

Wind Power
Industrial Manufacturing
Energy/Oil/Gas
Spot Welding
Medical Centers
Shipyards Cranes & Hoists
Data Centers
Mining
Shredders & Crushers
Inductive Heating

smARTvar[®]

Dynamic VAR Compensator



ARTECHE
POWER QUALITY

DOES YOUR BUSINESS NEED TO SAVE MONEY? DISCOVER A QUICK AND EASY WAY TO IDENTIFY COST SAVING OPPORTUNITIES.

Improve the dynamic
processes in your
facility with smARTvar®.

Reduce energy consumption...

increase energy efficiency

Trim electric bills...

virtually eliminate utility penalties

Alleviate equipment overheating...

help your electrical equipment run cooler

Decrease replacement and repair costs...

help your equipment last longer and operate more efficiently

Diminish voltage drops...

improve your system's reliability

Improve power sources...

release capacity in your existing power sources

Stabilize electrical output...

improve the constancy of your power system

Prevent high current demand...

reduce the amperes demanded by inductive loads supplied by transformers and generators

Improve unbalanced peak load management...

decrease peak demand

Lower air conditioning costs...

electrical equipment dissipates less heat into your building

Customized smARTvar® Solutions for Your Facility

Increase energy potential

The fastest possible VAR switching capability is offered by smARTvar®, from Artech PQ. VAR compensation enables users to add more loads to existing power sources, saving the costs associated with downtime and equipment for power source upgrades.

Reduce a cycle by 1/3 to 1/2

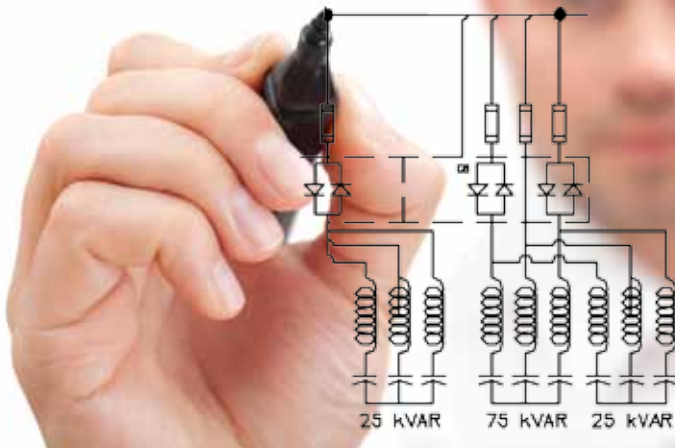
Insert capacitance onto a system within 16 ms or less of sensing the need for reactive compensation.

Available in medium and low voltage ratings

Systems may be ordered and installed on either low voltage (690 volts or less) or medium voltage (up to 69 kV Class) power systems. Low voltage systems are designed for direct connection to the power system, whereas medium voltage systems utilize an interposing step up transformer.

Reduce cost and complexity

Medium voltage smARTvar® solutions utilize low voltage power electronics with conventional cooling methods to reduce complexity, minimize costs, and ensure easy installation and maintenance.



THE CHALLENGE: MATCHING REACTIVE COMPENSATION TO LOAD DEMAND

Dynamic VAR compensation uses ultra-fast switching techniques to insert and remove capacitive reactance (the internal resistance of a capacitor) as demanded by highly dynamic loads. Many electrical loads have very rapid requirements for reactance that can't be satisfied with traditional automatic (electro-mechanical contactor) switching methods. These highly dynamic requirements for reactive power can only be satisfied with rapid switching technologies that match VAR compensation to load demand.

THE smARTvar® SOLUTION: DYNAMIC VAR COMPENSATION

Artech PQ offers a complete range of state-of-the-art switching products to provide rapid power compensation, harmonic filtering, and voltage support. In addition to our broad line of standard products, we can customize a system to meet your precise needs.

The fastest VAR switching capability

Using power switching modules, smARTvar® adds capacitance to power systems at zero voltage cross points to prevent switching transients. Use smARTvar® to insert capacitance into a system within 16ms (60hz) of sensing a need for reactive compensation.

Achieve dynamic VAR compensation

Through the use of power electronic techniques, smARTvar® adds capacitance to power systems within sub-cycle times to prevent switching transients and:

- Stabilize your facility's voltage
- Reduce your facility's voltage drops
- Improve the efficiency of your electrical system
- Minimize harmonic distortion
- Maximize your power factor
- Substantially reduce flicker
- Release capacity within your facility's system

THE smARTvar® SYSTEM

Reliable performance with industry proven componentry

Rapid switching devices act upon a switching command given by our smARTvar® controller. It rapidly switches VARs into or out of the system... as demanded by your loads.



