

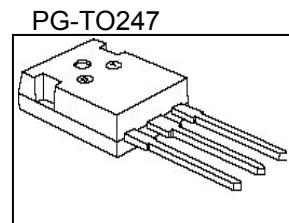
CoolMOS™ Power Transistor

Features

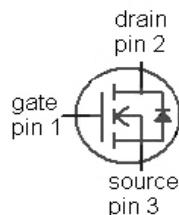
- New revolutionary high voltage technology
- Ultra low gate charge
- Periodic avalanche rated
- Extreme dv/dt rated
- Ultra low effective capacitances
- Improved transconductance
- Pb-free lead plating; RoHS compliant
- Qualified according to JEDEC⁰⁾ for target applications

Product Summary

$V_{DS} @ T_{j,max}$	650	V
$R_{DS(on),max}$	0.1	Ω
I_D	34.6	A



Type	Package	Ordering Code	Marking
SPW35N60C3	PG-T0247	Q67040-S4673	35N60C3



Maximum ratings, at $T_j=25^\circ\text{C}$, unless otherwise specified

Parameter	Symbol	Conditions	Value	Unit
Continuous drain current	I_D	$T_C=25^\circ\text{C}$	34.6	A
		$T_C=100^\circ\text{C}$	21.9	
Pulsed drain current ¹⁾	$I_{D,pulse}$	$T_C=25^\circ\text{C}$	103.8	
Avalanche energy, single pulse	E_{AS}	$I_D=17.3\text{ A}, V_{DD}=50\text{ V}$	1500	mJ
Avalanche energy, repetitive t_{AR} ^{1),2)}	E_{AR}	$I_D=34.6\text{ A}, V_{DD}=50\text{ V}$	1.5	
Avalanche current, repetitive t_{AR} ¹⁾	I_{AR}		34.6	A
Drain source voltage slope	dv/dt	$I_D=34.6\text{ A}, V_{DS}=480\text{ V}, T_j=125^\circ\text{C}$	50	V/ns
Gate source voltage	V_{GS}	static	± 20	V
	V_{GS}	AC ($f>1\text{ Hz}$)	± 30	
Power dissipation	P_{tot}	$T_C=25^\circ\text{C}$	313	W
Operating and storage temperature	T_j, T_{stg}		-55 ... 150	°C
Reverse diode dv/dt ⁶⁾	dv/dt		15	V/ns

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, wavesoldering	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, $I_D=34.6$ A	-	700	-	
Gate threshold voltage	$V_{GS(th)}$	$V_{DS}=V_{GS}$, $I_D=1.9$ 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	-	0.1	1	µA
		$V_{DS}=600$ V, $V_{GS}=0$ V, $T_j=150$ °C	-	-	100	
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, $I_D=21.9$ A, $T_j=25$ °C	-	0.081	0.1	Ω
		$V_{GS}=10$ V, $I_D=21.9$ A, $T_j=150$ °C	-	0.2	-	
Gate resistance	R_G	$f=1$ MHz, open drain	-	0.6	-	
Transconductance	g_{fs}	$ V_{DS} >2 I_D R_{DS(on)max}$, $I_D=21.9$ A	-	36	-	s

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	

Dynamic characteristics

Input capacitance	C_{iss}	$V_{GS}=0 \text{ V}, V_{DS}=25 \text{ V}, f=1 \text{ MHz}$	-	4500	-	pF
Output capacitance	C_{oss}		-	1500	-	
Reverse transfer capacitance	C_{rss}		-	100	-	
Effective output capacitance, energy related ³⁾	$C_{o(er)}$	$V_{GS}=0 \text{ V}, V_{DS}=0 \text{ V}$ to 480 V	-	180	-	
Effective output capacitance, time related ⁴⁾	$C_{o(tr)}$		-	324	-	
Turn-on delay time	$t_{d(on)}$	$V_{DD}=480 \text{ V}, V_{GS}=10 \text{ V}, I_D=34.6 \text{ A}, R_G=3.3 \Omega$	-	10	-	ns
Rise time	t_r		-	5	-	
Turn-off delay time	$t_{d(off)}$		-	70	-	
Fall time	t_f		-	10	-	

Gate Charge Characteristics

Gate to source charge	Q_{gs}	$V_{DD}=480 \text{ V}, I_D=34.6 \text{ A}, V_{GS}=0 \text{ to } 10 \text{ V}$	-	18	-	nC
Gate to drain charge	Q_{gd}		-	70	-	
Gate charge total	Q_g		-	150	200	
Gate plateau voltage	$V_{plateau}$		-	5.3	-	V

¹⁾ Pulse width limited by maximum temperature $T_{j,max}$ only

²⁾ Repetitive avalanche causes additional power losses that can be calculated as $P_{AV}=E_{AR} \cdot f$.

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} .

⁶⁾ $I_{SD} \leq I_D$, $di/dt \leq 200 \text{ A/us}$, $V_{DClink}=400 \text{ V}$, $V_{peak} < V_{BR, DSS}$, $T_j < T_{j,max}$.

