

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 JEDEC¹⁾

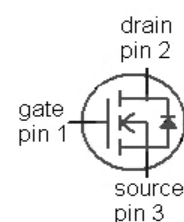
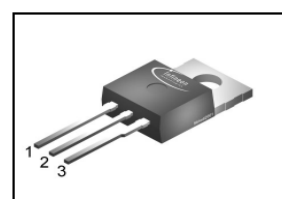
Product Summary

$V_{DS} @ T_{jmax}$	550	V
$R_{DS(on),max}$	0.350	Ω
$Q_{g,typ}$	19	nC

CoolMOS CP is designed for:

- Hard- & soft switching SMPS topologies
- CCM PFC for Lamp Ballast, LCD & PDP TV
- PWM for Lamp Ballast, LCD & PDP TV

PG-TO220



Type	Package	Marking
IPP50R350CP	PG-TO220	5R350P

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

Parameter	Symbol	Conditions	Value	Unit
Continuous drain current	I_D	$T_C=25\text{ °C}$	10	A
		$T_C=100\text{ °C}$	6	
Pulsed drain current ²⁾	$I_{D,pulse}$	$T_C=25\text{ °C}$	22	
Avalanche energy, single pulse	E_{AS}	$I_D=3.7\text{ A}$, $V_{DD}=50\text{ V}$	246	mJ
Avalanche energy, repetitive t_{AR} ^{2),3)}	E_{AR}	$I_D=3.7\text{ A}$, $V_{DD}=50\text{ V}$	0.37	
Avalanche current, repetitive t_{AR} ^{2),3)}	I_{AR}		3.7	A
MOSFET dv/dt ruggedness	dv/dt	$V_{DS}=0\ldots 400\text{ V}$	50	V/ns
Gate source voltage	V_{GS}	static	± 20	V
		AC ($f>1\text{ Hz}$)	± 30	
Power dissipation	P_{tot}	$T_C=25\text{ °C}$	89	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	$T_C=25\text{ °C}$	5.6	A
Diode pulse current ²⁾	$I_{S,pulse}$		22	
Reverse diode dv/dt ⁴⁾	dv/dt		15	V/ns

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	

Thermal characteristics

Thermal resistance, junction - case	R_{thJC}		-	-	1.4	K/W
Thermal resistance, junction - ambient	R_{thJA}	lead	-	-	62	
Soldering temperature, wavesoldering only allowed at leads	T_{solder}	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	$V_{GS(th)}$	$V_{DS}=V_{GS}$, $I_D=0.37\text{ mA}$	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	μA
		$V_{DS}=500\text{ V}$, $V_{GS}=0\text{ V}$, $T_j=150\text{ °C}$	-	10	-	
Gate-source leakage current	I_{GSS}	$V_{GS}=20\text{ V}$, $V_{DS}=0\text{ V}$	-	-	100	nA
Drain-source on-state resistance	$R_{DS(on)}$	$V_{GS}=10\text{ V}$, $I_D=5.6\text{ A}$, $T_j=25\text{ °C}$	-	0.32	0.35	Ω
		$V_{GS}=10\text{ V}$, $I_D=5.6\text{ A}$, $T_j=150\text{ °C}$	-	0.80	-	
Gate resistance	R_G	$f=1\text{ MHz}$, open drain	-	2.2	-	Ω

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	

Dynamic characteristics

Input capacitance	C_{iss}	$V_{GS}=0\text{ V}, V_{DS}=100\text{ V},$ $f=1\text{ MHz}$	-	1020	-	pF
Output capacitance	C_{oss}		-	46	-	
Effective output capacitance, energy related ⁵⁾	$C_{o(er)}$	$V_{GS}=0\text{ V}, V_{DS}=0\text{ V}$ to 400 V	-	43	-	
Effective output capacitance, time related ⁶⁾	$C_{o(tr)}$		-	92	-	
Turn-on delay time	$t_{d(on)}$	$V_{DD}=400\text{ V},$ $V_{GS}=10\text{ V}, I_D=5.6\text{ A},$ $R_G=30.9\ \Omega$	-	35	-	ns
Rise time	t_r		-	14	-	
Turn-off delay time	$t_{d(off)}$		-	80	-	
Fall time	t_f		-	12	-	

