

MOSFET

Metal Oxide Semiconductor Field Effect Transistor

CoolMOS™ CE

500V CoolMOS™ CE Power Transistor
IPA50R650CE

Data Sheet

Rev. 2.0
Final

Industrial & Multimarket

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.

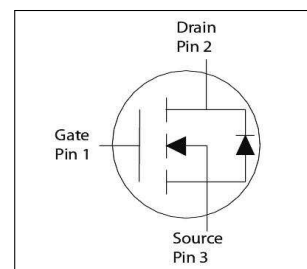


Table 1 Key Performance Parameters

Parameter	Value	Unit
$V_{DS} @ T_{j,max}$	550	V
$R_{DS(on),max}$	0.65	Ω
$Q_{g,typ}$	15	nC
$I_{D,pulse}$	19	A
$E_{oss@400V}$	1.69	μJ
Body diode di/dt	500	A/ μs

Type / Ordering Code	Package	Marking	Related Links
IPA50R650CE	PG-TO 220 FullPAK	5R650CE	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	-	-	6.1 3.8	A	$T_C = 25^\circ\text{C}$ $T_C = 100^\circ\text{C}$
Pulsed drain current ²⁾	$I_{D,pulse}$	-	-	19	A	$T_C = 25^\circ\text{C}$
Avalanche energy, single pulse	E_{AS}	-	-	102	mJ	$I_D = 2.3\text{A}$; $V_{DD} = 50\text{V}$
Avalanche energy, repetitive	E_{AR}	-	-	0.15	mJ	$I_D = 2.3\text{A}$; $V_{DD} = 50\text{V}$
Avalanche current, repetitive	I_{AR}	-	-	2.3	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 (FullPAK) TO-220FP	P_{tot}	-	-	27	W	$T_C = 25^\circ\text{C}$
Operating and storage temperature	T_j, T_{stg}	-55	-	150	$^\circ\text{C}$	-
Mounting torque (FullPAK) TO-220FP	-	-	-	50	Ncm	M2.5 screws
Continuous diode forward current	I_S	-	-	5.3	A	$T_C = 25^\circ\text{C}$
Diode pulse current ²⁾	$I_{S,pulse}$	-	-	19.0	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	$V_{DS} = 0 \dots 400\text{V}$, $I_{SD} \leq I_S$, $T_j = 25^\circ\text{C}$, $t_{cond} < 2\mu\text{s}$
Insulation withstand voltage for TO-220 FullPAK	V_{ISO}	-	-	2500	V	V_{rms} , $T_C = 25^\circ\text{C}$, $t = 1\text{min}$

3 Thermal characteristics

Table 3 Thermal characteristics (FullPAK) TO-220FP

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Thermal resistance, junction - case	R_{thJC}	-	-	4.6	$^\circ\text{C/W}$	-
Thermal resistance, junction - ambient	R_{thJA}	-	-	80	$^\circ\text{C/W}$	leaded
Soldering temperature, wavesoldering only allowed at leads	T_{sold}	-	-	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⁾ $V_{DClink}=400\text{V}$; $V_{DS,peak} < V_{(BR)DSS}$; identical low side and high side switch with identical R_θ

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	$V_{DS}=V_{GS}$, $I_D=0.15mA$
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	$R_{DS(on)}$	-	0.59 1.54	0.65 -	Ω	$V_{GS}=13V$, $I_D=1.8A$, $T_j=25^\circ C$ $V_{GS}=13V$, $I_D=1.8A$, $T_j=150^\circ C$
Gate resistance	R_G	-	3	-	Ω	$f=1MHz$, open drain

Table 5 Dynamic characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Input capacitance	C_{iss}	-	342	-	pF	$V_{GS}=0V$, $V_{DS}=100V$, $f=1MHz$
Output capacitance	C_{oss}	-	26	-	pF	$V_{GS}=0V$, $V_{DS}=100V$, $f=1MHz$
Effective output capacitance, energy related ¹⁾	$C_{o(er)}$	-	21	-	pF	$V_{GS}=0V$, $V_{DS}=0...400V$
Effective output capacitance, time related ²⁾	$C_{o(tr)}$	-	80	-	pF	$I_D=constant$, $V_{GS}=0V$, $V_{DS}=0...400V$
Turn-on delay time	$t_{d(on)}$	-	6	-	ns	$V_{DD}=400V$, $V_{GS}=13V$, $I_D=2.3A$, $R_G=5.3\Omega$
Rise time	t_r	-	5	-	ns	$V_{DD}=400V$, $V_{GS}=13V$, $I_D=2.3A$, $R_G=5.3\Omega$
Turn-off delay time	$t_{d(off)}$	-	27	-	ns	$V_{DD}=400V$, $V_{GS}=13V$, $I_D=2.3A$, $R_G=5.3\Omega$
Fall time	t_f	-	13	-	ns	$V_{DD}=400V$, $V_{GS}=13V$, $I_D=2.3A$, $R_G=5.3\Omega$

