

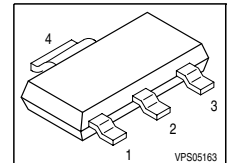
Cool MOS™ Power Transistor

Feature

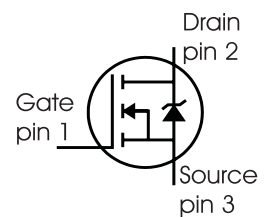
- New revolutionary high voltage technology
- Ultra low gate charge
- Extreme dv/dt rated
- Ultra low effective capacitances

$V_{DS} @ T_{jmax}$	650	V
$R_{DS(on)}$	1.4	Ω
I_D	0.7	A

SOT-223



Type	Package	Ordering Code	Marking
SPN03N60C3	SOT-223	Q67040S4552	03N60C3



Maximum Ratings

Parameter	Symbol	Value	Unit
Continuous drain current $T_A = 25\text{ °C}$ $T_A = 70\text{ °C}$	I_D	0.7 0.4	A
Pulsed drain current, t_p limited by T_{jmax} $T_A = 25\text{ °C}$	$I_{D\text{ puls}}$	3	
Avalanche current, repetitive t_{AR} limited by T_{jmax}	I_{AR}	3.2	
Gate source voltage static	V_{GS}	± 20	V
Gate source voltage AC ($f > 1\text{Hz}$)	V_{GS}	± 30	
Power dissipation, $T_A = 25\text{ °C}$	P_{tot}	1.8	W
Operating and storage temperature	T_j, T_{stg}	-55... +150	°C

Maximum Ratings

Parameter	Symbol	Value	Unit
Drain Source voltage slope $V_{DS} = 480\text{ V}$, $I_D = 3.2\text{ A}$, $T_j = 125\text{ °C}$	dv/dt	50	V/ns

Thermal Characteristics

Parameter	Symbol	Values			Unit
		min.	typ.	max.	
Thermal resistance, junction - soldering point	R_{thJS}	-	25	-	K/W
SMD version, device on PCB: @ min. footprint @ 6 cm ² cooling area ¹⁾	R_{thJA}	- -	110 -	- 70	

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	$V_{(BR)DS}$	$V_{GS}=0\text{ V}$, $I_D=3.2\text{ A}$	-	700	-	
Gate threshold voltage	$V_{GS(th)}$	$I_D=135\text{ }\mu\text{A}$, $V_{GS}=V_{DS}$	2.1	3	3.9	
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 -	1 70	μA
Gate-source leakage current	I_{GSS}	$V_{GS}=30\text{ V}$, $V_{DS}=0\text{ V}$	-	-	100	nA
Drain-source on-state resistance	$R_{DS(on)}$	$V_{GS}=10\text{ V}$, $I_D=2\text{ A}$, $T_j=25\text{ °C}$ $T_j=150\text{ °C}$	- -	1.26 3.8	1.4 -	Ω
Gate input resistance	R_G	$f=1\text{ MHz}$, open Drain	-	10	-	

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

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	
Transconductance	g_{fs}	$V_{DS} \geq 2 \cdot I_D \cdot R_{DS(on)max}$, $I_D = 0.4\text{A}$	-	3.4	-	S
Input capacitance	C_{iss}	$V_{GS} = 0\text{V}$, $V_{DS} = 25\text{V}$, $f = 1\text{MHz}$	-	400	-	pF
Output capacitance	C_{oss}		-	150	-	
Reverse transfer capacitance	C_{rss}		-	5	-	
Effective output capacitance, ²⁾ energy related	$C_{o(er)}$	$V_{GS} = 0\text{V}$, $V_{DS} = 0\text{V to } 480\text{V}$	-	12	-	pF
Effective output capacitance, ³⁾ time related	$C_{o(tr)}$		-	26	-	
Turn-on delay time	$t_{d(on)}$	$V_{DD} = 350\text{V}$, $V_{GS} = 0/10\text{V}$, $I_D = 0.7\text{A}$, $R_G = 20\Omega$	-	7	-	ns
Rise time	t_r		-	3	-	
Turn-off delay time	$t_{d(off)}$		-	64	100	
Fall time	t_f		-	12	20	

Gate Charge Characteristics

Gate to source charge	Q_{gs}	$V_{DD} = 420\text{V}$, $I_D = 0.7\text{A}$	-	2	-	nC
Gate to drain charge	Q_{gd}		-	6	-	
Gate charge total	Q_g	$V_{DD} = 420\text{V}$, $I_D = 0.7\text{A}$, $V_{GS} = 0\text{ to } 10\text{V}$	-	13	17	
Gate plateau voltage	$V_{(plateau)}$	$V_{DD} = 420\text{V}$, $I_D = 0.7\text{A}$	-	5.5	-	V

¹Device on 40mm*40mm*1.5mm epoxy PCB FR4 with 6cm² (one layer, 70 µm thick) copper area for drain connection. PCB is vertical without blown air.

