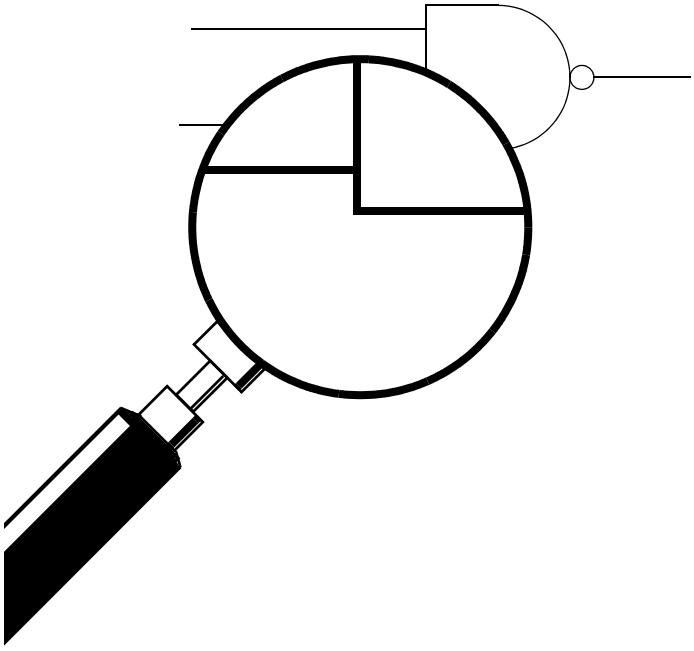
Xwave User's Guide



Genashor Corp.
17 Dogwood Drive
Hillsborough, New Jersey 08844-2517
Phone: (908) 369-8554
Email: support@genashor.com

Genashor Corp
17 Dogwood Drive
Hillsborough, NJ 08844-2517
Telephone: (908) 369-8554

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Documentation Conventions

`Courier` typeface is used to illustrate command syntax, command names, and signal names.

`Courier bold` typeface illustrates user input, the names of buttons in dialog boxes, and the names of bar menu buttons.

Italic type is used to indicated keyword-fields in commands and file names.

<key> (angle brackets surrounding this typeface) identifies a function key or a special keyboard key.

[] right braces identify optional items in commands and description statements.

Xwave User's Guide

Overview

Xwave displays simulation results graphically as waveforms in an X-Window[1] display. The aesthetics and contents of the display are controllable by the user. Areas of interest can be examined in greater detail by using pan and zoom functions. Markers (reference points) can be placed on the display in order to measure edge positions or intervals (deltas) between edges. A PostScript[2] description of the display can be generated and printed for documentation. In addition, Xwave preferences and/or display parameters can be saved and retrieved in current or future Xwave sessions.

In order to use Xwave, SIMIC history files must have been generated containing the simulation history of all signals that might be subsequently displayed.

Generating SIMIC History Information

SIMIC's `history` command controls the creation and content of the history files. Two files are created, with file extensions `hig` and `his`. This section contains a brief synopsis of the `history` command[3].

The `history` command must be issued to SIMIC prior to the `simulate` command. The format of the `history` command is:

`history` *list file prange*

where:

list is either:

(a) `LIST:` – specifying all signals are to be included in the history information, or

(b) `LIST=`*listofsignals* – *listofsignals* is a list of signals separated by commas or whitespace, specifying which signals to include in the history information. Note that SIMIC wildcarding and Meta-signals (&INPUTS, &OUTPUTS, &BUSINS, &BUSSES) for primary inputs, outputs, bus-inputs and bus-outputs respectively, are allowed.

file is an optional keyword field consisting of either:

(a) `FILE:` – indicating that the default file name is to use for the history files, or

(b) `FILE=`*filename* – *filename* is the name to use for the history files.

If *file* is omitted, `FILE:` is assumed.

prange is an optional keyword field consisting of the keyword `PRANGE=` followed by a list of

1. The X Window System is a trademark of Massachusetts Institute of Technology.
2. PostScript is a registered trademark of Adobe Systems Inc.
3. For further information on the `history` command and its options, see the SIMIC User's Guide.

stimulus ranges. This is used to suppress history information during portions of the simulation that are not of interest, thus reducing the size of the history files. If *prange* is omitted, then no history information will be suppressed during the simulation.

For example, the SIMIC command:

```
history list: file=mychip
```

causes all signal activity to be written to the files `mychip.hig` and `mychip.his` for the entire simulation.

Details Of The Xwave Environment

Mouse Buttons

Certain Xwave operations require use of the mouse. One of the buttons, called the SELECT button, performs special functions, such as setting input focus for user input (i.e., selecting panels in dialog boxes). Typically, the SELECT button would be the left mouse button, but this is not always the case; thus, experimentation may be necessary for some systems.

The Xwave bar menu and all dialog boxes contain "buttons" that allow you to select options. Throughout this guide, the words "press a button" or "select a button" are shorthand phrases that mean "move the cursor with the mouse so that it is over the button on the screen, and then click the SELECT button on the mouse".

Text Fields

Several options are specified to Xwave by typing them in dialog boxes. Text fields are the dialog box panels that accept keyboard input. Figure 1 illustrates a typical text field, the **Selection** panel of the **Filename Dialog Box**. A text field will only accept keyboard input when it has *input focus*; which is indicated when the field contains a text cursor and is surrounded by a highlighted border. Some dialog boxes contain multiple text fields, only one of which can have input focus at any given time. Input focus can be shifted to any text field by simply moving the mouse cursor over the text field and clicking the SELECT button on the mouse.

Sometimes, the text to be entered or displayed is longer than the text field's width, so only a portion of the text can be displayed. The left and right arrow keys on the keypad move the text cursor within the text field; if the cursor is "moved" when it is at either extreme of the field, the formerly hidden text at that extreme will scroll into view.

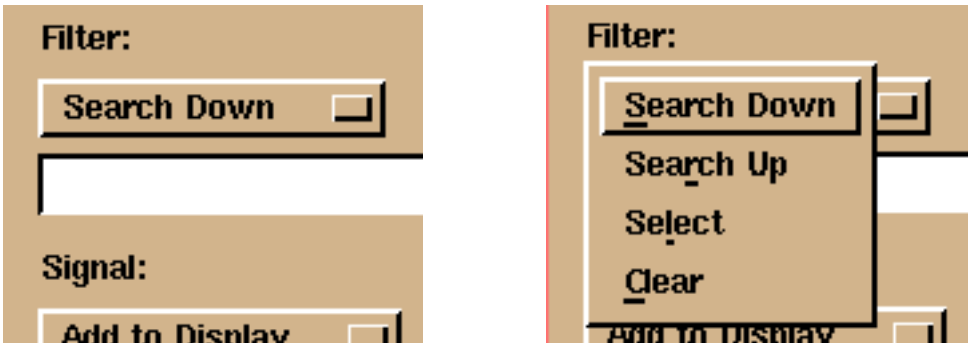
Figure 1 A Text Field Of The Filename Dialog Box

If you make a mistake while typing, the error can be corrected by using the left and right arrow keys to position the character cursor to the error (if necessary), the <Delete> key to delete the character *under* the cursor, and the <Backspace> key to delete the character *to the left of* the cursor. By default, typing with the cursor positioned inside the text will overwrite the text to the right of the cursor. To insert text instead, press the <Ins> key (the keypad 0 digit). The dialog box window will remain in insert mode until the <Ins> key is pressed again, or until the dialog box window is closed.

All keyboard input is case sensitive.

Option Buttons

Option buttons are buttons that support multiple actions. For example, the **Signal Dialog Box** contains four option buttons, one of which is illustrated in Figure 2 (see the Section *Displaying Signals* for a description of this button's options). As shown in Figure 2(a), an option button's label displays the action that will be performed if the button is "pressed"; in this case, **Search Down**.



(a) An Option Button **(b) An Option Button Menu**

Figure 2 An Option Button And Its Menu

When the option button is "pressed", its menu of possible actions pops up over the button, with the action corresponding to the button's label selected, as shown in Figure 2(b). Releasing the mouse's SELECT button will cause the action to be performed (**Search Down** in this example). If, instead, the mouse cursor is dragged vertically through the pop up menu to another action before the SELECT button is released, this other action (e.g., **Search Up**) will be performed, and subsequently will become the option button's label. If the mouse cursor is dragged outside the pop up menu before the SELECT button is released, then *no* action is performed. In all cases, the menu disappears when the SELECT button is released.

Alternatively, "pressing" the rectangular knob inside the option button causes the pop up menu to appear and remain on the screen. Selection can then be made either with the mouse, as above, or with the keyboard by (a) typing the single character underlined in each menu item (**s**, **r**, **l**, or **c** in this example) or (b) using the keypad up and down keys to move along the menu and pressing the <Return> key to perform the selected action. The pop up menu can be dismissed without making a selection by clicking the mouse SELECT button anywhere outside the menu.

Starting Xwave

Xwave is invoked with the system command:

`Xwave` [*history* [*restore*]]

where *history* is the common name of the history files, possibly containing their path name if these files are not in the working directory. For example, if the names of these files are `mychip.hig` and `mychip.his`, then Xwave would be invoked with the command:

`Xwave mychip`

The second command line argument, *restore*, is optional. If entered, it specifies the `.wav` file to use initially. The `.wav` file is generated by Xwave with the **Save** command, described later (see *Saving And Restoring The Display* on page 26). It allows you to recreate any display from a previous session.

If the *history* argument is omitted from the command line, Xwave will display the **Filename Dialog Box** shown in Figure 3, requesting the name of the history files. This box contains a number of panels.

The **Filter** panel displays the path to the directory and the search filter for the files in this directory. In this search filter, `*` and `?` are wildcards; an asterisk (*) specifies that *any* sequence of characters will match, and a question mark (?) specifies that any *single* character at the position of the question mark will match. For example, the path displayed in Figure 3 is `/home/genashor/test/mychip/` and the file search filter is `*.hig`, which specifies that all files in this directory whose names end with `.hig` should be included in the **Files** list. In general, only the directory portion of the **Filter** string should be modified (however, the file filter could be changed to `*.his`, which would also create an acceptable list of history files for selection). In order to enable the modified filter, you must press the **Filter** button on the bottom of the Dialog box.

Below the **Filter** panel are two scrolling lists, labeled **Directories** and **Files**. The **Directories** list shows the directories found in the current **Filter** path. Note that "`.`", specifies the current directory, and "`..`" specifies the parent directory. Selecting one of the directories in this list causes that directory to become the current one. Selection can be made with the keyboard by positioning the cursor over the selection and pressing the <Return> key, or with the mouse by double clicking on the proper directory. The **Files** list displays the files in the current directory that match the filter. Note that in Figure 3, only the `.hig` files are displayed, since they are the only files that match the "`*.hig`" filter. Selecting an item from this list will cause it to be displayed in the **Selection** panel. The **Selection** panel contains the currently selected file. You may enter a filename directly here, rather than using the above method; entries of the form `filename`, `filename.hig`, and `filename.his` are all acceptable. Once this panel contains the file you want, press the **OK** button to read in the history files (`.hig` and `.his`). Pressing **Quit** at any time will remove the Dialog, but not read in the selected file. Pressing **Help** provides some on-line help information about opening the history files.

