



Power Factor Correction - The Benefits

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Definition

The Power Factor of a load is defined as the ratio of active power to total demand, that is to say kW divided by kVA. In layman's terms, Power Factor is the percentage of the burden on the supply which is actually doing real, useful work.

Power Factor Correction (PFC) is the application of properly designed, manufactured and installed equipment which will compensate for the 'useless' yet essential part of the demand on the supply, leaving only 'useful' power to be drawn from the mains.

The nearer Power Factor is to unity, the less reactive power is drawn from the supply, the lower the demand, and the greater the overall efficiency.

Technical Benefits

By improving and maintaining the Power Factor at an optimum level:

- **Power Quality is improved.**
The 'voltage drop' evident on an increasing load is greatly reduced by maintaining an optimum level of Power Factor. The improvement in this aspect of Power Quality has numerous benefits, not least that any load connected to the network will be presented with a clean and consistent supply voltage. Reliability and performance are improved when compared to less well-regulated supplies.
 - **The Demand on the supply is reduced.**
A significant reduction in the demand for any given loading can release additional supply capacity. This can then be used to connect additional loads to the existing distribution network. Otherwise, supply reinforcement is the only option, often costing many tens of thousands of pounds.
 - **Network Reliability is increased.**
The reduction in demand as a result of improvement in Power Factor affects all components of the upstream distribution network. The resulting reduction in losses means that transformers, cables and switchgear all operate at lower temperatures. This reduction in stress on the distribution system increases both the reliability and useful life of these components, resulting in a more reliable and longer lasting network.
 - **Harmonic Distortion is reduced.**
When a properly-specified 'Detuned' Power Factor Correction system is installed on a network subject to significant levels of Harmonic Distortion, the levels of distortion are reduced. The amount of reduction varies according to the particular characteristics of each system. This reduction in distortion increases the reliability and lifetime of any item of equipment, and is a significant improvement in Power Quality.
 - **Specification Compliance is Achieved.**
The 18th edition wiring regulation (BS7671) are scheduled to come into force at the end of 2018. They will include a new section (part 8) focused on energy efficiency. This will include Power Factor Correction, Harmonic Reduction and Distribution Equipment losses.
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Commercial Benefits

Financial penalties imposed by the supply companies can be avoided by maintaining a Power Factor better than 0.95 lagging under all load conditions. Power Capacitors Ltd will typically select a target Power Factor of between 0.96 and 0.98 lagging, depending on the specific requirements of each installation.

By maintaining an improved Power Factor:

- **Excess Reactive Power Charges are avoided.**
Half-Hourly metered consumers are charged for 'excess reactive power', which is defined as occurring when the power factor is lower than 0.95 lagging. These charges can vary from tens to thousands of pounds per month, depending on the loading. The installation and proper maintenance of a well-designed PFC system can remove these charges completely.
- **Availability Charges are reduced.**
When the metered demand exceeds the Authorised Supply Capacity, Penalty Charges for excess demand are applied. By improving the Power Factor, the demand is reduced, and these penalty charges are reduced or removed entirely.
- **The Overall Demand on the supply is reduced.**
A chargeable item on all half-hourly metered supplies is 'Authorised Capacity'. By improving the power factor, less supply is required to do the same amount of work. This may permit a reduction in the authorised supply capacity required, with an associated reduction in charges from the supply company.
- **System Losses are reduced.**
Losses in distribution networks increase exponentially with the load. Doubling the load quadruples the losses. By reducing the demand on the supply network, the losses in all network components are reduced. Depending on the installation, this reduction may be between 0.5% and 3% of the total kWh consumption. These additional, hidden savings can amount to many thousands of pounds over the course of a year.

Environmental Benefits

The increasing focus on environmental issues is supported by maintaining an optimum level of Power Factor:

- **Carbon Dioxide emissions are reduced.**
The reduction in demand, losses, and loading which is achieved by properly improving the Power Factor is accompanied by a reduction in Carbon Dioxide emissions. The exact reduction will vary according to each particular installation, but studies have shown that reductions in the region of 150kg of CO₂ per kVA_r of PFC equipment are readily achievable.
- **Building Regulations compliance (Conservation of Fuel and Power).**
Part 'L' of the Building Regulations details reductions in the effective carbon dioxide emissions of a building which can be applied, if a properly designed and implemented Power Factor Correction scheme is installed and monitored. The optimum Power Factor Correction system can attract a reduction of 5% in the total CO₂ emissions for the building.

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