² $C_{o(er)}$ is a fixed capacitance that gives the same stored energy as C_{oss} while V_{DS} is rising from 0 to 80% V_{DSS} .

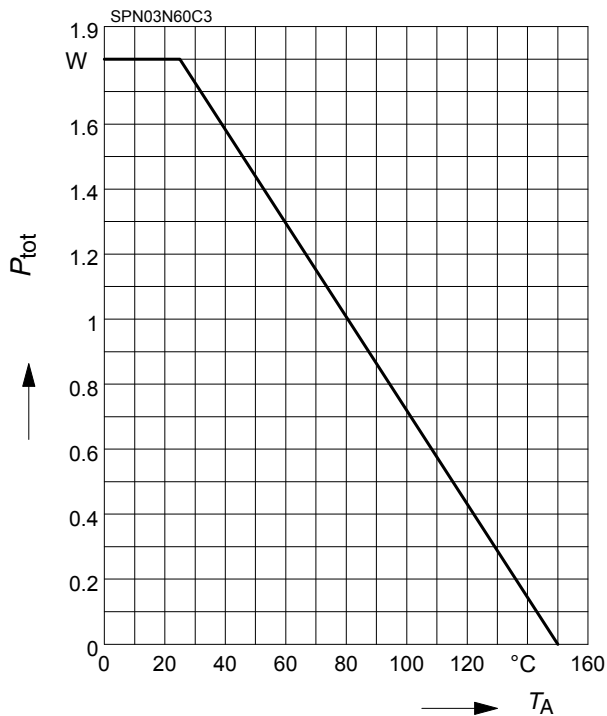
³ $C_{o(tr)}$ is a fixed capacitance that gives the same charging time as C_{oss} while V_{DS} is rising from 0 to 80% V_{DSS} .

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

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	
Inverse diode continuous forward current	I_S	$T_A = 25^{\circ}\text{C}$	-	-	0.7	A
Inverse diode direct current, pulsed	I_{SM}		-	-	3	
Inverse diode forward voltage	V_{SD}	$V_{GS} = 0\text{V}$, $I_F = I_S$	-	1	1.2	V
Reverse recovery time	t_{rr}	$V_R = 420\text{V}$, $I_F = I_S$, $di_F/dt = 100\text{A}/\mu\text{s}$	-	250	400	ns
Reverse recovery charge	Q_{rr}		-	1.8	-	μC
Peak reverse recovery current	I_{rrm}		-	15	-	A
Peak rate of fall of reverse recovery current	di_{rr}/dt		-	-	540	$\text{A}/\mu\text{s}$

