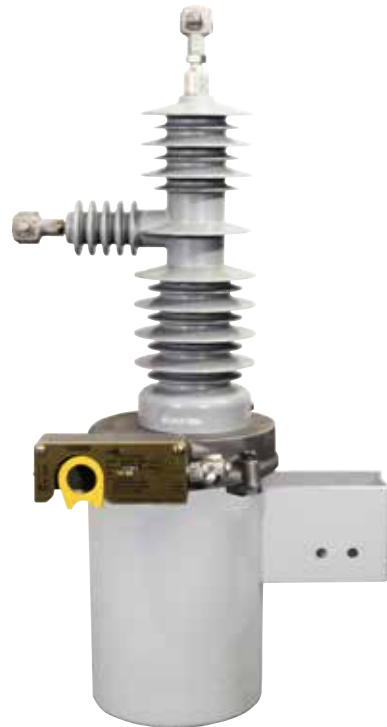


# Vacuum Switches

Service Information

## Type VCS-1M Single-Phase Vacuum Capacitor Switch Installation and Operation Instructions

# S260-15-4



**Figure 1.**  
Type VCS-1M single-phase vacuum capacitor switch.

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## SAFETY FOR LIFE



Cooper Power Systems products meet or exceed all applicable industry standards relating to product safety. We actively promote safe practices in the use and maintenance of our products through our service literature, instructional training programs, and the continuous efforts of all Cooper Power Systems employees involved in product design, manufacture, marketing and service.

We strongly urge that you always follow all locally approved safety procedures and safety instructions when working around high-voltage lines and equipment and support our “Safety For Life” mission.

## SAFETY INFORMATION

The instructions in this manual are not intended as a substitute for proper training or adequate experience in the safe operation of the equipment described. Only competent technicians, who are familiar with this equipment should install, operate and service it.

*A competent technician has these qualifications:*

- *Is thoroughly familiar with these instructions.*
- *Is trained in industry-accepted high- and low-voltage safe operating practices and procedures.*
- *Is trained and authorized to energize, de-energize, clear, and ground power distribution equipment.*
- *Is trained in the care and use of protective equipment such as flash clothing, safety glasses, face shield, hard hat, rubber gloves, clampstick, hotstick, etc.*

Following is important safety information. For safe installation and operation of this equipment, be sure to read and understand all cautions and warnings.

### Hazard Statement Definitions

This manual may contain four types of hazard statements:

#### **⚠ DANGER:**

Indicates a hazardous situation which, if not avoided, will result in death or serious injury.

#### **⚠ WARNING:**

Indicates a hazardous situation which, if not avoided, could result in death or serious injury.

#### **⚠ CAUTION:**

Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

**CAUTION:** Indicates a hazardous situation which, if not avoided, could result in equipment damage only.

### Safety Instructions

Following are general caution and warning statements that apply to this equipment. Additional statements, related to specific tasks and procedures, are located throughout the manual.

#### **⚠ DANGER:**

**Hazardous voltage. Contact with hazardous voltage will cause death or severe personal injury. Follow all locally approved safety procedures when working around high- and low-voltage lines and equipment.**

G103.3

#### **⚠ WARNING:**

**Before installing, operating, maintaining, or testing this equipment, carefully read and understand the contents of this manual. Improper operation, handling or maintenance can result in death, severe personal injury, and equipment damage.**

G101.0

#### **⚠ WARNING:**

**This equipment is not intended to protect human life. Follow all locally approved procedures and safety practices when installing or operating this equipment. Failure to comply can result in death, severe personal injury and equipment damage.**

G102.1

#### **⚠ WARNING:**

**Power distribution and transmission equipment must be properly selected for the intended application. It must be installed and serviced by competent personnel who have been trained and understand proper safety procedures. These instructions are written for such personnel and are not a substitute for adequate training and experience in safety procedures. Failure to properly select, install or maintain power distribution and transmission equipment can result in death, severe personal injury, and equipment damage.**

G122.3

## PRODUCT INFORMATION

### Introduction

*Service Information S260-15-4* provides installation, operation, and service instructions for Type VCS-1M capacitor switches.



