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Kind regards,

Team Nexperia

IP4059CX5

Integrated USB 2.0 and USB OTG ESD protection to IEC 61000-4-2 level 4

Rev. 1 — 15 September 2011 Product data sheet

1. Product profile

1.1 General description

The IP4059CX5 is designed to protect several I/O pins of computer interfaces, such as Universal Serial Bus (USB) 2.0, USB On-The-Go (OTG), Ethernet, Digital Visual Interface (DVI) etc. The IP4059CX5 incorporates ultra-low capacity diodes to provide protection to downstream components from ElectroStatic Discharge (ESD) voltages as high as ±8 kV contact discharge according to the IEC 61000-4-2 model.

The device is fabricated using monolithic silicon technology and integrates four ultra-low capacity ESD protection diodes in a 0.5 mm pitch Wafer-Level Chip-Scale Package (WLCSP) measuring 0.96 mm by 1.34 mm only.

1.2 Features and benefits

- Pb-free, RoHS compliant and free of halogen and antimony (Dark Green compliant)
- 4 ultra-low input capacity rail-to-rail ESD protection diodes with C_d = 3.0 pF
- Integrated ESD protection withstanding ±8 kV contact discharge and ±15 kV air discharge
- WLCSP with 0.5 mm pitch

1.3 Applications

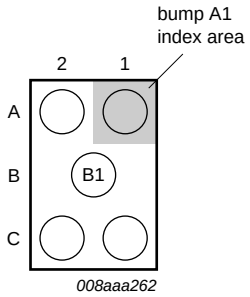
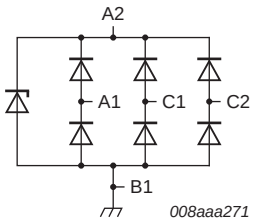
General purpose ElectroMagnetic Interference (EMI) and Radio Frequency Interference (RFI) filtering and downstream ESD protection for USB ports inside:

- Cellular and Personal Communication System (PCS) mobile handsets
- PC peripherals and PCs
- Cordless telephones
- Wireless data and Local Area Network (LAN) systems
- Personal Digital Assistants (PDAs)
- Digital cameras

2. Pinning information

Table 1. Pinning

Example of pin configuration for USB 2.0; other combinations for ID, D+ and D− in relation to pin A1, pin C1 and pin C2 are possible.

Pin	Symbol	Description	Simplified outline	Graphic symbol
A1	D−	USB 2.0 differential pair		
C1	D+			
B1	GND	ground		
A2	V_{BUS}	power		
C2	ID	USB OTG ID pin		

transparent top view, solder balls facing down

3. Ordering information

Table 2. Ordering information

Type number	Package		
	Name	Description	Version
IP4059CX5/LF	WLCSP5	wafer level chip-size package; 5 bumps (2-1-2)	IP4059CX5/LF

4. Limiting values

Table 3. Limiting values

In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions		Min	Max	Unit
V_{CC}	supply voltage			0	5	V
V_I	input voltage			−0.5	V_{CC} + 0.5	V
V_{ESD}	electrostatic discharge voltage	contact discharge	[1]	−15	+15	kV
		air discharge	[1]	−15	+15	kV
		IEC 61000-4-2 level 4				
		contact discharge		−8	+8	kV
		air discharge		−15	+15	kV
T_{stg}	storage temperature			−55	+150	°C
$T_{reflow(peak)}$	peak reflow temperature	10 s maximum		-	260	°C
T_{amb}	ambient temperature			−40	+85	°C

[1] Device is qualified with > 200 pulses of ±15 kV contact discharges each, according to the IEC 61000-4-2 model and far exceeds the specified level 4 (8 kV contact discharge).

5. Characteristics

Table 4. Electrical characteristics

T_{amb} = 25 °C; unless otherwise specified.

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
C_d	diode capacitance	pins A1, C1 and C2; $V_{bias(DC)}$ = 0 V; f = 1 MHz; V_{A2} = 0 V	[1]	-	3.0	4.0	pF
I_{LR}	reverse leakage current	V_I = 3.0 V		-	-	100	nA
V_{BR}	breakdown voltage	I_{test} = 1 mA		6	-	9	V
V_F	forward voltage			-	0.7	-	V

[1] Guaranteed by design.

