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WaveSurfer 3000
Oscilloscope
Demo Guide

wavesurfer 3074   750 MHz Oscilloscope   4 GS/s

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WaveSurfer 3000 Oscilloscope Demo Guide

A Guided Tour of Your WaveSurfer 3000 Oscilloscope

This guided tour will get you started with your WaveSurfer 3000 oscilloscope, and acquainted with a number of its advanced measurement and analysis features. We'll start with the instrument's built-in calibration signal as a source while we explore the basics. Later, we'll move on to some more advanced features and capabilities using the instrument's built-in WaveSource signal generator and stored setups that you'll load by using the oscilloscope's LabNotebook documentation and report generation utility.

Table of Contents

Introduction

Thank you for evaluating the WaveSurfer 3000. Following this demo guide will help you familiarize yourself with the basic and advanced features of this powerful oscilloscope. To aid in this process, some software options have been added.

The pre-installed trial options include:
- WS3K-EMB – I^2C, SPI, and UART Trigger and Decode
- WS3K-FG – WaveSource Function Generator
- Special option that affords access to WaveSource demonstration waveforms

Pre-installed LabNotebook files are saved on the oscilloscope's internal microSD card. These files will be used in the Advanced Features and Analysis Tools section of this guide.

Initial Setup

- Turn on the oscilloscope by pressing the Power button at lower left on the front panel
- After boot up, press the Default Setup button in the top row of buttons in the front panel
- Connect a passive probe to the instrument's Channel 1 input
- Connect the probe tip to the Cal output test point at lower right on the front panel
- Connect the probe ground lead to the adjacent ground lug on the front panel
- Press the Auto Setup button on the front panel
- Press the Normal button in the front panel's Trigger group.

Your oscilloscope's display should now appear as in Figure 2. This completes the initial setup for the sections of this document to follow.
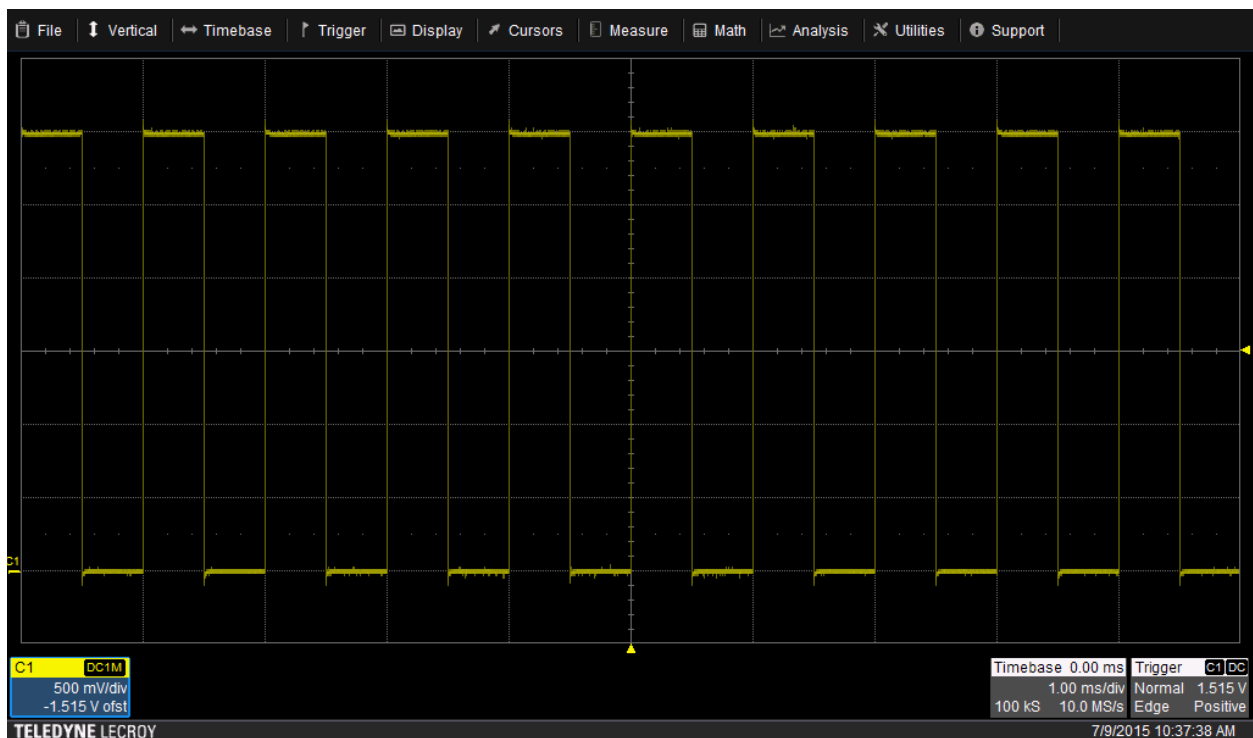

Figure 2: Screen capture with initial setup complete

Vertical and Horizontal Controls

At the lower left corner of your oscilloscope's touch screen display is a channel descriptor box (for details on this and other user interface items, refer to the Getting Started Guide that came with your oscilloscope). C1 tells us that the data for the trace associated with this box comes from the oscilloscope's Channel 1 input. DC1M means that C1 is set for DC coupling and 1MΩ input impedance. The box shows that the vertical sensitivity is set to 500 mV/division and the DC offset is -1.515 V (that is in the case of this example; actual DC offset on your trial oscilloscope may vary slightly).

Note that on the front panel (Figure 3), only the Channel 1 button is illuminated, as it is the only channel currently in use. Pressing the buttons 1-4 at center right of the front panel turns those channels on or off.

Turn on Channel 2 by pressing and illuminating its front panel button (the Channel 1 button will go dark as Channel 2 is now the active channel). A magenta-colored trace, labeled C2, appears on the left edge of the grid area, and a second channel descriptor box will appear. Turn off Channel 2 by pressing its button again.

The Vertical controls comprise one knob for DC offset and one knob for sensitivity. At any given time, these knobs will affect only the active channel. Use the offset knob to move the Channel 1 trace up and down on the screen. The offset number in the channel descriptor box will change as you do so. Then change the sensitivity setting to make the trace larger and smaller; the V/div number in the channel descriptor box will reflect the changes you have made.

The two knobs in the Horizontal section control the time/division and delay, as reflected in the timebase descriptor box at lower right on the display. In Figure 2, the timebase is 1 ms/div and the delay is 0.00 ms. Note that this box also shows the number of samples being acquired (100 kS) and the sampling rate (10 MS/s).

Figure 3: WaveSurfer 3000 front panel

Now turn the Time/Div knob. The trace will expand and contract horizontally and the corresponding time/div setting appears in the timebase descriptor box. Meanwhile, the WaveSurfer 3000 automatically adjusts the sampling rate based on the memory length and timebase setting.

Touching the Timebase descriptor box will open the Timebase dialog box at the bottom of the screen (Figure 4). Here, you can assign less than the maximum memory if desired. The amount of acquisition memory is a trade-off with processing time; it is typically best to use the minimum sufficient amount of memory possible.

Figure 4: Touch the Timebase descriptor box to open the Timebase dialog

Turn the delay knob, which positions your trigger position horizontally on the screen. The trigger-position indicator icon, a yellow triangle, can be seen at the bottom of the grid area. The trigger time can be all the way to the right-hand edge of the grid area, in which case the oscilloscope acquires all data pre-trigger. Moving the indicator off-screen to the left initiates post-trigger data acquisition.

Basic Edge Triggering

Oscilloscopes require a trigger either derived from or synchronous with the acquisition waveform. A trigger allows display of the acquired waveform in stable fashion. The traditional default trigger type is the simple edge trigger (other, more complex trigger types are available in the WaveSurfer 3000). Edge triggering occurs when the source waveform crosses the trigger threshold level with the user-specified slope (positive or negative).

Open the Trigger dialog box by touching the Trigger descriptor box on the display or pressing the Setup button in the Trigger section of the front panel. The Trigger dialog box should be similar to Figure 5.

