



**THE DATASHEET OF
SPN02N60C3 E6433**

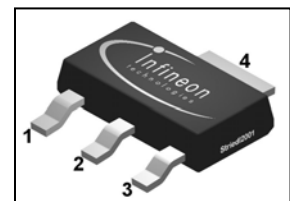


CoolMOS™ Power Transistor
Features

- New revolutionary high voltage technology
- Ultra low gate charge
- Ultra low effective capacitances
- Extreme dv/dt rated
- Qualified according to JEDEC⁰⁾ for target applications

Product Summary

$V_{DS} @ T_{j,max}$	650	V
$R_{DS(on),max}$	2.5	Ω
I_D	0.4	A

SOT223


Type	Package	Ordering Code	Marking
SPN02N60C3	SOT223	Q67040-S4553	02N60C3

drain pins 2, 4



source pin3

Maximum ratings, at $T_j=25\text{ °C}$, unless otherwise specified

Parameter	Symbol	Conditions	Value	Unit
Continuous drain current	I_D	$T_A=25\text{ °C}$	0.4	A
		$T_A=70\text{ °C}$	0.3	
Pulsed drain current ¹⁾	$I_{D,pulse}$	$T_A=25\text{ °C}$	5.4	
Avalanche energy, single pulse	E_{AS}	$I_D=0.9\text{ A}$, $V_{DD}=50\text{ V}$	50	mJ
Avalanche energy, repetitive t_{AR} ^{1),2)}	E_{AR}	$I_D=1.8\text{ A}$, $V_{DD}=50\text{ V}$	0.07	
Avalanche current, repetitive t_{AR} ¹⁾	I_{AR}		1.8	A
Drain source voltage slope	dv/dt	$I_D=1.8\text{ A}$, $V_{DS}=480\text{ V}$, $T_j=125\text{ °C}$	50	V/ns
Gate source voltage	V_{GS}	static	± 20	V
	V_{GS}	AC ($f > 1\text{ Hz}$)	± 30	
Power dissipation	P_{tot}	$T_A=25\text{ °C}$	1.8	W
Operating and storage temperature	T_j , T_{stg}		-55 ... 150	$^{\circ}\text{C}$

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	
Thermal characteristics						
Thermal resistance, junction - soldering point	R_{thJS}		-	30	-	K/W
Thermal resistance, junction - ambient	R_{thJA}	SMD version, device on PCB, minimal footprint	-	110	-	K/W
		SMD version, device on PCB, 6 cm ² cooling area ²⁾	-	70	-	
Soldering temperature	T_{sold}	1.6 mm (0.063 in.) from case for 10 s	-	-	260	°C

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

Drain-source breakdown voltage	$V_{(BR)DSS}$	$V_{GS}=0\text{ V}$, $I_D=250\text{ }\mu\text{A}$	600	-	-	V
Avalanche breakdown voltage	$V_{(BR)DS}$	$V_{GS}=0\text{ V}$, $I_D=0.25\text{ A}$	-	700	-	
Gate threshold voltage	$V_{GS(th)}$	$V_{DS}=V_{GS}$, $I_D=0.08\text{ mA}$	2.1	3	3.9	
Zero gate voltage drain current	I_{DSS}	$V_{DS}=600\text{ V}$, $V_{GS}=0\text{ V}$, $T_j=25\text{ °C}$	-	0.5	1	μA
		$V_{DS}=600\text{ V}$, $V_{GS}=0\text{ V}$, $T_j=150\text{ °C}$	-	-	50	
Gate-source leakage current	I_{GSS}	$V_{GS}=20\text{ V}$, $V_{DS}=0\text{ V}$	-	-	100	nA
Drain-source on-state resistance	$R_{DS(on)}$	$V_{GS}=10\text{ V}$, $I_D=1.1\text{ A}$, $T_j=25\text{ °C}$	-	2.0	2.5	Ω
		$V_{GS}=10\text{ V}$, $I_D=1.1\text{ A}$, $T_j=150\text{ °C}$	-	5.2	-	
Gate resistance	R_G	$f=1\text{ MHz}$, open drain	-	9	-	
Transconductance	g_{fs}	$ V_{DS} >2 I_D R_{DS(on)max}$, $I_D=1.1\text{ A}$	-	1.75	-	S

