ReactiVar® Low Voltage Capacitor Banks

Streamlining your electrical network's capacity

SQUARE D®

by Schneider Electric

How can you be energy efficent?

Most utilities charge for peak electrical demand on each month's electrical bill. The demand charge is to allow the utilities to recoup part of their capital investment in the distribution network they operate. Each customer pays a demand charge for its peak operating load. Often inherent in the structure of these demand charges is an allowance for some inefficiency but most utilities will offer an incentive to their customers to keep efficiency (measured by power factor) high. Power factor correction devices improve overall efficiency upstream of the point of connection in the electrical network and can be used to minimize utility kVA demand charges.

In today's facility, power electronic devices that have rapid and frequent load variations have become abundant due to their many process control related and energy saving benefits. However, they also bring a few major drawbacks to electrical distribution systems such as harmonics and rapid change of reactive power requirement.

Harmonics may disrupt normal operation of other devices and increase operating costs. Symptoms of problematic harmonic levels include overheating of transformers, motors, drives, cables, thermal tripping of protective devices and logic faults of digital devices. Harmonics can cause vibrations and noise in electrical machines (motors, transformers, reactors). The life span of many devices can be reduced by elevating the operating temperature.

Class 5860 ReactiVar low voltage capacitor banks – anti-resonant (AV6000), filtered (AV7000)

Low voltage capacitor compensation systems can provide the benefit of a centralized solution at an attractive cost for most small and medium industrial, commercial and institutional users. It offers a very flexible, yet effective power factor compensation system in a low voltage network.

Schneider Electric has suitable products to meet your needs

The AV6000 anti-resonant power factor correction systems are designed to provide power factor correction in today's industrial distribution networks. The AV6000 assemblies include custom-designed iron-core reactors in series with three-phase heavy-duty capacitor modules. The series capacitor and reactor combination are tuned below the first dominant harmonic (usually the 5th) to prevent resonance and harmonic magnification.

The AV7000 filtered systems are specifically designed for harmonic filtering with power factor correction as a secondary benefit. The series capacitor and reactor combination are tuned close to the 5th harmonic (4.7 Hz x 60 Hz tuning is typical). Such close tuning to the target harmonic increases the effectiveness of harmonic energy absorption of the capacitor and reactor stage. Due to the specific nature of the AV7000 filtered systems, application issues must be examined prior to system installation.

