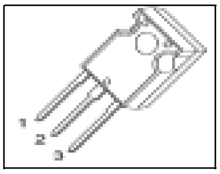
Cool MOS™ Power Transistor

Feature

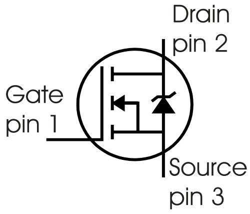
- New revolutionary high voltage technology
- Ultra low gate charge
- Periodic avalanche rated
- Extreme dv/dt rated
- Ultra low effective capacitances
- Improved transconductance
- Pb-free lead plating; RoHS compliant
- Qualified according to JEDEC[0)] for target applications

V_{DS} @ T_{jmax}	650	V
$R_{DS(on)}$	0.28	Ω
I_D	15	A

PG-TO247



Type	Package	Ordering Code	Marking
SPW15N60C3	PG-TO247	Q67040-S4604	15N60C3



Maximum Ratings

Parameter	Symbol	Value	Unit
Continuous drain current	I_D		A
T_C = 25 °C		15	
T_C = 100 °C		9.4	
Pulsed drain current, t_p limited by T_{jmax}	$I_{D\ puls}$	45	
Avalanche energy, single pulse I_D = 7.5 A, V_{DD} = 50 V	E_{AS}	460	mJ
Avalanche energy, repetitive t_{AR} limited by T_{jmax}[1)] I_D = 15 A, V_{DD} = 50 V	E_{AR}	0.8	
Avalanche current, repetitive t_{AR} limited by T_{jmax}	I_{AR}	15	A
Reverse diode dv/dt [4)]	dv/dt	15	V/ns
Gate source voltage static	V_{GS}	±20	V
Gate source voltage AC (f >1Hz)	V_{GS}	±30	
Power dissipation, T_C = 25°C	P_{tot}	156	W
Operating and storage temperature	T_j , T_{stg}	-55... +150	°C

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

Maximum Ratings

Parameter	Symbol	Value	Unit
Drain Source voltage slope V_{DS} = 480 V, I_D = 15 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}	-	-	0.8	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	600	-	-	V
Drain-Source avalanche breakdown voltage	$V_{(BR)DS}$	V_{GS}=0V, I_D=15A	-	700	-	
Gate threshold voltage	$V_{GS(th)}$	I_D=675µA, V_{GS}=V_{DS}	2.1	3	3.9	
Zero gate voltage drain current	I_{DSS}	V_{DS}=600V, V_{GS}=0V, T_j=25°C, T_j=150°C	 - -	 0.1 -	 1 100	µA
Gate-source leakage current	I_{GSS}	V_{GS}=30V, V_{DS}=0V	-	-	100	nA
Drain-source on-state resistance	$R_{DS(on)}$	V_{GS}=10V, I_D=9.4A, T_j=25°C T_j=150°C	 - -	 0.25 0.68	 0.28 -	Ω
Gate input resistance	R_G	f=1MHz, open Drain	-	1.23	-	

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=9.4A	-	11.9	-	S
Input capacitance	C_{iss}	V_{GS}=0V, V_{DS}=25V, f=1MHz	-	1660	-	pF
Output capacitance	C_{oss}		-	540	-	
Reverse transfer capacitance	C_{rss}		-	40	-	
Effective output capacitance,[2] energy related	$C_{o(er)}$	V_{GS}=0V, V_{DS}=0V to 480V	-	80	-	pF
Effective output capacitance,[3] time related	$C_{o(tr)}$		-	127	-	
Turn-on delay time	$t_{d(on)}$	V_{DD}=380V, V_{GS}=0/10V, I_D=15A, R_G=4.3Ω	-	10	-	ns
Rise time	t_r		-	5	-	
Turn-off delay time	$t_{d(off)}$		-	50	80	
Fall time	t_f		-	5	10	

Gate Charge Characteristics

Parameter	Symbol	Conditions	min.	typ.	max.	Unit
Gate to source charge	Q_{gs}	V_{DD}=480V, I_D=15A	-	7	-	nC
Gate to drain charge	Q_{gd}		-	29	-	
Gate charge total	Q_g	V_{DD}=480V, I_D=15A, V_{GS}=0 to 10V	-	63	-	
Gate plateau voltage	$V_{(plateau)}$	V_{DD}=480V, I_D=15A	-	5	-	V

[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}.

