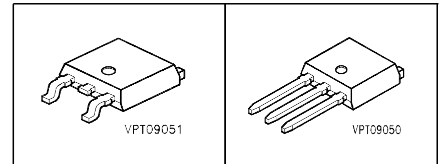
# Cool MOS™ Power Transistor

| $V_{DS}$ @ $T_{jmax}$ | 650 | V |
|---|---|---|
| $R_{DS(on)}$ | 6 | Ω |
| $I_D$ | 0.8 | A |

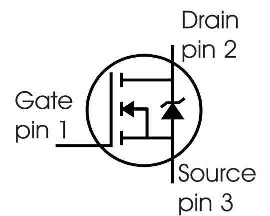
### Feature

- New revolutionary high voltage technology
- Ultra low gate charge
- Periodic avalanche rated
- Extreme d*v*/d*t* rated
- Ultra low effective capacitances
- Improved transconductance

P-TO252 P-TO251-3-1



| Type | Package | Ordering Code | Marking |
|---|---|---|---|
| SPU01N60C3 | P-TO251-3-1 | Q67040-S4193 | 01N60C3 |
| SPD01N60C3 | P-TO252 | Q67040-S4188 | 01N60C3 |




### Maximum Ratings

| Parameter | Symbol | Value | Unit |
|---|---|---|---|
| Continuous drain current | $I_D$ | | A |
| $T_C$ = 25 °C | | 0.8 | |
| $T_C$ = 100 °C | | 0.5 | |
| Pulsed drain current, $t_p$ limited by $T_{jmax}$ | $I_{D\ puls}$ | 1.6 | |
| Avalanche energy, single pulse<br>$I_D$ = 0.6 A, $V_{DD}$ = 50 V | $E_{AS}$ | 20 | mJ |
| Avalanche energy, repetitive $t_{AR}$ limited by $T_{jmax}$[1)]<br>$I_D$ = 0.8 A, $V_{DD}$ = 50 V | $E_{AR}$ | 0.01 | |
| Avalanche current, repetitive $t_{AR}$ limited by $T_{jmax}$ | $I_{AR}$ | 0.8 | A |
| Gate source voltage static | $V_{GS}$ | ±20 | V |
| Gate source voltage AC (f >1Hz) | $V_{GS}$ | ±30 | |
| Power dissipation, $T_C$ = 25°C | $P_{tot}$ | 11 | W |
| Operating and storage temperature | $T_j$ , $T_{stg}$ | -55... +150 | °C |

### Maximum Ratings

| Parameter | Symbol | Value | Unit |
|---|---|---|---|
| Drain Source voltage slope<br>$V_{DS}$ = 480 V, $I_D$ = 0.8 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 | $R_{thJC}$ | - | - | 11 | K/W |
| Thermal resistance, junction - ambient, leaded | $R_{thJA}$ | - | - | 75 | |
| SMD version, device on PCB:<br>@ min. footprint<br>@ 6 cm² cooling area [2) ] | $R_{thJA}$ | <br>-<br>- | <br>-<br>- | <br>75<br>50 | |
| Soldering temperature,<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 | 600 | - | - | V |
| Drain-Source avalanche breakdown voltage | $V_{(BR)DS}$ | $V_{GS}$=0V, $I_D$=0.8A | - | 700 | - | |
| Gate threshold voltage | $V_{GS(th)}$ | $I_D$=250μA, $V_{GS}$=$V_{DS}$ | 2.1 | 3 | 3.9 | |
| Zero gate voltage drain current | $I_{DSS}$ | $V_{DS}$=600V, $V_{GS}$=0V,<br>$T_j$=25°C,<br>$T_j$=150°C | <br>-<br>- | <br>0.1<br>- | <br>1<br>50 | µA |
| Gate-source leakage current | $I_{GSS}$ | $V_{GS}$=30V, $V_{DS}$=0V | - | - | 100 | nA |
| Drain-source on-state resistance | $R_{DS(on)}$ | $V_{GS}$=10V, $I_D$=0.5A,<br>$T_j$=25°C<br>$T_j$=150°C | <br>-<br>- | <br>5.6<br>15.1 | <br>6<br>- | Ω |

