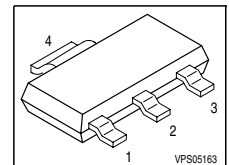


Cool MOS™ Power Transistor
Feature

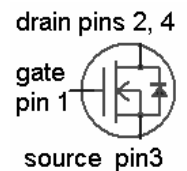
- New revolutionary high voltage technology
- Ultra low gate charge
- Extreme dv/dt rated
- Ultra low effective capacitances
- Qualified according to JEDEC⁽⁰⁾ for target applications

$V_{DS} @ T_{jmax}$	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	$^{\circ}\text{C}$

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 ² cooling area ¹⁾		-	-	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	μA
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	
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	Ω
			-	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, 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

⁰J-STD20 and JESD22

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} .

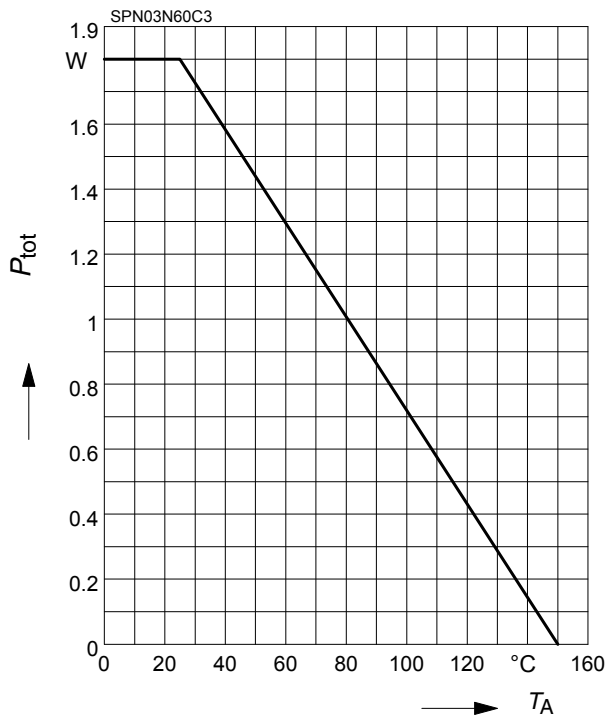
³ $C_{o(tr)}$ is a fixed capacitance that gives the same charging time as C_{oss} while V_{DS} is rising from 0 to 80% V_{DSS} .

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}	$V_R=420\text{V}, I_F=I_S,$	-	250	400	ns
Reverse recovery charge	Q_{rr}	$di_F/dt=100\text{A}/\mu\text{s}$	-	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

