

**KING FAHD UNIVERSITY OF PETROLEUM AND MINERALS**  
**DEPARTMENT OF ELECTRICAL ENGINEERING**  
Electronic Circuits I - EE203

*Experiment # 1*  
**Introduction to Basic Laboratory equipments**

**OBJECTIVE**

The objective of this experiment is to familiarize the students with the equipment in the electronics lab, specially

1. To learn the operational controls of function generator.
2. To learn the operational controls of Oscilloscope.

**INTRODUCTION**

Since students come from different backgrounds; therefore, this section may seem easy for some, while others may want to spend more time becoming familiar with the equipment. If you have not used the equipment before, spend some time with the equipment in this lab to insure you know how to correctly use it.

**OSCILLOSCOPE**

The oscilloscope is the most widely used general-purpose measuring instrument because it allows you see a graph of the voltage as a function of time in a circuit. Many circuits have specific timing requirements or phase relationships that can be measured with a two-channel oscilloscope. One can measure almost anything with the two-dimensional graph drawn by an oscilloscope. This general-purpose display presents far more information than is available from other test and measurement instruments like frequency counters or multimeters.

There are two basic types of oscilloscope –analog and digital. Analog scopes are classic "real-time" instruments that show the waveform on a cathode-ray tube (CRT). Digital oscilloscope are rapidly replacing analog scopes because of their ability to store waveforms and because of measuring automation and many other features such as connections for computers.

The TDS210 DSO is the standard laboratory oscilloscope in use for EE 203 Lab. This two channel, 100 MHz bandwidth, 1 GS/s (Giga Samples per Second) device provides a wide range of measurement capabilities in a compact package. It's LCD display is a primary reason that this instrument comes in a much smaller physical size than the previous generation oscilloscopes. Through an easy-to-use push-button run menu system, it allows the user to quickly utilize all of its features.



**Figure 1 Front Panel of TDS**

Built in automatic measurements and cursors make it possible to make many measurements quickly and accurately. In addition, a GPIB (IEEE 488) connection to a PC makes it possible to download waveform displays in formats that allow inclusion in other documents for writing labs reports, etc. This tutorial is intended to aid the student in getting an overview of the TDS210's capabilities, either in a group setting with an instructor available, or as a self-study. Further details of operation can be explored by referring to the User Manual and the Programmer Manual.

### **Taking automatic measurements using the Oscilloscope:**

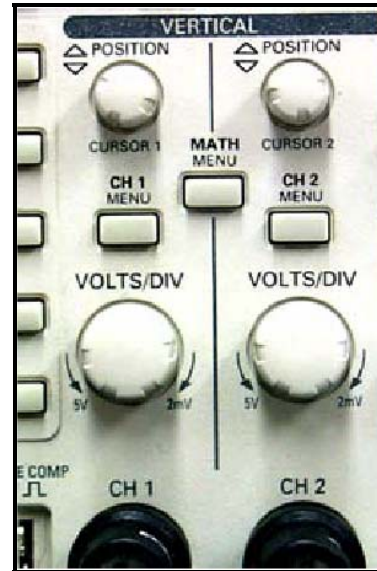
The oscilloscope can take automatic measurements of most displayed signal. To measure signal frequency, period, and peak-to-peak amplitude, do the following steps:

- Connect the output of the function generator to **CH1** of the oscilloscope.
- Turn on the power switch of the function generator.
- Select the **Sine wave** button of the function generator and set the input to 1000 Hz, 200 mV P-P
- Turn on the power switch of the oscilloscope.
- After you turn on the power of the scope, push the **autoset button**. Both channels should be displayed.

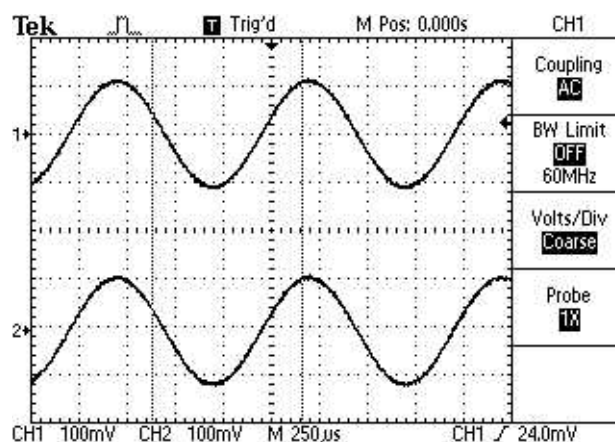
### ***VERTICAL***

The ***Vertical Controls*** relate totally to the vertical movement of the scope trace. This oscilloscope has two vertical sections so that it can display two waveforms simultaneously.