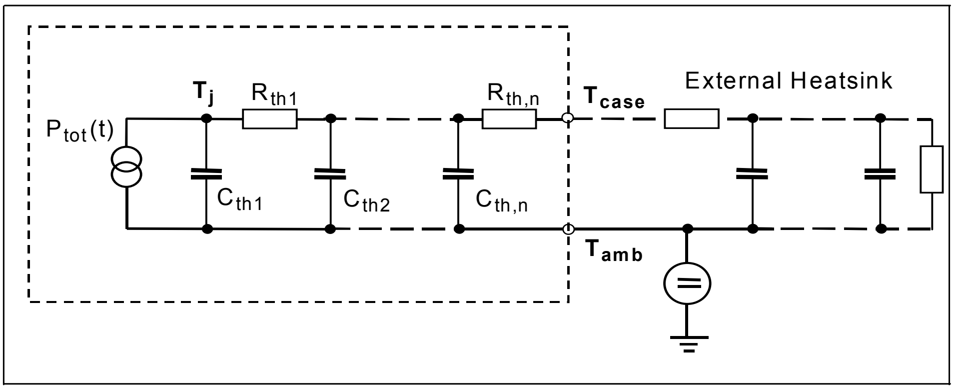
[4]I_{SD}<=I_D, di/dt<=400A/us, V_{DClink}=400V, V_{peak}<$V_{BR, DSS}$, T_j<$T_{j,max}$.
Identical low-side and high-side switch.

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	-	-	15	A
Inverse diode direct current, pulsed	I_{SM}		-	-	45	
Inverse diode forward voltage	V_{SD}	V_{GS}=0V, I_F=I_S	-	1	1.2	V
Reverse recovery time	t_{rr}	V_R=480V, I_F=I_S ,	-	460	-	ns
Reverse recovery charge	Q_{rr}	di_F/dt=100A/µs	-	27	-	µC
Peak reverse recovery current	I_{rrm}		-	55	-	A
Peak rate of fall of reverse recovery current	di_{rr}/dt		-	tbd	-	A/µs

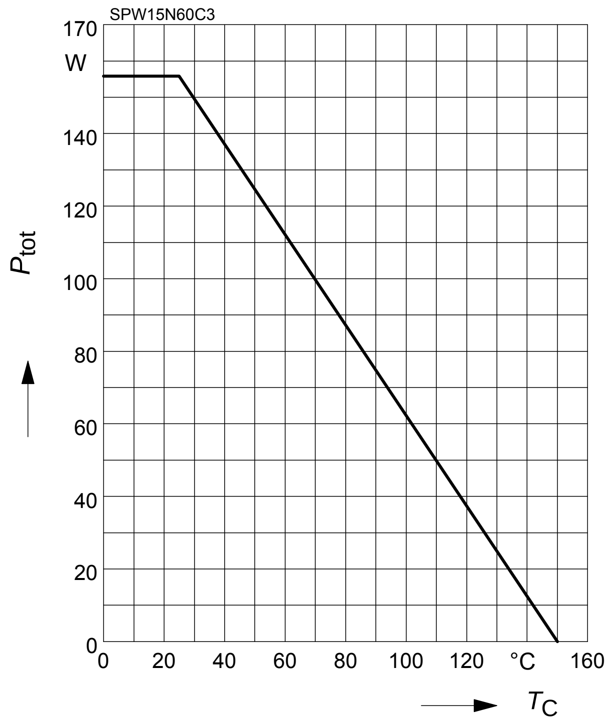
Typical Transient Thermal Characteristics

Symbol	Value	Unit	Symbol	Value	Unit
	typ.			typ.	
Thermal resistance			Thermal capacitance		
R_{th1}	0.012	K/W	C_{th1}	0.0002495	Ws/K
R_{th2}	0.023		C_{th2}	0.0009406	
R_{th3}	0.043		C_{th3}	0.001298	
R_{th4}	0.156		C_{th4}	0.00362	
R_{th5}	0.178		C_{th5}	0.009046	
R_{th6}	0.072		C_{th6}	0.412	



