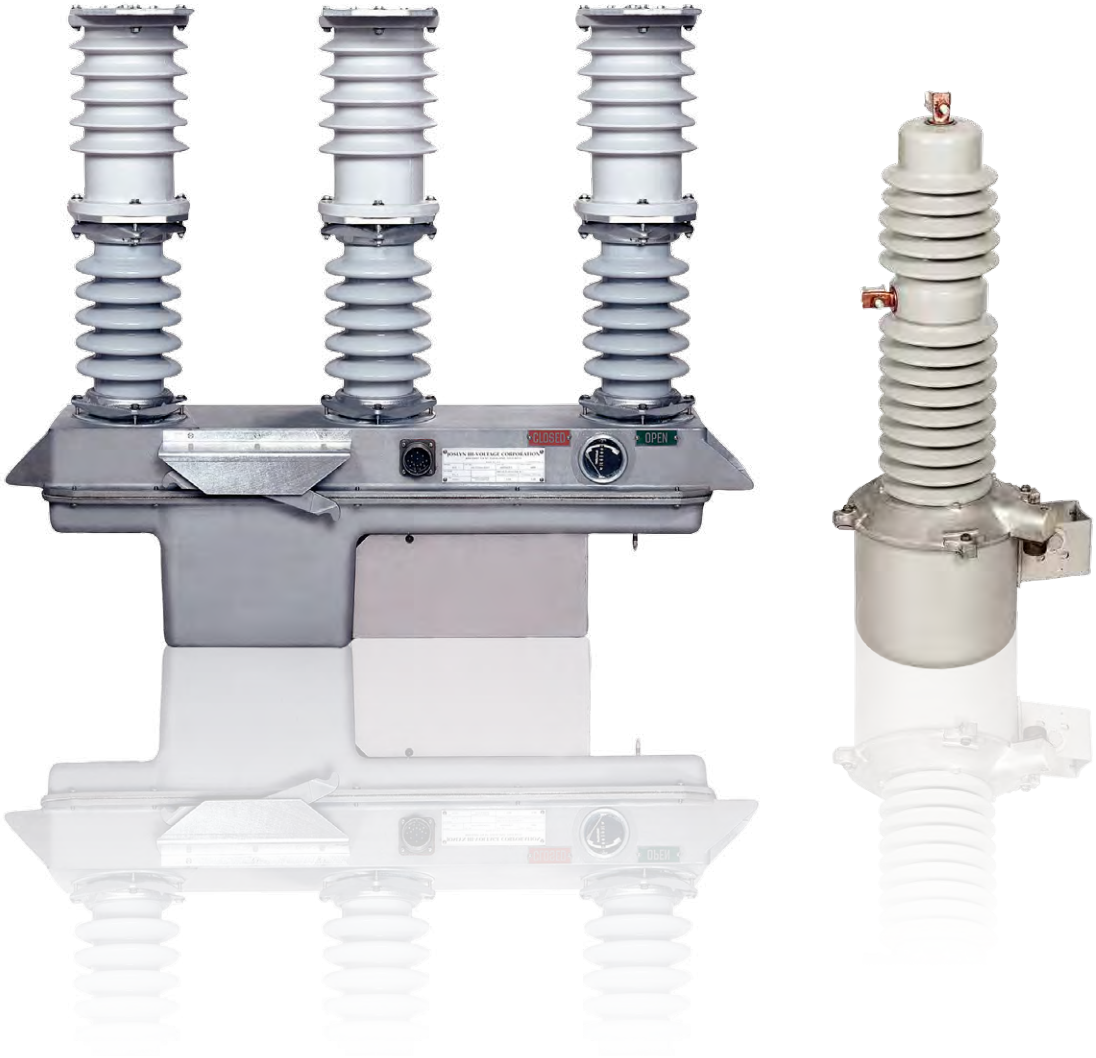
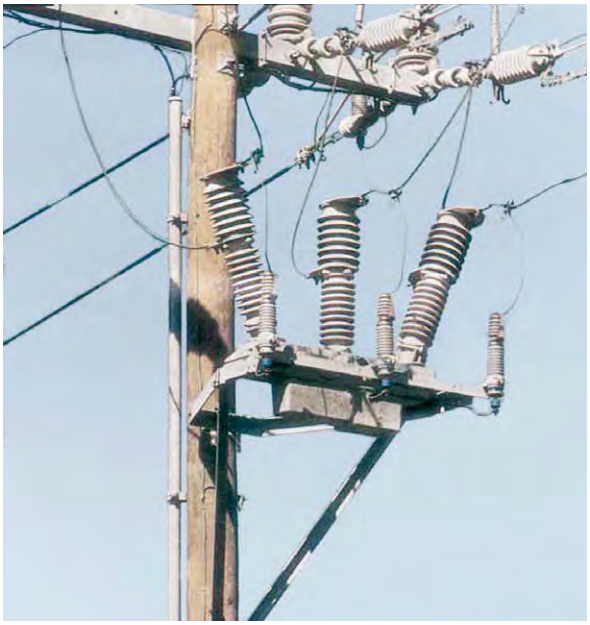
JOSLYN HI-VOLTAGE® CAPACITOR SWITCHES



Thomas&Betts
A Member of the ABB Group

Joslyn Hi-Voltage® capacitor switches

Environmentally sustainable. Compatible. Efficient. Lifecycle cost reducing.



Environmental sustainability — no oil or gases

- Uses vacuum interruption and solid dielectric insulation for 15kV to 72.5kV applications
- Solenoid operating mechanismprovides a long life of maintenance-free operations

Compatibility — with existing oil or vacuum switches

- The VSV and VBM can be rack or pole mounted
- Works with all major control platforms (Fisher Pierce, Schweitzer, Beckwith and ABB)

Compatibility — complete fixed capacitor bank retrofit

- Existing fixed capacitor banks can be converted easily to switched banks
- Uses existing capacitors to easily retrofit banks to a switched system

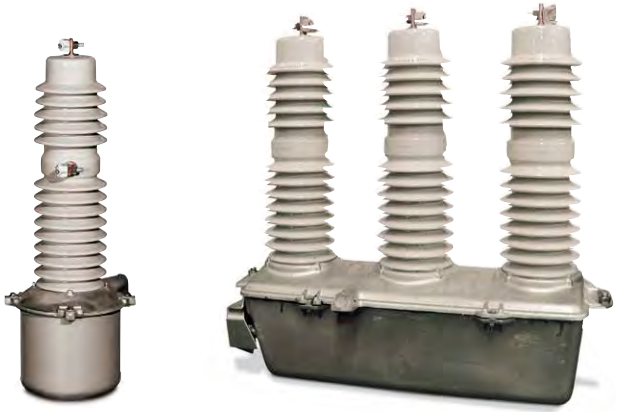
Efficiency — transient mitigation of system over-voltages and inrush current

- Zero voltage closing (ZVC) control
- Prevents customer equipment damage and stress on capacitors when bringing capacitor banks online
- Synchronous closing of three switch poles independently, with the occurrence of zero voltage in each phase
- Enables volt-VAR optimization (VVO)

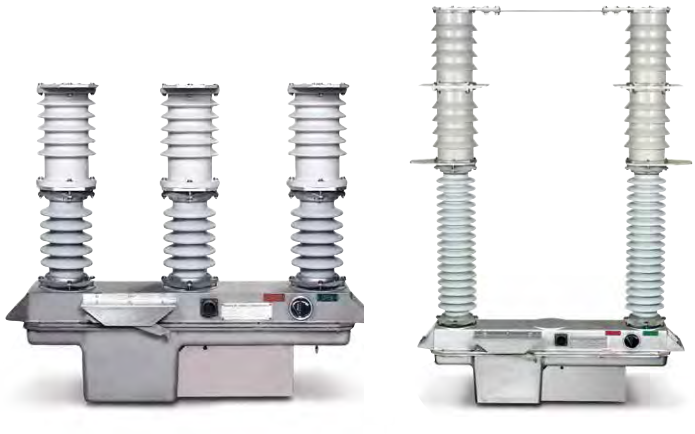
Lifecycle cost reductions — with solenoid operators

- SF6 interrupting mediums can result in SF6 leaks, maintenance, personal protective equipment (PPE) and regulatory requirements to monitor and measure usage/leakage
- Solenoid operators offer long operational life of between 10,000–50,000 open and close operations with no required maintenance

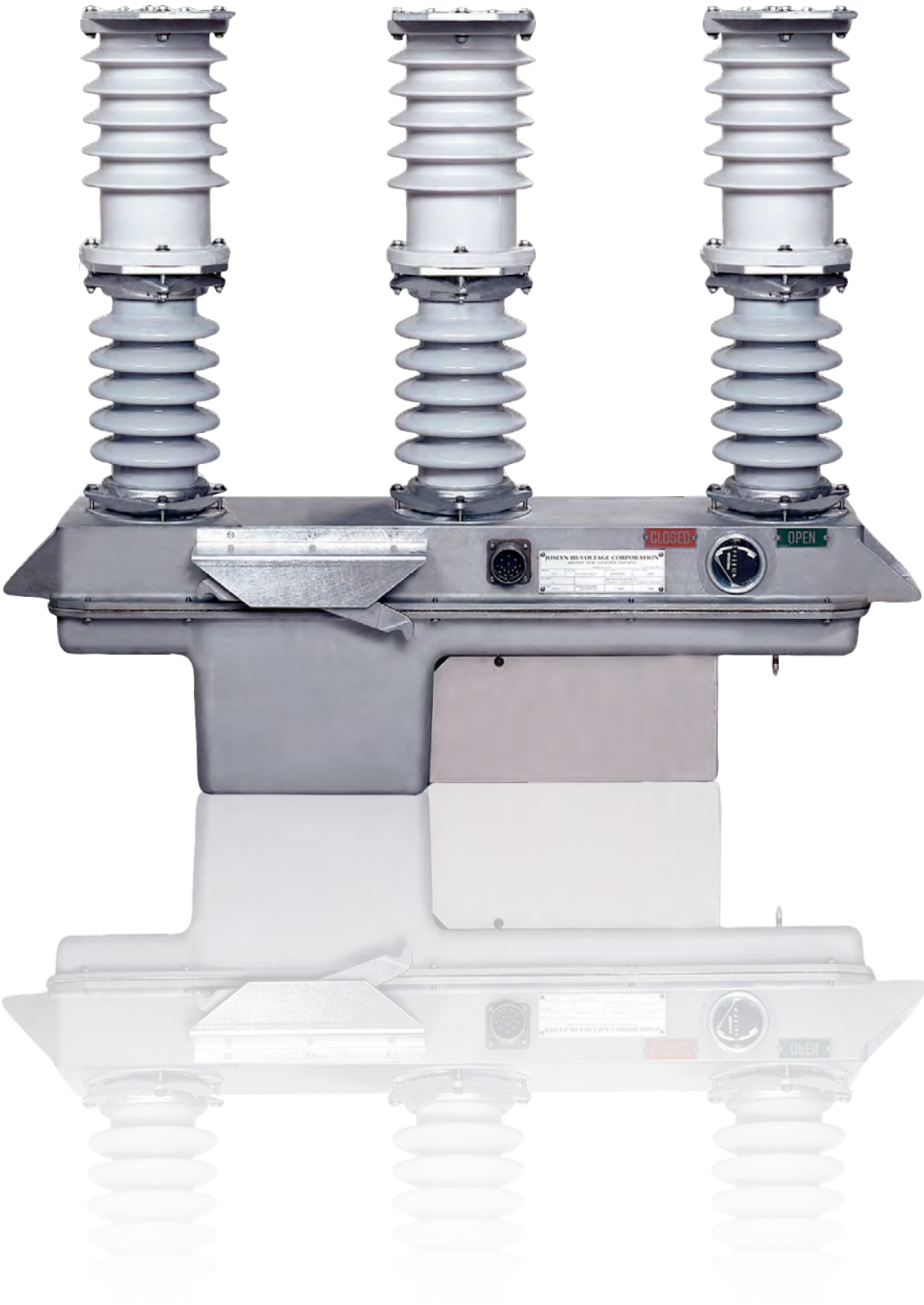
ZVC control



VerSaVac® switches



VBM (Varmaster) switches


CLOSED
OPEN

Joslyn Hi-Voltage® capacitor switches

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Joslyn Hi-Voltage® capacitor switches

Overview
Why use Joslyn Hi-Voltage® capacitor switches?

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There are four major reasons for using switched power capacitors:

1. To reduce losses caused by reactive load current
2. To reduce kVA demand
3. To improve voltage profile
4. To increase revenue or decrease customer energy consumption

Switched capacitor banks can dramatically reduce losses caused by the reactive component of the load. The resistance of the feeder conductors causes about 60% of a system's energy loss. Thus, it is important to locate the power capacitors on the feeders as close to the loads as practical. Losses can be reduced by 89% by installing one bank that is only two-thirds as large as the peak load KVAr. Typically, the VAr sensing control should be set to switch the bank to close when the load inductive current equals two-thirds of the bank capacitive current. Even though this scheme drives the line leading when the bank is first turned on and before it is turned off, the loss reduction is optimum for a single bank.

