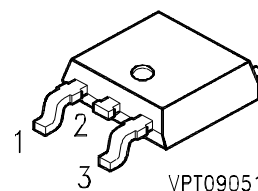
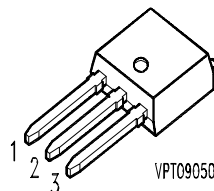


## SIPMOS® Power Transistor

- N channel
- Enhancement mode
- Avalanche-rated
- $dv/dt$  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 $\Omega$	P-TO252	Q67040 - S4138 - A2
SPU23N05	55 V	22 A	0.06 $\Omega$	P-TO251	Q67040 - S4131 - A2

### Maximum Ratings

Parameter	Symbol	Values	Unit
Continuous drain current $T_C = 25\text{ }^\circ\text{C}$ $T_C = 100\text{ }^\circ\text{C}$	$I_D$	22 16	A
Pulsed drain current $T_C = 25\text{ }^\circ\text{C}$	$I_{Dpuls}$	88	A
Avalanche energy, single pulse $I_D = 22\text{ A}$ , $V_{DD} = 25\text{ V}$ , $R_{GS} = 25\text{ }\Omega$ $L = 372\text{ }\mu\text{H}$ , $T_j = 25\text{ }^\circ\text{C}$	$E_{AS}$	90	mJ
Avalanche current, limited by $T_{jmax}$	$I_{AR}$	22	A
Avalanche energy, periodic limited by $T_{jmax}$	$E_{AR}$	5.5	mJ
Reverse diode $dv/dt$ $I_S = 22\text{ A}$ , $V_{DS} = 40\text{ V}$ , $di_F/dt = 200\text{ A}/\mu\text{s}$ $T_{jmax} = 175\text{ }^\circ\text{C}$	$dv/dt$	6	kV/ $\mu\text{s}$
Gate source voltage	$V_{GS}$	$\pm 20$	V
Power dissipation $T_C = 25\text{ }^\circ\text{C}$	$P_{tot}$	55	W

## Maximum Ratings

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

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

## Electrical Characteristics, at $T_j = 25^\circ\text{C}$ , unless otherwise specified

Parameter	Symbol	Values			Unit
		min.	typ.	max.	

## Static Characteristics

Drain- source breakdown voltage $V_{GS} = 0 \text{ V}$ , $I_D = 0.25 \text{ mA}$ , $T_j = 25^\circ\text{C}$	$V_{(BR)DSS}$	55	-	-	V
Gate threshold voltage $V_{GS}=V_{DS}$ , $I_D = 40 \mu\text{A}$	$V_{GS(th)}$	2.1	3	4	
Zero gate voltage drain current $V_{DS} = 50 \text{ V}$ , $V_{GS} = 0 \text{ V}$ , $T_j = -40^\circ\text{C}$ $V_{DS} = 50 \text{ V}$ , $V_{GS} = 0 \text{ V}$ , $T_j = 25^\circ\text{C}$ $V_{DS} = 50 \text{ V}$ , $V_{GS} = 0 \text{ V}$ , $T_j = 150^\circ\text{C}$	$I_{DSS}$	- - -	- 0.1 -	0.1 1 100	$\mu\text{A}$
Gate-source leakage current $V_{GS} = 20 \text{ V}$ , $V_{DS} = 0 \text{ V}$	$I_{GSS}$	-	10	100	
Drain-Source on-resistance $V_{GS} = 10 \text{ V}$ , $I_D = 16 \text{ A}$	$R_{DS(on)}$	-	0.04	0.06	

