

# Type VSO three-phase electronically controlled recloser



## Introduction

The benefits of automatic-reclosing overcurrent protection can be realized on higher voltage distribution systems with Eaton's Cooper Power™ series Type VSO electronically controlled, oil-insulated vacuum recloser. A high continuous current rating and a high fault-current-clearing capability make the Type VSO recloser an ideal selection for substation or main feeder protection applications. Your system benefits from:

- High reliability resulting from the application of time-tested vacuum interruption and control technologies to this higher-rated recloser
- Extended maintenance intervals with long-life maintenance-free vacuum interrupters that eliminate oil contamination from arcing by-products
- Simplified coordination with the Form 4D electronic recloser control, or enhanced coordination flexibility with the Form 6 microprocessor-based recloser control.

## Basic Ratings

The VSO recloser has a rating of 560 amps maximum continuous current (extendable to 800 amps with an accessory) and 12000 or 16000 symmetrical amps maximum interrupting current at a maximum voltage of 38 kV.

## Operating

Reclosers clear most faults with only momentary current interruption since the majority of faults are temporary in nature; thus, extended outages are usually prevented. With outage time kept to a minimum, customer service is improved and utility income is maintained. The Type VSO recloser includes an integral box frame fabricated of welded angle and channel steel that facilitates handling and mounting. The frame can be quickly assembled into an Eaton's Cooper Power series substation mounting extension or single-pole hanger.

The recloser controls available provide the Type VSO recloser with a wide range of operating parameters to simplify coordination with other protective devices on a system.

Sensing-current transformers mounted inside the recloser provide line-current information to the recloser control. Tripping and closing commands from the control energize operating circuits in the recloser.

Operation of the recloser contacts is accomplished through the release of charged opening and closing springs. A motor-and-gear-train mechanism charges the closing springs; release of the closing springs closes the main contacts and charges the opening springs. Energy to operate the motor must be supplied to the recloser from an external 240 Vac source.

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Current interruption takes place within vacuum interrupters that are suspended in oil from a mechanism frame under the head of the recloser. The head mechanism transfers forces from the operator mechanism to the moving contact in each of the three vacuum interrupters, causing them to move simultaneously through a one-inch stroke.

**Surge protection**

Best operating results are achieved when reclosers are protected with surge arresters. On line applications, arrester protection is recommended on both sides of a recloser. If protection is to be provided on one side only, then it should be on the source-side. In substations, arresters should be located on the load-side. Eaton's Cooper Power series distribution-class surge arresters provide excellent protection for the Type VSO recloser. See *Technical Data CA235018EN, UltraSIL™ Polymer-Housed Evolution™ Surge Arrester* or *Technical Data CA235005EN, UltraSIL Polymer-Housed VariSTAR™ Surge Arrester* for information.

**Ordering information**

A complete electronically controlled recloser installation includes:

- recloser and its accessories
- recloser control and its accessories
- interconnecting control cable
- recloser mounting equipment

Accessories for the recloser are priced separately and must be ordered separately.

**Orders must include:**

1. Catalog number and type designation of the basic recloser (Table 1).
2. Catalog number and description of recloser accessories (if required). See Table 2.
3. Catalog number and description of recloser mounting equipment (if required). See Table 3.

**Table 1. Basic Recloser**

Recloser Type	Catalog No.
VSO 12,000 amp interrupting	KVS038-12-560

**Table 2. Recloser Accessories**

Accessory Description	Catalog No.
VSO 16,000 amp interrupting	KVS038-16-560
Bushing current transformers	
600:5 multi-ratio BCTs mounted on bushings 1,3,5	KVS053VD
600:5 multi-ratio BCTs mounted on bushings 2,4,6	KVS053VE
1200:5 multi-ratio BCTs mounted on bushings 1,3,5	KVS053VK
1200:5 multi-ratio BCTs mounted on bushings 2,4,6	KVS053VL
Three thermal-amp demand meters; five-amp movement/five-amp scale*	
Without instantaneous elements	KRW324V20-3
With instantaneous elements	KRW324V1-3
Vertical rain-tight meter trough; three sockets with circuit closing contacts**	KA335R903
Meter trough mounting-and-wiring kit for use on substation extension	KVS054V
800-amp continuous current accessory on recloser equipped with accessory BCTs	
(with eyebolt terminals)	KVS055VD
(with 1-1/8-inch-12 stud terminals)	KVS055VC
120-Vac motor operator	KVS057V
Potential-type battery charger in operator cabinet***	
120-Vac	KA58VSM1
240-Vac	KA58VSM2
External spring-charging accessory	KA59VSM
External contact-position-indicating accessory	KA61VSM2
Flat-pad terminals	
On recloser without accessory BCTs	KA62RV3
On recloser with accessory BCTs	KA62RV4

\* Metering accessories are also available installed in the upper portion of a double-size ME control cabinet.  
 \*\* KVS054V meter trough mounting required if meters are to be mounted on substation frame.  
 \*\*\* For use with Form 3A electronic controls only, requires addition of KA1144ME control accessory.