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	

Dynamic characteristics

Input capacitance	C_{iss}	$V_{GS}=0\text{ V}, V_{DS}=25\text{ V},$ $f=1\text{ MHz}$	-	200	-	pF
Output capacitance	C_{oss}		-	90	-	
Reverse transfer capacitance	C_{rss}		-	4	-	
Effective output capacitance, energy related ³⁾	$C_{o(er)}$	$V_{GS}=0\text{ V}, V_{DS}=0\text{ V}$ to 480 V	-	8	-	
Effective output capacitance, time related ⁴⁾	$C_{o(tr)}$		-	16	-	
Turn-on delay time	$t_{d(on)}$	$V_{DD}=350\text{ V},$ $V_{GS}=10\text{ V}, I_D=1.8\text{ A},$ $R_G=25\ \Omega$	-	6	-	ns
Rise time	t_r		-	3	-	
Turn-off delay time	$t_{d(off)}$		-	68	-	
Fall time	t_f		-	12	30	

Gate Charge Characteristics

Gate to source charge	Q_{gs}	$V_{DD}=420\text{ V}, I_D=1.8\text{ A},$ $V_{GS}=0\text{ to }10\text{ V}$	-	1.6	-	nC
Gate to drain charge	Q_{gd}		-	4	-	
Gate charge total	Q_g		-	10	13	
Gate plateau voltage	$V_{plateau}$		-	5.5	-	V

¹⁾ Pulse width limited by maximum temperature $T_{j,max}$ only

²⁾ Device on 40 mm x 40 mm x 1.5 mm epoxy PCB FR4 with 6 cm² (one layer, 70 μm thick) copper area for drain connection. PCB is vertical in still air.

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

⁴⁾ $C_{o(tr)}$ is a fixed capacitance that gives the same charging time as C_{oss} while V_{DS} is rising from 0 to 80% V_{DSS} .

⁰⁾ J-STD20 and JESD22

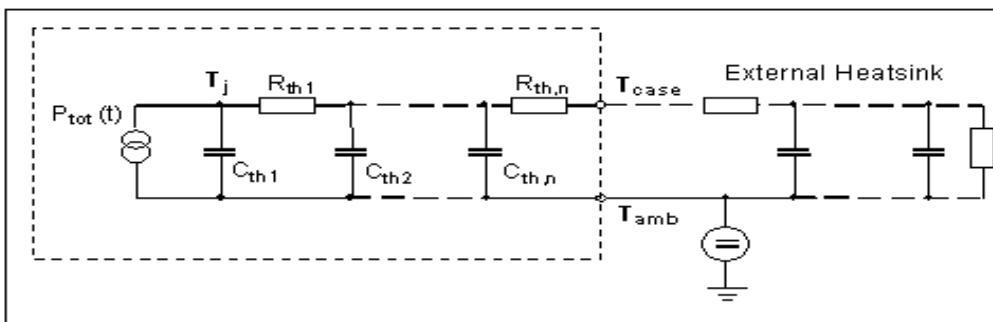
Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	

Reverse Diode

Diode continuous forward current	I_S	$T_C=25\text{ }^\circ\text{C}$	-	-	0.4	A
Diode pulse current	$I_{S,pulse}$		-	-	5.4	
Diode forward voltage	V_{SD}	$V_{GS}=0\text{ V}, I_F=0.4\text{ A}, T_J=25\text{ }^\circ\text{C}$	-	0.82	1.05	V
Reverse recovery time	t_{rr}	$V_R=420\text{ V}, I_F=I_S, di_F/dt=100\text{ A}/\mu\text{s}$	-	200	350	ns
Reverse recovery charge	Q_{rr}		-	1.3	-	μC
Peak reverse recovery current	I_{rrm}		-	9	-	A
Peak rate of fall of reverse recovery current	di_{rr}/dt		$T_J=25\text{ }^\circ\text{C}$	-	200	-

