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IP4358CX6

Quad channel low capacitance high performance ESD protection

Rev. 1 — 18 October 2010 Product data sheet

1. Product profile

1.1 General description

The IP4358CX6 is a quad channel low capacitance ElectroStatic Discharge (ESD) protection device, providing protection to downstream components from ESD voltages as high as ±15 kV contact discharge and > ±15 kV air discharge according the IEC 61000-4-2 model, far exceeding standard level 4.

The device is optimized for protection of high speed interfaces such as Universal Serial Bus (USB) 2.0, High Definition Multimedia Interface (HDMI), Digital Visual Interface (DVI) and other interfaces requiring very low capacitance ESD protection.

All four ESD protection channels share common ground connections but are electrically separated, preventing current back drive into the adjacent channel. The IP4358CX6 is fabricated using monolithic silicon technology in a single Wafer-Level Chip-Scale Package (WLCSP). These features make the IP4358CX6 ideal for use in applications requiring component miniaturization such as mobile phone handsets and other portable electronic devices.

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 $C_{(I/O-GND)}$ = 1.3 pF
- R_{dyn} = 0.45 Ω
- Integrated ESD protection withstanding ±15 kV contact discharge and > ±15 kV air discharge, far exceeding IEC 61000-4-2 level 4
- 2 × 3 solder ball WLCSP with 0.4 mm pitch

1.3 Applications

- High-speed interface ESD protection such as USB 2.0, HDMI, DVI etc.
- Interfaces with special requirements on low capacitive ESD protection
- Interfaces requiring separation of the positive clamping voltage/current path

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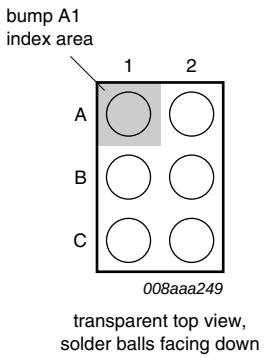
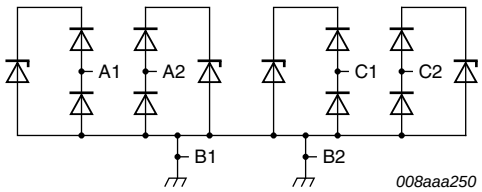
2. Pinning information

Table 1. Pinning

Pin	Description	Simplified outline	Graphic symbol
A1 and A2	ESD protection		
B1 and B2	ground		
C1 and C2	ESD protection		

3. Ordering information

Table 2. Ordering information

Type number	Package		
	Name	Description	Version
IP4358CX6	WLCSP6	wafer level chip-size package; 6 bumps (2 × 3)	IP4358CX6

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4. Limiting values

Table 3. Limiting values
In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions		Min	Max	Unit
V_I	input voltage	pins A1, A2, C1 and C2 to ground (B1, B2)		–0.5	+5.5	V
V_{ESD}	electrostatic discharge voltage	pins A1, A2, C1 and C2 to ground (B1, B2)				
		contact discharge	[1]	–15	+15	kV
		air discharge	[1]	–20	+20	kV
		IEC 61000-4-2 level 4; pins A1, A2, C1 and C2 to ground (B1, B2)				
		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			–35	+85	°C

[1] Device is qualified with 1000 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
$C_{(I/O-GND)}$	input/output to ground capacitance	pins A1, A2, C1 and C2 to ground (B1, B2); V_I = 3.3 V; f = 1 MHz	[1]	-	1.3	1.5	pF
I_{LR}	reverse leakage current	pins A1, A2, C1 and C2 to ground (B1, B2); V_I = 3.3 V		-	-	100	nA
V_{BRzd}	Zener diode breakdown voltage	I_{test} = 1 mA		6	-	9	V
V_F	forward voltage			-	0.7	-	V
R_{dyn}	dynamic resistance	I_{test} = 1 A; IEC 61000-4-5					
		positive discharge		-	0.45	-	Ω
		negative discharge		-	0.45	-	Ω

[1] Guaranteed by design.

