

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.

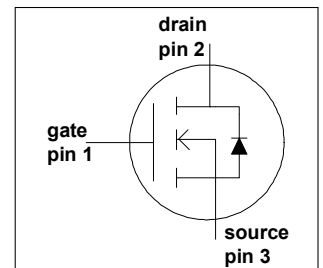
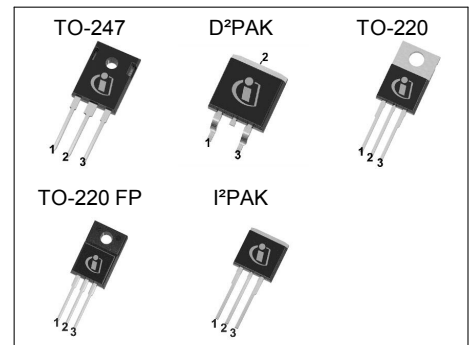


Table 1 Key Performance Parameters

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	lead
Soldering temperature, wavesoldering only allowed at leads	T_{sld}			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	lead
Soldering temperature, wavesoldering only allowed at leads	T_{sld}			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_{sld}			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

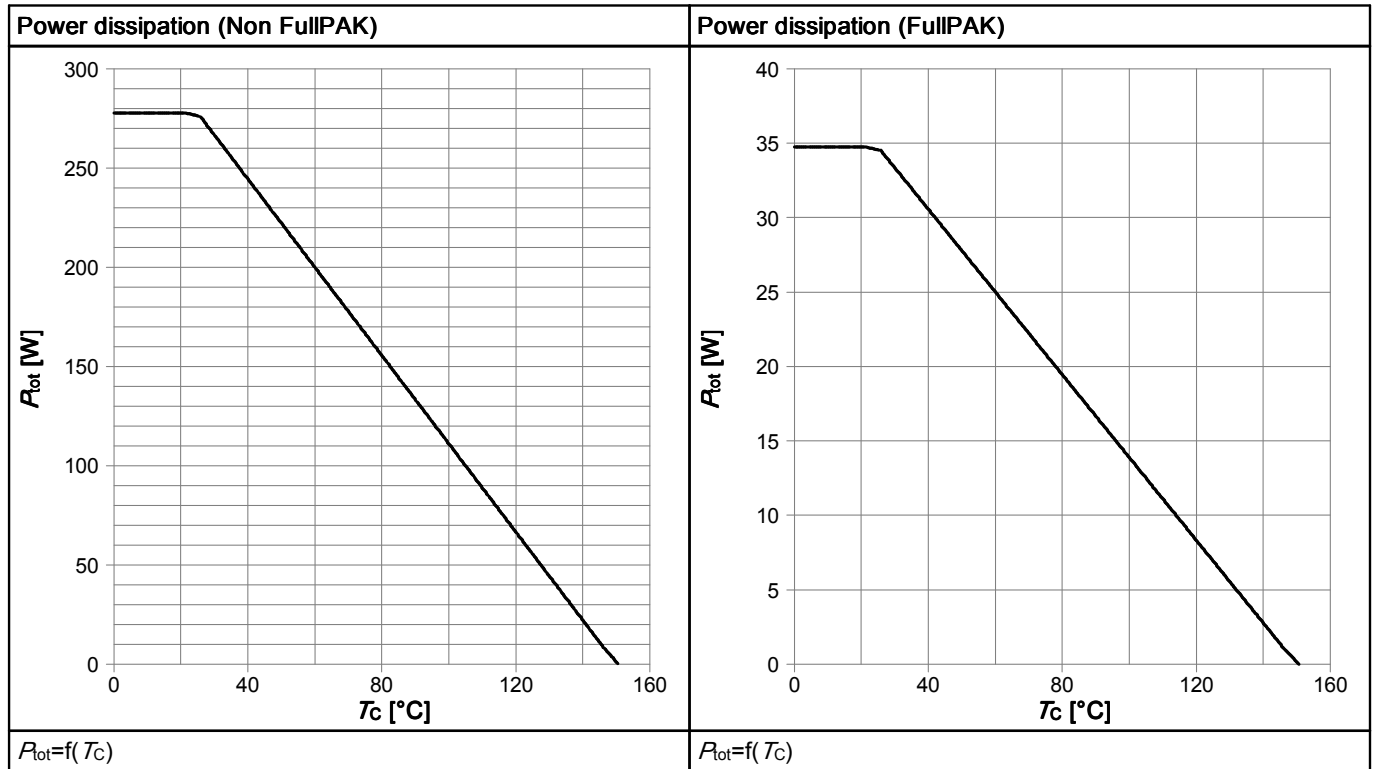


Table 11

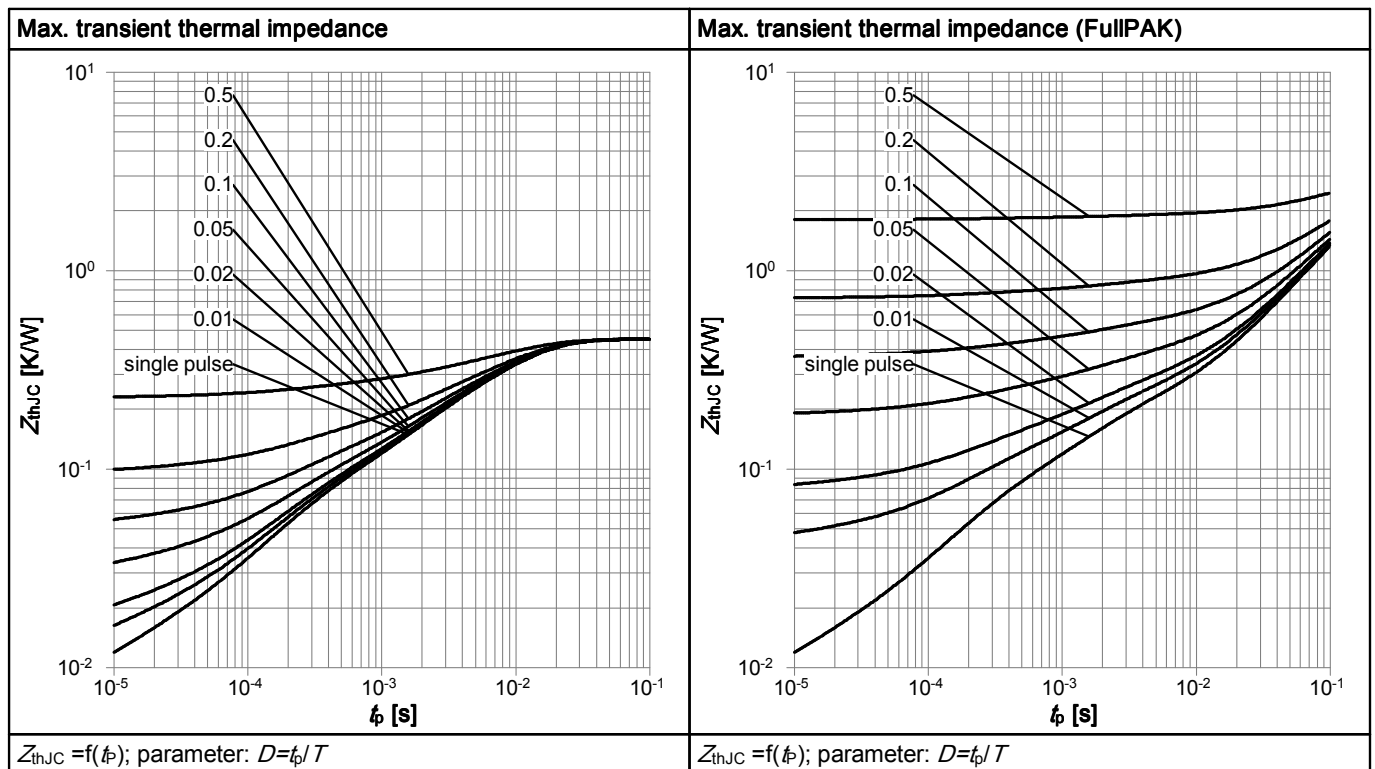


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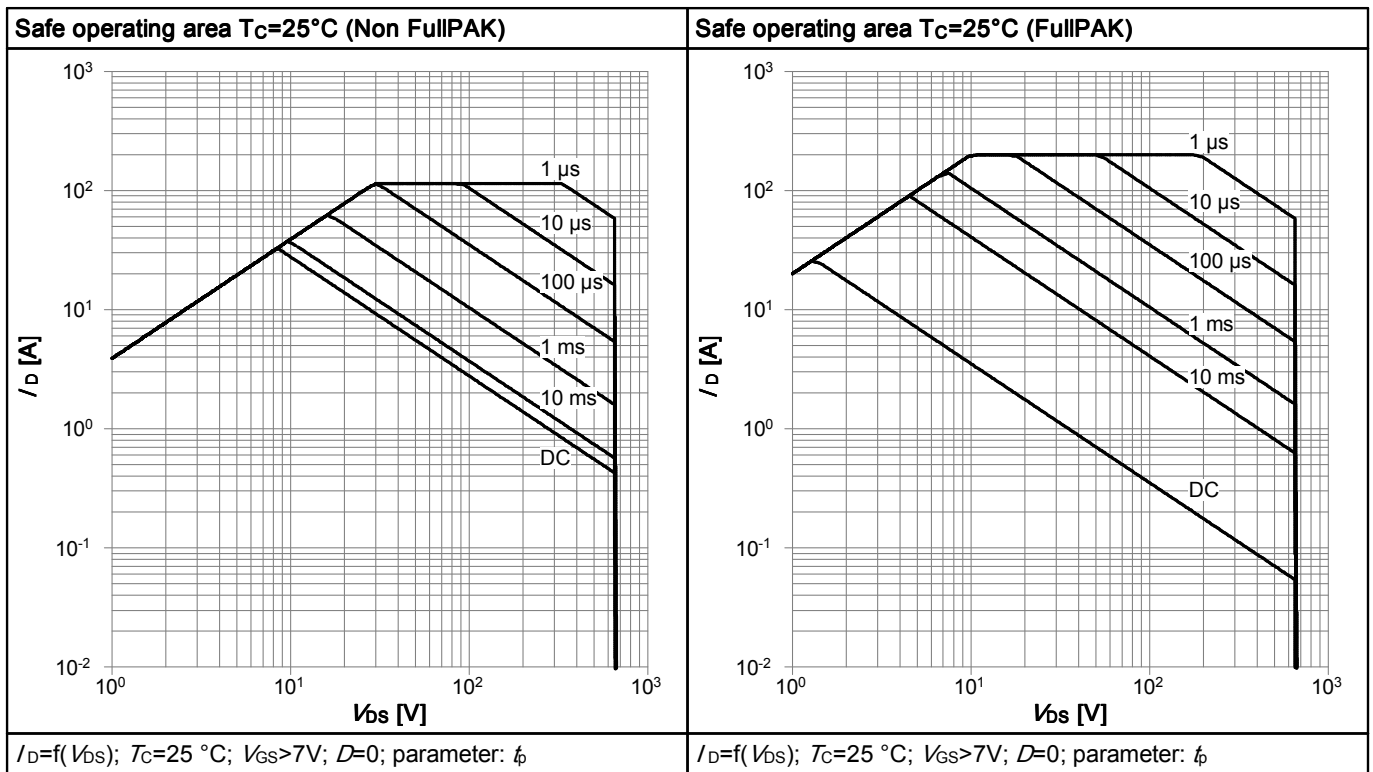


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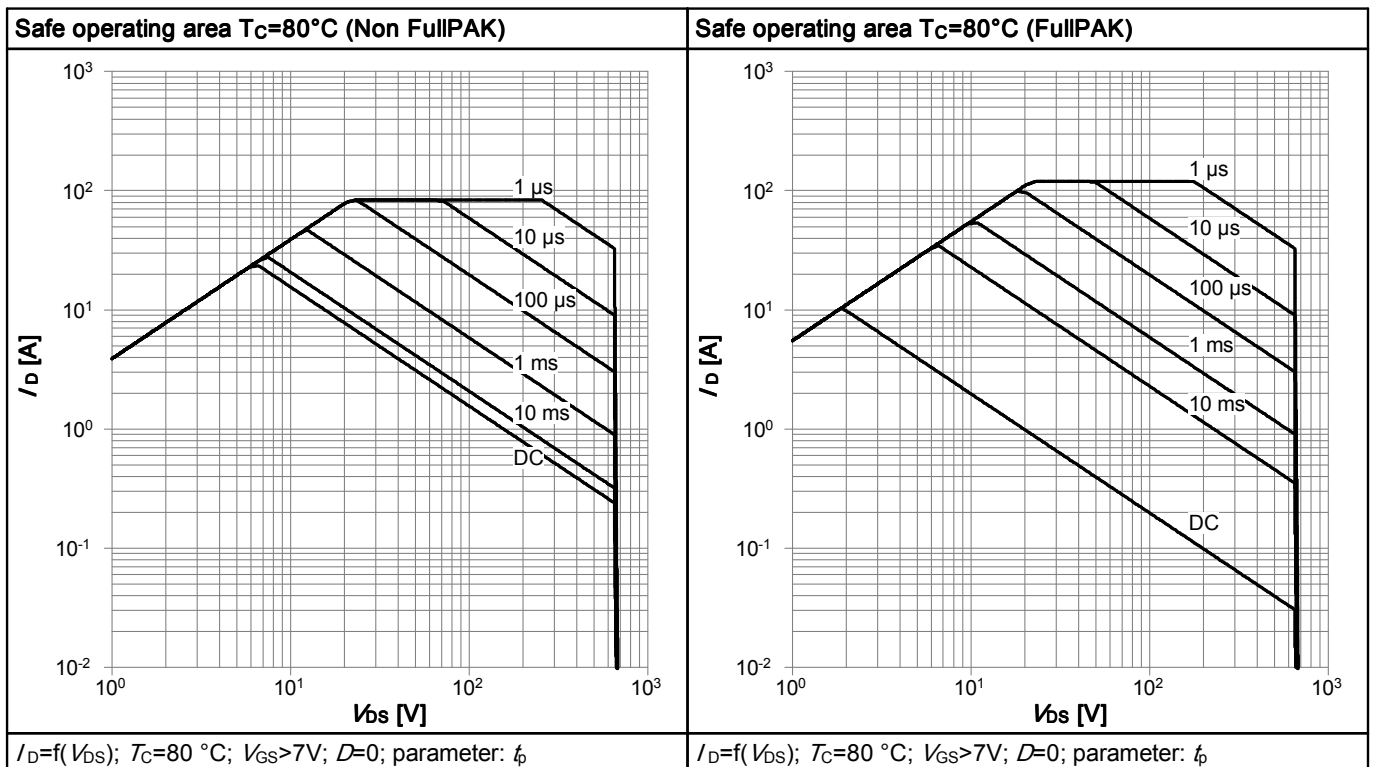


