PatternTool 8

Overview

PatternTool is a graphical tool for reading and editing binary pattern files. By using **PatternTool**, you can directly edit the source pattern file, instead of editing and recompiling the ASCII source file. After editing the file with **PatternTool**, you can update the tester with the edited pattern file. **PatternTool** can help you debug a pattern file by displaying a compiled pattern file as columns of data and the History RAM (HRAM) data captured on the tester.

Using PatternTool

The pattern file to be debugged is opened with **DataTool**. In the *debug* mode, the test program is run to the breakpoint, assuming a breakpoint has been set and occurred after at least one pattern burst has been run. **PatternTool** can now be run.

PatternTool is started from **DataTool** or by clicking the  button on the **DataTool** toolbar. You can locate failures in a pattern file by using **PatternTool** to examine the pattern file and to view the History RAM (HRAM) data generated by the pattern burst. Once a problem is found, you can use **PatternTool** to edit the pattern file.

After editing the pattern file, you can verify the edits to the pattern file by updating the pattern file loaded in the tester. The pattern file loaded in the tester is updated without having to update the disk file and rerun a pattern burst.

See also:

Worksheets on page 8-2

Toolbars on page 8-3 and *Displaying a Pattern File* on page 8-8

Editing with PatternTool on page 8-18

Vectors Worksheet on page 8-29

Other Worksheets on page 8-69

Displaying the History RAM on page 8-81

Requirements

To display or view a pattern file, **PatternTool** requires a pattern file with a *.pat* extension. **PatternTool** uses a pattern file to produce a set of worksheets from information in the pattern file.

Worksheets

The name of each worksheet appears on the tab at the bottom of the **PatternTool** window. To move between worksheets, click on a tab:

- *Vectors Worksheet* on page 8-29—contains the vector data from the pattern file, with columns for labels, pattern generator microcode, timing set (**tset**), pin data, and comments. Any data on this sheet can be edited. You can also overlay the HRAM data on the *Vectors* worksheet.
- *Pin List Worksheet* on page 8-70—is the pin list from the pattern file, with columns for each pin or pin group, its radix, and the number of pins in the group. Pins can be moved in and out of the pin groups on this sheet.
- *Pin Setups Worksheet* on page 8-72—is the **pin_setup** statement from the pattern file, defining any special modes for pins: mux mode pins, SCIO pins, high-voltage pins, or frequency counter pins. Certain pin setups can be edited.
- *Options Worksheet* on page 8-76—lists the compilation options selected for the pattern file. Some options can be edited.
- *Imports Worksheet* on page 8-79—contains the **tset** (time set) names and label names imported into the pattern file by the **import** statement. This sheet can be edited.
- *Instruments Worksheet* on page 8-80—contains information from any **instruments** statement in the pattern file.

Menu commands and shortcuts for displaying the next or previous worksheet:

Find/Goto | *Goto* | *Next Worksheet*	Control+Page Down
Find/Goto | *Goto* | *Previous Worksheet*	Control+Page Up

Toolbars

Overview

PatternTool provides the following toolbars:

Displaying or Hiding Toolbars

Toolbars are displayed when you place a checkmark next to the toolbar name in the *Toolbar* menu. Highlighting a toolbar name in the *Toolbar* menu displays a toolbar; unhighlighting a toolbar name hides the toolbar. The following commands display or hide a specific toolbar:

View | *Toolbar* | *Standard*

View | *Toolbar* | *Edit*

View | *Toolbar* | *Debug*

View | *Toolbar* | *Current Cell*

Standard Toolbar

The *Standard* toolbar, shown below, contains icons for the standard **Windows** file and editing commands:

- *New*  —creates an empty pattern file and displays it in a new window. Shortcut: Control + N. To open an existing pattern file, use *Open*.
- *Open*  —opens and loads an existing pattern file (*.pat*) in a new window. Shortcuts: Control + O or Control + F12. Selecting this command opens a window for you to select a file; be sure to open only pattern files. To open a pin map, refer to *Using Read Pinmap* on page 8-76.
- *Save*  —saves the active pattern file to its current name and directory. If you created a pattern file, but have not yet saved it, the *Save As* dialog box appears for you to enter a name and folder for the pattern file. Before saving the pattern file, **PatternTool** checks the file; refer to *File Checking* on page 8-14.
- *Cut*  —removes the data from the currently-selected cells and puts it on the clipboard. Shortcuts: Control + X or Shift + Delete. This command is disabled if no data is in the selected cell. Cutting data to the clipboard replaces the contents of the clipboard; refer to *Editing Cell Data* on page 8-23 and *Cutting, Copying, and Pasting Vector Data* on page 8-56.
- *Copy*  —copies the data from the currently-selected cells on the clipboard. Shortcuts: Control + C or Shift + Insert. This command is disabled if no data is in the selected cell. Copying data to the clipboard replaces the contents of the clipboard; refer to *Editing Cell Data* on page 8-23 and *Cutting, Copying, and Pasting Vector Data* on page 8-56.
- *Paste*  —inserts a copy of the clipboard contents into the currently-selected cell or cells. Shortcuts: Control + V or Shift + Insert. This command is disabled if the clipboard is empty; refer to *Editing Cell Data* on page 8-23 and *Cutting, Copying, and Pasting Vector Data* on page 8-56.
- *Print*  —prints the currently-displayed tab of the active pattern file. If the *Message* window is the active window, it is printed. Shortcuts: Control + P or Control + Shift + F12. Selecting this command opens a standard *Print* dialog box, providing the standard printing features, such as *Print Preview* and *Print Setup*.

- *About*  —displays the **PatternTool** version number and copyright notice.
- *Help*  —displays the standard online help for a selected item. When you click this button, the mouse pointer is transformed into the standard **Windows** *Help* icon: an arrow and a question mark, which provides the standard context-sensitive help features. Shortcut: Control + F1.

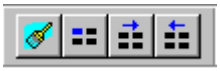
Edit Toolbar

The *Edit* toolbar, shown below, contains icons for the standard **Windows** editing commands and several FLASH 750 commands for editing pattern files:

- *Paste Text* command —pastes the copied ASCII text from **PatternTool** or another application; refer to *Paste Text* on page 8-57.
- *Paste Pin Data* command —pastes the data copied in the pin data format; refer to *Paste Pin Data* on page 8-57.
- *Fill Down* command —copies the cell contents to the selected cells below; refer to *Editing Cells with the Fill Commands* on page 8-24.
- *Fill Right* command —copies the cell contents to the selected cells to the right; refer to *Editing Cells with the Fill Commands* on page 8-24.
- *Fill From Current Cell* command —copies the cell contents to all selected cells; refer to *Editing Cells with the Fill Commands* on page 8-24.
- *Complement* command —changes each pin state to its complement (0 to 1, L to H); refer to *Complementing* on page 8-53.
- *Swap 0/1 with L/H* command —swaps the drive and receive data (0 to L, H to 1); refer to *Swapping the Drive and Receive Data* on page 8-54.
- *Find Previous* command —finds the previous instance of the search string; refer to *Find* on page 8-27. Shortcut: Shift + F3.
- *Find Next* command —finds the next instance of the search string; refer to *Find* on page 8-27. Shortcut: F3.

Debug Toolbar

The *Debug* toolbar, shown below, contains icons for frequently-used commands that manage the display of the site contents of the History RAM (HRAM):



- *Refresh* command  —refreshes the HRAM display; refer to *Viewing Sites* on page 8-89.
- *Select Site* command  —selects a different site to view; refer to *Viewing Sites* on page 8-89.
- *Next Site* command  —selects the next site to view; *Viewing Sites* on page 8-89.
- *Previous Site* command  —selects the previous site to view; refer to *Viewing Sites* on page 8-89.

Current Cell Bar

This toolbar displays the contents of the currently-selected cell; refer to *Selecting the Current Cell* on page 8-20. Use this toolbar when the displayed text for all cells extends beyond one screen. The *Current Cell* bar is read-only; thus, to change the cell contents, you must edit the cell; refer to *Editing Cell Data* on page 8-23.

To display or hide the *Current Cell* bar, use the following command:

View | *Toolbar* | *Current Cell*

Status Bar

The status bar at the bottom of the window shows connection information about the test program, which is useful for debugging; refer to *Connecting to a Job for Debugging* on page 8-82.

To display or hide the status bar, use the following command:

View | *Status Bar*

Managing PatternTool

Displaying a Pattern File

PatternTool opens separate windows when you open an existing pattern file or create a pattern files. Windows can be split, and more than one window can be open:

Opening an Existing Pattern File

Use the *Open* command to open and load an existing pattern file (*.pat*) in a new window. In the *Open* dialog that appears, select only pattern files. To open a pinmap, refer to *Using Read Pinmap* on page 8-76.

Opening a New Window

You can open a new window with the same contents as the active window by selecting *New Window* on the *View* menu. This feature lets you display different parts or views of a pattern file at the same time.

The new window uses the current *Pin List* tab to display the file contents. If columns in the original window has been expanded or regrouped, or if the display radix has been changed, these changes are ignored in the new window. If the *Pin List* tab has been edited, these changes are displayed in the new window.

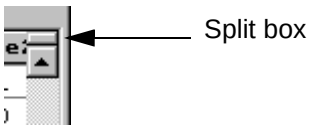
If multiple copies of the same document are open at one time, changes to the contents of one window are immediately displayed in the other windows. Changes to the appearance of the window are ignored.

Splitting the Pattern File Window

Window can be split to simultaneously view two or four different parts of a single worksheet. To split a window, select *Splitter View* on the *View* menu. Another window is created based on the current worksheet in the active window.

To split this new window:

1. Find the *split box:*
   a. If the grid extends vertically beyond the window, a split box is at the top of the vertical scroll bar: it is a small rectangle above the up arrow, as shown below.



   b. If the grid extends horizontally beyond the window, a split box is left of the horizontal scroll bar, to the left of the left-arrow.
2. Place the mouse pointer on the split box. The pointer becomes a two-headed arrow.
3. Click the pointer in the split box and drag the split bar to the position to split.
4. If both the vertical and horizontal split boxes appear, you can use two split bars to create four panes.
5. When finished with the split view, close the window by selecting *Close* under the *File* menu of the pattern file window or click on the close window (X) icon in the **PatternTool** window. Any changes to the splitter view window will appear in the regular window.

Opening Multiple Windows

The *Window* menu provides the standard commands for managing the display of multiple pattern files in the main window:

- *Tile*—arranges the multiple windows so all are equally visible and not overlapped.
- *Cascade*—overlaps the multiple windows so the top window is completely visible; only the title bars of the other windows are visible.
- *Arrange Icons*—arranges the icons of the minimized windows along the bottom of the main window. If a document is open at the bottom of the main window, some or all of the icons may not be visible because they are under this document window.

The numbers at the bottom of the *Window* menu represent the currently-open documents, including the *Message* window. Click one of these numbers to activate a window. A checkmark next to the window number indicates the active window.

Changing the Column Appearance

Overview

The appearance of the selected columns of data can be changed:

- *Hiding and Exposing Columns* on page 8-11
- *Resizing Columns and Rows* on page 8-12
- *Moving Columns in a Vector Display* on page 8-30

To change the appearance of columns in a Vectors worksheet, refer to *Changing the Column Appearance* on page 8-10.

+ Even though the appearance of the columns in a worksheet are changed, the contents of the data in the columns is not changed.

Selecting a Column

To change the appearance of a cell, select one cell by clicking on it. Once you have selected a cell, the entire column is selected. Selecting an entire column is not necessary. If you select an entire row by left-clicking in the row header in the leftmost column, all columns are selected; thus, any future commands or operations will affect all columns.

Hiding and Exposing Columns

Overview

Hiding a column removes it from the display without deleting it. You can hide any column on any worksheet except for the far left columns containing the row headers. You can hide or expose columns by using the menu bar or by using the mouse.

Using the Menu Bar

- To hide a column, select the column by using the mouse to select at least one cell in the column. Then, select *Hide* on the *Column* menu.
- To expose a hidden column, select *Expose* on the *Column* menu. A window appears listing the hidden columns. On the *Vectors* worksheet, a dollar sign prefix indicates a standard column name: for example, **$*label*** or **$*tset***. Names without a dollar sign are pins or pin groups. Click on the column or columns to expose them and then click *OK*.

Using the Mouse

- To hide a column, you can resize it to zero width by grabbing the right edge of the column header (gray rectangle at top of column) and by moving it until it meets the left column.
- To expose a hidden column, double-click on the line separating the headers of the two columns between the hidden column.

