

Reclosers

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

Service Information
S280-70-3

For Type F6-PA Control, Serial Numbers 464 through 9999; and Type F6-PB Control, Serial Numbers 1015 through 9999.

- F6-PA applies to Form 6 control for use with W, VS, and auxiliary-powered NOVA reclosers.
- F6-PB applies to Control-Powered NOVA Form 6 control for use with control-powered reclosers.



Figure 1.
Kyle® Form 6 Microprocessor-Based Pole Mount Recloser Control.

030001KM

Contents

Safety Information	2	Before Placing Control and Recloser into Service ..	30
Product Information	3	Using Removable Inserts	31
Introduction	3	Accessories	32
ANSI Standards	3	Low Voltage Closing	32
Quality Standards	3	Incoming Power Receptacles	32
Acceptance and Initial Inspection	3	BCT Terminal Blocks	34
Handling and Storage	3	Auxiliary Terminal Block	34
Control Power	3	Front Panel with Expanded LEDs	35
Battery Replacement and Disposal	3	Discrete Interface Board Accessory	35
Operation Upon Loss of AC Power	4	Cable Locking Sleeves	35
Form 6 Recloser Control Description	5	120 Vac GFI Duplex Outlet	35
Description	5	RS-232 Cable	35
Theory of Operation	5	Stainless Steel Cabinet	35
Control Front Panel	6	Fiber Optic Interface Accessory	36
Control Features	11	Radio Mounting Accessory	36
Communications	14	Testing	37
Control Information	14	Testing an Installed Control	37
Control Back Panel	14	Remove the Control from Service	38
Installation Procedure	15	Testing with Type MET Tester	38
Initial Programming Prior to Installation	15	Closing the Recloser During Testing	39
Control / Recloser Compatibility	15	Battery Test and Charging Procedures	42
Duty Cycle Monitor	16	Return the Control to Service	43
Control Cable	16	Additional Information	44
Mounting the Control	17	Replacement Kits	44
Grounding the Control	18	Factory-Authorized Service Centers	44
Customer Connections for AC Power	21	Factory Maintenance Classes	44



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 S280-70-3 provides installation and operation instructions for the Kyle® Form 6 microprocessor-based pole mount electronic recloser control below serial number 10,000.

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, please 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 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.

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

Control Battery Storage and Charging

The 24 Vdc control battery in the Form 6 recloser control is fully charged prior to shipment and is ready for use.

IMPORTANT: To maintain sufficient charge to operate the control and prevent battery cell damage, the sealed lead-acid batteries should be charged after no more than three months of storage.

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

To keep the battery charged, energize the control's built-in charger with ac power applied to the user ac supply input connector block TB1. See **Customer Connections for AC Power**. In addition, if power to the control is not possible a separate portable charger accessory is available. Catalog Number KA43ME7001 provides a 120 Volt battery charger to power individual batteries.

IMPORTANT: Connect the control battery when ac power is connected to the control's ac supply Input Terminal Block. The battery must be disconnected prior to shipping or storing the control.

Note: When shipped from the factory, the battery source is disconnected and its output plugs are taped to the cabinet. Connect the battery plugs into the mating connectors to complete the battery circuit.

Control Power

The control is powered from 120 or 240 Vac. The selector switch on the power supply board allows the user to select between 120 Vac or 240 Vac.

Note: The selector switch is factory-set for each control based upon the customer order requirement.

Battery Replacement and Disposal

The 24 Vdc control battery has a life expectancy of four to six years. It is recommended that the battery be replaced after four years.

Dispose expired batteries in an environmentally responsible manner. Consult local regulations for proper battery disposal.

Operation Upon Loss of AC Power

The control is equipped with either an 8 Amp-Hour or 13 Amp-Hour 24 Vdc lead acid battery for operation upon loss of ac power. The control maintains full operation from the battery for a period of time dependent upon the battery size:

- 8 Amp-Hour — 15 hour maximum (20°C)
- 13 Amp-Hour — 25 hour maximum (20°C)

In the event that the ac power has not returned within the times listed above, the control will disconnect the battery from the circuit.

Note: The control continuously monitors the battery voltage. To prevent battery damage, the control shuts down automatically upon detection of low battery voltage (below 22 Vdc) for 60 seconds.

Control programming settings and parameters—including event recorder—are stored in non-volatile memory and retained upon loss of control power. The time/date clock will continue to operate for approximately 30 days after loss of control power.

Phase B (Ø) is the factory default phase. Unless changed by the user, the B PHASE VOLTAGE red LED illuminates indicating ac is the operating power. If BØ (or the user-indicated phase) loses ac power, the ALARM red indicator LED will illuminate. The ALARM log on the LCD Display will indicate NO AC PRESENT and the CONTROL OK LED will not be illuminated.

IMPORTANT: If the the control shuts down due to low battery voltage before ac power is restored, and the connected energized recloser is CLOSED; it will only TRIP and LOCKOUT via front panel pushbutton command.

A control that has shut down due to low battery voltage before ac power is restored will have a blank LCD display (no text message shown).

The control clock may require resetting if the operating power has been disconnected for more than thirty days. Refer to *Service Information S280-70-4 Kyle Form 6 Microprocessor-Based Recloser Control Programming Guide* for information on setting the control clock.

Note: When ac power is present, the control will operate regardless of back-up battery presence.

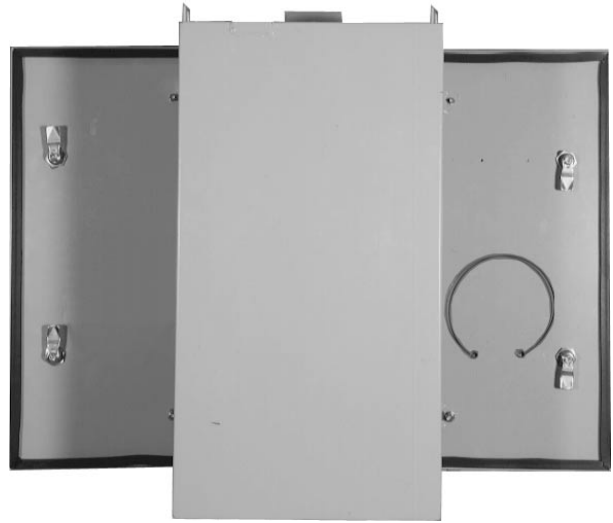


Figure 2. Form 6 pole mount recloser control is accessible from both the front and back of the cabinet.

030034KM

FORM 6 RECLOSER CONTROL DESCRIPTION

Description

The Kyle® Form 6 pole 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) on a per phase or total basis. Symmetrical components for both voltage and current are displayed along with kilowatt-hours for energy metering. Harmonics from the 2nd to the 15th harmonic are also included.

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.

ProView™ interface program software includes additional functions used to create and graphically display Time Current Curves and provides the 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.

The control is accessible from both the front and back of the cabinet (Figure 2).

Theory of Operation

A functional block diagram of the Form 6 recloser control is shown in Figure 3. Current sensing is provided by three current transformers located in the recloser and interfaced to the Form 6 recloser control via the control cable. This cable 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 input module through terminal block TB8.

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.

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

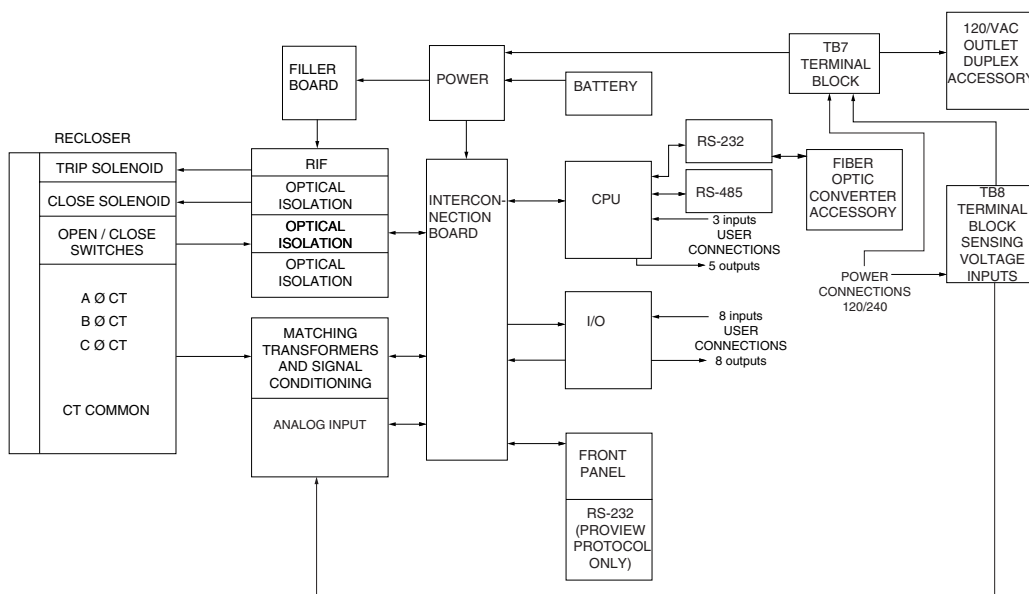


Figure 3.
Form 6 recloser control operational flow diagram.

temporary, the control ceases to command recloser operations after a successful reclose, and the control resets to the start of its operating sequence after a preset time delay. If the fault is permanent, the control performs its complete programmed sequence of 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 4). 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 five minutes. Pressing any key will reactivate the display and LEDs.

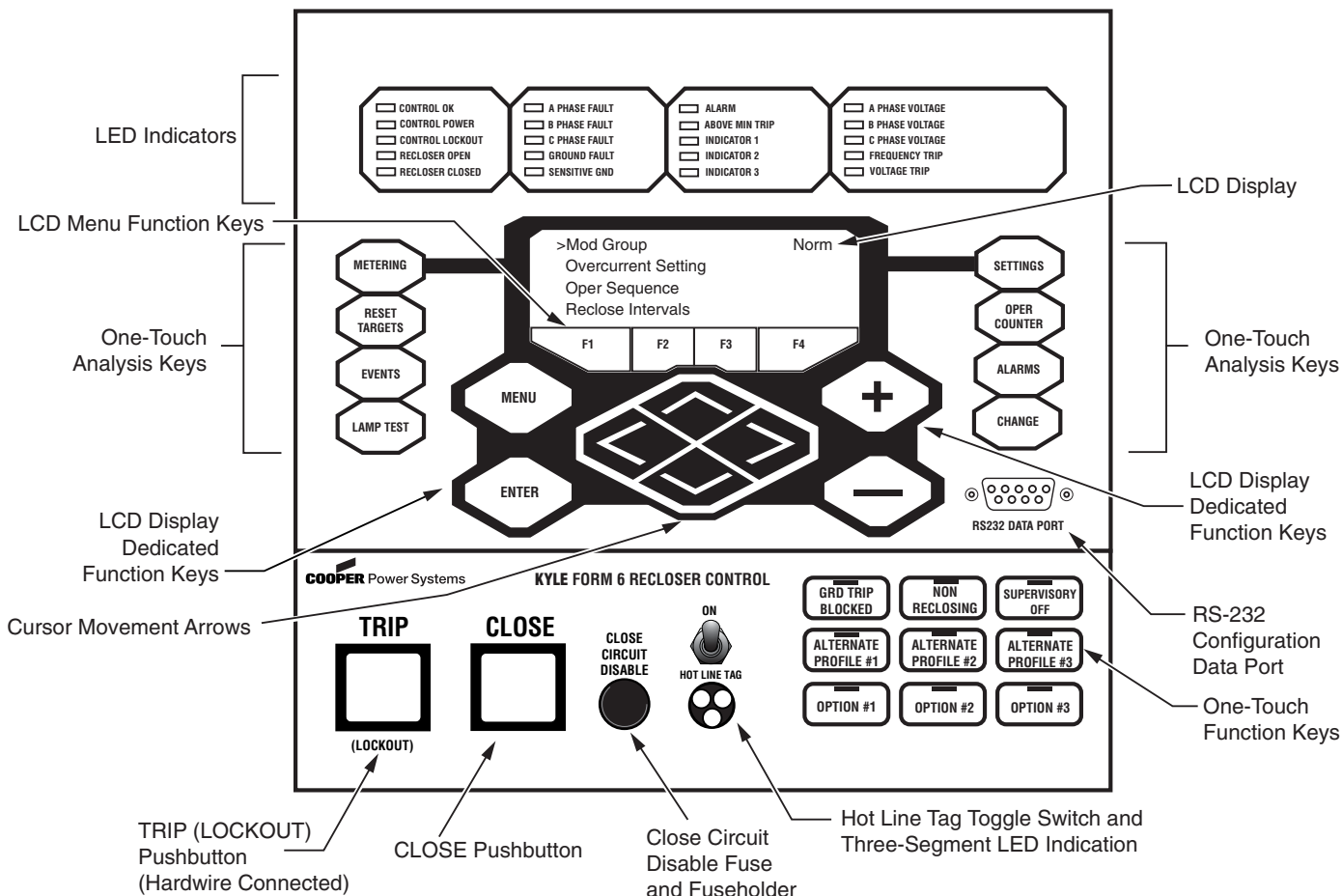


Figure 4.
Form 6 recloser control front panel.

Programming Panel

The Programming panel has the following sections:

One-Touch Analysis Keys

There are eight analysis keys (Figure 5) 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 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 5).

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: Identifies the LCD Display menu options.

ENTER: Selects 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.

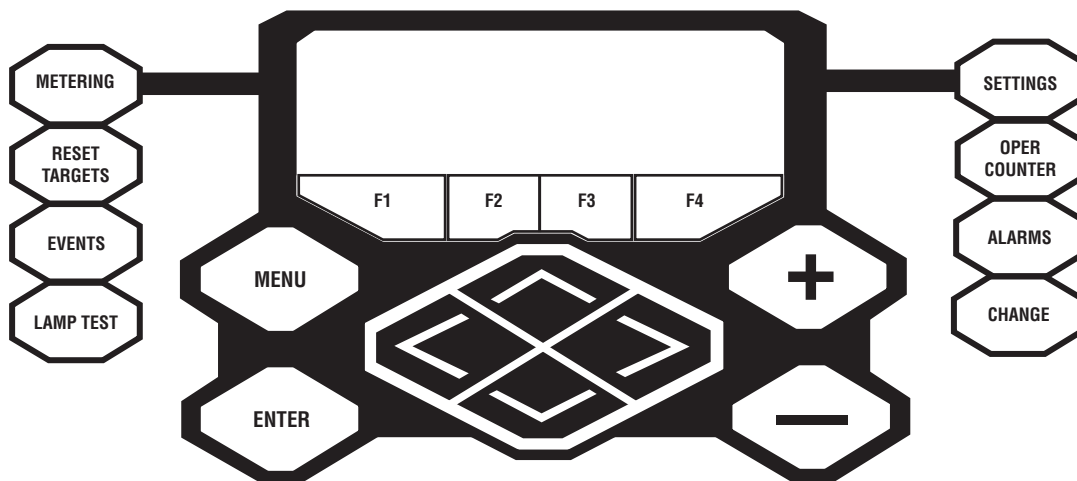


Figure 5. Form 6 recloser control shortcut keys, LCD display, LCD menu function keys, and cursor movement arrows.

Status Indicator LEDs

The status indicator LEDs (Figure 6) 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. The CONTROL OK LED will not be illuminated during these alarms (indicated by the red ALARM LED and displayed in the alarm status log):

- **Battery Alarm:** This alarm indicates battery voltage is low or the battery failed an operator-initiated manual test.
- **Memory Test:** This alarm indicates a failed ROM or RAM memory test.
- **No AC Power:** This alarm indicates AC power was unavailable for 10 continuous seconds. This alarm resets when AC power is restored.
- **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.

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 pickup 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.

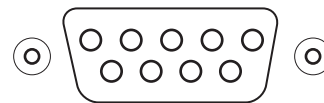
VOLTAGE TRIP: The red indicator LED indicates the voltage exceeds or fails to achieve a certain threshold.

