

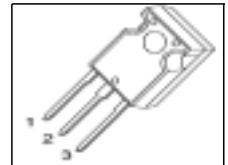
Cool MOS™ Power Transistor

Feature

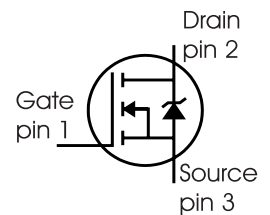
- New revolutionary high voltage technology
- Worldwide best $R_{DS(on)}$ in TO 247
- Ultra low gate charge
- Periodic avalanche rated
- Extreme dv/dt rated
- Ultra low effective capacitances
- Improved transconductance

V_{DS}	600	V
$R_{DS(on)}$	0.07	Ω
I_D	47	A

P-TO247



Type	Package	Ordering Code	Marking
SPW47N60S5	P-TO247	Q67040-S4240	47N60S5



Maximum Ratings

Parameter	Symbol	Value	Unit
Continuous drain current $T_C = 25\text{ °C}$ $T_C = 100\text{ °C}$	I_D	47 30	A
Pulsed drain current, t_p limited by T_{jmax}	$I_{D\text{ puls}}$	94	
Avalanche energy, single pulse $I_D = 10\text{ A}$, $V_{DD} = 50\text{ V}$	E_{AS}	1800	mJ
Avalanche energy, repetitive t_{AR} limited by T_{jmax} ¹ $I_D = 20\text{ A}$, $V_{DD} = 50\text{ V}$	E_{AR}	1	
Avalanche current, repetitive t_{AR} limited by T_{jmax}	I_{AR}	20	A
Gate source voltage	V_{GS}	± 20	V
Gate source voltage AC ($f > 1\text{ Hz}$)	V_{GS}	± 30	
Power dissipation, $T_C = 25\text{ °C}$	P_{tot}	415	W
Operating and storage temperature	T_j, T_{stg}	-55... +150	°C

Maximum Ratings

Parameter	Symbol	Value	Unit
Drain Source voltage slope $V_{DS} = 480\text{ V}$, $I_D = 47\text{ A}$, $T_j = 125\text{ °C}$	dv/dt	20	V/ns

Thermal Characteristics

Parameter	Symbol	Values			Unit
		min.	typ.	max.	
Thermal resistance, junction - case	R_{thJC}	-	-	0.3	K/W
Thermal resistance, junction - ambient, leaded	R_{thJA}	-	45	-	
Soldering temperature, 1.6 mm (0.063 in.) from case for 10s	T_{sold}	-	-	260	°C

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

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	
Drain-source breakdown voltage	$V_{(BR)DSS}$	$V_{GS}=0\text{ V}$, $I_D=0.25\text{ mA}$	600	-	-	V
Drain-Source avalanche breakdown voltage	$V_{(BR)DS}$	$V_{GS}=0\text{ V}$, $I_D=20\text{ A}$	-	700	-	
Gate threshold voltage	$V_{GS(th)}$	$I_D=2700\text{ }\mu\text{A}$, $V_{GS}=V_{DS}$	3.5	4.5	5.5	
Zero gate voltage drain current	I_{DSS}	$V_{DS}=600\text{ V}$, $V_{GS}=0\text{ V}$, $T_j=25\text{ °C}$, $T_j=150\text{ °C}$	-	0.5	25	μA
			-	-	250	
Gate-source leakage current	I_{GSS}	$V_{GS}=20\text{ V}$, $V_{DS}=0\text{ V}$	-	-	100	nA
Drain-source on-state resistance	$R_{DS(on)}$	$V_{GS}=10\text{ V}$, $I_D=30\text{ A}$, $T_j=25\text{ °C}$, $T_j=150\text{ °C}$	-	0.06	0.07	Ω
			-	0.16	-	
Gate input resistance	R_G	$f=1\text{ MHz}$, open Drain	-	8.7	-	