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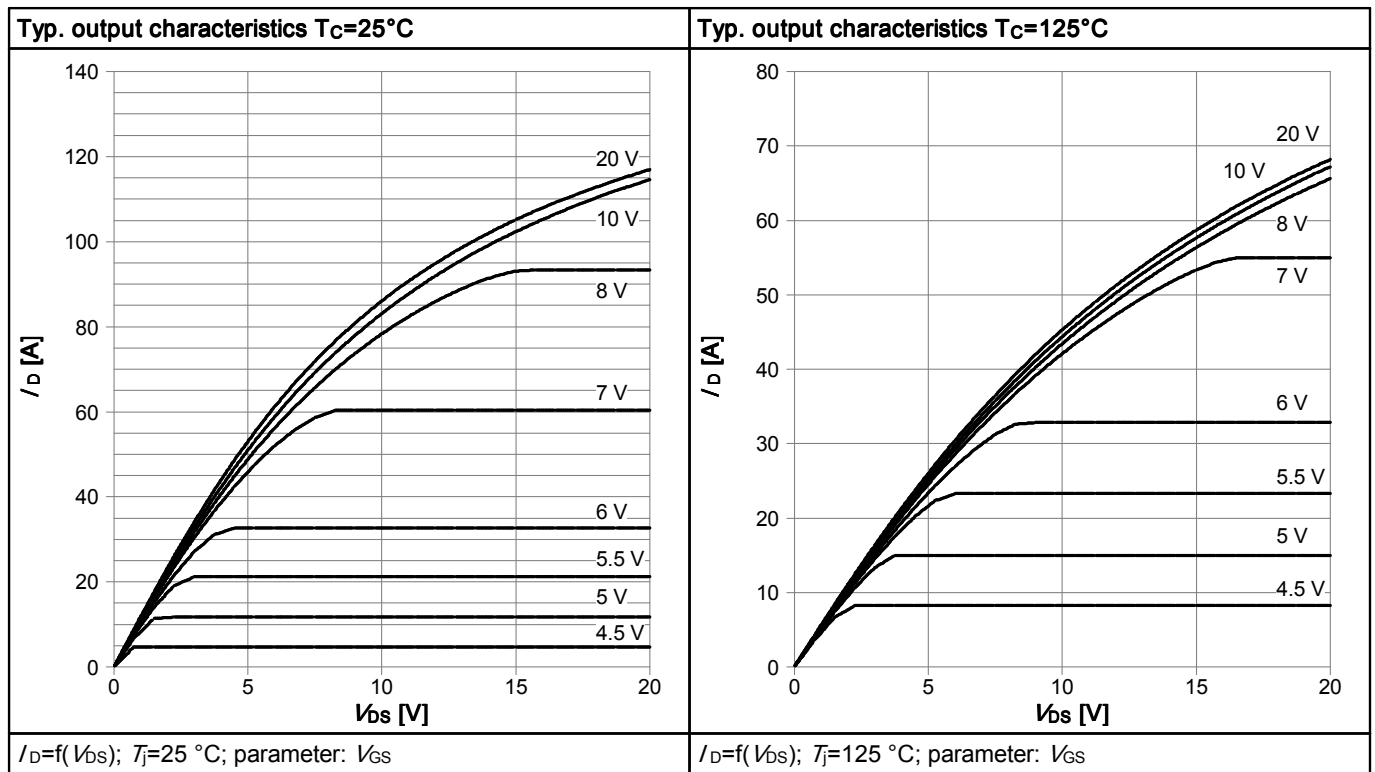


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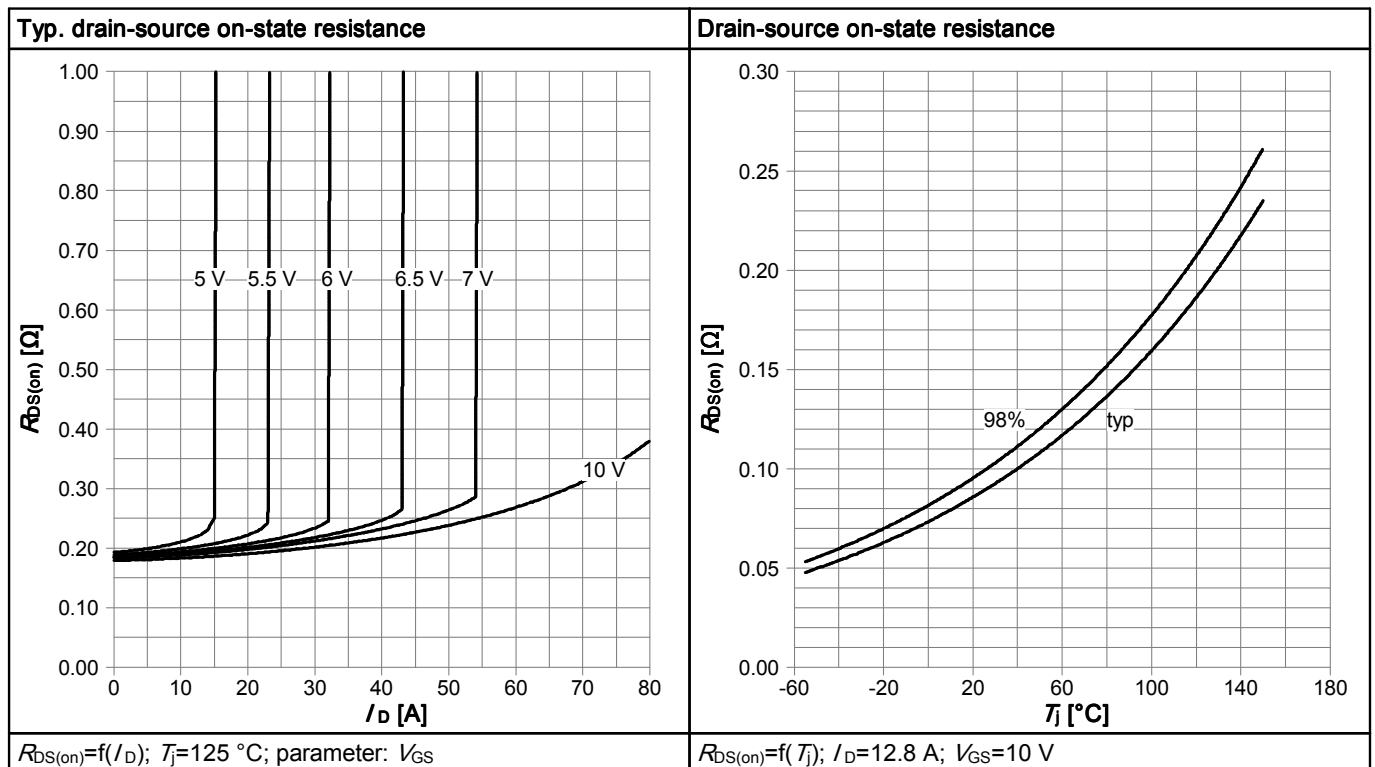


