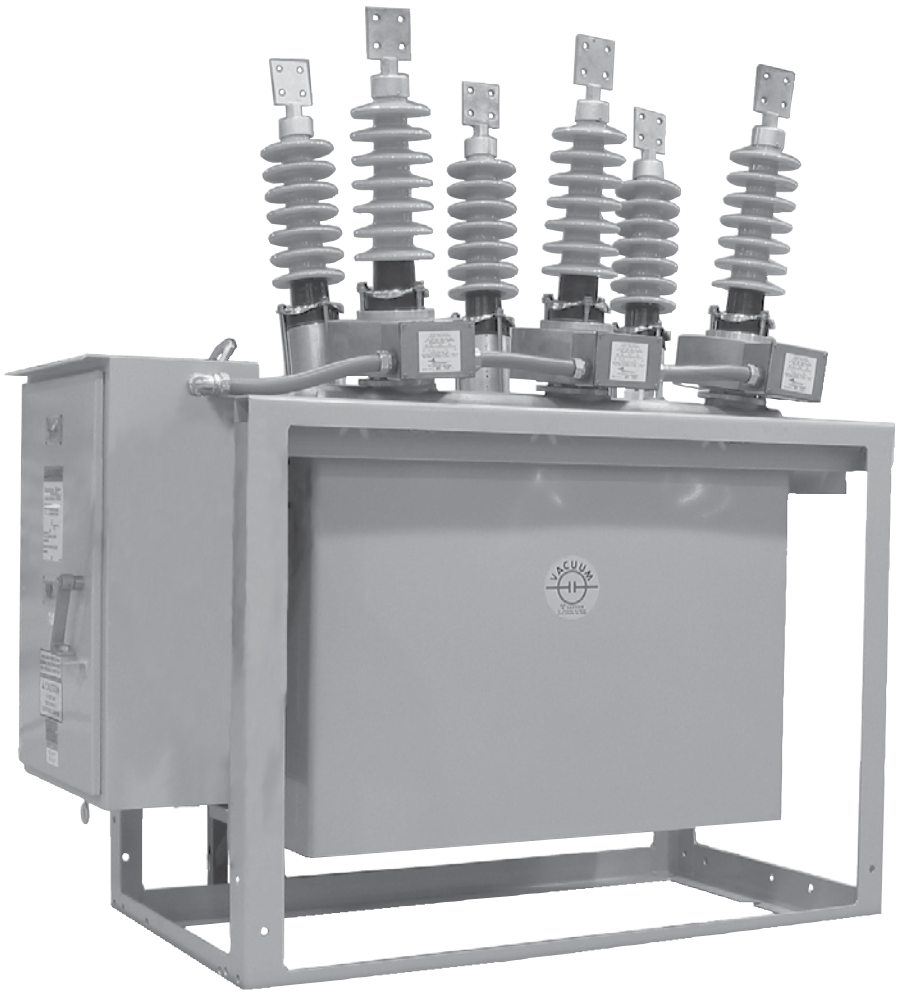
Type VSO12 and VSO16 motor-operated, electronically controlled recloser operation and installation instructions



Powering Business Worldwide

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Contents

Safety for life

Eaton meets or exceeds all applicable industry standards relating to product safety in its Cooper Power™ series products. 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 Eaton 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 arc 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 an imminently hazardous situation which, if not avoided, will result in death or serious injury.

WARNING

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

CAUTION

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

CAUTION

Indicates a potentially hazardous situation which, if not avoided, may 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 MN280065EN provides installation instructions, operating information, and testing procedures for Eaton Cooper Power series Type VSO12 and VSO16 three-phase, motor-operated reclosers.

The information contained in this manual is organized into the following major categories: Safety Information, Product Information, Specifications and Ratings, Dimensions and Weights, Installation, Accessories, Operation, and Service Information.

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 cannot cover all details or variations in the equipment, procedures, or process described nor provide directions for meeting every possible contingency during installation, operation, or maintenance. For additional information, contact your Eaton representative.

Acceptance and initial inspection

This product is completely assembled, tested, and inspected at the factory. It is carefully calibrated, adjusted, and in good condition when accepted by the carrier for shipment.

Upon receipt, inspect the carton for signs of damage. Unpack the control and inspect it thoroughly for damage incurred during shipment. If damage is discovered, file a claim with the carrier immediately.

Handling and storage

Be careful during handling and storage of this equipment to minimize the possibility of damage. In particular, protect the bushings and control equipment.

If the unit is to be stored for any length of time before installation, provide a clean, dry storage area. If the recloser is to be stored in a humid atmosphere, make provisions to keep the cabinet heaters energized.

ANSI standards

The VSO recloser is designed and tested in accordance with ANSI standards: C37.60, C37.61, and C37.85.

Quality standards

ISO 9001-Certified Quality Management System.

Description

A complete assembly consists of the recloser control unit, the oil-insulated vacuum interrupter assemblies, and the *operating mechanism housing*.

Recloser tripping employs stored spring energy. When the trip solenoid is actuated by the 24 Vdc trip signal, the stored spring energy is released to open the recloser. The 24 Vdc trip signal is originated at the recloser control. The 240 Vdc supply is not required to trip there closer. An external 240 Vac source is required to operate the drive motor. A 120 Vac input power supply accessoryis also available.

Type VSO reclosers are electronically controlled by an Eaton Cooper Power series recloser control.

Specifications and ratings

A recloser will effectively interrupt fault currents only when applied within its specified ratings. Check data plate ratings and compare with the system characteristics at point of application prior to installation.

Table 1. Voltage ratings

Maximum design voltage, kV	38
Nominal operating voltage, kV	34.5
Basic insulation level (BIL), kV	150
60 Hz withstand voltage, kV	
Dry, one minute	70
Wet, ten seconds	60
Max RIV at 23 kV, µV	100

Table 2. Bushing specifications

Bushing creepage distance, mm (in)	673 (26.5)
Arcing Distance,	
phase to ground, mm (in)	324 (12.75)
Arcing Distance,	
phase to phase, mm (in)	
VSO12, VSO16	314 (12.25)
VSO12, VSO16 with CT	324 (12.75)

Table 3. Current ratings

Continuous current rating, A	*560
Symmetric interrupting current, A	
VSO12	12,000
VSO16	16,000
Cable charging current, A	5
Magnetizing current, A	19.6
Three-second current, symmetric, A	
VSO12	12,000
VSO16	16,000
Momentary current, asymmetric, A	
VSO12	20,000
VSO16	25,600

*An 800 A accessory is available.

Table 4. Auxiliary switch interrupting ratings

Volts	inductive AC (AMPS)	Non-inductive AC (AMPS)	Inductive DC (AMPS)	Non-inductive DC (AMPS)
24	–	–	15.0	20.0
48	–	–	7.5	10.0
120	60	80	–	–
125	–	–	1.5	2.0
240	30	60	–	–
250	–	–	0.45	0.5

Table 5. Duty cycle

Percent of maximum circuit interrupting rating	Maximum X/R ration	Number of unit operations
15-20	4	88
45-55	8	112
90-100	16	32
Total		**232**

Table 6. Electrical specifications

Trip solenoid operating voltage, Vdc		24
Peak current, A		10.7
Actuation time, cycles		1
Close solenoid		
Operating voltage, Vdc		24
Peak current, A		10.8
Actuation time, cycles		2.75
Spring charging motor	*Standard*	*Accessory*
Operating voltage, Vac	240	120
Voltage range, Vac	160-257	90-127
Maximum current, RMS, A	12.9	18
Steady state current, A	4.1	9
Motor running time, cycles	40	40
Sensing current transformers	1000:1	
Maximum arcing time, cycles		1.0
Interrupting time, cycles		2.5

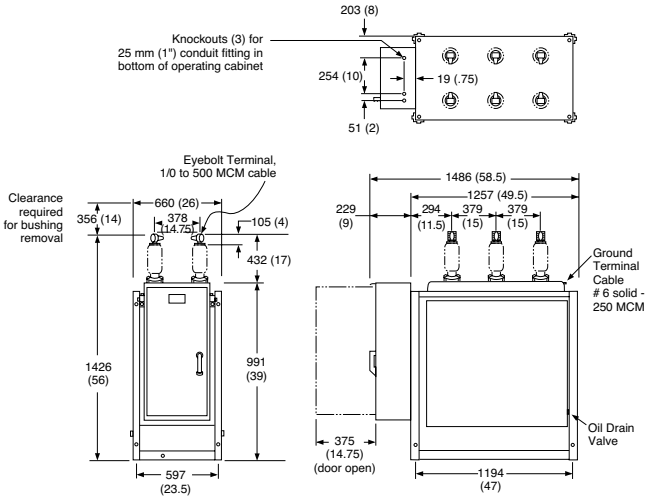
Table 7. Mechanical specifications

Operating temperature, °C Minimum	-30
Maximum	+50
Closing mechanism	Spring operated
Opening mechanism	Spring operated
Contact gap, mm (in)	13 (.5)
Close contact travel time, cycles	.75
Open contact travel time, cycles	.5
Allowable contact erosion, mm (in)	3 (.125)
Opening Time, 24 Vdc solenoid,	
Signal to contact part, m sec.	25
Closing Time, 24 Vdc solenoid,	
Signal to contact make, m sec.	50
Mechanical life	
Open-Close, no load, operations	2,500

Dimensions and weights

Table 8. Weights and oil capacity

Weight without control kg (lb)	470	(1035)
Weight with pole-top frame kg (lb)	498	(1098)
Weight with substation frame kg (lb)	533	(1175)
Oil capacity L (gal)	198	(52)



Note: All dimensions are mm (inches). Dimensions shown are approximate.

