# 0A

# IC Compiler™ GUI

## Learning Objectives

This lab has two purposes:

1. To familiarize you with the IC Compiler GUI.
2. To learn how to get help with commands and variables.

You will work with a design that has been previously placed by IC Compiler.

After completing this lab, you should be able to:

- Invoke and exit IC Compiler
- Load a saved design
- Configure “layout window”
- Navigate the layout view
- Select and query layout objects.
- Use *help*, *printvar* and *man* to get help and additional information about commands and variables

**Lab Duration: 45 minutes**

# Instructions

## Task 1. Start IC Compiler

**1.** Log in to the *UNIX* environment with the *user id* and *password* assigned by your instructor.

**2.** Before invoking IC Compiler, we want to remove a *GUI window configuration* file, if it exists. This file will exist if you have previously invoked IC Compiler in this login account – its purpose is to remember the last GUI window configuration you had before exiting the tool, so that the configuration will look the same the next time you invoke the tool. For this lab we need you to start with a default window configuration. If the following file exists in your home directory, delete it:

```
UNIX% rm ~/.config/Synopsys/icc_shell.conf
```

**Note:** This step is NOT necessary during regular use of the tool. It is ONLY done here to ensure a consistent lab environment.

**3.** From your login or home directory, change your current directory to *lab0_gui*, which is the working directory for this lab.

```
UNIX$ cd lab0_gui
```

**4.** Start IC Compiler from the *UNIX* prompt:

```
UNIX$ icc_shell
```

The *xterm UNIX* prompt becomes `icc_shell>`, the IC Compiler shell command prompt.

**5.** Have a look in your current directory. You can type `ls -a` in a *UNIX xterm* window, or in the IC Compiler shell type:

```
icc_shell> ls
```

You will see that command and output log files were created (`icc_shell.cmd` and `.log`). The *.cmd* file records all commands, including initialization commands invoked during IC Compiler start-up. The*.log* file records commands and command output after tool start-up.

**Note:** Log file naming can be defined through variables in the initialization file, `.synopsys_dc.setup`.

**6.** Start the GUI. This is the "on demand" (as needed) method:

```
icc_shell> start_gui or gui_start
```

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.

**Note:** Instead of invoking the GUI "on-demand", you can start the IC Compiler GUI from the *UNIX* prompt: **`icc_shell -gui`**.

**7.** Load the *placed* cell from the *risc_chip.mw* MilkyWay design library, as follows:

a. In the *MainWindow* click on the little yellow "open design" icon on the top left, or use the menu command: **File → Open Design …**

b. 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 ***risc_chip.mw*** and click **Choose**.

c. The middle of the *Open Design* dialog now shows the stored *CELs*. Since there is only one cell (***placed***) in the list, it should already be selected (highlighted in blue). Click **OK** to open it.

A new window labeled *LayoutWindow.1* opens.

**8.** 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 *placed* cell? (scroll up until you find it)

.....

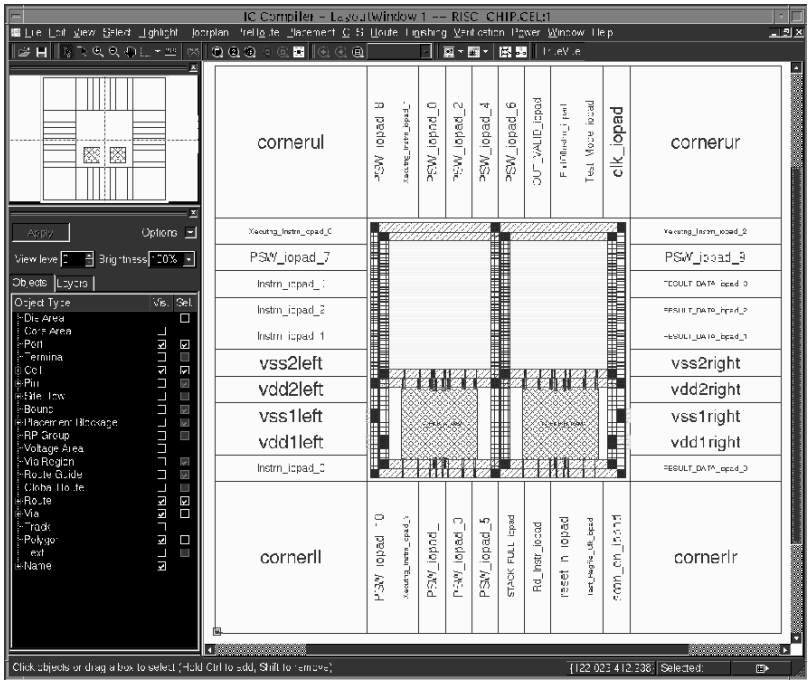
***Check your answer against the answer at the end of this lab.***

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.