Long Life Capacitors The Heart of the smARTvar® System

- Designed for rigorous applications, including harmonic rich environments
- Industry's longest life expectancy; physical construction minimizes element heating
- 85° C rated capacitors offer more than 1,000,000 hours of life expectancy in a 40° C ambient



The smARTvar® Switch Our Rapid Responder

- Responds to rapid load changes
- Power switching modules provide transient free switching of capacitors
- Notch immune
- Fast acting power switching-modules insert and remove capacitance in as little as 5-8 milliseconds



The smARTvar® Controller The Brains Behind smARTvar®

- Fully adjustable from 100 ms to sub-cycle reaction speeds
- Rapid sensing and rapid acting controller with LCD graphic display
- Makes 7,600 calculations per second to determine reactive power demand
- Can control up to 12 capacitor steps
- Fast acting power switching-modules insert and remove capacitance in as little as 5-8 milliseconds



Reactors For Tuned and Detuned Systems

- Detune the capacitor network to block harmonics
- Avoid power system resonance
- Utilize PolyGap™ core construction to minimize losses, audible noise, and stray magnetic fields

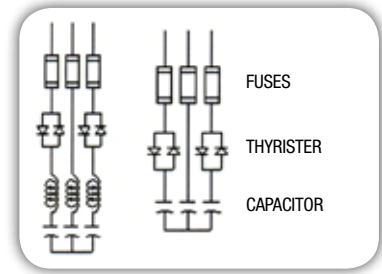


K-Rated Transformers For Medium Voltage Systems

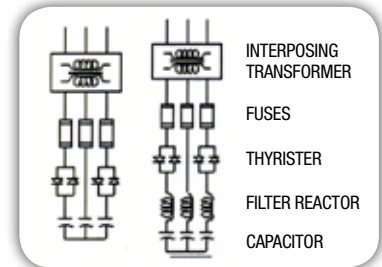
- High performance dry-type transformers specially constructed for rapidly switching system applications
- Liquid-cooled or air-cooled depending on service voltage and application needs

Product Specifications

Power Systems:	3-phase, 3 wire
Frequency:	60Hz or 50Hz
System Voltage:	LOW Voltage: 208, 240, 380, 400, 415, 480, 600 or 690 volts MEDIUM Voltage: 2400, 4160, 7200, 69KV Class
Auxiliary Power:	110 to 230VAC, 50/60Hz (consumes less than 50 watts)
Connection:	LOW Voltage: Direct connection to system MEDIUM Voltage: Interposing step up transformer
VAR Capacity:	Unlimited
VARs / switch:	25 to 150 kVARs per switch
Response time:	100 m-sec to sub-cycle (adjustable)
Switch legs:	2 (switches 2 out of 3 phases, no neutral connections)
Enclosures:	Type 1, Type 3R, Type 12 (others upon request)
Temperature:	Storage: -30° C to 60° C Operating: 0° C to 40° C
Altitude:	2000 meters
Standards:	Complies with NEMA, ANSI, UL, CUL, IEC, EIA, IEEE, NFPA requirements



Low Voltage smARTvar®
with and without harmonic filter reactor or capacitor protection reactor



Medium Voltage smARTvar®
with and without harmonic filter reactor or capacitor protection reactor

Capacitor Specifications

Temperature capability:	-40° C minimum to +85° C maximum
Capacitor Life:	>1,000,000 hours at 40° C operating temperature
Agency Approval:	Meets or exceeds UL 810 standards



VAR COMPENSATION

The most cost-effective solution to dynamic VAR compensation

Time proven technology and components help you adapt to the specific needs of your demanding applications.

- High performance low voltage controls, switches, and capacitor cells
- Easily adapts to medium voltage applications with step up transformers

VAR compensation enables users to add more loads to existing power sources... saving the costs associated with downtime and equipment for power source upgrades.

More loads with less cost and less down time

By inserting and removing capacitive reactance from the system (as demanded by dynamic loads), smARTvar® supplies leading VARs exactly when needed. Rapid switching devices and soft switching technology rapidly insert or remove capacitive reactance from your system, and does so without switching transients. VAR compensation enables users to add more loads to existing power sources... saving the costs and reducing downtime associated with equipment and power source upgrades.