Figure 5: The Trigger dialog provides settings for all triggering parameters

A selection of trigger types appears on the left side of the Trigger dialog box. The oscilloscope selects the Edge trigger by default. To the right of the Trigger Types section is the Setup section, in which we see that Channel 1 (C1) is the signal source with a trigger threshold level of 1.510 V in this example (the actual trigger threshold level on your trial WaveSurfer 3000 oscilloscope may vary slightly). In the next section to the right, the Slope section, you can select positive, negative, or either. The default is positive. The Trigger descriptor box at the lower right corner of the grid area summarizes all of the above.

Touching the Source field opens a popup showing the possible trigger sources (Figure 6). These include the four analog input channels, the rear-panel External Trigger input, or the power line (mains). Touch the Line source button and note that the C1 trace becomes unstable. Bring up the Source popup again and re-select C1 as the trigger source to restabilize the waveform display.

8

Figure 6: The Source field in the Trigger dialog box displays all possible trigger sources

The Coupling section of the Trigger dialog box provides options for coupling of input signals into the triggering circuitry of the oscilloscope. DC coupling allows both DC and AC components of the trigger source into the circuit, while AC coupling blocks the DC component. LFREJ, or low-frequency reject, applies a high-pass filter in the trigger signal path to attenuate lower-frequency components, and HFREJ accomplishes the inverse function.

You can move the trigger position indicator mentioned above using the Horizontal Delay control on the front panel, within the Timebase dialog box, or by touching and dragging the yellow triangle on screen. In addition, if you change the Slope setting from positive to negative, the displayed trace shifts to align the selected slope with the trigger position indicator.

Another yellow triangle icon indicates the trigger level, this one on the right-hand edge of the grid area. It can be set from the Level field in the Setup section of the Trigger dialog box or by manipulating the front panel Trigger Level knob. Pushing the Trigger Level knob commands the oscilloscope to find the trigger level automatically (all of the front panel knobs have an action assigned to the push function).

Note that the trigger level indicator appears only when you select DC coupling. Try varying the trigger level up and down using one of the methods described above. A trigger level near the top or bottom of the waveform may result in an unstable display due to a fixed hysteresis built into the trigger circuit to help the oscilloscope fend off noise on the signal. When the trigger level is outside of the signal range, the instrument stops triggering and flashes a "Waiting for Trigger" warning message in the lower right-hand corner of the display. This indicates that the instrument has stopped triggering.

9

Basic Measurements

Digital oscilloscopes derive their power from numerically quantifying of signal/device performance, and the WaveSurfer 3000 is no different. The most commonly used method of characterizing the shape of a signal is to use measurement parameters.

- Touch the Measure drop-down menu at the top of the screen
- Touch the Measure Setup button to open the Measure dialog (Figure 7).
- Alternately, touch the Channel dialog box and then touch the Measure button in the dialog. This allows setup of a measurement on a specific channel only, but it is very useful for setting up more than one parameter measurement on the channel.
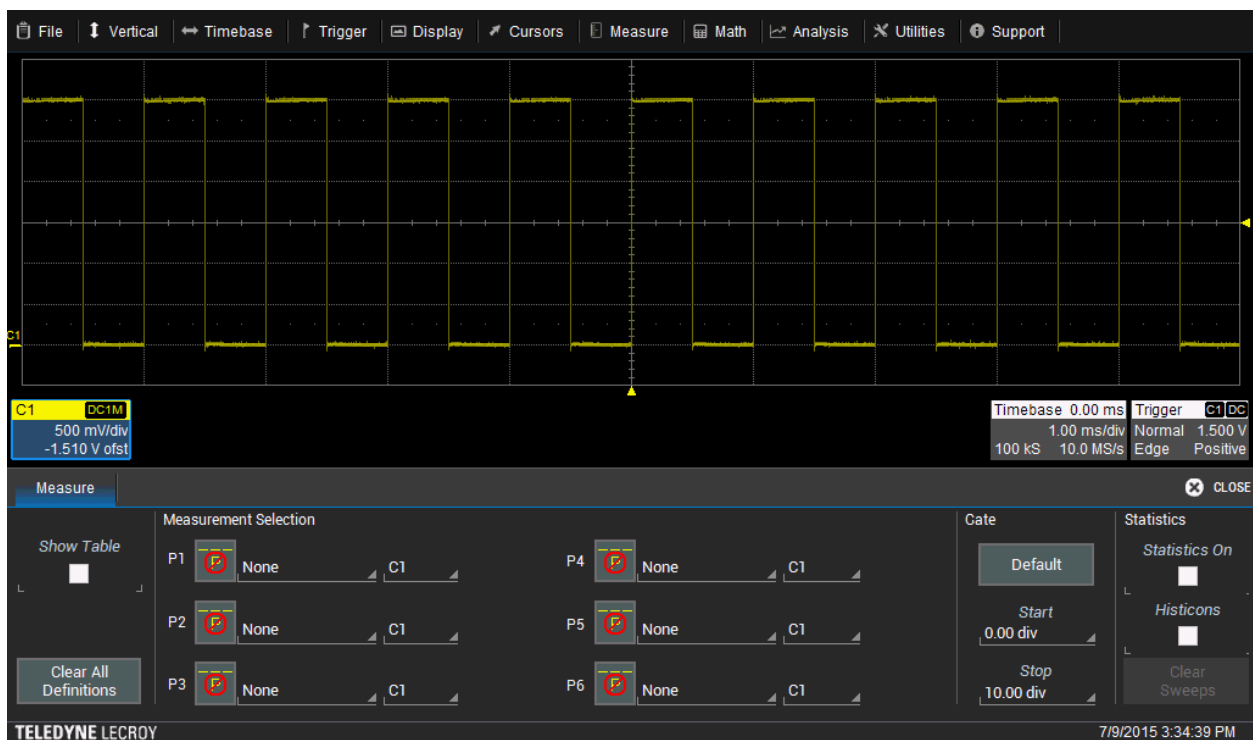

Figure 7: The Measure dialog enables easy setup of measurements

Parameters are pre-programmed measurements that eliminate the need to set up cursors for commonly measured characteristics such as rise/fall time, peak-to-peak amplitude, period, width, and so on. The WaveSurfer 3000 can make such measurements on more than one channel at once and display up to six parameter measurements at a time. It can also display statistics: maximum, minimum, average, standard deviation, and the number of measurements made. Note that when measuring parameters that can occur many times across the screen in a single acquisition, such as rise time, the oscilloscope measures all instances of the parameter.

Within the Measure dialog box is a section labeled Measurement Selection, with six fields for Parameter 1 through Parameter 6 (P1-P6).

- Touch P1 to bring up a comprehensive parameter menu
- Choose a parameter to associate with P1.

You then define which channel is the source for the measurement. The source selection defaults to C1, but touching the source field opens a Select Source popup that offers options that include analog/digital input channels (available only with the MSO option), math traces, memories, traces from the WaveScan utility (described later), and zoom traces.