Table 6 Gate charge characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Gate to source charge	Q_{gs}	-	1.8	-	nC	$V_{DD}=400V$, $I_D=2.3A$, $V_{GS}=0$ to $10V$
Gate to drain charge	Q_{gd}	-	8.1	-	nC	$V_{DD}=400V$, $I_D=2.3A$, $V_{GS}=0$ to $10V$
Gate charge total	Q_g	-	15	-	nC	$V_{DD}=400V$, $I_D=2.3A$, $V_{GS}=0$ to $10V$
Gate plateau voltage	$V_{plateau}$	-	5.3	-	V	$V_{DD}=400V$, $I_D=2.3A$, $V_{GS}=0$ 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}	-	0.84	-	V	$V_{GS}=0V$, $I_F=2.3A$, $T_f=25^{\circ}C$
Reverse recovery time	t_{rr}	-	162	-	ns	$V_R=400V$, $I_F=2.3A$, $di_F/dt=100A/\mu s$
Reverse recovery charge	Q_{rr}	-	1	-	μC	$V_R=400V$, $I_F=2.3A$, $di_F/dt=100A/\mu s$
Peak reverse recovery current	I_{rrm}	-	11.1	-	A	$V_R=400V$, $I_F=2.3A$, $di_F/dt=100A/\mu s$