Figure 1. Type VSO dimensions and weights

Installation

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

Do not operate this equipment if energized parts are not immersed in dielectric fluid. Operation when parts are not properly immersed in dielectric fluid may result in internal flashovers that will damage the equipment and can cause death or severe personal injury. G104.4

WARNING

Hazardous voltage. This equipment must be de-energized and grounded prior to conducting any maintenance, dielectric fluid sampling, or dielectric fluid filling procedures. Failure to comply can result in death or severe personal injury. T239.2

Installation procedure

All reclosers are carefully tested and adjusted at the factory. Well-equipped test facilities, detailed testing procedures, and thoroughly trained personnel assure accurately calibrated equipment. Each recloser leaves the factory ready for installation.

1. Check for proper oil level. Using the dipstick and oilsight gauge provided on the recloser, make sure the oil in the recloser tank is at a proper level.

   Note: The oil level should be above the sight-gauge window. If the oil line is visible in the window, add oil to raise the level to the upper line on the dipstick.

⚠ CAUTION

This equipment relies on dielectric fluid to provide electrical insulation between components. The dielectric strength of the fluid must be checked on a regular basis, as part of the routine maintenance inspection, to ensure that it is at or above minimum dielectric requirements. Use of this equipment with dielectric fluid that does not meet minimum requirements can result in internal flashovers that will damage the equipment and can cause personal injury. G107.3

2. Test the dielectric strength of the oil. The oil must have a minimum dielectric strength of 26 kV. If the dielectric strength of the oil is less than 26 kV, filter the oil to restore the dielectric strength to the acceptable minimum level.
3. Check the data plate ratings. Make sure the ratings of each recloser data plate are correct for the planned installation.
4. Perform high-potential withstand tests. Prior to installing the Type VSO recloser, with the recloser in the OPEN position, perform high-potential withstand tests across each open interrupter assembly. Refer to the **High-Potential Withstand Testing** section of this manual.

⚠ WARNING

Falling equipment. Use the lifting lugs provided and follow all locally approved safety practices when lifting and mounting the equipment. Lift the unit smoothly and do not allow the unit to shift. Improper lifting can result in severe personal injury, death, and/or equipment damage. G106.3

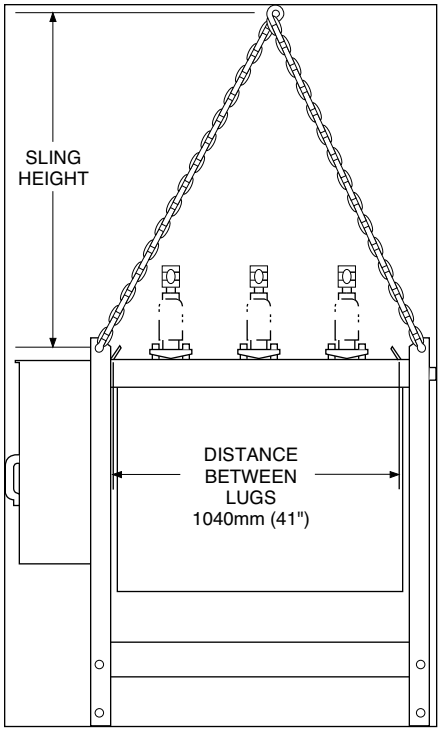


Figure 2. Lifting the recloser

IMPORTANT

This recloser has four lifting lugs; all must be used when lifting. Maximum strength is attained with a vertical lift. Use of a spreader bar, with a fixed attachment point for the hook at the load center, is recommended when lifting. If a sling is used for lifting the recloser, it must have a fixed attachment point at the load center. Rig the recloser so that the sling height is equal to or greater than the distance between lugs.

5. Mount the recloser. Use the lifting lugs located on the frame and follow approved procedures. See Figure 3.

⚠ WARNING

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

6. Ground the recloser. Make ground connections to the recloser ground connector. For substation installations, the ground connector is moved to the bottom of one of the extension legs, as shown in Figure 13. It will accommodate 2/0 to 250 MCM stranded conductors. Make ground connections in accordance with approved utility standards.

The VSO recloser is used with an Eaton Cooper Power series control. Refer to the appropriate service information manual for complete recommended grounding instructions for the control.

IMPORTANT

Form 3 and Form 3A electronic controls must be equipped with the KA1175ME fuse accessory. This accessory supplies a MDQ-2.5 closing coil control fuse, which is required for operation of the closing solenoid.

The instantaneous reclose delay plug must not be used in Form 3 and Form 3A controls. For fast reclosing, use the KA1177ME1 reclose delay plug, which provides a fixed 0.5 second delay.

VSO12 and VSO16 reclosers use 1000:1 ratio current sensing transformers (CTs). Form 3 and Form 3A controls, used with 1000:1 CTs, require *YELLOW* labeled trip resistors; *BLUE* labeled trip resistors are required with 2000:1 CTs.

Refer to *Service Information S280-75-1* for additional information on using the Form 3A Control.

All microprocessor controls must be programmed for the appropriate CT ratio.

7. Install the control. Connect the control cable between the control and the recloser. Make sure the control is grounded and properly programmed for the planned installation.
8. Make the high-voltage line connections. See Figure 4.

Note: Disconnect switches and bypass switches are recommended to facilitate switching and isolation.

   A. Surge protection on both sides of the recloser is recommended. However, if protection is provided on only one side, it should be located on the source side for line installation and on the load side for substation installation.

   B. Connect high-voltage lines to recloser bushing terminals. The Type VSO12 and VSO16 standard eyebolt bushing terminals are will accommodate conductors ranging in size from 1/0 to 500 MCM for 600 A units and 1/0 to 750 MCM for 800 A units.

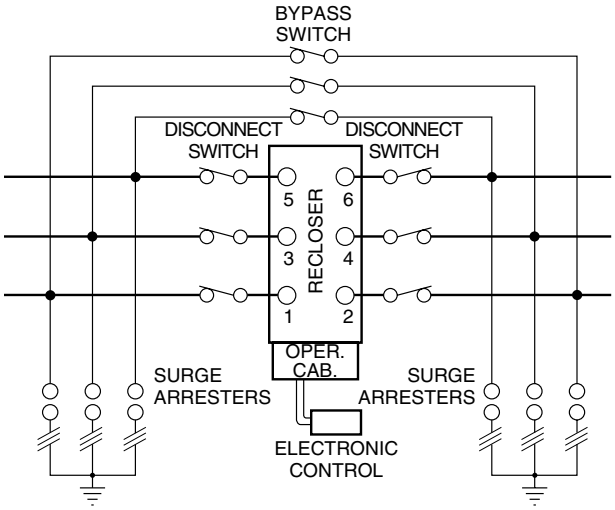


Figure 3. Typical recloser connections, with switches to facilitate maintenance and with complete surge protection

9. Block ground sensing via the control panel.
10. Close source and load disconnect switches.
11. Closer reclosers via control signal.
12. Open bypass switches.
13. Enable ground sensing, if applicable.

Auxiliary switch

A four-stage auxiliary switch is provided as a standard feature of the Type VSO recloser. Each stage has two independent contacts: a (open when interrupter contacts are open) and b (closed when interrupter contacts are open). The switch is wired to the terminal block at the upper right side of the mechanism cabinet for convenient customer connection.

The switch contacts are insulated for 600 V and have a continuous current rating of 10 A. Their interrupting ratings are shown in Table 4 in the **Specifications and Ratings** section of this manual.

Heaters

A cabinet heater is provided in the operating mechanism cabinet. Power is supplied from the 240 Vac source and is connected through a DPST toggle switch and a 2 A fuse, see Figures 5 and 6. The two mechanism cabinet heating resistors are rated 500Ω, 50 W.