Gate Charge Characteristics

Gate to source charge	Q_{gs}	$V_{DD}=400\text{ V}, I_D=5.6\text{ A},$ $V_{GS}=0\text{ to }10\text{ V}$	-	4	-	nC
Gate to drain charge	Q_{gd}		-	6	-	
Gate charge total	Q_g		-	19	25	
Gate plateau voltage	$V_{plateau}$		-	5.2	-	V

Reverse Diode

Diode forward voltage	V_{SD}	$V_{GS}=0\text{ V}, I_F=5.6\text{ A},$ $T_j=25\text{ °C}$	-	0.9	1.2	V
Reverse recovery time	t_{rr}	$V_R=400\text{ V}, I_F=I_S,$ $di_F/dt=100\text{ A}/\mu\text{s}$	-	250	-	ns
Reverse recovery charge	Q_{rr}		-	2.3	-	μC
Peak reverse recovery current	I_{rrm}		-	19	-	A

¹⁾ J-STD20 and JESD22

²⁾ Pulse width t_p limited by $T_{j,max}$

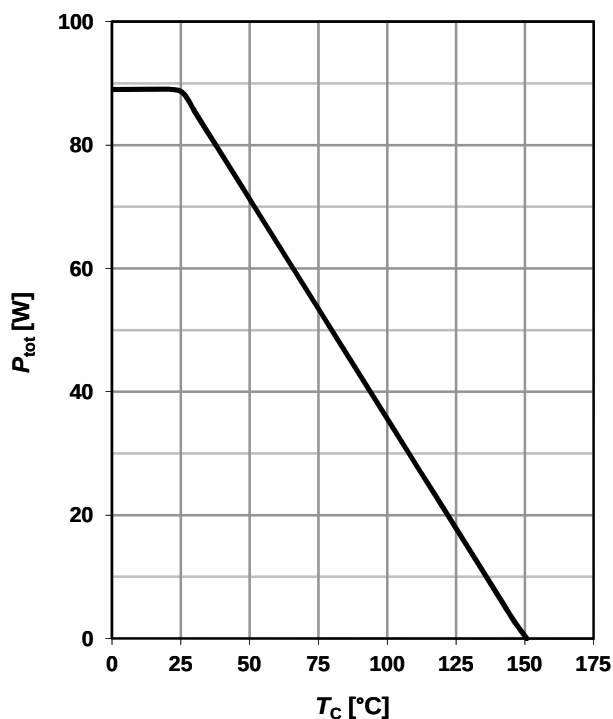
³⁾ Repetitive avalanche causes additional power losses that can be calculated as $P_{AV}=E_{AR}*f$.