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

| Parameter | Symbol | Conditions | Values | | | Unit |
|---|---|---|---|---|---|---|
| | | | min. | typ. | max. | |
| Transconductance | $g_{fs}$ | $V_{DS} \geq 2*I_D*R_{DS(on)max}$, $I_D$=0.5A | - | 0.75 | - | S |
| Input capacitance | $C_{iss}$ | $V_{GS}$=0V, $V_{DS}$=25V, $f$=1MHz | - | 100 | - | pF |
| Output capacitance | $C_{oss}$ | | - | 40 | - | |
| Reverse transfer capacitance | $C_{rss}$ | | - | 2.5 | - | |
| Turn-on delay time | $t_{d(on)}$ | $V_{DD}$=350V, $V_{GS}$=0/10V, $I_D$=0.8A, $R_G$=100Ω | - | 30 | - | ns |
| Rise time | $t_r$ | | - | 25 | - | |
| Turn-off delay time | $t_{d(off)}$ | | - | 55 | 82 | |
| Fall time | $t_f$ | | - | 30 | 45 | |

**Gate Charge Characteristics**

| Parameter | Symbol | Conditions | min. | typ. | max. | Unit |
|---|---|---|---|---|---|---|
| Gate to source charge | $Q_{gs}$ | $V_{DD}$=350V, $I_D$=0.8A | - | 0.9 | - | nC |
| Gate to drain charge | $Q_{gd}$ | | - | 2.2 | - | |
| Gate charge total | $Q_g$ | $V_{DD}$=350V, $I_D$=0.8A, $V_{GS}$=0 to 10V | - | 3.9 | 5 | |
| Gate plateau voltage | $V_{(plateau)}$ | $V_{DD}$=350V, $I_D$=0.8A | - | 5.5 | - | V |

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

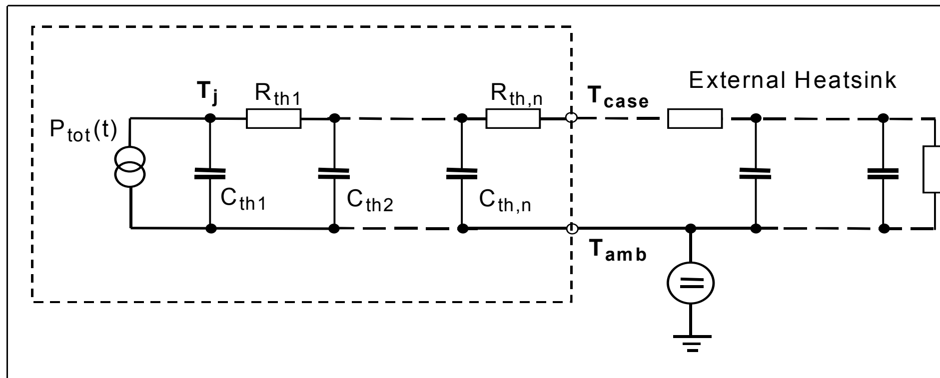
[2]Device on 40mm*40mm*1.5mm epoxy PCB FR4 with 6cm² (one layer, 70 µm thick) copper area for drain connection. PCB is vertical without blown air.

**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 | - | - | 0.8 | A |
| Inverse diode direct current, pulsed | $I_{SM}$ | | - | - | 1.6 | |
| Inverse diode forward voltage | $V_{SD}$ | $V_{GS}$=0V, $I_F$=$I_S$ | - | 1 | 1.2 | V |
| Reverse recovery time | $t_{rr}$ | $V_R$=350V, $I_F$=$I_S$ , | - | 570 | 970 | ns |
| Reverse recovery charge | $Q_{rr}$ | $di_F/dt$=100A/µs | - | 0.75 | - | µC |