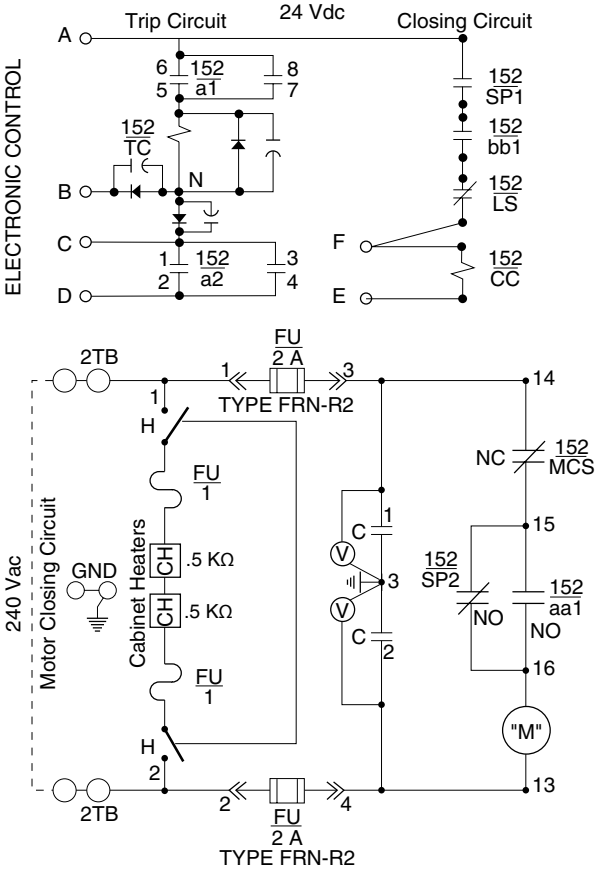
240 Vac power connections

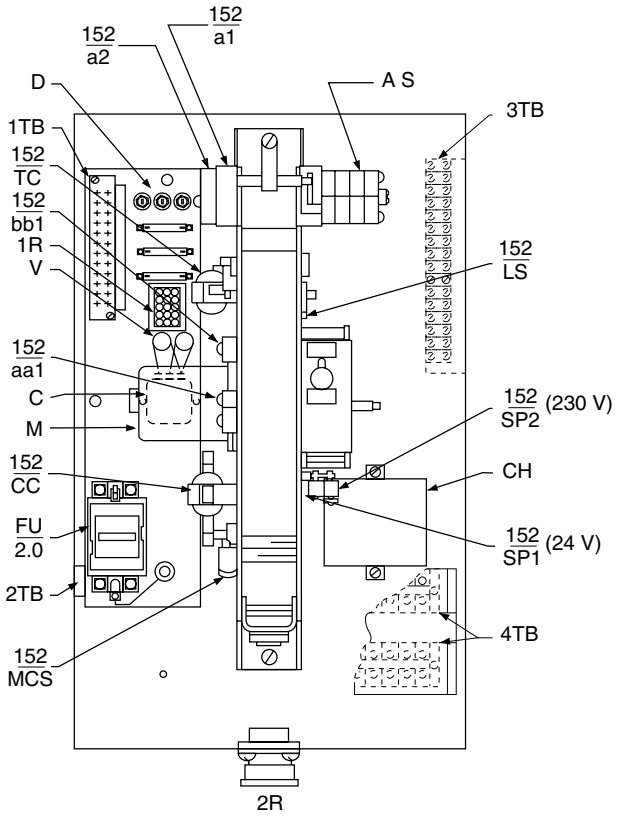
A 240 Vac power source is required to operate the recloser. A 120 Vac input power supply accessory is also available. The source is brought into the operator mechanism cabinet and connected to the terminal block mounted on the left side wall of the cabinet. The terminal block is permanently wired to the circuit-fused disconnect and the heater control panel. Two 2 A fuses are included on the heater control panel.

A schematic diagram of the recloser circuit and the physical arrangement of the operator mechanism, with parts identified, is shown in Figure 5. Figure 6 is an interconnection diagram.

Remove recloser from service

1. Block ground tripping via the control panel.
2. Close all three bypass switches.
3. With a hotstick, pull down the yellow MANUAL TRIP PULLRING under the cabinet.
4. The control will sense that the recloser is open.
5. Open the source and load disconnect switches.
6. Follow standard utility procedures regarding removal of recloser from service.





AS Auxiliary Switch

D Diodes 1N3209

C Surge Capacitor

FU 2.0 Fuse Box 1R Socket

2R Recloser Receptacle

152 a1 **a** Contact to Open Trip Coil

152 a2 **a** Contact to Open Trip Circuit

152 SP1 (24 Vdc) Spring Position Switch

152 SP2 (240 Vac) Spring Position Switch Close Motor Circuit

M Motor

152 aa1 Cam-Operated Switch Open Motor Circuit

152 bb1 b Contact to Close Closing Circuit

152 TC Trip Coil (Solenoid)

152 CC Close Coil (Solenoid)

152 MCS Manual Close Switch

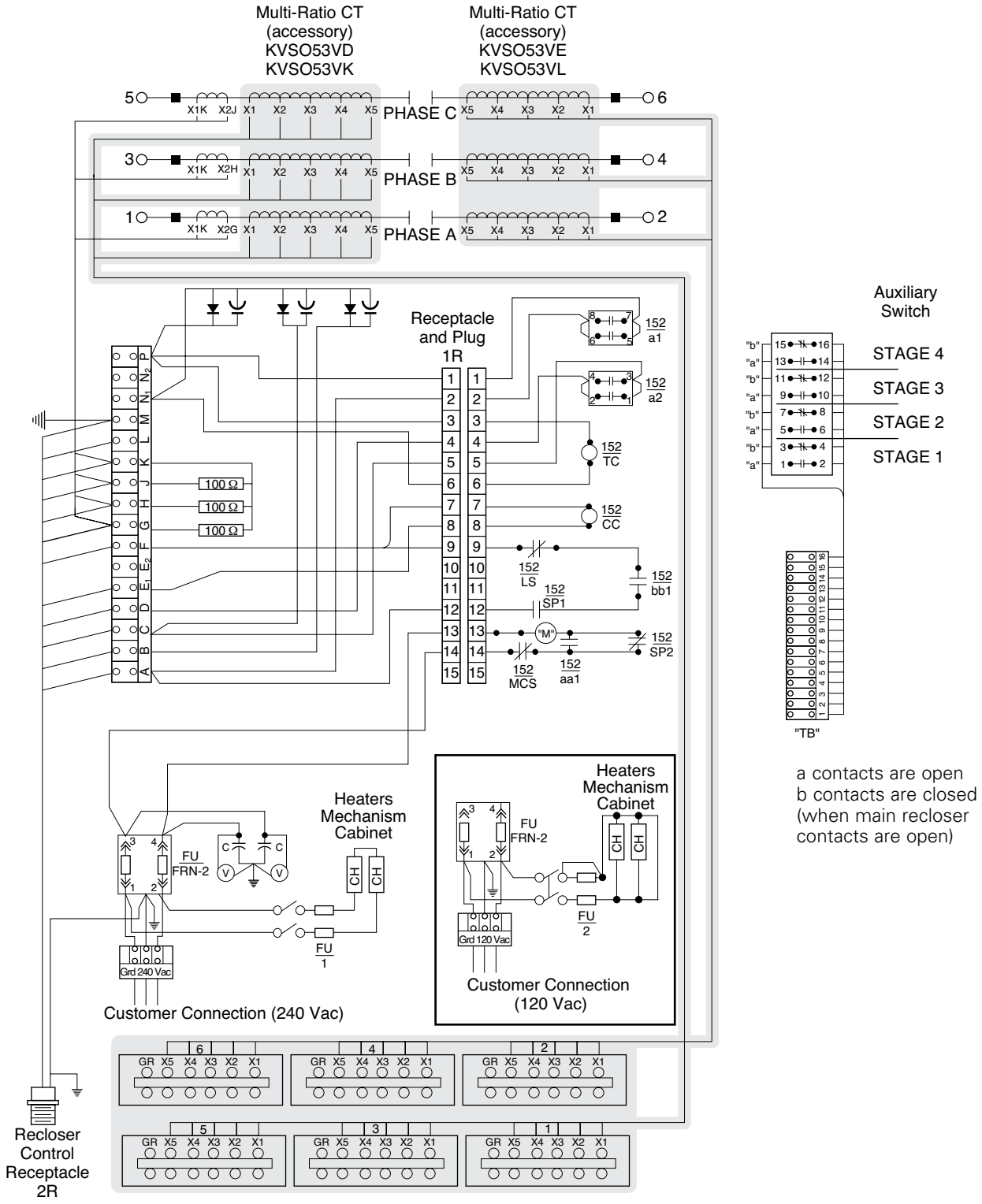
152 LS Contact for Manual Limit Switch - Trip and Reset

V Varistor

CH Mechanism Cabinet Heater

TB Terminal Board

Figure 4. Schematic diagram of recloser circuits and approximate location of circuit components



Note: Circuit shown with main contacts open and closing springs discharged.

Figure 5. Recloser interconnection diagram (shaded areas are accessories), 240 Vac shown

Accessories

Current transformers

⚠ WARNING

Hazardous voltage. The equipment is shipped with the shorting thumbscrews in the CT terminal blocks. These thumbscrews must not be removed until external connections are made to the terminal blocks. Energizing the equipment with the shorting screws removed, and no load connected, will cause high voltage to be generated in the CT secondaries. Contact with high voltage can cause severe personal injury or death and equipment damage. T208.2

Multi-ratio bushing current transformers are available in either 600:5 or 1200:5 A ratios. Each multi-tapped CT secondary is wired to a separate six-point terminal block in the operator mechanism cabinet (Figure 6). The available current ratios and terminal block terminations are shown in Table 9.

Figure 7 shows one of the three terminal blocks for the multi-ratio bushing CTs in the as-shipped condition. The secondary of each CT is shorted and grounded by the thumbscrew which shorts terminals X1 and X5 to the grounding bar. After external connections are made, the thumbscrew at X1 is removed and stored in the corner of the terminal block. The other thumbscrew remains in the grounding bar to make the common ground connection for one side of the CT secondary winding. The location of the screw in the bar is dependent upon the CT ratio desired and is always the higher of the two terminal numbers. Typical customer wiring to the three terminal blocks is shown in Figure 8.