**Table 3. Mounting Equipment**

Description	Catalog No.
Single-pole hanger	KVS052V
Substation-mounting-frame extension	KVS051V
Tank-lifting mechanism	KVS056V

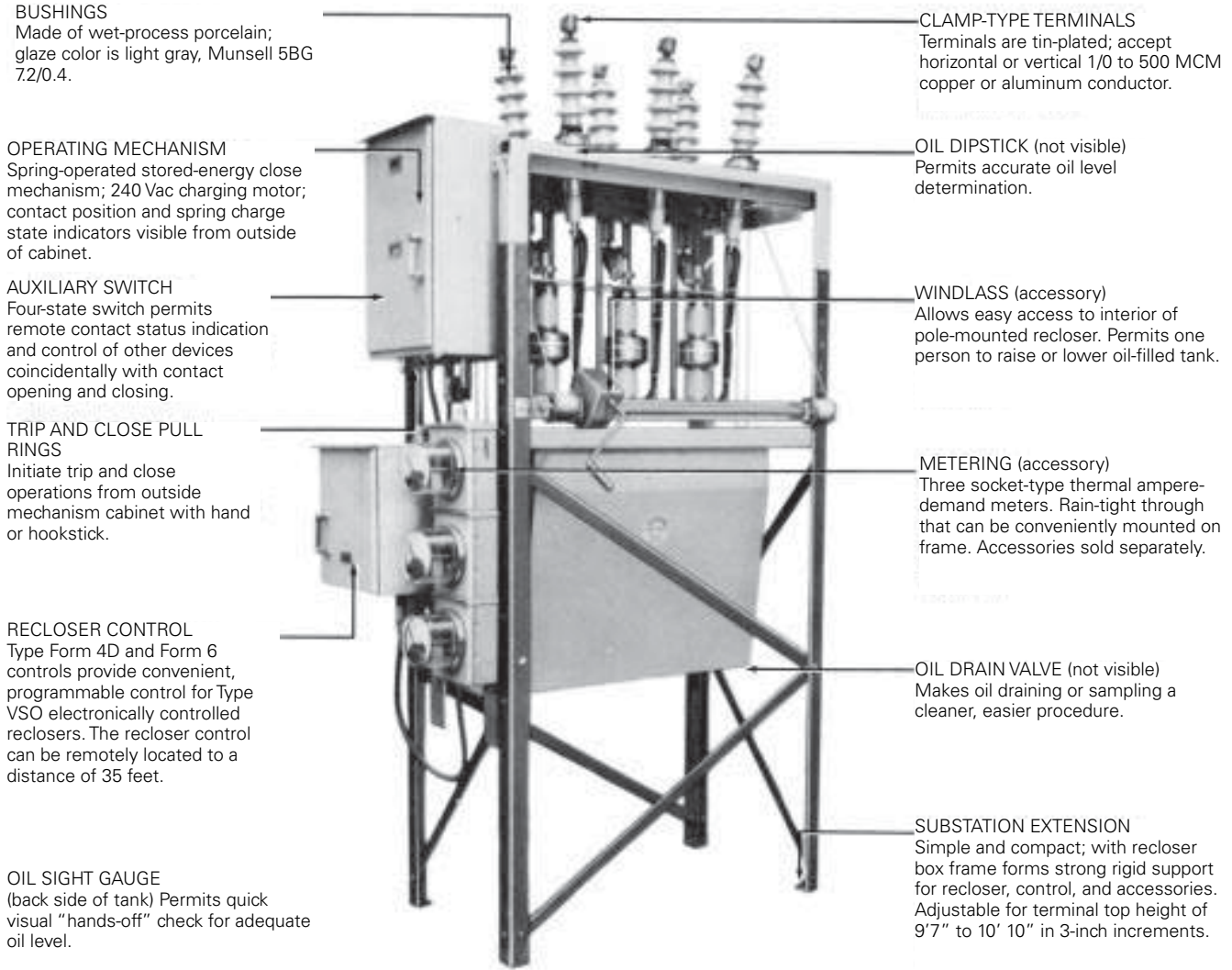


Figure 1. Type VSO recloser in substation extension, untanked, with some accessories

The electronically controlled, oil-insulated, three-phase Type VSO vacuum recloser from Eaton can be used in substations or in close-in feeder applications where it would be subject to high fault current levels.

Vacuum interrupters provide a single break on each phase through separation of contacts within each vacuum envelope. All arcing is contained within the interrupters. Low energy arc interruption in a vacuum results in far less shock and demonstration, extending the recloser mechanism life. Vacuum interruption offers longer duty cycles and long contact life.

The force required to trip and close the recloser contacts is provided by the release of charged opening and closing springs in the operator cabinet. A motor-operated mechanism, powered from an external 240 Vac supply, charges the closing springs. Release of the closing springs closes the recloser contacts and also charges the opening springs.

Line current is sensed by three 1000:1 ratio current transformers mounted on bushings 1, 3, and 5 under the recloser head. They provide the recloser control with a continuous measurement of line current.

When the programmed minimum-trip is exceeded, and after the programmed time delay, the control energizes a trip solenoid in the recloser to release the charged opening springs.

When the recloser contacts open, the recloser control activates the closing mechanism. Energy to operate the trip solenoid and activate the closing mechanism is provided by the control.

The Type VSO recloser is designed and built in accordance with ANSI® C37.60. Each recloser is thoroughly tested before shipment.

## Construction

In common with other reclosers from Eaton, Type VSO reclosers are designed for long service life with minimum maintenance. The recloser head is an aluminum casting. The tank is fabricated of heavy-gauge steel and is finished with a corrosion-inhibiting-epoxy prime coat, followed by a finish coat of thermosetting acrylic paint. Finish color is light gray, Munsell 5BG 7.0/0.4.

The oil-filled tank can be lowered and raised easily by one person with a windlass accessory, usable whether the recloser is mounted in a substation frame or on a pole. An oil sampling-and-drain valve, oil level sight gauge, and oil dipstick are provided as standard features.

An oil-tight, weather-resistant seal between the head and the tank is assured by a Buna-N synthetic rubber gasket confined in a groove in the head to provide controlled compression.

The recloser head is attached to a welded angle- and channel-steel box frame which facilitates handling and mounting. The tank is suspended within the box frame from the head. Each interrupter is independently suspended from the internal mechanism under the recloser head in a way which eliminates mechanical stress on the bushings as well as any need for adjustment between the bushing and interrupter. Wet-process porcelain bushings are oil-filled, capacitively graded type.