Now select a few parameters and put them on the display by checking the Show Table box on the left side of the Measure dialog box. On the right side are the check boxes for Statistics and Histicons. Histicons display the distribution of the set of measurements compiled for each parameter (Figure 8).
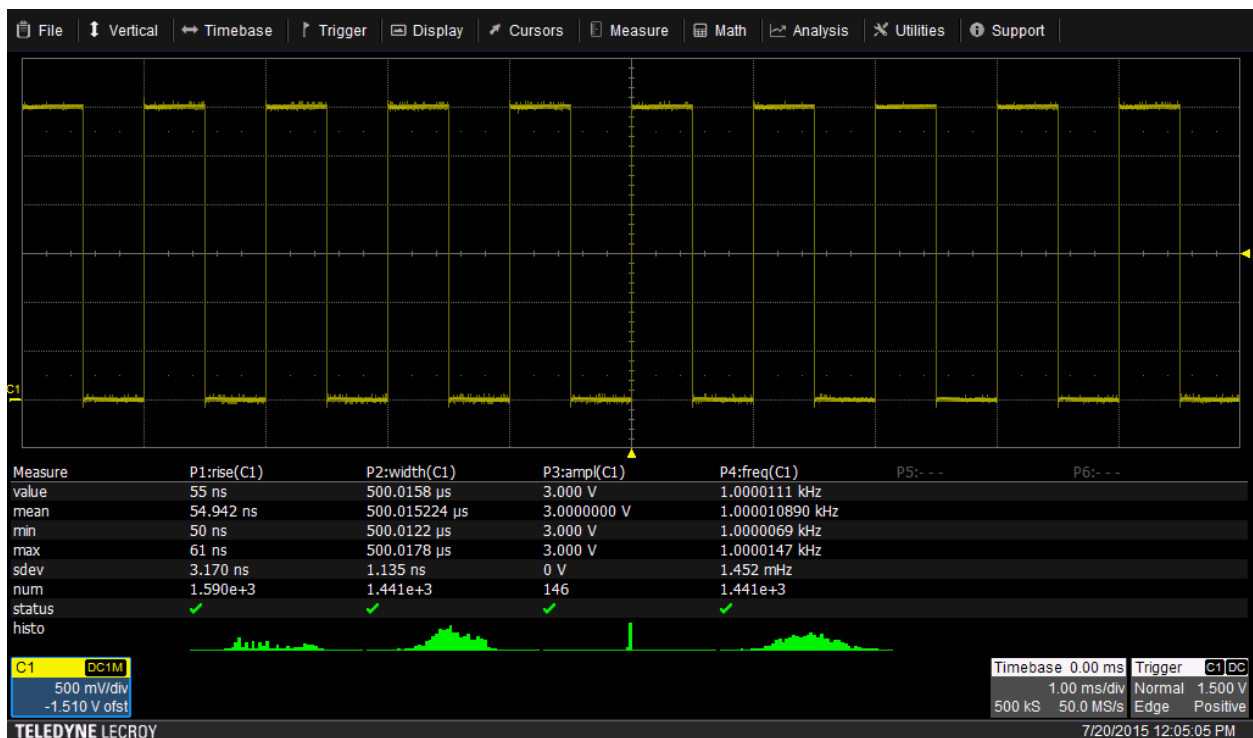

Figure 8: Statistics and histicons give you deep insight into measurement data

Basic Math Operations

There are several ways to invoke math operations on waveforms:
- Press the Math button on the front panel
- Open the Math drop-down menu on the display and touch Math Setup.
- Alternately, touch the Channel dialog box and then touch the Math button in the dialog box. This allows setup of a math trace on a specific channel only, but it is very useful for setting up more than one math trace on the channel.

Math traces are defined by selecting an operator and a source. There are many operators available grouped into categories of basic math, frequency analysis, and graphing; examples include add, subtract, divide, multiply, and FFT. Choose a source from among channels, zoom traces, or memories. Some operators require two sources and some one.

Figure 9 shows an example of an FFT trace (the FFT of a square wave contains all the odd harmonics of the fundamental frequency).

- Set up the Math functions for average, reciprocal, square, or FFT with C1 as the source from F1 tab. Try each function separately so as to get a feel for how they work.
- Check the Trace On box at left in the Math Setup dialog box to display the math trace
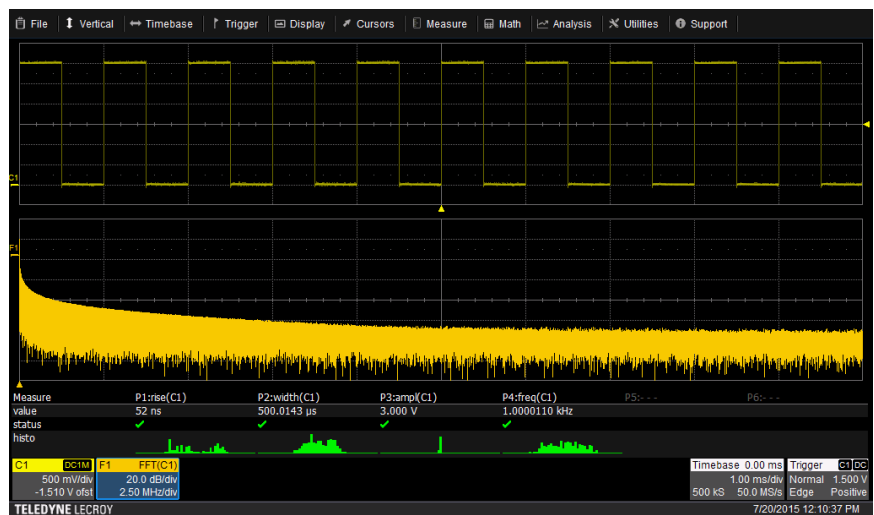

Figure 9: An example of an FFT trace

Note that the Math trace has its own descriptor box similar to that of the input channel.

Touching the descriptor box of a Math trace makes it the active trace, which means that the front panel horizontal and vertical controls will change the trace's position and scale. Note that WaveSurfer 3000 can display two math functions simultaneously (F1 and F2). You can even use F1 as the input to F2 for complex math-on-math functions.

Using Zoom Traces for More Detail

Oscilloscopes with long acquisition memory such as the WaveSurfer 3000 store many more points of data in memory than the number of horizontal pixels on the display. Sometimes you'll want to see more detail in the shape of a signal or math trace, and that is where zoom traces prove very useful.

There are three ways to open a zoom trace:
- Draw a box around part of the trace on the display with your finger, a pointing tool, or a mouse
- Touch the Zoom button on the front panel
- Touch the channel descriptor box and then touch the Zoom button in the Actions for Trace C1 section of the channel dialog box.

The zoom trace comes up on a separate grid with a horizontal timebase that differs from the acquisition timebase because the zoom is a small portion of the whole signal. In Figure 10, the acquisition timebase is 1 ms/div while the zoom trace's timebase is 100 μs/div. Thus, the zoom carries much more detail. You can zoom in to a display timebase that shows individual data samples or the shape of fast overshoot on an edge. Zoom traces only zoom the source trace horizontally. To zoom vertically, you must use the zoom math function.
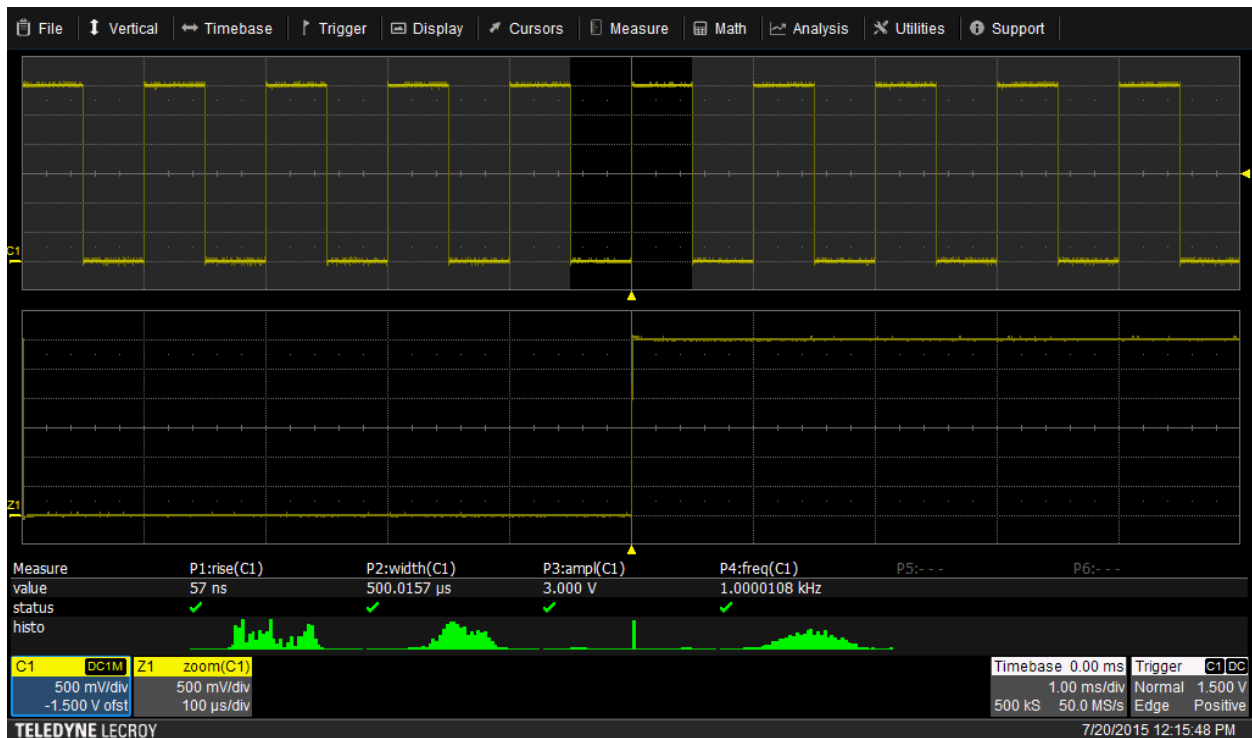

Figure 10: Zoom traces expose fine details of a waveform

You may perform parameter measurements or math operations on zoom traces just as with acquisition channels simply by defining the zoom trace as the source. If you note interesting noise on some portion of a signal, zoom in on that portion and apply an FFT to the zoom to determine the frequency makeup of the noise.

