

**CoolMOS® Power Transistor**
**Features**

- Worldwide best  $R_{DS(on)}$  in TO220
- 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
$R_{DS(on),max}$	0.140	$\Omega$
$Q_{g,typ}$	48	nC

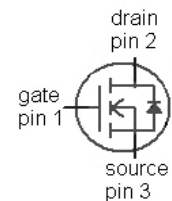
**CoolMOS CP is designed for:**

- Hard & soft switching SMPS topologies
- CCM PFC for ATX, Notebookadapter & PDP and LCD TV
- PWM Stages for Server, Adapter

TO-262-3-1



Type	Package	Marking
IPI50R140CP	PG-TO220	5R140P


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

Parameter	Symbol	Conditions	Value	Unit
Continuous drain current	$I_D$	$T_C=25^\circ\text{C}$	23	A
		$T_C=100^\circ\text{C}$	15	
Pulsed drain current <sup>2)</sup>	$I_{D,pulse}$	$T_C=25^\circ\text{C}$	56	
Avalanche energy, single pulse	$E_{AS}$	$I_D=9.3\text{ A}, V_{DD}=50\text{ V}$	616	mJ
Avalanche energy, repetitive $t_{AR}^{2),3)}$	$E_{AR}$	$I_D=9.3\text{ A}, V_{DD}=50\text{ V}$	0.93	
Avalanche current, repetitive $t_{AR}^{2),3)}$	$I_{AR}$		9.3	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 ( $f > 1\text{ Hz}$ )	$\pm 30$	
Power dissipation	$P_{tot}$	$T_C=25^\circ\text{C}$	192	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	$I_S$	$T_C=25\text{ °C}$	14	A
Diode pulse current <sup>2)</sup>	$I_{S,pulse}$		56	
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	$R_{thJC}$		-	-	0.65	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	$V_{GS(th)}$	$V_{DS}=V_{GS}, I_D=0.93\text{ mA}$	2.5	3	3.5	
Zero gate voltage drain current	$I_{DSS}$	$V_{DS}=500\text{ V}, V_{GS}=0\text{ V}, T_j=25\text{ °C}$	-	-	2	$\mu\text{A}$
		$V_{DS}=500\text{ V}, V_{GS}=0\text{ V}, T_j=150\text{ °C}$	-	20	-	
Gate-source leakage current	$I_{GSS}$	$V_{GS}=20\text{ V}, V_{DS}=0\text{ V}$	-	-	100	nA
Drain-source on-state resistance	$R_{DS(on)}$	$V_{GS}=10\text{ V}, I_D=14\text{ A}, T_j=25\text{ °C}$	-	0.13	0.14	$\Omega$
		$V_{GS}=10\text{ V}, I_D=14\text{ A}, T_j=150\text{ °C}$	-	0.32	-	
Gate resistance	$R_G$	$f=1\text{ MHz}, \text{ open drain}$	-	2.2	-	$\Omega$

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	

**Dynamic characteristics**

Input capacitance	$C_{iss}$	$V_{GS}=0\text{ V}, V_{DS}=100\text{ V},$ $f=1\text{ MHz}$	-	2540	-	pF
Output capacitance	$C_{oss}$		-	110	-	
Effective output capacitance, energy related <sup>5)</sup>	$C_{o(er)}$	$V_{GS}=0\text{ V}, V_{DS}=0\text{ V}$ to 400 V	-	110	-	
Effective output capacitance, time related <sup>6)</sup>	$C_{o(tr)}$		-	230	-	
Turn-on delay time	$t_{d(on)}$	$V_{DD}=400\text{ V},$ $V_{GS}=10\text{ V}, I_D=14\text{ A},$ $R_G=12.2\ \Omega$	-	35	-	ns
Rise time	$t_r$		-	14	-	
Turn-off delay time	$t_{d(off)}$		-	80	-	
Fall time	$t_f$		-	8	-	

**Gate Charge Characteristics**

Gate to source charge	$Q_{gs}$	$V_{DD}=400\text{ V}, I_D=14\text{ A},$ $V_{GS}=0\text{ to }10\text{ V}$	-	11	-	nC
Gate to drain charge	$Q_{gd}$		-	15	-	
Gate charge total	$Q_g$		-	48	64	
Gate plateau voltage	$V_{plateau}$		-	5.2	-	V

**Reverse Diode**

Diode forward voltage	$V_{SD}$	$V_{GS}=0\text{ V}, I_F=14\text{ A},$ $T_j=25\text{ }^\circ\text{C}$	-	0.9	1.2	V
Reverse recovery time	$t_{rr}$	$V_R=400\text{ V}, I_F=I_S,$ $di_F/dt=100\text{ A}/\mu\text{s}$	-	400	-	ns
Reverse recovery charge	$Q_{rr}$		-	5.6	-	$\mu\text{C}$
Peak reverse recovery current	$I_{rrm}$		-	26	-	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  $P_{AV}=E_{AR} \cdot f$ .

