# CoolMOS™ Power Transistor

Features

- New revolutionary high voltage technology
- Intrinsic fast-recovery body diode
- Extremely low reverse recovery charge
- Ultra low gate charge
- Extreme dv/dt 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
$R_{DS(on),max}$	0.083	Ω
I_D	46	A

PG-TO247

drain pin 2
gate pin 1
source pin 3
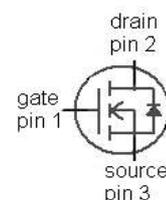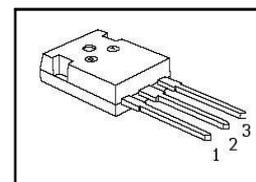
Type	Package	Ordering Code	Marking
SPW47N60CFD	PG-TO247	Q67045A5051	47N60CFD

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

Parameter	Symbol	Conditions	Value	Unit
Continuous drain current	I_D	T_C=25 °C	46	A
		T_C=100 °C	29	
Pulsed drain current[1]	$I_{D,pulse}$	T_C=25 °C	115	
Avalanche energy, single pulse	E_{AS}	I_D=10 A, V_{DD}=50 V	1800	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	dv/dt	I_D=46 A, V_{DS}=480 V, T_j=125 °C	80	V/ns
Reverse diode dv/dt	dv/dt	I_S=46 A, V_{DS}=480 V, T_j=125 °C	40	V/ns
Maximum diode commutation speed	di/dt		600	A/µs
Gate source voltage	V_{GS}	static	±20	V
		AC (f>1 Hz)	±30	
Power dissipation	P_{tot}	T_C=25 °C	417	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

Parameter	Symbol	Conditions	min.	typ.	max.	Unit
Thermal resistance, junction - case	R_{thJC}		-	-	0.3	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

Parameter	Symbol	Conditions	min.	typ.	max.	Unit
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=46 A	-	700	-	
Gate threshold voltage	$V_{GS(th)}$	V_{DS}=V_{GS}, I_D=2.9 mA	3	4	5	
Zero gate voltage drain current	I_{DSS}	V_{DS}=600 V, V_{GS}=0 V, T_j=25 °C	-	6	-	µA
		V_{DS}=600 V, V_{GS}=0 V, T_j=150 °C	-	5000	-	
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=29 A, T_j=25 °C	-	0.07	0.083	Ω
		V_{GS}=10 V, I_D=29 A, T_j=150 °C	-	0.15	-	
Gate resistance	R_G	f=1 MHz, open drain	-	0.62	-	
Transconductance	g_{fs}	$|V_{DS}|$>2$|I_D|R_{DS(on)max}$, I_D=29 A	-	30	-	S

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	

Dynamic characteristics

Parameter	Symbol	Conditions	min.	typ.	max.	Unit
Input capacitance	C_{iss}	V_{GS}=0 V, V_{DS}=25 V, f=1 MHz	-	7700	-	pF
Output capacitance	C_{oss}		-	2200	-	
Reverse transfer capacitance	C_{rss}		-	77	-	
Effective output capacitance, energy related[4]	$C_{o(er)}$	V_{GS}=0 V, V_{DS}=0 V to 480 V	-	245	-	
Effective output capacitance, time related[5]	$C_{o(tr)}$		-	453	-	
Turn-on delay time	$t_{d(on)}$	V_{DD}=400 V, V_{GS}=10 V, I_D=46 A, R_G=3.3 Ω	-	30	-	ns
Rise time	t_r		-	30	-	
Turn-off delay time	$t_{d(off)}$		-	100	-	
Fall time	t_f		-	15	-	

Gate Charge Characteristics

Parameter	Symbol	Conditions	min.	typ.	max.	Unit
Gate to source charge	Q_{gs}	V_{DD}=480 V, I_D=46 A, V_{GS}=0 to 10 V	-	54	-	nC
Gate to drain charge	Q_{gd}		-	130	-	
Gate charge total	Q_g		-	248	322	
Gate plateau voltage	$V_{plateau}$		-	7.1	-	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}.