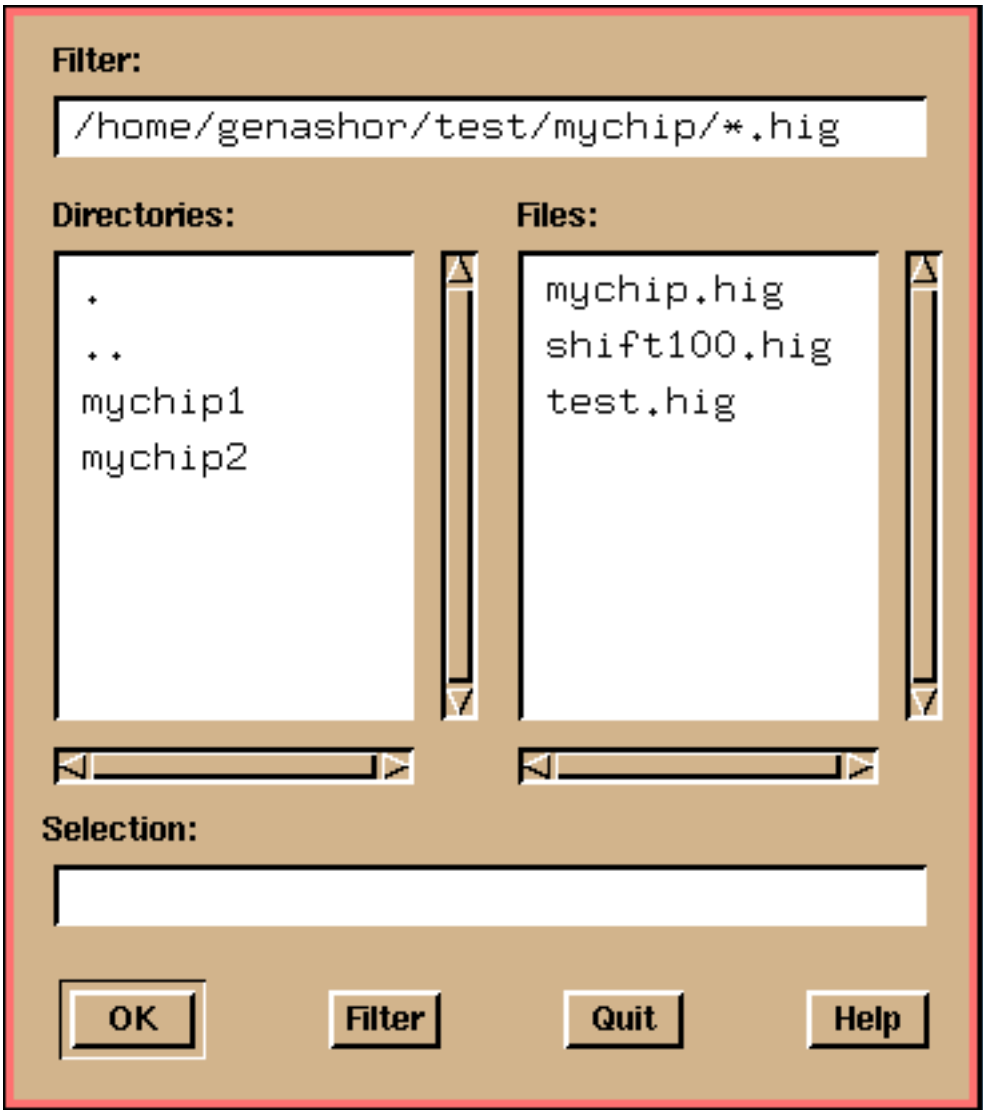


Figure 3 Filename Dialog Box

If Xwave cannot find the specified history files, it displays the **Correct Filename Dialog Box** shown in Figure 4. Placing the cursor over the **OK** button and clicking the SELECT mouse button causes the **Filename Dialog Box** to appear for re-specifying the file name. Clicking the SELECT mouse button with the cursor over the **Cancel** button causes Xwave to exit.

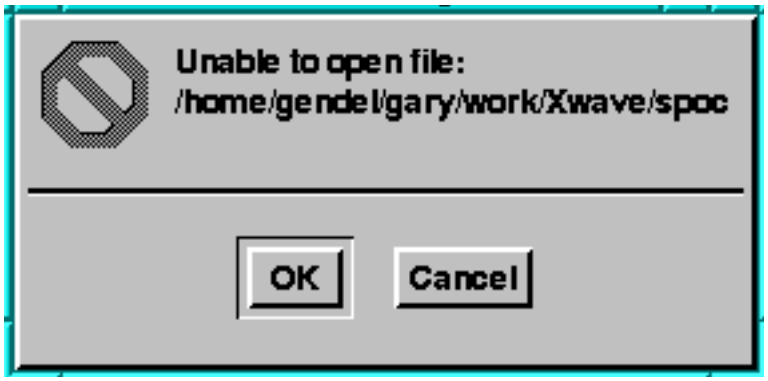


Figure 4 Correct Filename Dialog Box

Command Line Switches

There are a number of optional command line switches that can be specified:

Table 1: Command Line Switches

Switch	Description
-A	Turn Auto sizing of waveforms on (default).
-a	Turn Auto sizing of waveforms off.
-h	Display command line help information.
-L	Use window geometry information in .wav file (default).
-l	Ignore Window geometry information from .wav file.
-r	Read following argument as restore file.
-T	Display character tags on signal transitions.
-t	Don't display character tags on signal transitions (default).

The Xwave Display

As shown in Figure 5, the Xwave display contains six main areas:

(1) At the top is a **bar menu** with selections for: **File**, **Signals**, **View**, **Info**, and **Help**.

(2) Directly below this menu is a **message area**. This area is used by Xwave to display error messages, issue prompts, or display marker information (see *Markers*).

(3) The left side of the display below the message area is the **signal name area**, which contains the names of the signals being displayed.

(4) The **waveform display area** is to the right is the signal area. This area displays the waveforms for the signals in the signal name area; each waveform is vertically aligned with the corresponding signal name.

(5) **Simulation time** is displayed at the bottom of the waveform area.

(6) **Test numbers** are displayed at the top of the waveform area.

In addition, the signal name area and the waveform display area have individual horizontal scrollbars to scroll long names and to pan through the waveforms, respectively. Both areas can be simultaneously scrolled vertically with the vertical scrollbar at the right of the display.

The initial size of the Xwave display is the default size; it cannot be made any smaller. However, its size can be increased to display more signals or to extend the range of displayed simulation time. To resize the display, move the mouse cursor to one of the resize handles, located at the outside corners of the display's border (the cursor changes shape when it is over the handle). Then, press the SELECT mouse button and drag the resize handle until the display attains the desired size.

At the start of the program, the signal name and waveform areas are empty. Signals can then be selected for display (see *Displaying Signals* on page 9), or a previously-saved display can be restored (see *Saving And Restoring The Display* on page 26).

Selecting Items In The Bar Menu Area

The bar menu has five items for selection: **File**, **Signal**, **View**, **Info**, and **Help**. Each item can be selected by pressing the SELECT mouse button while the mouse cursor is over the item. Alternatively, the <F10> key will select the bar menu. Items in the bar menu can be then be selected either by pressing the key corresponding to the underlined letter of the item, or by using the left/right arrow keys. You may use the down arrow to display pulldown menus and then the up/down keys to walk the items in the pulldown menu. The menu items are selected by pressing the <Return> key. Pressing <F10> again will deselect the bar menu, as will clicking the SELECT mouse button anywhere outside the pulldown menu.

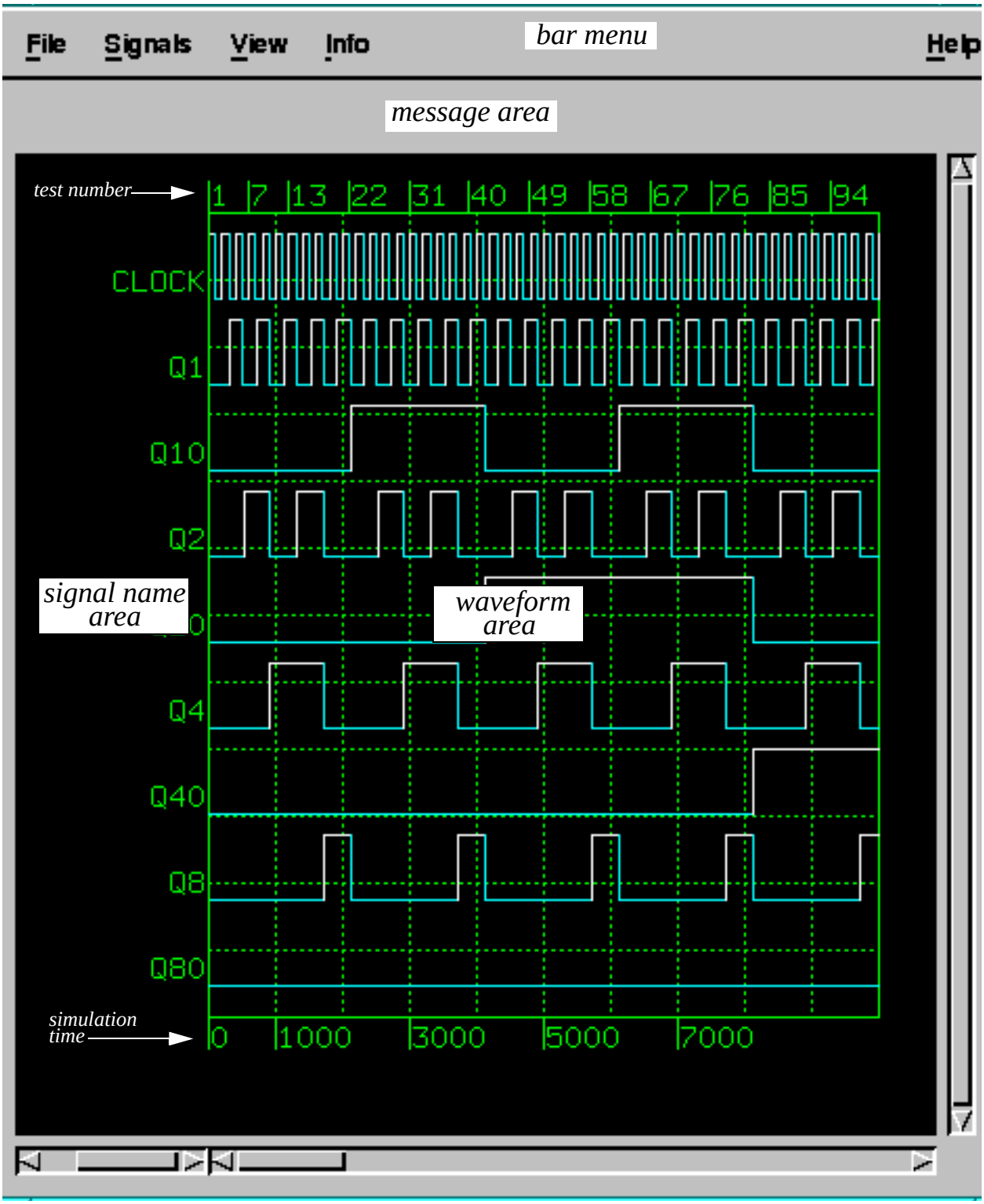


Figure 5 The Xwave Display

Exiting Xwave

To exit Xwave, select **File** in the bar menu (see *Selecting Items In The Bar Menu Area* above). This causes the **File** item's pulldown menu to appear, as shown in Figure 6. Then, select **Exit** to quit the program.

