

January 11, 2012

Summary

Sequence sampling mode is a fast acquisition mode which breaks the scope's acquisition memory into thousands of segments. Each segment can store a single acquisition. This mode offers fast update rate, time stamping of trigger events, minimization of dead time between trigger events and the ability to separately view and measure each event, if desired.

Using Sequence Mode, thousands of trigger events can be stored as segments into the oscilloscope's acquisition memory (the exact number depends on oscilloscope model and memory options). This is ideal when capturing many fast pulses in quick succession with minimum dead time or when capturing few events separated by long time periods. The instrument can capture complicated sequences of events over large time intervals in fine detail, while ignoring the uninteresting periods between the events. You can also make time measurements between events on selected segments using the full precision of the acquisition timebase.

Sequence mode offers a number of unique capabilities:

You can acquire up to four channels simultaneously.

You can minimize dead time between trigger events for consecutive segments.

You can view time stamps for acquisitions. This provides information on trigger event timing

You can either place all the acquisitions on the screen simultaneously in order to view similarities/differences of the ensemble of measurements or you can view/measure individual events.

You can zoom segments or use them as input to math functions.

You can combine sequence mode with an advanced trigger to isolate a rare event, capture all instances over hours or days, and view/analyze each afterwards.

LeCroy's 'all instance' measurement parameters function across all segments.

You can use Sequence mode in remote operation to take full advantage of the instrument's high data-transfer capability.

Displays shown in the tutorial are based on the following initial setup on a WaveSurfer 104 MXs-B scope:

1. Connect a passive probe from channel 1 to the CAL test point on the front panel. The CAL output is a 1 kHz square wave with an amplitude of 1 V
2. Recall the default setup: File pull down > Recall Setup> Recall Default.
3. Turn off channel 2.
4. Auto Setup the scope: Press Auto Setup twice
5. Using the C1 dialog box, set the channel 1 vertical scale to 200 mV/division and the vertical offset so that the bottom of the trace is one and one half divisions above the bottom of the display grid.
6. Set the trigger level to 500 mv.
7. This completes the initial setup. The scope display should be similar to Figure 1.

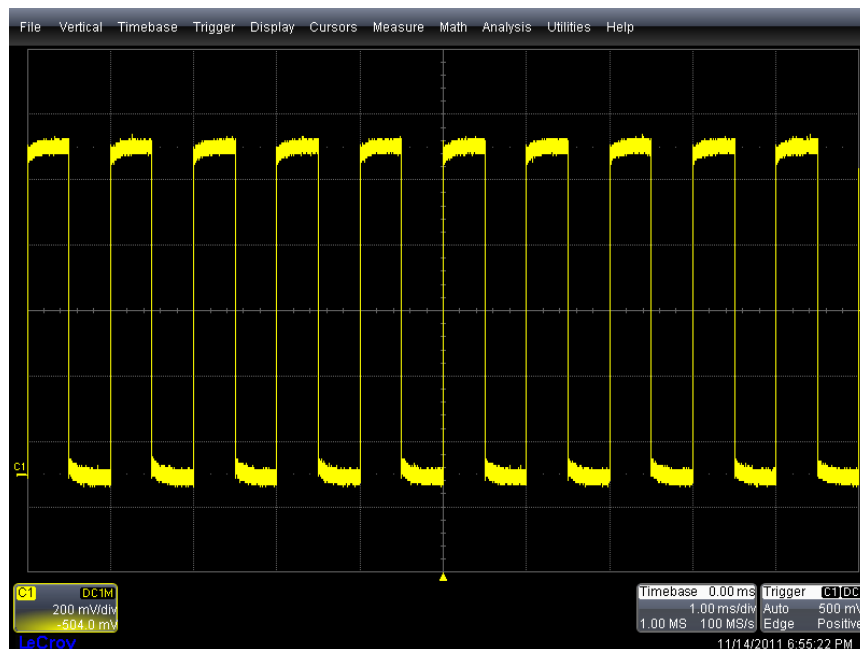


Figure 1: The oscilloscope initial setup showing 10 cycles of the CAL signal

Open the Timebase dialog box by either touching or clicking the Timebase annotation box or using the Timebase pull-down menu and selecting Horizontal Setup. Change the Time/Division field to 50 ns/division. Press the Sequence button this will turn on the Sequence acquisition mode.