#### **Read This Manual First**

Read and understand the contents of this manual and follow all locally approved procedures and safety practices before installing or operating this equipment.

### Additional Information

These instructions can not cover all details or variations in the equipment, procedures, or processes described nor provide directions for meeting every possible contingency during installation, operation, or maintenance. For additional information, please contact your Cooper Power Systems representative.

### Acceptance and Initial Inspection

Each switch is completely assembled, tested, inspected, and adjusted at the factory. It is in good condition when accepted by the carrier for shipment. Upon receipt, inspect the switch thoroughly for damage and loss of parts incurred during shipment. If damage or loss of parts is discovered, file a claim with the carrier immediately.

### Handling and Storage

Be careful during handling and storage of the switch to minimize the possibility of damage. If the switch is to be stored for any length of time prior to installation, provide a clean, dry storage area.

### Standards

Cooper Power System switches are designed and tested in accordance with IEEE Std C37.66™-2005 standard.

### Quality Standards

ISO 9001 Certified Quality Management System

### Description

The Type VCS-1M Vacuum Capacitor Switch is a single-phase, motor-operated vacuum switch that includes close and latch capability for either electrical or manual operation. The solid polymer insulation system does not rely on gas, foam, or liquid dielectrics. Highly resistant to ozone, oxygen, moisture, contamination, and ultraviolet light, it is an environmentally safe capacitor switch. The VCS-1M switch has a single solid polymer bushing and is suitable for operation through a temperature range of -40 °C to +65 °C.

## RATINGS AND SPECIFICATIONS

### Check Switch Ratings Prior to Installation

The switch must be applied within its specified ratings. Check data plate ratings and compare with the system characteristics at the point of application prior to installation. Tables 1–4 list the ratings and specifications for the VCS-1M switch.

All ratings meet or exceed values in IEEE Std C37.66™-2005 standard for a distribution class switch, where applicable.

**TABLE 1  
Voltage Ratings**

Maximum Voltage, solidly grounded capacitor banks, phase-to-ground voltage . . . . .	15.5 kV
Maximum Voltage, ungrounded capacitor banks, phase-to-phase voltage . . . . .	13.0 kV
Basic Insulation Level (BIL) line-to-ground . . . . .	125 kV
Basic Insulation Level (BIL) open contact . . . . .	95 kV
Max. RIV @ 9.4 kV . . . . .	100.0 μV
60 Hz Withstand dry, 1 minute . . . . .	50 kV
wet, 10 seconds . . . . .	45 kV

**TABLE 2  
General Specifications**

Mass (Weight) [kg (lb)] . . . . .	12 (26)
Operating Temperature Range . . . . .	-40 °C to +65 °C
Rated Frequency (Hz) . . . . .	50/60
Mechanical Operations (close/open without maintenance) . . . . .	30,000

**TABLE 3  
Electrical Specifications**

Operating Voltage, Nominal, 120 V ac Operating Voltage Range . . . . .	107–127 Vac
Current (nominal, ac) . . . . .	1.4 A
Motor run time—Opening (typical) . . . . .	2.3 sec
Motor run time—Closing (typical) . . . . .	1.8 sec

**TABLE 4  
Current Ratings**

Rated Asymmetrical Making Current . . . . .	9000 A
Rated Continuous Current . . . . .	200 A
Load Interrupting Ability (Inductive) 10 to 100% Power Factor . . . . .	200 A
Capacitive Current (Max.) . . . . .	200 A
Short-Time Current Momentary Asymmetric (10 cycles) . . . . .	9000 A
Symmetrical (0.5 second) . . . . .	6000 A
Symmetrical (1 second) . . . . .	4500 A
Rated High Frequency Peak Transient Making Current . . . . .	6000 A
Rated Transient Inrush Frequency . . . . .	6000 Hz
Duty Cycle Operations at 40 A . . . . .	400
Operations at 100 A . . . . .	400
Operations at 200 A . . . . .	400

