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CATALOG

# Joslyn Hi-Voltage®

## Capacitor switches



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**Thomas & Betts is now ABB Installation Products, but our long legacy of quality products and innovation remains the same. From connectors that help wire buildings on Earth to cable ties that help put machines in space, we continue to work every day to make, market, design and sell products that provide a smarter, safer and more reliable flow of electricity, from source to socket.**

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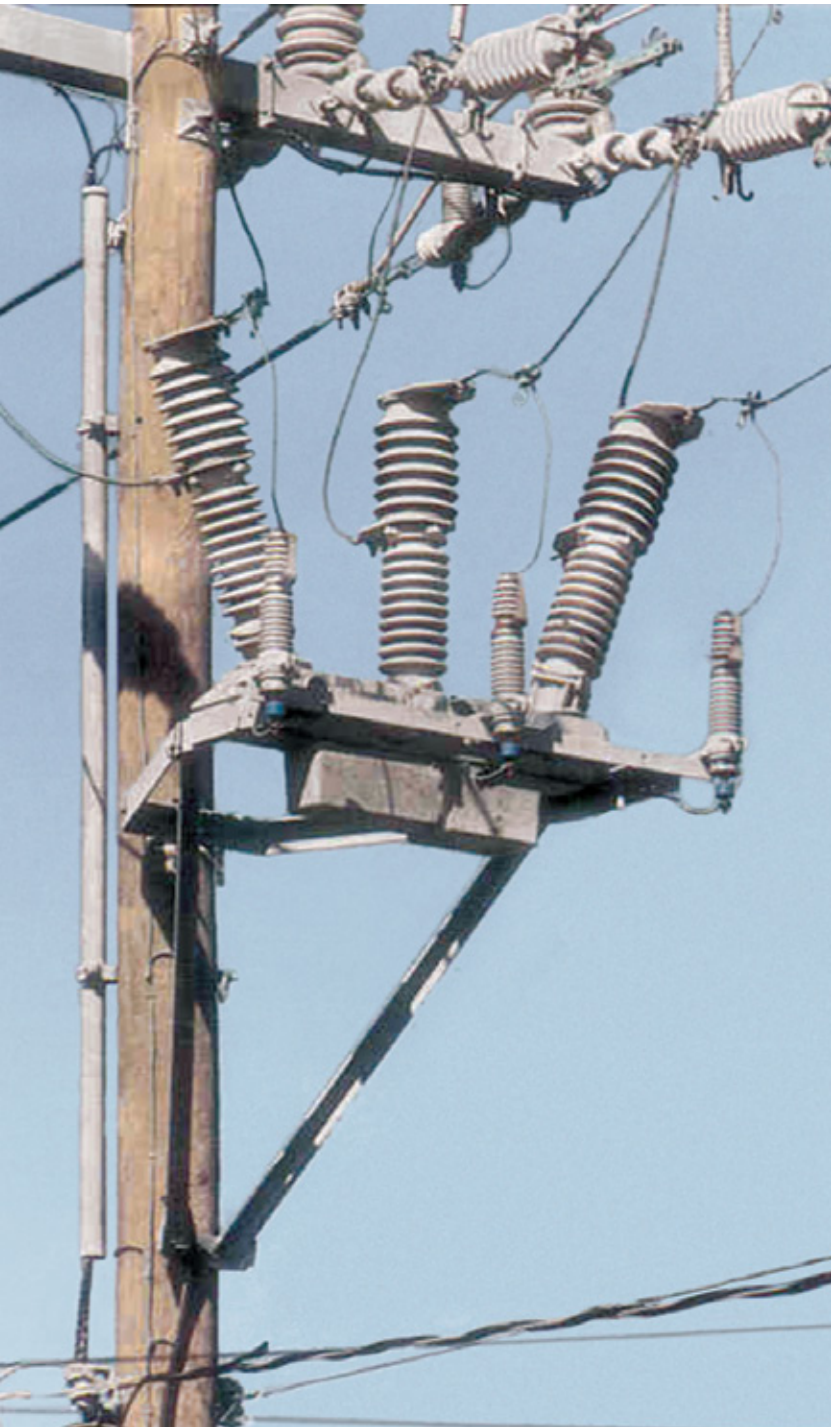
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# Joslyn Hi-Voltage® capacitor switches

Environmentally sustainable. Compatible.  
Efficient. Lifecycle cost reducing.



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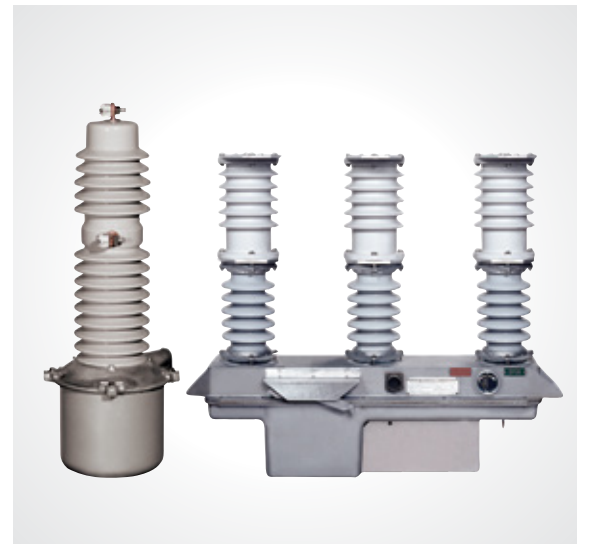
Environmental sustainability —  
no oil or gases

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

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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)



- 01 ZVC control
- 02 VerSaVac® switches
- 03 VBM (Varmaster) switches

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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

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

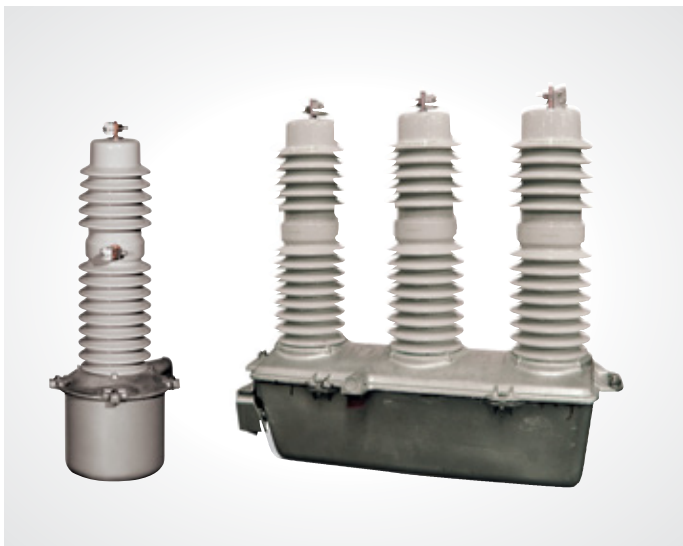
- Zero voltage closing (ZVC) control
- Prevents customer equipment damage and stress on capacitors when bringing capacitor banks online
- Synchronous closing of three switch poles independently, with the occurrence of zero voltage in each phase
- Enables volt-VAR optimization (VVO)

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Lifecycle cost reductions — with solenoid operators

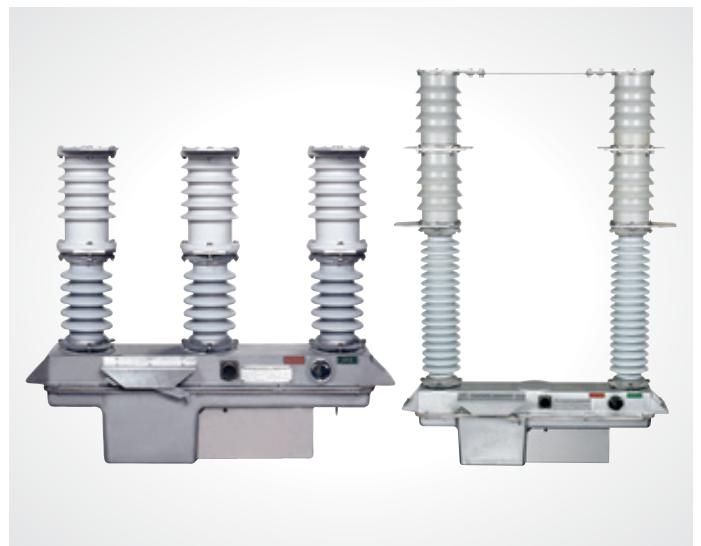
- SF6 interrupting mediums can result in SF6 leaks, maintenance, personal protective equipment (PPE) and regulatory requirements to monitor and measure usage/leakage
- Solenoid operators offer long operational life of between 10,000–50,000 open and close operations with no required maintenance



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# Joslyn Hi-Voltage® capacitor switches

## Overview

Why use Joslyn Hi-Voltage capacitor switches?

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01 VerSaVac®  
single-phase switch  
15 kV–38 kV

**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.

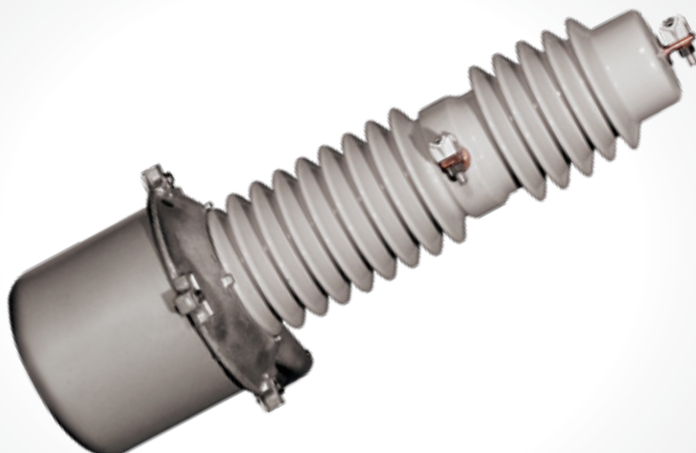
The reduction in reactive current caused by a switched power capacitor also reduces the total line current. This reduction in kVA demand during heavy load periods has a number of benefits:

- 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

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01  
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.



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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 72.5 kV.

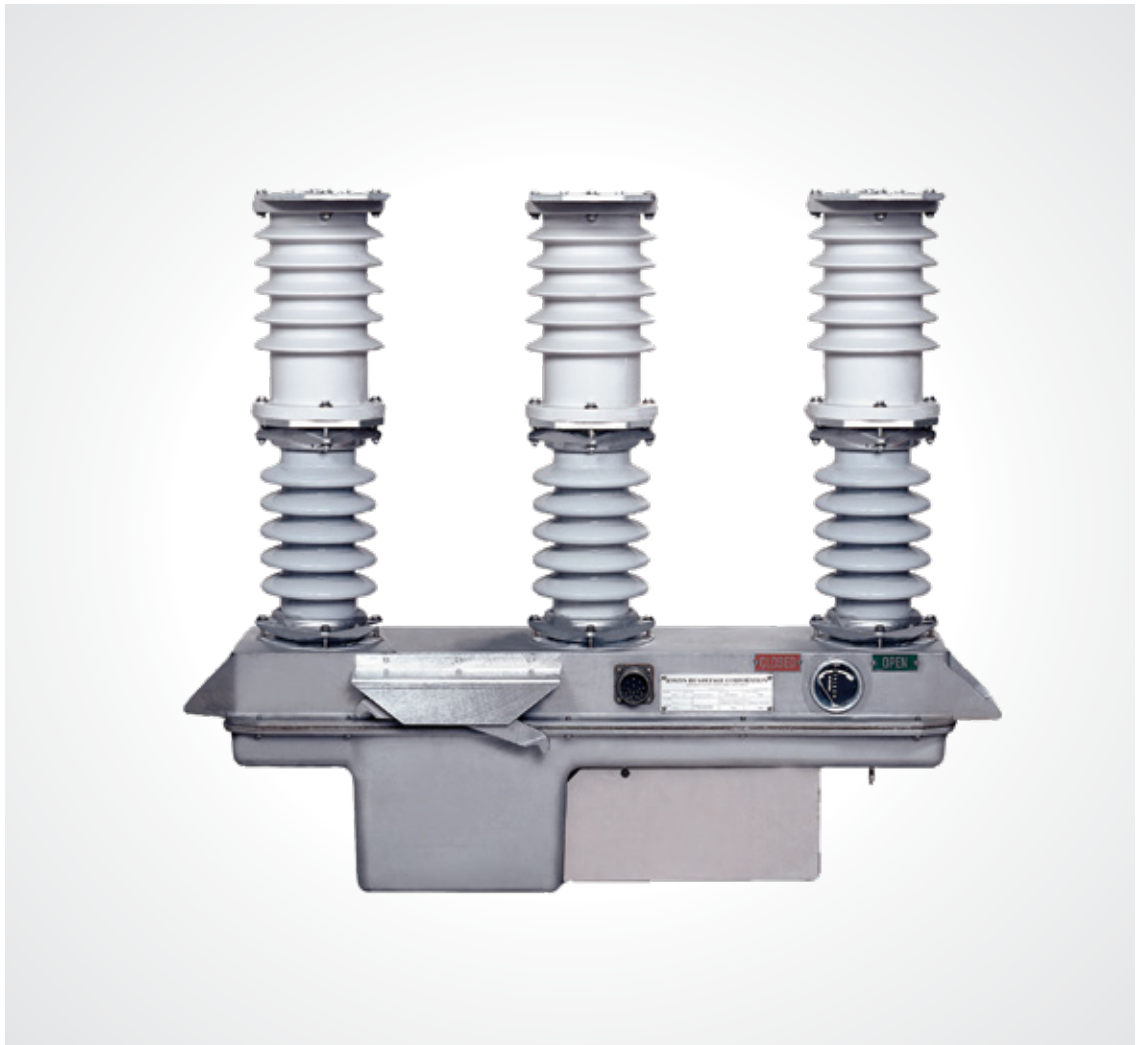
- 01 Varmaster VBM switch 15 kV–72.5 kV
- 02 VerSaVac® three-phase switch 15 kV–38 kV
- 03 Varmaster VBM switch 15 kV–72.5 kV



— 01



— 02



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# VerSaVac® 15–38 kV capacitor switches

## Joslyn Hi-Voltage® VerSaVac capacitor switches

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

—  
01 Single-phase

—  
02 Three-phase

- Synchronized operation from a fast, repeatable solenoid operating mechanism ensures all phases will operate within  $\frac{1}{4}$  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, 15–38 kV, 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.



