EXPERIMENT 1
AVERAGE AND RMS VALUES

INTRODUCTION

In this experiment, it is aimed to show how to measure RMS values of sinusoidal, triangular, and square waveforms using Digital Multi Meter (DMM). Most Digital Multimeters are designed to measure RMS values of a sinusoidal waveform. Digital Multimeters perform a full wave rectification of the waveform and compute the average value of the rectified waveform, and then a constant correction factor is multiplied while measuring RMS value. An ordinary DMM constant correction factor is chosen according to sinusoidal waveform.

Since the correction factor is chosen according to sinusoidal waveform, measurement of RMS value of triangular or square wave with ordinary DMM does not give correct RMS value. In this experiment it is learned how to measure RMS value of triangular and square waveform using DMM.

EQUIPMENT

Digital Multimeter (DMM)
Oscilloscope
Frequency Generator
1k ohm resistor

PRELIMINARY WORK

P1 Calculate the RMS values of the following waveforms using the formula

$$V_{RMS} = \sqrt{\frac{1}{T}\int_0^T v(t)^2\, dt}$$

a) Sinusoidal waveform

$$v(t) = V_M \sin\left(\frac{2\pi}{T}t\right) \quad for \quad 0 \le t \le T$$

b) Square waveform

$$v(t) = V_M \quad for \quad 0 \le t \le \frac{T}{2}$$

$$v(t) = -V_M \quad for \quad \frac{T}{2} \le t \le T$$

c) Triangular waveform

$$v(t)=\frac{4V_M t}{T} \quad for \quad 0\le t\le \frac{T}{4}$$

$$v(t)=2V_M-\frac{4V_M t}{T} \quad for \quad \frac{T}{4}\le t\le \frac{3T}{4}$$

$$v(t)=-4V_M+\frac{4V_M t}{T} \quad for \quad \frac{3T}{4}\le t\le T$$

P2 Calculate the average values of the rectified waveforms given in P1 using the formula given below.

$$V_{average}=\frac{1}{T}\int_0^T |v(t)|\,dt$$

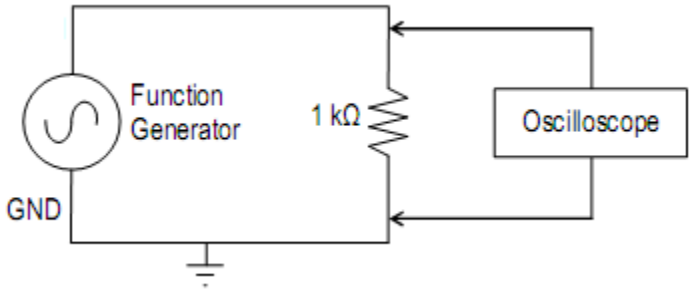
P3 Calculate the correction factor of sinusoidal, square and triangular waveforms.

$$\text{Correction Factor} = \frac{V_{RMS}}{V_{Average}}$$

P4 Concerning the explanations given in introduction, how can you correct the measurement error of square and triangular waveform if their RMS values are measured by an ordinary DMM? Explain your method in details.

EXPERIMENTAL WORK

E1 Setup the circuit given in Figure. Set frequency of function generator 500 Hz V_m=10V



a) Measure the voltage across 1k ohm resistor using **Measurement Tool** on the oscilloscope to obtain the **RMS value.**
b) Measure the voltage across 1k ohm resistor using DMM

E2 Repeat same procedure for triangular wave with V_m=10V

E3 Repeat same procedure for square wave with V_m = 10V

CONCLUSION

C1 Calculate the RMS values using the formulas that you obtained in preliminary work by taking V_m=10V. Compare the results that you obtained in the experiments E1, E2 and E3. If there are any differences, explain why?