VarStec Power Solutions, Inc.
PO Box 942
Saratoga Springs, NY 12866
VarStec.com
Info@VarStec.com
518.369.7589

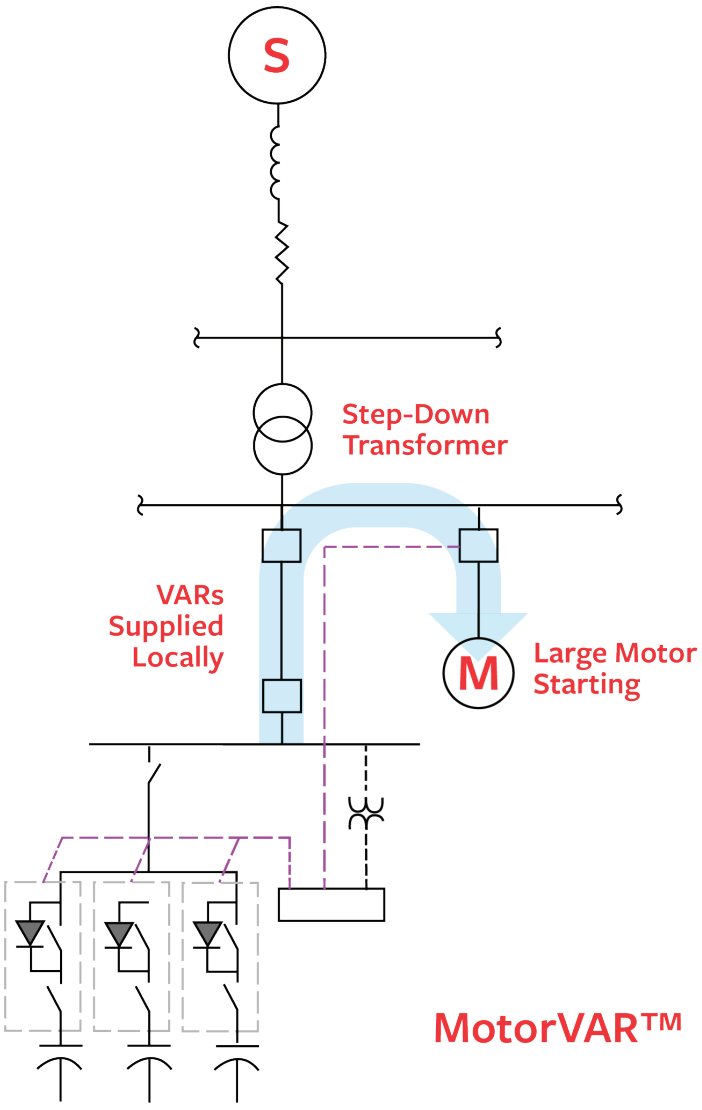
MotorVAR™ Medium-Voltage Motor Starting Capacitor Banks

OVERVIEW / KEY FUNCTION

System-fit, medium-voltage motor starting capacitor banks designed to provide precise, transient-free reactive power at the motor bus during large motor starts. These purpose-built, metal-enclosed MotorVAR™ systems support the reliable starting of large induction and synchronous motors, maintain acceptable system and motor terminal voltages, preserve available starting torque, and reduce voltage sag with a simpler, more maintainable alternative to VFD, RVSS, and transfer-switchgear-based starting schemes.

When large medium-voltage motors start, they draw high inrush current that can depress system voltage, disturb other plant loads, and reduce motor terminal voltage to the point that available starting torque becomes inadequate for the driven load. These challenges become more pronounced as motor size increases, system strength decreases, or utilities impose voltage-sag or inrush-current limits. Traditional starting approaches such as reduced-voltage soft starters (RVSS) and variable frequency drives (VFD/ASD) are often used to address the problem, but they also introduce added cost, larger equipment lineups, harmonic considerations, controls complexity, and maintenance burden.

VarStec's MotorVAR™ is a system-fit, medium-voltage motor starting capacitor bank engineered to deliver precise, transient-free reactive power locally during motor acceleration. By supporting voltage at the motor bus during starting, MotorVAR helps maintain acceptable system and motor terminal voltages, preserve starting torque, and reduce the voltage sag imposed on the upstream electrical network. Delivered as a fully integrated, metal-enclosed, factory-assembled solution built from proven, non-proprietary components, MotorVAR provides a simpler and more maintainable alternative to complex VFD and RVSS based starting schemes.