Identical low-side and high-side switch.

⁰⁾ J-STD20 and JESD22

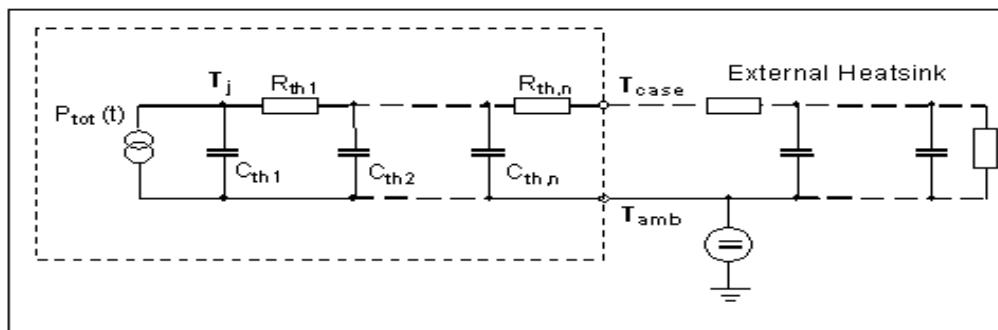
Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	

Reverse Diode

Diode continuous forward current	I_S	$T_C=25\text{ }^\circ\text{C}$	-	-	34.6	A
Diode pulse current	$I_{S,\text{pulse}}$		-	-	103.8	
Diode forward voltage	V_{SD}	$V_{GS}=0\text{ V}, I_F=34.6\text{ A}, T_j=25\text{ }^\circ\text{C}$	-	0.95	1.2	V
Reverse recovery time	t_{rr}	$V_R=480\text{ V}, I_F=I_S, di_F/dt=100\text{ A}/\mu\text{s}$	-	600	-	ns
Reverse recovery charge	Q_{rr}		-	21	-	μC
Peak reverse recovery current	I_{rrm}		-	90	-	A

Typical Transient Thermal Characteristics

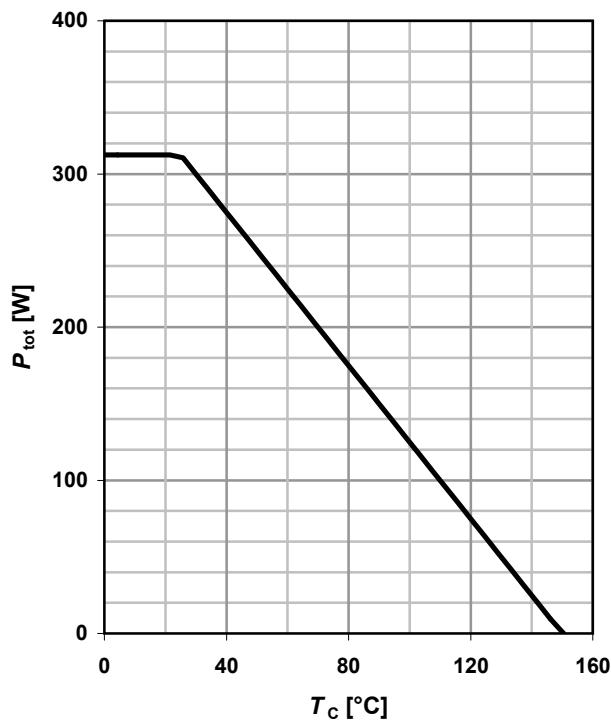
Symbol	Value	Unit	Symbol	Value	Unit
R_{th1}	0.00441	K/W	C_{th1}	0.00037	Ws/K
	0.00608		C_{th2}	0.00223	
	0.0341		C_{th3}	0.00315	
	0.0602		C_{th4}	0.0179	
	0.0884		C_{th5}	0.098	
			C_{th6}	4.4 ⁵⁾	