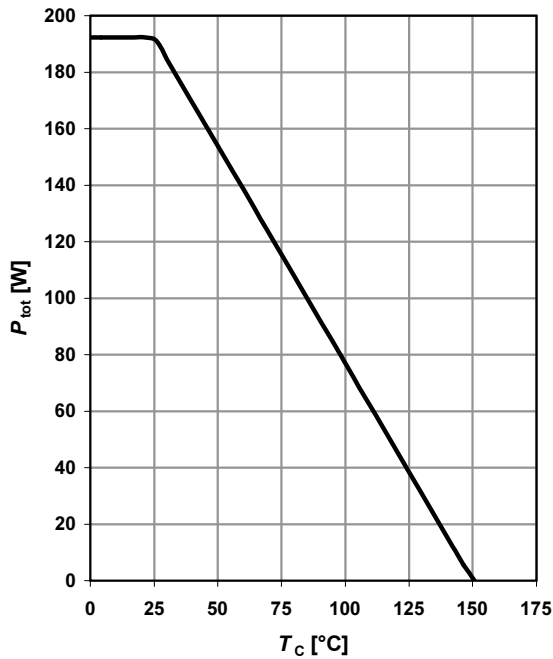
<sup>4)</sup>  $I_{SD} \leq I_D, di/dt \leq 200\text{ A}/\mu\text{s}, V_{DClink}=400\text{ V}, V_{peak} < V_{(BR)DSS}, T_j < T_{j,max}$ , identical low and high side switch

<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%  $V_{DSS}$ .

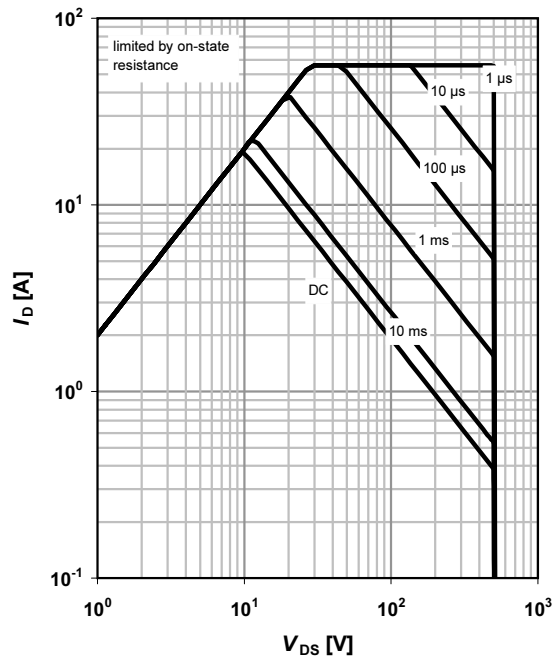
<sup>6)</sup>  $C_{o(tr)}$  is a fixed capacitance that gives the same charging time as  $C_{oss}$  while  $V_{DS}$  is rising from 0 to 80%  $V_{DSS}$ .

