

# IC Compiler

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## Lab 1: Introduction to IC Compiler GUI

### Objectives

In this Lab you will get familiarized with IC Compiler graphical interface. You will work with a design that has been previously *placed* by IC Compiler.

### Activity 1: Start IC Compiler

Go to `(your_directory)/ICC/lab1/` and execute ICC to start the simulation.



```
> cd (your_directory)/ICC/lab1/  
> icc_shell -gui
```

After a short wait a window labeled IC Compiler - *MainWindow.1* is opened. This window can display schematics and logical hierarchy browsers, among other things, once a design is loaded.

Load the placed cell from the MW\_DTMF\_LIB.mw MilkyWay design library, as follows.

1. In the *MainWindow* click on the little yellow “open design” icon  on the top left, or use the menu command:

**File → Open Design**

2. In the Open Design dialog panel, click the yellow folder icon . The Select Library dialog box opens. MilkyWay libraries are marked by an orange “L” icon . Select the library folder MW\_DTMF\_LIB.mw and click “Choose”.

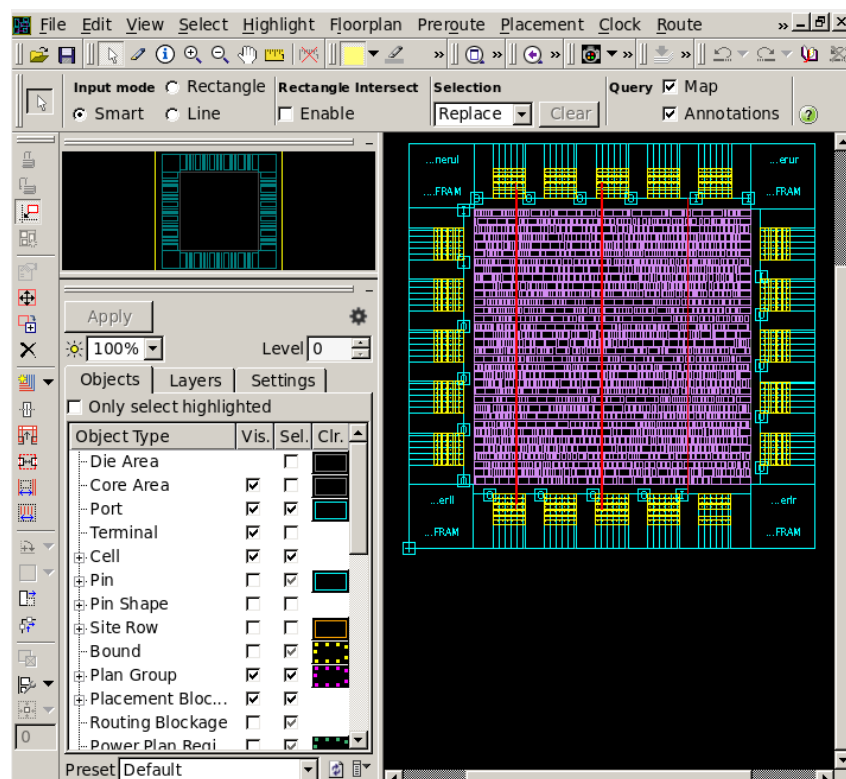
3. The middle of the Open Design dialog now shows the stored CELs. Select *DTMF\_postPlaceOPT* from the list, and Click OK to open it. A new window labeled *LayoutWindow.1* opens.

Bring the *MainWindow* to the foreground and look at the command transcript near the bottom of the window to answer the following question.

**Question 1.** What command was executed to open the *DTMF\_postPlaceOPT* cell? (Scroll up until you find it).

Looking at the transcript is useful to begin to learn IC Compiler’s commands. Look at the UNIX window where IC Compiler was invoked. Commands can be executed, and are also echoed, there.

Bring the *LayoutWindow* to the foreground and enlarge or maximize the window. Press the lower-case [F] key to fit the layout to the larger window.

