CoolMOS™ Power Transistor

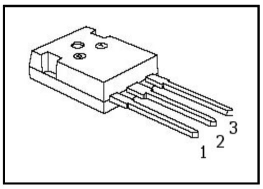
Features

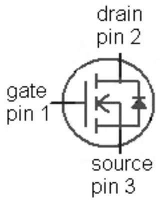
- New revolutionary high voltage technology
- Intrinsic fast-recovery body diode
- Extremely low reverse recovery charge
- Ultra low gate charge
- Extreme d*v*/d*t* rated
- High peak current capability
- Periodic avalanche rated
- Qualified for industrial grade applications according to JEDEC[1)]
- Pb-free lead plating; RoHS compliant

Product Summary

V_{DS}	600	V
$R_{DS(on),max}$	0.118	Ω
I_D	34	A

PG-TO247





Type	Package	Ordering Code	Marking
SPW35N60CFD	PG-TO247	Q67045A5053	35N60CFD

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

Parameter	Symbol	Conditions	Value	Unit
Continuous drain current	I_D	T_C=25 °C	34.1	A
		T_C=100 °C	21.6	
Pulsed drain current[2)]	$I_{D,pulse}$	T_C=25 °C	85	
Avalanche energy, single pulse	E_{AS}	I_D=10 A, V_{DD}=50 V	1300	mJ
Avalanche energy, repetitive t_{AR}[2),3)]	E_{AR}	I_D=20 A, V_{DD}=50 V	1	
Avalanche current, repetitive t_{AR}[2),3)]	I_{AR}		20	A
Drain source voltage slope	d*v*/d*t*	I_D=34.1 A, V_{DS}=480 V, T_j=125 °C	80	V/ns
Reverse diode d*v*/d*t*	d*v*/d*t*	I_S=34.1 A, V_{DS}=480 V, T_j=125 °C	40	V/ns
Maximum diode commutation speed	d*i*/d*t*		600	A/µs
Gate source voltage	V_{GS}	static	±20	V
		AC (*f*>1 Hz)	±30	
Power dissipation	P_{tot}	T_C=25 °C	313	W
Operating and storage temperature	T_j, T_{stg}		-55 ... 150	°C

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

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	
Thermal characteristics						
Thermal resistance, junction - case	R_{thJC}		-	-	0.4	K/W
Thermal resistance, junction - ambient	R_{thJA}	leaded	-	-	62	
Soldering temperature, wave soldering	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=34.1 A	-	700	-	
Gate threshold voltage	$V_{GS(th)}$	V_{DS}=V_{GS}, I_D=1.9 mA	3	4	5	
Zero gate voltage drain current	I_{DSS}	V_{DS}=600 V, V_{GS}=0 V, T_j=25 °C	-	4	-	µA
		V_{DS}=600 V, V_{GS}=0 V, T_j=150 °C	-	3300	-	
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=21.6 A, T_j=25 °C	-	0.10	0.118	Ω
		V_{GS}=10 V, I_D=21.6 A, T_j=150 °C	-	0.23	-	
Gate resistance	R_G	f=1 MHz, open drain	-	0.6	-	
Transconductance	g_{fs}	$\|V_{DS}\|>2\|I_D\|R_{DS(on)max}$, I_D=21.6 A	-	21	-	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	-	5060	-	pF
Output capacitance	C_{oss}		-	1400	-	
Reverse transfer capacitance	C_{rss}		-	52	-	
Effective output capacitance, energy related[4)]	$C_{o(er)}$	V_{GS}=0 V, V_{DS}=0 V to 480 V	-	162	-	
Effective output capacitance, time related5[)]	$C_{o(tr)}$		-	299	-	
Turn-on delay time	$t_{d(on)}$	V_{DD}=400 V, V_{GS}=10 V, I_D=34.1 A, R_G=3.3 Ω	-	20	-	ns
Rise time	t_r		-	25	-	
Turn-off delay time	$t_{d(off)}$		-	65	-	
Fall time	t_f		-	12	-	
Gate Charge Characteristics						
Gate to source charge	Q_{gs}	V_{DD}=480 V, I_D=34.1 A, V_{GS}=0 to 10 V	-	36	-	nC
Gate to drain charge	Q_{gd}		-	87	-	
Gate charge total	Q_g		-	163	212	
Gate plateau voltage	$V_{plateau}$		-	7.2	-	V

1) J-STD20 and JESD22

2) Pulse width t_p limited by $T_{j,max}$

3) Repetitive avalanche causes additional power losses that can be calculated as $P_{AV}=E_{AR}*f$.

