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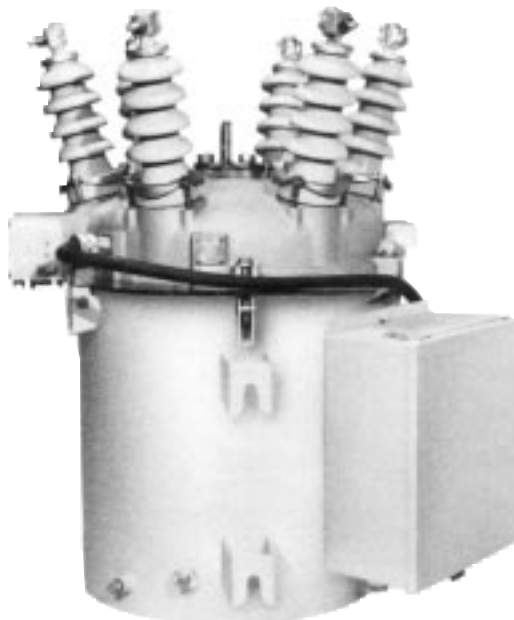



Figure 1. Type KFE recloser combines vacuum interruption with hydraulic counting and electronic fault sensing and trip timing.

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RADIATION WARNING

Before performing electrical tests on types KFE and KFVE Reclosers, refer to Service Information S280-90-1, "Vacuum Interrupters Radiation Warning".

These instructions do not claim to cover all details or variations in the equipment, procedure, or process described, nor to provide direction for meeting every possible contingency during installation, operation, or maintenance. When additional information is desired to satisfy a problem not covered sufficiently for the user's purpose, please contact your Cooper Power Systems sales engineer.

CAUTION

Do not energize this equipment out of oil.

SHIPMENT AND ACCEPTANCE

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

1. 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.
2. Check for oil leakage and tighten all bolts that may have loosened during shipment, especially the bolts which attach the head to the tank.

HANDLING AND STORAGE

If the recloser is to be stored for some time before installation, provide a clean, dry storage area. Take precautions during handling and storage to minimize the possibility of mechanical damage; in particular, protect the bushings and control equipment.

DESCRIPTION

A complete Type KFE or KFVE Recloser assembly consists of a KFE or KFVE recloser and a separate control cabinet connected to the recloser with a 6-foot-long control cable. The control cabinet is designed to be mounted to the recloser tank, however it can be mounted to the pole or other mounting structure at a distance equal to the cable length. The control cable is hard-wired to the recloser and attached to the control with a threaded, separable weatherproof connector.

Recloser

The Type KFE Recloser is a self-contained, three-phase current interrupting device. KFE reclosers protect systems rated 2.4 through 14.4 kV, KFVE reclosers 2.4 through 24.9kV, both are rated at 400 amps maximum continuous and 8000 amps symmetrical interrupting. The KFE and KFVE Reclosers sense both line current and zero-sequence ground (earth) current and automatically interrupts all three phases of the distribution circuit to which it is connected when any current exceeds the minimum-trip level. It automatically recloses to restore service if the fault is temporary. If the fault is permanent the recloser locks out after two, three or four preset trip operations. Once locked-out, the recloser must be manually reset to restore service. Should the fault clear before lockout, the recloser will reset automatically for another sequence of operations.

The recloser can be also set for non-reclosing operation (lockout after the first trip operation) with a manually operated external non-reclosing lever.

The trip operations of the recloser can be all fast, all delayed, or any combination of fast operations followed by delayed operations up to a maximum total of four. Fast operations clear temporary faults before branch line fuses are damaged. Delayed operations allow time for fuses or other downline protective devices to clear to limit permanent faults to the smallest section of line.

The KFE and KFVE Reclosers employ a simple time-proven hydraulic mechanism to count operations, program the operating sequence, and determine reclosing time. Solid state electronics provide the accuracy, reliability, and flexibility for overcurrent sensing and trip timing. The electronic circuits are housed in a separate cabinet attached to the recloser tank and connected to the recloser with a six-foot cable.

Vacuum Interruption

Arc interruption takes place within the three sealed vacuum interrupters. Oil is used for electrical insulation, but is not involved in arc interruption. The insulating oil is also used in the counting and sequencing mechanism and in reclose timing.

The moving contacts in the vacuum interrupters are driven by the release of opening springs. A low energy tripper actuated by the electronic circuitry releases the opening spring when line current is sensed above the preset minimum-trip level. Closing energy, as well as energy to charge the opening spring, is supplied by a high-voltage closing solenoid momentarily connected phase-to-phase through a high-voltage contactor.

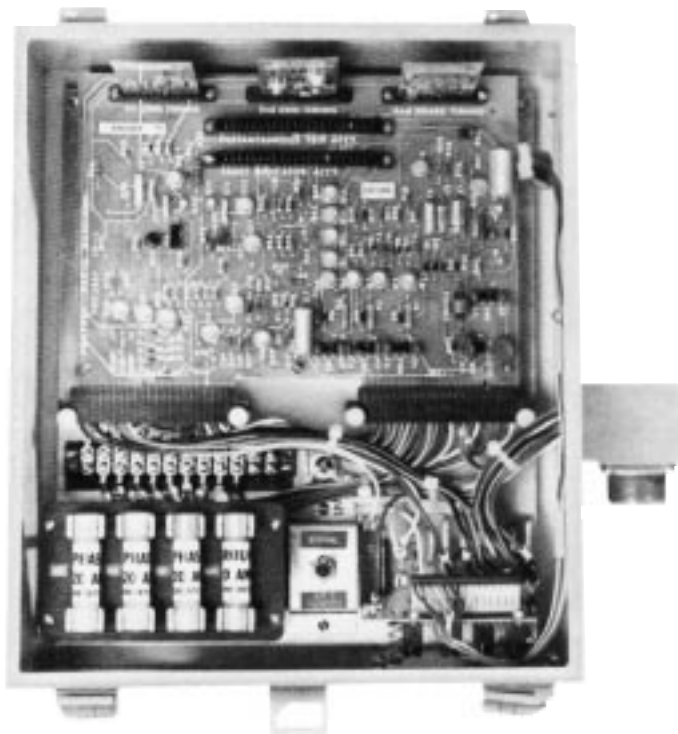


Figure 2.
KFE electronic control.

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Electronic Control

The electronic circuits and the plug-in units for programming minimum-trip and trip timing are located in a separate cabinet mounted to the recloser tank as shown in Figure 2. No external power source or battery is required to operate the electronics. Power is obtained from the line by means of bushing current transformers. A minimum of 5 amperes of primary current flow is sufficient to power the electronics and charge the trip capacitors which actuate the low energy tripper. In addition, a pickup coil wound on one leg of the closing solenoid, provides additional charge to the trip capacitors during each reclosing operation to insure that the electronic circuits are energized at the instant of contact make.

Electronic control circuitry is centralized on a single printed circuit board which is easily field-replaceable. Plug-in trip resistors and trip-timing curves increase application flexibility and are easily installed. Instantaneous phase- and ground-tripping and fault-indicating accessories are available to further enhance the application capabilities of the control.

RATINGS AND SPECIFICATIONS

The recloser will operate effectively only when applied within its specified ratings. Consult the following ratings tables and compare to system characteristics at point of application prior to installation.

**Table 1
Voltage Ratings**

	KFE	KFVE
Nominal operating (kV)	2.4-14.4	2.4-24.9
Maximum design (kV) . . .	15.5	27.0
Impulse withstand (BIL)* 1.2 x 50 microsecond wave, crest (kV)	110	125
60-Hz withstand (rms) Dry, 1 min (kV)	50	60
Wet, 10 sec (kV)	45	50
RIV at 1000 kHz, at 9.41 kV (microvolts max)	100	100
Operating frequency (Hz)	50-60	50-60

*In accordance with ANSI standard C37.60-1981.

**Table 2
Current Ratings**

Maximum continuous current (amps)	400
Overload capability (4 hr) (amps).....	500*
(2 hr) (amps)	600*
Interrupting current (amps)	8000
Magnetizing interrupting current (amps)	14
KFE cable charging current at 8.94 kV (Ø to gnd) (amps)	2
KFE cable charging current at 15.5 kV (Ø to gnd) (amps)	5
Three-second current (rms sym amps)	8000
Momentary current (rms sym amps) ..	12800
Surge current (amps).....	65000

*After level-off rated continuous current.

**Table 4
Operating Times**

Normal reclosing time (sec).....	2*
Resetting time at 25° C (minutes per recloser operation).....	1.5

*A four-second reclosing time is available.

**Table 5
Closing Coil Impedance Ratings**

Nominal ac Voltage (kV)	Impedance Z (ohms)	ac Resistance (ohms)	Reactance X (ohms)	Power Factor	dc Resistance (ohms)
2.4	41.83	16.01	38.65	38.3	8.22
4.16					
4.8	149.43	62.09	135.92	41.5	31.52
7.2					
7.62	408.49	145.86	381.56	35.7	84.12
8.0					
8.32	504.02	172.05	473.74	34.1	95.99
11.5	978.14	316.03	925.68	32.3	211.4
12.0					
12.47	1163.5	384.6	1098.1	33.1	226.9
13.2					
14.4	1551.89	511.64	1465.12	33.0	550.8
20.0	3034.32	967.32	2875.0	31.9	647.8
125 (Vdc)	-	-	-	-	1.289
250 (Vdc)	-	-	-	-	4.77

**Table 6
Mechanical Specifications**

Operating temperature (° C):	
Minimum	-20
Maximum	40
Close mechanism	Solenoid close
Open mechanism.....	Spring operated
Contact close time (cycles).....	0.75
Contact gap (cm) (in.).....	0.95 (0.375)
Contact open time (cycles)	0.50
Interrupting time (cycles)	1.50
Allowable contact erosion (cm) (in.).....	0.32 (0.125)
Resetting time, integrator, minutes at 25° C; per trip operation.	
Quick reset after lockout	1.5 (approx.)
Resistance, Nominal (micro-ohms):	
Bushings, terminal-to-terminal	400
Across the interrupter.....	25
Reclosing time (see at 25° C)	1.5—2.5
Mechanical life (minimum operations)	2500

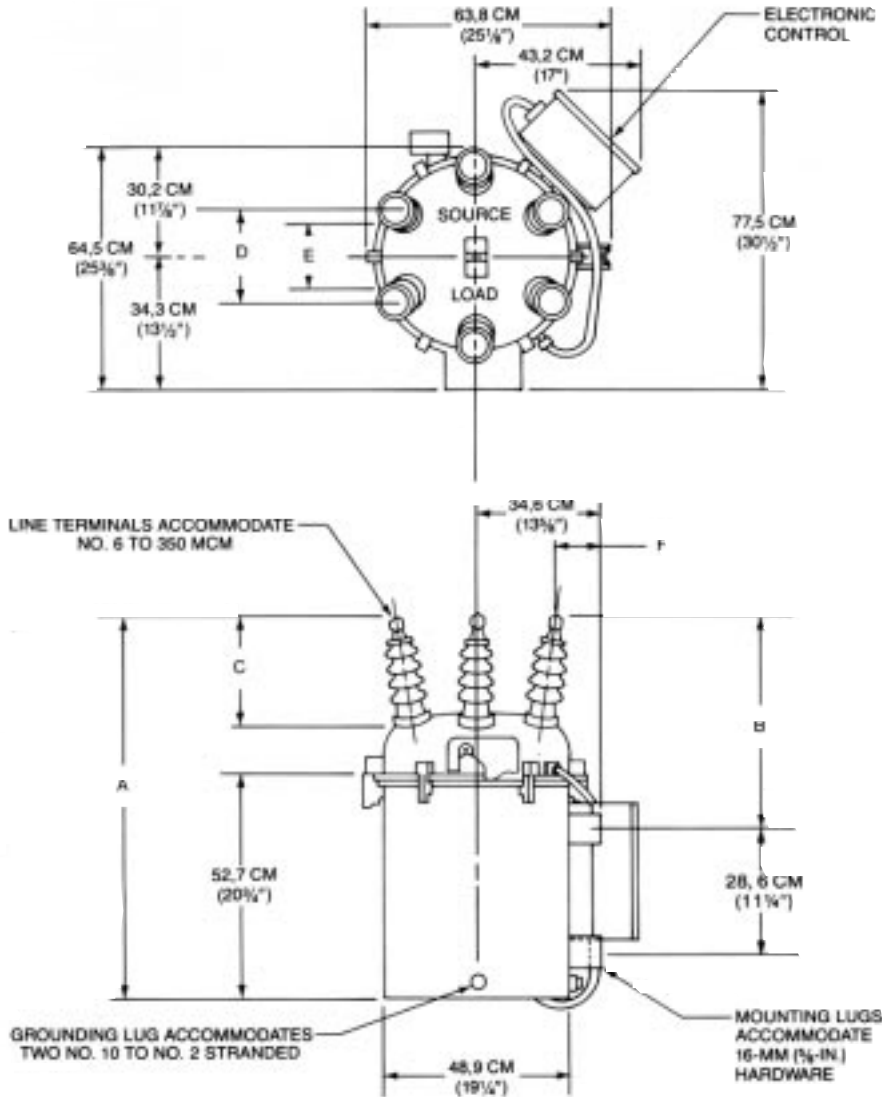
**Table 3
Interrupting Ratings**

Minimum Trip Current (amps)		Maximum interrupting Current (rms symmetrical amps)
Phase	Ground	
10	5	8000
20	10	8000
30	20	8000
50	30	8000
70	50	8000
100	70	8000
140	100	8000
200	140	8000
280	200	8000
320	280	8000
400	320	8000
450	400	8000
560	—	8000
800	—	8000

**Table 7
Duty Cycle**

Number of Operations	% of Interrupting Rating	Max Circuit X/R Ratio	
		KFE	KFVE
96	15—20	3	4
120	45—55	7	8
32	90—100	14	15
248 Total Operations			

Dimensions and Weights



DIM.	KFE		KFVE	
	ST'D. UNIT	ST'D. UNIT	ST'D. UNIT	UNIT w/BCT's
A	93,7 CM (36 7/8")	109,8 CM (43 1/4")	121,4 CM (47 3/8")	
B	54,8 CM (21 5/8")	69,9 CM (27 1/2")	81,4 CM (32 1/8")	
C	28,3 CM (11 1/8")	44,5 CM (17 1/2")	56 CM (22 1/8")	
D	27,3 CM (10 3/4")	23,2 CM (9 1/8")	26,0 CM (10 1/4")	
E	20,3 CM (8")	31,4 CM (12 3/8")	34,3 CM (13 3/8")	
F	11,1 CM (4 3/8")	7,6 CM (3")	5,1 CM (2")	

Figure 3.
KFE and KFVE top and front view dimensions.

Table 8
Dimensions and Weights

	KFE	KFVE
Recloser weight with oil, kg (lb.)	172 (380)	189 (416)
Recloser weight with pole-top frame, kg (lb.)	181 (400)	198 (436)
Recloser weight with substation frame, kg (lb.)	240 (530)	257 (566)
Recloser oil capacity, liters (gal.)	71,9 (19)	71,9 (19)
Standard bushing creepage, cm (in.)	29,53 (115/8)	67,3 (26.5)

Operating Levers and Indicators

The operating levers and indicators for the Type KFE and KFVE Reclosers are located under the sleet hood (Figures 4 and 5).

MANUAL OPERATING HANDLE

The manual operating handle (yellow) permits manual opening and closing of an energized recloser. Pulling down the handle trips and locks open the main contacts of the recloser. Lifting up the handle closes the closing-coil contactor, and if high-voltage power is supplied to recloser bushing terminals 1 and 5, the closing coil will close the main contacts. The handle can be operated with a hookstick.

