

Feng Chia University
Electrical Engineering Fundamentals I Lab

Laboratory 4
Voltage vs. time measurements

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I. Introduction

- Generate a specified signal using waveform generator and display that signal on the oscilloscope.
- Display the waveform of an unknown signal on the oscilloscope and measure its amplitude, frequency, period, and average value as well as give a functional representation of the signal.

II. Materials

- a. Waveform Generator
- b. Oscilloscope

III. Circuit diagram

Connect Waveform Generator and Oscilloscope

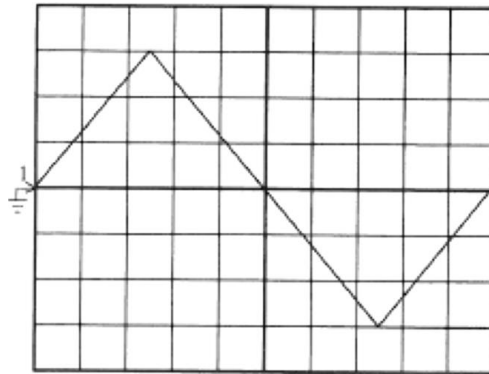
IV. Methods

Use oscilloscope to observe and record the waves generated by function generator.

V. Experiments data

a. Experiment 4.a Typical Oscilloscope Waveforms:

1.



Vertical Scale = 0.1 V/Div

Peak to Peak = 0.6 V

Average Value = 0 V

Horizontal Scale = 1 ms/Div

Period = 0.01 s

Frequency = 100 Hz

Functional Representation: $V(t) = 0.3 \text{ tri}(200\pi t)$ (V)

2.



Vertical Scale = 0.5 V/Div

Peak to Peak = 2 V

Average Value = 1 V

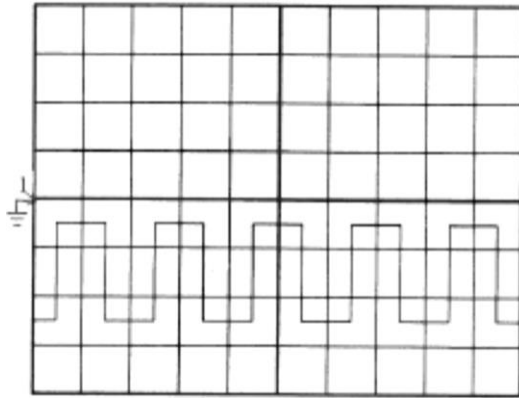
Horizontal Scale = 1.0 s/Div

Period = 5 s

Frequency = 0.2 Hz

Functional Representation: $V(t) = \sin(0.4\pi t) + 1$ (V)

3.



Vertical Scale = 1 V/Div

Peak to Peak = 2 V

Average Value = -1.5 V

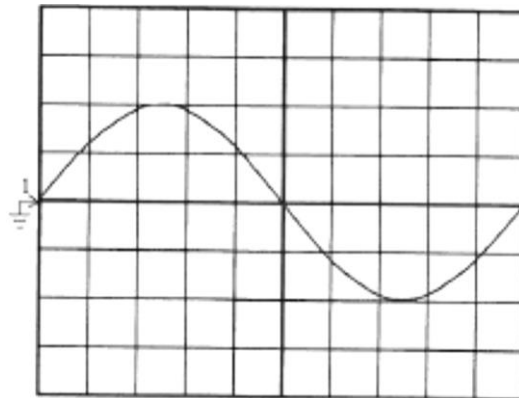
Horizontal Scale = 1 ms/Div

Period = 0.002 s

Frequency = 500 Hz

Functional Representation: $V(t) = \text{sqr}(1000\pi t) - 1.5 \text{ (V)}$

4.



