3

Creating the Multiplexer Layout

In this chapter, you learn to use the Virtuoso® layout editor to create a hierarchical design for a multiplexer by doing the following tasks. You also continue to use basic editing commands and learn some shortcuts.

When you finish this chapter, you will be able to

- Copy cell instances to create a hierarchical design
- View different levels of hierarchy
- Edit a cell while viewing it in the context of the surrounding design
- Stretch an area
- Flatten instances

- Use path stitching
- Create labels
- Create pins
- Create a multipart path

If You Have Not Completed the Previous Chapters

This chapter assumes you have followed the steps in the previous chapters. If you did not follow the steps in the previous chapter but want to go through this chapter, you can copy a completed design from the `master` library as explained in the following steps.

If you did follow the steps in the previous chapter you can skip to "Creating a Hierarchical Layout" on page 3-4.

Note: It is possible to run out of resources, such as memory, if you run multiple layout editors. Before you start the software, you need to check whether the software is already running.

1. Type the following in an xterm window to check whether the layout editor is already running:

   ```
   ps auxw | grep layout
   ```

2. If the layout editor is running, choose *File – Exit* in the Command Interpreter Window (CIW) to exit the software.

3. Type the following in an xterm window to start the layout editor:

   ```
   cd ~/cell_design
   layoutPlus &
   ```

4. Choose *File – Open.*

   The Open File form appears.

5. Type the library, cell, and view names as follows:

Library Name	`master`
Cell Name	`Inv_save`
View Name	`layout`

6. Click *OK*.

   The inverter cell from the `master` library opens.

7. In the cellview window, choose *Design – Save As*.

   The Save As form appears.

8. In the Save As form, type the library and cell names as follows:

Library Name	`tutorial`
Cell Name	`Inv`

9. Click *OK*.

   The inverter cell is copied to the `tutorial` library but the inverter cell from the `master` library remains on your screen.

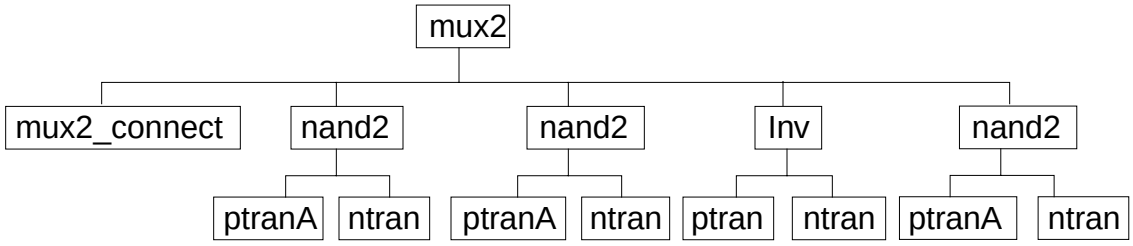
10. In the cellview window, choose *Window – Close* to close the inverter cellview from the `master` library.

You use the inverter from the `tutorial` library later in this chapter.

Creating a Hierarchical Layout

In this section, you create a *hierarchical* design. A hierarchical design is one containing instances of other cells. Those cells, in turn, can contain instances of cells.

You create the multiplexer in this section by placing instances of several cells inside the multiplexer cellview, *mux2*, as shown in the following figure.



You place the following cells from the `tutorial` library: *mux2_connect*, *nand2*, and *Inv,* the inverter you created in the previous chapter or just copied from the `master` library. Most of these cells contain other cells.

Later in this section, you flatten the *mux2_connect* cell, so its contents appear in the top *mux2* cellview and it is no longer an instance.

In the following sections, you learn to

- Create the multiplexer layout, *mux2*
- Create and copy the nand instance

- Create the inverter instance

Creating a New Cellview

In this section, you learn to create a layout view for the *mux2* cell.

1. In the CIW, choose *File – New – Cellview.*

   The Create New File form appears. If you have continued from Chapter 2, the last file you created (*Inv layout*) is displayed in the form. If you have just started, no cell name is displayed.

   Set the library, cell, and view names as follows:

Library Name	`tutorial`
Cell Name	`mux2`
View Name	`layout`
Tool	`Virtuoso`

2. Click *OK* to create the *mux2* layout.

   A window appears containing just the cellview axes and grid points.

Opening a Schematic for Reference

You can open the schematic view of the *mux2* design for reference as you build the layout view of *mux2*.

1. Choose *File – Open.*

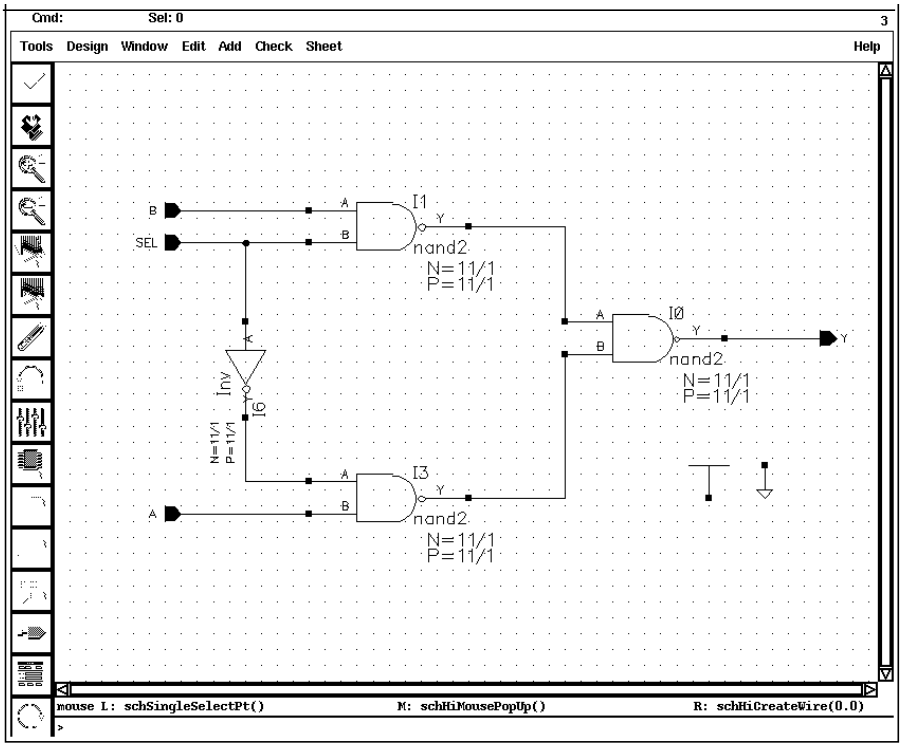
The Open File form appears.

2. Set the library, cell, and view names as follows

Library Name	`master`
Cell Name	`mux2`
View Name	`schematic`

3. Click *OK* or press the `Return` key.

The schematic view of the *mux2* design appears.



Note: For a better fit of all your windows on your screen, click and hold any corner of the schematic window and move the mouse until the window is a smaller size. Then press the `f` key in the schematic window to fit the schematic drawing within the resized window.

Creating the First nand2 Instance

You are now ready to place the first instance of the *nand2* cell into the *mux2* cellview.

1. Move the cursor inside the *mux2* layout window and press the `i` key.

   The Create Instance form appears. If you have continued from Chapter 2, the last cell you placed (*ptransistor*) is displayed in the form. If you have just started, no cell name is displayed.

2. Type the library, cell, and view names as follows:

Library Name	`master`
Cell Name	`nand2`
View Name	`layout`

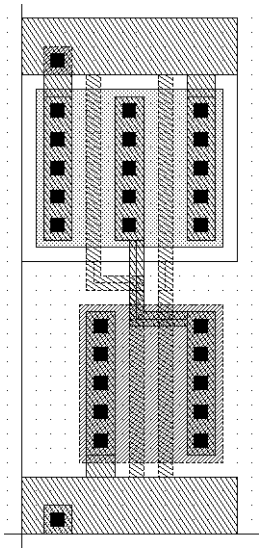
3. Click X = 0, Y = 0 to place the first *nand2* instance.

   The *nand2* instance appears in the *mux2* cellview.

4. Press the `Escape` key to stop the *Create Instance* command.

   The Create Instance form disappears.

5. Press the f key to fit the design in the window.



6. You need to move to the right of the nand2. You do this with the *Pan* command. Press the Tab key to start the *Pan* command.
7. Click X = 18.0, Y = 18.0 to move to the right of the nand2.

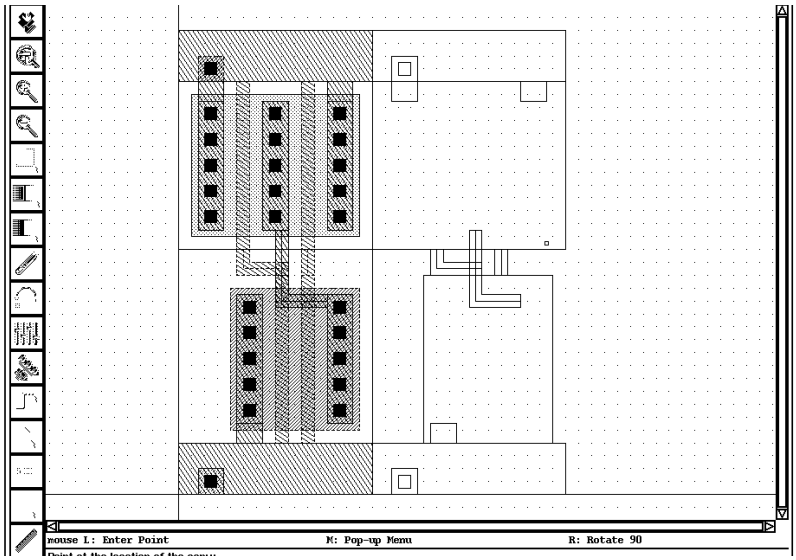
Copying the nand2 Instance

You copy the first nand instance to create the second nand instance.

1. Press the c key to start the *Copy* command.
2. Click anywhere inside the first instance.

   The outline and shapes inside the first instance are highlighted.

