3.3 Ω | - | 12 | - | 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, $I_D$=12 A, $V_{GS}$=0 to 10 V | - | 9 | - | nC |
| Gate to drain charge | $Q_{gd}$ | | - | 13.0 | - | |
| Gate charge total | $Q_g$ | | - | 39 | 52 | |
| Gate plateau voltage | $V_{plateau}$ | | - | 5.0 | - | V |
| **Reverse Diode** | | | | | | |
| Diode forward voltage | $V_{SD}$ | $V_{GS}$=0 V, $I_F$=12 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 | - | 390 | - | ns |
| Reverse recovery charge | $Q_{rr}$ | | - | 7.5 | - | µC |
| Peak reverse recovery current | $I_{rrm}$ | | -3 | 8- | | 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

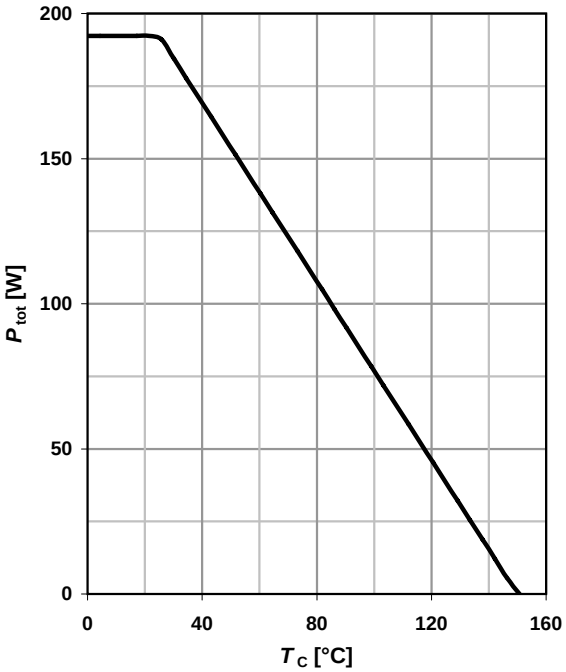
[5)] Device on 40mm*40mm*1.5 epoxy PCB FR4 with 6cm2 (one layer, 70µm thick) copper area for drain connection. PCB is vertical without blown air

[6)] $C_{o(er)}$ is a fixed capacitance that gives the same stored energy as $C_{oss}$ while $V_{DS}$ is rising from 0 to 80% $V_{DSS}$.