Hiding and Exposing Memory (MTM) Columns

Displaying the MTM (Memory) data adds several columns to the *Vectors* worksheet; refer to the *Memory (MTM) Data* on page 8-63. The *Hide MTO* and *Expose MTO* commands in the *Column* menu hide or expose all columns of memory data.

Cutting, Copying, and Pasting Hidden Columns

If entire rows are cut, copied, or pasted, the data in any hidden columns in the row is also cut, copied, or pasted. However, if only a range of pin data cells on the *Vectors* worksheet is selected (not an entire row), no data is cut or copied from any hidden cell, and no data is pasted to any hidden cell.

Resizing Columns and Rows

Resizing Columns to a Specific Width

1. Select at least one cell in the column. To select all columns, click on the row header, which selects an entire row, as well as all columns.
2. Select *Resize* on the *Column* menu**.** A dialog box appears.
3. In the dialog box, enter the desired pixel width of the column. Default is 80. If you use the default value, many columns are truncated, but most are visible. You can resize individual columns.

AutomatIcally Resizing Columns

An auto resize feature provides several ways to resize the entire column to the desired width:

- Resize an entire column to the width of the widest text in one of the columns:

1. Select the entire column by clicking in the column header.
2. Select *Auto Resize* on the *Column* menu.

- Resize an entire column to the width of a specific cell:

1. Select the desired cell as the standard for all cells in the column.
2. Select *Auto Resize* on the *Column* menu.

- Resize all columns, including headers, to the maximum cell width:

1. Select the entire grid by clicking on the gray blank rectangle at the upper-left corner of the grid; refer to *Selecting the Entire Grid* on page 8-22.
2. Select *Auto Resize* on the *Column* menu.

Manually Resizing Columns

To manually resize a column by using the gray column headers at the top of the worksheet data area:

1. Position the cursor on the right border of the column header, until the cursor becomes a two-headed arrow.
2. Hold the left mouse button down to grab the border.
3. Pull the border to widen or narrow the column.

Resizing the Row Height

To change the height of all rows in the *Vectors* worksheet:

1. In the far left column of the gray row headers, which contain the vector numbers, put the cursor on the bottom border of a row header cell.
2. Position of the cursor until it becomes two-headed arrow.
3. Hold down the mouse button to grab the border.
4. Pull the border down to increase the cell height. All rows of the grid are resized to the same height.

If any column headers are too long to fit in the current column width, you can resize the row of column headers without changing the rest of the data rows of the grid. By increasing the height of the column header row, the headers are expanded vertically.

File Checking

Overview

When you compile an ASCII source file, the **Pattern Compiler** verifies the pattern syntax; however, when you use **PatternTool**, you are editing a compiled file, and the compiler cannot verify the pattern syntax in the edited file. Consequently, when you try to save a pattern file after editing it, **PatternTool** verifies the pattern syntax. Because a file is checked only when it is saved, the syntax of the pattern file may be temporarily invalid while you are editing it. For example, if you change the *opcode_mode* option from *extended* to *normal*, other parts of the pattern file may change, such as, the *normal* mode not allowing pin setups that are valid in the *extended* mode.

Items Checked in Pattern File

- **tset** numbers and **tset** names cannot both be used.
- Duplicate **tsets** and duplicate labels cannot be used.
- All **tset** names must be imported. Any external labels referenced in the file must also be imported. All symbols on the *Imports* worksheet must be valid.
- If the *opcode_mode* option is *normal*, the following pin setup modes cannot be used: *mux*, *io_midband*, *io_valid*, *freq_count*. These are valid only in the *extended* mode.
- The *extended* and *normal* modes have different value ranges for *min_period*.
- Pattern file cannot contain both pins (pin names and pin group names) and channel numbers.
- Channel numbers only: the proper channel number must be used for any *high_voltage* pin setup mode.
- Vector cannot contain both the **halt** opcode and the **ign** control bit.

File Fails File Checking

If you try to save a pattern file or update the tester with a pattern file and the file fails the file check, how **PatternTool** behaves depends on the command you issued:

- *Save* command—the failed file is not saved. **PatternTool** does not overwrite the existing valid file.
- *Save As* command—**PatternTool** writes the failed file to the specified filename, but the file is marked as invalid. **PatternTool** cannot subsequently open an invalid file.
- *Update Tester* command—Before **PatternTool** updates the tester with the active pattern file, it checks the file; refer to *Updating the Tester with the Edited Binary Pattern File* on page 8-17.

If the file check fails, the error messages are written to the *Message* window; refer to *Message Window* on page 8-16.

Message Window

Overview

PatternTool displays error, warning, and general messages in the *Message* window:

- If a pattern file fails file checking, error and general messages are written to the *Message* window.
- If an edited Pin List worksheet or Pin Setups worksheet fails to update the worksheet, all resulting messages are written to the *Message* window.

PatternTool uses one window for writing messages for all pattern files opened from a single instance of **PatternTool**. This window displays the message number, message type (E=error, W=warning, I=informational), location, and message. The location consists of the filename, the tab name, and the row number.

Viewing the Message Window

If **PatternTool** has detected errors, a popup reports the number of errors. After you click *OK* in the popup to acknowledge the message, the *Message* window appears.

Once **PatternTool** has initially created a *Message* window, you can view it at any time by selecting the *Message Window* on the *View* menu or the *Messages* file on the *Window* menu.

Clearing the Message Window

PatternTool does not clear messages from the *Message* window until you exit **PatternTool**. New messages are appended; thus, the window may contain messages from several failed attempts to save a file. To clear all current messages, select *Clear All* on the *Edit* menu. This command is enabled only when the *Message* window is the active window.

Exiting the Message Window

To exit the *Message* window, go to the *Window* menu and select any other file already opened.

Updating the Tester with the Edited Binary Pattern File

Overview

After editing a binary pattern file with **PatternTool**, you can update the pattern file loaded on the tester to verify the edits to the pattern file. This method does not save the file to disk, which would overwrite the existing pattern file.

To update the tester with the edited pattern file, click *Update Tester* command in the *Debug* menu. The active pattern file is written to a temporary file and then the pattern syntax is checked. If the pattern syntax is valid, the tester loads this temporary file.

Requirements

- **PatternTool** is connected to the tester; *Connecting to a Job for Debugging* on page 8-82.
- Pattern file to update is already loaded.
- Active window displays the pattern file to update the tester.
- Viewing mode is *File Data*, not *HRAM*.
- Edited pattern is the only pattern in a pattern burst.
- Multiple files in a burst are not supported.

Editing with PatternTool

Overview

The following editing features apply to all **PatternTool** worksheets:

- *Selecting Data to Edit* on page 8-19
- *Changing the Column Appearance* on page 8-10: hiding, exposing, resizing, and moving
- *Editing Cell Data* on page 8-23: editing cells directly, using dialog boxes, or using the *Fill* or *Cut*, *Copy*, and *Paste* commands.
- *Using Find, Replace, and Goto* on page 8-27
- *Inserting and Deleting Rows* on page 8-26

In addition to the these general editing features, several worksheets have additional editing features:

- *Vectors Worksheet* on page 8-29
- *Other Worksheets* on page 8-69

Selecting Data to Edit

Overview

Before you can edit or manipulate the data in a pattern file, you must select the data in the cell or the cells.

See also:

Selecting the Current Cell on page 8-20

Selecting a Range of Cells on page 8-20

Editing Cells Directly on page 8-23

Editing Cells with Drop-Down Lists on page 8-23

Editing Cells with Edit Popups on page 8-24

Editing Cells with the Fill Commands on page 8-24

Editing with the Cut, Copy, and Paste Commands on page 8-25

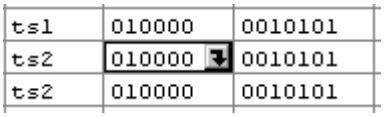
Invalid Cell Data on page 8-25

Inserting and Deleting Rows on page 8-26

Using Find, Replace, and Goto on page 8-27

Selecting the Current Cell

Pattern data is displayed in a grid of cells with only one of those cells as the currently-selected cell, also known as the *current cell*. As shown below, the current cell has an outline around it. Also, as shown below, the current cell may contain a button to open an editing dialog box or a drop-down list:



To select a cell as the current cell, click on it once. Once a cell is selected, you can change the selected cell by using the drop-down list or by directly entering data.

Selecting a Range of Cells

A selected range of cells is highlighted by reverse video: white text on a black background. The first cell clicked on is the current cell, which is not in reverse video (except for a split view: the entire range is in reverse video). Having selected a range, use the arrow keys to select a different current cell that is not part of the selected range without de-selecting the current range of cells.

Selecting a Rectangle of Adjacent Cells

Two methods for selecting a rectangle of adjacent cells:

- Left-click on the cell in one corner of the desired rectangle. While holding down the left mouse button, drag the cursor to the opposite corner to select the rectangle of cells.
- Left-click on the cell in one corner of the rectangle. Hold down the Shift key and left-click on the cell in the opposite corner to select the rectangle of cells.

Selecting Non-Adjacent Cells

1. Select the first cell or range of cells.
2. Hold down the Control key and select the next cell or range of cells.

Selecting an Entire Column

Left-click on the column heading, which is the gray rectangle with a label at the top of the column.

Also, refer to *Changing the Column Appearance* on page 8-10.

Selecting More than One Column

- For adjacent columns:

1. Left-click on the first column heading in the range of cells.
2. Hold down the mouse button and drag the cursor to the last column heading.

OR

1. Left-click on the first column heading.
2. Hold down the Shift key and left-click on the last column heading.

- For non-adjacent columns:

1. Select the first column heading or headings.
2. Hold down the Control key and select the next column heading or headings.

Selecting an Entire Row

Left-click on the row heading, which is the gray rectangle in the leftmost column, containing a number or identifier.

When inserting or deleting rows or vectors, you select the entire row by selecting just one cell in a row; refer to *Inserting and Deleting Rows* on page 8-26.

Selecting More than One Row

- For adjacent rows:

1. Left-click on the first row in the range.
2. Hold down the mouse button and drag the cursor through to the last row.

OR

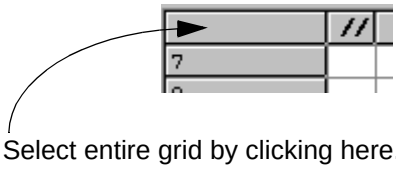
1. Left-click on the first row heading.
2. Hold down the Shift key and left-click on the last row heading.

- For non-adjacent columns:

1. Select the first row heading or headings.
2. Hold down the Control key and select the next row heading or headings.

Selecting the Entire Grid

Left-click in the gray blank rectangle at the upper-left corner of the grid, which is the intersection of the column headings and the row headings; see the following figure.



Clearing All Selections, Including the Current Cell

1. Select the entire grid by left-clicking in the gray, blank rectangle in the upper-left corner of the grid.
2. Left-click again in the same rectangle. All selections are cleared.

Editing Cell Data

Editing Cells Directly

You can edit the current cell by selecting *Edit Cell* on the *Edit* menu or by pressing the F2 key. An editing cursor appears. You can now delete and add characters in the existing text.

You can also edit a selected cell by typing in the cell:

- If you click on the white space in a cell or navigate to the white space in a cell with the arrow keys, the cell is selected but the edit cursor does not appear. Even though the edit cursor does not appear, what you type replaces the contents of the cell.
- If you click on the text in a cell, an edit cursor appears in the text. You can delete and add characters in the existing text. Once an edit cursor is visible, the left and right arrows keys move the cursor within the cell text.

If you enter invalid data**,** you cannot exit the cell until you change the invalid characters by entering valid data or discard the changes and exit the cell by pressing the Esc key. After you exit the cell, the cell text returns to its original value.

To move from the current cell to adjacent cells, use the arrow, Tab, or Return keys.

Editing Cells with Drop-Down Lists

Some cells have a drop-down list. After you select a cell, a gray button with an inverted triangle appears, shown below, signifying a drop-down list:

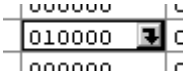
Clicking the button displays a drop-down list with valid values to select. The button is visible only for the current cell.

These cells can also be directly edited.

Editing Cells with Edit Popups

Some cells provide an edit popup dialog box for entering a valid cell value. You enter selections in the dialog box until the desired cell value is displayed in the *Vector* worksheet. You can also directly edit these cells.

After you select a cell, a gray button with a curved arrow appears, shown below, signifying an edit popup. The button is visible only for the current cell:



You can open the dialog box for the selected current cell by using one of several methods:

1. Click the gray button or a non-text part of the cell.
2. Select *Cell Edit Popup* on the *Edit* menu.
3. Press the F7 key.