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02



## VerSaVac® single-phase capacitor switch

- 01 Bottom view: closed
- 02 Bottom view: open
- 03 Bottom view: trip lever 45°
- 04 Bottom view: trip lever 180°

**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.

Bladder completely seals switch system.

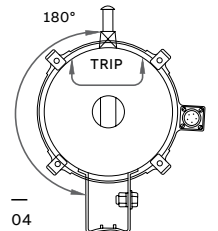
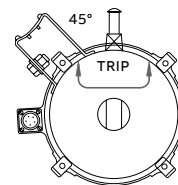
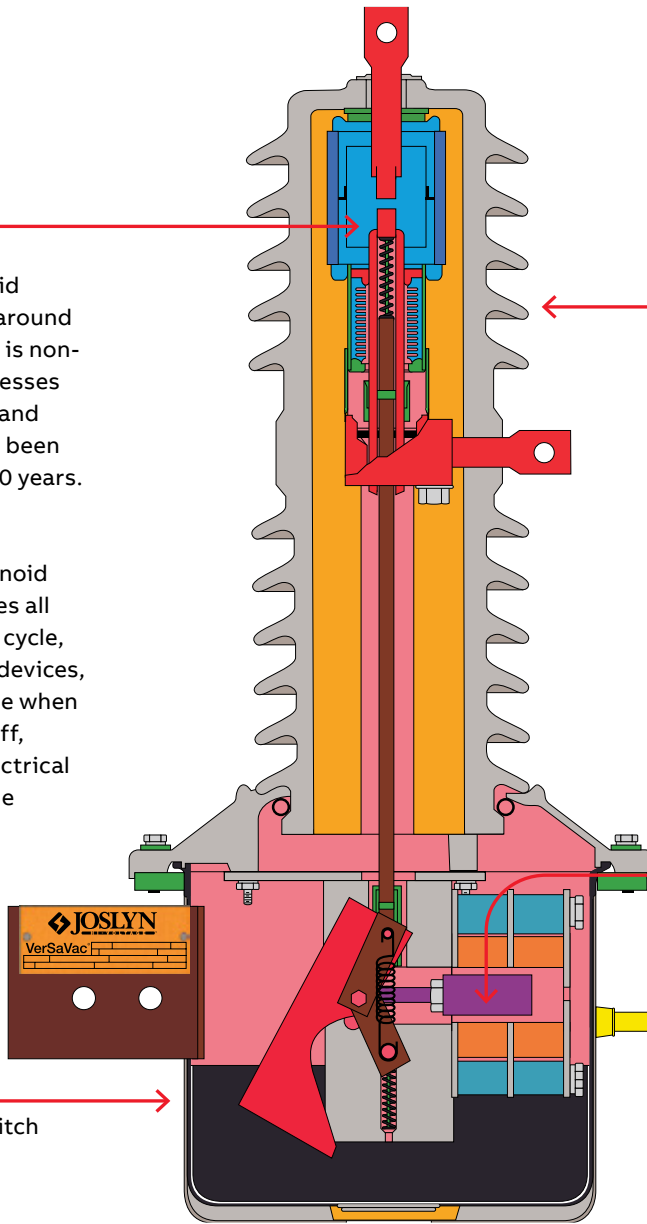
Position indicator (bottom view). Highly visible reflective lettering indicates switch position.

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.



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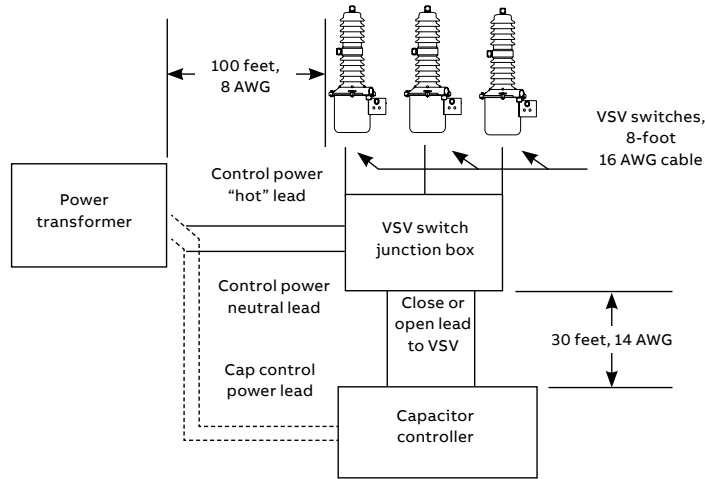
— 03

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# VerSaVac® 15–38 kV capacitor switches

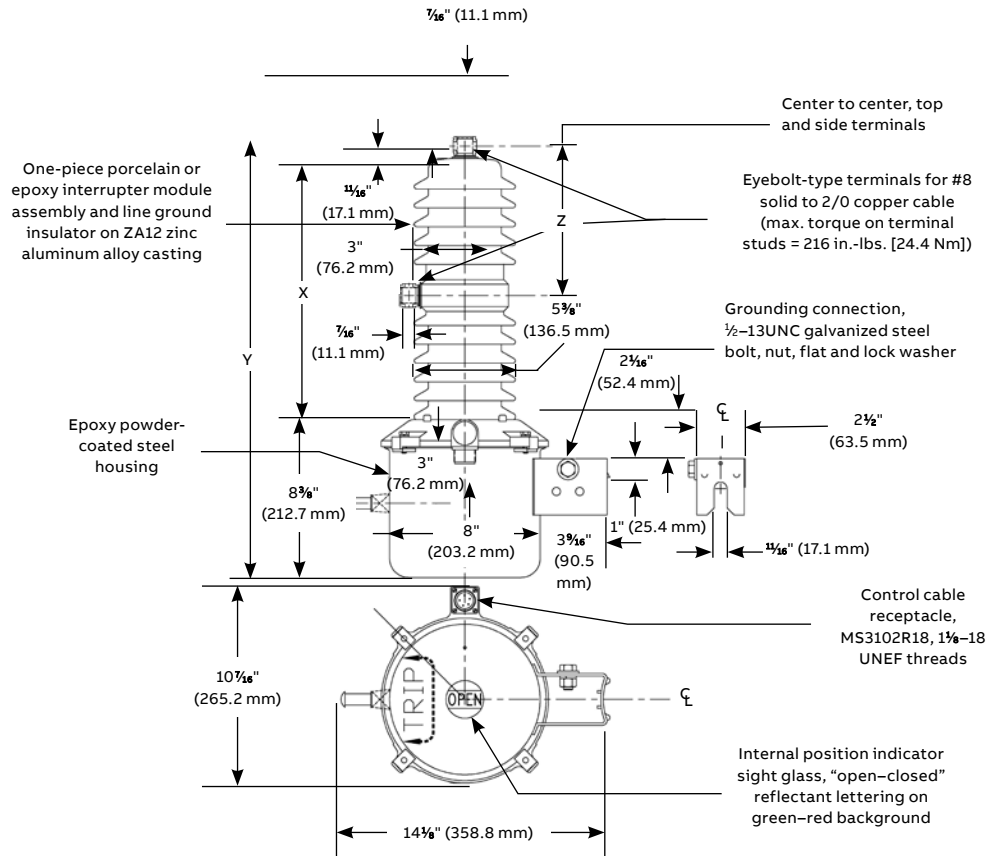
## VerSaVac single-phase capacitor switch

### Typical VerSaVac single-phase installation



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

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



## Dimensions and creepage distances & ratings

### Dimensions and creepage distances

Max. voltage (kV)	Line to ground kV BIL	Line to ground insulation creepage distance			X		Y		Z		Weight	
		in.	mm	in.	mm	in.	mm	in.	mm	lbs	kg	
15	95	12.63	320.7	14	355.6	23.63	600.1	7.94	201.6	27.5	12.5	
15	125	17.19	436.6	16	406.4	25.63	650.9	7.94	201.6	28.5	12.9	
27	125	17.19	436.6	17	431.8	26.63	676.3	8.94	227.0	29.3	13.3	
27	150	19.44	493.7	18	457.2	27.63	701.7	8.94	227.0	30.8	14.0	
27*	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	200 A
Short-time current	6 kA (½ sec.), 4.5 kA (1 sec.)
Asymmetrical momentary/making current	9 kA Asymmetrical RMS/23 kA Peak
Peak inrush current limit for parallel or back-to-back switching applications	6 kA
Control voltages	120 V AC, 240 V AC (see accessories, p. 15)
Minimum operating voltage	80 V AC, 160 V AC
Recommended control pulse time	100 msec.
Auxiliary contact rating	15A @ 120 V AC, .5A @ 125 VDC
Operating temperature range	-60° to 40 °C
<b>Voltage class (kV)</b>	
<b>Maximum voltage</b>	
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
<b>Impulse withstand (kV BIL)</b>	
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® 15–38 kV capacitor switches

## VerSaVac three-phase capacitor switch

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.

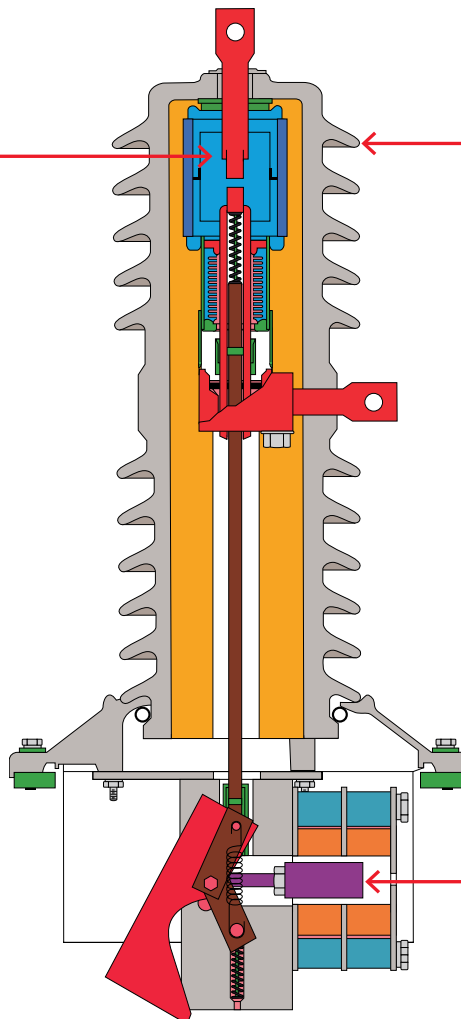
### Compatibility

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.

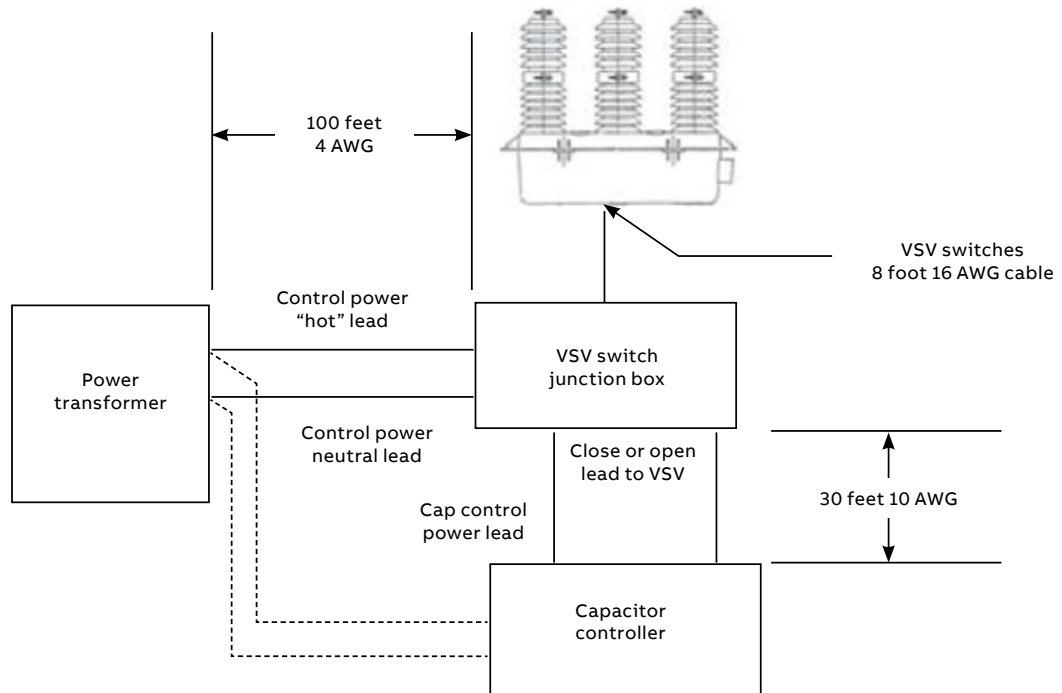
Exceeds electrical requirements of ANSI C37.66.



