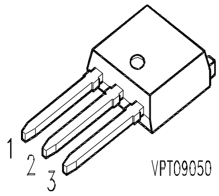
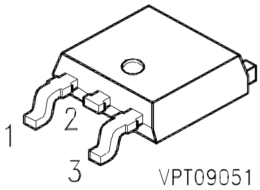
**SIPMOS ® Power Transistor**

- N channel
- Enhancement mode
- Avalanche-rated
- d*v*/d*t* rated
- 175°C operating temperature





| Pin 1 | Pin 2 | Pin 3 |
|---|---|---|
| G | D | S |

| Type | $V_{DS}$ | $I_D$ | $R_{DS(on)}$ | Package | Ordering Code |
|---|---|---|---|---|---|
| SPD23N05 | 55 V | 22 A | 0.06 Ω | P-TO252 | Q67040 - S4138 - A2 |
| SPU23N05 | 55 V | 22 A | 0.06 Ω | P-TO251 | Q67040 - S4131 - A2 |

**Maximum Ratings**

| Parameter | Symbol | Values | Unit |
|---|---|---|---|
| Continuous drain current | $I_D$ | | A |
| $T_C$ = 25 °C | | 22 | |
| $T_C$ = 100 °C | | 16 | |
| Pulsed drain current | $I_{Dpuls}$ | | |
| $T_C$ = 25 °C | | 88 | |
| Avalanche energy, single pulse | $E_{AS}$ | | mJ |
| $I_D$ = 22 A, $V_{DD}$ = 25 V, $R_{GS}$ = 25 Ω | | | |
| $L$ = 372 µH, $T_j$ = 25 °C | | 90 | |
| Avalanche current,limited by $T_{jmax}$ | $I_{AR}$ | 22 | A |
| Avalanche energy,periodic limited by $T_{jmax}$ | $E_{AR}$ | 5.5 | mJ |
| Reverse diode d*v*/d*t* | d*v*/d*t* | | kV/µs |
| $I_S$ = 22 A, $V_{DS}$ = 40 V, d$i_F$/d*t* = 200 A/µs | | | |
| $T_{jmax}$ = 175 °C | | 6 | |
| Gate source voltage | $V_{GS}$ | ± 20 | V |
| Power dissipation | $P_{tot}$ | | W |
| $T_C$ = 25 °C | | 55 | |

**Maximum Ratings**

| Parameter | Symbol | Values | Unit |
|---|---|---|---|
| Operating temperature | $T_j$ | -55 ... + 175 | °C |
| Storage temperature | $T_{stg}$ | -55 ... + 175 | |
| Thermal resistance, junction - case | $R_{thJC}$ | $\leq$ 2.7 | K/W |
| Thermal resistance, junction - ambient (PCB mount)** | $R_{thJA}$ | $\leq$ 50 | |
| Thermal resistance, junction - ambient | $R_{thJA}$ | $\leq$ 100 | |
| IEC climatic category, DIN IEC 68-1 | | 55 / 175 / 56 | |

** when mounted on 1 " square PCB ( FR4 );for recommended footprint

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

| Parameter | Symbol | Values | | | Unit |
|---|---|---|---|---|---|
| | | min. | typ. | max. | |
| **Static Characteristics** | | | | | |
| Drain- source breakdown voltage | $V_{(BR)DSS}$ | | | | V |
| $V_{GS}$ = 0 V, $I_D$ = 0.25 mA, $T_j$ = 25 °C | | 55 | - | - | |
| Gate threshold voltage | $V_{GS(th)}$ | | | | |
| $V_{GS}$=$V_{DS,}$ $I_D$ = 40 µA | | 2.1 | 3 | 4 | |
| Zero gate voltage drain current | $I_{DSS}$ | | | | µA |
| $V_{DS}$ = 50 V, $V_{GS}$ = 0 V, $T_j$ = -40 °C | | - | - | 0.1 | |
| $V_{DS}$ = 50 V, $V_{GS}$ = 0 V, $T_j$ = 25 °C | | - | 0.1 | 1 | |
| $V_{DS}$ = 50 V, $V_{GS}$ = 0 V, $T_j$ = 150 °C | | - | - | 100 | |
| Gate-source leakage current | $I_{GSS}$ | | | | nA |
| $V_{GS}$ = 20 V, $V_{DS}$ = 0 V | | - | 10 | 100 | |
| Drain-Source on-resistance | $R_{DS(on)}$ | | | | Ω |
| $V_{GS}$ = 10 V, $I_D$ = 16 A | | - | 0.04 | 0.06 | |