Operating Panel

The Operating section includes the following sections:

RS-232 Configuration Data Port

The RS-232 Connector (Figure 7) 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 7.
RS-232 Configuration Data Port.

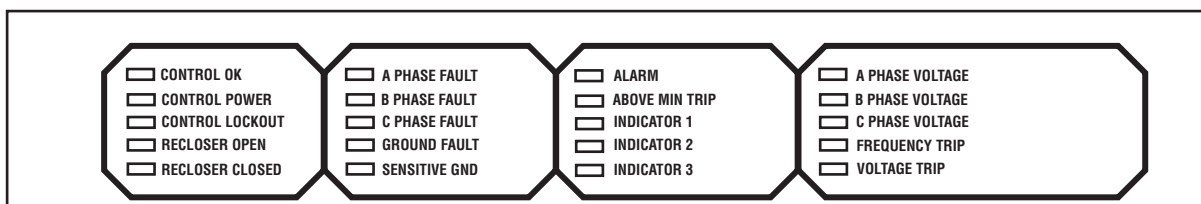


Figure 6.
Status indicator LEDs.

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 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 8. 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 8) 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 8) 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 8) 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.

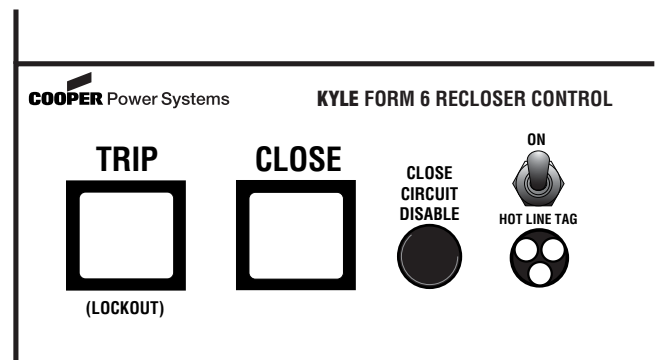


Figure 8. TRIP (Lockout) pushbutton; CLOSE pushbutton; Close Circuit Disable removable fuse; and Hot Line Tag switch and Hot Line Tag red indicator LED.

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 9). 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.

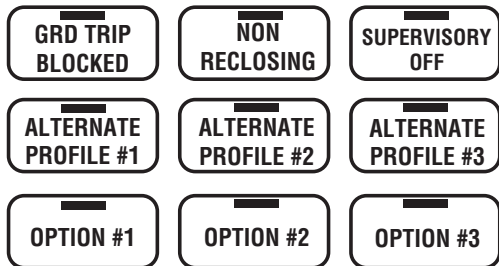


Figure 9.
Operator panel function keys.

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 underfrequency 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 second 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.

Thermostatically Controlled Heater

The control has a standard 15 Watt thermostatically controlled heater (ON 70°F, OFF 85°F) for humidity control and voltage input independent. The heater is powered from the power supply board.

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. Sixteen of these inputs are 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 Remote Trip and Lockout.

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. Filtered and unfiltered data are provided for viewing.

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. Analog oscillography is displayed at 16 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. Refer to **Using Removable Inserts** for more information.

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 / Form6 / Form 6 Inserts.doc

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.

To access the menu function in the user-defined scheme in the Idea Workbench™ drag the desired menu items to create the desired logical functions.

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 and 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 0–90 degrees.

Note: Three potential transformers are required for directional protection on the Form 6 control because it uses zero sequence voltage as a reference.

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 is a permissive system used to qualify any close signal to the mechanism when enabled via the sync check settings. Sync check allows for closing for any combination of dead/live bus/line, and to perform anticipatory closing for a live bus/live line condition by calculating slip and anticipating the mechanism closing delay. In addition to the anticipatory close calculation, the sync check system performs verification of line and bus voltage magnitudes and frequencies to determine that they are within pre-determined ranges, and that the angular difference between the two systems is also within the pre-determined range. For a live/live close, where there is no slip between the systems, the sync check system allows permissive closing after the two systems are within frequency and voltage limits, and the angular difference between the systems has been within the allowable limits for a pre-determined time.

Sync Check functionality includes the following applications: Hot Line/Hot Bus Closing; Dead Line/Hot Bus Closing; Hot Line/Dead Bus Closing; and 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; and 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 10.

Communication Protocols

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

- Modbus
- DNP3
- 2179

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

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

When Modbus, DNP3, 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, 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 pole mount control using both the front panel data port and the appropriate back panel serial communication port (provided the back panel RS-232 port is not configured to be ProView protocol).

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 is easily accessible through the back door of the control cabinet (Figure 11) with readily identifiable serial ports and connections (Figure 10).

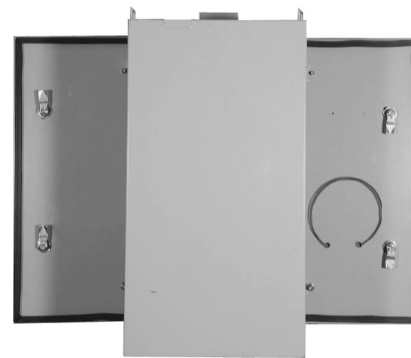


Figure 11.
Form 6 pole mount recloser control cabinet.

030034KM

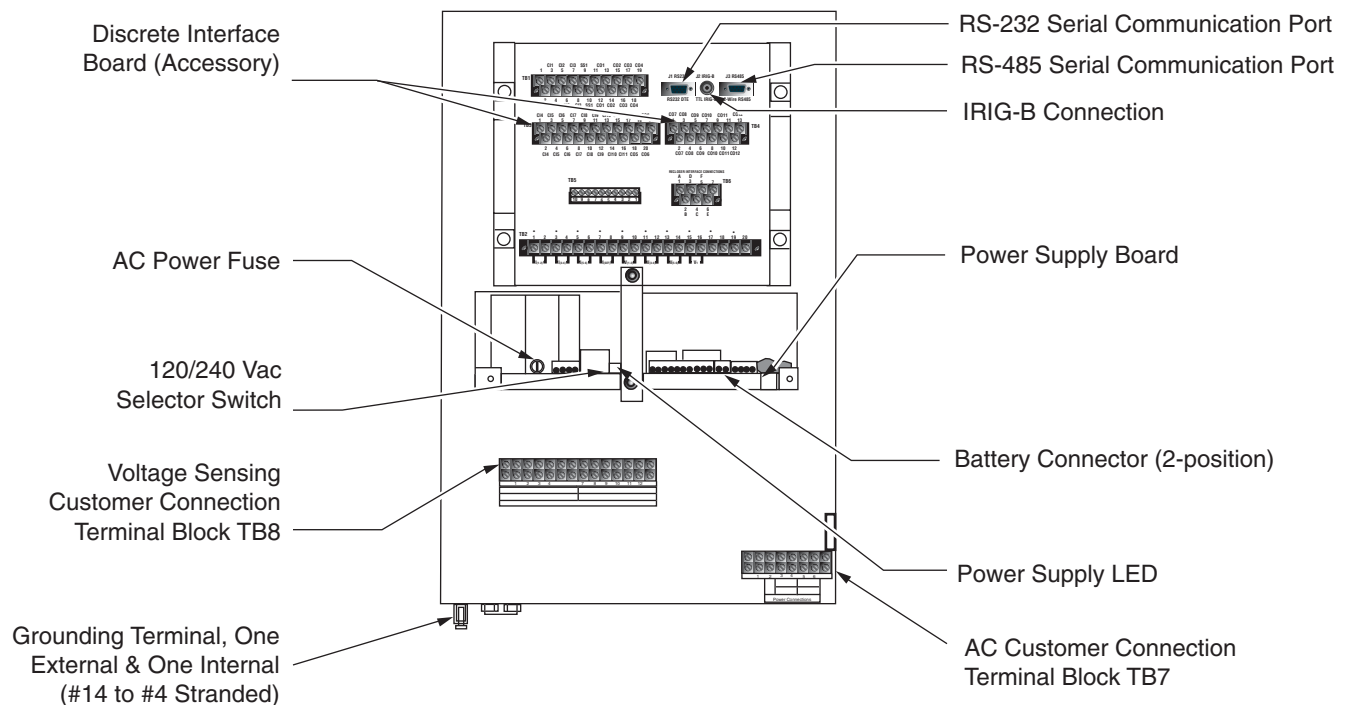


Figure 10.
Form 6 recloser control back panel terminal block and communication port identification.

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

Note: The *Pole Mounted Control* checkbox in the ProView System Configuration screen must be selected for all Form 6 pole mount controls. This includes both pole and substation applications.

Control / Recloser Compatibility

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

WE*, WVE27, WVE38X, VWE, VWVE27, VWVE38X, VSA12, VSA16, VSA20, VSA12B, VSA20A, VS012, VS016, NOVA15, and NOVA27.

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

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 $Current^{1.5} \times \text{Number of Operations for Each Phase}$ (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 WE WE	6,000 12,000 @ 4.8 kV 10,000 @ 14.4 kV	97 257 196
VWE VWVE27 VWVE38X	12,000	1045
WVE27	8,000	140
WVE38X	8,000	140
VSA12 VSA16	12,000 16,000	1045 1608
VSA20 VSA20A VSA20B	20,000	2248
VSO12	12,000	1045
VSO16	16,000	1608
Auxiliary-Powered NOVA	12,500	1111
Control-Powered NOVA	12,500	1111

*Duty Cycle Factor is Value x 10⁵.

TABLE 3
Available Form 6 Control Cable Lengths for Kyle Reclosers

Recloser Type	Gauge	Length (Meters)	Length (Feet)
WE, WVE27, WVE38X, VWE, VWVE27, VWVE38X, Auxiliary-Powered NOVA15, Auxiliary-Powered NOVA27	18	24.4 (maximum)	80 (maximum)
	16	24.7 to 38	81 to 125
	14	38.4 to 61	126 to 200
VSA12, VSA12B, VSA16, VSA20, VSA20A, VSO12, VSO16	18	3.4 to 6	11 to 20
	16	6.4 to 10.7	21 to 35
	14	11 to 15.25	36 to 50
Control-Powered NOVA15, Control-Powered NOVA27	16	3.4 to 38	11 to 125

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

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

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

IMPORTANT: All external 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.

Limits on control cable lengths are determined by the recloser type and the distance between the control and recloser: See Table 3 for available Form 6 recloser control Cable Lengths for Kyle reclosers.

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

Mount the Form 6 recloser control in a convenient, accessible location. Mounting dimensions are provided in Figure 12.

A hole and keyway in the control mounting bracket accommodates a 15.9 mm (5/8") bolt.

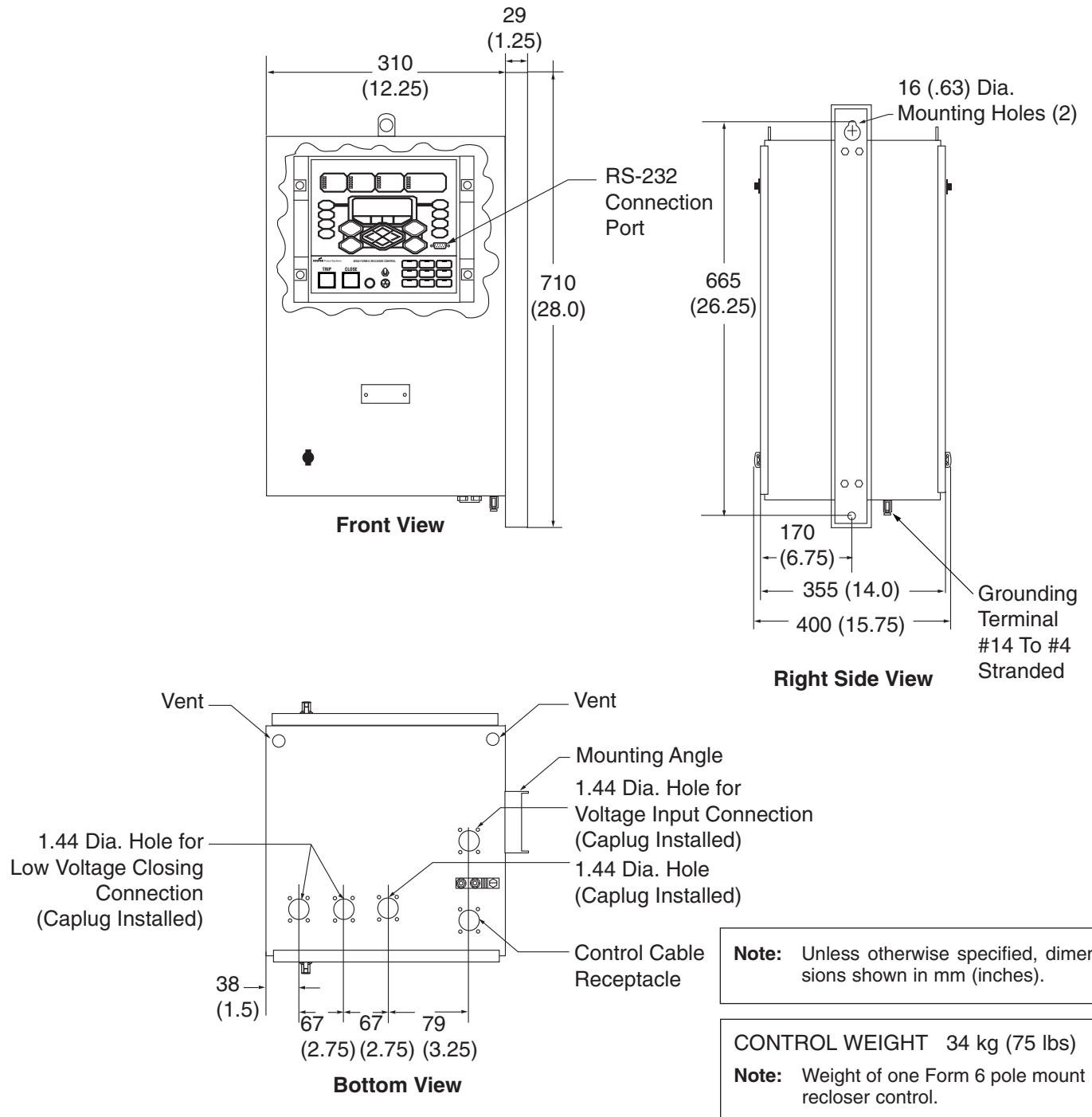



Figure 12.
Form 6 pole mount recloser control weight and dimensions.

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 control cabinet must be grounded. A grounding connector on the underside of the cabinet will accommodate No. 14 solid through No. 4 stranded conductors.

Suggested methods for grounding the control and recloser are shown in Figures 13 and 14.

Figure 13 illustrates grounding methods for 4-wire multi-grounded systems with local supply voltage transformer.

Figure 14 illustrates grounding methods for 4-wire multi-grounded systems with remote supply voltage transformer.

For effective surge protection, all control and power conductors for the Form 6 must be routed parallel to a corresponding ground path. For example, the ac power supply for the control should be parallel to and equal in length to the transformer ground path. The control cable should be parallel to and routed close to the recloser ground path.

Grounding with a Local Supply Voltage Transformer; 4-Wire Multi-Grounded

Installation of a Form 6 recloser control with a local supply voltage transformer must include the following:

- Protection of the recloser bushings and the supplying transformer with lightning arresters.
- Grounding of the recloser head and tank.
- Grounding of the transformer tank.
- Grounding of the control cabinet.
- Grounding of the SCADA equipment.

IMPORTANT: All external 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.

4-Wire Multi-Grounded Systems

IMPORTANT: In pole-mounted applications, a ground connection must be made between the recloser, transformer, recloser control, and SCADA equipment for proper protection of the equipment. The pole ground must be sized per local utility practices to minimize the impedance between the recloser and the control.