Porcelain or cycloaliphatic epoxy housing.

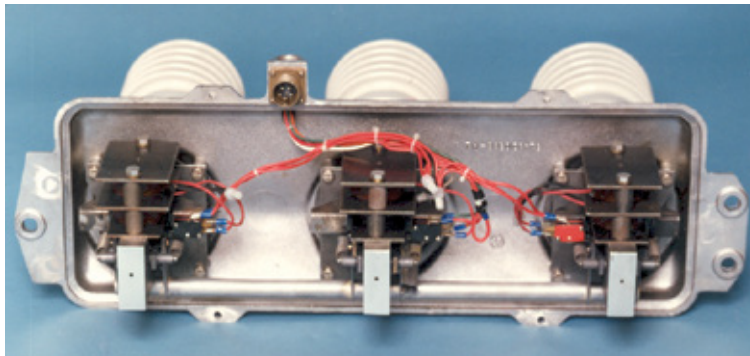
Long-life solenoid mechanism. Provides 100,000 operations (50,000 open/50,000 close).

Typical VerSaVac® three-phase switch installation



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

02 Manual operating handle for open and close



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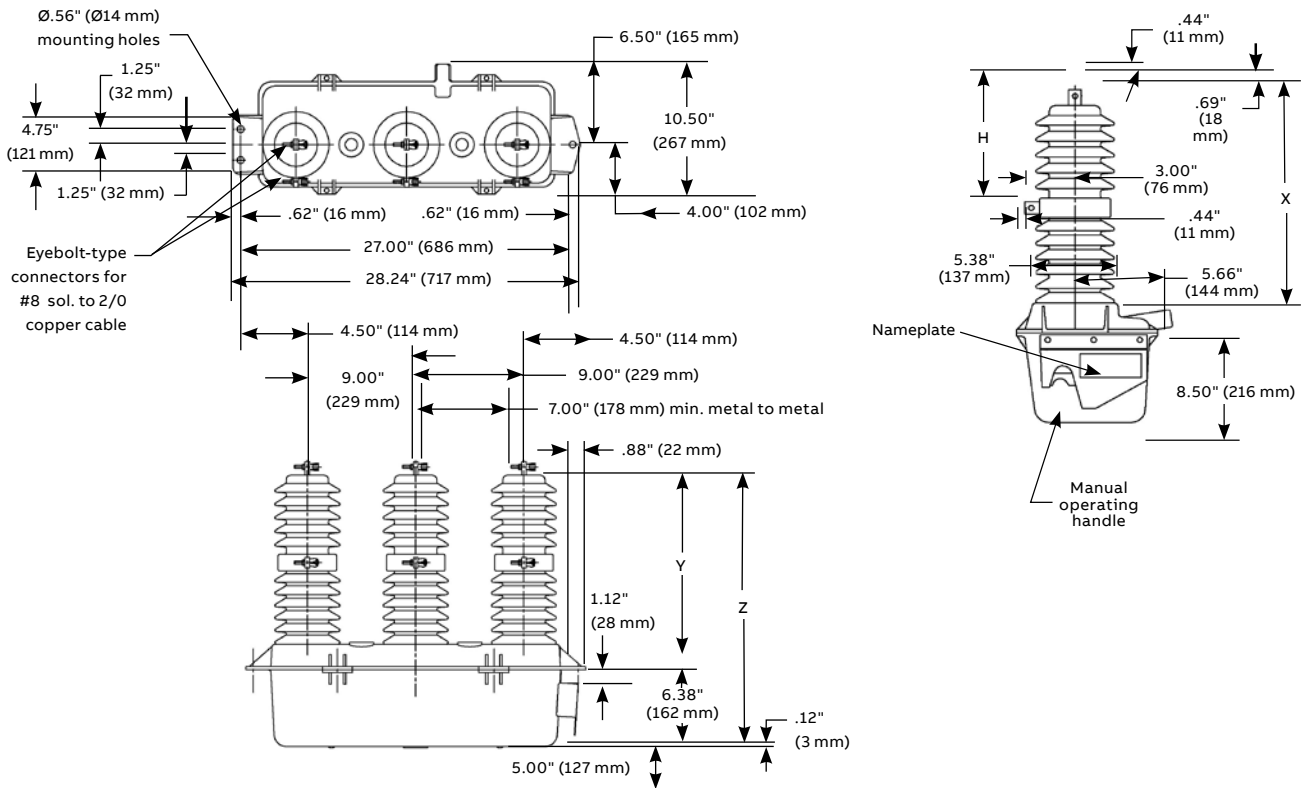
# VerSaVac® 15–38kV capacitor switches

VerSaVac® three-phase capacitor switch

## Dimensions and creepage distances

Line to ground kV BIL	Line to ground insulation creepage distance		X		Y		Z		H		Weight	
	in	mm	in	mm	in	mm	in	mm	in	mm	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

## Dimensions



Control cable receptacle MS 3102 R18  
1.125–18 UNEF thread

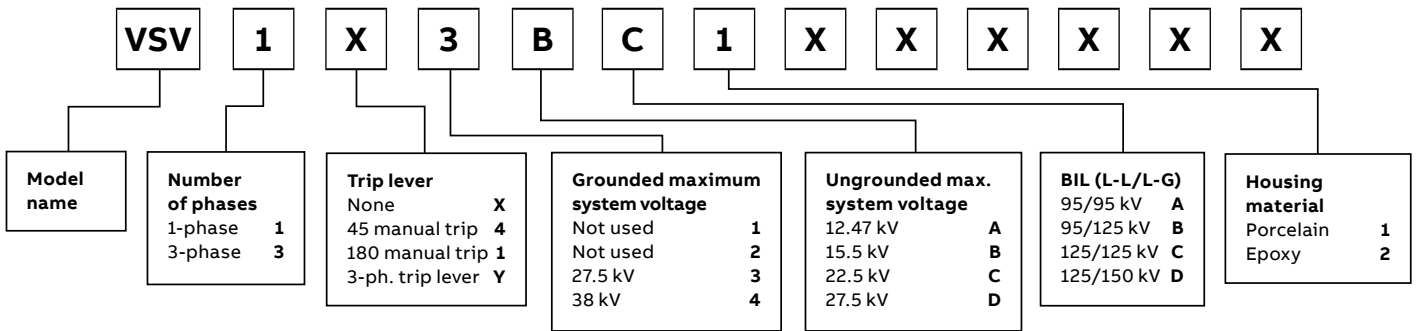
## Ordering details for VerSaVac® single- and three-phase capacitor switch

- To order a basic VerSaVac switch, the catalog number is constructed as shown below.
- **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 33–37)
- 125 V DC control interface

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



# Varmaster VBM 15–72.5 kV capacitor switches

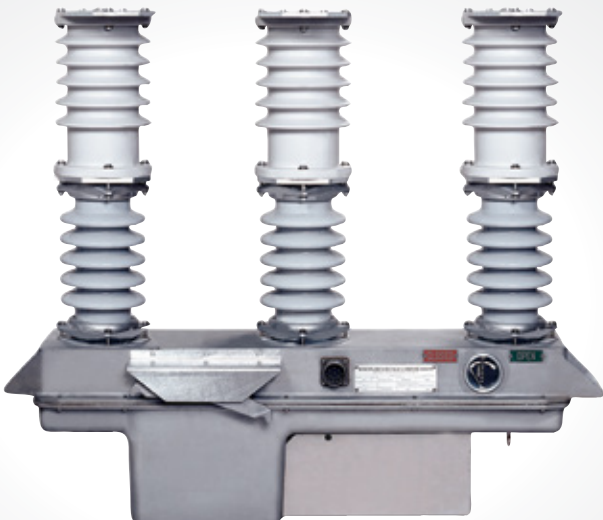
## Joslyn Hi-Voltage® Varmaster VBM switching systems

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
- 15 kV–72.5 kV 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 15 kV to 72.5 kV, 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.





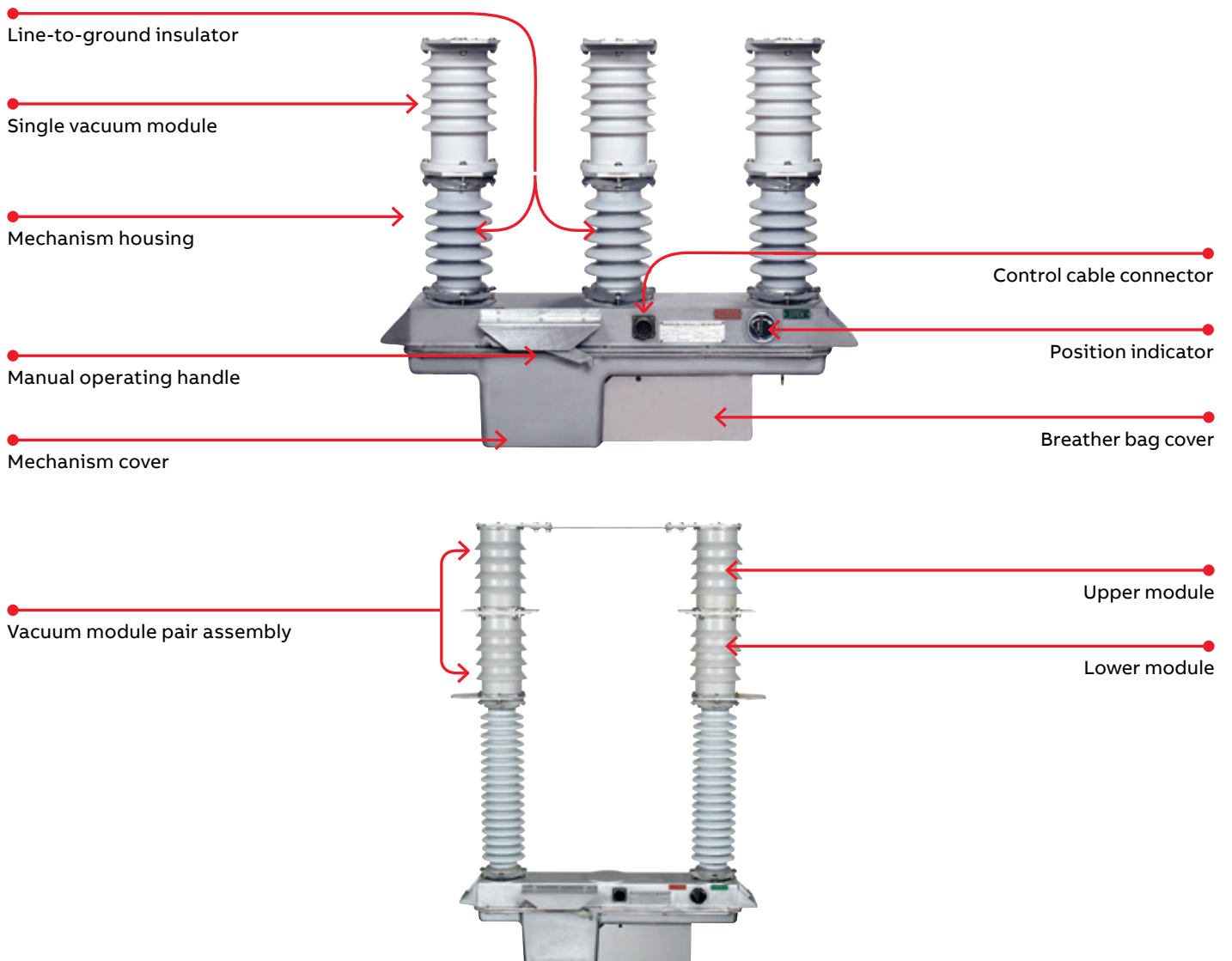
Stored-energy operating mechanisms, which can be operated manually or electrically, move the contacts at high speed and are unaffected by control voltage fluctuation or manual operating speed. Each switch features an operation counter.

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 15 kV to 72.5 kV with continuous current capabilities from 200 A to 600 A. The mechanism

may be operated manually, or electrically by solenoid or motor operators.

