Reclosers

COOPER Power Systems

Kyle® Form 5 Microprocessor-Based Recloser Control Installation and Operation Instructions

Service Information

S280-79-1

970021KM

Figure 1.
Kyle® Form 5 microprocessor-based recloser controls.

Contents

SAFETY FOR LIFE

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

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

SAFETY INFORMATION

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

A competent technician has these qualifications:

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

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

Hazard Statement Definitions

This manual may contain four types of hazard statements:

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

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

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

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

Safety Instructions

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

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

PRODUCT INFORMATION

Introduction

Service Information S280-79-1 provides installation and operating instructions for the Kyle Form 5 microprocessor-based electronic recloser control.

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 5 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 connector block TB1 located left of the Recloser Interface (RIF) module within the control. Refer to the **Customer Connection for AC Power** section in this manual.

Control Battery Storage and Charging

The batteries are fully charged prior to shipment and ready for use. The batteries must be fully charged before being removed from the control for long term 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 temperature exceeding 47°C (117°F), as damage can result in approximately one month.

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.

The batteries can be kept charged by energizing the control's built-in charger with ac power applied to the user ac supply input connector block TB1, located left of the RIF module within the control cabinet.

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.

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.

Control Power

The primary source of power is factory configured for 120 Vac or 240 Vac. The 240 Vac version is available as an option at time of order entry. Primary power is rectified to charge the power capacitor and to power the dc-to-dc converter that provides power to the control. A minimum of 500 mA of ac current is required for heater operation, battery-charging current, and to keep all modules energized.

AC Reclosers

Power to operate the tripping and closing solenoids in the recloser is provided by the power capacitor located near the lower right corner at the rear of the control. A sealed, 24 V lead-acid battery, consisting of two 12 Vdc, 13 Ah batteries wired in series, is located in the lower portion of the control cabinet and is utilized to provide operating and tripping energy when ac power is temporarily lost. The control is equipped with an ac-powered, temperature-compensated battery charger.

Operation Upon Loss Of AC Power

Upon loss of ac power two 12 Vdc rechargeable batteries, connected in series, will power the control until the battery voltage drops below 20.5 V, at which point the power supply disconnects the battery from the load to prevent battery damage.

The standard control, without external loads and LCDs and LEDs turned off, will maintain full operation from the battery for a minimum of 43 hours at 20°C, or 9 hours at -40°C.

Control programming settings and parameters—including event recorder, duty monitor, and all demand metering parameters—are stored in non-volatile memory and retained upon loss of control power. Collected data from histograms and demand metering are stored in volatile memory and erased upon loss of control power.

The ac-powered LED indicator on the front panel of the control will not illuminate upon loss of ac power.

Initializing the Control

Two methods are available to initialize the Form 5 control.

Method 1: Connect ac power to the input connector terminal TB-1. (See the **Customer Connections for ac power** section of this manual.)

Method 2: Connect the battery terminal on the control and press the MANUAL BATTERY RECONNECT button located on the Form 5 power supply. See Figure 4.

Note: Method 2 powers the control off the battery and is not intended for long term operation.

In both methods, after initialization, set the control clock via the interface software.

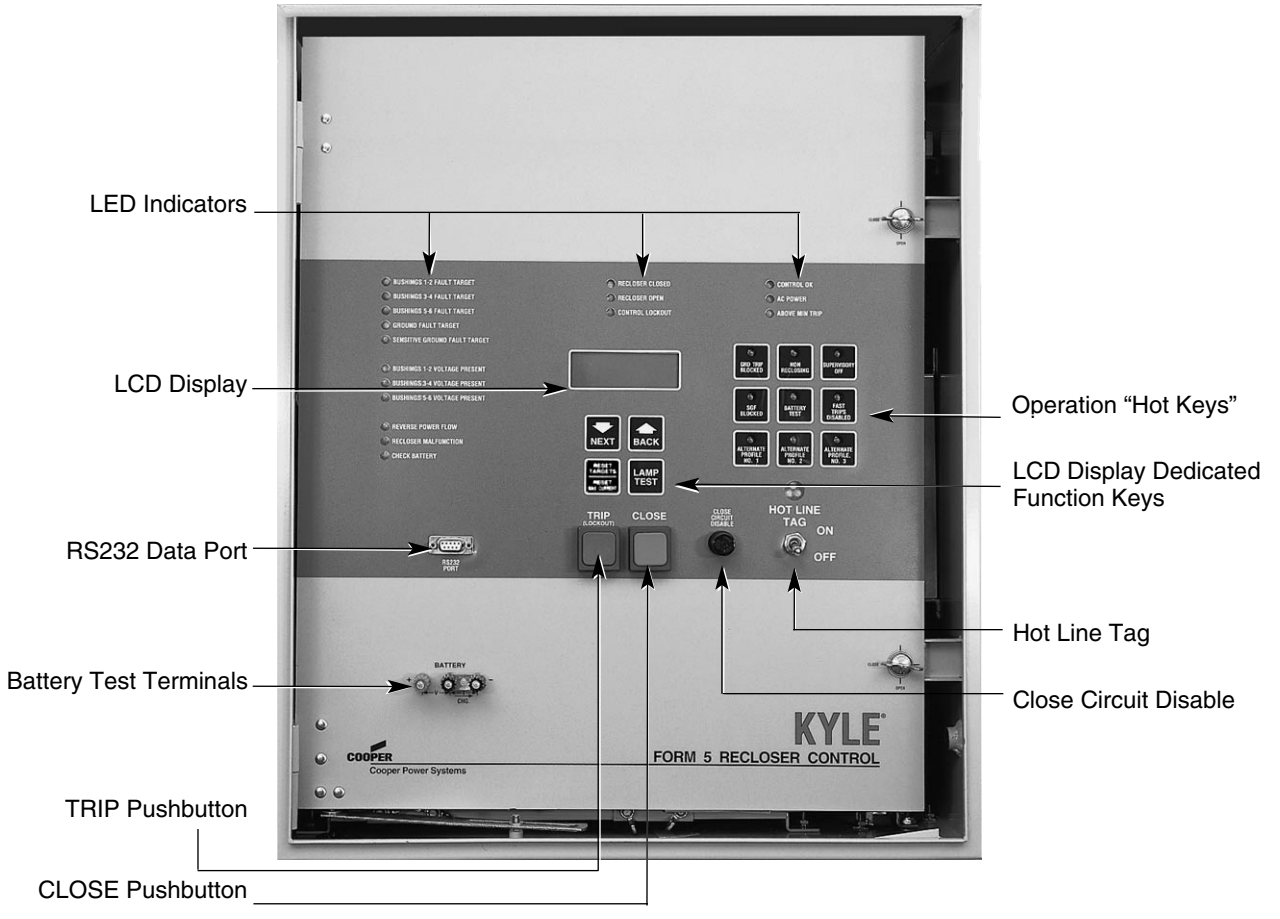

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Figure 2.
Form 5 recloser control front panel.

FORM 5 CONTROL DESCRIPTION

Current sensing is provided by three current transformers located in the recloser housing and interfaced to the Form 5 control via the control cable. This cable also supplies Trip, Close, and Recloser status and connects to the RIF module to provide isolation for reliable operation. Voltages for metering and control power are also connected to the RIF module via the connector terminal block, TB-1 (Figure 3).

A functional block diagram of the Form 5 control is shown in Figure 3. 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 32 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/over voltage, and under/over frequency 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. For metering, the fundamental and harmonic current and voltages are determined.

When the phase or ground current exceeds its programmed minimum-trip value and associated time–current curve (TCC) timing, the control initiates the programmed sequence of recloser tripping and reclosing operations via the CPU and RIF modules. If the fault is temporary, the control ceases to command recloser operations after a successful reclosure, and the control resets to the start of its operating sequence after a preset time delay. If the fault is permanent, the control performs its complete programmed sequence of recloser commands and locks out with the recloser open. Once locked out, the control must be closed via the front 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:

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 battery and capacitor 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 tripping and reclosing sequence is repeated.
6. The control begins the reset-delay timer if the overcurrent is cleared before the operating sequence reaches lockout indicated by a closed recloser and current below minimum trip.
7. When the reset-delay times out, the control is reset to the home state and is ready for another programmed operating sequence. If current rises above minimum trip prior to the reset-delay timing out, the timer is halted and the control resumes the operating sequence while the accumulated reset-delay timing is reset.

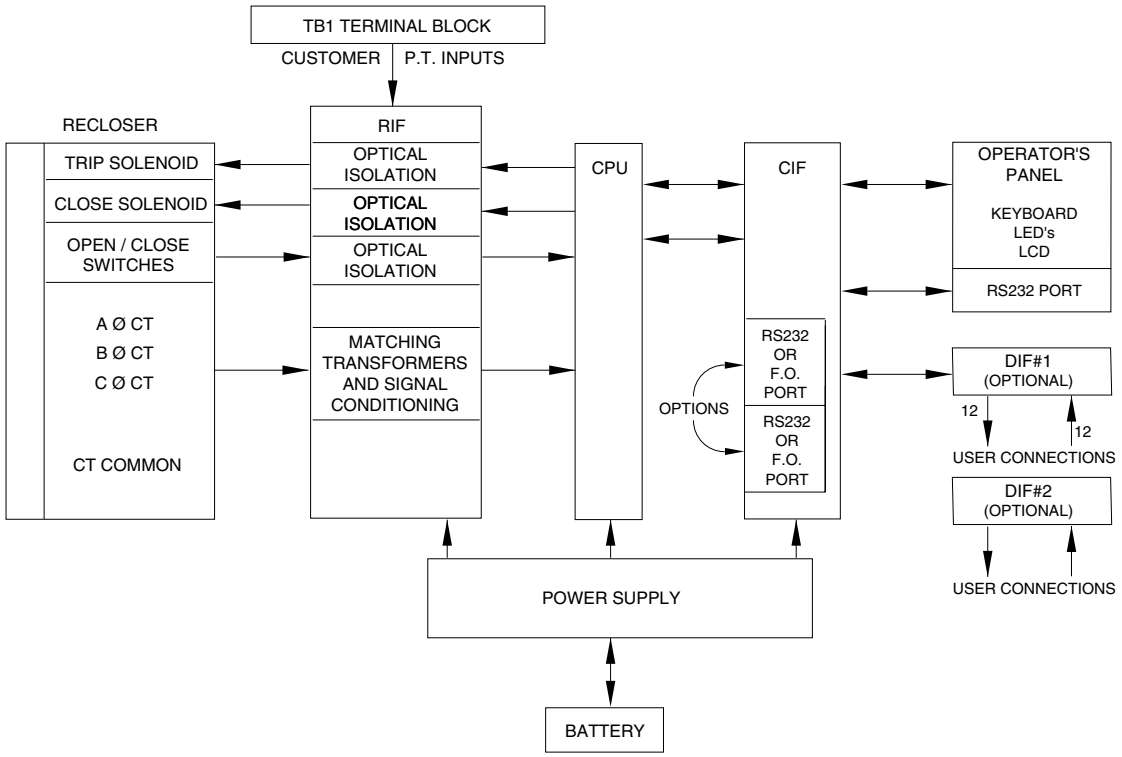


Figure 3.
Form 5 control operational flow diagram.

