

## CoolMOS™ Power Transistor

### Features

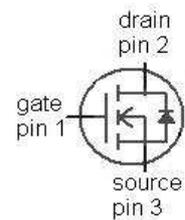
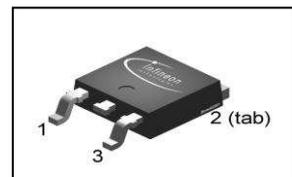
- Lowest figure of merit  $R_{ON} \times Q_g$
- Ultra low gate charge
- Extreme dv/dt rated
- High peak current capability
- Pb-free lead plating; RoHS compliant, Halogen free
- Fully qualified according to JEDEC<sup>1)</sup> for Industrial Applications

### Product Summary

$V_{DS} @ T_{jmax}$	550	V
$R_{DS(on),max}$	0.399	$\Omega$
$Q_{g,typ}$	17	nC

### CoolMOS CP is designed for:

- Hard and softswitching SMPS topologies
- DCM PFC for Lamp Ballast
- PWM for Lamp Ballast & PDP and LCD TV

**PG-TO252**


Type	Package	Marking
IPD50R399CP	PG-TO252	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	$V_{DS}=0\text{...}400\text{ V}$	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	$^{\circ}\text{C}$

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

Parameter	Symbol	Conditions	Value	Unit
Continuous diode forward current	$I_S$	$T_C=25\text{ °C}$	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, reflowsoldering	$T_{sold}$	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	$V_{GS(th)}$	$V_{DS}=V_{GS}$ , $I_D=0.33\text{ mA}$	2.5	3	3.5	
Zero gate voltage drain current	$I_{DSS}$	$V_{DS}=500\text{ V}$ , $V_{GS}=0\text{ V}$ , $T_j=25\text{ °C}$	-	-	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	$R_{DS(on)}$	$V_{GS}=10\text{ V}$ , $I_D=4.9\text{ A}$ , $T_j=25\text{ °C}$	-	0.36	0.399	$\Omega$
		$V_{GS}=10\text{ V}$ , $I_D=4.9\text{ A}$ , $T_j=150\text{ °C}$	-	0.90	-	
Gate resistance	$R_G$	$f=1\text{ MHz}$ , open drain	-	2.2	-	$\Omega$

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	

**Dynamic characteristics**

Input capacitance	$C_{iss}$	$V_{GS}=0\text{ V}, V_{DS}=100\text{ V},$ $f=1\text{ MHz}$	-	890	-	pF
Output capacitance	$C_{oss}$		-	40	-	
Effective output capacitance, energy related <sup>6)</sup>	$C_{o(er)}$	$V_{GS}=0\text{ V}, V_{DS}=0\text{ V}$ to 400 V	-	38	-	
Effective output capacitance, time related <sup>7)</sup>	$C_{o(tr)}$		-	81	-	
Turn-on delay time	$t_{d(on)}$	$V_{DD}=400\text{ V},$ $V_{GS}=10\text{ V}, I_D=4.9\text{ A},$ $R_{G,ext}=35.1\ \Omega$	-	35	-	ns
Rise time	$t_r$		-	14	-	
Turn-off delay time	$t_{d(off)}$		-	80	-	
Fall time	$t_f$		-	14	-	

**Gate Charge Characteristics**

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

**Reverse Diode**

Diode forward voltage	$V_{SD}$	$V_{GS}=0\text{ V}, I_F=4.9\text{ A},$ $T_j=25\text{ °C}$	-	0.9	1.2	V
Reverse recovery time	$t_{rr}$	$V_R=400\text{ V}, I_F=I_S,$ $di_F/dt=100\text{ A}/\mu\text{s}$	-	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

