# Cool MOS™ Power Transistor

COOLMOS Power Semiconductors

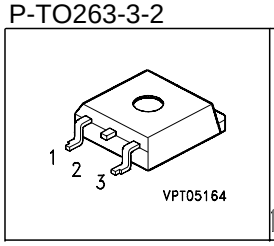
## Feature

- New revolutionary high voltage technology
- Worldwide best $R_{DS(on)}$ in TO 220
- Ultra low gate charge
- Periodic avalanche rated
- Extreme d*v*/d*t* rated
- Ultra low effective capacitances
- Improved noise immunity

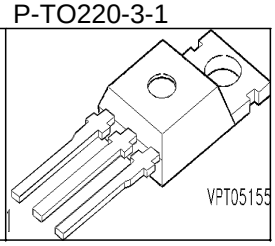
## Product Summary

| | | |
|---|---|---|
| $V_{DS}$ | 800 | V |
| $R_{DS(on)}$ | 290 | mΩ |
| $I_D$ | 17 | A |

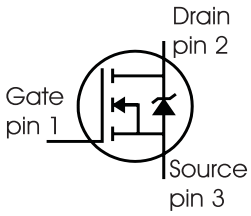
P-TO263-3-2




P-TO220-3-1




| Type | Package | Ordering Code | Marking |
|---|---|---|---|
| SPP17N80C2 | P-TO220-3-1 | Q67040-S4353 | SPP17N80C2 |
| SPB17N80C2 | P-TO263-3-2 | Q67040-S4354 | SPB17N80C2 |




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

| Parameter | Symbol | Value | Unit |
|---|---|---|---|
| Continuous drain current | $I_D$ | | A |
| $T_C$ = 25 °C | | 17 | |
| $T_C$ = 100 °C | | 11 | |
| Pulsed drain current, $t_p$ limited by $T_{jmax}$ | $I_{D\ puls}$ | 51 | |
| Avalanche energy, single pulse | $E_{AS}$ | 670 | mJ |
| $I_D$=4A, $V_{DD}$=50V | | | |
| Avalanche energy, repetitive $t_{AR}$ limited by $T_{jmax}$[1)] | $E_{AR}$ | 0.5 | |
| $I_D$=17A, $V_{DD}$=50V | | | |
| Avalanche current, repetitive $t_{AR}$ limited by $T_{jmax}$ | $I_{AR}$ | 17 | A |
| Reverse diode d*v*/d*t* | d*v*/d*t* | 6 | V/ns |
| $I_S$=17A, $V_{DS} < V_{DD}$, d*i*/d*t*=100A/µs, $T_{jmax}$=150°C | | | |
| Gate source voltage | $V_{GS}$ | ±20 | V |
| Power dissipation | $P_{tot}$ | 208 | W |
| $T_C$ = 25 °C | | | |
| Operating and storage temperature | $T_j$ , $T_{stg}$ | -55... +150 | °C |

## Thermal Characteristics

| Parameter | Symbol | Values | | | Unit |
|---|---|---|---|---|---|
| | | min. | typ. | max. | |
| **Characteristics** | | | | | |
| Thermal resistance, junction - case | $R_{thJC}$ | - | - | 0.6 | K/W |
| Thermal resistance, junction - ambient, leaded | $R_{thJA}$ | - | - | 62 | |
| SMD version, device on PCB: | $R_{thJA}$ | | | | |
| @ min. footprint | | - | - | 62 | |
| @ 6 cm$^2$ cooling area [2)] | | - | 35 | - | |
| Linear derating factor | | - | - | 1.67 | W/K |
| Soldering temperature, 1.6 mm (0.063 in.) from case for 10s | $T_{sold}$ | - | - | 260 | °C |

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

| **Static Characteristics** | | | | | |
|---|---|---|---|---|---|
| Drain-source breakdown voltage<br>$V_{GS}$=0V, $I_D$=0.25mA | $V_{(BR)DSS}$ | 800 | - | - | V |
| Drain-source avalanche breakdown voltage<br>$V_{GS}$=0V, $I_D$=17A | $V_{(BR)DS}$ | - | 870 | - | |
| Gate threshold voltage, $V_{GS}$ = $V_{DS}$<br>$I_D$=1mA | $V_{GS(th)}$ | 2 | 3 | 4 | |
| Zero gate voltage drain current | $I_{DSS}$ | | | | µA |
| $V_{DS}$ = 800 V, $V_{GS}$ = 0 V, $T_j$ = 25 °C | | - | 0.5 | 25 | |
| $V_{DS}$ = 800 V, $V_{GS}$ = 0 V, $T_j$ = 150 °C | | - | - | 250 | |
| Gate-source leakage current<br>$V_{GS}$=20V, $V_{DS}$=0V | $I_{GSS}$ | - | - | 100 | nA |
| Drain-source on-state resistance<br>$V_{GS}$=10V, $I_D$=11A, $T_j$=25°C | $R_{DS(on)}$ | - | 250 | 290 | mΩ |
| Gate input resistance<br>$f$ = 1 MHz, open drain | $R_G$ | - | 0.7 | - | Ω |