5 Electrical characteristics diagrams

Table 8

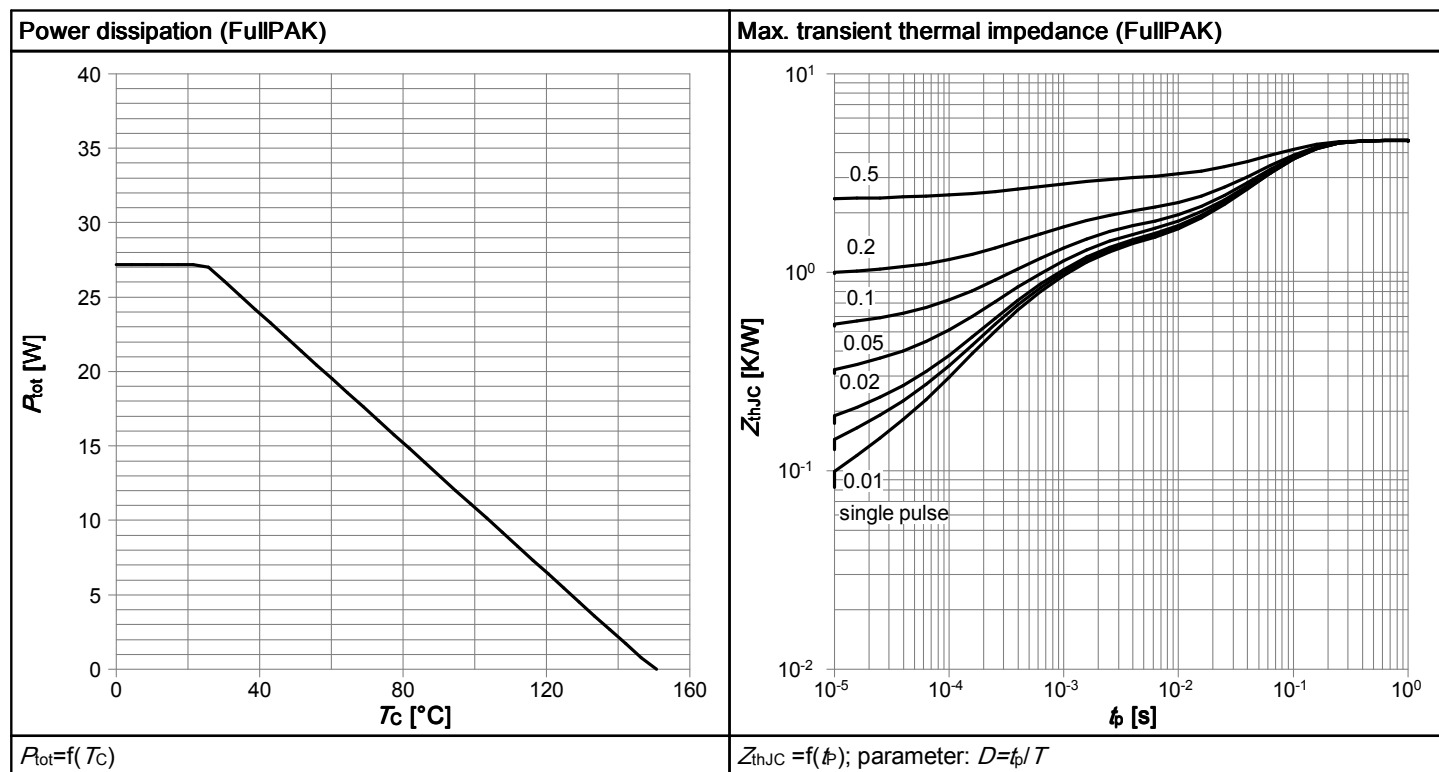


Table 9

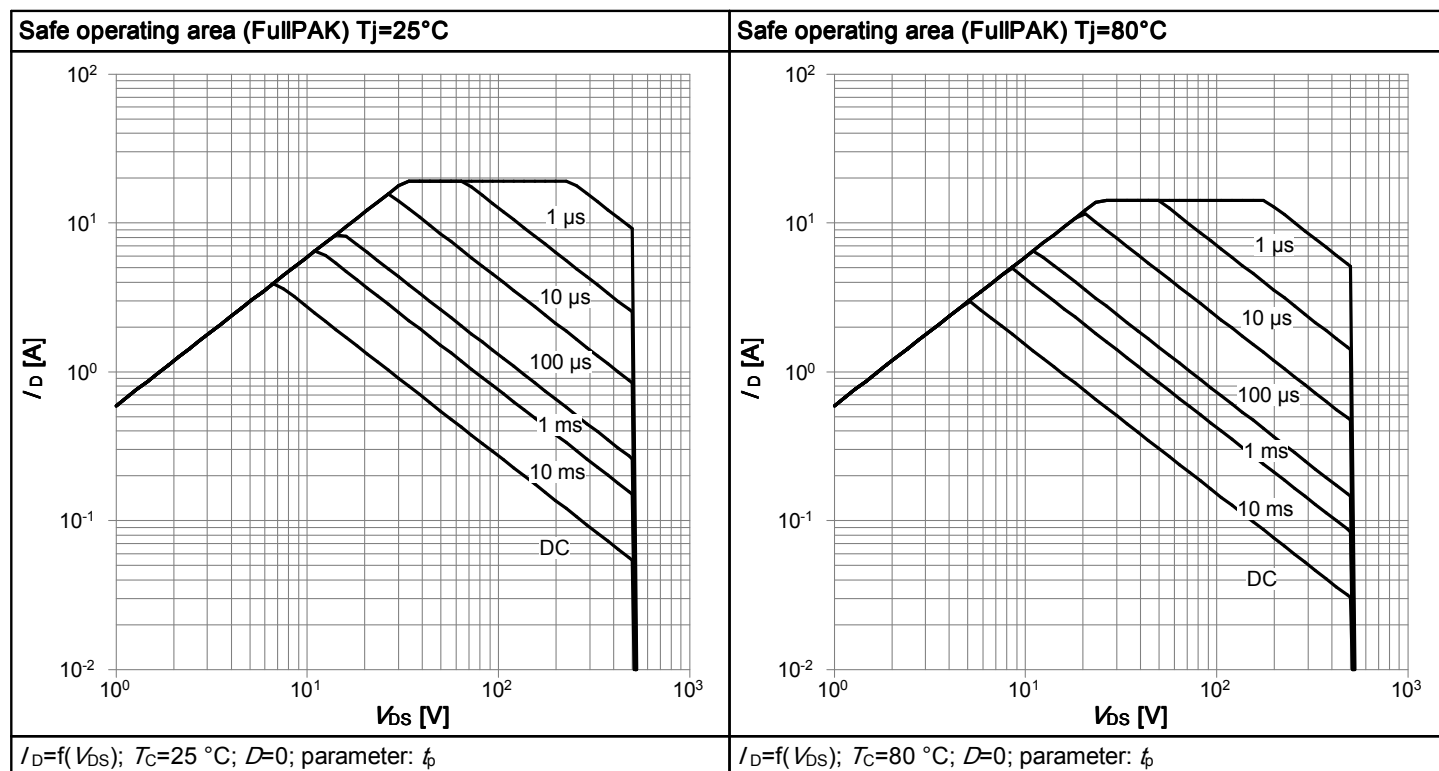


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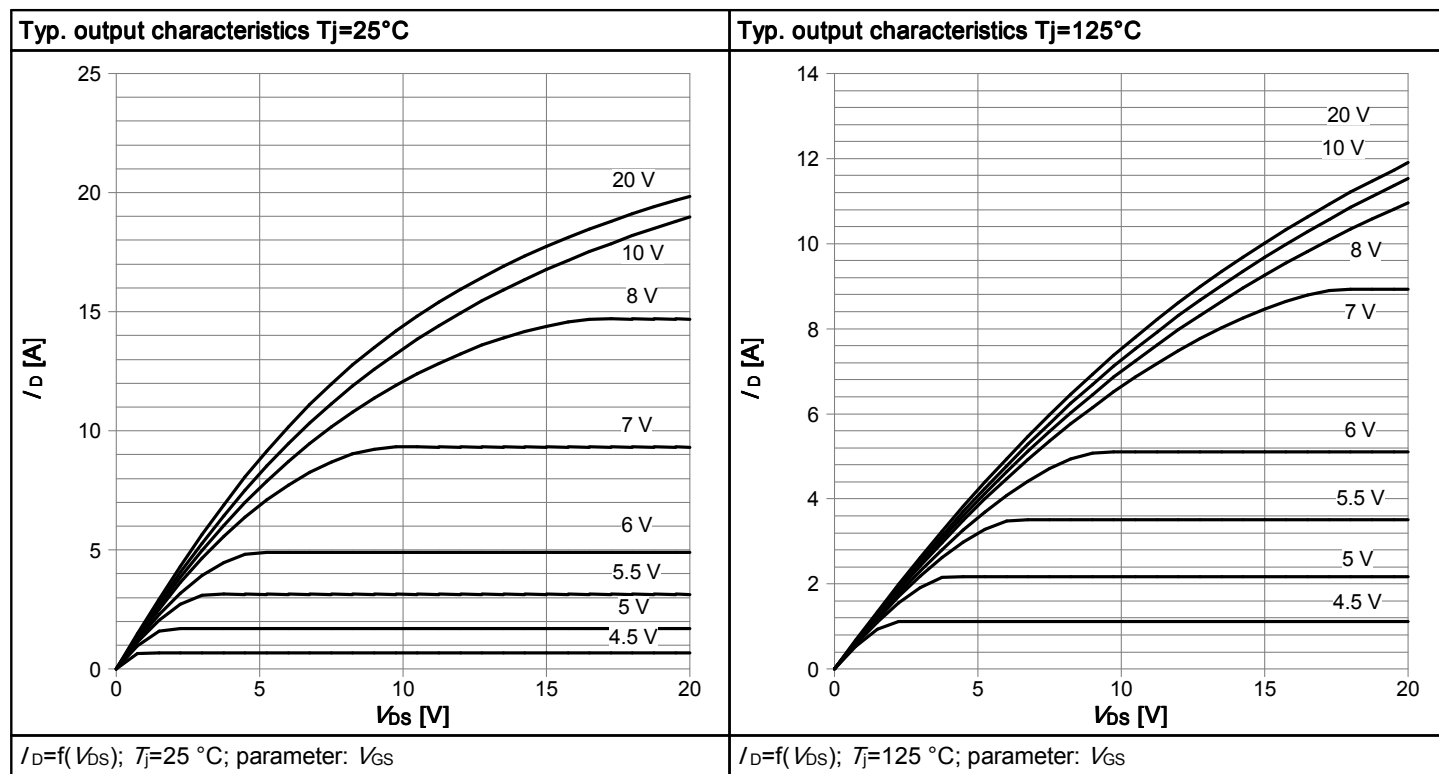