**9.** Bring the *LayoutWindow* to the foreground and enlarge or maximize the window.

**10.** 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 *placed*, which is part of the *risc_chip.mw* design library. On the outer perimeter of the layout, *IO pad cells* (light blue rectangles) surround the brightly colored center or *core* region on all 4 sides. Between the *core* and the *periphery* or IO pad area there are green and red metal *rings* for power and ground (VDD/VSS). There are also vertical and horizontal VDD/VSS *straps* through the core for better power distribution. At the bottom of the *core* area there are two RAM *macros*. 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 darker blue area above the RAM macros). The details of the rows and the standard cells may not be visible. Once you know how to zoom (Task 2) you will better be able to see the standard cells. The blue area is made up of narrow metal lines running horizontally, VDD/VSS *rails*, which distribute power to the standard cells.



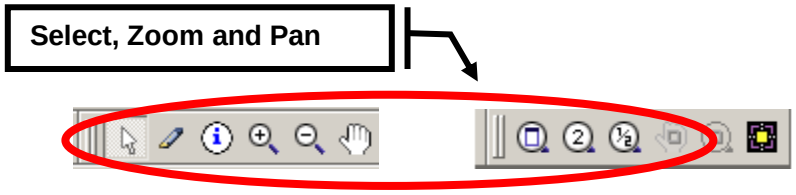

**Note:** The *LayoutWindow* has its own set of menu entries. Some of these entries are shared with the *MainWindow*, while others are unique to the *LayoutWindow*. Most of the physical processing of the design can be done by commands from this menu system.

## Task 2. Navigating the Layout View

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

.....

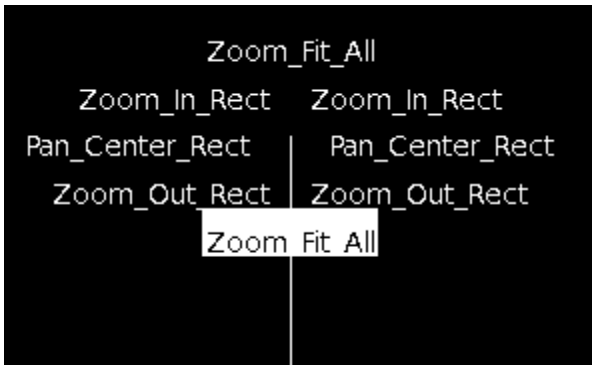
**2.** "Hot keys" are also available when the *LayoutWindow* is active (i.e. currently selected). Lower-case [**F**] or [**Ctrl F**] both correspond to "zoom fit all" (or full view), for example. [**Z**] is zoom-in.

**3.** 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**].

**4.** Some people like to use mouse "strokes" to pan and zoom, instead of using GUI buttons or keyboard "hot keys". Try using *strokes* as follows:

Zoom in on an area of interest: [**Z**] and [**Esc**].

Now click and hold the middle mouse button while moving the pointer straight up or down and holding it there. The stroke menu appears near the pointer:




Release the middle button and the design should zoom to fit the display window ("Zoom Fit All"). 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 in the east/west direction *pans* the display such that the start point of the stroke is moved to the center of the window.

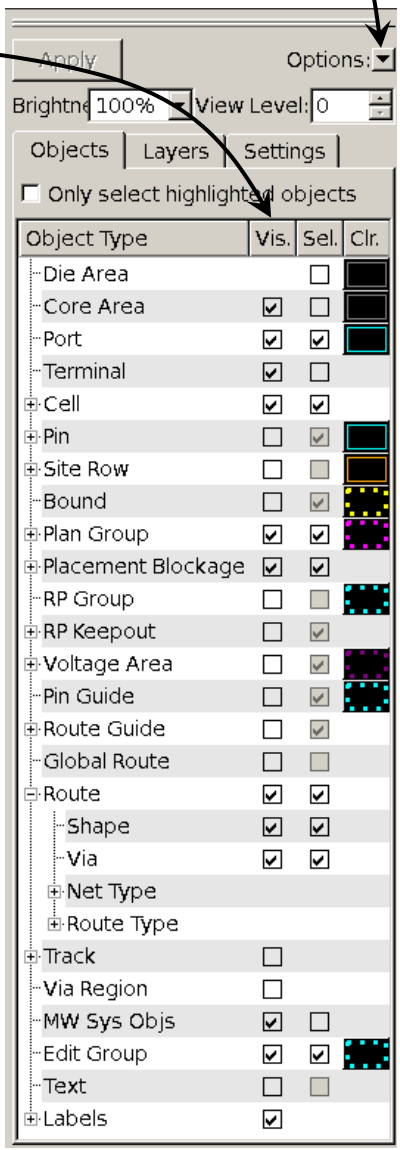
**Note:** In the interest of time, do not attempt this presently, but it is useful to note that you can query or define your own strokes by using the commands `get_gui_stroke_bindings` and `set_gui_stroke_binding`. "Hot keys" can be defined by using `gui_set_hotkey`.

**5.** The keyboard **arrow keys** can also be used to pan the display North/South/East/West. Try it.

**6.** 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.

## Task 3. 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. First make sure that under the *Options* pull down menu *Auto apply* is checked: This way selections are applied immediately without having to click on the *Apply* button each time.




**a.** In the ***Vis.*** column, uncheck everything except ***Cell***. Only the standard-, macro- and IO pad cells are displayed.