VerSaVac® single-phase switch
15kV–38kV

The reduction in reactive current caused by a switched power capacitor also reduces the total line current. This reduction in kVA demand during heavy load periods has a number of benefits:

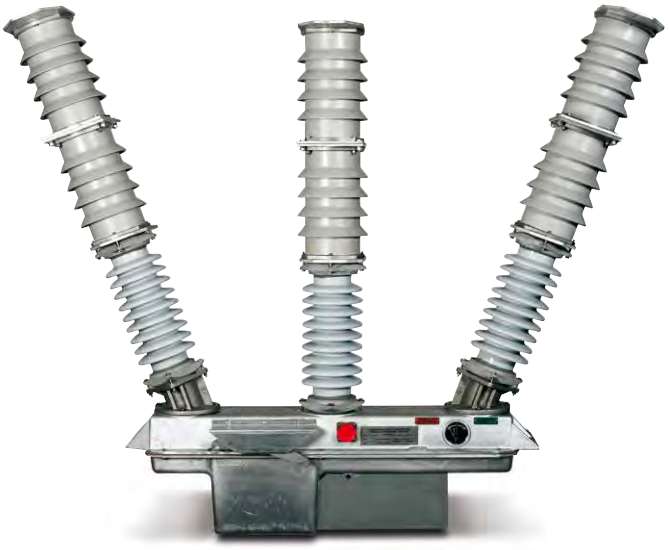
- The peak allowable loading is increased when it is most needed
- The effective ampacity of the lines is increased
- The operating temperatures of the lines and transformers are reduced, increasing equipment life
- The necessity to upgrade lines and transformers may be delayed

The demand capacity of distribution feeders is usually limited by voltage drop along the line. The service entrance voltage of all customers must be kept within certain limits, usually +5 to +10%. "Flattening" the feeder voltage profile offers several benefits:

- The kVA demand can be increased
- The substation voltage can be lowered to reduce peak demand and save energy
- The service entrance voltage can be allowed to increase, resulting in increased revenue

When one bank on a feeder is switched on, the entire feeder voltage, upstream and downstream from the bank, is increased. Additional banks on the line will add to the voltage rise, so that all active capacitors contribute to the shape of the voltage profile along the entire feeder.

Joslyn Hi-Voltage® capacitor switches, together with Fisher Pierce® capacitor controls, provide a complete solution to optimize losses, voltage, kVA demand and, ultimately, revenue in electrical systems from 15 to 72.5kV.



Varmaster VBM switch
15kV–72.5kV

VerSaVac® three-phase switch
15kV–38kV

Varmaster VBM switch
15kV–72.5kV

VerSaVac® 15–38kV capacitor switches
Joslyn Hi-Voltage® VerSaVac® capacitor switches

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Single-phase

Three-phase

Solenoid operating mechanism offers the longest life of any distribution capacitor switch — 100,000 maintenance-free operations!

- Synchronized operation from a fast, repeatable solenoid operating mechanism ensures all phases will operate within ¼ cycle — unlike slow motor-operated devices — reducing recovery voltage when the bank is switched off, which, in turn, reduces electrical stress on capacitor bank insulation
- Optional zero voltage closing (ZVC) control mitigates transients associated with bringing capacitor banks online, virtually eliminating costly customer equipment damage resulting from voltage spikes created when switching capacitor banks
- Retrofits to existing oil switch power supply transformer impedances and existing 14 AWG oil switch wiring*
- Optional manual trip lever not mechanically connected to operating mechanism to eliminate wear during normal operation
- Vacuum interruption and solid dielectric Joslyte insulation — no oil, no gas, no maintenance
- Long-life solenoid operating mechanism yields 100,000 maintenance-free operations (50,000 open and 50,000 close)
- Models support grounded and ungrounded systems in a variety of applications, 15–38kV, single- or three-phase
- Compatible with existing oil switch or vacuum switch installations
- Field-proven reliable design — more than 150,000 worldwide installations and more than 20 years of operational experience
- Choose porcelain or polymer housing

The Joslyn Hi-Voltage® VerSaVac® capacitor switch is a completely sealed vacuum switch that provides an operational life of more than 100,000 (50,000 open/50,000 close) maintenance-free operations — greater than other switches used for pole-top capacitor switching. Specifically designed as a replacement for maintenance-intensive oil switches, the VerSaVac® switch can be used as a direct replacement on existing capacitor banks or supplied by capacitor manufacturers on new banks. The VerSaVac® switch not only results in substantial savings from reduced maintenance and maximized capacitor bank uptime, but also improves power quality.

* See I 750-271 Single-Phase VerSaVac® Switch Installation and Operating Procedure for complete details.

VerSaVac® single-phase capacitor switch

No oil or gas.
Vacuum interruption and solid dielectric Joslyte insulation around vacuum bottle. This material is non-hydroscopic and absorbs stresses from the thermal expansion and shock. Joslyte insulation has been field-proven for more than 40 years.

Synchronized operation.
The fast and repeatable solenoid operating mechanism ensures all phases will operate within ¼ cycle, unlike slow motor-operated devices, reducing the recovery voltage when the bank is being switched off, which in turn reduces the electrical stress on the insulation of the capacitor bank.

Exceeds electrical requirements of ANSI C37.66.

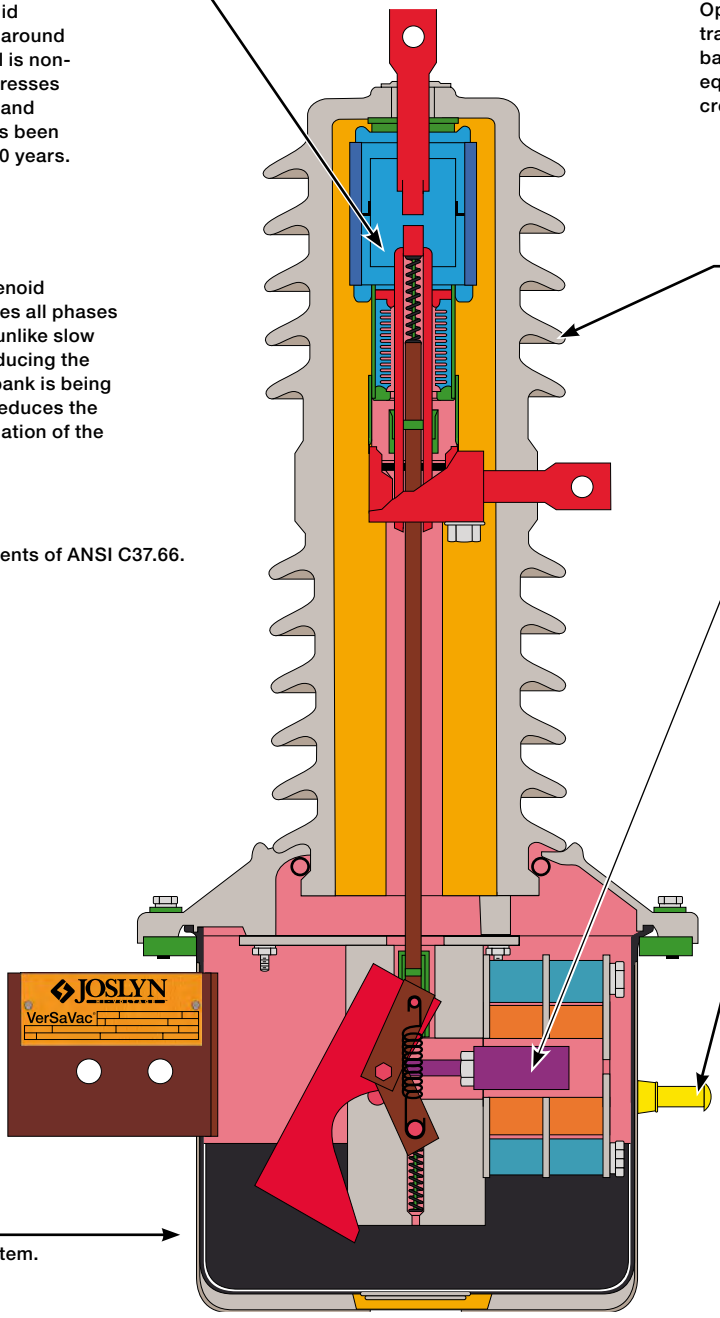
Zero voltage closing (ZVC) control.
Optional zero voltage closing control mitigates transients associated with bringing capacitor banks online. It virtually eliminates costly customer equipment damage resulting from voltage spikes created when switching capacitor banks.

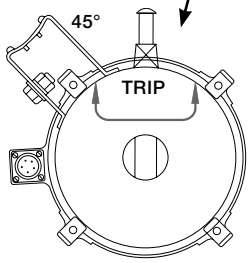
Porcelain or cycloaliphatic epoxy housing.

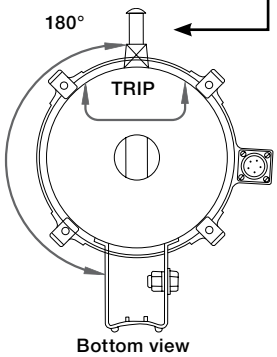
Long-life solenoid mechanism.
Provides 100,000 operations (50,000 open/50,000 close).

Optional manual trip lever.

Bottom view







Bottom view

Bladder
completely seals switch system.

Position indicator (bottom view).
Highly visible reflective lettering indicates switch position.

VerSaVac® 15–38kV capacitor switches
VerSaVac® single-phase capacitor switch

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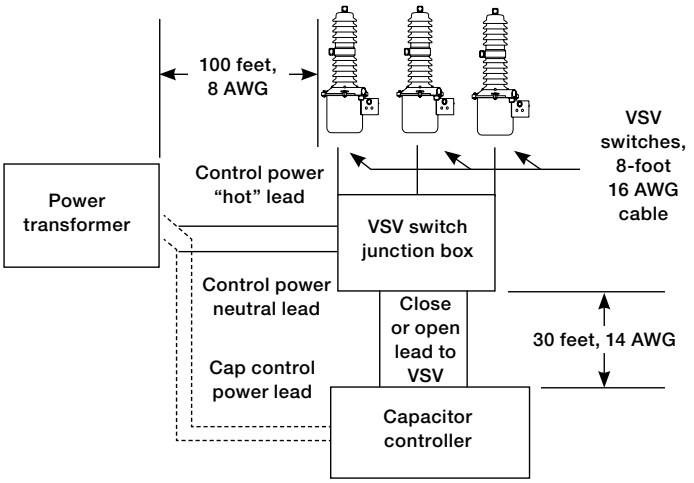
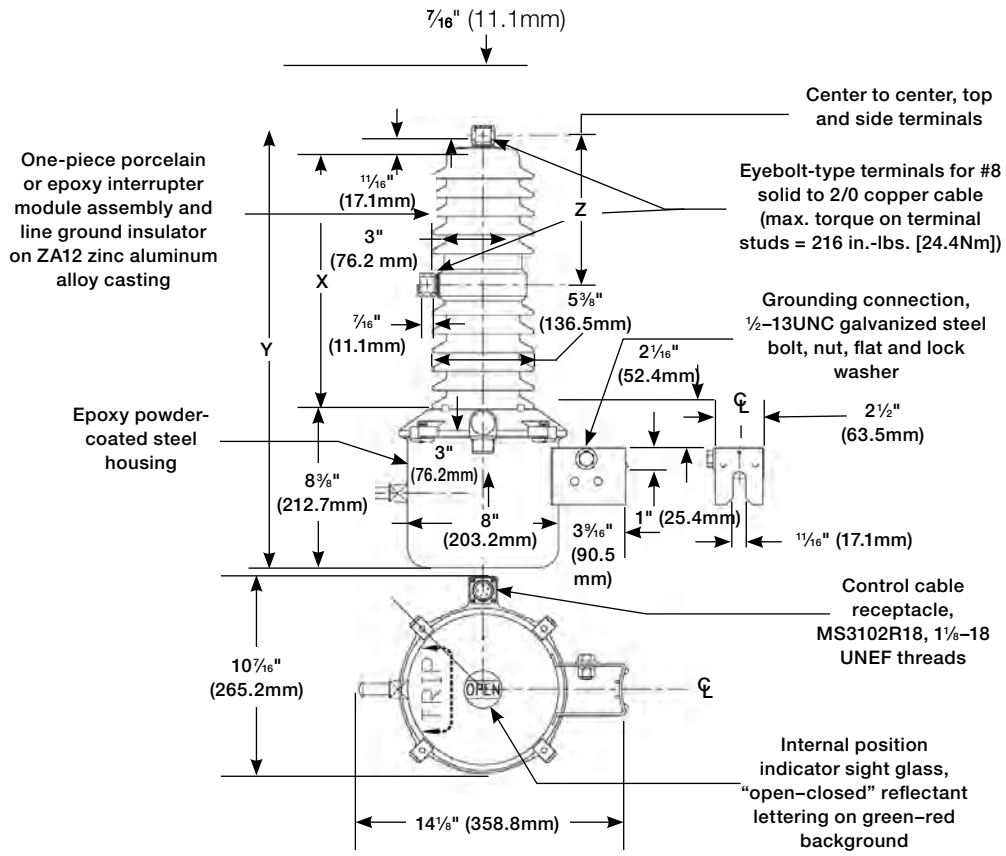
Typical VerSaVac® single-phase installation



Dimensions and creepage distances for Joslyn Hi-Voltage® VerSaVac® single-phase capacitor switch



Note: Non-trip handle switches can be rotated by loosening the lug bolts, and retightening to 45 in.-lbs. (5.1Nm)

Dimensions and creepage distances						
Max. voltage	**Line to ground kV BIL**	**Line to ground insulation creepage distance in. (mm)**	**X in. (mm)**	**Y in. (mm)**	**Z in. (mm)**	**Weight lbs. (kg)**
15kV	95	12.63 (320.7)	14 (355.6)	23.63 (600.1)	7.94 (201.6)	27.5 (12.5)
15kV	125	17.19 (436.6)	16 (406.4)	25.63 (650.9)	7.94 (201.6)	28.5 (12.9)
27kV	125	17.19 (436.6)	17 (431.8)	26.63 (676.3)	8.94 (227.0)	29.3 (13.3)
27kV	150	19.44 (493.7)	18 (457.2)	27.63 (701.7)	8.94 (227.0)	30.8 (14.0)
27kV*	150	27.5 (698.5)	17.7 (449.8)	27.2 (691.1)	9 (229)	36.5 (16.5)

* Extra creepage insulator available in porcelain housing material.