**Electrical Characteristics**, at  $T_j = 25^\circ\text{C}$ , unless otherwise specified

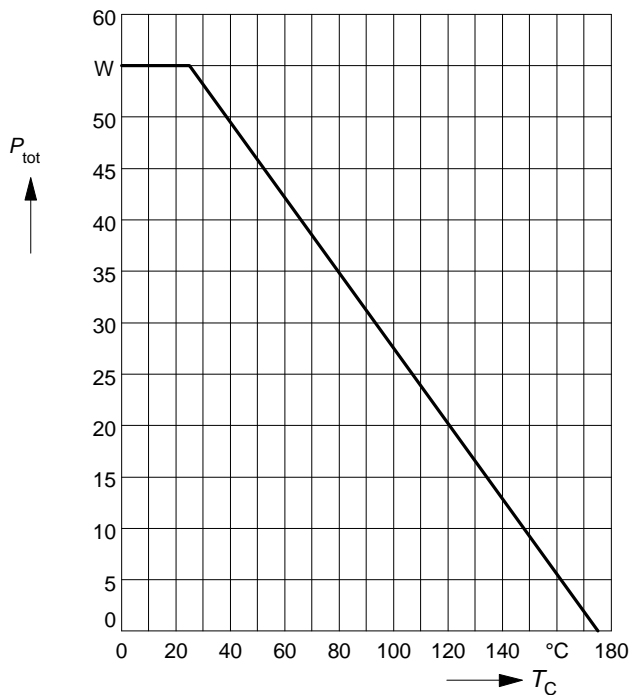
Parameter	Symbol	Values			Unit
		min.	typ.	max.	
Dynamic Characteristics					
Transconductance $V_{DS} \geq 2 * I_D * R_{DS(ON)max}$ , $I_D = 16\text{ A}$	$g_{fs}$	7	10	-	S
Input capacitance $V_{GS} = 0\text{ V}$ , $V_{DS} = 25\text{ V}$ , $f = 1\text{ MHz}$	$C_{iss}$	-	490	615	pF
Output capacitance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

Electrical Characteristics, at  $T_j = 25^\circ\text{C}$ , unless otherwise specified

Parameter	Symbol	Values			Unit
		min.	typ.	max.	
Reverse Diode					
Inverse diode continuous forward current $T_C = 25\text{ }^{\circ}\text{C}$	$I_S$	-	-	22	A
Inverse diode direct current,pulsed $T_C = 25\text{ }^{\circ}\text{C}$	$I_{SM}$	-	-	88	
Inverse diode forward voltage $V_{GS} = 0\text{ V}, I_F = 44\text{ A}$	$V_{SD}$	-	1.2	1.8	V
Reverse recovery time $V_R = 30\text{ V}, I_F = I_S, di_F/dt = 100\text{ A}/\mu\text{s}$	$t_{rr}$	-	55	85	ns
Reverse recovery charge $V_R = 30\text{ V}, I_F = I_S, di_F/dt = 100\text{ A}/\mu\text{s}$	$Q_{rr}$	-	0.12	0.18	$\mu\text{C}$