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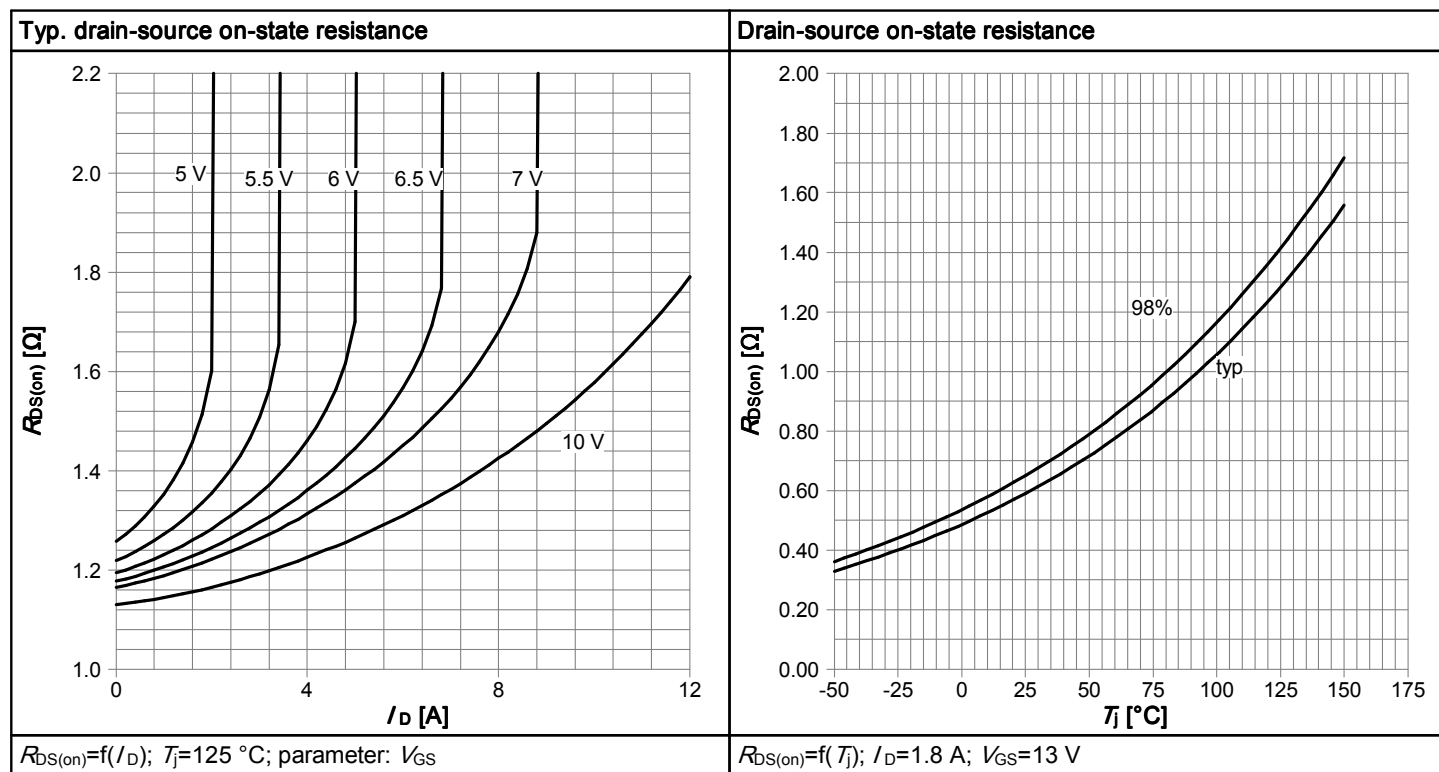