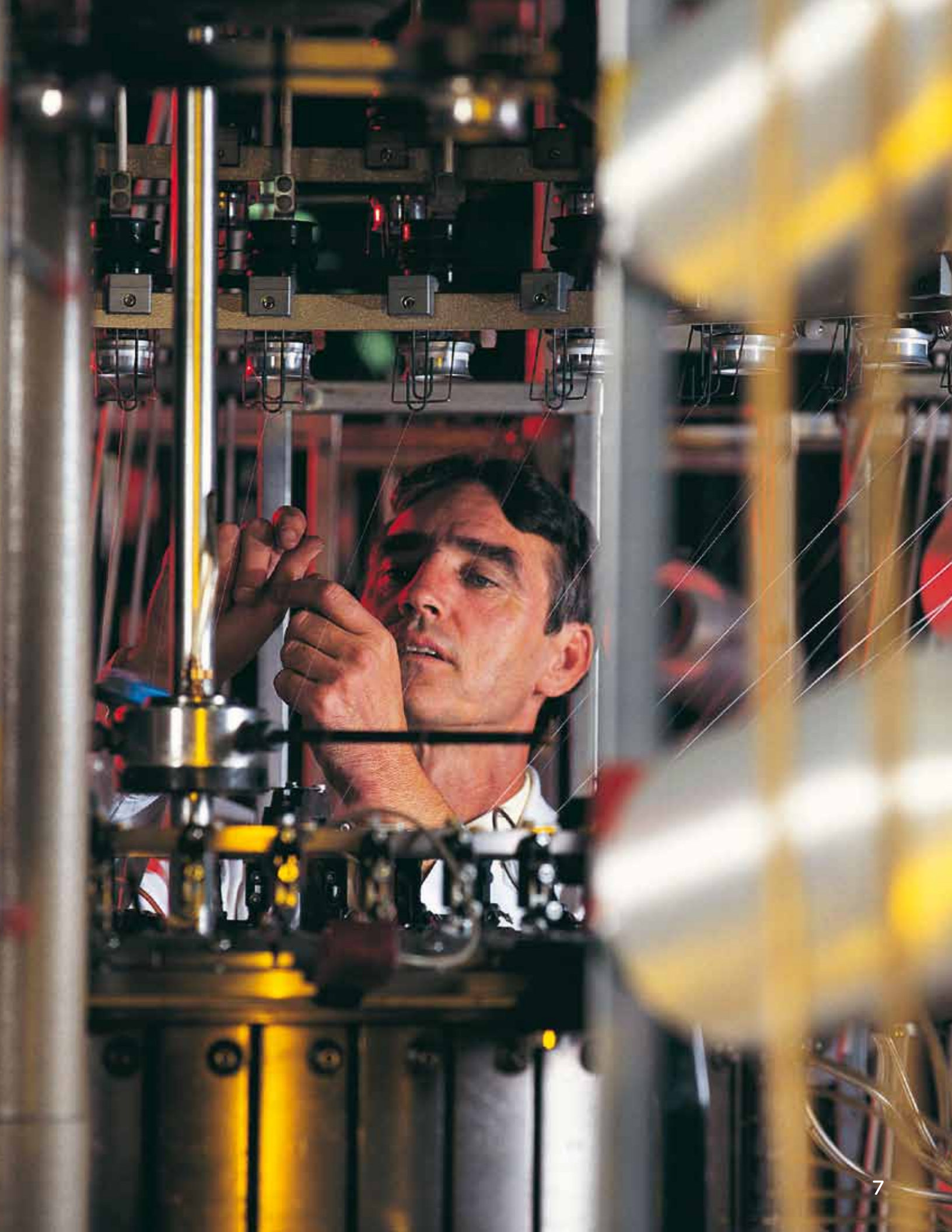
Key Features

- Voltage rating range from 208 V to 600 V
- Capacity available up to 1500 kVAR at 600 V
- Thermal-protected iron-core reactors preventing network resonance
- Capacitor-switching rated contactor with proven reliability
- Sophisticated power factor controller options
- Backlit display on controller shows current power factor, stage status, load and reactive currents, THD values, alarm conditions and more
- QED switchboard-style section constructed of 12-gauge steel frame covered with removable 16-gauge steel panels
- NEMA 1 indoor enclosures finished with ASA 49 (ASA 61 optional) gray
- CSA and CSA-US listed

Standard Features and Options	AV6000	AV7000
Silver Flashed Copper Bus	◆	◆
Copper Power and Control Wiring	◆	◆
Heavy-Duty Capacitor Elements	◆	◆
Iron Core De-tuning Reactors with Thermistor Overload Protection	◆	◇
Iron Core Filter Reactors with Thermistor Overload Protection	◇	◆
Control Power Transformer with Class A Ground Fault Protection	◆	◆
Varlogic NR12, 12-Step Controller	◆	◆
Varlogic NRC12, Advanced Controller	◆	◆
RS485 Modbus Communication Module	◆	◆
Fans with Thermostat	◆	◆
Heaters with Thermostat	◆	◆
Over-temperature Protection	◆	◆
CT Shorting Block	◆	◆
Main Lugs	◆	◆
Main Breaker	◆	◆
Top Cable Entry	◆	◆
Bottom Cable Entry	◆	◆
Type 1 Indoor Enclosure	◆	◆
Type 3R Outdoor Enclosure	◆	◆
ASA 49 Gray Paint	◆	◆
ASA 61 Gray Paint	◆	◆
PowerLogic® Circuit Monitor	◆	◆
Special Control Arrangements	◆	◆
Custom Staging Ratios	◆	◆
Fixed Stages	◆	◆
Other Voltages and Frequencies	◆	◆

◆ Standard feature
◆ Available option – contact Schneider Electric for details
◇ Not available

Note: For seismic qualification unit, contact Schneider Electric.



Key Components

Power factor controller

Three Varlogic® controller options to suit the application: NR12, NRC12 and NRC12 with communication module.

