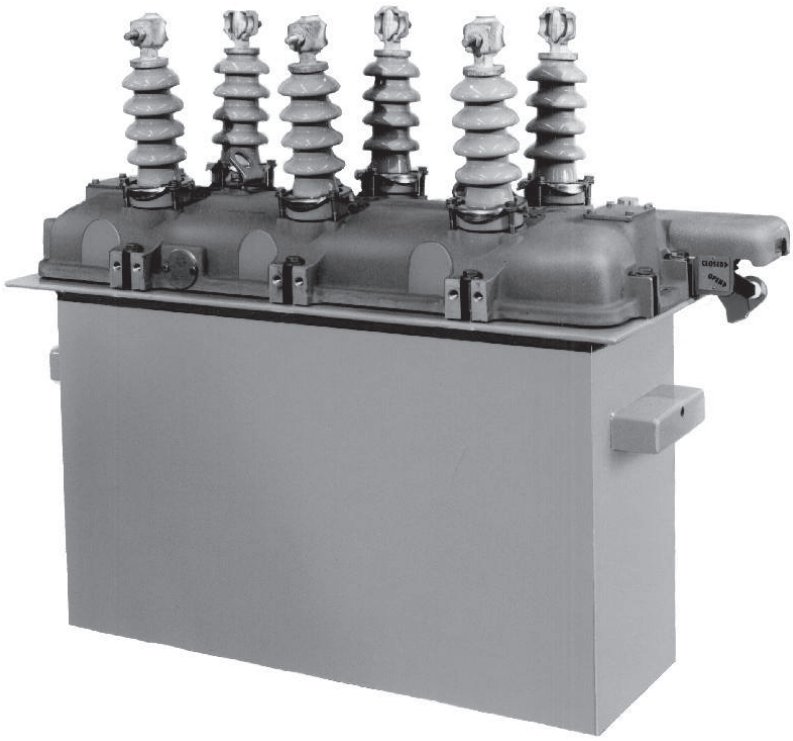
Types W, WV27, WV38X, VW, VWV27, and VWV38X Three-phase Hydraulically Controlled Recloser Installation and Operation Instructions



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. G122.2

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Product information

Introduction

Service Information MN280021EN provides installation, operation, and testing information for Eaton's Cooper Power™ series three-phase, hydraulically controlled W-group reclosers.

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 to provide directions for meeting every possible contingency during installation, operation, or maintenance. For additional information, contact your Eaton representative.

ANSI standards

Eaton's reclosers are designed and tested in accordance with the following ANSI® standards: C37.60 and C37.85 and ANSI® Guide C37.61.

Quality standards

ISO 9001 Certified Quality Management System

Acceptance and initial inspection

Each recloser is completely assembled, carefully inspected and calibrated, and filled to the correct level with insulating oil at the factory. It is in good condition when accepted by the carrier for shipment.

Upon receipt, inspect the recloser thoroughly for damage and loss of parts or oil incurred during shipment. If damage or loss is discovered, file a claim with the carrier immediately.

Check for oil leakage and tighten all bolts that may have loosened during shipment, especially the bolts attaching the head to the tank. Tank mounting bolts should be tightened to 25-40 ft.-lbs. torque.

Handling and storage

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

Description

This recloser (cover) is a self-contained device that senses and interrupts distribution system fault currents. It automatically recloses to restore service if a fault is temporary. If a fault is permanent, the recloser locks out after two, three, or four preset trip operations.

Should a fault clear before lockout, the recloser will reset for another cycle of operations.

Recloser operation

Opening sequences of the recloser can be all fast, all delayed, or any combination of fast operations followed by delayed operations up to a total of four. Fast operations clear temporary faults before branch line fuses can be weakened. Delayed openings allow time for fuses to clear so that longer outages can be confined to smaller sections of the line. Ratings and duty cycles are listed in Tables 1, 2 and 3; dimensions are shown in Figure 3; weights are listed in Table 4.

Oil and vacuum interrupters

Oil interrupters are used in Types W, WV27 and WV38X reclosers. Vacuum interrupters are used in Types VW, VWV27 and VWV38X reclosers. All are oil-insulated.

Tripping and closing

The moving contacts are driven by springs that are charged by a solenoid energized by line voltage from the source side of the recloser. Trip solenoids, in series with the main contacts, release the opening springs when current above minimum trip is sensed.

Recloser data plates

⚠ WARNING

Hazardous voltage. Closing coil voltage and current ratings must be compatible with the system application. Refer to the data plates, located on the sleethood of the recloser, for specific rating information. Failure to comply can result in death, severe personal injury, and equipment damage. G129.0

Check the recloser data plates (shown in Figure 1), which are located on the sleethood, to make sure the closing coil voltage and the series coil current ratings are compatible with the system on which the recloser is to be installed.

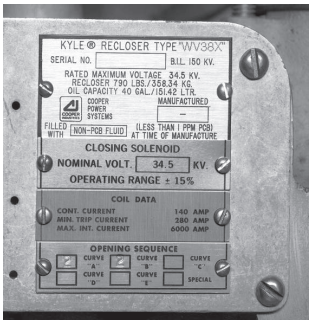


Figure 1. Recloser data plates are located on the sleethood

Manual operating levers and indicators

The manual operating levers and indicators (Figure 2) are under the sleethood.

Manual operating handle

When the recloser operates to lockout, the yellow manual operating handle drops down from under the sleethood. It must be reset manually to close the recloser. Lifting up the handle closes the closing solenoid contactor and, if the closing coil circuit is energized, the closing solenoid will immediately close the main contacts of the recloser.

The handle is trip-free. It will not impart a blow to the operator if the recloser trips while the handle is held closed. For a permanent fault, the recloser will operate through its normal sequence and lock out even though the yellow operating handle is held closed. The handle must then be moved to its extreme down position to engage the mechanism before the recloser can be closed by lifting up the handle. If the recloser is closed, it may be manually opened and locked out by pulling down the handle. It is not to be used as a substitute for a visible break during line work. The handle can be operated with a hotstick.

⚠ 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

Non-reclosing lever

The non-reclosing lever provides the capability of locking out the recloser on the first trip operation regardless of the preset number of operations to lockout. This feature is especially desirable for hotline work in the higher loaddensity areas served by these reclosers.

The recloser can be opened or closed manually regardless of the position of the non-reclosing lever. The nonreclosing lever can be operated with a hotstick.

Operations counter

The four-digit mechanical operations counter, which records all trip operations, is located under the sleethood.

Contact-position indicator

The red contact position indicator flag is coupled to the recloser mechanism to show the position of the main contacts. When the flag is down, the main contacts are open; when the flag is up, the main contacts are closed.

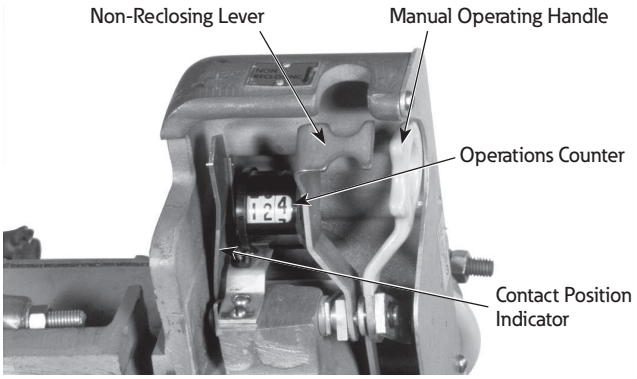


Figure 2. Manual operating levers and indicators are located under the sleethood

Ratings

⚠ WARNING

Hazardous voltage. Closing coil voltage and current ratings must be compatible with the system application. Refer to the data plates, located on the sleethood of the recloser, for specific rating information. Failure to comply can result in death, severe personal injury, and equipment damage. G129.0

Check recloser ratings prior to installation

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

Table 1. Electrical Ratings

Recloser Type	Rated System Nominal Voltage (kV)	Rated System Max Voltage (kV)	Rated Impulse With-stand Voltage (kV)	60-Hz Insulation Level Withstand		Continuous Current (amps)
				Dry 1-Min (kV)	Wet 10-Sec (kV)	
W	14.4	15.5	110	50	45	560
VW	14.4	15.5	110	50	45	560
WV27	24.9	27	150	60	50	560
VWV27	24.9	27	125	60	50	560
VWV38X	34.5	38	150	70	60	560
WV38X	34.5	38	170	70	60	560

Table 2. Interrupting Ratings

Trip Coil Rating Continuous Amps	Minimum Trip Amps	W		VW 2.4-14.4 kV	WV27 @ 24.9 kV	VWV27 @ 24.9 kV	WV38X @ 34.5 kV	VWV38X @ 34.5 kV
		@ 4.8 kV	@ 14.4 kV					
5	10	300	300	300	300	300	300	300
10	20	600	600	600	600	600	600	600
15	30	900	900	900	900	900	900	900
25	50	1500	1500	1500	1500	1500	1500	1500
35	70	2100	2100	2100	2100	2100	2100	2100
50	100	3000	3000	3000	3000	3000	3000	3000
70	140	4200	4200	4200	4200	4200	4200	4200
100	200	6000	6000	6000	6000	6000	6000	6000
140	280	8400	8400	8400	8000	8400	8000	8400
160	320	9600	9600	9600	8000	9600	8000	9600
185	370	11100	10000	11100	8000	11100	8000	11100
200	400	12000	10000	12000	8000	12000	8000	12000
225	450	12000	10000	12000	8000	12000	8000	12000
280	560	12000	10000	12000	8000	12000	8000	12000
400	800	12000	10000	12000	8000	12000	8000	12000
560	1120	12000	10000	12000	8000	12000	8000	12000
70X	100	3000	3000	3000	3000	3000	3000	3000
100X	140	4200	4200	4200	4200	4200	4200	4200
140X	200	6000	6000	6000	6000	6000	6000	6000
160X	225	6750	6750	6750	6750	6750	6750	6750
185X	260	7800	7800	7800	7800	7800	7800	7800
225X	315	9450	9450	9450	8000	9450	8000	9450
280X	400	12000	10000	12000	8000	12000	8000	12000
400X	560	12000	10000	12000	8000	12000	8000	12000
560X	750	12000	10000	12000	8000	12000	8000	12000

Note: Minimum-trip on "X" coils is approximately 140% of continuous ratings.

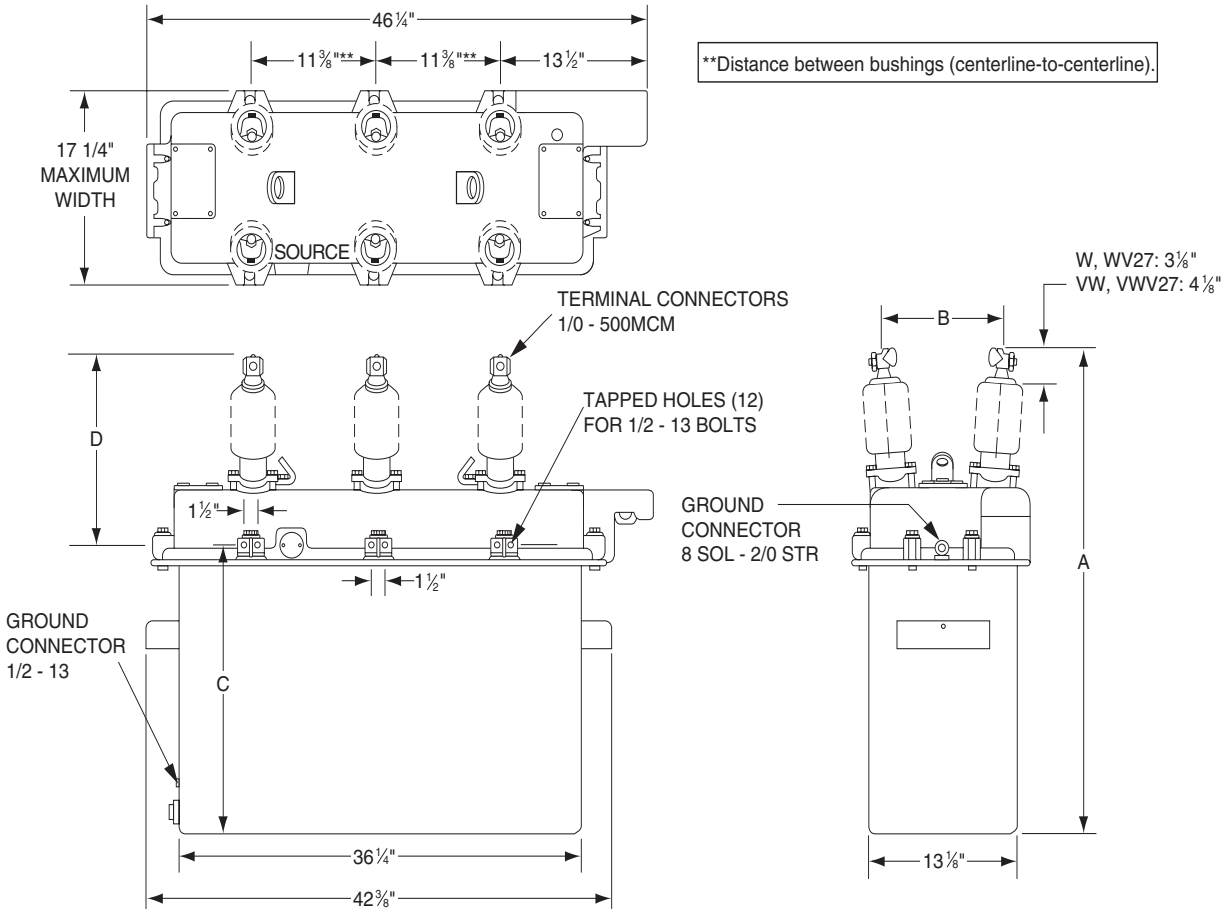
Table 3. Duty Cycle

Type	% of Interrupting Rating	No. of Unit Operations	Maximum Circuit X/R Value
W	15-20	28	3
	45-55	20	7
	90-100	10	14
		Total 58	
WV27	15-20	28	4
	45-55	20	8
	90-100	10	15
		Total 58	
WV38X	15-20	28	4
	45-55	20	8
	90-100	10	15
		Total 58	

Table 3. Duty Cycle (continued)

Type	% of Interrupting Rating	No. of Unit Operations	Maximum Circuit X/R Value
VW	15-20	88	4
	45-55	112	8
	90-100	32	15
		Total 232	
VWV27	15-20	88	4
	45-55	112	8
	90-100	32	15
		Total 232	
VWV38X	15-20	88	4
	45-55	112	8
	90-100	32	15
		Total 232	

Dimensions and weights



Dimensions, Recloser Without BCT Accessory*

Type	Bushing Type	A (in.)	B (in.)	C (in.)	D (in.)
W	13 in. standard creepage	41 5⁄8	11 1⁄8	26 5⁄8	15
VW	or 17 in. extra creepage	43 7⁄8	11 1⁄8	28 7⁄8	15
WV27	26 1⁄2 in. creepage	47 3⁄4	11 3⁄4	26 5⁄8	21 1⁄8
VWV27		50	11 3⁄4	28 7⁄8	21 1⁄8

*Dimensions configured to the nearest 1⁄8 in.

