

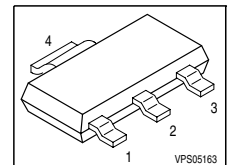
### Cool MOS™ Power Transistor

#### Feature

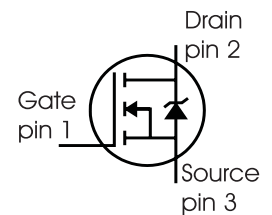
- New revolutionary high voltage technology
- Ultra low gate charge
- Extreme dv/dt rated
- Ultra low effective capacitances

$V_{DS} @ T_{jmax}$	650	V
$R_{DS(on)}$	1.4	$\Omega$
$I_D$	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	$V_{GS}$	$\pm 20$	V
Gate source voltage AC ( $f > 1\text{Hz}$ )	$V_{GS}$	$\pm 30$	
Power dissipation, $T_A = 25\text{ °C}$	$P_{tot}$	1.8	W
Operating and storage temperature	$T_j, T_{stg}$	-55... +150	$^{\circ}\text{C}$

**Maximum Ratings**

Parameter	Symbol	Value	Unit
Drain Source voltage slope $V_{DS} = 480\text{ V}$ , $I_D = 3.2\text{ A}$ , $T_j = 125\text{ °C}$	$dv/dt$	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	$R_{thJA}$	-	110	-	
@ 6 cm <sup>2</sup> cooling area <sup>1)</sup>		-	-	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	$V_{GS(th)}$	$I_D=135\mu\text{A}$ , $V_{GS}=V_{DS}$	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	$\mu\text{A}$
			-	-	70	
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	1.4	$\Omega$
			-	3.8	-	
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, <sup>2)</sup> energy related	$C_{o(er)}$	$V_{GS} = 0\text{V}$ , $V_{DS} = 0\text{V to } 480\text{V}$	-	12	-	pF
Effective output capacitance, <sup>3)</sup> 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

<sup>1</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>2</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%  $V_{DSS}$ .

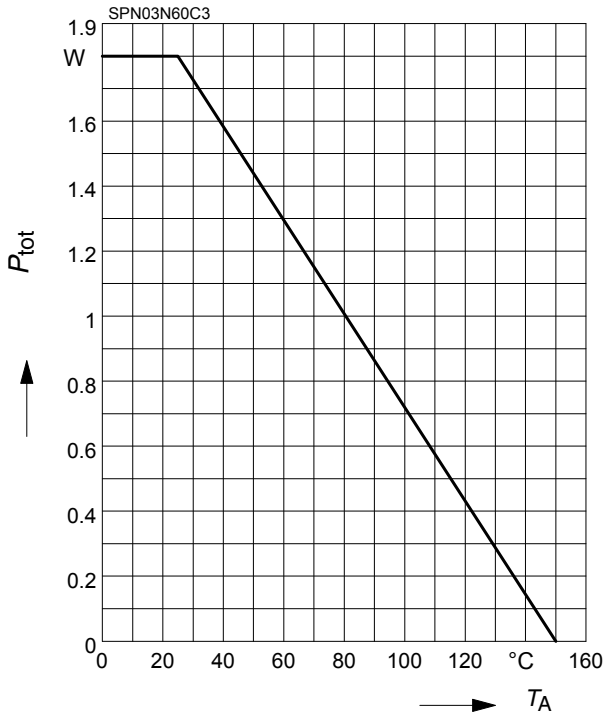
<sup>3</sup> $C_{o(tr)}$  is a fixed capacitance that gives the same charging time as  $C_{oss}$  while  $V_{DS}$  is rising from 0 to 80%  $V_{DSS}$ .

**Electrical Characteristics**, at  $T_j = 25\text{ }^\circ\text{C}$ , 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	$t_{rr}$	$V_R=420\text{V}, I_F=I_S,$	-	250	400	ns
Reverse recovery charge	$Q_{rr}$	$di_F/dt=100\text{A}/\mu\text{s}$	-	1.8	-	$\mu\text{C}$
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**

