

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

- Lowest figure-of-merit  $R_{ON} \times Q_g$
- Extreme dv/dt rated
- High peak current capability
- Fully qualified according to JEDEC for Industrial Applications
- Pb-free lead plating; RoHS compliant, available in Halogen free mold compound<sup>a)</sup>
- Ultra low gate charge

**Product Summary**

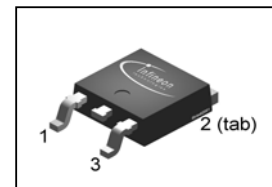
$V_{DS} @ T_J=25^\circ\text{C}$	900	V
$R_{DS(on),max} @ T_J=25^\circ\text{C}$	1.2	$\Omega$
$Q_{g,typ}$	28	nC

**CoolMOS™ 900V is designed for:**

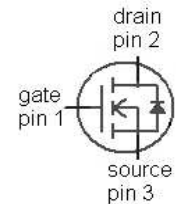
- Quasi Resonant Flyback / Forward topologies
- PC Silverbox and consumer applications
- Industrial SMPS



PG-TO252



Type	Package	Marking
IPD90R1K2C3	PG-TO252	9R1K2C


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

Parameter	Symbol	Conditions	Value	Unit
Continuous drain current	$I_D$	$T_C=25^\circ\text{C}$	5.1	A
		$T_C=100^\circ\text{C}$	3.2	
Pulsed drain current <sup>2)</sup>	$I_{D,pulse}$	$T_C=25^\circ\text{C}$	10	
Avalanche energy, single pulse	$E_{AS}$	$I_D=0.92\text{ A}, V_{DD}=50\text{ V}$	68	mJ
Avalanche energy, repetitive $t_{AR}$ <sup>2),3)</sup>	$E_{AR}$	$I_D=0.92\text{ A}, V_{DD}=50\text{ V}$	0.31	
Avalanche current, repetitive $t_{AR}$ <sup>2),3)</sup>	$I_{AR}$		0.92	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	$P_{tot}$	$T_C=25^\circ\text{C}$	83	W
Operating and storage temperature	$T_J, T_{stg}$		-55 ... 150	$^\circ\text{C}$

<sup>a)</sup> non-Halogen free (OPN: IPD90R1K2C3BT); Halogen free (OPN: IPD90R1K2C3AT)

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

Parameter	Symbol	Conditions	Value	Unit
Continuous diode forward current	$I_S$	$T_C=25\text{ °C}$	2.8	A
Diode pulse current <sup>2)</sup>	$I_{S,pulse}$		11	
Reverse diode $dv/dt$ <sup>4)</sup>	$dv/dt$		4	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	°C

**Electrical characteristics, at  $T_J=25\text{ °C}$ , unless otherwise specified**
**Static characteristics**

Drain-source breakdown voltage	$V_{(BR)DSS}$	$V_{GS}=0\text{ V}$ , $I_D=250\text{ }\mu\text{A}$	900	-	-	V
Gate threshold voltage	$V_{GS(th)}$	$V_{DS}=V_{GS}$ , $I_D=0.31\text{ mA}$	2.5	3	3.5	
Zero gate voltage drain current	$I_{DSS}$	$V_{DS}=900\text{ V}$ , $V_{GS}=0\text{ V}$ , $T_J=25\text{ °C}$	-	-	1	$\mu\text{A}$
		$V_{DS}=900\text{ V}$ , $V_{GS}=0\text{ V}$ , $T_J=150\text{ °C}$	-	10	-	
Gate-source leakage current	$I_{GSS}$	$V_{GS}=20\text{ V}$ , $V_{DS}=0\text{ V}$	-	-	100	nA
Drain-source on-state resistance	$R_{DS(on)}$	$V_{GS}=10\text{ V}$ , $I_D=2.8\text{ A}$ , $T_J=25\text{ °C}$	-	0.94	1.2	$\Omega$
		$V_{GS}=10\text{ V}$ , $I_D=2.8\text{ A}$ , $T_J=150\text{ °C}$	-	2.5	-	
Gate resistance	$R_G$	$f=1\text{ MHz}$ , open drain	-	1.3	-	$\Omega$

