

Reclosers

Type FXA and FXB Microprocessor-Based Recloser Control Installation, Operation, and Maintenance Instructions

Service Information
S280-78-1

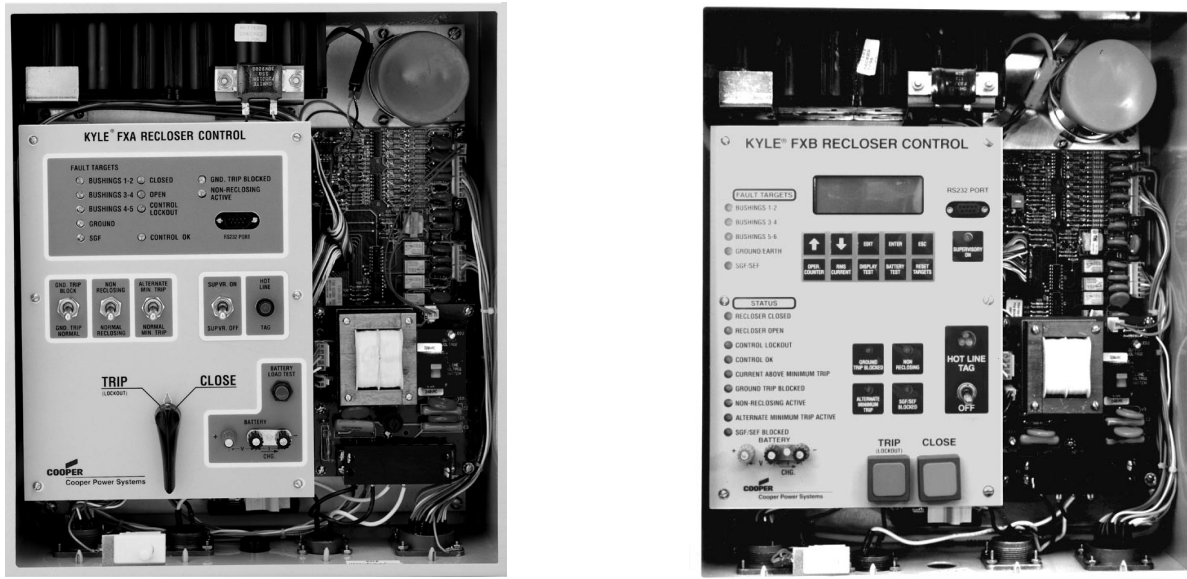


Figure 1.
Kyle® Type FXA (left) and FXB Microprocessor-Based Recloser Controls.

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SAFETY FOR LIFE



Cooper Power Systems products meet or exceed all applicable industry standards relating to product safety. We actively promote safe practices in the use and maintenance of our products through our service literature, instructional training programs, and the continuous efforts of all Cooper Power Systems employees involved in product design, manufacture, marketing, and service.

We strongly urge that you always follow all locally approved safety procedures and safety instructions when working around high voltage lines and equipment and support our “Safety For Life” mission.

SAFETY INFORMATION

The instructions in this manual are not intended as a substitute for proper training or adequate experience in the safe operation of the equipment described. Only competent technicians who are familiar with this equipment should install, operate, and service it.


A competent technician has these qualifications:


- *Is thoroughly familiar with these instructions.*
- *Is trained in industry-accepted high- and low-voltage safe operating practices and procedures.*
- *Is trained and authorized to energize, de-energize, clear, and ground power distribution equipment.*
- *Is trained in the care and use of protective equipment such as flash clothing, safety glasses, face shield, hard hat, rubber gloves, hotstick, etc.*


Following is important safety information. For safe installation and operation of this equipment, be sure to read and understand all cautions and warnings.

Hazard Statement Definitions

This manual may contain four types of hazard statements:

 **DANGER:** Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.


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


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


CAUTION: Indicates a potentially hazardous situation which, if not avoided, may result in equipment damage only.


Safety Instructions

Following are general caution and warning statements that apply to this equipment. Additional statements, related to specific tasks and procedures, are located throughout the manual.

 **DANGER:** Hazardous voltage. Contact with hazardous voltage will cause death or severe personal injury. Follow all locally approved safety procedures when working around high voltage lines and equipment. G103.3

 **WARNING:** Before installing, operating, maintaining, or testing this equipment, carefully read and understand the contents of this manual. Improper operation, handling or maintenance can result in death, severe personal injury, and equipment damage. G101.0

 **WARNING:** This equipment is not intended to protect human life. Follow all locally approved procedures and safety practices when installing or operating this equipment. Failure to comply can result in death, severe personal injury and equipment damage. G102.1

 **WARNING:** Power distribution equipment must be properly selected for the intended application. It must be installed and serviced by competent personnel who have been trained and understand proper safety procedures. These instructions are written for such personnel and are not a substitute for adequate training and experience in safety procedures. Failure to properly select, install, or maintain power distribution equipment can result in death, severe personal injury, and equipment damage. G122.2

PRODUCT INFORMATION

Introduction

Service Information S280-78-1 provides installation and operating instructions for the Kyle Type FXA and FXB microprocessor-based recloser controls. Before installing and operating either of these controls, carefully read and understand the contents of this manual.

Read This Manual First

Read and understand the contents of this manual and follow all locally approved procedures and safety practices before installing or operating this equipment.

Additional Information

These instructions cannot cover all details or variations in the equipment, procedures, or process described, nor provides directions 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 Division sales engineer.

Acceptance and Initial Inspection

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

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

Handling and Storage

Be careful during handling and storage of the control to minimize the possibility of damage. If the control is to be stored for any length of time prior to installation, provide a clean, dry storage area. If storage is in a humid atmosphere, make provisions to keep the control circuitry energized.

Note: To energize the control, apply ac power to the ac supply input terminal block located in the lower right corner of the control cabinet. Refer to the **Customer Connections for ac Power** section in this manual.

Quality Standards

The Quality System at the Cooper Power Systems Kyle Distribution Switchgear plant is certified to the ISO 9001 Standard.

Control Battery Storage, Charging, and Disposal

Temperature has an effect on battery life. Sealed lead acid batteries should be stored, fully charged, at room temperature. Never store lead acid batteries at temperatures exceeding 47°C (117°F), as damage can result in approximately one month.

IMPORTANT: Connect the control battery when ac power is connected to the control AC Supply Input Terminal Block, shown in Figure 3. Disconnect the battery prior to shipping or storing the control.

The 24 Vdc control battery is fully charged prior to shipment and is ready for use. Depending on conditions, the sealed lead acid battery can be stored for up to three months and still maintain sufficient charge to operate the control.

Note: If ac power is lost to the control, the battery maintains normal control operations for a minimum amount of time (depending on control state). See **Operation Upon Loss of ac Power**.

Note: When shipped from the factory, the battery is disconnected. Connect the battery plug into the mating connector to complete the battery circuit.

The battery can be kept charged by energizing the control's built-in charger with ac power applied to the customer ac supply input terminal block, located in the lower right corner of the control cabinet.

Battery Charger

An optional, portable, 120 Vac-to-24 Vdc battery charger is also available. If the battery is removed from the control for long term storage, or if a spare battery requires charging prior to being put into service, order the plug-in, bench-type battery charger with the following catalog number:

KME4-85-1 (120 Vac)

Battery Disposal

Dispose of a defective battery in an environmentally responsible manner. Consult local regulations for proper battery disposal.

Control Power

The primary source of power is either 120 Vac or 240 Vac, which is rectified to charge the power capacitor and a dc/dc converter that provides logic voltage to the control. Maximum power consumption is 35 W. This includes operation of the temperature-regulated heater, current charging in bulk rate, and energization of all input/output contacts.

Power to operate the tripping and closing solenoids in the recloser is provided by the power capacitor located near the top of the rear panel of the control. A sealed 24-volt lead acid battery located in the upper portion of the control cabinet (Figure 3 & 4) is utilized to provide operating and tripping energy when ac power is temporarily lost. The control is equipped with an ac-powered, temperature-regulated battery charger.

Operation Upon Loss of ac Power

If the control is equipped with the standard 24 Vdc lead-acid battery, the control will maintain full operation from the battery power supply as listed in Table 1.

Control programming settings and parameters—including event recorder, duty monitor, and demand metering data—are stored in non-volatile memory. Data is retained in the event that both ac power and battery backup power are disconnected.

The total battery operating time, without and with SCADA, and with two different conditions of status output with SCADA, is listed in Table 1.

For units equipped with the SCADA feature, battery drain is increased according to the number of status output contacts closed. Thus, total backup operating time is less with SCADA, and is dependent on the number of SCADA contacts closed.

Condition “A” is normal control condition with status output indications for supervisory switch ON, Recloser closed, Control OK.

Condition “B” is a worst-case example, with Control in lockout after a three-phase fault involving ground, with status output indications for Supervisory Switch ON, Recloser Open, Control Locked Out, Control OK, Ground Trip Blocked, Non-Reclosing On, Targets A, B, C, and Ground On, and Hot Line Tag ON.

Note: Upon restoration of 120 Vac power, the control is restored to full operation within approximately one second.

To prevent battery damage, the control will shut down automatically upon detection of battery voltage below 21.6 Vdc.

Initializing the Control

To initialize or re-initialize the control each time it has been de-energized, ac power is required. The control clock should be reset upon re-energization. Refer to *Service Information S280-78-2 FX, FXA and FXB Programmer's Software User's Manual* for the *Set Clock procedure*, or *S280-78-3 Front Panel Programming Guide for FXB*.

TABLE 1
Battery Minimum Operating Time, FXA/FXB (hrs)

Temperature	Without SCADA	With SCADA Cond. “A”	With SCADA Cond. “B”
25°C (77°F)	60/38	33/27	15/14
-17.8°C (0°F)	40/25	21/17	10/9
-28°C (-20°F)	35/21	18/14	9/8

DESCRIPTION OF CONTROL

Control Operation

Line current flowing through the recloser is sensed by three internally mounted bushing-current transformers in the recloser, one for each phase. When the phase current or the zero-sequence (ground) current exceeds its programmed minimum-trip value, the Kyle Type FXA or FXB control initiates the programmed sequence of recloser tripping and reclosing operations. If the fault is temporary, the control ceases to command recloser operations after successful reclosing, and the control resets to the start of its operating sequence after a preset time delay. If the fault is permanent, the control performs its complete programmed sequence of recloser commands and locks out with the recloser open.

A functional block diagram of control operation is shown in Figure 2. Line current conditions are monitored continuously by three bushing-type current transformers in the recloser, one for each phase. Output of these transformers is fed to the control front end which consists of isolation transformers and a multiplexer. The control microprocessor samples the current and computes the RMS current for each phase and ground.

When current above the programmed minimum-trip level is detected in one or more phases, the following chain of events will occur for an operating sequence of two fast and two delayed operations:

1. The overcurrent signal is integrated with time on the selected curve for the first trip operation to produce the signal which energizes the trip circuit.

2. Energizing the trip circuit connects the battery and capacitor to the trip solenoid to open the recloser.
3. Simultaneously, the microprocessor starts timing on the first reclosing interval delay time.
4. Upon expiration of this reclosing interval delay, a closing signal is issued from the control, closing the recloser and selecting the time-current characteristics for the second trip operation.

If current remains above the minimum-trip level, the tripping and reclosing sequence (fast and delayed operation) is repeated as programmed to lockout.

If the overcurrent is cleared before the operating sequence reaches lockout, the microprocessor starts timing a reset-delay when the recloser closes into the line and current is below minimum trip.

5. When the reset delay times out, the control is reset to the home state and is ready for another programmed operating sequence. If current rises above minimum trip prior to the reset-delay timing-out, the timer is halted and the control continues the operating sequence from where it left off and the accumulated reset-delay timing is cleared.

Ground fault tripping is separately programmable and includes minimum trip, operations to lockout, and four time-current curves. Reclose and reset intervals are common for phase and ground fault operation.

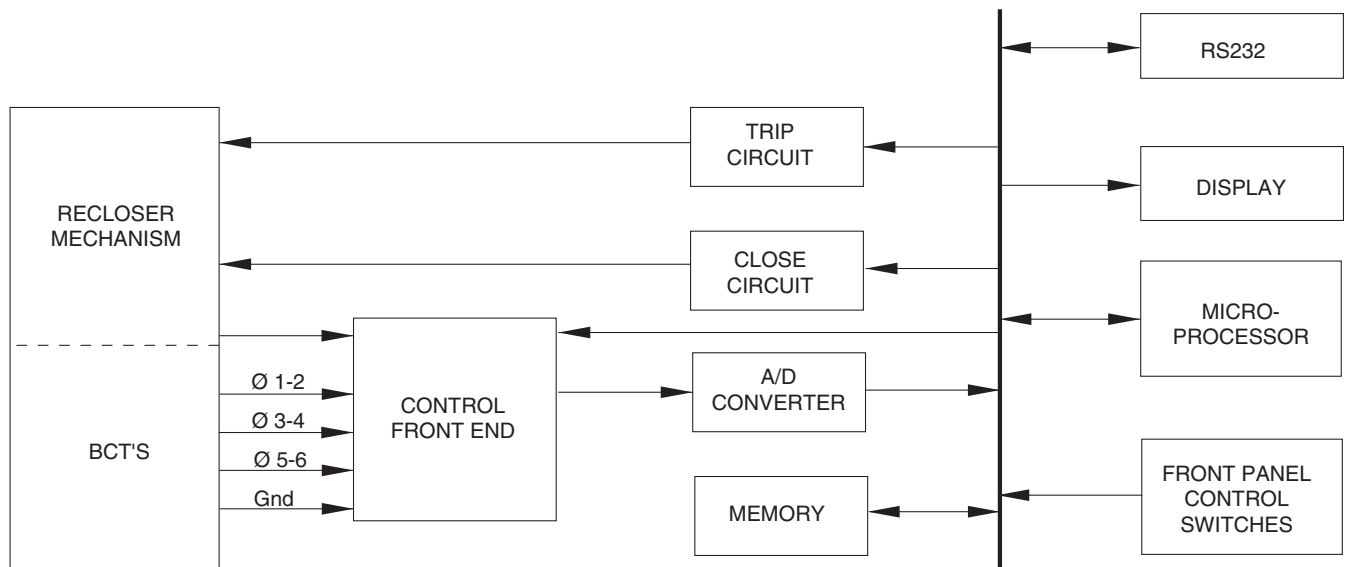


Figure 2.
Functional block diagram of the Type FXA or FXB control.

