

**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>

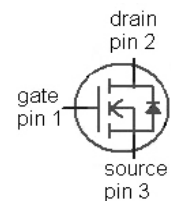
**Product Summary**

$V_{DS} @ T_{jmax}$	550	V
$R_{DS(on),max}$	0.250	$\frac{m\Omega}{cm^2}$
$Q_{g,typ}$	27	nC

**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

TO-262-3



Type	Package	Marking
IPI50R250CP	PG-TO262	5R250P

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

Parameter	Symbol	Conditions	Value	Unit
Continuous drain current	$I_D$	$T_C=25\text{ °C}$	13	A
		$T_C=100\text{ °C}$	9	
Pulsed drain current <sup>2)</sup>	$I_{D,pulse}$	$T_C=25\text{ °C}$	31	
Avalanche energy, single pulse	$E_{AS}$	$I_D=5.2\text{ A}$ , $V_{DD}=50\text{ V}$	345	mJ
Avalanche energy, repetitive $t_{AR}$ <sup>2),3)</sup>	$E_{AR}$	$I_D=5.2\text{ A}$ , $V_{DD}=50\text{ V}$	0.52	
Avalanche current, repetitive $t_{AR}$ <sup>2),3)</sup>	$I_{AR}$		5.2	A
MOSFET dv/dt ruggedness	dv/dt	$V_{DS}=0\dots400\text{ V}$	50	V/ns
Gate source voltage	$V_{GS}$	static	$\pm 20$	V
		AC (f>1 Hz)	$\pm 30$	
Power dissipation	$P_{tot}$	$T_C=25\text{ °C}$	114	W
Operating and storage temperature	$T_j$ , $T_{stg}$		-55 ... 150	°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	$I_S$	$T_C=25\text{ °C}$	7.8	A
Diode pulse current <sup>2)</sup>	$I_{S,pulse}$		31	
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	$R_{thJC}$		-	-	1.1	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	$V_{GS(th)}$	$V_{DS}=V_{GS}, I_D=0.52\text{ mA}$	2.5	3	3.5	
Zero gate voltage drain current	$I_{DSS}$	$V_{DS}=500\text{ V}, V_{GS}=0\text{ V}, T_j=25\text{ °C}$	-	-	1	$\mu\text{A}$
		$V_{DS}=500\text{ V}, V_{GS}=0\text{ V}, T_j=150\text{ °C}$	-	10	-	
Gate-source leakage current	$I_{GSS}$	$V_{GS}=20\text{ V}, V_{DS}=0\text{ V}$	-	-	100	nA
Drain-source on-state resistance	$R_{DS(on)}$	$V_{GS}=10\text{ V}, I_D=7.8\text{ A}, T_j=25\text{ °C}$	-	0.22	0.25	$\text{m}\Omega$
		$V_{GS}=10\text{ V}, I_D=7.8\text{ A}, T_j=150\text{ °C}$	-	0.54	-	
Gate resistance	$R_G$	$f=1\text{ MHz}, \text{open drain}$	-	2.2	-	$\text{m}\Omega$

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 <sup>5)</sup>	$C_{o(er)}$	$V_{GS}=0\text{ V}, V_{DS}=0\text{ V}$ to 400 V	-	60	-	
Effective output capacitance, time related <sup>6)</sup>	$C_{o(tr)}$		-	130	-	
Turn-on delay time	$t_{d(on)}$	$V_{DD}=400\text{ V},$ $V_{GS}=10\text{ V}, I_D=7.8\text{ A},$ $R_G=23.1\leq$	-	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	$V_{SD}$	$V_{GS}=0\text{ V}, I_F=7.8\text{ A},$ $T_j=25\text{ }^\circ\text{C}$	-	0.9	1.2	V
Reverse recovery time	$t_{rr}$	$V_R=400\text{ V}, I_F=I_S,$ $di_F/dt=100\text{ A}/\mu\text{s}$	-	300	-	ns
Reverse recovery charge	$Q_{rr}$		-	3.1	-	$\mu\text{C}$
Peak reverse recovery current	$I_{rrm}$		-	23	-	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  $P_{AV}=E_{AR} \cdot f$ .