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

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	

Reverse Diode

Parameter	Symbol	Conditions	min.	typ.	max.	Unit
Diode continuous forward current	I_S	T_C=25 °C	-	-	46	A
Diode pulse current	$I_{S,pulse}$		-	-	115	
Diode forward voltage	V_{SD}	V_{GS}=0 V, I_F=46 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	-	210	-	ns
Reverse recovery charge	Q_{rr}		-	2	-	µC
Peak reverse recovery current	I_{rrm}		-	18	-	A

Typical Transient Thermal Characteristics

Symbol	Value	Unit	Symbol	Value	Unit
	typ.			typ.	
R_{th1}	0.00289	K/W	C_{th1}	0.000564	Ws/K
R_{th2}	0.00399		C_{th2}	0.0034	
R_{th3}	0.0224		C_{th3}	0.0048	
R_{th4}	0.0421		C_{th4}	0.0273	
R_{th5}	0.0619		C_{th5}	0.149	
			C_{th6}	4.4[5]	
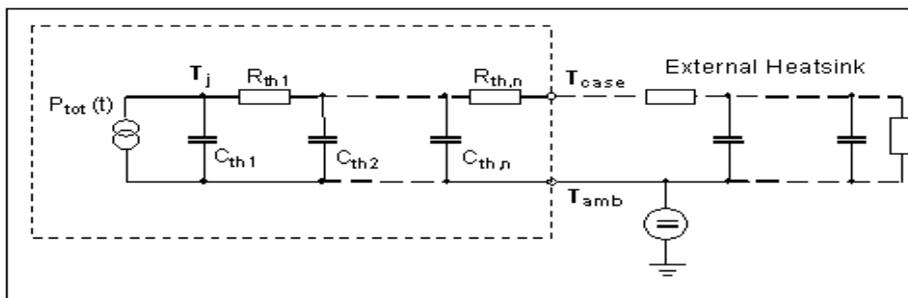
[5] C_{th6} models the additional heat capacitance of the package in case of non-ideal cooling. It is not needed if R_{thCA}=0 K/W.

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

1 Power dissipation

P_{tot}=f(T_C)
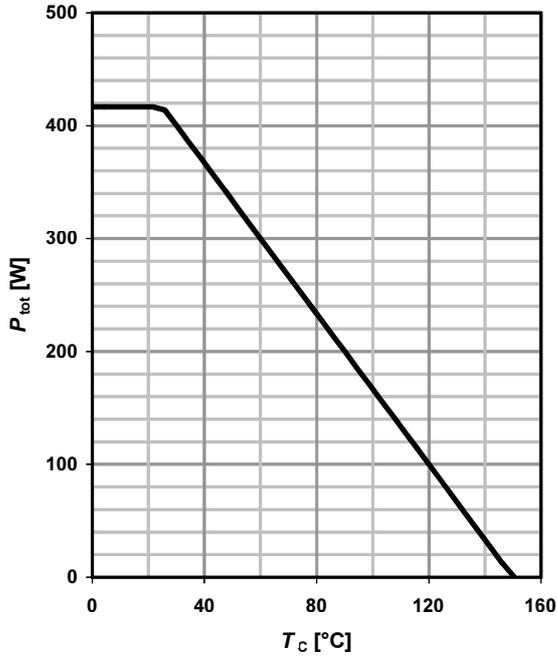
2 Safe operating area

I_D=f(V_{DS}); T_C=25 °C; D=0

parameter: t_p
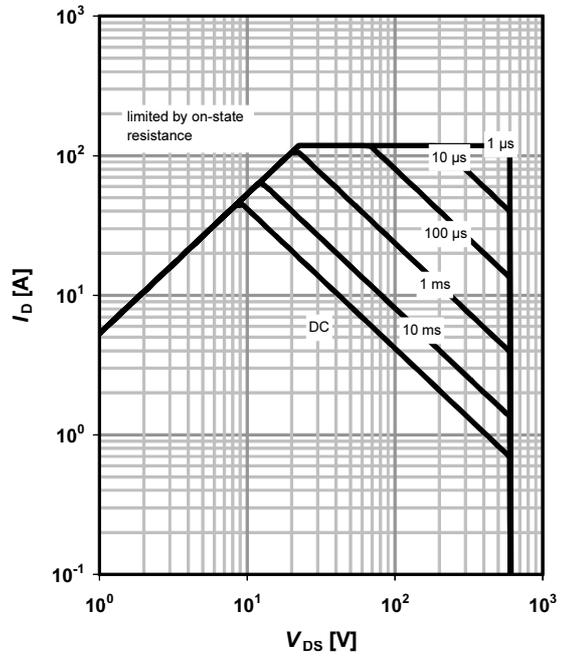
**3 Max. transient thermal impedance**