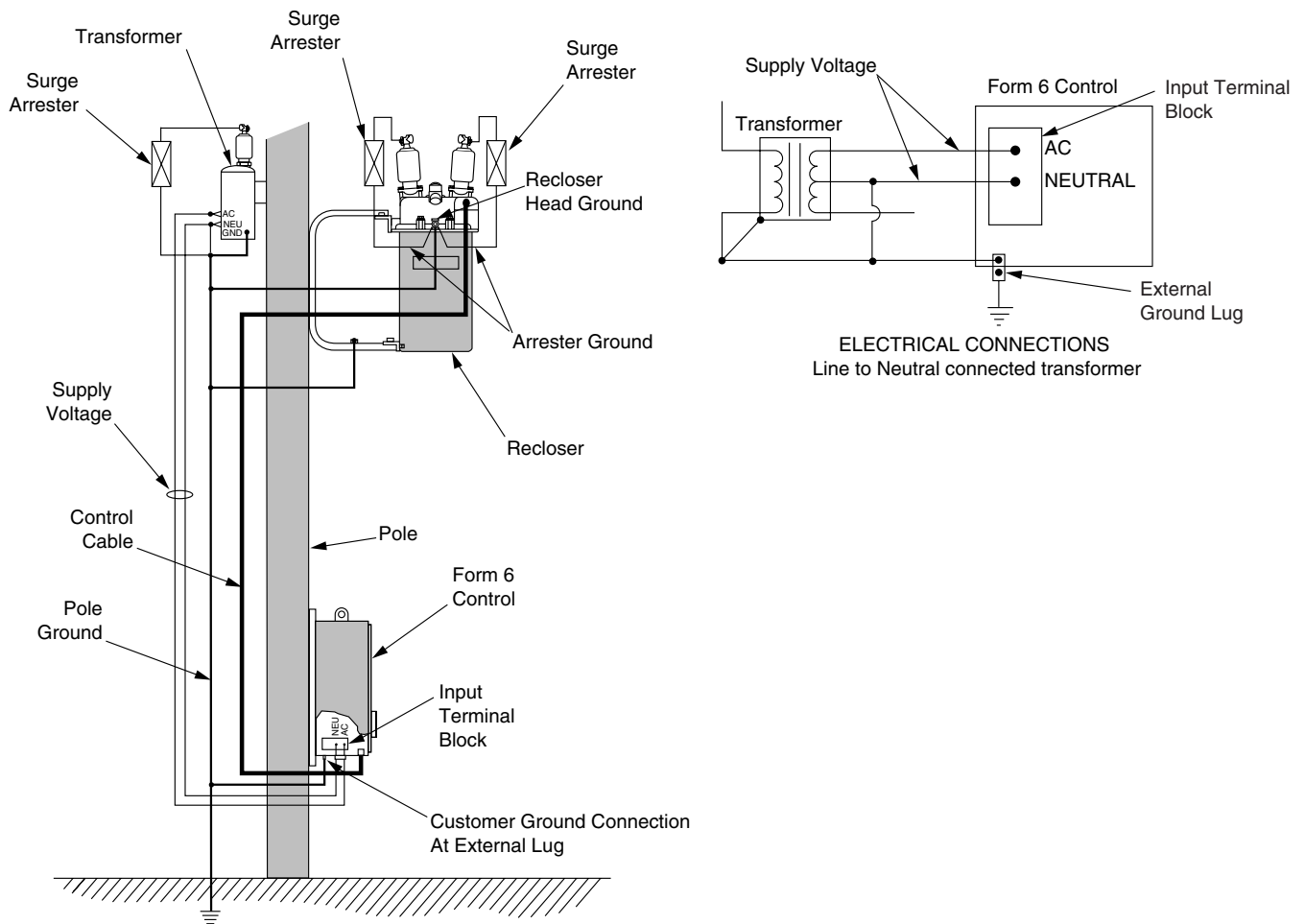


Figure 13. Recommended grounding method for the Form 6 recloser control installed on 4-wire multi-grounded, with local supply voltage transformer.

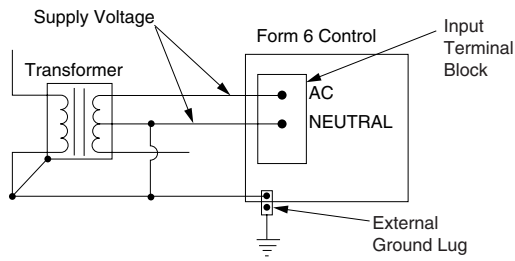
Grounding with a Remote Supply Voltage Transformer; 4-Wire Multi-Grounded

Installation of a Form 6 recloser control with a remote supply voltage transformer must include the following:

- Protection of the recloser bushings and the supplying transformer with lightning arresters.
- Grounding of the recloser head and tank.
- Grounding of the transformer tank.
- Grounding of the control cabinet.
- Grounding of the SCADA equipment.

IMPORTANT: In pole-mounted applications, a ground connection must be made between the recloser, transformer, recloser control, and SCADA equipment for proper protection of the equipment. The pole ground must be sized per local utility practices to minimize the impedance between the recloser and the control.

IMPORTANT: All external 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.



ELECTRICAL CONNECTIONS - Remote dedicated supply transformer

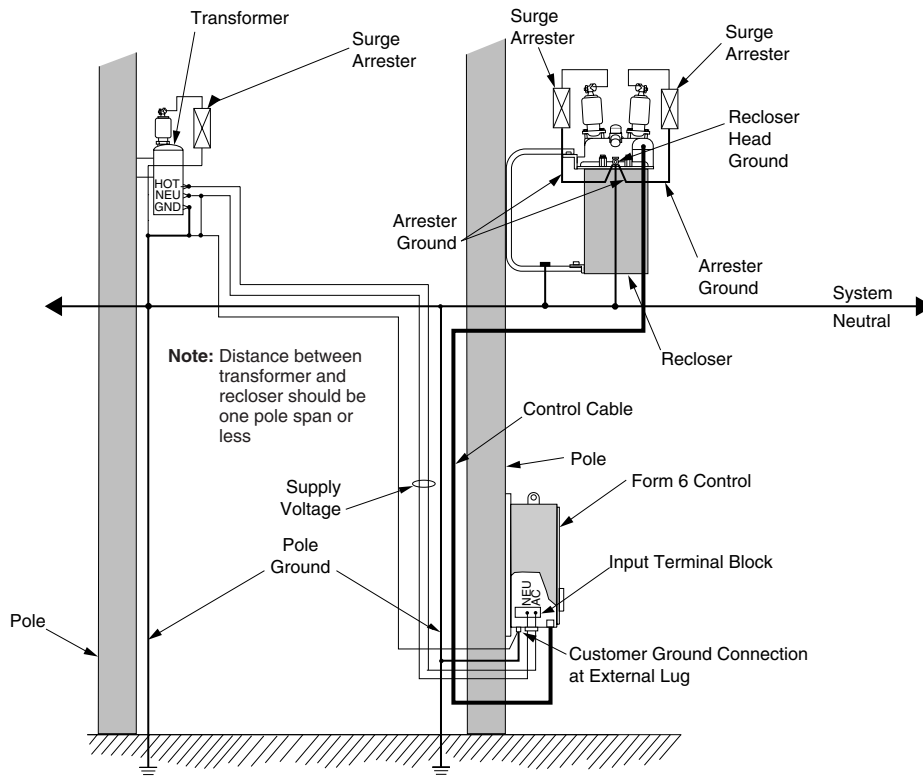


Figure 14. Recommended grounding method for the Form 6 recloser control installed on 4-wire multi-grounded with remote supply voltage transformer.

Customer Connections for AC Power

CAUTION: Equipment damage. Do not drill connection holes into the top of the cabinet. Connection holes in the top of the cabinet will allow moisture to seep into the control and damage the components or cause control misoperation. Failure to comply will void the control's factory warranty. T249.0

Input power to the Form 6 recloser control is connected to terminal block TB7 for single-phase power or TB8 for three-phase power. See Figures 17, 19, and 21. For single-phase incoming voltage supply for 120 Vac or 240 Vac, connect to TB7 as shown in Figure 17. For three-phase incoming voltage supply, the user should supply and connect to TB8 as shown in Figure 19. For 240 Volt, 3-wire transformer connection refer to Figure 21. Refer to **Accessory** section for 120 Vac or 240 Vac low voltage closing.

Input power is required:

- To power the control
- To provide voltage and power metering
- To power the thermostatically controlled heater
- For the low voltage closing accessory
- For the convenience outlet accessory

Power Supply / Battery Charger Board

Incoming ac power is routed to the Power Supply / Battery Charger Board designed to accept either 120 Vac or 240 Vac through a selector switch located directly on the board (Figure 15). The battery charger includes a temperature-compensated design to optimally charge the control battery. The power supply / battery charger board also includes an auxiliary power supply for connection to communication equipment (radios, modems, etc.). The auxiliary power supply is rated 28 Vdc, 65 Watts peak. A separate 28 Vdc to 13.8 Vdc power supply accessory is available for communication equipment rated for 13.8 Vdc. Some additional features are as follows:

- Positive LED indicator for power supply presence.
- Selectable 120/240 Vac switch for adapting to multiple transformer connections. The selector switch is factory-set based upon each customer order.
- Self-protective fuse (5 amp, 250 Vac).
- 28 Vdc whetting voltage for I/O contact inputs.

IMPORTANT: Prior to energizing the control, the selector switch must be set as follows:

- For 120 Vac incoming power, the selector switch must be set to the 115V position.
- For 240 Vac incoming power, the selector switch must be set to the 230V position.

CAUTION: Equipment misoperation. Verify that the 120/240 Vac selector switch is correctly set for incoming voltage. Failure to comply may cause misoperation (unintentional operation) of the control and/or equipment damage resulting in personal injury. T278.0

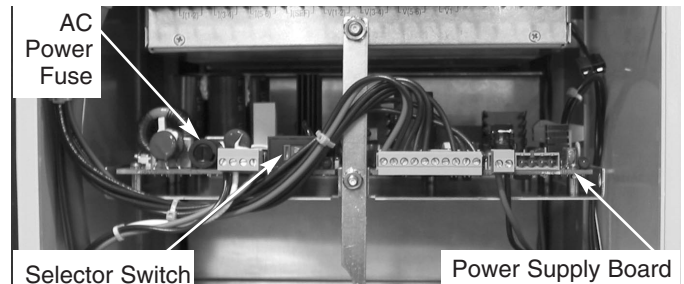


Figure 15.
Power Supply / Battery Charger Board.

030003KM

Terminal Blocks

Two terminal blocks are used for connection to the Form 6 recloser control. Both terminal blocks are fit for a #6 screw which can allow a maximum ring size for a #10 AWG for metering.

Terminal Block TB7 provides power to the Form 6 recloser control and is directly connected to the power supply circuit board. Terminal Block TB8 is used to connect sensing transformer voltage. The wiring of the transformers should follow the application illustrations per Figures 18, 19, 20, and 21.

Default factory wiring includes connection of two wires from Power Supply Terminal Block TB7 to the Metering Terminal Block TB8. See Figure 16.

Figure 20 shows customer connections for TB8, 120 Vac Delta Connection.

The wiring from TB7-3 to TB8-3 and from TB7-5 to TB8-4 connects the metering B phase to the control. If the incoming power supply voltage is different, the B phase power supply input must be moved to the appropriate location. See Figure 18.

For A phase incoming power, connect to TB8-1.

For C phase incoming power, connect to TB8-5.

Note: Terminal Block positions TB7-3 and TB7-4 are factory-jumpered together.

Note: Terminal Block positions TB7-5 and TB7-6 are factory-jumpered together.

Power Connections

The transformer required for power should be a minimum of 5 kVA for low-voltage ac closing reclosers and 1 kVA for high voltage ac closing reclosers and control-powered NOVA reclosers.

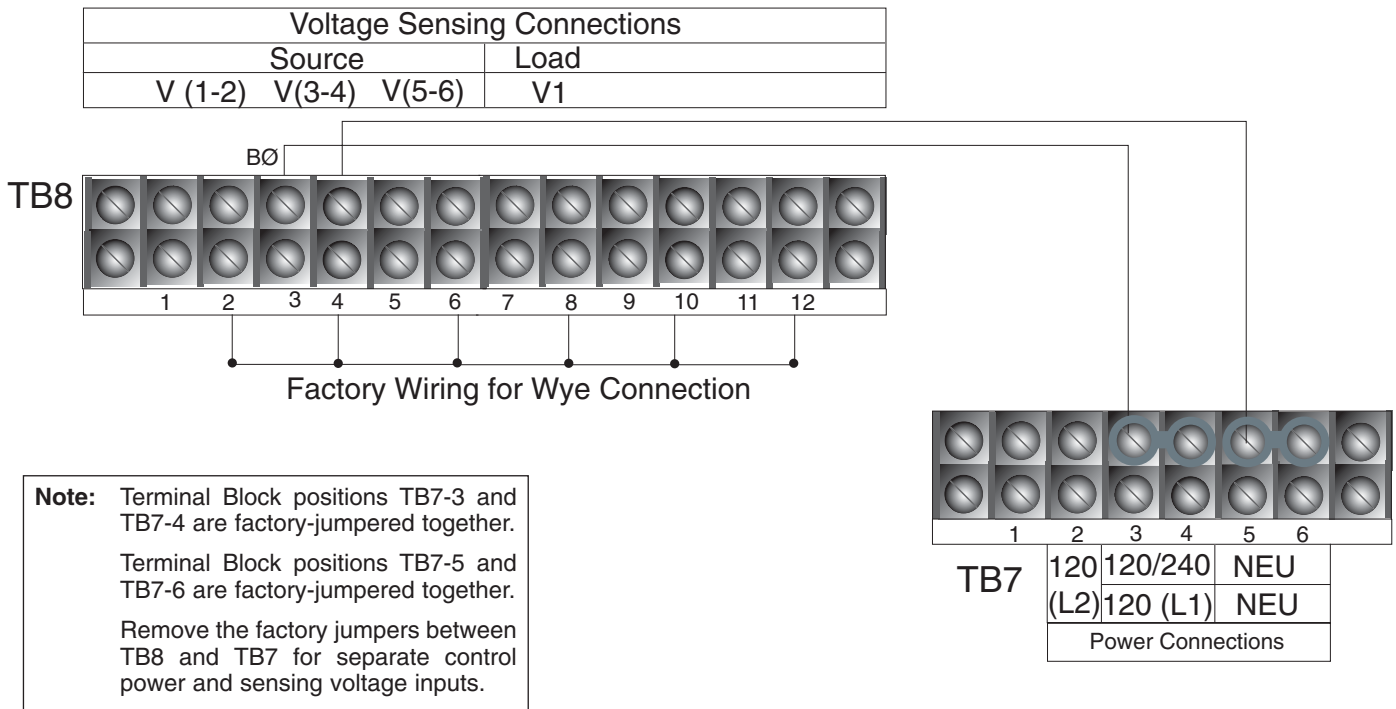


Figure 16.
Default factory wiring connected to B-Phase voltage metering with B-Phase incoming supply.