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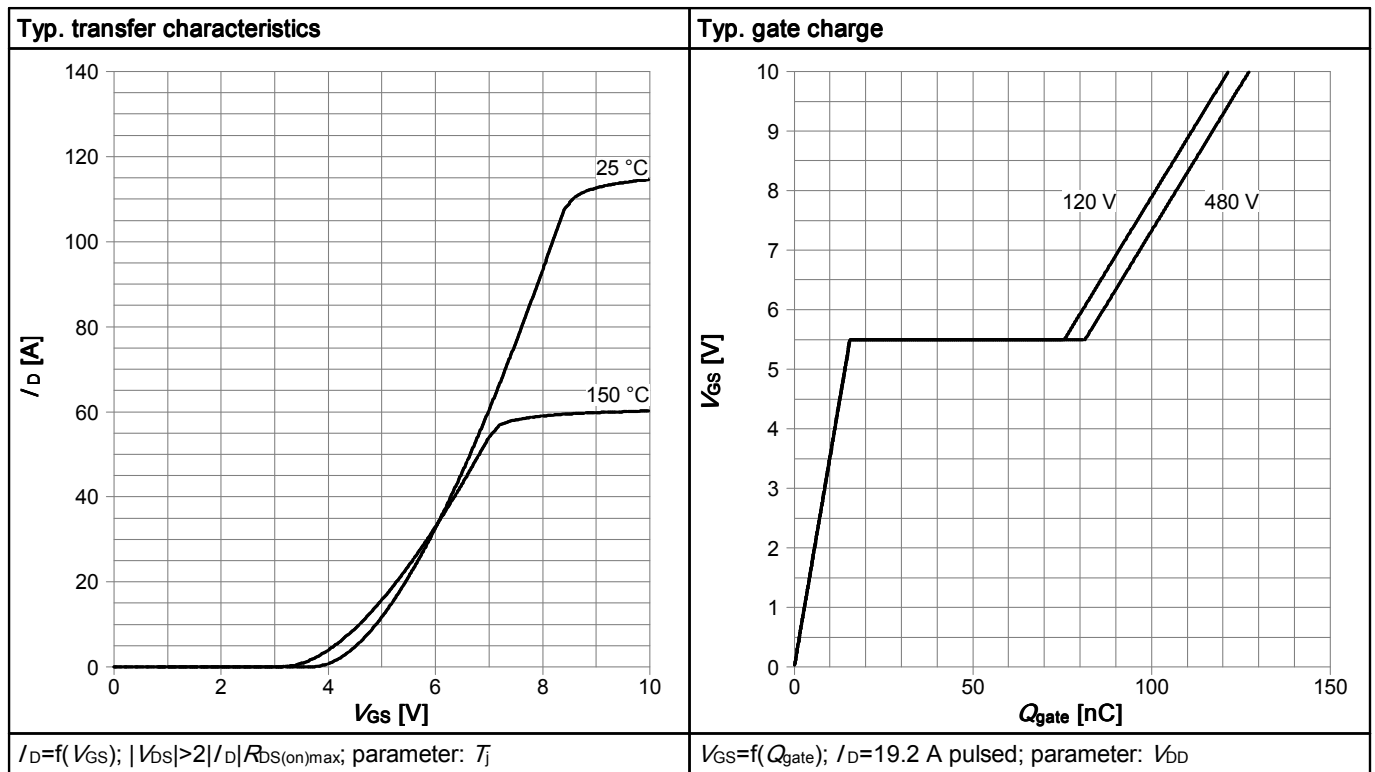


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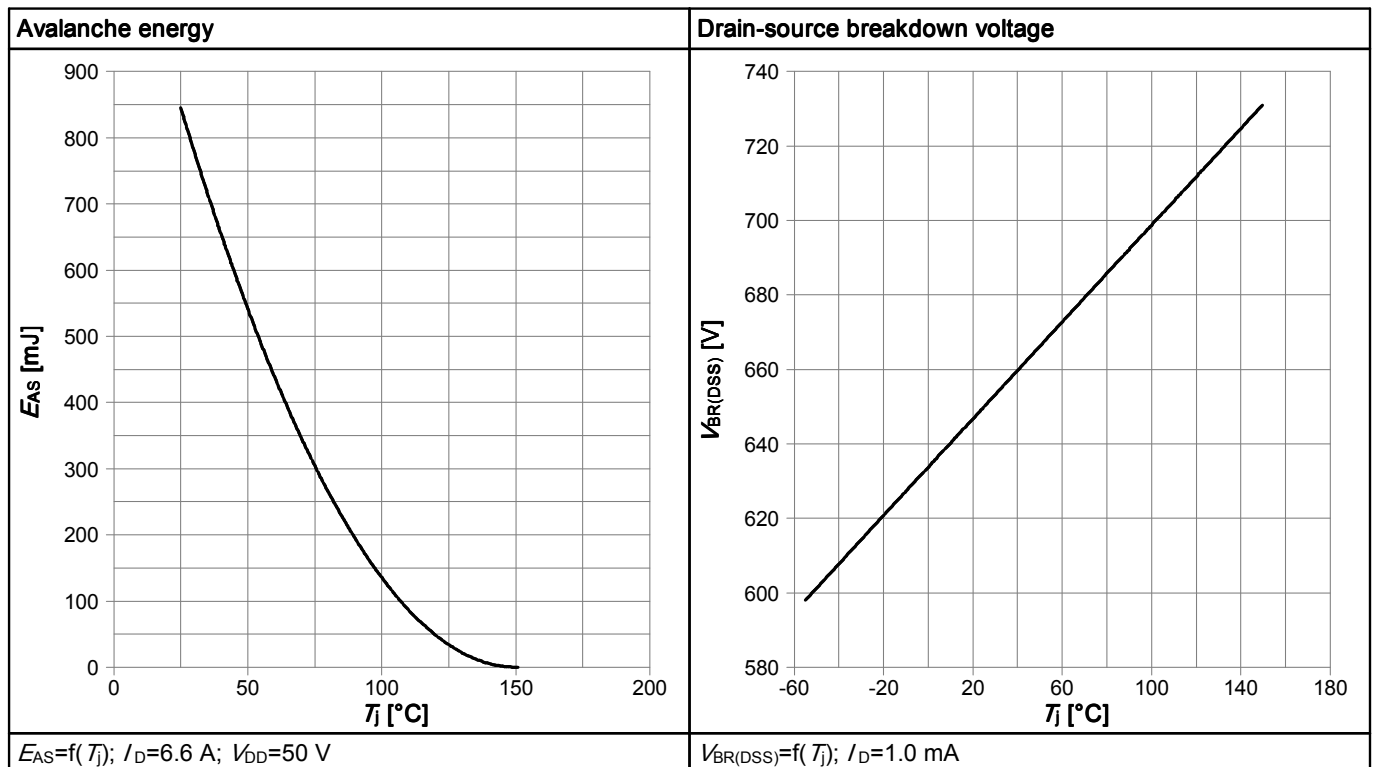


