

CoolMOS™ Power Transistor

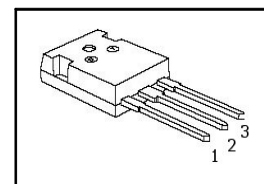
Features

- Lowest figure-of-merit $R_{ON} \times Q_g$
- Ultra low gate charge
- Extreme dv/dt rated
- High peak current capability
- Pb-free lead plating; RoHS compliant
- Qualified for industrial grade applications according to JEDEC¹⁾

Product Summary

$V_{DS} @ T_{jmax}$	550	V
$R_{DS(on),max}$	0.250	Ω
$Q_{g,typ}$	27	nC

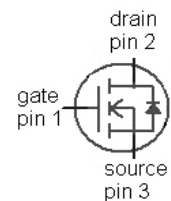
PG-TO247



CoolMOS CP is designed for:

- Hard & soft switching SMPS topologies
- CCM PFC for ATX, Notebook adapter, PDP and LCD TV
- PWM Stages for ATX, Notebook adapter, PDP and LCD TV

Type	Package	Marking
IPW50R250CP	PG-TO247	5R250P



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

Parameter	Symbol	Conditions	Value	Unit
Continuous drain current	I_D	$T_C=25^\circ\text{C}$	13	A
		$T_C=100^\circ\text{C}$	9	
Pulsed drain current ²⁾	$I_{D,pulse}$	$T_C=25^\circ\text{C}$	31	
Avalanche energy, single pulse	E_{AS}	$I_D=5.2\text{ A}$, $V_{DD}=50\text{ V}$	345	mJ
Avalanche energy, repetitive $t_{AR}^{2),3)}$	E_{AR}	$I_D=5.2\text{ A}$, $V_{DD}=50\text{ V}$	0.52	
Avalanche current, repetitive $t_{AR}^{2),3)}$	I_{AR}		5.2	A
MOSFET dv/dt ruggedness	dv/dt	$V_{DS}=0\ldots 400\text{ V}$	50	V/ns
Gate source voltage	V_{GS}	static	± 20	V
		AC ($f>1\text{ Hz}$)	± 30	
Power dissipation	P_{tot}	$T_C=25^\circ\text{C}$	114	W
Operating and storage temperature	T_j , T_{stg}		-55 ... 150	$^\circ\text{C}$
Mounting torque		M3 and M3.5 screws	60	Ncm

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

Parameter	Symbol	Conditions	Value	Unit
Continuous diode forward current	I_S	$T_C=25\text{ }^{\circ}\text{C}$	7.8	A
Diode pulse current ²⁾	$I_{S,pulse}$		31	
Reverse diode dv/dt ⁴⁾	dv/dt		15	V/ns

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	

Thermal characteristics

Thermal resistance, junction - case	R_{thJC}		-	-	1.1	K/W
Thermal resistance, junction - ambient	R_{thJA}	lead	-	-	62	
Soldering temperature, wavesoldering only allowed at leads	T_{solder}	1.6 mm (0.063 in.) from case for 10 s	-	-	260	$^{\circ}\text{C}$

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

Static characteristics

Drain-source breakdown voltage	$V_{(BR)DSS}$	$V_{GS}=0\text{ V}, I_D=250\text{ }\mu\text{A}$	500	-	-	V
Gate threshold voltage	$V_{GS(th)}$	$V_{DS}=V_{GS}, I_D=0.52\text{ mA}$	2.5	3	3.5	
Zero gate voltage drain current	I_{DSS}	$V_{DS}=500\text{ V}, V_{GS}=0\text{ V}, T_j=25\text{ }^{\circ}\text{C}$	-	-	1	μA
		$V_{DS}=500\text{ V}, V_{GS}=0\text{ V}, T_j=150\text{ }^{\circ}\text{C}$	-	10	-	
Gate-source leakage current	I_{GSS}	$V_{GS}=20\text{ V}, V_{DS}=0\text{ V}$	-	-	100	nA
Drain-source on-state resistance	$R_{DS(on)}$	$V_{GS}=10\text{ V}, I_D=7.8\text{ A}, T_j=25\text{ }^{\circ}\text{C}$	-	0.22	0.25	Ω
		$V_{GS}=10\text{ V}, I_D=7.8\text{ A}, T_j=150\text{ }^{\circ}\text{C}$	-	0.54	-	
Gate resistance	R_G	$f=1\text{ MHz}$, open drain	-	2.2	-	Ω