Click or touch the Sequence Tab on the Timebase dialog box to display the sequence mode controls as shown in Figure 2.

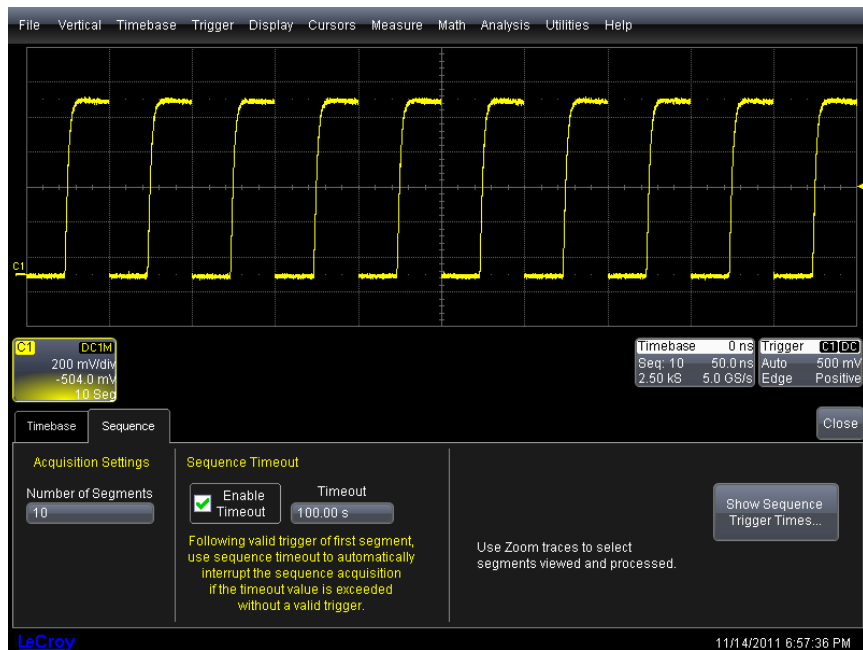


Figure 2: The Sequence Mode controls

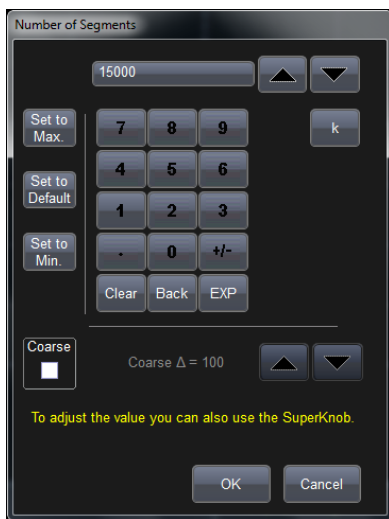


Figure 3: Setting the number of segments

Double click or touch the ‘Number of Segments’ field in the Acquisition Settings area twice. This will bring up the ‘Number of Segments’ pop up box. Press the ‘Set to Max’ button and observe the maximum number of segments for your scope (this is scope and memory dependent). Press the ‘Set to Min’ button. The minimum number of segments is 2. Press the ‘Set to Default’ button to restore the number of segments to 10. Press ‘Cancel’ to close the pop up.

In sequence mode the scope will continue to acquire data until all the segments are filled or until the user presses the “Stop” button on the front panel. There is also a ‘Sequence Timeout’ setting on the sequence tab (In Figure 2) to stop the acquisition after a preset time delay without a trigger event.

Press the ‘Show Sequence Mode Trigger Times’ button on the Timebase, Sequence tab. This will display a table listing the sequence mode trigger time, shown in Figure 4. The trigger time table has four columns. These are Seg (for segment number), Time, (time) since Segment 1, and (time) between Segments.

