

MOSFET

Metal Oxide Semiconductor Field Effect Transistor

CoolMOS™ C6 650V

650V CoolMOS™ C6 Power Transistor
IPx65R099C6

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, UPS and Solar.

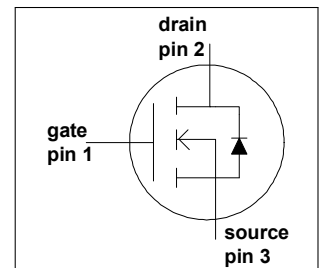
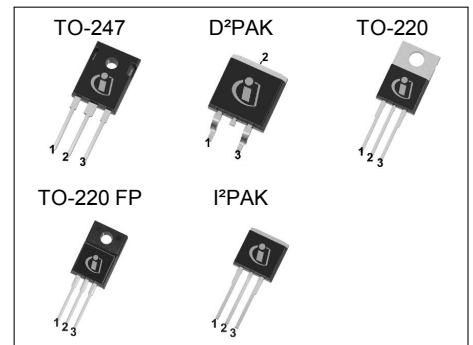


Table 1 Key Performance Parameters

Parameter	Value	Unit
$V_{DS} @ T_{j \max}$	700	V
$R_{DS(on),max}$	0.099	Ω
Q_g, typ	127	nC
$I_D, pulse$	115	A
$E_{oss} @ 400V$	10	μJ
Body diode di/dt	300	A/ μs

Type / Ordering Code	Package	Marking	Related Links
IPW65R099C6	PG-TO 247	65C6099	see Appendix A
IPB65R099C6	PG-TO 263		
IPP65R099C6	PG-TO 220		
IPA65R099C6	PG-TO 220 FullPAK		
IPI65R099C6	PG-TO 262		

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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			38.0	A	$T_C = 25^\circ\text{C}$
				24.0		$T_C = 100^\circ\text{C}$
Pulsed drain current ²⁾	$I_{D,pulse}$			115	A	$T_C = 25^\circ\text{C}$
Avalanche energy, single pulse	E_{AS}			845	mJ	$I_D = 6.6\text{A}$, $V_{DS} = 50\text{V}$
Avalanche energy, repetitive	E_{AR}			1.28	mJ	$I_D = 6.6\text{A}$, $V_{DS} = 50\text{V}$
Avalanche current, repetitive	I_{AR}			6.6	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-247, TO-220, I ² PAK	P_{tot}			278.0	W	$T_C = 25^\circ\text{C}$
Power dissipation (FullPAK) TO-220 FP	P_{tot}			35.0	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-247, TO-220, I ² PAK				60	Ncm	M3 and M3.5 screws
Mounting torque (FullPAK) TO-220 FP				50	Ncm	M2.5 screws
Continuous diode forward current	I_S			33.0	A	$T_C = 25^\circ\text{C}$
Diode pulse current	$I_{S,pulse}$			115	A	$T_C = 25^\circ\text{C}$
Reverse diode dv/dt ³⁾	dv/dt			15	V/ns	$V_{DS} = 0 \dots 480\text{V}$, $I_{SD} \leq I_D$, $T_j = 25^\circ\text{C}$
Maximum diode commutation speed	di _f /dt			300	A/ μs	

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

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

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

3 Thermal characteristics

Table 3 Thermal characteristics TO-247, TO-220, I²PAK

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Thermal resistance, junction - case	R_{thJC}			0.45	°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

Table 4 Thermal characteristics TO-220 FP

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Thermal resistance, junction - case	R_{thJC}			3.6	°C/W	
Thermal resistance, junction - ambient	R_{thJA}			80	°C/W	leaded
Soldering temperature, wavesoldering only allowed at leads	T_{sold}			260	°C	1.6 mm (0.063 in.) from case for 10s

Table 5 Thermal characteristics D²PAK

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Thermal resistance, junction - case	R_{thJC}			0.45	°C/W	
Thermal resistance, junction - ambient ¹⁾	R_{thJA}			62	°C/W	SMD version, device on PCB, minimal footprint
			35			SMD version, device on PCB, 6cm ² cooling area
Soldering temperature, wave- & reflowsoldering allowed	T_{sold}			260	°C	reflow MSL

¹⁾ Device on 40mm*40mm*1.5mm one layer epoxy PCB FR4 with 6cm² copper area (thickness 70µm) for drain connection. PCB is vertical without air stream cooling.

4 Electrical characteristics

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

Table 6 Static characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Drain-source breakdown voltage	$V_{(BR)DSS}$	650			V	$V_{GS} = 0V$, $I_D = 1mA$
Gate threshold voltage	$V_{GS(th)}$	2.5	3	3.5	V	$V_{DS} = V_{GS}$, $I_D = 1.2mA$
Zero gate voltage drain current	I_{DSS}			1	μA	$V_{DS} = 650V$, $V_{GS} = 0V$, $T_j = 25^\circ\text{C}$
			10			$V_{DS} = 650V$, $V_{GS} = 0V$, $T_j = 150^\circ\text{C}$
Gate-source leakage current	I_{GSS}			100	nA	$V_{GS} = 20V$, $V_{DS} = 0V$
Drain-source on-state resistance	$R_{DS(on)}$		0.089	0.099	Ω	$V_{GS} = 10V$, $I_D = 12.8A$, $T_j = 25^\circ\text{C}$
			0.231			$V_{GS} = 10V$, $I_D = 12.8A$, $T_j = 150^\circ\text{C}$
Gate resistance	R_G		1.7		Ω	$f = 1MHz$, open drain

Table 7 Dynamic characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Input capacitance	C_{iss}		2780		pF	$V_{GS} = 0V$, $V_{DS} = 100V$, $f = 1MHz$
Output capacitance	C_{oss}		142		pF	
Effective output capacitance, energy related ¹⁾	$C_{o(er)}$		110		pF	$V_{GS} = 0V$, $V_{DS} = 0 \dots 480V$
Effective output capacitance, time related ²⁾	$C_{o(tr)}$		525		pF	$I_D = \text{constant}$, $V_{GS} = 0V$, $V_{DS} = 0 \dots 480V$
Turn-on delay time	$t_{d(on)}$		10.6		ns	$V_{DD} = 480V$, $V_{GS} = 13V$, $I_D = 19.2A$, $R_G = 1.7\Omega$ (see table 21)
Rise time	t_r		9		ns	
Turn-off delay time	$t_{d(off)}$		77		ns	
Fall time	t_f		6		ns	

Table 8 Gate charge characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Gate to source charge	Q_{gs}		15		nC	$V_{DD} = 480V$, $I_D = 19.2A$, $V_{GS} = 0 \text{ to } 10V$
Gate to drain charge	Q_{gd}		65		nC	
Gate charge total	Q_g		127		nC	
Gate plateau voltage	$V_{plateau}$		5.5		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 9 Reverse diode characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Diode forward voltage	V_{SD}		0.9		V	$V_{GS} = 0V, I_F = 19.2A, T_j = 25^{\circ}C$
Reverse recovery time	t_{rr}		615		ns	$V_R = 400V, I_F = 19.2A,$ $di_F/dt = 100A/\mu s$ (see table 20)
Reverse recovery charge	Q_{rr}		14.8		μC	
Peak reverse recovery current	I_{rrm}		46		A	