I_D=f(V_{DS}); T_j=25 °C

parameter: D=t_p/T
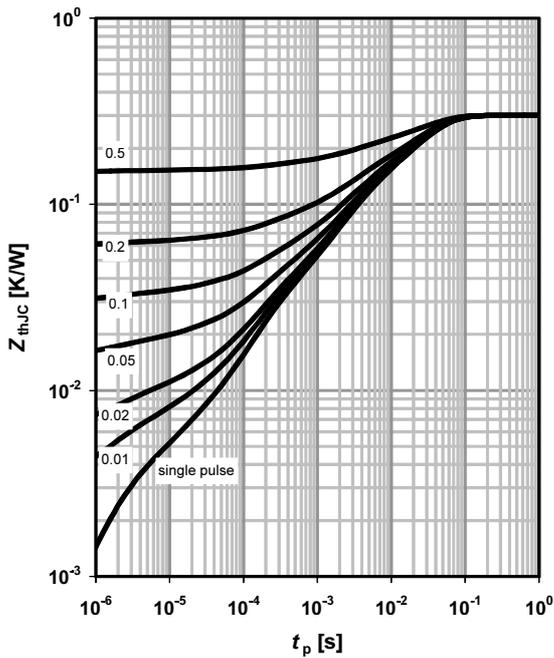
4 Typ. output characteristics

I_D=f(V_{DS}); T_j=25 °C

parameter: V_{GS}

Please note the new package dimensions arccording to PCN 2009-134-A
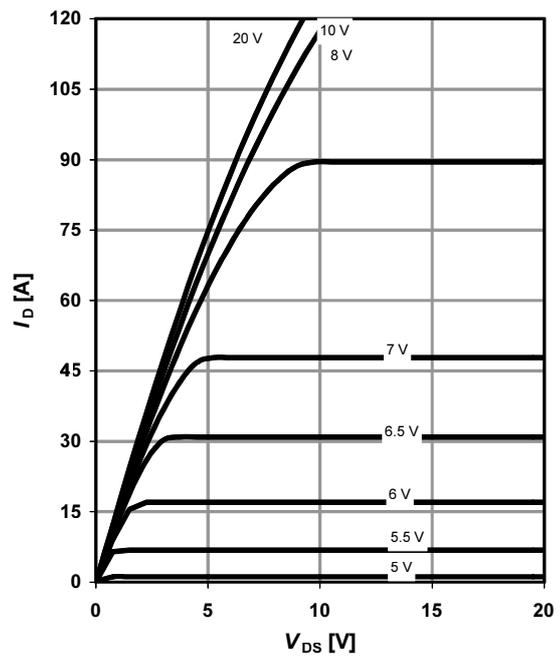
5 Typ. output characteristics

I_D=f(V_{DS}); T_j=150 °C

parameter: V_{GS}
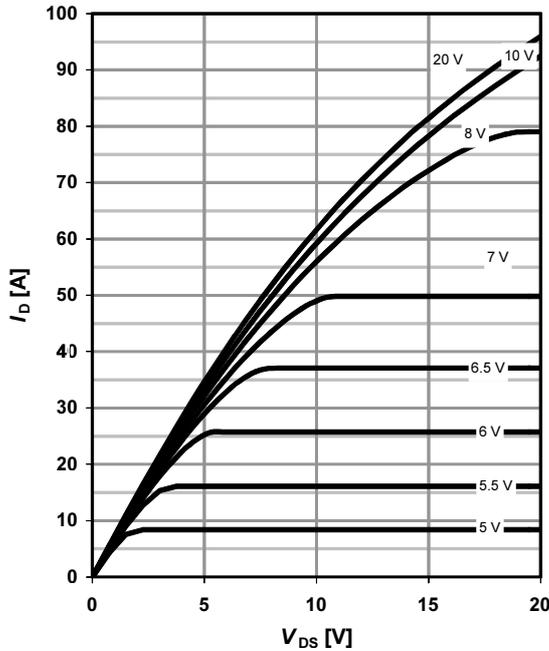
6 Typ. drain-source on-state resistance