1 Power dissipation

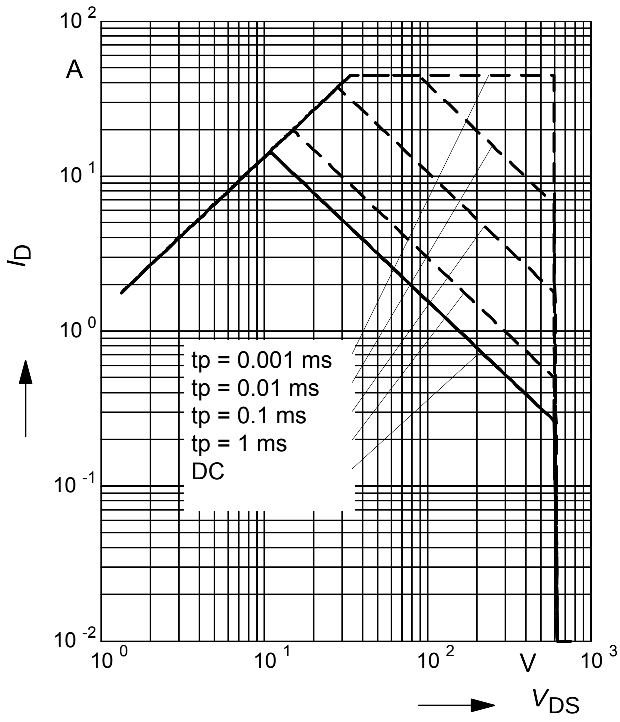
$P_{tot} = f(T_C)$



2 Safe operating area

$I_D = f(V_{DS})$

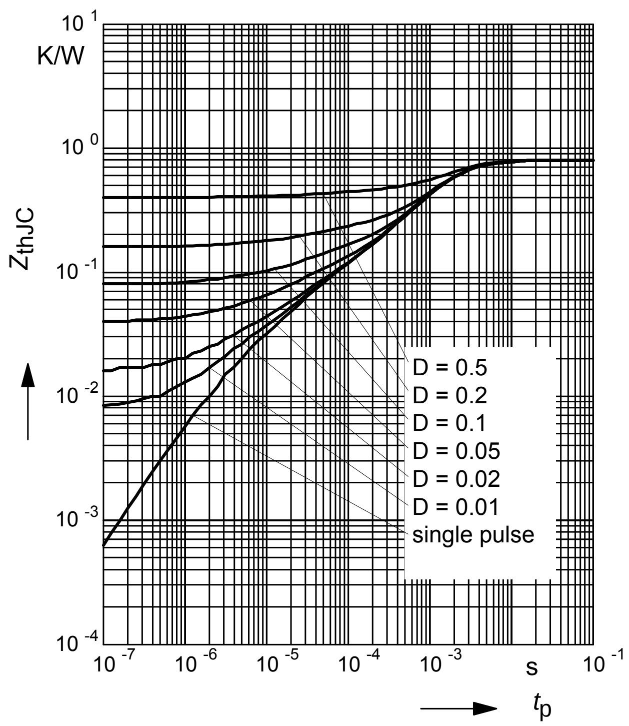
parameter : $D = 0$, T_C=25°C



3 Transient thermal impedance

$Z_{thJC} = f(t_p)$

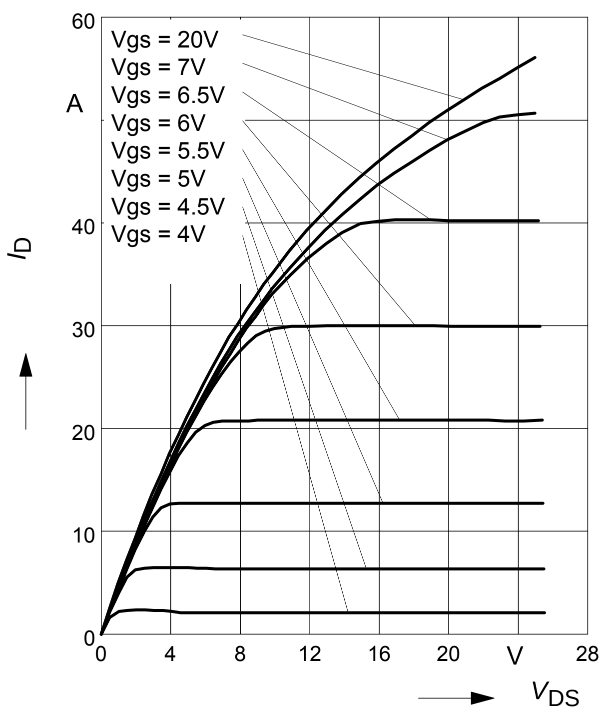
parameter: $D = t_p/T$



4 Typ. output characteristic

$I_D = f(V_{DS})$; T_j=25°C

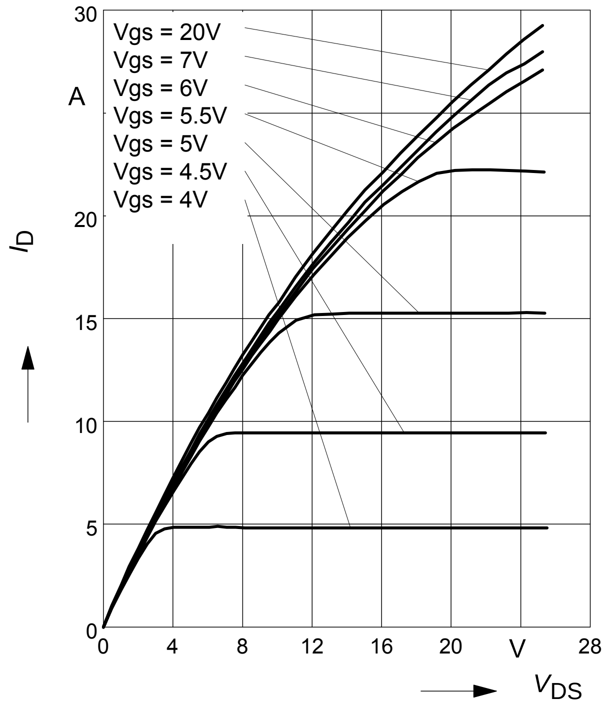
parameter: t_p = 10 µs, V_{GS}



5 Typ. output characteristic

$I_D = f(V_{DS})$; T_j=150°C