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	

**Dynamic characteristics**

Input capacitance	$C_{iss}$	$V_{GS}=0\text{ V}, V_{DS}=100\text{ V},$ $f=1\text{ MHz}$	-	710	-	pF
Output capacitance	$C_{oss}$		-	35	-	
Effective output capacitance, energy related <sup>5)</sup>	$C_{o(er)}$	$V_{GS}=0\text{ V}, V_{DS}=0\text{ V}$ to 500 V	-	23	-	
Effective output capacitance, time related <sup>6)</sup>	$C_{o(tr)}$		-	86	-	
Turn-on delay time	$t_{d(on)}$	$V_{DD}=400\text{ V},$ $V_{GS}=10\text{ V}, I_D=2.8\text{ A},$ $R_G=81.3\ \Omega$	-	70	-	ns
Rise time	$t_r$		-	20	-	
Turn-off delay time	$t_{d(off)}$		-	400	-	
Fall time	$t_f$		-	40	-	

**Gate Charge Characteristics**

Gate to source charge	$Q_{gs}$	$V_{DD}=400\text{ V}, I_D=2.8\text{ A},$ $V_{GS}=0\text{ to }10\text{ V}$	-	3.2	-	nC
Gate to drain charge	$Q_{gd}$		-	12	-	
Gate charge total	$Q_g$		-	28	tbd	
Gate plateau voltage	$V_{plateau}$		-	4.6	-	V

**Reverse Diode**

Diode forward voltage	$V_{SD}$	$V_{GS}=0\text{ V}, I_F=2.8\text{ A},$ $T_j=25\text{ }^\circ\text{C}$	-	0.8	1.2	V
Reverse recovery time	$t_{rr}$	$V_R=400\text{ V}, I_F=I_S,$ $di_F/dt=100\text{ A}/\mu\text{s}$	-	310	-	ns
Reverse recovery charge	$Q_{rr}$		-	3.7	-	$\mu\text{C}$
Peak reverse recovery current	$I_{rrm}$		-	19	-	A

<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  $P_{AV}=E_{AR} \cdot f$ .

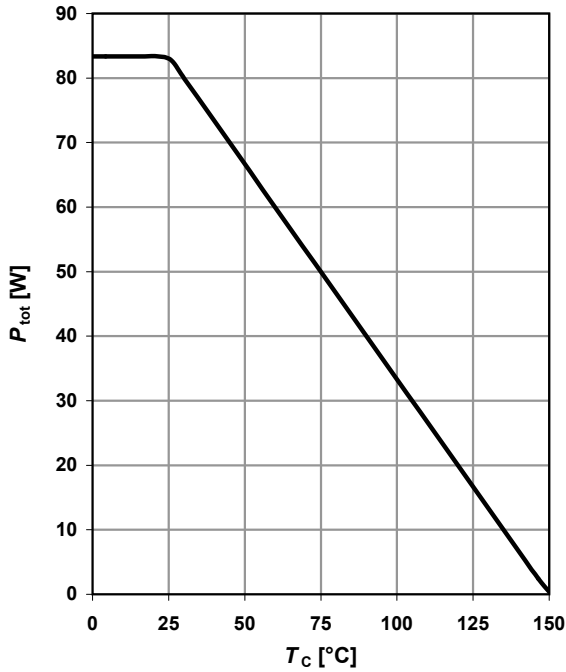
<sup>4)</sup>  $I_{SD} \leq I_D$ ,  $di/dt \leq 200\text{ A}/\mu\text{s}$ ,  $V_{Dlink}=400\text{ V}$ ,  $V_{peak} < V_{(BR)DSS}$ ,  $T_J < T_{J,max}$ , identical low side and high side switch

<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 50%  $V_{DSS}$ .

<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 50%  $V_{DSS}$ .