Ratings			
Exceeds electrical requirements of ANSI C37.66			
Continuous current	200A		
Short-time current	6kA (½ sec.), 4.5kA (1 sec.)		
Asymmetrical momentary/making current	9kA Asymmetrical RMS/23kA Peak		
Peak inrush current limit for parallel or back-to-back switching applications	6kA		
Control voltages	120 VAC, 240 VAC (see accessories, p. A-11)		
Minimum operating voltage	80 VAC, 160 VAC		
Recommended control pulse time	100 msec.		
Auxiliary contact rating	15A @ 120 VAC, .5A @ 125 VDC		
Operating temperature range	-60 to 40˚ C		
Voltage class (kV)			
Maximum voltage			
Solid grounded applications (kV)	15.5	27.5	38
Ungrounded applications (kV)	15.5	27.5	N/A
Ungrounded applications with manual trip* (kV)	12.47	22.5	N/A
Impulse withstand (kV BIL)			
Line to ground	95	125	150
Open-gap	95	95/125	125
Power frequency AC withstand dry/wet (kV RMS)	36/30	60/50	70/60

*Units equipped with manual trip handle.

VerSaVac® 15–38kV capacitor switches
VerSaVac® three-phase capacitor switch

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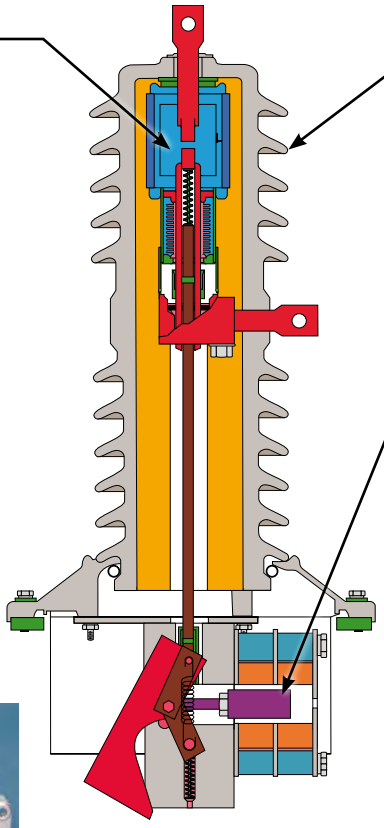
The VerSaVac® switch is a completely sealed, long-life vacuum switch that provides an operational life of over 100,000 (50,000 open/50,000 close) maintenance-free operations. This results in an operational life greater than other switches used for pole-top capacitor switching. The VerSaVac® switch was specifically designed as a replacement for maintenance-intensive oil switches and can be used as a direct replacement on existing banks or supplied by capacitor manufacturers on new banks. Using the VerSaVac® switch will result in substantial savings from reduced maintenance and maximized bank uptime and will also improve power quality.

No oil or gas.
Vacuum interruption and solid dielectric Joslyte insulation around vacuum bottle. This material is non-hydroscopic and absorbs stresses from thermal expansion and shock. Joslyte insulation has been field proven for more than 40 years.

Compatibility.
VerSaVac® switches are compatible with existing oil switch or vacuum switch installations.

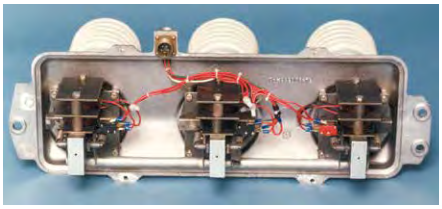
Reliability.
Proven design with over 150,000 worldwide installations and over 35 years of operational experience.

Exceeds electrical requirements of ANSI C37.66.



Porcelain or cycloaliphatic epoxy housing.

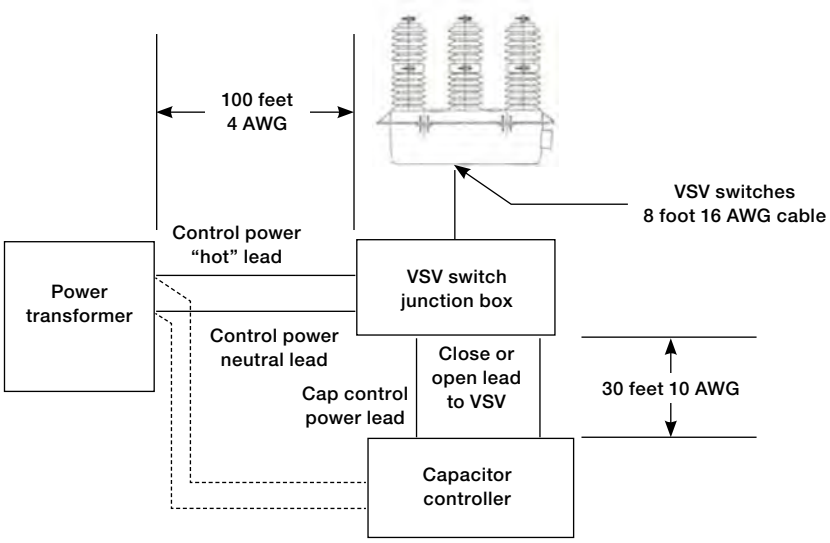
Long-life solenoid mechanism. Provides 100,000 operations (50,000 open/50,000 close).



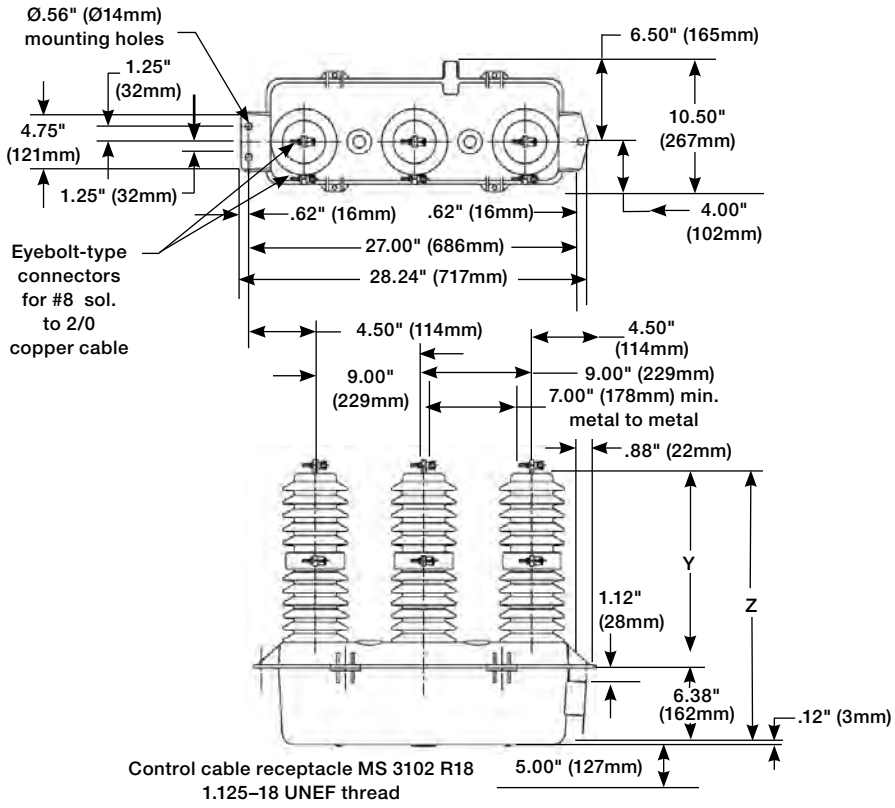
*See I 750-272 Three-Phase VerSaVac® Switch Installation and Operating Procedure for complete details.

Manual operating handle for open and close

Typical VerSaVac® three-phase switch installation



Dimensions and creepage distances for Joslyn Hi-Voltage™ VerSaVac® three-phase capacitor switch



VerSaVac® 15–38kV capacitor switches
VerSaVac® three-phase capacitor switch

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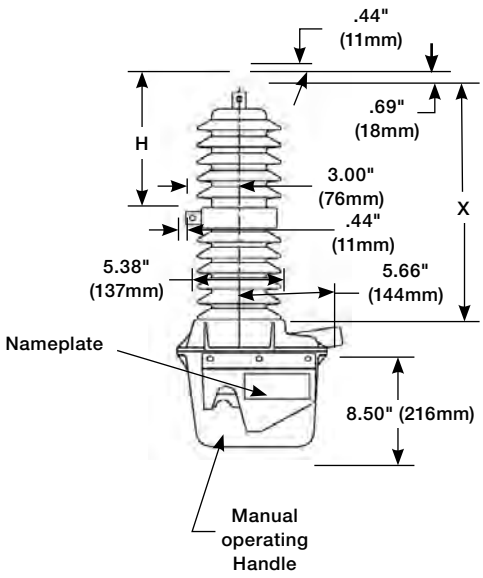
Dimensions and creepage distances for Joslyn Hi-Voltage® VerSaVac® three-phase capacitor switch (continued)

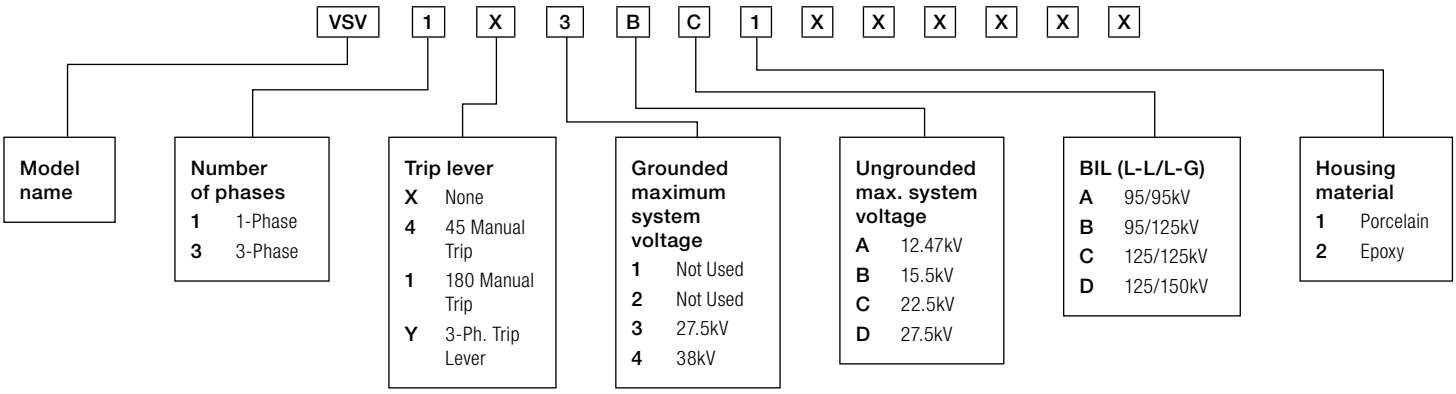


Dimensions and creepage distances

Line to ground kV BIL	Line to ground insulation creepage distance in. (mm)	X in. (mm)	Y in. (mm)	Z in. (mm)	H in. (mm)	Weight lbs. (kg)
95	12.63 (321)	14 (356)	17.25 (438)	23.63 (600)	7.94 (202)	75 (34.0)
125	17.19 (437)	16 (406)	19.25 (489)	25.63 (651)	7.94 (202)	78 (35.4)
150	19.44 (494)	18 (457)	21.25 (540)	27.63 (702)	8.94 (227)	85 (38.6)

Ordering details for VerSaVac® single- and three-phase capacitor switch

To order a basic VerSaVac® switch, the catalog number is constructed as follows:



X Indicates sequential numbers. Sequential numbers are used for controls and other accessories.

Options and accessories:

- Animal protectors (2 per pole): 3148b0338p1
- Junction boxes
- Cable assemblies
- Current sensors
- Capacitor controls
- Mating connectors
- Undervoltage trip control
- Zero voltage closing (ZVC) control (see pages A-29–A-33)
- 125 VDC control interface

NOTE: For more information on capacitor controls and current sensors, see our Fisher Pierce® Product Guide, CAT313.

Varmaster VBM 15–72.5kV capacitor switches
Joslyn Hi-Voltage® Varmaster VBM switching systems

A

For substation capacitor switching.