[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. | |
| **Characteristics** | | | | | | |
| Transconductance | $g_{fs}$ | $V_{DS}\geq 2*I_D*R_{DS(on)max}$, $I_D$=11A | - | 15 | - | S |
| Input capacitance | $C_{iss}$ | $V_{GS}$=0V, $V_{DS}$=25V, $f$=1MHz | - | 2320 | - | pF |
| Output capacitance | $C_{oss}$ | | - | 1250 | - | |
| Reverse transfer capacitance | $C_{rss}$ | | - | 60 | - | |
| Effective output capacitance, [1] energy related | $C_{o(er)}$ | $V_{GS}$=0V, $V_{DS}$=0V to 640 V | - | 59 | - | pF |
| Effective output capacitance, [2] time related | $C_{o(tr)}$ | | - | 124 | - | |
| Turn-on delay time | $t_{d(on)}$ | $V_{DD}$=400V, $V_{GS}$=0/10V, $I_D$=17A, $R_G$=5.6Ω, $T_j$=125°C | - | 45 | - | ns |
| Rise time | $t_r$ | | - | 17 | - | |
| Turn-off delay time | $t_{d(off)}$ | | - | 77 | 88 | |
| Fall time | $t_f$ | | - | 10 | 13 | |
| **Gate Charge Characteristics** | | | | | | |
| Gate to source charge | $Q_{gs}$ | $V_{DD}$=640V, $I_D$=17A | - | 9 | - | nC |
| Gate to drain charge | $Q_{gd}$ | | - | 42 | - | |
| Gate charge total | $Q_g$ | $V_{DD}$=640V, $I_D$=17A, $V_{GS}$=0 to 10V | - | 83 | 107 | |
| Gate plateau voltage | $V_{(plateau)}$ | $V_{DD}$=640V, $I_D$=17A | - | 6 | - | V |

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

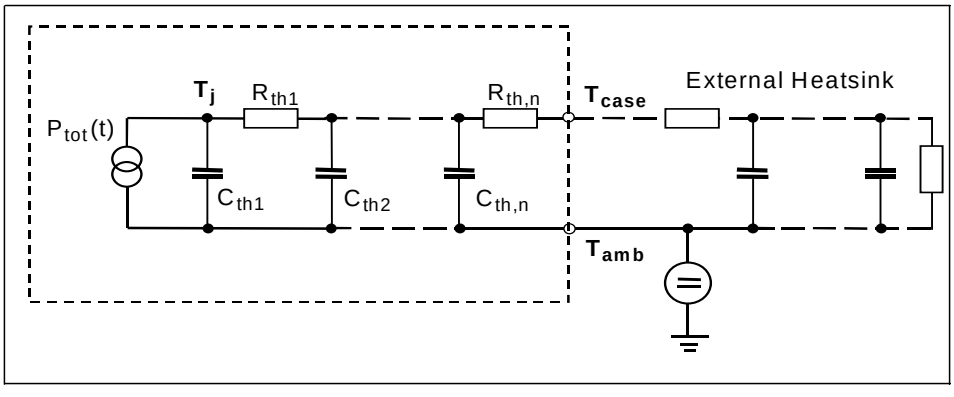
[2] $C_{o(tr)}$ is a fixed capacitance that gives the same charging time as $C_{oss}$ while $V_{DS}$ is rising from 0 to 80% $V_{DSS}$.

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

| Parameter | Symbol | Conditions | Values | | | Unit |
|---|---|---|---|---|---|---|
| | | | min. | typ. | max. | |
| **Reverse Diode** | | | | | | |
| Inverse diode continuous forward current | $I_S$ | $T_C$=25°C | - | - | 17 | A |
| Inverse diode direct current, pulsed | $I_{SM}$ | | - | - | 51 | |
| 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, $I_F$=$I_S$, d$i_F$/d$t$=100A/µs | - | 550 | - | ns |
| Reverse recovery charge | $Q_{rr}$ | | - | 13 | - | µC |
| Peak reverse recovery current | $I_{rrm}$ | | - | 40 | - | A |
| Peak rate of fall of reverse recovery current | $di_{rr}/dt$ | | - | 1200 | - | A/µs |

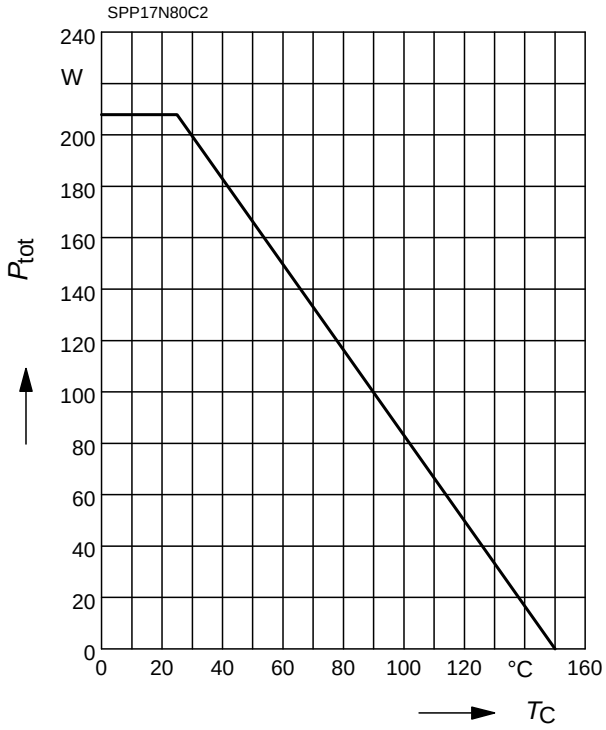
**Transient Thermal Characteristics**

| Symbol | Value | Unit | Symbol | Value | Unit |
|---|---|---|---|---|---|
| | typ. | | | typ. | |
| **Transient thermal impedance** | | | | | |
| Thermal resistance | | | Thermal capacitance | | |
| $R_{th1}$ | 0.00716 | K/W | $C_{th1}$ | 0.000441 | Ws/K |
| $R_{th2}$ | 0.01 | | $C_{th2}$ | 0.0014 | |
| $R_{th3}$ | 0.022 | | $C_{th3}$ | 0.000985 | |
| $R_{th4}$ | 0.065 | | $C_{th4}$ | 0.0045 | |
| $R_{th5}$ | 0.083 | | $C_{th5}$ | 0.02 | |
| $R_{th6}$ | 0.038 | | $C_{th6}$ | 0.146 | |



