Lab Report1

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Objective

1. Observing Lissajous Figures on a CRO
2. Capturing a one-time event using a Cathode Ray Oscilloscope (CRO)

Apparatus

- Cathode Ray Oscilloscope (CRO)
- Signal Generator (2 channels)
- Probes and Connecting Wires

1 Observing Lissajous Figures on a CRO

Theory

In Lissajous figures we plot V_2 wrt V_1 on Y and X axis respectively

$$V_1(t) = A_x \sin(2\pi f_x t),$$
$$V_2(t) = A_y \sin(2\pi f_y t + \phi),$$

where:

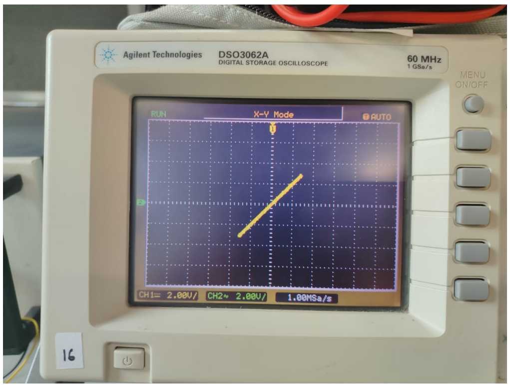
- A_x and A_y are the amplitudes of the signals.
- f_x and f_y are the frequencies.
- ϕ is the phase difference.

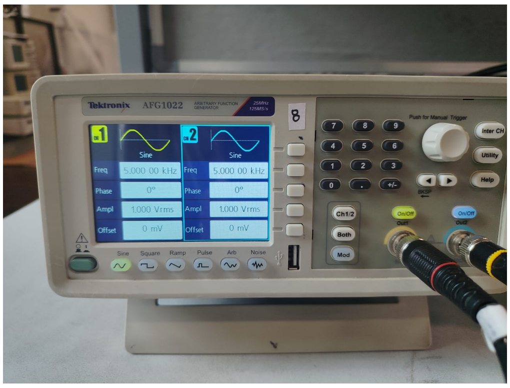
Procedure

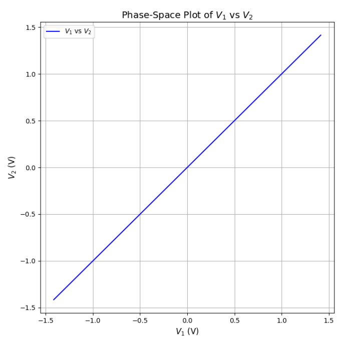
1. Connect the first signal generator to the horizontal (X-axis) input of the CRO.
2. Connect the second signal generator to the vertical (Y-axis) input of the CRO.
3. Set both signal generators to sinusoidal waveforms with adjustable frequency and phase.
4. Vary the frequency ratio $f_x : f_y$ to create different patterns.
5. Adjust the phase difference ϕ and observe changes in the figures.

1.Lissajous figures

1.1

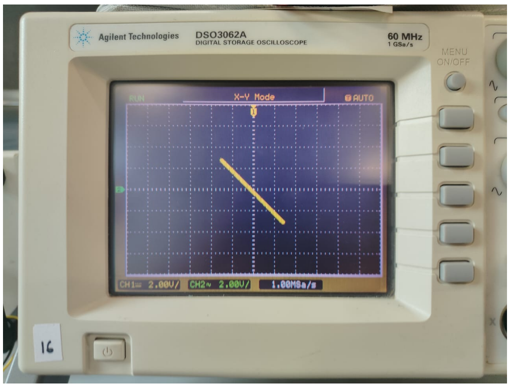


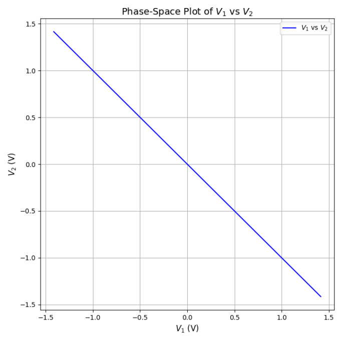




$$V_1 = \sqrt{2}\sin(2\pi 5000t)V \tag{1}$$
$$V_2 = \sqrt{2}\sin(2\pi 5000t)V \tag{2}$$
$$V_1 = V_2 \tag{3}$$

