

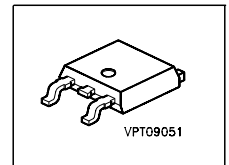
## Cool MOS™ Power Transistor

### Feature

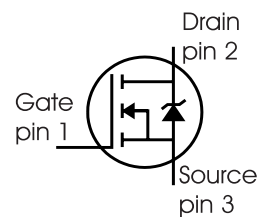
- New revolutionary high voltage technology
- Worldwide best  $R_{DS(on)}$  in TO252
- Ultra low gate charge
- Periodic avalanche rated
- Extreme  $dv/dt$  rated

$V_{DS}$	800	V
$R_{DS(on)}$	0.9	$\Omega$
$I_D$	6	A

P-TO252



Type	Package	Ordering Code	Marking
SPD06N80C3	P-TO252	Q67040-S4352	06N80C3



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

Parameter	Symbol	Value	Unit
Continuous drain current	$I_D$	6	A
$T_C = 25^\circ\text{C}$			
$T_C = 100^\circ\text{C}$		3.8	
Pulsed drain current, $t_p$ limited by $T_{jmax}$	$I_{D\ puls}$	18	
Avalanche energy, single pulse	$E_{AS}$	230	mJ
$I_D=1.2\text{A}$ , $V_{DD}=50\text{V}$			
Avalanche energy, repetitive $t_{AR}$ limited by $T_{jmax}$ <sup>1)</sup>	$E_{AR}$	0.2	
$I_D=6\text{A}$ , $V_{DD}=50\text{V}$			
Avalanche current, repetitive $t_{AR}$ limited by $T_{jmax}$	$I_{AR}$	6	A
Gate source voltage	$V_{GS}$	$\pm 20$	V
Power dissipation, $T_C = 25^\circ\text{C}$	$P_{tot}$	83	W
Operating and storage temperature	$T_j, T_{stg}$	-55... +150	$^\circ\text{C}$

## Maximum Ratings

Parameter	Symbol	Value	Unit
Drain Source voltage slope $V_{DS} = 640 \text{ V}$ , $I_D = 6 \text{ A}$ , $T_j = 125 \text{ }^\circ\text{C}$	$dv/dt$	50	V/ns

## Thermal Characteristics

Parameter	Symbol	Values			Unit
		min.	typ.	max.	
Thermal resistance, junction - case	$R_{thJC}$	-	-	1.5	K/W
Thermal resistance, junction - ambient, leaded	$R_{thJA}$	-	-	62	K/W
SMD version, device on PCB: @ min. footprint @ 6 cm <sup>2</sup> cooling area <sup>2)</sup>	$R_{thJA}$	-	-	75	
		-	-	50	
Soldering temperature, 1.6 mm (0.063 in.) from case for 10s <sup>3)</sup>	$T_{sold}$	-	-	260	°C

## Electrical Characteristics

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	
Drain-source breakdown voltage	$V_{(BR)DSS}$	$V_{GS}=0\text{V}$ , $I_D=0.25\text{mA}$	800	-	-	V
Drain-Source avalanche breakdown voltage	$V_{(BR)DS}$	$V_{GS}=0\text{V}$ , $I_D=6\text{A}$	-	870	-	
Gate threshold voltage	$V_{GS(th)}$	$I_D=250\mu\text{A}$ , $V_{GS}=V_{DS}$	2.1	3	3.9	
Zero gate voltage drain current	$I_{DSS}$	$V_{DS}=800\text{V}$ , $V_{GS}=0\text{V}$ , $T_j=25^\circ\text{C}$ , $T_j=150^\circ\text{C}$	-	0.5	10	$\mu\text{A}$
			-	-	100	
Gate-source leakage current	$I_{GSS}$	$V_{GS}=20\text{V}$ , $V_{DS}=0\text{V}$	-	-	100	nA
Drain-source on-state resistance	$R_{DS(on)}$	$V_{GS}=10\text{V}$ , $I_D=3.8\text{A}$ , $T_j=25^\circ\text{C}$ $T_j=150^\circ\text{C}$	-	0.78	0.9	$\Omega$
			-	2.1	-	
Gate input resistance	$R_G$	$f=1\text{MHz}$ , open Drain	-	0.7	-	