$R_{DS(on)}$=f(I_D); T_j=150 °C

parameter: V_{GS}
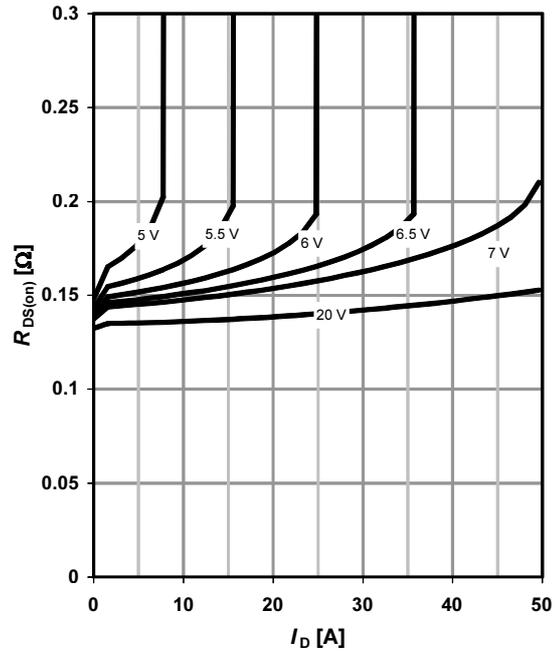
7 Drain-source on-state resistance

$R_{DS(on)}$=f(T_{ji}); I_D=30 A; V_{GS}=10 V
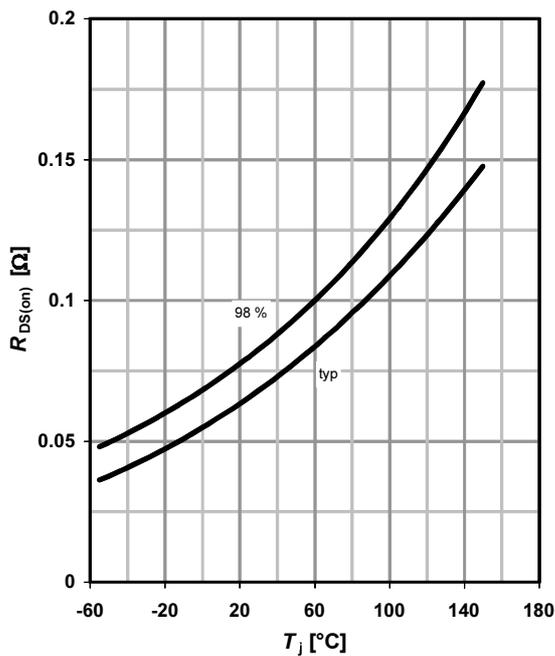
8 Typ. transfer characteristics

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

parameter: T_j
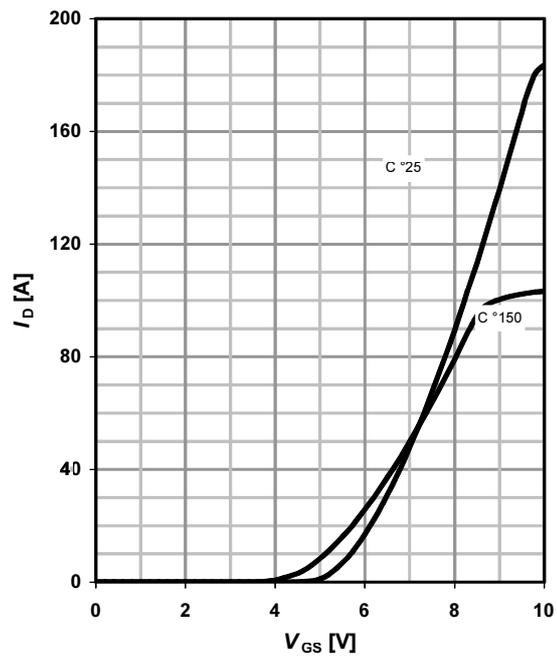
9 Typ. gate charge

V_{GS}=f(Q_{gate}); I_D=47 A pulsed

parameter: V_{DD}
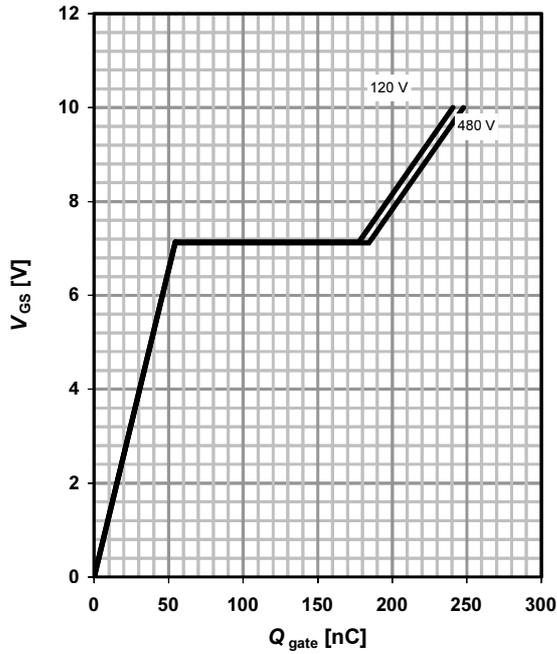
**10 Forward characteristics of reverse diode**