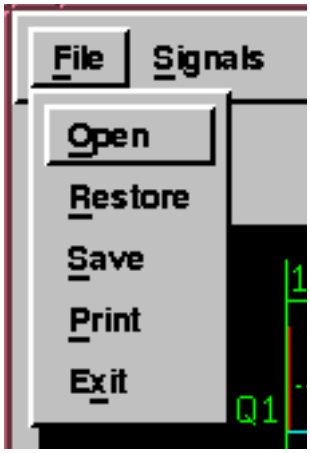


Figure 6 File Item's Pulldown Menu

Displaying Signals

The **Signals** item in the bar menu controls signal selection and arrangement. Selecting this item causes a pulldown menu to be displayed that contains the options **Add**, **Color**, **Move**, **Remove**, as shown in Figure 7.

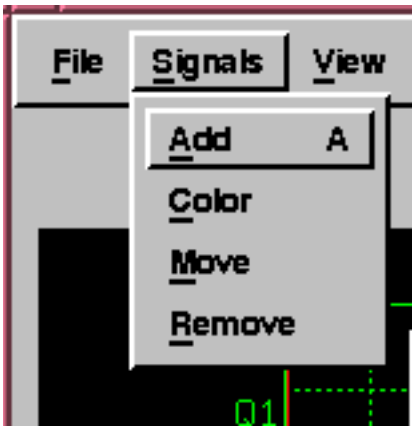


Figure 7 Signals Item's Pulldown Menu

Selecting **Add** from the **Signals** item's pulldown menu brings up the **Signal Dialog Box** shown in Figure 8. This Dialog box contains a text field and its associated option button, three scrolling lists and their associated option buttons, and a **Close** button that dismisses it. The **Filter** text field is used to enter signal names or patterns for signal name matching from the keyboard. The **Signal** scrolling list contains the names of all signals written to the history files during simulation, sorted

alphanumerically. Therefore, this list contains all the signals that can be displayed. Xwave allows signals to be grouped for display; the **Group Signals** scrolling list contains a list of signals that will be used in the creation of a group, and the **Group** scrolling list contains the list of available groups.

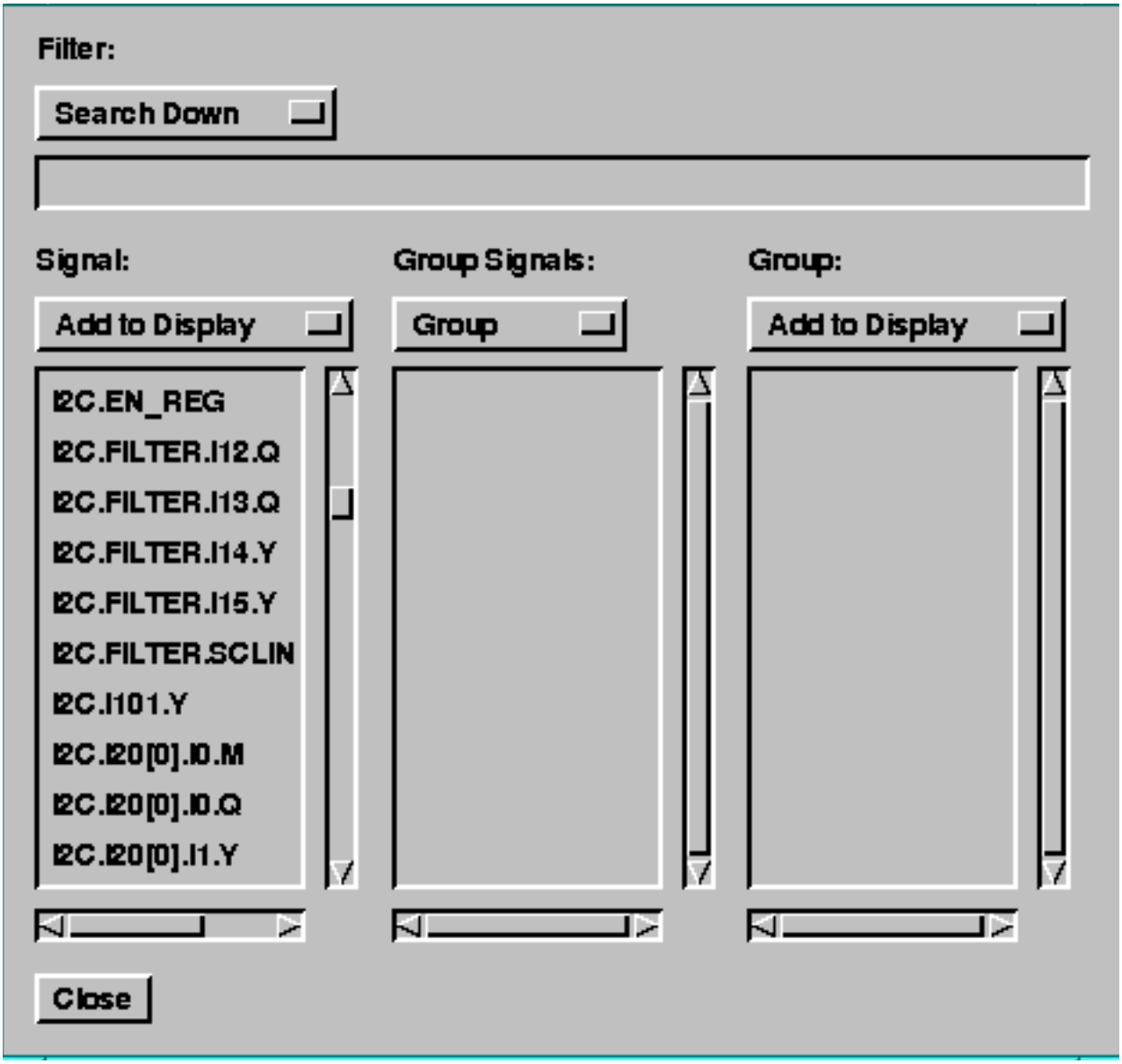


Figure 8 The Signal Dialog Box

Adding Signals To The Display

Signals are added at the top of the waveform display, but may be moved by the **Move** Signal option described in *Moving Signals Within The Display* on page 14.

Signals are added to the display by selecting them in the **Signal** list and then "pressing" **Add to Display** in the **Signal** list's *option button* (directly above the list; see *Option Buttons* on page 3). Selection can be performed in a number of ways.

(1) By setting input focus to the **Filter** text field, entering a signal name in this window, and then "pressing" **Select** in the **Filter** window's *option button* (directly above the window; see *Option Buttons* on page 3).

A regular expression may be entered in the **Filter** text field. Regular expression is zero or more decision branches, which are separated by a '|'. A regular expression will match any signal that matches any one of the branches.

A branch is one or more pieces, concatenated together. A match is made if all the pieces match.

A piece is an atom, possibly followed by a '#', '+', or '@'. An atom is a regular expression within parenthesis, a range contained within '<' and '>' characters, a '$', or a '\' followed by any single character.

A range sequence is a sequence of characters enclosed in '<' and '>' characters, it normally matches a single character from this sequence. If the sequence begins with '^' then it will match a single character not from this sequence. If two characters are separated by a '-', then this specifies all characters from the first character, to the second, in ASCII sequence. For example, <0-9> will match any digit character.

To select all signals within block `top`, enter `top.*` in the **Filter** window, then "press" **Select** in the **Filter** window's *option button*. Table 2 below lists all the meta characters allowed in regular expressions:

Table 2: Regular Expression Meta Characters

Character	Description
$	Matches any single character.
< >	Delimits a list of acceptable match characters. The list may include a range, such as a-z (to represent all lowercase letters). "ha<td>" will match the signals "hat" or "had".
*	Matches any sequence of characters. "a*b" will match any signal that starts with the character "a" and ends with the character "b", including a signal called "ab".
#	Matches zero or one occurrences of the previous character or expression group. "(ab)#d" will match "d", "abd", etc.
+	Matches one or more occurrences of the previous character expression grouping. "a+b" will match "ab", "aab", "aaab", etc.

Table 2: Regular Expression Meta Characters

Character	Description
@	Matches zero or more occurrences of the previous character."a#b" will match "b", "ab", "aab", etc.
( )	Delimits an expression grouping.
|	Logical Or of expression grouping. "(ab | cd)efg" will match the signals "abefg" and "cdefg".
\	Escape character causing the next character is to be used literally. The "\" must be used to specify any of the meta characters described in this table to represent themselves. "a\$b" will match the signal "a$b", but "a$b" will match "a0b", "a.b", etc.

(2) By selecting signals in the **Signal** scrolling list area. Individual signals are selected by clicking the mouse SELECT button when the cursor is over the signal name. Contiguous signals in the scrolling list can be selected by pressing the SELECT button when the cursor is over the first signal name, and dragging the cursor over the remaining signal names with the SELECT button still depressed.

(3) By setting input focus to the scrolling list, and using the selection cursor, which is a rectangular box enclosing a scrolling list entry. The selection cursor can be moved by the arrow keys or the mouse. The <Return> or <Space Bar> keys toggles selection of the signal within the selection cursor.

Clicking the mouse SELECT button with the cursor over a signal name in the scrolling list toggles that signal's selection.

The **Clear** button in the **Filter** *option button*'s menu can be used to remove specific signals from the selection before the **Add to Display** button is "pressed". For example, referring to Figure 8, one way to display all signals whose names begin with `I2C.FILTER`, except for signal `I2C.FILTER.I15.Y` would be to (a) select all signals beginning with `I2C.FILTER` using any of the methods described above, (b) enter `I2C.FILTER.I15.Y` in the **Filter** text window as described by method (1) above, (c) "press" the **Clear** button, and (d) "press" the **Add to Display** button.