Two targets, visible through windows in the operator cabinet door, provide continuous (easily readable) indications of contact position and closing spring charge state. Contact position indication is either CLOSED (white letters on red background) or OPEN (white letters on green background). Spring charge state indication is either SPRING CHARGED (black letters on yellow background) or SPRING DISCHARGED (black letters on white background).

A four-stage auxiliary switch is provided as standard. Normally set for four "a" and four "b" contacts, the switch can be programmed for other "a" and "b" combinations totaling eight. It is operated by the recloser mechanism and is wired to a terminal block in the operator cabinet. The switch can be used to provide a remote indication of contact position or to switch other devices, such as alarm circuits, coincidentally with recloser contact opening and closing.

## Operation

### Tripping

Line current in all three phases is sensed by 1000:1 ratio current transformers on bushings 1, 3, and 5 under the recloser head. Continuous signals from the CTs, proportional to line currents, are routed to the recloser control, where they are monitored.

When the line current flows in excess of the programmed minimum trip level, in one or more phases, and after a time delay based on the programmed time-current characteristic, a trip solenoid in the operating mechanism is energized by the control. The solenoid trips a latch that releases the charged trip springs and mechanism. A linkage simultaneously operates all three phases, opening the recloser contacts and a switch which interrupts the trip signal from the control.

### Closing

As with contact opening, contact closing force is provided through the release of stored spring energy. The closing springs are charged by operation of a 240 Vac motor and gear train. Upon receiving a closing signal from the control, a solenoid energizes, tripping a latch which releases the closing springs. When released, the closing springs cause the operating mechanism to close the vacuum interrupter contacts and simultaneously charge the opening springs. Immediately following the release of the closing springs, the 240 Vac motor runs to recharge the springs in preparation for the next closing operation. Limit switches interrupt the supply to the motor and the signal from the control when the closing springs are fully charged. Spring charging time is less than one second.

An external 240 Vac source supplies power for the motor operator. An undervoltage relay opens a contact in the motor circuit if the 240-volt motor supply voltage falls below 165 volts. This prevents the motor from operating on inadequate voltage, which could result in motor stalling and burnout.

If the 240-volt supply voltage is lost, the recloser can still perform a limited number of trip and close operations, operating from the stored spring energy. If power loss occurs while the main contacts are closed (and the motor has run to recharge the closing springs), the capability exists to trip, close, and trip again. If power loss occurs while the main contacts are open, the capability exists to close once and trip once.

### Manual

A closed recloser can be tripped manually from inside the operator cabinet by moving the Trip-Reset knob to TRIP or from outside the cabinet by pulling down on the yellow trip ring under the cabinet. When the recloser is manually tripped, the closing circuit is opened to prevent reclosing. The recloser can be manually restored to service either by moving the Trip-Reset knob to RESET and pressing the Manual Close lever down or by pushing up on the yellow trip ring and pulling down on the close ring.

The manual operation described in the preceding paragraph involves levers that are mechanically linked to the operating mechanism. The recloser can also be tripped and closed with the Manual Control switch on the recloser control panel. An emergency means is provided to manually close the recloser (on an energized line if necessary and with the closing springs discharged) in the absence of 240 Vac auxiliary power. A crank stored inside the operator cabinet door is engaged with the motor shaft and cranked through approximately 150 turns to charge the closing springs; a closing operation can then be initiated.

**LIMIT SWITCH**  
De-energizes trip-coil circuit to minimize battery drain when recloser opens.

**TRIP SOLENOID**  
Operates on 24 Vdc signal from electronic control; trips latch releasing opening springs.

**UNDERVOLTAGE RELAY**  
Prevents motor from operating if 240 Vac supply voltage fails below 165 volts; safeguards motor from stalling and burnout.

**SERIES UNIVERSAL MOTOR, 240 VAC**  
Charges closing springs in less than one second; low power requirement; needs no lubrication.

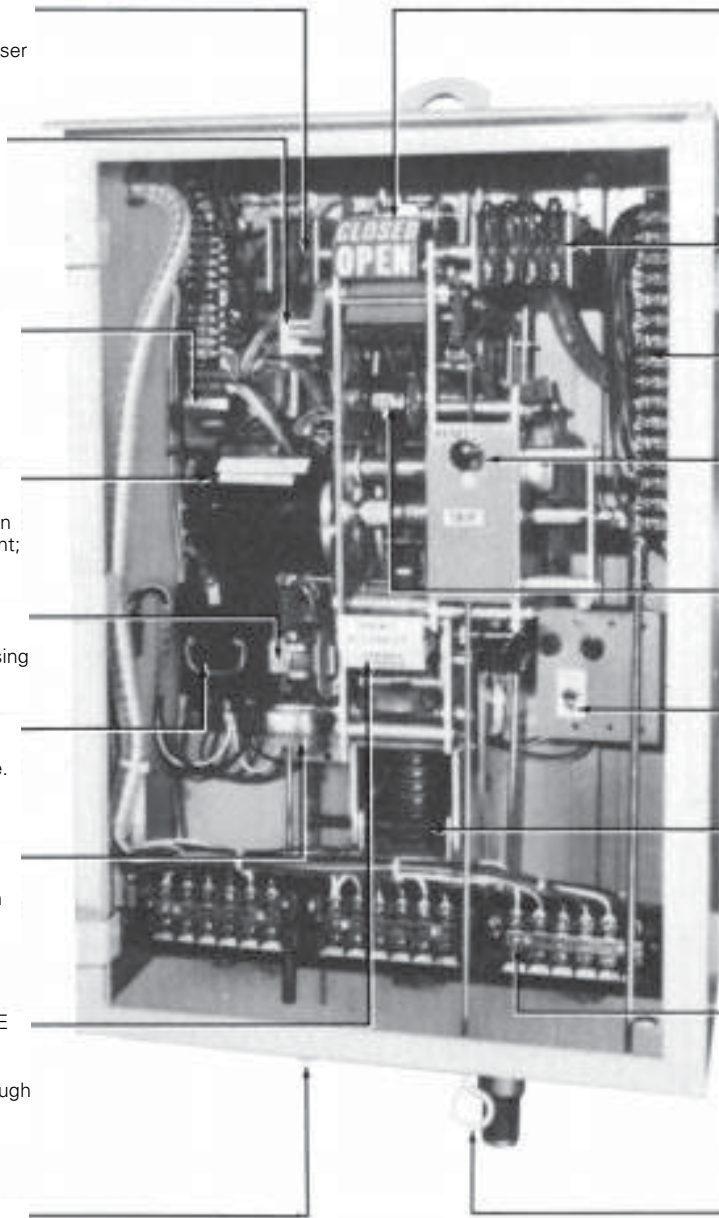
**CLOSE SOLENOID**  
Operates on 24 Vdc signal from electronic control; trips latch releasing closing springs.