## 1 Power dissipation

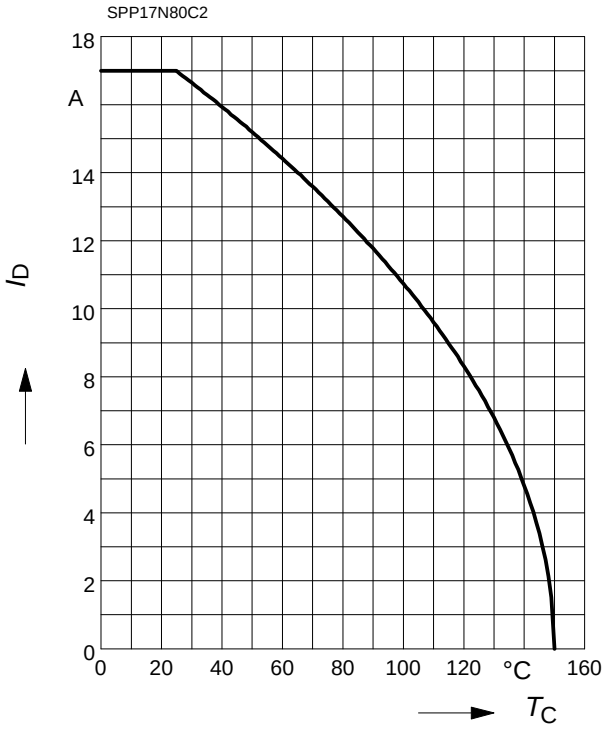
$P_{tot} = f(T_C)$




## 2 Drain current

$I_D = f(T_C)$

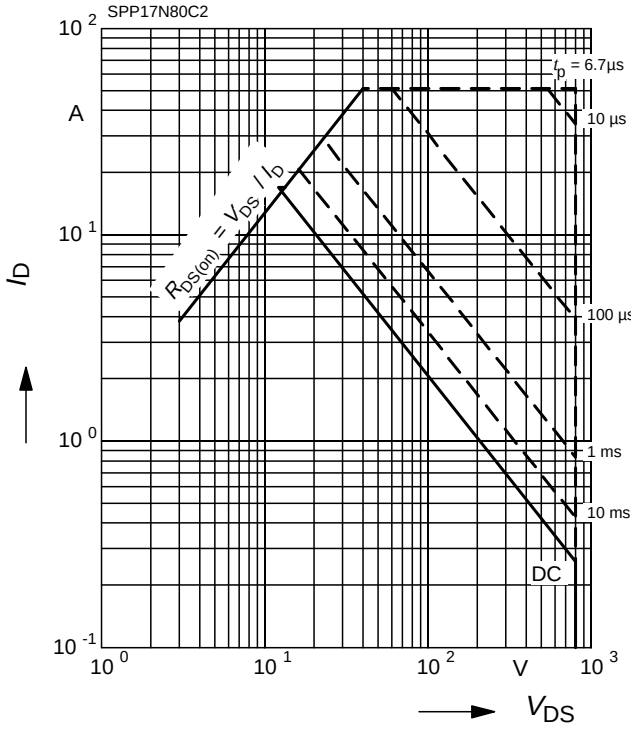
parameter: $V_{GS} \geq 10$ V




## 3 Safe operating area

$I_D = f(V_{DS})$

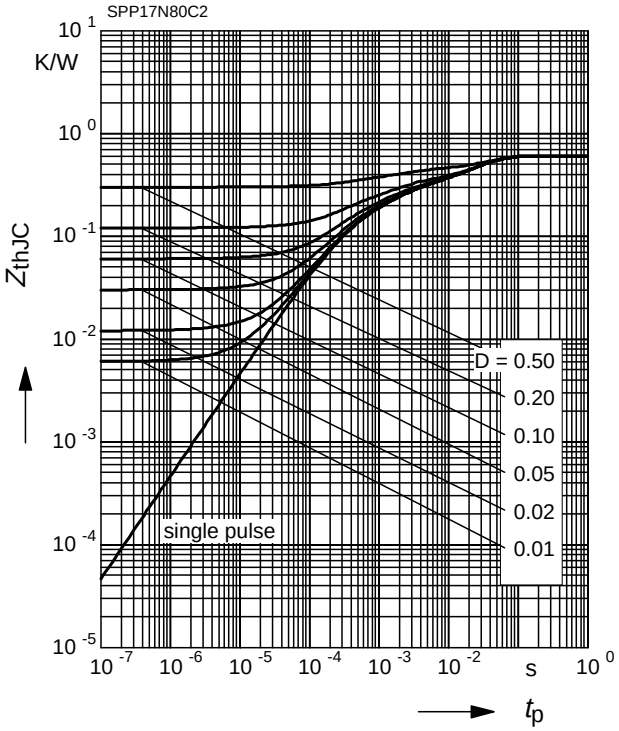
parameter : $D = 0$ , $T_C$=25°C




## 4 Transient thermal impedance

$Z_{thJC} = f(t_p)$

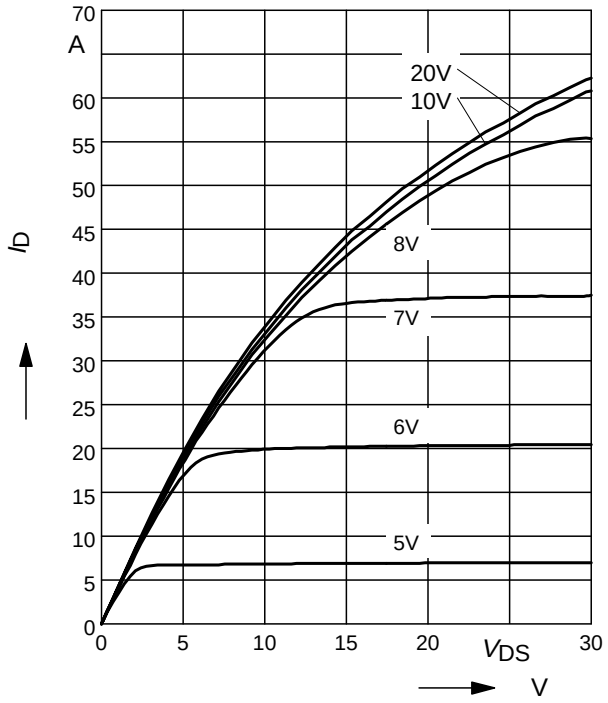
parameter : $D = t_p/T$



## 5 Typ. output characteristic

$I_D = f(V_{DS})$; $T_j$=25°C

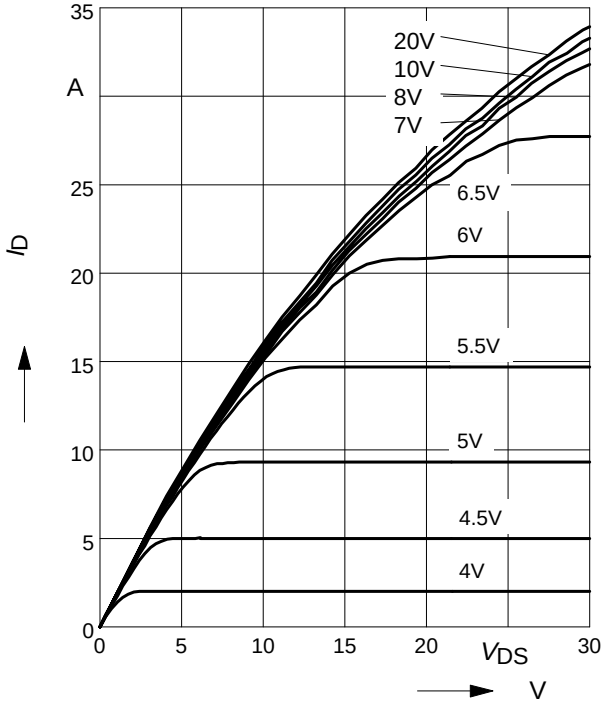
parameter: $t_p$ = 10 µs, $V_{GS}$