Dimensions, Recloser With BCT Accessory*

Type	Bushing Type	A (in.)	B (in.)	C (in.)	D (in.)
W	13 in. standard creepage	46 3⁄8	11 7⁄8	26 5⁄8	19 3⁄4
VW	or 17 in. extra creepage	48 5⁄8	11 7⁄8	28 7⁄8	19 3⁄4
WV27	26 1⁄2 in. creepage	52 1⁄2	12 5⁄8	26 5⁄8	25 7⁄8
VWV27		54 3⁄4	12 5⁄8	28 7⁄8	25 7⁄8

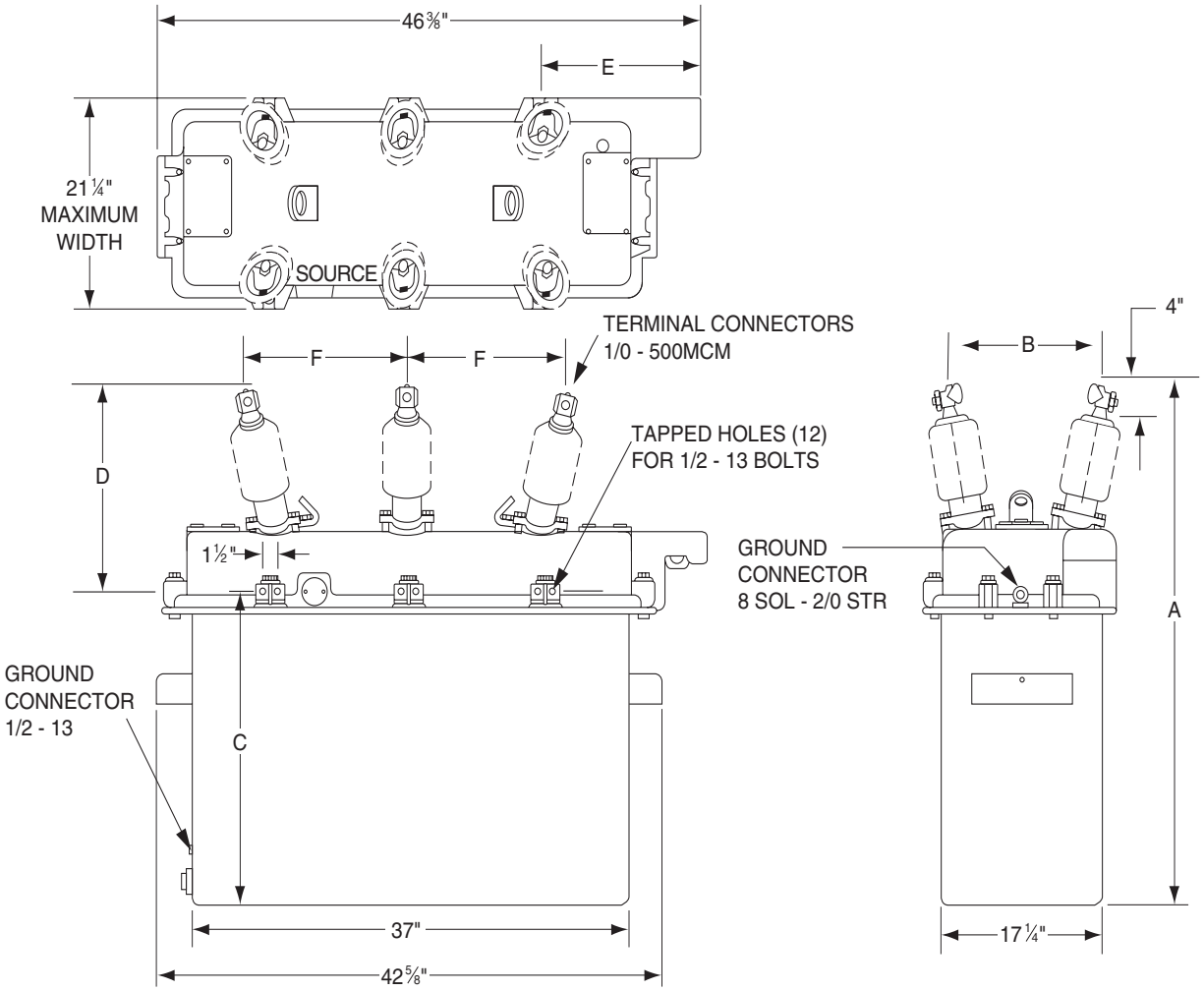
*Dimensions configured to the nearest 1⁄8 in.

Figure 3. Dimensions of Types W, VW, WV27 and VWV27 reclosers with and without the bushing current transformer accessory

Table 4. Weights and Oil Capacity

Recloser Type	Weight With Oil* (lb)	Oil Capacity (gal)
W	805	38
WV27	845	38
WV38X	995	52
VW	830	45
VWV27	870	45
VWV38X	995	61

* Add 25 lb for each bushing current transformer.



Dimensions of Recloser With and Without BCT Accessory*

Type	Bushing Type	A (in.)	B (in.)	C (in.)	D (in.)	E (in.)	F (in.)
WV38X	26 1/2 in. creepage	47-1/8	15	26-5/8	20-1/2	10	15-1/8
VWV38X	26 1/2 in. creepage	49-3/8	15	28-7/8	20-1/2	10	15-1/8
WV38X	26 1/2 in. w/ BCT	51-3/4	15-7/8	26-5/8	25-1/8	9-1/2	15-5/8
VWV38X	26 1/2 in. w/ BCT	54	15-7/8	28-7/8	25-1/8	9-1/2	15-5/8

* Dimensions configured to the nearest 1/8 in.

Figure 4. Dimensions of Types WV38X and VWV38X reclosers with and without the bushing current transformer accessory

Installation procedure

1. Check the oil level before putting the recloser into service. Using the dipstick provided on the recloser head, make sure the oil in the recloser tank is at the proper level (Figure 5). If the oil is below the minimum level, fill the recloser with oil to the proper level using the dipstick hole. Do not exceed the maximum oil level, as indicated by the dipstick.

Note: If the recloser is equipped with an oil-sight gauge, 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.

⚠ 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

⚠ 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

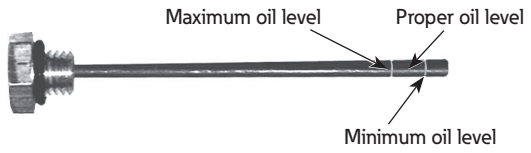


Figure 5. Oil dipstick.

2. Test the oil dielectric strength. If the recloser has been stored for some time or is being relocated, perform a dielectric test on the oil in accordance with ASTM-approved testing procedures.

   A. On new equipment, the oil must have a minimum dielectric strength of 26 kV.

   B. If the dielectric strength of the oil is less than 26 kV, filter the oil to restore its dielectric strength to the acceptable minimum level.

⚠ WARNING

Hazardous voltage. Closing coil voltage and current ratings must be compatible with the system application. Refer to the data plates, located on the sleethood of the recloser, for specific rating information. Failure to comply can result in death, severe personal injury, and equipment damage. G129.0

3. Check the data plate ratings. Make sure the ratings and settings on the recloser data plates are correct for the planned installation.

⚠ 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

4. Mount the recloser.

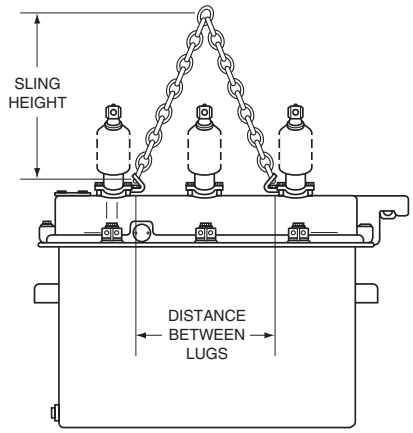
Note: Eaton's mounting frames should always be used, refer to the instructions accompanying the mounting frames.

Lifting a recloser

Follow all approved safety practices when making hitches and lifting the equipment. Lift the unit smoothly and do not allow the unit to shift.

This recloser has two lifting lugs - both must be used when lifting. Maximum strength is attained with a vertical lift attached to the lugs. Use a spreader bar with a fixed attachment point for the hook at the load center.

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 lifting lugs.



⚠ WARNING

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

5. Ground the recloser. Make ground connections to the recloser head (Figure 6).

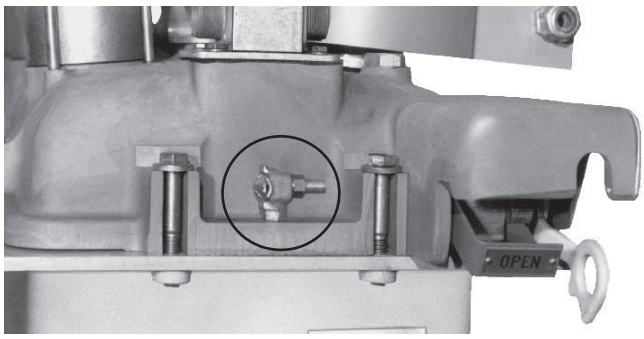


Figure 6. Ground connector on recloser head

6. Make the high-voltage line connections. (Figure 7).

Note: The six disconnect switches and the three bypass switches shown in Figure 7 are not required, but they do facilitate maintenance.

A. Connect high-voltage lines to the recloser bushing terminals with source leads connected to bushings 1, 3, and 5 to provide voltage to the closing solenoid. The bushings connecting the closing solenoid are identified on the head. The universal clamp-type terminals for main- line connections accept 1/0- through 500 MCM cable.

B. The following surge arrester protection is recommended:

- **Substation-mounted reclosers**

  Connect the surge arresters on the load side.

- **Line-mounted reclosers**

  Connect the surge arresters on both the source and the load side. If only one set of surge arresters is used, connect the set on the source side of the recloser.

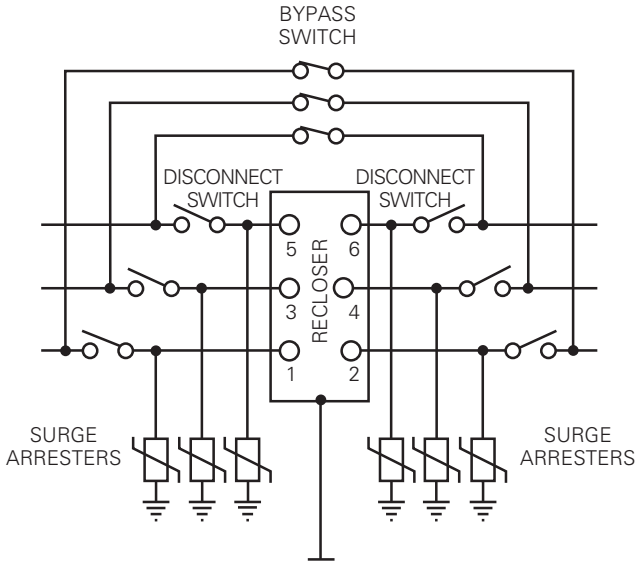


Figure 7. Connection diagram shows complete surge protection and illustrates switches to facilitate maintenance

Operation

Initial 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

1. After all connections have been completed, close the source-side disconnect switches.
2. With a hotstick, move the yellow manual operating handle (under the sleethood) to the CLOSED (up) position. The recloser should close immediately.
3. Close the load-side disconnect switches and open the bypass switches.
4. The recloser is now in service.

Routine operation

After the recloser has been closed and is in service, it operates automatically as overcurrent conditions demand. However, once locked out, the recloser must be manually closed by returning the yellow operating handle to the CLOSED (up) position.

⚠ WARNING

Hazardous voltage. This device is not a substitute for a visible disconnect. Follow all locally approved safety practices. Failure to follow proper safety practices can result in contact with high voltage, which will cause death or severe personal injury. G112.1

When the recloser operates to lockout, the hydraulic mechanism resets and the unit is ready for another full operating sequence as soon as the yellow operating handle is returned to the CLOSED position.