The **Search Up** and **Search Down** buttons in the **Filter** *option button*'s menu are used to find a signal in the **Signal** scrolling list. A regular expression is entered in the **Filter** entry window, and then the **Search Up** (**Down**) button is "pressed". The search starts at the current position of the cursor in the **Signal** scrolling list, and searches back (forward) to find a match. This positions the scrolling list to the match, to find the next match press the **Search Up** (**Down**) button again.

The **Close** button dismisses the **Signal Dialog Box**, but any signals selected will remain selected the next time this dialog box is opened.

Grouping Signals

Signals may be grouped together and displayed in a variety of radix formats. Signals are grouped in the following manner:

(1) Select signal(s) to be in the group in the **Signal** scrolling list, using this scrolling list and/or the **Filter** text window and its *option button* **Select** or **Clear** actions. "Press" **Add to Group** in the **Signal** scrolling list's *option button* menu. You may also enter all the signals in a predefined group by selecting the group in the **Group** scrolling list and pressing **Add to Group** in the *option button* menu above the **Group** scrolling list.

(2) Once all the signals are in the **Group Signals** list that you wish to group, order this list so the MSB is at the top to the LSB at the bottom. This is accomplished by selecting the out of place signals in the **Group Signals** list, and pressing the **Up** button in the **Group Signals** *option button* menu to move these signals up one position, or the **Down** button to move these signals down one position.

(3) Next press the **Group** button in the **Group Signals** *option button* menu. The **Group Creation Dialog Box** will be displayed, as illustrated by Figure 9.

(4) You must enter the name for the group in the **Group Name** field and select the format for display from the choices provided.

(5) Once your are satisfied with your choice of name and format, press the **OK** button at the bottom of the **Group Creation Dialog Box**. If you wish to abort the group, press the **Cancel** button.

(6) If you pressed **OK**, then this group will be added to the **Group** scrolling list.

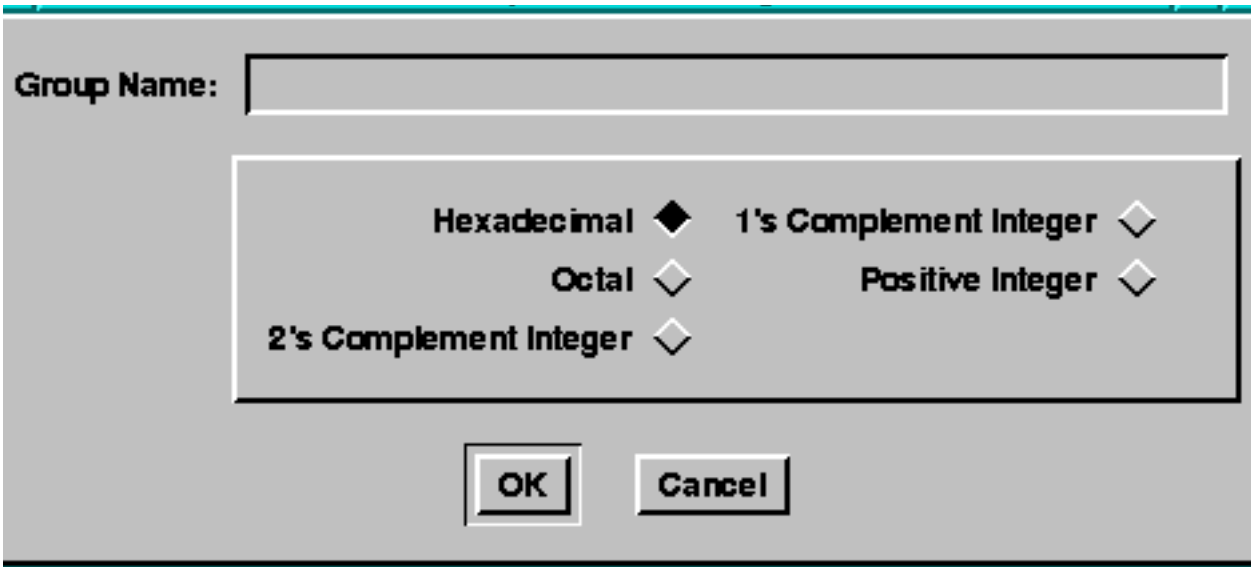


Figure 9 Group Creation Dialog Box

Displaying Grouped Signals

Once a group has been created, you can display this group from the **Signal Dialog Box** in the same fashion as adding signals. First, select the groups to added to the display in the **Group** scrolling list, then press the **Add to Display** button in the **Group** *option button* menu.

Figure 10 illustrates hexadecimal display of four signals, `Q8`, `Q4`, `Q2`, `Q1`, grouped in that order and assigned the name `HexExample`.

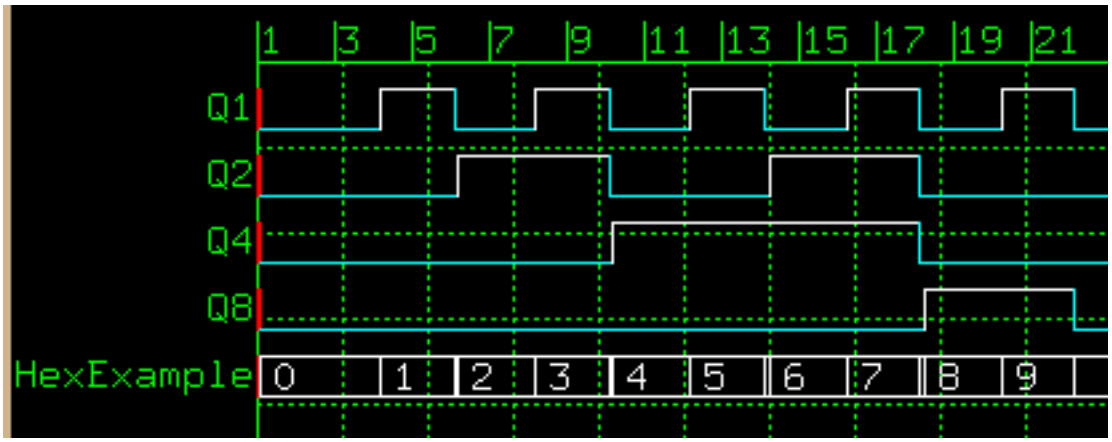


Figure 10 Illustration Of Hexadecimal Display Group

Moving Signals Within The Display

Waveform display positions can be moved within the display. To move one or more waveforms:

(1) Select each waveform (signal or group) to be moved by clicking the mouse SELECT button when the cursor is over the name in the display's signal name area. Selection causes the name to be highlighted.
Clicking the SELECT button again with the cursor over a name toggles that waveform's selection.

(2) Select **Move** from the **Signals** item's pulldown menu (see Figure 7 on page 9). Xwave will then display the prompt "Select Position to insert signals" in the message area.

(3) Move the cursor to the position in the display where the selected signals should be moved and press the mouse SELECT button.

For example, suppose that in the display shown in Figure 10, `HexExample` should be moved above `Q1`. Figure 11 illustrates the display after completion of Step (2), where `HexExample` has been selected and the **Move** button has been "pressed". The move would be completed by moving the cursor on, or immediately above, the display of `Q1` (either in the signal name area or in the waveform area) and clicking the mouse SELECT button.

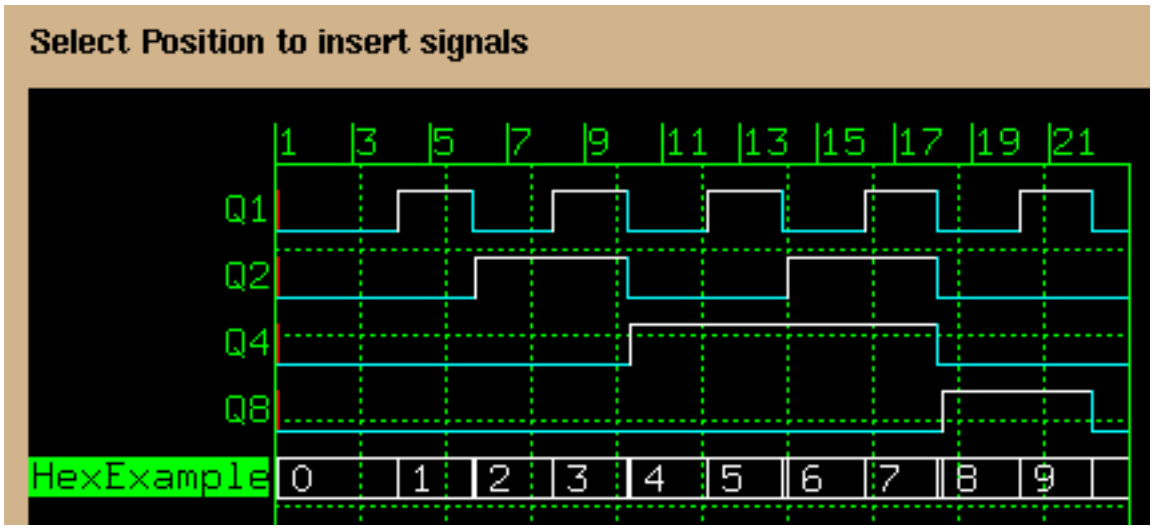


Figure 11 Signal Selection In The Display And The Move Prompt

Waveform Colors

The waveform display utilizes a different color for each logic level by default. Each of these colors may be changed by specifying the respective X-resource color, either in the command line or in a resource file (see *X-Resources Used by Xwave* on page 31). The default colors are:

logic-0 .....cyan line
logic-1 .....white line
unknown (X).....red solid box
tristate (Z) .....green stippled box

In addition, colors may be set on a per-signal basis. To assign a color to one or more displayed waveforms:

(1) Select each waveform (signal or group) to be assigned the color by moving the cursor over each waveform's name in the signal name area and clicking the mouse SELECT button (same as for Move operation).

(2) Select **Color** from the **Signals** item's pulldown menu, as shown in Figure 7 on page 9. The **Color Assign Dialog Box**, shown in Figure 12, is displayed.

Type the color you want in the text window labeled **Color Name**. If left blank, then the default colors will be assigned to the selected signals. Any color valid for your X server may be used.

Assigning monotone coloring on the waveforms may make their values difficult to ascertain. The **Tag Signals** option in the **Setup Dialog Box** can be used to additionally display the character representation of each waveform (e.g., 0, 1, X, etc.). Busses are always tagged with their values as long as there is room to display it.