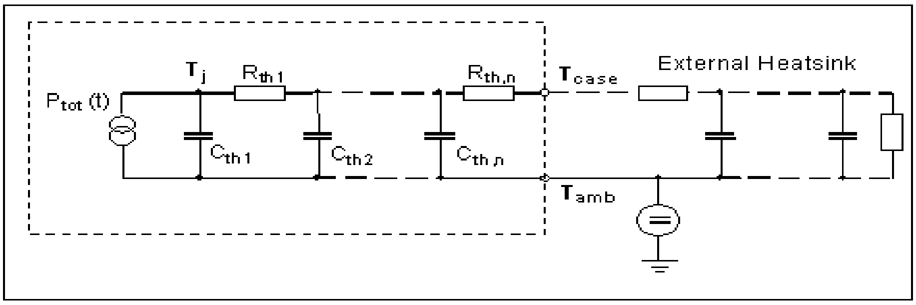
4) $C_{o(er)}$ is a fixed capacitance that gives the same stored energy as C_{oss} while V_{DS} is rising from 0 to 80% V_{DSS}.

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

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	
Reverse Diode						
Diode continuous forward current	I_S	T_C=25 °C	-	-	34.1	A
Diode pulse current	$I_{S,pulse}$		-	-	85	
Diode forward voltage	V_{SD}	V_{GS}=0 V, I_F=34.1 A, T_j=25 °C	-	1.0	1.2	V
Reverse recovery time	t_{rr}	V_R=480 V, I_F=I_S, di_F/dt=100 A/µs	-	180	-	ns
Reverse recovery charge	Q_{rr}		-	1.5	-	µC
Peak reverse recovery current	I_{rrm}		-	16	-	A

Typical Transient Thermal Characteristics

Symbol	Value	Unit	Symbol	Value	Unit
	typ.			typ.	
R_{th1}	0.00441	K/W	C_{th1}	0.00037	Ws/K
R_{th2}	0.00608		C_{th2}	0.00223	
R_{th3}	0.0341		C_{th3}	0.00315	
R_{th4}	0.0602		C_{th4}	0.0179	
R_{th5}	0.0884		C_{th5}	0.098	
			C_{th6}	4.4[5)]	

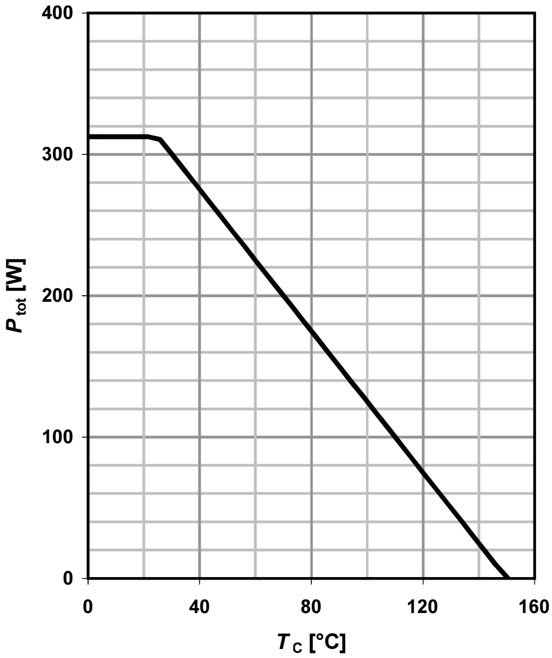


5) C_{th6} models the additional heat capacitance of the package in case of non-ideal cooling. It is not needed if R_{thCA}=0 K/W.