**1 Power dissipation**

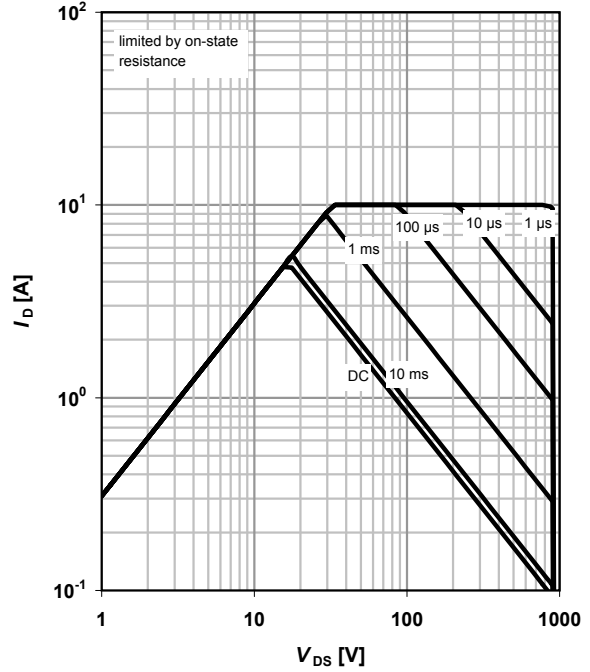
$P_{tot}=f(T_C)$



**2 Safe operating area**

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

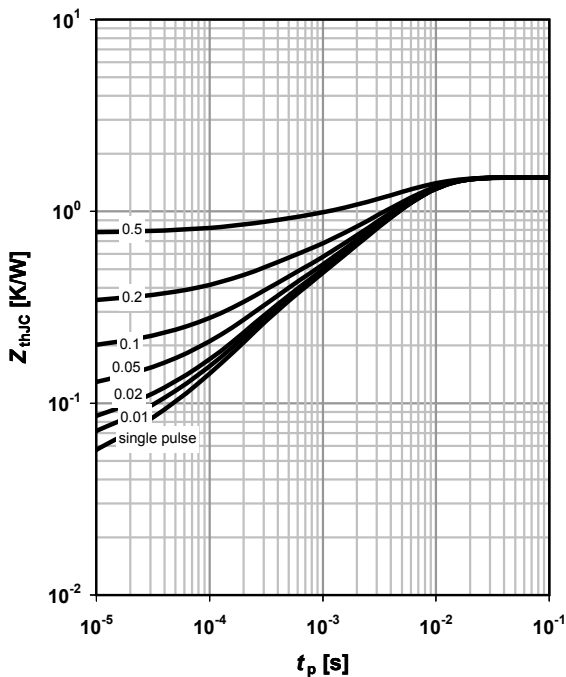
parameter:  $t_p$



**3 Max. transient thermal impedance**

$Z_{thJC}=f(t_p)$

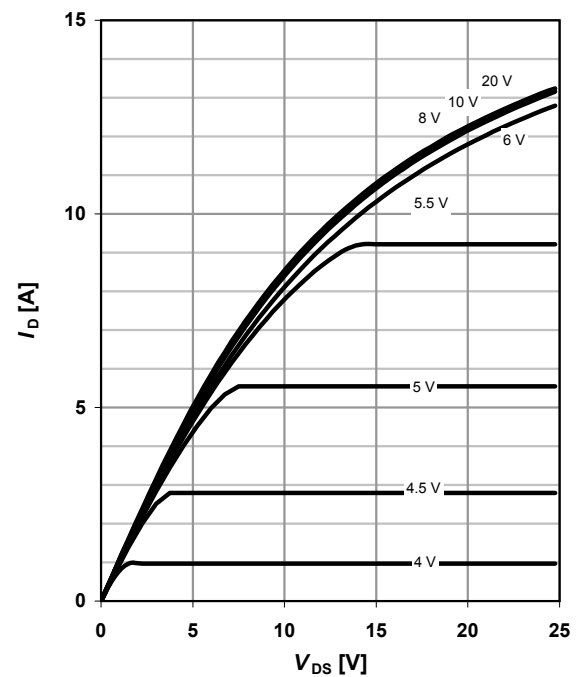
parameter:  $D=t_p/T$



**4 Typ. output characteristics**

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