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

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	
Transconductance	$g_{fs}$	$V_{DS} \geq 2 \cdot I_D \cdot R_{DS(on)max}$ , $I_D = 3.8\text{A}$	-	4	-	S
Input capacitance	$C_{iss}$	$V_{GS} = 0\text{V}$ , $V_{DS} = 25\text{V}$ , $f = 1\text{MHz}$	-	785	-	pF
Output capacitance	$C_{oss}$		-	390	-	
Reverse transfer capacitance	$C_{rss}$		-	20	-	
Effective output capacitance, <sup>4)</sup> energy related	$C_{o(er)}$	$V_{GS} = 0\text{V}$ , $V_{DS} = 0\text{V to } 480\text{V}$	-	22	-	pF
Effective output capacitance, <sup>5)</sup> time related	$C_{o(tr)}$		-	42	-	
Turn-on delay time	$t_{d(on)}$	$V_{DD} = 400\text{V}$ , $V_{GS} = 0/10\text{V}$ , $I_D = 6\text{A}$ , $R_G = 15\Omega$ , $T_j = 125^\circ\text{C}$	-	25	-	ns
Rise time	$t_r$		-	15	-	
Turn-off delay time	$t_{d(off)}$		-	65	75	
Fall time	$t_f$		-	8	11	

**Gate Charge Characteristics**

Gate to source charge	$Q_{gs}$	$V_{DD} = 640\text{V}$ , $I_D = 6\text{A}$	-	3.3	-	nC
Gate to drain charge	$Q_{gd}$		-	14	-	
Gate charge total	$Q_g$	$V_{DD} = 640\text{V}$ , $I_D = 6\text{A}$ , $V_{GS} = 0 \text{ to } 10\text{V}$	-	27	35	
Gate plateau voltage	$V_{(plateau)}$	$V_{DD} = 640\text{V}$ , $I_D = 6\text{A}$	-	6	-	V

<sup>1</sup> Repetitive avalanche causes additional power losses that can be calculated as  $P_{AV} = E_{AR} \cdot f$ .

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

<sup>3</sup> Soldering temperature for TO-263: 220°C, reflow

<sup>4</sup>  $C_{o(er)}$  is a fixed capacitance that gives the same stored energy as  $C_{oss}$  while  $V_{DS}$  is rising from 0 to 80%  $V_{DSS}$ .

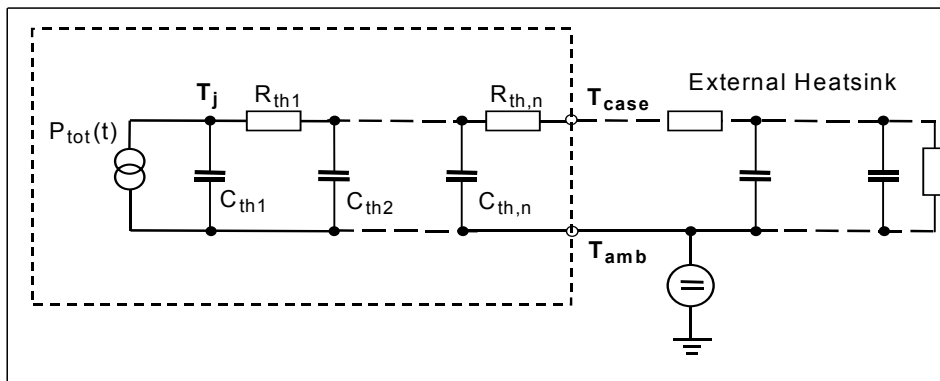
<sup>5</sup>  $C_{o(tr)}$  is a fixed capacitance that gives the same charging time as  $C_{oss}$  while  $V_{DS}$  is rising from 0 to 80%  $V_{DSS}$ .

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

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	
Inverse diode continuous forward current	$I_S$	$T_C = 25^\circ\text{C}$	-	-	6	A
Inverse diode direct current, pulsed	$I_{SM}$		-	-	18	
Inverse diode forward voltage	$V_{SD}$	$V_{GS} = 0\text{V}$ , $I_F = I_S$	-	1	1.2	V
Reverse recovery time	$t_{rr}$	$V_R = 400\text{V}$ , $I_F = I_S$ , $di_F/dt = 100\text{A}/\mu\text{s}$	-	520	-	ns
Reverse recovery charge	$Q_{rr}$		-	5	-	$\mu\text{C}$
Peak reverse recovery current	$I_{rrm}$		-	18	-	A
Peak rate of fall of reverse recovery current	$di_{rr}/dt$		-	400	-	$\text{A}/\mu\text{s}$

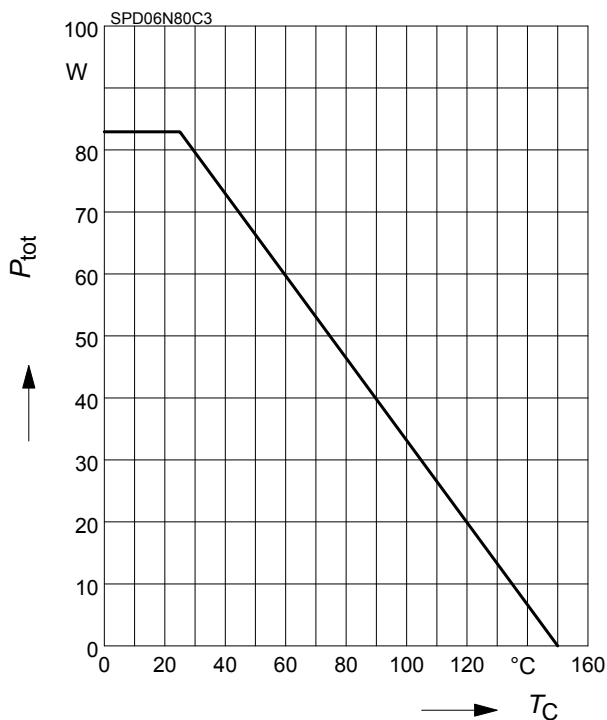
#### Typical Transient Thermal Characteristics

