GTKWave User Guide

The GTKWave software is used to view simulation results when running the testbench in the ForgeFPGA Software. This user guide will help in navigating different features of the software and aid in getting better results.

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Figures

1. Reference

For related documents and software, please visit our website:

Download our free ForgeFPGA Designer software [1] and follow the steps in the software user guide [2]. Use Configuration Document to understand the different modes of configuration [3]. Renesas Electronics provides a complete library of application notes [4] featuring design examples as well as explanations of features and blocks within the Renesas IC.

[1] ForgeFPGA Designer Software, Software Download, Renesas Electronics

[2] ForgeFPGA Workshop User Guide, Renesas Electronics

[3] SLG47910, Preliminary Configuration Document, Renesas Electronics

[4] Application Notes, ForgeFPGA Application Notes & Design Files, Renesas Electronics

[5] ForgeFPGA Development Board User Guide, Renesas Electronics

[6] ForgeFPGA Socket Adapter User Guide, Renesas Electronics

[7] ForgeFPGA Test Bench User Guide, Renesas Electronics

2. Introduction

GTKWave is a fully featured GTK+ wave viewer for Unix, Win32, and Mac OSX which reads LXT, LXT2, VZT, FST, and GHW files as well as standard Verilog VCD/EVCD files and allows their viewing. Its official website is at http://gtkwave.sourceforge.net/. GTKWave is the best free wave viewer and is the recommended viewer by Icarus Verilog simulation tool.

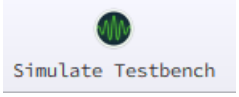
The GTKWave software is used as a simulation tool to verify the Verilog design code through a testbench. A testbench a set of code which is used to verify the complexity of the system before implementing it on the hardware. Inside the testbench the user needs to instantiate the Unit Under Test (UUT) or Device Under Test (DUT) and drive the inputs though all the possible combinations. The outputs are then viewed on the GTKWave software.

3. Installation

Install the latest version of Icarus Verilog (iVerilog) from here. Be sure to add iVerilog to the PATH while downloading and let it install GTKWave on your system.

4. Usage

To Verify the testbench the user created, we need to simulate the testbench and this is done through GTKWave software. In order to open GTKWave you can either type ‘gtkwave’ in terminal, or by clicking on its icon:



in the ForgeFPGA Workshop Software. If you choose to open the software externally, then the user must choose the .vcd files which are dumpfiles produced for our ForgeFPGA Workshop software when you run a testbench (simulation).

5. Creation of .vcd Files

Value Change Dump(vcd) is an ASCII-based format used for generating dumpfiles that contains the state of the design as the software simulates. A vcd file is created inside the testbench. Use **$dumpfile** directive to create a file that contains the dumped waveforms. Note, the name of the testbench must be **modulename_tb** for it be recognized as a testbench by the ForgeFPGA Software. When creating a custom testbench, ForgeFPGA Workshop software automatically creates two lines for **$dumpfile & $dumpvars** (see Figure 1) in the template code according to the name of the module and places it inside the "initial" block so that the dumpfiles are generated when the "initial block" is executed.

```
module test1;
..
initial begin
     $dumpfile("mydumpfile.vcd");
$dumpvars(0,my_module_name);
end
..
endmodule
```

Figure 1. Syntax for creating .vcd files in testbench

The declaration of the input, output signals and the module instantiation are defined above the initial block.

The "initial block" is executed only once and terminated when the last line of the block is executed (before "end"). Inside this block, we define the dumpfiles and assign different values to the signals in our design and different wait-times for each signal if needed.

After Simulate Testbench button is clicked on the ForgeFPGA Workshop Software, the GTKWave software automatically opens the .vcd file. When the Wave Window opens, there are no waveforms displayed. This gives the user an opportunity to select which signal's waveform it needs to display.