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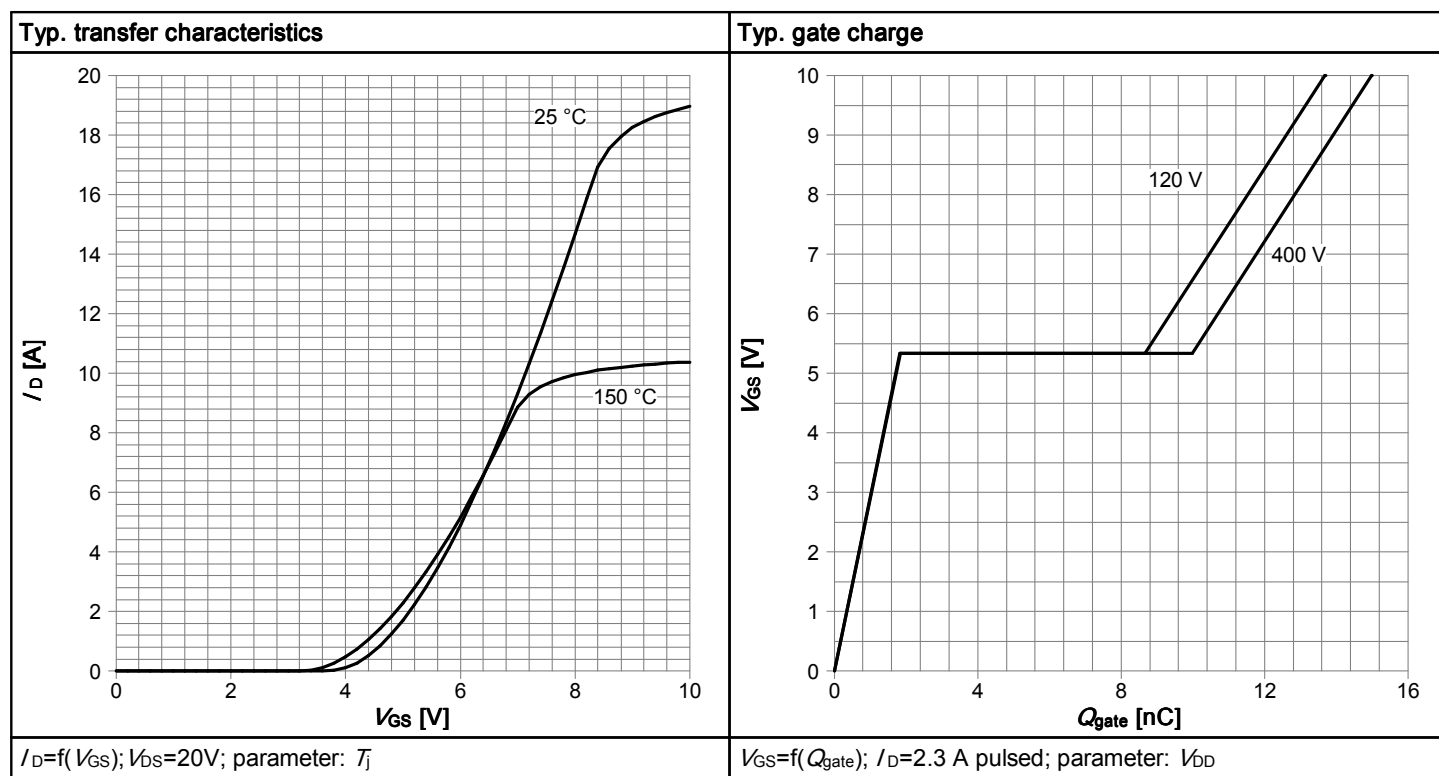


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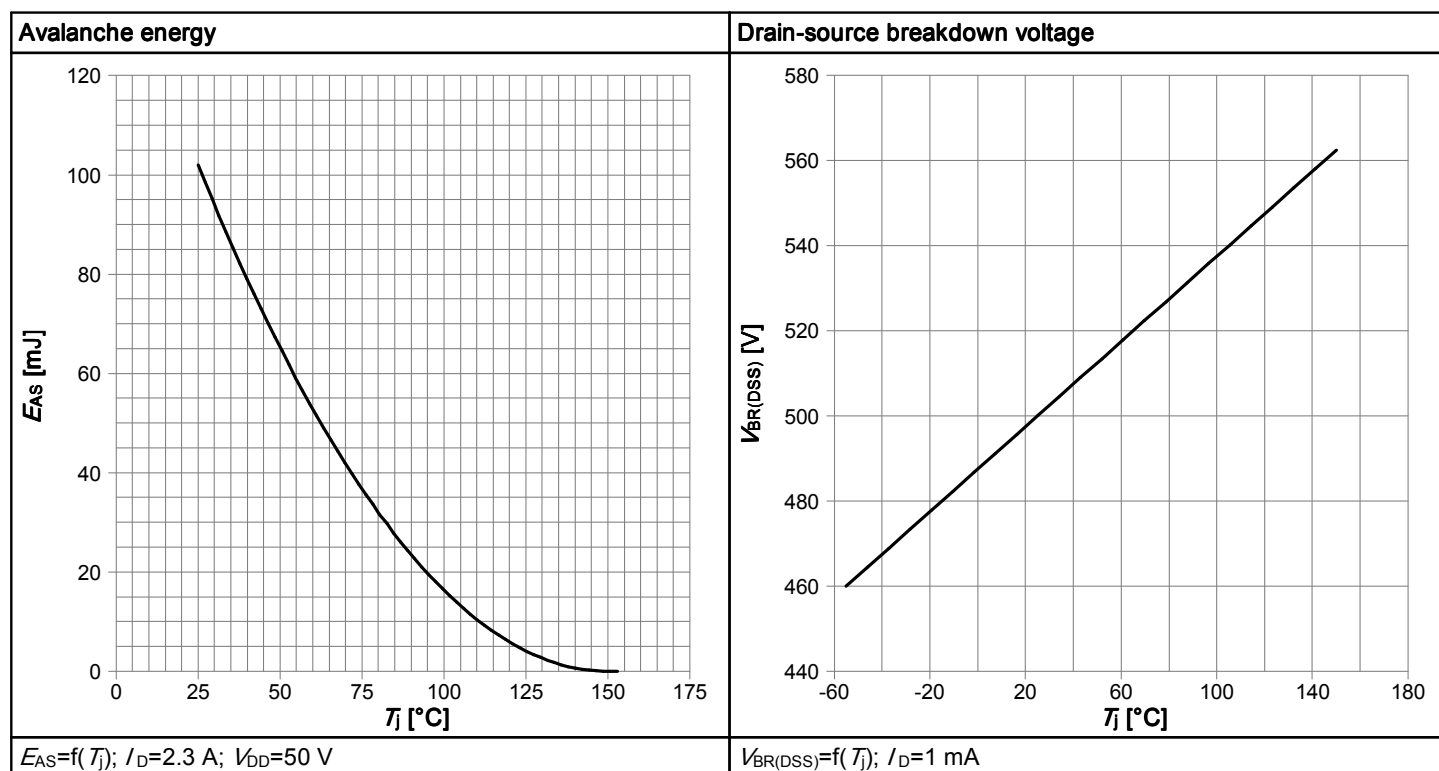