1. Varlogic NR12 features:

- Menu-driven operation for monitoring, commissioning and configuring
- Automatic adjustment for current transformer polarity and phase sequence
- Automatic no-voltage release and automatic-staged reconnection
- A backlit display for: power factor, steps energized, step reconnection delay, real and reactive power, voltage THD, alarm codes and more
- Alarm relay and indication available for abnormal conditions

In addition to the functions of the Varlogic NR12, the Varlogic NRC12 provides the following additional features:

2. Varlogic NRC12 features:

- Measurement of total current harmonic distortion
- Harmonic spectrum for current and voltage
- Step-condition monitoring (capacitance loss)
- On-line user help menus
- Alarm relay and indication for: low power factor, hunting, abnormal power factor, low voltage, over-capacitive, over-current, over-voltage, over-temperature and excessive voltage THD
- Future optional RS485 Modbus® auxiliary communication module

Iron core reactors

3. The iron core reactors in AV6000 and AV7000 systems are custom-designed and manufactured under tight tolerances:

- Reactors are constructed with EI laminated low-loss magnetic material and precision-controlled air gaps
- Three-phase windings consist of rectangular cross section, 220˚ C (428˚ F) insulation for 115˚ C (239˚ F) rise with insulated all-copper conductors
- Entire reactor assembly is impregnated and baked with high-temperature thermo-setting epoxy resin to provide superior insulation levels
- Each reactor has a thermistor embedded in the center leg and wired to thermistor relay. The thermal protection system will shut down overheated stage affected by excessive harmonic currents. Automatic reset is standard

1.	2.	3.
		

Capacitor element

4. Varplus² capacitors have a unique, patented design that has been developed based on the Varplus M capacitor design that was in service for over 20 years with several million elements installed around the world. Advances in materials and design provide reliability, safety and longevity unsurpassed in the industry:

- The HQ (high-quality) protection system provides protection against two types of end-of-life faults: high-current faults are protected by an HRC cartridge fuse, low-current faults are protected by a combination of the overpressure disconnect device and the HRC fuse
- The unique, modular-cell design encapsulates the elements in a plastic housing mounted on a molded plastic base. The plastic materials minimize the chances of ground faults originating from the cells. Furthermore, the design of the cells leads to better heat dissipation resulting in a cooler operation and longer life

Contactors

5. UL and CSA listed LC1F contactors are capacitor switching duty rated and designed to provide performance and durability

4.	5.
	

Product Specification

Type	Enclosed automatic capacitor bank
Capacitor dielectric	Metalized polypropylene film
Internal connection	3 Phase, Delta
Tolerance on capacitance	0%/+15%
Discharge mechanism	Polycarbonate resistor, one per phase
Discharge time	One minute to less than 50 V
Expected life*	130,000 hours (nominal voltage and current), 0% THD (V)
Rated voltage (U_n)	208 V, 240 V, 480 V, 600 V
Rated frequency	60 Hz
Interrupting rating (maximum)	50 kA symmetrical at 600 V
	65 kA symmetrical ≤ 480 V
Continuous over-voltage	1.1 x U_n
Continuous over-current	1.35 x I_n
Maximum recommended harmonic current (I_h)	1.05 x I_h
Maximum recommended harmonic voltage (V_h)	1.07 x V_h
Ambient temperature range	-10˚C to +40˚C (+14˚F to +104˚F)
Highest mean over: 24 hours	+40˚C (+104˚F)
Highest mean over: one year	+30˚C (+86˚F)
Other conditions	Consult Schneider Electric
Altitude	≤ 1800 meters (6000 feet) without de-rating
Standards	CSA C22.2 No. 190, UL 810
Paint finish: indoor	ASA 49 standard; ASA 61 available upon request
Outdoor	Gray ASA 61
Enclosure	NEMA 1 standard, N3R available

* : 5% reduction in rated kVAR near the end of life is typical

Typical Applications

Applications	Requirement	Benefit
Power factor correction	Utilities impose power factor penalty, if power factor below target	Reduce power factor penalty expense
Power factor improvement	Increase distribution system capacity	Free up transformer capacity without capital expenditure
Fast reactive power compensation	Reactive power compensation responds load fluctuation	Provide on-time reactive power support

