

## Lab 4 – Analyze (30 Minutes)

*Note:*(Screenshots below show a white background configuration of your WaveAce to save black ink in printing, this configuration is explained in Lab 2 – VIEW)

### Overview

The Analyze Lab addresses the different math functions and the FFT-function found in modern digital oscilloscopes like the WaveAce.

A test at the end of the Lab allows you to check your knowledge.

### Goal

Learn how to configure and use:

- Basic math functions
- FFT

In this Lab you will learn the basic math functions of the WaveAce instrument, how to set them up and how to use them.

### System Requirements

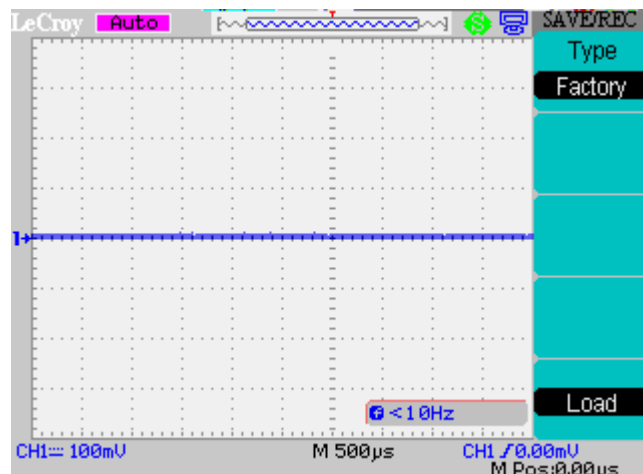
- 2 x WaveAce passive probes.

### Setup

Connect the two probes to the signal to be measured. In this case, to the calibrator (CAL) output loop on the front panel using the sprung hook with the probe BNCs connected on CH1 and CH2.

### Step 1

Reset the scope configuration to the default factory settings using the front panel DEFAULT SETUP button. An alternative method is to use the front panel SAVE/RECALL button, then press the Type button until Factory is displayed and finally press the Load button.



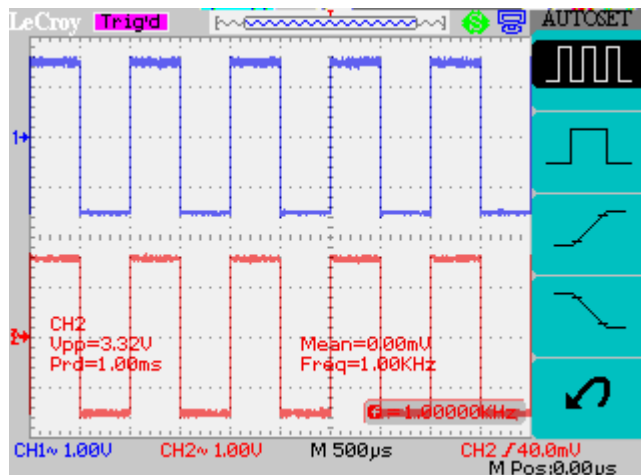
At any time the menu on the right-hand side of the screen can be removed/restored by pressing the front panel MENU ON/OFF button.

### Step 2

Press the CH1 channel button. Set the coupling on CH1 to AC. Check the slider switch on the probe is set to X10 and using the Probe button set 10X on the screen. Repeat for CH2.

## Step 3

Press the [blue] AUTO button on the front panel. In a few seconds you should have a triggered signal with a number of cycles shown on the screen.

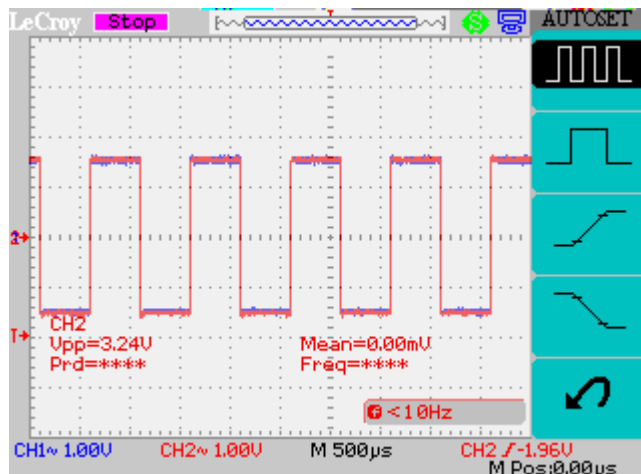


## Step 4

Notes: Pressing the CH1 / CH2 position knobs is a quick method of setting the channel offset to zero.