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

1 Power dissipation

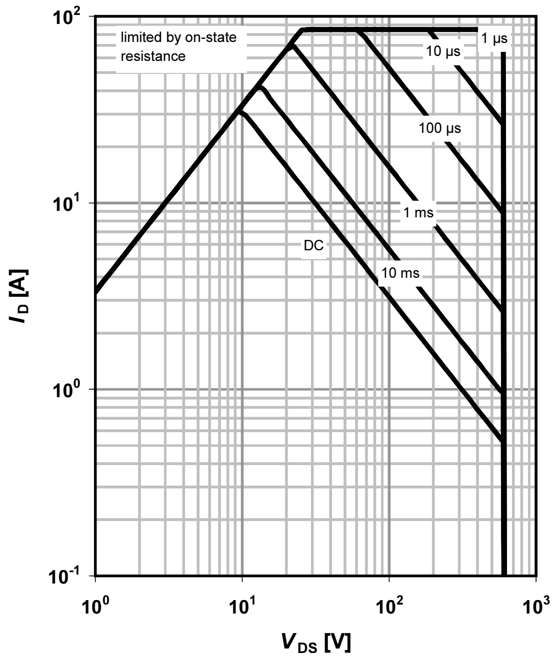
$P_{tot}=f(T_C)$



2 Safe operating area

$I_D=f(V_{DS})$; $T_C=25$ °C; $D=0$

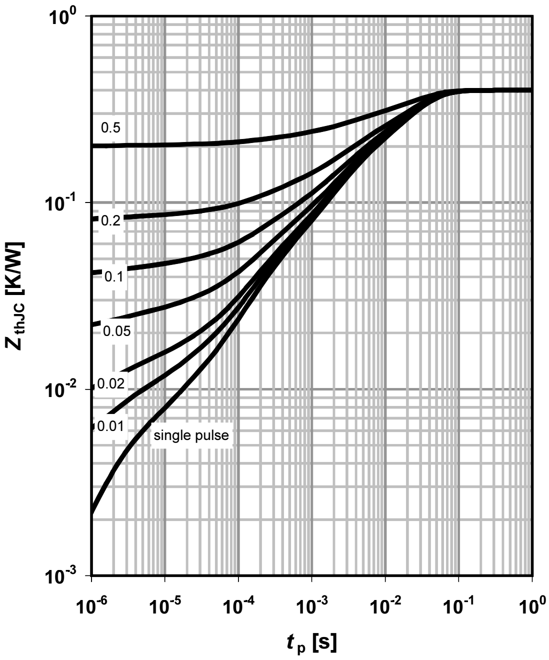
parameter: t_p



3 Max. transient thermal impedance

$I_D=f(V_{DS})$; $T_j=25$ °C

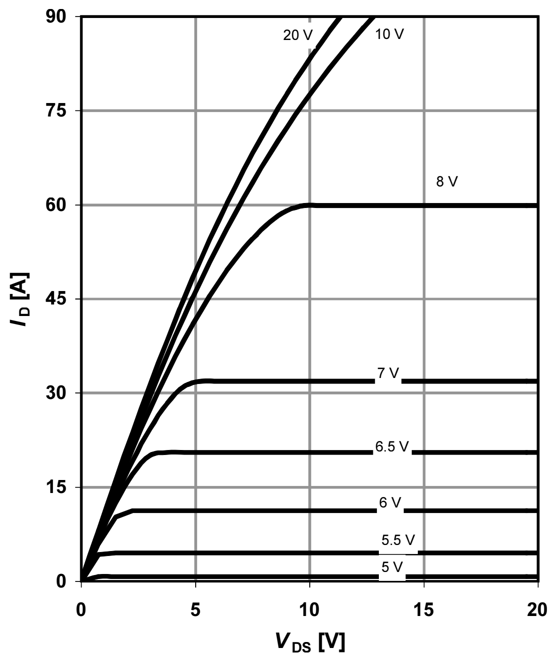
parameter: $D=t_p/T$



4 Typ. output characteristics

$I_D=f(V_{DS})$; $T_j=25$ °C