Standard Control Features

Both FXA (Figure 3) and FXB (Figure 4) controls are equipped with numerous sophisticated features that provide application flexibility, supervisory operation, and event recording, all contained in a compact package designed for reliability and ease of operation.

For application flexibility, both the FXA and FXB controls are interchangeable with existing Form 2, 3, 3A, 4A, and 4C controls used on Kyle electronically controlled reclosers.

The FXA and FXB recloser controls provide complete phase and ground/earth overcurrent detection with a wide choice of minimum trip settings, time-current curves, and control functions. All operating parameters and settings are programmable via personal computer with a Microsoft® Windows®-based control programming software package. Refer to *Service Information S280-78-2 FX, FXA and FXB Programmer's Software User's Manual* for programming procedures.

Standard features of the FXA and FXB controls include:

Line Voltage Selector Switch

The line voltage selector switch (see Figures 3 and 4) allows selection of either 120 Vac or 240 Vac line input voltage.

IMPORTANT: Adjustments to the line voltage selector switch must be made only after disconnecting the control from the line voltage source.

RS232 Port

The local RS232 port, located on the control panel, allows the control to be programmed directly from a personal computer. It also permits the control's programmed and stored data files to be downloaded to a personal computer. The Supervisory Switch must be in the OFF position on the FXB control to interrogate through the RS232 port.

Battery Test Terminals

Voltage and current measurement of the standard backup control battery under both no-load and load conditions can be read directly from the FXA and FXB front panels (see Figure 11) with an ohm/voltmeter or through the programming software.

Heater

A 7.8 W thermostat-controlled heater is included to reduce moisture and ensure reliable operation of the FXA and FXB control. The heater is on below 70°F (21°C) and off above 85°F (29°C).

Event Recorder

The event recorder records event history information which includes date, time, and current levels on all three phases and ground for 50 events in 19 event categories. Refer to *Service Information S280-78-2 FX, FXA and FXB Programmer's Software User's Manual* for further information about the event recorder.

Recloser Interrupter Duty Monitor

The recloser interrupter duty monitor measures, calculates, and records the recloser interrupter duty for each individual phase.

Load Profile Monitor

The load profile monitor records the RMS current value for each phase and ground at 15-minute intervals for the most recent 25.5 hours.

Demand Metering

The demand metering feature records instantaneous and integrated line current and ground current values over a 5- or 15-minute interval (1- or 5-minute for ground), as well as peak demand (draghand) values.

Sequence Coordination

The sequence coordination feature prevents unnecessary operation of the backup recloser for a fault beyond a downline recloser.

Targets and Operation Counters

Phase and ground fault target indication is provided by control panel LEDs. Software counters identify and count all fault-initiated trip operations.

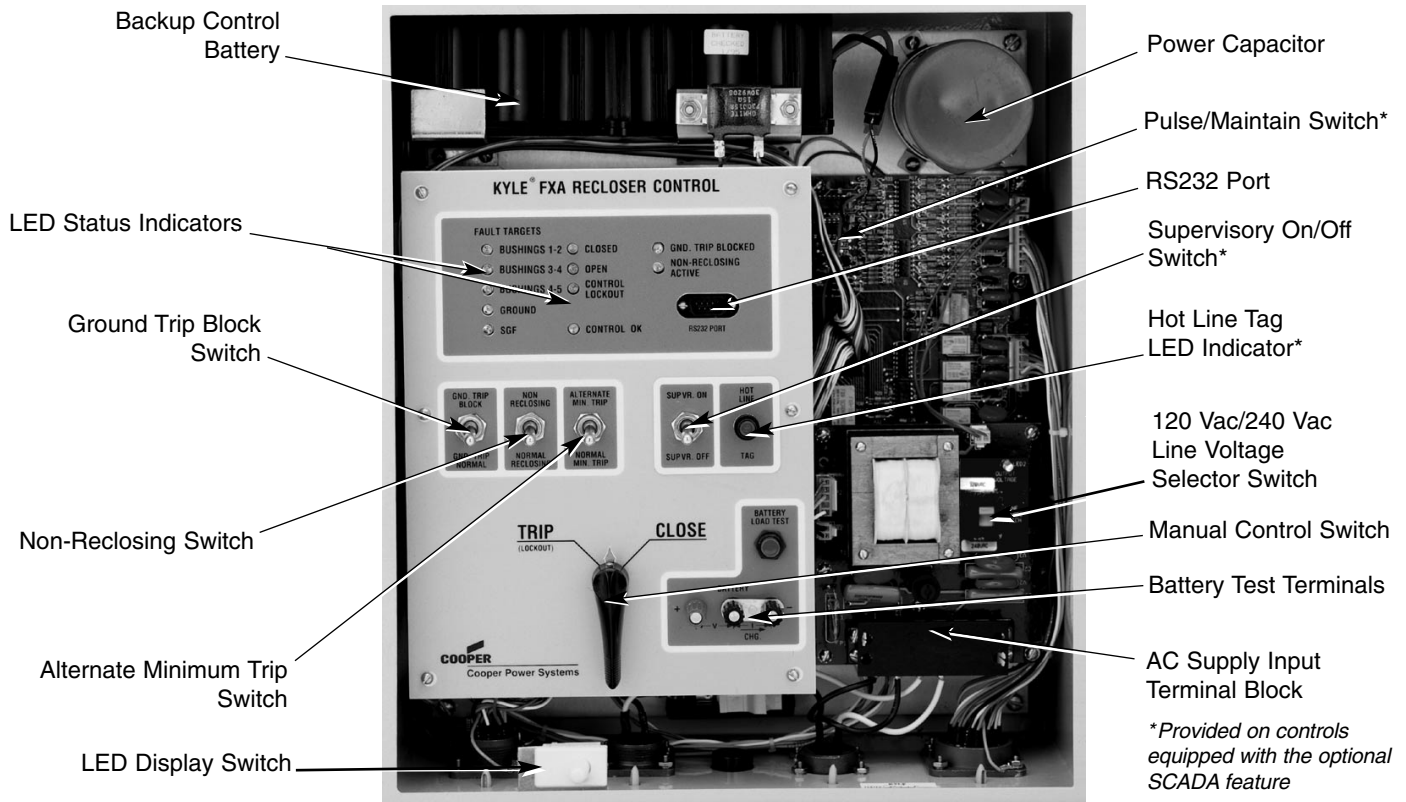


Figure 3.
Type FXA recloser control front panel and unit interior.

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Contact Position Indicator

Contact position indicator LEDs provide convenient visual indication of recloser contact position.

Ground Trip Block

The ground trip block feature prevents tripping when ground and sensitive ground/earth faults (SGF) are involved. Ground trip block can be enabled via the front panel switch, activated through a discrete contact on the optional SCADA feature, or programmed active with the programming software. Priority for ground trip block is given to the activation signal, regardless of source.

Non-Reclosing Operation

The non-reclosing feature sets the control to one-trip-to-lockout operation on TCC#1 without changing the pre-programmed operations to lockout sequence. Non-reclosing operation can be enabled via the front panel switch, activated through a discrete contact on the optional SCADA feature, or programmed active with the control programming software. Priority for non-reclosing operation is given to the activation signal, regardless of source.

Alternate Minimum Trip

The alternate minimum trip feature provides local selection of alternate phase, ground, and sensitive ground fault (SGF) minimum trip settings.

High Current Lockout

The high current lockout feature shortens the programmed operating sequence when a fault current exceeds a user-selected current level.

High Current Trip

The high current trip feature trips the recloser with time delays (0.016 to 0.15 sec.) for both phase and ground for fault-level currents that exceed a user-selected current level.

Ground Trip Precedence

With ground trip precedence (see Figure 5) OFF, for all faults above the phase minimum trip setting, the control will operate on the pre-programmed phase sequence.

With ground trip precedence ON, for all faults involving ground above the phase minimum trip setting, the control will operate on the pre-programmed ground sequence.

Sensitive Ground/Earth Fault (SGF/SEF)

The sensitive ground/earth fault feature allows detection and recloser-tripping operations for ground currents below the normal programmed ground minimum trip level.

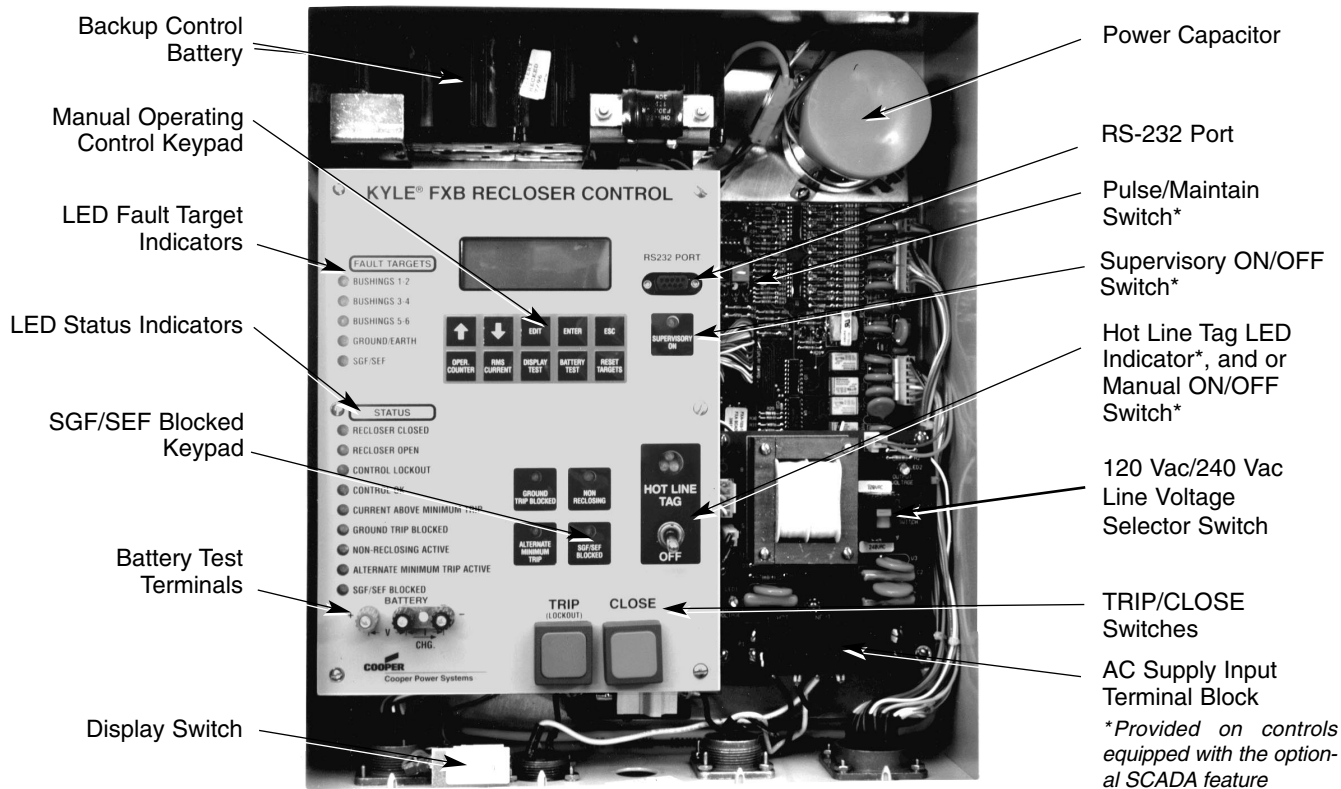


Figure 4. Type FXB recloser control front panel and unit interior.

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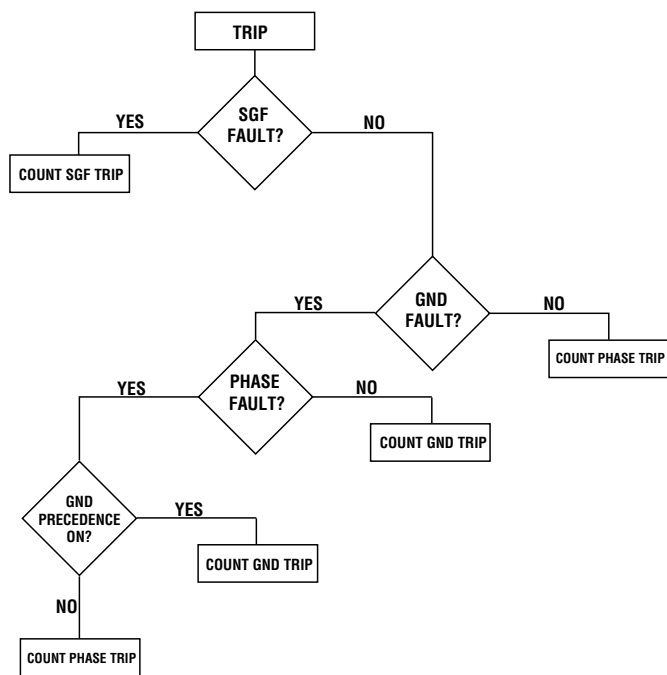


Figure 5. Ground trip precedence flow chart.