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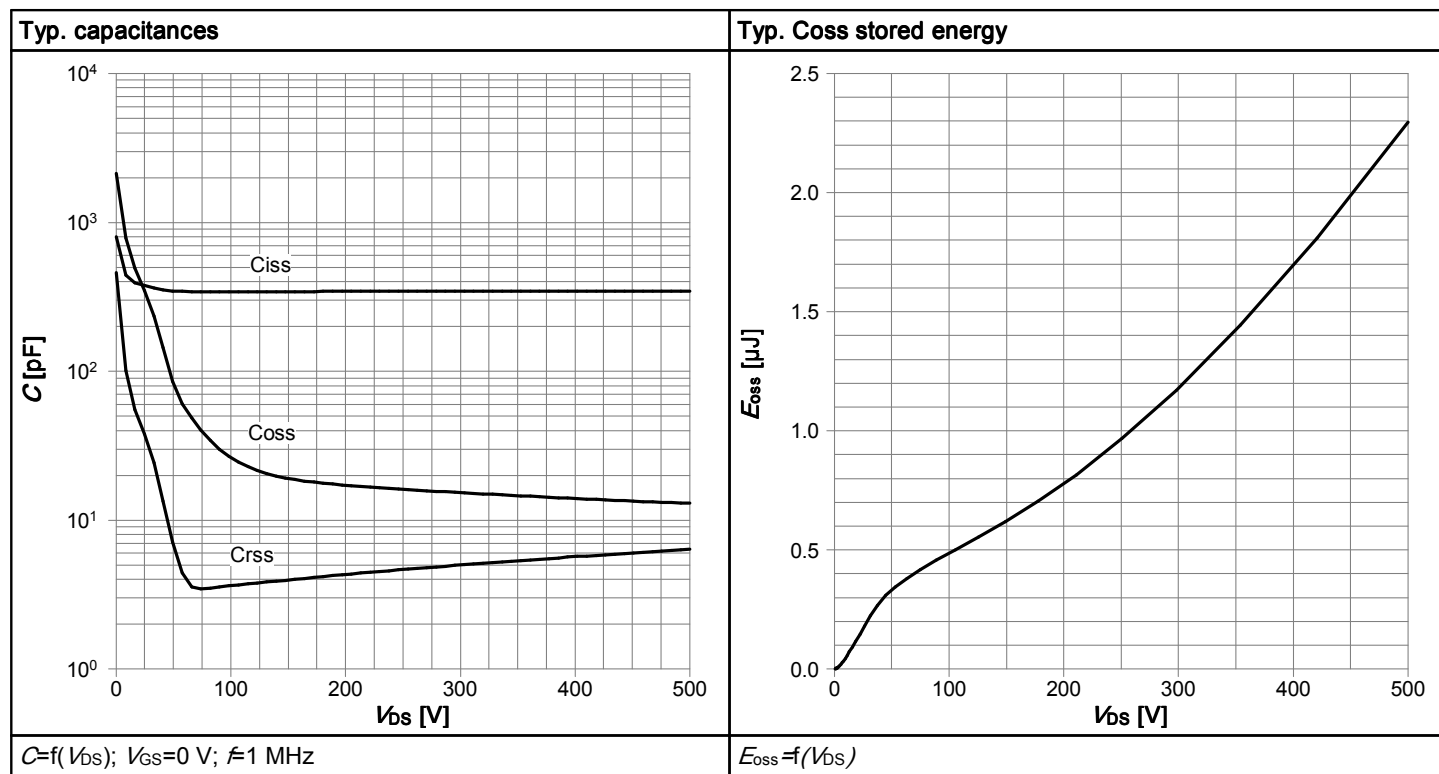
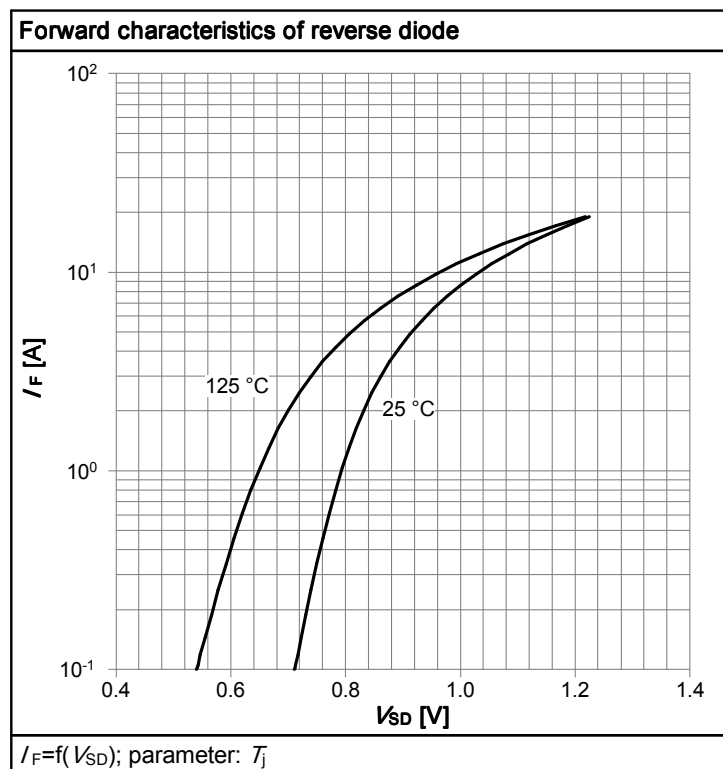