In order to choose the signal, you want to see, you should go to the left window with the SST name. Here you can see your hardware hierarchy. By clicking the + of every instance, you can see the signals that are related with that instance in the bottom section. Then you can drag & drop the desired signal or double-click them to be displayed in the Signals window. You can also select all (CTRL + A) and insert them to the signals window (see Figure 2).

After adding the desired signals to the signal window, click on  to fit the signals to the current width of the window and then reload the signals from the reload  symbol present on the toolbar. You can now see the signals with their respective values.

By default, the values of the signals are in hexadecimal format and all the waves are colored green (if correctly running).

User can change the properties of these signal by right-clicking on the signal and choosing Data Format or Color Format. User can also insert a blank signal to make sections between group of signals. When you have the desired optical result, you can save your configurations by going **File → Write Save File**.

Let's discuss the Menu options found in the GTKWave Software.

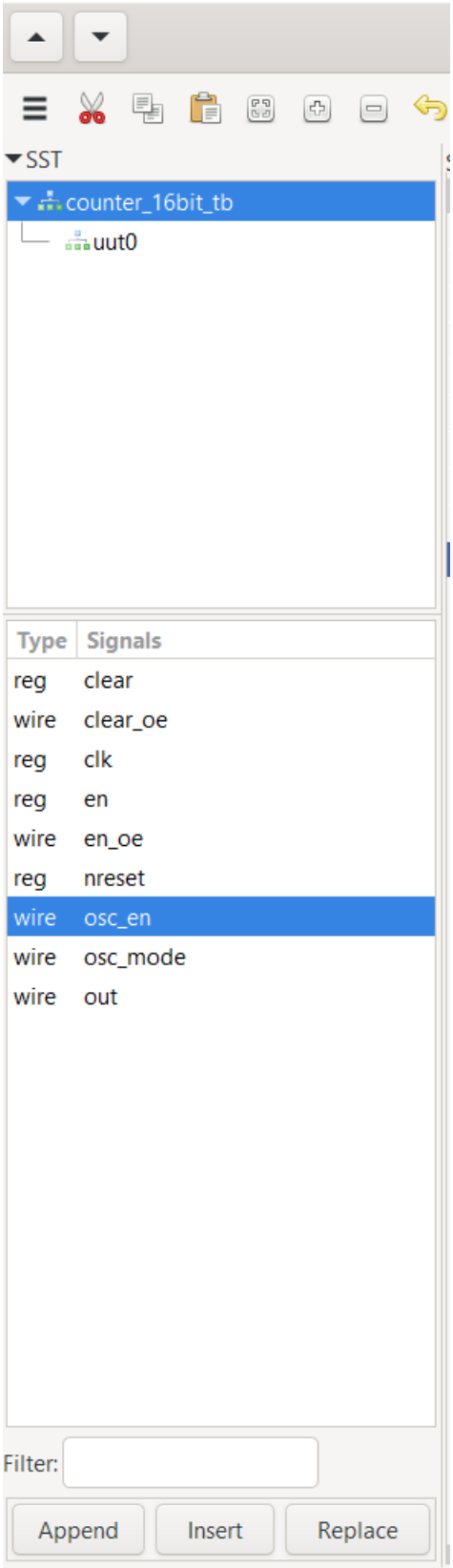


Figure 2. Adding desired signals to signal window

6. GTKWave Menu Functions

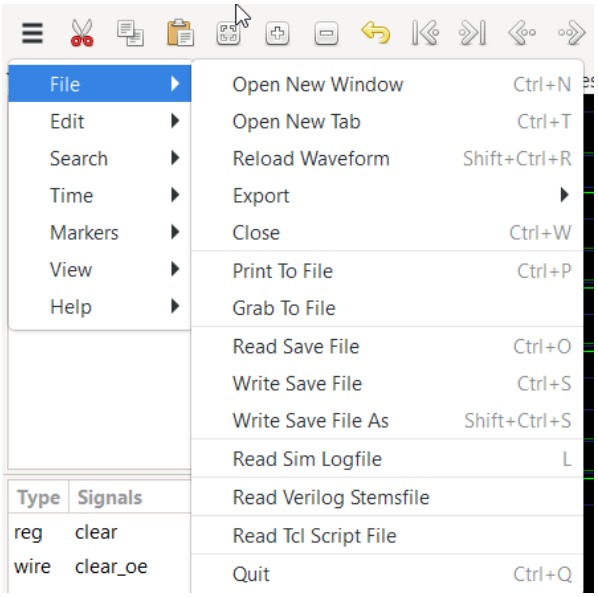


Figure 3. Menu options

6.1 File

The File submenu contains various items related to accessing of files, importing-exporting VCD files, printing, and reading/writing files and exiting.

6.2 Edit

The Edit submenu is used to perform various utility functions such as changing the data representation of values in the wave sub window. Using the options under the Edit submenu, user can change the data format of the signals, rearrange them, shift them, trim it, highlight it, group signals, comment on signals, change the color of the signals, and others.

6.3 Search

The Search submenu is used to perform searches on net names and values. It helps to perform functions on different hierarchy levels of the signals and instances in the VCD file.

6.4 Time

The time submenu contains a superset of the functions performed by the Navigations and the Status Panel buttons. It enables simple time related functions like zooming, moving to a particular time point, shifting the signal in a certain direction, and others.

6.5 Marker

The marker submenu is used to perform various manipulations on the marker as well as control scrolling offscreen. It enables the functionality of adding numerous markers on the signal window. A maximum of 26 names markers are allowed and the times for all must be different.

6.5.1. To Add Markers in the Signal Window

Left click at the required point where you want the Marker to be placed and press ALT + N. This will place a named marker (A, B, C, and others) at the required point. User can continue to do this for 26 different time locations.
To compare the time value at all the places markers, **Menu → Markers → Show Change Marker Data**. This will open a window with the time value at each Marker. User can manually note the time value at each marker placed and subtract them to calculate the time difference between 2 markers.

Another way to calculate the time difference between 2 markers is to first place the 2nd marker (white color) at your desired location by clicking the middle button of your mouse. Then the time difference between the first marker (red color) and the 2nd marker (white color) will be visible in the top of the screen below the name of the file. It will be denoted as **Marker: B+ or Marker: B-** depending if the 2nd marker is placed on the right or the left side of the red marker. The number next to Marker: B± **2515ps** will denote the time difference between the two markers. To remove the placed white marker, user needs to re-click the middle button of the mouse.

6.5.2. To Remove Marker in the Signal Window

User can go to **Menu → Markers → Collect Named Marker**. This will remove the last-named Marker placed in the signal window. User can remove all the named Markers by going to **Menu → Markers → Collect All Named Marker** (see Figure 4).