CH1 and CURSOR1 Position	Vertically adjust the channel 1 display or position cursor 1.
CH2 and CURSOR2 Position	Vertically adjust the channel 2 display or position cursor 2.
MATH MENU	Displays waveform math operations menu
CH 1 and CH 2 MENU	Displays the channel input menu selections and toggles the channel display on and off
VOLTS/DIV (CH 1 and CH 2)	Selects calibrated scale factors



- Press **CH1 MENU** Button
  - Note that this button will toggle the display of channel 1 on or off
  - Using the buttons on the right side of the LCD screen, set CH1 for (see figure 2):
    - Coupling: **AC**
    - BW Limit: **OFF**
    - Volts/Div: **COARSE**
    - Probe: **1X**
  - Adjust **VOLTS/DIV** to 100mV
- Press **CH2 MENU** Button
  - Note that this button will toggle the display of channel 2 on or off
  - Set CH2 the same as CH1



**Figure 2**

- Display both channels (as show in Figure 2)

- Adjust **POSITION** controls so that the 1=> is positioned in the top half of the LCD screen
- Adjust **POSITION** controls so that the 2=> is positioned in the bottom half of the LCD screen

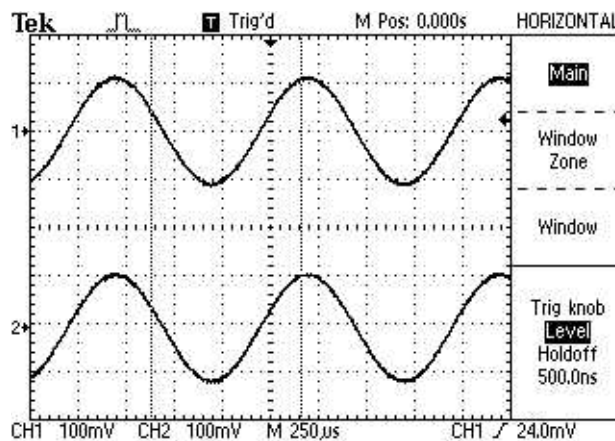
## ***HORIZONTAL***

The ***Horizontal Controls*** relate to the horizontal movement of the scope trace.

POSITION	Horizontally adjust the position of all channels
HORIZONTAL MENU	Displays horizontal menu
SEC/DIV	Selects the horizontal time/div (scale factor) for the main timebase and the Window Zone



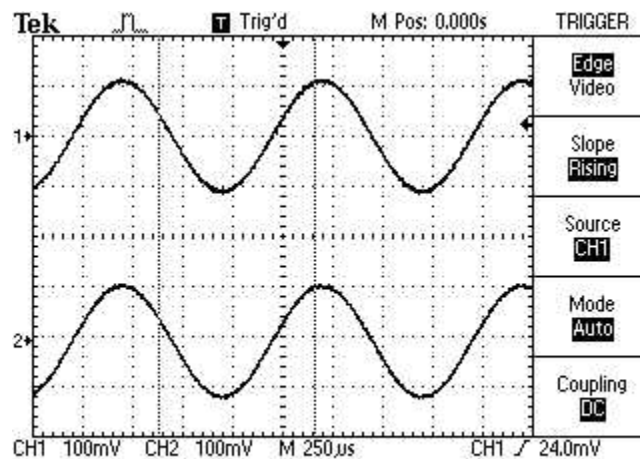
- Press **HORIZONTAL MENU** Button
- Using the buttons on the right side of the LCD screen, choose:(see figure 3)
  - **Main** (not window zone or window)
  - Trig knob = **Level**
- Adjust **SEC/DIV** for 250 us (see Figure 3 )
- When the input frequency changes, adjust SEC/DIV for a meaningful waveform.