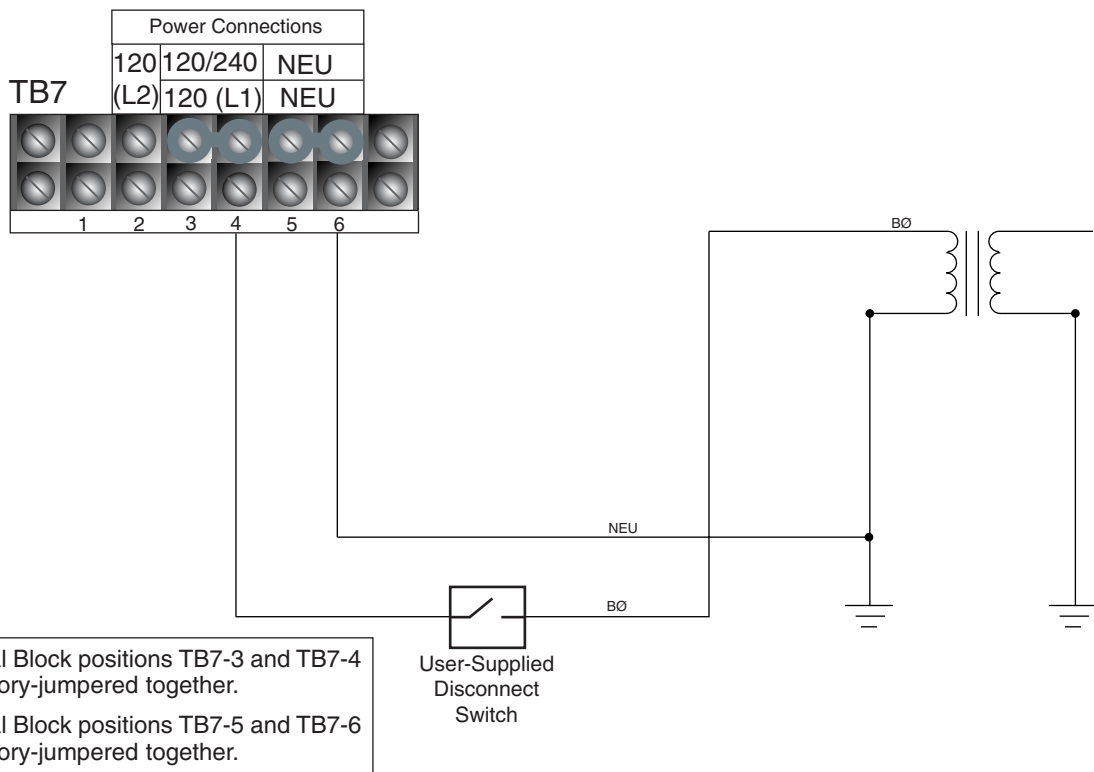
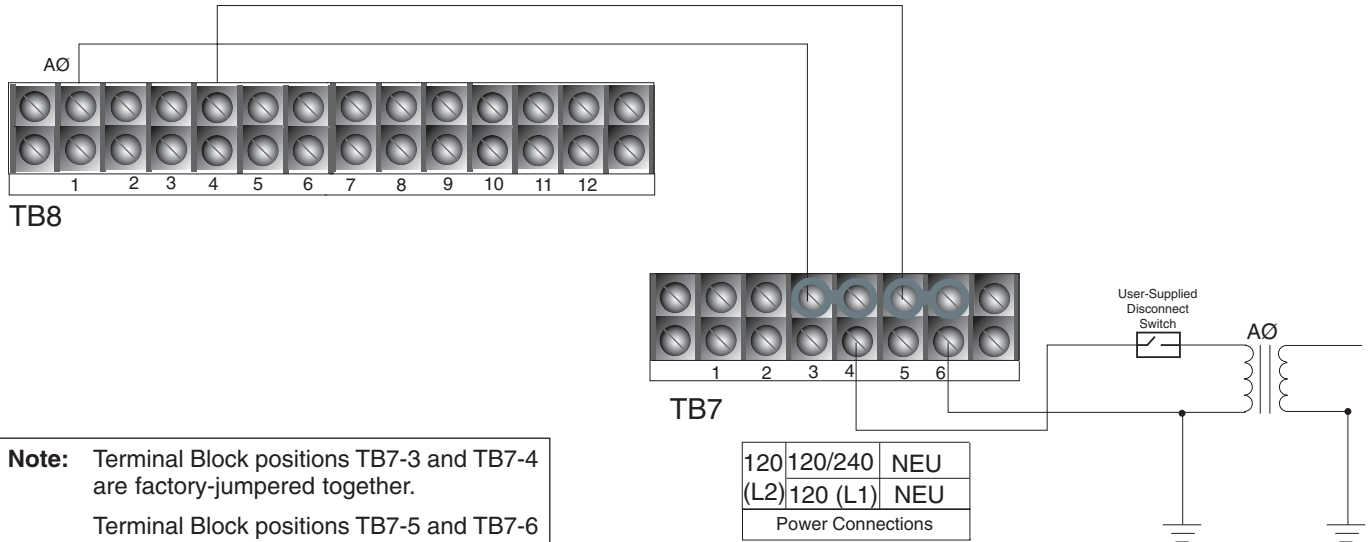


Figure 17.
Single-Phase Transformer Connection, B phase input for Power and Sensing.

Voltage Sensing Connections			
Source		Load	
V (1-2)	V(3-4)	V(5-6)	V1



Note: Terminal Block positions TB7-3 and TB7-4 are factory-jumpered together.
Terminal Block positions TB7-5 and TB7-6 are factory-jumpered together.

Figure 18. Modified wiring connected to A-Phase voltage metering with A-Phase incoming supply.

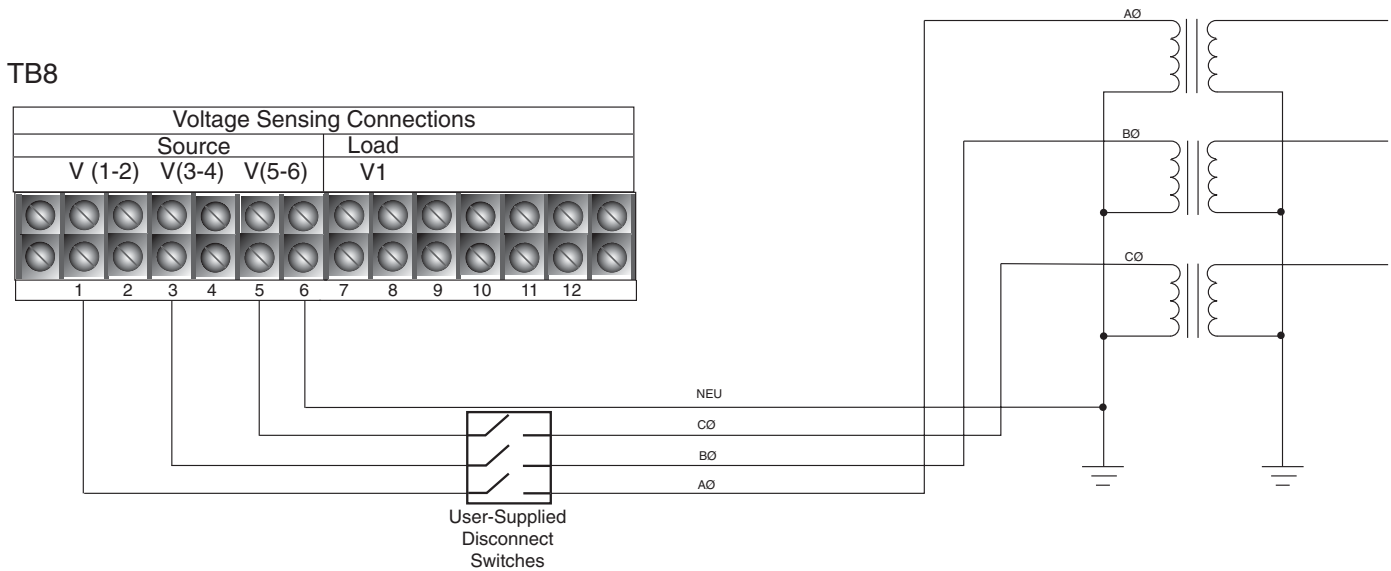


Figure 19. Three-Phase Transformer Connection, Wye configuration only (TB8 Terminal Block Connection).

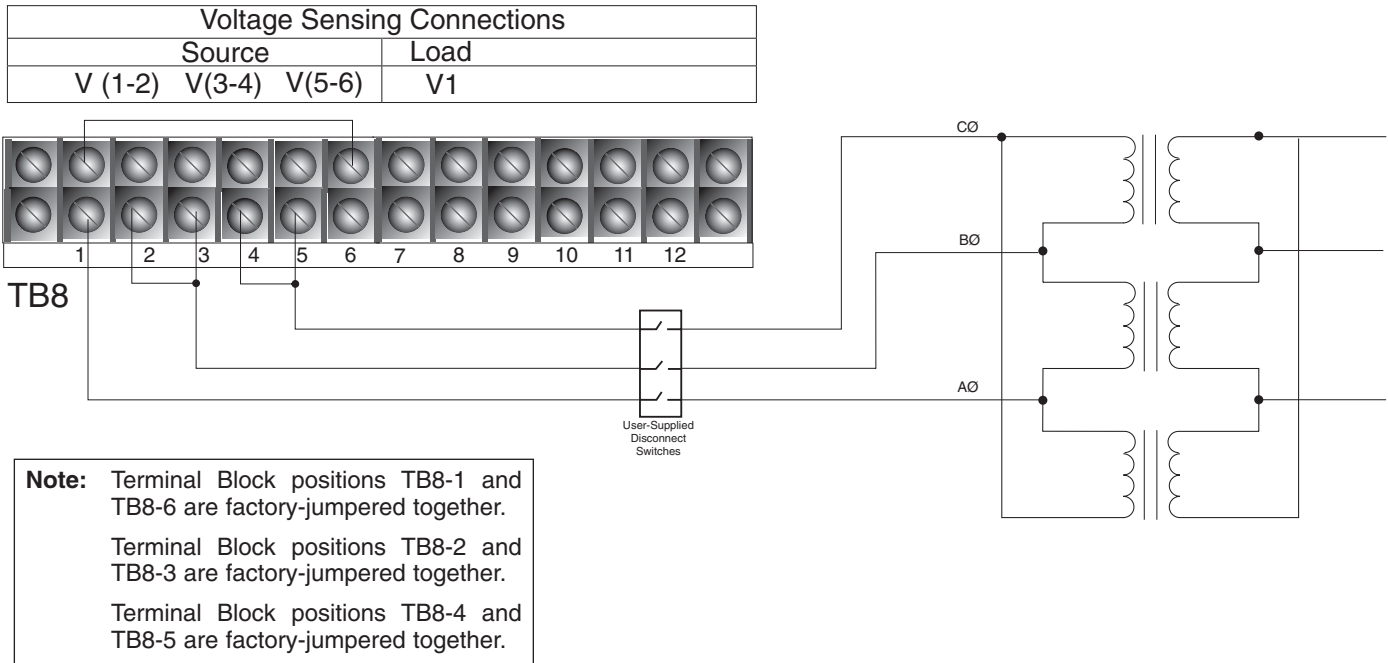


Figure 20.
Customer connections to TB8, 120 Vac Delta Connection.

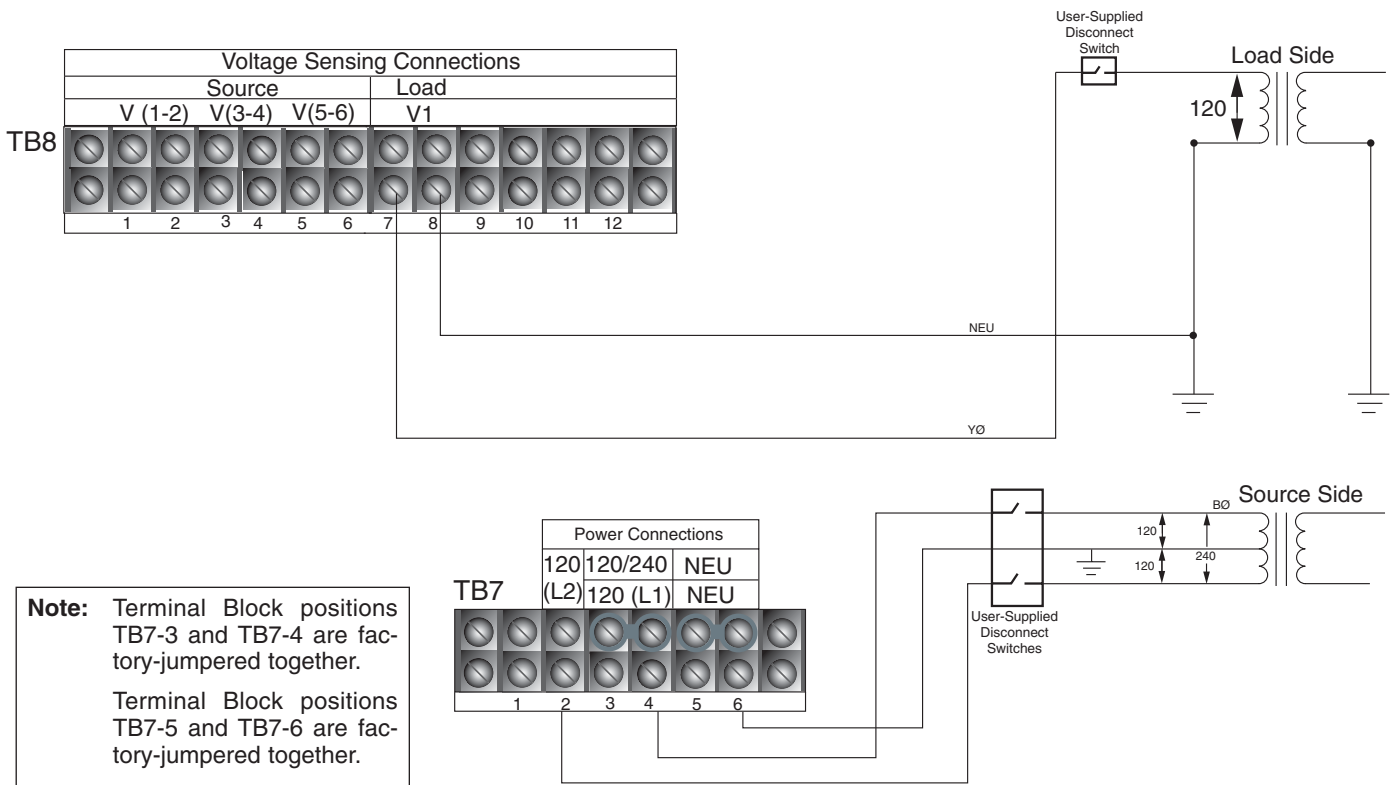


Figure 21.
240 Volt, 3-wire transformer connection. B phase input for Power and Sensing. *YØ for Sync Check Voltage.

Standard Default Supervisory Input Control and Output Status Contacts

Standard customer connections TB1 and accessory customer connections are TB3 and TB4. Refer to Figures 22 and 23 and Tables 4, 5, and 6. The Idea Workbench™ allows customization of all the control and status points. 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 24.

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 4
Operating Current Requirements for Standard and Optional Supervisory Inputs

Module Mfg. No.*	Input Voltage	Nominal Current	Minimum Operating Time
6A00160101 6A00160102 6A00160103 6A00160104	12 Vdc – 48 Vdc	5 mA	5 milliseconds
6A00160105 6A00160106 6A00160107 6A00160108	48 Vdc – 125 Vdc, 120 Vac	5 mA	5 milliseconds

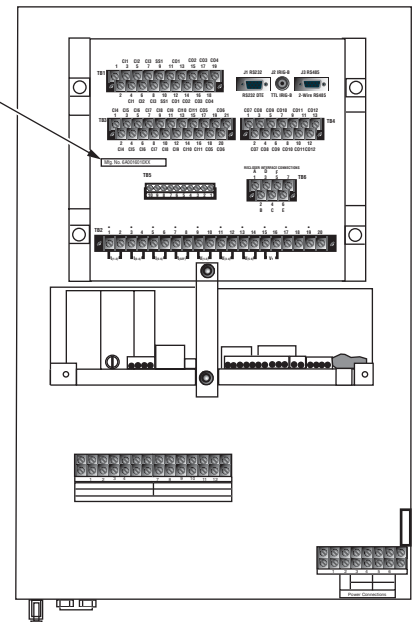
TABLE 5
Ratings Table for Output Status Contacts CO1 through CO12
(Resistive Load – Pickup Time 8 ms, Dropout 15 ms)

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 6
Ratings Table for Output Status Contact SS1
(Resistive Load – Pickup Time 2 ms, Dropout 15 ms)

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

*Location of Module Mfg. No.