**TABLE 5  
Control Wiring Specifications**

Accessory Plugs			
Catalog Number	Number of Pins	Cable Range O.D.	Max. Wire Size AWG
KA48NR	5	11–14 mm (0.437–0.562 in.)	12
KA98NR	6	13–16 mm (0.500–0.625 in.)	16

# INSTALLATION PROCEDURE

## Check-out Procedure

**CAUTION:** Personal Injury. Sheds on epoxy encapsulation have sharp edges. Wear protective gloves when handling the unit. Failure to do so can result in cuts and abrasions. T259.1

- 1. Check data plate.** Make sure that ratings on the data plate are correct for the planned installation.
- 2. Test mechanical operation.** Close and open the switch contacts manually using the yellow operating handle. Confirm that the contacts have closed and opened by listening for the sound of operation or by a continuity check between the switch terminals. Transport unit with contacts in the closed position.
- 3. Perform high-potential withstand tests.** Prior to installing the VCS-1M Switch, perform high-potential withstand tests. Refer to the **SERVICE INFORMATION** section for high-potential withstand test procedures.
- 4. Reorient switch terminals if required for installation.** Loosen the head-to-tank mounting fasteners only if it is necessary to reorient the position of the switch terminals to make high-voltage line connections. Do not position the manual operating handle over the pole-mounting bracket. After reorienting the terminals, immediately retorque the head-to-tank mounting fasteners in an alternating pattern to 13–20 Nm (10–15 ft•lbs) to prevent dust, dirt, or other contaminants from entering the unit.
- 5. Install the switch.** Follow locally approved installation procedures. Mounting hardware is available for pole mounting as an accessory.

## High-Voltage Connections

**WARNING:** Hazardous Voltage. Solidly ground all equipment. Failure to comply can result in death, severe personal injury, and equipment damage. T223.2

**WARNING:** This equipment is not intended to protect human life. Follow all locally approved procedures and safety practices when installing or operating this equipment. Failure to comply can result in death, severe personal injury, and equipment damage. G102.1

- 1. Ground the switch.** Make the ground connection to the ground connector located on the switch as shown in Figure 6. Do not rely on a ground connection to the tank.
- 2. Reorient bushing terminals if required for installation.** The bushing terminals are factory-torqued to assure proper continuous current requirements and should not be adjusted or rotated without using the following procedure. Should adjustment be required, maintain the position of the jam nut and loosen the terminal. Next, realign the terminal and jam nut to the desired orientation. Then, while maintaining the jam nut, tighten the terminal and retorque to 12–14 Nm (9–10 ft•lbs).

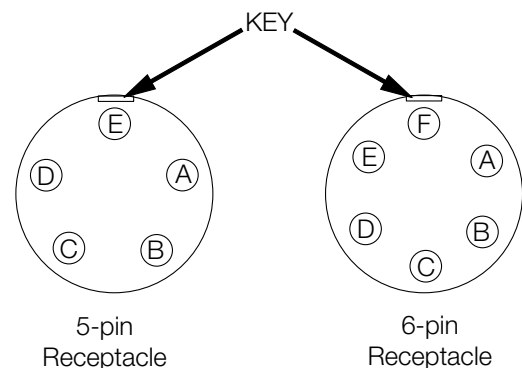
**3. Make line connections.** Connect the primary leads to the switch terminals. The universal clamp-type terminals accommodate AWG No. 8 solid through 2/0 stranded conductor.

## Control Wiring

Connections to the actuating mechanism are made through the standard five-pin (or optional six-pin) receptacle on the head casting.

Mating plugs for the receptacle must be ordered separately. Maximum cable and wire sizes accommodated by the plugs are indicated in Table 5.

Pin orientation diagrams for the accessory receptacles are shown in Figure 2.