**FUSED PULLOUT SWITCH**  
Provides a safe visible means of disconnecting motor power source.

**MANUAL CLOSE LEVER**  
Permits manual release of closing springs from operating mechanism cabinet.

**CLOSING SPRING CHARGE STATE INDICATOR**  
Indicates whether springs are charged or discharged; visible through window in cabinet door.

**EXTERNAL CLOSE PULL RING**  
Permits manual release of closing springs from beneath cabinet with hand or hookstick.



**CONTACT POSITION INDICATOR**  
Linked to main operating shaft; visible through window in cabinet door.

**FOUR-STAGE AUXILIARY SWITCH**  
Used for remote contact position indication or switching of other devices coincidentally with recloser operations; with terminal strip for convenient connection.

**MANUAL TRIP AND RESET KNOB**  
Permits manual release of trip springs from operating mechanism cabinet.

**OPERATIONS COUNTER**  
Indicates accumulated total of tripping operations performed by recloser.

**HEATER CONTROL**  
Switch and fuses for operator cabinet heater.

**CLOSING SPRINGS**  
Charged by drive motor; provide energy to close main contacts; simultaneously charge opening springs. (Opening springs are located in recloser head mechanism.)

**CURRENT TRANSFORMER TERMINAL BLOCKS**  
Used for connection to multiratio bushing current transformer accessory.

**EXTERNAL TRIP PULL RING**  
Permits manual release of trip springs from beneath cabinet by hand or with hookstick.

Figure 2. Operating mechanism used on Type VSO recloser

### Vacuum interrupters

Vacuum interrupters provide a single break on each phase. Vacuum interrupters provide fast, low-energy arc interruption with long contact and interrupter life, low mechanical stress, and maximum operating safety. With arc interruption taking place in a vacuum, isolated from the insulating oil, contact and interrupter life is greatly extended, and oil contamination and maintenance are virtually eliminated. At the same time, mechanical stress and wear on the mechanism is minimal.



**Figure 3. Vacuum interrupter used in Type VSO recloser (cutaway to show contacts).**

Eaton’s Cooper Power series vacuum interrupters are designed with a metal and ceramic housing for maximum strength. The high-alumina ceramic has more than five times the strength of glass, permits a higher processing temperature to develop maximum purity of the assembly, and is impervious to helium penetration to sustain the vacuum level. Metal end closures and the arcing chambers are of high-purity alloy to minimize contamination. Enclosed in the interrupter is a stationary and a moving contact assembly. The moving contact has a travel of one inch, its shaft passing through a flexible bellows which maintains vacuum integrity. Contacts are made of a special non-welding alloy.

### Recloser control

Type VSO recloser is electronically controlled by an Eaton’s Cooper Power series recloser control. A choice of two controls can be used in conjunction with this recloser.

The Form 4D control, shown in Figure 4, is a microprocessor-based recloser control, which performs outstanding protection, metering, and communication functions. The control has fully modular communication (up to 2 serial or Ethernet interfaces) to meet expanded SCADA and automation applications.

The Form 4D recloser control provides phase and ground current sensing, and three-phase voltage sensing. The Form 4D control can compute power, energy, power factor, and power flow direction from these current and voltage inputs.

The standardized front panel of the Form 4D control can be used to program and interrogate the control, as well as to display metering and alarm information. Control parameters can also be programmed via personal computer using ProView® NXG interface software. Temporary connection to the control can be made through the front panel USB port. The ProView NXG interface software includes the functionality to create and modify time-current curves (TCCs), and provides diagnostic information. The Form 4D control analysis tools include event recording, data profiling, and various metering capabilities.



**Figure 5. Form 6 microprocessor-based recloser control**

The Form 6 microprocessor-based recloser control, shown in Figure 5, incorporates computer technology to provide enhanced application versatility and ease of operation. All standard control operating parameters including; phase- and ground-fault minimum trip levels, time-current curve selection, and sequences of recloser operation, are keyboard programmable. An easy-to-use HMI interface provides convenient programming and interrogation of the control’s various operating parameters. A large LCD display provides control feedback during programming and integration, and front panel LCD indicators provide control and recloser status, at a glance.

In addition, the power of the Workbench within the ProView® software allows users to use custom logic to create complex control schemes to support a variety of control applications. With the use of the Virtual Test Set™ feature, different fault events can be simulated to test virtual responses prior to field exposure, and confirm proper protection logic functionality before implementation.

