

# IP3338CX24

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

Rev. 02 — 10 March 2009

Product data sheet

## 1. Product profile

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### 1.1 General description

The IP3338CX24 is a 10-channel<sup>1</sup> LC low-pass filter network designed to filter undesired RF signals in the 800 MHz to 3000 MHz frequency band. In addition, the IP3338CX24 incorporates diodes which protect downstream components from ElectroStatic Discharge (ESD) voltages as high as 15 kV.

The IP3338CX24 is fabricated using monolithic silicon technology and integrates 10 inductors and 20 back-to-back diodes in a single Wafer-Level Chip-Scale Package (WLCSP) measuring 2.11 mm by 2.11 mm (typical). These features make the IP3338CX24 ideal for use in applications requiring the utmost in miniaturization such as mobile phone handsets, cordless telephones and personal digital devices.

### 1.2 Features

- Pb-free, RoHS compliant and halogen free package; Dark Green compliant
- Integrated 10-channel  $\pi$ -type LC filter network with 60 nH channel inductance
- 125  $\Omega$  series resistance; 25 pF (typical) capacitance per line
- Integrated ESD protection withstanding  $\pm 15$  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
- PDAs

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1. Also available as a 7-channel device (IP3337CX18).

## 2. Pinning information

### 2.1 Pinning

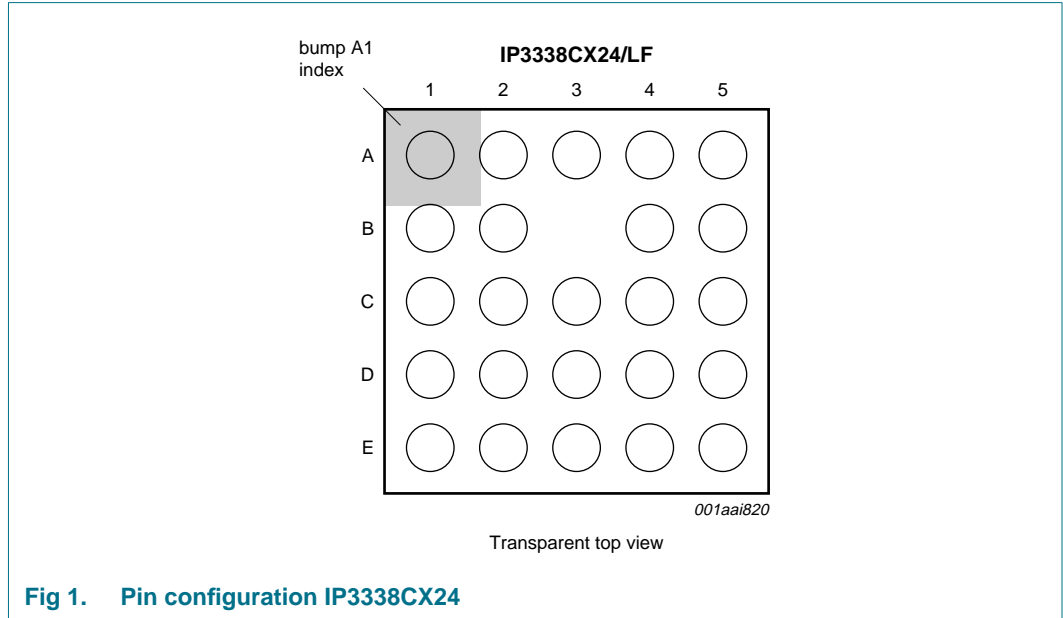


Fig 1. Pin configuration IP3338CX24

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
IP3338CX24/LF	WLCSP24	wafer level chip-size package; 24 bumps; 2.11 × 2.11 × 0.61 mm	IP3338CX24/LF