Back of Form 6 Pole Mount Control

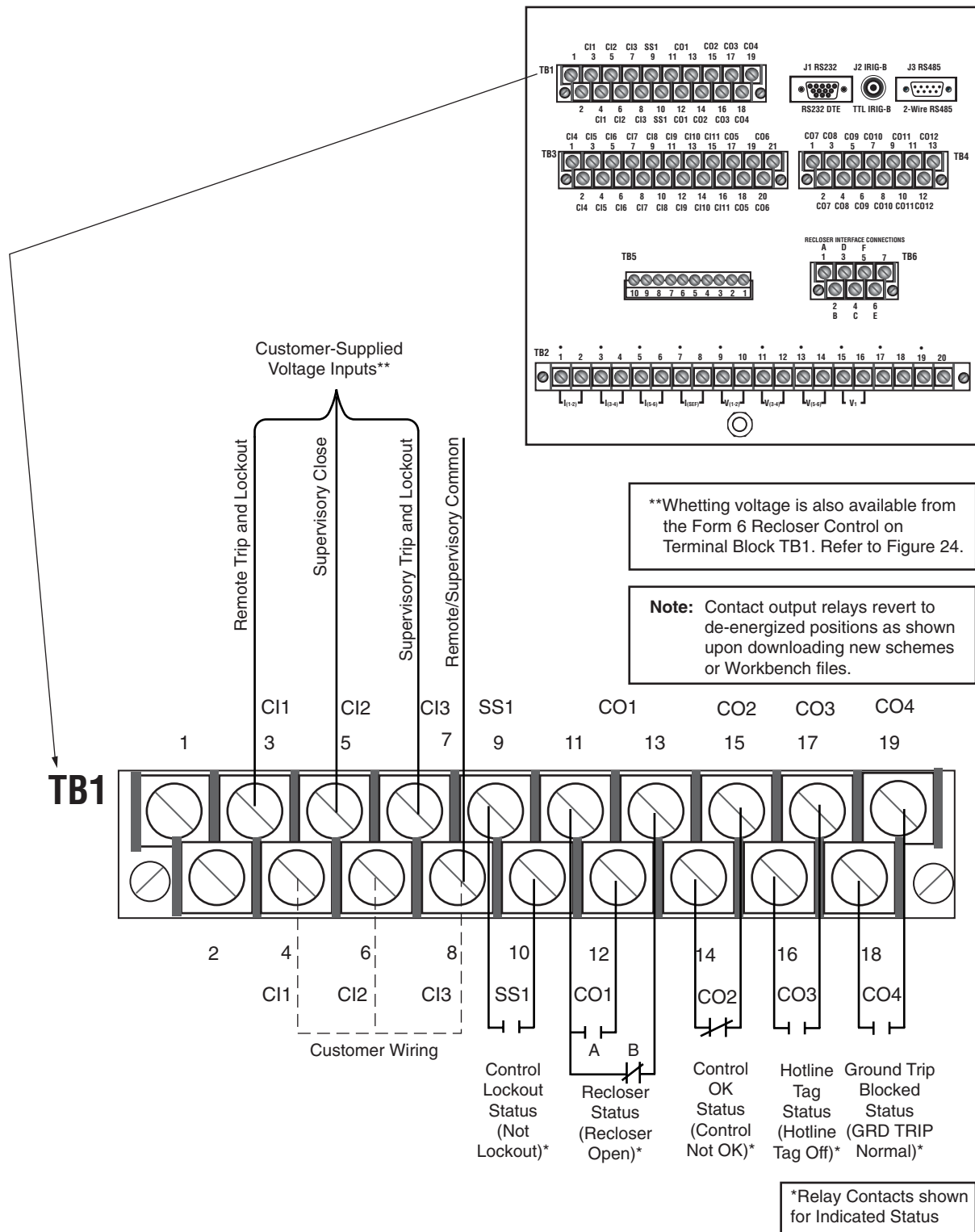


Figure 22.
Form 6 recloser control standard default supervisory input control and output status contacts.

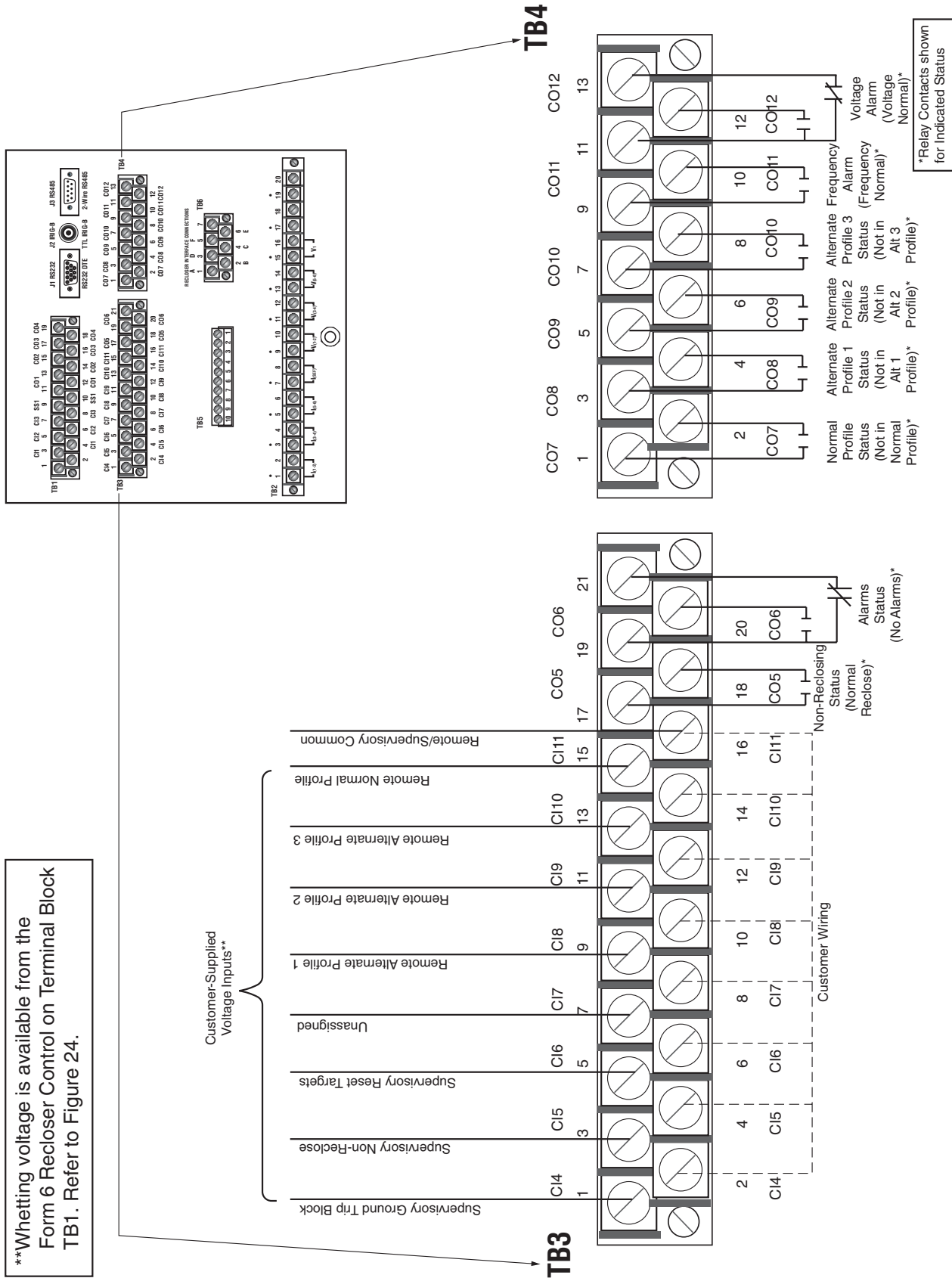


Figure 23.
Form 6 recloser control Discrete Interface Board Accessory default supervisory input control and output status contacts.

FORM 6 RECLOSER CONTROL

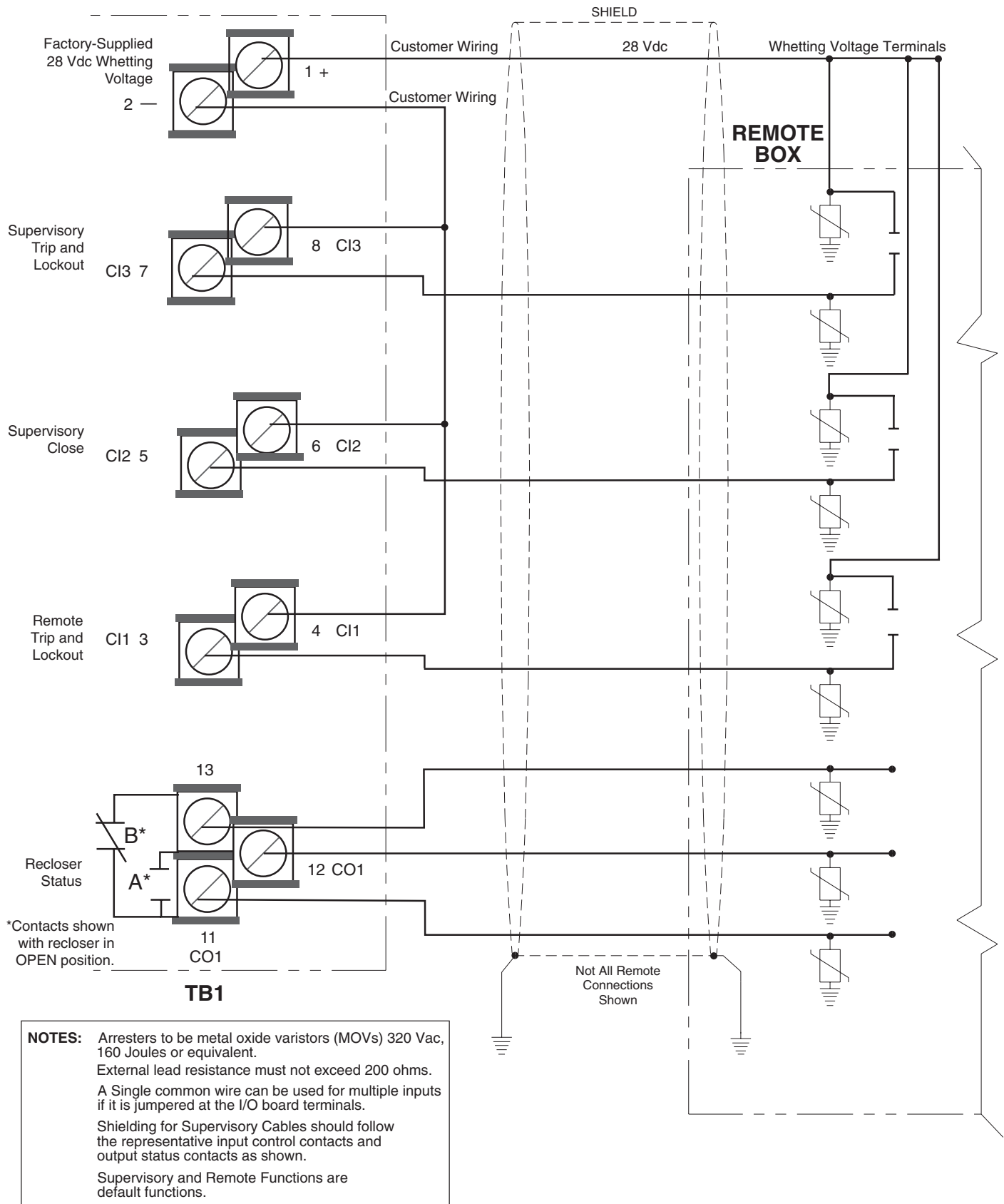


Figure 24. Shielding and Surge Protection for Supervisory and Remote Cables.

Rear Panel Communication Port Pin Assignments

Tables 7 and 8 indicate the pin assignments for the rear panel RS-232 and RS-485 communication ports (Figure 25). Refer to Figures 26 and 27 for pin identification. Refer to **Protocols** for additional information.

TABLE 7
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

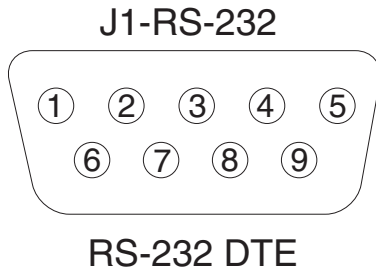


Figure 26.
Rear Panel RS-232 Communication Port Pin Identification.

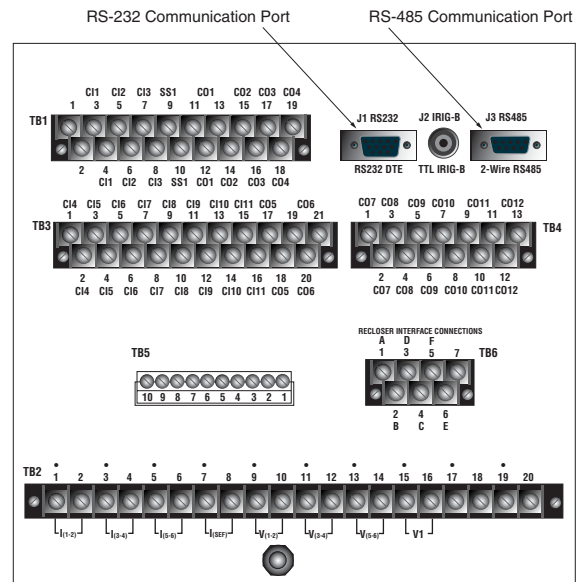


Figure 25.
Form 6 recloser control rear panel RS-232 and RS-485 communication ports.

TABLE 8
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)

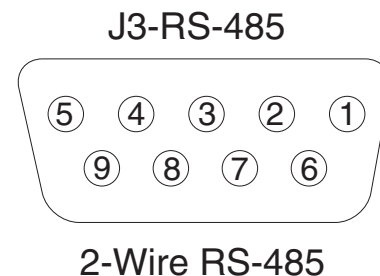



Figure 27.
Rear Panel RS-485 Communication Port Pin Identification.

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:

1. Option Labels 1–3 changed (if applicable) on the operating panel.

Note: Refer to **Using Removable Inserts** in this manual.
2. Control properly mounted for the installation.
3. Recloser installed according to all locally approved standards and practices.
4. AC disconnect switches installed.
5. Control and recloser properly grounded in accordance with guidelines in this manual and the applicable recloser manual.
6. Control cable properly connected and supported.

 **CAUTION:** Equipment misoperation. Verify that the 120/240 Vac selector switch is correctly set for incoming voltage. Failure to comply may cause misoperation (unintentional operation) of the control and/or equipment damage resulting in personal injury.

T278.0

7. Verify the selector switch on the Power Supply/Battery Charger Board is set to the correct position based upon the incoming power supply:
 - For 120 Vac incoming power, the selector switch must be set to the 115V position.
 - For 240 Vac incoming power, the selector switch must be set to the 230V position.

8. Control battery connected and tested for proper operation.

Note: The battery test is blocked for 60 seconds upon power-up of the control.

Test the battery as follows:

- A. Press the MENU button on the front panel.
- B. Using the down arrow key, navigate to the BATTERY menu and press ENTER.
- C. Using the down arrow key, navigate to the TEST BATTERY menu and press ENTER.
- D. Press the F4 button to test the battery.

Note: This message will appear on the programming panel LCD display: ---TESTING---

The battery test results will display in the battery metering menu.

Note: With AC disconnected and the battery supplying the load, current will read -400 to -600 mA depending on accessories connected.

9. AC power connected to the control. (Control OK LED indicator is illuminated.)

Note: The control Power Save feature will turn off the backlit LCD display and all LEDs if no front panel keypad is pressed within five minutes.

10. 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.

11. Control clock set to the correct time.

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

12. Customer connections for remote and supervisory operation checked and completed in accordance with proper shielding and surge protection.