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

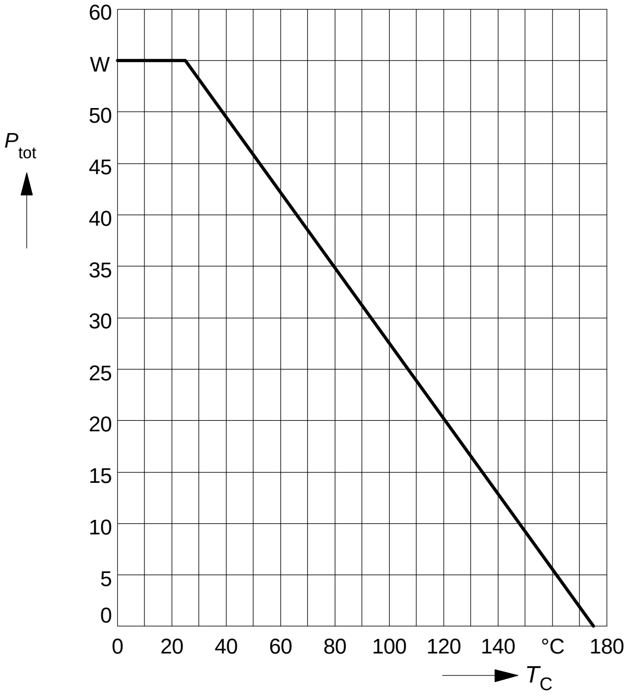
| **Parameter** | **Symbol** | **Values** | | | **Unit** |
|---|---|---|---|---|---|
| | | **min.** | **typ.** | **max.** | |
| **Dynamic Characteristics** | | | | | |
| Transconductance<br>$V_{DS} \geq 2 * I_D * R_{DS(on)max}$, $I_D$ = 16 A | $g_{fs}$ | 7 | 10 | - | S |
| Input capacitance<br>$V_{GS}$ = 0 V, $V_{DS}$ = 25 V, $f$ = 1 MHz | $C_{iss}$ | - | 490 | 615 | pF |
| Output capacitance<br>$V_{GS}$ = 0 V, $V_{DS}$ = 25 V, $f$ = 1 MHz | $C_{oss}$ | - | 170 | 215 | |
| Reverse transfer capacitance<br>$V_{GS}$ = 0 V, $V_{DS}$ = 25 V, $f$ = 1 MHz | $C_{rss}$ | - | 95 | 120 | |
| Turn-on delay time<br>$V_{DD}$ = 30 V, $V_{GS}$ = 10 V, $I_D$ = 22 A<br>$R_G$ = 20 Ω | $t_{d(on)}$ | - | 15 | 25 | ns |
| Rise time<br>$V_{DD}$ = 30 V, $V_{GS}$ = 10 V, $I_D$ = 22 A<br>$R_G$ = 20 Ω | $t_r$ | - | 25 | 40 | |
| Turn-off delay time<br>$V_{DD}$ = 30 V, $V_{GS}$ = 10 V, $I_D$ = 22 A<br>$R_G$ = 20 Ω | $t_{d(off)}$ | - | 30 | 45 | |
| Fall time<br>$V_{DD}$ = 30 V, $V_{GS}$ = 10 V, $I_D$ = 22 A<br>$R_G$ = 20 Ω | $t_f$ | - | 25 | 40 | |
| Gate charge at threshold<br>$V_{DD}$ = 40 V, $I_D$ = 0.1 A, $V_{GS}$ =0 to 1 V | $Q_{g(th)}$ | - | 0.5 | 0.75 | nC |
| Gate charge at 7.0 V<br>$V_{DD}$ = 40 V, $I_D$ = 22 A, $V_{GS}$ =0 to 7 V | $Q_{g(7)}$ | - | 13 | 20 | |
| Gate charge total<br>$V_{DD}$ = 40 V, $I_D$ = 22 A, $V_{GS}$ =0 to 10 V | $Q_{g(total)}$ | - | 17 | 26 | |
| Gate plateau voltage<br>$V_{DD}$ = 40 V, $I_D$ = 22 A | $V_{(plateau)}$ | - | 5.9 | - | V |

