ModelSim® GUI Reference Manual

Software Version 10.4c

Mentor Graphics Corporation
8005 S.W. Boeckman Road, Wilsonville, Oregon 97070-7777
Telephone: 503.685.7000
Toll-Free Telephone: 800.592.2210
Website: www.mentor.com
SupportNet: supportnet.mentor.com/

Send Feedback on Documentation: supportnet.mentor.com/doc_feedback_form

Table of Contents

List of Examples

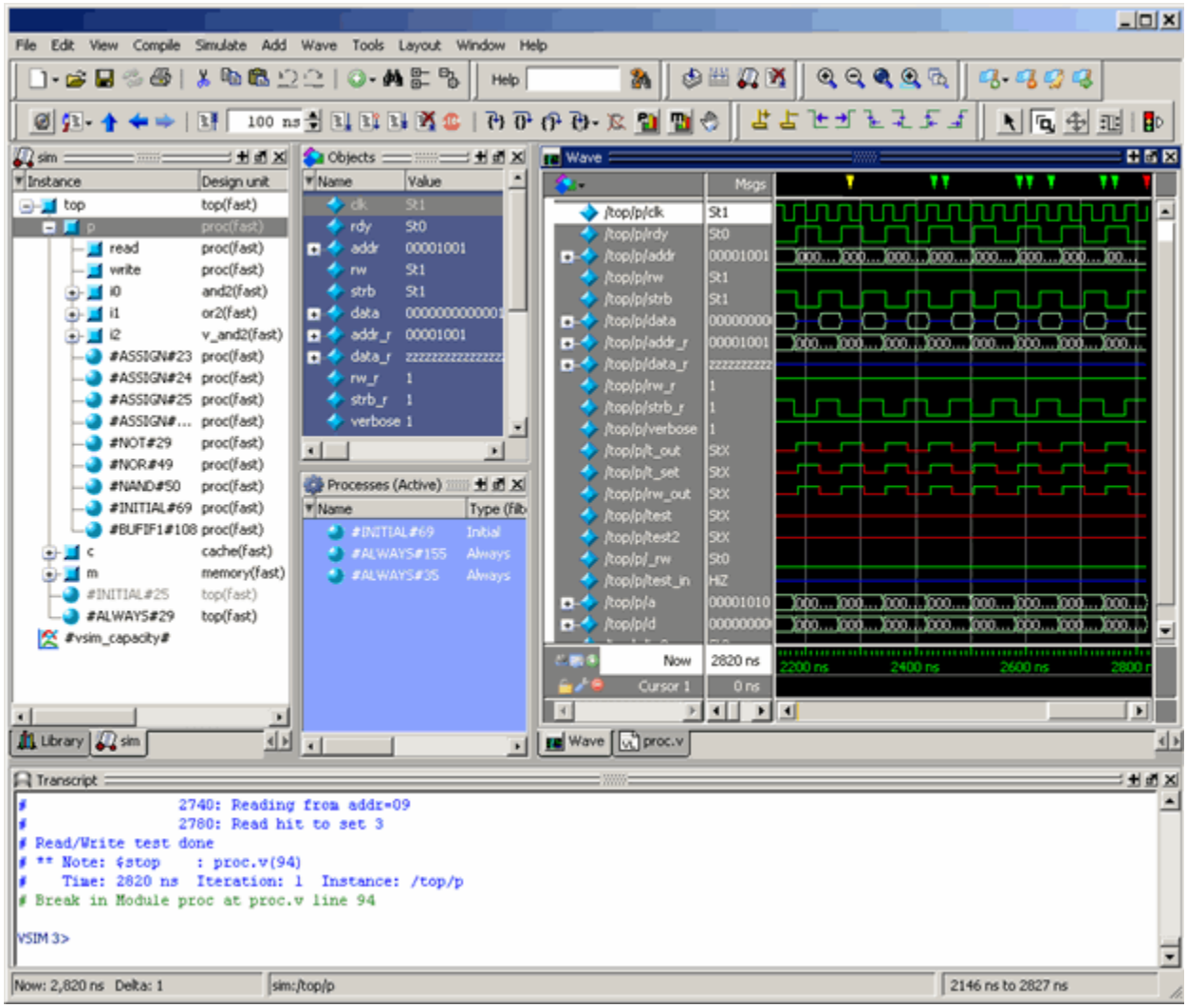
List of Figures

List of Tables

Chapter 1
Overview

The ModelSim graphical user interface (GUI) provides access to numerous debugging tools and windows that enable you to analyze different parts of your design. All windows initially display within the ModelSim Main window.

Figure 1-1. Graphical User Interface



General GUI Features

This section describes tasks common to more than one individual window and is organized into the following categories:

Window Management

The following tasks define actions you can take with the various windows.

Saving the Layout Upon Exit

By default when you exit ModelSim, the current layout is saved for a given design so that it appears the same the next time you invoke the tool.

Resetting the Window Layout to the Default

The windows are customizable in that you can position and size them as you see fit, and ModelSim will remember your settings upon subsequent invocations. You can restore ModelSim windows and panes to their original settings by selecting **Layout > Reset** in the menu bar.

Copying Text from a Window Header

You can copy the title text in a window header by selecting it and right-clicking to display a popup menu. This is useful for copying the file name of a source file for use elsewhere .

Selecting the Active Window

When the title bar of a window is highlighted - solid blue - it is the active window. All menu selections will correspond to this active window. You can change the active window in either of the following ways:

- (default) Click anywhere in a window or on its title bar.
- Move the mouse pointer into the window.

  To turn on this feature, select **Window > FocusFollowsMouse**. Default time delay for activating a window after the mouse cursor has entered the window is 300ms. You can change the time delay with the PrefMain(FFMDelay) preference variable.

Window Arrangement

The GUI provides features for moving and grouping the various windows.

Moving a Window or Tab Group

Relocating a window or tab group to a new location within the Main window.

Procedure

1. Click on the header handle in the title bar of the window or tab group.

Figure 1-2. Window Header Handle

2. Drag, without releasing the mouse button, the window or tab group to a different area of the Main window

   Wherever you move your mouse you will see a dark blue outline that previews where the window will be placed.

   If the preview outline is a rectangle centered within a window, it indicates that you will convert the window or tab group into new tabs within the highlighted window.

3. Release the mouse button to complete the move.

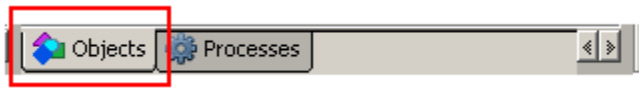
Moving a Tab out of a Tab Group

Removing a window from a tab group.

Procedure

1. Click on the tab handle that you want to move.

Figure 1-3. Tab Handle



2. Drag, without releasing the mouse button, the tab to a different area of the Main window

   Wherever you move your mouse you will see a dark blue outline that previews where the tab will be placed.

   If the preview outline is a rectangle centered within a window, it indicates that you will move the tab into the highlighted window.

3. Release the mouse button to complete the move.

Undocking a Window from the Main Window

You can move a window to exist outside of the main window.

Procedure

Do either of the following:

- Follow the steps in Moving a Window or Tab Group, but drag the window outside of the Main window.
- Click on the Dock/Undock button for the window.

Figure 1-4. Window Undock Button

Column-Based Windows

This section describes tasks related to column-based windows throughout the GUI.

Customizing the Column Views

You can customize the display of columns column-based windows, and then save these views for later use.

Procedure

1. Right-click in the column headings and select **Configure Column Layout**. This displays the Configure Column Layout dialog box.
2. Click **Create**. This displays the Create Column Layout dialog box.
3. For Layout Name, enter a name for the layout for future reference.
4. For Column Selections, move columns to your desired state.
5. Click **OK**. This adds your new layout to the Layouts list.
6. Click **Done**.

Results

After applying your selections, the rearranged columns and custom layouts are saved and appear when you next open that column view in the window.

Bookmarks

You can create bookmarks that allow you to return to a specific view or place in your design for some of the windows. The bookmarks you make can be saved and automatically restored. Some of the windows that allow bookmarking include the Structure, Files, Wave, and Objects windows.

Bookmark Actions

The Bookmarks toolbar and the Bookmarks menu give you access to several bookmarking features.

- Add Bookmarks — Bookmarks are added to an active window by selecting **Bookmarks > Add Bookmark** or by clicking the **Add Bookmark** button. You will be prompted to automatically save and restore your bookmarks when you set the first bookmark. You can change the automatic save and restore settings in the Bookmark Options Dialog Box.
- Add Custom — Selecting **Add Custom** opens the **New Bookmark** dialog box with the context field(s) populated and a field for specifying an alias for the bookmark. Click and hold the **Add Bookmark** button to access this feature from the **Bookmarks** toolbar.

Note

Aliases are mapped to the window in which a bookmark is set. You can use the same alias for different bookmarks as long as each alias is assigned to a bookmark set in a different window.

- Deleting Bookmarks — You can choose to delete the bookmarks from the currently active window or from all windows.
- Manage Bookmarks — Opens the **Manage Bookmarks** dialog box. Refer to Bookmarks Management for more information.
- Load Bookmarks — Loads the bookmarks saved in the *bookmarks.do* file. You can choose whether to load bookmarks for the currently active window or all the bookmarks saved in the *bookmarks.do* file. Bookmarks are automatically loaded from the saved *bookmarks.do* file when you start a new simulation session.

Note

You must reload bookmarks for a window if you close then reopen that window during the current session.

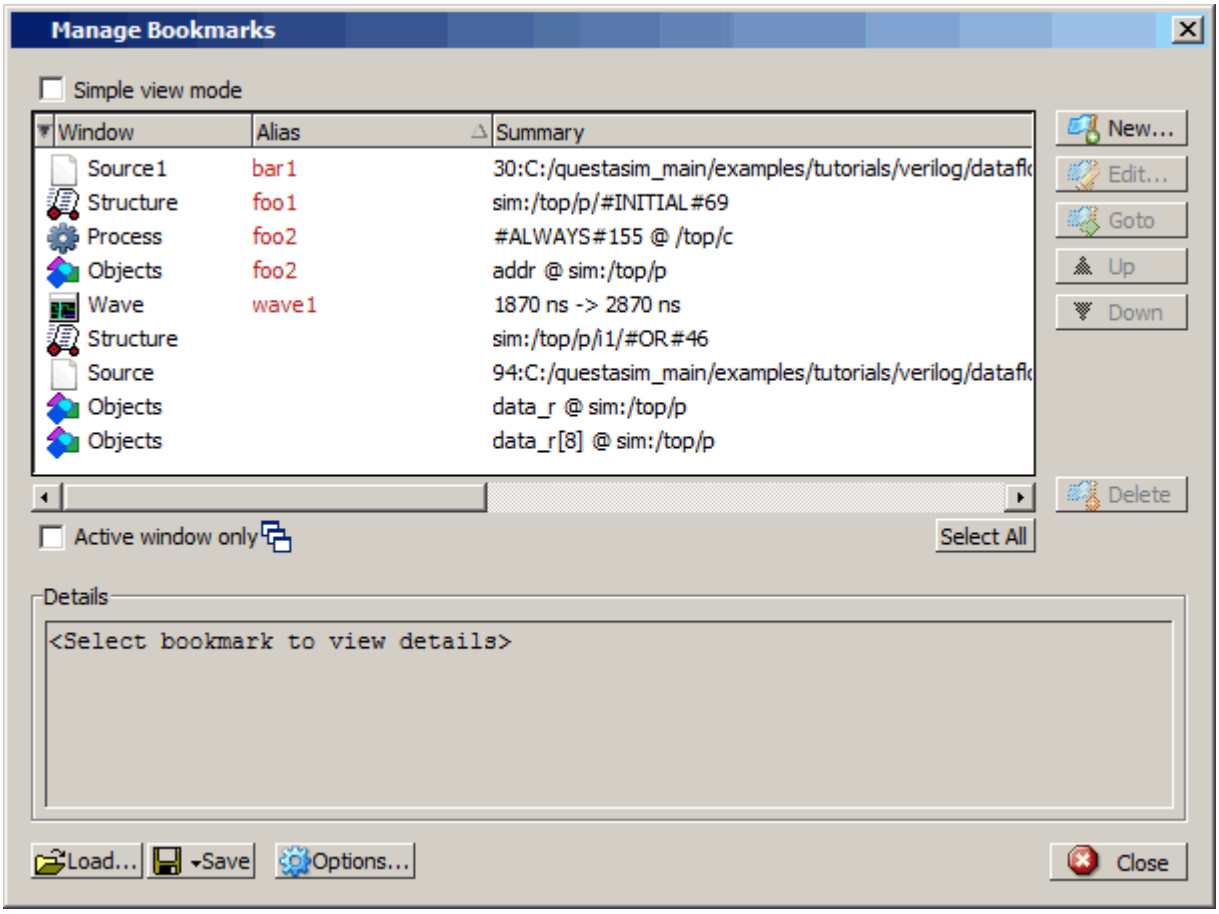
- Jump to Bookmark — Shows the available bookmarks in the currently active window followed by a drop down list of bookmarks for each window. You can set the maximum number of bookmarks listed in the Bookmark Options Dialog Box.

Bookmarks Management

You can open the Manage Bookmarks dialog box with the **Manage Bookmarks** toolbar button or by selecting **Bookmarks > Manage Bookmarks**.

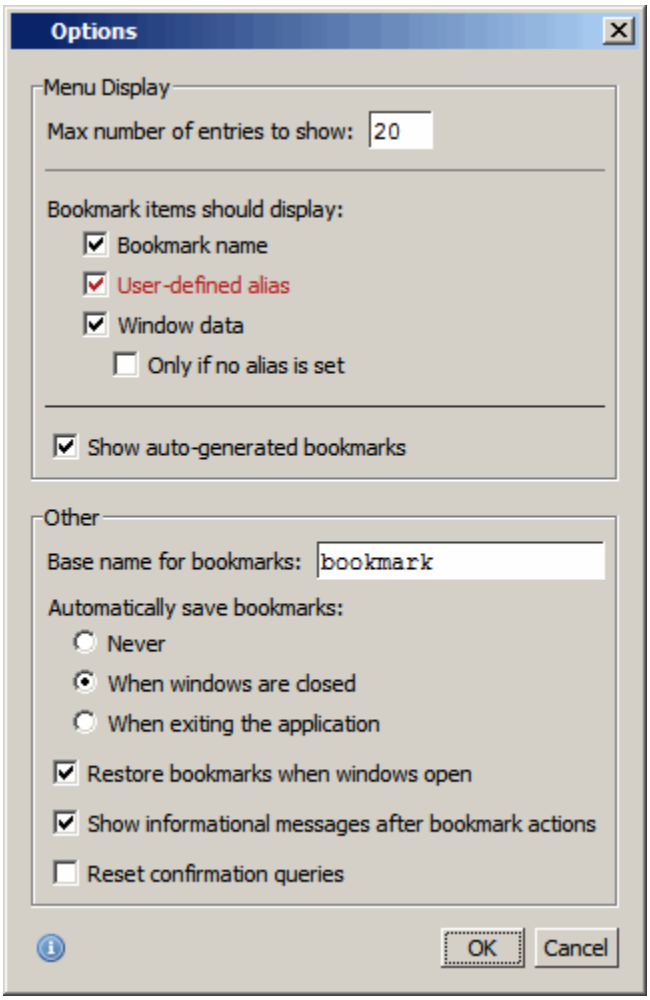
The dialog box can be kept open during your simulation (Figure 1-5).

Figure 1-5. Manage Bookmarks Dialog Box



- **Simple view mode** changes the buttons from name and icon mode to icon only mode.
- Checking **Active window only** changes the display to show the bookmarks in the currently active window. Selecting a different window in the tool changes the display to the bookmarks set in that window.
- Selecting **New** opens the **New Bookmark** dialog box. The fields in the dialog automatically load the settings of the view in the currently active window. You can choose to name the bookmark with an alias to provide a more meaningful description. Aliases are displayed in the Alias column in the Manage Bookmarks dialog box.
- Selecting **Options** opens the **Bookmark Options** dialog box (Figure 1-6).

Figure 1-6. Bookmark Options Dialog Box



The **Menu Display** section allows you to:

- Set the number of bookmarks displayed in the Bookmarks menu or the Jump to Bookmark button menu.
- Select the types of information displayed for each bookmark.

The **Other** section allows you to:

- Specify a different base name for bookmarks.
- Choose whether you want to automatically save bookmarks and when they are saved.
- Automatically restore the bookmarks when windows are first loaded in the current session.
- **Show informational message after bookmark actions** sends bookmark actions to the transcript. For example:

```
# Bookmark(s) were restored for window "Source"
```

Saving and Reloading Formats and Content

You can use the write format restart command to create a single *.do* file that will recreate all debug windows and breakpoints (see Saving and Restoring Breakpoints) when invoked with the do command in subsequent simulation runs. The syntax is:

write format restart <filename>

If the ShutdownFile *modelsim.ini* variable is set to this *.do* filename, it will call the **write format restart** command upon exit.

Font Management

You may need to adjust font settings to accommodate the aspect ratios of wide screen and double screen displays or to handle launching ModelSim from an X-session.

Refer to Setting GUI Preferences for more information.

Font Scaling

To change font scaling, select the Transcript window, then **Transcript > Adjust Font Scaling**. You will need a ruler to complete the instructions in the lower right corner of the dialog. When you have entered the pixel and inches information, click OK to close the dialog. Then, restart ModelSim to see the change. This is a one time setting; you should not need to set it again unless you change display resolution or the hardware (monitor or video card). The font scaling applies to Windows and UNIX operating systems. On UNIX systems, the font scaling is stored based on the $DISPLAY environment variable.

Find and Filter Functions

Finding and/or filtering capabilities are available for most windows.

The Find mode toolbar is shown in Figure 1-7. The filtering function is denoted by a “Contains” field (Figure 1-8).

Figure 1-7. Find Mode

Figure 1-8. Filter Mode

Windows that support both Find (Figure 1-7) and Filter modes (Figure 1-8) allow you to toggle between the two modes by doing any one of the following:

- Use the **Ctrl+M** hotkey.
- Click the “Find” or “Contains” words in the toolbar at the bottom of the window.
- Select the mode from the Find Options popup menu (see Find Options Popup Menu).

The last selected mode is remembered between sessions.

A “Find” toolbar will appear along the bottom edge of the active window when you do either of the following:

- Select **Edit > Find** in the menu bar.
- Click the **Find** icon in the Standard Toolbar. 

All of the above actions are toggles - repeat the action and the Find toolbar will close.

The Find or Filter entry fields prefill as you type, based on the context of the current window selection. The find or filter action begins as you type.

There is a simple history mechanism that saves find or filter strings for later use. The keyboard shortcuts to use this feature are:

- **Ctrl+P** — retrieve previous search string
- **Ctrl+N** — retrieve next search string

Other hotkey actions include:

- **Esc** — closes the Find toolbar
- **Enter** — initiates a “Find Next” action
- **Ctrl+T** — search while typing (default is on)

The entry field turns red if no matches are found.

The graphic elements associated with the Find toolbar are shown in Table 1-1.

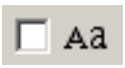
Note

The Find Toolbar graphic elements are context driven. The actions available change for each window.

Table 1-1. Graphic Elements of Toolbar in Find Mode

Graphic Element	Action
 Find	opens the find toolbar in the active window

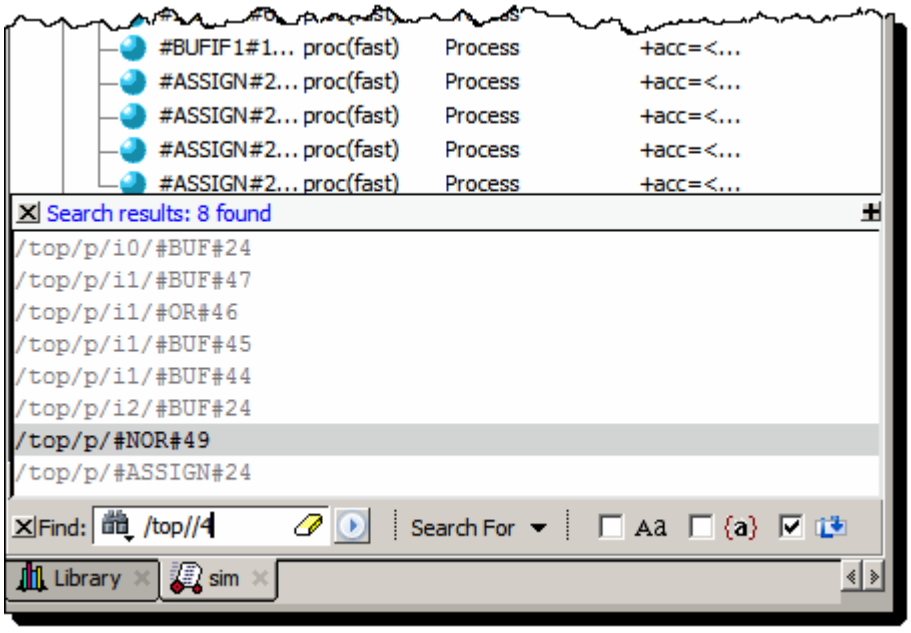
Table 1-1. Graphic Elements of Toolbar in Find Mode (cont.)

Graphic Element	Action
 Close	closes the find toolbar
 Find entry field	allows entry of find parameters
 Find Options	opens the Find Options popup menu at the bottom of the active window. The contents of the menu changes for each window.
 Clear Entry Field	clears the entry field
 Execute Search	initiates the search
 Toggle Search Direction	toggles search direction upward or downward through the active window
 Find All Matches; Bookmark All Matches (for Source window only)	highlights every occurrence of the find item; for the Source window only, places a blue flag (bookmark) at every occurrence of the find item
 Search For	Click and hold the button to open a drop down menu with the following options: • Instance • Design Unit
 Match Case	search must match the case of the text entered in the Find field
 Exact (whole word)	searches for whole words that match those entered in the Find field
 Regular Expression	Searches for a regular expression; Source window only.
 Wrap Search	Searches from cursor to bottom of window then continues search from top of the window.

Structure Window Search Features

The Structure window Find bar supports hierarchical searching to limit the regions of a search. A forward slash (/) character is used to separate the search words. A double slash (//) is used to specify a recursive search from the double slash down the hierarchy (Figure 1-9). Refer to Finding Items in the Structure Window for more information.

Figure 1-9. Find Mode Popup Displaying Matches



Filter Mode Options

By entering a string in the “Contains” text entry box you can filter the view of the selected window down to the specific information you are looking for.

Table 1-2. Graphic Elements of Toolbar in Filter Mode

Button	Name	Shortcuts	Description
	Filter Regular Expression	None	A drop down menu that allows you to set the wildcard mode. A text entry box for your filter string.
	Clear Filter	None	Clears the text entry box and removes the filter from the active window.

Wildcard Usage

There are three wildcard modes:

- **glob-style** — Allows you to use the following special wildcard characters:

  ***** — matches any sequence of characters in the string

  ? — matches any single character in the string

  [<**chars**>] — matches any character in the set <chars>

\<**x**> — matches the single character <x>, which allows you to match on any special characters (*, ?, [,], and \)

Refer to Finding Items in the Structure Window and the Tcl documentation for more information:

Help > Tcl Man Pages
Tcl Commands > string > string match

- **regular-expression** — (Source window only) allows you to use wildcard characters based on Tcl regular expressions. For more information refer to the Tcl documentation:

  Help > Tcl Man Pages
  Tcl Commands > re_syntax

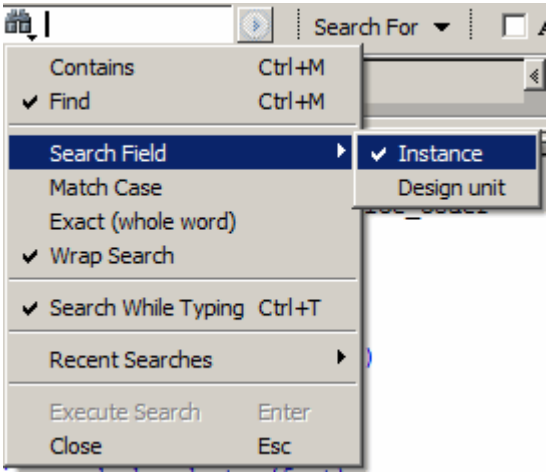
- **exact** — indicates that no characters have special meaning, thus disabling wildcard features.

The string entry field of the Contains toolbar item is case-insensitive, If you need to search for case-sensitive strings in the Source window select “regular-expression” and prepend the string with (?c).

Find Options Popup Menu

When you click the Find Options icon  in the Find entry field it will open a Find Options popup menu (Figure 1-10).

Figure 1-10. Find Options Popup Menu



The Find Options menu displays the options available to you as well as hot keys for initiating the actions without the menu.

General Visual Elements

This section descibes elements that are used by multiple windows.

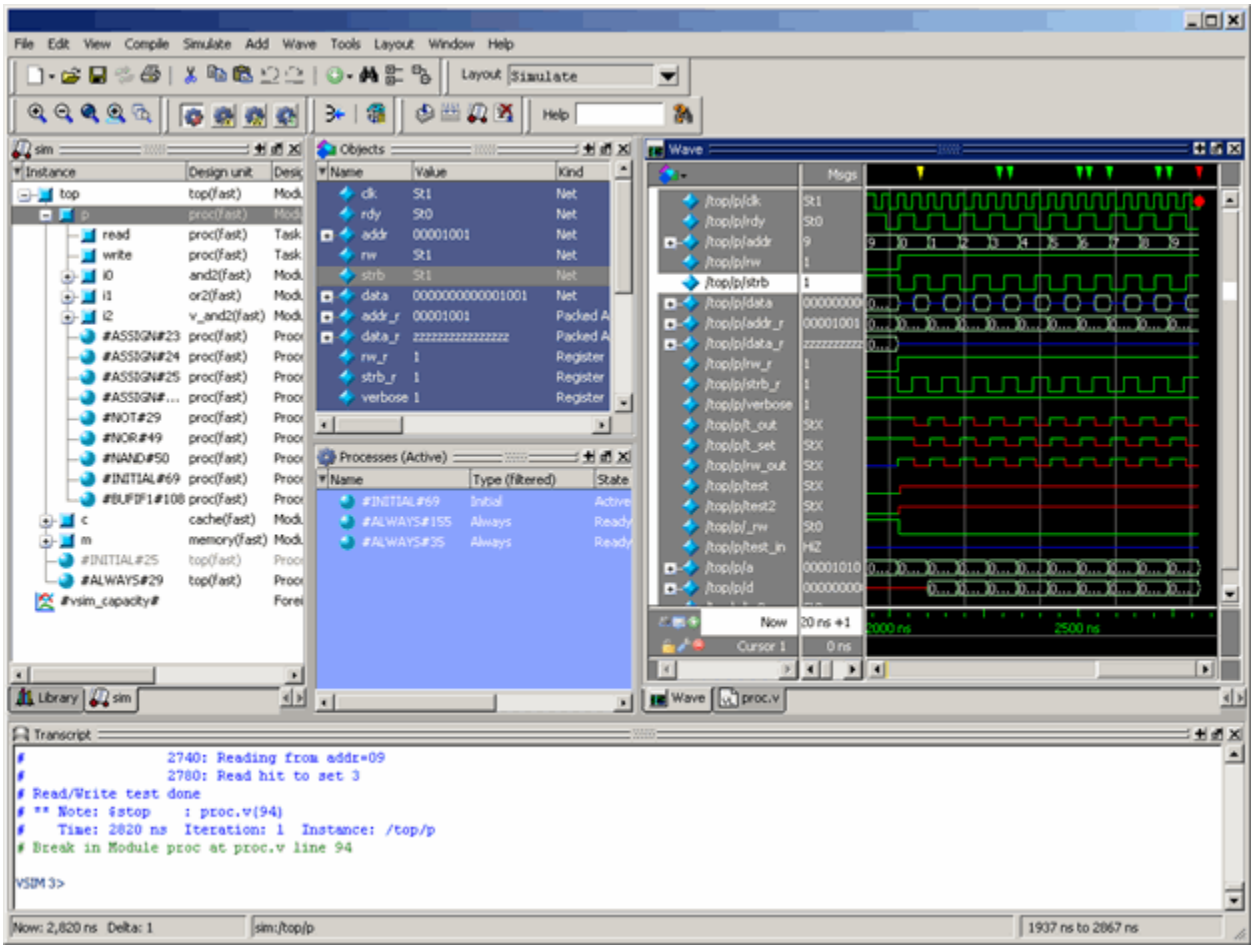
Elements of the Main Window

The following sections outline the GUI terminology used in this manual.

Menu Bar	Toolbar Frame
Toolbar	Window
Tab Group	Pane

The Main window is the primary access point in the GUI. Figure 1-11 shows an example of the Main window during a simulation run.

Figure 1-11. Main Window of the GUI



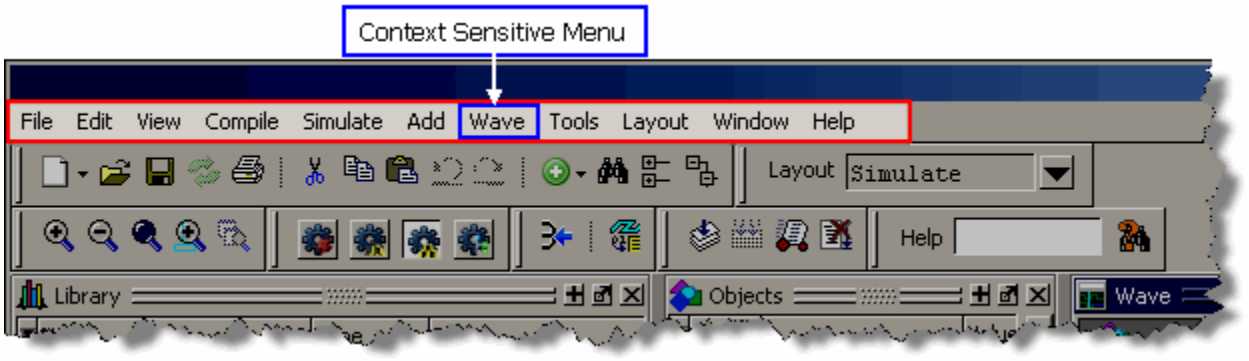
The Main window contains a menu bar, toolbar frame, windows, tab groups, and a status bar, which are described in the following sections.

Menu Bar

The menu bar provides access to many tasks available for your workflow. Figure 1-12 shows the selection in the menu bar that changes based on whichever window is currently active.

The menu items that are available and how certain menu items behave depend on which window is active. For example, if the Structure window is active and you choose Edit from the menu bar, the Clear command is disabled. However, if you click in the Transcript window and choose Edit, the Clear command is enabled. The active window is denoted by a blue title bar

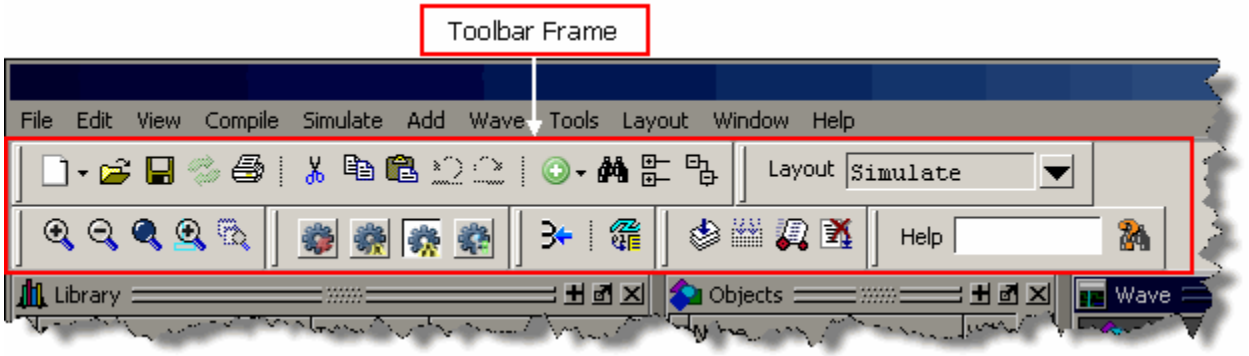
Figure 1-12. Main Window — Menu Bar



Toolbar Frame

The toolbar frame contains several toolbars that provide quick access to various commands and functions.

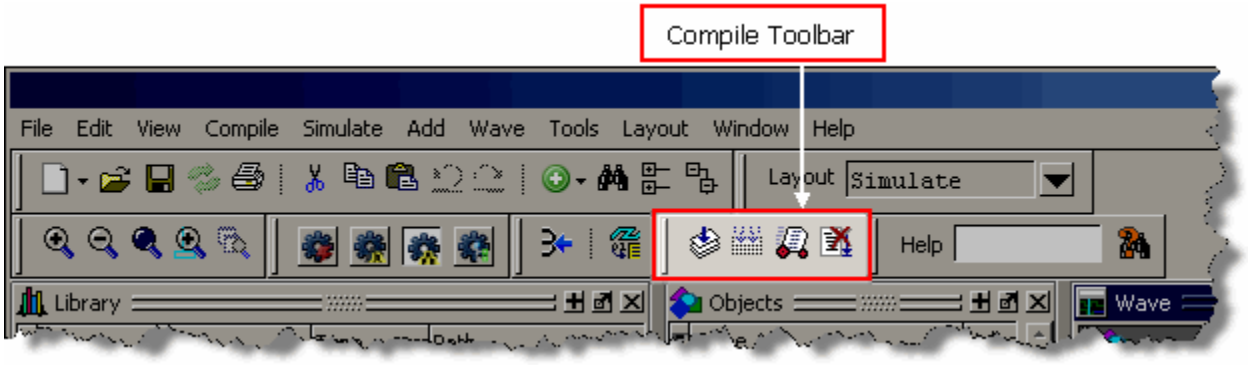
Figure 1-13. Main Window — Toolbar Frame



Toolbar

A toolbar is a collection of GUI elements in the toolbar frame and grouped by similarity of task. There are many toolbars available within the GUI, refer to the section "Toolbars" for more information about each toolbar. Figure 1-14 highlights the Compile toolbar in the toolbar frame.

Figure 1-14. Main Window — Toolbar

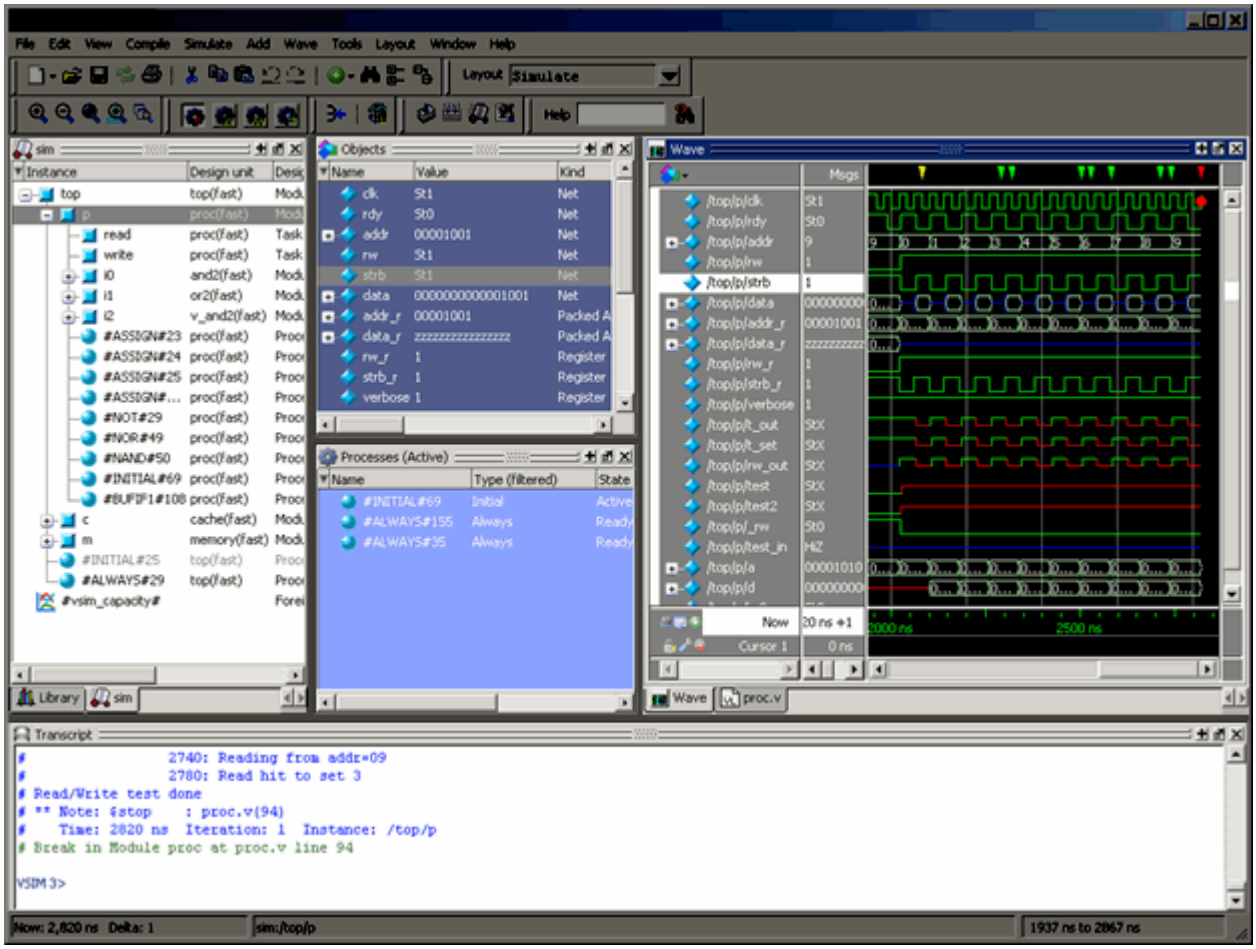


Window

ModelSim can display over 40 different windows you can use with your workflow. This manual refers to all of these objects as windows, even though you can rearrange them such that they appear as a single window with tabs identifying each window.

Figure 1-15 shows an example of a layout with five windows visible; the Structure, Objects, Processes, Wave and Transcript windows.

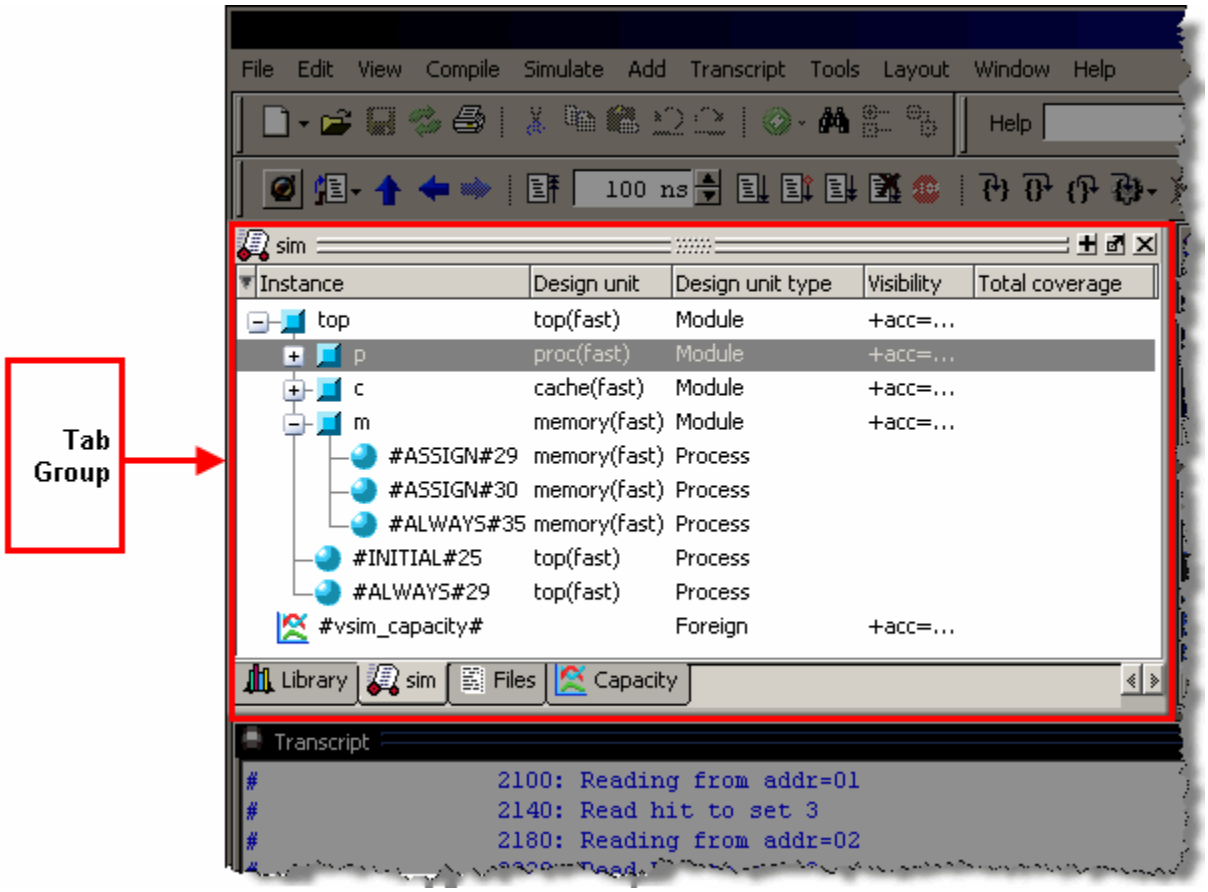
Figure 1-15. GUI Windows



Tab Group

You can group any number of windows into a single space called a tab group, allowing you to show and hide windows by selecting their tabs. Figure 1-16 shows a tab group of the Library, Files, Capacity and Structure windows, with the Structure (sim) window visible.

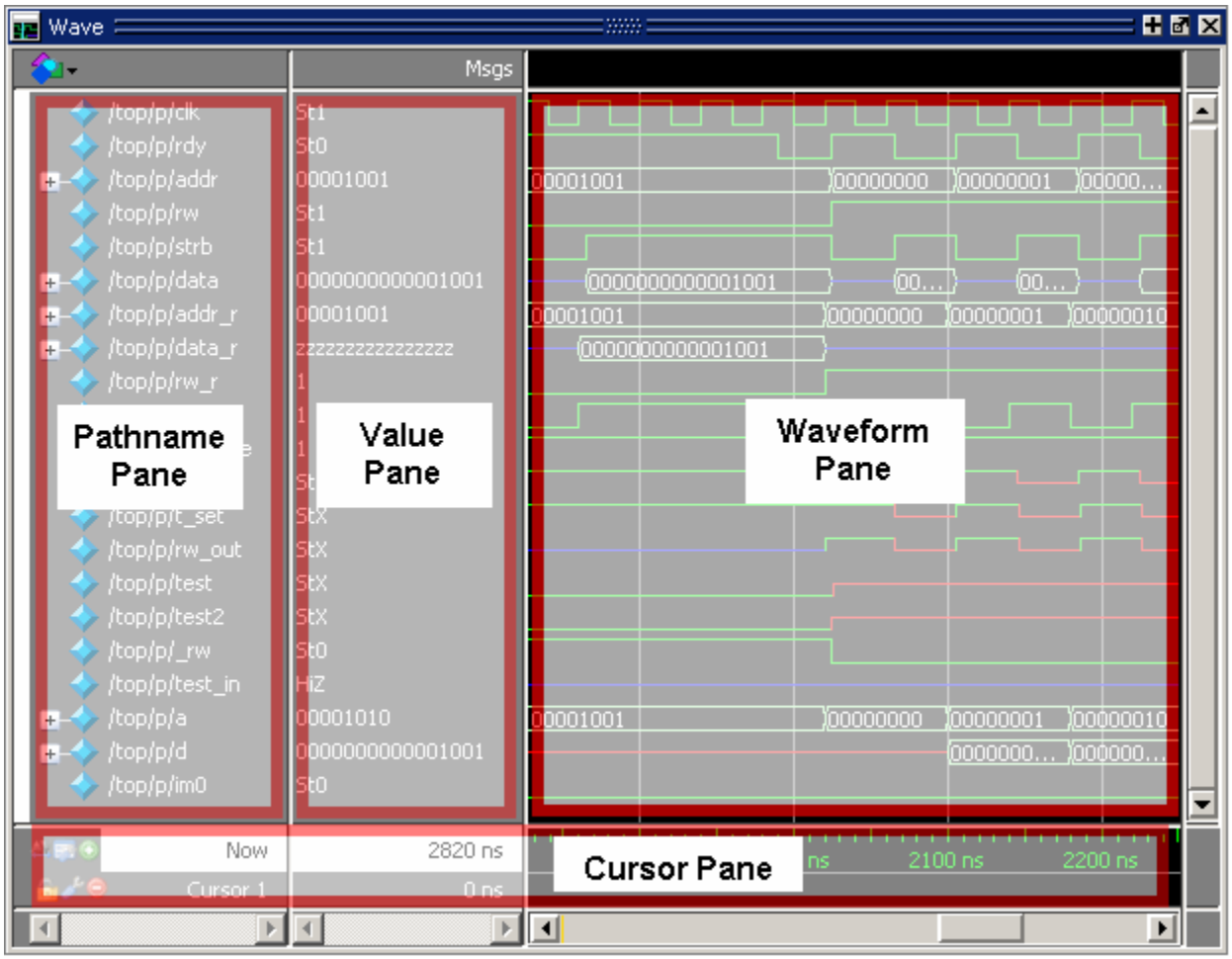
Figure 1-16. GUI Tab Group



Pane

Some windows contain panes, which are separate areas of a window display containing distinct information within that window. One way to tell if a window has panes is whether you receive different popup menus (right-click menu) in different areas. Windows that have panes include the Wave, Source, and List windows. Figure 1-17 shows the Wave window with its the three panes.

Figure 1-17. Wave Window Panes



Main Window Status Bar

Fields at the bottom of the Main window provide the following information about the current simulation:

Figure 1-18. Main Window Status Bar

Table 1-3. Information Displayed in Status Bar

Field	Description
Project	name of the current project
Now	the current simulation time

Table 1-3. Information Displayed in Status Bar (cont.)

Field	Description
Delta	the current simulation iteration number
Profile Samples	the number of profile samples collected during the current simulation
Memory	the total memory used during the current simulation
environment	name of the current context (object selected in the active Structure window)
line/column	line and column numbers of the cursor in the active Source window

Design Object Icons and Their Meanings

The color and shape of icons convey information about the language and type of a design object.

Table 1-4 shows the icon colors and the languages they indicate.

Table 1-4. Design Object Icons

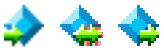
Icon color	Design Language
light blue	Verilog or SystemVerilog
dark blue	VHDL
orange	virtual object

Here is a list of icon shapes and the design object types they indicate:

Table 1-5. Icon Shapes and Design Object Types

Icon shape	Example	Design Object Type
Square		any scope (VHDL block, Verilog named block, SC module, class, interface, task, function, and so forth.)
Square and red asterix		SystemVerilog object, OVM, and UVM test bench scope or object
Circle		process
Diamond		valued object (signals, nets, registers, and so forth.)
Diamond and yellow pulse on red dot		an editable waveform created with the waveform editor

Table 1-5. Icon Shapes and Design Object Types (cont.)

Icon shape	Example	Design Object Type
Diamond and red asterix		valued object (abstract)
Diamond and green arrow		indicates mode (In, Inout, Out) of an object port
Triangle		caution sign on comparison object
Star		transaction; The color of the star for each transaction depends on the language of the region in which the transaction stream occurs: dark blue for VHDL light blue for Verilog and SystemVerilog

Window Time Display

There are two basic time designations used to control display of object values in many simulator windows.

