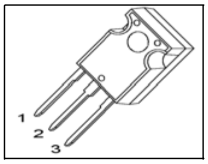
CoolMOS™ Power Transistor

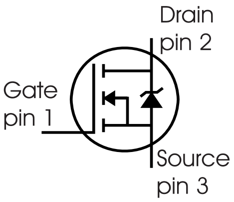
V_{DS} @ T_{jmax}	560	V
$R_{DS(on)}$	0.07	Ω
I_D	52	A

Feature

- New revolutionary high voltage technology
- Worldwide best $R_{DS(on)}$ in TO-247
- Ultra low gate charge
- Periodic avalanche rated
- Extreme d*v*/d*t* rated
- Ultra low effective capacitances
- Improved transconductance
- Pb-free lead plating; RoHS compliant
- Qualified according to JEDEC[0)] for target applications

PG-TO247





Type	Package	Marking
SPW52N50C3	PG-TO247	52N50C3

Maximum Ratings

Parameter	Symbol	Value	Unit
Continuous drain current	I_D		A
T_C = 25 °C		52	
T_C = 100 °C		30	
Pulsed drain current, t_p limited by T_{jmax}	$I_{D\ puls}$	156	
Avalanche energy, single pulse	E_{AS}	1800	mJ
I_D = 10 A, V_{DD} = 50 V			
Avalanche energy, repetitive t_{AR} limited by T_{jmax}[1)]	E_{AR}	1	
I_D = 20 A, V_{DD} = 50 V			
Avalanche current, repetitive t_{AR} limited by T_{jmax}	I_{AR}	20	A
Gate source voltage	V_{GS}	±20	V
Gate source voltage AC (f >1Hz)	V_{GS}	±30	
Power dissipation, T_C = 25°C	P_{tot}	417	W
Operating and storage temperature	T_j , T_{stg}	-55... +150	°C
Reverse diode dv/dt [4)]	*dv*/*dt*	15	V/ns

Please note the new package dimensions arccording to PCN 2009-134-A

Maximum Ratings

Parameter	Symbol	Value	Unit
Drain Source voltage slope V_{DS} = 400 V, I_D = 52 A, T_j = 125 °C	dv/dt	50	V/ns

Thermal Characteristics

Parameter	Symbol	Values			Unit
		min.	typ.	max.	
Thermal resistance, junction - case	R_{thJC}	-	-	0.3	K/W
Thermal resistance, junction - ambient, leaded	R_{thJA}	-	-	62	
Soldering temperature, wavesoldering 1.6 mm (0.063 in.) from case for 10s	T_{sold}	-	-	260	°C

Electrical Characteristics, at Tj=25°C unless otherwise specified

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	
Drain-source breakdown voltage	$V_{(BR)DSS}$	V_{GS}=0V, I_D=0.25mA	500	-	-	V
Drain-Source avalanche breakdown voltage	$V_{(BR)DS}$	V_{GS}=0V, I_D=20A	-	600	-	
Gate threshold voltage	$V_{GS(th)}$	I_D=2700µA, V_{GS}=V_{DS}	2.1	3	3.9	
Zero gate voltage drain current	I_{DSS}	V_{DS}=500V, V_{GS}=0V, T_j=25°C, T_j=150°C	 - -	 0.5 -	 25 250	µA
Gate-source leakage current	I_{GSS}	V_{GS}=20V, V_{DS}=0V	-	-	100	nA
Drain-source on-state resistance	$R_{DS(on)}$	V_{GS}=10V, I_D=30A, T_j=25°C T_j=150°C	 - -	 0.06 0.16	 0.07 -	Ω
Gate input resistance	R_G	f=1MHz, open Drain	-	0.7	-	

Electrical Characteristics , at T_j = 25 °C, unless otherwise specified

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	
Transconductance	g_{fs}	$V_{DS} \geq 2*I_D*R_{DS(on)max}$, I_D=30A	-	40	-	S
Input capacitance	C_{iss}	V_{GS}=0V, V_{DS}=25V, f=1MHz	-	6800	-	pF
Output capacitance	C_{oss}		-	2200	-	
Reverse transfer capacitance	C_{rss}		-	150	-	
Effective output capacitance,[2] energy related	$C_{o(er)}$	V_{GS}=0V, V_{DS}=0V to 400V	-	212	-	pF
Effective output capacitance,[3] time related	$C_{o(tr)}$		-	469	-	
Turn-on delay time	$t_{d(on)}$	V_{DD}=380V, V_{GS}=0/10V, I_D=52A, R_G=1.8Ω	-	20	-	ns
Rise time	t_r		-	30	-	
Turn-off delay time	$t_{d(off)}$		-	120	-	
Fall time	t_f		-	10	-	

Gate Charge Characteristics

Gate to source charge	Q_{gs}	V_{DD}=380V, I_D=52A	-	30	-	nC
Gate to drain charge	Q_{gd}		-	160	-	
Gate charge total	Q_g	V_{DD}=380V, I_D=52A, V_{GS}=0 to 10V	-	290	-	
Gate plateau voltage	$V_{(plateau)}$	V_{DD}=380V, I_D=52A	-	5	-	V

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[0] J-STD20 and JESD22

[1] Repetitve avalanche causes additional power losses that can be calculated as $P_{AV}=E_{AR}*f$.