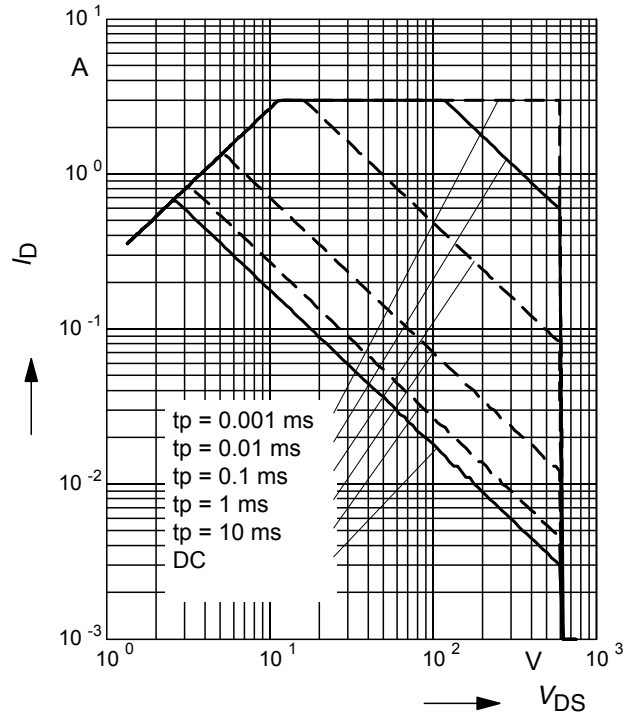
$P_{tot} = f(T_A)$



2 Safe operating area

$I_D = f(V_{DS})$

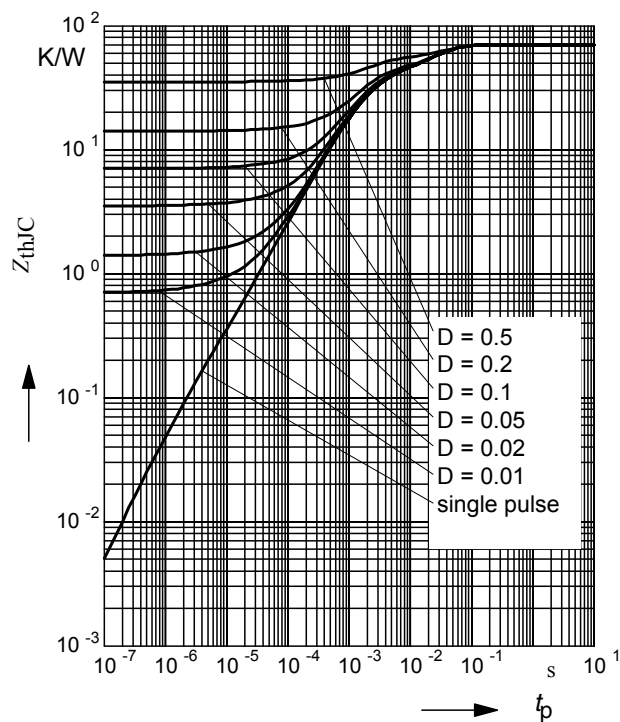
parameter : $D = 0$, $T_A = 25^\circ\text{C}$



3 Transient thermal impedance

$Z_{thJC} = f(t_p)$

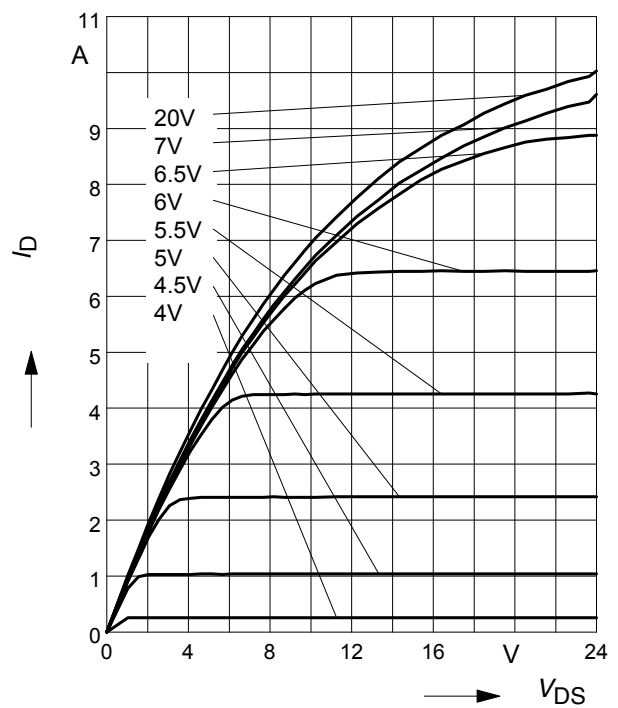
parameter: $D = t_p/T$



4 Typ. output characteristic

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

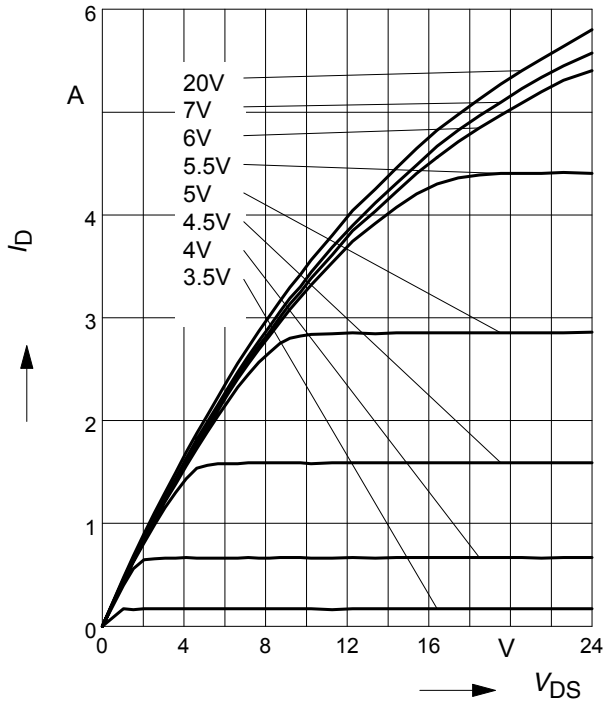
parameter: $t_p = 10 \mu\text{s}$, V_{GS}



