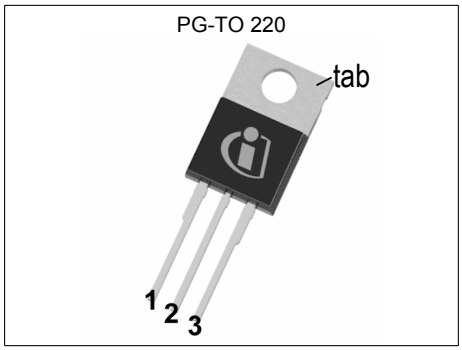
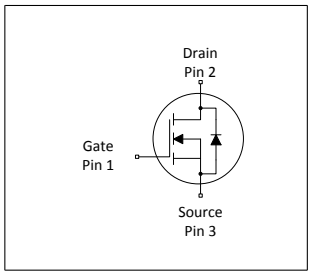
MOSFET

500V CoolMOS™ CE Power Transistor



CoolMOS™ is a revolutionary technology for high voltage power MOSFETs, designed according to the superjunction (SJ) principle and pioneered by Infineon Technologies. CoolMOS™ CE series combines the experience of the leading SJ MOSFET supplier with high class innovation while representing a cost appealing alternative compared to standard MOSFETs in target applications. The resulting devices provide all benefits of a fast switching SJ MOSFET while not sacrificing ease of use. Extremely low switching and conduction losses make switching applications even more efficient, more compact, lighter and cooler.

Features



- Extremely low losses due to very low FOM Rdson*Qg and Eoss
- Very high commutation ruggedness
- Easy to use/drive
- Pb-free plating, Halogen free mold compound
- Qualified for industrial grade applications according to JEDEC (J-STD20 and JESD22)

Applications

PFC stages, hard switching PWM stages and resonant switching PWM stages for e.g. PC Silverbox, LCD & PDP TV and Lighting.

Table 1 Key Performance Parameters

Parameter	Value	Unit
V_{DS} @ $T_{j,max}$	550	V
$R_{DS(on),max}$	0.38	Ω
I_D	14.1	A
$Q_{g,typ}$	24.8	nC
$I_{D,pulse}$	32.4	A
E_{oss} @ 400V	2.54	µJ

Type / Ordering Code	Package	Marking	Related Links
IPP50R380CE	PG-TO 220	5R380CE	see Appendix A

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1 Maximum ratings

at T_j = 25°C, unless otherwise specified

Table 2 Maximum ratings

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Continuous drain current[1]	I_D	- -	- -	14.1 8.9	A	T_C = 25°C T_C = 100°C
Pulsed drain current[2]	$I_{D,pulse}$	-	-	32.4	A	T_C=25°C
Avalanche energy, single pulse	E_{AS}	-	-	173	mJ	I_D =4A; V_{DD} = 50V
Avalanche energy, repetitive	E_{AR}	-	-	0.26	mJ	I_D =4A; V_{DD} = 50V
Avalanche current, repetitive	I_{AR}	-	-	4.0	A	-
MOSFET dv/dt ruggedness	dv/dt	-	-	50	V/ns	V_{DS} =0...400V
Gate source voltage	V_{GS}	-20 -30	- -	20 30	V	static; AC (f>1 Hz)
Power dissipation (non FullPAK) TO-220	P_{tot}	-	-	98	W	T_C=25°C
Operating and storage temperature	T_j, T_{stg}	-55	-	150	°C	-
Mounting torque (non FullPAK) TO-220	-	-	-	60	Ncm	M3 and M3.5 screws
Continuous diode forward current	I_S	-	-	10	A	T_C=25°C
Diode pulse current[2]	$I_{S,pulse}$	-	-	32.4	A	T_C = 25°C
Reverse diode dv/dt[3]	dv/dt	-	-	15	V/ns	V_{DS} =0...400V, I_{SD}<=I_S, T_j=25°C, t_{cond}<2µs
Maximum diode commutation speed[3]	di_f/dt	-	-	500	A/µs	V_{DS} =0...400V, I_{SD}<=I_S, T_j=25°C, t_{cond}<2µs

2 Thermal characteristics

Table 3 Thermal characteristics (non FullPAK) TO-220

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Thermal resistance, junction - case	R_{thJC}	-	-	1.27	°C/W	-
Thermal resistance, junction - ambient	R_{thJA}	-	-	62	°C/W	leaded
Soldering temperature, wavesoldering only allowed at leads	T_{sold}	-	-	260	°C	1.6mm (0.063 in.) from case for 10s

[1] Limited by $T_{j\,max}$ <150°C, Maximum Duty Cycle D = 0.5
[2] Pulse width t_p limited by $T_{j,max}$
[3] V_{DClink}=400V; $V_{DS,peak}$<$V_{(BR)DSS}$; identical low side and high side switch with identical R_G

3 Electrical characteristics

Table 4 Static characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Drain-source breakdown voltage	$V_{(BR)DSS}$	500	-	-	V	V_{GS}=0V, I_D=1mA
Gate threshold voltage	$V_{(GS)th}$	2.50	3	3.50	V	V_{DS}=V_{GS}, I_D=0.26mA
Zero gate voltage drain current	I_{DSS}	- -	- 10	1 -	µA	V_{DS}=500V, V_{GS}=0V, T_j=25°C V_{DS}=500V, V_{GS}=0V, T_j=150°C
Gate-source leakage curent	I_{GSS}	-	-	100	nA	V_{GS}=20V, V_{DS}=0V
Drain-source on-state resistance	$R_{DS(on)}$	- -	0.35 0.90	0.38 -	Ω	V_{GS}=13V, I_D=3.2A, T_j=25°C V_{GS}=13V, I_D=3.2A, T_j=150°C
Gate resistance	R_G	-	3	-	Ω	f=1 MHz, open drain

