

CoolMOS™ Power Transistor

Features

- Lowest figure-of-merit $R_{ON} \times Q_g$
- Extreme dv/dt rated
- High peak current capability
- Qualified according to JEDEC¹⁾ for target applications
- Pb-free lead plating; RoHS compliant
- Worldwide best $R_{DS(on)}$ in TO247
- Ultra low gate charge

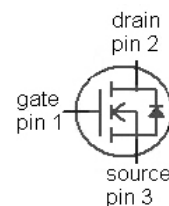
CoolMOS™ 900V is designed for:

- Quasi Resonant Flyback / Forward topologies
- PC Silverbox and consumer applications
- Industrial SMPS

Product Summary

$V_{DS} @ T_J=25^{\circ}\text{C}$	900	V
$R_{DS(on),max} @ T_J=25^{\circ}\text{C}$	0.12	Ω
$Q_{g,typ}$	270	nC

PG-TO247



Type	Package	Marking
IPW90R120C3	PG-TO247	9R120C

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

Parameter	Symbol	Conditions	Value	Unit
Continuous drain current	I_D	$T_C=25^{\circ}\text{C}$	36	A
		$T_C=100^{\circ}\text{C}$	23	
Pulsed drain current ²⁾	$I_{D,pulse}$	$T_C=25^{\circ}\text{C}$	96	
Avalanche energy, single pulse	E_{AS}	$I_D=8.8\text{ A}, V_{DD}=50\text{ V}$	1940	mJ
Avalanche energy, repetitive $t_{AR}^{2),3)}$	E_{AR}	$I_D=8.8\text{ A}, V_{DD}=50\text{ V}$	2.9	
Avalanche current, repetitive $t_{AR}^{2),3)}$	I_{AR}		8.8	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}	$T_C=25^{\circ}\text{C}$	417	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	$T_C=25\text{ }^{\circ}\text{C}$	26	A
Diode pulse current ²⁾	$I_{S,pulse}$		81	
Reverse diode dv/dt ⁴⁾	dv/dt		4	V/ns

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	

Thermal characteristics

Thermal resistance, junction - case	R_{thJC}		-	-	0.3	K/W
Thermal resistance, junction - ambient	R_{thJA}	leaded	-	-	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	$V_{(BR)DSS}$	$V_{GS}=0\text{ V}$, $I_D=250\text{ }\mu\text{A}$	900	-	-	V
Gate threshold voltage	$V_{GS(th)}$	$V_{DS}=V_{GS}$, $I_D=2.9\text{ mA}$	2.5	3	3.5	
Zero gate voltage drain current	I_{DSS}	$V_{DS}=900\text{ V}$, $V_{GS}=0\text{ V}$, $T_j=25\text{ }^{\circ}\text{C}$	-	-	10	μA
		$V_{DS}=900\text{ V}$, $V_{GS}=0\text{ V}$, $T_j=150\text{ }^{\circ}\text{C}$	-	50	-	
Gate-source leakage current	I_{GSS}	$V_{GS}=20\text{ V}$, $V_{DS}=0\text{ V}$	-	-	100	nA
Drain-source on-state resistance	$R_{DS(on)}$	$V_{GS}=10\text{ V}$, $I_D=26\text{ A}$, $T_j=25\text{ }^{\circ}\text{C}$	-	0.10	0.12	Ω
		$V_{GS}=10\text{ V}$, $I_D=26\text{ A}$, $T_j=150\text{ }^{\circ}\text{C}$	-	0.27	-	
Gate resistance	R_G	$f=1\text{ MHz}$, open drain	-	0.9	-	Ω

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	

Dynamic characteristics

Input capacitance	C_{iss}	$V_{GS}=0\text{ V}, V_{DS}=100\text{ V},$ $f=1\text{ MHz}$	-	6800	-	pF
Output capacitance	C_{oss}		-	330	-	
Effective output capacitance, energy related ⁵⁾	$C_{o(er)}$	$V_{GS}=0\text{ V}, V_{DS}=0\text{ V}$ to 500 V	-	200	-	
Effective output capacitance, time related ⁶⁾	$C_{o(tr)}$		-	790	-	
Turn-on delay time	$t_{d(on)}$	$V_{DD}=400\text{ V},$ $V_{GS}=10\text{ V}, I_D=26\text{ A},$ $R_G=7.3\ \Omega$	-	70	-	ns
Rise time	t_r		-	20	-	
Turn-off delay time	$t_{d(off)}$		-	400	-	
Fall time	t_f		-	25	-	