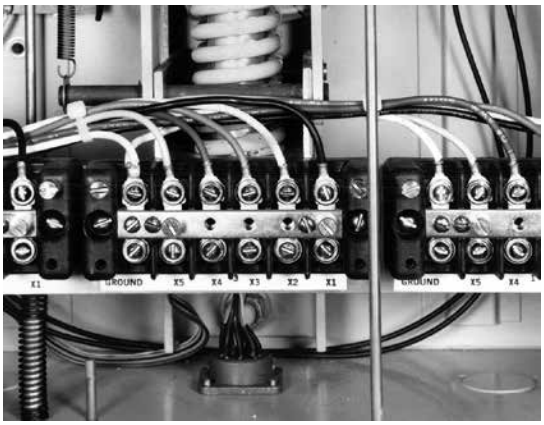


Figure 6. Position of shorting thumbscrews (as shipped)

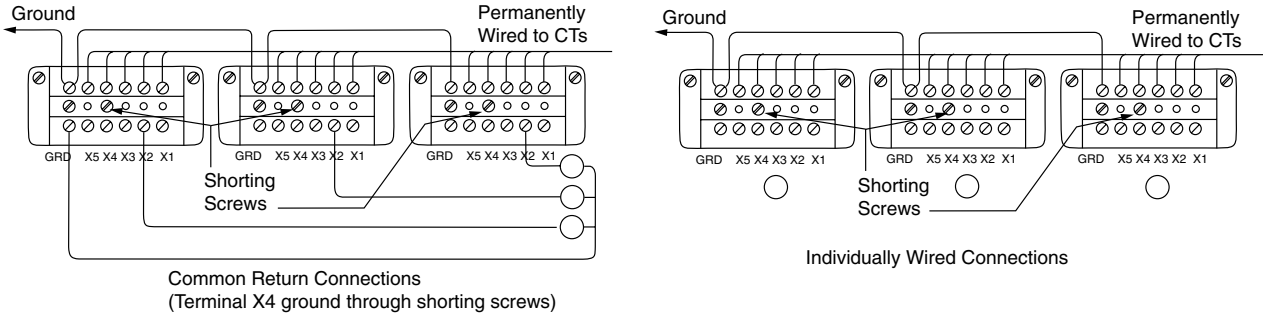


Figure 7. Position-shorting thumbscrews in terminal block and customer wiring

Table 9. Bushing-type current transformer ratios, terminal connections, and accuracies

Ratio	Terminal connection	Relay accuracy class	Metering accuracy class		
600:5	X1-X5	C100	.3B-0.5	.6B-1.0	1.2B-2.0
500:5	X2-X5	–	.3B-0.5	.6B-1.0	1.2B-2.0
450:5	X3-X5	–	.3B-0.5	.6B-1.0	1.2B-2.0
400:5	X1-X4	–	.3B-0.2	.6B4.5	1.2B-2.0
300:5	X2-X4	–	.3B-0.2	.6B-0.5	1.2B-1.0
250:5	X3-X4	–	–	.6B-0.2	1.2B-0.5
200:5	X4-X5	–	–	.6B4.2	1.2B-0.5
150:5	X1-X3	–	–	–	1.2B-0.2
100:5	X1-X2	–	–	–	–
50:5	X2-X3	–	–	–	–
1200:5	X1-X5	C200	.3B-2.0	.6B-4.0	1.2B-8.0
1000:5	X2-X5	–	.3B-2.0	6B- 4.0	1.2B-8.0
900:5	X3-X5	–	.3B-1.0	.6B-4.0	1.2B-8.0
800:5	X1-X4	–	.3B-1.0	.6B-2.0	1.2B-4.0
600:5	X2-X4	–	.3B-0.5	.6B-1.0	1.2B-2.0
500:5	X3-X4	–	.3B-0.5	.6B-1.0	1.2B-2.0
400:5	X4-X5	–	.3B-0.2	.6B-0.5	1.2B-1.0
300:5	X1-X3	–	.3B-0.2	.6B-0.5	1.2B-1.0
200:5	X1-X2	–	–	.6B-0.2	1.2B-0.5
100:5	X2-X3	–	–	–	1.2B-0.1

800 A continuous current accessory

This accessory increases the continuous current carrying capability of the VSO recloser, extending its rating from 560 A to 800 A. It consists of additional braided leads on each interrupter structure, larger bushing terminals (studtype, 1 1/8-12 UNF-2A; eyebolt, 1/0-750 MCM; or four-hole flat-head), stainless steel bushing clamps, and associated small hardware.

Terminals

Stud-type terminals, 1 1/8-12 UNF-2A, and 2-hole and 4-hole flat-pad terminals are available for the Type VSO recloser.

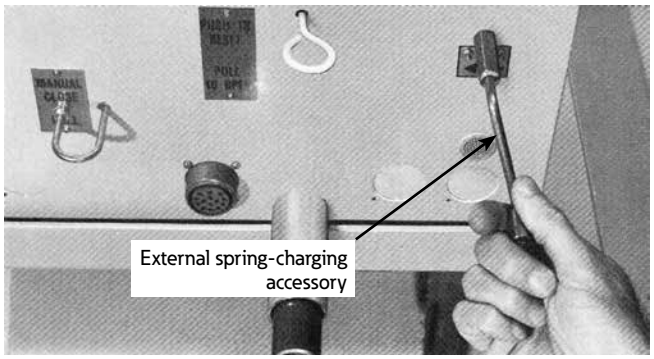


Figure 8. External spring-charging accessory

External spring charging

Enhanced operator safety is provided by this accessory which relocates the receptacle for the hand-spring charging crank from the side of the operator cabinet to its underside. See Figure 9. When recharging springs in a recloser on a live circuit, a lineman need not have any part of his body closer to exposed live parts than the underside of the cabinet to effectively operate the crank.

To operate, insert the manual-closing crank (stored on the inside of the operator cabinet door) into the crank mechanism and crank in the direction of the arrow until the spring charge-state indicator reads SPRINGS CHARGED.

External contact position indicator

Spotting a tripped recloser in a row of substation-mounted reclosers, or spotting a tripped pole-mounted recloser from a moving vehicle is easy with this indicator accessory. A green cylinder (1 1/4" diameter X 2" long), mechanically linked to the mechanism, is enclosed in a sleeve extending from the bottom of the mechanism cabinet. See Figure 10.

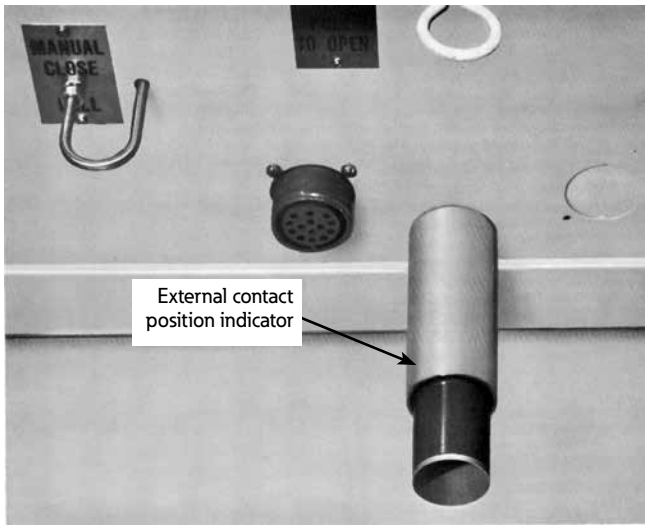


Figure 9. External contact position-indicating accessory

When the reclose contacts are open, the cylinder extends from the sleeve (green visible); when the contacts are closed, the cylinder retracts in the sleeve (green hidden). The cylindrical-indicator design provides a definite indication easily seen from various positions around the cabinet end of the recloser, eliminating possible difficulty in view and interpreting a flag-type indicator from some positions.

Tank-lifting windlass

One person can easily lower and raise the oil-filled tank with this accessory, which is usable with pole- or substation- mounted Type VSO reclosers. See Figure 11. The windlass features a 30:1 ratio worm-and-pinion gear box that minimizes cranking effort and holds the tank stationary when cranking is stopped and the operator's hand is removed from the crank. A shear pin connects the crank to the gear-box shaft to guard against overstressing the mechanism when the rank is fully raised.

The accessory is shipped inside the recloser crate and partially assembled to the recloser. The windlass assembly is placed inside the frame and banded to the crating to prevent damage during shipment. Its cables are routed and connected in their operating configuration at the factory.

