• Varmaster Switches 15kV - 69kV
• VBU Switches 69kV - 230kV
• Zero Voltage Closing Controls
• Fisher Pierce Capacitor Controls
Varmaster switching systems use VBM switches that are completely sealed breaker class devices utilizing vacuum as the interrupting dielectric. VBM switches offer high reliability with little or no maintenance. Interruption is safe, with no external arcing, and quiet. VBM Interrupters are manufactured for application at system voltages from 15 to 69 kV. Vacuum interrupters are connected electrically in series to provide the necessary recovery voltage characteristics for the specific application. Vacuum interrupters may also be connected electrically in parallel for high continuous or momentary current requirements.

VBM Switches are lightweight and require no special foundations or supports. VBMs are completely factory assembled, ready for fast, easy installation.

Each vacuum interrupter is enclosed in a shatterproof, high dielectric housing to form a module (Figure 1) designed with all solid insulation. The interrupter is surrounded by “Joslyte™” high-dielectric strength non-hygrosopic solid foam that does not absorb moisture, eliminates condensation and increases the impulse level on the outside of the vacuum interrupter. No gas, oil or other material is required to maintain electrical properties.

One or two vacuum modules are mounted on each line-to-ground insulator and are connected to the operating mechanism by a high strength pull rod. The operating mechanism is completely sealed in a housing, which supports the line-to-ground insulators and the modules. An environmental protection system in the housing, consisting of a breather chamber and desiccant prevents moisture and contaminated air from entering the switch operator. An “Open/Closed” position indicator is directly coupled to the mechanism. The entire assembly can withstand a force of several “G’s” without damage.

Stored energy operating mechanisms that can be operated manually or electrically move the contacts at a high speed and are unaffected by control voltage fluctuation or manual operating speed. An operation counter is included with each switch. A wide range of AC and DC voltage control package options are available. All electrical control connections to the operating mechanism are made through a single environmental control cable connector.
Capacitor Switching
Joslyn VBM Varmaster Switches are ideally suited for repetitive switching of any load, and can carry or switch full continuous current rating regardless of power factor. Maximum load current including harmonics, nameplate-rating tolerances of the load, and system voltages must be considered in selecting the continuous current rating. Switching capacitor banks connected back-to-back may require current limiting reactors, available from Joslyn, to limit high frequency inrush currents.

Zero Voltage Closing (ZVC)
The Joslyn ZVC control can be supplied with the Varmaster switching package to reduce system overvoltages and stress on capacitors due to overvoltages and high inrush currents. Refer to the ZVC section in this brochure for a more detailed description.

Reactor Switching
The Joslyn VBM Varmaster reactor switch can reliably switch shunt reactors. The “low” 4.1-ampere mean chop current of these switches eliminates overvoltage concerns. Continuous current ratings through 3000 amperes are available.
VARMASTER MODELS

THREE PHASE
15kV/25kV\(^1\) 400A
15kV/25kV\(^1\) 600A

THREE PHASE
25kV 200A
25kV 300A
25kV 400A

THREE PHASE
38kV 300A

\(^1\)Solid grounded system and capacitor banks only.

ONE POLE
38kV 400A
38kV 600A
48.5kV 200A
(with longer insulators)