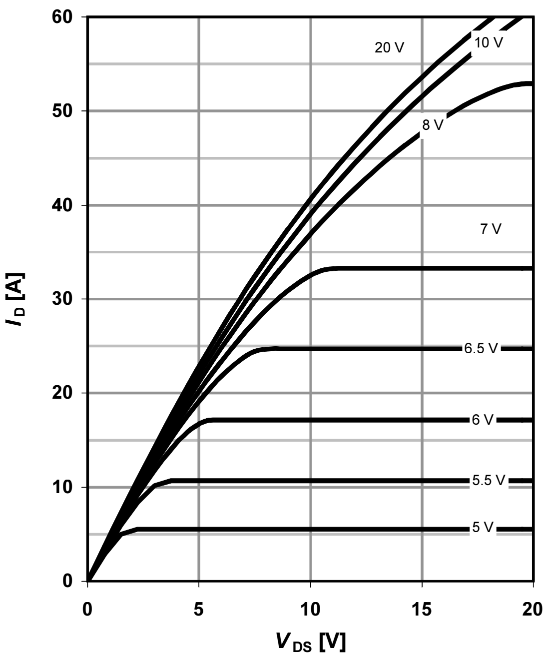
parameter: V_{GS}



5 Typ. output characteristics

I_D=f(V_{DS}); T_j=150 °C

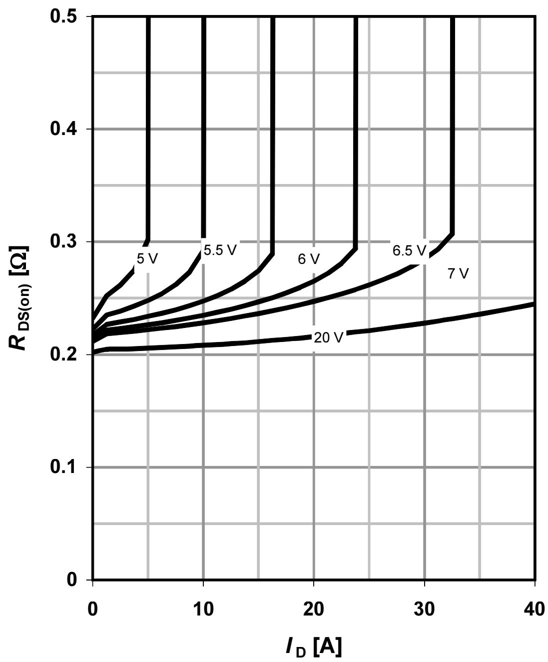
parameter: V_{GS}



6 Typ. drain-source on-state resistance

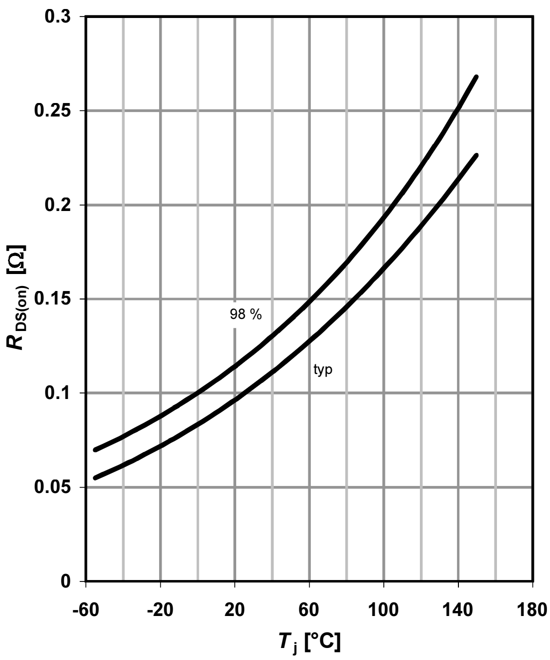
$R_{DS(on)}$=f(I_D); T_j=150 °C

parameter: V_{GS}



7 Drain-source on-state resistance

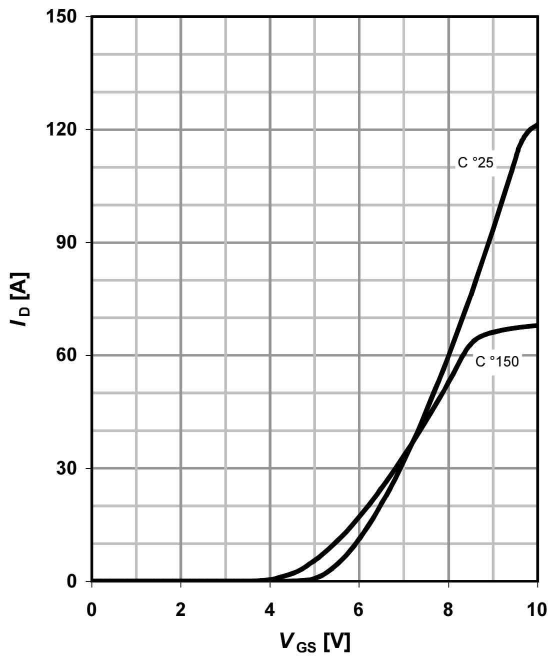
$R_{DS(on)}$=f(T_j); I_D=21.9 A; V_{GS}=10 V