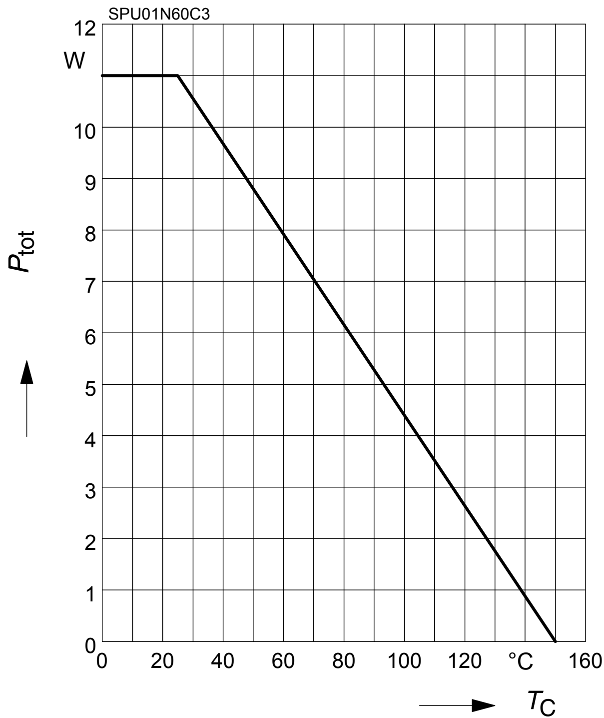
**Typical Transient Thermal Characteristics**

| Symbol | Value | Unit | Symbol | Value | Unit |
|---|---|---|---|---|---|
| | typ. | | | typ. | |
| Thermal resistance | | | Thermal capacitance | | |
| $R_{th1}$ | 0.225 | K/W | $C_{th1}$ | 0.00001221 | Ws/K |
| $R_{th2}$ | 0.395 | | $C_{th2}$ | 0.00005037 | |
| $R_{th3}$ | 0.603 | | $C_{th3}$ | 0.0000809 | |
| $R_{th4}$ | 0.995 | | $C_{th4}$ | 0.0002915 | |
| $R_{th5}$ | 0.691 | | $C_{th5}$ | 0.001844 | |
| $R_{th6}$ | 0.148 | | $C_{th6}$ | 0.412 | |



