

CoolMOS™ Power Transistor
Features

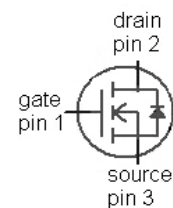
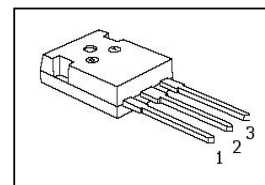
- Worldwide best $R_{DS(on)}$ in TO247
- Lowest figure of merit $R_{ON} \times Q_g$
- Ultra low gate charge
- Extreme dv/dt rated
- High peak current capability
- Pb-free lead plating; RoHS compliant
- Qualified according to JEDEC¹⁾ for target applications

CoolMOS CP is designed for:

- Hard & soft switching SMPS topologies
- CCM PFC

Product Summary

$V_{DS} @ T_{jmax}$	550	V
$R_{DS(on),max}$	0.045	Ω
$Q_{g,typ}$	150	nC

PG-TO247


Type	Package	Marking
IPP50R045CP	PG-TO247	5R045P

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

Parameter	Symbol	Conditions	Value	Unit
Continuous drain current	I_D	$T_C=25\text{ °C}$	62	A
		$T_C=100\text{ °C}$	39	
Pulsed drain current ²⁾	$I_{D,pulse}$	$T_C=25\text{ °C}$	170	
Avalanche energy, single pulse	E_{AS}	$I_D=11\text{ A}$, $V_{DD}=50\text{ V}$	1920	mJ
Avalanche energy, repetitive t_{AR} ^{2),3)}	E_{AR}	$I_D=11\text{ A}$, $V_{DD}=50\text{ V}$	2.9	
Avalanche current, repetitive t_{AR} ^{2),3)}	I_{AR}		11.0	A
MOSFET dv/dt ruggedness	dv/dt	$V_{DS}=0\dots400\text{ V}$	50	V/ns
Gate source voltage	V_{GS}	static	± 20	V
		AC ($f>1\text{ Hz}$)	± 30	
Power dissipation	P_{tot}	$T_C=25\text{ °C}$	431	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 $T_j=25\text{ °C}$, unless otherwise specified

Parameter	Symbol	Conditions	Value	Unit
Continuous diode forward current	I_S	$T_C=25\text{ °C}$	62	A
Diode pulse current ²⁾	$I_{S,pulse}$		170	
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}		-	-	0.29	K/W
Thermal resistance, junction - ambient	R_{thJA}	leaded	-	-	62	
Soldering temperature, wavesoldering only allowed at leads	T_{sold}	1.6 mm (0.063 in.) from case for 10 s	-	-	260	°C

Electrical characteristics, at $T_j=25\text{ °C}$, 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	$V_{GS(th)}$	$V_{DS}=V_{GS}$, $I_D=2.9\text{ mA}$	2.5	3	3.5	
Zero gate voltage drain current	I_{DSS}	$V_{DS}=500\text{ V}$, $V_{GS}=0\text{ V}$, $T_j=25\text{ °C}$	-	-	10	μA
		$V_{DS}=500\text{ V}$, $V_{GS}=0\text{ V}$, $T_j=150\text{ °C}$	-	50	-	
Gate-source leakage current	I_{GSS}	$V_{GS}=20\text{ V}$, $V_{DS}=0\text{ V}$	-	-	100	nA
Drain-source on-state resistance	$R_{DS(on)}$	$V_{GS}=10\text{ V}$, $I_D=44\text{ A}$, $T_j=25\text{ °C}$	-	0.04	0.045	Ω
		$V_{GS}=10\text{ V}$, $I_D=44\text{ A}$, $T_j=150\text{ °C}$	-	0.10	-	
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}	$V_{GS}=0\text{ V}, V_{DS}=100\text{ V},$ $f=1\text{ MHz}$	-	7900	-	pF
Output capacitance	C_{oss}		-	350	-	
Effective output capacitance, energy related ⁵⁾	$C_{o(er)}$	$V_{GS}=0\text{ V}, V_{DS}=0\text{ V}$ to 400 V	-	320	-	
Effective output capacitance, time related ⁶⁾	$C_{o(tr)}$		-	710	-	
Turn-on delay time	$t_{d(on)}$	$V_{DD}=400\text{ V},$ $V_{GS}=10\text{ V}, I_D=44\text{ A},$ $R_G=3.3\ \Omega$	-	35	-	ns
Rise time	t_r		-	20	-	
Turn-off delay time	$t_{d(off)}$		-	100	-	
Fall time	t_f		-	10	-	