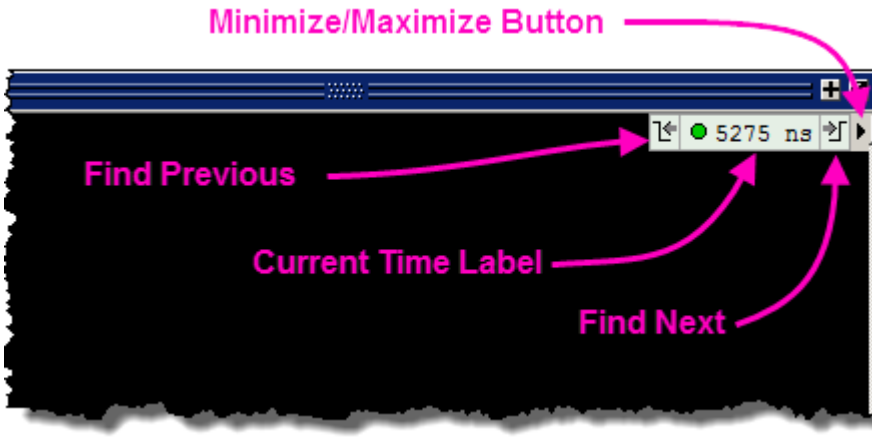
- Now — The end-of-simulation time or the time at which the simulation has stopped.
- Current Time — The current time displayed in an open window. The time may be any time between 0 and the end of simulation, and is set in several ways:
  - by moving a wave cursor
  - by interacting with the Current Time Label. Refer to Current Time Label for more information.

A number of windows are dynamically linked to update when the time setting in one is changed. The windows include the FSM, Objects, Source, and Watch windows.

Current Time Label

The Current Time Label allows you to interact with and change the simulation time displayed in several windows. The Current Time Label displays the Now (end of simulation) or Current Time, and allows you to search the time line for a transition on a selected object in the window (Figure 1-19).

Figure 1-19. Current Time Label



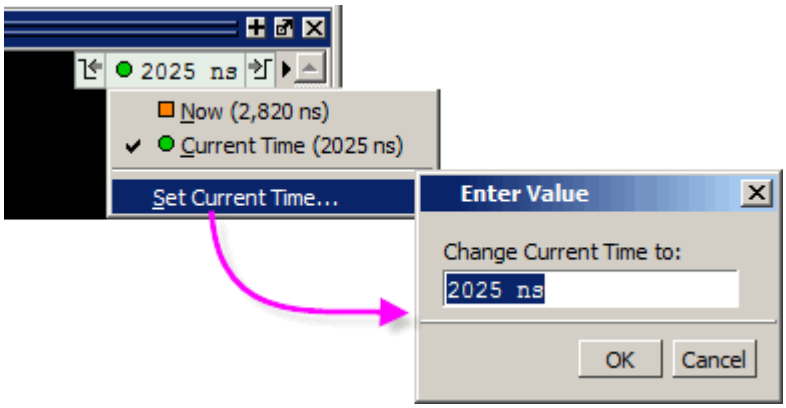
When you run a simulation and it comes to an end, the Current Time Label displays the Now time which is the end-of-simulation time. When you select a cursor in the Wave window, the Current Time Label automatically changes to display the time of the current active cursor and updates the other windows to the same time.

The Current Time Label includes a minimize/maximize button that allows you to hide or display the label.

When you select an object in a window displaying the Current Time label, you can jump to the previous or next transition for that object, with respect to the current time, by clicking the Find Previous or Find Next button.

To change the display from showing the Current Time to showing the Now time (default), or vice versa, click on the time display in the Current Time label to open a drop down menu (Figure 1-20) or select **View > Time Mode**.

Figure 1-20. Enter Current Time Value



Chapter 2
Menus

The selections in the menu bar of the main window change dynamically, based on which window is currently active. As a result, some menu items change their names or become unavailable (dimmed). This section describes the menu items provided at the highest level provided for a given window.

Window-specific Menu

Every window has a window-specific menu that appears in the menu bar between the Add and Tools menus.

The menu options available pertain only to that window and are described in the window-specific section of the chapter "Window Reference."

File Menu

The File menu provides access to a number of simulation-wide options.

Table 2-1. File Menu — Item Description

Menu Item	Description
New	• Folder — create a new folder in the current directory • Source — create a new VHDL, Verilog or other source file • Project — create a new project • Library — create a new library and mapping • Debug Archive — archive debug data for post-simulation analysis. Refer to the archive write command for more information. •
Open	Open a file of any type.
Load	• DO File — load and run a script file (*.do* or *.tcl*) • Debug Archive — load archived debug data for post-simulation analysis. Refer to the archive load command for more information.
Close	Close an opened file

Table 2-1. File Menu — Item Description (cont.)

Menu Item	Description
Import	• Library — import FPGA libraries • EVCD — import an extended VCD file previously created with the ModelSim Waveform Editor. This item is enabled only when a Wave window is active • Memory Data — initialize a memory by reloading a previously saved memory file. • Column Layout — apply a previously saved column layout to the active window •
Export	• Waveform — export a created waveform • Tabular list — writes List window data to a file in tabular format • Event list — writes List window data to a file as a series of transitions that occurred during simulation • TSSI list — writes List window data to a file in TSSI format • Image — saves an image of the active window • Memory Data — saves data from the selected memory in the Memory List window or an active Memory Data window to a text file • Column Layout — saves a column layout from the active window • • HTML — opens up a dialog where you can specify the name of an HMTL file and the directory where it is saved
Save Save as	These menu items change based on the active window.
Report	Produce a textual report based on the active window
Change Directory	Opens a browser for you to change your current directory. Not available during a simulation, or if you have a dataset open.
Use Source	Specifies an alternative file to use for the current source file. This mapping only exists for the current simulation. This option is only available from the Structure window.
Source Directory	Control which directories are searched for source files.
Datasets	Manage datasets for the current session.
Environment	Set up how different windows should be updated, by dataset, process, and/or context. This is only available when the Structure, Locals, Processes, and Objects windows are active.

Table 2-1. File Menu — Item Description (cont.)

Menu Item	Description
Page Setup Print Print Postscript	Manage the printing of information from the selected window.
Recent Directories	Display a list of recently opened working directories. You may change the number of directories displayed by changing the value of the PrefMain(recentDirectoryLimit) preference setting. Select **Tools > Edit Preferences**, then the **By Name** tab. The default value is 8.
Recent Projects	Display a list of recently opened projects. You may change the number of projects displayed by changing the value of the PrefMain(recentProjectLimit) preference setting. Select **Tools > Edit Preferences**, then the **By Name** tab. The default value is 8.
Close Window	Close the active window
Quit	Quit the application

Edit Menu

The Edit menu provides access to a number of options for manipulating information in the GUI.

Table 2-2. Edit Menu — Item Description

Menu Item	Description
Undo Redo	Alter your previous edit in a Source window.
Cut Copy Paste	Use or remove selected text.
Delete	Remove an object from the Wave and List windows
Clear	Clear the Transcript window
Select All Unselect All	Change the selection of items in a window
Expand	Expand or collapse hierarchy information
Goto	Goto a specific line number in the Source window
Find	Open the find toolbar. Refer to the section “Find and Filter Functions” for more information
Replace	Find and replace text in a Source window.

Table 2-2. Edit Menu — Item Description (cont.)

Menu Item	Description
Signal Search	Search the Wave or List windows for a specified value, or the next transition for the selected object
Find in Files	search for text in saved files

View Menu

The View menu provides to options for manipulating the GUI windows.

Table 2-3. View Menu — Item Description

Menu Item	Description
window name	Displays the selected window
New Window	Open additional instances of the Wave, List, or Dataflow windows
Sort	Change the sort order of the Wave window
Filter	Filters information from the Objects and Structure windows.
Justify	Change the alignment of data in the selected window.
Properties	Displays file property information from the Files or Source windows.

Compile Menu

The Compile menu provides access to options related to the compile step of your simulation run.

Table 2-4. Compile Menu — Item Description

Menu Item	Description
Compile	Compile source files
Compile Options	Set various compile options.
Compile All	Compile all files in the open project. Disabled if you don’t have a project open
Compile Selected	Compile the files selected in the project tab. Disabled if you don’t have a project open
Compile Order	Set the compile order of the files in the open project. Disabled if you don’t have a project open

Table 2-4. Compile Menu — Item Description (cont.)

Menu Item	Description
Compile Report	report on the compilation history of the selected file(s) in the project. Disabled if you don't have a project open
Compile Summary	report on the compilation history of all files in the project. Disabled if you don't have a project open

Simulate Menu

The Simulate menu provides access to options related to the simulation step of your simulation run

Table 2-5. Simulate Menu — Item Description

Menu item	Description
Design Optimization	Open the Design Optimization dialog to configure simulation optimizations
Start Simulation	Load the selected design unit
Runtime Options	Set various simulation runtime options
Run	• Run <default> — run simulation for one default run length; change the run length with **Simulate > Runtime Options**, or use the Run Length text box on the toolbar • Run -All — run simulation until you stop it • Continue — continue the simulation • Run -Next — run to the next event time • Step — single-step the simulator • Step -Over — execute without single-stepping through a subprogram call • Restart — reload the design elements and reset the simulation time to zero; only design elements that have changed are reloaded; you specify whether to maintain various objects (logged signals, breakpoints, etc.)
Break	Stop the current simulation run
End Simulation	Quit the current simulation run

Add Menu

The Add menu provides access to options for populating windows with data from other windows.

Table 2-6. Add Menu — Item Description

Menu Item	Description
To Wave	Add information to the Wave window
To List	Add information to the List window
To Log	Add information to the Log file
To Dataflow	Add information to the Dataflow window
Window Pane	Add an additional pane to the Wave window. You can remove this pane by selecting **Wave > Delete Window Pane**.

Tools Menu

The Tools menu provides access to various tools available within the GUI.

Table 2-7. Tools Menu — Item Description

Menu Item	Description
Breakpoints	Manage breakpoints
Trace	Perform signal trace actions.
Dataset Snapshot	Enable periodic saving of simulation data to a *.wlf* file.
Tcl	Execute or debug a Tcl macro.
Wildcard Filter	Refer to the section "Using the WildcardFilter Preference Variable" for more information
Edit Preferences	Set GUI preference variables. Refer to the section "Setting GUI Preferences" for more information.

Layout Menu

The Layout menu provides access to options for manipulating the configuration of the GUI.

Table 2-8. Layout Menu — Item Description

Menu Item	Description
Reset	Reset the GUI to the default appearance for the selected layout.

Table 2-8. Layout Menu — Item Description (cont.)

Menu Item	Description
Save Layout As	Save your reorganized view to a custom layout. Refer to the section "Simulator GUI Layout Customization" for more information.
Configure	Configure the layout-specific behavior of the GUI. Refer to the section "Configure Window Layouts Dialog Box" for more information.
Delete	Delete a customized layout. You can not delete any of the five standard layouts.
layout name	Select a standard or customized layout.

Bookmarks Menu

The Bookmarks menu provides access to options related to bookmarking the Wave window.

Table 2-9. Bookmarks Menu — Item Description

Menu Item	Description
Add	Clicking this button bookmarks the current view of the Wave window.
Add Custom	Opens the New Bookmark dialog box.
Manage	Opens the Manage Bookmarks dialog box.
Delete All	• Active Window Only • All Windows.
Reload from File	• Active Window Only • All Windows.

Window Menu

The Window menu provides access to options for organizing and controlling features of GUI windows.

Table 2-10. Window Menu — Item Description

Menu Item	Description
Cascade Tile Horizontally Tile Vertically	Arrange all undocked windows. These options do not impact any docked windows.

Table 2-10. Window Menu — Item Description (cont.)

Menu Item	Description
Icon Children Icon All Deicon All	Minimize (Icon) or Maximize (Deicon) undocked windows. These options do not impact any docked windows.
Show Toolbar	Toggle the appearance of the Toolbar frame of the Main window
Show Window Headers	Toggle the appearance of the window headers. Note that you will be unable to rearrange windows if you do not show the window headers.
FocusFollowsMouse	Mouse pointer makes window active when pointer hovers in the window briefly. Refer to Selecting the Active Window for more information.
Toolbars	Toggle the appearance of available toolbars. Similar behavior to right-clicking in the toolbar frame.
window name	Make the selected window active.
Windows	Display the Windows dialog box, which allows you to activate, close or undock the selected window(s).

Help Menu

The Help menu provides access to various types of documentation.

Table 2-11. Help Menu — Item Description

Menu Item	Description
About	Display ModelSim application information.
Release Notes	Display the current Release Notes in the ModelSim Notepad editor. You can find past release notes in the *<install_dir>/docs/rlsnotes/* directory.
Welcome Window	Display the Important Information splash screen. By default this window is displayed on startup. You can disable the automatic display by toggling the **Don't show this dialog again** radio button.

Table 2-11. Help Menu — Item Description (cont.)

Menu Item	Description
Command Completion	Toggles the command completion dropdown box in the transcript window. When you start typing a command at the Transcript prompt, a dropdown box appears which lists the available commands matching what has been typed so far. You may use the Up and Down arrow keys or the mouse to select the desired command. When a unique command has been entered, the command usage is presented in the drop down box.
Register File Types	Associate files types (such as *.v, .sv, .vhd, .do*) with the product. These associations are typically made upon install, but this option allows you to update your system in case changes have been made since installation.
ModelSim Documentation - PDF Bookcase	Open the PDF-based portal for the most commonly used PDF documents.
Tcl Help	Open the Tcl command reference (man pages) in Windows help format.
Tcl Syntax	Open the Tcl syntax documentation in your web browser.
Tcl Man pages	Open the Tcl/Tk manual in your web browser.
Technotes	Open a technical note in the ModelSim Notepad editor.

Chapter 3
Toolbars

The Main window contains a toolbar frame that displays context-specific toolbars. The following sections describe the toolbars and their associated buttons.

You can determine the name of a toolbar in the GUI by right-clicking on the toolbar and looking for the bolded name in the pop-up menu.

Bookmarks Toolbar

The Bookmark toolbar allows you to manage your bookmarks of the Wave window

Figure 3-1. Bookmarks Toolbar

Table 3-1. Bookmarks Toolbar Buttons

Button	Name	Shortcuts	Description
	Add Bookmark	**Command Wave window only**: bookmark add wave **Menu Wave window only**: **Add > To Wave > Bookmark**	Clicking this button bookmarks the current view of the active window. Click and hold the button to open a drop down menu with the following options: • Add Current View • Add Custom ... • Set Default Action
	Delete All Bookmarks	**CommandWave window only**: bookmark delete wave -all	Removes all bookmarks, after prompting for your confirmation. Click and hold the button to open a drop down menu with the following options: • Active Window • All Windows

Table 3-1. Bookmarks Toolbar Buttons (cont.)

Button	Name	Shortcuts	Description
	Manage Bookmarks	None	Displays the Manage Bookmarks dialog box.
	Reload from File	None	Reloads bookmarks from the *bookmarks.do* file. • Set Default Action
	Jump to Bookmark	**CommandWave window only**: bookmark goto wave <name>	Displays bookmarks grouped by window. Select the bookmark you want to display.

Compile Toolbar

The Compile toolbar provides access to compile and simulation actions.

Figure 3-2. Compile Toolbar

Table 3-2. Compile Toolbar Buttons

Button	Name	Shortcuts	Description
	Compile	**Command**: vcom or vlog **Menu**: **Compile** > **Compile**	Opens the Compile Source Files dialog box.
	Compile All	**Command**: **vcom** or **vlog** **Menu**: **Compile** > **Compile all**	Compiles all files in the open project.
	Simulate	**Command**: vsim **Menu**: **Simulate** > **Start Simulation**	Opens the Start Simulation dialog box.
	Break	**Menu**: **Simulate** > **Break** **Hotkey**: Break	Stop a compilation, elaboration, or the current simulation run.

Dataflow Toolbar

The Dataflow toolbar provides access to various tools to use in the Dataflow window.

Figure 3-3. Dataflow Toolbar

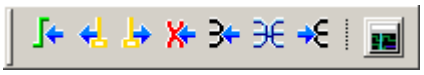


Table 3-3. Dataflow Toolbar Buttons

Button	Name	Shortcuts	Description
	Trace Input Net to Event	**Menu**: **Tools** > **Trace** > **Trace next event**	Move the next event cursor to the next input event driving the selected output.
	Trace Set	**Menu**: **Tools** > **Trace** > **Trace event set**	Jump to the source of the selected input event.
	Trace Reset	**Menu**: **Tools** > **Trace** > **Trace event reset**	Return the next event cursor to the selected output.
	Trace Net to Driver of X	**Menu**: **Tools** > **Trace** > **TraceX**	Step back to the last driver of an unknown value.
	Expand Net to all Drivers	None	Display driver(s) of the selected signal, net, or register.
	Expand Net to all Drivers and Readers	None	Display driver(s) and reader(s) of the selected signal, net, or register.
	Expand Net to all Readers	None	Display reader(s) of the selected signal, net, or register.
	Show Wave	**Menu**: **Dataflow** > **Show Wave**	Display the embedded wave viewer pane.

Help Toolbar

The Help toolbar provides a way for you to search the HTML documentation for a specified string. The HTML documentation will be displayed in a web browser.

Figure 3-4. Help Toolbar

Table 3-4. Help Toolbar Buttons

Button	Name	Shortcuts	Description
	Search Documentation	None	A text entry box for your search string.
	Search Documentation	**Hotkey**: Enter	Activates the search for the term you entered into the text entry box.

Layout Toolbar

The Layout toolbar allows you to select a predefined or user-defined layout of the graphical user interface.

Refer to the section "Simulator GUI Layout Customization" for more information.

Figure 3-5. Layout Toolbar

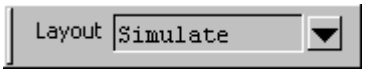


Table 3-5. Layout Toolbar Buttons

Button	Name	Shortcuts	Description
	Change Layout	**Menu**: **Layout** > *<layoutName>*	A dropdown box that allows you to select a GUI layout. • NoDesign • Simulate •

Memory Toolbar

The Memory toolbar provides access to common functions.

Figure 3-6. Memory Toolbar

Table 3-6. Memory Toolbar Buttons

Button	Name	Shortcuts	Description
	Split Screen	**Menu: Memory > Split Screen**	Splits the memory window.
	Goto Address		Highlights the first element of the specified address.

Mode Toolbar

The Mode toolbar provides access to tools for controlling the mode of mouse navigation.

Figure 3-7. Mode Toolbar

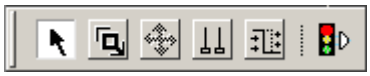


Table 3-7. Mode Toolbar Buttons

Button	Name	Shortcuts	Description
	Select Mode	**Menu**: **Dataflow > Mouse Mode > Select Mode**	Set the left mouse button to select mode and middle mouse button to zoom mode.
	Zoom Mode	**Menu**: Dataflow > Mouse Mode > Zoom Mode	Set left mouse button to zoom mode and middle mouse button to pan mode.
	Pan Mode	**Menu**: Dataflow > Mouse Mode > Pan Mode	Set left mouse button to pan mode and middle mouse button to zoom mode.
	Two Cursor Mode	Menu: Wave > Mouse Mode > Two Cursor	Sets two cursors in Wave window. First cursor moves with LMB, second cursor with MMB.
	Edit Mode	**Menu**: Wave or Dataflow > Mouse Mode > Edit Mode	Set mouse to Edit Mode, where you drag the left mouse button to select a range and drag the middle mouse button to zoom.
	Stop Drawing	None	Halt any drawing currently happening in the window.

Objectfilter Toolbar

The Objectfilter toolbar provides filtering of design objects appearing in the Objects window.

Figure 3-8. Objectfilter Toolbar

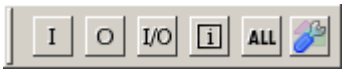


Table 3-8. Objectfilter Toolbar Buttons

Button	Name	Shortcuts	Description
	View Inputs Only	None	Changes the view of the Objects Window to show inputs.
	View Outputs Only	None	Changes the view of the Objects Window to show outputs.
	View Inouts Only	None	Changes the view of the Objects Window to show inouts.
	Vies Internal Signals	None	Changes the view of the Objects Window to show Internal Signals.
	Reset All Filters	None	Clears the filtering of Objects Window entries and displays all objects.
	Change Filter	None	Opens the Filter Objects dialog box.

Process Toolbar

The Process toolbar contains three toggle buttons (only one can be active at any time) that controls the view of the Process window.

Figure 3-9. Process Toolbar

Table 3-9. Process Toolbar Buttons

Button	Name	Shortcuts	Description
	View Active Processes	**Menu**: Process > Active	Changes the view of the Processes Window to only show active processes.
	View Processes in Region	**Menu**: Process > In Region	Changes the view of the Processes window to only show processes in the active region.
	View Processes for the Design	**Menu**: Process > Design	Changes the view of the Processes window to show processes in the design.
	View Process hierarchy	**Menu**: Process > Hierarchy	Changes the view of the Processes window to show process hierarchy.

Schematic Toolbar

The Schematic toolbar provides access to tools for manipulating highlights and signals in the Dataflow and Schematic windows.

Figure 3-10. Schematic Toolbar

Table 3-10. Schematic Toolbar Buttons

Button	Name	Shortcuts	Description
	Remove All Highlights	**Menu**: Dataflow > Remove Highlight or Schematic > Edit > Remove Highlight	Clear the green highlighting identifying the path you've traversed through the design. Click and hold the button to open a drop down menu with the following options: • Remove All Highlights • Remove Selected Highlights • Set Default Action

Table 3-10. Schematic Toolbar Buttons (cont.)

Button	Name	Shortcuts	Description
	Delete Content	**Menu**: Dataflow > Delete or Schematic > Edit > Delete Schematic > Edit > Delete All	Delete the selected signal. Click and hold the button to open a drop down menu with the following options: • Delete Selected • Delete All • Set Default Action
	Regenerate	**Menu**: Dataflow > Regenerate or Schematic > Edit > Regenerate	Redraws the current schematic view to better take advantage of the available space. For example, after adding or removing elements.

Simulate Toolbar

The Simulate toolbar provides various tools for controlling your active simulation.

Figure 3-11. Simulate Toolbar

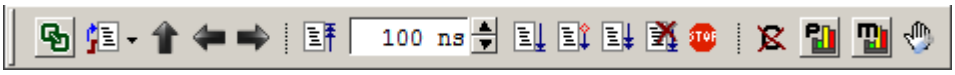
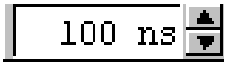


Table 3-11. Simulate Toolbar Buttons

Button	Name	Shortcuts	Description
	Source Hyperlinking	None	Toggles display of hyperlinks in design source files.
	Environment Up	**Command**: env .. **Menu**: File > Environment	Changes your environment up one level of hierarchy.
	Environment Back	**Command**: env -back **Menu**: File > Environment	Change your environment to its previous location.
	Environment Forward	**Command**: env -forward **Menu**: File > Environment	Change your environment forward to a previously selected environment.

Table 3-11. Simulate Toolbar Buttons (cont.)

Button	Name	Shortcuts	Description
	Restart	**Command**: restart **Menu**: Simulate > Run > Restart	Reload the design elements and reset the simulation time to zero, with the option of maintaining various settings and objects.
	Run Length	**Command**: run **Menu**: Simulate > Runtime Options	Specify the run length for the current simulation.
	Run	**Command**: run **Menu**: Simulate > Run > Run *default_run_length*	Run the current simulation for the specified run length.
	Continue Run	**Command**: run -continue **Menu**: Simulate > Run > Continue	Continue the current simulation run until the end of the specified run length or until it hits a breakpoint or specified break event.
	Run All	**Command**: **run -all** **Menu**: Simulate > Run > Run -All	Run the current simulation forever, or until it hits a breakpoint or specified break event.
	Break	**Menu**: Simulate > Break **Hotkey**: Break	Immediate stop of a compilation, elaboration, or simulation run. Similar to hitting a breakpoint if the simulator is in the middle of a process.
	Stop -sync	None	Stop simulation the next time time/delta is advanced.
	Performance Profiling	**Menu**: Tools > Profile > Performance	Enable collection of statistical performance data.
	Memory Profiling	**Menu**: Tools > Profile > Memory	Enable collection of memory usage data.
	Edit Breakpoints	**Menu**: Tools > Breakpoint	Enable breakpoint editing, loading, and saving.

Source Toolbar

The Source toolbar allows you to perform several activities on Source windows.

Figure 3-12. Source Toolbar

Table 3-12. Source Toolbar Buttons

Button	Name	Shortcuts	Description
	Clear Bookmarks	**Menu**: Source > Clear Bookmarks	Removes any bookmarks in the active source file.

Standard Toolbar

The Standard toolbar contains common buttons that apply to most windows.

Figure 3-13. Standard Toolbar

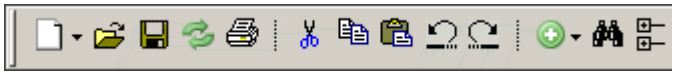


Table 3-13. Standard Toolbar Buttons

Button	Name	Shortcuts	Description
	New File	**Menu**: File > New > Source	Opens a new Source text file. The icon changes to reflect the default file type set with the Set Default Action menu pick from the dropdown menu. Click and hold the button to open a dropdown menu with the following options: • VHDL • Verilog • SystemVerilog • Do • Other • Set Default Action
	Open	**Menu**: File > Open	Opens the Open File dialog

Table 3-13. Standard Toolbar Buttons (cont.)

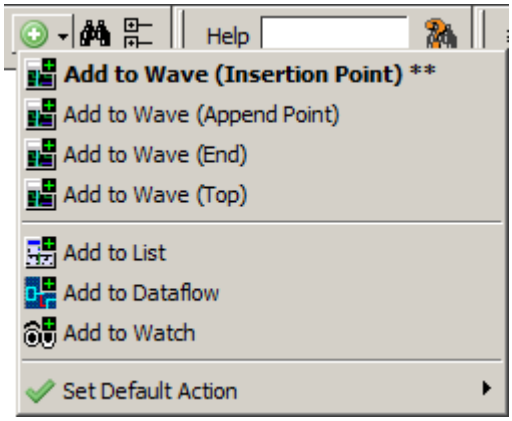
Button	Name	Shortcuts	Description
	Save	**Menu**: File > Save	Saves the contents of the active window or Saves the current wave window display and signal preferences to a DO file script.
	Reload	**Command**: Dataset Restart **Menu**: File > Datasets	Reload the current dataset.
	Print	**Menu**: File > Print	Opens the Print dialog box.
	Cut	**Menu**: Edit > Cut **Hotkey**: Ctrl+x	
	Copy	**Menu**: Edit > Copy **Hotkey**: Ctrl+c	
	Paste	**Menu**: Edit > Paste **Hotkey**: Ctrl+v	
	Undo	**Menu**: Edit > Undo **Hotkey**: Ctrl+z	
	Redo	**Menu**: Edit > Redo **Hotkey**: Ctrl+y	
	Add Selected to Window	Menu: Add > to Wave **Hotkey**: Ctrl+w	Clicking adds selected objects to the Wave window. Refer to "Add Selected to Window Button" for more information about the dropdown menu selections. [1] • Set Default Action
	Find	**Menu**: Edit > Find **Hotkey**: Ctrl+f (Windows) or Ctrl+s (UNIX)	Opens the Find dialog box.
	Collapse All	**Menu**: Edit > Expand > Collapse All	

1. You can set the default insertion location in the Wave window from menus and hotkeys with the **PrefWave(InsertMode)** preference variable.

Add Selected to Window Button

This button is available when you have selected an object in any of the following windows: Dataflow, List, Locals, Memory, Objects, Process, Structure, Watch, and Wave windows. Using a single click, the objects are added to the Wave window. However, if you click-and-hold the button you can access additional options via a dropdown menu, as shown in Figure 3-14.

Figure 3-14. The Add Selected to Window Dropdown Menu



- Add to Wave (Anchor Location) — Adds selected signals above the Insertion Point Bar in the Pathname Pane by default.
- Add to Wave (Append Point) — Adds selected signals below the insertion pointer in the Pathname Pane.
- Add to Wave (End) — Adds selected signals after the last signal in the Wave Window.
- Add to Wave (Top) — Adds selected signals above the first signal in the Wave window.
- Add to List — Adds selected objects to the List Window.
- Add to Dataflow — Adds selected objects to the Dataflow Window.
- Add to Watch — Adds selected objects to the Watch Window.
- Set Default Action — Selecting one of the items from the dropdown menu sets that item as the default action when you click the **Add Selected to Window** button. The title of the selection is shown in bold type in the **Add Selected to Window** dropdown menu and two asterisks (**) are placed after the title to indicate the current default action. For example, **Add to Wave (Anchor Location)** is the default action in Figure 3-14.
- You can change the default

Step Toolbar

The Step toolbar allows you to step through your source code.

Figure 3-15. Step Toolbar

Table 3-14. Step Toolbar Buttons

Button	Name	Shortcuts	Description
	Step Into	**Command**: step **Menu**: Simulate > Run > Step	Step the current simulation to the next statement.
	Step Over	**Command**: **step -over** **Menu**: Simulate > Run > Step -Over	Execute HDL statements, treating them as simple statements instead of entered and traced line by line.
	Step Out	**Command**: **step -out**	Step the current simulation out of the current function or procedure.
	Step Into Current	**Command**: **step -current**	Step the simulation into the current instance, process, or thread.
	Step Over Current	**Command**: **step -over -current**	Step the simulation over the current instance, process, or thread.
	Step Out Current	**Command**: **step -out -current**	Step the simulation out of the current instance, process, or thread.

Wave Toolbar

The Wave toolbar allows you to perform specific actions in the Wave window.

Figure 3-16. Wave Toolbar

Table 3-15. Wave Toolbar Buttons

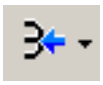
Button	Name	Shortcuts	Description
	Show Drivers Show Drivers (source only)	None	Display driver(s) of the selected signal, net, or register in the Dataflow and Source windows. Display drivers only in the Source window The source window is not shown if there are no drivers.
	Show Readers Show Readers (source only)	None	Display reader(s) of the selected signal, net, or register in the Dataflow window. Display drivers only in the Source window The source window is not shown if there are no readers.
	Add Contributing Signals	**Menu**: Add > To Wave > Contributing Signals	Creates a group labeled **Contributors: <name>**, where <name> is the name of the currently selected signal. This group contains the inputs to the process driving <name>.
	Wave Search Box	Click on the box when in transition mode (Falling Edge, Rising Edge, or Any Transition) to cycle through these options.	Text-entry box for the search string. Dropdown button displays previous search strings. Long search times result in the display of a stop icon you can use to cancel the search.
	Search Previous/Next	Previous: Shift+Enter Next: enter	Searches for the next occurrence of the string, either backward or forward in time, from the cursor.

Table 3-15. Wave Toolbar Buttons (cont.)

Button	Name	Shortcuts	Description
	Search Options		Dropdown button to: • Change Mode: value, rising edge, falling edge, or any transition. • Display the Wave Signal Search Dialog Box for advanced search behavior. • Clear the value history.

Using the Wave Search Box

You can use the Wave Search box to search the timeline of a selected signal for transitions to a specific value, or just for transitions themselves.

1. Select a signal in the left-hand side of the Wave window.
2. Place a wave cursor where you want to begin the search.
3. Enter a value in the Wave Search box. The value must be of a compatible format type for the signal you selected.

   Alternatively you can use the Search Options button to change the mode from “value” to Rising Edge, Falling Edge, or Any Transition. This populates the Wave Search box with the selected transition type.
4. Use the Search Reverse or Search Forward buttons to locate the next occurrence of the value (or transition).

   For large simulations, if the search takes a long time, the Wave Search box will display a stop icon you can click to stop the search.

Wave Cursor Toolbar

The Wave Cursor toolbar provides various tools for manipulating cursors in the Wave window.

Figure 3-17. Wave Cursor Toolbar

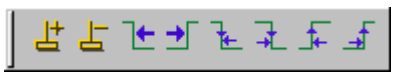


Table 3-16. Wave Cursor Toolbar Buttons

Button	Name	Shortcuts	Description
	Insert Cursor	None	Adds a new cursor to the active Wave window.
	Delete Cursor	**Menu**: Wave > Delete Cursor	Deletes the active cursor.
	Find Previous Transition	**Menu**: Edit > Signal Search **Hotkey**: Shift + Tab	Moves the active cursor to the previous signal value change for the selected signal.
	Find Next Transition	**Menu**: Edit > Signal Search **Hotkey**: Tab	Moves the active cursor to the next signal value change for the selected signal.
	Find Previous Falling Edge	**Menu**: Edit > Signal Search	Moves the active cursor to the previous falling edge for the selected signal.
	Find Next Falling Edge	**Menu**: Edit > Signal Search	Moves the active cursor to the next falling edge for the selected signal.
	Find Previous Rising Edge	**Menu**: Edit > Signal Search	Moves the active cursor to the previous rising edge for the selected signal.
	Find Next Rising Edge	**Menu**: Edit > Signal Search	Moves the active cursor to the next rising edge for the selected signal.

Wave Edit Toolbar

The Wave Edit toolbar provides easy access to tools for modifying an editable wave.

Figure 3-18. Wave Edit Toolbar

Table 3-17. Wave Edit Toolbar Buttons

Button	Name	Shortcuts	Description
	Insert Pulse	**Menu**: Wave > Wave Editor > Insert Pulse **Command**: wave edit insert_pulse	Insert a transition at the selected time.
	Delete Edge	**Menu**: Wave > Wave Editor > Delete Edge **Command**: wave edit delete	Delete the selected transition.
	Invert	**Menu**: Wave > Wave Editor > Invert **Command**: wave edit invert	Invert the selected section of the waveform.
	Mirror	**Menu**: Wave > Wave Editor > Mirror **Command**: wave edit mirror	Mirror the selected section of the waveform.
	Change Value	**Menu**: Wave > Wave Editor > Value **Command**: wave edit change_value	Change the value of the selected section of the waveform.
	Stretch Edge	**Menu**: Wave > Wave Editor > Stretch Edge **Command**: wave edit stretch	Move the selected edge by increasing/decreasing waveform duration.
	Move Edge	**Menu**: Wave > Wave Editor > Move Edge **Command**: wave edit move	Move the selected edge without increasing/decreasing waveform duration.
	Extend All Waves	**Menu**: Wave > Wave Editor > Extend All Waves **Command**: wave edit extend	Increase the duration of all editable waves.

Wave Expand Time Toolbar

The Wave Expand Time toolbar provides access to enabling and controlling wave expansion features.

Figure 3-19. Wave Expand Time Toolbar

Table 3-18. Wave Expand Time Toolbar Buttons

Button	Name	Shortcuts	Description
	Expanded Time Off	**Menu**: Wave > Expanded Time > Off	turns off the expanded time display (default mode)
	Expanded Time Deltas Mode	**Menu**: Wave > Expanded Time > Deltas Mode	displays delta time steps
	Expanded Time Events Mode	**Menu**: Wave > Expanded Time > Events Mode	displays event time steps
	Expand All Time	**Menu**: Wave > Expanded Time > Expand All	expands simulation time over the entire simulation time range, from 0 to current time
	Expand Time at Active Cursor	**Menu**: Wave > Expanded Time > Expand Cursor	expands simulation time at the simulation time of the active cursor
	Collapse All Time	**Menu**: Wave > Expanded Time > Collapse All	collapses simulation time over entire simulation time range
	Collapse Time at Active Cursor	**Menu**: Wave > Expanded Time > Collapse Cursor	collapses simulation time at the simulation time of the active cursor

Zoom Toolbar

The Zoom toolbar allows you to change the view of the Wave window.

Figure 3-20. Zoom Toolbar

Table 3-19. Zoom Toolbar Buttons

Button	Name	Shortcuts	Description
	Zoom In	**Menu**: Wave > Zoom > Zoom In **Hotkey**: i, I, or +	Zooms in by a factor of 2x.

Table 3-19. Zoom Toolbar Buttons (cont.)

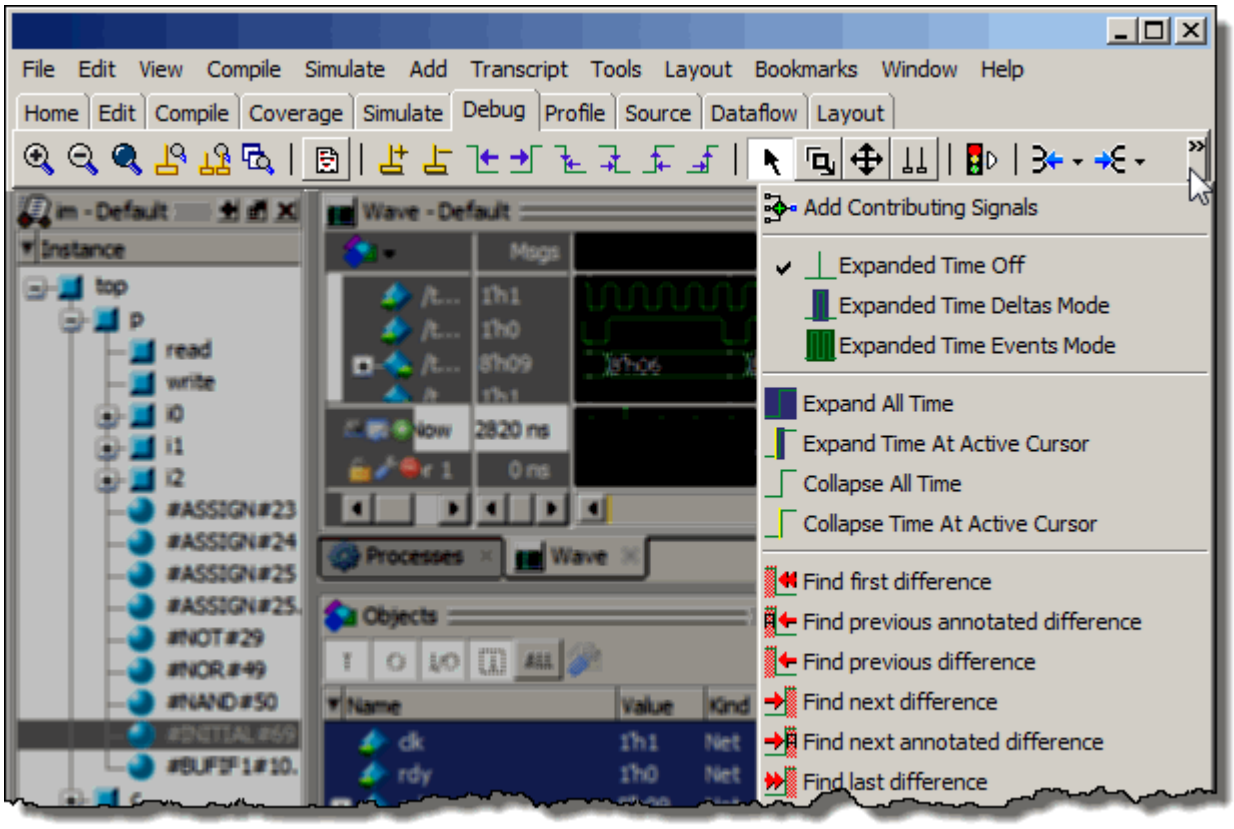
Button	Name	Shortcuts	Description
	Zoom Out	**Menu**: Wave > Zoom > Zoom Out **Hotkey**: o, O, or -	Zooms out by a factor of 2x.
	Zoom Full	**Menu**: Wave > Zoom > Zoom Full **Hotkey**: f or F	Zooms to show the full length of the simulation.
	Zoom in on Active Cursor	**Menu**: Wave > Zoom > Zoom Cursor **Hotkey**: c or C	Zooms in by a factor of 2x, centered on the active cursor.
	Zoom between Cursors		Zooms in or out to show the range between the last two selected cursors.
	Zoom Other Window		Changes the view in additional instances of the Wave window to match the view of the active Wave window.

Toolbar Tabs

The default GUI toolbar format of multiple separate toolbars can be replaced with a row of tabs containing buttons grouped into common tasks such as editing, debugging, and so forth.

The buttons are context-driven and are either operative or dimmed, depending on which window is currently active. To change the GUI to Toolbar Tab format, set **prefToolbar(newEnabled)** to 1 (select **Tools > Edit Preferences**, **By Name** tab, and expand the Toolbar object). You must restart the application for the change to take effect. On restarting the application, the GUI displays the toolbar tabs (Figure 3-21).

Figure 3-21. Toolbar Tabs and Overflow Menu



If the application window is too narrow to accommodate all of the buttons and widgets assigned to it, an overflow button will appear on the right edge of the toolbar. Clicking the overflow button opens a drop-menu (Figure 3-21) which displays the remaining buttons. You can change the overflow from a drop-menu to a scrolling menu by setting **prefToolbar(newScrollable**) to 1.

The following sections describe the tabs and their associated buttons.

Compile Toolbar Tab

The Compile Toolbar Tab provides access to compile actions.

Figure 3-22. Compile Tab

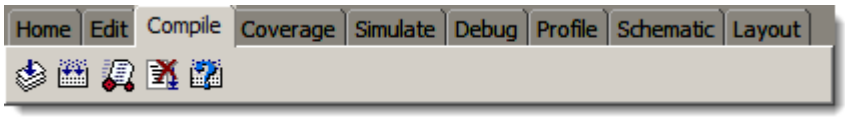


Table 3-20. Compile Toolbar Tab Buttons

Button	Name	Shortcuts	Description
	Compile	**Command**: vcom or vlog **Menu**: **Compile** > **Compile**	Opens the Compile Source Files dialog box.
	Compile All	**Command**: **vcom** or **vlog** **Menu**: **Compile** > **Compile all**	Compiles all files in the open project.
	Simulate	**Command**: vsim **Menu**: **Simulate** > **Start Simulation**	Opens the Start Simulation dialog box.
	Break	**Menu**: **Simulate** > **Break** **Hotkey**: Break	Stop a compilation, elaboration, or the current simulation run.
	Compile Out of Date		Recompile if changes have been made to any source files.

Debug Toolbar Tab

The Debug toolbar tab provides tools for debugging in various windows.

Figure 3-23. Debug Tab

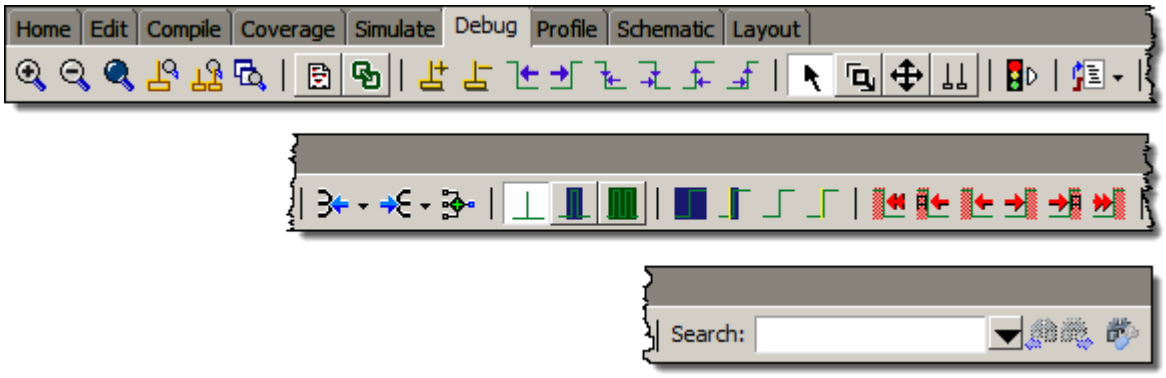


Table 3-21. Debug Toolbar Tab Buttons

Button	Name	Shortcuts	Description
	Zoom In	**Menu**: Wave > Zoom > Zoom In **Hotkey**: i, I, or +	Zooms in by a factor of 2x.
	Zoom Out	**Menu**: Wave > Zoom > Zoom Out **Hotkey**: o, O, or -	Zooms out by a factor of 2x.
	Zoom Full	**Menu**: Wave > Zoom > Zoom Full **Hotkey**: f or F	Zooms to show the full length of the simulation.
	Zoom in on Active Cursor	**Menu**: Wave > Zoom > Zoom Cursor **Hotkey**: c or C	Zooms in by a factor of 2x, centered on the active cursor.
	Zoom between Cursors		Zooms in or out to show the range between the last two selected cursors.
	Zoom Other Window		Changes the view in additional instances of the Wave window to match the view of the active Wave window.
	Source Hyperlinking	None	Toggles display of hyperlinks in design source files.
	Insert Cursor	None	Adds a new cursor to the active Wave window.
	Delete Cursor	**Menu**: Wave > Delete Cursor	Deletes the active cursor.
	Find Previous Transition	**Menu**: Edit > Signal Search **Hotkey**: Shift + Tab	Moves the active cursor to the previous signal value change for the selected signal.
	Find Next Transition	**Menu**: Edit > Signal Search **Hotkey**: Tab	Moves the active cursor to the next signal value change for the selected signal.
	Find Previous Falling Edge	**Menu**: Edit > Signal Search	Moves the active cursor to the previous falling edge for the selected signal.

Table 3-21. Debug Toolbar Tab Buttons (cont.)

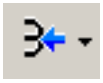
Button	Name	Shortcuts	Description
	Find Next Falling Edge	**Menu**: Edit > Signal Search	Moves the active cursor to the next falling edge for the selected signal.
	Find Previous Rising Edge	**Menu**: Edit > Signal Search	Moves the active cursor to the previous rising edge for the selected signal.
	Find Next Rising Edge	**Menu**: Edit > Signal Search	Moves the active cursor to the next rising edge for the selected signal.
	Select Mode	**Menu**: **Dataflow > Mouse Mode > Select Mode**	Set the left mouse button to select mode and middle mouse button to zoom mode.
	Zoom Mode	**Menu**: Dataflow > **Mouse Mode** > Zoom Mode	Set left mouse button to zoom mode and middle mouse button to pan mode.
	Pan Mode	**Menu**: Dataflow > **Mouse Mode** > Pan Mode	Set left mouse button to pan mode and middle mouse button to zoom mode.
	Two Cursor Mode	**Menu:** Wave > **Mouse Mode** > Two Cursor	Sets two cursors in Wave window. First cursor moves with LMB, second cursor with MMB.
	Stop Drawing	None	Halt any drawing currently happening in the window.
	Show Drivers Show Drivers (source only)	None	Display driver(s) of the selected signal, net, or register in the Dataflow and Source windows. Display drivers only in the Source window The source window is not shown if there are no drivers.

Table 3-21. Debug Toolbar Tab Buttons (cont.)

Button	Name	Shortcuts	Description
	Show Readers Show Readers (source only)	None	Display reader(s) of the selected signal, net, or register in the Dataflow window. Display drivers only in the Source window The source window is not shown if there are no readers.
	Add Contributing Signals	**Menu**: Add > To Wave > Contributing Signals	Creates a group labeled **Contributors: <name>**, where <name> is the name of the currently selected signal. This group contains the inputs to the process driving <name>.
	Expanded Time Off	**Menu**: Wave > Expanded Time > Off	turns off the expanded time display (default mode)
	Expanded Time Deltas Mode	**Menu**: Wave > Expanded Time > Deltas Mode	displays delta time steps
	Expanded Time Events Mode	**Menu**: Wave > Expanded Time > Events Mode	displays event time steps
	Expand All Time	**Menu**: Wave > Expanded Time > Expand All	expands simulation time over the entire simulation time range, from 0 to current time
	Expand Time at Active Cursor	**Menu**: Wave > Expanded Time > Expand Cursor	expands simulation time at the simulation time of the active cursor
	Collapse All Time	**Menu**: Wave > Expanded Time > Collapse All	collapses simulation time over entire simulation time range
	Collapse Time at Active Cursor	**Menu**: Wave > Expanded Time > Collapse Cursor	collapses simulation time at the simulation time of the active cursor
	Find First Difference	None	Find the first difference in a waveform comparison

Table 3-21. Debug Toolbar Tab Buttons (cont.)

Button	Name	Shortcuts	Description
	Find Previous Annotated Difference	None	Find the previous annotated difference in a waveform comparison
	Find Previous Difference	None	Find the previous difference in a waveform comparison
	Find Next Difference	None	Find the next difference in a waveform comparison
	Find Next Annotated Difference	None	Find the next annotated difference in a waveform comparison
	Find Last Difference	None	Find the last difference in a waveform comparison
	Wave Search Box	Click on the box when in transition mode (Falling Edge, Rising Edge, or Any Transition) to cycle through these options.	Text-entry box for the search string. Dropdown button displays previous search strings. Long search times result in the display of a stop icon you can use to cancel the search.
	Search Previous/Next	Previous: Shift+Enter Next: enter	Searches for the next occurrence of the string, either backward or forward in time, from the cursor.
	Search Options	**Menu**: Edit > Signal Search	Dropdown button to: • Change Mode: value, rising edge, falling edge, or any transition. • Display the Wave Signal Search Dialog Box for advanced search behavior. • Clear the value history.