The handle is trip free, meaning that it will not impart a blow to the operator if the recloser trips on a fault while the handle is being held closed. However, the recloser will continue to reclose and trip (in excess of its programmed number of operations to lockout) until the handle is allowed to drop to the open position.

When the recloser operates to lockout, the yellow handle drops down from under the sleet hood. It must be reset manually from the lockout position before the recloser can close.

NON-RECLOSING LEVER

The non-reclosing lever provides the recloser with the capability of locking out on the first trip operation regardless of the operations to lockout setting inside the recloser. This feature provides added safety during downline, hotline work.

The non-reclosing lever can be operated with a hookstick. For nonreclosing operation it is pulled from under the sleet hood to its down position. It must be manually returned to the up position in order to return the recloser to its pre-programmed number of operations to lockout.

The recloser can be opened or closed manually regardless of the position of the non-reclosing lever.

CONTACT-POSITION INDICATOR

Located on the outboard side of the sleet hood, this indicator shows the word "OPEN" when the main recloser contacts are open and "CLOSED" when the recloser contacts are closed.

OPERATIONS COUNTER

A three-digit mechanical counter, located under the sleet hood, cumulatively records each time the recloser opens.

GROUND-TRIP DISABLING SWITCH

Located on the recloser head, opposite the sleet hood (Figure 5), this manually operated switch disables the groundtrip operation when pulled to its "blocked" position. It can be hookstick operated and will remain in the down position until manually returned.

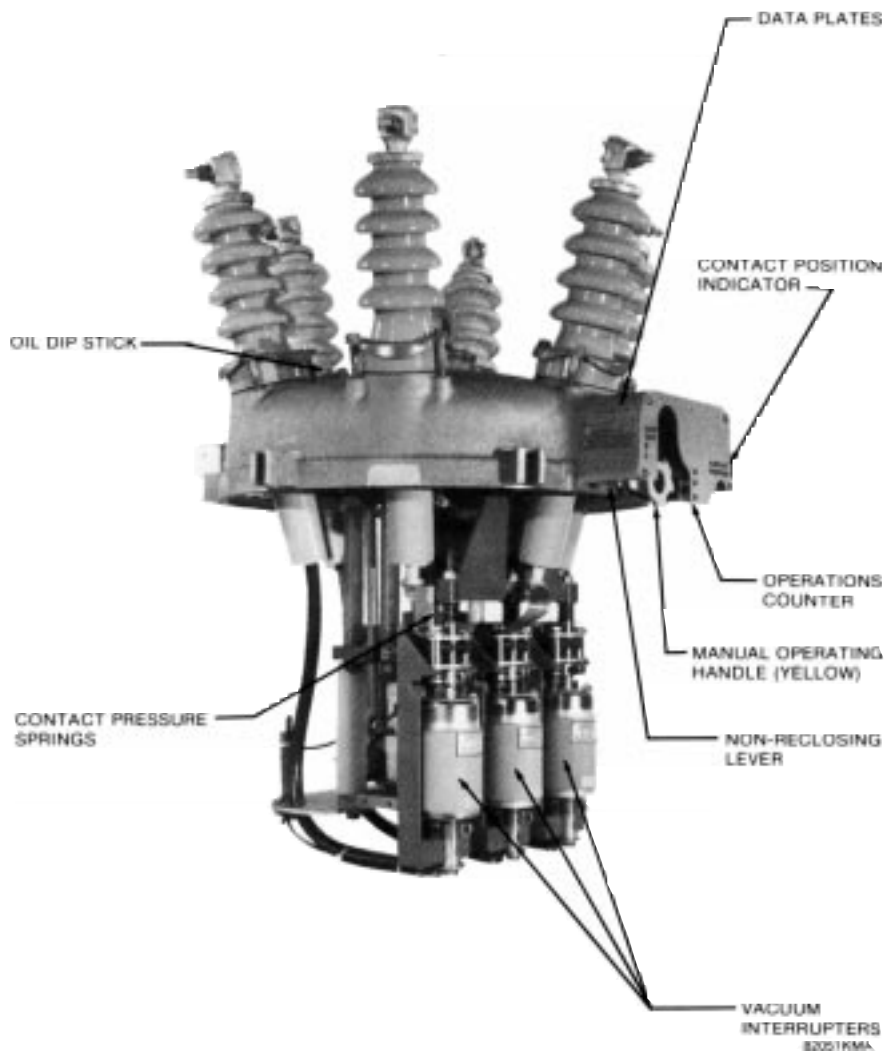


Figure 4.
Untanked Type KFE recloser viewed from interrupter side.

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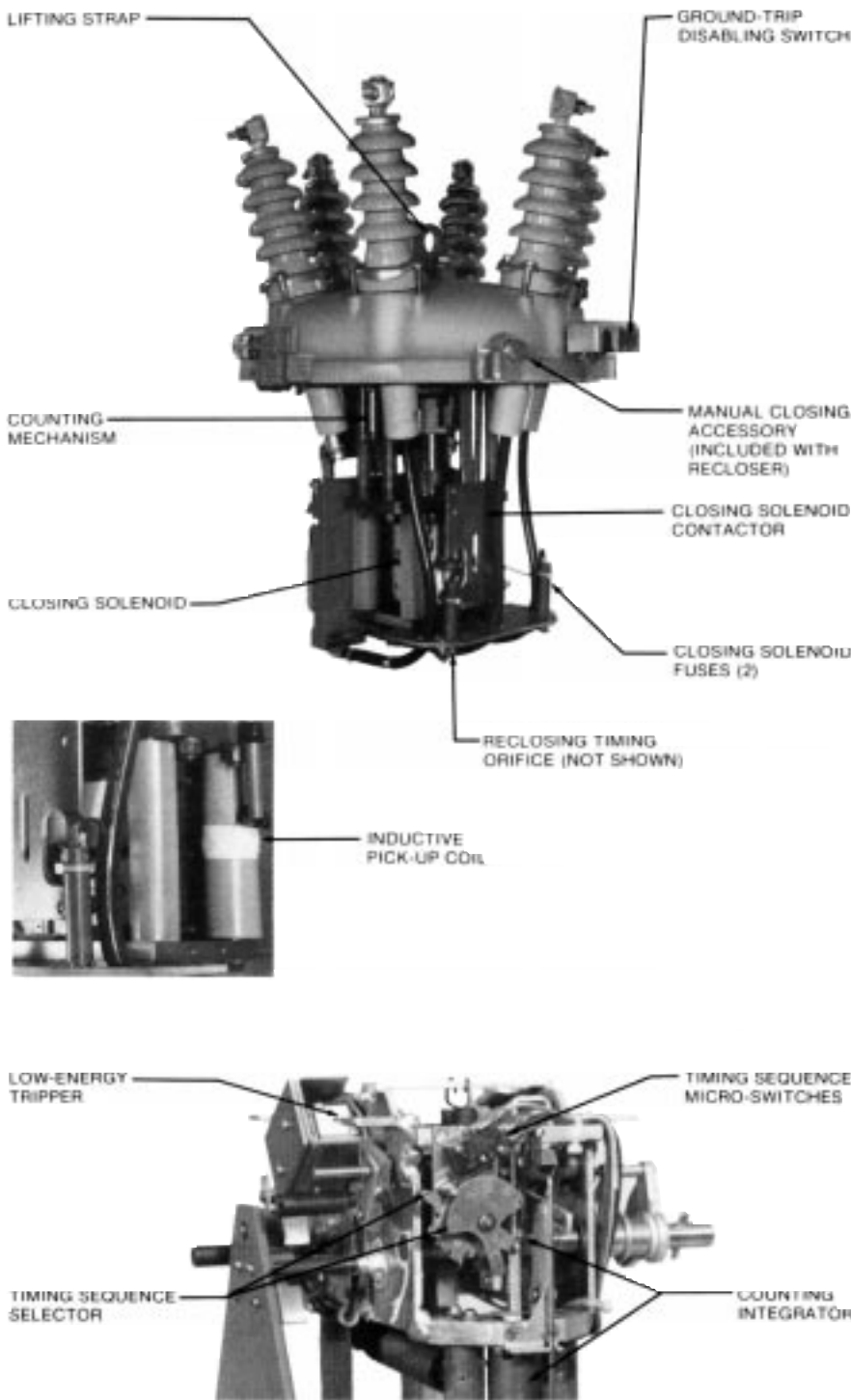


Figure 6.
Head mechanism of Type KFE recloser (head removed).

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Closing Solenoid

Energy to operate the recloser mechanism to close the vacuum interrupter contacts, compress the contact pressure springs and charge the opening spring is obtained from the system through a high-voltage closing solenoid. As shown in Figure 7, this solenoid is connected phase-to-phase on the recloser's source side through a high-voltage contactor (switch). Selection of the closing solenoid voltage rating is based on the phase-to-phase voltage of the system on which the recloser is to be used.

Low-voltage dc closing coils (125 or 250 Volts) are available for the closing solenoid. Rectifier kits to operate the dc coils from a 120- or 240-Vac source, as applicable, are also available. Electrical power for low-voltage closing is supplied through a junction box mounted on the recloser head.

CLOSING SOLENOID OPERATION

The closing operation is illustrated by considering the recloser to be connected to the line but locked-out (yellow manual operating handle in downward position). To close from lockout, the manual operating handle is raised to the closed position. This allows the closing solenoid contactor to close the phase-to-phase connection, thereby energizing the closing solenoid and imparting a downward acceleration to the solenoid plunger. Downward movement of the plunger causes the recloser operating mechanism to effect the following actions:

- Contact operating rods move downward to close vacuum interrupter contacts and compress contact pressure springs.
- Closing solenoid contactor opens.
- Opening spring is charged and recloser mechanism sets up for a tripping operation.

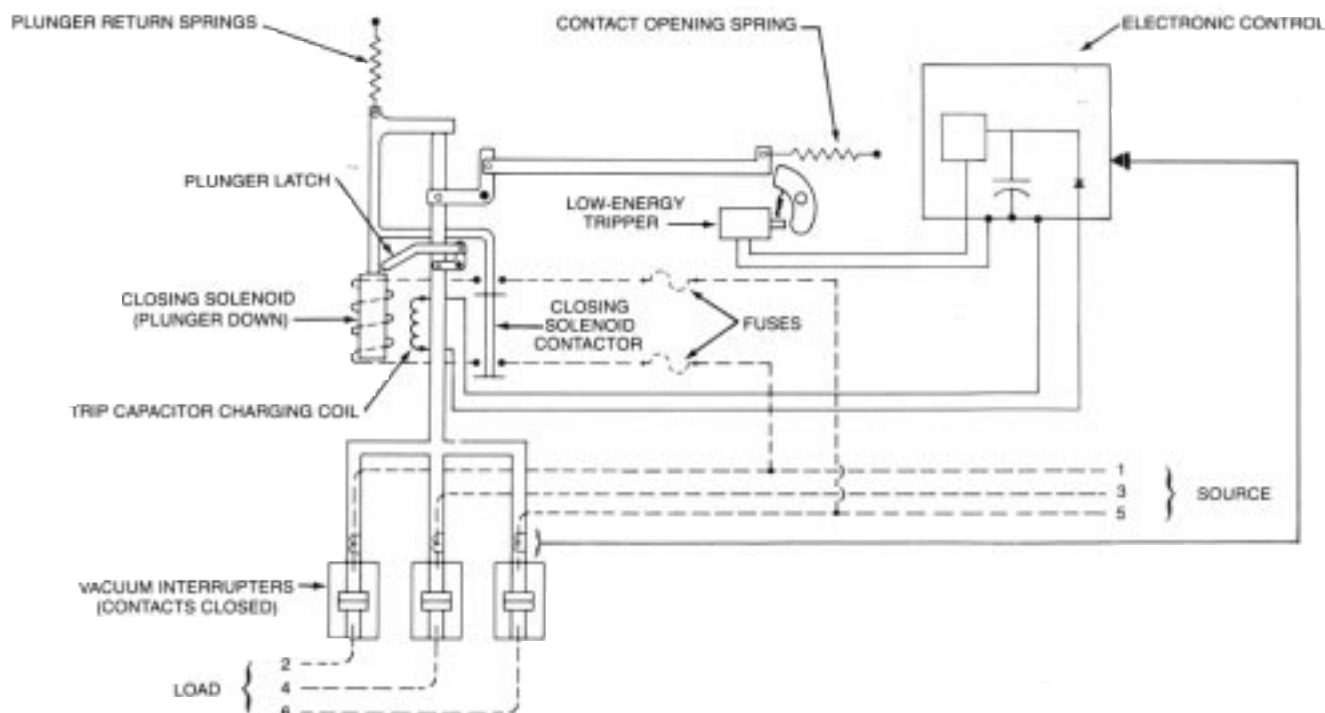


Figure 7.
Schematic diagram of recloser's major electrical and mechanical components.

Low Energy Tripper

The low energy tripping mechanism, operated from the electronic control, initiates the overcurrent tripping operation. The mechanism consists of a permanent magnet, and an armature and coil assembly which operate a trip lever (Figure 7).

During the closing operation, an electromagnetic charging coil instantaneously charges the trip capacitors in the electronic trip control—assuring that the recloser is armed and ready for an immediate trip operation if necessary. When the recloser is closed, the tripper armature plunger is held in by the magnetic force of the permanent magnet. In this position, the armature spring is compressed and energized—ready to withdraw the armature when magnetically released.

During a trip operation, the stored energy in the trip capacitors energizes the solenoid coil in the low energy tripper. This creates a counter-magnetic field which momentarily neutralizes the field of the permanent magnet—thus allowing the spring driven armature movement to instantaneously operate the trip lever which in turn opens the recloser contacts. As the recloser contacts open, the pre-charged reset spring is released and returns the solenoid plunger to its de-energized position. This low energy trip assembly is thus recocked and able to perform another trip operation as soon as a closing operation is completed.

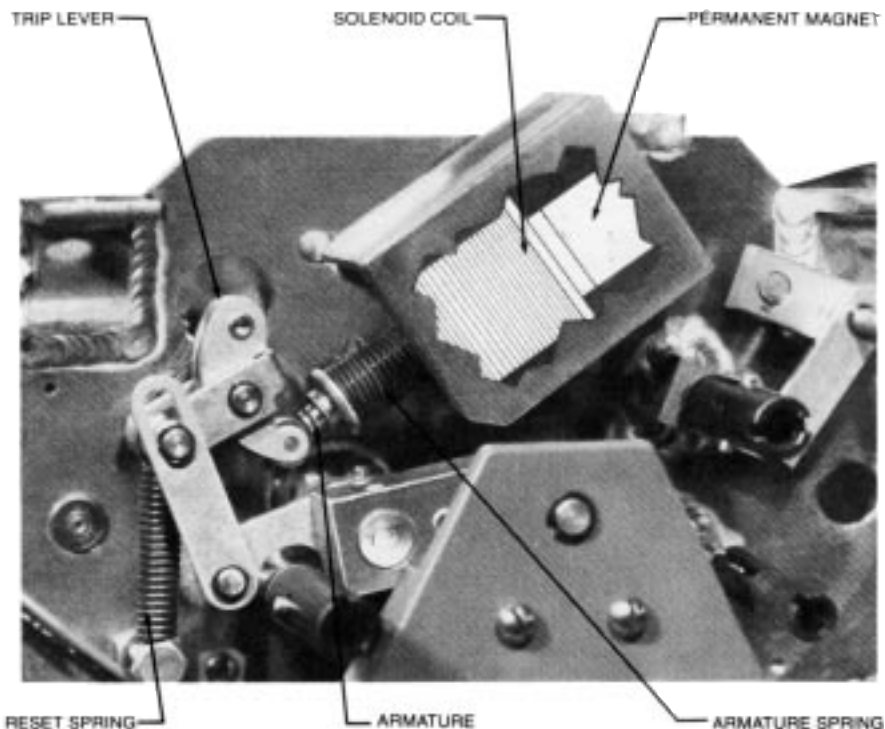


Figure 8.
Low energy tripper.