3. Move the cursor to the right until the second instance aligns with the first.



4. Click to place the copy.

Creating the Inv Instance

Now you place an instance of the inverter layout you created in the previous chapter or copied from the `master` library.

1. Press the `Tab` key, and click X = 32.0, Y = 18.0 to pan right.
2. Press the `i` key.

   The *Copy* command is canceled and the Create Instance form appears.

3. In the Create Instance form, type the library, cell, and view names as follows:

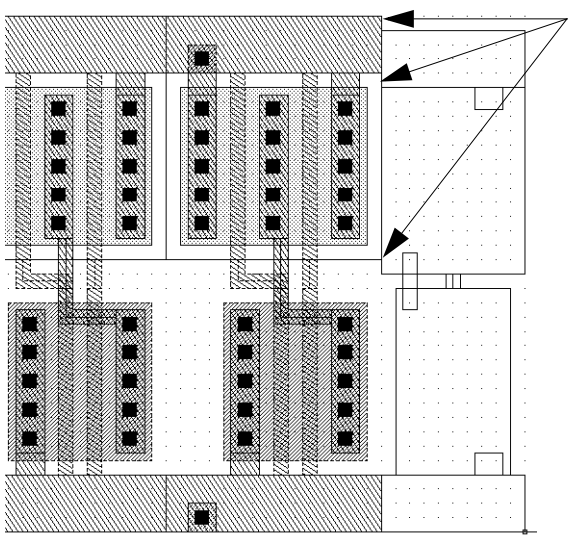
Library Name	`tutorial`
Cell Name	`Inv`
View Name	`layout`

4. You need to mirror the inverter along the X axis. Click *Sideways* to mirror the inverter.

5. In the cellview, click X = 40, Y = 0 for the instance origin.

6. Press the `Escape` key to stop the *Create Instance* command.

The inverter appears next to the nands.



The inverter is not aligned properly with the nands. You correct this error in the following section.

Editing the Inverter in Place

The inverter you placed in the previous section does not align properly with the nands. You can correct this error by stretching the top half of the inverter up by 1 micron. But you cannot edit the inverter now because you are looking only at an instance of the inverter cell inside the multiplexer.

You could open the inverter cell layout in a separate window and edit the inverter there, but then you would not be able to see how the inverter aligns with the other instances in the multiplexer.

The *Edit in Place* command lets you edit the inverter master cell while viewing it inside the multiplexer layout. This way, you can edit the inverter instance as it appears in this cellview and see how it aligns with the nand next to it.

In the following sections, you edit in place to correct the inverter cell. You learn to

- Open the inverter cell to edit in place
- Stretch the top of the inverter
- Return to editing the *mux2* cellview

Opening a Cell to Edit in Place

Open the inverter cell for editing using *Edit in Place*.

1. Choose *Design – Hierarchy – Edit in Place*.

   The layout editor prompts you to point to a shape in the design to be edited.

2. Click the *metal1* polygon at the top or bottom of the inverter.

   Note: The transistors are pcells (parameterized cells). You cannot edit pcells in place because they must be created by compiling (you learn how to compile pcells later in this tutorial). If you accidentally click on a shape inside one of the pcells, a message says you cannot edit pcells in place.

   When you successfully open the inverter using *Edit in Place*, you might not notice any change in the display. Look at the window title to see that you are editing the *Inv layout*.

3. Choose *Window – Fit Edit.*

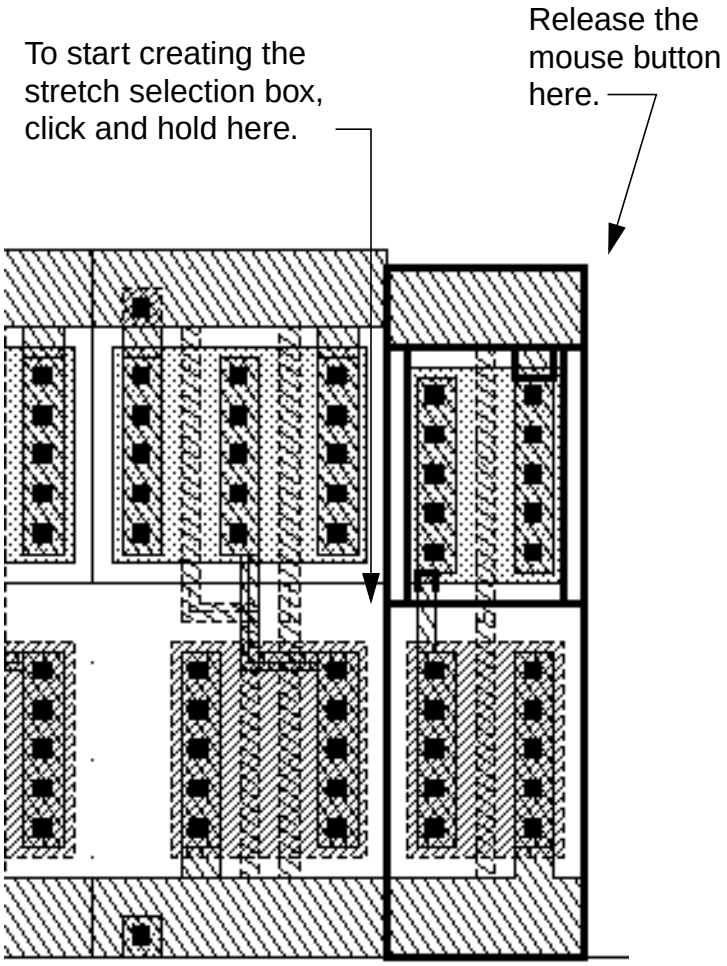
   The *Inv layout* data is fitted to the window and the border of the inverter is highlighted in light brown. This confirms you are editing the inverter cell. You still see the surrounding multiplexer data, but you cannot edit it because it is at a different level of the hierarchy.

Stretching an Area

Use *Stretch* to stretch the top of the inverter.

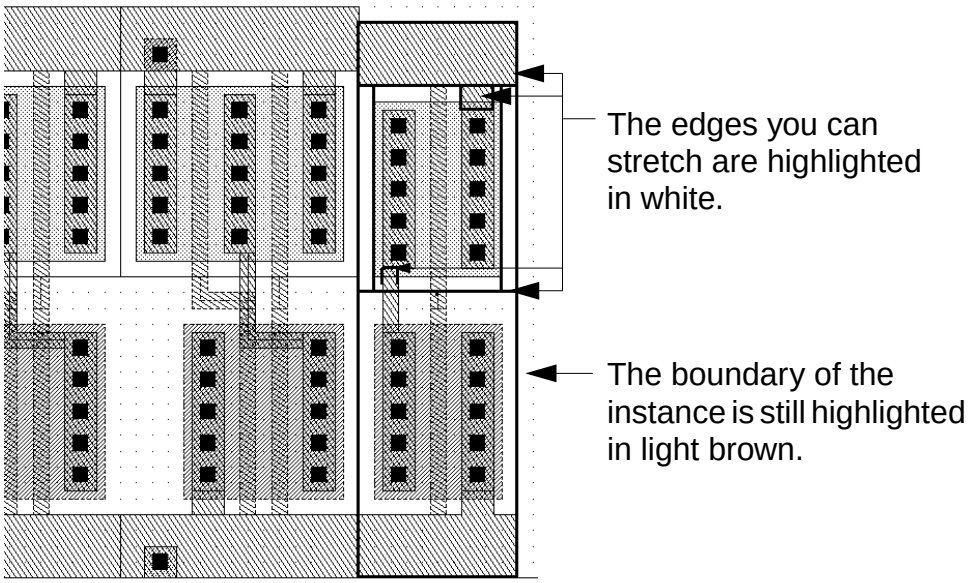
1. Choose *Edit – Stretch*.

2. You need to define the area you want to stretch. Click X = 29, Y = 18 and drag the box to a point above and to the right of the area to be stretched.



3. Release the mouse button.

The edges you can stretch are highlighted.

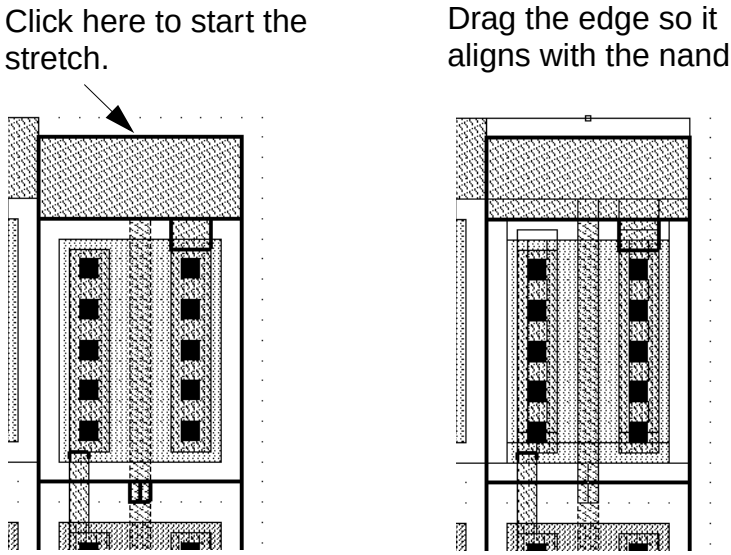


The prompt in the CIW reads

```
Point at the reference point for the stretch
```

The layout editor often asks for a *reference point* as you use editing commands. The reference point is the startpoint for the command; for example, the starting point from which you move a group of objects. In this case, the reference point is the starting point for the stretch.

4. Click the top edge of the polygon for a reference point. Move the cursor up until the edge of the inverter aligns with the nand.



5. Click to complete the stretch.

   The inverter and the nand instance now align correctly.

   The inverter is still highlighted in light brown to remind you that you are editing this cell, not the multiplexer.

