



Improved  $R_{DS(on)}$  !

SPD 09N05

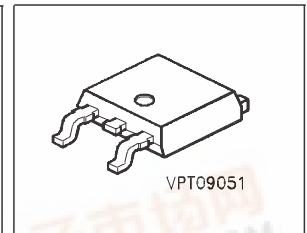
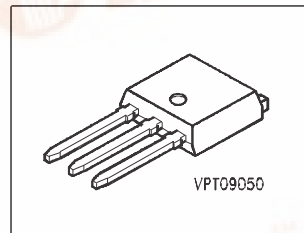
## SIPMOS® Power Transistor

### Features

- N channel
- Enhancement mode
- Avalanche rated
- dv/dt rated
- 175°C operating temperature

### Product Summary

Drain source voltage	$V_{DS}$	55	V
Drain-Source on-state resistance	$R_{DS(on)}$	0.1	$\Omega$
Continuous drain current	$I_D$	9.2	A



Type	Package	Ordering Code	Packaging	Pin 1	Pin 2	Pin 3
SPD09N05	P-TO252	Q67040-S4136	Tape and Reel	G	D	S
SPU09N05	P-TO251	Q67040-S4130-A2	Tube			

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

Parameter	Symbol	Value	Unit
Continuous drain current $T_C = 25^\circ\text{C}$ $T_C = 100^\circ\text{C}$	$I_D$	9.2 6.5	A
Pulsed drain current $T_C = 25^\circ\text{C}$	$I_{Dpulse}$	37	
Avalanche energy, single pulse $I_D = 9.2\text{ A}$ , $V_{DD} = 25\text{ V}$ , $R_{GS} = 25\ \Omega$	$E_{AS}$	35	mJ
Avalanche energy, periodic limited by $T_{jmax}$	$E_{AR}$	2.4	
Reverse diode dv/dt $I_S = 9.2\text{ A}$ , $V_{DS} = 40\text{ V}$ , $di/dt = 200\text{ A}/\mu\text{s}$	dv/dt	6	kV/ $\mu\text{s}$
Gate source voltage	$V_{GS}$	$\pm 20$	V
Power dissipation $T_C = 25^\circ\text{C}$	$P_{tot}$	24	W
Operating and storage temperature	$T_j, T_{stg}$	-55... +175	$^\circ\text{C}$
IEC climatic category; DIN IEC 68-1		55/175/56	



**Thermal Characteristics**

Parameter	Symbol	Values			Unit
		min.	typ.	max.	
<b>Characteristics</b>					
Thermal resistance, junction - case	$R_{thJC}$	-	-	6.25	K/W
Thermal resistance, junction - ambient, leded	$R_{thJA}$	-	-	100	
SMD version, device on PCB: @ min. footprint @ 6 cm <sup>2</sup> cooling area <sup>1)</sup>	$R_{thJA}$	-	-	75 50	

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

Parameter	Symbol	Values			Unit
		min.	typ.	max.	
<b>Static Characteristics</b>					
Drain- source breakdown voltage $V_{GS} = 0\text{ V}$ , $I_D = 0.25\text{ mA}$	$V_{(BR)DSS}$	55	-	-	V
Gate threshold voltage, $V_{GS} = V_{DS}$ $I_D = 10\text{ }\mu\text{A}$	$V_{GS(th)}$	2.1	3	4	
Zero gate voltage drain current $V_{DS} = 50\text{ V}$ , $V_{GS} = 0\text{ V}$ , $T_j = 25\text{ }^\circ\text{C}$ $V_{DS} = 50\text{ V}$ , $V_{GS} = 0\text{ V}$ , $T_j = 150\text{ }^\circ\text{C}$	$I_{DSS}$	-	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-state resistance $V_{GS} = 10\text{ V}$ , $I_D = 6.5\text{ A}$	$R_{DS(on)}$	-	0.093	0.1	$\Omega$

<sup>1</sup> Device on 40mm\*40mm\*1.5mm epoxy PCB FR4 with 6 cm<sup>2</sup> (one layer, 70 $\mu\text{m}$  thick) copper area for drain connection. PCB is vertical without blown air.