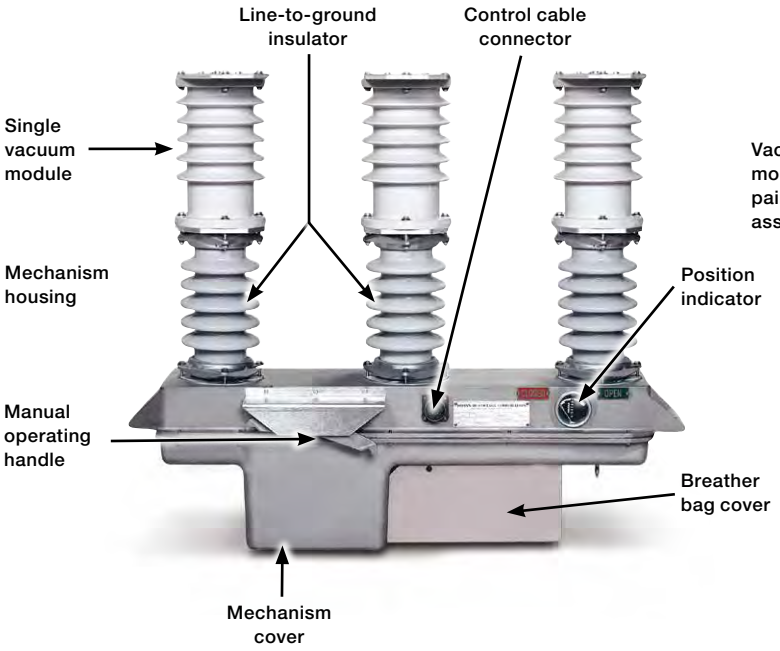
- Vacuum interruption and solid dielectric Joslyte insulation — no oil, no gas, no maintenance
- Depending on operating mechanism and control voltage selection, offers up to 100,000 maintenance-free operations
- 15kV–72.5kV system range, substation or pole-mounted installations
- Available zero voltage closing (ZVC) control mitigates the system overvoltages and high inrush currents typically associated with bringing capacitor banks online, preventing resulting customer equipment damage and stress on capacitors
- Compact and lightweight, no special foundations or support required
- Completely sealed construction provides safe interruption with no external arcing and quiet yet high-speed operation
- Factory-assembled for fast, easy, low-cost installation
- Solenoid or motor operating mechanism with AC or DC control voltage

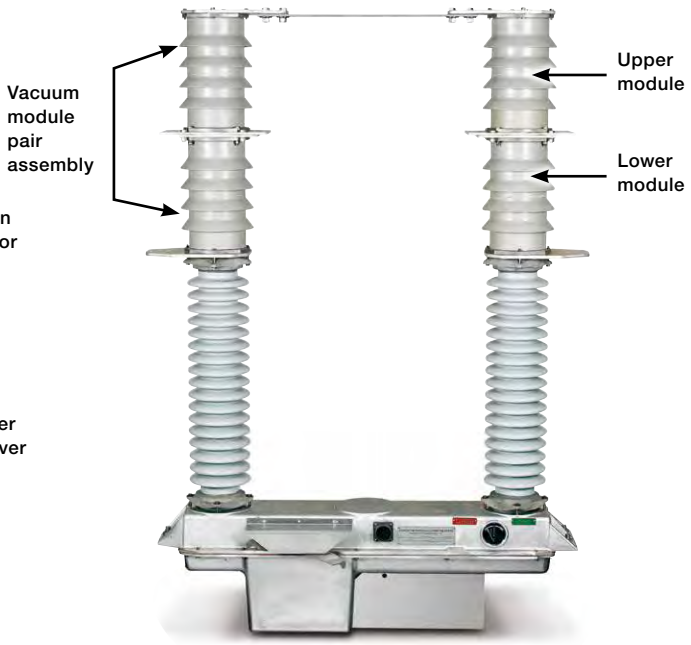
Joslyn Hi-Voltage® Varmaster switching systems use VBM switches that are completely sealed, breaker-class devices using a vacuum as the interrupting dielectric. VBM switches offer high reliability with little or no maintenance and quiet, safe interruption with no external arcing. Manufactured for system voltages from 15kV to 72.5kV, VBM switches are electrically connected in series to provide the necessary recovery voltage characteristics for the specific application. They may also be electrically connected in parallel for high continuous or momentary current requirements. VBM switches ship completely factory-assembled, ready for fast, easy installation requiring no special foundations or supports due to their compact, lightweight design. Each vacuum interrupter is enclosed in a shatterproof, high-dielectric housing to form a module designed with all solid insulation. The interrupter is surrounded by Joslyte high-dielectric, non-hydroscopic solid insulation 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 connected to the operating mechanism by a high-strength pull rod. The operating mechanism is completely sealed in a housing that 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, and 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, which can be operated manually or electrically, move the contacts at high speed and are unaffected by control voltage fluctuation or manual operating speed. Each switch features an operation counter. 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.

VBM switch construction





The VBM switch is manufactured in voltage ratings from 15kV to 72.5kV with continuous current capabilities from 200A to 600A. The mechanism may be operated manually, or electrically by solenoid or motor operators.

Varmaster VBM 15–72.5kV capacitor
Joslyn Hi-Voltage® Varmaster VBM switching systems

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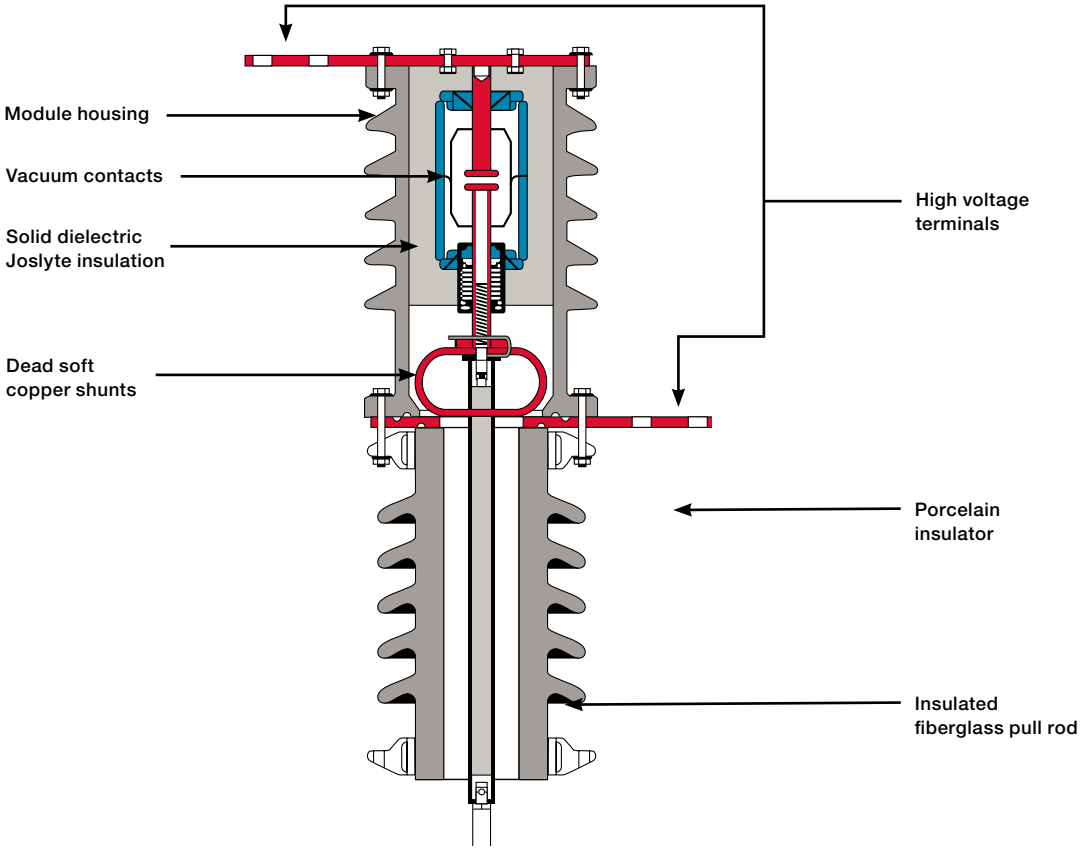
Single vacuum module cutaway



Cutaway of single-vacuum module mounted on 15kV line-to-ground insulator.

The assembly containing the vacuum interrupter is called a module. Each module has a vacuum interrupter contact sealed in Joslyte solid dielectric insulation, which provides mechanical strength, high dielectric strength and complete moisture sealing. The module housing is cycloaliphatic or EPR rubber bonded to a fiberglass tube. One or two modules are mounted on each insulator and connect to the mechanism by a high-strength pull rod.

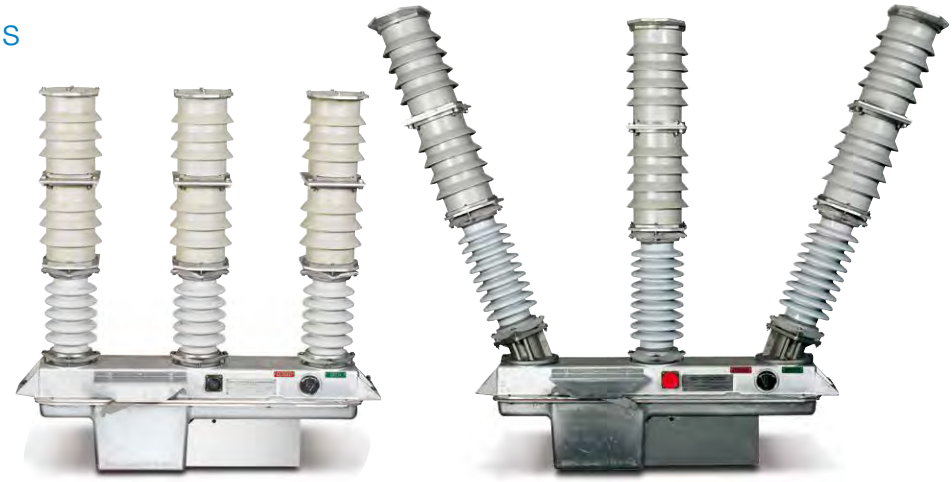
Varmaster VBM switch models

Three phase

15kV/25kV* 400A

15kV/25kV* 600A

* 25kV rating for solidly grounded capacitor bank configurations only.



Three phase

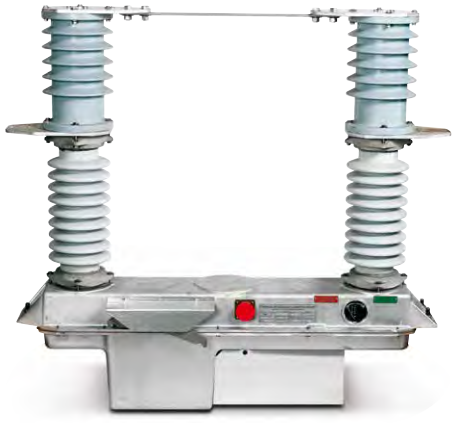
25kV 200A

25kV 300A

25kV 400A

Three phase

38kV 300A



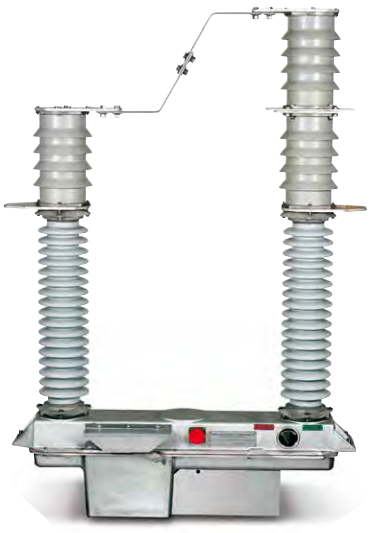
One pole*

38kV 400A

38kV 600A

48.5kV 200A**

* Three poles required for a three-phase installation.
** Solidly grounded capacitor bank configurations only.



One pole*

48.5kV 300A

48.5kV 400A

* Three poles required for a three-phase installation.

One pole*

72.5kV 300A

* Three poles required for a three-phase installation.

Varmaster VBM 15–72.5kV capacitor
Joslyn Hi-Voltage® Varmaster VBM switching systems

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Varmaster VBM switch options and accessories

Operating mechanisms

A solenoid mechanism has 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.

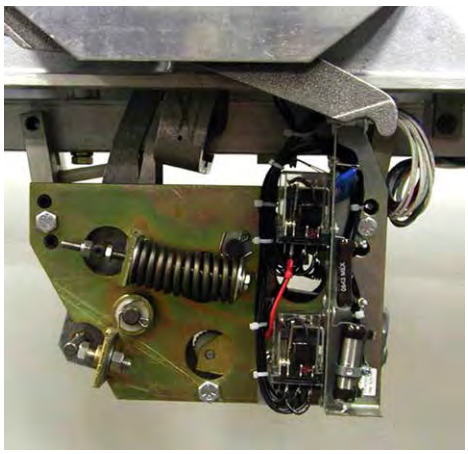
A motor operator is only used on single-mechanism three-phase Varmaster VBM switches, such as 15kV, 400A and 600A models and 34.5kV, 300A models. All controls are located inside the VBM mechanism housing. Inspection after 10,000 operations is recommended.

The completely sealed operating mechanism housing supports line-to-ground insulators and the modules. An expansion bag in the housing prevents the intake of contaminants or moisture and contains a desiccant package to maintain dry air.

All electrical control connections to the mechanism are made through a single environmental control cable connector.

An “open-closed” position indicator is directly coupled to the mechanism. A separate operating crank enables manual operation of the switch. The entire assembly can withstand several G’s without damage. Note that there may be one or more mechanisms for a three-phase Varmaster VBM switch.

Solenoid operator



Motor operator

Operating mechanism options

Control voltage	Operating mechanism	Control current per switch mechanism	Close time[4]	Trip time[4]	Auxiliary contacts
AC 120V	Motor[5]	5A	3 sec.	2 cycles	2 A and 2 B[1]
AC 120V	Solenoid[3]	60A[7, 8]	6 cycles	6 cycles	4 A and 4 B[2]
DC 48V	Motor[5]	3A	5 sec.	2 cycles	2 A and 2 B[1]
DC 48V	Solenoid[3, 8]	60A[6]	6 cycles	6 cycles	4 A and 4 B[2]
DC 125V	Motor[5]	4A	3 sec.	2 cycles	2 A and 2 B[1]
DC 125V	Solenoid[3]	60A[7, 8]	6 cycles	6 cycles	4 A and 4 B[2]
DC 250V	Solenoid[3, 8]	60A	6 cycles	6 cycles	4 A and 4 A[2]

1. Two A and two B mechanically operated contacts are standard. Six A and six B contacts are available as an option. Contacts are rated at 10A, 125VDC or 115VAC.
2. Four A and four B contacts available from auxiliary relay. Eight A and eight B contacts are available as an option. Contacts are rated at 15A, 120VAC and 10A, 125VDC.
3. For capacitor or reactor switching, a low-energy control is available. See 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 Varmaster VBM switches have built-in anti-pump controls.
5. Motor operating mechanisms are designed for single-mechanism three-phase switches only.
6. Current is 60A peak for one-, two- or three-mechanism switch systems.
7. Current is 120A for the 34.5kV, 300A Varmaster VBM switch.
8. Current for three-mechanism switch systems is approximately 180A peak for three cycles.