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

| **Parameter** | **Symbol** | **Values** | | | **Unit** |
|---|---|---|---|---|---|
| | | **min.** | **typ.** | **max.** | |
| **Reverse Diode** | | | | | |
| Inverse diode continuous forward current<br>$T_C$ = 25 °C | $I_S$ | - | - | 22 | A |
| Inverse diode direct current,pulsed<br>$T_C$ = 25 °C | $I_{SM}$ | - | - | 88 | |
| Inverse diode forward voltage<br>$V_{GS}$ = 0 V, $I_F$ = 44 A | $V_{SD}$ | - | 1.2 | 1.8 | V |
| Reverse recovery time<br>$V_R$ = 30 V, $I_F$=$I_{S,}$ d$i_F$/d$t$ = 100 A/µs | $t_{rr}$ | - | 55 | 85 | ns |
| Reverse recovery charge<br>$V_R$ = 30 V, $I_F$=$I_{S,}$ d$i_F$/d$t$ = 100 A/µs | $Q_{rr}$ | - | 0.12 | 0.18 | µC |

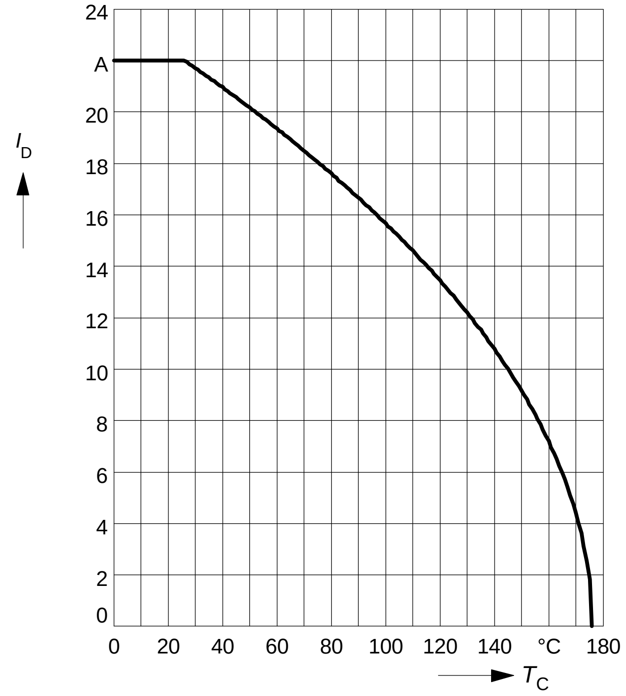
### Power dissipation

$P_{tot} = f(T_C)$



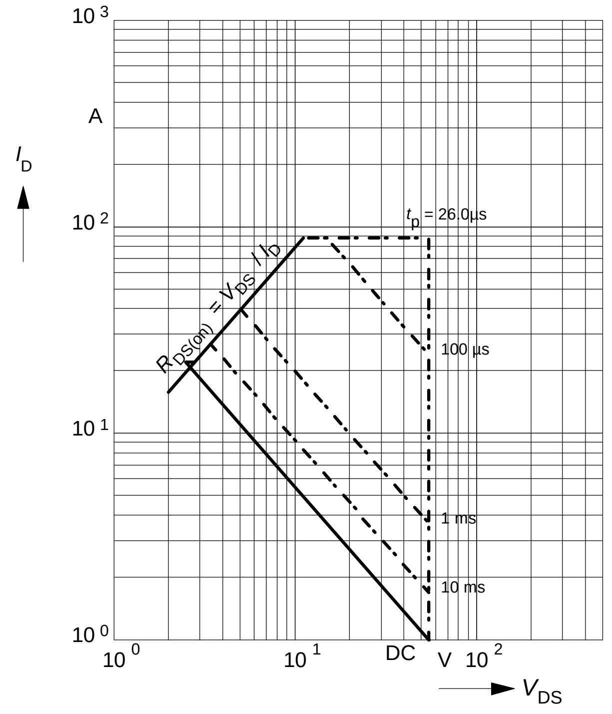
### Drain current

$I_D = f(T_C)$
parameter: $V_{GS} \geq 10$ V



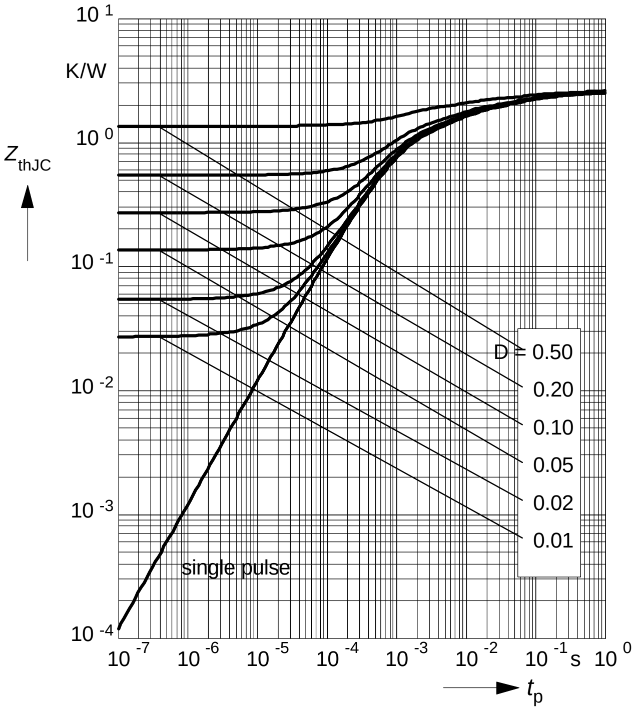
### Safe operating area

$I_D = f(V_{DS})$
parameter: $D = 0.01$, $T_C = 25°C$



### Transient thermal impedance

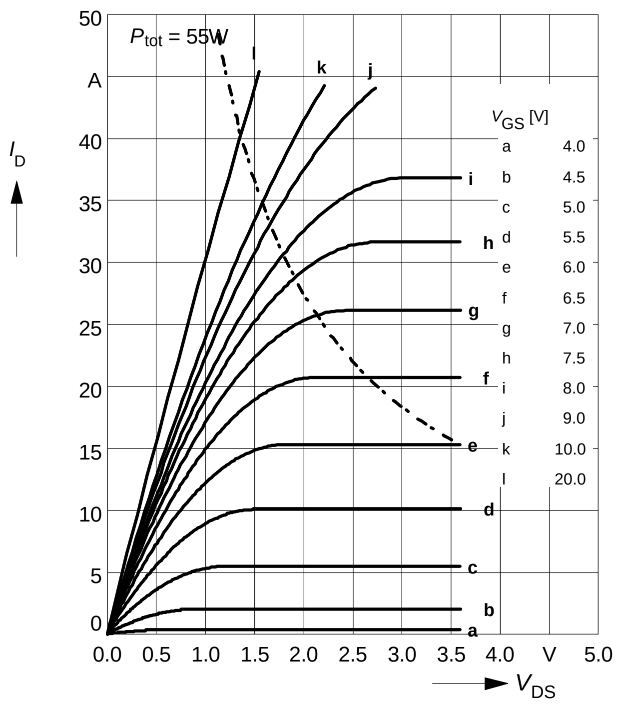
$Z_{th\ JC} = f(t_p)$
parameter: $D = t_p / T$