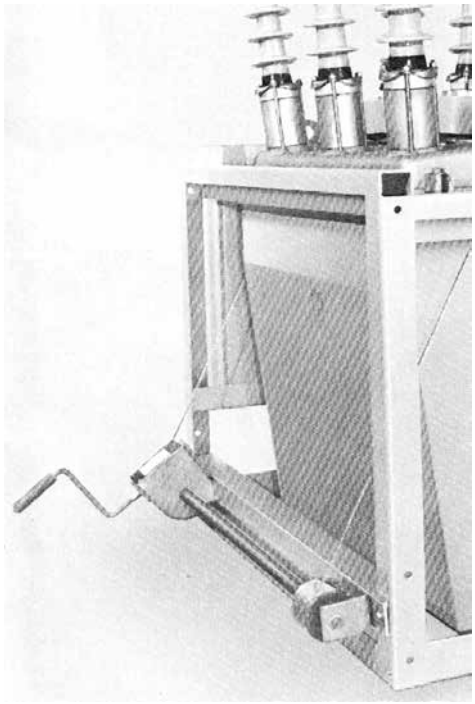


Figure 10. Tank-lifting windlass accessory

To install, remove the bands securing the windlass, and, while tilting it slightly, move it to the outside of the frame. Position it as shown in Figure 11 and secure it to the frame with two 1/2 X 1 1/4" long bolts, lock washer, and nuts. Insert the crank and one of the two 1/8" brass cotter pin retainer pins furnished.

DC station supply interface accessory

The DC Station Supply interface accessory is designed for the Form 6 Rack Mount Control only. For other control applications, contact your Eaton representative.

The factory-installed accessory, located in the mechanism cabinet, is powered by a 24, 48, or 125 Vdc substation battery, as specified at time of order. It allows the recloser to be located up to 150 m (500 ft) from the control; see Table 10. The quiescent current drain from the substation battery is only 20–40 mA. Refer to Figures 12–15.

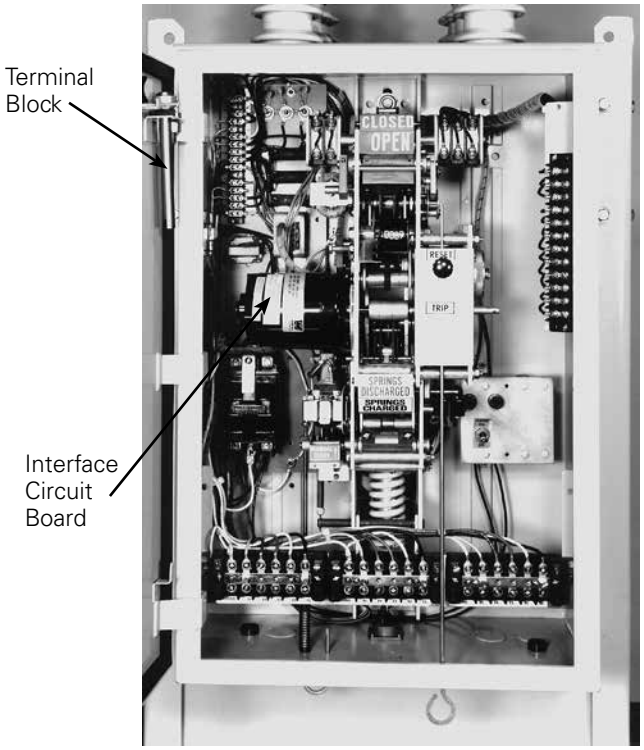


Figure 11. Type VSO recloser mechanism cabinet with dc station supply accessory

Figure 12. Terminal block for customer connection of DC power supply accessory

Accessory connections

The Form 6 Rack Mount Control cable connects to the VSO recloser using the standard 14-pin receptacle located at the bottom of the VSO mechanism cabinet. The dc supply voltage is wired to the terminal block located within the VSO mechanism cabinet; refer to Figures 12 and 14. Refer to Figures 13 and 15 for wiring connections.

1. Connect the dc supply voltage to the terminal block at terminals 11 (-) and 12 (+). Verify that the label on the terminal block agrees with the dc power supply voltage.
2. Connect 240 Vac to the terminal block at terminals 8 and 10.

Table 10. Cable lengths for DC station supply interface accessory

	Substation battery voltage					
Wire gauge	**24 Vdc meters**	**Feet**	**Meters**	**48 Vdc feet**	**125 Vdc meters**	**Feet**
18 AWG	12	40	24	80	48	120
16 AWG	18	60	36	120	54	180
14 AWG	30	100	60	200	90	300
12 AWG*	50	175	100	350	150	500

*12 gauge cable to be used with junction box accessory KME6-1859 or KME6-1811.

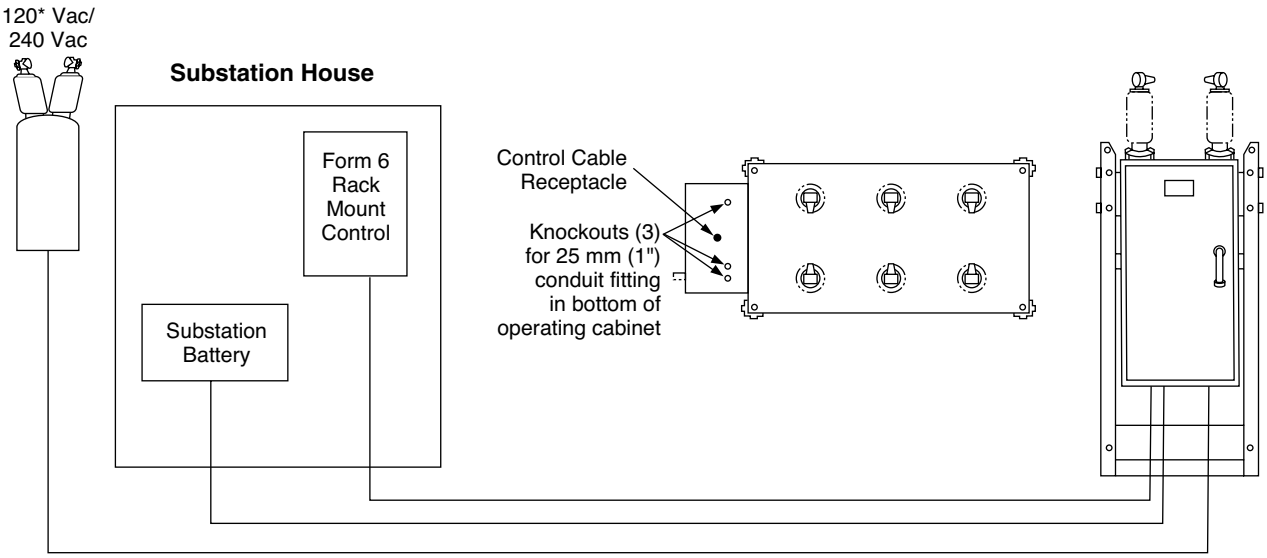
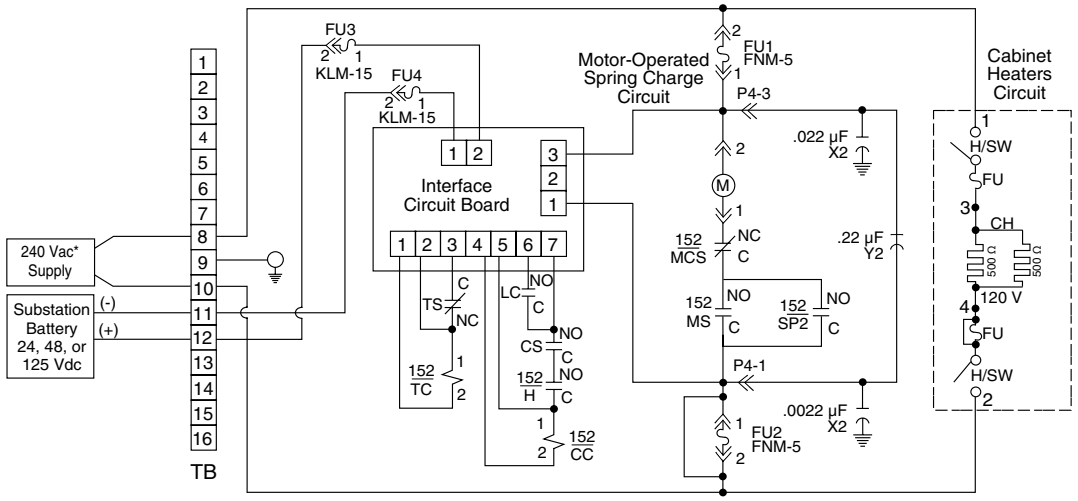


Figure 13. DC station supply interface accessory application



* 120 Vac available with KA60VSM2 120 Vac Motor Operator Accessory

C Capacitor

F Fuse

2R>> Receptacle for supplied control cable between operating mechanism cabinet and remote-mounted electronic control cabinet.