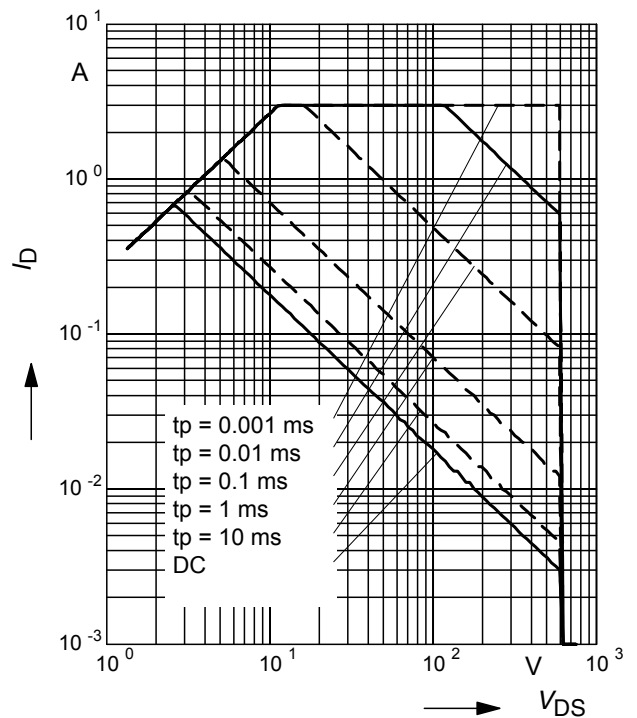
1 Power dissipation

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



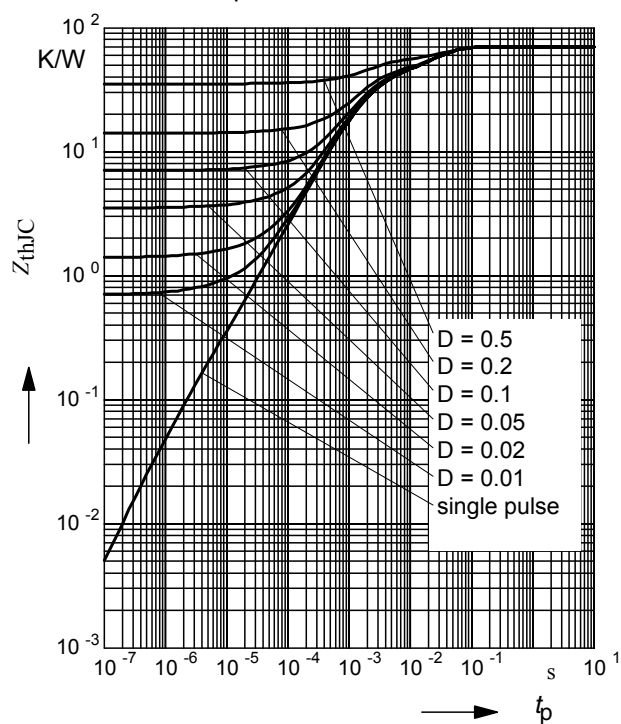
2 Safe operating area

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

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


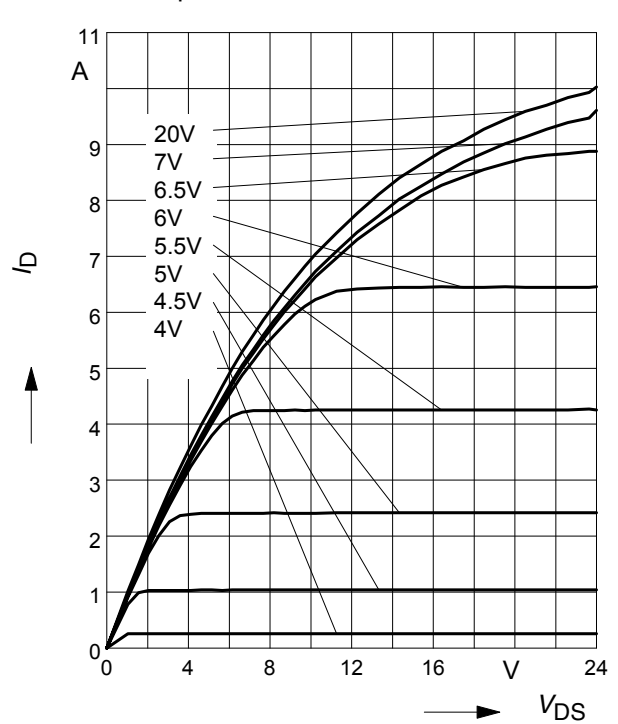
3 Transient thermal impedance

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

parameter: $D = t_p/T$


4 Typ. output characteristic

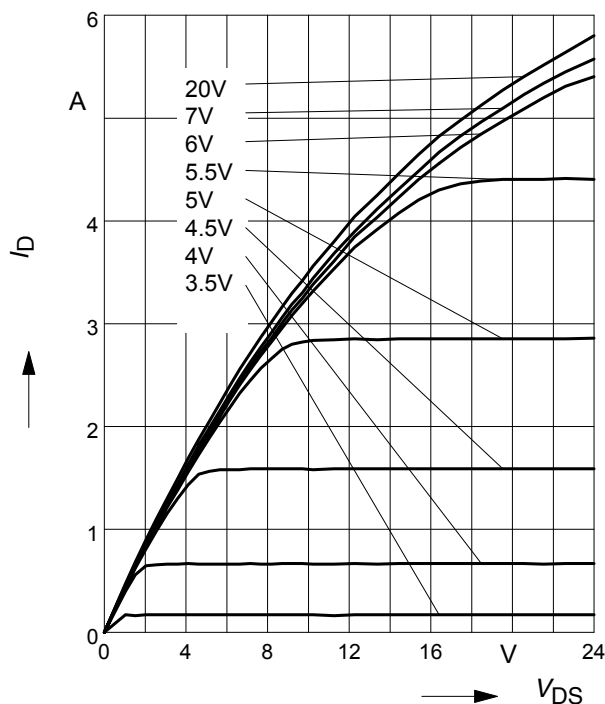
$$I_D = f(V_{DS}); T_j = 25^\circ\text{C}$$