**Figure 3**

## **TRIGGER**

- Press **TRIGGER MENU** Button
- Using the buttons on the right side of the LCD screen, choose(see Figure 4):
  - **Edge**
  - **Slope Rising**
  - **Source CH1**
  - **Mode AUTO**
  - **Coupling DC**
- Adjust trigger level ( $\leq$  on right side of LCD screen) for a stable waveform
- If the trigger level is greater than or less than the displayed waveform, the waveform will turn gray.



**Figure 4**

## **DISPLAY**

- Press **DISPLAY** Button
- Using the buttons on the right side of the LCD screen, choose: (see Figure 5)
  - **Type Vectors**
  - **Persist Off**
  - **Format YT**
- Note that using the buttons for **Contrast Increase** and **Contrast Decrease** may make the LCD screen more viewable.

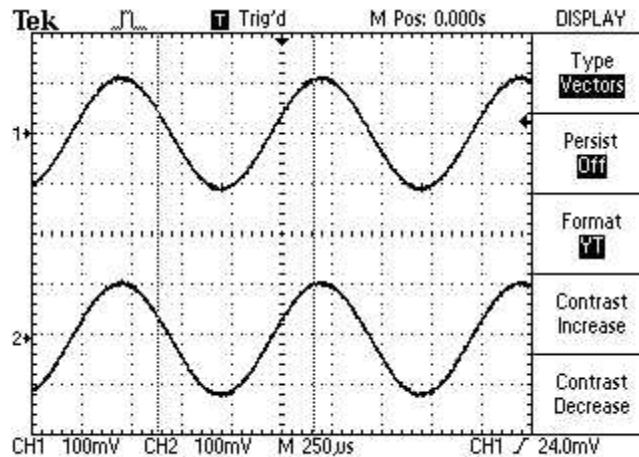


Figure 5

## CURSORS

- Press **CURSOR** Button
- Cursor types are **VOLTAGE**, **TIME**, and **OFF**
  - Toggle top button, on right side of LCD screen, to change **CURSOR** type

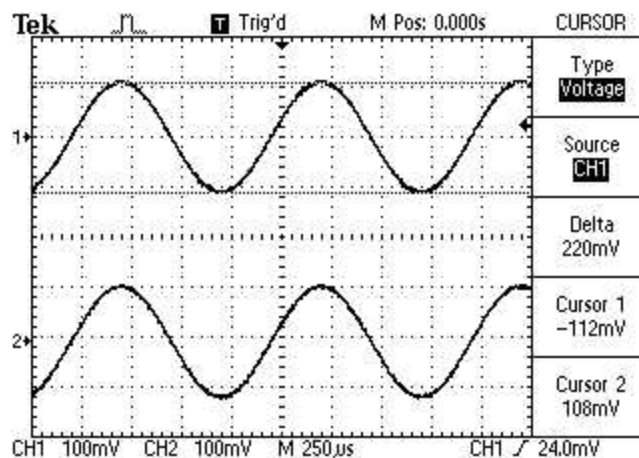


Figure 6

- **VOLTAGE** cursor
  - Adjust **VERTICAL POSITION** knobs to adjust voltage cursors to the top and bottom of CH1 waveform
  - Note that the voltage values are displayed on the right side of the LCD screen
- **TIME** cursor
  - Adjust **VERTICAL POSITION** knobs to adjust time cursors to the top of two adjacent waveforms
  - Note that the period and frequency are displayed on the right side of the LCD screen

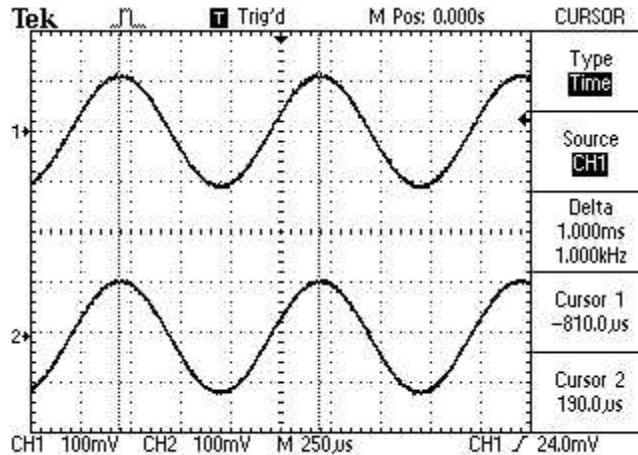


Figure 7

- Push the **Measure** button to see the Measure menu.
- Push the top menu box button to select **Source**.
- Select **CH1** for the first three measurements.
- Push the top menu box button to select **Type**.
- Push the first **CH1** menu box button to select **Freq**.
- Push the second **CH1** menu box button to select **Period**.
- Push the third **CH1** menu box button to select **Pk-Pk**.
- Push the **measure** button.

