

MOSFET

Metal Oxide Semiconductor Field Effect Transistor

CoolMOS C6

600V CoolMOS™ C6 Power Transistor
IPW60R041C6

Data Sheet

Rev. 2.1, 2010-07-12
Final

Industrial & Multimarket

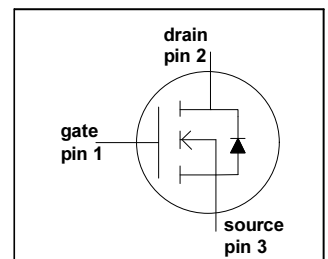
1 Description

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 offered 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
- JEDEC¹⁾ qualified, Pb-free plating, Halogen free



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.

Please note: For MOSFET paralleling the use of ferrite beads on the gate or separate totem poles is generally recommended.



Table 1 Key Performance Parameters

Parameter	Value	Unit
$V_{DS} @ T_{j,max}$	650	V
$R_{DS(on),max}$	0.041	Ω
$Q_{g,typ}$	290	nC
$I_{D,pulse}$	272	A
$E_{oss} @ 400V$	22	μJ
Body diode di/dt	300	A/ μs

Related Links

- [IFX C6 Product Brief](#)
- [IFX C6 Portfolio](#)
- [IFX CoolMOS Webpage](#)
- [IFX Design tools](#)

Type	Package	Marking
IPW60R041C6	PG-TO247	6R041C6

1) J-STD20 and JESD22

Table of Contents

1	Description	2
	Table of Contents	3
2	Maximum ratings	4
3	Thermal characteristics	4
4	Electrical characteristics	5
5	Electrical characteristics diagrams	7
6	Test circuits	11
7	Package outlines	12
8	Revision History	13

2 Maximum ratings

at $T_j = 25\text{ °C}$, unless otherwise specified.

Table 2 Maximum ratings

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Continuous drain current ¹⁾	I_D	-	-	77.5	A	$T_C = 25\text{ °C}$
				49		$T_C = 100\text{ °C}$
Pulsed drain current ²⁾	$I_{D,pulse}$	-	-	272	A	$T_C = 25\text{ °C}$
Avalanche energy, single pulse	E_{AS}	-	-	1954	mJ	$I_D = 13.4\text{ A}, V_{DD} = 50\text{ V}$ (see table 17)
Avalanche energy, repetitive	E_{AR}	-	-	2.96		$I_D = 13.4\text{ A}, V_{DD} = 50\text{ V}$
Avalanche current, repetitive	I_{AR}	-	-	13.4	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	P_{tot}	-	-	481	W	$T_C = 25\text{ °C}$
Operating and storage temperature	T_j, T_{stg}	-55	-	150	°C	
Mounting torque		-	-	60	Ncm	M3 and M3.5 screws
Continuous diode forward current	I_S	-	-	67.2	A	$T_C = 25\text{ °C}$
Diode pulse current ²⁾	$I_{S,pulse}$	-	-	272	A	$T_C = 25\text{ °C}$
Reverse diode dv/dt ³⁾	dv/dt	-	-	15	V/ns	$V_{DS} = 0 \dots 400\text{ V}, I_{SD} \leq I_D,$ $T_j = 25\text{ °C}$
Maximum diode commutation speed ³⁾	di/dt	-	-	300	A/ μ s	(see table 18)

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-247

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Thermal resistance, junction - case	R_{thJC}	-	-	0.26	°C/W	
Thermal resistance, junction - ambient	R_{thJA}	-	-	62		leaded
Soldering temperature, wavesoldering only allowed at leads	T_{sold}	-	-	260	°C	1.6 mm (0.063 in.) from case for 10 s