ONE POLE
48.5kV 300A
48.5kV 400A

ONE POLE
72.5kV 300A

\(^2\)Three poles required for a 3-Phase installation

Figure 2
Table 1  VBM Varmaster Ratings

<table>
<thead>
<tr>
<th>Maximum Voltage</th>
<th>15.5kV/25kV³</th>
<th>25kV</th>
<th>38kV</th>
<th>48.5kV</th>
<th>72.5kV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacitor Switching and Continuous Current¹,² (Amperes)</td>
<td>400</td>
<td>600</td>
<td>600</td>
<td>200</td>
<td>300</td>
</tr>
<tr>
<td>Fault Interrupting Current (Amperes)</td>
<td>3kA</td>
<td>4kA</td>
<td>8kA</td>
<td>3kA</td>
<td>3kA</td>
</tr>
<tr>
<td>Momentary Current (RMS Amperes, Asymmetric)</td>
<td>20kA</td>
<td>20kA</td>
<td>20kA</td>
<td>15kA</td>
<td>15kA</td>
</tr>
<tr>
<td>Impulse Withstand, Terminal-to-Terminal⁵</td>
<td>110</td>
<td>110</td>
<td>110</td>
<td>200</td>
<td>200</td>
</tr>
<tr>
<td>Line-to-Ground (1.2 x 50 Positive Wave)</td>
<td>150</td>
<td>150</td>
<td>150</td>
<td>150</td>
<td>150</td>
</tr>
<tr>
<td>Two Seconds Wet</td>
<td>74</td>
<td>74</td>
<td>74</td>
<td>74</td>
<td>74</td>
</tr>
<tr>
<td>Maximum Peak Making Current (kA)</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>Maximum Peak Back-to-Back Inrush Current (kA)⁶</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Two-second Current</td>
<td>12,500 Amperes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Four-second Current</td>
<td>9,000 Amperes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

¹VBM Varmasters can switch loads of any power factor up to their continuous current rating. Include effects of voltage variances, harmonic currents and load tolerances in calculating continuous current.

²VBM Varmasters are available with continuous current ratings through 3000 amperes. Consult factory regarding application of these switches.

³Grounded systems only

⁴In capacitor switching applications the 48.5kV, 200 ampere VBM may be used on solidly grounded systems and grounded capacitor banks with total current less than 200 amperes. For all other loads, this VBM rating is 600 amperes.

⁵Interrupter portion of switch does not provide a visible open gap; therefore it cannot be used to establish a safety clearance for personnel.

⁶In back-to-back capacitor bank switching applications, it is recommended that inrush current be limited to the values shown for maximum maintenance-free performance. Current limiting reactors through 60 microhenries/phase are available from Joslyn Hi-Voltage. Refer to Joslyn bulletin T.D. 750-457
VARMASTER OPTIONS & ACCESSORIES

VARMASTER OPERATING MECHANISMS

1. Solenoid Mechanism
Solenoid operators have an expected maintenance-free life of 100,000 operations on AC and 15,000 operations on DC. Controls for solenoid operators are mounted in a separate enclosure.

2. Motor Mechanism
Motor operators are primarily used on single mechanism VBM’s such as 15kV, 400A and 600A switches and 34.5kV, 300A switches. All controls are located inside the VBM mechanism housing. Inspection after 10,000 operations is recommended.

Table 2  Operating Mechanisms Options

<table>
<thead>
<tr>
<th>Voltage</th>
<th>Operating Mechanism</th>
<th>Control Current Per Switch Mechanism</th>
<th>Close Time</th>
<th>Trip Time</th>
<th>Auxiliary Contacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC</td>
<td>120 V</td>
<td>Motor(^5) Solenoid(^3)</td>
<td>5 amps</td>
<td>3 sec</td>
<td>2 cycles</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>60 amps(^7,8)</td>
<td>6 cycles</td>
<td>4”a” and 4”b”(^2)</td>
</tr>
<tr>
<td>48 V</td>
<td></td>
<td>Motor(^5) Solenoid(^3,8)</td>
<td>3 amps</td>
<td>5 sec</td>
<td>2 cycles</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>60 amps(^6)</td>
<td>6 cycles</td>
<td>4”a” and 4”b”(^2)</td>
</tr>
<tr>
<td>DC</td>
<td>125 V</td>
<td>Motor(^5) Solenoid(^3)</td>
<td>4 amps</td>
<td>3 sec</td>
<td>2 cycles</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>60 amps(^7,8)</td>
<td>6 cycles</td>
<td>4”a” and 4”b”(^2)</td>
</tr>
<tr>
<td>250 V</td>
<td></td>
<td>Solenoid(^3,8)</td>
<td>60 amps</td>
<td>6 cycles</td>
<td>6 cycles</td>
</tr>
</tbody>
</table>

\(^1\)Two A and two B mechanically operated contacts are standard. Six A and six B contacts available as option. Contacts are rated at 10 amps 125 VDC or 115 VAC.
\(^2\)Four A and four B contacts available from auxiliary relay. Eight A and eight B contacts available as option. Contacts are rated at 15 amps 120 VAC and 10 amps 125 VDC.
\(^3\)For capacitor or reactor switching, a low energy control is available. See Table 3, Options and Accessories.
\(^4\)Close or Trip Times are measured from applying of close or trip signals. Vacuum contact travel time is six milliseconds. All VBM’s have built-in anti-pump controls.