Reclose Retry

Following a reclose interval, the control issues a close command to the recloser. If the recloser does not respond with a close operation, the control will turn off the close signal and go into Reclose-Retry mode.

In this mode, a close signal is initiated at a programmed interval for a programmed number of attempts. The number of retries is selectable from 1 to 5000 in increments of one. The close signals are issued at a user-selectable interval between 1 and 60 seconds until closing power is restored to the recloser or programmed number of retries is exhausted, at which time the control will go to lockout.

Cold Load Pickup

The cold load pickup feature allows transfer from the normally programmed phase and ground TCCs to cold-load pickup phase and ground TCCs at a user-selectable interval between 1 and 60 seconds.

The cold load pickup feature can be separately enabled for a main operating switch close, or a close via the RS232 port, or both. The position of the front panel main operating switch is not a factor in determining the cold load pickup mode.

Programmable Settings

The FXA and FXB controls incorporate microprocessor technology to provide versatility and ease of operation.

Operating personnel use a Microsoft® Windows®-based programming software, via PC, to establish the control's operating settings. Refer to *Service Information S280-78-2 FX, FXA, and FXB Programmer's Software User's Manual* or for FXB, see *S280-078-3 FXB Front Panel Programming Guide* for programming procedures.

The various control parameters that can be easily programmed are:

- Phase and Ground-Earth Fault minimum trip level, programmable in 1 amp increments.
- Ground/Earth Fault minimum trip level programmable in 1 amp increments.
- Phase and Ground time-current curve selection from a total of 41 separate timing curves.
- Sensitive Ground/Earth Fault Constant Trip times programmable from 0.5 seconds to 120 seconds in 0.1-second increments.
- TCC shape modifications through a vertical shift multiplier value, minimum response time delay, constant time adder, and high current trip, applicable to any TCC.
- Number of operations to lockout (1, 2, 3, 4).
- Reclose interval is (0.6 to 1000 seconds) and is independently selectable for each operation.
- Reset interval (3 to 180 seconds) after successful reclose.
- Phase and ground TCCs independently selectable on each operation (1, 2, 3, or 4).
- Cold-load pickup TCCs independently selectable for both phase and ground.

Control Panel LED Indicators

LED indicators (Figure 6 & 7), located at the top of the control panel, provide a visual report of control and recloser operating status. The operation of each LED is described as follows:

Fault Targets: BUSHING 1-2, BUSHING 3-4, BUSHING 5-6, GROUND, (Ground / Earth on FXB Control) and SGF (sensitive ground/earth) (SGF/SEF on FXB control) indicate the detection of fault current on individual phases or ground.

FAULT TARGETS

- | | | |
|----------------|-------------------|------------------------|
| ● BUSHINGS 1-2 | ● CLOSED | ● GND TRIP BLOCKED |
| ● BUSHINGS 3-4 | ● OPEN | ● NON-RECLOSING ACTIVE |
| ● BUSHINGS 5-6 | ● CONTROL LOCKOUT | |
| ● GROUND | | |
| ● SGF | ● CONTROL OK | |

Figure 6. Type FXA control panel LED indicators.

CLOSED (Recloser CLOSED on FXB control) indicates that recloser contacts are in the closed position.

OPEN (Recloser OPEN on FXB control) indicates that recloser contacts are in open position.

CONTROL LOCKOUT indicates that the control has operated to lockout.

CONTROL OK indicates that the control's continuous self-diagnostics have detected no EEPROM malfunctions.

CURRENT ABOVE MINIMUM TRIP indicates that the line current is above the programmed minimum trip current.

GROUND TRIP BLOCKED indicates that ground trip block has been activated by either the front panel switch, via supervisory control or through programming.

NON RECLOSING ACTIVE indicates that non-reclosing has been activated by the front panel switch, via supervisory control or through programming.

ALTERNATE MINIMUM TRIP-ACTIVE (FXB only) indicates Alternative Minimum Trip has been activated by the front panel keypad, via supervisory control, or through programming.

SGF/SEF BLOCKED (FXB only) indicates sensitive ground/earth fault is blocked via the front panel keypad, via supervisory control, or through programming. Current above minimum trip (FXB only). An LED/DISPLAY switch (Figure 3 and 4) is located at the base of the control cabinet to turn the LED indicators off when the cabinet door is closed and help preserve battery charge.

FAULT TARGETS

- BUSHING 1-2
- BUSHING 3-4
- BUSHING 5-6
- GROUND/EARTH
- SGF/SEF

STATUS

- RECLOSER CLOSED
- RECLOSER OPEN
- CONTROL LOCKOUT
- CONTROL OK
- CURRENT ABOVE MINIMUM TRIP
- GROUND TRIP BLOCKED
- NON-RECLOSING ACTIVE
- ALTERNATE MINIMUM TRIP ACTIVE
- SGF/SEF BLOCKED

Figure 7. Type FXB control panel LED indicators.

RS232 Port on Front Panel

Both the Type FXA and FXB are equipped with an RS232 port (Figure 3 and 4), located on the upper portion of the control panel, adjacent to the LED indicators. It is used for temporary connection of a PC to the control. Refer to page 6 for additional information.

The RS232 port permits the operator or technician to upload all the programming information into the control, including minimum trip settings, operating parameters, and time-current curves.

The RS232 port also provides a convenient means to download stored control parameters and data files, including time-current curves, load profile monitor, event recorder, recloser interrupter duty monitor, and control settings for analysis using the control programming software.

Manual Operating Controls



Figure 8.
Manual Operating Controls on the FXA Recloser Control.

The lower portion of the front panel of the Type FXA control contains manual operating controls as shown in Figure 8. The manual operating control keypads of the FXB control are shown in Figure 9. See *S280-78-3 Front Panel Programming Guide*.

The operation of each manual control is described as follows:

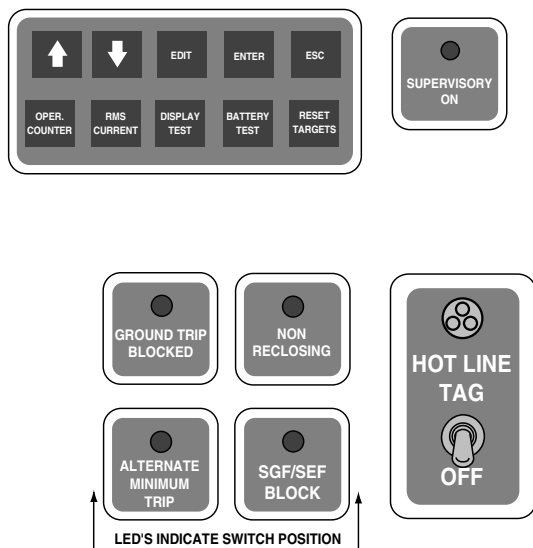


Figure 9.
Manual Operating Controls on the FXB Recloser Control.

Ground Trip Block

Ground fault trip operation of the control is disabled (when the Ground Trip Block Switch is set in the Block position for FXA, or Ground Trip Block LED Indicator is lit on FXB). Blocking ground trip operations is useful during known periods of three-phase load imbalance and is recommended while performing single-phase testing or switching. The sensitive ground/earth function is also blocked.

Non-Reclosing

The control can be set to block reclosing after an automatic trip (one trip operation to lockout) for phase and ground (by setting the operating mode switch to Non-Reclosing position for FXA or the Non Reclosing LED is lit for FXB). When set to the Normal Reclosing mode, the control will operate on its programmed operating sequence.

Alternate Minimum Trip

This permits switching to alternate, pre-programmed phase, ground, and sensitive ground fault minimum trip values (when the Alternate Minimum Trip switch is set to Alternate Minimum Trip for FXA, or the Alternate Minimum Trip LED is lit for FXB).

SGF/SEF (FXB only) Sensitive Ground/Earth Fault

Momentarily depressing the sensitive Ground/Earth Fault push button switch will activate/deactivate the feature and give LED switch position indication. This feature can be enabled/disabled independent of the initial activation point. Sensitive Earth Fault/Sensitive Ground Fault. Independent from normal earth trip, SEF operates below the normal earth minimum trip level to provide additional system protection.

Supervisory On/Off

The supervisory ON/OFF switch (pushbutton on FXB), is provided on controls equipped with the optional SCADA feature. The OFF position prevents supervisory operation of the control. This also controls access to the Local RS232 Port on the FXB Control.

Hot Line Tag LED Indicator

The Hot Line Tag indicator is provided on controls equipped with the optional SCADA feature. When lit, the Hot Line Tag LED indicates that the Hot Line Tag feature has been activated to prevent all closing operations from the manual control switch, from a supervisory signal, or from the programming software.

Hot Line Tag is activated or deactivated via a momentary supervisory signal (0.1 second minimum) sent to the Hot Line Tag Set/Reset terminals provided with the SCADA feature or by operating the Local Toggle Switch (FXB only) as shown in Figure 9.

Manual Control Switch

Located in the lower center of the control panel, the manual control switch allows manual closing and tripping of the recloser.

When operated to Trip, the recloser opens and the control locks out. When operated to CLOSE, the control returns to the reset condition and the recloser closes. While held in the CLOSE position, the control is still free to trip and lock out if closed into a fault.

Cold-load pickup is enabled or disabled via the Microsoft® Windows®-based programming (FXA/FXB) software. Cold-load pickup may also be enabled/disabled on the front panel of the FXB control. When active, all trip operations are transferred to separate cold-load pickup phase and ground TCCs for the programmed time (1 to 60 seconds).

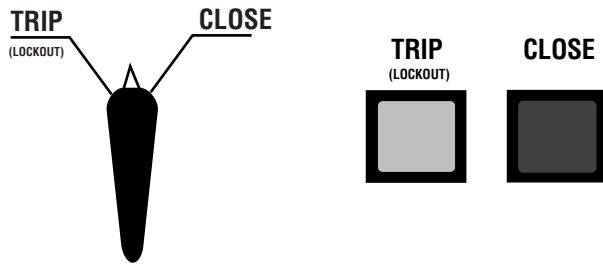


Figure 10. FXA (left)/FXB (right) manual TRIP/CLOSE controls.

Battery Test Terminals

The battery test terminals (Figure 11) are located at the lower right of the control front panel. The battery test panel contains a switch and test points for checking the condition of the 24 Vdc lead-acid battery.

CAUTION: Equipment damage. Shorting battery positive to battery negative at the battery test terminals on the control panel will cause damage to the control. The control will be inoperative and possible mis-operation (unintentional operation of the recloser) can result.

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IMPORTANT: Battery voltage and charge current measurements made from the test terminals on the battery test panel can be done while the control is in service as explained in the *Battery Test Procedure* and *Battery Charger Operation* sections of this manual. The control must be taken out of service for all other battery maintenance, battery replacement, or battery drain tests.

Battery Test Procedure

The values in the following test procedures are based on testing at 25°C (77°F).

With Control Connected to ac Power

Use the following procedure to test the performance of the control battery while connected to ac power:

Initial Condition: AC power is connected to control, and battery circuit is connected.

- 1. FXA units:** Connect a voltmeter to the battery test terminals located on the lower half of the front panel. Battery voltage should read 26-28 Vdc.

FXB units: Monitor the LCD display.

- 2. FXA units:** Press the Battery Load Test switch for 5 seconds, this places a 15 ohm load on the battery. Voltage drop should not exceed 2.0 Vdc.

FXB units: Press Battery Test Button. The FXB unit will display the unloaded and loaded battery voltages and provide a BATTERY OK or BATTERY NOT OK indication. Refer to *Service Bulletin S280-78-3, FXB Front Panel Programming Guide* for additional information.

With Control Disconnected from ac Power

The control battery can also be tested if the ac power is disconnected and the control is operating on battery power only.

Initial Condition: AC power is disconnected, and battery circuit is connected.

- 1. FXA units:** Battery voltage should read 23–27 Vdc. If the battery voltage is less than 23 Vdc, recharge the battery prior to performing the battery load test described in step 2.

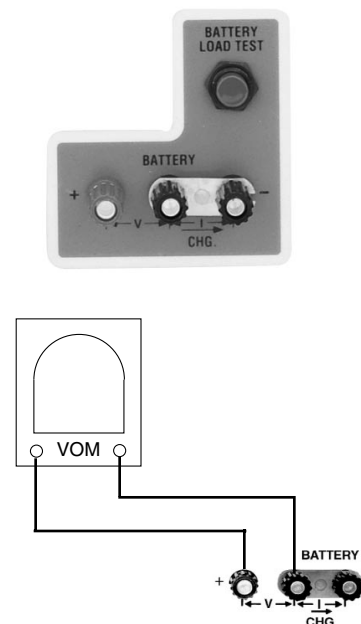


Figure 11. Battery Test Terminals FXA (top) and FXB (bottom).

- 2. FXA units:** Press the Battery Load Test switch for 5 seconds, this places a 15-ohm load on the battery. Voltage drop should not exceed 2.0 Vdc.