Edit Toolbar Tab

The Edit toolbar tab provides tools for modifying an editable waveform.

Figure 3-24. Edit Tab

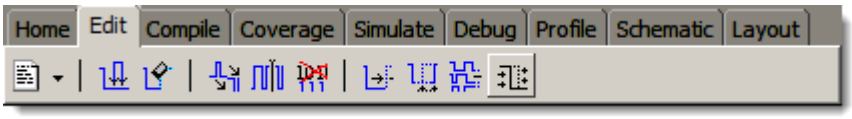


Table 3-22. Edit Toolbar Tab Buttons

Button	Name	Shortcuts	Description
	New File	**Menu**: File > New > Source	Opens a new Source text file. The icon changes to reflect the default file type set with the Set Default Action menu pick from the dropdown menu. Click and hold the button to open a dropdown menu with the following options: • VHDL • Verilog • SystemVerilog • Do • Other • Set Default Action
	Insert Pulse	**Menu**: Wave > Wave Editor > Insert Pulse **Command**: wave edit insert_pulse	Insert a transition at the selected time.
	Delete Edge	**Menu**: Wave > Wave Editor > Delete Edge **Command**: wave edit delete	Delete the selected transition.
	Invert	**Menu**: Wave > Wave Editor > Invert **Command**: wave edit invert	Invert the selected section of the waveform.
	Mirror	**Menu**: Wave > Wave Editor > Mirror **Command**: wave edit mirror	Mirror the selected section of the waveform.
	Change Value	**Menu**: Wave > Wave Editor > Value **Command**: wave edit change_value	Change the value of the selected section of the waveform.

Table 3-22. Edit Toolbar Tab Buttons (cont.)

Button	Name	Shortcuts	Description
	Stretch Edge	**Menu**: Wave > Wave Editor > Stretch Edge **Command**: wave edit stretch	Move the selected edge by increasing/decreasing waveform duration.
	Move Edge	**Menu**: Wave > Wave Editor > Move Edge **Command**: wave edit move	Move the selected edge without increasing/decreasing waveform duration.
	Extend All Waves	**Menu**: Wave > Wave Editor > Extend All Waves **Command**: wave edit extend	Increase the duration of all editable waves.
	Edit Mode	**Menu**: Wave or Dataflow > Mouse Mode > Edit Mode	Set mouse to Edit Mode, where you drag the left mouse button to select a range and drag the middle mouse button to zoom.

Home Toolbar Tab

The Home toolbar tab contains common buttons that apply to most windows.

Figure 3-25. Home Tab

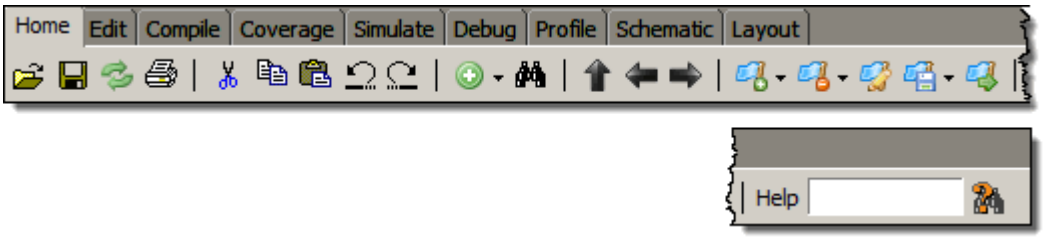


Table 3-23. Home Toolbar Tab Buttons

Button	Name	Shortcuts	Description
	Open	**Menu**: File > Open	Opens the Open File dialog
	Save	**Menu**: File > Save	Saves the contents of the active window or Saves the current wave window display and signal preferences to a DO file script.

Table 3-23. Home Toolbar Tab Buttons (cont.)

Button	Name	Shortcuts	Description
	Reload	**Command**: Dataset Restart **Menu**: File > Datasets	Reload the current dataset.
	Print	**Menu**: File > Print	Opens the Print dialog box.
	Cut	**Menu**: Edit > Cut **Hotkey**: Ctrl+x	
	Copy	**Menu**: Edit > Copy **Hotkey**: Ctrl+c	
	Paste	**Menu**: Edit > Paste **Hotkey**: Ctrl+v	
	Undo	**Menu**: Edit > Undo **Hotkey**: Ctrl+z	
	Redo	**Menu**: Edit > Redo **Hotkey**: Ctrl+y	
	Add Selected to Window	Menu: Add > to Wave **Hotkey**: Ctrl+w	Clicking adds selected objects to the Wave window. Refer to "Add Selected to Window Button" for more information about the dropdown menu selections. [1] • Set Default Action
	Find	**Menu**: Edit > Find **Hotkey**: Ctrl+f (Windows) or Ctrl+s (UNIX)	Opens the Find dialog box.
	Environment Up	**Command**: env.. **Menu**: File > Environment	Changes your environment up one level of hierarchy.
	Environment Back	**Command**: env -back **Menu**: File > Environment	Change your environment to its previous location.
	Environment Forward	**Command**: env -forward **Menu**: File > Environment	Change your environment forward to a previously selected environment.

Table 3-23. Home Toolbar Tab Buttons (cont.)

Button	Name	Shortcuts	Description
	Add Bookmark	**Command Wave window only**: bookmark add wave **Menu Wave window only**: **Add > To Wave > Bookmark**	Clicking this button bookmarks the current view of the active window. Click and hold the button to open a drop down menu with the following options: • Add Current View • Add Custom ... • Set Default Action
	Delete All Bookmarks	**CommandWave window only**: bookmark delete wave -all	Removes all bookmarks, after prompting for your confirmation. Click and hold the button to open a drop down menu with the following options: • Active Window • All Windows
	Manage Bookmarks	None	Displays the Manage Bookmarks dialog box.
	Reload from File	None	Reloads bookmarks from the *bookmarks.do* file. • Set Default Action
	Jump to Bookmark	**CommandWave window only**: bookmark goto wave <name>	Displays bookmarks grouped by window. Select the bookmark you want to display.
	Search Documentation	None	A text entry box for your search string.
	Search Documentation	**Hotkey**: Enter	Activates the search for the term you entered into the text entry box.

1. You can set the default insertion location in the Wave window from menus and hotkeys with the **PrefWave(InsertMode)** preference variable.

Layout Toolbar Tab

The Layout toolbar tab allows you to select a predefined or user-defined layout of the graphical user interface.

Refer to the section "Simulator GUI Layout Customization" for more information.

Figure 3-26. Layout Tab

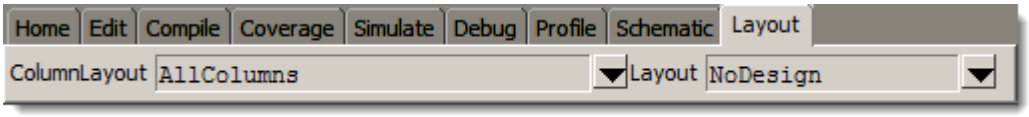
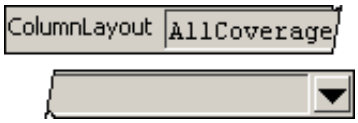


Table 3-24. Layout Toolbar Tab Buttons

Button	Name	Shortcuts	Description
	Column Layout	**Menu**: **Verification Browser** > **Configure Column Layout**	A dropdown box that allows you to specify the column layout for the active window.
	Change Layout	**Menu**: **Layout** > *<layoutName>*	A dropdown box that allows you to select a GUI layout. • NoDesign • Simulate •

Schematic and Dataflow Toolbar Tab

The Schematic toolbar tab provides access to tools for manipulating highlights and signals in the Dataflow and Schematic windows.

Figure 3-27. Schematic Tab

Table 3-25. Schematic Toolbar Tab Buttons

Button	Name	Shortcuts	Description
	Trace Input Net to Event	**Menu**: **Tools** > **Trace** > **Trace next event**	Move the next event cursor to the next input event driving the selected output.

Table 3-25. Schematic Toolbar Tab Buttons (cont.)

Button	Name	Shortcuts	Description
	Trace Set	**Menu**: **Tools > Trace > Trace event set**	Jump to the source of the selected input event.
	Trace Reset	**Menu**: **Tools > Trace > Trace event reset**	Return the next event cursor to the selected output.
	Trace Net to Driver of X	**Menu**: **Tools > Trace > TraceX**	Step back to the last driver of an unknown value.
	Expand Net to all Drivers	None	Display driver(s) of the selected signal, net, or register.
	Expand Net to all Drivers and Readers	None	Display driver(s) and reader(s) of the selected signal, net, or register.
	Expand Net to all Readers	None	Display reader(s) of the selected signal, net, or register.
	Remove All Highlights	**Menu**: Dataflow > Remove Highlight or Schematic > Edit > Remove Highlight	Clear the green highlighting identifying the path you've traversed through the design. Click and hold the button to open a drop down menu with the following options: • Remove All Highlights • Remove Selected Highlights • Set Default Action
	Delete Content	**Menu**: Dataflow > Delete or Schematic > Edit > Delete Schematic > Edit > Delete All	Delete the selected signal. Click and hold the button to open a drop down menu with the following options: • Delete Selected • Delete All • Set Default Action
	Regenerate	**Menu**: Dataflow > Regenerate or Schematic > Edit > Regenerate	Redraws the current schematic view to better take advantage of the available space. For example, after adding or removing elements.

Table 3-25. Schematic Toolbar Tab Buttons (cont.)

Button	Name	Shortcuts	Description
	Show Wave	**Menu**: **Dataflow** > **Show Wave**	Display the embedded wave viewer pane.

Simulate Toolbar Tab

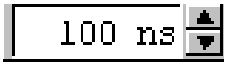
The Simulate Toolbar tab allows you to control aspects of simulation including running the simulation and stepping through your code.

Figure 3-28. Simulate Tab

Table 3-26. Simulate Toolbar Tab Buttons

Button	Name	Shortcuts	Description
	Source Hyperlinking	None	Toggles display of hyperlinks in design source files.
	Step Into	**Command**: step **Menu**: Simulate > Run > Step	Step the current simulation to the next statement.
	Step Over	**Command**: **step -over** **Menu**: Simulate > Run > Step -Over	Execute HDL statements, treating them as simple statements instead of entered and traced line by line.
	Step Out	**Command**: **step -out**	Step the current simulation out of the current function or procedure.
	Step Into Current	**Command**: **step -current**	Step the simulation into the current instance, process, or thread.
	Step Over Current	**Command**: **step -over -current**	Step the simulation over the current instance, process, or thread.
	Step Out Current	**Command**: **step -out -current**	Step the simulation out of the current instance, process, or thread.

Table 3-26. Simulate Toolbar Tab Buttons (cont.)

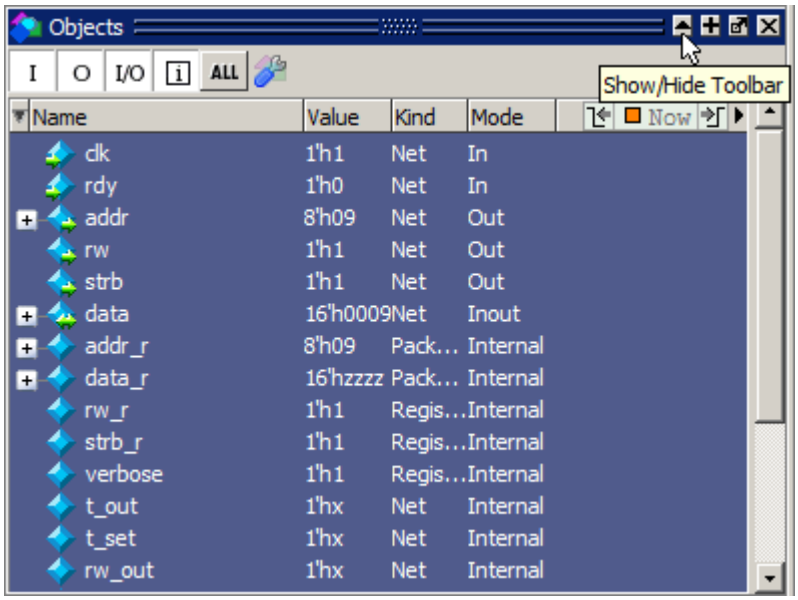
Button	Name	Shortcuts	Description
	Restart	**Command**: restart **Menu**: Simulate > Run > Restart	Reload the design elements and reset the simulation time to zero, with the option of maintaining various settings and objects.
	Run Length	**Command**: run **Menu**: Simulate > Runtime Options	Specify the run length for the current simulation.
	Run	**Command**: run **Menu**: Simulate > Run > Run *default_run_length*	Run the current simulation for the specified run length.
	Continue Run	**Command**: run -continue **Menu**: Simulate > Run > Continue	Continue the current simulation run until the end of the specified run length or until it hits a breakpoint or specified break event.
	Run All	**Command**: **run -all** **Menu**: Simulate > Run > Run -All	Run the current simulation forever, or until it hits a breakpoint or specified break event.
	Simulate	**Command**: vsim **Menu**: **Simulate > Start Simulation**	Opens the Start Simulation dialog box.
	Break	**Menu**: Simulate > Break **Hotkey**: Break	Immediate stop of a compilation, elaboration, or simulation run. Similar to hitting a breakpoint if the simulator is in the middle of a process.
	Stop -sync	None	Stop simulation the next time time/delta is advanced.
	Edit Breakpoints	**Menu**: Tools > Breakpoint	Enable breakpoint editing, loading, and saving.

Windows With Dedicated Toolbars

Buttons that function only in a specific window are available in a bar at the top of the window.

Click the Show/Hide Toolbar button in the window title bar to display the window specific buttons (Figure 3-29). You can add buttons to any currently open window. Refer to Customizing Button and Tab Location for more information.

Figure 3-29. Window Specific Buttons



The following windows have default buttons or widgets:

- FSM Viewer Window
- Memory Data Window
- Objects Window
- Processes Window
- Source Window

Toolbar Visibility and Layout

You can customize the display of the Toolbar Tabs in the main GUI and undocked windows.

Procedure

1. Right-click in the tab or toolbar area of the GUI.
2. Select one of the following items from the popup menu (Table 3-27):

Table 3-27. Toolbar Tab Popup Menu

Popup Menu Item	Description
Hide Tabs	Hides all tabs except for the currently active tab.
Edit Toolbars	Opens the Toolbar Tab Widget Toolbox and locks the GUI into edit mode.
Remove <name> Tab	Removes the tab that is under the cursor.
Add Tab	Opens the Add/Create Tab dialog box. Use this dialog box to create a new user-defined tab or restore a previously defined tab.
Reset Tabs	Resets GUI to the default tabs and order of tabs. Removes user-defined tabs.
Reset <name> Toolbar	Resets the selected tab to the default buttons and widgets.
Reset All Toolbars	Resets all toolbar tabs to their default buttons and widgets. User-defined toolbar tabs default to an empty toolbar.

You can also remove all toolbars from the GUI by selecting **Window > Show Toolbar**. This removes toolbar tabs from the main GUI only.

Creating and Restoring Toolbar Tabs

You can create your own tabs and populate them with the buttons and widgets you want to use. In addition you can restore tabs you have deleted from the main GUI or an undocked window.

Procedure

Right-click in the toolbar area of the main GUI or the undocked window you want to modify and select **Add Tab** from the popup menu to open the **Add/Create Tab** dialog box.

- To create a user defined toolbar tab, enter a name in the **Tab Name** field then click **Add**. The new tab is added to the main GUI or the currently active undocked window.
- To restore an existing toolbar tab, select a tab name from the drop down list in the Tab Name field. The tab and all buttons currently registered to that tab are added to the GUI or undocked window.

Customizing Button and Tab Location

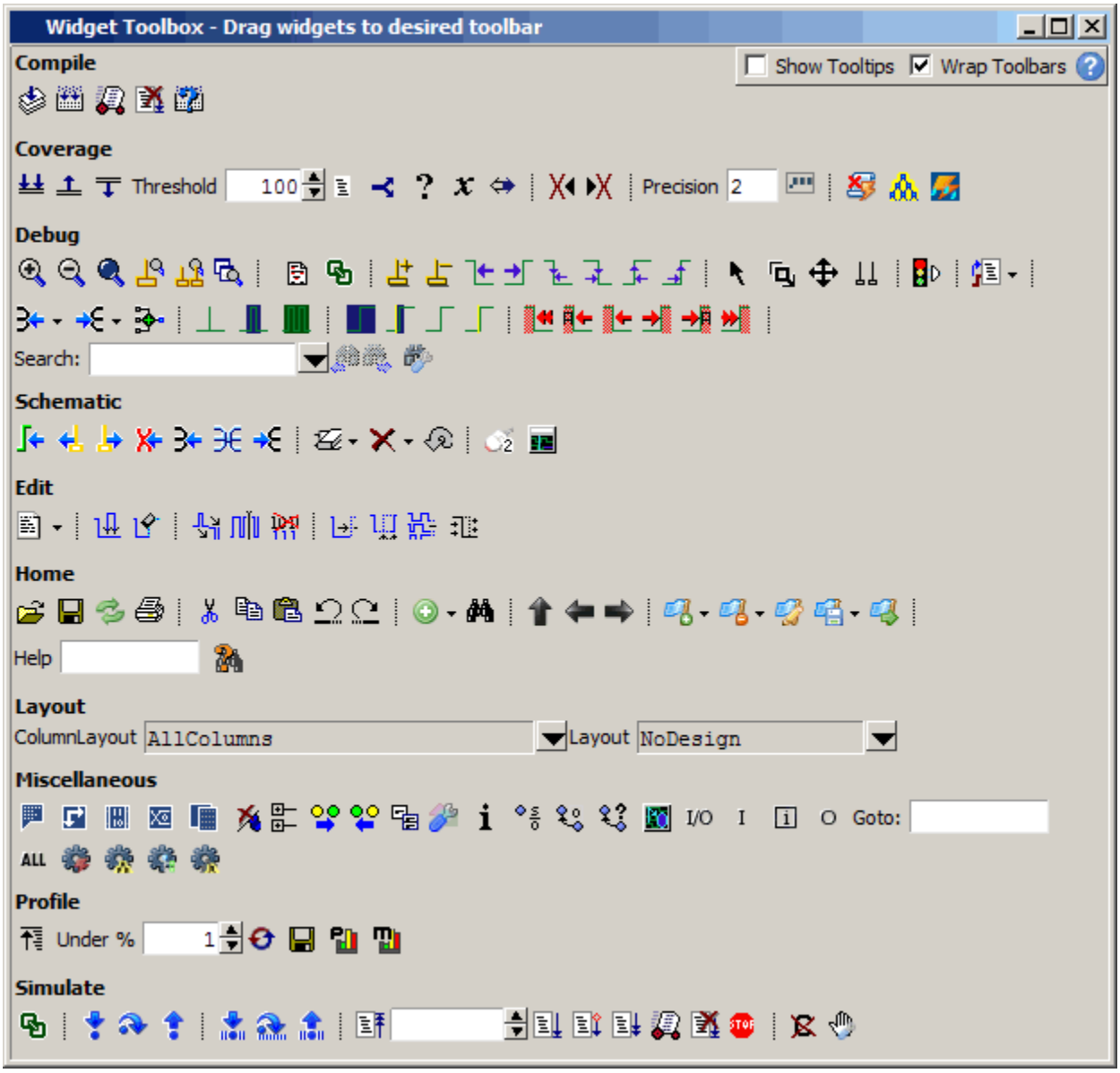
You can add and delete buttons from any Toolbar Tab or window and add buttons to windows that do not have default buttons associated with them.

In addition you can change the order of the Toolbar Tabs. Open the Toolbar Tab Widget Toolbox to make modifications to Toolbar Tabs by right-clicking in the toolbar area of the main GUI and selecting **Edit Toolbars**.

Toolbar Tab Widget Toolbox

The Widget Toolbox allows you to change the default layout of the Toolbar Tabs and buttons on each tab and window.

Figure 3-30. Toolbar Widget Toolbox



The GUI locks into edit mode when the Widget Toolbox is open preventing interaction with your design and allowing you to change the following items in the GUI:

- Button Location — Add or delete buttons from the main GUI or an undocked window by dragging and dropping. All currently open windows will display a toolbar area at the top of the window where you can add buttons. The toolbar area in a window will disappear if it doesn't contain any buttons when the Widget Toolbox closes. To delete buttons, drag the button to the Widget Toolbox or outside of the main GUI and drop it. Refer to Windows With Dedicated Toolbars for more information on windows with dedicated toolbar buttons.
- Tab Ordering — Change the order of the tabs by dragging the tab to a new location in the GUI. You can also change tab order in undocked windows. Tab order in undocked windows is saved separately from the main GUI and reloaded every time you undock a modified window.

Tabbed Toolbar Mapping to Default Toolbars

The following table provides you with the toolbar tab locations of the 10.2 and earlier toolbars.

Table 3-28. Pre-10.3 Toolbar Mapping to Toolbar Tab Location

Default Toolbar	Toolbar Tab
Bookmarks Toolbar Help Toolbar Standard Toolbar	Home Toolbar Tab
Wave Edit Toolbar	Edit Toolbar Tab
Compile Toolbar	Compile Toolbar Tab
Process Toolbar	
Simulate Toolbar Step Toolbar	Simulate Toolbar Tab
Mode Toolbar Source Toolbar Wave Toolbar Wave Cursor Toolbar Wave Expand Time Toolbar Zoom Toolbar	Debug Toolbar Tab
Dataflow Toolbar Schematic Toolbar	Schematic and Dataflow Toolbar Tab
Layout Toolbar	Layout Toolbar Tab
Memory Toolbar	Memory Data Window
Objectfilter Toolbar	Object Window Toolbar
Process Toolbar	Process Window Toolbar
Bookmarks Toolbar	Source Window Toolbar

Chapter 4
Window Reference

The following table summarizes all of the available windows.

Table 4-1. GUI Windows

Window	Description
Call Stack Window	displays the current call stack, allowing you to debug your design by analyzing the depth of function calls
Class Graph Window	displays interactive relationships of SystemVerilog classes in graphical form
Class Instances Window	displays class instances
Class Tree Window	displays interactive relationships of SystemVerilog classes in tabular form
Dataflow Window	displays "physical" connectivity and lets you trace events (causality)
Files Window	displays the source files and their locations for the loaded simulation
Library Window	lists design libraries and compiled design units
List Window	shows waveform data in a tabular format
Locals Window	displays data objects that are immediately visible at the current execution point of the selected process
Memory List Window Memory Data Window	windows that show memories and their contents
Message Viewer Window	allows easy access, organization, and analysis of Note, Warning, Errors or other messages written to transcript during simulation
Objects Window	displays all declared data objects in the current scope
Processes Window	displays all processes that are scheduled to run during the current simulation cycle
Projects	provides access to information about Projects
Source Window	a text editor for viewing and editing files, such as Verilog, VHDL, and DO files

Table 4-1. GUI Windows (cont.)

Window	Description
Structure Window Also known as the “sim” window.	displays hierarchical view of active simulation. Name of window is either “sim” or “<dataset_name>”
Transcript Window	keeps a running history of commands and messages and provides a command-line interface
Watch Window	displays signal or variable values at the current simulation time
Wave Window	displays waveforms

Call Stack Window

To access:

- **View > Call Stack**

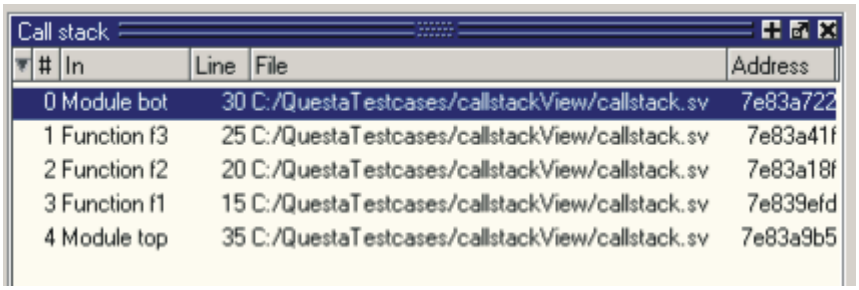
The Call Stack window displays the current call stack when you single step the simulation, the simulation has encountered a breakpoint, or when you select any process in either the Structure or Processes windows.

Description

When debugging your design you can use the call stack data to analyze the depth of function calls that led up to the current point of the simulation, which include:

- Verilog functions and tasks
- VHDL functions and procedures
- C/C++ functions

Figure 4-1. Call Stack Window



Fields

Table 4-2. Call Stack Window Columns

Column Title	Description
#	indicates the depth of the function call, with the most recent at the top.
In	indicates the function. If you see “unknown” in this column, you have most likely optimized the design such that the information is not available during the simulation.
Line	indicates the line number containing the function call.
File	indicates the location of the file containing the function call.

Usage Notes

Call Stack Window Tasks

This window allows you to perform the following actions:

- Double-click the line of any function call:
  - Displays the local variables at that level in the Locals Window.
  - Displays the corresponding source code in the Source Window.

Related Commands of the Call Stack Window

Table 4-3. Commands Related to the Call Stack Window

Command Name	Description
stack down	This command moves down the call stack.
stack frame	This command selects the specified call frame.
stack level	This command reports the current call frame number.
stack tb	This command is an alias for the tb command.
stack up	This command moves up the call stack.

Class Graph Window

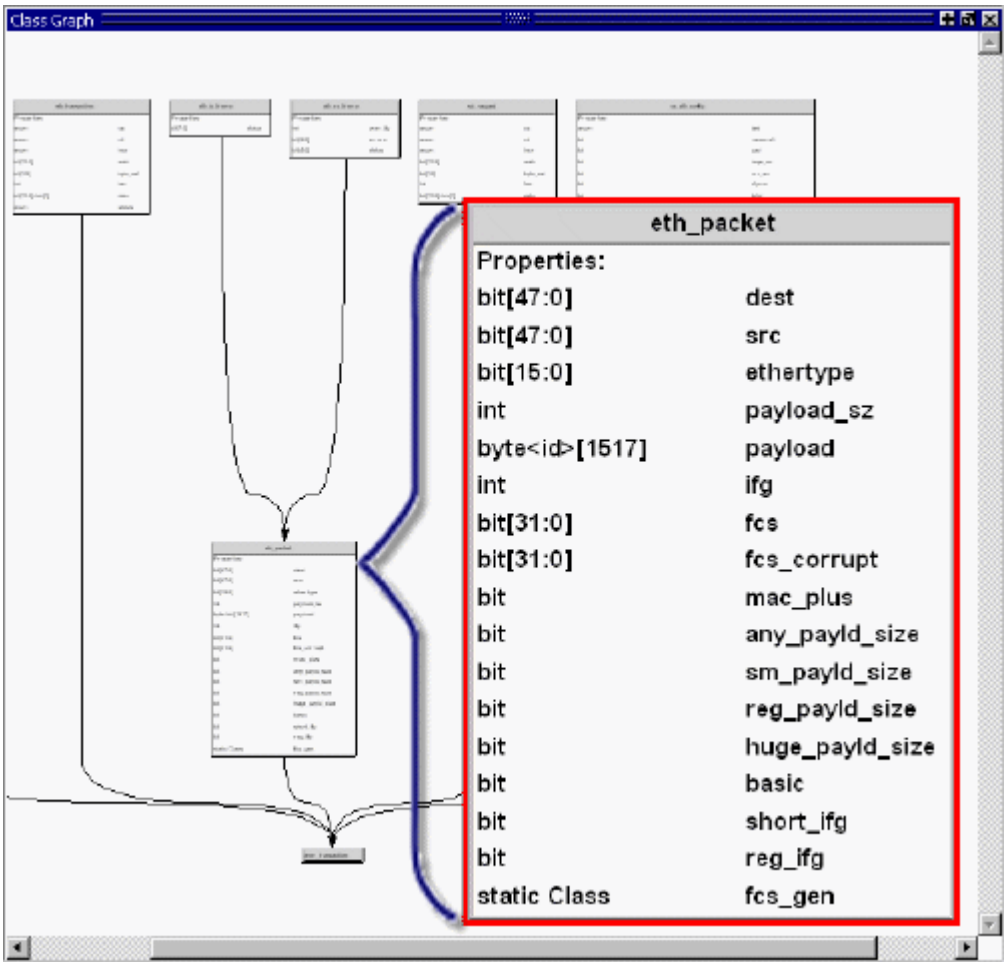
To access:

- **View > Class Browser > Class Graph**
- view classgraph command

The Class Graph window provides a graphical view of your SystemVerilog classes, including any extensions of other classes and related methods and properties.

Description

Figure 4-2. Class Graph Window



Fields

Table 4-4. Class Graph Window Popup Menu

Popup Menu Item	Description
Filter	Controls the display of methods and properties from the class boxes.
Zoom Full	
View Entire Design	Reloads the view to show the class hierarchy of the complete design.
Print to Postscript	
Organize by Base/Extended Class	Reorganizes the window so that the base or extended (default) classes are at the top of the hierarchy.

Usage Notes

Class Graph Window Tasks

This section describes tasks for using the Cover Directives window.

Navigating in the Class Graph Window

You can change the view of the Class Graph window with your mouse or the arrow keys on your keyboard.

- **Left click-drag** — Allows you to move the contents around in the window.
- **Middle Mouse scroll** — Zooms in and out.
- Middle mouse button strokes:
  - **Upper left** — Zoom full
  - **Upper right** — Zoom out. The length of the stroke changes the zoom factor.
  - **Lower right** — Zoom area.
- **Arrow Keys** — Scrolls the window in the specified direction.
  - **Unmodified** — Scrolls by a small amount.
  - **Ctrl+<arrow key>** — Scrolls by a larger amount
  - **Shift+<arrow key>** — Shifts the view to the edge of the display

Class Instances Window

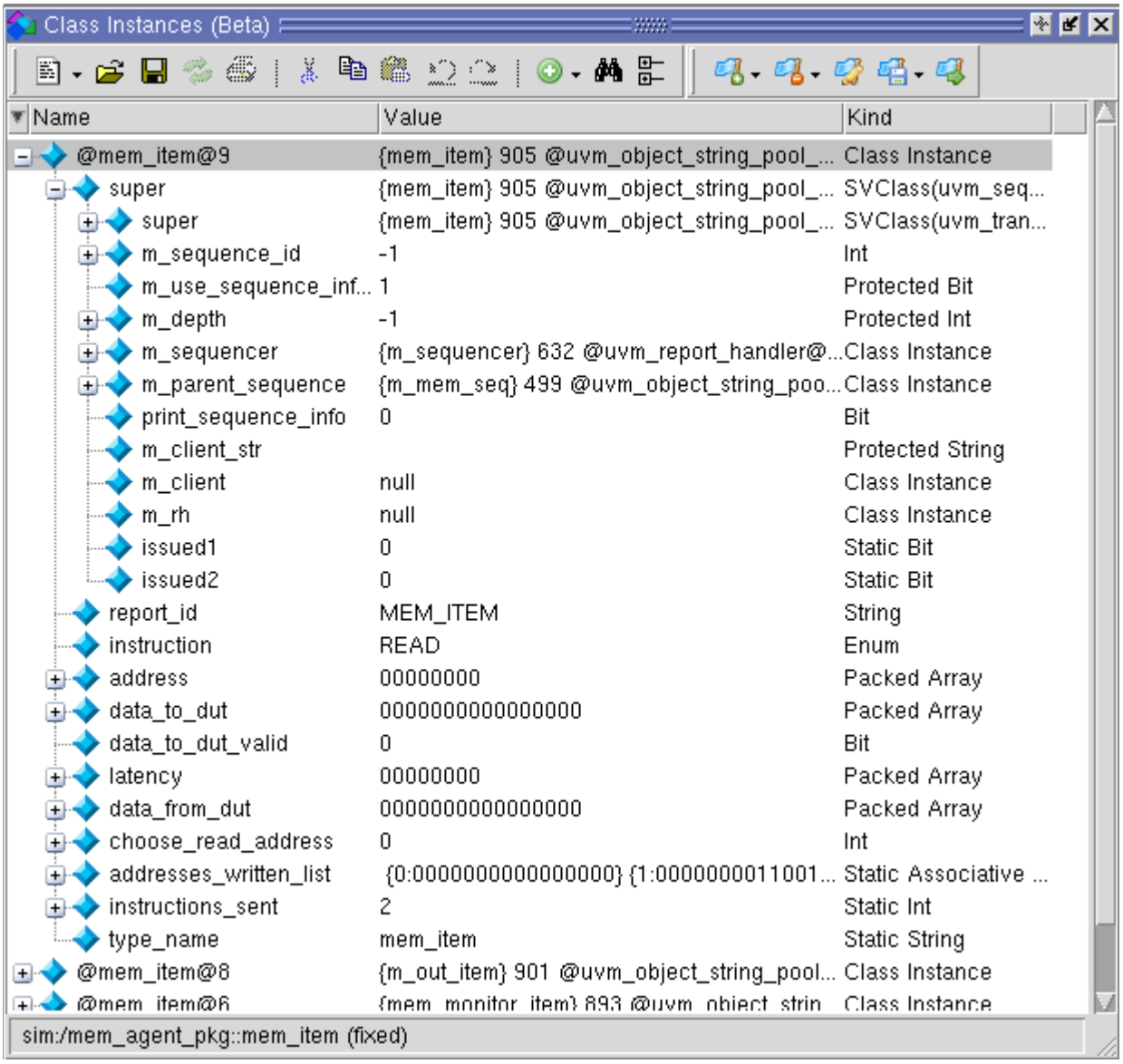
To access:

- **View > Class Browser > Class Instances**
- view classinstances command

The Class Instances window shows the list of class instances and their values for a particular selected class type. You may add the class items directly to the wave or list windows, log them, or get other information about them.

Description

Figure 4-3. Class Instances Window



Fields

Table 4-5. Class Instances Window Popup Menu

Popup Menu Item	Description
View Declaration	Highlights the line of code where the type of the instance is declared, opening the source file if necessary.
Add Wave	Adds the selected class instance to the Wave window.
Add to	Allows you to log the selected class instance, or add it to the Wave or List windows.

Usage Notes

Viewing Class Instances

The Class Instances window is dynamically populated by selecting SVClasses in the Structure (sim) window. All currently active instances of the selected class are displayed in the Class Instances window. Class instances that have not yet come into existence or have been destroyed are not displayed.

Once you have chosen the class type you want to observe, you can fix that instance in the window while you debug by choosing **File > Environment > Fix to Current Context**.

Class Naming Format

Class instance names are formatted as follows: @<class_type>@<nnn> where @<class_type>@ is the name of the class type and <n> is the reference identifier for a particular instance of the class type. For example, @uvm_queue_3@14 is the 14th instance of the class uvm_queue_3.

Class Tree Window

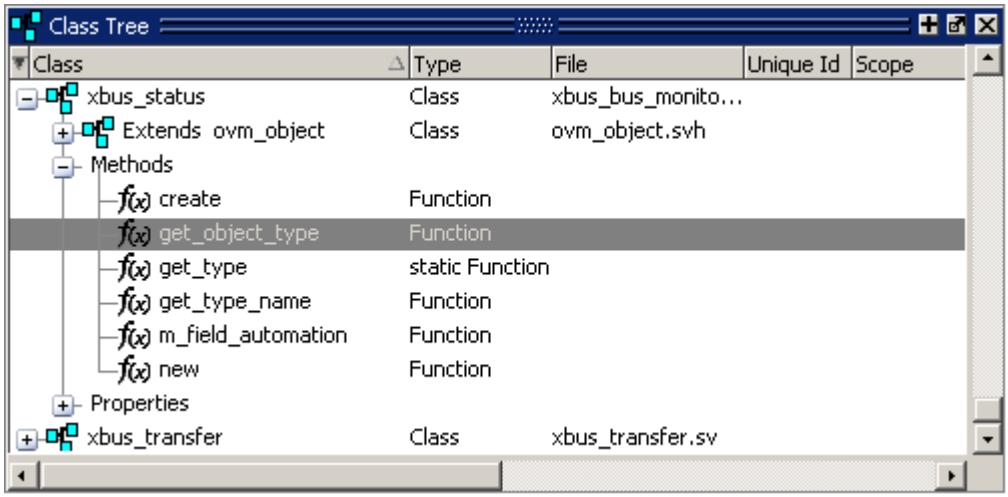
To access:

- **View > Class Browser > Class Tree**
- view classtree command

The Class Tree window provides a hierarchical view of your SystemVerilog classes, including any extensions of other classes, related methods and properties, as well as any covergroups.

Description

Figure 4-4. Class Tree Window



Fields

Table 4-6. Class Tree Window Icons

Icon	Description
	**Class**
	**Parameterized Class**
	**Function**
	**Task**
	**Variable**
	Virtual Interface
	**Covergroup**
	**Structure**

Table 4-7. Class Tree Window Columns

Column	Description
Class	The name of the item
Type	The type of item
File	The source location of the item
Unique Id	The internal name of the parameterized class (only available with parameterized classes)
Scope	The scope of the covergroup (only available with covergroups

Table 4-8. Class Tree Window Popup Menu

Popup Menu Item	Description
View Declaration	Highlights the line of code where the item is declared, opening the source file if necessary.
View as Graph	Displays the class and any dependent classes in the Class Graph window. (only available for classes)
Filter	allows you to filter out methods and or properties
Organize by Base/Extended Class	reorganizes the window so that the base or extended (default) classes are at the top of the hierarchy.

Dataflow Window

To access:

- **View > Dataflow**
- **view dataflow** command

Use this window to explore the "physical" connectivity of your design. You can also use it to trace events that propagate through the design; and to identify the cause of unexpected outputs.

Description

The Dataflow window displays:

- processes
- signals, nets, and registers

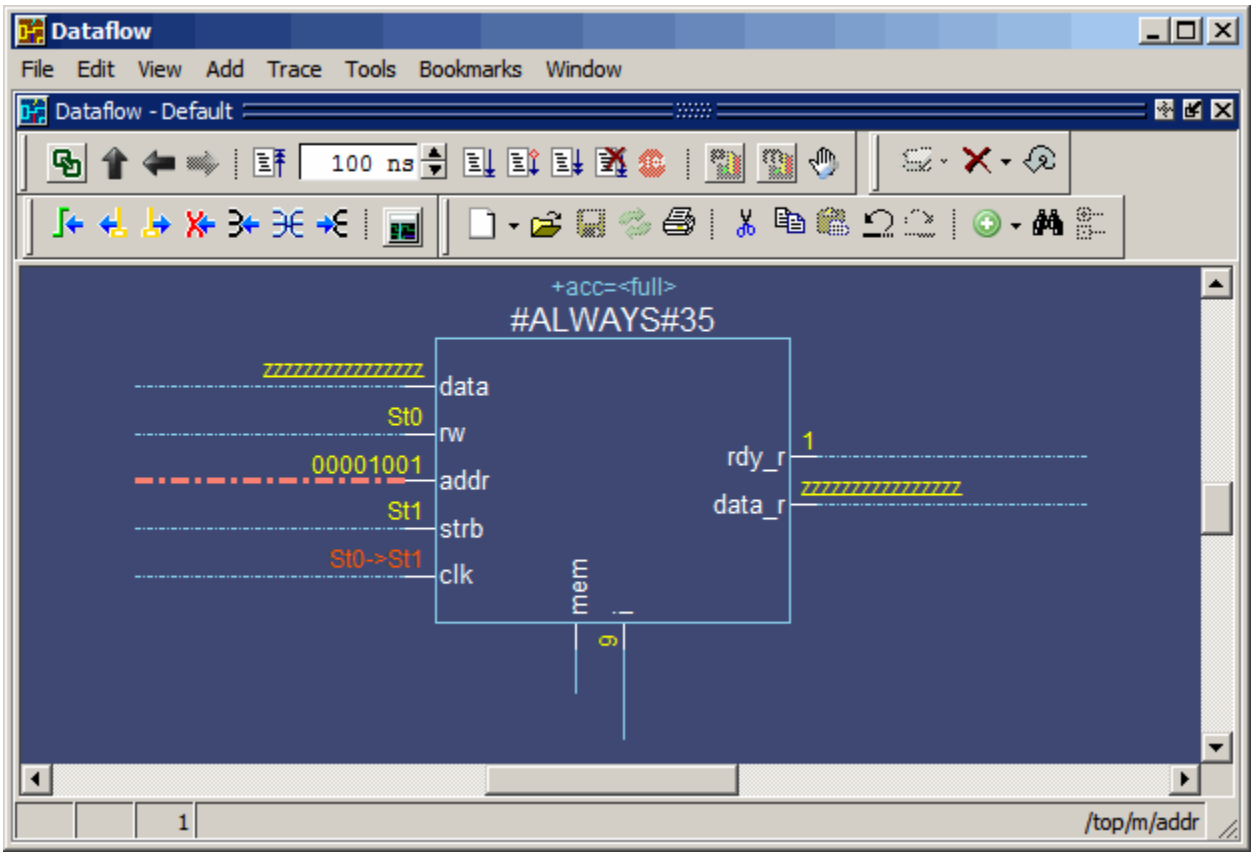
The window has built-in mappings for all Verilog primitive gates (such as AND, OR, PMOS, NMOS). For components other than Verilog primitives, you can define a mapping between processes and built-in symbols. See Symbol Mapping for details.

Note

Note

This version of ModelSim has limited Dataflow functionality resulting in many of the features described in this chapter operating differently. The window will show only one process and its attached signals or one signal and its attached processes, as displayed in Figure 4-5.

Figure 4-5. Dataflow Window - ModelSim



Fields

- Dataflow view

Dataflow Window Tasks

This section describes tasks for using the Dataflow window.

You can interact with the Dataflow in one of three different Mouse modes, which you can change through the DataFlow menu or the Zoom Toolbar:

- **Select Mode** — your left mouse button is used for selecting objects and your middle mouse button is used for zooming the window. This is the default mode.
- **Zoom Mode** — your left mouse button is used for zooming the window and your middle mouse button is used for panning the window.
- **Pan Mode** — your left mouse button is used for panning the window and your middle mouse button is used for zooming the window.

Selecting Objects in the Dataflow Window

When you select an object, or objects, it will be highlighted an orange color.

Procedure

Perform the following selection tasks as needed:

If you want to...	Do the following:
Select a single object	Single click
Select multiple objects	Shift-click on all objects you want to select or click and drag around all objects in a defined area. Only available in Select Mode.

Zooming the View of the Dataflow Window

Several zoom controls are available for changing the view of the Dataflow window, including mouse strokes, toolbar icons and a mouse scroll wheel.

Procedure

If you want to...	Do the following...
Zoom Full — Fills the Dataflow window with all visible data	
Mouse stroke	Up/Left. Middle mouse button in Select and Pan mode, Left mouse button in Zoom mode.
Menu	**DataFlow > Zoom Full**
Zoom Toolbar	Zoom Full
Zoom Out	
Mouse stroke	Up/Right. Middle mouse button in Select and Pan mode, Left mouse button in Zoom mode.
Menu	**DataFlow > Zoom Out**
Zoom Toolbar	Zoom Out
Mouse Scroll	Push forward on the scroll wheel.
Zoom In	
Menu	**DataFlow > Zoom In**
Zoom Toolbar	Zoom In
Mouse Scroll	Pull back on the scroll wheel.
Zoom Area — Fills the Dataflow window with the data within the bounding box.	
Mouse stroke	Down/Right
Mouse stroke	Down/Left

Panning the View of the Dataflow Window

You can pan the view of the Dataflow window with the mouse or keyboard.

Procedure

Pan the view of the Dataflow window using one of the following methods:

If you want to...	Do the following...
Pan with the Mouse	In Zoom mode, pan with the middle mouse button. In Pan mode, pan with the left mouse button. In Select mode, pan with the Ctrl key and the middle mouse button.
Pan with the Keyboard	Use the arrow keys to pan the view. Shift+<arrow key> pans to the far edge of the view. Ctrl+<arrow key> pans by a moderate amount.

Displaying the Wave Viewer Pane

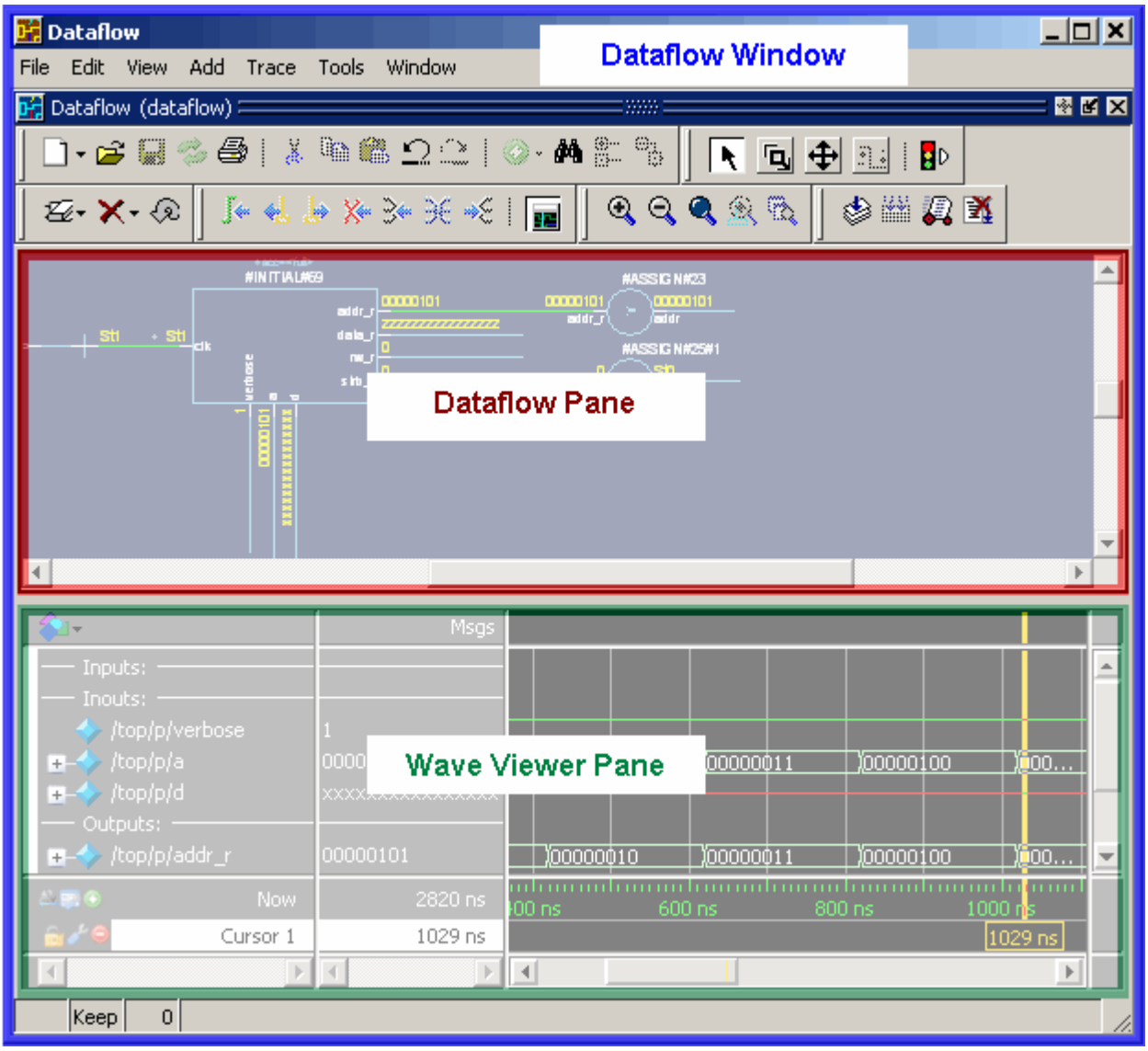
You can embed a miniature wave viewer in the Dataflow window.

Procedure

1. Choose the **DataFlow > Show Wave** menu item.
2. Select a process in the Dataflow pane to populate the Wave pane with signal information.

Refer to the section "Exploring Designs with the Embedded Wave Viewer" for more information.

