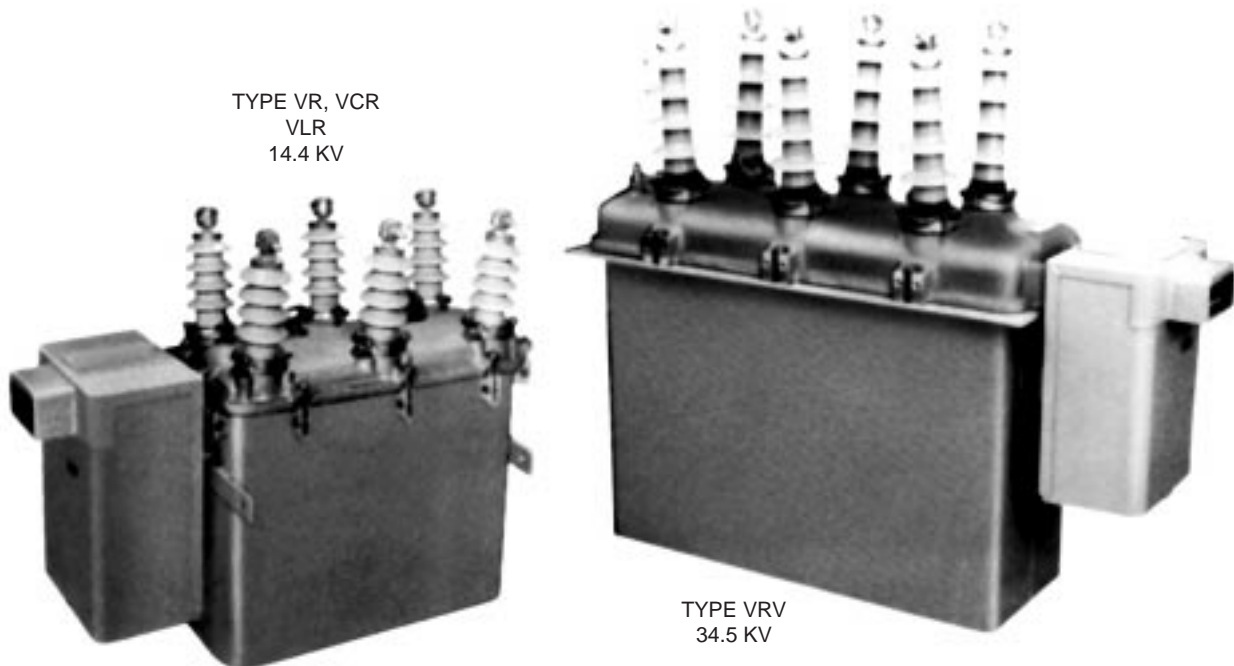


## Type VR, VLR, VCR, VRV Installation Instructions

## S260-20-6 Service Information



**Figure 1.**  
Cooper Power Systems electrically controlled, three-phase oil switches.

### SHIPMENT AND ACCEPTANCE

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

Upon receipt, inspect the switch 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. Save the shipping carton or crate, with all packing, for inspection.

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

### HANDLING AND STORAGE

If the switch is stored for any appreciable time before installation, provide a clean, dry storage area located to minimize the possibility of mechanical damage (especially to the bushings).

### DESCRIPTION

Type VR, VCR, and VLR (14.4-kv applications) and VRV (34.5-kv applications) motor-operated oil switches provide convenient three-phase load switching by remote control on command or automatically through the use of current, voltage, or time-sensitive devices.

Type VR, VCR, and VLR switches are differentiated from each other by their contact structures. Type VR switches have two sets of arcing and load-carrying contacts per phase.

*These instructions do not claim to cover all details or variations in the equipment, procedure, or process described, nor to provide directions for meeting every 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.*

Type VCR contacts are similar to the Type VR with the addition of damping resistors in series with the arcing contacts. The resistors damp both the magnitude and frequency of transient inrush currents to values within the short-time ratings of the switch.

The Type VLR switch utilizes two bayonet-type moving contacts per phase operating within self-blast interrupters. This same type of contact structure is also used in the Type VRV switch with increased arc gaps for 34.5-kv service.

The motor-operated actuator enables the switch to be remotely controlled with a manually operated SPDT switch or by automatic current, voltage, or time-sensitive devices. A six-pin plug and receptacle are furnished for connecting the control circuits to the switch. Other standard equipment includes a contact-position indicator, an operations counter, manual trip ring, and provision for manual closing.

Accessories include a quick-close feature, a manual-trip-and-block switch, a four stage auxiliary switch, an operator-cabinet heater, and low-voltage surge arresters for the externally con-

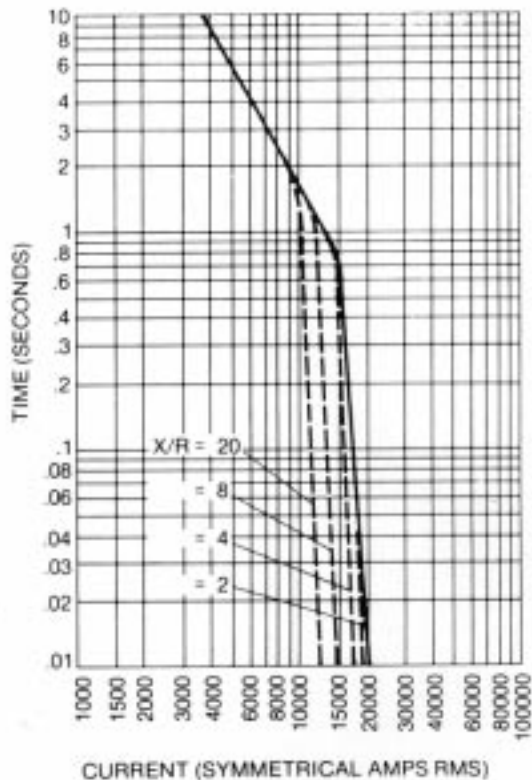


Figure 2. Short-time current ratings—Type VR, VCR, and VLR oil switches.

## RATINGS

### Electrical Ratings

Description	Type VR VCR, VLR	Type VRV
Rated maximum voltage (kv rms)	15.5	38.0
Nominal system voltage (kv rms)	2.4-14.4	34.5
Rated impulse withstand voltage (BIL) (kv crest)	110	150
60-Hz insulation level with-stand (kv rms)		
Dry, 1 minute	50	70
Wet, 10 seconds	45	60
Rated continuous current (amps)	400	400

### Short-Time Current Ratings

Description	Type VR VCR, VLR	Type VRV
Rated momentary asymmetrical current (amps)	20,000	15,000
Rated 1/2-second asymmetrical current (amps)	13,500	
Rated 1-second symmetrical current (amps)	10,000	10,000
Rated 10-second symmetrical current (amps)	—	3,500
Rated asymmetrical making current	20,000	15,000

### Load Switching Ratings

Type	Application	Power Factor (%)	Rated Current (amp)	
			@ 7.2 kv	@ 14.4 kv
VR	Capacitive current switching	—	300	
			400	200
	Inductive load switching	75-100 50-75 10-50	200 100 50	
VCR	Capacitive current switching*	—	400	
VLR	Inductive load switching	10-100	400	
VRV	Inductive load switching	70	400	

\*Rated for parallel bank applications.

