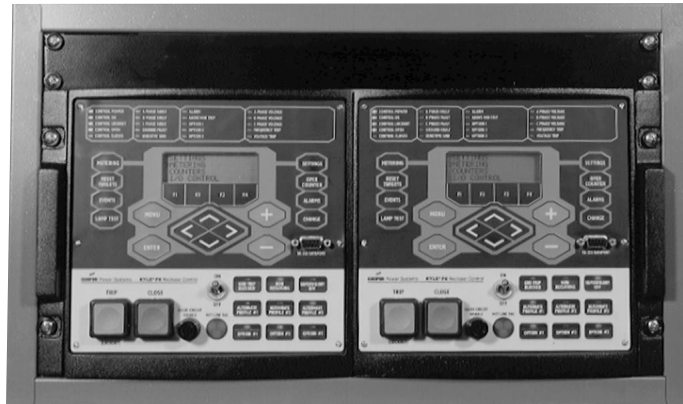


# Reclosers

## Form 6 Microprocessor-Based Rack Mount Recloser Control Installation and Operation Instructions

Service Information  
**S280-70-1**

For Serial Numbers above 581 and below 20,000.



**Figure 1.**  
Two Kyle® Form 6 microprocessor-based recloser controls in a standard 19” substation rack.

000007KM

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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.

### Safety Instructions

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

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

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

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

**⚠ WARNING:** Power distribution 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

### 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.

## PRODUCT INFORMATION

### Introduction

*Service Information S280-70-1* provides installation and operation instructions for the Kyle® Form 6 microprocessor-based rack mount recloser control above serial number 581 and below serial number 20,000.

Refer to *Service Information S280-70-4 Kyle Form 6 Microprocessor-Based Recloser Control Programming Guide* for additional information.

### 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 provide 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, contact your Cooper Power Systems sales representative.

### ANSI Standards

Kyle reclosers are designed and tested in accordance with the following ANSI standards: C37.60 and C37.85 and ANSI Guide C37.61.

### Quality Standards

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

### Acceptance and Initial Inspection

Each Form 6 rack mount recloser 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.

### Control Power

All operating power is obtained from the substation battery bank. There are two power supply options available for the Form 6 rack mount recloser control. Examine the voltage decal on the back of the recloser control to verify the correct voltage rating.

The following power supply options are available and configured at the factory:

- 24 Vdc  $\pm 20\%$   
Burden 14 Watts
- 40 Vdc – 140 Vdc  
Burden 14 Watts

**Note:** The 40 Vdc – 140 Vdc power supply is a universal power supply adaptable for either 48 Vdc or 125 Vdc substation batteries.

Refer to the **Customer Connections for DC Power and AC Voltage Sensing** section of this manual for incoming power wiring illustrations for the Form 6 rack mount recloser control.

# FORM 6 RECLOSER CONTROL DESCRIPTION

## Description

The Kyle® Form 6 rack mount microprocessor-based recloser control includes extensive system protection functionality, including phase, ground, and negative sequence overcurrent protection, over/underfrequency, and voltage protection, directionality, sensitive ground fault, and sync check.

Analysis tools include fault locating, event recording, TCC Editor™ II, Idea Workbench™, and oscillography functions, including oscillography replay.

Metering functions include demand and instantaneous current on a per-phase basis, instantaneous voltage and power factor on a per-phase basis, and power (real, reactive, apparent).

The front panel LCD display is used to configure the operating settings for the control. It is also used to display metering, counter information, control parameters, reset alarms, and provide diagnostic information.

Control parameters can also be programmed via a personal computer connected to the control through the front panel RS-232 port. Control programming, interrogation, and operations are performed with Form 6 ProView™ interface software on a personal computer.

The interface program software includes additional functions used to create and graphically display Time Current Curves and provide Idea Workbench™ for configuring user-selected inputs and outputs, configurable event and alarm data, and selectable communication points for serial communication.

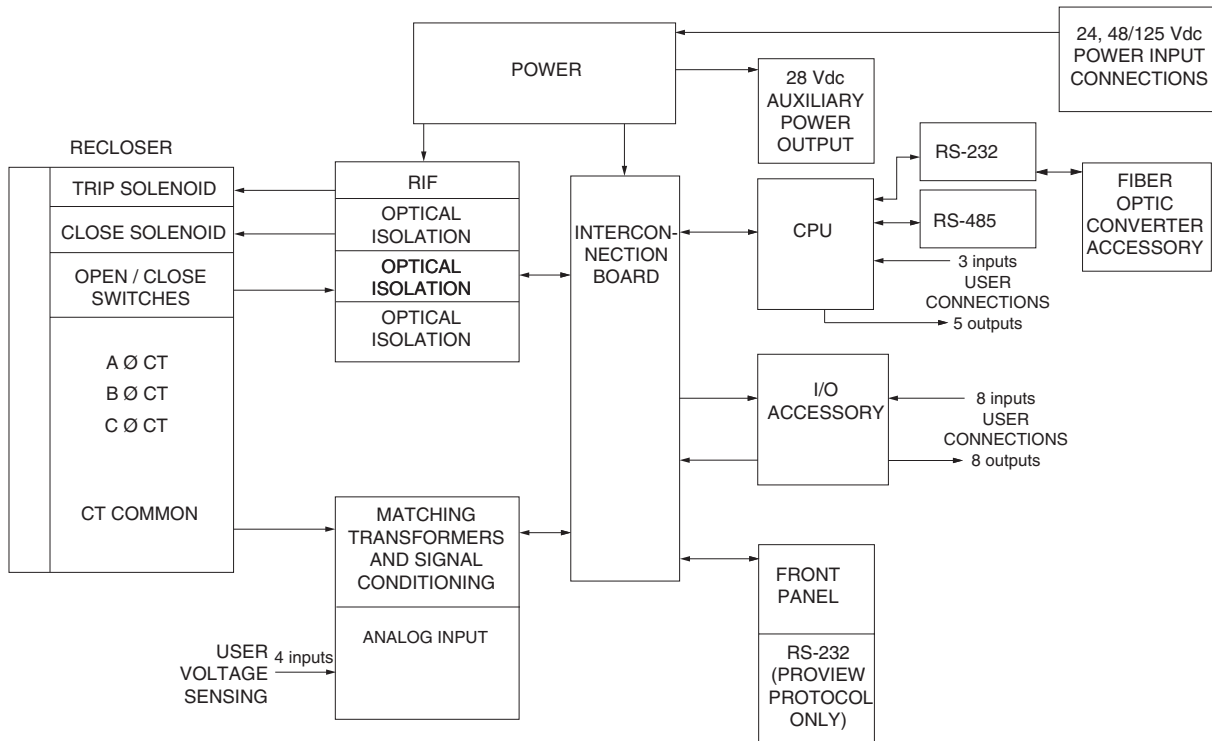
The control operates on 50 and 60 Hz systems.

The control can be configured, by the factory or by the user, for a wide variety of applications. If user requirements change, the control functions can be modified to meet the new requirements.

## Theory of Operation

Current sensing is provided by three current transformers located in the recloser and interfaced to the Form 6 recloser control via control wiring. This wiring also supplies Trip, Close, and Recloser status, and connects to the Recloser Interface (RIF) module to provide isolation for reliable operation. Voltages for metering are connected to the analog board via the connector terminal block, TB-2.

A functional block diagram of the Form 6 recloser control is shown in Figure 2. Line current flowing through the recloser is converted by the CPU module to a digital signal suitable for metering and fault current calculations. Data sampling occurs at a rate of 64 times per cycle. The CPU contains a data acquisition section that uses the acquired samples to compute the fundamental currents and voltage for use in overcurrent, under/overvoltage, and under/overfrequency protection, as well as currents and voltages for metering functions. The current for overcurrent protection is calculated on a sub-cycle basis; it includes only the fundamental and DC component.



**Figure 2.**  
**Form 6 rack mount recloser control operational flow diagram.**

When the phase or ground current exceeds its programmed minimum-trip value and associated time-current-curve (TCC) timing, the control initiates the programmed sequence of recloser tripping and reclosing operations via the CPU and RIF modules. If the fault is temporary, 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 reclose commands and locks out with the recloser open. Once locked out, the control must be closed via the operator panel or SCADA communications. This resets the control to the start of the operating sequence.

The following chain of events occurs for an operating sequence of two trips to lockout (one trip on TCC1, one trip on TCC2):

1. The overcurrent signal is integrated with time on the selected curve for the first trip operation (TCC1) to produce the signal which energizes the trip circuit.
2. Energizing the trip circuit connects the supply to the trip solenoid to open the recloser.

3. Upon opening, the control starts timing on the first reclosing interval-delay time.

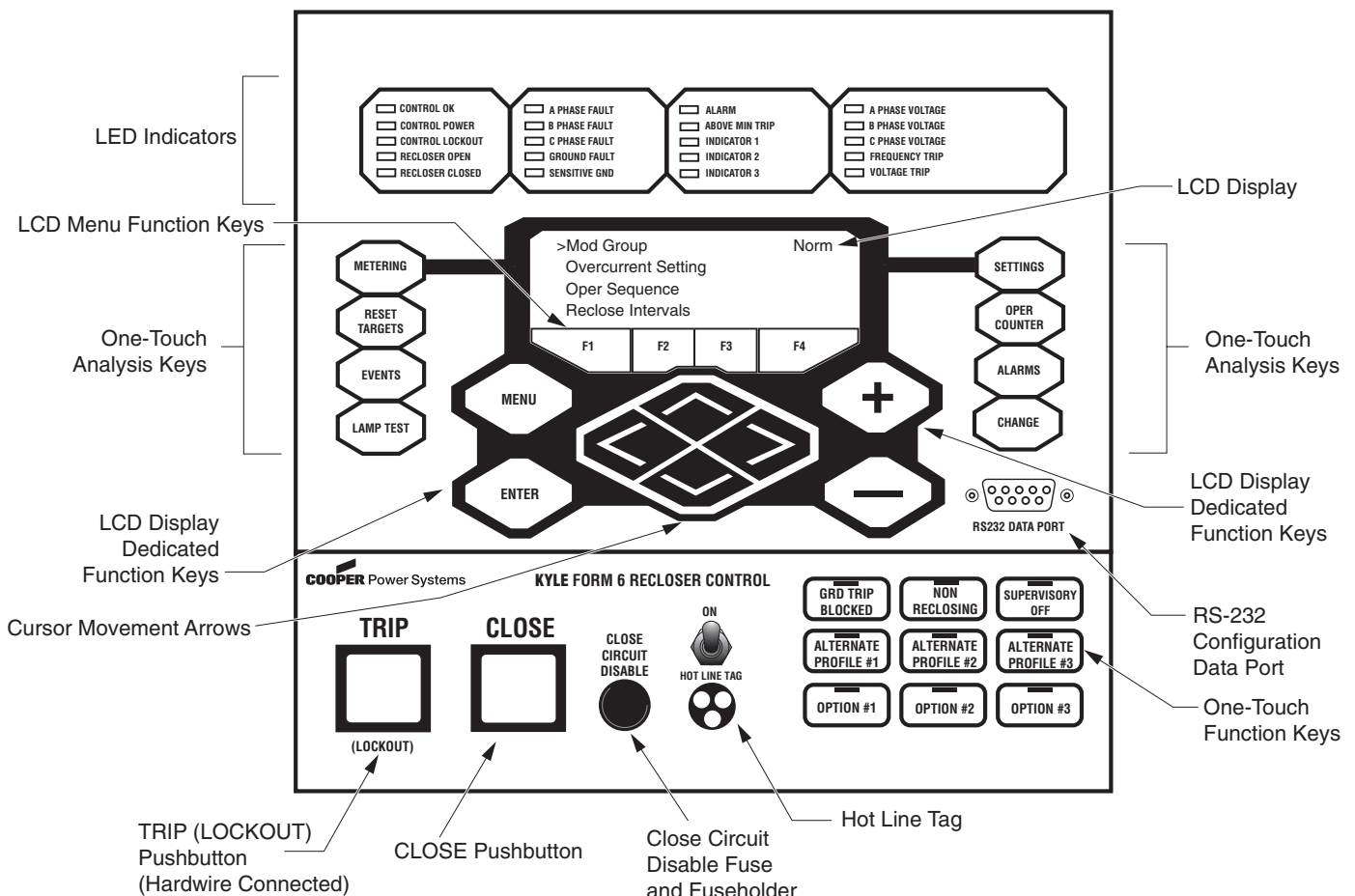
4. Upon expiration of this reclosing interval-delay, a closing signal is issued from the control, closing the recloser, and selecting the time-current characteristics for the second trip operation (TCC2).

5. If current remains above the minimum-trip level, the recloser will trip on TCC2 and lockout the recloser.

### Control Front Panel

The front panel is separated into two clearly identified, color-coded sections (Figure 3). The top portion of the front panel is used for programming the control and providing LED status indication. The lower portion of the front operating panel is used for operating the control and recloser.

**Note:** The control includes a Power Save feature that will turn off the backlit LCD display and all LEDs if no front panel keypad is pressed within ten minutes. Pressing any key will reactivate the display and LEDs.



**Figure 3.**  
Form 6 recloser control front panel.

## Programming Panel

The Programming panel has the following sections:

### One-Touch Analysis Keys

There are eight analysis keys (Figure 4) that allow one-button access to a variety of control and monitoring functions that appear in the LCD display. Pressing these buttons causes the following information to display or function to occur:

- **METERING:** Displays the systems instantaneous metering values for current and voltage on the LCD display.
- **RESET TARGETS:** Resets the fault target indicators on the operator panel.
- **EVENTS:** Displays the fault location information, including distance in miles, fault current, duration, and fault type.
- **LAMP TEST:** All operator panel LEDs are illuminated for verification of proper connection and operating status of all indicator lights. All status indicators will then return to their previous state. While in the LAMP TEST mode, the control response to operator panel keys is disabled, except for the TRIP (LOCKOUT), CLOSE, and HOT LINE TAG switches.
- **SETTINGS:** Displays recloser settings on the LCD display.
- **OPER COUNTER:** Displays the total number of trip operations and target counters for each A, B, and C Phase; Ground, and Sensitive Ground on the LCD display.
- **ALARMS:** Provides status information on the LCD display for all recloser alarms. Alarms are issued if user-specified settings are exceeded.
- **CHANGE:** Allows the user to change the state of the control functions on the operator panel function keys.

**Note:** The CHANGE mode is a ten second period in which one function setting can be changed. If no change is made in that time, the control returns to the current setting.

## LCD Display

The LCD Display is a backlit 4-line, 20-character display that provides extensive distribution system, recloser, and control status information using a minimum of eight navigation keypads (Figure 4).

**Note:** The LCD display panel contrast is field-adjustable to allow for various mounting heights and applications. Press the MENU key and then press the (+) or (-) key to increase or decrease the contrast.

The four LCD navigation buttons are as follows:

**MENU:** Identify the menu options available in the LCD display.

**ENTER:** Select a menu option.

+ Scrolls up menu or increases value selection.

— Scrolls down menu or decreases value selection.

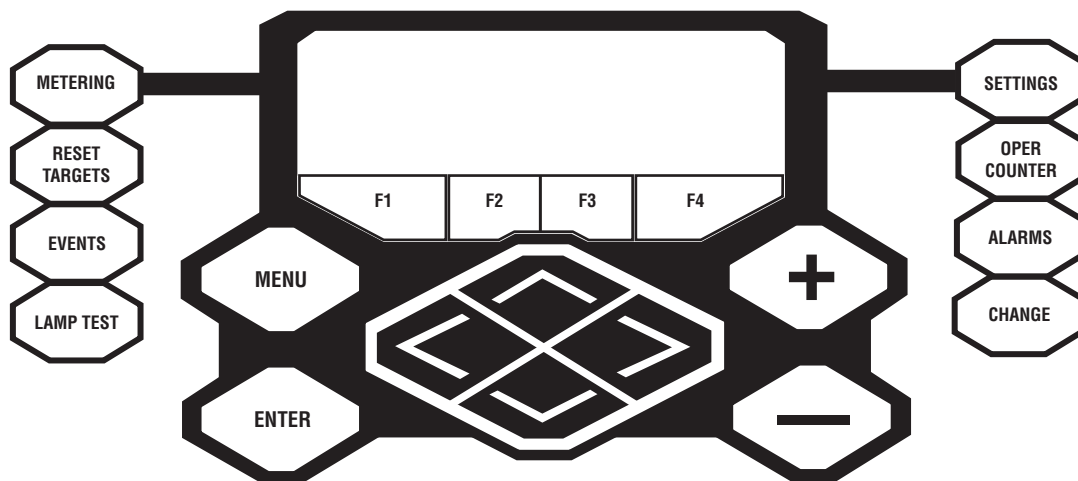
The four LCD menu function keys activate specific menu commands. When a command appears in the LCD display directly above one of the four LCD menu function keys, the user can press the key to accept/select the command.

The four LCD menu function keys are as follows:

F1                  F2                  F3                  F4

The four cursor movement arrows allow movement in the following directions:

- ◀ Moves the cursor left.
- ▶ Moves the cursor right.
- ▲ Moves the cursor up one line.
- ▼ Moves the cursor down one line.



**Figure 4.** Shortcut keys, LCD display, LCD menu function keys, and cursor movement arrows.



### Status Indicator LEDs

The status indicator LEDs (Figure 5) in the Programming section of the Operator Panel give instant information on the control and recloser status:

**CONTROL OK:** The green LED indicates the control is operating normally and not in an alarm state. This LED will not be illuminated during these alarms (indicated by the red ALARM LED and displayed in the alarm status log):

- **Memory Test:** This alarm indicates a failed ROM or RAM memory test.
- **Internal Power Failure:** This alarm indicates internal control operation power was outside of its operating tolerance for more than 20 seconds. This alarm resets when the internal control operation power returns to operation within its normal tolerances.

**CONTROL POWER:** The green LED indicates there is adequate charge (voltage) on the trip circuit capacitor to trip or close the recloser. This LED does not indicate the presence of AC or battery power.

**CONTROL LOCKOUT:** The green LED indicates the recloser is open and a reclosing sequence is not in progress. Manual tripping of the recloser is an example of control lockout.

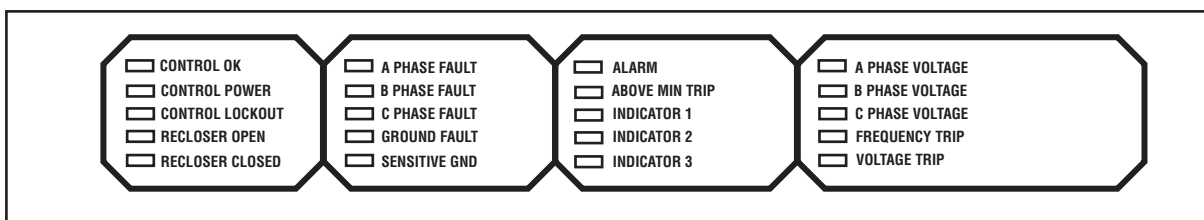
**RECLOSER OPEN:** The green LED indicates the recloser is in the open position.

**RECLOSER CLOSED:** The red LED indicates the recloser is in the closed position.

**A PHASE FAULT, B PHASE FAULT, C PHASE FAULT, GROUND FAULT, SENSITIVE GROUND FAULT:** The red LEDs indicate the control issued an overcurrent trip signal while A, B, or C phase or ground current exceeded the minimum pickup value. The red LEDs will also indicate if A, B, or C phase or ground current was within 80% of minimum pickup when another phase exceeded minimum trip value.

**ALARM:** The red LED indicates an alarm has been issued. Review the alarm status and log on the LCD display for the specific alarm.

**Note:** If a Battery Alarm occurs, de-select the Pole Mounted Control checkbox in the ProView application software Configure>System Configuration dialog box. Refer to *S280-70-4 Form 6 Control Programming Guide* for additional information.



**Figure 5.**  
Status indicator LEDs.

**ABOVE MINIMUM TRIP:** The red LED indicates the current exceeds the level set for minimum trip.

**INDICATOR 1, INDICATOR 2, INDICATOR 3:** Customizable LEDs that are used with functions programmed through the Idea Workbench™. The LED indicators do not have active default values. The LEDs are illuminated when the status configured via the Idea Workbench™ is present. These status indicators also include a user-customizable removable label insert. Refer to **Using Removable Inserts** for information on changing the labels in the removable insert.

**A PHASE VOLTAGE, B PHASE VOLTAGE, C PHASE VOLTAGE:** The red LED indicates a presence of voltage on the respective phases. The undervoltage phase pick-up setting controls the voltage indication for the front panel LEDs as defined in the Low Voltage Setting dialog box for the active setting profile. Refer to **Settings - Voltage** in the **Schemes** section of *S280-70-4 Form 6 Control Programming Guide*.