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

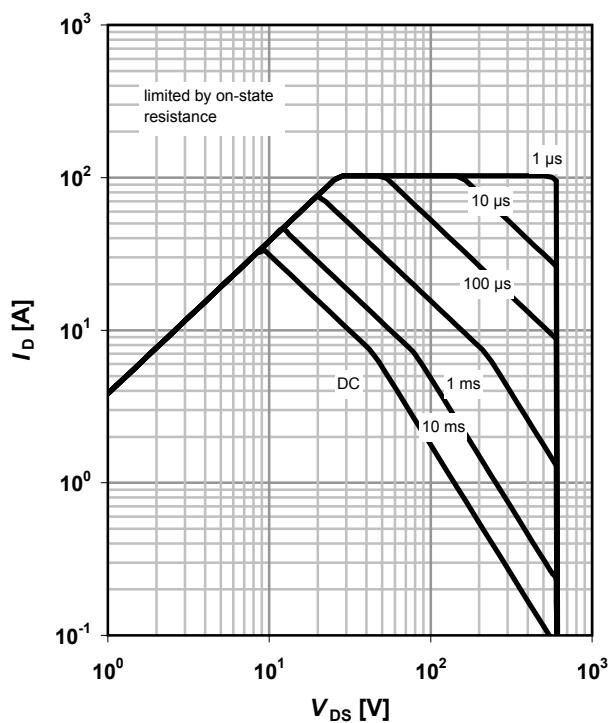
1 Power dissipation

$$P_{\text{tot}} = f(T_c)$$


2 Safe operating area

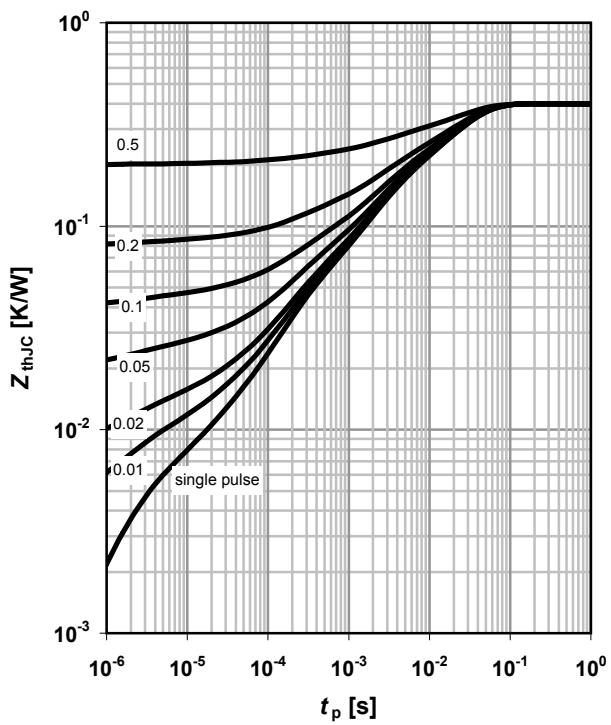
$$I_D = f(V_{DS}); T_c = 25^\circ\text{C}; D = 0$$

parameter: t_p


3 Max. transient thermal impedance

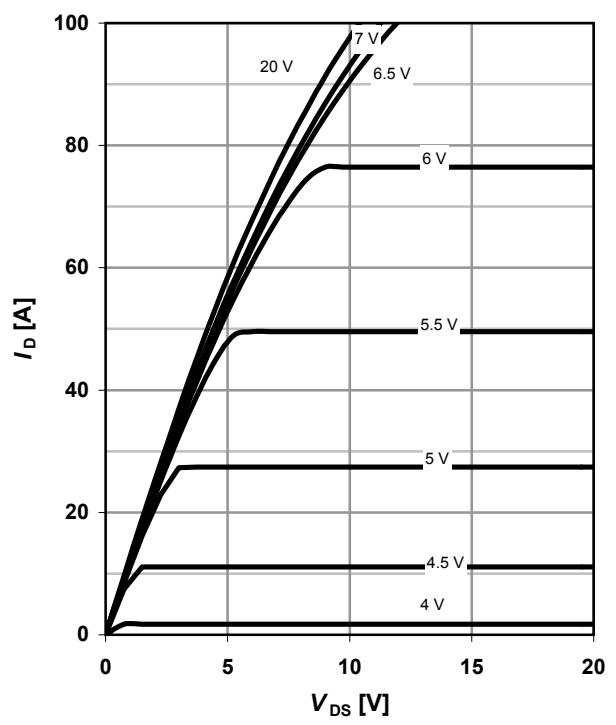
$$I_D = f(V_{DS}); T_j = 25^\circ\text{C}$$

