

**CoolMOS™ Power Transistor**
**Features**

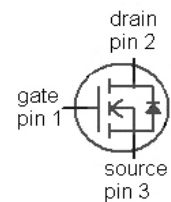
- Lowest figure of merit  $R_{ON} \times Q_g$
- Ultra low gate charge
- Extreme  $dv/dt$  rated
- High peak current capability
- Pb-free lead plating; RoHS compliant; Halogen free for mold compound
- Qualified for industrial grade applications according to JEDEC<sup>1)</sup>

**Product Summary**

$V_{DS} @ T_{jmax}$	560	V
$R_{DS(on),max}$	0.399	$\Omega$
$Q_{g,typ}$	17	nC

**CoolMOS CP is designed for:**

- Hard and softswitching SMPS for server power supplies
- DCM PFC for Lamp Ballast
- PWM-Stages Lamp Ballast, LCD and PDP TV

**PG-TO262**


Type	Package	Marking
IPI50R399CP	PG-TO262	5R399P

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

Parameter	Symbol	Conditions	Value	Unit
Continuous drain current	$I_D$	$T_C=25\text{ °C}$	9	A
		$T_C=100\text{ °C}$	6	
Pulsed drain current <sup>2)</sup>	$I_{D,pulse}$	$T_C=25\text{ °C}$	20	
Avalanche energy, single pulse	$E_{AS}$	$I_D=3.3\text{ A}$ , $V_{DD}=50\text{ V}$	215	mJ
Avalanche energy, repetitive $t_{AR}^{2),3)}$	$E_{AR}$	$I_D=3.3\text{ A}$ , $V_{DD}=50\text{ V}$	0.33	
Avalanche current, repetitive $t_{AR}^{2),3)}$	$I_{AR}$		3.3	A
MOSFET $dv/dt$ ruggedness	$dv/dt$	$V_{DS}=0\dots 400\text{ V}$	50	V/ns
Gate source voltage	$V_{GS}$	static	$\pm 20$	V
		AC ( $f>1\text{ Hz}$ )	$\pm 30$	
Power dissipation	$P_{tot}$	$T_C=25\text{ °C}$	83	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	$I_S$	$T_C=25\text{ }^\circ\text{C}$	4.9	A
Diode pulse current <sup>2)</sup>	$I_{S,pulse}$		20	
Reverse diode $dv/dt$ <sup>4)</sup>	$dv/dt$		15	V/ns

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	

**Thermal characteristics**

Thermal resistance, junction - case	$R_{thJC}$		-	-	1.5	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	$^\circ\text{C}$

**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	$V_{GS(th)}$	$V_{DS}=V_{GS}, I_D=0.33\text{ mA}$	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	$\mu\text{A}$
		$V_{DS}=500\text{ V}, V_{GS}=0\text{ V}, T_j=150\text{ }^\circ\text{C}$	-	10	-	
Gate-source leakage current	$I_{GSS}$	$V_{GS}=20\text{ V}, V_{DS}=0\text{ V}$	-	-	100	nA
Drain-source on-state resistance	$R_{DS(on)}$	$V_{GS}=10\text{ V}, I_D=4.9\text{ A}, T_j=25\text{ }^\circ\text{C}$	-	0.36	0.399	$\Omega$
		$V_{GS}=10\text{ V}, I_D=4.9\text{ A}, T_j=150\text{ }^\circ\text{C}$	-	0.90	-	
Gate resistance	$R_G$	$f=1\text{ MHz}, \text{open drain}$	-	2.2	-	$\Omega$