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ADJUSTMENTS

The operating characteristics of the Type KFE and KFVE Reclosers are preset and tested at the factory to operate as specified on the data plates attached to the sleet hood. However, if the recloser is relocated or the coordination scheme is modified, these characteristics can be easily changed in the field. The adjustments are accessible under the head casting after the tank has been lowered.

Operations to Lockout

The recloser can be set for 2, 3, or 4 operations to lockout. The number of trip operations to lockout is counted by the lockout integrator which trips the lockout mechanism when the preset number of phase, ground, or any combination of phase and ground operations is reached. Recloser can be set for one operation to lockout with the non-reclosing lever as described in the "Operating Levers and Indicators" section.

The number of operations to lockout is determined by the position of a cylindrical spacer, held in place by an "E" ring in one of the three grooves on the upper end of the integrator ratchet rod. Figure 9 shows the mechanism set for 4 operations to lockout. The recloser mechanism must be untanked to gain access to the lockout integrator which is mounted on one end of the mechanism frame.

To change the operations to lockout setting:

1. Remove the "E" ring from the rod.
2. Position the spacer above the groove for the desired number of operations to lockout as indicated in Figure 9 and snap the "E" ring into the groove.
3. Make sure the spacer seats properly on the "E" ring.

Number of Fast Operations

The phase- and ground-trip cams of the sequencing mechanism are used to program the number of fast trip operations required in the recloser's operating sequence. As seen in Figure 10, the cam plates contain an indexing number (0, 1, 2, 3) for both phase and ground. The operating sequence is set by simply lifting the locking tab on either the phase- or ground-trip cam and rotating it until it aligns with the desired number of operations on the fast curve. The number of slow operations will be automatically established — it will be the difference between the number of fast operations and the number of operations to lockout. In all cases, the total number of operations on both phase and

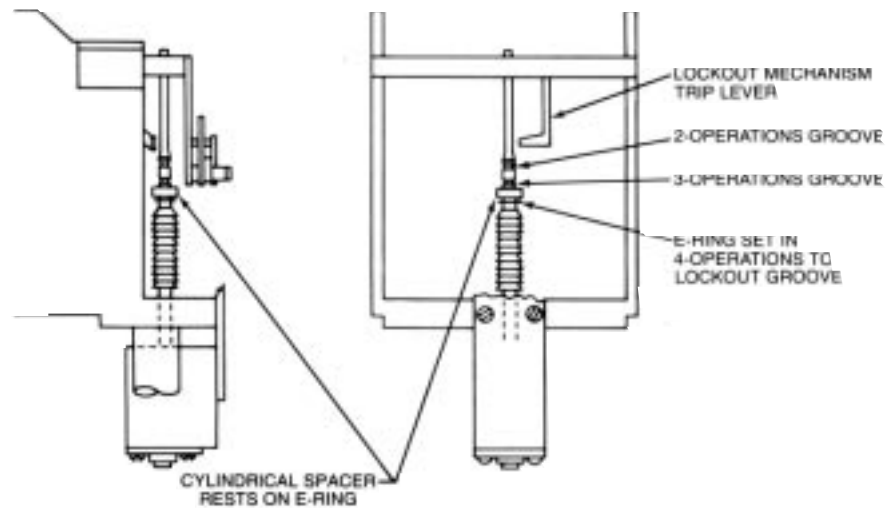


Figure 9. Simplified diagram showing operations to lockout settings on counting mechanism ratchet rod.

Sequencing Mechanism

The sequencing mechanism consists of a cam rod, a phase- and ground-trip cam, and a phase- and ground-sequencing switch connected to the electronic control. It determines on which characteristic the recloser will time its opening operations. The mechanism is actuated by movement of the ratchet rod as shown in Figure 10.

When the recloser operates, the ratchet rod moves upward as previously described and causes a similar upward movement of the cam rod. This causes a counterclockwise rotation of the cam assembly.

As the recloser operates through its preset program, the sequencing switch rollers ride along the phase- and ground-trip cam edges. When the fast operations have been completed, the cam assembly will have rotated sufficiently to cause the sequencing roller to engage the sequencing switch. This switches the electronic control to its slow timing characteristic.

The sequencing mechanism will return to its reset position as the counting mechanism resets.

PHASE-TRIP SEQUENCE

To change the phase-trip sequence setting refer to Figure 10:

1. Lift the locking tab on the spring-loaded phase-trip cam, (the front cam, stamped "PHASE") to disengage the locking pin from the indexing plate.
2. Rotate the cam to align the locking pin with the slot for the desired number of operations on the fast curve.
3. Release the tab making sure the pin is engaged in the proper slot of the indexing plate.

GROUND-TRIP SEQUENCE

To change the ground-trip sequence setting refer to Figure 10:

1. Lift the locking tab of the spring-loaded ground-trip sequence cam (the rear cam) to disengage the locking pin from the indexing plate.
2. Rotate the cam to align the locking pin with the slot for the desired number of operations on the faster curve.
3. Release the tab making sure the pin is engaged in the proper slot of the indexing plate.

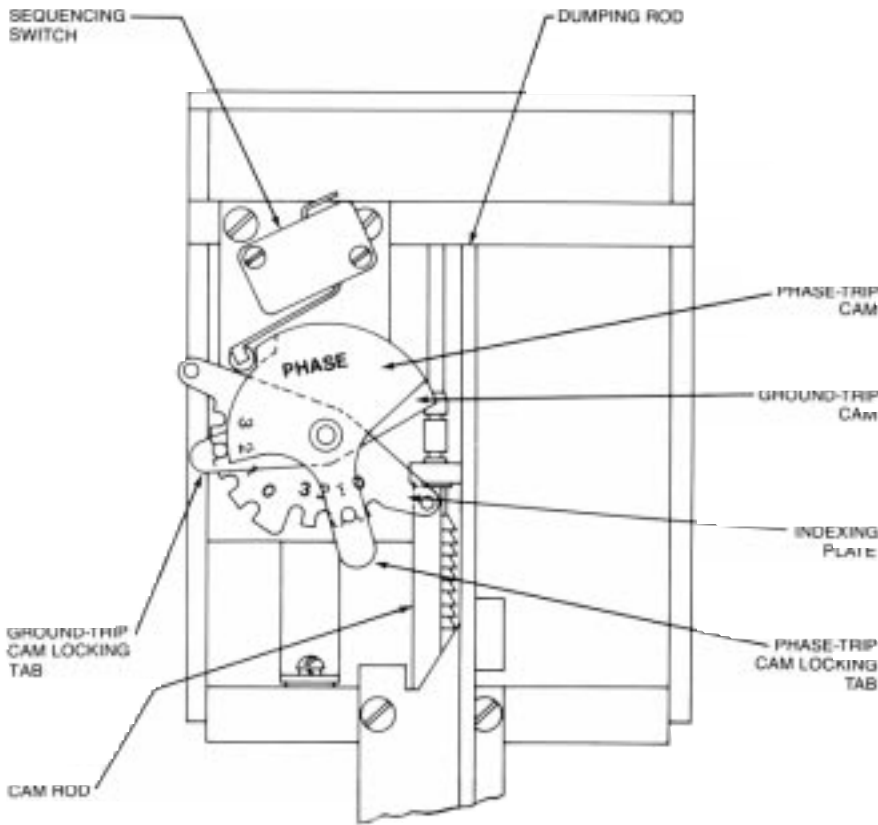


Figure 10. Sequencing mechanism and number of fast operations settings.

Reclosing Time

The reclosing time is a fixed 2-second delay controlled by an orifice on the bottom of the closing coil. Reclosing time is not adjustable.

Reset Time

The KFE and KFVE Reclosers include a quick-reset feature which resets the lockout integrator whenever lockout occurs.

For faults cleared before lockout, the integrator resets at a rate of approximately 1.5 minutes per operation at 25°C.

ELECTRONIC CONTROL

The Type KFE and KFVE Electronic Controls utilize solid-state circuitry and provides the intelligence for current sensing and trip timing. All the control electronics and electronic accessories are located in an external cabinet connected to the recloser with a 6 foot-long cable. No battery or external power source is required to operate the electronics. Power is obtained from the line by means of bushing current transformers. The separate control cabinet is intended to be mounted to the recloser tank, although it can be mounted to the pole or other mounting structure at a distance equal to the cable length.

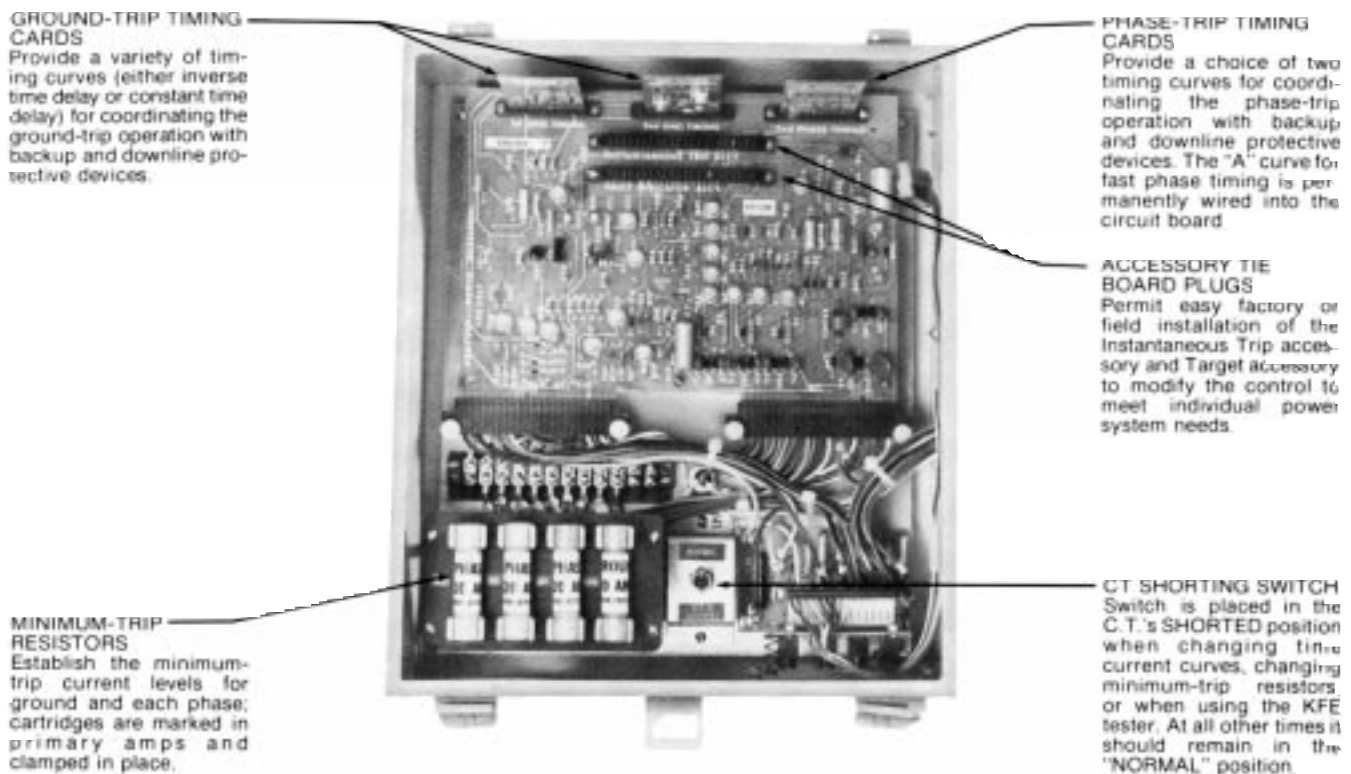


Figure 11. Type KFE and KFVE electronic control.

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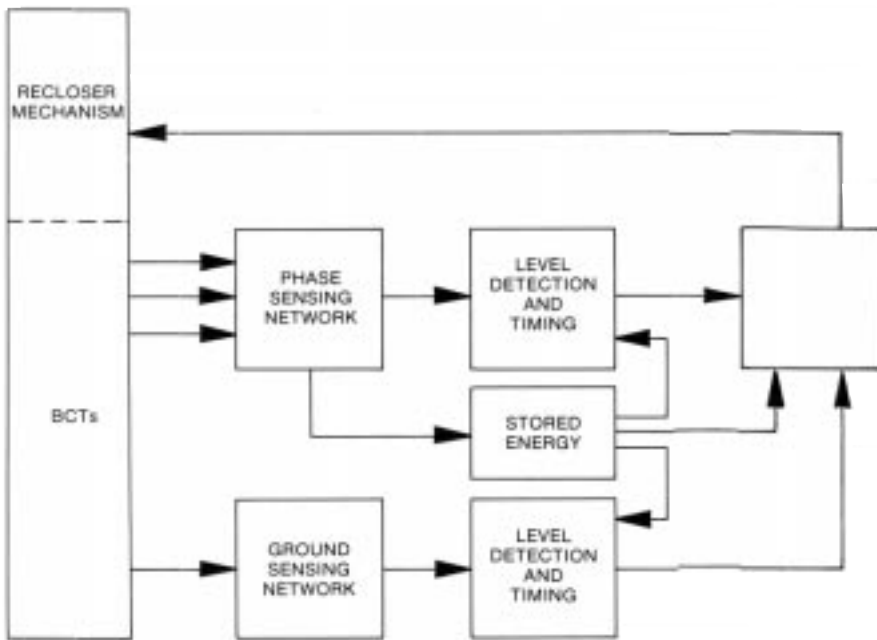


Figure 12.
Functional block diagram of the Type KFE and KFVE electronic control.

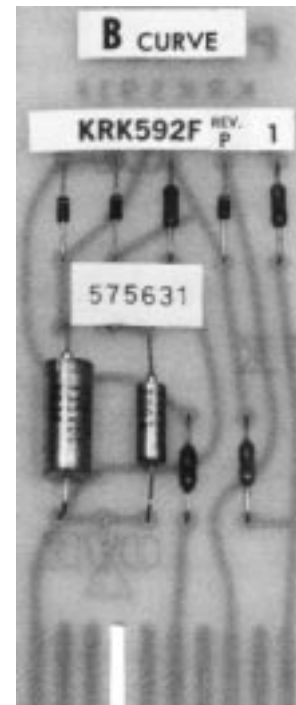


Figure 13.
Typical time-current curve plug-in circuit card (phase-trip "B" curve shown).

Current Sensing

The KFE and KFVE Reclosers have six 1000:1-ratio sensing-current transformers mounted on the bushings under the head—which provide both phase and ground (zero-sequence) current sensing. The CT's are connected to the electronic control cabinet through the 6-foot control cable. A solid-state CT protector is connected to the current transformers inside the recloser, ahead of the cable disconnect, to permit disconnection of the control cable.