Typical Transient Thermal Characteristics

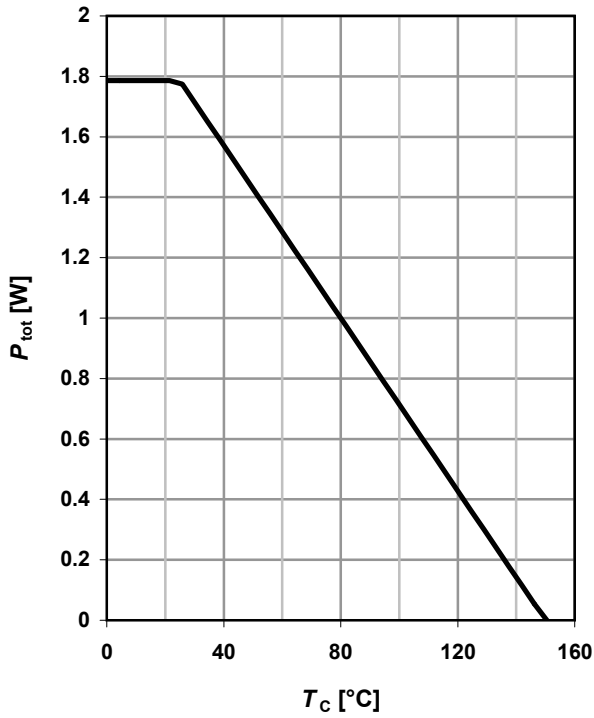
Symbol	Value	Unit	Symbol	Value	Unit
	typ.			typ.	
R_{th1}	0.113	K/W	C_{th1}	0.0000144	Ws/K
R_{th2}	0.156		C_{th2}	0.000087	
R_{th3}	0.875		C_{th3}	0.000123	
R_{th4}	3.63		C_{th4}	0.0005	
R_{th5}	8.29		C_{th5}	0.012	
			C_{th6}	$0.05^{5)}$	



⁵⁾ C_{th6} models the additional heat capacitance of the package in case of non-ideal cooling. It is not needed if $R_{thCA}=0\text{ K/W}$.