R Resistor

CH Cabinet Heater

H/SW Heater Disconnect Switch

TS Closed when Main Contacts are Open

CS Open when Main Contacts are Open

IEH Interrupter Enclosure Heater

152a Auxiliary Switch Contact Open when Main Contacts Open

152b Auxiliary Switch Contact Closed when Main Contacts Open

152SP2 Closing Spring Position Switch (ac control) Closed when Closing Springs Discharged

152LC Limit Switch Contact for Manual Trip and Reset

152TC Trip Coil (Solenoid)

152CC Close Coil (Solenoid)

152MCS Manual Close Switch (ac control)

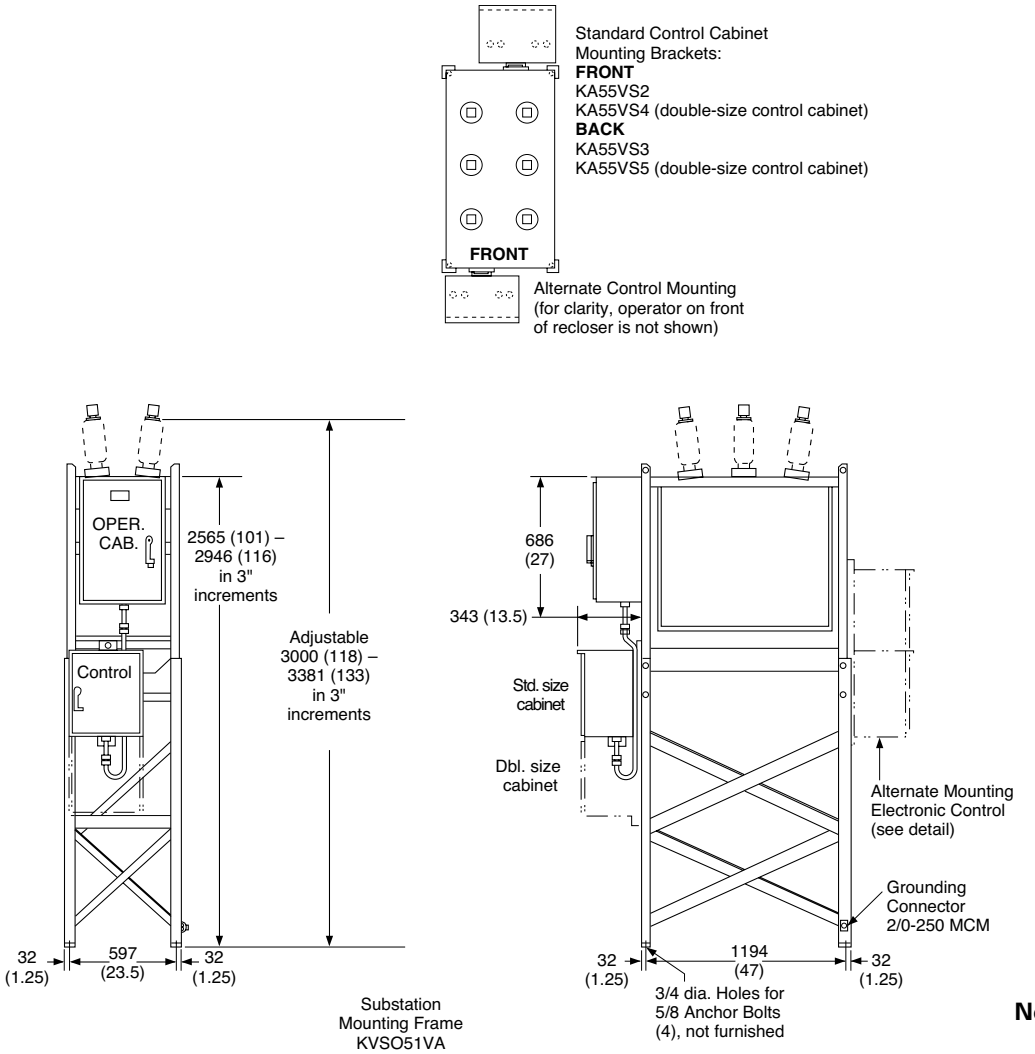
152H Manual Trip and Reset Switch (when not in reset position, will prevent a close)

Figure 14. DC station supply interface accessory circuit diagram

Substation mounting

The Type VSO substation mounting frame consists of angle-iron extension legs and braces that adjust to meet specific installation requirements.This galvanized steel substation frame differs from many other recloser substation frames in that it is assembled to the recloser box frame rather than being assembled separately to accept the recloser. Refer to Figure 16. Determine the bushing terminal top height appropriate for the recloser and site.

1. Lift the recloser by its lifting lugs, see Figure 3, to a position where its bottom frame members are approximately 2 m (7 ft.) above ground level.
2. Using holes corresponding to desired recloser height, secure an extension leg to each corner of the recloser frame with three 1/2 X 1″ long bolts, lock washers, and nuts. Tighten nuts only finger tight.
3. Secure diagonal braces to legs with 1/2 X 1″ long bolts (use the three 1 1/4″ long bolts at points where two braces are joined to a leg with a common bolt), lock washers, and nuts. Before inserting bolts through lower holes in legs and long braces, slip a ground connector onto each bolt. Tighten nuts only finger tight.
4. Secure two electronic control cabinet mounting straps to the frame beneath the mechanism cabinet. Use 1/2 X 1″ long bolts, lock washers, and nuts on the horizontal strap. Use a 5/8 X 2 1/2″ long bolt, lock washer, and nut to secure the top of the vertical strap to the box frame. This bolt also serves to secure the tip of a single or double control cabinet.
5. With the remaining 5/8″ diameter bolts (one 1 1/4″ long and one 2 1/2″ long), lock washers, and nuts, secure the bottom of the vertical brace to the horizontal brace (1 1/4″ bolt) and the bottom of the control cabinet to the vertical brace (2 1/2″ bolt).
6. Tighten all bolts securely, and lower the frame to the mounting surface. The frame may be used as a template to mark the location of mounting holes. Secure to the mounting surface with 3/4″ diameter anchor bolts.



Note: All dimensions are mm (inches).Dimensions shown are approximate.

Figure 15. Outline dimensions with substation mounting frame accessory (recloser and mounting frame only)

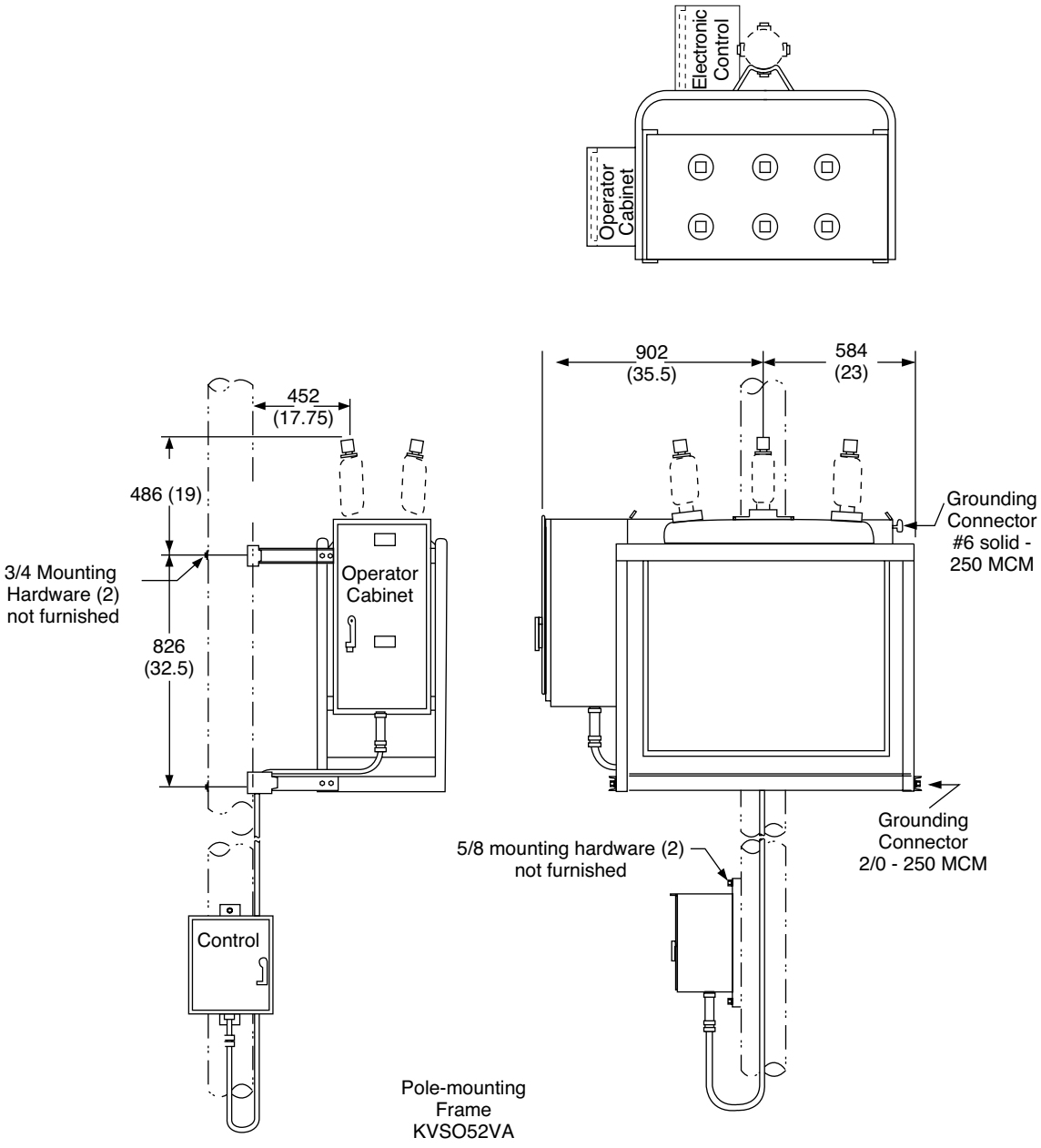
Pole mounting

The Type VSO recloser pole-mounting hanger, consisting of two C-shaped, galvanized channel-steel brackets, forms a strong, rigid supporting frame when joined to the recloser's welded box frame. Refer to Figure 17.