Minimum-Trip Selection

The minimum-trip current ratings (Table 9), for both phase (10-800 amps) and ground (5-400 amps) are established by plug-in resistor cartridges mounted in the lower left corner of the electronic control cabinet (Figure 11). The cartridges are labeled with their minimum-trip current values and are identified for PHASE-TRIP (3 required) and GROUND-TRIP (1 required). All three phase-trip cartridges must have the same current rating. The minimum-trip setting of the recloser can be changed by merely changing the trip resistors. A 1 amp ground minimum-trip rating is also available by jumping tabs X and Y on the main circuit board and installing a 5 amp ground minimum-trip resistor.

Table 9
Minimum-Trip Current Ratings

Minimum-Trip Current Ratings* (Amps)	
Phase	Ground
10	5
20	10
30	20
50	30
70	50
100	70
140	100
200	140
280	200
320	280
400	320
450	400
560	
800	

* Minimum-trip levels are within $\pm 10\%$ of the published value at 25°C, except for the 5 amp ground-trip level which is within $\pm 15\%$ of the published value at 25°C.

Time-Current Trip Characteristics

The complete set of KFE and KFVE time-current characteristic (TCC) curves for both phase- and ground-tripping is published in "Reference Data KFE10004-E". Typical sets of curves are illustrated in Figures 14 and 15. They are established by individual circuit cards (Figure 13) that plug into the circuit board of the control.

The large number of plug-in time-current characteristic curves available for the electronic control enable the KFE and KFVE to meet a wide variety of application requirements and simplify coordination with other protective devices in the distribution system. All timing starts at initiation of a fault, or when closing into a fault. Phase and ground TCC circuit cards are not interchangeable.

PHASE-TRIP TIMING CARDS

Phase-trip TCC curves are "A" (fast), "B" (delayed), and "C" (extra-delayed). The "A" curve is permanently wired on the control circuit board. The "B" and "C" curves are available on individual printed circuit cards (Figure 13) which plug into the 2nd PHASE-TIMING socket at the top of the control circuit board.

GROUND-TRIP TIMING CARDS

Ground-trip inverse time TCC curves are "1" (fast), "2" (delayed) and "3" (extra-delayed). Also available are nine constant-time TCC curves: #1-0.1 sec, #2-0.2 sec, #3-0.5 sec, #4-1.0 sec, #5-2.0 sec, #6-3.0 sec, #7-5.0 sec, #8-10.0 sec, and #9-15.0 sec.

All ground-trip timing curves are generated by individual printed circuit cards which plug into the 1st GROUND-TIMING or 2nd GROUND-TIMING sockets at the top of the control circuit board as shown in Figure 11.

When dual timing operation is programmed the TCC curve in the 1st GROUND-TIMING socket always precedes the curve in the 2nd GROUND-TIMING socket. Therefore, the faster of the two times selected should be installed in the 1st GROUND-TIMING socket. When single timing operation is programmed the timing card is installed in the 2nd GROUND-TIMING socket and the ground-trip sequence cam is set for 0 fast operations.

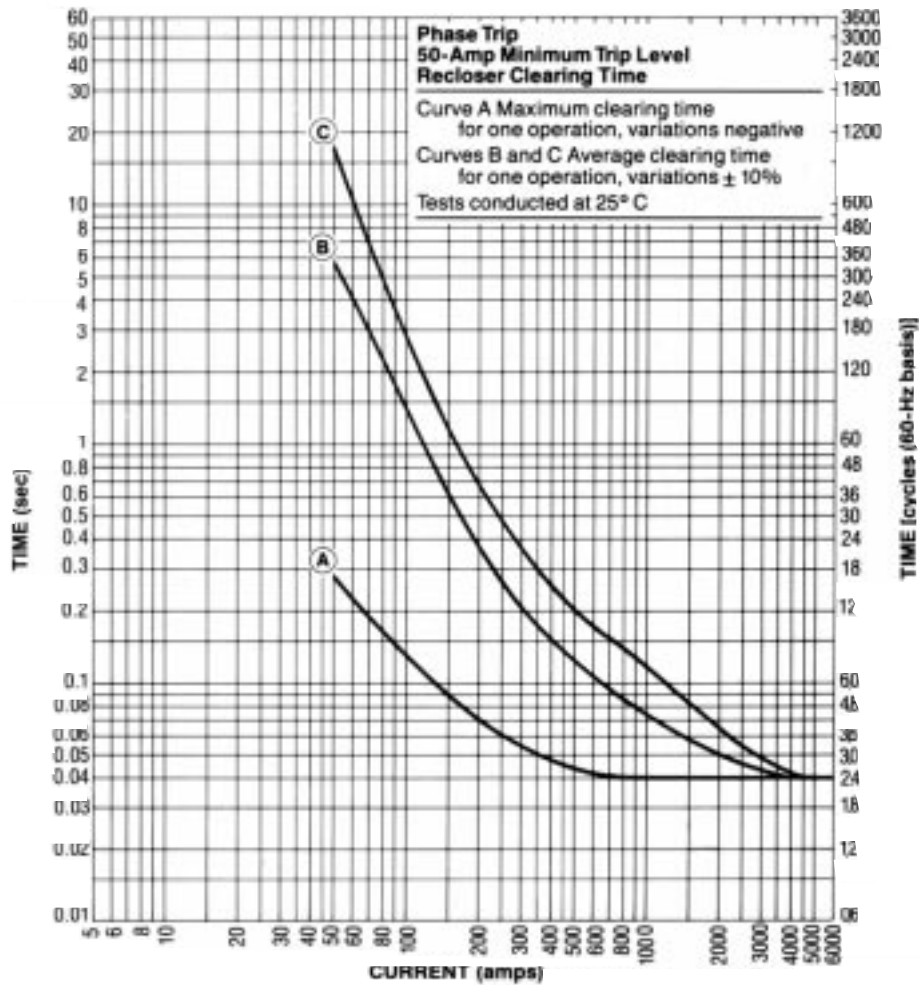


Figure 14.
Typical set of time-current curves for phase-trip operations.

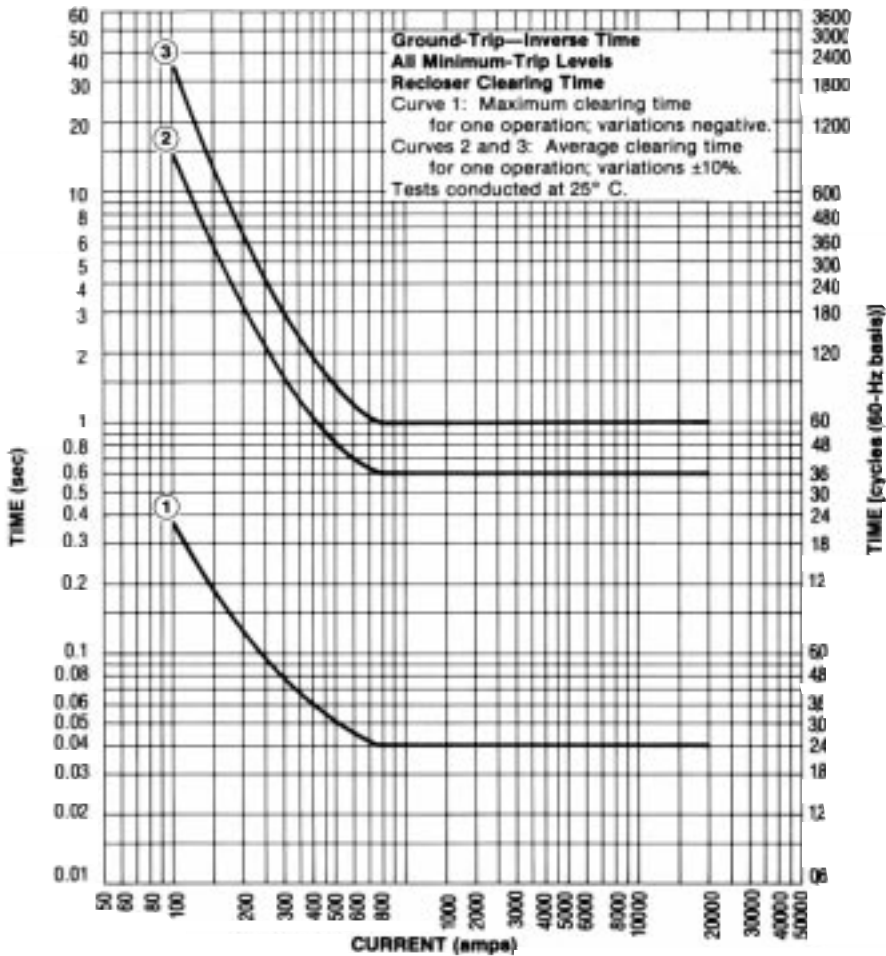


Figure 15.
Inverse time-current curves for ground-trip operation.

Control Power

The KFE and KFVE reclosers are completely self-contained and require no external power source or battery to operate the electronics. The electronic circuitry is powered from the line by means of bushing current transformers mounted under the recloser head. A minimum of 5 amperes of primary current flow is sufficient to power the electronics and charge the trip capacitors which actuate the low-energy tripper. In addition, a pickup coil wound on one leg of the closing solenoid frame provides additional charge to the trip capacitors during each reclosing operation. This insures that sufficient tripping power is available immediately following a closing operation—thus eliminating the necessity of a time delay to charge trip capacitors from load or fault current.

INSTALLATION

Preliminary Checks

OIL LEVEL

1. Using the dipstick located on the top of the recloser head, make sure the oil in the recloser tank is between the limits specified on the dipstick.
2. Perform a dielectric test on the oil in accordance with ASTM-approved testing procedures (see R280-90-1 for detailed oil specifications and tests).
 - A. 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 the dielectric strength to the acceptable minimum level.

RECLOSER

Make sure that the ratings and settings listed on the recloser data plates are correct for the planned installation.

CAUTION

Closing coil voltage rating of the recloser must equal system voltage.

All reclosers are carefully tested and adjusted at the factory to operate according to published data. Well equipped test facilities, a detailed testing procedure, and thoroughly trained personnel assure accurately calibrated equipment. Each recloser leaves the factory ready for installation. Pre-installation testing is not necessary.

ELECTRONIC CONTROL

All electronic controls are carefully tested at the factory and shipped with plug-in components connected and ready for operation. Before installation, inspect control and make sure that all plug-in components are correct for the planned installation and that the control cable is connected between recloser and control.

VACUUM INTERRUPTERS



RADIATION WARNING

At voltages up to the specified test voltages, the radiation emitted by the vacuum interrupter is negligible. However at higher test voltages radiation injurious to personnel may be emitted. See *Radiation Warning Service Information Bulletin S280-90-1, Vacuum Interrupter Radiation Warning*, for further details.

Radiation Information

It is possible for X-radiation to result when voltage in excess of the 27-kV rated maximum voltage is applied across the open-contact gap of a vacuum interrupter. Such radiation can become a health hazard upon long exposure at close range. When performing high-voltage tests on vacuum reclosers, personnel safety can be insured by noting the following information and taking the necessary precautions.

1. American National Standard C37.09-1964 "A-C High-Voltage circuit Breakers" allows tests after delivery which include application of 75 percent of rated low-frequency withstand voltage across open contacts of the interrupters.

NOTE: To prevent possible interrupter damage, dc test source should be limited to 100 milliamps maximum. (A dc arc, once struck, will not extinguish since there is no current zero as in ac.)

2. At these voltages, radiation is negligible when interrupters are mounted in the recloser operating structure, installed in the oil-filled recloser tank, and have contacts open to the recommended .953 cm (3/8 in.) open-contact gap.
3. Testing at voltages higher than those listed in Item 1 may cause radiation emission injurious to personnel. If testing is to be performed at voltages above those listed in item 1, additional radiation shielding is required.
4. Vacuum interrupter testing above 50 kV ac rms is not recommended.

To check the vacuum integrity of the interrupter assemblies, the following procedure can be used:

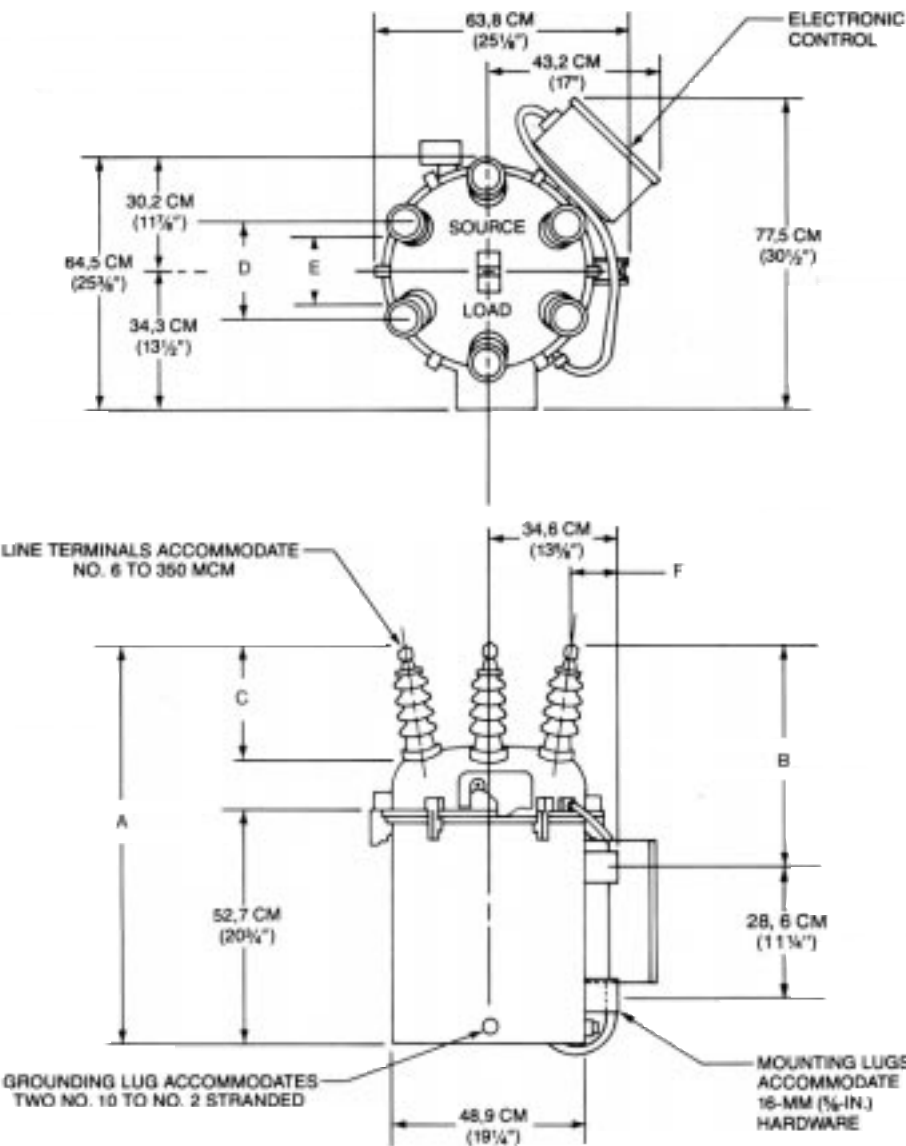
With the recloser in the open position, perform a high-pot test across each open vacuum interrupter assembly at 37.5 kV rms, 60 Hz KFE, 45 kV rms, 60 Hz KFVE; or 53 kV dc KFE, 63.5 kV dc KFVE; for one minute. To prevent possible damage to the vacuum interrupters, the dc test source should be limited to a maximum of 100 milliamps. The interrupter should withstand the test voltage and should not load down the source.

Lifting

CAUTION

Follow all approved safety practices for lifting methods and equipment when lifting the recloser.