## 4. Functional diagram

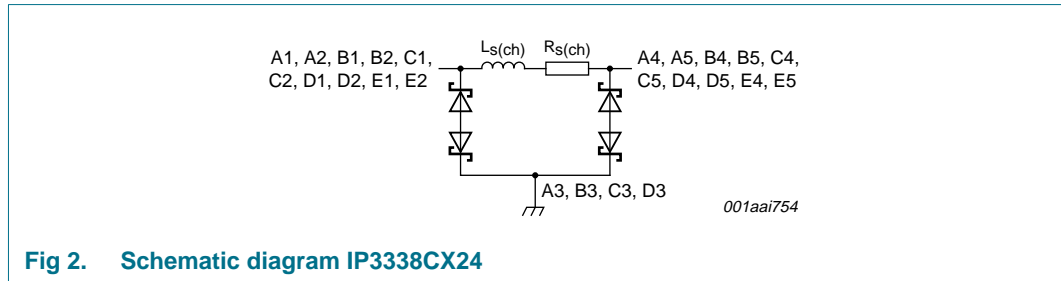


Fig 2. Schematic diagram IP3338CX24

## 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		-4.0	+4.0	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)	$T_{amb} = 70\text{ °C}$	-	10	mA
$I_{ch(M)}$	peak channel current	$T_{amb} = 70\text{ °C}; 60\text{ s}$	-	50	mA
$P_{ch}$	channel power dissipation	continuous power; $T_{amb} = 70\text{ °C}$	-	10	mW
$P_{tot}$	total power dissipation	$T_{amb} = 70\text{ °C}$	-	100	mW
$T_{stg}$	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 tested with 1000 pulses of  $\pm 15\text{ kV}$  contact discharges, according to the IEC 61000-4-2 model, which far exceeds IEC 61000-4-2, level 4 (8 kV contact discharge).

## 6. Characteristics

**Table 4. Channel characteristics**

$T_{amb} = 25\text{ }^{\circ}\text{C}$ ; unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$R_{s(ch)}$	channel series resistance	$f = 0\text{ Hz (DC)}$	100	125	150	$\Omega$
$C_{ch}$	channel capacitance	$V_{bias(DC)} = 0\text{ V}; f = 1\text{ MHz}$	-	25	30 <sup>[1]</sup>	pF
$L_{s(ch)}$	channel series inductance		<sup>[1]</sup> -	60	-	nH
$V_{BR}$	breakdown voltage	$I_{test} = 1\text{ mA}$	6	-	10	V
		$I_{test} = -1\text{ mA}$	-10	-	-6	V
$I_{LR}$	reverse leakage current	per channel; $V_I = 3.0\text{ V}$	-	-	100	nA

[1] Guaranteed by design.

**Table 5. Frequency characteristics**

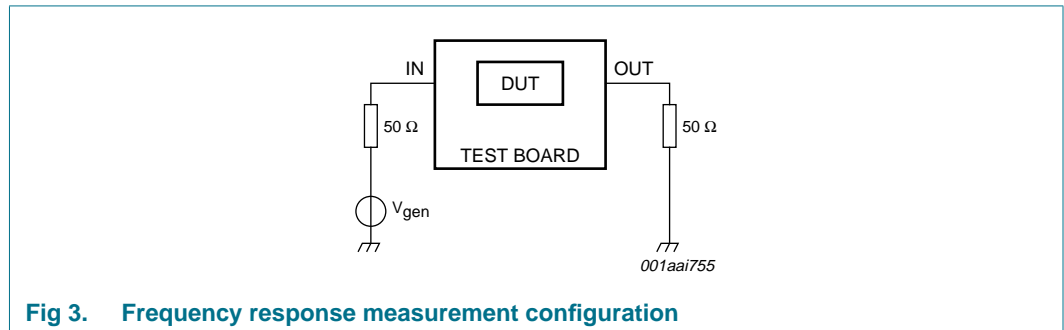
$T_{amb} = 25\text{ }^{\circ}\text{C}$ ; unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$\alpha_{ij}$	insertion loss	$R_{gen} = 50\ \Omega; R_L = 50\ \Omega$				
		$800\text{ MHz} < f < 1\text{ GHz}$	38	40	-	dB
		$1\text{ GHz} < f < 3\text{ GHz}$	35	40	-	dB
		at 0 Hz; $R_{gen} = 50\ \Omega;$ $R_L = 50\ \Omega; V_{bias(DC)} = 0\text{ V}$	6	7	10	dB
$f_{-3dB}$	cut-off frequency	measured relative to insertion loss at DC; $R_{gen} = 50\ \Omega; R_L = 50\ \Omega$	150	180	-	MHz
$\alpha_{ct}$	crosstalk attenuation	$800\text{ MHz} < f < 3\text{ GHz};$ $R_{gen} = 50\ \Omega; R_L = 50\ \Omega$	35	40	-	dB