FXB units: Press Battery Test Button. The FXB unit will display the unloaded and loaded battery voltages and provide a BATTERY OK or BATTERY NOT OK indication. Refer to *Service Bulletin S280-78-3, FXB Front Panel Programming Guide* for additional information.

Note: Disconnect the battery when the control is removed from service.

Battery Charger Operation

The batteries in the Type FXA and FXB controls, when supplied with ac power, will remain charged, using a current-limited, temperature-compensated, constant-voltage charging technique. The battery charger is divided into two parts: a trickle charger (supplying approximately 20 mA) that is always on, and a voltage-dependent charger that supplies battery-charging current up to 220 mA.

The total charge current depends on climate, temperature conditions (values shown below are for 72°F), and what part of the cycle the charger is in. The charger will operate in the following sequence:

1. When the control is supplied with ac power, if battery voltage falls below approximately 20 Vdc, only the trickle charger is enabled, supplying approximately 20 mA to the battery until the voltage reaches 20 Vdc.
2. When battery voltage reaches 20 Vdc, the charger will go into its bulk rate charge mode of 220 mA. The charge current will decrease gradually until the battery reaches approximately 27 Vdc.
3. When the battery voltage reaches approximately 27 Vdc, the charger reverts to the trickle charge rate.
4. In a normal steady-state mode, with the battery fully charged (27 to 29 Vdc), only a trickle charge (approximately 6-10 mA) is supplied to the battery.
5. If the control loses ac power, when battery voltage falls below 21.6 under load, the control will shut down automatically to preserve the battery, and will not turn on again until ac power is restored at the power input. The optional SCADA feature provides an extensive array of supervisory and remote operation functions for enhanced distribution system control.

TIME-CURRENT CURVE MODIFIERS

The FXA and FXB standard time-current curve (TCC) library contains 41 curves which can be used to program the control. To assist in system coordination, modification of the standard curves is possible.

The methods of modification include:

- **Constant Time Adder:** Add a specific time to the selected TCC.
- **Vertical Translation Multiplier:** Multiply the entire curve by a programmed value.
- **Minimum Response Time Adder:** Establish a minimum control response time independent of the selected TCC.
- **High Current Trip:** Establish a constant trip time for a fault over a programmed ratio.

Refer to *Service Information S280-78-2 FX, FXA and FXB Programmer's Software User's Manual* for programming procedures. Refer to reference data R280-91-34 for the available TCCs. Please see *S280-78-3 FXB Front Panel Programmers Guide*.

DISCRETE SCADA/SUPERVISORY FEATURES

The optional Discrete SCADA feature provides an extensive array of supervisory and remote operation functions for enhanced distribution system control.

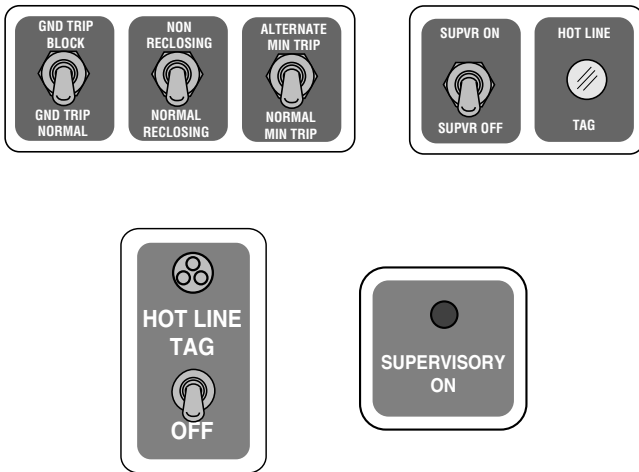


Figure 12. Supervisory ON/OFF Switch and Hot Line Tag Indicator, located on control front panel (SCADA only). FXA (top) FXB (bottom).

Figure 12 shows additional LED status indicators, located on the control front panel, provided with the SCADA option: the Supervisory On and Hot Line Tag.

The supervisory functions utilize dry contact inputs for operation and are controlled by the Supervisory ON/OFF function.

Status indication of key control and recloser conditions is provided by contact outputs.

With the supervisory ON, the supervisory functions are operative. With supervisory OFF, supervisory operation is blocked. The recloser can be tripped or closed via the front panel manual control, regardless of the position of the Supervisory mode.

SCADA Operations

SCADA operations include Remote Trip and Lockout, Supervisory Trip and Lockout, Remote Hot Line Tag (see *Hot Line Tag*), Supervisory Close, Supervisory Ground Trip Block, and Supervisory Non-Reclose.

Remote Trip and Lockout

Remote Trip and Lockout trips the recloser open and locks out the control. It functions independently of the position of the Supervisory ON/OFF switch and can be used for tripping from external relays and alarms.

Supervisory Trip and Lockout

Supervisory Trip and Lockout trips the recloser open and locks out the control. The control remains locked out until it is closed manually or by the supervisory close feature.

Supervisory Close

Supervisory Close initiates a closing signal to the recloser and modifies the operating sequence to one trip to lockout on the Cold-Load Pickup (CLPU) TCC. After the adjustable reset time interval has elapsed, the control returns to its programmed sequence of operations.

Supervisory Close Cold-Load Pickup can not be separately disabled from Cold-Load Pickup for the main operation switch on the front panel. CLPU can be disabled for both the main operation switch and for Supervisory Closes via the interface software.

Supervisory Ground Trip Block

Supervisory Ground Trip Block blocks ground tripping. Supervisory operation is dependent upon the positions of the front panel GROUND TRIP BLOCK and SUPERVISORY ON/OFF switches.

Supervisory Non-Reclose

The Supervisory Non-Reclose feature provides selection of non-reclosing operation.

For momentary operation, a minimum signal duration of 100 ms is required. If pulsed to the Non-Reclosing mode, the control will operate one trip to lockout on the next TCC programmed in the sequence. Should control power be lost (both ac and battery), the control will revert to the Normal Reclosing mode upon power-up.

If maintained signal operation is initiated with the supervisory switch in the OFF position, the reclosing will remain NORMAL. When the supervisory function is operated to ON, Non-Reclosing operation is active (with closed contacts). If control power is lost and subsequently restored, the power-up condition will correspond to the customer contact position.

If Supervisory Non-Reclose is activated when the recloser is closed during a non-fault condition or during a fault sequence, a fault will result in one trip operation to lockout.

Selection of Non-Reclosing is disabled when the supervisory function is off.

Ground Trip Block and Non-Reclosing Operation

Both the Ground Trip Block and the Non-Reclosing Feature can be activated by any of three sources:

- Front panel switch.
- Personal computer connected to the front panel RS232 port.
- SCADA feature.

The controlling logic of the feature is that of a three-input OR gate. If any of the inputs is active, the feature is active. Also, whichever input is used to activate the feature must be the input to deactivate the feature.

Hot Line Tag

WARNING: Hazardous voltage. Do not use Hot Line Tag as a substitute for a visible disconnect. Always establish a visible disconnect prior to performing any work requiring a de-energized line. Failure to comply may cause death, severe personal injury, or equipment damage. T276.0

Hot Line Tag is provided for live-line work applications. All closing operations are disabled when the Hot Line Tag feature is activated.

IMPORTANT: Hot Line Tag activation does not cause the recloser to trip open. It only prevents the recloser from closing.

IMPORTANT: Hot Line Tag is intended solely for live-line work applications, such as maintenance, repairs, or improvements to the distribution system, that occur while the line remains energized.

Hot Line Tag prevents all closing attempts and shifts protection to one trip to lockout on the next programmed definite time–current curve. Cold-Load Pickup and Non-Reclosing functions are overridden by Hot Line Tag.

Hot Line Tag is activated from either the operator panel toggle switch or a discrete SCADA function. All sources must be off to deactivate Hot Line Tag.

Hot Line Tag prevents all closing operations by opening a contact in series with the recloser low-voltage circuit closing coil. This is accomplished by means of a latching relay on the SCADA circuit board and is completely independent of the control microprocessor.

The FXB control has a front panel ON/OFF Switch for manual operation of Hot Line Tag.

To activate the function from the operator panel, flip toggle switch up to the ON position. See Figure 12. The LED indicator illuminates when the function is active.

If the Hot Line Tag feature is activated while the recloser is closed and the control is in the reset (home) position, a fault will cause one trip operation to lockout. The timing will be on the next programmed TCC.

If the Hot Line Tag feature is activated during a reclose interval, the recloser will not reclose, and the control will go to lockout. The timing will be on the next programmed TCC.

The Hot Line Tag feature may only be reset by the source which initiates the function. For example, if Hot Line Tag is activated at the operator panel, the reset function is only possible at the operator panel and not via SCADA command.

The feature is activated (SET) or deactivated (RESET) by separate momentary (100 ms minimum) contact signals.

If Hot Line Tag operation is set and control power is lost (both AC and battery), the Hot Line Tag operation will be active when operating power is restored.

If both inputs are energized the state is SET. The feature is not controlled by the Supervisory ON-OFF Switch.



SCADA Status Outputs

The SCADA option includes the status outputs:

Supervisory Switch Status

Contact closed to status common when the Supervisory switch is ON. Output is volatile and will be OFF (status contacts open) when ac power is removed and battery is dead. Correct status will return upon control power-up.

Recloser Open Status

Contact closed to status common when the recloser contacts are OPEN (recloser close circuit has continuity or when the Manual Trip Handle on the recloser is in the Trip Position). Contact closed corresponds to the front panel LED (OPEN) indicator.

Output is volatile and will be OFF (status contacts open) when ac power is removed and battery is dead. Correct status will return upon control power-up.

Recloser Closed Status

Contact closed to status common when the recloser contacts are CLOSED (Trip circuit has continuity). Contact closed corresponds to the front panel LED (CLOSED) indicator. Output is volatile and will be OFF (status contacts open) when ac power is removed and battery is dead. Correct status will return upon control power-up.

Control Locked Out Status

Contact closed to status common when the control microprocessor is indicating lockout state. Contact closed corresponds to the front panel LED (CONTROL LOCKOUT) indicator.

Output is volatile and will be OFF (status contacts open) when ac power is removed and battery is dead. Correct status will return upon control power-up.

Control Status - Control OK

Contact closed to status common when the control microprocessor is not indicating and malfunctions. Contact closed corresponds to the front panel LED (CONTROL OK) indicator.

Output is volatile and will be OFF (status contacts open) when AC power is removed and battery is dead. Correct status will return open control power up.

Ground Trip Block Status

A Form-C contact pair provides two contact outputs; Ground Trip Blocked and Ground Trip Normal will be indicated by closed contacts, common to status common. For Ground Trip Blocked status, the closed contact corresponds to the front panel LED (GND TRIP BLOCKED) indicator.

Output is volatile and will indicate Ground Trip Normal when ac power is removed and battery is dead. Correct status will return upon control power up; however, that status may have changed due to power loss.

Non-Reclose Status

Contact closed to status common when the control is in the Non-Reclosing mode. Contact closed corresponds to the front panel LED (NON-RECLOSING ACTIVE) indicator.

Output is volatile and contact will open when ac power is removed and battery is dead. Correct status will return upon control power up; however, that status may have changed due to the power loss.

Hot Line Tag Status

Contact closed to status common when the Hot Line Tag (HLT) feature is active. The closed contact corresponds to the front panel Hot Line Tag LED indicator.

If set through SCADA feature, output is volatile and contact will open when ac power is removed and battery is dead. Correct status will return upon control power-up; however, that status may have been changed due to power loss. The FXB Controls Hot Line Tag Status Contact also monitors the local Hot Line Tag Switch.

Control Power Status

Contact closed to status common when the control is operating on ac power (120 or 240 Vac).

Discrete SCADA User Connections

All SCADA connections are made through a connector mounted on the bottom of the control cabinet (Figure 13, 14, and 15). There are no provisions for customers to make connections to a terminal block.

The SCADA feature does not include the required matching plug or cable (Figure 13). Customers must specify cable length (FXA-20 accessory).

Both control inputs and status outputs are “DRY” contacts. The control input dry contacts may be either a momentary or maintained contact. All control inputs are either momentary or maintained based upon the position of the Pulse/Maintain Switch shown in Figures 3 and 4.

Momentary Contact

The user activates the function by pulsing the control input contact for a minimum of 100 milliseconds. To deactivate the function, the user again pulses the input contact for 200 milliseconds.

Maintained Contact

The user activates the function by closing the control input contact and maintaining the closed contact. Opening the contact will deactivate the function.

NOTE: Supervisory Trip and Lockout, Supervisory Close, and Remote Trip and Lockout will not automatically close or trip when the control input is deactivated.

Contact Ratings for Status Outputs:

Rating (Resistive):

Max. Switching Power: 60 W (dc), 125 VA (ac)

Max. Switching Voltage: 125 Vdc, 120 Vac

Max. Switching Current: 2 A

UL/CSA Rating:

0.6 A 125 Vac

0.6 A 110 Vdc

2.0 A 30 Vdc

Customer contacts for SCADA inputs (this refers to the customer's contacts, not the contacts on the control) must be capable of the following operating conditions:

Voltage = 45 Vdc

Current = 15 mA

Control Power Status

Contact closed to status common when the control is operating on ac power (120 or 240 Vac).

Cable Connections

Table 2 shows SCADA cable connections as configured in the KFXA-20 cable accessory.

Note: Controls equipped with the KFXA-20 cable accessory may have cables provided by different manufacturers. Identify the cable as having either a) only single-color trace colors or 2) single- and double-color trace colors.

Shielding and Surge Protection of Supervisory Cables

All supervisory operation and control monitor leads should be protected within shielded cables. The cable shield is grounded at the control.