The KFE and KFVE reclosers are equipped with a single lifting lug intended for vertical lifting. When lifting the recloser for mounting or any other purpose, follow approved safety practices, lift the load smoothly and do not allow it to shift.



Mounting

DIRECT MOUNTING

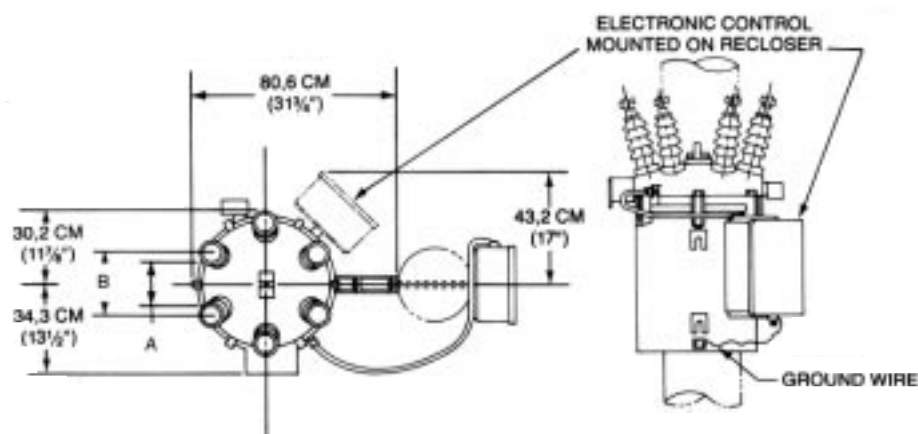
Type KFE and KFVE reclosers can be mounted directly to a substation structure or frame if adequate electrical and physical clearances can be allowed (Figure 16). The recloser should be mounted using 1,59 cm (5/8 in.) diameter mounting hardware which must be furnished by the customer. When mounting the recloser on a flat surface, be sure to use adapter plates (shipped with recloser) between the tank lugs and the flat surface.

DIM.	KFE		KFVE	
	ST'D. UNIT	ST'D. UNIT	ST'D. UNIT	UNIT w/BCT's
A	93,7 CM (36 3/4")	109,8 CM (43 1/4")	121,4 CM (47 3/8")	
B	54,8 CM (21 5/8")	69,9 CM (27 1/2")	81,4 CM (32 1/8")	
C	28,3 CM (11 1/8")	44,5 CM (17 1/2")	56 CM (22 1/4")	
D	27,3 CM (10 3/4")	23,2 CM (9 1/8")	26,0 CM (10 1/4")	
E	20,3 CM (8")	31,4 CM (12 3/8")	34,3 CM (13 3/8")	
F	11,1 CM (4 3/8")	7,6 CM (3")	5,1 CM (2")	

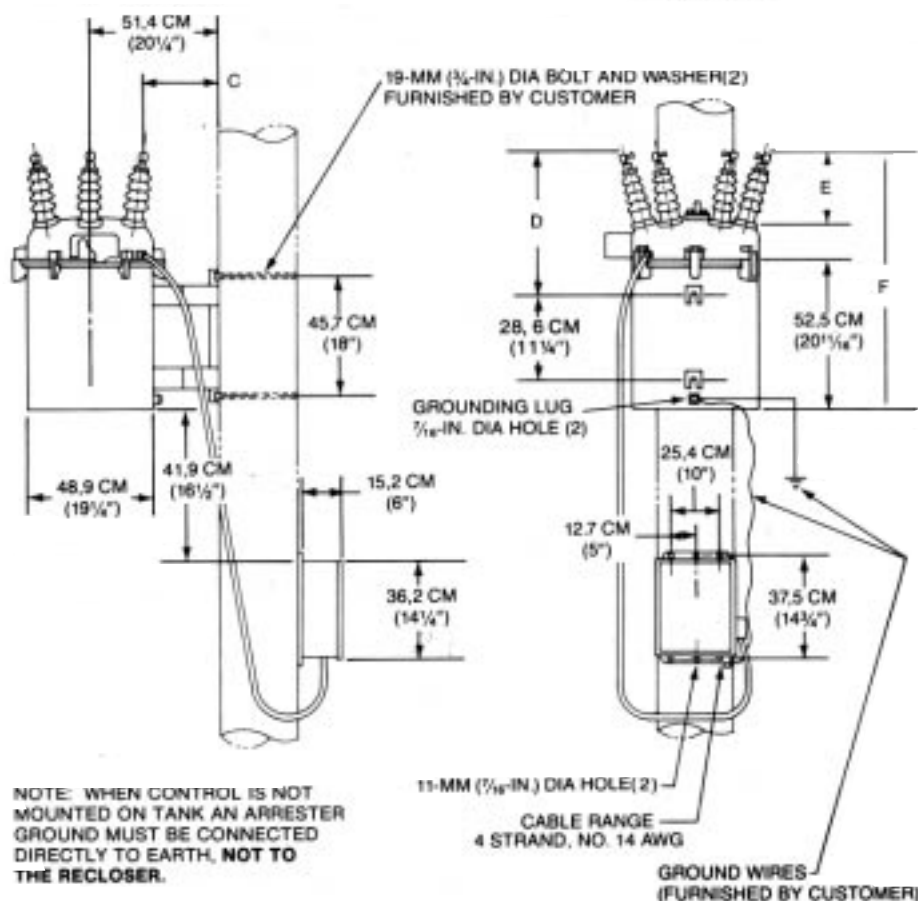
Figure 16.
Mounting dimensions for KFE and KFVE reclosers.

POLE MOUNTING

KFE and KFVE reclosers can be pole mounted by using the pole-mounting extension hanger shown in Figure 17. Hardware to attach the extension hanger to the recloser is included with the hanger. Be sure to use flat-surface adapter plates between recloser tank lugs and extension hanger lugs. Hardware to mount on the pole must be furnished by the customer.



NOTE: WHEN CONTROL IS MOUNTED ON TANK AN ARRESTER GROUND MAY BE CONNECTED TO TANK OR DIRECTLY TO EARTH.



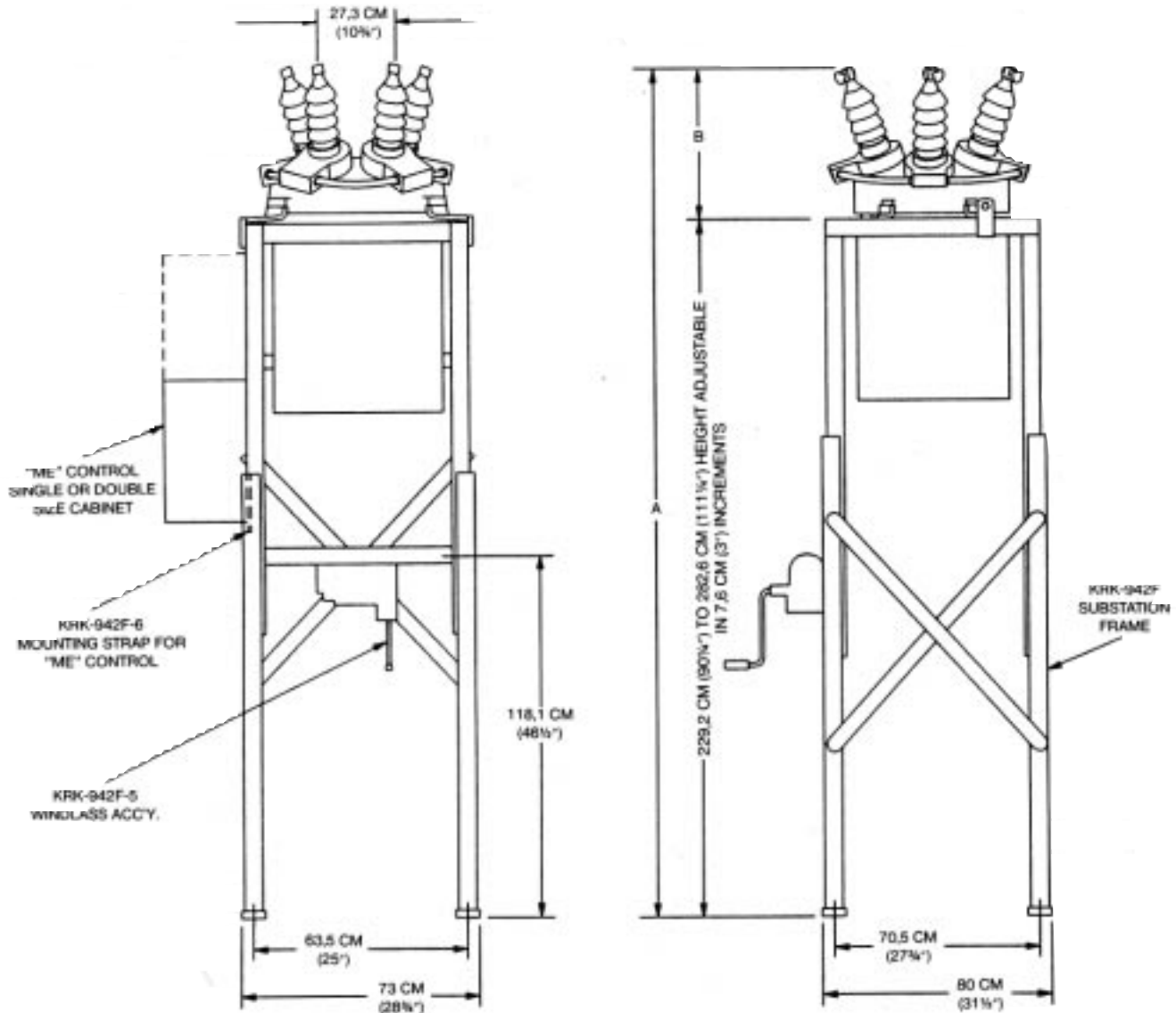
	KFE	KFVE
A	20.3 CM (8")	23.2 CM (9 1/4")
B	27.3 CM (10 3/4")	31.4 CM (12 3/8")
C	27.9 CM (11")	24.4 CM (9 5/8")
D	54.8 CM (21 5/8")	69.8 CM (27 1/2")
E	28.5 CM (11 1/4")	44.5 CM (17 1/2")
F	93.7 CM (36 7/8")	109.8 CM (43 1/4")

Figure 17. Mounting and clearance dimensions for pole mounting extension hanger.

SUBSTATION ELEVATING STRUCTURE

KFE and KFVE reclosers can be substation mounted by using the KRK942F Substation Elevating Structure shown in Figure 18. Hardware to attach the recloser to the elevating structure is furnished with the structure. Hardware to anchor the structure must be furnished by the customer.

A series of mounting holes, spaced 7,6 cm (3 in.) apart at the upper end of each identical extension leg permits varying the recloser height.



	Dimension	A	B
KFE	Without BCT's	271,3 CM (106 1/4") to 324,6 CM (127 3/4")	42,0 CM (16 1/2")
	With BCT's	283,4 CM (111 5/8") to 336,7 CM (132 1/4")	54,1 CM (21 3/8")
KFVE	Without BCT's	286,5 CM (112 3/4") to 339,9 CM (133 1/4")	57,3 CM (22 5/8")
	With BCT's	298,6 CM (117 5/8") to 352,6 CM (138 1/4")	71,0 CM (27 7/8")

Figure 18. Mounting and clearance dimensions for KFE/KFVE recloser with KRK942F Substation Elevating Structure.

MAIN WIRING CONNECTIONS FOR INSTALLATION

Bypass Switches

It is suggested that KFE and KFVE reclosers installation be provided with bypass and disconnect switches for maintenance ease. Figure 19 illustrates a typical installation with crossarm mounted by-pass switches and Figure 20 illustrates an installation with inline bypass switches.

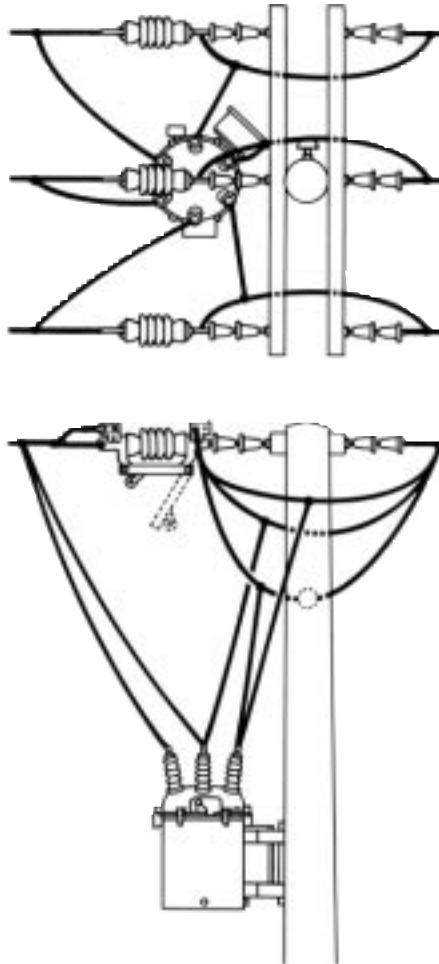


Figure 19.
Typical recloser installation with cross-
arm mounted bypass switches.

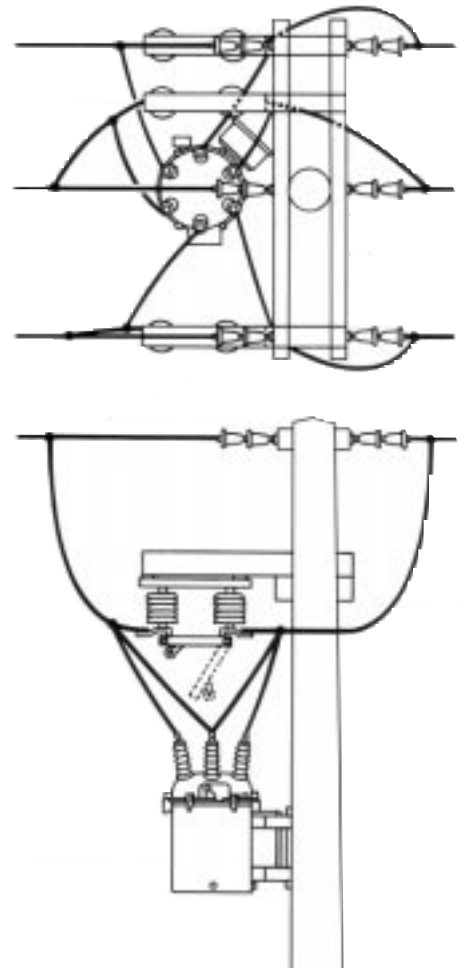


Figure 20.
Typical recloser installation with inline
bypass switches.

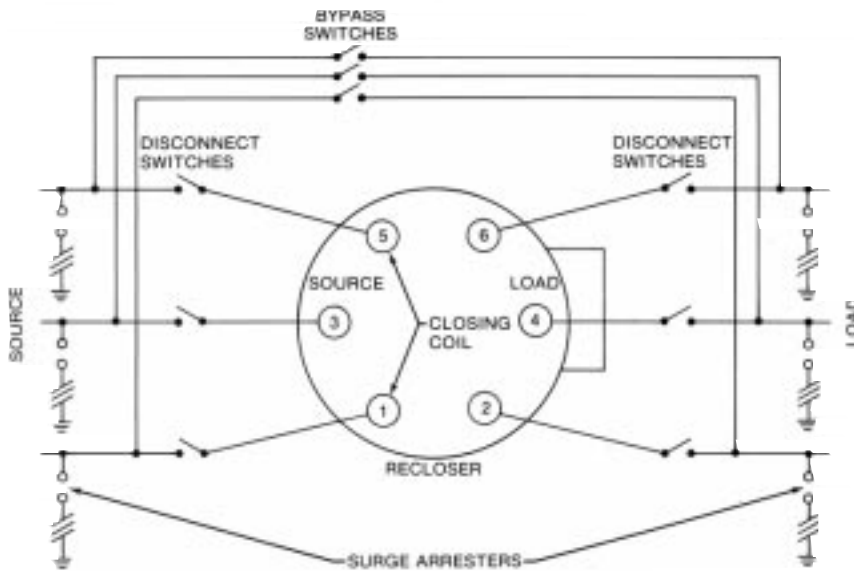


Figure 21.
Typical recloser connections with bypass and disconnect switches and surge protection on source and load sides.

