CoolMOS™ Power Transistor

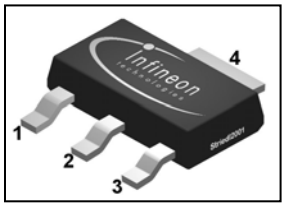
Features

- New revolutionary high voltage technology
- Ultra low gate charge
- Ultra low effective capacitances
- Extreme d*v*/d*t* rated
- Qualified according to JEDEC[0)] for target applications

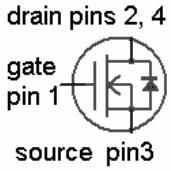
Product Summary

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



Maximum ratings, at T_j=25 °C, unless otherwise specified

Parameter	Symbol	Conditions	Value	Unit
Continuous drain current	I_D	T_A=25 °C	0.4	A
		T_A=70 °C	0.3	
Pulsed drain current[1)]	$I_{D,pulse}$	T_A=25 °C	5.4	
Avalanche energy, single pulse	E_{AS}	I_D=0.9 A, V_{DD}=50 V	50	mJ
Avalanche energy, repetitive t_{AR}[1),2)]	E_{AR}	I_D=1.8 A, V_{DD}=50 V	0.07	
Avalanche current, repetitive t_{AR}[1)]	I_{AR}		1.8	A
Drain source voltage slope	d*v*/d*t*	I_D=1.8 A, V_{DS}=480 V, T_j=125 °C	50	V/ns
Gate source voltage	V_{GS}	static	±20	V
	V_{GS}	AC (*f*>1 Hz)	±30	
Power dissipation	P_{tot}	T_A=25 °C	1.8	W
Operating and storage temperature	T_j, T_{stg}		-55 ... 150	°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	-	
		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 °C, unless otherwise specified						
Static characteristics						
Drain-source breakdown voltage	$V_{(BR)DSS}$	V_{GS}=0 V, I_D=250 µA	600	-	-	V
Avalanche breakdown voltage	$V_{(BR)DS}$	V_{GS}=0 V, I_D=0.25 A	-	700	-	
Gate threshold voltage	$V_{GS(th)}$	V_{DS}=V_{GS}, I_D=0.08 mA	2.1	3	3.9	
Zero gate voltage drain current	I_{DSS}	V_{DS}=600 V, V_{GS}=0 V, T_j=25 °C	-	0.5	1	µA
		V_{DS}=600 V, V_{GS}=0 V, T_j=150 °C	-	-	50	
Gate-source leakage current	I_{GSS}	V_{GS}=20 V, V_{DS}=0 V	-	-	100	nA
Drain-source on-state resistance	$R_{DS(on)}$	V_{GS}=10 V, I_D=1.1 A, T_j=25 °C	-	2.0	2.5	Ω
		V_{GS}=10 V, I_D=1.1 A, T_j=150 °C	-	5.2	-	
Gate resistance	R_G	f=1 MHz, open drain	-	9	-	
Transconductance	g_{fs}	$\|V_{DS}\|>2\|I_D\|R_{DS(on)max}$, I_D=1.1 A	-	1.75	-	S

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	
Dynamic characteristics						
Input capacitance	C_{iss}	V_{GS}=0 V, V_{DS}=25 V, f=1 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 V, V_{DS}=0 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 V, V_{GS}=10 V, I_D=1.8 A, R_G=25 Ω	-	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 V, I_D=1.8 A, V_{GS}=0 to 10 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 cm^2 (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}.

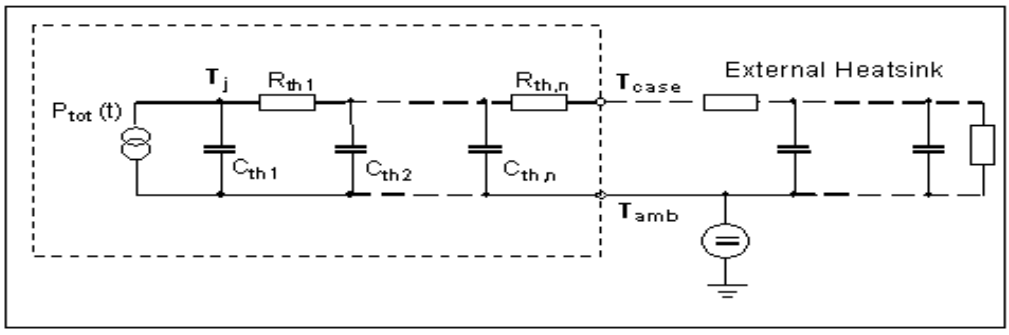
[4)] $C_{o(tr)}$ is a fixed capacitance that gives the same charging time as C_{oss} while V_{DS} is rising from 0 to 80% V_{DSS}.