Table 15



6 Test Circuits

Table 16 Diode characteristics

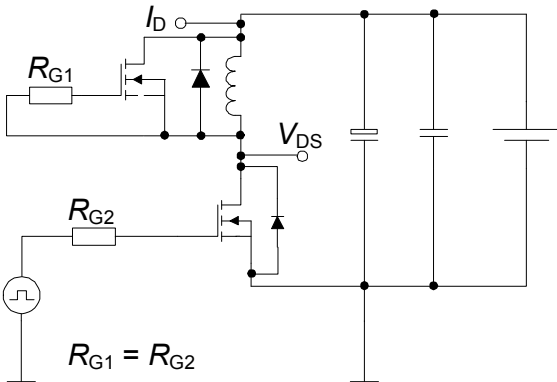
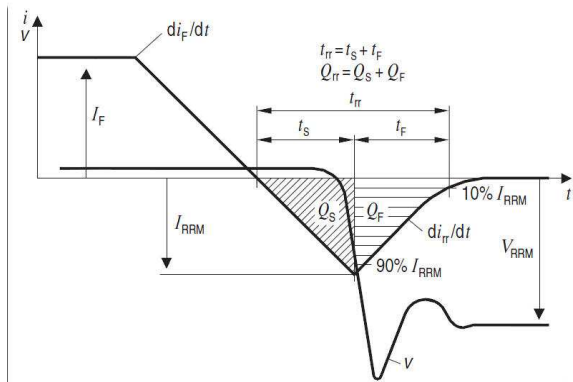
Test circuit for diode characteristics	Diode recovery waveform
 $R_{G1} = R_{G2}$	

Table 17 Switching times

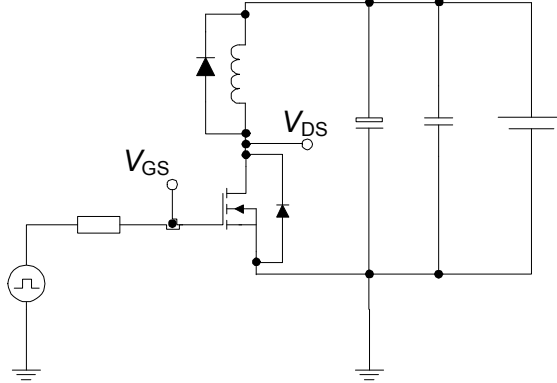
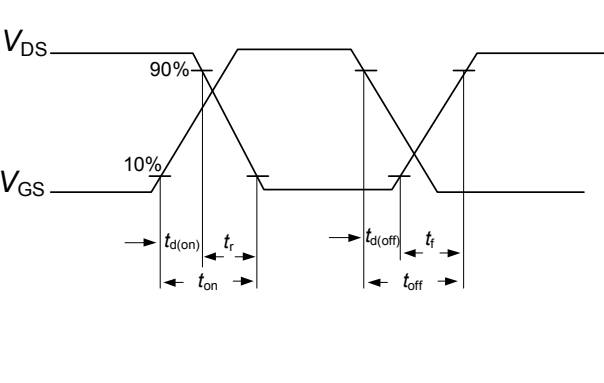
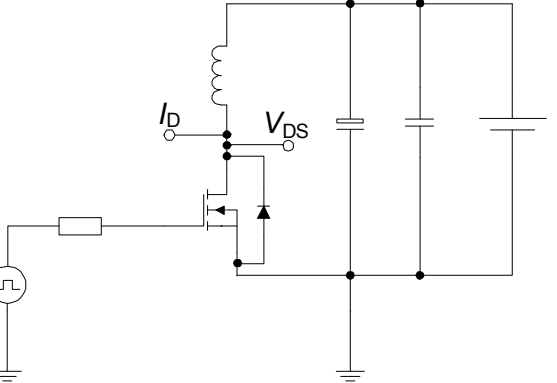
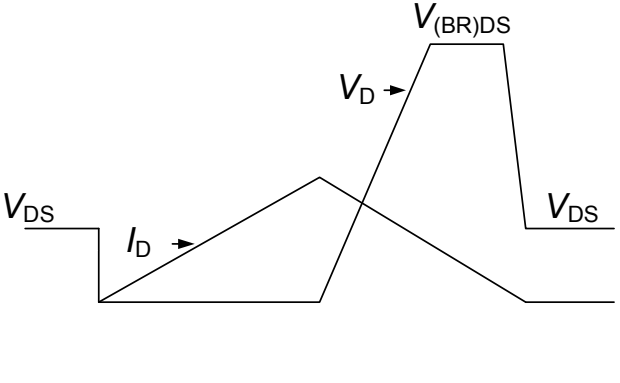
Switching times test circuit for inductive load	Switching times waveform
	

