

MOSFET

Metal Oxide Semiconductor Field Effect Transistor

CoolMOS™ CE

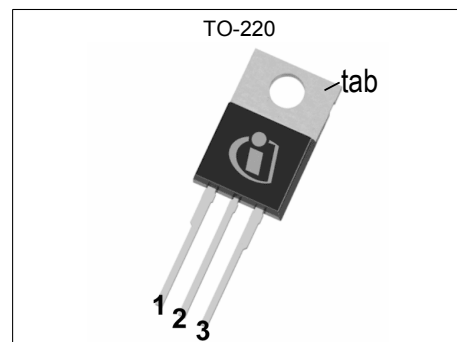
500V CoolMOS™ CE Power Transistor
IPx50R500CE

Data Sheet

Rev. 2.1
Final

1 Description

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 $R_{DS(on)} \cdot Q_g$ and E_{oss}
- 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.

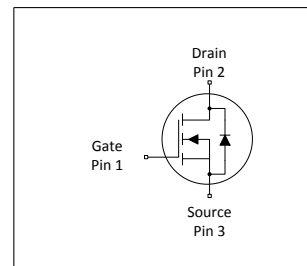


Table 1 Key Performance Parameters

Parameter	Value	Unit
$V_{DS} @ T_{j,max}$	550	V
$R_{DS(on),max}$	0.5	Ω
$Q_{g,typ}$	18.7	nC
$I_{D,pulse}$	24	A
$E_{oss}@400V$	2.02	μJ
Body diode di/dt	500	A/ μs

Type / Ordering Code	Package	Marking	Related Links
IPP50R500CE	PG-TO 220	5R500CE	see Appendix A

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2 Maximum ratings

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

Table 2 Maximum ratings

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Continuous drain current ¹⁾	I_D	-	-	7.6 4.8	A	$T_C = 25^\circ\text{C}$ $T_C = 100^\circ\text{C}$
Pulsed drain current ²⁾	$I_{D,pulse}$	-	-	24	A	$T_C = 25^\circ\text{C}$
Avalanche energy, single pulse	E_{AS}	-	-	129	mJ	$I_D = 2.9\text{A}$; $V_{DD} = 50\text{V}$
Avalanche energy, repetitive	E_{AR}	-	-	0.20	mJ	$I_D = 2.9\text{A}$; $V_{DD} = 50\text{V}$
Avalanche current, repetitive	I_{AR}	-	-	2.9	A	-
MOSFET dv/dt ruggedness	dv/dt	-	-	50	V/ns	$V_{DS} = 0 \dots 400\text{V}$
Gate source voltage	V_{GS}	-20 -30	-	20 30	V	static; AC ($f > 1\text{ Hz}$)
Power dissipation (non FullPAK) TO-220	P_{tot}	-	-	57	W	$T_C = 25^\circ\text{C}$
Operating and storage temperature	T_j, T_{stg}	-55	-	150	$^\circ\text{C}$	-
Mounting torque (non FullPAK) TO-220	-	-	-	60	Ncm	M3 and M3.5 screws
Continuous diode forward current	I_S	-	-	6.6	A	$T_C = 25^\circ\text{C}$
Diode pulse current ²⁾	$I_{S,pulse}$	-	-	24.0	A	$T_C = 25^\circ\text{C}$
Reverse diode dv/dt ³⁾	dv/dt	-	-	15	V/ns	$V_{DS} = 0 \dots 400\text{V}$, $I_{SD} \leq I_S$, $T_j = 25^\circ\text{C}$, $t_{cond} < 2\mu\text{s}$
Maximum diode commutation speed ³⁾	di/dt	-	-	500	A/ μs	$V_{DS} = 0 \dots 400\text{V}$, $I_{SD} \leq I_S$, $T_j = 25^\circ\text{C}$, $t_{cond} < 2\mu\text{s}$

3 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}	-	-	2.19	$^\circ\text{C/W}$	-
Thermal resistance, junction - ambient	R_{thJA}	-	-	62	$^\circ\text{C/W}$	lead
Soldering temperature, wavesoldering only allowed at leads	T_{sld}	-	-	260	$^\circ\text{C}$	1.6mm (0.063 in.) from case for 10s

¹⁾ Limited by $T_{j,max}$. Maximum duty cycle $D=0.75$

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

³⁾ $V_{DClamp}=400\text{V}$; $V_{DS,peak} < V_{(BR)DSS}$; identical low side and high side switch with identical R_G

4 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	$V_{DS}=V_{GS}, I_D=0.2mA$
Zero gate voltage drain current	I_{DSS}	-	-	1	μA	$V_{DS}=500V, V_{GS}=0V, T_j=25^\circ C$ $V_{DS}=500V, V_{GS}=0V, T_j=150^\circ C$
Gate-source leakage current	I_{GSS}	-	-	100	nA	$V_{GS}=20V, V_{DS}=0V$
Drain-source on-state resistance	$R_{DS(on)}$	-	0.45	0.50	Ω	$V_{GS}=13V, I_D=2.3A, T_j=25^\circ C$ $V_{GS}=13V, I_D=2.3A, T_j=150^\circ C$
Gate resistance	R_G	-	3	-	Ω	$f=1\text{ MHz}$, open drain