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

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	
Transconductance	g_{fs}	$V_{DS} \geq 2 \cdot I_D \cdot R_{DS(on)max}$, $I_D = 30\text{A}$	-	30	-	S
Input capacitance	C_{iss}	$V_{GS} = 0\text{V}$, $V_{DS} = 25\text{V}$, $f = 1\text{MHz}$	-	7600	-	pF
Output capacitance	C_{oss}		-	2900	-	
Reverse transfer capacitance	C_{rss}		-	27	-	
Turn-on delay time	$t_{d(on)}$	$V_{DD} = -V$, $V_{GS} = 0/10\text{V}$, $I_D = 47\text{A}$, $R_G = 1.3\Omega$	-	360	-	ns
Rise time	t_r		-	30	-	
Turn-off delay time	$t_{d(off)}$		-	200	300	
Fall time	t_f		-	30	45	

Gate Charge Characteristics

Gate to source charge	Q_{gs}	$V_{DD} = -V$, $I_D = 47\text{A}$	-	56	-	nC
Gate to drain charge	Q_{gd}		-	123	-	
Gate charge total	Q_g	$V_{DD} = -V$, $I_D = 47\text{A}$, $V_{GS} = 0\text{ to }10\text{V}$	-	220	286	
Gate plateau voltage	$V_{(plateau)}$	$V_{DD} = -V$, $I_D = 47\text{A}$	-	8	-	V

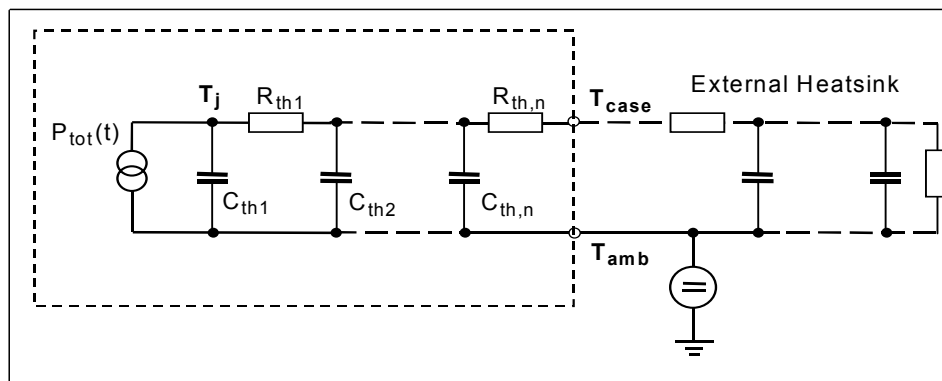
¹ Repetitive avalanche causes additional power losses that can be calculated as $P_{AV} = E_{AR} \cdot f$.

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	$T_C = 25^\circ\text{C}$	-	-	47	A
Inverse diode direct current, pulsed	I_{SM}		-	-	94	
Inverse diode forward voltage	V_{SD}	$V_{GS} = 0\text{V}$, $I_F = I_S$	-	1	1.2	V
Reverse recovery time	t_{rr}	$V_R = -V$, $I_F = I_S$, $di_F/dt = 100\text{A}/\mu\text{s}$	-	650	1100	ns
Reverse recovery charge	Q_{rr}		-	24	-	

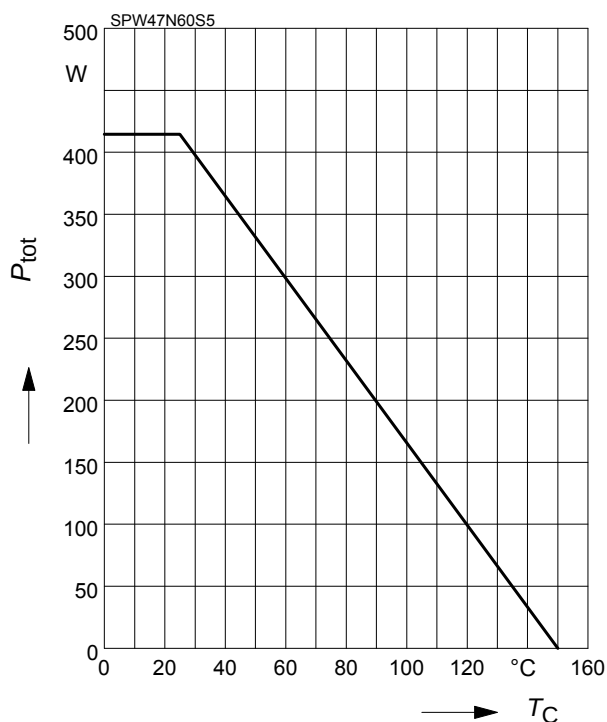
Typical Transient Thermal Characteristics