TABLE 2
Type FXA SCADA Cable Connections
(KFXA-20 Cable Accessory)

FUNCTION	PIN	Single-Trace-Color Cable		Double-Color-Trace Cable	
		Base Color	Trace Color	Base Color	Trace Color
Supervisory Common	Z	Orange	Green	Orange	Green
Remote Trip & Lockout	N	White	Black	White	Black
Supervisory Trip & Lockout	M	Orange	Black	Orange	Black
Supervisory Close	L	Orange	---	Orange	---
Supervisory Ground Trip Block	J	Red	White	Red	White
Supervisory Non-Reclose	K	Green	White	Green	White
Set Hot Line Tag	P	Orange	Red	Orange	Red
Reset Hot Line Tag	R	Blue	White	Blue	White
Status Common	B	White	Red	White	Red
Supervisory Switch Status	b	Black	---	Black	---
Recloser Open Status	E	Blue	Green	Black	White/Red
Recloser Closed Status	C	Red	Black	Red	Black
Control Locked Out Status	G	Black	White	Black	White
Control OK Status	H	Blue	Black	Blue	Black
Ground Trip Normal Status	W	Blue	Orange	Red	Black/White
Ground Trip Block Status	d	White	---	White	---
Non-Reclose Status	X	Green	---	Green	---
Target 1-2 Status	A	Black	Red	Black	Red
Target 3-4 Status	D	Red	Green	Red	Green
Target 5-6 Status	F	Red	---	Red	---
Target GND Status	T	Blue	---	Blue	---
Target SGF Status	U	Green	Black	Green	Black
Hot Line Tag Status	V	White	Green	White	Black/Red
ac Power Status	S	Blue	Red	Blue	Red
No Connection	Y	---	---	---	---
Cabinet Ground	a	Braided Stainless	Cable Shield	Braided Stainless	Cable Shield

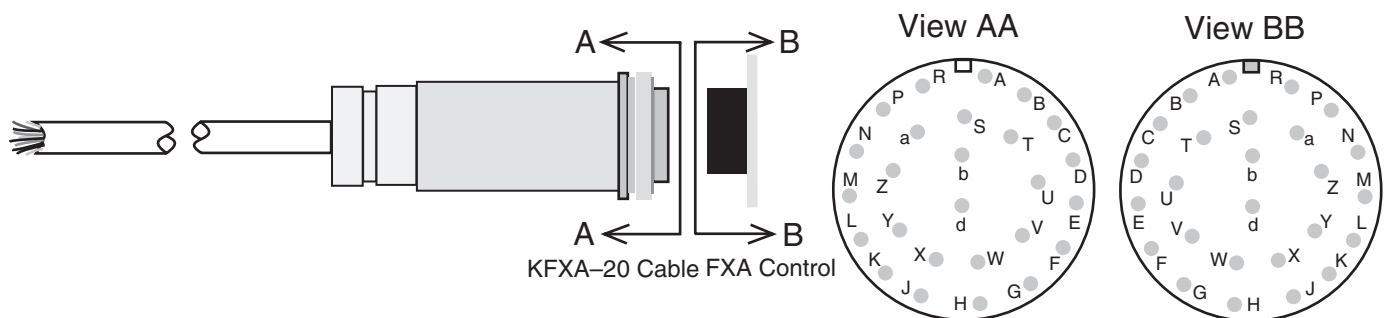


Figure 13.
KFXA-20 Accessory Cable and plug (View AA) and Type FXA / FXB optional SCADA accessory receptacle (View BB). See note under “Cable Connections” in this manual.

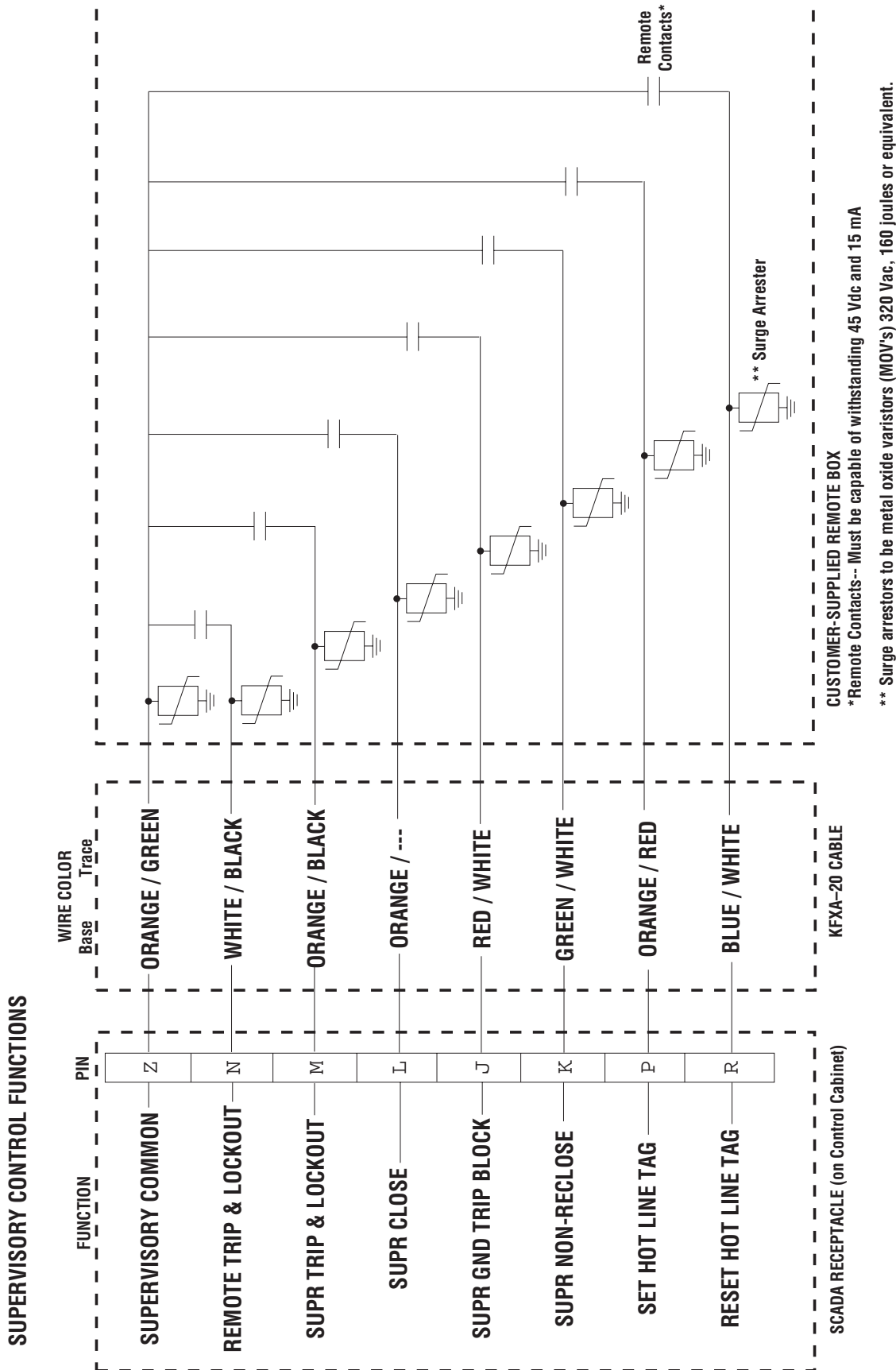
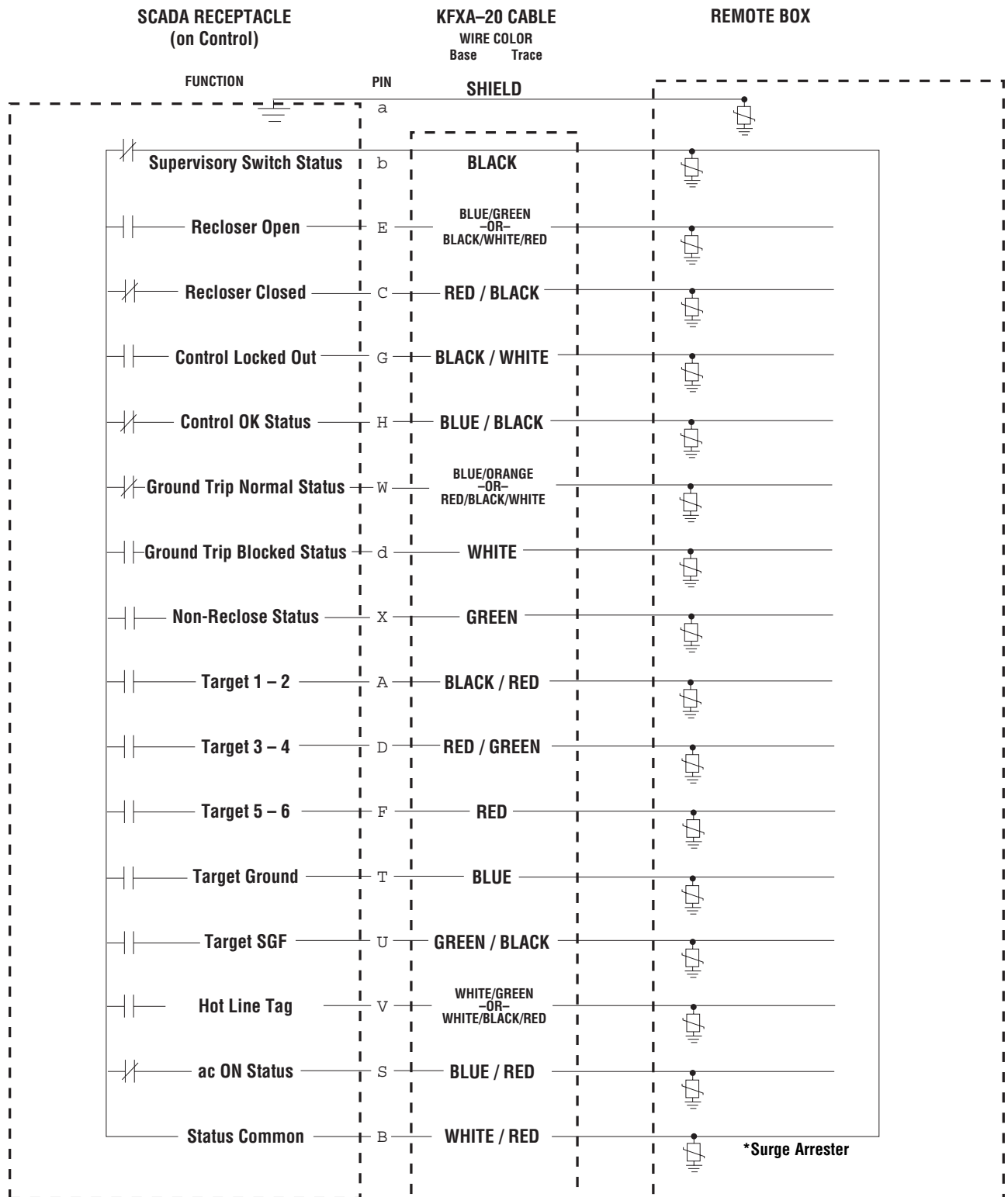


Figure 14. Typical SCADA customer inputs and surge protection for supervisory and remote signals.



Status Contacts shown for the following conditions:

- | | | |
|-----------------------|----------------------|----------------------|
| ac Power ON | Recloser Closed | Control Reset |
| Control OK | Ground Trip Normal | Normal Reclosing |
| Supervisory Switch ON | No Target Indication | Hot Line Tag not set |

* Surge Arresters to be metal oxide varistors (MOV's), 320 Vac, 160 joules or equivalent

Figure 15. SCADA status contacts. See note under "Cable Connections" in this manual.

INITIAL PROGRAMMING PRIOR TO INSTALLATION

CAUTION: Equipment misoperation. Do not connect this control to an energized recloser until all control settings have been properly programmed and verified. Refer to the programming information for this control. Failure to comply can result in control and recloser misoperation, equipment damage and personal injury.

G110.3

The control must be programmed with all necessary operating settings and parameters prior to operation with an energized recloser.

Initial programming of the type FXA or FXB control is the responsibility of a qualified technician or engineer who is familiar with the functions of the control and the programming parameters required for the specific recloser installation. The control must be programmed using a Microsoft® Windows®-based personal computer (PC) connected to the recloser control via the front panel RS232 port.

Service Information S280-78-2 FX, FXA, and FXB Programmer's Software User's Manual lists all software program settings and describes software operating parameters.

Control Security

The recloser control security is inherent in its software, which requires a password to enable a WRITE operation from the computer to the control.

Programmer's Software

Prior to interrogation and programming, the operator should be familiar with the control programmer's software. Refer to *Service Information S280-78-2 FXA, FXB, and FX Programmer's Software User's Manual* for information. Figure 16 shows two of the screens available in the programmer's software.

Interrupter Duty Monitor

To reflect appropriate duty, the control must be set for the correct recloser type, or duty readings will be incorrect. Refer to *Service Information S280-78-2 FXA, FXB, and FX Programmer's Software Users Manual* for information about the Interrupter Duty Monitor.