## Power dissipation

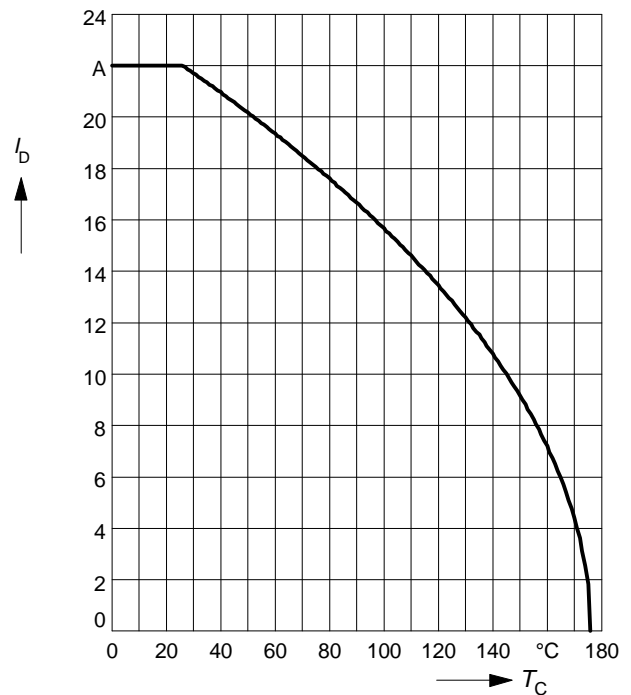
$$P_{\text{tot}} = f(T_C)$$



## Drain current

$$I_D = f(T_C)$$

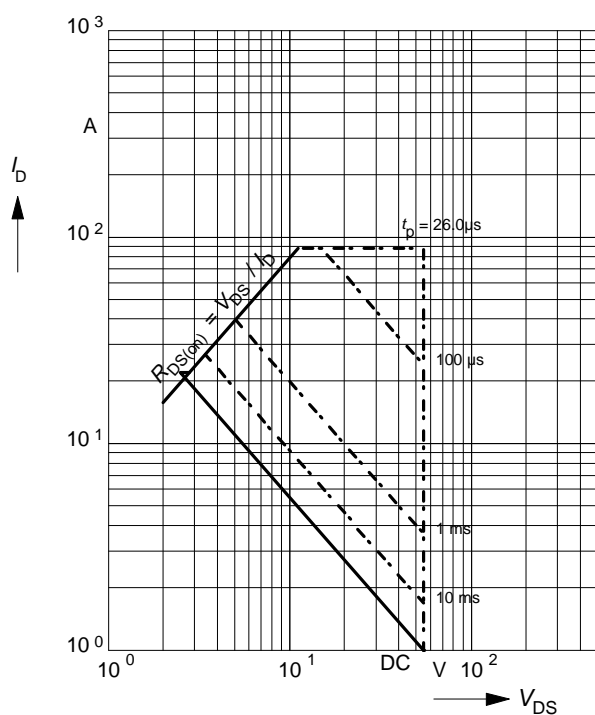
parameter:  $V_{GS} \geq 10$  V



## Safe operating area

$$I_D = f(V_{DS})$$

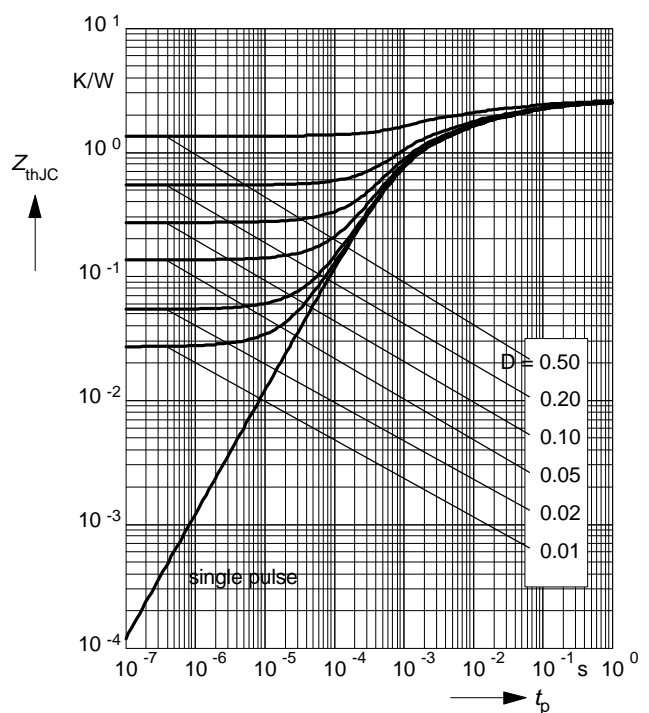
parameter:  $D = 0.01$ ,  $T_C = 25^\circ\text{C}$