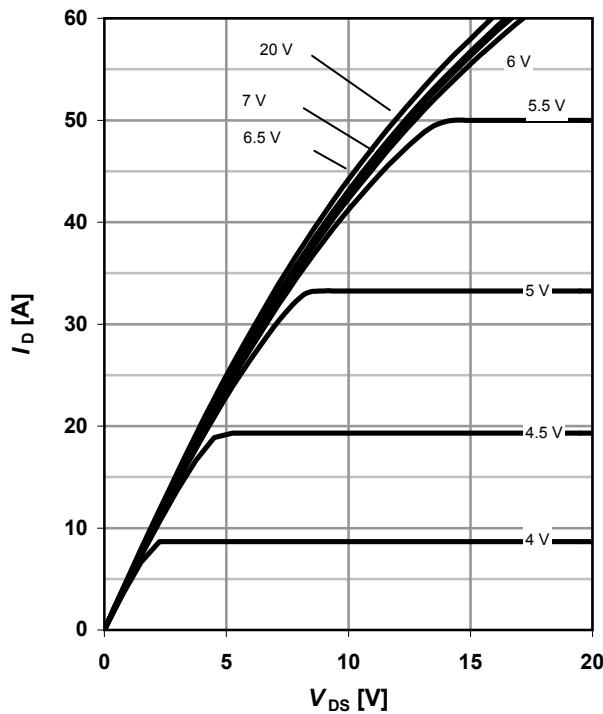
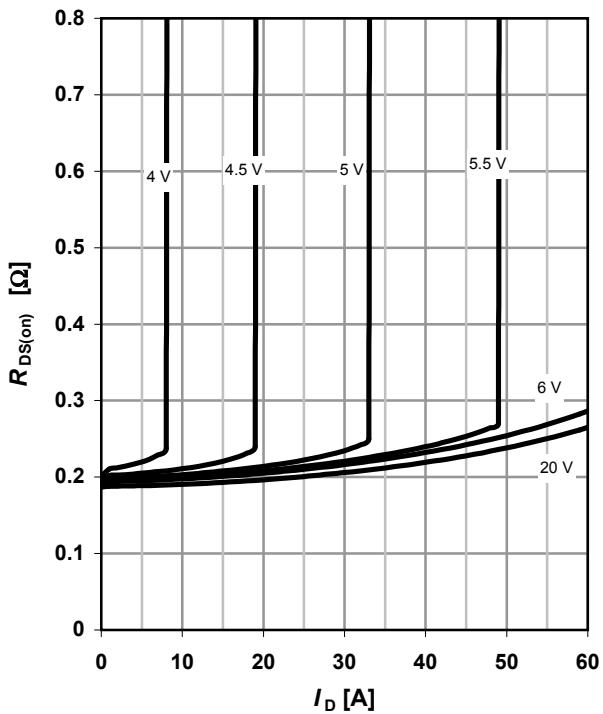
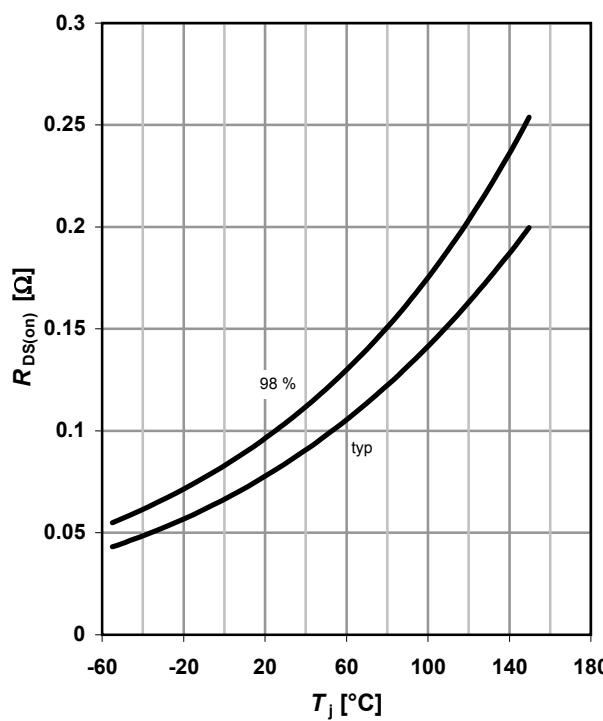
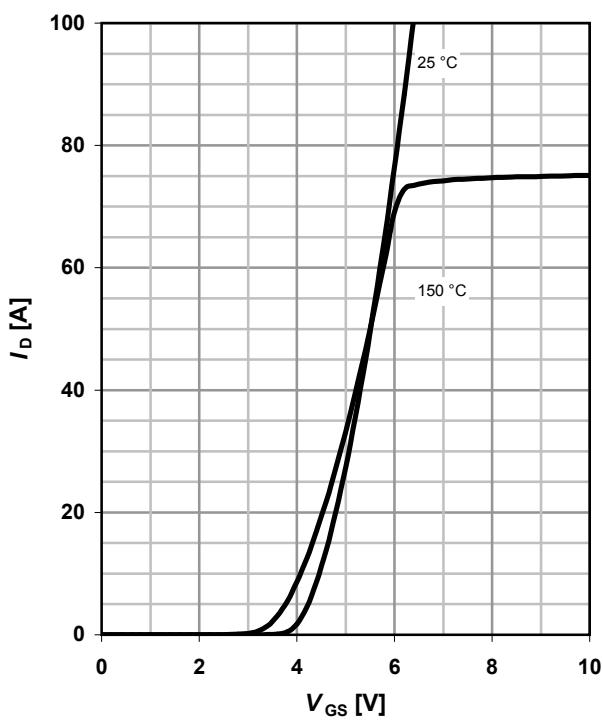
parameter: $D = t_p/T$