If the operating sequence does not reach lockout (temporary fault cleared), the resetting time is approximately 1-1⁄2 minutes per operation at an oil temperature of 77°F (25°C). Another fault occurring prior to complete reset may result in fewer operations to lockout for the second fault.

⚠ 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

Adjustments

The operating sequence and time-current characteristics of each recloser are set and calibrated at the factory and shown on the data plate attached to the sleethood. However, either/or both can be changed in a suitably equipped repair shop.

The recloser must be removed from service and untanked to gain access to the adjustment mechanism.

Untanking the recloser

When untanking recloser, use care to keep from catching the corona shields on the inside lip of tank. This is particularly likely on units that are heavily unbalanced, such as those equipped with accessory BCTs on one side.

Number of operations to lockout

The recloser can be set for two, three, or four operations to lockout by indexing the lockout bar (Figure 8) to the proper notch. The outer notches (2 and 4) correspond to two and four operations to lockout; the middle notch corresponds to three operations to lockout.

To change the operations-to-lockout setting:

1. Grasp the lockout piston linkage (Figure 8) in one hand and, with the other hand, pull the lockout bar forward to release the engagement.
2. Move the lockout bar to the notch corresponding to the desired number of operations to lockout.
3. Release the bar to lock the setting.

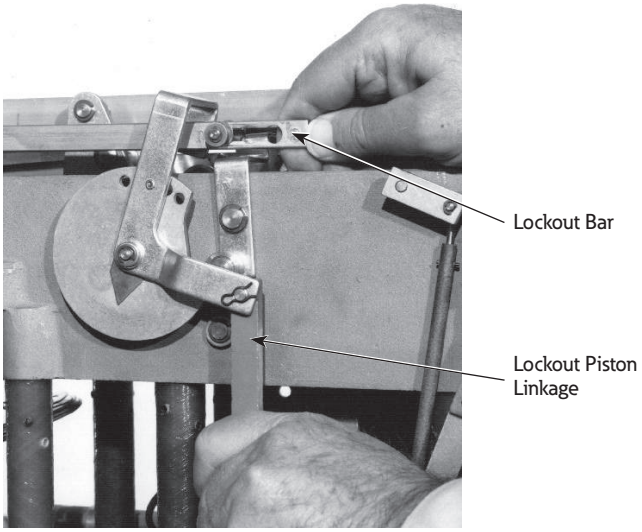


Figure 8. Setting the number of operations to lockout

Number of fast operations

The number of fast operations (0, 1, 2, 3, or 4) is set on the indexing plate (Figure 9).

To change the number-of-fast-operations setting:

1. Lift the spring clip to disengage the indexing pin.
2. Rotate the indexing plate until the desired number of fast operations appears in the window of the spring clip.
3. Be sure the indexing pin seats properly in the plate notch when the spring clip is released.

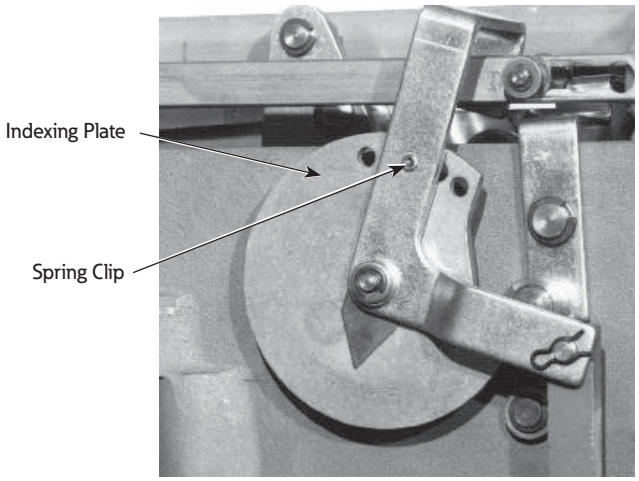


Figure 9. Setting the number of fast operations

Time-delay characteristics

Each recloser is equipped with time-delay units that can provide four different time-current characteristics (B, C, D, and E). Any one unit can provide either of two characteristics, but not all four. Thus, one unit provides the B and C curves; another unit, the D and E curves.

To change the time-delay characteristics:

1. Loosen the thumbscrew (Figure 10).
2. Index the adjustment bracket to the other curve.
3. Tighten the thumbscrew.

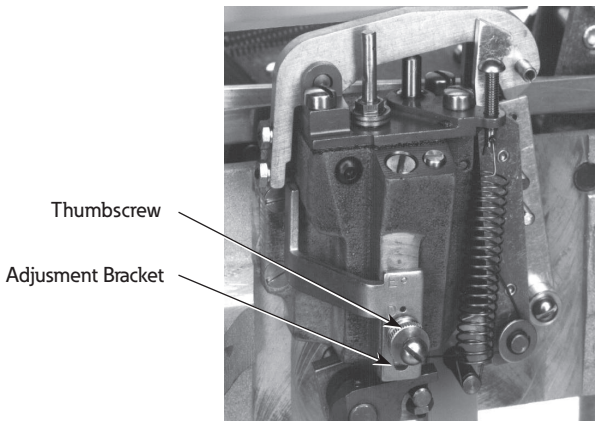


Figure 10. Setting the time-delay characteristics

Testing

All reclosers are carefully tested and adjusted at the factory to operate according to the published data. Well equipped test facilities, a detailed testing procedure, and thoroughly trained personnel assure accurately calibrated equipment. Thus, each recloser leaves the factory ready for installation.

Pre-installation testing is not necessary. However, should verification of recloser operation prior to installation be desired, the procedures are included for checking the following recloser characteristics.

Procedures for checking recloser characteristics:

1. Minimum-trip current.
2. Operation of closing solenoid.
3. Operating sequence.
4. Operation of non-reclosing feature.

Test results should concur with the information shown on the data and nameplates attached to the sleethood. To check minimum-trip current, the recloser can be closed manually and tripped electrically with a low-voltage ac source. To check automatic reclosing, a high-voltage ac source is needed to operate the closing solenoid.

Safety requirements

⚠ 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

To prevent accidental contact with high-voltage parts, the recloser and high-voltage transformer must be placed in a test cage and all proper grounding procedures must be observed.

If the recloser is equipped with a ground-fault-trip accessory, operate the external ground-trip blocking switch (if provided) to disable the ground-fault-trip function during phase-trip testing. Refer to the Accessories section for ground-trip test procedures.

If a ground-trip blocking switch is not provided with the hydraulic ground-fault trip unit, refer to the Accessories section wiring diagram (Figure 33) and jumper Terminals 3 and 4 in the junction box to disable the accessory.

If a ground-trip blocking switch is not provided with electronic ground-fault trip unit, refer to the Accessories section wiring diagram in Figure 21 and jumper Terminals 2 and 3 of the 12-point accessory terminal block to disable the accessory.

Test equipment required

The following equipment (see Figure 12) is required for the recommended test setup:

1. Variable autotransformer (T1) — 230 volts, 20 amps.
2. High-voltage transformer — To operate the closing solenoid (T3).

   A. Low-side rating should equal the voltage rating of the available power source.

   B. High-side rating should equal the voltage rating of the recloser.

   Note: Make sure that the solenoid coil operating voltage as shown on the nameplate is maintained at the recloser terminals during the two-to-three cycle interval the closing coil is energized. In general, a 75 kVA transformer of the proper voltage rating with an impedance drop of about 3% is satisfactory provided the source impedance is reasonably low.
3. Low-voltage transformer — To operate the trip solenoid (T2).

   A. Ratio and kVA size depend on the size of the recloser trip coil and the maximum test current used.

   B. Table 5 shows the test voltage and kVA requirements for all recloser ratings.
4. Ammeter — Full-scale deflection should be at least 300% of the recloser rating. A current transformer will probably be required.

Table 5. Test Circuit Voltage and kVA Requirements

Coil Size (Amps)	Test Current (2 x Minimum Trip) (Amps)	Test Voltage (Volts)	Short-Time Test (kVA)
25	100	43.0	4.3
35	140	26.0	3.7
50	200	17.5	3.5
70	280	13.5	3.8
100	400	9.0	3.6
140	560	6.2	3.5
160	640	6.0	3.9
185	740	5.5	4.1
225	900	5.1	4.6
280	1120	4.5	5.1
400X	1120	4.0	4.5
400	1600	4.4	7.0
560X	1500	3.3	5.0
560	2240	3.4	7.6

Test procedures

Manual closing operation

The manual closing tool is used to close a de-energized recloser. It is never to be used to close an energized recloser.

⚠ WARNING

Explosion hazard. Excessive Contact Arcing. Do not use the manual closing tool to close an oil-insulated energized recloser. Closing an energized oil-insulated recloser with a manual closing tool can cause excessive contact arcing, rapid build-up of gas within the equipment, and possible explosion that can cause death, severe personal injury, and equipment damage. T203.2

When manual closing of the recloser is called for in these test procedures, use the following procedure:

1. Remove the closing tool port cover and gasket from the side of the recloser head casting.
2. Place the yellow operating handle (under the sleethood) into the CLOSED (up) position.

CAUTION

Equipment damage. Do not turn the manual closing tool more than one-quarter turn clockwise. Forcing the tool beyond the mechanism stop may shear the pin on the closing shaft of the recloser. T222.0

3. Insert the KA90R T-handled closing tool (available as an accessory) into the port, engaging the pin on the closing shaft (Figure 11). Turn the closing tool one quarter turn clockwise to close the recloser.
4. After each trip operation, about two seconds (normal reclosing time) elapse while the closing solenoid plunger is moving upward to reset the main toggle latch.
5. After the main toggle latch resets, the recloser can be closed again by operating the manual reclosing tool.
6. If manual closing is used during the operating sequence verification test, close and trip the recloser without appreciable delay between operations. Otherwise, extra operations to lockout may occur due to the resetting of the trip piston between operations.
7. Replace the gasket and port cover on the recloser head after testing has been completed.

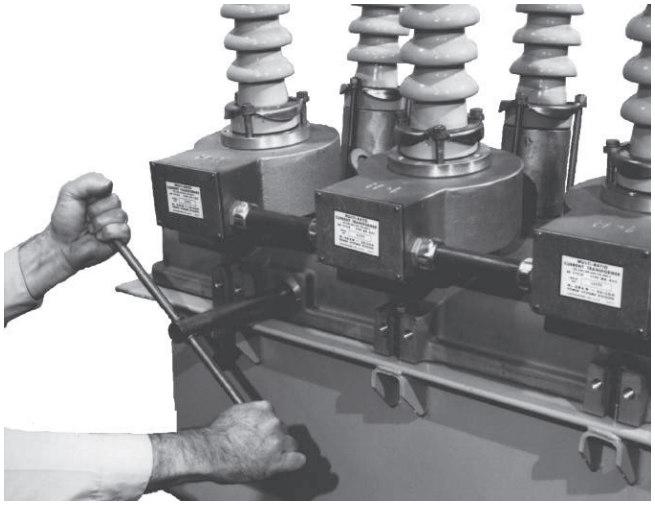


Figure 11. Using a KA90R manual reclosing tool to operate the recloser

Phase minimum-trip current test

The minimum-trip current of each phase can be checked by closing the recloser manually with the closing tool and tripping electrically with the low-voltage ac source. Assemble and connect the low-voltage test circuit portion of the test set-up shown in Figure 12 and proceed as follows:

1. **Phase A**

   A. Connect low-voltage test leads X and W to bushing terminals 1 and 2, respectively.

   B. With the yellow operating handle up in the CLOSED position, manually close the recloser with the closing tool.

   C. Slowly increase the variable autotransformer voltage from zero and note the ammeter reading when the recloser trips.

   D. As the trip solenoid plunger starts to move, the trip coil impedance will rise and cause a decrease in current. The maximum reading before the current decreases, is the minimum-trip current.

2. **Phase B**

   A. Connect low-voltage test leads X and W bushing terminals 3 and 4, respectively.

   B. Repeat steps 1B through 1D.

3. **Phase C**

   A. Connect low-voltage test leads X and W to bushing terminals 5 and 6, respectively.

   B. Repeat steps 1B through 1D.

Operation of the closing solenoid

The operation of the closing solenoid can be verified by tripping the recloser manually and closing electrically with the high- voltage ac source.

1. Assemble and connect the high-voltage test circuit portion of the test setup (Figure 12).

   Note: Coil connections are indicated on the head of the recloser.

2. With high-voltage leads Y and Z connected to the solenoid coil as shown in Figure 13, trip open the recloser manually by pulling down the yellow operating handle (under the sleethood). Then move the handle up to the CLOSED position.

3. Energize high-voltage transformer T3. The recloser should close immediately, indicating correct closing solenoid operation.

Operating sequence

The operating sequence can be verified by tripping the recloser electrically with the low-voltage ac source and closing the recloser electrically with the high-voltage AC source:

1. Assemble and connect the test circuit (Figure 12).

2. Set the current output of T2 high enough to readily operate the recloser (at least twice the minimum trip is suggested).

3. With the recloser operating handle up in the CLOSED position, energize high-voltage transformer T3 to close the recloser.

4. Check the number of fast operations and the number of operations to lockout by observing the operation of the red contact position indicator under the sleethood.

   Note: The recloser may be closed manually during the operating sequence to eliminate the high-voltage transformer T3. Refer to the Manual Closing Operation section, particularly Step 6.