I_F=f(V_{SD})

parameter: T_j
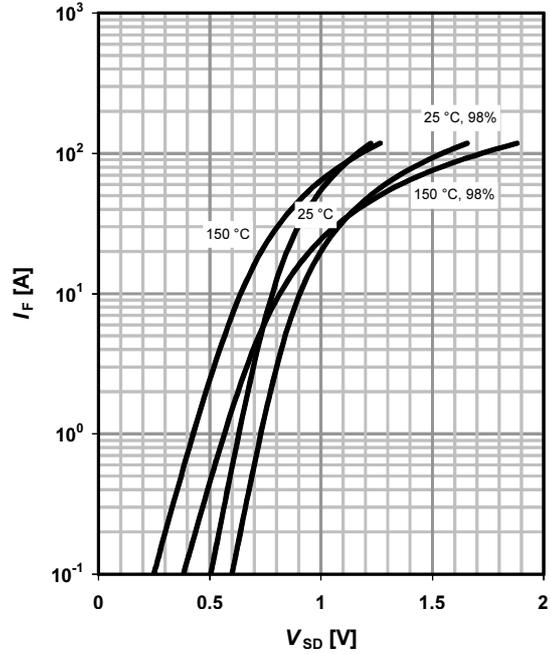
**11 Avalanche SOA**

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

parameter: $T_{j(start)}$
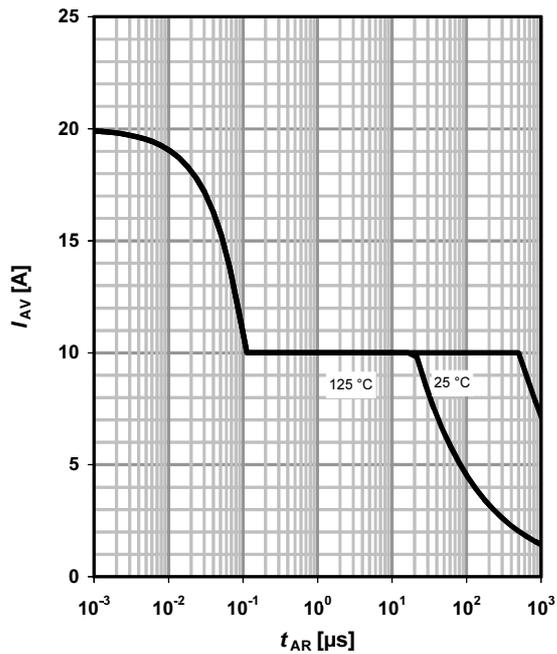
**12 Avalanche energy**

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

Please note the new package dimensions arccording to PCN 2009-134-A
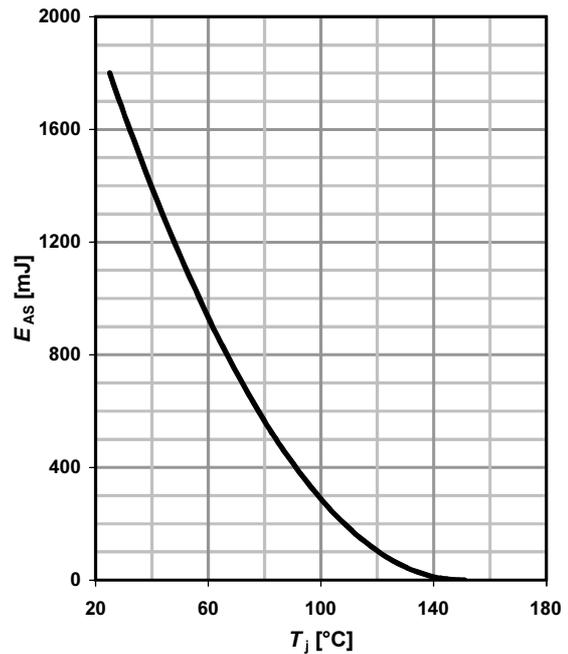
13 Drain-source breakdown voltage