Editing Cells with the Fill Commands

Another way to edit cells is to use the *Fill* commands in the *Edit* menu to copy the contents of the current cell to other cells. The *Fill* commands also have the following buttons on the *Edit* Toolbar:

- *Fill From Current Cell* command  —copies the current cell to all selected cells. The text must be valid for all affected cells; otherwise, the text is not copied. Multiple cells can be selected to receive the copied text.
- *Fill Right* command  —requires that you select a single rectangle of at least two columns. In each row, the value in the far left cell of the selected region is copied to all other cells in the same row within the selected region.
- *Fill Down* command  —requires that you select a single rectangle of at least two rows. In each column, the value in the top cell of the selected region is copied to all other cells in the same column within the selected region.

Fill commands do not copy hidden cells.

Editing with the Cut, Copy, and Paste Commands

You can use the *Cut*, *Copy*, and *Paste* commands in the *Edit* menu to edit a worksheet. To use these editing commands, click the appropriate icons in the *Standard* toolbar or press the appropriate shortcut keys:

- *Cut*  —Ctrl+X
- *Copy*  —Ctrl+C
- *Paste*  —Ctrl+V

Compared with than in other worksheets, cutting, copying, or pasting data in a *Vectors* worksheet may have different effects. Also, only the *Vectors* worksheet supports several paste operations; refer to *Cutting, Copying, and Pasting Vector Data* on page 8-56.

Invalid Cell Data

Invalid cell data may be displayed because the worksheet has been changed during editing. In this case, the cell background appears pink, indicating the cell has invalid characters. Correcting the value causes the pink background to disappear. For example, if you edit the *Options* tab by changing from the *Extended* mode to the *Normal* mode, some opcodes or pin data values on the *Vectors* tab may become invalid. Invalid cells are highlighted in pink.

Inserting and Deleting Rows

Overview

You can insert and delete rows on the editable worksheets without a fixed number of rows; however, you cannot delete rows on the *Options* tab because each option must have one row.

On the *Vectors* worksheet, vectors are inserted and deleted, not rows; refer to *Inserting Vectors in a Pattern FIle* on page 8-59 and *Deleting Vectors from a Pattern File* on page 8-59.

Inserting Rows into Worksheet

1. From the *Insert Mode* command on the *Edit* menu, select where to insert the new rows:

   Insert Before Selection

   Insert After Selection

   Insert Before Current Cell
2. Highlight the same number of rows as the number of rows to insert. For example, to insert 5 rows, select 5 rows as the current rows. Select a row by highlighting at least one cell in the row.
3. After selecting the correct number of rows, select *Insert Rows* on the *Edit* menu**.** The new rows will be blank.

Deleting Rows from Worksheet

1. Select the rows to delete by clicking on them in the far left heading column. You must select the entire row to delete it.
2. Select *Remove Rows* on the *Edit* menu. If you select multiple non-adjacent cells by holding down the Control key while clicking on the cells, the *Remove Rows* command is disabled. This command removes only a single row at a time.

Using Find, Replace, and Goto

Overview

You can find a string of text or navigate to particular points in a worksheet sheet by using the Find Text or Goto commands. A particular string of text can be searched for and replaced by using the Find/Replace Text command.

Find

To find text, select *Find Text* in the *Find/Goto* menu or use the shortcut keys Control + F. The *Find* dialog box appears:

1. In the *Find what* box, enter the string to be found.
2. Click *Match case*, if desired.
3. Select the direction of the search: *Up* or *Down*.

   If *Up* or *Down* is selected, **PatternTool** searches within the selected range; otherwise, it searches the entire worksheet, wrapping when it reaches one end of the worksheet.
4. After entering text in the *Find* dialog box, you can search for the next or previous match by using *Find Next* and *Find Previous* in the *Find/Goto* menu, the appropriate icons in the *Edit* toolbar or the shortcut keys:

- *Find Next*  —F3
- *Find Previous*  —Shift + F3

+ Text in hidden columns is not searched; refer to *Hiding and Exposing Columns* on page 8-11.

Find Fail

Find Fail command is enabled only when displaying the History RAM (HRAM); refer to *Finding Fails* on page 8-89.

Find/Replace Text

To search for and replace text, click *Find/Replace Text* on the *Find/Goto* menu. The *Replace* dialog box appears:

1. In the *Find what* box, enter the string to be found.
2. In the *Replace with* box, enter the text to replace the found text.
3. Click on *Match case*, if desired.
4. Click *Find Next*. If a match is found, the matched text is highlighted.
5. To replace only this single match of text with the replacement text, click *Replace*.
6. To replace all matches of the text with the replacement text, click *Replace All*.
7. To find the next match, click *Find Next*.

   After entering text in the *Find* dialog box, you can search for the next or previous match by (1) clicking *Find Next* or *Find Previous* in the *Find/Goto* menu, (2) the appropriate icons in the Edit toolbar, or (3) the shortcut keys.

Goto

To go to a specific location on a worksheet, click *Goto* in the *Find/Goto* menu and then use the submenu to select the location:

- *Top* or *Bottom* column
- *Leftmost* or *Rightmost* row
- one *Page Up* or one *Page Down*
- next *Vector* (F5)
- *Next Worksheet* or *Previous Worksheet* (Control + page down or Control + page up)

If you have scrolled away from the current-selected cell, return to that cell by clicking *Goto Current Cell* in the *Goto* menu**.**

Additional Search Features on the Vectors Worksheet

The *Vectors* worksheet provides additional search and navigation commands: *Goto Vector* and *Goto Label*; refer to *Using Find/Goto on the Vectors Worksheet* on page 8-46.

Vectors Worksheet

Overview

The *Vectors* worksheet, which displays the vector data in a pattern file, is based on the **vector** statement in the pattern file; refer to *Vector Statement* on page 6-30, *Pattern Language Reference*, Chapter 6.

Columns

For information on individual columns of the *Vectors* worksheet, including editing specific columns and editing popup dialog boxes, refer to the following items:

- *Vector Number Column* on page 8-31
- *// column* on page 8-31
- *label Column* on page 8-32
- *patgen Column* on page 8-33
- *tset Column* on page 8-34
- *Pin Data Columns* on page 8-35
- *comment Column* on page 8-36

Columns on this worksheet can be moved, hidden, or exposed.

Special Vector Data

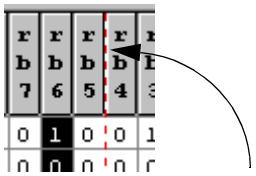
This worksheet displays the standard data from the pattern file, as well as the MTM (Memory Test Module) data, which may require additional columns or special modes of display; refer to *Memory Data Columns* on page 8-63.

Editing the Vectors Worksheet

All editing features mentioned in *Editing with PatternTool* on page 8-18 also apply to this worksheet. Other editing features, such as changing the radix of the pin data columns or adding comments are supported only by the *Vectors* worksheet; refer to *Editing the Vectors Worksheet* on page 8-45.

Moving Columns in a Vector Display

1. Select the entire column by clicking the left mouse button once on the column header.
2. Release the left mouse button and click on the column header again. A small, gray rectangle appears, indicating the column can be moved.
3. Hold down the mouse button and move the cursor in the desired direction. A red dotted vertical line appears, shown below, indicating the current position of the moved column. This line indicates where the left border of the moved column would be:

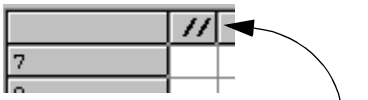


Current position of moved column

4. When the column is in the proper position, release the mouse button.

Restriction

The **//** (block comment) column on the *Vectors* worksheet should not be moved from its position, which is next to the vector number column. If this column is moved, block comments cannot be displayed or entered; refer to *Block Comments* on page 8-61.



Column for block comments

Vectors Worksheet Columns

Vector Number Column

Overview

The far left column lists the vector number. Vectors are numbered sequentially, starting from 0. You cannot edit this column.

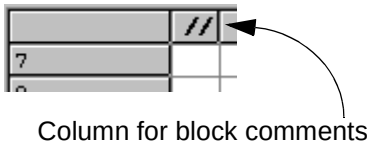
Block comments have special numbering, in the form `5.C:1`, signifying this comment (`C`) appears after vector `5`, on the second line of the block comment; 0 is the first line.

Vector Number Rules

- If any pins are in the **SCIO** or **mux** mode, each vector requires two rows, with numbering in the format `5.1` and `5.2`.
- Vector numbers are assigned by **PatternTool**.

// column

If a column displays `//`, adding block comments is enabled. Block comments extend the width of the window; however, block comments are not added in this window.



Existing block comments can be edited, and new block comments can be inserted; refer to *Block Comments* on page 8-61.

label Column

Overview

If the current cell supports labels, this column displays a vector label and a button.

Editing the label Column

Edit a label by the following methods:

- Click the button to open the *Label Edit Popup*; refer to *Label Edit Popup* on page 8-37.
- Directly edit a label. Use the following format:

  type labelname:

  where *type* is **start_label, subr, global subr,** or **global.**

  The colon is part of the label.

  If *type* is omitted, the label is a local label.

  For more information about labels, refer to *Kinds of Labels* on page 6-35, *Pattern Language Reference*, Chapter 6.

Label Rules

- In the *normal* mode, a label appears only on the first vector of a pair.
- In the *extended* mode, a label may appear on any vector.
- In the *SCIO* or *mux* mode, a vector appears only on the first line of the vector.

patgen Column

Overview

This column displays the pattern generator microcode, which is an opcode or control bits or both; refer to *Control Bits* on page 6-88, *Pattern Language Reference*, Chapter 6.

Expanding the patgen Column

The *patgen* column can be expanded into its sub-columns: opcode column, plus one column for each control bit: **clr_fail, icc, ifc, ign, mask,** and **stv**; refer to *Expanding and Collapsing Columns* on page 8-49. Each control bit column displays *Y* or *N*, signifying whether the control bit is set for this vector; refer to *Control Bits* on page 6-88, *Pattern Language Reference*, Chapter 6.

Editing the patgen Column

If the current cell supports microcode, this column displays microcode and a button. Edit the microcode by the following methods:

- In the cell, click the button to open the *Patgen Microcode Edit Popup*; refer to *Patgen Microcode Edit Window* on page 8-37.
- Directly edit the microcode.

Microcode Rules

- In the *normal* mode, the microcode appears only on the first vector of a pair except for a mask control bit that supports microcode on any vector.
- In the *extended* mode, microcode may appear on any vector.
- In the *SCIO* or *mux* mode, a vector appears only on the first line of the vector.

tset Column

Overview

This column displays the **tset** (timing set) name or number for the vector; refer to *tset (Timing Set) Data* on page 6-39, *Pattern Language Reference*, Chapter 6.

A dash (-) in this column signifies runtime repeat, which repeats the **tset** from the previously executed vector.

Requirements

- All **tset** names are declared in the Imports worksheet.
- Single pattern cannot contain both **tset** names and numbers.
- **tset** value must appear for every vector.

Editing the tset Column

If the current cell supports **tset** values, the column displays a **tset** and a button. Edit the **tset** values by the following methods:

- In the cell, click the button to list a drop-down list of **tset** values; all imported **tset**s names include a plus "-". Select one of them.
- Directly edit this column.

tset Rules

In the source pattern file, the **tset** may be part of the vector pin list, or it may be specified only on selected vectors:

- For a pin list:
  a. **tset** column appears in the same position where **$tset** appears in the vector pin list.
  b. **$tset** entry appears in the same position as on the Pin List worksheet.
- For selected vectors:
  a. **tset** column appears after all pin data columns,
  b. **$tset** does not appear as on the Pin List worksheet.

Pin Data Columns

Overview

These columns list the pin names, pin group names, or channel numbers. Initially, the pin data columns are in the same order as the items on the Pin List worksheet. Columns containing only a pair of parentheses are unnamed groups. For information about the pin data values, refer to *Symbolic and Numeric Pin Vector Data* on page 6-41, *Pattern Language Reference*, Chapter 6.

Some column headings have an appended colon and a code letter identifying the display radix. For example, abus:H is a pin group named *abus* displayed in hexadecimal. Available radices: *S* (symbolic), *H* (hexadecimal), *B* (binary), *O* (octal), and *D* (decimal). Default radix: symbolic; refer to *Changing the Radix* on page 8-48.

A dash (-) in this column means runtime repeat, which repeats the data for this column from the previously-executed vector.

Editing the Pin Data Column

If the current cell supports pin data, the column displays the pin data and a button. Pin data can be edited or changed without editing by the following methods:

- In the cell, click the button to open the *Patgen Microcode Edit Popup*; refer to *Pins Edit Popup* on page 8-75. This editing method is useful because **PatternTool** ensures the syntax for format, (symbol or numeric, drive or receive) radix, and symbols are correct.
- Directly edit the pin data.
- Change the pin data states without direct editing: complementing data or swapping drive and receive data; refer to *Changing Pin Data States* on page 8-52.