**Figure 2.** Receptacle pin orientation.

## Three-Wire Control

Remote control of the VCS-1M switch is supplied by a single-pole, double-throw switch (three-wire control) supplied by the customer. Any manual switch, relay contact, time switch, voltage-, current- or photo-electric-controlled switch, or similar device can be used, provided the control circuit is energized for a minimum of 3 seconds (at -40 °) for each operation. A connection diagram for a standard three-wire control is shown in Figure 3.

## Two-Wire Control Accessory

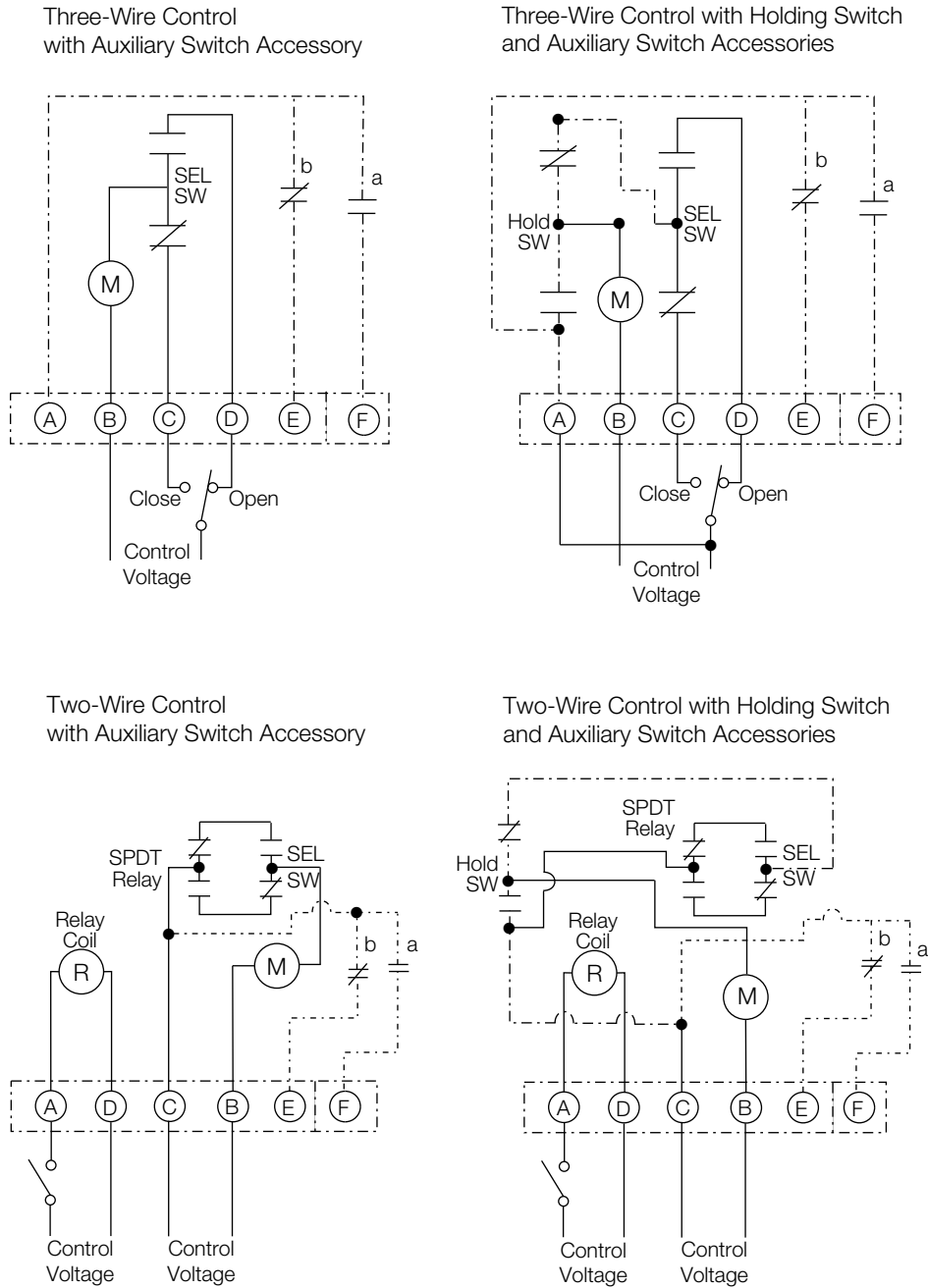
The control can also be operated by an SPST device (two-wire control), applicable voltage 120 Vac only. A factory-installed SPDT relay accessory is required for two-wire control operation. A connection diagram for a two-wire control is shown in Figure 3.