## 6 Typ. output characteristic

$I_D = f(V_{DS})$; $T_j$=150°C

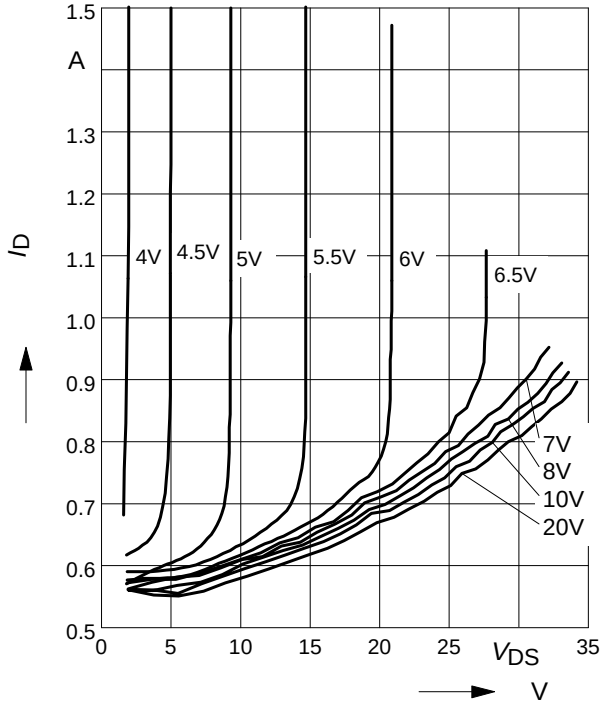
parameter: $t_p$ = 10 µs, $V_{GS}$




## 7 Typ. drain-source on resistance

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

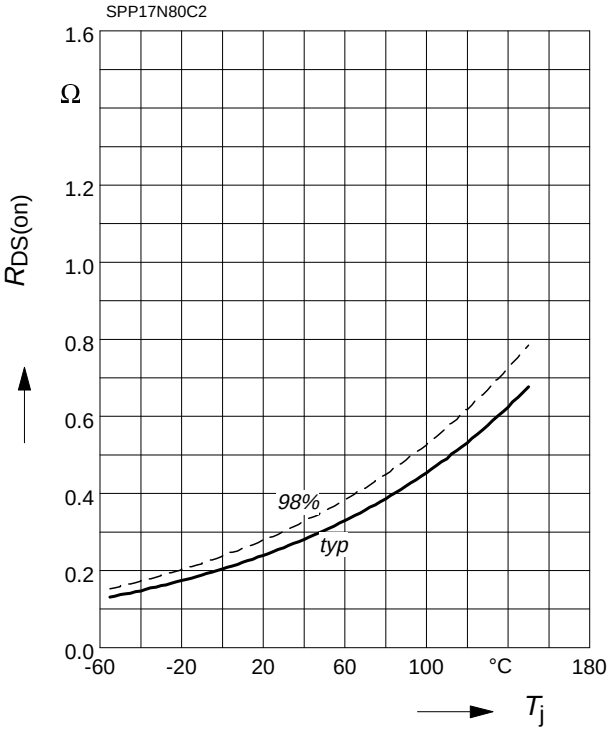
parameter: $T_j$=150°C, $V_{GS}$




## 8 Drain-source on-state resistance

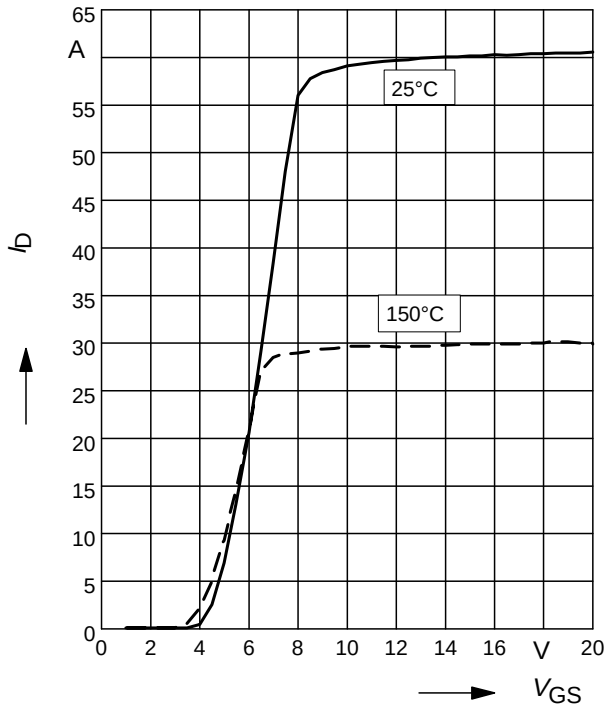
$R_{DS(on)} = f(T_j)$

parameter : $I_D$ = 11 A, $V_{GS}$ = 10 V



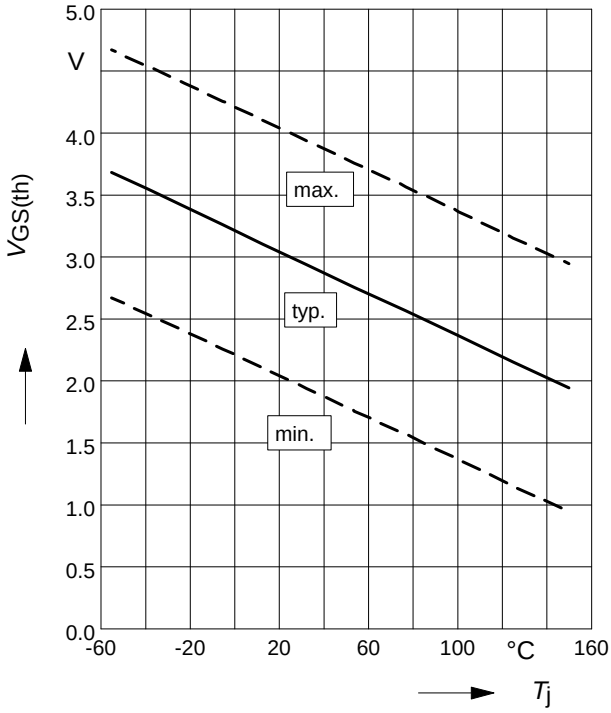
## 9 Typ. transfer characteristics

$I_D = f(V_{GS})$; $V_{DS} \geq 2 \times I_D \times R_{DS(on)max}$
parameter: $t_p$ = 10 µs