Gate Charge Characteristics

Gate to source charge	Q_{gs}	$V_{DD}=400\text{ V}, I_D=44\text{ A},$ $V_{GS}=0\text{ to }10\text{ V}$	-	35	-	nC
Gate to drain charge	Q_{gd}		-	44	-	
Gate charge total	Q_g		-	150	200	
Gate plateau voltage	$V_{plateau}$		-	5.2	-	V

Reverse Diode

Diode forward voltage	V_{SD}	$V_{GS}=0\text{ V}, I_F=44\text{ A},$ $T_j=25\text{ }^\circ\text{C}$	-	0.9	1.2	V
Reverse recovery time	t_{rr}	$V_R=400\text{ V}, I_F=I_S,$ $di_F/dt=100\text{ A}/\mu\text{s}$	-	500	-	ns
Reverse recovery charge	Q_{rr}		-	12	-	μC
Peak reverse recovery current	I_{rrm}		-	50	-	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 $P_{AV}=E_{AR} \cdot f$.

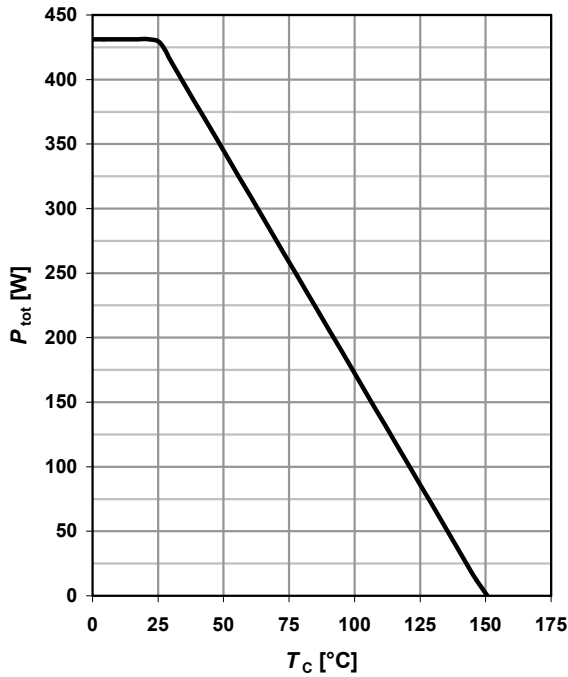
⁴⁾ $I_{SD} \leq I_D, di/dt \leq 100\text{ A}/\mu\text{s}, V_{DClink}=400\text{ V}, V_{peak} < V_{(BR)DSS}, T_j < T_{j,max}$, identical low and high side switch