4 Electrical characteristics

Electrical characteristics, at $T_J=25\text{ °C}$, 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	$V_{GS}=0\text{ V}$, $I_D=0.25\text{ mA}$
Gate threshold voltage	$V_{GS(th)}$	2.5	3	3.5		$V_{DS}=V_{GS}$, $I_D=2.96\text{ mA}$
Zero gate voltage drain current	I_{DSS}	-	-	5	μA	$V_{DS}=600\text{ V}$, $V_{GS}=0\text{ V}$, $T_J=25\text{ °C}$
		-	50	-		$V_{DS}=600\text{ V}$, $V_{GS}=0\text{ V}$, $T_J=150\text{ °C}$
Gate-source leakage current	I_{GSS}	-	-	100	nA	$V_{GS}=20\text{ V}$, $V_{DS}=0\text{ V}$
Drain-source on-state resistance	$R_{DS(on)}$	-	0.037	0.041	Ω	$V_{GS}=10\text{ V}$, $I_D=44.4\text{ A}$, $T_J=25\text{ °C}$
		-	0.096	-		$V_{GS}=10\text{ V}$, $I_D=44.4\text{ A}$, $T_J=150\text{ °C}$
Gate resistance	R_G	-	0.7	-	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}	-	6530	-	pF	$V_{GS}=0\text{ V}$, $V_{DS}=100\text{ V}$, $f=1\text{ MHz}$
Output capacitance	C_{oss}	-	360	-		
Effective output capacitance, energy related ¹⁾	$C_{o(er)}$	-	235	-		
Effective output capacitance, time related ²⁾	$C_{o(tr)}$	-	1210	-		$I_D=\text{constant}$, $V_{GS}=0\text{ V}$ $V_{DS}=0\dots480\text{ V}$
Turn-on delay time	$t_{d(on)}$	-	23	-	ns	$V_{DD}=400\text{ V}$, $V_{GS}=13\text{ V}$, $I_D=44.4\text{ A}$, $R_G=1.7\Omega$ (see table 16)
Rise time	t_r	-	10	-		
Turn-off delay time	$t_{d(off)}$	-	130	-		
Fall time	t_f	-	7	-		

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 6 Gate charge characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Gate to source charge	Q_{gs}	-	36	-	nC	$V_{DD}=480\text{ V}$, $I_D=44.4\text{ A}$, $V_{GS}=0\text{ to }10\text{ V}$
Gate to drain charge	Q_{gd}	-	150	-		
Gate charge total	Q_g	-	290	-		
Gate plateau voltage	$V_{plateau}$	-	5.4	-	V	

Table 7 Reverse diode characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Diode forward voltage	V_{SD}	-	0.9	-	V	$V_{GS}=0\text{ V}$, $I_F=44.4\text{ A}$, $T_j=25\text{ °C}$
Reverse recovery time	t_{rr}	-	950	-	ns	$V_R=400\text{ V}$, $I_F=44.4\text{ A}$,
Reverse recovery charge	Q_{rr}	-	32	-	μC	$di_F/dt=100\text{ A}/\mu\text{s}$ (see table 18)
Peak reverse recovery current	I_{rrm}	-	62	-	A	

5 Electrical characteristics diagrams

Table 8

Power dissipation	Max. transient thermal impedance
$P_{tot} = f(T_c)$	$Z_{(thjC)} = f(t_p)$; parameter: $D = t_p/T$

Table 9

Safe operating area $T_c = 25\text{ °C}$	Safe operating area $T_c = 80\text{ °C}$
$I_D = f(V_{DS}); T_c = 25\text{ °C}; D = 0$; parameter t_p	$I_D = f(V_{DS}); T_c = 80\text{ °C}; D = 0$; parameter t_p

