ARTICLE

Power Factor and Cos φ

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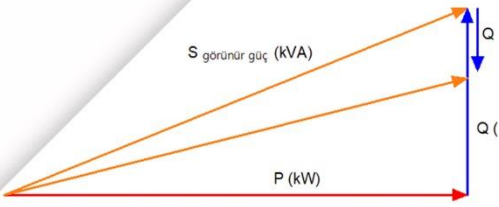
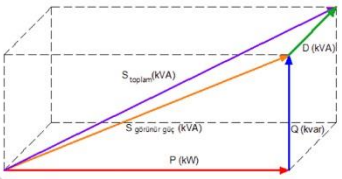
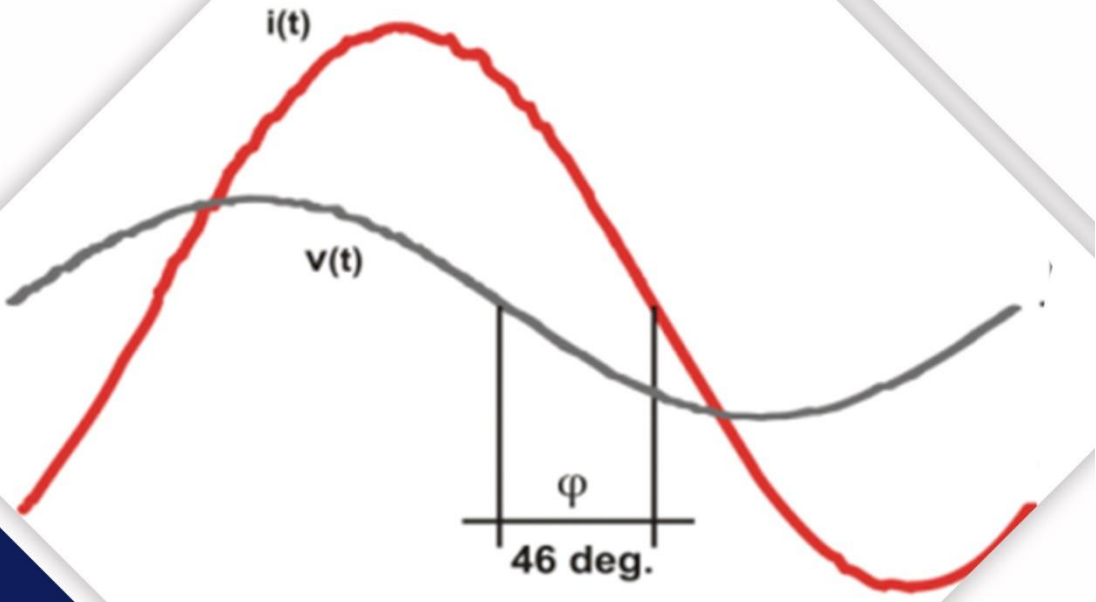






ERGUN ELEKTRİK

POWER FACTOR AND COS Φ

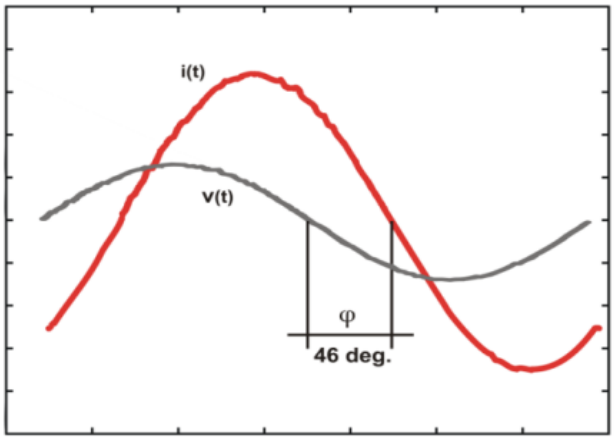
In Turkey, the permissible ratio of "Reactive Inductive Energy / Active Energy" is 20%, while the permissible ratio of "Reactive Capacitive Energy / Active Energy" is 15%.