The control provides a wide range of standard features, which include: supervisory operation, remote status indication, fault indication via LCD targets and counters, sequence of events recorder, recloser duty monitor, demand metering, and load profile monitor.



**Figure 4. Form 4D microprocessor-based recloser control**

The microprocessor-based control can also be equipped with an additional input/output board or a variety of communication cards (Serial Fiber, RS-485, Ethernet Wire or Fiber) to extend the supervisory operation capabilities of the control.

**Accessories**

Accessories available for the Type VSO recloser are described in the following paragraphs.

**Bushing-type, multiratio current transformers**

Multiratio current transformers for operating relays or load meters can be mounted on the source-side bushings (Figure 6), the load-side bushings, or both the source- and load-side bushings. Whether three or six current transformers are ordered, the accessory includes six extra-length bushings to accommodate the current transformers and maintain an equal terminal-top height. (When the accessory is ordered for one side only, extender sleeves are included on the opposite side). Addition of the transformers increases terminal top height by five inches.

These current transformers have only one primary turn – the bushing rod. They are offered with secondary windings that provide primary/secondary current ratios of either 600:5 or 1200:5. Different ratios can be obtained by connection to appropriate taps on their secondary windings. The ratios obtainable from 600:5 and 1200:5 transformers, and the corresponding accuracy classes, are shown in Table 4.

For ease of connection and ratio selection, secondary taps are factory-wired to terminal blocks (one corresponding to each transformer) in the mechanism cabinet (Figure 7). Wiring from meters or relays is routed into the cabinet by the customer and joined to two of the five terminals on each block to obtain the ratio desired. Two thumbscrews in each of the blocks, positioned to short and ground the current transformers for shipping, are then removed and repositioned to complete electrical connection of the device. To order bushing-type multiratio current transformers see the Recloser Accessories listing under ORDERING INFORMATION.

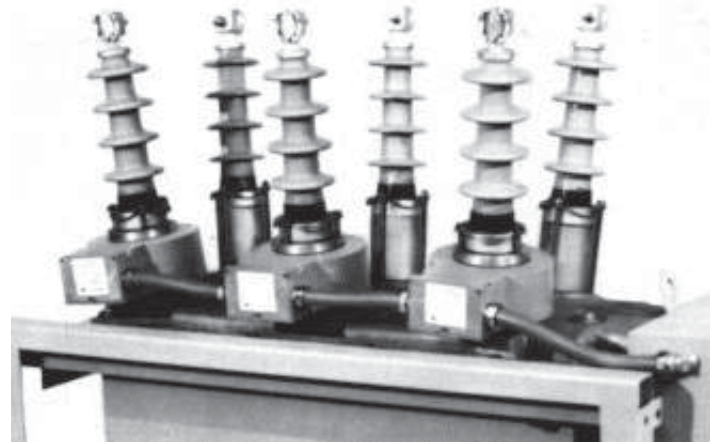


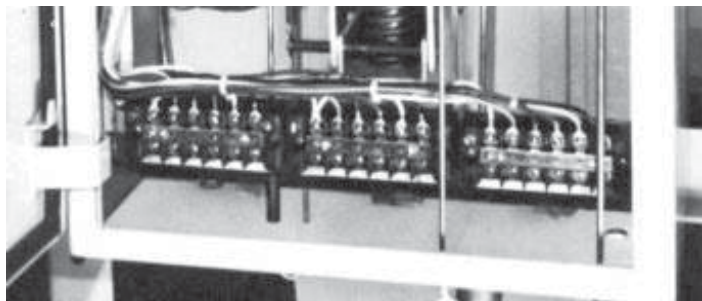
Figure 6. Multiratio current transformers

Table 4. 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	.6B-0.5	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	–	–	.6B-0.2	1.2B-0.5
150:5	X1-X3	–	–	–	1.2B-0.2
100:5	X1-X2	–	–	–	–
50:5	X2-X3	–	–	–	–

Ratio	Terminal Connection	Relay Accuracy Class	Metering Accuracy Class		
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

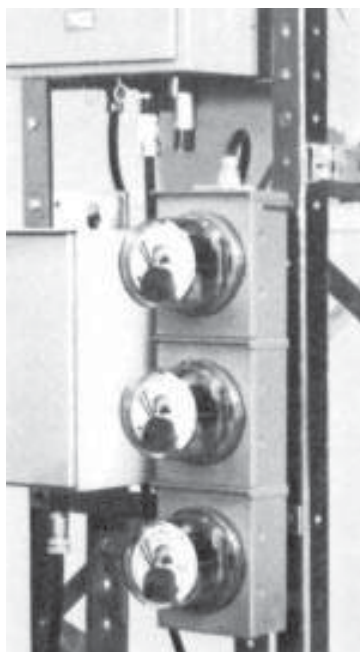


**Figure 7. Current transformer terminal blocks**

### Current metering

Useful in load balance studies, current metering is offered for the Type VSO recloser in the form of three 3-1/2-inch socket-mounting thermal ampere-demand meters. The five-amp movement/five-amp scale meters are available with or without instantaneous indicators in addition to the average indicators.

A meter trough mounting-and wiring kit contains the parts required to conveniently mount the trough to the substation extension alongside the control and make electrical connections to the current transformer terminal blocks inside the mechanism cabinet.



**Figure 8. Current metering accessory**

### 800-Amp continuous current

The continuous current carrying capability of the Type VSO recloser can be increased, extending its rating from 560 amps to 800 amps, with this accessory. It consists of larger bushing terminals stainless steel bushing clamps, and associated small hardware. Two types of bushing terminals are offered: a 1-1/8 inch-12 stud type terminal and an eyebolt terminal that accepts 2/0-1000 MCM copper or aluminum conductor.