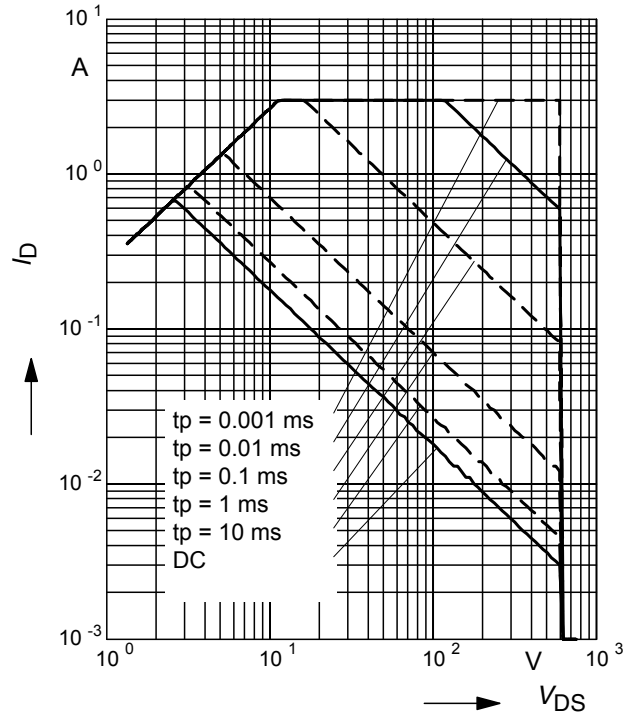
$P_{tot} = f(T_A)$



**2 Safe operating area**

$I_D = f(V_{DS})$

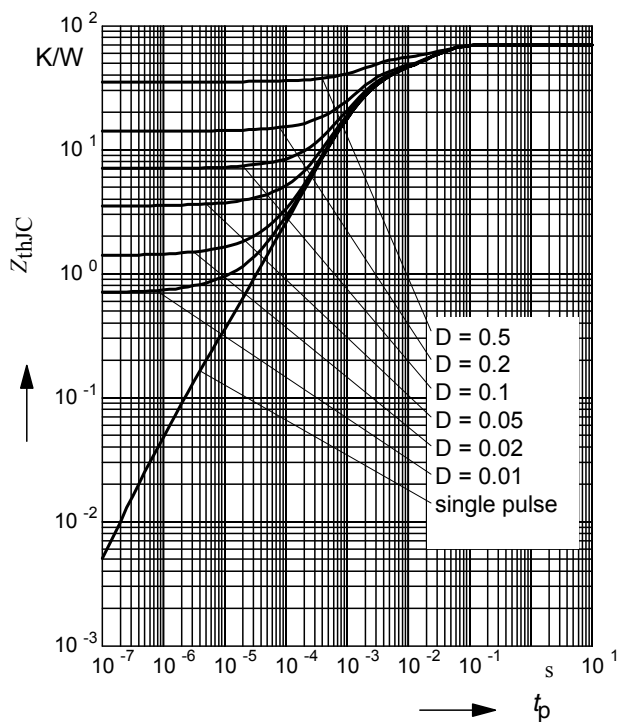
parameter :  $D = 0$  ,  $T_A = 25^\circ\text{C}$