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

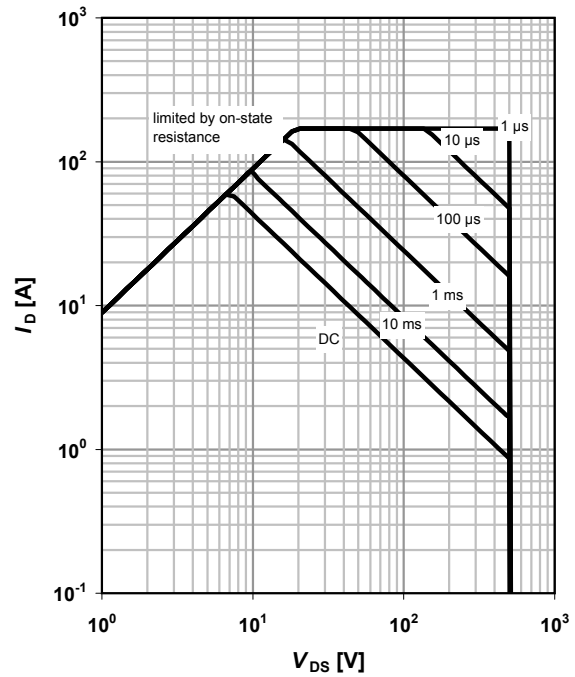
$$P_{tot} = f(T_C)$$



2 Safe operating area

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

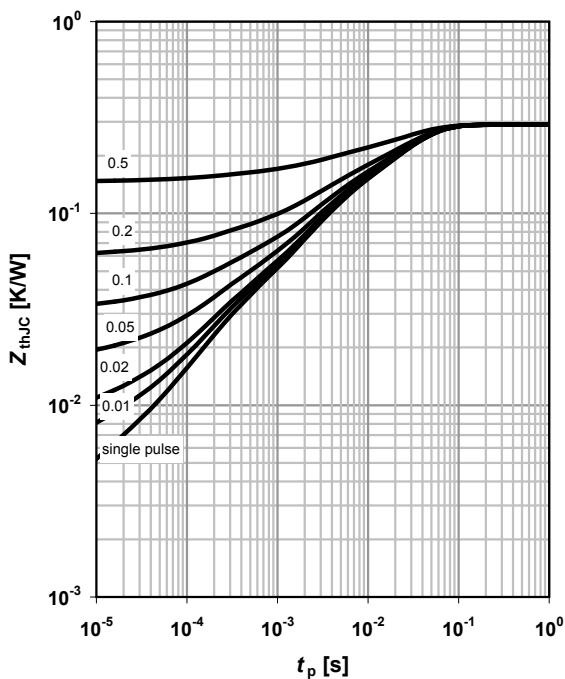
parameter: t_p



3 Max. transient thermal impedance

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

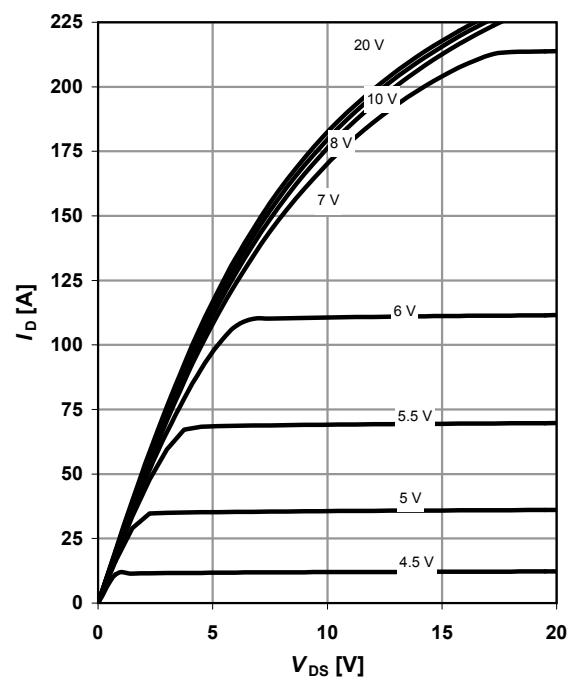
parameter: $D = t_p / T$



4 Typ. output characteristics

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

