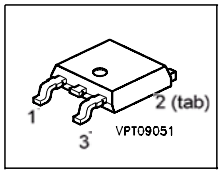
## Cool MOS™ Power Transistor

| | | |
|---|---|---|
| $V_{DS}$ @ $T_{jmax}$ | 560 | V |
| $R_{DS(on)}$ | 3 | Ω |
| $I_D$ | 1.8 | A |

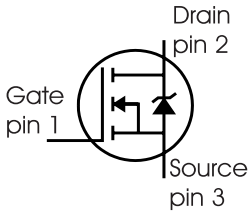
PG-TO252




### Feature

- New revolutionary high voltage technology
- Ultra low gate charge
- Periodic avalanche rated
- Extreme d*v*/d*t* rated
- Ultra low effective capacitances
- Improved transconductance
- Pb-free lead plating; RoHS compliant
- Qualified according to JEDEC[0)] for target applications

| Type | Package | Ordering Code | Marking |
|---|---|---|---|
| SPD02N50C3 | PG-TO252 | Q67040-S4570 | 02N50C3 |




### Maximum Ratings

| Parameter | Symbol | Value | Unit |
|---|---|---|---|
| Continuous drain current<br>$T_C$ = 25 °C<br>$T_C$ = 100 °C | $I_D$ | <br>1.8<br>1.1 | A |
| Pulsed drain current, $t_p$ limited by $T_{jmax}$ | $I_{D\ puls}$ | 5.4 | |
| Avalanche energy, single pulse<br>$I_D$ = 1.35 A, $V_{DD}$ = 50 V | $E_{AS}$ | 50 | mJ |
| Avalanche energy, repetitive $t_{AR}$ limited by $T_{jmax}$[1]<br>$I_D$ = 1.8 A, $V_{DD}$ = 50 V | $E_{AR}$ | 0.07 | |
| Avalanche current, repetitive $t_{AR}$ limited by $T_{jmax}$ | $I_{AR}$ | 1.8 | A |
| Gate source voltage | $V_{GS}$ | ±20 | V |
| Gate source voltage AC (f >1Hz) | $V_{GS}$ | ±30 | |
| Power dissipation, $T_C$ = 25°C | $P_{tot}$ | 25 | W |
| Operating and storage temperature | $T_j$ , $T_{stg}$ | -55... +150 | °C |
| Reverse diode dv/dt [5)] | dv/dt | 15 | V/ns |

**Maximum Ratings**

| Parameter | Symbol | Value | Unit |
|---|---|---|---|
| Drain Source voltage slope<br>$V_{DS}$ = 400 V, $I_D$ = 1.8 A, $T_j$ = 125 °C | d$v$/d$t$ | 50 | V/ns |

**Thermal Characteristics**

| Parameter | Symbol | Values | | | Unit |
|---|---|---|---|---|---|
| | | min. | typ. | max. | |
| Thermal resistance, junction - case | $R_{thJC}$ | - | - | 5 | K/W |
| Thermal resistance, junction - ambient, leaded | $R_{thJA}$ | - | - | 75 | |
| SMD version, device on PCB:<br>@ min. footprint<br>@ 6 cm$^2$ cooling area [2)] | $R_{thJA}$ | <br>-<br>- | <br>-<br>- | <br>75<br>50 | |
| Soldering temperature, reflow soldering, MSL3<br>1.6 mm (0.063 in.) from case for 10s | $T_{sold}$ | - | - | 260 | °C |

**Electrical Characteristics,** at $T$j=25°C unless otherwise specified

| Parameter | Symbol | Conditions | Values | | | Unit |
|---|---|---|---|---|---|---|
| | | | min. | typ. | max. | |
| Drain-source breakdown voltage | $V_{(BR)DSS}$ | $V_{GS}$=0V, $I_D$=0.25mA | 500 | - | - | V |
| Drain-Source avalanche breakdown voltage | $V_{(BR)DS}$ | $V_{GS}$=0V, $I_D$=1.8A | - | 600 | - | |
| Gate threshold voltage | $V_{GS(th)}$ | $I_D$=80µA, $V_{GS}$=$V_{DS}$ | 2.1 | 3 | 3.9 | |
| Zero gate voltage drain current | $I_{DSS}$ | $V_{DS}$=500V, $V_{GS}$=0V,<br>$T_j$=25°C,<br>$T_j$=150°C | <br>-<br>- | <br>0.1<br>- | <br>1<br>100 | µA |
| Gate-source leakage current | $I_{GSS}$ | $V_{GS}$=20V, $V_{DS}$=0V | - | - | 100 | nA |
| Drain-source on-state resistance | $R_{DS(on)}$ | $V_{GS}$=10V, $I_D$=1.1A,<br>$T_j$=25°C<br>$T_j$=150°C | <br>-<br>- | <br>2.7<br>7.3 | <br>3<br>- | Ω |
| Gate input resistance | $R_G$ | $f$=1MHz, open Drain | - | 12 | - | |