## 1 Power dissipation

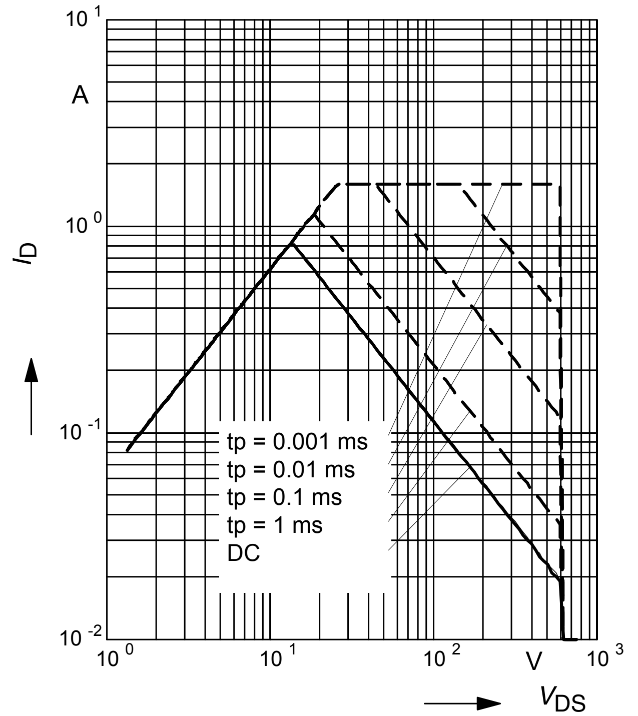
$P_{tot} = f(T_C)$




## 2 Safe operating area

$I_D = f(V_{DS})$

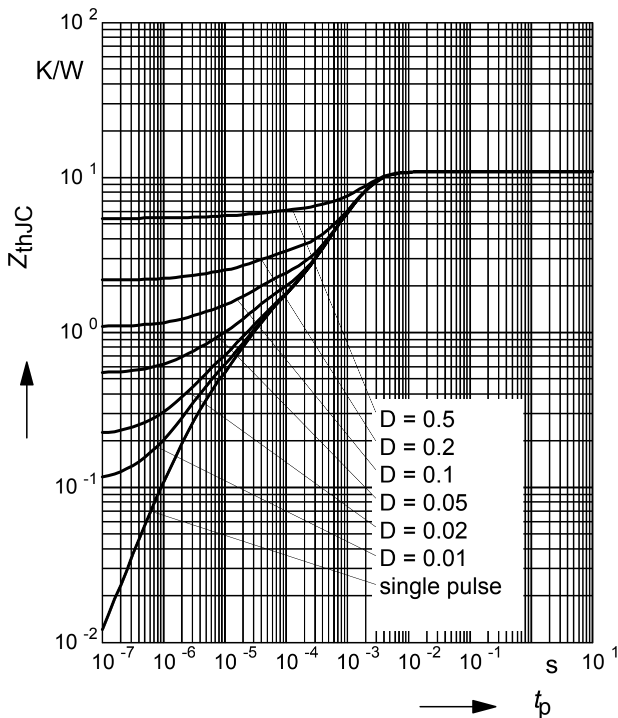
parameter : $D = 0$ , $T_C$=25°C




## 3 Transient thermal impedance

$Z_{thJC} = f(t_p)$

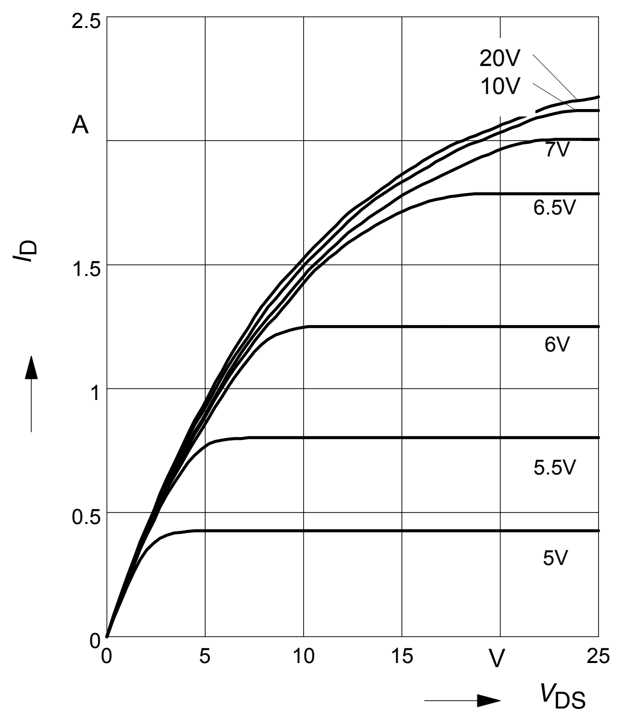
parameter: $D = t_p/T$




