



ZC Analytics

Introduction to analog signal analysis with the iMSO-204x

In this exercise, you will learn how to acquire and visualize electrical signals with the iMSO-204x and analyze the data using the iMSO software. You will make simple recordings and measurements using a signal generator.

BACKGROUND

Oscilloscopes are used for a wide array of applications across a number of industries. Examples of professionals who use oscilloscopes include electrical engineers, automotive mechanics, medical researchers, electronic repair technicians, as well as neurobiology and physical sciences. Oscilloscopes are an integral tool for those designing, testing, or repairing electronic equipment. To complete today's exercise you will use the iMSO-204x digital storage oscilloscope to acquire and analyze analog signals and demonstrate your proficiency with the basics of analog signal acquisition.

The raw input signal is in the form of an analog voltage signal whose amplitude varies continuously over time. This voltage signal is monitored by the iMSO scope, the analog voltage signal is sampled at regular intervals. The signal is then converted to digital signal and transferred to the attached computer or mobile device. The iMSO software displays the data directly; it plots the sampled and digitized data points and reconstructs the original waveform by drawing lines between the points. The software can also easily manipulate and analyze the data in a variety of ways.

The basic hardware is a iMSO-204x, a digital recording instrument that measures electrical signals through the analog or digital inputs. It is capable of recording two analog signals and four digital sources simultaneously. The connections to the iMSO-204x is shown in Figure 1.

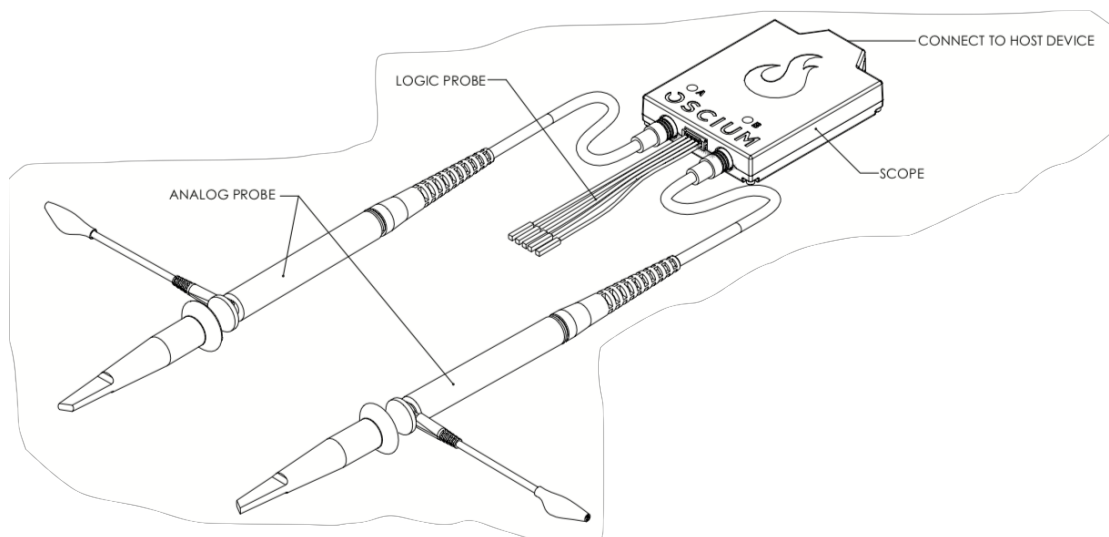


Figure 1. Principle components of the iMSO-204x digital storage oscilloscope.

Please identify these parts on the iMSO-204x

1. Power indicator light: illuminates when the iMSO-204x is connected to and recognized by a computer or mobile device.
2. Analog probe input channel A
3. Analog probe input channel B

Introduction to the iMSO-204x and signal analysis

4. Logic Probe input
5. Digital Input Connector
6. Micro USB connector: connects a computer or mobile device to the iMSO-204x
7. SMB to BNC adaptor

The iMSO-204x should be connected to your computer or mobile device using the appropriate cable. The iMSO-204x hardware is controlled through the iMSO software thus, there are no knobs or dials on the scope. The iMSO software displays the electrical signals in a format that resembles a traditional digital oscilloscope.