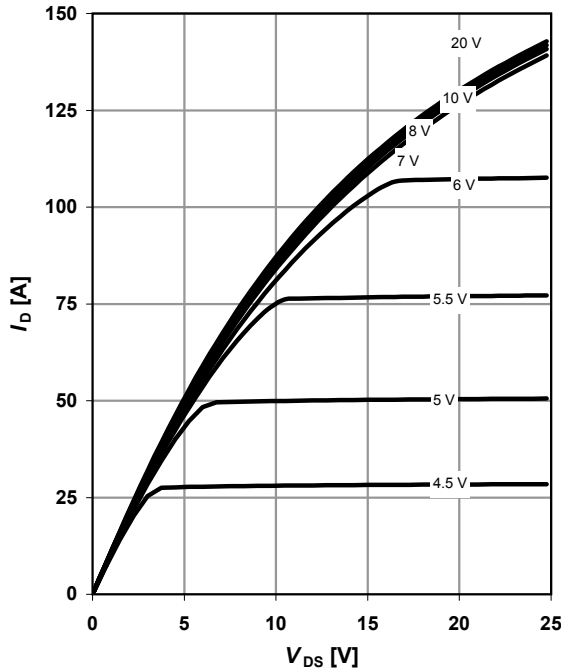
parameter: V_{GS}



5 Typ. output characteristics

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

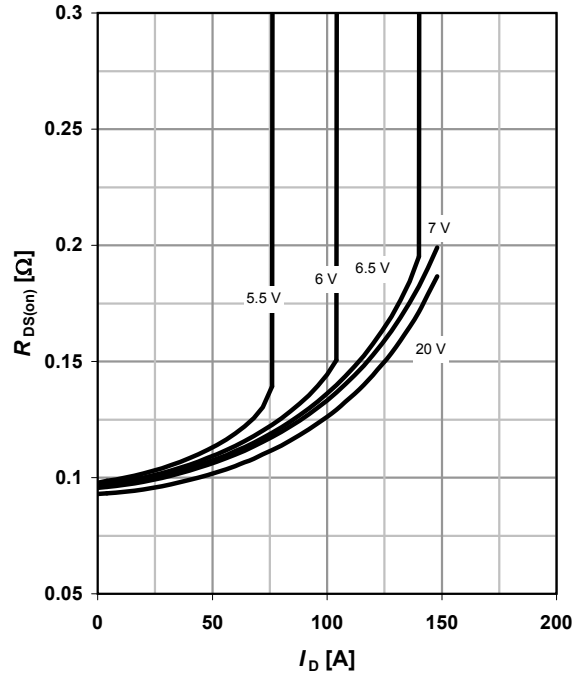
parameter: V_{GS}



6 Typ. drain-source on-state resistance

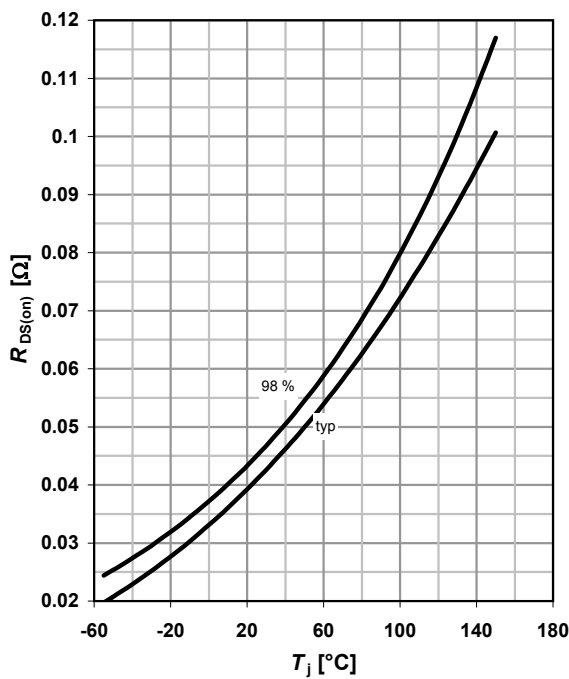
$R_{DS(on)} = f(I_D); T_j = 150\text{ }^\circ\text{C}$

parameter: V_{GS}



7 Drain-source on-state resistance

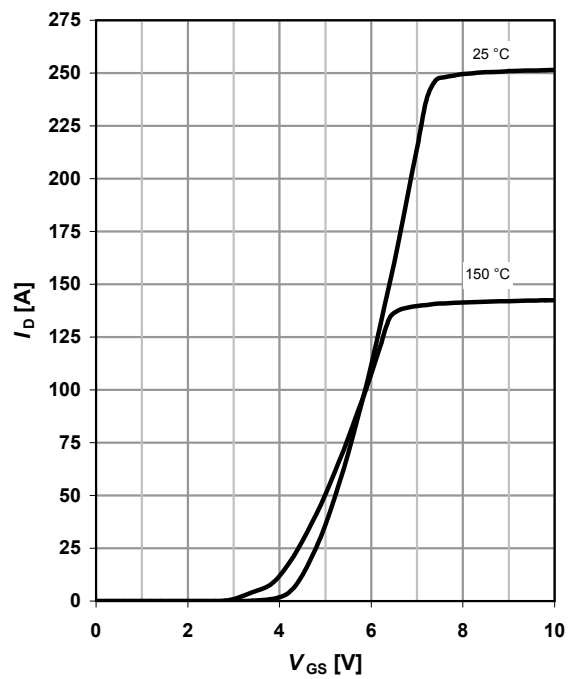
$R_{DS(on)} = f(T_j); I_D = 44\text{ A}; V_{GS} = 10\text{ V}$