6. Press the Escape key to stop the *Stretch* command.

Returning to the Multiplexer

While you edit a cell in place, you cannot edit the surrounding data (in this case, the other objects in *mux2*). When you finish editing the inverter in place, you must return to editing the multiplexer cell.

1. Choose *Design – Hierarchy – Return*.

   Return takes you back to the previous editing level. It also checks whether you have saved or not. Because you did not save yet, a dialog box appears asking if you want to save your changes to *tutorial Inv layout*.

2. Click *Yes* to save your changes.

   The inverter is saved, and the window title bar shows that you are now editing the multiplexer (*mux2*) again.

Displaying Hierarchy Levels

You might want to verify the instances you have created so far. In this section, you learn to

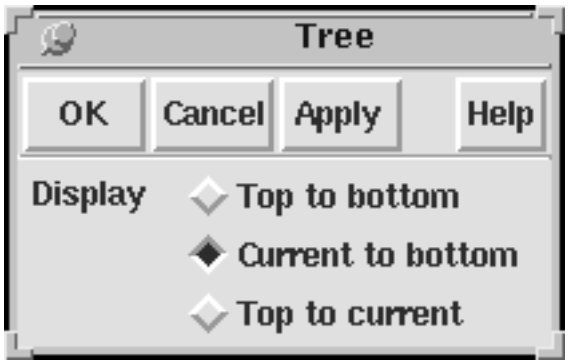
- Use the *Tree* command to list the names of the cell instances in *mux2*
- Change the amount of detail displayed in the *mux2* cellview, so you see only the instance names

Listing the Cells in the Multiplexer

Use the *Tree* command to list all the cell instances placed in the multiplexer.

1. Choose *Design – Hierarchy – Tree*.

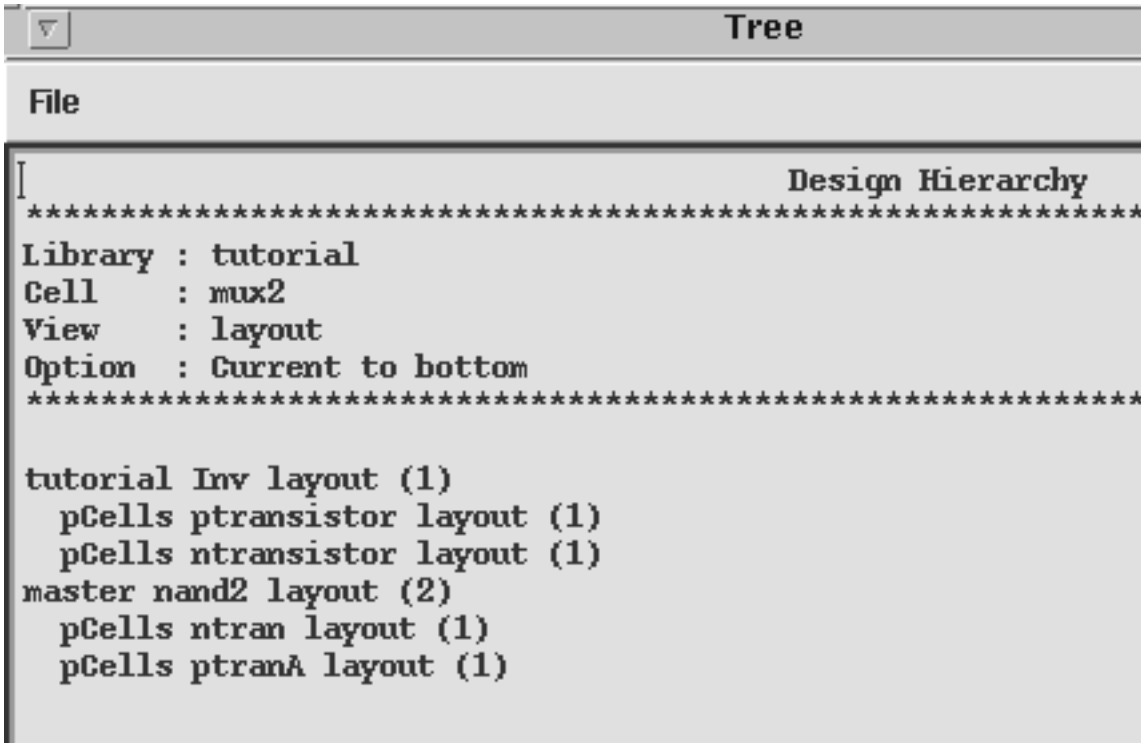
The Tree form appears.



The *Display* option lets you choose how much of the hierarchy you want to see. The top is this cellview and the current cell is the cell you are editing. When you were editing the *Inv* cell in place, it was the current cell.

2. Click *OK*.

A window appears, listing the cells inside the *mux2* cellview. The window displayed by *Tree* is a text window. Commands that list information usually display the data in a text window.



Tree shows all the hierarchy contained in *mux2*. It lists all the cell instances placed in *mux2* and any instances inside those cells. It gives the library, cell, and view name for each instance. It also shows the number of instances of a particular cell, in parentheses.

You can use *Tree* whenever you want to review the levels of hierarchy in a design.

3. Click *File* to display the *File* menu.

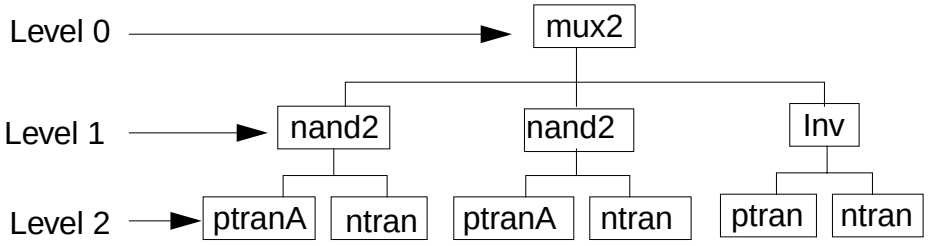
You can use the *File* menu to save the data in the window to a text file or to search through the text.

4. Choose *File – Close Window* to close the window.

Changing Display Levels

At present, you are viewing all the detail in all instances placed inside the *mux2* cell. You can turn off some of this detail so you see only the outlines of instances and the master cell name for each instance.

To change the amount of detail in a cellview, you indicate the starting level in the hierarchy you want to view and the hierarchy level at which you want to stop viewing detail. The current cellview (in this case, *mux2*) is level 0 in the hierarchy. Any cells directly inside it are level 1. Cell instances inside those cells are level 2.



In the following steps, you learn how to display only the top level of the hierarchy (level 0) and how to display data within a range of levels.

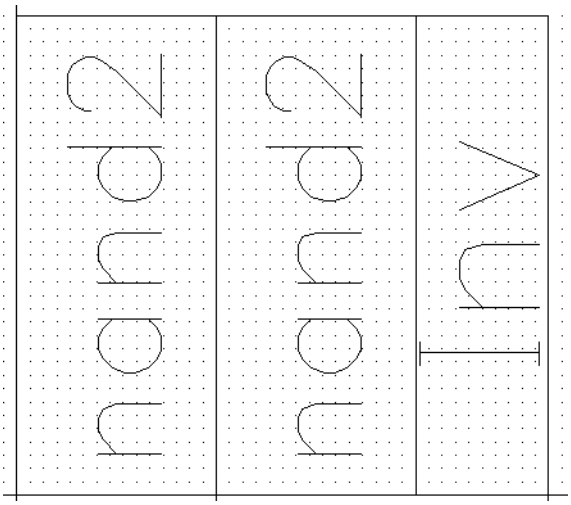
1. Press the `f` key to fit the design in the window.
2. Choose *Options – Display*.

The Display Options form appears.

3. Under *Display Levels*, change the *To* field to `0`.
4. Click *Apply*.

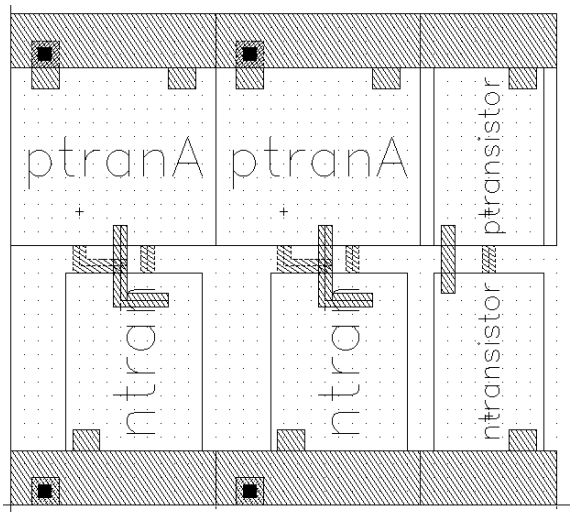
   The multiplexer is redrawn to show only data at level 0. You see only the outlines and master cell names for the instances you placed. These are the only objects at level 0.

   The master cell name is not relative to the orientation of the instance; it is just displayed as large as possible inside the outline.



5. Change the *To* field to 1.
6. Click *Apply*.

The multiplexer is redrawn to show data at levels 0 through 1. You see the objects in the *nand2* and *inverter* layouts, but only outlines for the cells at the next level.



7. Change the *To* field to `20`.

8. Click *OK*.

All levels of data are displayed.

Because you change display levels often, you can use the following bindkeys.

- `Shift-f` displays levels 0 through 20.
- `Control-f` displays only level 0.

9. Press `Control-f`.

Only level 0 data is displayed.

10. Press `Shift-f`.

All levels of data are displayed.

Placing and Flattening an Instance

You still need to place the last nand for the multiplexer. You also need to create the connections between the instances. The tutorial database contains a layout cell containing predefined connections for the instances in the multiplexer so you do not have to create all the connections yourself. You create the final connections later in this chapter.

Normally, you would create the connections at the top level (level 0). Because you place these connections using a cell instance (level 1), you flatten the instance after you place it. Flattening the instance moves its contents up to the top level so it is no longer an instance.