[7)] $C_{o(tr)}$ 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

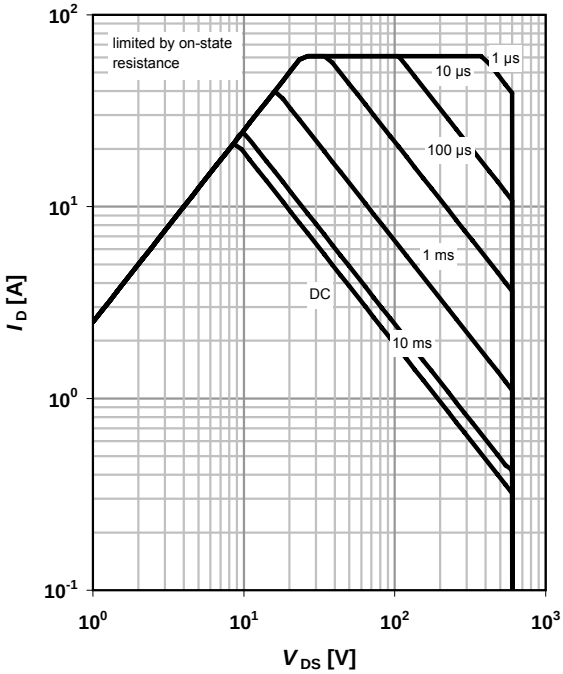
$P_{tot}=f(T_C)$




### 2 Safe operating area

$I_D=f(V_{DS})$; $T_C=25$ °C; $D=0$

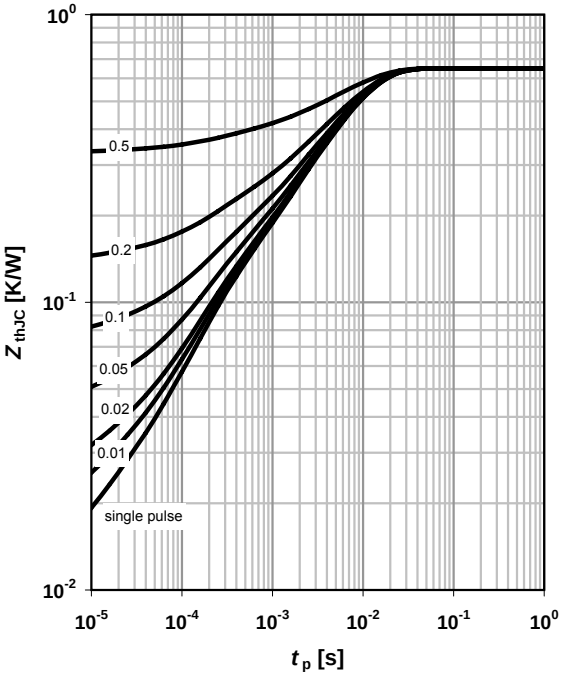
parameter: $t_p$




### 3 Max. transient thermal impedance

$Z_{thJC}=f(t_p)$

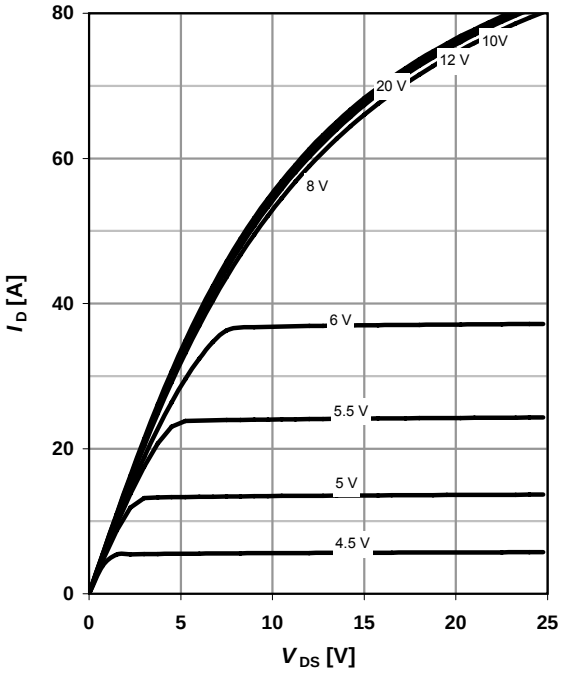
parameter: $D=t_p/T$




### 4 Typ. output characteristics

$I_D=f(V_{DS})$; $T_j=25$ °C