**3 Transient thermal impedance**

$Z_{thJC} = f(t_p)$

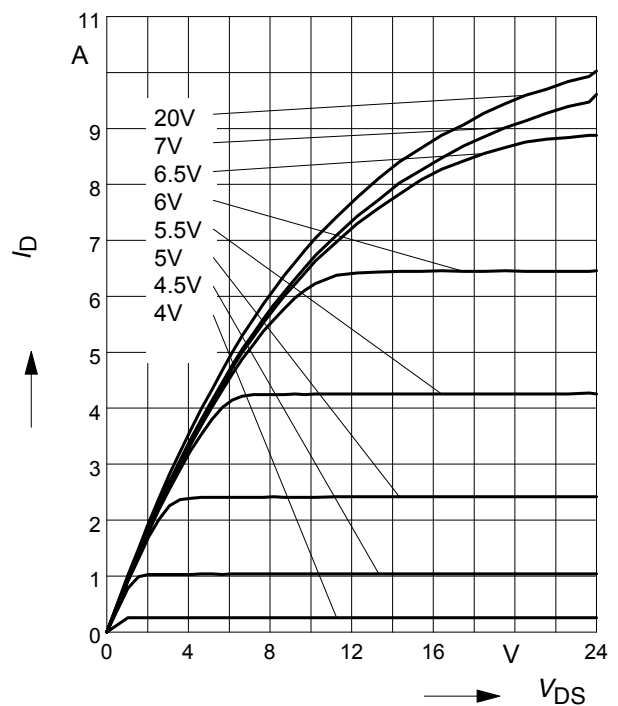
parameter:  $D = t_p/T$



**4 Typ. output characteristic**

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

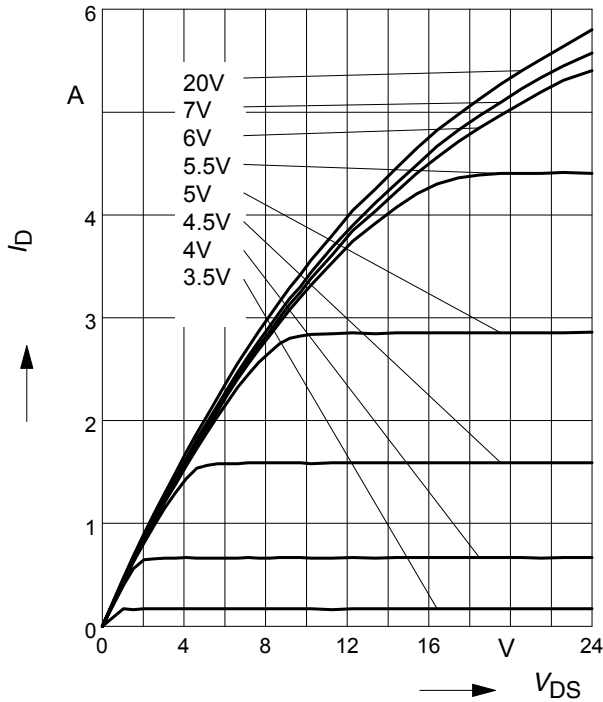
parameter:  $t_p = 10 \mu\text{s}$ ,  $V_{GS}$



**5 Typ. output characteristic**

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

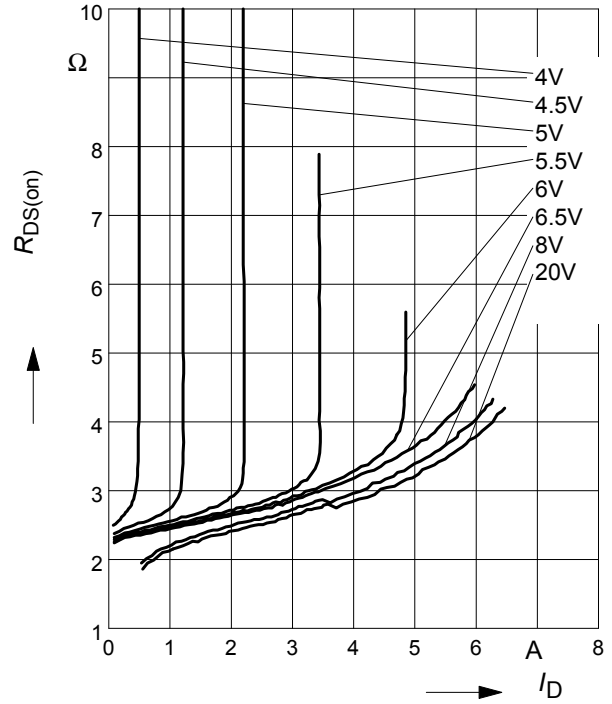
parameter:  $t_p = 10 \mu\text{s}, V_{GS}$



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

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

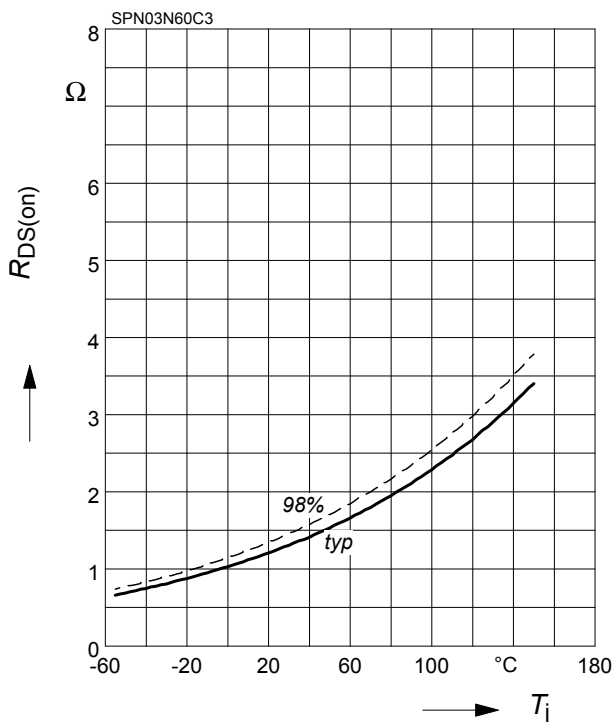
parameter:  $T_j = 150^\circ\text{C}, V_{GS}$