Vertical Scale = 2 V/Div

Peak to Peak = 8 V

Average Value = 0 V

Horizontal Scale = 10 ms/Div

Period = 0.1 s

Frequency = 10 Hz

Functional Representation: $V(t) = 4 \sin(20\pi t) \text{ (V)}$

b. Experiment 4.b Generate Signals with Waveform Generator

1. $V_1(t) = A \sin(2\pi ft)$ (V), where $A=1$ V, $f=5$ kHz

Table 1: Results of the $V_1(t)$ Measurements

Sine Wave	
Vertical Scale	0.5 V/Div
Peak to Peak	2 V
Horizontal Scale	50 μ s/Div
Period	0.0002 s

2. $V_2(t) = B \sin(2\pi ft)$ (V)+ C, where $B=1$ V, $f=0.2$ Hz, $C=1$ V

Table 2: Results of the $V_2(t)$ Measurements

Sine Wave	
Vertical Scale	0.5 V/Div
Peak to Peak	2 V
Horizontal Scale	1 s/Div
Period	5 s

3. $V_3(t) = D \text{tri}(2\pi ft)$ (V)+ E, where $D=4$ V, $f=2$ kHz, $E=2$ V

Table 3: Results of the $V_3(t)$ Measurements

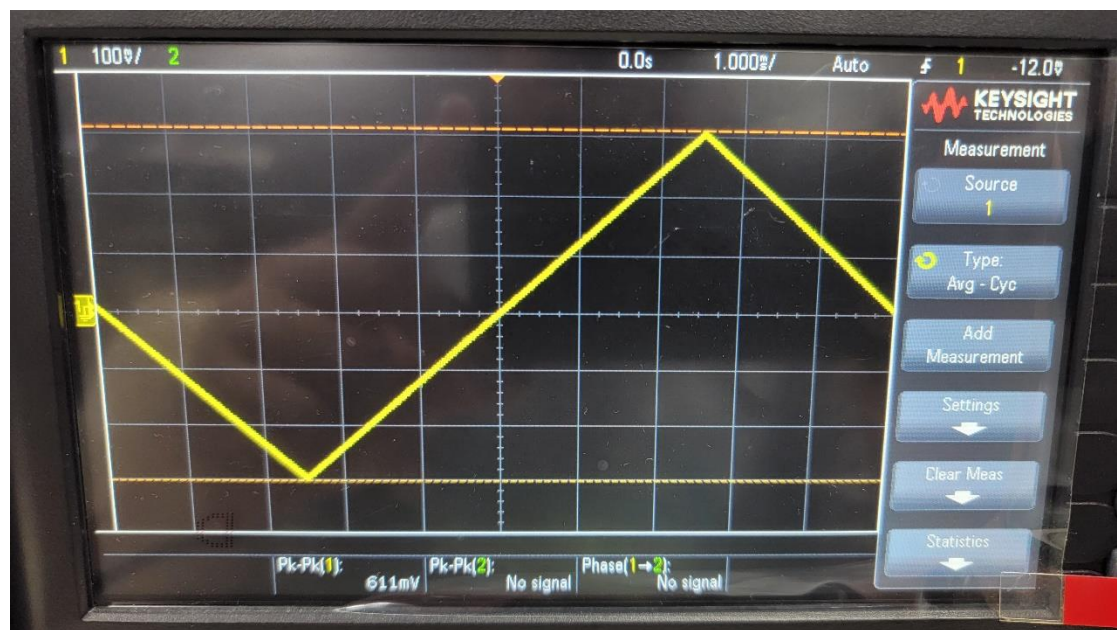
Triangle Wave	
Vertical Scale	2 V/Div
Peak to Peak	8 V
Horizontal Scale	100 μ s/Div
Period	0.0005 s

4. $V_4(t) = F \text{tri}(2\pi ft)$ (V)+ G, where $F=1$ V, $f=5$ kHz, $G=3$ V

Table 4: Results of the $V_4(t)$ Measurements

Triangle Wave	
Vertical Scale	0.5 V/Div
Peak to Peak	2 V
Horizontal Scale	50 μ s/Div
Period	0.0002 s