[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}.

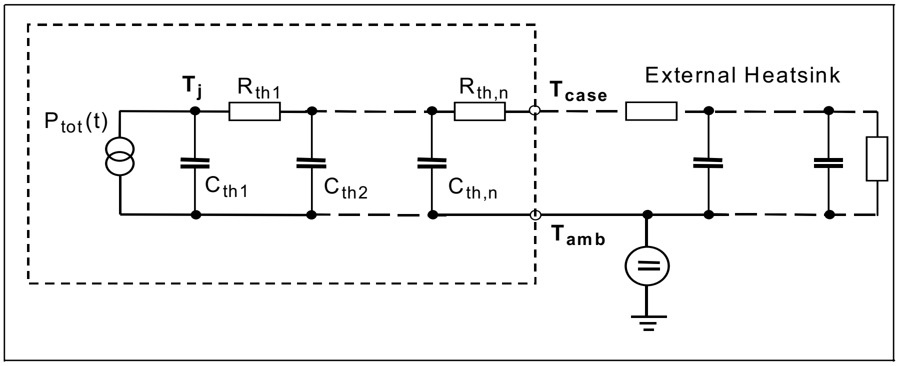
[4] I_{SD}<=I_D, di/dt<=200A/us, V_{DClink}=400V, V_{peak}<$V_{BR, DSS}$, T_j<$T_{j,max}$.
Identical low-side and high-side switch.

Electrical Characteristics, at T_j = 25 °C, unless otherwise specified

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	
Inverse diode continuous forward current	I_S	T_C=25°C	-	-	52	A
Inverse diode direct current, pulsed	I_{SM}		-	-	156	
Inverse diode forward voltage	V_{SD}	V_{GS}=0V, I_F=I_S	-	1	1.2	V
Reverse recovery time	t_{rr}	V_R=380V, I_F=I_S , di_F/dt=100A/µs	-	580	-	ns
Reverse recovery charge	Q_{rr}		-	20	-	µC
Peak reverse recovery current	I_{rrm}		-	70	-	A
Peak rate of fall of reverse recovery current	di_{rr}/dt		-	900	-	A/µs

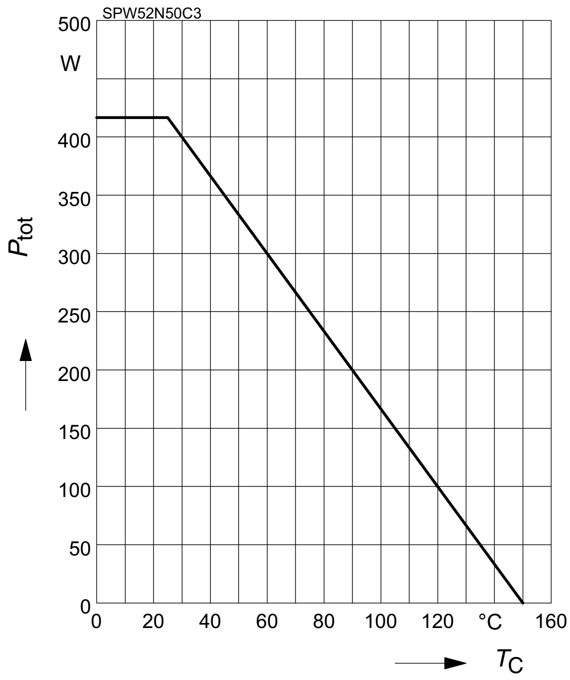
Typical Transient Thermal Characteristics

Symbol	Value	Unit	Symbol	Value	Unit
	typ.			typ.	
Thermal resistance			Thermal capacitance		
R_{th1}	0.002689	K/W	C_{th1}	0.001081	Ws/K
R_{th2}	0.005407		C_{th2}	0.004021	
R_{th3}	0.011		C_{th3}	0.005415	
R_{th4}	0.054		C_{th4}	0.014	
R_{th5}	0.071		C_{th5}	0.025	
R_{th6}	0.036		C_{th6}	0.158	