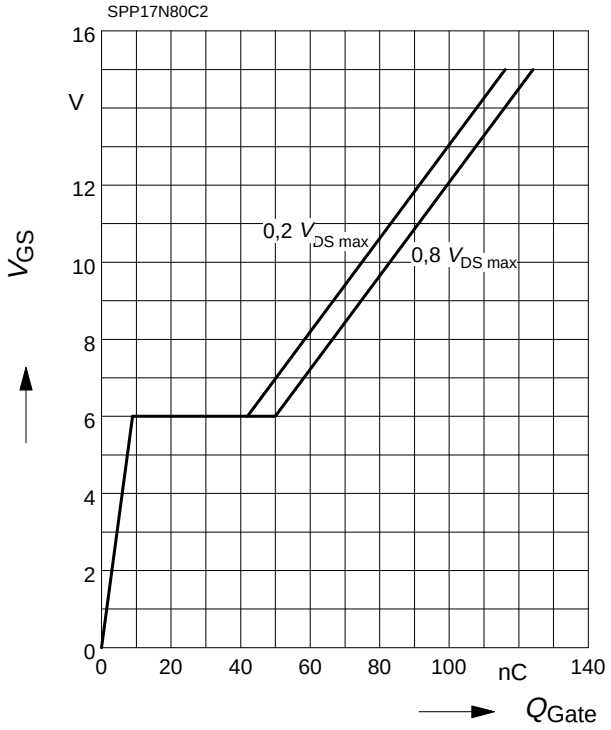

## 10 Gate threshold voltage

$V_{GS(th)} = f(T_j)$
parameter: $V_{GS} = V_{DS}$, $I_D$ = 1 mA



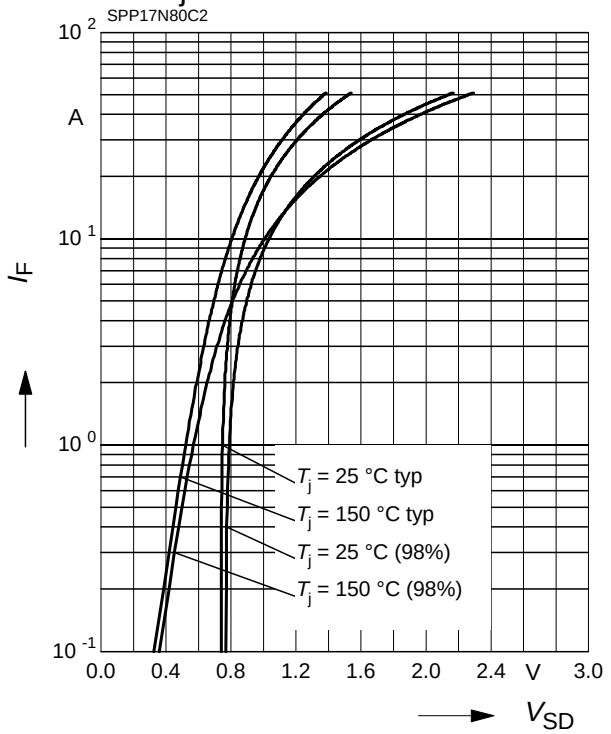

## 11 Typ. gate charge

$V_{GS} = f(Q_{Gate})$
parameter: $I_D$ = 17 A pulsed




## 12 Forward characteristics of body diode

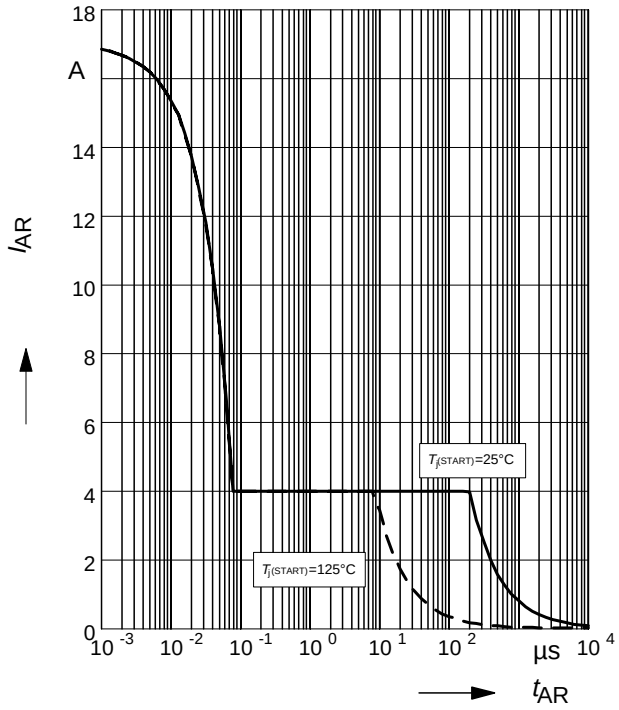
$I_F = f(V_{SD})$
parameter: $T_j$ , tp = 10 µs