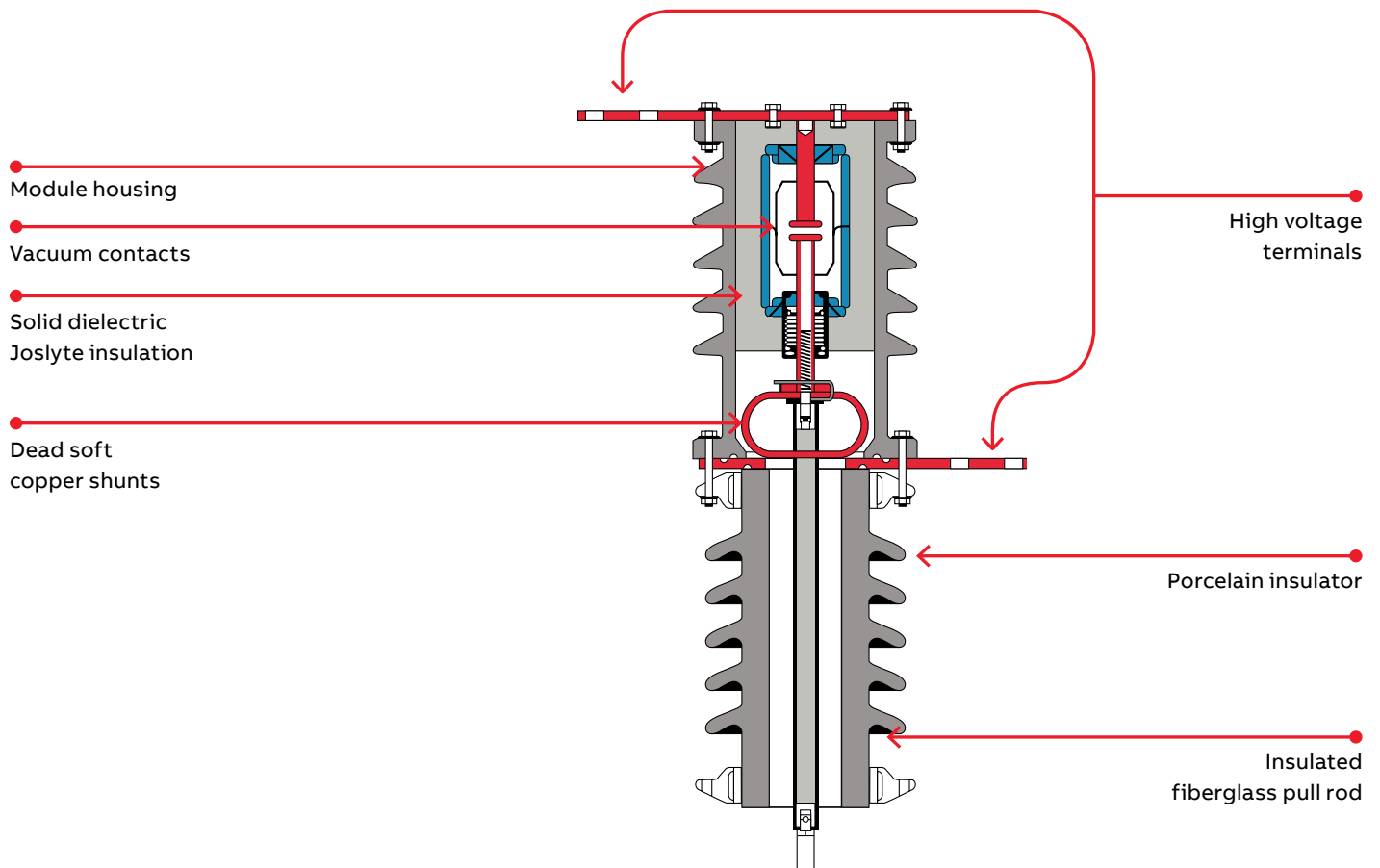


# Varmaster VBM 15–72.5 kV capacitor switches

## Joslyn Hi-Voltage® Varmaster VBM switching systems

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.



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

Single vacuum module cutaway

Varmaster VBM switch models



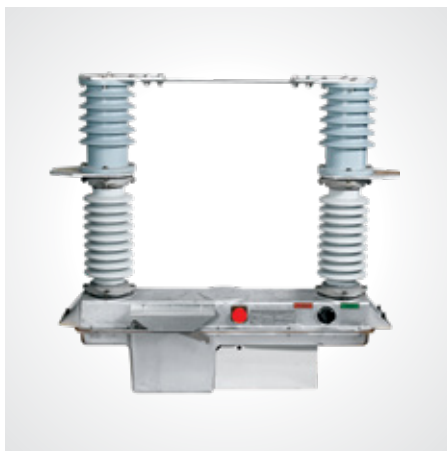
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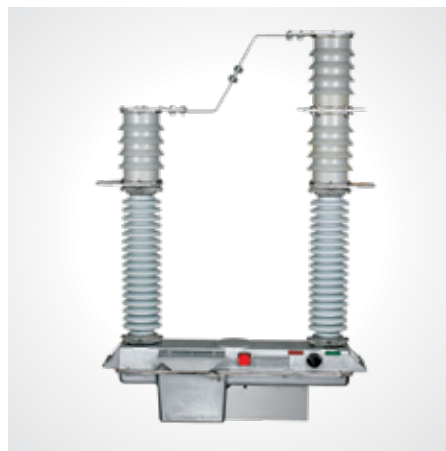
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01 **Three phase**  
15 kV/25 kV\* 400 A  
15 kV/25 kV\* 600 A  
\* 25 kV rating for solidly grounded capacitor bank configurations only.

02 **Three phase**  
25 kV 200 A  
25 kV 300 A  
25 kV 400 A

03 **Three phase**  
38 kV 300 A

04 **One pole\***  
38 kV 400 A  
38 kV 600 A  
48.5 kV 200 A\*\*  
\* Three poles required for a three-phase installation.  
\*\* Solidly grounded capacitor bank configurations only.

05 **One pole\***  
48.5 kV 300 A  
48.5 kV 400 A  
\* Three poles required for a three-phase installation.

06 **One pole\***  
72.5 kV 300 A  
\* Three poles required for a three-phase installation.

# Varmaster VBM 15–72.5 kV capacitor switches

## Joslyn Hi-Voltage® Varmaster VBM switching systems

### Varmaster VBM switch options and accessories

- 01 Solenoid operator
- 02 Motor operator

#### 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 15 kV, 400 A and 600 A models and 34.5 kV, 300 A models. All controls are located inside the VBM mechanism housing. Inspection after 10,000 operations is recommended.

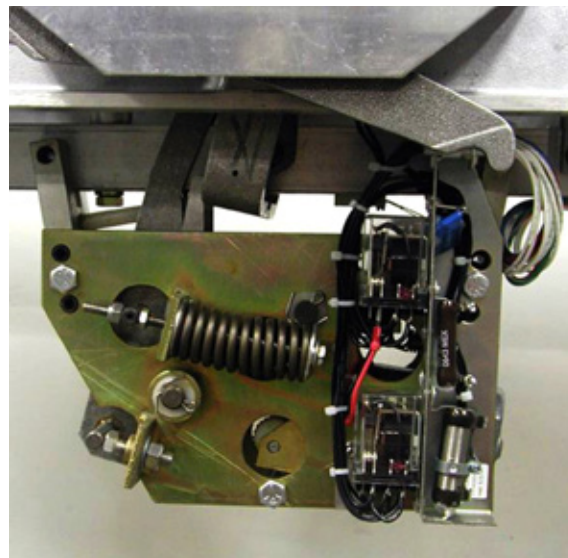
The completely sealed operating mechanism housing supports line-to-ground insulators and the modules. An expansion bag in the housing prevents the intake of contaminants or moisture and contains a desiccant package to maintain dry air.

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.



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## Operating mechanism options

### Operating mechanism options

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

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 10 A, 125 V DC or 115 V AC.

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 15 A, 120 V AC and 10 A, 125 V DC.

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 60 A peak for one-, two- or three-mechanism switch systems.

7. Current is 120 A for the 34.5 kV, 300 A Varmaster VBM switch.

8. Current for three-mechanism switch systems is approximately 180 A peak for three cycles.

# Varmaster VBM 15–72.5 kV capacitor switches

## Joslyn Hi-Voltage® Varmaster VBM switching systems

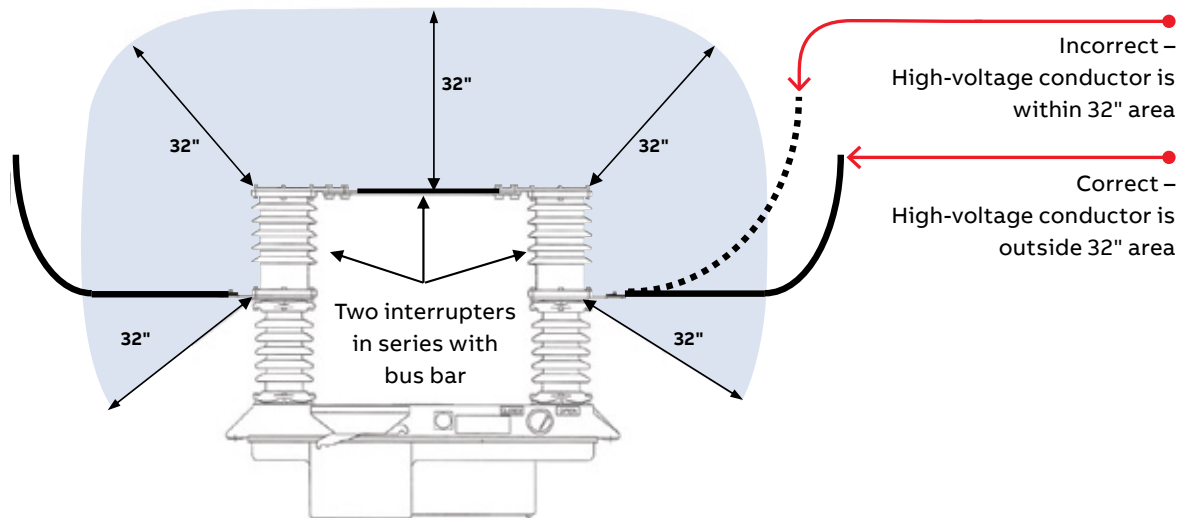
— 01 32" clearance around 38 kV single-phase interrupters, front view

— 02 T32" clearance around 38 kV single-phase interrupters, side view

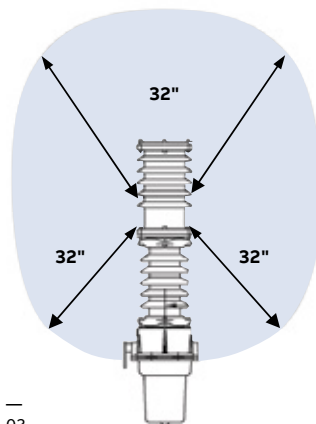
### Varmaster VBM switch clearance requirements

For Varmaster VBM switches with multiple vacuum interrupters in series, a 32" (813 mm) 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.



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

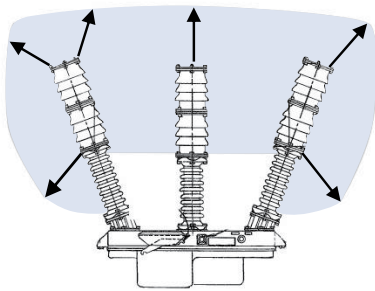
- 01 **Three-phase**  
15 kV/25 kV
- 02 **Three-phase**  
38 kV
- 03 **Single-phase**  
48.5 kV
- 04 **Single-phase**  
72.5 kV
- 05 **Double-stack**  
**interrupters**
- 06 **Three-phase**  
25 kV



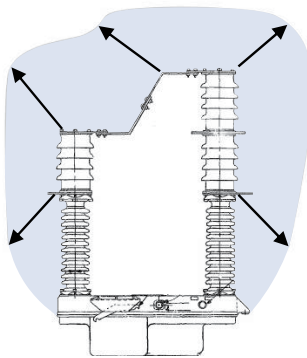
NOTE: The 32" (813 mm) clearance requirement does not apply to Varmaster VBM switches with only one interrupter per phase, as shown above. All other configurations shown must maintain the 32" (813 mm) clearance.

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01

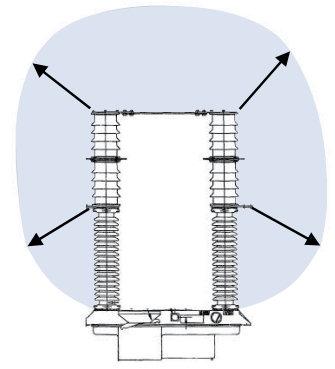
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 Two or more interrupters per phase, 32" (813 mm) clearance required



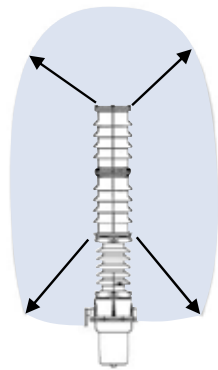
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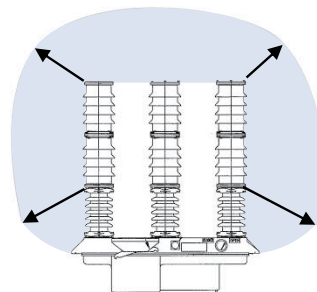
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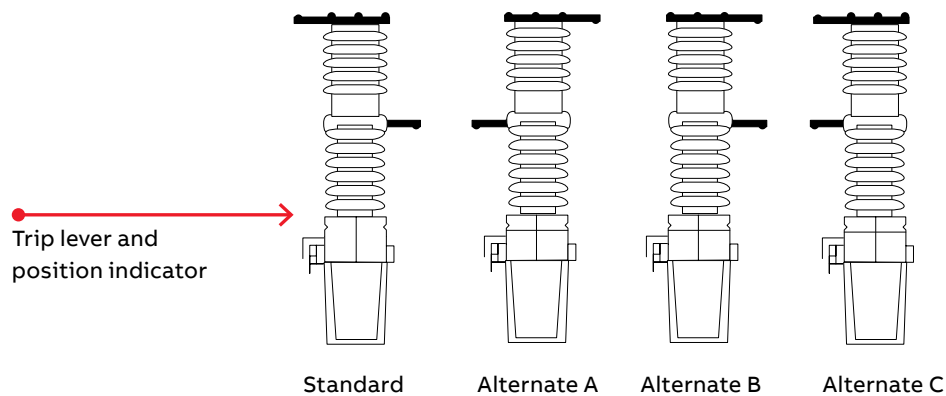


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06

# Varmaster VBM 15–72.5 kV capacitor switches

## Joslyn Hi-Voltage® Varmaster VBM switching systems

Varmaster VBM terminal pad orientation options for single-mechanism switches

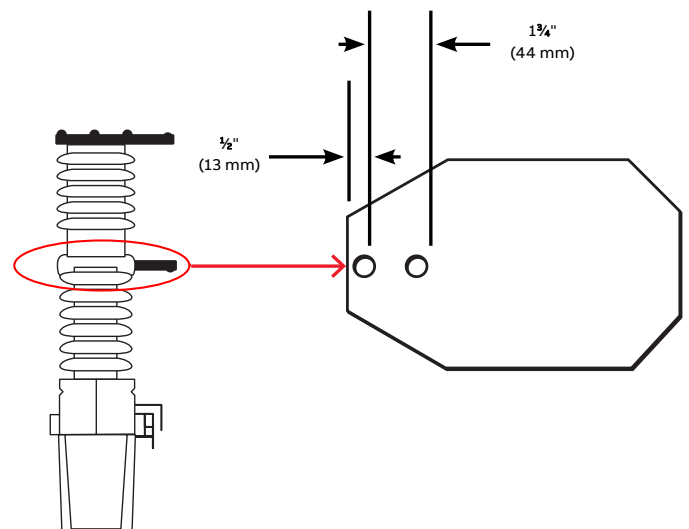


## High-voltage connections

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.

