

MOSFET

Metal Oxide Semiconductor Field Effect Transistor

CoolMOS™ C6 600V

600V CoolMOS™ C6 Power Transistor
IPP60R1K4C6

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™ C6 series combines the experience of the leading SJ MOSFET supplier with high class innovation. 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, Adapter, LCD & PDP TV, Lighting, Server, Telecom and UPS.

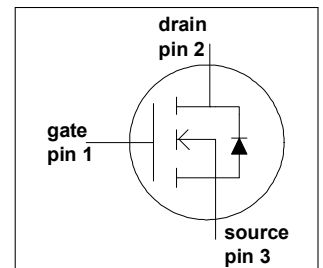
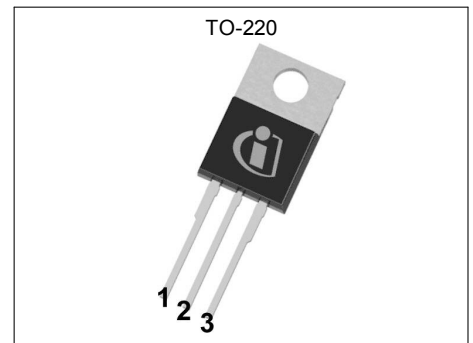


Table 1 Key Performance Parameters

Parameter	Value	Unit
$V_{DS} @ T_{j \max}$	650	V
$R_{DS(on),max}$	1.4	Ω
Q_g, typ	9.4	nC
$I_D, pulse$	8	A
$E_{oss} @ 400V$	1	μJ
Body diode di/dt	500	A/ μs

Type / Ordering Code	Package	Marking	Related Links
IPP60R1K4C6	PG-TO 220	6R1K4C6	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			3.2	A	$T_C = 25^\circ\text{C}$
				2.0		$T_C = 100^\circ\text{C}$
Pulsed drain current ²⁾	$I_{D,pulse}$			8	A	$T_C = 25^\circ\text{C}$
Avalanche energy, single pulse	E_{AS}			26	mJ	$I_D = 0.6\text{A}$, $V_{DD} = 50\text{V}$ (see table 18)
Avalanche energy, repetitive	E_{AR}			0.09	mJ	$I_D = 0.6\text{A}$, $V_{DD} = 50\text{V}$
Avalanche current, repetitive	I_{AR}			0.6	A	
MOSFET dv/dt ruggedness	dv/dt			50	V/ns	$V_{DS} = 0 \dots 480\text{V}$
Gate source voltage	V_{GS}	-20		20	V	static
		-30		30		AC ($f > 1\text{ Hz}$)
Power dissipation (non FullPAK) TO-220	P_{tot}			28.4	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			2.8	A	$T_C = 25^\circ\text{C}$
Diode pulse current	$I_{S,pulse}$			8	A	$T_C = 25^\circ\text{C}$
Reverse diode dv/dt ³⁾	dv/dt			15	V/ns	$V_{DS} = 0 \dots 480\text{V}$, $I_{SD} \leq I_D$, $T_j = 25^\circ\text{C}$ (see table 16)
Maximum diode commutation speed	di/dt			500	A/ μs	

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

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

³⁾ Identical low side and high side switch with identical R_G

3 Thermal characteristics

Table 3 Thermal characteristics TO-220

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Thermal resistance, junction - case	R_{thJC}			4.4	°C/W	
Thermal resistance, junction - ambient	R_{thJA}			62	°C/W	leaded
Soldering temperature, wavesoldering only allowed at leads	T_{sold}			260	°C	1.6 mm (0.063 in.) from case for 10s

4 Electrical characteristics

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

Table 4 Static characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Drain-source breakdown voltage	$V_{(BR)DSS}$	600			V	$V_{GS} = 0V$, $I_D = 0.25mA$
Gate threshold voltage	$V_{GS(th)}$	2.5	3	3.5	V	$V_{DS} = V_{GS}$, $I_D = 0.09mA$
Zero gate voltage drain current	I_{DSS}			1	μA	$V_{DS} = 600V$, $V_{GS} = 0V$, $T_j = 25^\circ\text{C}$
			10			$V_{DS} = 600V$, $V_{GS} = 0V$, $T_j = 150^\circ\text{C}$
Gate-source leakage current	I_{GSS}			100	nA	$V_{GS} = 20V$, $V_{DS} = 0V$
Drain-source on-state resistance	$R_{DS(on)}$		1.260	1.4	Ω	$V_{GS} = 10V$, $I_D = 1.1A$, $T_j = 25^\circ\text{C}$
			3.280			$V_{GS} = 10V$, $I_D = 1.1A$, $T_j = 150^\circ\text{C}$
Gate resistance	R_G		14		Ω	$f = 1MHz$, open drain