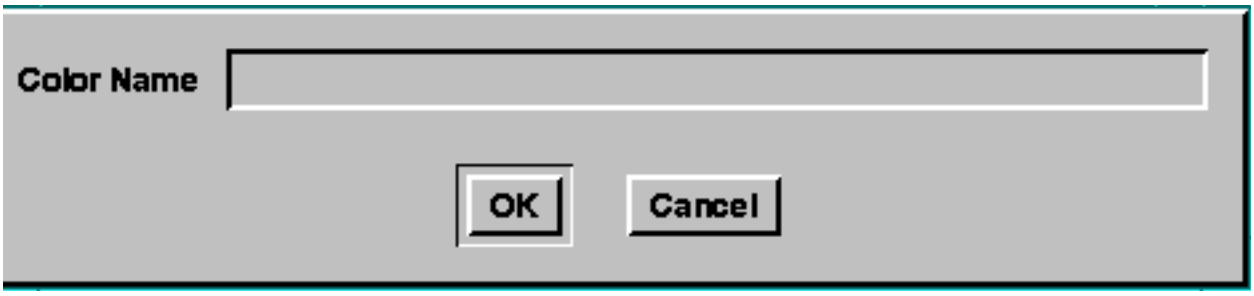


Figure 12 Color Assign Dialog Box

Deleting Signals From The Display

Signals can be removed from the display selectively, or all signals can be removed. To remove signals selectively:

(1) Select each waveform (signal or group) to be removed by moving the cursor over each waveform's name in the signal name area and clicking the mouse SELECT button (same as for Move operation).

(2) Select **Remove** from the **Signals** item's pulldown menu. This selection causes display of a cascaded pulldown menu, as shown in Figure 13. Select **Selected** in this menu.

To remove all signals, select **Remove** from the **Signals** item's pulldown menu and select **All** from the cascaded pulldown menu.

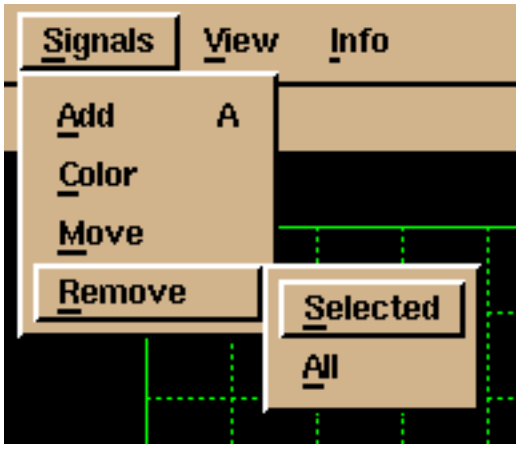


Figure 13 Remove Cascaded Pulldown Menu

Panning Through Simulation Time

The scrollbar underneath the waveform area is used to pan through simulation time. Referring to Figure 14:

(a) Clicking any mouse button with the cursor over the left arrow causes the waveform display to move backward in time by an amount equivalent to one grid line (cm.). This can also be accomplished by holding the <control> key and pressing the <left arrow> key.

(b) Clicking any mouse button with the cursor over the right arrow causes the waveform display to move forward in time by an amount equivalent to one grid line (cm.). This can also be accomplished by holding the <control> key and pressing the <right arrow> key.

(c) Clicking any mouse button with the cursor between the left arrow and the slider causes the waveform display to move backward in time by an amount equivalent to one display window. The equivalent action is to press is the <left arrow> key.

(d) Clicking any mouse button with the cursor between the slider and the right arrow causes the waveform display to move forward in time by an amount equivalent to one display window. The equivalent action is to press the <right arrow> key.

(e) Pressing any mouse button with the cursor over the slider, and then dragging the slider with the mouse button still pressed, causes the waveform display to move in that direction.

Note: In (a) through (d) above, pressing the mouse button instead of clicking it causes continuous motion.

Figure 14 Scrollbar

Markers can also be used to make the waveform display jump forward or backward in simulation time to transitions at selected signals (see *Viewing A Marker*).

Zooming In and Out

The range of simulated time within the display window can be modified either with the **View** Menu (see *Modifying The Display Settings* below), or with the key presses shown in Table 3.

In order to zoom with key presses, (1) the mouse cursor must be in the display window and (2) the waveform area must have input focus. When the mouse cursor is moved into the display area, input focus will reside either in the waveform area or in the signal name area of the display window, depending on previous operations. If the latter situation occurs, the display will not respond to zoom key presses. To shift input focus to the waveform area, either press the <Tab> key or click the mouse SELECT button anywhere to the right of the waveform area. Then, press the zoom key again.

Table 3: Zoom Keys

Key	Description
f	Displays the full simulation.
m	Zoom (and pans) to display all placed markers.
t	Popup a dialog to zoom to a specified time range.
z	Zoom out (1/2X).
Shift z	Zoom in (2X).

Modifying The Display Settings

The simulation time scale, width of the signal name area, and display aesthetics can be modified with the **Setup** selection in the **View** bar menu item. Selecting this menu item causes the **View Setup** dialog box to be displayed, as shown in Figure 15. The entries shown in this figure are the default values upon start-up.

When the **View Setup** dialog box is brought up, the **Time-Units per grid** entry window has input focus, that is, it is highlighted and ready to receive user input. To modify any of the other settings, move the cursor into the appropriate entry window and click the mouse SELECT button before typing.

Time-Units per grid controls the simulation-time scale. The value entered in this field will set the number of simulation time-units for each vertical grid spacing (1 cm.).

Note: When the time scale changes, the reference time, or leftmost simulation time of the display, remains the same as before the change; the display expands or contracts to the right of this time. Therefore, to zoom about a particular event, move that event into the leftmost grid interval before changing the time scale.

The **signal characters displayed** entry controls the width of the signal name area. The value placed here determines the maximum number characters that can be visibly displayed.

The **waveform height** entry specifies the height assigned to each waveform (in cm.). By default this is set to the signal display font size. This value is ignored if **AutoSizing** (see below) is turned on.

The **spacing between waveforms** entry sets the spacing between each waveform (in cm.). By default this is set to the minimum space required to display the markers between waveforms (see *Markers*).

The checkbox labeled **Grids** control whether the horizontal or vertical grid lines should be displayed (darkened box) or not (light box). Clicking any mouse button with the cursor over these switches toggles them. By default both vertical and horizontal grids are displayed.

The radiobox labeled **Autosizing** controls whether auto sizing is on or off. If on, the waveforms will automatically size themselves to best fit the display. If off, the waveforms will stay at the current size when the display is resized. The default is on, but can be initially set off with the `-a` command line switch.

The radiobox labeled **Tag Signals** controls whether signals are tagged with (labeled with the character representation of) their simulation values. This can be useful, especially when monotone colors are used for the waveform display. By default, signal tagging is turned off, but can be initially set on with the `-T` command line switch. Busses are always tagged as long as there is room.

The **OK** button processes changes in the form, and the **Cancel** button aborts all changes. Click the mouse SELECT button with the cursor over the appropriate button.

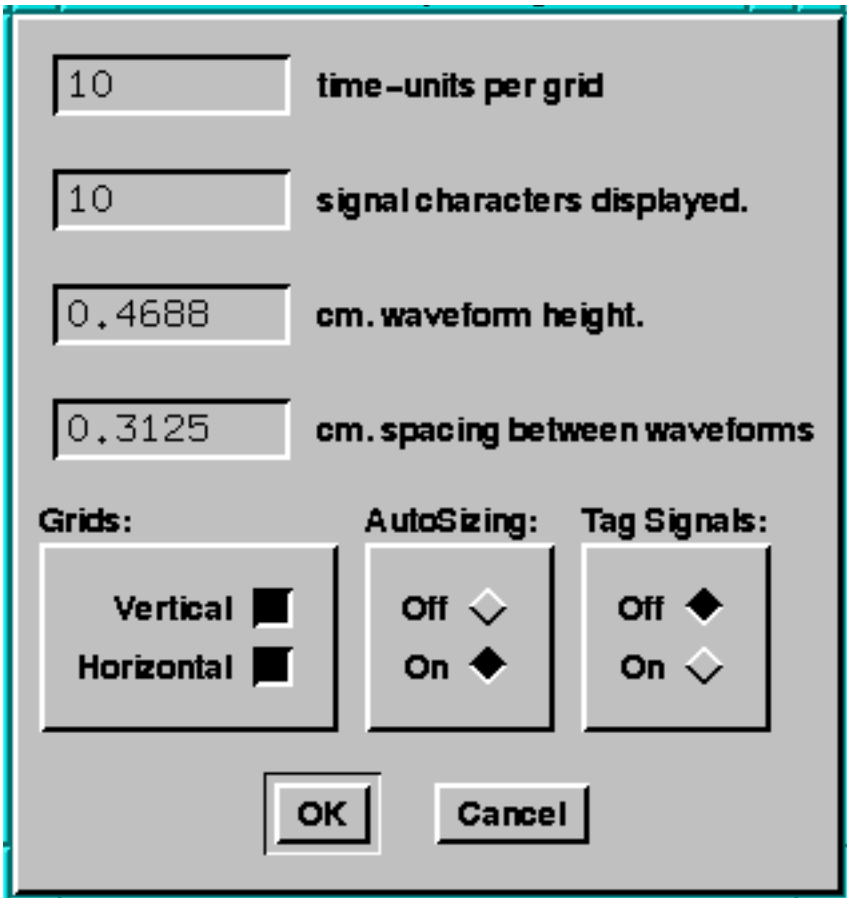


Figure 15 The View Setup Dialog Box

Markers

Markers are reference points used to locate waveform events (level transitions), measure deltas (time intervals) between transition edges, and bring the display to sections of the simulation marked by relevant events.

When the mouse is in the waveform area, each button on the mouse controls a dedicated marker.

Xwave supports a maximum of three markers placed concurrently. Button presses, in conjunction with key-presses, control marker operation.

Placing A Marker

A marker is placed on a waveform by moving the cursor over the waveform and clicking the appropriate mouse button. The marker is placed at the cursor position.

Moving A Marker

Each subsequent click of a mouse button on that waveform will cause the associated marker to successively move forward in time to the next event (transition) time, which may be outside the visible display area. If the <Control> key is pressed simultaneously, then the marker will move backward in time to previous events in the waveform.

Figure 16 illustrates all three markers. Note that each marker has a unique shape, and that more than one marker can be placed on a single waveform.