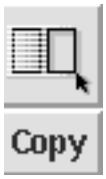
In the following sections, you learn to

- Copy and place the last nand in the multiplexer
- Place the *mux2_connect* instance containing most of the connections for the multiplexer
- Flatten the *mux2_connect* instance so it is no longer an instance, moving its contents up one level in the hierarchy

Copying the nand2 Instance Again

Now you copy one of the *nand2* instances to the right of the inverter to place the last nand in the multiplexer. You do this just as you did for the second nand as described in "Copying the nand2 Instance" on page 3-8. If you feel confident, copy the nand again on your own and skip to the "Placing the Connect Cell" on page 3-24.

1. Press the Tab key and click X = 35.0, Y = 18.0 to pan right.
2. Click the *Copy* command icon in the icon menu to start the *Copy* command.

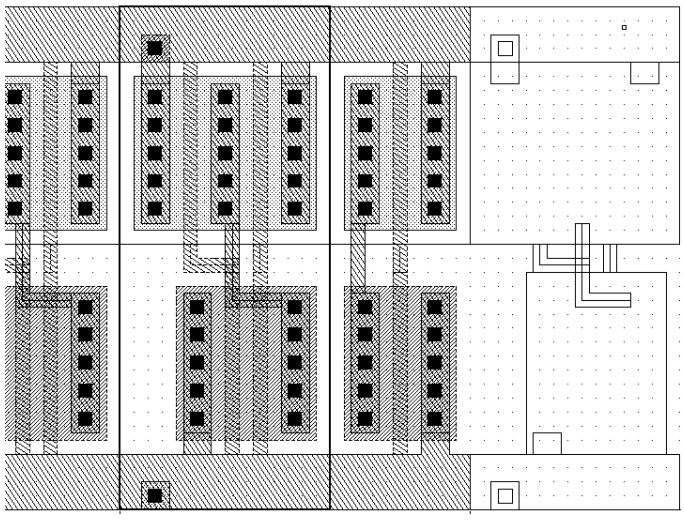


   The Copy form appears.

3. Click anywhere inside the second *nand2* instance.

   The outline and shapes inside the instance are highlighted.

4. Move the cursor to the right until the last *nand2* aligns with the inverter.



5. Click to place the copy.
6. Press the Escape key to stop the *Copy* command.
7. Press the f key to fit the entire design in the multiplexer window.

Placing the Connect Cell

Use *Create Instance* to place a layout cell containing predefined connections for the instances in the multiplexer.

1. Click the *Create Instance* command icon in the icon menu to display the Create Instance form.

   The Create Instance form appears.

2. Type the library and cell names as follows:

Library Name	`master`
Cell Name	`mux2_connect`

3. Move the cursor into the *mux2* cellview.

   An outline of the connections in *mux2_connect* follows the cursor.

4. Move the cursor to X = 0, Y = 0.

   The *poly1* connections at the top and bottom of the multiplexer should align exactly.

5. Click to place the *mux2_connect* cell.

6. Press the `Escape` key to stop the *Create Instance* command.

Flattening the Connect Cell

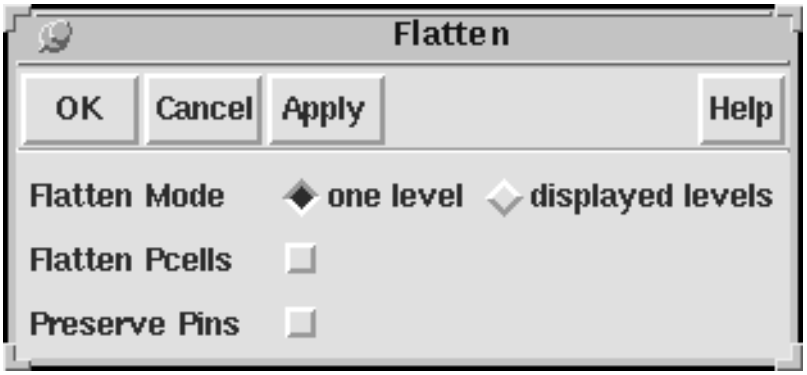
Normally, you would create the connections between the instances in the multiplexer at the top level (level 0); they would not be in a cell. The

mux2_connect cell was provided to save you time. You use *Flatten* to move the data in *mux2_connect* up to level 0 so it is no longer an instance.

1. Press `Control-f` to display outlines of the instances.

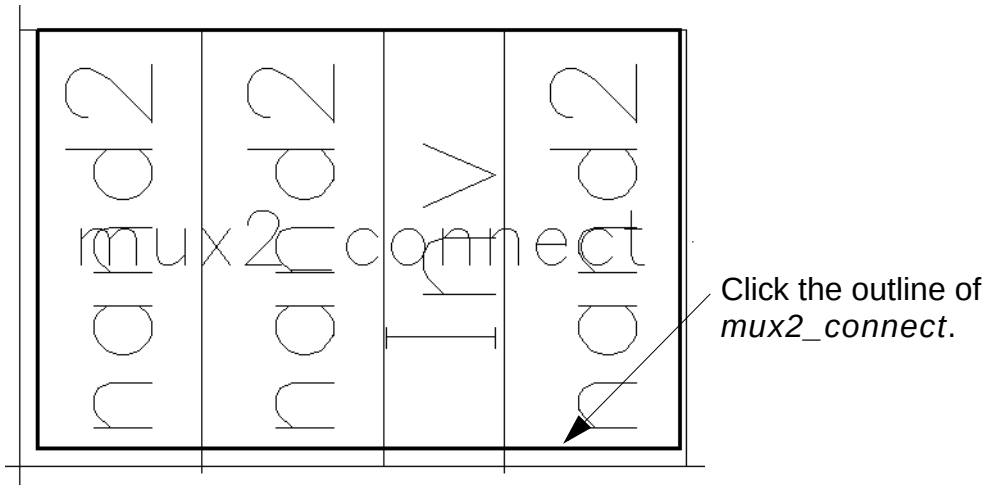
   It is often easier to select a cell instance while viewing only instance outlines.

2. Choose *Edit – Hierarchy – Flatten*.



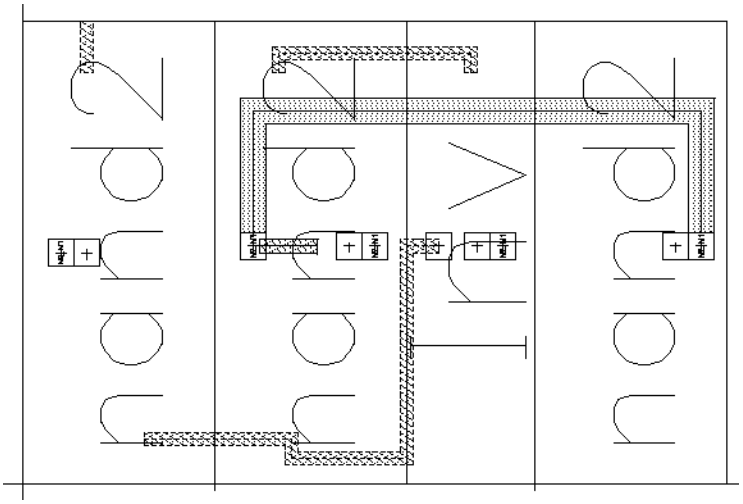
   The Flatten form appears. You need to move the contents of *mux2_connect* up just one level (from level 1 to level 0). The default form settings are set correctly.

3. Click the outline of the *mux2_connect* cell.



4. Click *OK*.

The instance outline disappears and the data in the *mux2_connect* cell appears.



5. To display all levels, press `Shift-f`.

Saving the Design

It is always a good idea to save your design periodically.

➤ Press the `F2` key to save your design.

The multiplexer is saved to disk.

Using Path Stitching

Not all the connections for the multiplexer were in the *mux2_connect* cell you placed in the previous section. You still need to connect the output of the first *nand2* instance to one of the inputs for the last *nand2*.

You use *Path* to create the final connections. You cannot create a path on a single layer all the way across the multiplexer, so you use *path stitching* to change layers within the path. Path stitching automatically changes the path from one layer to another, placing an appropriate contact to connect the two layers. The *Create Path* command chooses the contact for you from the technology file.

In this section, you learn to

- Turn gravity off so you can create the path
- Start the path on the *metal1* layer
- Switch to the *metal2* layer, automatically placing a metal1-to-metal2 contact
- Switch back to *metal1*, then to *poly1*, each time placing contacts

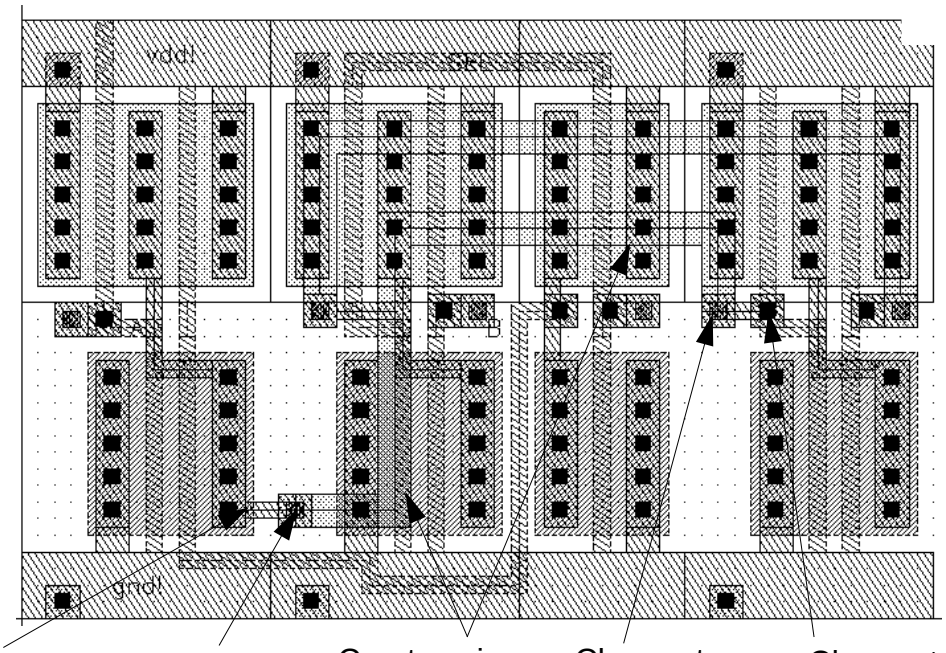
Turning Gravity Off

Snapping the cursor to objects is called *gravity*. Gravity is turned on by default and is helpful when creating instances and devices. In this section, you turn gravity off to make it easier to create a path. You can toggle the gravity on and off using either the Layout Editor Options form or the g bindkey.