Gate Charge Characteristics

Gate to source charge	Q_{gs}	$V_{DD}=400\text{ V}, I_D=26\text{ A},$ $V_{GS}=0\text{ to }10\text{ V}$	-	32	-	nC
Gate to drain charge	Q_{gd}		-	115	-	
Gate charge total	Q_g		-	270	tbd	
Gate plateau voltage	$V_{plateau}$		-	4.7	-	V

Reverse Diode

Diode forward voltage	V_{SD}	$V_{GS}=0\text{ V}, I_F=26\text{ A},$ $T_j=25\text{ }^\circ\text{C}$	-	0.8	1.2	V
Reverse recovery time	t_{rr}	$V_R=400\text{ V}, I_F=I_S,$ $di_F/dt=100\text{ A}/\mu\text{s}$	-	920	-	ns
Reverse recovery charge	Q_{rr}		-	30	-	μC
Peak reverse recovery current	I_{rrm}		-	65	-	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 $P_{AV}=E_{AR} \cdot f$.

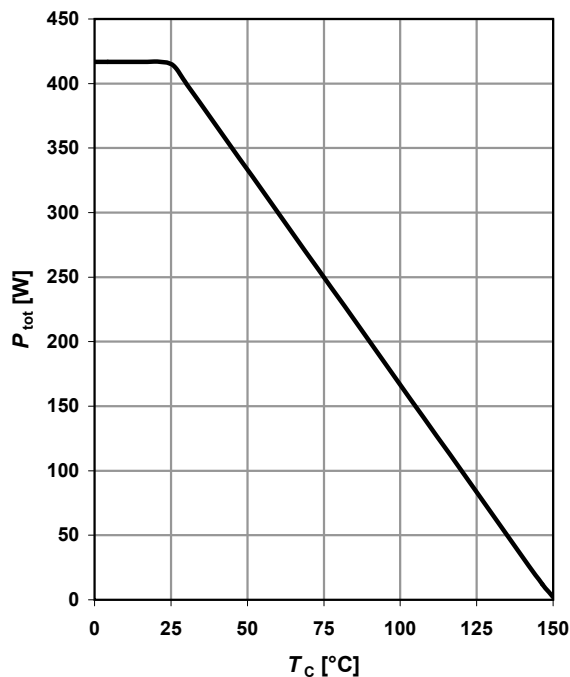
⁴⁾ $I_{SD} \leq I_D$, $di/dt \leq 100\text{ A}/\mu\text{s}$, $V_{DClk}=400\text{ V}$, $V_{peak} < V_{(BR)DSS}$, $T_j < T_{j,max}$, identical low side and high side switch

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 50% 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 50% V_{DSS} .