**FREQUENCY TRIP:** The red LED indicates the recloser control has issued a trip signal based upon frequency settings.

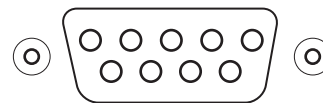
**VOLTAGE TRIP:** The red indicator LED indicates the voltage exceeds or fails to achieve a certain threshold.

### Operating Panel

The Operating section includes the following sections:

#### RS-232 Configuration Data Port

The RS-232 Connector (Figure 6) on the front operating panel allows direct connection to a personal computer without any special cables or connectors. This port is used only for configuring the control with an internal Cooper Power Systems protocol. All settings, metering, events, and oscillography data are available from this port. The port is Data Communication Equipment (DCE) wired for direct connection to a personal computer.



**RS232 DATA PORT**

**Figure 6.**  
RS-232 configuration data port.

## HOT LINE TAG ON/OFF Toggle Switch and LED Indicator

**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. While active, the control utilizes an independent, user-selectable time-current curve for trip operations.

**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 from the control and shifts protection to one trip-to-lockout on the composite curve of the Hot Line Tag definite time and the TCC1 curve (whichever is faster). Hot Line Tag takes precedence over Cold Load Pickup, Non-Reclosing, and Fast Trips Disabled.

Hot Line Tag is activated from either the operator panel toggle switch, serial communications, or a discrete SCADA function. All sources must be off to de-activate Hot Line Tag.

To activate the function from the operator panel, flip toggle switch up to the ON position. See Figure 7. The LED indicator illuminates when the function is active.

The Hot Line Tag function may only be reset by the source which initiates it. 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.

### CLOSE CIRCUIT DISABLE

Close Circuit Disable (Figure 7) is a removable fuse that, when removed from the front operating panel, disables the close circuit from the control to the recloser. Removing the cartridge from the control disables all electrical closing of the recloser and provides a physical disconnect to the recloser closing circuit. As a result, the control cannot perform a close operation. This disconnect overrides all close functions and makes a remote or manual close operation impossible.

**Note:** When the Close Circuit Disable fuse is removed, the trip circuit remains active and will trip per the programmed time current curve for a faulted condition.

**IMPORTANT:** If the CLOSE button is pressed after the Close Circuit Disable fuse is removed, do not reinstall the fuse until after the ALARM LED illuminates (within approximately five seconds) to indicate CLOSE MALFUNCTION. Re-installing the Close Circuit Disable fuse prior to the CLOSE MALFUNCTION ALARM indication will cause the control to close the recloser.

## TRIP (Lockout) Pushbutton

The TRIP pushbutton (Figure 7) provides front-panel access to trip (lockout) the recloser. When pressed, the TRIP pushbutton opens the recloser and locks out the control. The TRIP pushbutton operates independent of the microprocessor and is directly connected to the trip coil in the recloser.

**Note:** In the event of microprocessor failure, the trip circuit can operate independent of the main microprocessor.

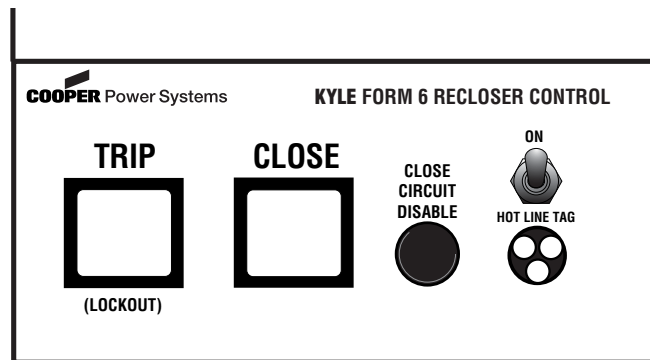
## CLOSE Pushbutton

When pressed, the CLOSE pushbutton (Figure 7) returns the control to the initial or home sequence position, closing the recloser. The control is ready for the start of a new trip/close sequence.

**Note:** Pressing the CLOSE pushbutton from the Lockout position initiates Cold Load Pickup (CLPU) protection, if the feature is enabled.

The user does have the ability to block COLD LOAD PICKUP through one of the user-configurable Option keys on the Operator Panel Function keypad (Figure 8). If the COLD LOAD PICKUP BLOCKED option button has been pushed, pressing the CLOSE pushbutton from the Lockout position will not initiate Cold Load Pickup Protection, even if the feature has been enabled from the interface software Protection Profile screen.

If the recloser is closed, pushing and holding the CLOSE pushbutton does not activate the Cold Load Pickup feature. See **Cold Load Pickup** in the **Control Features** section of this manual.



**Figure 7.** TRIP (Lockout) pushbutton; CLOSE pushbutton; Close Circuit Disable removable fuse; and Hot Line Tag switch and Hot Line Tag red indicator LED.

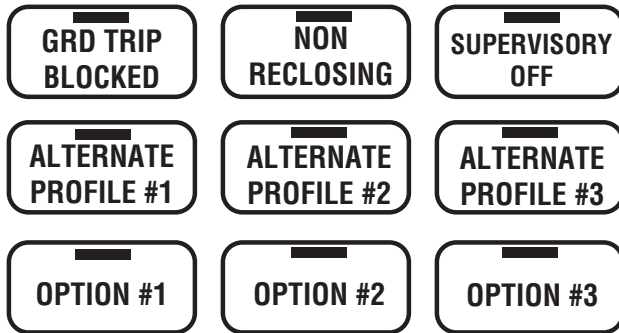
## One-Touch Function Keys

Quick access to frequently operated Form 6 features is provided with nine function key pushbuttons on the control operator panel (Figure 8). These nine features can be activated locally from the membrane-type pushbuttons, or remotely via the interface software or SCADA.

Red LEDs located on each function key indicate the status of the function, regardless of local or remote activation. For example, if Ground Trip Blocked is activated from a SCADA signal, the red indicator will illuminate even though it is not activated from the operator panel.



**Operator panel function key activation or de-activation** requires the operator to first press the CHANGE key to enter the CHANGE mode. A function must then be selected or de-selected within ten seconds to activate or de-activate the function. Once selected, the control returns to normal operation until prompted for another change request. This prevents accidental changing of settings.



**Figure 8.**  
**Operator panel function keys.**

**GRD TRIP BLOCKED**

The Ground Trip Blocked function blocks all ground sensing in the control for the active profile. This red indicator is illuminated when Ground Trip Block is activated from the serial port, I/O, the interface software, or locally (via the front panel) causing the control to block all ground sensing.

**NON RECLOSING**

The control is operating in a non-reclosing mode when the NON RECLOSING red indicator is illuminated. Non-reclosing mode disables any automatic reclosing operations. Non-reclosing does not alter the active TCC. Activation is possible from the serial port, I/O, the interface software, or locally (via the front panel).

**SUPERVISORY OFF**

When the SUPERVISORY OFF red indicator is illuminated, supervisory commands are blocked. Supervisory functions through the back panel serial communication ports and the discrete I/O are blocked. Serial communications through the front panel RS-232 port remain active independent of the status of the SUPERVISORY OFF switch. Activation of this function key is restricted to the operator panel and is accomplished by pressing the CHANGE key and then pressing the SUPERVISORY OFF key. Operational data and metering information are available while the control is in the SUPERVISORY OFF position. The TRIP and CLOSE pushbuttons and Hot Line Tag are active independent of the SUPERVISORY OFF function.

**ALTERNATE PROFILE #1, #2, and #3**

The Form 6 has four separate protection profiles; a normal profile, and Alternate Profiles 1, 2, and 3. Each profile changes all protection parameters for the control. Except for the normal profile, each has an indication and selection key. When the operator panel display lights are active and none of the three indicators are on, the normal profile is active. Only one profile can be active.

To select an alternate profile, press the CHANGE key and then press the desired alternate profile.

To return to the normal profile, press the CHANGE key and then press the active alternate profile to deselect it. These functions can also be completed remotely via communications interfaces.

**IMPORTANT:** Unused alternate profiles should be programmed with the same settings as one of the applicable profiles. Default settings on unused alternate profiles can cause unnecessary outages if they are below normal system requirements.

**IMPORTANT:** Check minimum trip values prior to changing an alternate profile to avoid misoperation of the control under load conditions.

**OPTION #1, OPTION #2, AND OPTION #3**

There are nine additional functions available to program as Option #1, Option #2, or Option #3 function keys. Any three of these nine functions can become an option on the operator panel function key pad. The available functions are as follows:

- *Sensitive Earth Fault Enable:* Allows activation of Sensitive Earth Fault protection with a minimum sensitivity of 0.5 Amps selectable in 0.1 Amp increments.
- *Cold Load Pickup Blocked:* For applications where no loss of diversity occurs.
- *Sequence Coordination Disable:* Disables sequence Coordination for testing purposes.
- *Fast Trip Blocked:* Disables tripping on TCC1; trips on TCC2 time setting for total operating sequence.
- *Underfrequency Trips Enable:* Activates under-frequency protection pickup and time-delay settings.
- *Overfrequency Trips Enable:* Activates the overfrequency pickup and time-delay settings.
- *Single-Phase Undervoltage Trips Enable:* Activates the single-phase *only* undervoltage pickup and time delay settings.
- *Three-Phase Undervoltage Trips Enable:* Activates the three-phase *only* undervoltage pickup and time delay settings.
- *Overvoltage Trips Enable:* Activates *both* single- and three-phase overvoltage pickup and time-delay settings.

The OPTION #1, OPTION #2, and OPTION #3 function keys must be programmed via the Idea Workbench™. The options do not have active default values. The option LEDs are illuminated when the options configured via the Idea Workbench™ are selected. These function keys also include a user-customizable removable label insert. Refer to **Using Removable Inserts** for information on changing the labels in the removable insert.

**Note:** The OPTION #1, OPTION #2, and OPTION #3 function keys are intentionally not defaulted to any function. The functions are assigned to each OPTION key via the Idea Workbench™ application.

## Control Features

The Form 6 recloser control offers numerous standard features and accessories that allow the user the utmost flexibility applying the recloser control.

### Control Security

The Form 6 recloser control has multiple customer-programmable security codes to limit control programming and viewing function access to authorized personnel. The front panel Human-Machine Interface (HMI) includes a user-selected security code to access the settings. Plus, the ProView™ interface software has its own security levels for multiple-user access.

Refer to *Service Information S280-70-4 Kyle Form 6 Microprocessor-Based Recloser Control Programming Guide* for additional information.

### Protection Profiles

Four protection profiles capable of fully specifying control operation are standard in the control. Each protection profile includes the following as a minimum:

- Overcurrent Protection
- Over/Undervoltage Protection
- Over/Underfrequency Protection
- Directional Protection
- Hot Line Tag Functionality
- Sync Check
- Sensitive Earth Fault Protection
- Sequence Coordination
- Operation Settings

### Time Current Curves

Time-current curves are available for numerous functions, including fast and delayed operations for phase, ground, and negative sequence protection. Each time-current is selected from a defined fifty curves which can be further customized by the user. The time-current curves are also selected from a graphical TCC Editor™ II to visualize any modifications prior to configuring the control.

The time-current curves include the following modifications for phase, ground, and negative sequence protection:

- Time Multiplier with a range of 0.1 to 25 in .1 increments.
- Time Adder with a range of 0 to 30 seconds in .01 second increments.
- Minimum Response Time with a range of 0.1 to 1 seconds in .001 second increments.
- High Current Trip multiplier with a range of 1 to 32 multipliers in increments of 0.1.
- High Current Trip Time Delay with a range of .016 to .150 seconds in .001 second increments.
- Time Dial Reset co-efficient with a range of .1 to 30 seconds in 1 second increments.

## Sequence Coordination

Sequence Coordination eliminates nuisance tripping through trip coordination. It allows the control to step through selected operations in the operating sequence without tripping. The number of Sequence Coordination advances is programmable from one to three operations to provide trip coordination with a downline recloser. This feature is independently selectable for each protection profile.

### Cold Load Pickup

The control includes a Cold Load Pickup feature to prevent the control from tripping while energizing non-fault system loads. This feature has independently programmable minimum trip value time-current curve, reclose interval, and number of independent operations to lockout for each protection profile. Cold Load Pickup also includes TCC Multipliers, TCC Adders, Minimum Response Time, Time Dial Reset, and High Current Lockout. Also, direct values, not multiples of minimum trip, are provided for high current lockout.

### Fast Trips Disabled

The control includes a Fast Trips Disabled feature to modify protection, so that all trip operations use the programmed TCC2. This feature is independently selectable for each protection profile. All trip operations will time on TCC2. Typically, TCC1 is fast and TCC2 is delayed. So, as an example, the control will change its sequence from 2 fast and 2 delayed operations to 2 operations on TCC2 when Fast Trips Disabled is active.

### High Current Lockout

The High Current Lockout feature will automatically lockout the control on the selected operation when current exceeds a programmable level. The active trip numbers for the lockout is selectable for phase, ground, and negative sequence. This feature is independently selectable for each protection profile.

### Sensitive Ground/Earth Fault Operation

The control has a Sensitive Ground/Earth Fault Trip feature that provides tripping of the recloser after a programmable, definite time for ground currents below normal ground minimum trip levels. The feature has programmable operations to lockout and reclose intervals independent of the ground settings. This feature is independently selectable for each protection profile.

## Metering

The control provides instantaneous and/or demand metering with programmable integration intervals for the following functions:

- Real and reactive power for each phase and total, including directional, on an individual phase basis.
- Demand currents on a per phase basis.
- Instantaneous currents, including ground current.
- Instantaneous voltage on a per phase basis.
- Instantaneous frequency.
- Positive, negative, and zero sequence voltages.
- Instantaneous power factor on a per phase basis.
- Metering settings to include demand interval, and alarm thresholds for current, single-phase kW, three-phase kW, single-phase kVAr, and three-phase kVAr.

## Event Recorder

The Form 6 contains capabilities to perform Sequence of Events time-stamping for up to 33 event types. An additional 16 events can be user-defined through the Idea Workbench™.

Factory-defined event types include:

- Overcurrent Protection Trip
- External Trip
- Non-Reclose Trip
- External Close
- Lockout
- Reset

The Event Recorder maintains a minimum of 90 event records. The last 25 events are viewable on the front panel LCD display. Refer to *S280-70-4 Form 6 Control Programming Guide* for additional information.

## Recloser Duty Monitor

The Form 6 recloser control software is equipped with a Recloser Interrupting Duty Monitor. The Duty Monitor accumulates the summation of  $I^{1.5}$  for all interrupted currents on each interrupter. This feature permits programmable entries to preset the duty of an existing recloser. The recloser duty monitor displays interrupting duty in percent of duty used. If the duty cycle monitor exceeds 100%, the recloser should be examined for maintenance.

## Discrete SCADA Communications

The control provides five configurable output status contacts and three configurable input control contacts as standard. Each status contact is configurable using graphical interface software to combine status functionality along with Boolean algebra. Default output status contacts are: Lockout, Recloser Open, Recloser Closed, Ground Trip Block, and Hot Line Tag. One output status contact is a solid state output (SS1) with a pickup time no longer than two milliseconds.

The control also provides a minimum of three configurable input control contacts. Each control contact is configurable using a graphical interface software. Contacts accept a wetting voltage range of 12–48 Vdc or 48–125 Vdc, 120 Vac based upon the option selected at the time of the order. Each digital input is configured for either a momentary, maintained, or maintained with precedence contact. Default input control contacts are: Supervisory Trip and Lockout, Supervisory Close, and Hot Line Tag.

A Discrete Interface Board is also available as an accessory to provide an additional eight output status contacts and eight input control contacts. The expansion I/O board is completely user-configurable.

## TCC Editor™ II

Coordination and actual time current modifications are available with a graphic interactive TCC Editor™ or similar graphical software.

The TCC Editor™ II includes a complete database of standard recloser industry time current curves (TCC), both ANSI and IEC types, along with the ability to customize the TCCs with multipliers, constant time adders, or minimum response time adders. Also, the user is able to derive their own specific TCC through data point entry. Each modified time current curve can be identified with a user-customized name and is selectable for configuring the control. The grid and format for presenting the TCCs has a user-adjustable scale, including the option of presenting multiple TCCs in various user-configured colors.

## Oscillography

Oscillography is provided to present current and voltage waveforms, along with protection element and recloser response status changes.

The recorded values are super-imposed on the protection scheme, and the state or value at any point in the scheme is displayed. The user has the capability to move through the event and watch the response of every function. All analog signals, digital inputs, and contact outputs are monitored. The oscillography sampling rate is a minimum of 64 samples per cycle.

Oscillographic data is recorded to analyze multiple events during a permanent fault or other event type. The oscillographic data shows two cycles before the trigger point and eight cycles after the trigger point (default).

**Note:** The configuration settings are programmable.

Oscillography automatically initiates trigger points for the following functions:

- Above Minimum Trip for Phase, Ground, and Sensitive Ground Fault
- Single and Three-Phase Overvoltage
- Single and Three-Phase Undervoltage
- Over and Underfrequency
- Trip Signal Issued
- Close Signal Issued

## Removable Inserts

Removable inserts are included with the control design for customization of specific protection requirements. Inserts are available for LED Indicators 1, 2, and 3, and for keypad Options 1, 2, and 3. The removable inserts are designed for use without adhesives, labelmakers, or temporary labels.

An electronic label template is included on the ProView™ application software CD and can be accessed through the following default address:

C: / Program Files / Cooper / Proview40 / Form 6 / Form 6 Inserts.doc

Refer to **Using Removable Inserts** for more information.

## Idea Workbench™

The Idea Workbench™ provides access to various inputs, intermediate variables, and internal Form 6 alarms, status, and targets to allow user-customization of the Form 6 recloser control to meet specific and unique applications. Idea Workbench™ also gives the user the ability to perform logical functions with these variables by using a simple graphical user interface. Use of Idea Workbench™ is not a requirement for operation.

Refer to *Service Information S280-70-4 Kyle Form 6 Microprocessor-Based Recloser Control Programming Guide* for additional Idea Workbench™ information.

## Over/Underfrequency Protection

The control includes two-stage operation for both underfrequency and overfrequency protection. A fixed time delay ranging from 0 to 100 seconds in .001 second increments is available for both over and underfrequency. A frequency restoration function, enabled or disabled by the user, is provided to allow the recloser to automatically close should frequency return to within configured settings for a user-settable time. Over/Underfrequency Protection is included as part of each protection profile.

## Over/Undervoltage Protection

The control includes single-phase and three-phase undervoltage tripping. The control also includes three-phase overvoltage tripping. Both over and undervoltage functions include a single-phase and three-phase pick-up setting; a single-phase and three-phase time delay setting ranging from 0 to 100 seconds.

## Directional

Directional functionality is included to maintain system coordination from multiple sources, as well as circuit reconfiguration for each profile. Directional applies to phase, ground, and negative sequence protection, selected independently. A maximum torque angle has a range of 45–90 degrees within an accuracy of  $\pm 1$  degree.

## Fault Location

The control includes an impedance-based fault locator based upon the Takagi algorithm. Load-compensated impedance calculation is used for calculating the distance. Positive and zero sequence is configured in ohms, and the fault locator line length is configured in kilometers/miles.

## Sync Check

Sync Check functionality includes the following applications:

- Hot Line/Hot Bus Closing
- Dead Line/Hot Bus Closing
- Hot Line/Dead Bus Closing
- Dead Line/Dead Bus Closing

Sync Check Parameters include the following configurable settings:

- Voltage Angle
- Mechanism Operating Delay
- Static Angle Delay
- Dead Threshold
- Live Threshold
- Positive Sequence Dead Threshold
- Upper Voltage Limit
- Lower Voltage Limit
- Lower Frequency Limit
- Upper Frequency Limit
- Fail to Close Timer

## Data Profiler

A fully-configurable data profiler is available which allows the user to collect information by sampling data at selectable intervals. These time-stamped values can then be viewed to determine weekly load profiles, daily harmonic disturbances or hourly voltage fluctuations. The number of days of information the data profiler can provide depends upon configuration parameters.

Refer to *Service Information S280-70-4 Form 6 Microprocessor-Based Recloser Control Programming Guide* for additional information.

## Manual Close Delay

Manual Close Delay provides a delay from the time that the manual CLOSE button is pushed to the time the manual close operation is performed.

The delay is programmable from 0 to 60 seconds in 1 second increments. A programmed delay value can be overridden for immediate closing by pressing the CLOSE button a second time.

An active Manual Close Delay can be canceled by pressing the TRIP/LOCKOUT button.

The default setting has the feature disabled (0 seconds). A countdown on the front panel LCD screen indicates Manual Close Delay is active.

## Communications

### Communication Ports

The Form 6 recloser control has two user-accessible communication ports, plus a front panel configuration data port. The front panel configuration data port is described in the **Operating Panel** section of this manual.