REQUIRED EQUIPMENT

- iMSO software installed on your PC, phone, or tablet.
 - iMSO-204x Digital oscilloscope with appropriate connector for your PC, phone, or tablet.
 - This will be a Mini-B to: Lightning, Micro-B, USB A, or USB C cable depending upon your device
 - BNC to SMB adaptor on channel A.
 - Analog signal generator.
 - BNC cable.
1. Connect the iMSO-204x Digital oscilloscope to your device with the appropriate cable.
 2. Connect the BNC to SMB adaptor to Chanel A on the iMSO-204x (Figure 2).

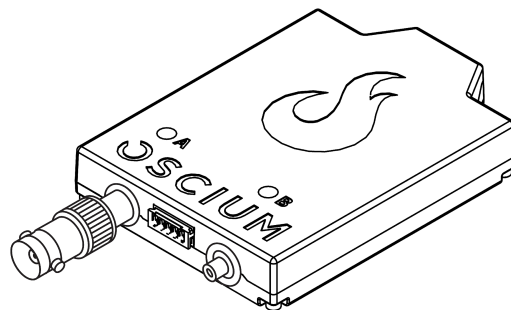





Figure 2. Use the BNC adaptor on Chanel A analog input to connect the iMSO-204x to your signal generator.

SAFETY

1.  **The maximum input voltage for the iMSO scope when using the BNC-SMB adaptor is -8v / +13v.**
2. In other applications, you will use the analog probe which has a sliding red lever  that allows the user to move between 1x and 10x modes.
 - a. The maximum voltage limit for the analog probe in 1X mode is -8v / +13v.
 - b. The maximum voltage limit for the analog probe in 10x mode is -40V / +40V.
 - c. To enable 10x mode, slide the red lever located on the probe itself.
 - i. The 10x option located in software only changes the voltage scales in software; it does not actually divide the input voltage. Please remember to slide the red lever on the physical probe for all 10x measurements.

STARTING IMSO SOFTWARE

1. Find the Oscium icon  on the desktop and launch iMSO software as you would any other computer program.
 - a. If using a mobile device, launch the app.
2. iMSO software will appear on the screen as in Figure 3.

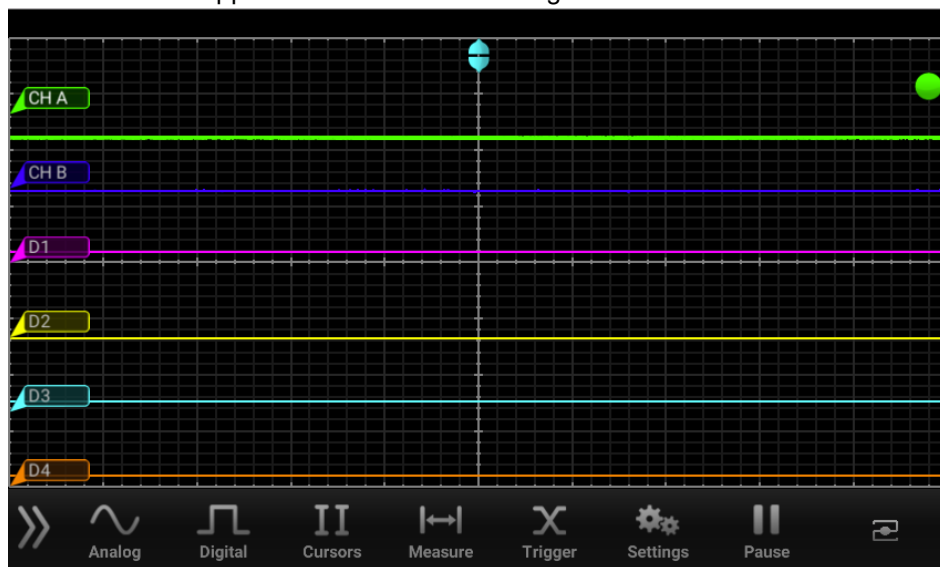




Figure 3. Default iMSO software display.

SETTING UP THE SOFTWARE INTERFACE

iMSO has an interface focused around the main iMSO window, the toolbar at the bottom will have several sub menus with controls. In this exercise, you will navigate the appropriate menus to set the iMSO software to acquire and analyze analog signals.