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	

Dynamic characteristics

Input capacitance	C_{iss}	$V_{GS}=0\text{ V}, V_{DS}=100\text{ V},$ $f=1\text{ MHz}$	-	1420	-	pF
Output capacitance	C_{oss}		-	63	-	
Effective output capacitance, energy related ⁵⁾	$C_{o(er)}$	$V_{GS}=0\text{ V}, V_{DS}=0\text{ V}$ to 400 V	-	60	-	
Effective output capacitance, time related ⁶⁾	$C_{o(tr)}$		-	130	-	
Turn-on delay time	$t_{d(on)}$	$V_{DD}=400\text{ V},$ $V_{GS}=10\text{ V}, I_D=7.8\text{ A},$ $R_G=23.1\Omega$	-	35	-	ns
Rise time	t_r		-	14	-	
Turn-off delay time	$t_{d(off)}$		-	80	-	
Fall time	t_f		-	11	-	

Gate Charge Characteristics

Gate to source charge	Q_{gs}	$V_{DD}=400\text{ V}, I_D=7.8\text{ A},$ $V_{GS}=0\text{ to }10\text{ V}$	-	6	-	nC
Gate to drain charge	Q_{gd}		-	9	-	
Gate charge total	Q_g		-	27	36	
Gate plateau voltage	$V_{plateau}$		-	5.2	-	V

Reverse Diode

Diode forward voltage	V_{SD}	$V_{GS}=0\text{ V}, I_F=7.8\text{ A},$ $T_j=25\text{ °C}$	-	0.9	1.2	V
Reverse recovery time	t_{rr}	$V_R=400\text{ V}, I_F=I_S,$ $di_F/dt=100\text{ A}/\mu\text{s}$	-	300	-	ns
Reverse recovery charge	Q_{rr}		-	3.1	-	μC
Peak reverse recovery current	I_{rrm}		-	23	-	A

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 $P_{AV}=E_{AR} \cdot f$.

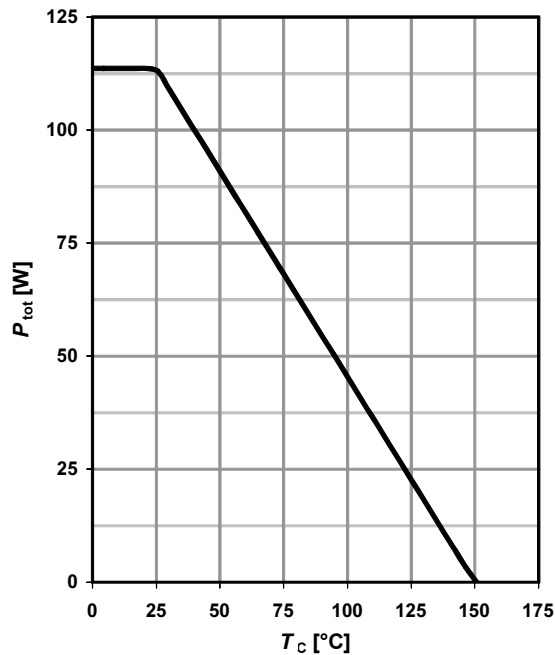
⁴⁾ $I_{SD} \leq I_D$, $di/dt \leq 200\text{ A}/\mu\text{s}$, $V_{DClink}=400\text{ V}$, $V_{peak} < V_{(BR)DSS}$, $T_j < T_{j,max}$, identical low and high side switch

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

⁶⁾ $C_{o(tr)}$ is a fixed capacitance that gives the same charging time as C_{oss} while V_{DS} is rising from 0 to 80% V_{DSS} .