**1 Power dissipation**

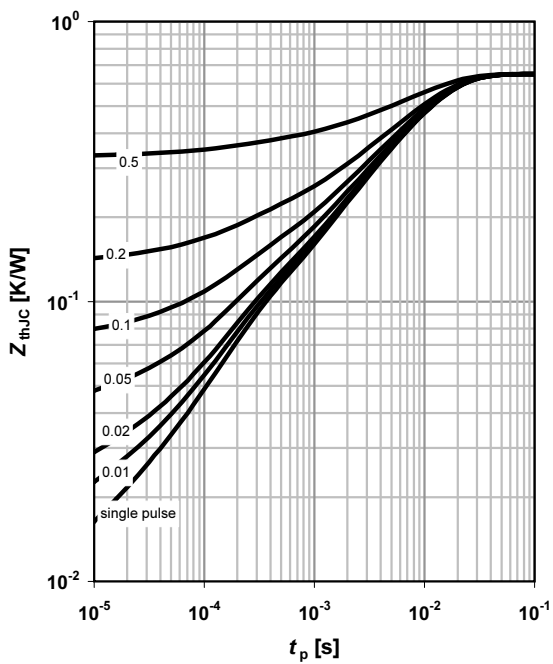
$$P_{\text{tot}} = f(T_C)$$


**2 Safe operating area**

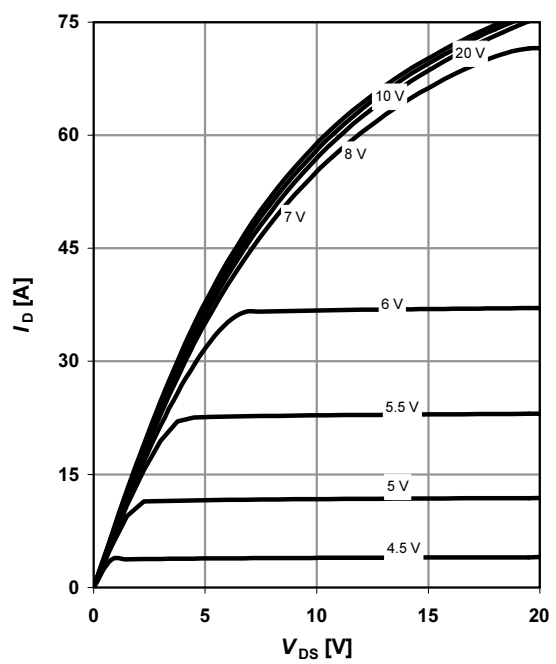
$$I_D = f(V_{DS}); T_C = 25^\circ\text{C}; D = 0$$

 parameter:  $t_p$ 

**3 Max. transient thermal impedance**

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

 parameter:  $D = t_p / T$ 

**4 Typ. output characteristics**

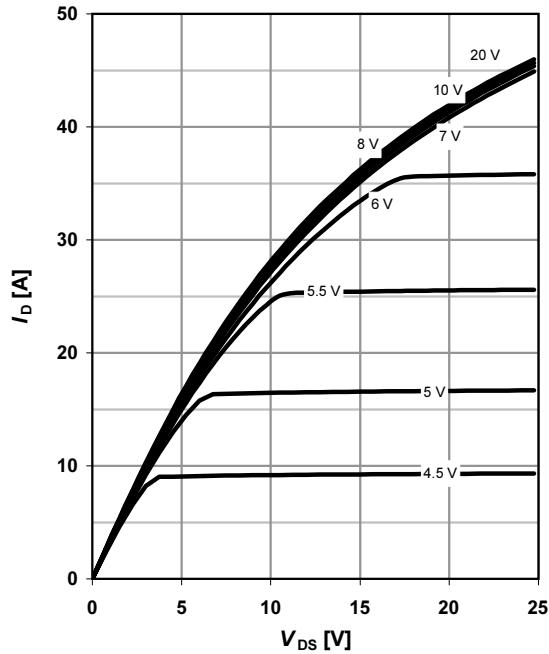
$$I_D = f(V_{DS}); T_J = 25^\circ\text{C}$$