To mount the recloser, first bolt the hanger brackets to the recloser box frame while the recloser is on the ground.

One bracket is secured at the top ends of the box frame, the other at the bottom ends of the box frame. Use two 12″ X 1″ long bolts, lock washers, and nuts at each bracket end.

Hoist the recloser (see Figure 3) into position and secure with two 3/4″ diameter bolts of suitable length (customer supplied bolts). Be sure to use the two furnished rein forcing washers at the back side of the pole before tightening the bolts.



Note: All dimensions are mm (inches). Dimensions shown are approximate.

Figure 16. Outline dimensions with single-pole mounting hanger accessory (recloser and mounting frame only)

Operation

⚠ 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

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 or the contact position indicator; 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. G114.1

Type VSO three-phase reclosers feature vacuum interruption and oil insulation. Current interruption takes place in the vacuum interrupter assemblies that are suspended from the recloser cover by insulating supports. The moving contacts, which are located in each interrupter assembly and driven by the recloser operating mechanism, utilize a stroke of approximately one-half inch to close or open the circuit.

Recloser tripping and closing are initiated by signals from the recloser control unit. When current in excess of the programmed minimum trip level is detected on any phase or phases, the recloser control initiates a trip signal which energizes a solenoid in the operating mechanism of the recloser. When actuated, this solenoid trips the opening springs which opens the interrupter contacts. Refer to Figure 18.

Closing springs provide the force required to close the vacuum interrupters as well as the force required to charge the opening springs. A 240 Vac motor charges the closing springs through a multi-stage gear drive. When 240 Vac is present, the motor is automatically operated to keep the closing springs in a charged state.

To close the recloser, the control initiates a signal which energizes a solenoid in the recloser operating mechanism. Once actuated, the solenoid releases the closing springs, closing the vacuum interrupters. At the same time, the opening springs are charged and, when 240 Vac is present, the closing springs are charged. An external 240 Vac source is required to operate the drive motor.

Recloser tripping employs stored spring energy. The 24 Vdc supply is not required to trip the recloser. When the trip solenoid is actuated by the 24 Vdc trip signal, the stored spring energy is released to open the recloser. The 24 Vdc trip signal is originated at the recloser control.

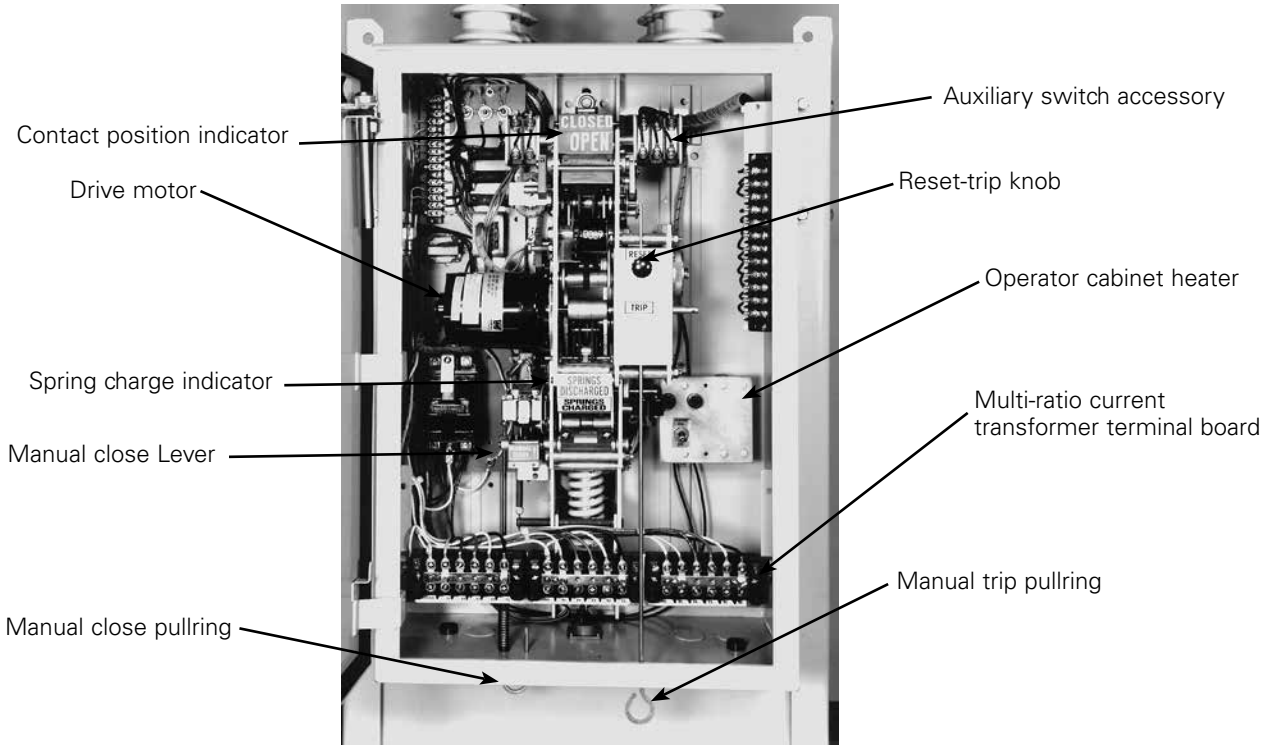


Figure 17. VSO recloser operating mechanism

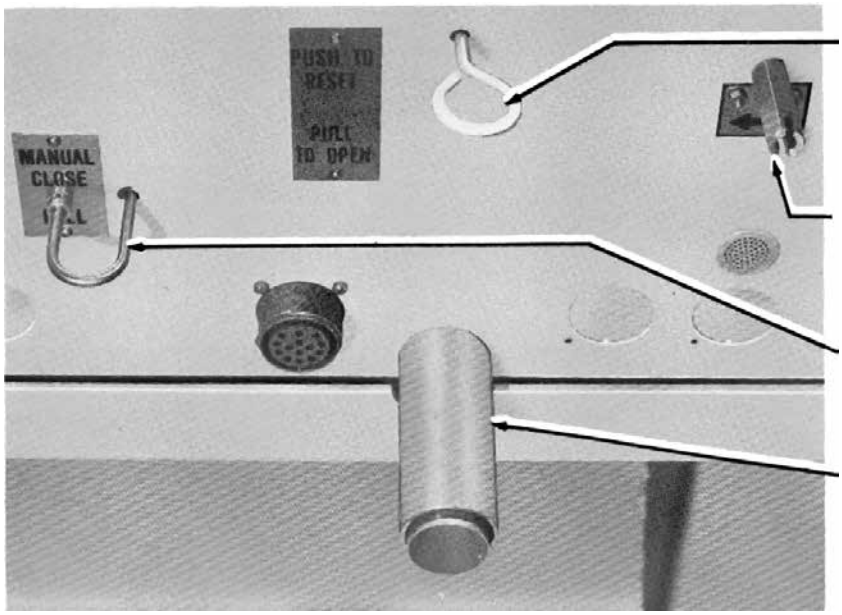


Figure 18. Underside of mechanism operating cabinet.

Manual tripping

A closed recloser can be tripped manually, from inside the operator cabinet by moving the RESET-TRIP knob to TRIP or from outside the cabinet by pulling down the yellow MANUAL TRIP PULLRING under the cabinet. When the recloser is manually tripped, the closing circuit is opened to prevent reclosing. Refer to Figure 19.

Manual closing

Closing springs must be charged prior to manual closing operation (see the **Testing Operation** section of this manual). There are two ways to manually close the recloser. Refer to Figure 19.

A. From inside the operator cabinet, move the RESET-TRIP knob to RESET and press up on the MANUAL CLOSE LEVER.

B. From outside the operator cabinet, push up the yellow MANUAL TRIP PULLRING, then pull down on the MANUAL CLOSE PULLRING.

Service information

⚠ CAUTION

This equipment requires routine inspection and maintenance to ensure proper operation. If it is not maintained, it can fail to operate properly. Improper operation can cause equipment damage and possible personal injury. G105.1

⚠ CAUTION

This equipment relies on dielectric fluid to provide electrical insulation between components. The dielectric strength of the fluid must be checked on a regular basis, as part of the routine maintenance inspection, to ensure that it is at or above minimum dielectric requirements. Use of this equipment with dielectric fluid that does not meet minimum requirements can result in internal flashovers that will damage the equipment and can cause personal injury. G107.3

Maintenance

Manuals

Maintenance instructions for the VSO12 and VSO16 reclosers can be found in *Service Information MN280066EN Type VSO Maintenance Instructions. Reference Data TD280022EN* provides information on recloser insulating oil specifications and tests.

Frequency of maintenance

To assure proper and trouble-free operation, reclosers must be maintained when they have operated the equivalent of a related duty cycle or before, see Table 4, Duty Cycle in the **Ratings and Specifications** section of this manual.

Note: ANSI C37.61, *Guide for the Application, Operation, and Maintenance of Automatic Circuit Reclosers, gives a procedure for converting the rated standard duty cycle into an equivalent duty cycle based on the actual operating duty of the recloser.*

If the recloser has not completed an equivalent duty cycle within six years, an inspection must be made and any needed maintenance performed. *Refer to Service Information MN280066EN Type VSO Maintenance Instructions* for inspection and maintenance procedures.