5 Electrical characteristics diagrams

Table 10

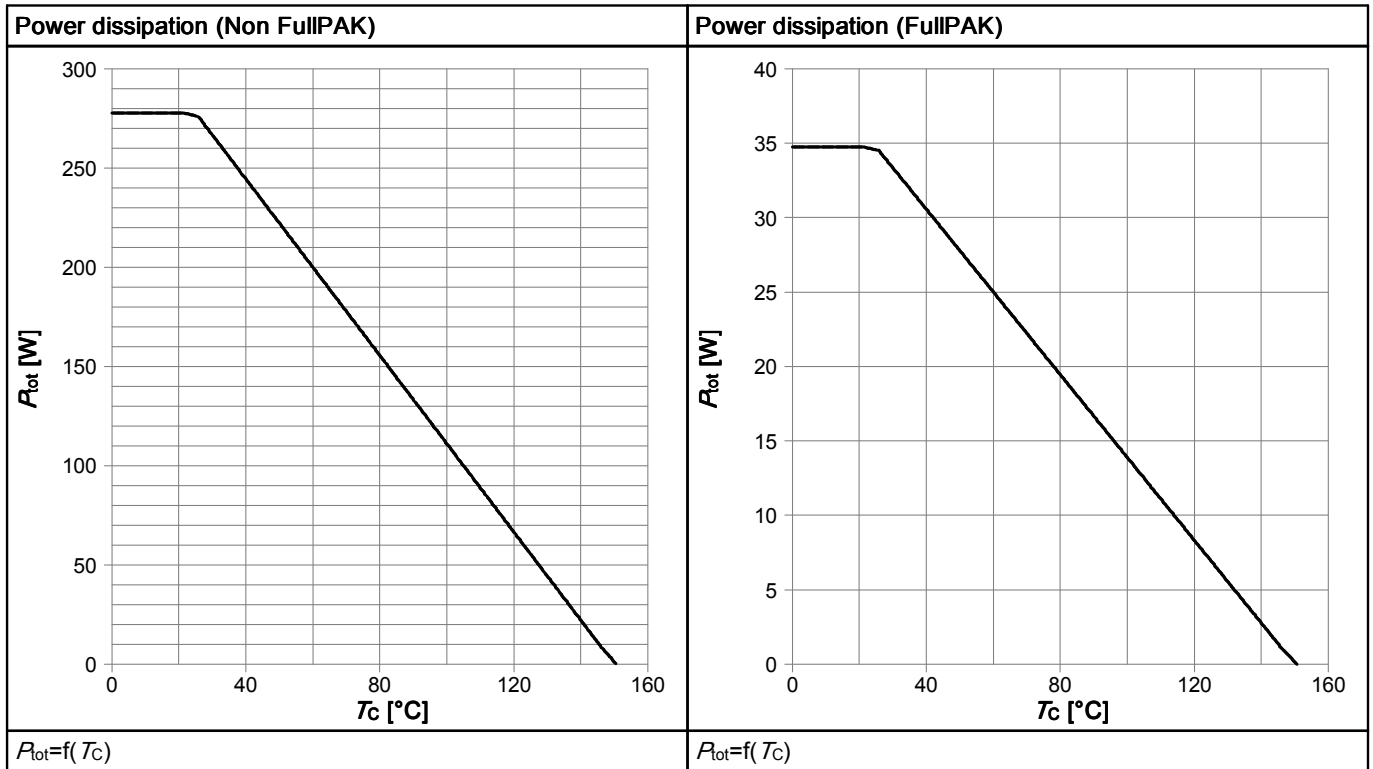


Table 11

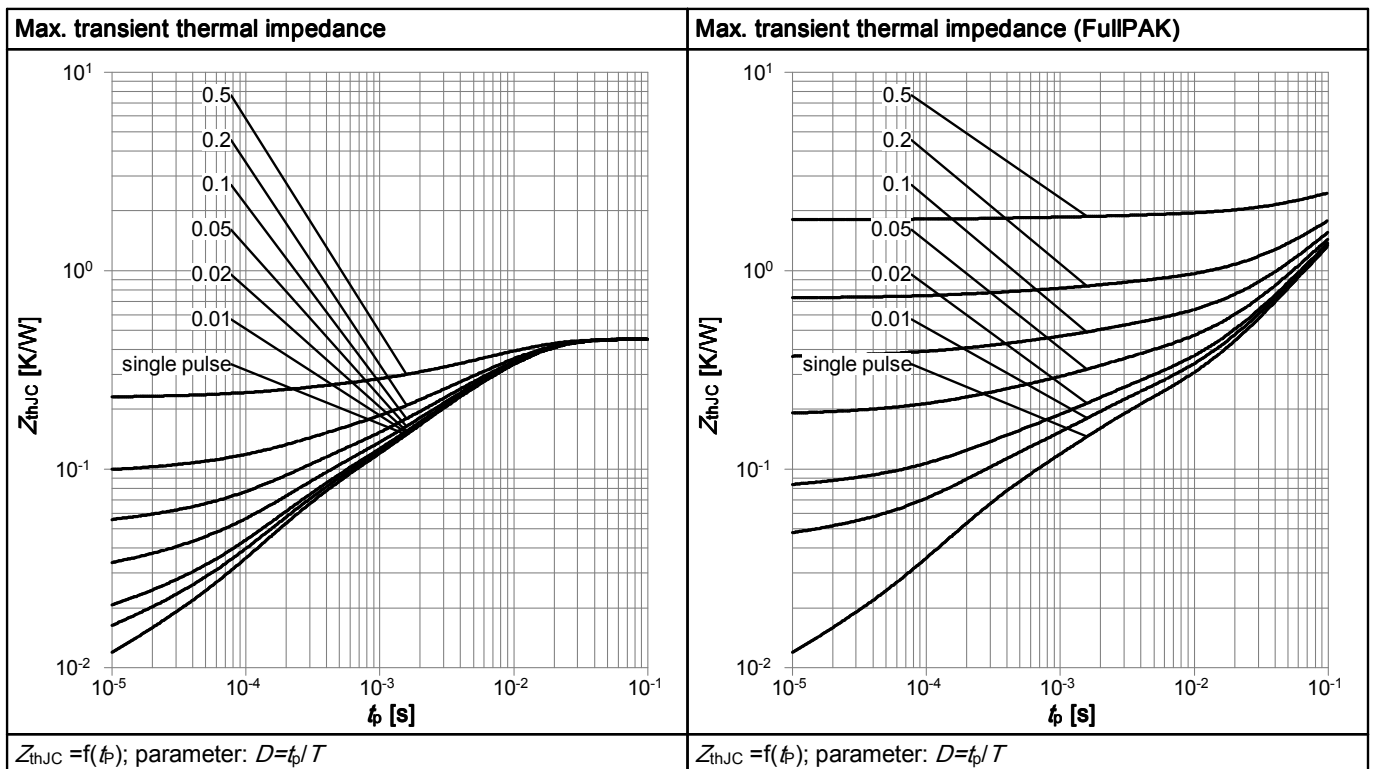


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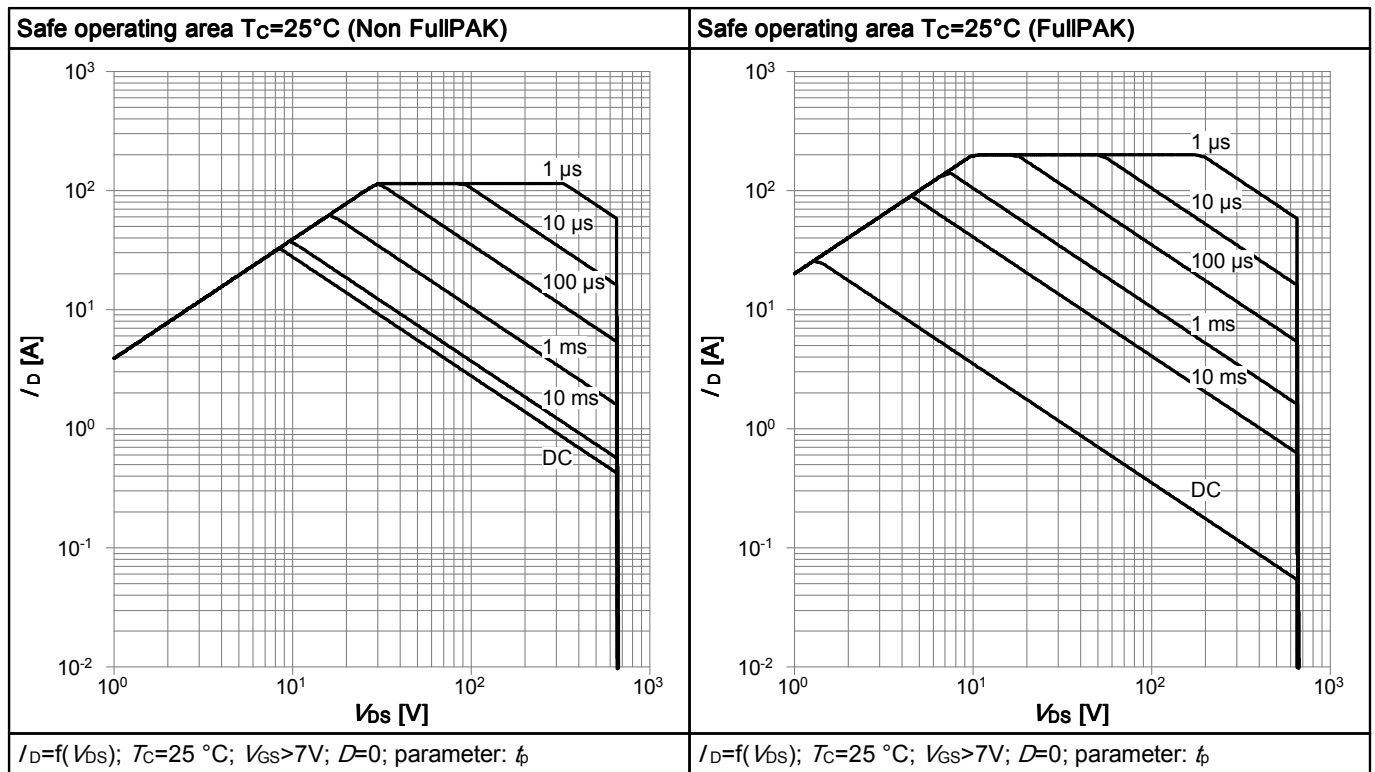