Table 5 Dynamic characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Input capacitance	C_{iss}	-	433	-	pF	$V_{GS}=0V, V_{DS}=100V, f=1MHz$
Output capacitance	C_{oss}	-	31	-	pF	$V_{GS}=0V, V_{DS}=100V, f=1MHz$
Effective output capacitance, energy related ¹⁾	$C_{o(er)}$	-	25	-	pF	$V_{GS}=0V, V_{DS}=0...400V$
Effective output capacitance, time related ²⁾	$C_{o(tr)}$	-	100	-	pF	$I_D=\text{constant}, V_{GS}=0V, V_{DS}=0...400V$
Turn-on delay time	$t_{d(on)}$	-	6	-	ns	$V_{DD}=400V, V_{GS}=13V, I_D=2.9A, R_G=3.4\Omega$
Rise time	t_r	-	5	-	ns	$V_{DD}=400V, V_{GS}=13V, I_D=2.9A, R_G=3.4\Omega$
Turn-off delay time	$t_{d(off)}$	-	30	-	ns	$V_{DD}=400V, V_{GS}=13V, I_D=2.9A, R_G=3.4\Omega$
Fall time	t_f	-	12	-	ns	$V_{DD}=400V, V_{GS}=13V, I_D=2.9A, R_G=3.4\Omega$

Table 6 Gate charge characteristics

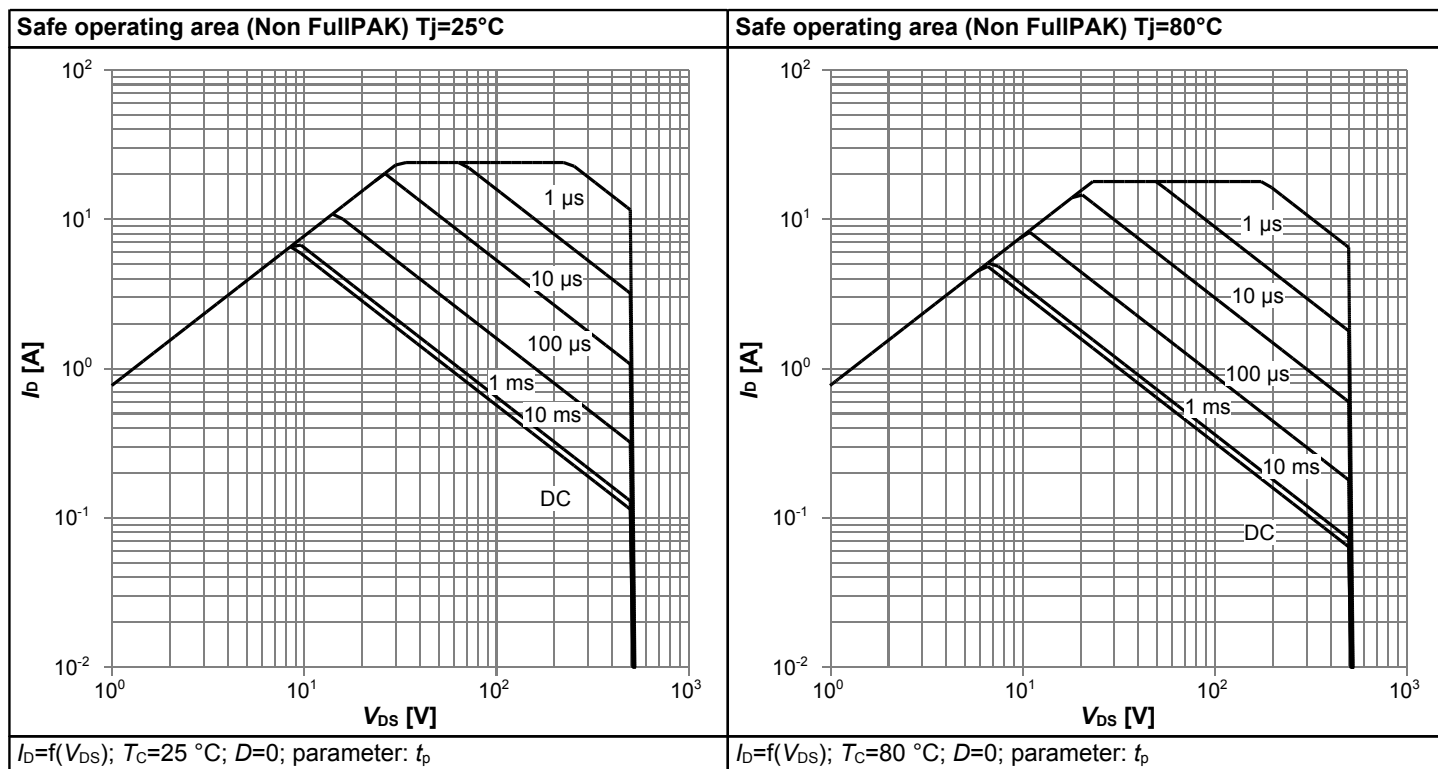
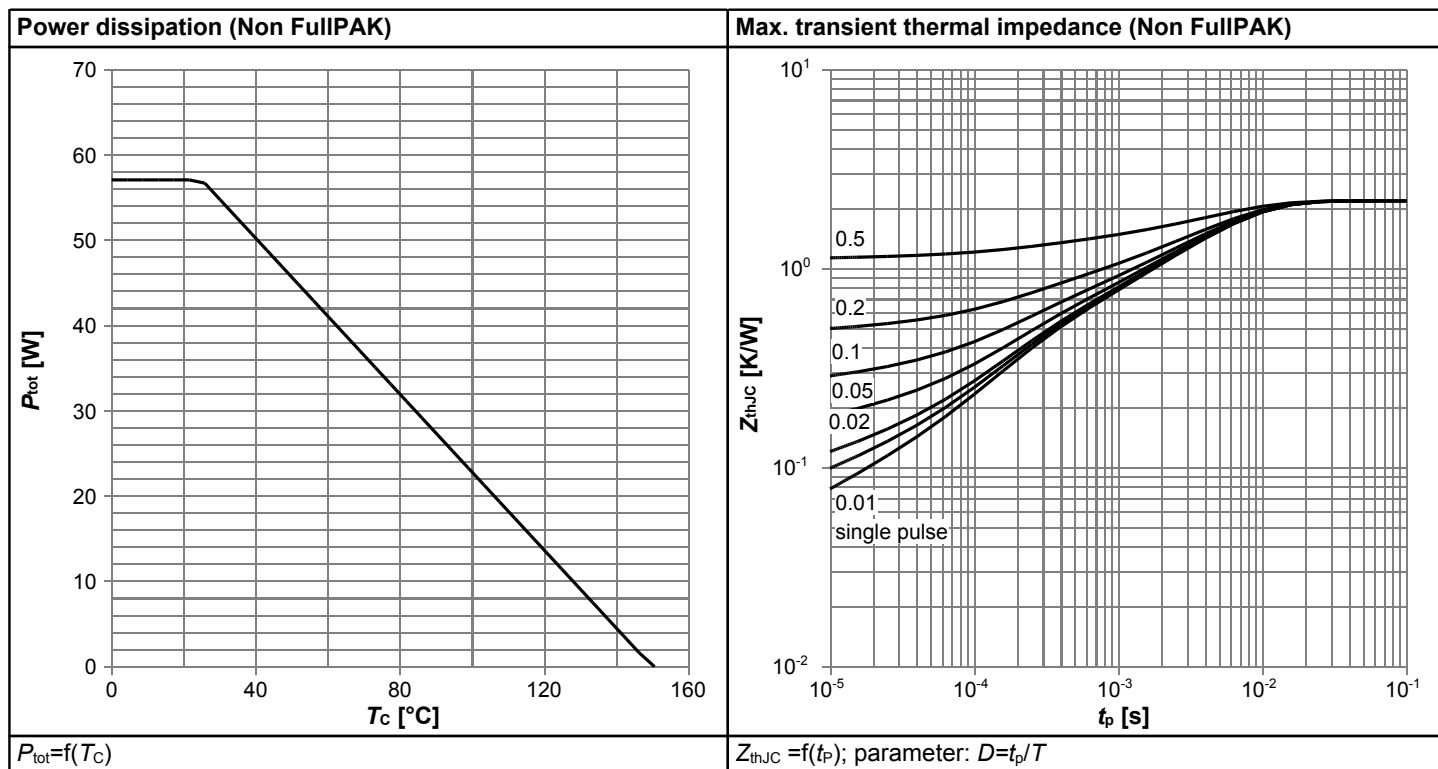
Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Gate to source charge	Q_{gs}	-	2.3	-	nC	$V_{DD}=400V, I_D=2.9A, V_{GS}=0\text{ to }10V$
Gate to drain charge	Q_{gd}	-	10	-	nC	$V_{DD}=400V, I_D=2.9A, V_{GS}=0\text{ to }10V$
Gate charge total	Q_g	-	18.7	-	nC	$V_{DD}=400V, I_D=2.9A, V_{GS}=0\text{ to }10V$
Gate plateau voltage	$V_{plateau}$	-	5.3	-	V	$V_{DD}=400V, I_D=2.9A, V_{GS}=0\text{ to }10V$

