ELG2336: Experiment 2

Oscilloscope and Function Generator

Objectives:

- To introduce the operation of an oscilloscope as a measuring instrument.
- To introduce the operation of a function generator as a signal source.

Introduction:

Have you ever found yourself troubleshooting a circuit, needing more information than a simple multimeter can provide? If you need to uncover information like frequency, noise, amplitude, or any other characteristic that might change over time, you need an oscilloscope! The O-scope is an important tool in any electrical engineer's lab. It allows to see the electric signals as they vary over time.

The analog oscilloscopes were cathode ray tube (CRT) generations in which the users needed to measure most of the parameters and values by themselves while in the new generations, digital ones, LCDs or LEDs are used as monitors which all the values are measured by these devices automatically with less human regulation.

Some of the advantages of digital oscilloscopes over analog oscilloscopes include the scope's ability to store digital data for later viewing, upload to a computer, generate a hard copy or save to a USB flash drive and its capacity to instantly make measurements on the digital data.

Equipment:

- Oscilloscope
- Function generator
- Various resistors
- 330 nf capacitor
- Breadboard
- Coaxial cables with BNC (Bayonet Neill–Concelman) connector

Set-up and Operation:

You may find more information about the operation of function generator and oscilloscope in the following datasheets:

https://www.keysight.com/en/pdx-x201827-pn-DSOX2002A/oscilloscope-70-mhz-2-analog-channels?nid=-32542.1150180&cc=CA&lc=eng

http://literature.cdn.keysight.com/litweb/pdf/5990-6618EN.pdf

http://literature.cdn.keysight.com/litweb/pdf/5991-0692EN.pdf

STEP ONE: Set the oscilloscope controls as follows (Figure 1):

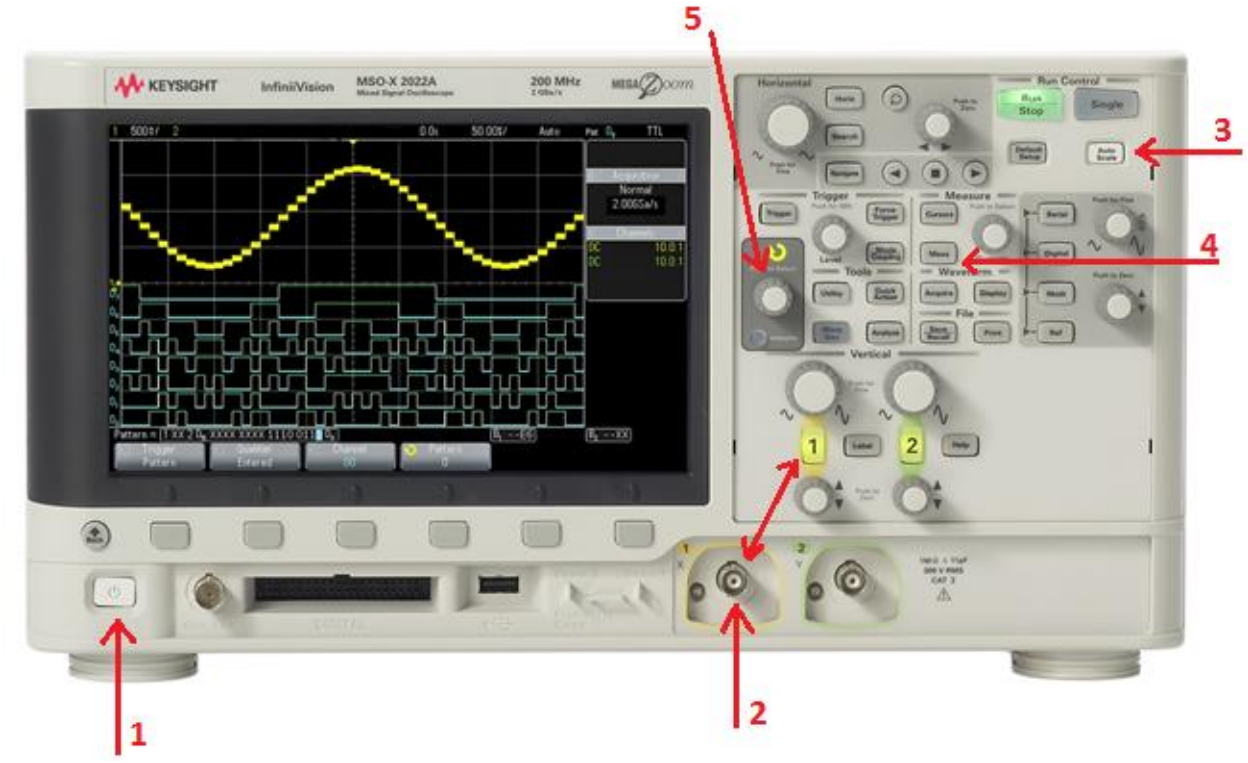

Figure 1: Digital oscilloscope.

Since oscilloscope is a measuring device, the coaxial cables with BNC are employed to apply an AC signal. A coaxial cable with BNC (Figure 2) is illustrated in Figure 2. Different steps of setting up a digital oscilloscope is shown in Figure 1 as following:

1. Turn on the power switch
2. Apply coaxial cable to a desired channel. In figure 1, channel 1 was chosen and at the same time the front panel knob related to this channel is pushed.

