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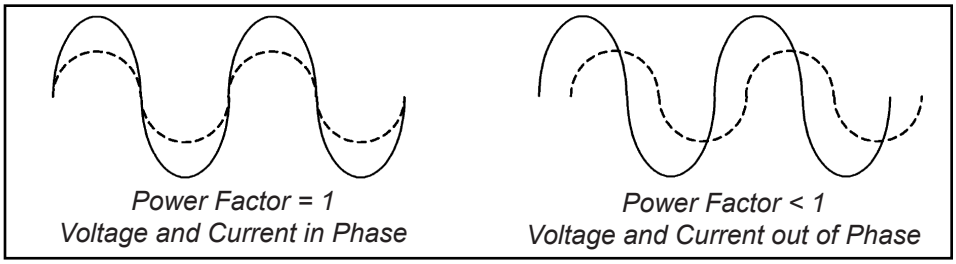
The PULS Advantage

PFC or PFC.... What Do You Really Need?

It is a common marketing practice in North America for manufacturers of switched-mode power supplies to promote their product as offering PFC. This terminology can be misleading, as PFC in the North American Market is generally understood by most users as Power Factor Correction. However, some power supply manufacturers use the term PFC to refer to the supply's ability to limit the amount of harmonic emissions placed on the AC mains according to the European Standard EN61000-3-2, but offer only a minor improvement in the power factor. If one truly needs to improve their power factor a power supply with active power factor correction is required. It is important for a user to understand the differences between PFC as it applies to the EN61000-3-2 standard and true Active Power Factor Correction.

Typical Loads

There are primarily three types of loads; resistive, capacitive, and inductive. A resistive load has a power factor of 1 which means that all the power is dissipated at the load. A capacitive or inductive load forces the voltage and current waveforms out of phase from each other resulting in a power factor less than 1. This causes power to be returned to the source, which can cause excess heating on the AC mains as well as a loss of energy. Because a switched-mode power supply uses current in short pulses the supply is a non-linear load typically resulting in a poor power factor between 0.5 and 0.7.



Power Factor = 1
Voltage and Current in Phase

Power Factor < 1
Voltage and Current out of Phase

PFC According to EN61000-3-2

The European or IEC standard EN61000-3-2 addresses the limitation of harmonic currents put back out on the public mains system and applies to electrical and electronic equipment with an input current up to and including 16A with a nominal input voltage of 230VAC or 415VAC 3-Phase. The standard does not apply to equipment with an input voltage less than 220VAC or professional equipment rated above 1kW. A power supply that incorporates passive PFC to meet the EN61000-3-2 standard typically uses inductors to correct for the AC corruption that a switched-mode power supply creates by design. This method is less expensive and corrects the power factor by 0.1 to 0.15 points but does not use the full potential of the AC power. The passive PFC supplies are used primarily in Europe because of the standard EN61000-3-2. Buying a power supply with passive PFC that will be operated at 120VAC in the US is not necessary and is an added expense because the PFC choke circuit does not apply. Most manufacturers do not even incorporate this circuit into the 120VAC portion of the input stage. Even in Europe, the number of PFC versus non PFC power supply sales is small because many power supplies are used in an industrial environment and therefore have their own distribution transformer. This isolates the connection to the public mains and thus does not require a supply with PFC.

True Power Factor Correction (Active PFC)

Power supplies with active PFC use an added circuit in the design to correct for power factor. This circuit can be complex adding cost to the supply as well as typically utilizing more energy. This in turn can lower the efficiency of the device. Active PFC circuits in switched-mode power supplies can correct power factor to as

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much as 0.99. Active PFC has many advantages in the US as will be explained in this article and it meets the requirements of the European standard EN61000-3-2 mentioned above.

Maximum Current per UL

UL508A 30.2.1 states that the maximum current allowed for a circuit breaker shall not exceed 80 percent of its nominal rating. Power factor plays a significant role in this calculation and can affect the number of power supplies connected to one branch circuit. If we look at a 20A branch circuit the maximum current allowed by UL is 16A. If we were to look at a PULS SL10.100, 240W switched-mode power supply with an input voltage of 120VAC, that has an efficiency rating of 90%, and a power factor of 0.6. The input current calculation is approximately 3.7A base on the formula shown above and up to four power supplies could be connected to the 20A circuit breaker. If we compare the calculation above to the PULS QS10.241 you will see a substantial difference. The QS10.241 has an efficiency rating of 93% and a power factor of 0.99. If we use the formula above with the same 120VAC input voltage you will see that this unit has an input current of approximately 2.2A allowing up to 7 power supplies to be connected to the one 20A circuit breaker.

$$\text{Current}_{in} = \text{Power}_{out} \;/\; (\text{Voltage}_{in} \times \text{Efficiency} \times \text{PF})$$

Input Current Formula

Energy Savings

Most industrial plants are charged for the electrical activity that occurs which includes normal usage, peak energy demands, power factor and corruption that occur on the AC lines. If we compare the two power supplies above from an energy consumption standpoint you will see that using the input voltage and current for the SL10.100 results in 444W of usage or approximately 4.4kW for a 10 hour day. Using an average cost of 13 cents per kilowatt it would cost approximately 57 cents to operate per day or $2.86 per five day work week. The QS10.241 usage would be 264W or 2.6kW for the same 10 hour day. Using the same kilowatt cost the QS10.241 would only cost 34 cents per 10 hour day or $1.72 per five day work week. Multiply this by the number of power supplies in a factory and the savings can be quite significant for a user over the life of the control system.

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PULS offers a wide range of power supplies so that you can apply the appropriate unit to deliver the performance you are looking for without paying for capabilities that may not be required. There is no need to specify a unit that complies to the EN61000-3-2 standard if the power supply is being applied in North America. If you need to meet the European standard, PULS offers units with PFC according to EN61000-3-2, and if you need to improve the power factor in your facility, PULS Dimension Q series power supplies offer active power factor correction without sacrificing size or efficiency. How do competitive products compare with PULS? The table below tells the story.

MFG/Series	Units Available with PFC According to EN61000-3-2	Units Available with True Active Power Factor Correction
PULS - Dimension	Yes	Yes
PULS - ML & SL	Yes	No
Phoenix - Quint	Yes	Yes
Sola - SDN & SDP	Yes	No
Siemens - Sitop	Yes	No

PFC Comparison Chart