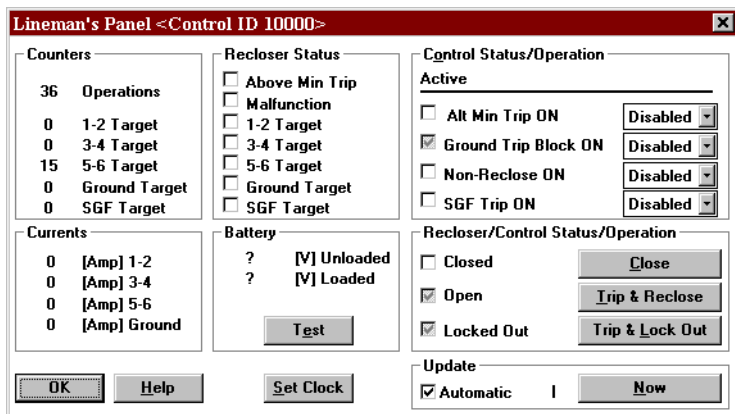
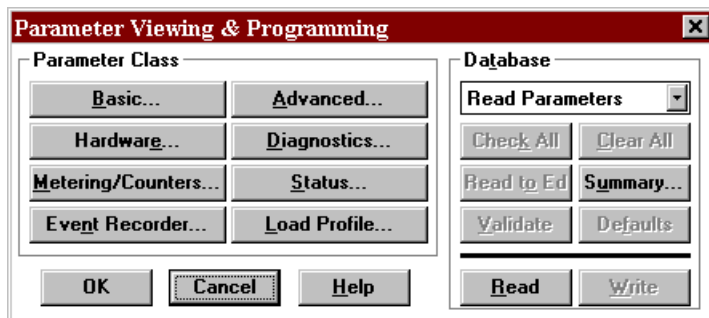


Figure 16.
Software screens.



INSTALLATION PROCEDURE

WARNING: Hazardous voltage. Recloser and control must be solidly grounded. Follow all locally approved procedures and safety practices when grounding this equipment. Improper grounding can result in contact with high voltage, which will cause death or severe personal injury. G115.1

Control / Recloser Compatibility

IMPORTANT: This control is not compatible with Form 1 Type WE reclosers below S/N 300 and Form 1 Type RE reclosers below S/N 400.

Reclosers manufactured prior to June 1989 are equipped with Type A bushing current transformers (CT's). These reclosers were designed for use with Form 2, Form 3, and Form 3A controls.

NOTICE

RECLOSER IS EQUIPPED WITH TYPE B SENSING CT'S.
AN OPTIONAL BATTERY CHARGER IS ALSO AVAILABLE.

Reclosers manufactured since June 1989 are equipped with new-design sensing CT's, designated type B CT's; reclosers with these CT's are identified with a decal on the recloser sleet hood or operator cabinet.

Reclosers equipped with Type B sensing CT's are compatible with all Kyle recloser controls (Form 2, Form 3, Form 3A, Form 4A, Form 4C, and Type FXA and FXB controls). Kyle® microprocessor-based controls, Form 4A, Form 4C, Form 5, and Form 6, have the ability to generate event records and/or oscillographs during a fault. These controls should be used with Type B sensing CT's. Type B sensing CT's may also be used with Form 2, Form 3, and Form 3A controls.

Retrofit kits with the new Type B sensing CT's are available to upgrade existing families of reclosers. For additional information, contact your Cooper Power Systems representative.

For identification, Table 3 lists the serial number breaks between old-style Type A and the new-style Type B sensing CT's. Below this serial number, the recloser is equipped with the Type A CT's.

Note: For reclosers shipped prior to 1989 and not listed below, please contact your Cooper Power Systems representative with the recloser type and serial number for verification of Type A or B bushing current transformers.

TABLE 3
Serial Number Break for Reclosers with Type A Sensing CTs

Recloser	Below Serial Number
RXE	5831
RVE	5894
WE	11199
WVE	3695
VWE	7199
VWVE27	7208
VWVE38	1204

All VSA reclosers are equipped with Type A Sensing CTs.
All VSML reclosers are equipped with Type A Sensing CTs.
All VSA12, VSA12B, VSA16, VSA20, VSA20A, and VSA20B reclosers are equipped with Type B Sensing CTs.
All VWVE38X and VWE38X reclosers are equipped with Type B Sensing CTs.

Mounting The Control

The Type FXA and FXB recloser controls should be mounted at a convenient, accessible location.

- For pole-mounted installation, a hole and keyway in the control mounting bracket accommodates a (16mm) 5/8" bolt.
- For substation installation, brackets are available as an accessory for mounting the control to a substation frame.

Limits on control cable length are determined by the maximum distance between the control and the recloser. Solenoid-operated and motor-operated reclosers have different maximum distances.

- Up to 125 feet for solenoid-operated reclosers (VWE, VWVE27, VWVE38X, WE, WVE27, WVE38X).
- Up to 35 feet for motor-operated reclosers (VSA12, VSA12B, VSA16, VSA20, VSA20A, VSA20B breaker, VSO12, and VSO16).

Note: Consult your Cooper Power Systems representative if longer cable lengths are required.

Outline, mounting (Figure 17), and knockout dimensions for the control cabinet are shown in Figure 21.

Control Cable

The control cable is fabricated with connectors which mate with the female receptacle of the recloser on one end and the male receptacle of the control on the other end.

Note: The control cable must be supported along its length to prevent repeated movement due to wind or other outside forces, which can damage the cable and/or connector.

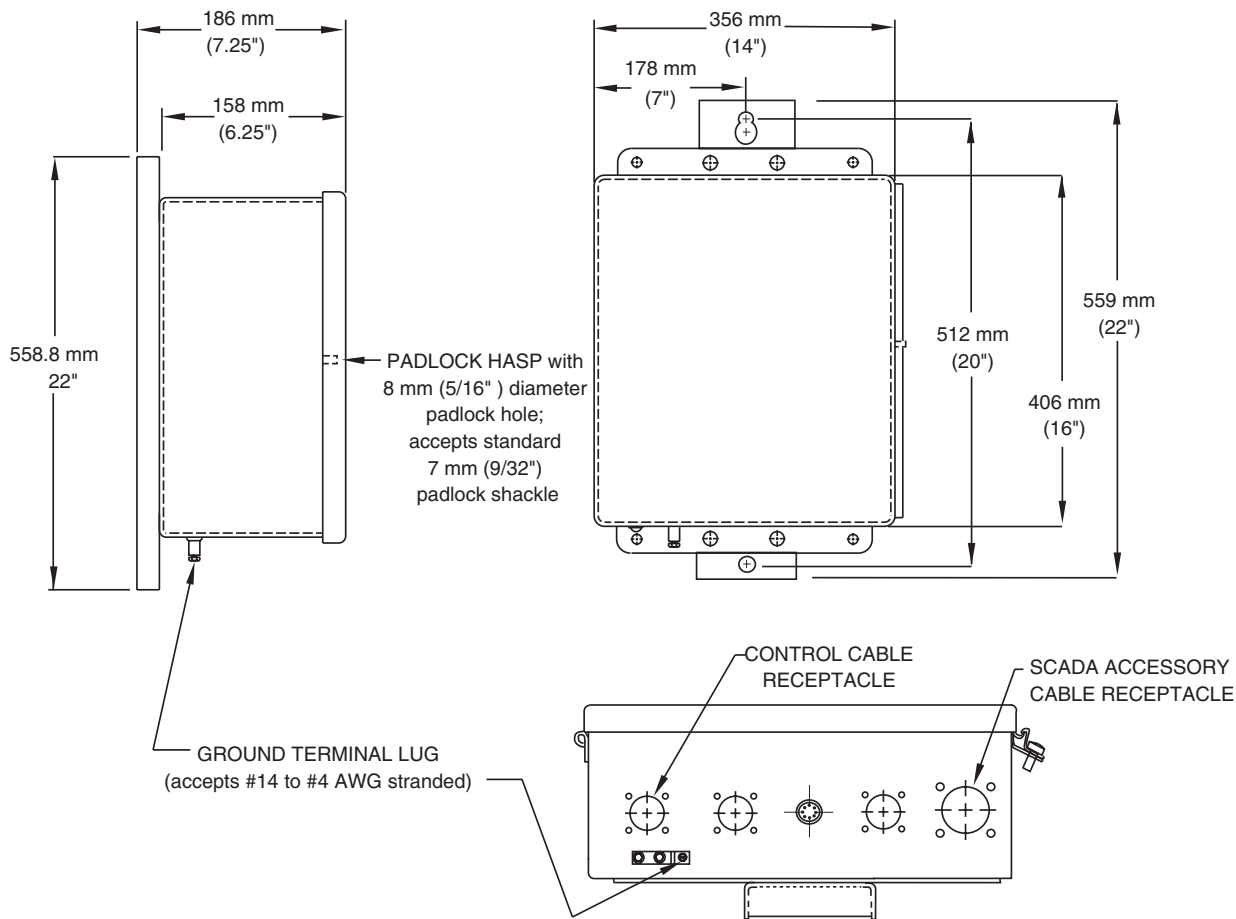


Figure 17.
Cabinet mounting dimensions.

Older control cables (KA1ME) shipped prior to 1970 were of a non-shielded design and are not satisfactory for operation with the FXA and FXB control. These older cables had a YELLOW decal on each connector. The newer shielded cables have a GREEN decal and are identified as "SHIELDED CABLE" and must be used with the FXA and FXB controls.

Grounding The Control

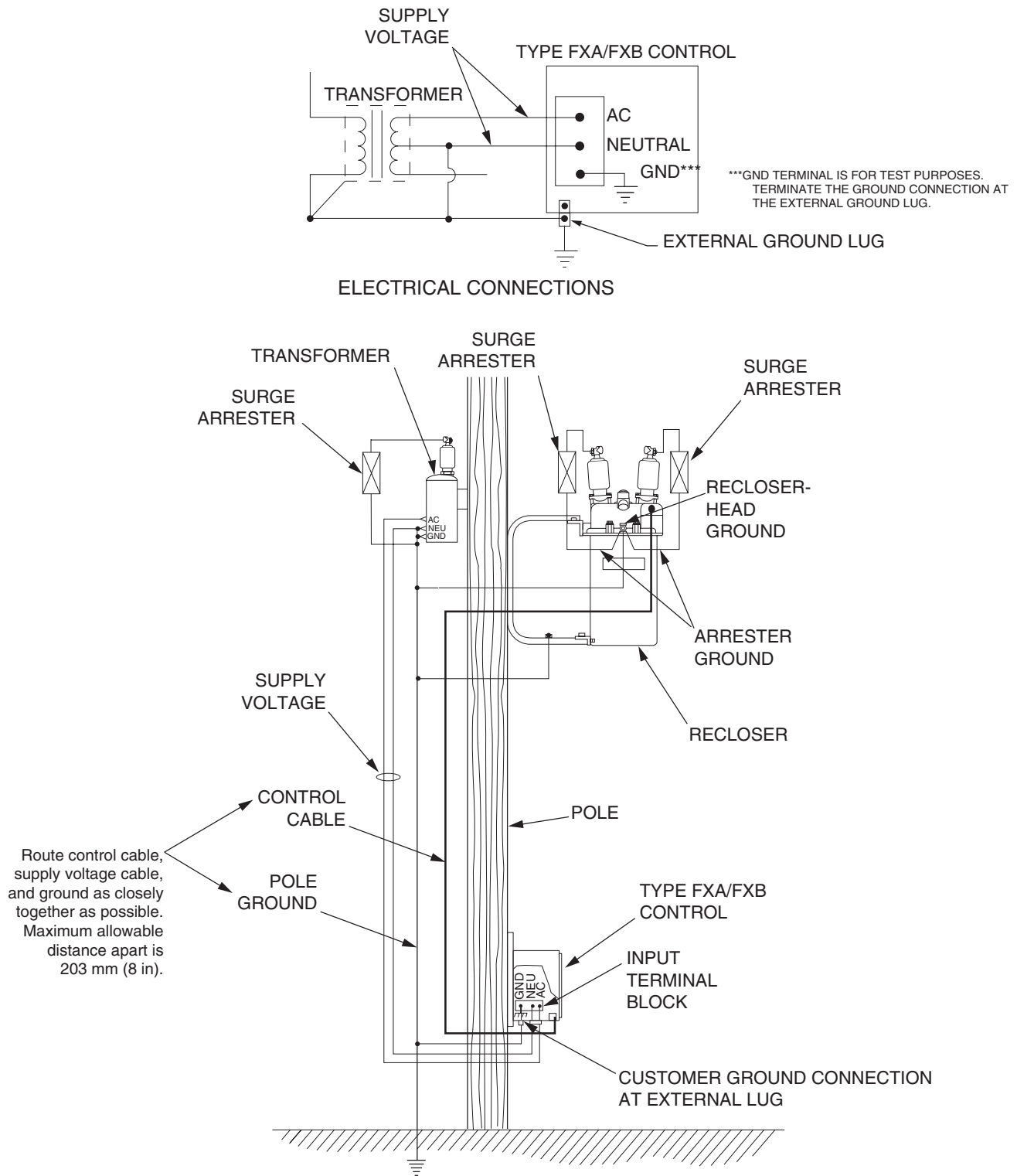
The control cabinet must be grounded. A grounding connector on the underside of the cabinet will accommodate No. 14 solid through No. 4 stranded conductors. Recommended methods for grounding the control and recloser are shown in Figures 17, 18, and 19.

It is important for effective surge protection that all control and power conductors for the FXA or FXB be routed parallel to a corresponding ground path. For example, the ac power supply for the control should be parallel and equal in length to the transformer ground path. The control cable should be parallel to and routed close to the recloser ground path.

