

# Total Power Factor Correction An AccuSine® Solution

## Summary

In AC electrical systems, poor power factor increases the current loading on all wiring and components, thus leading to higher capital and operating costs, shortened equipment lifetime and higher utility bills. Owners of high power electrical systems, their engineering consultants and supplying utilities have long recognized the need for power factor correction.

Poor power factor implies high reactive current, which is not capable of performing useful work. Reactive current is additive to the current requirement of the loads and burdens the electrical components and wiring. It displaces or uses up system capacity that would otherwise be available to serve the loads. The capacity of the wiring and components of the electrical system must be increased to accommodate these inefficiencies. In addition, reactive current increases heating through increased resistance losses, leading to shorter component lifetimes, and higher utility bills. All utilities are aware of the burdens of poor power factor. While your utility may not be concerned with excessive reactive currents inside a facility, they will not permit the burden to extend to the power grid. Rather they are likely to require that the customer correct the problem on his side of the meter or charge the customer a power factor penalty.

## The benefits of power factor correction include:

- Freeing up of electrical system capacity which can be used for additional loads.
- Increased components lifetime due to reduced heating.
- Lower utility bills through reduced losses.
- Elimination of power factor penalties imposed by the utility.
- Minimization of current-induced voltage sags.

## A Complete Solution

AccuSine® is a Power Correction System that provides Total Power Factor Correction. AccuSine® is a versatile, cost effective solution for virtually all power factor problems.

Most traditional products that control power factor add substantial, fixed increments of reactive power, measured in terms of "kilovolt-amperes (reactive)" or KVARs. The need for reactive power generally changes continuously up or down, so a fixed increment is virtually never exactly what is needed. In other words, it is often too much or too little. In addition, when substantial increments are added, negative dynamic

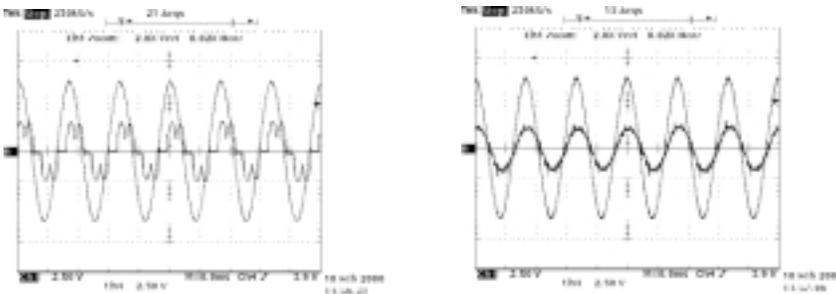
effects occur - often voltage spikes and oscillations. Some power factor correction systems have multiple increments that attempt to cover wide load swings by adding or subtracting more than one increment, but these effects are still present. AccuSine® is a fully electronic product which does not add a fixed increment of reactive power. Instead, it measures the precise amount of KVARs necessary to maintain a given power factor and adds just that amount. There are no dynamic effects that might "shock" the system.

## How AccuSine® Works

AccuSine® is a power electronic product utilizing analog and digital logic to sense and inject current, providing reactive power. If sized properly, AccuSine® can improve power factor to unity.

AccuSine® is installed directly on the AC lines parallel to the load. For 3-phase, 3-wire power systems, current transducers are placed on two of the three phases to provide the control logic with the shape of the current waveform just upstream of the load. The AccuSine® logic then deducts the fundamental frequency (50 or 60 Hertz) from this waveform. It inverts the remaining waveform and directs the firing of the IGBTs to duplicate the inverted waveform. The result is a cancellation of the current harmonics in the upstream electrical system. Total power factor correction is achieved by the elimination of harmonic current and the injection of reactive current at the fundamental frequency.

AccuSine® is designed using components similar to those found in variable frequency drives including power semiconductors, DC link capacitors, buses and fuses. The IGBTs use pulse-width modulation at a switching speed of 20 kHz. An internal filter blocks this frequency from entering the AC lines and decouples AccuSine® from the rest of the system so no harmful interaction occurs.

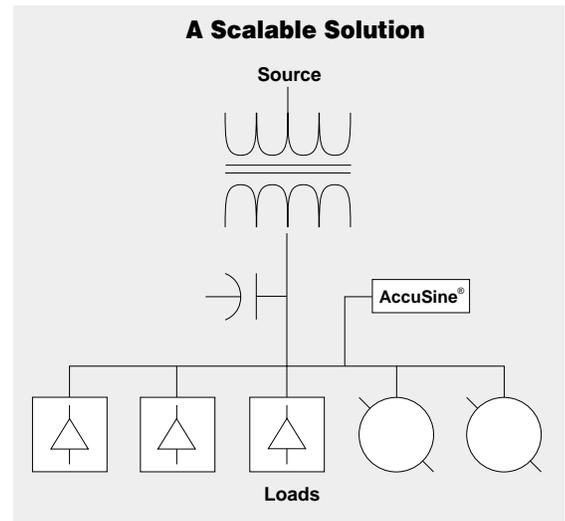


Voltage/current before AccuSine®

Voltage/current after AccuSine®

## Application Guidelines

AccuSine® is a flexible solution that can be installed virtually anywhere in an electrical system. It can be applied on the main facility distribution bus, a sub-distribution bus, a local breaker panel or a single load. Since it is installed in parallel to the load, it does not carry the full current going to the load. It is sized only for the reactive current that is necessary to bring the power factor to the desired level. For example if the load were drawing 200 amps of real current and 100 amps of reactive current, then an AccuSine® unit with only 100 amps of capacity would be necessary.



If the reactive current requirements increase later due to the addition of loads, another AccuSine® unit can be added in parallel. Up to five AccuSine® units can be paralleled in this way.

## Comparing Alternatives

You have choices when it comes to power factor correction. They include:

### Traditional Power Factor Correction Capacitors

The traditional method for correcting power factor is to add capacitors. While capacitors are inexpensive (on a component basis), they have certain pitfalls. They must be added in increments that do not match the requirement well and switching may shock the system. In addition, they are capable of interacting with other system components through resonance. Sometimes resonance can be avoided by "detuning" the capacitors by adding an appropriate inductor. Capacitors are also capable of delivering unacceptably high voltage in lightly loaded conditions.

### Multi-Stage Capacitor Banks

A multi-stage capacitor bank has multiple increments of capacitors and appropriate switches that enable them to be intelligently added and subtracted as the load varies. These systems are almost always designed and configured for an individual system and are not scalable. They are often difficult to justify economically. Last, they have all of the pitfalls of simple capacitors, but avoiding resonance is made more complicated by the addition of many combinations of capacitor and load increments.

## **AccuSine®**

A Power Correction System like AccuSine® delivers complete total power factor correction. In fact, the ability of AccuSine® to correct power factor is a subset of its capability to cancel harmonics - when AccuSine® is applied for active harmonic control, power factor correction comes almost for free. AccuSine® offers dynamic correction (no increments) and will not increase voltage under any circumstances. A system resonance is viewed by the active filter as just another harmonic to be canceled, and so AccuSine® fights any such instability. AccuSine® has even been installed for the sole purpose of eliminating resonance or to simply permit the use of power factor correction capacitors that otherwise could not be confidently used.

Remember, Total Power Factor Correction is just one of the benefits of a Power Conditioning System.

*For more information, contact the Schneider Electric Power Quality Correction Group at (905) 459-8805 or [pqc@squared.com](mailto:pqc@squared.com) or visit [www.reactivar.com](http://www.reactivar.com).*