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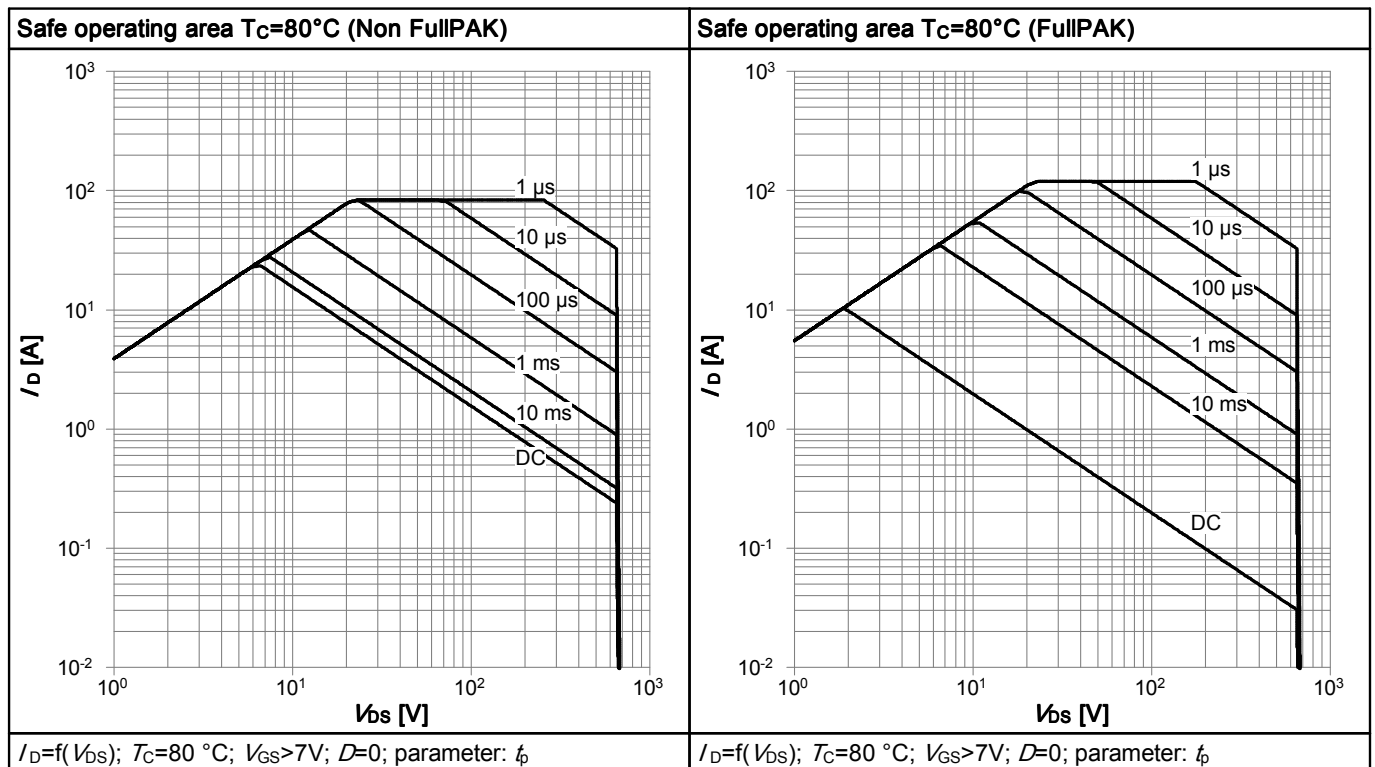


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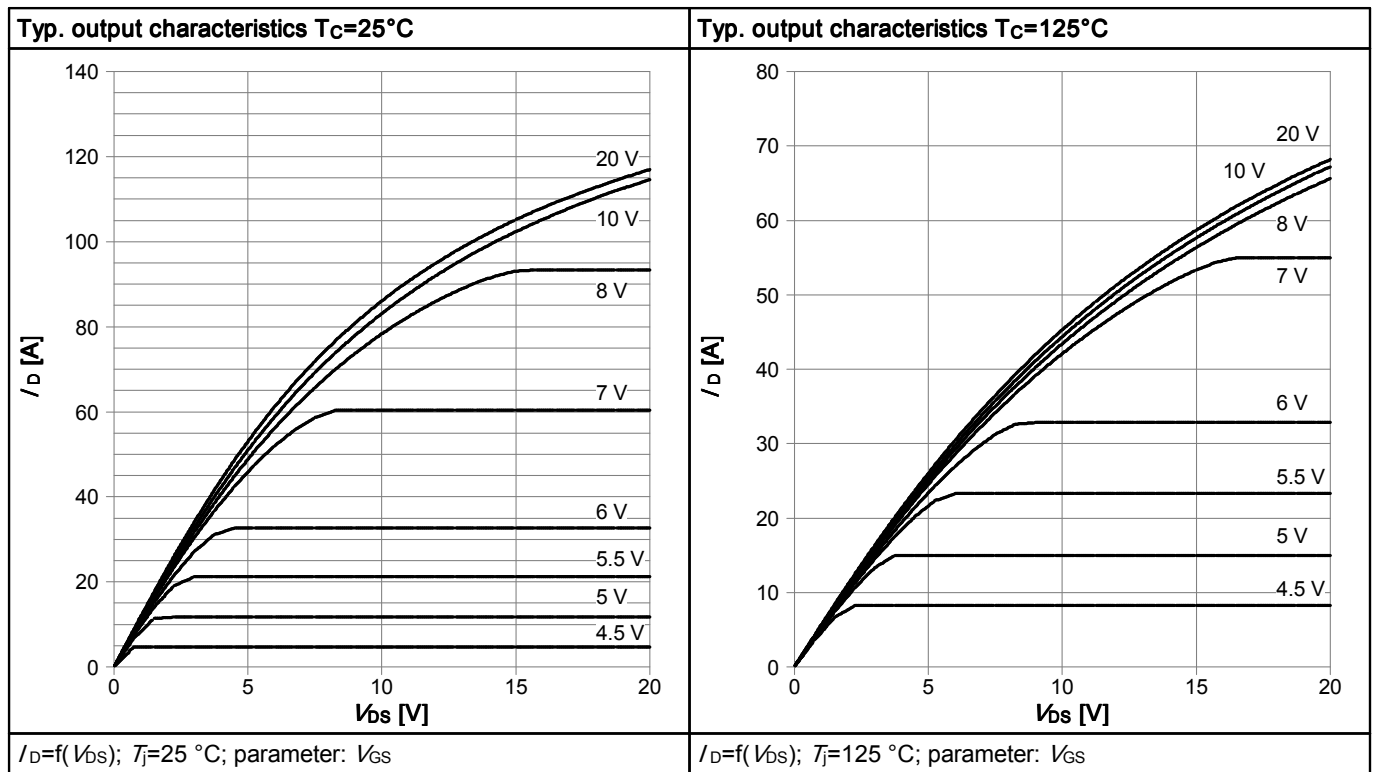