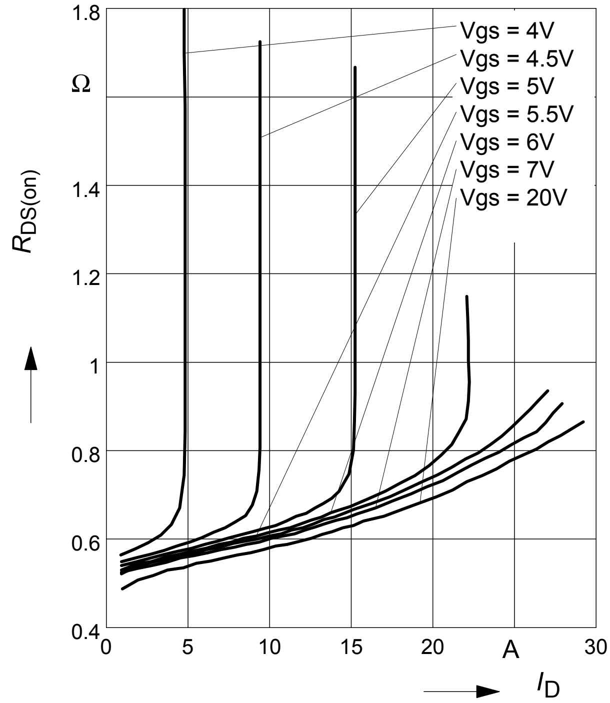
parameter: t_p = 10 µs, V_{GS}



6 Typ. drain-source on resistance

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

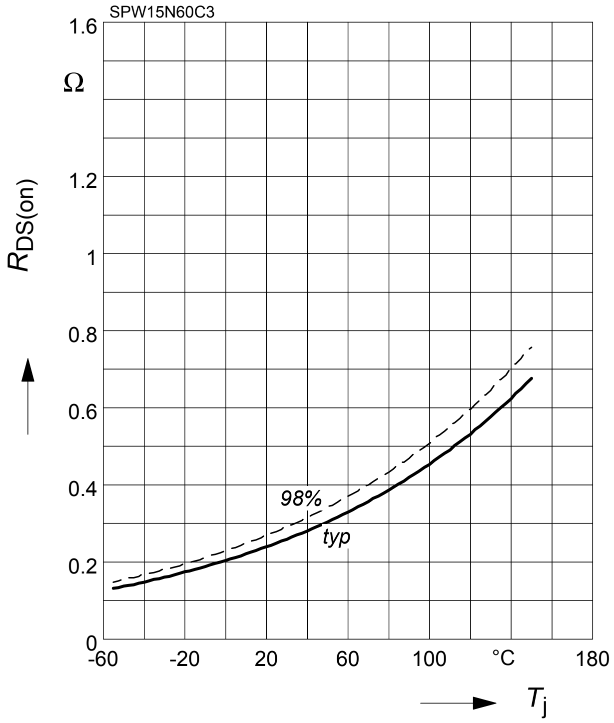
parameter: T_j=150°C, V_{GS}



7 Drain-source on-state resistance

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

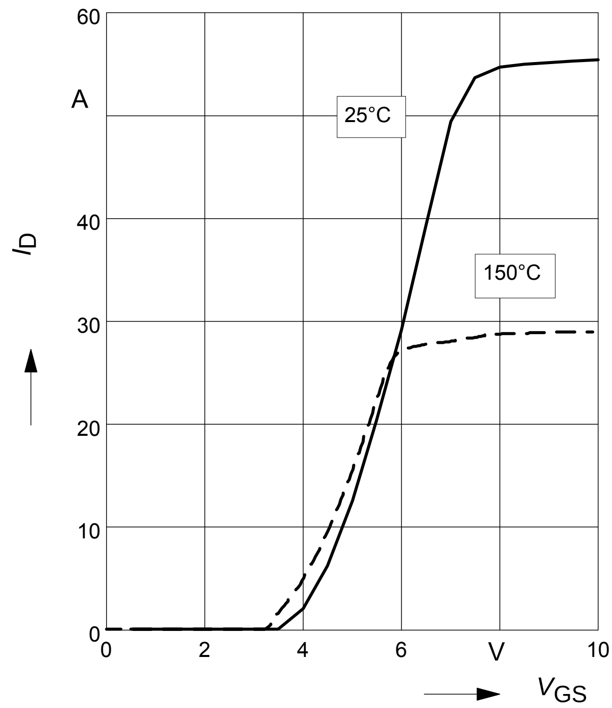
parameter : I_D = 9.4 A, V_{GS} = 10 V



8 Typ. transfer characteristics

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