## 7. Application information

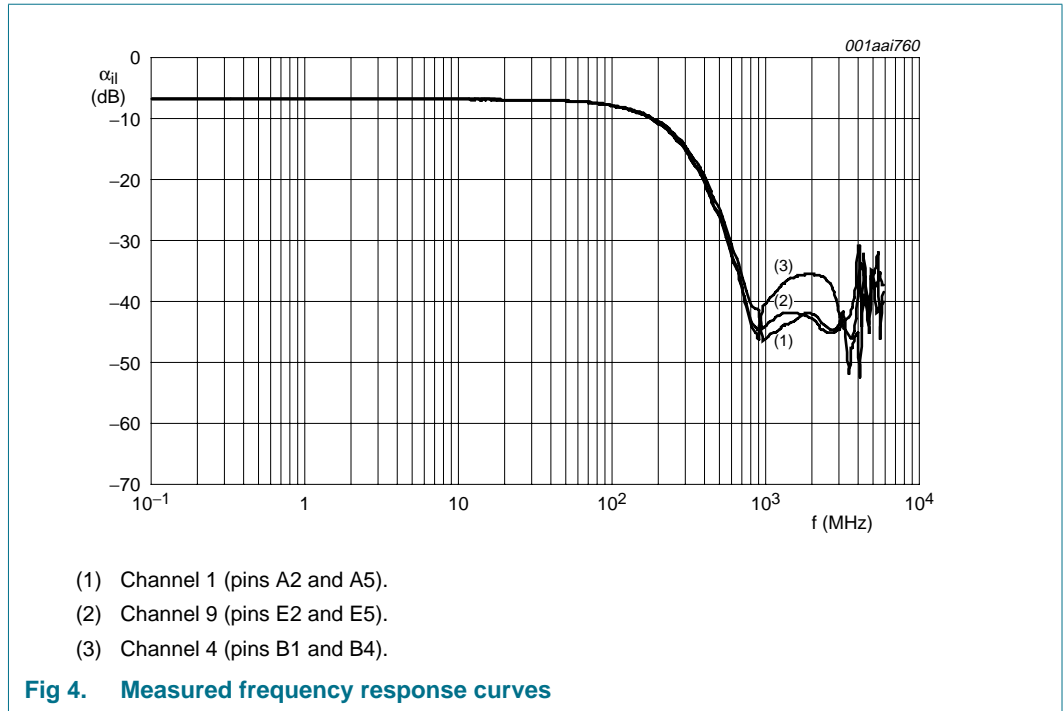
### 7.1 Insertion loss

The setup for measuring insertion loss in a 50  $\Omega$  system is shown in [Figure 3](#).