8 Typ. transfer characteristics

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

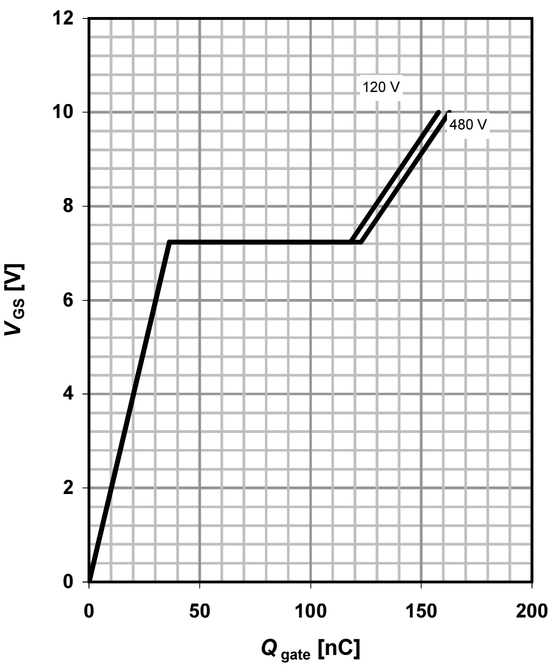
parameter: T_j



9 Typ. gate charge

V_{GS}=f(Q_{gate}); I_D=34.1 A pulsed

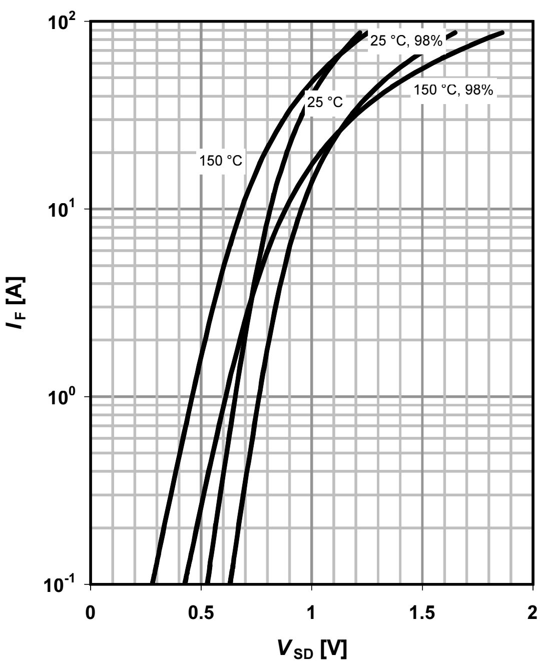
parameter: V_{DD}



10 Forward characteristics of reverse diode

I_F=f(V_{SD})

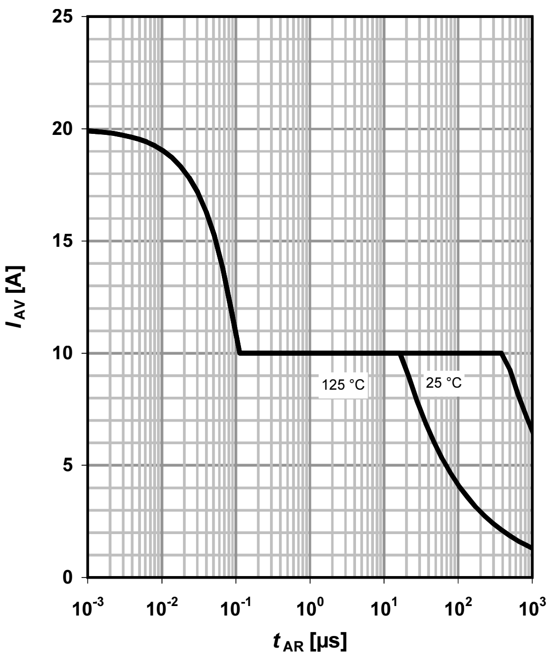
parameter: T_j



11 Avalanche SOA

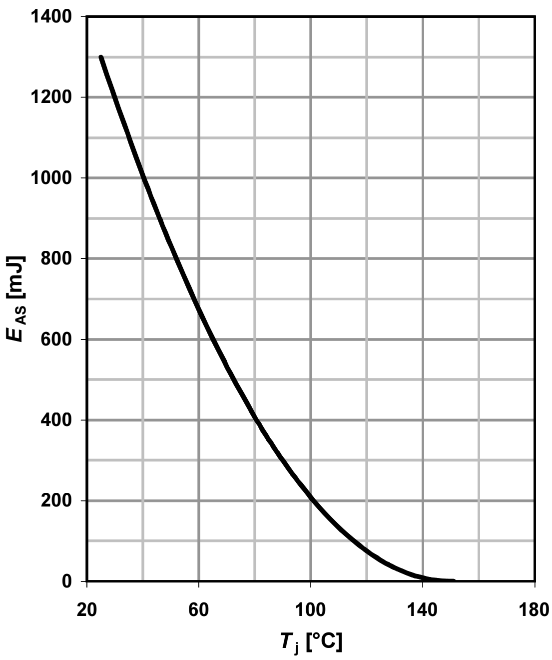
I_{AR}=f(t_{AR})