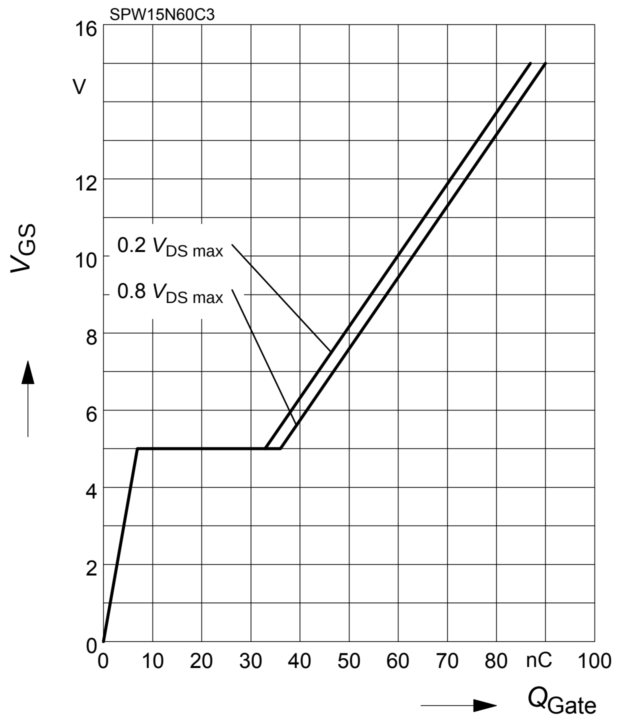
parameter: t_p = 10 µs



9 Typ. gate charge

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

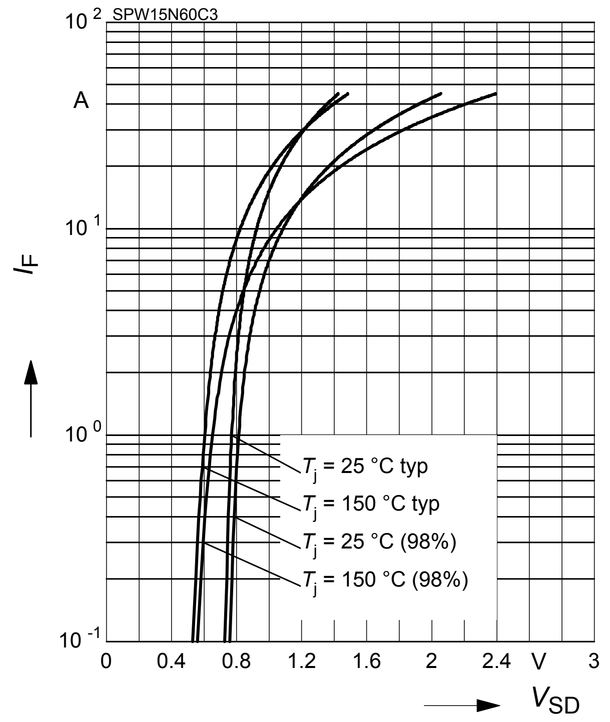
parameter: I_D = 15 A pulsed



10 Forward characteristics of body diode

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

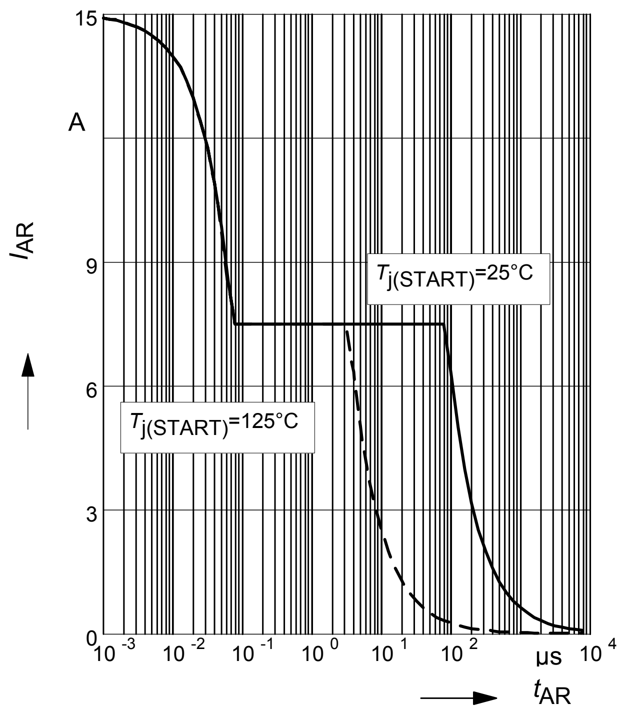
parameter: T_j , tp = 10 µs



11 Avalanche SOA

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

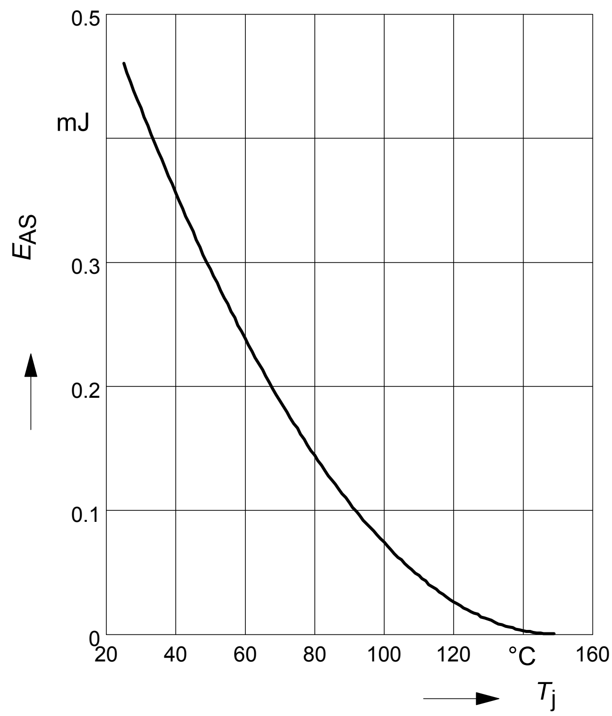
par.: $T_j \leq 150$ °C