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	
<b>Dynamic characteristics</b>						
Input capacitance	$C_{iss}$	$V_{GS}=0\text{ V}, V_{DS}=100\text{ V},$ $f=1\text{ MHz}$	-	890	-	pF
Output capacitance	$C_{oss}$		-	40	-	
Effective output capacitance, energy related <sup>5)</sup>	$C_{o(er)}$	$V_{GS}=0\text{ V}, V_{DS}=0\text{ V}$ to 400 V	-	38	-	
Effective output capacitance, time related <sup>6)</sup>	$C_{o(tr)}$		-	81	-	
Turn-on delay time	$t_{d(on)}$	$V_{DD}=400\text{ V},$ $V_{GS}=10\text{ V}, I_D=4.9\text{ A},$ $R_G=35.1\ \Omega$	-	35	-	ns
Rise time	$t_r$		-	14	-	
Turn-off delay time	$t_{d(off)}$		-	80	-	
Fall time	$t_f$		-	14	-	
<b>Gate Charge Characteristics</b>						
Gate to source charge	$Q_{gs}$	$V_{DD}=400\text{ V}, I_D=4.9\text{ A},$ $V_{GS}=0\text{ to }10\text{ V}$	-	4	-	nC
Gate to drain charge	$Q_{gd}$		-	6	-	
Gate charge total	$Q_g$		-	17	23	
Gate plateau voltage	$V_{plateau}$		-	5.2	-	V
<b>Reverse Diode</b>						
Diode forward voltage	$V_{SD}$	$V_{GS}=0\text{ V}, I_F=4.9\text{ A},$ $T_j=25\text{ }^\circ\text{C}$	-	0.9	1.2	V
Reverse recovery time	$t_{rr}$	$V_R=400\text{ V}, I_F=I_S,$ $di/dt=100\text{ A}/\mu\text{s}$	-	260	-	ns
Reverse recovery charge	$Q_{rr}$		-	1.9	-	$\mu\text{C}$
Peak reverse recovery current	$I_{rrm}$		-	12.2	-	A

<sup>1)</sup> J-STD20 and JESD22

<sup>2)</sup> Pulse width  $t_p$  limited by  $T_{j,max}$

<sup>3)</sup> Repetitive avalanche causes additional power losses that can be calculated as  $P_{AV}=E_{AR} \cdot f$ .

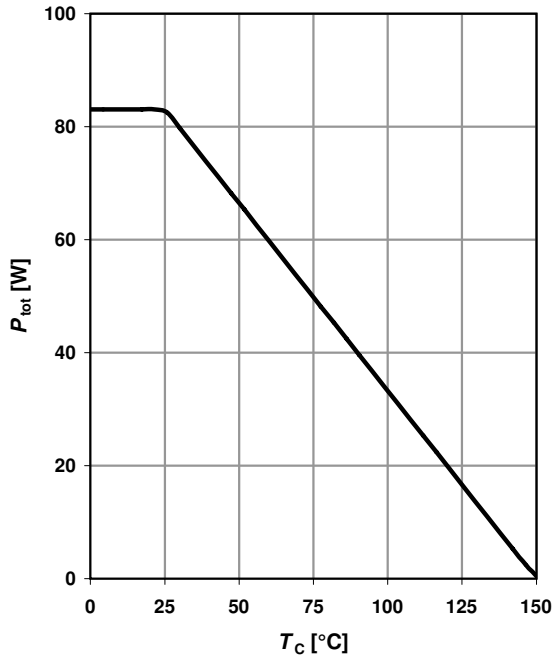
<sup>4)</sup>  $I_{SD} \leq I_D, di/dt \leq 400\text{ A}/\mu\text{s}, V_{DClink}=400\text{ V}, V_{peak} < V_{(BR)DSS}, T_j < T_{j,max}$ , identical low and high side switch

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

<sup>6)</sup>  $C_{o(tr)}$  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**