## 4 Typ. output characteristic

$I_D = f(V_{DS})$; $T_j$=25°C

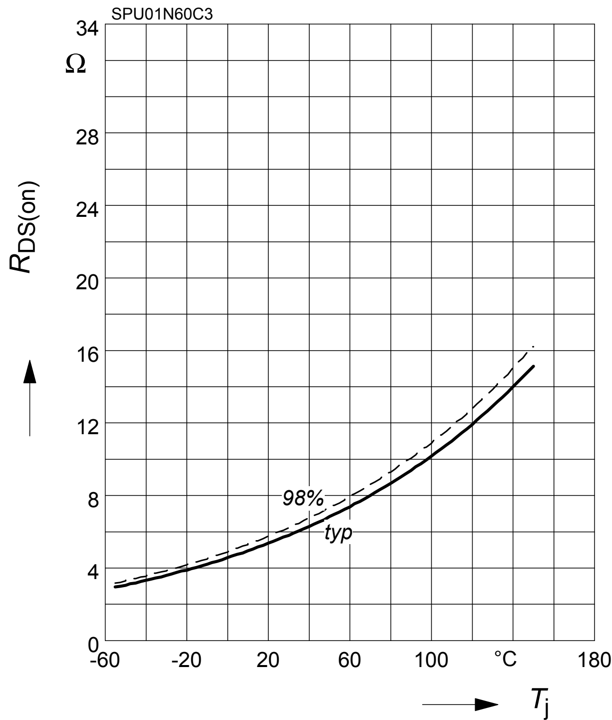
parameter: $t_p$ = 10 µs, $V_{GS}$



## 5 Drain-source on-state resistance

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

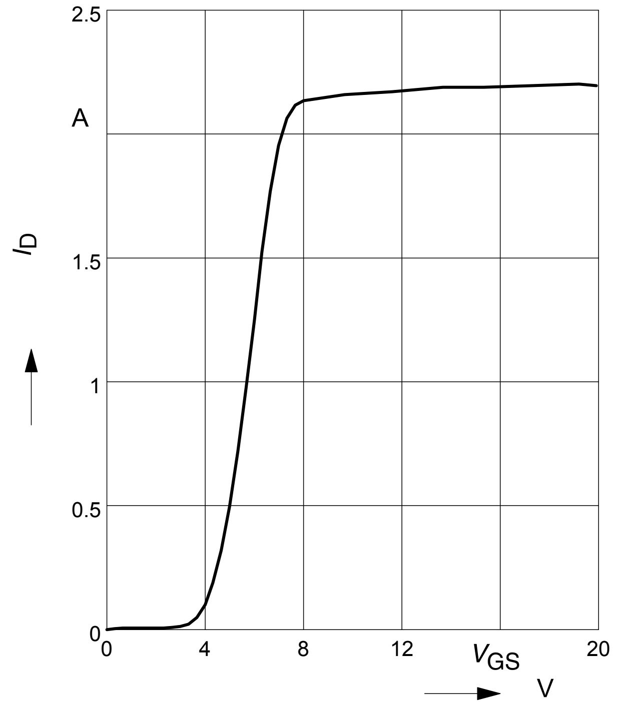
parameter : $I_D$ = 0.5 A, $V_{GS}$ = 10 V