**Electrical Characteristics** , at $T_j$ = 25 °C, unless otherwise specified

| Parameter | Symbol | Conditions | Values | | | Unit |
|---|---|---|---|---|---|---|
| | | | min. | typ. | max. | |
| Transconductance | $g_{fs}$ | $V_{DS}\geq 2*I_D*R_{DS(on)max}$, $I_D$=1.1A | - | 1.8 | - | S |
| Input capacitance | $C_{iss}$ | $V_{GS}$=0V, $V_{DS}$=25V, $f$=1MHz | - | 190 | - | pF |
| Output capacitance | $C_{oss}$ | | - | 80 | - | |
| Reverse transfer capacitance | $C_{rss}$ | | - | 2 | - | |
| Effective output capacitance,[3] energy related | $C_{o(er)}$ | $V_{GS}$=0V, $V_{DS}$=0V to 400V | - | 9 | - | pF |
| Effective output capacitance,[4] time related | $C_{o(tr)}$ | | - | 17 | - | |
| Turn-on delay time | $t_{d(on)}$ | $V_{DD}$=350V, $V_{GS}$=0/10V, $I_D$=1.8A, $R_G$=25Ω | - | 10 | - | ns |
| Rise time | $t_r$ | | - | 5 | - | |
| Turn-off delay time | $t_{d(off)}$ | | - | 70 | - | |
| Fall time | $t_f$ | | - | 15 | - | |

**Gate Charge Characteristics**

| | | | | | | |
|---|---|---|---|---|---|---|
| Gate to source charge | $Q_{gs}$ | $V_{DD}$=400V, $I_D$=1.8A | - | 1.5 | - | nC |
| Gate to drain charge | $Q_{gd}$ | | - | 4.5 | - | |
| Gate charge total | $Q_g$ | $V_{DD}$=400V, $I_D$=1.8A, $V_{GS}$=0 to 10V | - | 9 | - | |
| Gate plateau voltage | $V_{(plateau)}$ | $V_{DD}$=400V, $I_D$=1.8A | - | 5 | - | V |

[0] J-STD20 and JESD22

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

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

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

[4] $C_{o(tr)}$ is a fixed capacitance that gives the same charging time as $C_{oss}$ while $V_{DS}$ is rising from 0 to 80% $V_{DSS}$.

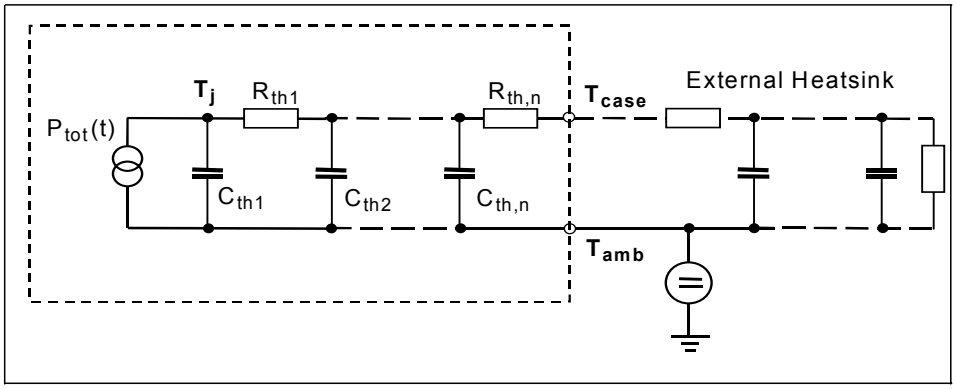
[5] $I_{SD}$<=$I_D$, di/dt<=400A/us, $V_{DClink}$=400V, $V_{peak}$<$V_{BR, DSS,}$ $T_j$<$T_{j,max}$.
Identical low-side and high-side switch.

**Electrical Characteristics**, at $T_j$ = 25 °C, unless otherwise specified

| Parameter | Symbol | Conditions | Values | | | Unit |
|---|---|---|---|---|---|---|
| | | | min. | typ. | max. | |
| Inverse diode continuous forward current | $I_S$ | $T_C$=25°C | - | - | 1.8 | A |
| Inverse diode direct current, pulsed | $I_{SM}$ | | - | - | 5.4 | |
| Inverse diode forward voltage | $V_{SD}$ | $V_{GS}$=0V, $I_F$=$I_S$ | - | 1 | 1.2 | V |
| Reverse recovery time | $t_{rr}$ | $V_R$=400V, $I_F$=$I_S$ , | - | 180 | - | ns |
| Reverse recovery charge | $Q_{rr}$ | $di_F/dt$=100A/µs | - | 1.2 | - | µC |
| Peak reverse recovery current | $I_{rrm}$ | | - | 8 | - | A |
| Peak rate of fall of reverse recovery current | $di_{rr}/dt$ | | - | 200 | - | A/µs |