There is one standard 9-pin RS-232 and one RS-485 communication port on the back operator panel, as well as a standard IRIG-B port for user time-syncing. See Figure 9.

### Communication Protocols

Four communication protocols are available for the Form 6 recloser control:

- Modbus
- DNP3
- 2179
- IEC870-5-101

One communication protocol can be selected for either the back panel RS-232 or RS-485 port.

These protocols are selected and configured by the user with the ProView™ Communications Workbench™ application software.

When Modbus, DNP3, IEC870 or 2179 communication protocol is selected for the RS-485 serial port, the RS-232 serial port is defaulted to ProView™ interface software protocol.

When Modbus, DNP3, IEC870 or 2179 communication protocol is selected for the RS-232 serial port, the RS-485 serial port is not active. The RS-485 serial port does not support ProView™ interface software protocol. DNP3 is factory-defaulted to the RS-232 port.

The user can simultaneously communicate to the Form 6 control with ProView™ connected to either the front panel RS-232 port or (if appropriately selected) the rear panel RS-232 port while communicating with the selected serial protocol (2179, DNP3, Modbus, IEC870) through the designated rear port.

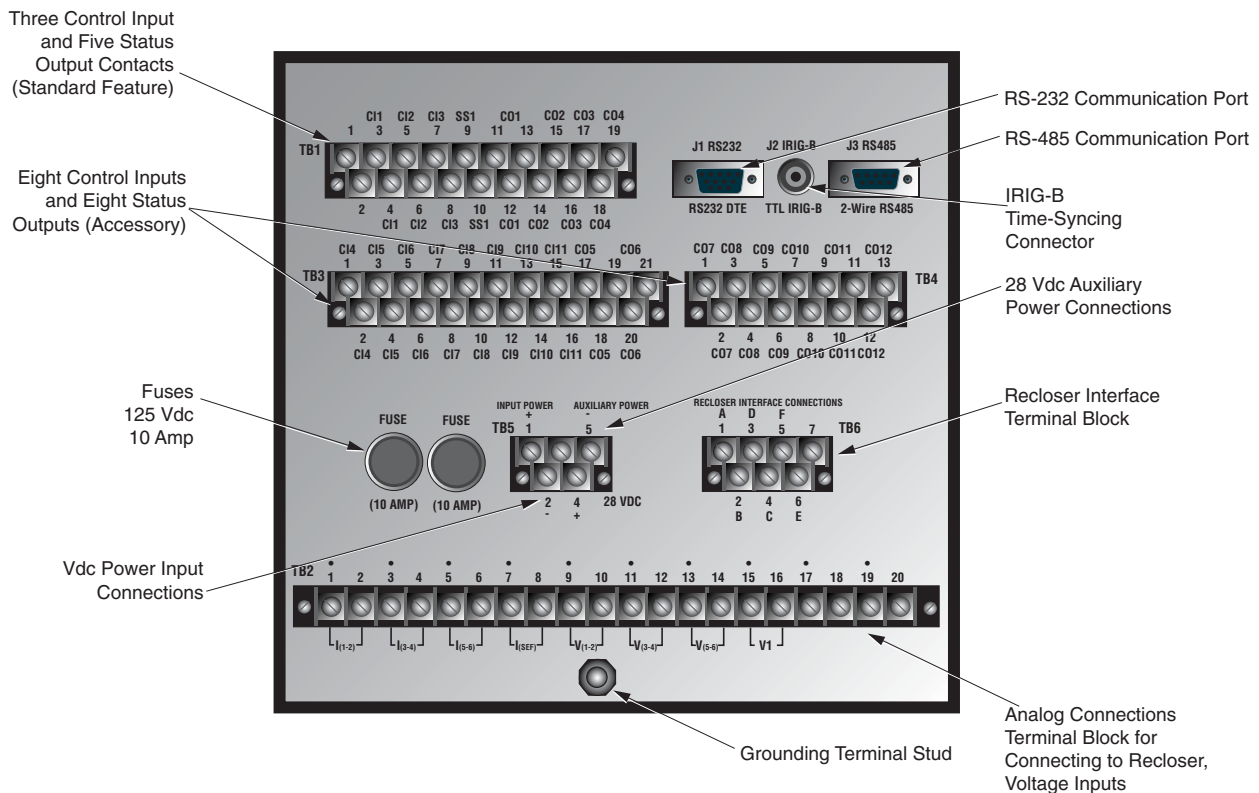
### Control Information

Control information includes firmware identification by catalog number and name, date code, and ProView release number. Control information is available through the Settings menu on the front panel (Figure 4).

### Control Back Panel

The control back panel (Figure 9) is easily accessible when the control is mounted in a standard 19" rack.

**Note:** It is not necessary to remove the control from the standard 19" rack to access the wiring to the power supply and recloser.



**Figure 9.**  
Form 6 rack recloser control back panel.

## INSTALLATION PROCEDURE

### 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, all alternate profiles, and parameters prior to operation with an energized recloser.

**IMPORTANT:** Program all protection profiles. Unused alternate profiles should be programmed with the same settings as one of the applicable profiles. Default settings on unused alternate profiles can cause unnecessary outages if they are below normal system requirements.

**IMPORTANT:** Check minimum trip values prior to setting or changing an alternate profile to avoid misoperation of the control under load conditions.

**Note:** Initial programming of the control is the responsibility of a qualified technician or engineer familiar with control functions and programming parameters required for the specific recloser installation.

The control must be programmed with the Form 6 ProView interface software. Refer to *Service Information S280-70-4 Kyle Form 6 Microprocessor-Based Recloser Control Programming Guide* for additional information.

### Control / Recloser Compatibility

The Form 6 rack mount recloser control is adaptable to the following Kyle reclosers:

WE\*, WVE27, WVE38X, VWE, VWVE27, VWVE38X, VSA12, VSA16, VSA20, VSA12B, VSA20A, VSO12, VSO16, Auxiliary-Powered NOVA15, and Auxiliary-Powered NOVA27.

\* This control is not compatible with Form 1 Type WE reclosers below s/n 300 and RE reclosers below s/n 400.

A new control cable is required to connect the Form 6 rack mount recloser control to these reclosers. Refer to TABLE 3 in the **Recloser Connections/Control Cable** Section of the **Customer Connections for DC Power and AC Voltage Sensing** section of this manual.

Reclosers manufactured prior to June 1989 are equipped with Type A bushing current transformers. These reclosers were designed for use with Form 2, Form 3, and Form 3A controls. Because the Form 6 recloser control is designed for use with reclosers equipped with Type B current-sensing Transformers, reclosers retrofitted with Form 6 recloser controls should be retrofitted with Type B

current transformers. All reclosers manufactured since 1989 are equipped with Type B (1000:1, 1000/500:1, or 2000:1) sensing CTs.

Reclosers equipped with Type B sensing CTs are compatible with all Kyle recloser controls (Form 2, Form 3, Form 3A, Form 4A, Form 4C, FXA, FXB, Form 5, Form 5 LS/UDP, and Form 6 recloser controls), and are identified with the following label prominently displayed on the recloser sleet hood or the front of the operator cabinet:

**NOTICE**

RECLOSER IS EQUIPPED WITH TYPE B SENSING CTs.  
RECLOSER DOES NOT HAVE A BATTERY CHARGER.

The Form 6 recloser control can be used with the old-style Type A CTs; however, the event recorder and duty cycle monitor will have limited accuracy for currents above 5000 Amps.

Retrofit kits with the new Type B sensing CTs are available to upgrade existing families of reclosers for operation with Form 6 recloser controls. For additional information, contact your Cooper Power Systems representative.

For identification, Table 1 lists the serial number breaks between old-style Type A and the new-style Type B sensing CTs. Below this serial number, the recloser is equipped with the Type A CTs.

**Note:** For reclosers shipped prior to June 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 1**  
**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.



## Duty Cycle Monitor

The Duty Cycle Monitor provides the following duty cycle information:

- Measures and records duty for each individual phase in non-volatile memory.
- The recloser duty is measured and stored on the basis of  $Current^{1.5} \times Number\ of\ Operations\ for\ Each\ Phase$  (ANSI C37.61).
- Readout is based on a percentage of total duty cycle for each phase.
- Duty record can be adjusted or reset if recloser is changed-out, serviced, etc.

Using Table 2, select the appropriate recloser interrupting duty cycle factor and enter that value via the ProView™ interface software.

**TABLE 2**  
**Duty Cycle Factor**

Recloser Type	Interrupting Rating (rms sym Amps)	100% Duty Cycle Factor*
RXE, RVE	6,000	97
WE	12,000 @ 4.8 kV	257
WE	10,000 @ 14.4 kV	196
VVE		
VWVE27	12,000	1045
VWVE38X		
WVE27	8,000	140
WVE38X	8,000	140
VSA12	12,000	1045
VSA16	16,000	1608
VSA20		
VSA20A	20,000	2248
VSA20B		
VSO12	12,000	1045
VSO16	16,000	1608
Auxiliary-Powered NOVA	12,500	1111

\*Duty Cycle Factor is Value x 10<sup>5</sup>.

## Mounting the Control

**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 may result in death, severe personal injury and equipment damage.

G102.1

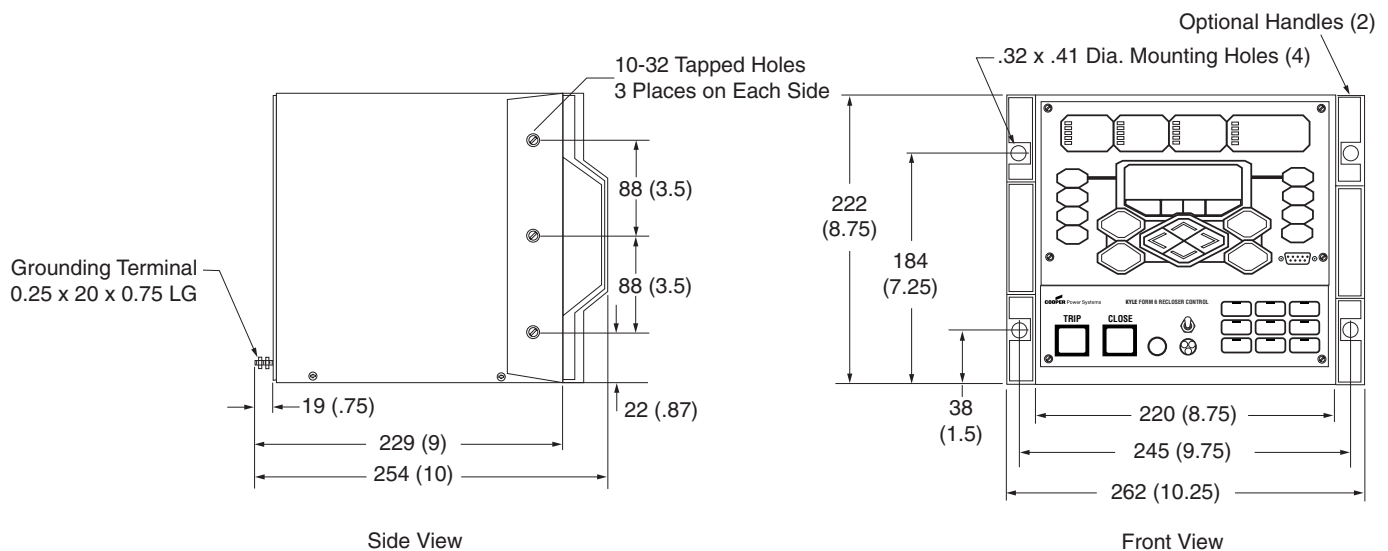
The Form 6 rack mount recloser control is intended to be mounted in a substation facility protected from weather elements, such as rain, snow, wind, etc. Mount the control in a convenient and accessible location that fits the above criteria. See Figure 10 for control weight and dimensions.

The control is designed to be mounted in a standard 19" substation rack. There are three available mounting accessories available:

- Double rack mount accessory with two handles and one connecting plate.
- Single rack mount accessory with two handles.
- Double rack – single mount accessory with two handles and one filler plate.

Refer to **Accessories** section of this manual for accessory attachment instructions.

CONTROL WEIGHT: 7 kg (15 lbs)  
**Note:** Weight of one Form 6 rack mount recloser control with handles attached to both sides.



**Figure 10.**  
**Form 6 rack mount recloser control weight and dimensions.**

## Grounding the Control

**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

The Form 6 rack mount recloser control must be solidly grounded prior to installation or energization. Refer to Figure 11 for grounding connections.

**Note:** Grounding of the mounting panel or standard 19" rack does not eliminate the control grounding requirement.

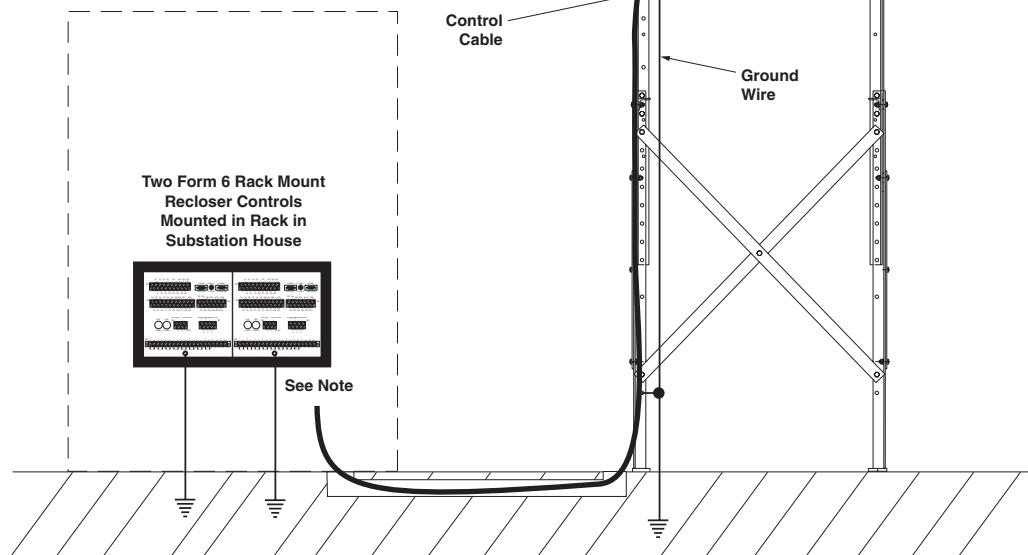
The grounding connection on the back of the control will accommodate a spade connector or ring terminal that fits on a .25 inch diameter grounding terminal stud (Figure 12).

**Note:** Control grounding must comply with all locally approved procedures and safety practices that apply in a substation or other appropriate indoor facility.

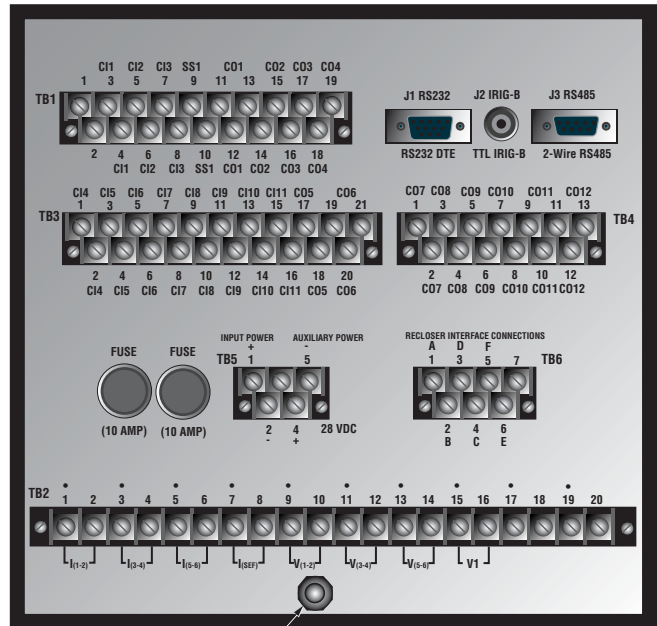
The recloser that the control will be connected to must also be properly grounded per the grounding requirements of the individual recloser. Refer to the appropriate installation and operation manual for grounding requirements.

**IMPORTANT:** All external wiring inputs to the Form 6 recloser control must be routed within 8 inches of their corresponding ground. During a surge, a potential of approximately 1.5 kV 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.

**Note:** Refer to Customer Connections for DC Power and AC Voltage Sensing section of this manual for control cable wiring connections.



**Figure 11.** Grounding connections for a Form 6 rack mount control installed in a substation.



Grounding Terminal Stud  
.25 inch diameter x .75 inch length

**Figure 12.** Form 6 rack mount recloser control grounding terminal identification (back of control).

# Customer Connections for DC Power and AC Voltage Sensing

## DC Power

Wiring connections to the Form 6 rack mount recloser control are made to the back panel (Figure 13). Input dc power is required to power the control.

**IMPORTANT:** Verify the label on the Form 6 rack mount recloser control matches the voltage of the substation supply prior to installation.

Dc power is connected to terminal block TB5, terminal points 1(+) and 2(-). Battery negative is not grounded at the control as the control should be grounded as discussed in the **Grounding the Control** section.

## AC Voltage Sensing

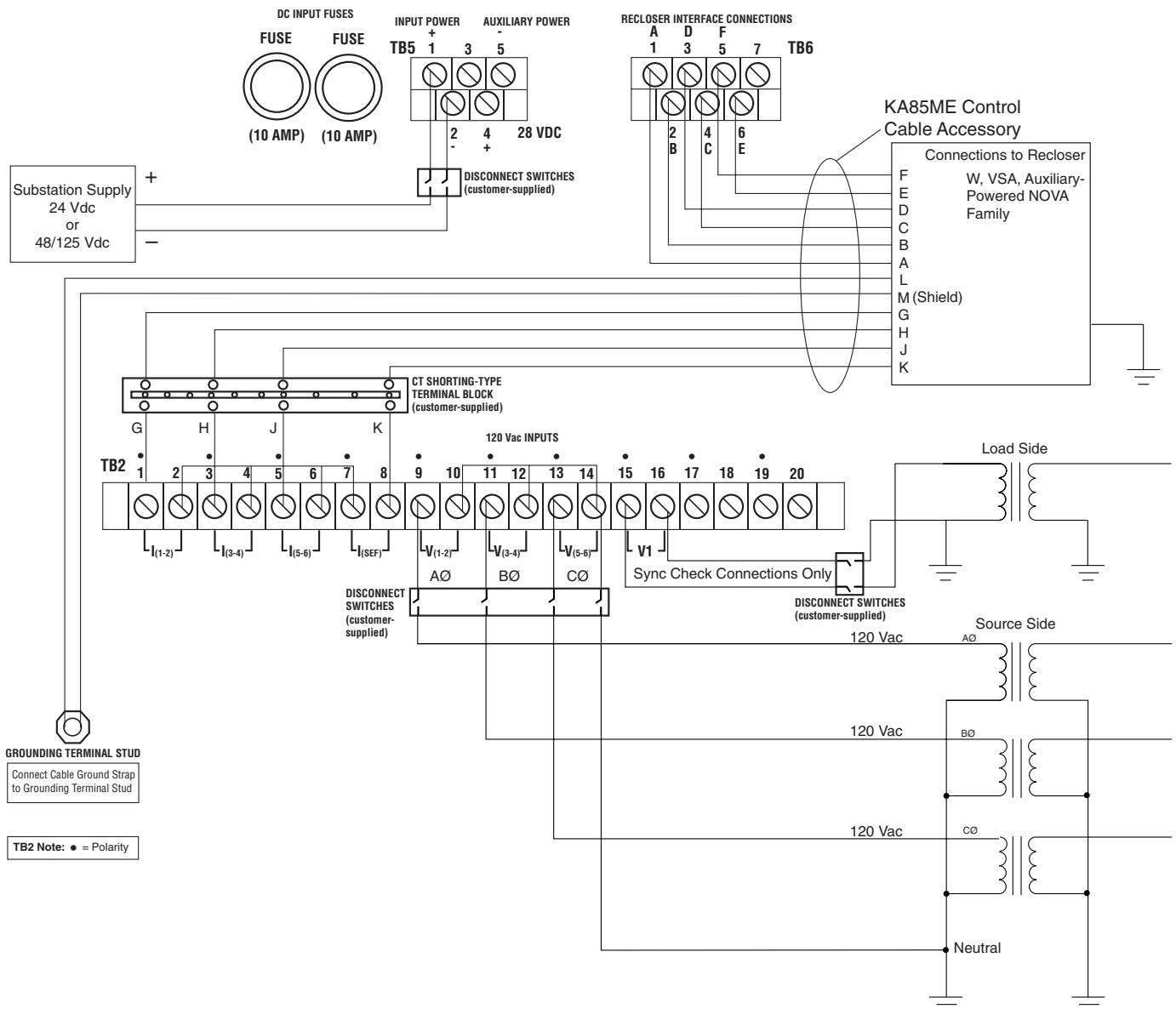
Input ac power is required to provide the following functions:

- Directional Protection
- Sync Check Protection
- Voltage Protection
- Frequency Protection
- Single- or Three-Phase Voltage and Power Metering

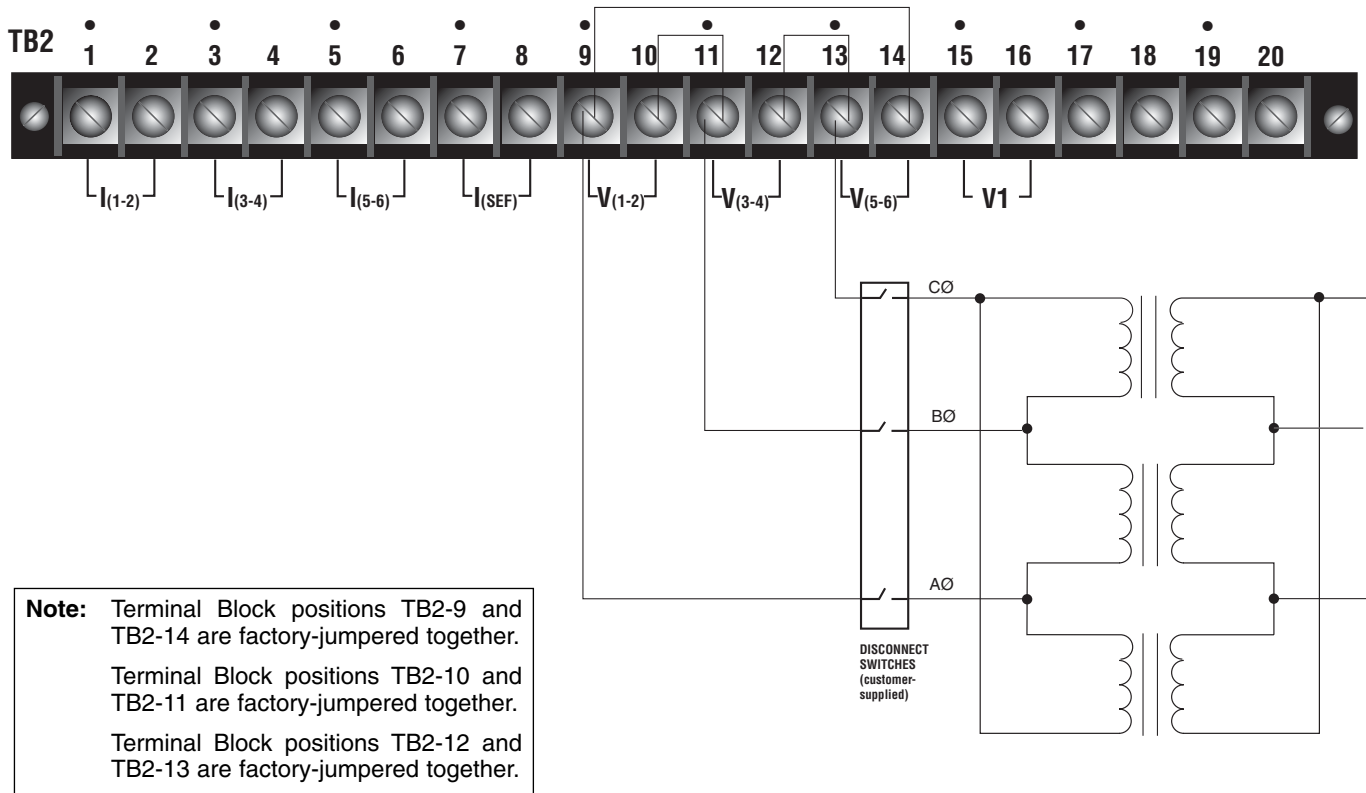
Ac voltage input connections are connected to TB2 for Wye connections only. Figure 13 illustrates three-phase wiring connections for source side connections and single-phase wiring connections for load side connections.

**Note:** Three-phase wiring connections for load side connections are not available.

Figure 14 illustrates customer connections to TB2, 120 Vac Delta connection.



**Figure 13.** Three-phase transformer connection. Wye configuration only.



**Figure 14.**  
**Customer connections to TB2, 120 Vac Delta Connection.**

The ac voltage inputs for both source or load side accept a voltage input of 120 Vac nominal. For single-phase source side ac voltage inputs, connections to AØ, BØ, or CØ are acceptable.

The following are not functional for single phase ac voltage input:

- Directional Protection
- Single-Phase Voltage Protection
- Three-Phase Metering
- Sync Check

## Recloser Connections/Control Cable

**WARNING:** Hazardous voltage. Recloser and control must be solidly grounded. Follow all 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

Recloser connections are accomplished with either of these methods:

- Cooper Power Systems provides a control cable accessory (KA85ME) with a connector on one end to connect to the receptacle on the recloser. The other end is hard-wired directly to the Form 6 rack mount recloser control. Several control cables are available based upon the recloser type and required distance between the recloser and control. Refer to Table 3 for available control cable lengths.
- The user can hardwire directly to the recloser via a recloser interface junction box accessory. The interface junction box is mounted on the substation frame and connected to the receptacle on the recloser with a short cable. If the cable lengths are insufficient for the desired application, control wiring with larger gauge wire is recommended. To facilitate wiring, two types of recloser interface junction box accessories are available. Refer to **Accessories** for more information.

Connections to the Form 6 rack mount recloser control are made at terminal blocks TB2 and TB6. Terminal Block TB2 is used to connect the recloser current transformers while terminal block TB6 is used for connection of the signal and status functions. If the Cooper Power Systems Control Cable KA85ME is ordered, Table 4 identifies the connection point and corresponding color wire. Also, connect the cable shield wiring to the grounding terminal stud.

Various commercial wire terminals are available for connection to the terminal blocks on the back of the Form 6 rack mount recloser control. Table 5 identifies common terminal types suitable for connection to the Form 6 rack mount recloser control.

**IMPORTANT:** Disconnect switches for both ac and dc circuits and a current transformer shorting-type terminal block are necessary to isolate the Form 6 recloser control for testing and servicing.

**TABLE 3**  
Available Form 6 Recloser Rack Mount Control Cable Lengths for Kyle Reclosers with KA85ME Control Cable Accessory

Recloser Type	Gauge	Length	
		Meters	Feet
WE, WVE27, WVE38X, VWE, VWVE27, VWVE38X, Auxiliary-Powered NOVA15, Auxiliary-Powered NOVA27	14	3 to 61	10 to 200
VSA12, VSA12B, VSA16, VSA20, VSA20A, VSO12, VSO16	14	1.5 to 9	5 to 30

**TABLE 4**  
Cable KA85ME Wire Color and Corresponding Connection Point

Pin	Color	Connection Point
A	BRN/BLK	TB6-1
B	BLK/RED	TB6-2
C	ORANGE	TB6-4
D	YELLOW	TB6-3
E	BROWN	TB6-6
F	BLUE	TB6-5
G	RED/BLK	TB2-1
H	BLU/BLK	TB2-3
J	ORG/BLK	TB2-5
K	BLACK	TB2-8
L	RED	GROUNDING TERMINAL STUD
M	GROUND STRAP	GROUNDING TERMINAL STUD

**TABLE 5**  
Common Terminal Types Suitable for Connection to the Form 6 Recloser Control

Wire Size AWG	Terminal Type	Size	Model
16	Ring	#6	AMP# 320619
14	Ring	#6	AMP# 320619
12	Ring	#6	AMP# 35149
10	Ring	#6	AMP# 35149

## Standard Default Supervisory Input Control and Output Status Contacts

The standard Form 6 rack mount recloser control includes three control contact inputs and five status contact outputs. The standard default I/O terminal connections are identified in Figure 15. A discrete interface board accessory is available if additional I/O is required. The accessory includes eight control contact inputs and eight status outputs as identified in Figure 16.

All of the control inputs and status outputs are user-configurable via the Idea Workbench™. To avoid configuration time, the most common control inputs and status outputs are included as default values. Refer to Figures 15 and 16 and Tables 6, 7, and 8. Refer to *Service Information S280-70-4 Kyle Form 6 Microprocessor-Based Recloser Control Programming Guide* for additional information.

### IMPORTANT

#### Shielding and Surge Protection of Supervisory Cables

All supervisory operation and control monitor leads must be protected within shielded cables. Refer to Figure 17 (12-48 Vdc whetting voltage option) or Figure 18 (48-125 Vdc, 120 Vac whetting voltage option).

**CAUTION:** Equipment damage; misoperation. External leads must be shielded and the shield must be grounded at both ends. Terminate each lead with a 320 Vac, 160 Joules metal oxide resistor (MOV), or equivalent, at the remote end. Attach MOVs between the leads and ground. Failure to properly shield and protect leads can result in equipment damage and/or unintentional operation. G117.3

**TABLE 6**  
Operating Current Requirements for Standard and Optional Supervisory Inputs

Module Mfg. No.*	Input Voltage	Nominal Current	Minimum Operating Time
6A00160121 through 6A00160128	12 Vdc – 48 Vdc	5 mA	5 milliseconds
6A00160129 through 6A00160136	48 Vdc – 125 Vdc, 120 Vac	5 mA	5 milliseconds

\*Refer to Figure 15 for location of Module Mfg. No.

**TABLE 7**  
Ratings Table for Output Status Contacts CO1 through CO12 (TB1, TB3, and TB4) (Resistive Load – pickup time 8 ms, dropout 5 ms)

Input Voltage	Contact Rating
120 Vac	8 A
12 Vdc	8 A
24 Vdc	8 A
48 Vdc	1 A
125 Vdc	0.4 A

**TABLE 8**  
Ratings Table for Output Status Contact SS1 (Resistive Load – pickup time 2 ms, dropout 15 ms) (TB1)

Input Voltage	Contact Rating
120 Vac	8 A
12 Vdc	8 A
24 Vdc	8 A
48 Vdc	8 A
125 Vdc	8 A

## Before Placing the Control and the Recloser into Service

**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

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

- Removable insert labels changed. (Not required – user-preference option.)  
**Note:** Refer to **Using Removable Inserts** section in this manual for more information.
- Control properly mounted for the installation.
- Recloser installed according to all locally approved standards and practices.
- Ac and dc disconnect switches installed.
- Shorting CT terminal-type block installed.
- Control wiring between control and recloser properly connected and supported.
- Control and recloser properly grounded in accordance with guidelines in this manual and the applicable recloser manual.
- Dc power and ac voltage sensing connected to the control.  
**Note:** The control Power Save feature will turn off the backlit LCD display and all LEDs if no front panel keypad is pressed within ten minutes.
- All control programming entered and verified by appropriate personnel.  
**Note:** Refer to *Service Information S280-70-4 Kyle Form 6 Microprocessor-Based Recloser Control Programming Guide* for additional information.
- Customer connections for remote and supervisory operation checked and completed in accordance with proper shielding and surge protection.



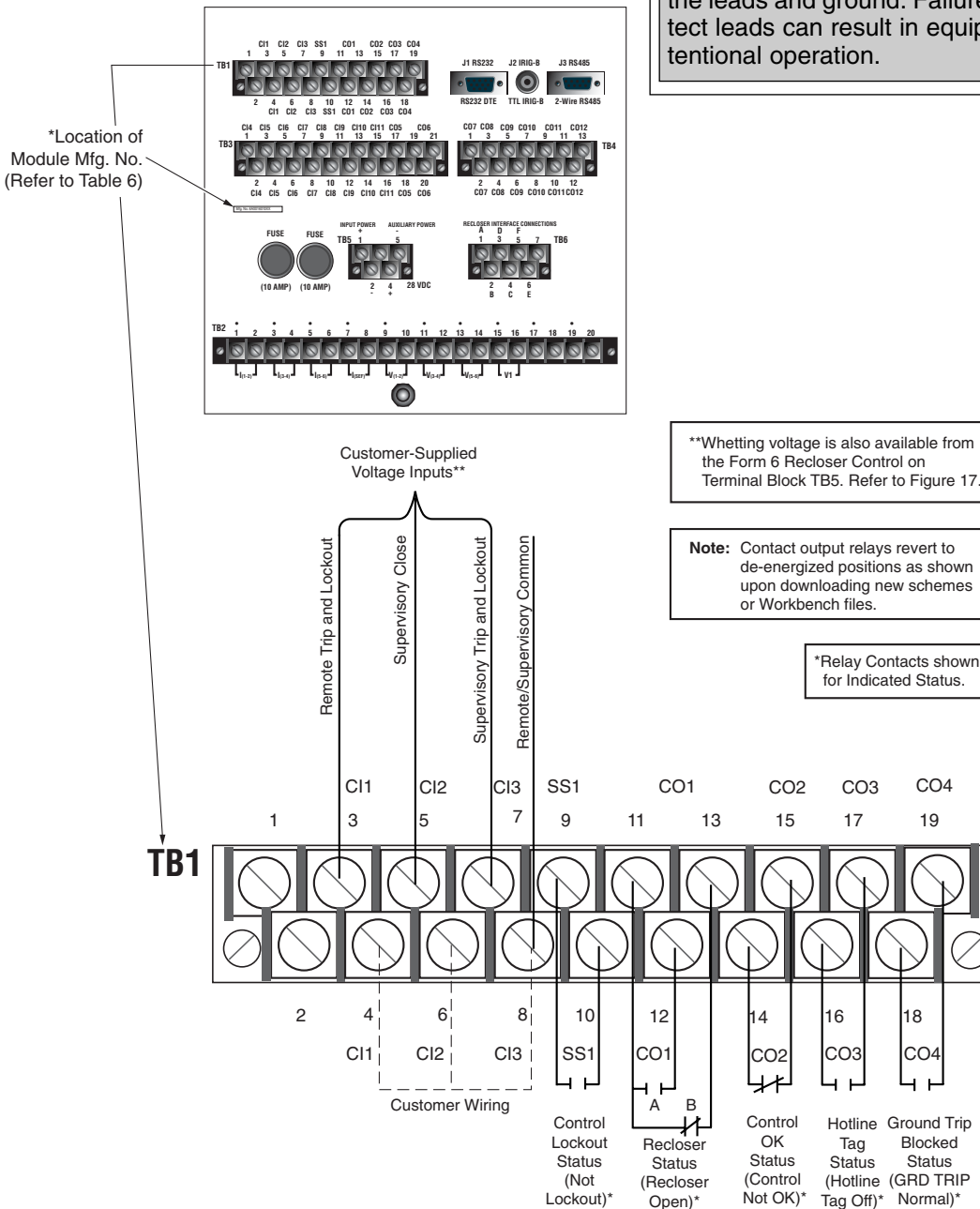
### IMPORTANT

#### Shielding and Surge Protection of Supervisory Cables

All supervisory operation and control monitor leads must be protected within shielded cables. Refer to Figure 17 (12-48 Vdc whetting voltage option) or Figure 18 (48-125 Vdc, 120 Vac whetting voltage option).

**CAUTION:** Equipment damage; misoperation. External leads must be shielded and the shield must be grounded at both ends. Terminate each lead with a 320 Vac, 160 Joules metal oxide resistor (MOV), or equivalent, at the remote end. Attach MOVs between the leads and ground. Failure to properly shield and protect leads can result in equipment damage and/or unintentional operation.

G117.3



**Figure 15.** Form 6 recloser control standard Discrete Interface Board and default configurations. These default contact input/outputs are completely configurable via the Idea Workbench™.

## IMPORTANT

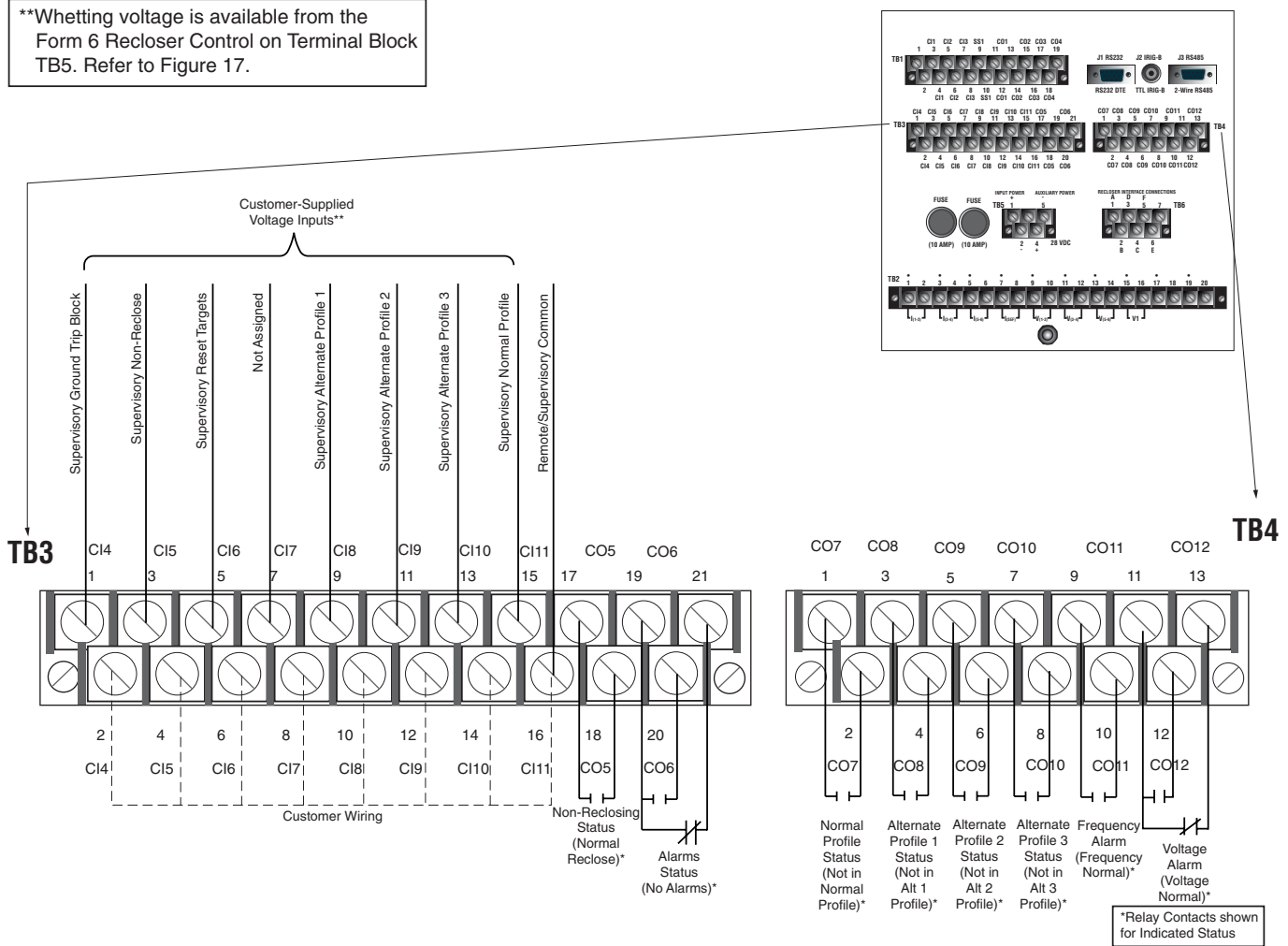
### Shielding and Surge Protection of Supervisory Cables

All supervisory operation and control monitor leads must be protected within shielded cables. Refer to Figure 17 (12-48 Vdc whetting voltage option) or Figure 18 (48-125 Vdc, 120 Vac whetting voltage option).

**CAUTION:** Equipment damage; misoperation. External leads must be shielded and the shield must be grounded at both ends. Terminate each lead with a 320 Vac, 160 Joules metal oxide resistor (MOV), or equivalent, at the remote end. Attach MOVs between the leads and ground. Failure to properly shield and protect leads can result in equipment damage and/or unintentional operation.