$V_{BR(DSS)}$=f(T_j); I_D=15 mA
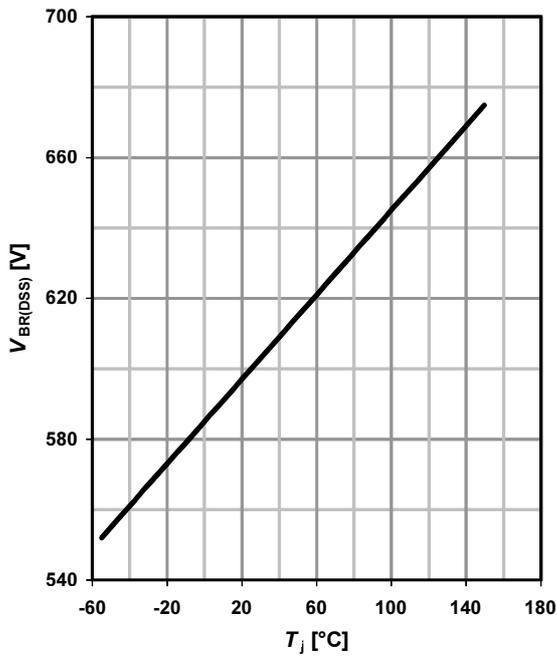
14 Typ. capacitances

C=f(V_{DS}); V_{GS}=0 V; f=1 MHz
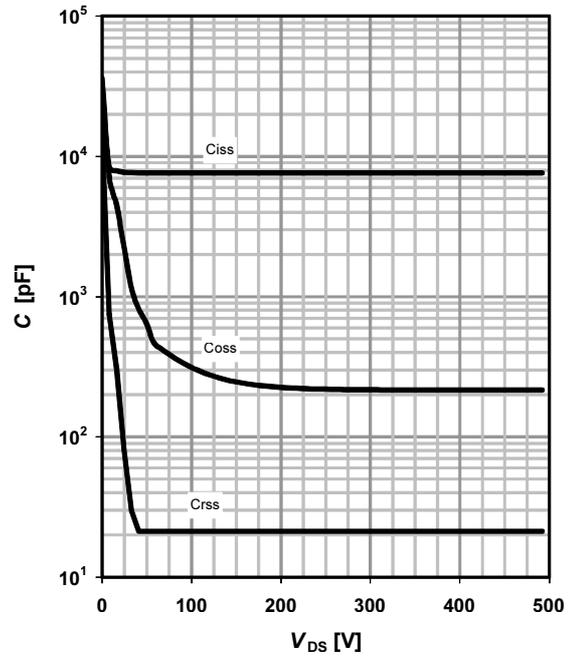
15 Typ. C_{oss} stored energy

E_{oss}= f(V_{DS})
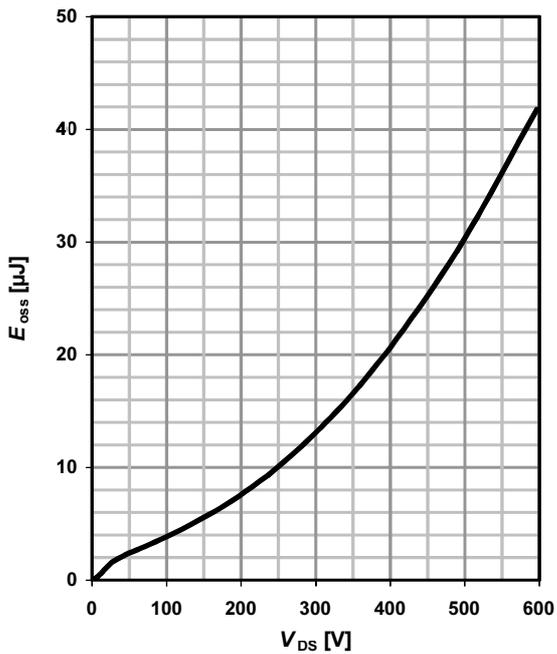
16 Typ. reverse recovery charge