### Typ. output characteristics

$I_D = f(V_{DS})$

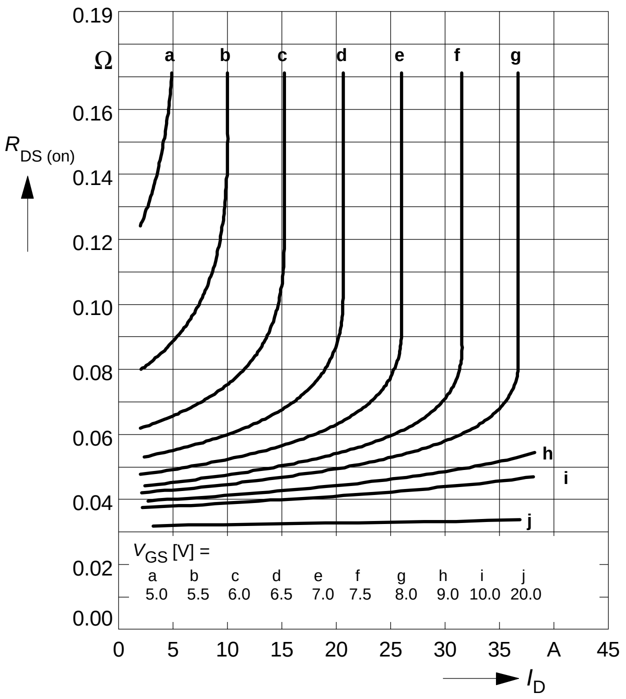
parameter: $t_p$ = 80 µs , $T_j$ = 25 °C