Table 5 Dynamic characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Input capacitance	C_{iss}	-	584	-	pF	V_{GS}=0V, V_{DS}=100V, f=1MHz
Output capacitance	C_{oss}	-	40	-	pF	V_{GS}=0V, V_{DS}=100V, f=1MHz
Effective output capacitance, energy related[1)]	$C_{o(er)}$	-	32	-	pF	V_{GS}=0V, V_{DS}=0...400V
Effective output capacitance, time related[2)]	$C_{o(tr)}$	-	133	-	pF	I_D=constant, V_{GS}=0V, V_{DS}=0...400V
Turn-on delay time	$t_{d(on)}$	-	7.2	-	ns	V_{DD}=400V, V_{GS}=13V, I_D=3.9A, R_G=3.4Ω
Rise time	t_r	-	5.6	-	ns	V_{DD}=400V, V_{GS}=13V, I_D=3.9A, R_G=3.4Ω
Turn-off delay time	$t_{d(off)}$	-	35	-	ns	V_{DD}=400V, V_{GS}=13V, I_D=3.9A, R_G=3.4Ω
Fall time	t_f	-	8.6	-	ns	V_{DD}=400V, V_{GS}=13 V, I_D=3.9A, R_G=3.4Ω

Table 6 Gate charge characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Gate to source charge	Q_{gs}	-	3.1	-	nC	V_{DD}=400V, I_D=3.9A, V_{GS}=0 to 10V
Gate to drain charge	Q_{gd}	-	13.1	-	nC	V_{DD}=400V, I_D=3.9A, V_{GS}=0 to 10V
Gate charge total	Q_g	-	24.8	-	nC	V_{DD}=400V, I_D=3.9A, V_{GS}=0 to 10V
Gate plateau voltage	$V_{plateau}$	-	5.3	-	V	V_{DD}=400V, I_D=3.9A, V_{GS}=0 to 10V

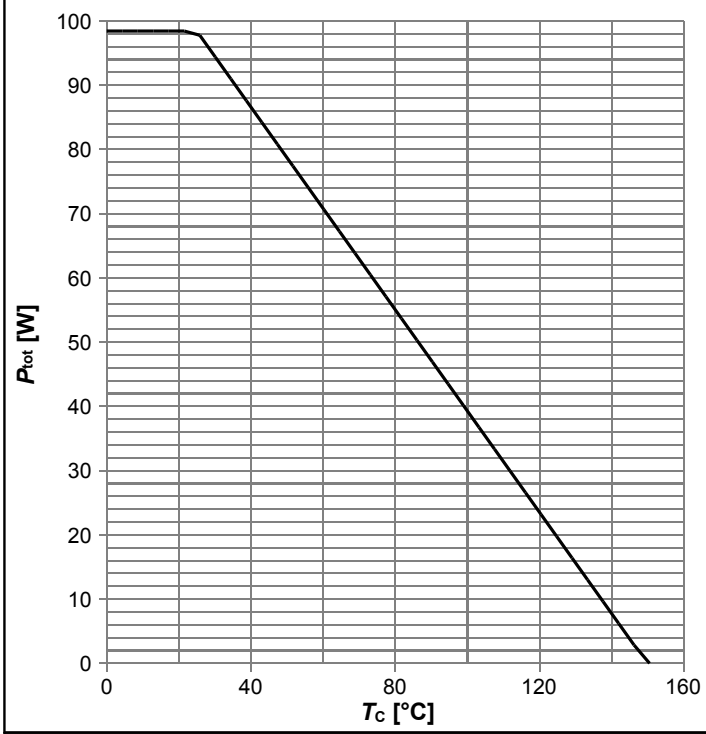
[1)] $C_{o(er)}$ is a fixed capacitance that gives the same stored energy as C_{oss} while V_{DS} is rising from 0 to 80% $V_{(BR)DSS}$
[2)] $C_{o(tr)}$ is a fixed capacitance that gives the same charging time as C_{oss} while V_{DS} is rising from 0 to 80% $V_{(BR)DSS}$

Table 7 Reverse diode characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Diode forward voltage	V_{SD}	-	0.85	-	V	V_{GS}=0V, I_F=3.9A, T_f=25°C
Reverse recovery time	t_{rr}	-	207	-	ns	V_R=400V, I_F=3.9A, di_F/dt=100A/µs
Reverse recovery charge	Q_{rr}	-	1.7	-	µC	V_R=400V, I_F=3.9A, di_F/dt=100A/µs
Peak reverse recovery current	I_{rrm}	-	15.5	-	A	V_R=400V, I_F=3.9A, di_F/dt=100A/µs