The Form 5 control is constructed in a modular fashion to simplify servicing and to allow adding accessories with relative ease (see Figure 4). The standard configuration incorporates a Computer Processing Unit (CPU) module, power supply module, Recloser Interface (RIF) module, Communication Interface module (CIF), and an operator's panel.

Discrete Interface (DIF) module(s) and fiber-optic/RS232 communication interface cards may be ordered as accessories. Mounting provisions can be provided to add customer-supplied radio and modem modules.

Recloser Interface (RIF) Module

The Recloser Interface (RIF) Module provides the interface between the recloser and the CPU module, as well as the interface between the voltage sensors and the CPU module. The RIF is designed to interface with the following reclosers: WE/WVE group, VSA/VSO group, KFME/KFVME (50 Hz) group and NOVA.

The recloser connector includes three current-transformer inputs, Open and Closed status sensing, and Trip and Close controls. The voltage sensor connector accepts six voltage inputs; three for source-side, and three for load-side voltage. Six slide-type switches (one for each phase) are mounted on the module to facilitate loss of voltage testing.

The RIF board accepts either 12, 120, or 240 Vac voltage inputs for metering. The factory configuration is outlined on the front panel matrix and can be customized to user specification. See **RECLOSER INTERFACE (RIF) MODULE CONFIGURATION** section of this manual.

Computer Processing Unit (CPU) Module

The CPU module is the center of the Form 5 control. The CPU contains a 32-bit micro-controller, a Digital Signal Processor, RAM and EEPROM memory, and a 16-bit analog-to-digital converter. The CPU module accepts 16 analog inputs which it routes through the digital signal processor, which samples 32 times per cycle, to compute harmonic analysis to the 15th harmonic.

Communication Interface (CIF) Module

The Communications Interface (CIF) module provides the link between the CPU module and the front operator's panel. The standard CIF module can also provide the link between the CPU module and all external communications such as personal computers, modems, and radios. The CIF can house up to two communication interface cards (optional), in addition to the required Local User Interface (LUIF), plus provide communication to the front operating panel. Direct serial communication is achieved via fiber optic or RS232.

Discrete Interface (DIF) Module

The Discrete Interface (DIF) module allows users with existing RTUs the ability to interface with the Form 5 control. The DIF module contains 12 inputs and 12 outputs that are customized for a remote or supervisory function. Each Form 5 control can accommodate two DIF modules. See **DISCRETE INTERFACE (DIF) ACCESSORY** section of this manual.

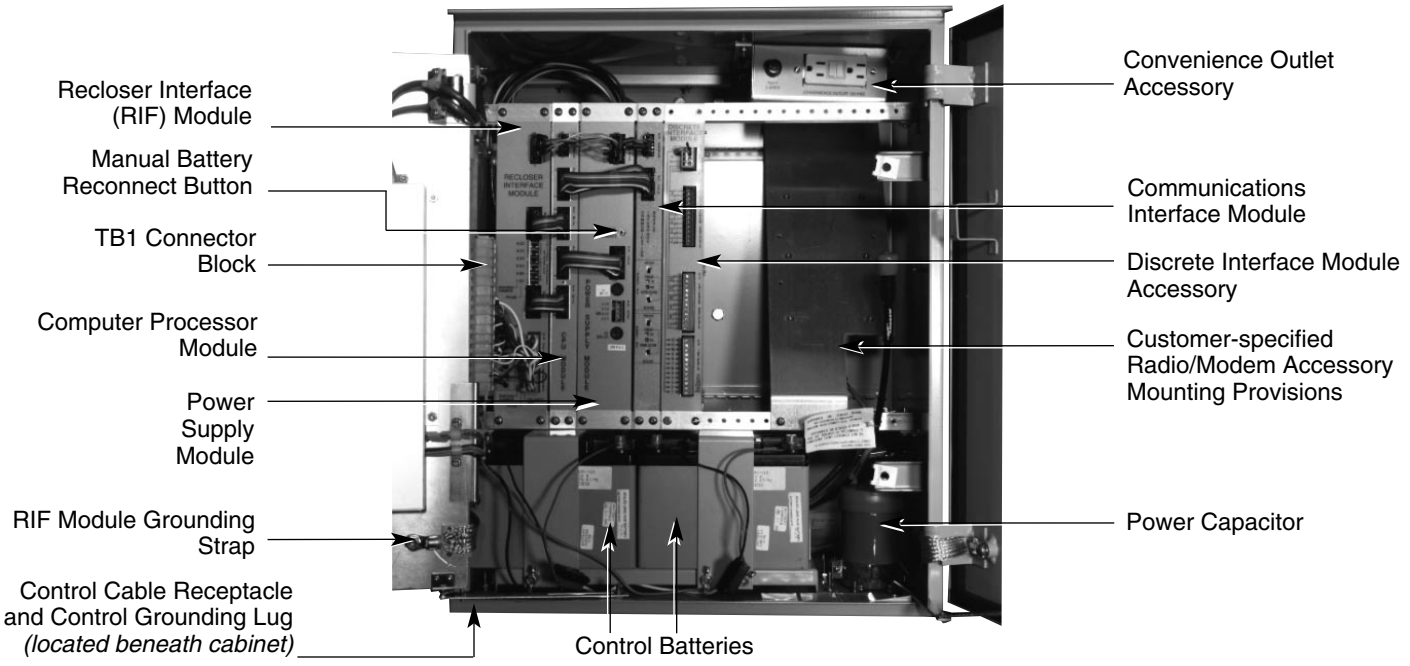


Figure 4.
Form 5 control back panel.

Control Features

The Form 5 recloser control offers numerous standard features and accessories that allow the user the utmost flexibility in designing a control suitable for their application requirements.

Under/Over Frequency Loadshedding

The Form 5 control includes provisions for frequency loadshedding that trips the recloser for conditions of under or over system frequency. Access to this feature is through frequency threshold, trip time, and allowable voltage threshold.

With the auto-restoration feature, the Form 5 can be set to close the recloser after the system frequency and voltage have recovered. Parameters available for setting include frequency and voltage thresholds and time delay.

A frequency alarm is available and can be configured for notification.

Voltage Protection (120 Vac-based)

Voltage protection functionality is included as standard on all Form 5 controls. A recloser trip will be issued for under and /over voltage conditions when the monitored voltage falls outside user specified limits for a selectable time. Response mode include any single phase, all three phases and also single phase with three-phase inhibit. This mode facilitates protecting against a single phase condition common when a high side fuse operates on a distribution transformer. Parameters are also available to provide auto restoration after a trip. A voltage alarm is available and can be configured for notification.

Protection Profiles

Four separate protection profiles are included to allow the user to adapt overcurrent settings for varying system conditions such as load, live line work or weather. The active profile is selected from the operator's panel or with the interface software or SCADA (see Figure 5). Each profile has 14 TCC specifications plus reclose intervals, sequence coordination and reset times to maintain independent protection parameters.

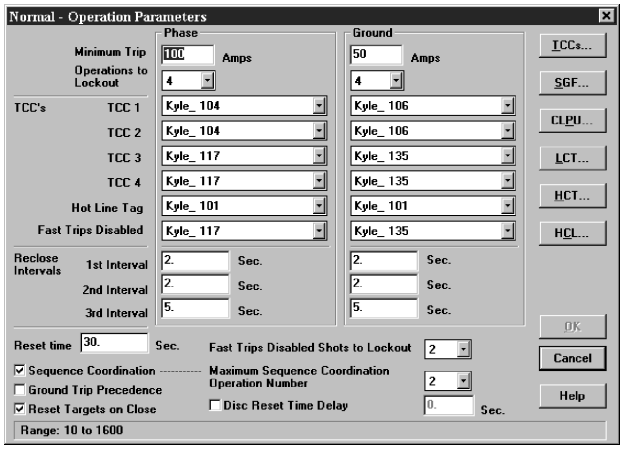


Figure 5.
Interface software sample protection profile.

Power Metering

Power metering includes single- and three-phase Watts, VARS, kVARS, kWh measurements, and the per phase and total system Power Factor (PF).

Voltage Metering

Six voltages (3-source and 3-load) are metered as standard on the Form 5 control. The user selects either phase-to-phase or phase-to-ground values from the control front panel, interface software, or serial communications. This reference is altered by selecting the voltage sensor correction in the "Hardware" setup portion of the interface software. Refer to *Service Information S280-79-2 Form 5 Microprocessor-Based Electronic Recloser Control Interface Software User's Guide* for further information.

Communications

One serial communication port is located on the front panel and a second communications port is optional. They can be configured to either 2179 or DNP 3.0 protocols. The front panel RS232 communication port provides temporary local personal computer (PC) access when connected with a standard 9-pin cable. The other ports are resident on the Communication Interface Module (CIF) and factory configured. The CIF board is the link between the CPU module and the front panel, discrete interface module and the fiber-optic RS232 board accessories.