The frequency, period, and peak-to-peak measurements are shown in the menu and are updated periodically.

Note the readings.

## FUNCTION GENERATOR

Two types of function generators are available in our labs. They are:

- 1 **Agilent 33120A** 15MHz Function/Arbitrary Waveform generator
- 2 **SFG-830** 30MHz **Arbitrary/Function Generator**

### 1. **Agilent 33120A 15MHz Function/Arbitrary Waveform generator**

This function generator will output a variety of waveforms - including sine and cosine waves - at frequencies up to 15MHz

#### **The function generator controls**

- Take a look at the Agilent 33120A 15 MHz (see Figure 8) Function/Arbitrary Waveform generators. Just to the left of the terminals are four arrow buttons. These are used to select menu options and to make incremental changes in various numerical quantities (frequency,

amplitude, offset, etc.) The arrow buttons are multi-purpose in nature. They are used to

- Select peak-peak voltage setting,
- Select mega-Hertz frequency setting
- Select an RMS voltage setting
- Just above the arrow button is a large dial knob. This dial knob can be used to set numerical quantities for frequency, amplitude, offset, etc. You can also use this dial knob to "fine tune" any quantity.
- Locate the three buttons under the Function/Modulation heading on the left side of the front panel with the sine wave, square wave, and triangle wave shapes. These buttons allow you to select the wave shape. Just below these three buttons are buttons used to set the frequency, amplitude, and DC offset.

The buttons described above are the features most frequently used for the experiments in this lab.



**Figure 8**

### **Setting the frequency**

Press the frequency button labeled **Freq**

*Using the Enter Number button*

- Note that the twelve keys on the left and center of the panel have green numbers printed to the left of each key. Note key having the number 7. Note key having the +- symbol. Note key having the decimal point
- You can use these keys for numerical input if you press the **Enter Number** key. Press the **Enter Number** key. Now enter the following key sequence: 3, ., 1, 5, 1 Now press the **ENTER** button. What is the frequency displayed?
- You may change the units to MHz by pressing the MHz (up arrow button) instead of the ENTER button. Set the frequency to 2.701 MHz

### **Setting the AC magnitude**

Let's set the amplitude to 2 volts peak-to-peak

*Press the Amplitude key **Ampl***



- Press **Enter Number**
- Press **2**
- Press  $V_{pp}$  (the up arrow button)

### Setting the DC offset

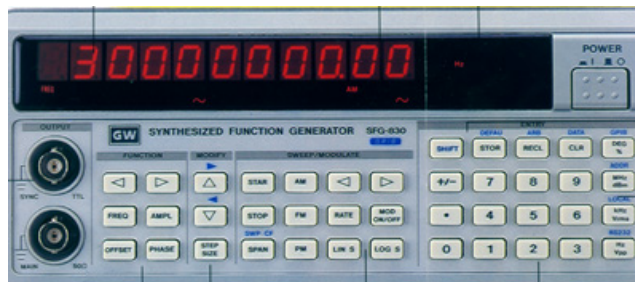
Now let's set the DC offset to 1.2 volts.

*Press the **offset** button*

- Press Enter Number
- Press 1.2
- Press **ENTER**

Reset the DC offset to zero

## 2. SFG-830 30MHz Arbitrary/Function Generator



**Figure 9**

The operation of **SFG-830 30MHz Arbitrary/Function Generator** (see **Figure 9**) is almost same as the **Agilent 33120A** function generator. Follow the same procedure to enter the frequency and amplitude. In this function generator we have 2 arrow keys above the **freq & Ampl**, which are used to change the wave shape and the changed shape is displayed on the bottom of the display. On the right side of panel we have buttons to enter frequency in Hz, KHz, and MHz. Other important function is the up-down arrow key which work like increment and decrement of the displayed quantity.