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IP4338CX24/LF

10-channel integrated filter network with ESD input protection to IEC 61000-4-2 level 4

Rev. 02 — 20 August 2009 Product data sheet

1. Product profile

1.1 General description

The IP4338CX24/LF is a 10-channel RC low-pass filter array which is designed to provide filtering of undesired RF signals in the 800 MHz to 3000 MHz frequency band. In addition, the IP4338CX24/LF incorporates diodes to provide protection to downstream components from ElectroStatic Discharge (ESD) voltages as high as ±15 kV.

The IP4338CX24/LF is fabricated using monolithic silicon technology and integrates 10 resistors and 20 diodes in a single Wafer-Level Chip-Scale Package (WLCSP) measuring 1.96 mm by 2.01 mm (typical). These features make the IP4338CX24/LF ideal for use in applications requiring the utmost in miniaturization.

1.2 Features

- Pb-free, RoHS compliant and free of halogen and antimony (Dark Green compliant)
- Integrated 10-channel π-type RC filter network
- 70 Ω series resistance; 25 pF (typical) capacitance per line
- Integrated ESD protection withstanding ±15 kV contact discharge, far exceeding IEC 61000-4-2 level 4
- WLCSP with 0.4 mm pitch

1.3 Applications

- Cellular and Personal Communication System (PCS) mobile handsets
- Cordless telephones
- Wireless data (WAN/LAN) systems

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2. Pinning information

2.1 Pinning

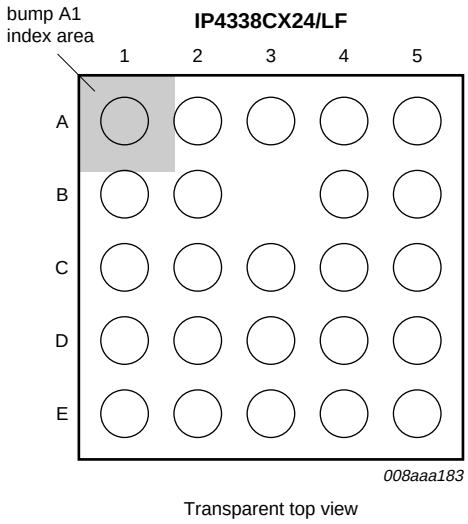


Fig 1. Pin configuration IP4338CX24/LF

2.2 Pin description

Table 1. Pinning

Pin	Description
A2 and A5	filter channel 1
A1 and A4	filter channel 2
B2 and B5	filter channel 3
B1 and B4	filter channel 4
C2 and C5	filter channel 5
C1 and C4	filter channel 6
D2 and D5	filter channel 7
D1 and D4	filter channel 8
E2 and E5	filter channel 9
E1 and E4	filter channel 10
A3, C3, D3, E3	ground
B3	no ball

3. Ordering information

Table 2. Ordering information

Type number	Package		
	Name	Description	Version
IP4338CX24/LF	WLCSP24	wafer level chip-size package; 24 bumps; 1.96 × 2.01 × 0.61 mm	IP4338CX24/LF

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4. Functional diagram

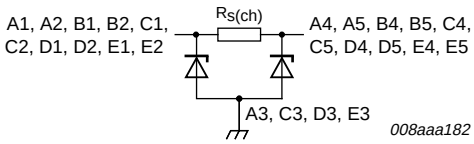


Fig 2. Schematic diagram IP4338CX24/LF

5. 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			–0.5	+5.5	V
V_{ESD}	electrostatic discharge voltage	all pins to ground				
		contact discharge	[1]	–15	+15	kV
		air discharge	[1]	–15	+15	kV
		IEC 61000-4-2 level 4; all pins to ground				
		contact discharge		–8	+8	kV
		air discharge		–15	+15	kV
I_{ch}	channel current (DC)	T_{amb} = 70 °C		-	33	mA
P_{ch}	channel power dissipation	continuous power; T_{amb} = 70 °C		-	60	mW
P_{tot}	total power dissipation	continuous power; T_{amb} = 70 °C		-	250	mW
T_{stg}	storage temperature			–55	+150	°C
$T_{reflow(peak)}$	peak reflow temperature	10 s maximum		-	260	°C
T_{amb}	ambient temperature			–30	+85	°C

[1] Device is qualified with 1000 pulses of ±15 kV contact discharges each, according to the IEC61000-4-2 model and far exceeds the specified level 4 (8 kV contact discharge).