### Terminal pad



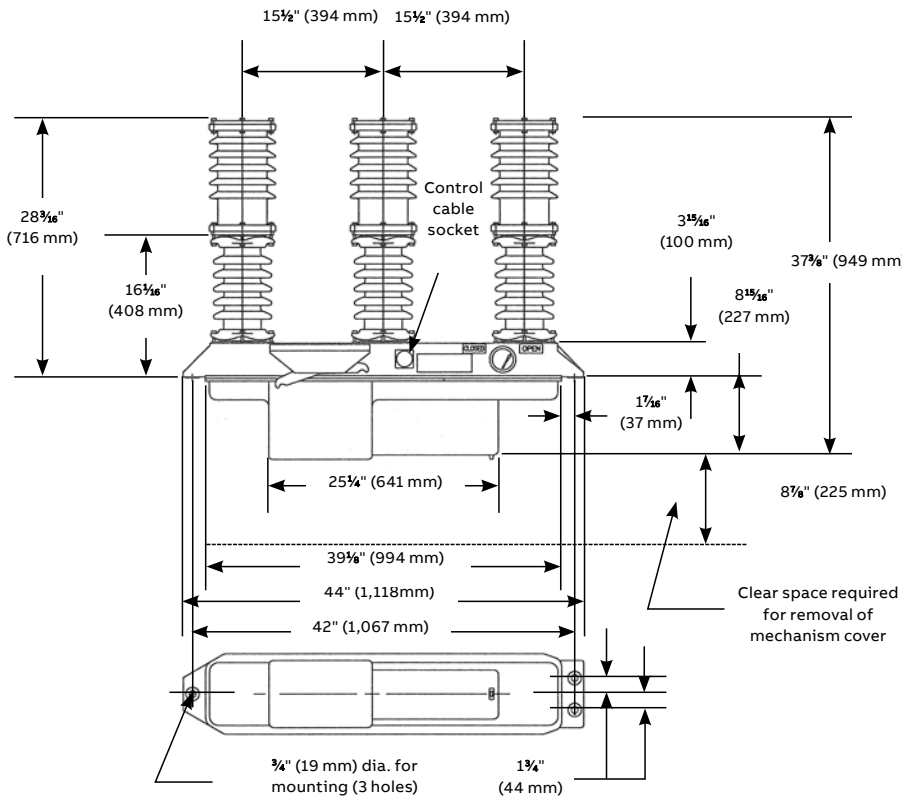


# Varmaster VBM 15-72.5 kV capacitor switches

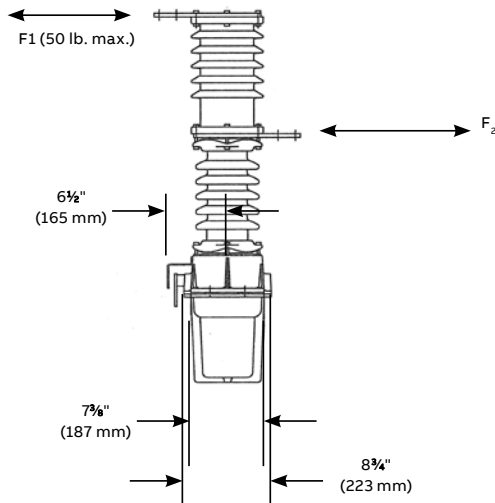
Joslyn Hi-Voltage® Varmaster VBM switching systems

Weight: 148 lb.  
(67 kg) maximum.  
\* Solid grounded systems  
and capacitor bank only.

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



$$2 F_1 + F_2 \leq 100 \text{ lb.}$$



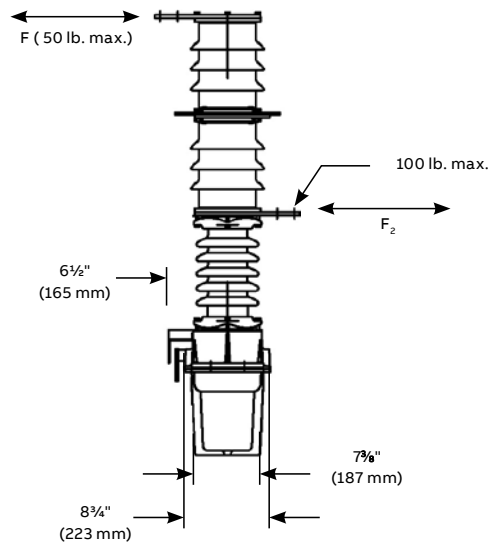
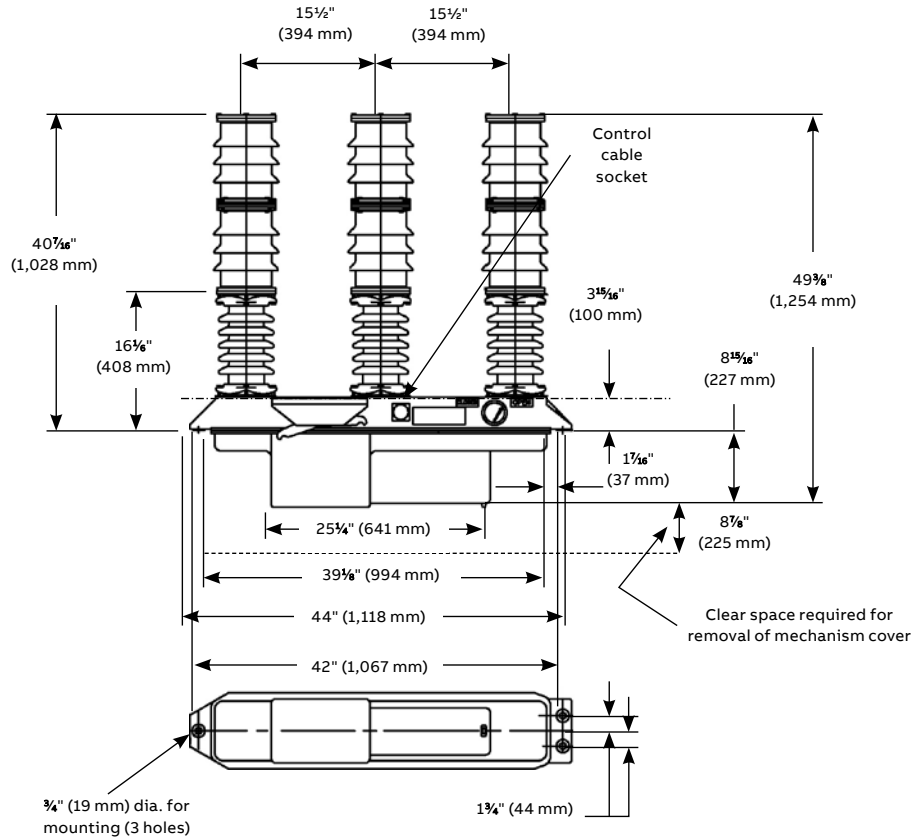
Side view

# Varmaster VBM 15–72.5 kV capacitor switches

Joslyn Hi-Voltage® Varmaster VBM switching systems

Weight: 225 lb.  
(102 kg) maximum.

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



Side view

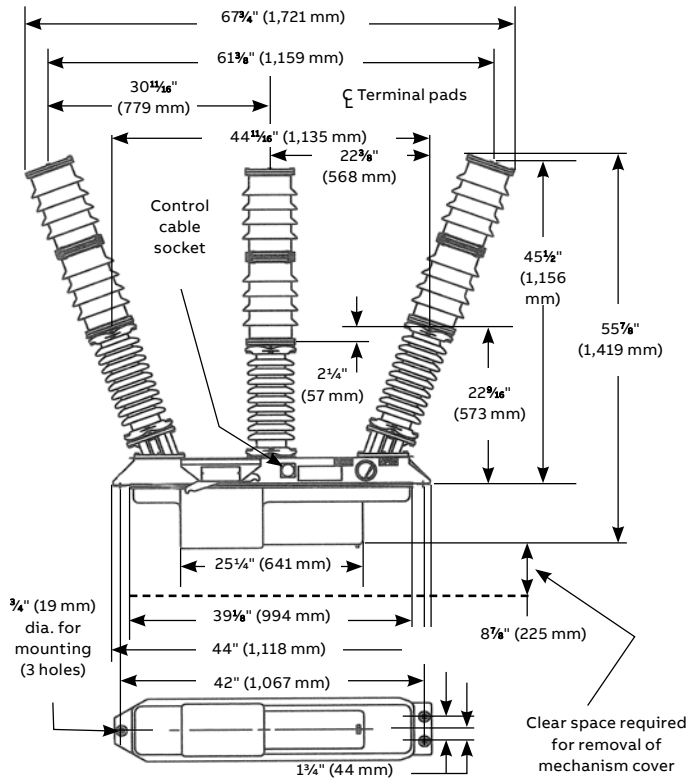
# Varmaster VBM 15-72.5 kV capacitor switches

Joslyn Hi-Voltage® Varmaster VBM switching systems

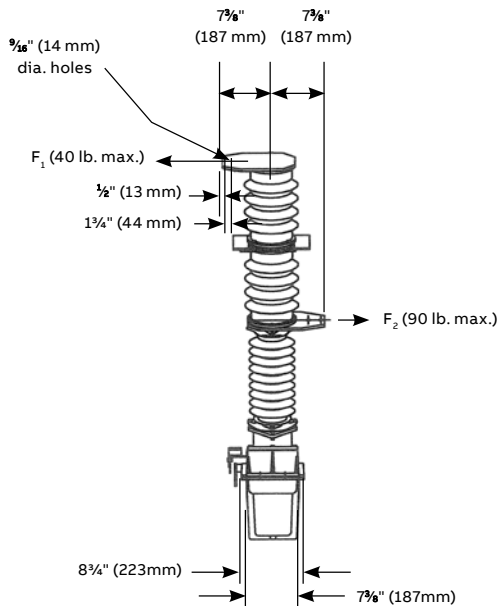
Weight: 225 lb.  
(102 kg) maximum.

**Note:** Other insulation ratings are available for extra creepage.

## Dimensions for three-phase switch, 38 kV 300 A



Front view



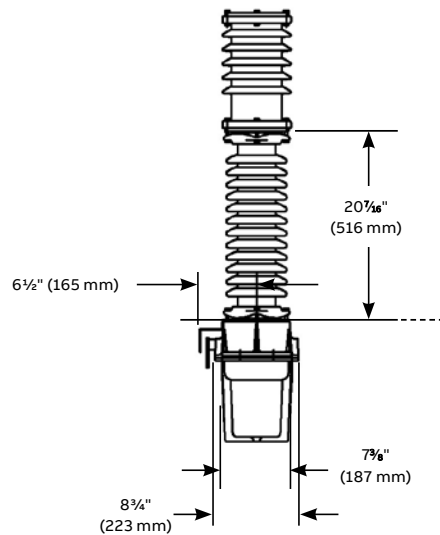
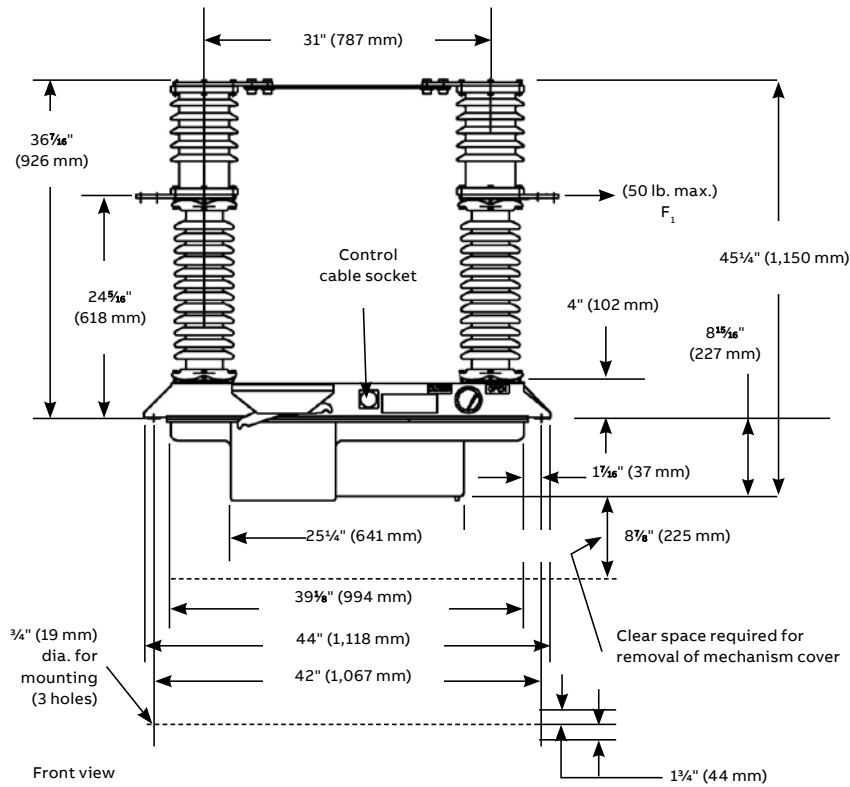
Side view

