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Linear Circuits



An introduction to linear electric circuit elements and a study of circuits containing such devices.



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Power Factor and Power Triangles Part 2

Gain an understanding of the way that sinusoidal power is analyzed.



Previous Lesson

- ⦿ Calculated complex power
- ⦿ Identified what complex power represents

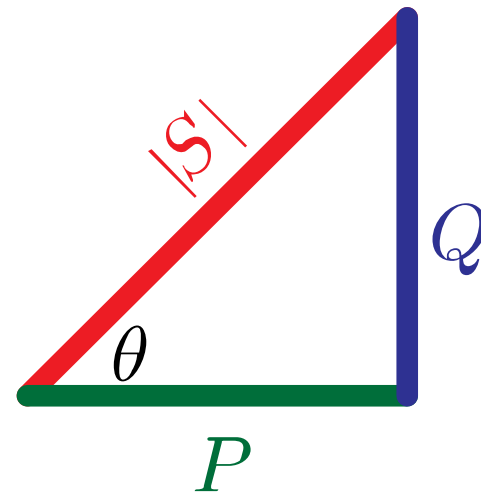
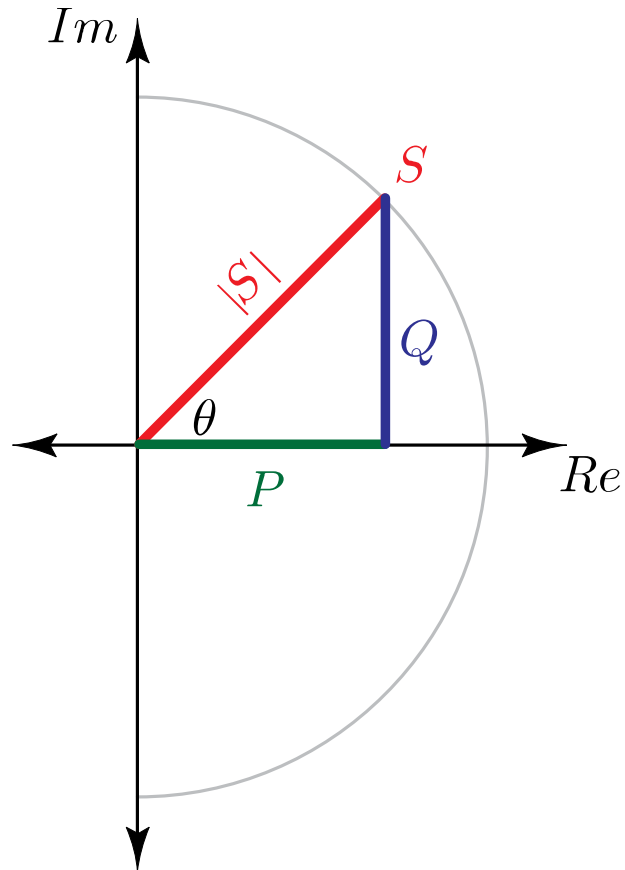
Module 5: Power

- ◎ Root-Mean Square
- ◎ Power Factor and Power Triangles
- ◎ Maximum Power Transfer
- ◎ Transformers

Lesson Objectives

- ◎ Use power triangles
- ◎ Calculate
 - Power angle and power factor
 - Real and reactive power
 - Apparent power