Table 5 Dynamic characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Input capacitance	C_{iss}		200		pF	$V_{GS} = 0V$, $V_{DS} = 100V$, $f = 1MHz$
Output capacitance	C_{oss}		16		pF	
Effective output capacitance, energy related ¹⁾	$C_{o(er)}$		11		pF	$V_{GS} = 0V$, $V_{DS} = 0 \dots 480V$
Effective output capacitance, time related ²⁾	$C_{o(tr)}$		41.3		pF	$I_D = \text{constant}$, $V_{GS} = 0V$, $V_{DS} = 0 \dots 480V$
Turn-on delay time	$t_{d(on)}$		8		ns	$V_{DD} = 480V$, $V_{GS} = 10V$, $I_D = 1.4A$, $R_G = 12.2\Omega$ (see table 17)
Rise time	t_r		7		ns	
Turn-off delay time	$t_{d(off)}$		40		ns	
Fall time	t_f		20		ns	

Table 6 Gate charge characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Gate to source charge	Q_{gs}		1.1		nC	$V_{DD} = 480V$, $I_D = 1.4A$, $V_{GS} = 0 \text{ to } 10V$
Gate to drain charge	Q_{gd}		5		nC	
Gate charge total	Q_g		9.4		nC	
Gate plateau voltage	$V_{plateau}$		5.4		V	

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}		0.9		V	$V_{GS} = 0V, I_F = 1.4A, T_j = 25^\circ C$
Reverse recovery time	t_{rr}		230		ns	$V_R = 400V, I_F = 1.4A,$ $di_F/dt = 100A/\mu s$ (see table 16)
Reverse recovery charge	Q_{rr}		1.1		μC	
Peak reverse recovery current	I_{rrm}		9.8		A	