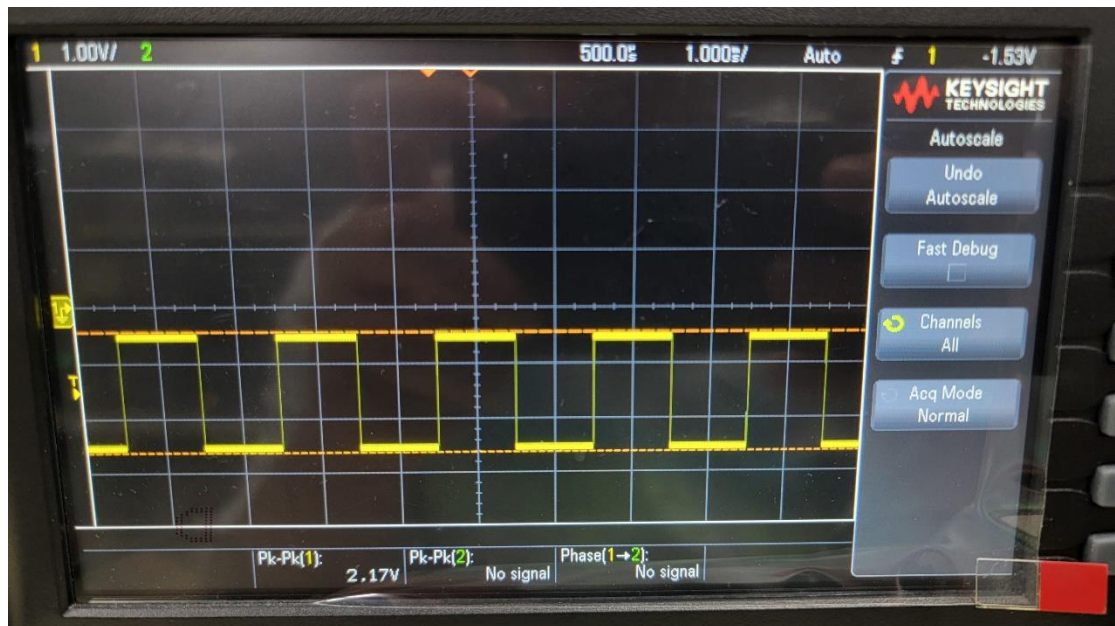
VI. Results



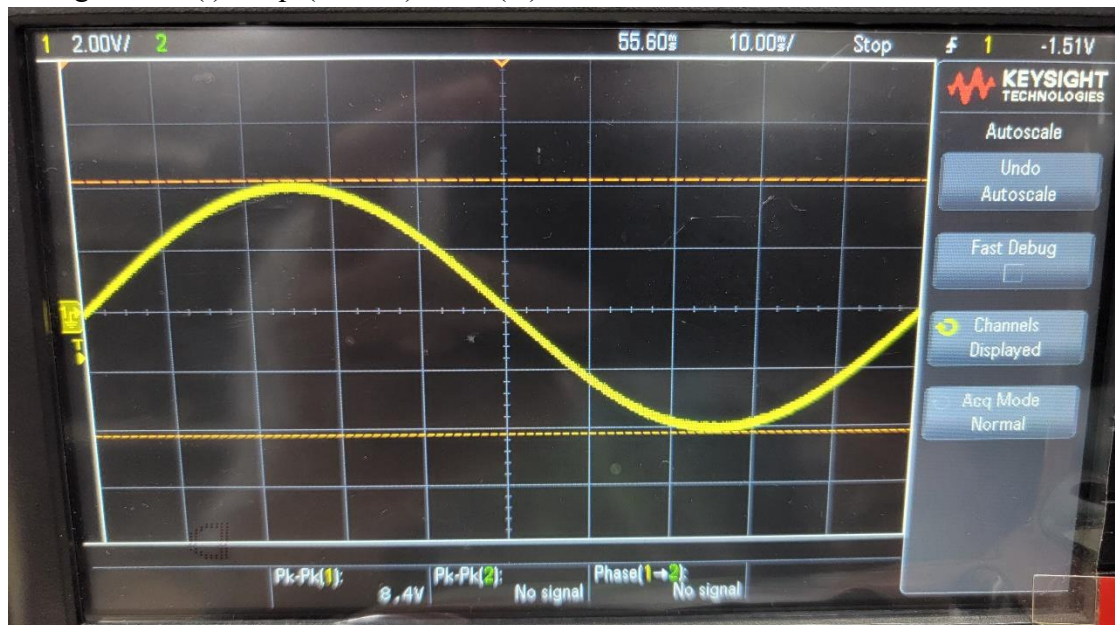
▲ Figure 1. $V(t) = 0.3 \text{ tri}(200\pi t)$ (V), 0.1 V/Div, 1 ms/Div