For additional information and specific maintenance requirements, including periodic maintenance inspection procedures, refer to the maintenance manual.

Testing operation

This recloser is used with Eaton Cooper Power series microprocessor-based recloser controls. Refer to the appropriate control operation manual.

⚠ 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. Check the data plate ratings. Make sure the ratings on the recloser data plate are correct for the planned testing.
2. Test electrical open and close operation. Close and open the recloser contacts using the microprocessor control. Confirm that the contacts have closed and opened by:
   A. The OPEN/CLOSE contact position indicator, or
   B. By a continuity check between the recloser terminals.
3. Test manual open, see Figures 18 and 19. Confirm that the contacts have opened by:
   A. The OPEN/CLOSE contact position indicator, or
   B. By a continuity check between the recloser terminals.
   C. A simple non-electric test of recloser operation will assure that the operator mechanism and the recloser linkage are functioning properly. The following procedure may be used prior to high-voltage connection:
      1. If the recloser is connected to a Vac power supply, pull out the fused disconnect switch to prevent the spring charging motor from running.
      2. Make sure the electronic control is in the CONTROL LOCKOUT state.
      3. Check that the recloser is open. The contact position indicator in the operator cabinet should read OPEN. The RESET-TRIP knob should be in the RESET position and the spring charge-state indicator should read SPRINGS DISCHARGED.
         a. If the recloser is closed, trip the recloser following the Manual Tripping instructions in this section. This will release a latch in the tripping mechanism, and energy stored in the opening springs will drive the operating mechanism to open the recloser contacts. The contact position indicator will read OPEN. Return the RESET-TRIP knob to RESET.
         b. If the spring charge state indicator shows SPRINGS CHARGED, close the recloser following the Manual Closing instructions in this section. This will close the recloser contacts and charge the opening springs. The contact position indicator will read CLOSED. Repeat procedure in Step 3A above.

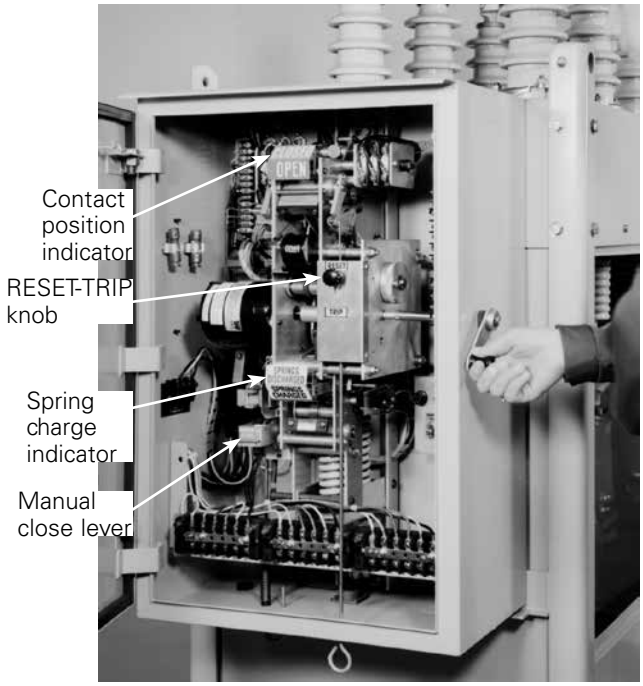


Figure 19. Manual closing

4. Insert the manual closing crank (stored on the inside of the operator cabinet door) through the hole in the right-hand side of the operator cabinet (sealed with a bolt-nut-seal) and onto the drive shaft (see Figure 20).
5. Crank the motor in a counterclockwise direction until the springs charge: approximately 150 revolutions of the motor shaft are required. The spring indicator will rotate to the SPRINGS CHARGED position.
6. Push up the manual closing lever to manually close the recloser. This will close the contacts and charge the opening springs. The contact position indicator will read CLOSED and the spring charge-state indicator will show SPRINGS DISCHARGED.
7. Move the RESET-TRIP knob to TRIP. The recloser contacts will trip open and the contact position indicator will read OPEN.
8. Replace the fused disconnect if it was removed.

4. **To close the recloser contacts:**
   A. First, push the yellow manual open handle up.
   B. Close the recloser using the microprocessor-based control.

High-potential withstand testing

⚠ WARNING

Hazardous voltage. The switchgear and high voltage transformer must be in a test cage or similar protective device 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. T221.3

⚠ 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 MN280062EN, Vacuum Interrupter Withstand Test Voltage Ratings Information* for further information. G109.3

The high-potential withstand test provides information on the dielectric condition of the recloser and the vacuum integrity of the interrupters. Use the following procedures to perform high-potential withstand tests at 52.5 kV rms, 60 Hz ac testing or at 74.2 kV for dc testing, for a maximum of 60 seconds. See Figure 21 for test connection diagrams.

Test 1

1. Close the recloser contacts.
2. Ground the recloser.
3. Connect terminals 2, 4, and 6 together.
4. Apply proper test voltage to terminals 2, 4, and 6.
5. The recloser should withstand the test voltage for 60 seconds.

Test 2

1. Close the recloser contacts.
2. Ground the recloser.
3. Ground Phase A (terminal 2) and Phase C (terminal 6).
4. Apply proper test voltage to Phase B (terminal 3).
5. The recloser should withstand the test voltage for 60 seconds.

Test 3

1. Open the recloser contacts.
2. Ground the recloser.
3. Connect and ground terminals 1, 3, and 5.
4. Connect terminals 2, 4, and 6.
5. Apply proper test voltage to terminals 2, 4, and 6.
6. The recloser should withstand the test voltage for 60 seconds.

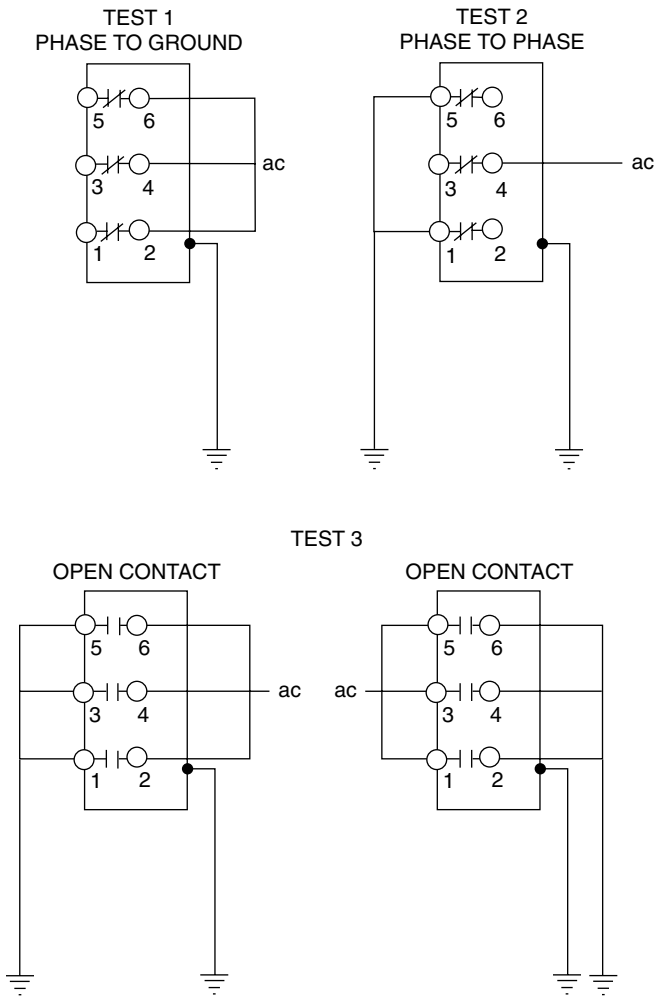


Figure 20. Connection diagrams for high-potential withstand testing

7. Reverse the connections: ground terminals 2, 4, and 6.
8. Apply test voltage to terminals 1, 3, and 5 for 60 seconds.
9. The recloser should withstand the test voltage for 60 seconds.

Withstand test results

The high-potential withstand tests provide information on the dielectric condition of the recloser and the vacuum integrity of the interrupters.

If the recloser passes the closed-contacts tests (Tests 1 and 2), but fails the open-contacts test (Test 3), the cause is likely to be in the interrupter assembly. Retest each phase individually to determine the failed phase or phases.

If the recloser does not pass Tests 1, 2, or 3, contact an authorized service center or your Eaton representative.

Replacement parts

Replacement parts for Eaton Cooper Power series reclosers are available through the factory Service Department. To order replacement parts, refer to the maintenance manual and the current Replacement Parts price list for catalog numbers and pricing. Contact your Eaton representative for additional information and ordering procedures.

Factory-authorized service centers

Factory-authorized repair shops are located throughout the continental United States to provide maintenance, repair, and testing services for Eaton Cooper Power series reclosers. For further information, contact your Eaton representative.

Factory maintenance classes

The factory Service Department offers recloser maintenance training classes. These classes, taught by experienced service technicians, are held at the factory's in-house training facility.

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