Looking for extra capacity in your electrical system?

This equipment could be your answer.

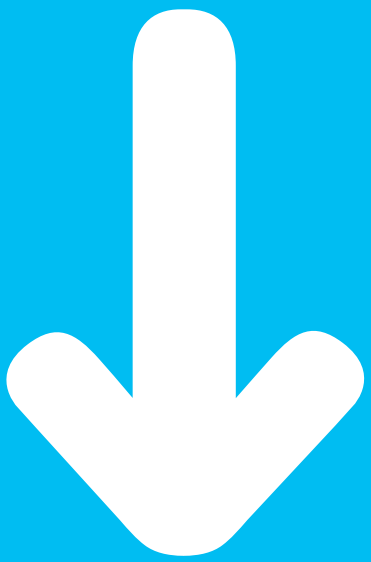
ReactiVar® Metal-Enclosed
Medium Voltage Capacitor Systems

SQUARE D
by Schneider Electric

Make the most of your energy℠

Schneider Electric

Many industrial facilities place poor power quality at the top of the list of factors responsible for efficiency loss, reduced productivity and lower quality of products. Optimization of electric power usage becomes a challenge as well as a necessity to keep up with ever-increasing energy demand without drastic increases in energy costs.



6000/7000

MV6000 anti-resonant and MV7000 filtered systems utilize higher voltage rated capacitor elements to ensure long-term system stability.

ReactiVar® Metal-Enclosed

Medium Voltage Power Factor Correction and Harmonic Filtering Capacitor Systems

Enhanced quality and sustained availability of electric power at an affordable cost is a major challenge today and into the future. Energy-hungry industrial, commercial and institutional facilities place a major challenge on the generating capacity of all utilities. Cost of new power generating facilities and power delivery transmission systems, further constrained by environmental and human factors, will force humankind to change energy consumption habits and enforce energy conservation.

Large industrial, commercial and institutional power users can benefit from centralized medium voltage reactive power compensation systems. Medium voltage solutions typically require lower initial capital expenditures ($/kVAR) than low voltage solutions while addressing most common power quality problems. Medium voltage metal-enclosed compensation systems provide a centralized solution approach with attractive installation options and support the scale of large electrical services. Large commercial customers supplied at higher voltage levels than 480/600V can utilize and take advantage of medium voltage reactive compensation systems.

Schneider Electric's Square D® ReactiVar metal-enclosed medium voltage capacitor systems are designed for industrial, commercial, institutional and utility power networks for which power factor correction, harmonic filtering and voltage regulation is required.