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

Parameter	Symbol	Values			Unit
		min.	typ.	max.	
<b>Dynamic Characteristics</b>					
Transconductance $V_{DS} \geq 2 \cdot I_D \cdot R_{DS(on)max}$ , $I_D = 6.5\text{ A}$	$g_{fs}$	3	4.5	-	S
Input capacitance $V_{GS} = 0\text{ V}$ , $V_{DS} = 25\text{ V}$ , $f = 1\text{ MHz}$	$C_{iss}$	-	215	270	pF
Output capacitance $V_{GS} = 0\text{ V}$ , $V_{DS} = 25\text{ V}$ , $f = 1\text{ MHz}$	$C_{oss}$	-	75	95	
Reverse transfer capacitance $V_{GS} = 0\text{ V}$ , $V_{DS} = 25\text{ V}$ , $f = 1\text{ MHz}$	$C_{rss}$	-	45	60	
Turn-on delay time $V_{DD} = 30\text{ V}$ , $V_{GS} = 10\text{ V}$ , $I_D = 9.2\text{ A}$ , $R_G = 50\text{ }\Omega$	$t_{d(on)}$	-	15	25	ns
Rise time $V_{DD} = 30\text{ V}$ , $V_{GS} = 10\text{ V}$ , $I_D = 9.2\text{ A}$ , $R_G = 50\text{ }\Omega$	$t_r$	-	20	30	
Turn-off delay time $V_{DD} = 30\text{ V}$ , $V_{GS} = 10\text{ V}$ , $I_D = 9.2\text{ A}$ , $R_G = 50\text{ }\Omega$	$t_{d(off)}$	-	30	45	
Fall time $V_{DD} = 30\text{ V}$ , $V_{GS} = 10\text{ V}$ , $I_D = 9.2\text{ A}$ , $R_G = 50\text{ }\Omega$	$t_f$	-	25	40	

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

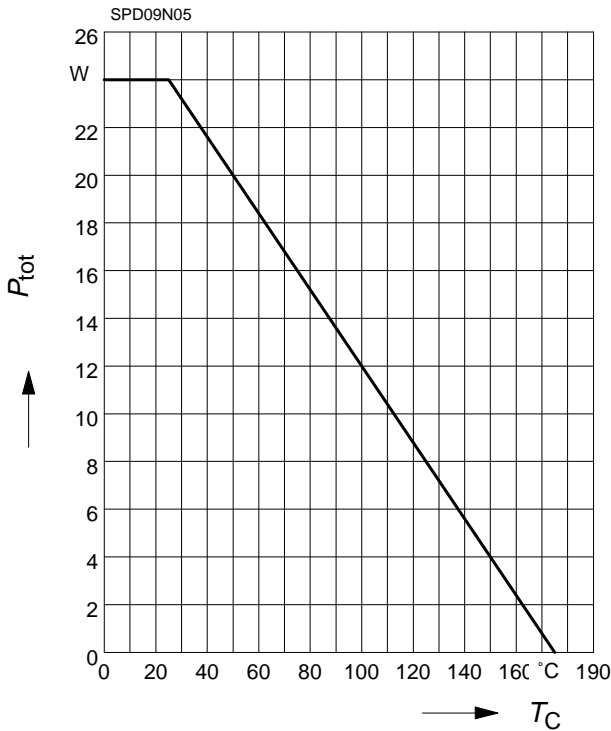
Parameter	Symbol	Values			Unit
		min.	typ.	max.	
<b>Dynamic Characteristics</b>					
Gate to source charge $V_{DD} = 40\text{ V}$ , $I_D = 9.2\text{ A}$	$Q_{gs}$	-	1.3	2	nC
Gate to drain charge $V_{DD} = 40\text{ V}$ , $I_D = 9.2\text{ A}$	$Q_{gd}$	-	3.5	5.25	
Gate charge total $V_{DD} = 40\text{ V}$ , $I_D = 9.2\text{ A}$ , $V_{GS} = 0\text{ to }10\text{ V}$	$Q_g$	-	7	11	
Gate plateau voltage $V_{DD} = 40\text{ V}$ , $I_D = 9.2\text{ A}$	$V_{(\text{plateau})}$	-	5.9	-	V

**Reverse Diode**

Inverse diode continuous forward current $T_C = 25\text{ }^\circ\text{C}$	$I_S$	-	-	9.2	A
Inverse diode direct current,pulsed $T_C = 25\text{ }^\circ\text{C}$	$I_{SM}$	-	-	37	
Inverse diode forward voltage $V_{GS} = 0\text{ V}$ , $I_F = 18.5\text{ A}$	$V_{SD}$	-	1.05	1.8	V
Reverse recovery time $V_R = 30\text{ V}$ , $I_F = I_S$ , $di_F/dt = 100\text{ A}/\mu\text{s}$	$t_{rr}$	-	50	75	ns
Reverse recovery charge $V_R = 30\text{ V}$ , $I_F = I_S$ , $di_F/dt = 100\text{ A}/\mu\text{s}$	$Q_{rr}$	-	0.085	0.13	$\mu\text{C}$