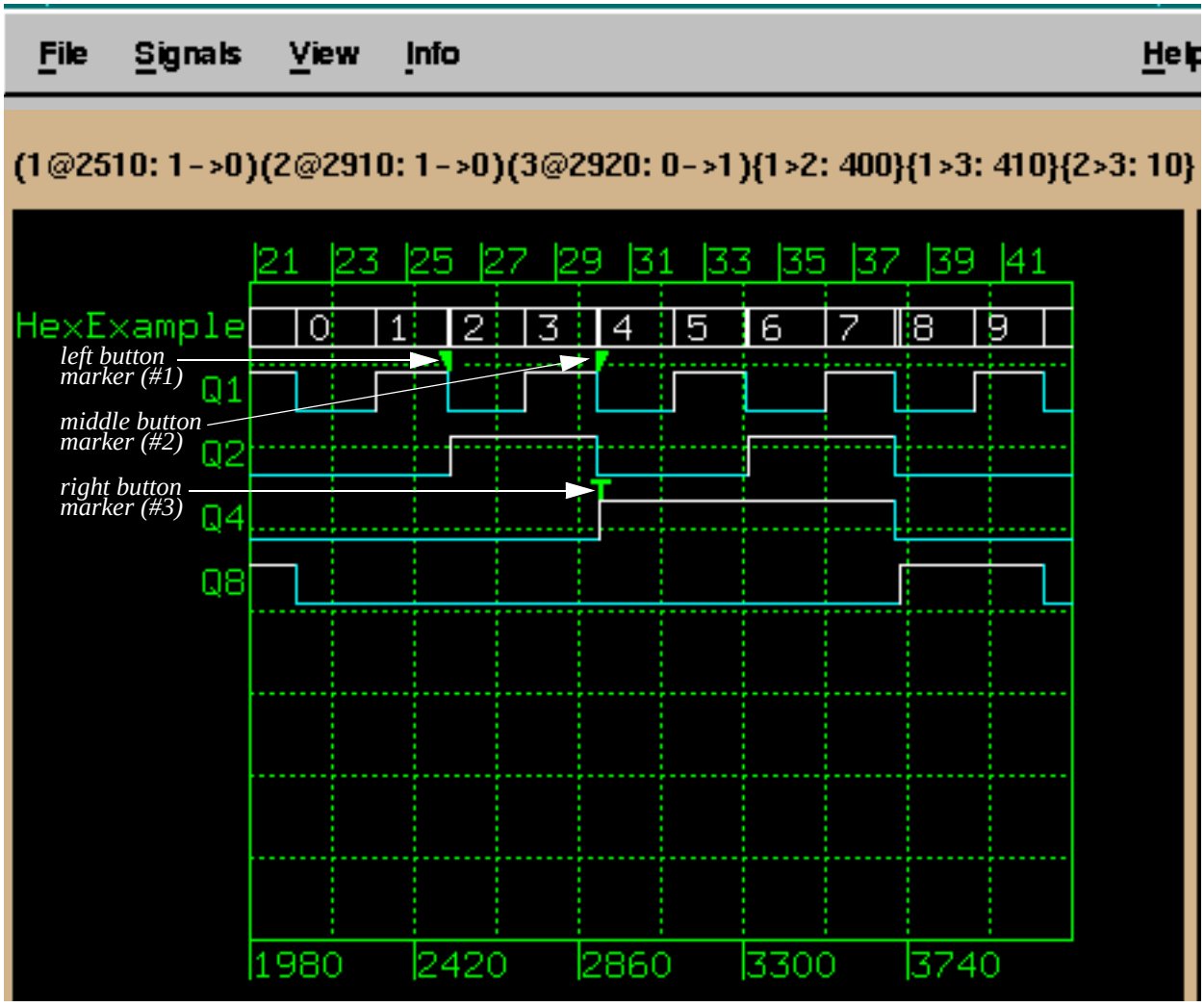


Figure 16 Markers

Marker Information

The message area displays information about the location of each marker, the value(s) of the marked signal, and, if more than one marker is placed, delta values between markers. While marker placement can be visually interpolated from the simulation time axis (possibly after expanding the time scale), the message area display provides a precise and instantaneous report.

Marker information is displayed in the following format:

(markernumber@time: *value*)

where *markernumber* is 1, 2, or 3 corresponding to the three possible markers, *time* is the simulation time at which the marker is currently located, and *value* is the value of the signal at the marker. If the marker is at a transition (it will be if the marker has been moved from its initial placement), then *value* will be a two-tuple of the form:

initial->final

where *initial* is the signal value prior to the marker, and *final* is the value after the marker.

For example, in Figure 14 on page 17, the message segment:

`(2@2910: 1->0)`

states that marker #2 is placed at simulation time 2910, over a 1→0 transition of signal `Q1`.

If more than one marker is placed, then marker deltas will also be displayed in the following format:

{*firstmarker* > *secondmarker*: *delta*}

where *firstmarker* is 1 or 2, corresponding to a placed marker, *secondmarker* is 2 or 3, corresponding to a different marker, and *delta* is the time difference between the placements of *secondmarker* and *firstmarker* (which may be negative if *firstmarker* marks a later simulation time than *secondmarker*).

For example, again referring to Figure 14, the message segment:

`{1>2: 400}`

states that the time difference between the placement of marker #2 and marker #1 is 400 timeunits (marker #2 is at simulation time 2910, and marker #1 is at time 2510).

Viewing A Marker

If the <Shift> key is pressed, then clicking a mouse button will cause the visible display region to move so that the corresponding marker is centered in the display. This can be very useful for quickly switching visibility between different simulation intervals.

Deleting A Marker

If the <Control> and <Shift> keys are pressed simultaneously, then clicking a mouse button will remove the corresponding marker.

Printing The Display

Xwave will optionally generate a PostScript description of the display that can be directed to a PostScript printer or written to a file for subsequent printing. The print is scaled and oriented to best fill a single page.

To create this output, select the **Print** option of the bar menu **File** item (see Figure 6 on page 9). This brings up the **Print Request Dialog Box** shown in Figure 17. The radiobox (mutually exclusive options) labeled **Destination** selects whether the print output should be directed to a printer or to a file. The text entry window below the radiobox qualifies the destination.

- If **File** is selected for the destination, this window will contain a default name for the file, *filename.ps*, where *filename* is the history file name. If this name is not appropriate, modify it as necessary.
- If **Printer** is selected, then the name of the printer may be entered; otherwise, the default printer is used.

If **File** is selected, and the file specified in the text window already exists, Xwave brings up the dialog box shown in Figure 18, asking whether the existing file should be overwritten. "Press" **OK** to overwrite the file, or **Cancel** to subsequently specify a different file. If the file cannot be created (usually due to lack of write privilege or an attempt to overwrite a protected file), Xwave brings up the dialog box shown in Figure 19. "Press" **OK** to specify another file, or **Cancel** to abort creation of the file.

.

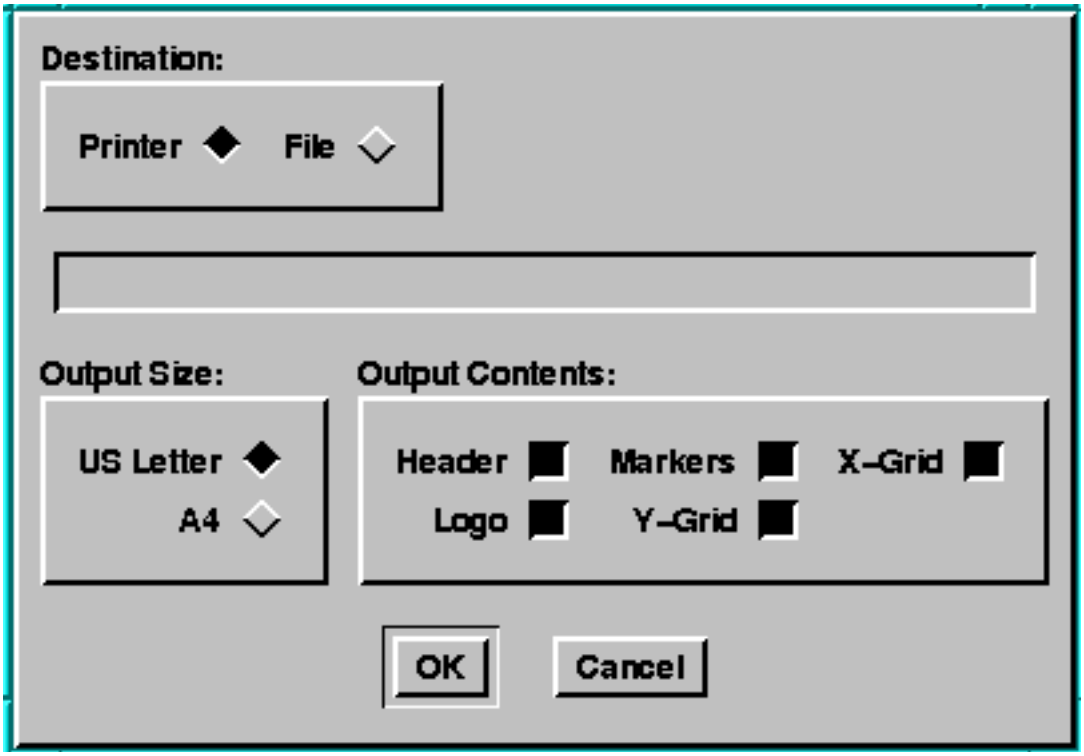


Figure 17 Print Request Dialog Box

Figure 18 Dialog Box For Overwriting Existing File

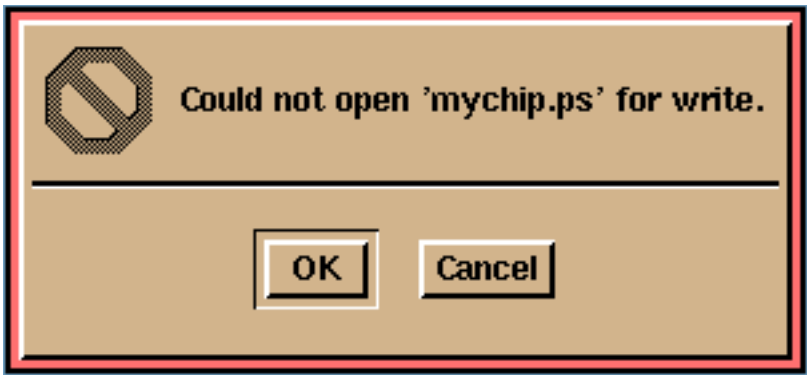
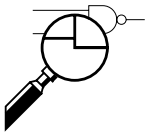


Figure 19 Dialog Box For Failed File Creation

Below the text entry window, the **Output Size** box selects standard US letter or A4 as the page size. The **Output Contents** box selects individual components of the display to be included in the print output.

"Pressing" **OK** causes the print output to be generated, and **Cancel** aborts the print operation.

Figure 20 illustrates the Postscript printout generated for Figure 5 on page 8, reduced to 70% of its actual size.