APPLICATIONS FOR LARGE-SCALE MOTOR STARTING SUPPORT

MotorVAR™ systems are engineered for applications where large medium-voltage induction or synchronous motors, typically in the 4,000 to 15,000+ HP range, must be started reliably without unacceptable voltage sag, inadequate starting torque, or the cost and complexity of traditional reduced-voltage starting schemes. Because the required reactive support depends on source strength, transformer impedance, utility limits, motor characteristics, and bus configuration, each MotorVAR solution is system-fit to the specific electrical network and starting duty. Typical applications include:

- **Large Pumping and Compression Facilities**
  Gas compression stations, pipeline pumping installations, and similar facilities often include multiple large motors on a common bus. In these applications, one MotorVAR™ system can support the sequential starting of multiple pumps or compressors, replacing one or more RVSS or VFD starter lineups without the need for synchronous bypass switchgear.
- **Weak Systems or Utility-Limited Interconnections**
  Installations where available short-circuit strength is limited, or where utilities impose voltage-sag and inrush-current constraints that make conventional across-the-line starting impractical or non-compliant with utility interconnect requirements.
- **Facilities with Captive Transformer Configurations**
  Plants where motors are supplied through dedicated or captive transformers and voltage performance must be managed across multiple plant voltage levels during starting.
- **Retrofit or Hybrid Starting Applications**
  Existing installations where an RVSS or line reactor has already been applied but cannot independently achieve acceptable starting performance. In these cases, MotorVAR can be coordinated with existing equipment to extend practical operating range and improve voltage support during starting.
- **Plant-Wide Shared Motor Starting Support:**
  One MotorVAR™ system can be applied as a plant-wide solution to assist with the sequential starting of multiple large motors, replacing several RVSS or VFD starter systems with a single shared reactive support system. As the number of supported motors increases, this approach becomes increasingly attractive through reduced equipment cost, lower switchgear requirements, and less startup and commissioning complexity.
- **Redundant Power Systems**
  MotorVAR™ can be applied on redundant main-tie-main systems using dual incoming connections to support motor starting on either bus section. For fully redundant applications, two MotorVAR systems can be provided so that either system can support either bus, allowing one complete system to be shut down without losing motor-starting capability.

TECHNICAL DETAILS & SYSTEM CONFIGURATION

VarStec applies system-fit engineering to deliver MotorVAR™ solutions aligned with the specific source strength, transformer impedance, utility constraints, motor characteristics, and plant voltage-performance objectives of each project. Each system is engineered to support acceptable voltage at the motor bus and upstream electrical system during starting while preserving the motor terminal voltage needed for reliable acceleration of the driven load.

Advanced Transient-Free Switching
MotorVAR integrates ABB's DS1M diode-based transient-free switching technology, modified for motor-starting duty, to energize and de-energize capacitor stages without the switching transients, restrikes, or overvoltages associated with conventional capacitor switching methods.

Intelligent Open-Architecture Protection and Control
MotorVAR utilizes a specially programmed SEL-487V relay to provide high-speed protection, staging logic, sequencing, and system monitoring. The control scheme is configured to coordinate capacitor-stage switching with motor-starting duty, automatically bringing the required reactive support online during acceleration and sequencing stages offline as the motor approaches normal operating speed.

Integrated Power Factor Correction Capability
MotorVAR can be equipped with dedicated power factor correction stages, improving overall project economics. In addition, where the application permits, one or more MotorVAR stages can be repurposed after motor starting to provide steady-state power factor correction. This allows a single integrated system to support both motor-starting performance and ongoing plant reactive power needs.

Rapid Sequential Motor Starting
Standard MotorVAR systems are configured with a 5-minutes capacitor discharge interval between motor starts. Where operating requirements demand faster repeat starts, MotorVAR can be equipped with a fast-discharge option that significantly reduces the time between sequential starts to 10 seconds.

Flexible System Integration
MotorVAR can be engineered for direct across-the-line motor starting, coordinated operation with existing RVSS installations, combined application with line reactors, and captive-transformer configurations where voltage performance must be managed across multiple plant voltage levels.

Harmonic-Environment Compatibility
In harmonic environments, including installations with non-linear process loads or existing RVSS equipment, MotorVAR can be equipped with detuning reactors so the capacitor system does not interact adversely with the plant harmonic profile.

STRATEGIC BENEFITS OF MOTORVAR™ ENGINEERING

MotorVAR™ is engineered to improve motor-starting performance while reducing the cost and complexity typically associated with conventional reduced-voltage starting schemes. By delivering reactive power locally and switching it transient-free, MotorVAR supports reliable starting of large motors with a simpler, more maintainable system architecture.