**Power Dissipation**

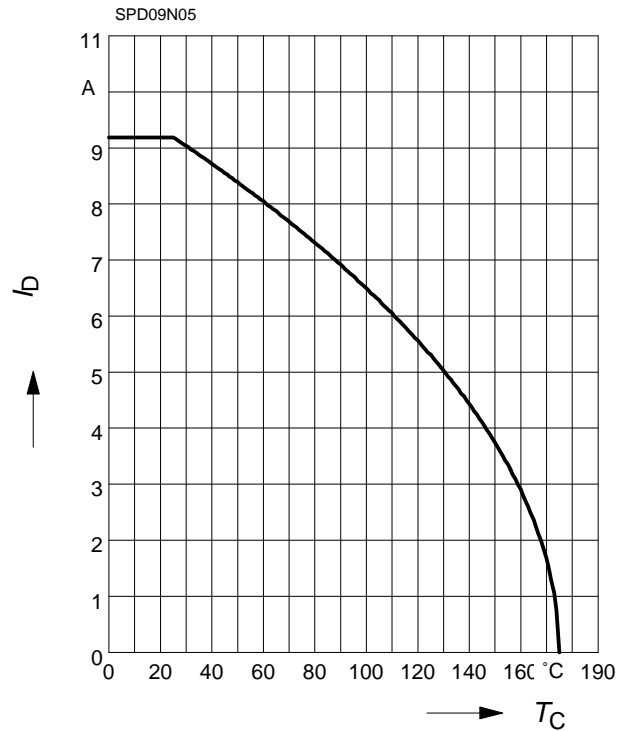
$P_{tot} = f(T_C)$



**Drain current**

$I_D = f(T_C)$

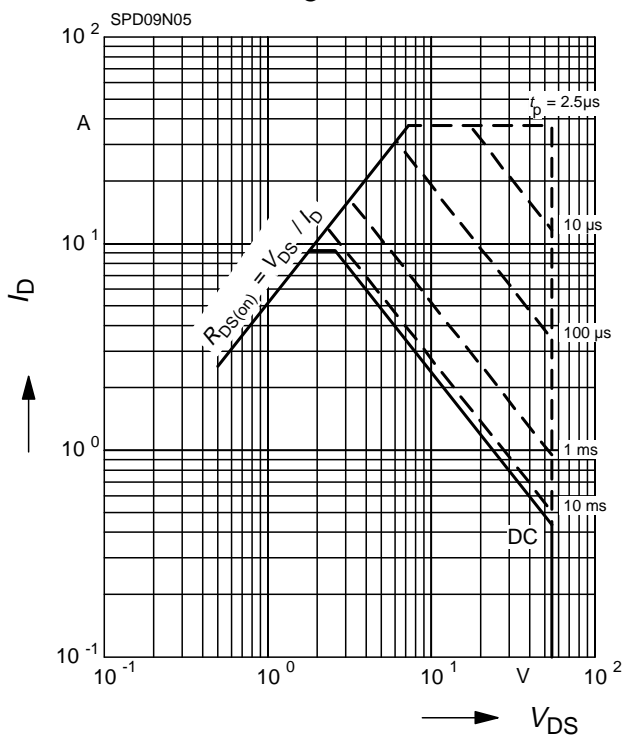
parameter:  $V_{GS} \geq 10\text{ V}$



**Safe operating area**

$I_D = f(V_{DS})$

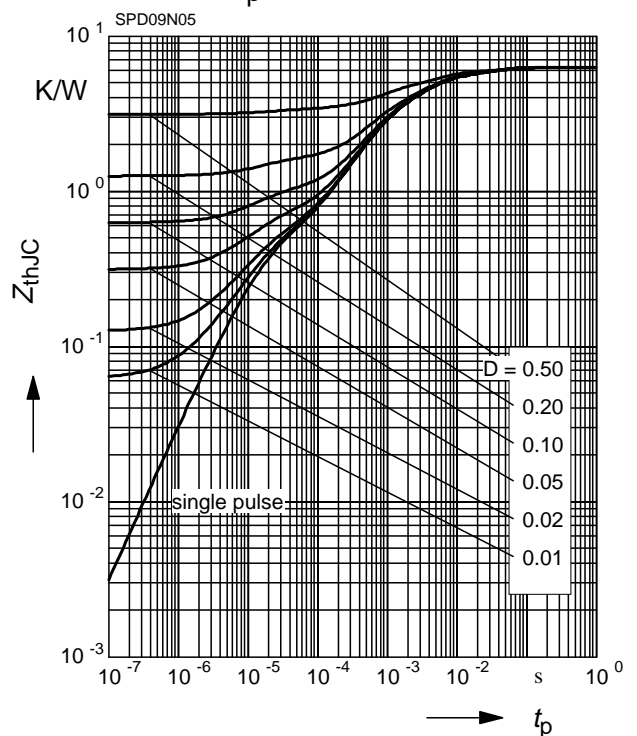
parameter :  $D = 0, T_C = 25\text{ °C}$