[0)] J-STD20 and JESD22

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	
Reverse Diode						
Diode continuous forward current	I_S	T_C=25 °C	-	-	0.4	A
Diode pulse current	$I_{S,pulse}$		-	-	5.4	
Diode forward voltage	V_{SD}	V_{GS}=0 V, I_F=0.4 A, T_j=25 °C	-	0.82	1.05	V
Reverse recovery time	t_{rr}	V_R=420 V, I_F=I_S, di_F/dt=100 A/µs	-	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 °C	-	200	-	A/µs

Typical Transient Thermal Characteristics

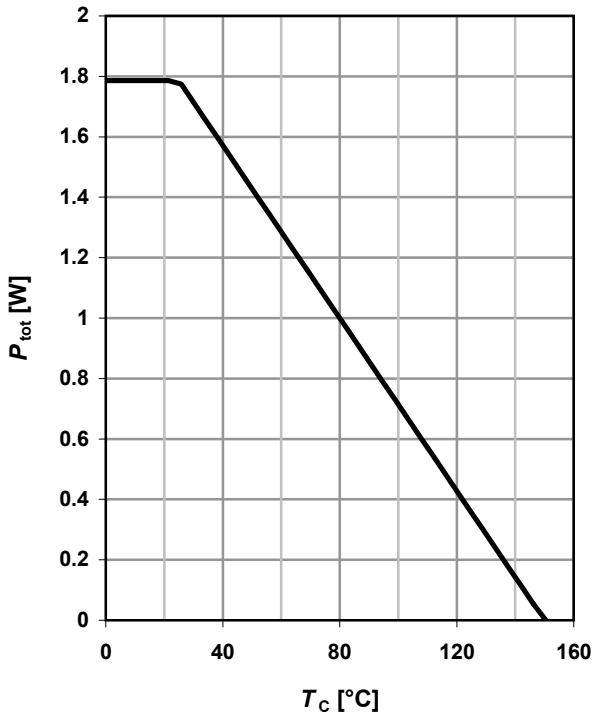
Symbol	Value	Unit	Symbol	Value	Unit
	typ.			typ.	
R_{th1}	0.113	K/W	C_{th1}	0.0000144	Ws/K
R_{th2}	0.156		C_{th2}	0.000087	
R_{th3}	0.875		C_{th3}	0.000123	
R_{th4}	3.63		C_{th4}	0.0005	
R_{th5}	8.29		C_{th5}	0.012	
			C_{th6}	0.05[5)]	



[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 K/W.