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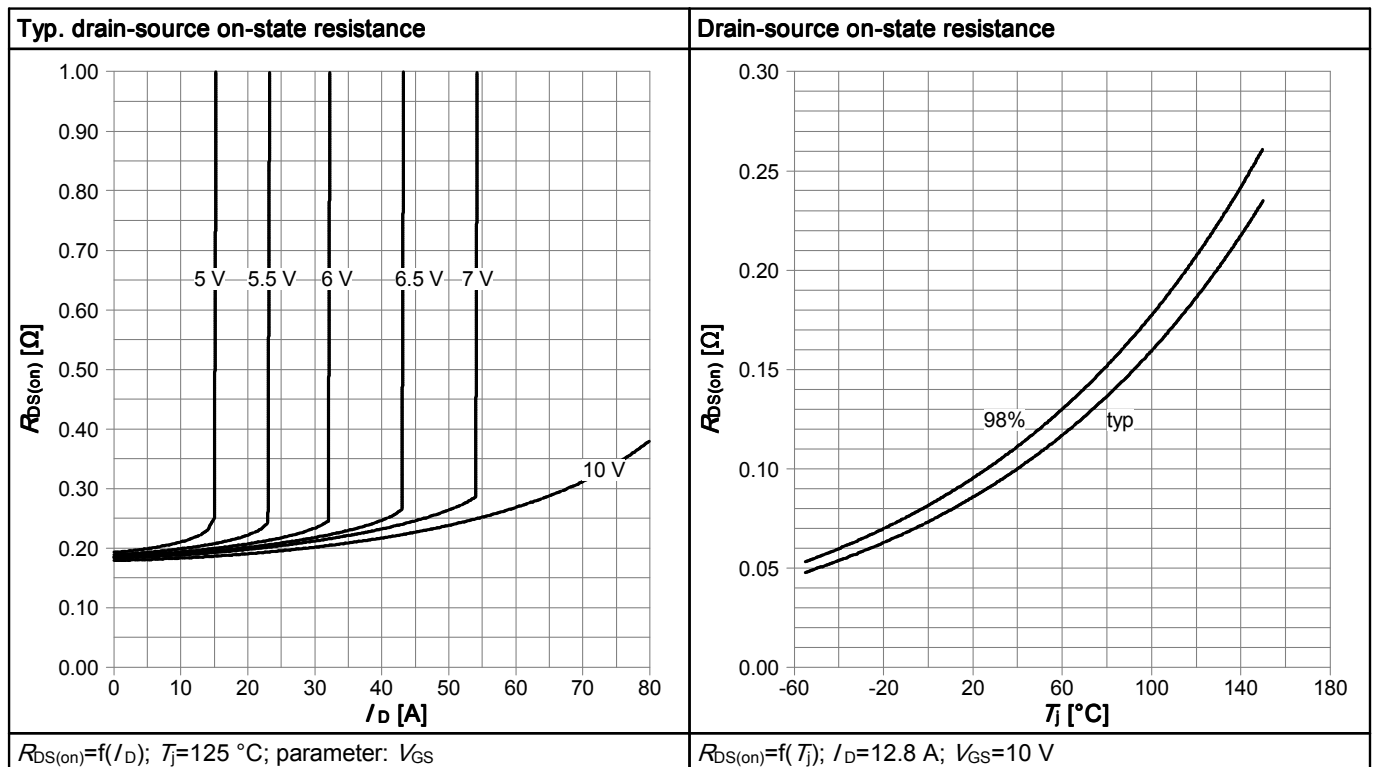


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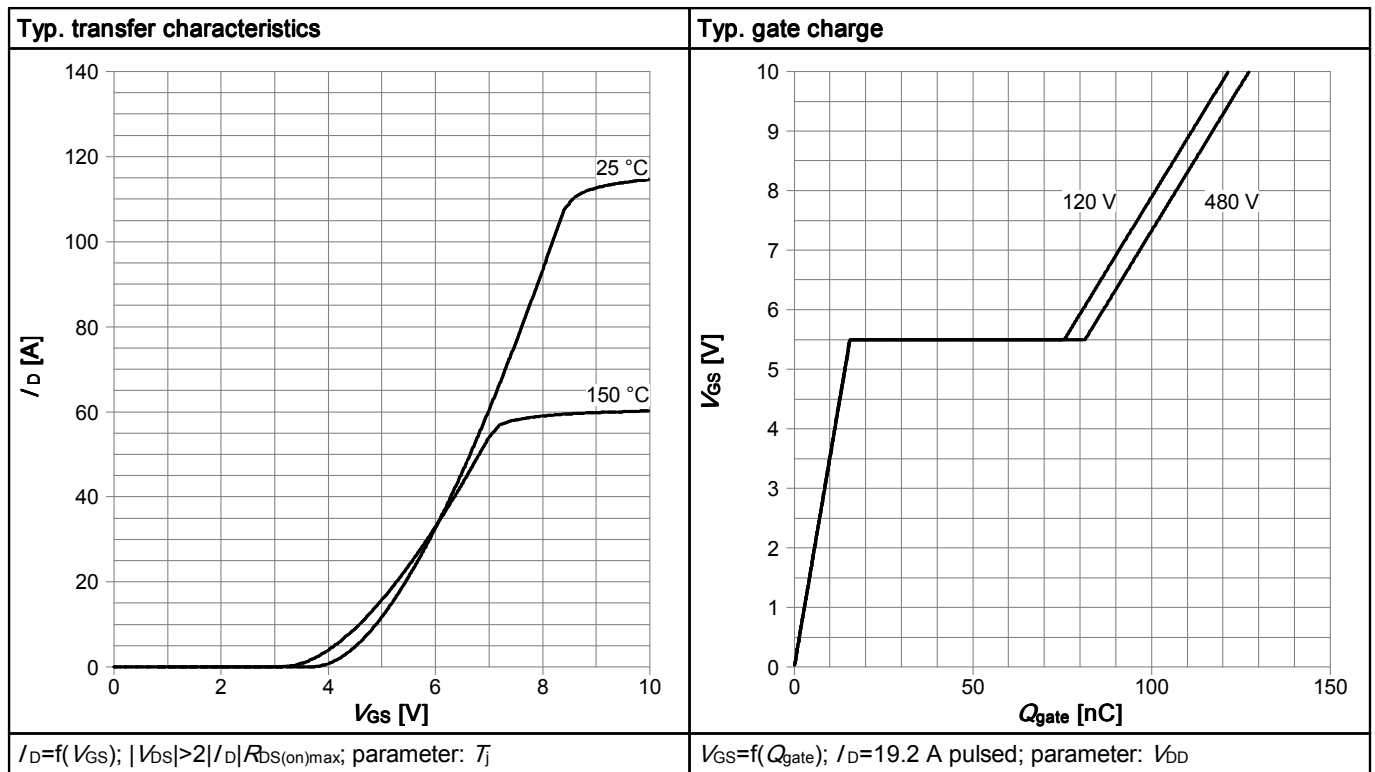