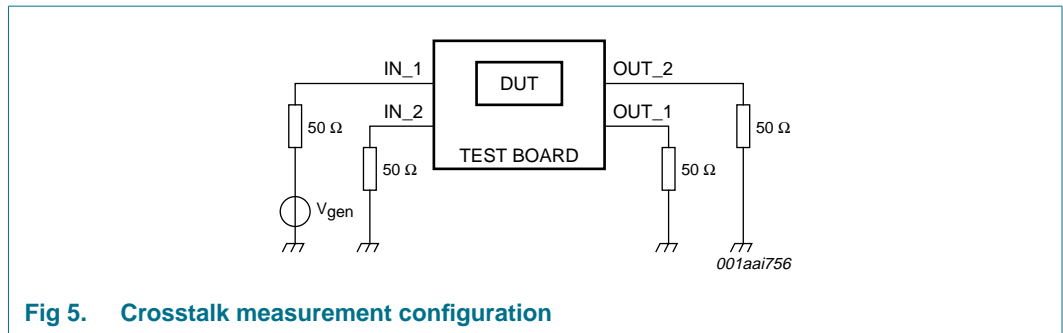
**Fig 3. Frequency response measurement configuration**

The measured frequency response curves for all channels are shown in [Figure 4](#).



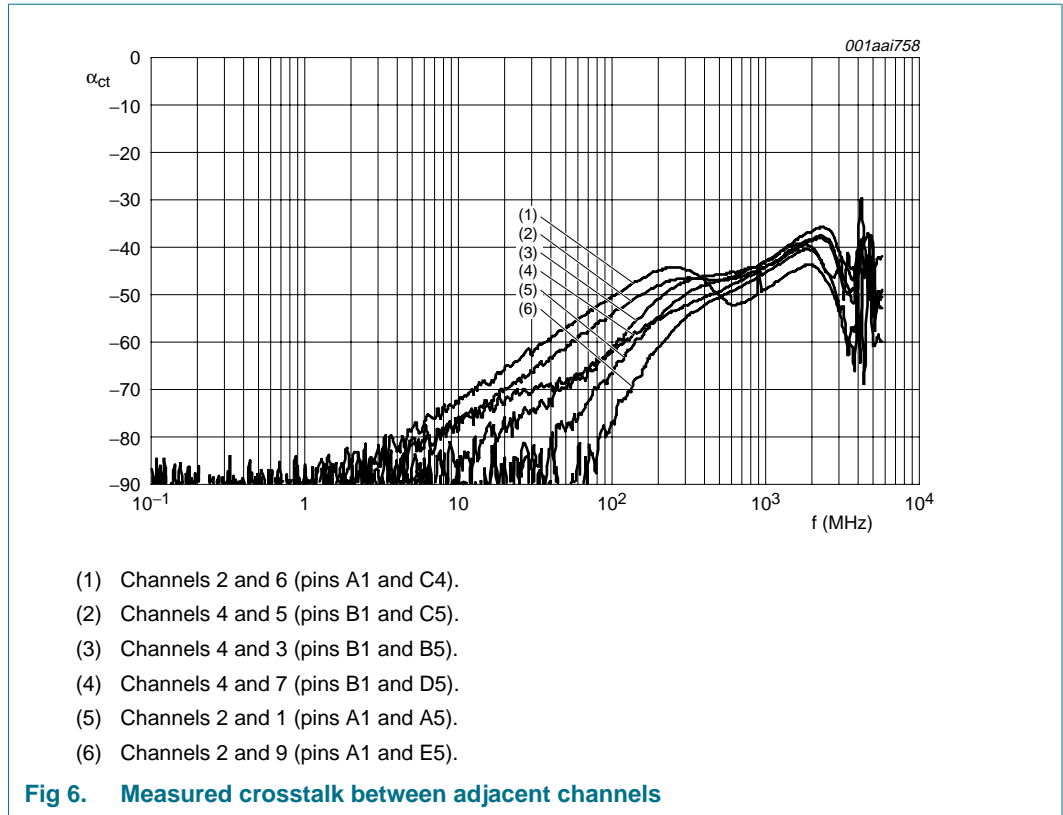
## 7.2 Crosstalk

The setup for measuring crosstalk in a 50 Ω system is shown in [Figure 5](#).