Table 18

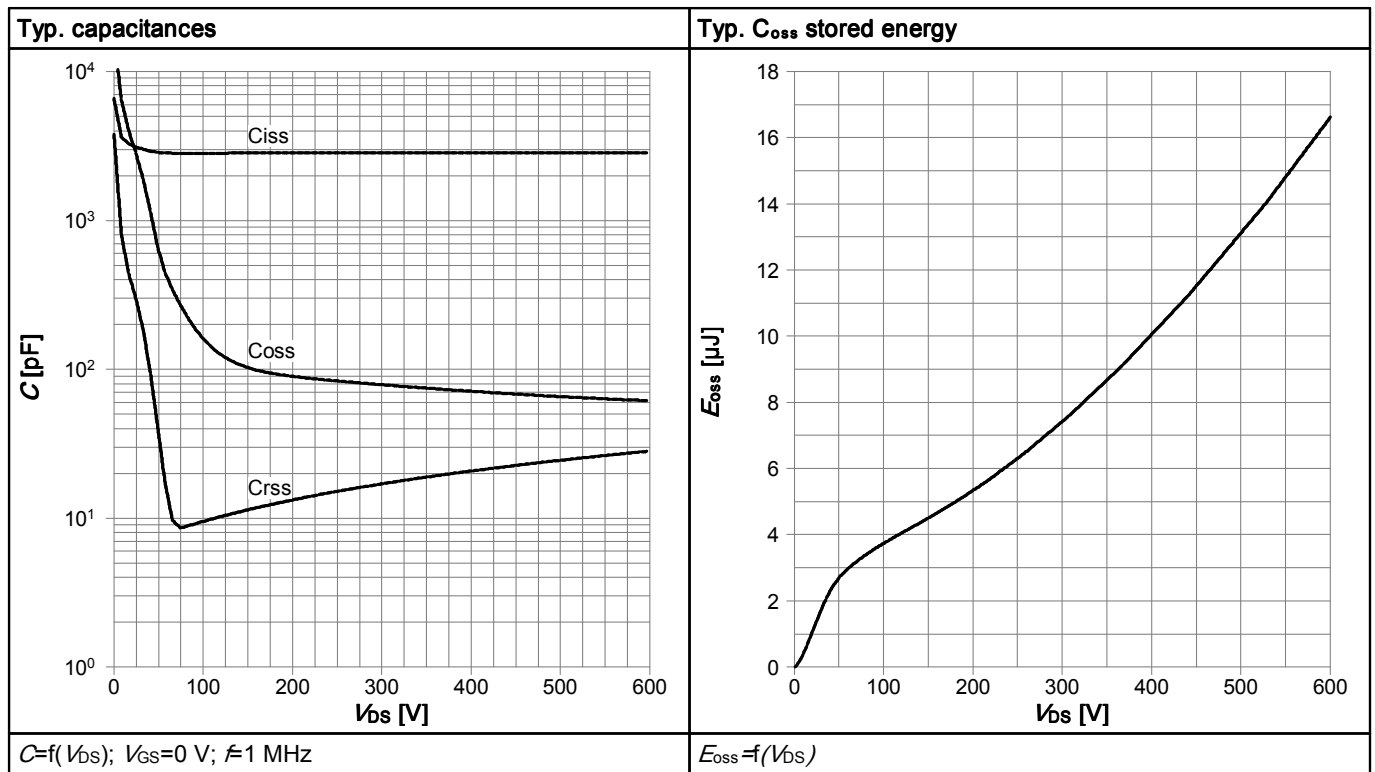
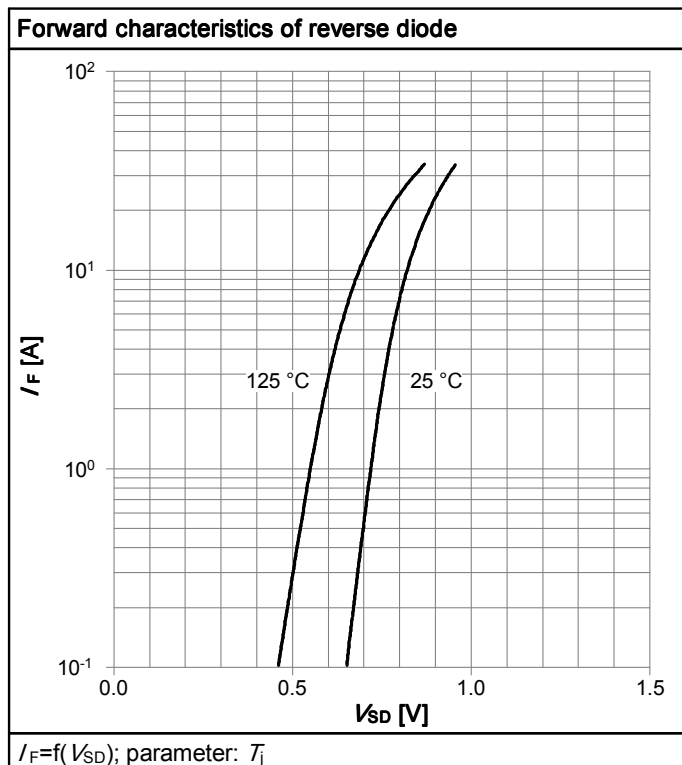


Table 19



6 Test Circuits

Table 20 Diode characteristics

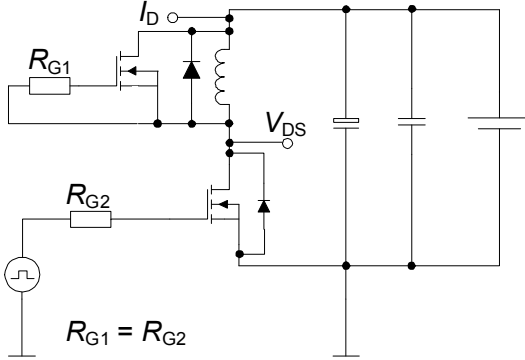
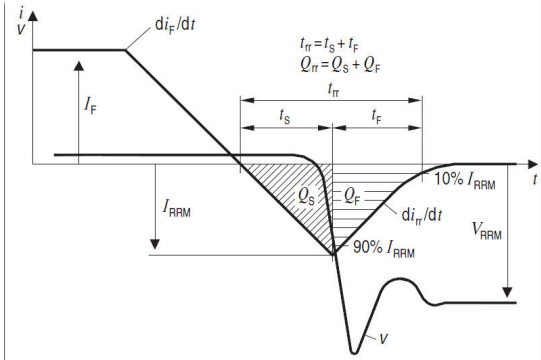
Test circuit for diode characteristics	Diode recovery waveform
 $R_{G1} = R_{G2}$	