3. Auto Scale: Auto scale lets you quickly display any analog or digital active signals, automatically setting the vertical, horizontal and trigger controls for the best display
4. Measurement key: By choosing this key the most of the measurement can be seen on the screen.
5. Entry knob: By rotating the Entry knob and pushing it a selection can be enabled or disabled.

Figure 2: Coaxial cable with a BNC connector.

STEP TWO: Set up the function generator to produce a 1 kHz sine wave (Figure 3):

1. Turn the device on
2. Attach the coaxial cable to highlighted part
3. Different parameters of a signal such as frequency, amplitude, and phase of a signal may be changed by this button.
4. By choosing this knob the signal is ready at the output channel.
5. Once knob 5 is pushed from OFF to ON, the signal will be generated at the output as shown in Figure 4.

Figure 3: Digital function generator.

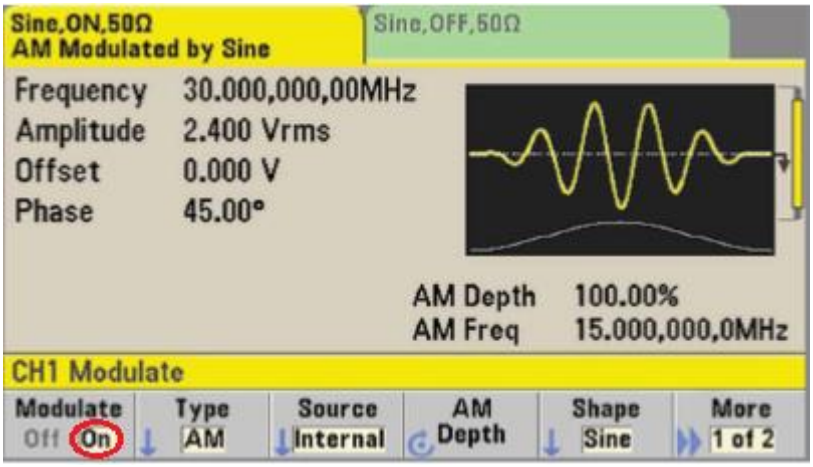

Figure 4: A screen shot of the function generator.

STEP THREE: Connect the alligator clip of the black lead from the function generator to the alligator clip of the black lead from the oscilloscope and do the same with the red leads (Figure

5). Apply different waveforms produced by the function generator to the oscilloscope and examine them.

Figure 5: Connection of two different coaxial cables to each other.

The Experiment:

1) Implement the following circuit (Figure 6) to measure V_C and V_S and then calculate I_C. Use only 1 resistor and 1 capacitor. Work with frequencies in the interval 1 kHz to 10 kHz. Avoid using electrolytic capacitors in this experiment.

2) Measure the magnitude and phase of Vo, if Vs (as reference) is a sinusoidal wave with no DC offset 5 V magnitude (10 V peak-to-peak). Vary the frequency between 1 kHz and 10 kHz and insert the results in the following table.

Frequencies	1 kHz	2 kHz	4 kHz	6 kHz	8 kHz	10 kHz
V_O						
Phase Diff. (V_0 and V_s)						

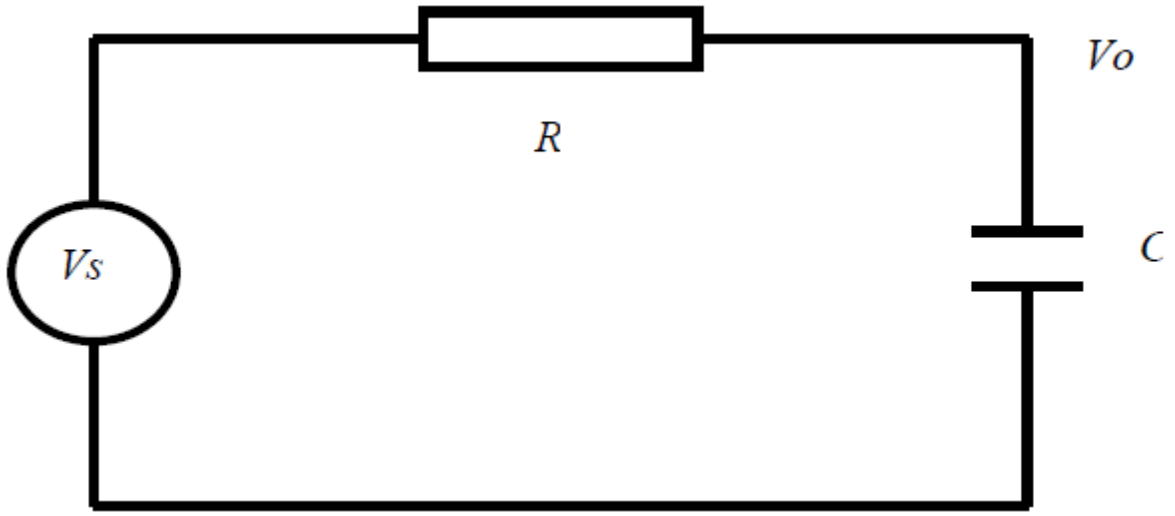

Figure 6: RC circuit.

Report:

- Do you think that the measured values agree with the calculated values in all cases? If not, why?
- Describe what happens to the current in the RC series circuit as the frequency increases.
- Explain in general terms why the observed change should occur.
- What is the phase angle between the current and the voltage of the capacitor? Find the impedance of the circuit.
- Based upon the sketches of the waveforms and the measured amplitudes for the waves in the circuit, does KVL hold for the AC circuit? Support the answer further with numerical data.