Advanced Features and Analysis Tools

Now that you've explored the basics of your WaveSurfer 3000 oscilloscope, let's move on to some of the more advanced features of the instrument as well as a number of its built-in signal analysis tools. To do so, you'll now need to open some pre-loaded LabNotebook files from the oscilloscope's microSD card. The integrated LabNotebook tool lets you store/recall waveform images, setup files, and waveform files right on the oscilloscope with the push of a button.

Opening LabNotebook Entries

- Touch the Default Setup at the top of the front panel
- Touch the File drop-down menu at the top-left corner of the display
- Touch the LabNotebook button to open the LabNotebook dialog (Figure 11).

You will find the pre-installed LabNotebook files in the field labeled "My Notebook Entries." Each of the ensuing sections of this guide will instruct on which file to recall. Files are recalled by selecting the entry in the list and pressing the Flashback (Recall) button.

Figure 11: The LabNotebook dialog lets you recall stored setups and waveforms

14

Fast Display

Because your WaveSurfer 3000 oscilloscope updates its display up to 130,000 waveforms/s, no waveform variations or details will be missed. Thus, the instrument easily displays random or rare events to simplify detection, identification, and debug of signal anomalies. Let's explore the benefits of a fast display and learn how to use cursors to make basic measurements.

- Connect a BNC cable from the WaveSource output on the oscilloscope's rear panel to the Channel 1 input
- Touch the WaveSource button at lower right on the front panel (or touch the Utilities drop-down menu and then touch WaveSource) to open the WaveSource dialog box (see Figure 12)
- In the dialog box, check the Enable box at left and touch the Demo button in the Waveform section
- From the DEMO Setup tab (see Figure 13), select the **Runt** waveform and close the WaveSource dialog box
- Recall the **Fast Display** LabNotebook entry (see Opening LabNotebook Files above)
- Press the Normal Trigger button in the front panel's Trigger section to display a live waveform

Notice how intermittent runts and varying pulse widths are observable.

- Press the Single Trigger button in the front panel's Trigger section several times to see how each of these signal anomalies can be observed individually
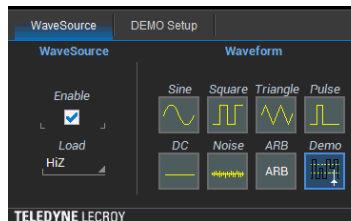- Press the Normal Trigger button again to display a live waveform

Figure 12: The WaveSource dialog box controls the WaveSurfer 3000's internal signal generator
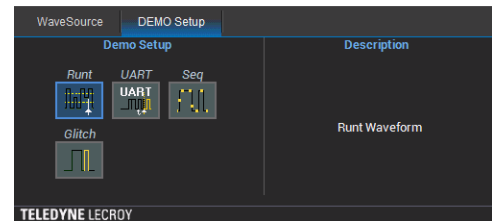
Figure 13: The DEMO Setup tab contains a number of preset waveforms

Now we'll use cursors to take a measurement of the runt pulses:
- Adjust the Cursor knob on the front panel to position the first (highlighted) cursor even with the top of a runt pulse
- Press the Cursor knob to highlight the second cursor and position it even with a full-amplitude pulse
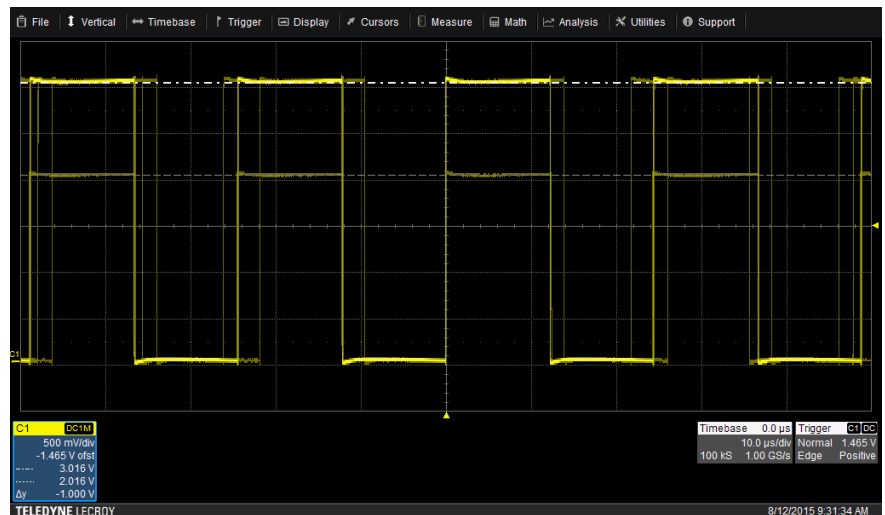

Figure 14: Using horizontal cursors to measure a runt pulse

Note that the C1 descriptor box now displays the positions of the two cursors in the vertical scale (volts) and a Δy value, which should be about 1 V (Figure 14). Measure the differential in pulse widths in the same fashion using vertical cursors. Note that pressing the Type button in the Cursors section of the front panel rotates through a variety of horizontal and vertical cursor sets or turns them off.

History Mode

The WaveSurfer 3000 offers history mode, a means of "traveling back in time" to examine previously acquired waveforms. History mode always runs in the background to enable measurement and validation of these waveforms from acquisition memory.

- Connect a BNC cable from the WaveSource output on the oscilloscope's rear panel to the Channel 1 input
- Touch the WaveSource button at lower right on the front panel (or touch the Utilities drop-down menu and then touch WaveSource) to open the WaveSource dialog box (see Figure 12)
- In the dialog box, check the Enable box at left and touch the Demo button in the Waveform section
- From the DEMO Setup tab (see Figure 13), select the **Runt** waveform and close the WaveSource dialog box
- Recall the **History Mode** LabNotebook entry (see Opening LabNotebook Files above)
- Press the Normal Trigger button in the front panel's Trigger section to display a live waveform
- After allowing the instrument to acquire some number of waveforms, press the History button at the bottom of the front panel to automatically stop the acquisition and display the list of history waveforms
- Using the front panel's Adjust knob at lower right, scroll through the History table at upper left of the display to view any of the previously acquired waveforms.

Scrolling backward in time through the acquisitions will soon turn up a runt pulse (Figure 15). In the screen capture, the History dialog box shows the on-screen navigation controls, which provide another way to scroll through the waveforms. Closing the History dialog box will give you a deeper History table. Note that the default times shown in the History table are absolute times. Checking the Relative Times checkbox in the History dialog box toggles the table between absolute and relative times.

Measurements, math functions, and other advanced analyses may be performed on history mode waveforms.

Figure 15: History Mode lets you scroll back in time to view acquired waveforms

WaveScan

Yet another powerful signal analysis tool in the WaveSurfer 3000 oscilloscope is WaveScan, which finds and can perform a selected action when anomalies are identified.