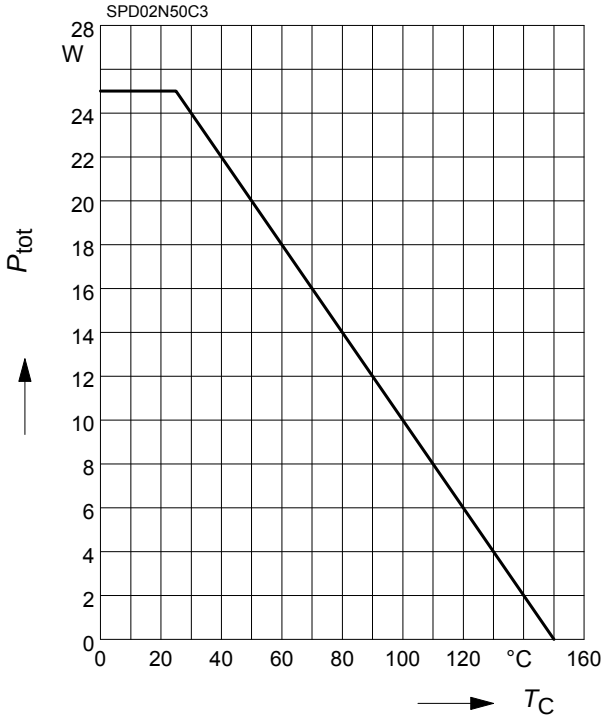
**Typical Transient Thermal Characteristics**

| Symbol | Value | Unit | Symbol | Value | Unit |
|---|---|---|---|---|---|
| | typ. | | | typ. | |
| Thermal resistance | | | Thermal capacitance | | |
| $R_{th1}$ | 0.1 | K/W | $C_{th1}$ | 0.00002806 | Ws/K |
| $R_{th2}$ | 0.184 | | $C_{th2}$ | 0.0001113 | |
| $R_{th3}$ | 0.306 | | $C_{th3}$ | 0.0001679 | |
| $R_{th4}$ | 1.207 | | $C_{th4}$ | 0.000547 | |
| $R_{th5}$ | 0.974 | | $C_{th5}$ | 0.001388 | |
| $R_{th6}$ | 0.251 | | $C_{th6}$ | 0.019 | |