### 120-Volt AC motor operator

For installations where 240 Vac auxiliary power is not accessible, the Type VSO recloser can be ordered with an accessory which permits operation on 120 Vac. All of the standard recloser capabilities are retained.

### Potential-type battery charger

Form 4D and Form 6 recloser controls contain battery charging circuits that require a 120 Vac supply voltage. For those installations where 120 Vac is not available at the control, or when a prior model Form 3 control (which may not have a battery charger) is to be used, the recloser must be equipped with a battery charger. Installed in the operator cabinet, chargers are provided in either of two versions: 240 Vac for the standard Type VSO recloser, or 120 Vac for the Type VSO recloser equipped with the 120 Vac motor operator accessory.

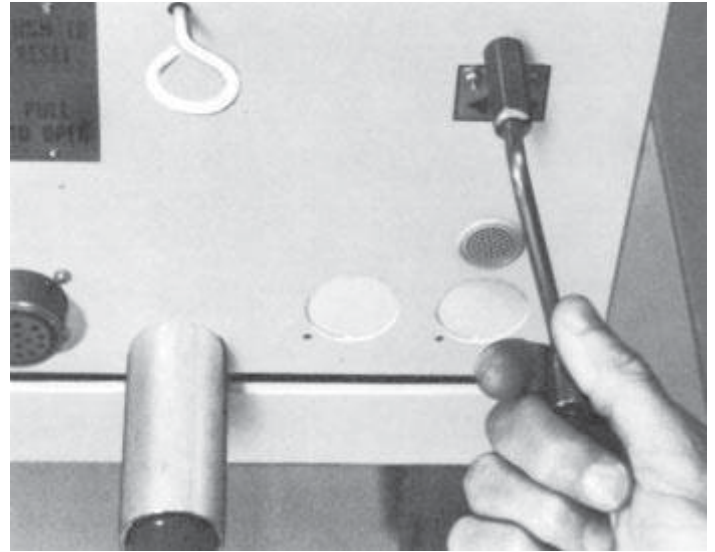


**External spring charging**

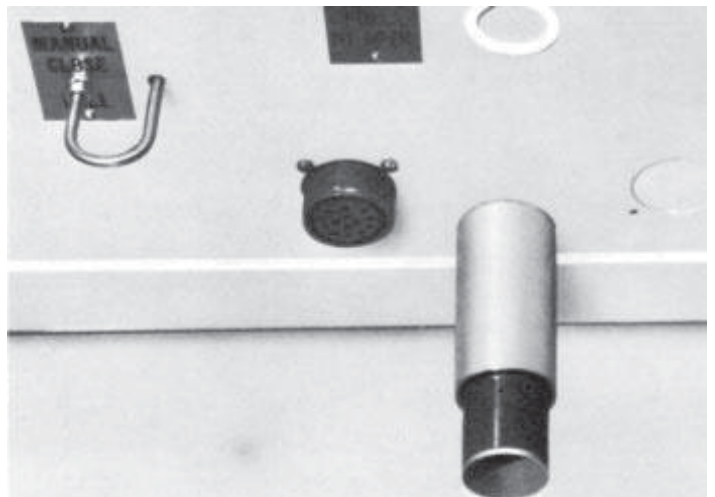
Enhanced operator safety is provided by this accessory, which relocates the receptacle for the hand spring charging crank from the side of the operator cabinet to its underside (Figure 9). When recharging springs in a recloser on a live circuit, a lineman need not have any part of his body closer to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

**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 (Figure 10). A green cylinder (1-1/4-inch diameter x 2 inches long), mechanically linked to the mechanism is enclosed in a sleeve extending from the bottom of the mechanism cabinet. When the recloser contacts are open, the cylinder extends from the sleeve (green visible); when the contacts are closed, the cylinder retracts into 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 viewing and interpreting a flag-type indicator from some positions.



**Figure 9. External spring-charging accessory**



**Figure 10. External contact position indicating accessory (shown with green cylinder extended from sleeve, indicating open recloser contacts)**

### Flat-pad terminals

Two-hole or four-hole flat-pad type bushing terminals (Figure 11) of silver-plated, red brass alloy are offered for the Type VSO recloser.

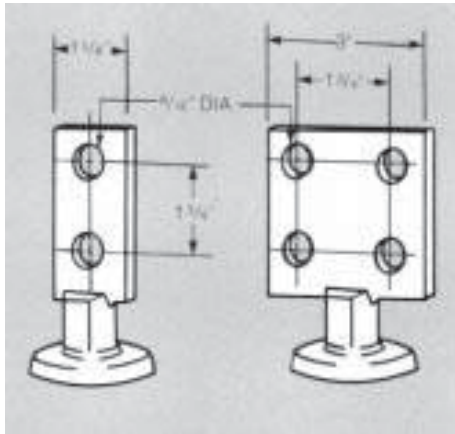


Figure 11. Flat-pad terminals

## Mounting Equipment

### Single-pole hanger

Consisting of two horseshoe-shaped, galvanized channel-steel brackets, the Type VSO recloser single-pole hanger (Figure 12) forms a strong rigid supporting frame when joined to the recloser's welded box frame. The hanger brackets are conveniently bolted to the box frame with four 1/2-inch bolts while the recloser is on the ground. The recloser/hanger assembly is then hoisted into position and secured to the pole with two 3/4-inch through-bolts (customer-furnished). Two reinforcing washers are included with the accessory.

### Substation extension

Compact and adjustable, the Type VSO recloser substation extension (Figure 13) provides a structure of ample strength to support the recloser and a complement of accessories. Consisting of four galvanized angle-steel legs, galvanized strap-steel braces, and associated hardware, the extension is easily assembled to the recloser frame. A mounting strap is provided for the recloser control, located to allow space for mounting the metering accessory alongside. The extension is adjustable in three-inch increments to provide a terminal-top height of nine feet, nine inches to eleven feet.

