

The Amount of Reactive Power in the sinusoidal system

A. The instantaneous of reactive power.

The instantaneous power is given by the product of the instantaneous voltage and current, for an RL circuit that is:

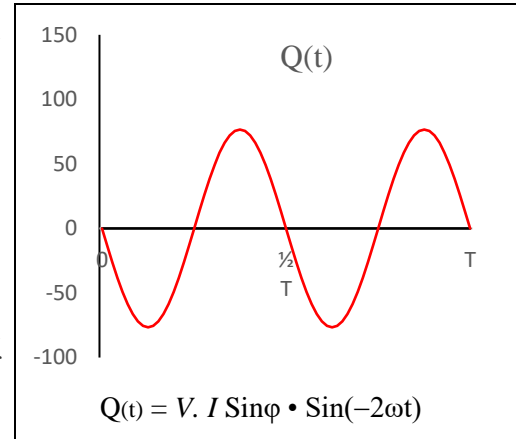
$$V(t) \cdot I(t) = 2 VI \sin(\omega t) \cdot \sin(\omega t - \varphi)$$

$$V(t) \cdot I(t) = VI \cos \varphi - VI \cos (2\omega t - \varphi)$$

$$V(t) \cdot I(t) = \underbrace{VI \cos \varphi \{1 - \cos 2\omega t\}}_{\text{PART I}} + \underbrace{VI \sin \varphi \sin(-2\omega t)}_{\text{PART II}}$$

$$V(t) \cdot I(t) = \text{PART I} + \text{PART II}$$

PART II shows a bidirectional flow of power with an average value of nil. It's a function of time and has the meaning of reactive power [Q(t)].



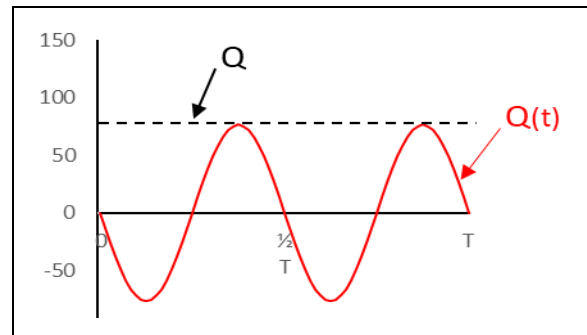
B. The amount of reactive power. The IEEE 1459 Std declares:

Reactive power. The magnitude of the reactive power Q equals the **amplitude** of the oscillating instantaneous reactive power $Q = VI \sin \varphi$

As the physics principle, power means the **average value** of energy that is transferred or oscillated during a cycle period.

The active power defined as the **average value** which is correct, but the reactive power as the **peak value** of the power function, therefore;

$Q = VI \sin \varphi$ is an incorrect assumption.



C. The new amount of oscillating power.

The average value of reactive power [$Q = 0$], **but** an amount of power is oscillating between the source and load.

We calculate this **Oscillating Power** with notation of [Q^+] according to the physics principle, which would represent in another file, and the amount is calculated:

$$Q^+ = \frac{1}{\pi} (VI \sin \varphi)$$