6. Package outline

WLCSP5: wafer level chip-size package; 5 bumps (2-1-2)

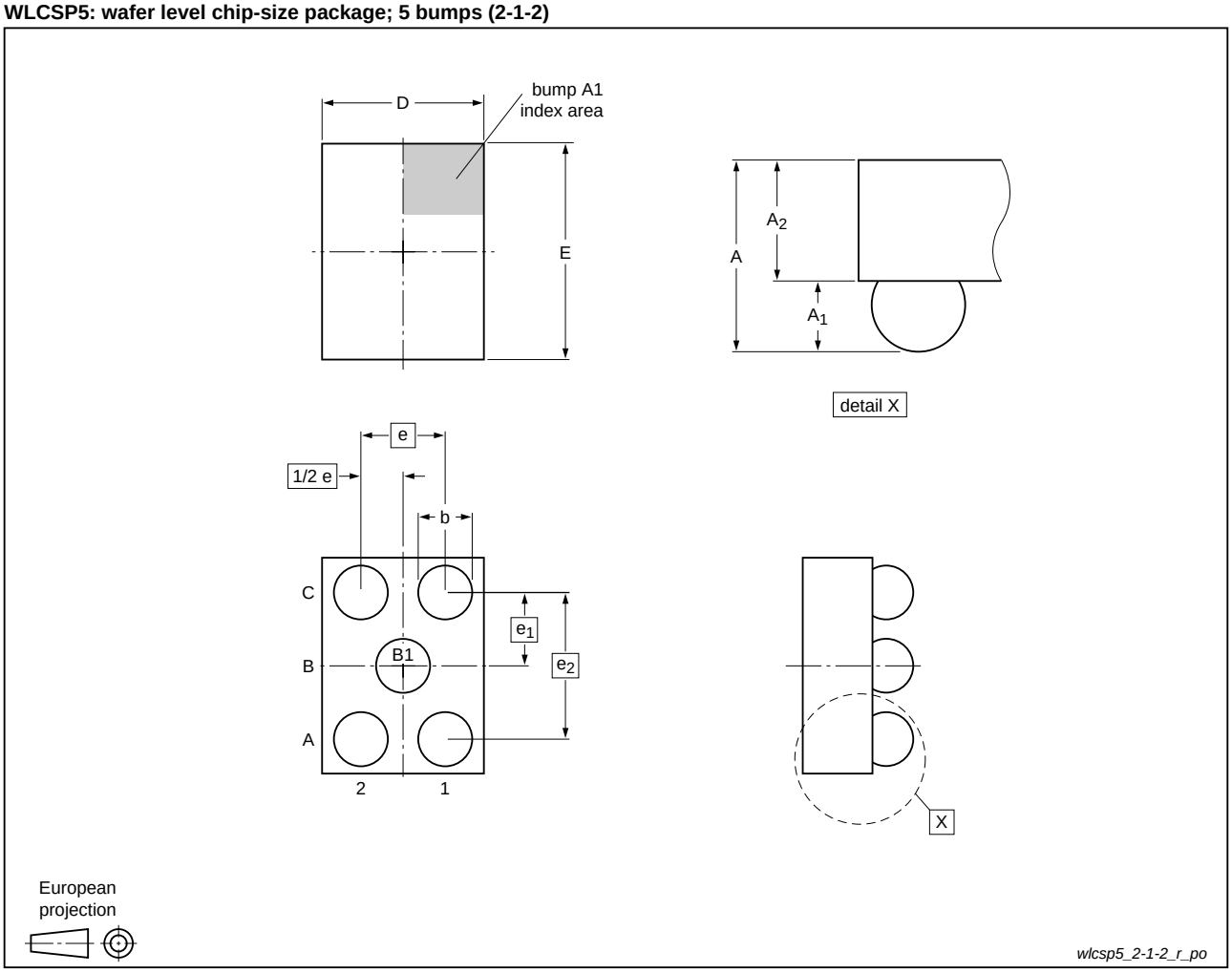


Fig 1. Package outline IP4059CX5/LF (WLCSP5)

Table 5. Dimensions for Figure 1

Symbol	Min	Typ	Max	Unit
A	0.61	0.65	0.69	mm
A_1	0.22	0.24	0.26	mm
A_2	0.39	0.41	0.43	mm
b	0.27	0.32	0.37	mm
D	0.91	0.96	1.01	mm
E	1.29	1.34	1.39	mm
e	-	0.5	-	mm
e_1	-	0.435	-	mm
e_2	-	0.87	-	mm

7. Design and assembly recommendations

7.1 PCB design guidelines

For optimum performance it is recommended to use a Non-Solder Mask Defined (NSMD), also known as a copper-defined design, incorporating laser-drilled micro-vias connecting the ground pads to a buried ground-plane layer. This results in the lowest possible ground inductance and provides the best high frequency and ESD performance. For this case, refer to Table 6 for the recommended PCB design parameters.