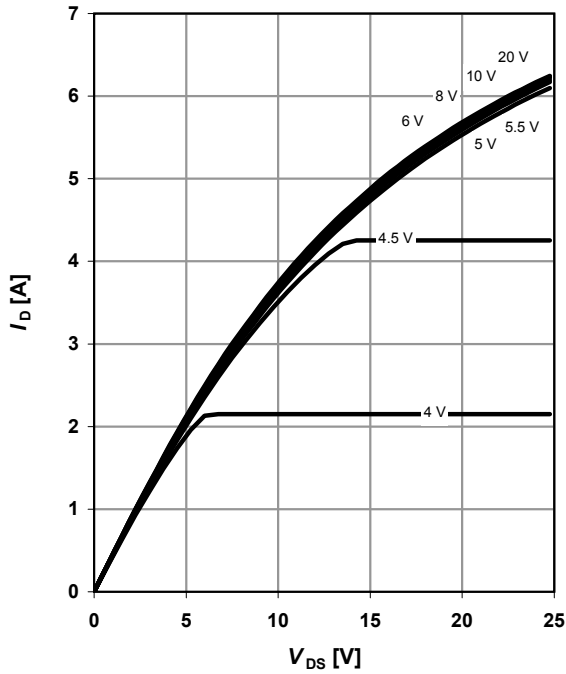
parameter:  $V_{GS}$



**5 Typ. output characteristics**

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

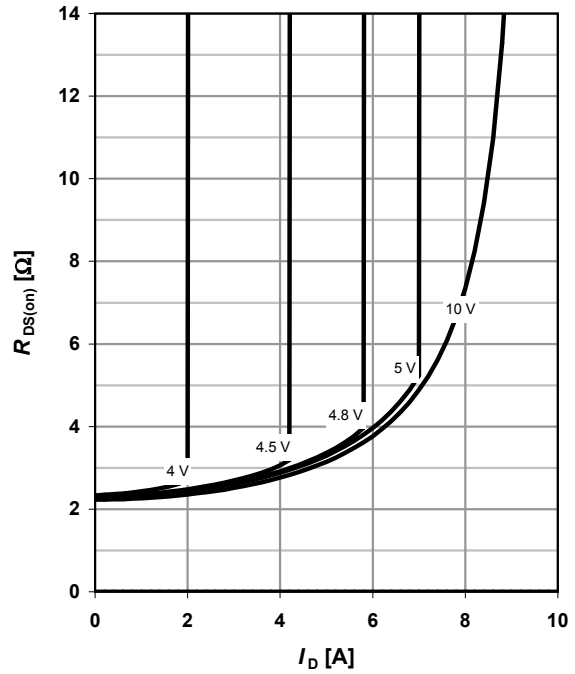
parameter:  $V_{GS}$



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

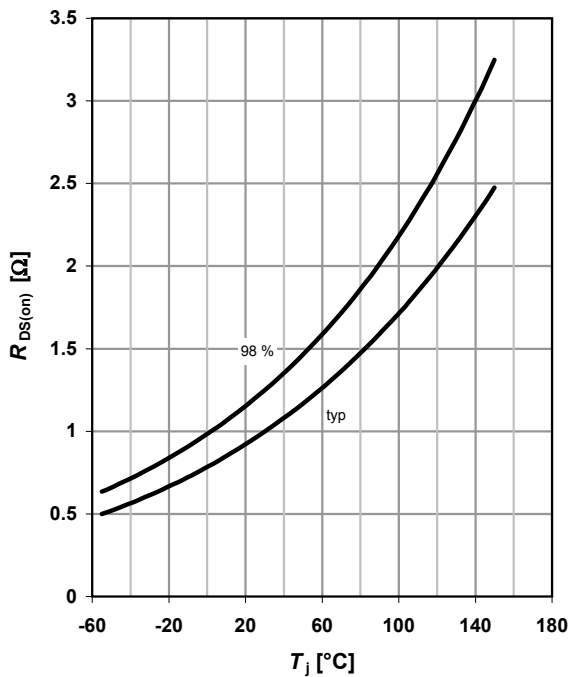
$R_{DS(on)} = f(I_D); T_J = 150\text{ }^\circ\text{C}$