5 Electrical characteristics diagrams

Table 8

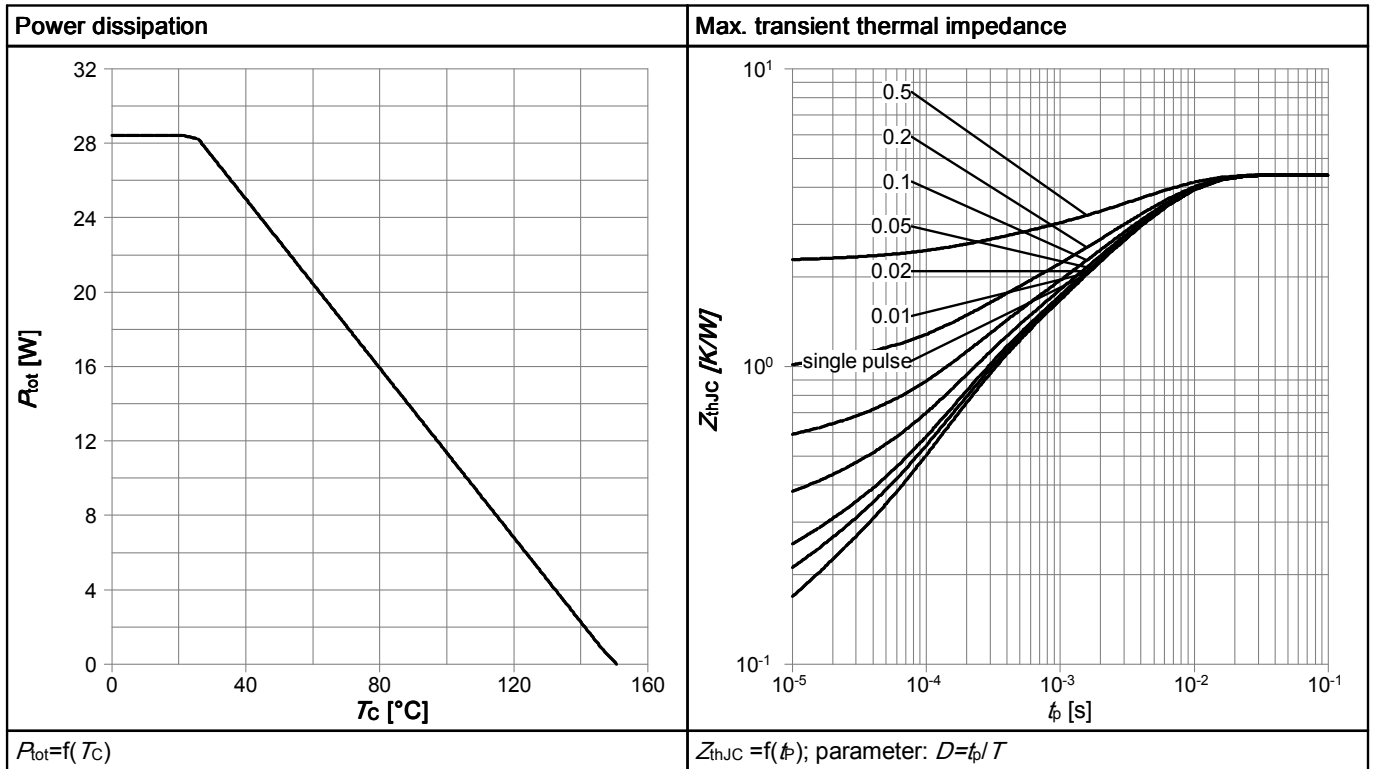


Table 9

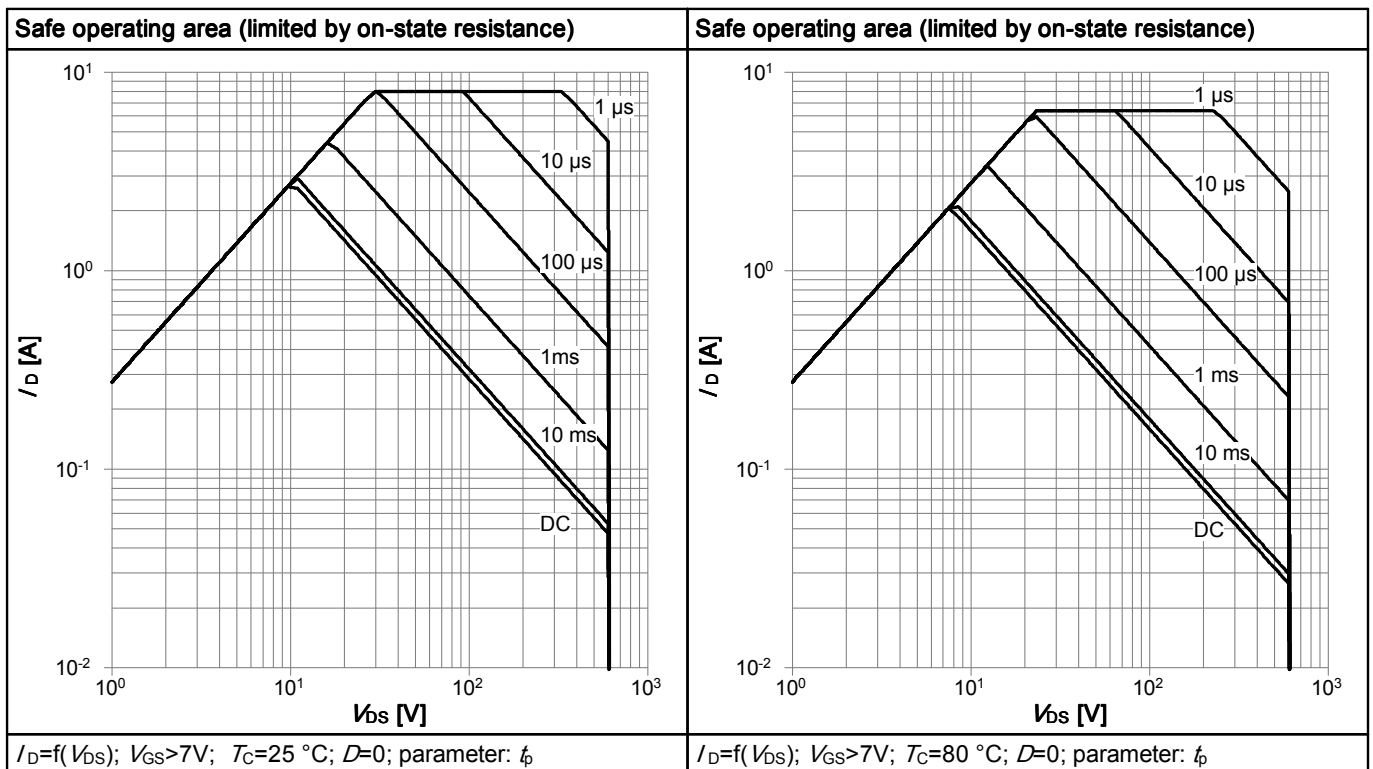