Symbol	Value	Unit	Symbol	Value	Unit
	typ.			typ.	
Thermal resistance			Thermal capacitance		
$R_{th1}$	0.024	K/W	$C_{th1}$	0.0001172	Ws/K
$R_{th2}$	0.024		$C_{th2}$	0.000447	
$R_{th3}$	0.086		$C_{th3}$	0.0006303	
$R_{th4}$	0.309		$C_{th4}$	0.001828	
$R_{th5}$	0.317		$C_{th5}$	0.004786	
$R_{th6}$	0.112		$C_{th6}$	0.046	



### 1 Power dissipation

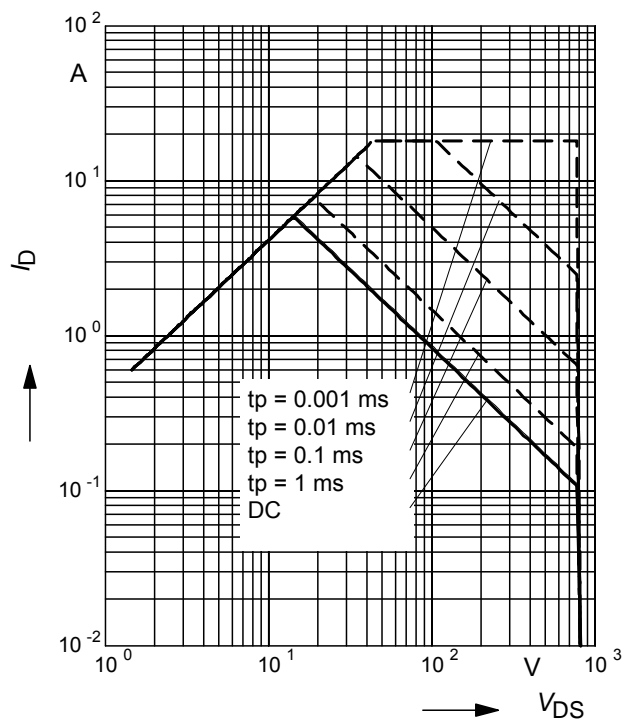
$$P_{\text{tot}} = f(T_C)$$



### 2 Safe operating area

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

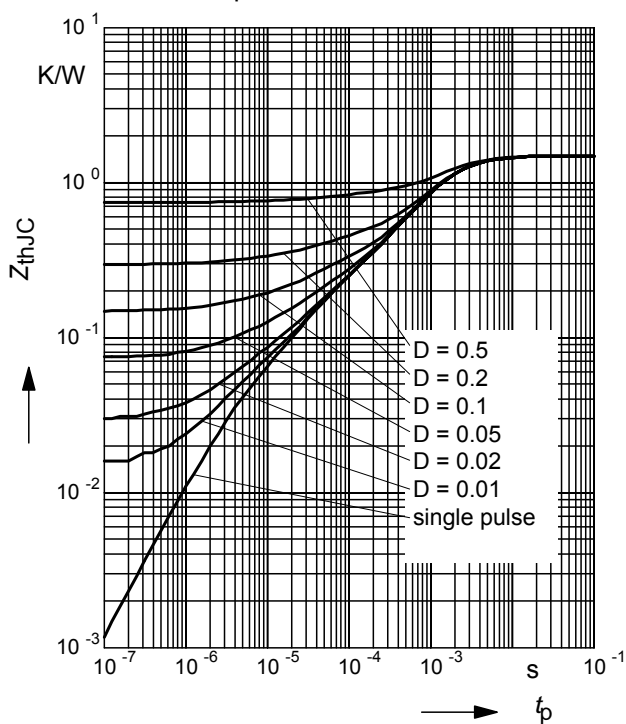
parameter :  $D = 0$  ,  $T_C = 25^\circ\text{C}$