1. Locate the toolbar and select the Analog channel  button on the menu bar. Channels can be turned either on or off by selecting the on or off button. Leave channel A turned on and turn channel B off, leave all other setting as is for this portion of the exercise (See figure 4)
2. Open the Digital channel menu . For this exercise, we will not be using this functionality so turn off the digital channels see figure 4:

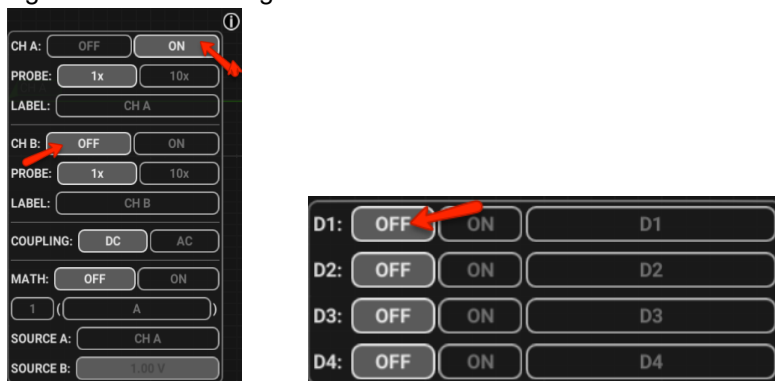


Figure 4: Analog channel controls (left) and Digital channel controls (right). Check to make sure your settings match these before moving on with this exercise.

SETTING UP YOUR SIGNAL GENERATOR

Many different signal generators are available, but all will have the same fundamental controls. Please check with your instructor if your signal generator controls differ from these.

1. Select the following output parameters:
 - Waveform: Sine
 - Frequency: 10,000.00 Hz.
 - Offset: 0.00V
 - Duty Cycle: 50%
 - Amplitude 5.0V
2. Attach the output of the signal generator with a BNC cable to the channel A input on your scope.

VISUALIZING AND RECORDING DATA

The next series of exercises teaches you how to collect data with the iMSO software, make adjustments to the display to visualize the data and save a screenshot.

1. When the signal generator is turned on, your screen will look similar to figure 5.

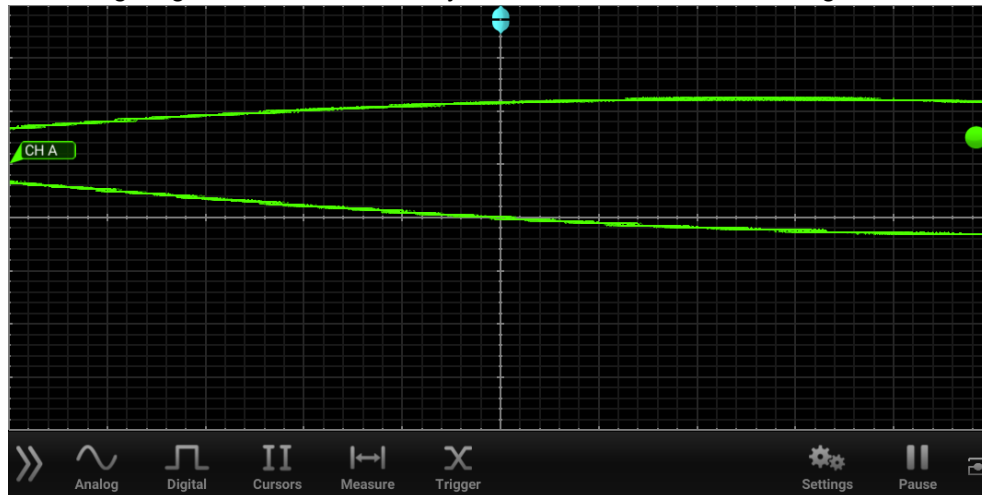


Figure 5. Example of Waveform from a 10kHz signal with default scaling.

2. Adjust the time base and amplitude display by pinching on a touch screen device or using the arrow keys on your computer keyboard (figure 6). Adjust until the entire waveform is visible.

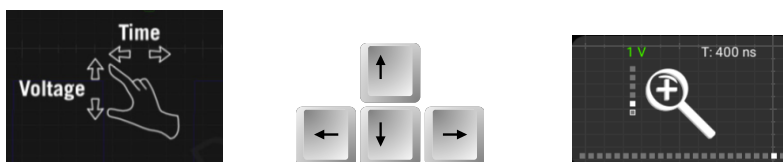


Figure 6. Adjust the screen by pinching a touchscreen (right) or by using the arrow keys (center) on a PC. The zoom dialog (left) will appear. Adjust until the entire waveform is visible.

3. Once the entire waveform is visible you can slide the tool bar off of the screen and view the time base and amplitude setting for your recording Figure 7.