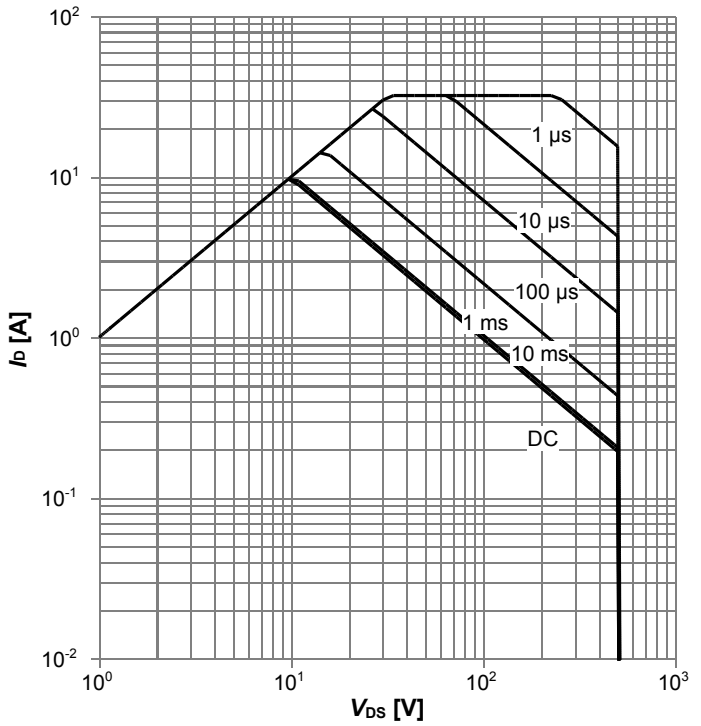
4 Electrical characteristics diagrams

Diagram 1: Power dissipation



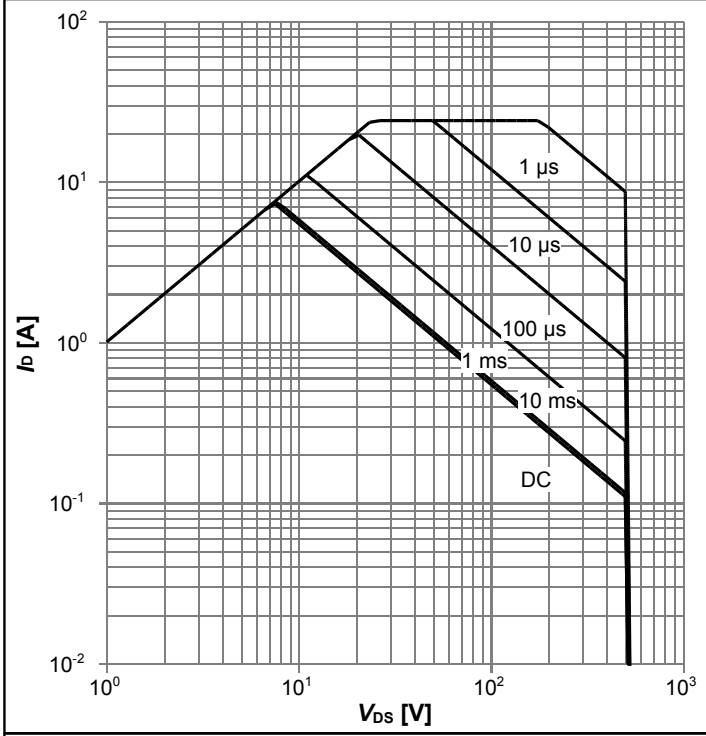
$P_{tot}=f(T_C)$

Diagram 2: Safe operating area



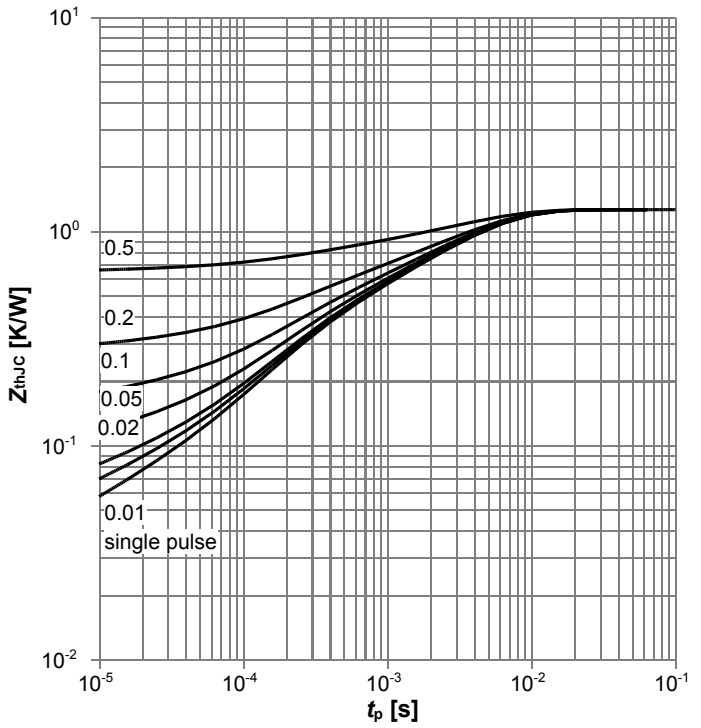
$I_D=f(V_{DS})$; $T_C=25$ °C; $D=0$; parameter: t_p

Diagram 3: Safe operating area



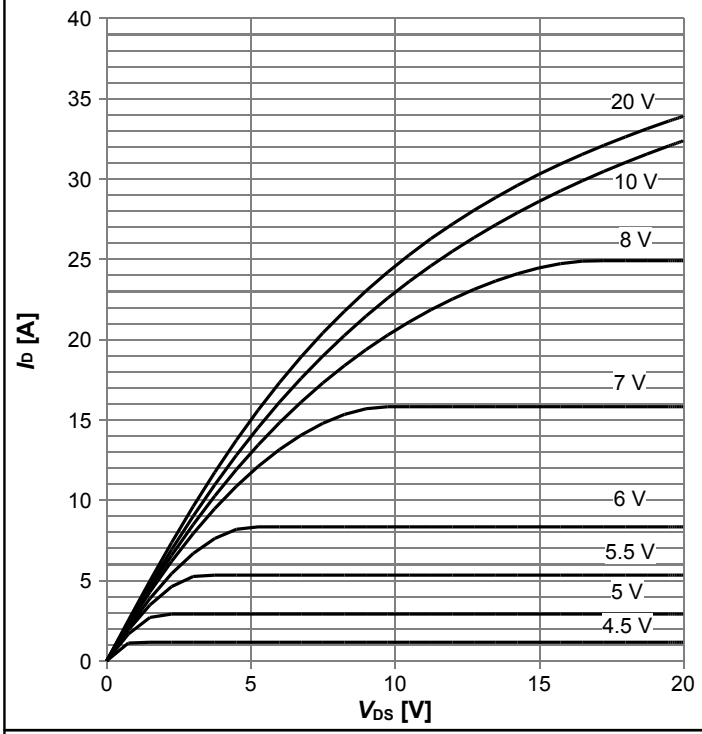
$I_D=f(V_{DS})$; $T_C=80$ °C; $D=0$; parameter: t_p