### 3 Transient thermal impedance

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

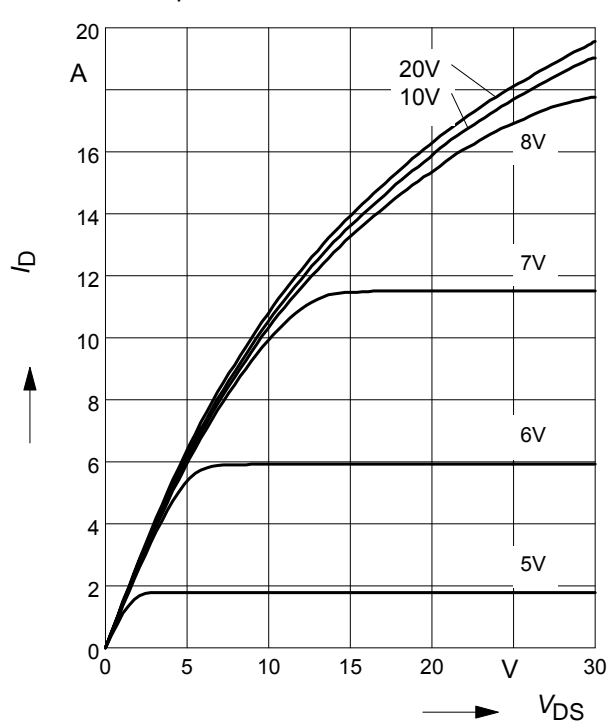
parameter:  $D = t_p/T$



### 4 Typ. output characteristic

$$I_D = f(V_{DS}); T_J = 25^\circ\text{C}$$

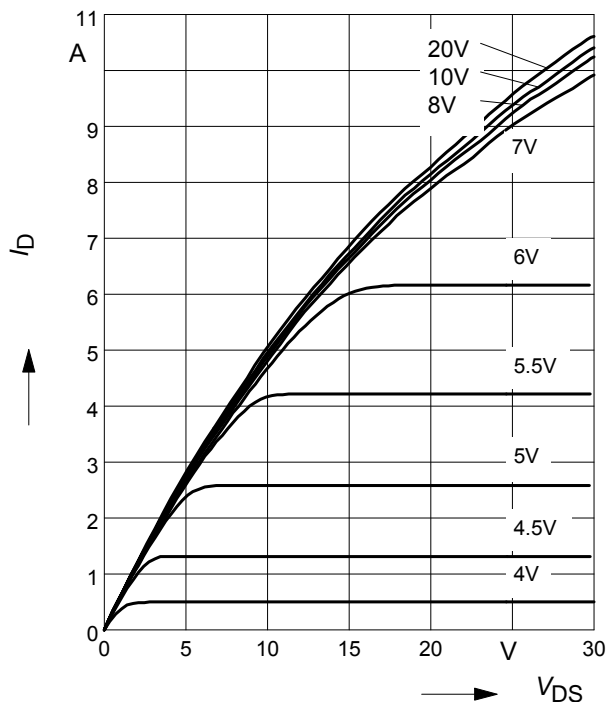
parameter:  $t_p = 10 \mu\text{s}$ ,  $V_{GS}$



### 5 Typ. output characteristic

$$I_D = f(V_{DS}); T_j = 150^\circ\text{C}$$

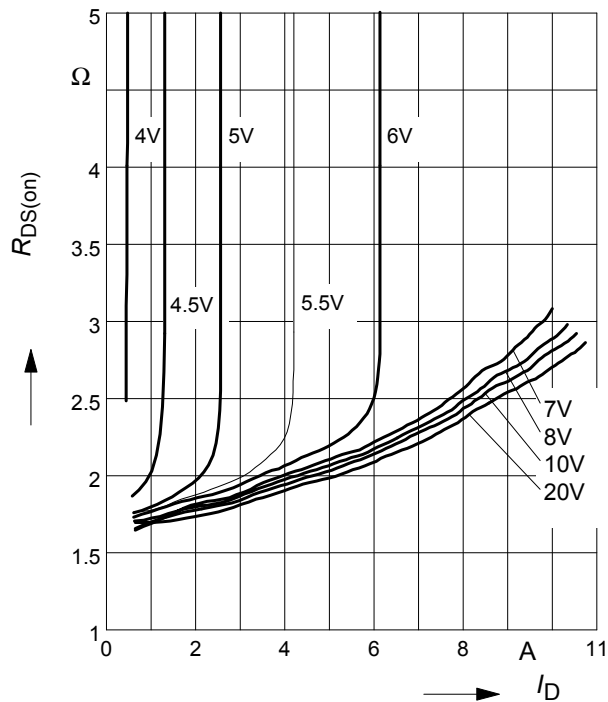
parameter:  $t_p = 10 \mu\text{s}$ ,  $V_{GS}$