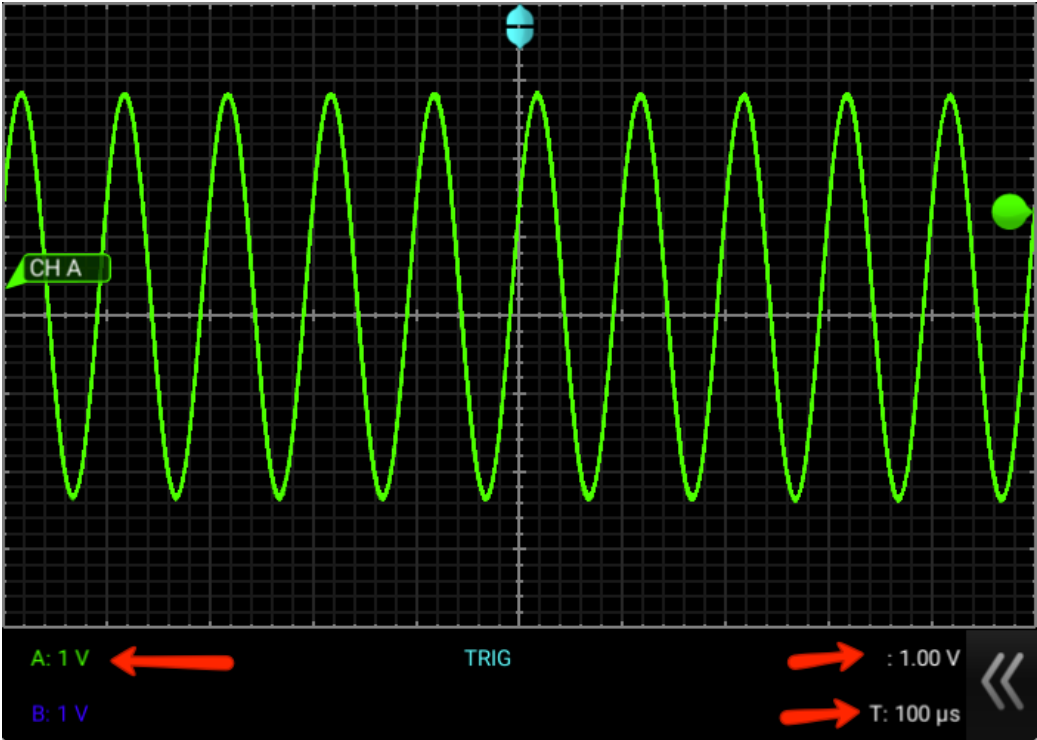


Figure 7: Example of a 5V, 10kHz waveform displayed in the iMSO software.

Triggering

Triggering can be thought of as synchronizing the display window with a particular portion of the continuously moving signal and displaying it so we can make accurate measurements. Your oscilloscope is generating tens of thousands of potential screen images per second of the input signal (Figure 8). To properly view these waveforms the images must be synchronized to “something”.

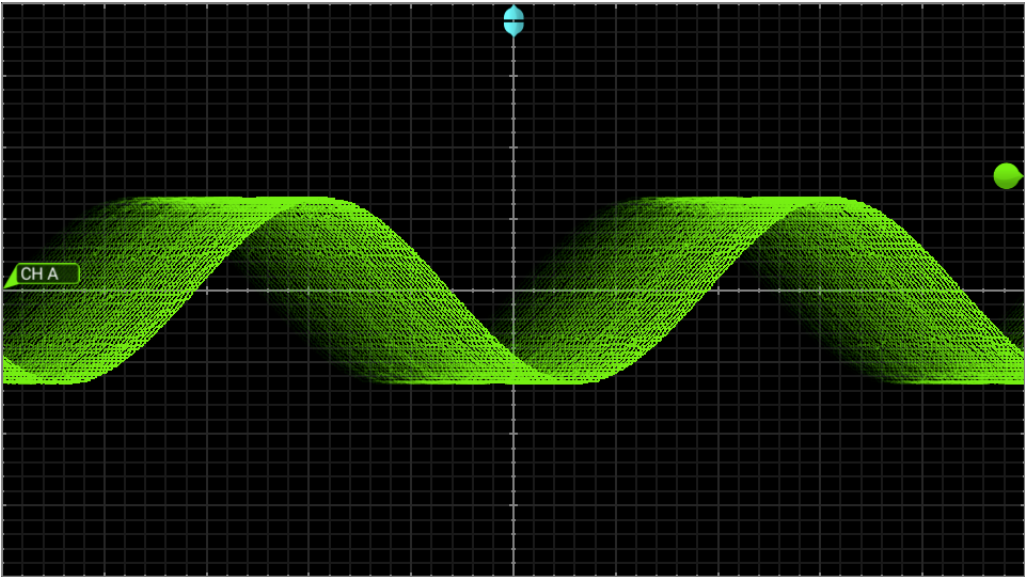


Figure 8: Example of a 5V, 10kHz waveform without triggering.