### Typ. drain-source on-resistance

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

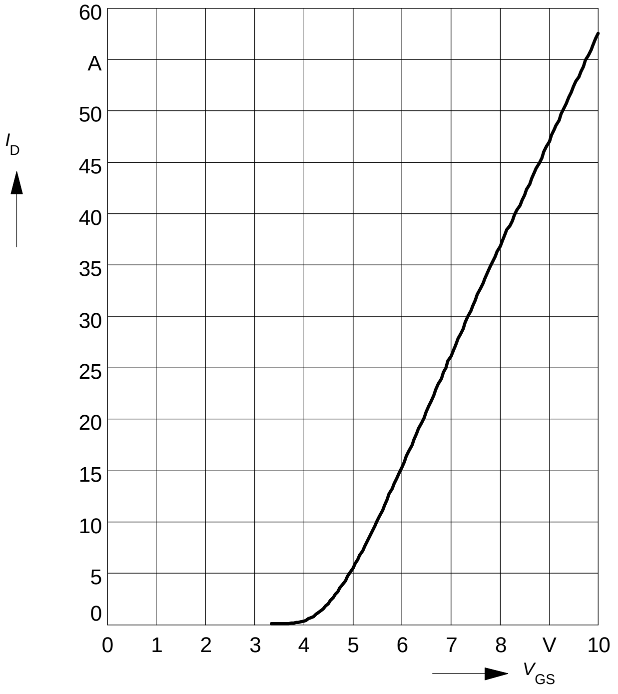
parameter: $t_p$ = 80 µs, $T_j$ = 25 °C



**Typ. transfer characteristics** $I_D = f\ (V_{GS})$

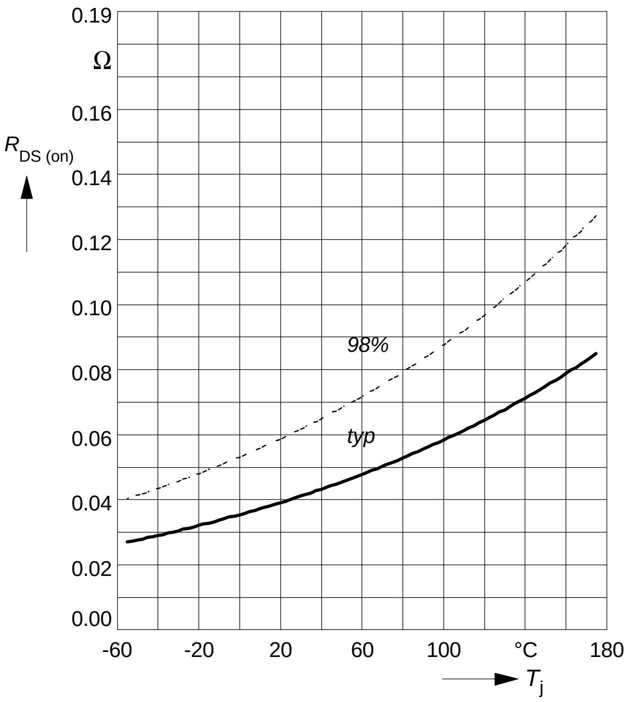
parameter: $t_p$ = 80 µs

$V_{DS} \geq 2 \times I_D \times R_{DS(on)max}$



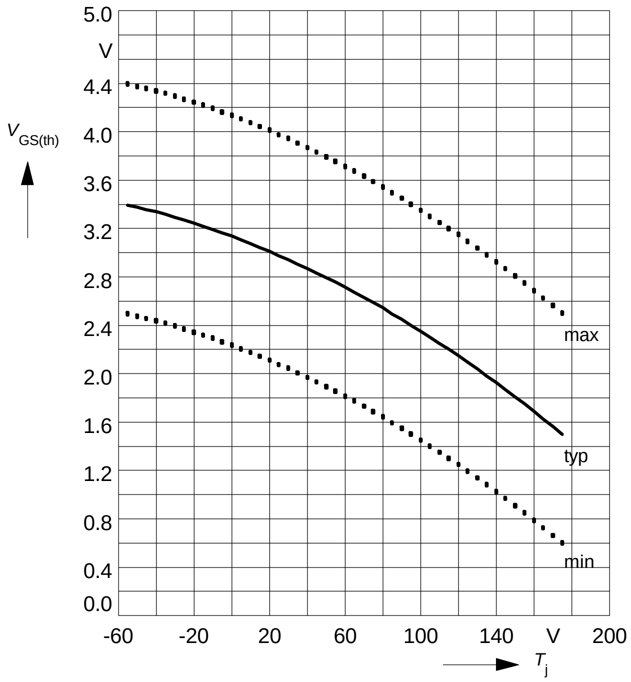
### Drain-source on-resistance

$R_{DS\,(on)} = f(T_j)$
parameter: $I_D$ = 16 A, $V_{GS}$ = 10 V



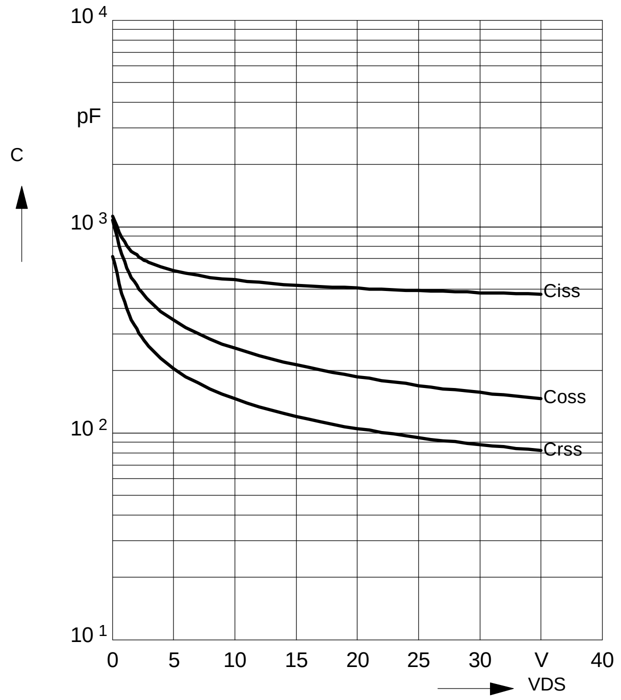
### Gate threshold voltage

$V_{GS(th)} = f\,(T_j)$
parameter: $V_{GS}$=$V_{DS}$, $I_D$ =40µA