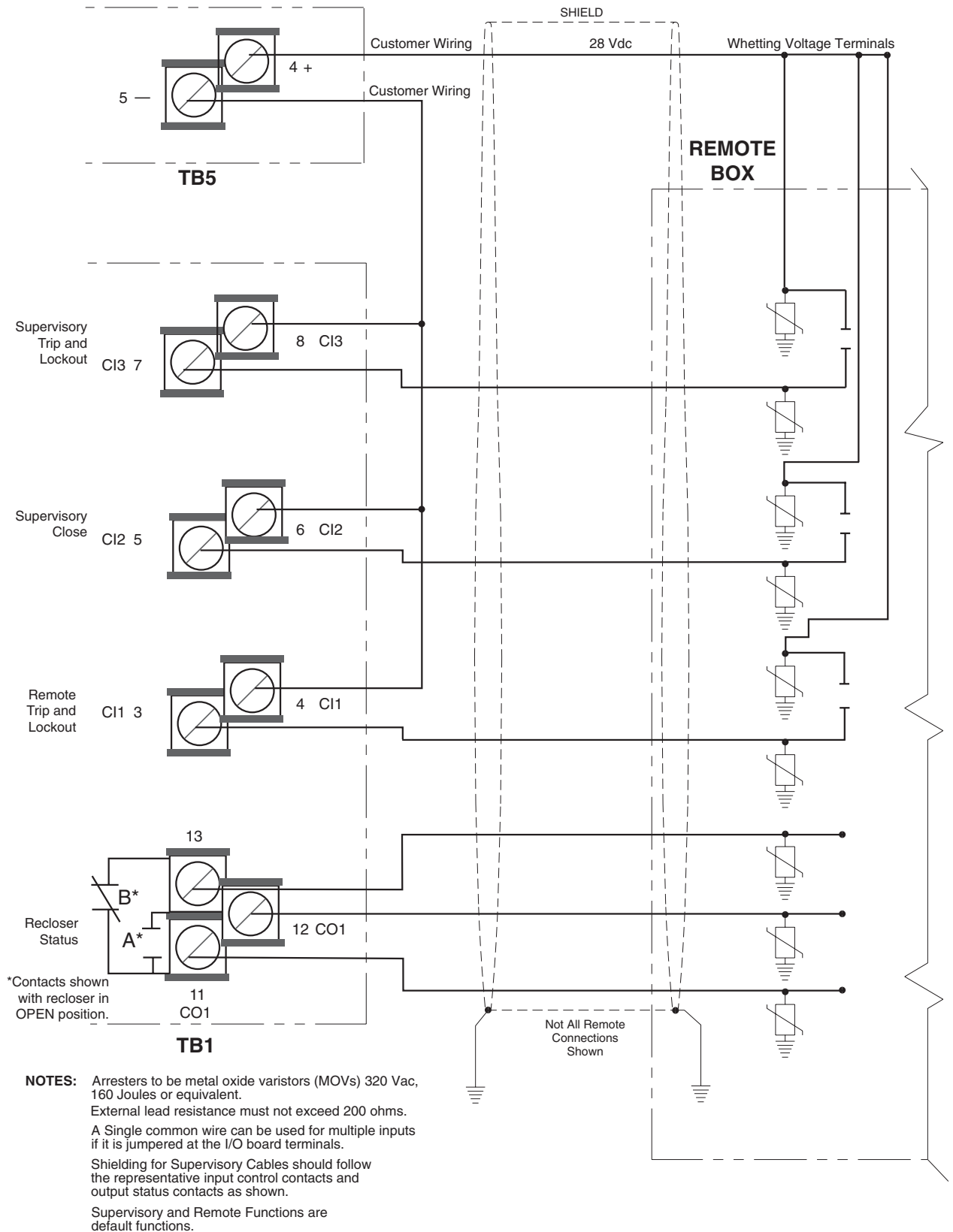
G117.3

\*\*Whetting voltage is available from the Form 6 Recloser Control on Terminal Block TB5. Refer to Figure 17.



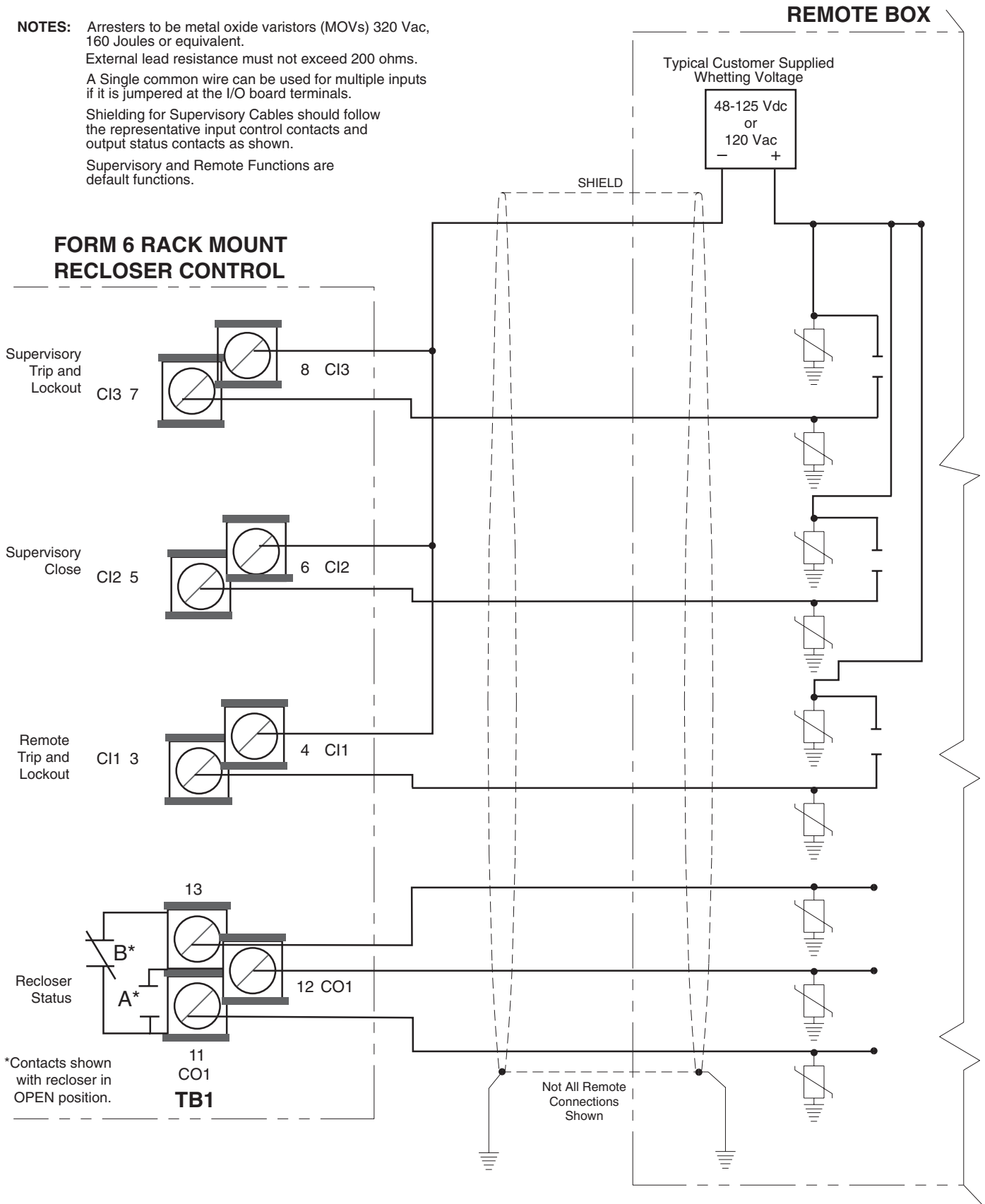
**Figure 16.** Form 6 recloser control Discrete Interface Board accessory and default configurations. These default contact input/outputs are completely configurable via the Idea Workbench™.

**FORM 6 RACK MOUNT  
RECLOSER CONTROL**



**Figure 17.**  
**Shielding and Surge Protection for Supervisory and Remote Cables (12-48 Vdc option).**

- NOTES:** Arresters to be metal oxide varistors (MOVs) 320 Vac, 160 Joules or equivalent.  
 External lead resistance must not exceed 200 ohms.  
 A Single common wire can be used for multiple inputs if it is jumpered at the I/O board terminals.  
 Shielding for Supervisory Cables should follow the representative input control contacts and output status contacts as shown.  
 Supervisory and Remote Functions are default functions.



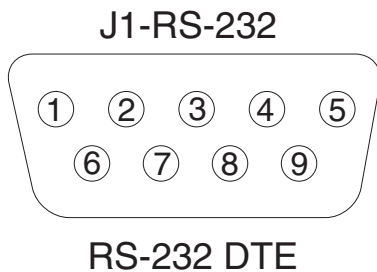
**Figure 18.** Shielding and Surge Protection for Supervisory and Remote Cables (48-125 Vdc, 120 Vac option).

## Rear Panel Communication Port Pin Assignments

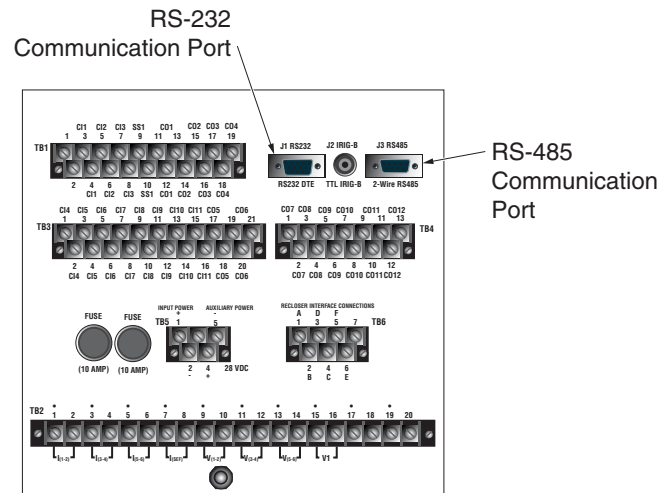
Tables 9 and 10 indicate the pin assignments for the rear panel RS-232 and RS-485 communication ports (Figure 19). Refer to Figures 20 and 21 for pin identification. Refer to **Protocols** for additional information.

**TABLE 9**  
Rear Panel RS-232 Communication Port Pin Assignments

Pin Number	Signal Name
1 DCD	Carrier Detect
2 RXD	Receive Data
3 TXD	Transmit Data
4 DTR	Data Terminal Ready (Not Connected)
5 GND	Signal Ground
6 DSR	Data Set Ready (Not Connected)
7 RTS	Request to Send
8 CTS	Clear to Send
9 NC	Not Used
10 (Shroud)	Chassis Ground



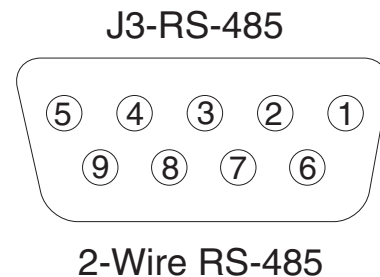
**Figure 20.**  
Rear Panel RS-232 Communication Port Pin Identification.



**Figure 19.**  
Form 6 recloser control rear panel RS-232 and RS-485 communication ports.

**TABLE 10**  
Rear Panel RS-485 Communication Port Pin Assignments

Pin Number	Signal Name
1 SGND	RS-485 Signal Ground (Same as 3)
2 GND	Chassis Ground
3 SGND	RS-485 Signal Ground (Same as 1)
4 A	RS-485 "A" Signal (+) (Same as 8)
5 B	RS-485 "B" Signal (-) (Same as 9)
6 GND	Chassis Ground
7 GND	Chassis Ground
8 A	RS-485 "A" Signal (+) (Same as 4)
9 B	RS-485 "B" Signal (-) (Same as 5)



**Figure 21.**  
Rear Panel RS-485 Communication Port Pin Identification.

## Using Removable Inserts

**CAUTION:** Control damage. De-energize both ac and dc power prior to removing or installing any internal connections or circuit boards in the control. Failure to comply can result in damage to the control. T241.1

**CAUTION:** Equipment damage. Always wear a grounding wrist strap to control static electricity before handling circuit boards. Failure to use this strap may result in circuit board damage. T253.1

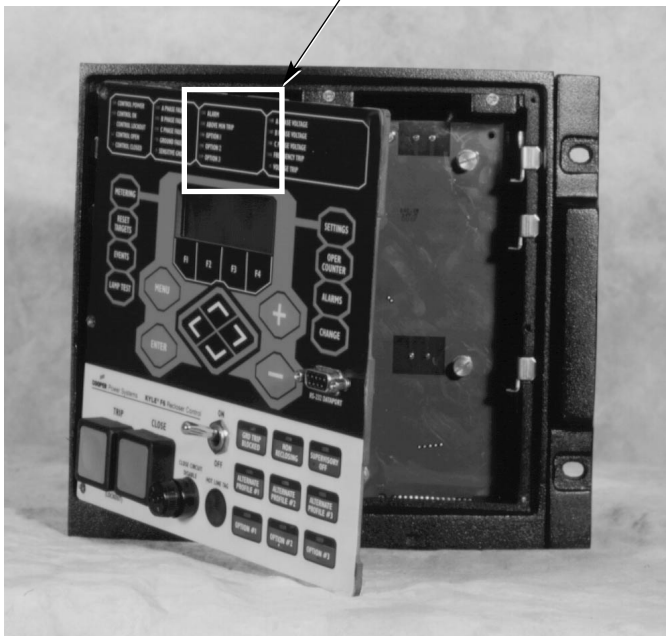
The removable insert labels on the operating panel (OPTION 1, OPTION 2, and OPTION 3) or LED Status Indicators on the programming panel (INDICATOR 1, INDICATOR 2, AND INDICATOR 3), can be changed, if desired.

1. De-energize both ac and dc power.
2. Use a flathead screwdriver to unscrew the six front panel screws.
3. Pull the right side of the front panel out towards the left (Figure 22).

**Note:** Various connecting wires will keep the panel attached to the control.

**Note:** It is not necessary to disconnect any wires.

Removable LED Status Indicator Panel



**Figure 22.** Open front panel. Labels (INDICATOR 1, INDICATOR 2, AND INDICATOR 3) are easily removed from and inserted into the top of the programming panel LED status indicator section. 010063KM

4. Use tweezers to gently pull out the removable insert.

**Note:** The insert will slide out of the right side of the operating panel (Figure 23).

**Note:** The insert will slide out of the top of the programming panel indicator section (Figure 22).

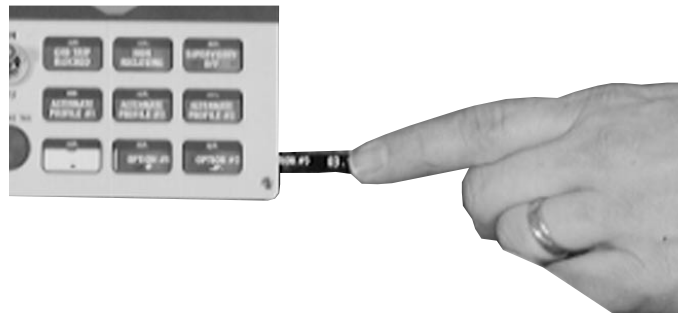
5. Change the existing label or slide in a new label with the name of the configured option.

An electronic label template is included on the ProView™ application software CD and can be accessed through the following default address:

C: / Program Files / Cooper / Proview40 / Form 6 / Form 6 Inserts.doc

**IMPORTANT:** Laminate the removable inserts prior to installing. This will seal the ink/toner and avoid damage to the front panel.

6. Gently push the removable insert from right to left into the right side of the operating panel (Figure 23) or down into the programming panel LED indicator section (Figure 22).



000008KM

**Figure 23.** Labels (OPTION 1, OPTION 2, and OPTION 3) are easily removed from and inserted into the operating panel.

7. Place the front cover panel back onto the control. Using a flathead screwdriver screw the screws into the control and tighten all hardware completely.



## ACCESSORIES

These accessories are available. Contact your Cooper Power Systems representative for additional information.

### Control Cable

The control cable consists of two separate wire sizes pending the distance from the Form 6 recloser control to the selected Kyle recloser. The control cable is fabricated with a connector on one end and pigtailed on the other. The connector is mated to the recloser receptacle on one end and hardwired to the control on the other end. Refer to Table 3 in the **Recloser Connection/Control Cable** section of this manual for available control cable lengths.

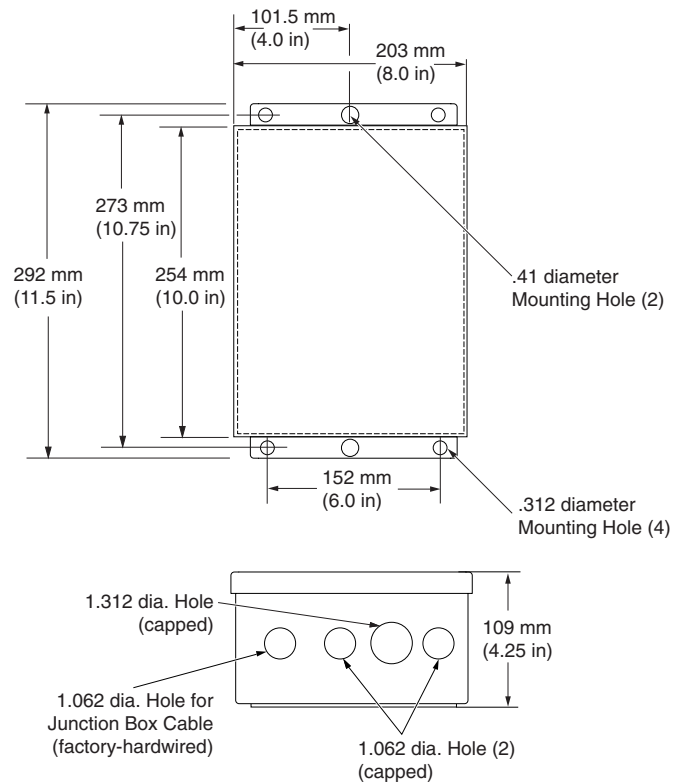
### Recloser Interface Junction Box

The recloser interface junction box (mounted on a recloser substation frame) facilitates customer wiring from the recloser to the control. The junction box is required when the distance between the recloser and control exceeds the maximum available control cable length for the KA85ME control cable (Table 3).

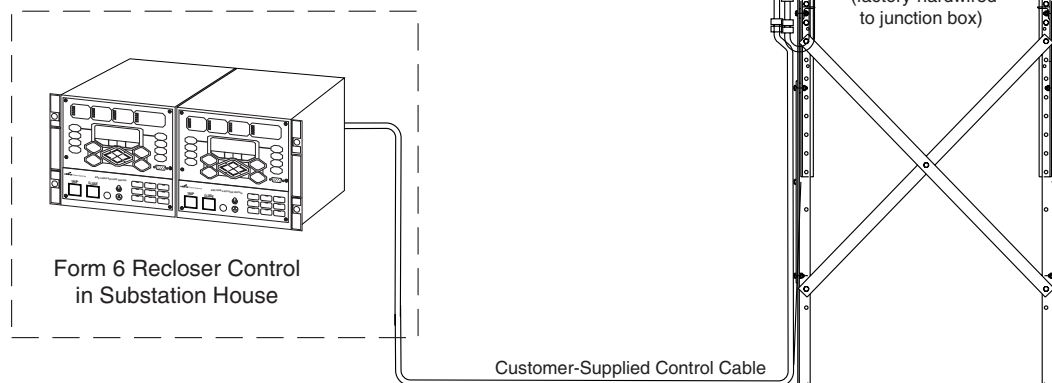
There are two types of junction boxes available:

- KME6-1811 The recloser interface junction box cable is factory-hardwired between the recloser and the junction box. Refer to Figures 24, 25, and 28.
- KME6-1859 The recloser interface junction box cable disconnects at both ends. The junction box has a male receptacle that enables connection between the recloser and the junction box with existing control cables from other Kyle® controls (Form 3A, Form 4C, etc.). Refer to Figures 26, 27, and 29.

The junction box is mounted on the substation frame based upon the mounting dimensions in Figure 24 or Figure 26. The junction box cabinet includes multiple diameter holes for sealing grip connections to hardwire to the control. A recloser interface junction box cable connects from the junction box to the recloser (Figure 25 or Figure 27). Refer to Figure 28 or Figure 29 for control-to-junction box customer connection diagrams. Refer to Table 11 for control-to-junction box cable requirements.



**Figure 24.** Form 6 recloser interface junction box KME6-1811 dimensions mm (in). (Dimensions are approximate.)



**Figure 25.** Form 6 recloser control connected to a recloser through a KME6-1811 recloser interface junction box.

## Recloser Interface Junction Box Cable

A recloser interface junction box cable for connection between the recloser and KME6-1811 junction box is available in lengths of 5 to 15 feet. This cable is factory-hardwired into the junction box. Refer to Figure 28 for Customer Connection information.