### 6 Typ. drain-source on resistance

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

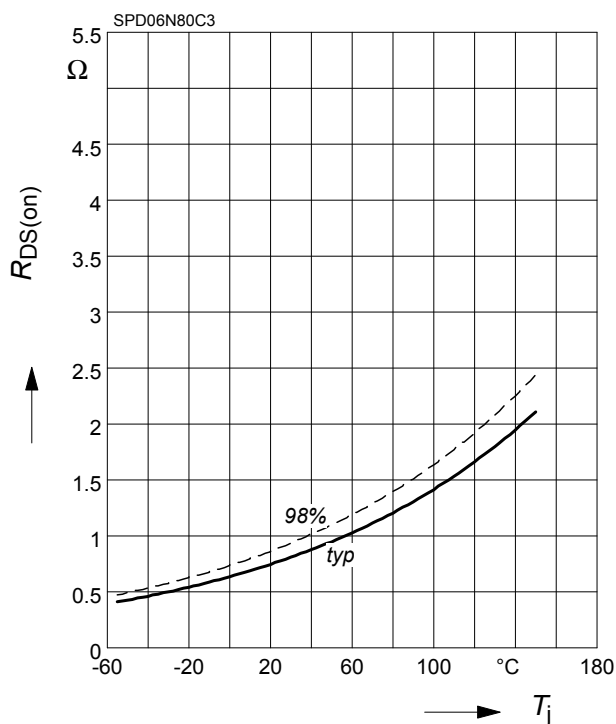
parameter:  $T_j = 150^\circ\text{C}$ ,  $V_{GS}$



### 7 Drain-source on-state resistance

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

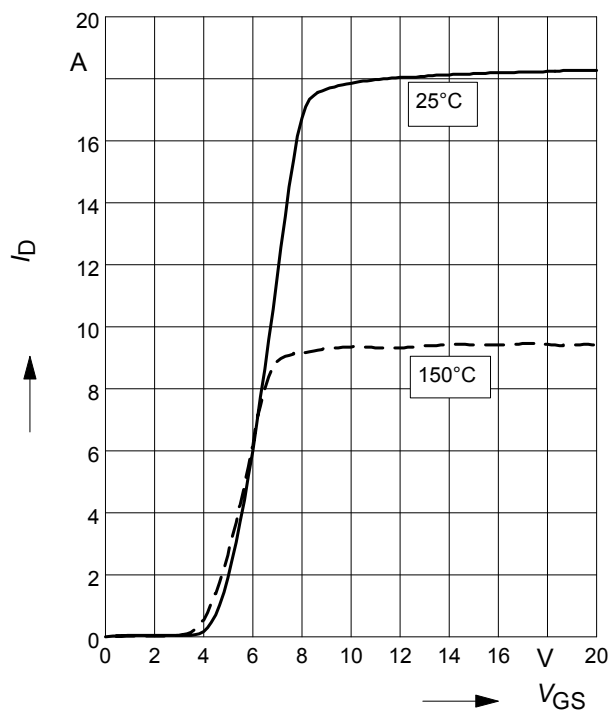
parameter:  $I_D = 3.8 \text{ A}$ ,  $V_{GS} = 10 \text{ V}$