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), 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 28).

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

Note: It is not necessary to disconnect any wires.

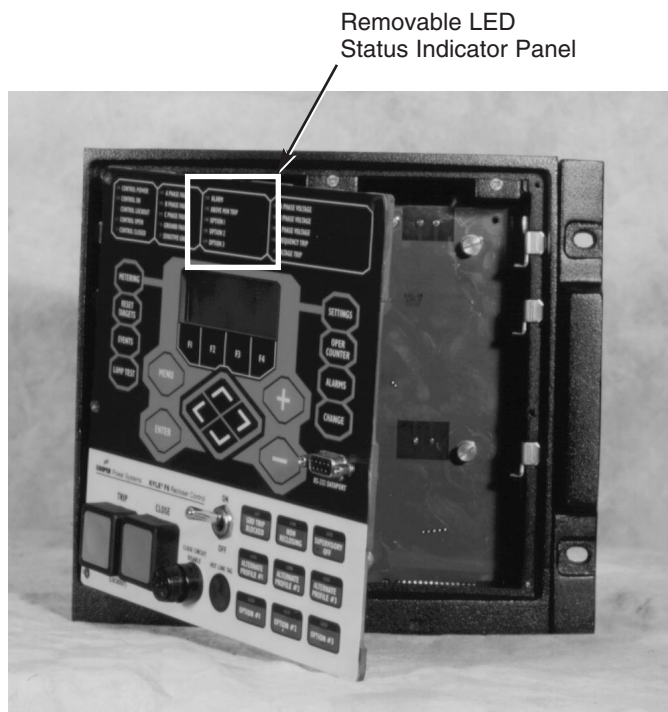


Figure 28. Open front panel. Labels (INDICATOR 1, INDICATOR 2, AND INDICATOR 3) are easily removed from and inserted into the top of the programming panel LED status indicator section. 010063KM

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 29).
 - Note:** The insert will slide out of the top of the programming panel indicator section (Figure 28).
5. Change the existing label or slide in a new label with the name of the programmed 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 29) or down into the programming panel LED indicator section (Figure 28).

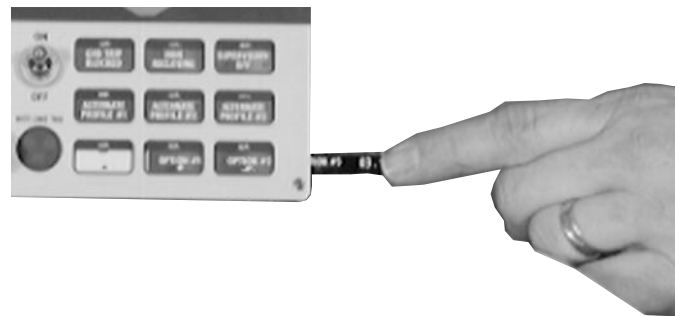


Figure 29. Labels (OPTION 1, OPTION 2, and OPTION 3) are easily removed from and inserted into the operating panel. 000008KM

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.

Low Voltage Closing

The Low Voltage Closing Accessory utilizes 120 or 240 Vac for closing power (Figures 30, 31, 32, and 33). Multiple low voltage closing accessories are available for reclosers equipped with low voltage closing. The low voltage closing accessories available for the Form 6 recloser control include the appropriate receptacles and wiring

based upon the input supply voltage. Table 9 lists the available low voltage closing input/output receptacles for the Form 6 recloser control.

Incoming Power Receptacles

The Incoming Power Receptacle allows the user to conveniently plug the power cable into the control, eliminating the need for hardwiring to the control. Various options are available based upon the input power voltage, and phase sensing requirements. Table 9 includes the available input receptacles for the Form 6 recloser control.

TABLE 9
Low Voltage Closing and Input Receptacles

Description	Catalog Number
120 Vac low-voltage closing 2-pin input and 2-pin outlet receptacles	KME6-1775-A
120 Vac low-voltage closing with 3-pin input and 2-pin output receptacles	KME6-1775-B
120 Vac low-voltage closing with inlet hole and 2-pin outlet receptacle	KME6-1775-C
240 Vac low-voltage closing with 2-pin input and 2-pin outlet receptacle	KME6-1775-D
240 Vac low-voltage closing with 3-pin input and 2-pin outlet receptacle	KME6-1775-E
240 Vac low voltage closing, for 2-wire with inlet hole and 2-pin output receptacle	KME6-1775-F
240 Vac low-voltage closing, for 3-wire with inlet hole and 2-pin outlet receptacle	KME6-1775-G
120 Vac or 240 Vac input receptacle, 2-pin	KME6-1775-H
120 Vac input receptacle, 3-pin	KME6-1775-J
240 Vac input receptacle, 3-pin	KME6-1775-K

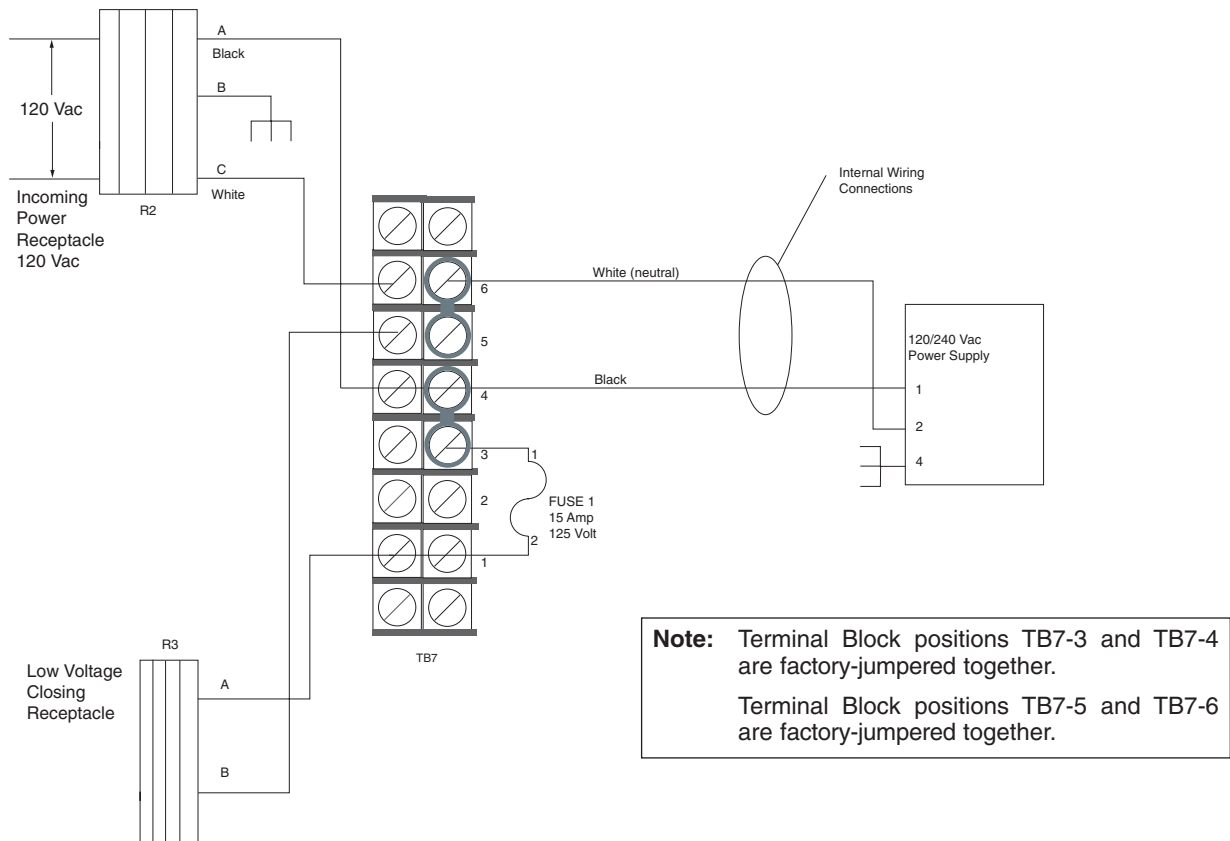


Figure 30.
120 Vac low voltage closing accessory with incoming power terminal block and low voltage closing receptacle.

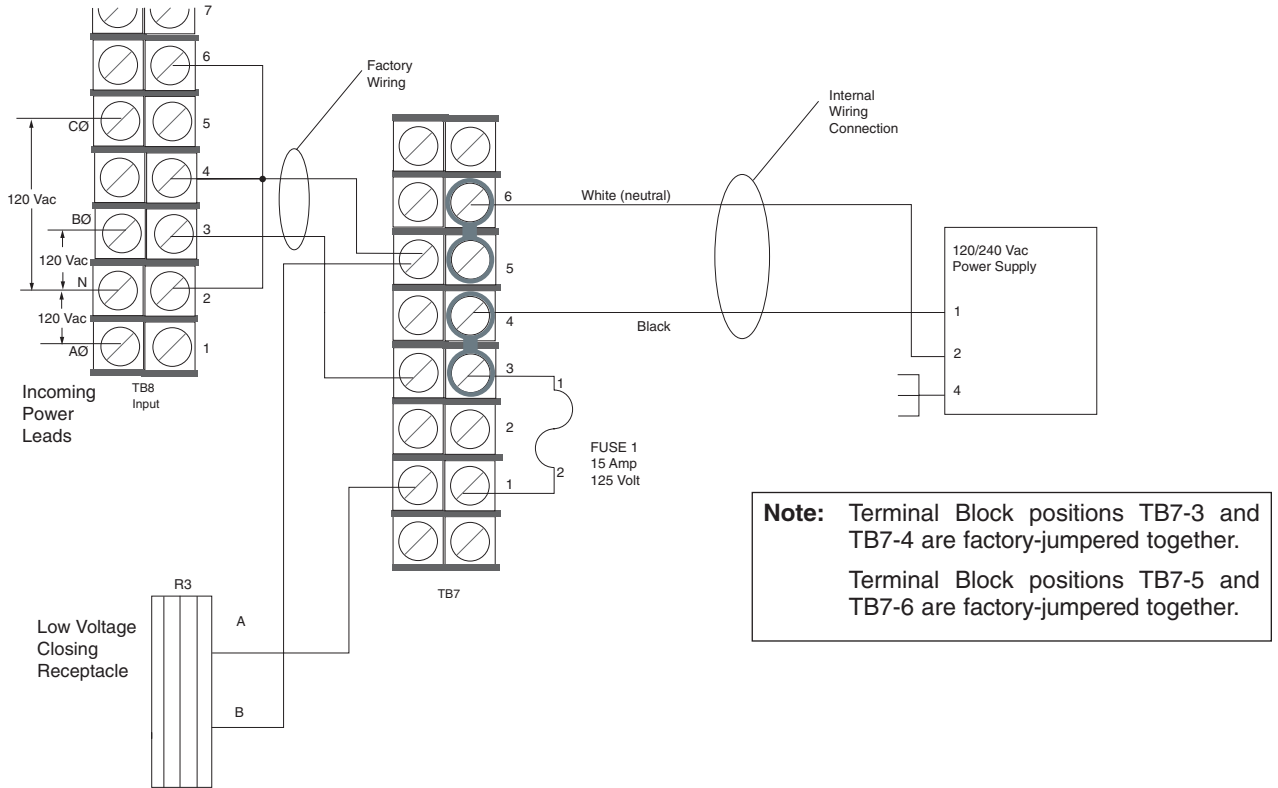


Figure 31. Three-phase 120 Vac low voltage closing accessory with incoming power terminal block and low voltage closing receptacle.

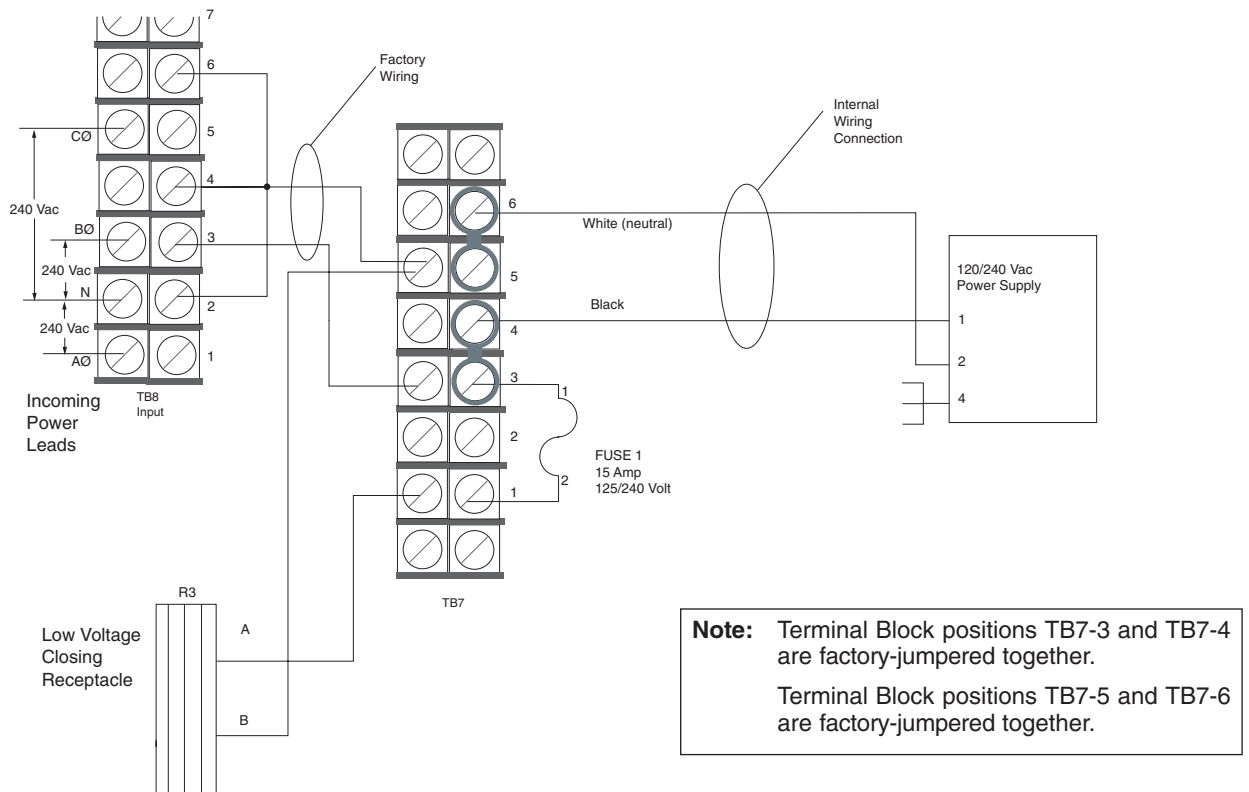


Figure 32. Three-phase 240 Vac low voltage closing accessory with incoming power terminal block and low voltage closing receptacle.