## Holding Switch Accessory

If the controlling switch is energized for less than the required time, a factory-installed holding switch accessory is required. However, the control circuit must be energized for at least one second for each operation to ensure operation of the holding switch. A connection diagram for a two- or three-wire control with holding switch is shown in Figure 3.

## Wiring Diagrams

Schematic diagrams of switch actuators wired for two- and three-wire controls are shown in Figure 3. Accessories are shown with dashed lines.



**Figure 3.** Typical connection diagrams (switch shown in OPEN position).



## Wiring Table

A wiring table for various combinations of accessories is shown in Table 6.

**TABLE 6**  
**Wiring Table**

Unit Description	Receptacle Pin Description						Applicable Voltage	Receptacle
	A	B	C	D	E	F		
Standard 3-wire control	–	M	SS-NC	SS-NO	–	–	120, 240 Vac 12, 24 Vdc	5-pin
3-wire control, Holding Switch	HS-NO	M	SS-NC	SS-NO	–	–	120, 240 Vac 12, 24 Vdc	5-pin
3-wire control, SPDT Aux Switch	Aux-Com	M	SS-NC	SS-NO	Aux-NO	Aux-NC	120, 240 Vac 12, 24 Vdc	6-pin
3-wire control, Holding Switch, SPDT Aux Switch	Aux-Com	M	SS-NC	SS-NO	Aux-NO	Aux-NC	120, 240 Vac 12, 24 Vdc	6-pin
3-wire control, Surge Arrestor	–	M	SS-NC	SS-NO	–	–	120 Vac 12, 24 Vdc	5-pin
3-wire control, Holding Switch, Surge Arrestor	HS-NO	M	SS-NC	SS-NO	–	–	120 Vac 12, 24 Vdc	5-pin
3-wire control, SPDT Aux, Surge Arrestor	Aux-Com	M	SS-NC	SS-NO	Aux-NO	Aux-NC	120 Vac 12, 24 Vdc	6-pin
3-wire control, Holding Switch, SPDT Aux Switch, Surge Arrestor	Aux-Com	M	SS-NC	SS-NO	Aux-NO	Aux-NC	120 Vac 12, 24 Vdc	6-pin
Standard 2-wire control	R-B	M	R	R-A	–	–	120 Vac only	5-pin
2-wire control, Holding Switch	R-B	M	HS-NO R	R-A	–	–	120 Vac only	5-pin
2-wire control, SPDT Aux Switch	R-B	M	Aux-Com R	R-A	Aux-NO	Aux-NC	120 Vac only	6-pin
2-wire control, Holding Switch, SPST Aux Switch (b contact)	R-B	M	HS-NO R	R-A	Aux-Com	Aux-NO	120 Vac only	6-pin
2-wire control, SPDT Relay, Surge Arrestor	R-B	M	R	R-A	–	–	120 Vac only	5-pin
2-wire control, Holding Switch, Surge Arrestor	R-B	M	HS-NO R	R-A	–	–	120 Vac only	5-pin
2-wire control, SPDT Aux Switch, Surge Arrestor	R-B	M	Aux-Com R	R-A	Aux-NO	Aux-NC	120 Vac only	6-pin
2-wire control, Holding Switch, SPST Aux Switch (b contact), Surge Arrestor	R-B	M	HS-NO R	R-A	Aux-Com	Aux-NO	120 Vac only	6-pin

M: Motor Common  
 SS: Selector Switch  
 NC: Normally Closed  
 NO : Normally Open  
 HS: Holding Switch  
 Aux: Auxiliary Switch  
 Com: Common  
 R-B: Relay Contact B  
 R-A: Relay Contact A  
 R: SPDT Relay

## SWITCH OPERATION

### Electrical Operation

The switch may be opened and closed electrically by applying rated control voltage to the proper terminals of the actuator receptacle. Refer to the INSTALLATION PROCEDURE for electrical connections and operating time.