1 Power dissipation

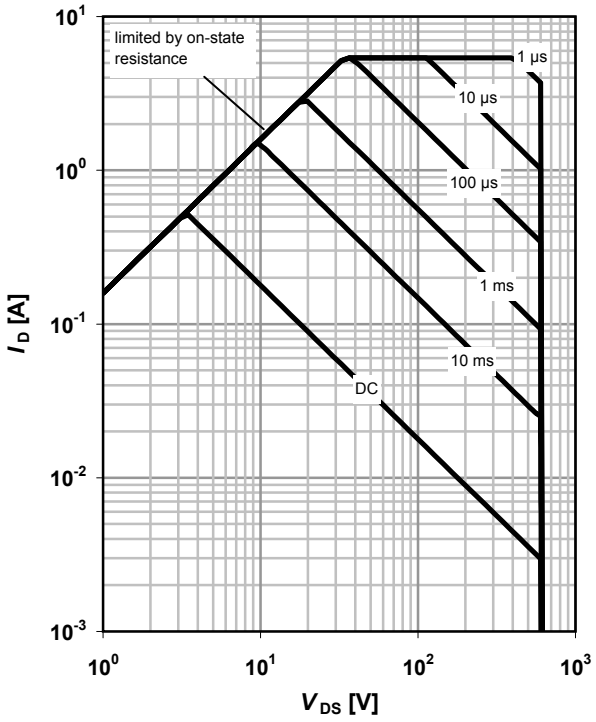
$P_{tot}=f(T_C)$



2 Safe operating area

$I_D=f(V_{DS})$; $T_C=25$ °C; $D=0$

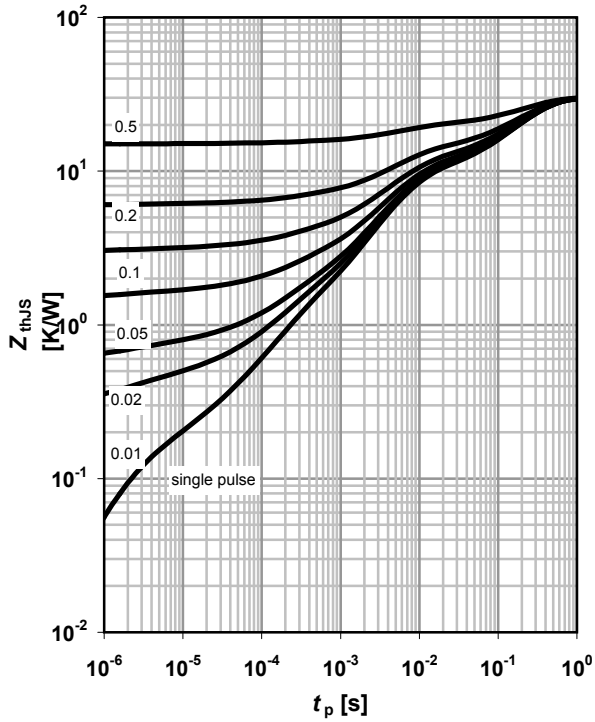
parameter: t_p



3 Max. transient thermal impedance

$I_D=f(V_{DS})$; $T_j=25$ °C

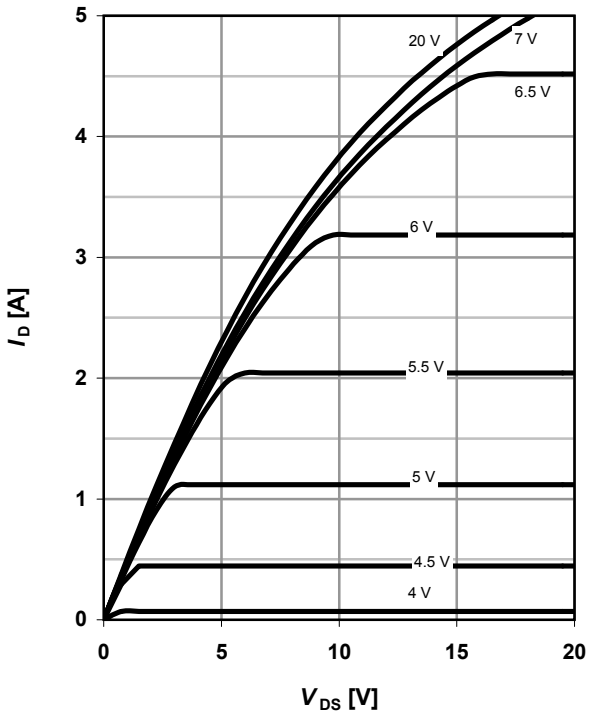
parameter: $D=t_p/T$



4 Typ. output characteristics

$I_D=f(V_{DS})$; $T_j=25$ °C

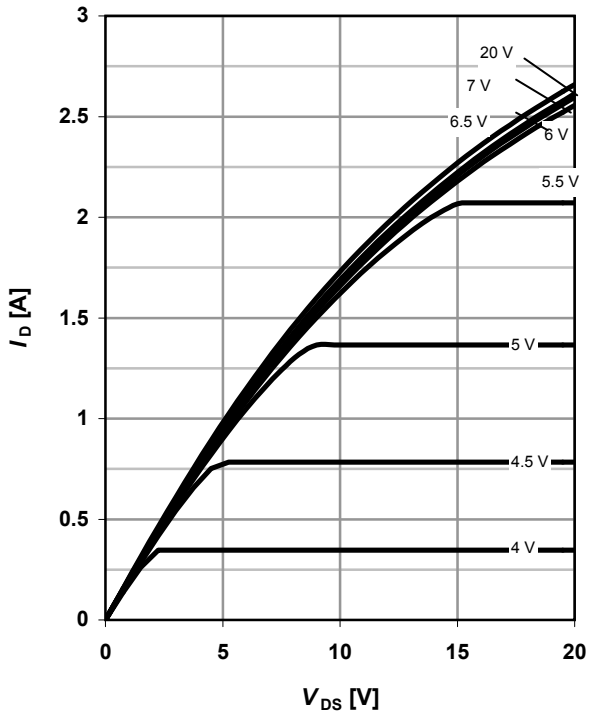