Varmaster VBM 15–72.5kV capacitor
Joslyn Hi-Voltage® Varmaster VBM switching systems

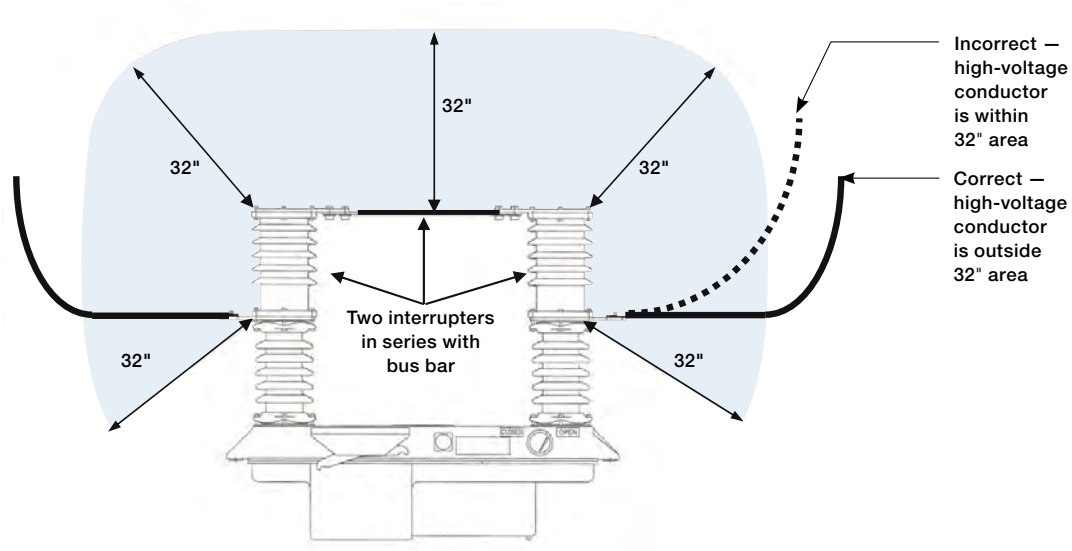
A

Varmaster VBM switch clearance requirements

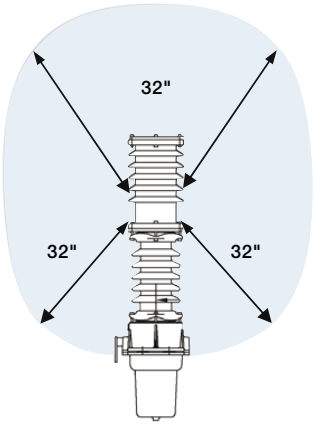
For Varmaster VBM switches with multiple vacuum interrupters in series, a 32" (813mm) clearance must be maintained from all switch line parts to adjacent equipment, such as buses, reactors, CTs, transformers or frames. Adjacent equipment also includes high-voltage conductors, which must run horizontally for at least 32" before bending upward.

Failure to meet this clearance requirement will adversely affect the electrical voltage distribution and electromagnetic field within the interrupters during opening and closing operations. This insufficient clearance can prevent proper interruption within the vacuum switch interrupters, resulting in undesirable restrikes during opening operations for some application parameters.

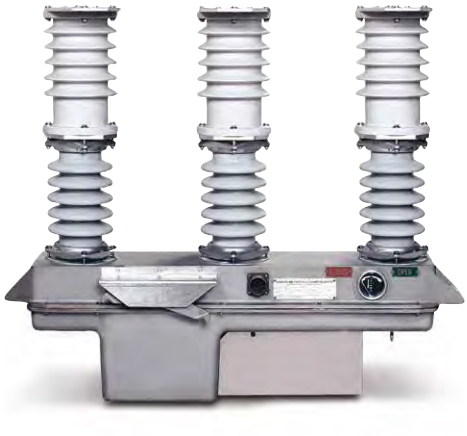
32" Clearance around 38kV single-phase interrupters, front view



32" Clearance around 38kV single-phase interrupters, side view



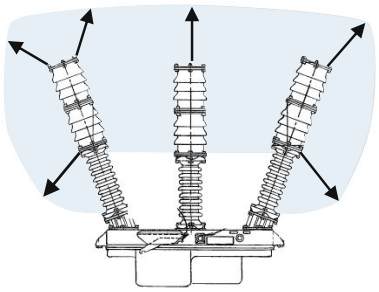
One interrupter per phase, 32" (813mm) clearance not required



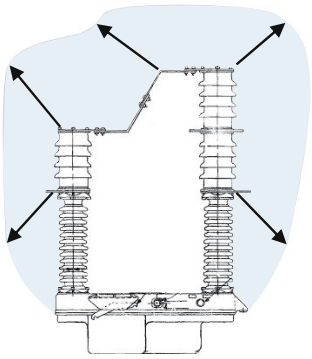
Three-phase 15kV/25kV

Note: The 32" (813mm) clearance requirement does not apply to Varmaster VBM switches with only one interrupter per phase, as shown above. All other configurations shown must maintain the 32" (813mm) clearance.

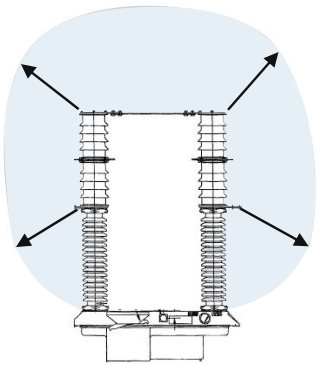
Two or more interrupters per phase, 32" (813mm) clearance required



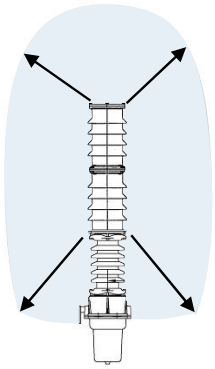
Three-phase
38kV



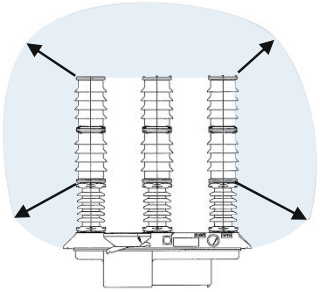
Single-phase
48.5kV



Single-phase
72.5kV



Double-stack
interrupters

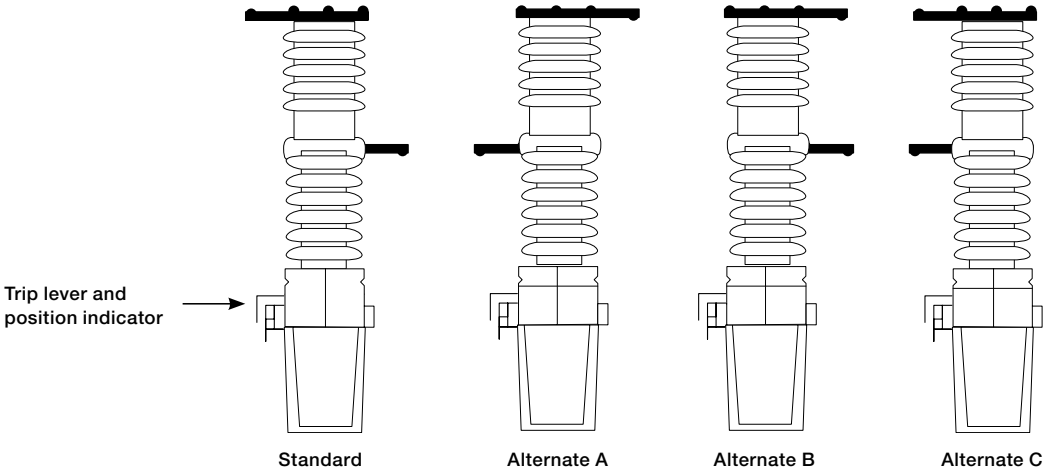


Three-phase
25kV

Varmaster VBM 15–72.5kV capacitor
Joslyn Hi-Voltage® Varmaster VBM switching systems

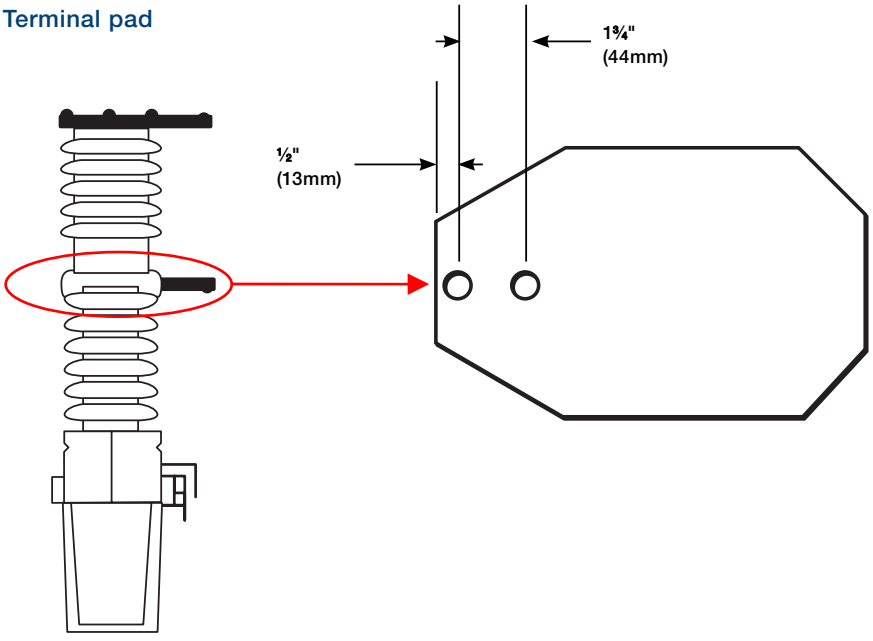
A

Varmaster VBM terminal pad orientation options for single-mechanism switches

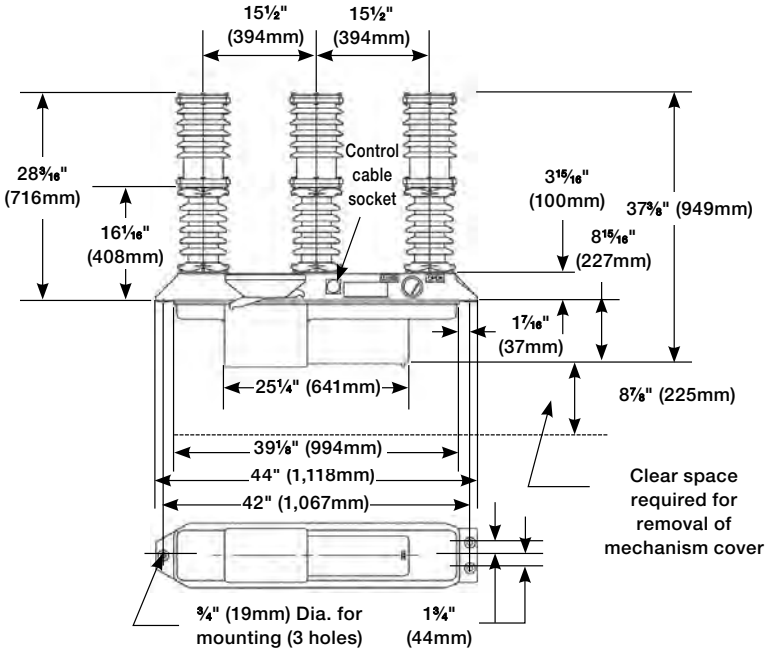


High-voltage connections

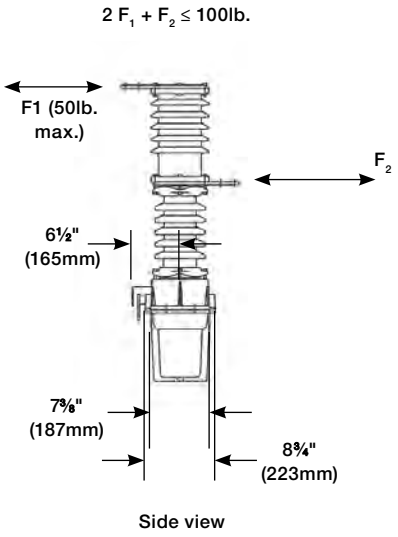
Varmaster VBM switches have terminal pads made of aluminum alloy with standard NEMA two-hole drilling. The electrical connection at the terminal pad must be treated with Alcoa No. 2 joint compound or equivalent. Remove the brown paper from the terminal pad before making electrical connections. Wire brushing through the compound will improve the connection.



Dimensions for three-phase switch, 15kV/25kV* grounded 400A, 15kV/25kV* grounded 600A



Weight: 148lb. (67kg) maximum.