 parameter:  $V_{GS}$ 


**5 Typ. output characteristics**

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

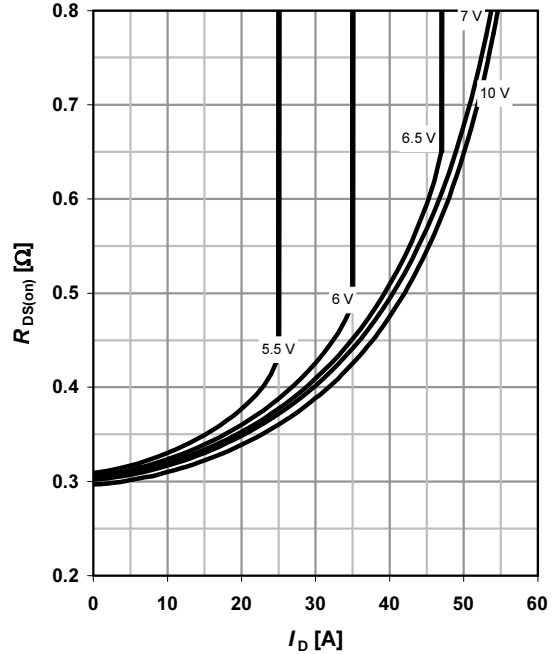
parameter:  $V_{GS}$



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

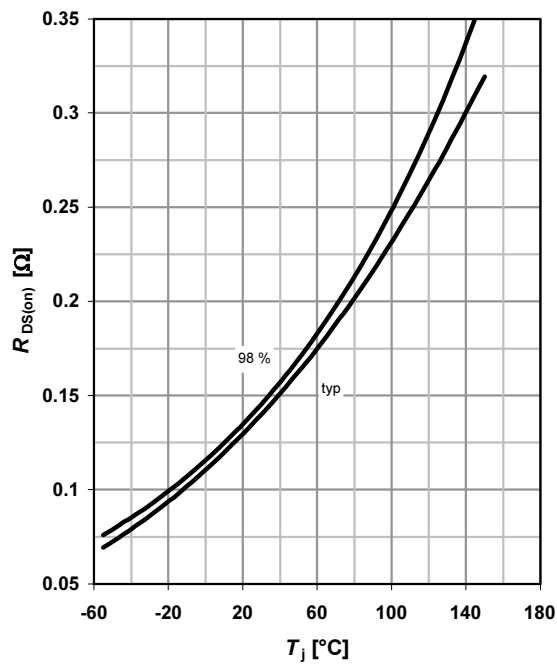
$R_{DS(on)} = f(I_D); T_j = 150\text{ }^\circ\text{C}$

parameter:  $V_{GS}$



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

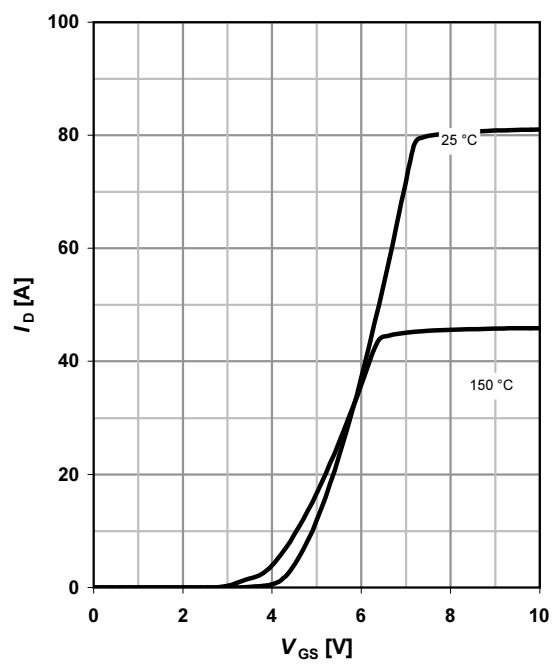
$R_{DS(on)} = f(T_j); I_D = 14\text{ A}; V_{GS} = 10\text{ V}$



**8 Typ. transfer characteristics**

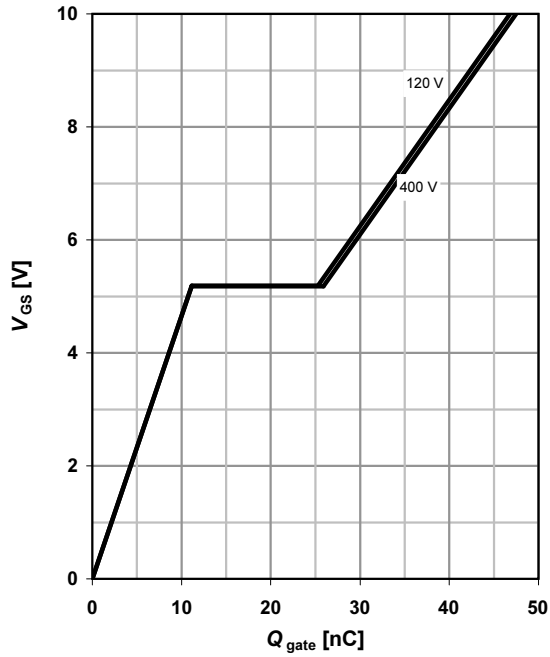
$I_D = f(V_{GS}); |V_{DS}| > 2|I_D|R_{DS(on)max}$