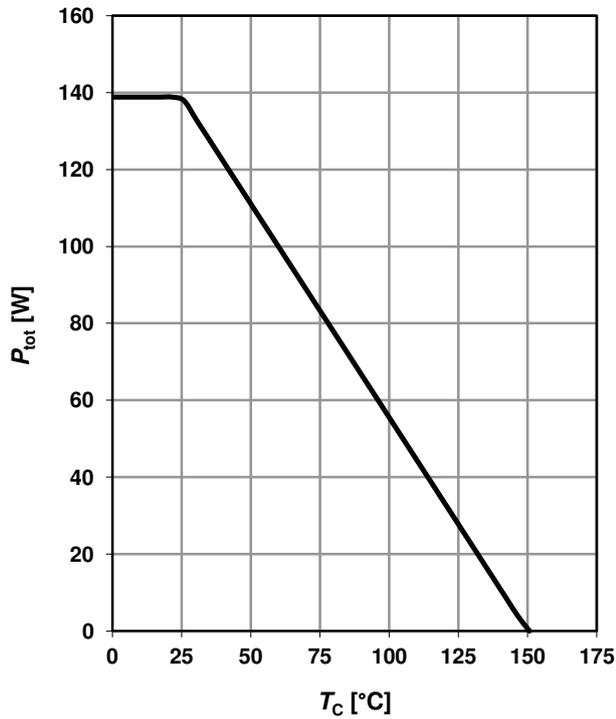
<sup>5)</sup> Device on 40mm\*40mm\*1.5mm epoxy PCB FR4 with 6cm<sup>2</sup> (one layer, 70mm thick) copper area for drain connection. PCB without blown air.

<sup>6)</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>7)</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**