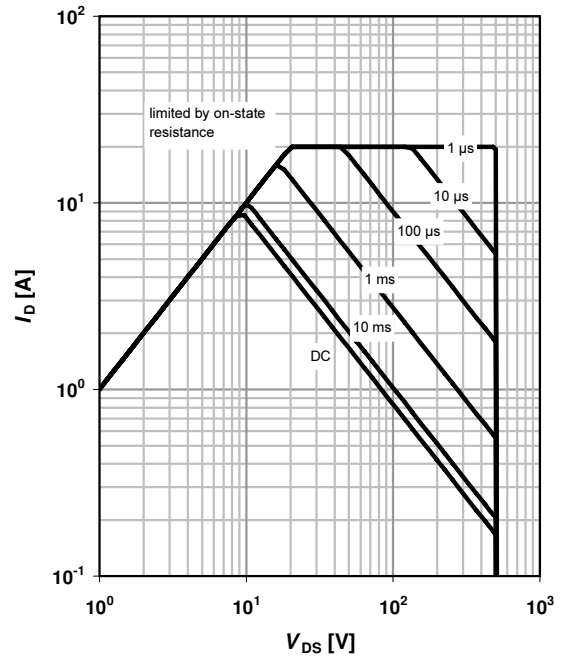
$P_{tot}=f(T_C)$



**2 Safe operating area**

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

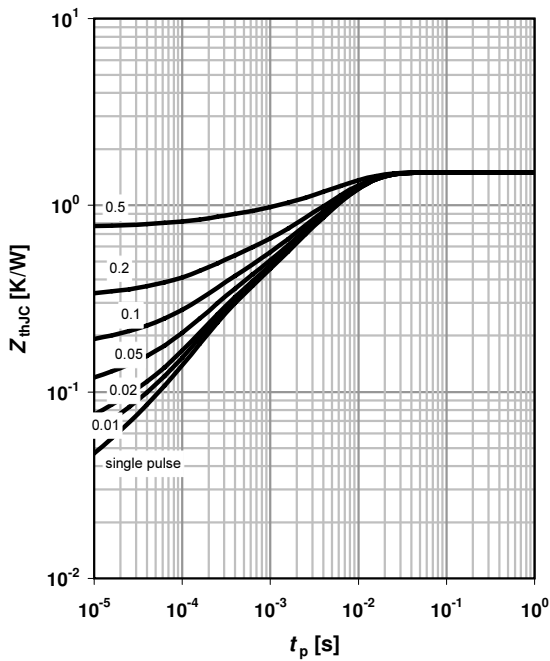
parameter:  $t_p$



**3 Max. transient thermal impedance**

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

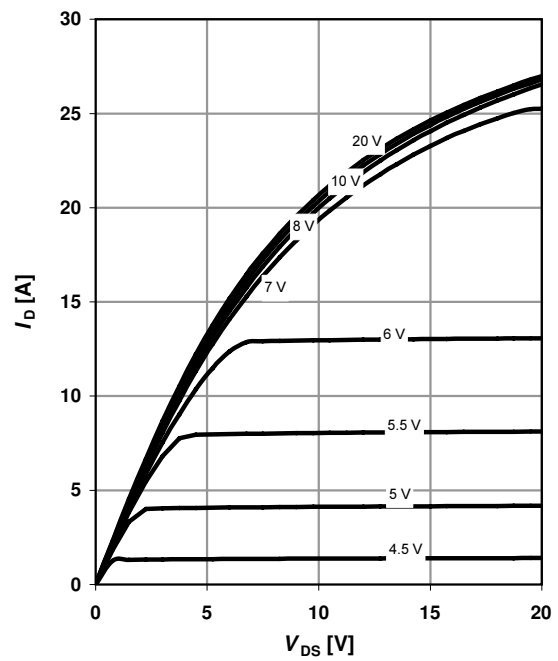
parameter:  $D=t_p/T$



**4 Typ. output characteristics**

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

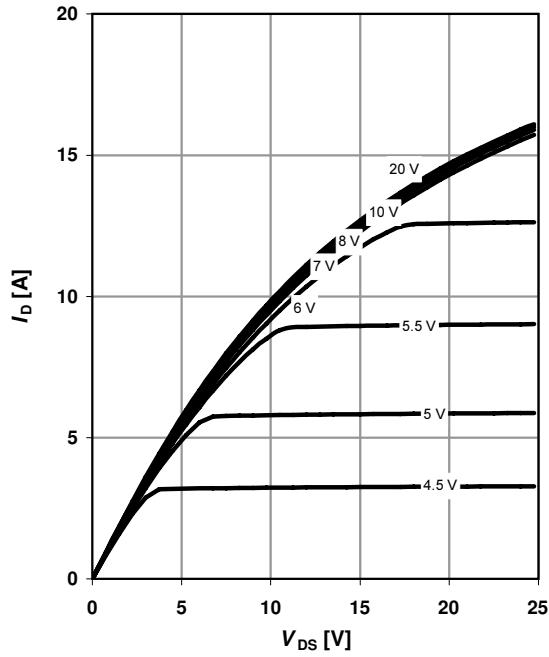