## Varmaster VBM 15–72.5 kV capacitor switches

Joslyn Hi-Voltage® Varmaster VBM switching systems

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

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



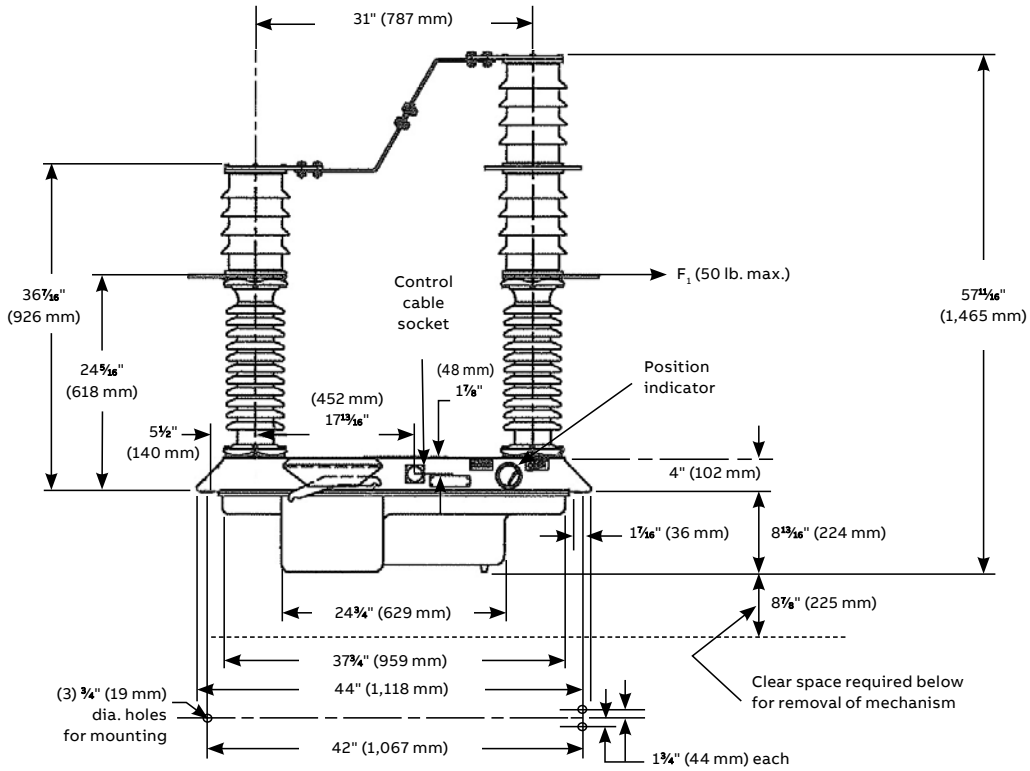
Side view

# Varmaster VBM 15-72.5 kV capacitor switches

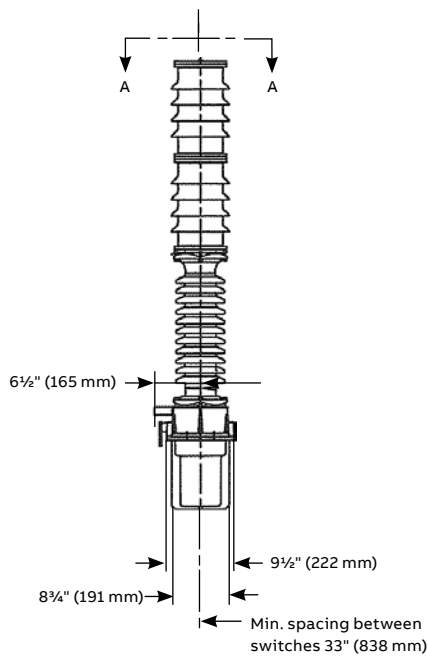
Joslyn Hi-Voltage® Varmaster VBM switching systems

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

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



Front view



Side view

## Varmaster VBM 15–72.5 kV capacitor switches

Joslyn Hi-Voltage® Varmaster VBM switching systems

### Joslyn Hi-Voltage Varmaster VBM switching systems

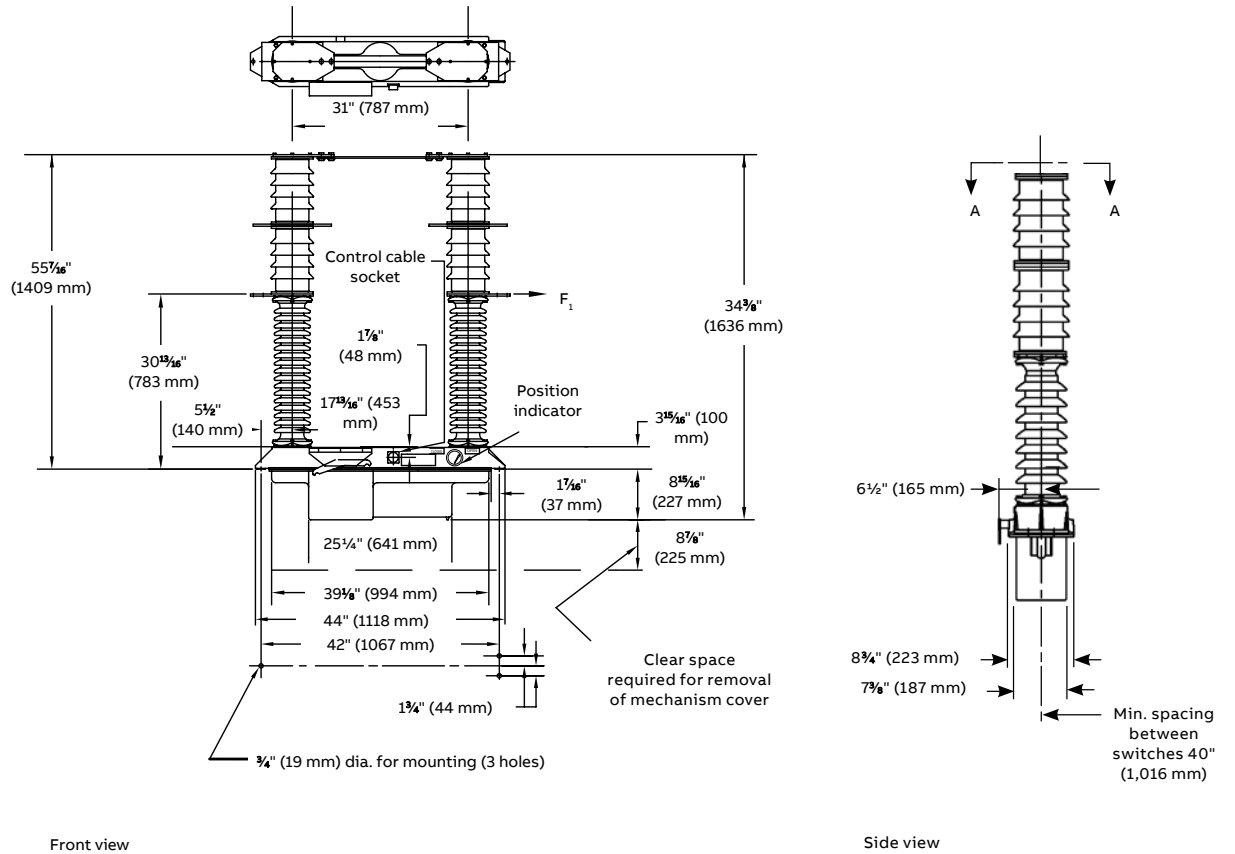
Maximum voltage	15.5 kV/25 kV <sup>3</sup>			25 kV	
<b>VBM switch ratings</b>					
Capacitor and load switching current <sup>1,2</sup> (Amps)	400	600	200	300	400
Fault interrupting current (kA)	3	4	3	3	3
Momentary current (kA RMS, asymmetric)	20	20	15	15	15
Impulse withstand (kV BIL) Terminal-to-terminal <sup>5</sup>	110	110	200	200	200
Line-to-ground (kV BIL) (1.2 x 50 positive wave)	150	150	150	150	150
<b>Maximum 60-cycle withstand line-to-ground (kV)</b>					
One minute dry	101	101	101	101	101
Two seconds wet	74	74	74	74	74
Maximum peak making current (kA) <sup>6</sup>	20	20	15	15	15
Maximum peak back-to-back inrush current (kA)	10	10	8	8	8
Two-second current (Amps)	12,500	–	–	–	–
Four-second current (Amps)	9,000	–	–	–	–

Notes:

- 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.
- Varmaster VBM switches are available with continuous current ratings through 3,000 A for non-capacitor bank applications. Consult your ABB representative regarding application of these switches.
- Grounded systems only at 25 kV.
- In capacitor switching applications, the 48.5 kV, 200 A Varmaster VBM may be used on solidly grounded systems and grounded capacitor banks with total current less than 200 A. For all other loads, this VBM rating is 600 A.
- Interrupter portion of switch does not provide a visible open gap; therefore, it cannot be used to establish a safety clearance for personnel.
- 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.

38 kV				48.5 kV		72.5 kV
300	400	600	200 <sup>4</sup>	300	400	300
3	3	4	4	3	3	3
15	20	20	20	15	15	15
200	200	200	200	250	250	280
200	200	200	250	250	250	350
<hr/>						
138	138	138	178	178	178	178
119	119	119	176	176	176	176
15	20	20	20	15	15	15
8	10	10	10	8	8	8
-	-	-	-	-	-	-
-	-	-	-	-	-	-

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



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

Front view

Side view

## Varmaster VBM 15–72.5 kV capacitor switches

Joslyn Hi-Voltage® Varmaster VBM switching systems

\* Apply only to 15 kV through 38 kV 300 A. For more information on terminal pad orientation, see page 24.

\*\* Apply to 38 kV and above. For more information on terminal pad orientation, see page 24.

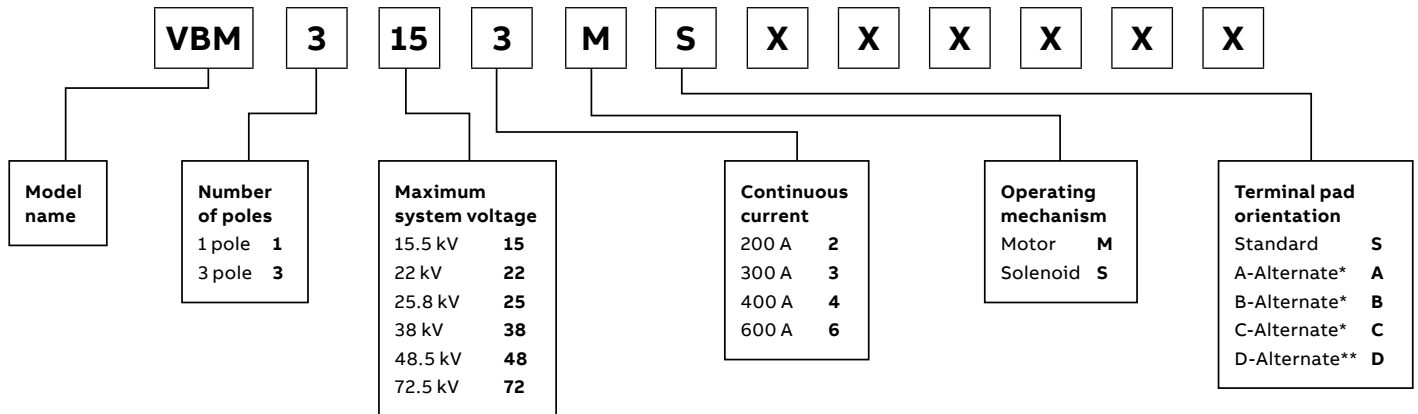
### Ordering details for Varmaster three-phase capacitor switch

- To order a basic Varmaster® 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
- Cable assemblies
- Operating control
- Current sensors
- Capacitor controls
- Mating connectors
- Current limiting reactors
- Zero voltage closing (ZVC) control (see pages 33–37)

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





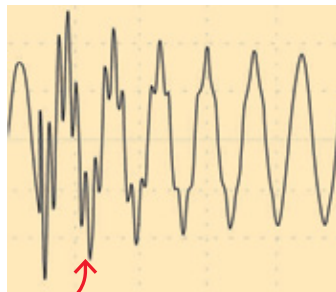
## Zero voltage closing control

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



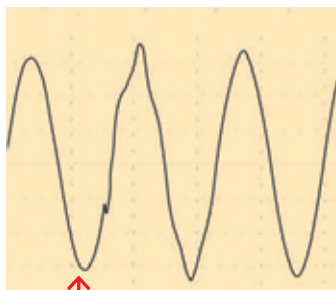
—  
\* Only one phase  
shown for clarity.