**Note:** Main contacts and auxiliary switch operate before the motor has completed its operation.

**IMPORTANT:** If the switch does not respond to an electrical operating signal, it may be that the main switch contacts are not synchronized with the electrical control. For example, if the switch is manually opened, an electrical OPEN signal must be transmitted to bring the control into synchronism with the switch contacts before an electrical CLOSE signal will close the switch. The converse is also true.

### Manual Hotstick Operation

**WARNING:** Hazardous Voltage. Always use a hotstick when working with this equipment. Failure to do so could result in contact with high voltage, which will cause death or severe personal injury. G108.1

**WARNING:** Hazardous Voltage. Do not rely on the open position of the yellow operating handle; it does not ensure that the line has been de-energized. Always establish a visible disconnect. Failure to follow proper safety practices can result in contact with high voltage, which will cause death or severe personal injury. G116.0

The switch may be manually opened and closed by using a hotstick to operate the yellow manual operating handle under the sleet hood as shown in Figures 4 and 5.

To open the switch contacts, insert the hotstick tip into the eyelet of the manual operating handle and pull downward to the OPEN position. See Figure 4.

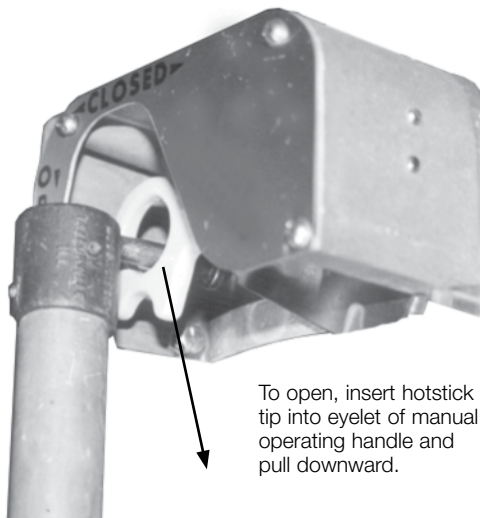
To close the switch contacts, place the hotstick tip against the manual operating handle and push upward to the CLOSE position. See Figure 5.

**IMPORTANT:** The hotstick tip must be placed in the groove **under** the eyelet of the manual operating handle when closing the switch.

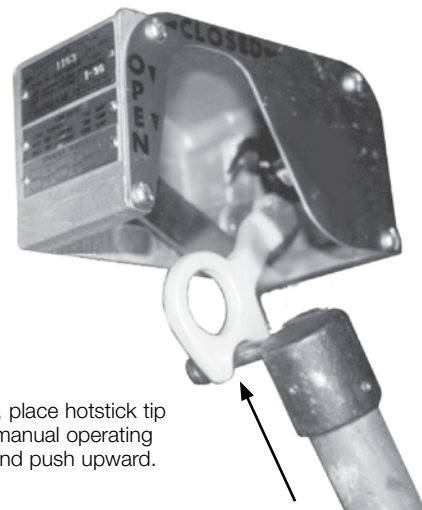
Incorrect placement of the hotstick during closing (placing the hotstick hook into the eyelet) causes the hook to catch on the sleet hood before the complete motion to fully close the switch can be accomplished. This incorrect closing method can also cause damage to the sleet hood.

### Contact Position Indication

The yellow operating handle is also used as a contact position indicator. The switch is closed when the operating handle is in the up position and is open when the operating handle is in the down position.



To open, insert hotstick tip into eyelet of manual operating handle and pull downward.