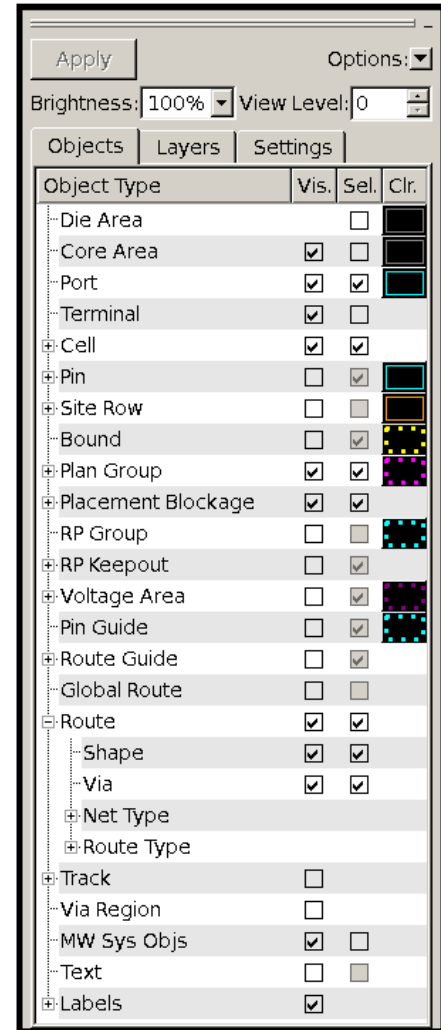


You are looking at the layout view of the design CEL called *DTMF\_postPlaceOPT*, which is part of the *top\_LIB.mw* design library. On the outer perimeter of the layout, IO pad cells (light blue rectangles) surround the brightly pink colored center or core region on all 4 sides. There are also vertical VDD/VSS red straps through the core for better power distribution. The core and periphery layout, as well as the power routing were defined during the design planning phase. During the placement phase, the standard cells have been automatically placed in horizontal placement rows (the pink area). The details of the rows and the standard cells may not be visible. Once you know how to zoom (Activity 2) you will better be able to see the standard cells. The pink area is made up of narrow metal lines running horizontally, VDD/VSS rails, which distribute power to the standard cells.

## Activity 2: Controlling Layer Visibility

You can control what types of objects are visible and/or selectable in the viewing window through the View Settings panel. In the following steps you will turn on visibility to some key objects one at a time, to clearly see what they represent:

- a. In the Vis. column, uncheck everything except Cell. Click Apply to update the layout view. Only the standard-, macro- and IO pad cells are displayed.
- b. Now check Pin as well and Apply. The input, output and power connection pins of the cells are displayed.
- c. Check Route and Apply. All metal routes become visible. Since the design has not been routed yet, only power/ground “pre-routes” (from the design planning phase) are seen. You should see power supply rings around the core as well as vertical and horizontal straps through the core area.
- d. Check Labels and Apply. Cell and instance names become visible. Expand Labels by clicking on the “+” icon on the left. Check Pin and Apply. Zoom in [Z] on one of the standard cell instances - its pin names are now visible. Fit the view to the window [F].
- e. Select the Layers tab, which can be used to “fine tune” the visibility further on a layer-by-layer basis. At the intersection of the row labeled “metal3” and the column labeled “Shape” click on the red square with dots, and Apply. The red vertical “metal3” straps disappear.
- f. Make “metal3” visible again.
- g. It is also possible to “color-code” certain objects. Select the Settings tab, then the Pins sub-tab. Select Color by Direction and Apply. Zoom in to a standard cell to see the color-coded input (red), output (blue) and inout pins (orange).
- h. Return the original color-coding: Select Color by object type and Apply.
- i. Select the Objects tab and re-apply the original visibility settings shown in the panel above.

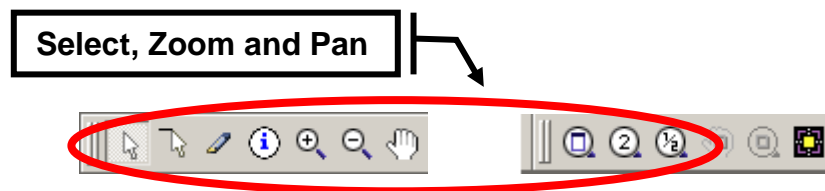


- a. **Question 2.** What is the difference between the Vis. (visibility) and Sel. (selection) columns in the above panel?
- j. Select the Layers tab and use the colors and fill patterns to answer the following questions:
  - a. **Question 3.** On what layer name and number are the red vertical power straps?
  - b. **Question 4.** On what layer name and number are the blue horizontal power rails?
- k. You can confirm your findings by hovering the pointer over one of the straps and rails. A “query” window appears which displays information about the object, including its layer name.