parameter: V_{GS}



5 Typ. output characteristics

I_D=f(V_{DS}); T_j=150 °C

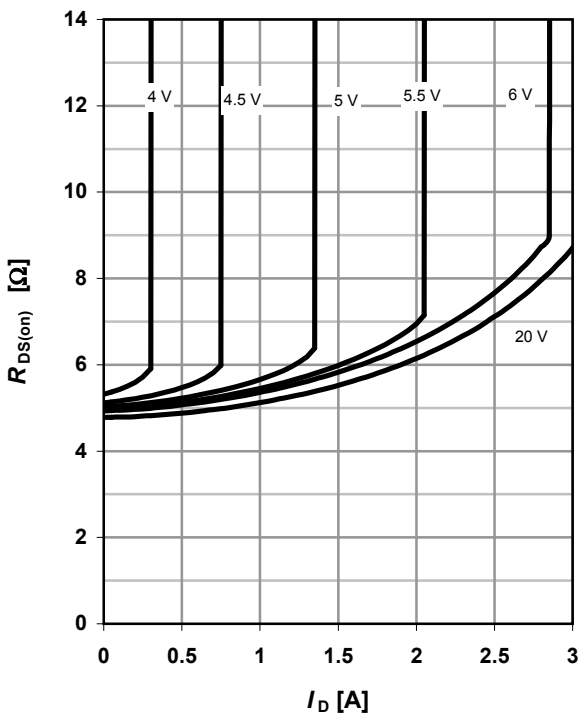
parameter: V_{GS}



6 Typ. drain-source on-state resistance

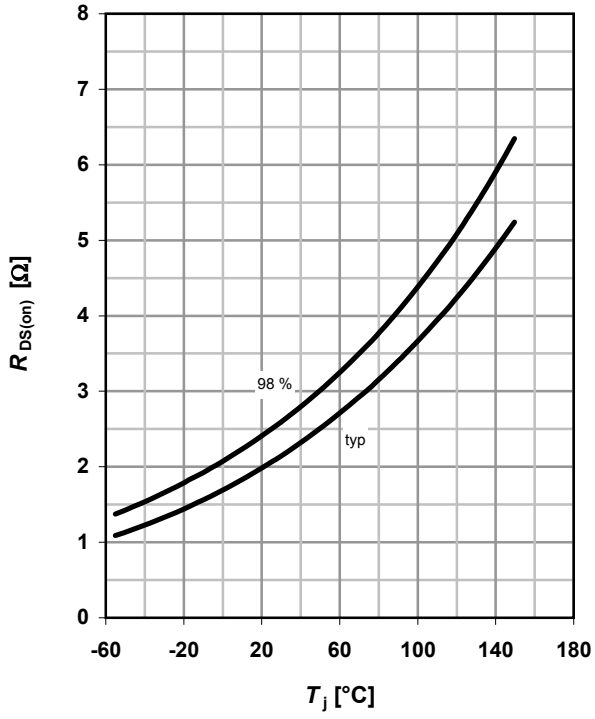
$R_{DS(on)}$=f(I_D); T_j=150 °C

parameter: V_{GS}



7 Drain-source on-state resistance

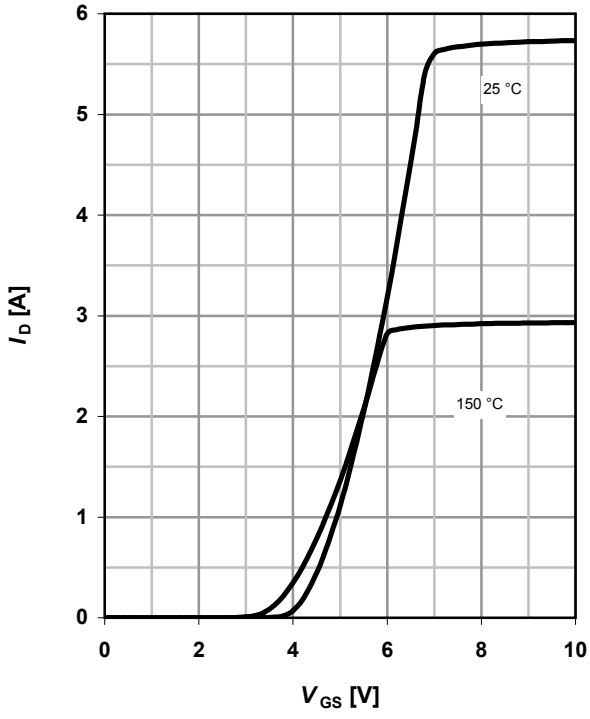
$R_{DS(on)}$=f(T_j); I_D=1.1 A; V_{GS}=10 V