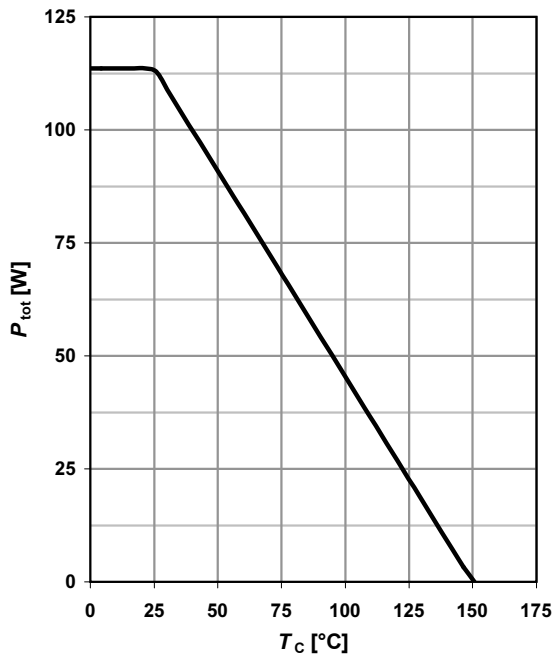
<sup>4)</sup>  $I_{SD} \leq I_D, di/dt \leq 200\text{ A}/\mu\text{s}, V_{DClink}=400\text{ V}, V_{peak} < V_{(BR)DSS}, T_j < T_{j,max}$ , identical low and high side switch

<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%  $V_{DSS}$ .

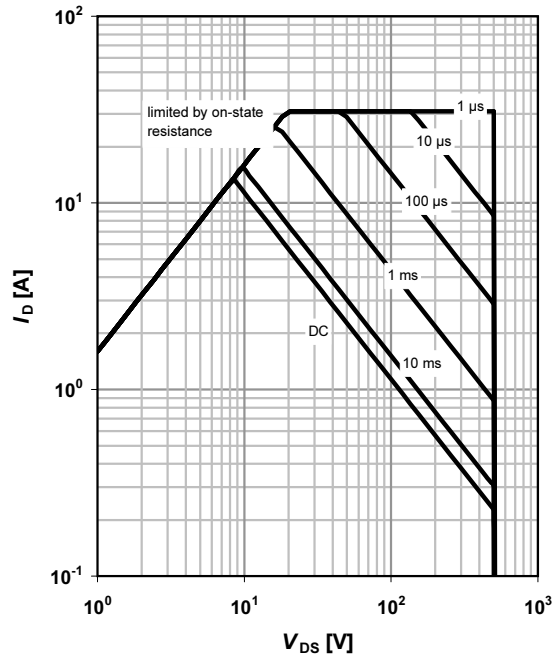
<sup>6)</sup>  $C_{o(tr)}$  is a fixed capacitance that gives the same charging time as  $C_{oss}$  while  $V_{DS}$  is rising from 0 to 80%  $V_{DSS}$ .