The side menu can be turned off using the MENU ON/OFF button or by selecting a finite time for the Menu Display in the DISPLAY menu.

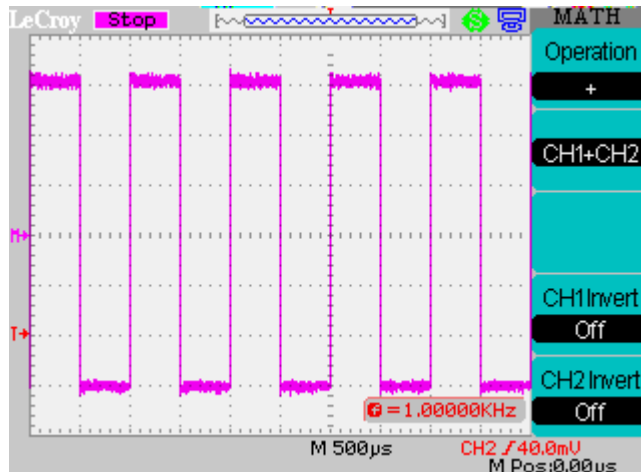
Press RUN/STOP to stop the acquisition. Press the CH1 and CH2 Position knobs to center the traces on the screen.



Turn off the CH1 and CH2 traces

## Step 5

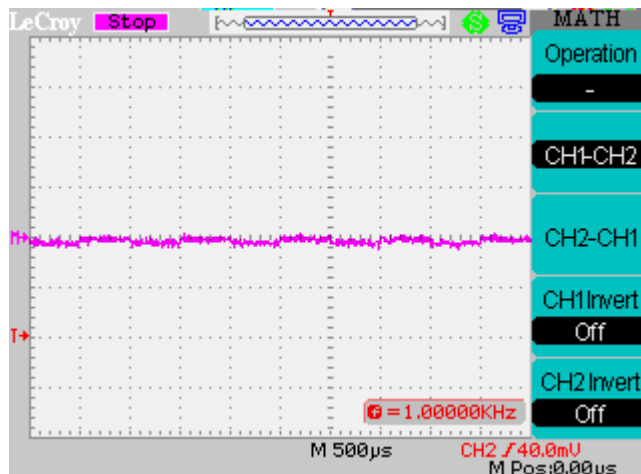
Press the front panel MATH button. By default the Operation will be set to +. Note that the signal is the sum of CH1 and CH2.



Observe the effects of pressing the CH1Invert and CH2Invert buttons.

## Step 6

Press the Operation button to select -. In the menu we now also have the ability to select CH1-CH2 or CH2-CH1. Since the CH1 and CH2 signals are the same the result will be a trace close to zero.



Observe the effects of pressing the CH1Invert and CH2Invert buttons in combination with the CH1-CH2 and CH2-CH1 options.

## Step 7

Press the Operation button to select \*.

## Step 8

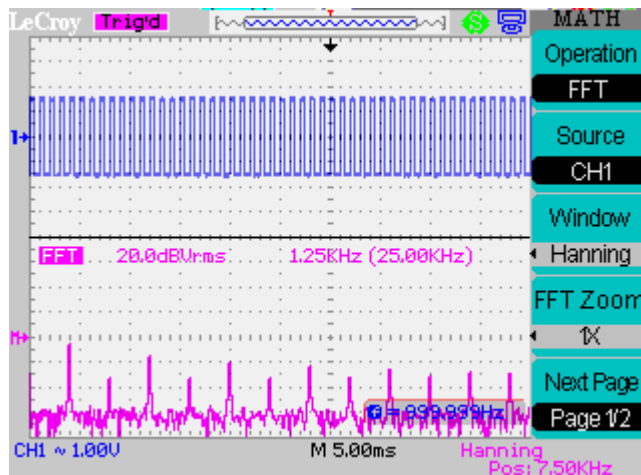
Press the Operation button to select /. In the menu we now also have the ability to select CH1/CH2 or CH2/CH1.