8 Typ. transfer characteristics

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

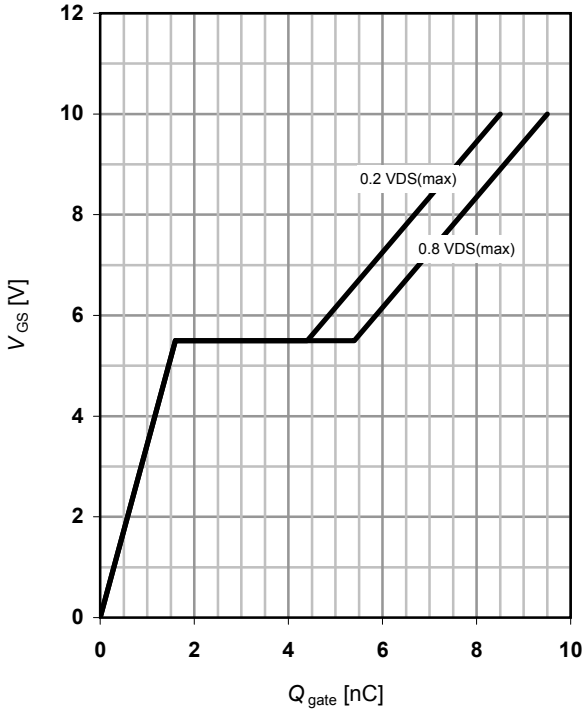
parameter: T_j



9 Typ. gate charge

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

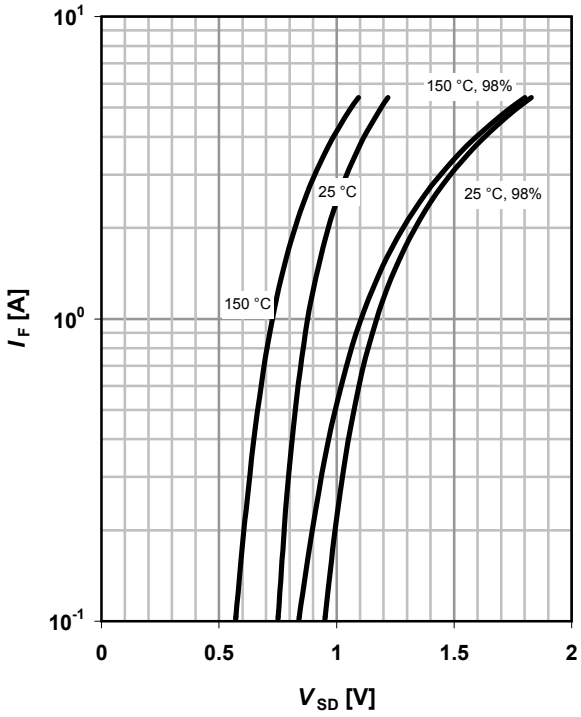
parameter: V_{DD}



10 Forward characteristics of reverse diode

I_F=f(V_{SD})