In Figure 4 the table shows ten segments, if there were more an index selection will appear to allow you to select the number of the first segment displayed in the table.

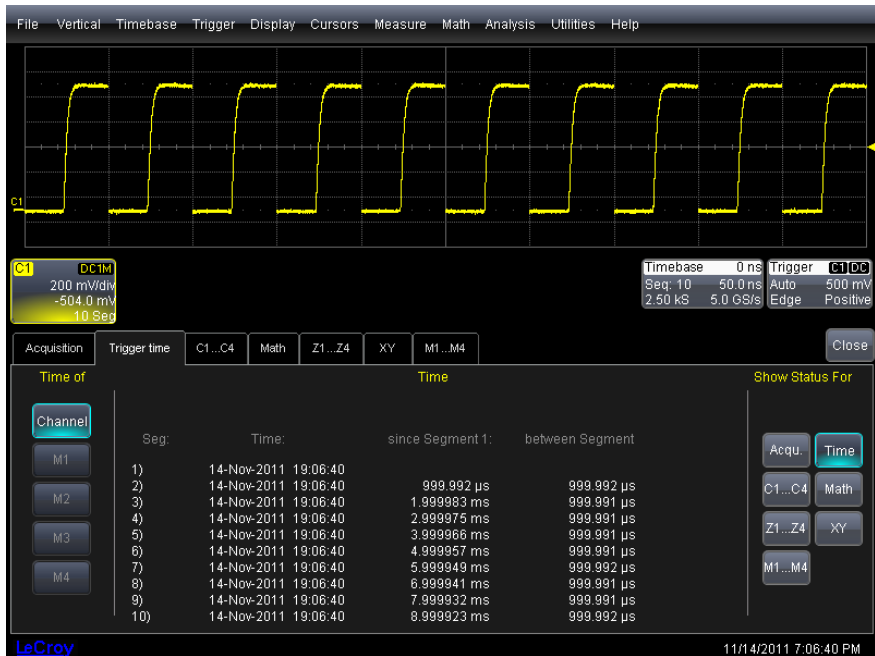


Figure 4: The sequence mode time stamp table

Each segment has an absolute time stamp which is derived from the scope's real time clock with 1 sec displayed resolution. The relative time stamps read the time since segment 1 and the time between segments. These display time down to nanosecond resolution. Internally, the relative time stamps have picosecond resolution which can be accessed via remote commands.

You can view each segment individually by using the zoom function. Press the 'Quick Zoom' button on the front panel (marked with the magnifying glass over a waveform icon). The 'Horizontal Delay' control can be used to scroll through each segment. The Zoom dialog box (shown in Figure 5) allows users to select the first segment and the number of segments displayed in each zoom trace. Multiple zoom traces can be used to select and compare different segments.

Turn off the zoom trace.



Figure 5: Using Zoom to view individual segments

Use the 'Measure' pull down menu and select Measure setup.

Set up parameter P1 to measure the amplitude value of channel C1 and P2 to measure the risetime of C1.

Click 'Show Table' and Statistics On' check boxes as shown in Figure 6.

On the front panel press the Stop button in the Trigger control group.

Press the Clear Sweeps push button on the front panel.

Press the Single button in the Trigger control group on the front panel.

The oscilloscope will take a single acquisition sequence of 10 segments and stop acquiring.

LeCroy's 'All Instance' measurements is applied to sequence mode acquisition directly. In the example above you see how each of the parameters returned 10 measurements, one for each segment.

Turn off the measurement parameters using the Measurement pull down menu and selecting Off.