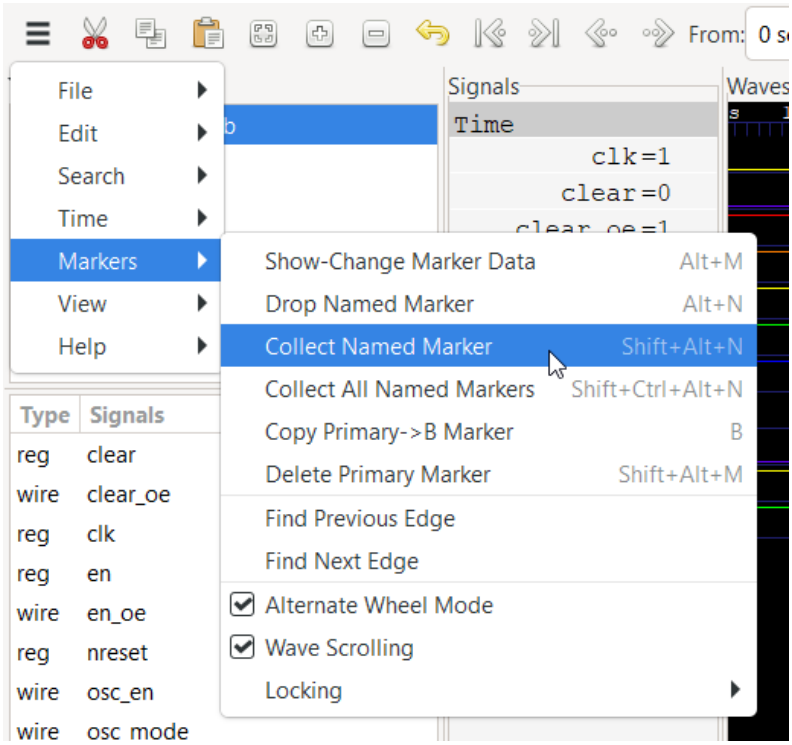


Figure 4. Marker options

In Figure 5, we can see how the signal colors have been changed. You can observe a Blank Signal added to the signal window as well with a comment - Blank Signal.

Also note the presence of 6 Named Markers (A-E) and the comparation of the time value between these Markers in ps.