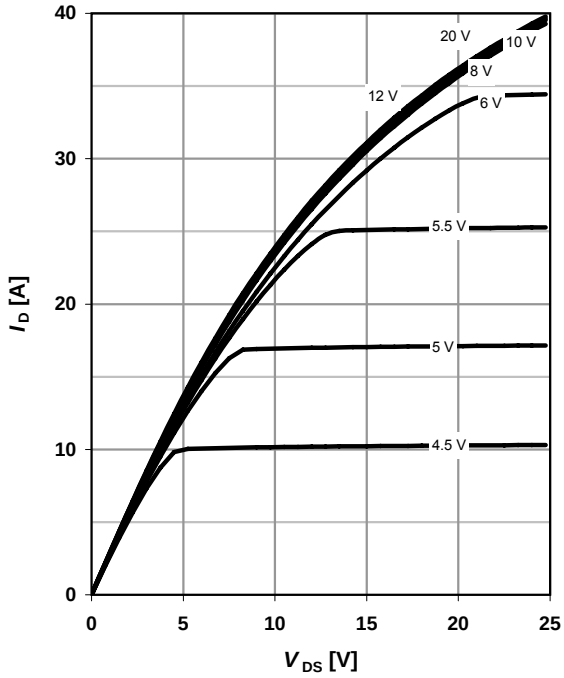
parameter: $V_{GS}$



### 5 Typ. output characteristics

$I_D=f(V_{DS})$; $T_j=150$ °C

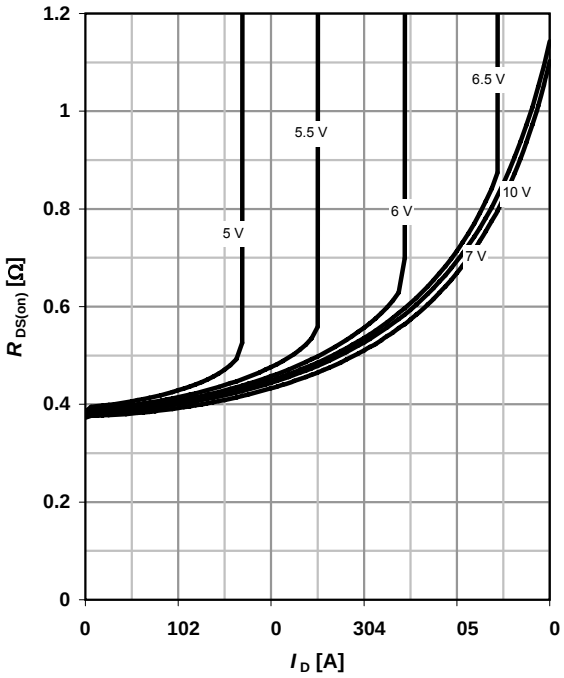
parameter: $V_{GS}$




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

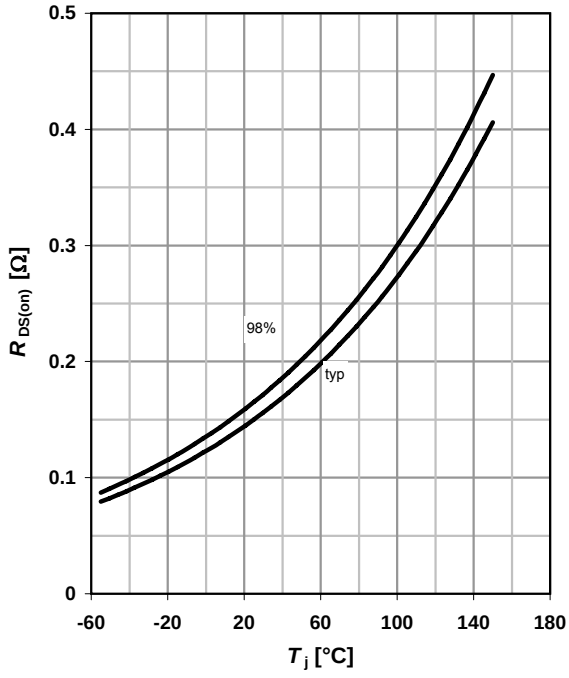
$R_{DS(on)}=f(I_D)$; $T_j=150$ °C

parameter: $V_{GS}$




### 7 Drain-source on-state resistance

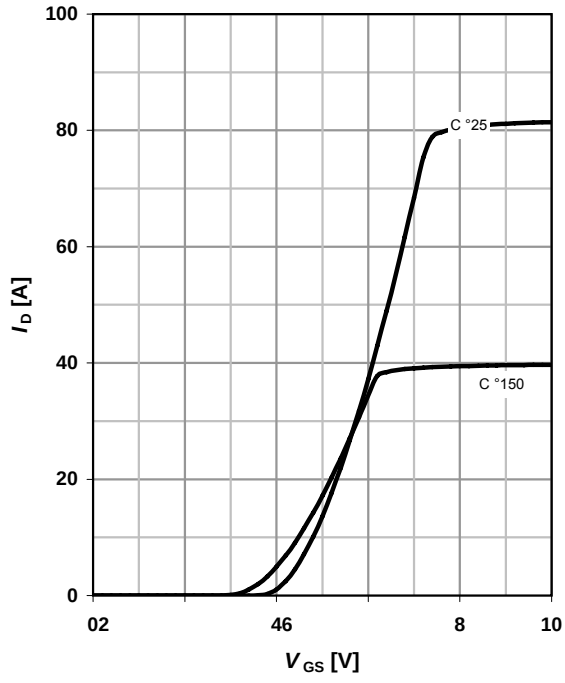
$R_{DS(on)}=f(T_j)$; $I_D=12$ A; $V_{GS}=10$ V