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

⁶⁾ $C_{o(tr)}$ 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

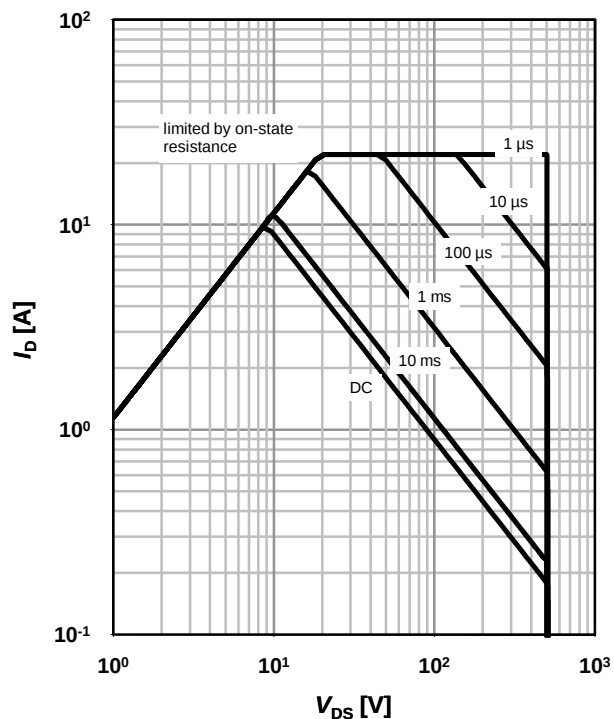
$$P_{\text{tot}} = f(T_c)$$



2 Safe operating area

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

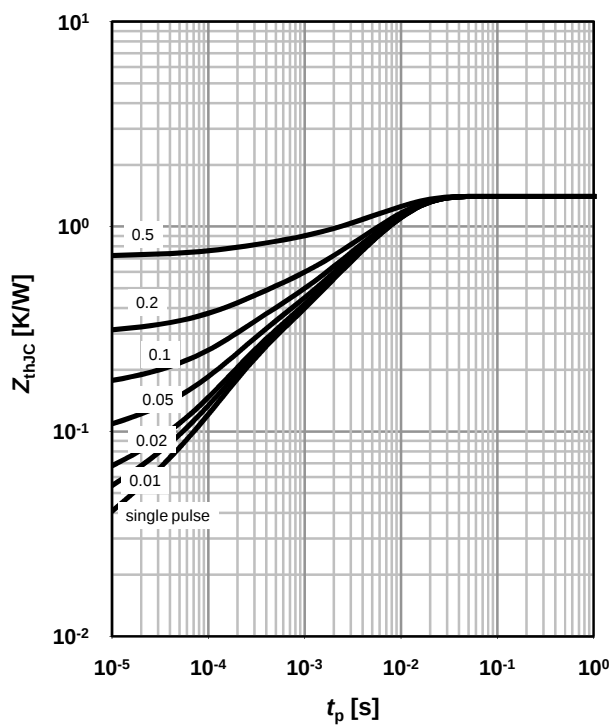
parameter: t_p



3 Max. transient thermal impedance

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

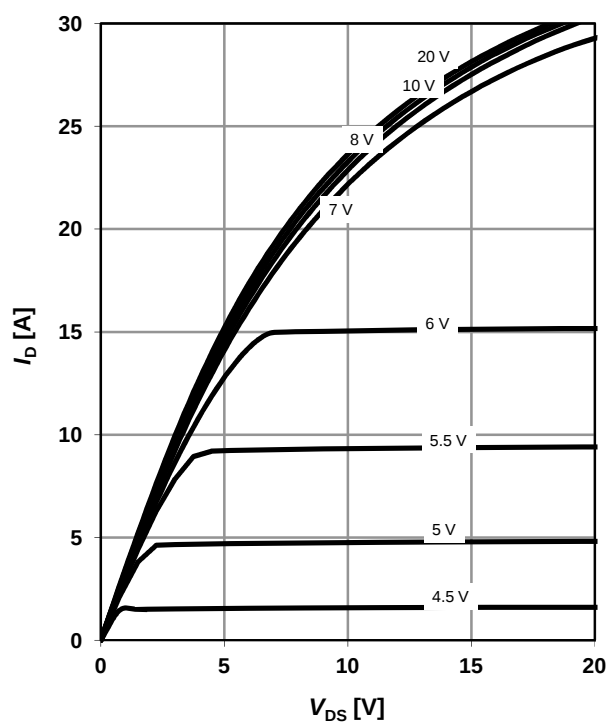
parameter: $D = t_p / T$



4 Typ. output characteristics

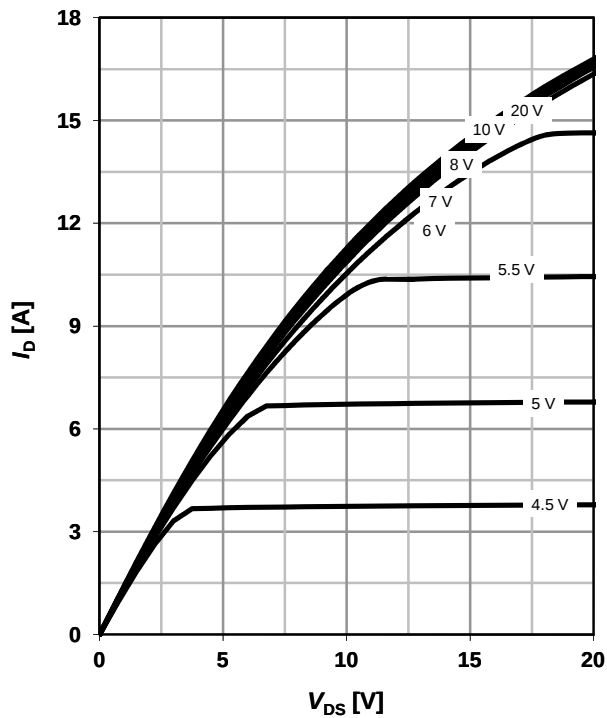
$$I_D = f(V_{DS}); T_j = 25^\circ\text{C}$$