**Transient thermal impedance**

$Z_{thJC} = f(t_p)$

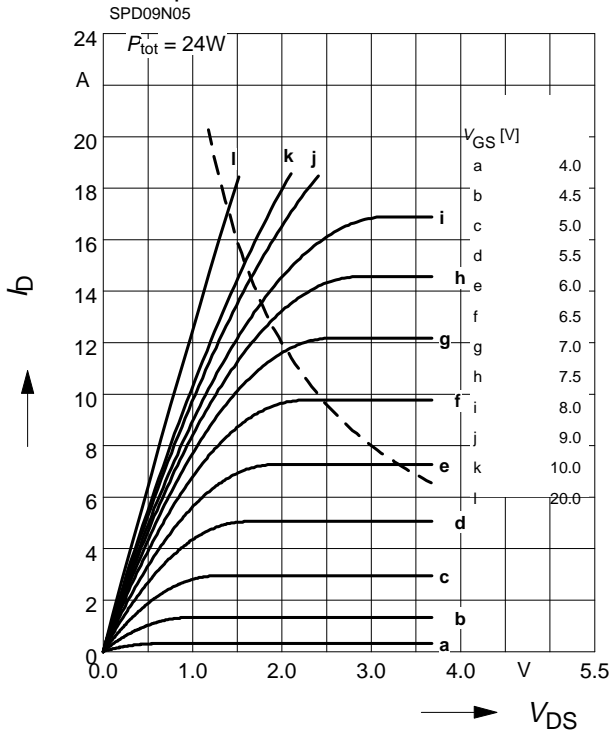
parameter :  $D = t_p/T$



**Typ. output characteristics**

$I_D = f(V_{DS})$

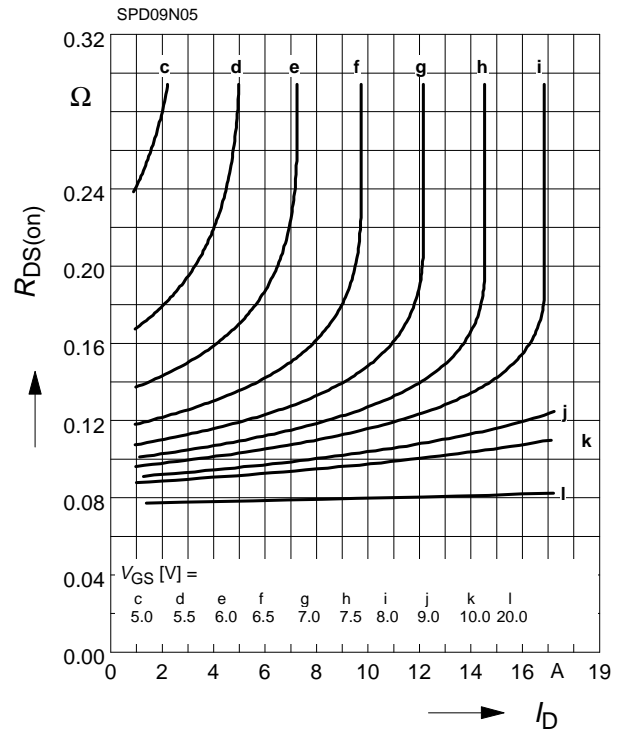
parameter:  $t_p = 80 \mu s$



**Typ. drain-source-on-resistance**

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

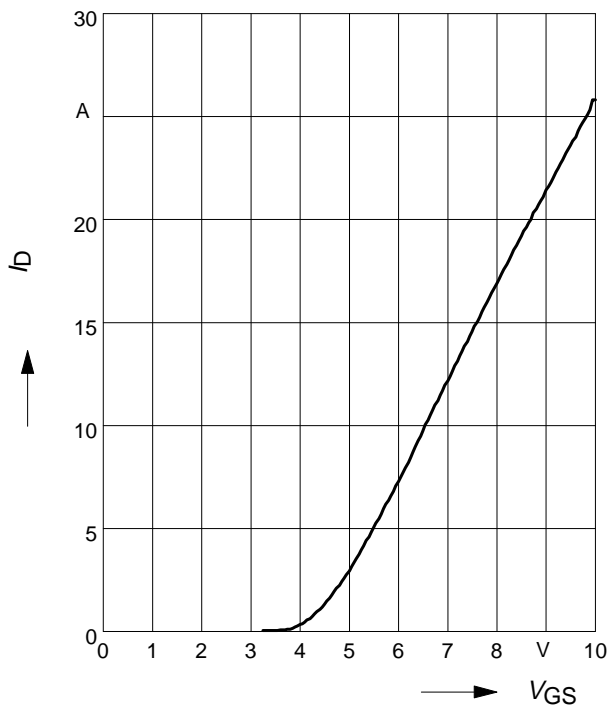
parameter:  $V_{GS}$



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

parameter:  $t_p = 80 \mu s$

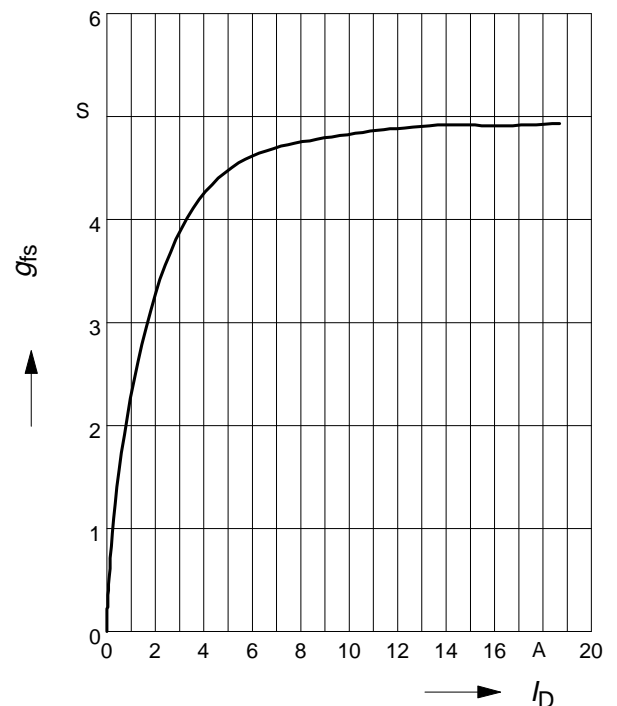
$V_{DS} \geq 2 \times I_D \times R_{DS(on)} \text{ max}$