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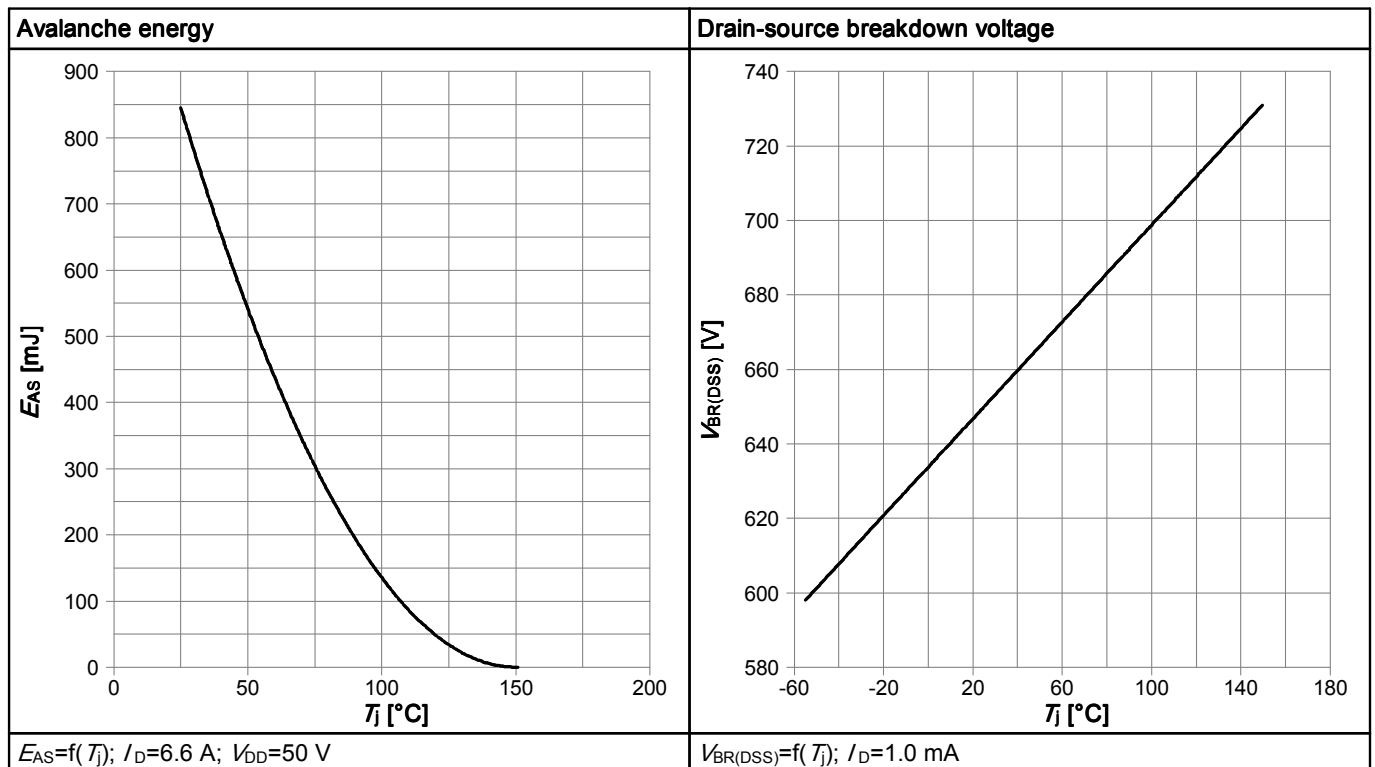


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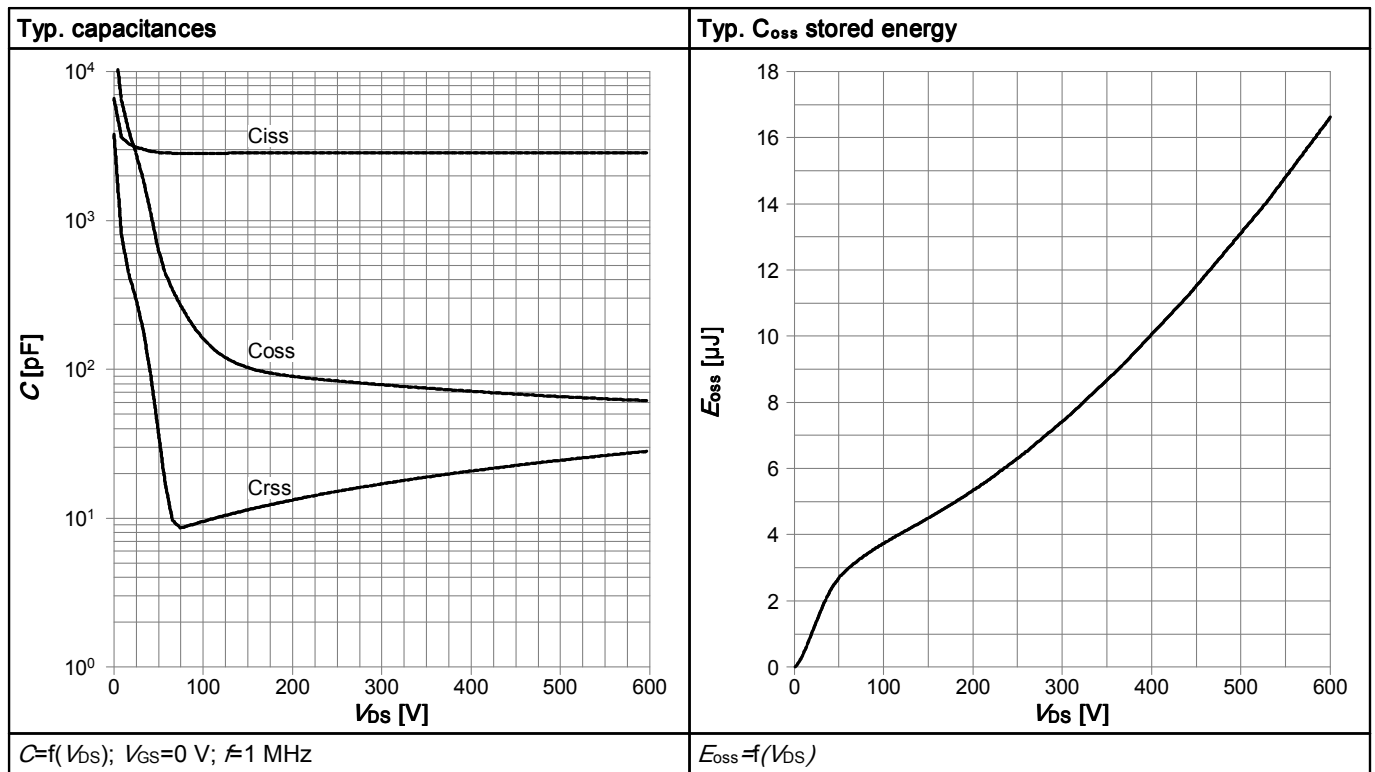
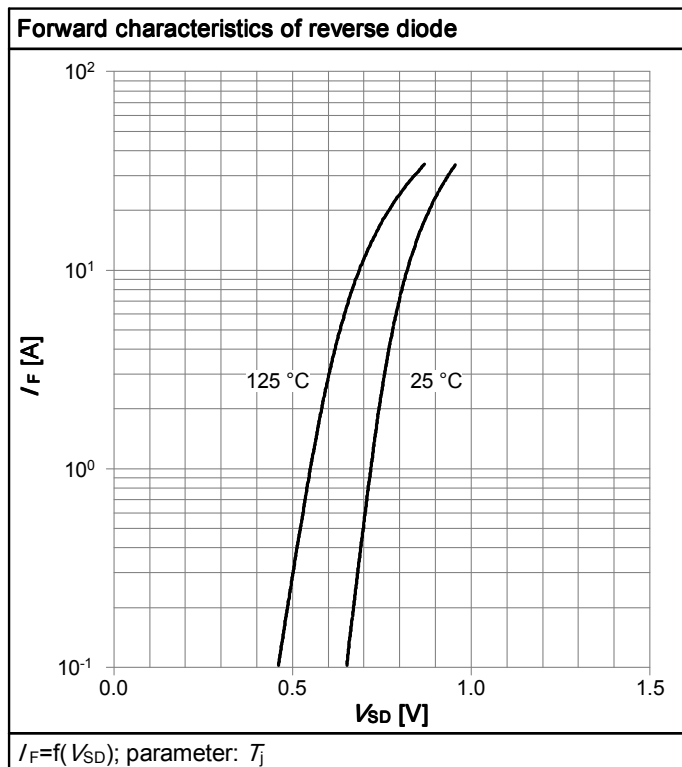