5 Typ. output characteristic

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

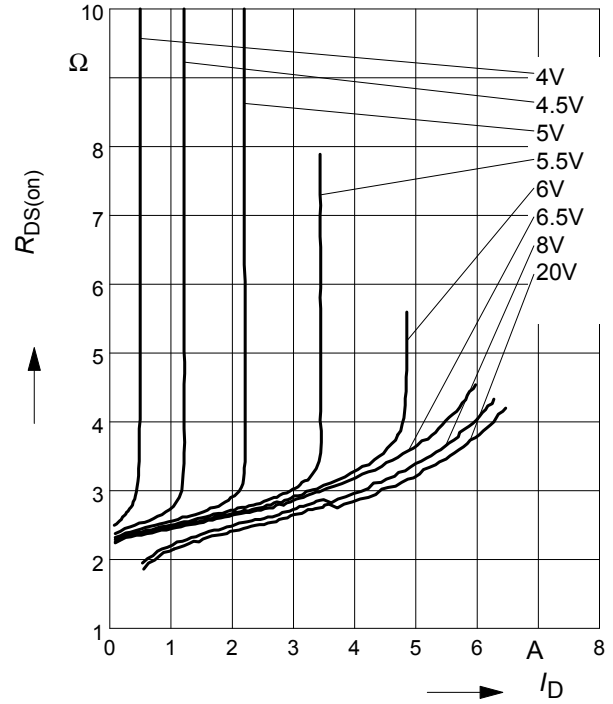
parameter: $t_p = 10 \mu\text{s}, V_{GS}$



6 Typ. drain-source on resistance

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

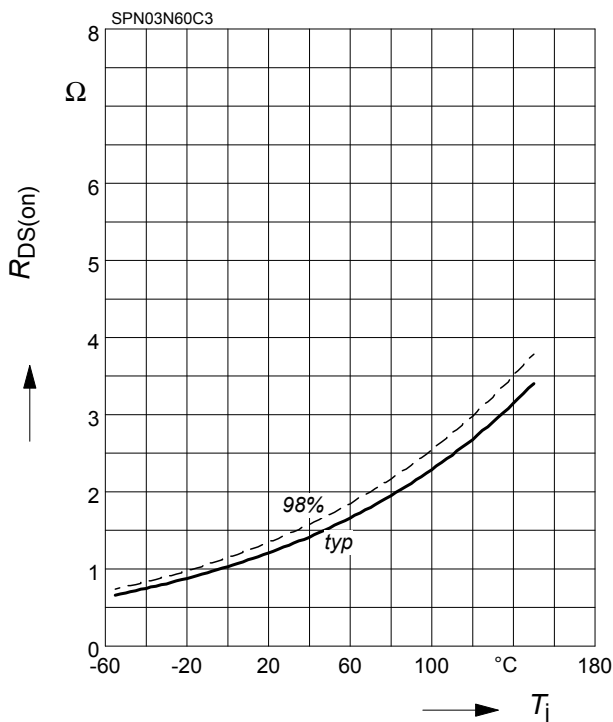
parameter: $T_j = 150^\circ\text{C}, V_{GS}$



7 Drain-source on-state resistance

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

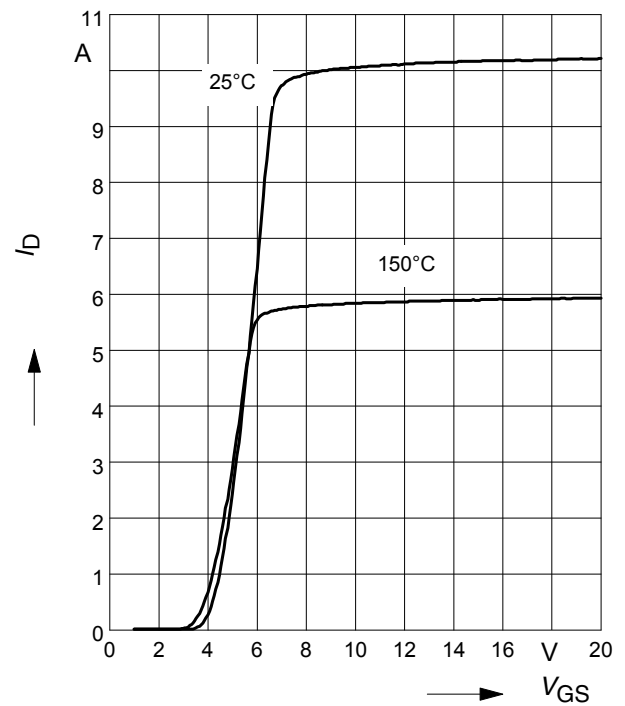
parameter: $I_D = 0.4 \text{ A}, V_{GS} = 10 \text{ V}$