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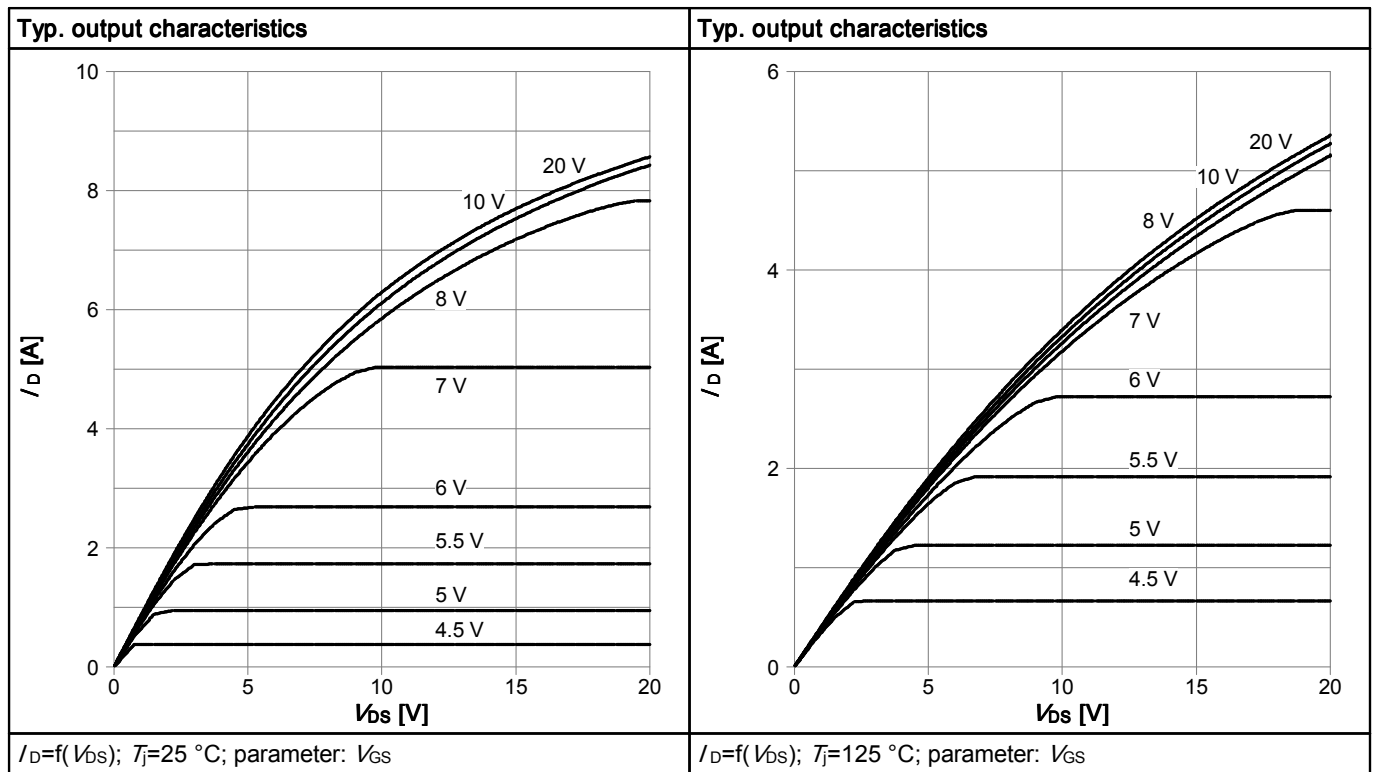


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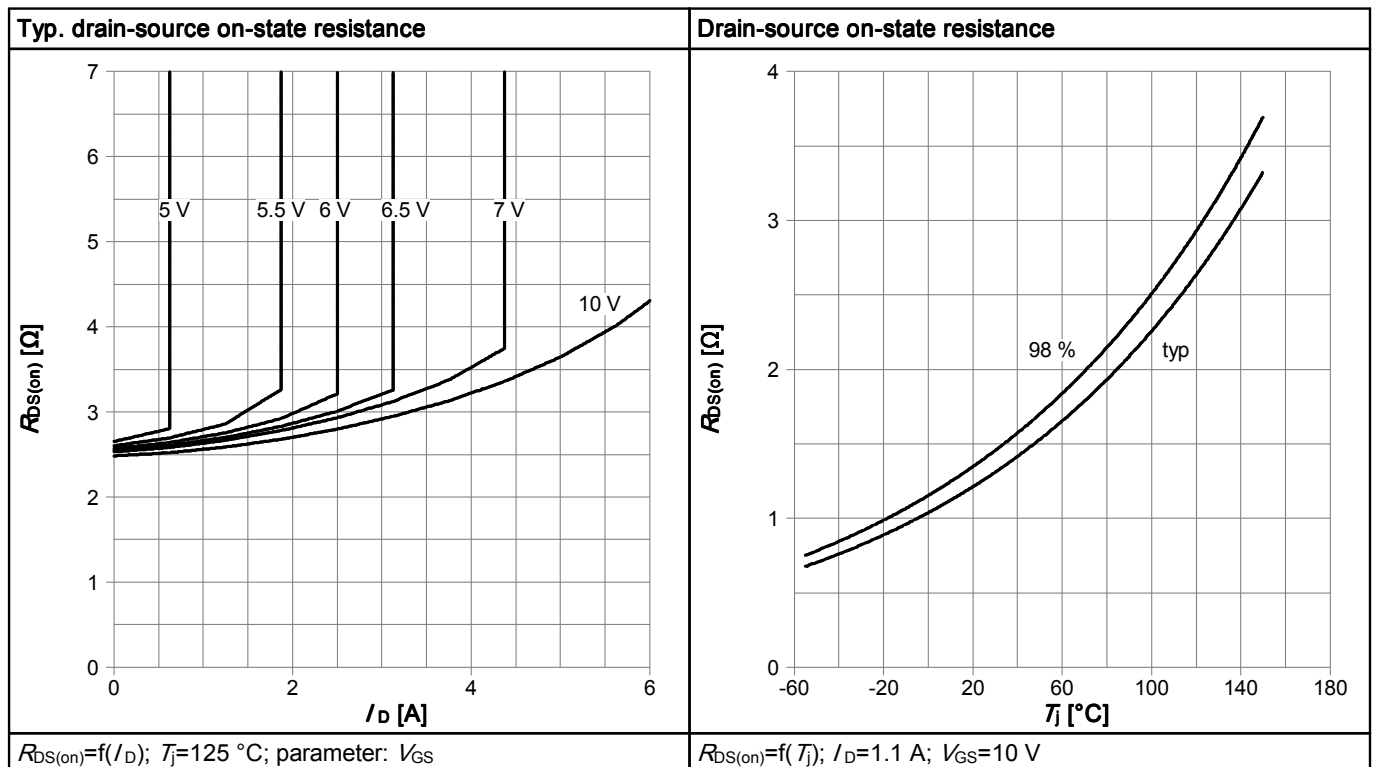