Eliminates E-Houses and Reduces Starting-System Complexity

Unlike VFD and RVSS configurations that rely on proprietary solid-state equipment sensitive to heat, dust, and environmental conditions, MotorVAR avoids the need for large climate-controlled E-Houses and synchronized bypass switchgear.

Preserves Available Starting Torque

RVSS and line-reactor starting methods reduce inrush current by reducing the voltage applied to the motor, which can also reduce available starting torque. By supplying reactive power locally at the motor bus during acceleration, MotorVAR helps preserve the torque needed for strong, stable acceleration of large induction and synchronous motors.

Reduces Upstream System Disturbance

Because the required reactive power is supplied locally during starting, MotorVAR reduces the inrush burden seen by the upstream network, helping limit voltage sag at the PCC and reduce disturbance to other plant loads connected to the same electrical system.

Highly Scalable for Multiple Motors

A single MotorVAR installation applied at the main motor bus can often support the sequential starting of multiple large motors across a facility.

As the number of supported motors increases, the economic advantage of one shared MotorVAR system over multiple dedicated RVSS or VFD starter lineups becomes increasingly compelling.

Factory-Integrated, Pre-Tested Delivery

MotorVAR is delivered as a fully integrated, metal-enclosed, factory-assembled system, shifting critical assembly, integration, and testing work away from the field and into a controlled manufacturing environment.

Open Architecture for Simplified Maintenance

Built from proven, off-the-shelf, non-proprietary components, MotorVAR avoids black-box control dependencies. Protection and control logic are visible, documented, and adjustable, allowing qualified plant personnel to perform routine maintenance and troubleshooting without dependence on vendor-locked service support.

Flexible Application Across Plant Configurations

MotorVAR can be engineered for across-the-line starting, coordinated application with existing RVSS or line-reactor systems, captive-transformer configurations, plant-wide shared motor-starting duty, and redundant main-tie-main distributions.

RATINGS, CONFIGURATION & OPTIONS SYSTEM-FIT TO SPECIFICATIONS

Electrical Ratings & Configuration

- **Capacitor Bank Type:** multiple-stage
- **Capacitor Connection:** Single-wye ungrounded
- **Operating Voltage (L-L):** 2.4 kV to 13.8 kV
- **Maximum Operating Voltage:** +10%
- **Reactive Power Output:** 1 MVAR to 60 MVAR
- **Impulse Withstand Voltage** (BIL): 95 - 110kV
- **Short-Time Withstand Voltage (1 minute):** 38 kV

Switching, Protection & Control

- **Control Mode:** automatically switched based on motor command
- **Switching Devices:** ABB DS1M transient-free switching device
- **Controllers:** SEL487V Relay – Special programming by VarStec
- **Protection Functions:** Overcurrent | overvoltage | unbalance | neutral voltage, split-wye neutral current | direct-fuse sensing | fuse-failure detection | VTHD | ITHD | over-temperature | other
- **Unbalance / Blown Fuse Detection:** Direct Fuse Sensing | other approved methods
- **Interlocks:** Mechanical | electrical | key

Communications & Integration

- **Communication Protocols:** Modbus RTU | Modbus TCP | DNP3 | IEC 61850 | IEC 60870-5-103/101/104 | Ethernet/IP | SEL-specific legacy protocols | SNTP | IEEE 1588 PTP | RSTP | FTP | Telnet
- **Remote Monitoring:** Alarm reporting | event recording | waveform capture | remote engineering access

Power Components & Accessories

- **Capacitor Units:** As specified, by Hitachi Energy, Eaton, GE
- **Power Fuses:** Current-limiting, by SIBA
- **Surge Arresters:** Station-class | distribution-class

Connections & Construction

- **Enclosure Type:** NEMA 1 | 3R | 4X | 12 | or IP equivalent
- **Sheet Metal:** 11-gauge cold-rolled galvanneal steel standard | 12-gauge 304, 316, or 409 stainless steel
- **Coating System:** High-solid epoxy siloxane marine coating (5,500-hour salt-spray resistance)

Environmental & Site Conditions

- **Operating Temperature Range**: -50°C to +55°C (-58°F to +131°F)
- **Maximum Altitude Without De-Rating:** Up to 1,000 m (3,300 ft), or higher with VarStec mitigation
- **Seismic Qualification:** Up to Zone 4

Standards, Testing & Documentation

- **Applicable Standards:** IEEE Std 18-2012, IEEE 1036, IEEE 519, IEEE C37.20.2, etc.
- **Listing / Certification:** UL | NRTL | CSA | CE