8 Typ. transfer characteristics

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

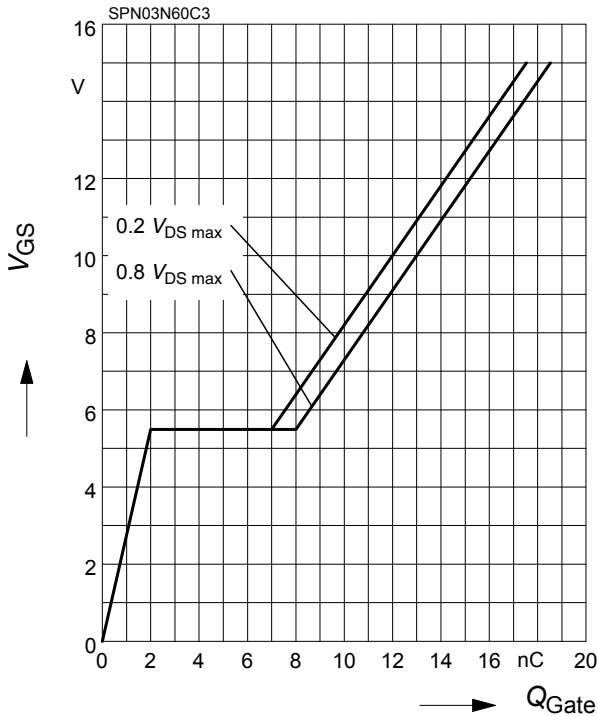
parameter: $t_p = 10 \mu\text{s}$



9 Typ. gate charge

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

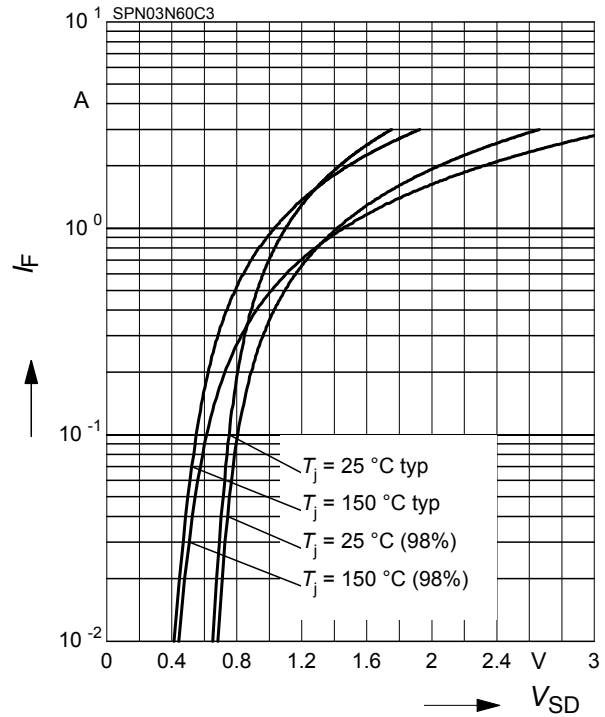
parameter: $I_D = 0.7 \text{ A pulsed}$



10 Forward characteristics of body diode

$I_F = f(V_{SD})$