Varmaster Terminal Pad Orientation Options
(for single mechanism switches)

![Diagram 1]
Zero Voltage, Independent Pole closing control for Capacitor Switching
Closes the three poles independently synchronized with zero voltage in each phase to eliminate overvoltages and reduce inrush current. See page 10 for more information.

Fisher Pierce Brand Capacitor Controls

Series 4400 AutoCap™
Adaptive Capacitor Controller and Recorder
Microprocessor based control featuring one-to-four programming adapts itself to the installation. The controller automatically corrects for installation errors. Programmable control modes include Var, current, voltage, time and temperature, as well as override and protective functions. Windows based application software is included.

Series 4500 AutoCap™ Adaptive Capacitor Controller with Two-Way Communications
Microprocessor based control including all features of the Series 4400 with data radios for two-way communications. A dedicated communications microprocessor and flash memory allow the use of data radios cellular, and modern communication technologies. The result is a powerful tool for discrete feeder management, data gathering, trouble shooting, system evaluation analysis.

PowerFlex® Two and Three Step Capacitor Switching Controllers
Multi-step controllers are intended for use with multiple capacitor racks found in substation applications. The controls can be purchased in Var, voltage or line current configurations. The control operates the first step which activates the following steps after a fixed time delay. Proper sequencing on capacitors is ensured.

Joslyn Capmaster Capacitor Controls
The Joslyn Capmaster family of capacitor controllers can be provided with standard time or voltage sensing functions including voltage override.

Undervoltage Trip Option
The undervoltage trip accessory causes the switch to open within three cycles of loss of control power.

Low Energy, Capacitor Discharge Option
This control package enables use of solenoid operated switches in locations where control power is limited. The main application for this system is in switching substation capacitor banks and reactors, which are located at long distances from the source of power. Current drain is 5 amperes peak and less than 30 milliamperes average.

Current Limiting Reactors
For back-to-back capacitor switching applications, reactors with wide range of inductance are available for all system voltages. Refer to Joslyn bulletin TD 750-457.

Overcurrent Relay Packages
Complete relay packages are available for fault interruption applications.

Junction Box Accessory (Motor Operated VBM’s only)
A weatherproof junction box can be mounted on the VBM mechanism housing containing terminal strips for customer connections to the internal switch control circuits. This can be supplied instead of the control cable.

Time Delay Relay
A 5-minute time delay can be included in the controls to prevent closing into a charged capacitor bank.

Heater For Control Enclosures
(No heater is required for the VBM or VBU switch).

Electrical Operations Counter
This counter is mounted in the control cabinet. (A mechanical counter is always provided on the VBM switch.)

Upright Stands and Pole Mounting Frames

Special Controls
Joslyn can design special controls for particular applications. Please contact the factory.
The VBU Switching System is completely sealed against the environment. They are immune to ice and to the effects of contamination. The mechanism is completely sealed so no heaters are required. Routine “exercise” is not required. The VBU is designed to withstand system voltage continuously in the open position.

Suitable for all loads, the VBU with reliable vacuum interrupters ensure dependable switching of magnetizing current, cable or line charging current or load current of any power factor. VBUs are ideally suited for capacitor switching.

The VBU can be applied on 69kV to 230 kV systems. The flexibility of modular design makes a change in the voltage rating of VBUs as simple as adding or subtracting the appropriate number of vacuum contact modules.

The VBU is safe even when exposed to fault currents that exceed the equipment rating. They are free of explosive or combustible materials.

VBUs are virtually maintenance-free. All that is needed is a normal operation inspection every five years or 10,000 operations.

VBUs are easily installed. They are shipped completely assembled and adjusted. They are lightweight. Field installation is quickly and easily accomplished. Often they are mounted on potential transformer stands.