## Step 9

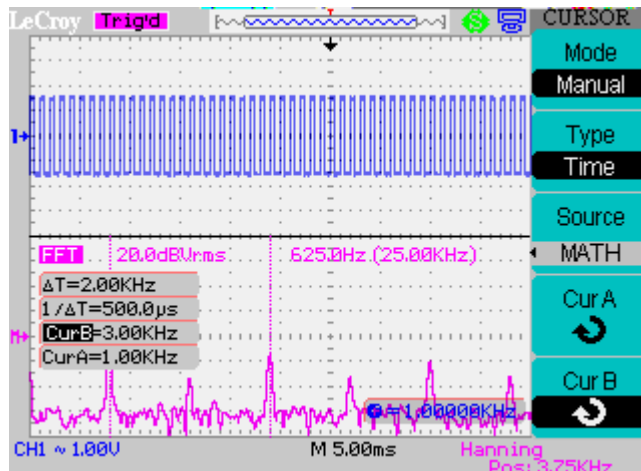
Turn off the math trace and turn on CH1 by pressing the corresponding front panel buttons. Press

*Note: In an ideal square wave only odd harmonics of the frequency will be present. In a real square wave it is likely that some even harmonics will also be present. A further complication is that the scope only captures a finite length of the signal. The windowing functions are used to minimise the effects of this. Refer to the Getting Started Manual for a description.*

RUN/STOP and set the timebase to 5ms/div. Now turn on the MATH trace and select FFT



Use the FFT Zoom to select 2X and turn on cursors selecting Manual mode, Time type and MATH as the source. Adjust the cursors to the first and third peaks. The cursors can now be used to read the frequency of these peaks.

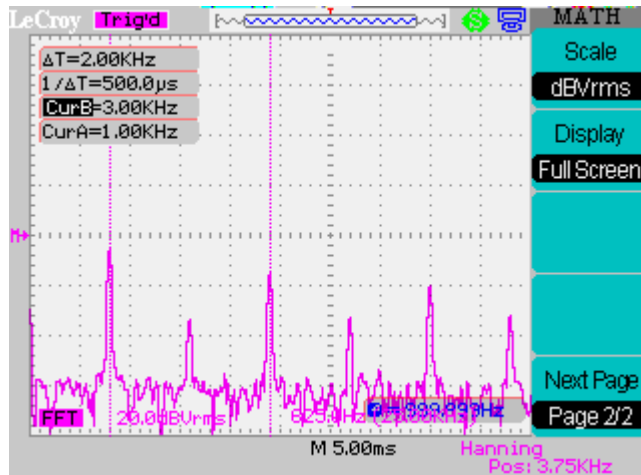


## Step 10

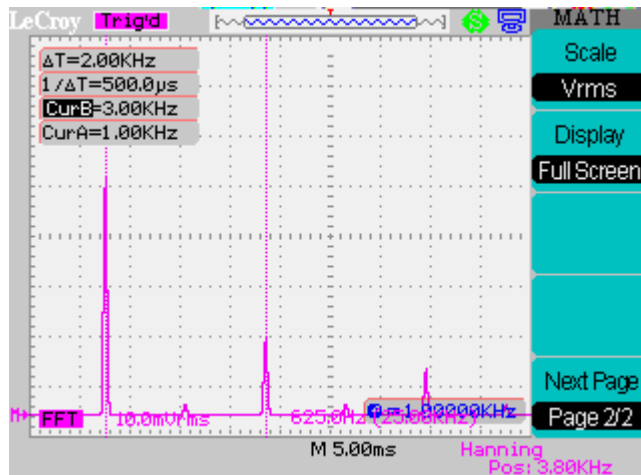
*Note: When the FFT symbol is highlighted the front panel Vertical and Horizontal knobs change function. Since the FFT source is CH1 the CH1 vertical controls adjust the vertical position and size of the FFT trace. Similarly the Horizontal*

The above trace is difficult to see as the cursor values overlay the trace. When the FFT function is first selected the display is in Split mode. Turn off the CH1 display and reselect the MATH menu. Now use Next Page to select Page 2/2. Press Display to select Full Screen.

controls can now be used to adjust the FFT's horizontal settings.



This page also contains a setting to switch to a non-logarithmic vertical scale. Select it now.



## Test

### Question 1

The amplitude of the third harmonic of a square wave is theoretically  $1/3^{\text{rd}}$  of the amplitude of the first. How would you measure the peaks to verify this?

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What results do you get?

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### Question 2

Can you use the scope to measure the instantaneous power consumption of a circuit?

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### Question 3

Can you use the Track cursor mode for an FFT waveform?

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### Summary

In this lab you have learned how to configure the WaveAce to perform basic math functions such as +, -, \* and /. Using the FFT function, you are now also able to set up an FFT of one input source and to look at the signal not only in the time domain but also in the frequency domain.