➤ Move the cursor inside the *mux2* layout and press the g key to turn gravity off.

Overview of Path Route

The connections you make are shown below. You can use the illustration and the summary table as guides while you go through the following steps.



Start here (X=13.5, Y=6.5) on *metal1*.

Change to *metal2* here (X=16.5, Y=6.5).

Create using *metal2*; avoid other *metal2*.

Change to *metal1* here (X=42, Y=18.5).

Change to *poly1* here (X=45, Y=18.5) to place poly contact.

Note: If you make an incorrect click while path stitching, press the `Backspace` key to cancel the last click, and then continue with your path.

Table 3-1 Summary of Path Route

Number of points	Location	Angle	Layer	Purpose
First	X=13.5, Y=6.5	orthogonal	metal1	Start path
Second	X=16.5, Y=6.5	orthogonal	metal1	Create path
Third	X=16.5, Y=6.5	orthogonal	metal2	Place contact
Fourth	X=22.5, Y=23.5	L90XFirst	metal2	Create path
Fifth	X=42, Y=18.5	L90XFirst	metal2	Create path
Sixth	X=42, Y=18.5	L90XFirst	metal1	Place contact
Seventh	X=45, Y=18.5	L90XFirst	metal1	Create path
Eight	X=45, Y=18.5	L90XFirst	poly1	Place contact
Ninth	X=45, Y=18.5	L90XFirst	poly1	End path

Starting the Path on metal1

1. In the Layer Selection Window (LSW), click the *metal1 dg* layer.
2. In the cellview window, press the p key.

   The Create Path form appears. Notice that the path width is set to 1 micron. This width is defined in the technology file as a property of the *metal1* layer.

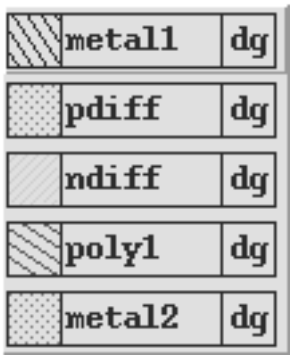
3. Click X = 13.5, Y = 6.5 to start the path.
4. Click X = 16.5, Y = 6.5.

Changing to metal2

You use the *Change To* cyclic field in the Create Path form to change from *metal1* to *metal2*.

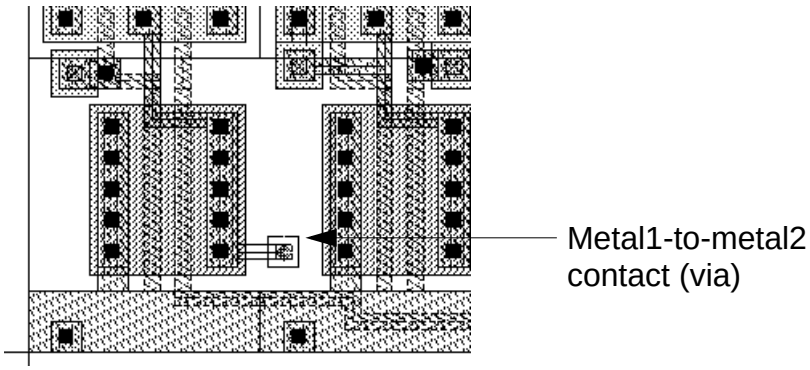
1. In the Create Path form, click and hold *metal1 dg* in the *Change To* field.

   A list of layer names appears. These are the layers you can change to from *metal1*, based on the *metal1* contacts defined in your technology file.



2. Slide the cursor to *metal2* and release.
3. Move the cursor back into the cellview.

A metal1-to-metal2 contact appears on top of your cursor.



4. Click again on X = 16.5, Y = 6.5 to anchor the contact.

   The entry layer shown at the top of the LSW changes to *metal2*. You are now entering points on *metal2*. The path width changes to 2 microns, the width set in the technology file for the *metal2* layer.

5. In the Create Path form, change the *Snap Mode* to *L90XFirst*.
6. Move the cursor back to the cellview.
7. Click X = 22.5, Y = 23.5.
8. Click X = 42, Y = 18.5.

Completing the Path

To complete the path, you change the path layer two more times: to *metal1* and then to *poly1*.

1. In the Create Path form, choose *metal1* from the *Change To* field.

2. Move the cursor back into the cellview.

   A metal2-to-metal1 contact appears on top of your cursor.

3. Click again on X = 42, Y = 18.5 to anchor the contact.

4. Click X = 45, Y = 18.5.

5. In the Create Path form, choose *poly1* from the *Change To* field.

   A metal1-to-poly1 contact appears on top of your cursor.

6. Click again on X = 45, Y = 18.5 to anchor the contact.

7. Check that your cursor is on X = 45, y = 18.5 and press `Return` to complete the path.

   The connections for the multiplexer are now complete.

8. Press the `Escape` key to stop the *Create Path* command.

9. Press the `F2` key to save your design.

Creating Pins

Now that all the connections are complete, you need to add some information used by other Cadence® tools.

You need to add net labels to help you diagnose problems found by the Layout Versus Schematic (LVS) program. You run LVS in the next chapter.

You also need to create pins. Pins are used by Cadence tools as follows:

- Pins define the connectivity between hierarchy levels. That is, a pin indicates where this cell can connect to routing or to other instances when the cell is placed into a larger design.
- Pins specify the access directions for Cadence routing tools.
- LVS checks to see if you have placed labels that conflict with the nets you define for the pins.

In this section, you

- Create pins and label them
- Save the multiplexer design to disk

About Pins

Pins show what areas of the multiplexer can connect to routing or other cells when you place an instance of the *mux2* into another design cell.

Note: You create pins coincident with shapes in the instances placed in *mux2*. If you make a mistake, it is easier to select and correct pins if the instances in *mux2* are unselectable. If you need to make instances unselectable during the following steps, click the button next to *Inst* (Instances) in the LSW so it is empty.

Creating Pins

You create six pins in the *mux2* cellview. The pins have different characteristics. This table summarizes the characteristics of the pins you create in the following exercise.

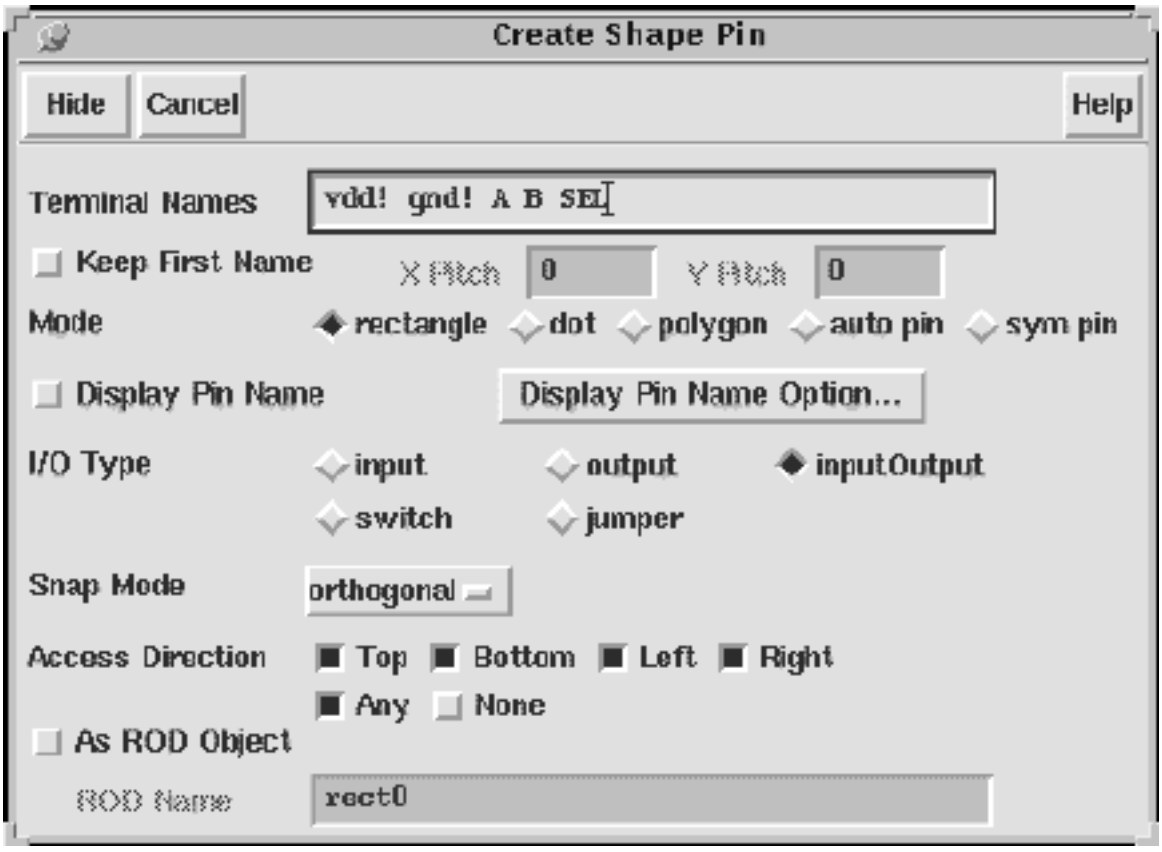
Pin	Input/Output Type	Access Direction	Layer
vdd!	I/O	top, left, right	metal1 dg
gnd!	I/O	bottom, left, right	metal1 dg
A	input	top, bottom	metal2 dg
B	input	bottom	metal2 dg
SEL	input	bottom	metal2 dg
Y	output	right	metal1 dg

1. In the LSW, click the *metal1 dg* layer.
2. Choose *Create – Pin*.

   The Create Symbolic Pin form appears. You use shape pins in this tutorial, not symbolic pins.