**1 Power dissipation**

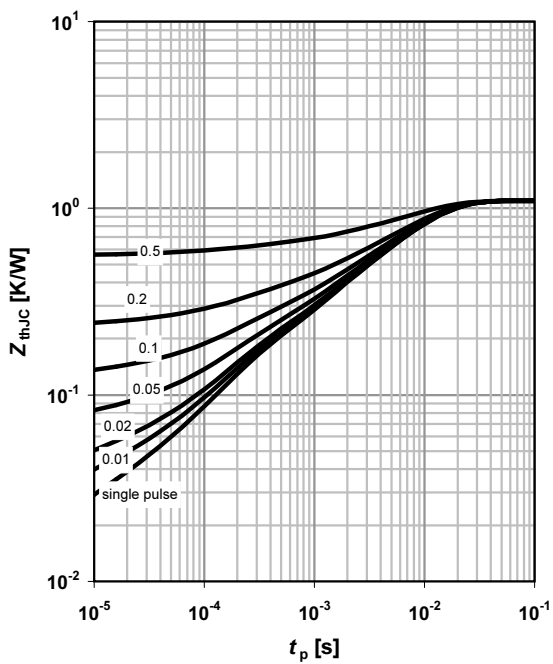
$$P_{tot} = f(T_C)$$


**2 Safe operating area**

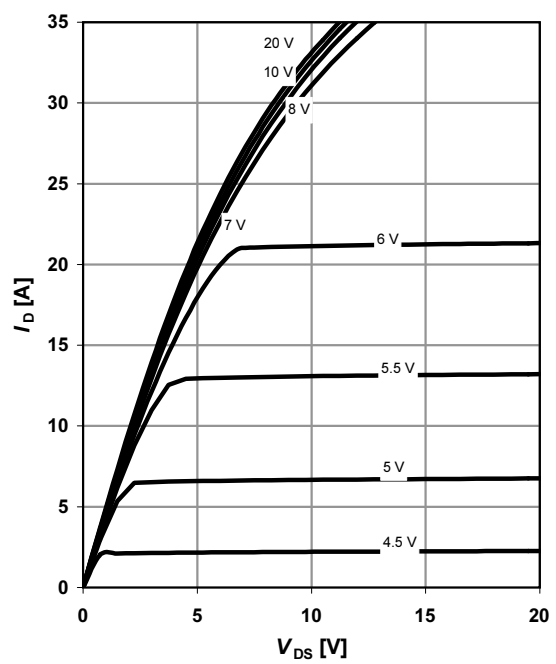
$$I_D = f(V_{DS}); T_C = 25^\circ\text{C}; D = 0$$

 parameter:  $t_p$ 

**3 Max. transient thermal impedance**

$$Z_{(th)JC} = f(t_p)$$

 parameter:  $D = t_p / T$ 

**4 Typ. output characteristics**

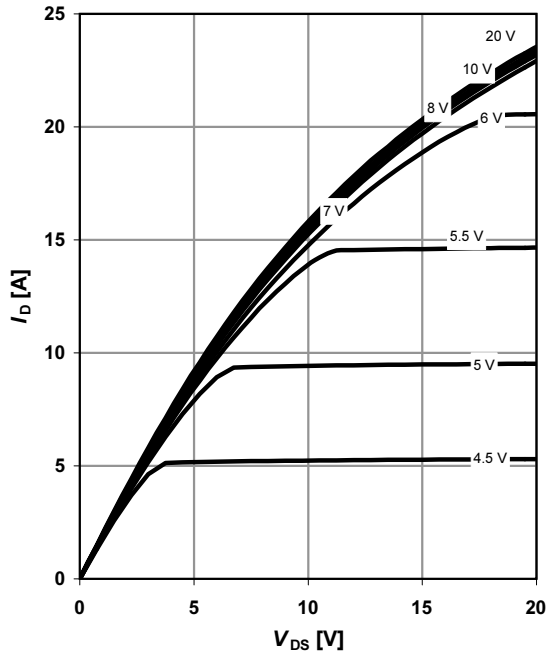
$$I_D = f(V_{DS}); T_J = 25^\circ\text{C}$$

 parameter:  $V_{GS}$ 


**5 Typ. output characteristics**

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

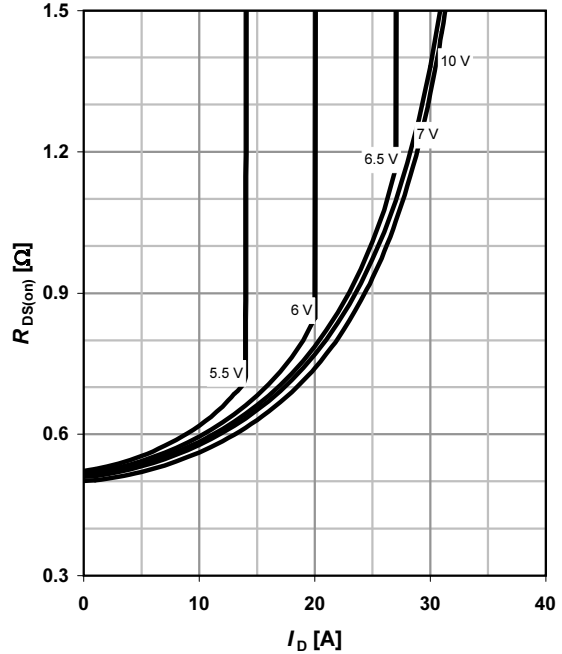
parameter:  $V_{GS}$



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

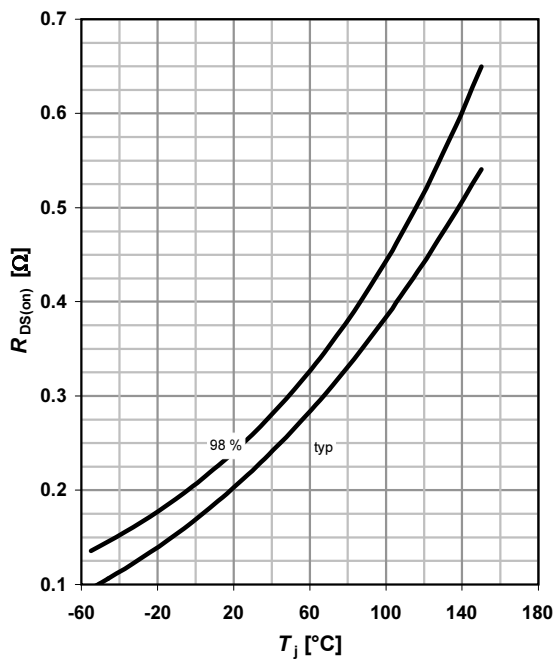
$R_{DS(on)} = f(I_D); T_j = 150\text{ °C}$