parameter: $T_{j(start)}$



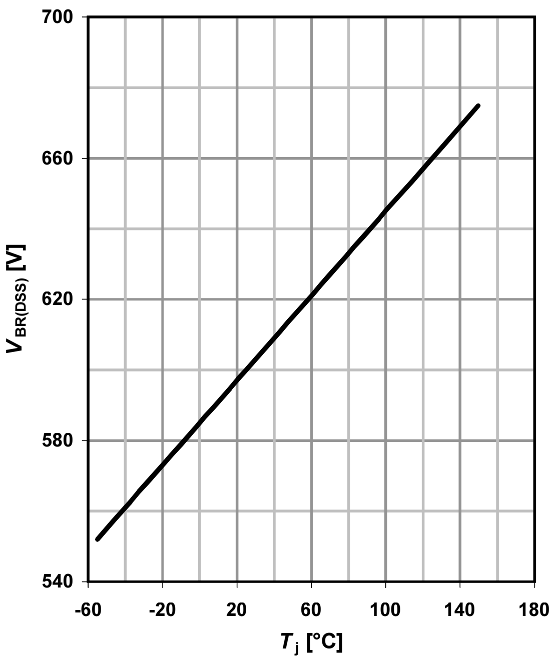
12 Avalanche energy

E_{AS}=f(T_j); I_D=10 A; V_{DD}=50 V



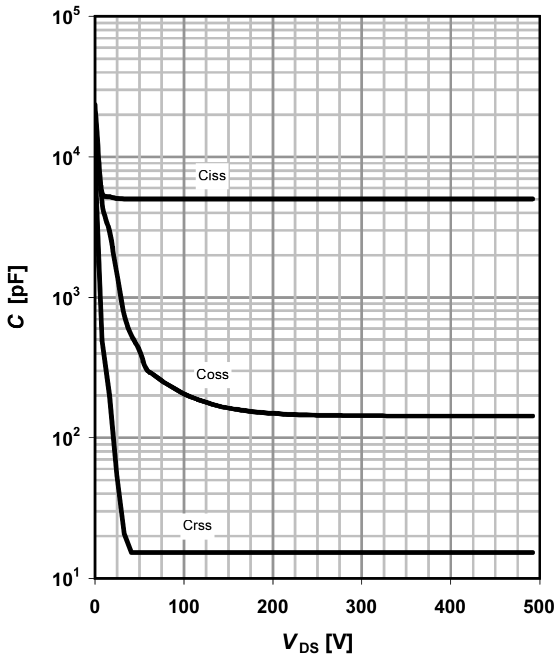
13 Drain-source breakdown voltage

$V_{BR(DSS)}$=f(T_j); I_D=10 mA



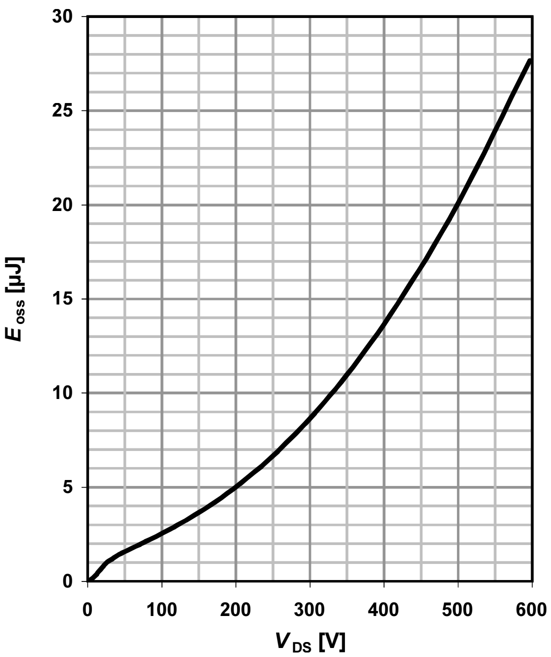
14 Typ. capacitances

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



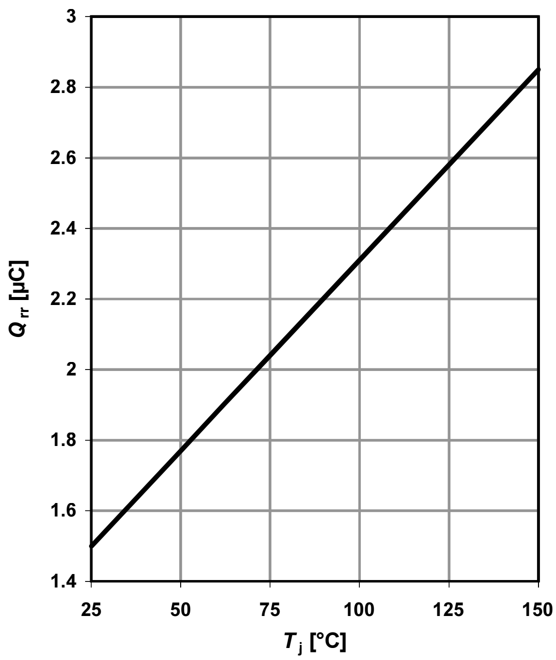
15 Typ. C_{oss} stored energy

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



16 Typ. reverse recovery charge

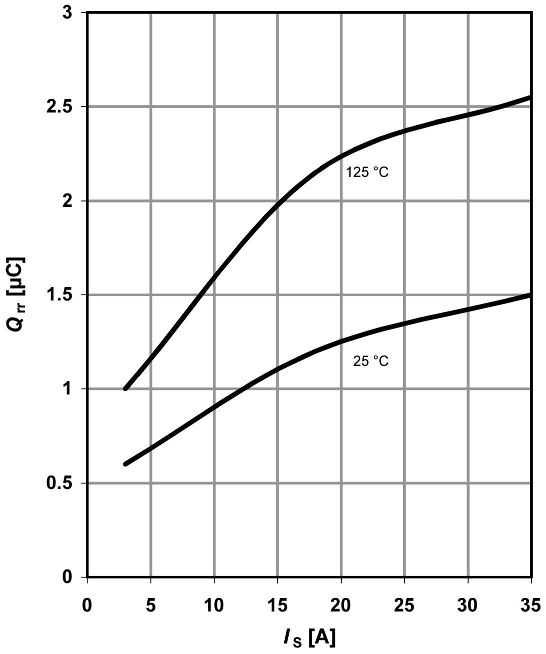
Q_{rr}=f(T_j); I_S=34.1 A; di/dt=100 A/µs