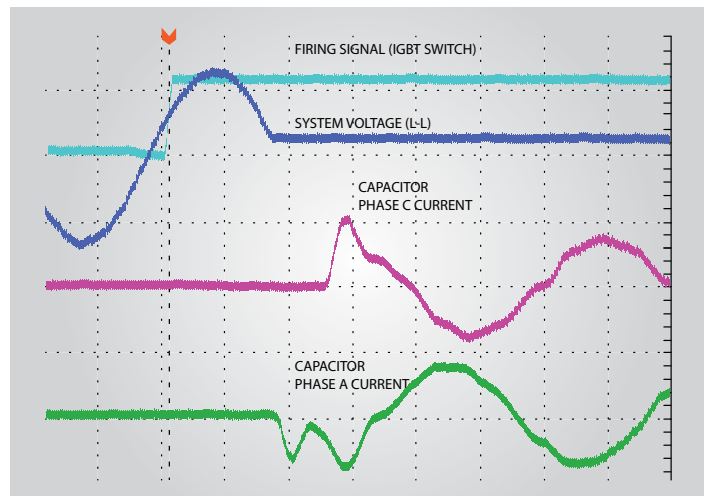
Higher energy efficiency and voltage stability

By using smARTvar® to control VARs, you can reduce energy flows between the source and the smARTvar® equipment... resulting in higher energy efficiency and voltage stability. In cases where energy charges increase with lower power factor, you can reduce electricity costs.

Maintains targeted power factor

Using smARTvar® helps sense a need for reactive VARs in an application and completes the switching of capacitive elements in sub-cycle times. The controller calculates the VAR requirements and switches the appropriate steps of capacitance to maintain the targeted power factor.

Rapid switching devices act upon a switching command given by our smARTvar® controller and rapidly switch VARs into or out of the system... as demanded by your loads.



Provide the VARs Needed by Inductive Loads with smARTvar®

- Local injection of VARs eliminates dependence on VARs from utility or generator
- Reduces your VAR demand, energy consumption, and peak demand
- Eliminate power factor penalties
- Increase KVA available from your existing power sources

Inductive Loads Demand Reactive VARs

- Inductive VARs are non-productive and waste energy
- Inductive VAR demand can fluctuate with various load conditions
- VARs are in addition to KW supplied by utility
- Inductive VARs increase total KVA demanded from power source
- VARs increase energy consumption
- Inductive VAR consumption may increase your electricity costs

HARMONIC MITIGATION

Reactive compensation and harmonic filtering to pacify offending type loads

When dynamic loads are controlled by thyristors, diodes, or SCRs (Silicone Controlled Rectifiers), the input current waveforms (voltage and current) may become highly distorted. In addition to having high reactive demand, the rectifiers may cause significant harmonic distortion of the electrical power system.

The natural operation of a thyristor or SCR causes voltage notching, which often results in multiple zero crossings of the voltage waveform. Voltage notching represents voltage distortion and can give false signals to equipment that is zero cross sensitive.

Harmonic voltage distortion affects the entire power supply bus. It can cause:

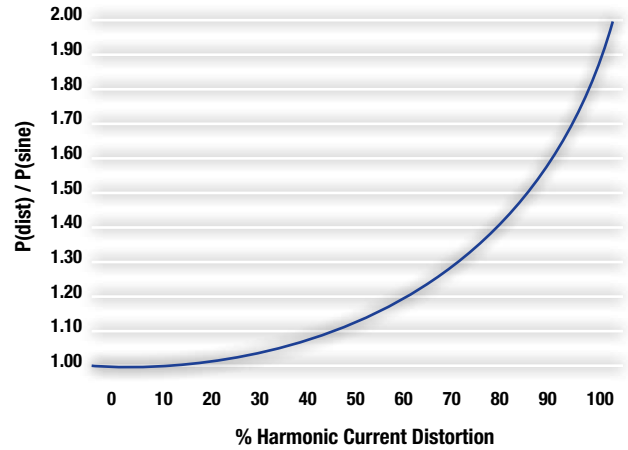
- malfunctions
- premature or catastrophic equipment failure
- overheating
- mis-operation of other equipment
- lower productivity and increased downtime

When a power system is distorted, it becomes a voltage source at multiple frequencies (e.g.: 180hz, 300Hz, 420Hz, etc). In these instances, each connected load draws current at each of the harmonic frequencies resulting in higher copper and iron losses.



Copper Losses VS % THDi

Copper losses increase when harmonic currents flow through electrical systems and equipment. Certain iron losses will also increase based on the square of the frequency.



A smARTvar® SOLUTION CUSTOMIZED FOR YOU

You can configure smARTvar® into a hybrid form to provide a combination of fixed and switched compensation. This is especially useful for large motors where steady state power factor needs to be corrected and additional leading VARs are required during inrush. The smARTvar® can also be configured to include active filters.