1 Power dissipation

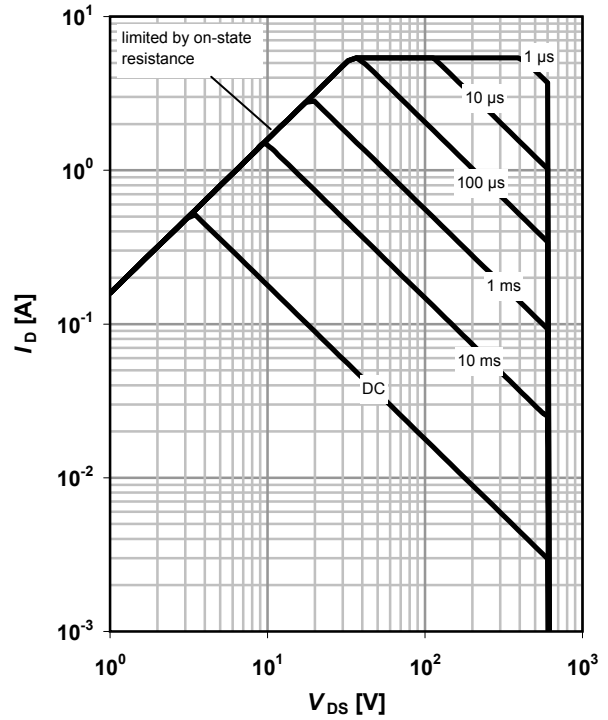
$P_{tot}=f(T_C)$



2 Safe operating area

$I_D=f(V_{DS}); T_C=25\text{ °C}; D=0$

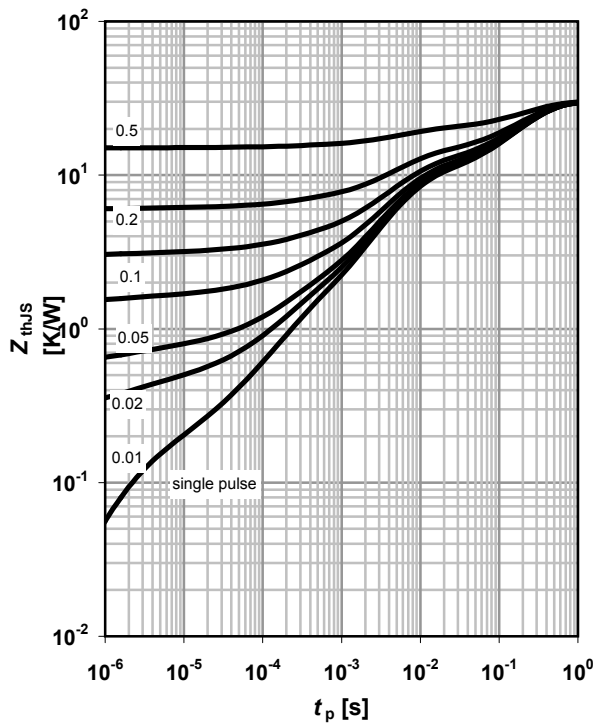
parameter: t_p



3 Max. transient thermal impedance

$I_D=f(V_{DS}); T_j=25\text{ °C}$

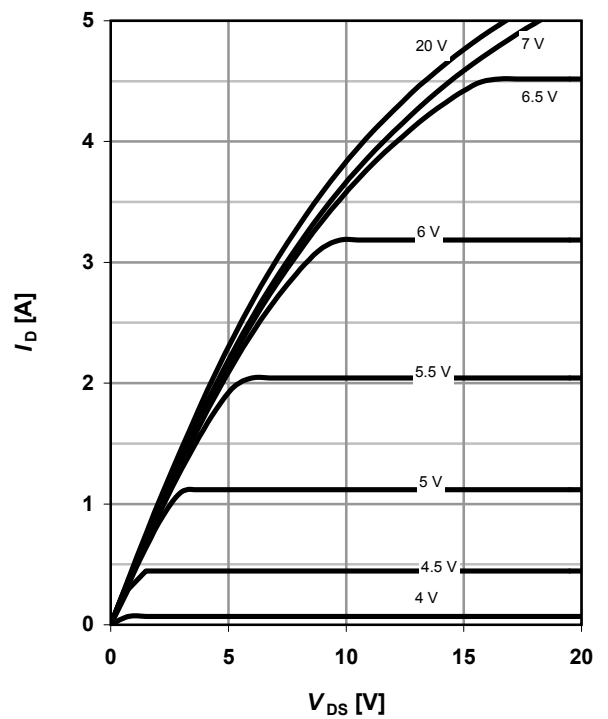
parameter: $D=t_p/T$



4 Typ. output characteristics

$I_D=f(V_{DS}); T_j=25\text{ °C}$

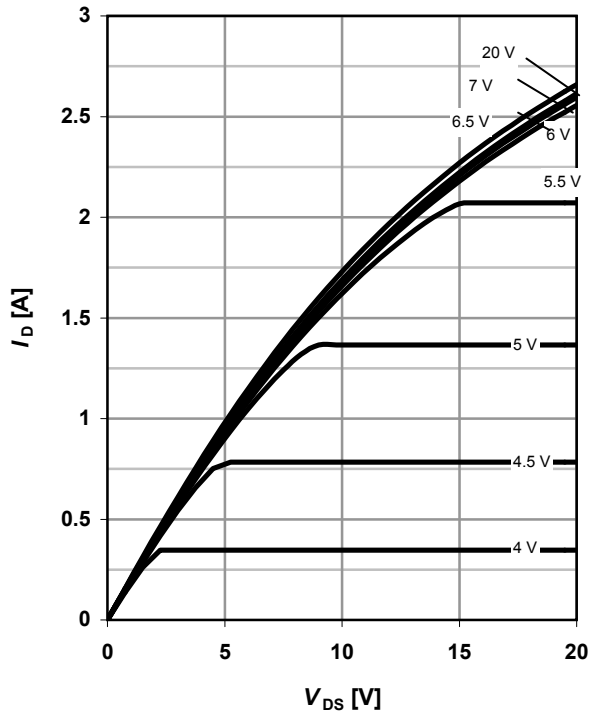
parameter: V_{GS}