XWAVE (Version 1.02.00)

mychip
Waveform Display using waveform stimulus

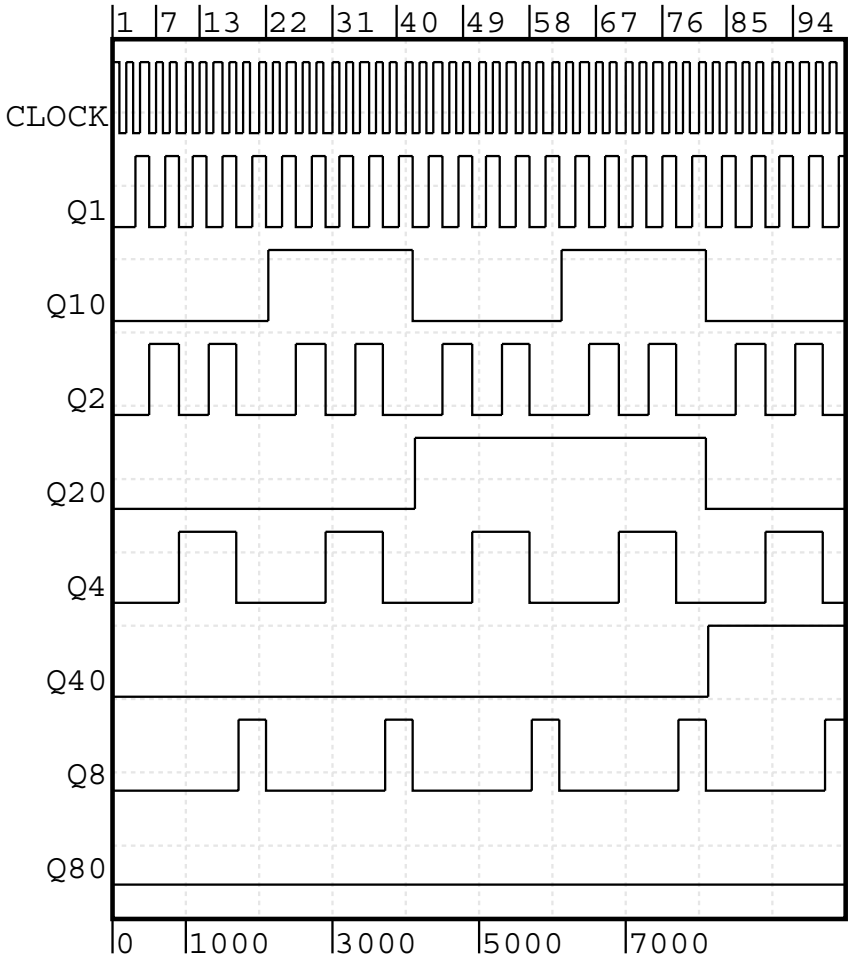


Figure 20 PostScript Printout Corresponding To The Display Of Figure 5

Saving And Restoring The Display

The state of the display can be saved and subsequently restored, either in the current session or in a future session. If the same simulation events are of interest in multiple Xwave sessions, this feature eliminates the identical selection and setup operations that would otherwise have to be repeated at the start of each session.

Saving The Display

The state of the display is written to a file by selecting the **Save** option of the bar menu **File** item. This brings up the **Save Display Dialog Box** shown in Figure 21. The text entry window of this dialog box contains a default name for the file, *filename.wav,* where *filename* is the history file name. If this name is not appropriate, modify it as necessary.

A checkbox of three options is directly below the entry window; each option is enabled if the corresponding button is dark, and disabled if light. Clicking any mouse button with the cursor over these buttons will toggle them. If **Display Options** is enabled, then the **Display Layout**, **Grid Settings**, **Waveform Layout**, **Time Start** and **Time Scale** settings will be saved (see *Restoring The Display*). If **Waveforms Displayed** is enabled, then the list of signals being displayed will be saved. If **Markers Placed** is enabled, then the locations of the placed markers is saved. Selecting **OK** will perform the write, **Cancel** will abort the write.

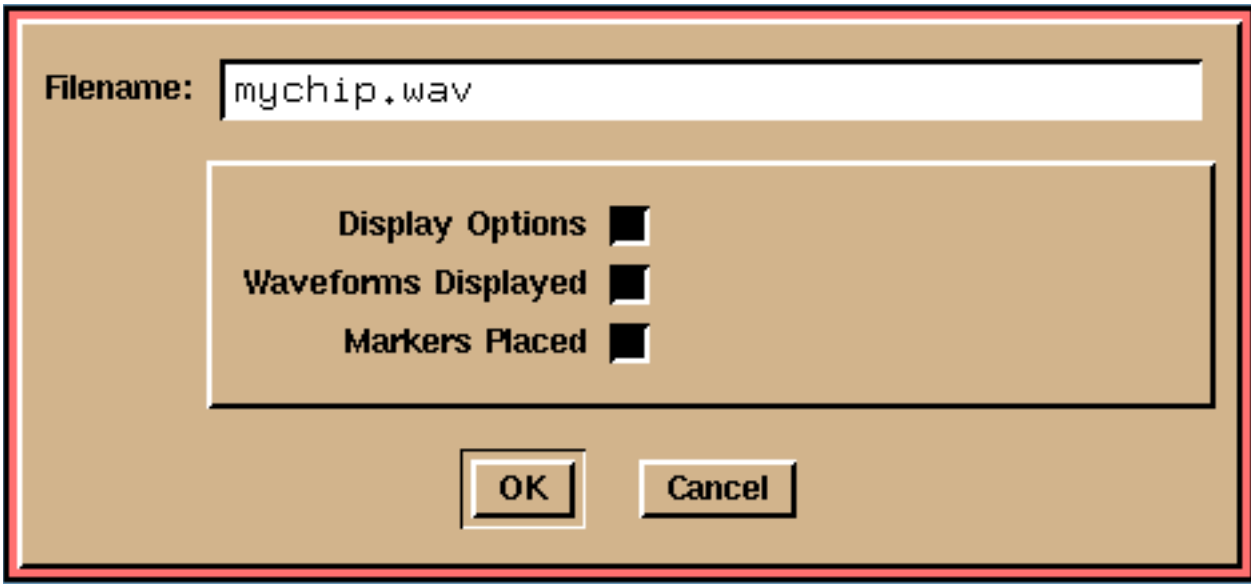


Figure 21 Save Display Dialog Box

If the specified file already exists, or if it cannot be opened for writing, the corresponding dialog boxes similar to the ones shown in Figure 18 and Figure 19 are displayed.

Restoring The Display

A previously-saved display state is restored by selecting the **Restore** option of the bar menu **File** item. This brings up the **Restore Display Dialog Box** shown in Figure 22. The entry window of this dialog box contains a default name for the saved-display file, *filename.wav,* where *filename* is the history file name. If this name is not appropriate, modify it as necessary.

A checkbox of seven options is directly below the entry window; each option is enabled if the corresponding button is dark, and disabled if light. Clicking any mouse button with the cursor over these buttons will toggle them.

If **Display Position** is enabled, then the screen position of the Xwave window will be restored. If **Display Layout** is enabled, then the signal name area and waveform area display sizes will be restored. If **Grid Visibility** is enabled, then the X and Y grid line options will be restored. If **Waveform Height and Spacing** is enabled, then the waveform height and spacing will be restored. If **Time Start** is enabled, then the starting time in the waveform display will be restored. If **Time Scale** is enabled, then the waveform display time scale will be restored. If **Waveform List** is enabled, then the displayed signals will be restored. Lastly, if **Markers** is enabled, the placed markers will be restored. Selecting the **OK** button performs the restore, whereas the **Cancel** button aborts the restore. Pressing **Find** will display a **Filename Selection** Dialog box, similar to Figure 3 on page 5, allowing you to browse through possible files for selection.

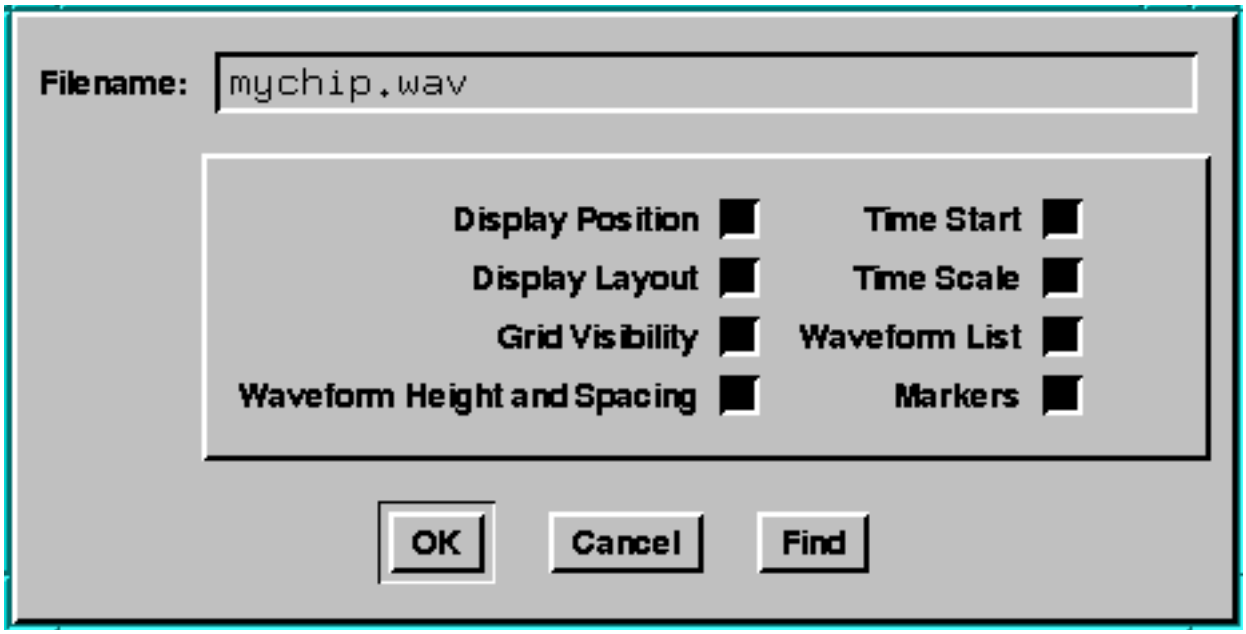


Figure 22 Restore Display Dialog Box

If Xwave could not open the specified file, the dialog box of Figure 23 is displayed. "Press" **OK** to enter another file name, or **Cancel** to abort the restore operation.

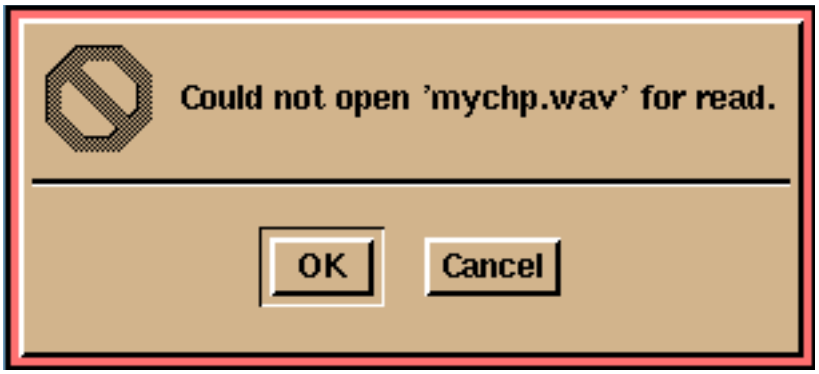


Figure 23 Dialog Box For Failed Read Operation

The Help Bar Menu Item

Selecting this item will cause a scrollable help window to display information on Xwave usage, as shown in Figure 24.