3. Click the button next to *shape pin* to open the Create Shape Pin form.

The Create Shape Pin form appears.



4. In the Create Shape Pin form, type the following in the *Terminal Names* field.

```
vdd! gnd! A B SEL Y
```

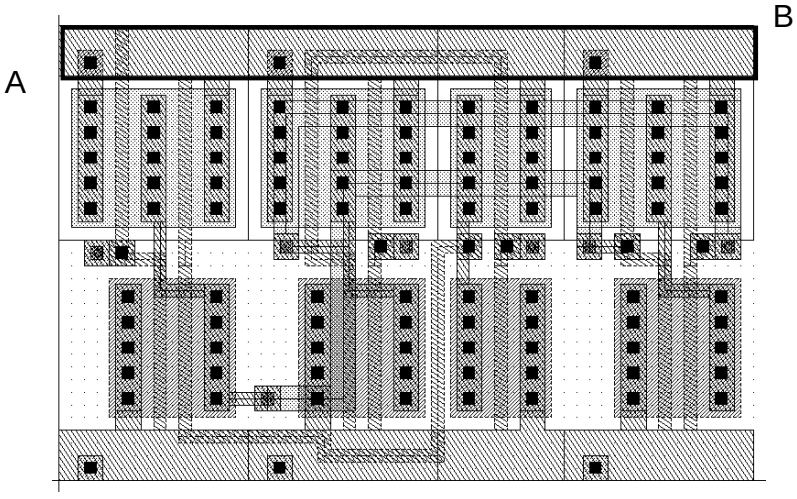
You can type any number of names in the Create Shape Pin (or Create Symbolic Pin) form. Each pin you create is assigned the next name, from left to right, in the *Terminal Names* field.

5. Click *Display Pin Name* to associate the name with the pin.

6. Set the access direction to *Top*, *Left*, and *Right* by clicking *Bottom* to turn them off.

7. Create the rectangle for the *vdd!* pin coincident with the power line at the top of the multiplexer.

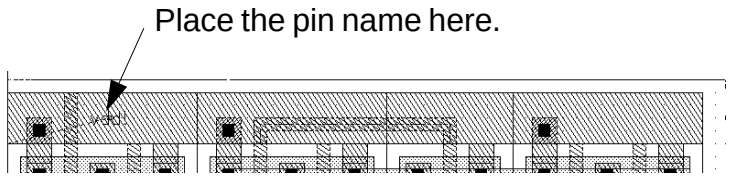
- Start the *vdd!* pin at corner A.
- Finish the *vdd!* pin at corner B.



The name of the pin (*vdd!*) appears near the cursor after you click the second corner.

A dashed line extends from the first corner of the pin to the name, showing the pin name is attached to the pin. If you move or delete the pin, the attached label will also be moved or deleted.

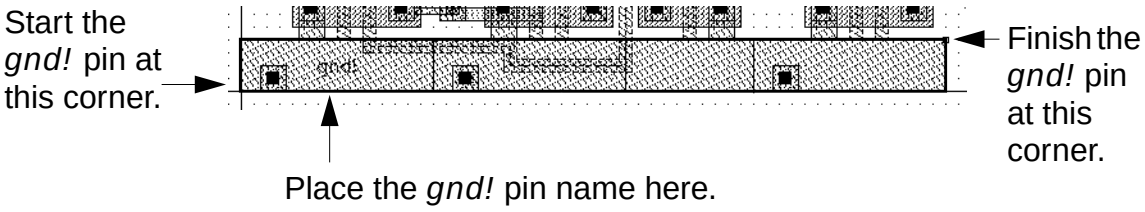
8. Move the cursor so the *vdd!* text appears near the left side of the pin, then click.



The name *vdd!* disappears from the Create Shape Pin form. The first name listed is now *gnd!* (the ground pin).

9. In the Create Shape Pin form, turn off the *Top* access direction and turn on the *Bottom* access direction.

10. Create the rectangle for the *gnd!* pin coincident with the ground line at the bottom of the multiplexer.



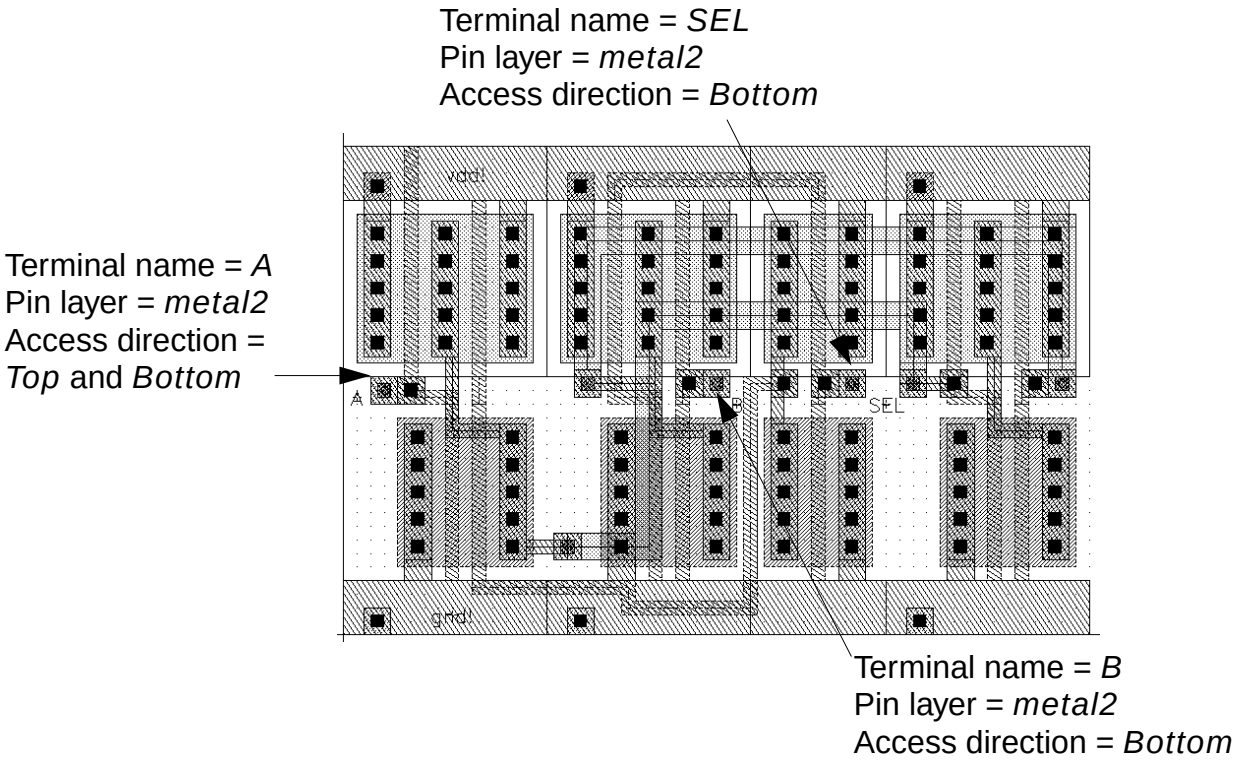
11. In the LSW, click *metal2 dg*.

12. In the Create Shape Pin form, set the *I/O Type* to *input*.

13. Enter the following information in the Create Shape Pin form before you create each input pin for terminals *A*, *B*, and *SEL*.

For Pin. . .	Set the Access Direction to. . .
A	*Top* and *Bottom*
B	*Bottom*
SEL	*Bottom*

Use this illustration to determine the location for each pin.



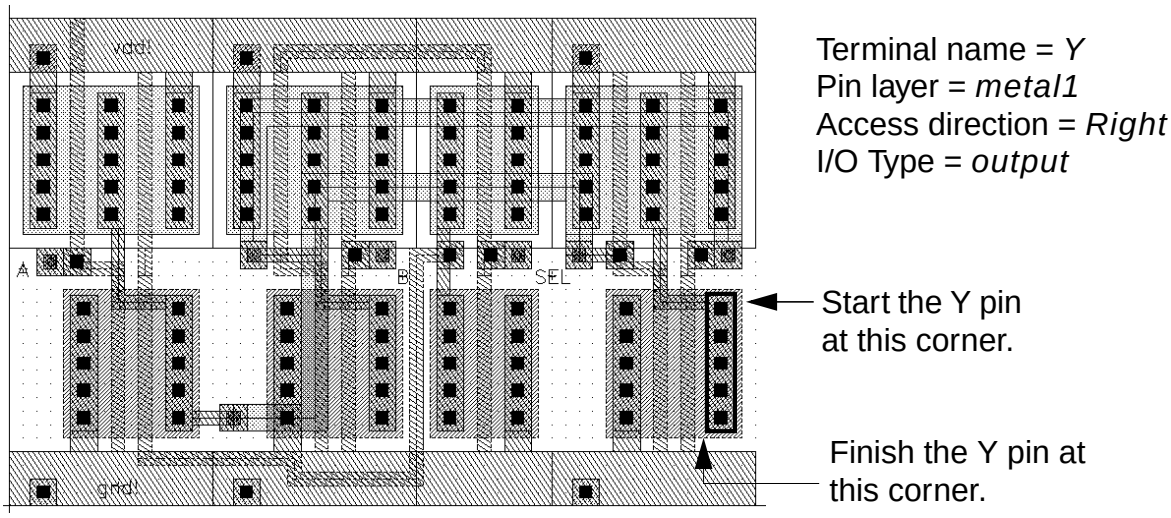
After you create the pins shown in the illustration, the pin form now shows only one pin to create: the Y pin for the multiplexer output.