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


5 Typ. output characteristic

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

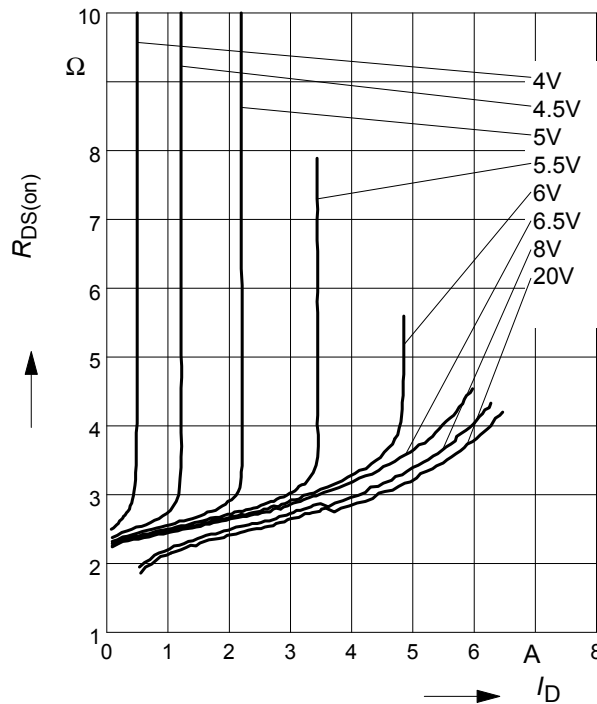
parameter: $t_p = 10\ \mu\text{s}$, V_{GS}



6 Typ. drain-source on resistance

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

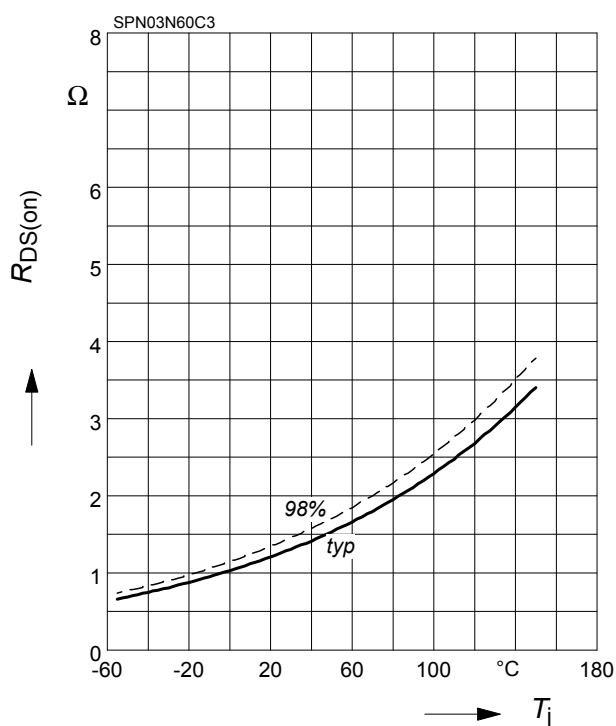
parameter: $T_j = 150^\circ\text{C}$, V_{GS}



7 Drain-source on-state resistance

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

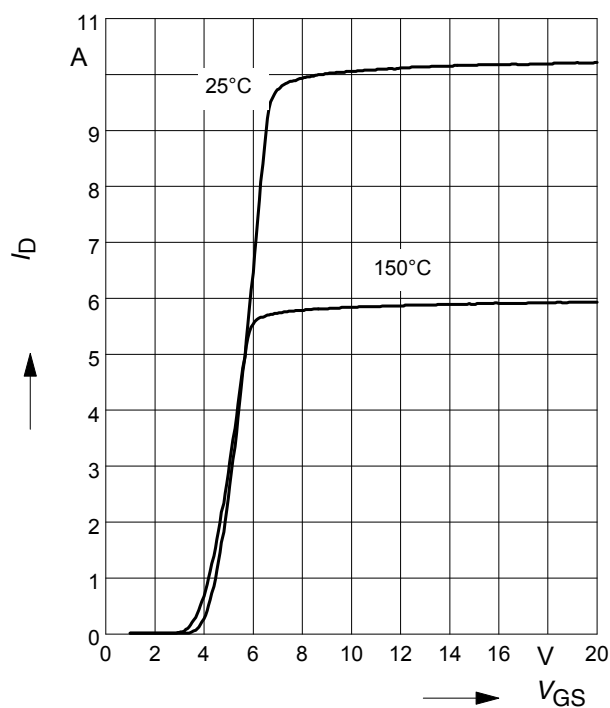
parameter: $I_D = 0.4\ \text{A}$, $V_{GS} = 10\ \text{V}$