parameter:  $V_{GS}$



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

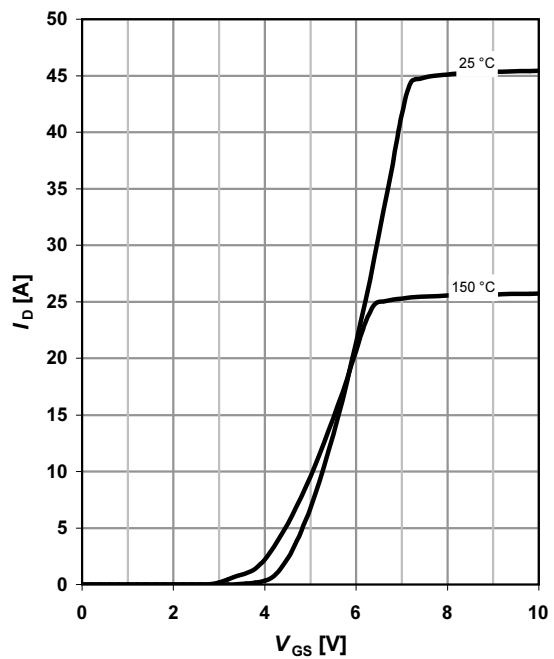
$R_{DS(on)} = f(T_j); I_D = 7.8\text{ A}; V_{GS} = 10\text{ V}$