Surge Protection

Reclosers operate best when protected with surge arresters. on line applications, surge protection is recommended on both sides of the recloser. If protection is to be provided on one side only, install the arresters on the source side. In substations, arresters are located on the load side. Figure 21 illustrates a protection scheme for reclosers, including surge arresters.

Grounding

The recloser ground connector, located on the recloser tank near the bottom (Figure 17) will accommodate two no.10 solid through no. 2 stranded conductors.

Another ground connector is provided at the bottom of the electronic control cabinet (Figure 17) for connecting a no. 14 through no. 4 stranded grounding cable to the substation elevating structure or to other suitable ground if the control is remotely mounted.

Connect the ground in accordance with utility standards.

High Voltage

Bushing terminals are universal clamp type connectors which accept no. 6 through 350 MCM conductors. High voltage line connections must be made to recloser bushing terminals in accordance with "SOURCE" and "LOAD" markings on the head casting.

CAUTION

Source leads **MUST** be connected to terminals 1,3 and 5 marked "SOURCE" on the head casting to provide operating energy for the high voltage closing solenoid. The closing solenoid is connected between terminals 1 and 5 during a closing operation.

PLACING RECLOSER IN SERVICE

Always follow approved local practice when placing recloser in service. With the recloser connected as shown in Figure 21 and source side high voltage lines energized, the recloser can be placed in service. Move the yellow manual operating handle under the sleet hood to the "CLOSE" position as indicated by the Contact-Position Indicator on the sleet hood. The recloser should immediately close. Block ground by means of the ground-trip disabling switch. Close the load side disconnect switch and open the bypass switch. Then, open the ground-trip disabling switch. The recloser is now in service. To remove from service, block ground and then close the bypass switch and open the disconnect switches. To prevent a trip operation, always block ground when bypassing the recloser when phases are temporarily unbalanced.

Manual Operation of Energized Recloser

To manually operate an energized recloser involves only a hookstick engagement of the yellow operating handle located under the sleet hood. When the handle is pulled down, the mechanism is tripped to open the main contacts. When the handle is pushed up, the closing solenoid is energized to latch the main contacts in the closed position.

Manual Operation of De-energized Recloser

WARNING

Never use a manual closing tool to close an energized recloser.

A manual closing tool (KA90R) is used for closing a *de-energized* recloser. Remove the pipe plug on the side of the cover casting to provide access for the closing tool to engage the main operating shaft of the recloser mechanism. A de-energized recloser is tripped open merely by pulling down the yellow operating handle.

Use the following procedure for manual slow closing of a de-energized recloser:

1. Make sure yellow handle is in the closed position.
2. Remove pipe plug in side of recloser head and insert closing tool.

CAUTION

Forcing the closing tool beyond the mechanism stop may shear the pin on the closing shaft.

3. Engage the main operating shaft, and rotate the tool about 1/4 turn clockwise to close the recloser contacts. Avoid forcing the closing tool beyond the stop; doing so may shear the pin on the closing shaft.
4. A de-energized recloser can be tripped open merely by pulling the yellow operating handle down.

CAUTION

Be sure to replace the pipe plug in the head casting before placing the recloser in service.

Non-Reclosing Operation

When the non-reclosing lever has been manually pulled down into the nonreclosing position, any current over minimum-trip rating will cause a mechanical linkage to automatically lock open the recloser on the first trip operation instead of cycling through the normal operating sequence. This immediate lockout protection is especially important for hotline work.

The non-reclosing lever does not interfere with manual recloser operation. The recloser can be opened or closed manually regardless of the position of the non-reclosing lever.

In-Service Recloser Operation

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

TESTING

Type KFE and KFVE 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 trained personnel assure accurate calibration. Permanent records are kept of each recloser's test performance. Thus, each recloser leaves the factory ready for installation, and pre-installation testing is not necessary.

However, should verification of recloser operation be desired prior to installation, the following characteristics can be checked:

1. Number of operations to lockout.
2. Number of fast openings.
3. Satisfactory operation of closing solenoid.
4. Minimum-trip current.
5. Reclosing time.
6. Operation of the non-reclosing feature.

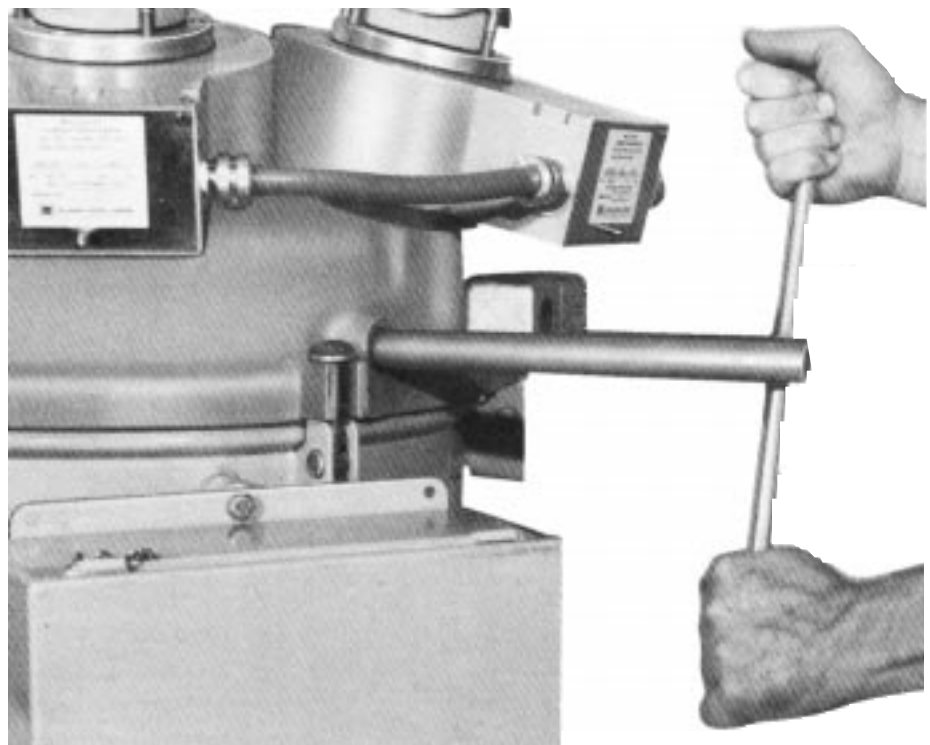


Figure 22.
Using a KA90R manual reclosing tool to operate the recloser.

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The test findings should agree with the information shown on the data plates located on the sleet hood of the recloser. The recloser can be test tripped with a low-voltage ac source, however for automatic closing a high-voltage ac source is required. For personnel safety the recloser and high-voltage transformer should be enclosed in a test cage to prevent accidental contact and all grounding precautions should be observed. All metering and measuring equipment should be located outside of the test cage.

IMPORTANT:

When testing phase minimum-trip current, be sure to disable ground-trip function. Testing on individual phases without disabling ground-trip will cause the ground-trip function to operate.

CAUTION

Solidly ground recloser to a suitable earth ground.

CAUTION

Do not energize the recloser out of oil.

CAUTION

Do not attempt to trip a recloser using a dc source such as a storage battery. The vacuum interrupters may be severely damaged if interruption of the dc arc is attempted.

Test Equipment Required

A suggested test circuit is shown in Figure 23. The following equipment is required for this circuit:

1. **Variable autotransformer** — 240 Volts, 20 amps.
2. **Low-voltage transformer T₂**—Ratio and kVa size depend upon size of recloser trip coil and maximum current to be used.
3. **Ammeter** — Full scale deflection should be at least 300% of reclosing rating. Use of current transformer may be required.
4. **Cycle counter** — or other timing device.
5. **High-voltage transformer T₁**—Used to operate high-voltage closing solenoid. In general, a 50-kVa transformer having an impedance of about three percent will be satisfactory if the source impedance is reasonably low. Low-side rating should equal voltage of available test source. High-side should equal voltage of recloser's closing solenoid. Be sure minimum allowable voltage shown in Table 10 is maintained at recloser terminals during the two- to three-cycle interval the closing solenoid is energized.

Test Procedures—Electrical Closing

WARNING

Solidly ground leads X and Z and inter-connect to the recloser tank. DO NOT connect leads W and Y to the SAME PHASE. Dangerous voltages to ground exist on the phase connected to Y.

OPERATION OF CLOSING SOLENOID

Assemble and connect the equipment as shown in Figure 23.

1. Trip the recloser manually by moving manual operating (yellow) handle down to "LOCKOUT" position, then move the yellow handle up to its "CLOSED" position.
2. Energize the high-voltage transformer T₁. The recloser should close immediately, indicating correct operation of the closing solenoid.

Table 10
Closing Solenoid Electrical Constants and Minimum Voltage

Closing Solenoid Rating (kV)	Closing Solenoid Code Number	Minimum Allowable Voltage at Recloser When Solenoid is Energized-(Volts)
50-Hz 6.0 11.0 13.2 14.4	51 52 53 54	5100 9350 11220 12240
60-Hz 2.4 4.16-4.8 6.0 12.0-13.2 14.4 20	21 22 31 30 27 29	2040 3540 5100 10200 12240 17000
23-24.9	33	19550

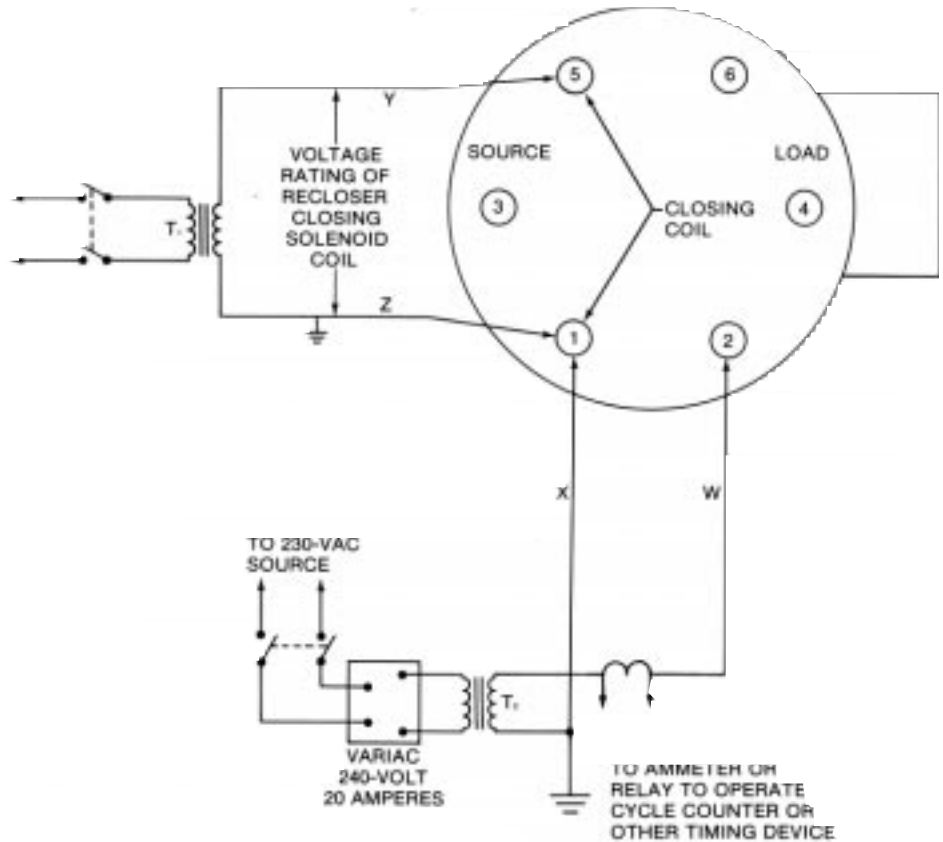


Figure 23.
Suggested test diagram for low-voltage tripping, high-voltage closing.

PHASE MINIMUM-TRIP CURRENT

When testing phase minimum-trip level, block ground by lowering ground disable handle.

"A" Phase (Bushings 1 and 2)

Connect leads X and W from low-voltage transformer T2 to bushing terminals 1 and 2 respectively, and proceed as follows:

1. Program one or more "A" trip characteristics.
2. With manual operating handle in its "CLOSED" position, energize high-voltage transformer T1 to close the recloser.
3. De-energize transformer T1.
4. Energize variable autotransformer and slowly raise the voltage from zero, noting the ammeter reading. If current is raised gradually when tripping on an "A" trip characteristic, the minimum-trip is essentially that current at which the trip occurs.
5. Lower the yellow handle to lockout the recloser. This will cancel count accumulation so that subsequent operation will be on first "A" curve characteristic.

"B" Phase (Bushings 3 and 4)

Connect leads X and W from low-voltage transformer T2 to bushing terminals 3 and 4 respectively, and repeat Steps 1, 2, 3, 4 and 5 above.

"C" Phase (Bushings 5 and 6)

Before applying any voltage to "C" Phase reverse the high-voltage transformer leads; connect grounded lead Z to Bushing 5 and hot lead Y to Bushing 1. Then connect the low-voltage transformer test leads X and W to Bushings 5 and 6 respectively, and repeat Steps 1, 2, 3, 4 and 5 above.

GROUND MINIMUM-TRIP CURRENT

Accurate minimum-trip is best obtained if the first ground-trip characteristic is #1 inverse, or #1, 2, or 3 constant time. Slower tripping characteristics require very gradual increase in current. Use fastest time available. Connect leads X and W on low-voltage transformer T2 to one pair of bushing terminals (1 and 2, or 3 and 4, or 5 and 6) and use the following procedure:

1. Set the Ground-Trip Disabling Switch to "NORMAL" (up) position.
2. Move the yellow manual operating handle to its closed position and use the manual closing tool to close the recloser.
3. Energize the variable autotransformer and slowly raise the voltage from zero. Note the ammeter reading when the recloser trips and compare to plug-in trip resistor value.

OPERATING SEQUENCE AND RECLOSING TIME—PHASE

With the test circuit connected as shown in Figure 23 and ground blocked by lowering the Ground Disable Handle, proceed as follows:

1. Move the yellow manual operating handle to its "CLOSED" position and energize the high-voltage transformer T1 to close the recloser. Leave T1 energized.
2. Set the variable autotransformer high enough to cause the recloser to trip readily (suggest 150 to 300 percent minimum-trip resistor current rating).
3. Energize the low-voltage transformer T2. The recloser should trip, reclose, and continue tripping and reclosing through its programmed sequence to lockout.
4. Observe the following:
 - A. Count the number of fast operations by watching the Contact Position Indicator on the sleet hood.
 - B. Read reclosing time from the timing device arranged to record the period during which the current is not flowing.
 - C. Count the number of operations to lockout by counting the trip operations until the yellow handle drops.