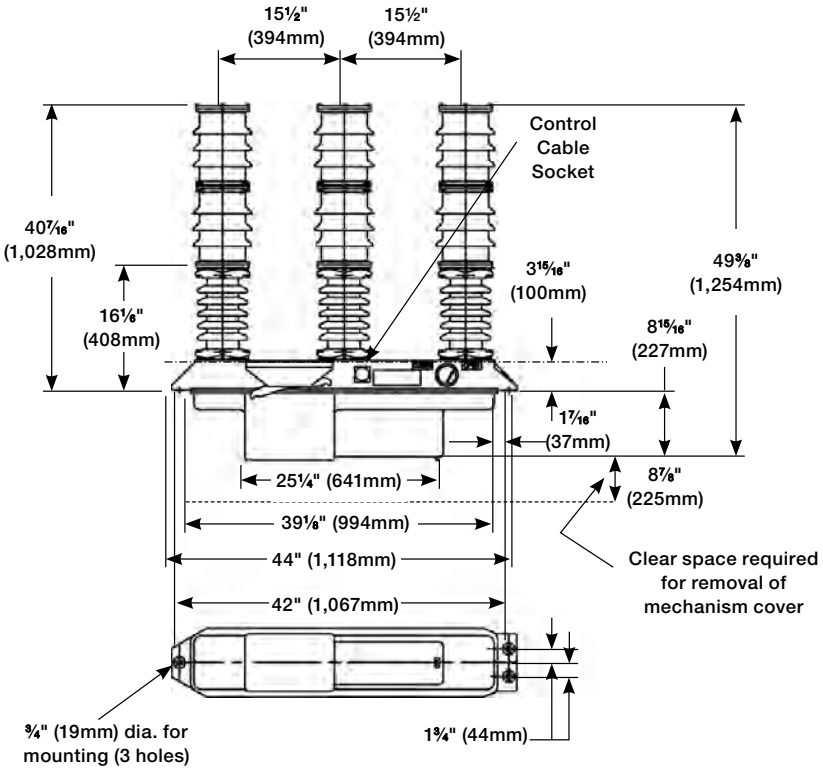


* Solid grounded systems and capacitor bank only.

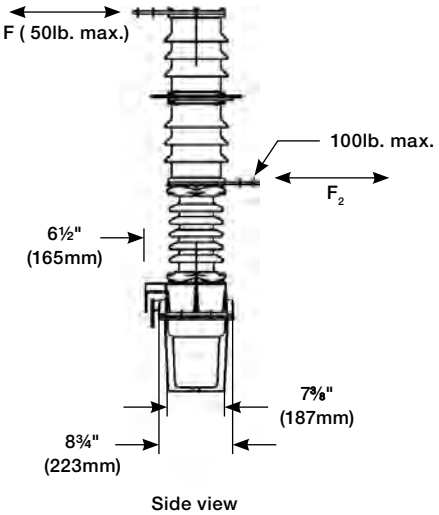
Varmaster VBM 15–72.5kV capacitor switches
Joslyn Hi-Voltage® Varmaster VBM switching systems

A

Dimensions for three-phase switch, 25kV 200A, 25kV 300A, 25kV 400A

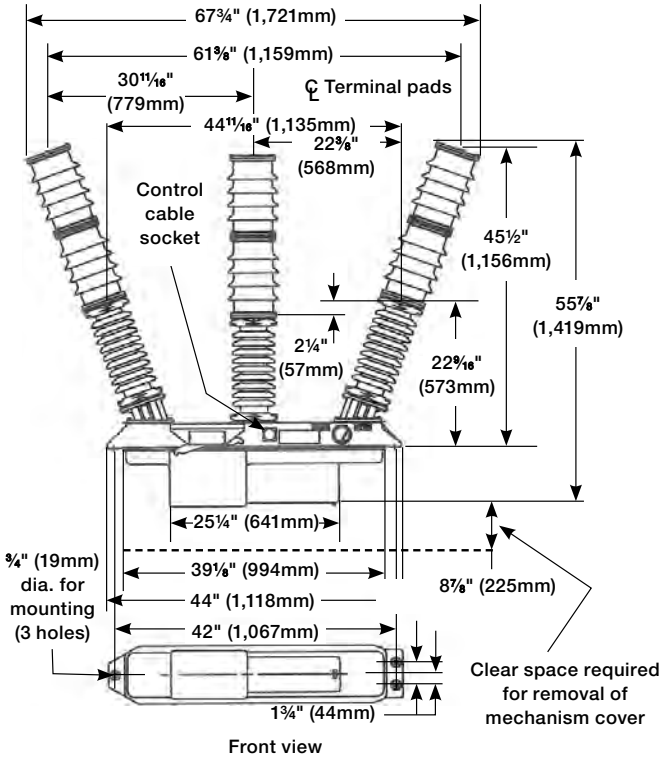


Weight: 225 lb. (102kg) maximum.

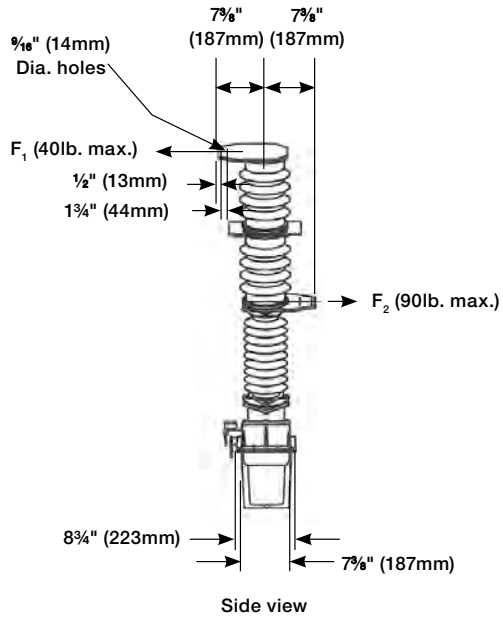


Side view

Dimensions for three-phase switch, 38kV 300A



Weight: 225 lb. (102kg) maximum.

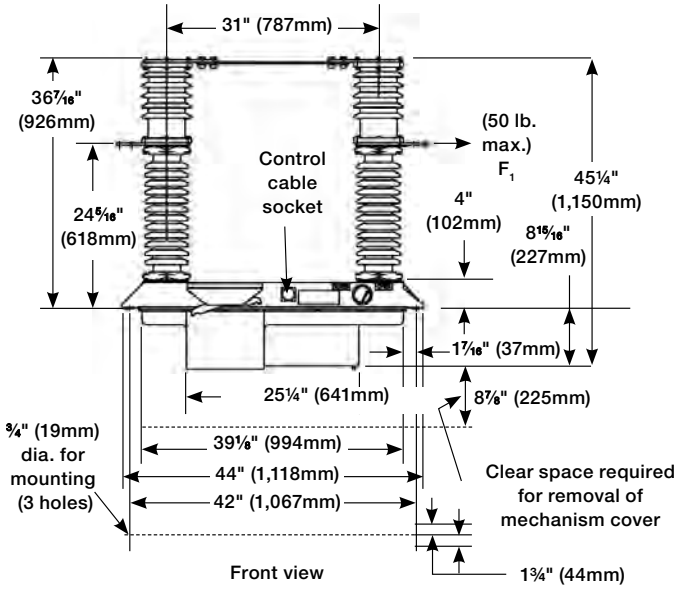


Note: Other insulation ratings are available for extra creepage.

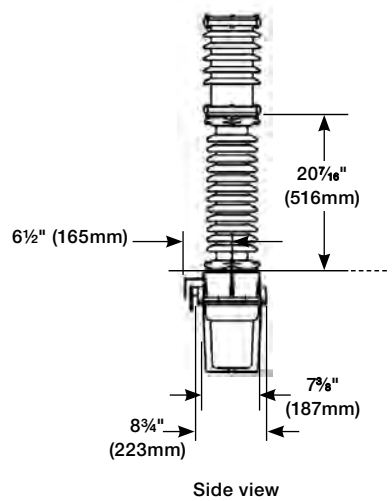
Varmaster VBM 15–72.5kV capacitor switches
Joslyn Hi-Voltage® Varmaster VBM switching systems

A

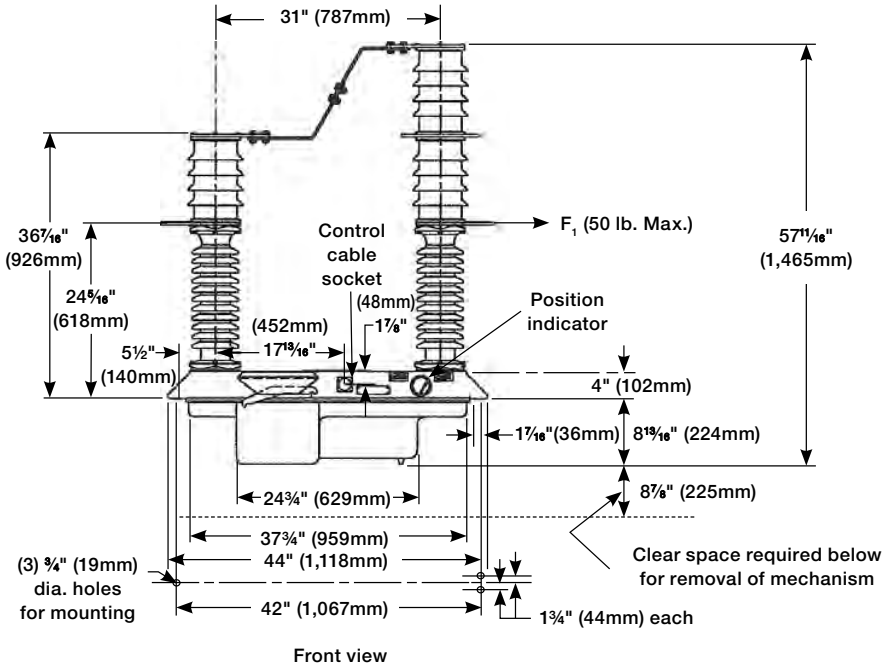
Dimensions for one-pole* switch, 38kV 400A, 38kV 600A, 48.5kV 200A*



Weight: 180 lb. (82kg) maximum.
* Solidly grounded 46kV capacitor bank configuration.
** Cover not shown for clarity.

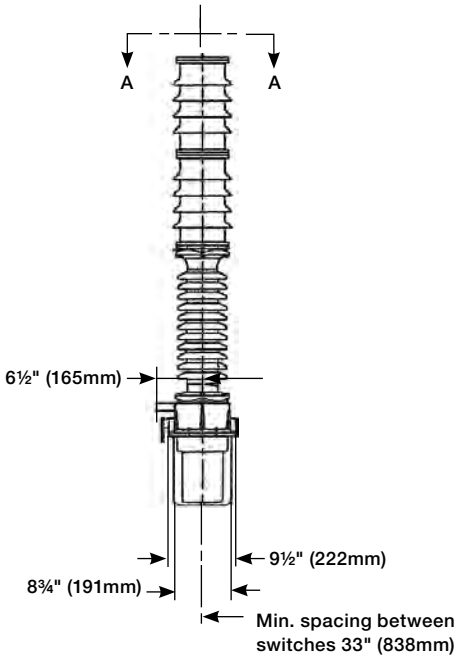


Dimensions for one-pole* switch, 48.5kV 300A, 48.5kV 400A



Front view

Weight of one-pole switch: 200 lb. (91kg) maximum.
* Three poles are required for a three-phase installation.

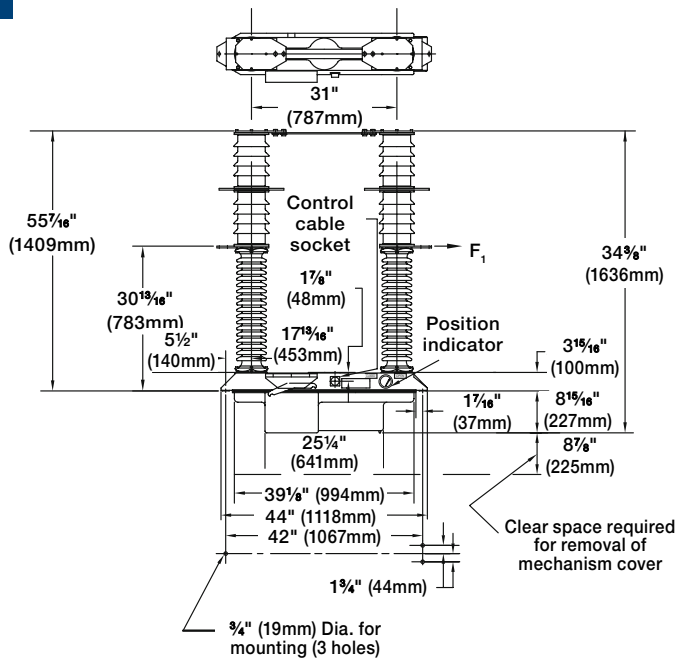


Side view

Varmaster VBM 15–72.5kV capacitor switches
Joslyn Hi-Voltage® Varmaster VBM switching systems

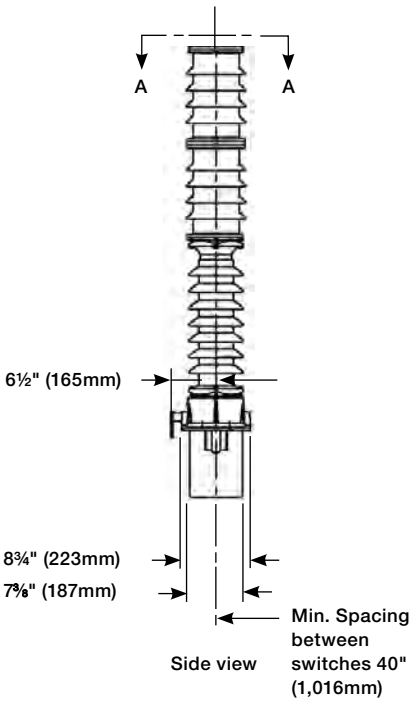
A

Dimensions for one-pole* switch, 72.5kV 300A



Front view

Weight of one-pole switch: 225 lb. (103kg) maximum.
* Three poles are required for a three-phase installation.
**Cover not shown for clarity.