**8 Typ. transfer characteristics**

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

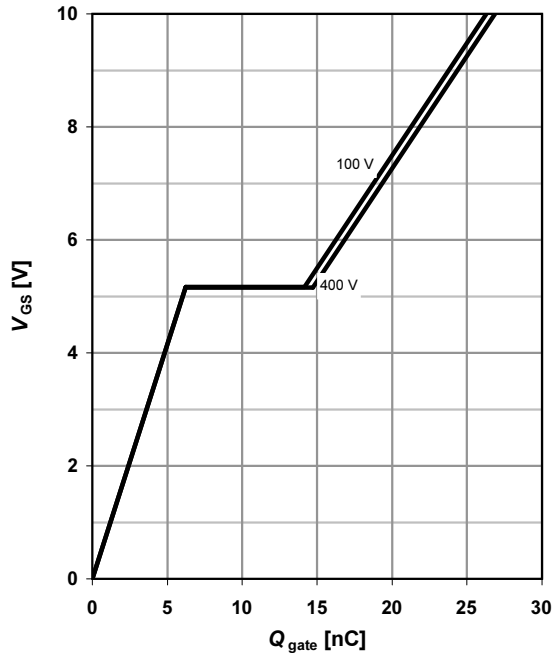
parameter:  $T_j$



**9 Typ. gate charge**

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

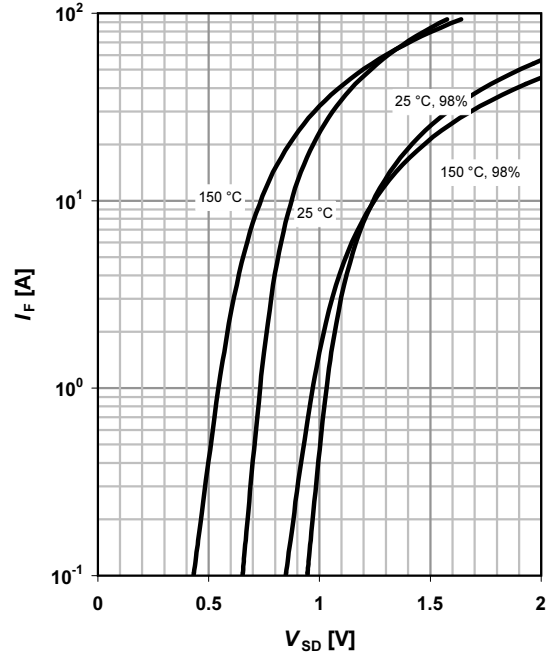
parameter:  $V_{DD}$



**10 Forward characteristics of reverse diode**

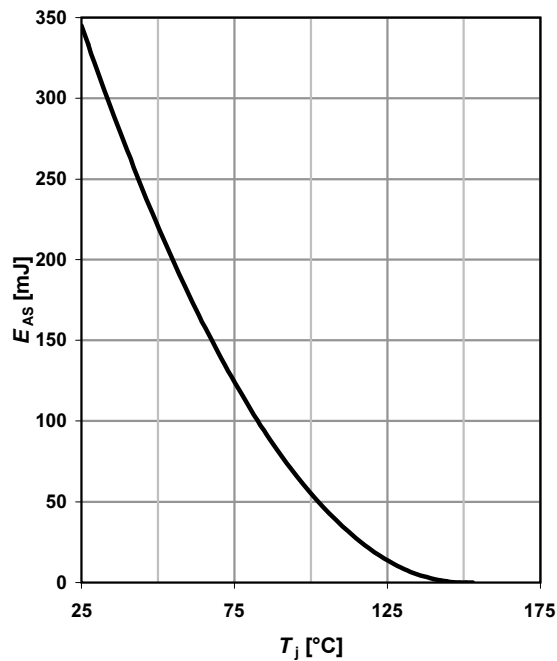
$I_F=f(V_{SD})$

parameter:  $T_j$



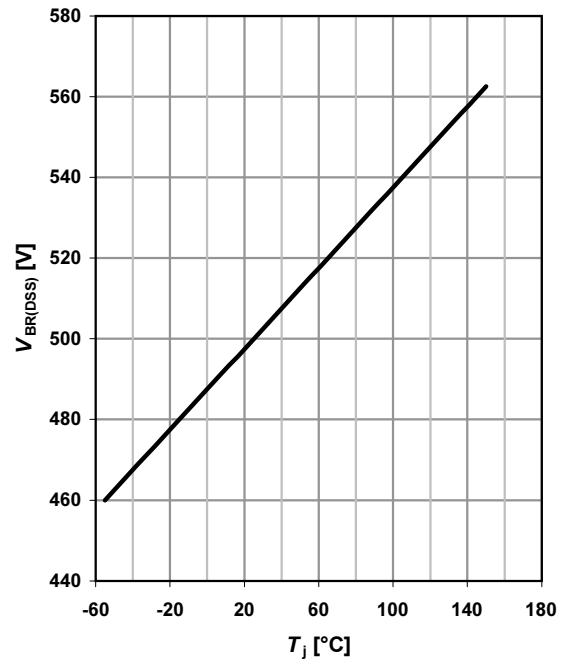
**11 Avalanche energy**

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



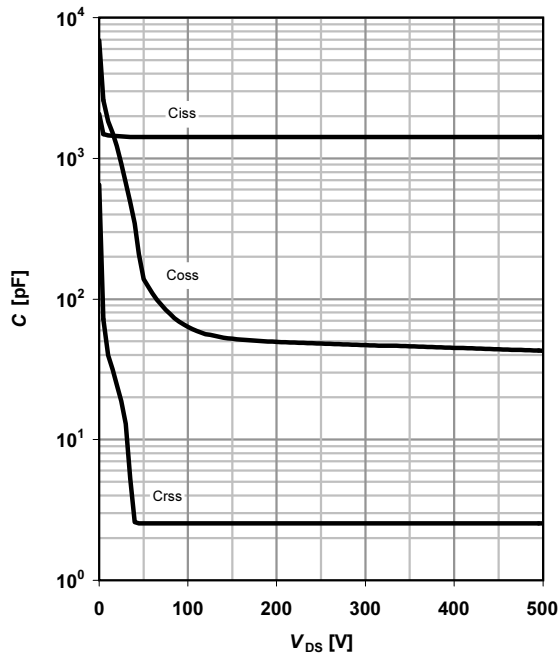