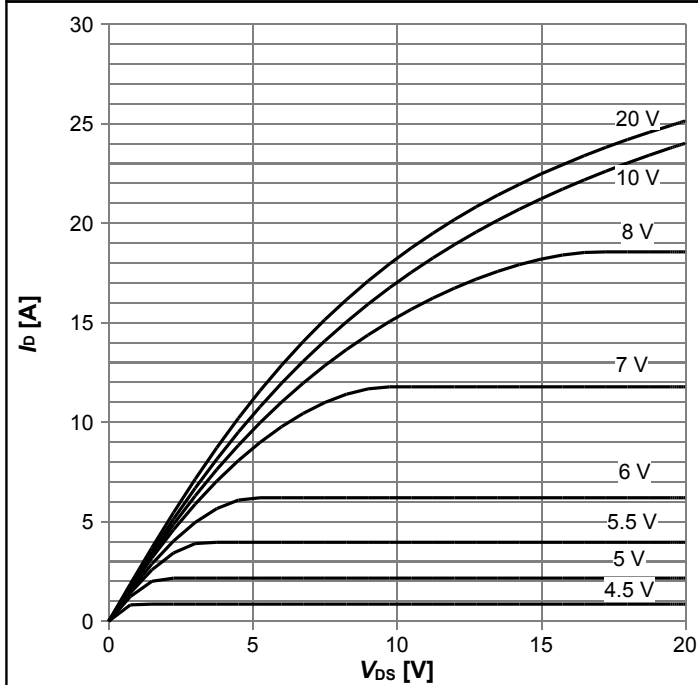
¹⁾ $C_{o(er)}$ is a fixed capacitance that gives the same stored energy as C_{oss} while V_{DS} is rising from 0 to 80% $V_{(BR)DSS}$
²⁾ $C_{o(tr)}$ is a fixed capacitance that gives the same charging time as C_{oss} while V_{DS} is rising from 0 to 80% $V_{(BR)DSS}$

