

# Medium Voltage

**Power Factor Correction**

**Reactive Compensation**

**Harmonic Filters**



**Electrical Power Quality Management at its best...**  
**From electricity generation, transmission,**  
**thru its distribution to utilization**





# Enclosed Harmonic Filters & Capacitors

## Pad Mount & Switchgear style enclosed systems

Custom engineered solutions for both utility and industrial applications, our capacitor systems and harmonic filters are available in both pad mount or switchgear style enclosures. Switchgear style units are typically located at the main service entrance of an industrial facility and can be supplied as automatic switching units to maintain desired power factor and harmonics under changing load conditions. Pad mounted capacitors and filters accommodate installations using underground cable. Our Arteche PQ Systems Engineering group engineers will assist you with analysis of your reactive compensation and harmonic mitigation needs.

### Capacitor Assembly Specifications

Capacity: ANY kVAr rating  
Voltage: Any up to 34.5kV  
Frequency: 50hz or 60hz  
Connection: Fixed or Automatic  
Service: indoor or outdoor  
Enclosure: Nema 1, Nema 3R, Nema 12

### Capacitor Cell Specifications

Tolerance: +0%, -10%  
Operating Temperature: 50C  
Discharge: Internal resistors  
Standards: ANSI/IEEE 18, IEC 871-1  
Manufacturer: General Electric

### Optional Equipment

Automatic Controls—  
Voltage  
Current  
Power factor  
Fuses / Circuit Breakers—  
Expulsion or current limiting  
Reactors—  
Capacitor Protection Reactor  
Inrush Current Limiting Reactor  
Harmonic Tuning Reactors  
Relays—  
Surge Arresters  
Switches—  
Capacitor or grounding



### Data we need to know for quotes and orders

kVAr's required  
System Voltage & frequency  
Enclosure style  
(Nema 1, Nema 3R, Nema 12)

Fixed or automatic

-Number of steps  
-kVAr steps  
-Control Method  
(Voltage, current, VAr's, time)

Fused or non-fused

Reactor requirements  
-Capacitor protection reactor  
-Inrush current limiting reactor  
-Harmonic tuning reactor  
(Harmonic to be filtered)



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# Rack Mount Capacitors & Harmonic Filters



## Substation Suitability

Capacitor systems for reactive compensation and harmonic filter systems are available in rack mount configurations for use in either covered or open construction substation applications. Rack mounts are manufactured with hot zinc immersion galvanized steel brackets.

Whether you are replacing failed units, performing a system upgrade or constructing a new reactive compensation system, the ARTECHE PQ Alliance offers an economical solution with full technical support.

For extended capacitor life, all of our capacitors are available with our proprietary Capacitor Protection Reactor (CPR™). Consult with ARTECHE PQ Engineering group engineers for harmonic analysis and optimized solutions for Volt / VAR management and harmonic mitigation.

## Capacitor Assembly Specifications

Capacity: ANY kVAR rating  
Voltage: Any up to 230 kV  
Frequency: 50hz or 60hz  
Connection: Fixed or Automatic  
Service: outdoor  
Mounting: Galvanized Iron structure

## Capacitor Cell Specifications

Tolerance: +0%, -10%  
Operating Temperature: 50C  
Discharge: Internal resistors  
Standards: ANSI/IEEE 18, IEC 871-1  
Manufacturer: General Electric

## Optional Equipment

Automatic Controls—  
Voltage  
Current  
Power factor  
Fuses / Circuit Breakers—  
Expulsion or current limiting  
Reactors—  
Capacitor Protection Reactor  
Inrush Current Limiting Reactor  
Harmonic Tuning Reactors  
Relays—  
Surge Arresters  
Switches—  
Capacitor or grounding



## Data we need to know for quotes and orders

**kVARs required**  
**System Voltage & frequency**  
**Fixed or automatic**  
-Number of steps  
-kVAR steps  
-Control Method  
(Voltage, current, VARs, time)  
**Fused or non-fused**  
**Reactor requirements**  
-Capacitor protection reactor  
-Inrush current limiting reactor  
-Harmonic tuning reactor  
(Harmonic to be filtered)



# Pole Mount Capacitors

## Capacitors for Reactive Compensation

The most effective reactive compensation is achieved when capacitor banks are distributed throughout the entire power system—after all, this is also how the inductive loads are applied. Reactive compensation reduces the burden on the upstream electricity infrastructure. The nearer to the load that reactive compensation is applied, the greater the overall system improvement. ARTECHE PQ offers a complete range of pole mount capacitor solutions to support power system voltage, improve power factor and reduce line heating and sagging. Whether you are replacing failed capacitor units or installing a new system, ARTECHE PQ can meet your needs with economical solutions and technical support. For longest life capacitor operation, we recommend the use of our Capacitor Protection Reactors (CPR™) which help prevent harmonics from entering and damaging the capacitor. When distribution system harmonics need to be mitigated, our pole mounted capacitors can be supplied with tuning reactors to form a harmonic filter which can remove the specified harmonics, resulting in improved distribution system power quality.