17 Typ. reverse recovery charge

Q_{rr}=f(I_S); di/dt=100 A/µs

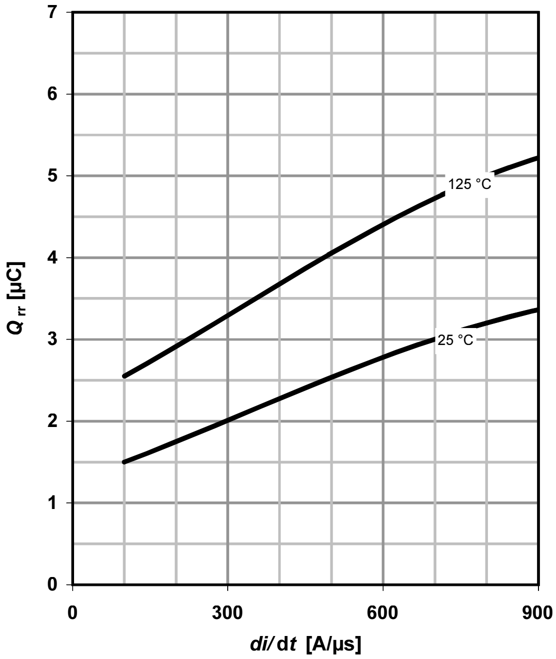
parameter: T_j



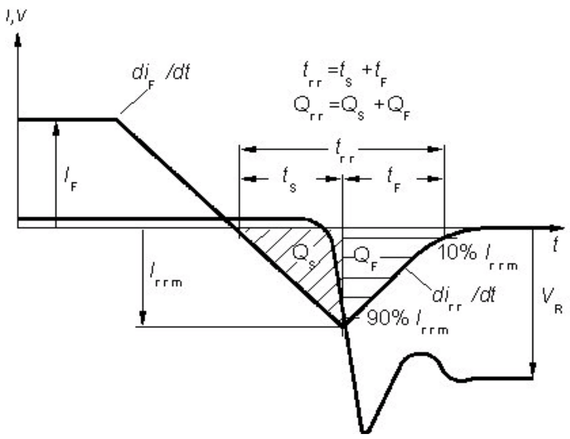
18 Typ. reverse recovery charge

Q_{rr}=f(di/dt); I_S=34.1 A

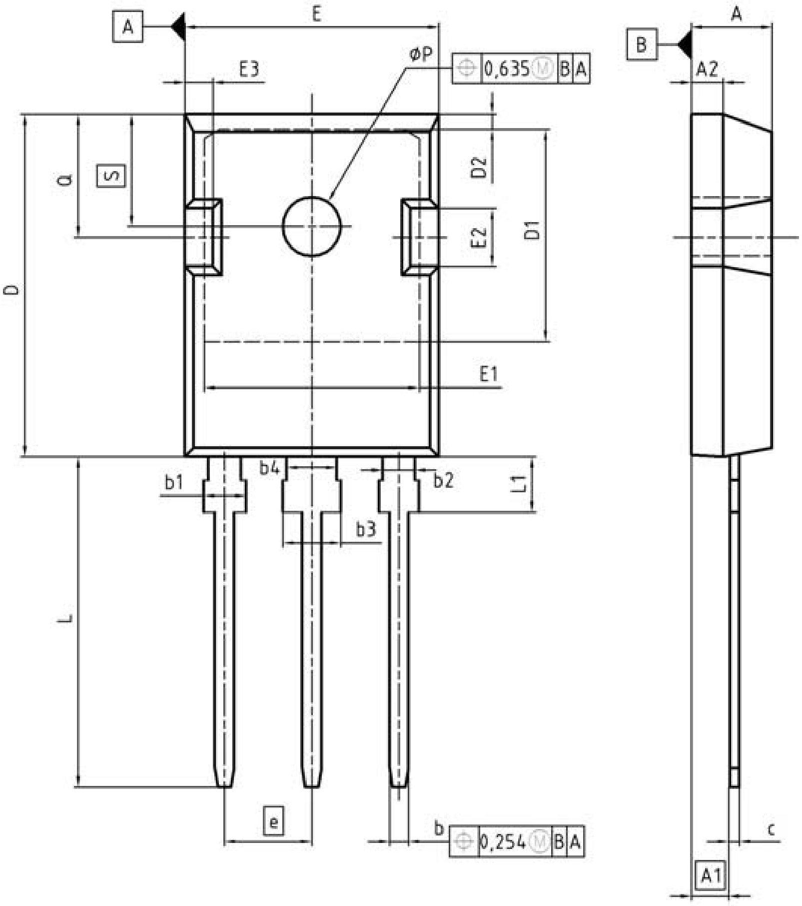
parameter: T_j



Definition of diode switching characteristics



PG-TO247-3-21-41



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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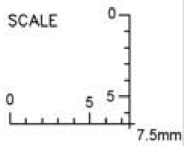
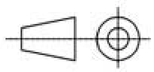
SCALE