5 Typ. output characteristics

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

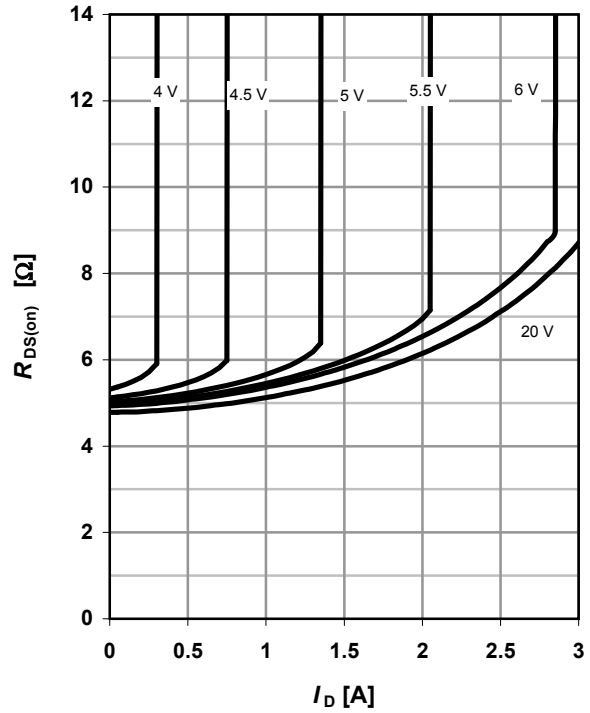
parameter: V_{GS}



6 Typ. drain-source on-state resistance

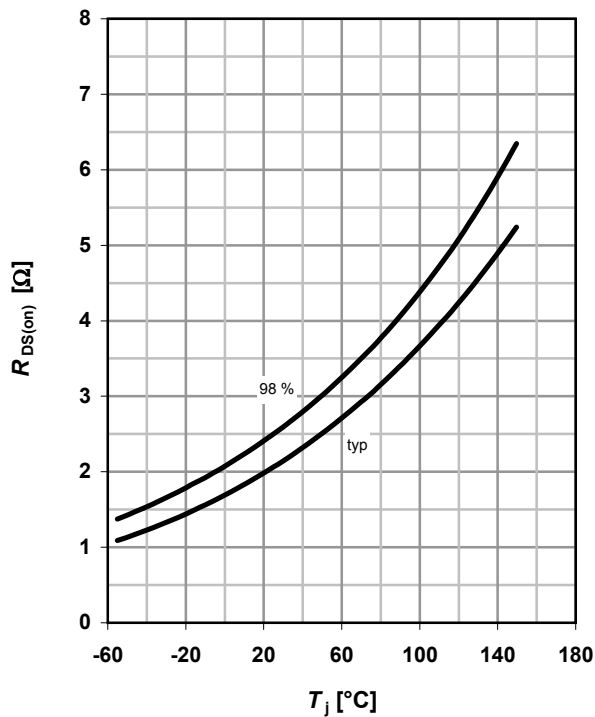
$R_{DS(on)} = f(I_D); T_j = 150\text{ }^\circ\text{C}$

parameter: V_{GS}



7 Drain-source on-state resistance

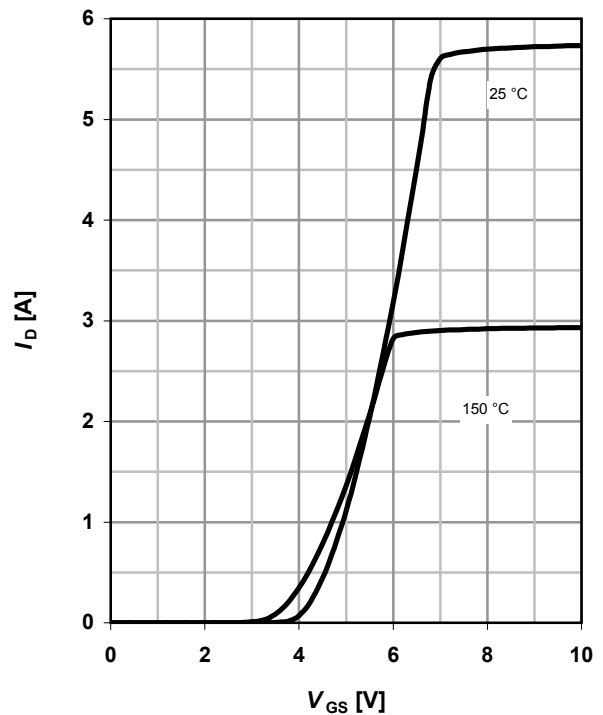
$R_{DS(on)} = f(T_j); I_D = 1.1\text{ A}; V_{GS} = 10\text{ V}$