Pin Data Rules

- In the *mux* mode, two multiplexed items appear in the same column: however, only the first item is named in the column header. The first vector line displays the data for the first item, and the second line displays the second (unnamed) item.
- In the *SCIO* mode, each *io_valid* or *io_midband* item requires two lines to display the data. The first line is either drive or receive, as specified on the Pin Setups worksheet.

comment Column

This column is for end-of-line comments. You can directly edit this column; refer to *End-of-line Comments* on page 8-62.

Label Edit Popup

Overview

This popup is opened from the *label* column on the *Vectors* worksheet.

For label requirements, refer to *Vector Labels* on page 6-34, *Pattern Language Reference*, Chapter 6.

Creating a Label

1. Select a *Label type*: *start*, *local*, *global*, *subr*, or *global subr.*
2. In the *Label name* field, enter a label, containing only letters, digits, and underscores. It must begin with a letter.
3. As you enter a name, the *List* field displays the keyword, the name you are entering, and a terminating colon. Note that **local** label does not have a keyword.
4. If you enter an invalid character, the name disappears from the *List* field.
5. Do not enter the terminating colon; it is appended by **PatternTool**.
6. After entering a name, click *Add*. You can create another label in the same cell.
7. When you have finished, click *OK*.

Deleting and Modifying a Label

To delete an existing label, highlight the label in the *List* field and click *Delete*.

You cannot modify an existing label; instead, delete it and add a modified version.

Patgen Microcode Edit Window

Overview

This window is opened from the *patgen* column on the *Vectors* worksheet. If the column is expanded, you can also open it from the opcode column or any control bit column. For information about opcodes and control bits, refer to *Vector Data* on page 6-31, *Pattern Language Reference*, Chapter 6.

Window Elements

Enabled and Disabled Options in Patgen Microcode Edit

When you choose an opcode in the Opcode choice area of the dialog box, other areas of the dialog box are enabled or disabled, depending on the valid syntax elements for this opcode. For example, if the opcode you select does not take a label as an operand, the *Label* area is disabled.

Microcode Window

As you select or enter elements of the microcode, they are added to the *Microcode* field at the bottom of the window. You cannot directly edit this text, but you edit this information by selecting, deselecting, entering and deleting elements elsewhere in this window.

Enabling and Disabling the OK Button

Until you have entered a valid operand required by the opcode, the *OK* button is disabled. For example, if you select the **repeat** opcode, *OK* is disabled until you enter a valid number in the *Number* field**.** After you enter a valid operand, *OK* is enabled, and you can continue to edit the microcode.

+ Recommended order for entering selections in this window: opcode choice, loop register, label, number, condition, and control bits.

Opcode choice Box

1. In the *Opcode choice* area, select one of the four tabs listing the opcode group and then choose a specific opcode listed on the tab:

Repeat/Loop tab	Branch tab	Subroutine tab	Miscellaneous tab
end_loop	**enable**	**call**	**clr_code**
exit_loop	**end_module**	**call_glo**	**clr_flag**
loop	**halt**	**ccall**	**set_code**
mrepeat	**jmp_glo**	**pop**	**set_cpu**
pipe_minus	**jump**	**push**	**set_glo**

Repeat/Loop tab	Branch tab	Subroutine tab	Miscellaneous tab
pop_loop	**keep_alive**	**resume**	**set_pcf**
repeat	None	**return**	None
set_loop		None	
None			

2. Once you have chosen an opcode, other options for this opcode are enabled while invalid options are disabled.

+ If control bits without an opcode are required, select *None*.

3. After selecting the required option, click *OK*.

To clear the current opcode from the *Microcode* field and any operands and conditions, select *None*. Note that any currently-selected control bits are not cleared because control bits can be used without an opcode.

Loop Reg Box

For certain loop opcodes, you must select a loop register. In this case, select *A*, *B*, or *C* in the *Loop Reg* area. Note that register A is a stack, not a single register.

Label Field

If the opcode requires a label operand, enter a label name in the *Label* field for the selected opcode.

Number Field

If the selected opcode requires a numeric operand, enter a valid number for the selected opcode in the *Number* field.

Condition/Flag List Box

The title for this box depends on the selected opcode:

- For the **clr_flag** or **set_cpu** opcode on the *Miscellaneous* tab, this area is titled *Flag List* because the operands for these two opcodes are flags. You are not conditioning the execution of these opcodes—you are selecting the flags to be cleared or set for these opcodes.

- For a selected opcode accepting conditions or flags, the flags or conditions valid for the opcode are listed in the *Condition* or *Flag List* area. For more about conditions, refer to *Conditional Statements* on page 6-91, *Pattern Language Reference*, Chapter 6.

  All conditions or flag are listed as they appear in the *Condition* box:

		and	**or**
flag		**pcf**	**!pcf**
fail	**pass**	**xext**	**!xext**
ext	**!ext**	**xfail**	**!xfail**
cpuA	**!cpuA**	**cpuC**	**cpuD**
cpuB	**!cpuB**	**cpuD**	**!cpuD**

Determine whether a single or compound flag or condition is required:

- Single Condition/Flag

To select a single condition or flag to execute the opcode, click the desired condition box. The condition or flag appears in the *Microfield* field with the following syntax:

if (*condition*) *opcode*

- Compound Condition/Flag

To select a compound condition or flag to execute the opcode:

1. On *Branch* tab, select the **enable** opcode to start building a compound condition.
2. The *Condition* area lists the valid operands. The selecting conditions here do not condition the execution of the **enable** itself. You can select any number of the conditions except **flag**. Complementary conditions, such as **cpuA** and **!cpuA,** or **fail** and **pass**, cannot both be selected.
3. Choose the logic conditions for the compound, if required: **and** or **or.**

Control Bits Box

Control bits can be added to any vector—an opcode is not required. All control bits are listed as they appear in the *Control Bits* box:

mask	**icc**
ign	**ifc**
stv	**clr_fail**
clr_cond	

For more information about control bits, refer to *Control Bits* on page 6-88, *Pattern Language Reference*, Chapter 6.

Control Bit Restrictions

- **clr_cond** bit is enabled only when the opcode is conditioned with **exit_loop**, **jmp_glo**, **jmp**, **call**, **call_glo**, **resume**, or **return**.
- **ign** control bit is disabled when the **halt** opcode is selected.

Pin Data Edit Window

Overview

This editing dialog box can be opened from any pin data column of the *Vectors* worksheet. In the *SCIO* or *mux* modes, the second row of a vector has columns that do not support data; thus, the edit window is not available for those cells.

Each pin data format enables different editing capabilities.

For more information, refer to *Symbolic and Numeric Pin Vector Data* on page 6-41, *Pattern Language Reference*, Chapter 6.

Pin Data Field

The pin data for the currently-selected format is displayed in the *Pin Data* field at the bottom of the panel. You can edit this data by inserting or deleting characters. If you enter invalid characters, the *OK* button is disabled.

You can also use the panel controls to edit the data in the *Pin Data* area:

- Use the left-arrow and right-arrow buttons above the window to select a character to edit. If no character is highlighted, click one of these buttons to select a character.
- Use the up-arrow and down-arrow buttons on the left side of the window to select the pin data valid for the currently-selected *Format* and *Radix*. The selected *Drive* and *Receive* formats also affect the currently-selected *Radix* of the pin data.

Format Area

The selected format determines what options are enabled; thus, you should choose the format first:

- *Symbolic*—enables the *Symbolic States* area. In the *extended* mode, all buttons are enabled; in the *normal* mode, *D*, *S*, *E*, and *R* are not enabled. When you click on one of these buttons, the current character in the *Pin Data* area is changed to that state, and the next pin data character is highlighted. Use the left-arrow and right-arrow buttons above the *Pin Data* area to select the character to edit.

  If you use the mouse to select several characters in the *Pin Data* area, clicking *Symbolic States* button changes all selected characters to that value.

- *All same*—sets all pins to the same symbolic value. You can use a *Symbolic States* button to set the value. The *Pin Data* area displays the single symbolic value, preceded by a period.

- *Drive/Receive*—These formats use radix values. If you select one of these formats, the Radix options are enabled.

Radix Area

The following numeric options are enabled when the *Drive* or *Receive* format is selected:

- *Binary*
- *Octal*
- *Decimal*
- *Hexadecimal*

Use the left-arrow and right-arrow buttons above the *Pin Data* area to select the radix character to edit. You can then use the up-arrow and buttons to display all valid values for that character.

Symbolic States Area

Selecting the *Symbol* format enables the *Symbolic States* area, which displays the following state values:

0	**1**	**L**	**H**
X	**M**	**V**	**-** (minus)
D	**S**	**E**	**R**

+ In the *extended* mode, all state buttons are enabled. In the *normal* mode, the *D*, *S*, *E*, and *R* states are not enabled.

When you click on one of these buttons, the current character in the *Pin Data* area is changed to that state, and the next pin data character is highlighted. Use the left-arrow and right-arrow buttons above the *Pin Data* area to select the character to edit.

If you use the mouse to select several characters in the *Pin Data* area, clicking the *Symbolic States* button changes all selected characters to that value.

Editing the Vectors Worksheet

Editing Vectors Columns

Some vector columns have edit popups to assist you in editing the columns; refer to *Vectors Worksheet Columns* on page 8-31.

The *Vectors* worksheet has several columns with unique editing features; however, the general editing features for all worksheets also apply to the *Vectors* worksheet:

- *Selecting Data to Edit* on page 8-19
- *Hiding and Exposing Columns* on page 8-11
- *Editing Cell Data* on page 8-23
- *Using Find, Replace, and Goto* on page 8-27

In addition to the general editing features, only the *Vectors* worksheet supports the following editing features:

- *Changing the Appearance of the Vector Column* on page 8-47
- *Changing the Radix* on page 8-48
- *Expanding and Collapsing Columns* on page 8-49
- *Creating Pin Groups* on page 8-51
- *Changing Pin Data States* on page 8-52
- *Cutting, Copying, and Pasting Vector Data* on page 8-56
- *Inserting and Deleting Vectors* on page 8-59
- *Adding and Editing Comments* on page 8-60

Editing MTM (Memory Test Module) Data

MTM (Memory Test Module) data may require special editing considerations; refer to *Memory (MTM) Data* on page 8-63.

Using Find/Goto on the Vectors Worksheet

In addition to the general search features of Find/Goto, only the *Vectors* worksheet supports the following additional searching features:

- Go to a specific vector:

1. On the *Find/Goto* menu, select *Vector* from the *Goto* submenu**.** You can also use the shortcut F5 key. The *Go To Vector* dialog box opens.
2. In the *Go To Vector* dialog box, enter the number of the vector you want to go to in the *Enter Vector Number* box. The number must be an integer. For two-line vectors with vector numbers like 3.1 and 3.2, entering the integer, such as 3, goes to the first of the two vector lines.

- Go to a specific label:

1. On the *Find/Goto* menu, select *GotoLabel***.** The *Go To Label* dialog box opens.
2. In the *Go To Label dialog box*, enter the name of the label, but not the label type, such as **global** or **subr**, in the *Enter Label Name* box. Only the labels in the label columns are searched for; references to labels are not searched for, such as the operand of a **jump** opcode. To find references, use Find Text**.**

Saving an Edited Pattern File

When you save an edited pattern file with the *Save* or *Save As* command, it is checked for errors. If errors are found, the errors are written to a *Message* window; refer to the following topics for more information:

- *File Checking* on page 8-14
- *Message Window* on page 8-16

Changing the Appearance of the Vector Column

Overview

Certain commands and operations change the appearance of the selected columns of vector data on the *Vectors* worksheet; however, the data in the columns is not changed:

- *Changing the Radix* on page 8-48
- *Expanding and Collapsing Columns* on page 8-49
- *Creating Pin Groups* on page 8-51

In addition, the appearance of columns on any worksheet, including the *Vectors* worksheet, can be changed by hiding, exposing, resizing, or moving columns; refer to *Changing the Column Appearance* on page 8-10.

Selecting a Column

To change appearance of a column, select a cell in the column by clicking on it. The entire column is selected. You do not have to select all individual cells in the column: if you select an entire row by left-clicking in the row header in the far left column, every column is selected.

Changing the Radix

Overview

Pin data can be displayed in different radices:

- *Symbolic*
- Numeric: *Binary*, *Octal*, *Decimal*, and *Hex*

The current radix is displayed in the column heading, as a code appended to the pin or group name. If no radix code is appended, the default radix is *Symbolic*. For example: `abus:H`

where `abus` in the pin group, and `:H` indicates hexadecimal representation.