Table 19



6 Test Circuits

Table 20 Diode characteristics

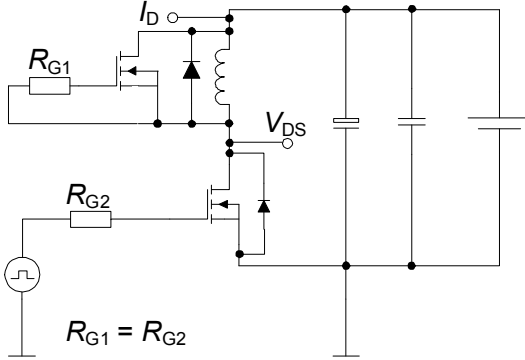
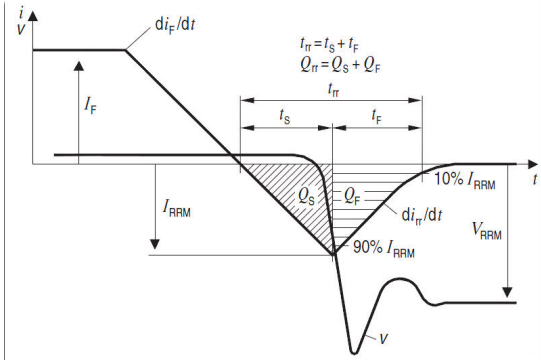
Test circuit for diode characteristics	Diode recovery waveform
	

Table 21 Switching times

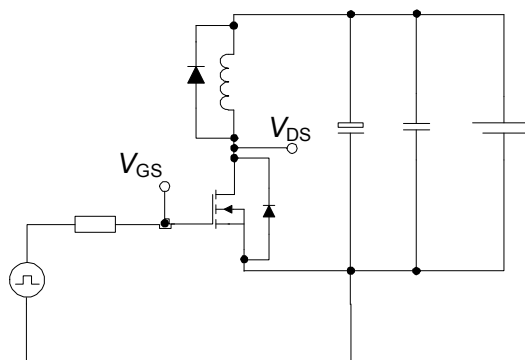
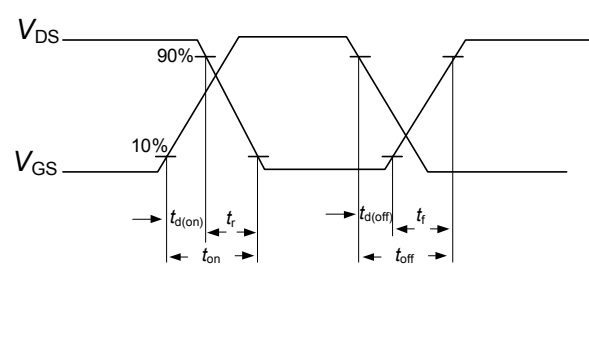
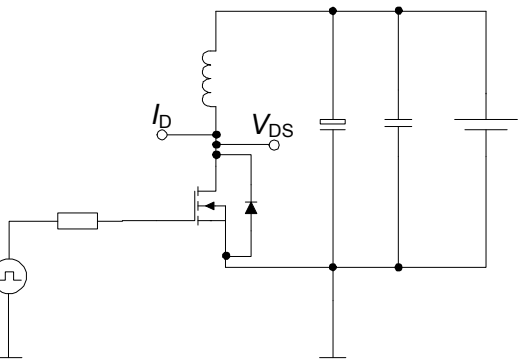
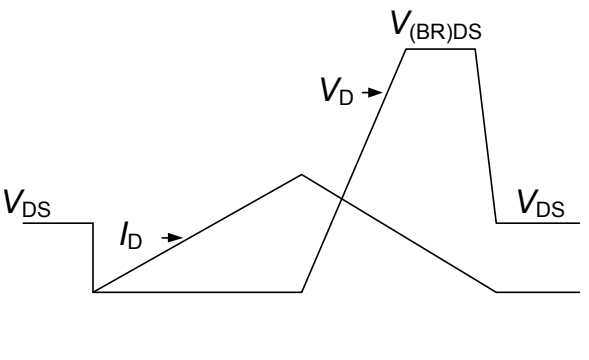
Switching times test circuit for inductive load	Switching times waveform
	