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6. Characteristics

Table 4. Channel characteristics

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

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$R_{s(ch)}$	channel series resistance	f = 0 Hz (DC)	52.5	70	87.5	Ω
C_{ch}	channel capacitance	$V_{bias(DC)}$ = 0 V; f = 1 MHz [1]	-	25	30	pF
V_{BR}	breakdown voltage	I_{test} = 1 mA	6	-	20	V
I_{LR}	reverse leakage current	per channel; V_I = 3.0 V	-	-	20	nA

[1] Guaranteed by design.

Table 5. Frequency characteristics

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

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
α_{il}	insertion loss	800 MHz < f < 3 GHz; R_{gen} = 50 Ω; R_L = 50 Ω	-	20	-	dB
α_{ct}	crosstalk attenuation	800 MHz < f < 3 GHz; R_{gen} = 50 Ω; R_L = 50 Ω	-	25	-	dB

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7. Application information

7.1 Insertion loss

The insertion loss measurement configuration of a typical 50 Ω NetWork Analyzer (NWA) system for evaluation of the IP4338CX24/LF is shown in Figure 3.

As an example, the insertion loss of channels between pins A2 and A5, A1 and A4, C1 and C4, E2 and E5, E1 and E4 at frequencies up to 6 GHz is displayed in Figure 4.

The insertion loss is measured with a test PCB utilizing laser drilled micro-via holes that connect the PCB ground plane to the IP4338CX24/LF ground pins.

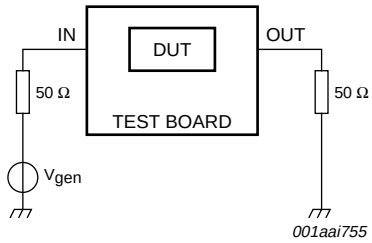
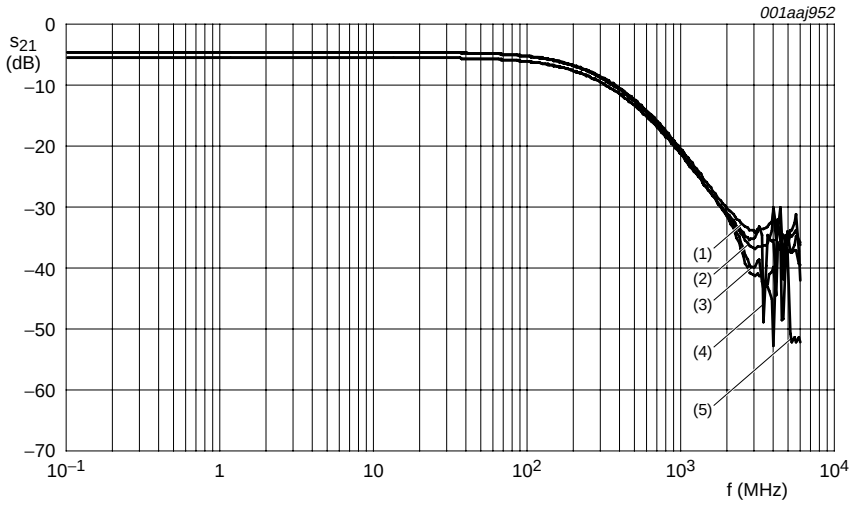


Fig 3. Frequency response measurement configuration



(1) Channel 10 (pins E1 and E4).
(2) Channel 9 (pins E2 and E5).
(3) Channel 1 (pins A2 and A5).
(4) Channel 2 (pins A1 and A4).
(5) Channel 6 (pins C1 and C4).

Fig 4. Measured insertion loss magnitudes

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7.2 Crosstalk

The crosstalk measurement configuration of a typical 50 Ω NWA system for evaluation of the IP4338CX24/LF is shown in Figure 5.