Figure 4-6. Dataflow Window and Panes



Files Window

To access:

- **View > Files**
- view files command

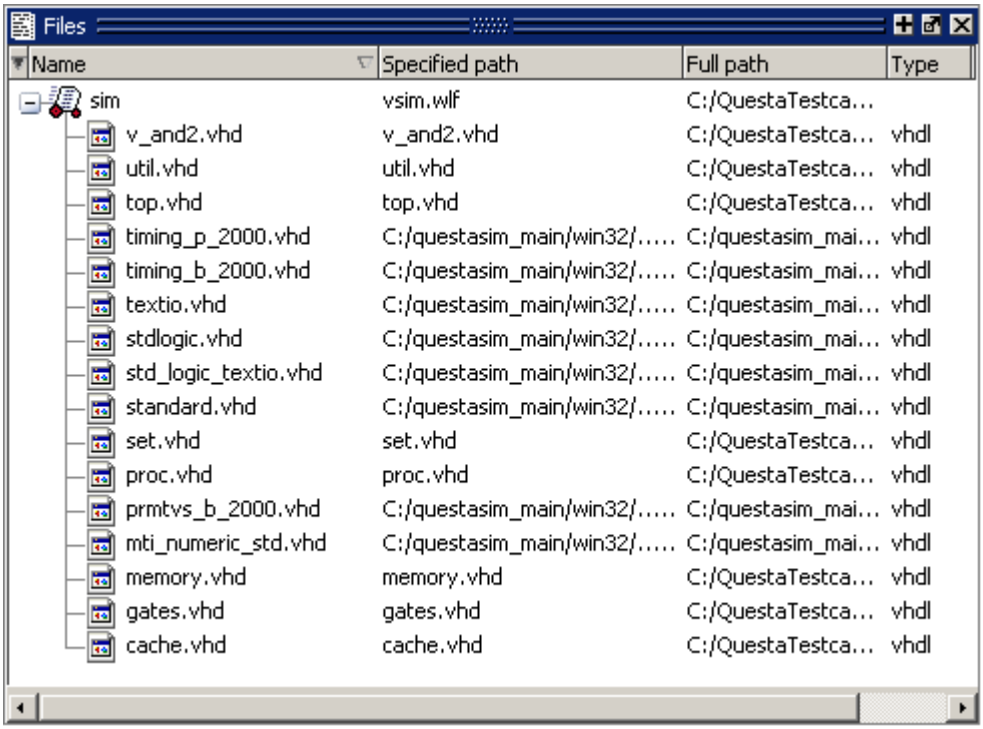
Use this window to display the source files and their locations for the loaded simulation.

Note

You must have executed the vsim command before this window will contain any information about your simulation environment.

Description

Figure 4-7. Files Window



Right-click anywhere in the window to display the popup menu and select one of the options in Table 4-21.

The Files menu (see Table 4-22) becomes available in the **Main** menu when the Files window is active.

Fields

Table 4-9. Files Window Columns

Column Title	Description
Name	The name of the file
Specified Path	The location of the file as specified in the design files.
Full Path	The full-path location of the design files.
Type	The file type.

:

Table 4-10. Files Window Popup Menu

Menu Item	Description
View Source	Opens the selected file in a Source window
Open in external editor	Opens the selected file in an external editor. Only available if you have set the Editor preference: • set PrefMain(Editor) {<path_to_executable>} • **Tools > Edit Preferences**; **by Name** tab, **Main** group.
Properties	Displays the File Properties dialog box, containing information about the selected file.

Table 4-11. Files Menu

Files Menu Item	Description
View Source	Opens the selected file in a Source window
Open in external editor	Opens the selected file in an external editor. Only available if you have set the Editor preference: • set PrefMain(Editor) {<path_to_executable>} • **Tools > Edit Preferences**; **by Name** tab, **Main** group.
Save Files	Saves a text file containing a sorted list of unique files, one per line. The default name is *summary.txt*.

Library Window

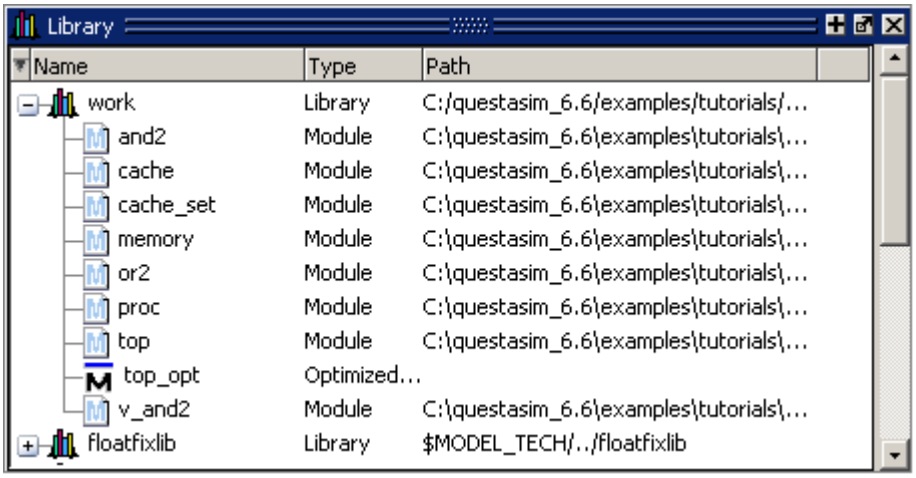
To access:

- **View > Library**
- view library command

Use this window to view design libraries and compiled design units.

Description

Figure 4-8. Library Window



Fields

This section describes GUI elements specific to this Window.

Table 4-12. Library Window Columns

Column Title	Description
Name	Name of the library or design unit
Path	Full pathname to the file
Type	Type of file

Right-click anywhere in the window to display the popup menu and select one of the following options:

Table 4-13. Library Window Popup Menu

Popup Menu Item	Description
Simulate	

Table 4-13. Library Window Popup Menu (cont.)

Popup Menu Item	Description
Edit	Opens the selected file in your editor window.
Refresh	Reloads the contents of the window
Recompile	Compiles the selected file.
Update	
Create Wave	Runs the wave create command for any ports in the selected design unit.
Delete	Removes a design unit from the library or runs the vdel command on a selected library.
Copy	Copies the directory location of libraries or the library location of design units within the library.
New	Allows you to create a new library with the Create a New Library dialog box.
Properties	Displays information about the selected library or design unit.

List Window

To access:

- **View > List**
- view list command

The List window displays simulation results in tabular format. Use this window to display a textual representation of waveforms, which you can configure to show events and delta events for the signals or objects you have added to the window.

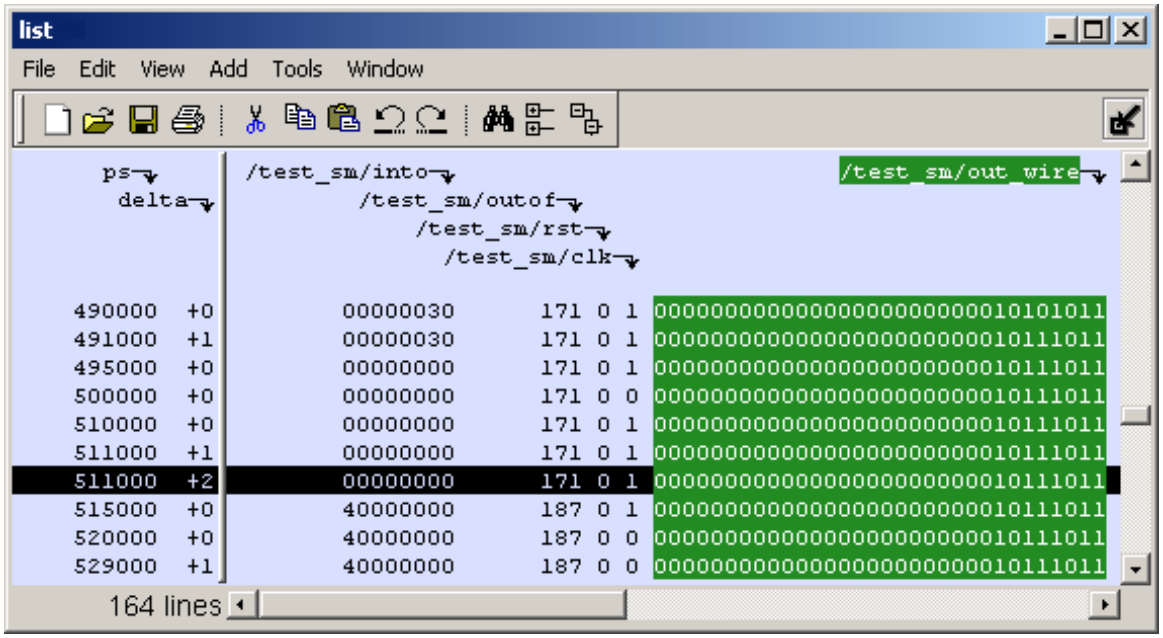
Description

Common List window tasks include:

- Using gating expressions and trigger settings to focus in on particular signals or events. See Configuring New Line Triggering.
- Debugging delta delay issues. See Delta Delays for more information.

The window is divided into two adjustable panes, which allows you to scroll horizontally through the listing on the right, while keeping time and delta visible on the left.

Figure 4-9. Tabular Format of the List Window

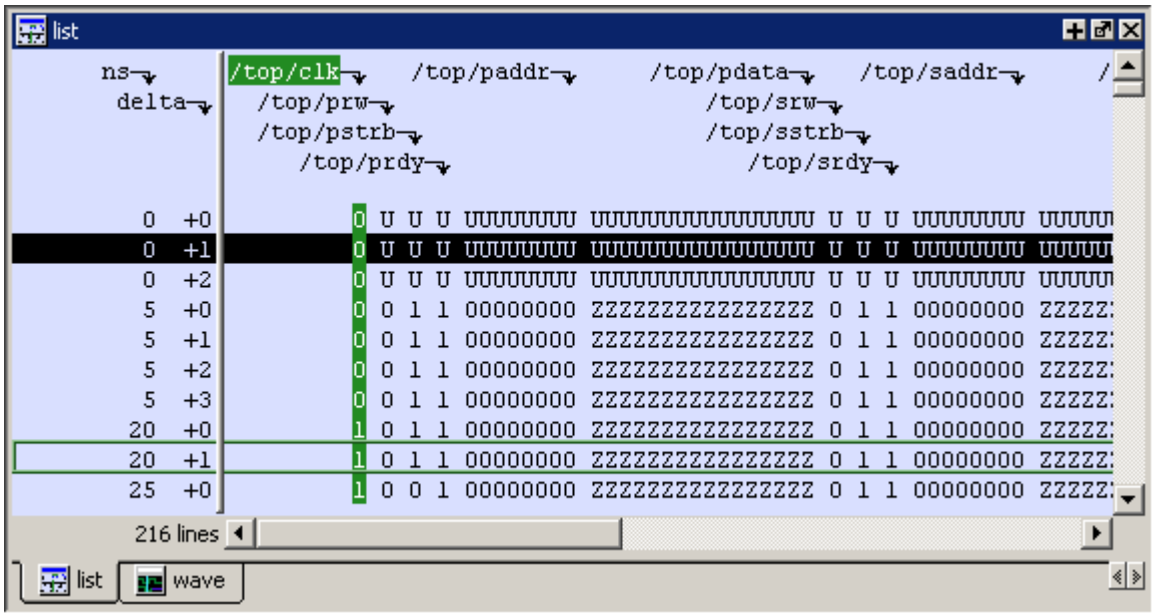


You can view the following object types in the List window:

- **VHDL** — Signals, aliases, process variables, and shared variables
- **Verilog** — Nets, registers, and variables

- **Virtuals** — Virtual signals and functions

Figure 4-10. List Window



This section describes the GUI elements specific to the List window.

The List window is divided into two adjustable panes, which allow you to scroll horizontally through the listing on the right, while keeping time and delta visible on the left.

- The left pane shows the time and any deltas that exist for a given time.
- The right pane contains the data for the signals and objects you have added for each time shown in the left pane. The top portion of the window contains the names of the signals. The bottom portion shows the signal values for the related time.

Note

The display of time values in the left column is limited to 10 characters. Any time value of more than 10 characters is replaced with the following:

```
too narrow
```

The markers in the List window are analogous to cursors in the Wave window. You can add, delete and move markers in the List window similarly to the Wave window. You will notice two different types of markers:

Active Marker — The most recently selected marker shows as a black highlight.

Non-active Marker — Any markers you have added that are not active are shown with a green border.

You can manipulate the markers in the following ways:

Setting a marker — When you click in the right-hand portion of the List window, you will highlight a given time (black horizontal highlight) and a given signal or object (green vertical highlight).

Moving the active marker — List window markers behave the same as Wave window cursors. There is one active marker which is where you click along with inactive markers generated by the Add Marker command. Markers move based on where you click. The closest marker (either active or inactive) will become the active marker, and the others remain inactive.

Adding a marker — You can add an additional marker to the List window by right-clicking at a location in the right-hand side and selecting Add Marker.

Deleting a marker — You can delete a marker by right-clicking in the List window and selecting Delete Marker. The marker closest to where you clicked is the marker that will be deleted.

Right-click in the right-hand pane to display the popup menu and select an option in Table 4-33. Several menu items (See Table ??) are available when the List window is active:

Fields

Table 4-14. List Window Popup Menu

Popup Menu Item	Description
Examine	Displays the value of the signal over which you used the right mouse button, at the time selected with the Active Marker
Add Marker	Adds a marker at the location of the Active Marker
Delete Marker	Deletes the closest marker to your mouse location

Usage Notes

Other List Window Tasks

List > List Preferences — Allows you to specify the preferences of the List window.

File > Export > Tabular List — Exports the information in the List window to a file in tabular format. Equivalent to the command:

```
write list <filename>
```

File > Export > Event List — Exports the information in the List window to a file in print-on-change format. Equivalent to the command:

```
write list -event <filename>
```

File > Export > TSSI List — Exports the information in the List window to a file in TSSI. Equivalent to the command:

```
write tssi -event <filename>
```

Edit > Signal Search — Allows you to search the List window for activity on the selected signal.

List Window Tasks

You can perform multiple tasks using the List window.

Adding Data to the List Window

You can add objects to the List window from the menu, the command line, or the button bar.

Procedure

To add data to the List window, perform one of the following methods:

If you want to...	Do the following...
Use menu to add data	Right-click signals and objects in the Objects window or the Structure window and select **Add > to List**.
Use the command line to add data	Use the add list command.

If you want to...	Do the following...
Use the button bar to add data	Use the Add Selected to Window Button".

Selecting Multiple Signals

You can create a larger group of signals and assign a new name to this group.

Procedure

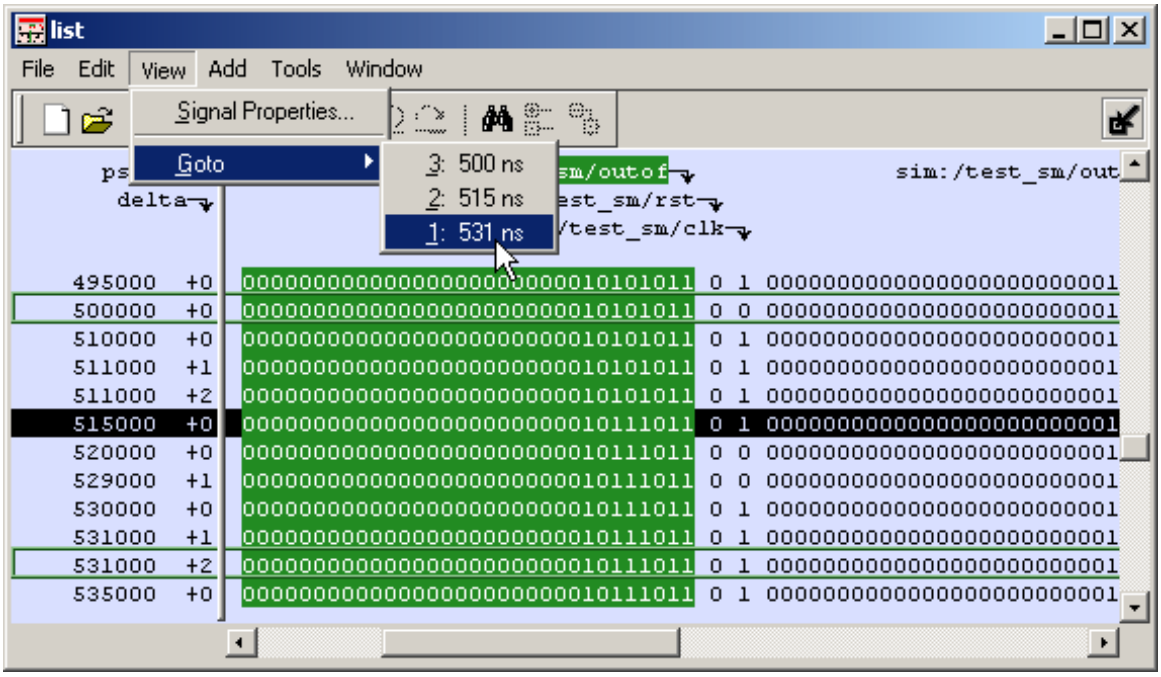
1. Select a group of signals
   - Shift-click on signal columns to select a range of signals.
   - Control-click on signal columns to select a group of specific signals.
2. Choose **List > Combine Signals**.
3. Complete the Combine Selected Signals dialog box:
   - **Name** — Specify the name you want to appear as the name of the new signal.
   - **Order of Indexes** — Specify the order of the new signal as ascending or descending.
   - **Remove selected signals after combining** — Specify whether the grouped signals should remain in the List window.

This process creates virtual signals. For more information, refer to the section Virtual Signals.

Setting Time Markers in the List Window

Time markers in the List window are similar to cursors in the Wave window. Time markers tag lines in the data table so you can quickly jump back to that time. Markers are indicated by a thin box surrounding the marked line.

Figure 4-11. Time Markers in the List Window



Working with Markers

The table below summarizes actions you can take with markers.

Table 4-15. Actions for Time Markers

Action	Method
Add marker	Select a line and then choose **List** > **Add Marker**
Delete marker	Select a tagged line and then choose **List** > **Delete Marker**
Goto marker	Choose **View** > **Goto** > **<time>** (only available when undocked)

Expanded Time Viewing in the List Window

Event time may be shown in the List window in the same manner as delta time by using the **-delta events** option with the configure list command.

When the List window displays event times, the event time is relative to events on other signals also displayed in the List window. This may be misleading, as it may not correspond to event times displayed in the Wave window for the same events if different signals are added to the Wave and List windows.

The write list command (when used after the configure list -delta events command) writes a list file in tabular format with a line for every event. Please note that this is different from the write list -events command, which writes a non-tabular file using a print-on-change format.

The following examples illustrate the appearance of the List window and the corresponding text file written with the write list command after various options for the configure list -delta command are used.

Figure 4-12 shows the appearance of the List window after the configure list -delta none command is used. It corresponds to the file resulting from the write list command. No column is shown for deltas or events.

Figure 4-12. List Window After configure list -delta none Option is Used

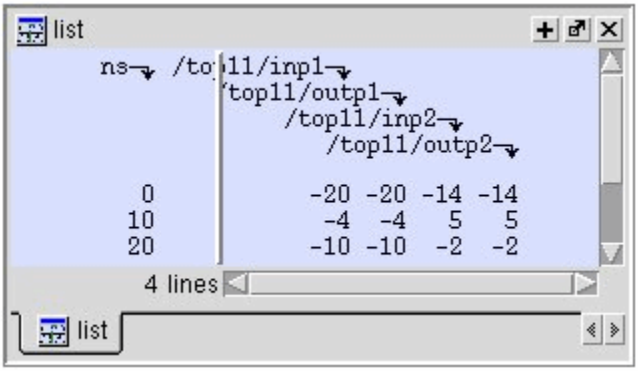


Figure 4-13 shows the appearance of the List window after the configure list -delta collapse command is used. It corresponds to the file resulting from the write list command. There is a column for delta time and only the final delta value and the final value for each signal for each simulation time step (at which any events have occurred) is shown.

Figure 4-13. List Window After configure list -delta collapse Option is Used

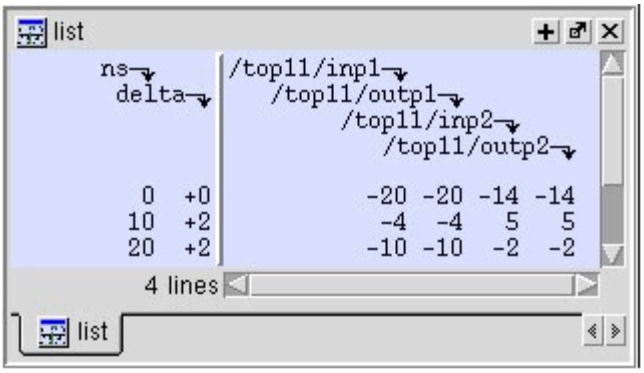


Figure 4-14 shows the appearance of the List window after the configure list -delta all option is used. It corresponds to the file resulting from the write list command. There is a column for delta time, and each delta time step value is shown on a separate line along with the final value for each signal for that delta time step.

Figure 4-14. List Window After write list -delta all Option is Used

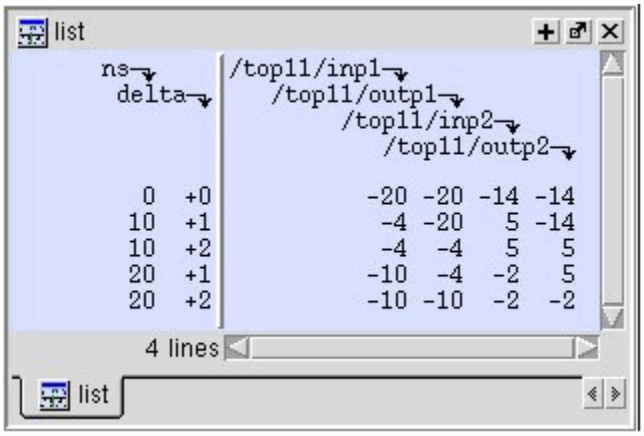
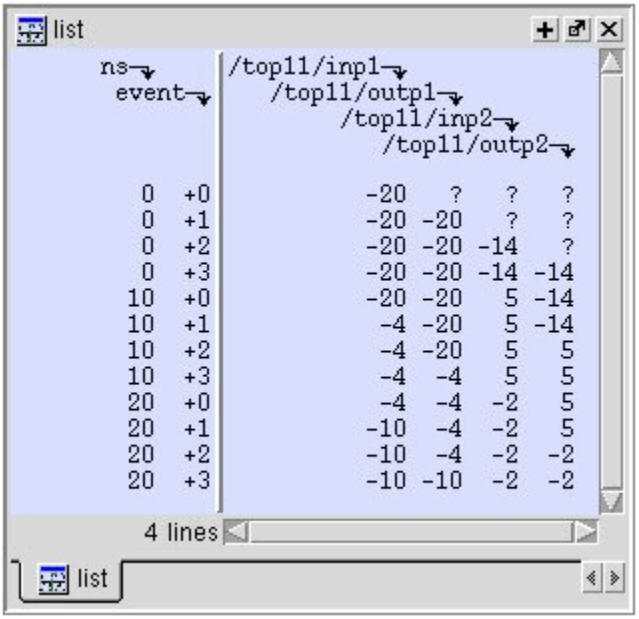


Figure 4-15 shows the appearance of the List window after the configure list -delta events command is used. It corresponds to the file resulting from the write list command. There is a column for event time, and each event time step value is shown on a separate line along with the final value for each signal for that event time step. Since each event corresponds to a new event time step, only one signal will change values between two consecutive lines.

Figure 4-15. List Window After write list -event Option is Used



Searching in the List Window

Use the List window to locate objects.

Procedure

Search the List window using one of the following methods:

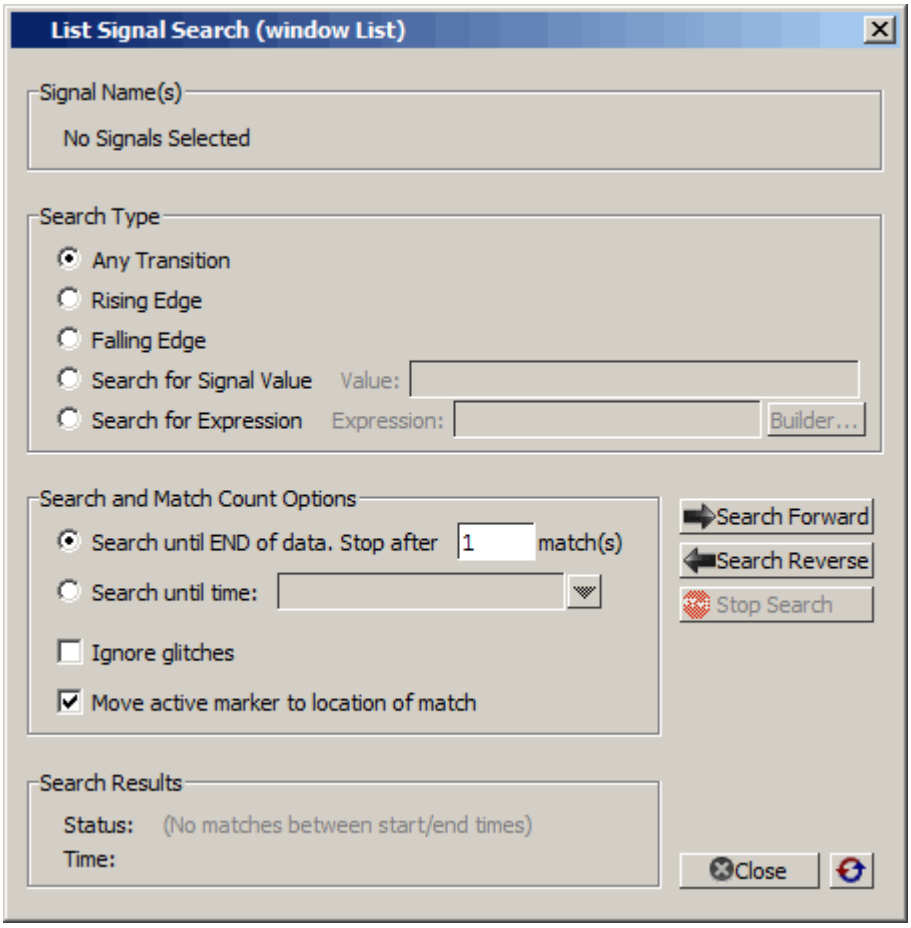
If you want to...	Do the following...
Find signal names	• Choose **Edit > Find**. • Click the **Find** toolbar button (binoculars icon). • Use the find command. The first two of these options will open a Find mode toolbar at the bottom of the List window. By default, the "Search For" option is set to "Name." For more information, see Find and Filter Functions.
Search for values or transitions	• Choose **Edit > Signal Search**. • Click the **Find** toolbar button (binoculars icon) and select **Search For > Value** from the Find toolbar that appears at the bottom of the List window. •

Searching for Values or Transitions

The search command lets you search for values of selected signals.

When you choose **Edit > Signal Search**, the List Signal Search dialog box appears.

Figure 4-16. Wave Signal Search Dialog Box



One option of note is **Search for Expression**. The expression can involve more than one signal but is limited to signals currently in the window. Expressions can include constants, variables, and DO files. Refer to Expression Syntax for more information.

Any search terms or settings you enter are saved from one search to the next in the current simulation. To clear the search settings during debugging click the Reset To Initial Settings button. The search terms and settings are cleared when you close ModelSim.

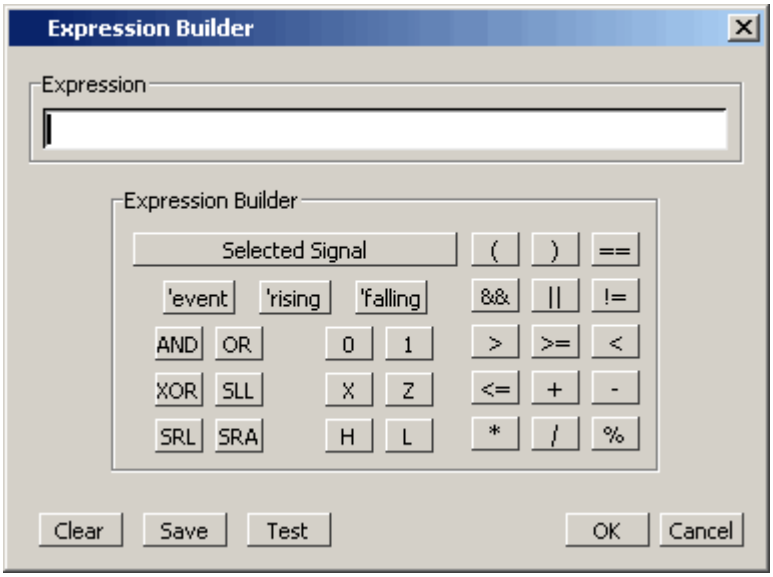
Using the Expression Builder for Expression Searches

The Expression Builder is a feature of the List Signal Search dialog box and the List trigger properties dialog box. You can use it to create a search expression that follows the GUI_expression_format.

Procedure

1. Choose **Edit > Signal Search...** from the main menu. This displays the Wave Signal Search dialog box.
2. Select **Search for Expression**.
3. Click the **Builder** button. This displays the Expression Builder dialog box shown in Figure 4-17.

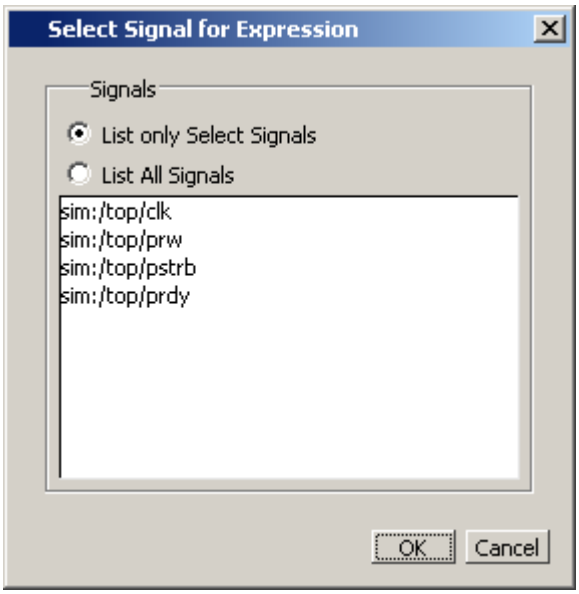
Figure 4-17. Expression Builder Dialog Box



You click the buttons in the Expression Builder dialog box to create a GUI expression. Each button generates a corresponding element of Expression Syntax and is displayed in the Expression field. In addition, you can use the **Selected Signal** button to create an expression from signals you select from the List window.

For example, instead of typing in a signal name, you can select signals in a List window and then click **Selected Signal** in the Expression Builder. This displays the Select Signal for Expression dialog box shown in Figure 4-18.

Figure 4-18. Selecting Signals for Expression Builder



Note that the buttons in this dialog box allow you to determine the display of signals you want to put into an expression:

> **List only Select Signals** — list only those signals that are currently selected in the parent window.
>
> **List All Signals** — list all signals currently available in the parent window.

Once you have selected the signals you want displayed in the Expression Builder, click **OK**.

Saving an Expression to a Tcl Variable

Clicking the **Save** button will save the expression to a Tcl variable. Once saved this variable can be used in place of the expression. For example, say you save an expression to the variable "foo."

Here are some operations you could do with the saved variable:

- Read the value of *foo* with the set command:

  set foo

- Put $foo in the Expression: entry box for the Search for Expression selection.
- Issue a searchlog command using foo:

  searchlog -expr $foo 0

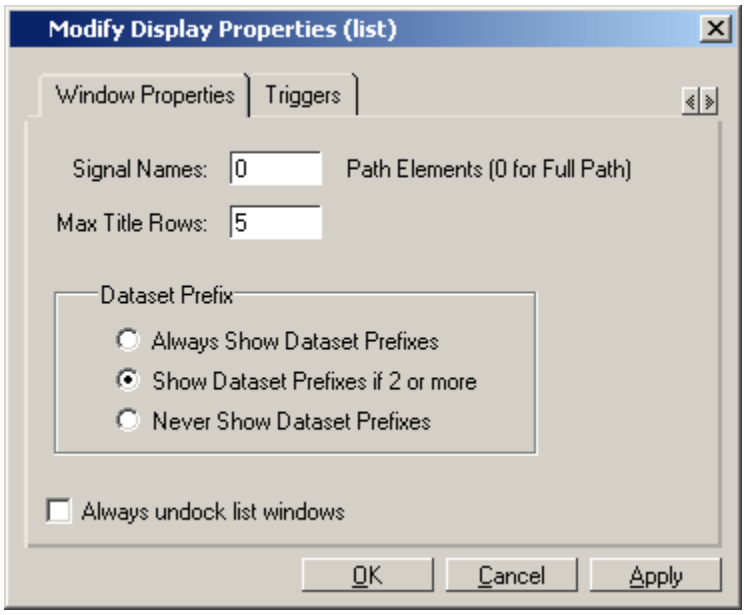
Formatting the List Window

Modify the display properties and objects of the List window to create a view that is easiest for you to use.

Setting List Window Display Properties

Before you add objects to the List window, you can set the window's display properties. To change when and how a signal is displayed in the List window, choose **Tools > List Preferences** from the List window menu bar (when the window is undocked).

Figure 4-19. Modifying List Window Display Properties



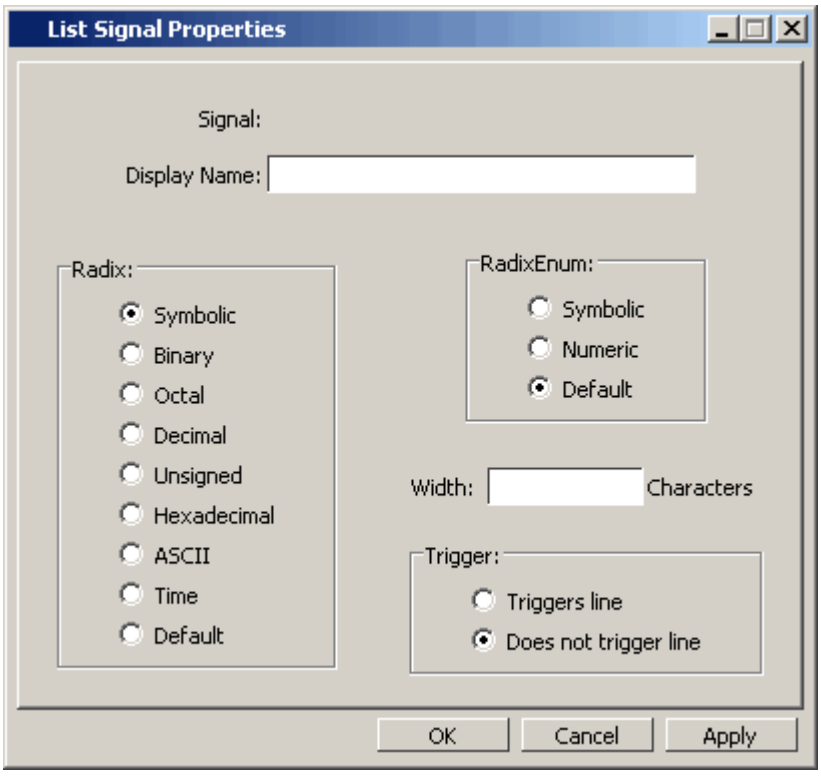
Formatting Objects in the List Window

You can adjust various properties of objects to create the view you find most useful. Select one or more objects and then choose **View > Signal Properties** from the List window menu bar (when the window is undocked).

Changing Radix (base) for the List Window

One common adjustment you can make to the List window display is to change the radix (base) of an object. To do this, choose **View > Properties** from the main menu, which displays the List Signal Properties dialog box. Figure 4-20 shows the list of radix types you can select in this dialog box.

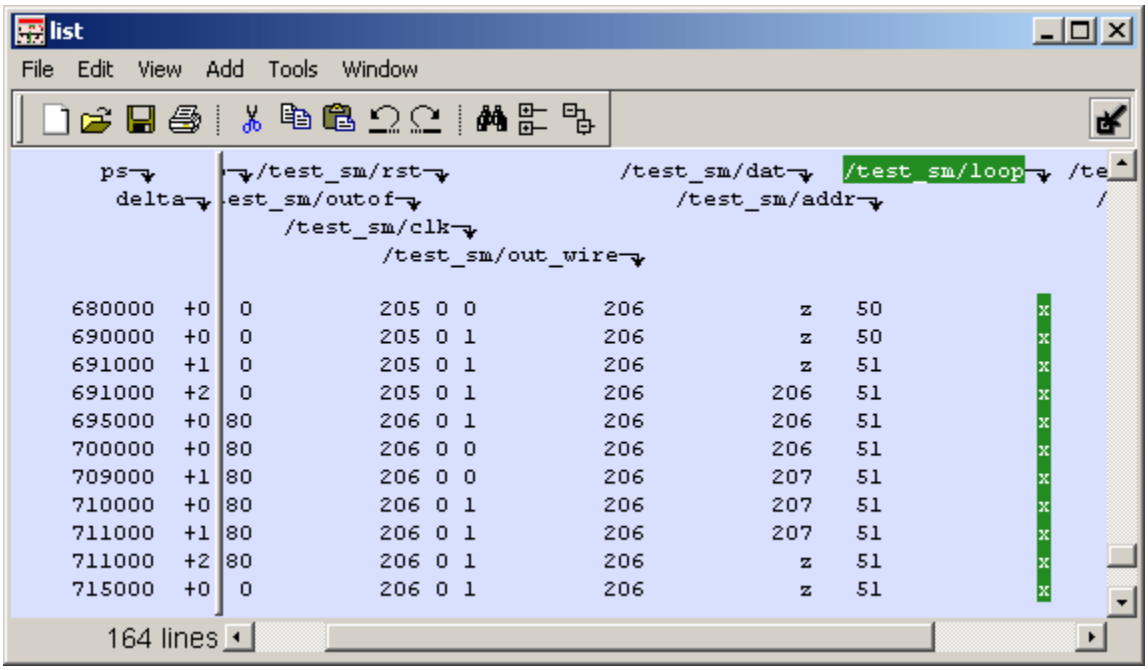
Figure 4-20. List Signal Properties Dialog



The default radix type is symbolic, which means that for an enumerated type, the window lists the actual values of the enumerated type of that object. For the other radix types (binary, octal, decimal, unsigned, hexadecimal, ASCII, time), the object value is converted to an appropriate representation in that radix.

Changing the radix can make it easier to view information in the List window. Compare the image below (with decimal values) with the image in the section List Window (with symbolic values).

Figure 4-21. Changing the Radix in the List Window



In addition to the List Signal Properties dialog box, you can also change the radix:

- Change the default radix for the current simulation using **Simulate > Runtime Options** (Main window)
- Change the default radix for the current simulation using the radix command.
- Change the default radix permanently by editing the DefaultRadix variable in the *modelsim.ini* file.

Saving the Window Format

By default, all List window information is lost once you close the window. If you want to restore the windows to a previously configured layout, you must save a window format file as follows.

Procedure

1. Add the objects you want to the List window.
2. Edit and format the objects to create the view you want.
3. Save the format to a file by choosing **File > Save Format**. This opens the Save Format dialog box where you can save List window formats in a *.do* file.

   To use the format file, start with a blank List window and run the DO file in one of two ways:

- Invoke the do command from the command line:

  VSIM> do <my_format_file>

- Choose **File** > **Load**.

Note

Window format files are design-specific. Use them only with the design you were simulating when they were created.

In addition, you can use the write format restart command to create a single *.do* file that will recreate all debug windows and breakpoints (see Saving and Restoring Breakpoints) when invoked with the do command in subsequent simulation runs. The syntax is:

write format restart <filename>

If the ShutdownFile *modelsim.ini* variable is set to this *.do* filename, it will call the write format restart command upon exit.

Combining Signals into Buses

You can combine signals in the List window into buses. A bus is a collection of signals concatenated in a specific order to create a new virtual signal with a specific value. A virtual compare signal (the result of a comparison simulation) is not supported for combination with any other signal.

Procedure

To combine signals into a bus, use one of the following methods:

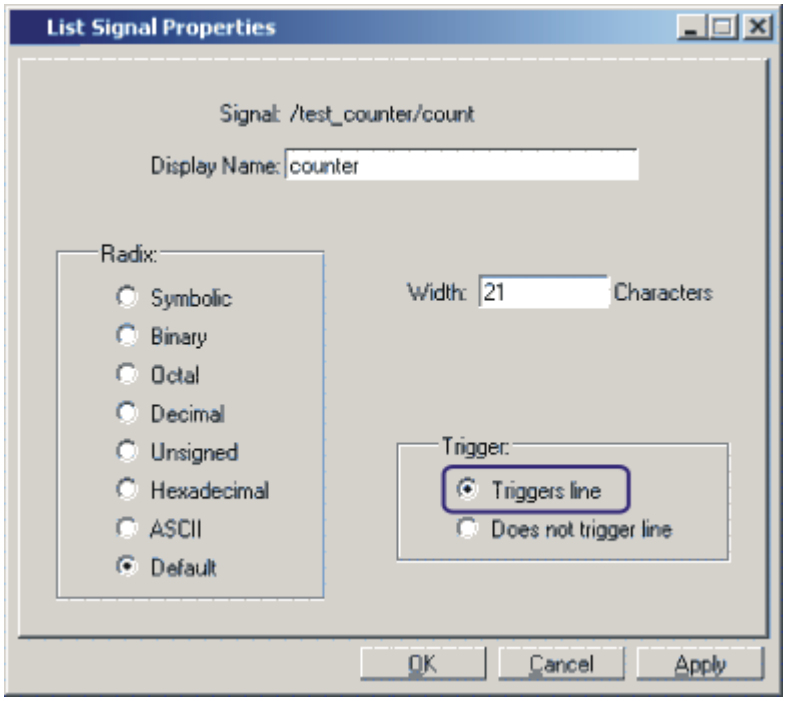
If you want to...	Do the following...
Use the GUI	Select two or more signals in the Wave or List window and then choose **List** > **Combine Signals** from the menu bar. A virtual signal that is the result of a comparison simulation is not supported for combining with any other signal.
Use the Command Line	Use the virtual signal command at the Main window command prompt.

Configuring New Line Triggering

New line triggering refers to what events cause a new line of data to be added to the List window. By default ModelSim adds a new line for any signal change including deltas within a single unit of time resolution.

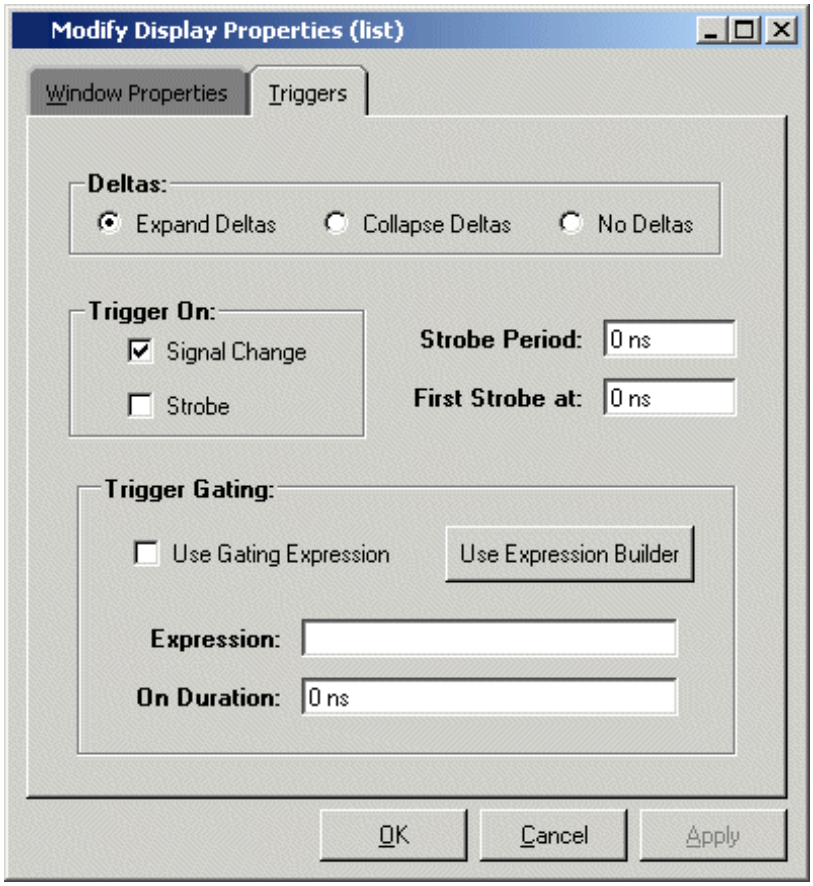
You can set new line triggering on a signal-by-signal basis or for the whole simulation. To set for a single signal, choose **View > Signal Properties** from the List window menu bar (when the window is undocked) and select the **Triggers line** setting. Individual signal settings override global settings.

Figure 4-22. Line Triggering in the List Window



To modify new line triggering for the whole simulation, choose **Tools > List Preferences** from the List window menu bar (when the window is undocked), or use the configure command. When you choose **Tools > List Preferences**, the Modify Display Properties dialog appears:

Figure 4-23. Setting Trigger Properties



The following table summaries the triggering options:

Table 4-16. Triggering Options

Option	Description
Deltas	Choose between displaying all deltas (Expand Deltas), displaying the value at the final delta (Collapse Delta). You can also hide the delta column all together (No Delta), however this will display the value at the final delta.
Strobe trigger	Specify an interval at which you want to trigger data display
Trigger gating	Use a gating expression to control triggering; see Using Gating Expressions to Control Triggering for more details.

Using Gating Expressions to Control Triggering

Trigger gating controls the display of data based on an expression. Triggering is enabled once the gating expression evaluates to true. This setup behaves much like a hardware signal analyzer that starts recording data on a specified setup of address bits and clock edges.

Here are some points about gating expressions:

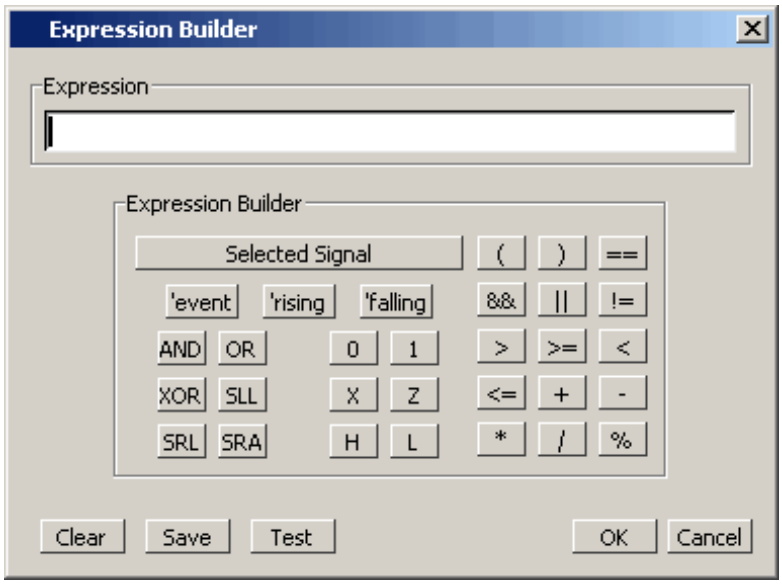
- Gating expressions affect the display of data but not acquisition of the data.
- The expression is evaluated when the List window would normally have displayed a row of data (given the other trigger settings).
- The duration determines for how long triggering stays enabled after the gating expression returns to false (0). The default of 0 duration will enable triggering only while the expression is true (1). The duration is expressed in x number of default timescale units.
- Gating is level-sensitive rather than edge-triggered.