**b.** Now check ***Pin*** as well. The input, output and power connection pins of the cells are displayed.

**c.** Check ***Route***. 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***. Cell and instance names become visible. Expand *Labels* by clicking on the "+" icon on the left. Check ***Pin***. 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 "METAL(14)" and the column labeled "Shape" click on the **blue square** with diagonal lines. The blue horizontal *METAL* (= metal 1) rails disappear.

**f.** Make "metal 1" visible again.

**g.** Select the ***Objects*** tab and re-apply the original visibility settings shown in the panel above.

**Question 3.** What is the difference between the **Vis.** (visibility) and **Sel.** (selection) columns in the above panel?

.....

.....

**7.** Select the **Layers** tab and use the colors and fill patterns to answer the following questions:

**Question 4.** On what layer name and number are the red horizontal power straps?

.....

**Question 5.** On what layer name and number are the green vertical power straps?

.....

**8.** You can confirm your findings by hovering the pointer over one of the straps. A "query" window appears, which displays information about the object, including its *layer* name.

## Task 4. Selecting and Querying Objects

**1.** 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.

**2.** 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.

**3.** Unselect all objects by either clicking on an empty area in the layout, by using the menu **Select → Clear**, or by typing [**Ctrl D**].

**4.** Select multiple objects in the same area with a left button "drag-and-draw". All objects within the drawn rectangle are selected.

**5.** Keep what is selected and select additional objects by holding down the [**Ctrl**] key while selecting with the left mouse click.

**6.** 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.

**7.** Zoom into the blue core area. Select a handful of standard cells by dragging a selection box around them.

**8.** Incase 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%** to see the improved contrast.

**9.** 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.

**10.** Close the query window by clicking the "Hide" **minus sign** in its upper right corner.

**11.** From the *MainWindow* or *LayoutWindow* use **File → Close Design** to close the current design in the *LayoutWindow*. If the *Close Design* dialog box appears, click on **Discard All** to close the design without saving it.

**12.** You are done using the GUI. To close the GUI, while keeping the IC Compiler session active, type:

```
stop_gui or gui_stop
```

The *MainWindow* is now closed, but the IC Compiler *shell* is still active in the *UNIX* window.

## Task 5. Getting Help with Commands and Variables

**1.** IC Compiler supports command name, variable name, file name and command option "completion" through the [**Tab**] key. Try the following in the IC Compiler command shell window:

```
h[Tab]e[Tab] –v[Tab] help[Enter]
```

**2.** To view the *man* page on a command or variable you need to enter the exact command or variable name. Alternatively, you can enter the starting characters of the command/variable and use *command completion* to find the rest. If you are not sure what the exact name is, use `help` for commands, and `printvar` for variables, along with the * wildcard. Here are some examples:

Let's say you are looking for more information about a certain optimization command. You don't remember the exact command name, but you know it contains the string "syn" (for "synthesis"). To list all commands that contain this string enter:

```
help *syn*
```

From the displayed list of commands, you pick out the one you are interested, namely, `psynopt`.

**3.** To list the available options for `psynopt`, use the `verbose` option:

```
help –verbose psynopt
or
help –v psynopt
```

**4.** To get a full help *manual page* – a detailed description of the command and all of its options, type:

```
man psynopt
or
man psyno[Tab]
```

**5.** Now let's say you need help on a specific variable, but again, you don't remember its exact name, but it contains "library". To list all variables containing this string, enter:

```
printvar *library*
```

From the list you identify the variable of interest, namely `target_library`.

Notice that the `printvar` command also lists the current value of each variable.

**6.** To get a full help manual page of the variable, type:

```
man target_library
or
man target_l[Tab]
```

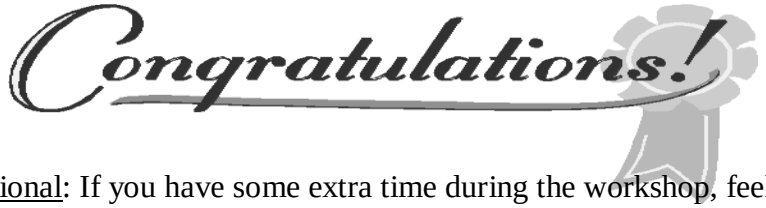
**7.** Lastly, you can also get additional help with an error or warning message, using the unique message code, for example:

```
man PSYN-025
```

**8.** Quit the IC Compiler shell:

```
exit    or    quit
```

***You have completed the IC Compiler GUI lab 0A.***




Lab 0B is optional: If you have some extra time during the workshop, feel free to return and try out the additional GUI features shown in Lab 0B.

# Answers / Solutions

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

```
open_mw_cel placed
```

**Question 2.** 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.

**Question 3.** 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. Invisible objects cannot be selected.

**Question 4.** On what layer name and number are the red horizontal power straps?

The layer name is METAL3, corresponding to layer number 22. Power nets are defined during design planning.

**Question 5.** On what layer name and number are the green vertical power straps?

The layer name is METAL4, corresponding to layer number 26.