8 Typ. transfer characteristics

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

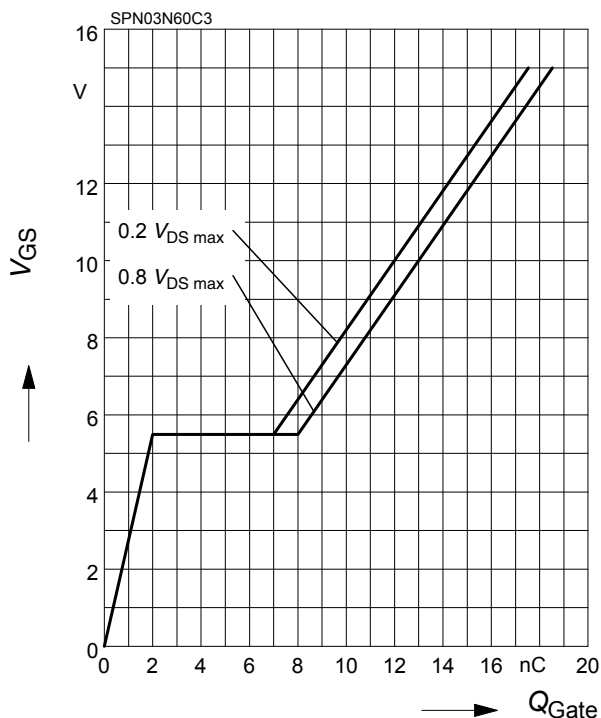
parameter: $t_p = 10\ \mu\text{s}$



9 Typ. gate charge

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

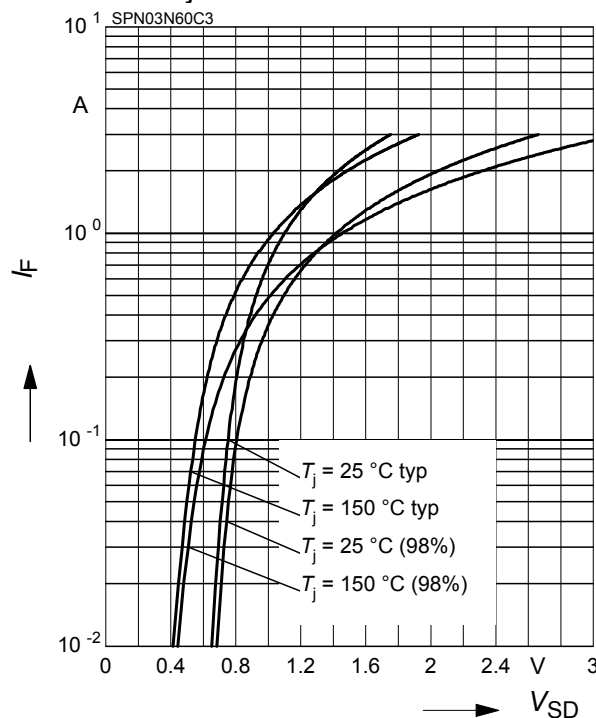
parameter: $I_D = 0.7 \text{ A}$ pulsed



10 Forward characteristics of body diode

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