## Transient thermal impedance

$$Z_{\text{thJC}} = f(t_p)$$

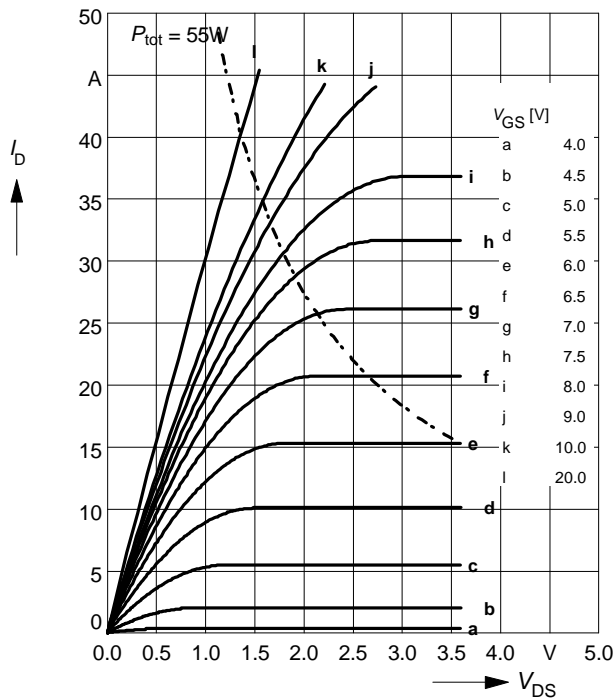
parameter:  $D = t_p / T$



## Typ. output characteristics

$$I_D = f(V_{DS})$$

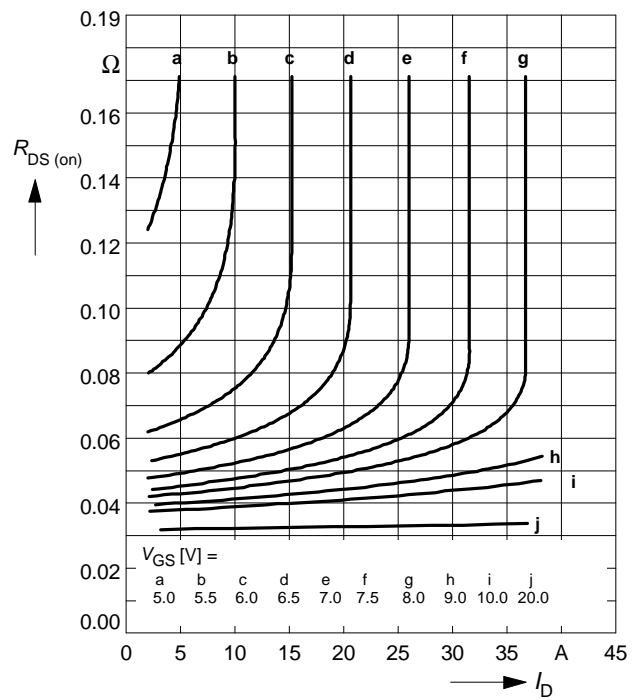
parameter:  $t_p = 80 \mu s$ ,  $T_j = 25^\circ C$



## Typ. drain-source on-resistance

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

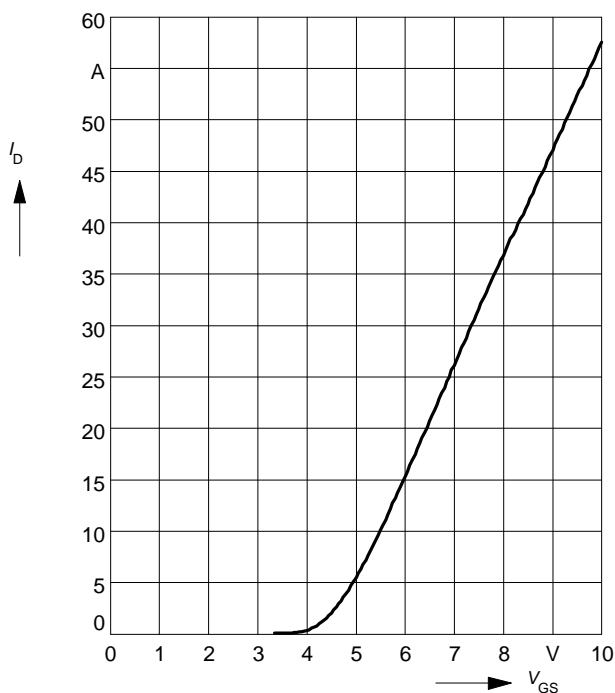
parameter:  $t_p = 80 \mu s$ ,  $T_j = 25^\circ C$



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

parameter:  $t_p = 80 \mu s$

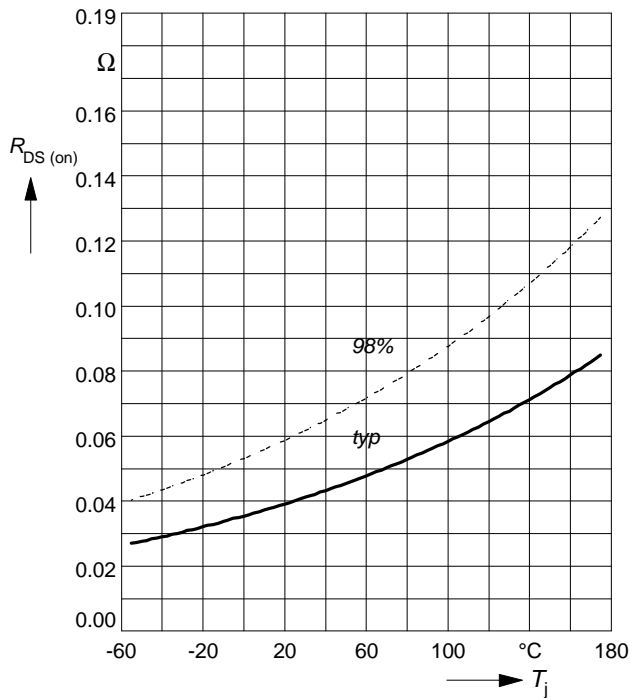
$$V_{DS} \geq 2 \times I_D \times R_{DS(on)max}$$