ARTECHE PQ pole mount capacitor systems utilize GE (non- PCB) capacitor cells with BIL ratings up to 200kV, internal discharge resistor and porcelain bushings and are completely suitable for outdoor service. Our capacitors are available as single or three phase units with optional fuses.

## Capacitor Assembly Specifications

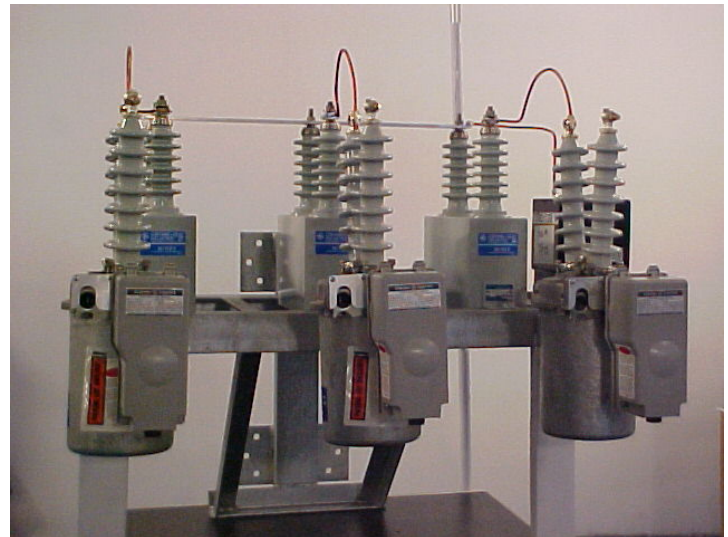
- Capacity: 150—3600 kVAR
- Voltage: Any up to 34.5kV
- Frequency: 50hz or 60hz
- Connection: Fixed or Automatic
- Service: outdoor (pole)
- Mounting: Iron structure

## Capacitor Cell Specifications

- Tolerance: +0%, -10%
- Operating Temperature: 50C
- Discharge: Internal resistors
- Standards: ANSI/IEEE 18, IEC 871-1
- Manufacturer: General Electric

## Optional Equipment

- Automatic Controls—
  - Voltage
  - Current
  - Power factor
- Fuses / Circuit Breakers—
  - Expulsion or current limiting
- Reactors—
  - Capacitor Protection Reactor
  - Inrush Current Limiting Reactor
  - Harmonic Tuning Reactors
- Relays—
- Surge Arresters
- Switches—
  - Capacitor or grounding



## Data we need to know for quotes and orders

- kVARs required
- System Voltage & frequency
- Fixed or automatic
  - Number of steps
  - kVAR steps
  - Control Method
    - (Voltage, current, VArS, time)
- Fused or non-fused
- Reactor requirements
  - Capacitor protection reactor
  - Inrush current limiting reactor
  - Harmonic tuning reactor
  - Harmonic to be filtered



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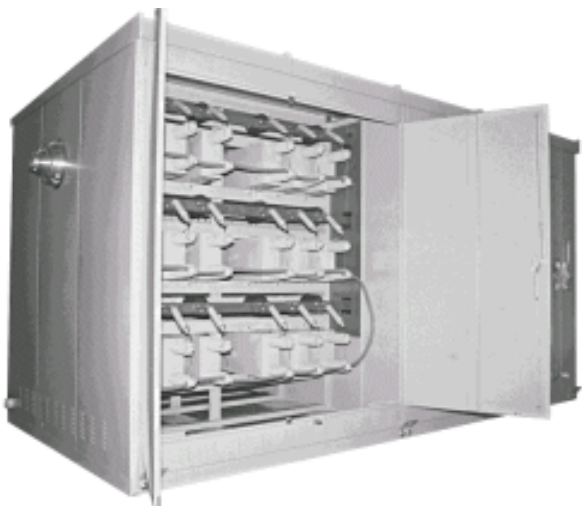
# Pad Mount Capacitors



## Capacitors for Reactive Compensation

ARTECHE PQ offers a complete range of pad mount capacitor solutions complete with an air disconnect switch on incoming lines and ground switch, both in an isolated compartment for maximum safety. ARTECHE PQ can meet your needs with economical solutions to power factor, power system harmonics, voltage support and reactive compensation. For longest life capacitor operation, we recommend the use of our Capacitor Protection Reactors (CPR™) which help prevent harmonics from entering and damaging the capacitor.