1 Power dissipation

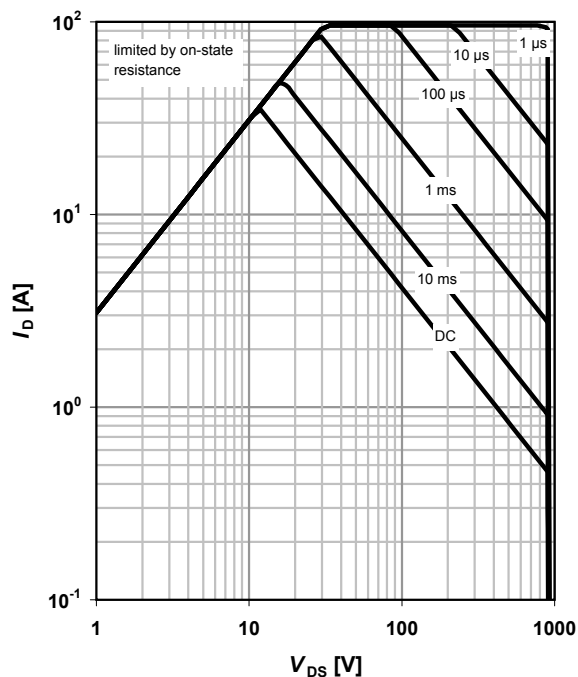
$$P_{\text{tot}} = f(T_C)$$



2 Safe operating area

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

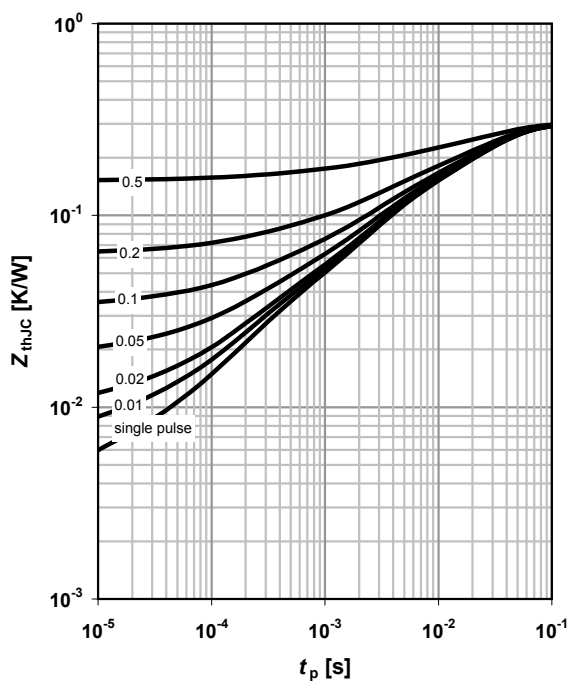
parameter: t_p



3 Max. transient thermal impedance

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

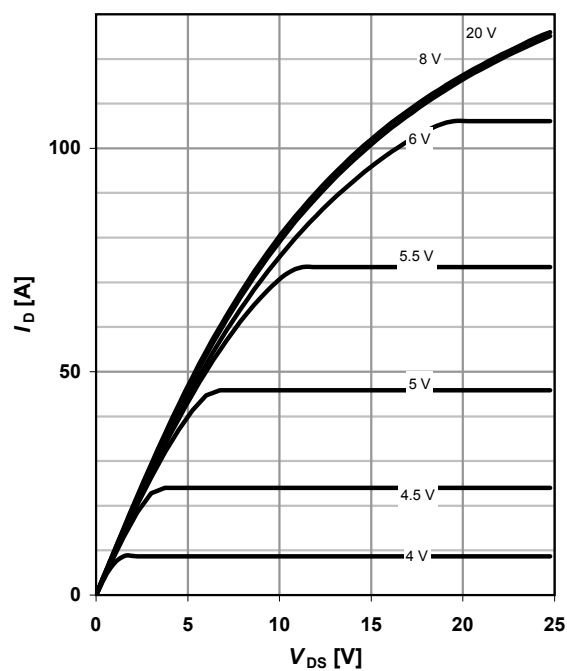
parameter: $D = t_p / T$



4 Typ. output characteristics