parameter: V_{GS}



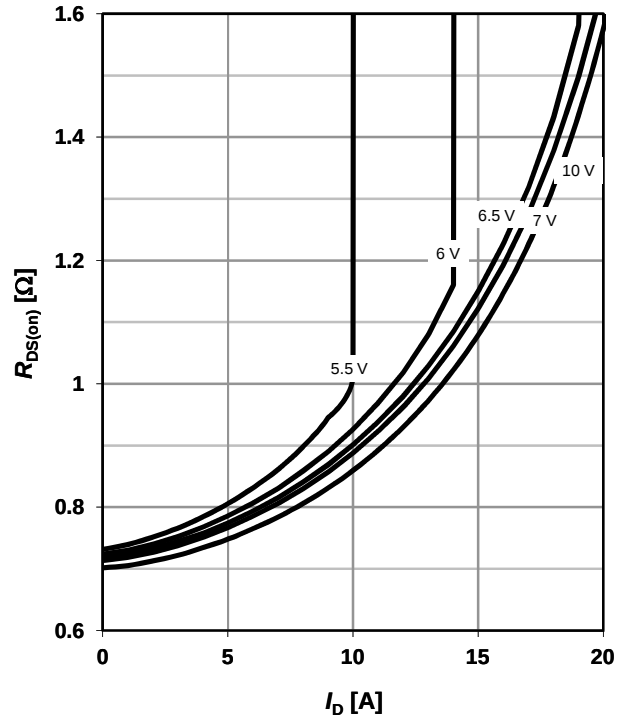
5 Typ. output characteristics

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

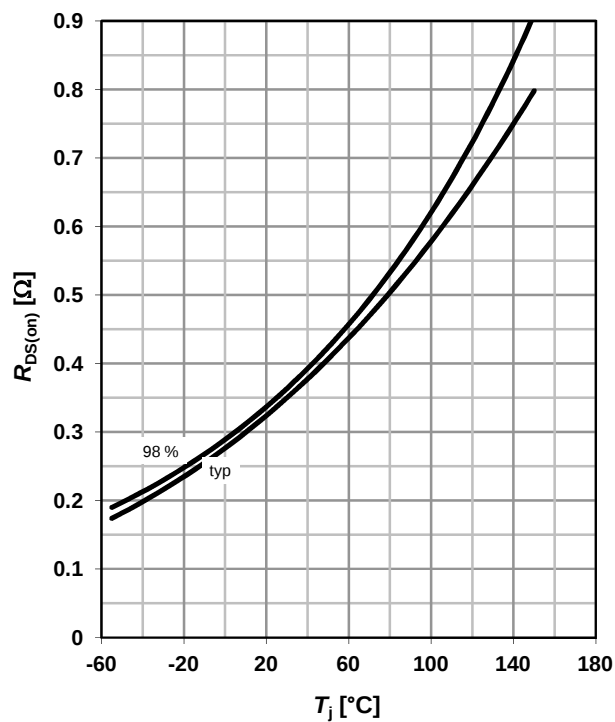
parameter: V_{GS}


6 Typ. drain-source on-state resistance