## 6 Typ. transfer characteristics

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

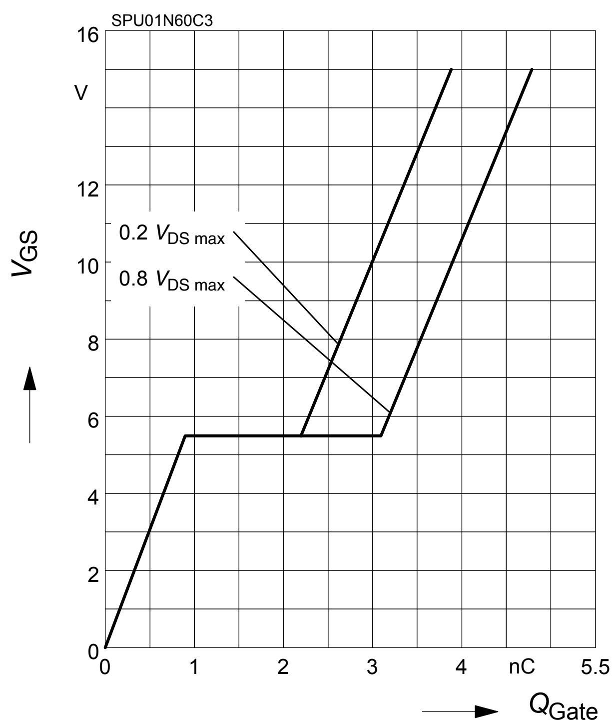
parameter: $t_p$ = 10 µs




## 7 Typ. gate charge

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

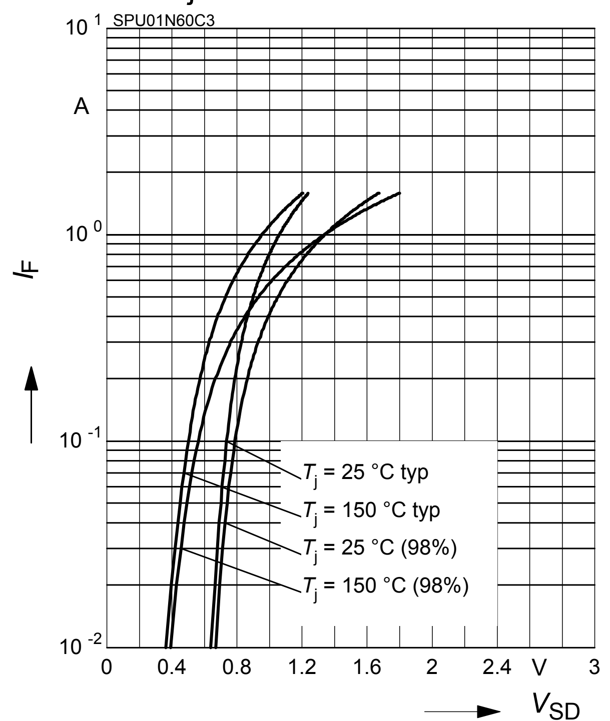
parameter: $I_D$ = 0.8 A pulsed




## 8 Forward characteristics of body diode

$I_F = f(V_{SD})$

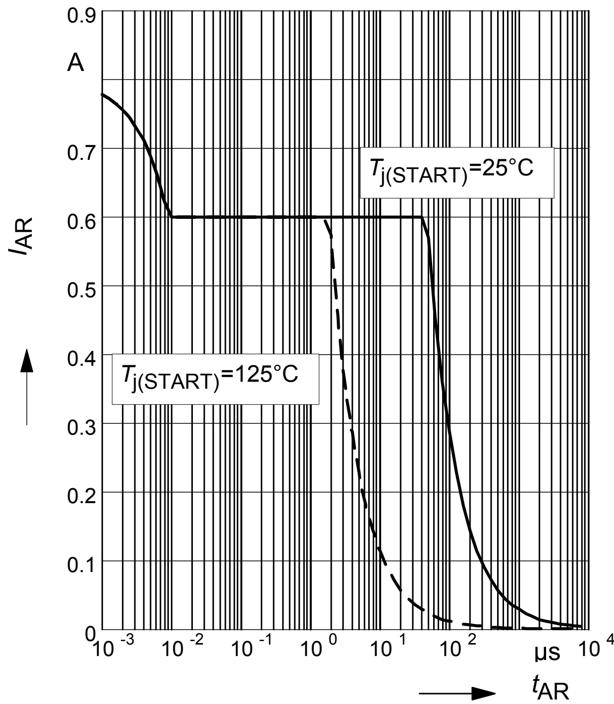