Symbol	Value	Unit	Symbol	Value	Unit
	typ.			typ.	
Thermal resistance			Thermal capacitance		
R_{th1}	0.002689	K/W	C_{th1}	0.001081	Ws/K
R_{th2}	0.005407		C_{th2}	0.004021	
R_{th3}	0.011		C_{th3}	0.005415	
R_{th4}	0.054		C_{th4}	0.014	
R_{th5}	0.071		C_{th5}	0.025	
R_{th6}	0.036		C_{th6}	0.158	



1 Power dissipation

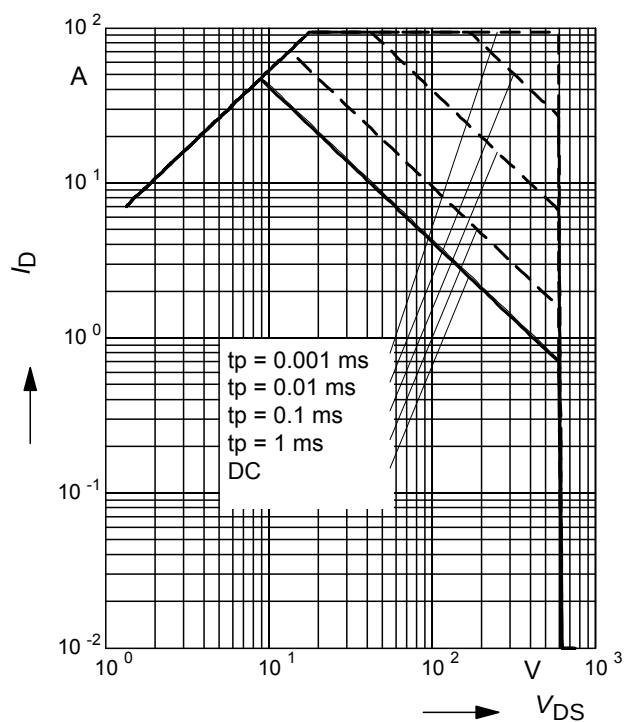
$$P_{\text{tot}} = f(T_C)$$



2 Safe operating area

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

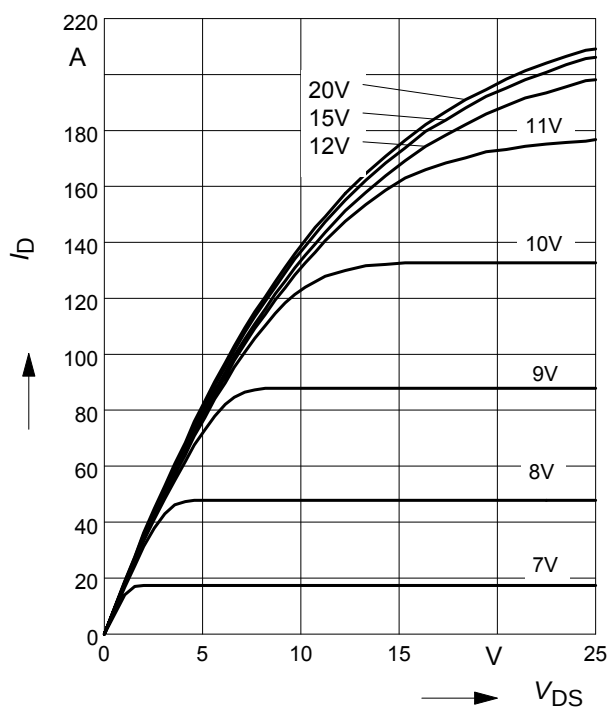
parameter : $D = 0$, $T_C = 25^\circ\text{C}$