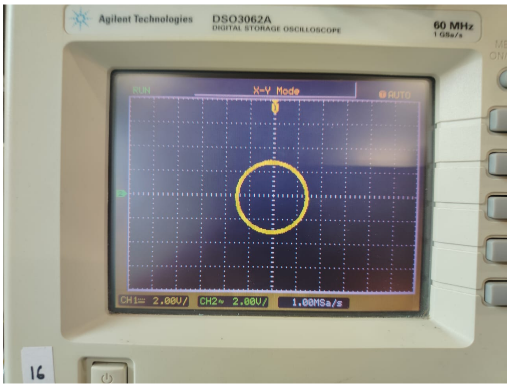
1.2

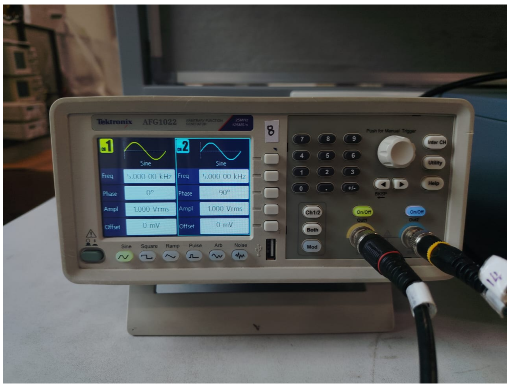


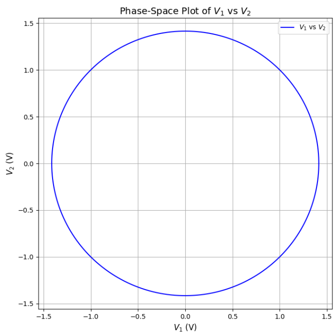


$$V_1 = \sqrt{2}\sin(2\pi 5000t)V \tag{4}$$
$$V_2 = \sqrt{2}\sin(2\pi 5000t + \pi)V \tag{5}$$
$$V_2 = -\sqrt{2}\sin(2\pi 5000t)V \tag{6}$$
$$V_1 = -V_2 \tag{7}$$

1.3







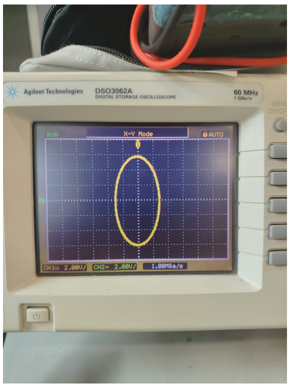
$$V_1 = \sqrt{2}\sin(2\pi 5000t)V \tag{8}$$

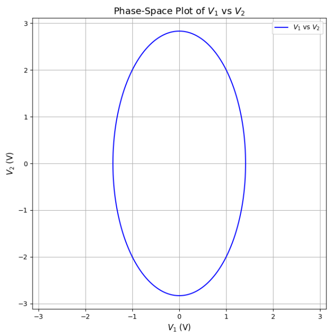
$$V_2 = \sqrt{2}\sin(2\pi 5000t + \frac{\pi}{2})V \tag{9}$$

$$V_2 = \sqrt{2}\cos(2\pi 5000t)V \tag{10}$$

$$V_1^2 + V_2^2 = 2 \tag{11}$$

1.4





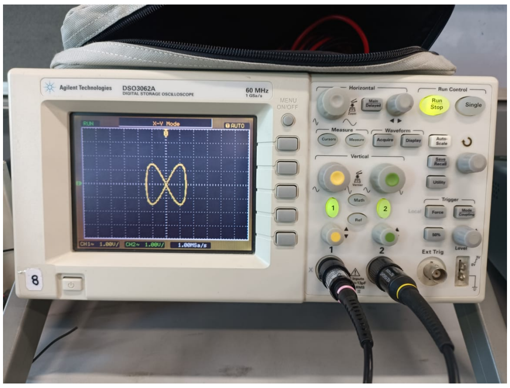
$$V_1 = \sqrt{2}\sin(2\pi 5000t)V \tag{12}$$

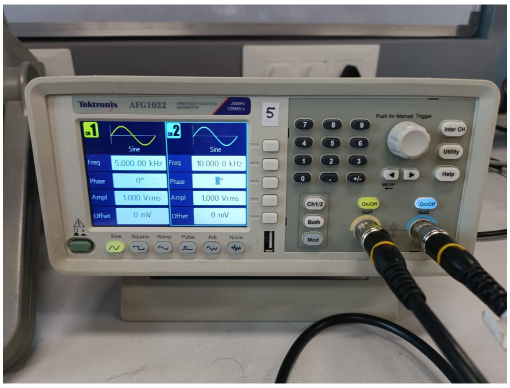
$$V_2 = 2\sqrt{2}\sin(2\pi 5000t + \frac{\pi}{2})V \tag{13}$$