ARTECHE PQ pad mount capacitor systems utilize GE (non- PCB) capacitor cells with BIL ratings up to 200kV, internal discharge resistor and porcelain bushings and are completely suitable for outdoor service. Our capacitors are available as single or three phase units with optional fuses.



### Capacitor Assembly Specifications

Capacity: Any kVAr rating  
Max. kVAr: 135% of rating  
Max. Current: 180% of rating (rms)  
Voltage: Any up to 34.5kV  
Max. Voltage: 110% of rating (rms)  
Frequency: 50hz or 60hz  
Service: outdoor (pad)  
Enclosure: Galvanized steel  
Mounting: Galvanized steel

### Capacitor Cell Specifications

Type: Single phase, double bushing  
Tolerance: +0%, -10%  
Operating Temperature: 50C  
Dielectric: Polypropylene  
Discharge: Internal resistors  
Standards: ANSI/IEEE 18, IEC 871-1  
Manufacturer: General Electric

### Standard Equipment

Automatic Capacitor Controller —  
Voltage, Current, PF  
Fuses—Expulsion type w/ indicator  
Lightning arresters—heavy duty, distribution class, polymer  
Switches— Capacitor and grounding  
Key interlocked compartments  
Blown fuse protection system  
Control Power Transformer  
Copper phase and ground bus

### **Data we need to know for quotes and orders**

kVArS required  
System Voltage & frequency  
Fused or non-fused  
Reactor requirements  
    Capacitor protection reactor  
    Inrush current limiting reactor  
    Harmonic tuning reactor  
    Harmonic to be filtered





# SmartVAR™ Dynamic VAR Compensation and Filters

## What is a SmartVAR™?

SmartVAR™ is a rapid response method of adjusting reactive power and harmonic filtering to dynamic loads. It employs Thyristor switching techniques to rapidly insert and remove capacitive reactance or harmonic filters as demanded by dynamic loads. Many electrical loads have rapid demand requirements for reactance that cannot be satisfied with traditional automatic (contactor) switching methods. These highly dynamic requirements for reactive power can only be satisfied with the most rapid switching techniques that match reactive compensation to load demand. ARTECHE PQ offers a complete range of rapid switching products to provide reactive power compensation, harmonic filtering and voltage support. Choose from standard products or we'll customize a system to meet your precise needs.

## SmartVAR™ Performs Transient Free Switching

SmartVAR™, by ARTECHE PQ, offers the fastest VAR switching capability available. Using SCR (thyristor) soft-switching techniques, SmartVAR™ adds capacitance or harmonic filters to power systems at zero cross points to prevent switching transients. SmartVAR™ can insert the capacitors or filters (at the next zero cross point) in as little as 8-10 msec after sensing a need for reactive power. That's only 1/2 to 2/3 of a cycle!

## Benefits of Dynamic VAR Compensation

- VAR compensation is directly matched to dynamic load requirements
- Facility voltage is stabilized
- Facility voltage drops are reduced
- System electrical efficiency is improved
- Harmonic distortion can be minimized
- Power factor can be maximized
- Flicker can be reduced substantially
- Release system capacity



**SmartVAR™ utilizes low voltage power electronics components and capacitors as well as conventional cooling methods. This reduces complexity and initial cost while simplifying maintenance.**

## SmartVAR™ is the right choice for:

- |                         |                   |
|-------------------------|-------------------|
| Wind Power              | Arc Furnaces      |
| Spot Welding            | Injection Molding |
| Laser Cutting & Welding | Cranes & Hoists   |
| Elevators               | Electric Trains   |
| Induction Heating       | Amusement Rides   |
| Shredders / Crushers    | HVAC, Chillers    |

*And for many other dynamic processes.*



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**Available in Medium Voltage and Low Voltage Ratings!**



## VAR Compensation

*SmartVAR™* supplies leading VARs when they are needed, by utilizing rapid switching devices coupled with soft switching technology to rapidly add or remove capacitive reactance or harmonic filter sections from your system. It does this without any switching transients. VAR compensation enables users to add more loads to existing power sources, saving the costs associated with downtime and equipment for power source upgrades. By using *SmartVAR™* to control VARs, you'll reduce energy flows between the source and the *SmartVAR™* equipment resulting in higher energy efficiency and voltage stability. In cases where energy costs increase with lower power factor, you'll be able to reduce your energy costs.

*SmartVAR™* can sense a need for reactive VAR in and perform capacitor or filter switching in less than 2/3 cycle. *SmartVAR™* controllers calculate the VAR requirements and switch the precise amount of capacitance in steps, to maintain your target power factor.