Q_{rr}=f(T_j); I_S=47 A; di/dt=100 A/µs

Please note the new package dimensions arccording to PCN 2009-134-A
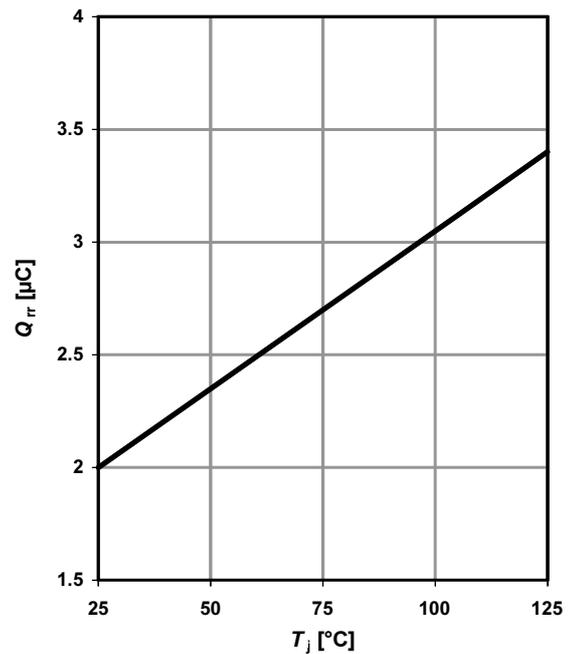
17 Typ. reverse recovery charge

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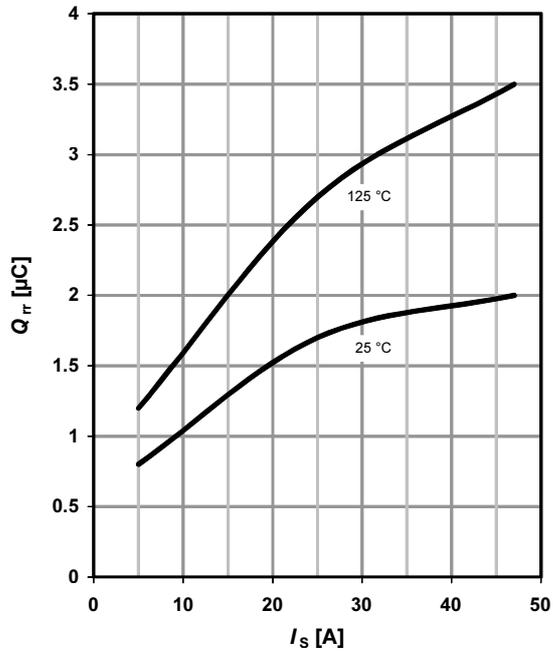
parameter: T_j

18 Typ. reverse recovery charge

Q_{rr}=f(di/dt); I_S=47 A

parameter: T_j

Please note the new package dimensions arccording to PCN 2009-134-A
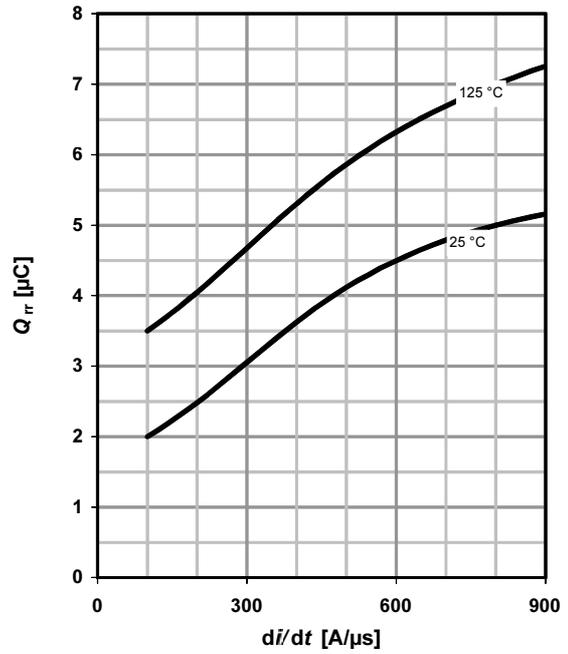
Definition of diode switching characteristics