**Typ. forward transconductance**

$g_{fs} = f(I_D); T_j = 25^\circ C$

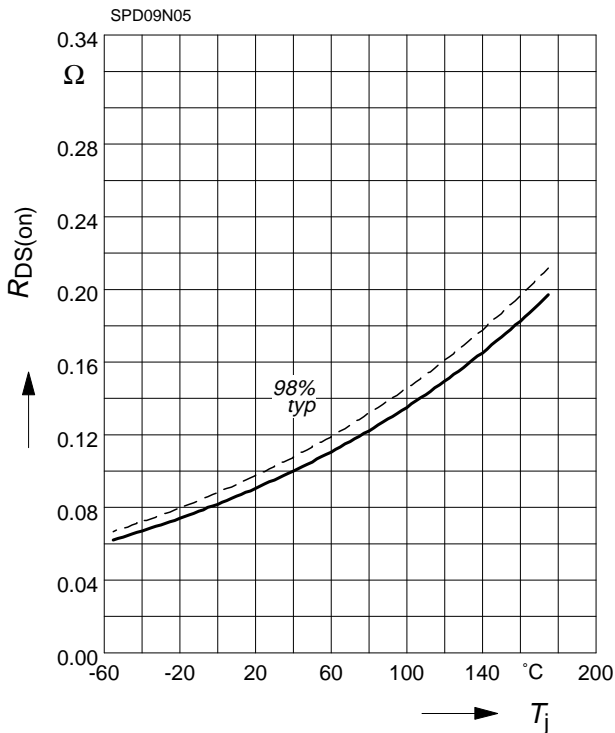
parameter:  $g_{fs}$



**Drain-source on-resistance**

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

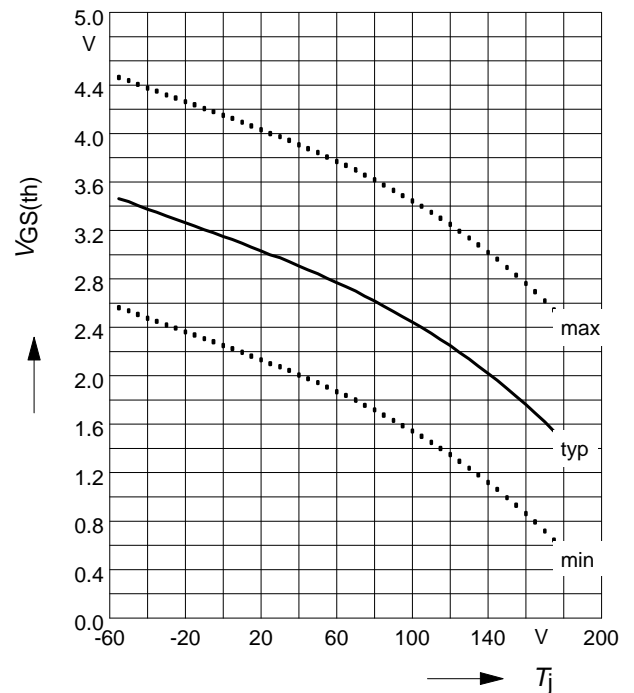
parameter :  $I_D = 6.5 \text{ A}$ ,  $V_{GS} = 10 \text{ V}$