Operation of non-reclosing feature

The operation of the non-reclosing feature can be verified immediately after operating sequence testing has been completed with the same test setup. Proceed as follows:

⚠ WARNING

Hazardous voltage. Solidly ground leads X and Z and interconnect them to the recloser tank. Do not connect leads W and Y to the same phase. Dangerous voltage to ground exists on the phase connected to lead Y. Failure to comply can result in contact with high voltage, which can cause death, severe personal injury, and equipment damage. T230.2

1. Pull down the non-reclosing lever located under the sleethood.

2. Place the yellow operating handle in the CLOSED (up) position and energize high-voltage transformer T3 to close the recloser. The recloser should lockout after the first trip operation.

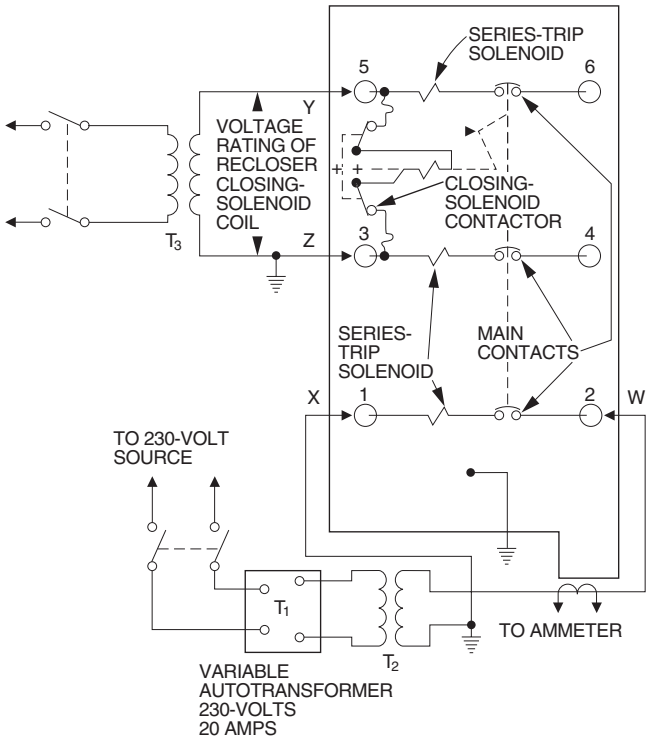


Figure 12. Suggested test circuit for reclosers with phase-to-phase closing solenoid

Testing vacuum interrupters

⚠ 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 following procedure can be used for routine verification tests of vacuum interrupters in new reclosers:

1. Pull down the yellow operating handle to make sure the recloser is open.

2. Perform a hi-pot test across each open phase at the voltages specified in *Service Information MN280062EN, Vacuum Interrupters Withstand Test Voltage Ratings Information*. The interrupters should withstand the specified test voltage for one minute and should not load down the test source.

High potential insulation level withstand tests

High potential withstand tests provide information on the dielectric condition of the recloser. Testing is performed at 75% of the rated low-frequency withstand voltage. Refer to Table 6 for test voltages and to the connection diagrams shown in Figure 13.

CAUTION

Equipment damage. Never operate a vacuum recloser with a DC test source. The vacuum interrupters will be severely damaged if a DC arc interruption is attempted.

T229.1

Table 6. Test Voltages For High Potential Testing

	75% of Rated Low Frequency Withstand Voltage (kV rms)	
Recloser Type	**AC**	**DC**
W	37.5	53.0
VW	37.5	53.0
VWV27	45.0	63.5
VWV38X	52.5	74.2
WV27	45.0	63.5
WV38X	52.5	74.2

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

Test 1: phase to ground

1. Manually close main contacts of recloser.
2. Ground recloser tank and head.
3. Connect all three source-side bushings (1, 3, 5) together.
4. Apply proper test voltage to source-side bushings.
5. The recloser should withstand the test voltage for 60 seconds.

Test 2: phase to phase

1. Manually close main contacts of the recloser.
2. Ground recloser tank and head.
3. Ground Phase A (bushing 1) and Phase C (bushing 5).
4. Apply proper test voltage to Phase B (bushing 4).
5. The recloser should withstand the test voltage for 60 seconds.

Test 3: open contact

1. Open main contacts of recloser.
2. Ground recloser tank and head.
3. Connect and ground all three load-side bushings (2, 4, 6).
4. Connect all three source-side bushings (1, 3, 5).
5. Apply proper test voltage to source-side bushings.
6. The recloser should withstand the test voltage for 60 seconds.
7. Reverse the connections: ground source-side bushings (1, 3, 5); apply test voltage to load-side bushings (2, 4, 6) for 60 seconds.
8. The recloser should withstand the test voltage for 60 seconds.

Test results

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

1. If the recloser passes the closed-contacts tests (Tests 1 and 2) but fails the open-contacts test (Test 3) a deterioration of one or more of the interrupters is likely to be the cause. Check each interrupter individually to determine the failed phase or phases, and replace the interrupter(s). Retest to confirm the repair.
2. If the recloser fails the closed-contacts tests (Test 1 and 2) the cause is likely to be a diminished electrical clearances, low oil dielectric strength or failed insulation. After correcting the problem, retest to confirm the repair.

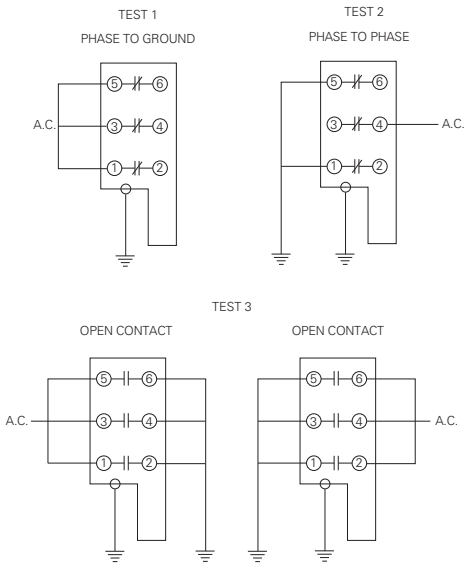


Figure 13. Connection diagrams for high potential testing

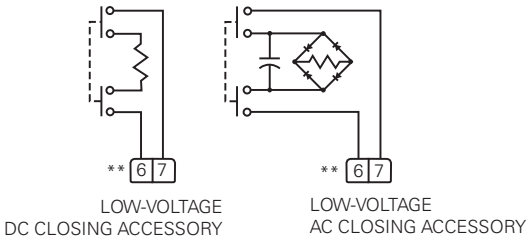
Accessories

A number of accessories are available that can adapt Wgroup reclosers to a wide variety of special applications. Some of the accessories modify the original operating function of the recloser; others increase the recloser's operating versatility (Figure 14).

Bushing-type multi-ratio current transformers

Either 600:5 or 1200:5 multi-ratio current transformers for operating relays, load meters, or the hydraulic ground-trip accessory can be installed on the source-side bushings (Figure 16) and/or the load-side bushings.

These transformers have only one primary turn — the bushing rod. Taps on the secondary winding provide the different ratios. The available ratios and their corresponding terminal connections and accuracies are shown in Table 7. The terminal arrangement for the tapped secondary, Figure 16, is accessible when the cover plate on the transformer housing is removed. The connection diagram for BCT application is shown in Figure 14.



**JUNCTION BOX TERMINALS 6 and 7 - Refer to Figure 34.

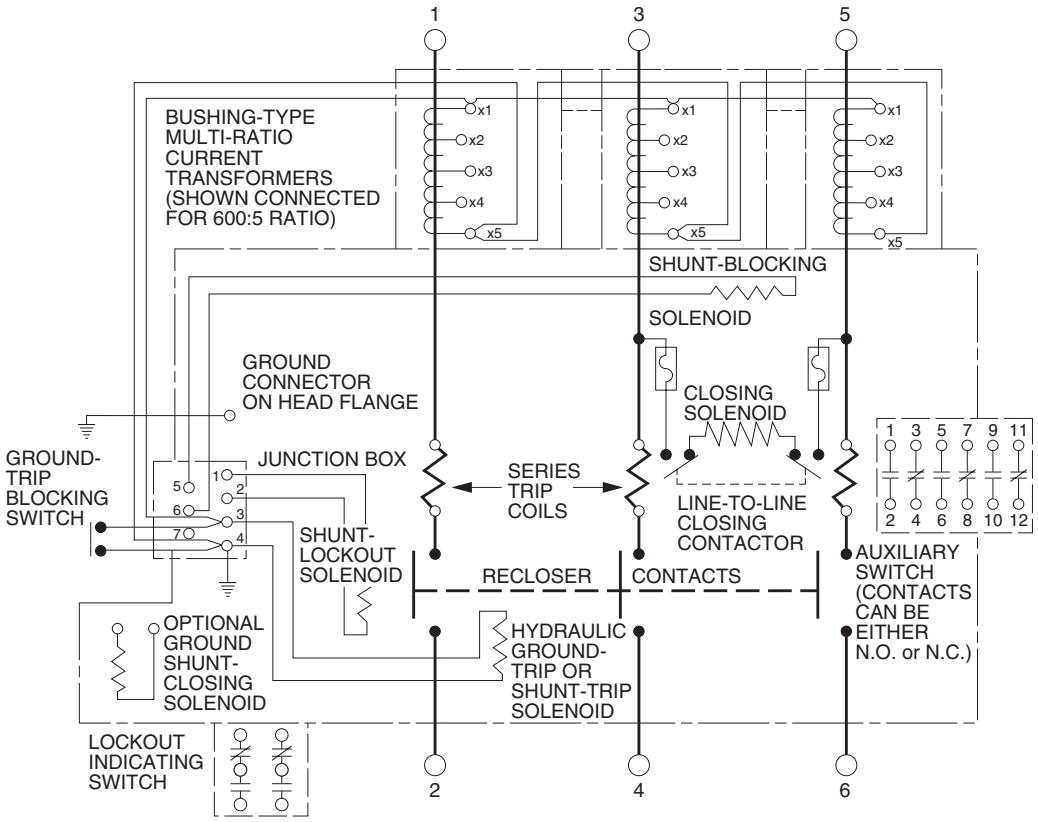


Figure 14. Connection diagram for accessories available for W-group hydraulically controlled reclosers

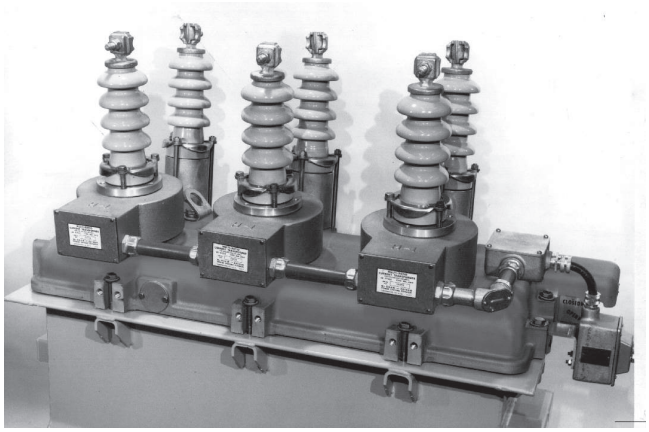


Figure 15. Multi-ratio current transformers mounted on sourceside bushings

⚠ 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

CAUTION

Equipment damage. Do not use metallic (electrically conductive) conduit when connecting the current transformers that are enclosed in metal housings. Metallic conduit will form a shorted turn, linking the CT core, which will increase exciting current and adversely affect accuracy and it can also damage the transformer winding. T227.1

Table 7. Bushing-Current Transformer Accuracy

Ratio	Terminal Connection	Relay Accuracy Class	Metering Accuracy Class		
600:5 Multi-Ratio BCTs					
600:5	X1-X5	C-100	.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	–	–	–	–
1200:5 Multi-Ratio BCTs					
1200:5	X1-X5	C-200	.3B-2.0	–	–
1000:5	X2-X5	–	.3B-2.0	–	–
900:5	X3-X5	–	.3B-1.0	.6B-2.0	–
800:5	X1-X4	–	.3B-1.0	.6B-2.0	–
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-0.2

Hydraulic ground trip

An oil dashpot-type solenoid, connected to paralleled bushing-current-transformer secondaries (to sense zero-sequence current) trips the recloser if the rated minimum zero-sequence (ground) current is exceeded. This accessory enables the recloser to protect against ground-fault currents lower than the recloser's minimum phase-trip setting. For ground-fault currents greater than the minimum phase-trip setting, recloser opening is governed by either the phase-trip series solenoids or the ground-trip solenoid, whichever is faster.

The solenoid coil (either series-or parallel-connected) is operated from the bushing-type, multi-ratio current transformers to produce the minimum ground-trip currents shown in Table 8.

Ground minimum-trip setting

The minimum-ground-trip current depends on the current transformer ratio and the solenoid coil connection (Table 8). To change the transformer ratio, remove the cover plates on the three bushing transformer housings to gain access to the secondary winding terminals (Figure 16). Series- and parallel-connected solenoid coils are shown in Figure 17.

1. For a series connection, both copper straps are connected across lower terminals 2 and 3. The current transformers are connected to upper terminals 1 and 4.
2. For a parallel connection, the copper straps are connected across left-side terminals 1 and 2 and right-side terminals 3 and 4. The current transformers are connected to upper terminals 1 and 4.