- Connect a BNC cable from the WaveSource output on the oscilloscope's rear panel to the Channel 1 input
- Touch the WaveSource button at lower right on the front panel (or touch the Utilities drop-down menu and then touch WaveSource) to open the WaveSource dialog box (see Figure 12)
- In the dialog box, check the Enable box at left and touch the Demo button in the Waveform section
- From the DEMO Setup tab (see Figure 13), select the **Runt** waveform and close the WaveSource dialog box
- Recall the **WaveScan Runt** LabNotebook entry (see Opening LabNotebook Files above)
- Touch the WScan label at the upper left corner of the display (this is a shortcut to the WaveScan dialog box; you can also touch the Analysis drop-down menu and select WaveScan)
- Press the Normal Trigger button in the front panel's Trigger section to display a live waveform

The oscilloscope will begin to acquire waveforms and search for runt pulses. Within the WaveScan dialog box is the Runt Setup section in which you can specify low and high thresholds for the runt search.

- In the WaveScan dialog box, touch the Action on Features Found (Trigger Action) field and then touch Stop Acquisition to make the acquisition stop when the oscilloscope finds a runt pulse.

Once the oscilloscope stops, note that the WScan table shows one runt pulse with its amplitude (Figure 16).

Figure 16: The WaveScan tool finds and automatically stops on signal anomalies

WaveScan with Measurements

Your WaveSurfer 3000 oscilloscope will let you take WaveScan a step further and add measurement functionality to the search for signal anomalies.

- Connect a BNC cable from the WaveSource output on the oscilloscope's rear panel to the Channel 1 input
- Touch the WaveSource button at lower right on the front panel (or touch the Utilities drop-down menu and then touch WaveSource) to open the WaveSource dialog box (see Figure 12)
- In the dialog box, check the Enable box at left and touch the Demo button in the Waveform section
- From the DEMO Setup tab (see Figure 13), select the **Glitch** waveform and close the WaveSource dialog box
- Recall the **WaveScan with Measurements** LabNotebook entry (see Opening LabNotebook Files above)
- Press the Normal Trigger button in the front panel's Trigger section to display a live waveform.

When you stop the trigger using the Stop button in the Trigger section of the front panel, the WaveScan table at upper left of the display becomes interactive: Touch any entry in the table and the waveform grid area will automatically zoom to that specific instance.

- Touch the Single button in the Trigger section of the front panel
- Find the narrow glitch in the WaveScan table (around 920 µs) and select it to zoom to that measurement
- Touch the WScanZ1 descriptor box once to activate it and again to open the WScanZ1 dialog
- Use the Horizontal Timebase knob to adjust the zoom horizontal scale to 1 µs/div

Note that WaveScan has identified a glitch in the signal that was impossible to detect otherwise.
- Touch the WaveScan tab in the dialog box and select the Filter Method field
- In the popup box, select Less Than and enter 1 µs as the Filter Limit

Note how the filter makes WaveScan identify only measurements meeting specific criteria (Figure 17). Again, touching any entry in the WaveScan automatically zooms to that instance.
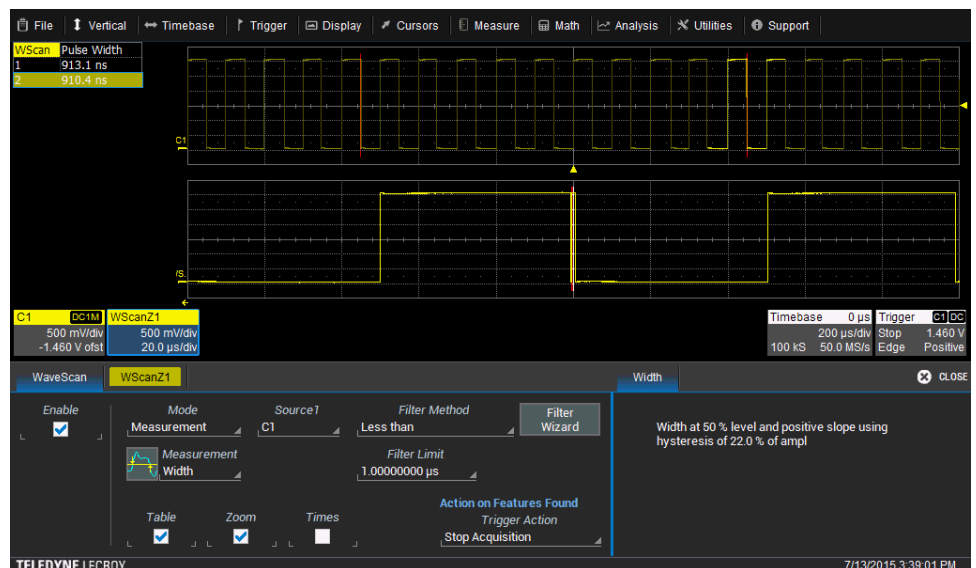

Figure 17: Adding measurement capabilities to a WaveScan search for a glitch

Advanced Measurement Capabilities

Today's measurement and debugging tasks require an oscilloscope with a deep feature set, and the WaveSurfer 3000 is easily up to the job. Let's take a look at what the instrument has to offer. Of particular note is the instrument's all-instance measurement capability.

- Connect a BNC cable from the WaveSource output on the oscilloscope's rear panel to the Channel 1 input
- Touch the WaveSource button at lower right on the front panel (or touch the Utilities drop-down menu and then touch WaveSource) to open the WaveSource dialog box (see Figure 12)
- In the dialog box, check the Enable box at left and touch the Demo button in the Waveform section
- From the DEMO Setup tab (see Figure 13), select the **Glitch** waveform and close the WaveSource dialog box
- Recall the **Advanced Measurements** LabNotebook entry (see Opening LabNotebook Files above)
- Press the Normal Trigger button in the front panel's Trigger section to display a live waveform
- Enter the Measure dialog box either by touching any part of the parameter table or by using the Measure drop-down menu
- Touch the Measurement selection field for P1 to display the list of available measurements, noting the rich range of options for measurement of standard parameters. Then press Cancel
- In the Trigger section of the front panel, press Stop, then Clear Sweeps (at top right of the front panel), and then Single [Trigger] in the Trigger section. Note the number of measurements taken on a single acquisition.

The WaveSurfer 3000 took ten or more measurements for frequency, pulse width, duty cycle, and rise/fall times. It took only one for peak-to-peak amplitude because there is only one value for that parameter per acquisition.

- Press the Normal [Trigger] button in the Trigger section of the front panel.

Figure 18: Histicons display the distribution for each measurement
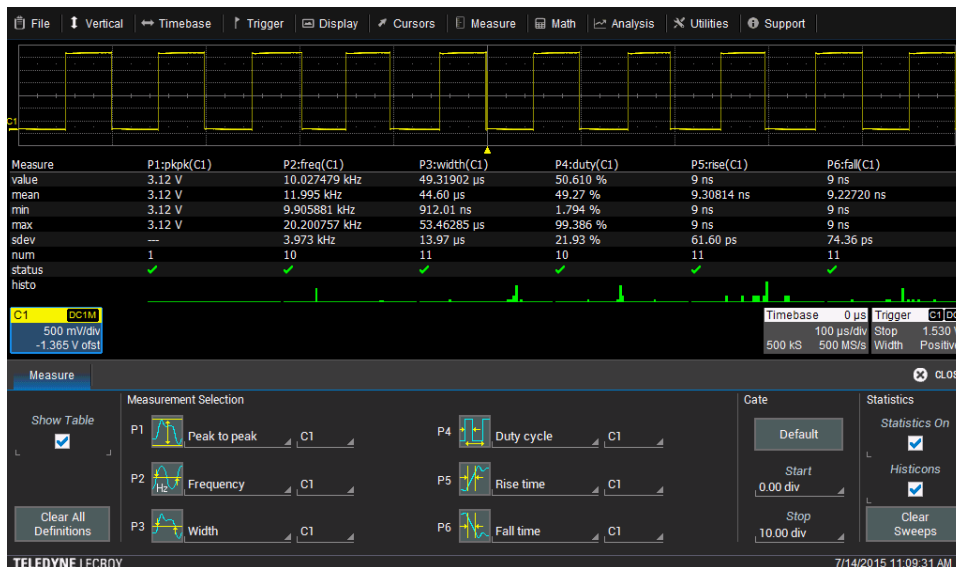
Below the Parameter table on the display is a row of histicons, which display the distributions for each measurement (Figure 18). Note the outlier in the distribution of pulse-width measurements (the small peak to the left of the large peak).