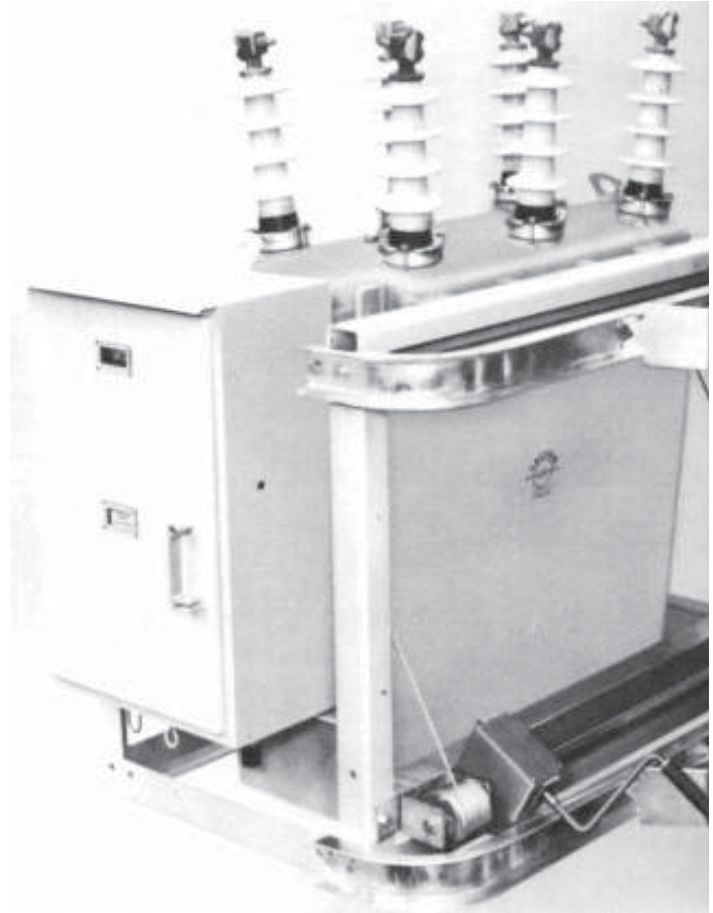


Figure 12. Type VSO recloser mounted in single-pole hanger, with windlass accessory

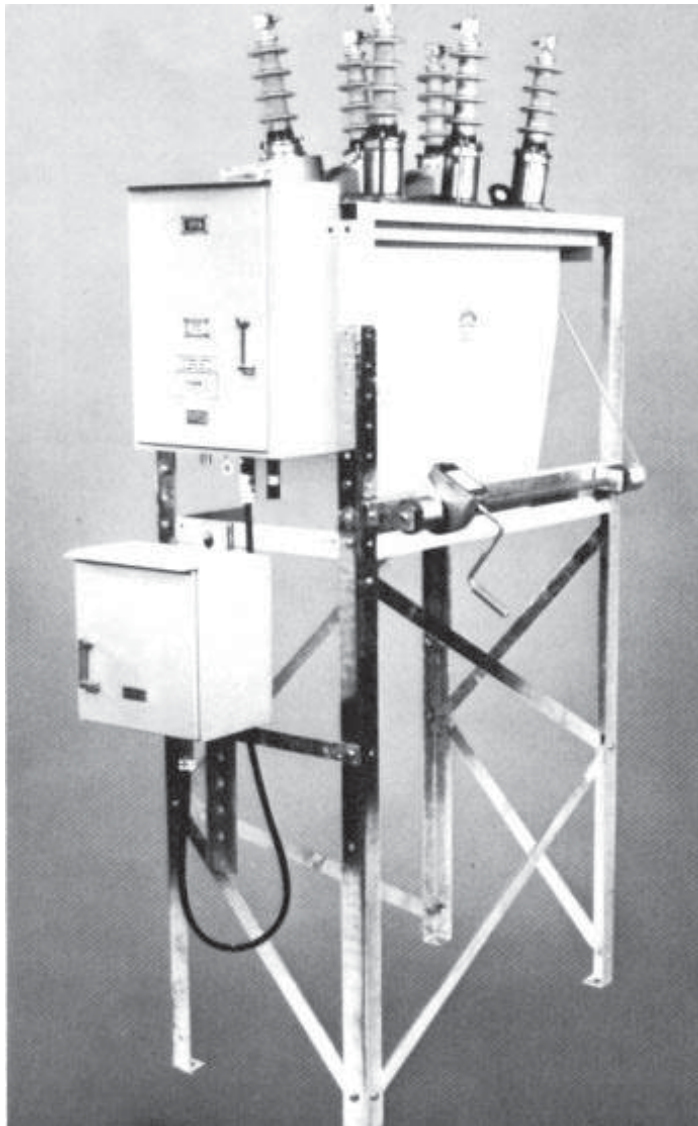


Figure 13. Type VSO recloser mounted in substation extension, with control and some accessories

#### Tank lifting windlass

One person can easily lower and raise the oil-filled tank with this accessory, which is usable with pole-mounted or substation-mounted Type VSO reclosers. The windlass, (Figure 14) features a 30-to-1 ratio worm-and-pinion gear box that minimizes cranking effort and holds the tank stationary any time 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 tank is fully raised. Supplied partly assembled to newly ordered Type VSO reclosers, the windlass accessory can also be ordered separately for addition to reclosers in the field.