3 Typ. output characteristic

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

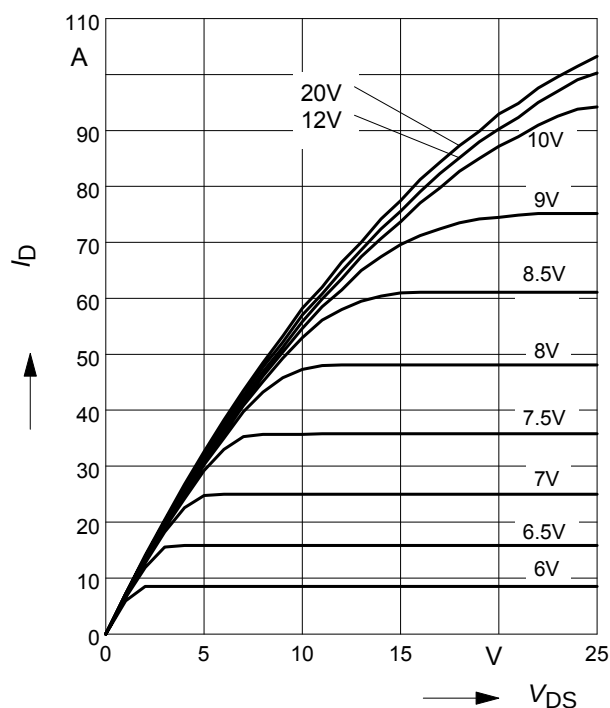
parameter: $t_p = 10 \mu\text{s}$, V_{GS}



4 Typ. output characteristic

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

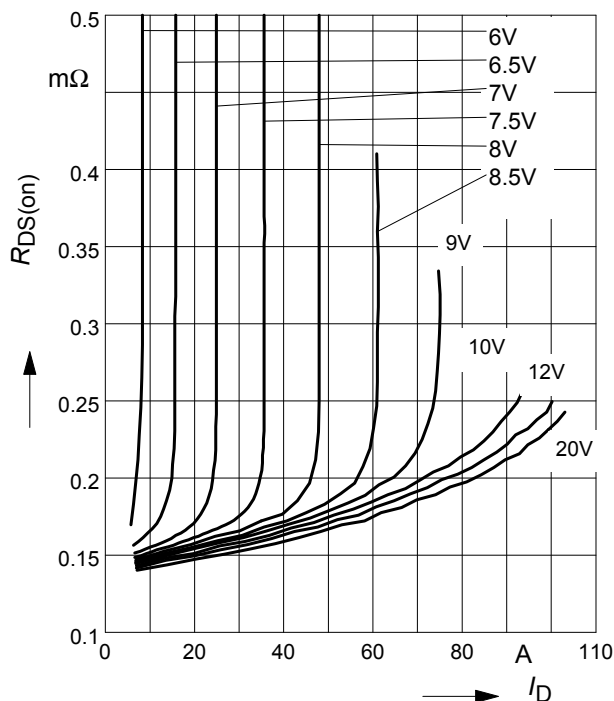
parameter: $t_p = 10 \mu\text{s}$, V_{GS}



5 Typ. drain-source on resistance

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

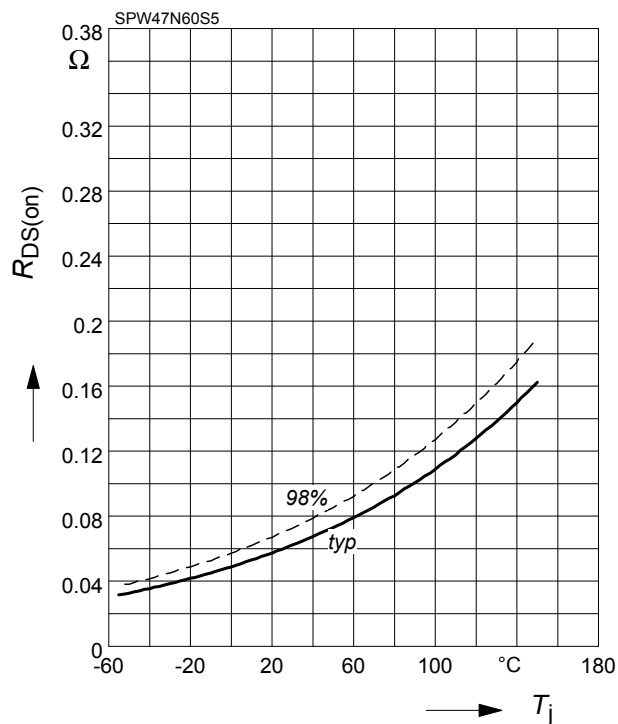
parameter: $T_j = 150^\circ\text{C}$, V_{GS}