IMPORTANT:

When repeating tests, be sure to allow enough time for the lockout integrator piston to reset. Time required is approximately 1.5 minutes per recloser trip operation. Fast resetting of integrator occurs immediately following lockout. Yellow handle can be raised after approximately 5 seconds (at room temperature).

OPERATING SEQUENCE AND RECLOSING TIME—GROUND

The verification of ground operating sequence is similar to phase except that the Ground Disable switch must be opened and the preset fault must be below phase minimum-trip.

With the test circuit connected as shown in Figure 23, proceed as follows:

1. Move the yellow manual operating handle to its "CLOSED" position and energize the high-voltage transformer T1 to close the recloser. Leave T energized.
2. Set the variable autotransformer high enough to cause the recloser to trip readily (make sure the setting is below phase minimum-trip resistor current rating).
3. Energize the low-voltage transformer T2. The recloser should trip, reclose, and continue tripping and reclosing through its programmed sequence to lockout.
4. Observe the following:
 - A. Count the number of fast operations by watching the Contact-Position Indicator on the sleet hood.
 - B. Read closing time from the timing device arranged to record the period during which the current is not flowing.
 - C. Count the number of operations to lockout by counting the trip operations until the yellow handle drops.

OPERATION OF NON-RECLOSING LEVER

While testing on any phase as previously described, operation of the nonreclosing feature can be checked, as follows:

1. Pull down the non-reclosing lever.
2. Repeat test steps 1, 2 and 3 in the "Operating Sequence and Reclosing Time-Phase" section.
3. The recloser should not reclose after the first trip operation and the yellow handle should drop indicating recloser lockout.

Test Procedures— Manual Closing

The manual closing tool (Figure 22) permits manual closing of the main contacts of the recloser for test purposes, when a high voltage source for closing is not available. Minimum-trip current and operating sequence can be tested in this manner.

Refer to instructions covering “Manual Operation of De-energized Recloser” for closing procedure when using the manual closing tool. The best procedure is to have one person operate the closing tool while another regulates the tripping circuit and observes test results.

IMPORTANT:

After each recloser trip, approximately two seconds elapse (reclosing time) while the closing solenoid plunger is moving upward. Near the end of this time period two metallic clicks will be heard. The first is the main toggle latch resetting; the second is the closing solenoid contactor closing. As soon as these clicks are heard, the closing tool can be turned to close the recloser.

PHASE MINIMUM-TRIP CURRENT

When testing phase minimum-trip level, block ground by lowering Ground Disable handle.

“A” Phase (Bushings 1 and 2)

Connect leads X and W from low-voltage transformer T2 to bushing terminals 1 and 2 respectively, and proceed as follows:

1. With manual operating handle in its “CLOSED” position, manually close the recloser.
2. Energize the variable autotransformer and slowly raise the voltage from zero, noting the ammeter reading at which tripping occurs.

“B” Phase (Bushings 3 and 4)

Connect leads X and W from low-voltage transformer T2 to bushing terminals 3 and 4 respectively, and repeat Steps 1 and 2 above.

“C” Phase (Bushings 5 and 6)

Connect leads X and W from low-voltage transformer T2 to bushing terminals 5 and 6 respectively, and repeat Steps 1 and 2 above.

GROUND MINIMUM-TRIP CURRENT

Accurate minimum-trip is best obtained if the first ground-trip characteristic is #1 inverse or #1, 2, or 3 constant time. Slower tripping characteristics require very gradual increase in current. Use fastest trip available.

Connect leads X and W on low-voltage transformer T2 to one pair of bushing terminals (1 and 2, or 3 and 4, or 5 and 6) and use the following procedure:

1. Set the Ground-Trip Disabling Switch to “NORMAL” (up) position.
2. Move the yellow manual operating handle to its closed position and use the manual closing tool to close the recloser.
3. Energize the variable autotransformer and slowly raise the voltage from zero. Note the ammeter reading when the recloser trips and compare to plug-in trip resistor value.

RECLOSER ACCESSORIES

The Type KFE and KFVE reclosers can be equipped with a number of factory-installed accessories which are described on the following pages. Power requirements, connection instructions and adjustments where needed are also described.

Extra Creepage Bushings

When KFE reclosers are to be installed where extensive salt spray, smog, smoke or other atmospheric contaminants reduce the effectiveness of porcelain insulation, Extra Creepage Bushings (KRK288FC) can be supplied. Standard Type KFE recloser bushings provide 29,6 cm (11-5/8 in.) of creepage; extra creepage accessory bushings provide 43,2 cm (17 in.).

Bushing-Type Multi-Ratio Current Transformers

A set of three 600:5 multi-ratio current transformers for operating relays or load meters can be factory installed externally on the source side bushings (Figure 24). The accessory includes three current transformers, conduit, fittings and factory wiring to a terminal block mounted in a weatherproof junction box. Taps on the secondary winding provide the different ratios. The available ratios and their corresponding terminal connections are shown in Table 11. The terminal arrangement for the tapped secondary (Figure 25) is accessible when the cover plate on the transformer housing is removed.

CAUTION

The recloser is shipped with each BCT secondary shorted with a jumper wire between terminals X1 and X5. Do not remove the jumper wire until external connections to the CT's have been completed. Energizing the recloser with the jumper wire removed and the CT's not connected may generate dangerous voltages in the CT secondaries.

Table 11
Bushing-Type Current Transformer Ratios and Terminal Connections

Ratio	Terminal Connection
600:5	X1-X5
500:5	X2-X5
450:5	X3-X5
400:5	X1-X4
300:5	X2-X4
250:5	X3-X4
200:5	X4-X5
150:5	X1-X3
100:5	X1-X2
50:5	X2-X3

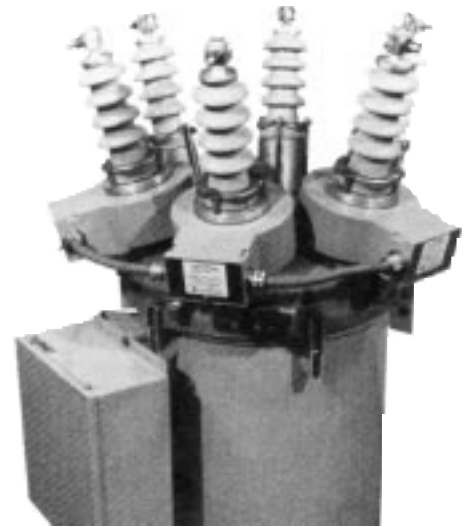


Figure 24.
Bushing Current Transformer accessory mounted on recloser bushings.

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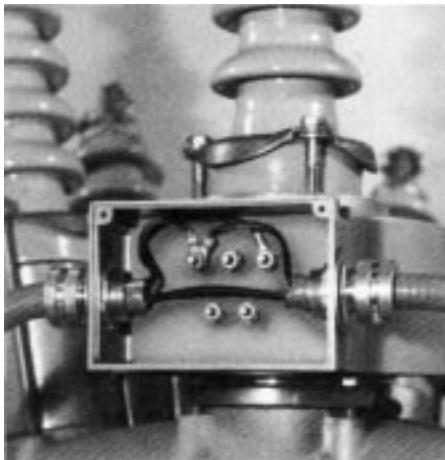


Figure 25. Bushing Current Transformer secondary winding taps are located in the transformer housing. 82084KMA

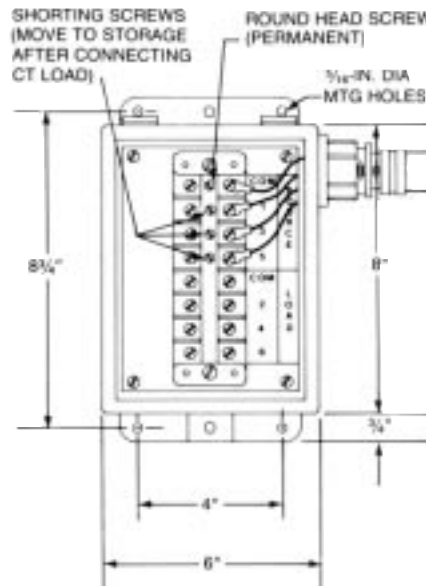


Figure 27. BCT Junction Box dimensions and position of shorting thumbscrews in terminal block when shipped to customer.



Figure 26. Bushing Current Transformer secondary tap wired to junction box for customer connections. 82086KMA

Bushing Current Transformer Connections

Customer connections to the secondary taps are made in the Bushing Current Transformer Junction Box as shown in Figure 26.

Figure 27 shows the shorting thumbscrews in the BCT terminal block “as shipped” and provides instructions for moving the thumbscrews in order to put the accessory in operation. Note that in the “as shipped” condition, the 1, 3, and 5 terminals are each short-circuited to the grounding bar with a thumbscrew. After external connections are made, the three thumbscrews are removed and stored in the corners of the terminal block. The round-head machine screw remains in the COM terminal position.

Accessory-Connection Junction Box

The Accessory-Connection Junction Box (KRK433FA or KRK433FB) must be included when KFE reclosers are to be furnished with one or more of the following accessories: Auxiliary Switch, Lockout-Indicating Switch, Remote-Trip, Remote-Lockout, Remote-Close, or Low-Voltage Closing.

When the recloser includes Remote-Close in addition to one of the other accessories, the KRK433FB (Figure 28) Junction Box must be specified.

The Junction Box provides a convenient single location for connection of customer remote operating and indicating circuits (Figure 29). The KRK433FA Junction Box includes a six-foot-long cable for interconnection of recloser and junction box. The KRK433FB includes an additional cable for connection to the Remote-Close

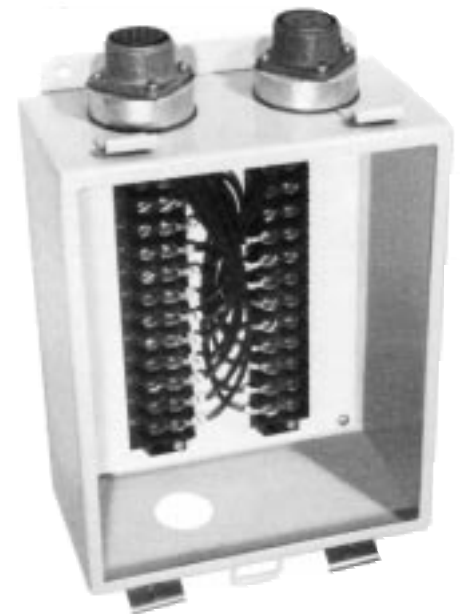


Figure 28. Accessory-Connection Junction Box (KRK433FB) with cable receptacles for connection to recloser and Remote-Close accessory. 83459KMA

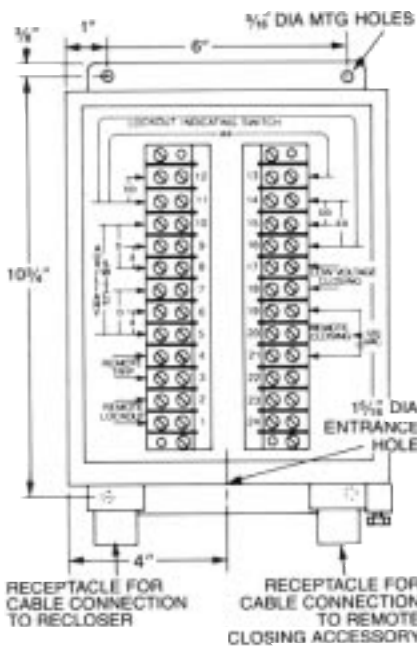


Figure 29.
Dimensions and accessory-connection locations in Accessory Junction Box.

Auxiliary Switch

Remote indication of recloser contact position can be accomplished with the Auxiliary Switch accessory KRK411FA (Figure 30). The contacts of the Auxiliary Switch can also be used to switch other circuits in accordance with the opening and closing of the recloser contacts. The auxiliary switch is mounted on the side of a KFE or KFVE recloser mechanism frame.

A two-stage switch is provided; each stage contains one single pole double throw isolated set of contacts—"a" and "b". When the recloser contacts are open, the "a" contacts are also open and the "b" contacts are closed. The relationship between the auxiliary switch and recloser contacts is shown in Table 12. The contacts cannot be changed. Auxiliary switch interrupting ratings are shown in Table 13.

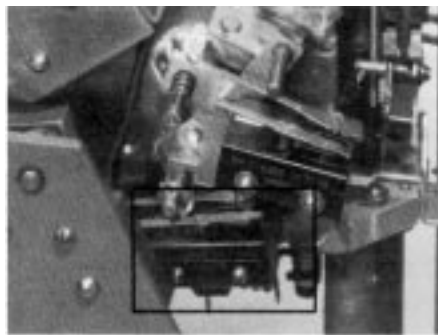


Figure 31. 82253KMA
Lockout-Indicating Switch KRK412FA mounted on side of recloser mechanism.

Table 12
Auxiliary Switch Contact Position

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

Customer connections to auxiliary switch contacts are made in the Accessory Connection Junction Box as shown in Figure 29. one stage (Terminals 8, 9 and 10 in Figure 29) is employed in the switching of the Remote-Trip accessory; however, the second stage of the Auxiliary Switch (Terminals 5, 6 and 7 in Figure 29) is available for customer use. NOTE: If Remote-Trip Accessory (KRK410) is included with the recloser, one stage of the auxiliary switch is connected into that accessory, allowing only one stage for customer use.

Table 13
Interrupting Ratings of Auxiliary Switch

Volts	Current (amps)
120 ac	15
240 ac	15
24 dc	2
48 dc	3/4
125 dc	1/2
250 dc	1/4

Lockout-Indicating Switch

The Lockout-Indicating Switch accessory KRK412FA, shown in Figure 31, is available on KFE and KFVE reclosers to provide a facility for remote indication that the recloser has locked-out. The accessory is useful in load-transfer schemes and other applications when lockout of one recloser may initiate the closing of another.

A two-stage switch is provided; each stage contains one single pole double throw isolated set of contacts—"aa" and "bb". When the recloser is locked-out, the "bb" contacts are closed and "aa" contacts are open. See Table 14 for relationship of recloser and indicating switch contacts. The contacts cannot be changed. Interrupting ratings of the Lockout-Indicating Switch are shown in Table 15.

Table 14
Lockout Switch Contact Position

Recloser Contacts	Locked-Out	Not Locked Out
Indicating Switch "aa" contacts are	Open	Closed
Indicating Switch "bb" contacts are	Closed	Open

Customer connections to Lockout Indicating Switch contacts are made in the Accessory-Connection Junction Box as shown in Figure 29. One stage (Terminals 14, 15 and 16 in Figure 29) is employed in the switching of the Remote-Lockout accessory; however, the second stage of the Lockout-Indicating Switch (Terminals 11, 12 and 13 in Figure 29) is available for customer use.

NOTE: If Remote-Lockout accessory KRK409 is included with the recloser, one stage of the Lockout-indicating Switch is connected into that accessory, allowing only one stage for customer use.

Table 15
Interrupting Ratings of Lockout-Indicating Switch

Volts	Current (amps)
120 ac	15
240 ac	15
24 dc	2
48 dc	3/4
125 dc	1/2
250 dc	1/4

Remote-Trip Accessory

Recloser trip operations can be triggered from a remote location by energizing the Remote-Trip accessory KRK410F (Figure 32) through an external supply circuit. Automatic reclosing will occur, the recloser will count the operation, and sequencing will occur in the same manner as if the electronic control had operated.