parameter:  $T_j$

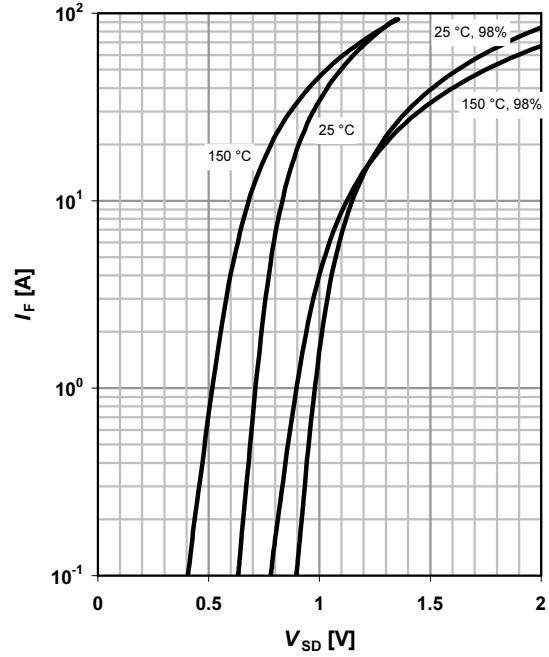


**9 Typ. gate charge**

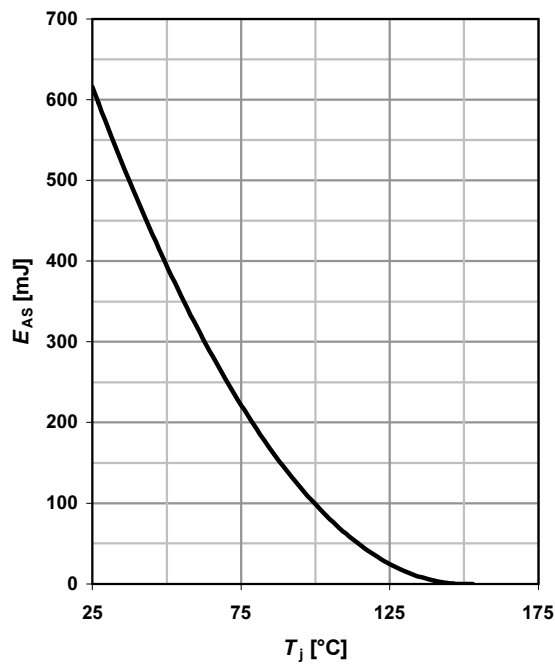
$$V_{GS}=f(Q_{gate}); I_D=14 \text{ A pulsed}$$