6 Drain-source on-state resistance

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

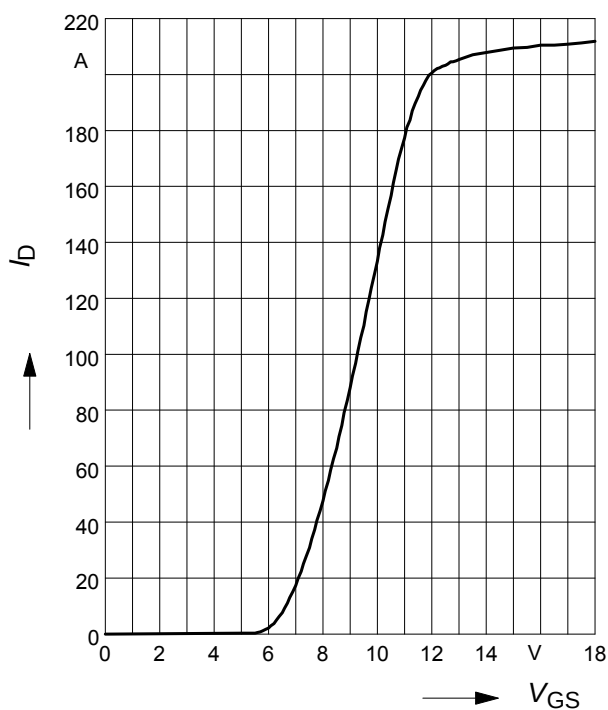
parameter: $I_D = 30\text{ A}$, $V_{GS} = 10\text{ V}$



7 Typ. transfer characteristics

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

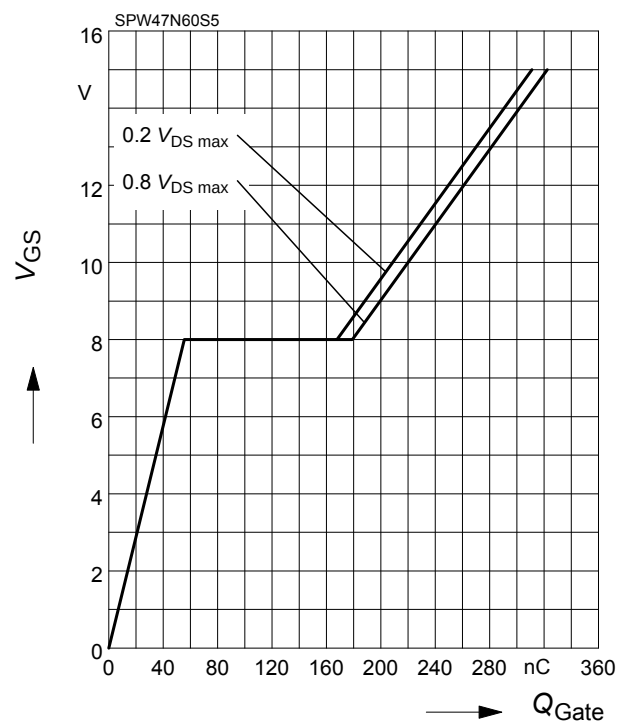
parameter: $t_p = 10\text{ }\mu\text{s}$