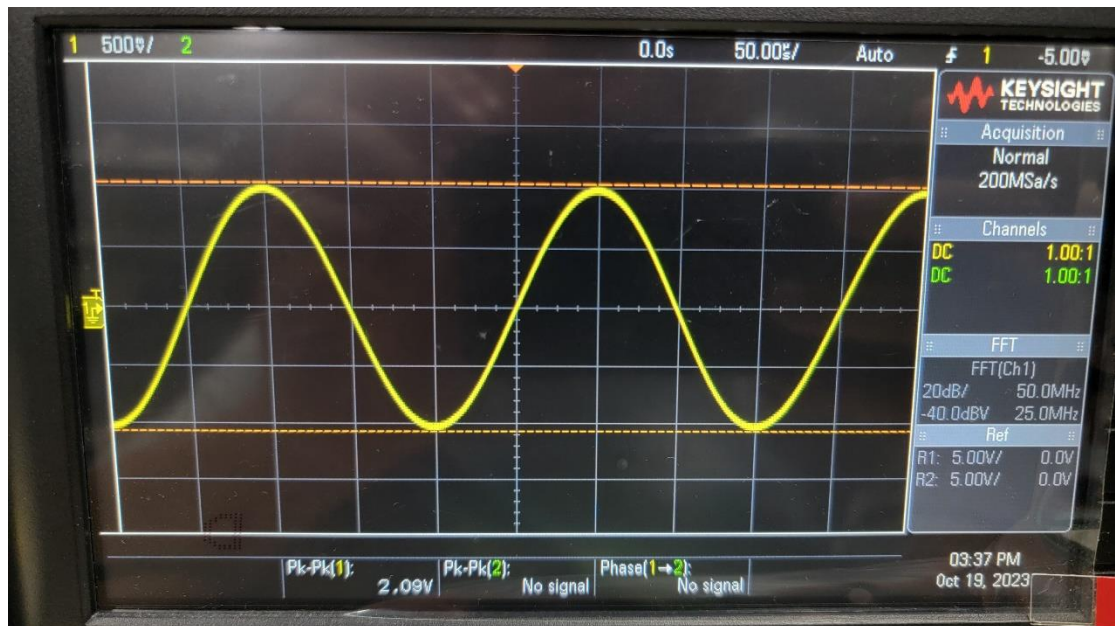
▲ Figure 2. $V(t) = \sin(0.4\pi t) + 1$ (V), 0.5 V/Div, 1 s/Div



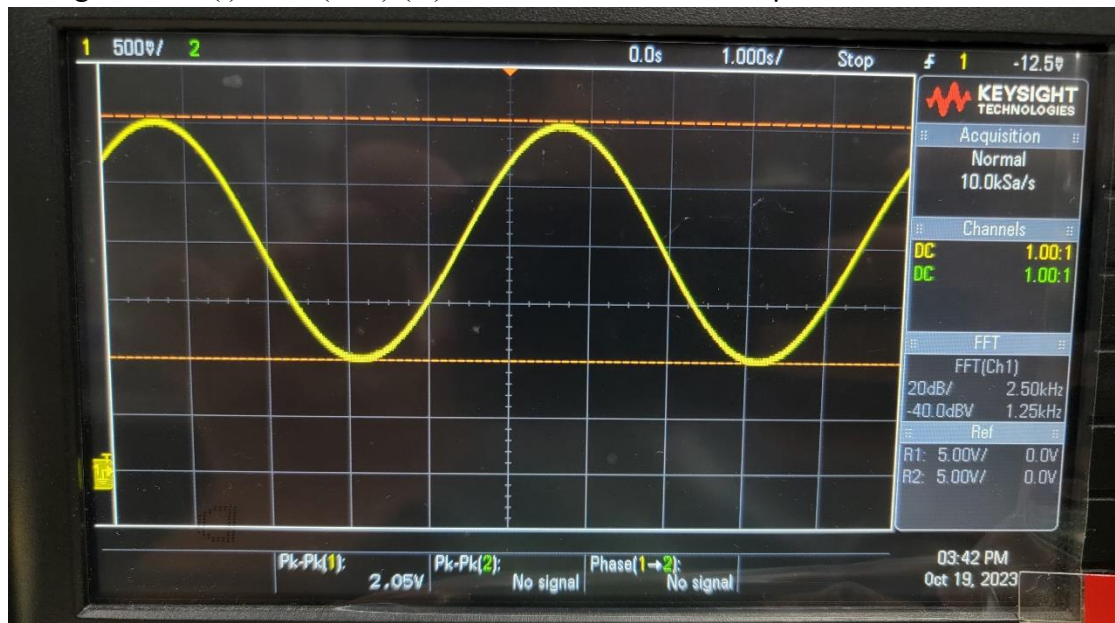
▲ Figure 3. $V(t) = \text{sqr}(1000\pi t) - 1.5$ (V), 1 V/Div, 1 ms/Div