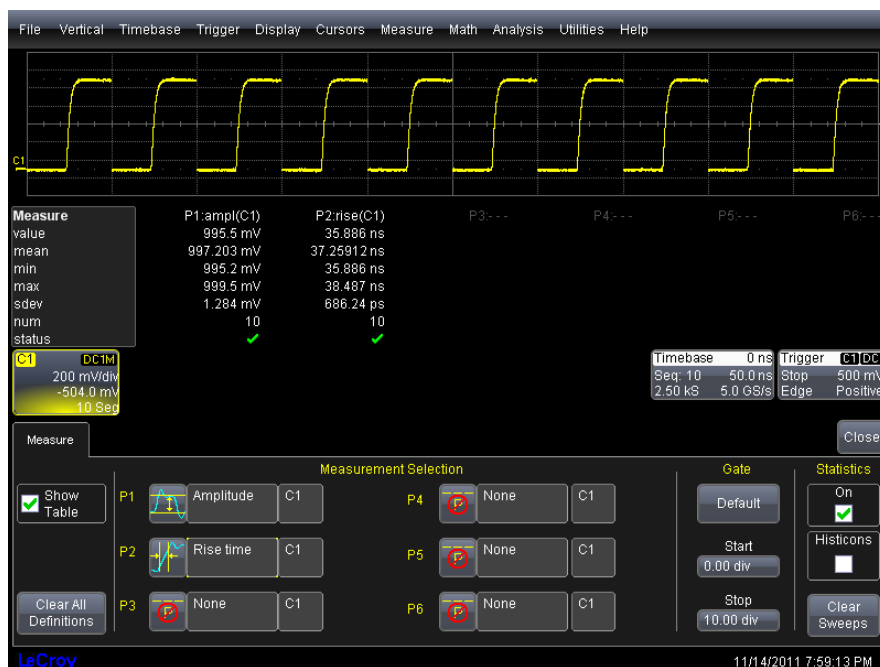


Figure 6: Showing the All Instance parameter measurement

Use the Math pulldown to view the Math Setup.

In the Math Setup dialog set the source to C1 and the operation to Average.

Note that the average is computed across the 10 segments producing a single averaged display shown in Figure 7. Note the average count in the math annotation box shows a value of 10. Any cumulative math operation will do the same. These operations include Average, Envelope, Floor, and Roof. Other math operation will return segmented waveforms.

Investigate several different math operations to see how they behave with sequence mode waveforms.

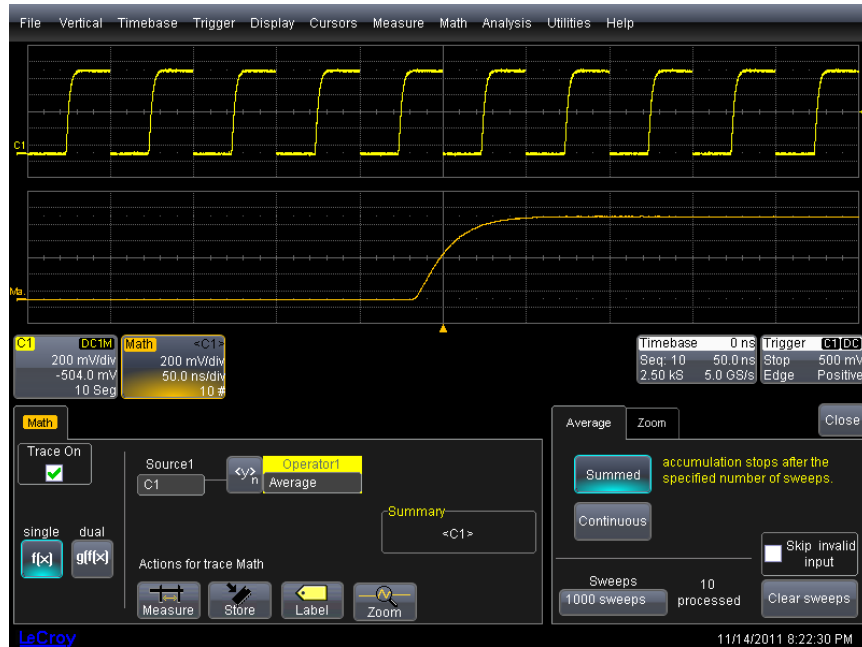


Figure 7: Applying a math function to a sequence mode acquisition. Cumulative operations, like averaging, return a single display including all the segments in the result

This completes the tutorial.