Table 22 Unclamped inductive

Unclamped inductive load test circuit	Unclamped inductive waveform
	

7 Package Outlines

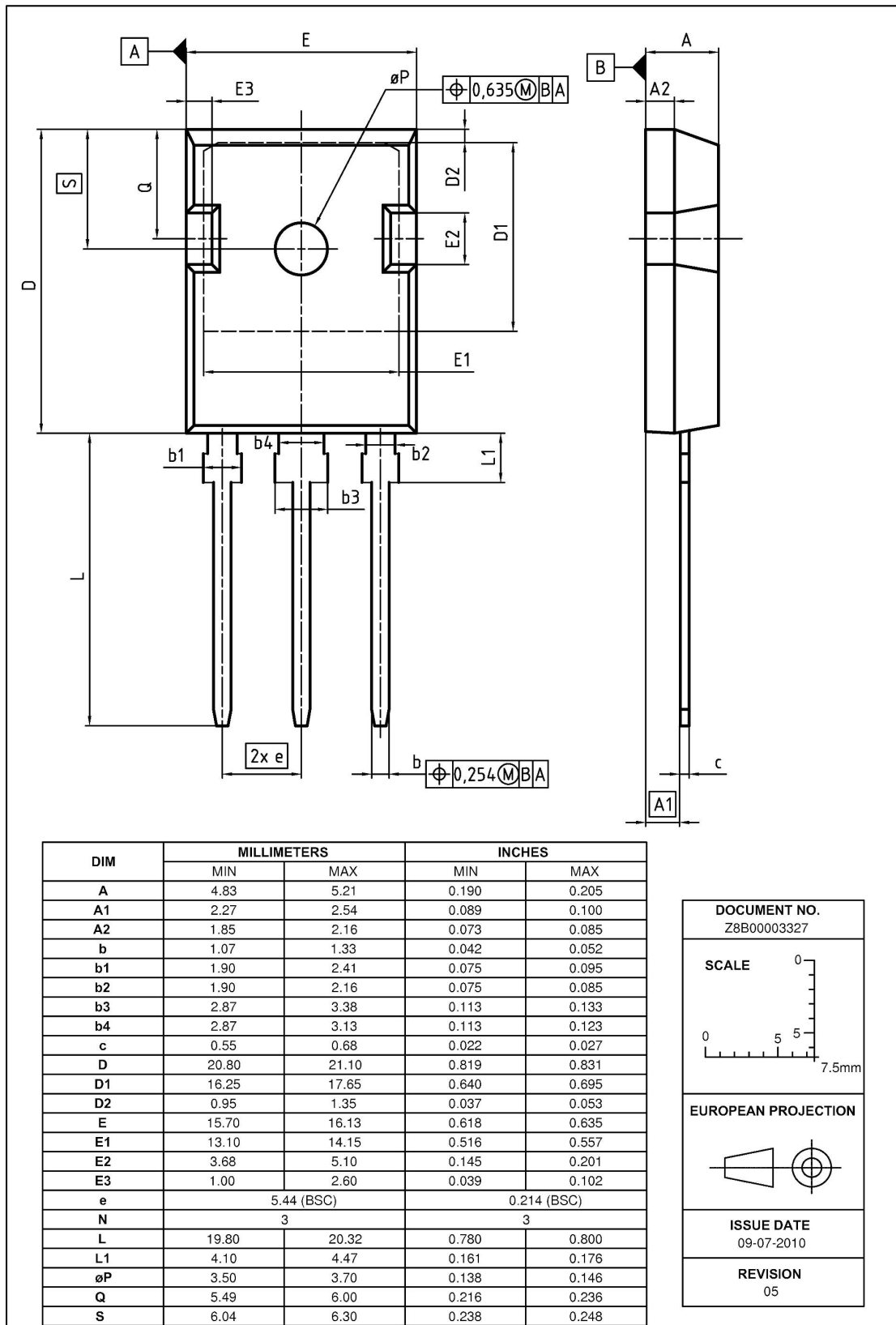


Figure 1 Outline PG-TO 247, dimensions in mm/inches

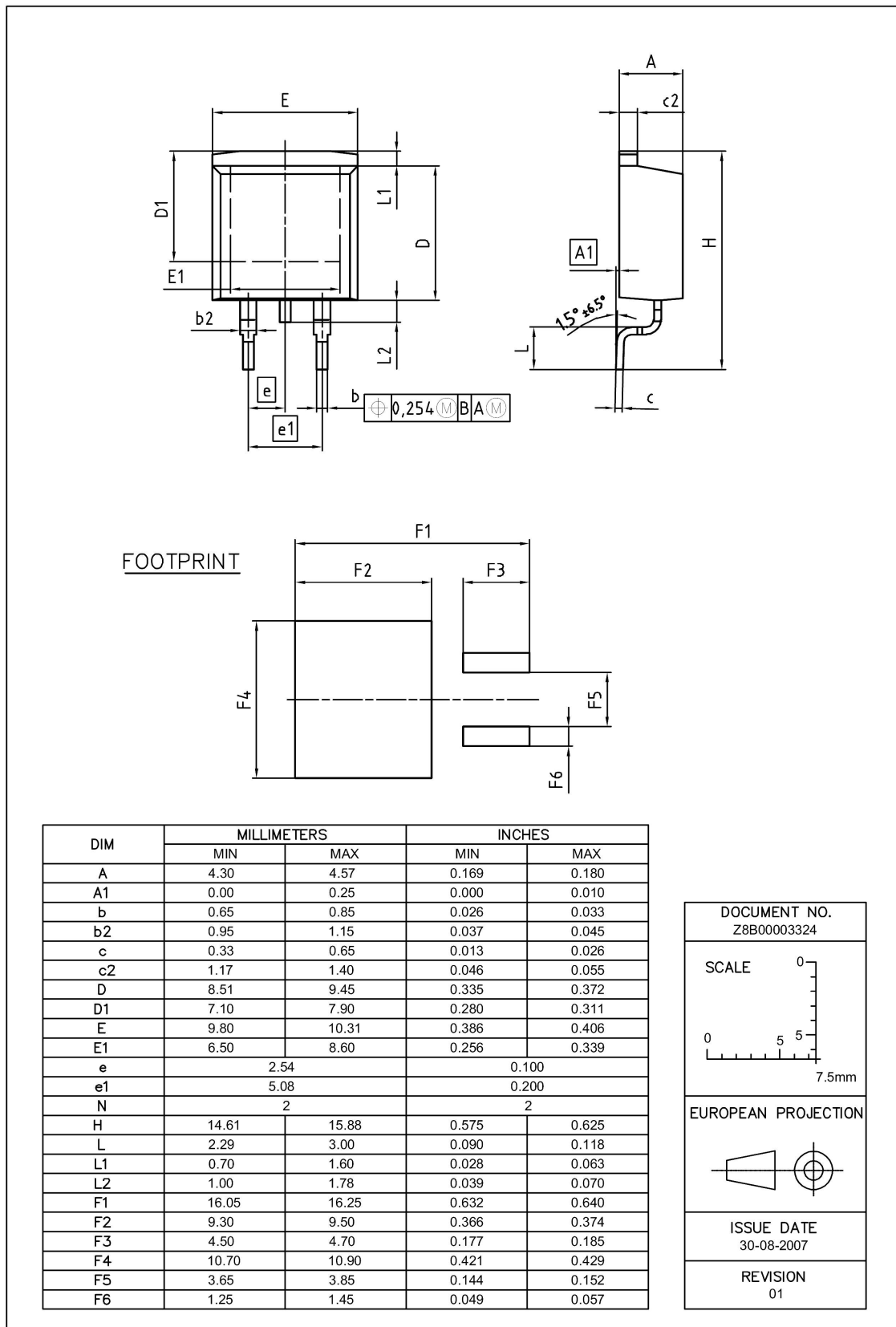


Figure 2 Outline PG-TO 263, dimensions in mm/inches

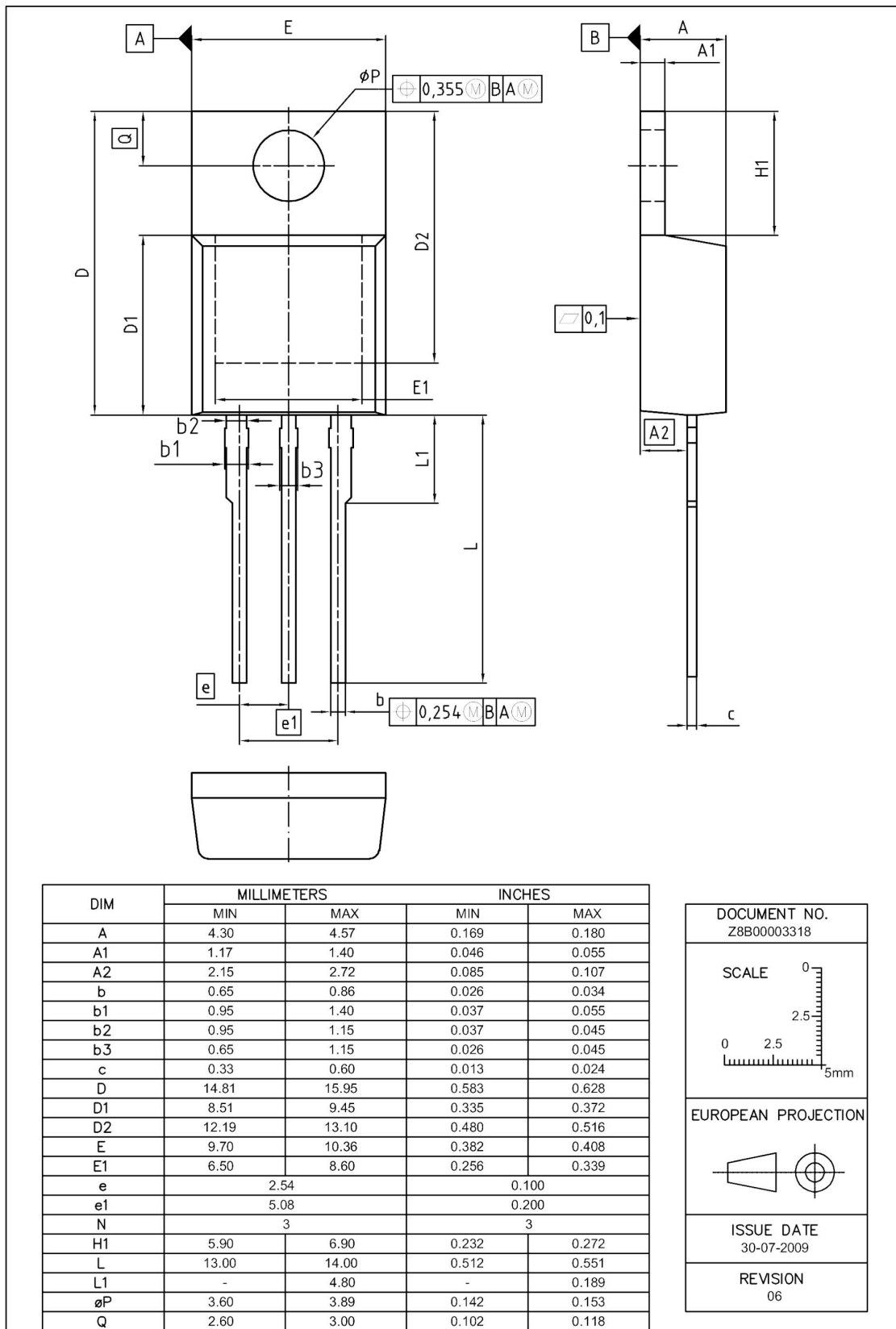


Figure 3 Outline PG-TO 220, dimensions in mm/inches

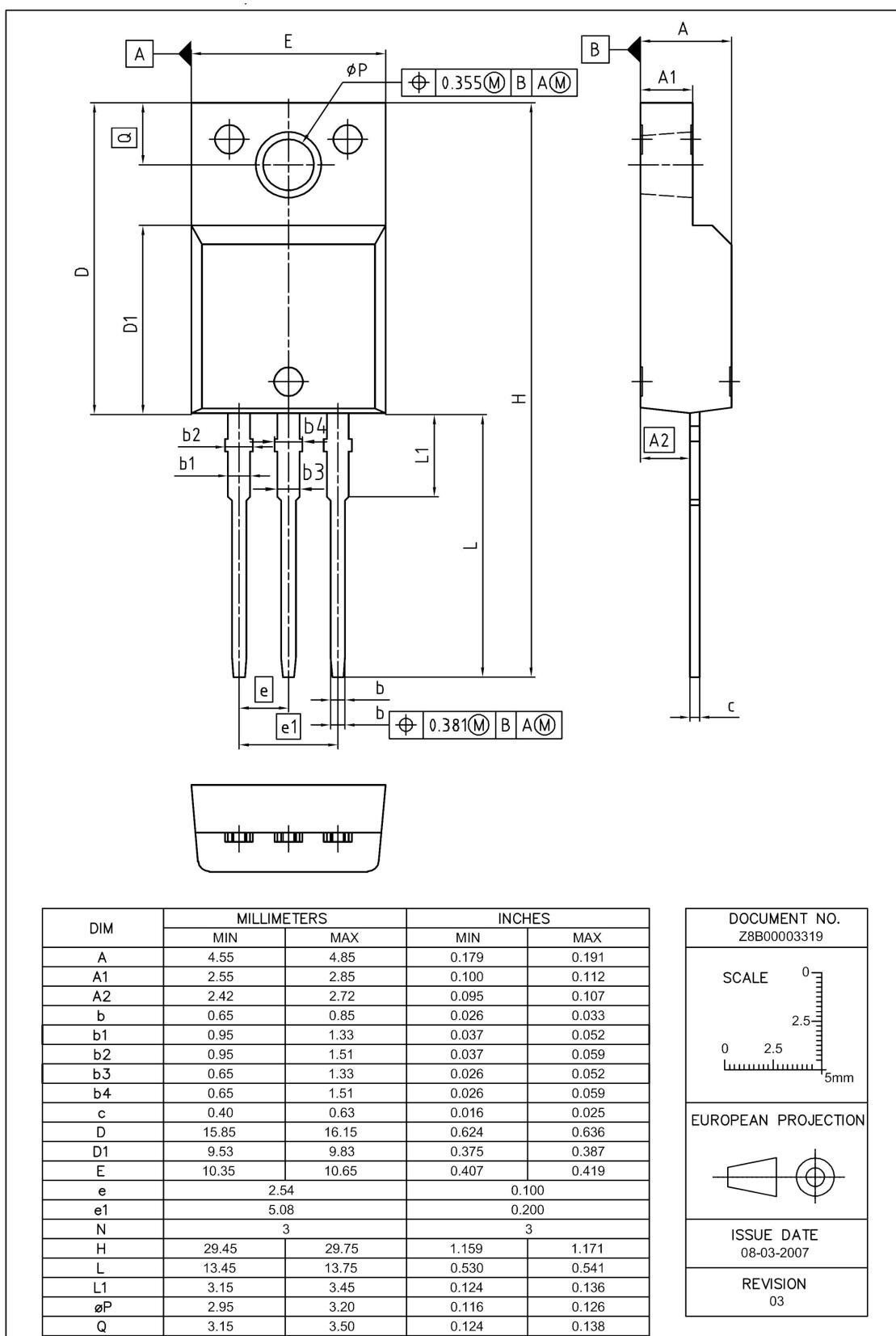


Figure 4 Outline PG-TO 220 FullPAK, dimensions in mm/inches