14. Click the *metal1 dg* layer in the LSW.

15. Change the I/O type to *output* in the Create Shape Pin form.

16. Turn off all access directions except *Right.*

17. Create the Y output pin as shown below.



Place the Y pin name anywhere near the pin.

18. Press the Escape key to stop the *Create Pin* command.

Saving the Design

➤ Press the F2 key to save your design.

The multiplexer is saved to disk.

Closing the mux2 Schematic

Because your design is finished, you can close the *mux2* schematic.

➤ To close the *mux2* schematic, in the schematic window, choose *Window – Close*.

Creating a Guard Ring

In this section, you use Virtuoso relative object design (ROD) functionality to create a guard ring around the *mux2* design using a multipart ROD object. ROD functionality is used for defining simple and complex layout objects and their relationships to each other. You perform more ROD exercises in Chapter 5.

For more information about ROD, see the *Virtuoso Relative Object Design User Guide*.

In this section, you

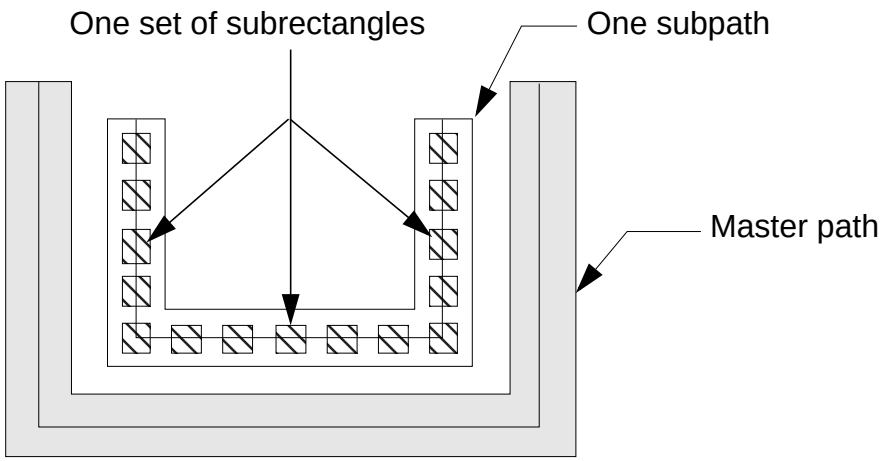
- Learn about multipart paths (MPP)
- Move the *mux2* design to make room for the guard ring
- Define values for the guard ring in the Create Multipart Path and ROD Subpart forms
- Save the values to a template in the technology file for future use
- Draw a guard ring around the multiplexer cell in the layout cellview

About Multipart Paths

You create a multipart path as the guard ring for the *mux2*. A multipart path is a single ROD object consisting of one or more parts at level 0 in the hierarchy on

the same or on different layers. A multipart path consists of a single *master path* and one or more *subparts*. The master path is an ordinary path; however, it is the defining part of a multipart path; all subparts are based on the master path.

For example, the multipart path shown below has one subpath and one set of subrectangles. Both the subpath and the set of subrectangles are offset from the master path



Preparing to Create the Multipart Path

Before you create the multipart path, you must make room for it. You move the *mux2* design up and to the right.

To move the design,

1. Choose *Edit – Select – Select All.*

All the elements of the *mux2* are highlighted.

2. Choose *Edit – Move.*

   You are prompted in the CIW to point at the reference point for the move.

3. Click X = 0, Y = 0.

   You are prompted in the CIW to point at the new location for the move.

4. Click X = 7, Y = 9.5.

   The designs moves to the right.

5. Press f to fit the design in the window.

Creating a Template for the Multipart Path

The best way to create a multipart path is to enter values for the MPP in the Create Multipart Path form, and save the values to a template for future use. Creating templates for multipart paths is important because you can reuse the information to,

- Create additional paths
- Edit the path by changing the template

The multipart path you create for this design has a master path, a enclosure subpath, and a set of subrectangles.

To create the template for this path;

1. Click the *diff* layer in the LSW.

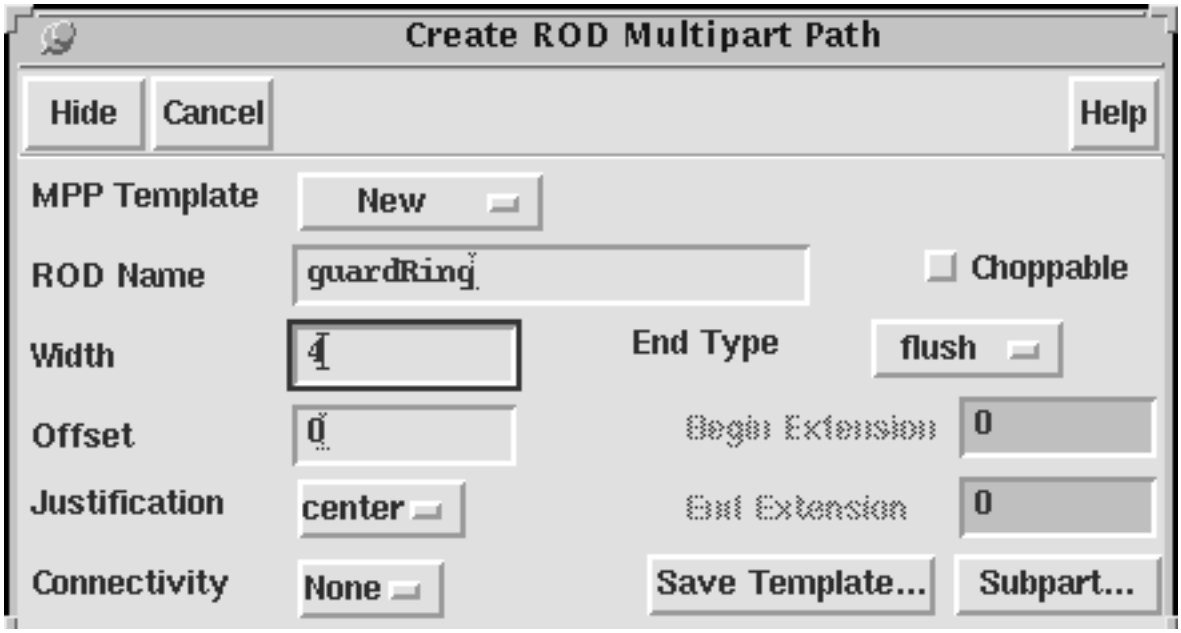
The diffusion layer is the master path layer.

2. Choose *Create – Multipart Path.*

The Create ROD Multipart Path form appears.

3. Type these values in the form:

MPP Template	*New*
ROD Name	`guardRing`
Choppable	off
Width	`4`
End Type	*flush*
Offset	`0`
Begin Extension	`0`
End Extension	`0`
Justification	*center*
Connectivity	*None*



You are ready to create the *metal1* layer as the enclosure subpath.

1. Click *Subpart* in the Create ROD Multipart Path form.

   The ROD Subpart form appears.

2. Click *Enclosure Subpath.*

   The enclosure subpath fields appear.

3. Enter these values in the form:

Layer	*metal1*
Choppable	on
Begin Offset	`-0.6`

Enclosure	`0.6`
End Offset	`-0.6`
Connectivity	*Pin*

When you choose *Pin*, new fields appear. Enter these values in the new fields:

Net Name	`gnd!`
I/O Type	*inputOutput*
Access Direction	*Bottom, Left, Right*
Display Pin Name	*No*
Reference Handle	*centerCenter*
Offset X	`0`
Offset Y	`0`

4. Click *Add* to register this data as subpath parameters.

   The data for the enclosure subpath appears in the scroll window at the top of the ROD Subpart form.

5. Click *Apply* in the ROD Subpart form to add this data to the template.

   The ROD Subpart form remains open.

You are ready to create the contacts as subrectangles.

1. In the ROD Subpart form, click on *Subrectangle*.

The subrectangle fields appear.

2. Enter these values in the form:

Layer	*cont*
Choppable	on
Begin Offset	-1.2
Width	1

By setting *Begin Offset* and *Width*, the system assigns the default values to *End Offset*, *Length*, and *Space*.

3. Click *Add* to register this data as subrectangle parameters.

The data for the subrectangles appears in the scroll window at the top of the ROD Subpart form.

4. Click *OK* in the ROD Subpart form to add this data to the template.

The ROD Subpart form closes.

Why You Save Changes to a Template

It is very important that you save your MPP form values as a template **before** you draw the MPP in your layout cellview. This is important because once you enter the last point for the master path, you can no longer make any changes to the MPP.

However, if you save the values as a template, you can create a similar MPP by loading the template and changing the values as desired. When you load the

template, all the fields display the template data **except** the *Net Name* field, which you must add every time you load a template. If you do not add the net name, the system beeps and a message appears in the CIW telling you to add the net name.

Saving Changes to the Template

To save all your MPP form values as a template,

1. In the Create Multipart Path form, click *Save Template*.
2. Type `guardRing` in the *Template Name* field,
3. Click *OK*.

Saving the Template to the Technology File

When you save an MPP template, the system updates the temporary version of your technology library in virtual memory. You still need to save your technology library changes to disk before you exit the software, or you will lose your template changes.

To make the changes to the temporary version of your technology file permanent,

1. In the CIW, choose *Technology File – Save*.

   The Save Technology File form appears.
2. Choose *cellTechLib* as the target technology file.
3. Click *OK*.

A dialog box appears asking you to confirm saving the technology file to disk.

4. Click *Yes*.

You have completed saving the MPP values as a template in your binary technology library. Now you are ready to draw a guard ring in your layout cellview.

Drawing the Guard Ring

With the multipart path parameters set and the template saved to the technology file, you are ready to draw the guard ring around the *mux2*.

In the cellview window, click at these points. For the last point, X=0, Y=50, either double click or press *Return*.