## 1 Power dissipation

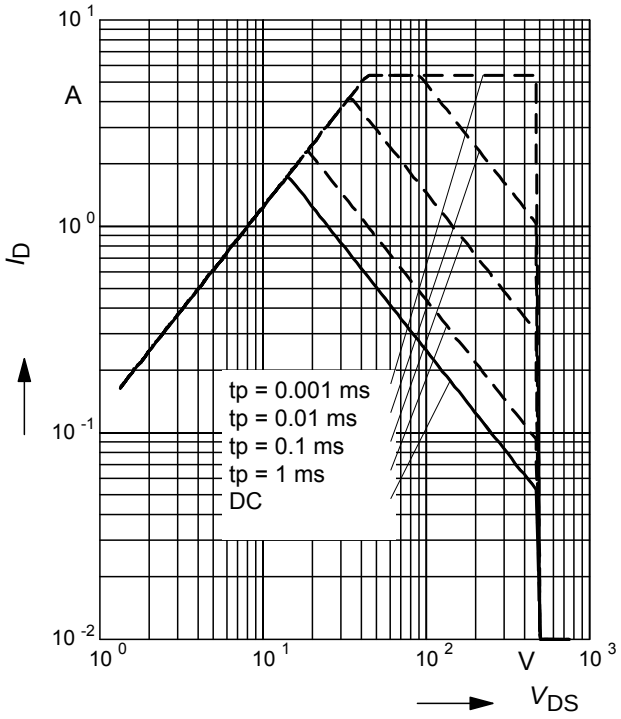
$P_{tot} = f(T_C)$




## 2 Safe operating area

$I_D = f(V_{DS})$

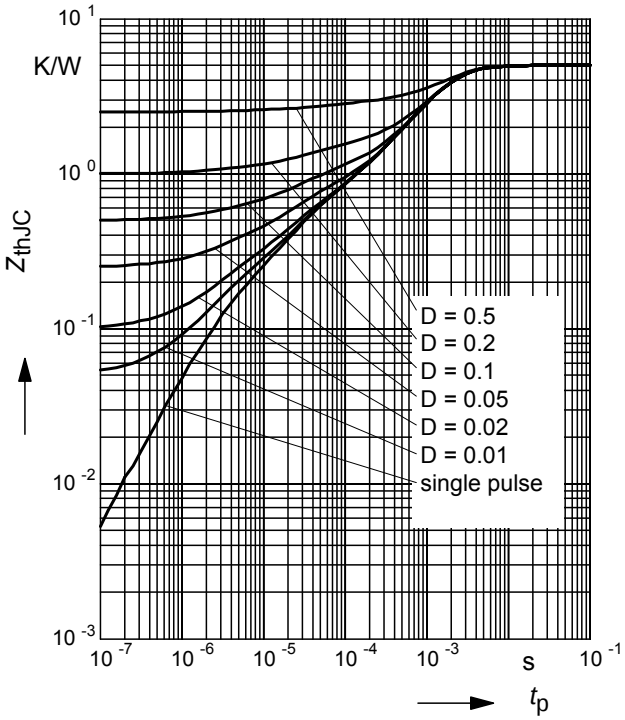
parameter : $D = 0$ , $T_C$=25°C




## 3 Transient thermal impedance

$Z_{thJC} = f(t_p)$

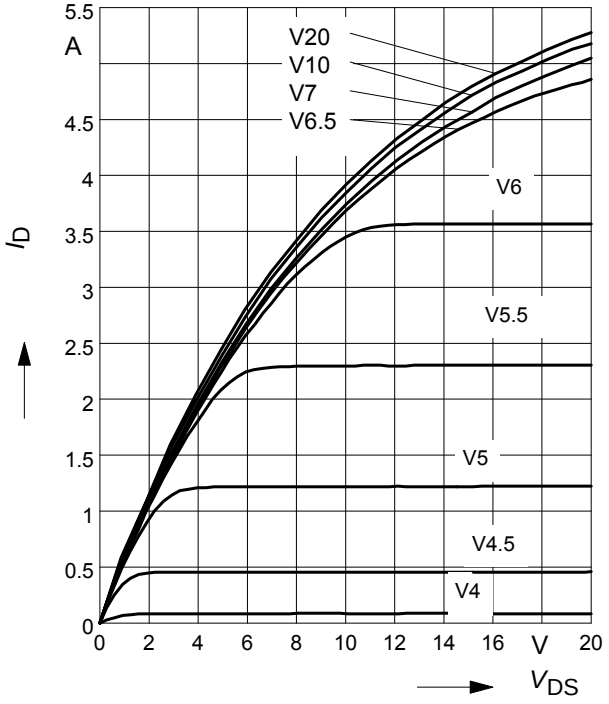
parameter: $D = t_p/T$




## 4 Typ. output characteristic

$I_D = f(V_{DS})$; $T_j$=25°C

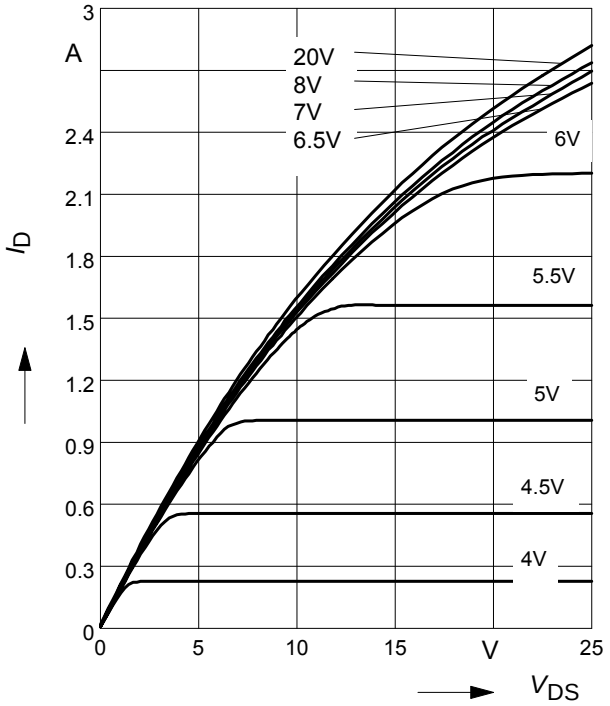