4 Typ. output characteristics

$$I_D = f(V_{DS}); T_j = 25^\circ\text{C}$$

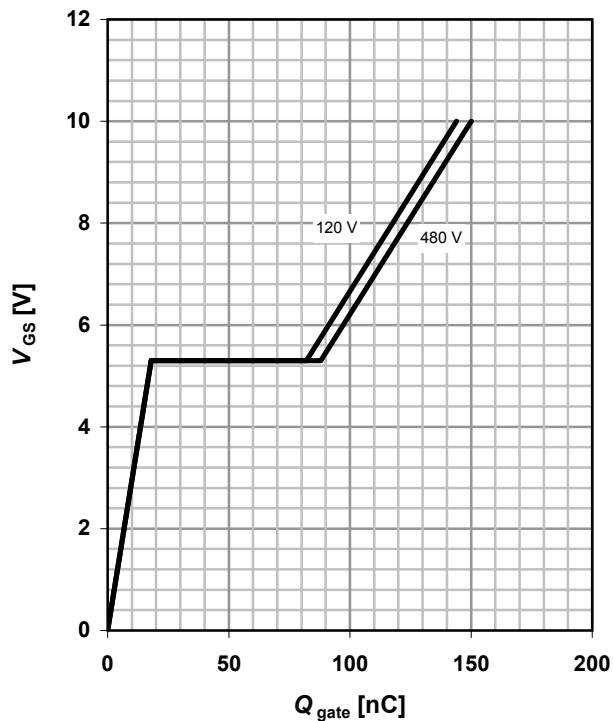
parameter: V_{GS}



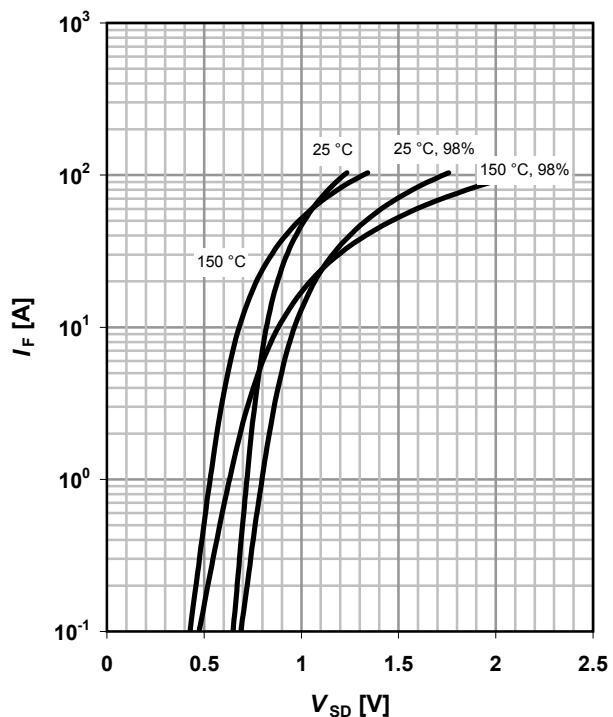
5 Typ. output characteristics
 $I_D = f(V_{DS})$; $T_j = 150 \text{ }^\circ\text{C}$
parameter: V_{GS} 
6 Typ. drain-source on-state resistance
 $R_{DS(on)} = f(I_D)$; $T_j = 150 \text{ }^\circ\text{C}$
parameter: V_{GS} 
7 Drain-source on-state resistance
 $R_{DS(on)} = f(T_j)$; $I_D = 21.9 \text{ A}$; $V_{GS} = 10 \text{ V}$

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

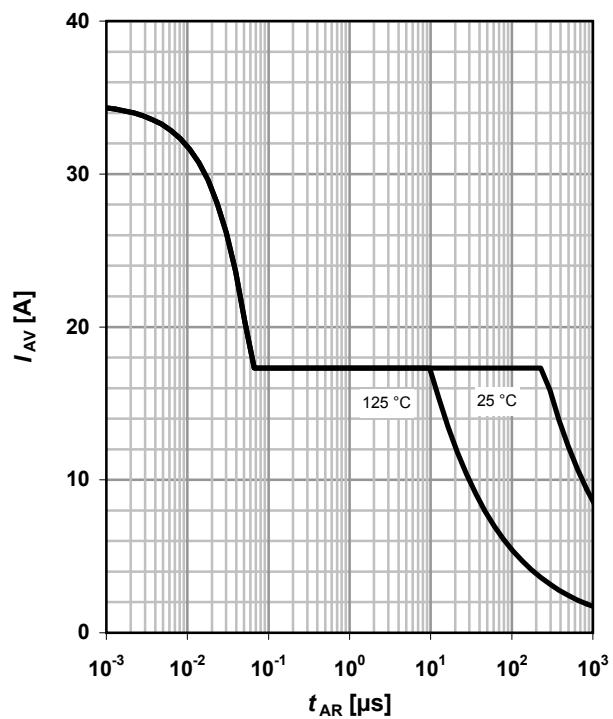
$V_{GS} = f(Q_{gate})$; $I_D = 34.6 \text{ A}$ pulsed
parameter: V_{DD}