parameter:  $V_{GS}$



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

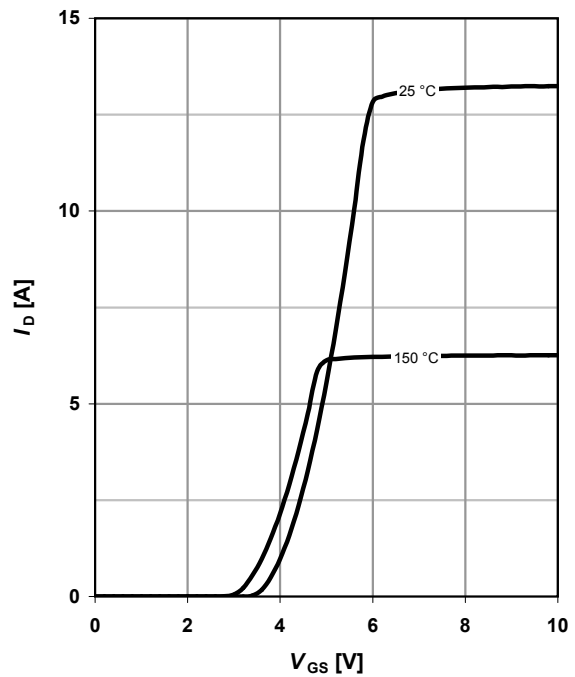
$R_{DS(on)} = f(T_J); I_D = 2.8\text{ A}; V_{GS} = 10\text{ V}$