parameter: $T_j$ , $t_p$ = 10 µs



## 9 Avalanche SOA

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

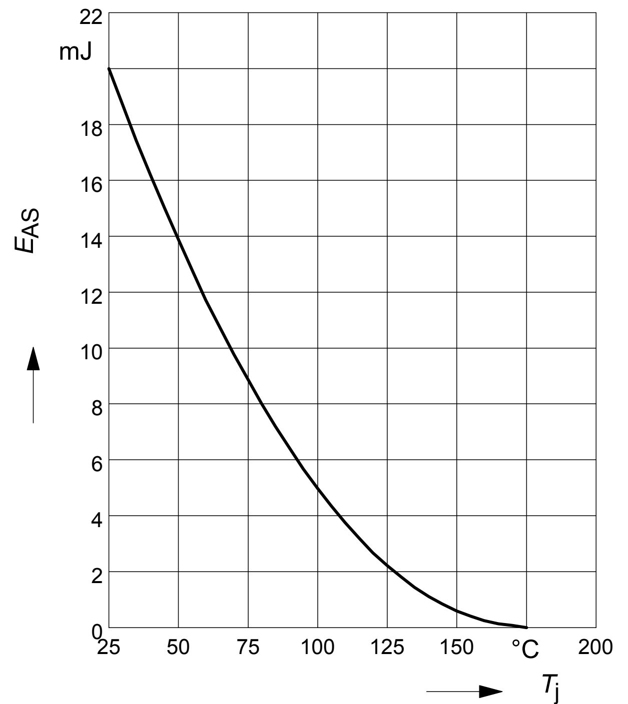
par.: $T_j \leq 150$ °C




## 10 Avalanche energy

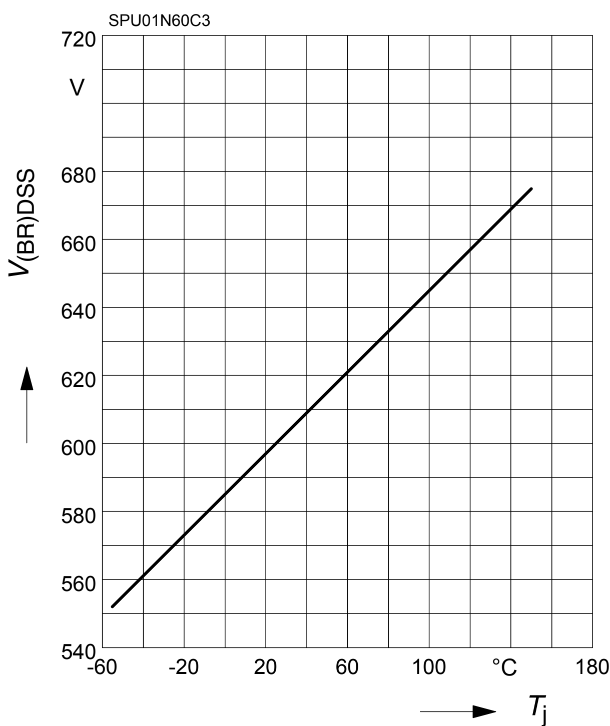
$E_{AS} = f(T_j)$

par.: $I_D$ = 0.6 A, $V_{DD}$ = 50 V




## 11 Drain-source breakdown voltage

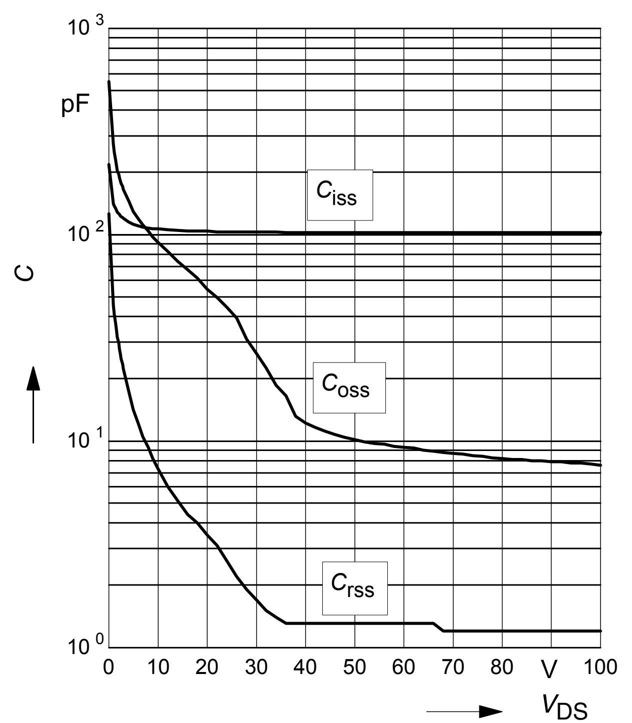
$V_{(BR)DSS} = f(T_j)$