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6. Application information

6.1 Insertion loss

The IP4358CX6 is designed as an ESD protection device for high speed interfaces such as USB 2.0, DVI and HDMI high speed data lines etc. The insertion loss measurement configuration of a typical 50 Ω NetWork Analyzer (NWA) system for evaluation of the IP4358CX6 is shown in Figure 1.

The insertion loss of IP4358CX6 is shown in Figure 2.

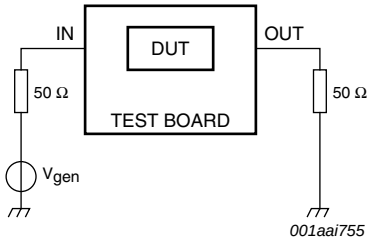
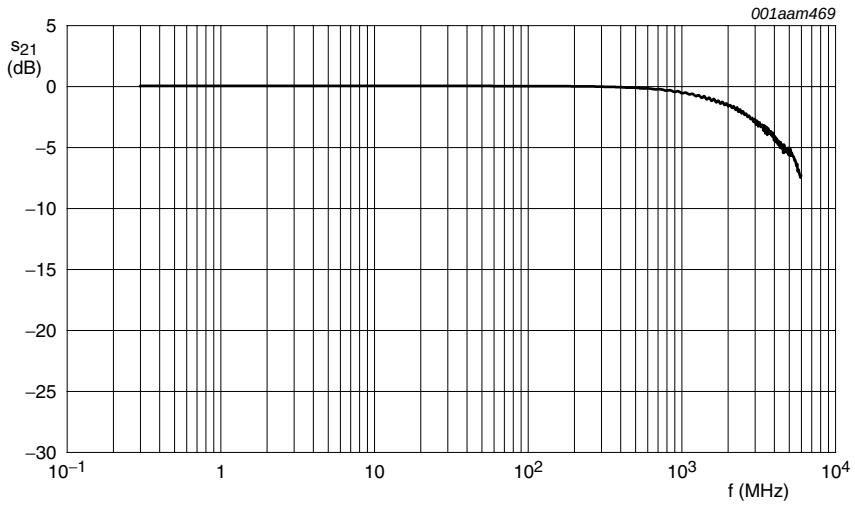


Fig 1. Frequency response measurement configuration



Pin A1 to ground.

Fig 2. Measured insertion loss magnitude

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6.2 Crosstalk

The crosstalk measurement configuration of a typical 50 Ω NWA system for evaluation of the IP4358CX6 is shown in Figure 3.

The crosstalk measurement results of IP4358CX6 are shown in Figure 4.

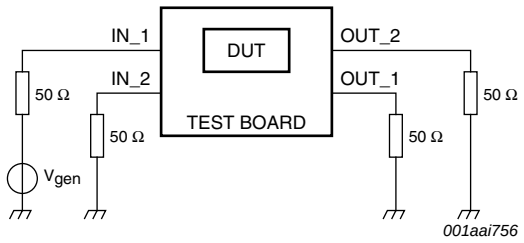
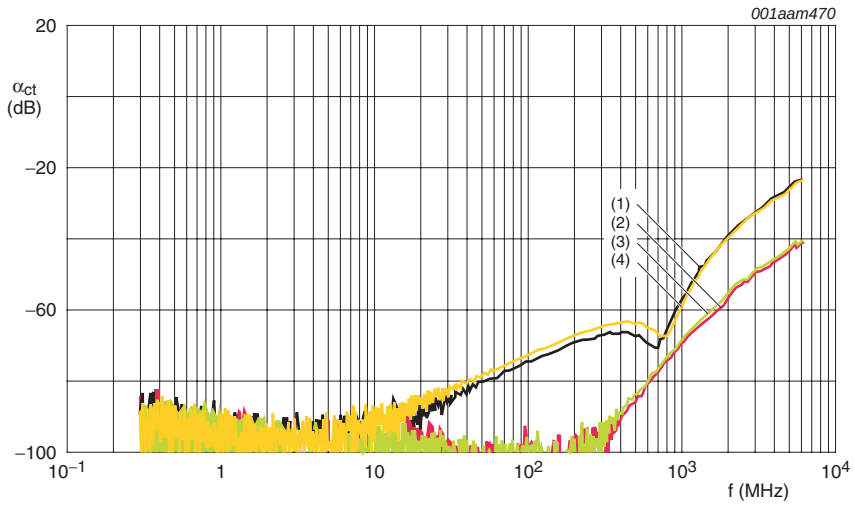