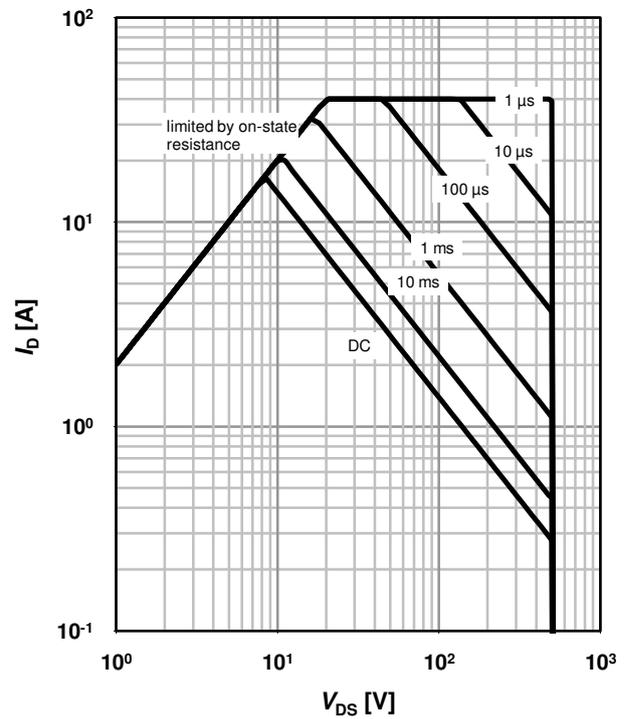
$P_{tot}=f(T_C)$



**2 Safe operating area**

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

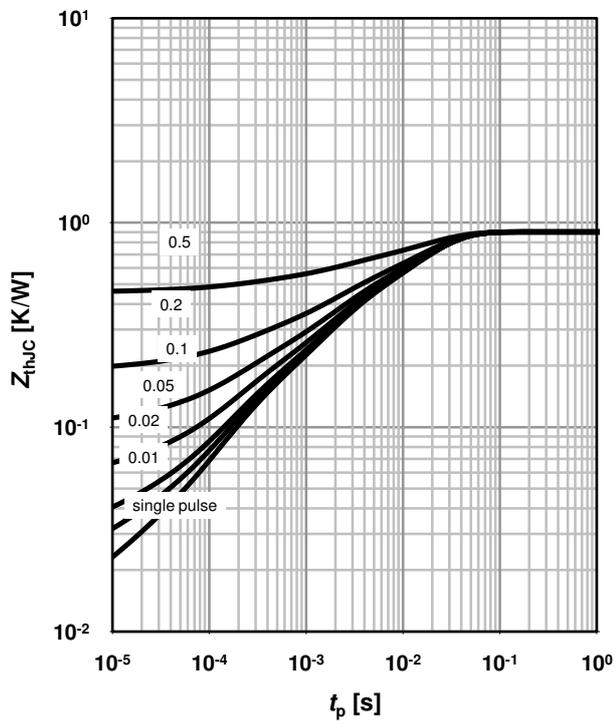
parameter:  $t_p$



**3 Max. transient thermal impedance**

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

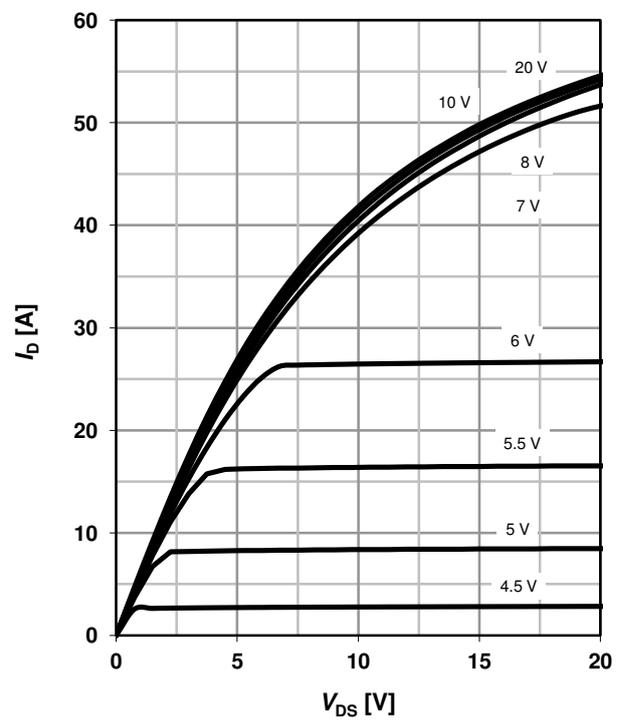
parameter:  $D=t_p/T$



**4 Typ. output characteristics**

$I_D=f(V_{DS}); T_j=25\text{ °C}$

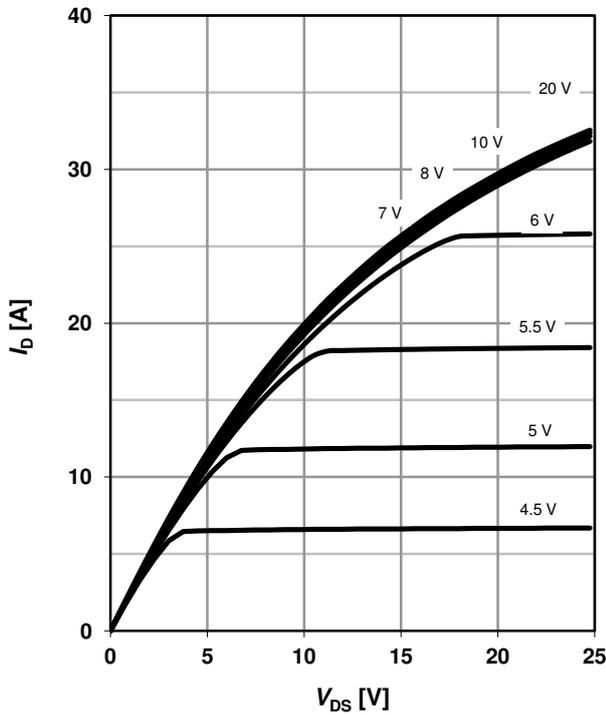
parameter:  $V_{GS}$