## Recloser Interface Junction Box Wiring

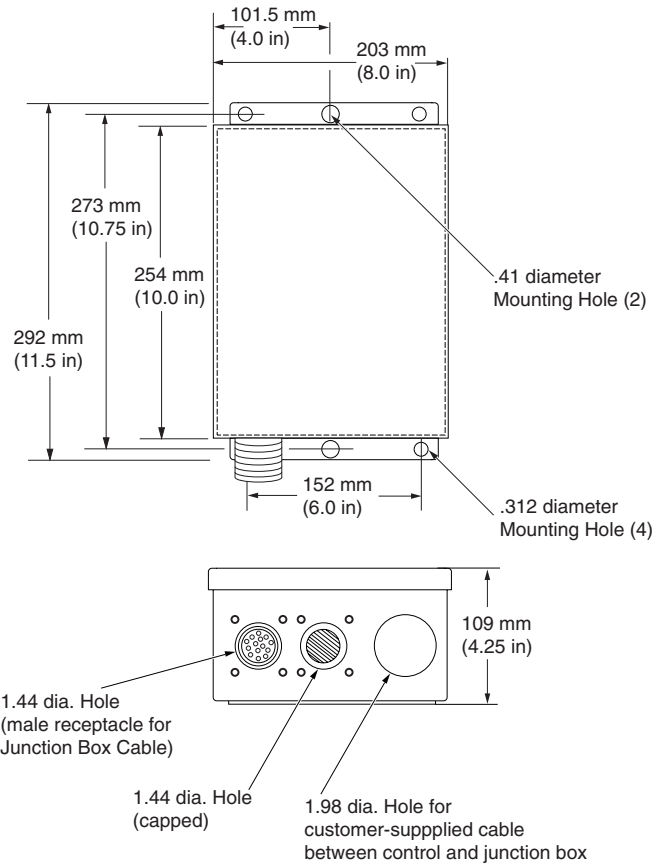
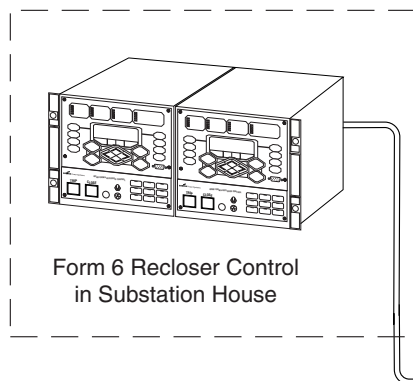
The recloser control has various connection options to connect the recloser. A recloser interface junction box is available for customer-supplied cable. The gauge of the cable is determined by the length needed for proper connection. Table 11 shows the required customer-supplied cable gauge and length used on Kyle three-phase electronic reclosers. Table 12 shows the common terminal type suitable for connection to the Recloser Interface Junction Box.

**TABLE 11**  
Customer-Supplied Cable Sizes for Wiring the Form 6 Rack Mount Control to the Interface Junction Box

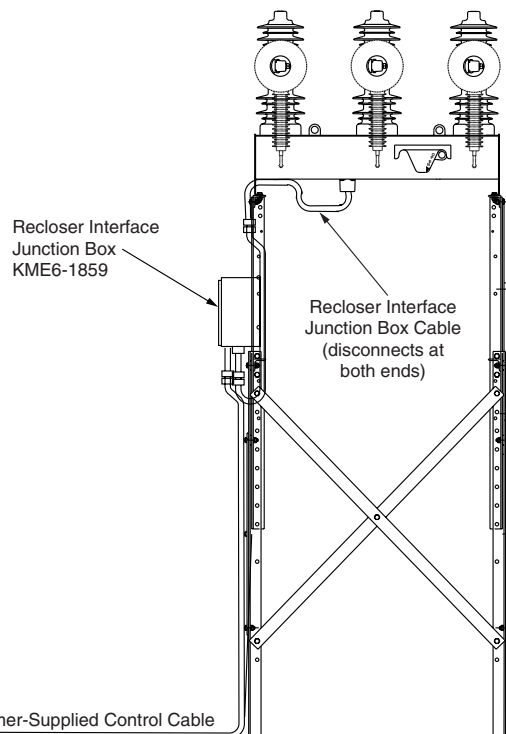
Recloser Type	Gauge	Length	
		Meters	Feet
WE, WVE27, WVE38X, VWE,VWVE27,VWVE38X, Auxiliary Powered NOVA15A Auxiliary Powered NOVA27A	12	91	300
	10	152	500
VSA12, VSA12B, VSA16, VSA20, VSA20A, VSO12, VSO16	12	14	45
	10	27	90

**TABLE 12**  
Common Terminal Type Suitable for Connection to the Recloser Interface Junction Box

Wire Size AWG	Terminal Type	Size	Model
12-10	Ring	#8	AMP# 8-35605-2



**Figure 26.**  
Form 6 recloser interface junction box KME6-1859 dimensions mm (in). (Dimensions are approximate.)



**Figure 27.**  
Form 6 recloser control connected to a recloser through a KME6-1859 recloser interface junction box.

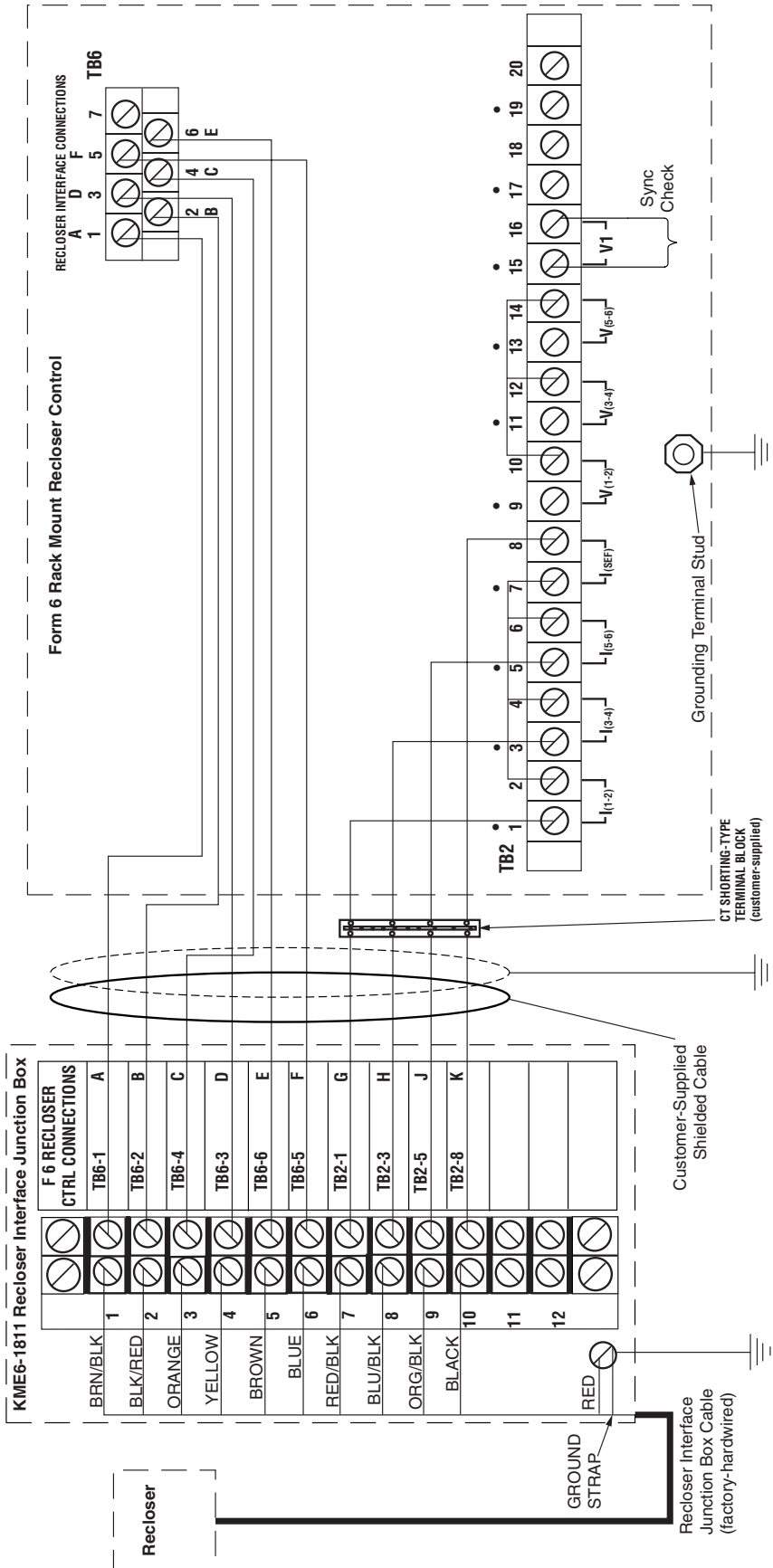
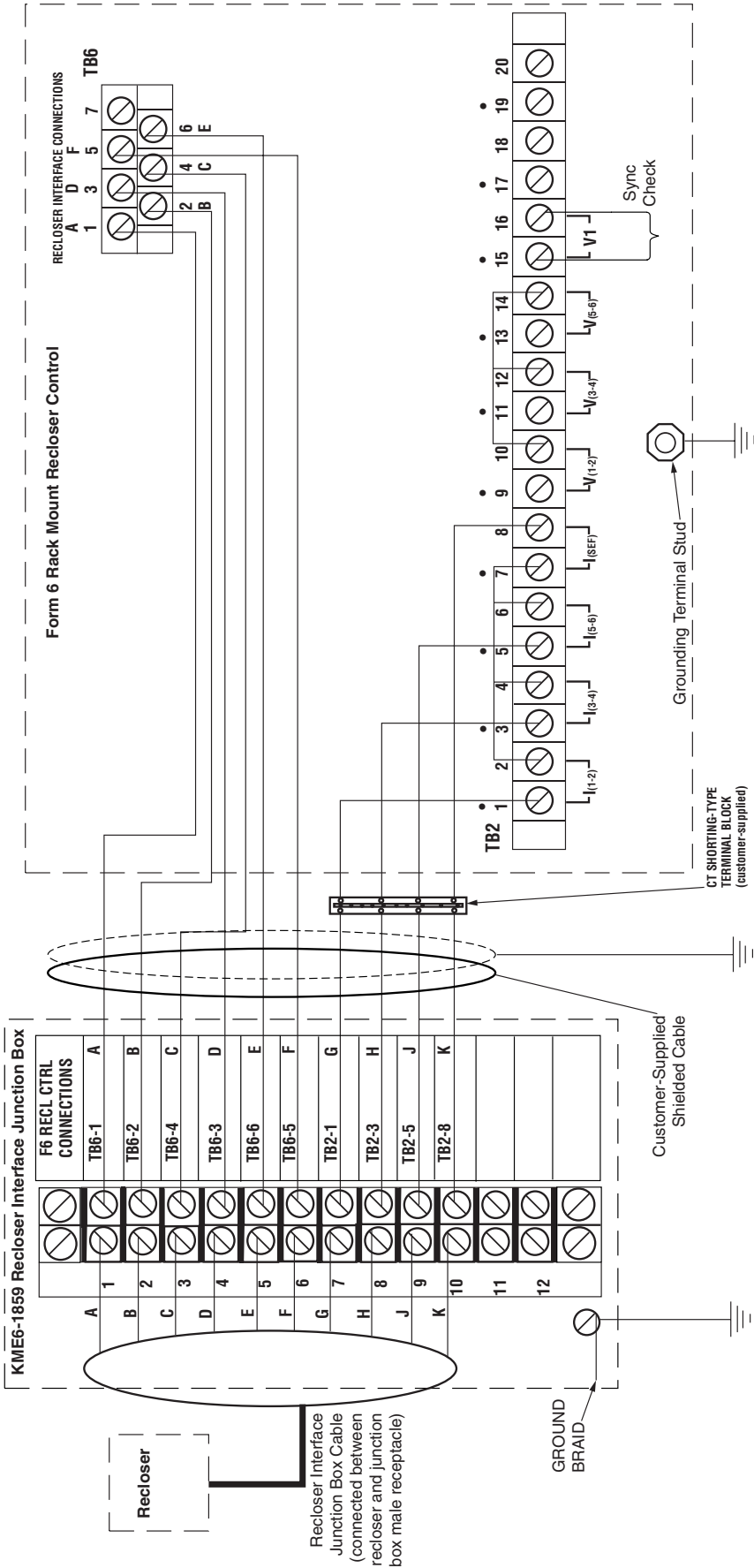


Figure 28. KME6-1811 Recloser interface junction box connection diagram.



**Figure 29.**  
**KME6-1859 Recloser interface junction box connection diagram.**

## Discrete Interface Board (DIF) Option Accessory

If additional I/O is required, a Discrete Interface Board Option accessory is available. The accessory includes eight control contact inputs and eight status outputs as identified in Figure 16. Refer to **Customer Connections for DC Power and AC Voltage Sensing** for additional information.

## Front Panel with Expanded LEDs

An ordering option for the front panel of the Form 6 rack mount recloser control includes the availability of additional configurable LEDs (Figure 30). The user is able to configure five additional LEDs for numerous status, alarms, or events using the Idea Workbench™ feature in the ProView™ interface software.

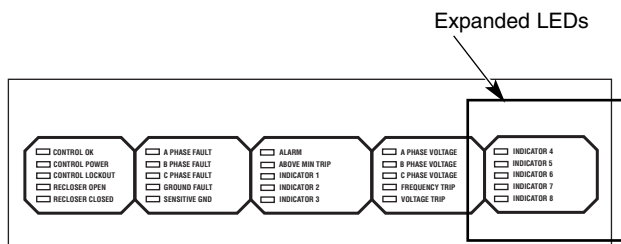
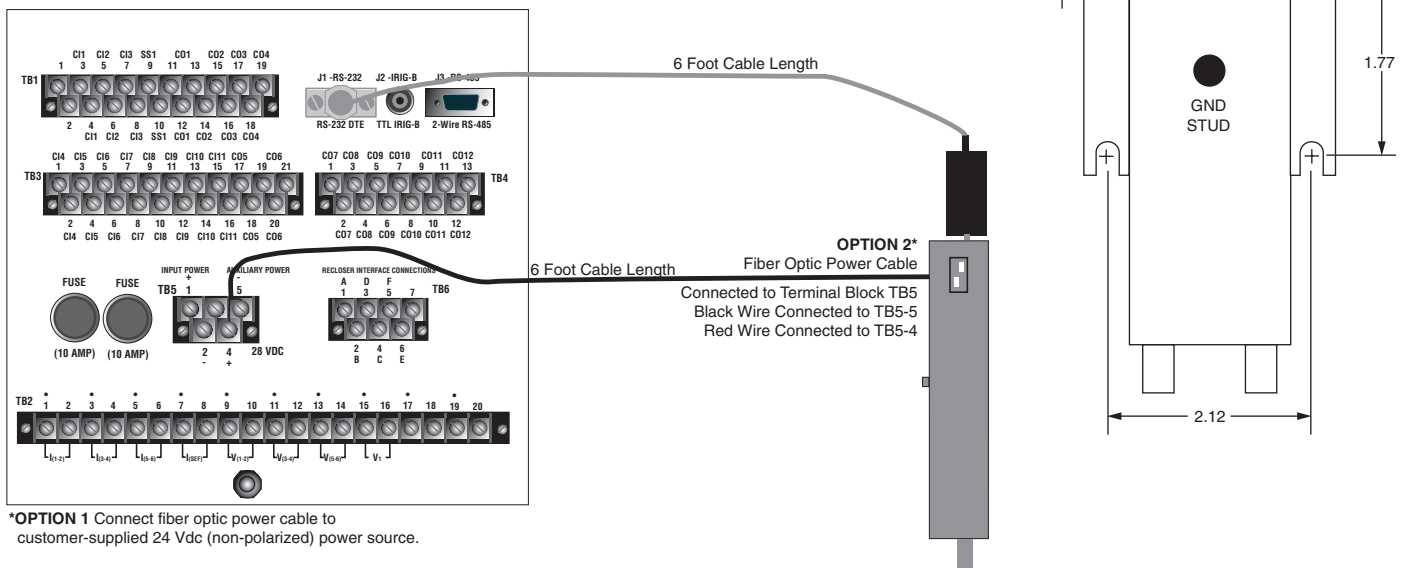


Figure 30. Expanded status indicator LEDs.

## Fiber Optic Accessory

The fiber optic interface accessory, (Figure 31), Catalog Number KME6-1875-3, provides a fiber-optic serial interface for two-way, real-time, serial communications with a remote terminal unit (RTU), telephone modem, or personal computer.



\*OPTION 1 Connect fiber optic power cable to customer-supplied 24 Vdc (non-polarized) power source.

Figure 31. KME6-1875-3 Form 6 rack mount control fiber optic interface accessory and mounting dimensions (inches) .

## RS-232 Cable

A nine-pin RS-232 Cable is available to connect from the personal computer to the data port on the front panel of the Form 6 rack mount recloser control. The front panel RS-232 port is wired as a DCE port for direct connection to the personal computer.

## Mounting Kits

The Form 6 rack mount recloser control is designed to be mounted in a standard 19" rack. There are three mounting kits available:

- Single Rack Mount – KME6-1802 Mounting Kit includes two handles. Refer to **Single Rack Mount Option Handle Attachment Instructions**.
- Double Rack Mount – KME6-1803 Mounting Kit includes two handles and one connecting plate. Refer to **Double Rack Mount Connecting Plate and Handle Attachment Instructions**.
- Single Mount w/Filler Plate – KME6-1804 Mounting Kit includes two handles and one filler plate. Refer to **Double Rack – Single Mount Handle and Filler Plate Attachment Instructions**.

## Double Rack Mount Connecting Plate and Handle Attachment Instructions

These instructions apply to the attachment of the handles and connecting plate to the Form 6 Double Rack Mount Recloser Control (Figure 32).

These controls are shipped without the handles or connecting plate attached. Follow this procedure to attach the handles and connecting plate and then secure the two controls together.

**CAUTION:** Control damage. De-energize both ac and dc power prior to removing or installing any internal connections or circuit boards in the control. Failure to comply can result in damage to the control. T241.1

### Attach Control Handles

1. Orient the handles and controls as illustrated in the Front View in Figure 32.
2. Attach one handle (Item 2) to each control (Item 1) using three #10-32 Flat Head Screws (Item 3) per handle as illustrated in Figure 32.

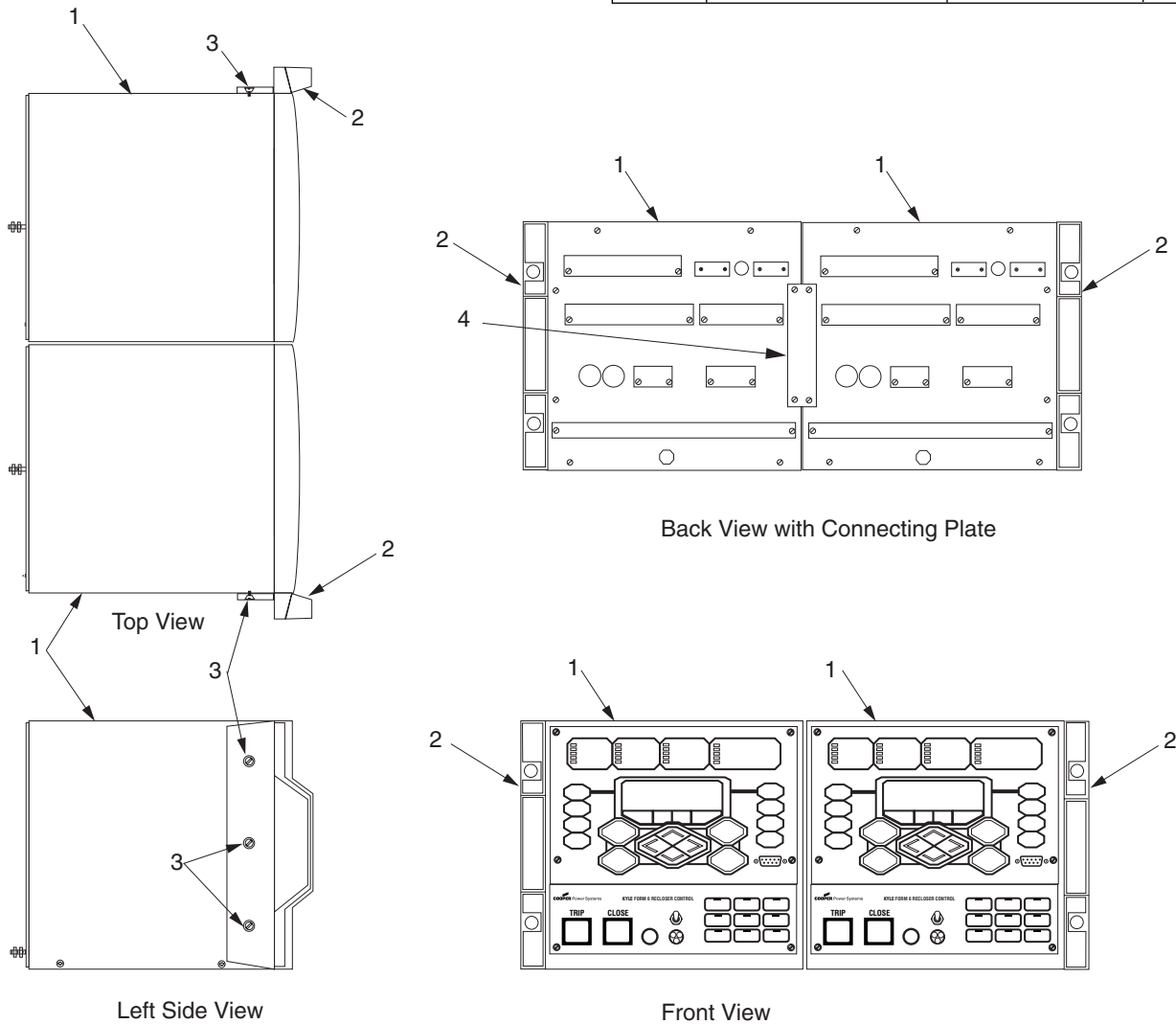
3. Completely tighten hardware. Do not torque.