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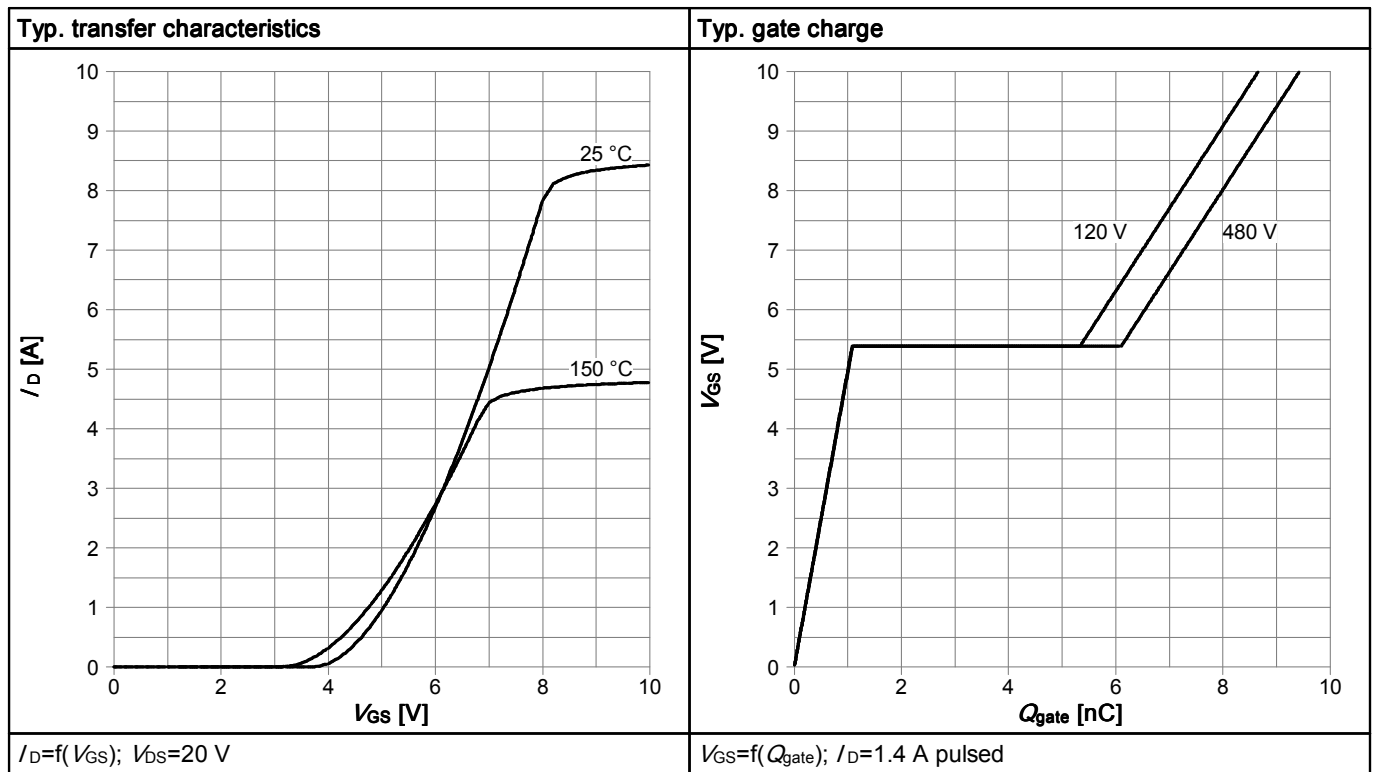


