# cādence<sup>®</sup>

## 2.5D Interposer Design Flow Using Dual-side Component Process in Cadence SiP Layout

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## Purpose

This application note uses an example to outline a recommended flow process for setting up 2.5D organic interposers in Cadence® SiP Layout that uses the new dual-side component support capabilities. This is article the first of two application notes in the interposer series. The second will describe process for interposer design and routing.

## Audience

This document is intended for any design implementation user of SiP Layout.

## Overview

Cadence® SiP Layout offers a rich technology portfolio for the design of IC packages, simple dies, stacked dies, complex two-sided dies, and, now, 2.5D interposers.

This article outlines a recommended flow for setting up the design database, and lists the steps to correctly design a basic 2.5D interposer component.

Only the 2.5D interposer component flow process is discussed, all other requirements for interface mapping (logic, memory, and so on), constraints, basic routing rules, and so forth are outside the scope of this document.

## Setting up Design

Begin designing by setting up the design parameters to support a simple 2.5D interposer. Since a large part of the 2.5D interposer *digita*l design space typically deals with both memory and logic, the settings support both regular die (die text in) and die abstracts, which are imported directly from Cadence® Innovus™ Implementation System and the Cadence® Virtuoso® platform.

- 1. <u>Set up cross-section information</u>
- 2. Design interposer
- 3. <u>Set grid</u>
- 4. Add pins
- 5. Verify interposer

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#### **Setting up Cross-Section Information**

The first step in the design process is to set up cross-section information. The interposer is placed and managed at the SiP Layout die-stack level.

1. Choose Setup — Cross-section.

You must add the die stack layers. A 10 layer interposer is defined for this example. The die stack defines the following three parameters:

- Die location layer (*DIE\_PLACE*).
- Top of interposer for micro bumps (*M1\_IPOSER\_UBUMP*).
- Bottom of interposer for c4 bumps and connections to package substrate (*M10\_IPOSER\_C4*).

Cross Section Editor Export Import Edit View Filters Primary Types >> Thickness >> Physical >> Objects Value Layer Layer Function Layer ID Material # Name um Surface 1 2 DIE PLACE D1 Die Stack M1\_IPOSER\_UBUMP Die Stack D2 Dielectric M2 D3 3 Die Stack Dielectric 4 M3 D4 Die Stack Dielectric 5 M4 Die Stack D5 Dielectric 6 M5 BU COREN Dielectric D6 7 CORE Dielectric D7 8 M6\_BU\_CORES D8 Die Stack Dielectric 9 M7 Die Stack D9 Dielectric 10 M8 Die Stack D10 Dielectric 11 M9 Die Stack D11 Dielectric 12 M10\_IPOSER\_C4 D12 Die Stack Dielectric Dielectric 25 Fr-4 Conductor 13 M1\_SUB Conductor 14 Copper Dielectrie Diologtric 4.4 En 4 Info Lock Embedded layers setup Unused pads suppression Refresh materials

The stack is shown in the following figure.

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#### **Designing the Interposer**

To generate the interposer component, use the Symbol Edit application mode.

'x

- 1. Choose Setup Application Mode Symbol Edit.
- 2. In the Find pane, select Comps.
- 3. Right-click on the canvas and choose *Add Component*.
- 4. In the Options pane, add parameters for the interposer.

The following figure shows the parameters used in the example in this document.

Note: The pad layer is the top of the interposer.

	Options	Find	Visibility				
	Options -				 	_	6
	Ref des:	IPC	)SER				
	Symbol nan	ne: IPC	)SER				
	Comp type:	Die	/Interposer	-			
	Upper right:						
I	opper light.						
I	X:	300	00 UM				
	Y:	200	00 UM				
	Lower left:						
I	X:	-30	00 UM				
	Y:	-20	00 UM				
	Pad layer:	M1	_IPOSER_L	IBUM 👻			
	Chip attach	ment:					
	🔘 Wire	Bond	Flip-Chip				
	Orientation:						
	💿 Chip	up	🔘 Chip dov	vn			
		Create C	omponent				

5. Click Create Component.

#### **Setting Grid**

A basic grid is set in the example.