### Actuator Operating Data

Description	Rated
Closing motor nominal operating voltage (vac)	120
Closing motor inrush current (amps)	6
Closing motor steady-state current (amps)	4
Closing motor running time (see)	10
Trip coil current at 115 vac (amps)	5

**DIMENSIONAL INFORMATION**

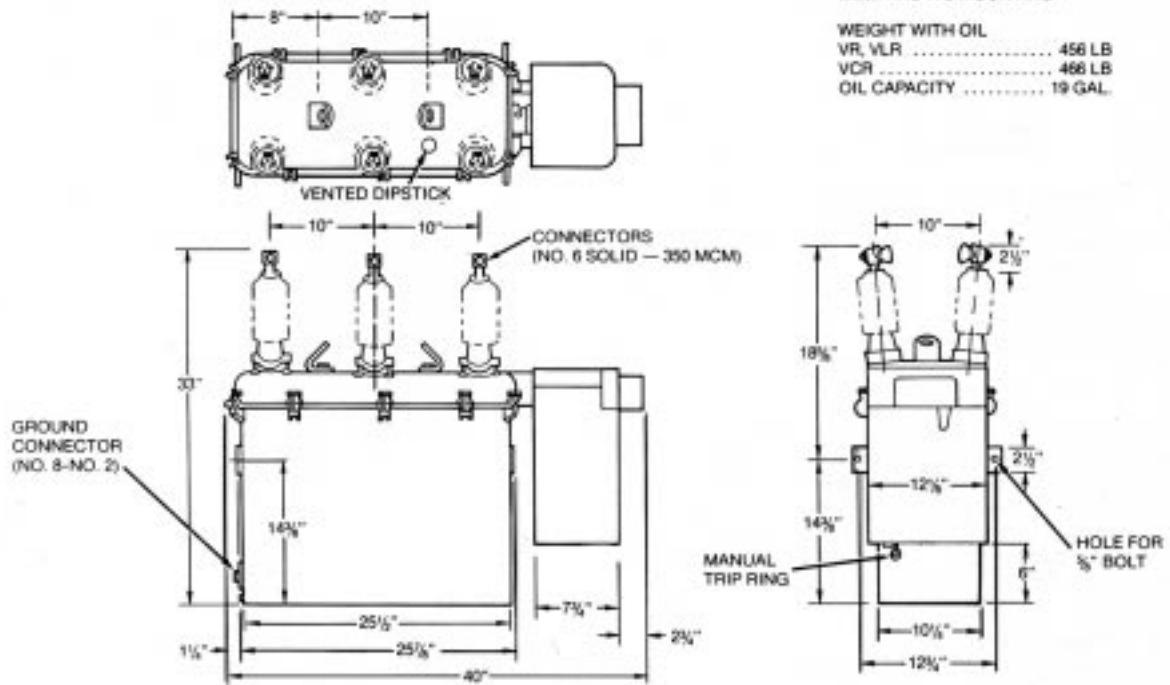


Figure 3. Outline dimensions for Type VR, VCR, and VLR oil switches.

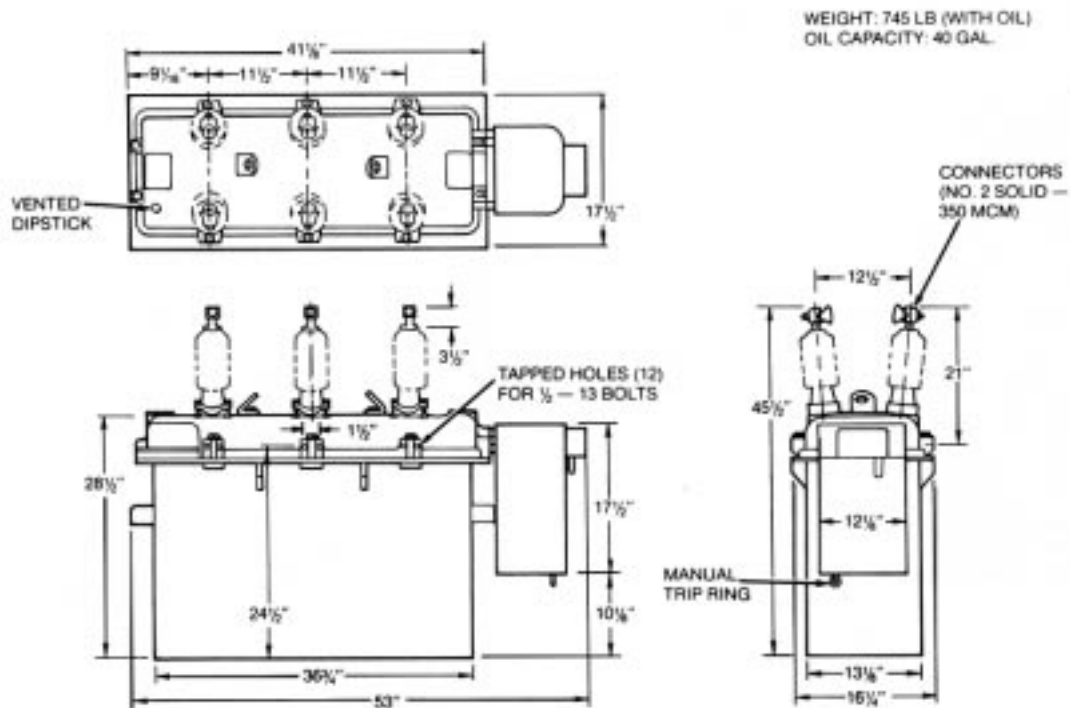


Figure 4. Outline dimensions for Type VRV oil switch.

## DESCRIPTION OF SWITCH OPERATION

### Standard Actuator

These switches are equipped with a motor-operated actuator mechanism (Figure 5) for remote closing. Remote tripping is initiated by energizing a trip-open solenoid which unlatches the spring-loaded operating mechanism to open the main switch contacts.

Subsequent closing is accomplished by operating the motor which loads the opening springs, latches the operating mechanism, and extends the closing spring until it over-toggles and closes the main switch contacts. Operating time of the closing circuit is approximately 10 seconds.

A selector switch provides an orderly transition from trip to close and from close to trip. The selector switch is operated from the main shaft that drives the main switch contacts open or closed. When the main contacts are closed, the trip circuit is closed and the close circuit is open. When the main contacts are open, the trip circuit is open and the close circuit is closed. The standard control circuit diagram is shown in Figure 6.