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

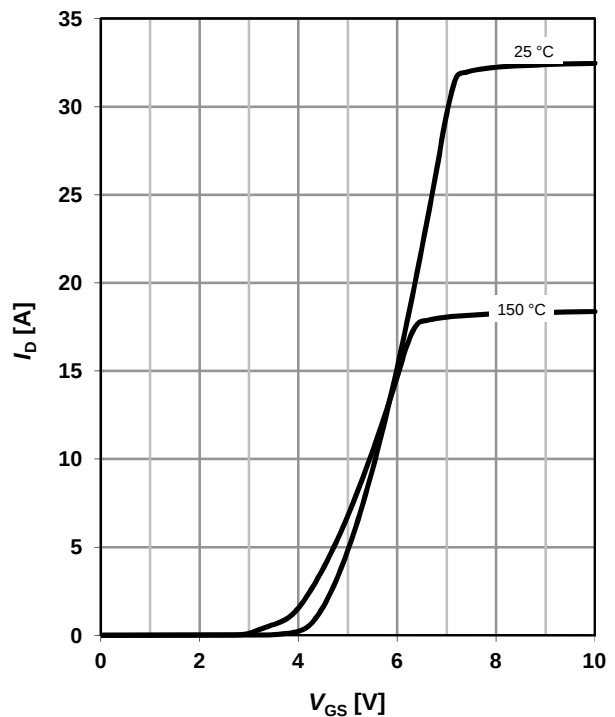
parameter: V_{GS}


7 Drain-source on-state resistance

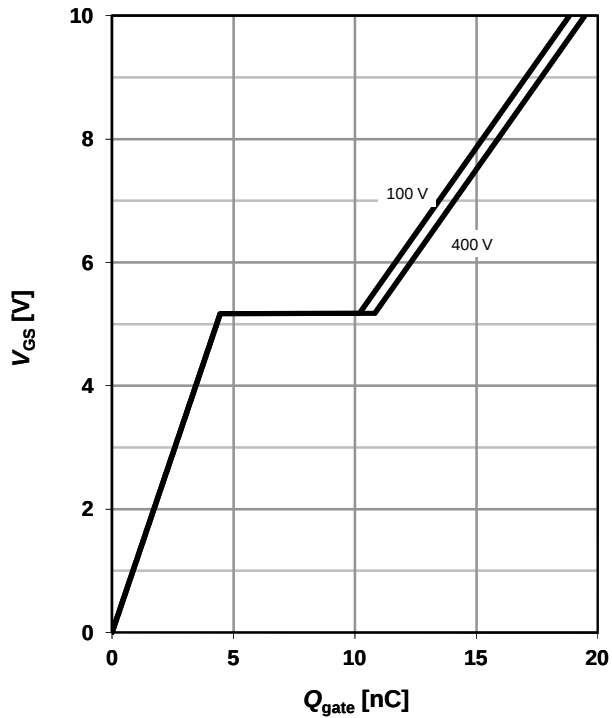
 $R_{DS(on)} = f(T_j); I_D = 5.6\text{ A}; V_{GS} = 10\text{ V}$