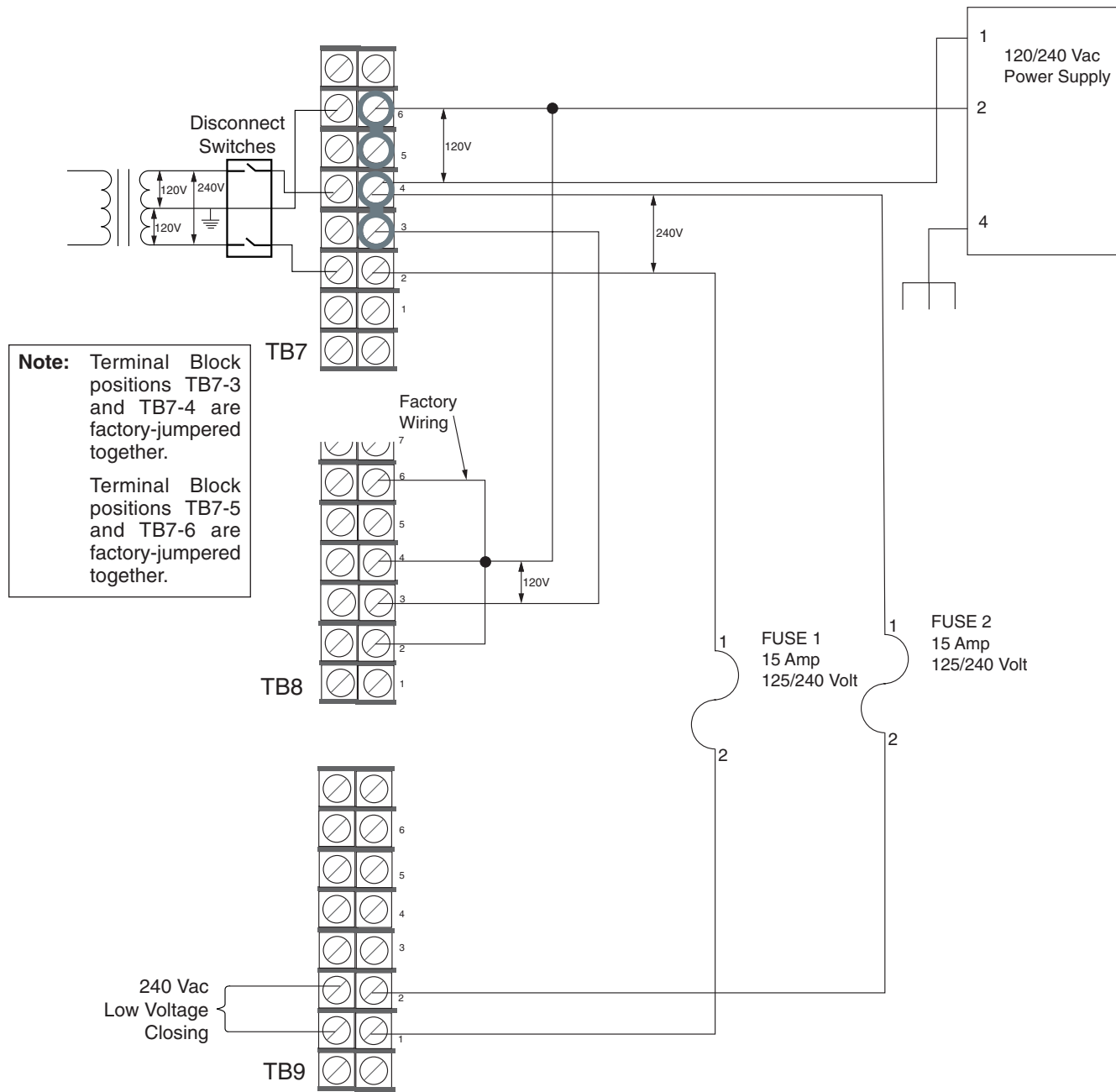


Figure 33.
3-wire 240 Volt transformer connection with 240 ac low voltage closing.

BCT Terminal Blocks Accessory

The BCT Terminal Blocks (Figures 34 and 35) attach to the back of the control and provide a connection point for external 600:5 or 1200:5 multi-ratio bushing current transformers. BCT Terminal Blocks are available for both the load or source sides and include wire for all ratios of the BCT. Refer to Table 10.

Auxiliary Terminal Block Accessory

An auxiliary terminal block and receptacle is available for three-stage auxiliary switch wiring. Refer to Table 10.

TABLE 10
Terminal Blocks

Description	Catalog Number
BCT shorting-type terminal block for (Load) bushings 2, 4, 6	KME6-1773-A
BCT shorting-type terminal block for (Source) bushings 1, 3, 5	KME6-1773-B
Terminal block and receptacle for wiring of three-stage auxiliary switch, KA542R3	KME6-1801-1

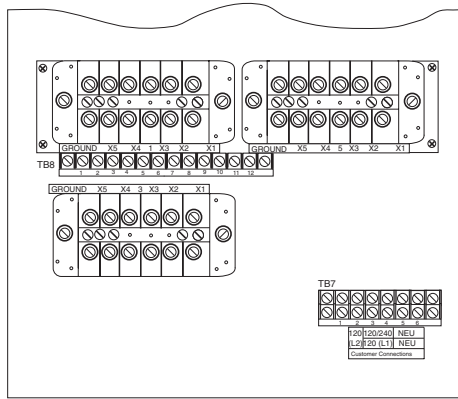


Figure 34.
Form 6 recloser control BCT terminal block accessory – Source Side.

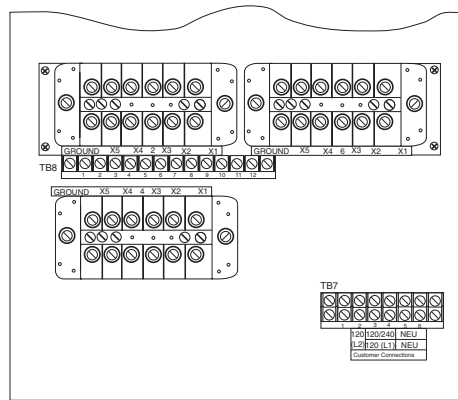


Figure 35.
Form 6 recloser control BCT terminal block accessory – Load Side.

Front Panel with Expanded LEDs

An ordering option for the front panel of the Form 6 pole mount recloser control includes the availability of additional configurable LEDs (Figure 36). 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.

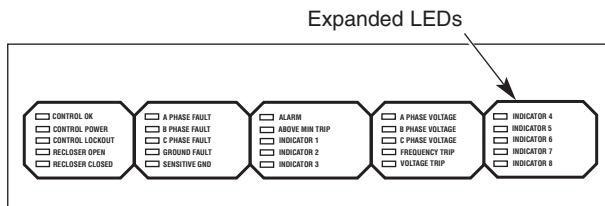


Figure 36.
Expanded status indicator LEDs.

Discrete Interface Board (DIF) Option Accessory

A Discrete Interface Board Option accessory provides eight configurable input control contacts and eight configurable output status contacts (Figure 37).

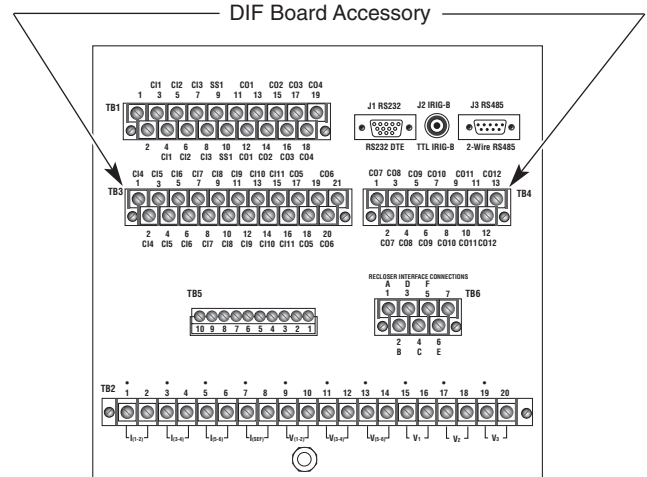


Figure 37.
Form 6 recloser control discrete interface board accessory.

Cable Locking Sleeves

To prevent detachment of the control cable from the control cabinet by unauthorized personnel, a cable-locking sleeve is available to enclose the cable plug. The plug is passed through the sleeve and the sleeve is then fastened from inside the control cabinet. There is no access to the cable receptacle without opening the locked cabinet door and detaching the sleeve.

120 Vac GFI Duplex Outlet

The GFI Duplex Outlet is available for controls powered by 120 Vac or 240 Vac three-wire supply power. This convenience outlet is rated for 15 Amperes and is accessible through the front door in the control cabinet. The 120 Vac GFI Duplex Outlet is used for many applications such as power for the MET Tester, auxiliary measurement equipment, and supplemental lighting.

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 pole mount recloser control. The front panel RS-232 port is wired as a DCE port for direct connection to the personal computer.

Stainless Steel Cabinet

A cabinet constructed from AISI 304 stainless steel is available as an accessory.

Fiber Optic Interface Accessory

The fiber optic interface accessory, (Figure 38), Catalog Number KME6-1875-1, provides a fiber-optic serial interface for two-way, real-time, serial communications with a remote terminal unit (RTU), telephone modem, or personal computer.

IMPORTANT: The KME6-1875-1 fiber optic accessory kit can not be combined, installed, or used with the KME6-1801-1 auxiliary switch accessory kit.

Radio Mounting Accessory

The radio mounting accessory (Figure 39) is powered from a voltage regulated power supply factory-calibrated with an output of 13.8 Vdc.

Note: This output cannot be field-calibrated.

The radio will continue to operate during the loss of ac power as long as power is supplied from the battery. The power supply is designed to provide up to 40 Watts (peak) and is fused to isolate any potential radio problems without disturbing the protection system in the recloser control. Refer to Table 11.

Contact your Cooper Power Systems representative for any additional voltage requirements.

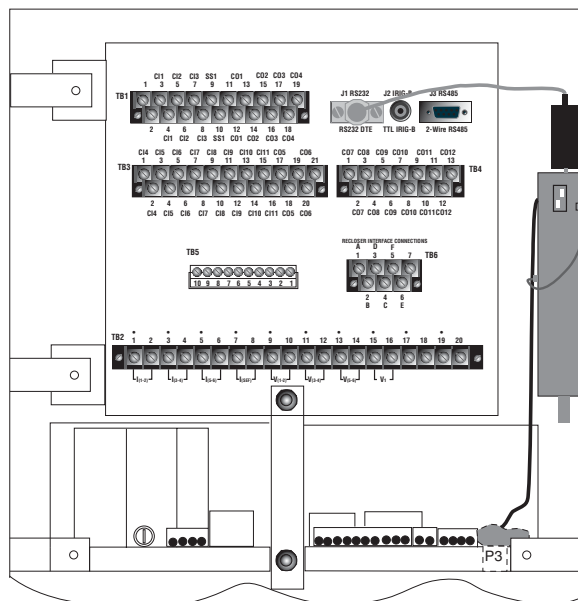


Figure 38.
KME6-1875-1 Form 6 pole mount control fiber optic interface accessory.

TABLE 11
Radio Mounting Accessories

Description	Catalog Number
Full Automation accessory 12 Vdc radio provision	KME6-1774-3
(Radio and fiber-optic/RS232 interface not included)	
Automation accessory (bracket only) 12 Vdc provision	KME6-1774-2

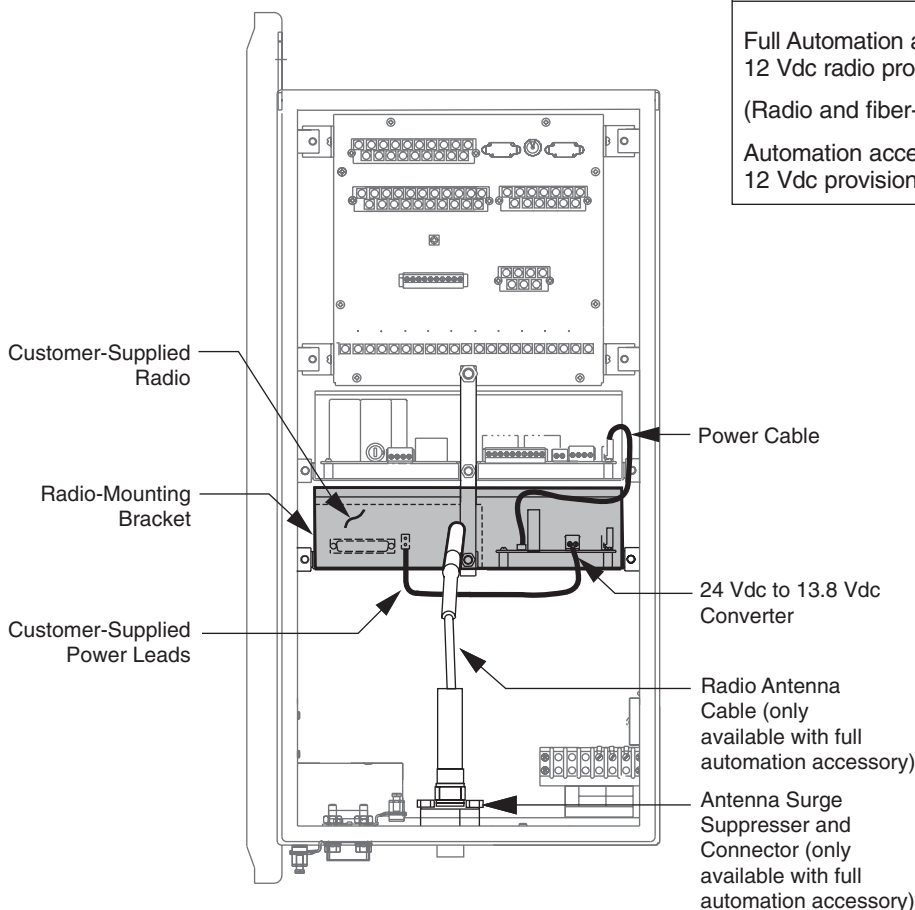


Figure 39.
Form 6 recloser control radio mounting accessory.

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 40).
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 40).

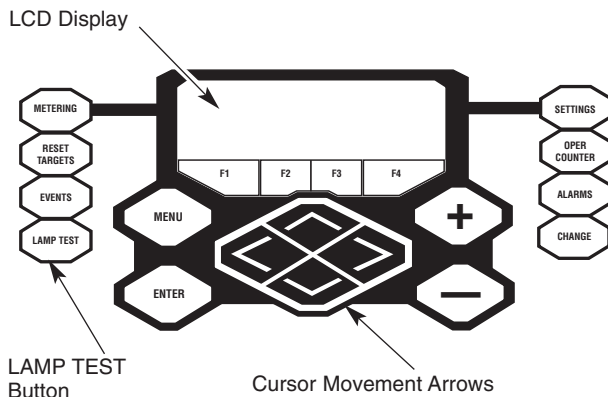


Figure 40. Lamp Test button, LCD display, and cursor movement arrows.

3. Test battery operation as follows:

Note: The battery test is blocked for 60 seconds upon power up of the control.

Note: AC power can be either connected or disconnected for battery test.

- A. Press the MENU button on the front panel.
- B. Using the down arrow key, navigate to the BATTERY menu, and press ENTER.
- C. Using the down arrow key, navigate to the TEST BATTERY menu and press ENTER.
- D. Press the F4 button to test the battery.

Note: This message will appear on the programming panel LCD display: ---TESTING---

The battery test results will display in the battery metering menu.

Note: Voltage should be between 25–31 Vdc – with the higher voltage at colder temperatures.

Under normal conditions, with AC connected and a fully charged battery, the charging current should be less than 20 mA.

With AC connected and a discharged battery, the current range should be 20–450 mA.

With AC disconnected and the battery supplying the load, current will read -400 to -600 mA depending on accessories connected.

4. Verify the Control OK LED is illuminated on the control operator panel (Figure 41). This indicates the presence of ac 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 five 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.

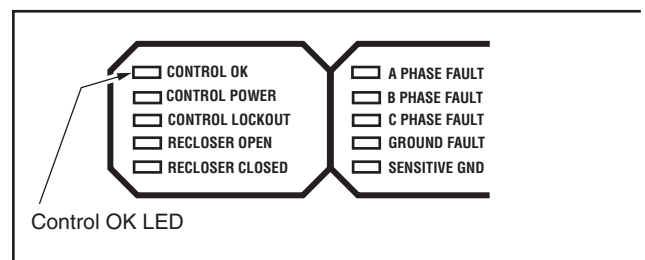


Figure 41. Control OK LED.

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 46). 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 44).

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 46). 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 46. 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 47.

- 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 45.

- 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.