**Gate threshold voltage**

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

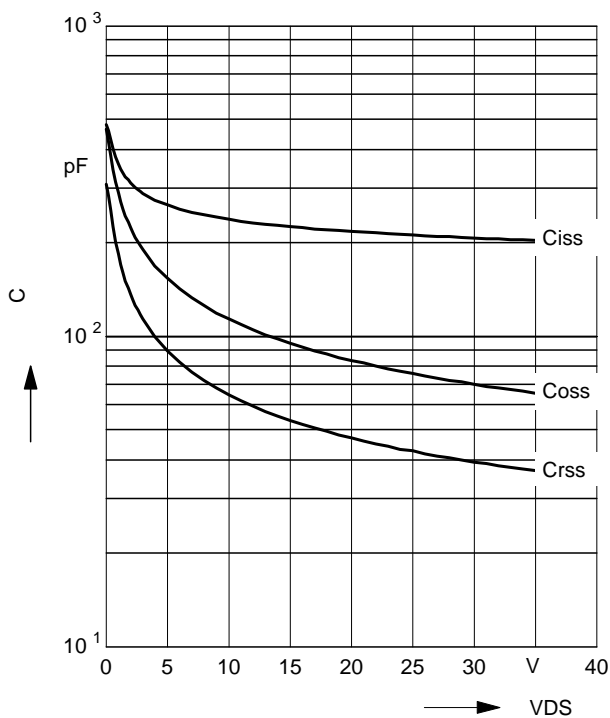
parameter :  $V_{GS} = V_{DS}$ ,  $I_D = 10 \mu\text{A}$



**Typ. capacitances**

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

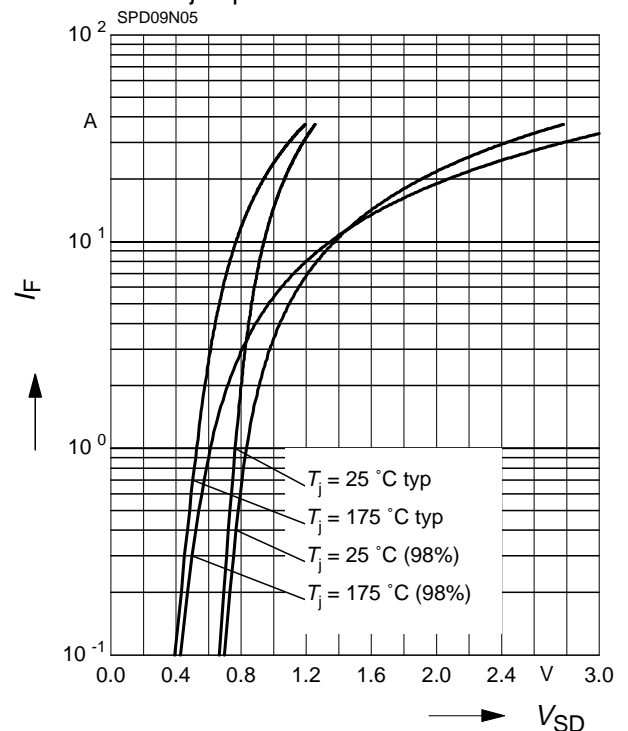
parameter:  $V_{GS} = 0 \text{ V}$ ,  $f = 1 \text{ MHz}$