Diagram 4: Max. transient thermal impedance



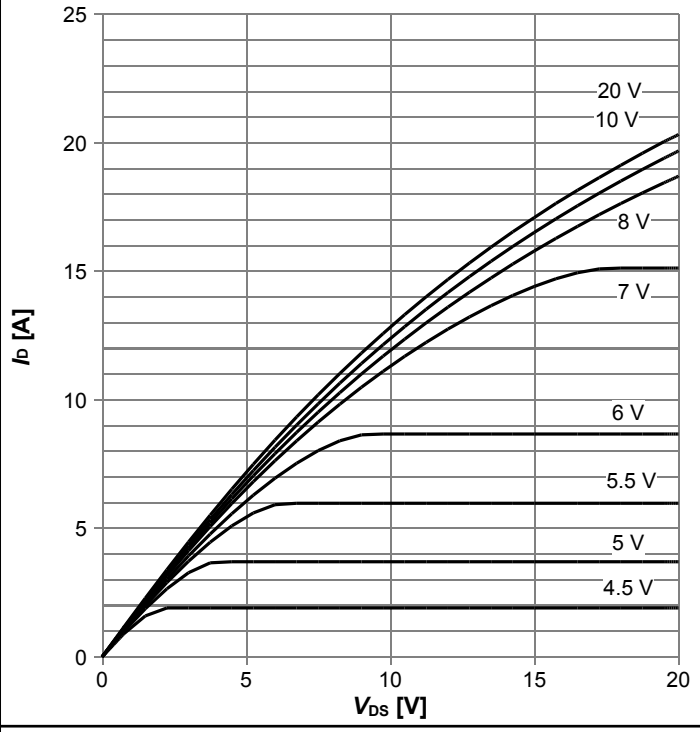
$Z_{thJC}=f(t_P)$; parameter: $D=t_p/T$

Typ. output characteristics Tj=25°C



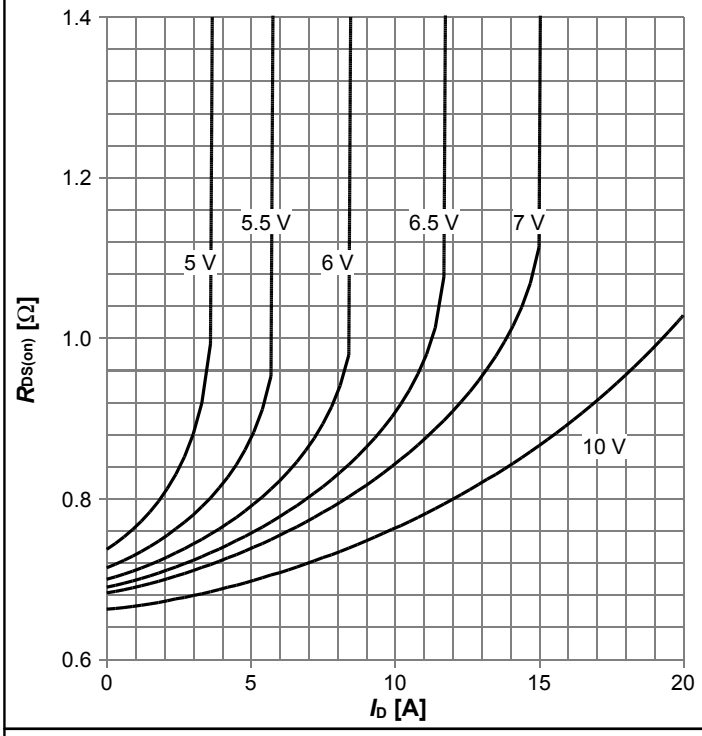
$I_D=f(V_{DS})$; $T_j=25$ °C; parameter: V_{GS}

Typ. output characteristics Tj=125°C



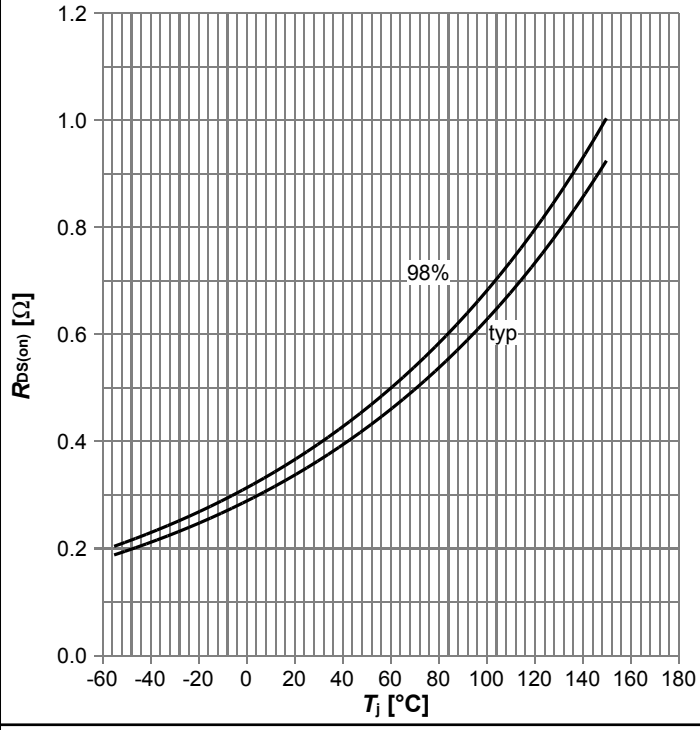
$I_D=f(V_{DS})$; $T_j=125$ °C; parameter: V_{GS}