## 13 Avalanche SOA

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

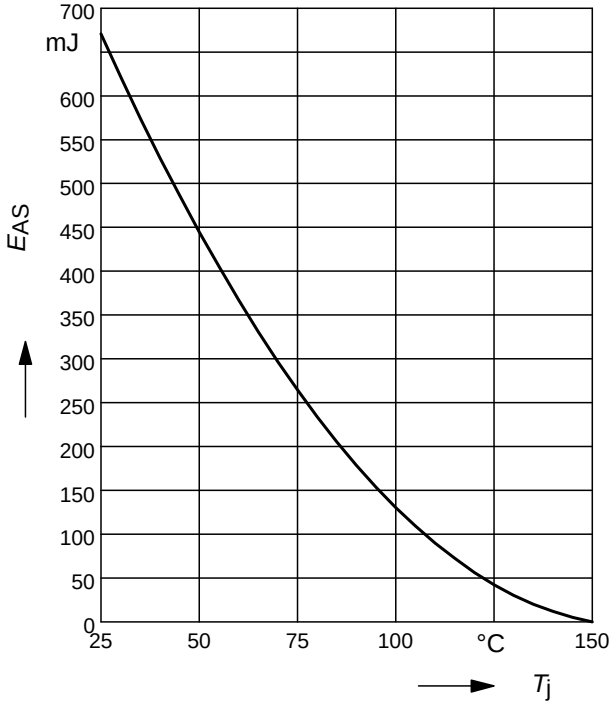
par.: $T_j \leq 150$ °C




## 14 Avalanche energy

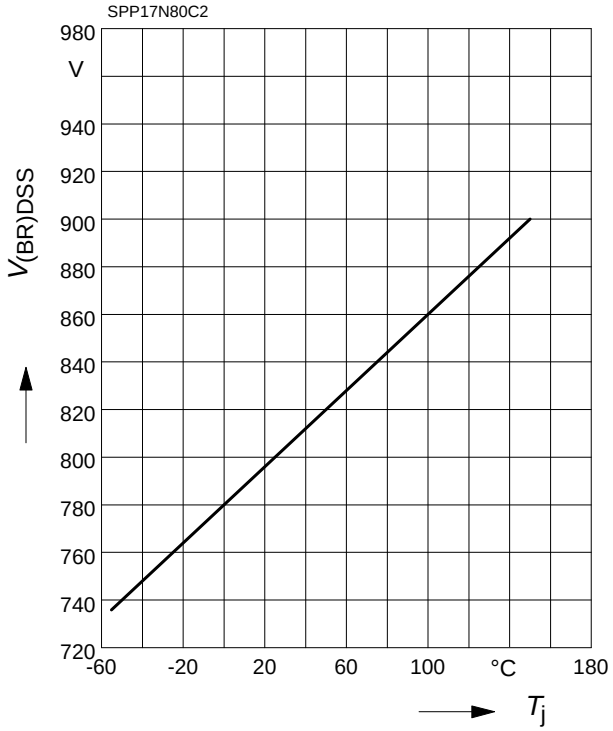
$E_{AS} = f(T_j)$

par.: $I_D$ = 4 A, $V_{DD}$ = 50 V




## 15 Drain-source breakdown voltage

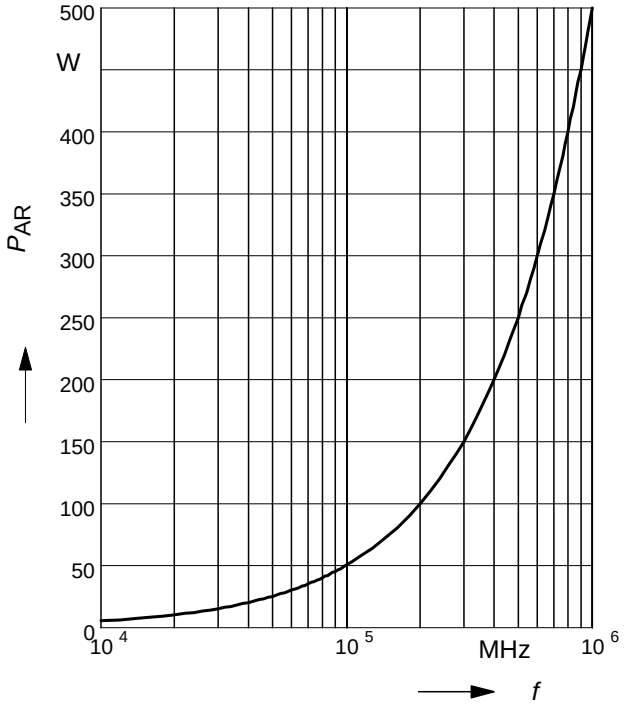
$V_{(BR)DSS} = f(T_j)$




## 16 Avalanche power losses

$P_{AR} = f(f)$

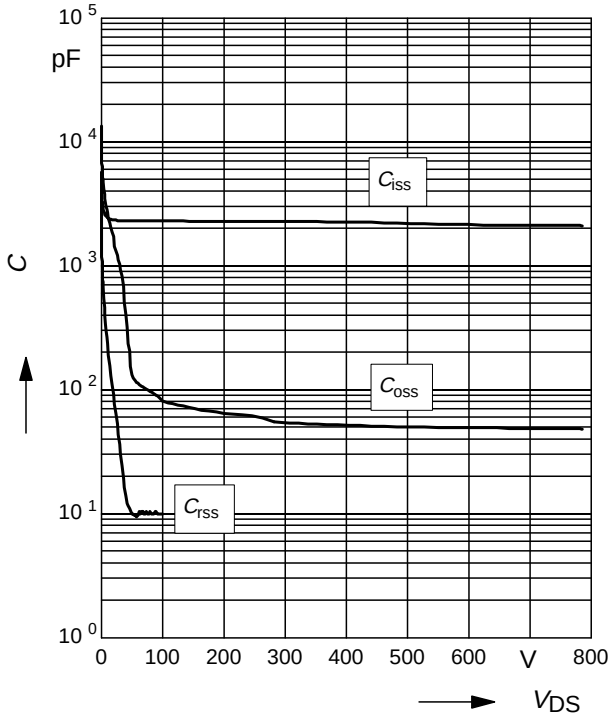
parameter: $E_{AR}$=0.5mJ



## 17 Typ. capacitances

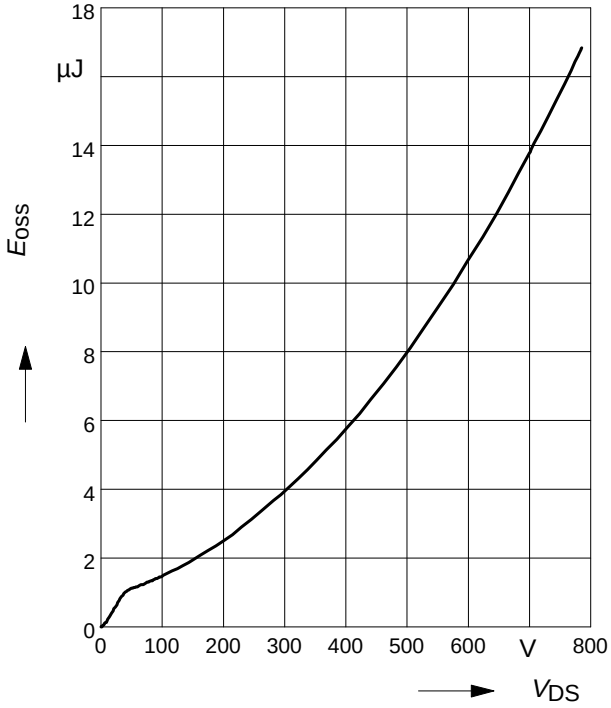
$C = f(V_{DS})$

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

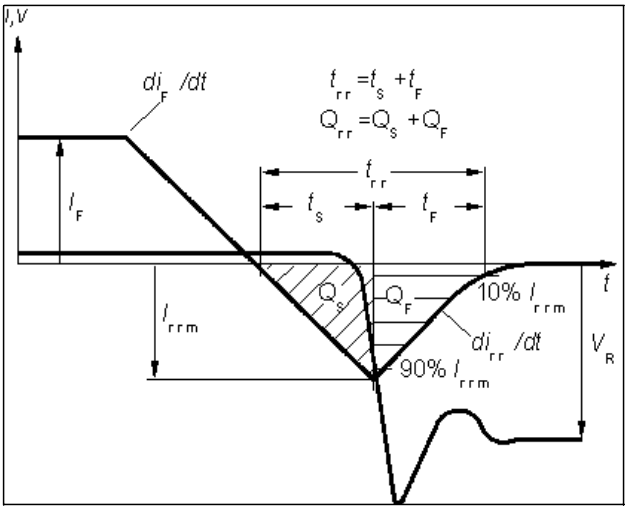



## 18 Typ. $C_{oss}$ stored energy

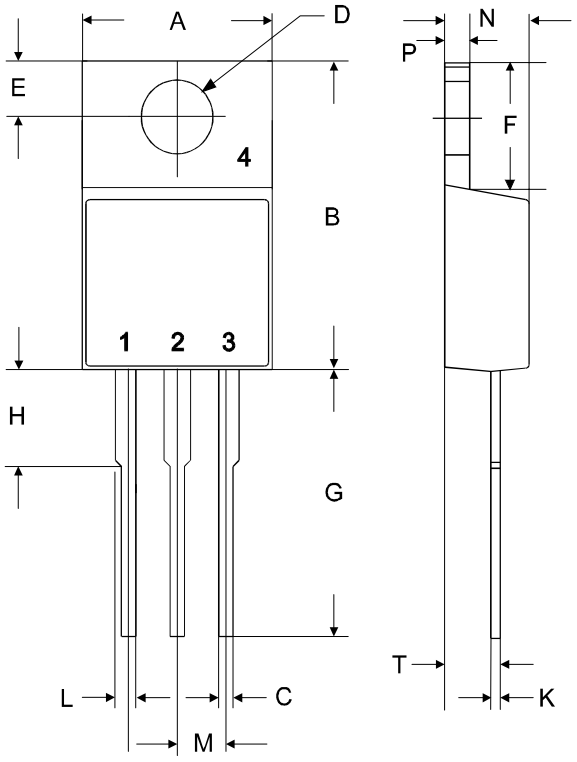
$E_{oss}=f(V_{DS})$




Definition of diodes switching characteristics

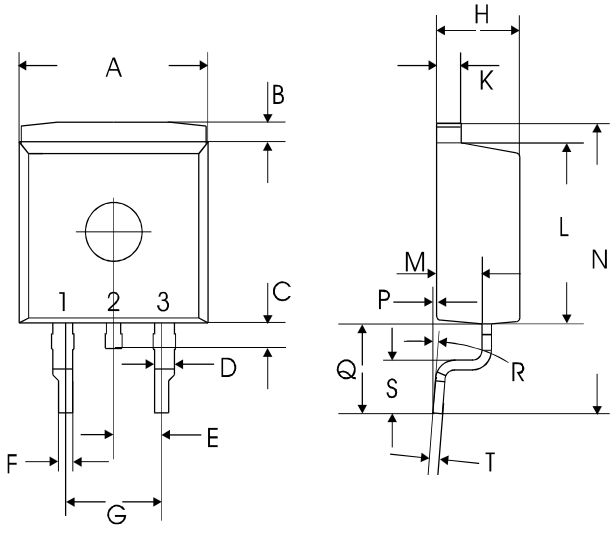


