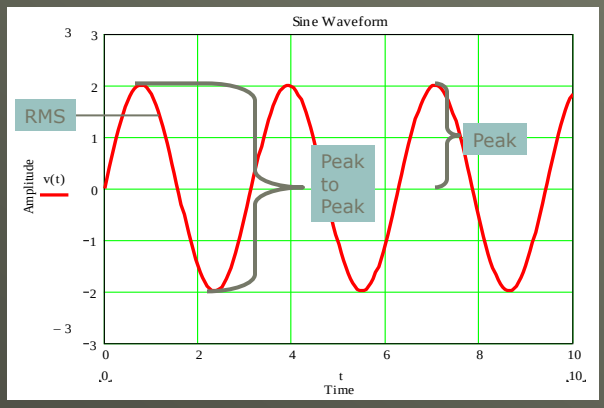
Functional Waveforms for Electronics

Lesson 16
EET 150

Learning Objectives

- In this lesson you will:
- see typical waveforms used in electronic circuits
- learn how to identify these waveforms by their shape
- identify the amplitudes of these waves
- learn where these waves are used
- see what instruments can produce and measure waveforms

Common Waveforms-Sine Wave



Characteristics

Amplitude Measures

Peak-to-peak value

Peak value

Measured with zero reference

Root Mean Square (RMS) Value

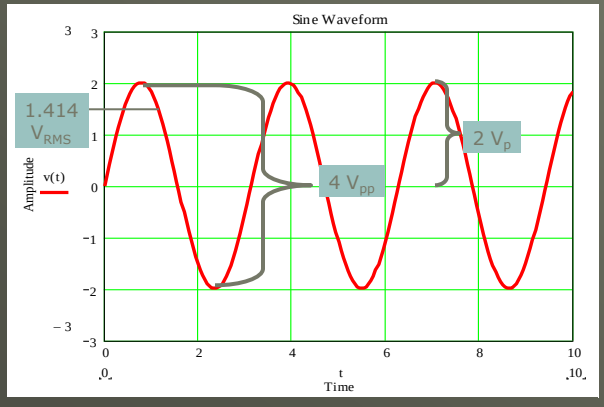
0.707 of Peak Value

RMS factor of 0.707 only valid for Sine waves

Sine waves used to test amplifiers

Common Waveforms-Sine Wave

Example



What is peak-to-peak value of the waveform shown?

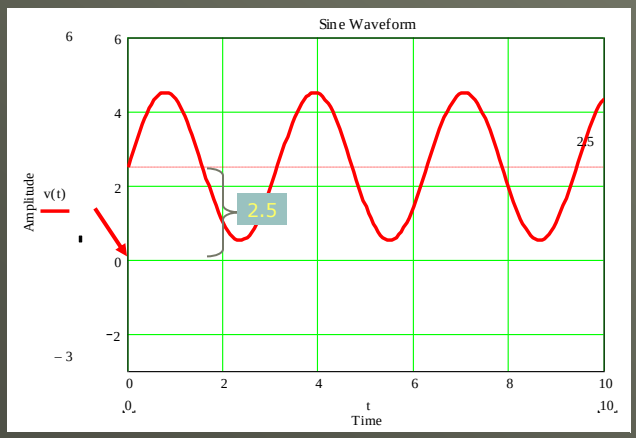
What is peak value of the waveform shown?

What is RMS value of the waveform shown?