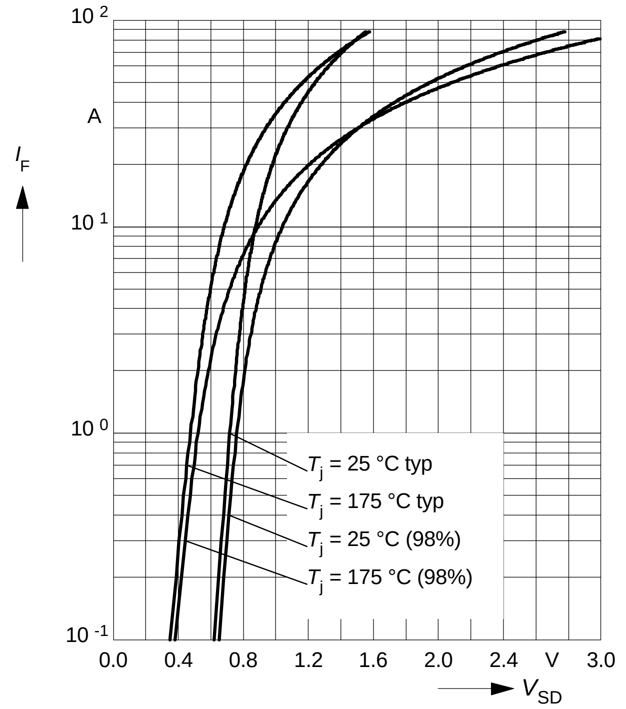
### Typ. capacitances

$C = f\,(V_{DS})$
parameter: $V_{GS}$ = 0V, $f$ = 1MHz



### Forward characteristics of reverse diode

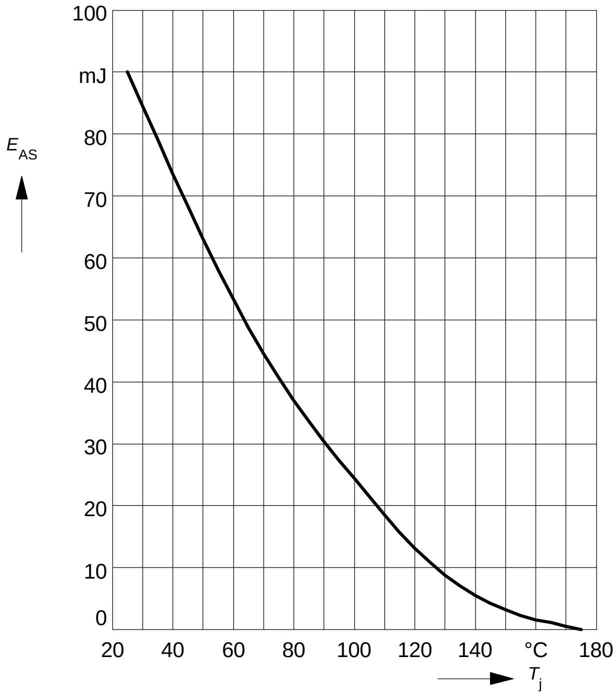
$I_F = f(V_{SD})$
parameter: $T_j$, $t_p$ = 80 µs



**Avalanche energy** $E_{AS} = f\,(T_j)$

parameter: $I_D$=22A, $V_{DD}$ =25 V

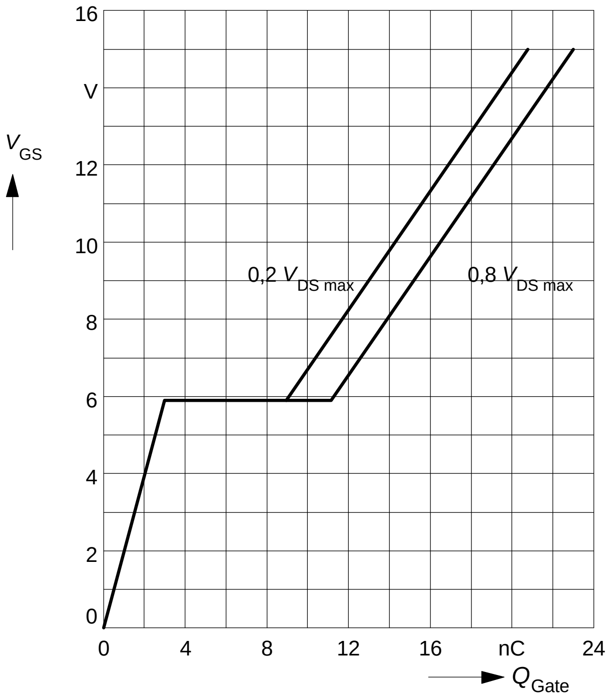
$R_{GS}$ =25 Ω , L = 372µH



### Typ. gate charge

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

parameter: $I_{D\ puls}$ = 22 A



### Drain-source breakdown voltage

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