8 Typ. transfer characteristics

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

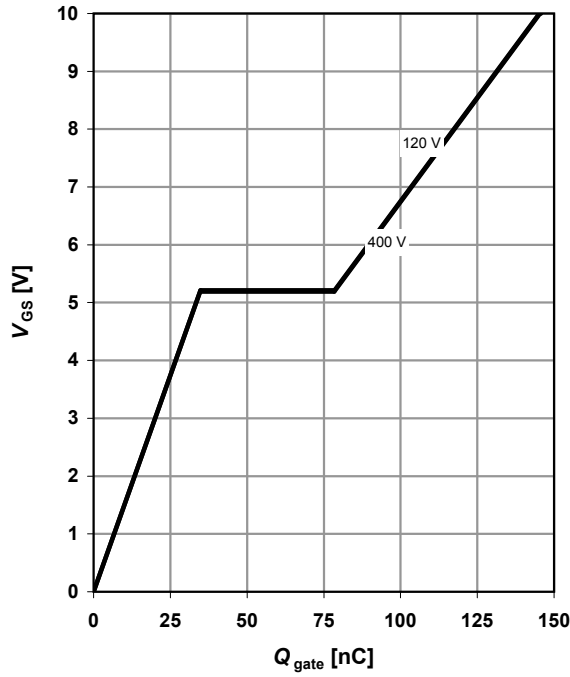
parameter: T_j



9 Typ. gate charge

$V_{GS}=f(Q_{gate}); I_D=44 \text{ A pulsed}$

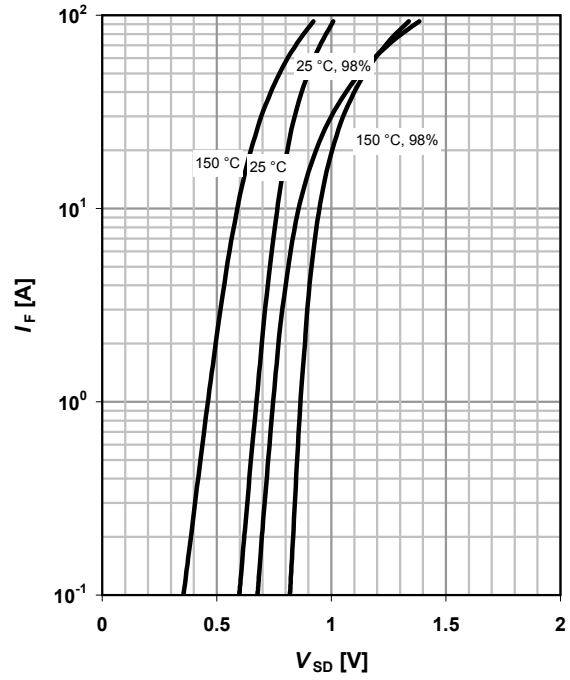
parameter: V_{DD}



10 Forward characteristics of reverse diode

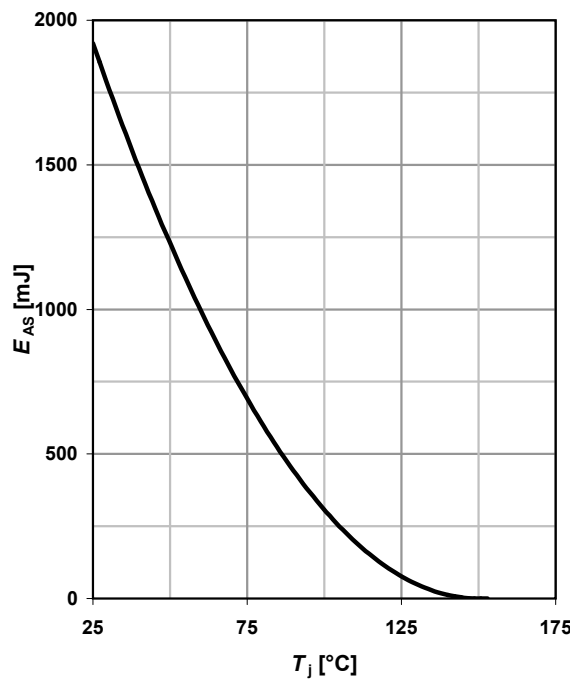