V_{RMS} =0.707(2)
V_{RMS} = 1.414 V

Common Waveforms-Sine Wave

Sine wave with DC offset

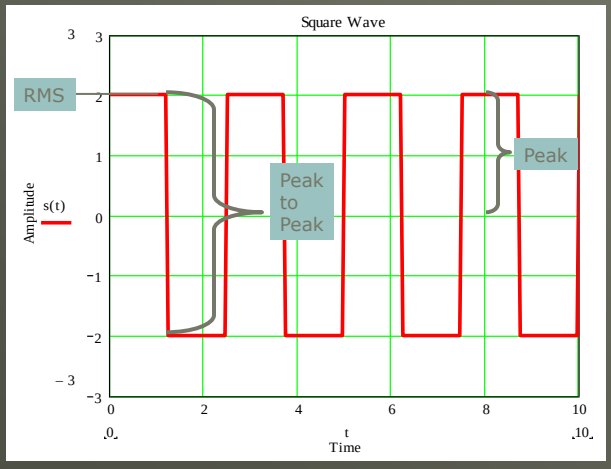


DC offset raises entire wave above zero

Waveform Symmetric about +2.5

DC offsets can be either positive or negative

Common Waveforms-Square Wave



Voltage Measures

Peak-to-peak value

Peak value

Measured with zero reference

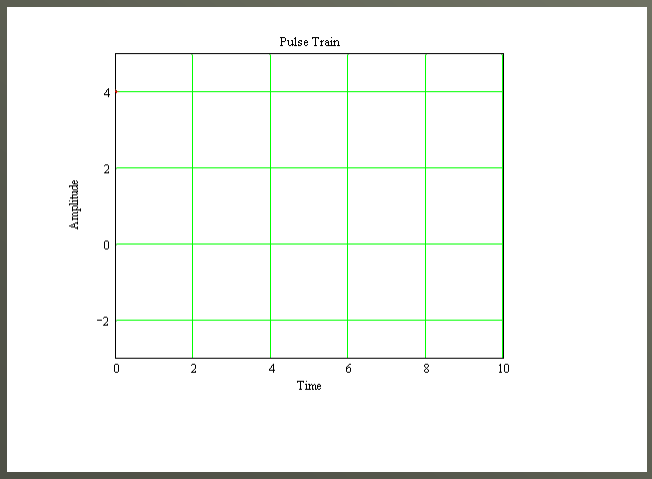
Root Mean Square (RMS) Value

Equals peak value

Square wave can Be off set with DC

Common Waveforms-Pulse Train

Pulse Train has only positive values

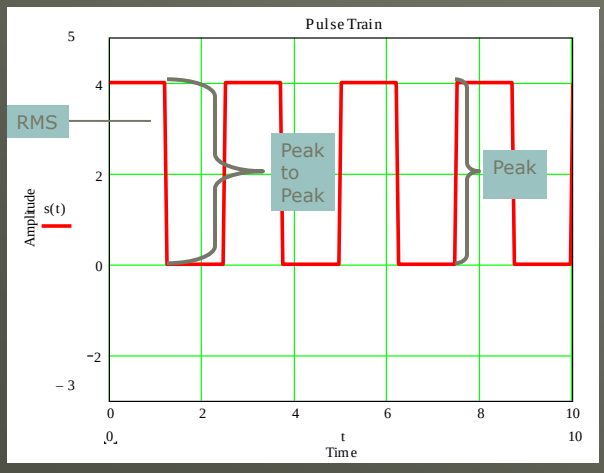


Signal used in computer circuits.