Trigger Gating Example Using the Expression Builder

This example shows how to create a gating expression with the ModelSim Expression Builder. Here is the procedure:

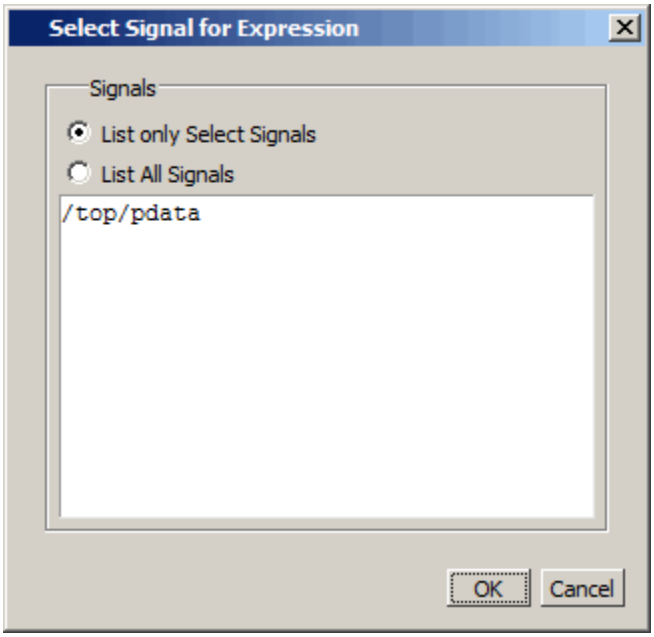
1. Select the signal in the List window by clicking on its name in the header area of the List window.
2. Undock the List window.
3. Choose **Tools > List Preferences** from the List window menu bar and select the Triggers tab.
4. Click the **Use Expression Builder** button.

Figure 4-24. Trigger Gating Using Expression Builder



5. Click the **Selected Signal** button to open the “Select Signal for Expression” dialog box.

Figure 4-25. Select Signal for Expression Dialog Box



6. Click the “List only Select Signals” radio button.
7. Click the desired signal to highlight it.
8. Click the **OK** button to close the Select Signal for Expression dialog box and enter the name of the selected signal into the Expression field of the Expression Builder.

9. In the Expression Builder, click the **'rising** button.
10. Click **OK** to close the Expression Builder.

    You should see the name of the signal plus "rising" added to the Expression entry box of the “Modify Display Properties” dialog box.
11. Click **OK** to close the dialog box.

If you already have simulation data in the List window, the display should immediately switch to showing only those cycles for which the gating signal is rising. If that isn't quite what you want, you can go back to the expression builder and adjust it until you get it the way you want it.

If you want the enable signal to work like a "One-Shot" that would display all values for the next, say 10 ns, after the rising edge of enable, then set the **On Duration** value to **10 ns**.

Trigger Gating Example Using Commands

The following commands show the gating portion of a trigger configuration statement:

```
configure list -usegating 1
configure list -gateduration 100
configure list -gateexpr {/test_delta/iom_dd'rising}
```

See the configure command for more details.

Sampling Signals at a Clock Change

You easily can sample signals at a clock change using the add list command with the **-notrigger** argument. The **-notrigger** argument disables triggering the display on the specified signals. For example:

```
add list clk -notrigger a b c
```

When you run the simulation, List window entries for *clk*, *a*, *b*, and *c* appear only when *clk* changes.

If you want to display on rising edges only, you have two options:

1. Turn off the List window triggering on the clock signal, and then define a repeating strobe for the List window.
2. Define a "gating expression" for the List window that requires the clock to be in a specified state. See above.

Locals Window

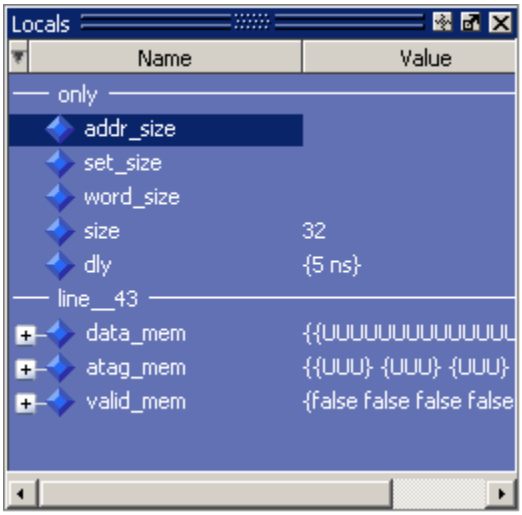
To access:

- **View > locals**
- view locals command

Use this window to display data objects declared in the current, or local, scope of the active process. These data objects are immediately visible from the statement that will be executed next, which is denoted by a blue arrow in a Source window. The contents of the window change from one statement to the next.

Description

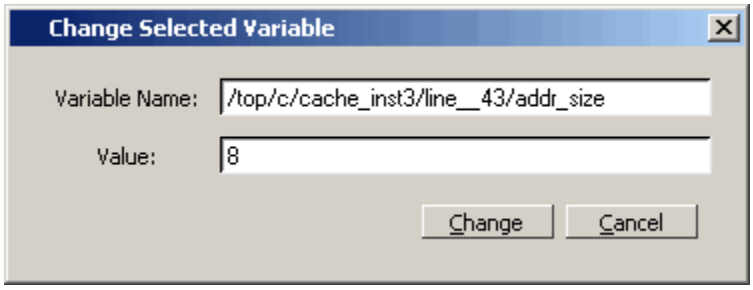
Figure 4-26. Locals Window



Change Selected Variable Dialog Box

This dialog box allows you to change the value of the object you selected. When you click Change, the tool executes the change command on the object.

Figure 4-27. Change Selected Variable Dialog Box



The Change Selected Variable dialog is prepopulated with the following information about the object you had selected in the Locals window:

Variable Name — contains the complete name of the object.

Value — contains the current value of the object.

When you change the value of the object, you can enter any value that is valid for the variable. An array value must be specified as a string (without surrounding quotation marks). To modify the values in a record, you need to change each field separately.

Right-click anywhere in the Locals window to open a popup menu (See Table 4-37).

Fields

Table 4-17. Locals Window Columns

Column	Description
Name	lists the names of the immediately visible data objects. This column also includes design object icons for the objects, refer to the section "Design Object Icons and Their Meanings" for more information
Value	lists the current value(s) associated with each name

Table 4-18. Locals Window Popup Menu

Popup Menu Item	Description
View Declaration	Displays, in the Source window, the declaration of the object
Add	Adds the selected object(s) to the specified window
Copy	Copies selected item to clipboard
Find	Opens the Find toolbar at the bottom of the window
Expand/Collapse	Expands or collapses data in the window
Global Signal Radix	Sets radix for selected signal(s) in all windows
Change	Displays the Usage Notes, which allows you to alter the value of the object

Usage Notes

This section describes tasks for using the Locals window.

Viewing Data in the Locals Window

You cannot actively place information in the Locals window, it is updated as you go through your simulation. However, there are several ways you can trigger the Locals window to be updated.

- Run your simulation while debugging.
- Select a Process from the Processes Window.
- Select a Verilog function or task or VHDL function or procedure from the Call Stack Window.

Memory Data Window

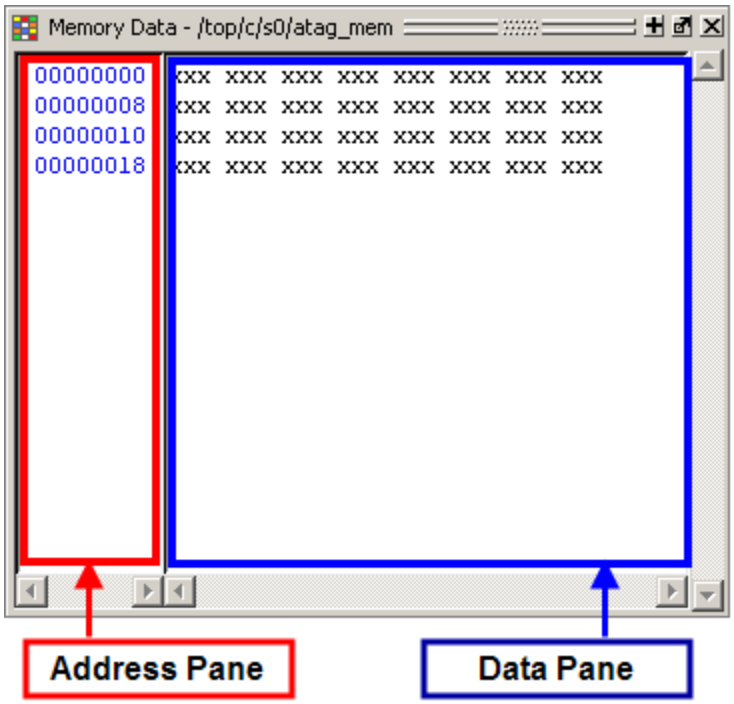
To access:

- Double-click a memory in the Memory List window.

Use this window to view the contents of a memory.

Description

Figure 4-28. Memory Data Window



This section describes GUI elements specific to this Window.

Right-click in the window to display the popup menu and select one of the options in Table 4-38. The Memory Data menu (see Table 4-40) becomes available in the **Main** menu when the Memory Data window is active.

Fields

Table 4-19. Memory Data Popup Menu — Address Pane

Popup Menu Item	Description
Goto	Allows you to go to a specific address
Split Screen	Splits the Memory Data window to allow you to view different parts of the memory simultaneously.

Table 4-19. Memory Data Popup Menu — Address Pane (cont.)

Popup Menu Item	Description
Properties	Allows you to set various properties for the Memory Data window.
Close Instance	Closes the active Memory Data window.
Close All	Closes all Memory Data windows.

Table 4-20. Memory Data Popup Menu — Data Pane

Popup Menu Item	Description
Edit	Allows you to edit the value of the selected data.
Change	Allows you to change data within the memory through the use of the Change Memory dialog box.
Import Data Patterns	Allows you to import data patterns into the selected memory through the Import Memory dialog box.
Export Data Patterns	Allows you to export data patterns from the selected memory through the Export Memory dialog box.
Split Screen	Refer to items in the Memory Data Popup Menu — Address Pane
Properties	
Close Instance	
Close All	

Table 4-21. Memory Data Menu

Popup Menu Item	Description
Memory Declaration	Opens a Source window to the file and line number where the memory is declared.
Compare Contents	Allows you to compare the selected memory against another memory in the design or an external file.
Import Data Patterns	Refer to items in the Memory Data Popup Menu — Data Pane
Export Data Patterns	
Expand Packed Memories	Toggle the expansion of packed memories.
Identify Memories Within Cells	Toggle the identification of memories within Verilog cells.
Show VHDL String as Memory	Toggle the identification of VHDL strings as memories.

Table 4-21. Memory Data Menu (cont.)

Popup Menu Item	Description
Split Screen	Refer to items in the Memory Data Popup Menu — Address Pane

Usage Notes

This section describes tasks for using the Memory Data window.

Direct Address Navigation

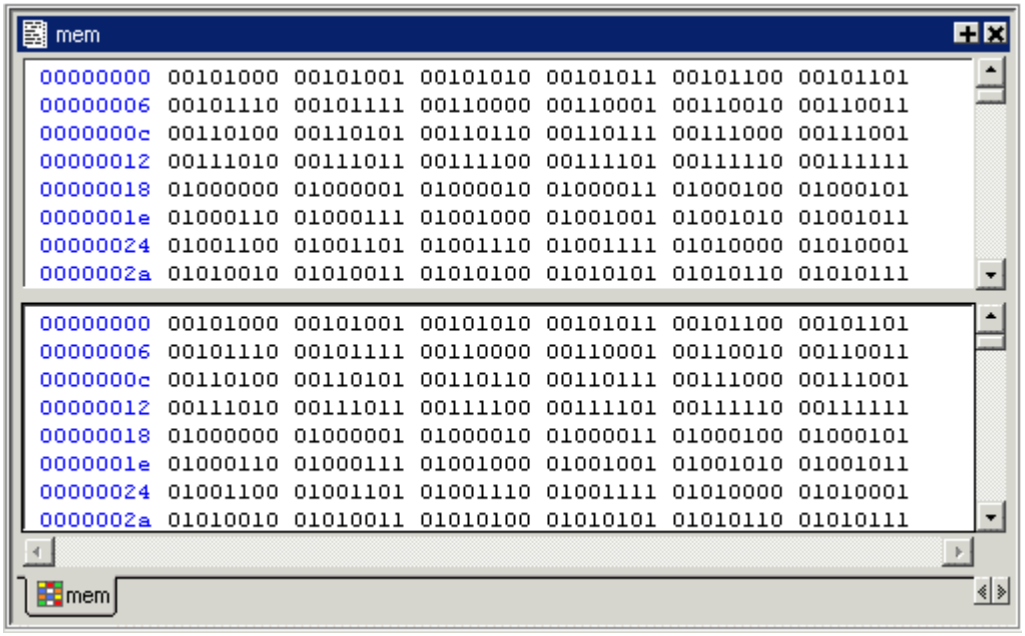
You can navigate to any address location directly by editing the address in the address column. Double-click any address, type in the desired address, and hit **Enter**. The address display scrolls to the specified location.

Splitting the Memory Contents Window

To split a memory contents window into two screens displaying the contents of a single memory instance choose **Memory Data > Split Screen**.

This allows you to view different address locations within the same memory instance simultaneously.

Figure 4-29. Split Screen View of Memory Contents



Memory List Window

To access:

- **View > Memory List**
- view memory list command

Use this window to view a list of all memories in your design.

Description

Single dimensional arrays of integers are interpreted as 2D memory arrays. In these cases, the word width listed in the Memory window is equal to the integer size, and the depth is the size of the array itself.

Memories with three or more dimensions display with a plus sign '+' next to their names in the Memory window. Click the '+' to show the array indices under that level. When you finally expand down to the 2D level, you can double-click on the index, and the data for the selected 2D slice of the memory will appear in a memory contents window.

The simulator identifies certain kinds of arrays in various scopes as memories. Memory identification depends on the array element kind as well as the overall array kind (that is, associative array, unpacked array, and so forth.).

Table 4-22. Memory Identification — ModelSim

	VHDL	Verilog/SystemVerilog
Element Kind[1]	• enum[2] • bit_vector • floating point type • std_logic_vector • std_ulogic_vector • integer type	any integral type (that is, integer_type): • shortint • int • longint • byte • bit (2 state) • logic • reg • integer • time (4 state) • packed_struct/ packed_union (2 state) • packed_struct/ packed_union (4 state) • packed_array (single-Dim, multi-D, 2 state and 4 state) • enum • string

Scope: Recognizable in	• architecture
	• process
	• record
		• module
		• interface
		• package
		• compilation unit
		• struct
		• static variables within a
		  • task
		  • function
		  • named block
		  • class

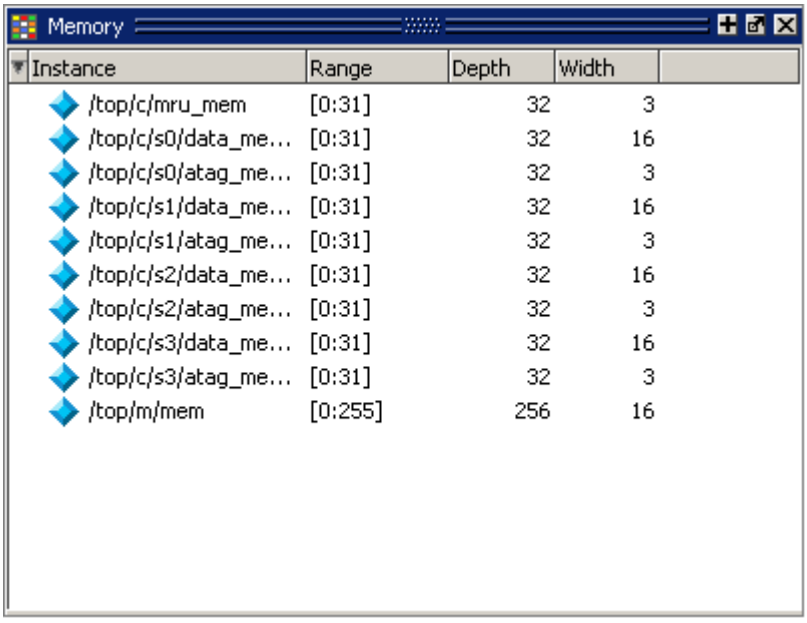
Array Kind	• single-dimensional • multi-dimensional	• any combination of unpacked, dynamic and associative arrays[3] • real/shortreal • float

1. The element can be "bit" or "std_ulogic" if the array has dimensionality >= 2.

2. These enumerated types must have at least one enumeration literal that is not a character literal. The listed width is the number of entries in the enumerated type definition and the depth is the size of the array itself.

3. Any combination of unpacked, dynamic, and associative arrays is considered a memory, provided the leaf level of the data structure is a string or an integral type.

Figure 4-30. Memory List Window



Right-click anywhere in the window to display the popup menu and select one of the options (See Table 4-43).

The **Memories** menu (See Table 4-44) becomes available in the **Main** menu when the Memory List window is active.

Fields

Table 4-23. Memory List Window Columns

Column Title	Description
Instance	Hierarchical name of the memory
Range	Memory range
Depth	Memory depth
Width	Word width

Table 4-24. Memory List Popup Menu

Popup Menu Item	Description
View Contents	Opens a Memory Data window for the selected memory.
Memory Declaration	Opens a Source window to the file and line number where the memory is declared.
Compare Contents	Allows you to compare the selected memory against another memory in the design or an external file.
Import Data Patterns	Allows you to import data patterns into the selected memory through the Import Memory dialog box.
Export Data Patterns	Allows you to export data patterns from the selected memory through the Export Memory dialog box.

Table 4-25. Memories Menu

Popup Menu Item	Description
View Contents	Refer to items in the Memory List Popup Menu
Memory Declaration	
Compare Contents	
Import Data Patterns	
Export Data Patterns	
Expand Packed Memories	Toggle the expansion of packed memories.
Identify Memories Within Cells	Toggle the identification of memories within Verilog cells.
Show VHDL String as Memory	Toggle the identification of VHDL strings as memories.

Usage Notes

This section describes tasks for using the Memory List window.

Viewing Packed Arrays

By default, packed dimensions are treated as single vectors in the Memory List window. To expand packed dimensions of packed arrays, choose **Memories > Expand Packed Memories**.

To change the permanent default, edit the PrefMemory(ExpandPackedMem) variable. This variable affects only packed arrays. If the variable is set to 1, the packed arrays are treated as unpacked arrays and are expanded along the packed dimensions such that they appear as a linearized bit vector. Refer to the section "Setting GUI Preferences" for details on setting preference variables.

Viewing Memory Contents

When you double-click an instance on the Memory List window, ModelSim automatically displays a Memory Data window, where the name used on the tab is taken from the name of the instance, as seen in the Memory window. You can also enter the command **add mem <instance>** at the **vsim** command prompt.

Viewing Multiple Memory Instances

You can view multiple memory instances simultaneously. A Memory Data window appears for each instance you double-click in the Memory List window. When you open more than one window for the same memory, the name of the tab receives an numerical identifier after the name, such as "(2)".

Saving Memory Formats in a DO File

You can save all open memory instances and their formats (for example, address radix, data radix, and so forth) by creating a DO file.

Procedure

1. Select the Memory List window
2. Choose **File > Save Format**

   displays the Save Memory Format dialog box
3. Enter the file name in the "Save memory format" dialog box

   By default it is named *mem.do*. The file will contain all open memory instances and their formats.

   To load it at a later time, choose **File > Load**.

Saving Memories to the WLF File

By default, memories are not saved in the WLF file when you issue a "log -r /*" command. To get memories into the WLF file you will need to explicitly log them.

For example:

```
log /top/dut/i0/mem
```

It you want to use wildcards, then you will need to remove memories from the WildcardFilter list. To see what is currently in the WildcardFilter list, use the following command:

```
set WildcardFilter
```

If "Memories" is in the list, reissue the set WildcardFilter command with all items in the list *except* "Memories." For details, see Using the WildcardFilter Preference Variable.

Note

For post-process debug, you can add the memories into the Wave or List windows but the Memory List window is not available.

Message Viewer Window

To access:

- **View > Message Viewer** and select a loaded WLF dataset for viewing
- view msgviewer <dataset>.wlf command

Use this window to easily access, organize, and analyze any Note, Warning, Error or other elaboration and runtime messages written to the transcript during the simulation run.

Description

By default, the tool writes transcripted messages during elaboration and runtime only to the transcript. To write messages to the WLF file (thus the Message Viewer window), use the -displaymsgmode and -msgmode options with the vsim commmand to change the default behavior. By writing messages to the WLF file, the Message Viewer window is able to organize the messages for your analysis during the current simulation as well as during post simulation.

You can control what messages are available in the transcript, WLF file, or both with the following switches:

- displaymsgmode messages — User generated messages resulting from calls to Verilog Display System Tasks . By default, these messages are written only to the transcript, which means you cannot access them through the Message Viewer window. In many cases, these user generated messages are intended to be output as a group of transcripted messages, thus the default of transcript only. The Message Viewer treats each message individually, therefore you could lose the context of these grouped messages by modifying the view or sort order of the Message Viewer.

  To change this default behavior you can use the -displaymsgmode argument with the vsim command. The syntax is:

  ```
  vsim -displaymsgmode {both | tran | wlf}
  ```

  You can also use the displaymsgmode variable in the *modelsim.ini* file.

  The message transcribing methods that are controlled by -displaymsgmode include:

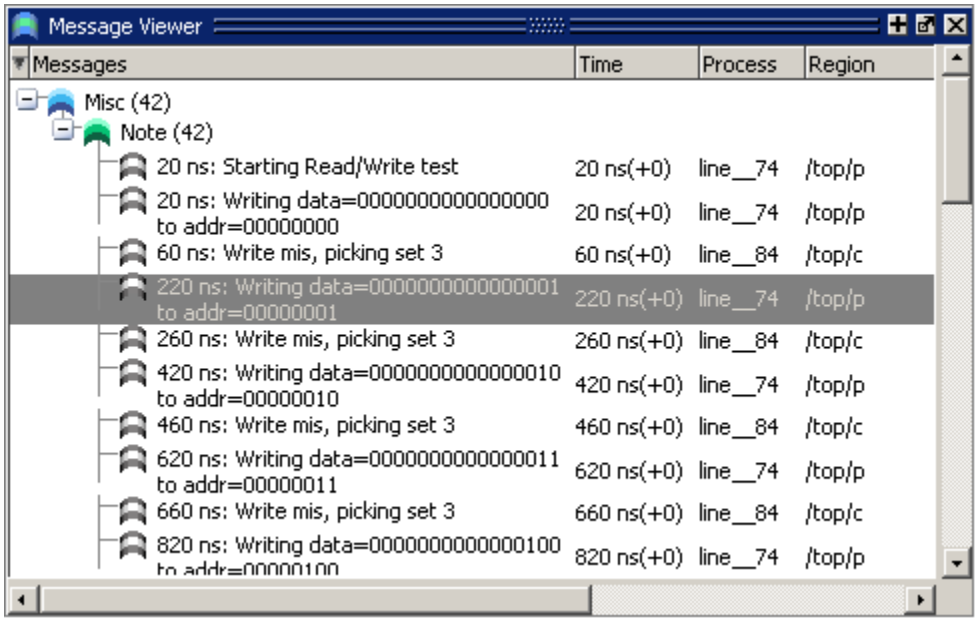
  Verilog Display System Tasks — $write, $display, $monitor, and $strobe. The following also apply if they are sent to STDOUT: $fwrite, $fdisplay, $fmonitor, and $fstrobe.

- msgmode messages — All elaboration and runtime messages not part of the displaymsgmode messages. By default, these messages are written only to the transcript. To change this default behavior you can use the -msgmode argument with the vsim command. The syntax is:

  ```
  vsim -msgmode {both | tran | wlf}
  ```

To write messages to the WLF file and transcript, which provides access to the messages through the Message Viewer window, you can also use the msgmode variable in the *modelsim.ini* file.

Figure 4-31. Message Viewer Window



Right-click anywhere in the window to open a popup menu (see Table 4-46) that contains multiple selections.

Note

The Messages Bar in the Wave window provides indicators as to when a message occurred.

Message Viewer Window Tasks

Figure 4-32 and Table 4-26 provide an overview of the Message Viewer and several tasks you can perform.

Figure 4-32. Message Viewer Window — Tasks

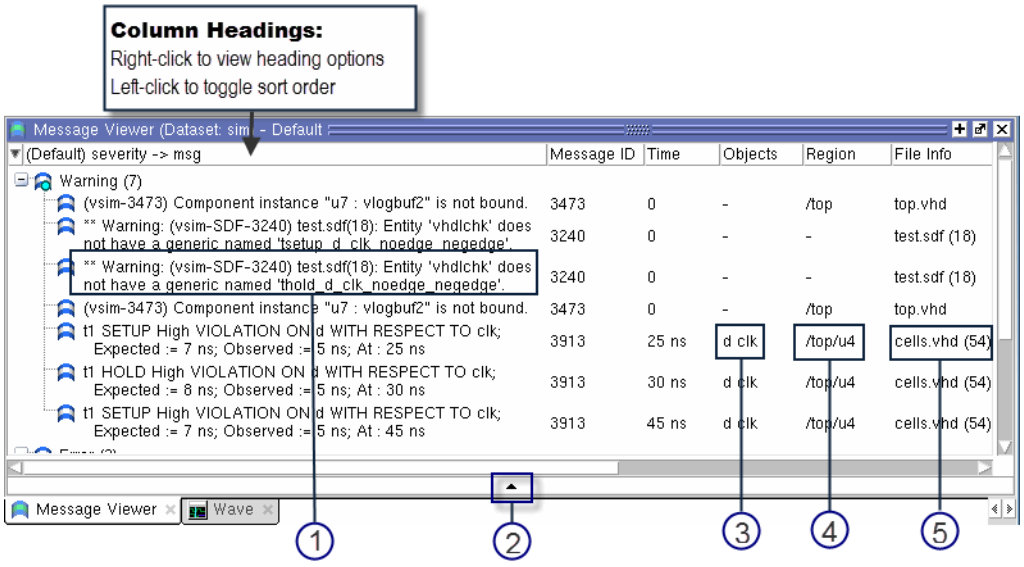


Table 4-26. Message Viewer Tasks

Icon	Task	Action
1	Display a detailed description of the message.	Right-click the message text then choose**View Verbose Message**.
	Open message in Source window	Double-click the message in the Message Column.
	Expand a hierarchical node	Double-click on a non-leaf node in the Messages column.
2	Open the Configuration Options for Message Viewer dialog. Provides access to Analysis Questions, Column Layout, Filter Expression, Hierarchy Configuration and Sort Configuration.	Left-click the down arrow to toggle the “drawer” open and closed.
3	Open the source file and add a bookmark to the location of the object(s).	Double-click the object name(s).
3	Change the focus of the Structure and Objects windows.	Double-click the hierarchical reference.
4	Open the source file and set a marker at the line number.	Double-click the file name.

Fields

Table 4-27. Message Viewer Window Columns

Column	Description
Category	Keyword for the various categories of messages: • DISPLAY • SDF • TCHK • VCD • VITAL • WLF • MISC • <user-defined>
Comment	User comment
Compulsory	Whether an item was in a compulsory (required) test for ranking
CPU Time	Total CPU time consumed
Date	Date the test was run
File Info	Filename related to the cause of the message, and in some cases the line number in parentheses
Host OS	Operating system in use by the host on which the test was run
Hostname	Name of host (server) on which the test was run
instance	Instance or region associated with the message
Iteration/Delta	Iteration (delta) in which the message occurs
LOG name	Name (path) to the generated log/transcript file
MEMUSAGE	Total memory used by the simulator for the test
Message	Organized tree-structure of the sorted messages, as well as, when expanded, the text of the messages.
Message ID	Message ID
Message ID Name	Message ID name
Objects	Object(s) related to the message, if any.
Process	Process or leaf associated with the message
Region	Hierarchical region related to the message, if any
run CWD	Directory in which the test was run
Seed	Random seed
Severity	Message severity, such as Warning, Note or Error.
Sim Time	Total simulation time

Table 4-27. Message Viewer Window Columns (cont.)

Column	Description
sim Timeunits	Timeunit used by the simulation
Source File Name	Name of the file where the message originated
Source File Number	Declaration number of the file associated with the message
Source Line Number	Line number within "filename" where the message originated
Test Name	Name of the test
Test Status	Completion status (OK, Error, etc.)
Time	Time of simulation when the message was issued.
Timing Check Kind	Information about timing checks
User ID	Username under which the test was run
VRM Context	Username under which the test was run
Vsim Args	Arguments passed to vsim command
WLF Filename	Name of WLF file from which message was imported
WLF Name	Name (path) to the generated WLF file
WLF Raw Time	Simulation time (in ticks) associated with the message
WLF Time Unit	Simulation time unit

Table 4-28. Message Viewer Window Popup Menu

Popup Menu Item	Description
Reload Viewer Data	Opens a Source window for the file, and in some cases takes you to the associated line number.

View
• Verbose Message
• Message Source
• Log File
• Object Declarations
• Change Environment
• Waveform:
  • Go to Time in Wave
  • Add Objs to Wave
	Opens selected item:
	Verbose Message dialog box with details about message
	Source code at line number where message is
	Log file, in a Source window
	Object window, to view declarations
	Change environment
	Waveform window, opens:
	at time of selected message
	adds objects associated with selected message

Analysis Questions	Opens Analysis Questions dialog box; used for saving and managing specific queries of the data.
Filter Expressions	Opens Filter Expressions dialog; used for saving and managing filters.

Table 4-28. Message Viewer Window Popup Menu (cont.)

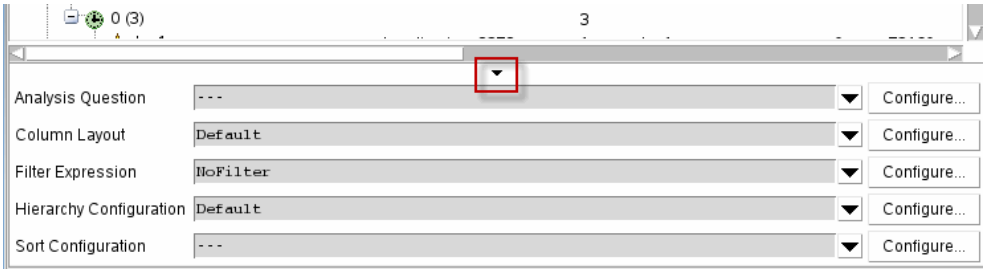
Popup Menu Item	Description
Hierarchy Configurations	Opens Hierarchy Configurations dialog box; used for saving and managing particular hierarchy configurations of the data.
Column Layouts	Opens Configure Column Layout dialog; used for creating, editing and managing the configuration of columns.
Show Titles in Hier Column	Toggles on and off showing the titles within the hierarchy column
Global Options	Configures how/when Message Viewer opens.
Edit Transforms...	Opens a dialog which will open a transform rules file for editing with the Transform Rule File Editor.
Load/Save Setup File	Loads/Saves a particular setup to a name you specify.
Expand/Collapse Selected/All	Manipulates the expansion of the Messages column.

Usage Notes

Message Viewer Configuration of Data

The Message Viewer window contains a “drawer” of options for configuring the data, including analysis questions, column layouts, filter expressions, hierarchy of data, and sort configurations. The “drawer”, where all these settings can be set in one convenient location, is opened with a small toggle button at the bottom of the window, as highlighted in Figure 4-33.

Figure 4-33. Configuration Options for Message Viewer



Custom Hierarchy Configurations

To save your own custom column layout and any filter settings to an external file (<*msgviewer*>.*do*), choose **File > Export > Hierarchy Configuration** while the window is active. You can reload these settings with the do command. This export does not retain changes to column width.

Filter Expressions Dialog Box

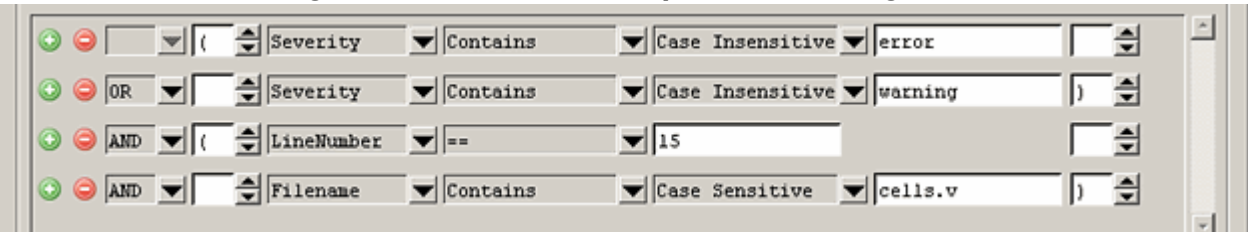
To access: **Filter Expressions > [Configure Filter] > Filter Expressions dialog box**

You can customize exactly which messages are shown in both the Message Viewer and the Results Analysis windows using the Filter Expressions dialog box.

Description

The Edit Filter Expression dialog box in Figure 4-34 shows an example where you want to show all messages, either errors or warnings, that reference the 15th line of the file *cells.v*.

Figure 4-34. Edit Filter Expression Dialog Box



Fields

- **Filter Expression Terms area** — Create filter rules that specify which messages are shown in the windows. From left to right, each filter rule is made up of the following:
  - **Add and Remove buttons** — either add a rule filter row below the current row or remove that rule filter row.
  - **Logic field** — specifies a logical argument for combining adjacent rules. Your choices are: AND, OR, NAND, and NOR.
  - **Open Parenthesis field** — controls rule groupings by specifying, if necessary, any open parentheses. The up and down arrows increase or decrease the number of parentheses in the field.
  - **Column field** — specifies that your filter value applies to a specific column of the Message Viewer.
  - **Inclusion field** — specifies whether the Column field should or should not contain a given value.
  - For text-based filter values your choices are: Contains, Doesn’t Contain, or Exact.
  - For numeric- and time-based filter values your choices are: ==, !=, <, <=, >, and >=.
  - **Case Sensitivity field** — specifies whether your filter rule should treat your filter value as Case Sensitive or Case Insensitive. This field only applies to text-based filter values.
  - **Filter Value field** — specifies the filter value associated with your filter rule.
  - **Time Unit field** — specifies the time unit. Your choices are: fs, ps, ns, us, ms. This field only applies to the Time selection from the Column field.

  - **Closed Parenthesis field** — controls rule groupings by specifying, if necessary, any closed parentheses. The up and down arrows increase or decrease the number of parentheses in the field.

- **First Message Filter area** — Allows you to control the appearance of either all matching messages or just the first matching message (with further filtering options).
- **Time Range area** — Allows you to filter which messages appear according to simulation time. The default is to display messages for the complete simulation time.
- **Displayed Objects area** — Allows you to filter which messages appear according to the values in the Objects column. The default is to display all messages, regardless of the values in the Objects column. The Objects in the list text entry box allows you to specify filter strings, where each string must be on a new line.

Objects Window

To access:

- **View > Objects**
- view objects command
- Wave window > View Objects Window Button

Use this window to view the names and current values of declared data objects in the current region, as selected in the Structure window.

Description

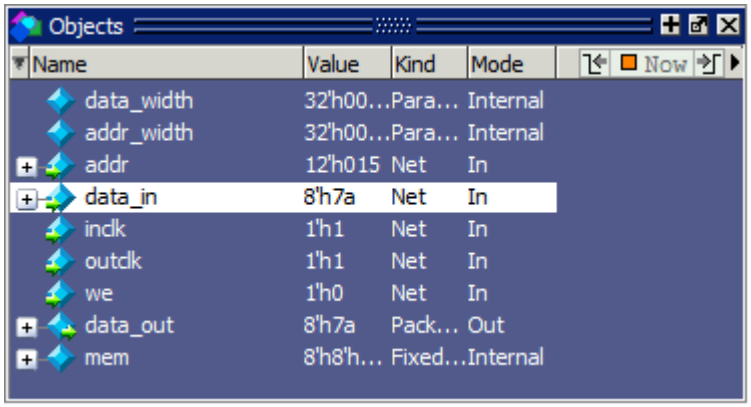
This section describes GUI elements specific to this Window.

> **Current Time Label** — Displays the Current Time or the Now (end of simulation) time. This is the time used to control state values annotated in the window. (For details, see Current Time Label.)

Viewable data objects include:

- signals
- nets
- registers
- constants and variables not declared in a process
- generics
- parameters

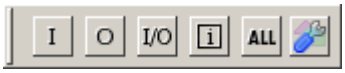
Figure 4-35. Objects Window



Right-click anywhere in the window to display the popup menu and an option displayed in Table 4-49:

The Object filter toolbar provides filtering of design objects appearing in the Objects window.

Figure 4-36. Object Window Toolbar



Fields

Table 4-29. Columns in the Objects Window

Column name	Description
Name	the name of each object in the current region
Value	the current value of each object
Kind	the object type
Mode	the object mode (internal, in, out, and so forth.)

Table 4-30. Objects Window Popup Menu

Popup Menu Item	Description
View Declaration	Opens a Source window to the declaration of the object
View Memory Contents	
Add Wave	Adds the selected object(s) to the Wave window
Add Wave New	Creates a new instance of the Wave window and adds the selected object(s) to that window.
Add Wave To	Opens a drop down list of Wave windows when multiple windows exist. Adds the selected object(s) to the selected Wave window.
Add Dataflow	Adds the selected object(s) to a Dataflow window
Add to	Add the selected object(s) to any one of the following: Wave window, List window, Log file, Schematic window, Dataflow window. You may choose to add only the Selected Signals, all Signals in Region, all Signals in Design.
Copy	Copies information about the object to the clipboard
Find	Opens the Find box
Insert Breakpoint	Adds a breakpoint for the selected object

Table 4-30. Objects Window Popup Menu (cont.)

Popup Menu Item	Description
Modify	Modify the selected object(s) by selecting one of the following from the submenu: • Force - opens Force Selected Signal dialog • Remove Force - remove effect of force command • Change Value - change value of selected • Apply Clock - opens Define Clock dialog • Apply Wave - opens Create Pattern Wizard
Radix	Opens Signal Radix dialog, allowing you to set the radix of selected signal(s) in all windows
Show	Shows list of port types and object kinds that are displayed. Includes a Change Filter selection that opens the Filter Objects dialog, which allows you to filter the display.

Table 4-31. Object Window Toolbar Buttons

Button	Name	Shortcuts	Description
	View Inputs Only	None	Changes the view of the Objects Window to show inputs.
	View Outputs Only	None	Changes the view of the Objects Window to show outputs.
	View Inouts Only	None	Changes the view of the Objects Window to show inouts.
	Vies Internal Signals	None	Changes the view of the Objects Window to show Internal Signals.
	Reset All Filters	None	Clears the filtering of Objects Window entries and displays all objects.
	Change Filter	None	Opens the Filter Objects dialog box.

Objects Window Tasks

This section describes tasks for using the Objects window.

Interacting with Other Windows

You can interact with other windows from the Objects window.

Procedure

1. Click an entry in the window to highlight that object in the Dataflow, and Wave windows.
2. Double-click an entry to highlight that object in a Source window

Setting Signal Radix

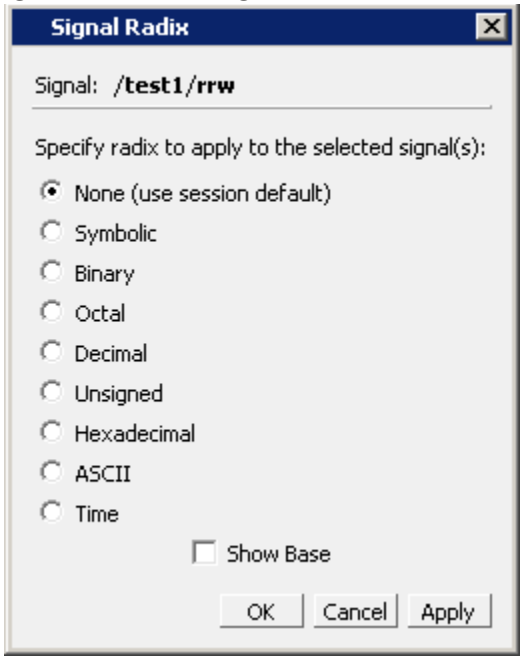
You can set the signal radix for a selected signal or signals in the Objects window as follows.

Procedure

1. Click (LMB) a signal to select it or use Ctrl-Click Shift-Click to select a group of signals.
2. Choose**Objects > Radix** from the menu bar; or right-click the selected signal(s) and choose **Radix** from the popup menu.

   This opens the Signal Radix dialog box (Figure 4-37), where you may select a radix. This sets the radix for the selected signal(s) in the Objects window and every other window where the signal appears.

Figure 4-37. Setting the Global Signal Radix from the Objects Window



Finding Contents of the Objects Window

You can filter the contents of the Objects window by either the Name or Value columns.

Procedure

1. Ctrl-F to display the Find box at the bottom of the window.
2. Click the “Search For” button and select the column to filter on.
3. Enter a string in the Find text box
4. Enter

Filtering Contents of the Objects Window

You can filter the contents of the Objects window by the Name column.

Procedure

1. Ctrl-F to display the Find box at the bottom of the window.
2. Ctrl-M to change to “Contains” mode.
3. Enter a string in the Contains text box

   The filtering will occur as you begin typing. You can disable this feature with Ctrl-T.

Filters are stored relative to the region selected in the Structure window. If you re-select a region that had a filter applied, that filter is restored. This allows you to apply different filters to different regions.

Filtering by Signal Type

The **View > Filter** menu selection allows you to specify which signal types to display in the Objects window. Multiple options can be selected. Choose **Change Filter** to open the Filter Objects dialog box, where you can select port modes and object types to be displayed.

Processes Window

To access:

- **View > Process**
- view process command

Use this window to view a list of HDL processes in one of four viewing modes. In addition, the data in this window will change as you run your simulation and processes change states or become inactive.

Description

The four viewing modes are as follows:

Active — (default) active processes in your simulation.

In Region — process in the selected region.

Design — intended for primary navigation of ESL (Electronic System Level) designs where processes are a foremost consideration.

Hierarchy — a tree view of any SystemVerilog nested fork-joins.

Figure 4-38. Processes Window

Fields

Table 4-32. Processes Window Column Descriptions

Column Title	Description
Name	Name of the process.
Class Info	SystemVerilog class object id or UVM component name.
Order	Displays the execution order of all processes in the Active and Ready states in the active kernel queue. Processes that are not in the Active or Ready states do not yet have any order, in which case the column displays a dash (-). The Process window updates the execution order automatically as simulation proceeds.

Table 4-32. Processes Window Column Descriptions (cont.)

Column Title	Description
Parent Path	Hierarchical parent pathname of the process
State	Process state. • **Wait** — Indicates the process is waiting for a wake up trigger (change in VHDL signal, Verilog net, or a time period). • **Ready** — Indicates the process is scheduled to be executed in current simulation phase (or in active simulation queue) of current delta cycle. • **Active** – Indicates the process is currently active and being executed. • **Queued** — Indicates the process is scheduled to be executed in current delta cycle, but not in current simulation phase (or in active simulation queue). • **Done** — Indicates the process has been terminated, and will never restart during current simulation run. Processes in the Idle and Wait states are distinguished as follows. Idle processes have never been executed before in the simulation, and therefore have never been suspended. Idle processes will become Active, Ready, or Queued when a trigger occurs. A process in the Wait state has been executed before but has been suspended, and is now waiting for a trigger.
Type	Process type, according to the language, including the following types: • Always • Assign • Final • Fork-Join (dynamic process like fork-join, sc_spawn, and so forth.) • Initial • Implicit (internal processes created by simulator like Implicit wires, and so forth.) • Primitive (UDP, Gates, and so forth.) • VHDL Process

Source Window

To access:

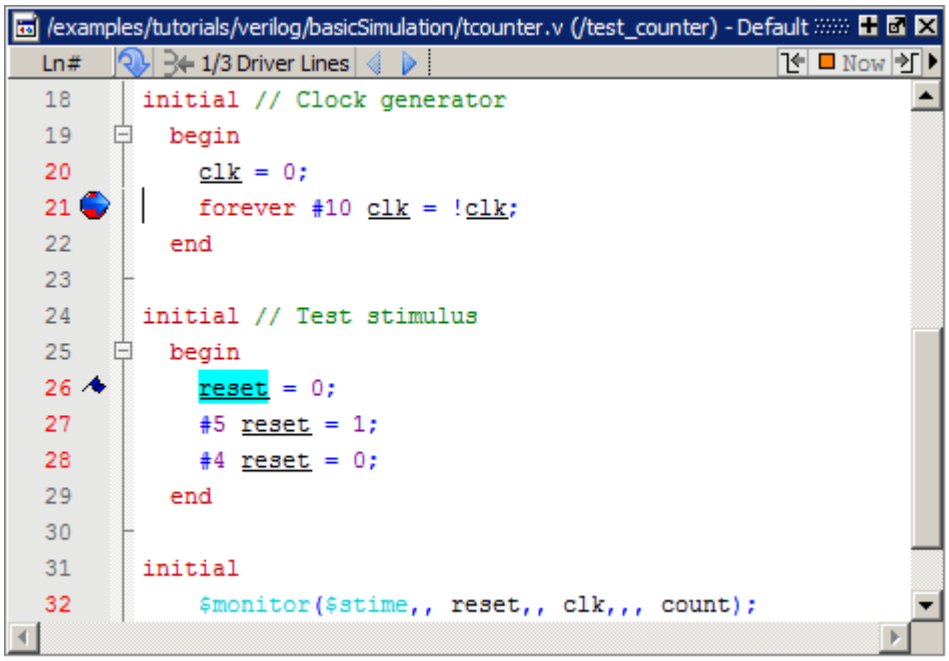
- **File > Open**
- Click the **Open** icon
- Double-click objects in other windows
- edit command

The Source window allows you to view and edit source files as well as set breakpoints, and step through design files.

Description

By default, the Source window displays your source code with line numbers. You may also see the different graphic elements.

Figure 4-39. Source Window



If you double-click an item in the Objects window or in the structure tab (**sim** tab), the underlying source file for the object will open in the Source window and scroll to the line where the object is defined.

By default, files you open from within the design (such as when you double-click an object in the Objects window) open in Read Only mode. To make the file editable, right-click in the Source window and select (uncheck) Read Only. To change this default behavior, set the PrefSource(ReadOnly) variable to 0. Refer to Setting GUI Preferences for details on setting preference variables.

Fields

- **Red line numbers** — denote executable lines, where you can set a breakpoint
- **Blue arrow** — denotes the currently active line or a process that you have selected in the Processes Window
- **Red ball in line number column** — denotes file-line breakpoints; gray ball denotes breakpoints that are currently disabled
- **Blue flag in line number column** — denotes line bookmarks
- **Current Time Label** — displays the Current Time or the Now (end of simulation) time. This is the time used to control state values annotated in the window (For details, refer to Current Time Label.)
- **Code Folding Indicators** — denotes sections of code that can be folded or expanded

Usage Notes

Disabling Automatic Opening of Source Files

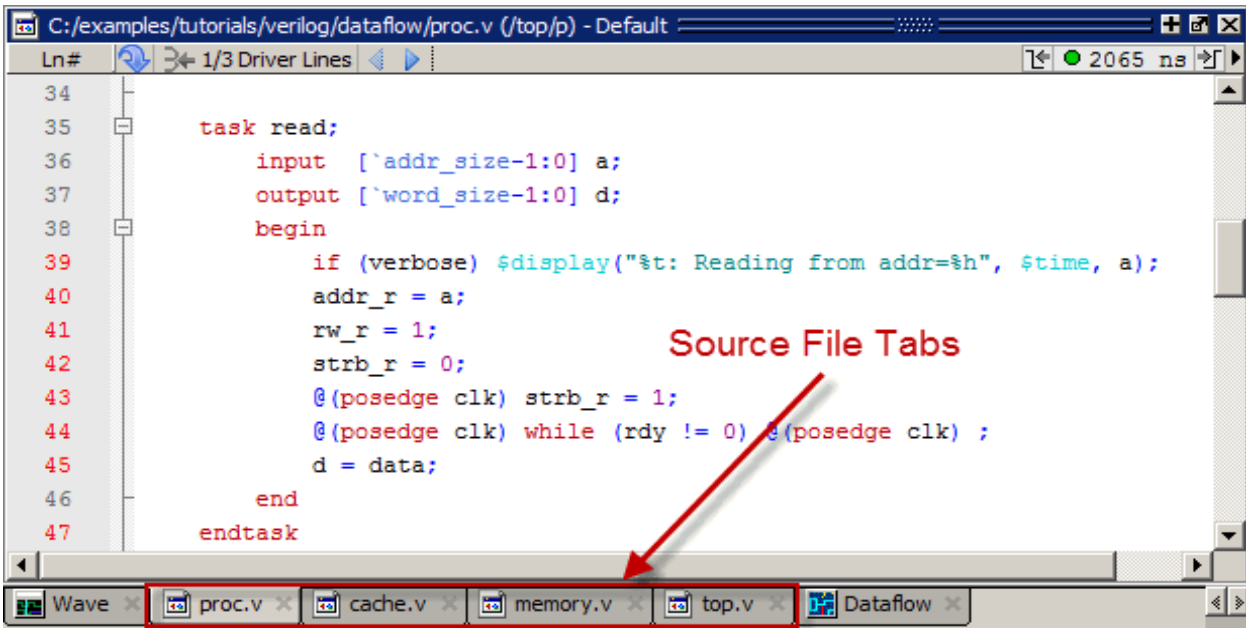
By default, the Source window opens when the simulator hits a breakpoint, encounters a call to $finish(), or you are single stepping through your code. In each case, the simulator stops, the Source window opens and displays the last line of code that was executed. You can disable automatic opening by changing the preference variable settings:

- Breakpoints — Set the PrefSource(OpenOnBreak) variable to 0.
- $finish() call — Set the PrefSource(OpenOnFinish) variable to 0.
- Single Stepping — Set the PrefSource(OpenOnStep) variable to 0.