parameter:  $V_{GS}$



**5 Typ. output characteristics**

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

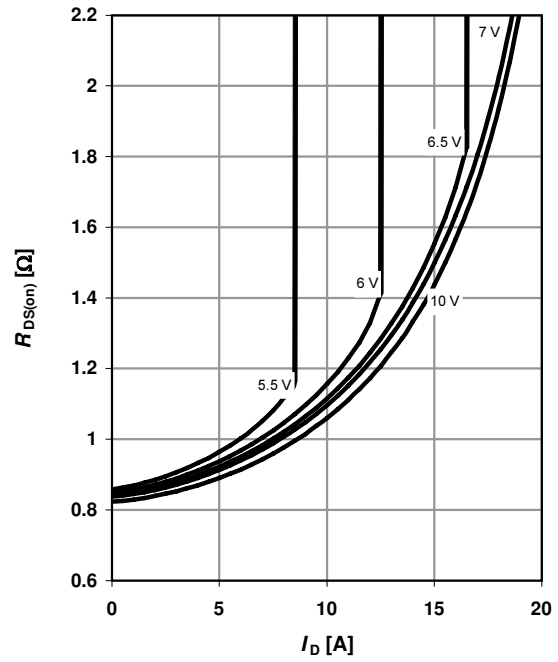
parameter:  $V_{GS}$



**6 Typ. drain-source on-state resistance**

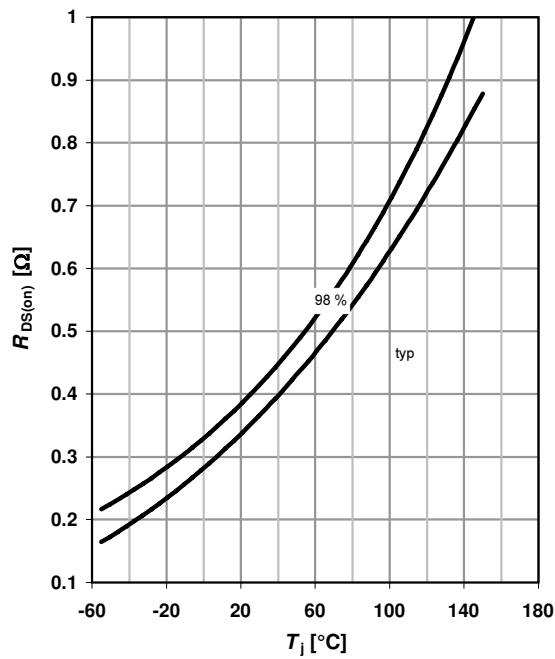
$R_{DS(on)} = f(I_D); T_j = 150\text{ °C}$

parameter:  $V_{GS}$



**7 Drain-source on-state resistance**

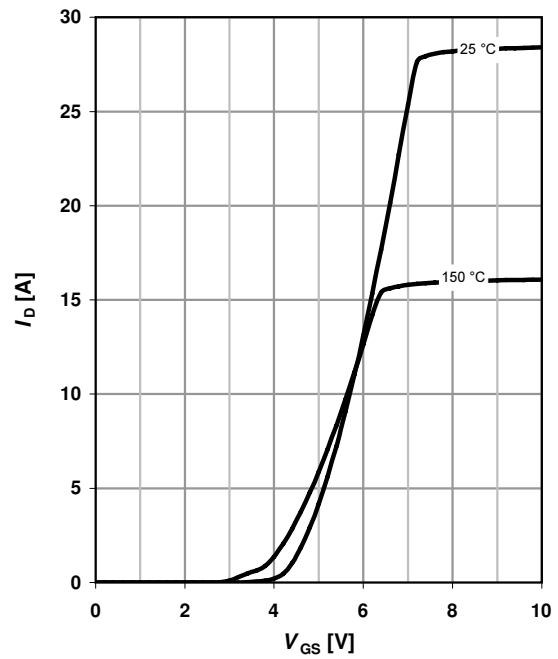
$R_{DS(on)} = f(T_j); I_D = 4.9\text{ A}; V_{GS} = 10\text{ V}$