### Quick-Close Actuator

When equipped with the quick-close accessory (Figure 7), the main switch contacts close in 2.5 to 5 *cycles* after energizing the closing circuit (compared to 10 seconds for the standard control). However, at least 10 seconds must elapse between an opening and closing operation to allow the motor operator to preload the closing springs.

The accessory includes a solenoid-operated latch to trip the pre-loaded closing mechanism and a cam-operated cutout switch to allow pre-loading of the closing mechanism.

Figure 8 shows the control circuit with the quick-close accessory with the main contacts open. A close signal energizes the quick-close coil, closing the main switch contacts. The selector switch is operated to the left, interrupting the current to the quick-close coil.

An open operation energizes the trip coil, opening the main switch contacts. The selector switch operates to the right, and the cutout switch operates to the left, energizing the motor. The motor operates to preload the closing spring. At the completion of this operation the cam operates the cutout switch to the right and the circuit is prepared for another quick-close signal.



Figure 5. Stand actuator.

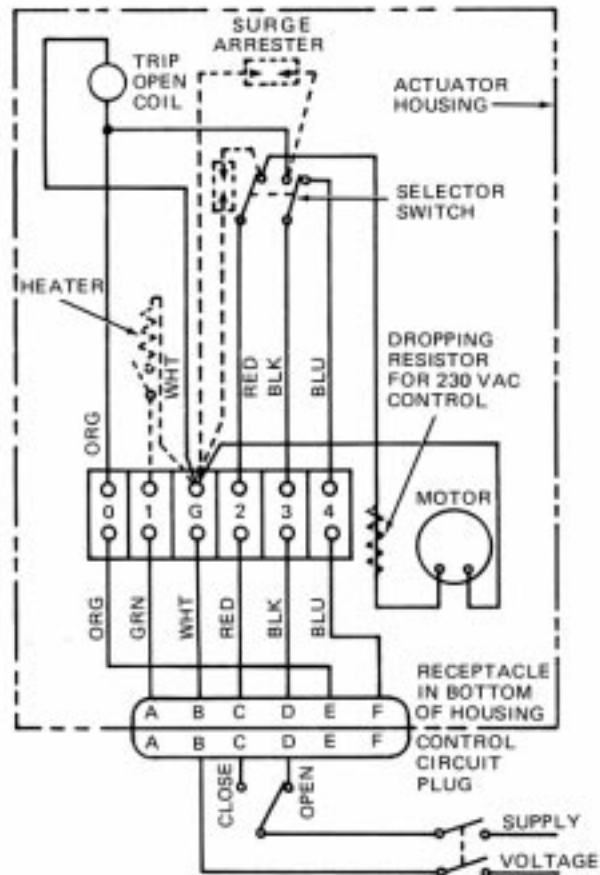


Figure 6. Stand actuator control circuit and customer connections—main switch contacts open (accessories shown in dotted lines).



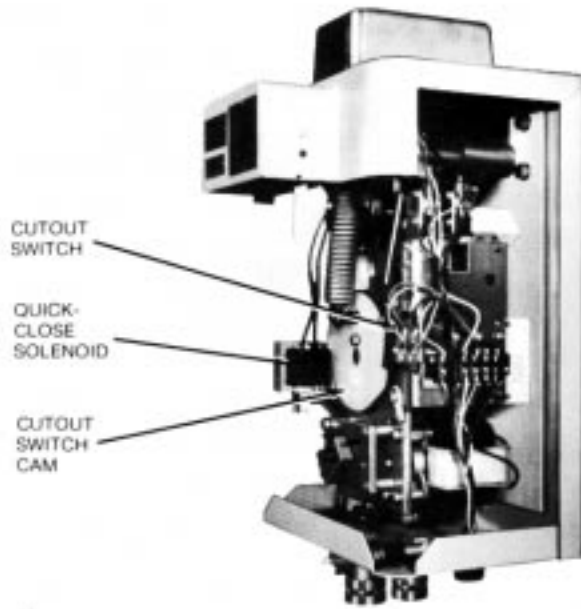


Figure 7.  
Quick-close actuator.

## INSTALLATION

### Preliminary Checks

Make sure the oil in the tank is at the proper level by checking the vented dipstick in the head casting. Replenish any loss with new, dry transformer oil.

If the switch has been stored for any length of time or is being relocated, check the dielectric strength of the oil in accordance with ASTM-approved testing procedures. Physical properties of the oil used in Cooper Power Systems distribution switchgear is found in Reference Data Publication R280-90-1.

1. In new equipment the oil must have a minimum dielectric strength of 26 kv. If less than 26 kv, filter the oil to restore its dielectric strength to an acceptable level.
2. If the equipment has been in service and is being relocated, the minimum dielectric strength of the oil must be at least 22 kv. If less than 22 kv, or if the oil is contaminated with carbon sludge, replace the oil.

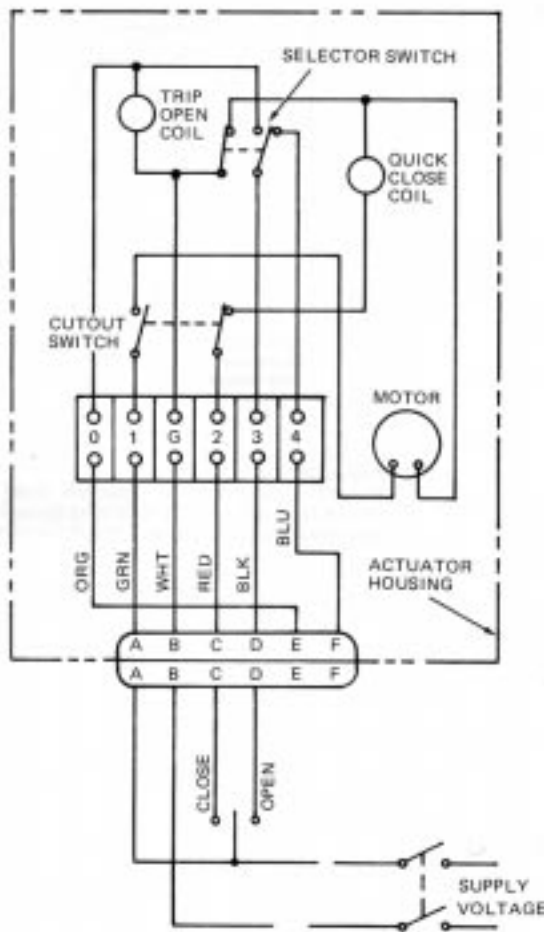


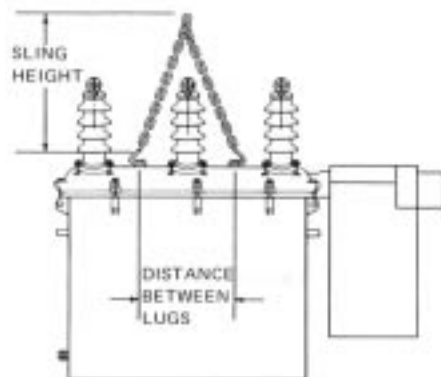
Figure 8.  
Quick-close control circuit and customer connections (main switch contacts open).