When using the analog inputs of the iMSO 204x that “thing” will be a point in time where the input signal voltage crosses the centerline of the screen. You will set this with the trigger bubble control on the iMSO screen. You may also adjust the position of the trace up and down on the screen, you will notice the trigger bubble will move with the trace

4. Adjust Chanel A so that the trace is centered on the centerline of the graticule and adjust the trigger voltage bubble to 2.0 V (Figure 9).

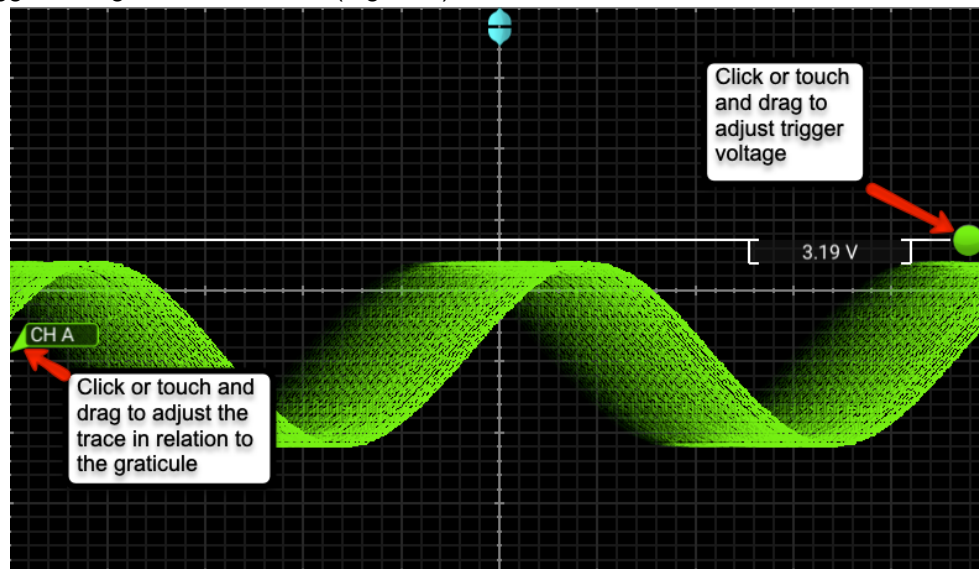


Figure 9: Adjusting the trace against the graticule and setting the triggering voltage.

5. Your screen should look like Figure 10.

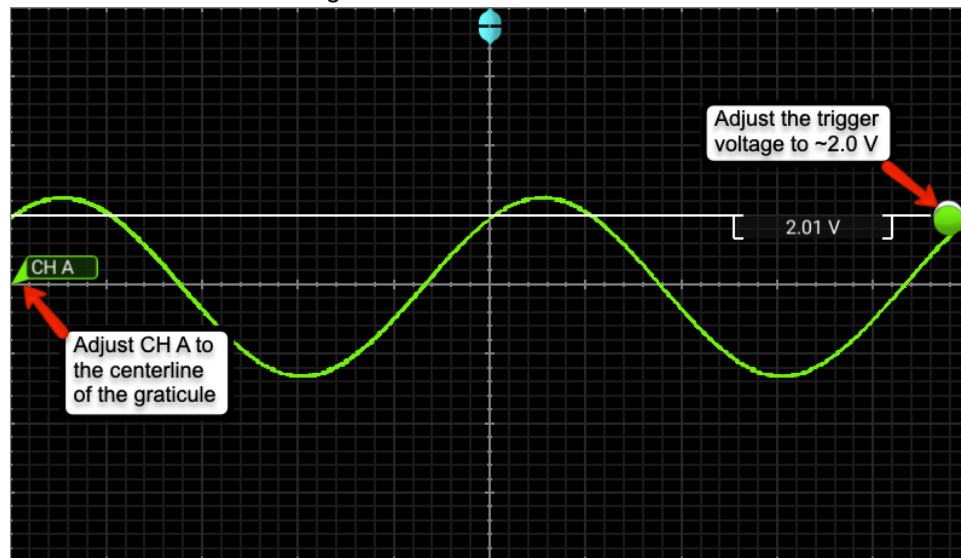


Figure 10: Example of a 5V, 10kHz waveform centered with 2.0 V trigger.