parameter: $t_p$ = 10 µs, $V_{GS}$



## 5 Typ. output characteristic

$I_D = f(V_{DS})$; $T_j$=150°C

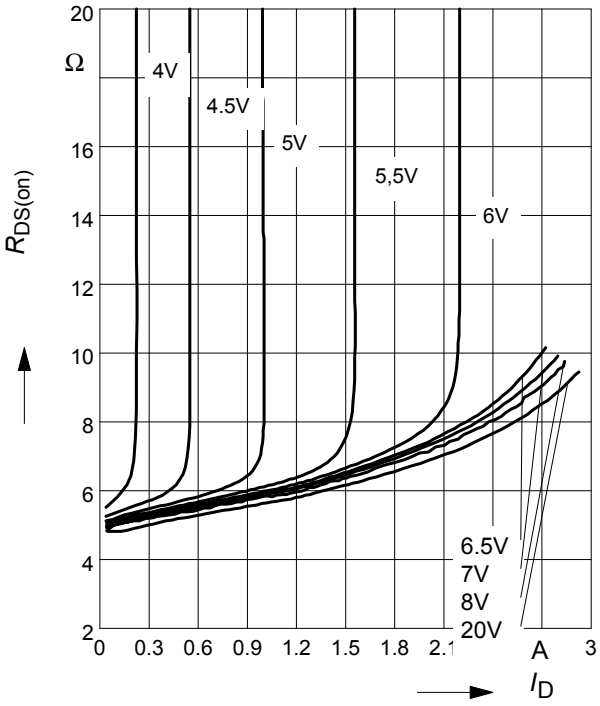
parameter: $t_p$ = 10 µs, $V_{GS}$




## 6 Typ. drain-source on resistance

$R_{DS(on)}=f(I_D)$

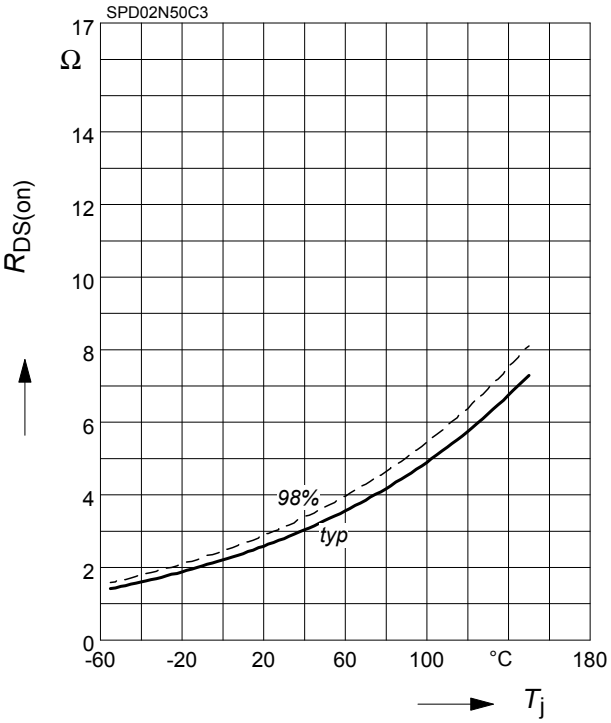
parameter: $T_j$=150°C, $V_{GS}$




## 7 Drain-source on-state resistance

$R_{DS(on)} = f(T_j)$

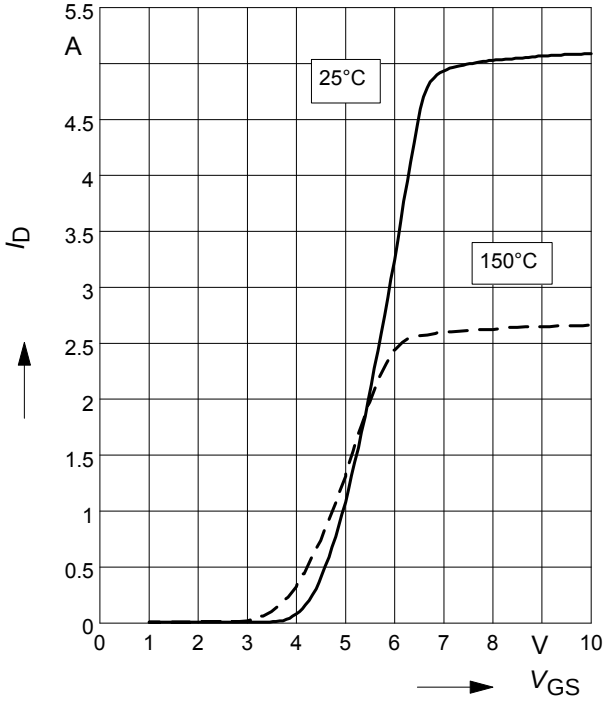
parameter : $I_D$ = 1.1 A, $V_{GS}$ = 10 V