### Lifting a Switch

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

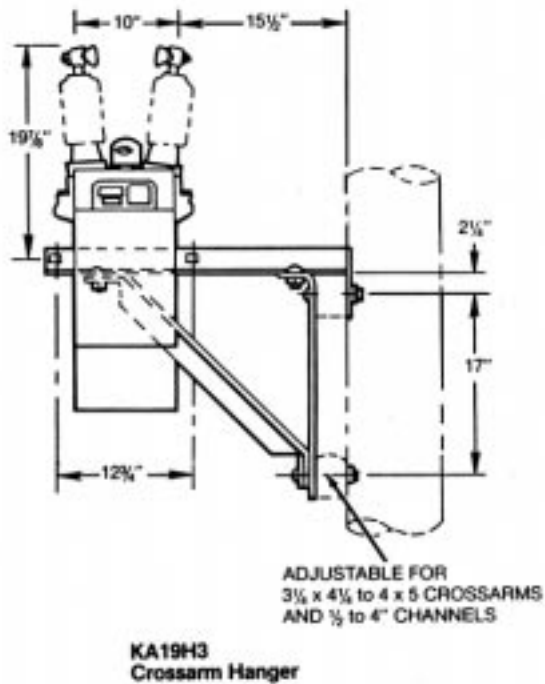
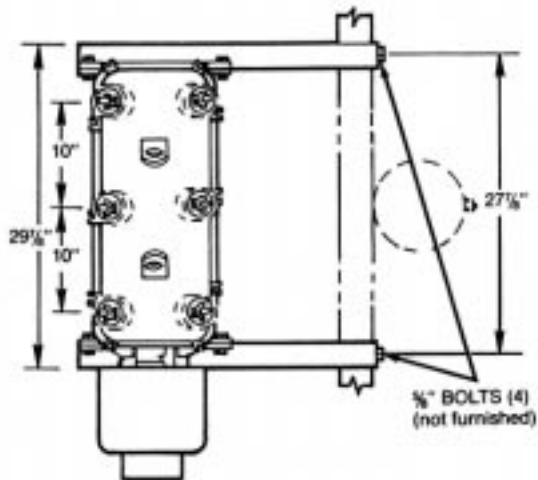
This switch has two lifting lugs—**both** must be used when lifting. Maximum strength is attained with a vertical lift attached to the lugs. Use a spreader bar with a fixed attachment point for the hook at the load center.

If a sling is used for lifting the switch, it must have a fixed attachment point at the load center. Rig the switch so that the sling height is equal to—or greater than—the distance between lifting lugs.



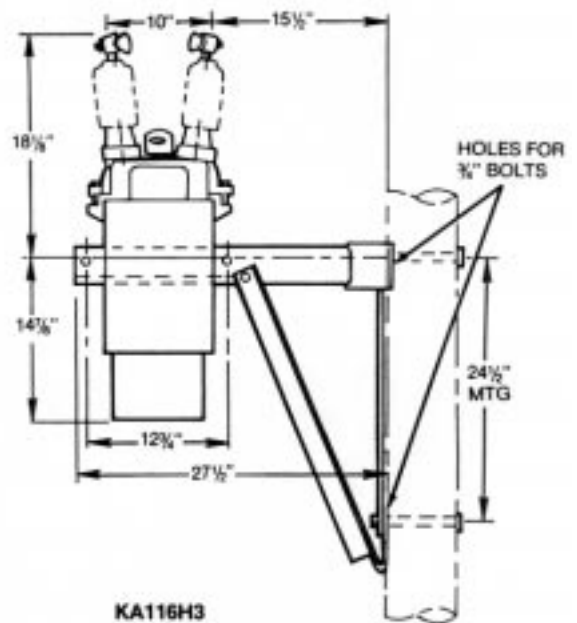
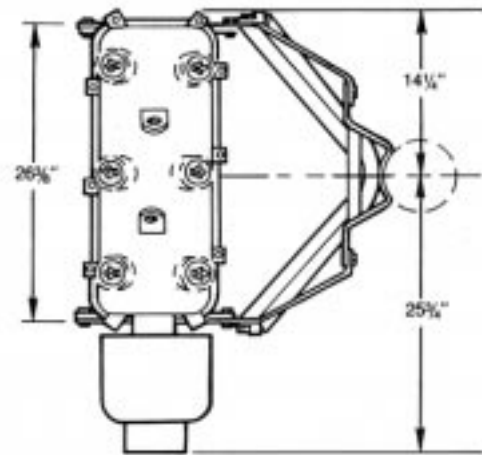
### Mounting Hardware

Mounting hardware and essential dimensional information are shown in Figures 9 through 11 for Type VR, VCR, and VLR switches and Figure 12 for the Type VRV switch.



**KA19H3  
Crossarm Hanger**

**Figure 9.**  
Mounting dimensions of Type VR, VCR, and VLR oil switches in KA19H3 double crossarm bracket or substation hanger.