The crosstalk between adjacent channels within the IP3338CX24 for different channel pairs measured in a 50 Ω NetWork Analyzer (NWA) system, is shown in [Figure 6](#). In all cases, all unused connections are terminated with 50 Ω to ground.

10-channel integrated LC-filter network with ESD input protection



## 8. Package outline

WLCSP24: wafer level chip-size package; 24 bumps; 2.11 x 2.11 x 0.61 mm

IP3338CX24/LF

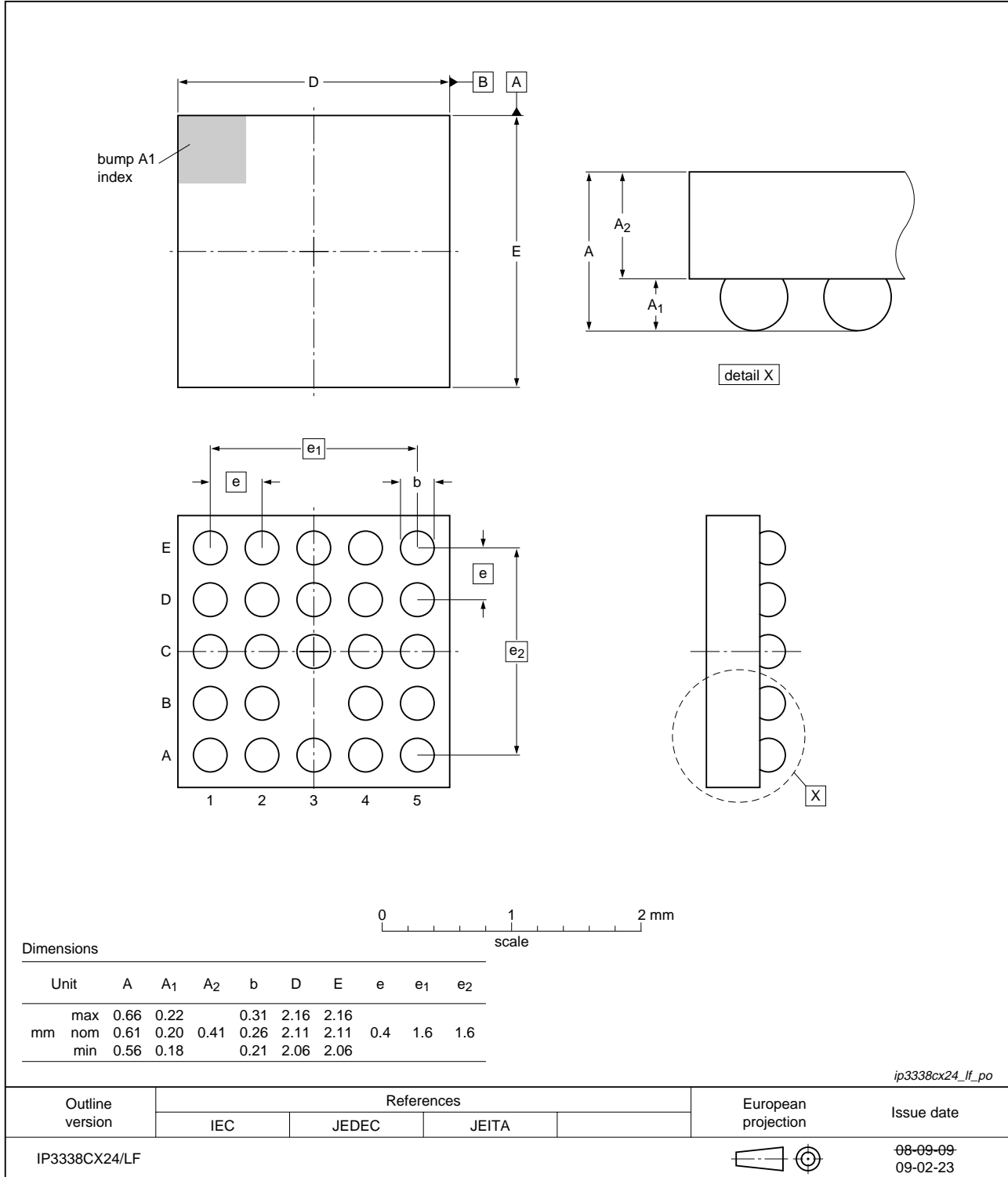


Fig 7. Package outline IP3338CX24/LF (WLCSP24)