8 Typ. gate charge

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

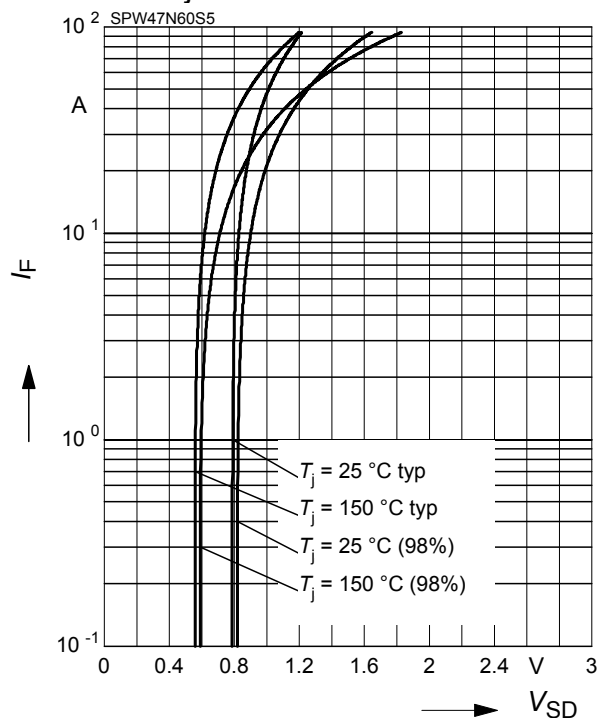
parameter: $I_D = 47\text{ A}$ pulsed



9 Forward characteristics of body diode

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

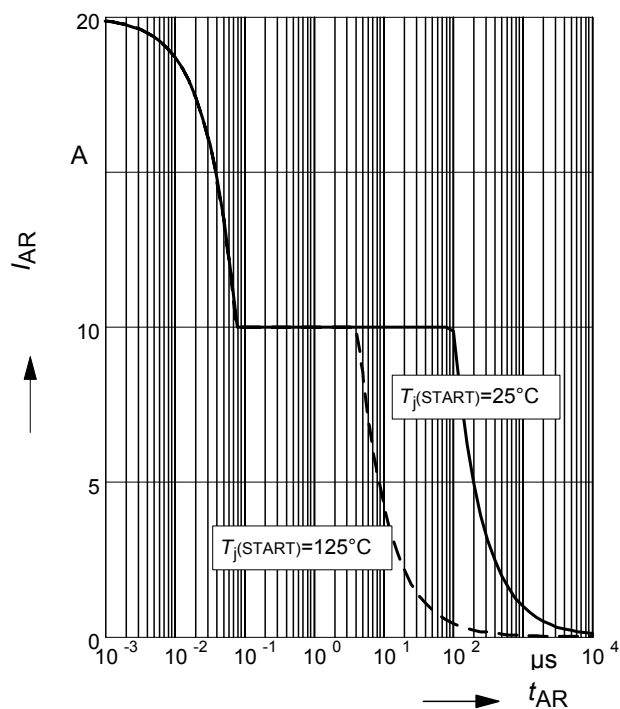
parameter: T_j , $t_p = 10 \mu s$



10 Avalanche SOA

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

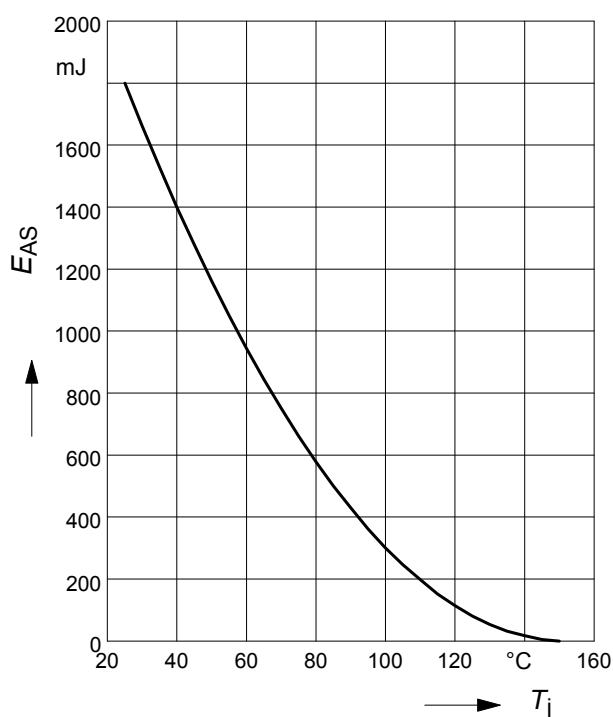
par.: $T_j \leq 150 \text{ } ^\circ\text{C}$



