

AC WAVEFORMS AND THEIR MEASUREMENT

Lesson 10 EET 150



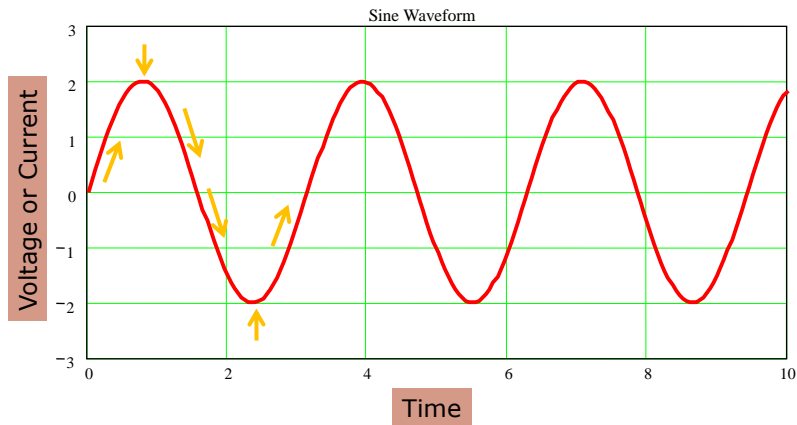
Ac Waveforms Learning Objectives

- ▣ **In this lesson you will:**
- ▣ learn the key points in measuring ac waveforms.
- ▣ define the peak, peak-to-peak and RMS values of ac waveforms.
- ▣ learn how to measure the period and frequency of ac waveforms.
- ▣ define phase shift between ac waveforms.
- ▣ learn how to compute phase shift.
- ▣ see other waveforms used in electronic and electrical systems.



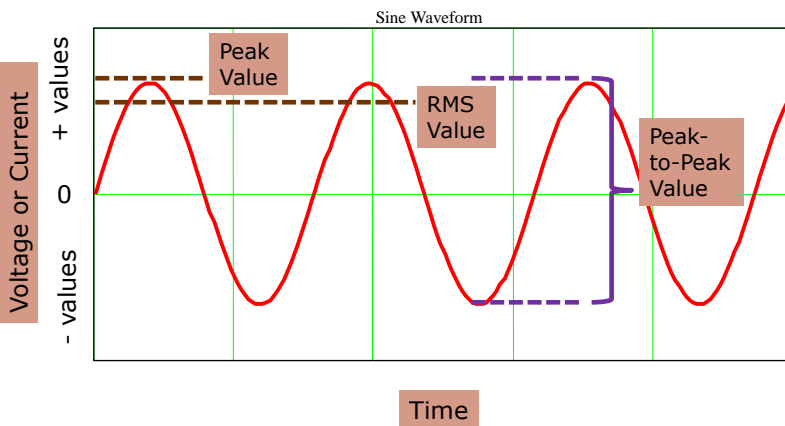
Ac Waveforms

Ac voltages and current change polarity are regular intervals
They take on different values as they change with time



Ac Waveforms

Waveform characteristics- Voltage and Current Measurement



Ac Voltage and Current Measurements

Measurement Abbreviations, Definitions and Relationships

Peak Measurement: V_p or I_p

Peak-to-peak Measurement: V_{pp} or I_{pp}

RMS (root mean square) Measurement: V_{rms} or I_{rms}

$$V_{pp} = 2V_p \text{ for sine wave}$$

$$I_{pp} = 2I_p \text{ for sine wave}$$

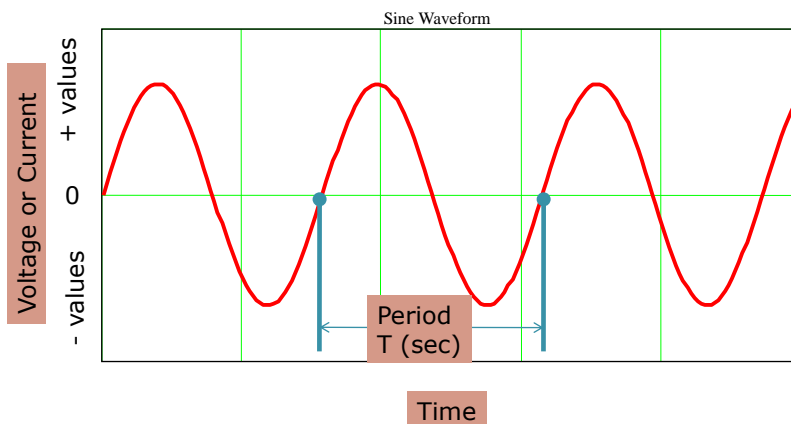
$$V_{rms} = 0.707V_p$$

$$I_{rms} = 0.707I_p$$

RMS values of V and I given equivalent power to dc values of V and I



Ac Measurements – Period and Frequency



Waveform repeats over one period



Period and Frequency

Period, T , is measured in units of time

Seconds (s)