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

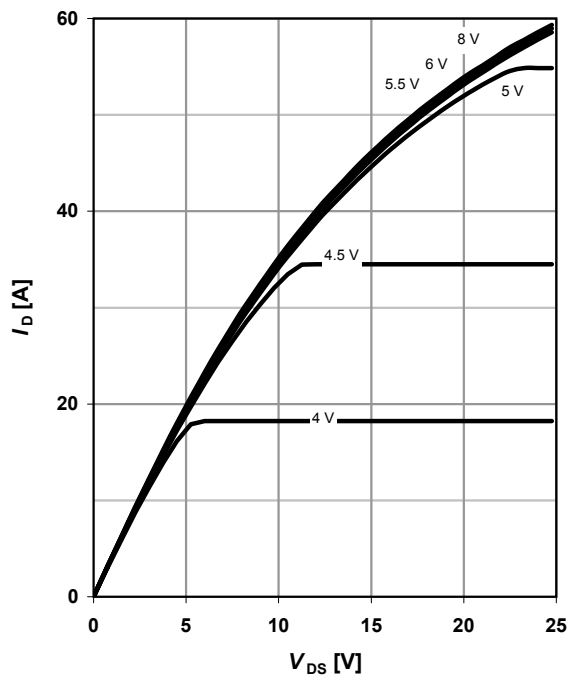
parameter: V_{GS}



5 Typ. output characteristics

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

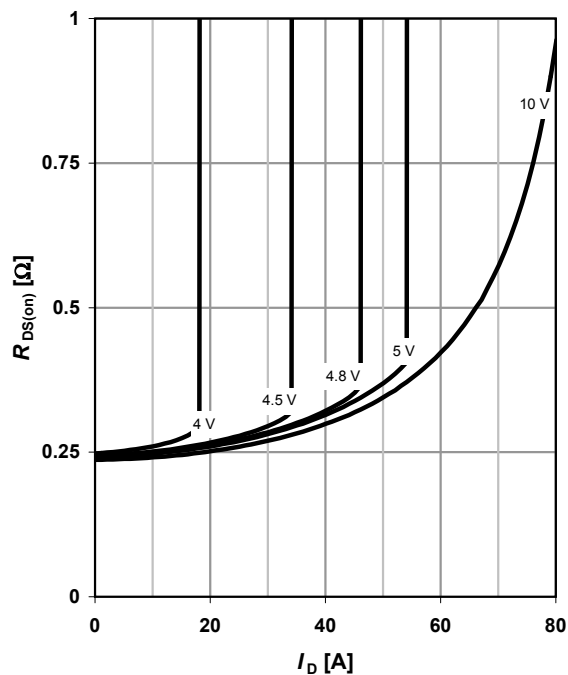
parameter: V_{GS}



6 Typ. drain-source on-state resistance

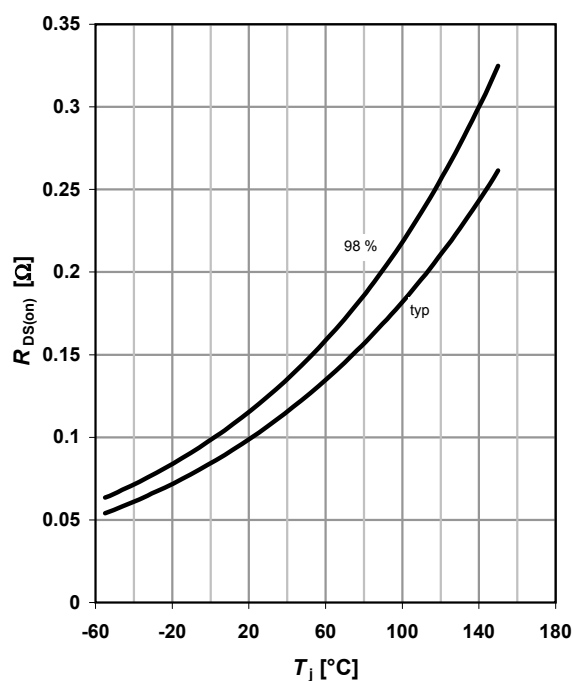
$$R_{DS(on)} = f(I_D); T_J = 150^\circ\text{C}$$