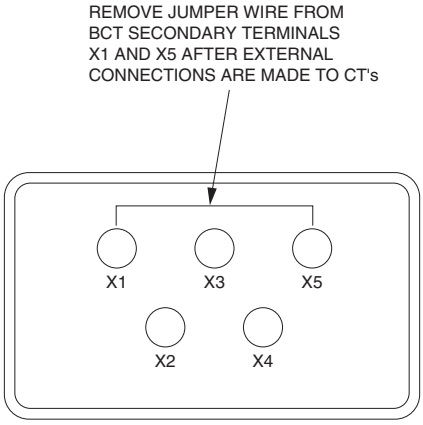


Figure 16. Secondary winding terminals

Number of operations to lockout

The total number of operations to lockout on ground trip is determined by the phase-trip operations to lockout setting of the lockout bar. Refer to the **Number Of Operations To Lockout** section on page 9.

Number of fast operations

The number of fast operations on ground-trip is independent of the phase-trip fast operations settings.

To change the number of fast operations:

1. Pull and turn the indexing plate (Figure 18) until the desired number (0F, 1F, 2F, 3F, or 4F) appears in the plate window.
2. Release the indexing plate.
3. Make sure the pin is seated in the proper index hole.

Note: To prevent ground trip from overriding phase trip at fault levels above minimum phase trip, the number of fast ground-trip operations must be equal to-or less than-the number of fast-phase trip operations. For example, if ground trip is set for two fast operations and phase trip for one fast operation, the recloser would time single-phase faults on the faster phase trip curve for the first operation, on the fast groundtrip curve for the second operation, and on the delayed phase-trip curve for subsequent operations.

Table 8. Ground-Trip Solenoid Operating Solenoid Operating Data

	Minimum Zero-Sequence Trip Current (primary amps)	
Bushing Current Transformer Ratio	**Series-Connected Coil**	**Parallel-Connected Coil**
50:5	N/A*	N/A*
100:5	63.5	110
150:5	87	156
200:5	110	204
250:5	133	250
300:5	156	300
400:5	204	400
450:5	227	450
500:5	250	500
600:5	300	600

* Not applicable; BCT output too low to operate solenoid.

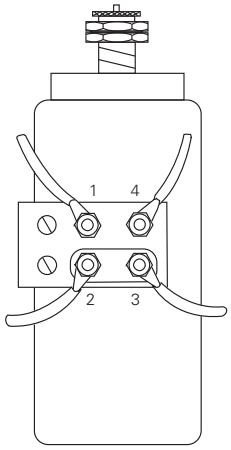


Figure 17. Connections for ground-trip solenoid

Inverse or definite time delay

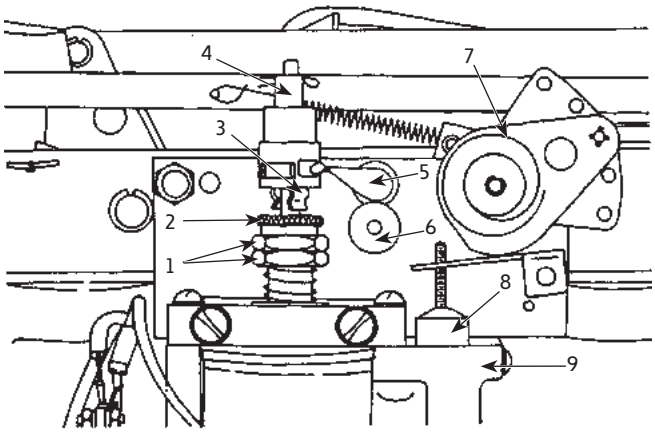
The ground-trip mechanism can be set to operate along inverse (Figure 19) or definite (Figure 20) time-delay curves.

To select inverse time-delay tripping:

1. Push knurled nut A (Figure 18) down to release it from the spring clips.
2. Holding the lower palnut with a wrench, turn knurled nut A clockwise until it is tight against the upper palnut.

To select definite time-delay tripping:

1. Holding the upper palnut with a wrench, turn knurled nut A counterclockwise until it is free of threads.
2. Push knurled nut A up to engage it with the spring clips.



1. Palnuts
2. Knurled nut A
3. Spring clip
4. Brass cap
5. Trip lever
6. Knurled nut B
7. Indexing plate
8. Valve rod guide
9. Fluid level about 3/4 in below top of casting with rod guide removed

Figure 18. Ground trip solenoid adjustments

Time delay curves

Two inverse time-delay curves (2 and 3) and three definite time-delay curves (7, 8, and 9) are available (Figures 19 and 20).

Note: The fast trip component of an inverse time curve is prefixed by the numeral 1; the fast trip component of a definite time curve is prefixed by the numeral 5. Thus, if Curve 3 is selected, fast ground-trip operations will follow Curve 1-3; if Curve 8 is selected, fast ground-trip operations will follow Curve 5-8.

To change from one time-delay curve to another:

1. Loosen knurled nut B (Figure 18) to release the trip lever from the grooves in the brass cap.

IMPORTANT

Changing from inverse to definite timedelay tripping - or vice-versa - or from one delay curve to another, may result in the ground-trip solenoid operating outside published limits. When these changes are made, it is recommended that the solenoid be returned to the factory for recalibration.

2. Turn the brass cap to align the correct groove with the trip lever.

Note: The numbers stamped above each groove correspond to the time-delay curve numbers shown in Figures 19 and 20.

3. Tighten knurled nut B.

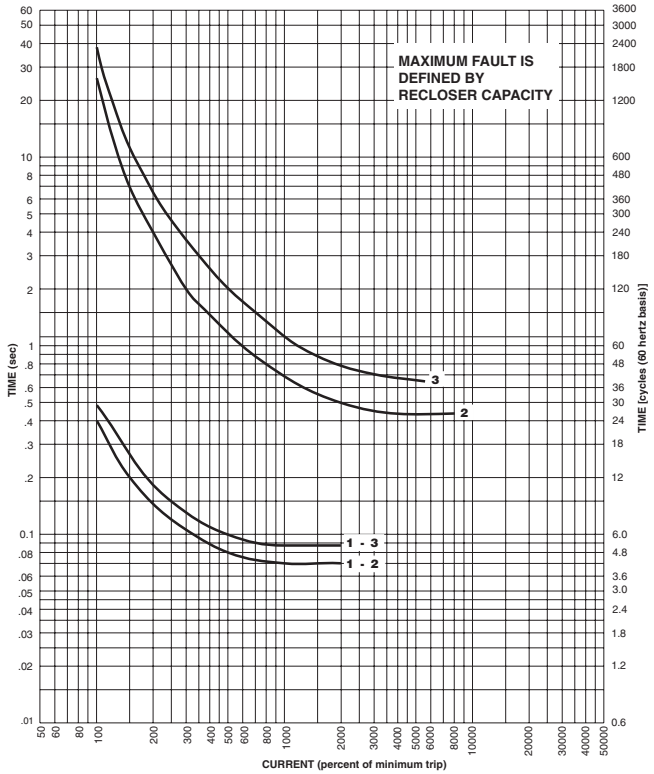


Figure 19. Typical example of time-current characteristics - inverse-time ground tripping (To determine operating data, refer to time-current curves in *Reference Data R280-91-7*)

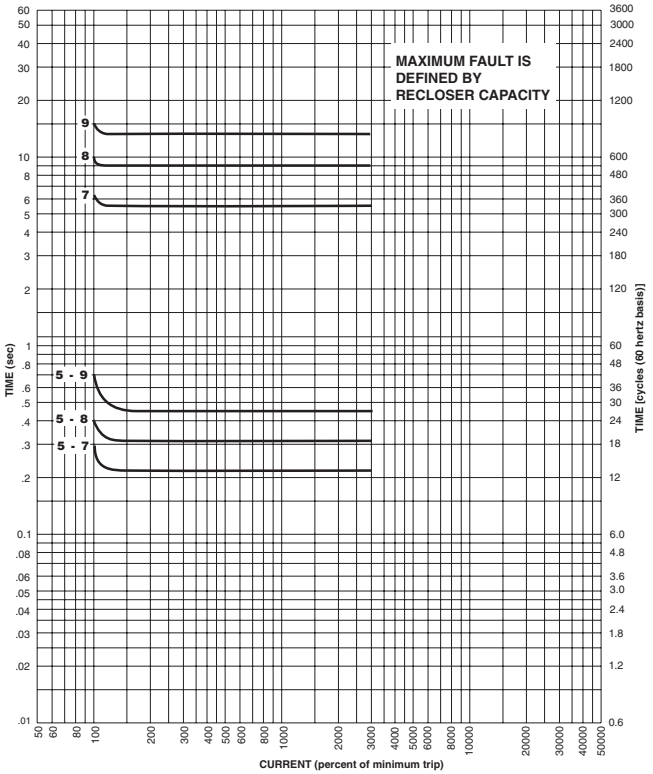


Figure 20. Typical example of time-current characteristics - definite-time ground tripping (To determine operating data, refer to time-current curves in *Reference Data R280-91-7*)

Electronic ground trip

The recloser is equipped with this accessory if a data plate reading: Inverse/Constant Time Electronic Ground Trip has been affixed to the side of the recloser's sleethood. This accessory provides self-contained, independent, ground-fault tripping when zero-sequence current exceeds the programmed ground minimum-trip current level.

Fault timing of trip operation is according to preselected time-current characteristics. These characteristics and timing operations are independent and separate from the recloser's phase fault timing and TCCs. Both inverse-time and constant-time characteristics are available. The accessory includes provision for dual timing of trip operations, enabling coordination with other protective apparatus on the system.

Accessory components include: An electronic control circuit board; a magnetically operated tripper; a dual-timing switch with indexing plates for setting the operations sequence (Figure 23); and a charging device that arms the control circuits during each electrical closing operation. A wiring connection diagram of the accessory is shown in Figure 21.

Control circuits are powered from the line through two circuit transformers mounted underneath the head casting on source-side bushings. Five amperes of line current is required to maintain circuit charge and arm the control for trip operation.

Zero-sequence (ground) current is sensed by three parallel-connected current-sensing transformers mounted underneath the head casting on the load-side bushings. When the ground current exceeds the selected minimumtrip level, the control circuits actuate the magnetic tripper to trip the recloser. Ground overcurrent timing is according to the time-current characteristics programmed on the accessory.

When the recloser automatically closes, or is otherwise closed by electrical operation of its closing solenoid, an initial arming feature instantly charges the accessory control circuits. This enables the ground trip accessory to respond immediately, according to its time-current characteristic, should a ground fault be present.

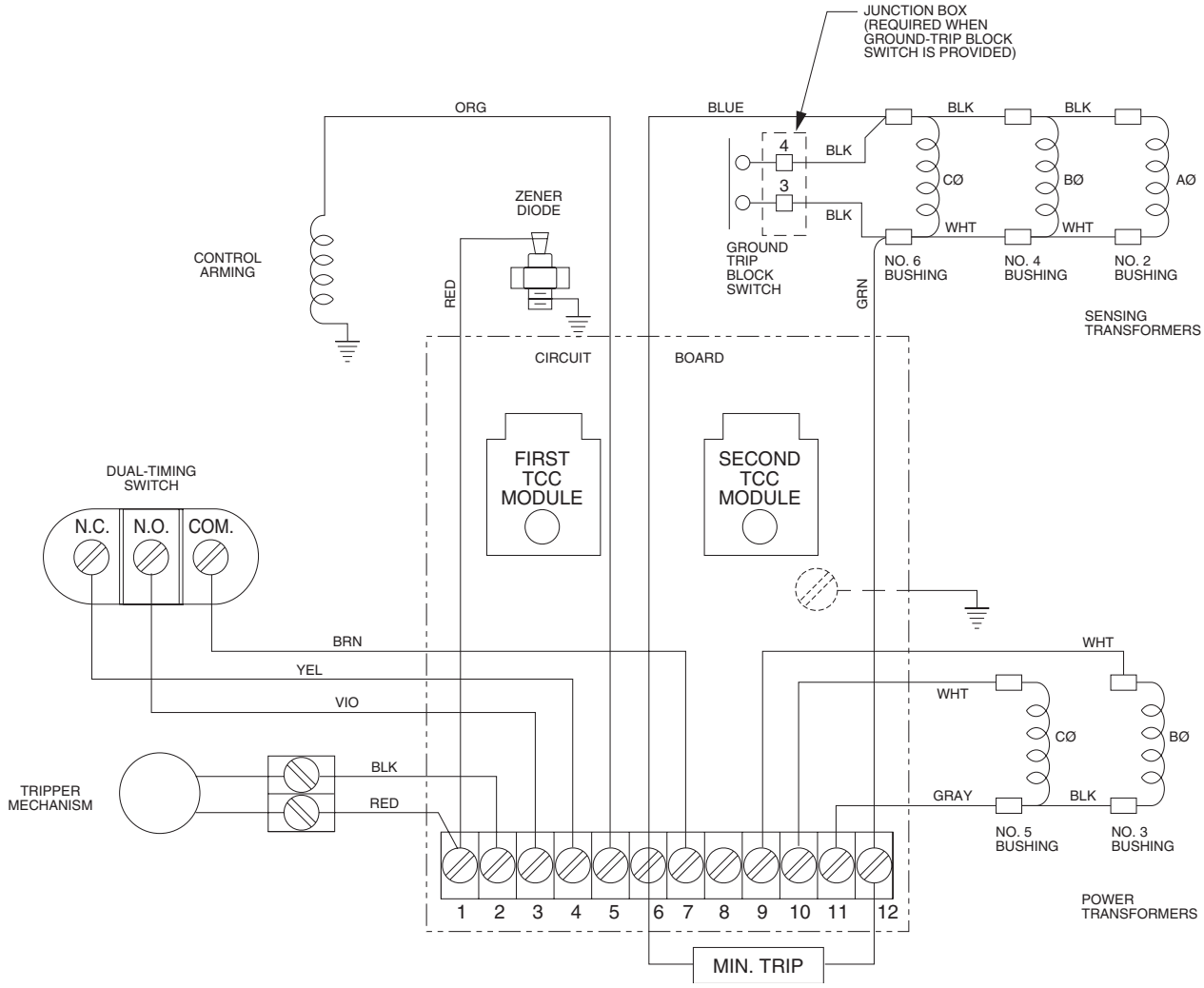


Figure 21. Electronic ground trip accessory connection diagram

If the downline system is energized by other than electrical operation of this recloser (such as the closing of an upline recloser or breaker) control circuit arming time must be added to the published time-current characteristic. If such circumstances are anticipated, refer to *Reference Data R280-91-12* for proper application of this accessory's time-current characteristics.