### 8 Typ. transfer characteristics

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

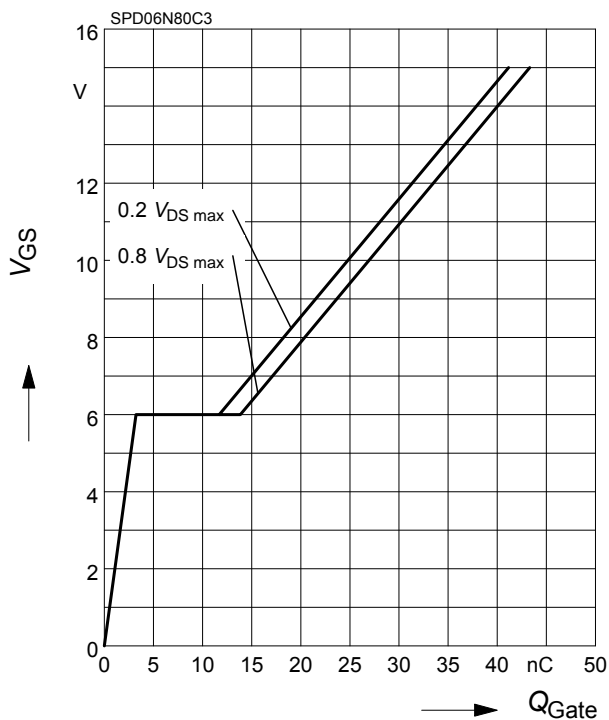
parameter:  $t_p = 10 \mu\text{s}$



## 9 Typ. gate charge

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

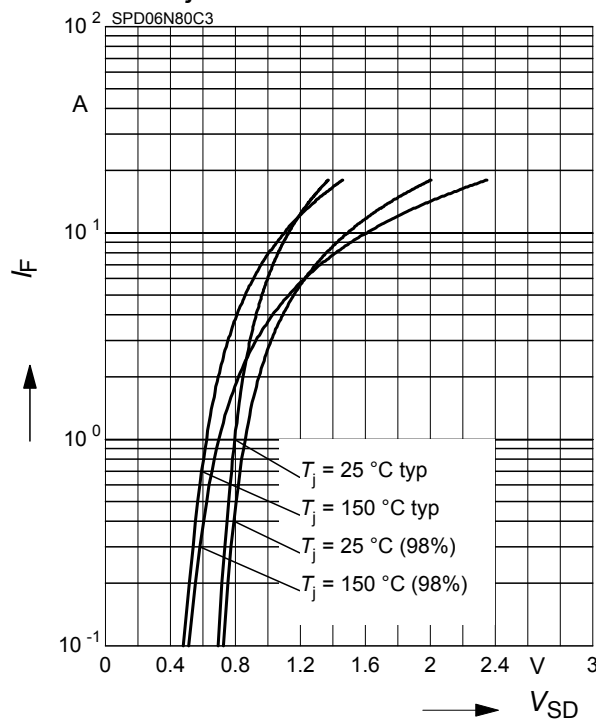
parameter:  $I_D = 6$  A pulsed



## 10 Forward characteristics of body diode

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

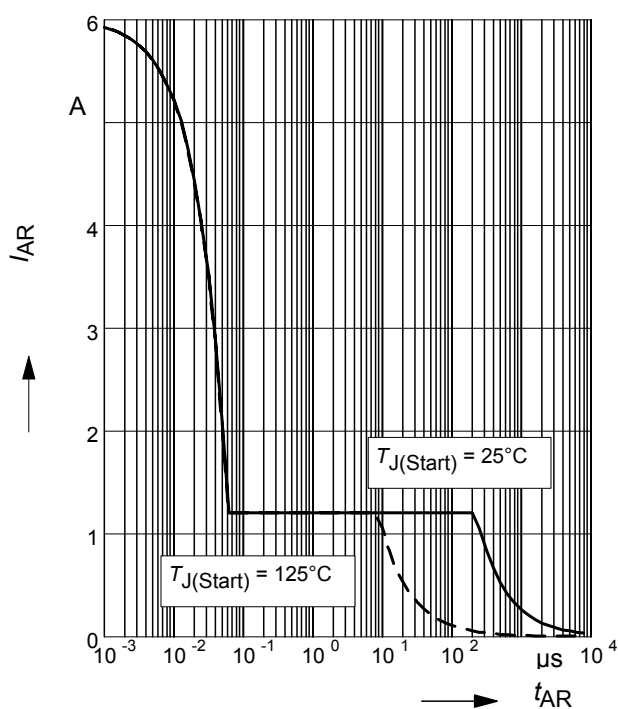
parameter:  $T_j$ ,  $t_p = 10$   $\mu$ s