Fast Trips Disabled

Fast Trips Disabled provides the user a quick and efficient method for reducing momentary interruptions or "blinks". When activated from the front keypad, programmed trips to lockout will time according to the selected time–current curve for Fast Trips Disabled. This curve is programmable for both phase and ground on each protection profile. A separate trips-to-lockout setting is also provided. See Figure 5.

Harmonic Analysis

Extensive harmonic analysis is performed by the Form 5 control for both currents and voltages. Analysis is performed on-line (updates every 30 seconds) or demand integrated to user-specified time values. The Total Harmonic Distortion (THD) for current and voltage is available from the front panel display (see Figure 6) while complete analysis, including graphing capabilities, is provided from the Form 5 interface software.

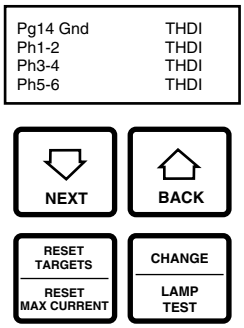


Figure 6.
Form 5 front panel harmonic readout.

Reverse Power Flow

Feeder load monitoring is enhanced with the inclusion of the power flow monitoring feature. When power flow from the load to the source side of the recloser is detected, the control issues an alarm and illuminates a front-panel indicator. Response time to a reverse power condition is one second. An alarm is also available for remote interrogation.

Hot Line Tag

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

The Hot Line Tag feature is provided for live-line work application.

Note: 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. Activation is indicated by a three-segment LED located on the front panel. Also, a close circuit disconnect is included as a removable link in the closing circuit.

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

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

Event Recorder

The Event Recorder maintains a rotating log of operating events for later readout and analysis by the user. Approximately 500 events can be stored in non-volatile memory. For each event type, time of occurrence and other relevant information is stored.

Histograms

Histograms in the form 5 are bar graph representations of the Form 5's demand metering. A histogram is available for each of the demand metering parameters. The bar graphs display the percentage of time since the last reset that the metered demand values have been within the range of a bin.

Data Profiler

A fully-configurable data profiler is available which allows the user to collect valuable information by sampling data at selectable intervals. These time-stamped values can then be plotted to determine weekly load profiles, daily harmonic disturbances, or hourly voltage fluctuations. The data profiler can provide more than 200 days of information, depending upon configuration parameters.

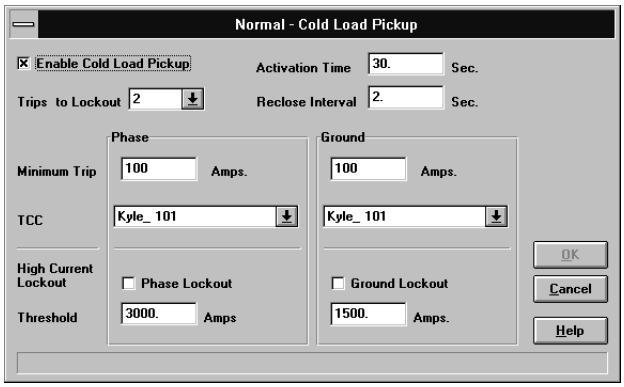


Figure 7.
Interface software Cold Load Pickup settings.

Cold Load Pickup

Cold Load Pickup (CLPU) is activated from both the operator's panel and remotely to provide the user with the ability to alter protection for abnormal system conditions. It is active for a programmable time interval which begins with each close signal or an automatic reclose signal after a Cold Load Pickup trip. Once this time elapses, protection reverts back to the programmed sequence. The setting's parameters are made through the Form 5 interface software (see Figure 7).

Note: When CLPU is active, the control utilizes the Cold Load Pickup TCC, reclose interval, operations to lockout and minimum trip settings in lieu of the normal first operation protection settings.

Alarms

Alarms are fully programmable to provide the user the capability to customize the parameters for individual installations. The alarms can also be configured to trigger a data profile and event record upon initiation. Alarms do not affect the operation of the control.

Form 5 Control Front Panel

The Form 5 control front panel (Figure 8) allows local operation and status interrogation through built-in operator controls and status displays. The swing-out panel contains LED indicators, operational pushbuttons, membrane-type functional/indication switches, backlit LCD display, Hot Line Tag switch with indication, Close Circuit Disable and battery test terminals. An RS232 port is also provided to permit the temporary connection of a PC for programming the parameters in the control.

All indicators with the exception of Hot Line Tag and recloser status are automatically turned off after 10 minutes of front panel inactivity.

Reactivating is accomplished by pressing any operation switch. The LCD messages will remain while in this power-saving mode, although the illuminating backlight will shut off.

Note: The control will not enter into this power-saving mode when Hot Line Tag is active.

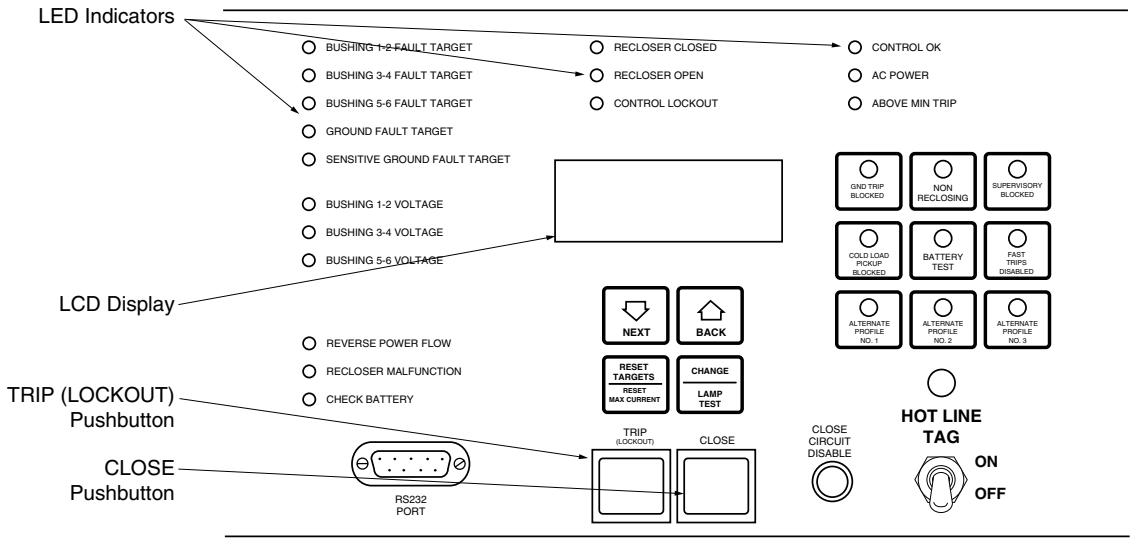


Figure 8.
Form 5 control front panel.

LED Indicators

The front panel LED indicators (Figure 8) give instant information on the control and recloser status. They are arranged across the front and down the left side of the front panel.

LED indicators include:

BUSHINGS 1-2 FAULT TARGET

BUSHINGS 3-4 FAULT TARGET

BUSHINGS 5-6 FAULT TARGET

GROUND FAULT TARGET

SENSITIVE GROUND FAULT TARGET

These red LED indicators illuminate when the control issues an overcurrent trip signal while the respective phase current or ground current exceeds the minimum pickup value. Reset is accomplished automatically when Auto Reset is activated and a successful close operation is performed; manual reset is accomplished by pressing the RESET TARGETS button on the control front panel.

BUSHINGS 1-2 VOLTAGE

BUSHINGS 3-4 VOLTAGE

BUSHINGS 5-6 VOLTAGE

These red LED indicators illuminate when the control detects the presence of voltage on the respective bushings as connected to TB1. Refer to the **Customer Connections for AC Power** section in these instructions to determine the appropriate power connections.

REVERSE POWER FLOW

This red indicator illuminates when the control detects power flow from the load side to the source side of the recloser.

RECLOSER MALFUNCTION

This red indicator is illuminated when the control detects a failure in a trip or close operation. It turns off automatically if the recloser returns to the proper state.

CHECK BATTERY

This red indicator illuminates for two conditions:

1. When the battery charging or discharging current drops below 10 mA. The LED will automatically shut off when current returns above the threshold.
2. When the control fails a manual battery test, the LED will remain on until a successful battery test is completed.

Refer to the Battery Test Procedure in this manual for more information.

RECLOSER CLOSED

This red indicator is illuminated when the control senses that the recloser mechanism is in the closed position.

RECLOSER OPEN

This green indicator is illuminated when the control senses that the recloser mechanism is in the open position.

CONTROL LOCKOUT

This green indicator is illuminated when the recloser is open and a reclosing sequence is not in progress or when the lockout handle on the recloser mechanism is in the down position; i.e., trip and close circuits are open.

CONTROL OK

This green indicator is illuminated when the continuous self-diagnostics of the control have detected no CPU or memory malfunctions and indicate that the control is capable of normal operation.

AC POWER

This green indicator is illuminated when the presence of ac input power to the control is sensed.

ABOVE MIN TRIP

This red indicator is illuminated when the control detects that current is above the programmed minimum trip value for Bushings 1-2, Bushings 3-4, Bushings 5-6, Ground, or Sensitive Ground.

TRIP (Lockout) Pushbutton

The TRIP pushbutton (Figure 8) provides front-panel access to trip (lockout) the recloser. When pressed, the TRIP push-button opens the recloser and locks out the control. This operation supersedes commands made in the Supervisory function; i.e., the TRIP (LOCKOUT) pushbutton will override SUPERVISORY commands in all cases.

CLOSE Pushbutton

When pressed, the CLOSE pushbutton (Figure 8) returns the control to the initial or home position and closes the recloser.