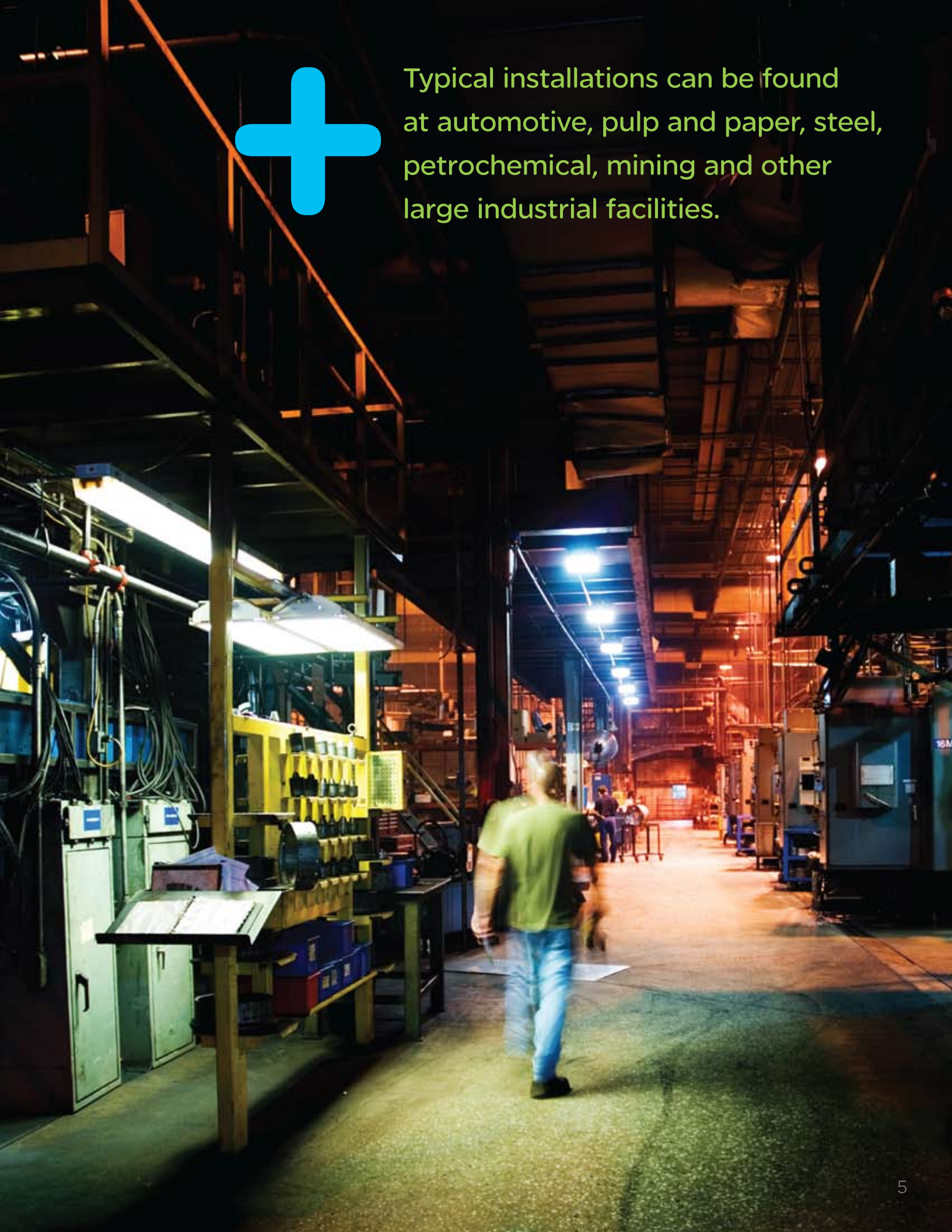
The product offer range includes fixed, single-stage, or multi-stage standard (MV5000), anti-resonant (MV6000) and filtered (MV7000) metal enclosed capacitor system assemblies to cover variety of objectives such as peak starting current reduction, power factor correction, harmonic filtering, utility demand charge minimization, system capacity release and network loss reduction. Custom engineered designs with a variety of standard or custom options are available to suit project-specific application and installation requirements.

Main Features

- Custom-engineered, metal-enclosed, multi-bay bolted lineups
- Systems available up to 20MVAR, 2.4kV through 15kV, 50/60Hz, 60/95kV BIL
- 11 Gauge bolted frame to meet ANSI switchgear standard
- Incoming section with integral Square D HVL fused air switch or Square D VR Vacuum breaker
- Externally-fused one-phase two-bushing or three-phase three-bushing capacitors connected in either ungrounded Wye or Delta
- Fully rated three- or four-pole grounding switches
- Stage unbalance protection relaying including stage lock-out and alarm functions
- Electrical solenoid time delay interlocks to ensure five minute capacitor discharge time before ground switch operation and enclosure access
- Kirk-Key interlock system for sequential operation of the control devices, main disconnect and ground switches
- State-of-the-art VarLogic® microprocessor based power factor controller
- All silver-flashed copper bussing and all copper power and control wiring
- Clear acrylic windows to inspect switch blade position and blown fuse indication
- Available in Type 1 indoor and Type 3R outdoor enclosure types