**12 Drain-source breakdown voltage**

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



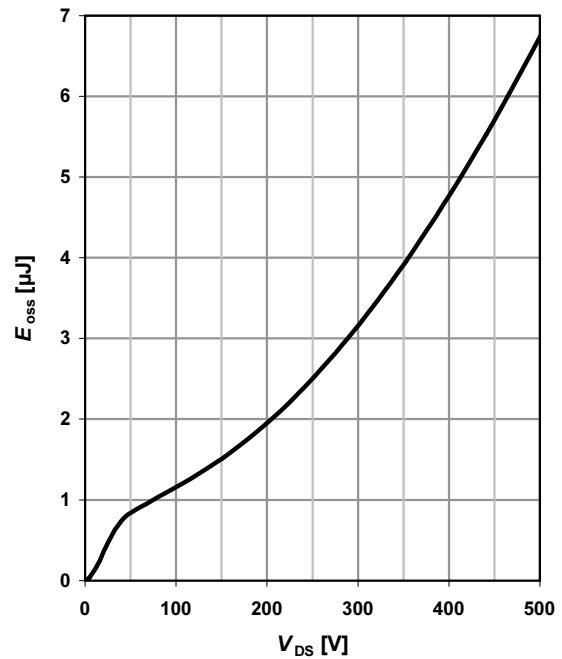
**13 Typ. capacitances**

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

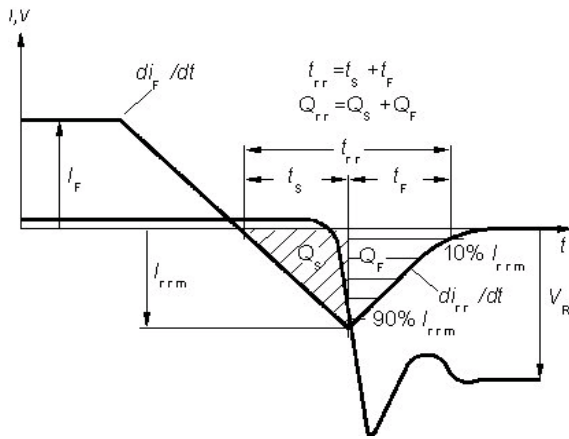


**14 Typ. Coss stored energy**

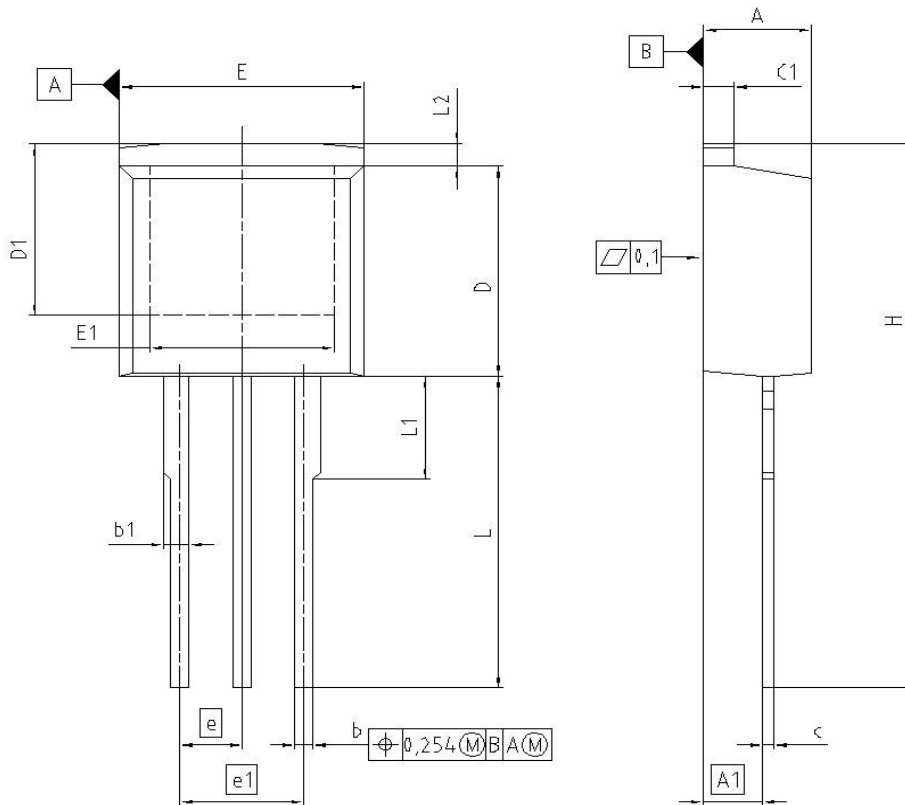
$E_{oss} = f(V_{DS})$



Definition of diode switching characteristics





**PG-TO262-3: 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

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**SCALE**

**EUROPEAN PROJECTION**

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