Note: Cold-Load Pickup is programmed using the interface software and activated through front panel hot keys. Pressing the CLOSE pushbutton will initiate Cold-Load Pickup protection if the feature is active as indicated by the front-panel LED. *Holding the CLOSE pushbutton in does not activate and has no effect on the feature.* Refer to the interface software program to determine the activation time and time–current characteristic applicable for Cold-Load Pickup.

LCD Display

The control front panel has a large, backlit LCD display (Figure 9) used for viewing control parameters and monitoring system conditions. Data is organized onto 38 messages or "pages" of information, with each page containing four lines of information, with up to 20 characters per line. Access to the messages is obtained through navigational keys which permit the user to scroll through the menu in a timely and efficient manner.

When an overcurrent trip occurs, the control automatically displays the fault current values as shown on the LCD display as Page 1 (see **LCD Display Messages** section of this manual).

NEXT Key

Pressing the NEXT key causes the LCD display to scroll to the next message or "page" of available information on the 4-line by 20-characters per page LCD display. Pressing and holding the NEXT key causes the control to scroll to subsequent pages at the rate of about two pages per second.

BACK Key

Pressing the BACK key causes the LCD display to scroll to the previous message or "page" of available information on the 4-line by 20-characters per page LCD display. Pressing and holding the BACK key causes the control to scroll to previous pages at the rate of two pages per second.

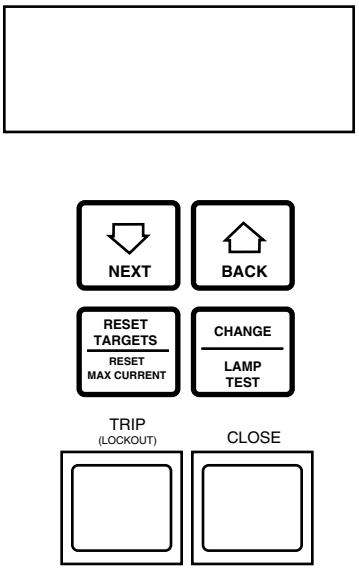


Figure 9.
LCD display and dedicated function keys.

RESET TARGETS/RESET MAX CURRENT Key

Pressing the RESET TARGETS/RESET MAX CURRENT key will reset the fault target indicators on the control front panel. The fault current values shown on Page 1 of the LCD display will reset to values of zero.

Pressing and holding the RESET TARGETS/RESET MAX CURRENT key for three seconds will reset the minimum and maximum values in LCD Display messages (pages 32 through 35).

CHANGE/LAMP TEST Key

Pressing this key for less than three seconds places the control into a CHANGE mode for 10 seconds as indicated by the LCD display. CHANGE mode permits the user to change the state of the nine function/indicator switches on the front panel. Security is ensured by permitting a single selection for each CHANGE mode period.

Pressing and holding the CHANGE/LAMP TEST key for three seconds will cause the control to perform a front-panel lamp test. In the Lamp Test Mode, the status indicators flash three times (one second on, one second off). All status indicators then return to their previous on/off state. While in the Lamp Test Mode, the control responses to front panel keys are disabled, except for responses to the TRIP (LOCKOUT), CLOSE, and HOT LINE TAG switches.

LCD Display Messages

Every message or "page" contains a parameter name, parameter value, and parameter units. If the control detects that a parameter value is invalid, the LCD display shows five dash characters (- - - - -) in the value field of the message. Demand metered values are indicated by (D) and instantaneous values by (I).

Page 1 - Instantaneous Current

Page 1 displays line current values present for the last overcurrent trip operation. Values are reset to zero when the fault targets are reset.

1 Gnd	_____	A
Ph1-2	_____	A
Ph3-4	_____	A
Ph5-6	_____	A

Page 2 - Fault Targets

Pg 2	Gnd Fault	A
Ph1-2 Fault	_____	A
Ph3-4 Fault	_____	A
Ph5-6 Fault	_____	A

Page 3 - Frequency Trip

Pg 3 Freq Trip	_____	Hz
Time	Date	
Present Freq	_____	Hz

Page 4 - Voltage Trip

Pg 4 Ph1-2 Trip	_____	V
Ph3-4 Trip	_____	V
Ph5-6 Trip	_____	V
Time	Date	

Page 5 - Power kWh

Pg 5 Tot	_____	kWh
Ph1-2	_____	kWh
Ph3-4	_____	kWh
Ph5-6	_____	kWh

Page 6 - S1 Phase-to-Neutral, Instantaneous Voltage

Pg 6 S1 Ph-N		Instant
Ph1-N	_____	V
Ph3-N	_____	V
Ph5-N	_____	V

Page 7 - S1 Phase-to-Phase, Instantaneous Voltage

Pg 7 S1 Ph-Ph		Instant
Ph1-3	_____	V
Ph3-5	_____	V
Ph5-1	_____	V

Page 8 - S2 Phase-to-Neutral, Instantaneous Voltage

Pg 8 S2 Ph-N		Instant
Ph2-N	_____	V
Ph4-N	_____	V
Ph6-N	_____	V

Page 9 - S2 Phase-to-Phase, Instantaneous Voltage

Pg 9 S2 Ph-Ph		Instant
Ph2-4	_____	V
Ph4-6	_____	V
Ph6-2	_____	V

Page 10 - Real Power

Pg 10 Tot	_____	kW
Ph1-2	_____	kW
Ph3-4	_____	kW
Ph5-6	_____	kW

Page 11 - Instantaneous kVA

Pg 11 Tot	_____	kVA
Ph1-2	_____	kVA
Ph3-4	_____	kVA
Ph5-6	_____	kVA

Page 12 - Instantaneous kVAR

Pg 12 Tot	_____	kVAR
Ph1-2	_____	kVAR
Ph3-4	_____	kVAR
Ph5-6	_____	kVAR

Page 13 - Instantaneous Power Factor

Pg 13 Tot	_____	PF
Ph1-2	_____	PF
Ph3-4	_____	PF
Ph5-6	_____	PF

Page 14 - Instantaneous THD Current

Pg 14 Gnd	_____	%THDI
Ph1-2	_____	%THDI
Ph3-4	_____	%THDI
Ph5-6	_____	%THDI

Page 15 - Instantaneous THD Voltage

Pg 15 Gnd	_____	%THDV
Ph1-2	_____	%THDV
Ph3-4	_____	%THDV
Ph5-6	_____	%THDV

Page 16 - S1 Ph-N Demand Voltage

Pg 16 S1 PH-N		Instant
Ph1-N(d)	_____	V
Ph3-N(d)	_____	V
Ph5-N(d)	_____	V

Page 17 - S1 Ph-Ph Demand Voltage

Pg 17 S1 Ph-Ph		Demand
Ph1-3 (d)	_____	V
Ph3-5(d)	_____	V
Ph5-1(d)	_____	V

Page 18 - S2 Ph-N Demand Voltage

Pg 18 S2 Ph-N		Demand
Ph2-N(d)	_____	V
Ph4-N(d)	_____	V
Ph6-N(d)	_____	V

Page 19 - S2 Ph-Ph Demand Voltage

P19 S2 Ph-Ph		Demand
Ph2-4(d)	_____	V
Ph4-6(d)	_____	V
Ph6-2(d)	_____	V

Page 20 - Demand Current

P20 Gnd(d)	_____	A
Ph1-2(d)	_____	A
Ph3-4(d)	_____	A
Ph5-6(d)	_____	A

Page 21 - Demand kW

P21 Tot(d)	_____	kW
Ph1-2(d)	_____	kW
Ph3-4(d)	_____	kW
Ph5-6(d)	_____	kW

Page 22 - Demand kVA

P22 Tot(d)	_____	kVA
Ph1-2(d)	_____	kVA
Ph3-4(d)	_____	kVA
Ph5-6(d)	_____	kVA

Page 23 - Demand kVAR

P23 Tot(d)	_____	kVAR
Ph1-2(d)	_____	kVAR
Ph3-4(d)	_____	kVAR
Ph5-6(d)	_____	kVAR

Page 24 - Demand Power Factor

Pg24 Tot(d)	_____	PF
Ph1-2(d)	_____	PF
Ph3-4(d)	_____	PF
Ph5-6(d)	_____	PF

Page 25 - Demand THD Current

Pg25 Gnd(d)	_____	%THDI
Ph1-2(d)	_____	%THDI
Ph3-4(d)	_____	%THDI
Ph5-6(d)	_____	%THDI

Page 26 - Demand THD Voltage

Pg26 Gnd (d)	_____	%THDV
Ph1-N(d)	_____	%THDV
Ph3-N(d)	_____	%THDV
Ph5-N(d)	_____	%THDV

Page 27 - Number of Trips for Ground and Phase

Pg27 Gnd Trips	
Ph1-2 Trips	_____
Ph1-3 Trips	_____
Ph5-6 Trips	_____

Page 28 - SGF Target and Operations Counter, Time and Date

Pg28 SGF trips	_____
Operations	_____

Page 29 - Battery Monitor

The Battery Monitor displays the battery voltage, current, and voltage during a battery test. The Battery Monitor is used with the Battery Test pushbutton. Refer to the Battery Test Procedure section of these instructions for more information.

Pg29 Battery Monitor		
Normal Volts	_____	V
Normal Current	_____	mA
Test Volts	_____	V

Page 30 - Phase Minimum Trip Settings

Phase minimum trip settings are listed for the four protection profiles. Line 1 is the normal setting, ALT1 is profile No. 1, ALT2 is profile No. 2, and ALT3 is profile No. 3. Phase Minimum Trip Settings allow verification of trip settings before selection of an alternate profile.

Pg30 – Phase MT	_____	A
ALT1 MT	_____	A
ALT2 MT	_____	A
ALT3 MT	_____	A

Page 31 - Ground Minimum Trip Settings

Ground minimum trip settings are listed for the four protection profiles. Line 1 is the normal setting, ALT1 is profile No. 1, ALT2 is profile No. 2, and ALT3 is profile No. 3. Ground Minimum Trip Settings allow verification of trip settings before selection of an alternate profile.