8 Typ. transfer characteristics

$I_D = f(V_{GS}); |V_{DS}| > 2|I_D|R_{DS(on)max}$

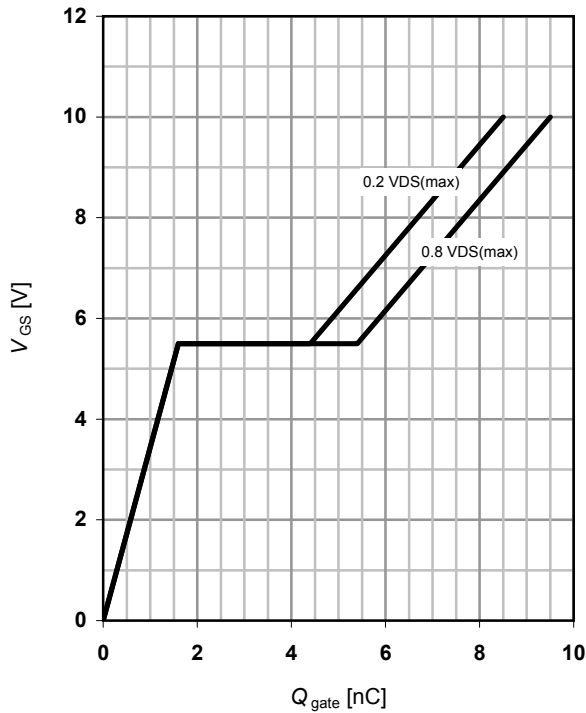
parameter: T_j



9 Typ. gate charge

$V_{GS}=f(Q_{gate}); I_D=1.8\text{ A pulsed}$

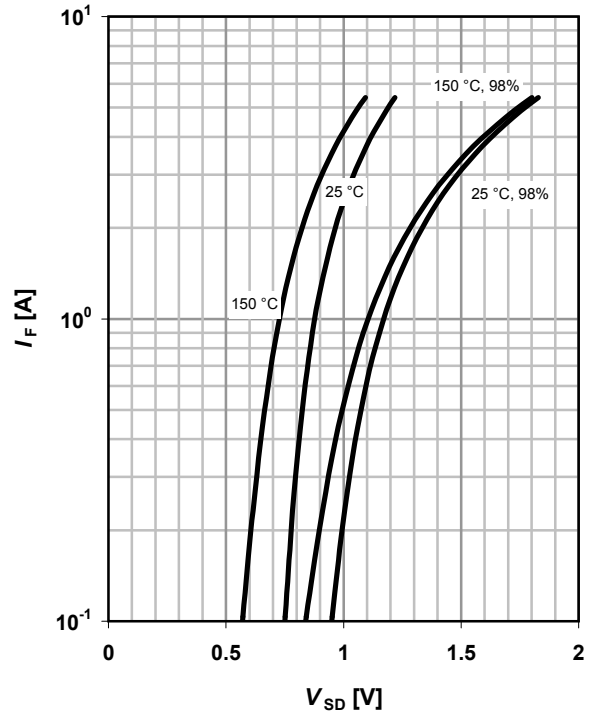
parameter: V_{DD}



10 Forward characteristics of reverse diode

$I_F=f(V_{SD})$

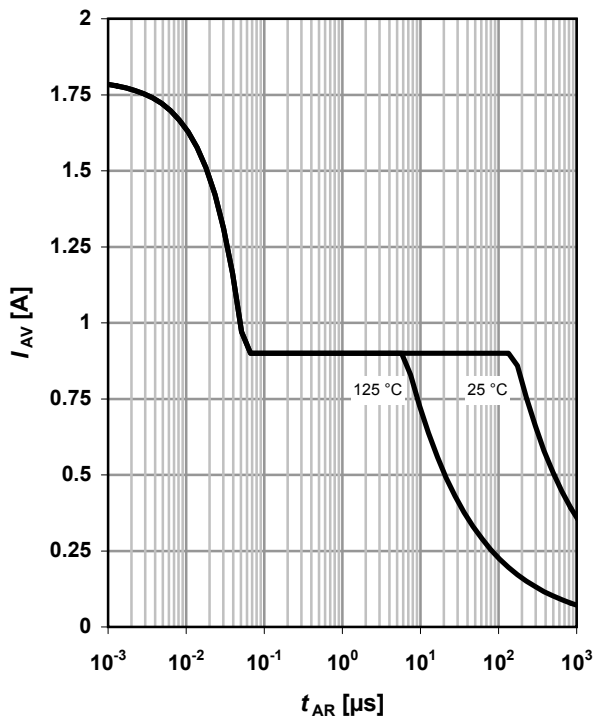
parameter: T_j