1 Power dissipation

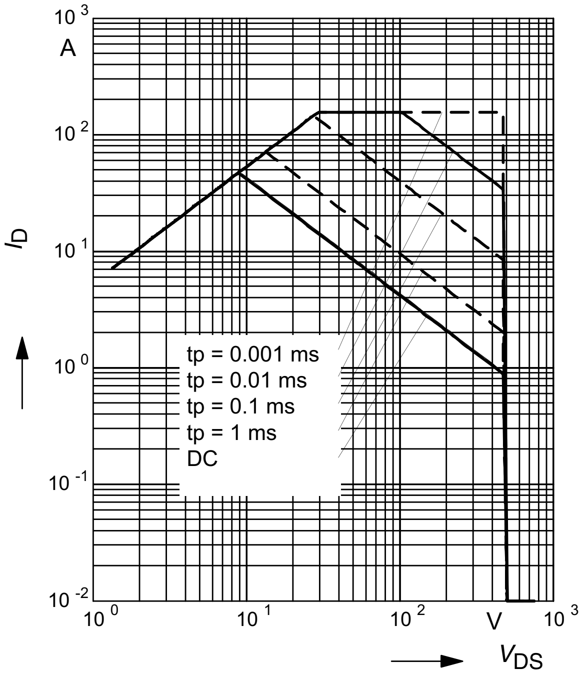
$P_{tot} = f\,(T_C)$



2 Safe operating area

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

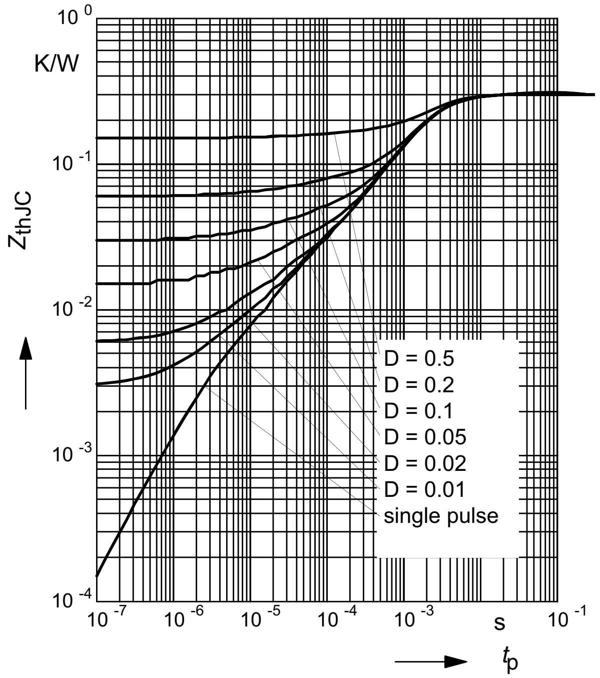
parameter : $D = 0$, T_C=25°C



3 Transient thermal impedance

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

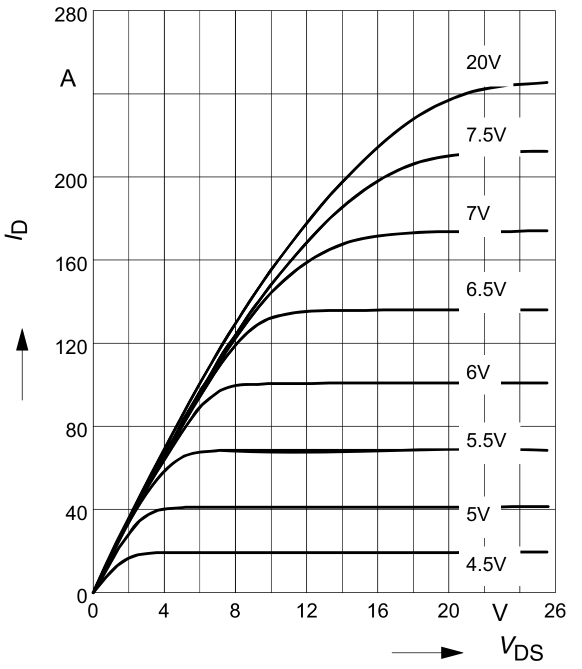
parameter: $D = t_p/T$



4 Typ. output characteristic

$I_D = f\,(V_{DS})$; T_j=25°C

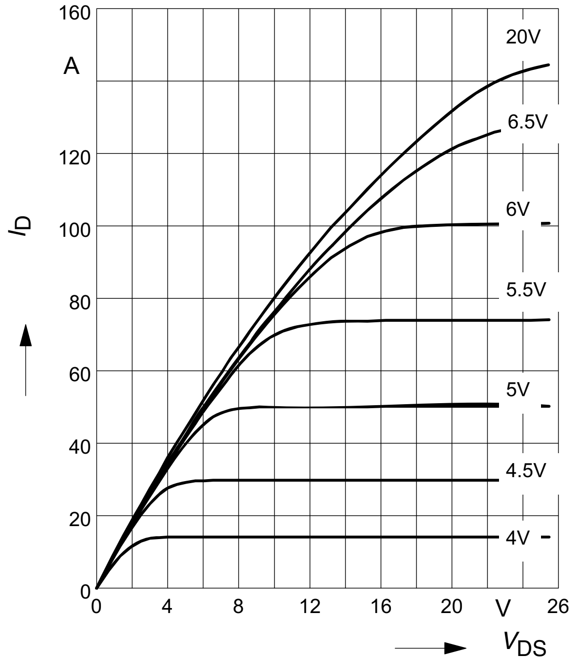