## Drain-source on-resistance

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

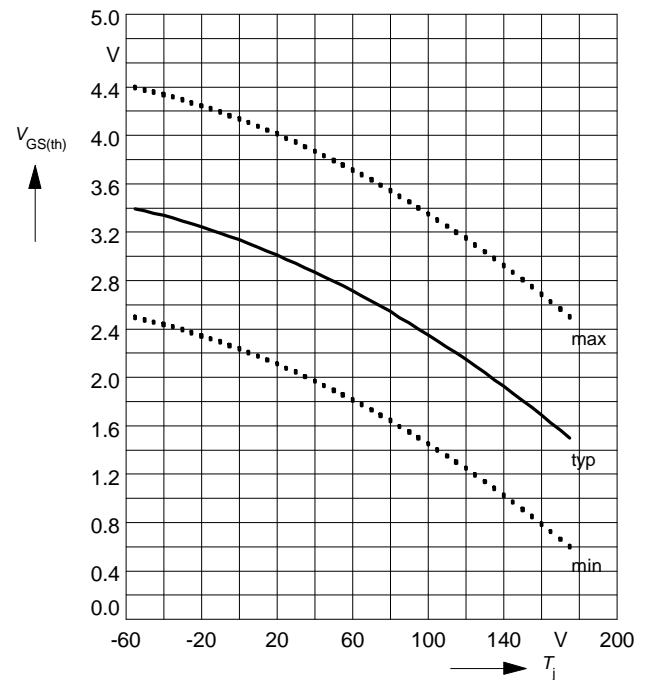
parameter:  $I_D = 16 \text{ A}$ ,  $V_{GS} = 10 \text{ V}$



## Gate threshold voltage

$$V_{GS(th)} = f(T_j)$$

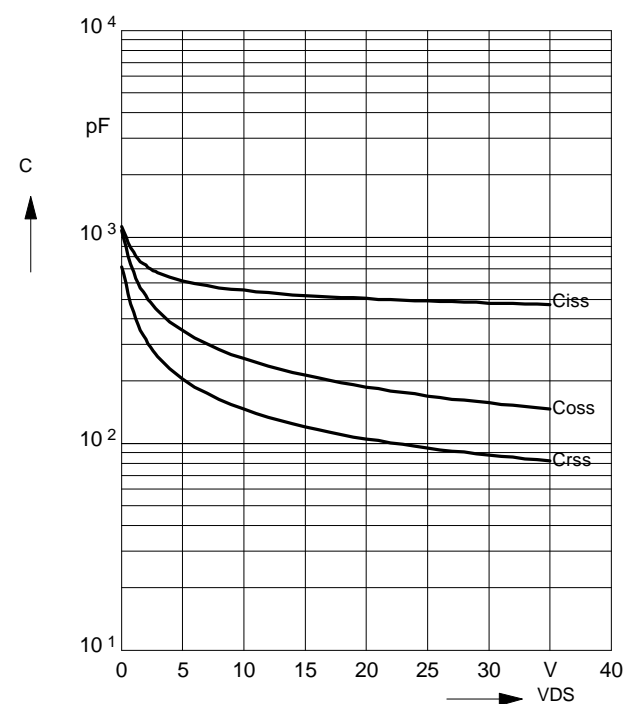
parameter:  $V_{GS} = V_{DS}$ ,  $I_D = 40 \mu\text{A}$