Typ. drain-source on-state resistance



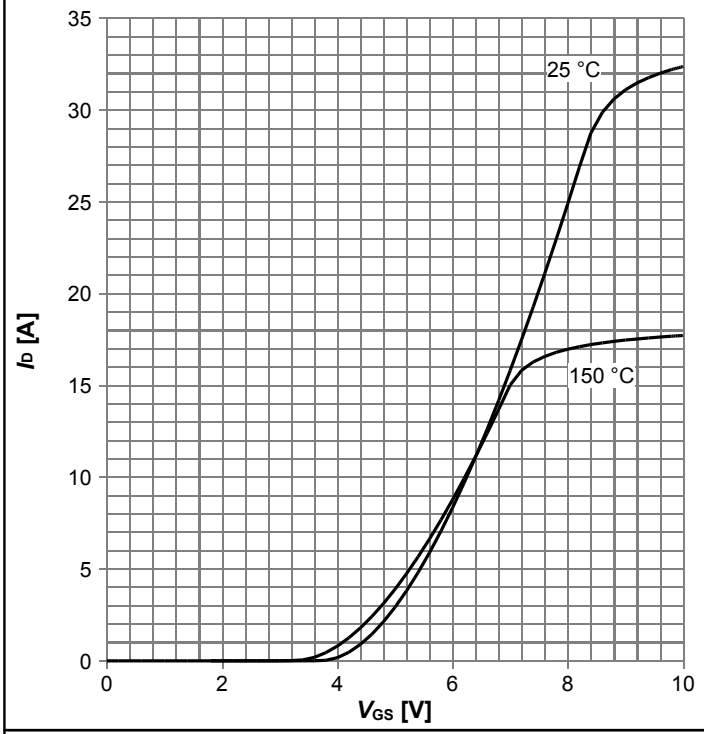
$R_{DS(on)}=f(I_D)$; $T_j=125$ °C; parameter: V_{GS}

Drain-source on-state resistance



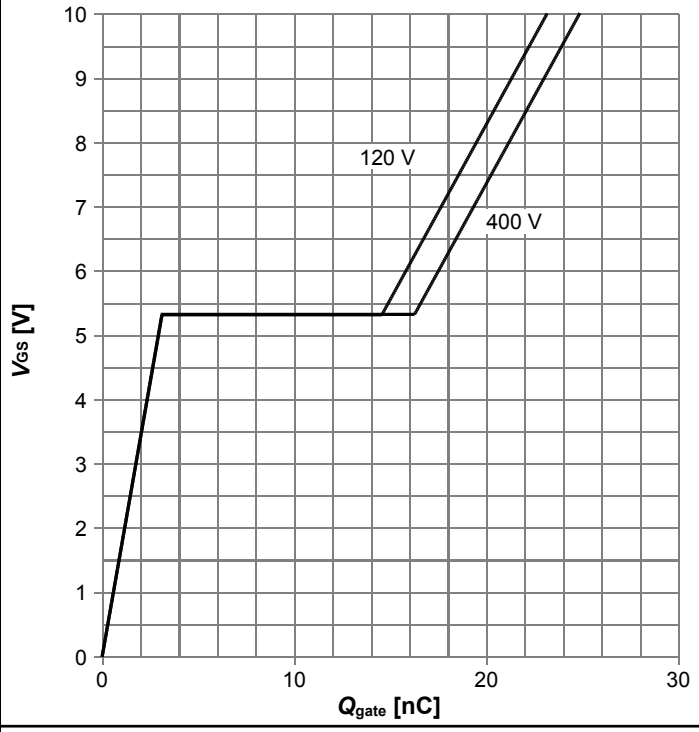
$R_{DS(on)}=f(T_j)$; $I_D=3.2$ A; $V_{GS}=13$ V

Typ. transfer characteristics



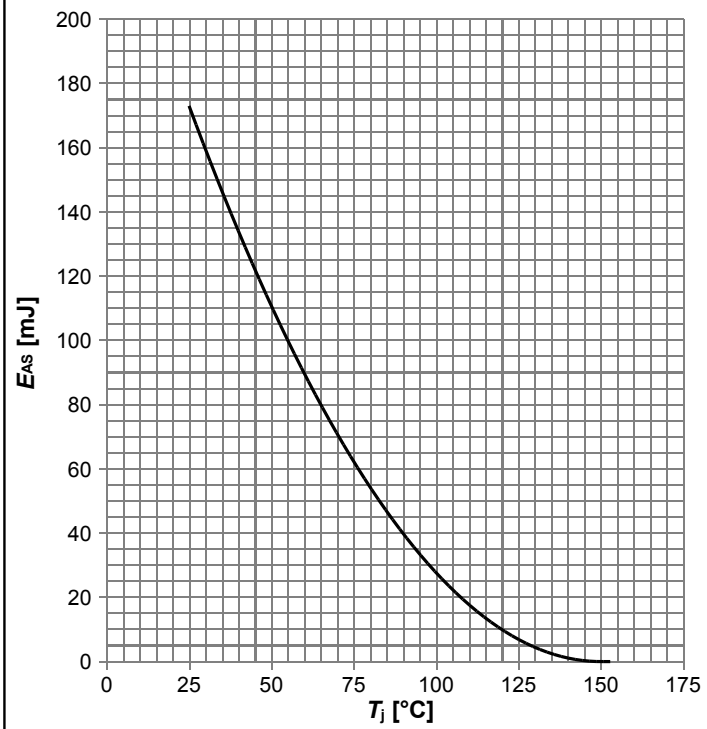
I_D=f(V_{GS}); V_{DS}=20V; parameter: T_j