Selection Guide Steps

Applying capacitors to a network containing highly cyclical loads or harmonic producing loads warrants special considerations. The following information is normally needed:

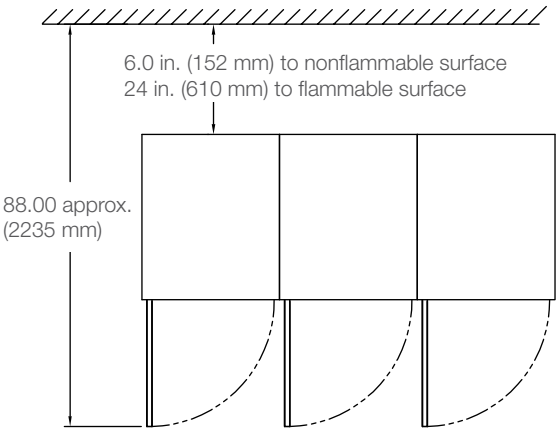
- 12 months of utility billing information
- Location of utility metering
- A single-line diagram of the network showing nature of loads (e.g. 150 HP FVNR starters; 200 HP VFD; etc.)
- Transformer(s) kVA rating, percent impedance (%Z), and primary and secondary voltages
- Current and Voltage Harmonic spectrum (magnitudes for each harmonic frequency) or TDD* and THD(V)** reading at point of the compensation
- Size and location of any existing capacitors

*TDD – Total Demand Distortion, indice to measure total harmonic current limit per IEEE519-1992
**THD(V) – Total Harmonic Voltage Distortion, indice to measure total harmonic voltage limit

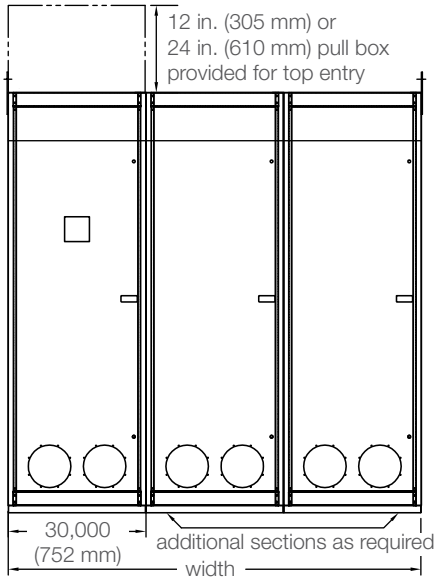
Typical dimension and weight information

Sections	Width Dimensions		AV6000/7000 Weight (maximum)		BV6000/7000 Weight (maximum)	
	in.	mm	Lb	Kg	Lb	Kg
1	30	762	1350	612	1250	567
2	60	1524	2700	1225	2600	1179
3	90	2286	4050	1837	3950	1792

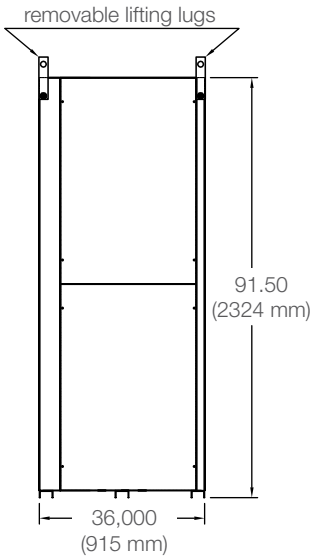
Note: weight information is approximate with section filled to maximum capacity.



Top view



Front view



Side view

A Wide Range of ReactiVar Products

Other ReactiVar products and services:

- PFCD LV fixed capacitors (Class 5810)
- AV5000 LV standard automatic capacitor banks for power factor correction of electrical networks (Class 5830)
- AT6000 and AT7000 transient-free reactive compensation systems (Class 5870)
- AccuSine® PCS active harmonic filters (Class 5820)
- Hybrid VAR compensator (HVC) systems for improved voltage regulation and power factor correction of highly cyclical loads (Class 5890)
- Medium voltage fixed capacitors up to 5kV (Class 5840)
- Medium voltage metal enclosed capacitors up to 15 kV (Class 5841)
- Engineering services available:
  - Size and rating assistance
  - Harmonic analysis
  - Computer simulations
  - Commissioning
  - Service contracts

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