Table 13

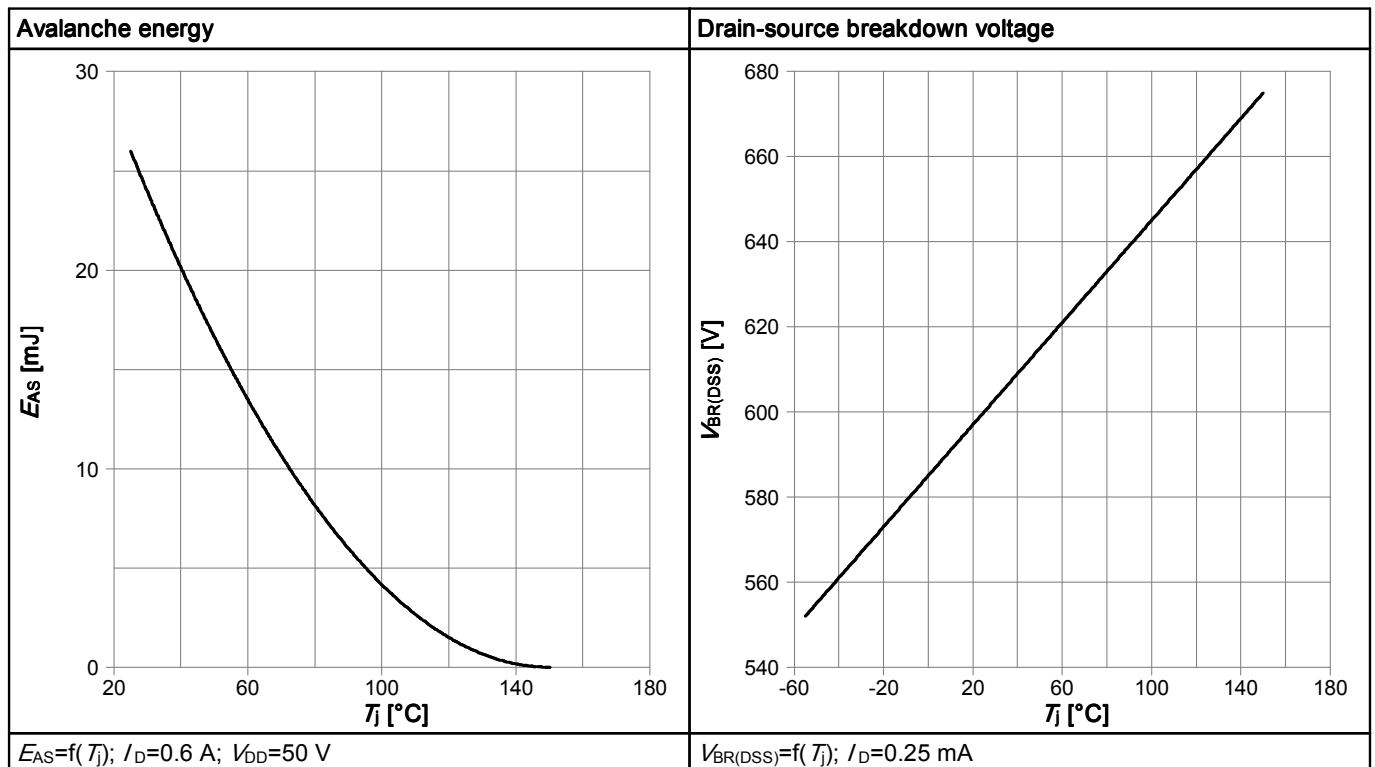


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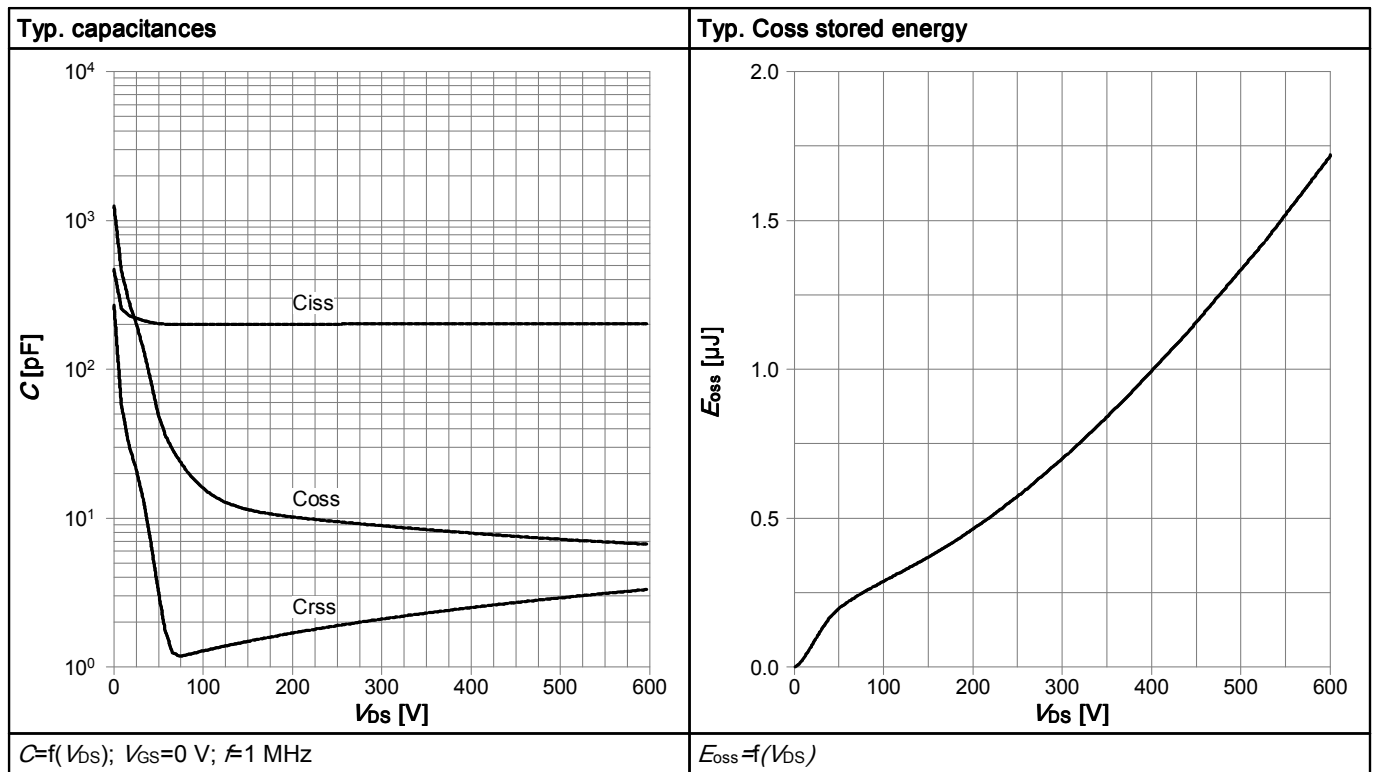
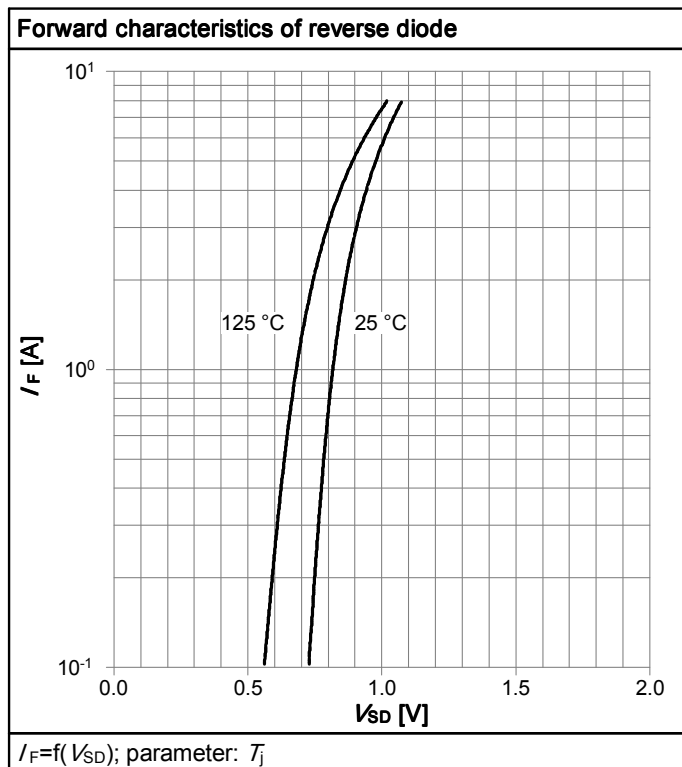


Table 15



6 Test Circuits

Table 16 Diode characteristics