The measured crosstalk within the IP4338CX24/LF in a 50 Ω NWA system from one channel to another is shown in Figure 6 for five different pairs of channels. In all cases, unused connections are terminated with 50 Ω to ground.

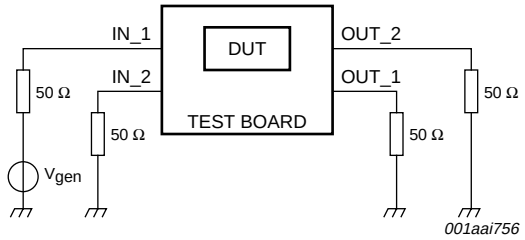
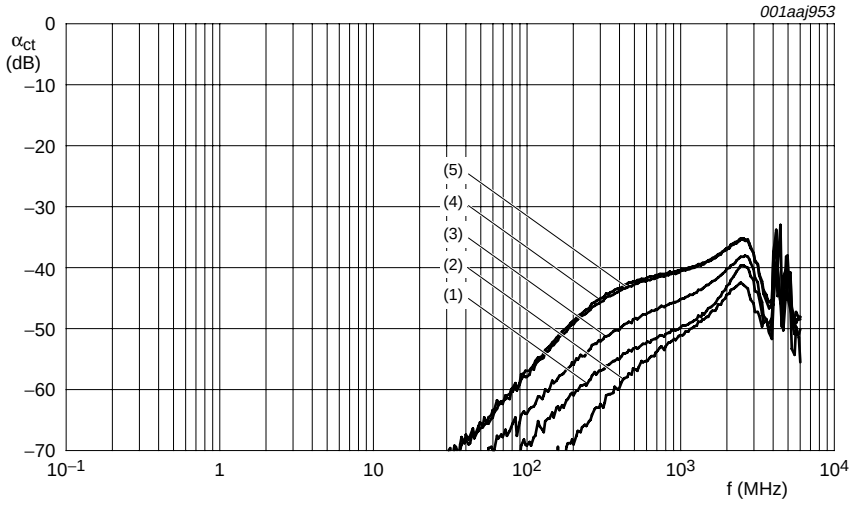


Fig 5. Crosstalk measurement configuration



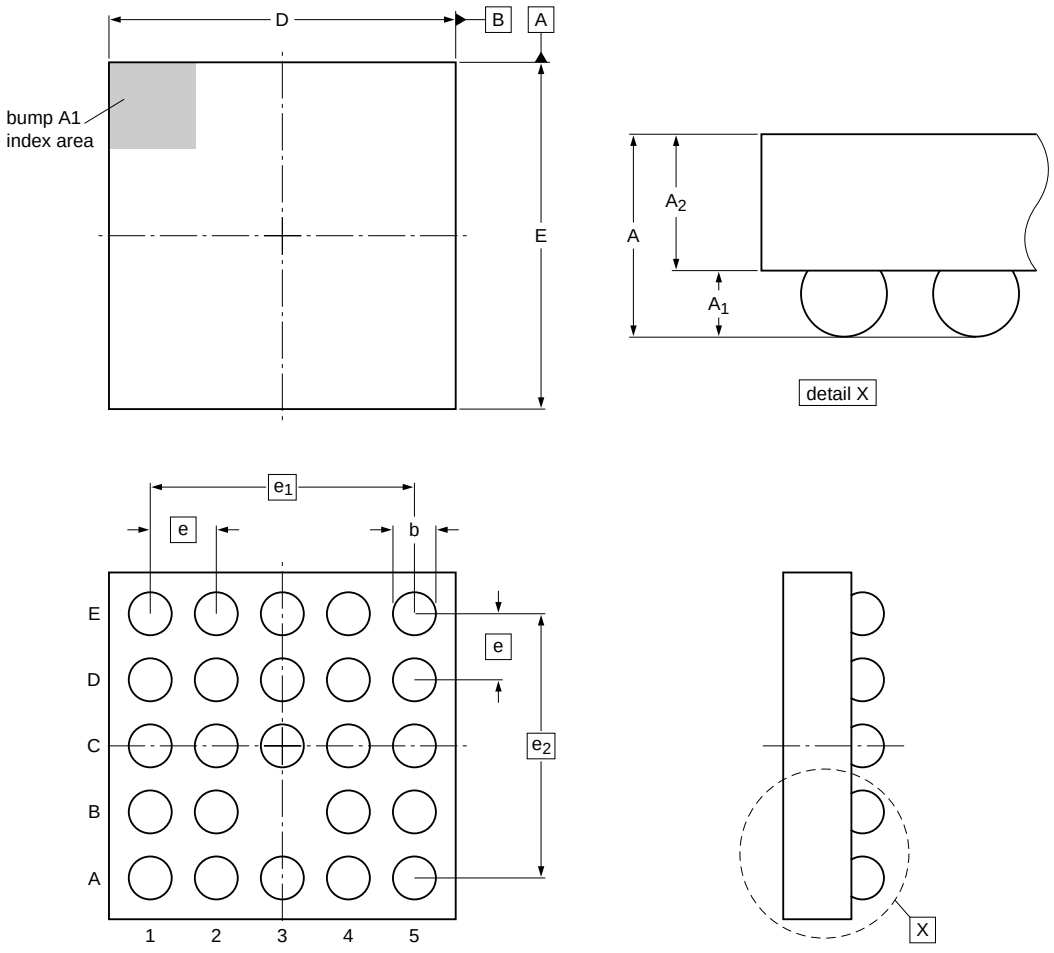
(1) Channels 2 and 6 (pins A1 and C4).
(2) Channels 2 and 10 (pins A1 and E4).
(3) Channels 3 and 7 (pins B2 and D5).
(4) Channels 5 and 3 (pins C2 and B5).
(5) Channels 5 and 7 (pins C2 and D5).