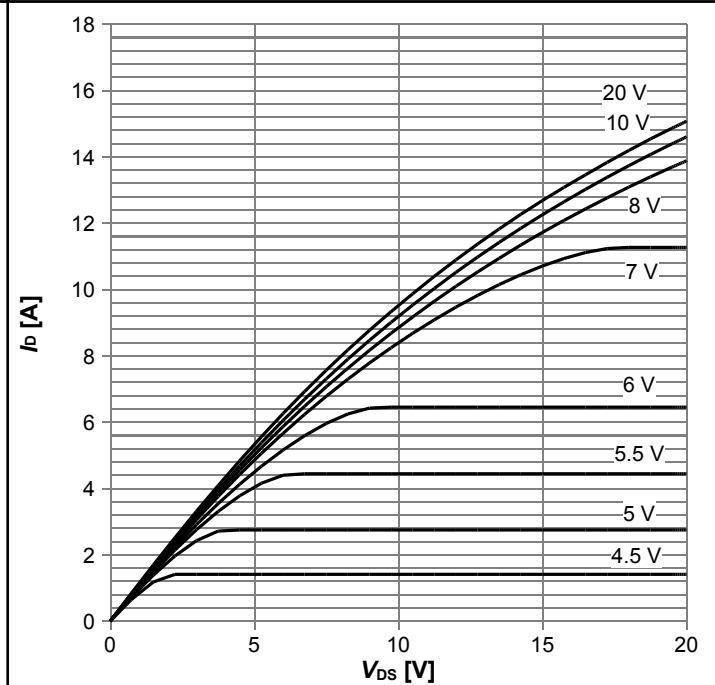
Table 7 Reverse diode characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Diode forward voltage	V_{SD}	-	0.85	-	V	$V_{GS}=0V$, $I_F=2.9A$, $T_i=25^{\circ}C$
Reverse recovery time	t_{rr}	-	180	-	ns	$V_R=400V$, $I_F=2.9A$, $di_F/dt=100A/\mu s$
Reverse recovery charge	Q_{rr}	-	1.2	-	μC	$V_R=400V$, $I_F=2.9A$, $di_F/dt=100A/\mu s$
Peak reverse recovery current	I_{rrm}	-	12	-	A	$V_R=400V$, $I_F=2.9A$, $di_F/dt=100A/\mu s$

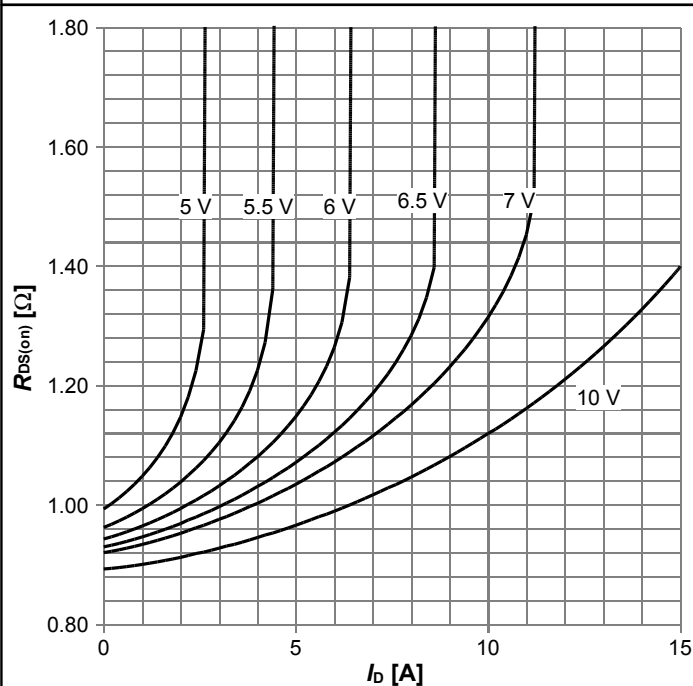
5 Electrical characteristics diagrams



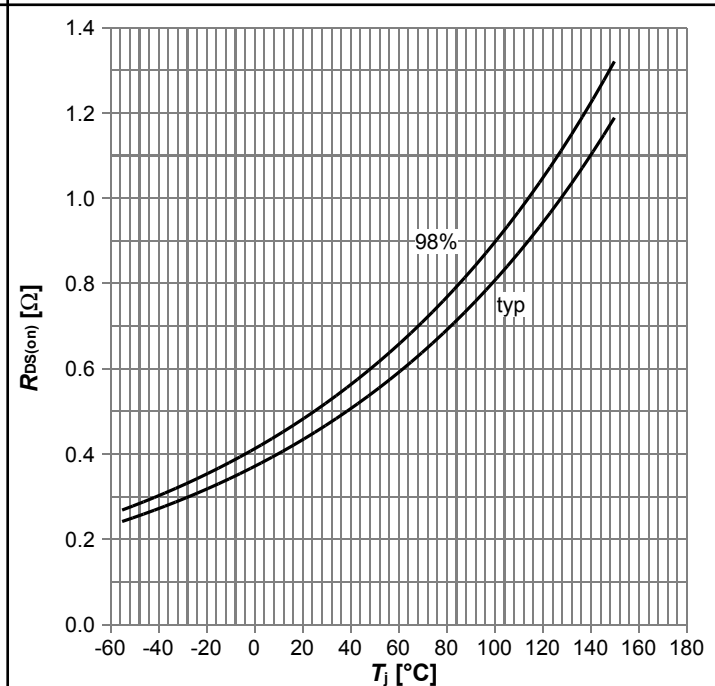
Typ. output characteristics $T_j=25^\circ\text{C}$