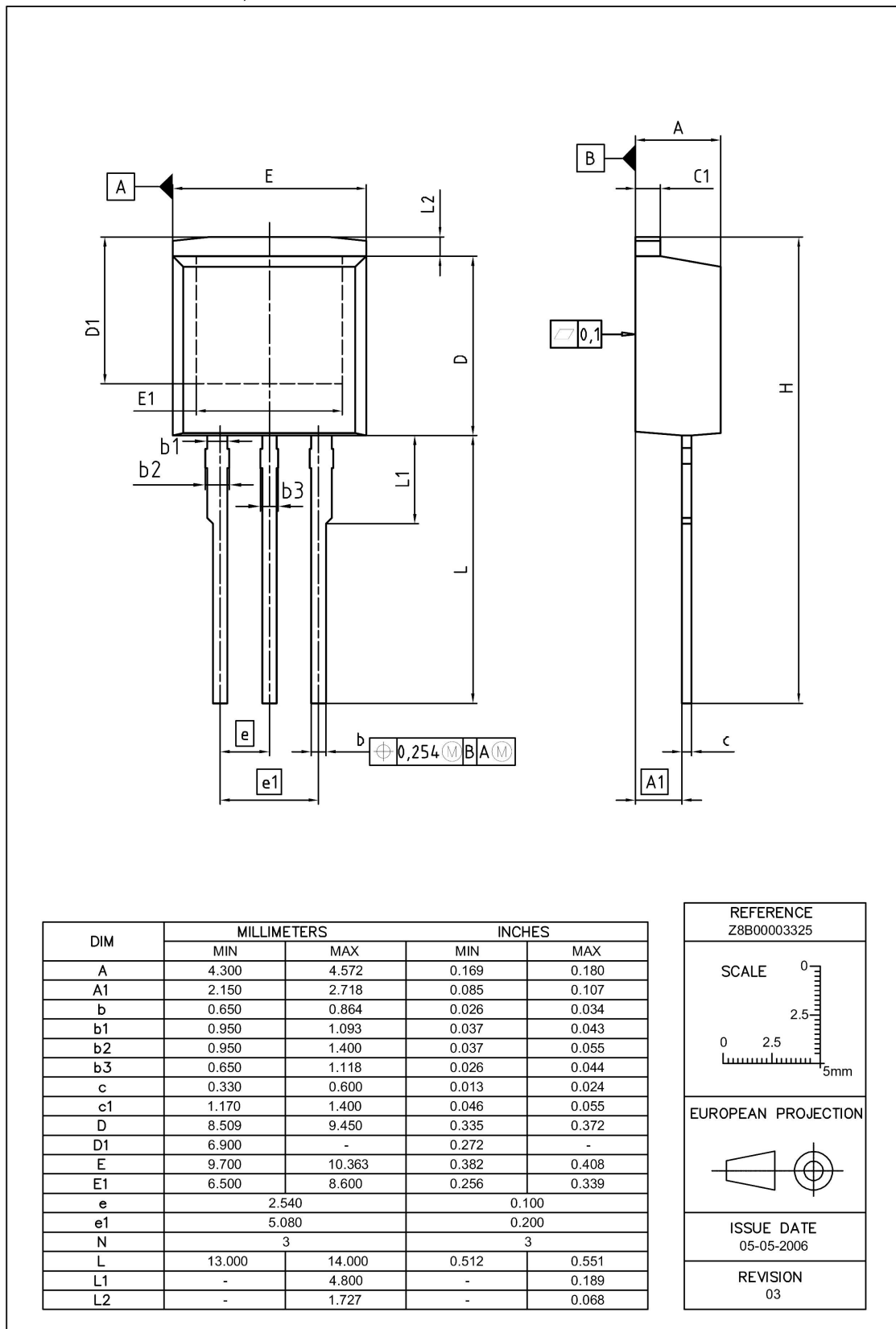


Figure 5 Outline PG-TO 262, dimensions in mm/inches

8 Appendix A

Table 23 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

IPW65R099C6, IPB65R099C6, IPP65R099C6, IPA65R099C6, IPI65R099C6

Revision: 2011-12-14, Rev. 2.0

Previous Revision

Revision	Date	Subjects (major changes since last revision)
1.0	2011-12-14	Release of final datasheet
2.0	2011-12-14	Release of final datasheet

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