Typ. gate charge



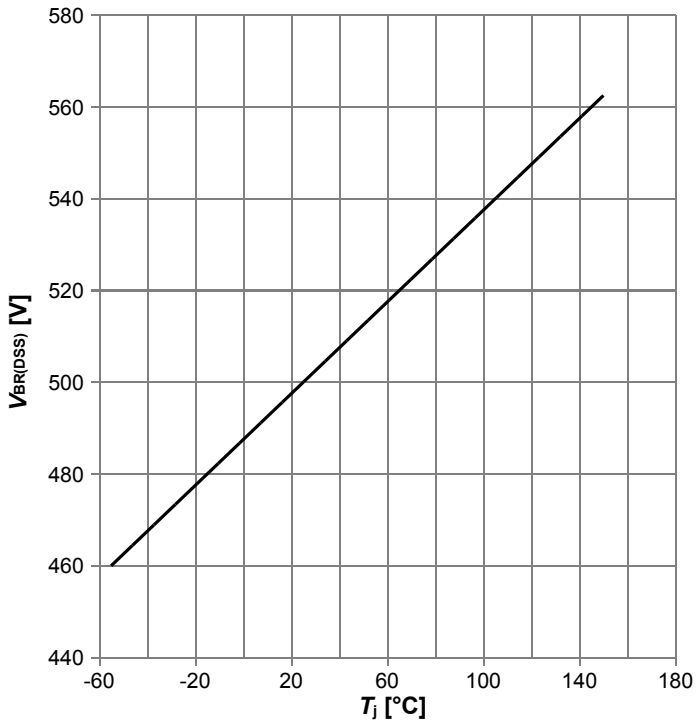
V_{GS}=f(Q_{gate}); I_D=3.9 A pulsed; parameter: V_{DD}