11 Avalanche SOA

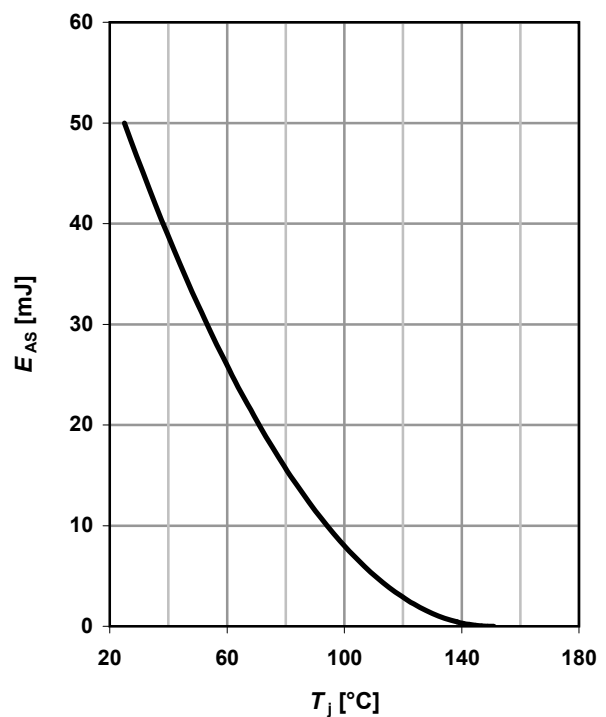
$I_{AR}=f(t_{AR})$

parameter: $T_{j(start)}$



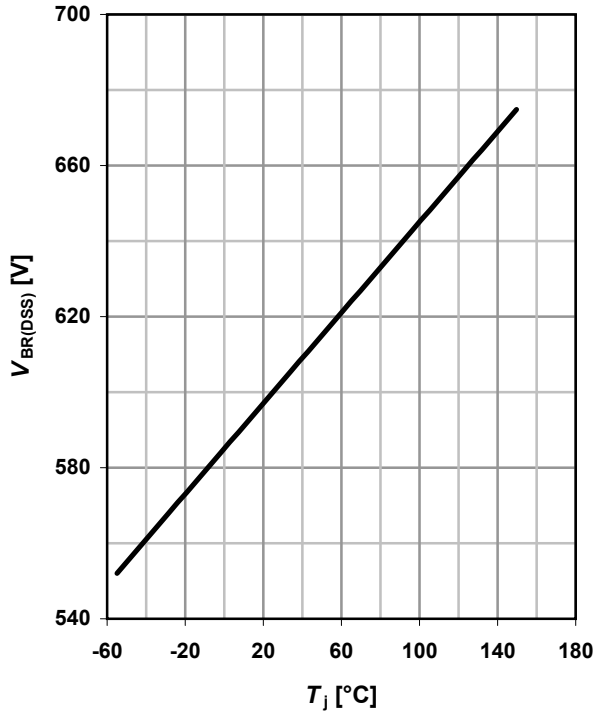
12 Avalanche energy

$E_{AS}=f(T_j); I_D=0.9\text{ A}; V_{DD}=50\text{ V}$



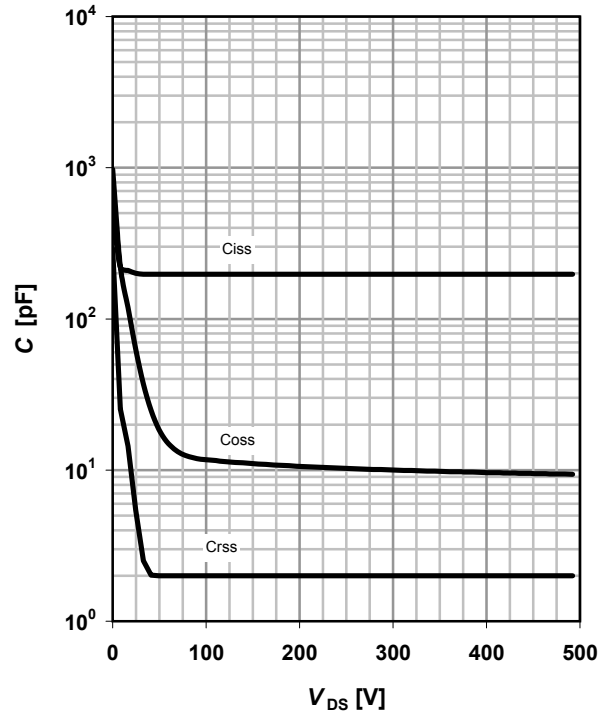
13 Drain-source breakdown voltage

$$V_{BR(DSS)} = f(T_j); I_D = 0.25 \text{ mA}$$



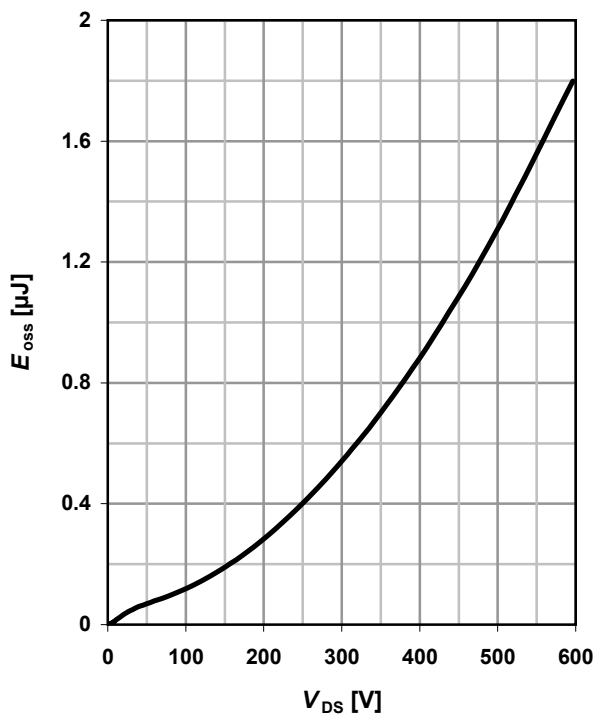