**KA116H3  
Broadside  
Pole Hanger**

**Figure 10.**  
Mounting dimensions of Type VR, VCR and VLR oil switches in KA19H3 broad-side-mounting pole frame.

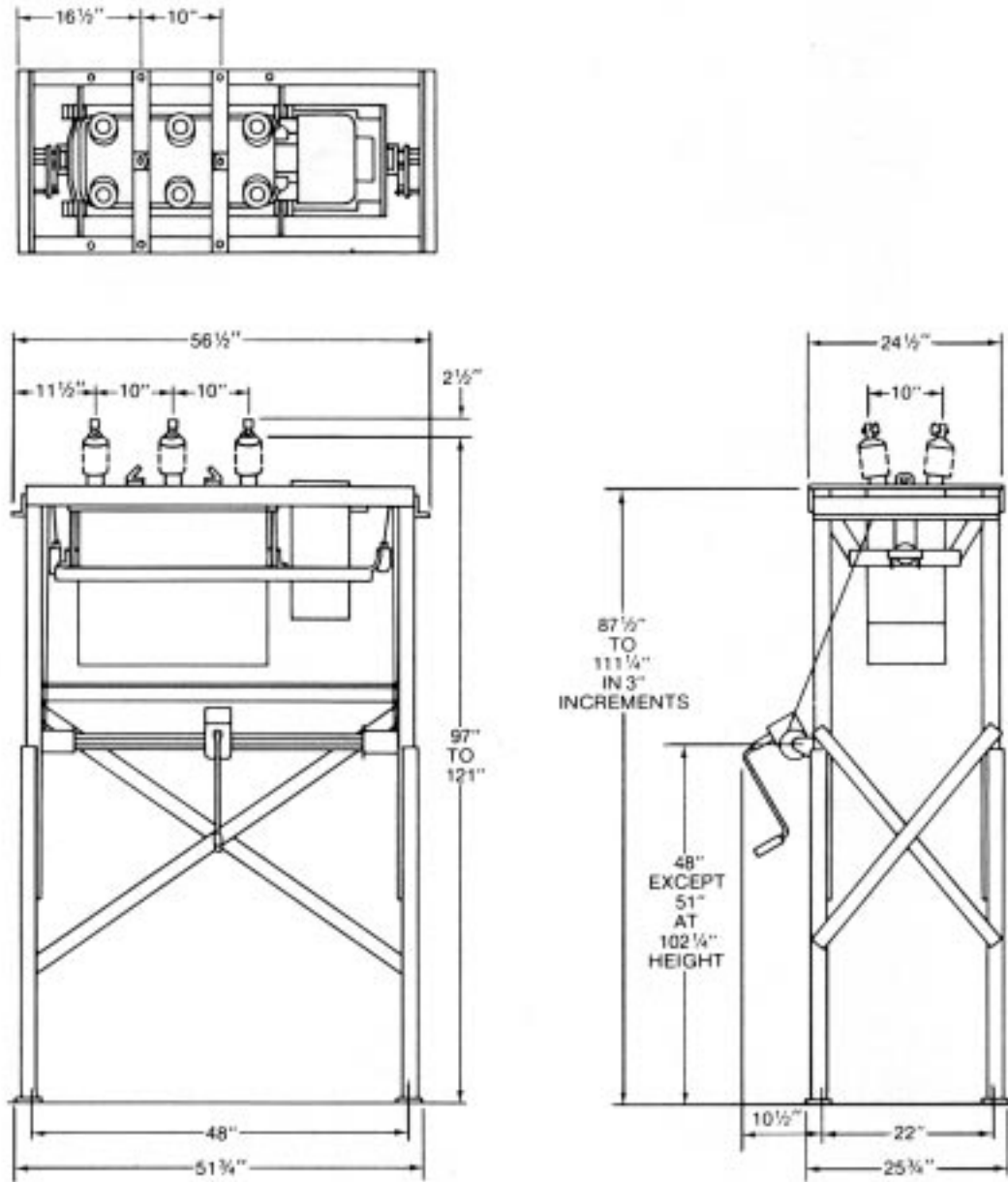
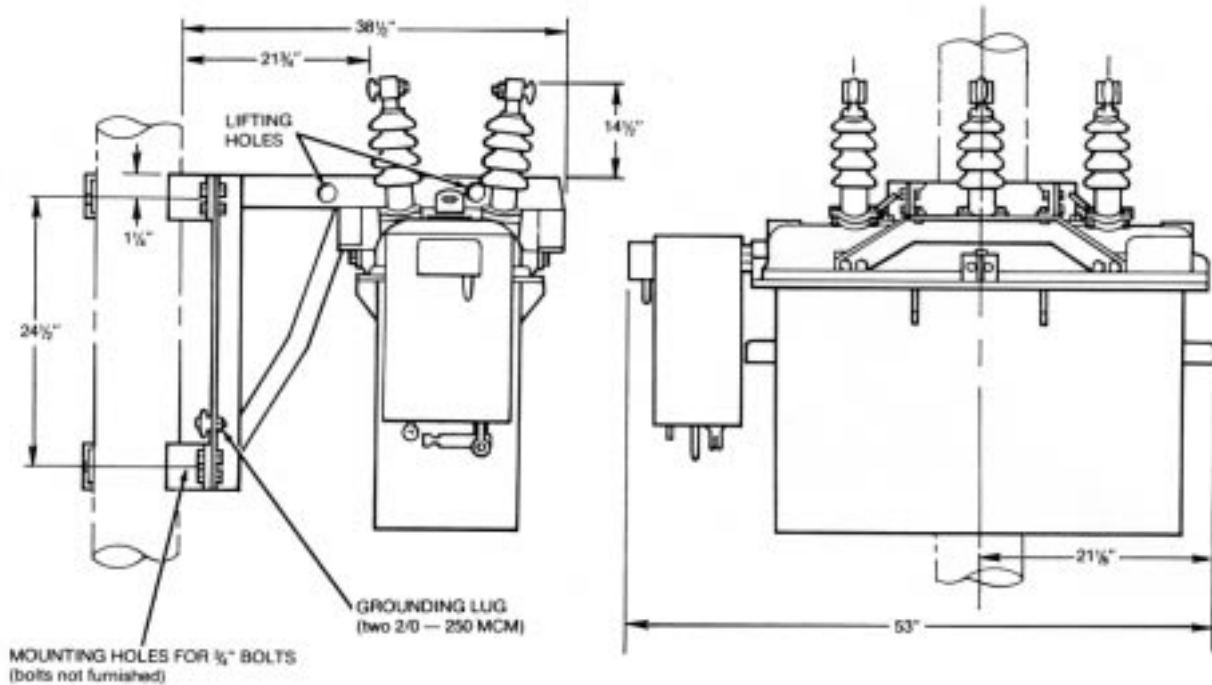


Figure 11.  
Mounting dimensions of Type VR, VCR, and VLR oil switches in KA194VR substation frame with KA584 R2 windlass.



**Figure 12.** Mounting dimensions of Type VRV oil switch in KA146W3 pole-mounted suspension hanger.

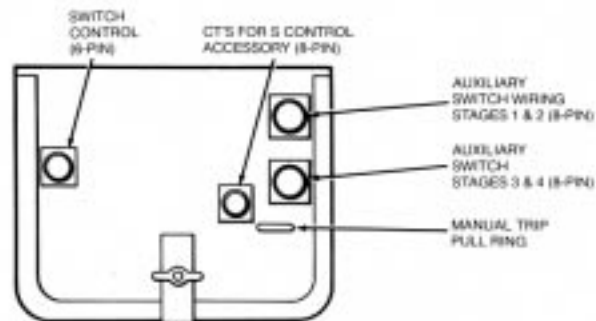
## CONNECTIONS

### Main Wiring

Primary connections to the VR, VCR, and VLR switches are made at the universal clamp-type bushing terminals that accommodate either copper or aluminum conductors from No. 6 solid to 350 MCM stranded in a vertical or a horizontal position. The Type VRV switch bushing terminals will accommodate No. 2 solid through 350 MCM stranded conductors.

### Control and Accessory Wiring

Control wiring and wiring for various accessories is brought to receptacles in the bottom of the operator cabinet. The receptacles are located in Figure 13.