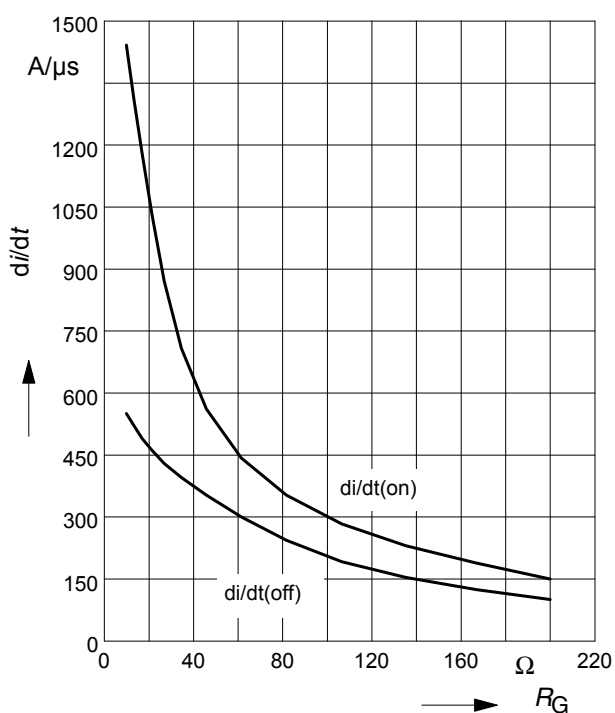
parameter: T_j , $t_p = 10 \mu\text{s}$



11 Typ. drain current slope

$di/dt = f(R_G)$, inductive load, $T_j = 125^\circ\text{C}$

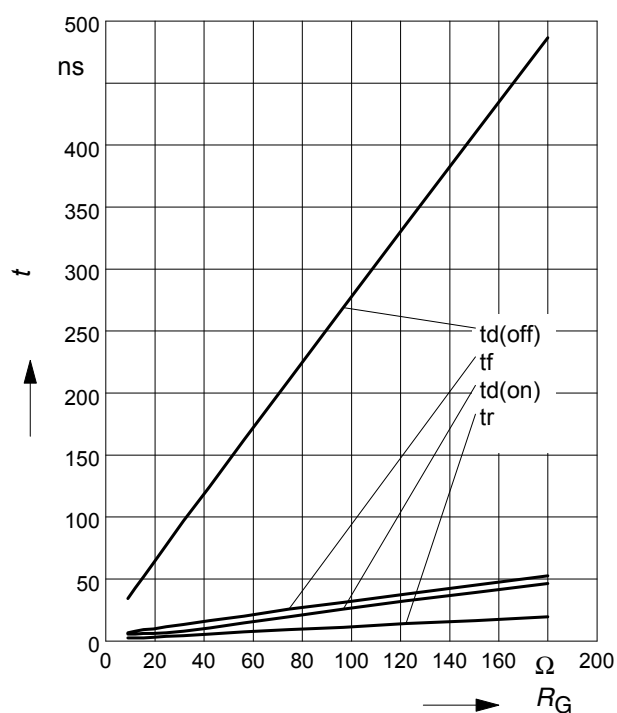
par.: $V_{DS}=380\text{V}$, $V_{GS}=0/+13\text{V}$, $I_D=0.7\text{A}$



12 Typ. switching time

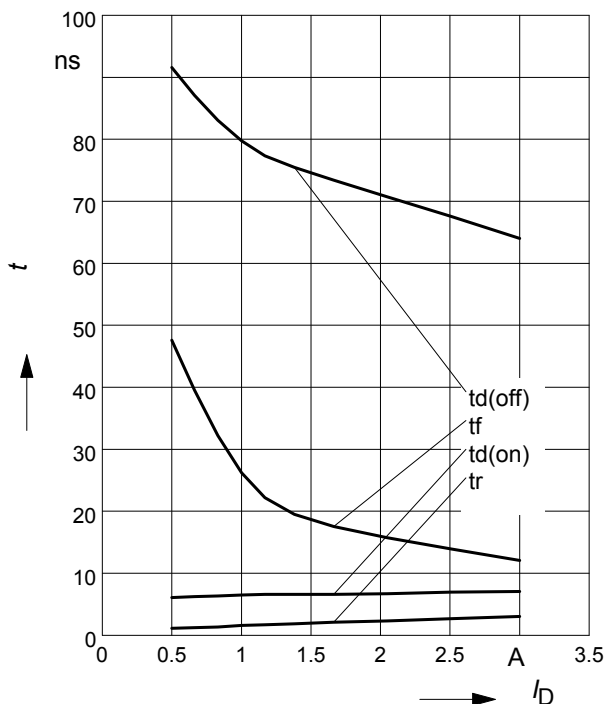
$t = f(R_G)$, inductive load, $T_j=125^\circ\text{C}$