10 Forward characteristics of reverse diode

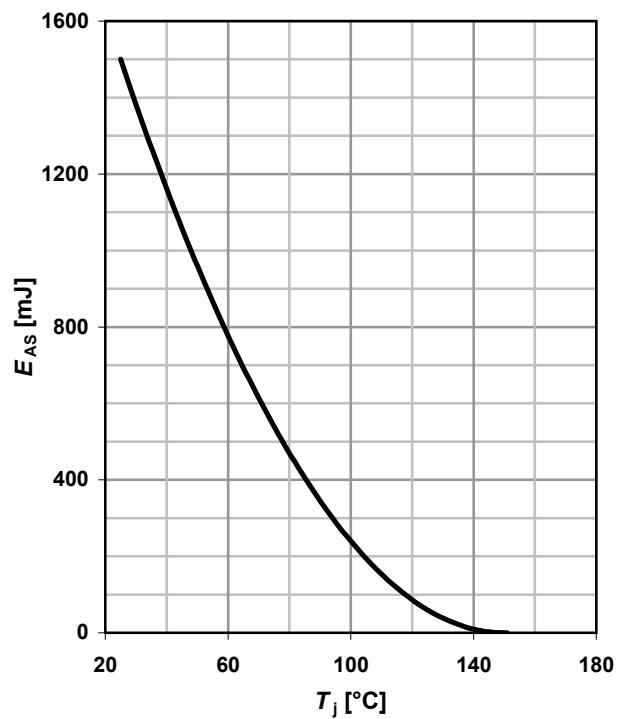
$I_F = f(V_{SD})$
parameter: T_j

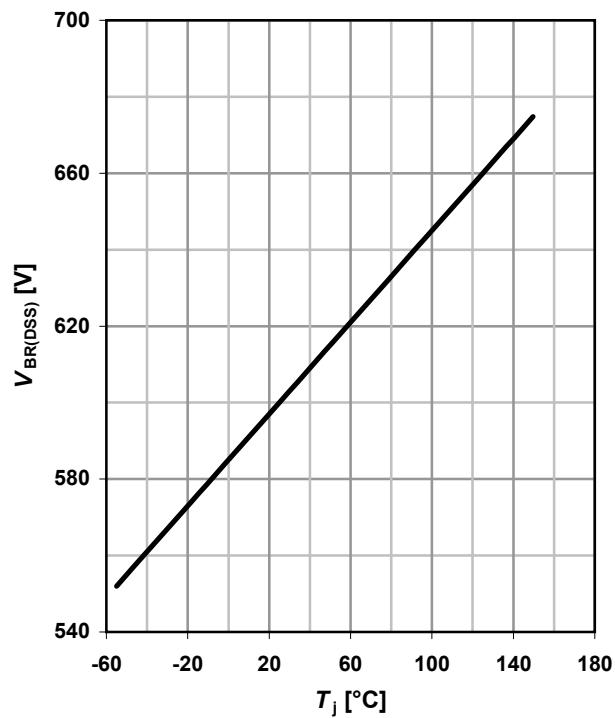
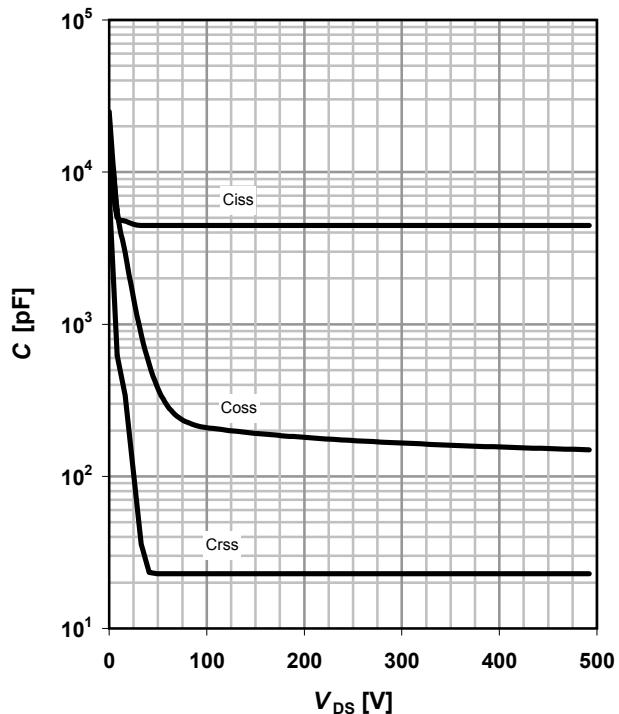
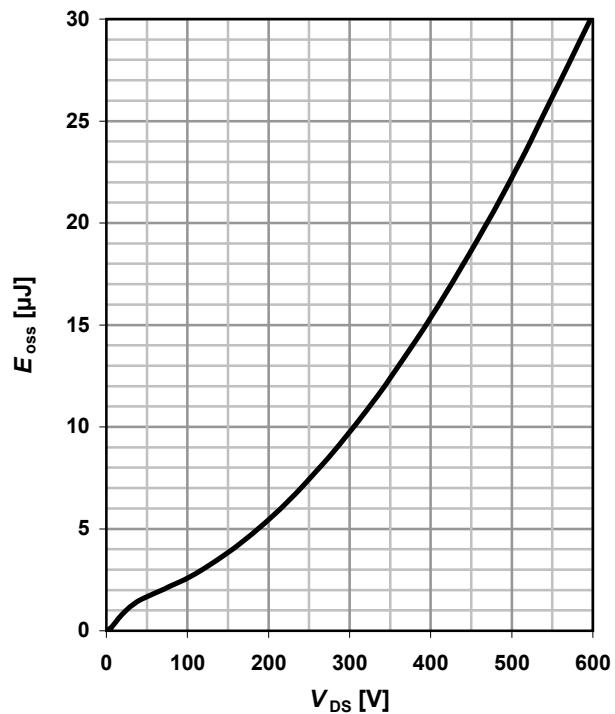