Side view

VBM switch ratings												
Maximum voltage	**15.5kV/25kV[3]**		**25kV**			**38kV**			**48.5kV**			**72.5kV**
Capacitor and load switching current[1,2] (Amps)	400	600	200	300	400	300	400	600	200[4]	300	400	300
Fault interrupting current (kA)	3	4	3	3	3	3	3	4	4	3	3	3
Momentary current (kA RMS, Asymmetric)	20	20	15	15	15	15	20	20	20	15	15	15
Impulse withstand (kV BIL) Terminal-to-terminal[5]	110	110	200	200	200	200	200	200	200	250	250	280
Line-to-ground (kV BIL) (1.2 x 50 positive wave)	150	150	150	150	150	200	200	200	250	250	250	350
Maximum 60-cycle withstand line-to-ground (kV)												
One minute dry	101	101	101	101	101	138	138	138	178	178	178	178
Two seconds wet	74	74	74	74	74	119	119	119	176	176	176	176
Maximum peak making current (kA)[6]	20	20	15	15	15	15	20	20	20	15	15	15
Maximum peak back-to-back inrush current (kA)	10	10	8	8	8	8	10	10	10	8	8	8
Two-second current (Amps)	12,500											
Four-second current (Amps)	9,000											

Notes:

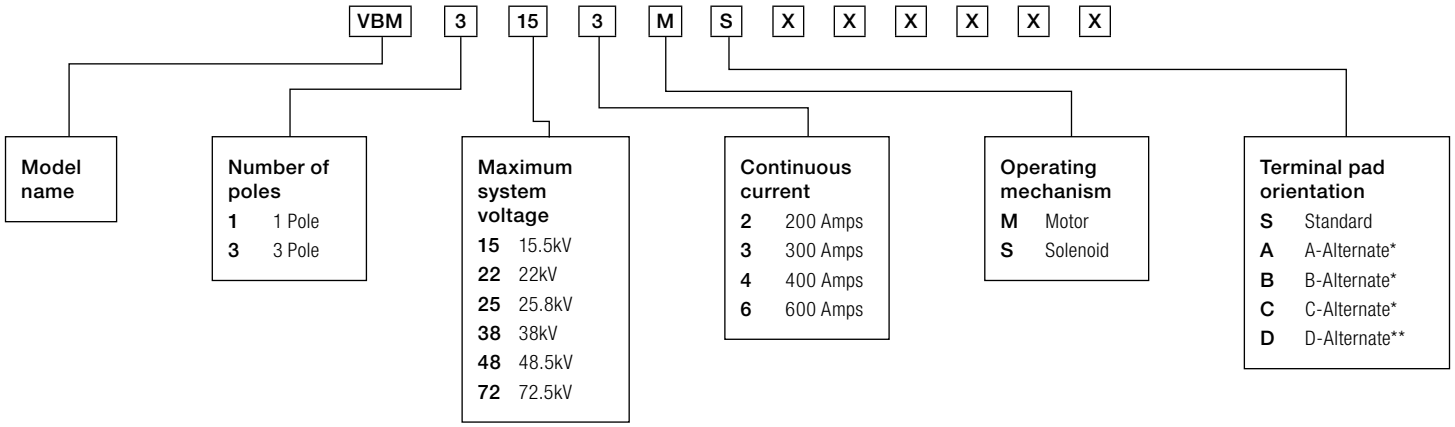
1. Varmaster VBM switches can switch loads of any power factor up to their continuous current rating. Include effects of voltage variances, harmonic currents and load tolerances in calculating continuous current.
2. Varmaster VBM switches are available with continuous current ratings through 3,000A for non-capacitor bank applications. Consult your T&B representative regarding application of these switches.
3. Grounded systems only at 25kV.
4. In capacitor switching applications, the 48.5kV, 200A Varmaster VBM may be used on solidly grounded systems and grounded capacitor banks with total current less than 200A. For all other loads, this VBM rating is 600A.
5. Interrupter portion of switch does not provide a visible open gap; therefore, it cannot be used to establish a safety clearance for personnel.
6. In 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. Refer to Joslyn Hi-Voltage bulletin T.D. 750-457.

Varmaster VBM 15–72.5kV capacitor switches
Joslyn Hi-Voltage® Varmaster VBM switching systems

A

Ordering details for Varmaster three-phase capacitor switch

To order a basic VerSaVac® Switch, the catalog number is constructed as follows:



X Indicates sequential numbers. Sequential numbers are used for controls and other accessories.

* Apply only to 15kV through 38kV 300A. For more information on terminal pad orientation, see page A-20.
** Apply to 38kV and above. For more information on terminal pad orientation, see page A-20.

Options and accessories:

- Animal protectors
- Cable assemblies
- Operating control
- Current sensors
- Capacitor controls
- Mating connectors
- Current limiting reactors
- Zero voltage closing (ZVC) control (see pages A-29–A-33)

NOTE: For more information on capacitor controls and current sensors, see our Fisher Pierce® Product Guide, CAT313.

Zero voltage closing control
Joslyn Hi-Voltage® zero voltage closing (ZVC) control

Eliminates overvoltage disturbances.

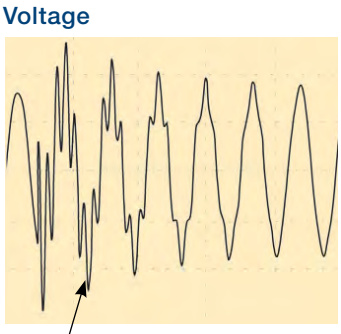
- Works with new or existing capacitor controllers and Joslyn Hi-Voltage® VerSaVac® capacitor switches and Varmaster VBM switches
- Mitigates system overvoltage disturbances and eliminates electronic adjustable-speed drive nuisance tripping
- Eliminates high inrush currents, increasing capacitor and related high-voltage equipment life
- Installations worldwide — more than 15 years' successful field experience
- Available for 15kV to 72.5kV voltages
- Supports a variety of systems and applications; available for pole-top distribution capacitor banks
- Easy installation and setup: Simply select phase rotation, reference phase, voltage sensing and bank configuration (grounded or ungrounded)

The Joslyn Hi-Voltage® zero voltage closing (ZVC) control is a cutting-edge microprocessor-based capacitor control. When an external close command is received, the ZVC virtually eliminates capacitor energization transients by closing three switch poles independently, synchronized with the occurrence of zero voltage in each phase. The closing sequence of the poles minimizes the time from the first pole closure to the last pole closure.

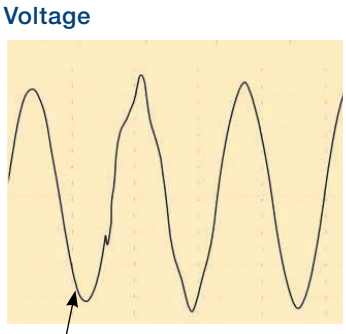
A selected reference phase of the system voltage is used for determining the zero voltage crossing information, and an internal calibration process is used for determining accurate closing time requirements. With this information, the microprocessor sets the individual close command delays required to ensure pole closures at points corresponding to the system zero voltage crossing.

The expected benefits include:

- Increased power quality by utilizing capacitor switching, significantly reducing voltage spikes that are a nuisance to sensitive equipment like computers and adjustable-speed drives
- Increased capacitor and switch life
- A reduction of induced voltages into the low-voltage control wiring
- A reduction of station ground transients and distribution ground transients



Close cap #1*
Standard control



Close cap #1*
With ZVC control

* Only one phase shown for clarity.

Zero voltage closing control
Joslyn Hi-Voltage® zero voltage closing (ZVC) control

A

The ZVC is designed to automatically close Joslyn Hi-Voltage® VerSaVac® capacitor switches and Varmaster VBM switches, at strategic points that correspond to the zero voltage crossing and the bank's configuration. For a grounded bank configuration, the capacitor phases energize 0.3 milliseconds after each respective phase zero voltage crossing point. For an ungrounded capacitor bank configuration, the ZVC initiates the first pole to close 0.3 milliseconds after the zero voltage crossing reference point. The second pole automatically closes 0.3 milliseconds after the voltage difference between the first and second phases is zero (which occurs 30 electrical degrees after the first pole's zero voltage crossing point). The third pole is closed at 0.3 milliseconds after the zero voltage crossing reference point associated with that phase. The microprocessor control circuitry is intentionally designed to energize at these timing points to allow for any switch variations to have minimal effect on the intended transient reduction results.

A timing accuracy of ±0.89 milliseconds, with respect to the zero voltage crossing target point, should be maintained after initial set-up of the ZVC. With this level of accuracy and control, overvoltages can be reduced from a theoretical maximum of 2 per-unit voltage to 0.1 per-unit voltage. Also, overcurrents can be reduced to less than 0.2 per-unit current of the maximum theoretical inrush currents that ranged from 40 to 100 per-unit current for back-to-back capacitor bank switching and 5 to 20 per-unit current for single-bank switching.

The ZVC control works with any manufacturer's new or existing capacitor controllers and offers:

- Zero voltage closing
- Low close energy
- Automatic calibration
- Calibration data storage (non-volatile memory)
- Voltage zero synchronization
- Improper sequence trip monitoring
- Flashing self-check LED
- Error-indication LED
- Error-reset push buttons

Provided standard features

- Automatic improper sequence trip
- Extra switch auxiliary contacts (four A and four B)
- Control alarm output contact (form C)
- Control cabinet heater
- Calibration cable (either 25- or 30-ft. length)

Additional available options

- Two-pole control for ungrounded capacitor bank applications
- Capacitor-operated low-energy trip
- Undervoltage trip
- Aluminum cabinet
- Bypass ZVC mode switch — enables emergency close operations without using the ZVC control logic

Specifications

- Timing accuracy: ±0.89ms @ 3 sigma with respect to designated zero voltage crossing target point
- Close response time: 5–7 cycles after receiving external close command
- Open response time: 3–5 cycles after receiving external open command
- Temperature range: -22 to 158° F (-30 to 70° C)*
- Control voltage: 120 VAC nominal, ±10%
- Reference signal power requirements: Less than 100mA

* Control is designed for operation through this range; however, timing variances greater than .89ms could be encountered at temperatures colder than -4° F (-18° C) and warmer than 140° F (60° C). These variances are expected to remain within 1ms of the zero voltage crossing reference point.

Specifications can change without notice.

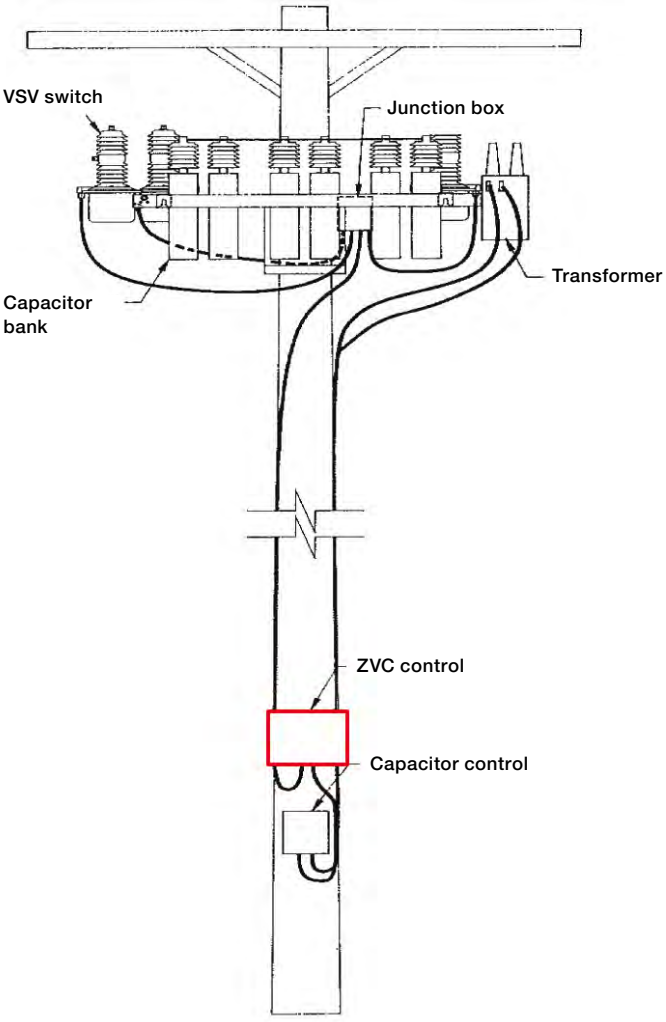
ZVC control and VerSaVac® switches

A typical layout of system and control using both the ZVC and a VerSaVac® switch is shown below. As a customer-ordered option, the ZVC control can be mounted directly on the capacitor rack assembly. This application will eliminate the need for the junction box assembly.