### Attach Connecting Plate

1. Remove the two middle screws from the back of each control with a Phillips head screwdriver as illustrated in Figure 32.
2. Place the connecting plate over the screw holes in the controls.
3. Secure the connecting plate with the previously removed screws.
4. Completely tighten hardware. Do not torque.

**TABLE 13**  
Form 6 Recloser Control Double Rack Mount Accessory Attachment Parts List (Figure 32)

Item	Description	Part Number	Quantity
1	Form 6 Control		2
2	Form 6 Handle	6A00163901	2
3	#10-32 FI Hd Screw	722915310050A	6
4	Connecting Plate	6A00169501	1
5	#10-24 Screw	813315110100A	2



**Figure 32.**  
Form 6 Double Rack Mount Recloser Control.

### Secure the Controls Together

Connecting two Form 6 rack mount recloser controls requires removing the front panel from the control (right-side) as shown in the Figure 33.

**CAUTION:** Equipment damage. Always wear a grounding wrist strap to control static electricity before handling circuit boards. Failure to use this strap may result in circuit board damage. T253.1

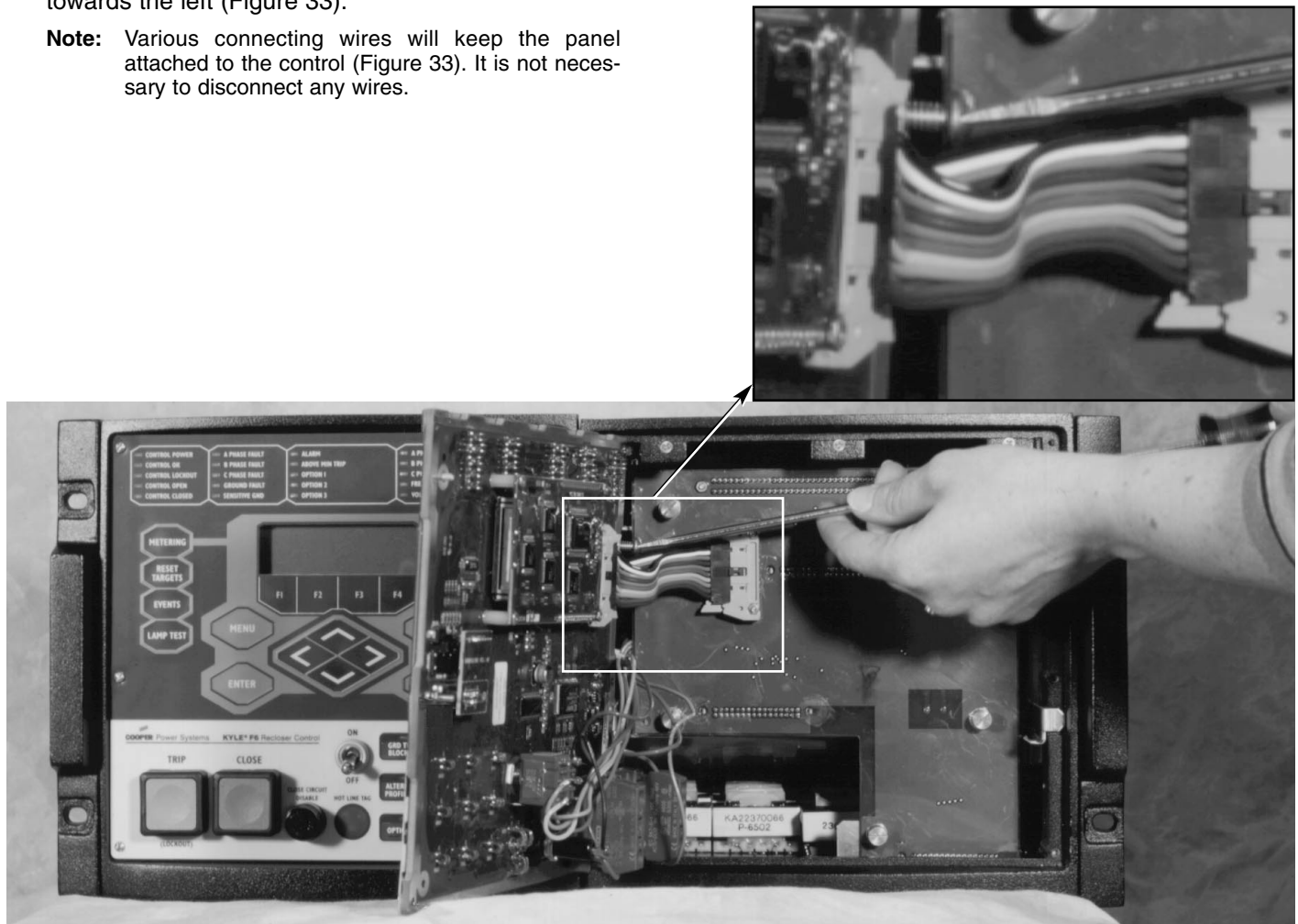
1. Unscrew the six screws from the control front panel until they detach from the control box.
2. Pull the right side of the right control front panel out towards the left (Figure 33).

**Note:** Various connecting wires will keep the panel attached to the control (Figure 33). It is not necessary to disconnect any wires.

3. Use a long flathead screwdriver to screw each #10-24 screw (Item 5, Table 13) right to left into the pre-threaded holes (Figure 33).

**Note:** It is not necessary to remove the front cover panel of the left control.

4. Tighten screws completely (Figure 33).
5. Gently place the front cover panel back onto the control.
6. Re-screw the screws back into the right control front panel and tighten all hardware completely. Do not torque.



**Figure 33.**  
Connect double rack mount controls with #10-24 screws.

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## Single Rack Mount Option Handle Attachment Instructions

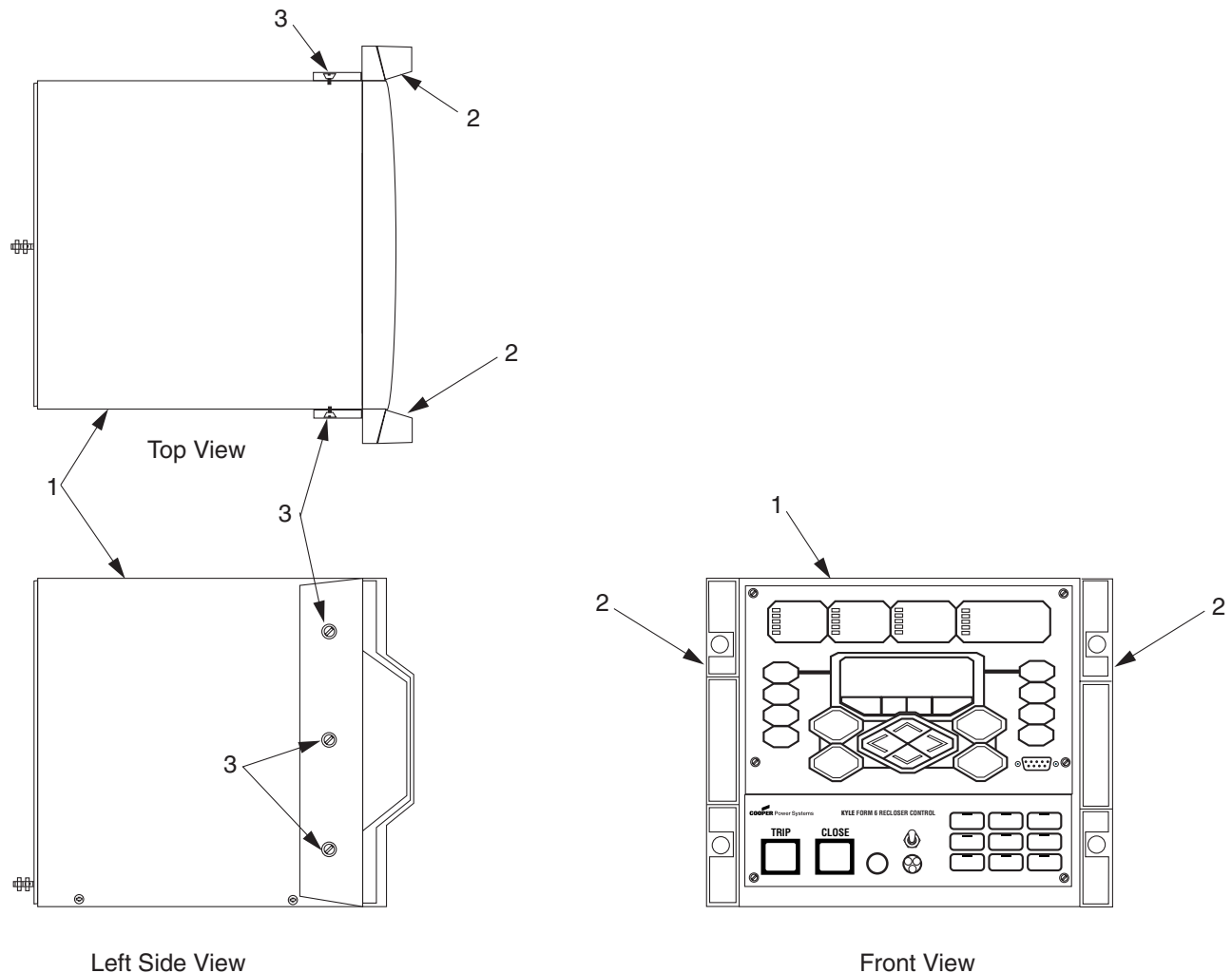
These instructions apply to the attachment of the handles to the Form 6 Single Rack Mount Recloser Control (Figure 34).

The control is shipped without the handles attached. Follow this procedure to attach the handles to both sides.

1. Orient the handles as illustrated in Figure 34.
  2. Attach the two handles (Item 2) to the control using six #10-32 Flat Head Screws (Item 3).
- Note:** Three screws will be used for each handle.
3. Tighten all hardware completely. Do not torque.

**TABLE 14**  
**Form 6 Recloser Control Single Rack Mount Accessory Handle Attachment Parts List (Figure 34)**

Item	Description	Part Number	Quantity
1	Form 6 Rack Mount Control		1
2	Form 6 Handle	6A00163901	2
3	#10-32 Flat Head Screw	722915310050A	6



**Figure 34.**  
**Form 6 Single Rack Mount Recloser Control.**

### Double Rack – Single Mount Handle and Filler Plate Attachment Instructions

These instructions apply to the attachment of two handles and one filler plate to the Form 6 Double Rack – Single Mount Recloser Control (Figure 35).

The control is shipped without the handles or filler plate attached. Follow this procedure to attach the handles to both sides and the filler plate to one side.

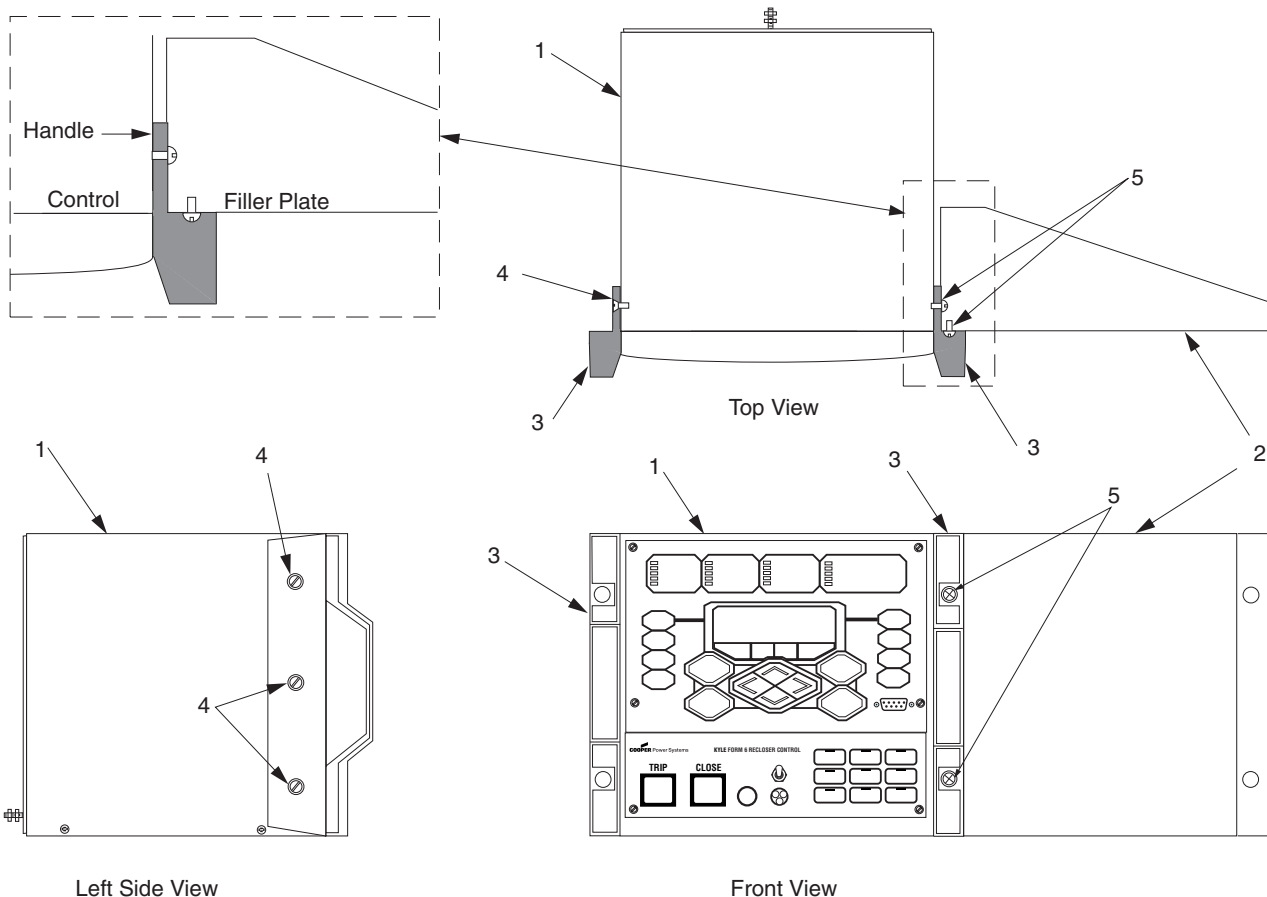
**Note:** The filler plate can be mounted on either side of the control.

**Note:** This procedure is required prior to mounting one Form 6 recloser control in the 19" rack.

1. Orient the handles as illustrated in the left side view in Figure 35.
2. Attach one handle (Item 3) with three #10-32 Flat Head Screws (Item 4) to the side of the control the filler plate is not going to be mounted to.
3. Tighten hardware completely. Do not torque.
4. Align the holes in the other handle over the pre-drilled holes on the side of the control.
5. Align the filler plate over the handle holes.
6. Attach the handle (Item 3) and filler plate (Item 2) to the control using five #10-32 Pan Head Screws (Item 5) (Figure 35).
7. Tighten all hardware completely. Do not torque.

**TABLE 15**  
Form 6 Recloser Control Single Rack Mount Handle and Filler Plate Attachment Parts List (Figure 35)

Item	Description	Part Number	Quantity
1	Form 6 Control	(for reference)	1
2	Filler Plate	6A00166801	1
3	Form 6 Handle	6A00163901	2
4	#10-32 Fl Hd Screw	722915310050A	3
5	#10-32 Pan Hd Screw	723315310050A	5



**Figure 35.**  
Form 6 Double Rack – Single Mount Recloser Control.

## TESTING

**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

**IMPORTANT:** The Form 6 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.

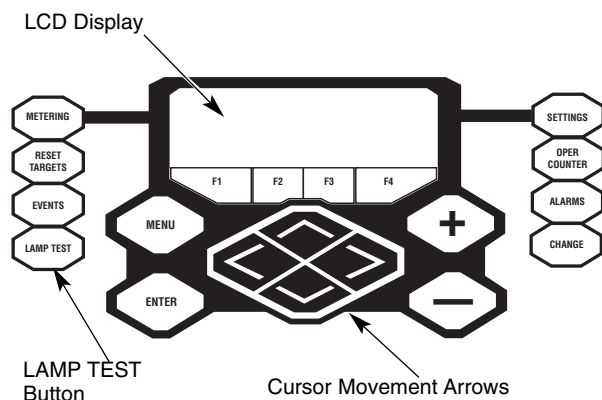
### Testing an Installed Control

The following tests to determine initial operation of the Form 6 recloser control can be performed while connected to an operating recloser.

**Note:** These are the only tests performed on an installed, operating control.

1. Verify operating status of all indicator lights by pressing the LAMP TEST key on the programming panel (Figure 36).
2. Check the operational values for currents, voltages, and other metering information.

**Note:** Scroll through the LCD display messages by pressing the  $\blacktriangle$  and  $\blacktriangledown$  cursor movement arrows underneath the LCD display on the programming panel (Figure 36).

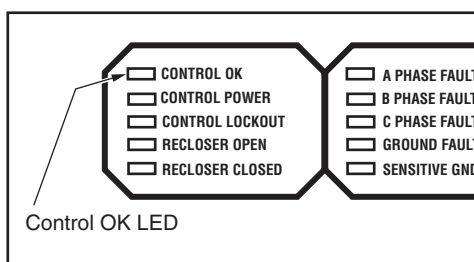


**Figure 36.** Lamp Test button, LCD display, and cursor movement arrows.

3. Verify the Control OK LED is illuminated on the control operator panel (Figure 37). This indicates the presence of dc power.

**Note:** The control includes a Power Save feature that will turn off the backlit LCD display and all LEDs if no front panel keypad is pressed within ten minutes. Pressing any key will reactivate the display and LEDs.

All other tests described in this **TESTING** section require the Form 6 recloser control to be removed from service, connected to a bypassed recloser, or tested at a location where the proper testing equipment is available. Refer to **Remove the Control from Service** for the proper procedure to remove the control from service.



**Figure 37.** Control OK LED.

### Remove the Control from Service

**IMPORTANT:** Disconnect switches for both ac and dc circuits and a current transformer shorting-type terminal block are necessary to isolate the Form 6 recloser control for testing and servicing.

1. Enable GRD TRIP BLOCKED to allow for ground trip to be disabled when re-energized.
  - A. Press the CHANGE button on the Operator Panel to enter the CHANGE mode.
  - B. Depress the GRD TRIP BLOCKED button within ten seconds after entering the CHANGE mode.
 

**Note:** If the GRD TRIP BLOCK button is not depressed within ten seconds, the function is not activated.
2. Remove dc power from the control using a separate disconnect switch.
3. Remove control ac sensing voltage from the control using a separate disconnect switch.



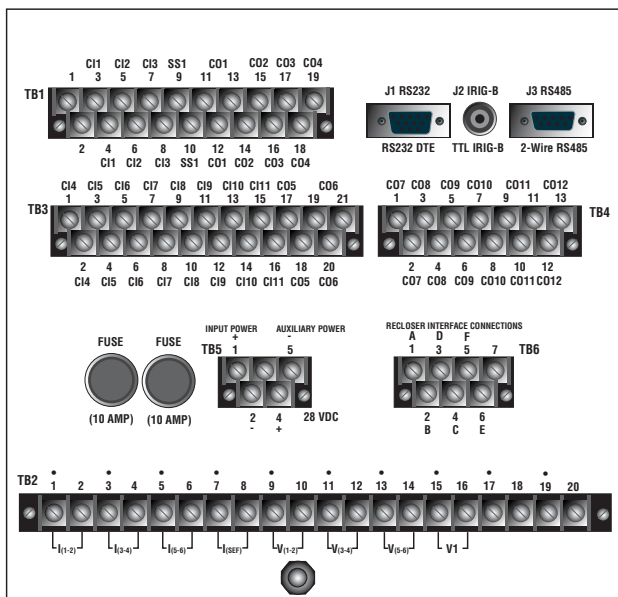
**WARNING:** Hazardous voltage. If the recloser is energized while the control cable is disconnected, the CT secondaries can generate high voltages. Contact with high voltage can cause severe personal injury or death.