- 1. Select the interposer in the design.
- 2. Right-click and choose Add Grid.
- 3. Setup grid as required. The grid settings for this example is shown in the following figure.

Options F	ind Visibility
Options	
Name:	GRID1
Priority:	1
🔲 Auto config	ure from selected pins
Staggered	grid
	<b>FOUR</b>
X Pitch:	50 UM
Edge inset:	200 UM
🔽 Y Pitch:	50 UM
Edge inset:	200 UM
Inset corner:	Bottom-Left Corner 🔻
📝 Snap grid e	xtents to base grid

4. Draw a box around the area of the interposer symbol for your grid setup.

#### Adding Pins to the Interposer

To enhance the pin array generation performance and DRC checks for interposers using large pin arrays, set the *NODRC\_SYM\_SAME\_PIN* property. This property stops the online DRC engine from checking pins defined in the symbol.

- 1. Set Find filter to Symbols.
- 2. Choose Edit Properties.
- 3. Select your Symbol.
- 4. In the Edit Property form, select *NODRC\_SYM\_SAME\_PIN*.

Now add micro bumps to the top and c4 bumps to the bottom of the interposer.

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To add micro bump pins to the top of the interposer, do the following steps:.

- 1. Right-click the interposer in SiP Layout canvas and choose Add pin.
- 2. Set Pad Type to BUMP.
- 3. Click for *Padstack* to create a new micro bump padstack.
- 4. Enter name for padstack.
- 5. Set layer to top of interposer. In the example, this layer corresponds to *M1\_IPOSER\_UBUMP*.
- 6. Set width; say 32um in this example.
- 7. Click OK

The pin is now attached to the cursor.

This example defines array for both top and bottom of the interposer.

- 8. In the Options pane, select Pattern definition.
- 9. Add a new group name or use the default.
- 10. From Pattern style, select Array.
- 11. Add X offset and Y offset. In the example, both are set to 200um.

12. Specify Horizontal and Vertical values for array size.

In this example, Horizontal is set to 115um and Vertical is set to 75um. Array pin pitch is set to Horizontal 50um and Vertical 50um.

The array is attached to the cursor. This is an easy way to ensure the array meets the final interposer top micro bump generation.

The following figure shows the final form prior to placing the micro bump array;

Options	Find	Visibility			
Options =			-	Ð	×
Pin con	figuration	Pattern definition			
	ngarador				
📝 Add pin	s to user	group			
IPOSER	R_PATTI	ERN_1			
Pattern styl	e: Arra	y 🗸			
Pattern orig	in: Curs	or Center 🔻			
X offset:	200	UM			
Y offset:	200	UM			
Dia anumb	0005				
Fin count.	0620				
Array size (i	in pins):				
Horizont	al:	115			
Vertical:		75			
Array pin pi	tch:				
Horizont	al:	50 UM			
Incre	ase by:	0 UM			
After	every:	50 pins			
Vertical:		50 UM			
Incre	ase by:	0 UM			
After	every:	1 pins			
Diagona	ul:	70.71 UM			
🔲 Stagger	pins				
Step co	unt:	2			
Start	with stag	ggered position			

13. Place the array.

14. Right-click and choose Done.

To add c4 bumps to the bottom of the interposer, do the following steps:

- 1. Select and right-click the interposer and then choose Add pin.
- 2. Set Pad Type to *BUMP*.
- 3. Create a new micro bump padstack. Click for Padstack
- 4. Enter name for padstack
- 5. Set layer to top of the interposer. In the example, the layer corresponds to *M10\_IPOSER\_C4*.

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- 6. Set width. In the example, it is 80um.
- 7. Click OK.

The pin is now attached to the cursor.

Use an array to define the array for both top and bottom of interposer.