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

Typ. output characteristics $T_j=125^\circ\text{C}$

 $I_D=f(V_{DS})$; $T_j=125^\circ\text{C}$; parameter: V_{GS}

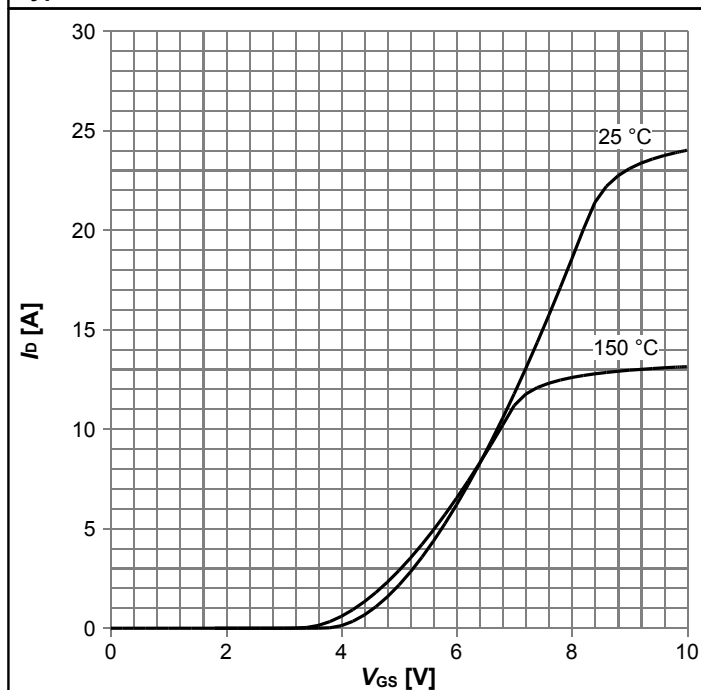
Typ. drain-source on-state resistance


 $R_{DS(on)}=f(I_D)$; $T_j=125^\circ\text{C}$; parameter: V_{GS}

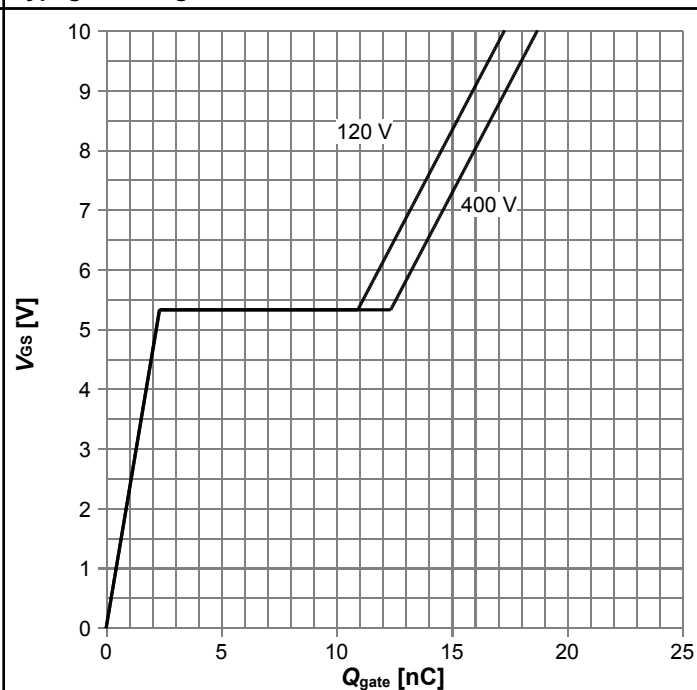