parameter: V_{GS}



7 Drain-source on-state resistance

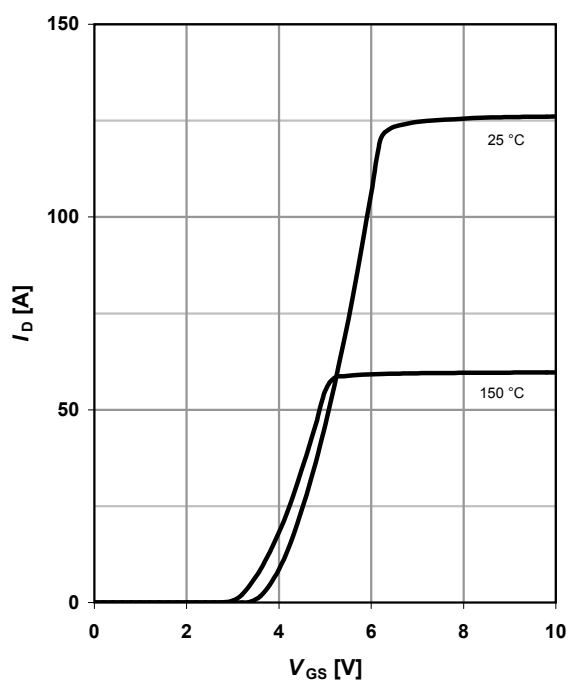
$$R_{DS(on)} = f(T_J); I_D = 26\text{ A}; V_{GS} = 10\text{ V}$$