Electronic ground trip settings

When factory assembled on a recloser, this accessory has its operating components preset and tested. If any of the following settings are changed, test the recloser to confirm the desired performance.

Ground minimum-trip resistor

Minimum zero-sequence (ground) trip current is determined by the minimum-trip resistor connected across terminal 6 and 12 of the ground-trip-accessory circuit board (Figure 22).

To change the minimum-trip setting substitute a different valued resistor. The following minimum-trip current values are available: 5, 10, 20, 30, 50, 70, 100, 140, 200, 280, 320, and 400 amps.

If this setting is changed, the data plate on the sleethood must also be changed so that it indicates the ground minimum-trip current setting in use.

Time-current characteristics cards

Time-current curves are established by TCC cards mounted on the accessory circuit board (Figure 22). Two cards are normally provided. Either can be changed by substituting a different TCC card.

Fifteen different TCCs are available, both inverse-time and constant-time. Curves are identified by label on the TCC card. The six inverse curves are labeled 1 Curve, 2 Curve, etc. The nine constant-time curves are labeled Curve 1C, Curve 2C, etc. The curves are correspondingly numbered and published in *Reference Data R280-91-12*.

Both inverse-time and constant-time can be used in the same operating sequence. However, in making the selection the published curves should be consulted to make sure that the TCC card for the faster curve is in the "first TCC module" position.

If a TCC is changed, make sure the new card is firmly inserted into the socket, slipped onto the guidepost, and is beneath the retaining clip. The accessory data plate on the recloser sleethood should also be changed to indicate the TCCs in use.

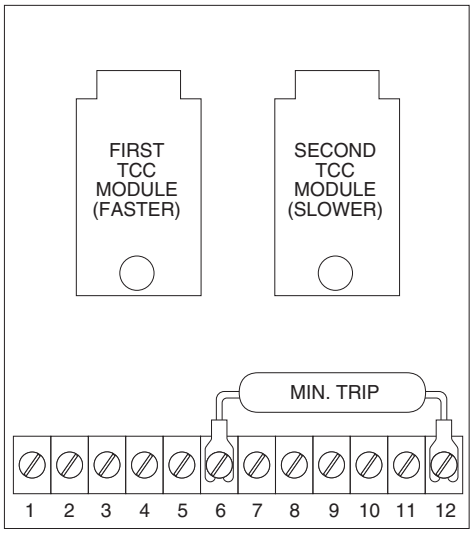


Figure 22. Ground-trip programming components

Number of operations to lockout

The total operations to lockout either on ground trip or phase trip is determined by setting the lockout bar (Refer to the **Number Of Operations To Lockout** section on page 9). Thus the recloser may lock out on all phase-trip operations, all ground-trip operations, or any combination of the two that reach the lockout setting.

Number of fast opperations

The number of initial (faster) operations is independent of the phase-trip fast operations setting and is determined by the setting of the cam on the ground-trip mechanism (Figure 23). The cam can be manually indexed for 0, 1, 2, 3, or 4 operations on the first timing curve. The remaining operations to lockout will occur on the second (slower) timing curve.

Note: To prevent ground trip from over-riding phase trip at fault levels above minimum phase trip, the number of fast ground-trip operations must be equal to–or less than–the number of fast phase-trip operations. For example, if ground trip is set for two fast operations and phase trip for one fast operation, the recloser would time single-phase faults on the faster phase-trip curve for the first operation, on the fast ground-trip curve for the second operation, and on the delayed phase-trip curve for subsequent operations.

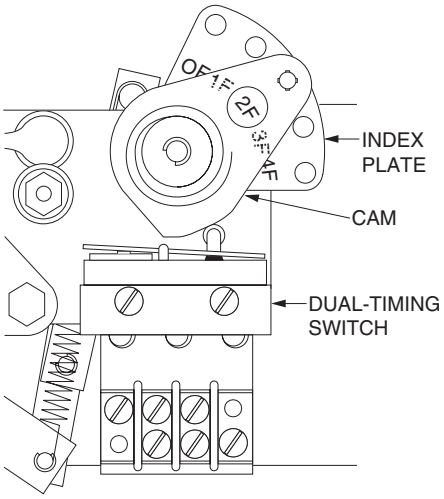


Figure 23. Components for setting dual timing

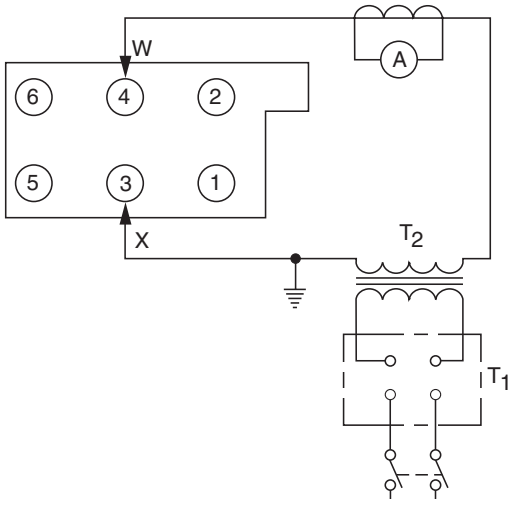


Figure 24. Test circuit for checking ground-trip accessory

Testing the electronic ground fault trip accessory

Each electronic ground trip accessory is carefully adjusted and tested at the factory to operate according to the data plate specifications. Pre-installation testing is not required. However, the following procedures may be followed for either the hydraulic or electronic unit if verification of operation is desired.

Test equipment required

A suggested test circuit is shown in Figure 24. The following equipment is required for the recommended test setup:

1. Variable auto transformer (T1): 230 Volts, 20 amps.
2. Low-voltage transformer (T2) to operate the groundtrip accessory: Same as for phase minimum-trip testing on page 11.
3. Ammeter: Full scale deflection should be at least twice the minimum-trip current.

Minimum-trip current

The minimum ground-trip current can be verified by closing the recloser manually with the tee-handled closing tool and tripping electrically with the low-voltage ac source.

Proceed as follows:

1. Connect low-voltage test leads X and W to the bushings of either Phase B or Phase C (terminals 3 and 4 or 5 and 6, Figure 24).
2. With the yellow operating handle in the CLOSED (up) position, manually close the recloser with the closing tool (refer to the **Manual Closing Operation** section, page 11).
3. Slowly increase the variable autotransformer voltage from zero and note the ammeter reading when the recloser trips.

Operating sequence

The operating sequence can be checked by passing current in excess of the minimum ground-trip level, but lower than the phase-trip level through either Phase B or C of the recloser and reclosing manually after each trip operation.

Proceed as follows:

1. Connect low-voltage test leads X and W to the bushings of either Phase B or Phase C (terminals 3 and 4 or 5 and 6, Figure 24).
2. With the yellow operating handle in the CLOSED (up) position, manually close the recloser with the closing tool (refer to the **Manual Closing Operation** section, page 11).
3. Set the variable autotransformer high enough to cause ground trip, but lower than the minimum phase-trip level.
4. Energize the low-voltage transformer T2. The recloser should trip.
5. After each trip operation, approximately two seconds (normal reclosing time) will elapse while the main toggle latch is resetting.
6. Immediately after the mechanism resets, the recloser can be closed again with the manual reclosing tool. The recloser should again trip.
7. Close and trip the recloser without appreciable delay between operations; otherwise, extra operations may occur due to partial resetting of the lockout piston.
8. Observe the number of fast ground-trip operations, the number of slower trip operations, and the number of ground-trip operations to lockout. When lockout is reached, the yellow manual operating handle will drop down and the manual closing mechanism will become inoperative.

Ground-trip blocking switch

A ground-trip blocking switch can be provided for either ground-fault trip accessory. The hotstick-operated blocking switch (Figure 25) is normally mounted on the recloser. The manual lever-operated blocking switch (Figure 26) is for remote mounting.

Ground-trip blocking switch wiring is shown in Figure 14 for the hydraulic ground trip accessory and in Figure 21 for the electronic ground trip accessory.

Moving the ground trip blocking switch to the ON (up), position, blocks ground trip operation. When the switch is in the OFF (down) position, normal ground trip operation occurs.

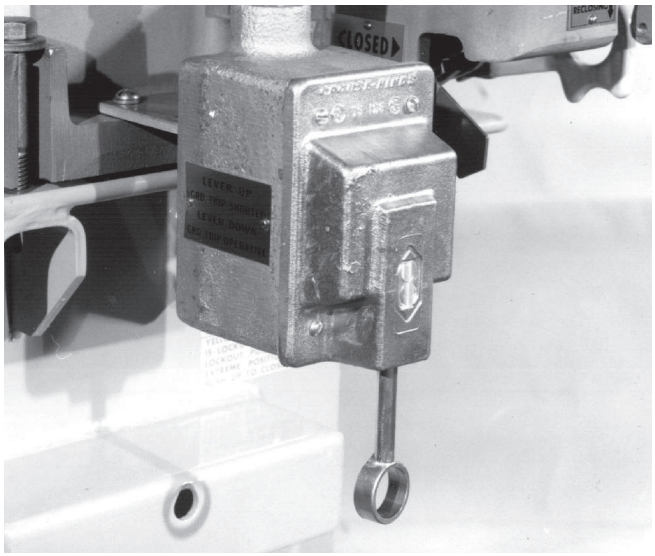


Figure 25. Ground-trip blocking switch; hotstick-operated

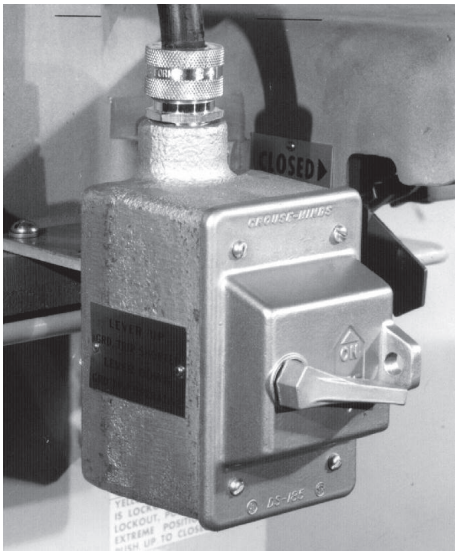


Figure 26. Ground-trip blocking switch for remote manual operation

Auxiliary switch

Remote indication of recloser contact position or switching of other devices can be accomplished with an auxiliary switch. A one-, two-, or three-stage switch can be provided.

A three-stage switch (with switch cover removed) is shown in Figure 27. Each stage or section has two independent sets of contacts: a and/or b. When the recloser's main contacts are open, the a contacts are also open and the b contacts are closed. Table 9 shows the related recloser/switch contact positions.

Table 9. Related Recloser/Switch Contact Position

Recloser Contacts	Closed	Open
Auxiliary a contacts are	Closed	Open
Auxiliary b contacts are	Open	Closed

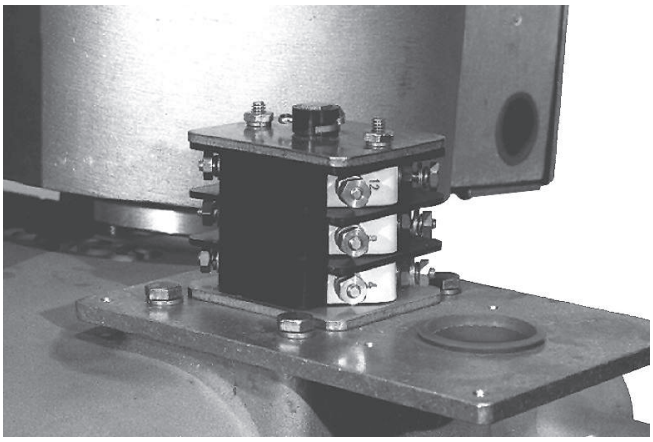


Figure 27. Auxiliary switch

Switch contacts are insulated for 600 volts and have a continuous-current rating of 10 amps. The interrupting rating of the auxiliary switch contacts is shown in Table 10.