Now you should adjust the frequency of the signal generator output and be able to describe how the image on the screen changes.

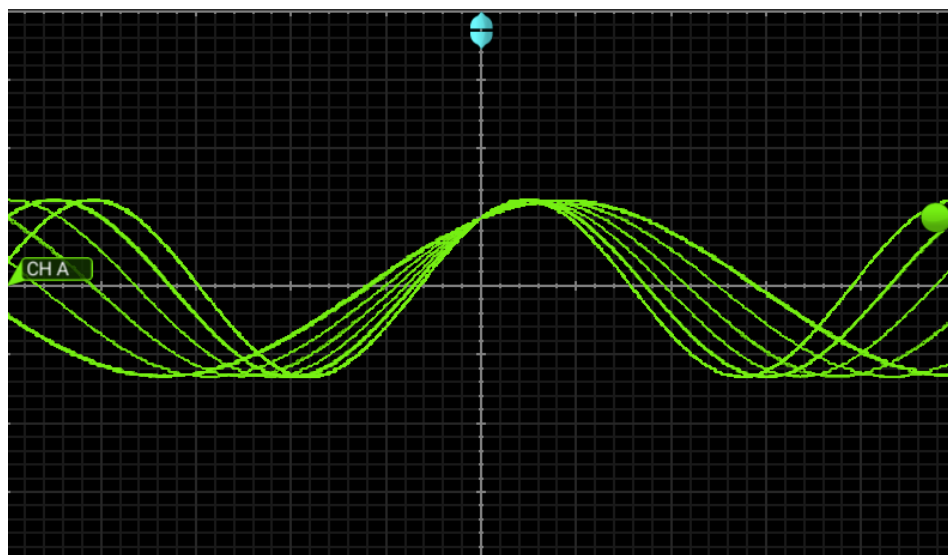




Figure 11: Example of a 5V, waveform centered with 2.0 V trigger, frequency is being adjusted on the signal generator.

MEASUREMENTS

The iMSO software can be used to make several measurements on the incoming signal automatically.

Vertical Cursors

1. Select the cursor icon  from the menu bar. select ON to activate the cursors.
2. Select VERTICAL from the cursors menu.
3. On the main screen, click and drag (or touch and swipe a touchscreen device) the desired cursor in the horizontal direction and place where desired.
 - a. The selected cursor will be displayed as a solid line and the un-selected cursor, a dashed line.
 - b. The position of the selected cursor is indicated next to @t in the summary bar.
 - c. The distance between the two cursors is indicated next to Δt in the summary bar.
 - d. The voltage level at the point where the selected cursor crosses the waveform is indicated in the summary bar next to @V and the vertical difference between the crossing points of the two vertical cursors is indicated in the summary bar next to ΔV . When using vertical cursors with the analog channel both @t, Δt and @V, V will be visible in the summary bar.
4. To move cursors independently of one another, touch INDEPENDENT.
5. To move cursors as a single unit with a fixed distance between them, click or touch  VERTICAL.
6. Slide the tool bar closed to view these measurements displayed in real time (figure 12).

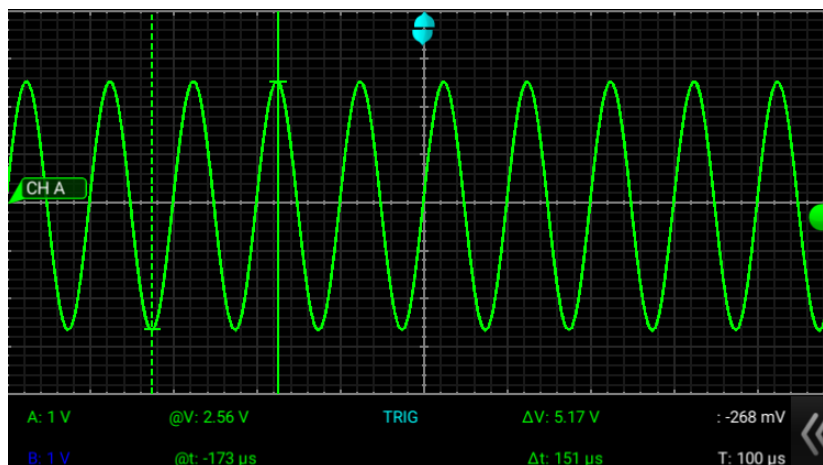


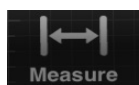
Figure 12: Example of a 5V, 10kHz. waveform measured with the vertical cursors.