**Forward characteristics of reverse diode**

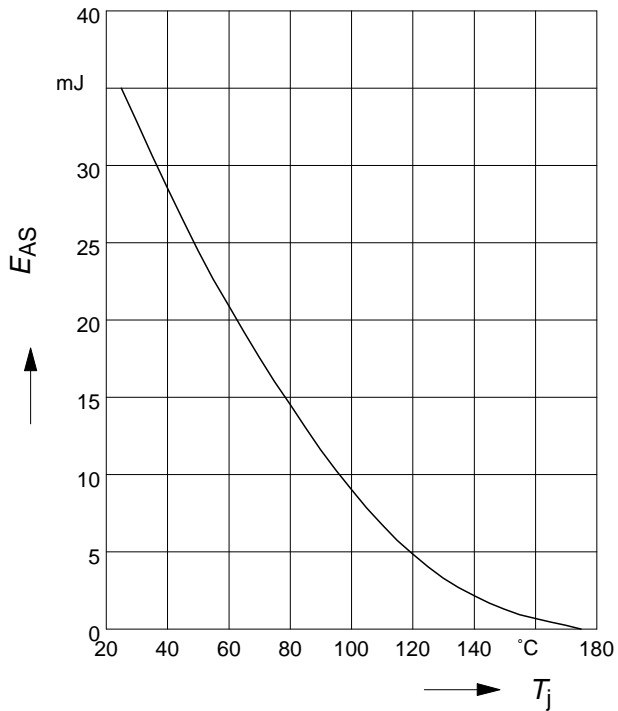
$$I_F = f(V_{SD})$$

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



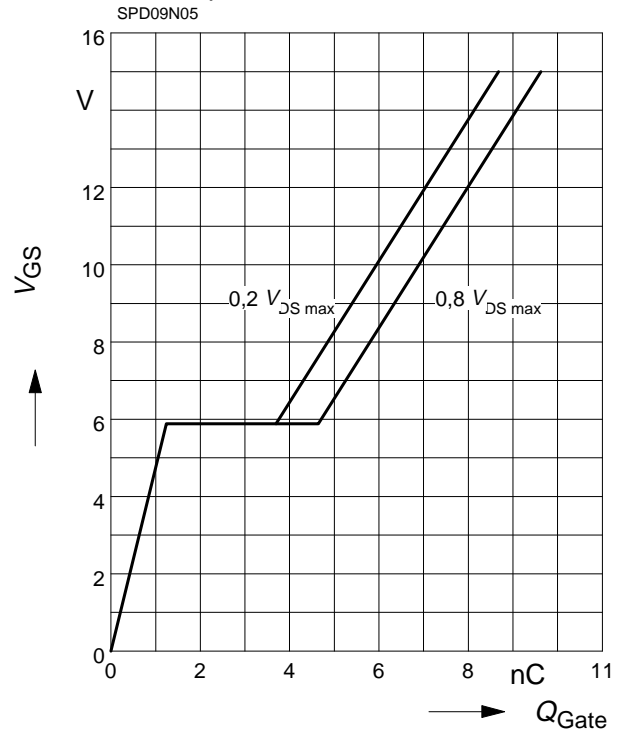
**Avalanche Energy  $E_{AS} = f(T_j)$**

parameter:  $I_D = 9.2 \text{ A}$ ,  $V_{DD} = 25 \text{ V}$   
 $R_{GS} = 25 \Omega$



**Typ. gate charge**

$V_{GS} = f(Q_{Gate})$   
parameter:  $I_{D \text{ puls}} = 9.2 \text{ A}$



**Drain-source breakdown voltage**

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