For more information, refer to *Symbolic and Numeric Pin Vector Data* on page 6-41, *Pattern Language Reference*, Chapter 6.

Changing the Radix

1. Select a column by selecting at least one cell in the column, refer to *Selecting Data to Edit* on page 8-19.
2. On the *Column* menu, from the *Radix* submenu, select *Symbolic*, *Binary*, *Octal*, *Decimal*, or *Hex*.

+ Only pin data columns in the Vectors worksheet support radix.

Expanding and Collapsing Columns

Overview

You can change how **PatternTool** displays the pin data or patgen microcode by displaying the pin data in individual columns for each pin in a pin group or the opcode code and each control bit.

If a pin data column represents a pin group, you can expand the group to display each pin in the group, one column per pin. Or, you may prefer to expand the pin data because editing individual pins is easier than changing a value representing the data for the entire pin group.

You can also expand the column for the patgen microcode to one opcode column and one column for each control bit: **clr_fail**, **icc**, **ifc**, **ign**, **mask**, and **stv**; refer to *Control Bits* on page 6-88, *Pattern Language Reference*, Chapter 6. The expanded control bit columns will display *Y* and *N*, signifying whether the control bit is set. You can directly manipulate the expanded control bits; refer to *Changing Pin Data States* on page 8-52.

Expanding a Pin Data Column

To expand a column:

1. Select the column by selecting at least one cell in it, refer to *Selecting Data to Edit* on page 8-19.
2. On the *Column* menu, click *Expand*.

Collapsing a Pin Data Column to a Single Column

To collapse the expanded columns to their original single column:

1. Select at least one cell from any of the expanded columns, refer to *Selecting Data to Edit* on page 8-19.
2. On the *Column* menu, click *Collapse*.

Collapsing a column returns the expanded columns to their original unexpanded grouping. If you select a subset of the expanded columns and collapse it, the columns in the subset are collapsed to the original column grouping.

Be aware that expanding and collapsing columns containing new column groupings may result in unexpected results. For instance, assume you expand a column, and then click the *Make Group* command on the *Column* menu to create a column group that is a subset of the expanded columns. When you click *Collapse*, the individual columns may not collapse to the original column grouping before the new column grouping was created. For more information about creating column groupings, refer to *Creating Pin Groups* on page 8-51.

Column Headings

Expanding a column may truncate the headings of the new columns because the headings are too wide. To display the entire heading, such as control bit headers, you can increase the height of the column header by resizing the top row containing the column headers; refer to *Resizing the Row Height* on page 8-13.

Creating Pin Groups

Overview

You can display pins in new pin groups, even if these groups are undefined in the pin list.

Note the following restrictions and requirements:

- Only pin or channel data columns can form a new group.
- Pins in the **mux** or **SCIO** mode cannot be grouped with pins not in the same mode.
- Columns of individual pins or pin groups can be grouped.
- A pin group can be expanded into individual pin columns, and then the individual columns can be grouped into new pin groups.

To combine pins or pin groups into a new group:

1. Select at least one cell in each of the columns to be grouped, refer to *Selecting Data to Edit* on page 8-19.
2. On the *Column* menu, click *Make Group*. The selected columns are grouped into a single column. The column header contain a list of all items, in parentheses.

Changing Pin Data States

Overview

The data in a selected range of cells can be changed, without manually editing the individual cells. The pin data states underlying a cell are changed, not the textual representation of the cell, such as its radix.

Selecting Pin Data Cells to Change

The cells must be selected before they can be edited; refer to *Selecting Data to Edit* on page 8-19. One cell, a rectangular range of cells, non-adjacent cells, an entire row or column of cells, or all cells in the grid can be selected. If you select cells whose pin data state cannot be changed, **PatternTool** ignores those cells, without issuing a warning.

Changing Pin Data States in Selected Cells

- *Complementing* on page 8-53
- *Swapping the Drive and Receive Data* on page 8-54
- *Replacing the Pin States in Pin Data Cells* on page 8-54

Complementing

Complementing the Pin Data States

To change the pin states to their complement, such as **L** to **H** or **1** to **0**:

1. Select the pin data cells, refer to *Selecting Data to Edit* on page 8-19.
2. On the *Edit* menu, select *Complement*. You can also use the  button on the *Edit* toolbar.

Changing each pin data state to its complement, such as **0** to **1**, **1** to **0**, **L** to **H**, and **H** to **L**, has no effect on the other data codes.

Complementing the Control Bits

To complement the control bit cells:

1. Expand the *patgen* microcode column into an opcode column and control bit columns; refer to *Expanding and Collapsing Columns* on page 8-49. If the patgen microcode column is not expanded, the *Complement* command does not affect the control bits.
2. Select the control bit cells, refer to *Selecting Data to Edit* on page 8-19.
3. On the *Edit* menu, select *Complement*. You can also use the  button on the *Edit* toolbar. In this case, *Y* is changed to *N* and *N* to *Y*.

In the *normal* mode, the opcode and most control bits are used only on the second vector of each vector pair. Also, only the mask control bit is allowed on the first vector of the pair. For these reasons, in the *normal* mode the mask control bit on only the first vector of a vector pair can be complemented, while all bits on the second vector are affected.

Swapping the Drive and Receive Data

Swapping the drive and receive data changes the data from **0** to **1**, **1** to **0**, **L** to **H**, and **H** to **L**. For a radix other than symbolic, the **.d** and **.r** indicators are swapped, such as **.d1F** becomes **.r1F**. Swapping has no affect on other symbolic datacodes or on control bits.

To swap the drive and receive data:

1. Select the pin data cells, refer to *Selecting Data to Edit* on page 8-19.
2. On the *Edit* menu, click *Swap 0/1 With L/H*. You can also use the  button on the *Edit* toolbar.

Replacing the Pin States in Pin Data Cells

Overview

You can replace one set of pin states of pin data cells with another set by specifying the states to be changed and those to be substituted. Each state can be replaced with a specific single state, or all states can be replaced with a single state. For example, you can specify that **0** and **L** should be replaced with **1** and **H**, or that **X** should replace **H**, **M**, and **V**.

Valid values for both *From States* and *To States* fields:

```
0 1 L H M V X - 2 D S E R
```

For information about the meaning of these states, *Symbolic and Numeric Pin Vector Data* on page 6-41, *Pattern Language Reference*, Chapter 6.

Replacing States

To replace states:

1. Select the pin data cells, refer to *Selecting Data to Edit* on page 8-19.
2. On the *Edit* menu, click *Replace States*. The *Find & Replace States* dialog box appears.
3. In the *From States* field, enter the state or states to be searched for and replaced. You can type in the states. Or, you can click on *Drive States*, *Receive States*, or *All States* button to have those states appear in the *From States* field. If you use the buttons to enter the states, you can edit the *From States* field, if needed.
4. In the *To States* field, enter the state or states to be substituted for the state listed in the *From States* field. You have the following options:

- Enter either one value, or the same number of values as in the *From States* field.
- If you enter a *n* (number) of states in both the *From States* and *To States* fields, the *n*th *From States* value is replaced by the *n*th value in the *To States* field.
- If you specify only one value in the *To State* field, all values in the *From States* field are replaced by a single *To States* value.

Cutting, Copying, and Pasting Vector Data

Overview

The *Vectors* worksheet supports the standard cut, copy, and paste operations; refer to *Editing Cell Data* on page 8-23. In addition, this worksheet supports several additional pasting features, because the *Vectors* columns have special requirements for any data pasted into them.

Standard pasting gets the data currently on the clipboard and pastes it into the vector. However, certain cases may require a special paste operation due to how the vector data was copied to the clipboard. The appropriate paste command depends on the contents of the clipboard. Data is copied to the clipboard in one of three different formats, which determines the proper paste command to use:

Clipboard Contents	*Use this paste command:*
Text	Paste Text
Pin data	Paste Pin Data
Whole row	Paste Rows

+ Pasting non-adjacent cells: select multiple non-adjacent cells by holding down the Ctrl key while clicking on individual cells. Although you can cut non-adjacent cells to delete their contents, **PatternTool** does not paste to the selected non-adjacent cells.

Paste Text

This command in the *Edit* menu copies data from a different application, such as **Excel**. You can also use the  button on the *Edit* toolbar.

If the replacement or pasted text does not compile within the cell, a message box appears. You are prompted to attempt the paste operation anyway. If you answer no, the current cell is skipped, and the paste operation goes to the next cell.

The behavior of *Paste Text* depends on the clipboard data:

- To paste pin data with *Paste Text*, you should have correctly copied the data to the clipboard: same pin type and, for pin groups, the same number of pins per group. In some cases, however, the paste operation may succeed even if the number of pins do not match.
- Clipboard data contains row markers. A row marker signifies that data has been copied to the clipboard as one or more complete rows:

  If the clipboard data contains row markers, *Paste Text* is the same as *Paste Rows*.

  If the clipboard has no row markers, *Paste Text* replaces each cell within the selected area with the clipboard data.
- If the clipboard data has extra rows or columns, they are ignored during pasting. If more rows or columns are selected than those in the clipboard data, these excess rows, which are referenced from the far right and bottom rows, do not receive any pasted data.

Paste Rows

This command in the *Edit* menu inserts new rows are above the selected row when the entire grid is selected, or rows are appended to the bottom of the grid when an entire column is selected.

This paste command has the following requirements:

- Clipboard data must be in a row format—an internal row format or text row format.
- Clipboard data must have enough data for all the columns of the grid.

Paste Pin Data

This command in the *Edit* Menu pastes pin data or control bit data that is copied from an expanded patgen column that displays the opcode and control bits. You can also use the  button on the *Edit* toolbar.

This command is less restrictive than the other paste commands:

- Selected area must have the same number of pins and of vector rows as the clipboard data; however, the pin groups do not have to be equal. For example, data can be copied from 2 pin groups with 6 pins each, and be pasted to 4 pin groups with 3 pins each, as long as the total number of pins and rows match.
- Number of columns is not significant.
- Data from one pin column can be pasted to another if the symbolic pin states are compatible, even if the pins have different modes. If you attempt to paste an invalid state, such as *V* to an *io_midband* pin, an error is reported.
- If the copied data includes any comment rows, the comment rows are not pasted; only pin data is pasted.

Inserting and Deleting Vectors

Overview

Improperly inserting or deleting a vector row may invalidate the entire pattern file. If the pattern file was compiled in the *normal* mode, opcodes and labels can appear only on every other vector. Consequently, if you insert or delete an odd number of vectors, this alternating pattern will be disrupted. In this case, the labels and opcodes appearing on illegal vectors are highlighted in pink until you restore the proper number of vectors.

Inserting Vectors in a Pattern FIle

+ Copying and pasting vectors (*Cutting, Copying, and Pasting Vector Data* on page 8-56) may be a more efficient method than inserting new ones because you can usually edit less data in the copied vectors than editing all default values of the inserted data, such as, runtime repeat.

1. On the *Edit* menu, under the *Insert Mode* submenu, select where you want to insert the new rows: *Insert Before Selection*, *Insert After Selection*, or *Insert Before Current Cell*.
2. On the grid, select the same number of rows as the number of rows to insert. For example, select 5 current rows to insert 5 rows. Select a row by highlighting at least one cell in the row.

+ In the *SCIO* or *mux* mode, each vector is represented on two lines numbered *n*.1 and *n*.2. You cannot insert a new vector between the lines of a two-line vector.

3. After selecting the correct number of rows, select *Insert Vectors* on the *Edit* menu**.** The new vectors have default values**:** no label or patgen microcode, each pin data cell is set to - (minus sign), which is runtime repeat of the data from the previous vector. In the *SCIO* mode, the drive cell is set to 0, and the receive cell is set to X.
4. Once the new vector is inserted, you can edit the Vectors worksheet to enter non-default data; refer to *Editing the Vectors Worksheet* on page 8-45

Deleting Vectors from a Pattern File

1. Select the vectors by selecting at least one cell in the row; refer to *Selecting Data to Edit* on page 8-19.
2. On the *Edit* menu, select *Remove Rows***.** If you select multiple non-adjacent cells by holding down the Control key while clicking on the cells, *Remove Rows* is disabled; the command can remove only adjacent rows in a single operation.

Adding and Editing Comments

Overview

The *Vectors* worksheet provides two columns for displaying comments:

//	Column next to the row header column containing the row numbers. It displays block comments**,** which take up the entire line; however, you do not use this column to enter the block comments; refer to *Block Comments* on page 8-61.
comment	By default, this far-right column displays end-of-line comments**,** which appear on the same line as the vector and are terminated by the end of the line; refer to *End-of-line Comments* on page 8-62.