Table 18 Unclamped inductive

Unclamped inductive load test circuit	Unclamped inductive waveform
	

7 Package Outlines

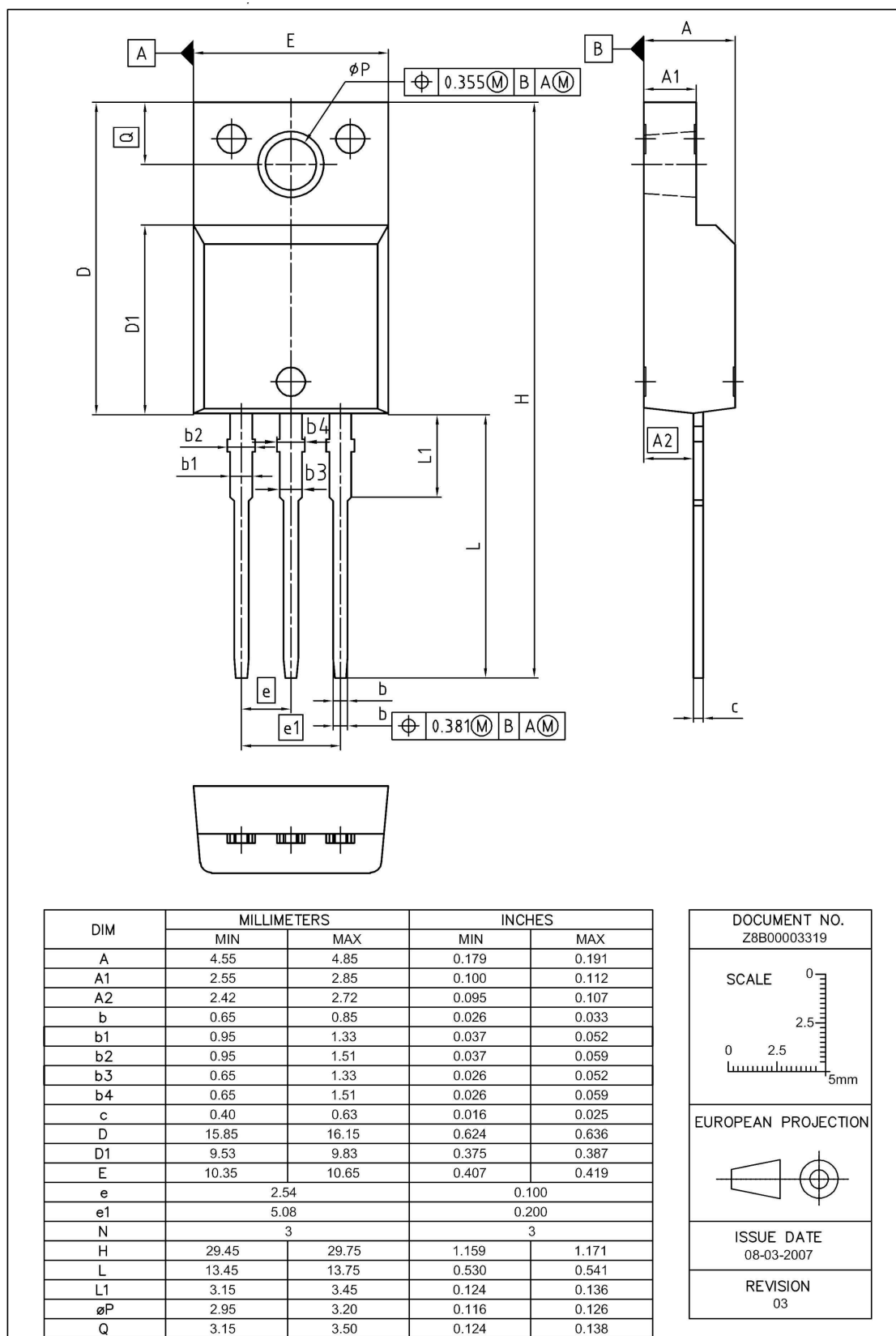


Figure 1 Outline PG-TO 220 FullPAK, dimensions in mm/inches

8 Appendix A

Table 19 Related Links

- **IFX CoolMOS Webpage:**
<http://www.infineon.com/cms/en/product/channel.html?channel=ff80808112ab681d0112ab6a628704d8>
- **IFX Design tools:**
<http://www.infineon.com/cms/en/product/promopages/designtools/index.html>

Revision History

IPA50R650CE

Revision: 2012-08-24, Rev. 2.0

Previous Revision

Revision	Date	Subjects (major changes since last revision)
2.0	2012-08-24	Release of final version

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