### 8 Typ. transfer characteristics

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

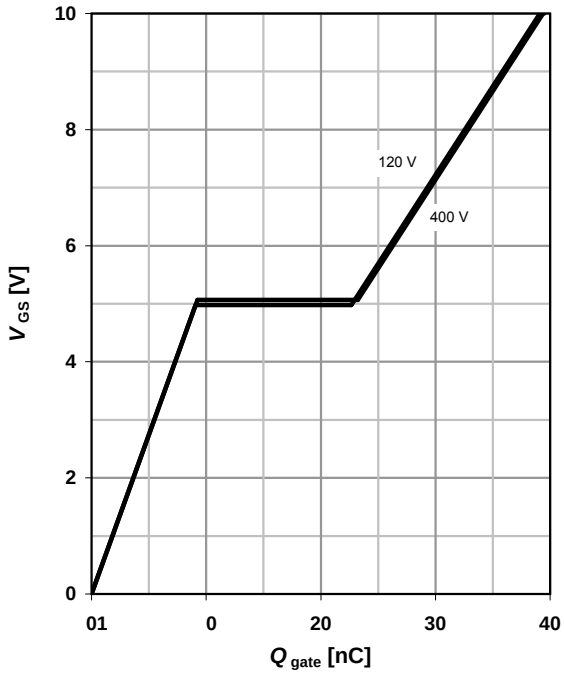
parameter: $T_j$



### 9 Typ. gate charge

$V_{GS}$=f($Q_{gate}$); $I_D$=12 A pulsed

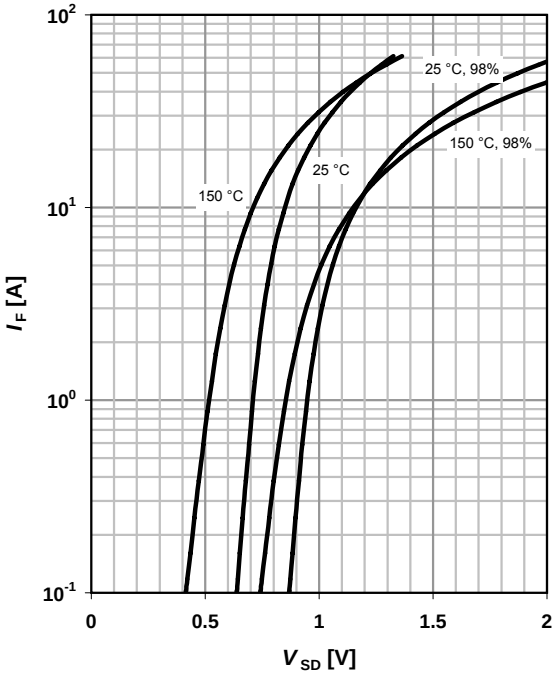
parameter: $V_{DD}$




### 10 Forward characteristics of reverse diode

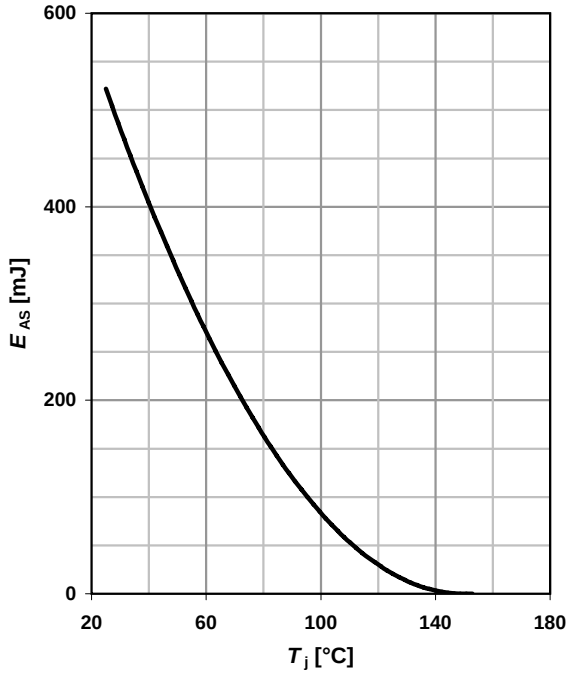
$I_F$=f($V_{SD}$)