Fig 6. Measured crosstalk between adjacent channels

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8. Package outline

WLCSP24: wafer level chip-size package; 24 bumps; 1.96 x 2.01 x 0.61 mm **IP4338CX24/LF**



Dimensions

Unit		A	A_1	A_2	b	D	E	e	e_1	e_2
mm	max	0.66	0.22		0.31	2.01	2.06			
	nom	0.61	0.20	0.41	0.26	1.96	2.01	0.4	1.6	1.6
	min	0.56	0.18		0.21	1.91	1.96			

ip4338cx24_lf_po

Outline version	References				European projection	Issue date
	IEC	JEDEC	JEITA			
IP4338CX24/LF						~~09-03-25~~ 09-05-19

Fig 7. Package outline IP4338CX24/LF (WLCSP24)

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9. Soldering of WLCSP packages

9.1 Introduction to soldering WLCSP packages

This text provides a very brief insight into a complex technology. A more in-depth account of soldering WLCSP (Wafer Level Chip-Size Packages) can be found in application note *AN10439 "Wafer Level Chip Scale Package"* and in application note *AN10365 "Surface mount reflow soldering description"*.

Wave soldering is not suitable for this package.

All NXP WLCSP packages are lead-free.

9.2 Board mounting

Board mounting of a WLCSP requires several steps:

1. Solder paste printing on the PCB
2. Component placement with a pick and place machine
3. The reflow soldering itself

9.3 Reflow soldering

Key characteristics in reflow soldering are:

- Lead-free versus SnPb soldering; note that a lead-free reflow process usually leads to higher minimum peak temperatures (see Figure 8) than a PbSn process, thus reducing the process window
- Solder paste printing issues, such as smearing, release, and adjusting the process window for a mix of large and small components on one board
- Reflow temperature profile; this profile includes preheat, reflow (in which the board is heated to the peak temperature), and cooling down. It is imperative that the peak temperature is high enough for the solder to make reliable solder joints (a solder paste characteristic) while being low enough that the packages and/or boards are not damaged. The peak temperature of the package depends on package thickness and volume and is classified in accordance with Table 6.