parameter: t_p = 10 µs, V_{GS}



5 Typ. output characteristic

$I_D = f(V_{DS})$; T_j=150°C

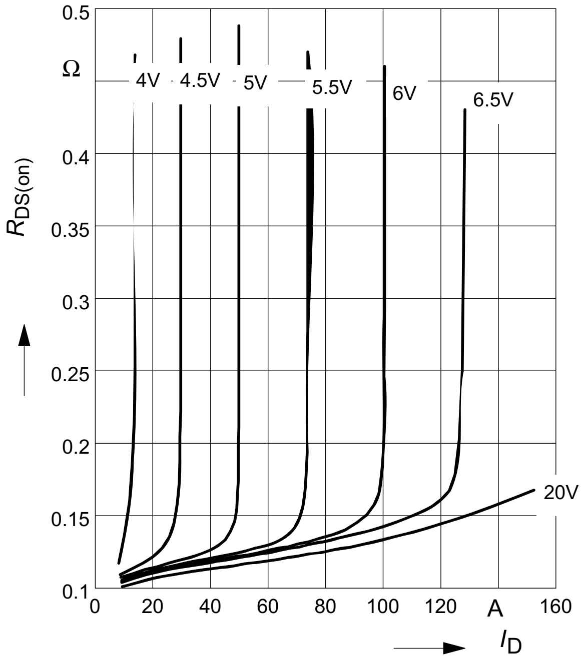
parameter: t_p = 10 µs, V_{GS}



6 Typ. drain-source on resistance

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

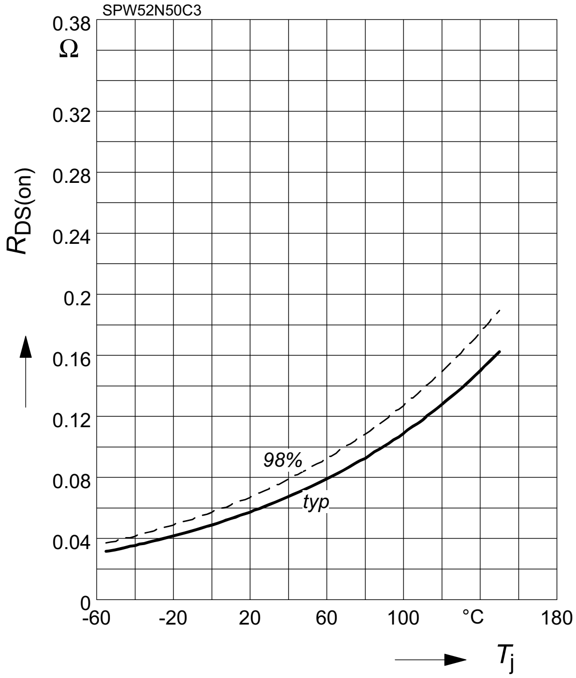
parameter: T_j=150°C, V_{GS}



7 Drain-source on-state resistance

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

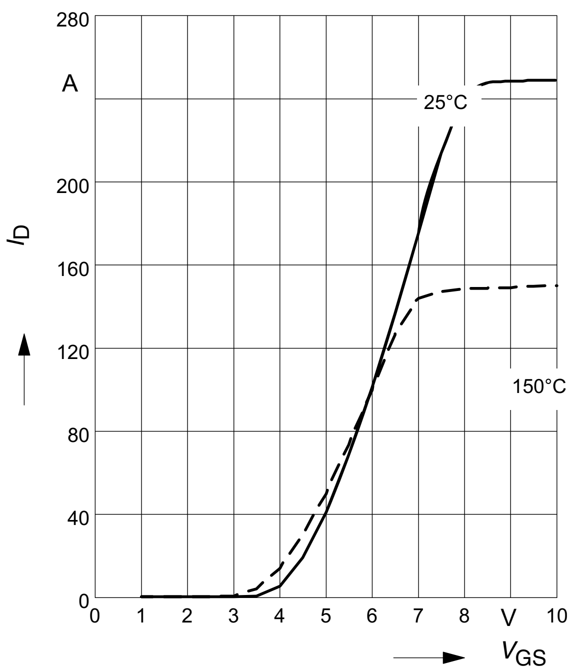