Standard Features and Options (automatic, multistage systems)*	MV5000	MV6000	MV7000
Silver Flashed Copper Bus	◆	◆	◆
Copper Power and Control Wiring	◆	◆	◆
Heavy Duty Capacitor Elements	◆	◆	◆
Inrush Current Limiting Reactors	◆	◇	◇
Iron Core De-tuning Reactors	◇	◆	◇
Iron Core Filter Reactors	◇	◇	◆
Control Power Transformer with HV/LV Fusing	◆	◆	◆
Electrical Time-delay Interlocks	◆	◆	◆
VarLogic NRC12 Controller	◆	◆	◆
Fans with Thermostat	◆	◆	◆
Heaters with Thermostat	◆	◆	◆
Three-phase Unbalance Protection Relaying on Each Stage	◆	◆	◆
CT Shorting Block	◆	◆	◆
Remote Mounted Control Cabinet	◆	◆	◆
Grounding Switch (each stage)	◆	◆	◆
Incoming Section with Non-load Break Air Switch	◆	◆	◆
Main Incoming Current Limiting Fuses	◆	◆	◆
Incoming Section with Main Draw-out Vacuum Circuit Breaker	◆	◆	◆
Bottom Cable Entry	◆	◆	◆
Top Cable Entry	◆	◆	◆
Type 1 Indoor Enclosure	◆	◆	◆
Type 3R Outdoor Enclosure	◆	◆	◆
ASA 70 Gray Paint	◆	◆	◆
ASA 61 Gray Paint	◆	◆	◆

◆ Standard feature
◆ Available option – contact Schneider Electric for details
◇ Not available
★ For fixed systems or other custom options, contact Schneider Electric at 1-888-squared for details



Typical installations can be found at automotive, pulp and paper, steel, petrochemical, mining and other large industrial facilities.

Key Components

Enclosure

1. Bolted-frame, free-standing, multiple-bay lineups constructed from 11-gauge formed steel specifically engineered for rigidity. Enclosure is painted with corrosion resistant ANSI 70 polyester powder paint. Plus, doors and panels include viewing windows. Outdoor NEMA 3R enclosures feature bottom frame for additional protection.

Capacitor Units

2. Low loss, polypropylene capacitor elements with biodegradable dielectric fluid are supplied. They are designed, manufactured and tested to meet or exceed IEC871, IEEE St.18 and NEM CP1 standards.
   - Each capacitor is supplied with internal discharge resistors to bring the residual voltage down to 50V within five minutes after de-energization
   - Three-phase, three-bushing or single-phase, two-bushing capacitor cells are available
   - Capacitor cells are Delta or ungrounded Wye connected – depending on the application
   - Capacitors can be externally fused (standard) or internally fused (optional)

Main Incoming

3. Integral, externally operated Square D HVL switch can be provided with or without fuses for disconnecting and/ visible isolation purpose. It can be used in a capacitor system as a load-break switch for up to 2400kVAR at either 5kV or 15kV. When provided with fuses, the HVL also provides integrated short circuit protection for the capacitor system. The switch disconnect is mechanically interlocked with grounding switches and with the customer's upstream device (if applicable). The Square D VR vacuum circuit breaker can be provided as an option. Breakers are draw-out type with full relaying protection.

Vacuum Switches

Depending on the operating voltage, vacuum contactors or vacuum breakers are used in multi-stage capacitor systems.

4. Vacuum contactors
   - Rated by system voltage and BIL requirements (7.2kV and below)
   - Designed for capacitive load switching
   - Insulated barrier between high and low voltage parts
   - Long electrical and mechanical life (over 250,000 operations)
   - Contact status indicators are included

1.	2.	3.	4.
			

5. Vacuum breakers

- Used in applications above 7.2kV in which high BIL and interrupting ratings are required
- Three-pole, fixed mounted with AC or DC independent controls
- Open/closed and charged/discharged indicators on the front of the circuit breaker for visible indication
- Anti-pump relay to avoid breaker cycling in the event that both a “close” and “trip” signal are present
- Contact status indicators are included

Reactors

6. Air core

- Inrush current limiting – used in multi-stage capacitor systems to protect against back-to-back switching transients
- Entire reactor assembly is impregnated and baked with high temperature thermo-setting epoxy resin to provide superior insulation levels
- Single-phase bus mounted
- Copper wire wound

7. Iron core for MV6000 and MV7000

- De-tuned or filtering applications
- Custom designed and manufactured under rigorous standard
- Reactors are constructed with laminated low loss magnetic material and precision controlled air gaps
- 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
- Three-phase or single-phase units are available

5.	6.	7.
		