**7 Drain-source on-state resistance**

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

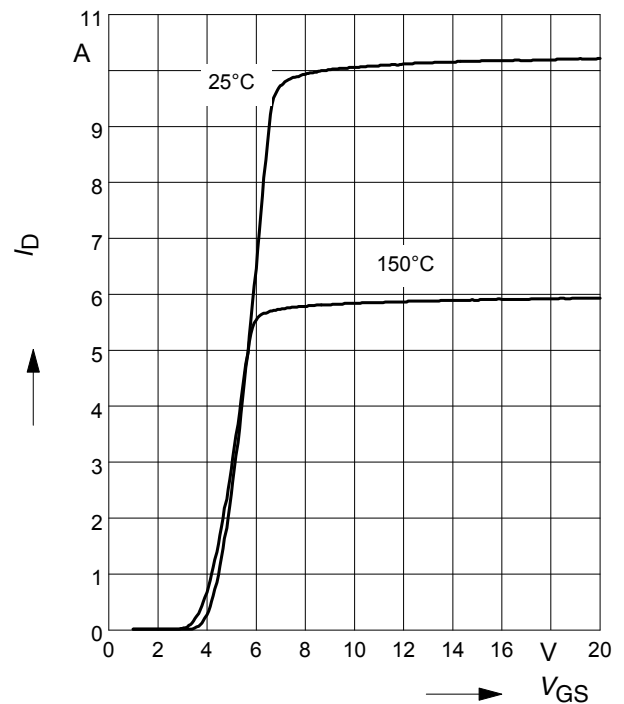
parameter:  $I_D = 0.4 \text{ A}, V_{GS} = 10 \text{ V}$



**8 Typ. transfer characteristics**

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

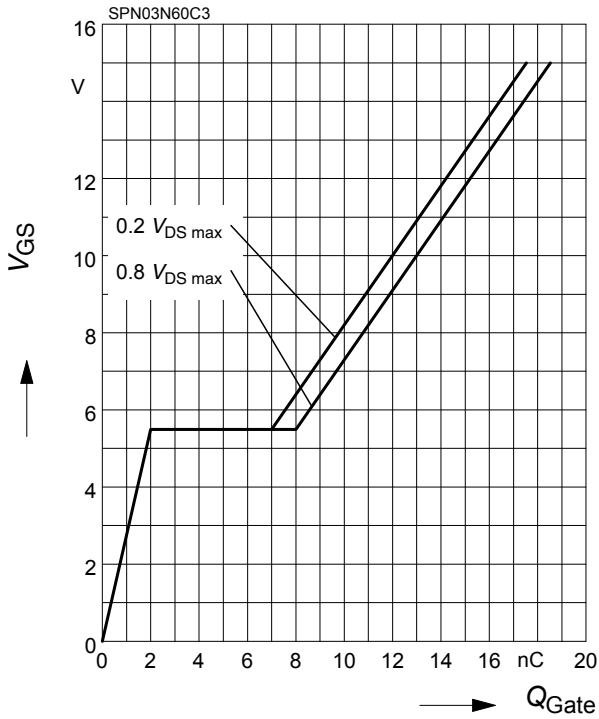
parameter:  $t_p = 10 \mu\text{s}$



**9 Typ. gate charge**

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

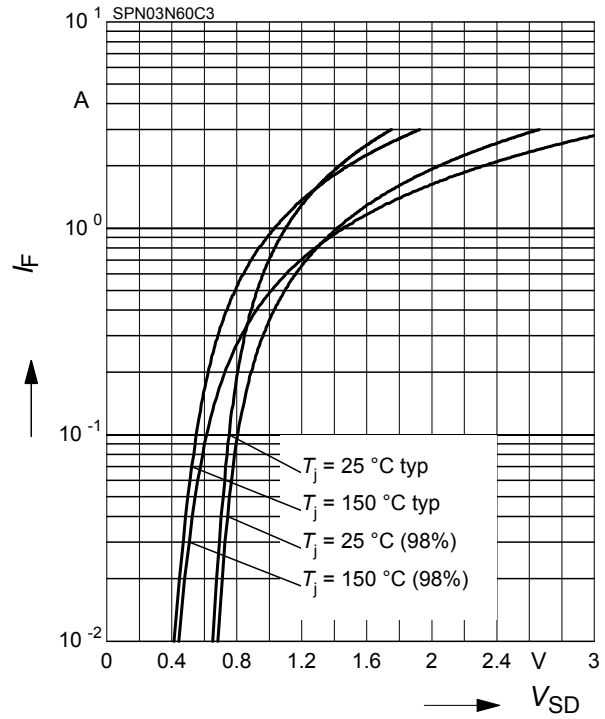
parameter:  $I_D = 0.7\text{ A}$  pulsed