parameter: $T_j$



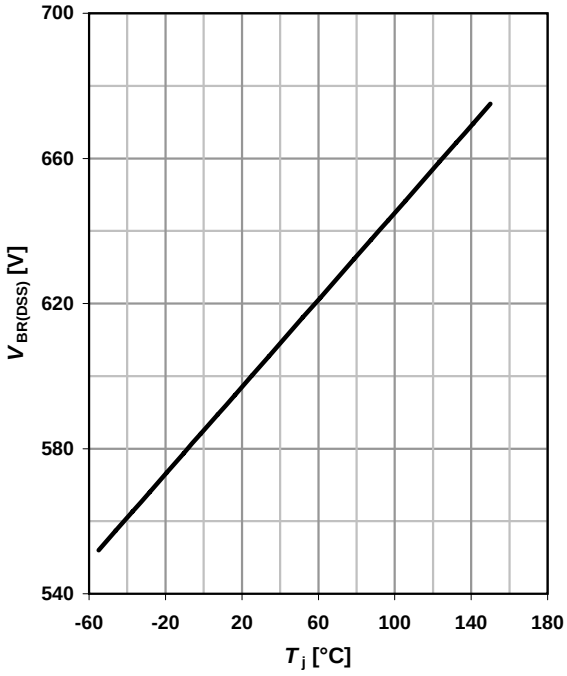

### 11 Avalanche energy

$E_{AS}$=f($T_j$); $I_D$=7.9 A; $V_{DD}$=50 V



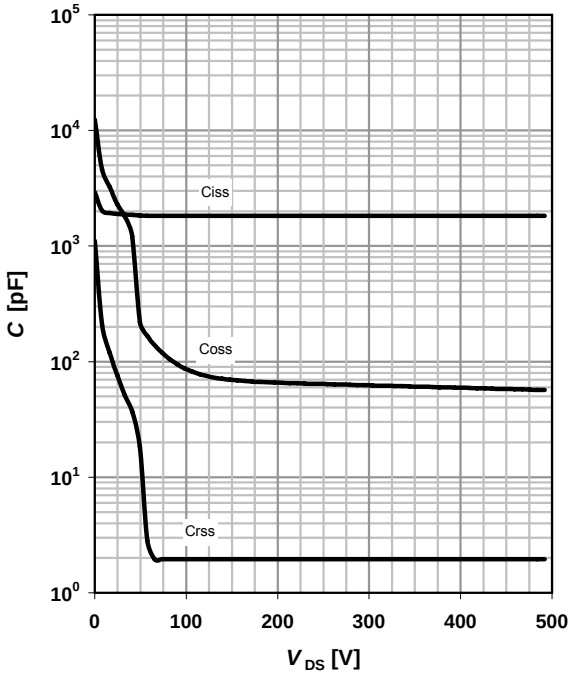

### 12 Drain-source breakdown voltage

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



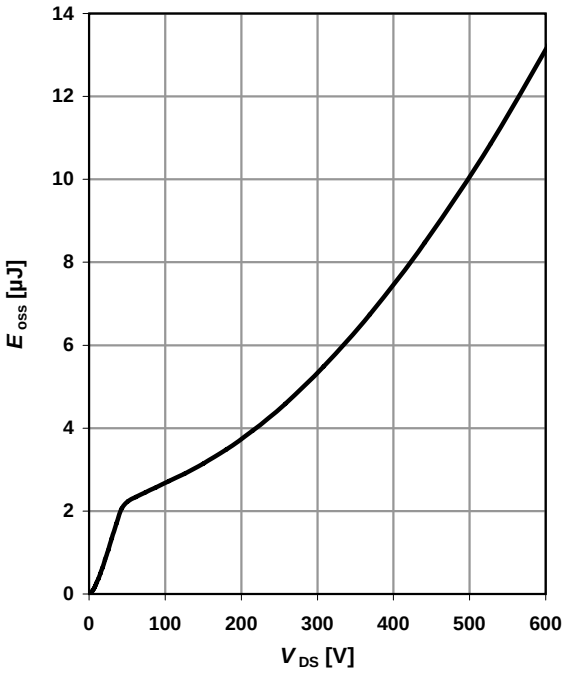
## 13 Typ. capacitances

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

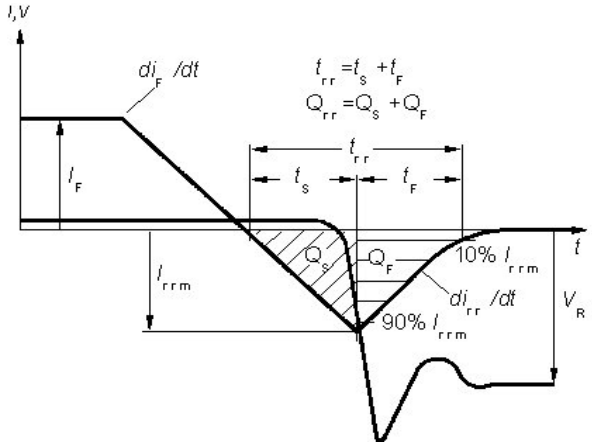



## 14 Typ. Coss stored energy

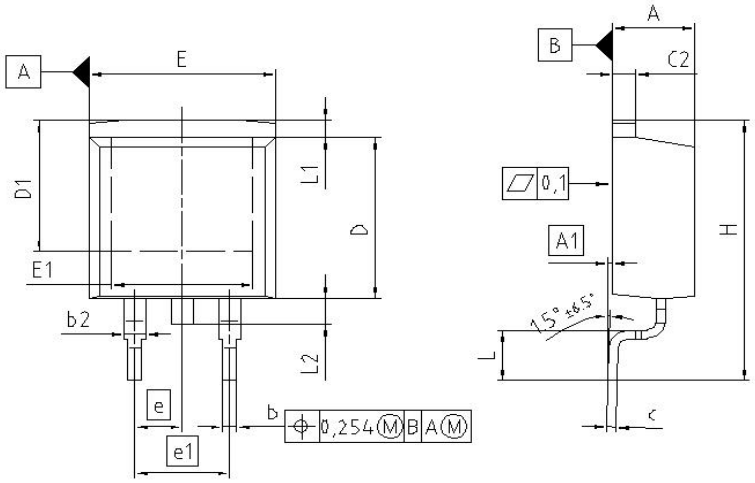
$E_{oss}$= f($V_{DS}$)



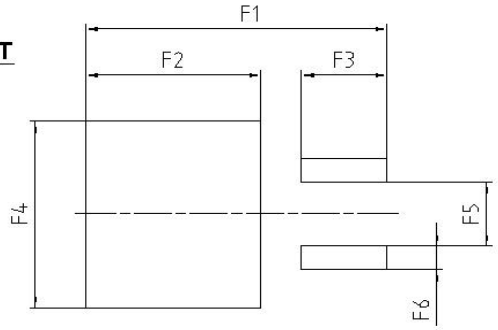
**Definition of diode switching characteristics**



**PG-TO263-3-2/TO-263-3-5/TO263-3-22: Outlines**




**FOOTPRINT**

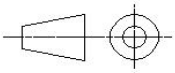



| DIM | MILLIMETERS | | INCHES | |
|---|---|---|---|---|
| | MIN | MAX | MIN | MAX |
| **A** | 4.300 | 4.572 | 0.169 | 0.180 |
| **A1** | 0.000 | 0.254 | 0.000 | 0.010 |
| **b** | 0.650 | 0.850 | 0.026 | 0.033 |
| **b2** | 0.950 | 1.321 | 0.037 | 0.052 |