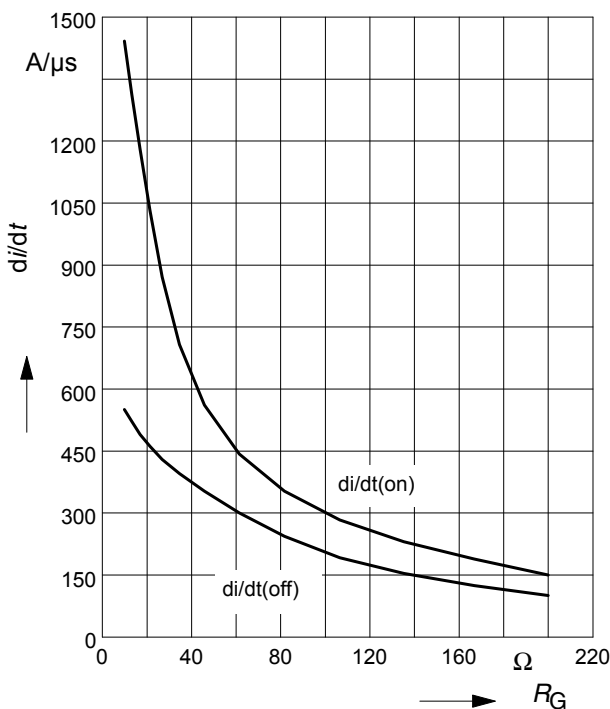
parameter: $T_j, t_p = 10 \mu\text{s}$



11 Typ. drain current slope

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

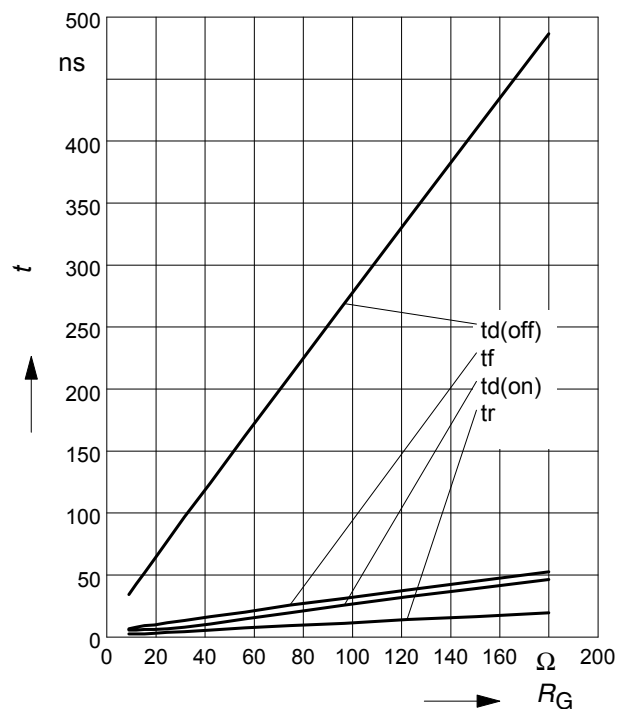
par.: $V_{DS}=380\text{V}, V_{GS}=0/+13\text{V}, I_D=0.7\text{A}$



12 Typ. switching time

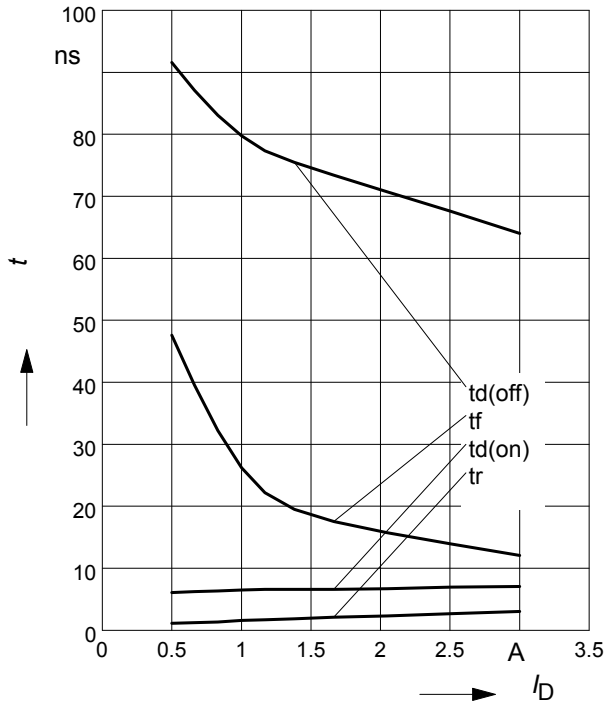
$t = f(R_G)$, inductive load, $T_j=125^\circ\text{C}$