Figure 14. Tank lifting windlass accessory

## Ratings and specifications

**Table 5. Voltage**

Nominal system voltage (kV rms)	34.5
Rated maximum voltage (kV rms)	38
Rated impulse withstand voltage (BIL) (kV crest)	150
60 Hz withstand voltage (kV rms)	
dry, one minute	70
wet, 10 seconds	60
Maximum Radio influence	
@ 23 kV (uV)	100

**Table 6. Continuous Current**

Maximum continuous current (amps)	560*
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\* Can be increased to 800 amps by adding an 800-amp accessory.

**Table 7. Interrupting Current**

Interrupting current (rms sym. amps)	
VSO 12	12000
VSO 16	16000

**Table 8. Duty Cycle**

Percent of interrupting rating	X/R ratio	No. of operations
15-20	4	88
45-55	8	112
90-100	15	32
		Total: 232

**Table 9. Spring-Charging Motor**

Nominal operating voltage (Vac)	240
Voltage range (Vac)	160-257
Inrush current (rms amps)	13
Steady-state current (amps)	8
Motor running time (cycles)	40

**Table 10. Auxiliary Switch Interrupting ratings (amps)**

Volts	Inductive (AC)	Noninductive (AC)	Inductive (DC)	Noninductive (DC)
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 11. Trip Solenoid**

Nominal operating voltage (Vdc)	24
Approx. peak current, 1-1/2 cycles (amps)	5.65

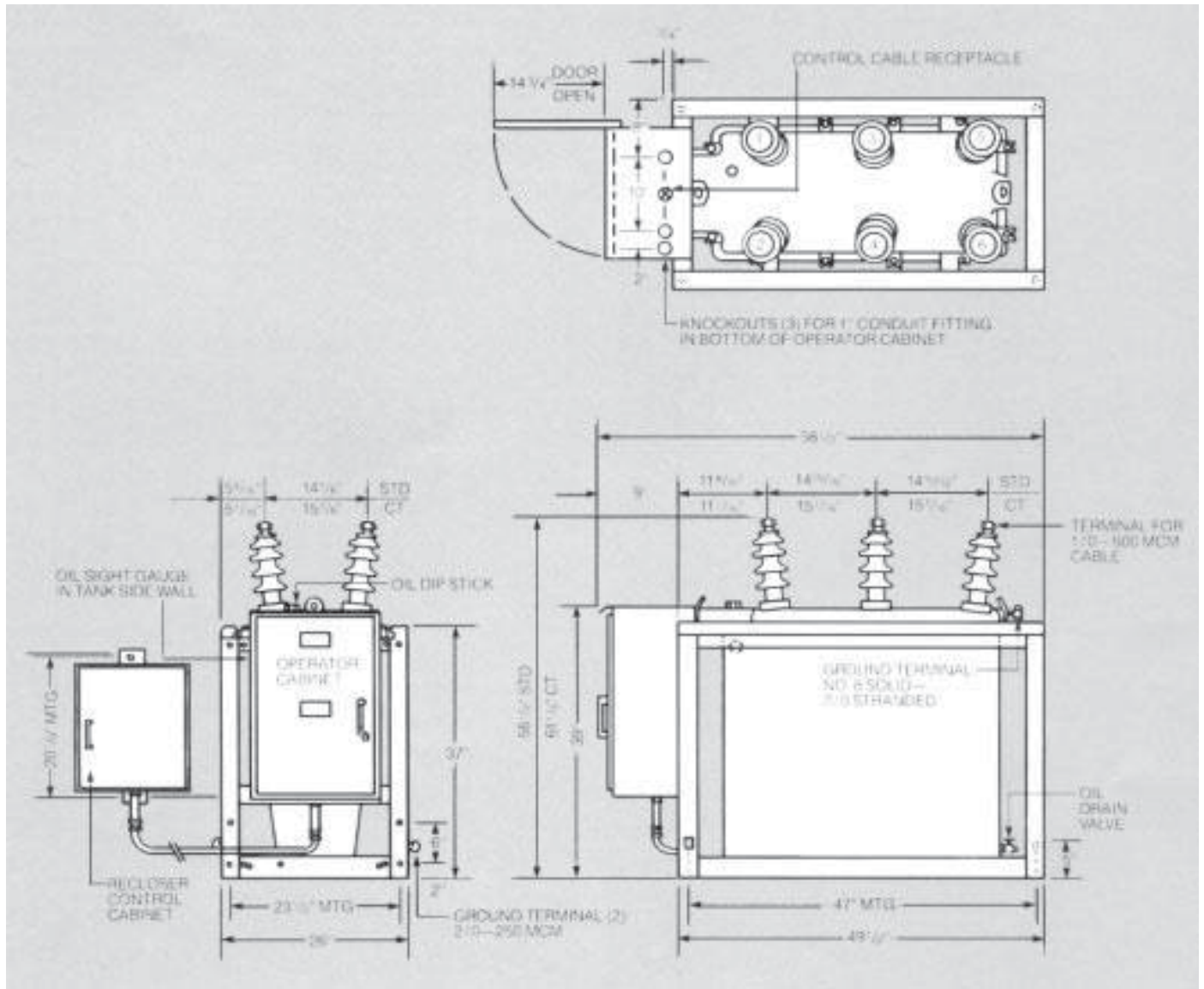
**Table 12. Specifications**

Contact closing time* (cycles)	0.75
Contact opening time** (cycles)	0.5
Bushing creepage distance (inches)	26-1/2
Mechanical life (no-load operations)	2500

\* Time from initial contact motion to contact make.

\*\* Time from contact break to end of contact motion.

**Dimensions and weights**



**Figure 15. Type VSO recloser outline dimensions**

**Table 13.**

Weight without control (lb)	1130
Weight with pole-top frame (lb)	1193
Weight with substation frame (lb)	1271
Oil capacity (gal)	65

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