$I_F=f(V_{SD})$

parameter: T_j



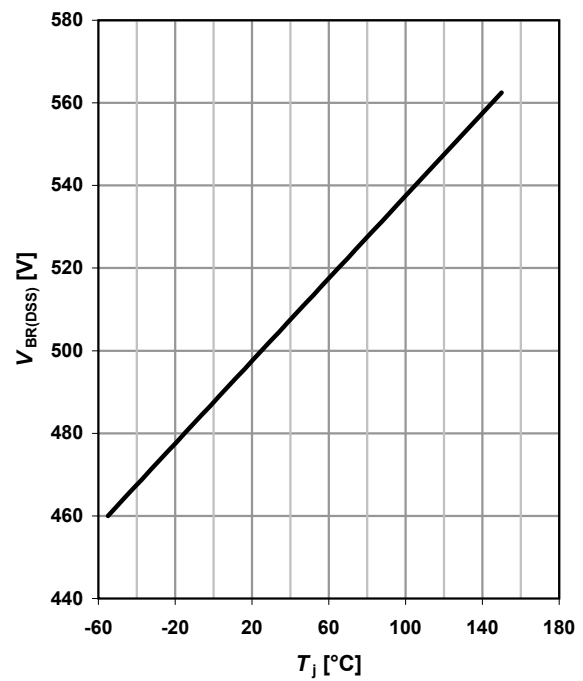
11 Avalanche energy

$E_{AS}=f(T_j); I_D=11 \text{ A}; V_{DD}=50 \text{ V}$



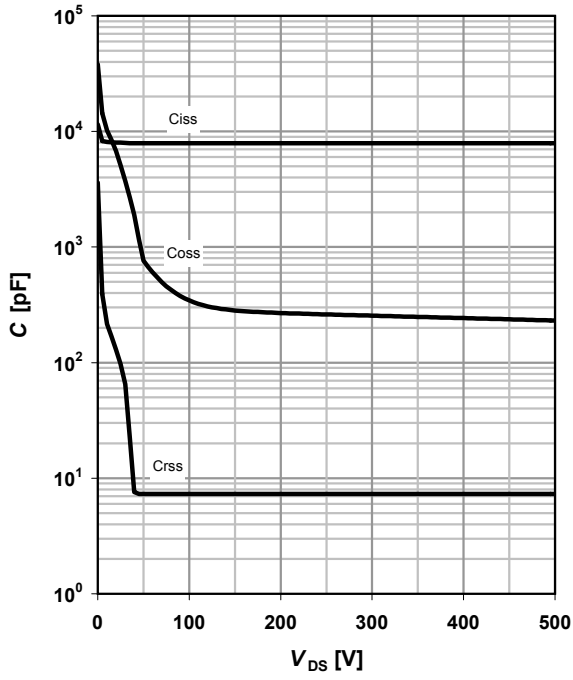
12 Drain-source breakdown voltage

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



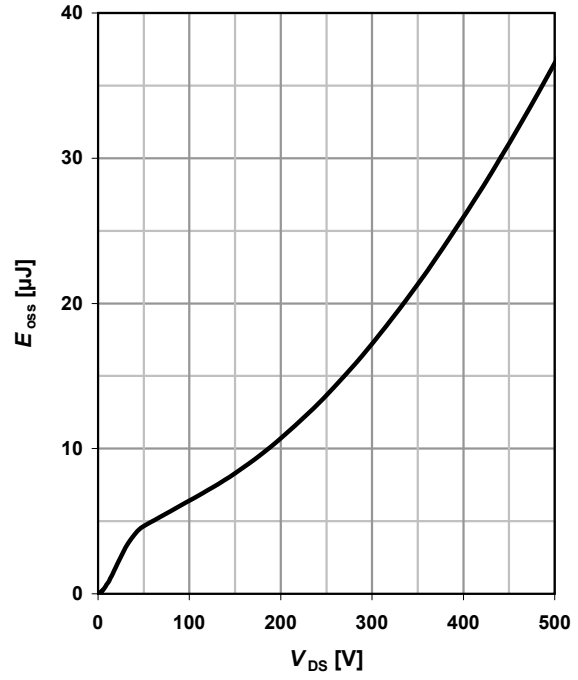
13 Typ. capacitances