Avalanche energy



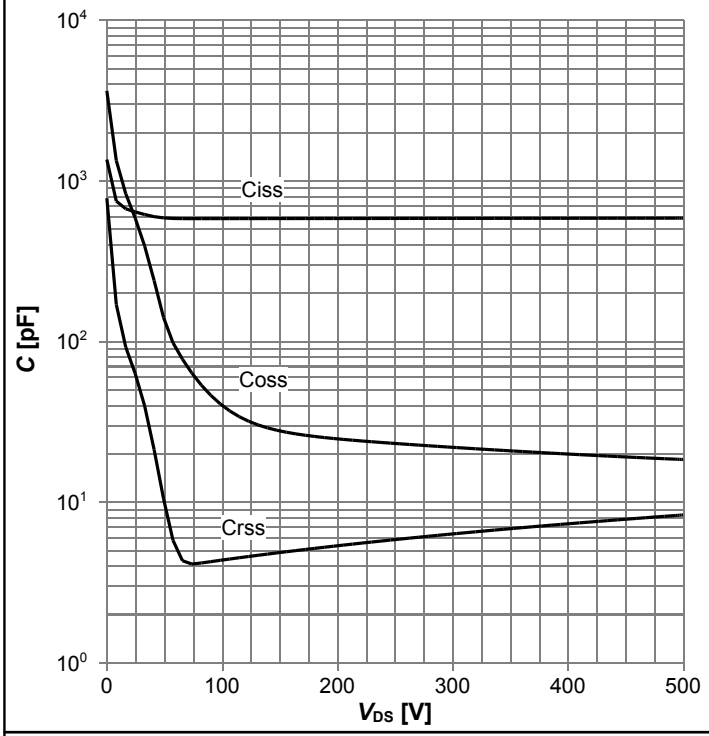
E_{AS}=f(T_j); I_D=4 A; V_{DD}=50 V

Drain-source breakdown voltage



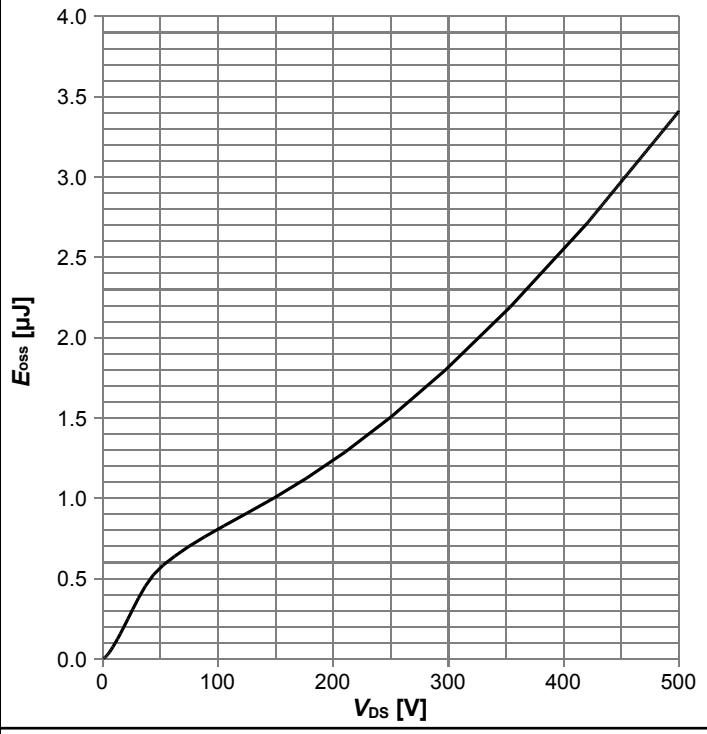
$V_{BR(DSS)}$=f(T_j); I_D=1 mA

Typ. capacitances



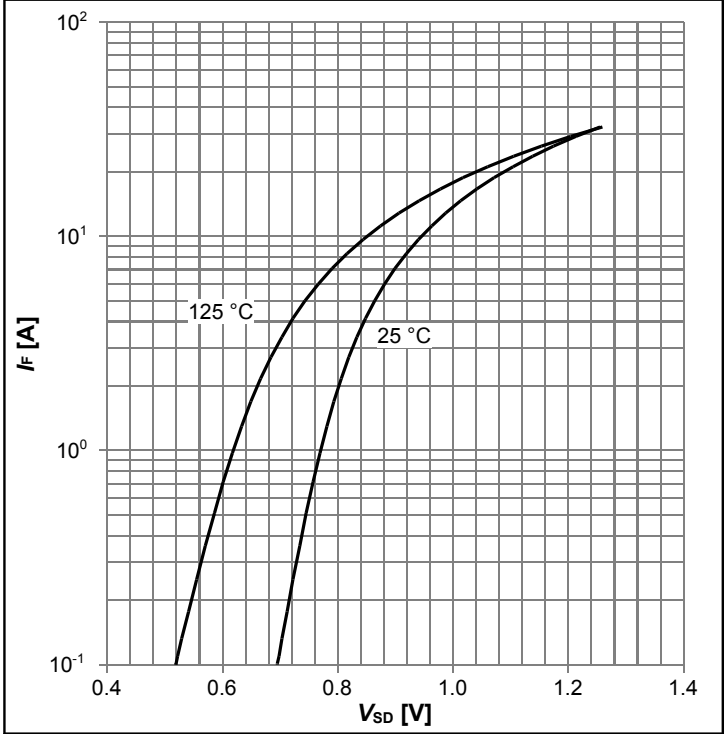
C=f(V_{DS}); V_{GS}=0 V; f=1 MHz

Typ. Coss stored energy



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

Forward characteristics of reverse diode



I_F=f(V_{SD}); parameter: T_j

5 Test Circuits

Table 8 Diode characteristics

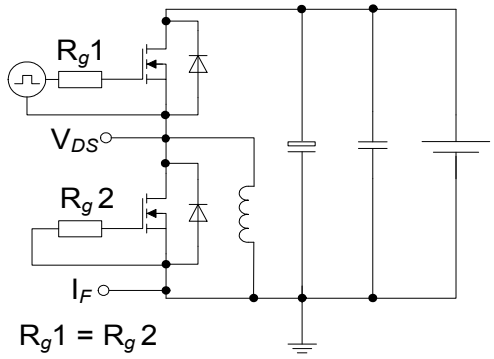
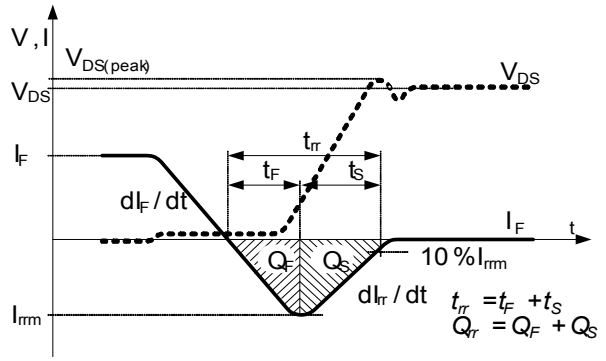
Test circuit for diode characteristics	Diode recovery waveform
	