## 8 Typ. transfer characteristics

$I_D= f(V_{GS})$; $V_{DS}\geq 2 \times I_D \times R_{DS(on)max}$

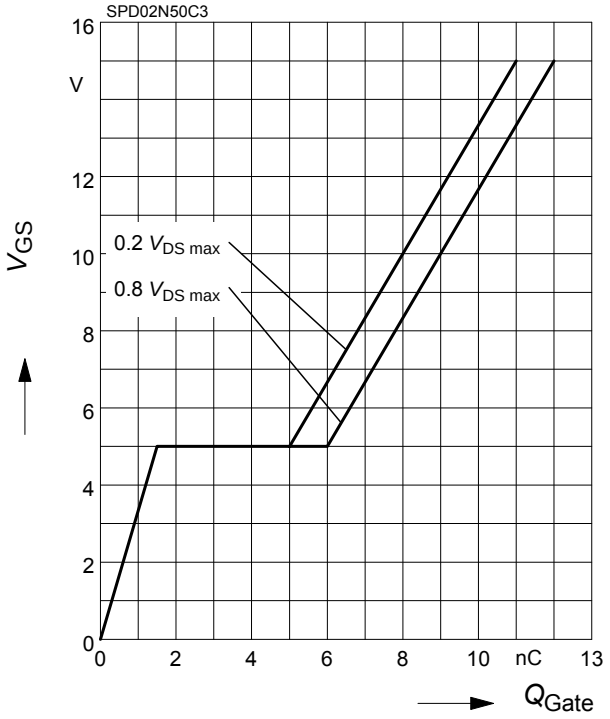
parameter: $t_p$ = 10 µs



## 9 Typ. gate charge

$V_{GS} = f\ (Q_{Gate})$

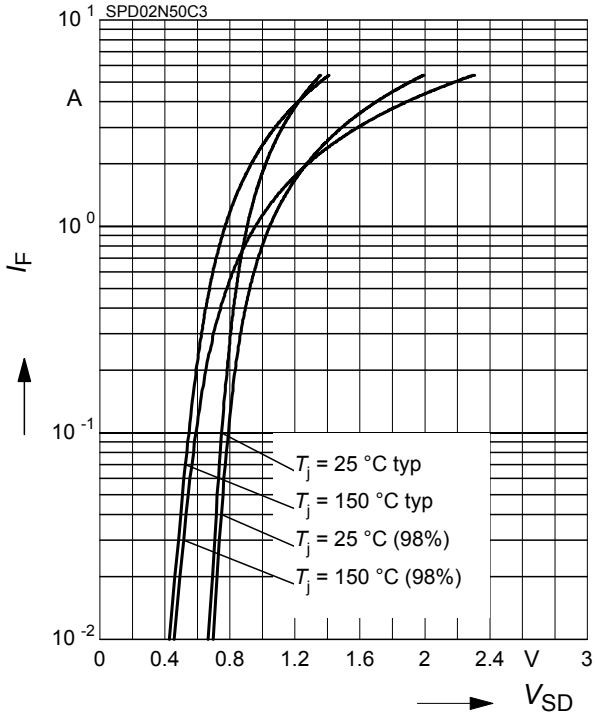
parameter: $I_D$ = 1.8 A pulsed




## 10 Forward characteristics of body diode

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

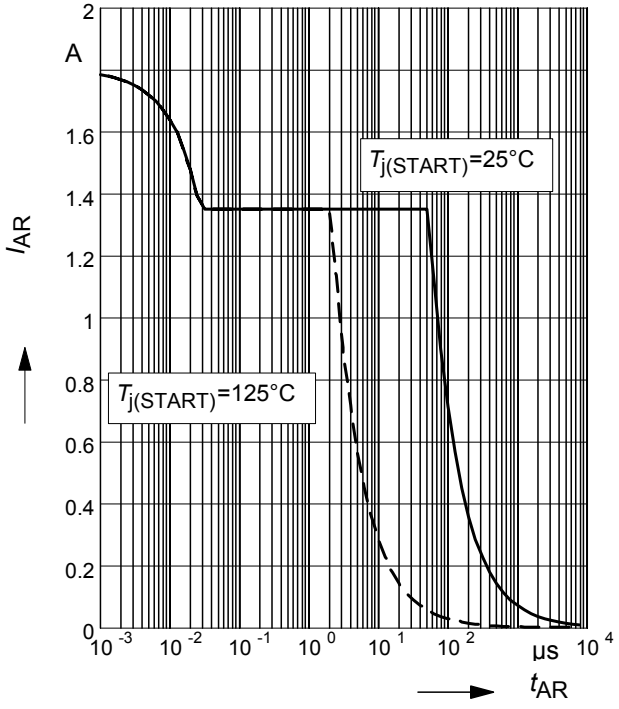
parameter: $T_j$ , tp = 10 µs