For greater control, opt for the Joslyn Hi-Voltage® ZVC control system with VerSaVac® switches. It consists of the following components:

- ZVC control
- Three VerSaVac® switches
- Junction box assembly that includes three separate VerSaVac® cables and one main control cable

General equipment layout



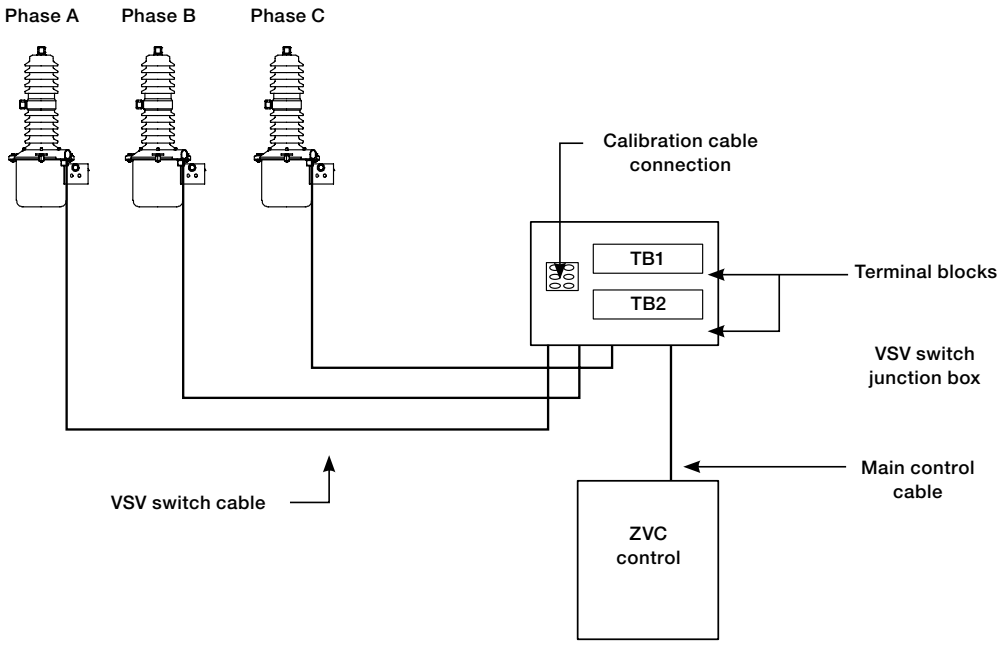
Zero voltage closing control
Joslyn Hi-Voltage® zero voltage closing (ZVC) control

A

ZVC control and the junction box assembly

Additional details on the junction box assembly are shown in the diagram below. The individual switches are connected to the junction box using cables with threaded pin connectors. Also, a keyed pin connector is provided for an easy and secure connection of the main control cable to the ZVC control. The main control cable runs from the junction box to the control. All necessary connections into the junction box for the individual VerSaVac® switch cables and the main control cable are made at the factory.

Junction box assembly



Notes: Connection of the individual cables to the correct system phase designation is critical to proper operation.

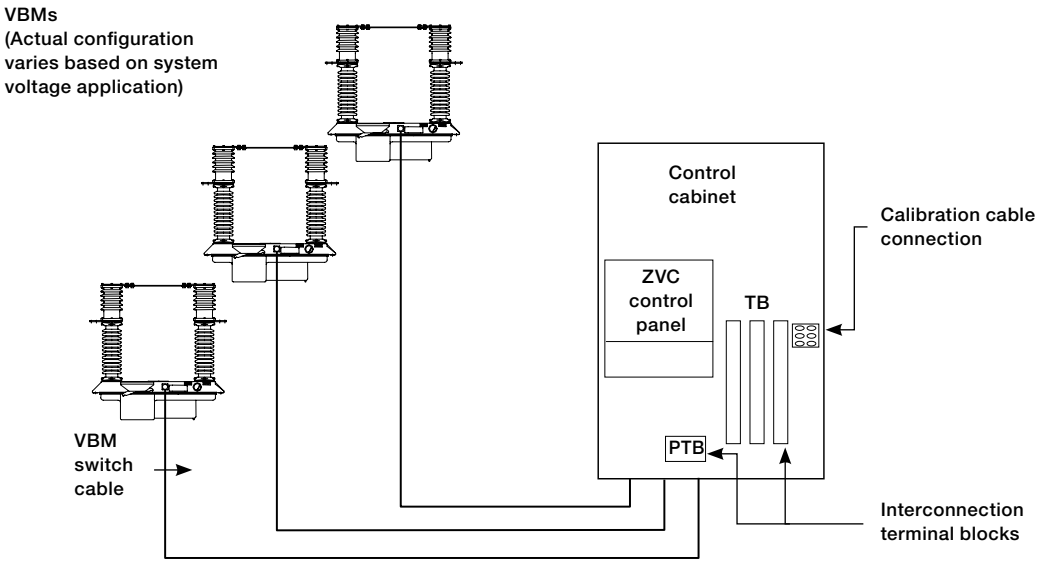
ZVC control and Varmaster VBM switches

A typical layout of system and control using both the ZVC control and Varmaster VBM switches is shown below. The individual poles are connected to the ZVC control using cables with keyed pin connectors on the switch end.

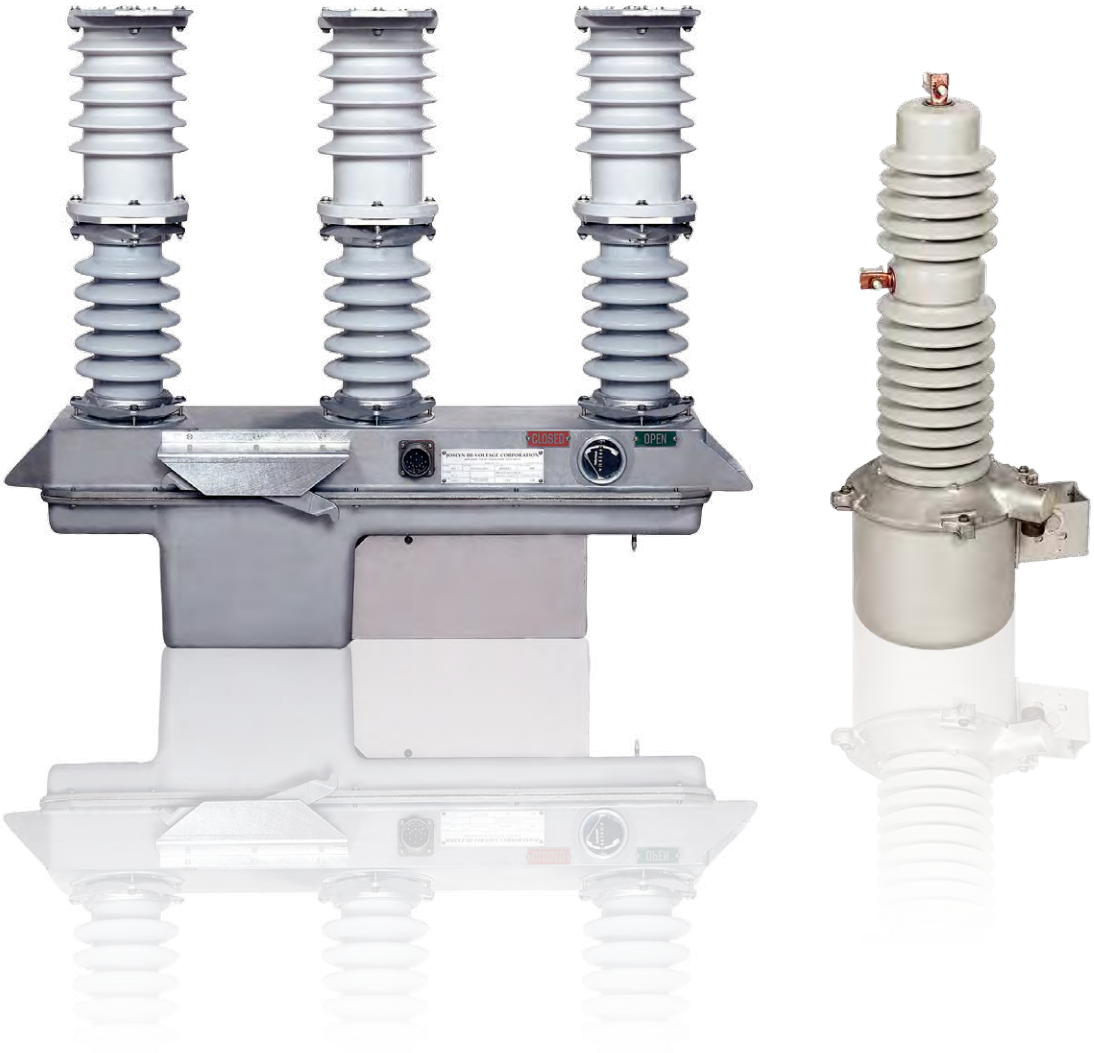
For greater control, opt for the Joslyn Hi-Voltage® ZVC control system with Varmaster VBM switches. It consists of the following components:

- ZVC control cabinet
- Three Varmaster VBM switches (poles)
- Three Varmaster VBM pole cables (either standard 17.5- or maximum 26-ft. lengths)

General system layout



Notes: The cables can be shortened as required in the field, but it is recommended that all three cables be the same length.
Connection of the individual cables to the correct system phase designation is critical to proper operation.
For ordering information for ZVC Control, see pages A-11 and A-28.

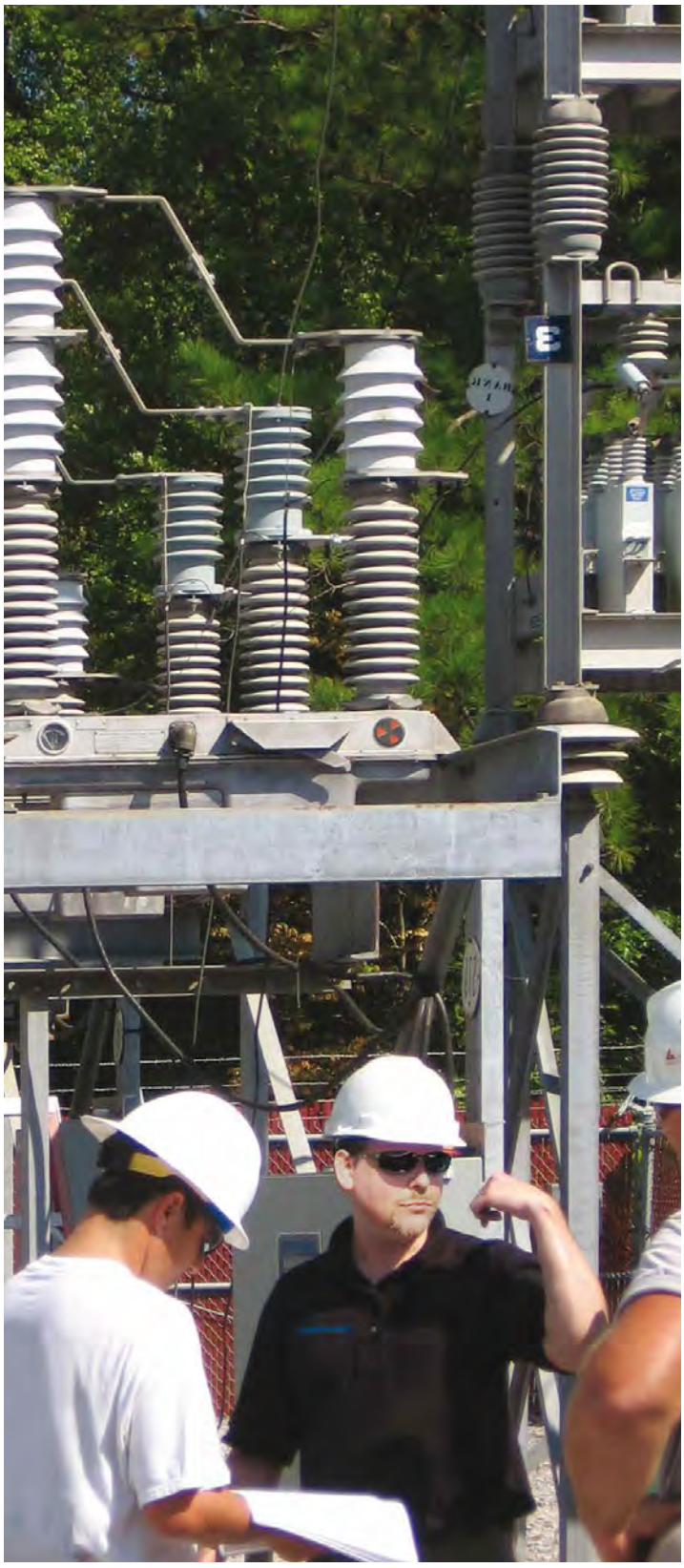

CLOSED
OPEN

Joslyn Hi-Voltage® capacitor switches

Service and support

B

T&B services



Customer service

Phone: 1-800-816-7809

Email: generalcustomerserviceteam@tnb.com

Customer service specialists personally serve your account and can answer questions about products, order status, price and availability and other service-related inquiries.

Field services

The field services team provides field maintenance and support for Elastimold®, Hi-Tech® and Joslyn Hi-Voltage® equipment in the field. Please contact your Thomas & Betts representative for more information.

Tool services

1-800-284-TOOL

T&B's dedicated tool services department answers all questions regarding tool applications, repair, warranties, sales/lease/rental and technical information. Ask about our specialized services, including customer/sales training, demos and calibration/ certification of tools.

Web catalog

www.tnb.com/webcatalog

Search for technical information by catalog number, UPC code, competitor number, keyword search, product category and/or brand. Use the "where to buy" function to locate a T&B local distributor and/or other support services.

Visit the T&B world of electrical product solutions

Visit our web site for more information about Thomas & Betts solutions and our newest products. For a user-friendly catalog and competitive part number search, application and technical support and other useful information, go to: www.tnb.com

Industry codes and specifications

All Thomas & Betts products meet or exceed applicable industry specifications or codes which are detailed in the appropriate T&B product literature.

IEEE ANSI IEC

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