IMPORTANT: All cable connections to the Type FXA/FXB control must be routed within 203 mm (8 inches) of their corresponding ground (see Figures 18 and 19). During a surge, a potential of approximately 1.5k V per foot can develop in the conductors. Differences between conductor and ground path lengths can add additional stress to the control components in the event of a power surge.

Installation of the control must include the following:

- Protection of the recloser and the supplying transformer with surge arresters.
- Grounding of the recloser head.
- Grounding of the transformer tank.
- Grounding of the control cabinet



Installation of the control must include the following:

- Protection of the recloser and the supplying transformer with surge arresters.
- Grounding of the recloser head.
- Grounding of the transformer tank.
- Grounding of the control cabinet

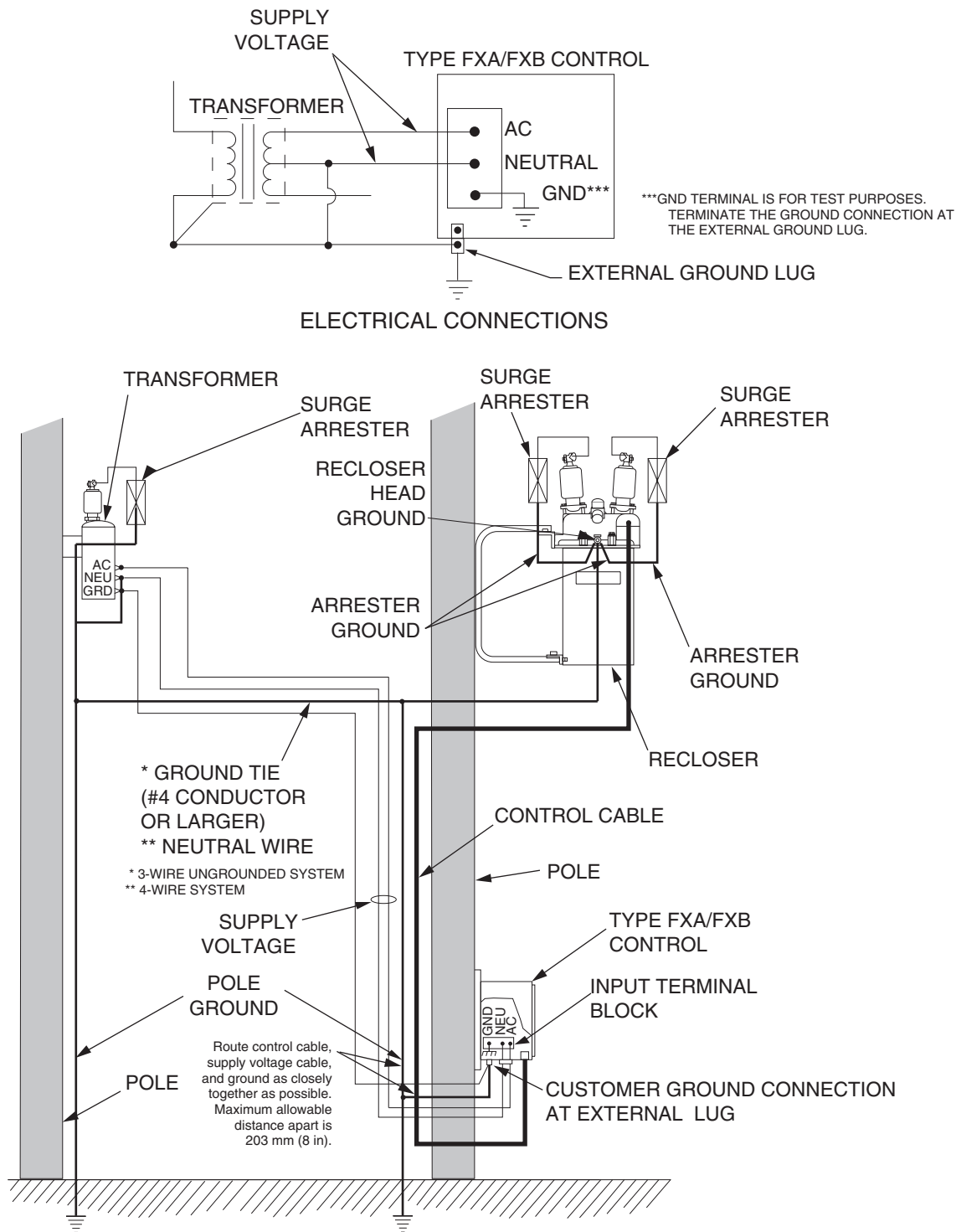


Figure 19. Recommended grounding method for both Type FXA and FXB control with remote supply voltage transformer. The supply voltage transformer should be no more than one pole span from the recloser mounting.

CAUTION: Equipment damage. Do not drill connection holes into the top of the cabinet. Connection holes in the top of the control cabinet will allow moisture to seep into the control and damage the components or cause control mis-operation. Failure to comply will void the control's factory warranty.

T249.0

Customer Connections for ac Power

All type FXA and FXB controls require customer-supplied ac power for operation. Figure 20 indicates the location of the knockout holes in the bottom of the cabinet.

The maximum operating power requirement for the FXA or FXB control is approximately 35 W. The customer's ac power supply cable is routed through the knockout hole entrance located on the bottom of the control cabinet.

The input power supply consists of an ac (terminals 1-2) and neutral connection (terminals 3&4). The terminal strip ground (terminals 5-6) is for bench-testing purposes only. Ground the control cabinet to the pole through the external cabinet. (see Figures 17, 18, and 19).

Note: It is not necessary to use shielded cable for the ac supply path if it runs next to the transformer ground path.

Receptacle / Cable Accessories

Figure 21 shows optional receptacle/cable accessories offered with the type FXA /FXB control.

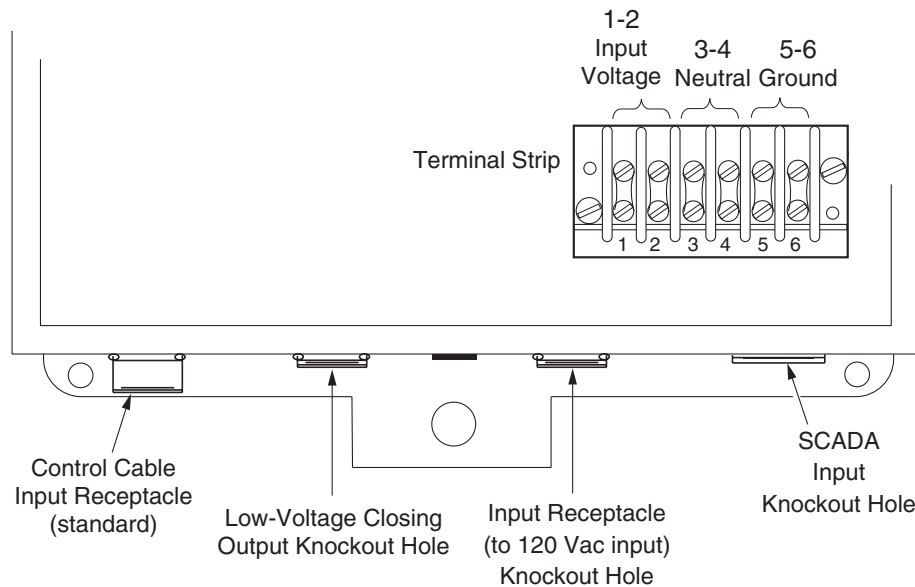


Figure 20.
Type FXA/FXB knockout holes and terminal strip.

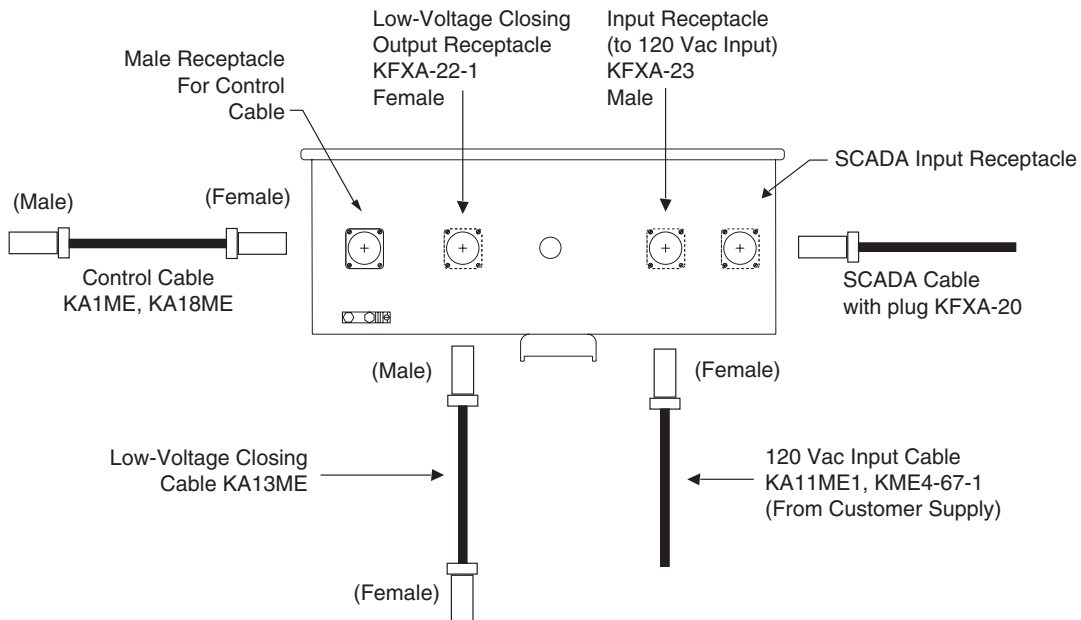


Figure 21.
Type FXA/FXB input receptacles and accessory cables with plugs.

BEFORE PLACING CONTROL AND RECLOSER INTO SERVICE

Prior to placing the control and recloser into service, the following installation procedures must be properly completed and verified:

1. The control is properly mounted for the installation.
2. The recloser is installed according to all locally approved standards and practices.
3. The control and the recloser are properly grounded in accordance with guidelines in this manual.
4. The line voltage selector switch (Figures 3 and 4) is set to match the local line voltage level.
5. The ac power is connected to the control (the ac Supply LED indicator is ON).

6. The control battery is connected and has been tested for proper operation.
7. All control programming has been entered and verified by appropriate personnel.
8. The control clock has been set to the correct time.
9. Customer connections for remote and supervisory operation have been checked and completed in accordance with shielding and surge protection instructions in this manual.
10. The control cable is properly connected and supported.

TESTING AND TROUBLESHOOTING

Testing and troubleshooting of the Kyle Type FXA or FXB recloser control must be done after the control has been removed from service. This testing and troubleshooting section assists the control operator in:

- Testing the operation of the AC Supply Board and the Control Front Panel.
- Testing the operation of the SCADA board.
- Testing the operation of the Battery Test Terminals.
- Trip testing of Phases 1-2, 3-4, 5-6, and Ground.

For testing purposes, turn off the Event Recorder, Interrupter Duty Monitor, and Operations Counter so they are not recorded. Refer to *Service Information S280-78-2 FX, FXA, and FXB Programmer's Software User's Manual* for further information.

Level I: Testing an Installed Control

Two tests to verify initial operation of the recloser controls can be performed while connected to an operating recloser. Verifying that the control is energized and verifying battery operation are the *only* tests performed on an installed operating control. All other tests described in the **TESTING AND TROUBLESHOOTING** section require the control be removed from service, connected to a by-passed recloser, or tested at a location where the proper testing equipment is available.

Verify The Control is Energized

Open the door to the control. On the AC Supply Input Circuit Board, located behind the AC terminal block (see Figure 3 and 4), there are two LED indicators. The upper right LED indicates 28 Vdc output voltage. The lower left LED indicates 120 Vac input voltage. If both the LED's are ON, the CPU board is receiving power. If only the lower left 120 Vac input voltage LED is on, the fuse on the AC power supply board is most likely blown.

Verify Battery Operation

To test battery operation, follow the procedures described in the **BATTERY TEST PROCEDURE** section of these instructions.

IMPORTANT: The Type FXA or FXB recloser control can be taken out of service for testing and placed back into service without de-energizing its recloser and interrupting the system. However, during the time the control is out of service, the recloser is inoperative.

CAUTION: Recloser misoperation. The control must be removed from service prior to performing any Level II testing. Failure to comply can result in misoperation (unintentional operation) of the recloser. T250.0

Level II: Testing a Control Removed From Service

To Remove Control From Service

For all Level II testing, the following steps must be taken to remove the control from service and prevent possible recloser misoperation:

1. Switch the GROUND TRIP BLOCK switch to BLOCK.
2. Disconnect the control cable from the control.
3. De-energize the AC power from the control.
4. Unplug the control battery.

On an out-of-service control, perform the following steps prior to Level II testing:

1. Ground the control cabinet using the grounding terminal lug (Figures 17, 18, and 19).
2. Energize the AC power to the control.
3. Reconnect the control battery.

Testing with Type MET Tester

The Kyle Type MET Electronic Recloser Control Tester (Figure 22) can be used for testing the Type FXA and FXB controls. The MET Tester is completely self-contained, includes all necessary metering and interconnecting cables, and is capable of performing all required checks and tests from a simple verification of operation to a complete verification of all operating parameters. Operating instructions for the Type MET Tester are contained in *Service Information S280-76-1*.



Figure 22.
Kyle Type MET electronic recloser control tester.

89989KM-F

A 30-minute videocassette program, KSPV7 Kyle® *Type MET Electronic Recloser Control Tester Operation and Testing Procedures*, is available as a supplemental training aid for service personnel.