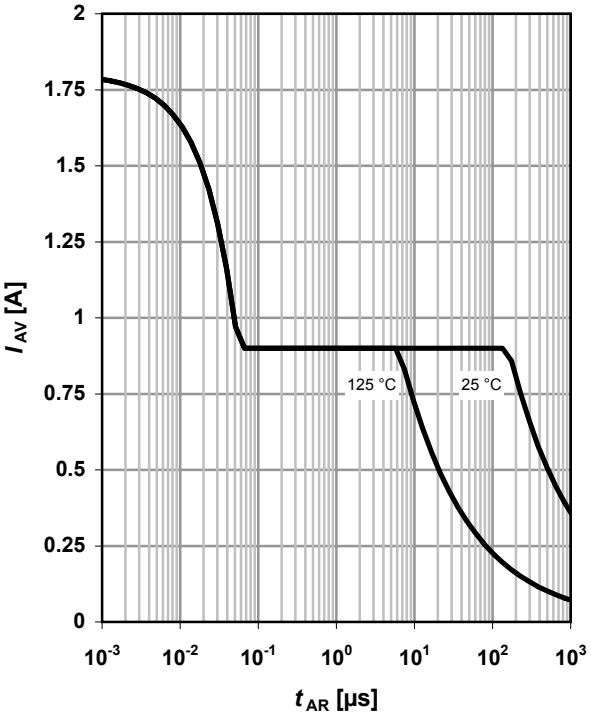
parameter: T_j



11 Avalanche SOA

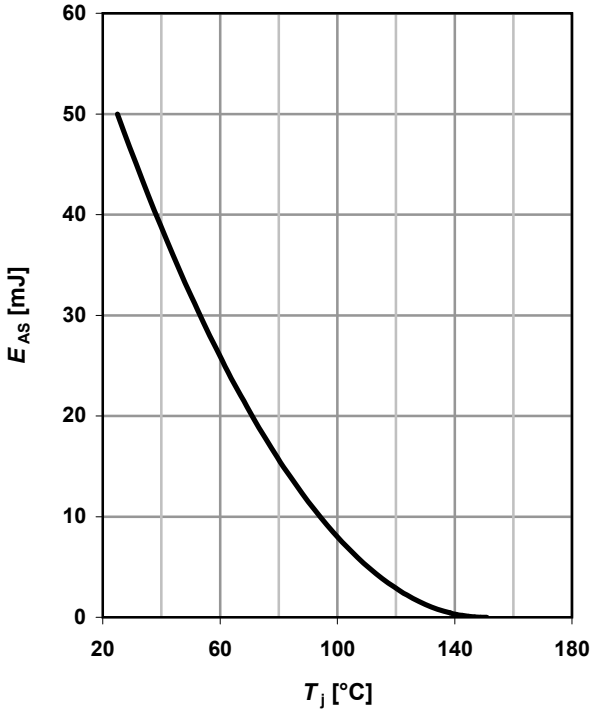
I_{AR}=f(t_{AR})