## 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](#).

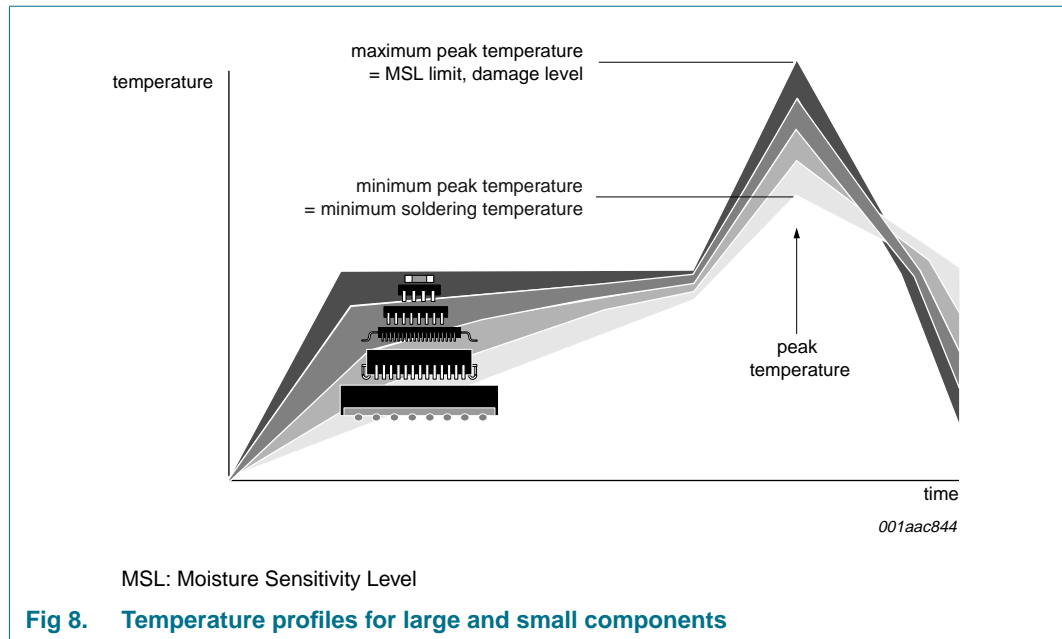
**Table 6. Lead-free process (from J-STD-020C)**

Package thickness (mm)	Package reflow temperature (°C)		
	Volume (mm <sup>3</sup> )		
	< 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](#).





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.

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
EMI	ElectroMagnetic Interference
ESD	ElectroStatic Discharge
FR4	Flame Retard 4
LAN	Local Area Network
NSMD	Non-Solder Mask Design
OSP	Organic Solderability Preservative
PCB	Printed-Circuit Board
PCS	Personal Communication System
PDA	Personal Digital Assistant
PSU	Power Supply Unit
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
IP3338CX24_2	20090310	Product data sheet	-	IP3338CX24_1
Modifications:	<ul style="list-style-type: none"> <li>• <a href="#">Figure 1</a>: replaced bump A1 index marker with grey square</li> <li>• Removed 'Marking' section</li> <li>• <a href="#">Figure 7</a>: replaced bump A1 index marker with grey square</li> <li>• Removed 'Packing information' section</li> <li>• Replaced 'Design and assembly recommendations' with standard text inset</li> </ul>			
IP3338CX24_1	20081113	Product data sheet	-	-

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Document status <sup>[1][2]</sup>	Product status <sup>[3]</sup>	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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