## Typ. capacitances

$$C = f(V_{DS})$$

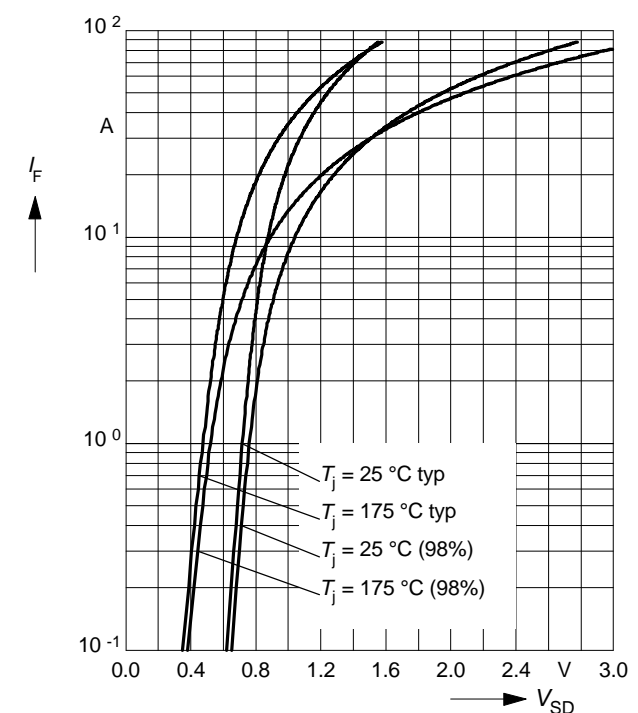
parameter:  $V_{GS} = 0 \text{ V}$ ,  $f = 1 \text{ MHz}$



## Forward characteristics of reverse diode

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

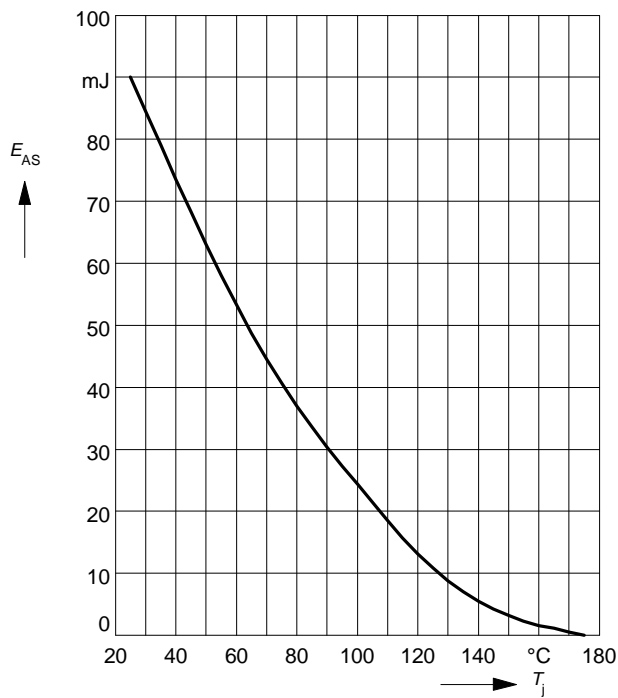
parameter:  $T_j$ ,  $t_p = 80 \mu\text{s}$



## Avalanche energy $E_{AS} = f(T_j)$

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

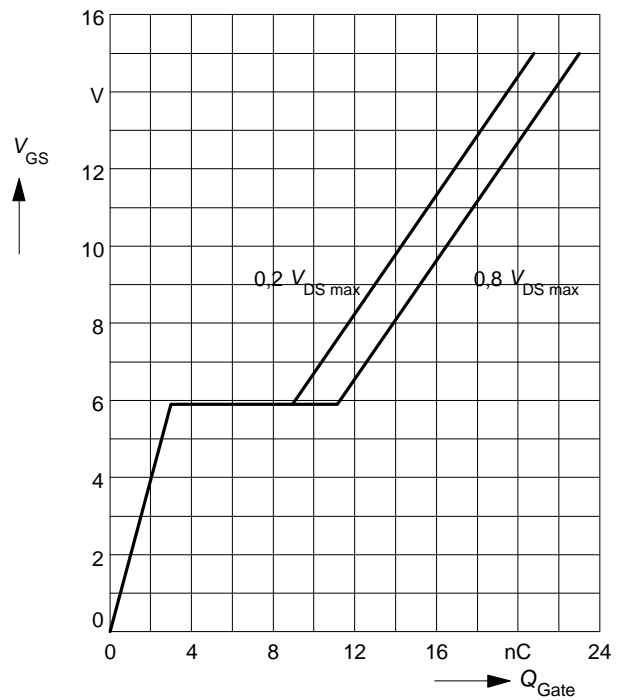
$R_{GS} = 25\Omega$ ,  $L = 372\mu H$



## Typ. gate charge

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

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



## Drain-source breakdown voltage

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