11 Avalanche SOA

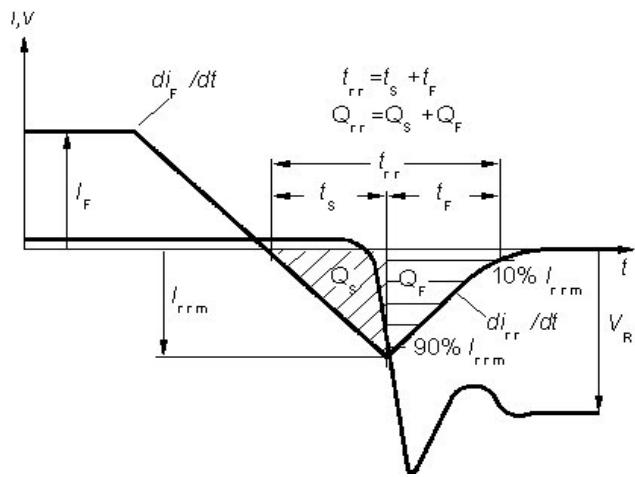
$I_{AR} = f(t_{AR})$
parameter: $T_{j(\text{start})}$

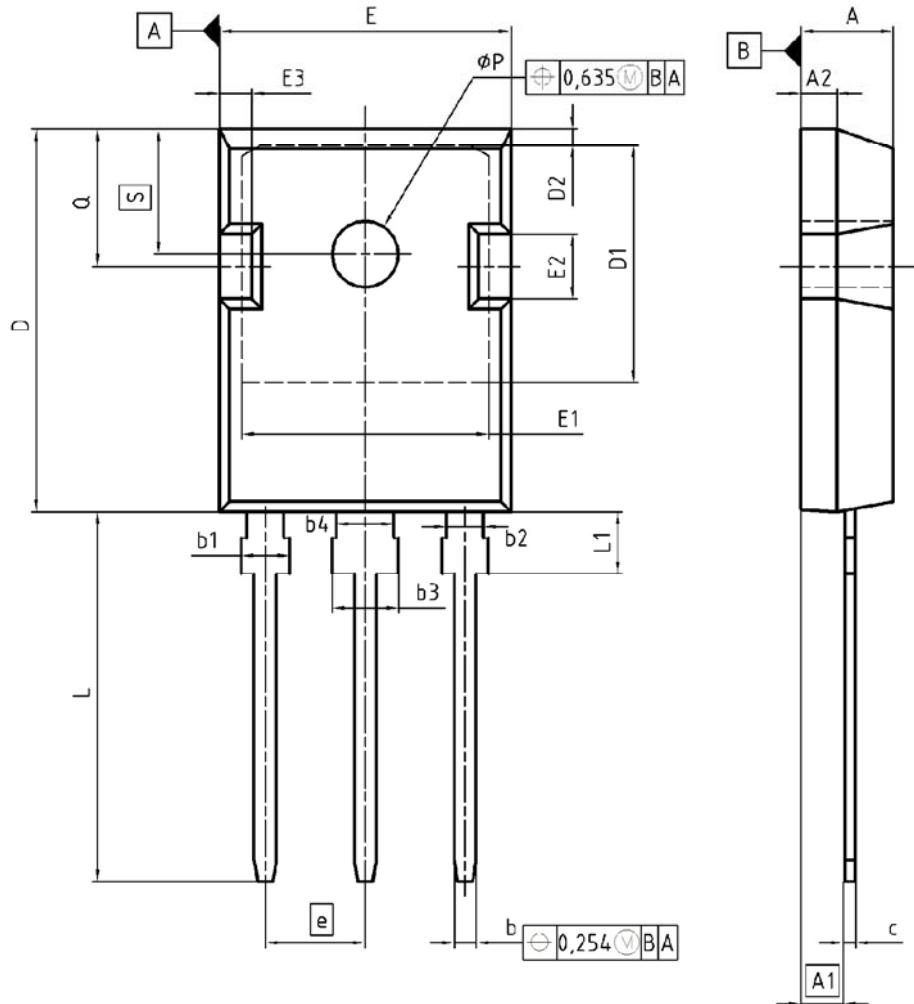

12 Avalanche energy

$E_{AS} = f(T_j)$; $I_D = 17.3 \text{ A}$; $V_{DD} = 50 \text{ V}$



13 Drain-source breakdown voltage
 $V_{BR(DSS)} = f(T_j); I_D = 0.25 \text{ mA}$

14 Typ. capacitances
 $C = f(V_{DS}); V_{GS} = 0 \text{ V}; f = 1 \text{ MHz}$

15 Typ. C_{oss} stored energy
 $E_{oss} = f(V_{DS})$


Definition of diode switching characteristics