Table 10

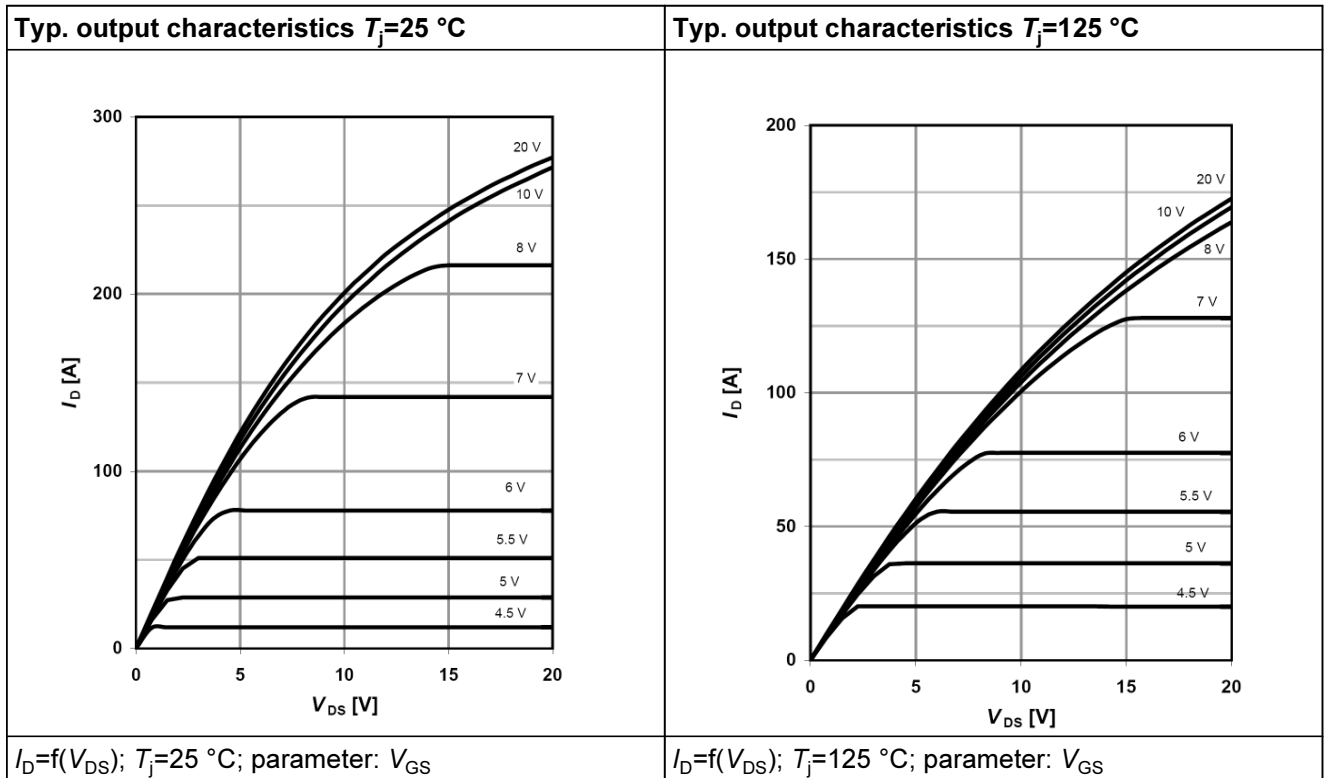


Table 11

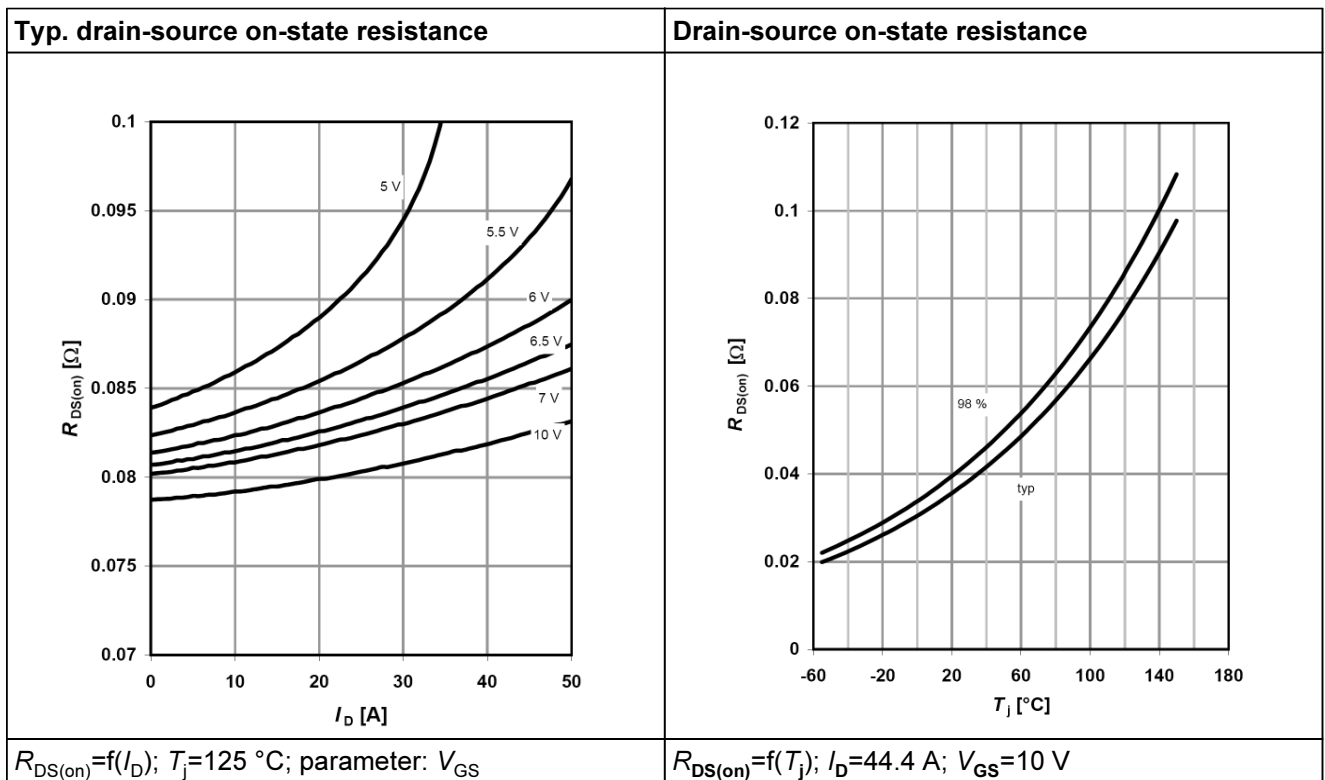


Table 12

Typ. transfer characteristics	Typ. gate charge
$I_D = f(V_{GS}); V_{DS} = 20V$	$V_{GS} = f(Q_{gate}); I_D = 44.4 \text{ A pulsed}$

Table 13

Avalanche energy	Drain-source breakdown voltage
$E_{AS} = f(T_j); I_D = 13.4 \text{ A}; V_{DD} = 50 \text{ V}$	$V_{BR(DSS)} = f(T_j); I_D = 0.25 \text{ mA}$