par.: $V_{DS}=380\text{V}$, $V_{GS}=0/+13\text{V}$, $I_D=0.7 \text{ A}$



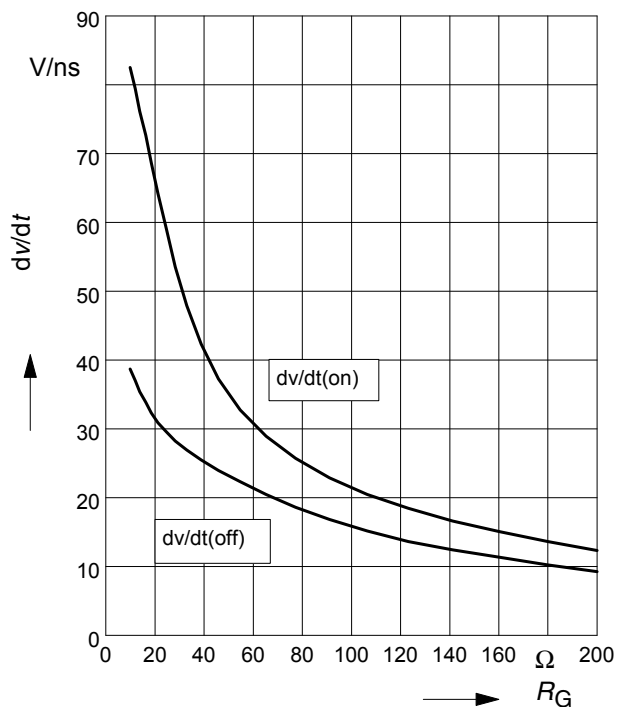
13 Typ. switching time

 $t = f(I_D)$, inductive load, $T_j = 125^\circ\text{C}$

par.: $V_{DS} = 380\text{V}$, $V_{GS} = 0/+13\text{V}$, $R_G = 20\Omega$


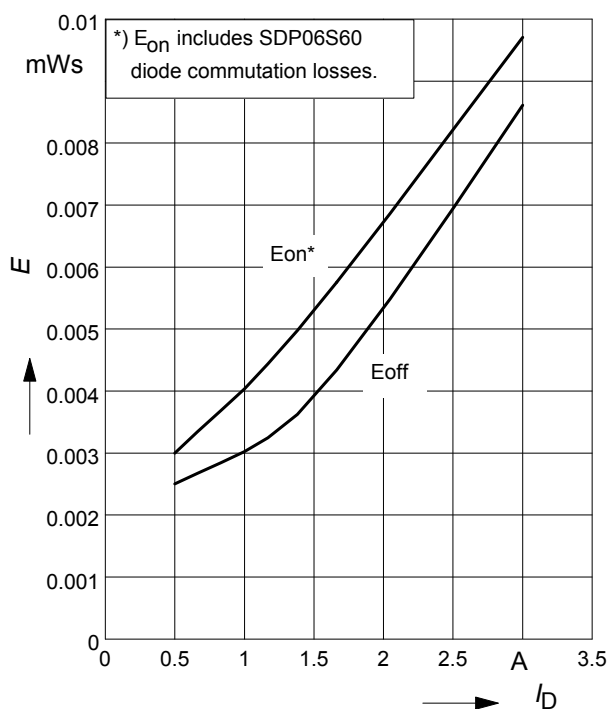
14 Typ. drain source voltage slope

 $dv/dt = f(R_G)$, inductive load, $T_j = 125^\circ\text{C}$

par.: $V_{DS} = 380\text{V}$, $V_{GS} = 0/+13\text{V}$, $I_D = 0.7\text{A}$


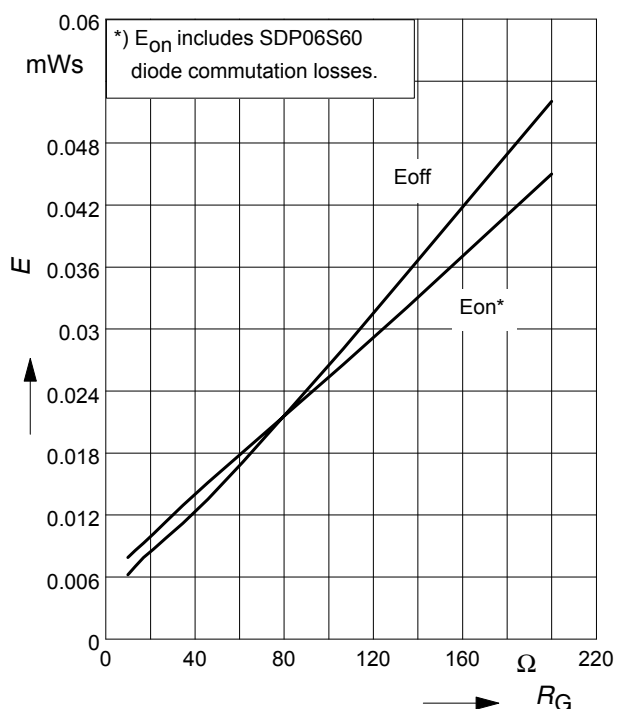
15 Typ. switching losses

 $E = f(I_D)$, inductive load, $T_j = 125^\circ\text{C}$

par.: $V_{DS} = 380\text{V}$, $V_{GS} = 0/+13\text{V}$, $R_G = 20\Omega$


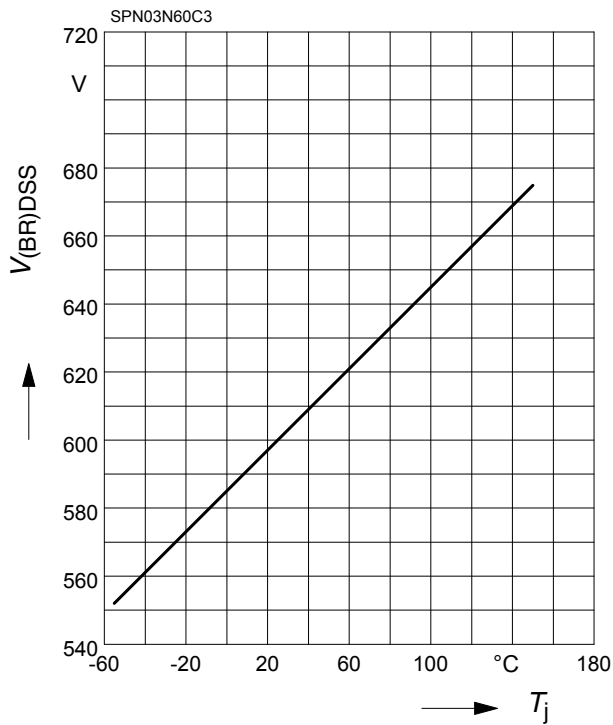