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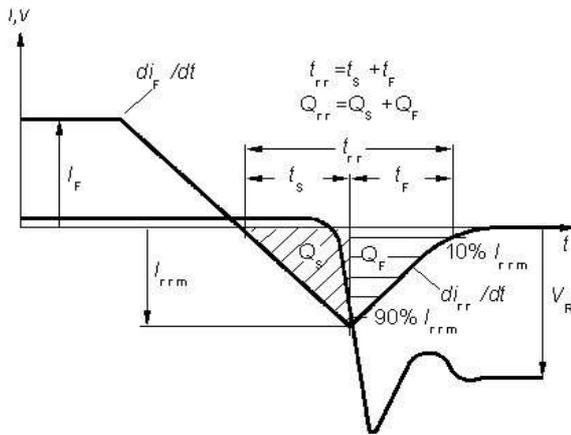
PG-TO247-3-21-41
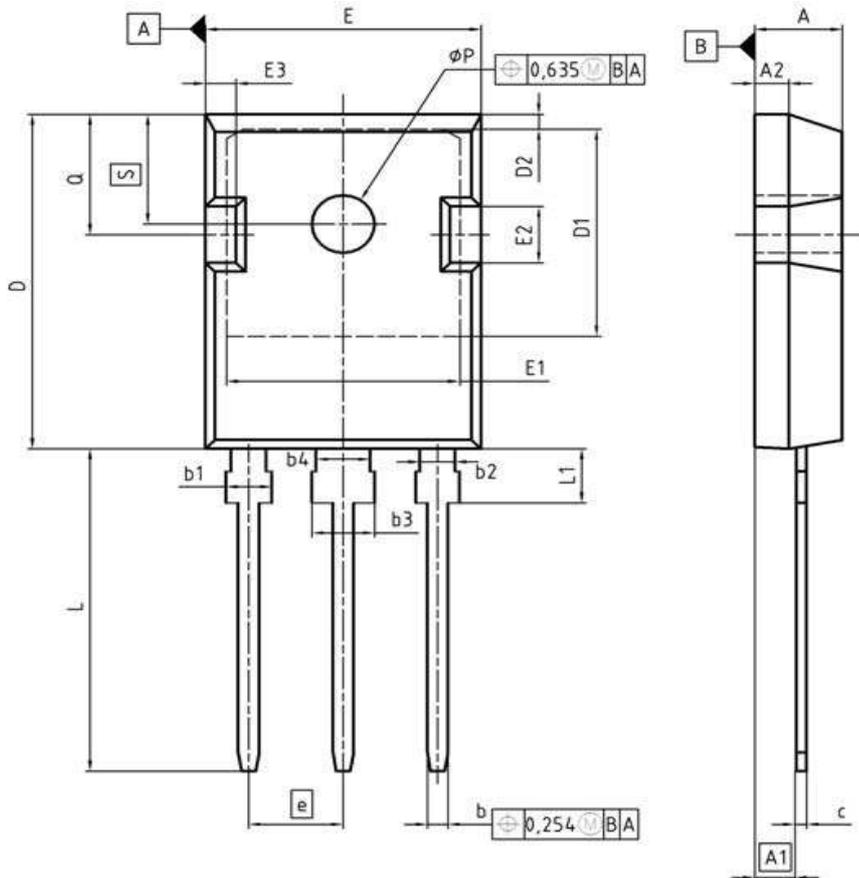
DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.90	5.16	0.193	0.203
A1	2.27	2.53	0.089	0.099
A2	1.85	2.11	0.073	0.083
b	1.07	1.33	0.042	0.052
b1	1.90	2.41	0.075	0.095
b2	1.90	2.16	0.075	0.085
b3	2.87	3.38	0.113	0.133
b4	2.87	3.13	0.113	0.123
c	0.55	0.68	0.022	0.027
D	20.82	21.10	0.820	0.831
D1	16.25	17.65	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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Z8B00003327

SCALE

EUROPEAN PROJECTION

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REVISION
03

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

Information
For further information on technology, delivery terms and conditions and prices, please contact the nearest Infineon Technologies Office (www.infineon.com).

Warnings
Due to technical requirements, components may contain dangerous substances. For information on the types in question, please contact the nearest Infineon Technologies Office. The Infineon Technologies component described in this Data Sheet may be used in life-support devices or systems and/or automotive, aviation and aerospace applications or systems only with the express written approval of Infineon Technologies, if a failure of such components can reasonably be expected to cause the failure of that life-support, automotive, aviation and aerospace device or system or to affect the safety or effectiveness of that device or system. Life support devices or systems are intended to be implanted in the human body or to support and/or maintain and sustain and/or protect human life. If they fail, it is reasonable to assume that the health of the user or other persons may be endangered.

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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7.5mm

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