Drain-source on-state resistance


 $R_{DS(on)}=f(T_j)$; $I_D=2.3\text{ A}$; $V_{GS}=13\text{ V}$

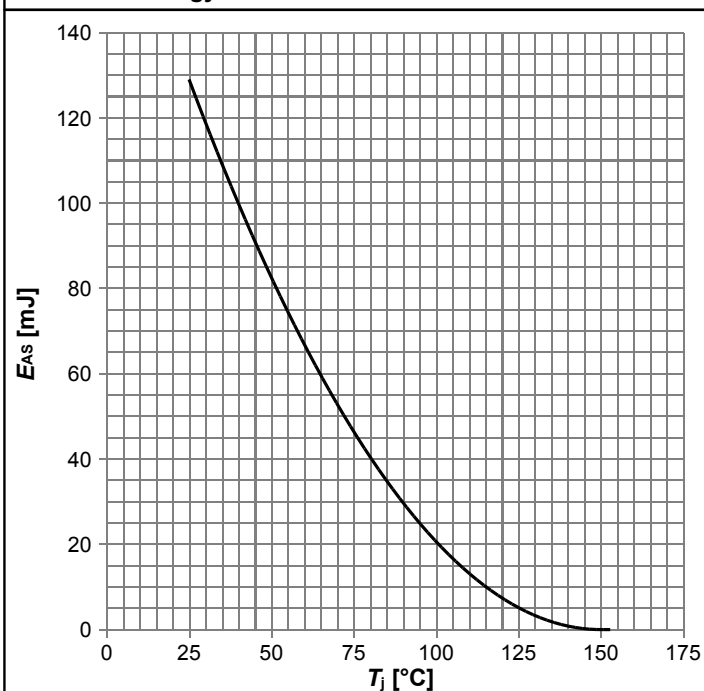
Typ. transfer characteristics


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

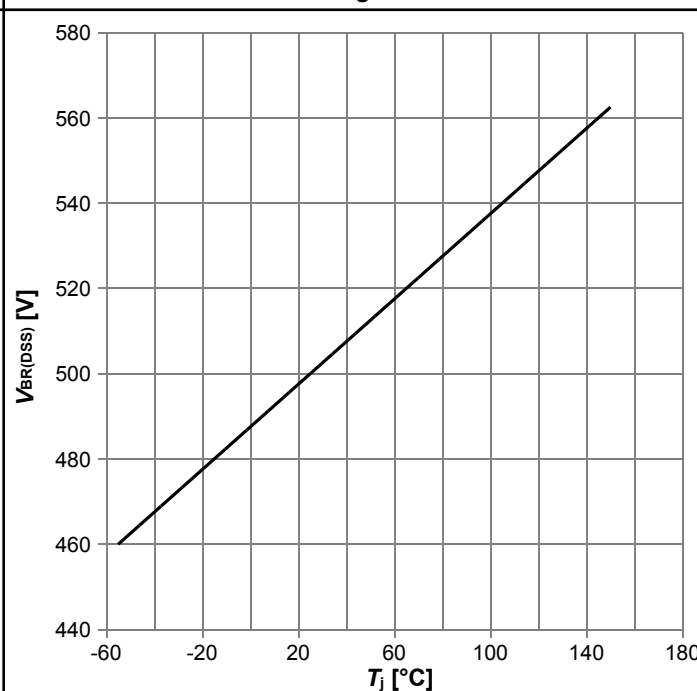
Typ. gate charge

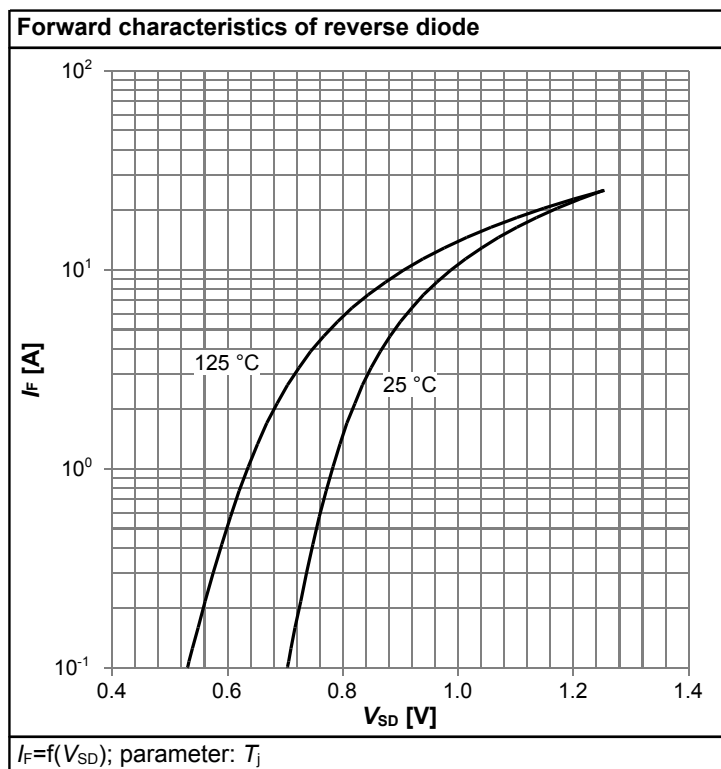
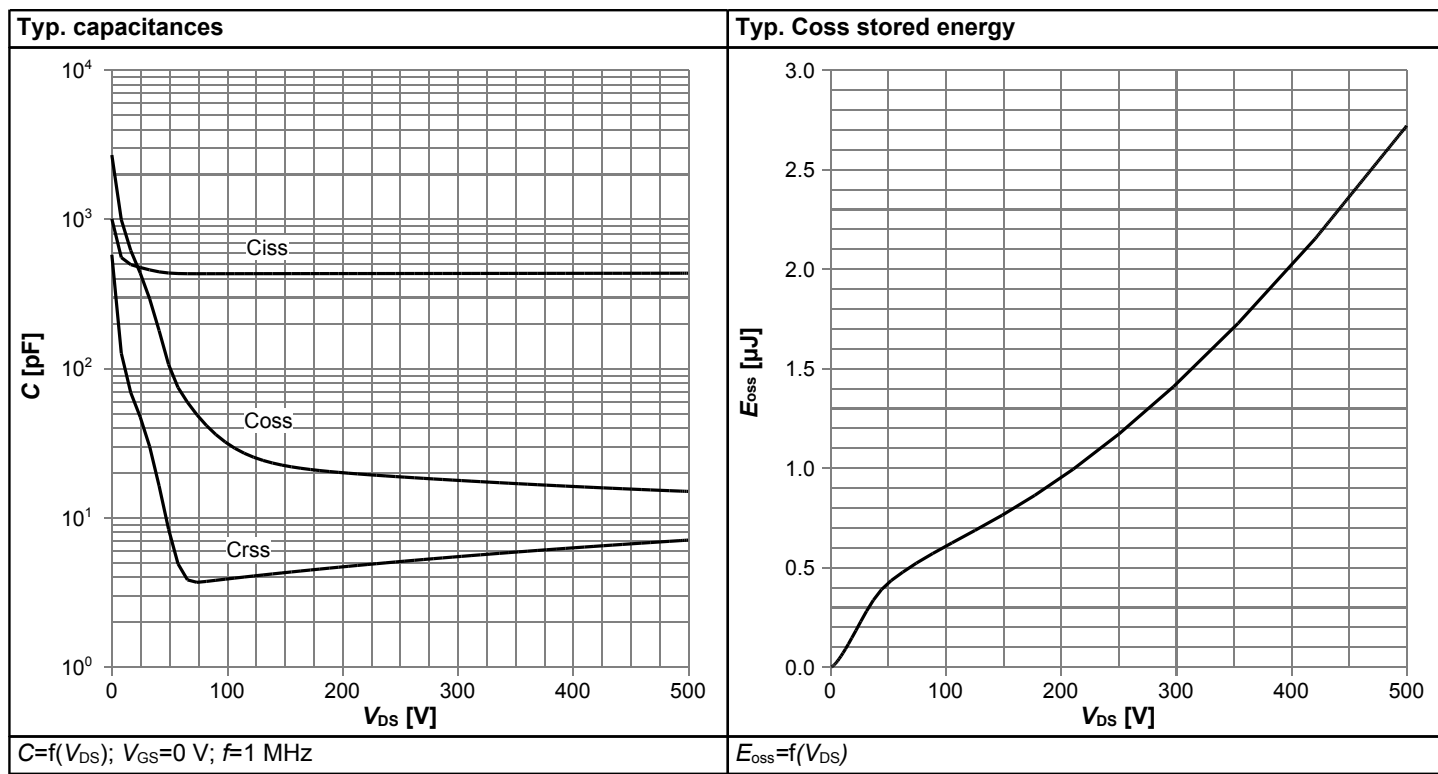