**10 Forward characteristics of body diode**

$I_F = f(V_{SD})$

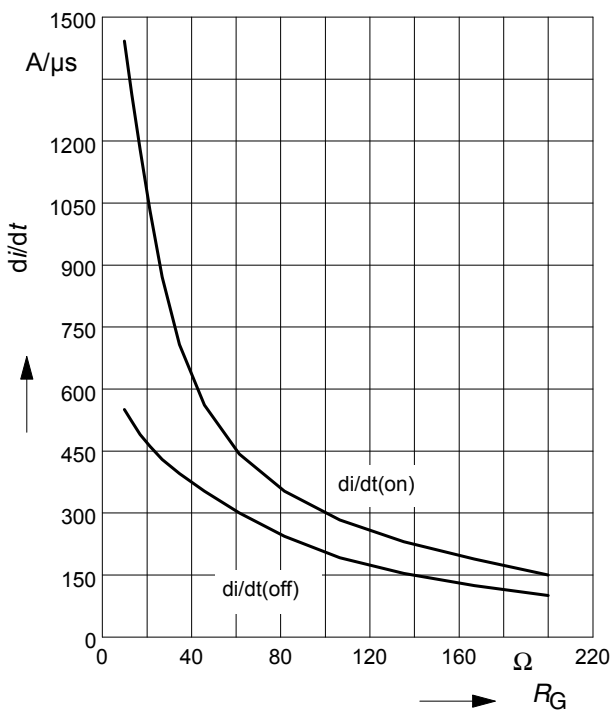
parameter:  $T_j, t_p = 10\ \mu\text{s}$



**11 Typ. drain current slope**

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

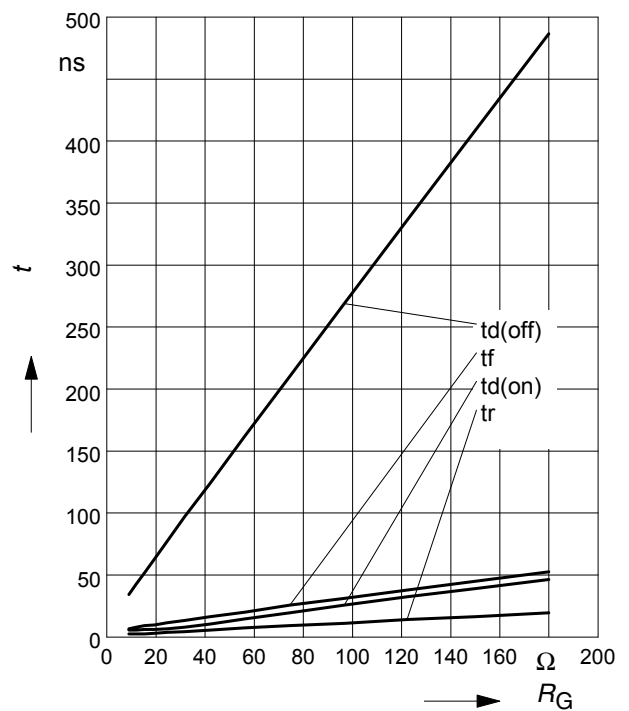
par.:  $V_{DS}=380\text{V}, V_{GS}=0/+13\text{V}, I_D=0.7\text{A}$



**12 Typ. switching time**

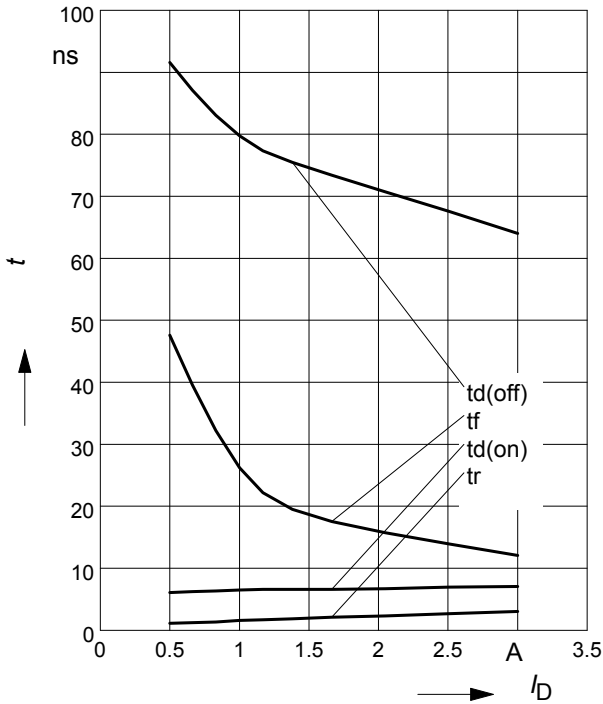
$t = f(R_G)$ , inductive load,  $T_j=125\text{ °C}$