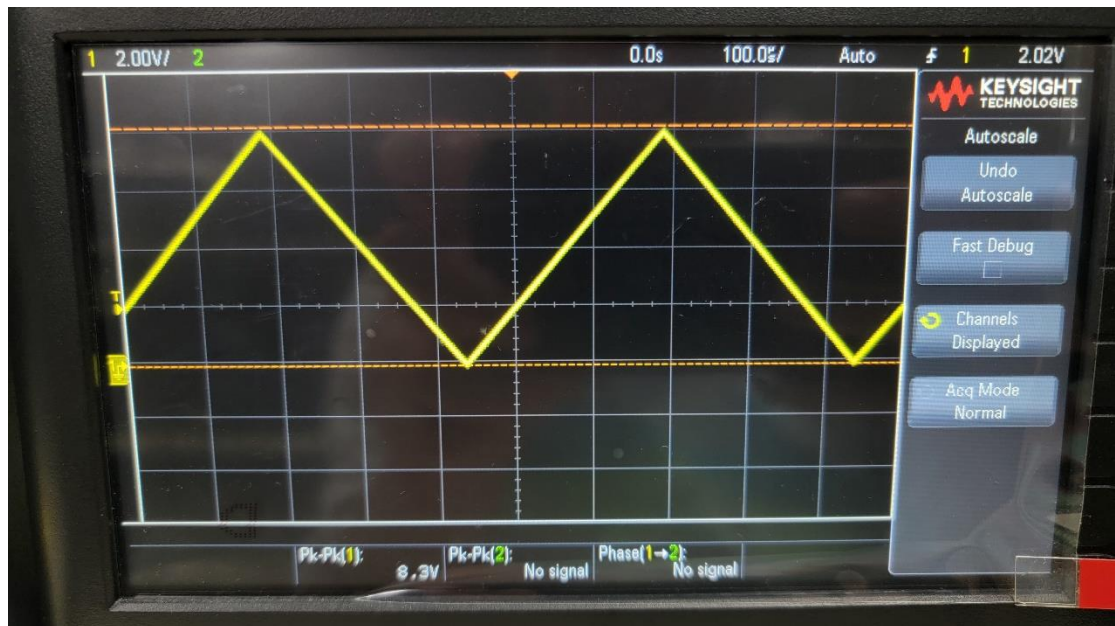
▲ Figure 4. $V(t) = 4 \sin(20\pi t)$ (V), 2 V/Div, 10 ms/Div



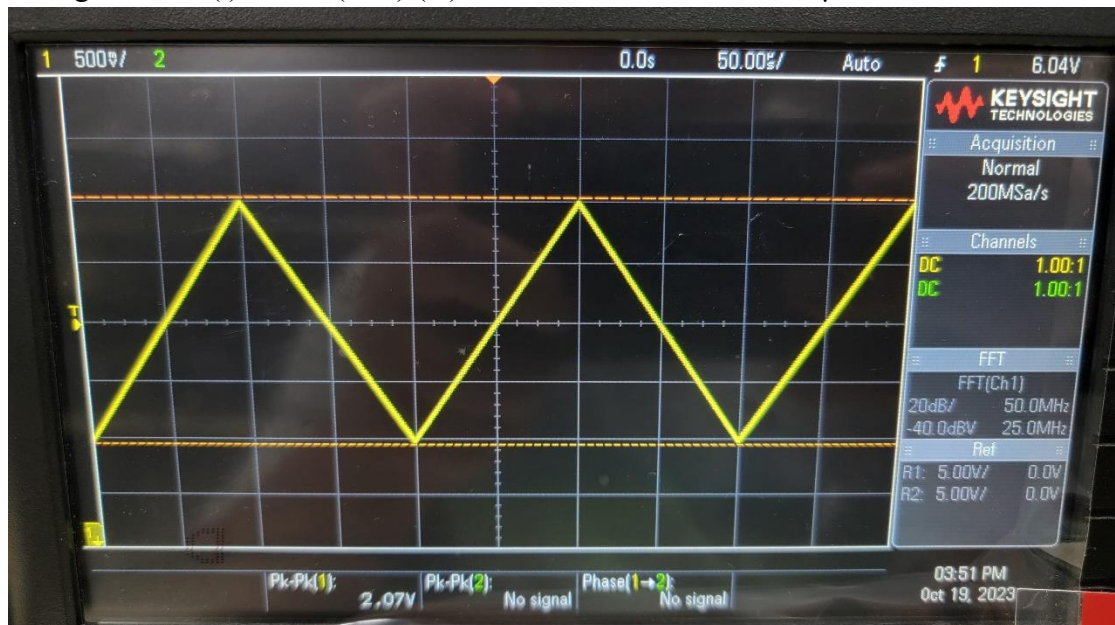
▲ Figure 5. $V_1(t) = \sin(2\pi ft)$ (V), $f = 5$ kHz, 0.5 V/Div, 50 μ s/Div