parameter : I_D = 30 A, V_{GS} = 10 V



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 µs

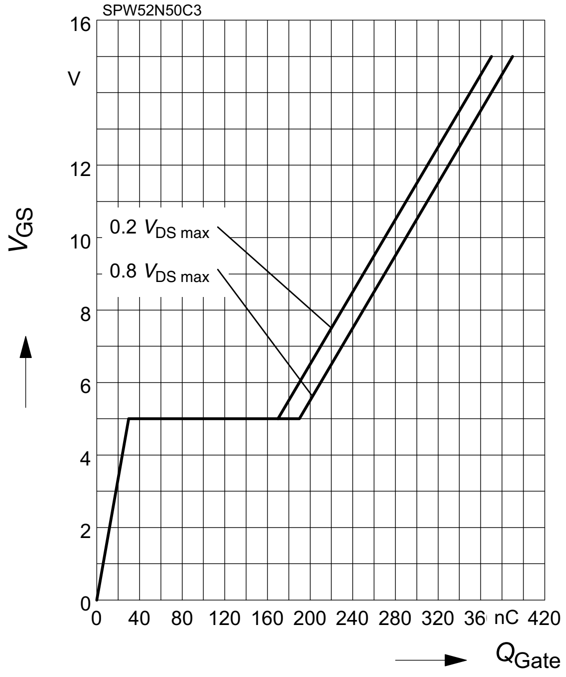


Please note the new package dimensions arccording to PCN 2009-134-A

9 Typ. gate charge

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

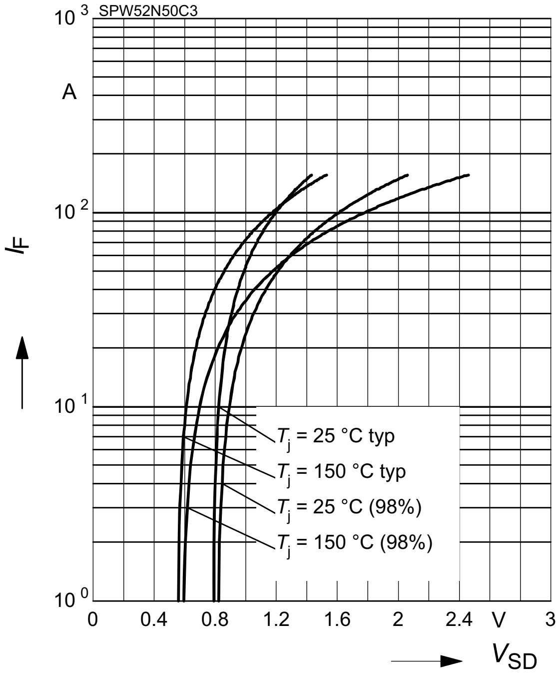
parameter: I_D = 52 A pulsed



10 Forward characteristics of body diode

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

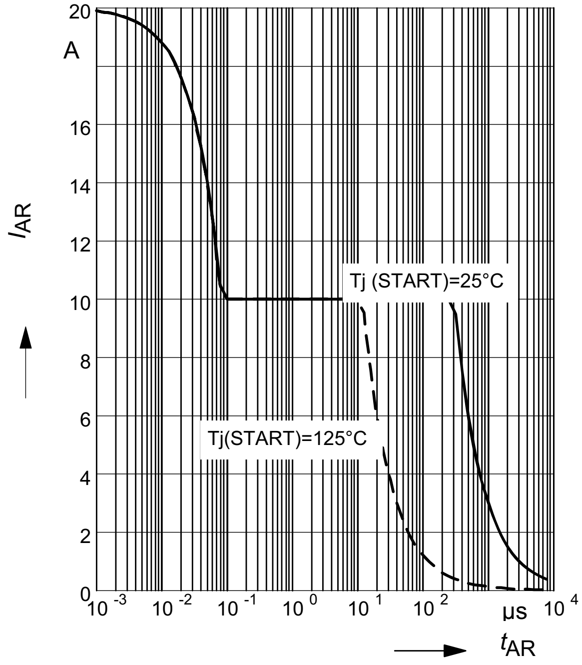