12 Avalanche energy

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

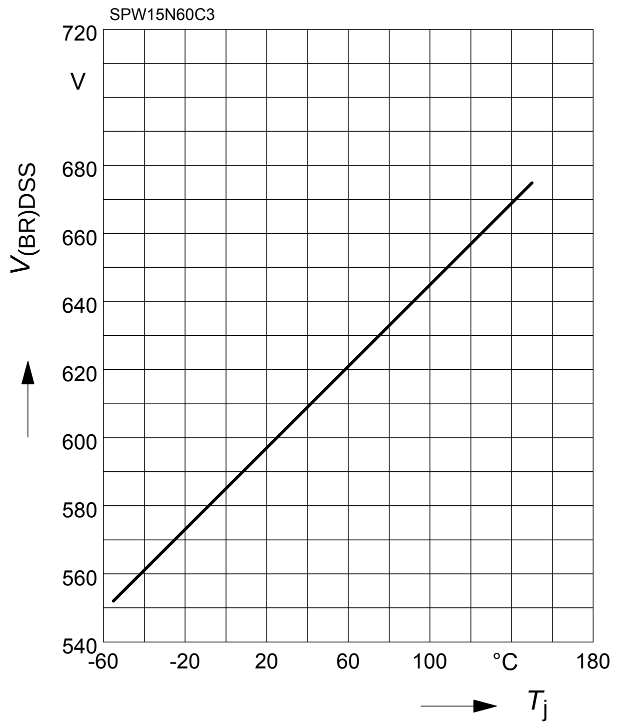
par.: I_D = 7.5 A, V_{DD} = 50 V



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

13 Drain-source breakdown voltage

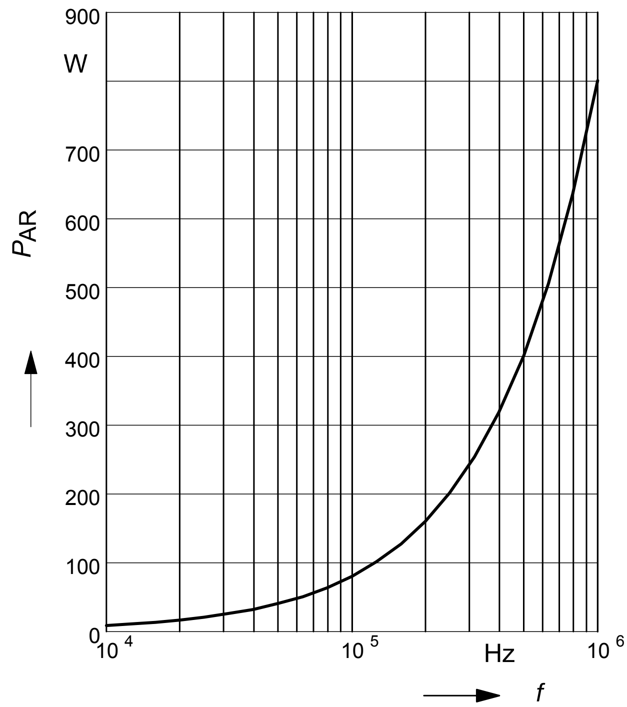
$V_{(BR)DSS} = f\,(T_j)$



14 Avalanche power losses

$P_{AR} = f\,(f\,)$

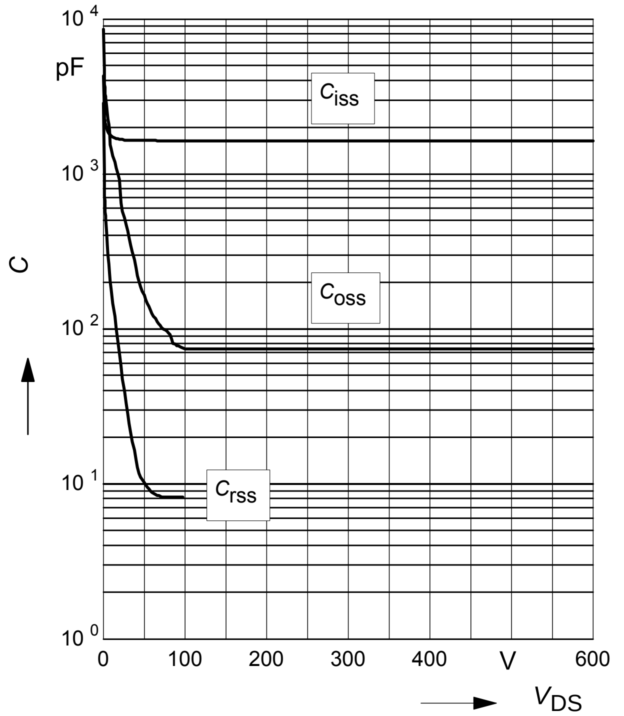
parameter: E_{AR}=0.8mJ



15 Typ. capacitances

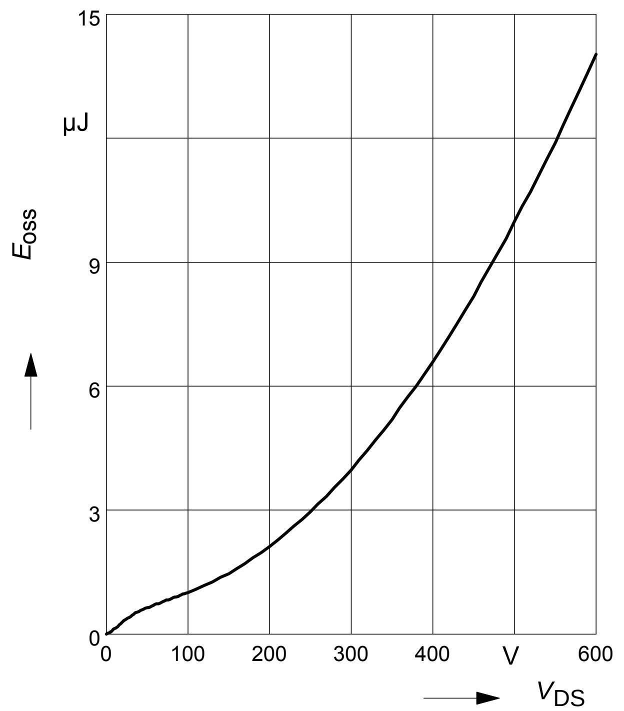
$C = f\,(V_{DS})$