Displaying Multiple Source Files

By default each file you open or create is marked by a window tab, as shown in the graphic below.

Figure 4-40. Displaying Multiple Source Files



Using the Source Window

Use the Source window to view and analyze your data.

Dragging and Dropping Objects into the Wave and List Windows

ModelSim allows you to drag and drop objects from the Source window to the Wave and List windows.

Procedure

1. In the Source window, double-click an object to highlight it.
2. Drag the object to the Wave or List window.
3. Optionally, to place a group of objects into the Wave and List windows, drag and drop any section of highlighted code.

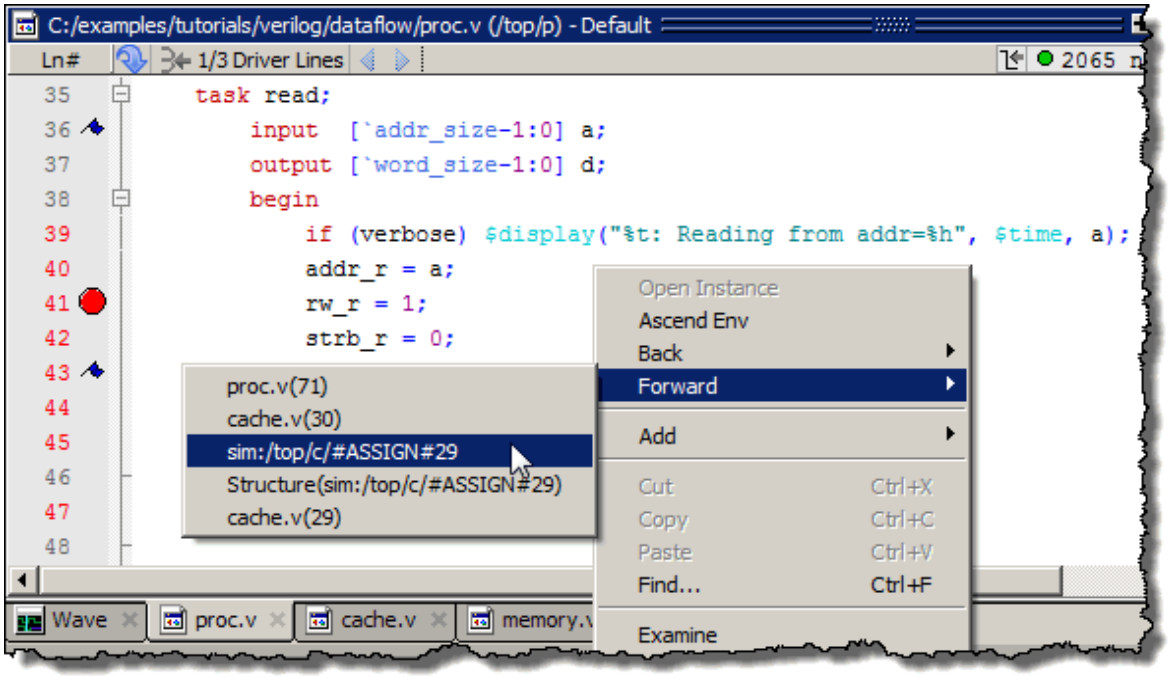
When an object is dragged and dropped into the Wave window, the add wave command will be reflected in the Transcript window.

Setting your Context by Navigating Source Files

When debugging your design from within the GUI, you can change your context while analyzing your source files.

Figure 4-41 shows the pop-up menu the tool displays after you select then right-click an instance name in a source file.

Figure 4-41. Setting Context from Source Files



The title bar of the Source window displays your current context, parenthetically, after the file name and location. This changes as you alter your context, either through the pop-up menu or by changing your selection in the Structure window.

This functionality allows you to easily navigate your design for debugging purposes by remembering where you have been, similar to the functionality in most web browsers. The navigation options in the pop-up menu function as follows:

- **Open Instance** — changes your context to the instance you have selected within the source file. This is not available if you have not placed your cursor in, or highlighted the name of, an instance within your source file.

  If any ambiguities exists, most likely due to generate statements, this option opens a dialog box allowing you to choose from all available instances.

- **Ascend Env** — changes your context to the file and line number in the parent region where the current region is instantiated. This is not available if you are at the top-level of your design.

- **Forward/Back** — allows you to change to previously selected contexts. This is not available if you have not changed your context.

The Open Instance option is essentially executing aCn environment command to change your context, therefore any time you use this command manually at the command prompt, that information is also saved for use with the Forward/Back options.

Highlighted Text in a Source Window

The Source window can display text that is highlighted as a result of various conditions or operations, such as the following:

- Double-clicking an error message in the transcript shown during compilation

In these cases, the relevant text in the source code is shown with a persistent highlighting. To remove this highlighted display, choose **More > Clear Highlights** from the right-click popup menu of the Source window. If the Source window is docked, you can also perform this action by selecting **Source > More > Clear Highlights** from the Main menu. If the window is undocked, select **Edit > Advanced > Clear Highlights**.

Note

Clear Highlights does not affect text that you have selected with the mouse cursor.

Example

To produce a compile error that displays highlighted text in the Source window, do the following:

1. Choose **Compile > Compile Options**
2. In the Compiler Options dialog box, click either the VHDL tab or the Verilog & SystemVerilog tab.
3. Enable Show source lines with errors and click OK.
4. Open a design file and create a known compile error (such as changing the word “entity” to “entry” or “module” to “nodule”).

5. Choose **Compile > Compile** and then complete the Compile Source Files dialog box to finish compiling the file.
6. When the compile error appears in the Transcript window, double-click on it.
7. The source window is opened (if needed), and the text containing the error is highlighted.
8. To remove the highlighting, choose **Source > More > Clear Highlights**.

Hyperlinked Text in a Source Window

The Source window supports hyperlinked navigation. To turn hyperlinked text on or off in the Source window, do the following:

1. Click anywhere in the Source window to make it the active window.
2. Select Source > Show Hyperlinks.

When you double-click on hyperlinked text, the selection jumps from the usage of an object to its declaration. This provides the following operations:

- Jump from the usage of a signal, parameter, macro, or a variable to its declaration.
- Jump from a module declaration to its instantiation, and vice versa.
- Navigate back and forth between visited source files.

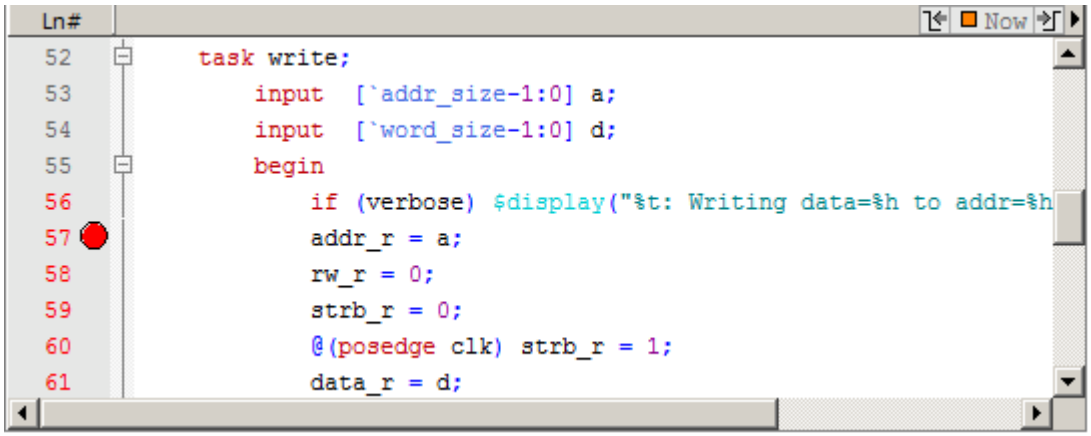
Setting File-Line Breakpoints with the GUI

You can easily set file-line breakpoints in your source code.

Procedure

1. In a Source window click in the line number column next to a red line number. A red ball denoting a breakpoint will appear (Figure 4-42).

Figure 4-42. Breakpoint in the Source Window



The breakpoint markers are toggles.

2. Click once to create the breakpoint; click again to disable or enable the breakpoint.

   To delete the breakpoint completely, right click the red breakpoint marker, and select **Remove Breakpoint**.

   Other options on the context menu include:

   - **Disable Breakpoint** — Deactivate the selected breakpoint.
   - **Edit Breakpoint** — Open the File Breakpoint dialog to change breakpoint arguments.
   - **Edit All Breakpoints** — Open the Modify Breakpoints dialog.
   - **Run Until Here** — Run the simulation from the current simulation time up to the specified line of code. Refer to Run Until Here for more information.
   - **Add/Remove Bookmark** — Add or remove a file-line bookmark.

Adding File-Line Breakpoints with the bp Command

Use the bp command to add a file-line breakpoint from the VSIM> prompt.

For example:

```
bp top.vhd 147
```

sets a breakpoint in the source file *top.vhd* at line 147.

Editing File-Line Breakpoints

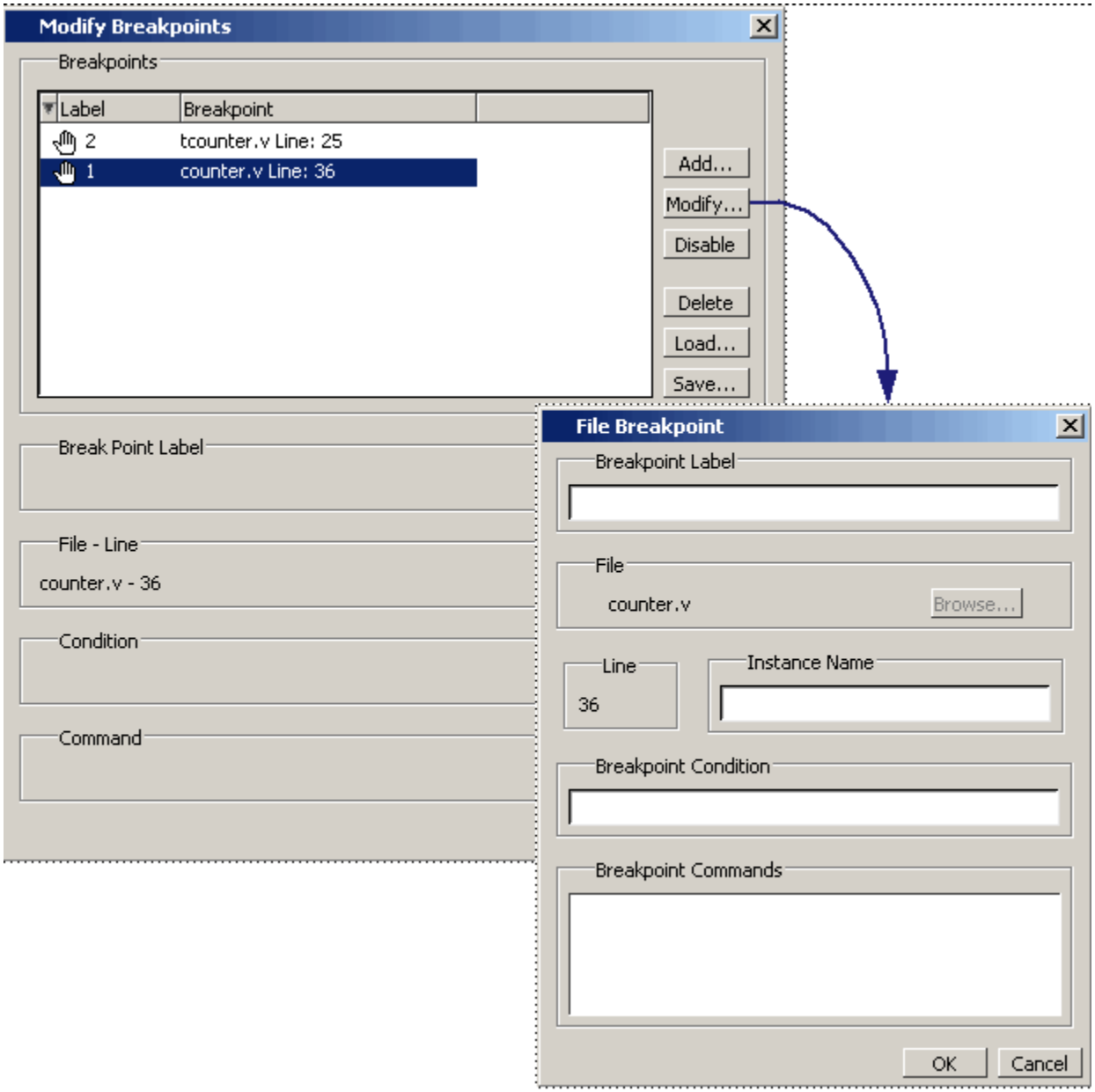
You can modify (or add) a breakpoint according to the line number in a source file.

Procedure

1. Perform one of the following actions:
   - Select **Tools > Breakpoints** from the Main menu.
   - Right-click a breakpoint and select **Edit All Breakpoints** from the popup menu.
   - Click the **Edit Breakpoints** toolbar button. See Simulate Toolbar.

   This displays the Modify Breakpoints dialog box shown in Figure 4-43.

Figure 4-43. Modifying Existing Breakpoints



The Modify Breakpoints dialog box provides a list of all breakpoints in the design. Select a file-line breakpoint from the list.

2. Click **Modify**, which opens the File Breakpoint dialog box shown in Figure 4-43.
3. Fill out any of the following fields to modify the selected breakpoint:

   Breakpoint Label — Designates a label for the breakpoint.

   Instance Name — The full pathname to an instance that sets a breakpoint so it applies only to that specified instance.

   Breakpoint Condition — One or more conditions that determine whether the breakpoint is observed. If the condition is true, the simulation stops at the breakpoint. If false, the simulation bypasses the breakpoint. A condition cannot refer to a VHDL variable (only a signal). Refer to the tip below for more information on proper syntax for breakpoints entered in the GUI.

   Breakpoint Command — A string, enclosed in braces ({}) that specifies one or more commands to be executed at the breakpoint. Use a semicolon (;) to separate multiple commands.

Tip: All fields in the File Breakpoint dialog box, except the Breakpoint Condition field, use the same syntax and format as the -inst switch and the command string of the **bp** command. Do not enclose the expression entered in the Breakpoint Condition field in quotation marks (“ ”). For more information on these command options, refer to the bp command in the *Questa SV/AFV Reference Manual*.

4. Click **OK** to close the File Breakpoints dialog box.
5. Click **OK** to close the Modify Breakpoints dialog box.

   The Modify Breakpoints dialog box (Figure 4-43) includes Load and Save buttons that allow you to load or save breakpoints.

Setting Conditional Breakpoints

In dynamic class-based code, an expression can be executed by more than one object or class instance during the simulation of a design. You set a conditional breakpoint on the line in the source file that defines the expression and specifies a condition of the expression or instance you want to examine. You can write conditional breakpoints to evaluate an absolute expression or a relative expression.

Note
Be sure to first compile and load your simulation before setting a conditional breakpoint.

You can use the SystemVerilog keyword **this** when writing conditional breakpoints to refer to properties, parameters or methods of an instance. The value of **this** changes every time the expression is evaluated based on the properties of the current instance. Your context must be within a local method of the same class when specifying the keyword **this** in the condition for a breakpoint. Strings are not allowed.

The conditional breakpoint examples below refer to the following SystemVerilog source code file *source.sv*:

Figure 4-44. Source Code for *source.sv*

```
1   class Simple;
2     integer cnt;
3     integer id;
4     Simple next;
5
6     function new(int x);
7        id=x;
8        cnt=0
9        next=null
10    endfunction
11
12    task up;
13       cnt=cnt+1;
14       if (next) begin
15          next.up;
16       end
17    endtask
18  endclass
19
20  module test;
21    reg clk;
22    Simple a;
23    Simple b;
24
25    initial
26    begin
27       a = new(7);
28       b = new(5);
29    end
30
31    always @(posedge clk)
32    begin
33       a.up;
34       b.up;
35       a.up
36    end;
37  endmodule
```

Setting a Breakpoint For a Specific Instance

Enter the following on the command line:

bp simple.sv 13 -cond {this.id==7}

Results

The simulation breaks at line 13 of the *simple.sv* source file (Figure 4-44) the first time module a hits the expression because the breakpoint is evaluating for an id of 7 (refer to line 27).

Setting a Breakpoint For a Specified Value of Any Instance

Enter the following on the command line:

bp simple.sv 13 -cond {this.cnt==8}

Results

The simulation evaluates the expression at line 13 in the *simple.sv* source file (Figure 4-44), continuing the simulation run if the breakpoint evaluates to false. When an instance evaluates to true the simulation stops, the source is opened and highlights line 13 with a blue arrow. The first time cnt=8 evaluates to true, the simulation breaks for an instance of module Simple b. When you resume the simulation, the expression evaluates to cnt=8 again, but this time for an instance of module Simple a.

You can also set this breakpoint with the GUI:

1. Right-click on line 13 of the simple.sv source file.
2. Select Edit Breakpoint 13 from the drop menu.
3. Enter

   ```
   this.cnt==8
   ```

   in the **Breakpoint Condition** field of the **Modify Breakpoint** dialog box. (Refer to Figure 4-43) Note that the file name and line number are automatically entered.

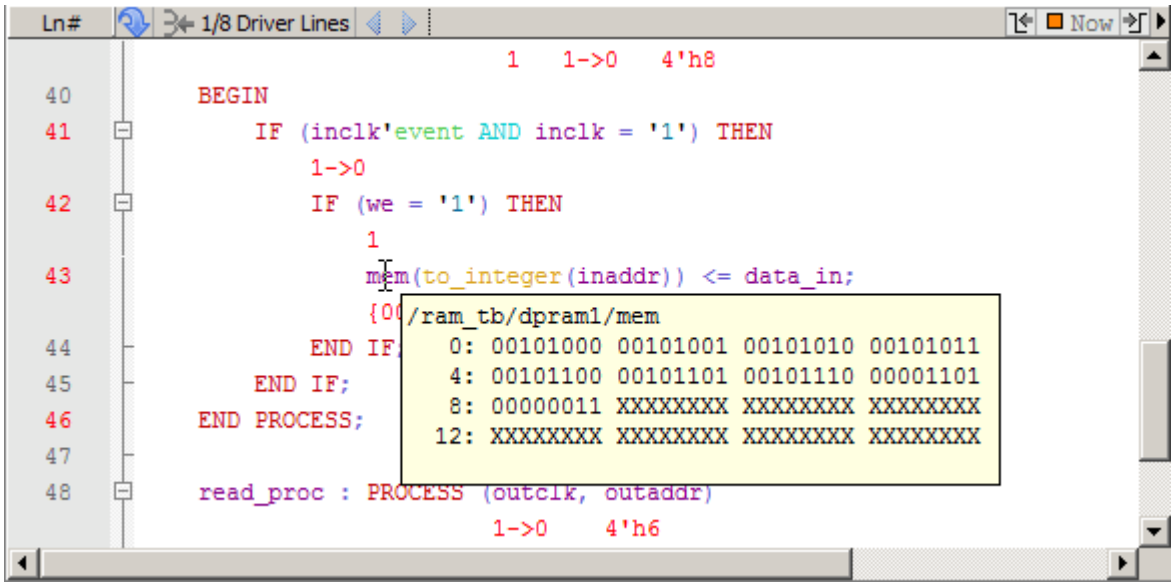
Checking Object Values and Descriptions

You can check the value or description of signals, indexes, and other objects in the Source window.

There are two quick methods to determine the value and description of an object:

- Select an object, then right-click and choose **Examine** or **Describe** from the context menu.
- Pause the cursor over an object to see an examine pop-up

Figure 4-45. Source Window Description



You can choose **Source > Examine Now** or **Source > Examine Current Cursor** to choose at what simulation time the object is examined or described.

You can also invoke the examine and/or describe commands on the command line or in a DO file script.

Marking Lines with Bookmarks

Source window bookmarks are blue flags that mark lines in a source file. These graphical icons may ease navigation through a large source file by highlighting certain lines.

As noted above in the discussion about finding text in the Source window, you can insert bookmarks on any line containing the text for which you are searching. The other method for inserting bookmarks is to right-click a line number and select **Add/Remove Bookmark**. To remove a bookmark, right-click the line number and select Add/Remove Bookmark again.

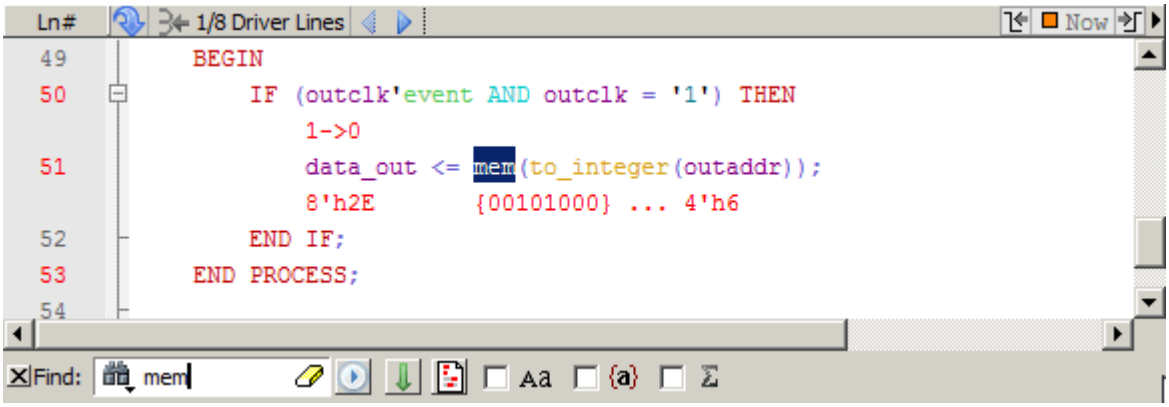
To remove all bookmarks from the Source window, select **Source > Clear Bookmarks** from the menu bar when the Source window is active.

Performing Incremental Search for Specific Code

The Source window includes a Find function that allows you to do an incremental search for specific code.

To activate the Find bar (Figure 4-46) in the Source window chooset **Edit > Find** from the Main menus or click the **Find** icon in the Main toolbar. For more information see Find and Filter Functions.

Figure 4-46. Source Window with Find Toolbar



Customizing the Source Window

You can customize the appearance and behavior of the Source window in several ways.

- Changing a *modelsim.ini* variable: for example, character encoding of files is controlled by the DefaultRadix variable
- Changing a preference variable: for example,
  - tab spacing: change the PrefSource(tabs) preference variable. Refer to Setting GUI Preferences for details on setting preference variables.
  - Syntax highlighting: change the PrefSource(highlightExecutableLines) preference variable.
  - Underlining of hyperlinked code: change the prefMain(HyperLinkingUnderline) preference variable.
- General Source window fonts and appearance: select **Source > Tools > Edit Preferences** and make changes to the settings on the **By Window** tab.

Refer to the GUI Preferences appendix for more information.

Structure Window

To access:

- **View > Structure**
- view structure command
- Button: View Objects Window Button

Use this window to view the hierarchical structure of the active simulation.

Description

The name of the structure window, as shown in the title bar or in the tab if grouped with other windows, can vary:

sim — This is the name shown for the Structure window for the active simulation.

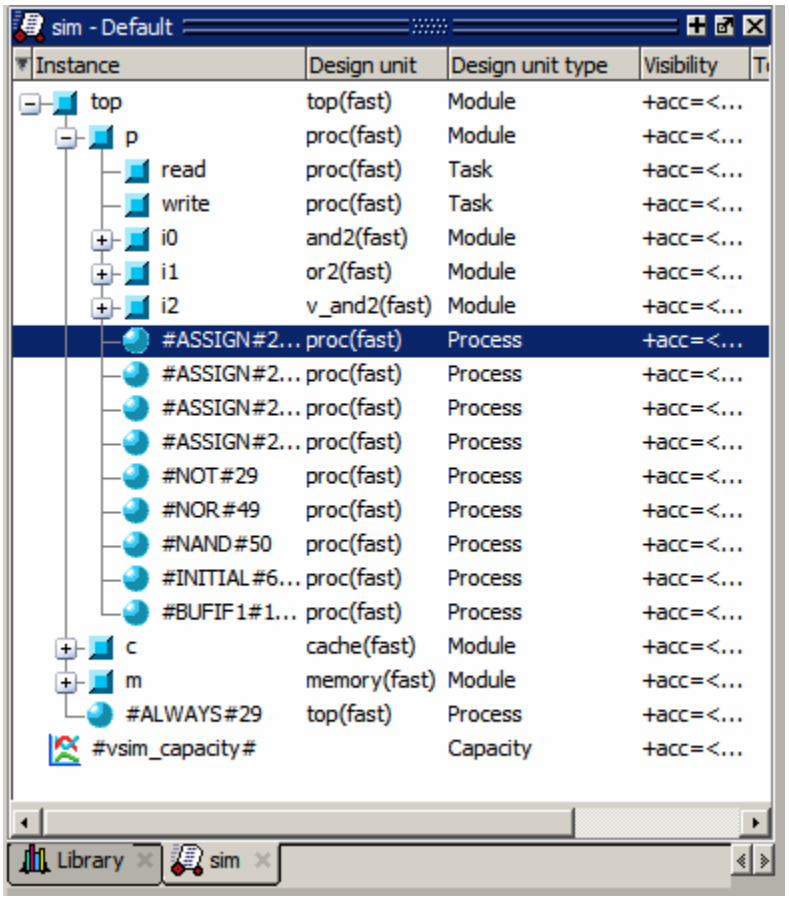
dataset_name — The Structure window takes the name of any dataset you load through the **File > Datasets** menu item or the dataset open command.

By default, the Structure window opens in a tab group with the Library windows after starting a simulation. You can also open the Structure window with the "View Objects Window Button".

The hierarchical view includes an entry for each object within the design. When you select an object in a Structure window, it becomes the current region.

The contents of several windows automatically update based on which object you select, including the Source window, Objects window, Processes window, and Locals window. All mouse button operations clear the current selection and select the item under the cursor.

Figure 4-47. Structure Window



Right-click an object in the Structure window to display the popup menu and select an option in Table 4-57.

Fields.

Table 4-33. Structure Window Popup Menu

Popup Menu Item	Description
View Declaration	Opens the source file and bookmarks the object.
View Instantiation	Opens the source file and bookmarks the object.
Add Wave	Adds the selected object(s) to the Wave window.
Add Wave New	Creates a new instance of the Wave window and adds the selected object(s) to that window.
Add Wave To	Opens a drop down list of Wave windows when multiple windows exist. Adds the selected object(s) to the selected Wave window.
Add Dataflow	Adds the selected object(s) to a Dataflow window.
Add to	Add the selected object(s) to any one of the following: Wave window, List window, Log file, Schematic window, Dataflow window. You may choose to add only the Selected Signals, all Signals in Region, all Signals in Design.
Copy	Copies the object instance path to the clipboard
Find	Opens the Search Bar (at bottom of window) in the Find mode to make searching for objects easier, especially with large designs.
Save Selected	Saves all hierarchy under the selected instance.
Expand Selected	Displays the hierarchy of the object recursively.
Collapse Selected	Closes the hierarchy of the object.
Collapse All	Collapses the hierarchy to the top instance.
XML Import Hint	Displays the XML Import Hint dialog box with information about the Link Type and Name

Table 4-33. Structure Window Popup Menu (cont.)

Popup Menu Item	Description
Show	Lists the design unit types that are currently displayed. • Processes • Functions • Packages • Tasks • Statement • VPackages • VITypedef • SVClass • Class Instances • Capacity • Change Filter

Table 4-34. Columns in the Structure Window

Column name	Description
Design Unit	The name of the design unit
Design Unit Type	The type of design unit

Structure Window Tasks

This section describes tasks for using the Structure window.

Display Source Code of a Structure Window Object

You can highlight the line of code that declares a given object in several ways.

- **Double-click an object** — Opens the file in a new Source window, or activates the file if it is already open.
- **Single-click an object** — Highlights the code if the file is already showing in an active Source window.

Add Structure Window Objects to Other Windows

You can add objects from the Structure window to the Dataflow window, List window, Watch window or Wave window in multiple ways.

- **Mouse** — Drag and drop
- **Menu Selection** — **Add** > **To** *window*
- **Toolbar** — **Add Selected to Window Button** > **Add to *window***
- **Command** — **add list**, **add wave**, or **add dataflow**

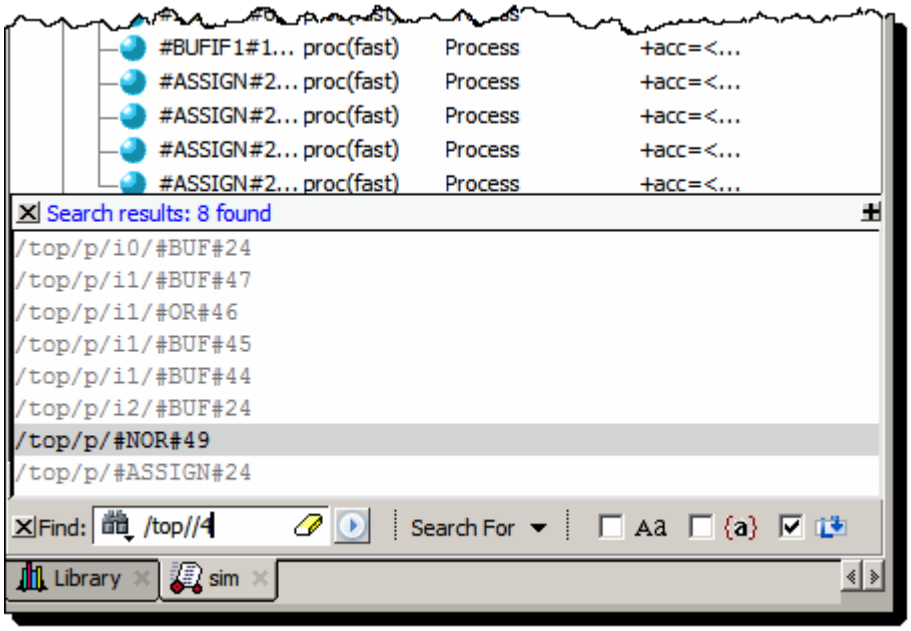
When you drag and drop objects from the Structure window to the Wave, Dataflow, or Schematic windows, the add wave, add dataflow, and add schematic (respectively) commands will be reflected in the Transcript window.

Finding Items in the Structure Window

To find items in the Structure window, press Ctrl-F on your keyboard with the Structure window active. This opens the Find bar at the bottom of the window.

Refer to the Find and Filter Functions section for details. As you type in the Find field, a popup window opens to display a list of matches (Figure 4-48). With 'Search While Typing' enabled (the default) each keypress changes the pattern and restarts the search immediately.

Figure 4-48. Find Mode Popup Displays Matches



The Structure window Find bar supports hierarchical searching to limit the regions of a search. The forward slash (/) character is used to separate the search words. A double slash (//) is used to specify a recursive search from the double slash down the hierarchy. For example:

foo — search the entire design space for regions containing "foo" in the name.

foo?bar — search the entire design space for regions containing "foo" then any single alphanumeric character, followed by "bar"

foo*bar — search the design for a name containing "foo", a string of zero or more alphanumeric characters, followed by "bar. For example, to following names match a search for "foo*bar": "foobar", "foo_fred_bar", and "fooIsAbar". "fooISbad" does not match the search string.

/foo — search the top of the design hierarchy for regions containing "foo".

/foo/bar — search for regions containing "foo" at the top, and then regions containing "bar".

/foo//bar — search for regions containing "bar" recursively below all top level regions containing "foo".

To search for a name that contains the slash (/) character, escape the slash using a backslash (\). For example: \/bar.

When you double-click any item in the match list that item is highlighted in the Structure window and the popup is removed. The search can be canceled by clicking on the 'x' button in the popup window or by pressing the Esc key on your keyboard.

Filtering Structure Window Objects

You can control the types of information available in the Structure window through the **View > Filter** menu items.

Processes — Implicit wire processes

Functions — Verilog and VHDL Functions

Packages — VHDL Packages

Tasks — Verilog Tasks

Statement — Verilog Statements

VlPackage — Verilog Packages

VlTypedef — Verilog Type Definitions

Cell Instances — Verilog cell instances or VHDL architecture instance.

Capacity — Memory capacity design unit

Subprogram — VHDL procedures and functions; Verilog functions and tasks

Transcript Window

To access: The Transcript window is always open in the Main window and cannot be closed.

The Transcript window maintains a running history of commands that are invoked and messages that occur as you work with ModelSim. When a simulation is running, the Transcript displays a VSIM prompt, allowing you to enter command-line commands from within the graphic interface.

Description

You can scroll backward and forward through the current work history by using the vertical scrollbar. You can also use arrow keys to recall previous commands, or copy and paste using the mouse within the window (see Main and Source Window Mouse and Keyboard Shortcuts for details).

The **Transcrip**t tab contains the command line interface, identified by the ModelSim prompt, and the simulation interface, identified by the VSIM prompt.

When the Transcript window is active, a "Transcript" menu selection appears in the Main window menu bar.

When undocked, the Transcript window allows access to the following toolbars:

- Standard Toolbar
- Help Toolbar

Fields

- **Adjust Font Scaling** — Displays the Adjust Scaling dialog box, which allows you to adjust how fonts appear for your display environment. Directions are available in the dialog box.
- **Transcript File** — Allows you to change the default name used when saving the transcript file. The saved transcript file will contain all the text in the current transcript file.
- **Command History** — Allows you to change the default name used when saving command history information. This file is saved at the same time as the transcript file.
- **Save File** — Allows you to change the default name used when selecting **File > Save As**.
- **Saved Lines** — Allows you to change how many lines of text are saved in the transcript window. Setting this value to zero (0) saves all lines.
- **Line Prefix** — Allows you to change the character(s) that precedes the lines in the transcript.

- **Update Rate** — Allows you to change the length of time (in ms) between transcript refreshes.
- **ModelSim Prompt** — Allows you to change the string used for the command line prompt.
- **VSIM Prompt** — Allows you to change the string used for the simulation prompt.
- **Paused Prompt** — Allows you to change the string used for when the simulation is paused.

Transcript Window Tasks

You can perform multiple tasks in the Transcript window.

Saving the Transcript File

Variable settings determine the filename used for saving the transcript. If either **PrefMain(file)** in the *.modelsim* file or **TranscriptFile** in the *modelsim.ini* file is set, then the transcript output is logged to the specified file. By default the **TranscriptFile** variable in *modelsim.ini* is set to *transcript*. If either variable is set, the transcript contents are always saved and no explicit saving is necessary.

If you would like to save an additional copy of the transcript with a different filename, click in the Transcript window and then choose **File > Save As**, or **File > Save**. The initial save must be made with the **Save As** selection, which stores the filename in the Tcl variable **PrefMain(saveFile)**. Subsequent saves can be made with the **Save** selection. Since no automatic saves are performed for this file, it is written only when you invoke a **Save** command. The file is written to the specified directory and records the contents of the transcript at the time of the save.

Refer to Creating a Transcript File for more information about creating, locating, and saving a transcript file.

Saving a Transcript File as a DO File

Perform the following steps to save a transcript file as a DO file.

1. Open a saved transcript file in a text editor.

2. Remove all commented lines leaving only the lines with commands.
3. Save the file as *<name>.do*.

Refer to the do command for information about executing a DO file.

Changing the Number of Lines Saved in the Transcript Window

By default, the Transcript window retains the last 5000 lines of output from the transcript. You can change this default by choosing **Transcript > Saved Lines**. Setting this variable to 0 instructs the tool to retain all lines of the transcript.

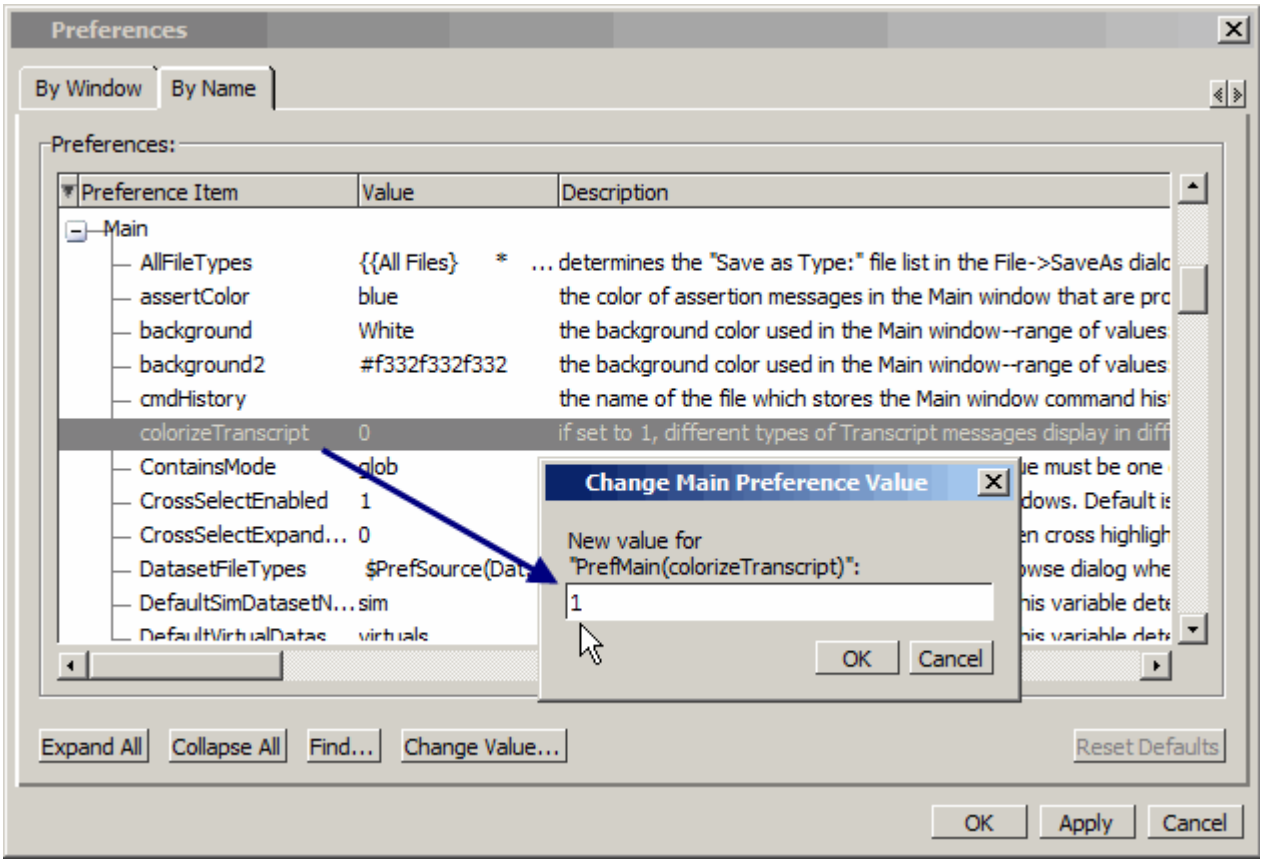
Colorizing the Transcript

By default, all Transcript window messages are printed in blue. You may colorized Transcript messages according to severity.

Procedure

1. Choose **Tools > Edit Preferences** from the Main window menus.
2. In the Preferences window click the **By Name** tab.
3. Expand the list of Preferences under "Main."
4. Select the colorizeTranscript preference and click the **Change Value** button.
5. Enter "1" in the Change Main Preference Value dialog and click **OK** (Figure 4-49).

Figure 4-49. Changing the colorizeTranscript Preference Value



Disabling Creation of the Transcript File

You can disable the creation of the transcript file by using a ModelSim command immediately after ModelSim starts.

Procedure

Enter the following command at the prompt:

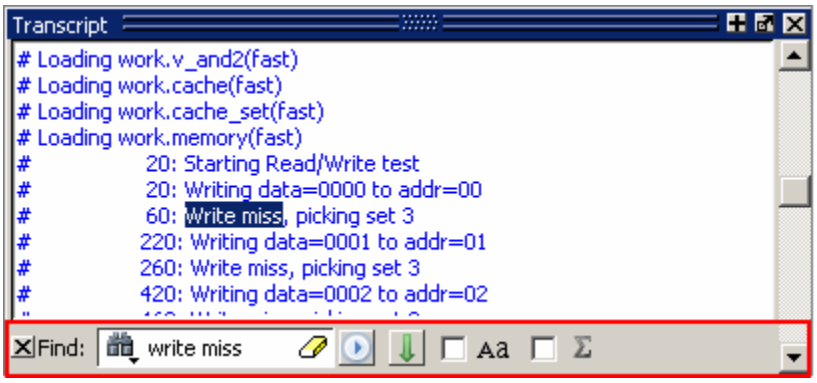
transcript file ""

Performing an Incremental Search

The **Transcript** tab includes an Find function that allows you to do an incremental search for specific text. To activate the Find bar choose **Edit > Find** from the menus or click the **Find** icon in the toolbar.

For more information see Find and Filter Functions.

Figure 4-50. Transcript Window with Find Toolbar



Using Automatic Command Help

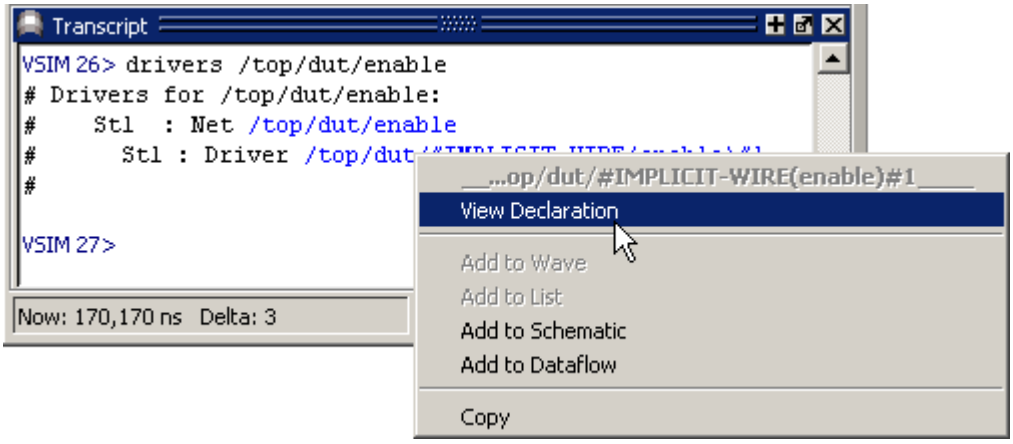
When you start typing a command at the prompt, a dropdown box appears which lists the available commands matching what has been typed so far. You may use the Up and Down arrow keys or the mouse to select the desired command. When a unique command has been entered, the command usage is presented in the drop down box.

You can toggle this feature on and off by choosing **Help > Command Completion**.

Using drivers and Readers Command Results

The output from the drivers and readers commands, which is displayed in the Transcript window as hypertext links, allows you to right-click to open a drop-down menu and to quickly add signals to various windows. It also includes a "View Declaration" item to open the source definition of the signal.

Figure 4-51. drivers Command Results in Transcript



Watch Window

To access:

- **View > Watch**
- view watch command

Use the Watch window to view values for signals and variables at the current simulation time and to explore the hierarchy of object oriented designs.

Description

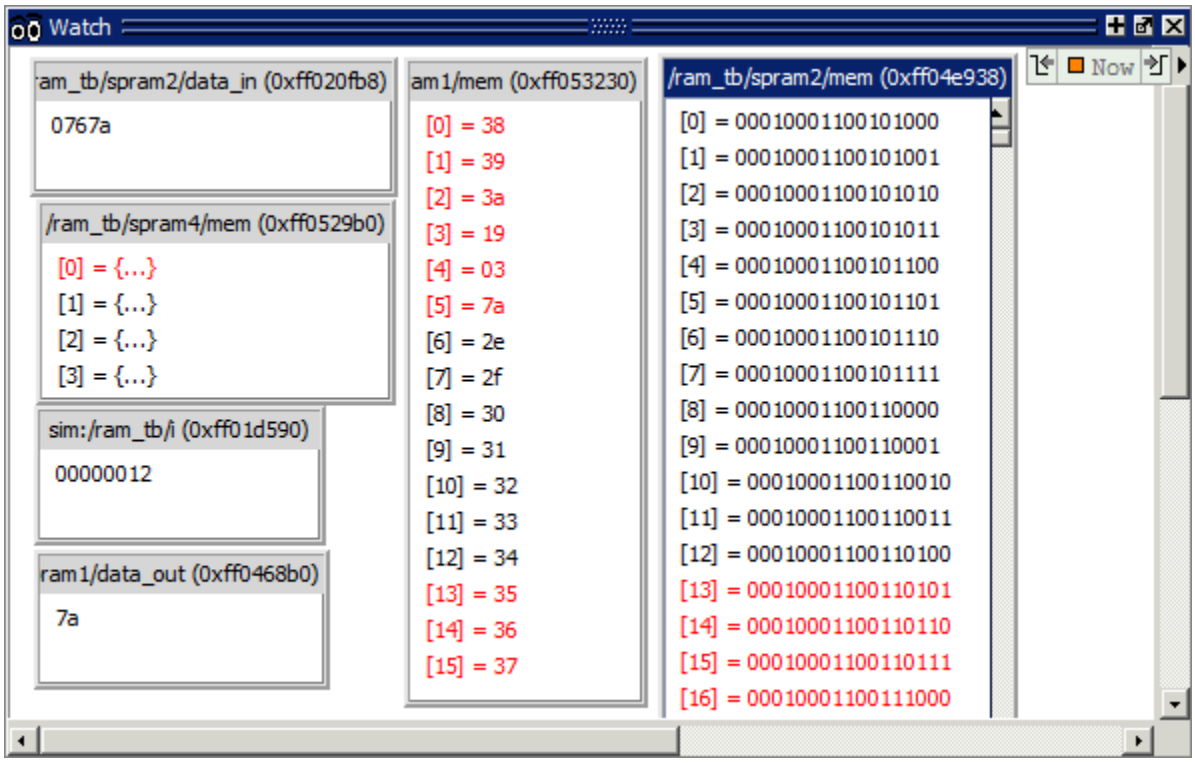
Unlike the Objects or Locals windows, the Watch window allows you to view any signal or variable in the design regardless of the current context. You can view the following objects:

VHDL objects — signals, aliases, generics, constants, and variables.

Verilog objects — nets, registers, variables, named events, and module parameters.

Virtual objects — virtual signals and virtual functions.

Figure 4-52. Watch Window



The primary graphical element of the watch window is the item box, which typically shows information about a single signal. The item can also be a group of signals created with the “group” popup window option.