parameter: T_j , t_p = 10 µs



11 Avalanche SOA

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

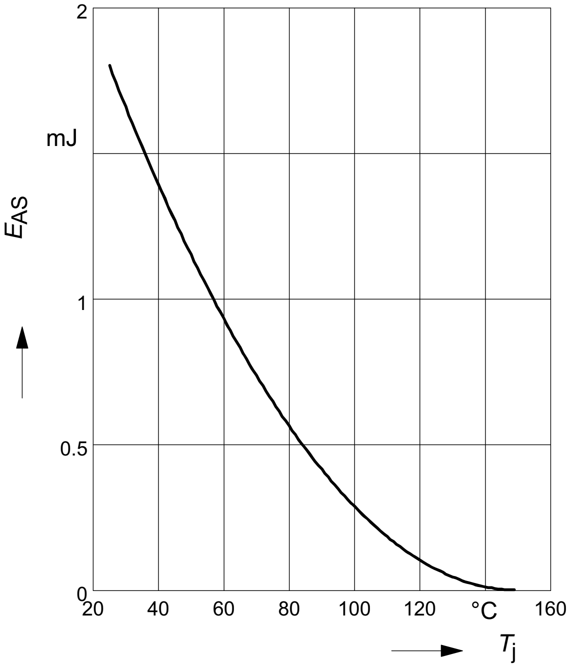
par.: $T_j \leq 150$ °C



12 Avalanche energy

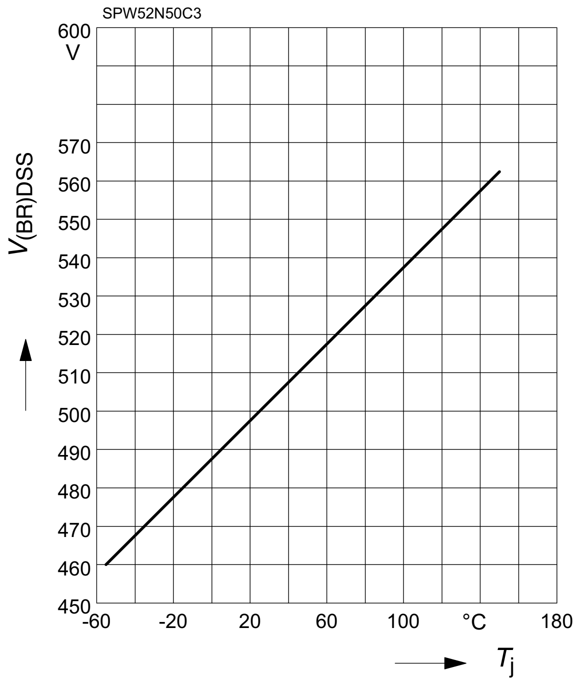
$E_{AS} = f\ (T_j)$

par.: I_D = 10 A, V_{DD} = 50 V



13 Drain-source breakdown voltage

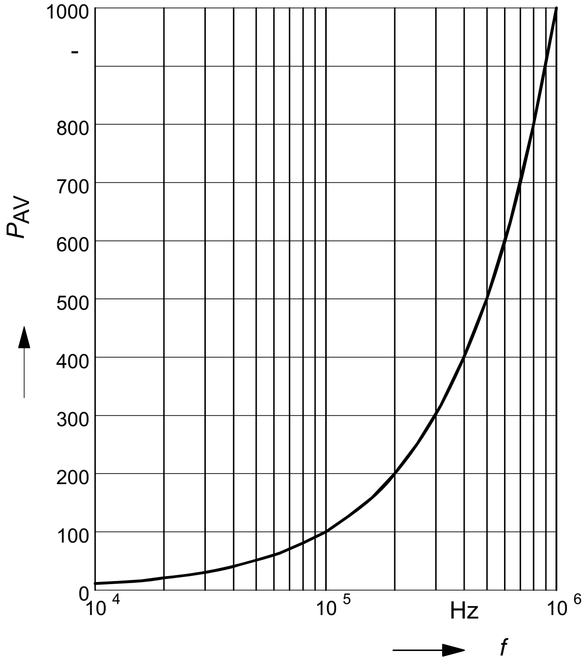
$V_{(BR)DSS} = f(T_j)$



14 Avalanche power losses

$P_{AR} = f(f)$

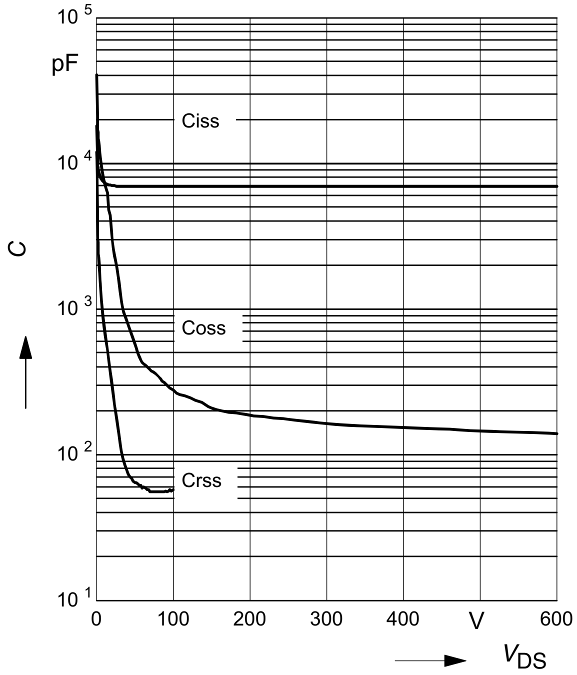