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

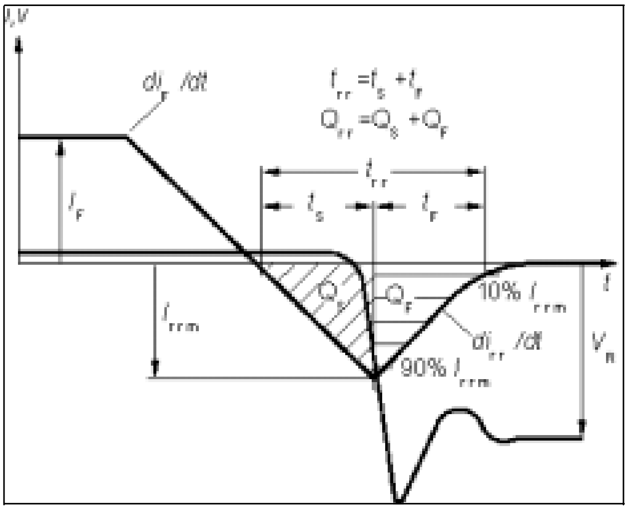


16 Typ. C_{oss} stored energy

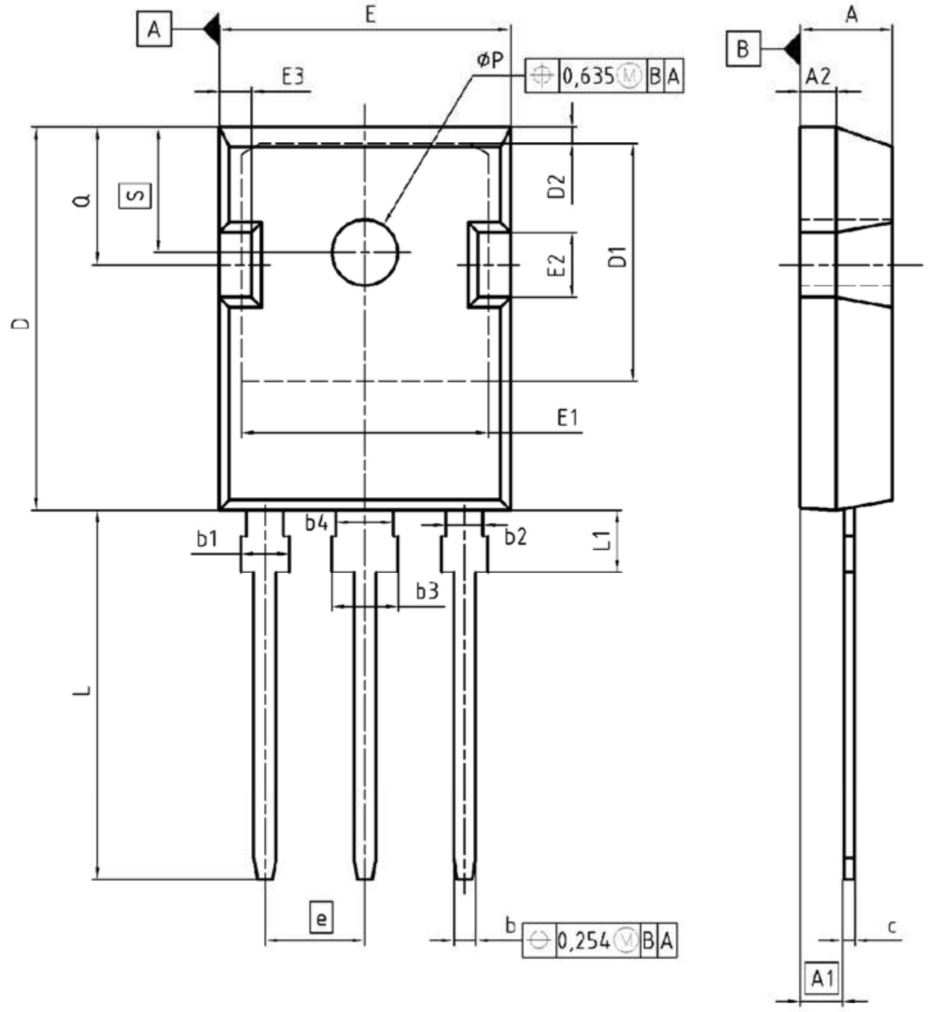
$E_{oss}=f(V_{DS})$



Definition of diodes switching characteristics



PG-TO-247-3-1



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

DOCUMENT NO.
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SCALE 0 5 7.5mm

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03

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