16 Typ. switching losses

 $E = f(R_G)$, inductive load, $T_j = 125^\circ\text{C}$

par.: $V_{DS} = 380\text{V}$, $V_{GS} = 0/+13\text{V}$, $I_D = 0.7\text{A}$


17 Drain-source breakdown voltage

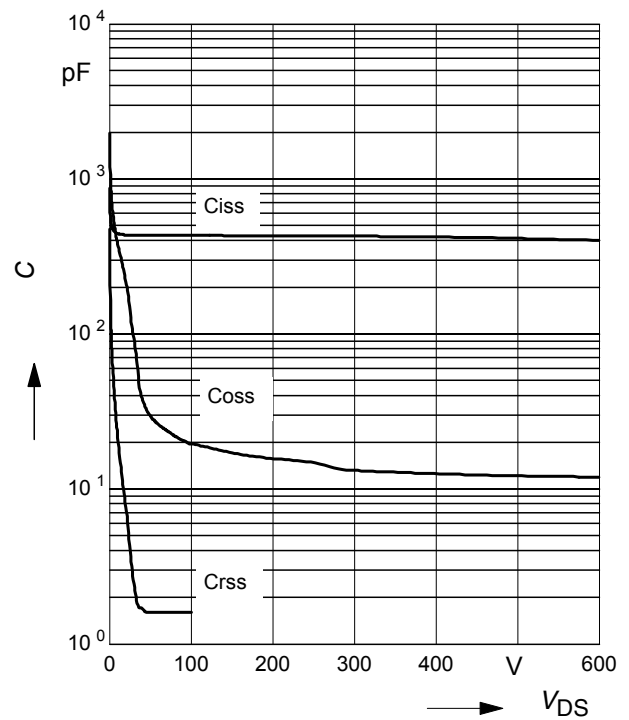
$$V_{(BR)DSS} = f(T_j)$$



18 Typ. capacitances

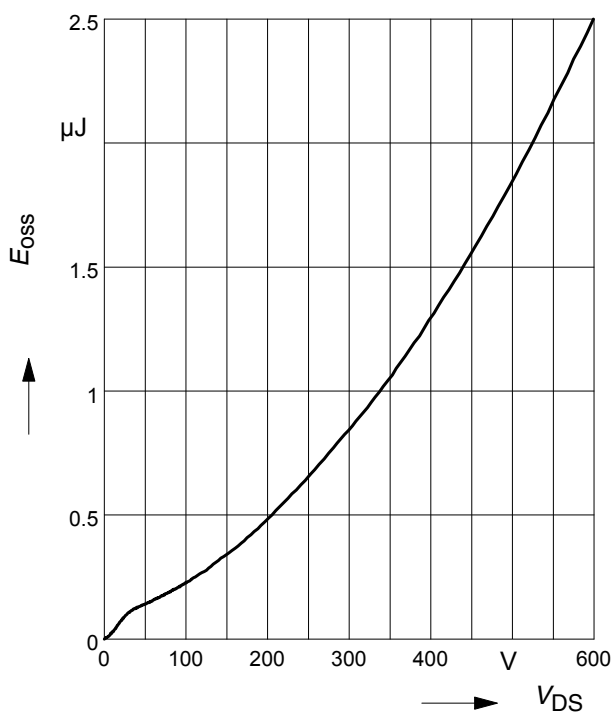
$$C = f(V_{DS})$$

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

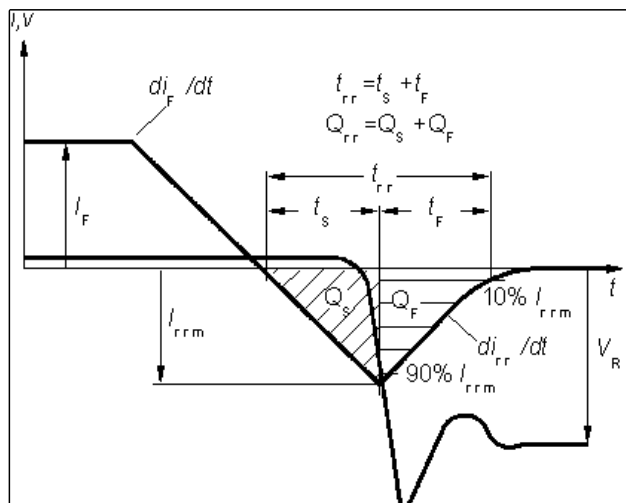


19 Typ. C_{oss} stored energy

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



Definition of diodes switching characteristics



Published by
Infineon Technologies AG,
Bereichs Kommunikation
St.-Martin-Strasse 53,
D-81541 München
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