- 8. In Options pane, switch to Pattern definition.
- 9. Add a new group name or use the default.
- 10. Select Array as the Pattern style.
- 11. Add offset for X, Y. In this example, both are set to 100um.
- 12. Enter Horizontal and Vertical Array size.

The array is attached to the cursor. This is an easy way to ensure the array meets the final interposer top micro bump generation.

- 13. Place the array.
- 14. Right-click and choose *Done*.

#### Verifying the Interposer

Verify the interposer by looking at the associated parameters using the die stack editor and 3D viewer.

- 1. Choose Edit Diestack.
- 2. Verify the die stack member information and also the view.

For the interposer created in this example, the die stack member details are shown in the following figure.

🚀 Die-stack Editor							
Die stack name: DIESTA	CK1   Renar	me					Ţ
Exclude Single-die Sta	oks						
Stack Placement							
Subsuale location.							
Sits of Tayer.	MI_306 •					IPOSER	
Cavity top layer:						SUBSTRATE TOP	
Cavity edge clearance:	0 UM						
Expansion per layer:	0 UM						
Die stack height:	120 UM						
Move Save	e as Defaults				Report Launch	3D viewer View O	Irientation: SOUTH 🔻
Die stack members:	1 1. 1						
Die stack members: Placement Me	ember details	Uninkt	Erent Lever	Paak Lawa	v	v	<b>▲</b>
Die stack members: Placement Me RefDes	mber details Type	Height	Front Layer	Back Layer	×	Y	► <b>→</b>
Die stack members: Placement Me RefDes *	mber details Type ×	Height	Front Layer	Back Layer	X	Y	Rotation
Die stack members: Placement Me RefDes * IPOSER	mber details Type * FLIP-CHIP CU	Height 120 UM	Front Layer	Back Layer M10_IPOSER_C4	X O UM	Y O UM	Rotation
Die stack members: Placement Me RefDes * IPOSER	mber details Type × FLIP-CHIP CU	Height 120 UM	Front Layer	Back Layer M10_IPOSER_C4	X O UM	Y O UM	Rotation
Die stack members: Placement Me RefDes * IPOSER	mber details Type × FLIP-CHIP CU	Height 120 UM	Front Layer	Back Layer M10_IPOSER_C4	UM CUM	Y O UM	Rotation
Die stack members: Placement Me RefDes * IPOSER	mber details Type × FLIP-CHIP CU	Height 120 UM	Front Layer	Back Layer M10_IPOSER_C4	Х ОИМ	Y О UM	Rotation
Die stack members: Placement Me RefDes * IPOSER	mber details Type × FLIP-CHIP CU	Height 120 UM	Front Layer	Back Layer M10_IPOSER_C4	UM CUM	UM	Rotation 0.000 deg
Die stack members: Placement Me RefDes * IPOSER	mber details Type × FLIP-CHIP CU	Height	Front Layer	Back Layer M10_IPOSER_C4	Х ОИМ	Y О UM	Rotation 0.000 deg
Die stack members: Placement Me RefDes * IPOSER	mber details Type × FLIP-CHIP CU	Height	Front Layer M1_IPOSER_UBUMP ¥	Back Layer M10_IPOSER_C4	Х 0 UM	Y 0 UM	Rotation 0.000 deg
Die stack members: Placement Me RefDes * IPOSER	mber details Type × FLIP-CHIP CU	Height	Front Layer M1_IPOSER_UBUMP ¥	Back Layer M10_IPOSER_C4	Х 0 UM	Y 0 UM	Rotation 0.000 deg
Die stack members: Placement Me RefDes * IPOSER	mber details Type × FLIP-CHIP CU FLIP-CHIP CU	Height 120 UM	Front Layer M1_IPOSER_UBUMP ¥	Back Layer M10_IPOSER_C4	Х О UM	Y 0 UM	Rotation 0.000 deg

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3. In Diestack editor, click *Launch 3D viewer* to open the interposer in Cadence 3D Design Viewer.



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