Table 21 Switching times

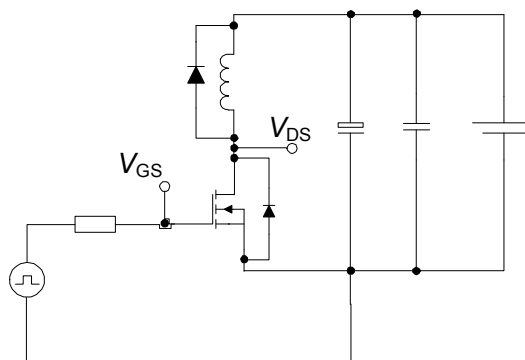
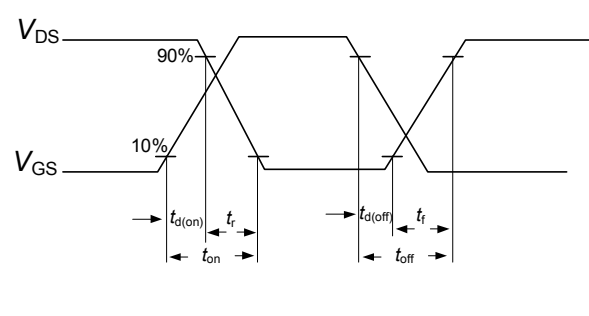
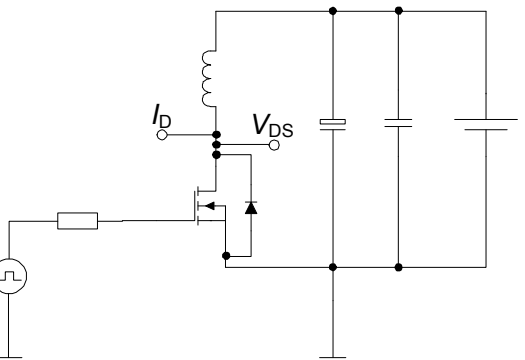
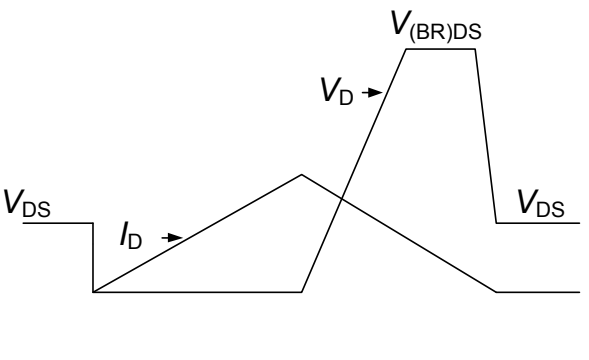
Switching times test circuit for inductive load	Switching times waveform
	