These columns are hidden if the pattern file was compiled without saving the comments; refer to *save_comments Option* on page 8-60. To expose the comments, refer to *Hiding and Exposing Columns* on page 8-11.

save_comments Option

The Pattern Compiler saves any comments you add to a compiled *.pat* file only if the *save_comments* option is enabled before compilation. When you save a pattern file, **PatternTool** determines whether the pattern file has comments and checks the setting of *save_comments*. If it is disabled, **PatternTool** prompts you to set it to *yes* so the comments can be saved. If you enter *no*, added comments are discarded, and the two columns for comments are hidden.

To set the *save_comments* option in a pattern file:

1. On the *Options* worksheet, click *save_comments* on the *Value* column.
2. From the drop-down list on the *Value* column, select *yes.*
3. To display the *comment* columns on the *Vectors* worksheet, click the *Expose* command in the *Column* menu on the highlighted *$//* and *$comment* columns. For more information, refer to *Hiding and Exposing Columns* on page 8-11.

Block Comments

Overview

Block comments in the *Vectors* worksheet are displayed in the // column. This column is next to the next to the column of vector numbers. You do not add comments to the // cell of a row that already contains vector data because anything you enter in that cell will be discarded.

Block comments fill the entire line. Each row of block comments extends across the entire grid, with no dividing lines for columns. Comments are numbered *m.C.n*, where *m* is the vector number of the vector preceding the block comment, *C* is a comment, and *n* is the line number within this block comments, starting at 0. For example, *5.C.3* is the fourth comment line after vector number 5. Even though the numbering of comments is based on the rows preceding them, they are actually associated with the preceding vector.

For header comments, the vector number (*m*) is -1; for example, *-1.C.10*.

Even though block comments seem to extend across the entire grid, they are stored only in the // column. Consequently, if you copy a pin data cell range extending above and below a block comment, the comment is not included when you paste the pin data.

If this column is moved, comments are not displayed and editing of existing comments is disabled.

Adding Block Comment Rows

1. On the *Edit* menu, under the *Insert Mode* submenu, select where to insert the new rows: *Insert Before Selection*, *Insert After Selection*, or *Insert Before Current Cell*.
2. On the grid, select the same number of comment rows as the number of rows to insert. For example, select 5 current rows to insert 5 comment rows. Select a row by highlighting at least one cell in the row.
3. After selecting the correct number of rows, select *Insert Comments* on the *Edit* menu to add the selected number of comment rows.

Editing Block Comments

Any text except a newline is permitted within a block comment. Entering a new line produces unpredictable results; thus, the recommended method is to continue a comment on a succeeding comment row instead of beginning a newline.

PatternTool starts each block comment row with the comment bars `//`. You do not need to maintain proper comment delimiters because **PatternTool** adds any needed delimiters to the comment rows when you save a file.

To use the `/*` and `*/` delimiters in block comments:

1. First line of the block comment must start with `/*`
2. Last line must end with `*/`
3. No `*/` between the beginning and ending comments.

If these rules are violated, **PatternTool** converts the comments to `//` style.

Header, Vector, and Trailer Comments

The **Pattern Compiler** recognizes three kinds of block comments:

- header comment at the start of the pattern file
- comment preceding an individual vector
- trailer comment at the end of the file

To distinguish between a header comment and a comment preceding the first vector, **PatternTool** ends a header comment with a comment row containing only a period (.).

End-of-line Comments

End-of-line comments are in the *comment* column. The comment is on the same line as a vector. If a vector requires two lines, such as for *mux_mode* or *SCIO*, a comment can appear only on the first line.

You can enter end-of-line comments without delimiters. **PatternTool** adds any missing comment delimiters when you save the file.

If a comment starts with `/*` and contains a `*/` before the end of the text, the text is truncated after the `*/`.

Memory (MTM) Data

Overview

A pattern file containing MTM (Memory) data is specified on the *Vectors* worksheet.

Memory Data Columns

If a pattern file contains memory (MTM) data, several columns for the MTM opcodes are added to the *Vectors* worksheet. These columns are listed below.

+ The column name is usually the same as opcode name; however, if the column name differs from the opcode name, the proper opcode is in parenthesis. Opcode syntax is listed in *MTM (Memory) Opcodes* on page 6-65, *Pattern Language Reference*, Chapter 6.

Column	Description
xalu	ALU for X counters
xa, xb, xc, xd,	Control an X address counter
xdevadr	X counter to address the DUT
xena (**load_xenable**)	Change the X address enable register
yalu	ALU for Y counters
ya, yb, yc, yd	Control a Y address counter
ydevadr	Y counter address to the DUT
yena (**load_yenable**)	Change the Y address enable register
zalu	ALU for Z counters
za, zb	Control an X address counter
zdevadr	Z counter to address the DUT
zena (**load_zenable**)	Change the Z address enable register
dga, dgb	Control the 32-bit data generator (**dgen**) counter

Column	Description
dg_sel	32-bit data counter (**dgen**) for data generation
dgroup	Select a data group (2-bit **dgen**)
dset	Select a data group (2-bit **dgen**)
xdgadr	X address counter as input to 2-bit **dgen**
ydgadr	Y address counter as input to 2-bit **dgen**
alu const (**alu_const**)	Constant for ALU expression
frame	Select the frame select bit
*sr reg (***sr_reg***)*	Control the serialization register.
*wr db (***wr_dbm***)*	Select DBM on the fly as the alternate data source instead of the Address Data Generator
*dbm en (***dbm_enable***)*	Enable masking of DBM output
*cap err (***capture_errs***)*	Enable error capturing to the ECR
*vihh0, vihh1, vihh2, vihh3 (***vihhen*X***)*	Enable VIHH control of the pin levels.
dps0, dps1, dps2, dps3	Control DPS ratcheting on selected DPS.
*acc 0 (***dbm_acc_zero)**	Enable DBM accumulate zeros mode
iddsync	Control the Ipeak current measurement
learn_dut	Enable DBM learn-DUT mode
*errors (***ecr_boe***)*	Control branching on error

Every MTM column has a value on every vector because every MTM opcode in a pattern file is programmed on every vector. If an MTM opcode is not explicitly included on a vector, a default opcode is used; consequently, **PatternTool** displays a value for every MTM column.

Hiding and Exposing MTM Columns

You can hide those columns containing MTM data. Click *Hide MTM* on the *Column* menu to hide the MTM columns without deleting them. This command is like the regular *Hide* command except that you do not have to select the MTM columns to hide. When MTM columns are hidden, click *Expose MTM* to display only the MTM columns; refer to *Hiding and Exposing Columns* on page 8-11.

Editing MTM Data

How you edit the MTM data depends on the complexity of the data expression:

- Opcodes with valid values—Most cells in MTM columns have a button to display a drop-down list of the valid values for a specific opcode. These lists are provided for opcodes with a set of simple values.
- Opcodes with no values—They are either included or omitted on a vector. They are specified on a drop-down list by *Y* (yes, include) and *N* (no, omit).
- Opcodes with complex expressions—cannot be configured by using a drop-down list, such as **xalu, yalu, zalu, dgalu** (16-bit only), and **alu_const.** Edit these opcodes by using the *MTM Microcode Edit Popup* on page 8-66.

MTM Microcode Edit Popup

Overview

The following techniques invoke the *MTM Microcode Edit* popup from a MTM cell:

1. Click on the right-arrow in a MTM cell.
2. Under *Edit* menu, select *Cell Edit Popup*.
3. Press the F7 key.

You can use the *MTM Microcode Edit* popup to edit all MTO microcodes for a vector, not just the opcode for the one column where you invoked the popup; however, only those opcodes valid for the data generator specified on the *Instruments* worksheet are displayed. Each MTM opcode has a corresponding control, such as a checkbox, combination box, or input box, for changing the opcode setting.

For information about opcodes, refer to *MTM (Memory) Opcodes* on page 6-65, *Pattern Language Reference*, Chapter 6.

MTO microcode: display

The read-only *MTO microcode:* field at the bottom of the popup shows the current MTO microcode, including any edits. It displays the opcodes having non-default values. If you specify a non-default value for an opcode, the opcode and value appear in the display. If you change a non-default to a default value, the opcode disappears from the display.

You cannot directly edit this field. This field is changed by manipulating the controls on the popup. You can highlight and copy the contents of the field, and then paste it into another file, such as an ASCII pattern file.

Checkbox, Combo Box and Text Box Controls

+ For information about valid values for the MTM opcodes, refer to *MTM (Memory) Opcodes* on page 6-65, *Pattern Language Reference*, Chapter 6.

Checkbox	These controls are for opcodes that do not accept values, but are either included or omitted on a vector. For example, you either include or omit the **capture_shift** opcode. Checking the box includes the opcode; not checking the box omits it. By default, these opcodes are omitted. On the *Vectors* worksheet, the columns for these opcodes have either *Y* (include) or *N* (omit). Opcodes with checkboxes: **load_xenable**, **load_yenable**, **load_zenable**, **wr_drm**, **dbm_enable**, **capture_errs**, **dbm_acc_zero**, **vihhen0**, **vihhen1**, **vihhen2**, **vihhen3**, **learn_dut**, and **iddsync**.
Combo Box	These controls are for the opcodes with a set of valid values. For example, **xa** opcode is set to **hold**, **inc**, **inc_link**, and others. Select a value from the drop-down list for the following opcodes: **xdevadr, ydevadr, zdevadr, dset, dgroup, xdgadr, ydgadr, sr_reg, xa, xb, xc, xd, ya, yb, yc, yd, za, zb, dgsel, frame, dps0, dps1, dps2, dps3,** and **ecr_boe**.
Text Box	Sets an integer constant for the ALU expression **alu_const**. Valid range: 0 to 65535.

+ For the text boxes for the **xalu, yalu, zalu,** and **dgalu** opcodes, refer to *ALU Tabs: xalu, yalu, zalu, dgalu* on page 8-68.

ALU Tabs: xalu, yalu, zalu, dgalu

These tabs are for creating expressions for the **xalu, yalu, zalu,** and **dgalu** opcodes, only for the 32-bit data generator.

All tabs include checkboxes to *invert* the expression and to *link* the X and Y ALUs; however, on the **dgalu** tab, *link*, *xdevadr,* and *ydevadr* are never enabled.

The read-only *xalu*, *yalu*, and *zalu* fields display the current values for each opcode for whatever tab is exposed.

Each ALU tab enables different buttons and checkboxes for specific operations. Each ALU tab has three sets of radio buttons:

+ On the **dgalu** tab, *link* is never enabled, and *xdevadr* and *ydevadr* are never enabled.

- **Operand 1**—To assign *Operand1* as the ALU value, select *nop* as the *Operation*. With this selection, the *Operand 2* buttons are disabled; *invert* box is enabled; *link* is disabled.
- **Operation** to be performed:
  a. Arithmetic operation (+, -) accepts both operands. Also, *invert* box is disabled; *link* is enabled.
  b. Logical operation (*and*, *or*, *xor*) accepts both operands. Also, *invert* box is enabled; *link* is disabled.
  c. For arithmetic or logical operand, *Operand 1* must be one of the counters; the other buttons are disabled.
  d. Shift operation (*<<1*, *>>1*) uses only *Operand 1*. *Operand 2* buttons are disabled. *invert* box is disabled; *link* is enabled.
- **Operand 2—**selects the additional operands as required.

Applying the MTM Microcode Edits

Apply the edits to the MTM microcode by clicking the *OK* button, which is enabled only if the integer in the **alu_const** input box is between 0 to 65535.

Other Worksheets

Overview

The remaining worksheets are editable. The *Pin List* and *Pin Edit* worksheets are not directly editable; instead, you open an edit worksheet for each one; refer to *Pin Edit Worksheets* on page 8-69.

All of the general editing features apply to these worksheets; refer to *Editing with PatternTool* on page 8-18. In addition, each worksheet has a specific editing features:

- *Pin List Worksheet* on page 8-70
- *Pin Setups Worksheet* on page 8-72
- *Options Worksheet* on page 8-76
- *Imports Worksheet* on page 8-79
- *Instruments Worksheet* on page 8-80

Pin Edit Worksheets

You do not directly edit the *Pin List* worksheet and *Pin Setups* worksheet worksheets; instead, you open an edit popup for each worksheet, make any changes on the edit worksheet, and then use the edit worksheet to update the actual worksheet; refer to *Pin List Edit Worksheet* on page 8-71 and *Pin Setup Edit Worksheet* on page 8-74.