Voltage



Close cap #1\*  
standard control

Voltage



Close cap #1\*  
with 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 15 kV to 72.5 kV 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

## Zero voltage closing control

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

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  $\pm 0.89$  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:  $\pm 0.89$  ms @ 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 V AC nominal,  $\pm 10\%$
- Reference signal power requirements: Less than 100 mA

\* 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.

## Zero voltage closing control

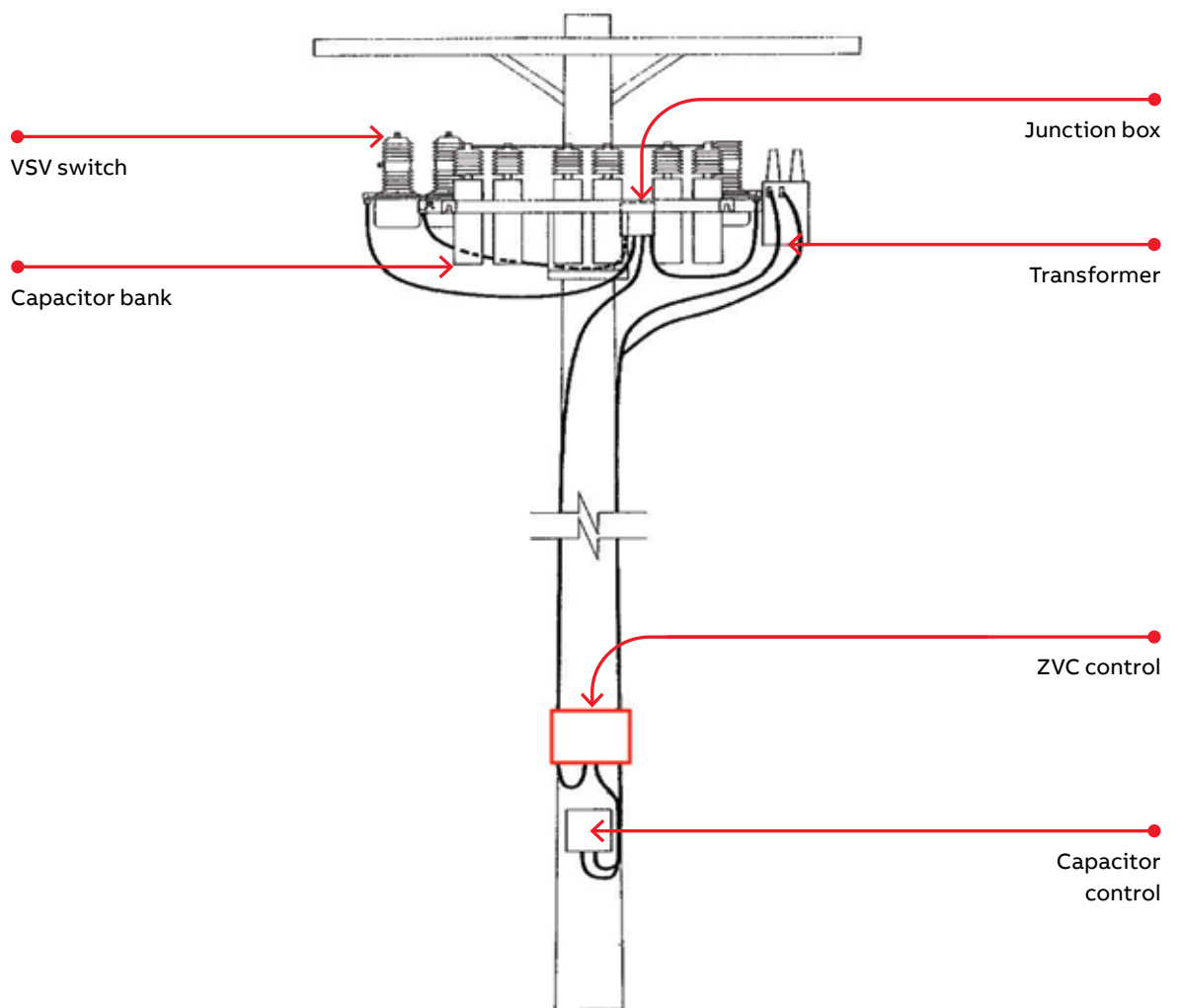
### ZVC control and VerSaVac® switches

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

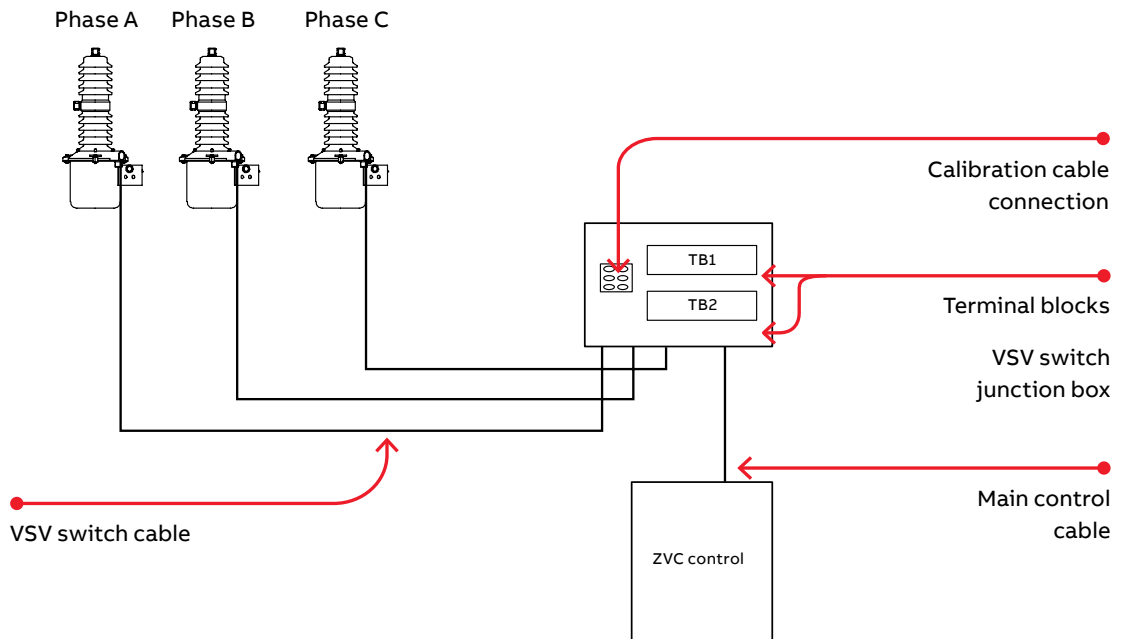
### ZVC control and the junction box assembly

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.

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

### Junction box assembly



## Zero voltage closing control

### 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)

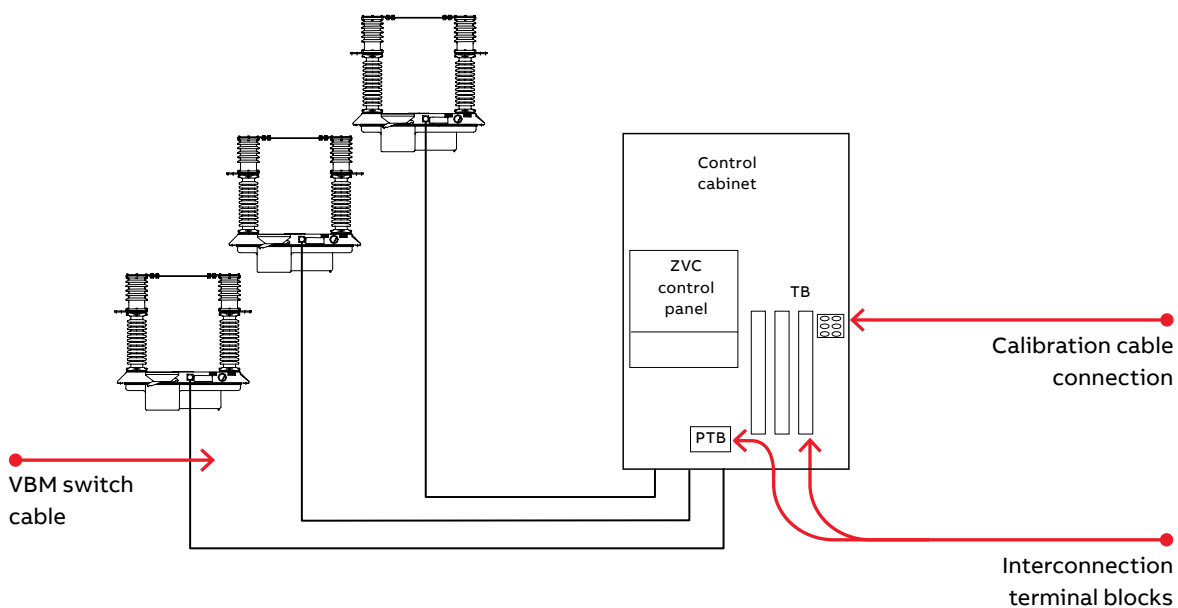
NOTES: The cables can be shortened as required in the field, but it is recommended that all three cables be the same length.

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

For ordering information for ZVC control, see pages 15 and 32.

VBMs  
(Actual configuration varies based on system voltage application)

#### General system layout



## Transmaster® VBT electric furnace switches

Joslyn Hi-Voltage® Transmaster electric furnace switch

—  
01 38 kV 600-Amp  
Transmaster Switch

### Longest life product for electric furnaces!

- Long, maintenance-free life under demanding conditions, designed for 100,000 operations
- No oil or gas used for interruption or insulation
- Safe – no visible or hazardous arcing and no hot exhaust or ionized gas dissemination
- Vacuum interrupter condition can be determined by a high-potential withstand test quickly
- Lightweight modular design – no special foundations or costly support required
- Removable fuses provide protection
- Vacuum contacts withstand excessive overloads and system short circuits at any power factor
- Eight heavy-duty auxiliary contacts are provided for remote indications, control and interlocking of other furnace functions or equipment
- Capacitor discharge circuit trips switch open upon loss of control voltage
- Circuit trips switch open if one mechanism does not close within the specified time

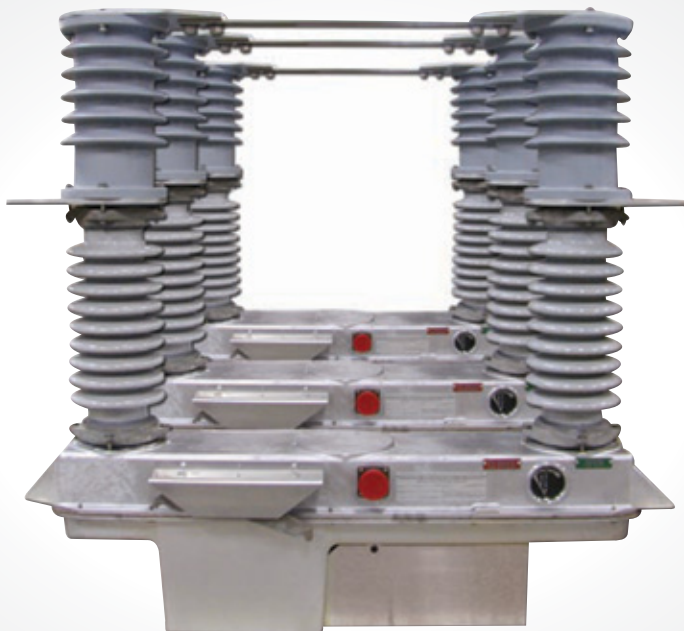
The operation of electric furnaces requires large amounts of power to be under constant control. The Transmaster switch is rugged and can withstand this kind of duty. Joslyn Hi-Voltage VBT and VBU-T switches operate uniformly on all power factors and are available for system voltages from 15 kV up to 230 kV.

If the primary circuit breaker is used as a switching device for control of transformer magnetizing, load and secondary fault currents, this will result in the circuit breaker being opened and closed more than 100 times per day.