Table 22 Unclamped inductive

Unclamped inductive load test circuit	Unclamped inductive waveform
	

7 Package Outlines

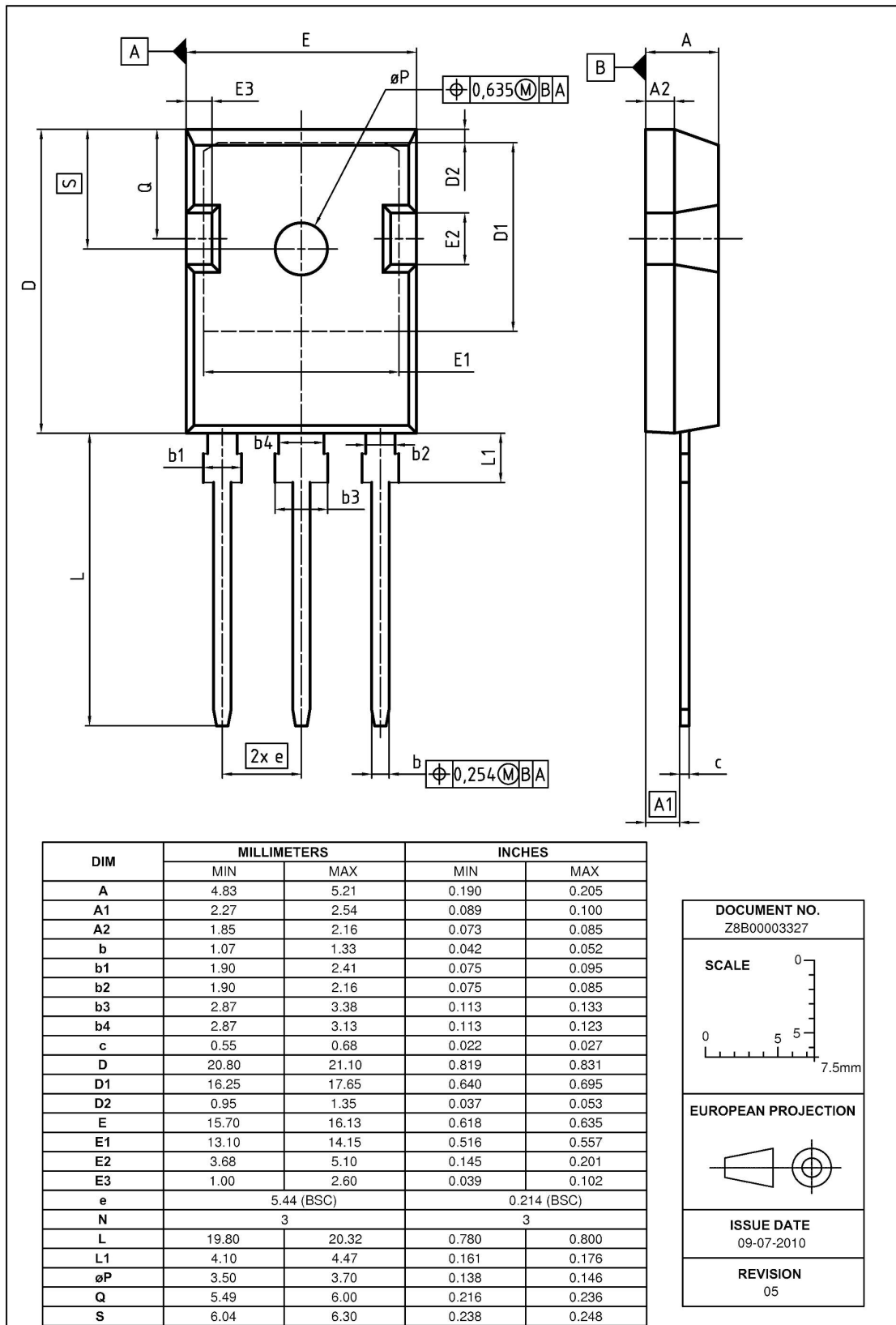


Figure 1 Outline PG-TO 247, dimensions in mm/inches

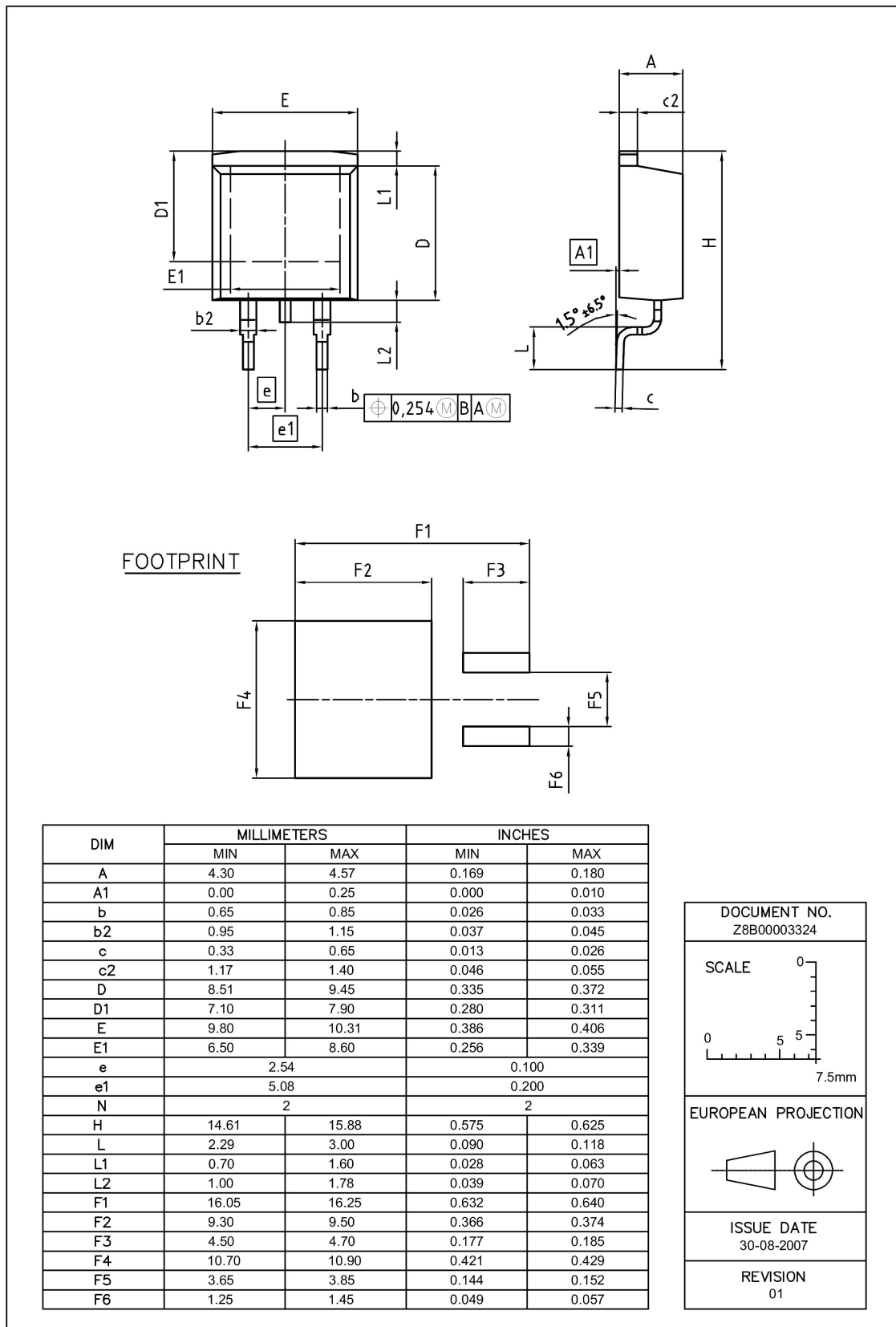


Figure 2 Outline PG-TO 263, dimensions in mm/inches

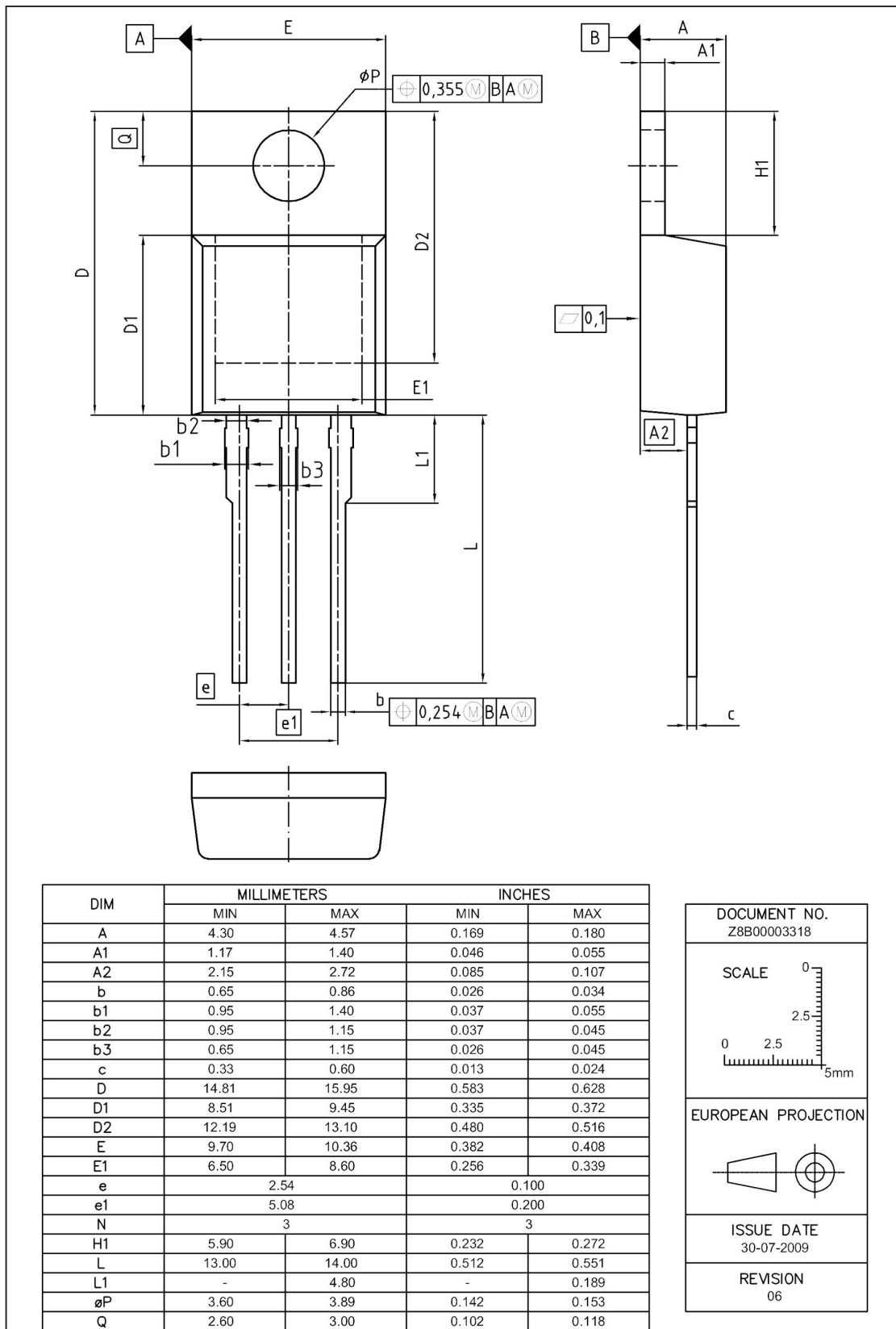