The *Pin Edit* worksheet is useful for validating edits because your worksheet can temporarily be in an invalid state when adding a pin to one row before deleting it from another. The edit worksheet is not validated until you actually try to update the worksheet.

Pin List Worksheet

Overview

The *Pin List* worksheet displays the list of pins for the vector data. These pin lists are used by the *Vectors* worksheet for assigning the data to each pin. The pin list is based on the pins listed in the **vector** statements in the pattern file; refer to *Vector Statement* on page 6-30, *Pattern Language Reference*, Chapter 6.

Name Column

The *Name* column specifies the pin, pin group, or channel. A list of comma-separated items creates an unnamed group. You can enter the keyword **$tset** in one row to designate the column in which the **tset** (timing set) name or number will appear.

You can add or edit any pin name or group name in the pin list by directly editing the item or by using the *Pin List Edit* popup; refer to *Pin List Edit Worksheet* on page 8-71.

Radix Column

You can directly enter a valid display radix or use the drop-down list to select a display radix:

S = symbolic

B = binary

O = octal

D = decimal

H = hexadecimal

For **$tset**, *Radix* is set to **D.**

Pin Count Column

The *Pin Count* column displays the number of pins or channels in the items listed in the *Name* column**.** For **$tset,** the number is 0.

You cannot edit the *Pin Count* value. **PatternTool** updates this value for the correct number of pins or channels in the *Name* column.

Pin List Edit Worksheet

1. On the *Pin List* worksheet, select *Edit Pin List* from the *Edit* menu. A *Pin List Edit* worksheet is created because you cannot directly edit a *Pin List* worksheet. Any changes to the worksheet during editing appear in blue. The *Undo* and *Redo* commands are enabled.
2. To create a new pin list item, insert a new row, refer to *Inserting and Deleting Rows* on page 8-26.
3. To delete an item, delete the row containing the item, refer to *Inserting and Deleting Rows* on page 8-26.
4. To edit an item in the *Name* column, use one or both of the following methods:
   a. To edit a selected *Name* column with the *Pins Edit* popup, click the arrow in the *Name* column. A popup opens. Use the popup to add or delete pins or groups; refer to *Pins Edit Popup* on page 8-75.
   b. You can directly edit an existing item. If you type more than one item into a single cell, surround these items with parentheses so they are recognized as an unnamed group. If you use the edit popup to edit an unnamed group, **PatternTool** adds the parentheses.
   c. If you have used the *Read Pinmap* command, you can edit any name defined in the pinmap; refer to *Reading the Pinmap* on page 8-76. You can also use the value **$tset,** which is available on the edit popup.
5. After you finish editing, select *Update Pin List* on the *Edit* menu to apply the edits to the actual *Pin List* worksheet. To cancel editing, select *Abort Pin List Edit*.

+ Any errors from updating the worksheet are written to the *Message Window* on page 8-16.

Restrictions

- An item on a pin list can be moved from one unnamed group enclosed in parenthesis to another group.
- A row can be added to move a pin out of a group.
- A new group name can be added if it is in a pinmap already loaded; however, you cannot add new pins.
- Set of all pins used must not change; but, you can reorganize the existing items.

Viewing Updates to the Vectors Worksheet

Changes to the *Pin List* worksheet are not immediately updated in the *Vectors* worksheet. To view the updated changes, open a new window by selecting *New Window* on the *Window* menu. The Vectors worksheet in the new window will use the updated pin list.

Pin Setups Worksheet

Overview

The *Pin Setups* worksheet displays the special modes for pins defined in the **pin_setup** statement in the pattern file. For information about this statement, refer to *Required pin_setup Statement* on page 6-46, *Pattern Language Reference*, Chapter 6.

Name Column

This column specifies the pin, pin group, or channel with the special mode. A list of comma-separated items surrounded by parentheses creates an unnamed group.

You can add or edit any pin name or group name in the pin list by directly editing the item or by using the Pin List Edit popup; refer to *Pin Setup Edit Worksheet* on page 8-74.

Mode Column

Use the drop-down list to specify one of the following modes:

- **mux**
- **io_midband**
- **io_valid**
- **high_voltage**
- **freq_count**

+ You cannot change a pin into or out of the **io_valid** or **io_midband** mode: the pin must stay in the **SCIO** mode; thus, if a pin is already in **io_valid** mode, you can change it to **io_midband,** and vice versa.

Effects of Changing a Pin Setup

Changing a pin setup can affect the pin data states on the *Vectors* worksheet:

- Specifying a **mux_mode** pin setup causes **PatternTool** to change the format of the *Vectors* worksheet to support two-line vectors, those with rows numbered *n*.1 and *n*.2. If all such pin setups are removed, the Vectors format changes from two-line to one-line vectors.
- By changing the mode from **io_midband** to **io_valid**, **PatternTool** will change any pin data with the value *M* to *X*; and any *X* will be changed to *V*; if you change **io_valid** to **io_midband**, *V* will be changed to *X* and *X* will be changed to *M*.

IO: Drive First Column

This column requires a value if the *Mode* column is **io_midband** or **io_valid**. Use the drop-down menu to select a valid value:

yes—drive data is specified first in the pattern.

no—receive data is specified first in the pattern.

blank (empty)—removes a value from the selected cell.

Mux: Alt Pins Column

This column requires a value if the *Mode* column is **mux.** The pins specified in this column are multiplexed with the pins specified in the *Name* column. A list of comma-separated items surrounded by parentheses creates an unnamed group.

You can add or edit any pin by directly editing the item or by using the *Pins Edit Popup* on page 8-75.

Choices for the final two columns do not depend on the *Mode* value. For example, you can enter a valid value for *Mux: Alt Pins* even if *Mode* is not **mux**; thus, you can edit the columns in any order because the columns are not validated until you try to update the pin setup.

Pin Setup Edit Worksheet

1. On the *Pin Setup* worksheet, select *Edit Pin Setups* from the *Edit* menu. A *Pin Setup Edit* worksheet is created because you cannot directly edit a *Pin Setup* worksheet. Any changes to the worksheet during editing appear in blue. The *Undo* and *Redo* commands are enabled.
2. To create a new pin setup, insert a new row; refer to *Inserting and Deleting Rows* on page 8-26.
3. To delete a pin setup, delete the row with the item; refer to *Inserting and Deleting Rows* on page 8-26.
4. To edit a selected *Name* column, use one or both of the following methods:
   a. To edit a selected *Name* column with the *Pins Edit* popup, select click the arrow in the column. This popup helps you in adding or deleting pins or groups; refer to *Pins Edit Popup* on page 8-75.
   b. You can also directly edit an existing item. If you type more than one item into a single cell, surround these items with parentheses so they are recognized as an unnamed group. If you use the edit popup to edit an unnamed group, **PatternTool** adds the parentheses.
   c. If you have used the *Read Pinmap* command, you can edit any name defined in the pinmap; refer to *Reading the Pinmap* on page 8-76. You can also use the value **$tset,** which is available on the edit popup.
5. After you finish editing, on the *Edit* menu, select *Update Pin Setups* to apply your changes to the actual Pin Setup worksheet. To cancel your edits, select *Abort Pin Setups Edit.*

+ Any errors from updating the worksheet are written to the *Message Window* on page 8-16.

Pins Edit Popup

Overview

Both the *Pin List Edit Worksheet* on page 8-71 called from the *Pin List Worksheet* on page 8-70 and the *Pin Setup Edit Worksheet* on page 8-74 called from the *Pin Setups Worksheet* on page 8-72 allow you to use the *Pins Edit* dialog box for editing the *Name* column in the *Pin List* and *Pin Setup* worksheets. Also, you can use this popup to edit the name of the multiplexed pins specified in the *Mux: Alt Pins* column on the *Pin Setup Edit* worksheet.

Using the Pins Edit Popup

+ If you have opened the *Pins Edit* popup from the *Pin List Edit* worksheet, the popup includes a box labeled **$tset.** To set this cell to **$tset**, check the box; if the box is checked, you cannot add any pins, and the other controls on the popup are disabled.

On the *Pins Edit* dialog box, the *List* window displays the current contents of the cell. You can add or delete pins or pin groups:

To add a pin or pin group to the list:

1. Enter a name in the *Pin* or *pin group name* field or use the scroll list that includes all pin and pin group names from the pattern file, and any pins from the pinmap if you have read in a pinmap; refer to *Reading the Pinmap* on page 8-76.
2. Click *Add*. The items are added Repeat Steps 1 and 2 for as many items as required.

To delete a pin or pin group:

1. In the *List* window, highlight the items to delete by clicking on them.
2. Click *Delete* to add the item to the *List* window. Repeat Steps 1 and 2 for as many items as required.
3. Click *OK* to delete the items.

+ If the *List* window contains multiple items, they are enclosed in parentheses in the cell on the edit worksheet. The parentheses signify the items are an unnamed group.

Reading the Pinmap

Overview

The pin list displayed in the *Pin List* worksheet is based on the **vector** statement in the pin list from the pattern file. By default, the *Pin List* worksheet contains all pins and groups in this pattern file; however, the *Pin List* worksheet may be a subset of the pins and groups defined on the *Pin Map* sheet of the test program workbook. Consequently, you can import these additional pins and groups when editing the *Pin List* or *Pin Setup* workbook by using the *Read Pinmap* command.

Using Read Pinmap

On the *File* menu, select *Read Pinmap*. The *Open Pinmap* dialog box opens. By default, this box displays the name of the workbook and pinmap sheet specified on the *Options* worksheet. You can specify a different workbook and pin map sheet in the *Pin Map* workbook and pinmap sheet fields. If the workbook contains only one pinmap, the pinmap sheet name can be blank.

To select a pinmap file, click the *Browse* button. An *Open Pinmap* dialog appears. After you have selected the pinmap file, click *OK* to load it.

Effects of Reading the Pinmap

The effects of reading the pinmap appear on the *Pin List Edit* and *Pin Setup Edit* worksheets. The drop-down lists for the *Name* columns for these two worksheets and the *Pins Edit* popups include all pins and pin groups from the pinmap, including those not used in the **vector** statement pin list. You can also directly enter the pin and group names into the appropriate columns of the *Pins Edit* popups. When you try to update the worksheet using the edit worksheet, **PatternTool** validates your edits, ensuring the entered pin or group names are valid. After you execute a *Read Pinmap* command, **PatternTool** uses all names from the pinmap, not just the default list; any name from the pinmap is valid.

Options Worksheet

Overview

The *Options* worksheet displays options that were selected when the pattern file was compiled. For more information about the compiler control statements, refer to *Compiler Control Statements* on page 6-23, *Pattern Language Reference*, Chapter 6.

Row Header Column

The row headers identify the options. The row headers cannot be deleted or inserted.

Value Column

This column lists the current value for each option.

When editing this column:

- If a *Value* cell has a predefined set of keyword values, such as *yes* and *no* or *normal* and *extended*, you can directly edit the selected cell or select one of the keywords from the drop-down list.
- If a *Value* cell lists a user-supplied string, such as a version value or the **min_period** value, select the cell and directly edit the value.
- If you cut a value from a *Value* column, any cells requiring a value are set to the default state and other cells are cleared.

File Statement Column

This column lists where the *File Statement* option was specified:

- *yes*—as a statement in the *.atp* source file.
- *no*—at compilation time by the **Pattern Compiler** GUI or command line.

To edit this column, you can directly edit the selected cell or select one of the keywords, *yes* and *no*, from the drop-down list.

Changing the *File Statement* value affects the reverse compilation of the file. If the new value is *yes*, reverse compilation will recreate the *File Statement* in the output *.apt* file; if *no* is the new value, the statement will not be recreated. For more information about reverse compilation, refer to *Pattern Reverse Compiler* on page 7-2, *Pattern Compiler and Pattern Reverse Compiler*, Chapter 7.

Effects of Changing the Compiling Options

Several options affect compiling of the pattern file: for example, the *Pin Map* workbook. Changing these options will have no affect unless you use the reverse compiler to create an *.atp* file from the pattern file and then compile the *.atp* file again.

- Changing the **opcode_mode** from *normal* to *extended* or vice versa immediately affects the *Vectors* worksheet. In the *normal* mode, opcodes and labels can appear only on every other vector; in the *extended* mode, they can appear on every vector. If the file was compiled in the *extended* mode, and you change the mode to *normal*, any invalid opcodes or labels appearing on the wrong vectors are highlighted, indicating an error.
- The *normal* and *extended* modes require different **min_period** values; thus, if you change the mode, the minimum period may require changing.
- When adding comments to a pattern file that previously did not have comments, change the *save_comments* value to *yes;* otherwise, they will not be saved; refer to *save_comments Option* on page 8-60.