 parameter:  $V_{DD}$ 

**10 Forward characteristics of reverse diode**

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

 parameter:  $T_j$ 

**11 Avalanche energy**

$$E_{AS}=f(T_j); I_D=9.3 \text{ A}; V_{DD}=50 \text{ V}$$

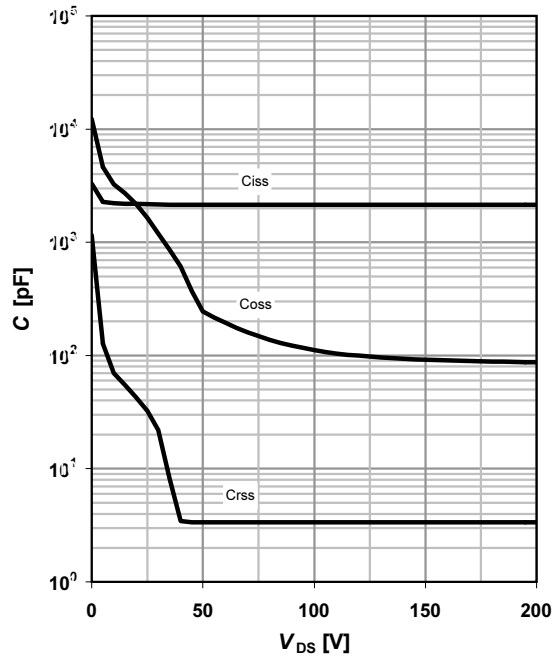

**12 Drain-source breakdown voltage**

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



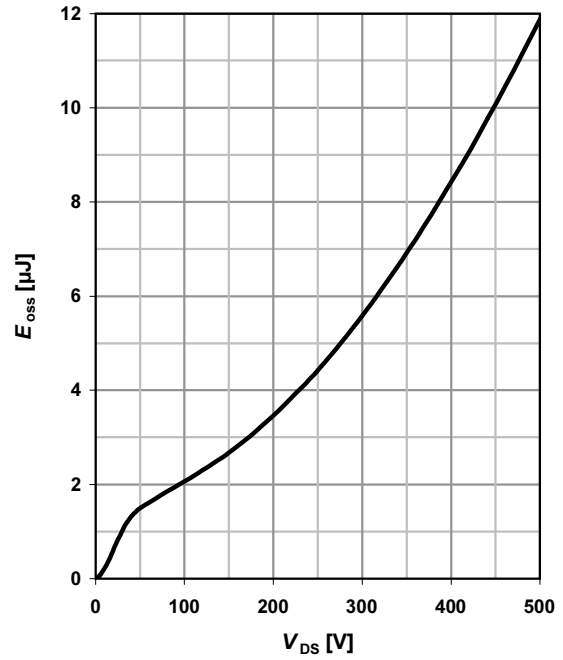
13 Typ. capacitances

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

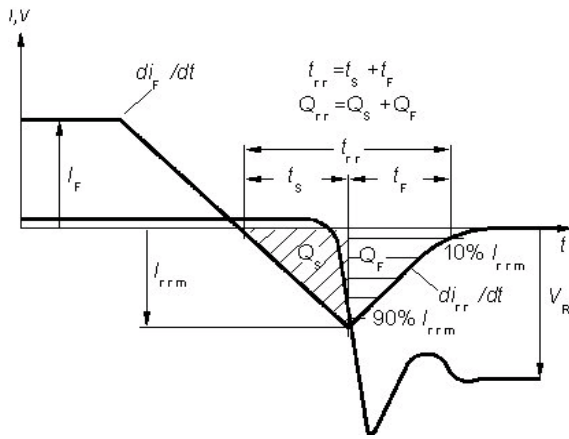


14 Typ. Coss stored energy

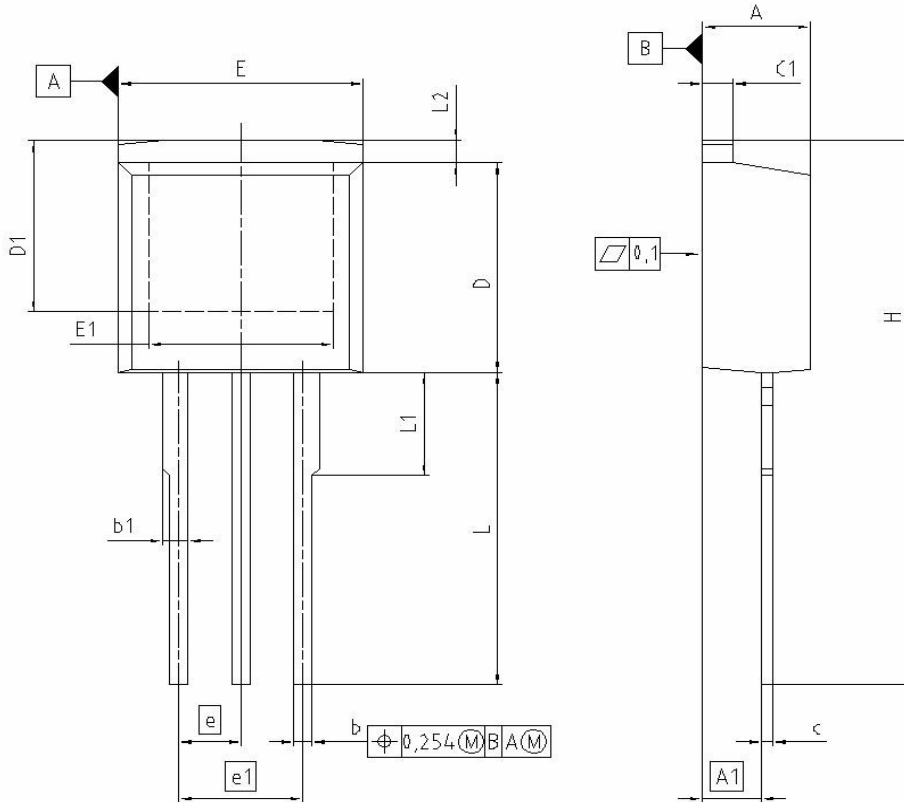
$$E_{oss} = f(V_{DS})$$



Definition of diode switching characteristics





**PG-TO262-3-1: Outlines**


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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