When testing the recloser control, turn off the Event Recorder, Interrupter Duty Monitor, Operations Counter, and Target Counters to avoid the recording of test events. Refer to *Service Information S280-78-2 FX, FXA, and FXB Programmers Software Users Manual* for further information.

Testing the Control with the Recloser

Electrical Closing - Solenoid Operated Reclosers

Line voltage is required for automatic recloser operation during testing of reclosers equipped with a closing solenoid (except for reclosers equipped with the low-voltage closing accessory).

For on-line testing, bypass the recloser, open the load-side disconnects, and keep the source-side disconnects closed. This will remove the recloser from service but will keep line voltage supplied to the closing solenoid. (See Figure 23).

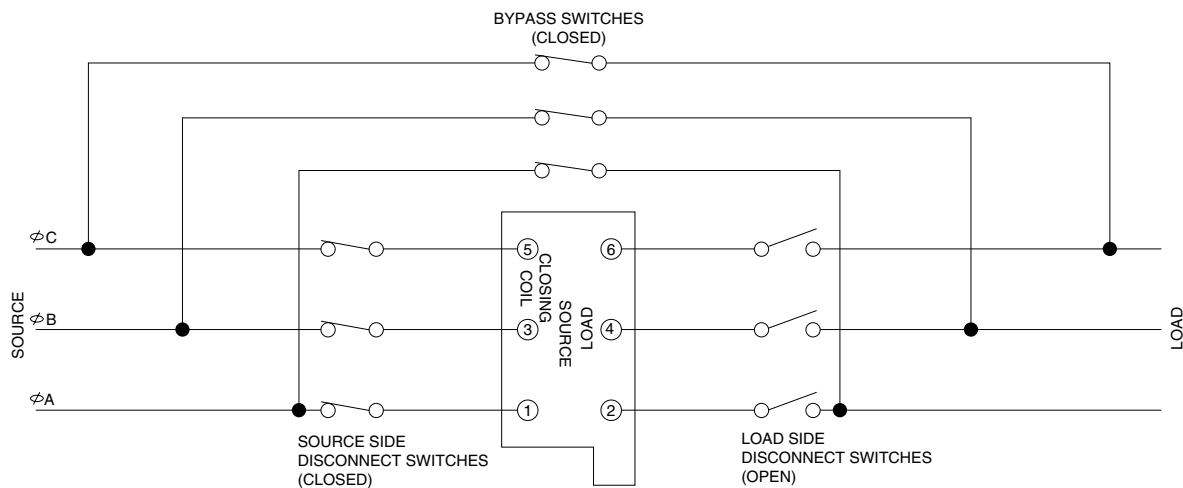


Figure 23
Closing source-side switches of a bypassed on-line recloser provides closing solenoid power for automatic operation during testing.

For shop testing, the closing solenoid voltage is supplied by back-feeding a transformer with a low-side rating equal to the voltage rating of an available power source and a high-side rating equal to the voltage rating of the recloser (Figure 24). A 75 kVA transformer of the proper voltage rating with an impedance drop of approximately 3% is satisfactory. The ac source must have a comparable impedance drop.

The closing coil requirement is approximately 200 kVA during the two-to-three cycle closing operation. The solenoid coil operating voltage must be maintained at the recloser bushings during the time interval the closing coil is energized. This procedure is not used on reclosers equipped with the low-voltage closing accessory.

WARNING: Hazardous voltage. Interconnect source leads X and Y and ground solidly to the recloser tank. Do not connect lead Z to any other phase or mechanical ground. Dangerous voltages to ground exist on the phase connected to lead Z. Solidly ground all equipment. Failure to comply can result in severe personal injury and/or equipment damage. T224.1

WARNING: Hazardous voltage. The switchgear and high voltage transformer must be in a test cage or similar protective device to prevent accidental contact with the high voltage parts. Solidly ground all equipment. Failure to comply can result in death, severe personal injury, and equipment damage. T221.3

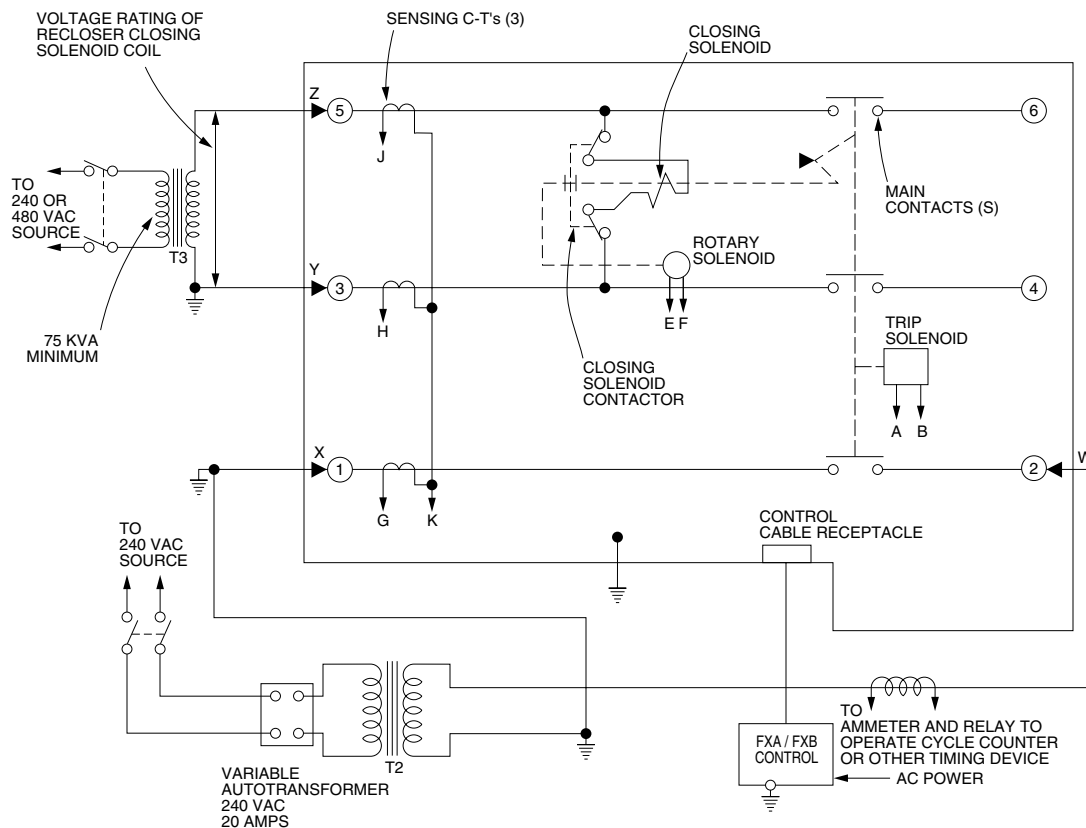


Figure 24.
Suggested test circuit for high-voltage solenoid-closing reclosers.

Manual Closing - Solenoid Operated Reclosers

If high voltage for operating the closing solenoid is not available, manual closing can be substituted for electrical closing. However, not all control settings can be checked since manual closing is not synchronized with the closing coil control circuit in the control.

IMPORTANT: If manual closing is used during trip testing, the recloser's manual closing must be synchronized with the FXA or FXB control's close signal.

If the recloser is not manually closed before the control completes its closing signal, the control will go into its close-retry mode.

At this point, if the recloser is manually closed, the control will define the recloser contact position as not valid. A "Close – Trip Circuit Open" event will be recorded in the event recorder

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

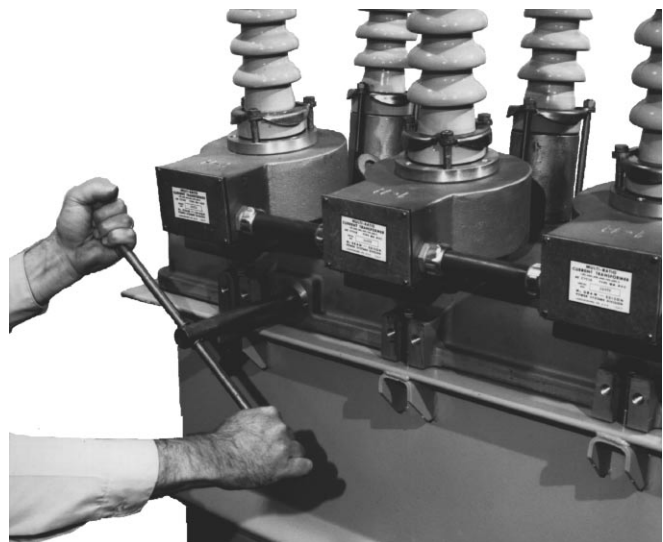
T203.2

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

T222.0

To manually close the recloser:

1. Remove the closing tool port cover and gasket from the side of the recloser head casting.
2. Insert the T-handled tool (available as an accessory) into the port, engaging the pin on the closing shaft (Figure 25).
3. Close the recloser by placing the yellow operating handle (located under the sleet hood) into the up or CLOSED position and turning the closing tool one-quarter turn clockwise.
4. After each trip operation, about 0.5 second elapses while the closing solenoid plunger is moving upward to reset the main toggle latch. Wait for the rotary solenoid to make an audible click sound.
5. After the main toggle latch resets, the recloser can be closed again by operating the manual closing tool. Wait for the rotary solenoid to make an audible click sound.
6. Replace the gasket and port cover on the recloser head after testing has been completed.



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Figure 25.
Using a manual closing tool to operate the recloser.

WARNING: Hazardous voltage. Recloser and control must be solidly grounded. Follow all locally approved procedures and safety practices when grounding this equipment. Improper grounding can result in contact with high voltage, which will cause death or severe personal injury. G115.1

Electrical Closing - Motor-Operated Reclosers

High voltage is not required for reclosers utilizing a motor-operated closing mechanism energized from a 240 Vac power source. For information on energizing the recloser, refer to the appropriate motor-operated recloser installation manual.

Figure 26 shows a test circuit for motor-operated reclosers. Since these reclosers require only a 240 Vac source for closing, a high-voltage transformer (Figure 25) and its protective cage is eliminated. All other equipment is the same as the test equipment shown in Figure 23.

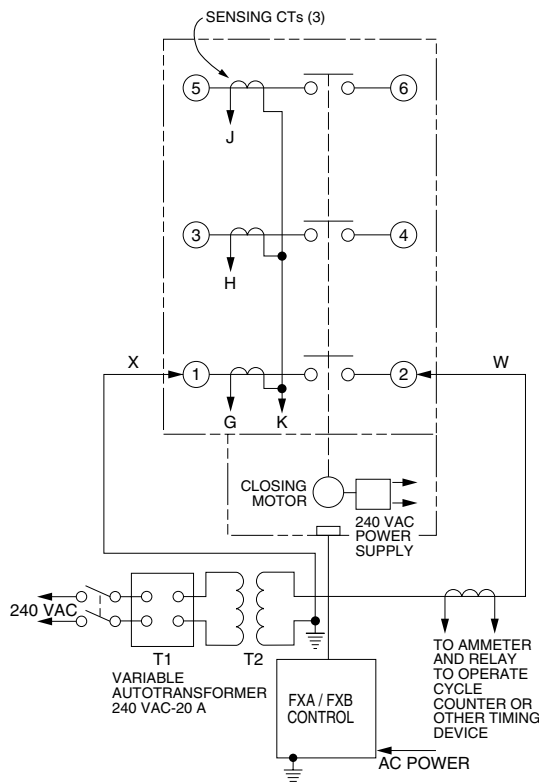


Figure 26.
Suggested test circuit for motor-operated reclosers.

After Testing the Control

After the required work is completed, disconnect the control from the test set and follow this procedure:


1. Remove AC power from the control.
2. Disconnect the control battery.
3. Disconnect the control cable.
4. Disconnect the ground cable.
5. After testing the recloser control, reset the Event Recorder, Interrupter Duty Monitor, Operations Counter, and Target Counters. Refer to *Service Information S280-78-2 FX, FXA, and FXB Programmers Software User's Manual* for further information.
6. Store the control in a dry, safe environment, or return it to service.

Return the Control to Service

Follow this procedure to return the control to service:

1. Verify that all control settings are correct.
2. Apply ac power to the control.
3. Plug in the control battery.
 - Note:** The control will not power up until ac power is applied.
4. Reconnect the control cable to the control.
5. Switch Ground Trip Block switch to NORMAL.
6. Reset the control clock after the AC power has been re-applied. Refer to the SET CLOCK information in *Service Information S280-78-2 FX, FXA, and FXB Programmer's Software User's Manual* or *S280-78-3 FXB Front Panel Programming Guide*.

MAINTENANCE INFORMATION

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

Frequency of Inspection

Because FXA and FXB recloser controls are applied under widely varying operating and climatic conditions, inspection intervals are best determined by the user, based on actual operating experience. Cooper Power Systems recommends that the recloser control be inspected yearly until experience indicates a more advantageous schedule.

Factory Authorized Service Centers

Factory authorized service centers are located throughout the world to provide maintenance, repair, and testing services for Kyle recloser controls. For further information, contact your Cooper Power Systems Division sales representative.

Replacement Parts

Replacement parts for the Kyle Type FXA or FXB control are available through the factory Service Department. To order these parts, refer to the Replacement Parts price list for catalog numbers and pricing. Contact your Cooper Power Systems representative for additional information and ordering procedures.

Factory Training

Specialized training on the FXA or FXB Microprocessor-based Recloser Control is available. For additional information, please contact your Cooper Power Systems sales representative.



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