Table 14

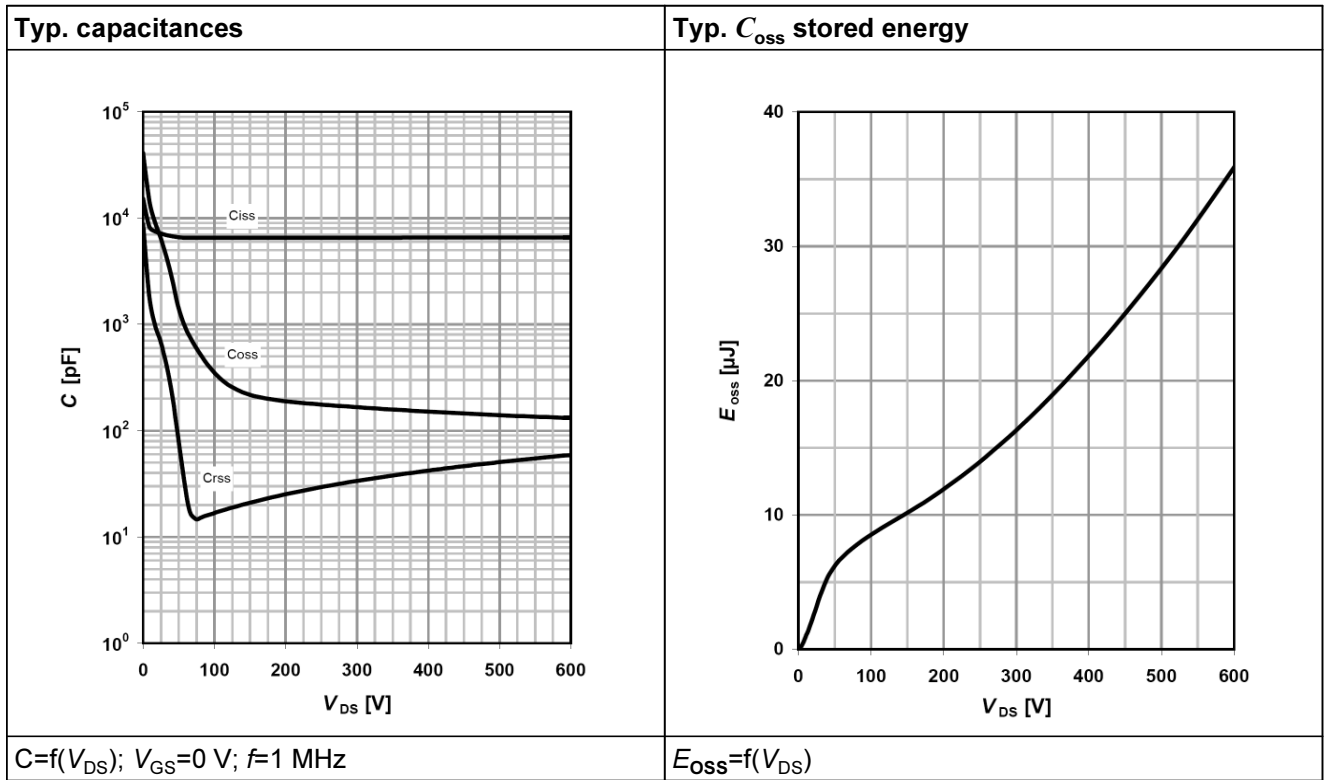
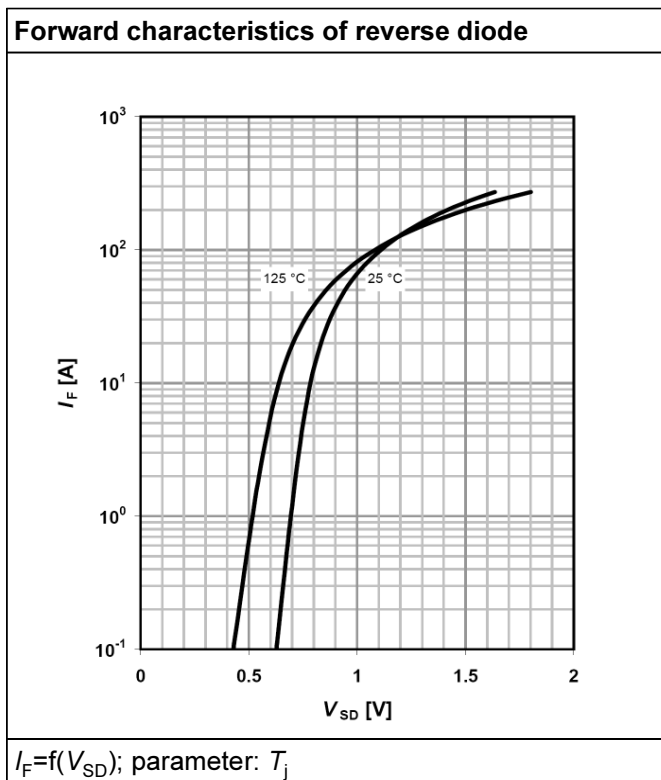