Fig 3. Crosstalk measurement configuration



(1) Pin A1 to pin A2.
(2) Pin A1 to pin C2.
(3) Pin C1 to pin A2.
(4) Pin C1 to pin C2.

Fig 4. Measured crosstalk between different channels

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7. Package outline

WLCSP6: wafer level chip-size package; 6 bumps (2 x 3)

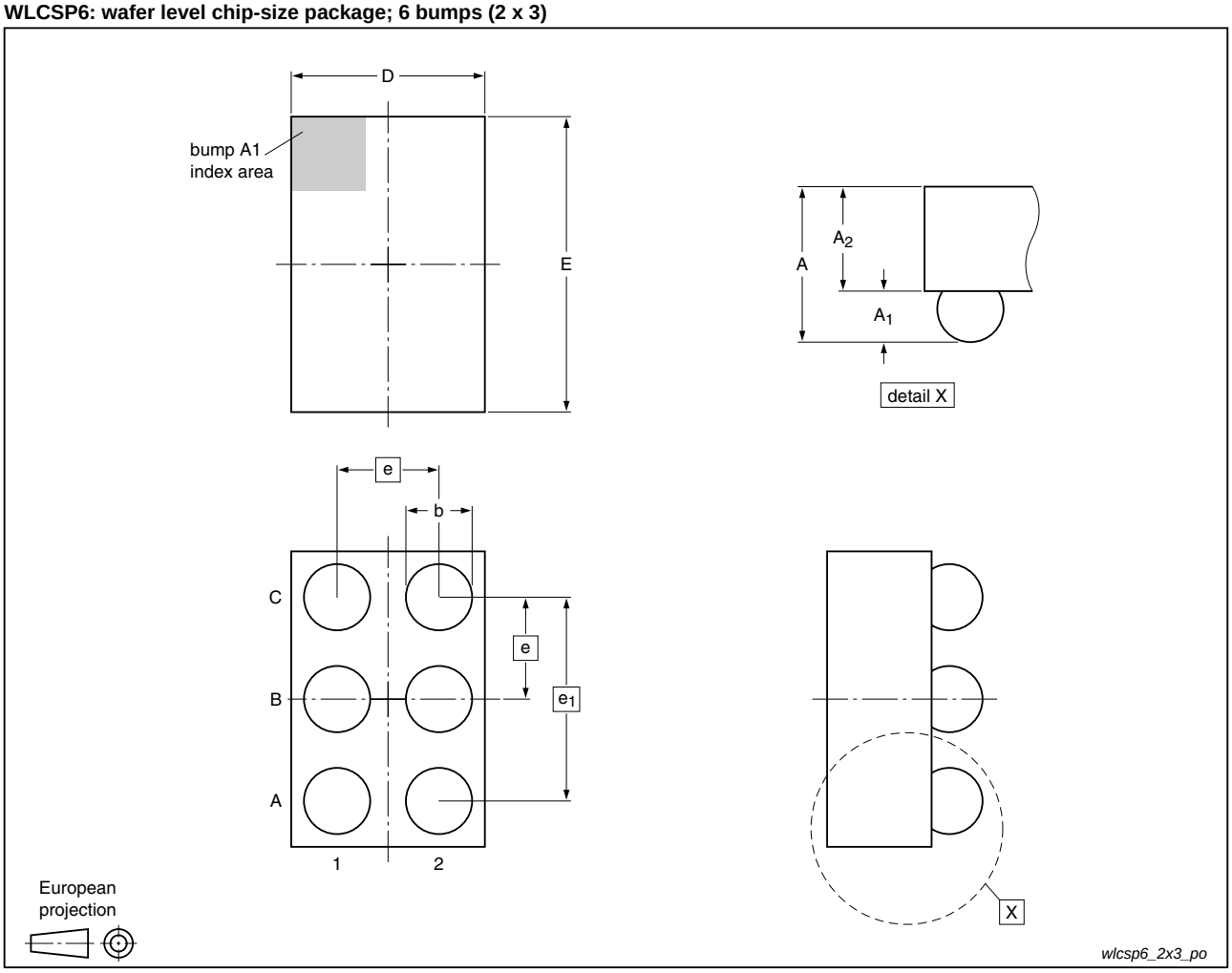

Fig 5. Package outline IP4358CX6 (WLCSP6)

Table 5. Dimensions of IP4358CX6 for Figure 5

Symbol	Min	Typ	Max	Unit
A	0.57	0.61	0.65	mm
A_1	0.18	0.20	0.22	mm
A_2	0.39	0.41	0.43	mm
b	0.21	0.26	0.31	mm
D	0.71	0.76	0.81	mm
E	1.11	1.16	1.21	mm
e	-	0.4	-	mm
e_1	-	0.8	-	mm

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8. Design and assembly recommendations

8.1 PCB design guidelines

It is recommended, for optimum performance, 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. Refer to Table 6 for the recommended PCB design parameters.

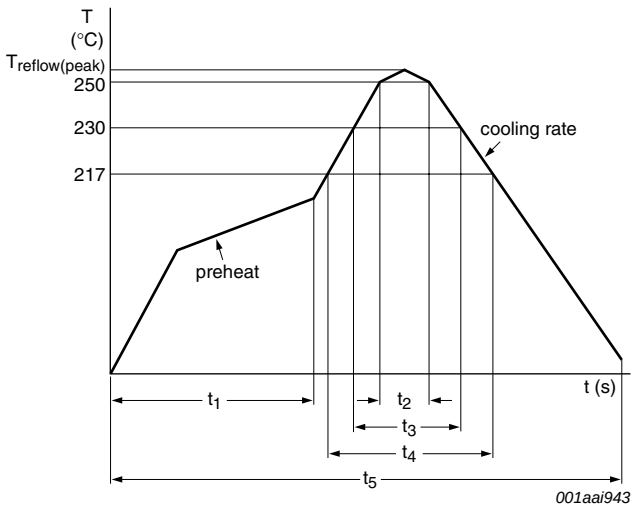
Table 6. Recommended PCB design parameters

Parameter	Value or specification
PCB pad diameter	250 μm
Micro-via diameter	100 μm (0.004 inch)
Solder mask aperture diameter	325 μm
Copper thickness	20 μm to 40 μm
Copper finish	AuNi or OSP
PCB material	FR4

8.2 PCB assembly guidelines for Pb-free soldering

Table 7. Assembly recommendations

Parameter	Value or specification
Solder screen aperture diameter	290 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 6



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

Fig 6. Pb-free solder reflow profile

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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

9. Abbreviations

Table 9. Abbreviations

Acronym	Description
DUT	Device Under Test
DVI	Digital Visual Interface
ESD	ElectroStatic Discharge
FR4	Flame Retard 4
HDMI	High Definition Multimedia Interface
NSMD	Non-Solder Mask Defined
NWA	NetWork Analyzer
OSP	Organic Solderability Preservative
PCB	Printed-Circuit Board
RoHS	Restriction of Hazardous Substances
USB	Universal Serial Bus
WLCSP	Wafer-Level Chip-Scale Package

10. Revision history

Table 10. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
IP4358CX6 v.1	20101018	Product data sheet	-	-

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Document status[1][2]	Product status[3]	Definition
Objective [short] data sheet	Development	This document contains data from the objective specification for product development.
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[2] The term 'short data sheet' is explained in section "Definitions".

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