Table 10. Auxiliary Switch Interrupting Ratings

	Amps Ac		Amps Dc	
Volts	Inductive	Non-Inductive	Inductive	Non-Inductive
24	–	–	15.00	20.0
48	–	–	7.50	10.0
120	50	80	–	–
125	–	–	1.50	2.0
240	25	40	–	–
250	–	–	0.45	0.5

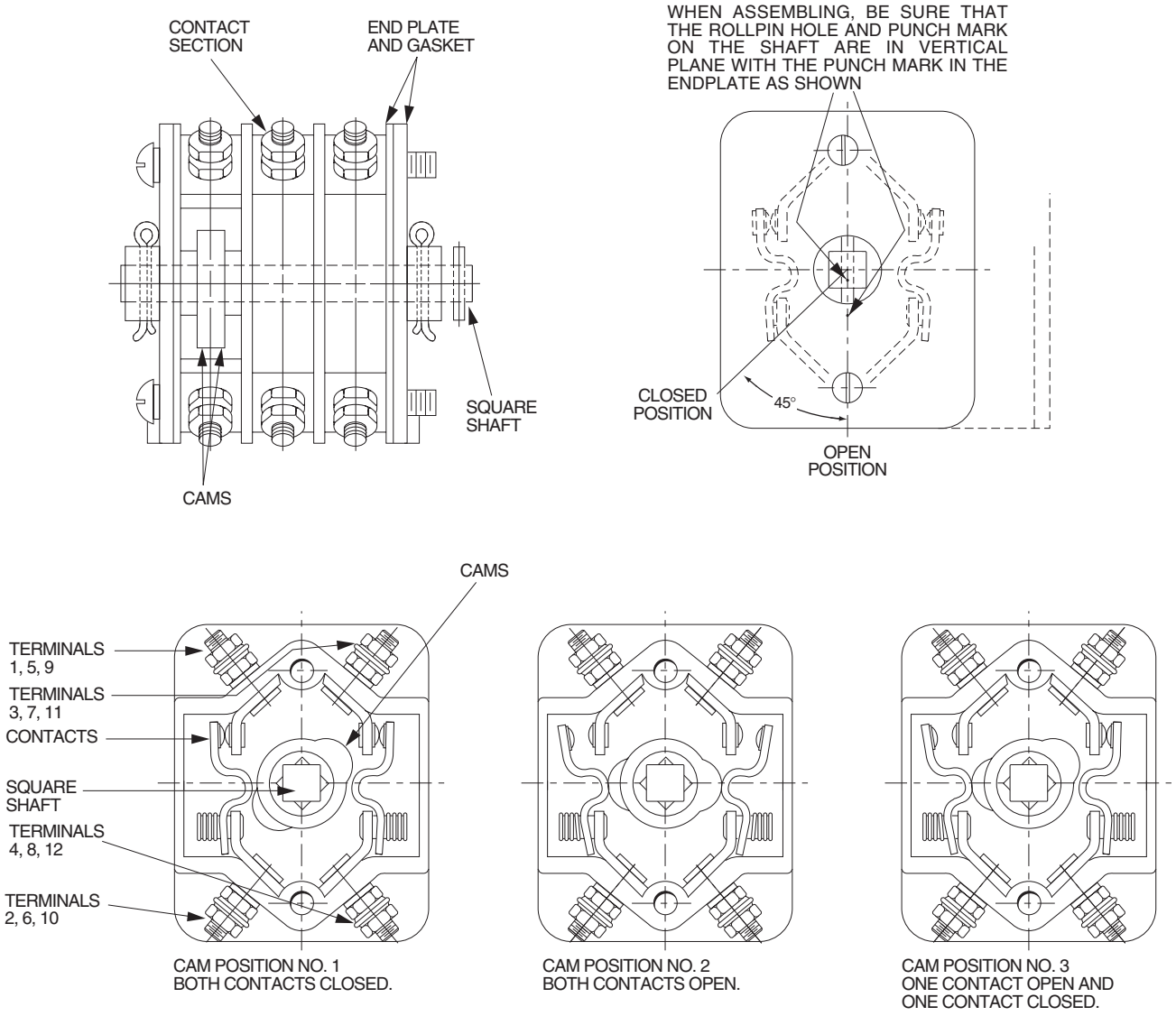


Figure 28. Auxiliary switch cam positions

A 1-1/8-in. diameter wiring entrance hole is provided in the base plate to accommodate standard 1-in. conduit or cable bushing. Contacts can be changed for either a or b operation by repositioning the cams inside each switch section.

To change cam position:

1. Remove the auxiliary switch housing cover.
2. Remove the four screws and lockwashers securing the housing baseplate to the recloser head.
3. Lift off the entire switch assembly.
4. Remove the cotter pin and collar from the square shaft.
5. Remove the hexnuts and lockwashers from the two long machine screws holding the switch sections to the baseplate.
6. Starting with the bottom section, lift the cams off the square shaft.
7. Replace the cams in one of the positions shown in Figure 28.
8. Reposition and fasten the switch sections to the housing baseplate.
9. Replace the collar and cotter pin on the shaft.
10. Remount the assembled switch on the recloser head making sure that the pin in the square shaft engages the notch in the switch operating shaft in the head casting.
11. Verify correct operation of each contact on the switch by using a continuity meter.

Lockout-indicating switch

The lockout-indicating switch (Figure 29), housed in a weather proof conduit fitting attached to the side of the sleethood, is mechanically coupled to the recloser's manual operating handle for remote indication of recloser lockout.

The lockout-indicating switch has a continuous-current rating of 10 amps and an inrush-current rating of 15 amps. Interrupting ratings are shown in Table 11.

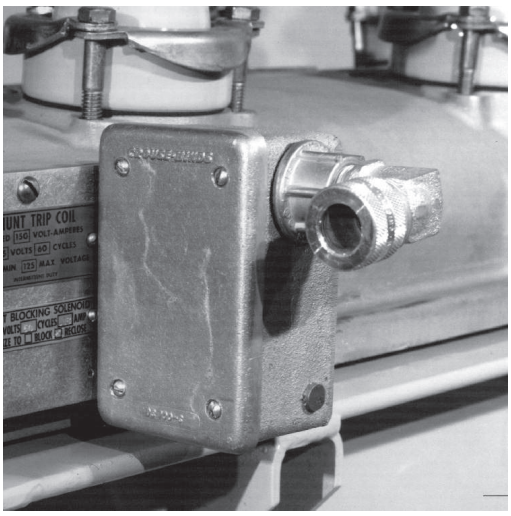


Figure 29. Lockout-indicating switch

The 1/2 in. IPS threaded conduit opening is fitted with a weather proof cable grip that will accommodate 5/8 to 3/4 in. OD cable. Figure 30 is a schematic diagram of a typical signal circuit employing the lockout-indicating switch. Connections are made to terminals marked COMMON, NORMALLY OPEN, and NORMALLY CLOSED (Figure 31).

Table 11. Interrupting Ratings of Lockout-Indicating Switch

Circuit Potential (Volts)	Interrupting Rating (Amps)
120 AC	10
240 AC	5
125 DC	0.5
250 DC	0.25

Remote trip

The remote trip solenoid (Figure 32) will trip the recloser when energized through a remote control. Automatic reclosing occurs and total operations to lockout are the same as when the series-trip solenoids operate. Reclosing will occur even if the solenoid remains energized. Should this occur, the recloser will simply operate to lockout. A remote trip solenoid can not be installed on a recloser equipped with either a hydraulic or electronic ground-trip accessory. Connections to the remote trip solenoid are made in the junction box as shown in Figure 33; electrical ratings are shown in Table 12.

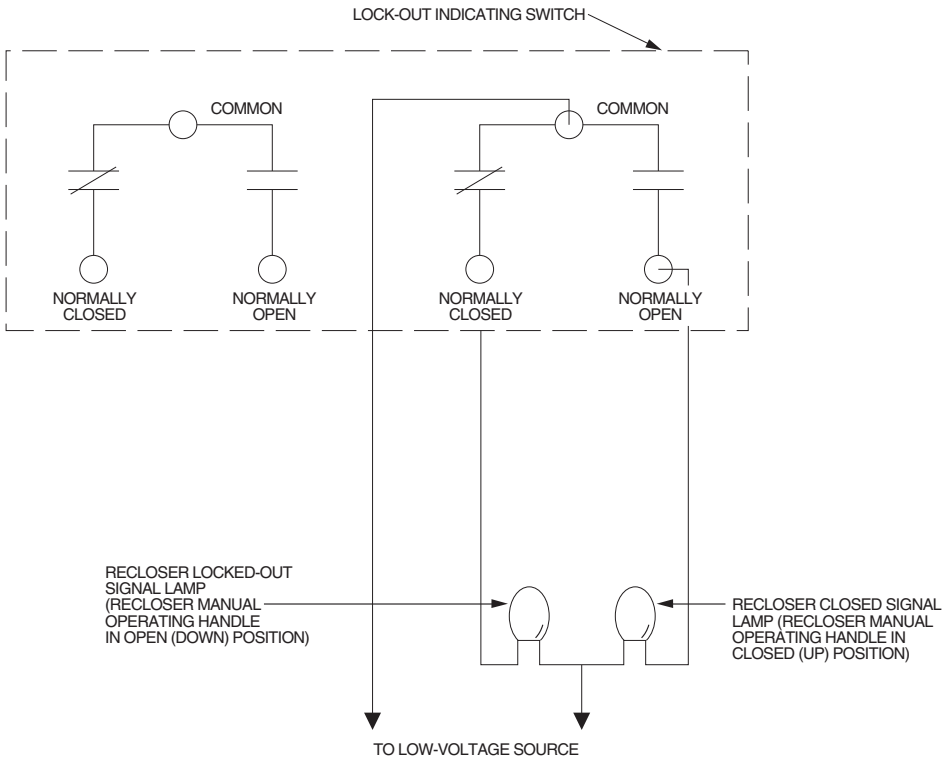


Figure 30. Typical signal circuit.

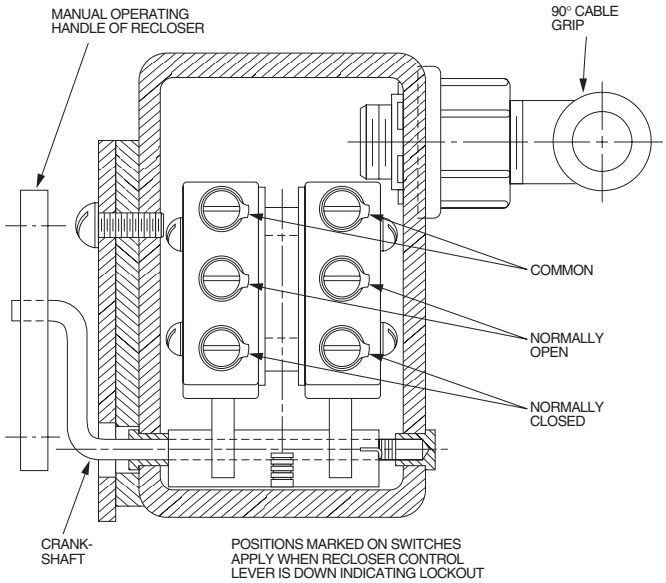


Figure 31. Terminal markings of lockout-indicating switch

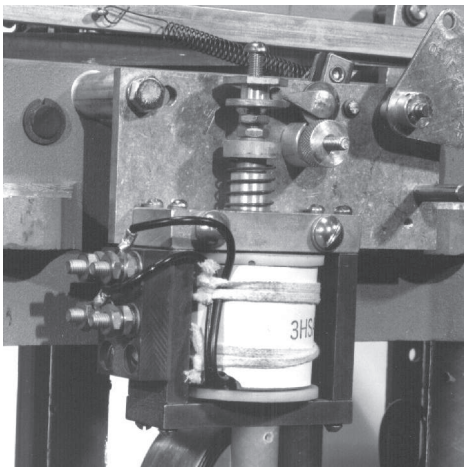


Figure 32. Remote trip solenoid

Table 12. Electrical Ratings of Remote trip Solenoid – Intermittent Duty Only

Catalog Number	Rated Voltage (volts)	Operating Voltage Range (volts)	Steady-State Current Required (amps)
KA378R1	115 AC	95 - 125 AC	1.3
KA378R2	230 AC	190 - 250 AC	0.65
KA378R3	125 DC	90 - 130 DC	0.2
KA378R4	48 DC	36 - 50 DC	1.0
KA378R5	24 DC	18 - 25 DC	1.8
KA378R6	250 DC	180 - 260 DC	0.1

Remote lockout

A remote lockout solenoid (Figure 34) enables an external control to trip the recloser and cause lockout by dropping the yellow manual operating handle to the open position.

Connections between the external control and the lockout solenoid are made in the junction box as shown in Figure 33; electrical ratings are shown in Table 13. The AC solenoid is rated for continuous energization, but it is normally energized only long enough to cause lockout.

The remote lockout accessory is usually used in conjunction with the remote close of a locked-out recloser accessory.

Remote close

Remote closing of a locked-out recloser can be achieved if the recloser is equipped with a remote closing solenoid (Figure 35). When energized from a remote source, the remote closing solenoid pulls the recloser's manual operating handle to the CLOSE position. The operating handle actuates the high-voltage closing solenoid contactor to energize the solenoid and close the recloser.

Because the remote closing solenoid is rated for intermittent duty, the remote control should have a normally open, momentary-contact switch wired in series with the solenoid. An opening in the solenoid housing accommodates a 1⁄2 in. ips conduit fitting. Electrical data for the remote closing solenoid is shown in Table 14.