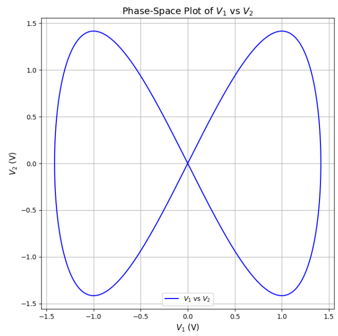
$$V_2 = 2\sqrt{2}\cos(2\pi 5000t)V \tag{14}$$

$$\frac{V_1^2}{2} + \frac{V_2^2}{8} = 1 \tag{15}$$

1.5







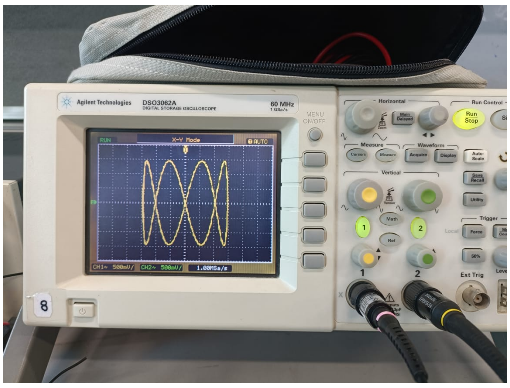
$$V_1 = \sqrt{2}\sin(2\pi 5000t)V \tag{16}$$

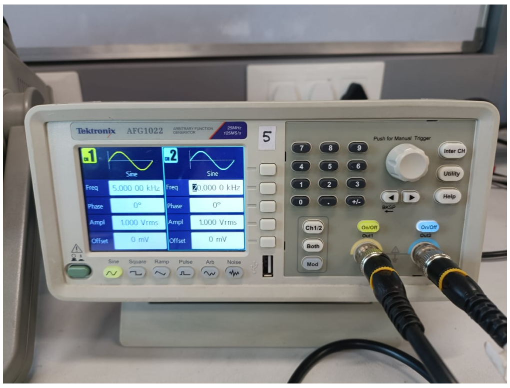
$$V_2 = \sqrt{2}\sin(2\pi 10000t)V \tag{17}$$

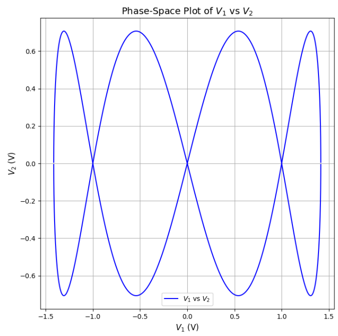
$$V_2 = 2\sqrt{2}\sin(2\pi 5000t)\cos(2\pi 5000t) \tag{18}$$

$$V_2 = \pm\sqrt{2}V_1\sqrt{(2 - V_1^2)} \tag{19}$$

1.6







$$V_1 = \sqrt{2}\sin(2\pi 5000t)V \tag{20}$$

$$V_2 = \sqrt{2}\sin(2\pi 20000t)V \tag{21}$$

$$V_2 = \sqrt{2}(2(2\sin(2\pi 5000t)\cos(2\pi 5000t))(1-2\sin^2(2\pi 5000t))) \tag{22}$$

$$V_2 = \pm 2\sqrt{2}V_1\sqrt{(2-V_1^2)(1-V_1^2)} \tag{23}$$

All the theoretical solution have been verified using the corresponding python plots. Codes are present in `https://github.com/ArnavYadnopavit/ElectricalLabEE1200/tree/main/LabReport1/codes`

2 Capturing a one-time event using a Cathode Ray Oscilloscope (CRO)

Theory

CROs typically have 2 trigger modes:

- **Auto Mode**: Continuously refreshes the display.
- **Normal Mode**: Displays a signal only when triggered.

Procedure

1. Connect probe to signal generator and turn it off
2. Press Mode/Coupling and change sweep mode from auto to normal
3. In the Trigger menu, press Mode until “Edge” is selected
4. Now press Single mode. Wait mode will initiate
5. Turn on the signal and get a captured one-time event

Capture

Thank You