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



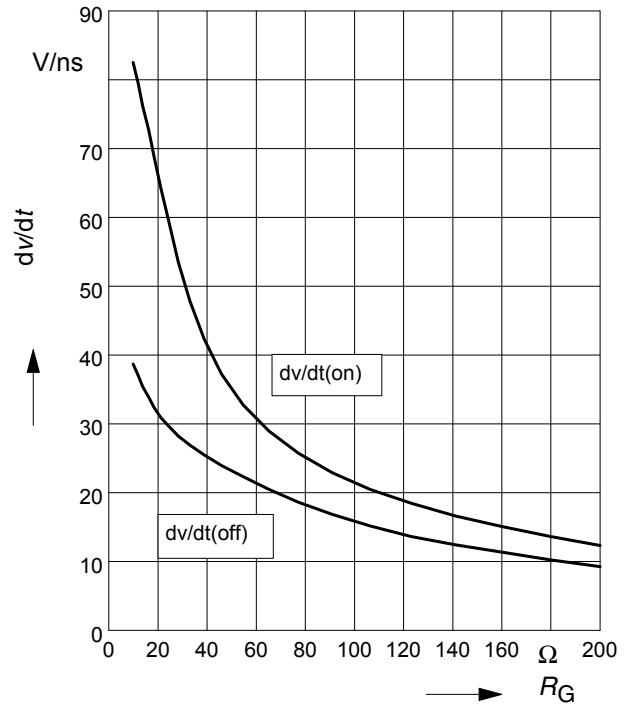
13 Typ. switching time

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



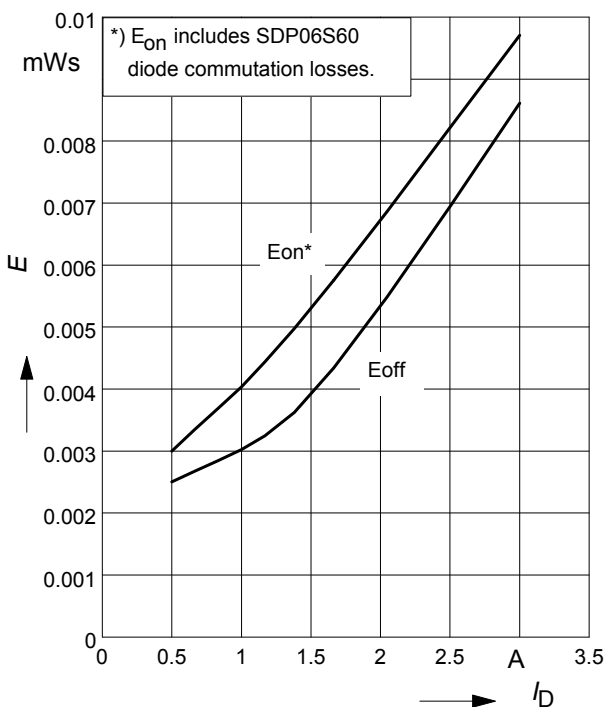
14 Typ. drain source voltage slope

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



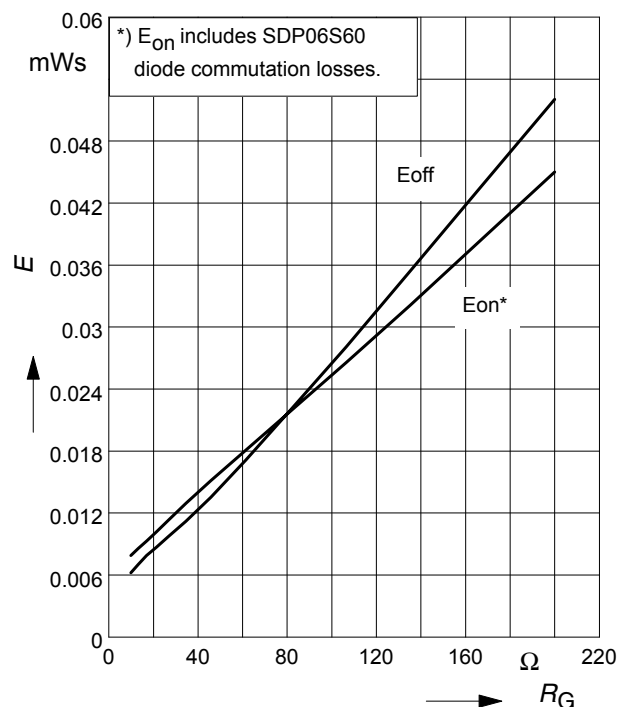
15 Typ. switching losses

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



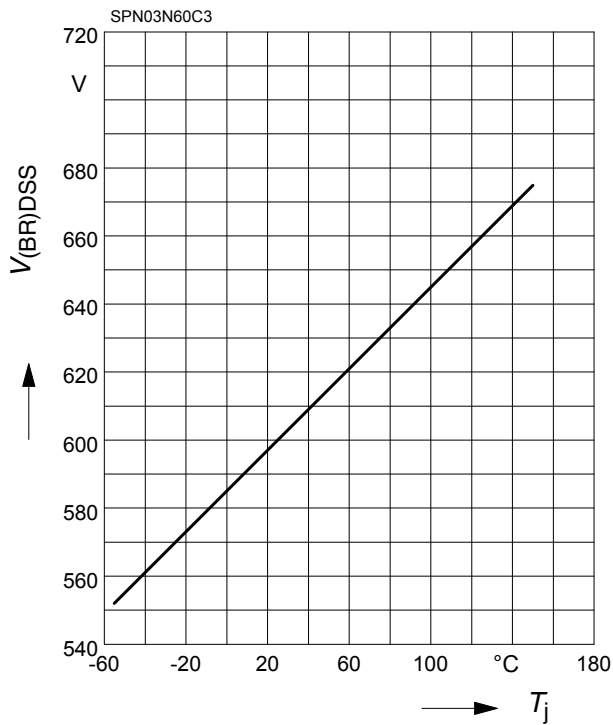
16 Typ. switching losses

$E = f(R_G)$, 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