14 Typ. capacitances

$$C = f(V_{DS}); V_{GS} = 0 \text{ V}; f = 1 \text{ MHz}$$

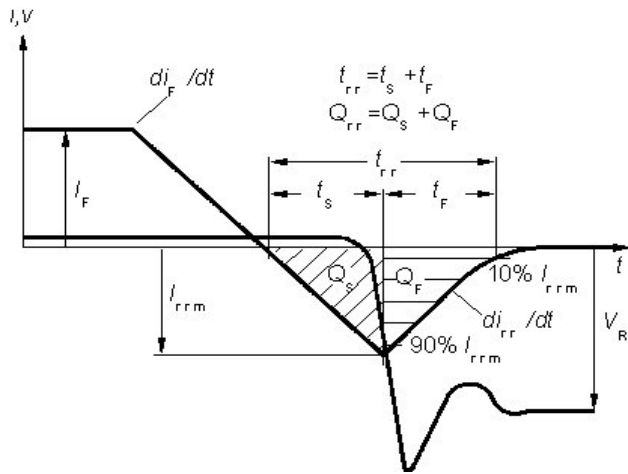


15 Typ. C_{oss} stored energy

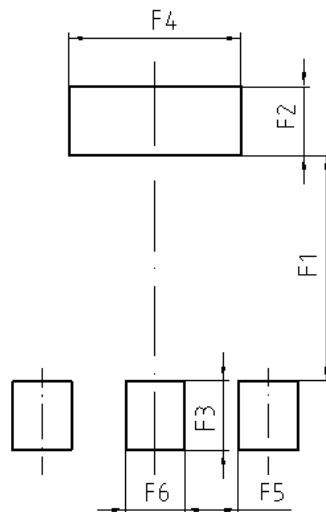
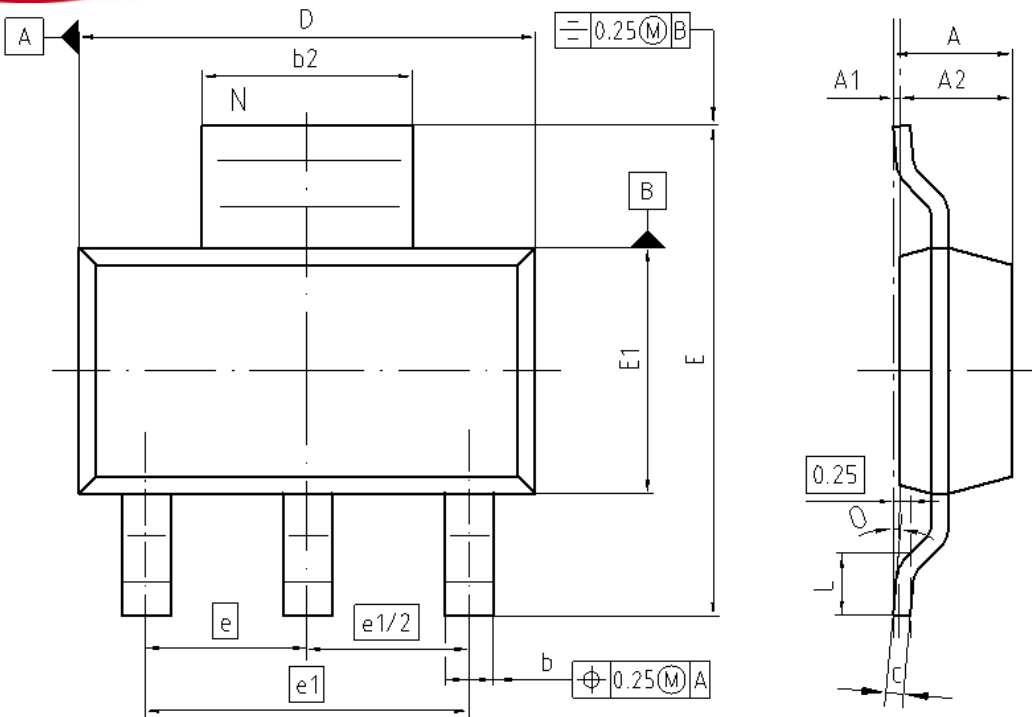
$$E_{oss} = f(V_{DS})$$



Definition of diode 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

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