## 11 Avalanche SOA

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

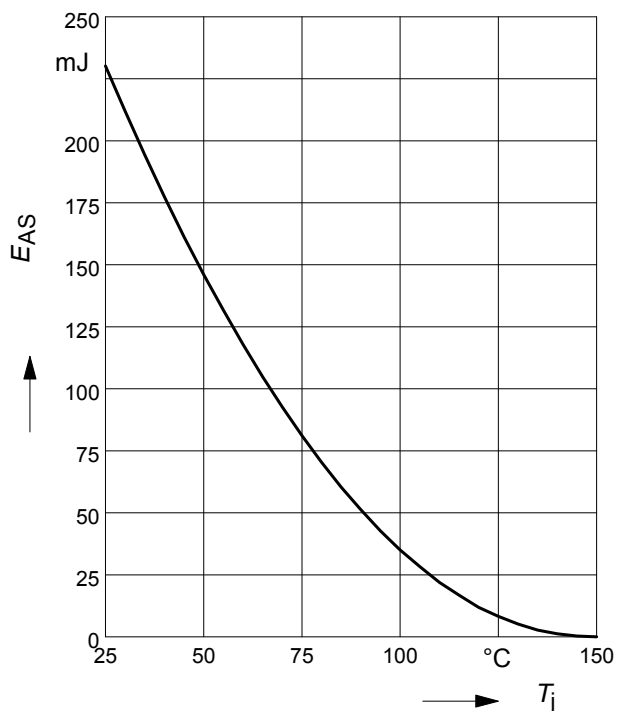
par.:  $T_j \leq 150$  °C



## 12 Avalanche energy

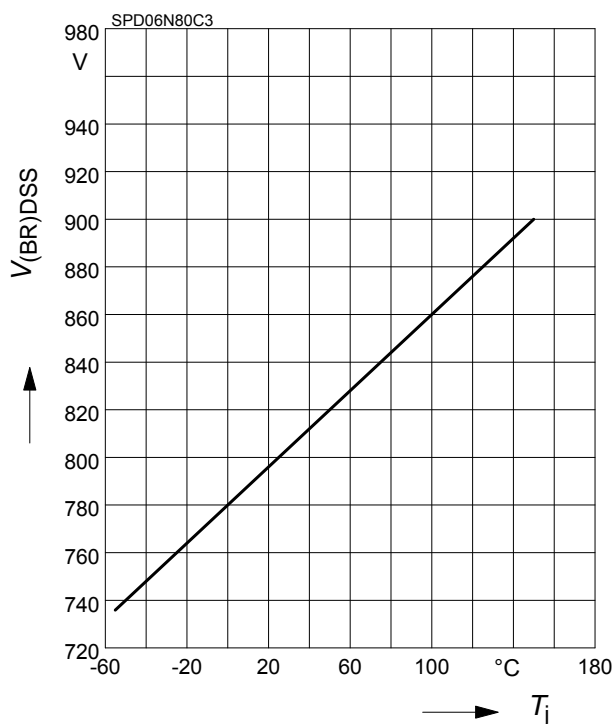
$$E_{AS} = f(T_j)$$

par.:  $I_D = 1.2$  A,  $V_{DD} = 50$  V



### 13 Drain-source breakdown voltage

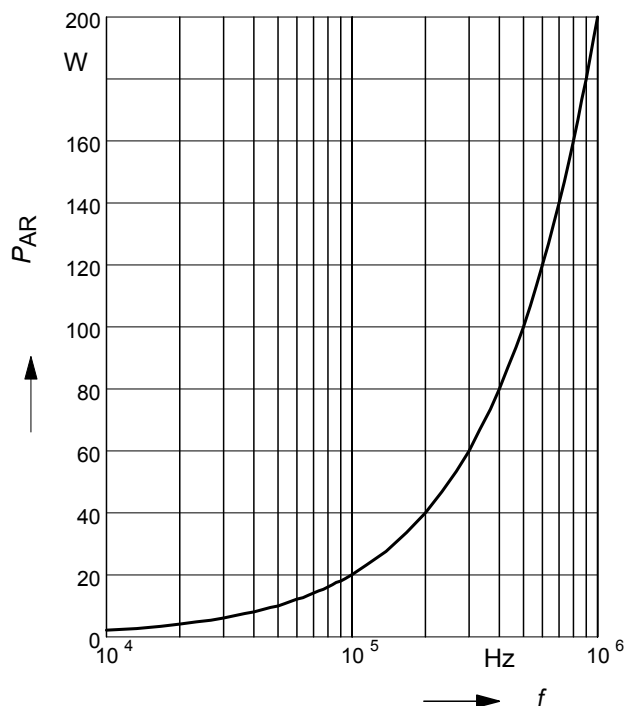
$$V_{(BR)DSS} = f(T_j)$$



### 14 Avalanche power losses

$$P_{AR} = f(f)$$

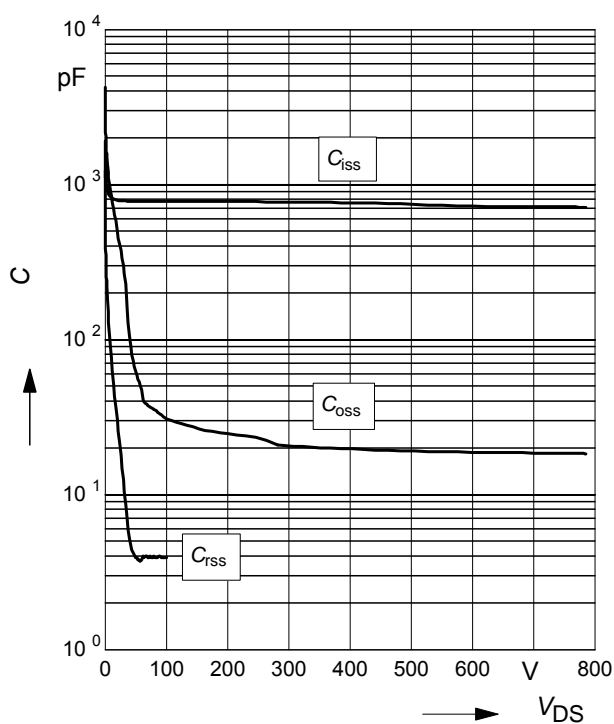