Hidden Costs of Harmonic Distortion

- Increases system and equipment power losses
- Increases equipment operating temperature
- Reduces total power factor
- Reduces equipment life
- May cause equipment failures
- May cause equipment interference/malfunctions



POWER FACTOR IMPROVEMENT

Are you paying for low power factor without knowing it?

Many electric utilities throughout the world charge premium prices to customers whose facility power factor drops below a specified threshold (often 0.95, 0.90, or 0.85 PF). In some cases, power companies pay rebates to customers if PF is higher than a specified level.

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 disguise the fact that customers are actually paying higher prices due to their actual power factor. Customers pay the energy bill without the knowledge that, if they improve their power factor, a lower price may be available.

Improve your facilities power factor for lower energy costs

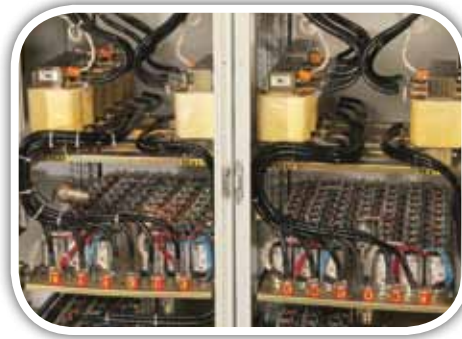
When you improve your power factor, your facility:

- reduces KVA and current demand
- reduces system losses
- improves voltage
- allows the addition of more equipment (loads) to your existing transformers

Proper consideration of power factor issues can lead to energy cost savings and improved life cycles of installed electrical equipment.

Power factor improvement products may realize a full payback in less than one year.

If you're looking for the best way to improve power factor when one or more loads are dynamic in nature... choose smARTvar®. It provides the necessary VARs as needed when starting large motors or performing other operations with rapidly changing VAR demands.



A smARTvar® SOLUTION CUSTOMIZED FOR YOU

PF charges may be based on peak demand. Normally, large motors experience peak demand during inrush when PF is at its lowest. A hybrid smARTvar® system, consisting of fixed and rapid switching capacitors, does two things:

1. Satisfies the short term VAR requirement for PF improvement at inrush.
2. Allows the fixed capacitors to compensate for steady state VAR requirements.



VOLTAGE SUPPORT AND FLICKER

Maintain desired system performance

Each of the following places additional stress on an electrical system... especially on its power sources (transformer, generators):

- large inductive loads
- harmonic producing loads
- switching of large loads
- arcing loads
- high inertia loads

Some loads have steady state requirements for VARs while others have VAR demands that change rapidly during their operating cycle.

Use smARTvar® to provide rapid detection of VAR demand and rapidly switch the proper amount of capacitance to achieve and maintain the desired performance of your system.

Large individual loads, or the combination of many loads on a power system, can cause unique fluctuations in a system's voltage. Arcing, inrush, and current harmonics can all increase the demand for peak current and attempt to draw higher magnitudes of current from a fixed capacity power source. When peak current demand exceeds the capacity of the power source, a voltage dip is experienced. In some cases, all three phases may rise/fall together, but in other cases, individual phases may behave differently.

When voltage dips, sensitive loads may shut down or malfunction, reducing productivity while increasing downtime, scrap, and tool or equipment failures. This may also increase the cost of maintenance and repairs.



Certain loads, such as those for spot welders and arc furnaces, cause rapid escalations in current demand. These loads can actually cause momentary short circuits resulting in repetitive voltage notching. These rapid changes in voltage may cause an effect known as "flicker," which is a noticeable effect experienced in lighting equipment. Flicker can cause:

- instrumentation and timing circuit errors
- process automation errors
- equipment interference
- UPS cycling, resulting in reduced equipment life
- increased scrap rate due to improper welds

A smARTvar® SOLUTION CUSTOMIZED FOR YOU

Solve voltage support and flicker problems by using the rapid switching technology of smARTvar® to compensate for extremely fast changes in reactive VAR demand. By inserting the proper steps of capacitance, system voltage can be supported and maintained within acceptable limits... and the effects of flicker can be eliminated.



Extensive Voltage Ranges

Systems are available from 200 to 690 volts at both 50 and 60 Hz and can be modified for medium voltage projects. Tuned filters targeting your problematic harmonic frequencies are available to meet your unique application requirements. If your desired option is not listed, please consult the factory for additional assistance.