## 11 Avalanche SOA

$I_{AR} = f\ (t_{AR})$

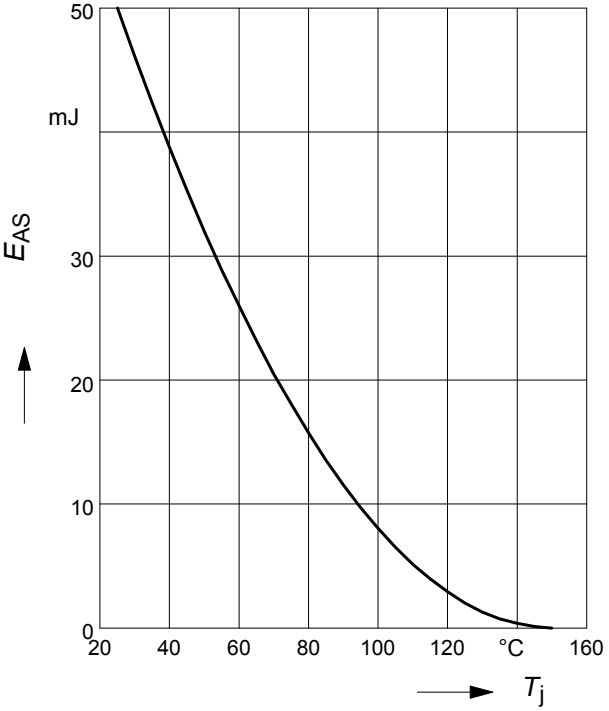
par.: $T_j \leq 150$ °C




## 12 Avalanche energy

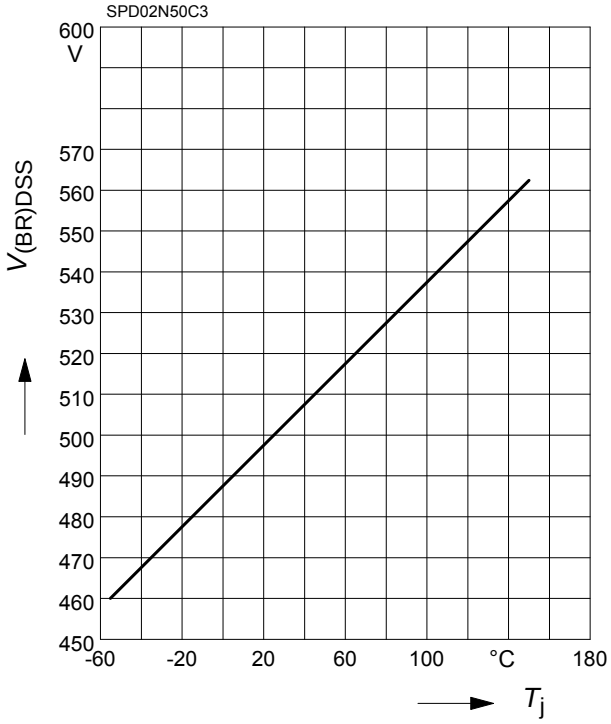
$E_{AS} = f\ (T_j)$

par.: $I_D$ = 1.35 A, $V_{DD}$ = 50 V



## 13 Drain-source breakdown voltage

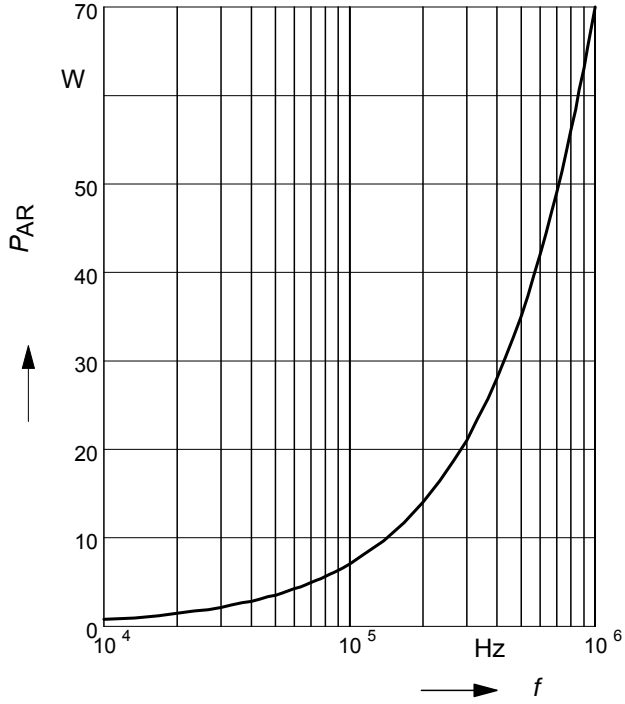
$V_{(BR)DSS} = f(T_j)$




## 14 Avalanche power losses

$P_{AR} = f(f)$

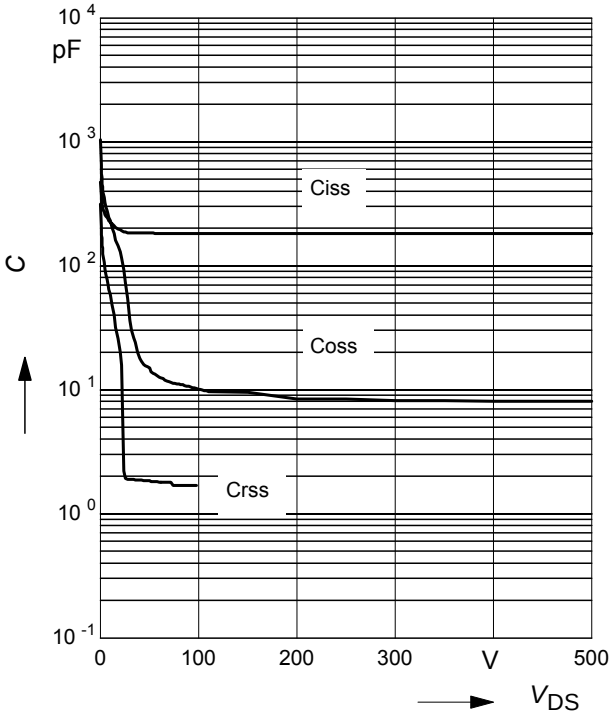
parameter: $E_{AR}$=0.07mJ




## 15 Typ. capacitances

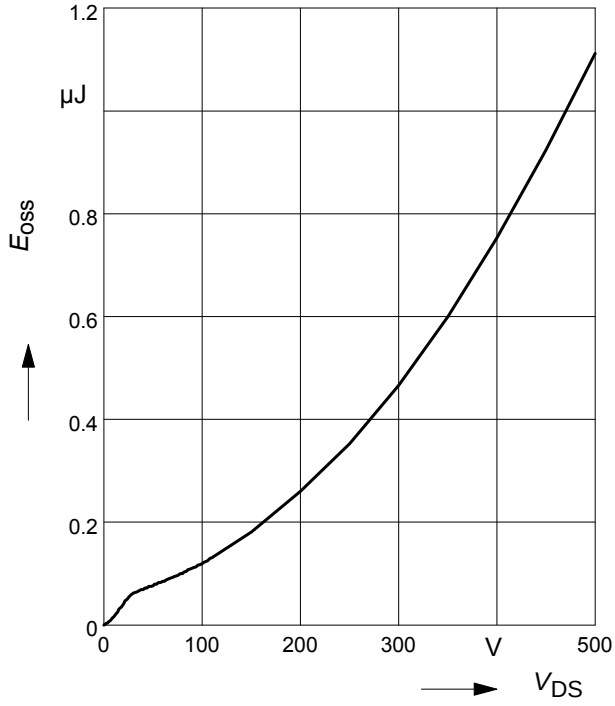