**Figure 13.** Location of wiring receptacles in bottom of operator cabinet.

### STANDARD SWITCH

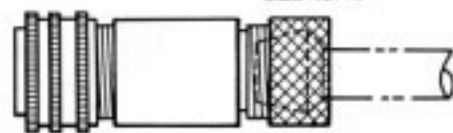
The control circuit is permanently wired to a six-pin receptacle in the bottom of the operator housing. The mating plug is furnished as standard with the switch.

Internal connections to the receptacle and customer connections to the plug are shown in Figure 6 for the standard control circuit and in Figure 8 for the quick-close control circuit. Pin arrangement for the mating plug is shown in Figure 14.

ALL PLUG CONTACTS ARE POLARIZED — KEYWAY IS ADJACENT TO F



1/2" TO 5/8" OD CABLE WITH MAX CONDUCTOR SIZE NO. 16



**Figure 14.** Control-circuit plug.



An SPDT switching device (furnished by the customer) is required to operate the switch. With the standard operator, the switching device must hold in the CLOSE position for at least 10 seconds to allow the motor to drive the main switch contacts closed. The OPEN signal may be momentary (at least 5 cycles).

With the quick-close operator, both the CLOSE and OPEN signals may be momentary. However, at least 10 seconds must elapse between an OPEN and a CLOSE signal to allow the motor to preload the close spring.

**LOAD-TRANSFER SWITCH**

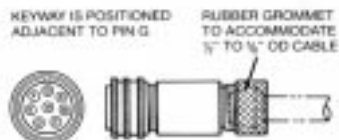
For application in automatic load-transfer schemes with the Type S control, the following accessories which modify these switches are available:

**Type S Control with Fault Block**

For this application, the modification includes internal bushing current transformers for fault sensing, an additional microswitch and the necessary circuit modifications all wired to a six-pin and an eight-pin receptacle as shown in Figure 15 for the standard operator and Figure 16 for the quick-close operator. Pin orientation for the six- and eight-pin mating plugs is shown in Figures 14 and 17.

**Type S Control without Fault Block**

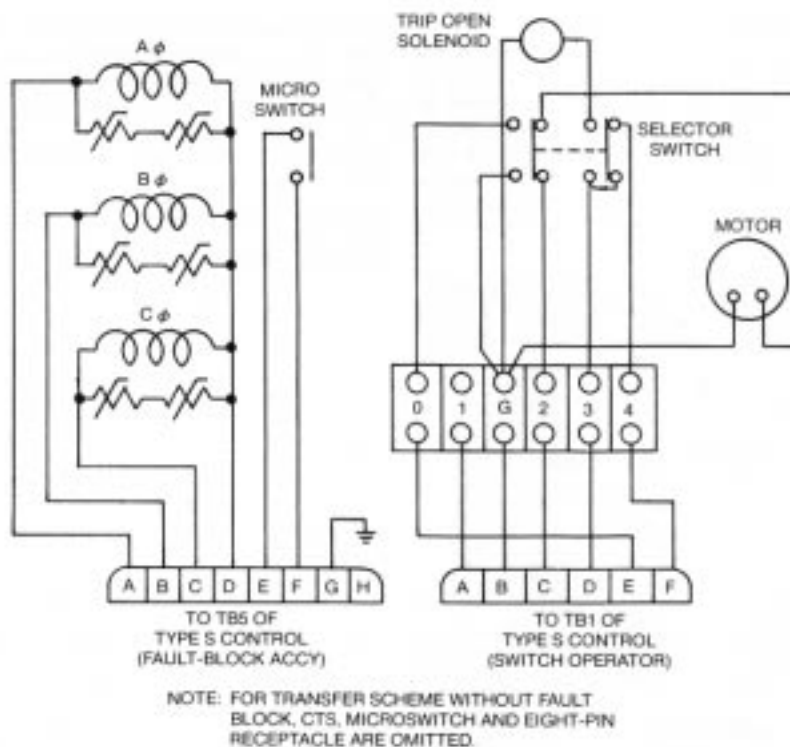
For this application the modification includes the necessary circuit modifications wired to the six-pin receptacle as shown in Figures 15 and 16. Pin orientation for the six-pin mating plug is shown in Figures 14 and 17.



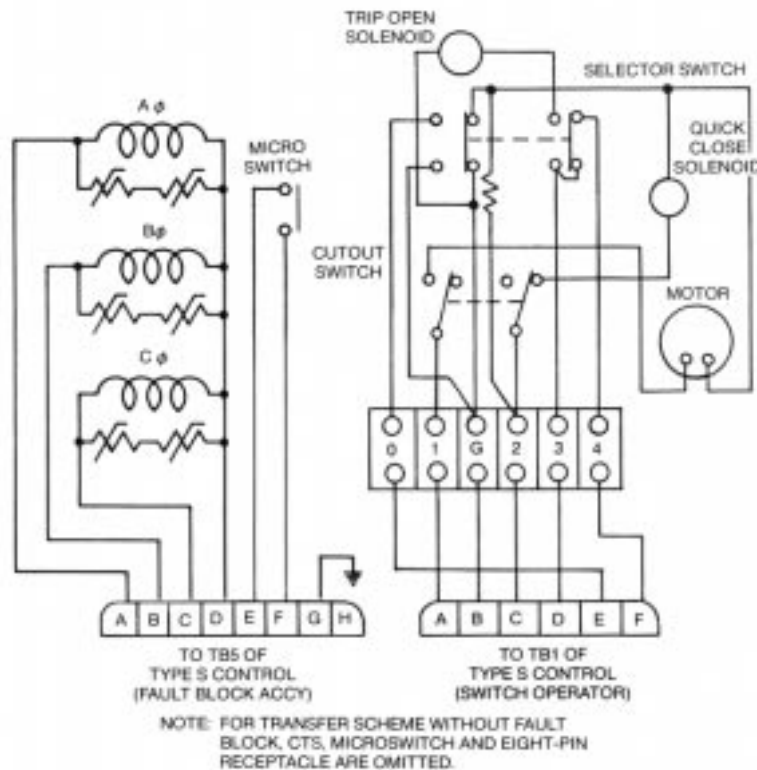
**Figure 17.**  
Eight-pin fault-block accessory cable plug.

**OPERATING INSTRUCTIONS**  
**Standard Operator**  
**ELECTRICAL OPERATION**

The switch is shipped from the factory in the open position. To close the switch electrically, make the connections as shown in Figure 6 and operate the SPDT switching device to its CLOSE position. The motor will operate and close the main contacts in approximately 10 seconds. To open the switch electrically, operate the SPDT device to the OPEN position. The trip solenoid will operate immediately to open the main switch contacts.