1 Power dissipation

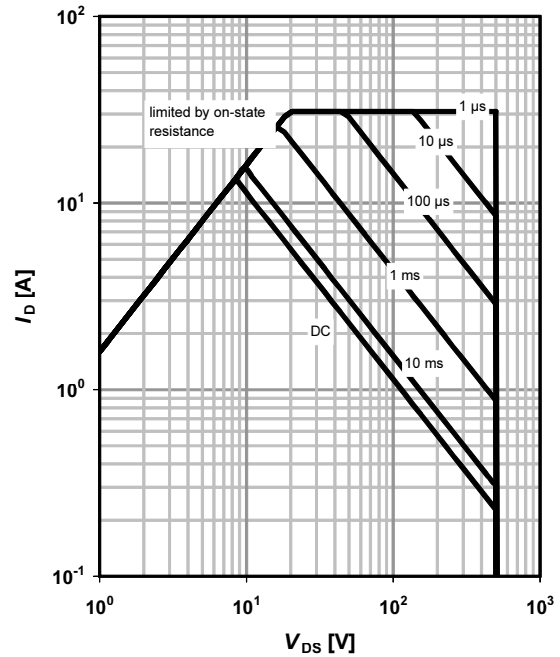
$$P_{\text{tot}} = f(T_C)$$



2 Safe operating area

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

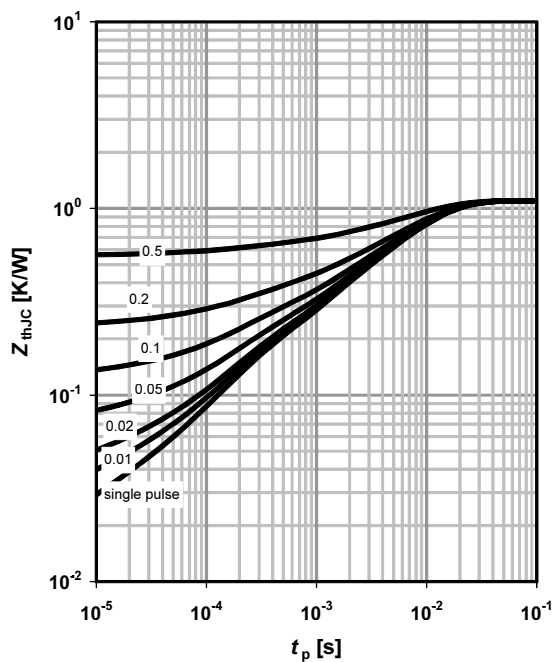
parameter: t_p



3 Max. transient thermal impedance

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

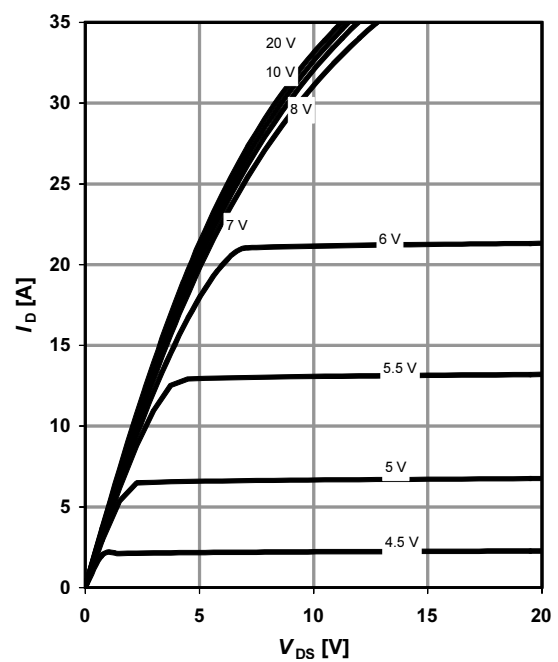
parameter: $D = t_p / T$



4 Typ. output characteristics

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