parameter:  $E_{AR}=0.2\text{mJ}$



### 15 Typ. capacitances

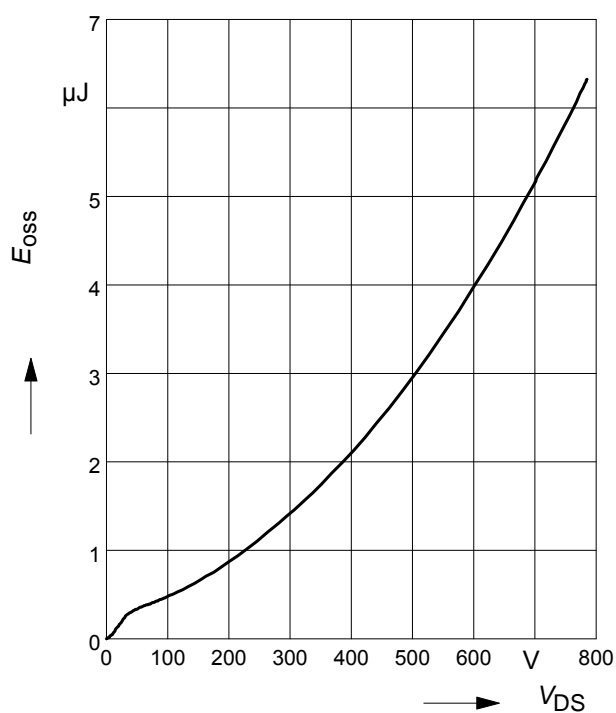
$$C = f(V_{DS})$$

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

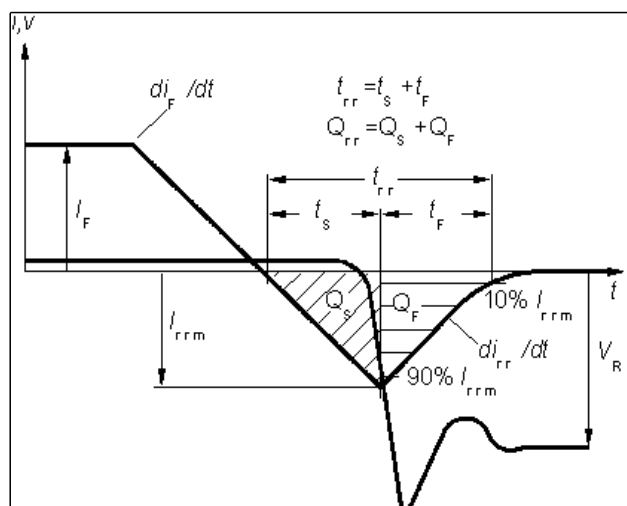


### 16 Typ. $C_{oss}$ stored energy

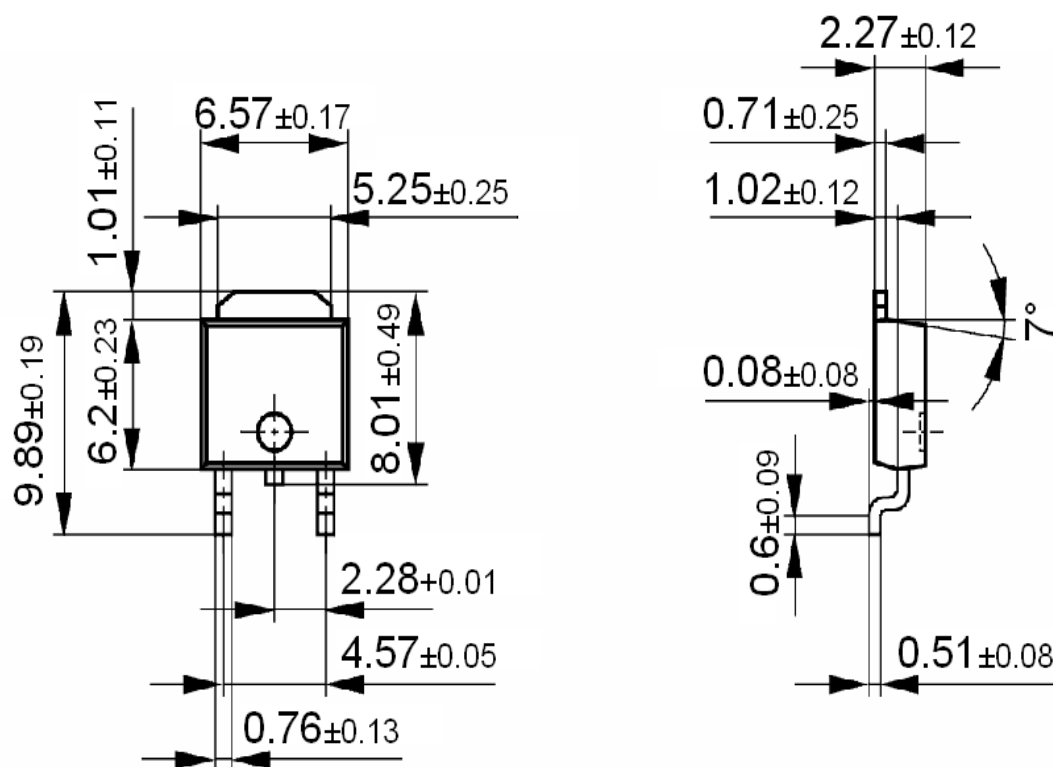
$$E_{oss}=f(V_{DS})$$



# Definition of diodes switching characteristics



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



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