$C = f(V_{DS})$

parameter: $V_{GS}$=0V, $f$=1 MHz

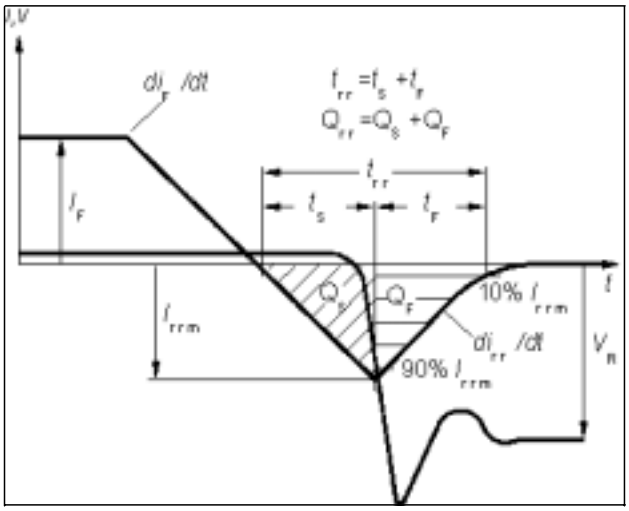



## 16 Typ. $C_{oss}$ stored energy

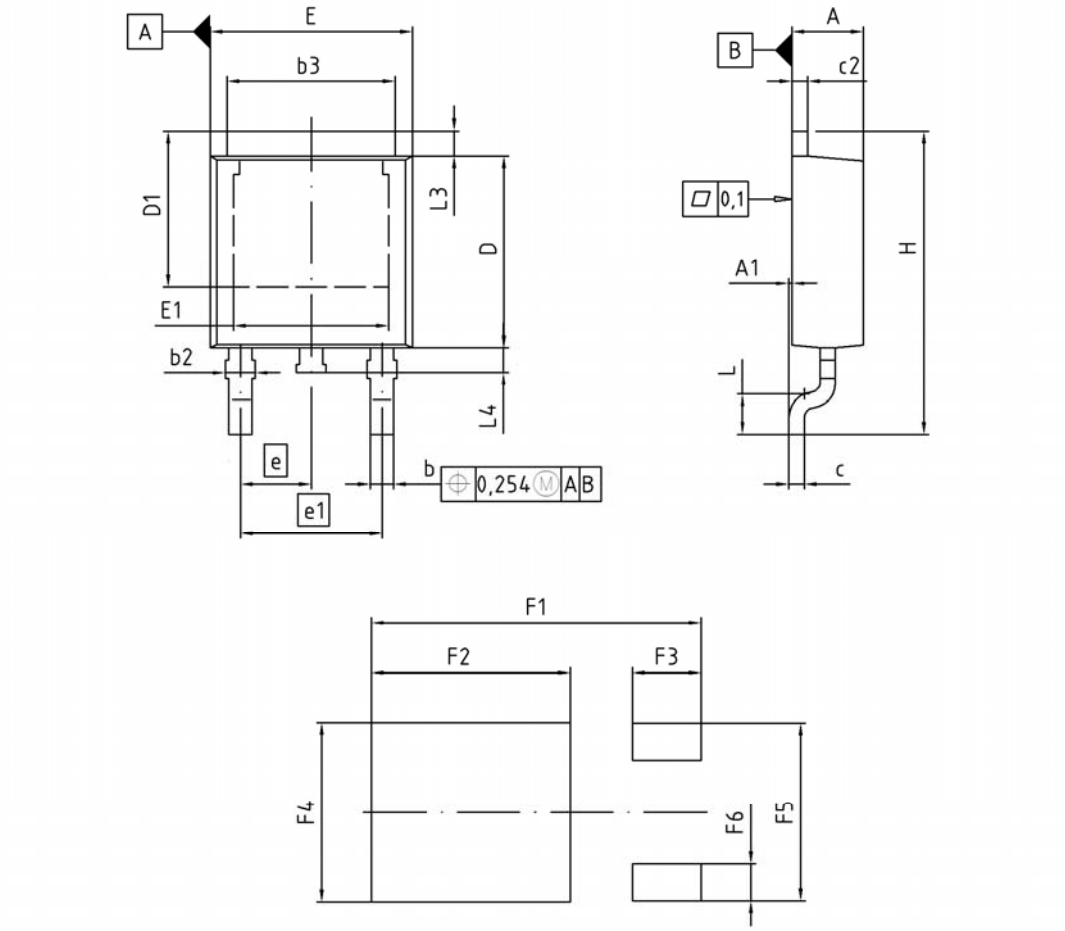
$E_{oss}$=$f(V_{DS})$



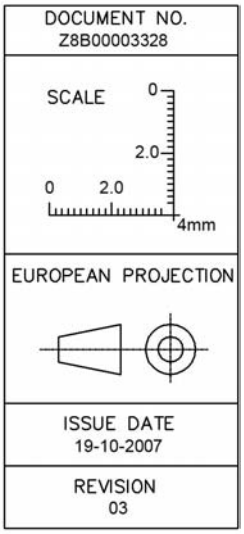
Definition of diodes switching characteristics



PG-TO252-3-1, PG-TO252-3-11, PG-TO252-3-21 (D-PAK)




| 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 |



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