8 Typ. transfer characteristics

$$I_D = f(V_{GS}); V_{DS} = 20\text{ V}$$

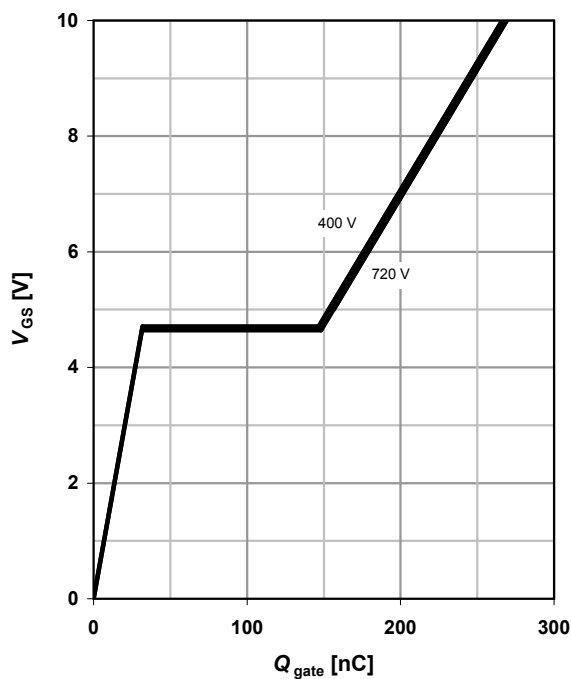
parameter: T_J



9 Typ. gate charge

$$V_{GS}=f(Q_{gate}); I_D=26 \text{ A pulsed}$$

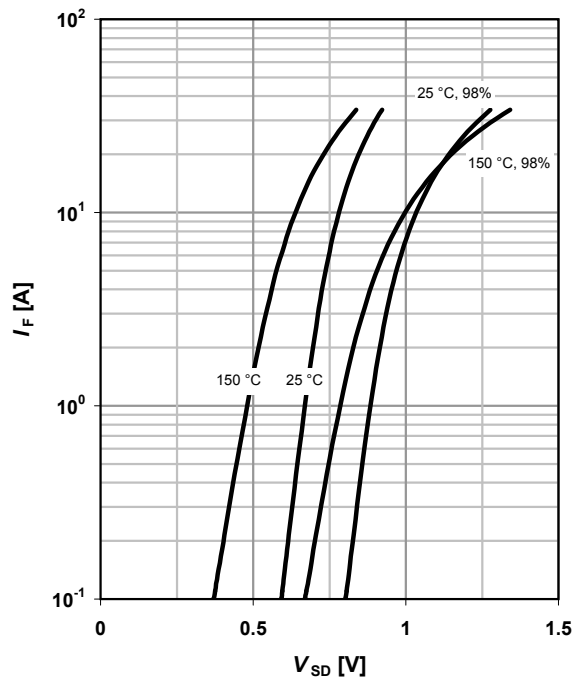
parameter: V_{DD}



10 Forward characteristics of reverse diode

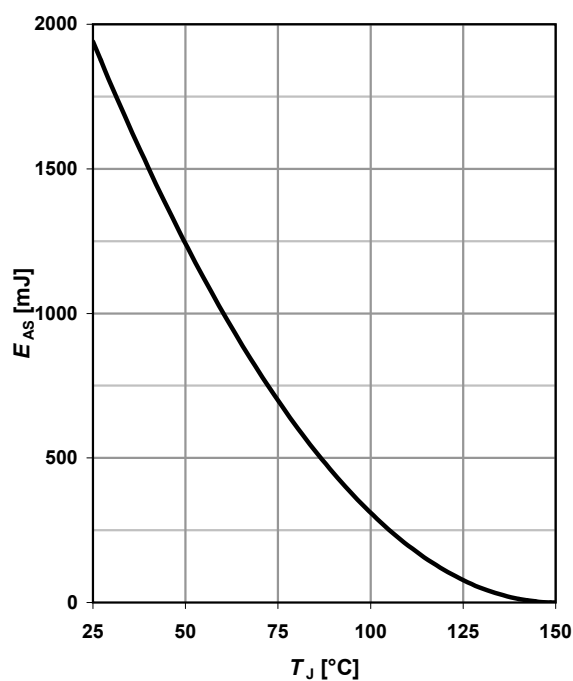
$$I_F=f(V_{SD})$$

parameter: T_J



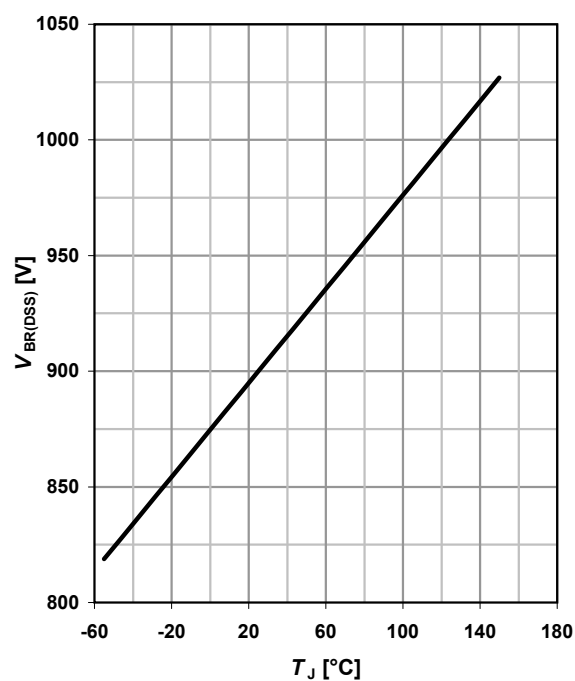
11 Avalanche energy

$$E_{AS}=f(T_J); I_D=8.8 \text{ A}; V_{DD}=50 \text{ V}$$