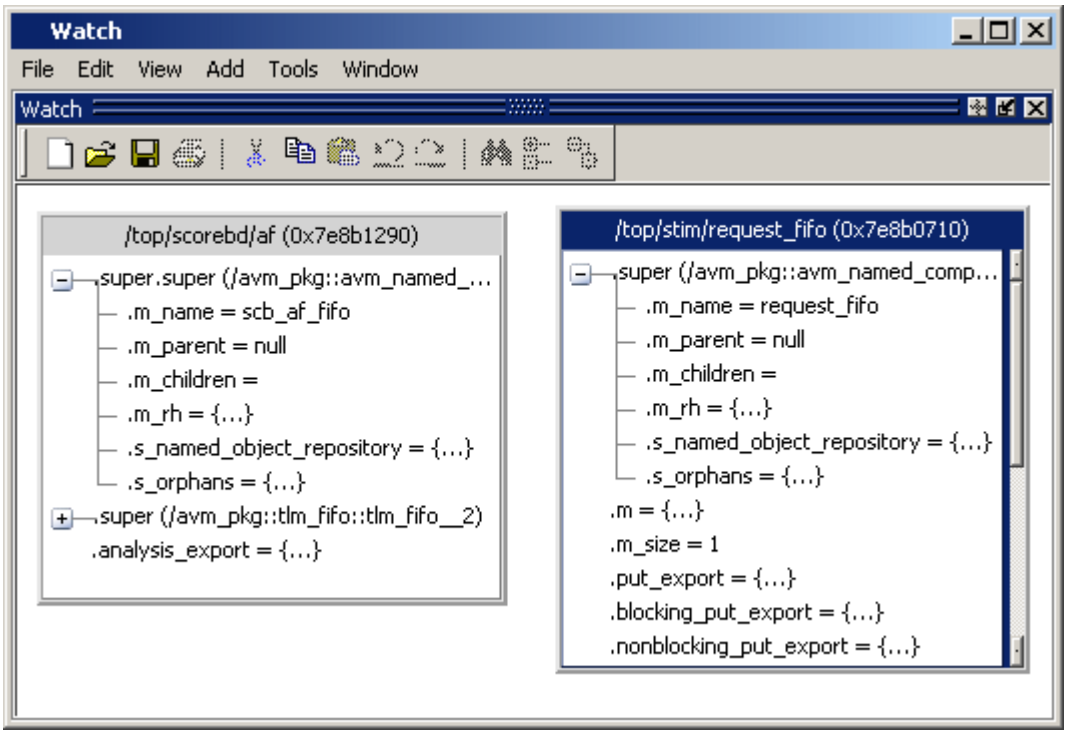
Header — shows the signal name, followed, parenthetically, by its address (if it has one).

Body — shows the current value of the signal. Values that are red have changed since the previous run command.

SystemVerilog Classes — Items are displayed in a scrollable, hierarchical list, such as in Figure 4-53 where extended SystemVerilog classes hierarchically display their super members.

Current Time Label — Displays the Current Time or the Now (end of simulation) time. This is the time used to control state values annotated in the window. (For details, refer to Current Time Label.)

Figure 4-53. Scrollable Hierarchical Display



Two Ref handles that refer to the same object will point to the same Watch window box, even if the name used to reach the object is different. This means circular references will be drawn as circular.

This Watch Window menu becomes available in the Main menu when the Watch window is active (see Table 4-74).

Fields

Table 4-35. Watch Window Popup Menu

Popup menu Item	Description
Add	Add the selected item or items to the desired window
Force	Opens the Force Selected Signal dialog box, which allows you to force the signal to given value. Refer to the force command for details about the options.
NoForce	Removes the force on the selected object. Refer to the noforce command.
Clock	Performs actions related to the force command with the -repeat argument.
Change	Performs actions related to the change command.
Follow Selection Context	Changes the current context in the Structure window.
Save Format Load Format	Saves a new (or loads an existing) .do file containing add watch commands to recreate the Watch window.
Group	Groups several selected signals into a single item.
UnGroup	Breaks a previously created group back into its individual signals
Properties	Opens the Properties dialog box, which allows you to alter the properties of the selected signal or group, including: • Header name • Radix type This option is not available when multiple signals are selected.
Delete Item	Removes the selected signal from the window. You can alternatively use the delete key.
Clear All	Removes all signals from the window.

Table 4-36. Watch Window Menu

Popup menu Item	Description
Force	Opens the Force Selected Signal dialog box, which allows you to force the signal to given value. Refer to the force command for details about the options.
NoForce	Removes the force on the selected object. Refer to the noforce command.
Clock	Performs actions related to the force command with the -repeat argument.
Change	Performs actions related to the change command.
Follow Selection Context	Changes the current context in the Structure window.
Save Format Load Format	Saves a new (or loads an existing) .do file containing add watch commands to recreate the Watch window.
Group	Groups several selected signals into a single item.
UnGroup	Breaks a previously created group back into its individual signals
Tile	Reorganizes the items in the Watch window into different tiled formats.
Delete Item	Removes the selected signal from the window. You can alternatively use the delete key.
Clear All	Removes all signals from the window.

Usage Notes

This section describes tasks for using the Watch window.

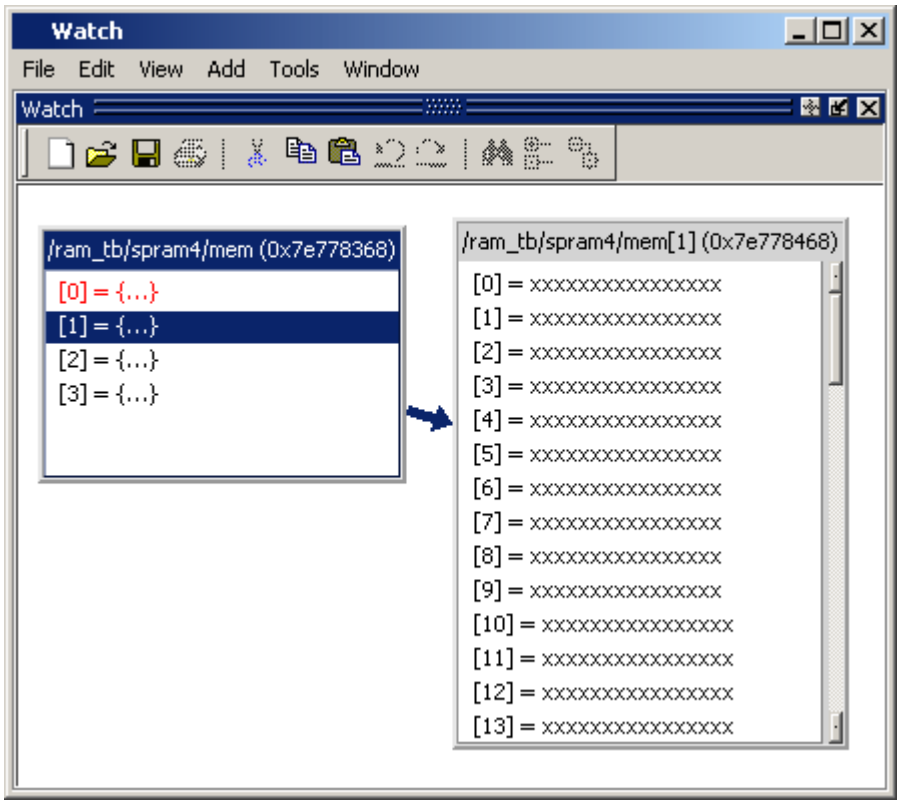
Adding Objects to the Watch Window

To add objects to the Watch window, drag -and-drop objects from the Structure window or from any of the following windows: List, Locals, Objects, Source, and Wave. You can also use the "Add Selected to Window Button". You can also use the add watch command.

Expanding Objects to Show Individual Bits

If you add an array or record to the window, you can view individual bit values by double-clicking the array or record. As shown in Figure 4-54, */ram_tb/spram4/mem* has been expanded to show all the individual bit values. Notice the arrow that "ties" the array to the individual bit display.

Figure 4-54. Expanded Array



Wave Window

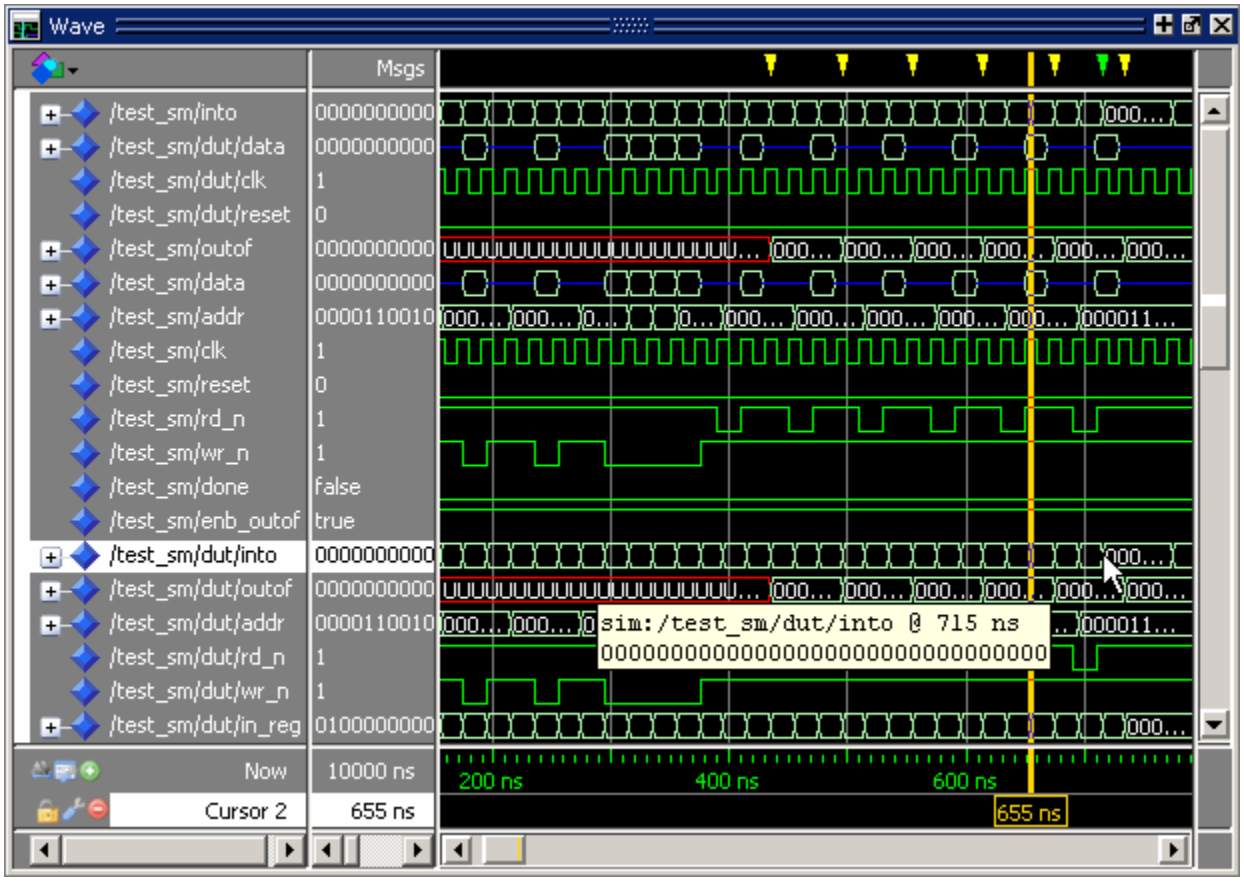
To access:

- Drag and drop.
- Click the middle mouse button when the cursor is over an object or group of objects in the Objects or Locals windows.
- Click-and-hold the **"Add Selected to Window Button"** to specify where selected signals are placed: above the Insertion Point Bar in the Pathnames Pane, appended after the Insertion Pointer in the Pathnames Pane, at the top or the end of the Pathnames Pane.
- add wave command

The Wave window, like the List window, allows you to view the results of your simulation. In the Wave window, however, you can see the results as waveforms and their values.

Description

Figure 4-55. Wave Window



When you drag and drop objects into the Wave window, the add wave command is reflected in the Transcript window.

Refer to Adding Objects to the Wave Window for more information about adding objects to the Wave window.

The Wave window is divided into a number of window panes. All window panes in the Wave window can be resized by clicking and dragging the bar between any two panes.

Pathname Pane

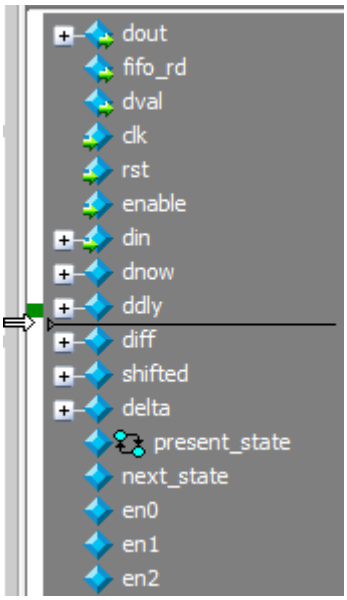
The pathname pane displays signal pathnames. Signals can be displayed with full pathnames, as shown here, or with any number of path elements. You can increase the size of the pane by clicking and dragging on the right border. The selected signal is highlighted.

The white bar along the left margin indicates the selected Wave window or pane of a split wave window (see Splitting Wave Window Panes).

Insertion Point Bar

You can select the location for inserting signals by placing the cursor over the left white bar in the Pathnames Pane. The white arrow and green bar indicate the selected location for the insertion pointer. Clicking the left mouse button sets the new insertion pointer.

Figure 4-56. Pathnames Pane



Values Pane

The values pane displays the values of the displayed signals. You can resize the values pane by clicking on and dragging the right border. Some signals may be too wide (too many bits) for their values to be fully displayed. Use the scroll bar at the bottom of the pane to see the entire signal value. Small signal values will remain in view while scrolling.

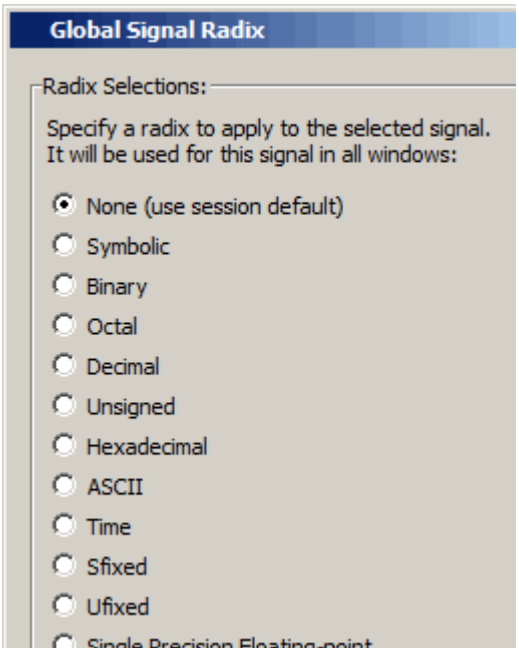
The radix for each signal can be symbolic, binary, octal, decimal, unsigned, hexadecimal, ASCII, or default. The default radix for all signals can be set by choosng **Simulate > Runtime Options**.

Note

When the symbolic radix is chosen for SystemVerilog reg and integer types, the values are treated as binary. When the symbolic radix is chosen for SystemVerilog bit and int types, the values are considered to be decimal.

To change the radix for just the selected signal or signals, choose **Wave > Format > Radix > Global Signal Radix** from the menus, or right-click the selected signal(s) and choose **Radix > Global Signal Radix** from the popup menu. This opens the Global Signal Radix dialog (Figure 4-57), where you may select a radix. This sets the radix for the selected signal(s) in the Wave window and every other window where the signal appears.

Figure 4-57. Setting the Global Signal Radix from the Wave Window



The data in this pane is similar to that shown in the Objects Window, except that the values change dynamically whenever a cursor in the waveform pane is moved.

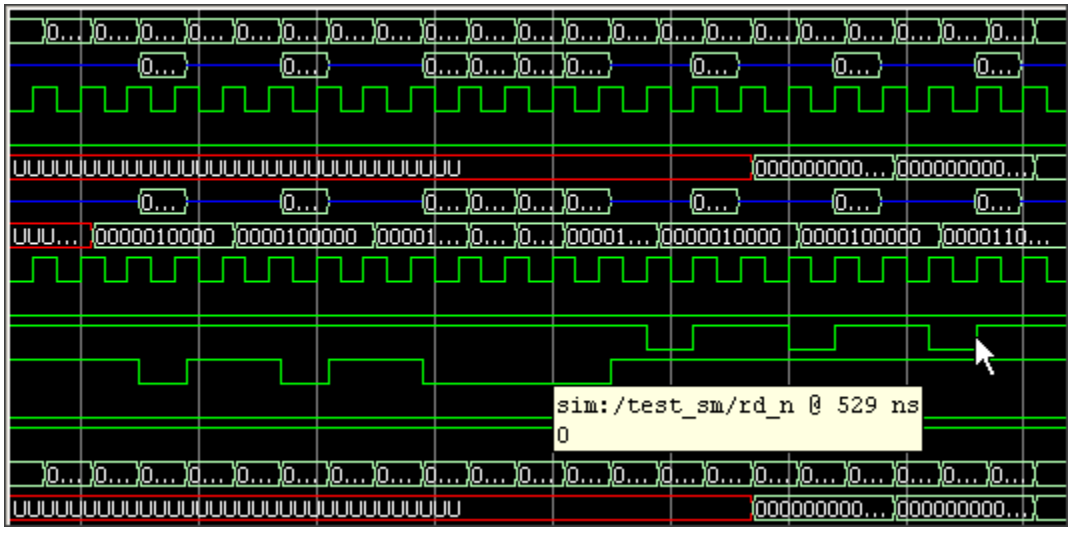
Figure 4-58. Values Pane

Waveform Pane

Figure 4-59 shows waveform pane, which displays waveforms that correspond to the displayed signal pathnames. It can also display as many as 20 user-defined cursors. Signal values can be displayed in analog step, analog interpolated, analog backstep, literal, logic, and event formats. You can set the format of each signal individually by right-clicking the signal in the pathname or values panes and choosing **Format** from the popup menu. The default format is Logic.

If you place your mouse pointer on a signal in the waveform pane, a popup menu displays with information about the signal. You can toggle this popup on and off in the **Wave Window Properties** dialog box.

Figure 4-59. Waveform Pane



Analog Sidebar Toolbox

When the waveform pane contains an analog waveform, you can hover your mouse pointer over the left edge of the waveform to display the Analog Sidebar toolbox (see Figure 4-60). This

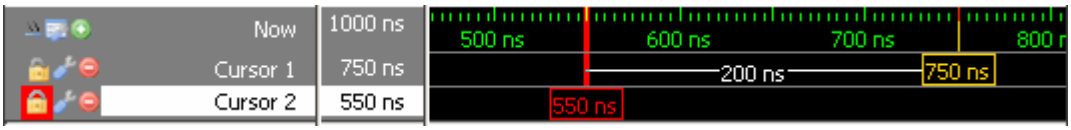
toolbox shows a group of icons that gives you quick access to actions you can perform on the waveform display, as described in Table 4-37.

Figure 4-60. Analog Sidebar Toolbox

Cursor Pane

Figure 4-61 shows the Cursor Pane, which displays cursor names, cursor values and the cursor locations on the timeline. You can link cursors so that they move across the timeline together. See Linking Cursors in the Waveform Analysis chapter.

Figure 4-61. Cursor Pane



On the left side of this pane is a group of icons called the Cursor and Timeline Toolbox (see Working with Cursors). This toolbox gives you quick access to cursor and timeline features and configurations. See Measuring Time with Cursors in the Wave Window for more information.

Messages Bar

The messages bar, located at the top of the Wave window, contains indicators pointing to the times at which a message was output from the simulator. By default, the indicators are not displayed. To turn on message indicators, use the **-msgmode** argument with the vsim command or use the msgmode variable in the *modelsim.ini* file.

Figure 4-62. Wave Window - Message Bar

The message indicators (the down-pointing arrows) are color-coded as follows:

Red — Indicates an error.

Yellow — Indicates a warning.

Green — Indicates a note.

Grey — Indicates any other type of message.

You can use the Message bar in the following ways.

- Move the cursor to the next message — You can do this in two ways:
  - Click on the word “Messages” in the message bar to cycle the cursor to the next message after the current cursor location.
  - Click anywhere in the message bar, then use Tab or Shift-Tab to cycle the cursor between error messages either forward or backward, respectively.
- Display the Message Viewer Window — Double-click anywhere amongst the message indicators.
- Display, in the Message Viewer window, the message entry related to a specific indicator — Double-click on any message indicator.

  This function only works if you are using the Message Viewer in flat mode. To display your messages in flat mode:

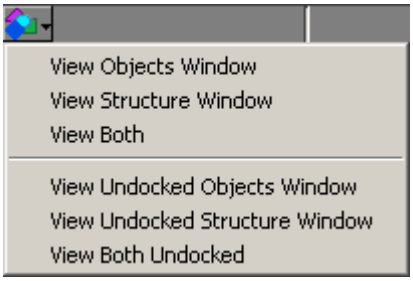
  a. Right-click in the Message Viewer and select **Display Options**

  b. In the Message Viewer Display Options dialog box, deselect **Display with Hierarchy**.

View Objects Window Button

This button opens the Objects window with a single click. However, if you click-and-hold the button you can access additional options via a dropdown menu, as shown in Figure 4-63

Figure 4-63. View Objects Window Dropdown Menu



Objects You Can View in the Wave Window

The following types of objects can be viewed in the Wave window

- VHDL objects (indicated by a dark blue diamond) — signals, aliases, process variables, and shared variables

- Verilog objects (indicated by a light blue diamond) — nets, registers, variables, and named events

  The GUI displays inout variables of a clocking block separately, where the output of the inout variable is appended with "__o", for example you would see following two objects:

  ```
  clock1.c1            /input portion of the inout c1
  clock1.c1__o         /output portion of the inout c1
  ```

  This display technique also applies to the Objects window

- Verilog transactions (indicated by a blue four point star) — see for more information
- Virtual objects (indicated by an orange diamond) — virtual signals, buses, and functions, see; Virtual Objects for more information

The data in the object values pane is very similar to the Objects window, except that the values change dynamically whenever a cursor in the waveform pane is moved.

At the bottom of the waveform pane you can see a time line, tick marks, and the time value of each cursor's position. As you click and drag to move a cursor, the time value at the cursor location is updated at the bottom of the cursor.

You can resize the window panes by clicking on the bar between them and dragging the bar to a new location.

Waveform and signal-name formatting are easily changed via the Format menu. You can reuse any formatting changes you make by saving a Wave window format file (see Saving the Window Format).

Wave Window Toolbars

The Wave window (in the undocked Wave window) gives you quick access to the following toolbars:

- Standard Toolbar
- Compile Toolbar
- Simulate Toolbar
- Step Toolbar
- Wave Cursor Toolbar
- Wave Edit Toolbar
- Wave Toolbar
- Zoom Toolbar
- Wave Expand Time Toolbar

Fields

Table 4-37. Analog Sidebar Icons

Icon	Action	Description
	Open Wave Properties	Opens the Format tab of the Wave Properties dialog box, with the Analog format already selected. This dialog box duplicates the Wave Analog dialog box displayed by choosing **Format > Format**... > Analog (custom) from the main menu.
	Toggle Row Height	Changes the height of the row that contains the analog waveform. Toggles the height between the Min and Max values (in pixels) you specified in the Open Wave Properties dialog box under Analog Display.
	Rescale to fit Y data	Changes the waveform height so that it fits top-to-bottom within the current height of the row.
	Show menu of other actions	Displays • View Min Y • View Max Y • Overlay Above • Overlay Below • Colorize All • Colorize Selected
	Drag to resize waveform height	Creates an up/down dragging arrow that you can use to temporarily change the height of the row containing the analog waveform.

Table 4-38. Window Icons

Icon shape	Example	Description
FSM button		opens the FSM Viewer window
Null		verilog/system verilog name event

Chapter 5
Keyboard Shortcuts and Mouse Actions

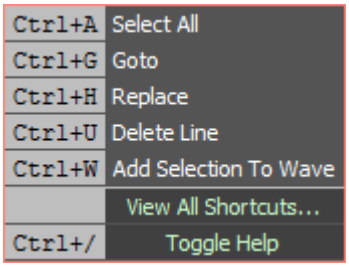
You can manipulate the user inteface with various keyboard and mouse actions.

Window-Specific Keyboard Shortcuts

You can open a dynamic list of common (predefined) and user-defined keyboard sortcuts for many ModelSim windows by entering "Ctrl+/" on your keyboard.

For example, Figure 5-1 shows the list of keyboard shortcuts provided for the Source window.

Figure 5-1. Keyboard Shortcuts for Source Window



You can find a complete list of all keyboard shortcuts—both predefined and user-defined—by clicking "View All Shortcuts" at the bottom of the list. Refer to User-Defined Keyboard Shortcuts for more information on how to create a customized shortcut.

ModelSim Windows That Have Keyboard Shortcuts

The following windows have keyboard shortcuts assigned:

- Dataflow Window
- Library Window
- Objects Window
- Source Window
- Structure Window
- Transcript Window
- Wave Window

User-Defined Keyboard Shortcuts

In addition to the predefined keyboard shortcuts, you can create your own shortcuts or modify predefined keyboard shortcuts with the Keyboard Shortcuts dialog box.

Shortcuts can be either window-specific (available only when the window is active) or global (available from anywhere in the tool). You can create a keyboard shortcut for any ModelSim window.

Once a shortcut is defined, it will be available in all subsequent invocations. The dynamic nature of the architecture makes the keyboard shortcuts available to any Mentor product that is based upon the ModelSim GUI, such as ADMS, 0-In, MVC, and Codelink.

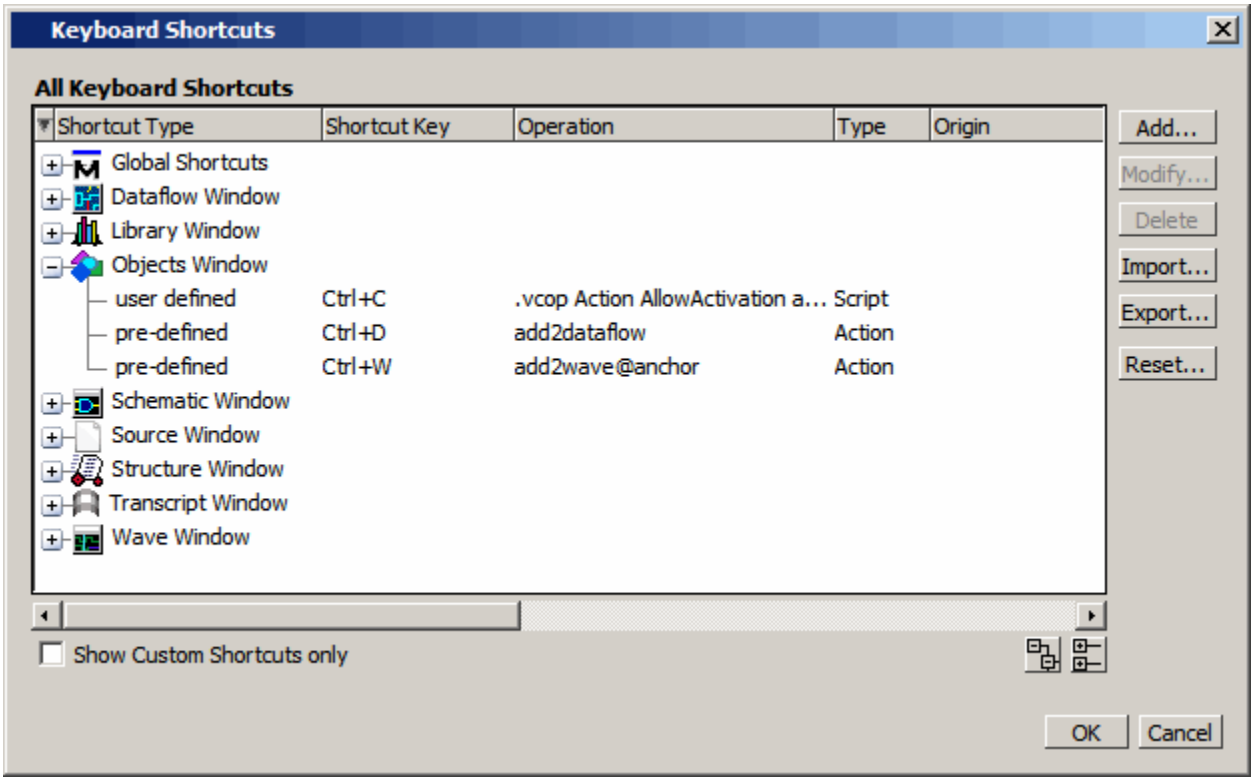
The Keyboard Shortcuts Dialog Box

The Keyboard Shortcuts dialog box lists all existing keyboard shortcuts. This dialog box distinguishes between shortcuts that are user-defined and shortcuts that come predefined with the ModelSim simulator.

Figure 5-2 shows an example of the Keyboard Shortcuts dialog box, which you can display by choosing the following from the main menu:

Windows > Keyboard Shortcuts...

Figure 5-2. Keyboard Shortcuts Dialog Box



The Keyboard Shortcuts dialog box allows you to:

- Add a new user defined keyboard shortcut. Refer to Creating A Keyboard Shortcut for more information.
- Modify an existing keyboard shortcut. Any shortcut can be modified including predefined shortcuts.
- Delete a shortcut.
- Import shortcuts from a previously saved *bindings.do* file. You can also reload the keyboard shortcuts file with the do command.
- Export all user defined keyboard shortcuts to *bindings.do* file. Keyboard shortcuts saved in the file can be reloaded either by selecting the **Import button** in the Keyboard Shorcuts Dialog Box or by entering **do bindings.do** on the command line.

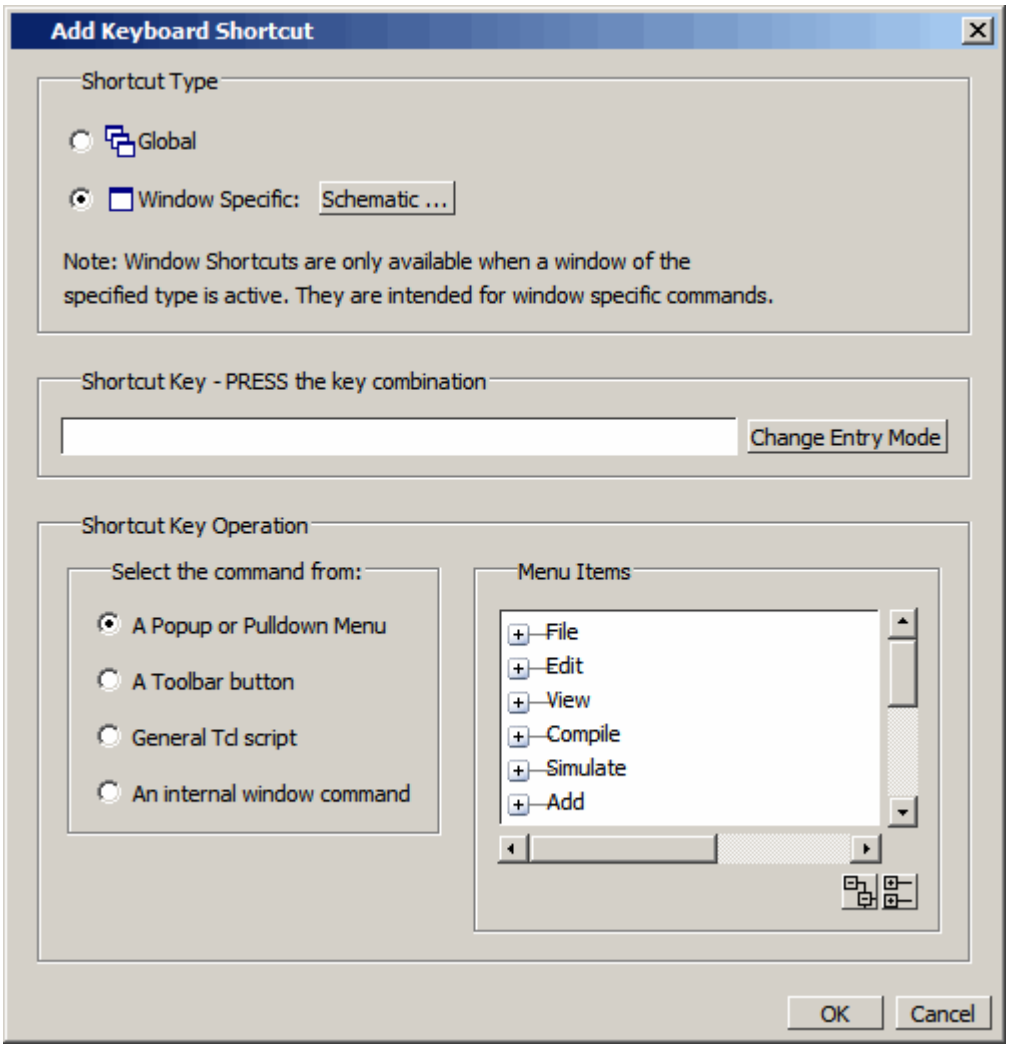
Creating A Keyboard Shortcut

You can create your own shortcut that is either global or that applies only to a specific window.

Procedure

1. If you are creating a window specific shortcut, the window must have been opened sometime during the simulation run.
2. Open the **Add Keyboard Shortcut** dialog box by selecting **Window > Keyboard Shortcuts**.
3. Click the **Add** button to open the Add Keyboard Shortcut dialog box.

Figure 5-3. Add Keyboard Shortcut Dialog Box



4. Select the Shortcut Type, either Global or Window. If you are creating a window specific shortcut, click the window button to open the **Select Window Type** dialog box. The dialog box displays every window that has been opened during the current simulation. If you do not see the window you are looking for, close both dialog boxes, open the window you want by entering **view** <window> on the command line, or by selecting the window from the **Vie**w menu. Choosing Global or a specific window changes the options available in the **Shortcut Key Operation** field and the dynamically populated field to the right.
5. Enter the key combination in the **Shortcut Key** field. Or select the **Change Entry Mode** button to enter a key combination.
6. Choose the type of operation the shortcut will execute.

- A Popup or Pulldown Menu — Opens the **Menu Items** dialog with a hierarchical list of all popup and pulldown menu items available either globally or for the window specified in step 4.
- A Toolbar button — Opens the Toolbar Buttons dialog with a hierarchical list of all toolbar button actions available either globally or for the window specified in step 4.
- General Tcl script — Selecting this option opens the Tcl Script field to the right. You can enter any Tcl script or command line sequence.
- An Internal window command — This choice is available only for window specific commands. Refer to step 4. Opens the Window Action dialog on the right with a list of all window specific commands.

Main and Source Window Mouse and Keyboard Shortcuts

The following mouse actions and special keystrokes can be used to edit commands in the entry region of the Main window.

They can also be used in editing the file displayed in the Source window and all **Notepad** windows (enter the **notepad** command within ModelSim to open the Notepad editor).

Table 5-1. Mouse Shortcuts

Mouse - UNIX and Windows	Result
Click the left mouse button	relocate the cursor
Click and drag the left mouse button	select an area
Shift-click the left mouse button	extend selection
Double-click the left mouse button	select a word
Double-click and drag the left mouse button	select a group of words
Ctrl-click the left mouse button	move insertion cursor without changing the selection
Click the left mouse button on a previous ModelSim or VSIM prompt	copy and paste previous command string to current prompt
Click the middle mouse button	paste selection to the clipboard
Click and drag the middle mouse button	scroll the window

Table 5-2. Keyboard Shortcuts

Keystrokes - UNIX and Windows	Result
Left Arrow Right Arrow	move cursor left or right one character
Ctrl + Left Arrow Ctrl + Right Arrow	move cursor left or right one word
Shift + Any Arrow	extend text selection
Ctrl + Shift + Left Arrow Ctrl + Shift + Right Arrow	extend text selection by one word
Up Arrow Down Arrow	Transcript window: scroll through command history Source window: move cursor one line up or down
Ctrl + Up Arrow Ctrl + Down Arrow	Transcript window: moves cursor to first or last line Source window: moves cursor up or down one paragraph
Alt + /	Open a pop-up command prompt for entering commands.
Ctrl + Home	move cursor to the beginning of the text
Ctrl + End	move cursor to the end of the text
Backspace Ctrl + h (UNIX only)	delete character to the left
Delete Ctrl + d (UNIX only)	delete character to the right
Esc (Windows only)	cancel
Alt	activate or inactivate menu bar mode
Alt-F4	close active window
Home Ctrl + a	move cursor to the beginning of the line
Ctrl + Shift + a	select all contents of active window
Ctrl + b	move cursor left
Ctrl + d	delete character to the right
End Ctrl + e	move cursor to the end of the line
Ctrl + f (UNIX) Right Arrow (Windows)	move cursor right one character
Ctrl + k	delete to the end of line

Table 5-2. Keyboard Shortcuts (cont.)

Keystrokes - UNIX and Windows	Result
Ctrl + n	move cursor one line down (Source window only under Windows)
Ctrl + o (UNIX only)	insert a new line character at the cursor
Ctrl + p	move cursor one line up (Source window only under Windows)
Ctrl + s (UNIX) Ctrl + f (Windows)	find
Ctrl + t	reverse the order of the two characters on either side of the cursor
Ctrl + u	delete line
Page Down Ctrl + v (UNIX only)	move cursor down one screen
Ctrl + x	cut the selection
Ctrl + s Ctrl + x (UNIX Only)	save
Ctrl + v	paste the selection
Ctrl + a (Windows Only)	select the entire contents of the widget
Ctrl + \	clear any selection in the widget
Ctrl + - (UNIX) Ctrl + / (UNIX) Ctrl + z (Windows)	undoes previous edits in the Source window
Meta + < (UNIX only)	move cursor to the beginning of the file
Meta + > (UNIX only)	move cursor to the end of the file
Page Up Meta + v (UNIX only)	move cursor up one screen
Ctrl + c	copy selection
F3	Performs a Find Next action in the Source window.
F4 Shift+F4	Change focus to next pane in main window Change focus to previous pane in main window
F5 Shift+F5	Toggle between expanding and restoring size of pane to fit the entire main window Toggle on/off the pane headers.
F8	search for the most recent command that matches the characters typed (Main window only)

Table 5-2. Keyboard Shortcuts (cont.)

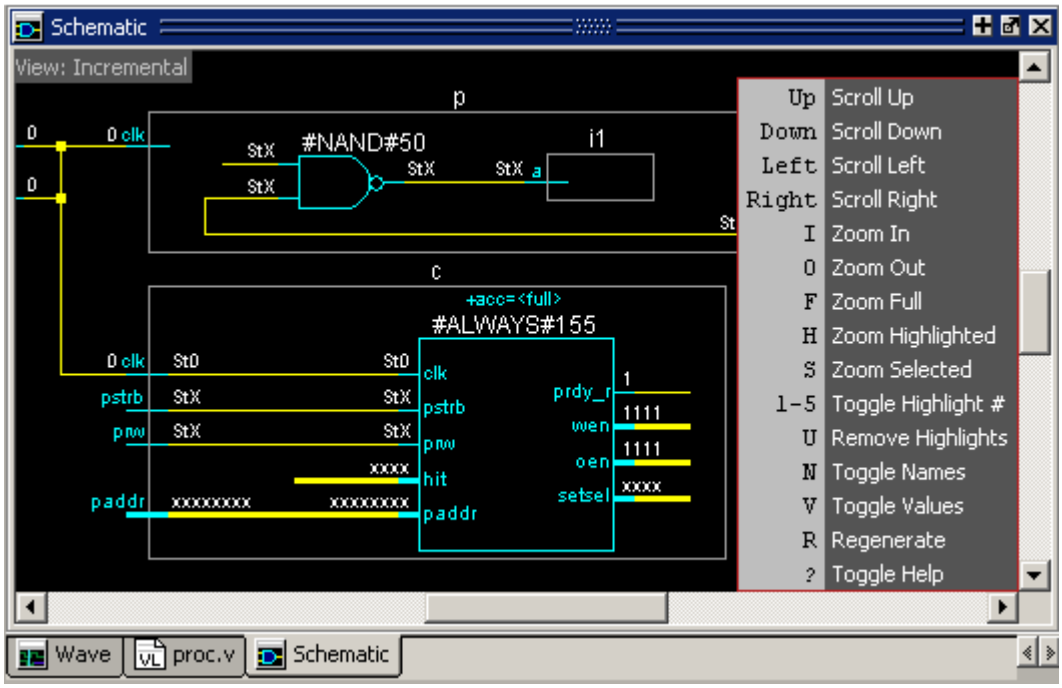
Keystrokes - UNIX and Windows	Result
F9	run simulation
F10	continue simulation
F11 (Windows only)	single-step
F12 (Windows only)	step-over

The Main window allows insertions or pastes only after the prompt; therefore, you don't need to set the cursor when copying strings to the command line.

List of Keyboard Shortcuts in GUI Windows

You can open a dynamic list of keyboard shortcuts, predetermined and user defined, for most windows by entering Ctrl-Shift-?

Figure 5-4. Schematic Window Keyboard Shortcuts



You can create user defined keyboard shortcuts and change predetermined shortcuts. Refer to User-Defined Keyboard Shortcuts for more information.

List Window Keyboard Shortcuts

Using the following keys when the mouse cursor is within the List window will cause the indicated actions:

Table 5-3. List Window Keyboard Shortcuts

Key - UNIX and Windows	Action
Left Arrow	scroll listing left (selects and highlights the item to the left of the currently selected item)
Right Arrow	scroll listing right (selects and highlights the item to the right of the currently selected item)
Up Arrow	scroll listing up
Down Arrow	scroll listing down
Page Up Ctrl + Up Arrow	scroll listing up by page
Page Down Ctrl + Down Arrow	scroll listing down by page
Tab	searches forward (down) to the next transition on the selected signal
Shift + Tab	searches backward (up) to the previous transition on the selected signal
Shift + Left Arrow Shift + Right Arrow	extends selection left/right
Ctrl + f (Windows) Ctrl + s (UNIX)	opens the Find dialog box to find the specified item label within the list display

Wave Window Mouse and Keyboard Shortcuts

The following mouse actions and keystrokes can be used in the Wave window.

Table 5-4. Wave Window Mouse Shortcuts

Mouse action[1]	Result
Ctrl + Click left mouse button and drag 	zoom area (in)
Ctrl + Click left mouse button and drag 	zoom out

Table 5-4. Wave Window Mouse Shortcuts (cont.)

Mouse action[1]	Result
Ctrl + Click left mouse button and drag 	zoom fit
Click left mouse button and drag	moves closest cursor
Ctrl + Click left mouse button on a scroll bar arrow	scrolls window to very top or bottom (vertical scroll) or far left or right (horizontal scroll)
Click middle mouse button in scroll bar (UNIX only)	scrolls window to position of click
Shift + scroll with middle mouse button	scrolls window

1. If you choose **Wave > Mouse Mode > Zoom Mode**, you do not need to press the Ctrl key.

Table 5-5. Wave Window Keyboard Shortcuts

Keystroke	Action
s	bring into view and center the currently active cursor
i Shift + i +	zoom in (mouse pointer must be over the cursor or waveform panes)
o Shift + o -	zoom out (mouse pointer must be over the cursor or waveform panes)
f Shift + f	zoom full (mouse pointer must be over the cursor or waveform panes)
l Shift + l	zoom last (mouse pointer must be over the cursor or waveform panes)
r Shift + r	zoom range (mouse pointer must be over the cursor or waveform panes)
m	zooms all open Wave windows to the zoom range of the active window.
Up Arrow Down Arrow	scrolls entire window up or down one line, when mouse pointer is over waveform pane scrolls highlight up or down one line, when mouse pointer is over pathname or values pane
Left Arrow	scroll pathname, values, or waveform pane left

Table 5-5. Wave Window Keyboard Shortcuts (cont.)

Keystroke	Action
Right Arrow	scroll pathname, values, or waveform pane right
Page Up	scroll waveform pane up by a page
Page Down	scroll waveform pane down by a page
Tab	search forward (right) to the next transition on the selected signal - finds the next edge
Shift + Tab	search backward (left) to the previous transition on the selected signal - finds the previous edge
Ctrl+G	automatically create a group for the selected signals by region with the name Group<n>. If you use this shortcut on signals for which there is already a "Group<n>" they will be placed in that region's group rather than creating a new one.
Ctrl + F (Windows) Ctrl + S (UNIX)	open the find dialog box; searches within the specified field in the pathname pane for text strings
Ctrl + Left Arrow Ctrl + Right Arrow	scroll pathname, values, or waveform pane left or right by a page

Chapter 6
GUI Customization

The ModelSim GUI is programmed using Tcl/Tk. The GUI is highly customizable—you can control a wide variety of display characteristics such as window size, position, color, the text of window prompts, and default output filenames.

Most user GUI preferences are stored as Tcl variables in the Registry on Windows platforms. The variable values save automatically when you exit ModelSim. Some of the variables are modified by actions you take with menus or windows (for example, resizing a window changes its geometry variable). Alternatively, you can edit the variables directly either from the prompt in the Transcript window or by using the **Tools > Edit Preferences** menu item.

Simulator GUI Layout Customization

GUI customization is saved in the form of layout modes.

Layout Modes

There are five predefined layout modes that the GUI will load dependent upon which part of the simulation flow you are currently in.

These modes include:

- **NoDesign** — This layout is the default view when you first open the GUI or quit out of an active simulation.
- **Simulate** — This layout appears after you have begun a simulation with vsim.

These layout modes are fully customizable and the GUI stores your manipulations in the registry (Windows) when you exit the simulation or change to another layout mode. The types of manipulations that are stored include: showing, hiding, moving, and resizing windows.

Layout Mode Loading Priority

The GUI stores your manipulations on a directory by directory basis and attempts to load a layout mode in the following order.

1. Directory — The GUI attempts to load any manipulations for the current layout mode based on your current working directory.

2. Last Used — If there is no layout related to your current working directory, the GUI attempts to load your last manipulations for that layout mode, regardless of your directory.
3. Default — If you have never manipulated a layout mode, or have deleted the *.modelsim* file or the registry, the GUI will load the default appearance of the layout mode.

Configure Window Layouts Dialog Box

The Configure Window Layouts dialog box allows you to alter the default behavior of the GUI layouts. You can display this dialog box by selecting the **Layout > Configure** menu item.

The elements of this dialog box include:

- **Specify a Layout to Use** — This pane allows you to map which layout is used for the four actions. Refer to the section Changing Layout Mode Behavior for additional information.
- **Save window layout automatically** — This option (on by default) instructs the GUI to save any manipulations to the layout mode upon exit or changing the layout mode.
- **Save Window Layout by Current Directory** — This option (on by default) instructs the tool to save the final state of the GUI layout on a directory by directory basis. This means that the next time you open the GUI from a given directory, the tool will load your previous GUI settings.
- **Window Restore Properties Button**— Opens the Window Restore Properties Dialog Box. Refer to Configuring Default Windows for Restored Layouts for more information.

Creating a Custom Layout Mode

You can create your own custom layout mode.

Procedure

1. Rearrange the GUI as you see fit.
2. Select **Layout > Save Layout As**.

   This displays the Save Current Window Layout dialog box.
3. In the Save Layout As field, type in a new name for the layout mode.
4. Click OK.

Result

The layout is saved to the *.modelsim* file or registry. You can then access this layout mode from the Layout menu or the Layout toolbar.

Changing Layout Mode Behavior

You can assign which predefined or custom layout appears in each mode.

Procedure

1. Create your custom layouts as described in Creating a Custom Layout Mode.
2. Select **Layout > Configure**.

   This displays the Configure Window Layouts Dialog Box.
3. Select which layout you want the GUI to load for each scenario. This behavior affects the Layout Mode Loading Priority.
4. Click OK.

Result

The layout assignment is saved to the *.modelsim* file or registry.

Resetting a Layout Mode to its Default

Revert a layout back to the default arrangement.

Procedure

1. Load the layout mode you want to reset via the Layout menu or the Layout toolbar.
2. Select **Layout > Reset**.

Deleting a Custom Layout Mode

You can delete one of your custom-made layout modes.

Procedure

1. Load a custom layout mode from the Layout menu or the Layout toolbar.
2. Select **Layout > Delete**.

   Displays the Delete Custom Layout dialog box.
3. Select the custom layout you wish to delete.
4. **Delete**.

Configuring Default Windows for Restored Layouts

The Window Restore Properties Dialog Box allows you to specify which windows will be restored when a layout is reloaded.