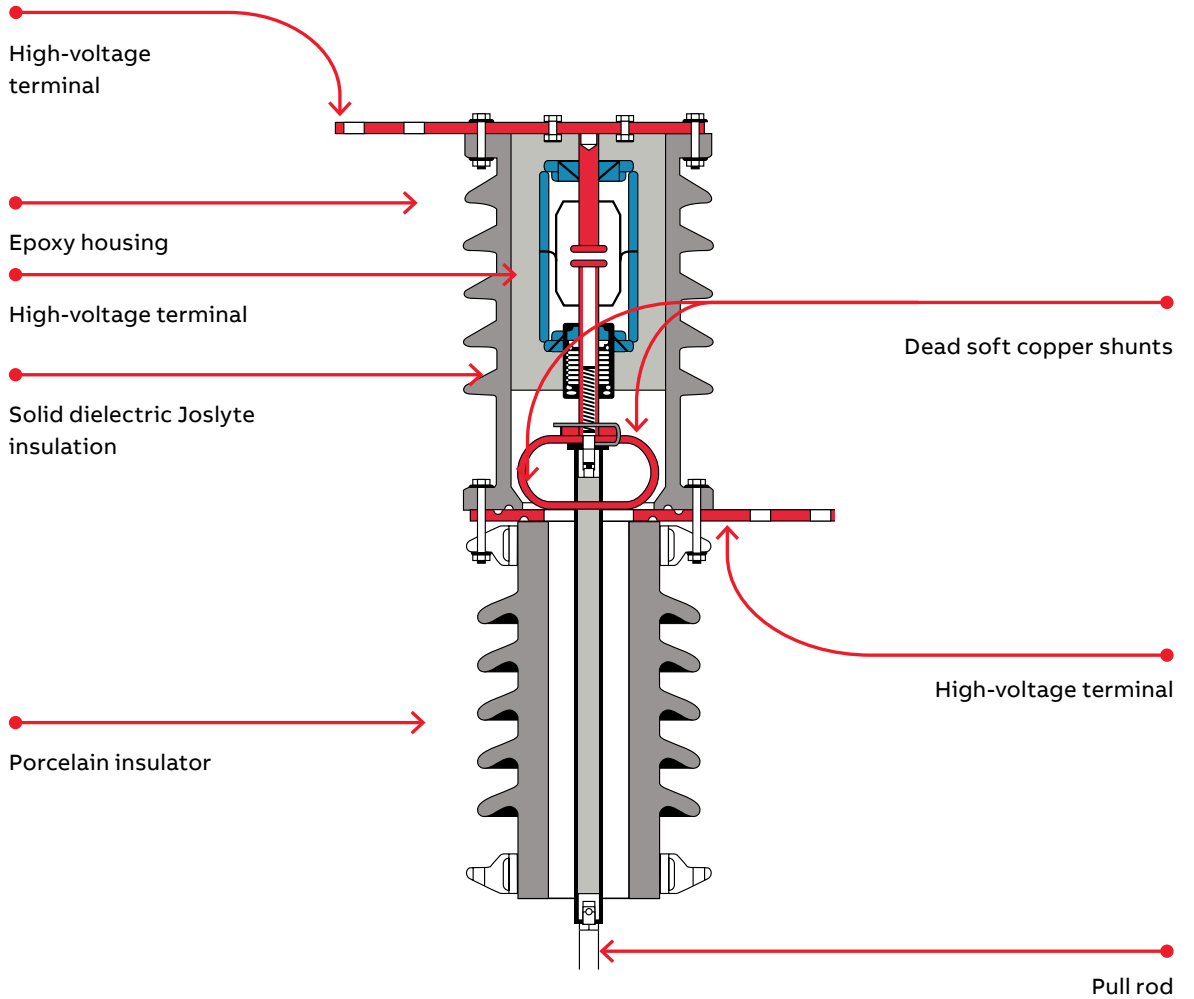
This wear and tear causes even the most durable breakers to require frequent maintenance, which is costly.

Joslyn Hi-Voltage engineers worked closely with electric furnace manufacturers to develop the Transmaster electric furnace switch, a heavy-duty vacuum switch designed to deliver maintenance-free switching of electric furnaces.

Since 1962, over 3500 field installations worldwide have proven the capability and reliability of the Transmaster electric furnace switch.



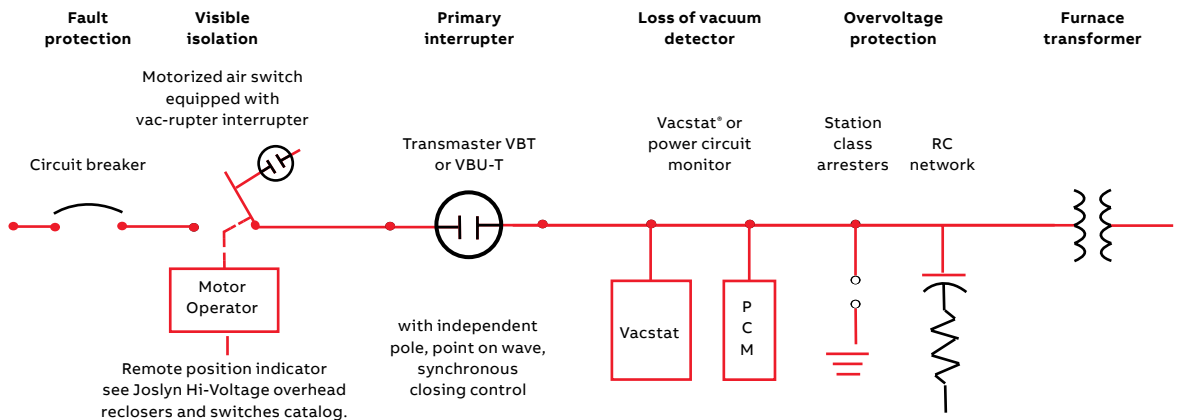
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01



**Options**

Extra auxiliary contacts, stainless steel enclosure, local/remote switch, heater, pushbuttons, point on wave control

**Ideal furnace system**



## Transmaster® VBT electric furnace switches

### Monitor alerts you immediately of loss of vacuum when you use the Transmaster VBT switch with Vacstat® vacuum interrupter monitor!

- Continuously monitors vacuum interrupter status while the switch is energized and in service
- Reduces operating and maintenance costs by eliminating the need for routine off-line vacuum interrupter inspections
- Blocks switch operation if vacuum loss is detected, protecting your equipment and personnel from potential harm
- Provides local and remote indication of vacuum interrupter status, enabling operating and maintenance personnel to take corrective action immediately in the event of loss of vacuum
- SCADA notification available

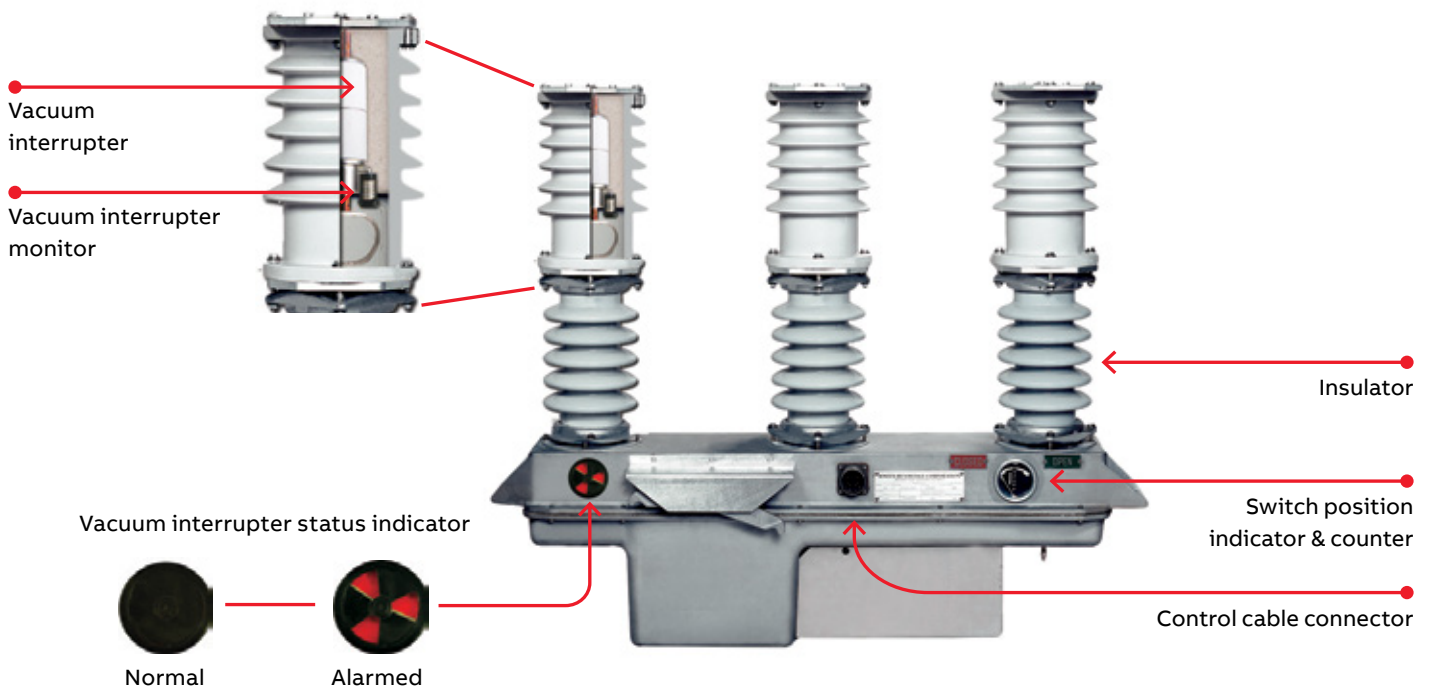
The Joslyn Hi-Voltage® Vacstat vacuum interrupter monitor provides you with real-time status monitoring of your vacuum interrupters. This simple device notifies you immediately of a loss of vacuum through a visual indicator located on the Transmaster VBT switch and via a contact in the switch control. Once the Vacstat vacuum interrupter monitor senses a loss of vacuum, all switch operations will be blocked until the switch has been serviced.

### How the Vacstat vacuum interrupter monitor works.

The Vacstat sensor is attached to the vacuum interrupter of a Transmaster VBT switch during the manufacturing process. The sensor then continuously monitors the interrupter for the presence of vacuum.

Once the capacitor switch is installed, the sensor generates an optical signal that travels via a pair of fiber optic cables to a control board in the low-voltage section of the switch. As long as vacuum exists, the fiber optic signal has a continuous path, and the Vacstat indicator remains in the normal (unalarmed) state.

If a loss of vacuum occurs, the sensor blocks the optical signal to the control board, and the Vacstat status indicator automatically turns to red to alert the operator to the problem. In addition, the remote status dry contact provides a means to send an alarm signal to a remote location. The Vacstat monitor also blocks further electrical operation of the switch to prevent possible damage to equipment or injury to personnel.





## Transmaster® VBT electric furnace switches

### VBT ratings and VBU-T ratings

#### VBT 15 kV–69 kV maximum voltage

Description	15.5 kV						38 kV					
	Continuous current (Amps)	600	1000	1500	2000	3000	4000	600	1000	1500	2000	2500
Momentary current (RMS Amps, asymmetrical) (kA)	20	35	50	65	65	65	20	35	50	65	65	65
Impulse withstand open-gap (kV BIL)	110	110	110	110	110	110	200	200	200	200	200	200
Impulse withstand line-to-ground (kV BIL)	150	150	150	150	150	150	200	200	200	200	200	200
Maximum 60 cycle withstand line-to-ground dry (one minute) (kV)	112	112	112	112	112	112	112	112	112	112	112	112
Maximum 60 cycle withstand line-to-ground wet (ten seconds) (kV)	55	55	55	55	55	55	55	55	55	55	55	55
Fault interrupting rating (amps, symmetric) (kA)	4	4	4	4	4	4	4	4	4	4	4	4

Description	48 kV					69 kV			
	Continuous current (Amps)	600	1000	1500	2000	2500	3000	300	400
Momentary current (RMS Amps, asymmetrical) (kA)	20	35	50	65	65	65	15	15	
Impulse withstand open-gap (kV BIL)	220	220	220	220	220	220	280	280	
Impulse withstand line-to-ground (kV BIL)	250	250	250	250	250	250	350	350	
Maximum 60 cycle withstand line-to-ground dry (one minute) (kV)	112	112	112	112	112	112	245	245	
Maximum 60 cycle withstand line-to-ground wet (ten seconds) (kV)	55	55	55	55	55	55	198	198	
Fault interrupting rating (amps, symmetric) (kA)	4	4	4	4	4	4	4	4	

#### VBU-T 72 kV–242 kV maximum voltage

Description	72 kV			121 kV			145 kV	161 kV	242 kV
	Continuous current (Amps)	600	1000	1500	600	1000	1500	600	600
Momentary current (RMS Amps, asymmetrical) (kA)	40	50	50	40	50	50	40	40	40
Impulse withstand open-gap (kV BIL)	400	400	400	550	550	550	650	750	950
Impulse withstand line-to-ground (kV BIL)	350	350	350	550	550	550	750	750	900
Maximum 60 cycle withstand line-to-ground dry (one minute) kV	175	175	175	293	293	293	350	365	425
Maximum 60 cycle withstand line-to-ground wet (ten seconds) (kV)	175	175	175	281	281	281	350	315	350
Fault interrupting rating (amps, symmetric) (kA)	4	4	4	4	4	4	4	4	4

01 VBU-T Transmaster module cutaway



01

02 VBU-T Transmaster switch installation 69 kV 600 A



02

## Transmaster® VBT electric furnace switches

### Point on wave control

#### 01 Point on wave control

The purpose of the independent pole, point on wave, synchronous close system is to reduce transformer energization transients by being able to close each pole at the natural current zero point. The expected benefits include significantly reduced inrush currents, reduced electromechanical stress on transformer bushings and windings and reduced stress on all equipment associated with the closing circuit of the transformer.

#### Application

When an electric furnace switch is called on to close, a “random closing” occurs, which can energize the transformer at any point on the voltage waveform. This produces high-magnitude transient inrush currents rated 1000% of full load current. The point on wave control is designed to energize the transformer at the optimal point on the voltage waveform which provides these benefits:

- **Longer equipment life**

Reduces mechanical forces on the transformer bushings and windings, resulting in lower total ownership cost

- **Increased safety**

Less electrical stress on transformer interwinding insulation

- **Reduced maintenance costs**

Minimal wear on components decreases maintenance requirements

- **Increased reliability**

Reduces stress on all other components of the furnace

NOTE: To order Joslyn Hi-Voltage® Transmaster VBT and VBU-T switching systems, contact your ABB representative.



#### Additional information

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