**8 Typ. transfer characteristics**

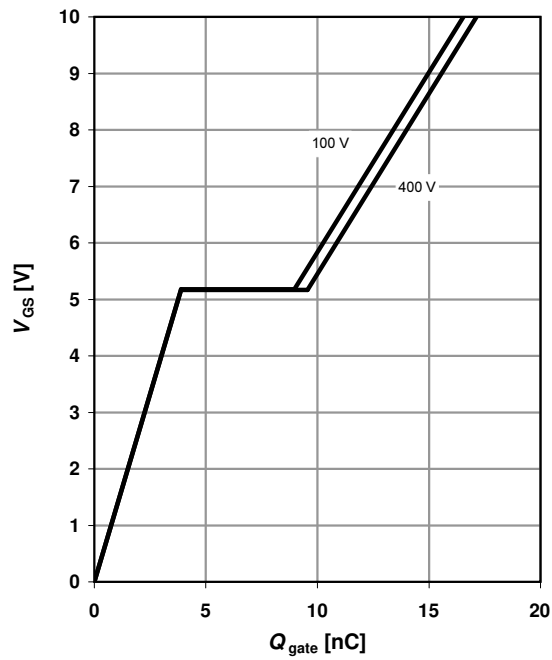
$I_D = f(V_{GS}); |V_{DS}| > 2|I_D|R_{DS(on)max}$

parameter:  $T_j$

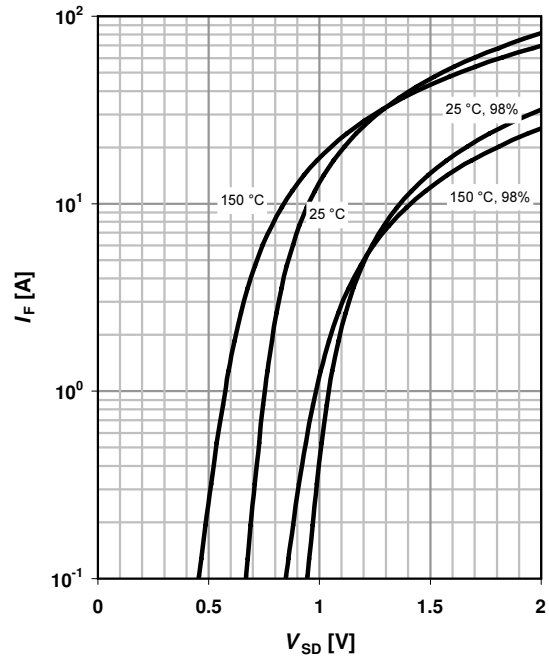


**9 Typ. gate charge**

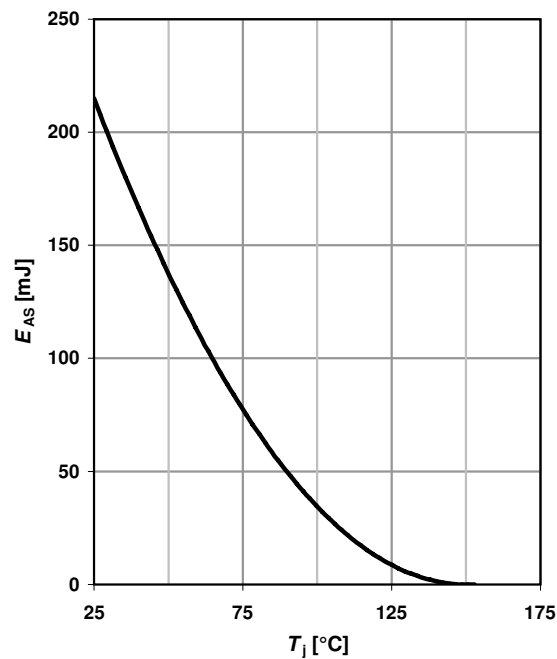
$$V_{GS}=f(Q_{gate}); I_D=4.9 \text{ A pulsed}$$