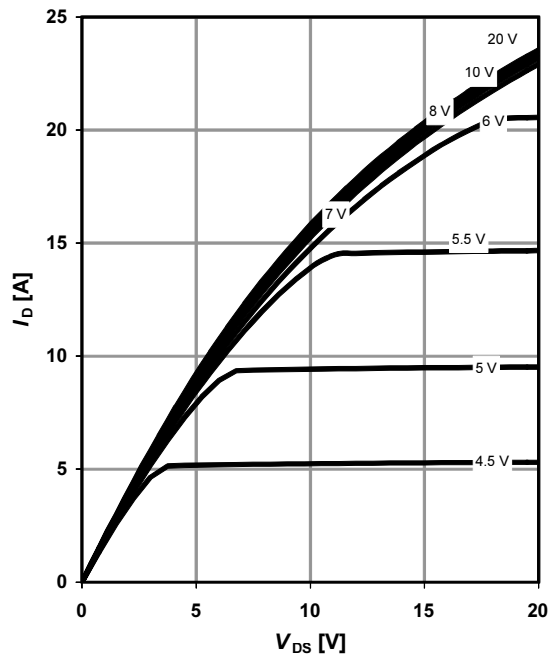
parameter: V_{GS}



5 Typ. output characteristics

$$I_D = f(V_{DS}); T_j = 150^\circ\text{C}$$

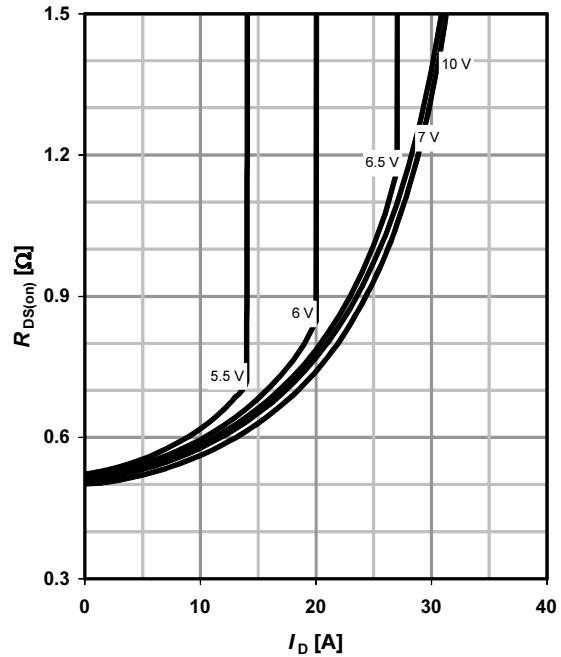
parameter: V_{GS}



6 Typ. drain-source on-state resistance

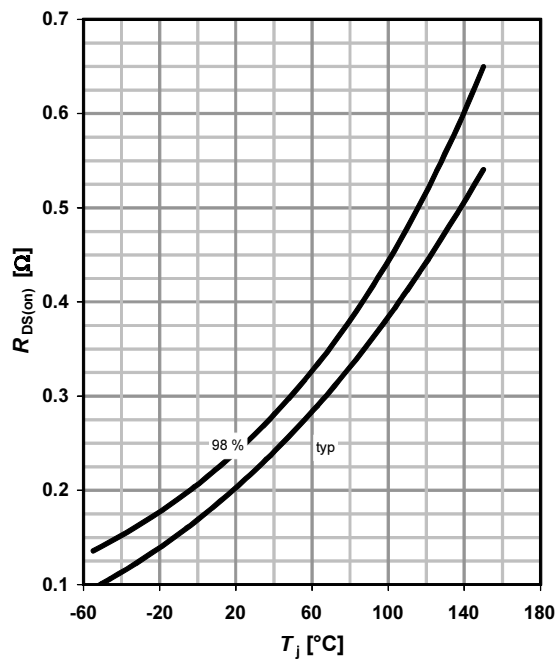
$$R_{DS(on)} = f(I_D); T_j = 150^\circ\text{C}$$

parameter: V_{GS}



7 Drain-source on-state resistance

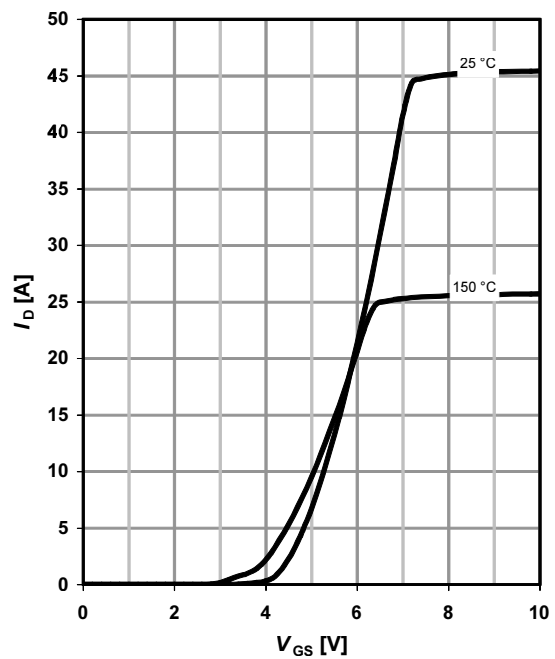
$$R_{DS(on)} = f(T_j); I_D = 7.8\text{ A}; V_{GS} = 10\text{ V}$$