Pg31 – Gnd MT	_____	A
ALT1 MT	_____	A
ALT2 MT	_____	A
ALT3 MT	_____	A

Page 32 - Ground Max, Phase 1-2 Max Currents

Pg32 Gnd Max	_____	A
Time	Date	
Ph1-2 Max	_____	A
Time	Date	

Page 33 - Phase 3-4 Max, Phase 5-6 Max Currents

Pg33 Ph 3-4 Max	_____	A
Time	Date	
Ph5-6 Max	_____	A
Time	Date	

Page 34 - Ground Min, Phase 1-2 Min Currents

Pg34 Gnd Min	_____	A
Time	Date	
Ph1-2 Min	_____	A
Time	Date	

Phase 35 - Phase 3-4 Min, Phase 5-6 Min Currents

Pg35 Ph3-4 Min	_____A
Time	Date
Ph5-6 Min	_____A
Time	Date

Note: Pressing and holding the RESET TARGETS/RESET MAX CURRENT key for three seconds will reset the minimum and maximum values in LCD Display messages pages 32 through 35.

Page 36 - Control Information

Pg36 – CPU Firmware	X.XX
Firmware DB	X
	<Control Identification>
Time	Date

Page 37 - Communication Port 2 Settings

This message displays the protocol settings (2179 or DNP3.0), baud rate, and address for Serial Port #2. Baud rate and address are set using the interface software, while protocol is set at the factory based on user's specifications.

Pg37 – Comm Port 2	_____
Protocol	_____
Speed	_____
Address	_____

Page 38 - Communication Port 3 Settings

This message displays the protocol settings (2179 or DNP3.0), baud rate, and address for Serial Port #3. Baud rate and address are set using the interface software, while protocol is set at the factory based on user's specifications.

Pg38 – Comm Port 3	_____
Protocol	_____
Speed	_____
Address	_____

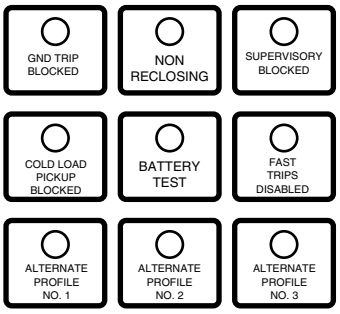


Figure 10.
Function/indication pushbuttons.

Operation/Indication Switches

Hot key access to frequently-operated Form 5 features is provided with nine function/indication pushbuttons on the control front panel (Figure 10). These nine features may be activated locally from the membrane-type pushbuttons or remotely via the interface software or SCADA.

Red LEDs located on each switch indicate the status of the function, regardless of local or remote activation. For example, if Cold Load Pickup was activated from a SCADA signal, the red indicator would illuminate even though it was not activated from the front panel.

Note: Function LEDs activated from local or remote sources do not illuminate when the front panel is in the power-save mode.

Front panel activation requires the operator to first press the CHANGE/LAMP TEST key to enter the CHANGE mode. A function may then be selected within ten seconds as displayed by the front panel LCD. Once selected, the control returns to normal operation until prompted for another change request.

GND TRIP BLOCKED

This red indicator is illuminated when ground trip block is activated from SCADA, the interface software or locally by pressing the CHANGE/LAMP TEST key, then pressing the GND TRIP BLOCKED key.

NON RECLOSING

The control is operating in a non-reclosing mode when the NON RECLOSING indicator is illuminated. Non-reclosing mode disables any automatic reclosing operations while operating one trip to lockout on the first programmed TCC. Activation is possible from SCADA, the interface software, or locally by pressing the CHANGE/LAMP TEST key, then pressing the NON RECLOSING key.

SUPERVISORY BLOCKED

When the SUPERVISORY BLOCKED indicator is illuminated, supervisory SCADA and interface software are disabled; remote SCADA remains active. Activation of the switch is restricted to the front panel and is accomplished by pressing the CHANGE/LAMP TEST key, then pressing the SUPERVISORY BLOCKED key. Operational data and metering information are available while the control is in the SUPERVISORY BLOCKED position. The TRIP and CLOSE pushbuttons are active independently of the SUPERVISORY BLOCKED function.

COLD LOAD PICKUP BLOCKED

The Cold Load Pickup feature is blocked while the COLD LOAD PICKUP BLOCKED indicator is illuminated. When CLPU is not blocked, the control utilizes the Cold Load Pickup TCC, reclose interval, operations to lockout and minimum trip settings in lieu of the normal first operation protection settings. This function may be toggled from SCADA, the interface software, or locally by pressing the CHANGE/LAMP TEST key, then pressing the COLD LOAD PICKUP BLOCKED key.

BATTERY TEST

The BATTERY TEST indicator illuminates when the control is performing a battery test. It turns off automatically when the control has finished performing the test. Testing is initiated remotely via SCADA or from the interface software, or locally by pressing the CHANGE/LAMP TEST key, then pressing the BATTERY TEST key. Refer to the Battery Test section of these instructions for further details on testing the control battery.

FAST TRIPS DISABLED

Fast Trips Disabled commands the control to use the programmed Fast Trips Disabled time–current curve for all tripping operations. When in the Fast Trips Disabled mode, the indicator will be illuminated. The function is activated from SCADA, the interface software, or locally by pressing the CHANGE/LAMP TEST key, then pressing the FAST TRIPS DISABLED key.

ALTERNATE PROFILE Indicator/Key

The control 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 front panel display lights are active and none of the three indicators are on, the normal profile is active. To select an alternate profile, press the CHANGE/LAMP TEST key, then press the desired alternate profile. To return to the normal profile, simply turn off the active alternate profile. These functions can also be operated remotely via available communications interfaces.

Note: The minimum trip values for each protection profile are shown on Pages 30 and 31 of the LCD display. Check these minimum trip values prior to changing an alternate profile to avoid misoperation of the control under load conditions.

HOT LINE TAG Switch

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 reclosing.

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

The Hot Line Tag feature (Figure 11) consists of a toggle switch and a three-segment LED indicator which illuminates when the function is active. When active, Hot Line Tag prevents all closing attempts and shifts protection to one trip to lockout on the programmed time-current curve. The Hot Line Tag function takes precedence over Cold Load Pickup, Non Reclosing and Fast Trips Disabled. Activation is accomplished by placing the front panel toggle switch to the “up” position, or via SCADA command. The Hot Line Tag feature may only be reset by the source that initiates the function. For example, if Hot Line Tag is activated at the front panel, the reset function is only possible at the front panel, and not via SCADA command.

Hot Line Tag includes a CLOSE CIRCUIT DISABLE feature that provides visible disconnect in the close circuit. The CLOSE CIRCUIT DISABLE feature (Figure 11) consists of a removable, solid-bus cartridge connected in series with the close circuit of 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.

970021KM

Figure 11.
Hot Line Tag and Close Circuit Disable.

RS232 Communication Port

The standard Form 5 control is equipped with a front panel RS232 port for interface with a personal computer running the Form 5 interface software program. This nine-pin communication port permits the uploading of all programming information stored in the control, including protection profiles, event recorder, data profiles, alarms, counters, and metering information. The communication port also provides a simple means to download operating parameters from a personal computer to the control.

Note: The front panel RS232 port is designed only for temporary connection of a personal computer. For surge immunity reasons, all permanent serial communications must be made via the Communications Interface Module (CIF).

Battery Test Terminals

The control monitors the state of the 24 Vdc battery on a continual basis as part of the self-check features. Monitored values include voltage and load/charging current. In addition to the self-checking features, battery test terminals are provided on the front panel for verification of battery condition (Figure 12). Voltage test terminals provide battery voltages for both normal and battery-test conditions.

Battery Test Procedure

The BATTERY TEST hot key on the front panel provides a quick and easy method for testing the condition of the control battery. This key, combined with the LCD readout, eliminates the need for an external current/voltage meter when testing the battery.

When a battery test is initiated, the spurious charge is first drained to allow the battery voltage to equalize. A 10 Ω, 55 W resistor is then placed across the battery terminals and a voltage drop is calculated. If the drop from the equalized voltage to the test voltage exceeds 2 V, then the CHECK BATTERY LED is illuminated.

To perform a battery test:

1. Using the Next and BACK keys, scroll through the LCD display to Page 29, the Battery Monitor page.
2. Record the NORMAL VOLTS and NORMAL CURRENT readings from the screen. Voltage should be between 31 and 25 V with higher readings at colder temperatures. Under normal conditions with ac connected and the battery trickle charging, the current should read between 12 mA and 20 mA. With ac connected and in bulk charging mode, current will range from 12 to 600 mA. With ac disconnected and the battery supplying the load, current will read -20 mA to -3 A depending on accessories connected. Service the battery if the readings exceed these limits.
3. Momentarily, press the CHANGE/LAMP TEST key, then BATTERY TEST key.

   Note: AC power can be either connected or disconnected for Step 3.
4. Record the TEST VOLTS reading from the LCD and the status of the CHECK BATTERY LED. Service the battery if the CHECK BATTERY LED is illuminated.

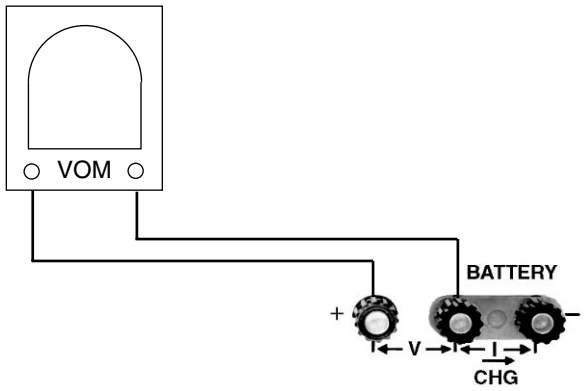


Figure 12.
Form 5 control battery test terminals.

Battery Replacemnet and Disposal

The control batteries have a life expectancy of three to five years. It is recommended that the batteries be replaces after four years.

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

Check Battery

The red indicator illuminates when the control fails a battery test. A failed test can indicate any of these conditions.