**5 Typ. output characteristics**

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

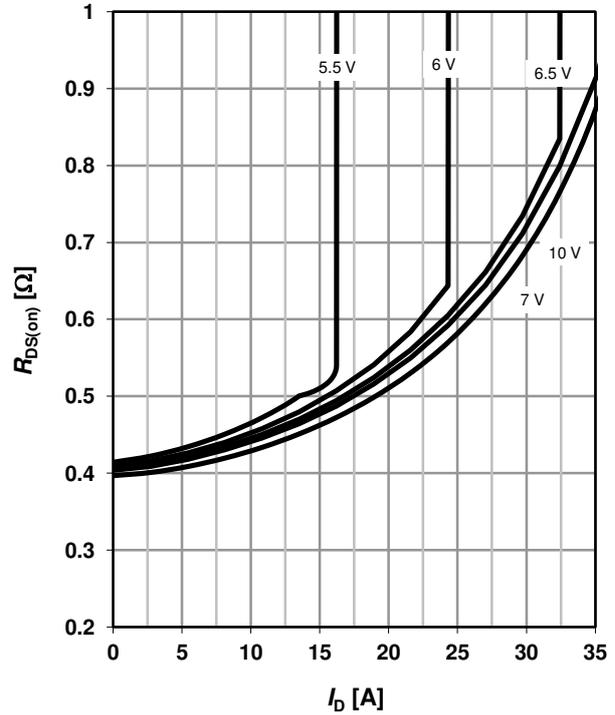
parameter:  $V_{GS}$



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

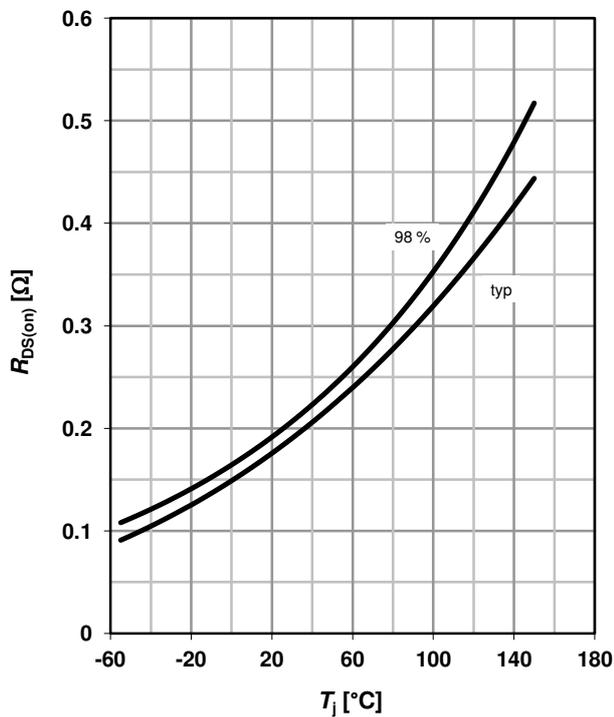
$R_{DS(on)} = f(I_D); T_j = 150\text{ °C}$

parameter:  $V_{GS}$



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

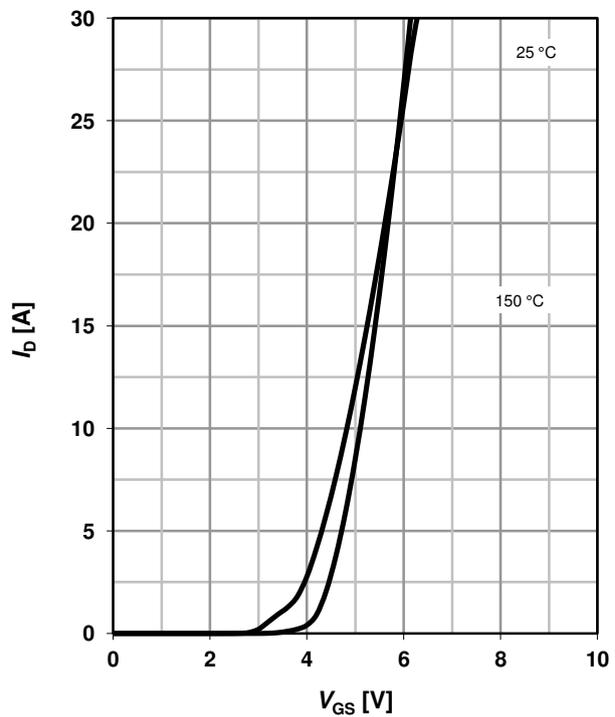
$R_{DS(on)} = f(T_j); I_D = 4.9\text{ A}; V_{GS} = 10\text{ V}$