 parameter:  $V_{DD}$ 

**10 Forward characteristics of reverse diode**

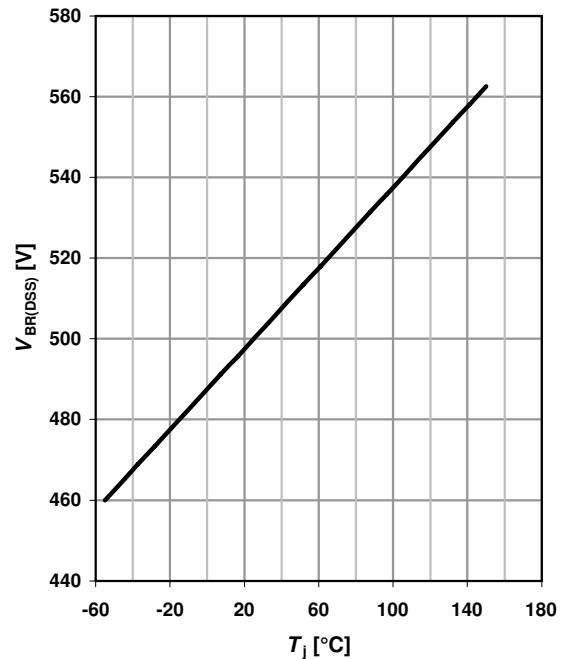
$$I_F=f(V_{SD})$$

 parameter:  $T_j$ 

**11 Avalanche energy**

$$E_{AS}=f(T_j); I_D=3.3 \text{ A}; V_{DD}=50 \text{ V}$$

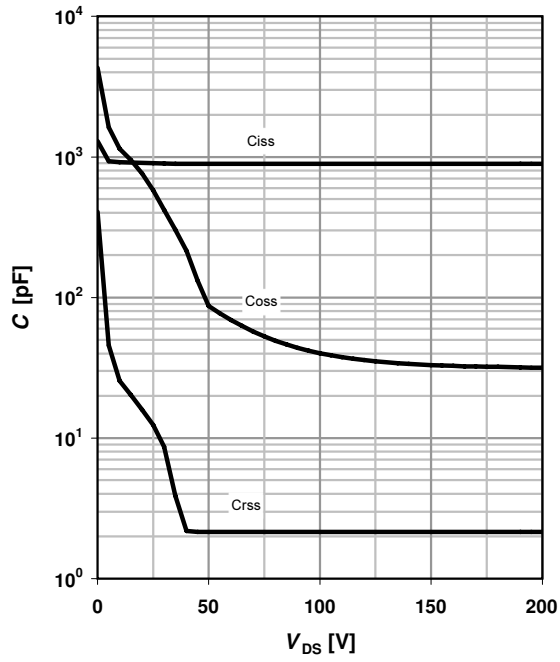

**12 Drain-source breakdown voltage**

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



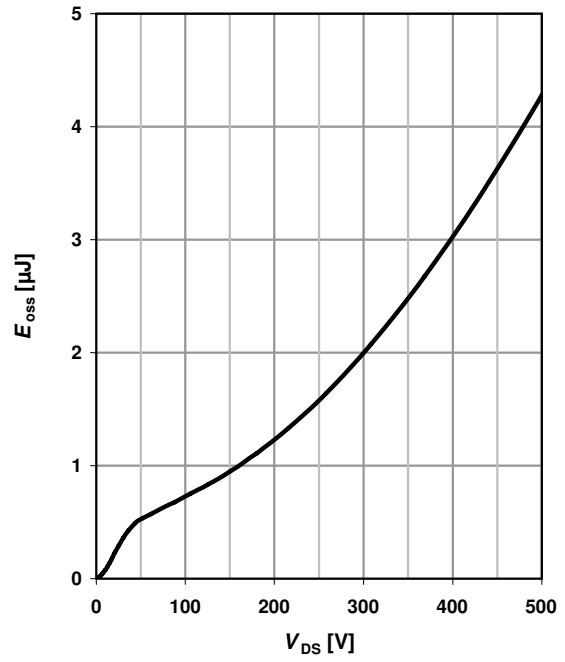
13 Typ. capacitances

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

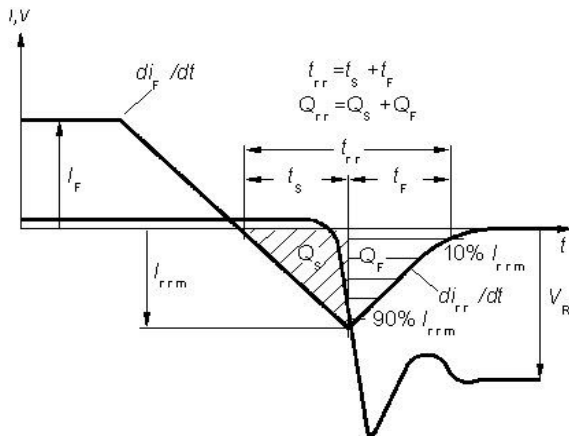


14 Typ. Coss stored energy

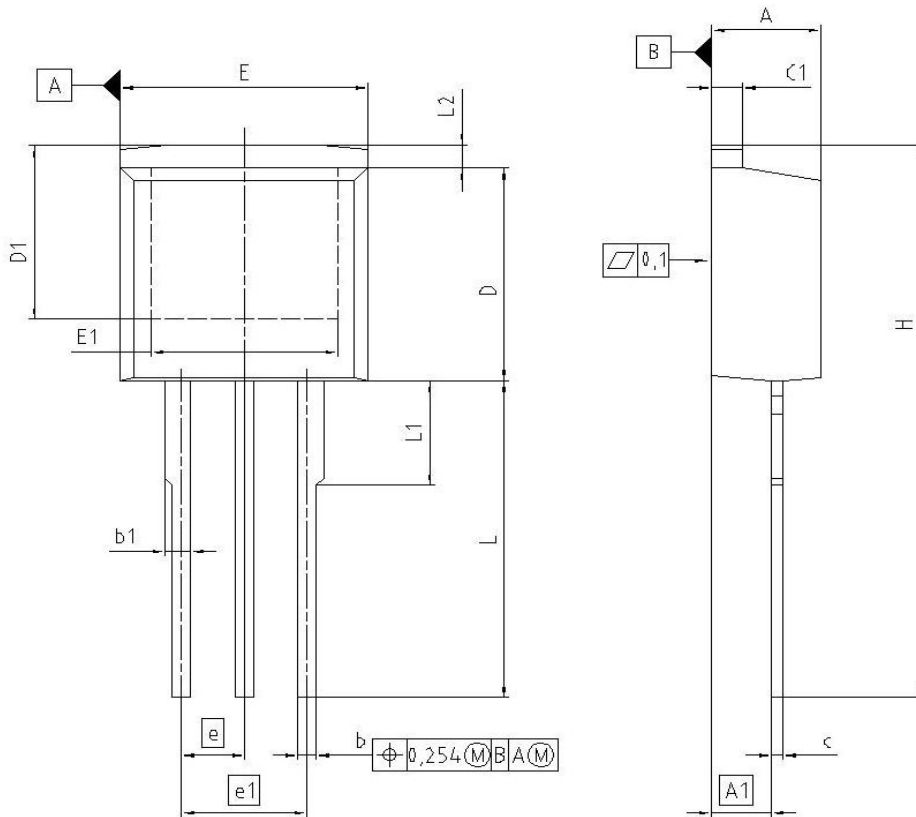
$$E_{oss} = f(V_{DS})$$



Definition of diode switching characteristics





**PG-TO262: Outline**


DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
<b>A</b>	4.300	4.500	0.169	0.177
<b>A1</b>	2.150	2.650	0.085	0.104
<b>b</b>	0.650	0.850	0.026	0.033
<b>b1</b>	0.635	1.400	0.025	0.055
<b>c</b>	0.400	0.600	0.016	0.024
<b>c1</b>	1.170	1.370	0.046	0.054
<b>D</b>	9.050	9.450	0.356	0.372
<b>D1</b>	6.900	7.650	0.272	0.301
<b>E</b>	9.800	10.200	0.386	0.402
<b>E1</b>	7.250	8.600	0.285	0.339
<b>e</b>	2.540		0.100	
<b>e1</b>	5.080		0.200	
<b>N</b>	3		3	
<b>L</b>	13.000	14.000	0.512	0.551
<b>L1</b>	4.350	4.750	0.171	0.187
<b>L2</b>	0.700	1.300	0.028	0.051

<b>REFERENCE</b> JEDEC TO262
<b>SCALE</b> 
<b>EUROPEAN PROJECTION</b> 
<b>ISSUE DATE</b> 01-06-2005
<b>FILE</b> TO262_1

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