EUROPEAN PROJECTION



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03

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

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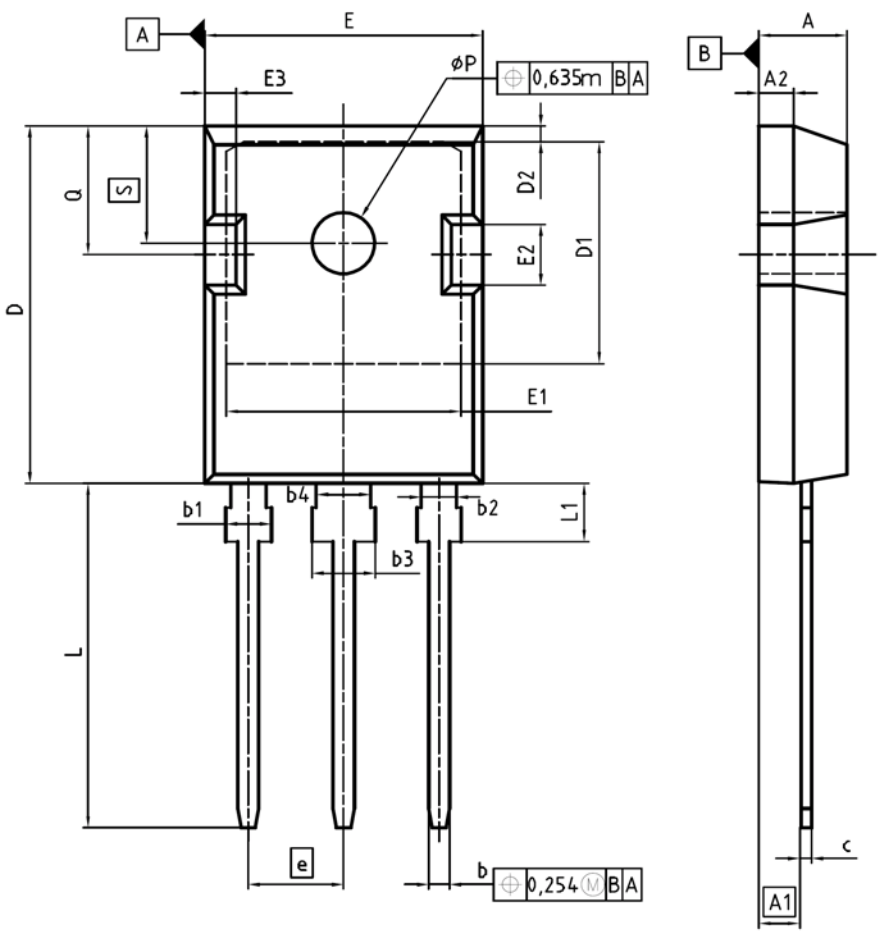
Please note the new package dimensions arccording to PCN 2009-134-A

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

DOCUMENT NO.
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SCALE 0 5 7.5mm

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04

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