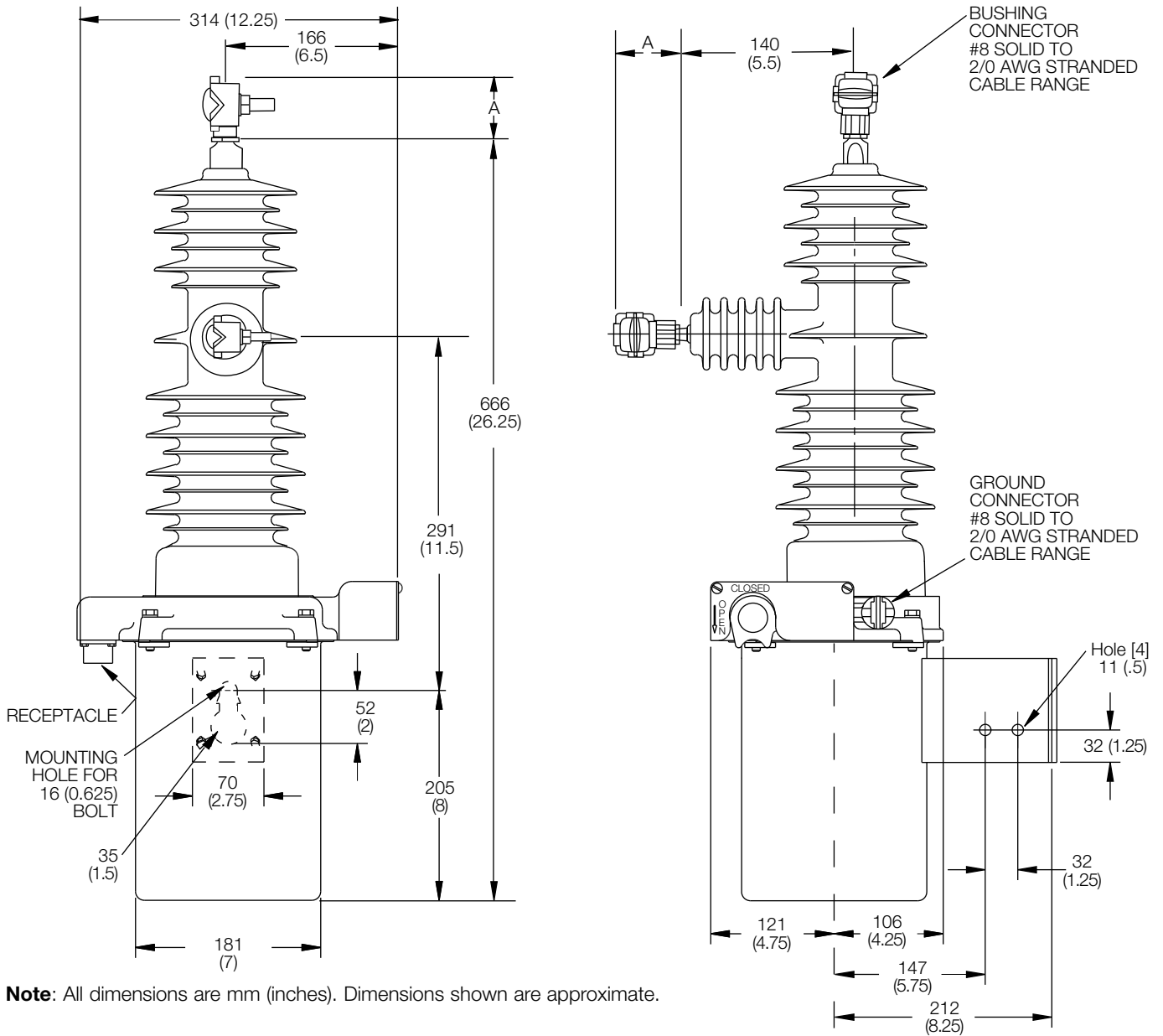
To close, place hotstick tip against manual operating handle and push upward.