8 Typ. transfer characteristics

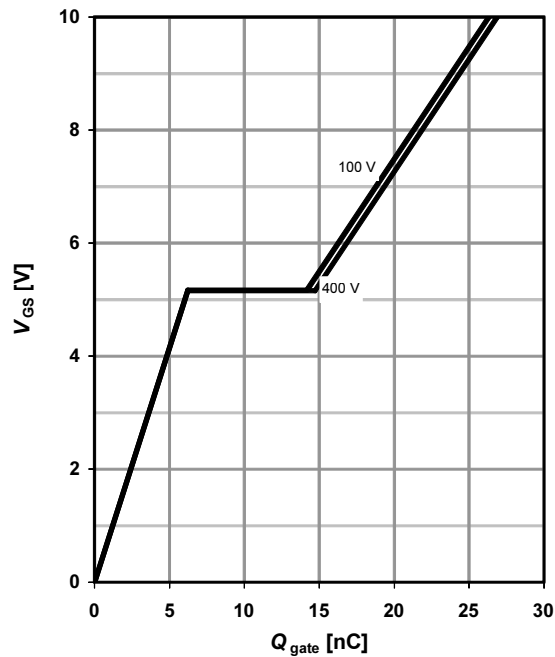
$$I_D = f(V_{GS}); |V_{DS}| > 2|I_D|R_{DS(on)\text{max}}$$