▲ Figure 6. $V_2(t) = \sin(2\pi ft) + 1$, $f = 0.2$ Hz, 0.5 V/Div, 1 s/Div



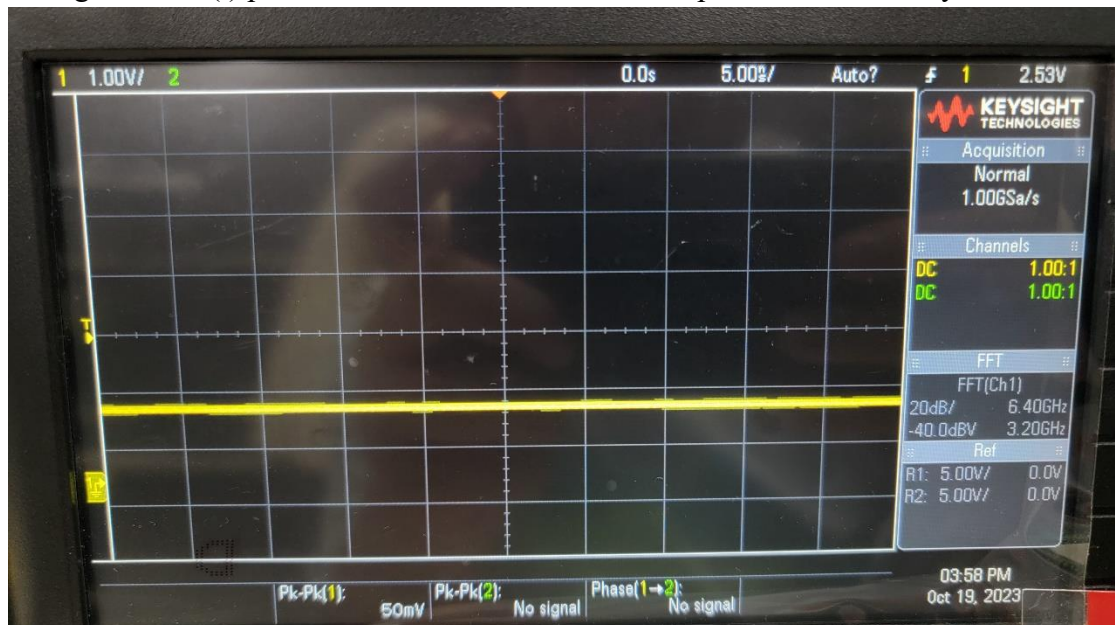
▲ Figure 7. $V_3(t) = 4 \text{ tri}(2\pi ft) (V) + 2$, $f = 2 \text{ kHz}$, 2 V/Div , $100 \mu\text{s/Div}$



▲ Figure 8. $V_4(t) = \text{tri}(2\pi ft) (V) + 3$, $f = 5 \text{ kHz}$, 0.5 V/Div , $50 \mu\text{s/Div}$



▲ Figure 9. $V_1(t)$ pattern with roll mode could make pattern show clearly



▲ Figure 10. $V_2(t)$ pattern without autoscale mode will make pattern a line



▲ Figure 11. $V_2(t)$ pattern with autoscale mode will make pattern clearly show

VII. Discussion

In this experiment, especially the slow frequency, I recognized that autoscale mode, although it's useful, can't be used in general in certain scenarios.

VIII. Conclusion

With Oscilloscope, we can easily observe the wave generated by waveform generator.