

➤ **What is Power Factor?**

Power Factor (PF) is an indicator of efficient utilization of power. In an AC (Alternating Current) electrical power system, PF is defined as the ratio of [real power](#) flowing to the load, to the [apparent power](#) in the circuit and is a dimensionless number. In order to have an “efficient” system, we want PF to be **as close to 1.0(i.e. 100%)** as possible.

➤ **What causes Low Power Factor?**

Inductive loads, which are sources of [Reactive Power](#), are mainly responsible for low PF. These constitute a major portion of power consumed in industrial complexes and include:

- **Transformers**
- **Induction Motors**
- **High Intensity Discharge Lighting etc.**

➤ **Why Improve Low Power Factor?**

Some of the benefits of improving PF include:

- **Lesser Electricity bill** by
 - a) Reducing peak billing demand: By improving PF, peak billing demand lowers which results in savings in Electricity bill if the Contract Demand is decided judiciously.
 - b) Eliminating the surcharge and enjoying rebate of PF: As per prevailing Tariff Order / Regulations stipulated by West Bengal Electricity Regulatory Commission (WBERC), PF Rebate and Surcharge are applicable for the power factor above 92% and below 86% respectively. Thus, by improving power factor, one can avoid additional payment and rather enjoy rebate in respect of PF.
- **Increased capacity and reduced losses** in electrical system: Low power factor causes losses in distribution system. By improving PF, losses can be reduced which in turn can enhance the capacity to bear additional load in your system.

Moreover, low PF not only causes **unnecessary increase in generation and transmission capacity** of the utility, in a broader perspective, it actually **increases amount of greenhouse gases** that get released into the atmosphere.

➤ **How to improve Power Factor?**

- Installing capacitors(kVAR Generators)
 - a) **Install capacitors close to the motors / load**
 - b) **Switch on or off the capacitor in tandem with motor / load** – This will maximise reactive compensation and provide relief to your internal electrical network.
To avoid manual operation, you may install Automatic Power Factor Controller (APFC).
- **Minimizing operation of idling or lightly loaded motors**
- Replace old inefficient motors with **energy-efficient** ones, if possible.
- In order to have notional view/preliminary guidance on Ratings of such capacitors, you may take help of our '**Capacitor Bank Calculator**' provided in our **website**.

➤ **Why the Power Factor shown in the monthly Electricity Consumption Bill differs from that shown on the display unit of the Energy Meter?**

The PF at any point of time shown on the display unit of the energy meter, installed to record consumption and related billing parameters of a consumer having High Voltage Bulk Supply, is the **instant PF** recorded corresponding to consumption drawn on that particular time.

Whereas the PF shown in the bill is the **Average PF for the whole month**; which is computed using the following formula:

Average PF for the month = Cosine of {inverse tangent of (Total monthly consumption of 'reactive power' i.e. '24 HRS SINE', mentioned in our bill/Chargeable units)}.

To understand **Power Factor**, we shall define the following **basic terms**:

kW is Working Power(P) (also called **Active Power** or **Real Power**).

It is the power that actually performs useful work.

kVAR is Reactive Power(Q).

It is the power that magnetic equipment (transformer, motor and relay) needs to produce the magnetizing flux.

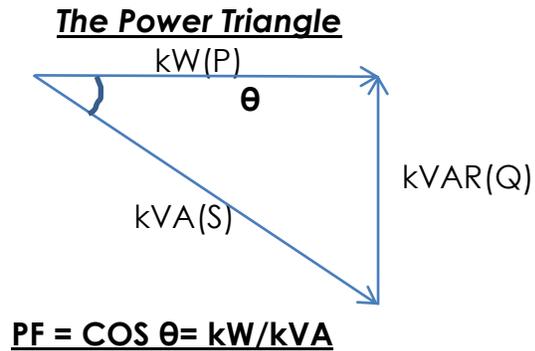
kVA is Apparent Power(S).

It is the "vectorial summation" of KVAR and KW.

Power Factor is the ratio of Working Power to Apparent Power.

$$\text{Power Factor} = \text{kW/kVA}$$

The “**Power Triangle**” (Figure below) illustrates this relationship between kW, kVA, kVAR, and Power Factor.



In an ideal situation,

- The **angle θ** (formed between kW and kVA) would approach **zero**.
- **Cosine θ** would then approach **one**.
- **Power Factor** would approach **Unity**.
- **kVAR** would be very small (approaching zero).
- **kW** and **kVA** would be almost equal.

Principle of Power Factor Compensation: The following figure illustrates the principal of compensation by reducing a large reactive power Q to a smaller value Q_1 by means of Power factor corrective instrument having a reactive power Q_c . In doing so, the apparent power S is seen reduced to S_1 .