This means that the power factor (cos φ) is required to be in the range of 0.98 to 1 in the inductive region, and in the range of 0.99 to 1 in the capacitive region.

To meet these requirements, power measurement is performed to determine the power requirements of the facility. Power measurement devices measure both power factor and cos φ.

In measurements made in various facilities, it is seen that in some measurements the two values are equal, while in other measurements the two values are different.

Power factor is the ratio of active power to apparent power. Cos φ is the phase shift between current and voltage waves, so the effect of harmonics is not taken into account.



For Cos **φ** = 0,7
Current-Voltage Waveform

Apparent
Power

Power
Triangle

Active power and reactive power are orthogonal to each other. Apparent power forms an angle of **φ** with active power.

Inductive reactive current lags the voltage by 90°.
Capacitive reactive current leads the voltage by 90°.

P= Active Power (Watt)

Q = Reactive Power (VAR)

S = Apparent Power (VA)

$$S = \sqrt{(P)^2 + (Q)^2}$$

$$VA = \sqrt{(W)^2 + (VAR)^2}$$

Cos **φ** = 1 It is a valid condition for resistive powers such as resistors.

Active power is equal to the apparent power value. The value is positive.

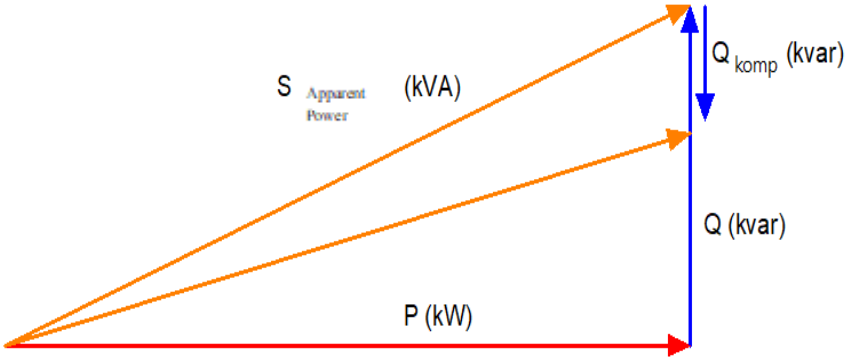
Cos **φ** = 0,7 This is a valid condition for inductive powers such as asynchronous motors.

If the measured facility is inductive in reactive character, a reactive capacitive load is installed, such as a capacitive compensation panel.

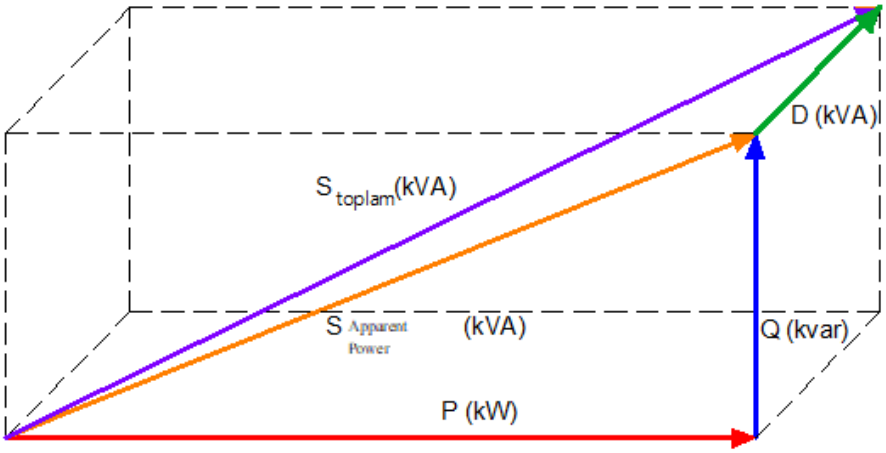
If the measured facility is capacitive in reactive character, a reactive inductive load is installed, such as an inductive compensation panel