Figure 3 Outline PG-TO 220, dimensions in mm/inches

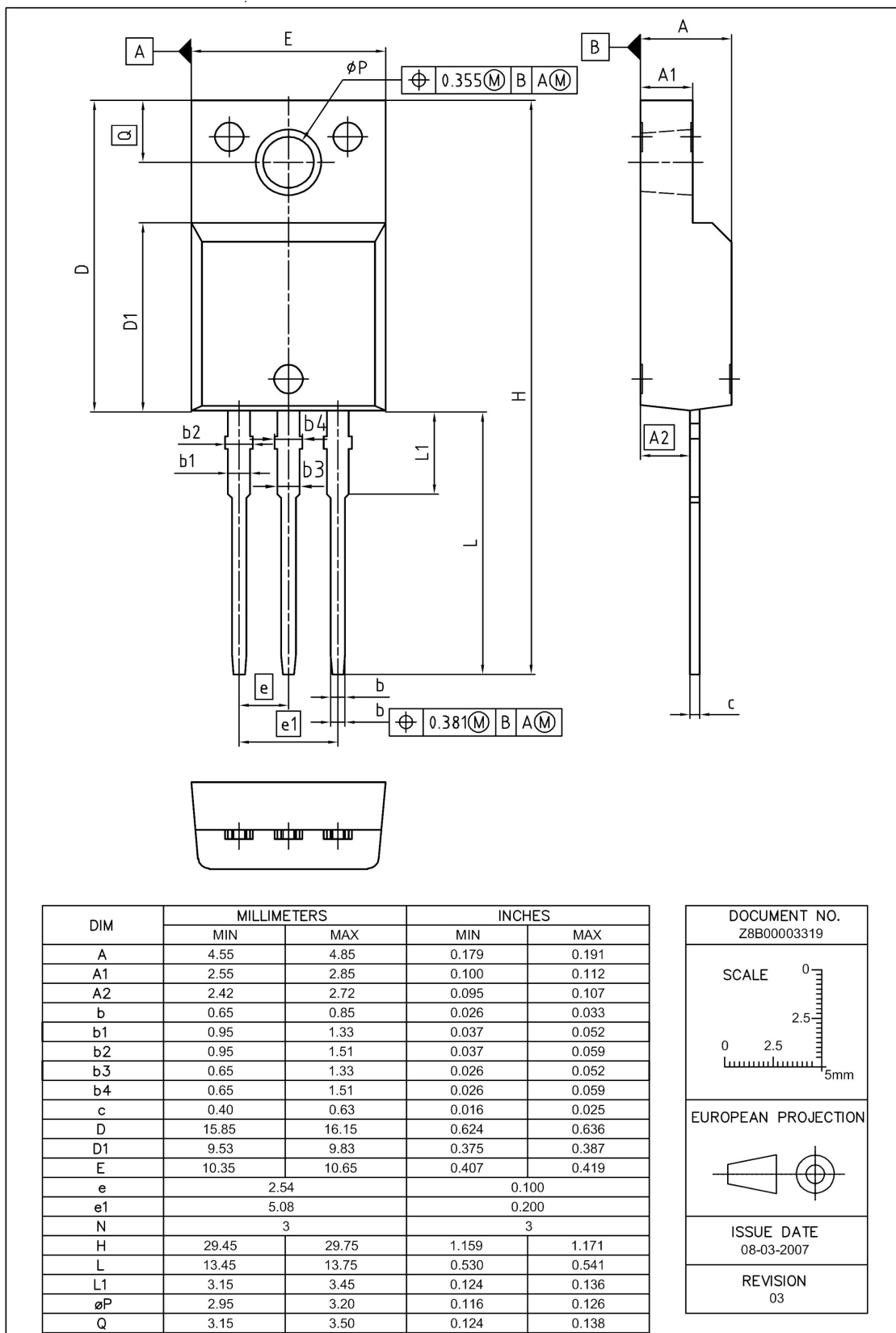


Figure 4 Outline PG-TO 220 FullPAK, dimensions in mm/inches

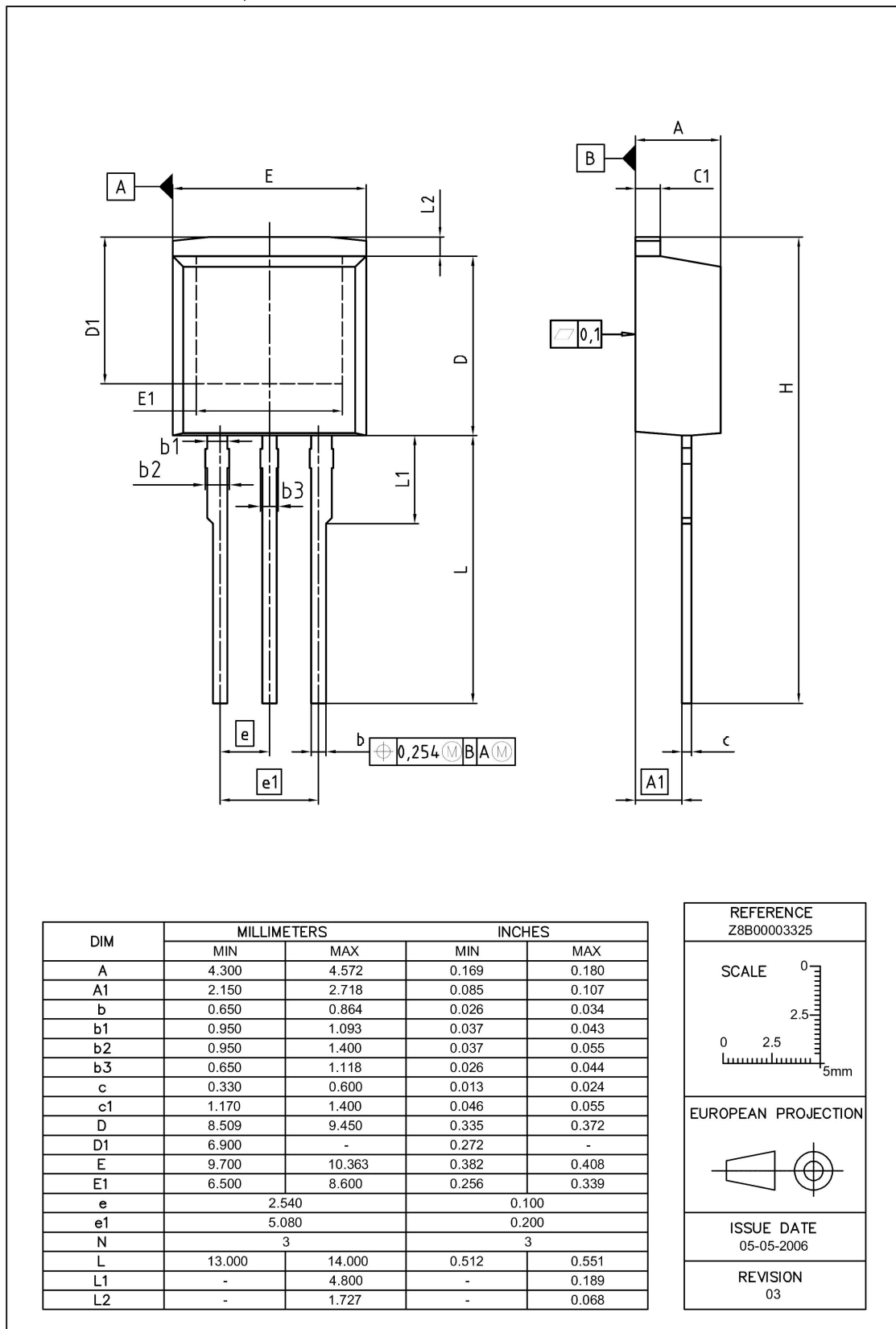


Figure 5 Outline PG-TO 262, dimensions in mm/inches

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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