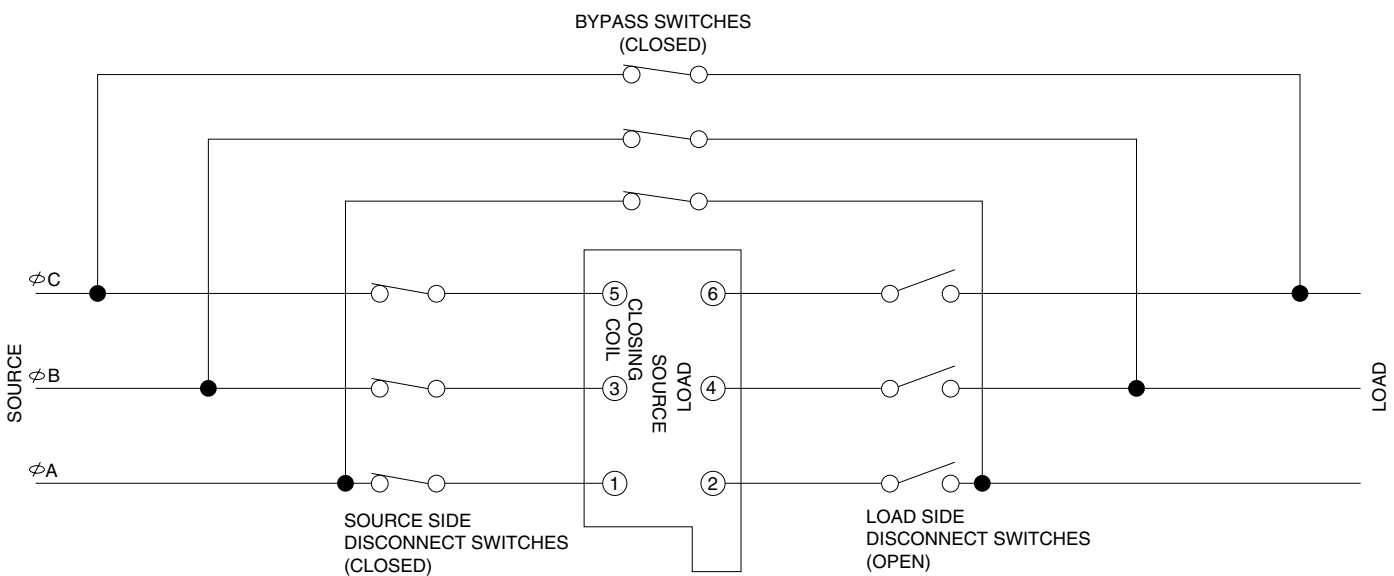


Figure 44. Closing source-side switches of a bypassed “on-line” recloser provides closing solenoid power for automatic operation during testing.

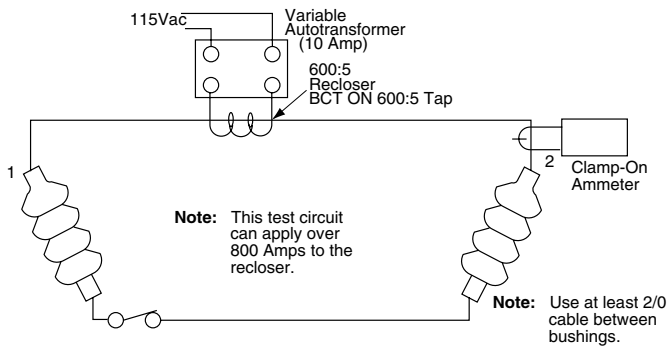


Figure 45.
Alternate method of producing variable line current (substitute for T2 and W-X circuit in Figures 46 and 47).

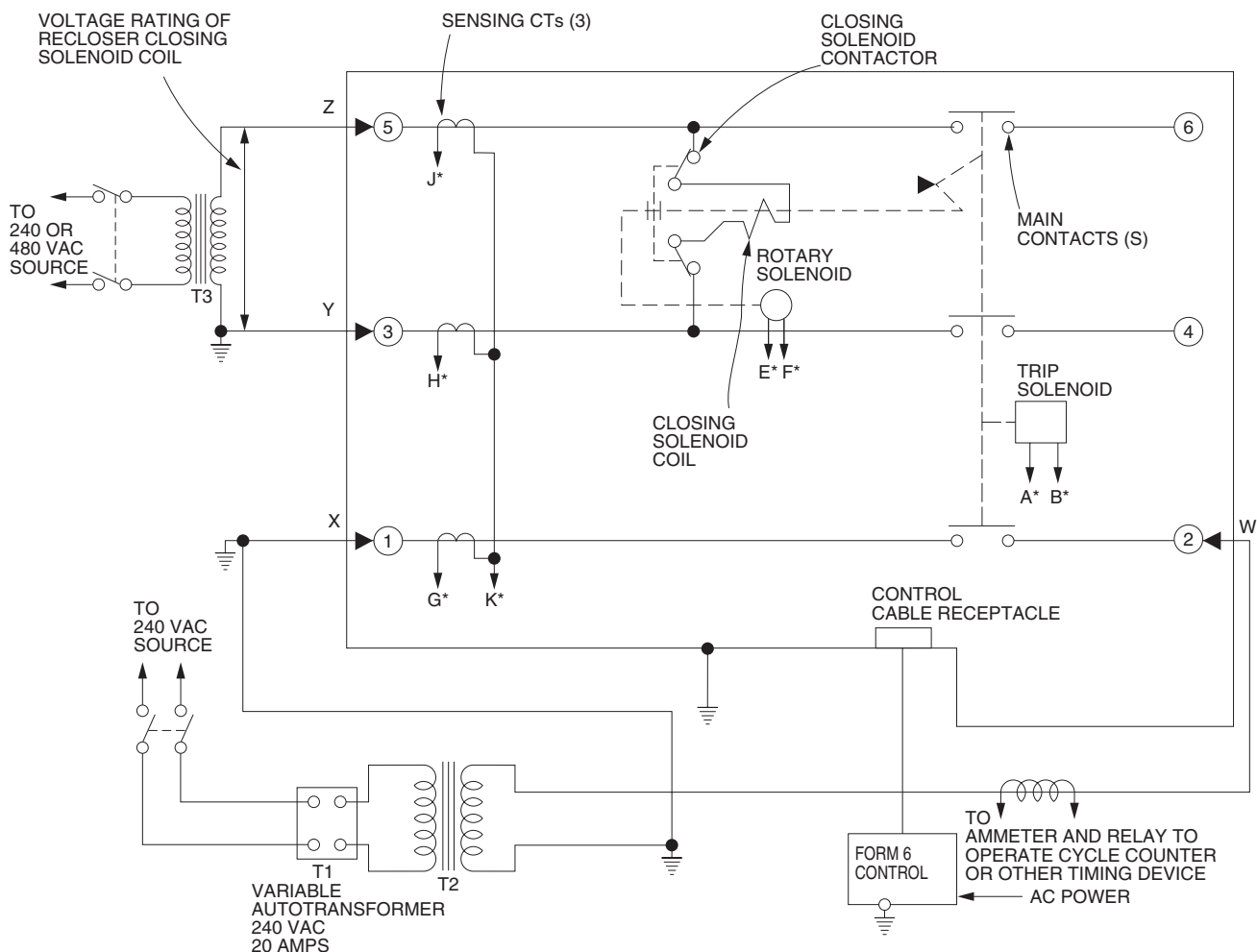
Electrical Closing – Motor-Operated Low Voltage Closing Solenoid / NOVA Reclosers

⚠ 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 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 47 shows a test circuit for motor-operated, low-voltage solenoid-closing, and 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 46.



*Indicates control cable receptacle pin/socket designation.

Figure 46.
Suggested test circuit for high voltage “shop-testing” solenoid-closing reclosers.

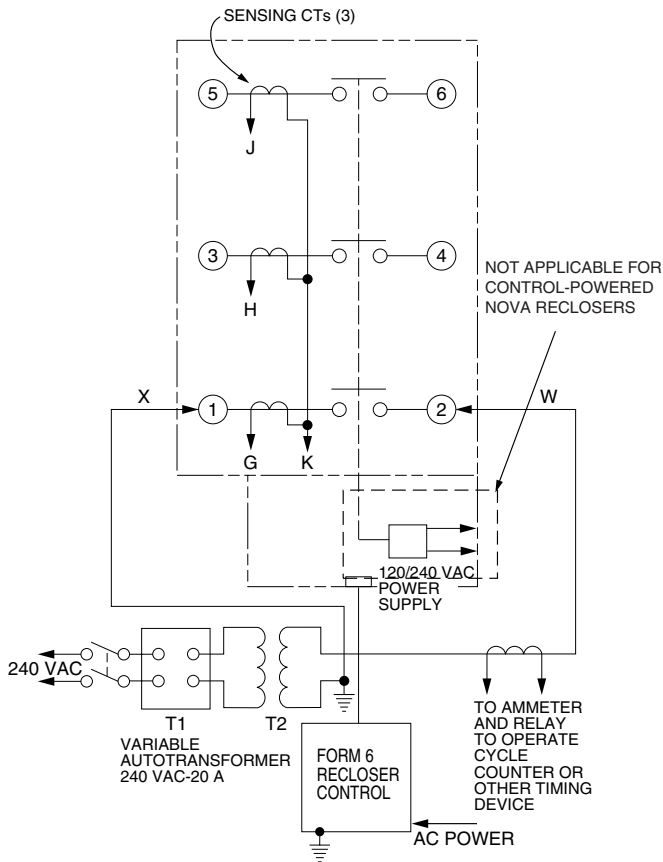


Figure 47.
Suggested test circuit for motor-operated, solenoid-closing reclosers with low-voltage closing.

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 48).
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.
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.

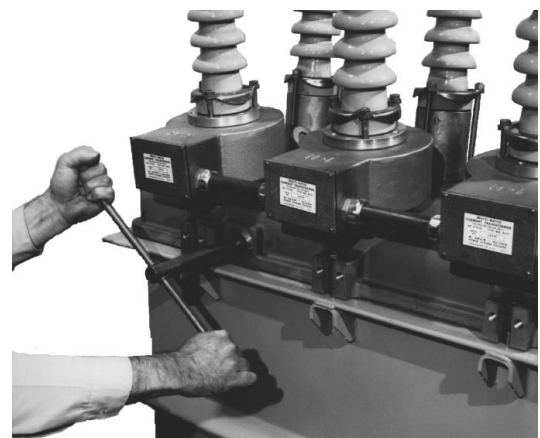


Figure 48.
Using a manual closing tool to operate the recloser. 82284KMA-F

Battery Test and Charging Procedures

Test Procedure for Installed Battery

Follow the procedure below to perform a battery test in the Form 6 control. The values in the test procedures are based on testing at 25°C (77°F).

The condition of the Form 6 control battery can be determined by using the Battery Test function in the BATTERY MENU. No external current/voltage meter is necessary for testing.

Alarm Conditions:

- During a manual battery test a 5Ω, 55 watt resistor is placed across the battery terminals for approximately 5 seconds. The Form 6 control measures the battery voltage, if the voltage drops below 22.8 Vdc for one full second, the ALARM LED (battery alarm) is illuminated.
- When the Form 6 control is disconnected from AC power and the control battery drops below 23.5 Vdc for 60 seconds, the ALARM LED will illuminate. If the battery voltage continues to decay and drops below 22 Vdc, the Form 6 control will shut down.

Note: The battery test is blocked for 60 seconds upon power up of the control.

Note: AC power can be either connected or disconnected for battery test.

1. Press the MENU button on the front panel.
2. Using the down arrow key, navigate to the BATTERY menu and press ENTER.
3. Using the down arrow key, navigate to the TEST BATTERY menu and press ENTER.
4. Press the F4 button to test the battery. The battery test results will display in the battery metering menu.

Note: Voltage should be between 25–31 Vdc with the higher voltage at colder temperatures.

Under normal conditions, with AC connected and a fully charged battery, the charging current should be less than 20 mA.

With AC connected and a discharged battery the current range should be 20–450 mA.

With AC disconnected and the battery supplying the load, current will read -400 to -600 mA depending on connected accessories.

Test Procedure for Uninstalled Battery



CAUTION: Recloser misoperation. The control must be removed from service before disconnecting the control battery. Disconnecting the control battery from an in-service control may cause recloser misoperation (unintentional operation) Failure to comply can result in equipment damage and personal injury.

T213.4

The entire process should be conducted in a clean environment, such as a repair shop.

Refer to Table 12 and follow this procedure to perform a bench test on a control battery in a service shop:

1. Remove the control from service. Refer to **Remove the Control from Service** procedure within the **Testing** section of this manual.
2. Remove the battery from the control and carefully transport it to a suitable service facility.
3. Measure battery voltage.
4. Apply test load and measure battery voltage after 5 seconds of load to determine voltage drop. Refer to Table 12 for Bench Test Load Condition.
5. Remove test load.

If the battery fails the test or is at least four years old, it should be replaced. Refer to Table 12 for battery catalog part numbers.

TABLE 12
Control Battery Bench Testing and Replacement Information

Control Type	Battery	Battery Catalog Part #	Voltage	Type	Amp/ Hour	Bench Test Load Condition for 5 sec.	Acceptable Voltage Drop at End of Test Load
Form 6 Pole Mount (standard capacity)	Hawker Cyclon	KME4-215	24v	Lead Acid	8	5Ω 55 watt	3v or less
Form 6 Pole Mount (high capacity)	Hawker Genesis	KME5-134-1	24v (two 12v batteries)	Lead Acid	13	5Ω 55 watt	2v or less



Battery Charging

If it is not possible to charge the battery with the control's built-in charger, a KA43ME7001 (120 Vac) portable bench type battery charger is available. Refer to *S280-79-14 KA43ME7001 Portable Lead Acid Battery Charger Instructions* for additional information.

IMPORTANT: Do not attempt to charge a lead acid battery below 19 Vdc with the KA43ME7001 charger. Attempting to do so will damage the charger.

If the lead acid battery is below 19 Vdc, replace the battery. The expired battery should be disposed of in an environmentally responsible manner. Consult local regulations for proper battery disposal.

Charge the battery with a KA43ME7001 (120 Vac) portable charger as applicable:

- Form 6 Pole Mount Recloser Control (**Standard Capacity**) – Connect the battery directly to the KA43ME7001 charger. The charger continuously monitors the battery voltage.
- Form 6 Pole Mount Recloser Control (**High Capacity**) – Use adapter KME5-325-1 to connect the two 12 volt batteries to the KA43ME7001 charger.

IMPORTANT: Never connect a single 12 volt battery to the KA43ME7001 charger. Use adapter KME5-325-1 with the battery assembly when connecting the charger to the two 12 volt batteries.

Note: A red LED indicator on the body of the charger illuminates when charging.

The charger senses when the battery voltage reaches 2.27 volts per cell, then the charge rate reduces to maintain a trickle charge.

The red LED flickers to indicate the battery has reached a full charge. This process can take up to 24 hours.

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

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

1. While still in service shop, appropriate personnel must verify that all control settings are correct.
2. Reconnect the ground cable to the control.
3. Control cable properly connected and supported.
4. Plug in the control battery.

Note: The Form 6 recloser control will not power up until ac power is applied.


CAUTION: Equipment misoperation. Verify that the 120/240 Vac selector switch is correctly set for incoming voltage. Failure to comply may cause misoperation (unintentional operation) of the control and/or equipment damage resulting in personal injury. T278.0

5. Verify the selector switch on the Power Supply/Battery Charger Board is set to the correct position based upon the incoming power supply:
 - For 120 Vac incoming power, the selector switch must be set to the 115V position.
 - For 240 Vac incoming power, the selector switch must be set to the 230V position.
6. Apply ac power to the control.
7. 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: Once selected (or after ten seconds), the control returns to normal operation.
8. Verify the control clock is set to the current time after ac power has been reapplied.

Note: The control clock may require resetting if the operating power has been disconnected for more than thirty days. Refer to *Service Information S280-70-4 Kyle Form 6 Microprocessor-Based Recloser Control Programming Guide* for information on setting the control clock.

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 pole mount 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 Maintenance 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.



**COOPER** Power Systems