Review of Complex Power

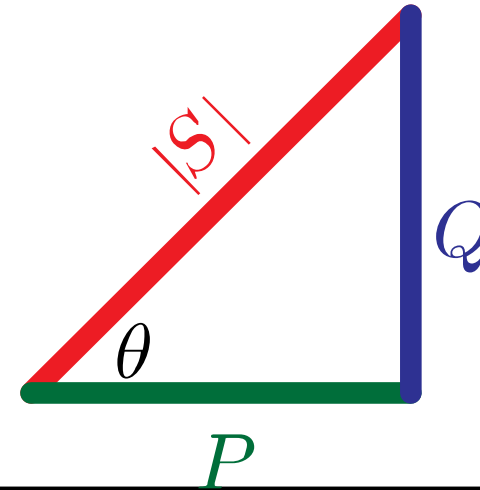


Power Factor

$$S = \frac{V_m I_m}{2} \angle \theta_v - \theta_i$$

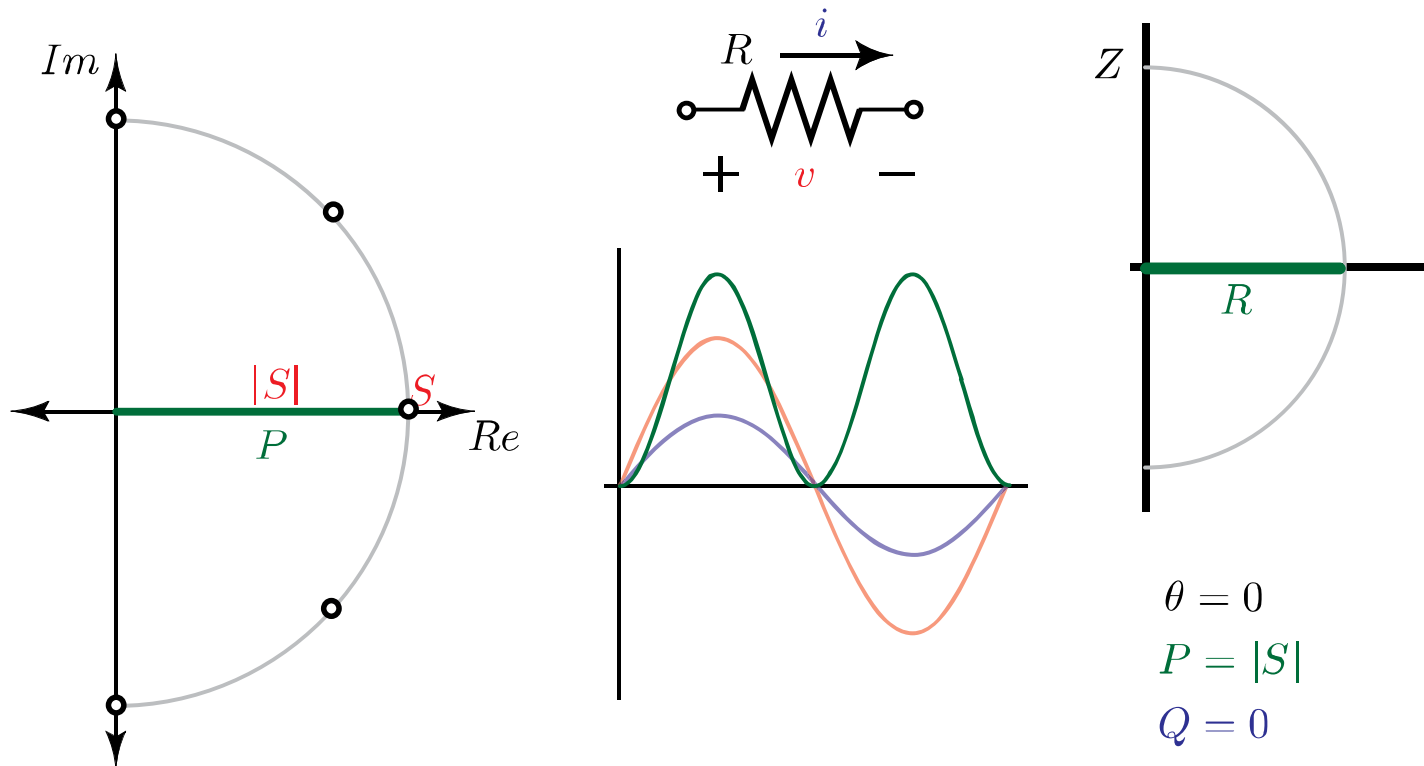
$$v = V_m \cos(\omega t + \theta_v)$$

$$i = I_m \cos(\omega t + \theta_i)$$

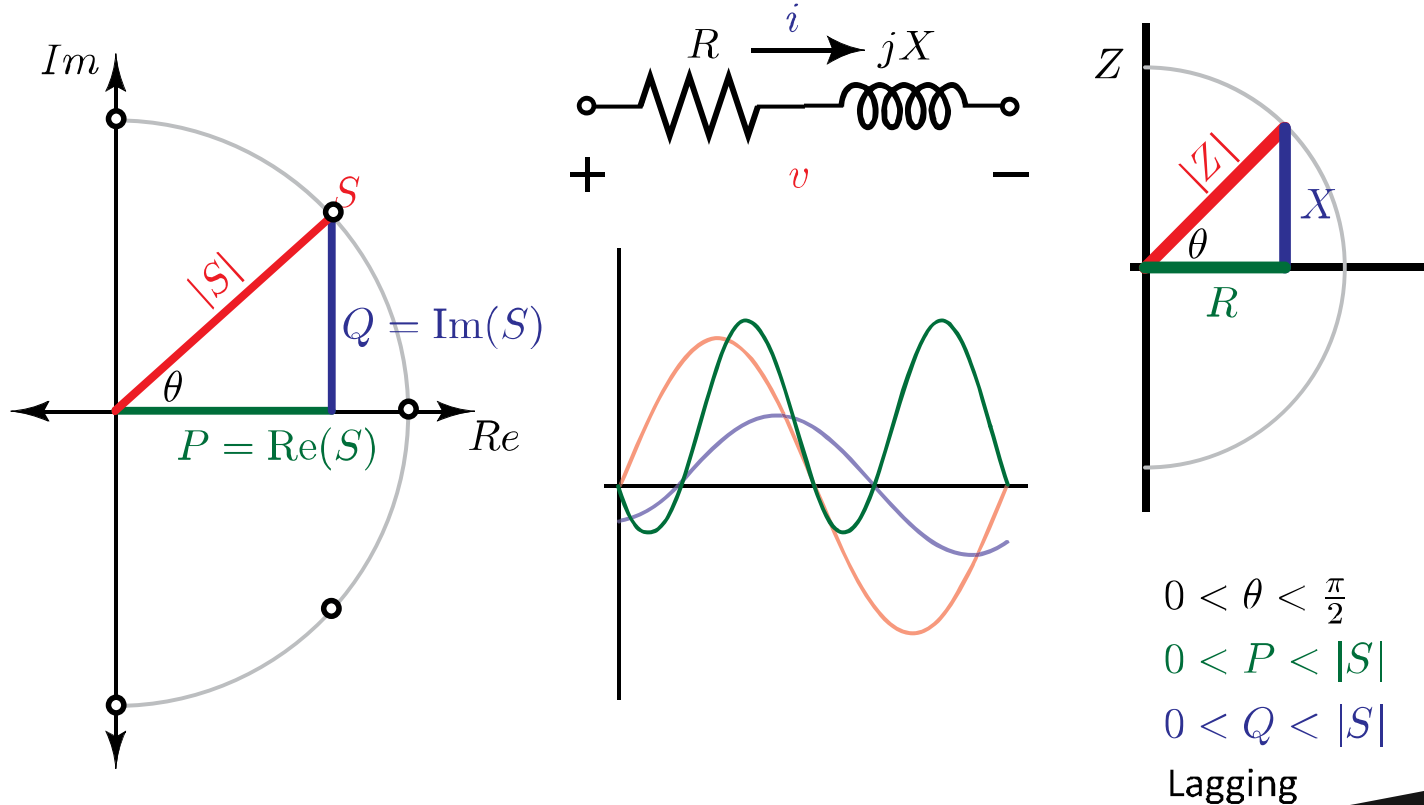


Power Angle	$\theta = \theta_v - \theta_i$	
Power Factor	$\cos(\theta)$	
Average (Real) Power	$P = V_{\text{rms}} I_{\text{rms}} \cos(\theta)$	Watts (W)
Reactive Power	$Q = V_{\text{rms}} I_{\text{rms}} \sin(\theta)$	Volt-Amperes Reactive (VAR)
Apparent Power	$ S = V_{\text{rms}} I_{\text{rms}}$	Volt-Amperes (VA)