Milliseconds (ms) 1×10^{-3} s

Microseconds (μ s) 1×10^{-6} s

Frequency, f , relate to period by

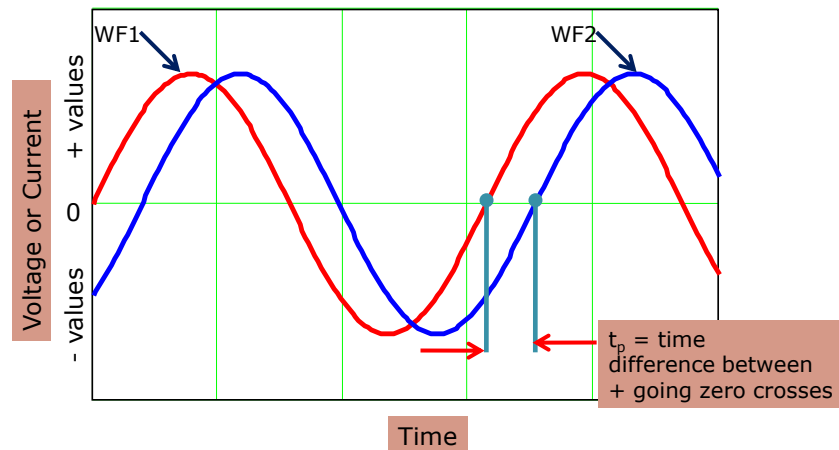
$$f \text{ (Hz)} = \frac{1}{T}$$

Where Hz is the unit Hertz (cycles/second)



Waveform Characteristics –Phase Shift

Phase shift – time difference between two waveforms measured in degrees.



Phase Shift Measurements

Time difference, t_p , related to phase shift in degrees by this formula

$$\phi \text{ (degrees)} = \left(\frac{t_p}{T} \right) (360)$$

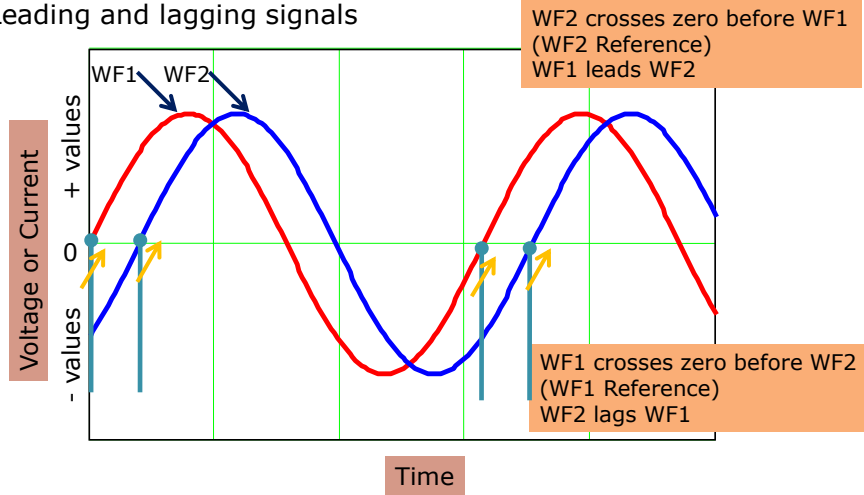
Where ϕ = phase shift in degrees
 T = waveform period
 t_p = time between + going zero crosses

There must be a reference waveform when measuring Phase shift.



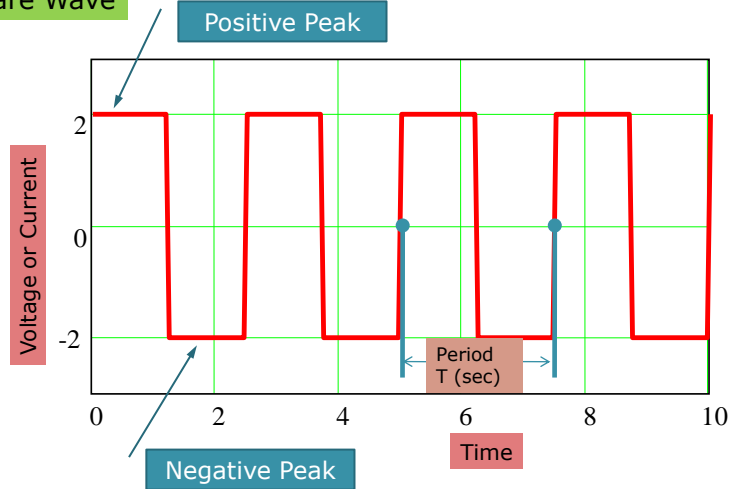
Waveform Measurements-Phase Shift

Leading and lagging signals



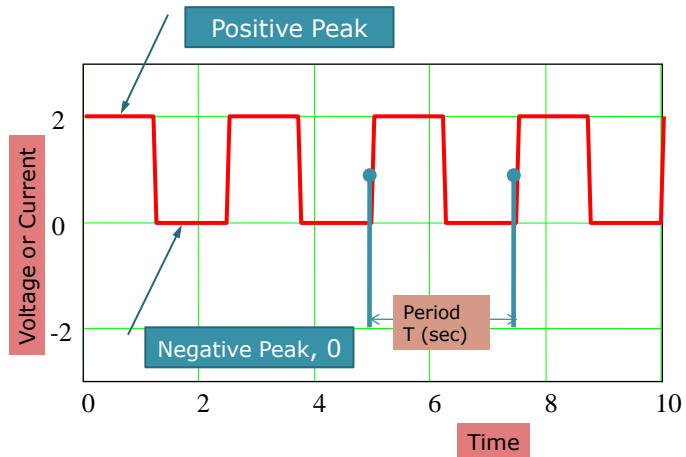
Other Waveforms

Square Wave



Other Waveforms

Pulse (50/50) 50% on 50% off



Ac Waveforms and Their Measurement

End Lesson 10 EET 150

Coming Next: Measuring Waveform Values Using An Oscilloscope