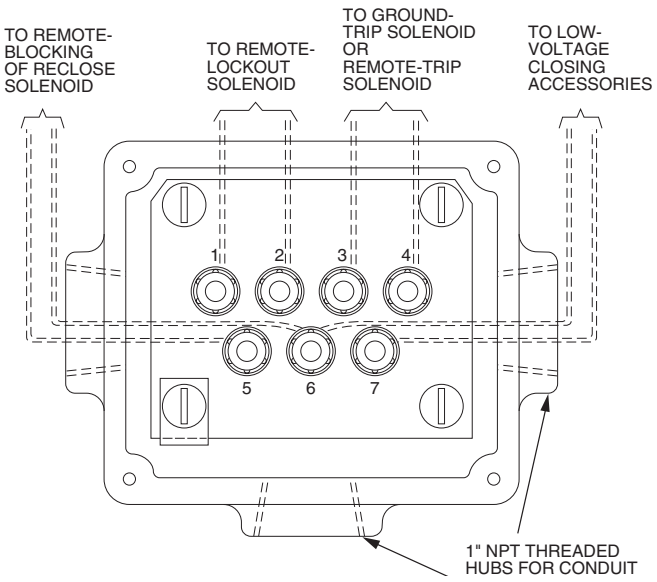


Figure 33. Junction box terminal arrangement

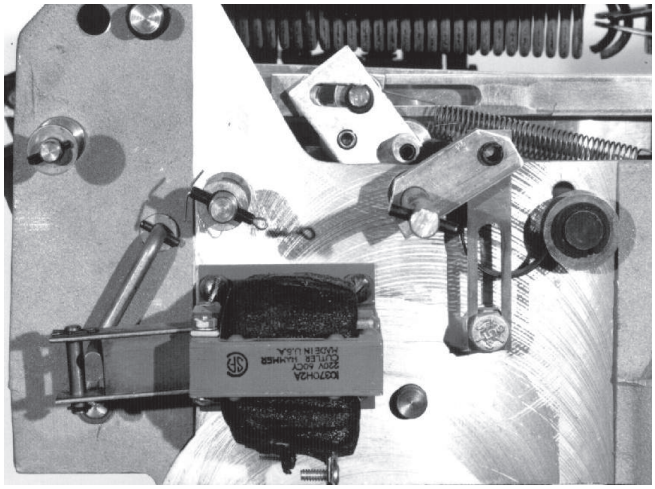


Figure 34. Remote lockout solenoid

Table 13. Electrical Ratings of Remote Lockout Solenoid - Continuous Duty

Catalog No.	Rated Voltage (volts)	Operating Voltage Range (volts)	Steady-State Current Required (amps)
KA475R1	115 AC	95 - 125 AC	0.36
KA475R2	230 AC	190 - 250 AC	0.18
KA475R3	24 DC	18 - 25 DC	2.0
KA475R4	48 DC	36 - 50 DC	4.0
KA475R5	125 DC	90 - 130 DC	0.64
KA475R6	250 DC	180 - 260 DC	0.45

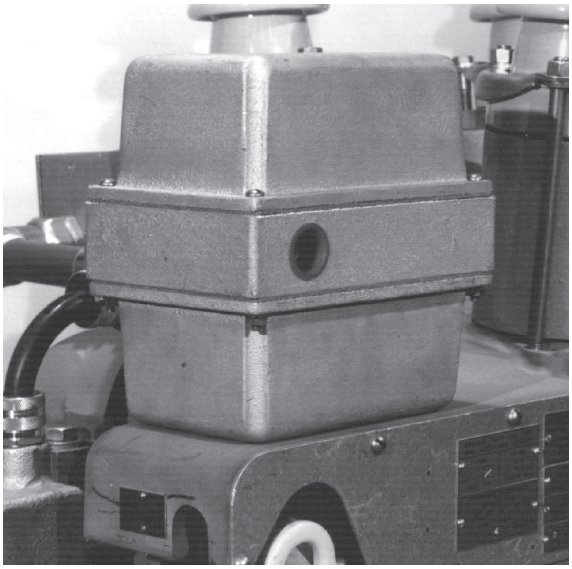


Figure 35. Remote closing solenoid

⚠ CAUTION

Equipment damage. The remote closing of a locked-out recloser disables the tripfree feature of the yellow, manual operating handle. Never hold the yellow operating handle in the closed position, either electrically by the remote closing accessory, or manually with a hotstick. If a permanent fault is present, and the handle is in the closed position, the unit will continue tripping until the handle is released. Failure to comply can result in equipment damage and personal injury. T252.1

Table 14. Electrical Ratings of Remote-Closing Solenoid - Intermittent Duty Only

Catalog No.	Rated Voltage (volts)	Operating Voltage Range (volts)	Current Requirements (amps)	
			Inrush	Steady-State
KA486R1	115	100 - 125	32 - 34	3.25
KA486R2	230	200 - 250	16 - 18	1.67

Table 15. Electrical Ratings of Remote Block of Reclosing Solenoid - Continuous Duty

Catalog No.	Rated Voltage (volts)	Operating Voltage Range (volts)	Steady-State Current Required (amps)
KA275R1	115	95 - 125	0.2 Blocks when
KA275R2	230	190 - 250	0.1 de-energized
KA276R1	115	95 - 125	0.2 Blocks when
KA276R2	230	190 - 250	0.1 energized

Remote block of reclosing

The remote block of reclosing solenoid (Figure 36) blocks automatic closing. The KA275R1 and KA275R2 solenoids (Table 16) block closing when de-energized; the KA276R1 and KA276R2 solenoids block closing when energized. External electrical connections to the remote blocking mechanism are made through the junction box (Figure 33). Electrical ratings for the remote block of reclosing solenoid, which is rated for continuous duty, are shown in Table 15.

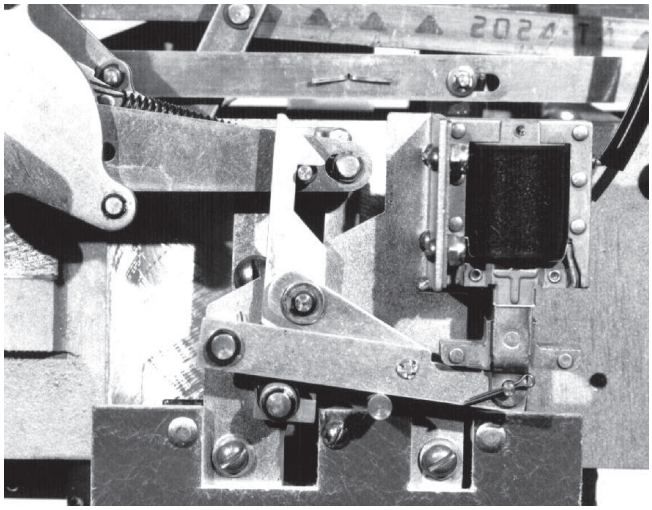


Figure 36. Remote block of reclosing solenoid

Low-voltage DC closing

With the substitution of a special DC closing coil and associated wiring and linkage, the recloser will operate from a low-voltage dc source rather than from a normal line-toline high-potential source. Connection of the closing coil to operate from a separate auxiliary source increases the flexibility of the recloser by enabling it to trip and close from either direction with an external control.

This is especially desirable when load-transfer schemes are employed. External controls can also provide a greater range of operating characteristics for the recloser. A DC closing coil and wiring is factory-installed only. Connections to the dc closing coil are made through the junction box as shown in Figure 33.

Refer to Figure 38 for the low-voltage closing connection diagram.

Low-voltage AC closing

The dc closing coil can be operated from a low-voltage ac source with the factory-installed modified closing contactor (Figure 37). The contactor is equipped with a full-wave diode bridge. Current requirements for AC closing are 55 amps at 115 Vac and 30 amps at 230 Vac (momentary - approximately five cycles in duration). Refer to Figure 38 for the low-voltage closing connection diagram.

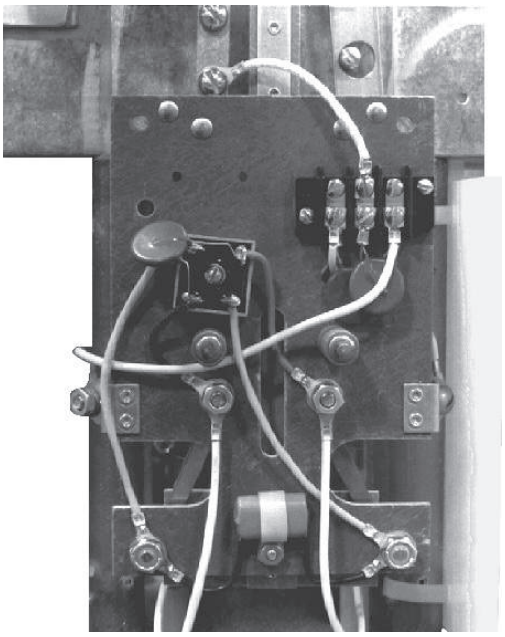
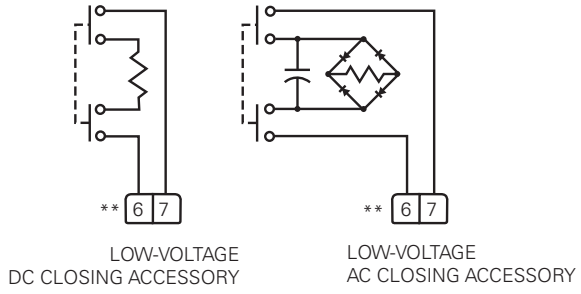


Figure 37. Low-voltage AC closing contactor



**JUNCTION BOX TERMINALS 6 and 7 - Refer to Figure 34.

Figure 38. Low-voltage closing connection diagrams

Junction box

Internally mounted accessories are connected to terminals in a junction box mounted on the head of the recloser. The junction box and terminal assembly facilitate connection to external auxiliary power sources and/or control devices. Terminal arrangement is shown in Figure 33.

Manual closing tools

⚠ WARNING

Explosion hazard. Excessive Contact Arcing. Do not use the manual closing tool to close an oil-insulated energized recloser. Closing an energized oil-insulated recloser with a manual closing tool can cause excessive contact arcing, rapid build-up of gas within the equipment, and possible explosion that can cause death, severe personal injury, and equipment damage. T203.2

CAUTION

Equipment damage. Do not attempt to trip a recloser by operating the manual closing tool from CLOSED to OPEN. This will result in damage to the recloser operating mechanism. T228.0

A T-handled closing tool, KA90R (shown on page 11 in Figure 11) is available for closing a de-energized recloser when high-voltage closing power is not available. Never use a manual closing tool to close an energized recloser.

If the recloser is mounted out of reach of the T-handled tool, the KA476R (Figure 39) manual closing tool is available. Instructions for using the KA90R closing tool are in the **Manual Closing Operation** section on page 11.

To close a de-energized recloser with the KA476R closing tool:

1. If the yellow manual operating handle under the sleet-hood is in the OPEN position, pull the handle down first, then move it up to the CLOSED position.
2. Engage the closing tool handle in the operator socket and move the handle clockwise approximately 45 degrees to close the recloser.
3. After the recloser has been closed, remove the KA476R closing tool handle from the operator socket.
4. To trip the recloser, pull down on the yellow manual operating handle.

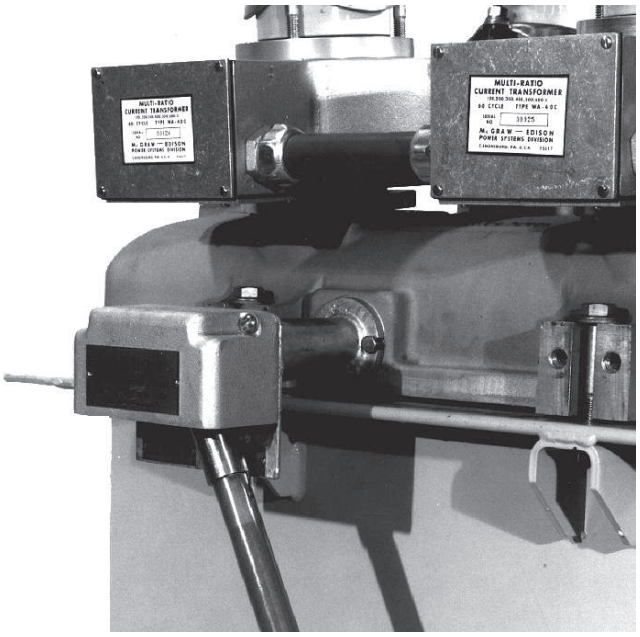


Figure 39. KA476R manual closing tool

Maintenance information

Maintenance requirements

All Eaton reclosers require routine inspection and maintenance to ensure proper operation. If the equipment is not adequately maintained, it may fail to operate properly.

⚠ 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 manuals for three-phase hydraulically controlled reclosers are listed in Table 16. *Reference Data TD280022EN* provides information on recloser insulating oil specifications and tests.

Table 16. Maintenance Manuals for Three-Phase Hydraulically Controlled Reclosers

Recloser Type	Service Information Number
VW	S280-30-7
VWV27	
VWV38	
W	S280-30-8
WV	S280-30-9

Frequency of maintenance

To assure proper and trouble-free operation, reclosers must be maintained when they have operated the equivalent of a rated duty cycle (see Table 3, page 3).

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.

Maximum recloser maintenance intervals

In the absence of specific operating experience, use the following guideline to establish maintenance intervals:

- Oil interrupting reclosers should be maintained at least every three years.
- Vacuum interrupting reclosers should be maintained at least every six years.

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

Replacement parts

Replacement parts for Eaton reclosers are available through the factory Service Department. Only factory authorized replacement parts are to be used. To order replacement parts, refer to the applicable 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 service centers are located throughout the continental United States to provide maintenance, repair, and testing services for Eaton 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. These courses provide training and factory recommended procedures for the routine maintenance, troubleshooting, repair and testing of Eaton reclosers. It is recommended that all personnel who service and maintain Eaton switchgear, attend the appropriate classes. For additional information, contact your Eaton representative.

Instructional video programs

Two DVD maintenance training programs; KSPV1A General Maintenance and Inspection Procedures for Reclosers and KSPV5A, Mechanical Operation Service and Testing For Three-Phase Hydraulic Reclosers; are also available as supplemental training aids for maintenance personnel. These video programs, developed for use in the factory training classes, are to be used in conjunction with existing service literature. For additional information, contact your Eaton representative.

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