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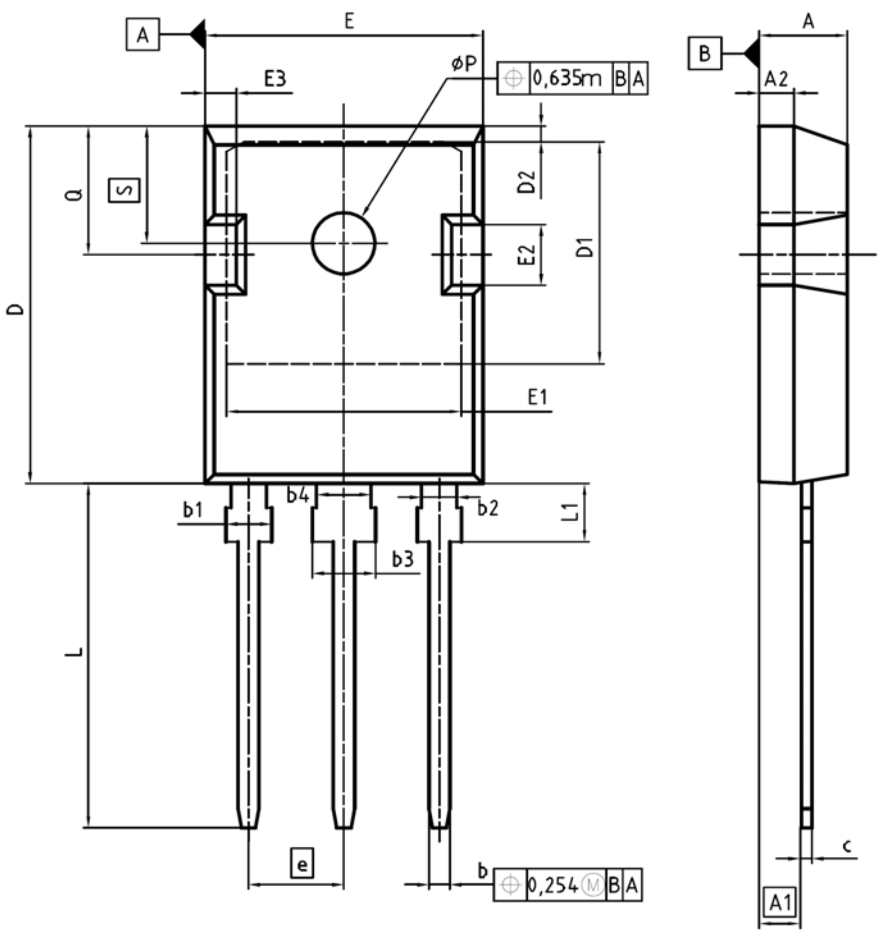
1 New package outlines TO-247

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	
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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

DOCUMENT NO.
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SCALE 0 5 7.5mm

EUROPEAN PROJECTION

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04

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