Changing measurement units.

To change the units displayed by the software the following options are available:

1. To select the time base of the display, select **BASE**. The options next to the word UNIT set the unit of time.
 - a. Time settings available in the Base option include: measure in seconds or in hertz
 s Hz
2. If cursor data are to be displayed in phase, Select **PHASE**.
 - a. The options next to the phrase “360° WITHIN:” sets the phase.
 - b. The option of **5 DIVS** sets 360° within 5 divisions.
 - c. The **CURSOR** option sets 360° between the two cursors.
3. If cursor data is to be displayed as a ratio, touch **RATIO**.
 - a. The options next to the phrase 100% WITHIN set the ratio.
 - b. The option of **5 DIVS** sets 100% within 5 divisions. Since there are 10 divisions in the horizontal time scale, this option effectively cuts the screen in half.
 - c. The **CURSOR** option sets 100% between the two cursors.
4. FFT Units.
 - a. The options next to the phrase FFT Units will set the voltage units.
 - b. Selecting the **Volts** option the voltage units will display as volts in the summary bar.
 - c. Touching the **dBv** option will change the voltage units to dBv.

iMSO software has the ability to calculate various parameters as you record using the measurements functions.



1. Select Measure **Measure** from the menu bar. Fifteen different measurements exist:

| | |
|-----------------|-----------------|
| Min | Pulse Width (-) |
| Max | Cycle Mean |
| Mean | Cycle RMS |
| Peak to Peak | Frequency |
| RMS | Period |
| Duty Cycle (+) | Rise Time |
| Duty Cycle (-) | Fall Time |
| Pulse Width (+) | |

2. To select the measurement options, scroll through the pick wheel and select the desired measurements.

3. To activate the settings, click (or touch on a mobile device) away from the menu.
4. Measurements appear on the top right of the interface (figure 13).

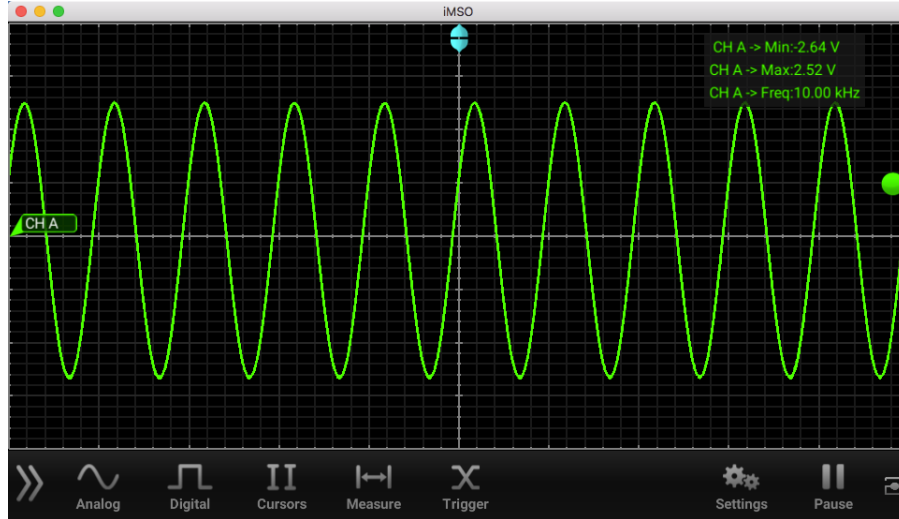



Figure 13: Waveform measurements are displayed in the iMSO software in the upper right hand corner.





EXPORTING DATA

Screenshots:

1. Select the Settings menu  and then SCREENSHOT will fade to from black to gray and the display will briefly change to full screen mode.
 - a. If using an Apple device simultaneously pressing the home and the power button. The screen will flash white while the picture is captured. When a picture is captured this way, everything visible on the LCD will be captured and available in photos.
2. On a mobile device, select email to send a copy of the screenshot to yourself.
3. On a Mac or PC Open a web browser, and launch your web mail or cloud storage site and upload your data. Your data log can be found here:
 - a. Mac: Drive> Users>*user*>Document>iMSO
 - b. PC: C:\Users*user*\AppData\Local\iMSO

Data logging:

The iMSO software has a built-in data logging feature that will allow you to export data as a .csv data file.