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



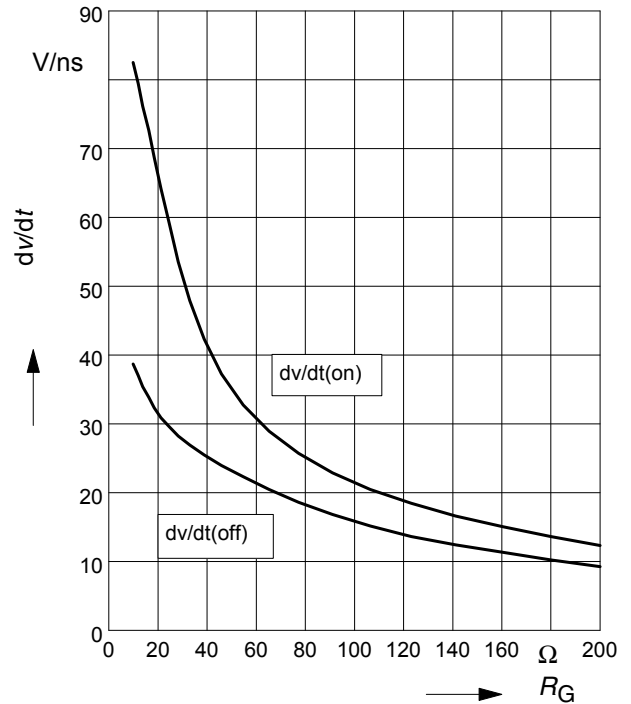
**13 Typ. switching time**

$t = f(I_D)$ , inductive load,  $T_j=125^\circ\text{C}$   
 par.:  $V_{DS}=380\text{V}$ ,  $V_{GS}=0/+13\text{V}$ ,  $R_G=20\Omega$



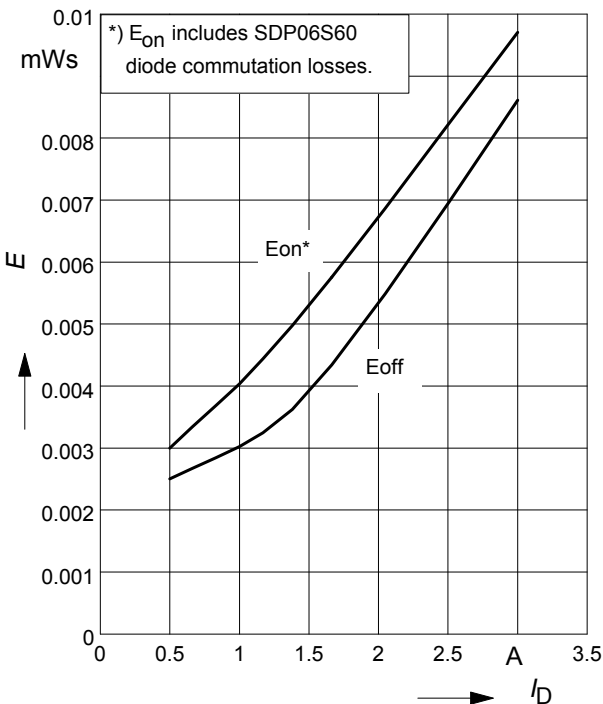
**14 Typ. drain source voltage slope**

$dv/dt = f(R_G)$ , inductive load,  $T_j = 125^\circ\text{C}$   
 par.:  $V_{DS}=380\text{V}$ ,  $V_{GS}=0/+13\text{V}$ ,  $I_D=0.7\text{A}$