**Figure 4.**  
**Correct placement of the hotstick to open the switch.**

**Figure 5.**  
**Correct placement of the hotstick to close the switch.**



# DIMENSIONS



Terminal Option	Dimension A
Eyebolt	50 mm (2 in)
Flat Pad, 1-Hole	75 mm (3 in)

Creepage	
Terminal to Terminal	521 mm (20.25 in)
Terminal to Ground	641 mm (25.0 in)

**Figure 6.**  
Dimensions of Type VCS-1M switch.

## SERVICE INFORMATION

### Service Requirements

The Type VCS-1M switch has been designed with a minimum mechanical life of 30,000 operations. The switch requires no routine maintenance; however, the switch should be inspected on a regular basis to check for physical damage and to verify operation.

### Frequency of Inspection

Because these switches are applied under widely varying operation and climatic conditions, maintenance intervals are best determined by the user based upon actual operating experience.

### High-Potential Withstand Testing

**WARNING:** Hazardous Voltage. The switchgear (apparatus and control) and high-voltage transformer must be in a test cage or similar protected area to prevent accidental contact with the high-voltage parts.

Solidly ground all equipment. Failure to comply can result in death, severe personal injury, and equipment damage.

T221.5

**CAUTION:** Radiation. At voltages up to the specified test voltages, the radiation emitted by the vacuum interrupter is negligible. However, above these voltages, radiation injurious to personnel can be emitted. See *Service Information S280-90-1, Vacuum Interrupter Withstand Test Voltage Ratings Information* for further information.

G109.2

Use the following procedures to perform high-potential withstand tests. The VCS-1M capacitor switch should be tested at 26 kV ac.

#### Closed Contacts Test

1. Close the switch contacts.
2. Ground the switch.
3. Apply proper test voltage to one of the bushing terminals. The switch should withstand the test voltage for 60 seconds.

#### Open Contacts Test

1. Open the switch contacts.
2. Ground the switch.
3. Ground the bushing on one side of the switch.
4. Apply proper test voltage to the ungrounded bushing. The switch should withstand the test voltage for 60 seconds.
5. Reverse the test and ground connections to the bushings.
6. Apply proper test voltage to the ungrounded bushing. The switch should withstand the voltage for 60 seconds.

### Withstand Test Results

The high-potential withstand tests provide information on the dielectric condition of the switch.

If the switch passes the closed-contacts test and fails the open-contacts test, the cause is likely to be in the interrupter assembly.

If the switch fails the closed contacts test, the cause is likely to be a diminished electrical clearance or insulation that has been damaged. Causes of insulation damage include failure, abuse, and overvoltage surges.

### Inspection of VCS-1M Module

If the VCS-1M module was exposed to an external flashover, an inspection process is recommended to assure proper operation of the switch. Should the VCS-1M exhibit external flashover attributes (carbon tracking or discoloration), the following procedure is recommended to restore the encapsulation back to its original condition:

1. Remove device from service.
2. Inspect module for damage to the terminals. Remove any damaged terminals and replace.
3. Inspect module for damage to the module conductor rods. If there is damage to the module rods, the module must be replaced.
4. Verify through careful inspection that there is no damage to the housing or head casting that could inhibit proper operation.
5. Clean the damaged module with isopropyl alcohol and a scratch-free, nylon scouring pad to remove any carbon deposit.
6. Confirm the dielectric strength of the module by performing high-potential withstand testing. Confirm both phase-to-ground and phase-to-phase conditions. See the High-Potential Withstand Testing section of this manual.

### Replacement Parts

Replacement parts kits for Cooper Power Systems switches are available through the factory Service Department. Only factory-authorized parts are to be used. To order replacement parts, refer to *Parts Guide S260-01 through S280-01* for catalog numbers. Contact your Cooper Power Systems representative for additional information and ordering procedures.

### Factory-Authorized Service Centers

Factory-authorized service centers are located throughout the continental United States to provide maintenance, repair and testing services for Cooper Power Systems Distribution Switchgear products. Refer to *Service Centers Brochure, B100-04009* for the Authorized Service Center closest to your location. For further information, contact your Cooper Power Systems representative.



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