- Touch the Parameter table to open the Measure dialog; in the Gate settings section, change the Stop parameter to 1.5
- Press the Stop button in the Trigger section of the front panel, then the Clear Sweeps button, and then Single [Trigger] in the Trigger section of the front panel.

In this acquisition, the oscilloscope has been set to measure only the first 1.5 divisions. Note that the pulse-width outlier is no longer in evidence. This mimics the lesser performance of some competitive oscilloscopes in that they do not perform all-instance measurements.

- Press the Zoom button in the front panel
- Set the Zoom trace's horizontal timebase to 2 µs/div.

Here you can clearly see the glitch that turned up using the advanced measurement techniques outlined above (Figure 19). This glitch corresponds with the outlier that we saw in the pulse-width measurement histicon before we changed the Stop parameter in the Gate section of the Measure dialog box.
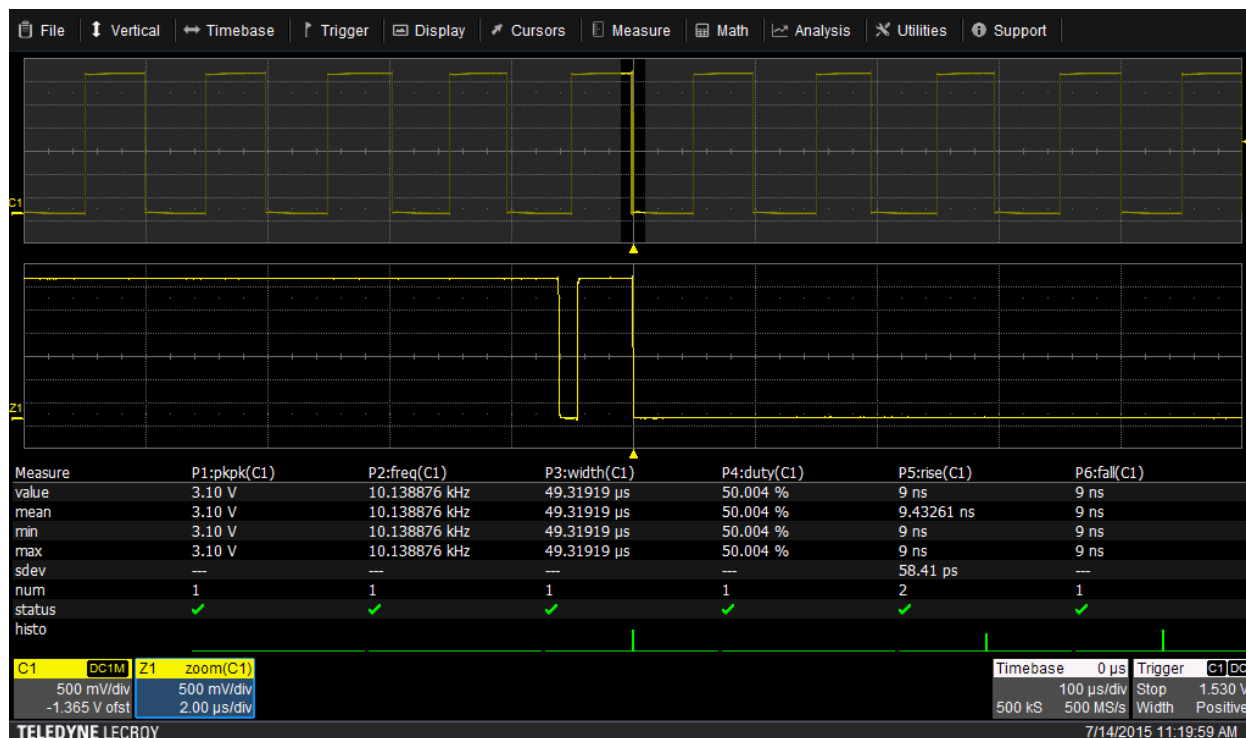

Figure 19: The WaveSurfer 3000's all-instance measurement capability helps find anomalies

Advanced Measurements with Trends

Taking measurements of a single acquisition or many acquisitions has its value, but what can be even more valuable is a look at how those measurements change over time.

- Connect a BNC cable from the WaveSource output on the oscilloscope's rear panel to the Channel 1 input
- Touch the WaveSource button at lower right on the front panel (or touch the Utilities drop-down menu and then touch WaveSource) to open the WaveSource dialog box (see Figure 12)
- In the dialog box, check the Enable box at left and touch the Demo button in the Waveform section
- From the DEMO Setup tab (see Figure 13), select the **Runt** waveform and close the WaveSource dialog box
- Recall the **Advanced Measurement with Trends** LabNotebook entry (see Opening LabNotebook Files above)
- Press the Normal Trigger button in the front panel's Trigger section to display a live waveform.

The F1 trace is a trend plot of the pulse-width measurement (P3). Essentially, you're seeing the pulse-width measurement as a waveform (Figure 20). Each point in the trend corresponds to one of the width measurements, allowing observation of the width as it changes over time. The two distinct widths that can be found in the signal are easily seen and quantified in using the Trend of the width measurement. Touch the F1 descriptor box (lower left of the screen) to see how the trend was set up using P3 as its source.
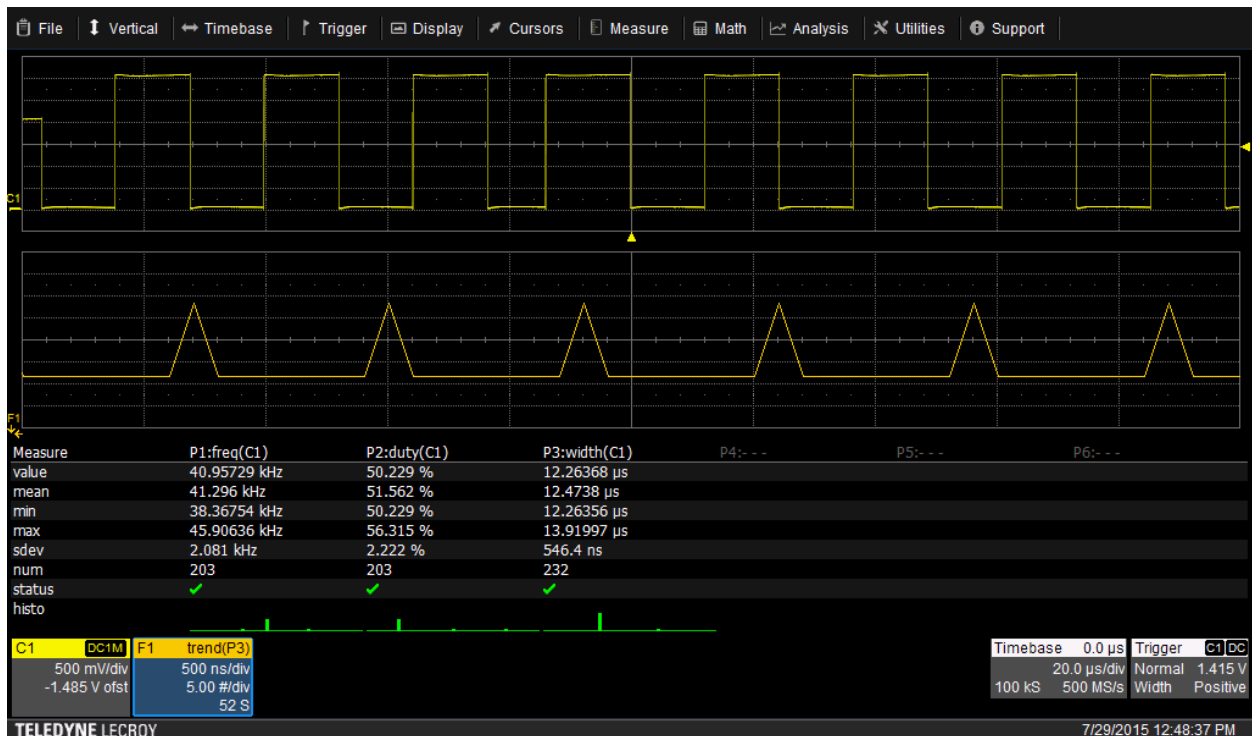

Figure 20: Trace F1 is a trend plot of the pulse-width measurement showing how it changes over time

Sequence Mode

If you're facing the task of combing through a long signal acquisition for a rarely occurring anomaly, or, conversely, capturing a large number of fast pulses in quick succession, Sequence Mode is an acquisition mode that provides time stamps for each acquisition and minimizes the dead time between trigger events. Combining Sequence Mode with advanced triggers isolates these rare events over time for subsequent analysis.