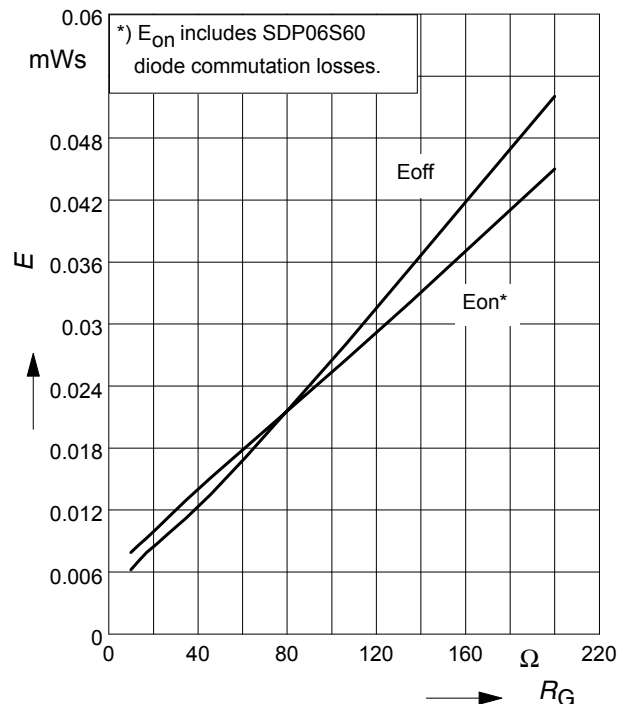
**15 Typ. switching losses**

$E = f(I_D)$ , 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**

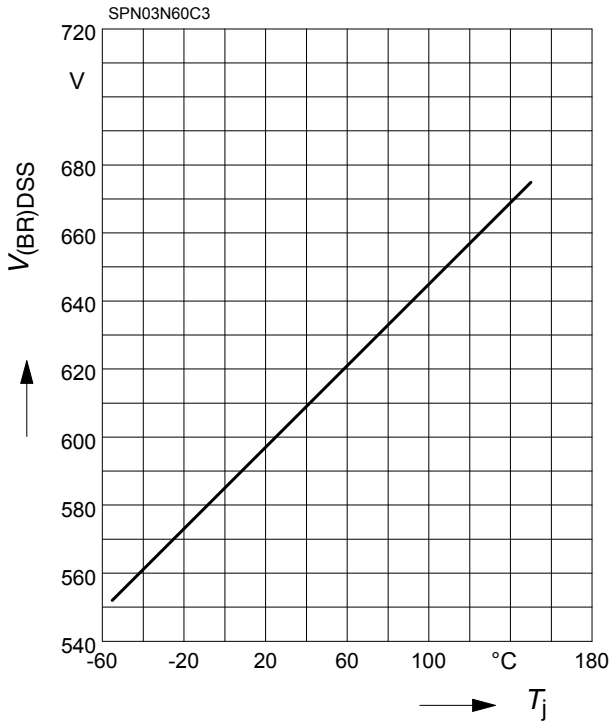
$E = f(R_G)$ , inductive load,  $T_j=125^\circ\text{C}$   
 par.:  $V_{DS}=380\text{V}$ ,  $V_{GS}=0/+13\text{V}$ ,  $I_D=0.7\text{A}$