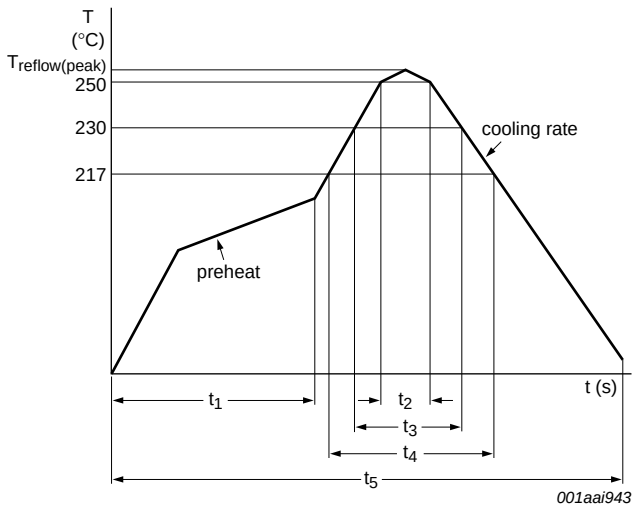
Table 6. Recommended PCB design parameters

Parameter	Value or specification
PCB pad diameter	275 μm
Micro-via diameter	100 μm (0.004 inch)
Solder mask aperture diameter	375 μm
Copper thickness	20 μm to 40 μm
Copper finish	AuNi
PCB material	FR4

7.2 PCB assembly guidelines for Pb-free soldering

Table 7. Assembly recommendations

Parameter	Value or specification
Solder screen aperture diameter	330 μm
Solder screen thickness	100 μm (0.004 inch)
Solder paste: Pb-free	SnAg (3 % to 4 %) Cu (0.5 % to 0.9 %)
Solder to flux ratio	50 : 50
Solder reflow profile	see Figure 2



The device is capable of withstanding at least three reflows with this profile.

Fig 2. Pb-free solder reflow profile

Table 8. Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$T_{reflow(peak)}$	peak reflow temperature		230	-	260	°C
t_1	time 1	soak time	60	-	180	s
t_2	time 2	time during T ≥ 250 °C	-	-	30	s
t_3	time 3	time during T ≥ 230 °C	10	-	50	s
t_4	time 4	time during T > 217 °C	30	-	150	s
t_5	time 5		-	-	540	s
dT/dt	rate of change of temperature	cooling rate	-	-	−6	°C/s
		preheat	2.5	-	4.0	°C/s

8. Abbreviations

Table 9. Abbreviations

Acronym	Description
DVI	Digital Visual Interface
EMI	ElectroMagnetic Interference
ESD	ElectroStatic Discharge
FR4	Flame Retard 4
IEC	International Electrotechnical Commission
I/O	Input/Output
LAN	Local Area Network
NSMD	Non-Solder Mask Defined
OTG	On-The-Go
PCB	Printed-Circuit Board
PCS	Personal Communication System
PDA	Personal Digital Assistant
RFI	Radio Frequency Interference
RoHS	Restriction of Hazardous Substances
USB	Universal Serial Bus
WLCSP	Wafer-Level Chip-Scale Package

9. Revision history

Table 10. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
IP4059CX5 v.1	20110915	Product data sheet	-	-

10. Legal information

10.1 Data sheet status

Document status[1][2]	Product status[3]	Definition
Objective [short] data sheet	Development	This document contains data from the objective specification for product development.
Preliminary [short] data sheet	Qualification	This document contains data from the preliminary specification.
Product [short] data sheet	Production	This document contains the product specification.

[1] Please consult the most recently issued document before initiating or completing a design.

[2] The term 'short data sheet' is explained in section "Definitions".

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12. Contents

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