 $V_{GS} = f(Q_{gate})$; $I_D = 2.9\text{ A}$ pulsed; parameter: V_{DD}

Avalanche energy


 $E_{AS} = f(T_j)$; $I_D = 2.9\text{ A}$; $V_{DD} = 50\text{ V}$

Drain-source breakdown voltage


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



6 Test Circuits

Table 8 Diode characteristics

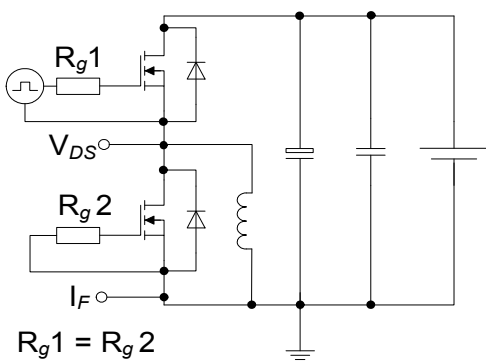
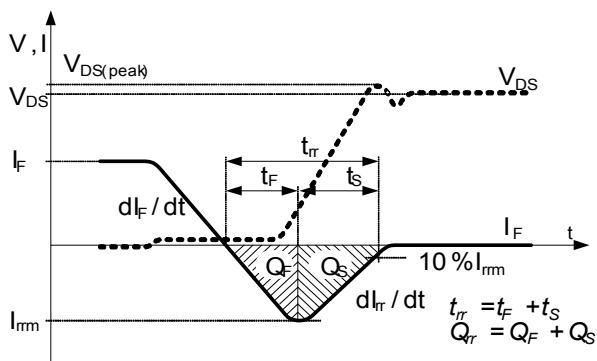
Test circuit for diode characteristics	Diode recovery waveform
 $R_{g1} = R_{g2}$	 $t_{rr} = t_F + t_S$ $Q_{rr} = Q_F + Q_S$

Table 9 Switching times

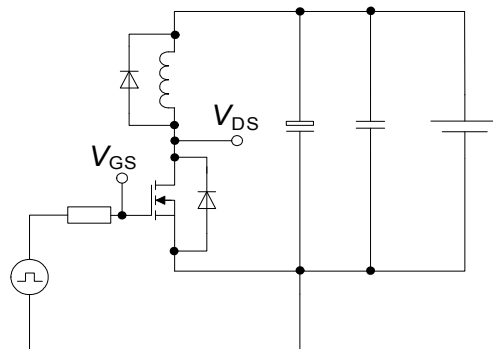
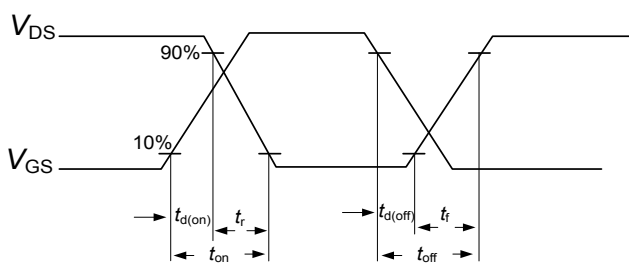
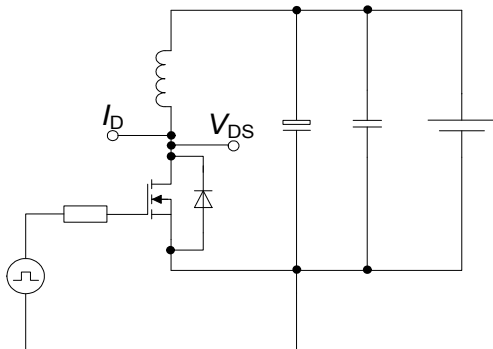
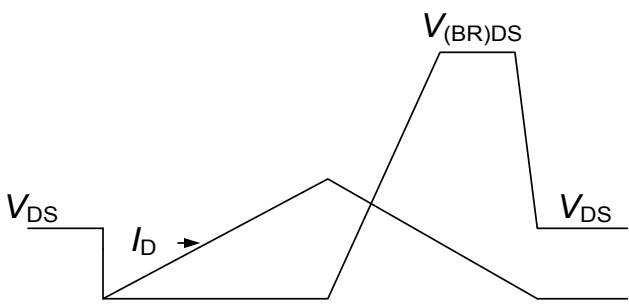
Switching times test circuit for inductive load	Switching times waveform
	