**17 Drain-source breakdown voltage**

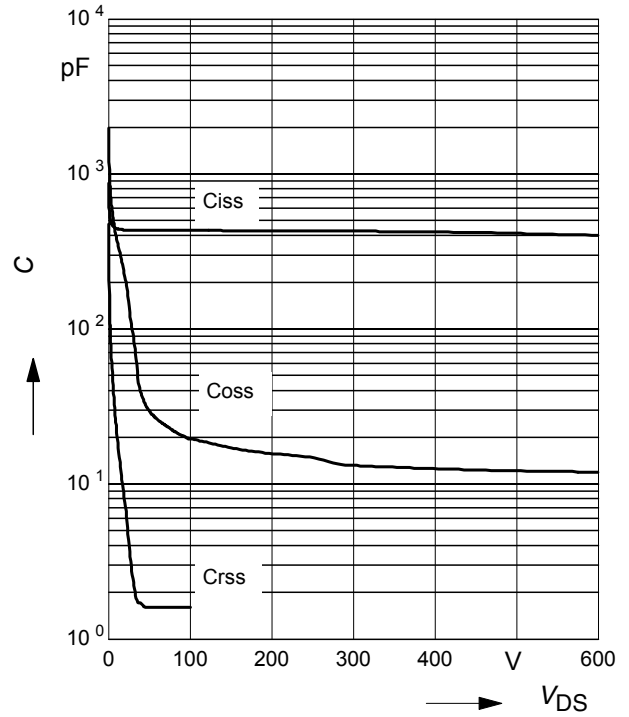
$$V_{(BR)DSS} = f(T_j)$$



**18 Typ. capacitances**

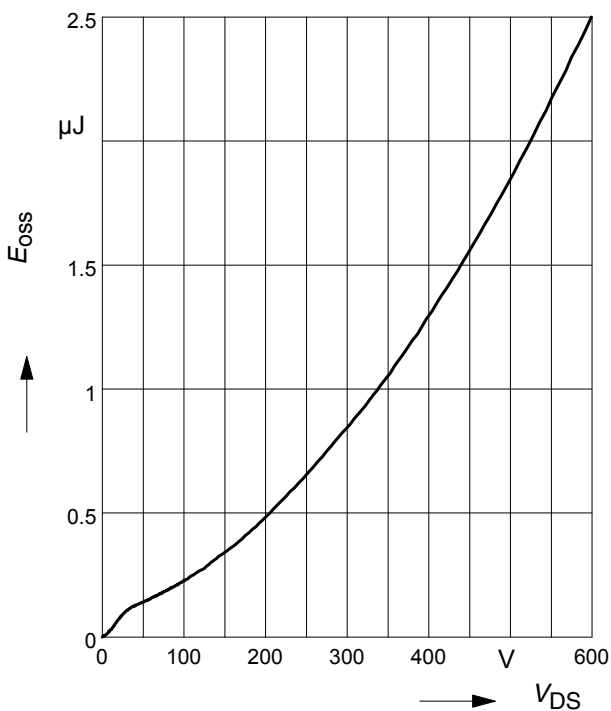
$$C = f(V_{DS})$$

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

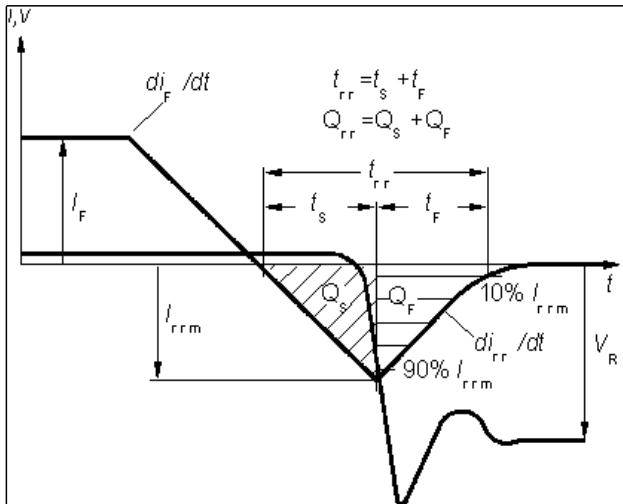


**19 Typ.  $C_{OSS}$  stored energy**

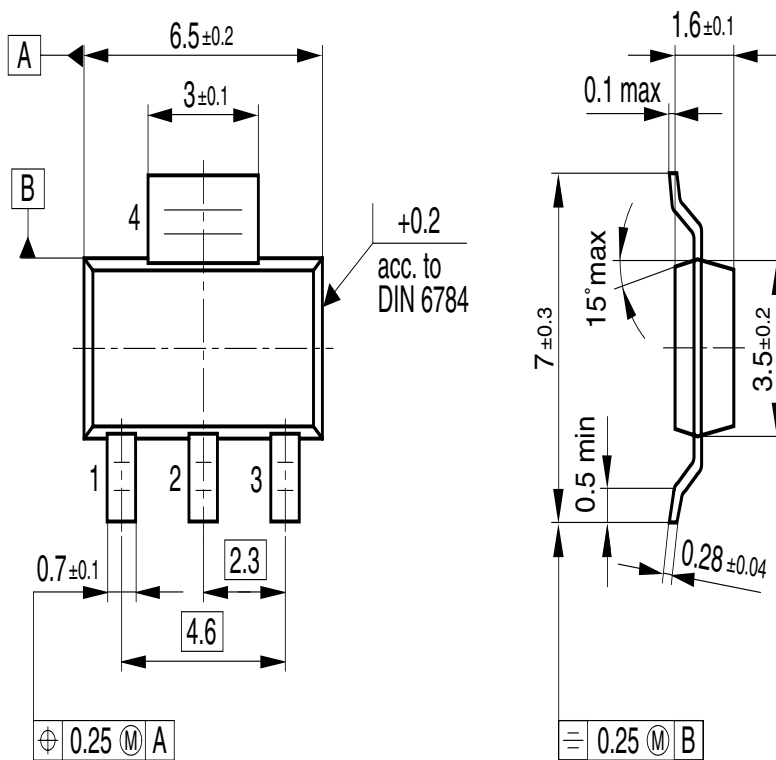
$$E_{OSS} = f(V_{DS})$$



Definition of diodes switching characteristics



SOT223



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