- The measured battery voltage is less than 22 V.
- The battery voltage drops more than 2 V during the battery test.
- A battery is not in the unit or the battery is open.

The other LED will remain on until a new battery is installed or other corrective action occurs and a successful battery test is completed. Refer to **Battery Testing and Charging Procedures** in the **Testing** section of this manual for more information.

RECLOSER INTERFACE (RIF) MODULE CONFIGURATION

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 Recloser Interface (RIF) Module is factory-configured at 120 Vac. For operating voltages other than 120 Vac, the RIF module must be removed from the control cabinet for configuration.

The Form 5 control must be completely de-energized prior to removing and configuring the RIF board. To remove the RIF board:

1. Remove the control battery located under the RIF module.
2. Release the clips securing the three wiring harness connectors.
3. Remove the nut and disconnect the RIF module grounding strap to the front panel. See Figure 4.
4. Disconnect the three wiring harnesses from the front of the RIF panel.
5. Disconnect the P8 Voltage Sensor connector.
6. Remove the four 11 mm (.437 in.) screws securing the board to the mounting bracket.
7. Pull the module out of the cabinet.

The DIP switches are located on the side of the module.

8. Configure the RIF board as shown in Figure 13.
9. After configuration, place the module back into position in the control cabinet and secure to the mounting bracket with screws previously removed.
10. Replace nut securing the RIF module grounding strap.

Example shown for 120 Vac operation:

SENSOR VOLTAGE	POLE1	POLE2
12 Vac	OFF	OFF
120 Vac*	OFF	ON
240 Vac	ON	ON

*120Vac is factory-set configuration

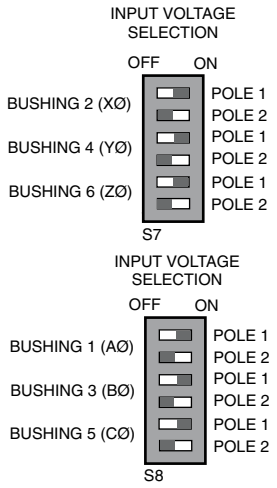


Figure 13.
Recloser Interface (RIF) Module configuration.

FORM 5 UNIVERSAL DEVICE PROTECTION (UDP) CONTROL

The UDP function allows the Form 5 control to become a switch control to provide indication of overcurrent trip conditions without issuing an overcurrent trip signal. The control is in the recloser mode when the feature is in the OFF position, and in the switch mode when the feature is ACTIVE. This non-tripping fault indication state is initiated via a front panel pushbutton (labeled SWITCH MODE), digital SCADA, or discrete SCADA. The UDP feature has local indication at the front panel (LED), digital indication, and remote indication via status contacts on the Discrete Interface (DIF) module 1. Refer to Figures 14 and 15.

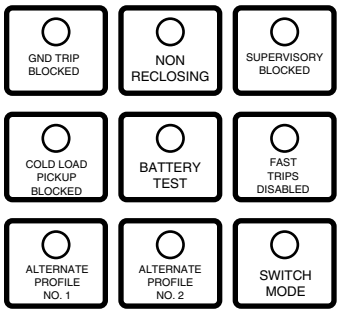


Figure 14.
Function/Indication pushbuttons for the Form 5 equipped with the UDP accessory.

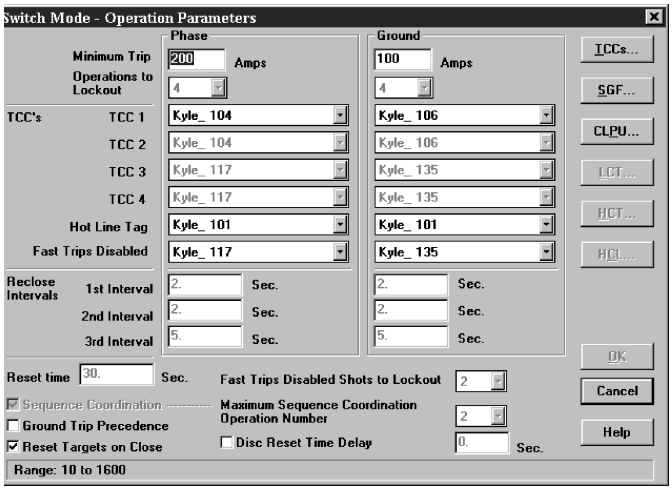


Figure 15.
Interface software Switch Mode settings

FORM 5 DC NOVA CONTROL

The Kyle Form 5 recloser control can be equipped with a dc-to-dc converter, interface circuit, and a fully shielded 19-pin cable for use with a Type NOVA recloser *with a dc interface only*. See Figure 16.

The dc-to-dc converter board (Figure 23) converts the control's 24 Vdc battery supply voltage to 53 Vdc to drive the trip/close capacitors in the NOVA mechanism. The output of the board is separately fused for operator indication. See Figures 17–19.

The dc-to-dc converter houses voltage monitoring and conditioning circuits which protect the battery from failure and provides trip/close operations without ac power. The 19-pin control cable interfaces the NOVA dc recloser to the Form 5 control through the interface circuit. The cable also provides ac power from the control to the recloser mechanism heater.

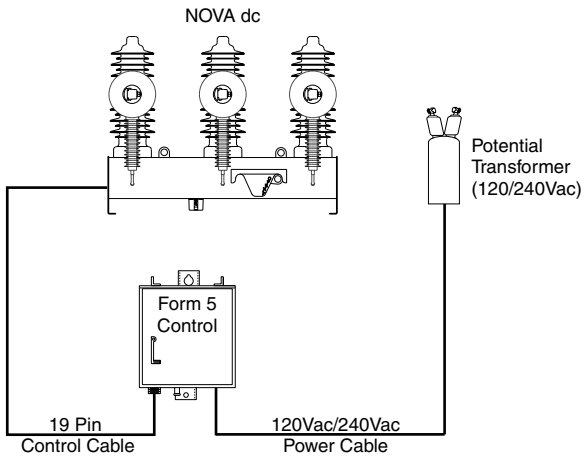


Figure 16.
Connections of a Form 5 control with dc NOVA accessory to a NOVA dc recloser.

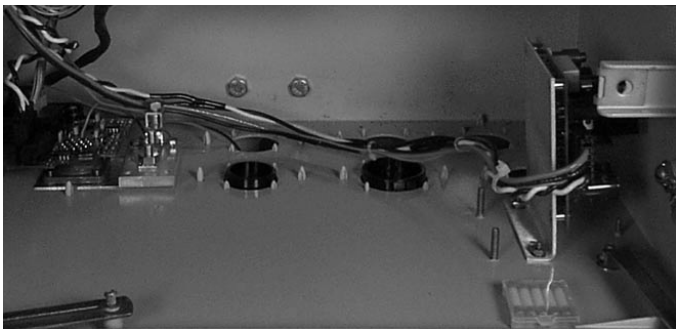


Figure 17. 98042KM
Dc-to-dc converter located in the bottom of control cabinet. (Control batteries and battery bracket removed.)

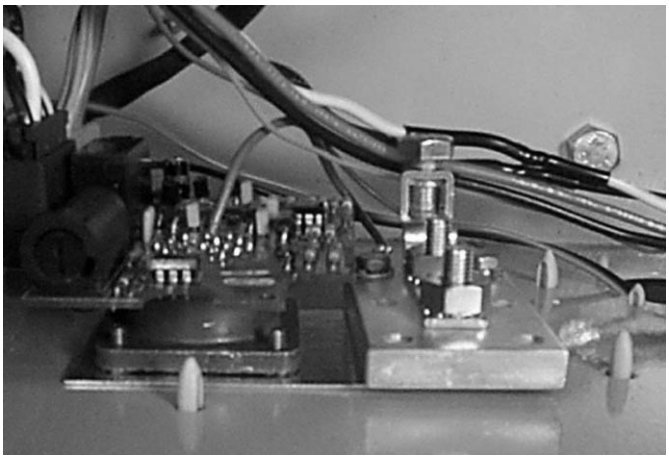


Figure 18. 98041KM
Dc interface circuit board.

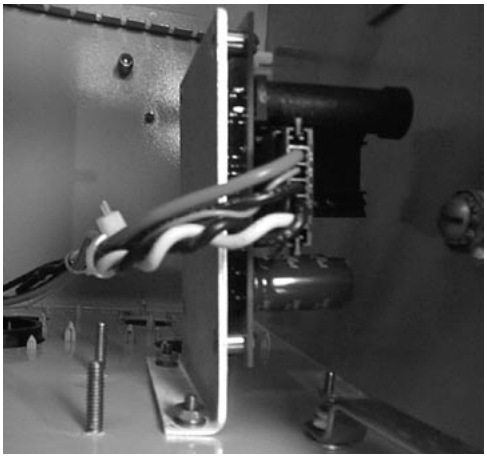


Figure 19. 98043KM
Dc-to-dc converter board.

DISCRETE INTERFACE (DIF) ACCESSORY

The Discrete Interface (DIF) module accessory (Figure 20) permits connection of contact-type input devices (switches, relays) and discrete indicating devices (relays, LEDs, lamps) to the Form 5 control to affect local discrete input/output (I/O). The DIF module accessory is used for supplementing normal local controls and status indicators for discrete SCADA functions. All DIF inputs and outputs can be factory-set to customer specifications.

IMPORTANT: The DIF should not be used for overcurrent protection. The control gives priority to TCC timing and issuing a trip signal rather than changing the status of a DIF input.

The DIF module contains 12 inputs and 12 outputs that are customized for a remote or SCADA function. Each Form 5 control can accommodate two DIF modules.

Whetting voltage for the DIF inputs can be supplied by the DIF module or by the customer as shown in Figure 21.

Note: The DIF module provides 28 Vdc (nominal) via connector P5 for use as whetting voltage for inputs to P4. As an alternative, the user can supply whetting voltage from an auxiliary source, such as an RTU.