For this signal, half period is on- half period off

Adding DC off set to square wave produces pulse

Common Waveforms-Pulse Train



Voltage Measures

Peak-to-peak value

Peak value

Peak value = peak-to-peak value

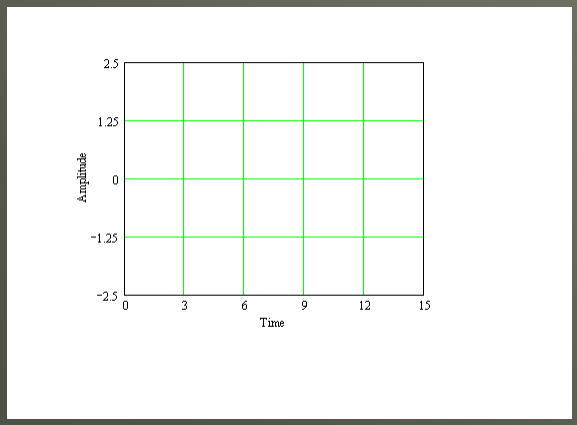
Root Mean Square (RMS) Value

$$RMS = \frac{A}{\sqrt{2}}$$

A = peak amplitude value

Common Waveforms-Ramp Waves

Ramp waves increase linearly, reset, then repeat

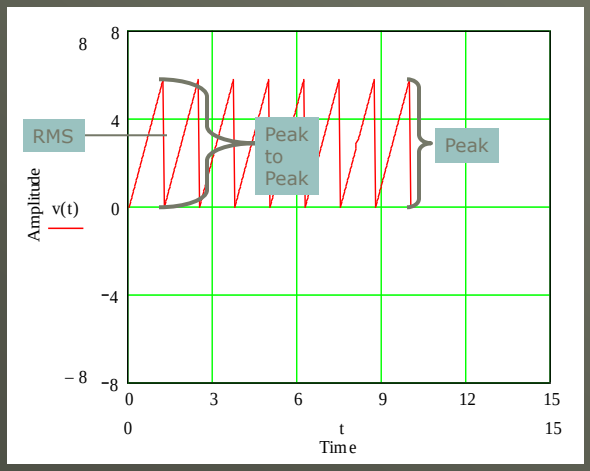


Ramp waves used to move trace in scopes

Used to control and sweep frequency linearly

Dc off set can move waveform up or down

Common Waveforms-Ramp Waves



Voltage Measures

Peak-to-peak value

Peak value

Peak value = peak-to-peak value

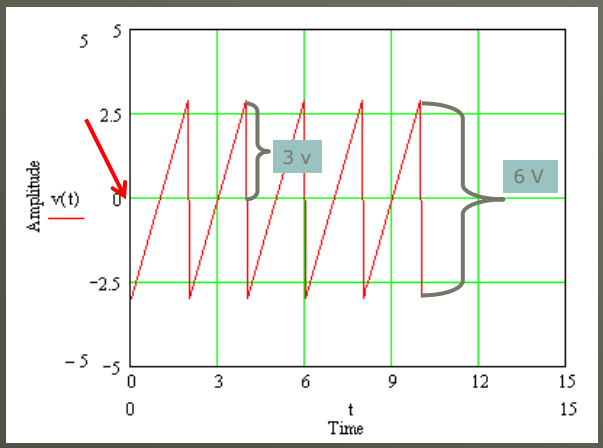
Root Mean Square (RMS) Value

$$RMS = \frac{A}{\sqrt{3}}$$

A = peak amplitude value

Common Waveforms-Ramp Waves

Ramp wave with negative dc off set

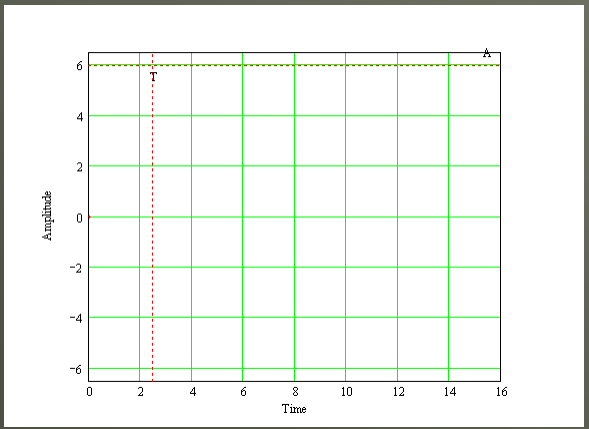


Negative Dc off set lowers half of wave below zero

RMS value of off set wave not equal to wave without offset

Common Waveforms-Triangle Waves

Triangle waves increase linearly then decrease linearly at a given frequency



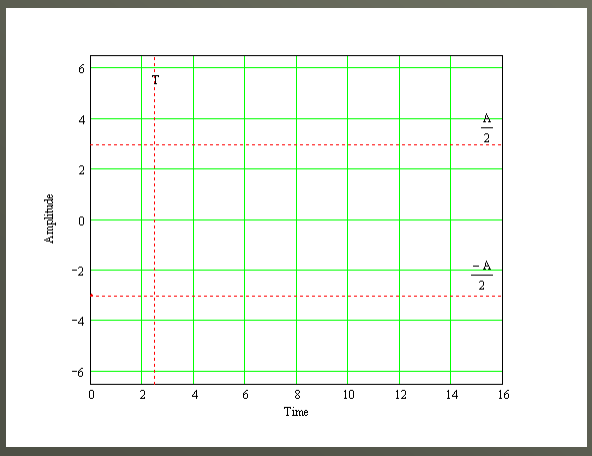
Waveform used in pulse-width modulators

Note: this waveform is all positive

It can be lowered or raised using DC off set

Common Waveforms-Triangle Waves

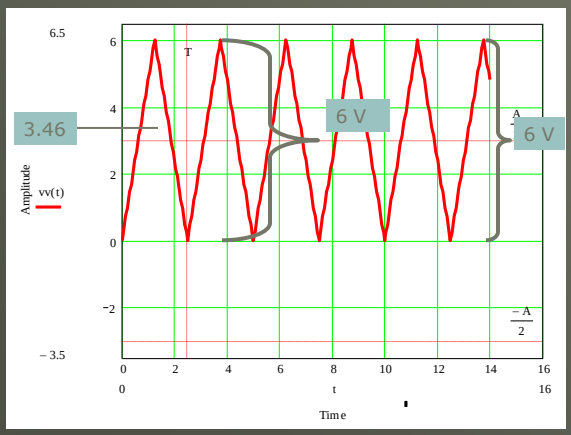
Off set triangle wave



This wave has equal positive and negative values

Off set equals Amplitude/2

Common Waveforms-Triangle Waves



Voltage Measures

Peak-to-peak value

Peak value

Peak value = peak-to-peak value

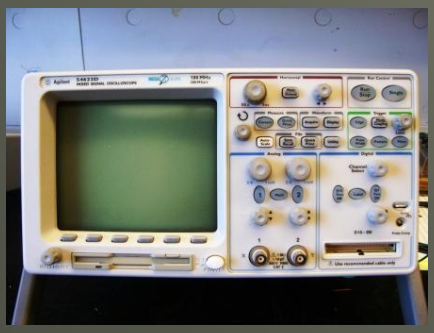
Root Mean Square (RMS) Value

$$RMS = \frac{A}{\sqrt{3}}$$

A = peak amplitude value

Measuring Waveform Amplitudes

An oscilloscope can measure all waveform amplitudes and frequency



Use an oscilloscope to verify waveform generator outputs

A DVM can measure and display RMS values

DVM frequency limits
Use "True RMS" for non-sinusoids

Producing Electronic Waveforms

An instrument called a **function generator** produces all the waveforms covered in this presentation

End Lesson 16 EET 150

Coming Next:

MORE WAVEFORM CHARACTERISTICS