parameter: T_j



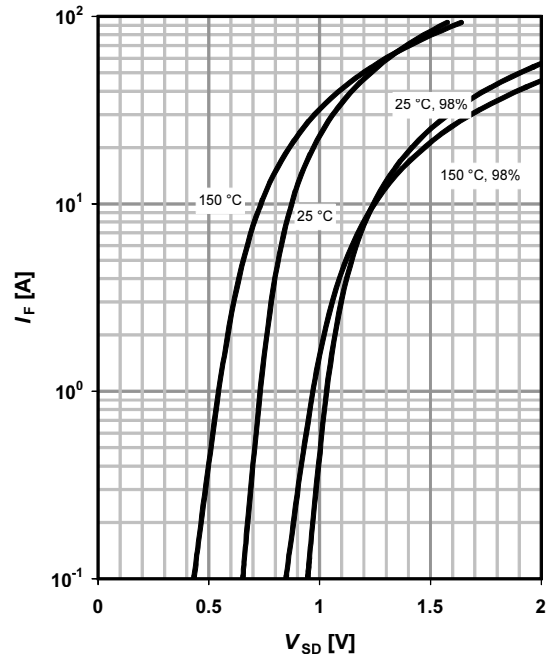
9 Typ. gate charge

 $V_{GS}=f(Q_{gate}); I_D=7.8 \text{ A pulsed}$

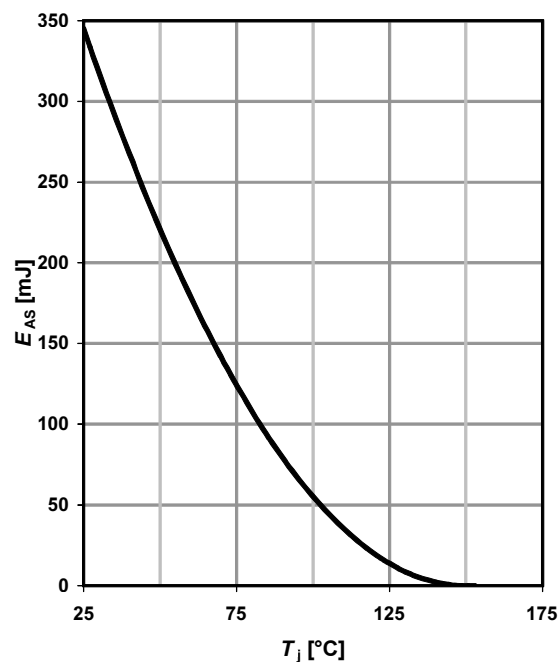
parameter: V_{DD}


10 Forward characteristics of reverse diode

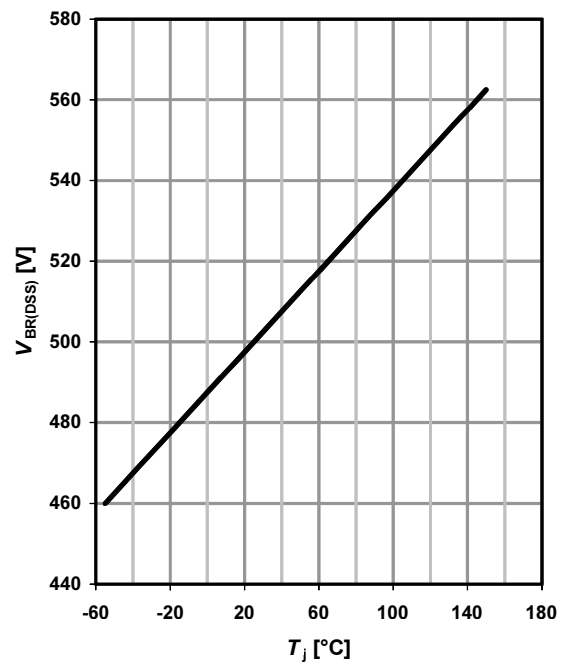
 $I_F=f(V_{SD})$

parameter: T_j


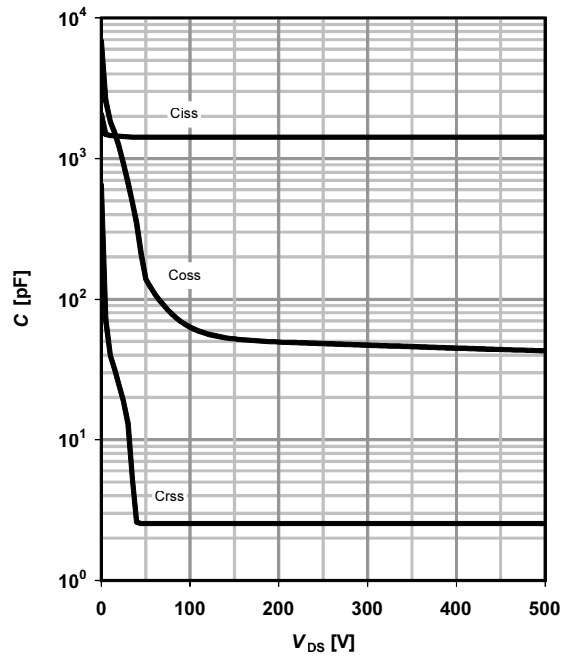
11 Avalanche energy

 $E_{AS}=f(T_j); I_D=5.2 \text{ A}; V_{DD}=50 \text{ V}$


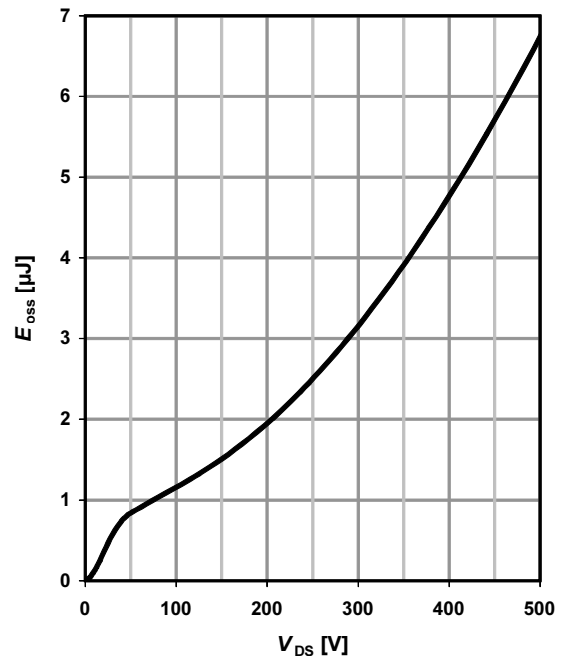
12 Drain-source breakdown voltage

 $V_{BR(DSS)}=f(T_j); I_D=0.25 \text{ mA}$


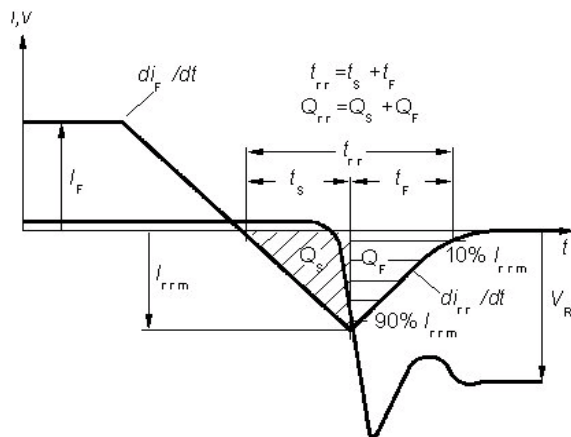
13 Typ. capacitances

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


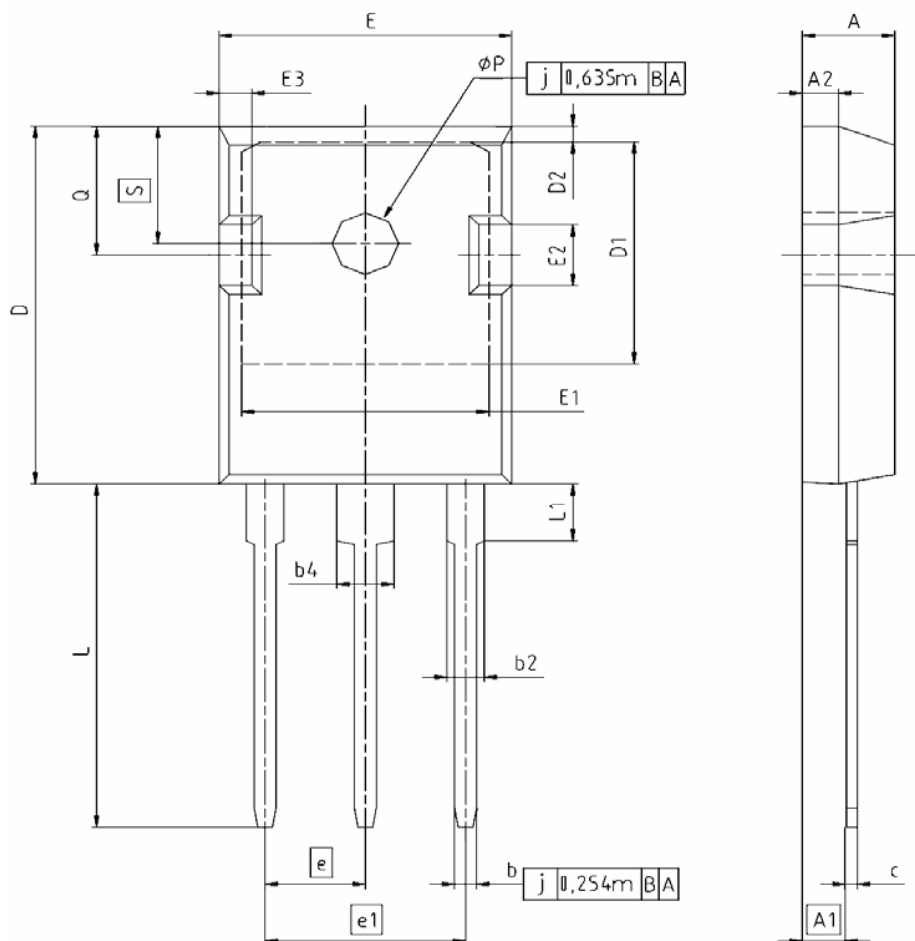
14 Typ. Coss stored energy

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


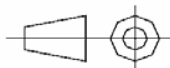
Definition of diode switching characteristics



PG-TO247 Outlines



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
b2	1.90	2.39	0.075	0.094
b4	2.87	3.45	0.113	0.136
c	0.55	0.75	0.022	0.030
D	20.82	21.10	0.820	0.831
D1	16.25	17.83	0.640	0.702
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	
e1	10.90		0.429	
N	3		3	
L	19.80	20.31	0.780	0.799
L1	4.17	4.47	0.164	0.176
ϕP	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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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.)