The input voltage range is 12 to 120 Vac or Vdc. The 12 outputs are Form C relay contacts. Six of the module outputs are latching and the other six are non-latching.

Note: *Latching* is defined as an output that retains its status when power is removed from that output.

Non-latching is defined as an output that changes its status when power is removed from that output.

Note: A remote function is not controlled by the SUPERVISORY BLOCKED switch.

Customer Connection Information

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

Figure 21 shows the customer-supplied wiring of whetting voltage for DIF module inputs. Connection is made from terminal P5 on the DIF module to the respective connections on P4 inputs 1 through 12.

Figure 22 shows customer connections to the DIF outputs at P2 and P3. Connections are customized per customer application.

Standard and UDP Controls

Standard and UDP Form 5 control DIF inputs and outputs are described in the following pages.

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 varistor (MOV), or equivalent, at the remote end. Attach MOV's between the leads and ground. Failure to properly shield and protect leads can result in equipment damage and/or unintentional operation. G117.3

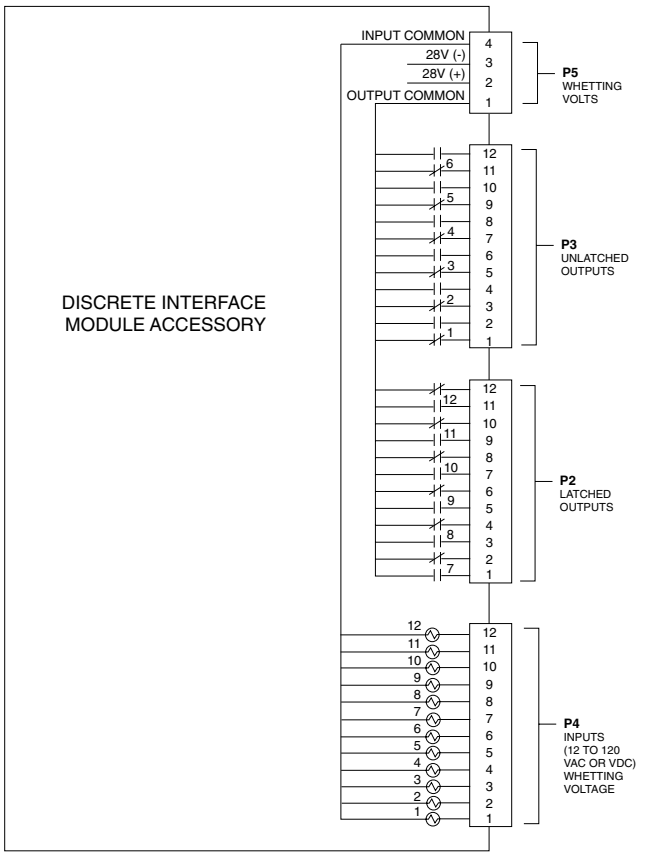


Figure 20.
Discrete Interface (DIF) Module.

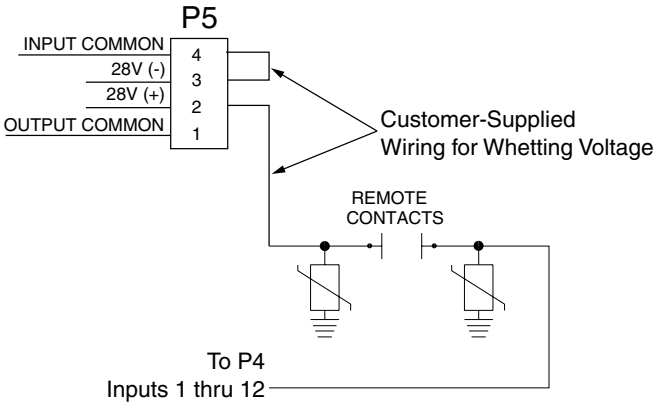


Figure 21.
Customer connections for supplying whetting voltage to DIF inputs.

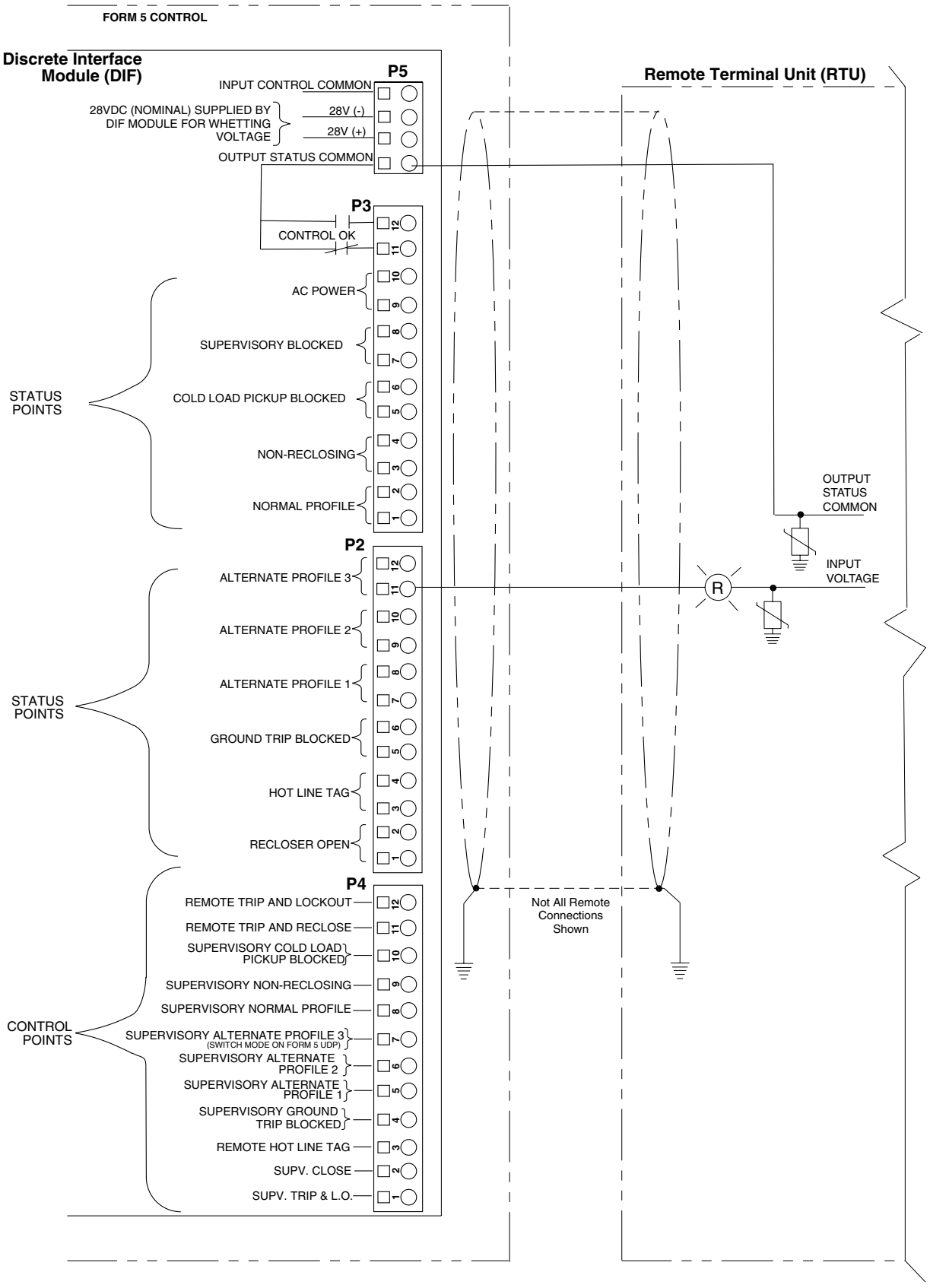


Figure 22.
Customer connections to DIF module outputs with shielding and surge protection.

IMPORTANT: Each DIF contains a small, isolated current source for use with external dry contacts. This supply is intended for use with the DIF inputs only and may be used for powering external circuits. This is considered a dry contact input for customer connection.

TABLE 1
DIF Input Ratings

Minimum Detection Level:	8 Vac	(50 or 60 Hz)	10 Vdc
Maximum Operating Voltage:	135 Vac	(50 or 60 Hz)	175 Vdc
Input Impedance:	10 K minimum (Inputs are current limited.)		
Maximum Input Loading:	2 mA per input		
Maximum Leakage Rejection:	1 mA		
Maximum Pickup Time:	10 msec (Does not count control response time.)		
Minimum Input Pulse Time	100 msec		
Minimum Transition Time Between Pulse Inputs	200 msec		
Input Protection	Shunting type using MOV's and capacitors. Opto Isolation from input to system		

TABLE 2
Whetting Voltage of DIF Inputs

Voltage Level:	28 Vdc (nominal)
Output Current:	30 mA maximum

TABLE 3
DIF Status Output Ratings

Maximum Switching Voltage:	135 Vac 110 Vdc
Maximum Switching Loading:	600 mA
Maximum Pickup-Release Time:	3 msec (Does not count control response time.)
Output Protection:	Shunting type using MOV's and capacitors

Standard and UDP Control DIF Module 1

Inputs

The DIF inputs are factory-configured as momentary (0.25 sec. duration) or maintained functions. Supervisory signals do not have any effect when supervisory blocked is active. Remote inputs function when supervisory is blocked.