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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New package outlines TO-247

1 New package outlines TO-247

Assembly capacity extension for CoolMOS™ technology products assembled in lead-free package PG-T0247-3 at subcontractor ASE (Weihai) Inc., China (Changes are marked in blue.)

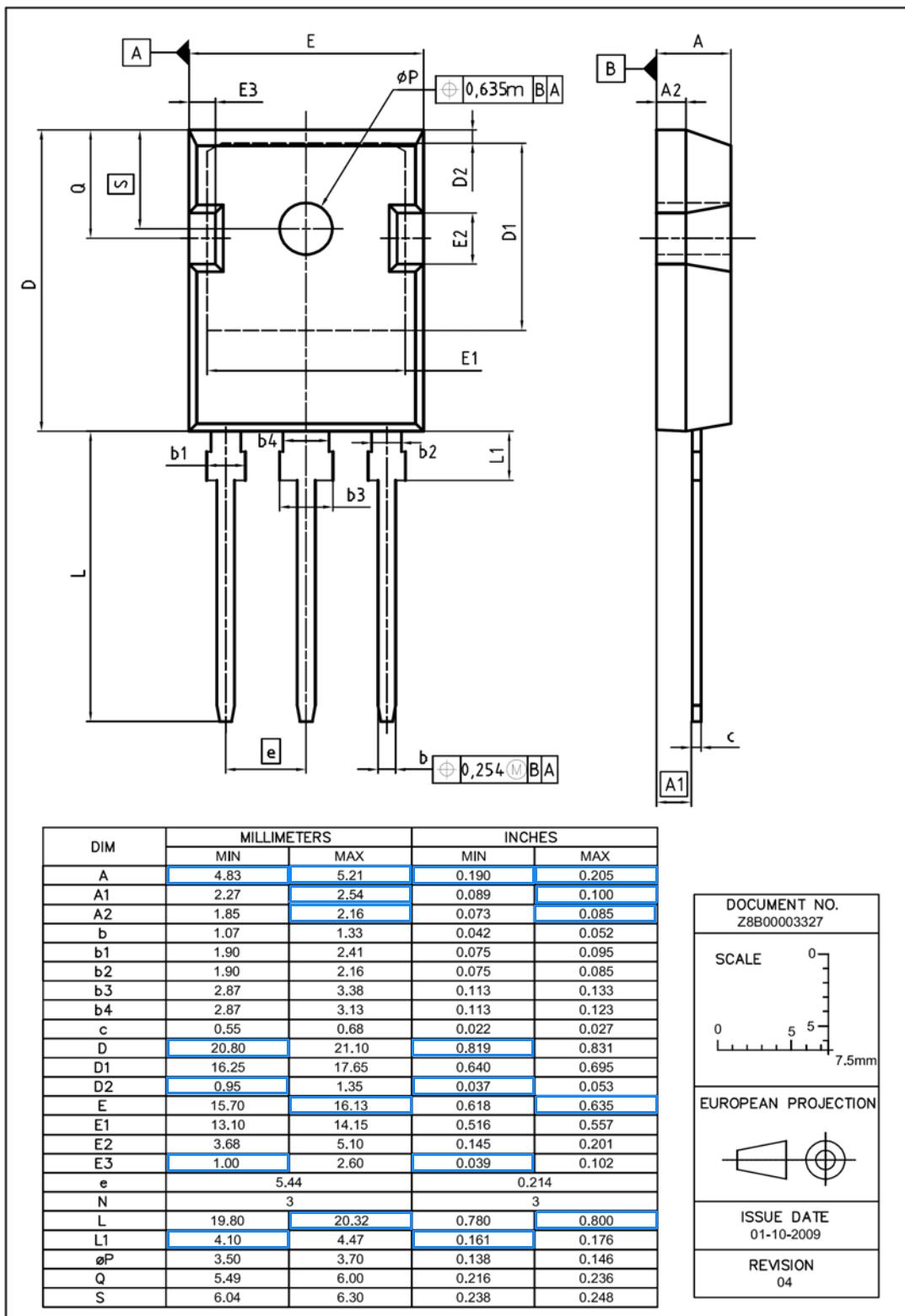


Figure 1 Outlines TO-247, dimensions in mm/inches

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