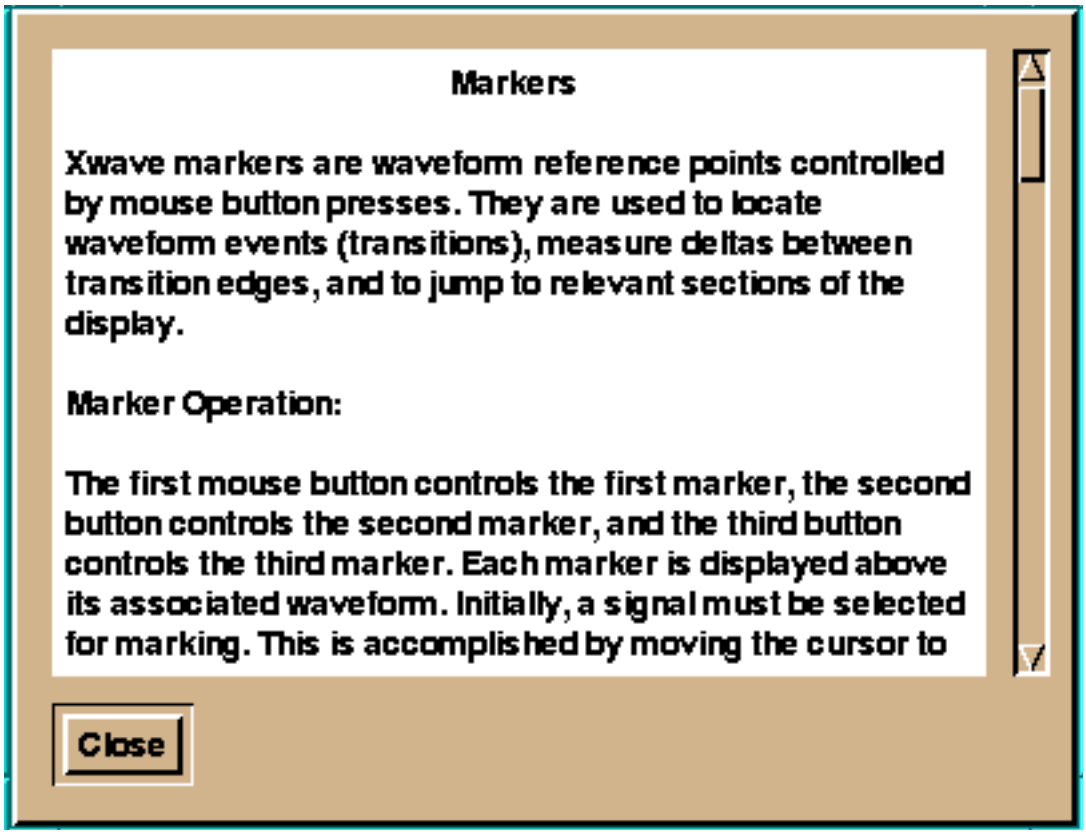


Figure 24 Help Information

The Info Bar Menu Item

Selecting this item will display an information box containing the current version of Xwave, as shown in Figure 25. "Pressing" **OK** will dismiss this window.

Figure 25 Xwave Info Display

Changing Files for Display

You may run as many Xwave processes as your operating system will allow. Once a process has started, you may, at any time, select new files for display. In this event, the contents of the previous history files will be discarded.

Selecting New Files in Xwave

To choose new files for display, select the **Open** item from the **File** menu as shown in Figure 26. Xwave will ask for confirmation as shown in Figure 27. If you choose **Cancel**, the current display state will be preserved. If you choose **OK**, Xwave will display the **Filename Dialog Box**, as shown in Figure 3 on page 5. Update the entry fields with the correct information, following the procedure outlined in *Starting Xwave* on page 4.

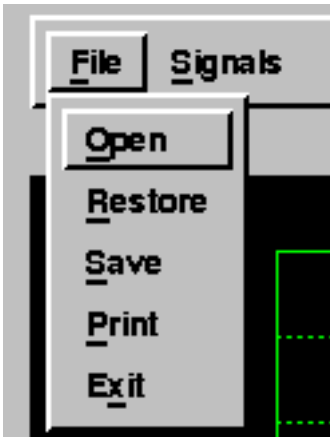


Figure 26 Open Item in File Menu

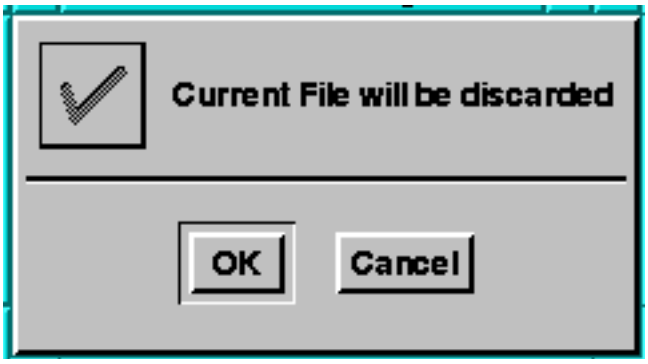


Figure 27 Confirmation Box for Open Selection.

Selecting New Files Outside of Xwave

A simple mechanism exists that allows another process to instruct a running Xwave process to open specific history or restore files for display. This can be used to maintain an open Xwave window in a CAE framework, and automatically update the display after a new simulation run or when new signals should be displayed. The **gcommand** program provides this interface. The format for invoking **gcommand** is:

```
gcommand <window title> <arg list>
```

where <*window title*> is the Xwave main window title name (Xwave by default), and <*arg list*> is a list of arguments to be sent to this window. The window title can be changed by the `-title` X-resource option. The X-resource options accepted by Xwave are described in *X-Resources Used by Xwave* below. The arguments are the same as if Xwave were invoked from a command line.

For example, if the title of the main Xwave window is `Xwave@chaos`, then you can make this Xwave process read the history files named `mycpu`, with the following command:

```
gcommand Xwave@chaos mycpu
```

The effect is the same as if you started Xwave with the equivalent argument list.

If there is more than one window with the specified title, then the first window encountered will be updated.

Important: **gcommand** arguments must **not** contain X-resource options.

X-Resources Used by Xwave

The user may specify X-resources by using the command line switches (long or short), or by entering the resource assignment into an X-resource file. Xwave searches for user-set resources in the following order (highest precedence last):

(a) If $XFILESEARCHPATH exists, search along this path, otherwise use /usr/lib/X11 as a path prefix with the following search string:
"/%L/%T/%N%C:/%l/%T/%N%C:/%L/%T/%N:/%l/%T/%N:/%T/%N"

(b) If $XUSERFILESEARCHPATH exists, search along this path. Otherwise, if $XAPPLRESDIR exists, use this (otherwise $HOME) as a path prefix with the following search string:
"/%L/%N%C:/%l/%N%C:/%L/%N:/%l/%N:/%N".

(c) If RESOURCE_MANAGER property exists, read it, otherwise read $HOME/.Xdefaults.

(d) If $XENVIRONMENT exists, read it, otherwise read $HOME/.Xdefaults-hostname. Where hostname is the name of the current host.

(e) Read the command line switches.

Notes: The words beginning with a dollar sign ($) (for example $LANG and $HOME), are system environment variables. Search string substitutions can be found in the Xt reference documentation. Currently, the %C substitution string is not supported, and an empty string will be used if found.

For example, if you wanted the background color to be blue, you could either use the command line switch:

```
Xwave -bg blue
```

or, insert the following line in one of the X-resource files mentioned above.

```
Xwave.Background:   Blue
```

Table 4 lists the X-resources that Xwave recognizes.

.

Table 4: List of Xwave X-resources

Short Command Line Switch	Long Command Line Switch	X-resource Name	Description
-bc	-baseColor	BaseColor	Specifies the color to use for all window backgrounds. The default is "Tan".
-bg	-background	BackGround	Specifies the color to use for the Widget backgrounds. The default is "White".

Table 4: List of Xwave X-resources

Short Command Line Switch	Long Command Line Switch	X-resource Name	Description
-bvc	-busVColor	BusVColor	Color to use for bus display when the value is not X or Z. The default is "White".
-bxc	-busXColor	BusXColor	Color to use for bus display with unknown (X) value. The default "Red".
-bzc	-busZColor	BusZColor	Color to use for bus display with high-impedance (Z) value. The default is "Pink".
	-display	display	Specifies the display device for Xwave output. The default is the DISPLAY environment variable.
-dsc	-darkShadeColor	DarkShadeColor	Specifies the color for dark shading used for 3-Dimensional appearance. Default is "Black".
-ff	-fixedFont	FixedFont	Specifies the font to use for all text displays that require fixed spaced fonts. Default is "6x9".
-fg	-foreground	Foreground	Specifies the color to use for all window foregrounds. Default is "Black".
	-geometry	geometry	Specifies the size and/or the location of the main Xwave window. The size is defined by the format: WxH, whereW is the width and H is the height. The location is in the format {+-}X{+-}Y, where X is the x position relative to the right, if positive, or left, if negative, and Y is the y position relative to the top, if positive, or bottom, if negative. If the width or height is smaller than the minimum, Xwave will force the window to the minimum value.

Table 4: List of Xwave X-resources

Short Command Line Switch	Long Command Line Switch	X-resource Name	Description
-hl	-highlight	Highlight	Specifies the color to use to highlight the currently selected entry widget. Default is "Red".
-lcc	-logicCColor	LogicCColor	Specifies the color to display high-impedance one (C) values. The default is "Red".
-ldc	-logicDColor	LogicDColor	Specifies the color to display high-impedance zero (D) values. The default is "Red".
-lsc	-lightShadeColor	LightShadeColor	Specifies the color for light shading used for 3-Dimensional appearance. Default is "White".
-lxc	-logicXColor	LogicXColor	Specifies the color to display unknown (X,Y, U). The default is "Red".
-lzc	-logicZColor	LogicZColor	Specifies the color to display high-impedance unknown (Z). The default is "Green".
-l0c	-logic0Color	Logic0Color	Specifies the color to display logic zero (0, L, F). The default is "Cyan".
-l1c	-logic1Color	Logic1Color	Specifies the color to display logic one (1, H, T). The default is "White"
-mka	-menuKeyAccelerator	MenuKeyAccelerator	Specifies whether underlining and accelerator keys are used for menu selection. Default is "On".
-os	-outputSize	OutputSize	Specifies the default paper size for printing. Values are "A4", or "USletter". Default is "USletter".
-sc	-scopeColor	ScopeColor	Specifies the background color for the waveform display. The default is "Black"

Table 4: List of Xwave X-resources

Short Command Line Switch	Long Command Line Switch	X-resource Name	Description
-sbc	-scrollBarColor	ScrollBarColor	Specifies the color for the scrollbar buttons and slider. Default is to use BaseColor.
-tc	-templateColor	TemplateColor	Specifies the color for the axis, labels and grids in the waveform display. The default is "green"
	-title	title	Sets the Xwave window title. Default is "Xwave".
-vf	-variableFont	VariableFont	Specifies the font to use for all text displays that use proportionally spaced fonts. Default is "variable".