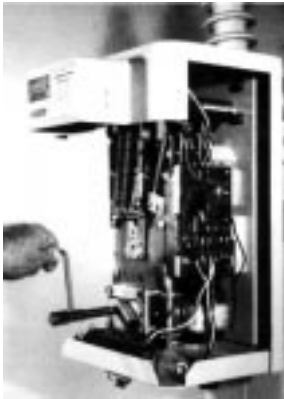
**Figure 15.**  
Connection diagram—standard operator wired for use with Type S auto load-transfer control.



**Figure 16.**  
Connection diagram—quick-close operator wired for use with Type S auto load-transfer control.

## MANUAL OPERATION

To close the switch manually, attach the handcrank (held by a clip in the bottom of the operator cabinet) to the crankshaft as shown in Figure 18 and crank the mechanism clockwise until the closing spring overtoggles and closes the main switch contacts. To open the switch manually, pull down the red pulling located underneath the operator cabinet.



**Figure 18.**  
Manual operation of actuator mechanism.

## QUICK-CLOSE OPERATOR Electrical Operation

When shipped from the factory, the switch is operated to the contacts-open position, but the motor is deenergized before it operates to load the closing spring. Before any electrical operation can be performed the motor must be energized to complete its operating cycle and load the closing springs. Apply source voltage across pins A and B of the control receptacle, or across terminals 1 and G of the terminal board; the motor will stop when it completes its cycle.

To close the switch electrically, make the connections as shown in Figure 8 and operate the SPDT switching device to its CLOSE position. The quick-close solenoid will operate immediately and close the main switch contacts. To open the switch electrically, operate the SPDT device to the OPEN position. The trip solenoid will operate immediately to open the main switch contacts and the motor will operate to preload the closing spring for the next operating cycle.

## MANUAL OPERATION

To close the switch manually, attach the handcrank (held by a clip in the bottom of the operator cabinet) to the crankshaft as shown in Figure 18 and crank the mechanism clockwise until

the closing spring cam hits its mechanical stop. Remove the crank and mechanically operate the quick-close solenoid to close the main switch contacts. To open the switch manually, pull down the red pulling located underneath the operator cabinet.

## ACCESSORIES

### Auxiliary Switch

The auxiliary switch is mounted to the top of the operator cabinet in a weatherproof housing (Figure 22) and is used for relaying or interlocking schemes and for remote contact indication. Figure 20 shows the auxiliary-switch mounting with covers removed.

A four-stage switch can be provided. Each stage consists of two independent contact assemblies with either a (normally open) or b (normally closed) contacts which can be easily changed in the field. A data plate attached to the switch cover shows the switch arrangement. Related switch contact positions are shown in Table 1.

**Table 1**  
Related Switch Contact Positions

When Sectionalizer	Closed	Open
Auxiliary a Contacts Are	Closed	Open
Auxiliary b Contacts Are	Open	Closed

The switch is permanently wired to two 8-pin receptacles in the bottom of the operator cabinet (Figure 13). The switch terminal-receptacle pin connections are shown in Table 2. The pin arrangement of the mating plugs is shown in Figure 20. The mating plugs are furnished with the accessory.

The switch contacts are insulated for 600 volts and have a continuous current rating of 10 amps. Their interrupting ratings are shown in Table 3.

**Table 2**  
Auxiliary-Switch-Receptacle Connections

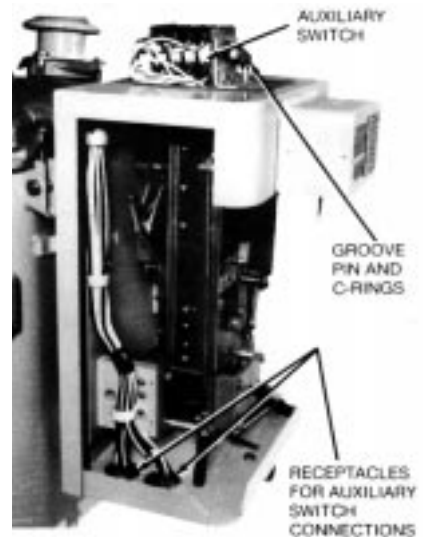
No. of Switch Stages	Switch Terminal	Contact Type	Receptacle Pin		Wire Marker Color Code	
4 3 2 1	1		A	Rear Receptacle	None	Short Tabs
	2	b	B		Green	
	3		C		Red	
	4	a	D		None	
	5	b	E		Orange	
	6		F		Lt. Blue	
	7	a	G		Dk. Blue	
	8		H		Yellow	
	9	b	A	Front Receptacle	Black	Long Tabs
	10		B		Green	
	11	a	C		Red	
	12		D		White	
	13	b	E		Orange	
	14		F		Lt. Blue	
	15	a	G		Dk. Blue	

**Table 3**  
Interrupting Ratings—Switch Contacts

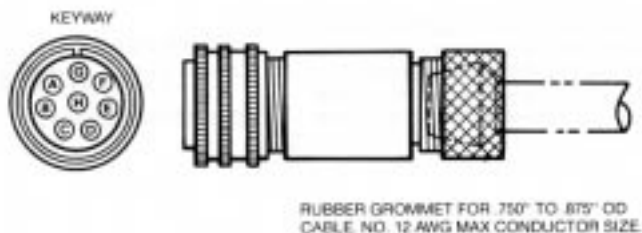
Volts	Inductive ac (amps)	Non-inductive ac (amps)	Inductive dc (amps)	- Non inductive dc (amps)
24	—	—	15.	20.
48	—	—	7.5	10.
125	60	80	1.5	2.
240	30	60	—	—
250	—	—	0.45	0.5

Switch positions can be changed from a or b operation by repositioning the cams inside each switch section. To change any cam position:

1. Remove the auxiliary switch cover.
2. Detach the switch from the switch link by removing the groove pin and C-rings (see Figure 19).