- Connect a BNC cable from the WaveSource output on the oscilloscope's rear panel to the Channel 1 input
- Touch the WaveSource button at lower right on the front panel (or touch the Utilities drop-down menu and then touch WaveSource) to open the WaveSource dialog box (see Figure 12)
- In the dialog box, check the Enable box at left and touch the Demo button in the Waveform section
- From the DEMO Setup tab (see Figure 13), select the **Seq** waveform and close the WaveSource dialog box
- Recall the **Sequence Mode** LabNotebook entry (see Opening LabNotebook Files above)
- Press the Normal Trigger button in the front panel's Trigger section to display a live waveform

Let's take a quick look at how Sequence Mode is set up:
- Touch the Horizontal Timebase descriptor box to open the Timebase dialog box. Note that the sampling mode is set to Sequence
- Touch the Sequence tab to switch to that view, where the Acquisition Settings section shows the Number of Segments set to 5.

The Number of Segments setting determines how many acquisitions (or segments) the oscilloscope will make in Sequence Mode. This number can range from two to 1000 with a default setting of 10. The WaveSurfer 3000 will acquire samples until it either reaches the set Number of Segments, exceeds a Sequence Timeout that can be set in the Sequence dialog box, or you manually stop the acquisition.

- Open the Zoom dialog box by touching the Z1 descriptor box.

By modifying the Segments section's parameters, you can determine how many segments to display in the zoom trace and which segment to display first. The current settings tell us that the first displayed segment in Zoom view will be the third segment of the five, and that it will display two segments. Note the dimming of the first, second, and fifth segments in the C1 trace, indicating that the third and fourth segments are what we see in the zoom trace (Figure 21).
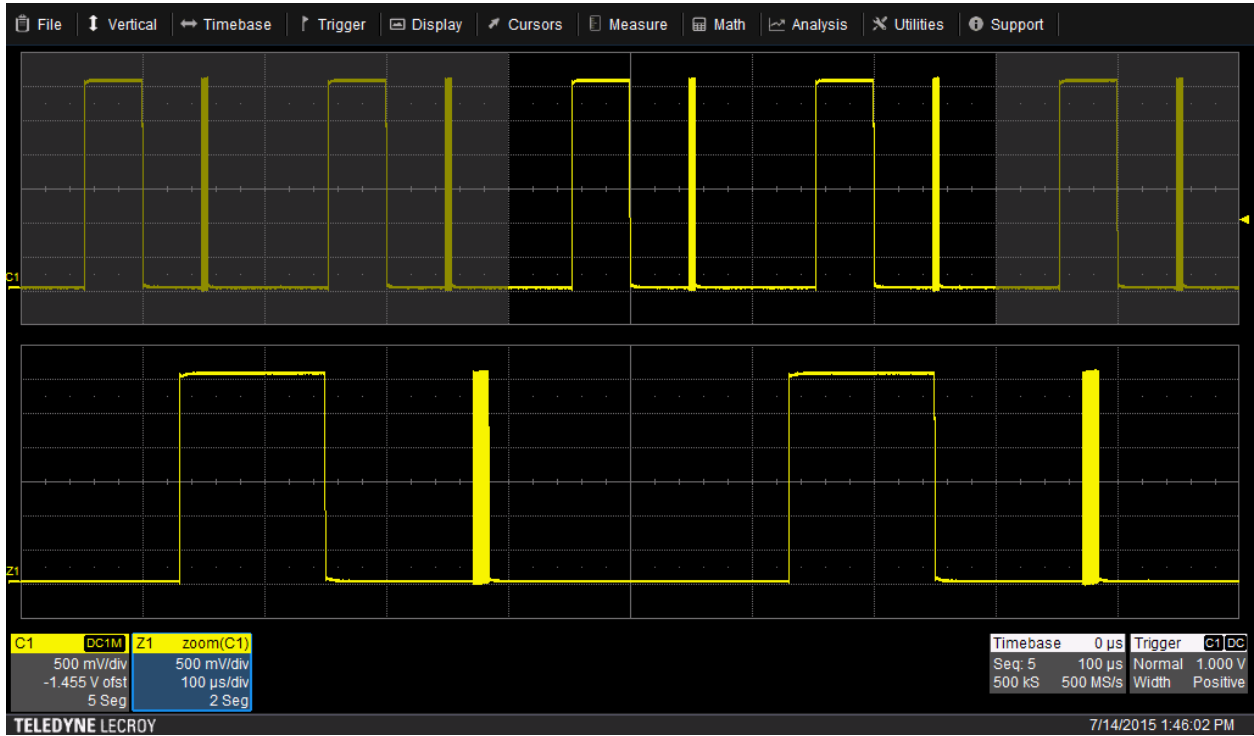

Figure 21: In Sequence Mode, you can find rare events over long time spans or fast pulses in rapid succession with ease

Saving LabNotebook Entries

Let's look a little more closely at the LabNotebook tool in your WaveSurfer 3000. You've been using it all along to recall setups for each of the sections of this tutorial. LabNotebook gives you a quick and easy way to save and recall waveforms, setup data, measurements, and a screen capture all by pressing a single button.

- Connect a BNC cable from the WaveSource output on the oscilloscope's rear panel to the Channel 1 input
- Touch the WaveSource button at lower right on the front panel (or touch the Utilities drop-down menu and then touch WaveSource) to open the WaveSource dialog box (see Figure 12)
- In the dialog box, check the Enable box at left and touch the Demo button in the Waveform section
- From the DEMO Setup tab (see Figure 13), select the **Runt** waveform and close the WaveSource dialog box
- Press the Default Setup button at the top of the front panel
- Press the Auto Setup button at the top of the front panel
- Configure some measurement parameters for C1 by touching the Measure drop-down menu and then touching Measure Setup
- Set P1-P6 to measure peak-to-peak, frequency, width, duty cycle, rise time, and fall time, respectively. Be sure to select Show Table at the left side of the Measure dialog box.
- Touch the File pull-down menu and then touch Create Notebook Entry.

You've just created a LabNotebook entry that automatically stored the waveforms, setup, measurements, and a screen capture. Let's recall the setup next:
- Disconnect the BNC cable from the Channel 1 input and press the Default Setup button
- Touch the File drop-down menu and then touch LabNotebook (see Figure 11)
- Note that an entry appears with the current time and date as its title (default title)
- Select that entry and press the Flashback (Recall) button in the LabNotebook dialog box

You have restored your WaveSurfer 3000 to the exact state it was in when you created the entry.

- Touch the tab in the LabNotebook dialog box labeled with the name of your entry
- Change the entry's name as needed and enter a description of the entry.

The Preferences tab offers more options for how LabNotebook operates.