The VBU System is economical. They are less expensive to purchase than circuit breakers and less expensive to install. They are free of routine maintenance, and require a minimum of structural support and space.
The VBU utilizes a modular design concept which connects vacuum interrupter modules electrically in series and mechanically in parallel. The VBU is supplied with the appropriate number of modules determined by recovery voltage considerations for specific applications. (Refer to table 4) Order by fully describing the application, options and accessories.

**Table 3 VBU Ratings**

<table>
<thead>
<tr>
<th>Voltage Class</th>
<th>69kV -230kV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuous Current (Amperes)</td>
<td>600</td>
</tr>
<tr>
<td>Fault Interrupting Current (Amperes, Symmetrical)</td>
<td>4,000</td>
</tr>
<tr>
<td>Momentary Current (Amperes, Asymmetric)</td>
<td>40,000</td>
</tr>
<tr>
<td>Two-Second Current (Amperes)</td>
<td>10,000</td>
</tr>
<tr>
<td>Three Second Current (Amperes)</td>
<td>8,000</td>
</tr>
<tr>
<td>Four Second Current (Amperes)</td>
<td>7,000</td>
</tr>
<tr>
<td>Closing Time</td>
<td>90 milliseconds</td>
</tr>
<tr>
<td>Maximum Interrupt Time</td>
<td>2 cycles</td>
</tr>
</tbody>
</table>

**Standard Control Features Include:**

- Electrical Operations
- Counter, Heater, Anti-Single Phasing Circuit

**Control Current Close:**

1 ampere peak at 48 V.D.C. or 25 V.D.C.

**Trip:**

18 amperes at 125 V.D.C.; 54 amperes at 48 V.D.C.

**Table 4 VBU Ratings**

<table>
<thead>
<tr>
<th>Rated Maximum Voltage kV</th>
<th>L-G BIL kV</th>
<th>Interrupter Modules per Phase</th>
<th>A</th>
<th>B</th>
<th>Weight per Phase Lbs.</th>
<th>Primary Application*</th>
</tr>
</thead>
<tbody>
<tr>
<td>72</td>
<td>350</td>
<td>4</td>
<td>8' 7¼”</td>
<td>30°</td>
<td>710</td>
<td>T G U</td>
</tr>
<tr>
<td>121</td>
<td>550</td>
<td>5</td>
<td>11' 1¼”</td>
<td>48°</td>
<td>860</td>
<td>T G</td>
</tr>
<tr>
<td>121</td>
<td>550</td>
<td>7</td>
<td>13' 1¼”</td>
<td>48°</td>
<td>940</td>
<td>U</td>
</tr>
<tr>
<td>145</td>
<td>750</td>
<td>6</td>
<td>13' 1¼”</td>
<td>60°</td>
<td>950</td>
<td>T</td>
</tr>
<tr>
<td>145</td>
<td>750</td>
<td>7</td>
<td>14' 1¼”</td>
<td>60°</td>
<td>990</td>
<td>G</td>
</tr>
<tr>
<td>145</td>
<td>750</td>
<td>8</td>
<td>15' 1¼”</td>
<td>60°</td>
<td>1030</td>
<td>U</td>
</tr>
<tr>
<td>169</td>
<td>750</td>
<td>7</td>
<td>14' 1¼”</td>
<td>60°</td>
<td>990</td>
<td>T</td>
</tr>
<tr>
<td>169</td>
<td>750</td>
<td>8</td>
<td>15' 1¼”</td>
<td>60°</td>
<td>1030</td>
<td>G</td>
</tr>
<tr>
<td>169</td>
<td>750</td>
<td>9</td>
<td>16' 1¼”</td>
<td>60°</td>
<td>1070</td>
<td>U</td>
</tr>
<tr>
<td>242</td>
<td>900</td>
<td>9</td>
<td>17' 7¼”</td>
<td>78°</td>
<td>1180</td>
<td>T G</td>
</tr>
</tbody>
</table>

*T- Transformer Switching & Fault Protection- Grounded or Ungrounded
G- Shunt Capacitor or Reactor Switching- Solidly Grounded Source & Load
U- Shunt Capacitor or Reactor Switching- Ungrounded Source or Load