**8 Typ. transfer characteristics**

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

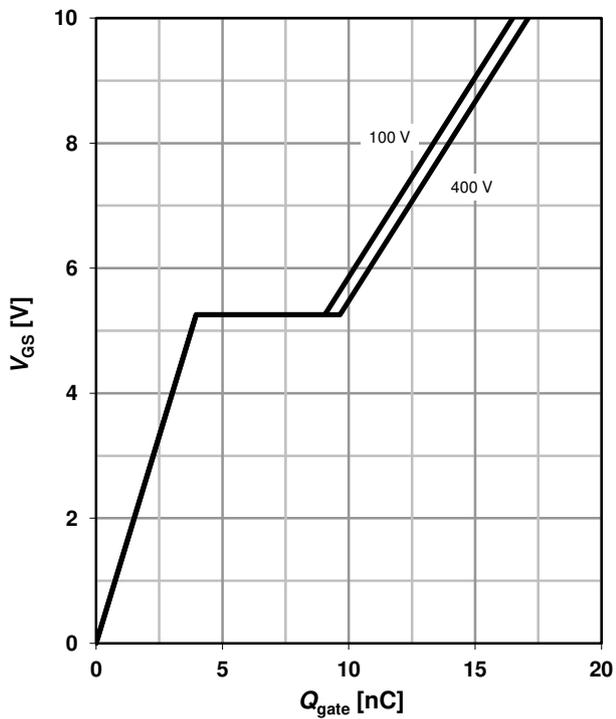
parameter:  $T_j$



**9 Typ. gate charge**

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

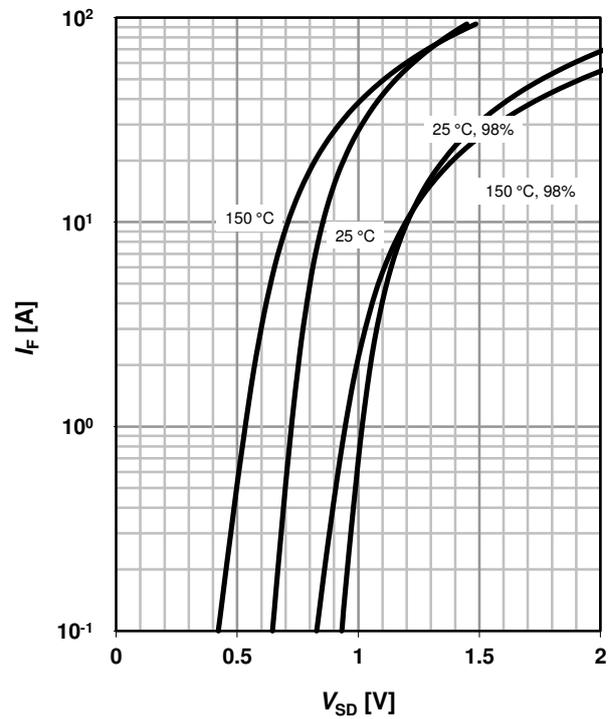
parameter:  $V_{DD}$



**10 Forward characteristics of reverse diode**

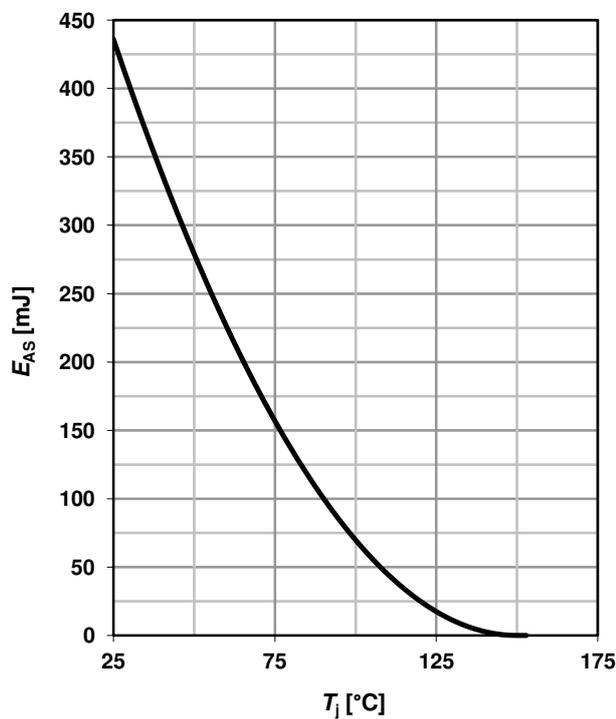
$I_F=f(V_{SD})$

parameter:  $T_j$



