ELP Experiment 1

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Contents

1 Voltage Measurement

1.1 Aim

To use DSO to measure the Voltage of given waveform

1.2 Apparatus

1. Digital Storage Oscilloscope
2. DC Power Supply
3. Function Generator
4. Resistors and Capacitors
5. Connecting Wires

1.3 Theory

$$V_{P-P} = Deflection \times \frac{Volts}{Division} \tag{1}$$

$$V_{RMS} = \frac{V_{P-P}}{2\sqrt{2}} \tag{2}$$

1.4 Observation

Deflection	$\frac{Volts}{Division}$	V_{P-P}	V_{RMS}
6	2.00	11.3	3.99
4	2.00	8.40	2.97
3	2.00	5.68	1.41
7	2.00	14.00	4.95

1.5 Conclusion

Hence, we were able to measure the amplitude voltage of a given sine wave signal with the help of a Digital Storage Oscilloscope.

2 Frequency Measurement

2.1 Aim

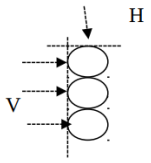
To study the basic working of Digital Storage Oscilloscope (DSO) and to make frequency measurement by means of Lissajous patterns.

2.2 Apparatus

1. Digital Storage Oscilloscope (DSO1052B)
2. DC Power supply (0 – 30 Volts)
3. Function Generator (0 – 3 MHz)

2.3 Theory

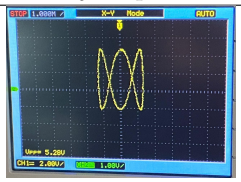
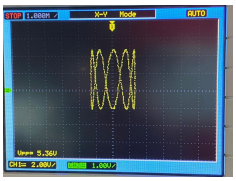
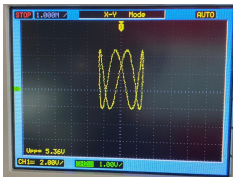
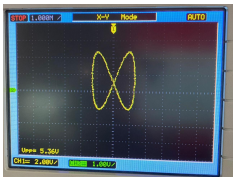
The unknown frequency signal is usually applied to the vertical terminal of the oscilloscope and the standard frequency signal is applied to the horizontal amplifier. The horizontal time-base mode should be set to XY mode. Once the DSO gets the two signals – the known and the unknown, the Lissajous pattern observed is evaluated.



$$F_{Unknown} = F_{Known} \times \frac{T_H}{T_V} \tag{3}$$

T_H is the number of points of horizontal tangency
T_V is the number of points of vertical tangency
F_{Known} is the known frequency

2.4 Observation

Lissajous pattern	T_H	T_V	$F_{Known}(inkHz)$	$F_{Unknown}(inkHz)$
	3	1	1	3
	5	1	1	5
	4	1	1	4
	2	1	1	2

2.5 Conclusion

Hence, we were able to study the basic working of Digital Storage Oscilloscope (DSO) and to make frequency measurement by means of Lissajous patterns.

3 Phase Measurement

3.1 Aim

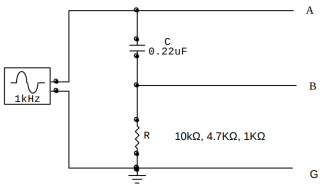
To measure the phase difference between two signals of the same frequency.

3.2 Apparatus

1. Digital Storage Oscilloscope (DSO1052B)
2. DC Power supply (0 – 30 Volts)
3. Function Generator (0 – 3 MHz)
4. Multimeter (FLUKE 115)
5. Variable resistor
6. Capacitor
7. Breadboard
8. Jumpers

3.3 Theory

According to the circuit, there are two signals that are generated – the first is the one across A and G, the second is across B and G. Let us call these set of signals as Signal A and Signal B. Switching the DSO into the X-Y mode, we get ellipses.

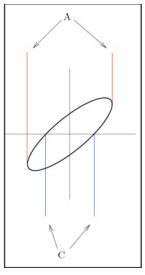


According to the figure, the phase difference θ is given by the equation:

$$sin\ \theta = \frac{C}{A} \tag{4}$$

Theoretically,

$$tan\theta = \frac{X_C}{R}$$

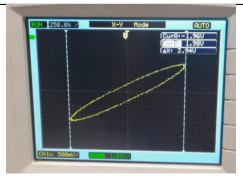
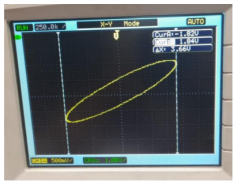
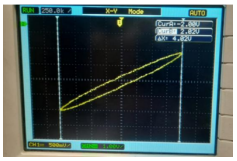


where X_C is the capacitive resistance of Capacitor, given by

$$X_C = \frac{1}{\omega \times Capacitance}$$

3.4 Observation

Capacitance= 0.23 µ
Frequency= 1 kHz
X_C= 692.33 Ω

Lissajous pattern	R(in ohms)	A	C	θ	Calculated Value of θ
	2.266	3.94	1.18	0.3042	0.2965
	1.34	3.67	1.72	0.4881	0.4678
	4.21	4.00	0.68	0.1708	0.1629

3.5 Conclusion

Hence, we were able to study the basic working of Digital Storage Oscilloscope (DSO) and to measure phase difference between two signals by use of Lissajous Patterns observed on the DSO screen.

4 Sources of Error

- Scale of DSO not properly set
- Loose connections
- Connections changed while circuit is powered
- Resistance in wires and change due to temperature

5 Precautions

- Make the connections neat and tight
- Don't leave the switch on for long continuous periods of time.
- Wear proper shoes and use insulated tools

6 Concluding Remarks

In this experiment, we learned how to use the DSO's(Digital Storage Oscilloscope) basic functions. The DSO was used to determine the voltage of an input sin wave signal from an FPG (Frequency Pulse Generator), as well as the frequency difference between two signals. Using the tangent approach is a good way to go. The DSO was also used to determine the phase difference between two signals, on an AC circuit, and the results were confirmed using theoretical formulae. Furthermore, we became acquainted with the fundamental functions of an oscilloscope, learned more about Lissajous Patterns, and learned how to use an oscilloscope know how to build a breadboard prototype circuit.
Hence we were able to analyze the theoretical knowledge gained via simple experiments using an oscilloscope.