Table 9 Switching times

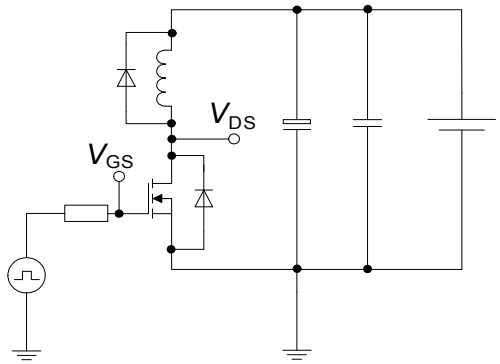
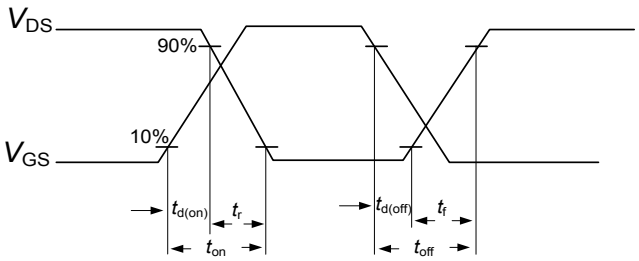
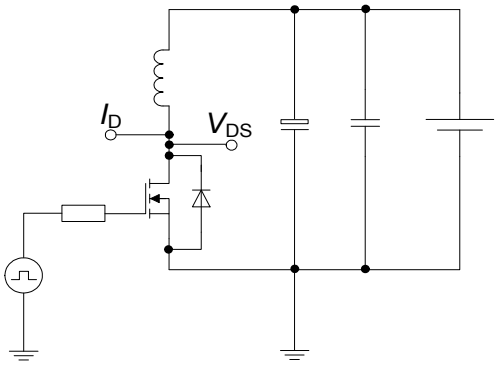
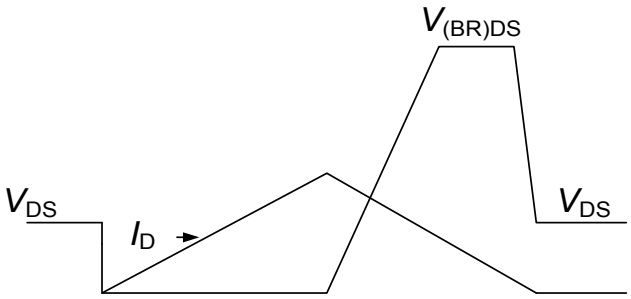
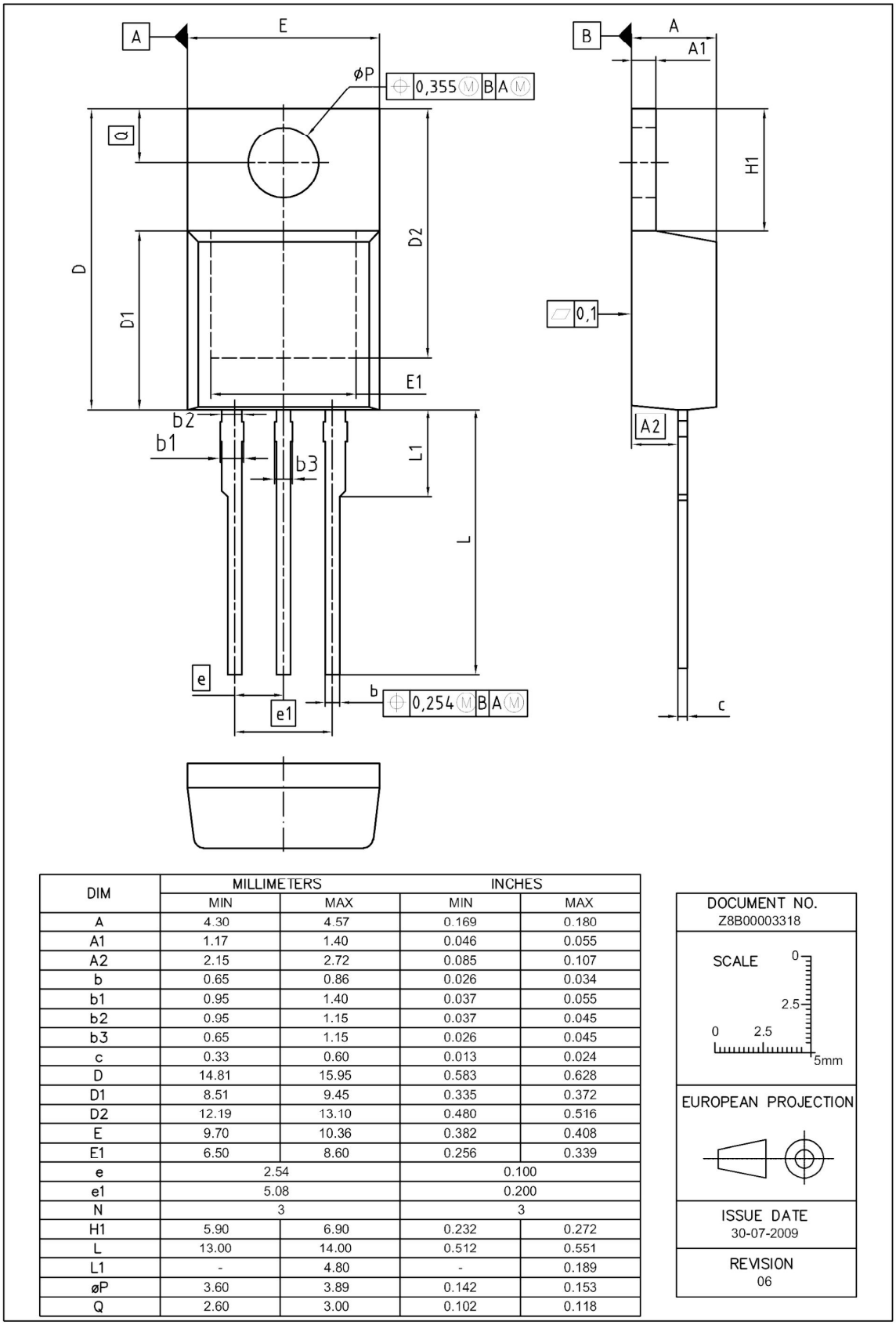
Switching times test circuit for inductive load	Switching times waveform
	

Table 10 Unclamped inductive load

Unclamped inductive load test circuit	Unclamped inductive waveform
	

6 Package Outlines



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 0 2.5 5mm

EUROPEAN PROJECTION

ISSUE DATE
30-07-2009

REVISION
06

Figure 1 Outline PG-TO 220, dimensions in mm/inches

7 Appendix A

Table 11 Related Links

- **IFX CoolMOS Webpage:** www.infineon.com
- **IFX Design tools:** www.infineon.com

Revision History

IPP50R380CE

Revision: 2016-06-13, Rev. 2.2

Previous Revision

Revision	Date	Subjects (major changes since last revision)
2.0	2012-08-24	Release of final version
2.1	2014-06-06	Removal of TO-220FP
2.2	2016-06-13	Updated ID rating, Zth, SOA and Pd curves

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