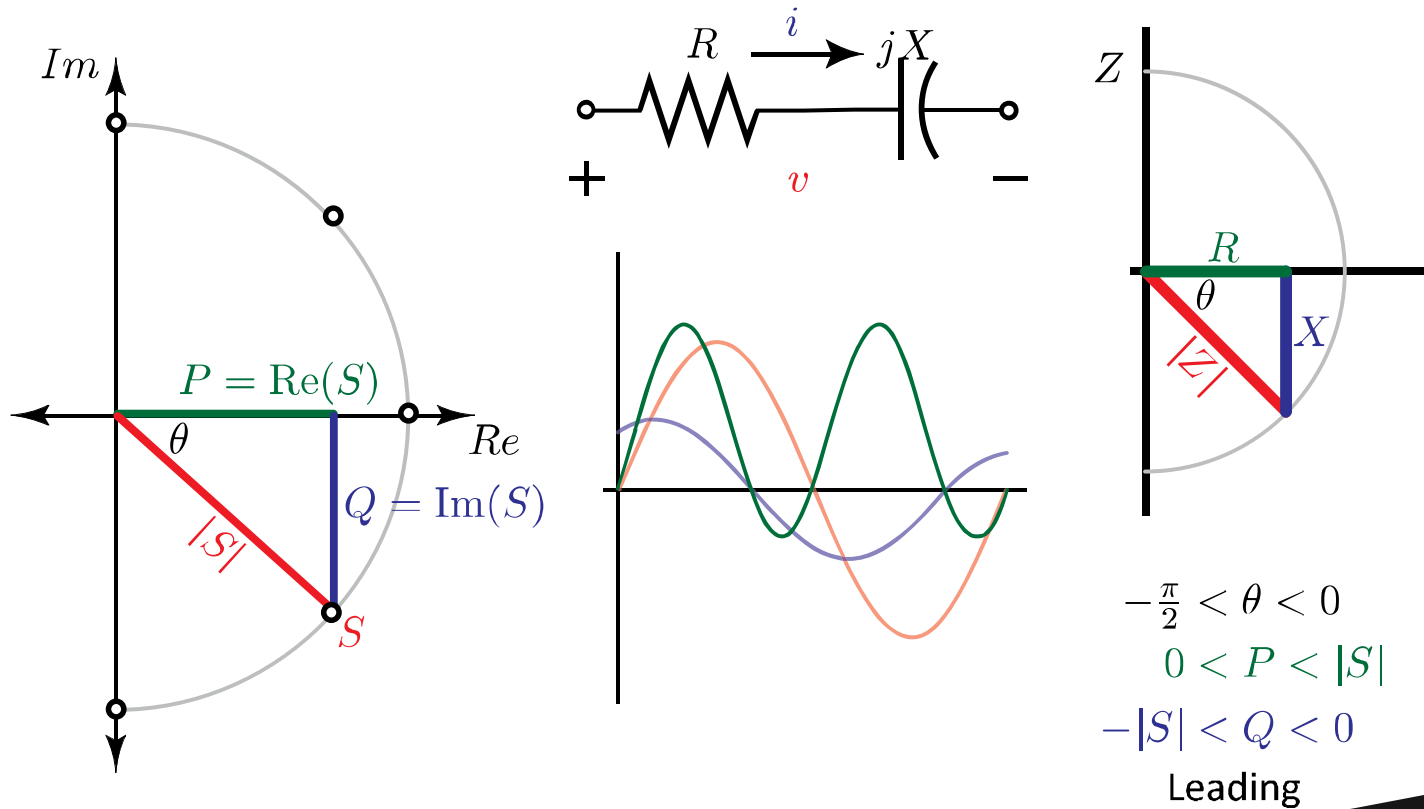
Complex Power for Impedances



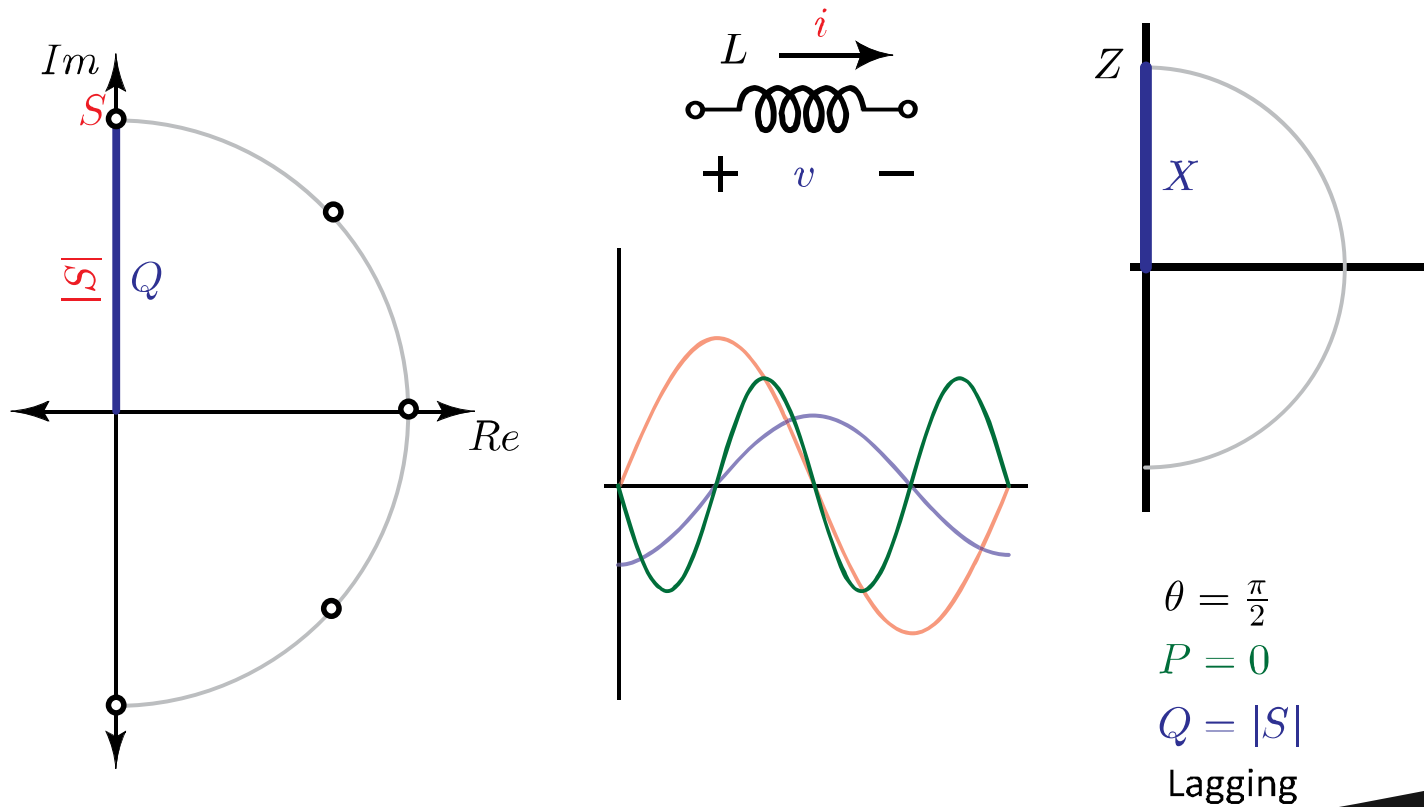
Complex Power for Impedances



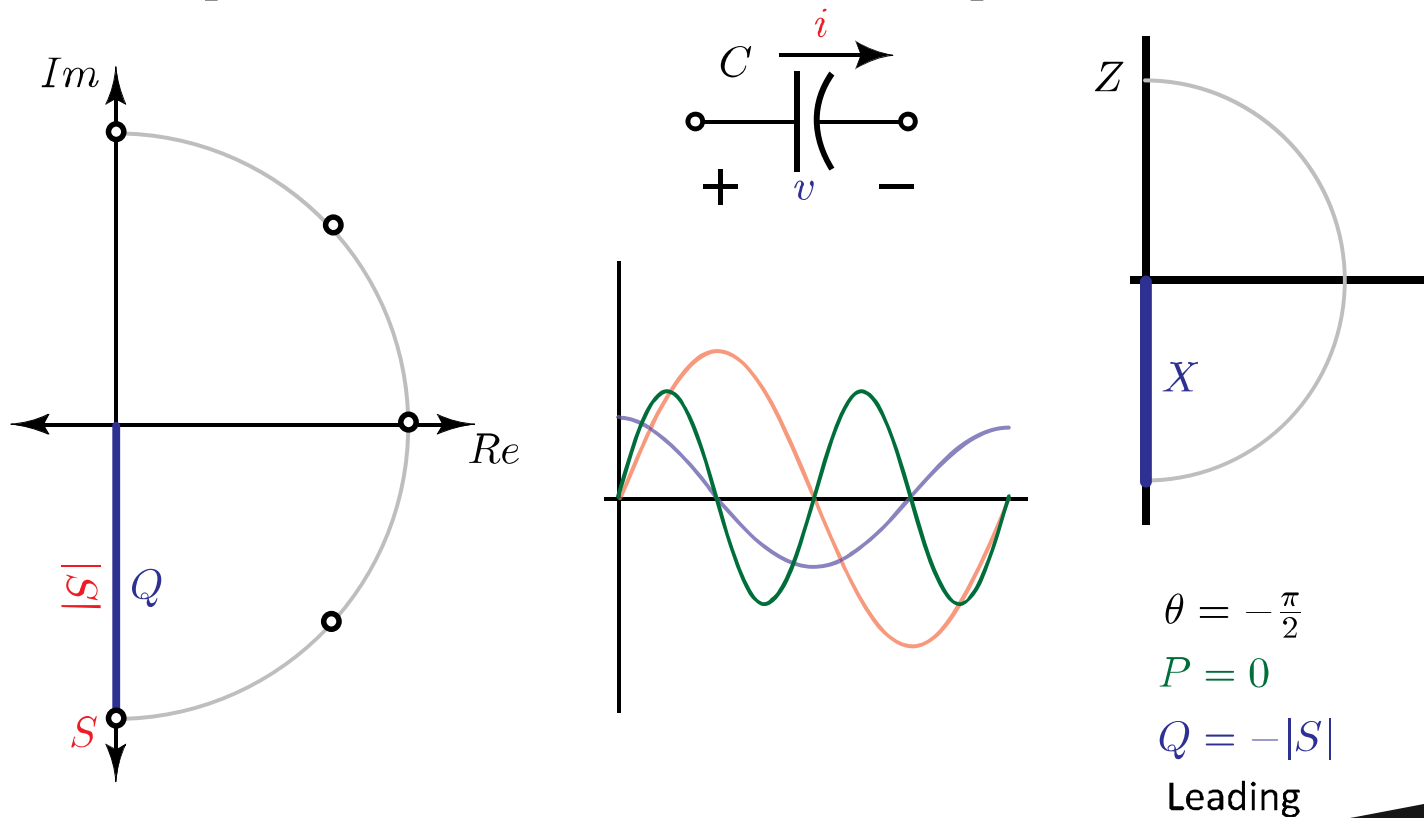
Complex Power for Impedances



Complex Power for Impedances



Complex Power for Impedances



Implications

- ◎ Only real power is being transformed to heat/light/etc.
- ◎ Reactive power causes increased current, so more power is consumed by resistive transmission lines
- ◎ Private customers generally only charged for real power, industrial customers charged for both

Summary

- ◎ Defined
 - Power angle and power factor
 - Real and reactive power
 - Apparent power
- ◎ Illustrated using power triangles

Next Lesson

- ◎ See how to control reactive power
- ◎ Maximum power transfer for AC circuits