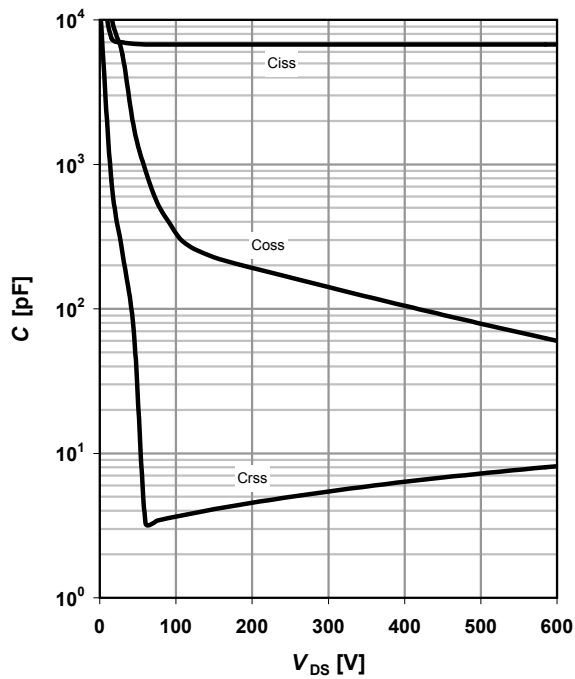


12 Drain-source breakdown voltage

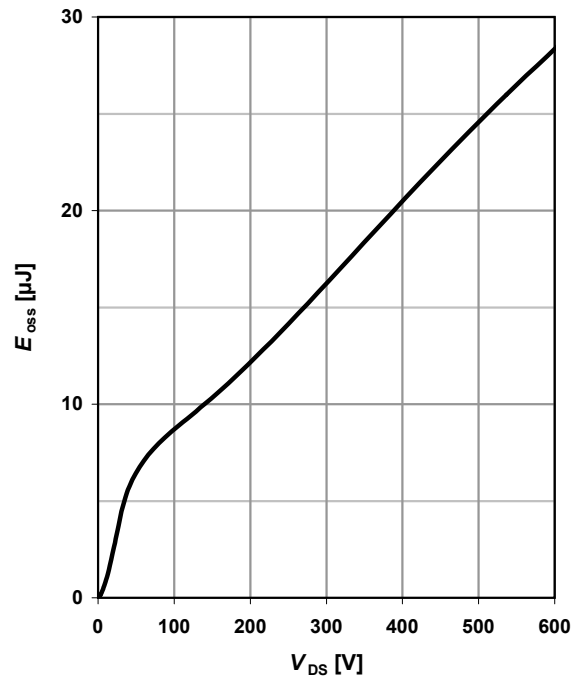
$$V_{BR(DSS)}=f(T_J); I_D=0.25 \text{ mA}$$



13 Typ. capacitances

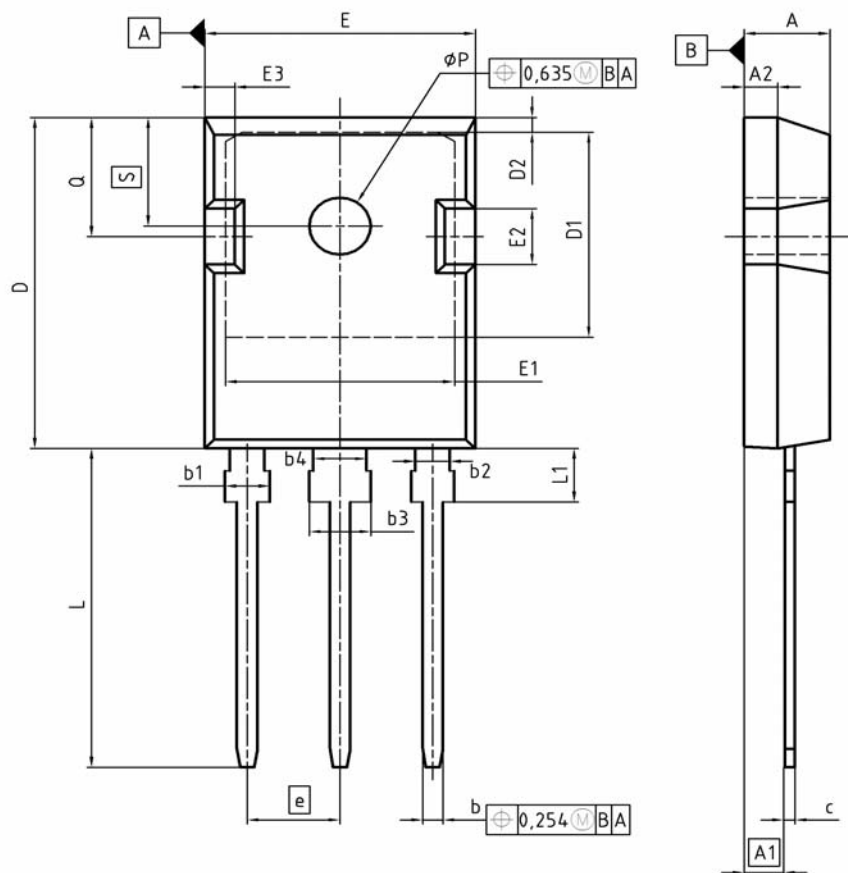
 $C = f(V_{DS}); V_{GS} = 0 \text{ V}; f = 1 \text{ MHz}$


14 Typ. C_{oss} stored energy

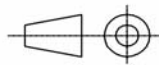
 $E_{oss} = f(V_{DS})$


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
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