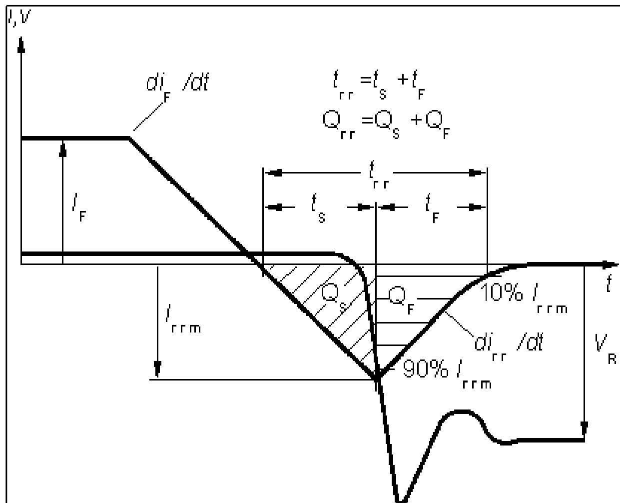

## 12 Typ. capacitances

$C = f(V_{DS})$

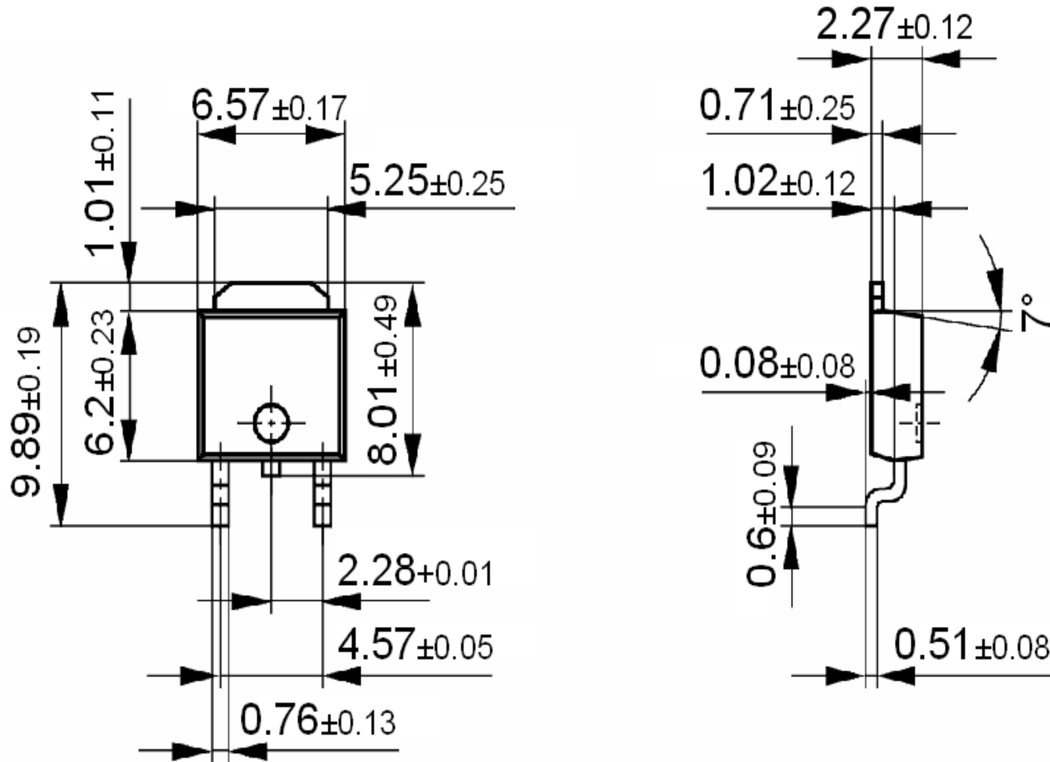
parameter: $V_{GS}$=0V, $f$=1 MHz



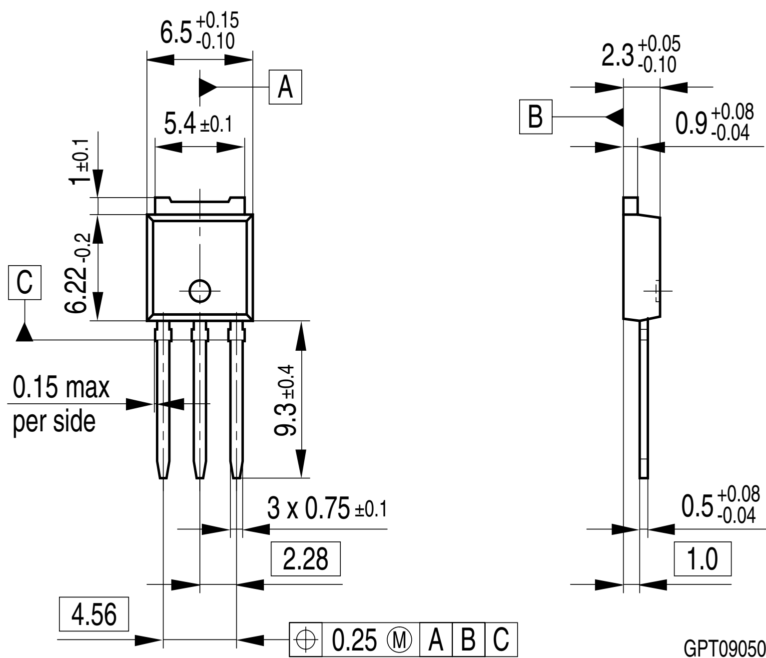
Definition of diodes switching characteristics



P-TO-252-3-1 (D-PAK)




P-TO-251-3-1 (I-PAK)




All metal surfaces tin plated, except area of cut.

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