4. Select Settings from the menu bar. Then click or touch  from the data log option,    will then change to in order to indicate data is being logged. To stop data logging click or touch Stop

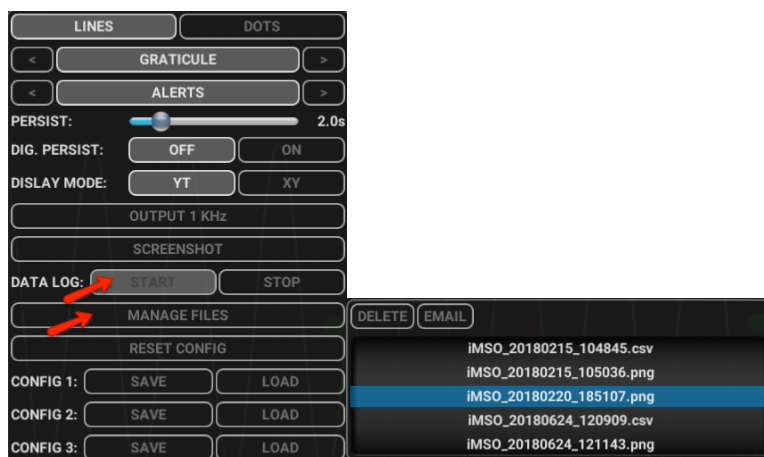


Figure 13: Data logging controls in the iMSO software (L) and pick wheel of captured screenshots and data logs from the manage files menu (R).

5. A pick wheel will appear with all of the data that has been previously logged.
6. On a mobile device, select email to send a copy of the logged data to yourself.
7. On a Mac or PC Open a web browser, and launch your web mail or cloud storage site and upload your data. Your data log can be found here:
 - a. Mac: Drive> Users>*user*>Documents>iMSO
 - b. PC: C:\Users*user*\AppData\Local\iMSO

Each column of the .csv (excluding the first) is the data point in time that is shown on the screen. When the time scale is set to less than 100ms, each row is a single screen capture. When the time scale is greater than or equal to 100ms, each row is a data point in time.

END OF LAB ACTIVITIES

Once you have successfully emailed yourself a screenshot and a data log; please clean up your workspace and power down all devices.

1. Please quit the iMSO software and close all other browsers and put computer to sleep.
2. Turn off the signal generator and disconnect all test cables from the iMSO scope.
3. Return all cables and leave the lab bench as you found it.
4. Discuss the following study questions with your group before leaving class unless your instructor gives additional instructions.

STUDY QUESTIONS

1. Find the email you just sent yourself. Write the Subject here:

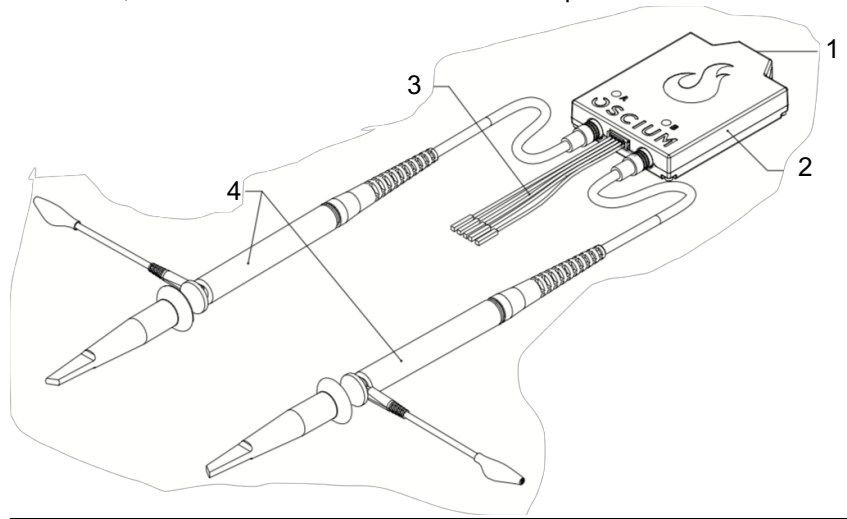
2. Where are data logs stored on your device?

3. Today you used a signal generator and made some recordings. In your own words, being as specific as you can, describe what is actually being recorded by the iMSO-204x and displayed in iMSO software.

4. Describe what triggering does for the display of your signal in the iMSO software.

5. Name two signal sources that you could measure with the iMSO-204x system.

6. In your own words, describe the function of the labelled parts of the iMSO-204x shown below.



- 1) _____
- 2) _____
- 3) _____
- 4) _____