Save LabNotebook entries either to the oscilloscope's internal microSD card or to an external USB device
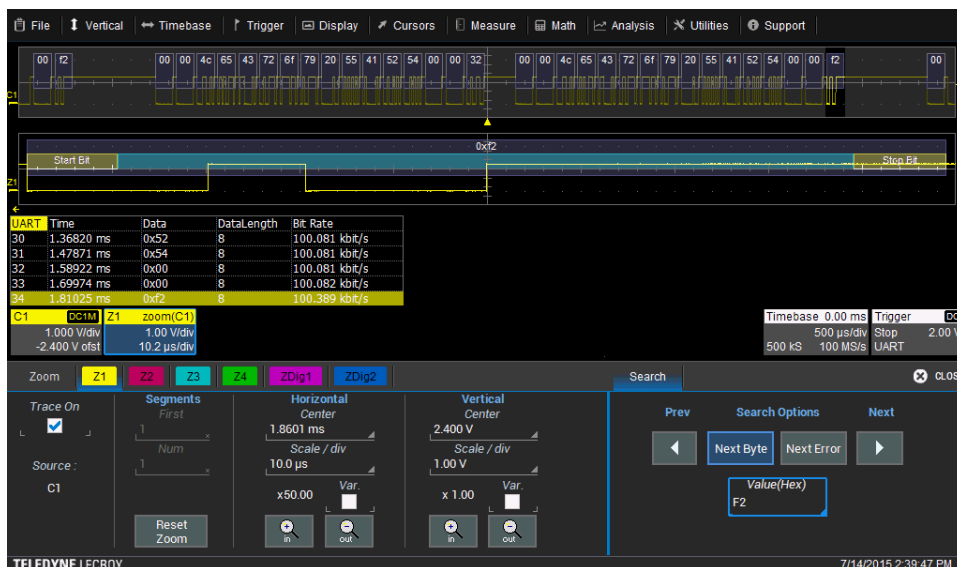
Serial Decode

Your WaveSurfer 3000 has been equipped with demos of the I^{2}C, SPI, and UART serial trigger/decode software packages. For these and many other serial protocols (see a fully list of supported serial data standards on the WaveSurfer 3000 webpage), the WaveSurfer 3000's Serial Decode functionality is the best tool for identifying components of serial data packets and/or frames. Color-coded decode overlays, search capability, and an interactive decode table are all present and help greatly in finding what you're looking for in a serial data stream.

- Connect a BNC cable from the WaveSource output on the oscilloscope's rear panel to the Channel 1 input
- Touch the WaveSource button at lower right on the front panel (or touch the Utilities drop-down menu and then touch WaveSource) to open the WaveSource dialog box (see Figure 12)
- In the dialog box, check the Enable box at left and touch the Demo button in the Waveform section
- From the DEMO Setup tab (see Figure 13), select the **UART** waveform and close the WaveSource dialog box
- Recall the **UART Trigger and Decode** LabNotebook entry (see Opening LabNotebook Files above)
- Press the Normal Trigger button in the front panel's Trigger section to display a live waveform
- Touch the Analysis drop-down menu and then touch Serial Decode to see how the UART decode was setup

Take note of the color-coded overlays on the C1 and Z1 traces highlighting and identifying individual bytes within the UART data stream. At bottom left of the display is the Decode table. Touching any entry in the table and selecting Zoom automatically zooms you to that location.

- Press the Stop button in the Trigger section of the front panel
- Touch the Z1 descriptor box to activate Z1 and open the Z1 dialog box
- In the Search section on the right side of the Z1 dialog box, enter F2 in the Value field
- Touch the Next Byte button and then touch the Next arrow button

Figure 22: Pinpoint specific addresses, packets, or data values with the Search function in serial decode software

Note that the Z1 trace automatically changes to zoom into the next packet with the value F2 (Figure 22). The Search function can find specific addresses, packets, or data values, depending on the protocol.

- Touch an entry in the Decode table (or the number on the left side of the table)
- Press Zoom on the pop-up menu to zoom automatically into that entry

Serial Trigger

Now that we've covered serial decode, let's look at the WaveSurfer 3000's ability to trigger on a wide range of different protocol-specific events. Using the serial trigger in tandem with the serial decode is a very powerful debugging tool for serial communications protocols.

- Connect a BNC cable from the WaveSource output on the oscilloscope's rear panel to the Channel 1 input
- Touch the WaveSource button at lower right on the front panel (or touch the Utilities drop-down menu and then touch WaveSource) to open the WaveSource dialog box (see Figure 12)
- In the dialog box, check the Enable box at left and touch the Demo button in the Waveform section
- From the DEMO Setup tab (see Figure 13), select the **UART** waveform and close the WaveSource dialog box
- Recall the **UART Trigger and Decode** LabNotebook entry (see Opening LabNotebook Files above)
- Press the Normal Trigger button in the front panel's Trigger section to display a live waveform
- Touch the Trigger descriptor box at lower right of the display and then touch the UART tab

Note that in the Data Pattern Setup section, the Data Value is set to 32. Change the value to F2 and the oscilloscope will begin triggering on that value instead (Figure 23). Try changing to other data values and observe how the trigger responds.
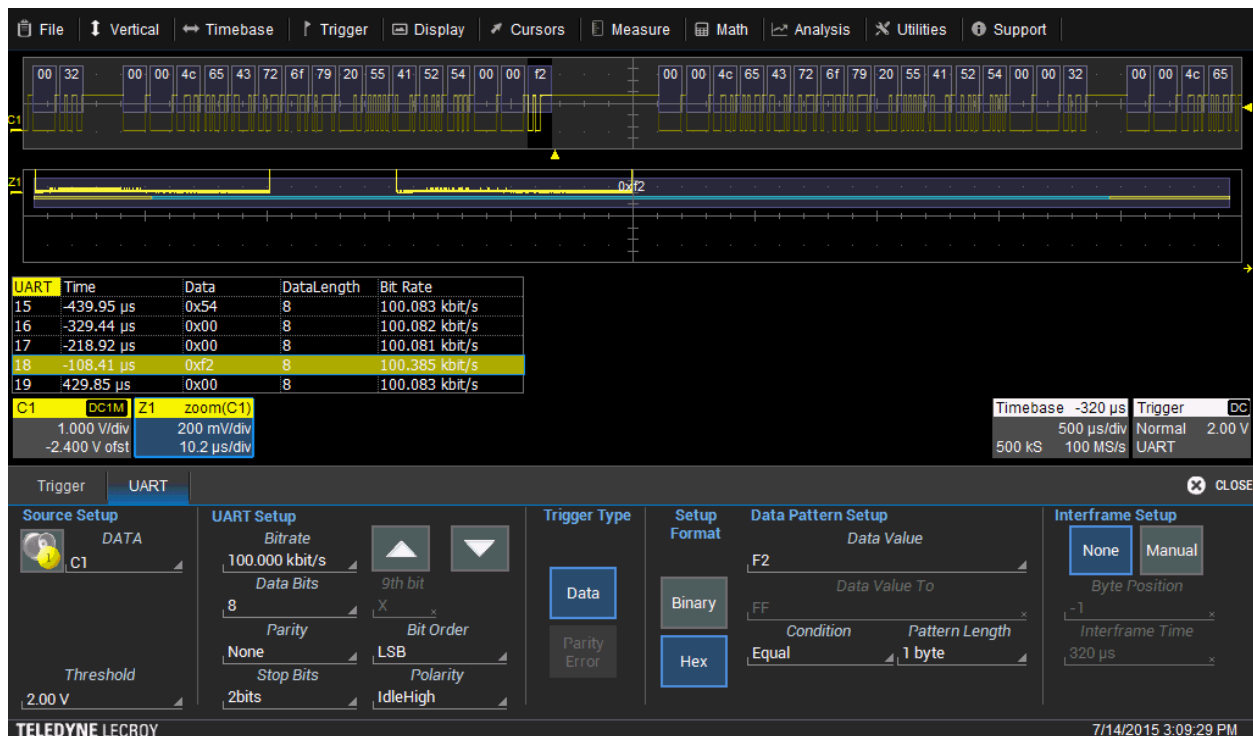

Figure 23: Serial trigger is a great aid in debugging serial data protocols

Conclusion

This set of guided demonstrations highlights the powerful visualization, measurement and analysis capabilities of the WaveSurfer 3000 while helping familiarize you with the user interface and features of the instrument.

Should you require more information or assistance during this demo, please contact us at 1-800-5LeCroy (1-800-553-2769) and select Option 3 for Technical Support.

Thank you for your participation.

TELEDYNE LECROY
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