Procedure

1. Select **Layout > Configure** to open the **Configure Window Layouts** dialog box.
2. Click the **Window Restore Properties** button to open the **Window Restore Properties** dialog box
3. Select the windows you want to have opened when a new layout is loaded. Windows that are not selected will not load until specified with the view command or by selecting View > <window>.

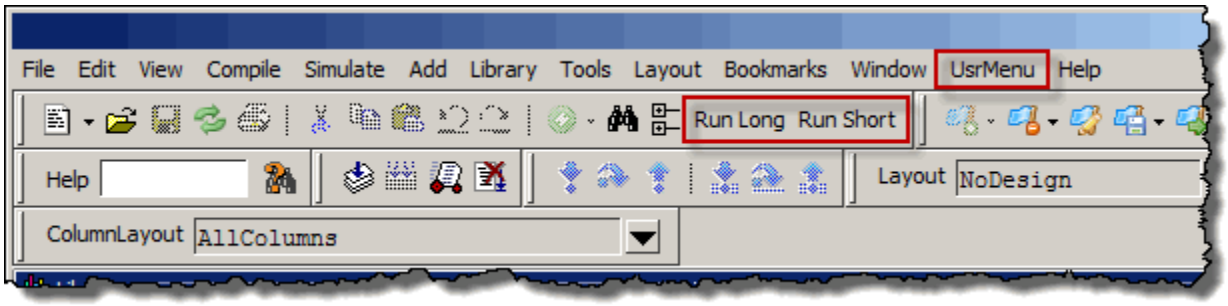
You can also work with window layouts by specifying **layout suppresstype <window>**, **layout restoretype**, or **layout showsuppresstypes**. Refer to the layout command for more information.

User-Defined Buttons and Menus

You can create Tcl processes (procs) that add user-defined buttons and menus to the main window of the ModelSim GUI.

The following Tcl example demonstrates two procs that create a menu and two buttons and the syntax for setting the procs with the **PrefMain(user_hook)** preference variable. Refer to (Figure 6-1).

Figure 6-1. User-Defined Buttons and Menus




```
proc AddMyMenus {wname} {
    global myglobalvar
    set cmd1 "echo my_own_thing $wname"
    set cmd2 "echo my_to_upper $wname"
    set cmd3 "echo my_to_lower $wname"
```

```
#               WinName    Menu                 MenuItem label     Command
#               -------    -------------------  -----------------  ----------------
add_menu        $wname     usrMenu
add_menuitem    $wname     usrMenu              "Do My Own Thing"  $cmd1
add_separator   $wname     usrMenu              ;#---------------  ----------------
add_submenu     $wname     usrMenu               changeCase
add_menuitem    $wname     usrMenu.changeCase   "To Upper"         $cmd2
add_menuitem    $wname     usrMenu.changeCase   "To Lower"         $cmd3
add_submenu     $wname     usrMenu               vars
add_menucb      $wname     usrMenu.vars         "Feature One"      -variable     \
                                                                   myglobalvar    \
                                                                   -onvalue 1     \
                                                                   -offvalue 0    \
                                                                   -indicatoron 1 \
}

proc my_buttons {args} {

   add button "Run Long" "run 2 us"

   add button "Run Short" "run 2 ns"

   }

lappend PrefMain(user_hook) AddMyMenus my_buttons
```

The code above is available in the following *modelsim.tcl* file:

<install_dir>/examples/gui/addmenu/modelsim.tcl

- Menu proc

  Adds a menu to the Main menu bar containing a top-level item labeled "Do My Own Thing...", which prints "my_own_thing.signals." It adds a cascading submenu labeled "changeCase" with two entries, "To Upper" and "To Lower", which echo "my_to_upper" and "my_to_lower" respectively. The menu selection **UserMenu** > **Vars** > **Feature One** sets a checkbox that controls the value of myglobalvar (.signals:one).

- Button proc

  Adds two buttons to the Standard tool bar. "Run Long," runs the simulation for 2 us, "Run Short," runs the simulation for 2 ns.

- The line:

  ```
  lappend PrefMain(user_hook) AddMyMenus my_buttons
  ```

  appends the two procs **AddMyMenus** and **my_buttons** to the **user_hook** variable when ModelSim is finished initializing. Multiple procs are specified as a space separated list.

User-Defined Radices

A user definable radix is used to map bit patterns to a set of enumeration labels.

After defining a new radix, the radix will be available for use in the List, Watch, and Wave windows or with the examine command.

There are four commands used to manage user defined radices:

- radix define
- radix names
- radix list
- radix delete

Using the radix define Command

You can create or modify a radix with the radix define command.

The radix define command is used to create or modify a radix. It must include a radix name and a definition body, which consists of a list of number pattern, label pairs.

Optionally, it may include the -color argument for setting the radix color (see Example 6-2).

```
{
    <numeric-value>  <enum-label>,
    <numeric-value> <enum-label>
    -default <radix>
}
```

A <numeric-value> is any legitimate HDL integer numeric literal. To be more specific:

```
<base>#<base-integer># --- <base> is 2, 8, 10, or 16
<base>"bit-value"      --- <base> is B, O, or X
<integer>
<size>'<base><number>  --- <size> is an integer, <base> is b, d, o, or h.
```

Check the Verilog and VHDL LRMs for exact definitions of these numeric literals.

The comma (,) in the definition body is optional. The <enum-label> is any arbitrary string. It should be quoted (""), especially if it contains spaces.

The -default entry is optional. If present, it defines the radix to use if a match is not found for a given value. The -default entry can appear anywhere in the list, it does not have to be at the end.

Example 6-1 shows the **radix define** command used to create a radix called “States,” which will display state values in the List, Watch, and Wave windows instead of numeric values.

Example 6-1. Using the radix define Command

```
radix define States {
    11'b00000000001 "IDLE",
    11'b00000000010 "CTRL",
    11'b00000000100 "WT_WD_1",
    11'b00000001000 "WT_WD_2",
    11'b00000010000 "WT_BLK_1",
    11'b00000100000 "WT_BLK_2",
```

```
    11'b00001000000 "WT_BLK_3",
    11'b00010000000 "WT_BLK_4",
    11'b00100000000 "WT_BLK_5",
    11'b01000000000 "RD_WD_1",
    11'b10000000000 "RD_WD_2",
    -default hex
}
```

Figure 6-2 shows an FSM signal called */test-sm/sm_seq0/sm_0/state* in the Wave window with a binary radix and with the user-defined "States" radix (as defined in Example 6-1).

Figure 6-2. User-Defined Radix "States" in the Wave Window

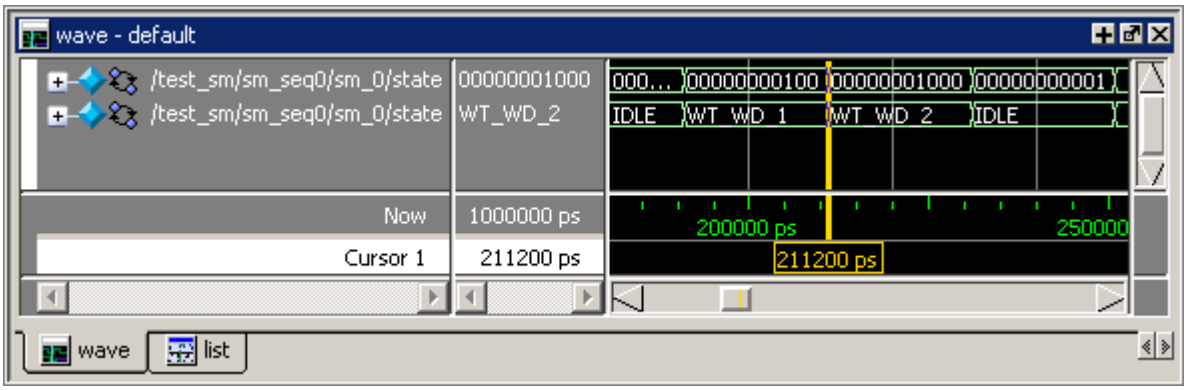
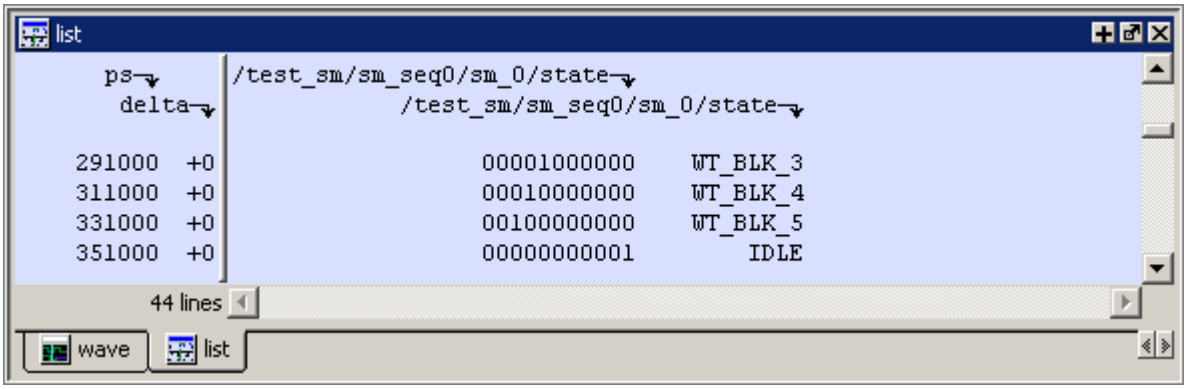


Figure 6-3 shows an FSM signal called */test-sm/sm_seq0/sm_0/state* in the List window with a binary radix and with the user-defined "States" radix (as defined in Example 6-1)

Figure 6-3. User-Defined Radix "States" in the List Window



Using radix define to Specify Radix Color

The following example illustrates how to use the radix define command to specify the radix color:

Example 6-2. Using radix define to Specify Color

```
radix define States {
   11'b00000000001 "IDLE" -color yellow,
```

```
        11'b00000000010 "CTRL" -color #ffee00,
        11'b00000000100 "WT_WD_1" -color orange,
        11'b00000001000 "WT_WD_2" -color orange,
        11'b00000010000 "WT_BLK_1",
        11'b00000100000 "WT_BLK_2",
        11'b00001000000 "WT_BLK_3",
        11'b00010000000 "WT_BLK_4",
        11'b00100000000 "WT_BLK_5",
        11'b01000000000 "RD_WD_1" -color green,
        11'b10000000000 "RD_WD_2" -color green,
        -default hex
        -defaultcolor white
    }
```

If a pattern/label pair does not specify a color, the normal wave window colors will be used. If the value of the waveform does not match any pattern, then -default <radix_type> and -defaultcolor will be used.

To specify a range of values, wildcards may be specified for bits or characters of the value. The wildcard character is '?', similar to the iteration character in a Verilog UDP, for example:

```
radix define {
   6'b01??00 "Write" -color orange,
   6'b10??00 "Read" -color green
}
```

In this example, the first pattern will match "010000", "010100", "011000", and "011100". In case of overlaps, the first matching pattern is used, going from top to bottom.

Setting Global Signal Radix

The Global Signal Radix feature allows you to set the radix for a selected signal or signals in the active window and in other windows where the signal appears.

Procedure

The Global Signal Radix can be set from the Locals, Objects, Schematic, or Wave windows as follows:

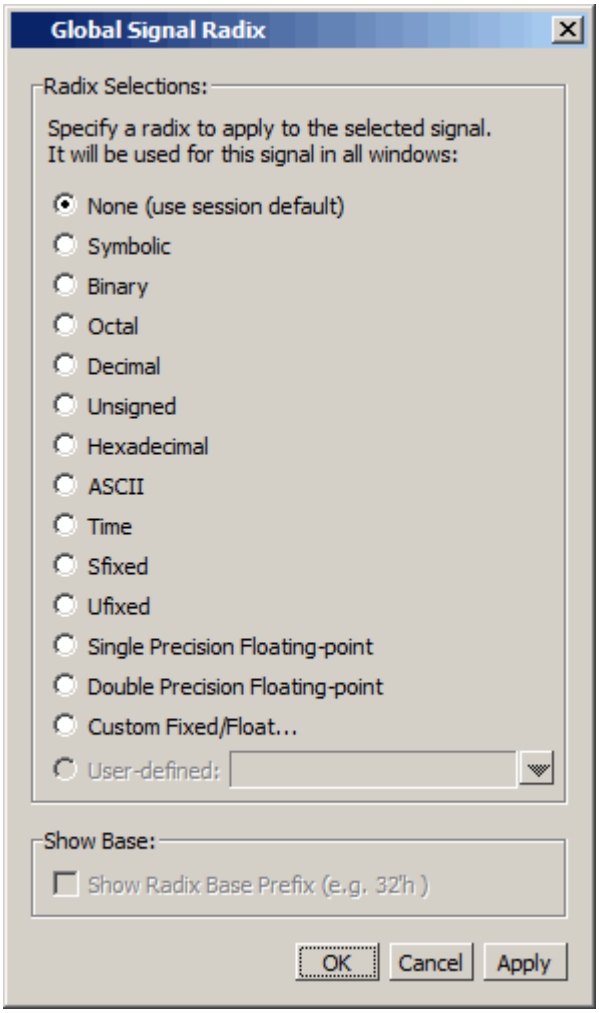
1. Select a signal or group of signals.
2. Right-click the selected signal(s) and click the following popup menu option:
   - Objects Window: **Radix**
   - Locals Window: **Global Signal Radix**
   - Wave Window: **Radix > Global Signal Radix**
   - Schematic Window: **Edit > Global Signal Radix**

This opens the Global Signal Radix dialog box (Figure 6-4), where you may select a radix. This sets the radix for the selected signal(s) in the active window and every other window where the signal appears.

Note

When you select two or more signals in step 1 of this procedure the **Fixed/Float** option in the Global Signal Radix dialog box is not available.

Figure 6-4. Setting the Global Signal Radix



Sfixed and Ufixed indicate “signed fixed” and “unsigned fixed,” respectively. To display an object as Sfixed or Ufixed the object must be an array of std_ulogic elements between 2 and 64 bits long with a descending range. The binary point for the value is implicitly located between the 0th and -1st elements of the array. The index range for the type need not include 0 or -1, for example (-4 downto -8) in which case the value will be extended for conversion, as appropriate. If the type does not meet these criteria the value will be displayed as decimal or unsigned, respectively.

Setting a Fixed Point Radix

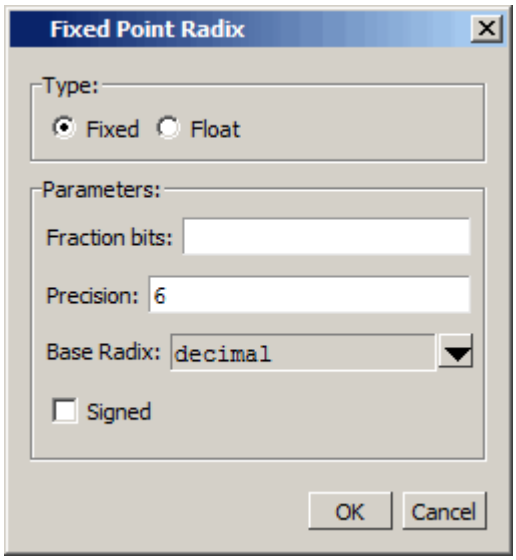
Fixed point types are used in VHDL to represents non-integer numbers without using a floating point format. ModelSim automatically recognizes VHDL sfixed and ufixeda types and displays them correctly with a fixed point format.

In addition, a general purpose fixed point radix feature is available for displaying any vector, regardless of type, in a fixed point format in the Wave window. You simply have to specify how many bits to use as fraction bits from the whole vector.

With the Wave window active:

1. Select (LMB) a signal or signals in the Pathnames pane of the Wave window.
2. Right-click the selected signal(s) and select **Radix > Global Signal Radix** from the popup menu. This opens the Global Signal Radix dialog box shown in Figure 6-4.
3. Click the **Custom Fixed/Float** selection to open the Fixed Point Radix dialog box (Figure 6-5).

Figure 6-5. Fixed Point Radix Dialog Box



The Fixed Point Radix dialog box allows you to select either a fixed or floating point radix type, and to set the Fraction bits, Precision, and Base Radix parameters. The default Base Radix is decimal. You can also check the Signed box if you want the radix to be signed.

Chapter 7
GUI Preferences

You can control various aspects of the Graphical User Interface through the use of user-controlled preferences.

Setting GUI Preferences

You can set user-controlled preferences in the ModelSim GUI with the Preferences dialog box.

Procedure

1. Invoke the ModelSim GUI.
2. Select the **Tools > Edit Preferences** menu item to display the Preferences Dialog Box.
3. Alter the various preference options to customize your GUI.

   By Window tab:

   a. Make selections, from left to right, to change GUI element colors or global fonts.

   By Name tab:

   a. Hierarchically expand the specific category in the Preference Item column.

   b. Select the specific Preference Item you want to change.

   c. Click **Change Value** to display a dialog box specific to the item.

   d. Set the preference to your desired value.

   e. Click **OK**.

Results

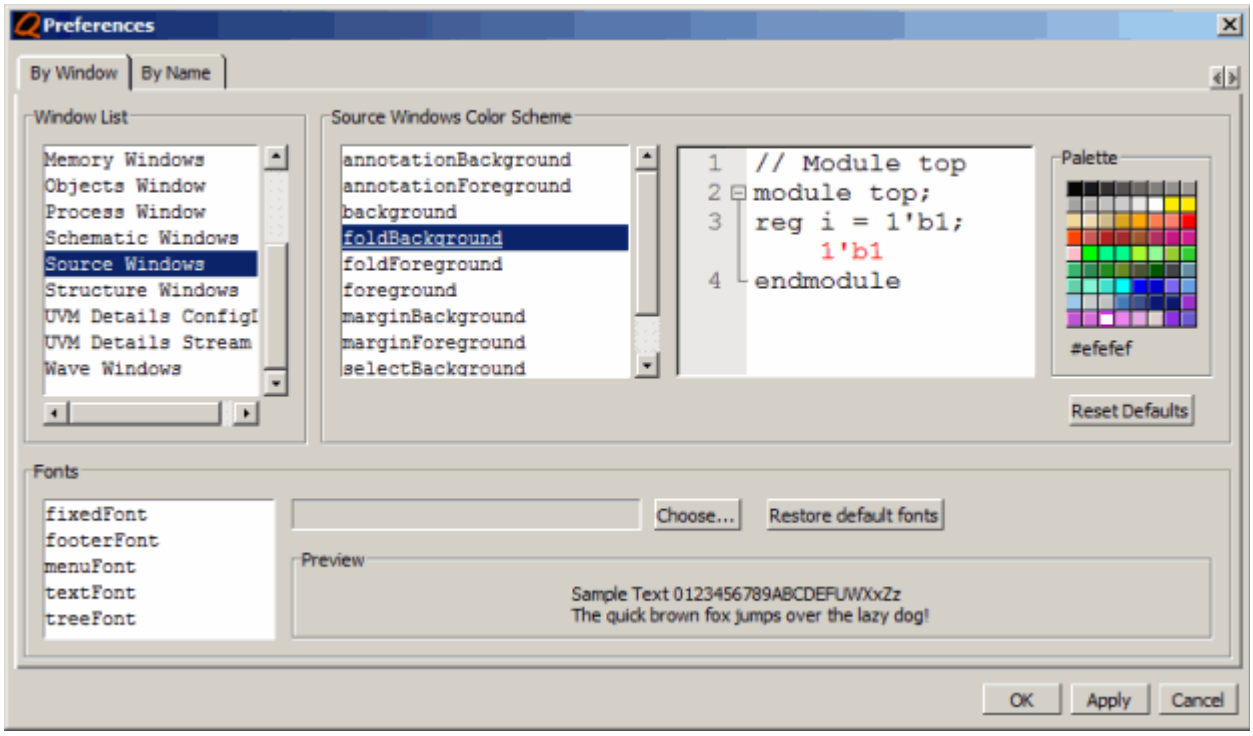
The preferences are applied immediately and saved automatically upon exit, either in the registry of your Windows machine.

Preferences Dialog Box

Tools > Edit Preferences

Dialog box for controlling user-defined preferences of the ModelSim GUI.

Figure 7-1. Preferences Dialog Box



Fields

- By Window tab — Allows you to control the color of various parts of many GUI windows, as well as the global appearance of fonts.
  - Fonts — The specific font types are defined as:
    - fixedFont — Text in Source window and in all text entry fields or boxes.
    - footerFont — Footer text that appears in footer of Main window and all undocked windows.
    - menuFont — Menu text.
    - textFont — Transcript window text and text in list boxes.
    - treeFont — Text that appears in any window that displays a hierarchical tree.
- By Name tab — Allows you to control many aspects of the different windows and features of the GUI.

Usage Notes

- In the By Window tab, the Palette box shows the default color below the color chooser.
- In the By Name tab, the Description column

Wave Window Variables

The LogicStyleTable combined with the ListTranslateTable define how single bit waveforms are displayed in the Wave window. The single value is first mapped into one of nine (9) possible states: U, 0, 1, X, Z, W, H, L, or '-' (Don't Care). Then the entry for the corresponding value in the LogicStyleTable is used to determine what is drawn in the Wave window. The line style is either Solid or DoubleDash. The line is drawn in the color specified. Lastly, the line is drawn at the top of the row (2), the middle of the row (1), or the bottom of the row (0).

The mapping of bit values to the 9 states is specified in the ListTranslateTable. The table is searched to find a matching value. When a match is found, the corresponding table entry defines the 9 state value used to define the style.

Table 7-1. Default ListTranslateTable Values

Mapped State	Bit Value
LOGIC_U	'U'
LOGIC_X	'X' 'x'
LOGIC_0	'0' FALSE
LOGIC_1	'1' TRUE
LOGIC_Z	'Z' 'z'
LOGIC_W	'W'
LOGIC_L	'L'
LOGIC_H	'H'
LOGIC_DC	'-'

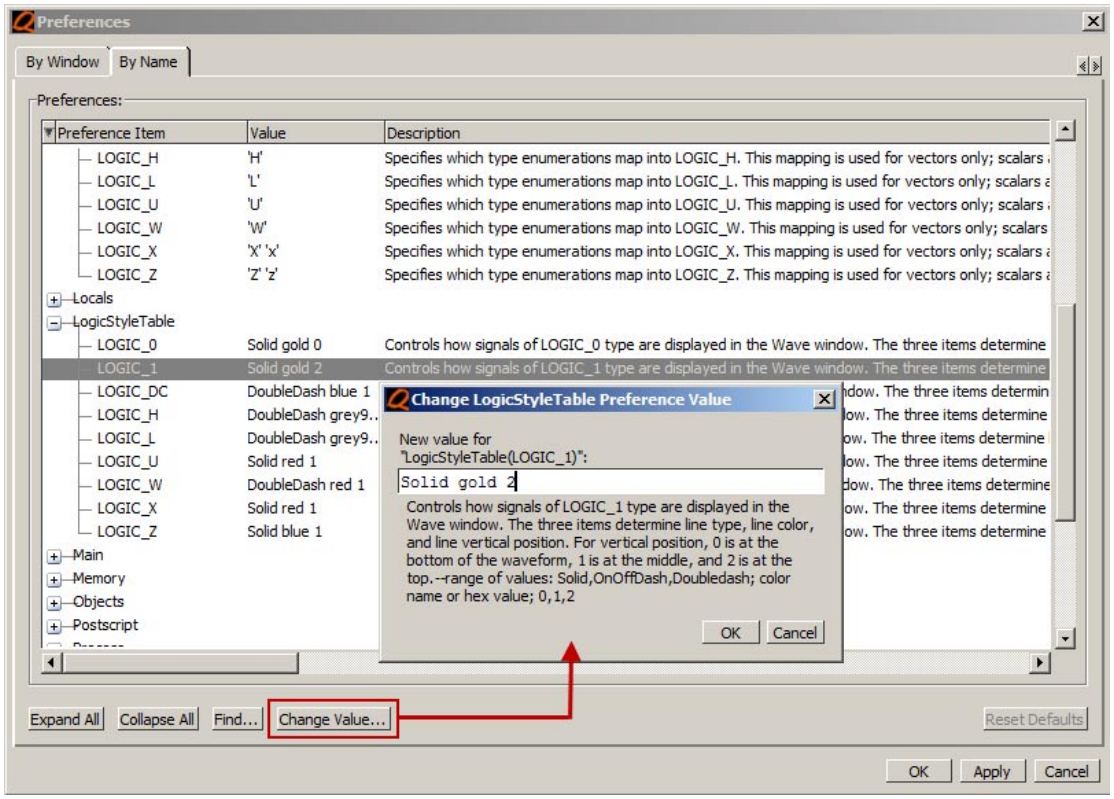
Table 7-2. Default LogicStyleTable Values

Mapped State	Line Style	Color	Row Position
LOGIC_U	Solid	red	1
LOGIC_X	Solid	red	1
LOGIC_0	Solid	green	0
LOGIC_1	Solid	green	2
LOGIC_Z	Solid	blue	1
LOGIC_W	DoubleDash	red	1
LOGIC_L	DoubleDash	grey90	0
LOGIC_H	DoubleDash	grey90	2

Table 7-2. Default LogicStyleTable Values (cont.)

Mapped State	Line Style	Color	Row Position
LOGIC_DC	DoubleDash	blue	1

Figure 7-2. Modifying Signal Display Attributes in the Wave Window



Index

End-User License Agreement

The latest version of the End-User License Agreement is available on-line at:
www.mentor.com/eula

IMPORTANT INFORMATION

USE OF ALL SOFTWARE IS SUBJECT TO LICENSE RESTRICTIONS. CAREFULLY READ THIS LICENSE AGREEMENT BEFORE USING THE PRODUCTS. USE OF SOFTWARE INDICATES CUSTOMER'S COMPLETE AND UNCONDITIONAL ACCEPTANCE OF THE TERMS AND CONDITIONS SET FORTH IN THIS AGREEMENT. ANY ADDITIONAL OR DIFFERENT PURCHASE ORDER TERMS AND CONDITIONS SHALL NOT APPLY.

END-USER LICENSE AGREEMENT ("Agreement")

This is a legal agreement concerning the use of Software (as defined in Section 2) and hardware (collectively "Products") between the company acquiring the Products ("Customer"), and the Mentor Graphics entity that issued the corresponding quotation or, if no quotation was issued, the applicable local Mentor Graphics entity ("Mentor Graphics"). Except for license agreements related to the subject matter of this license agreement which are physically signed by Customer and an authorized representative of Mentor Graphics, this Agreement and the applicable quotation contain the parties' entire understanding relating to the subject matter and supersede all prior or contemporaneous agreements. If Customer does not agree to these terms and conditions, promptly return or, in the case of Software received electronically, certify destruction of Software and all accompanying items within five days after receipt of Software and receive a full refund of any license fee paid.

1. **ORDERS, FEES AND PAYMENT.**

   1.1. To the extent Customer (or if agreed by Mentor Graphics, Customer's appointed third party buying agent) places and Mentor Graphics accepts purchase orders pursuant to this Agreement (each an "Order"), each Order will constitute a contract between Customer and Mentor Graphics, which shall be governed solely and exclusively by the terms and conditions of this Agreement, any applicable addenda and the applicable quotation, whether or not those documents are referenced on the Order. Any additional or conflicting terms and conditions appearing on an Order or presented in any electronic portal or automated order management system, whether or not required to be electronically accepted, will not be effective unless agreed in writing and physically signed by an authorized representative of Customer and Mentor Graphics.

   1.2. Amounts invoiced will be paid, in the currency specified on the applicable invoice, within 30 days from the date of such invoice. Any past due invoices will be subject to the imposition of interest charges in the amount of one and one-half percent per month or the applicable legal rate currently in effect, whichever is lower. Prices do not include freight, insurance, customs duties, taxes or other similar charges, which Mentor Graphics will state separately in the applicable invoice. Unless timely provided with a valid certificate of exemption or other evidence that items are not taxable, Mentor Graphics will invoice Customer for all applicable taxes including, but not limited to, VAT, GST, sales tax, consumption tax and service tax. Customer will make all payments free and clear of, and without reduction for, any withholding or other taxes; any such taxes imposed on payments by Customer hereunder will be Customer's sole responsibility. If Customer appoints a third party to place purchase orders and/or make payments on Customer's behalf, Customer shall be liable for payment under Orders placed by such third party in the event of default.

   1.3. All Products are delivered FCA factory (Incoterms 2010), freight prepaid and invoiced to Customer, except Software delivered electronically, which shall be deemed delivered when made available to Customer for download. Mentor Graphics retains a security interest in all Products delivered under this Agreement, to secure payment of the purchase price of such Products, and Customer agrees to sign any documents that Mentor Graphics determines to be necessary or convenient for use in filing or perfecting such security interest. Mentor Graphics' delivery of Software by electronic means is subject to Customer's provision of both a primary and an alternate e-mail address.

2. **GRANT OF LICENSE.** The software installed, downloaded, or otherwise acquired by Customer under this Agreement, including any updates, modifications, revisions, copies, documentation and design data ("Software") are copyrighted, trade secret and confidential information of Mentor Graphics or its licensors, who maintain exclusive title to all Software and retain all rights not expressly granted by this Agreement. Mentor Graphics grants to Customer, subject to payment of applicable license fees, a nontransferable, nonexclusive license to use Software solely: (a) in machine-readable, object-code form (except as provided in Subsection 5.2); (b) for Customer's internal business purposes; (c) for the term of the license; and (d) on the computer hardware and at the site authorized by Mentor Graphics. A site is restricted to a one-half mile (800 meter) radius. Customer may have Software temporarily used by an employee for telecommuting purposes from locations other than a Customer office, such as the employee's residence, an airport or hotel, provided that such employee's primary place of employment is the site where the Software is authorized for use. Mentor Graphics' standard policies and programs, which vary depending on Software, license fees paid or services purchased, apply to the following: (a) relocation of Software; (b) use of Software, which may be limited, for example, to execution of a single session by a single user on the authorized hardware or for a restricted period of time (such limitations may be technically implemented through the use of authorization codes or similar devices); and (c) support services provided, including eligibility to receive telephone support, updates, modifications, and revisions. For the avoidance of doubt, if Customer provides any feedback or requests any change or enhancement to Products, whether in the course of receiving support or consulting services, evaluating Products, performing beta testing or otherwise, any inventions, product improvements, modifications or developments made by Mentor Graphics (at Mentor Graphics' sole discretion) will be the exclusive property of Mentor Graphics.

3. **ESC SOFTWARE.** If Customer purchases a license to use development or prototyping tools of Mentor Graphics' Embedded Software Channel ("ESC"), Mentor Graphics grants to Customer a nontransferable, nonexclusive license to reproduce and distribute executable

files created using ESC compilers, including the ESC run-time libraries distributed with ESC C and C++ compiler Software that are linked into a composite program as an integral part of Customer's compiled computer program, provided that Customer distributes these files only in conjunction with Customer's compiled computer program. Mentor Graphics does NOT grant Customer any right to duplicate, incorporate or embed copies of Mentor Graphics' real-time operating systems or other embedded software products into Customer's products or applications without first signing or otherwise agreeing to a separate agreement with Mentor Graphics for such purpose.

4. **BETA CODE.**

4.1. Portions or all of certain Software may contain code for experimental testing and evaluation (which may be either alpha or beta, collectively "Beta Code"), which may not be used without Mentor Graphics' explicit authorization. Upon Mentor Graphics' authorization, Mentor Graphics grants to Customer a temporary, nontransferable, nonexclusive license for experimental use to test and evaluate the Beta Code without charge for a limited period of time specified by Mentor Graphics. Mentor Graphics may choose, at its sole discretion, not to release Beta Code commercially in any form.

4.2. If Mentor Graphics authorizes Customer to use the Beta Code, Customer agrees to evaluate and test the Beta Code under normal conditions as directed by Mentor Graphics. Customer will contact Mentor Graphics periodically during Customer's use of the Beta Code to discuss any malfunctions or suggested improvements. Upon completion of Customer's evaluation and testing, Customer will send to Mentor Graphics a written evaluation of the Beta Code, including its strengths, weaknesses and recommended improvements.

4.3. Customer agrees to maintain Beta Code in confidence and shall restrict access to the Beta Code, including the methods and concepts utilized therein, solely to those employees and Customer location(s) authorized by Mentor Graphics to perform beta testing. Customer agrees that any written evaluations and all inventions, product improvements, modifications or developments that Mentor Graphics conceived or made during or subsequent to this Agreement, including those based partly or wholly on Customer's feedback, will be the exclusive property of Mentor Graphics. Mentor Graphics will have exclusive rights, title and interest in all such property. The provisions of this Subsection 4.3 shall survive termination of this Agreement.

5. **RESTRICTIONS ON USE.**

5.1. Customer may copy Software only as reasonably necessary to support the authorized use. Each copy must include all notices and legends embedded in Software and affixed to its medium and container as received from Mentor Graphics. All copies shall remain the property of Mentor Graphics or its licensors. Customer shall maintain a record of the number and primary location of all copies of Software, including copies merged with other software, and shall make those records available to Mentor Graphics upon request. Customer shall not make Products available in any form to any person other than Customer's employees and on-site contractors, excluding Mentor Graphics competitors, whose job performance requires access and who are under obligations of confidentiality. Customer shall take appropriate action to protect the confidentiality of Products and ensure that any person permitted access does not disclose or use Products except as permitted by this Agreement. Customer shall give Mentor Graphics written notice of any unauthorized disclosure or use of the Products as soon as Customer becomes aware of such unauthorized disclosure or use. Except as otherwise permitted for purposes of interoperability as specified by applicable and mandatory local law, Customer shall not reverse-assemble, reverse-compile, reverse-engineer or in any way derive any source code from Software. Log files, data files, rule files and script files generated by or for the Software (collectively "Files"), including without limitation files containing Standard Verification Rule Format ("SVRF") and Tcl Verification Format ("TVF") which are Mentor Graphics' trade secret and proprietary syntaxes for expressing process rules, constitute or include confidential information of Mentor Graphics. Customer may share Files with third parties, excluding Mentor Graphics competitors, provided that the confidentiality of such Files is protected by written agreement at least as well as Customer protects other information of a similar nature or importance, but in any case with at least reasonable care. Customer may use Files containing SVRF or TVF only with Mentor Graphics products. Under no circumstances shall Customer use Products or Files or allow their use for the purpose of developing, enhancing or marketing any product that is in any way competitive with Products, or disclose to any third party the results of, or information pertaining to, any benchmark.

5.2. If any Software or portions thereof are provided in source code form, Customer will use the source code only to correct software errors and enhance or modify the Software for the authorized use. Customer shall not disclose or permit disclosure of source code, in whole or in part, including any of its methods or concepts, to anyone except Customer's employees or on-site contractors, excluding Mentor Graphics competitors, with a need to know. Customer shall not copy or compile source code in any manner except to support this authorized use.

5.3. Customer may not assign this Agreement or the rights and duties under it, or relocate, sublicense, or otherwise transfer the Products, whether by operation of law or otherwise ("Attempted Transfer"), without Mentor Graphics' prior written consent and payment of Mentor Graphics' then-current applicable relocation and/or transfer fees. Any Attempted Transfer without Mentor Graphics' prior written consent shall be a material breach of this Agreement and may, at Mentor Graphics' option, result in the immediate termination of the Agreement and/or the licenses granted under this Agreement. The terms of this Agreement, including without limitation the licensing and assignment provisions, shall be binding upon Customer's permitted successors in interest and assigns.

5.4. The provisions of this Section 5 shall survive the termination of this Agreement.

6. **SUPPORT SERVICES.** To the extent Customer purchases support services, Mentor Graphics will provide Customer with updates and technical support for the Products, at the Customer site(s) for which support is purchased, in accordance with Mentor Graphics' then current End-User Support Terms located at http://supportnet.mentor.com/supportterms.

7. **LIMITED WARRANTY.**

7.1. Mentor Graphics warrants that during the warranty period its standard, generally supported Products, when properly installed, will substantially conform to the functional specifications set forth in the applicable user manual. Mentor Graphics does not warrant that Products will meet Customer's requirements or that operation of Products will be uninterrupted or error free. The

warranty period is 90 days starting on the 15th day after delivery or upon installation, whichever first occurs. Customer must notify Mentor Graphics in writing of any nonconformity within the warranty period. For the avoidance of doubt, this warranty applies only to the initial shipment of Software under an Order and does not renew or reset, for example, with the delivery of (a) Software updates or (b) authorization codes or alternate Software under a transaction involving Software re-mix. This warranty shall not be valid if Products have been subject to misuse, unauthorized modification, improper installation or Customer is not in compliance with this Agreement. MENTOR GRAPHICS' ENTIRE LIABILITY AND CUSTOMER'S EXCLUSIVE REMEDY SHALL BE, AT MENTOR GRAPHICS' OPTION, EITHER (A) REFUND OF THE PRICE PAID UPON RETURN OF THE PRODUCTS TO MENTOR GRAPHICS OR (B) MODIFICATION OR REPLACEMENT OF THE PRODUCTS THAT DO NOT MEET THIS LIMITED WARRANTY. MENTOR GRAPHICS MAKES NO WARRANTIES WITH RESPECT TO: (A) SERVICES; (B) PRODUCTS PROVIDED AT NO CHARGE; OR (C) BETA CODE; ALL OF WHICH ARE PROVIDED "AS IS."

7.2. THE WARRANTIES SET FORTH IN THIS SECTION 7 ARE EXCLUSIVE. NEITHER MENTOR GRAPHICS NOR ITS LICENSORS MAKE ANY OTHER WARRANTIES EXPRESS, IMPLIED OR STATUTORY, WITH RESPECT TO PRODUCTS PROVIDED UNDER THIS AGREEMENT. MENTOR GRAPHICS AND ITS LICENSORS SPECIFICALLY DISCLAIM ALL IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE AND NON-INFRINGEMENT OF INTELLECTUAL PROPERTY.

8. **LIMITATION OF LIABILITY.** EXCEPT WHERE THIS EXCLUSION OR RESTRICTION OF LIABILITY WOULD BE VOID OR INEFFECTIVE UNDER APPLICABLE LAW, IN NO EVENT SHALL MENTOR GRAPHICS OR ITS LICENSORS BE LIABLE FOR INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES (INCLUDING LOST PROFITS OR SAVINGS) WHETHER BASED ON CONTRACT, TORT OR ANY OTHER LEGAL THEORY, EVEN IF MENTOR GRAPHICS OR ITS LICENSORS HAVE BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. IN NO EVENT SHALL MENTOR GRAPHICS' OR ITS LICENSORS' LIABILITY UNDER THIS AGREEMENT EXCEED THE AMOUNT RECEIVED FROM CUSTOMER FOR THE HARDWARE, SOFTWARE LICENSE OR SERVICE GIVING RISE TO THE CLAIM. IN THE CASE WHERE NO AMOUNT WAS PAID, MENTOR GRAPHICS AND ITS LICENSORS SHALL HAVE NO LIABILITY FOR ANY DAMAGES WHATSOEVER. THE PROVISIONS OF THIS SECTION 8 SHALL SURVIVE THE TERMINATION OF THIS AGREEMENT.

9. **HAZARDOUS APPLICATIONS.** CUSTOMER ACKNOWLEDGES IT IS SOLELY RESPONSIBLE FOR TESTING ITS PRODUCTS USED IN APPLICATIONS WHERE THE FAILURE OR INACCURACY OF ITS PRODUCTS MIGHT RESULT IN DEATH OR PERSONAL INJURY ("HAZARDOUS APPLICATIONS"). EXCEPT TO THE EXTENT THIS EXCLUSION OR RESTRICTION OF LIABILITY WOULD BE VOID OR INEFFECTIVE UNDER APPLICABLE LAW, IN NO EVENT SHALL MENTOR GRAPHICS OR ITS LICENSORS BE LIABLE FOR ANY DAMAGES RESULTING FROM OR IN CONNECTION WITH THE USE OF MENTOR GRAPHICS PRODUCTS IN OR FOR HAZARDOUS APPLICATIONS. THE PROVISIONS OF THIS SECTION 9 SHALL SURVIVE THE TERMINATION OF THIS AGREEMENT.

10. **INDEMNIFICATION.** CUSTOMER AGREES TO INDEMNIFY AND HOLD HARMLESS MENTOR GRAPHICS AND ITS LICENSORS FROM ANY CLAIMS, LOSS, COST, DAMAGE, EXPENSE OR LIABILITY, INCLUDING ATTORNEYS' FEES, ARISING OUT OF OR IN CONNECTION WITH THE USE OF MENTOR GRAPHICS PRODUCTS IN OR FOR HAZARDOUS APPLICATIONS. THE PROVISIONS OF THIS SECTION 10 SHALL SURVIVE THE TERMINATION OF THIS AGREEMENT.

11. **INFRINGEMENT.**

11.1. Mentor Graphics will defend or settle, at its option and expense, any action brought against Customer in the United States, Canada, Japan, or member state of the European Union which alleges that any standard, generally supported Product acquired by Customer hereunder infringes a patent or copyright or misappropriates a trade secret in such jurisdiction. Mentor Graphics will pay costs and damages finally awarded against Customer that are attributable to such action. Customer understands and agrees that as conditions to Mentor Graphics' obligations under this section Customer must: (a) notify Mentor Graphics promptly in writing of the action; (b) provide Mentor Graphics all reasonable information and assistance to settle or defend the action; and (c) grant Mentor Graphics sole authority and control of the defense or settlement of the action.

11.2. If a claim is made under Subsection 11.1 Mentor Graphics may, at its option and expense: (a) replace or modify the Product so that it becomes noninfringing; (b) procure for Customer the right to continue using the Product; or (c) require the return of the Product and refund to Customer any purchase price or license fee paid, less a reasonable allowance for use.

11.3. Mentor Graphics has no liability to Customer if the action is based upon: (a) the combination of Software or hardware with any product not furnished by Mentor Graphics; (b) the modification of the Product other than by Mentor Graphics; (c) the use of other than a current unaltered release of Software; (d) the use of the Product as part of an infringing process; (e) a product that Customer makes, uses, or sells; (f) any Beta Code or Product provided at no charge; (g) any software provided by Mentor Graphics' licensors who do not provide such indemnification to Mentor Graphics' customers; or (h) infringement by Customer that is deemed willful. In the case of (h), Customer shall reimburse Mentor Graphics for its reasonable attorney fees and other costs related to the action.

11.4. THIS SECTION 11 IS SUBJECT TO SECTION 8 ABOVE AND STATES THE ENTIRE LIABILITY OF MENTOR GRAPHICS AND ITS LICENSORS, AND CUSTOMER'S SOLE AND EXCLUSIVE REMEDY, FOR DEFENSE, SETTLEMENT AND DAMAGES, WITH RESPECT TO ANY ALLEGED PATENT OR COPYRIGHT INFRINGEMENT OR TRADE SECRET MISAPPROPRIATION BY ANY PRODUCT PROVIDED UNDER THIS AGREEMENT.

12. **TERMINATION AND EFFECT OF TERMINATION.**

12.1. If a Software license was provided for limited term use, such license will automatically terminate at the end of the authorized term. Mentor Graphics may terminate this Agreement and/or any license granted under this Agreement immediately upon written notice if Customer: (a) exceeds the scope of the license or otherwise fails to comply with the licensing or confidentiality provisions of this Agreement, or (b) becomes insolvent, files a bankruptcy petition, institutes proceedings for liquidation or winding up or enters into an agreement to assign its assets for the benefit of creditors. For any other material breach of any

provision of this Agreement, Mentor Graphics may terminate this Agreement and/or any license granted under this Agreement upon 30 days written notice if Customer fails to cure the breach within the 30 day notice period. Termination of this Agreement or any license granted hereunder will not affect Customer's obligation to pay for Products shipped or licenses granted prior to the termination, which amounts shall be payable immediately upon the date of termination.

12.2. Upon termination of this Agreement, the rights and obligations of the parties shall cease except as expressly set forth in this Agreement. Upon termination, Customer shall ensure that all use of the affected Products ceases, and shall return hardware and either return to Mentor Graphics or destroy Software in Customer's possession, including all copies and documentation, and certify in writing to Mentor Graphics within ten business days of the termination date that Customer no longer possesses any of the affected Products or copies of Software in any form.

13. **EXPORT.** The Products provided hereunder are subject to regulation by local laws and United States ("U.S.") government agencies, which prohibit export, re-export or diversion of certain products, information about the products, and direct or indirect products thereof, to certain countries and certain persons. Customer agrees that it will not export or re-export Products in any manner without first obtaining all necessary approval from appropriate local and U.S. government agencies. If Customer wishes to disclose any information to Mentor Graphics that is subject to any U.S. or other applicable export restrictions, including without limitation the U.S. International Traffic in Arms Regulations (ITAR) or special controls under the Export Administration Regulations (EAR), Customer will notify Mentor Graphics personnel, in advance of each instance of disclosure, that such information is subject to such export restrictions.

14. **U.S. GOVERNMENT LICENSE RIGHTS.** Software was developed entirely at private expense. The parties agree that all Software is commercial computer software within the meaning of the applicable acquisition regulations. Accordingly, pursuant to U.S. FAR 48 CFR 12.212 and DFAR 48 CFR 227.7202, use, duplication and disclosure of the Software by or for the U.S. government or a U.S. government subcontractor is subject solely to the terms and conditions set forth in this Agreement, which shall supersede any conflicting terms or conditions in any government order document, except for provisions which are contrary to applicable mandatory federal laws.

15. **THIRD PARTY BENEFICIARY.** Mentor Graphics Corporation, Mentor Graphics (Ireland) Limited, Microsoft Corporation and other licensors may be third party beneficiaries of this Agreement with the right to enforce the obligations set forth herein.

16. **REVIEW OF LICENSE USAGE.** Customer will monitor the access to and use of Software. With prior written notice and during Customer's normal business hours, Mentor Graphics may engage an internationally recognized accounting firm to review Customer's software monitoring system and records deemed relevant by the internationally recognized accounting firm to confirm Customer's compliance with the terms of this Agreement or U.S. or other local export laws. Such review may include FlexNet (or successor product) report log files that Customer shall capture and provide at Mentor Graphics' request. Customer shall make records available in electronic format and shall fully cooperate with data gathering to support the license review. Mentor Graphics shall bear the expense of any such review unless a material non-compliance is revealed. Mentor Graphics shall treat as confidential information all information gained as a result of any request or review and shall only use or disclose such information as required by law or to enforce its rights under this Agreement. The provisions of this Section 16 shall survive the termination of this Agreement.

17. **CONTROLLING LAW, JURISDICTION AND DISPUTE RESOLUTION.** The owners of certain Mentor Graphics intellectual property licensed under this Agreement are located in Ireland and the U.S. To promote consistency around the world, disputes shall be resolved as follows: excluding conflict of laws rules, this Agreement shall be governed by and construed under the laws of the State of Oregon, U.S., if Customer is located in North or South America, and the laws of Ireland if Customer is located outside of North or South America. All disputes arising out of or in relation to this Agreement shall be submitted to the exclusive jurisdiction of the courts of Portland, Oregon when the laws of Oregon apply, or Dublin, Ireland when the laws of Ireland apply. Notwithstanding the foregoing, all disputes in Asia arising out of or in relation to this Agreement shall be resolved by arbitration in Singapore before a single arbitrator to be appointed by the chairman of the Singapore International Arbitration Centre ("SIAC") to be conducted in the English language, in accordance with the Arbitration Rules of the SIAC in effect at the time of the dispute, which rules are deemed to be incorporated by reference in this section. Nothing in this section shall restrict Mentor Graphics' right to bring an action (including for example a motion for injunctive relief) against Customer in the jurisdiction where Customer's place of business is located. The United Nations Convention on Contracts for the International Sale of Goods does not apply to this Agreement.

18. **SEVERABILITY.** If any provision of this Agreement is held by a court of competent jurisdiction to be void, invalid, unenforceable or illegal, such provision shall be severed from this Agreement and the remaining provisions will remain in full force and effect.

19. **MISCELLANEOUS.** This Agreement contains the parties' entire understanding relating to its subject matter and supersedes all prior or contemporaneous agreements. Some Software may contain code distributed under a third party license agreement that may provide additional rights to Customer. Please see the applicable Software documentation for details. This Agreement may only be modified in writing, signed by an authorized representative of each party. Waiver of terms or excuse of breach must be in writing and shall not constitute subsequent consent, waiver or excuse.

Rev. 140201, Part No. 258976