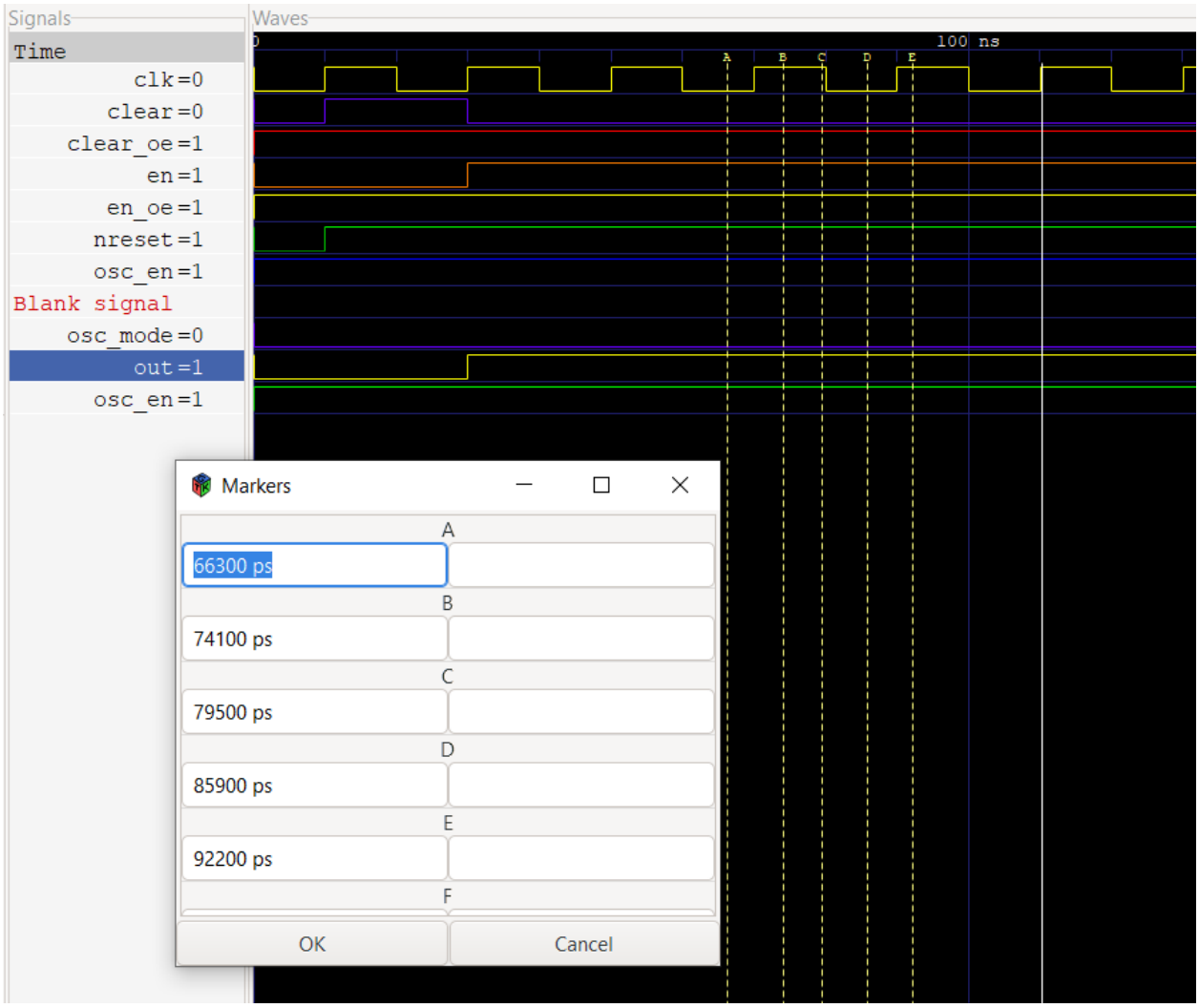


Figure 5. Collecting data from Markers

6.6 View

The View submenu is used to control various attributes dealing with the graphical rendering of status items as well as values in the signal sub window. From this menu, you can convert the signal window to Black & White or colored as well. The View submenu also enables you to change the time Dimension ranging from seconds (secs) to ficoseconds (fs). The user can find this option **View → Scale to Time Dimension → fs**.

6.7 Help

The help submenu contains options for enabling on-line help as well as displaying program version information.

7. GTKWave Toolbar

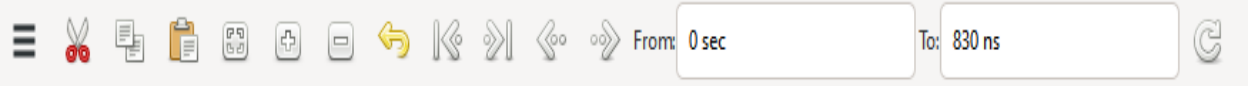


Figure 6. GTKWave toolbar

The toolbar allows the user to perform basic functions for the signal. Let us discuss each option on the toolbar from left to right.

1. **Menu Options**: Under this option we can view all the various features of the software that can be used to play around with the software. The details under this menu option are covered under Section 6 GTKWave Menu Functions of this user guide.
2. **Cut Traces**: It is used to delete/cut the select signal from the signal window.
3. **Copy Traces**: It is used to copy the selected signal from the signal window.
4. **Paste Traces**: The copied/cut trace can be pasted at a different location in the signal window.
5. **Zoom Fit**: It is used to fit the signals according to the size of the window the user chooses to display.
6. **Zoom In:** It is used to zoom in the signal window.
7. **Zoom Out**: It is used to zoom out the signal window.
8. **Zoom Undo**: it is used to undo the zoom in/out on the signal window.
9. **Zoom to Start**: This will zoom the signal window displaying the start time of the signals.
10. **Zoom to End:** This will zoom the signal window displaying the end time of the signals.
11. **Find previous edge**: This shifts the marker to the left side indicating the previous edge.
12. **Find next edge**: This shifts the marker to the right indicating the next edge.
13. **Scroll lower/ upper bond**: using this we can set the time frame in which the user wants to display. For example, we can set the time frame from 0 sec to 500 ns, it will display the signals under that duration only.
14. **Reload:** The reload is pressed whenever there is a change to the displayed signal. It will reload and display the signal according to the new parameters. For example, after changing the time frame of the signal, we need to reload the signal to display the signal in the new set time frame.

8. Conclusion

The GTKWave software can be used to read the simulation results generated after successfully writing the Testbench on the ForgeFPGA Workshop Software. This guide covers some aspects of the software such as how to navigate different features of it and the different menu options. The .vcd file generated after running the testbench can be imported separately as well to view the results.

9. Revision History

Revision	Date	Description
1.00	Jan 3, 2023	Updated format Added Installation Steps Initial release