$$Q = \sqrt{(S)^2 - (P)^2}$$

$$VAR = \sqrt{(VA)^2 - (W)^2}$$



$$\cos\varphi = \frac{P}{\sqrt{(P)^2 + (Q)^2}} = \frac{P}{S}$$

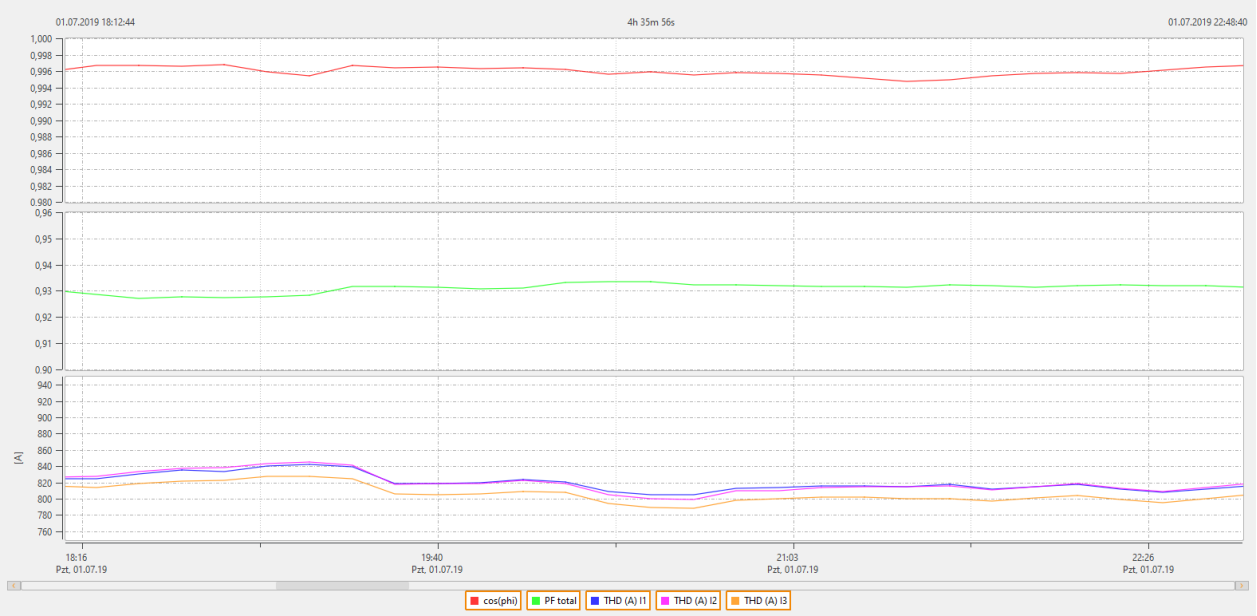


$$\mathrm{PF} = \frac{P}{\sqrt{(P)^2 + (Q)^2 + (D)^2}} = \frac{P}{S_{TOPLAM}}$$

If harmonic distortion is not measured in a facility and the measured waveforms are pure 50Hz sinusoidal waveforms, the power factor and cos **φ** values are measured to be equal.

Cos **φ** = **PF**

For example, in a facility where 830A harmonic currents are flowing, PF = 0.996 was measured in the band of cos **φ** =0.93, therefore **φ** ≠ PF in facilities where harmonic currents flow.



In facilities where harmonic currents do not flow, the power factor and cos **φ** are equal values.

In facilities where the total harmonic distortion ratio is measured to be high, the values of power factor and cos **φ** are moving away from each other.

Therefore, if the reactive power required for a facility is determined by measurement with a power measurement device, the power of the capacitor bank should be designed based on the cos **φ** value.

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