## Power Factor Improvement

Many electric utility companies demand high power factor for both loads as well as grid connected power generation systems. Premium prices may be assessed when power factor (PF) drops below a specified threshold. In some cases, utilities will pay a rebate to the customer if actual PF is higher than the target PF. Many customers are paying for low power factor without even knowing it! Utility invoices don't always itemize the charges for power factor but may bill on an adjusted KW, adjusted KVA, or on a total KVA basis. These and other methods may disguise the penalty for low power factor. Energy cost savings often await customers who implement power factor improvement measures. The fast response of our *SmartVAR™* system can save you energy costs, increase your power source capacity and can extend the life of your electrical equipment.

*SmartVAR™ can help you to realize these benefits of high power factor:*  
*reduced KVA demand,*  
*reduced current demand,*  
*reduced system losses, and*  
*improve facility voltage stability.*

## Voltage Support & Flicker

Rapid switching of large inductive loads or large harmonic producing loads, can stress the components of an electrical system, especially on the power sources (transformer and generators). Additionally, these types of loads can cause rapid fluctuations of the system voltage. The peak current demanded by large dynamic loads can cause excessive voltage drop and also cause incandescent lamps to flicker. When voltage dips occur, some sensitive loads may shut down completely, or as in the case of semiconductor manufacturing voltage dips can cause significant loss due to material scrap and damaged tools. *SmartVAR™* stabilizes system voltage by rapidly responding to demand for reactive power and can prevent voltage dips caused by switching of large inductive loads.





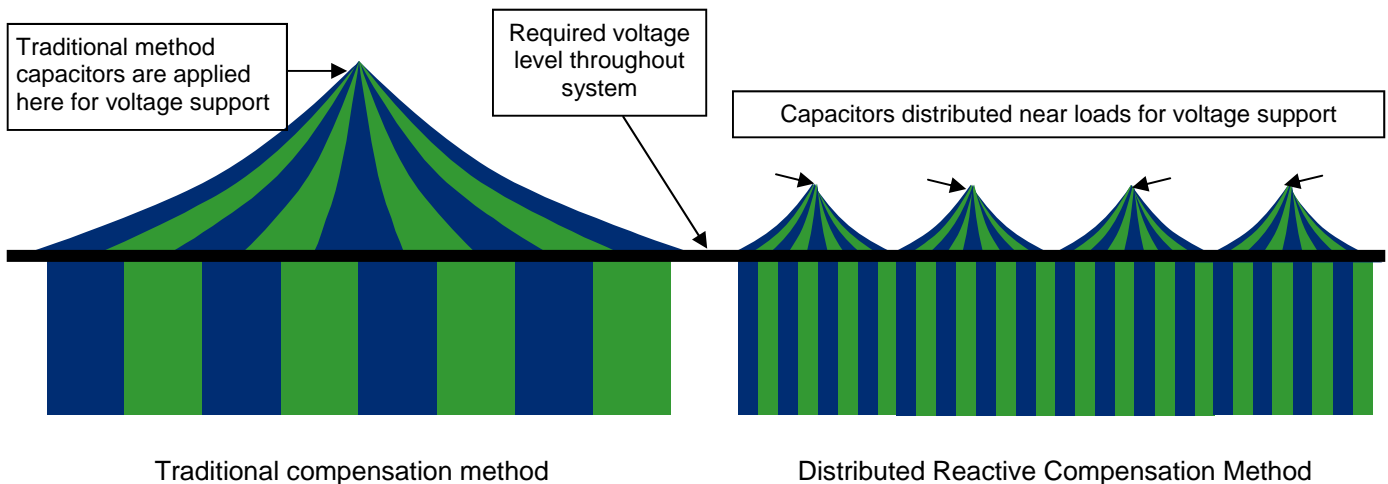
# Distributed Reactive Compensation

## Typical Approach

In a typical power system, reactive compensation is applied in large banks at the substation. If voltage anywhere on the line is too low, due to low power factor loads, line losses, or peak demand, capacitors can be switched at the substation to help support and stabilize the voltage. This is similar to the Big Tent concept. Regardless of where the contributing loads are located, all compensation is added at one central point. This can mean that voltage close to this point is high, while nominal voltage is experienced at the end of the line. Another problem with this method is that a failure at a single location can take the entire system down, resulting in a brownout, or black-out condition.

## Best Approach

The most practical and beneficial method involves the application of the reactive compensation as close as possible to where the loads are located. Distributed Reactive Compensation provides the reactive power right where it is needed and the benefit is realized all the way upstream. When reactive compensation is distributed near the loads, all upstream conductors, transformers and switchgear experience reduced current, reduced heating, and therefore longer life. Power is delivered more efficiently, and is more reliable. In the event that a failure occurs at one capacitor location, the rest of the system remains intact with full voltage support. Distributed Reactive Compensation makes the most sense in a world that demands highly reliable electrical power.



## Dependable Solutions for:

- ⇒ **Low Voltage**
- ⇒ **Medium Voltage**
- ⇒ **High Voltage**



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