11 Avalanche energy

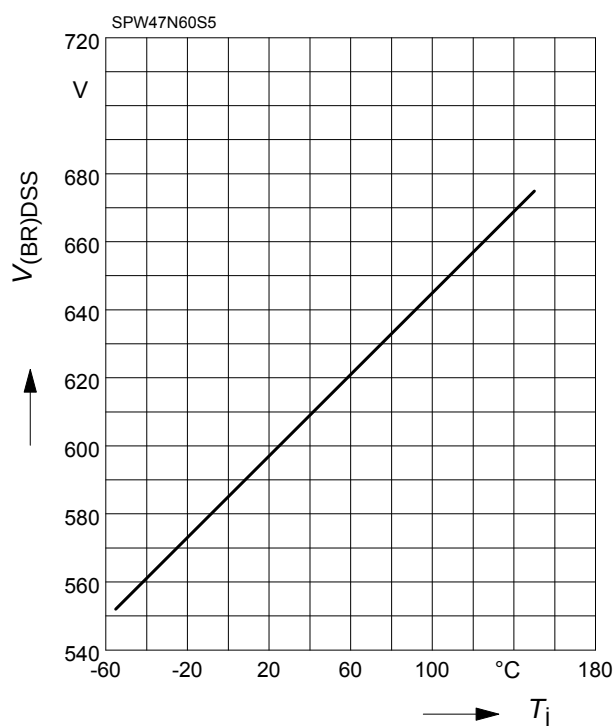
$$E_{AS} = f(T_j)$$

par.: $I_D = 10 \text{ A}$, $V_{DD} = 50 \text{ V}$



12 Drain-source breakdown voltage

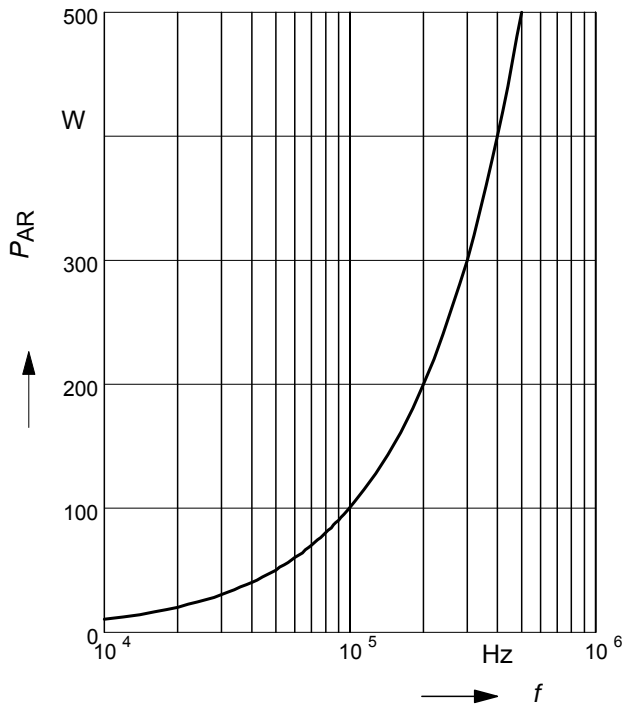
$$V_{(BR)DSS} = f(T_j)$$



13 Avalanche power losses

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

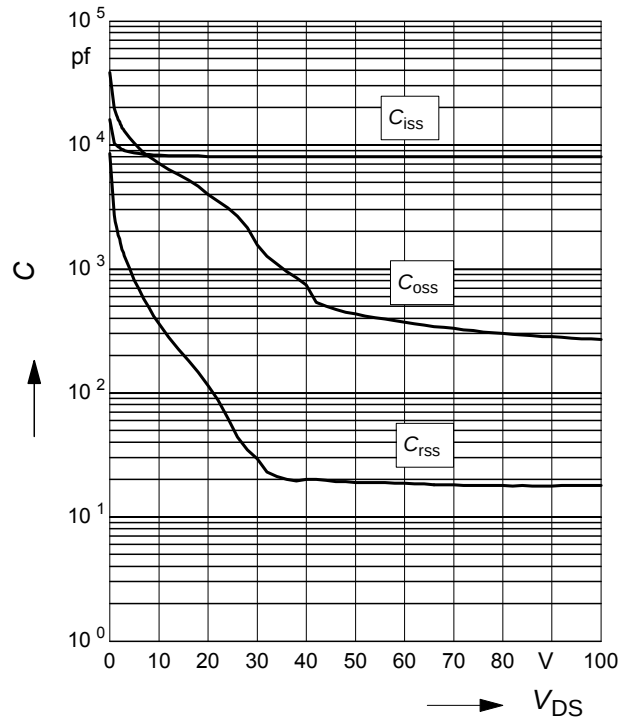
parameter: $E_{AR}=1\text{mJ}$



14 Typ. capacitances

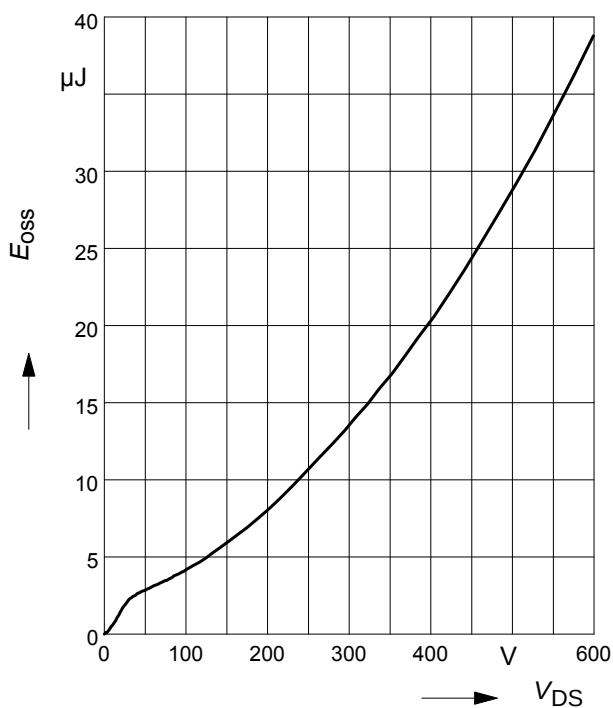