| **c** | 0.330 | 0.650 | 0.013 | 0.026 |
| **c2** | 0.170 | 1.400 | 0.046 | 0.055 |
| **D** | 8.509 | 9.450 | 0.335 | 0.372 |
| **D1** | 7.100 | - | 0.280 | - |
| **E** | 9.800 | 10.312 | 0.386 | 0.406 |
| **E1** | 6.500 | | 0.256 | |
| **e** | 2.540 | | 0.100 | |
| **e1** | 5.080 | | 0.200 | |
| **N** | 2 | | 2 | |
| **H** | 14.605 | 15.875 | 0.575 | 0.625 |
| **L** | 2.200 | 3.000 | 0.087 | 0.118 |
| **L1** | - | 1.600 | - | 0.063 |
| **L2** | 1.000 | 1.778 | 0.039 | 0.070 |
| **F1** | 16.050 | 16.250 | 0.632 | 0.640 |
| **F2** | 9.300 | 9.500 | 0.366 | 0.374 |
| **F3** | 4.500 | 4.700 | 0.177 | 0.185 |
| **F4** | 10.700 | 10.900 | 0.421 | 0.429 |
| **F5** | 3.630 | 3.830 | 0.143 | 0.151 |
| **F6** | 1.100 | 1.300 | 0.043 | 0.051 |

**REFERENCE**
JEDEC TO263

**SCALE**
0 5 5 7.5mm

**EUROPEAN PROJECTION**



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**FILE**
TO263_2

Dimensions in mm/inches

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