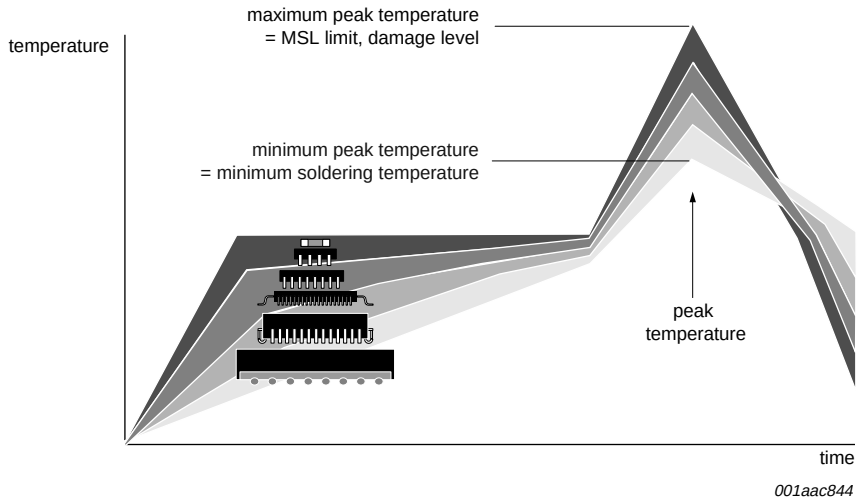
Table 6. Lead-free process (from J-STD-020C)

Package thickness (mm)	Package reflow temperature (°C)		
	Volume (mm^3)		
	< 350	350 to 2000	> 2000
< 1.6	260	260	260
1.6 to 2.5	260	250	245
> 2.5	250	245	245

Moisture sensitivity precautions, as indicated on the packing, must be respected at all times.

Studies have shown that small packages reach higher temperatures during reflow soldering, see Figure 8.

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MSL: Moisture Sensitivity Level

Fig 8. Temperature profiles for large and small components

For further information on temperature profiles, refer to application note *AN10365 "Surface mount reflow soldering description"*.

9.3.1 Stand off

The stand off between the substrate and the chip is determined by:

- The amount of printed solder on the substrate
- The size of the solder land on the substrate
- The bump height on the chip

The higher the stand off, the better the stresses are released due to TEC (Thermal Expansion Coefficient) differences between substrate and chip.

9.3.2 Quality of solder joint

A flip-chip joint is considered to be a good joint when the entire solder land has been wetted by the solder from the bump. The surface of the joint should be smooth and the shape symmetrical. The soldered joints on a chip should be uniform. Voids in the bumps after reflow can occur during the reflow process in bumps with high ratio of bump diameter to bump height, i.e. low bumps with large diameter. No failures have been found to be related to these voids. Solder joint inspection after reflow can be done with X-ray to monitor defects such as bridging, open circuits and voids.

9.3.3 Rework

In general, rework is not recommended. By rework we mean the process of removing the chip from the substrate and replacing it with a new chip. If a chip is removed from the substrate, most solder balls of the chip will be damaged. In that case it is recommended not to re-use the chip again.

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Device removal can be done when the substrate is heated until it is certain that all solder joints are molten. The chip can then be carefully removed from the substrate without damaging the tracks and solder lands on the substrate. Removing the device must be done using plastic tweezers, because metal tweezers can damage the silicon. The surface of the substrate should be carefully cleaned and all solder and flux residues and/or underfill removed. When a new chip is placed on the substrate, use the flux process instead of solder on the solder lands. Apply flux on the bumps at the chip side as well as on the solder pads on the substrate. Place and align the new chip while viewing with a microscope. To reflow the solder, use the solder profile shown in application note *AN10365 "Surface mount reflow soldering description"*.

9.3.4 Cleaning

Cleaning can be done after reflow soldering.

10. Abbreviations

Table 7. Abbreviations

Acronym	Description
DUT	Device Under Test
ESD	ElectroStatic Discharge
LAN	Local Area Network
NWA	NetWork Analyzer
PCB	Printed-Circuit Board
PCS	Personal Communication System
RoHS	Restriction of Hazardous Substances
WAN	Wide Area Network
WLCSP	Wafer-Level Chip-Scale Package

11. Revision history

Table 8. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
IP4338CX24LF_2	20090820	Product data sheet	-	IP4338CX24LF_1
Modifications:	• Figure 4: figure title and symbol changed			
IP4338CX24LF_1	20090618	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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