Active Power: (P)

- Alternative words used for Real Power (Actual Power, True Power, Watt-full Power, Useful Power, Real Power, and Active Power)

- In a DC Circuit, power supply to the DC load is simply the product of Voltage across the load and Current flowing through it i.e., P = V I. because in DC Circuits, there is no concept of phase angle between current and voltage. In other words, there is no Power factor in DC Circuits.

- But the situation is Sinusoidal or AC Circuits is more complex because of phase difference between Current and Voltage. Therefore average value of power (Real Power) is P = VI Cosθ is in fact supplied to the load.

- In AC circuits, When circuit is pure resistive, then the same formula used for power as used in DC as P = V I.

Real Power formulas:

- P = V I   (In DC circuits)
- P = VI Cosθ   (in Single phase AC Circuits)
- P = √3 V_L I_L Cosθ   or   (in Three Phase AC Circuits)
- P = 3 V_{Ph} I_{Ph} Cosθ
- P = √ $(S^2 - Q^2)^{or}$
- P =√ $(VA^2 - VAR^2)$ or
- Real or True power = √ (Apparent Power^2– Reactive Power^2) or
- kW = √ $(kVA^2 - kVAR^2)$

Reactive Power: (Q)

- Also known as (Use-less Power, Watt less Power)
- The powers that continuously bounce back and forth between source and load is known as reactive Power (Q)
- Power merely absorbed and returned in load due to its reactive properties is referred to as reactive power
- The unit of Active or Real power is Watt where 1W = 1V x 1 A.
- Reactive power represent that the energy is first stored and then released in the form of magnetic field or electrostatic field in case of inductor and capacitor respectively.
- Reactive power is given by Q = V I Sinθ which can be positive (+ve) for inductive, negative (-Ve) for capacitive load.
- The unit of reactive power is Volt-Ampere reactive. I.e. VAR where 1 VAR = 1V x 1A.
- In more simple words, in Inductor or Capacitor, how much magnetic or electric field made by 1A x 1V is called the unit of reactive power.

Reactive power formulas:

- $Q = V\,I\,Sin\theta$
- Reactive Power $=\sqrt{}$ (Apparent Power^2– True power^2)

VAR $=\sqrt{}$ (VA^2 – P^2)

kVAR $= \sqrt{}$ (kVA^2 – kW^2)

Apparent Power: (S)

- The combination of reactive power and true power is called apparent power
- The product of voltage and current if and only if the phase angle differences between current and voltage are ignored.
- Total power in an AC circuit, both dissipated and absorbed/returned is referred to as apparent power
- In an AC circuit, the product of the r.m.s voltage and the r.m.s current is called apparent power.
- **Apparent power formulas:**
- S = V I
- Apparent Power = $\sqrt{(\text{True power}^2 + \text{Reactive Power}^2)}$

Power Triangle

Power Triangle

Apparent Power (S) measured in VA
kVA

Reactive Power (Q) measured in VAR
kVAR

Real or True Power (P) measured in Watts
kW

Phase Angle

$$P = VI \cos\theta \text{ OR}$$

$$\cos\theta = \frac{P}{VI}$$

$$\cos\theta = \frac{kW}{kVA}$$

$$\cos\theta = \frac{True\ Power}{Apparent\ Power}$$

$$\cos\theta \frac{kW}{kVA} = Power\ Factor$$

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