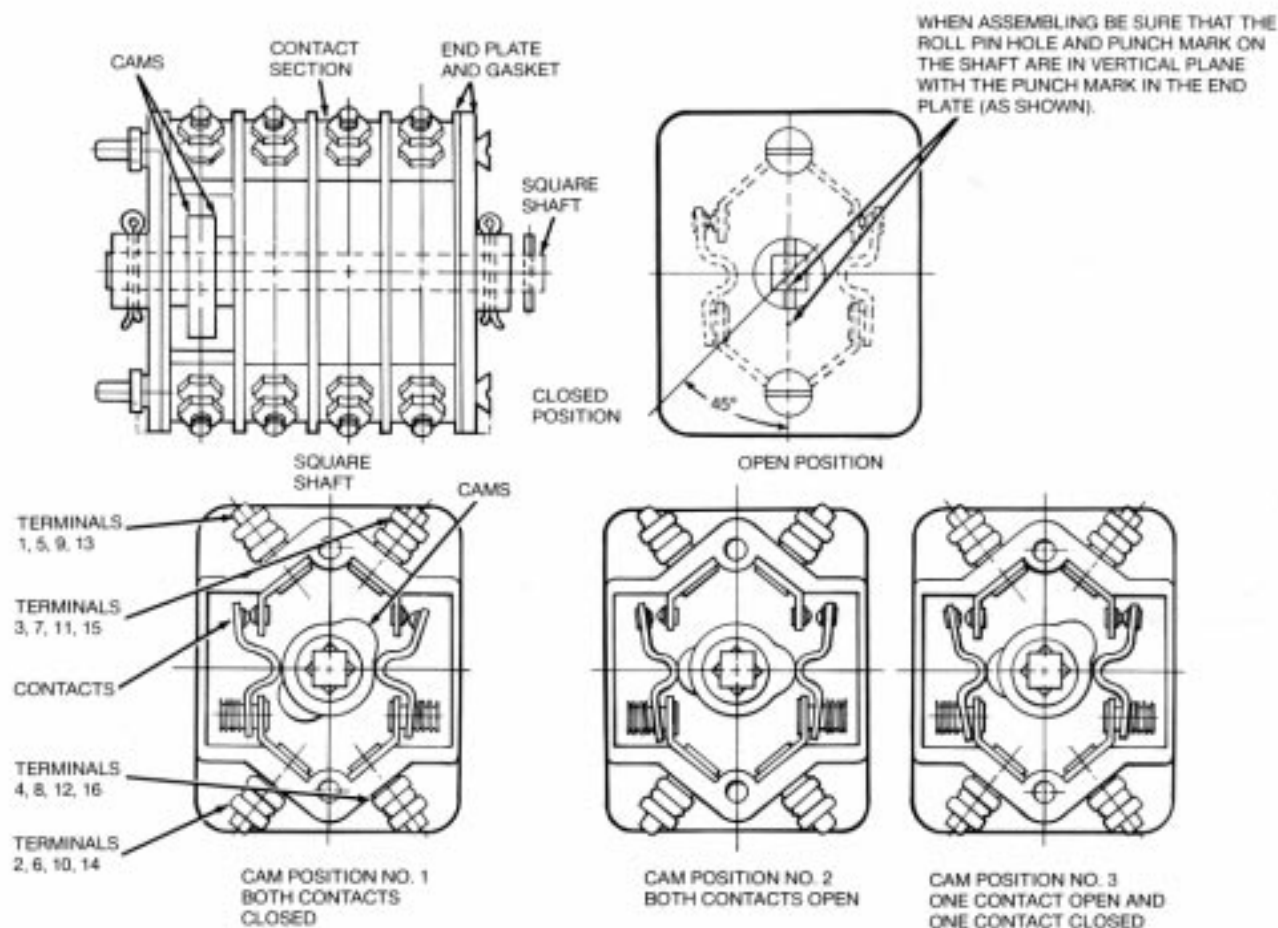


**Figure 19.**  
Four-stage auxiliary switch installed in operator cabinet.



**Figure 20.**  
Auxiliary-switch plug.

3. Remove the machine screws attaching the assembly to the cabinet.
4. With the switch removed, unfasten the two hex nuts and lockwashers from the long machine screws that hold the switch sections together.
5. Starting with the rear switch section, lift the cams off the operating shaft, replacing the cams in one of the positions shown in Figure 21.
6. Reposition and fasten the switch sections together and remount the switch on the sectionalizer.

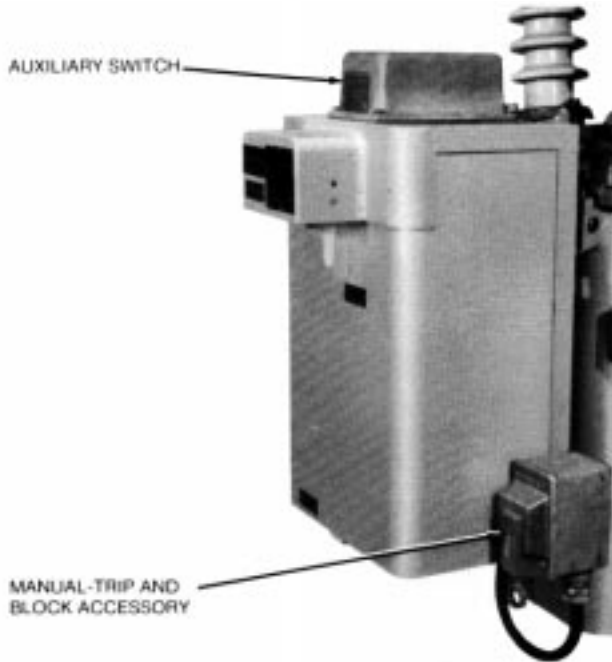


**Figure 21.**  
Cam positions inside the auxiliary switch.

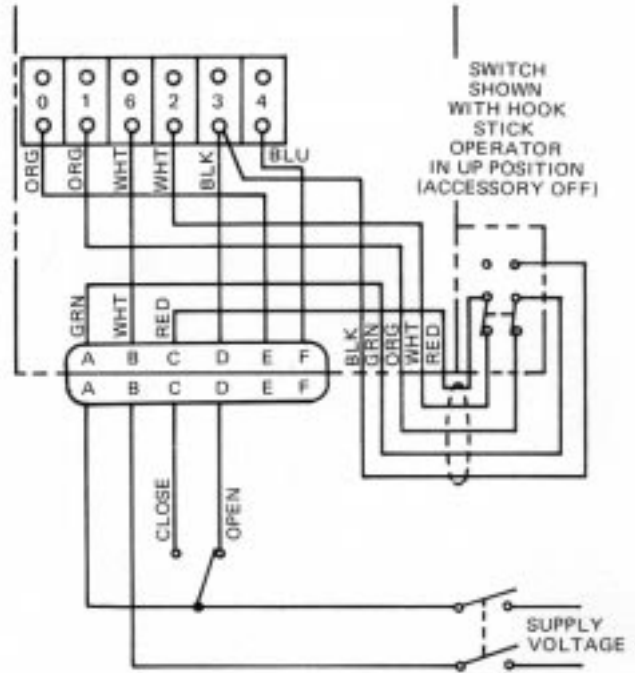
## Manual Trip and Block

This accessory consists of a hookstick operated DPDT switch in the weather-tight housing mounted to the side of the operator cabinet (see Figure 22) and permanently wired to the control circuit as shown in figure 23. When the

hookstick operator is pulled down the accessory electrically operates the trip solenoid to open the main switch contacts and disables the motor circuit to prevent electrical closing of the switch.



**Figure 22.**  
Manual-trip-and-block and auxiliary-switch accessories.



**Figure 23.**  
Control circuit and customer connections for manual-trip-and-block accessory (with or without quick-close).

KA2048-10