parameter: $T_{j(start)}$



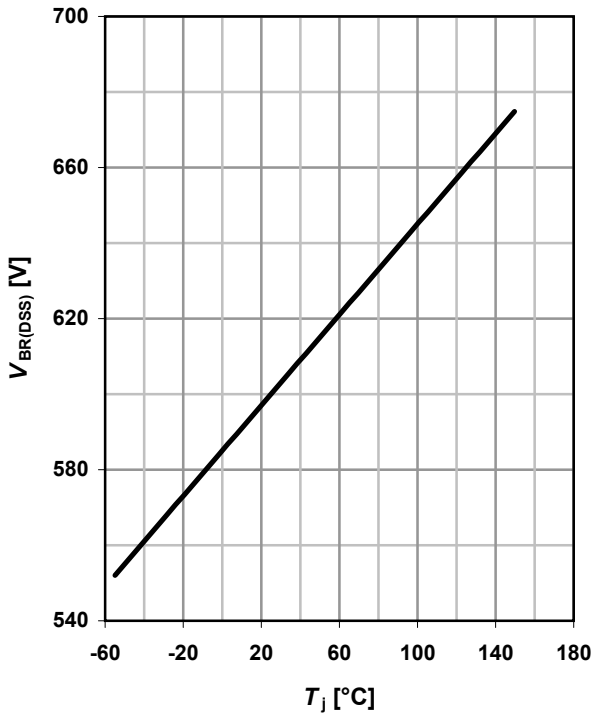
12 Avalanche energy

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



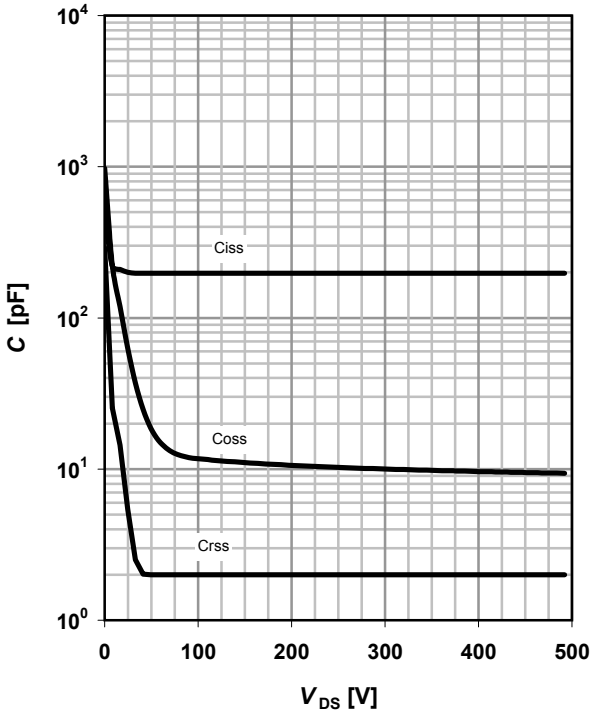
13 Drain-source breakdown voltage

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



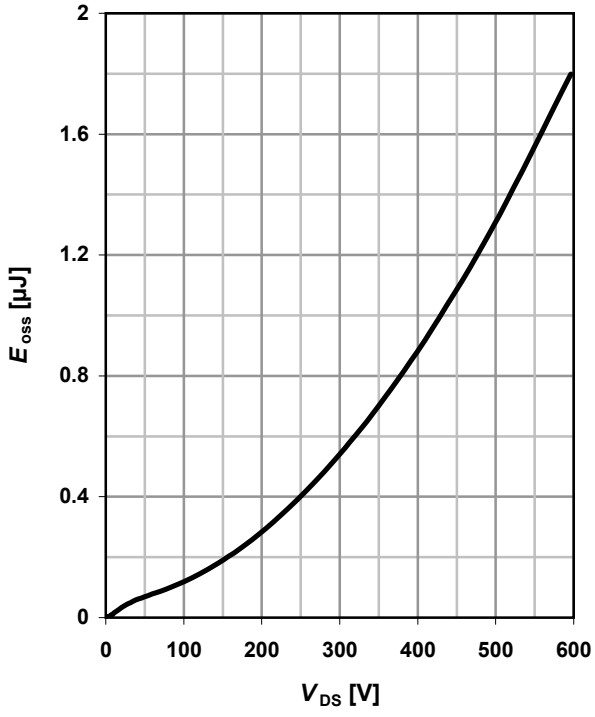
14 Typ. capacitances

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

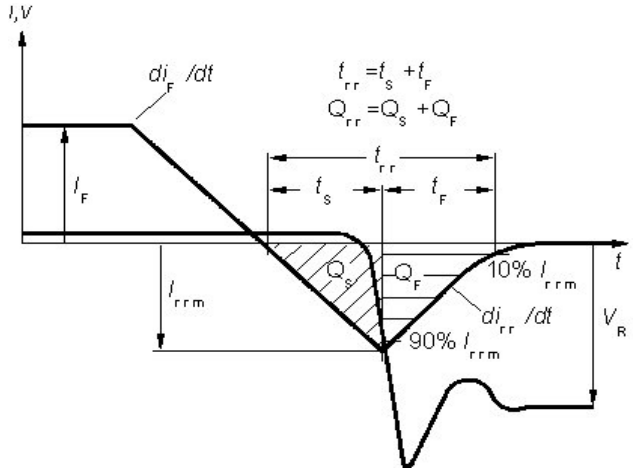


15 Typ. C_{oss} stored energy

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



Definition of diode switching characteristics



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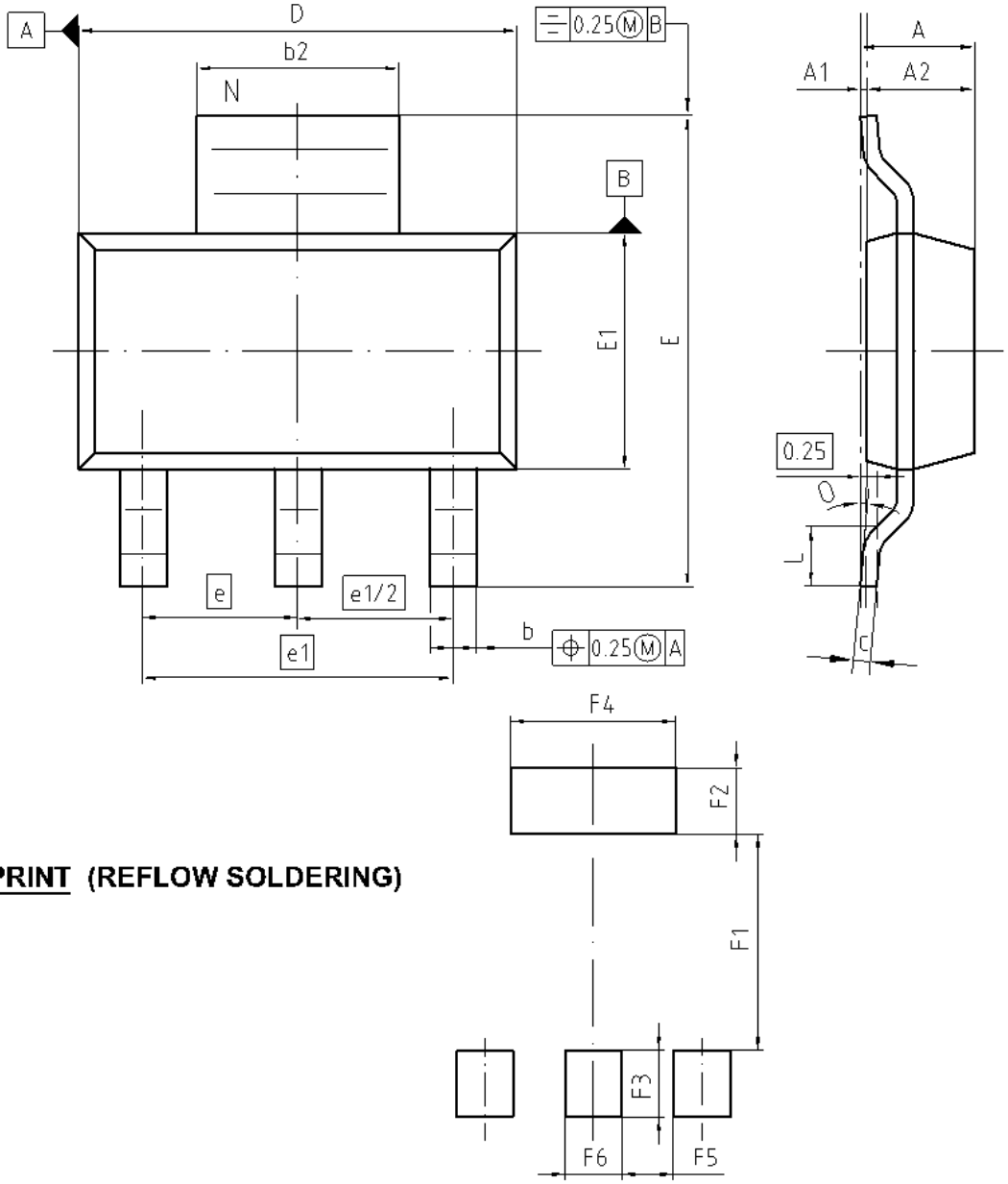
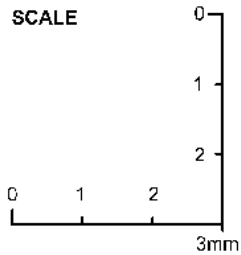


FOOTPRINT (REFLOW SOLDERING)

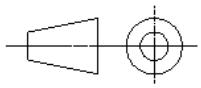
DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	1.6	1.8	0.063	0.071
A1	-	0.1	-	0.004
A2	1.5	1.7	0.059	0.067
b	0.6	0.8	0.024	0.031
b2	2.9	3.1	0.114	0.122
c	0.24	0.32	0.009	0.013
D	6.3	6.7	0.248	0.264
E	6.7	7.3	0.264	0.287
E1	3.3	3.7	0.123	0.146
e	2.3 BASIC		0.091 BASIC	
e1	4.6 BASIC		0.181 BASIC	
L	0.75	-	0.023	-
N	4		4	
θ	0°	10°	0°	10°
F1	4.8 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	

REFERENCE
JEDEC TO261 AA

SCALE



EUROPEAN PROJECTION



ISSUE DATE
04-28-2006

FILE
SOT223

Published by
Infineon Technologies AG
81726 Munich, Germany

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