Table 10 Unclamped inductive load

Unclamped inductive load test circuit	Unclamped inductive waveform
	

7 Package Outlines

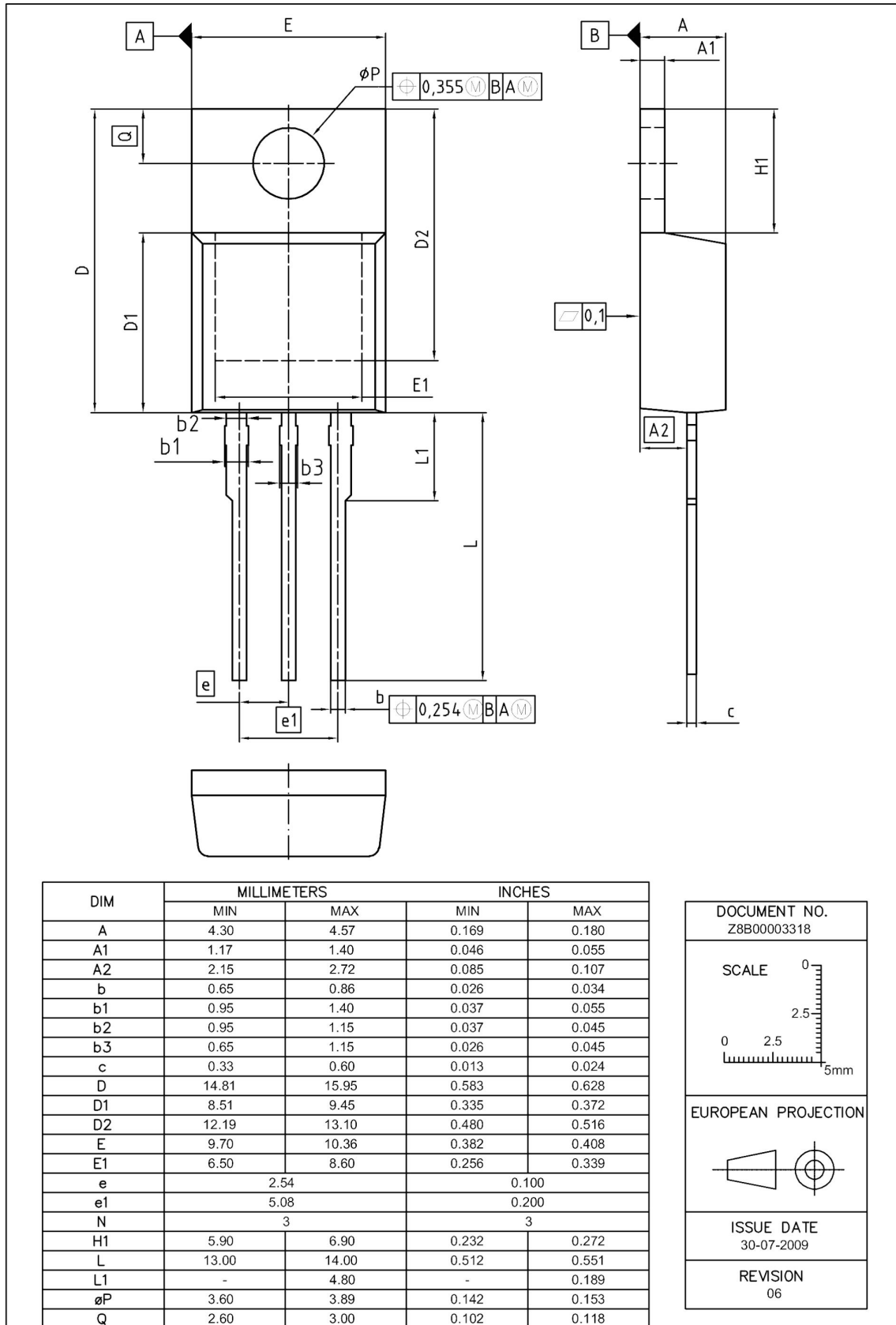


Figure 1 Outline PG-TO 220, dimensions in mm/inches

8 Appendix A

Table 11 Related Links

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

Revision History

IPP50R500CE

Revision: 2014-06-06, Rev. 2.1

Previous Revision

Revision	Date	Subjects (major changes since last revision)
2.0	2012-06-29	Release of final version
2.1	2014-06-06	Removal of TO-220FP

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