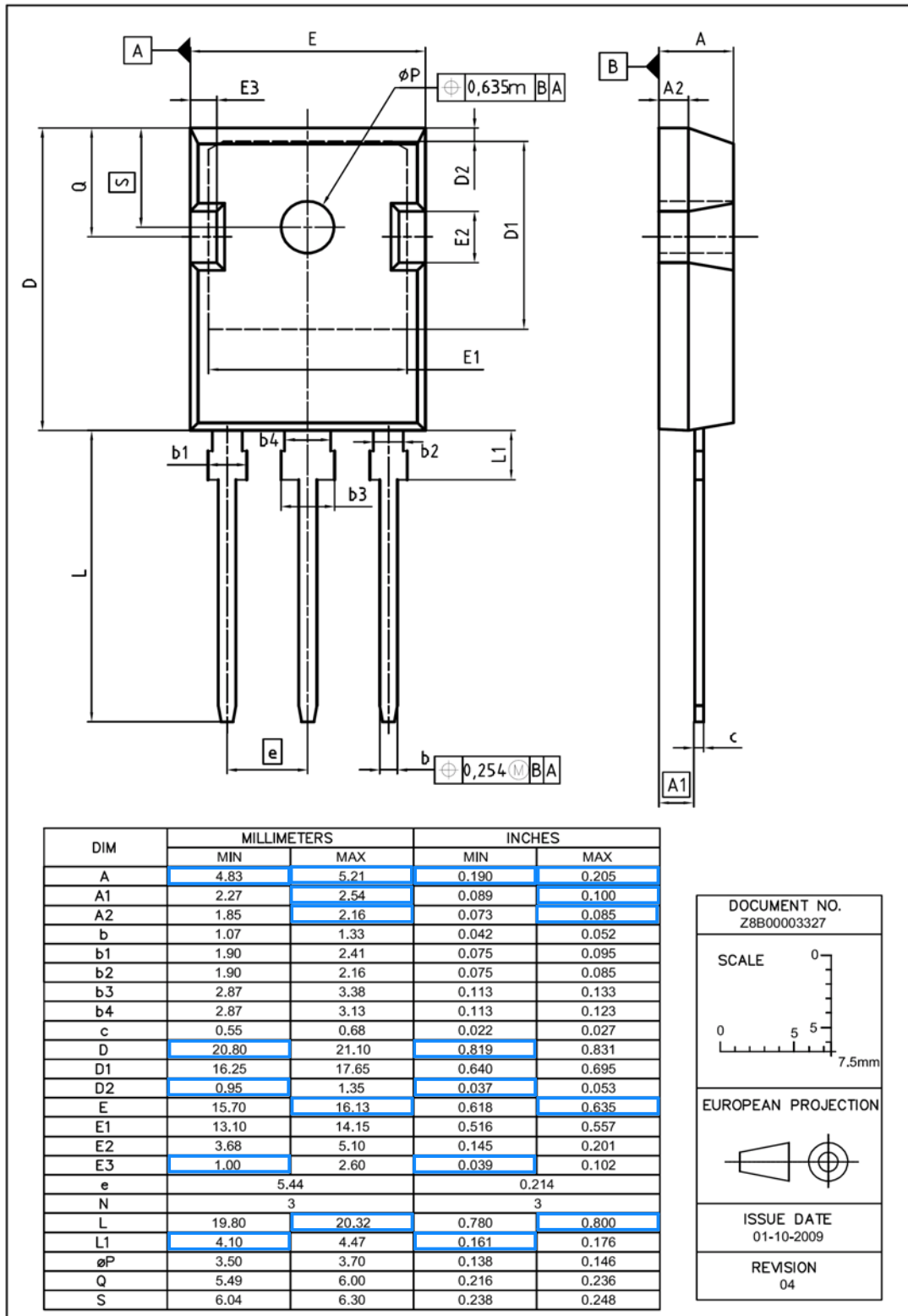


Figure 1 Outlines TO-247, dimensions in mm/inches