STACO ENERGY PRODUCTS CO.
A Components Corporation of America Company

Reactive Power and Harmonic Compensation

Low Voltage Systems

StacoVAR® ZX and ZXR

Product Highlights

- Virtually Transient Free Switching
- Real Time Response to Load Changes
- "Zero-Crossing," Precise Switching
- Unlimited Operations, Long Life
- High Speed Controllers
- Upgrade Existing Equipment
- Energy Savings

StacoVAR power factor correction and harmonic mitigation systems from Staco Energy are proven, effective solutions. For added capacitor switching protection and improvement, along with meeting the demands of dynamic loads with sensitive electronic systems, our StacoVAR ZX and StacoVAR ZXR capacitor products provide a further enhancement to meeting power quality needs.

By replacing traditional electro-mechanical contactors and inrush inductors with compact size electronic switches, power factor capacitors are operated with greater efficiency, while averting concerns of slower switching response times. High speed, "smooth" switching is performed at the "zero-crossing" angle, to avoid harmful inrush current and virtually eliminate transients. By operating many times per second, charged capacitors can be switched, and there is no capacitor discharge time necessary. However, discharge resistors are part of each power capacitor, specifically for the safe de-energization of the assembly.

The ZX and ZXR series offer extended life and limitless switching, very little mechanical wear, and quiet operation. Each switch is totally sealed, temperature controlled and includes "finger safe" connections. The design provides for inherently quick response times to varying load changes, while helping to reduce the demand on electrical power distribution systems.

In addition, ZX and ZXR equipment functions to stabilize the electrical system by helping with current spikes and voltage drop, decreasing energy consumption, and supporting increased capacity on the load. These benefits, along with improving power factor and protecting against harmonics, can add up to substantial savings on electric utility costs.

The StacoVAR ZX is typically used in a detuned capacitor application, incorporating heavy duty capacitors, iron-core reactors, electronic switches and a fast response controller (200ms). This arrangement allows for effective elimination of switched transients, while reducing the amplification of harmonics, and providing optimum power factor correction.

The StacoVAR ZXR is used exclusively for real time switching. Like the ZX products, the same benefits are provided, along with:

- Dynamic compensation, 16ms switching (reactive power compensation applied within one line cycle)
- Controller continually calculates and measures reactive power 10,000 times per second, selecting the optimum group of capacitor steps to maintain the pre-selected power factor set-point (1/4 line cycle time)
- Power electronic switches switch to a new "state" within the next ½ cycle
- Sweeping reduction of facility light "flicker" and improved voltage regulation
- Programmable step size and quantity values

With both the ZX and ZXR, capacitor life expectancy is increased with the sequential switching rotation pattern and lower temperature rise.

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General Operation

The power factor controller sends off-and-on commands to the electronic switch arrangement while constantly monitoring the line and load voltage, current, and reactive power requirements. The advanced control scheme allows for the rapid coordination of the firing pulses in the switches, as determined by the capacitor residual voltage. With this design, discharge time is eliminated, making for a great improvement in power quality.

As the power quality environment changes, Staco Energy remains a product leader by meeting new challenges with solutions that incorporate the latest in technology.

Electronic Switch Ratings

- KVAR Capacity: 25, 50, 100
- Voltage: 240 - 660 VAC
- Frequency: 45 - 65hz, phase
- Control Power: 110 - 230vac, 50/60hz
- Control Signals: 24 VDC to 230 VAC, digital (isolated) output, 4-20mA
- Switching time performance: 1-20ms, re-switch 40ms
- Topology: two phase (delta connected, no neutral), phase rotation sensitive
- Protection: control power 1.0 amp fuses
- Losses/Consumption: less than 0.5 watts
- Operating Temperature: 0° C to 40° C
- Altitude: 3280 feet, 1000 meters
- Overtemperature protection: fan cooled
- LED display for diagnostics: line, load, operation status, "on"/operational, switching signal, overtemperature

StacoVAR ZXR Controller and Display Panel

StacoVAR ZX Controller Ratings

- Power supply: 230 or 120 VAC
- Voltage tolerance: ±10%
- Frequency: 50/60hz
- Voltage consumption: 15 VA maximum
- Current consumption: 0.5 VA maximum
- C/K value sensitivity: automatic
- Circular and linear logic: 1:1:1, 1:2:2, 1:2:4
- Number of steps: 8
- Response: 200ms, solid state logic
- Protection: overvoltage, over-temperature, harmonic overload, power factor correction fault, and no voltage
- Front display: line current, main voltage, Line Cos, line active power, line reactive power, C.T. current crest factor, individual step, operations (counter), number of alarm conditions, and inside temperature (area around the controller)
  - Operating temperature: -10° C to +55° C
  - Communications: RS-485 serial port

StacoVAR ZXR Controller Ratings

- Power supply: 110 to 230 VAC, 50/60hz, power consumption <50 watts
- Control Signal: 24 VDC, power consumption < 0.5 watts
- Operating temperature: 0° C to 40° C
- Number of steps: up to 12 capacitor steps
- Altitude: 3280 feet, 1000 meters
- Alarm output: dry contact, 24V, 500mA maximum
- Communications: RS-485 with modbus protocol
- User Interface: LCD backlit display, 20x4 character, six button functionality
- Protection: 1 amp fuse
- Analog channels: up to 6 (3 current, 3 voltage)
- Separate user interface (door mounted display)
- Alarm: output indicating a step is not responding
- Current transformer: operates with either two or three CT's

Typical Applications

- Systems with constant fluctuations in the load, voltage sags and surges - such as motor starting, and processes such as plastic molding.
- Equipment with electronic controls and monitoring systems.
  - Welding
  - Rolling Mills
  - Microturbines
  - Engine-Generators
  - Cranes
  - Saw Mills
  - Flicker Problems
  - Elevators
  - Arc Furnaces
  - Wind Power

Application Note - Consult the Staco Energy factory when the ZX or ZXR will be used, or where contactor switched capacitor and/or filtering equipment exists, to verify inrush components and locations.

Capacitor and Filter Bank Application Considerations

- New or Existing Facility
- Upgrade present *switched* capacitor equipment
- Retrofit *fixed* capacitors to StacoVAR ZX and ZXR equipment
- Existing Staco Energy power factor/filter products can be upgraded to StacoVAR ZX and ZXR.
- StacoVar ZX and ZXR are available from 240 - 600 VAC, with a wide range of KVAR ratings and step sizes available.

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