Catalog number*	kVAR	kVARs per Step	Step Count	Ampere Rating	Disconnect Ampere Rating	# of Sections	Dimensions (Inches & Lbs)			
							Height	Width	Depth	Weight
SMV 0100 480 01 D S 04 A M	100	25	4	162	300	1	82.68	23.62	31.50	600
SMV 0125 480 01 D S 05 A M	125	25	5	203	300	1	82.68	23.62	31.50	618
SMV 0150 480 01 D S 06 A M	150	25	6	244	300	1	82.68	23.62	31.50	654
SMV 0150 480 01 D S 03 B M	150	50	3	244	300	1	82.68	23.62	31.50	658
SMV 0175 480 01 D S 07 A M	175	25	7	284	300	1	82.68	23.62	31.50	720
SMV 0200 480 01 D S 08 A M	200	25	8	325	400	1	82.68	23.62	31.50	837
SMV 0200 480 01 D S 04 B M	200	50	4	325	400	1	82.68	23.62	31.50	756
SMV 0250 480 01 D S 05 B M	250	50	5	406	500	1	82.68	23.62	31.50	775
SMV 0300 480 01 D S 06 B M	300	50	6	487	500	1	82.68	23.62	31.50	901
SMV 0300 480 01 D S 03 D M	300	100	3	487	500	1	82.68	23.62	31.50	833
SMV 0350 480 01 D S 07 B M	350	50	7	568	600	1	82.68	23.62	31.50	936
SMV 0400 480 01 D S 08 B M	400	50	8	650	800	2	82.68	47.24	31.50	1,514
SMV 0400 480 01 D S 04 D M	400	100	4	650	800	1	82.68	23.62	31.50	990
SMV 0450 480 01 D S 03 F M	450	150	3	731	800	1	82.68	23.62	31.50	1,198
SMV 0500 480 01 D S 04 E M	500	125	4	812	1000	1	82.68	23.62	31.50	1,213
SMV 0600 480 01 D S 12 B M	600	50	12	974	1000	2	82.68	47.24	31.50	2,275
SMV 0600 480 01 D S 06 D M	600	100	6	974	1000	2	82.68	47.24	31.50	1,667
SMV 0700 480 01 D S 07 D M	700	100	7	1134	1600	2	82.68	47.24	31.50	1,969
SMV 0800 480 01 D S 08 D M	800	100	8	1299	1600	2	82.68	47.24	31.50	1,987
SMV 0900 480 01 D S 06 F M	900	150	6	1461	1600	2	82.68	47.24	31.50	2,397
SMV 1000 480 01 D S 08 E M	1000	125	8	1624	2000	2	82.68	47.24	31.50	2,431
SMV 1200 480 01 D S 12 D M	1200	100	12	1949	2000	3	82.68	70.87	31.50	2,981
SMV 1500 480 01 D S 12 E M	1500	125	12	2436	2500	3	82.68	70.87	31.50	3,649
SMV 1800 480 01 D S 12 F M	1800	150	12	2923	3000	4	82.68	94.49	31.50	4,817

Standard current transformers

A current transformer (CT) must be rated for the amp rating of the switchboard it will measure.

- For example:
a 2000A switchboard would require an AC20-2 or AC20-4, which is a 2000 amp CT.

In order to properly size a CT for a smARTvar® system, multiply the nominal ampere rating by three (3).

- For example:
a 200kVAR SMV has a nominal current rating of 325 amps.
325 amps multiplied by 3 = 975 amps
– The CT for this application must be rated at 1000 amps

smARTvar® kVAR Ratings	Ampere Rating	Dimensions (Inches & Lbs)	
		2 3/4" x 6 5/8"	4" x 11"
100	500/5	AC05-2	NOT AVAILABLE
125 - 200	1000/5	AC10-2	NOT AVAILABLE
250 - 300	1500/5	AC15-2	AC15-4
350 - 400	2000/5	AC20-2	AC20-4
450 - 500	2500/5	AC25-2	AC25-4
600	3000/5	AC30-2	AC30-4
700 - 800	4000/5	AC40-2	AC40-4
900 - 1000	5000/5	NOT AVAILABLE	AC50-4
1200	6000/5	NOT AVAILABLE	AC60-4

4" x 11" I.D.



2 3/4" x 6 5/8" I.D.



The smARTvar[®] Dynamic VAR Compensator Part Number System



* Step-up Xfmr for detuned smARTvar only

The Right Solution For You

Your products and applications are unique to your business. Although Artech PQ offers a standardized version of the smARTvar[®] system, our goal is to provide the right equipment for the job. Our experienced Engineering Team can develop the custom solution to meet your budget and application requirements.

smARTvar®

Dynamic VAR Compensator

Amusement & Theme Parks

Elevators

Arc Furnaces

Injection Molding & Extruders

Laser Cutting

Commercial High Rise Buildings

Large Induction Motors (In-Rush)

Transit & Traction



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