First click: X = 2, Y = 48

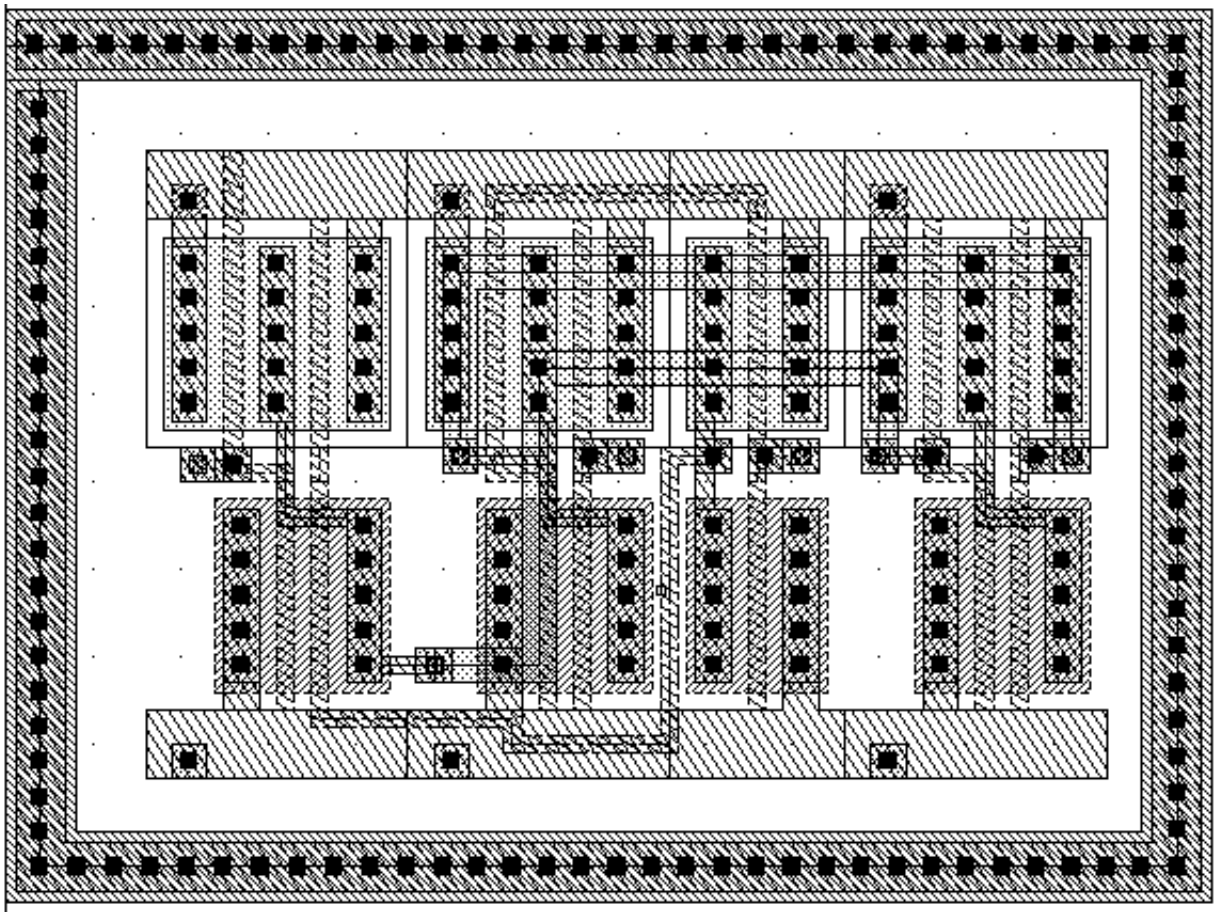
Second click: X = 2, Y = 3

Third click: X = 67, Y = 3

Fourth click: X = 67, Y = 50

Fifth click: X = 0, Y = 50

The completed design.



Editing the Guard Ring

In this section, you edit the guard ring by,

- Making it choppable
- Stretching the right side to a new X location

To edit the guard ring,

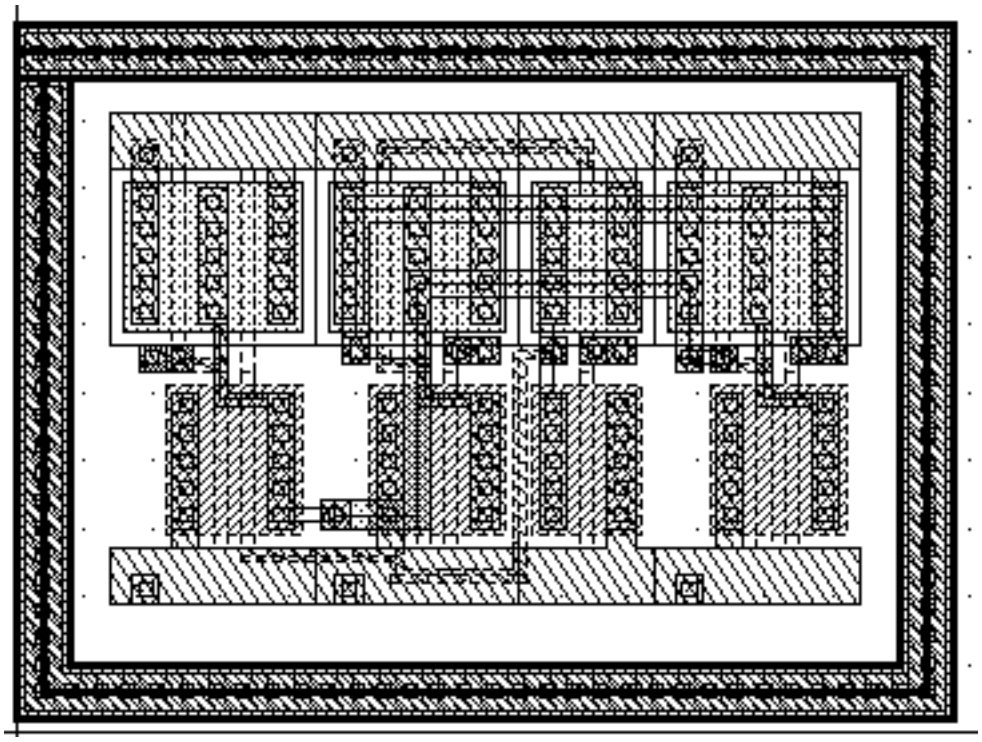
1. Select the guard ring in your layout window.
2. Choose *Edit – Properties*.

   The Edit Properties form appears.
3. Click *Choppable*.
4. Click *Apply.*

   The master path is now choppable.
5. Deselect the guard ring by clicking in an empty part of the window.
6. Choose *Edit – Stretch.*
7. Click on any of the contacts on the right side of the guard ring.

   The entire master path highlights in yellow.

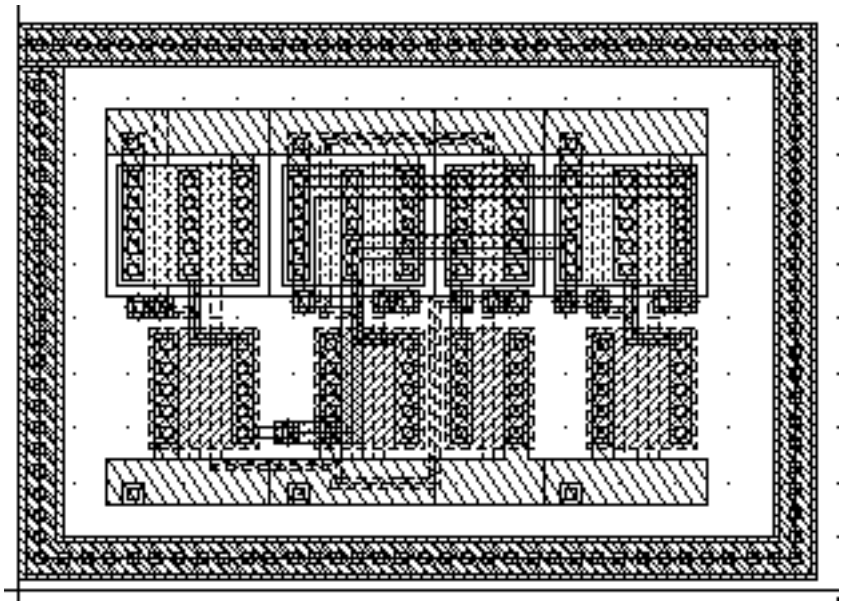
You are going to change the points for the path by stretching the path. Look at the points displayed in the *Points* field. They should reflect the points you entered to draw the guard ring.



8. Click on X = 71 to stretch the path to the right.

9. Press Escape to end the stretch.

The guard ring stretches to the right.



10. Examine the Edit Properties form for the revised point list. The third set of points should show (71 3).

11. Close the Edit Properties form.

12. Save and close your design.

Summary

In this section, you learned how to use the layout editor to create hierarchical designs. You also learned more about layout editor create and edit commands. Specifically, you

- Created a hierarchical layout

- Created instances
- Copied instances
- Mirrored instances

- Used the *Edit in Place* command
  - Opened a lower-level cell for editing
  - Returned to the previous level
  - Saved during *Edit in Place*
- Stretched an area
  - Selected an area
  - Used a reference point
- Displayed different hierarchy levels
  - Displayed a list of cells in the current cellview
  - Viewed instance outlines and master names only
  - Displayed a range of levels
  - Used bindkeys to change display levels
- Flattened the hierarchy in one cell
- Created paths using path stitching
  - Turned gravity off
  - Changed layers

- Automatically placed contacts

- Created labels
- Created pins
- Created a multipart path
- Saved the multipart path to a template
- Edited the multipart path
- Saved the design
- Used bindkeys
  - Create Instance [`i`]
  - Fit All [`f`]
  - Pan [`Tab`]
  - Copy [c]
  - Display Levels 0–20 [`Shift-f`]
  - Display Levels 0–0 [`Control-f`]
  - Gravity toggle [g]
  - Save [`F2`]
- Used the icon menu
  - Copy
  - Create Instance