Test circuit for diode characteristics	Diode recovery waveform
 $R_{G1} = R_{G2}$	 $t_{rr} = t_s + t_f$ $Q_{rr} = Q_s + Q_f$

Table 17 Switching times

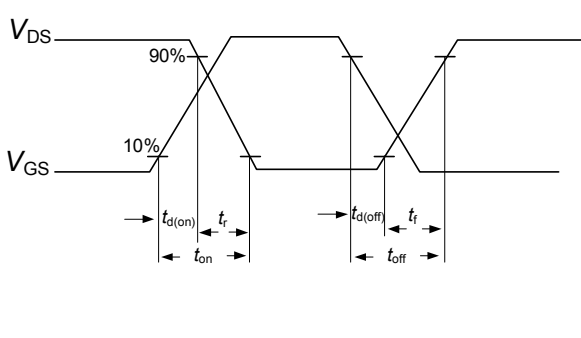
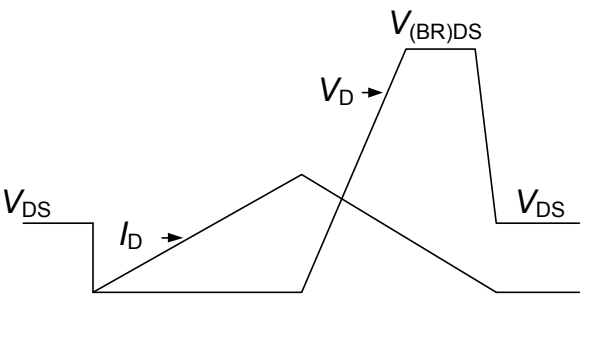
Switching times test circuit for inductive load	Switching times waveform
	