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

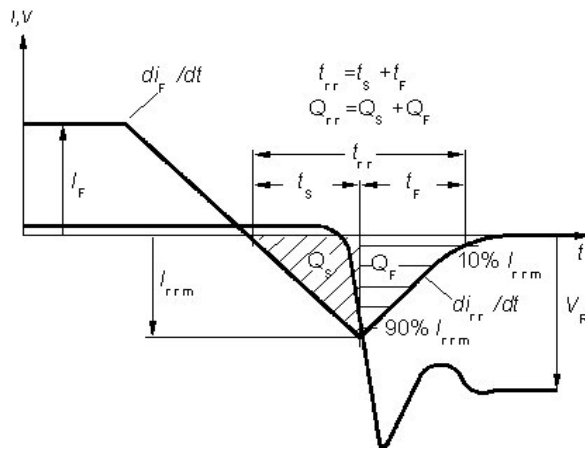


14 Typ. Coss stored energy

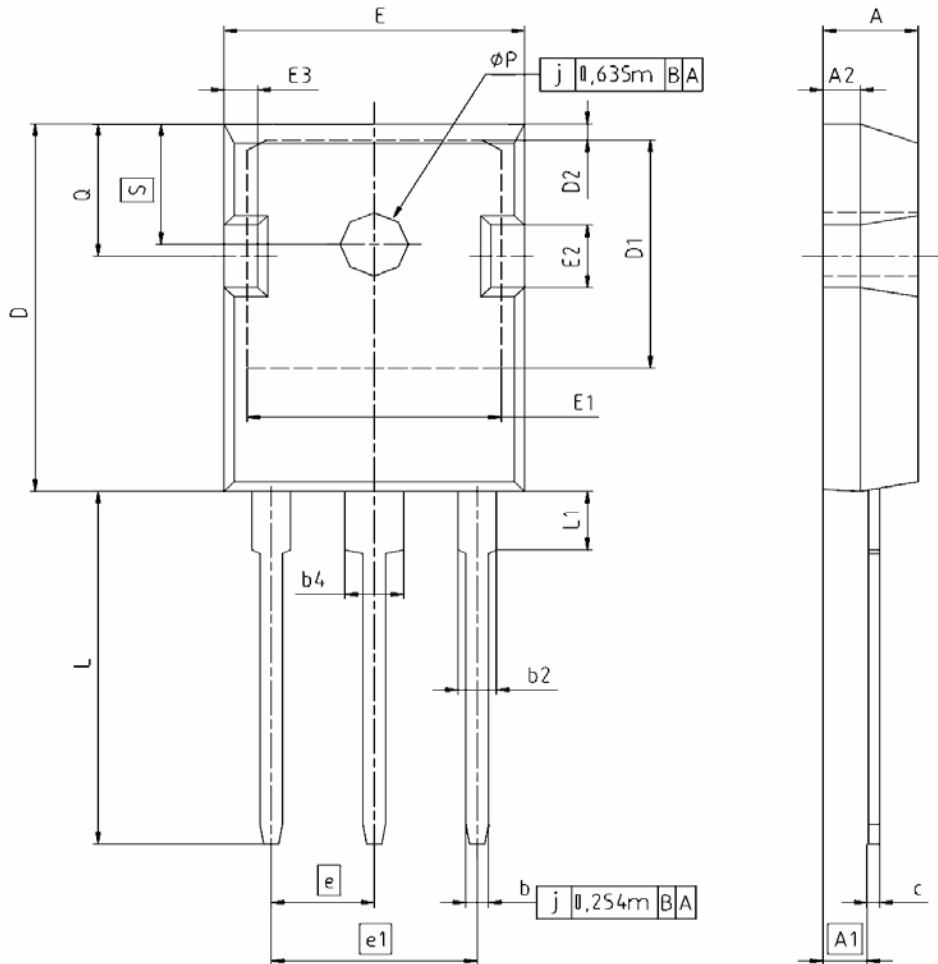
$E_{oss} = f(V_{DS})$



Definition of diode switching characteristics



PG-TO247: Outline



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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