parameter: E_{AR}=1mJ



15 Typ. capacitances

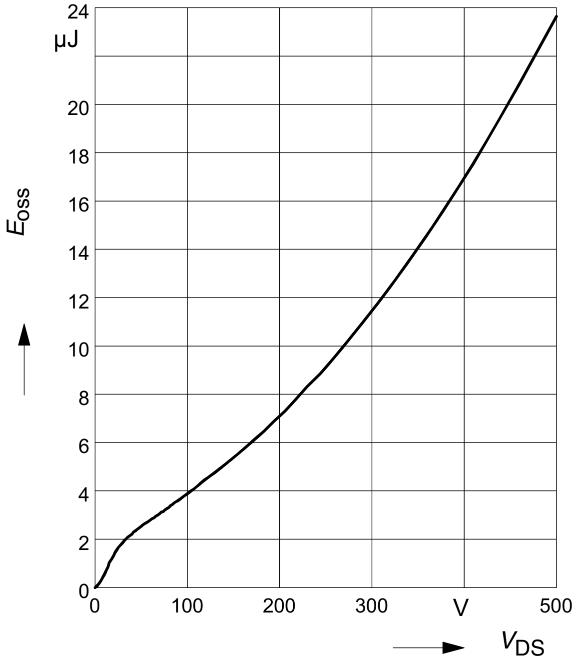
$C = f(V_{DS})$

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



16 Typ. C_{oss} stored energy

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



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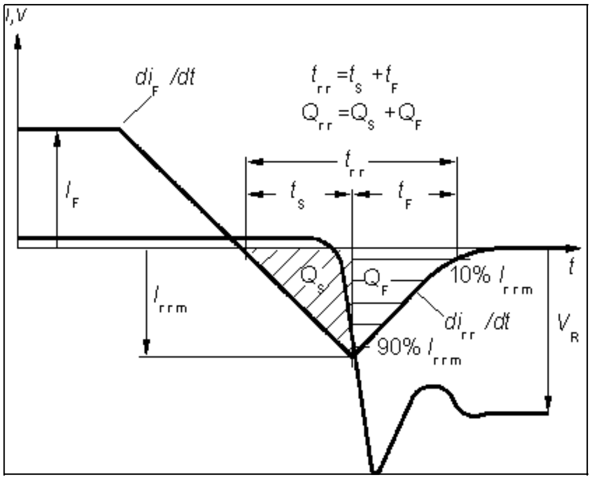
Definition of diodes switching characteristics



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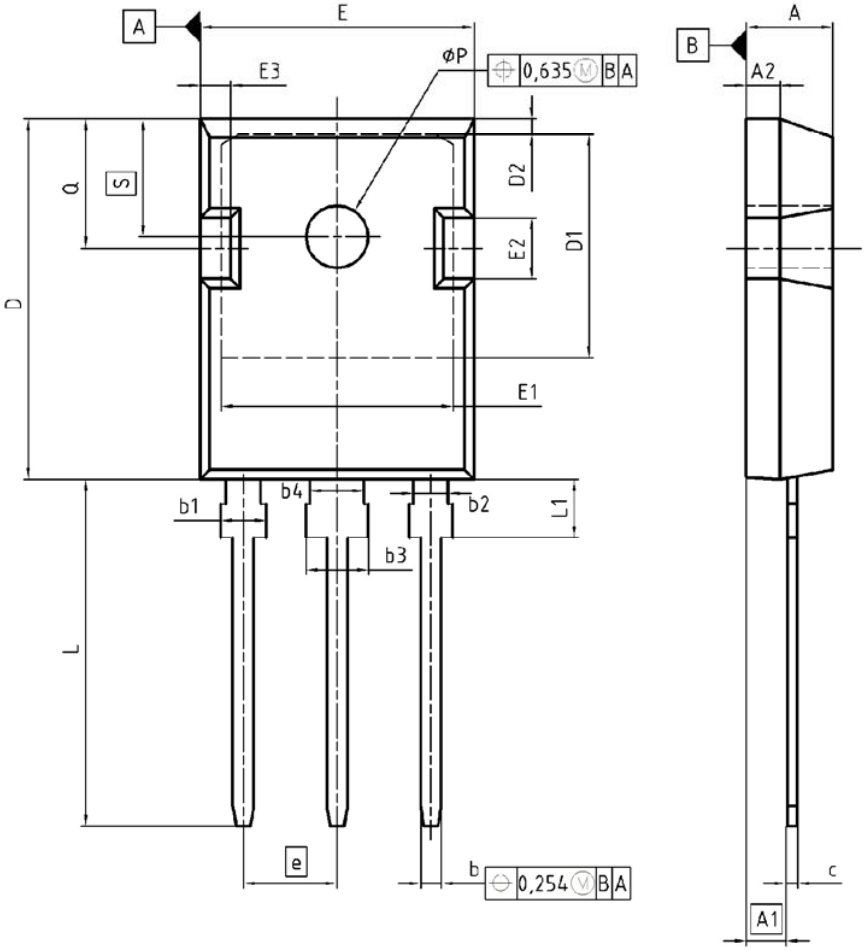