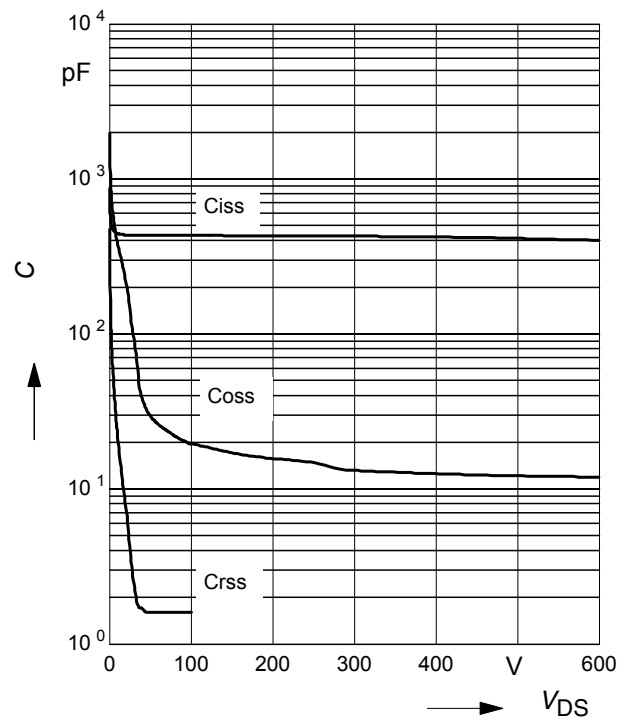
$$V_{(BR)DSS} = f(T_j)$$



18 Typ. capacitances

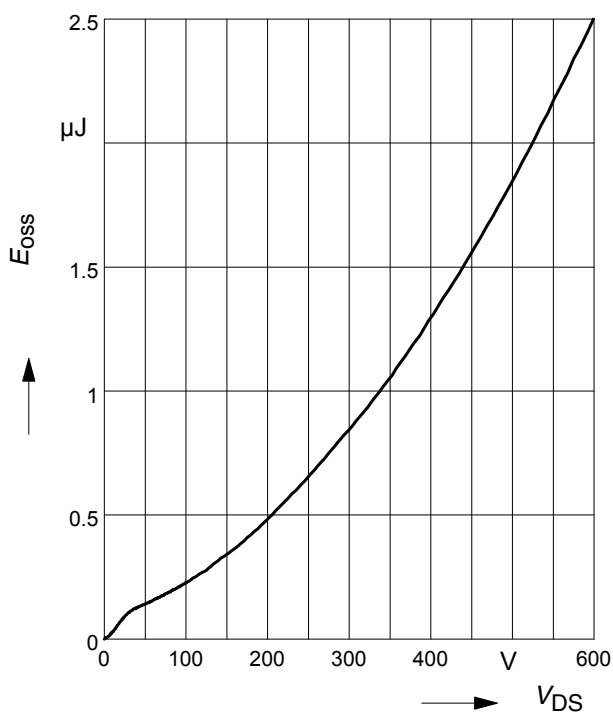
$$C = f(V_{DS})$$

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

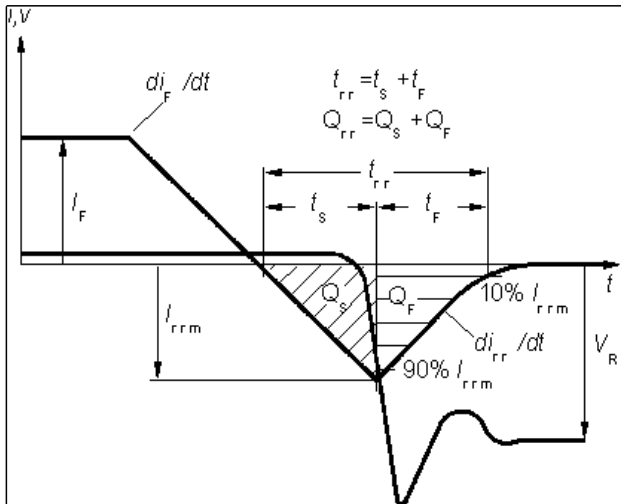


19 Typ. C_{OSS} stored energy

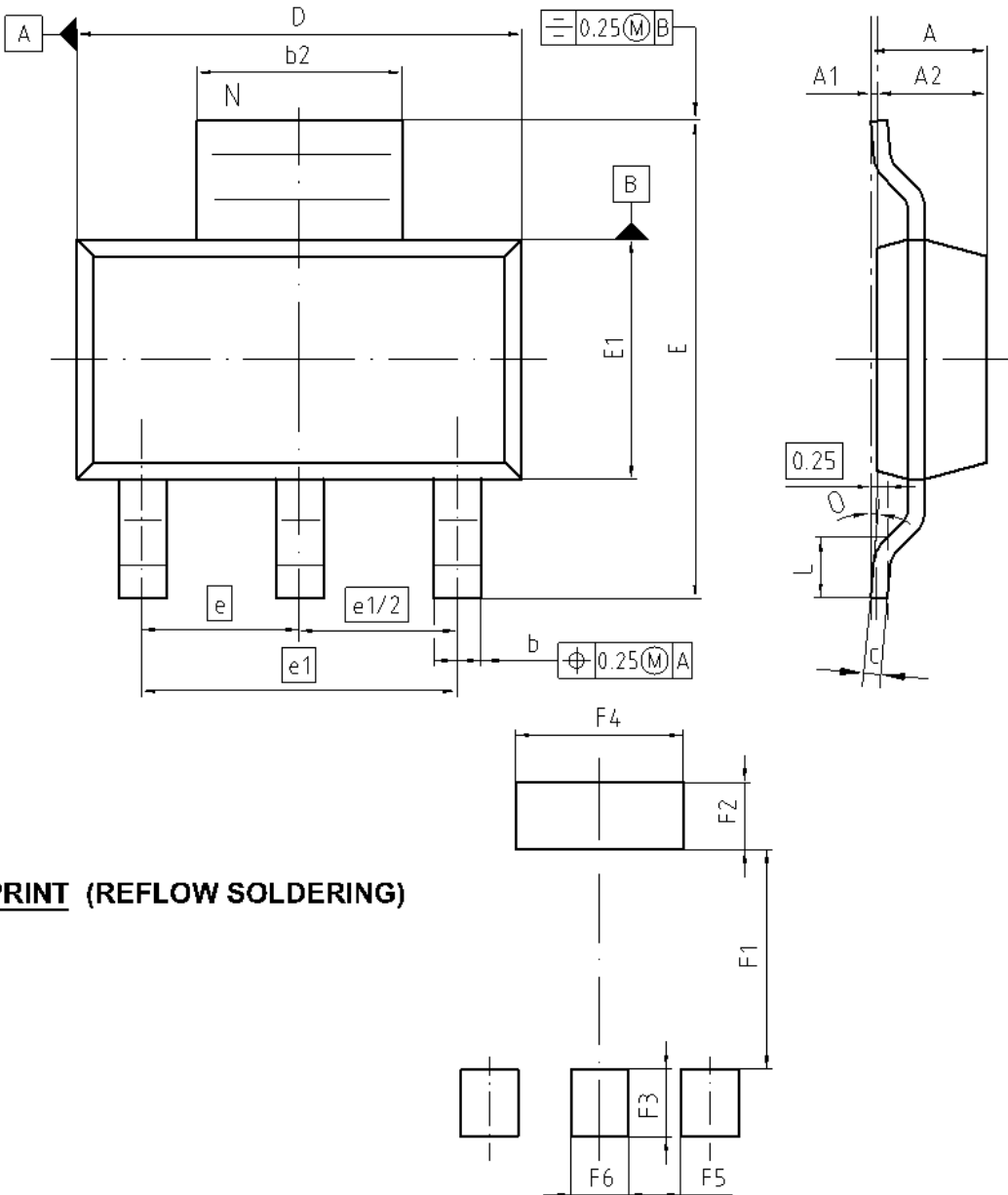
$$E_{OSS} = f(V_{DS})$$



Definition of diodes switching characteristics



SOT-223



FOOTPRINT (REFLOW SOLDERING)

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	1.6	1.8	0.063	0.071
A1	-	0.1	-	0.004
A2	1.5	1.7	0.059	0.067
b	0.6	0.8	0.024	0.031
b2	2.9	3.1	0.114	0.122
c	0.24	0.32	0.009	0.013
D	6.3	6.7	0.248	0.264
E	6.7	7.3	0.264	0.287
E1	3.3	3.7	0.123	0.146
e	2.3 BASIC		0.091 BASIC	
e1	4.6 BASIC		0.181 BASIC	
L	0.75	-	0.023	-
N	4		4	
O	0°	10°	0°	10°
F1	1.8 BASIC		0.189 BASIC	
F2	1.4 BASIC		0.055 BASIC	
F3	1.4 BASIC		0.055 BASIC	
F4	3.5 BASIC		0.138 BASIC	
F5	1.1 BASIC		0.043 BASIC	
F6	1.2 BASIC		0.047 BASIC	

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SCALE

EUROPEAN PROJECTION

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FILE
SOT223

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