**8 Typ. transfer characteristics**

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

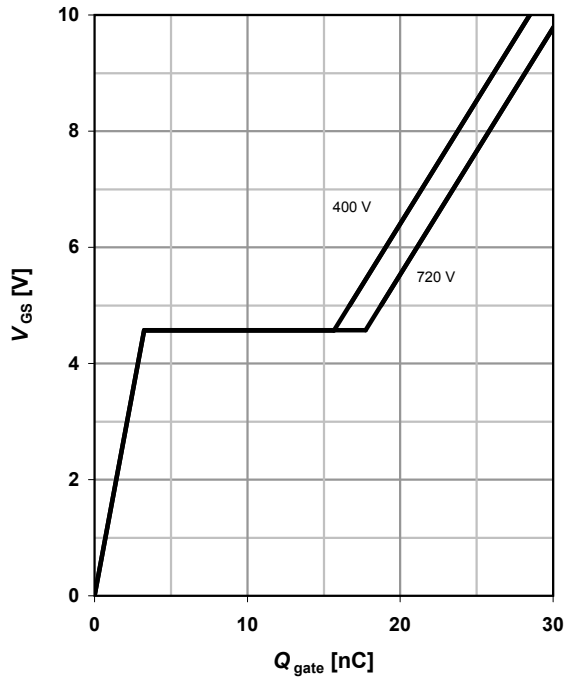
parameter:  $T_J$



**9 Typ. gate charge**

$V_{GS}=f(Q_{gate}); I_D=2.8 \text{ A pulsed}$

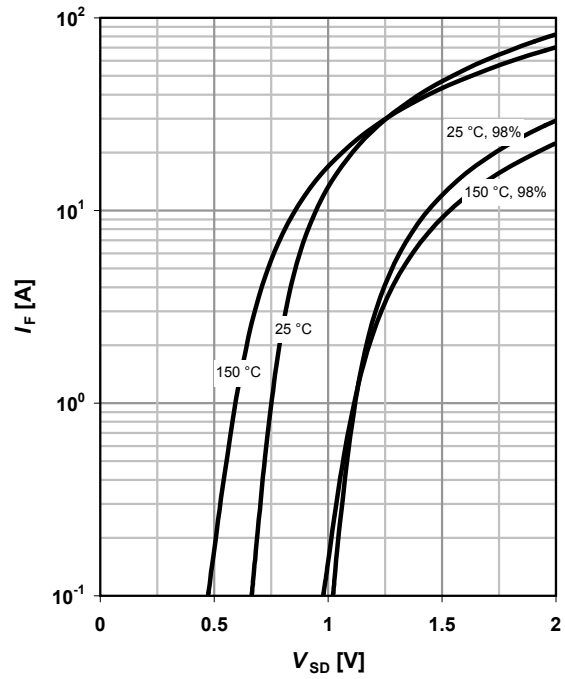
parameter:  $V_{DD}$



**10 Forward characteristics of reverse diode**

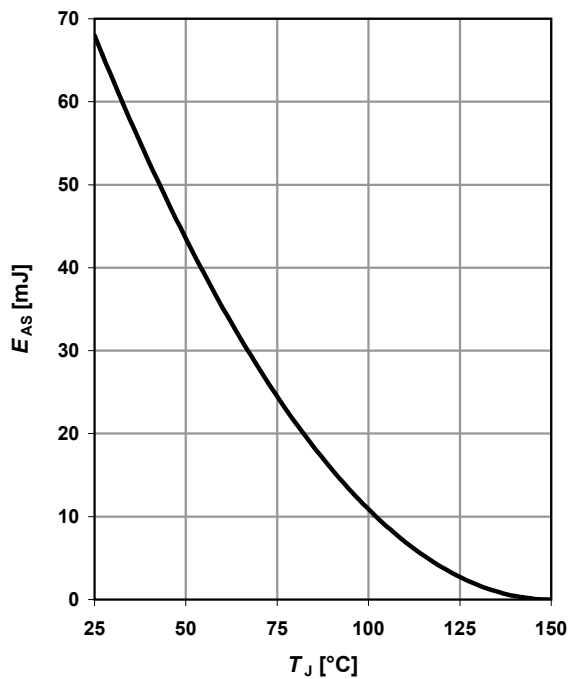
$I_F=f(V_{SD})$

parameter:  $T_J$



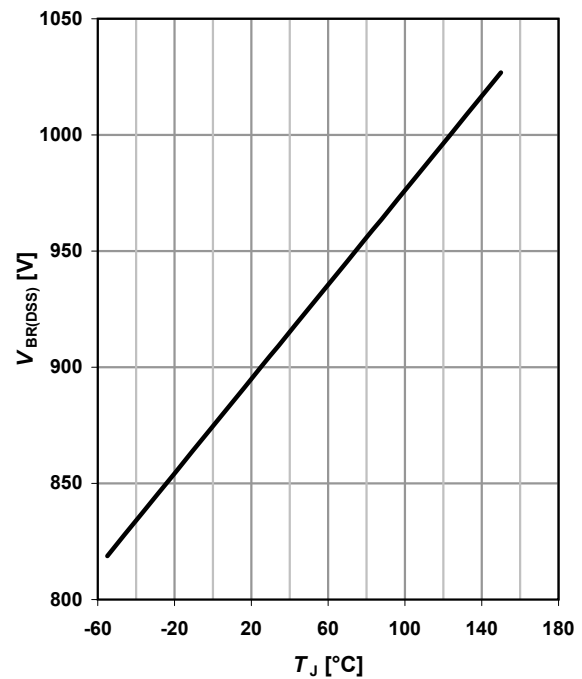
**11 Avalanche energy**

$E_{AS}=f(T_J); I_D=0.92 \text{ A}; V_{DD}=50 \text{ V}$



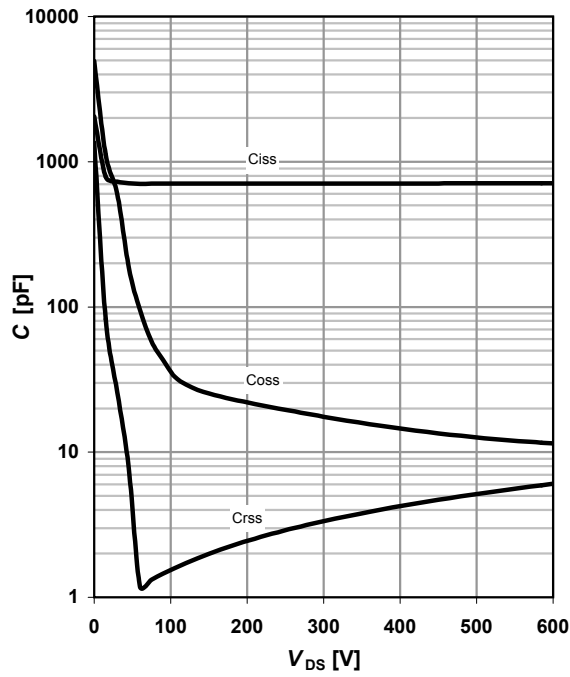