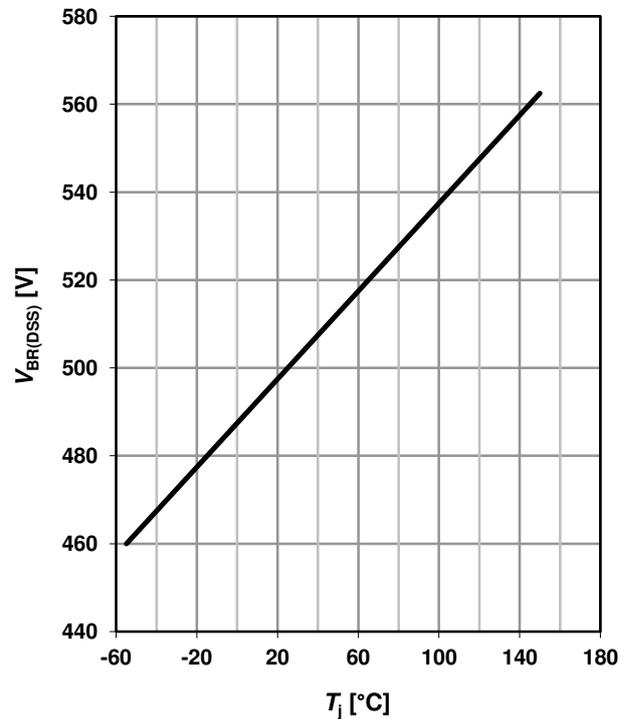
**11 Avalanche energy**

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



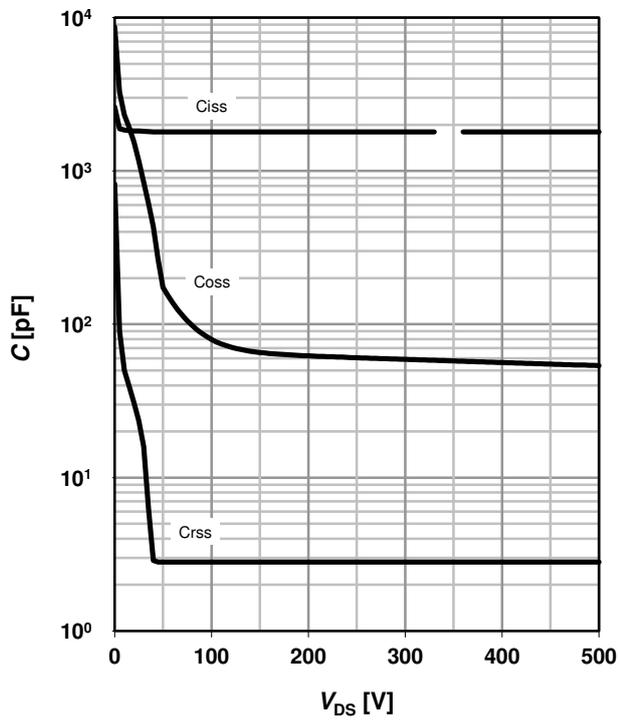
**12 Drain-source breakdown voltage**

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



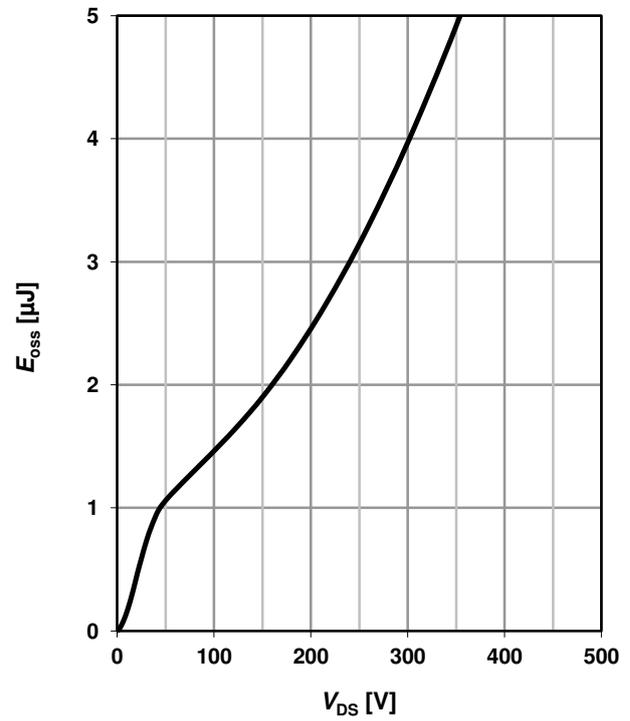
**13 Typ. capacitances**

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

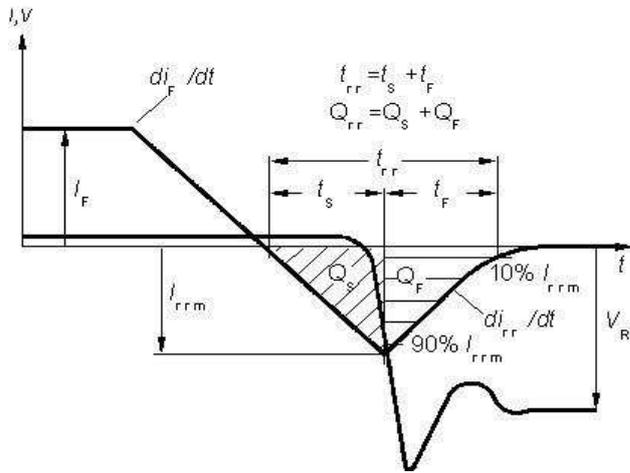