Imports Worksheet

Overview

This worksheet lists the **tset** (time set) names and label names imported into the pattern file by the **import** statement in the pattern file. All **tset** names and external labels referenced in a pattern file must be imported. For more information, refer to *Imported tset or Label Statement* on page 6-25, *Pattern Language Reference*, Chapter 6.

Type Column

This column declares the type of the imported item:

- **tset**—an imported **tset**
- **subr**—a label for a subroutine
- **svm_subr**—a label for an SVM-only subroutine
- **label**—an external label

Symbol Column

This column lists a user-supplied name for the **tset** or label.

Editing the Imports Worksheet

You can directly edit existing *Type* and *Symbol* definitions. Existing *Type* definitions can be edited directly or select an item from the drop-down list.

To add definitions of imported items:

1. Insert a new row; refer to *Inserting and Deleting Rows* on page 8-26.
2. In the blank row, define the type of item by selecting it from the drop-down list in the *Type* field.
3. In the *Symbol* field, enter a valid name.

To delete a pin setup, delete the row with the item; refer to *Inserting and Deleting Rows* on page 8-26

When saving an edited pattern file, the file is checked for duplicate or invalid **tset** names or labels; refer to *File Checking* on page 8-14.

Instruments Worksheet

Overview

This worksheet lists any **instruments** statement in the pattern file. This statement defines instruments that have extended microcode programmed in the file. Currently, the **instruments** statement only defines which data generator is used by the Memory Test Module (MTM).

This worksheet cannot be edited.

Name Column

This column always indicates *mtm*.

Type Column

This column specifies which data generator is to used—2-bit or 16-bit—**dgen_2bit** or **dgen_16bit**.

Pin Count Column

This column is always 0; it has no significance and is ignored by **PatternTool**.

Displaying the History RAM

Overview

History RAM (HRAM) is a pattern memory that captures data about pattern cycles while a pattern is executing. After a pattern has been executed, the captured data is available for viewing. The HRAM helps in pattern debugging of the most recent pattern burst.

To display the HRAM:

1. Connect to the job.

   You must connect to the **IG-XL** job that generated the HRAM. You can connect to the job by using **DataTool** to run the job and to then invoke **PatternTool**; refer to *Connecting to a Job for Debugging* on page 8-82.

2. Select a method for displaying the HRAM.

   After you have connected to the program, select one of the following methods for displaying the HRAM.

- Overlay the HRAM data on a pattern file.

  a. Open a pattern file used in the test program.

  b. From the *View* menu, select *Programmed*, *Actual*, or *Fail Status*. The HRAM data will be overlaid on the file data; refer to *Overlaying the HRAM Data on the File Data* on page 8-84.

- Open an HRAM window.

  From the *View* menu, select *HRAM***.** An HRAM window opens, displaying HRAM data in addition to the pin data; refer to *Opening the HRAM Window* on page 8-85 and *HRAM Window Columns* on page 8-85.

3. Viewing the HRAM.

   Viewing the HRAM is similiar whether the HRAM data is overlaid or the HRAM window is used; refer to *Viewing the HRAM* on page 8-88.

Connecting to a Job for Debugging

Before you can view the HRAM data, **PatternTool** must be connected to the most recently executed job. You can invoke **PatternTool** from **DataTool** by using the **DataTool** toolbar or from the **IG-XL** menu. This method ensures **PatternTool** is connected to the job when the **PatternTool** window opens.

You can invoke **PatternTool** independently by opening **DataTool** to run a program, and then connecting to the program by selecting the *Connect* command on the *Debug* menu.

To disconnect from a job, select the *Disconnect* command on the *Debug* menu.

Displaying the Pattern and Tester Status

When **PatternTool** is connected to a job, the current tester status is displayed in the four panes at the right end of the status bar. The status is updated at intervals, or you can update the status by selecting the *Debug* command on the *Debug* menu.

PATGEN Pane

`PATGEN vec: N`	Pattern generator is running a pattern. Vector number *N* was the vector being executed when the status was last read.
`PATGEN: Keepalive`	Pattern generator is running the keepalive vectors.
`PATGEN: Stopped`	Pattern generator is stopped.

HRAM Pane

`HRAM: Not Started`	No pattern has been run yet.
`HRAM: Keepalive`	Keep-alive vectors are being captured.
`HRAM: Patgen running`	Pattern generator is running a pattern.
`HRAM: N cycles`	Pattern generator has completed running a pattern. *N* is the number of cycles captured in HRAM.

The Fails Pane

`Fails: N`	*N* is the number of failures in the last pattern run.

Debug Connection status:

DEBUGGING	**PatternTool** is connected to the job for debugging patterns.
CONNECTING	**PatternTool** is attempting to connect to the job for debugging. No job has been started or the job has not started the DLL necessary for communicating with **PatternTool**. If you get this message, you should load a job in **DataTool** and, if necessary, click on the **PatternTool** button on the **DataTool** toolbar to complete the connection.
UNCONNECTED	**PatternTool** is no longer connected or is no longer attempting to connect for debug because another instance of **PatternTool** may already be connected to the job.
(blank)	**PatternTool** has not attempted to connect to the job for debug, or you may have disconnected from the job by selecting the *Disconnect* command on the *Debug* menu.

Overlaying the HRAM Data on the File Data

Overview

One method for displaying the HRAM data is to overlay it on top of a pattern file, so you can see how the file data corresponds to the captured failures in the HRAM data. By viewing the relationship between the vectors and the failures, you can edit the vectors causing the failures.

Many of the features for viewing the HRAM display overlaid on the pattern file are the same as displaying the file data in the *HRAM* window, such as, the colors used, the display of repeated vectors, and the way to view other sites; refer to *Viewing the HRAM* on page 8-88.

Method

1. Open a pattern file for the job that has been executed; *Opening an Existing Pattern File* on page 8-8.
2. With the pattern file as the active window, select from the *View* menu one of the following types of HRAM data to display:

   Programmed—Programmed (expect) data, captured from the tester.

   Actual—Data actually read from the device.

   Fail Status—Pass/fail status for each pin.

   You can overlay only one type of data at a time. To display more than one type of data simultaneously, use the *HRAM* window; refer to *Opening the HRAM Window* on page 8-85.

   The cell in the upper left corner of the window displays your current selection:

   Prog

   Actual

   Fails
3. To return to the display of the pattern file data without the HRAM data, select *View* from the *File Data* menu in **PatternTool**. This command also lets you edit the file again. The HRAM display is read-only.

Viewing HRAM Data in the HRAM Window

Overview

One option for displaying the HRAM data is to open an HRAM window and view the captured vectors. The displayed vectors are in the order they were executed. The HRAM window is read-only. You cannot edit the displayed data.

Many of the features for viewing the file data in the HRAM window are the same as viewing the HRAM display overlaid on the pattern file, such as, the colors used, the display of repeated vectors, and the way to view other sites; refer to *Viewing the HRAM* on page 8-88.

Opening the HRAM Window

1. On the *View* menu, select *HRAM*. The *History RAM* window opens.
2. To specify the HRAM data to display, select one or more of the following options from the *View* menu:

   Programmed—Programmed (expect) data, captured from the tester.

   Actual—Data read from the device.

   Fail Status—Pass or fail status for each pin.

In the open HRAM window, the default data displayed is *Programmed*. The letter *.P*, *.A*, or *.F* is appended to the row number, signify the data displayed in that row.

HRAM Window Columns

Overview

You can use the standard **PatternTool** commands on the *Column* menu to change the appearance of the columns in the *HRAM Display*; refer to *Changing the Column Appearance* on page 8-10:

- Hide and expose columns.
- Change the radix of a column with a radix header (:H, :S, :B, :D, or :O).
- Expand and collapse the pin data columns for pin groups.
- Create groups from individual pins.

Row Numbers Column

The row numbers list the index number of the History RAM. These numbers end with a letter indicating the kind of pin data displayed in this row: **.***P* = Programmed, **.***A* = Actual, .*F* = Fail Status.

For the **SCIO** or **mux** mode, the row headers also contain a *.1* or *.2*.

vector Column

This column lists the pattern file name without the *.pat* extension and the vector offset within the file.

cycle Column

This column lists the cycle count for this vector.

label Column

This column lists any label for this vector in the pattern file.

patgen microcode Column

This column lists any microcode for this vector.

repeat / loop Column

This column lists the counter selected to be captured by the HRAM. The HRAM captures only one counter: *Repeat*, *LoopA*, *LoopB*, or *LoopC*. The name of the counter appears in the column header. In this column the repeated rows display a count-down to 0.

mem Column

This column lists the source of the tester memory vector: *S* = SVM, *L* = LVM, *K* = Keepalive.

Flags Columns: fmtf, fail, ext, cpua, flag

This column lists whether the pattern generator has enabled various flags on this vector. Enabled flags are labeled *Y*, disabled flags are labeled *N*. If flags are enabled, the pattern can use the **if** opcode to branch; refer to *Conditional Statements* on page 6-91, *Pattern Language Reference*, Chapter 6.

- *fmtf*—Format fail—The vector *N* cycles earlier failed. The *fmtf* flag is set only once per failing vector; refer to note below.
- *fail*—Vector *N* or more cycles earlier failed. Once the *fail* flag is set, it remains set until it is cleared by the pattern or test program; refer to note below.

+ *Y* for *fail* or *fmtf* on this vector does not mean this vector failed. When a vector fails, a fail flag is set *N* vectors later, where *N* is the pipeline depth. **PatternTool** compensates for the pipeline delay when determining if the current vector failed, signified by the red or green color of the vector.

- *ext*—External flag set by the auxiliary pattern generator.
- *cpua*—Flag set from the pattern or the test program.
- *flag*—Whether the pattern has enabled a user flag for a subsequent **if** statement. For information about the enable opcode, *Conditional Statements* on page 6-91, *Pattern Language Reference*, Chapter 6.

tset Column

This column lists the timing set name or number for this vector.

Pin Data Column

This row displays the pin data for this vector, as determined by the display mode for this row: programmed, actual, or fail status.

If a pin data column is for a pin group, and a failure occurred on one or more pins, the entire group is red, meaning failure. To view the pass/fail results for individual pins, expand the column; refer to *Expanding and Collapsing Columns* on page 8-49.

Viewing the HRAM

Overview

PatternTool has common HRAM viewing features whether the HRAM data is overlaid on the pattern file or is viewed in a separate HRAM window. For information about the differences in how each method displays the HRAM data refer to:

- *Overlaying the HRAM Data on the File Data* on page 8-84
- *Viewing HRAM Data in the HRAM Window* on page 8-85

Display Colors

The HRAM data is displayed in green except for pin data containing a failure, which is red. For a pin group, only the failed pins are red; the rest are green.

When HRAM data is overlaid on a pattern file, some of the pin data may be black, which means the data was read from the pattern file, not from the HRAM. The data may have been read from the pattern file because the vector:

- was not executed, due to branching within the pattern.
- was not captured in the HRAM because of the HRAM setup instructions.

If data, such as labels and opcode, was read from the drivers, it is green; however, if it was read from the pattern file, it is black. In the HRAM window, all data is from HRAM; thus, it is always either green or red.

Display Symbols

If you include *Fail Status* as a viewing type, the row headers appended with an *.F* show the pass/fail result for each pin, instead of the expect or actual data:

- Column radix is *Symbolic*: green plus sign (+) represents a passing pin; red *F* represents a failing pin.
- Blank cell: No failures in the cell.
- Column radix is not *Symbolic*, but numeric, prefixed with *.f*, which identifies the passing and failing pins: 1 for a failing pin and 0 for a passing pin. For example, assume the following hexadecimal value:

.fA06

In the *Symbolic* mode, this example expands into the following passes and fails:

F+F++++++FF+

The zeroes are green, meaning that none of the pins in these positions failed; all other digits are red, meaning that at least one of the pins represented by this digit failed. If all pins in this group passed, the value would be:

.f000

In all viewing modes, if a pin group uses the *Decimal* radix, the entire number is displayed in red if any of the pins has a failure because decimal digits do not map to discrete groups of pins.

Repeated Vectors

A single vector in a pattern file may generate multiple vectors if the vector has a repeat opcode or is part of a loop. How the repeated vectors are displayed depends on the display window used:

- When HRAM data is overlaid on the pattern file, the display shows the HRAM only for the first cycle generated by the vector.
- In the HRAM window**,** the display shows each cycle generated by the repeated vector. The repeat or loop column lists a number for each repeated vector, without the numbers counting down to 0.

Viewing Sites