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.90	5.16	0.193	0.203
A1	2.27	2.53	0.089	0.099
A2	1.85	2.11	0.073	0.083
b	1.07	1.33	0.042	0.052
b1	1.90	2.41	0.075	0.095
b2	1.90	2.16	0.075	0.085
b3	2.87	3.38	0.113	0.133
b4	2.87	3.13	0.113	0.123
c	0.55	0.68	0.022	0.027
D	20.82	21.10	0.820	0.831
D1	16.25	17.65	0.640	0.695
D2	1.05	1.35	0.041	0.053
E	15.70	16.03	0.618	0.631
E1	13.10	14.15	0.516	0.557
E2	3.68	5.10	0.145	0.201
E3	1.68	2.60	0.066	0.102
e	5.44		0.214	
N	3		3	
L	19.80	20.31	0.780	0.799
L1	4.17	4.47	0.164	0.176
øP	3.50	3.70	0.138	0.146
Q	5.49	6.00	0.216	0.236
S	6.04	6.30	0.238	0.248

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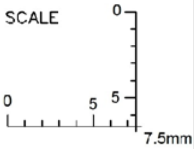
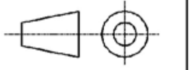


EUROPEAN PROJECTION



ISSUE DATE
17-12-2007

REVISION
03

Please note the new package dimensions arccording to PCN 2009-134-A

Published by
Infineon Technologies AG
81726 Munich, Germany

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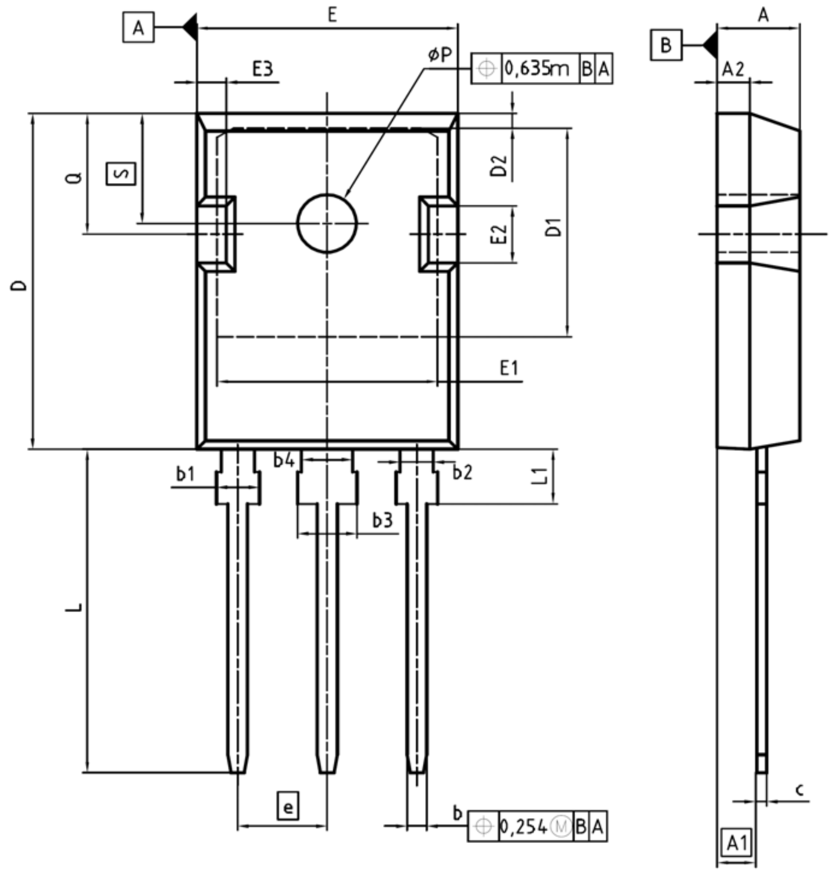
1 New package outlines TO-247

Assembly capacity extension for CoolMOSTM technology products assembled in lead-free package PG-TO247-3 at subcontractor ASE (Weihai) Inc., China (Changes are marked in blue.)



DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.83	5.21	0.190	0.205
A1	2.27	2.54	0.089	0.100
A2	1.85	2.16	0.073	0.085
b	1.07	1.33	0.042	0.052
b1	1.90	2.41	0.075	0.095
b2	1.90	2.16	0.075	0.085
b3	2.87	3.38	0.113	0.133
b4	2.87	3.13	0.113	0.123
c	0.55	0.68	0.022	0.027
D	20.80	21.10	0.819	0.831
D1	16.25	17.65	0.640	0.695
D2	0.95	1.35	0.037	0.053
E	15.70	16.13	0.618	0.635
E1	13.10	14.15	0.516	0.557
E2	3.68	5.10	0.145	0.201
E3	1.00	2.60	0.039	0.102
e	5.44		0.214	
N	3		3	
L	19.80	20.32	0.780	0.800
L1	4.10	4.47	0.161	0.176
øP	3.50	3.70	0.138	0.146
Q	5.49	6.00	0.216	0.236
S	6.04	6.30	0.238	0.248

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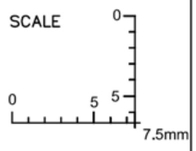
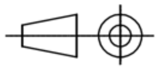


EUROPEAN PROJECTION



ISSUE DATE
01-10-2009

REVISION
04

Figure 1 Outlines TO-247, dimensions in mm/inches