**14 Typ. Coss stored energy**

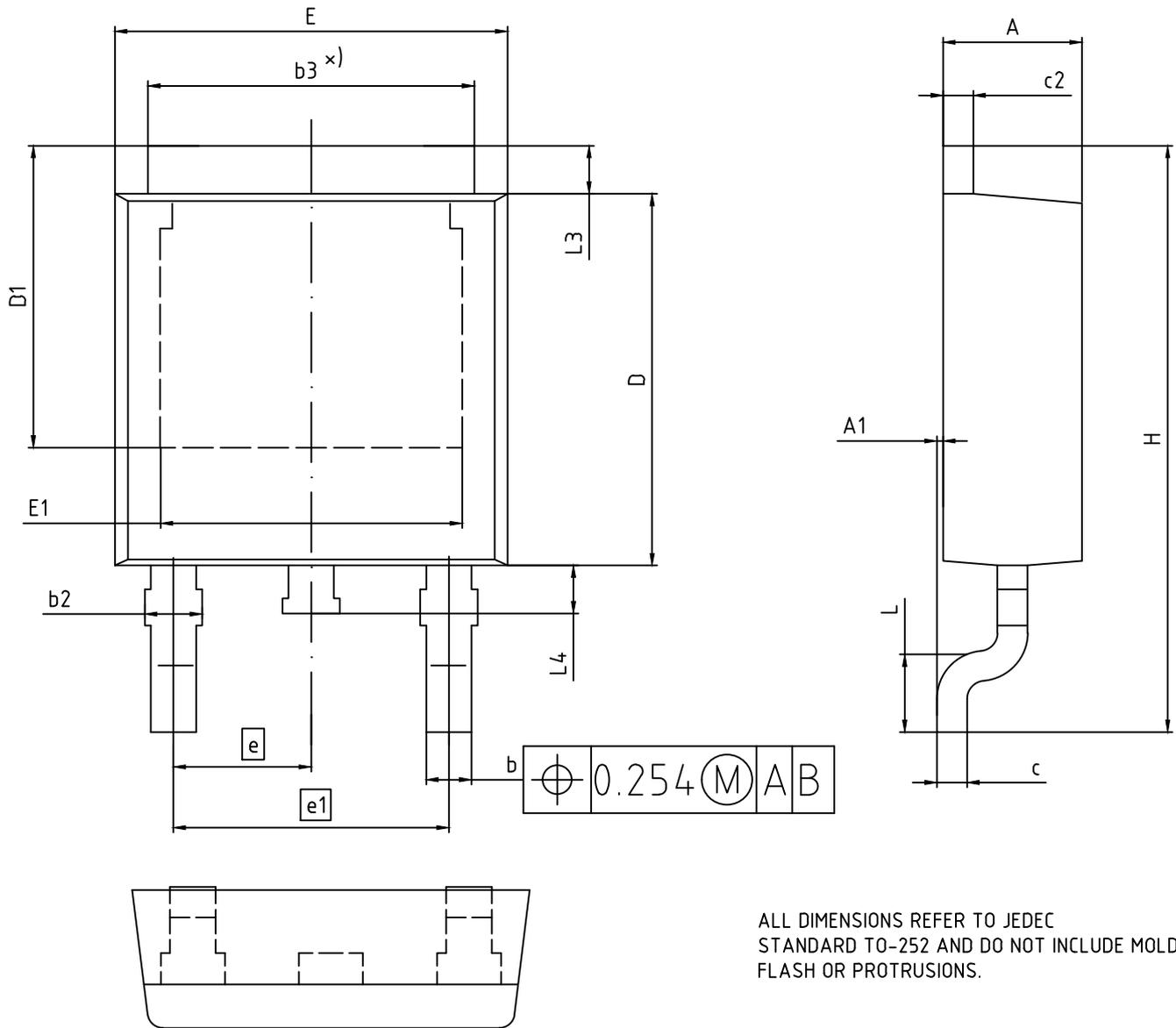
$E_{oss}=f(V_{DS})$



Definition of diode switching characteristics



PG-TO252-3-1/PG-TO252-3-11/PG-TO252-3-21: Outline



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

IPD50R399CP

**Revision: 2020-05-26, Rev. 2.3**

Previous Revision

Revision	Date	Subjects (major changes since last revision)
2.3	2020-05-26	Update package outline

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