A two-stage auxiliary switch is provided as part of the Remote-Trip accessory. One stage is employed in the switching of the Remote-Trip accessory; the second stage—to which connections are made at Terminals 5, 6 and 7 in the Junction Box accessory—is available for customer use. Ratings of the Remote-Trip accessory are shown in Table 16.

External circuit connections to the Remote-Trip accessory are made in the Accessory-Connection Junction Box as shown in Figure 29.

Table 16
Remote-Trip Accessory Ratings

Catalog Number	Rated Voltage (Volts)	Current Required (amps)
KRK410FA	24 ac	7.0
	24 dc	2.0
KRK410FB	48 ac	3.5
	48 dc	1.0
KRK410FC	120 ac	1.8
	125 dc	.5
KRK410FD	240 ac	.9
	250 dc	.25

Total time is open recloser contacts using the Remote-Trip accessory is 0.033 seconds (or 2 cycles on a 60-Hz basis).



Figure 32. Remote-Trip accessory KRK410F mounted on side of recloser mechanism. 82087KMA

Remote-Lockout Accessory

When energized from an external source, the Remote-Lockout accessory KRK409F (Figure 33) will cause the recloser to trip and its mechanism to lock out. The recloser's yellow manual operating handle will drop to its lockout position, providing a visual indication that the recloser is locked-out.

Closing from lockout can be accomplished manually by moving the yellow handle up to its closed position, or remotely with the Remote-Close accessory. Remote-Lockout and Remote-Close accessories are often applied on the same recloser to enable remote control of lockout and closing.

External circuit connections to the Remote-Lockout accessory are made in the Accessory-Connection Junction Box as shown in Figure 29.

A two-stage Lockout-Indicating Switch is provided as part of the Remote-Lockout accessory. One stage is employed in the switching of the Remote-Lockout accessory; the second stage—to which connections are made at Terminals 11, 12 and 13 in the Junction Box accessory—is available for customer use. Operation and ratings of the Lockout-Indicating Switch are the same as described for the Lock-out-Indicating Switch accessory. Table 17 shows the ratings of the Remote-Lockout accessory.

Table 17
Remote-Lockout Accessory Ratings

Catalog Number	Rated Voltage (Volts)	Current Required (amps)
KRK409FA	24 ac	7.0
	24 dc	2.0
KRK409FB	48 ac	3.5
	48 dc	1.0
KRK409FC	120 ac	1.8
	125 dc	.5
KRK409FD	240 ac	.9
	250 dc	.25

Time to open recloser contacts and lockout the mechanism using the Remote-Lockout accessory is 0.05 seconds (or 3 cycles on a 60-Hz basis).



Figure 33. Remote-Lockout accessory KRK409F mounted on side of recloser mechanism. 82087KMA

Remote-Close Accessory

When energized from an external source, the Remote-Close accessory KRK414FB (Figure 34) initiates a closing operation by moving the recloser's yellow manual operating handle to its closed position. This actuates the closing solenoid contactor to energize the solenoid and close the recloser.

The Remote-Close solenoid is rated for intermittent duty, and accordingly should be energized only with a three-wire supply including a normally open momentary contact. When the contact is closed, a relay is energized which closes the circuit to the accessory motor. On completion of the closing operation, switches restore the accessory circuits in preparation for the next closing signal.

External circuit connections are made in the Accessory Junction Box as shown in Figure 29 on reclosers equipped with accessories in addition to Remote-Close. When other accessories are not included on the recloser, the Accessory Junction Box is not required and customer connections for the Remote-Close accessory are made directly to the accessory.

Table 18
Electrical Ratings of the Remote-Close Accessory

Description	Remote-Close Accessory KRK414-B
Voltage	120-Vac
Current Inrush	1.25 amps
Current; Steady State	0.5 amp
Operating Time	2 sec.

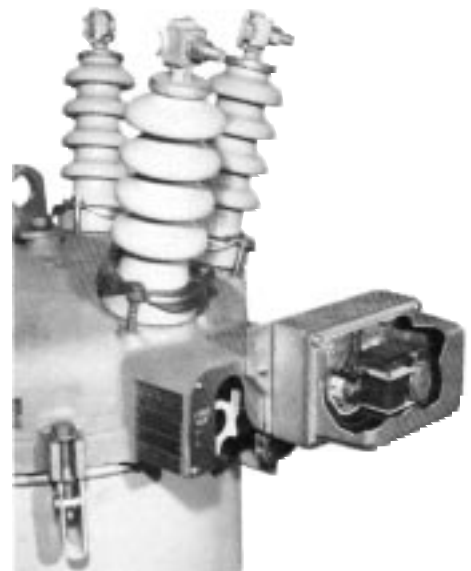


Figure 34. Remote-Close accessory KRK414FB mounted on KFE recloser sleet hood. 83458KMA

Low-Voltage Closing Accessory

When the proper closing coil is specified and a Low-Voltage Closing accessory KRK54FA or B (Figure 35) is included, the KFE or KFVE recloser can employ low voltage ac closing. The Low-Voltage Closing accessory provides the alternate closing solenoid contactor and the factory-installed wiring to accommodate the low-voltage closing power. A separate step-down transformer is also utilized to insure that sufficient voltage is present to charge the trip capacitors under low-voltage closing. Customer low-voltage power is connected in the Accessory-Connection Junction Box as shown in Figure 29. Reclosing time using the Low-Voltage Closing accessory is the same as listed earlier under "Operating Times"

Table 19
Low-Voltage Closing Accessory Ratings

Catalog Number	Rated Voltage (Volts)	Current Required (amps)	Closing Coil Code Number
KRK54FA	120 ac	40	26
KRK54FB	240 ac	25	28

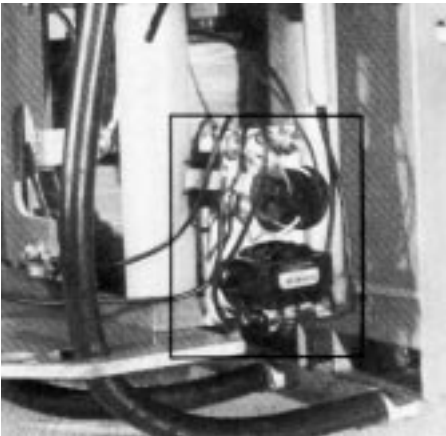


Figure 35. 82085KMA
Low-Voltage Closing accessory KRK54FA mounted on side of recloser mechanism.

CONTROL ACCESSORIES

A number of factory-installed accessories are available to extend the operating flexibility of the KFE or KFVE electronic control and broadened its application capabilities. The following sections describe the operation and use of the plug-in accessory components.

Instantaneous Trip Accessory

The Instantaneous Trip accessory KRK55F (Figure 36) extends the range of a KFE or KFVE recloser coordination with source-side devices at higher fault levels. Above a predetermined fault level, the accessory bypasses the programmed time-current characteristics to cause the recloser to trip immediately without intentional time delay. For fault currents below this actuation level, the control operates according to its normal programmed trip characteristics.

Actuating levels are based on multiples of the minimum-trip current settings of the control—2, 4, 6 or 3 times the normal trip level. Separate phase and ground multiple selections are made by push-on tabs located on the accessory circuit board.

The Instantaneous Trip accessory is operational on all shots in the operating sequence, unless the "Block" feature is selected. The phase and ground "Block" selection cancels all accessory operations. Phase or ground may be separately blocked, or they may both be blocked at the same time. The "Block" feature is operational on all shots in a sequence when it is selected.

The Instantaneous Trip accessory consists of a plug-in circuit board that mounts on the back panel inside the electronic control. There are no connections external to the control.

Coordination of a recloser equipped with Instantaneous Trip and a sourceside fuse is shown in Figure 37. With the recloser operating normally on its delayed TCC curve, coordination with the primary fuse will be lost at fault levels above approximately 2000 amps. However, with the Instantaneous Trip accessory set for a multiple of 4, the recloser will trip instantly at any fault level above 1600 amps and extend recloser-fuse coordination up to the maximum interrupting level of the recloser.

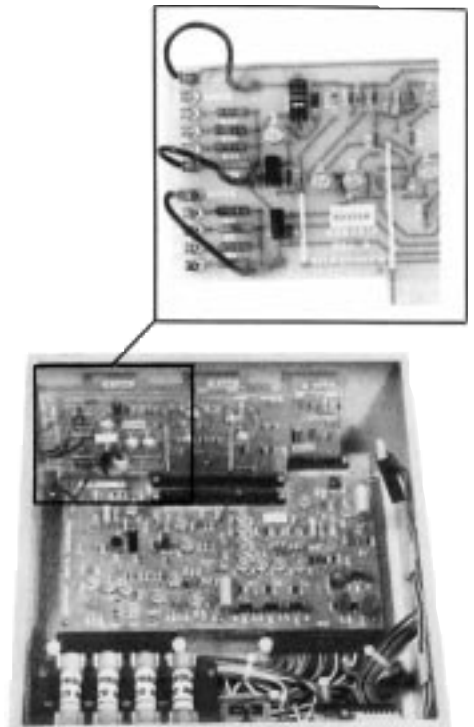


Figure 36. 83488KMA
Instantaneous Trip accessory KRK55F.

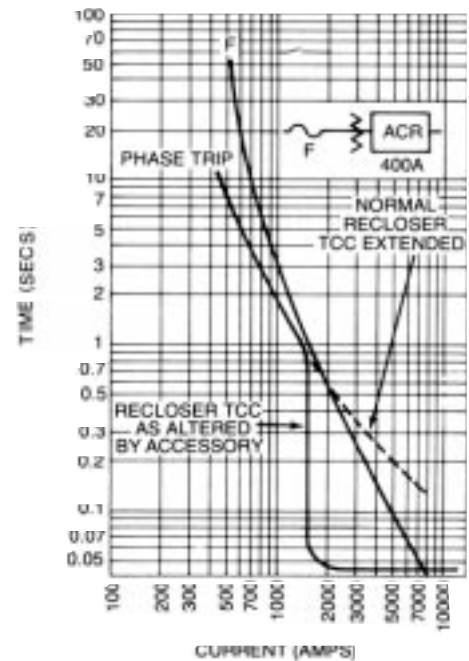


Figure 37.
Instantaneous Trip coordination with a high-side fuse.

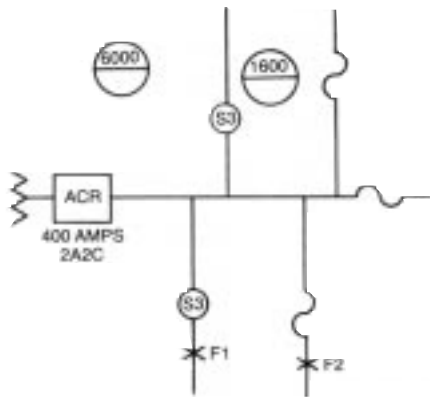


Figure 38.
On a load-side fault, instantaneous tripping occurs at high-current fault (F1) with normal coordination at F2 to allow the fuse to sectionalize.

Another application of the Instantaneous Trip accessory is diagrammed in Figure 38. With the accessory set for a multiple of 4, a fault at F1 would initiate instantaneous tripping for fault currents above 1600 amps. The fault would be sectionalized by the sectionalizer which requires only momentary current interruption to activate its counting mechanism.

A fault at F2, however, will not activate instantaneous tripping because the maximum available fault level is below 1600 amps. The recloser will operate on its programmed 2A 2C sequence and the delayed curve will allow the fuse to clear the fault.

Fault-Indicator Target Accessory

Fault indication of phase-to-ground, phase-to-phase, or three-phase faults is provided with the Fault-Indicator Target accessory KRK52F (Figure 39). The accessory consists of a plug-in circuit board that mounts on the back panel of the control and an annunciator circuit board that mounts inside a window on the bottom of the control cabinet.

The annunciator-type target shows an orange dot in the appropriate phase or ground window visible through the bottom of the control cabinet when the control trips due to an overcurrent. The targets reset automatically when the fault condition is cleared, or when reclosure occurs.

Sensitive Earth Fault Accessory

The Sensitive Earth Fault (SEF) accessory KRK1211F allows the KFE recloser to sense and trip on SEF faults to allow coordination with upline interrupting devices also equipped with SEF protection. The accessory is contained on a modified ground trip TCC card.

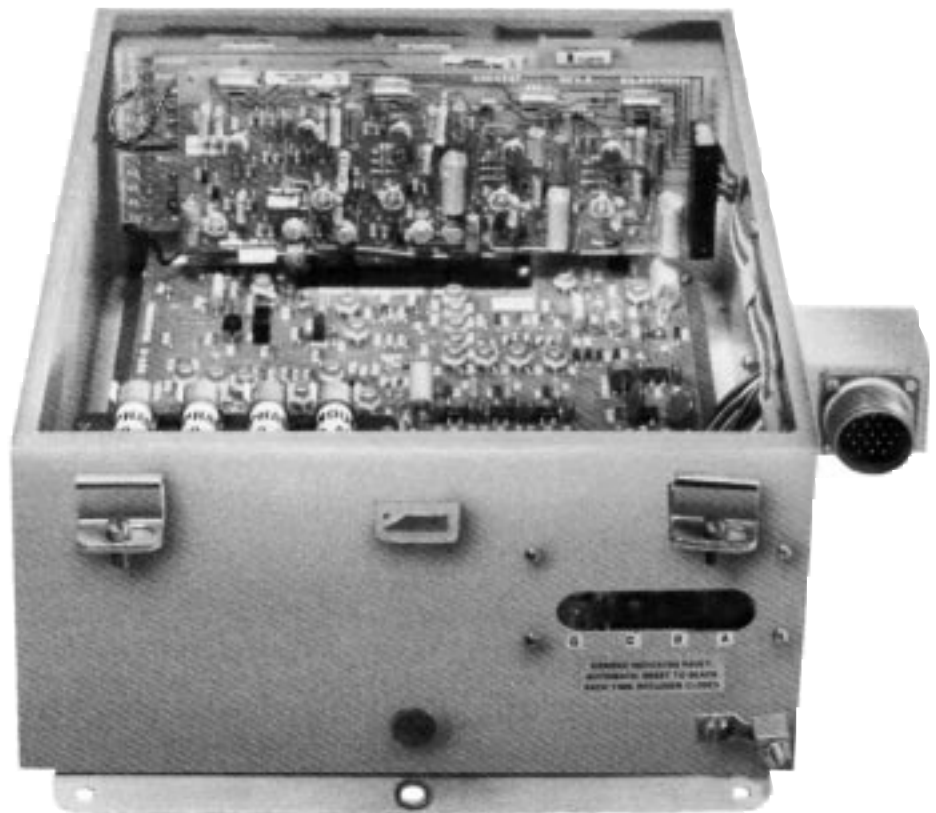


Figure 39.
Fault-Indicator Target accessory KRK52F.

83489KMA

The pick up levels for the SEF accessory is fixed at 25% of the standard ground fault trip level, but not less than 1 Amp. The time to trip for the SEF accessory is from 1-16 seconds, adjustable in one second increments, using a DIP switch located on the TCC card.

The SEF accessory also has a block switch which is located on the TCC card.

The SEF modified TCC card will function correctly when located in either the TCC 1 or TCC 2 card position in the control.

If Fault-Indicator Target accessory is installed, a SEF trip will register as a phase-to-ground fault.

The SEF accessory effectively clamps the current at which the control will trip for all ground faults. For example, if the SEF accessory is set to trip at five seconds and the inverse TCC for ground is 13 seconds at minimum trip the inverse curve timing cannot be longer than 5 seconds. Once the curve timing is lower than 5 seconds the time to trip will resume following the inverse curve.



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P.O. Box 1640
Waukesha, WI 53187