**12 Drain-source breakdown voltage**

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



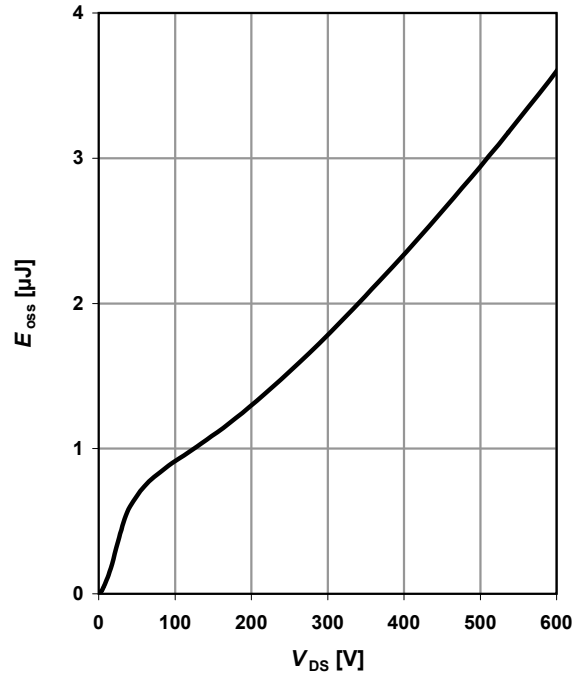
13 Typ. capacitances

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



14 Typ. C<sub>oss</sub> stored energy

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

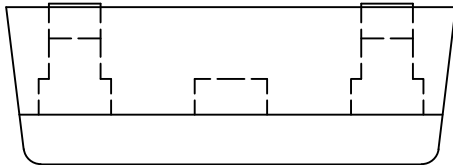
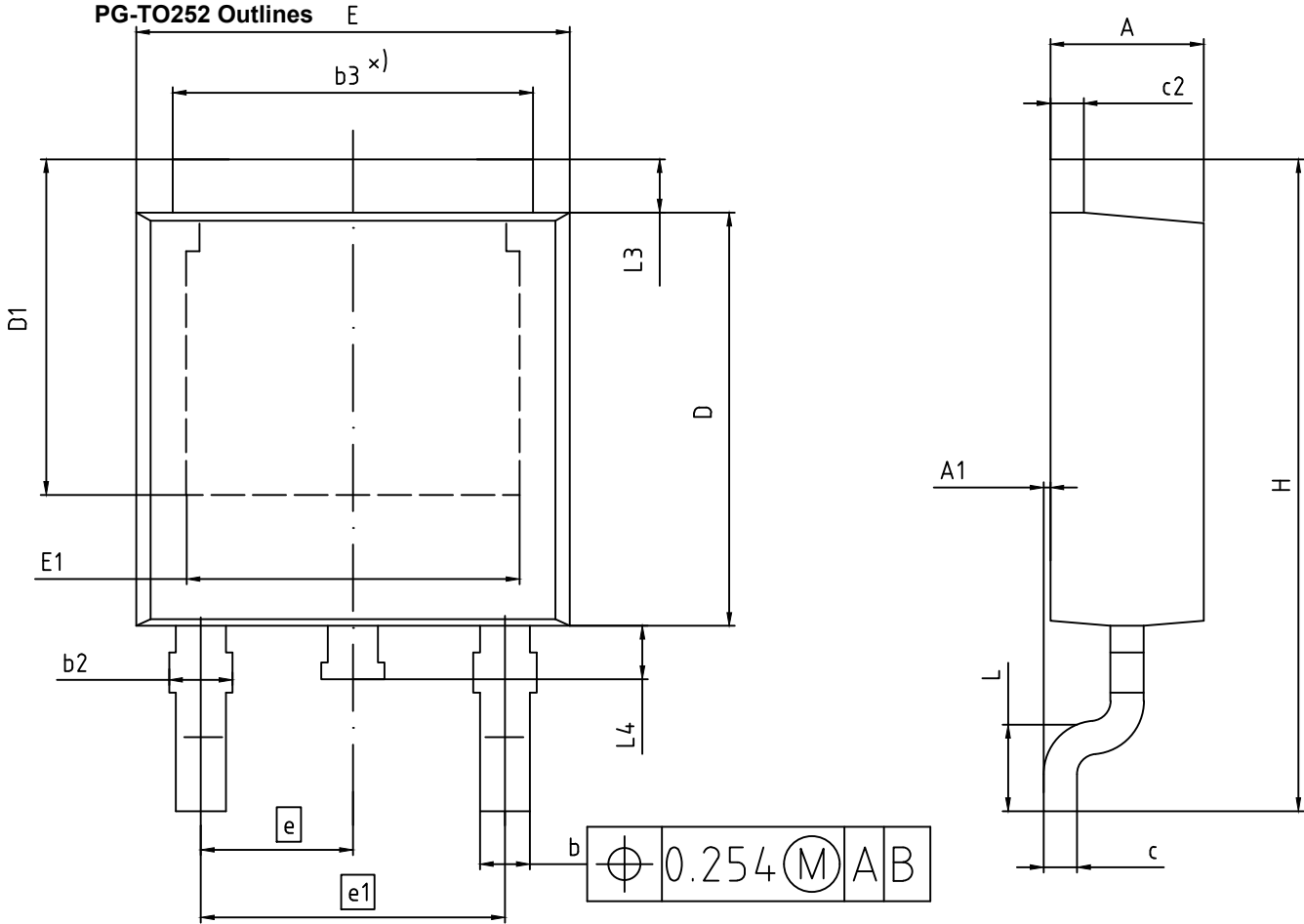


Definition of diode switching characteristics





PG-TO252 Outlines E



ALL DIMENSIONS REFER TO JEDEC STANDARD TO-252 AND DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS.

DIMENSION	MILLIMETERS	
	MIN.	MAX.
A	2.16	2.41
A1	0.00	0.15
b	0.64	0.89
b2	0.65	1.15
b3	4.95	5.50
c	0.46	0.61
c2	0.40	0.98
D	5.97	6.22
D1	5.02	5.84
E	6.35	6.73
E1	4.32	5.50
e	2.29	
e1	4.57	
N	3	
H	9.40	10.48
L	1.18	1.78
L3	0.89	1.27
L4	0.51	1.02

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## Revision History

IPD90R1K2C3

**Revision: 2020-05-26, Rev. 2.1**

Previous Revision

Revision	Date	Subjects (major changes since last revision)
2.1	2020-05-26	Update package outline

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