Key Components (Continued)

Protection

8. Grounding switch
- Three- or four-pole fully rated grounding switch is provided depending on the capacitor bank configuration
- Located on each stage in multi-stage systems
- Blades are visible via viewing window
- Kirk-Key interlocked with controls and main isolation/feeder device

9. Relaying
- Three-phase unbalance and overload protection via phase current sensing for either Wye or Delta connected capacitor banks
- Blown fuse detection
- Square D Sepam digital relays with phase current display, stage lock-out and alarm functions

10. Interlocking
- Kirk-Key interlocks are provided on doors, controls, grounding switches, main disconnects and external feeder devices (if applicable)
- Solenoid time-delay interlocks are included as a standard option to enforce capacitor discharge time

VarLogic NRC1 2 Controller

11. Automatic capacitor systems come equipped with a microprocessor-based automatic PFC (power factor correction) controller. The controller is fully programmable with extensive display functions and parameters. A wide range of alarm functions allow for advanced capacitor bank protection and remote indication. Main features include:
- Menu-driven operation for monitoring, commissioning and configuration
- Automatic adjustment for current transformer polarity and phase sequence
- Automatic no-voltage release and automatic staged reconnection
- A backlit display for display of power factor, steps energized, step status, time delay, real and reactive power, voltage THD, alarm codes and more
- Alarm menu with alarm relay indication available for abnormal conditions
- Measurement of total current harmonic distortion
- Harmonic spectrum for current and voltage
- Step condition monitoring (capacitance loss)
- Individual step programming (up to 12 steps)
- Online user help menus
- Optional RS485 Modbus® auxiliary communication module

8.	9.	10.	11.
			

Applying capacitors to medium voltage distribution networks is not straightforward. Many application aspects need to be considered such as capacitor kVAR size and switching configuration, back-to-back capacitor switching transients, presence of large existing capacitor banks and their configuration, available short circuit levels, harmonic energies and plant load sensitivities.

It is highly recommended that you contact the Schneider Electric Power Quality Correction Group for application assistance. The guide on the next page lists steps and indicates what information is required to properly and efficiently specify/recommend medium voltage compensation systems.

MV Selection Guide Steps

1. Network Information

Each MV capacitor bank project starts with basic information collection with respect to facility and immediate utility network characteristics. Network nominal voltage, operating voltage, frequency and short circuit availability are necessary for proper capacitor bank design. Information on power delivery transformer ratings (nominal kVA, impedance), presence of any existing capacitor banks (type and ratings) in the facility or at the utility feeder, and general network topology and operation are necessary. Most of the above information may be available from single line diagrams.

2. Reactive Power Estimation

Required reactive power calculations greatly depend on the purpose (objective) of the compensation system. Utility bills may provide total reactive power requirements and information on the target power factor levels required. Better yet is to have actual load magnitude measurements (either total for the entire facility or for individual services) to quantify required reactive power requirements. Special applications (i.e. motor starting compensation, highly fluctuating cyclical load compensation) may require special data collection, which is not typically available from general power metering devices.

3. Load Characteristics

Evaluation of the load characteristics with respect to harmonic content (both voltage and current) becomes a main factor in proper capacitor bank type specification. Presence of nonlinear (i.e. harmonic generating) loads such as VFDs, DC drives, welders and/or furnaces internal to the facility in question or in a neighboring facility, which is supplied by the same utility feed, may force special compensation system design requirements to avoid resonance conditions and protect the compensation system from harmonic overloads. Load harmonic content together with load variations – based on facility process and production – are important to set required capacitor bank type, stage sizes and define its operation parameters.

4. Site Information

Specific site information such as installation location, site environmental conditions, required feeder and main protection options are required to finalize the MV compensation system design.

A Wide Range of ReactiVar Products

Meet Your Facility Solution Needs

- PFCD Low Voltage Fixed Capacitors
- AV5000 Standard Automatic Capacitor Banks
- AV6000 LV Anti-Resonant Automatic Capacitor Banks
- AV7000 LV Filtered Automatic Capacitor Banks
- AT6000 Anti-Resonant LV Transient-Free Reactive Compensation Systems
- AT7000 Filtered LV Transient-Free Reactive Compensation Systems
- LV and MV Hybrid Harmonic and VAR Compensation Systems
- AccuSine® PCS Active Harmonic Filter
- Medium Voltage Fixed Motor Power Factor Capacitors up to 5kV
- Engineering Services Available:
  - Sizing and rating assistance
  - Computer simulations
  - Service contracts
  - Harmonic analysis
  - Commissioning

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