P-TO220-3-1

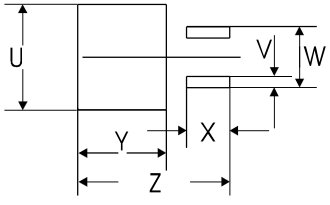



| symbol | dimensions | | | |
|---|---|---|---|---|
| | [mm] | | [inch] | |
| | min | max | min | max |
| A | 9.70 | 10.30 | 0.3819 | 0.4055 |
| B | 14.88 | 15.95 | 0.5858 | 0.6280 |
| C | 0.65 | 0.86 | 0.0256 | 0.0339 |
| D | 3.55 | 3.89 | 0.1398 | 0.1531 |
| E | 2.60 | 3.00 | 0.1024 | 0.1181 |
| F | 6.00 | 6.80 | 0.2362 | 0.2677 |
| G | 13.00 | 14.00 | 0.5118 | 0.5512 |
| H | 4.35 | 4.75 | 0.1713 | 0.1870 |
| K | 0.38 | 0.65 | 0.0150 | 0.0256 |
| L | 0.95 | 1.32 | 0.0374 | 0.0520 |
| M | 2.54 typ. | | 0.1 typ. | |
| N | 4.30 | 4.50 | 0.1693 | 0.1772 |
| P | 1.17 | 1.40 | 0.0461 | 0.0551 |
| T | 2.30 | 2.72 | 0.0906 | 0.1071 |

TO-263 (D²Pak/P-TO220SMD)




Footprint
(dif. scale)




| symbol | dimensions | | | |
|---|---|---|---|---|
| | [mm] | | [inch] | |