Table 18 Unclamped inductive

Unclamped inductive load test circuit	Unclamped inductive waveform
	

7 Package Outlines

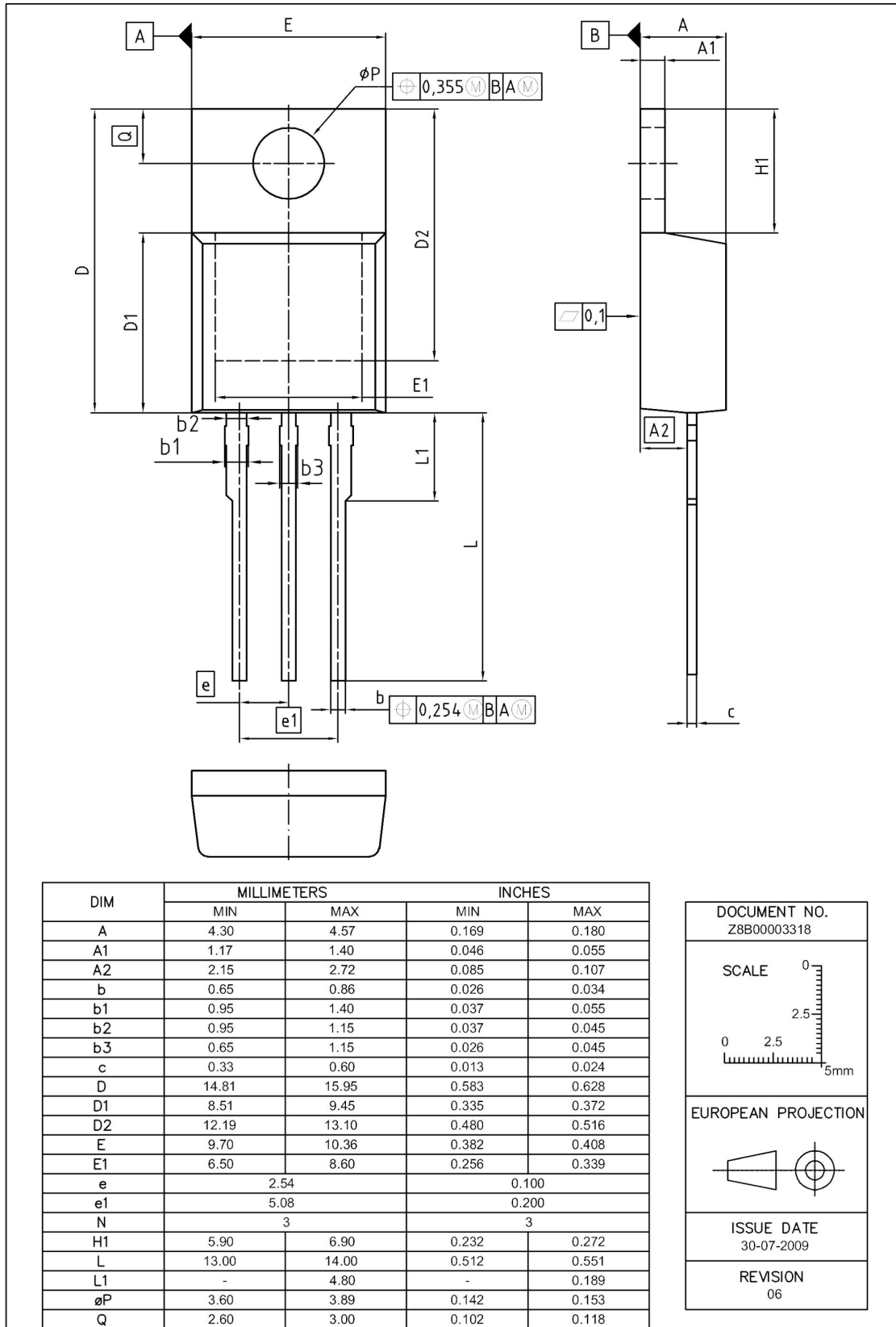


Figure 1 Outline PG-TO 220, dimensions in mm/inches

8 Appendix A

Table 19 Related Links

- **IFX C6 Product Brief:**

<http://www.infineon.com/dgdl/Product+Brief+600V+CoolMOS+C6+.pdf?folderId=db3a3043156fd5730115939eb6b506db>

- **IFX C6 Portfolio:**

http://www.infineon.com/cms/en/product/findProductTypeByName.html?q=ip*c6

- **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

IPP60R1K4C6

Revision: 2012-02-02, Rev. 2.0

Previous Revision

Revision	Date	Subjects (major changes since last revision)
2.0	2012-02-02	Final datasheet release

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Any information within this document that you feel is wrong, unclear or missing at all? Your feedback will help us to continuously improve the quality of this document. Please send your proposal (including a reference to this document) to: erratum@infineon.com

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