**VBU OPTIONS & ACCESSORIES**

Refer to options & accessories on page 7.
FEATURES

- Eliminates Electronic Adjustable Speed Drive Nuisance Tripping
- Increases Capacitor Life
- Eliminates High Inrush Currents
- Reduces System Overvoltages Normally Associated with Random Capacitor Switching
- Several Hundred Installations Worldwide
- Over Fifteen Years Successful Field Experience
- Available for Voltages from 15 to 230kv
- Now Available for Distribution Capacitor Banks

- Easy Installation Setup
  a. Select phase rotation
  b. Select reference phase (and phase shift if necessary)

Interfaces with new or existing Capacitor Controllers and Joslyn Vacuum Switch

Joslyn’s commitment to the demanding duty of capacitor switching is further demonstrated by the development of an optional control package to close three switch poles independently, synchronized with the occurrence of zero voltage in each phase.

The mechanical simplicity, high-speed operation and response repeatability of the Joslyn vacuum switches make this application feasible. The result is elimination of overvoltage duty on the capacitors and system overvoltage disturbances which were once tolerated as an inherent negative aspect of energizing a capacitor bank, and the significant reduction of inrush current duty on the capacitors as illustrated in the difference between Figure 5 and Figure 6. The control can be also interfaced with any manufacturer capacitor controller.
1. Select Application
   Capacitor Switching, Reactor Switching or Filter Bank Switching
   (Certain Filter Banks may require additional vacuum interrupters. Please consult the factory when applying VBM Varmasters or VBU's for Filter Bank Switching.

2. Voltage Rating
   VBM Varmaster: 15.5kV, 25kV, 38kV, 48.5kV, or 72.5kV
   VBU: 72kV, 121kV, 145kV, 169kV, or 242kV

3. Continuous Current Rating
   VBM Varmaster: 200A, 300A, 400A, or 600A
   VBU: 600A

4. Control Voltage
   120V AC, 48V DC, 125V DC, or 250V DC

5. Operating Mechanism
   VBM Varmaster: Solenoid or Motor. Motor operator can only be supplied with a single-mechanism switch, such as a 15kV model.
   VBU: Solenoid Only

6. Terminal Pad Orientation
   VBM Varmaster Only: Select terminal pad orientation from Diagram1, page 6.

7. Mounting Stand
   VBM Varmaster:
   Substation Frame:
   Height: 8 ft. or 10 ft.
   Material: Galvanized Steel or Aluminum
   Pole Mounting Frame- For 15.5kV or 38kV single-mechanism VBM Varmasters
   Material: Galvanized Steel
   VBU:
   8 ft. Tubular Galvanized Steel Substation Frame

8. Options & Accessories
   • Capacitor Controls
     - Fisher Pierce: 4400, 4500, Powerflex
     - Joslyn Capmaster
   • Zero Voltage Closing Control
   • Current Limiting Reactors

*Please consult the factory for standard control configurations available for faster delivery and cost effectiveness.

Example:
1. Capacitor Switching
2. 34kV VBM Varmaster
3. 600A Continuous
4. 120V AC Control Voltage
5. Solenoid Operated Mechanism
6. Terminal Pad Orientation- Standard
7. 8 ft. Galvanized Steel Mounting Stand
8. Zero Voltage Closing Control
   Fisher Pierce 4400 AutoCap Control
CAPACITOR CONTROLS

Fisher Pierce capacitor controls range from solid-state single function controls to state-of-the-art microprocessor based programmable units. Autocap™ Adaptive Capacitor Controllers feature adaptive functions which allow the unit to program itself. Model with two-way communications provides the use of a data radio and cellular technologies.

VerSaVac DISTRIBUTION CAPACITOR SWITCHES

Joslyn VerSaVac vacuum switches are used for pole top capacitor switching. VerSaVac switches are a direct replacement for oil switches, designed to eliminate costly maintenance and hazards.

AIR SWITCH & INTERRUPTER ATTACHMENTS

Joslyn Air Disconnect Switches provide highly dependable operation for sectionalizing or isolating service. Vertical-Break switches are available in voltage ratings from 15kV to 230kV. Side-Break switches are available in voltage ratings from 15kV through 115kV. Interrupter attachments can be easily mounted to most isolating switches to provide a complete interrupter switch.