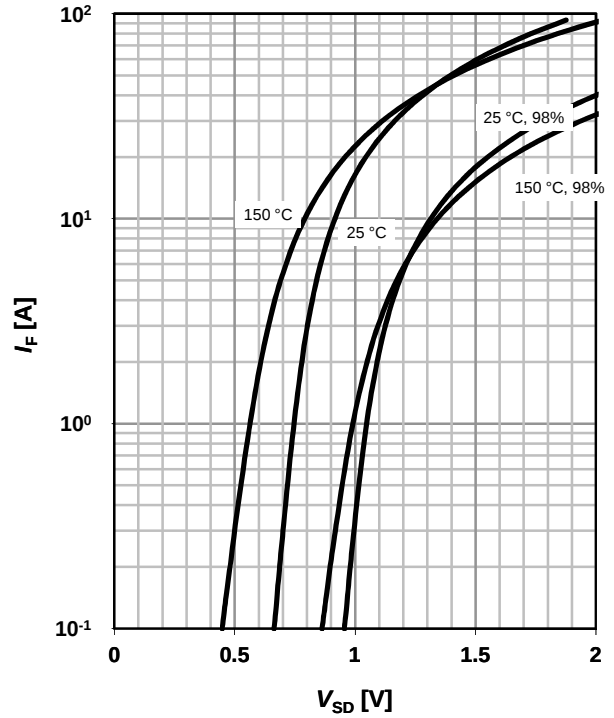
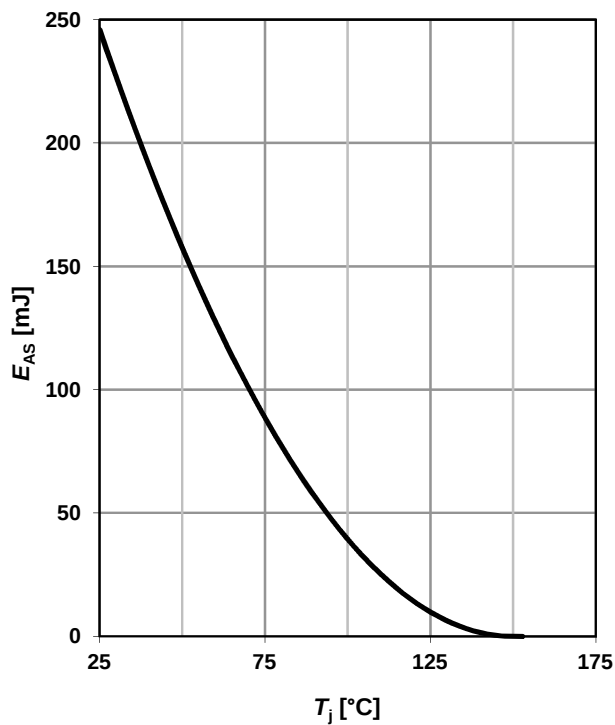
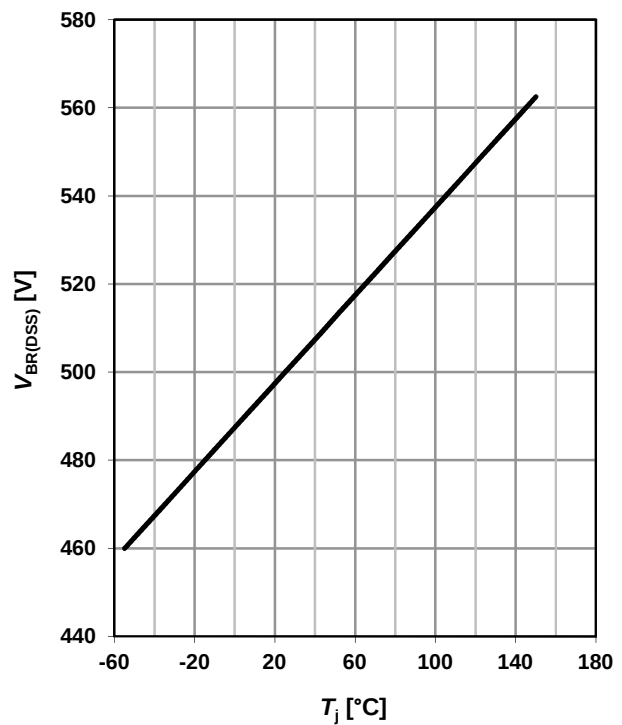
8 Typ. transfer characteristics