Table 15



6 Test circuits

Table 16 Switching times test circuit and waveform for inductive load

Switching times test circuit for inductive load	Switching time waveform

Table 17 Unclamped inductive load test circuit and waveform

Unclamped inductive load test circuit	Unclamped inductive waveform

Table 18 Test circuit and waveform for diode characteristics

Test circuit for diode characteristics	Diode recovery waveform

7 Package outlines

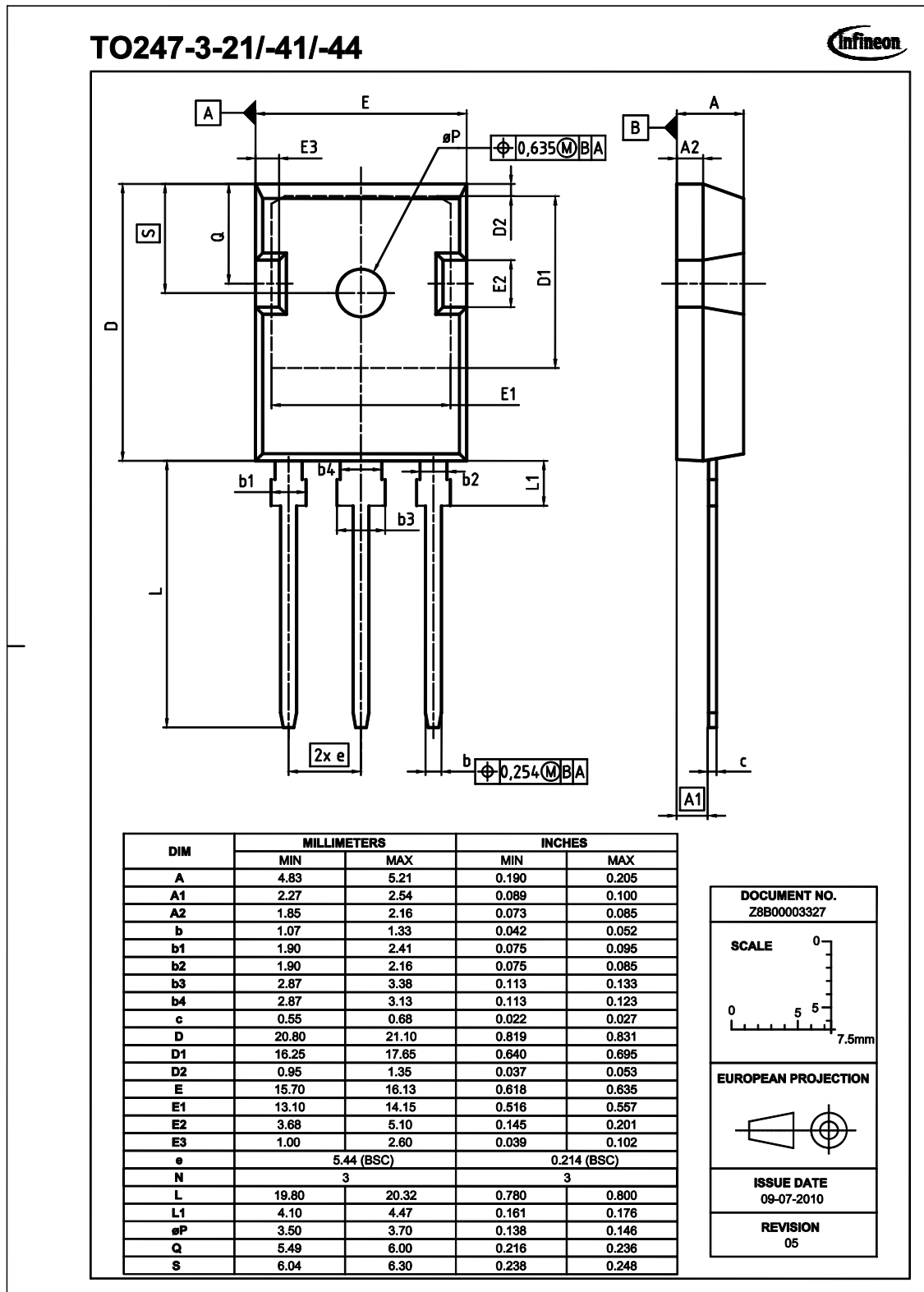


Figure 1 Outlines TO-247, dimensions in mm/inches

8 Revision History

Revision	Description

We Listen to Your Comments

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



Edition 2010-07-12

Published by

Infineon Technologies AG

81726 Munich, Germany

© 2010 Infineon Technologies AG

All Rights Reserved.

Legal Disclaimer

The information given in this document shall in no event be regarded as a guarantee of conditions or characteristics.

With respect to any examples or hints given herein, any typical values stated herein and/or any information regarding the application of the device, Infineon Technologies hereby disclaims

any and all warranties and liabilities of any kind, including without limitation, warranties of non-infringement of intellectual property rights of any third party.

Information

For further information on technology, delivery terms and conditions and prices, please contact the nearest Infineon Technologies Office (www.infineon.com).

Warnings

Due to technical requirements, components may contain dangerous substances. For information on the types in question, please contact the nearest Infineon Technologies Office. The Infineon Technologies component described in this Data Sheet may be used in life-support devices or systems and/or automotive, aviation and aerospace applications or systems only with the express written approval of Infineon Technologies, if a failure of such components can reasonably be expected to cause the failure of that life-support, automotive, aviation and aerospace device or system or to affect the safety or effectiveness of that device or system. Life support devices or systems are intended to be implanted in the human body or to support and/or maintain and sustain and/or protect human life. If they fail, it is reasonable to assume that the health of the user or other persons may be endangered.

单击下面可查看定价，库存，交付和生命周期等信息

[>>Infineon\(英飞凌\)](#)