T204.2

4. Short CT secondaries at a separate CT shorting-type terminal block.
5. Remove any control input and status output wiring from TB1, TB3, and TB4 (Figure 38).
6. Disconnect any serial communications ports and IRIG-B timing connection from J1, J2, and J3 (Figure 38).
7. Unscrew the mounting screw on each side of terminal block TB5 (Input Power) to disconnect and remove the terminal block from the control.

**CAUTION:** Equipment Damage. Pin 1 retains a 24 Vdc charge. Never allow conductive material (such as a screwdriver or other metal item) to touch TB6 Pin 1 to chassis. Failure to comply will damage the control. T272.0

8. Unscrew the mounting screw on each side of terminal block TB6 (Recloser Interface Connections) to disconnect and remove the terminal block from the control (Figure 38).
9. Use a screwdriver to disconnect all wiring on terminal block TB2 (Voltage/Current Inputs) from the control (Figure 38).
10. Disconnect the ground from the control.



**Figure 38.**  
Back view of Form 6 rack mount recloser control.



010028KM

**Figure 39.**  
Kyle® Type MET Electronic Recloser Control Tester.

### Testing with Type MET Tester

The Kyle® Type MET Electronic Recloser Control Tester (Figure 39) is used for testing the following functions of the Form 6 recloser control:

- Overcurrent Timing
- Reclose Time
- Operating Sequence
- Reset Time
- Minimum Trip Current
- High Current Trip and Lockout

The MET Tester is completely self-contained, capable of performing all required checks and tests from a simple verification of operation to a complete verification of all operating parameters. Refer to *Service Information S280-76-1 Type MET Electronic Recloser Control Tester Operating Instructions* for proper setup and use of the MET Tester.

Use the wiring harness KME6-1732 accessory to connect the MET tester to the Form 6 rack mount control. Refer to Table 16 for connection information. The wiring harness has a connector on one end for connection to the control receptacle on the MET Tester. The other end of the wiring harness has insulated locking fork terminals for connection to the Form 6 rack mount recloser control.

**TABLE 16**  
Wiring Harness KME6-1732 Wire Color and Corresponding Connection Point

Pin	Color	Connection Point
A	BLACK	TB6-1
B	WHITE	TB6-2
C	RED	TB6-4
D	GREEN	TB6-3
E	ORANGE	TB6-6
F	BLUE	TB6-5
G	WHT/BLK	TB2-1
H	RED/BLK	TB2-3
J	GREEN/BLK	TB2-5
K	ORANGE/BLK	TB2-8

## Closing the Recloser During Testing

### 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).

**WARNING:** Hazardous voltage. Interconnect source leads X and Y and ground solidly to the recloser tank (Figure 42). 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

**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 (Figure 40).

**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

**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 42). A 75 kA transformer of the proper voltage rating with an impedance drop of approximately 3% is satisfactory. The ac source must have a comparable impedance drop.

A test circuit for these solenoid-closed reclosers is shown in Figure 42. The following equipment is required for the recommended shop testing setup:

**Note:** Solenoid-closed reclosers equipped with a 120- or 240-Vac low-voltage closing coil accessory can be tested as shown in Figure 43.

- Variable Autotransformer T1, 230 Volts, 20 Amps.
- Low-Voltage transformer T2 to simulate fault conditions.

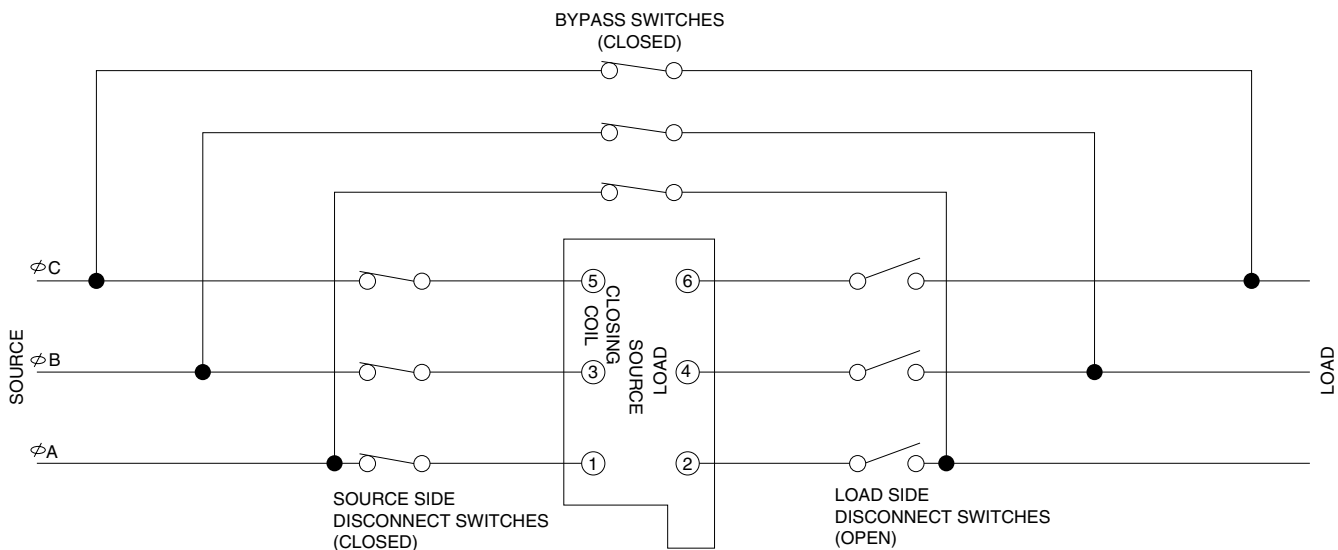
Ratio and size will depend upon the maximum current to be used. The recloser presents a low impedance to the transformer, so secondary voltage must be only high enough to force the required current through the secondary of the transformer and the recloser.

**Note:** An alternative method of providing the necessary current through the transformer is shown in Figure 41.

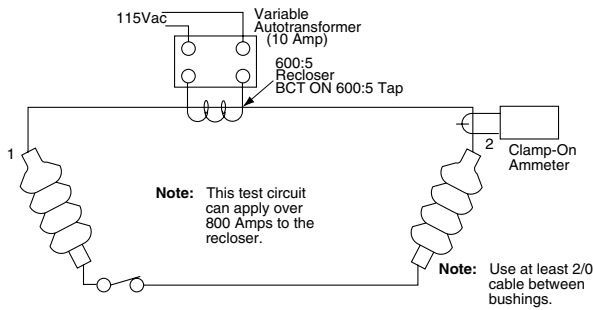
- High-Voltage T3 to operate the closing solenoid.

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 cycle interval the closing coil is energized. This procedure is not used on reclosers equipped with the low-voltage closing accessory.

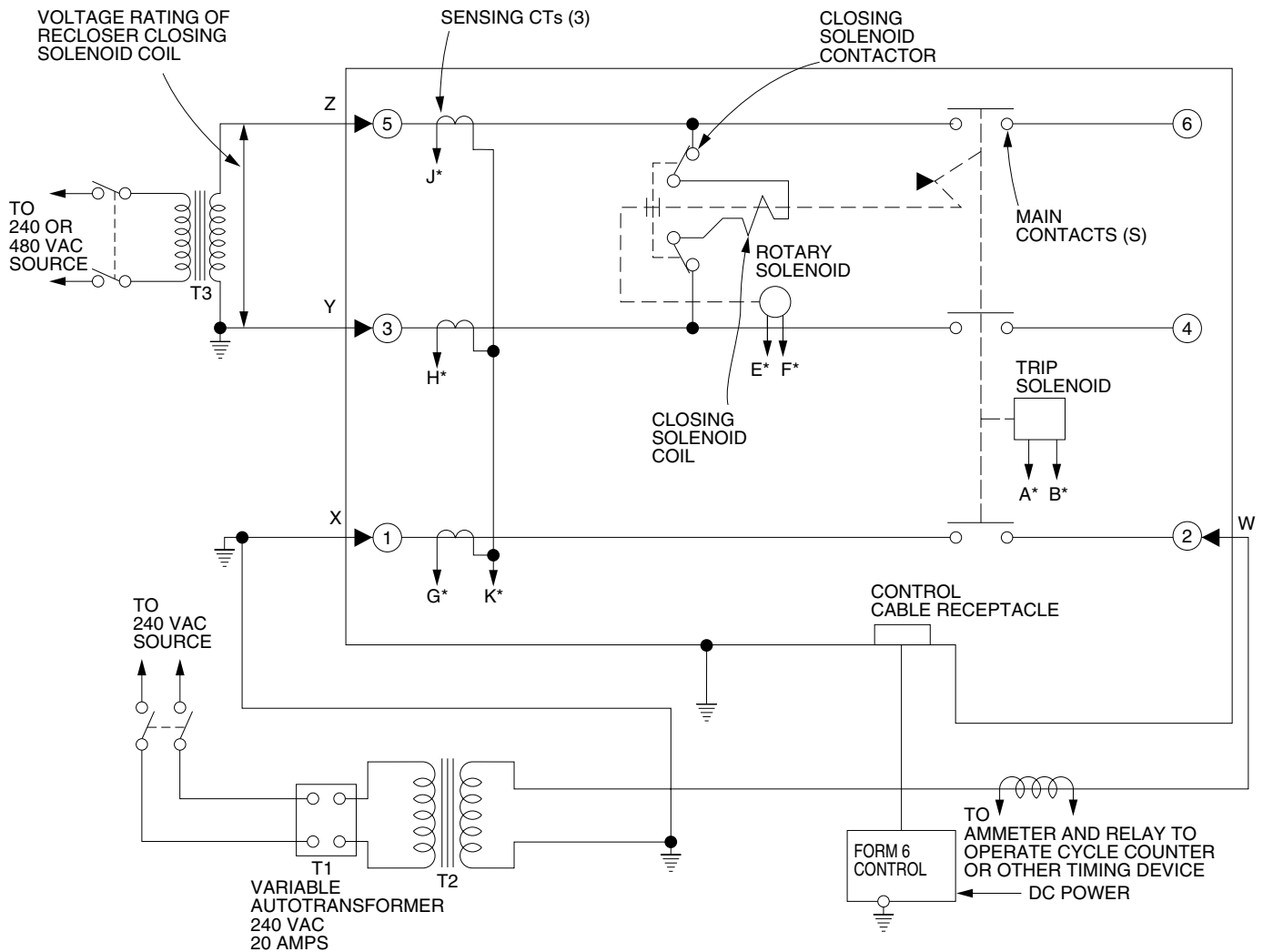
- Ammeter with a rating based on the level of test current.
- Current-actuated timer.



**Figure 40.** Closing source-side switches of a bypassed “on-line” recloser provides closing solenoid power for automatic operation during testing.



**Figure 41.**  
**Alternate method of producing variable line current (substitute for T2 and W-X circuit in Figures 42 and 43).**



\*Indicates control cable receptacle pin/socket designation.

**Figure 42.**  
**Suggested test circuit for high voltage "shop-testing" solenoid-closing reclosers.**

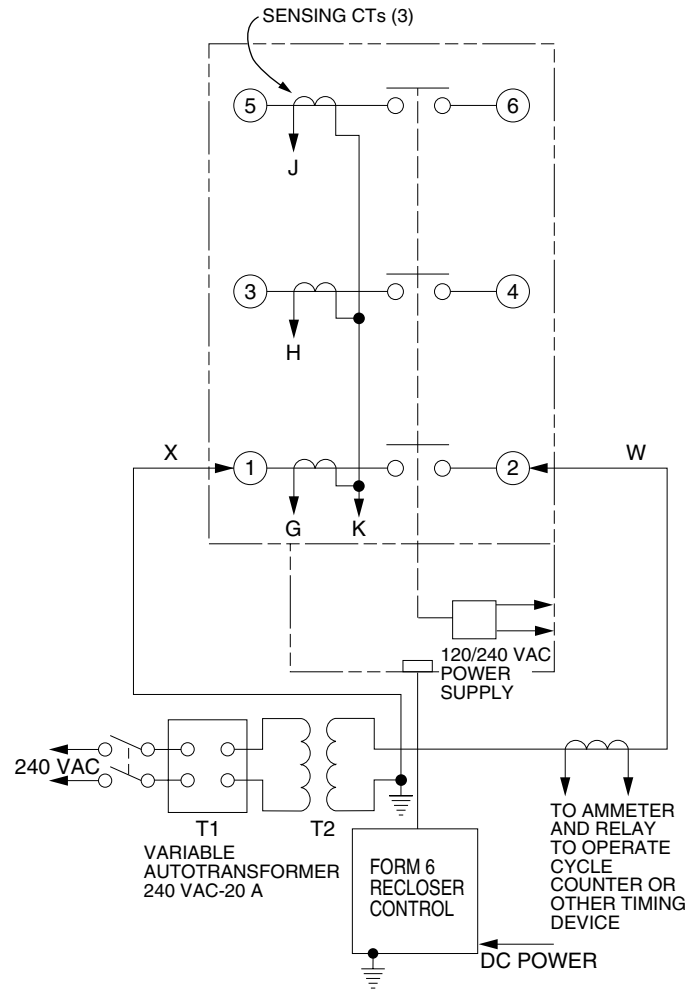
## Electrical Closing – Motor-Operated Low Voltage Closing Solenoid / Auxiliary-Powered NOVA Reclosers

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

T223.2

High-voltage is not required for reclosers utilizing a motor-operated closing mechanism, low voltage closing, or Auxiliary-Powered NOVA recloser. For information on energizing the recloser, refer to the appropriate recloser installation manual. Low voltage supply can use either 120 or 240 Vac for input power. Check the name plate on the recloser to verify the correct closing power requirements.

Figure 43 shows a test circuit for motor-operated, low-voltage solenoid-closing, and Auxiliary-Powered NOVA reclosers. Since these reclosers require only a low voltage source for closing, high-voltage transformer T3 and its protective cage is eliminated. All other equipment is the same as the test equipment shown in Figure 42.



**Figure 43.**  
Suggested test circuit for motor-operated, solenoid-closing reclosers with low-voltage closing.



## Manual Closing – Solenoid-Operated Reclosers

**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 which can cause death, severe personal injury, and equipment damage. T203.2

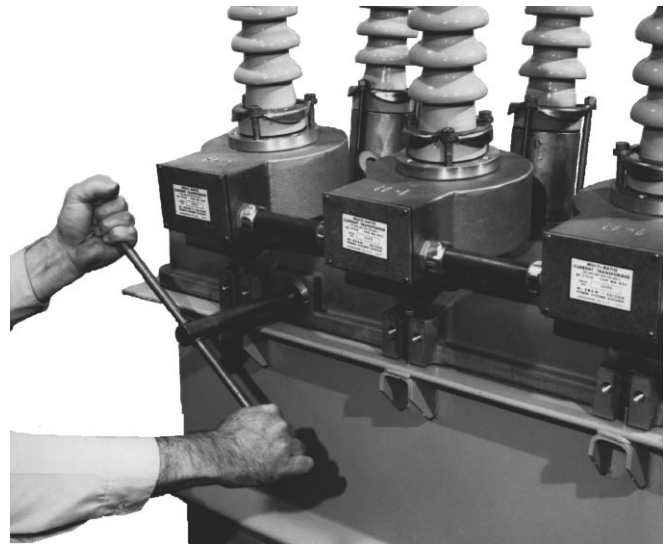
If high-voltage for operating the closing solenoid is not available, manual closing can be substituted for electrical closing. However, not all control settings can be checked since manual closing is not synchronized with the closing coil control circuit in the control.

Follow these steps to manually close the recloser:

1. Remove the closing tool port cover and gasket from the side of the recloser head casting.

**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

2. Insert the tee-handled tool (available as an accessory) into the port, engaging the pin on the closing shaft (Figure 44).
3. Close the recloser by placing the yellow operating handle (located under the sleethood) into the up or CLOSED position and turning the closing tool one-quarter turn clockwise.



**Figure 44.** Using a manual closing tool to operate the recloser. 82284KMA-F

4. After each trip operation, about 1/2 second elapses while the closing solenoid plunger is moving upward to reset the main toggle latch.
5. After the main toggle latch resets, the recloser can be closed again by operating the manual closing tool.
6. Replace the gasket and port cover on the recloser head after testing has been completed.

## Return the Control to Service

**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

After the required work or testing is completed, follow this procedure to return the control to service:

**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

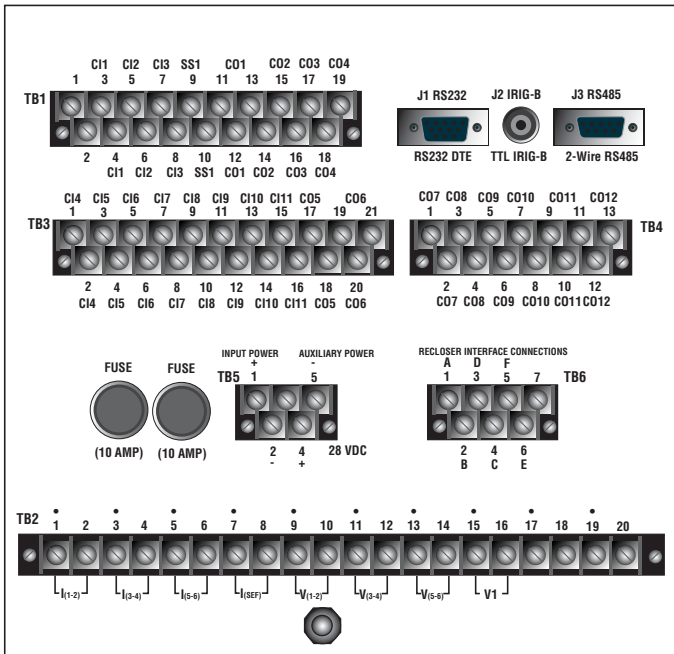
1. Verify that all control settings are correct prior to installation.

**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

2. Connect the ground to the control.

**Note:** Refer to **Grounding the Control** section.



**Figure 45.**  
Back of Form 6 rack mount recloser control.

3. Use a screwdriver to re-connect all wiring on terminal block TB2 (Voltage/Current Inputs) to the control (Figure 45).

4. Connect any serial communications ports and IRIG-B timing connection into J1, J2, and J3 (Figure 45).

5. Connect terminal block TB5 to the control by screwing the mounting screw through each side of the terminal block (Input Power) and into the control (Figure 45).

6. Connect any control input and status output wiring to TB1, TB3, and TB4 (Figure 45).

7. Connect terminal block TB6 to the control by screwing the mounting screw through each side of the terminal block (Recloser Interface Connections) and into the control (Figure 45).

8. Connect control ac sensing voltage to the control via disconnect switches.

**Note:** Refer to **Customer Connections for DC Power and AC Voltage Sensing** section.

9. Connect dc power to the control via disconnect switches.

**Note:** Refer to **Customer Connections for DC Power and AC Voltage Sensing** section.

**WARNING:** Hazardous voltage. If the recloser is energized while the control cable is disconnected, the CT secondaries can generate high voltages. Contact with high voltage can cause severe personal injury or death.

T204.2

10. Reconnect CT circuit by unshorting secondaries from the CT shorting-type terminal block.

11. The recloser and control are ready for service. Once installed, remove bypass switches on the recloser.


12. Disable GRD TRIP BLOCKED.

A. Press the CHANGE button on the Operator Panel to enter the CHANGE mode.

B. Depress the GRD TRIP BLOCKED button within ten seconds after entering the CHANGE mode.

**Note:** If the GRD TRIP BLOCK button is not depressed within ten seconds, the function is not activated.

## ADDITIONAL 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

### Replacement Kits

Replacement kits for the Kyle Form 6 rack mount recloser control are available through the factory Service Department. To order these kits, refer to the Replacement Parts price list for catalog numbers and pricing. Contact your Cooper Power Systems representative for additional information and order procedures.

### Factory-Authorized Service Centers

Factory-authorized service centers are located throughout the continental United States to provide maintenance, repair and testing services for Kyle controls and reclosers. For further information, contact your Cooper Power Systems representative.

### Factory Testing and Troubleshooting Classes

The factory service department offers a basic testing and troubleshooting course for the Form 6 Microprocessor-Based Electronic Recloser Control. This course, taught by experienced service technicians, is held at the factory's in-house training facility. For additional information, contact your Cooper Power Systems representative.

### Type MET Recloser Control Tester

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



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