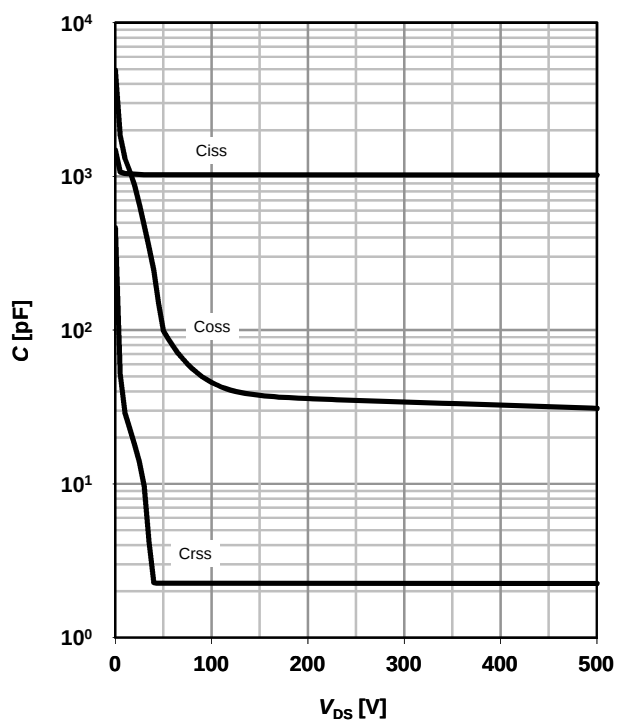
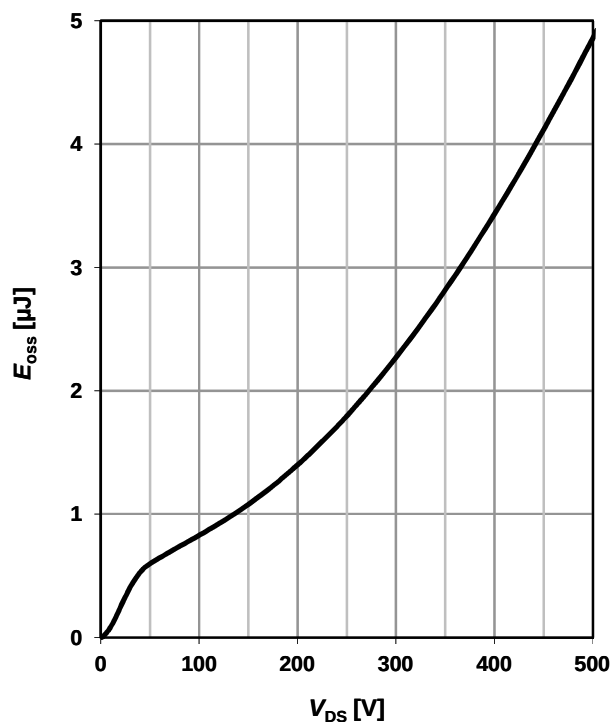
 $I_D = f(V_{GS}); |V_{DS}| > 2|I_D|R_{DS(on)\text{max}}$

parameter: T_j


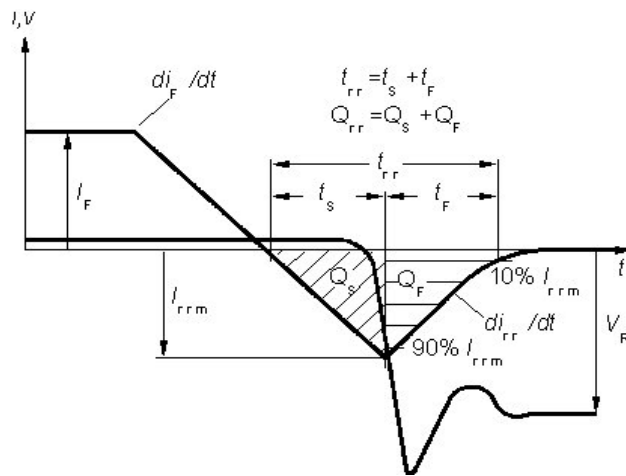
9 Typ. gate charge
 $V_{GS}=f(Q_{gate}); I_D=5.6 \text{ A pulsed}$