### Activity 3: Navigating the Layout View

Spend a few minutes to get familiar with the zoom and pan buttons in the *LayoutWindow*. While panning and zooming, notice how the yellow rectangle in the Overview window (the small “context” window in the upper left corner of the *LayoutWindow*) identifies the area of the design being displayed. Hint: A short, descriptive ‘ToolTip’

will pop up when a mouse pointer is held motionless over a button. To exit the zoom and pan mode pick the 'Selection Tool' (the white arrow icon) or press the **[Esc]** key. The cursor returns to an "arrow" or pointer shape.



**Question 5.** What is the difference between the "magnifier" button with "2" in it and the button with a "+" in it?


**Hot Keys.** "Hot keys" are also available when the *LayoutWindow* is active (i.e. currently selected). Lower-case **[F]** or **[Ctrl F]** both correspond to "zoom fit all" (or full view), for example. **[Z]** is zoom-in.

You can find out about other hot key definitions in two ways: Hover with the mouse over a button and a "balloon help" will appear showing the name of the function and the keyboard shortcut. You can also select the pull down menu Help → Report Hotkey Bindings. A new view appears, listing the hot key definitions. To close this view, select Window → Close View or **[Ctrl W]**.

**Mouse Strokes:** To zoom in on an area "stroke" (move mouse with middle button depressed) in a 45° direction upward (to the left or right) – the view should zoom-in to a rectangular area defined by the stroke. Stroking 45° downward zooms out. Stroking north or south "fits" the design to the window. Stroking in the east/west direction pans the display such that the start point of the stroke is moved to the center of the window.

The keyboard arrow keys can also be used to pan the display North/South/East/West. Try it. If your mouse has a scroll wheel, it can be used to zoom in/out (2X or ½X) around the area of the mouse's pointer.

## Activity 4: Selecting and Querying Objects

**Selecting objects.** To be able to select objects the mouse cursor must be an arrow, which denotes "select mode". If your cursor is not in select mode either click the arrow button  or press the **[Esc]** key.

- Try selecting different single objects with a left mouse click. A selected object is highlighted in white, and remains highlighted until un-selected, or a different object is selected.
- Unselect all objects by either clicking on an empty area in the layout, by using the menu Select → Clear, or by typing **[Ctrl D]**.
- Select multiple objects in the same area with a left button "drag-and-draw". All objects within the drawn rectangle are selected.

- d. Keep what is selected and select additional objects by holding down the [Ctrl] key while selecting with the left mouse click.
- e. You can cycle through “stacked” objects (multiple objects placed on top of each other) by repeatedly clicking the left mouse button until the desired object is highlighted. Try this by clicking on the corner intersection between the red-horizontal and green-vertical power/ground rings.
- f. Zoom into the pink core area. Select a handful of standard cells by dragging a selection box around them.
- g. In case it is difficult to notice the highlighted (selected) objects among other bright objects, it is possible to reduce the “brightness” of the unselected objects, thereby increasing the contrast. A “Brightness” control is located at the top of the View Settings panel. Reduce the brightness to 50% and Apply to see the improved contrast.

**Querying objects.** By default, when the cursor arrow hovers over an object, the object is lightly highlighted, and a query “summary” window appears in the bottom left, displaying some key attributes of the object. To obtain a “full query”, select a single standard cell, and query it by typing lower-case **[Q]** or by using the menu entry: Select → Query Selection. A window opens and lists all the attribute values of the selected cell.

- a. Close the query window by clicking the “Hide” minus sign in its upper right corner.
- b. From the *MainWindow* or *LayoutWindow* use File → Exit to exit the tool.

## Answers / Solutions

**Question 1.** What command was executed to open the placed cell? (scroll up until you find it)

`open_mw_cel top_LIB`

**Question 2.** What is the difference between the Vis. (visibility) and Sel. (selection) columns in the above panel?

Visibility is used to turn the display of objects on/off. Selection is used to control which objects are selectable when clicking on them.

**Question 3.** On what layer name and number are the red vertical power straps?

The layer name is METAL3, corresponding to layer number 62. Power nets are defined during design planning.

**Question 4.** On what layer name and number are the blue horizontal power rails?

The layer name is METAL1, corresponding to layer number 49.

**Question 5.** What is the difference between the “magnifier” button with “2” in it and the button with a “+” in it?

“+” allows you to select a window to zoom into using the mouse. The “2” button magnifies 2x around the center of the current display.