| | min | max | min | max |
| A | 9.80 | 10.20 | 0.3858 | 0.4016 |
| B | 0.70 | 1.30 | 0.0276 | 0.0512 |
| C | 1.00 | 1.60 | 0.0394 | 0.0630 |
| D | 1.03 | 1.07 | 0.0406 | 0.0421 |
| E | 2.54 typ. | | 0.1 typ. | |
| F | 0.65 | 0.85 | 0.0256 | 0.0335 |
| G | 5.08 typ. | | 0.2 typ. | |
| H | 4.30 | 4.50 | 0.1693 | 0.1772 |
| K | 1.17 | 1.37 | 0.0461 | 0.0539 |
| L | 9.05 | 9.45 | 0.3563 | 0.3720 |
| M | 2.30 | 2.50 | 0.0906 | 0.0984 |
| N | 15 typ. | | 0.5906 typ. | |
| P | 0.00 | 0.20 | 0.0000 | 0.0079 |
| Q | 4.20 | 5.20 | 0.1654 | 0.2047 |
| R | 8° max | | 8° max | |
| S | 2.40 | 3.00 | 0.0945 | 0.1181 |
| T | 0.40 | 0.60 | 0.0157 | 0.0236 |
| U | 10.80 | | 0.4252 | |
| V | 1.15 | | 0.0453 | |
| W | 6.23 | | 0.2453 | |
| X | 4.60 | | 0.1811 | |
| Y | 9.40 | | 0.3701 | |
| Z | 16.15 | | 0.6358 | |

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