 parameter: V_{DD}

10 Forward characteristics of reverse diode
 $I_F=f(V_{SD})$

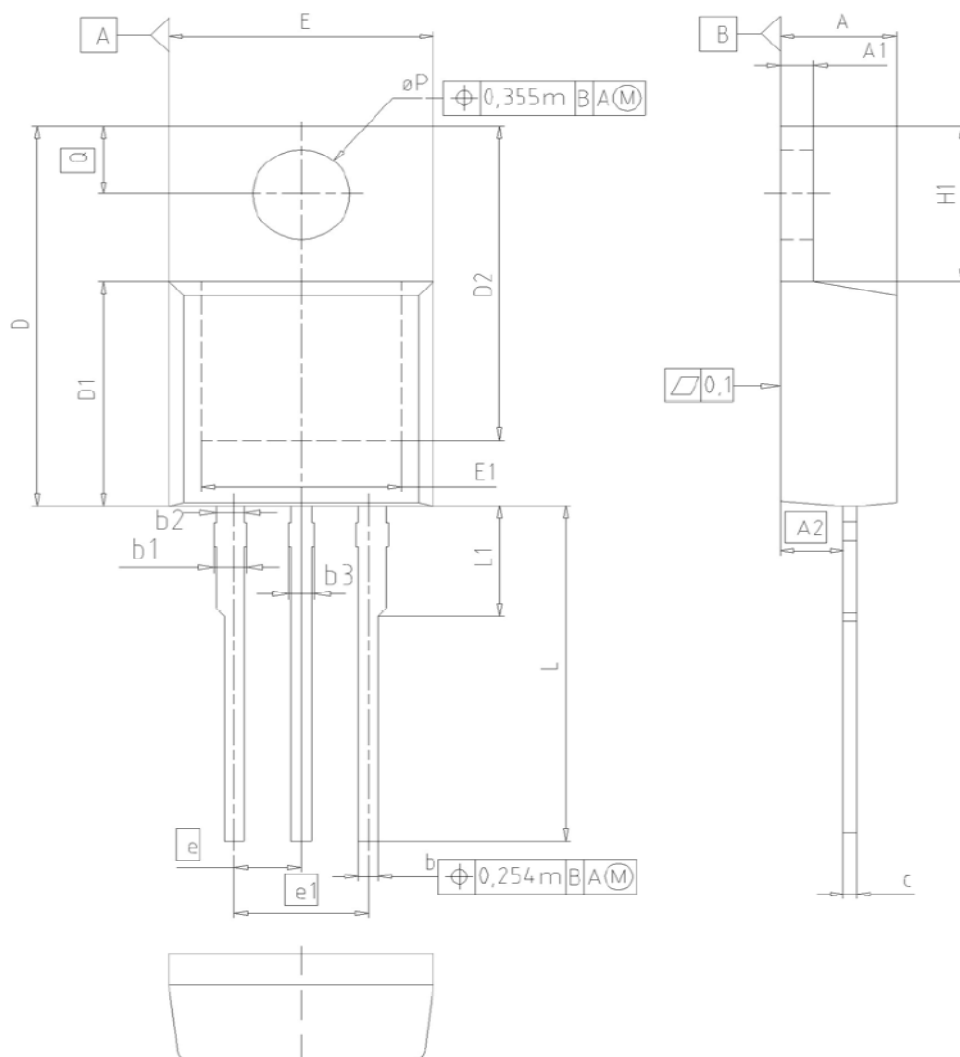
 parameter: T_j

11 Avalanche energy
 $E_{AS}=f(T_j); I_D=3.7 \text{ A}; V_{DD}=50 \text{ V}$

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-TO220-3-1/PG-TO220-3-21: Outline



DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.30	4.57	0.169	0.180
A1	1.17	1.40	0.046	0.055
A2	2.15	2.72	0.085	0.107
b	0.65	0.86	0.026	0.034
b1	0.95	1.40	0.037	0.055
b2	0.95	1.15	0.037	0.045
b3	0.65	1.15	0.026	0.045
c	0.33	0.60	0.013	0.024
D	14.81	15.95	0.583	0.628
D1	8.51	9.45	0.335	0.372
D2	12.19	13.10	0.480	0.516
E	9.70	10.36	0.382	0.408
E1	6.50	8.60	0.256	0.339
e	2.54		0.100	
e1	5.08		0.200	
N	3		3	
H1	5.90	6.90	0.232	0.272
L	13.00	14.00	0.512	0.551
L1	-	4.80	-	0.189
øP	3.60	3.89	0.142	0.153
Q	2.60	3.00	0.102	0.118

DOCUMENT NO. Z8B00003318
SCALE 0 2.5 5mm
EUROPEAN PROJECTION 
ISSUE DATE 23-08-2007
REVISION 05

Published by
Infineon Technologies AG
81726 München, Germany
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