$$C = f(V_{DS})$$

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

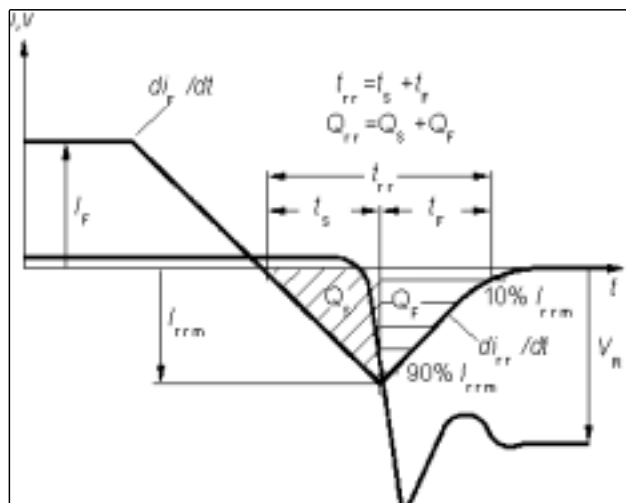


15 Typ. C_{oss} stored energy

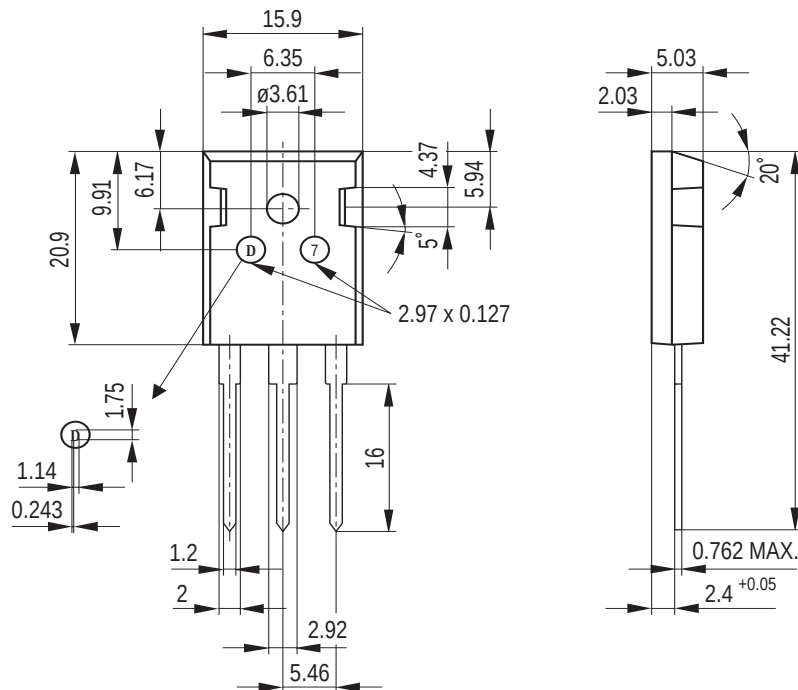
$$E_{oss}=f(V_{DS})$$



Definition of diodes switching characteristics



P-TO-247-3-1



General tolerance unless otherwise specified: Leadframe parts: ± 0.05
Package parts: ± 0.12

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