Input	Connector	Function	Description
1	P4-1	Supervisory Trip and Lockout	Supervisory Trip and Lockout trips the recloser open and locks out the control. The control remains locked out until closed manually or by the Supervisory Close feature. A ***momentary*** signal is required.
2	P4-2	Supervisory Close	Supervisory Close initiates a closing signal to the recloser. A ***momentary*** signal is required for proper operation.
3	P4-3	Remote Hot Line Tag	Remote Hot Line Tag performs the same functions as the HOT LINE TAG switch on the front panel. Remote Hot Line Tag is activated by a ***maintained*** SCADA command, a serial command, or locally via a front panel switch. This input is active regardless of the state of the supervisory function.
4	P4-4	Supervisory Ground Trip Block	Supervisory Ground Trip Block provides supervisory operation of ground trip block by a remote ***momentary*** signal. This input performs the same function as the GND TRIP BLOCKED key on the front panel. This input is inactive if the Supervisory function is disabled.
5 6 7	P4-5 P4-6 P4-7	Supervisory Alternate Profile 1 Supervisory Alternate Profile 2 Supervisory Alternate Profile 3	Supervisory Alternate Profiles provides selection of alternate programmed values for phase and ground minimum trip. This feature is activated by a remote ***momentary*** signal. Supervisory operation is inactive if Alternate Profiles have been activated from the front panel or the Supervisory function has been disabled. These inputs are active with a momentary whetting voltage and cause the control to select the respective Supervisory Alternate Profile. The inputs are inactive if the Supervisory function is disabled.
8	P4-8	Supervisory Normal Profile	Supervisory Normal Profile provides the ability to trip the recloser from a remote signal. Normal reclosing operations will follow. A ***momentary*** signal is required for proper operation. This input is active with a whetting voltage and causes the control to select Normal Protection Profile. This input is inactive if the Supervisory function is disabled.

Standard and UDP Control DIF Module 1

Inputs (cont'd)

Input	Connector	Function	Description
9	P4-9	Supervisory Non-Reclosing	Supervisory Non-Reclosing provides supervisory non-reclosing input by a remote ***momentary*** signal. This input performs the same function as the NON-RECLOSING key on the front panel. This input is inactive if the Supervisory function is disabled.
10	P4-10	Superv Cold-Load Pickup Blocked	This input performs the same function as the COLD LOAD PICKUP BLOCKED key on the front panel. This input is inactive if the Supervisory function is disabled. A ***momentary*** signal is required for proper operation.
11	P4-11	Remote Trip and Reclose	Remote Trip and Reclose initiates a trip operation followed by a reclose operation. A ***momentary*** signal is required for proper operation. This input is active with a whetting voltage and causes the control to perform a trip operation followed by a reclose operation. This input is active regardless of the state of the Supervisory function.
12	P4-12	Remote Trip and Lockout	Remote Trip and Lockout trips the recloser open and locks out the control. It can be used for tripping from external relays and alarms. A ***momentary*** signal is required for the event recorder to record a supervisory trip command. This input performs the same function as the TRIP (LOCKOUT) switch on the front panel and is active regardless of the state of the Supervisory function.

Standard and UDP Control DIF Module 1

Outputs

The 12 outputs of the DIF Module are Form C relay contacts. Six of the outputs are latching and six are non-latching.

Output	Connector	Function	Type	Description
1	P3-1 NC P3-2 NO	Normal Profile	Non-Latched	Normal Profile is active only when Alternate Profiles are inactive. Normal reclosing operations will follow.
2	P3-3 NC P3-4 NO	Non-Reclosing	Non-Latched	This output is active when the NON-RECLOSING indicator in the front panel is illuminated.
3	P3-5 NC P3-6 NO	Cold-Load Pickup Blocked	Non-Latched	This output is active when the COLD LOAD PICKUP BLOCKED indicator on the front panel is illuminated.
4	P3-7 NC P3-8 NO	Supervisory Blocked	Non-Latched	Supervisory Blocked prevents operation from supervisory control. Programming is accessible from the front panel. This output is active when the SUPERVISORY BLOCKED indicator on the front panel is illuminated.
5	P3-9 NC P3-10 NO	AC power	Non-Latched	Ac power indicator is active when the control detects the presence of ac power. This output is active when the ac power indicator on the front panel is illuminated.
6	P3-11 NC P3-12 NO	Control OK	Non-Latched	Control OK indicator is active when the control is able to perform protection operations. This output is active when the CONTROL OK indicator on the front panel is illuminated.
7	P2-1 NO P2-2 NC	Recloser Open	Latched	Recloser Open indicator is active when the recloser signals the control that the recloser contacts are open. This output is active when the RECLOSER OPEN indicator is illuminated.
8	P2-3 NO P2-4 NC	Hot Line Tag	Latched	With Hot Line Tag active, close circuit is disabled and the HOT LINE TAG indicator is illuminated. With Hot Line Tag inactive, the control switches back to the previous time current curve for the active profile, close circuit is enabled, and the HOT LINE TAG indicator is off. This output is active when the front panel indicator is illuminated.
9	P2-5 NO P2-6 NC	Ground Trip Blocked	Latched	Ground Trip Blocked causes the control to block ground tripping operations. This output is active when the GND TRIP BLOCKED INDICATOR on the front panel are illuminated.
10	P2-7 NO P2-8 NC	Alternate Profile 1	Latched	These outputs are active when the respective ALTERNATE PROFILE indicators on the front panel is illuminated.
11	P2-9 NO P2-10 NC	Alternate Profile 2	Latched	
12	P2-11 NO P2-12 NC	Alternate Profile 3	Latched	

Standard and UDP Control DIF Module 2

Inputs

The DIF inputs are factory-configured as momentary or maintained functions. Whetting voltage for the DIF inputs is supplied by the DIF module or by the user. The input voltage range is 12 to 120 Vac or Vdc.

Input	Connector	Function	Description
1	P4-1	Supervisory Fast Trips Disabled	This input performs the same function as the FAST TRIPS DISABLED key on the front panel and is inactive if the Supervisory function is disabled. This is a ***momentary*** function.
2	P4-2	Supervisory Reset Targets	This input performs the same function as the RESET TARGETS/RESET MAX CURRENT key on the front panel. This input is inactive if the Supervisory function is disabled. This is a ***momentary*** function.
3	P4-3	Supervisory Operation Counter OFF	The operation counter is disabled when this input is active with a ***maintained*** whetting voltage. This input is inactive if the Supervisory function is disabled.
4	P4-4	Supervisory Battery Test	This input performs the same function as the BATTERY TEST key on the front panel. This input is inactive if the Supervisory function is disabled. This is a ***momentary*** function.
5	P4-5	Supervisory SGF Blocked	This input is active with a ***momentary*** whetting voltage and causes the control to block or unblock sensitive ground fault operations. The input is inactive if the Supervisory function is disabled.

Standard and UDP Control DIF Module 2

Outputs

Output	Connector	Function	Type	Description
1	P3-1 P3-2	Control Lockout	Non-Latched	This output is active when the CONTROL LOCKOUT indicator is illuminated.
2	P3-3 P3-4	Check Battery	Non-Latched	This output is active when the CHECK BATTERY indicator is illuminated.
3	P3-5 P3-6	Reverse Power Flow	Non-Latched	This output is active when the REVERSE POWER FLOW indicator is illuminated.
4	P3-7 P3-8	Fast Trips Disabled	Non-Latched	This output is active when the FAST TRIPS DISABLED indicator is illuminated.
5	P3-9 P3-10	Operation Counter	Non-Latched	If the Supervisory function is enabled, this output is active when the OPERATION COUNTER OFF inputs from Comm Port 1-DIF2, Comm Port 2 and Comm Port 3 are not active.
6	P3-11 P3-12	Recloser Malfunction	Non-Latched	This output is active when the RECLOSER MALFUNCTION indicator is illuminated.
7	P2-1 P2-2	Bushings 1-2 Fault Target	Latched	This output is active when the BUSHINGS 1-2 FAULT TARGET indicator is illuminated.
8	P2-3 P2-4	Bushings 3-4 Fault Target	Latched	This output is active when the BUSHINGS 3-4 FAULT TARGET indicator is illuminated.
9	P2-5 P2-6	Bushings 5-6 Fault Target	Latched	This output is active when the BUSHINGS 5-6 FAULT TARGET indicator is illuminated.
10	P2-7 (ON) P2-8 (OFF)	Ground Fault Target	Latched	Output is active when the GROUND FAULT TARGET indicator is illuminated.
11	P2-9 (ON) P2-10 (OFF)	Sensitive Ground Fault Target	Latched	Output is active when the SENSITIVE GROUND FAULT TARGET indicator is illuminated.
12	P2-11 P2-12	Sensitive Ground Fault Blocked	Latched	Output is active regardless of the state of the Sensitive Ground Fault function.

INPUT ACCURACY

Sensed Currents

Phase Current—Individual Phase Currents:

Range: 1 to 10,000 A for 500:1 CTs

2 to 20,000 A for 1000:1 CTs

4 to 40,000 A for 2000:1 CTs

Accuracy: ± 1mA from 10 to 125 mA

0.8% from 125 to 1600 mA

(Control only, does not include sensor tolerance.)

Ground Current—Vector Sum of Three-Phase Currents:

Range: 1 to 5,000 A for 500:1 CTs

2 to 10,000 A for 1000:1 CTs

4 to 20,000 A for 2000:1 CTs

Accuracy: ± 3mA from 10 to 125 mA

2.4% from 125 to 1600 mA

(Control only, does not include sensor tolerance, but does include the phase current summing process.)

Sensed Source Voltages

Three-phase voltages used in voltage, power, and power-factor related calculations:

Voltage measurement accuracy:

± 0.4 V from 5 to 80 V

0.5% from 80 to 135 V

INSTALLATION PROCEDURE

Initial Programming Prior to Installation

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

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 5 interface software. Refer to *Service Information S280-79-2 Form 5 Microprocessor-Based Electronic Recloser Control Interface Software User's Guide* for detailed programming instructions.

Control / Recloser Compatibility

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 5 control is designed for use with reclosers equipped with Type B current-sensing Transformers, reclosers retrofitted with Form 5 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 and Form 5, Form 5 LS/UDP 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 5 control can be used with the old-style Type A CTs; however, the event recorder, data profiler, and duty cycle monitor will have limited accuracy for currents above 5000 A.

Retrofit kits with the new Type B sensing CTs are available to upgrade existing families of reclosers for operation with Form 5 controls. For additional information, contact your Cooper Power Systems representative.

For identification, Table 4 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 4
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

Mounting the Control

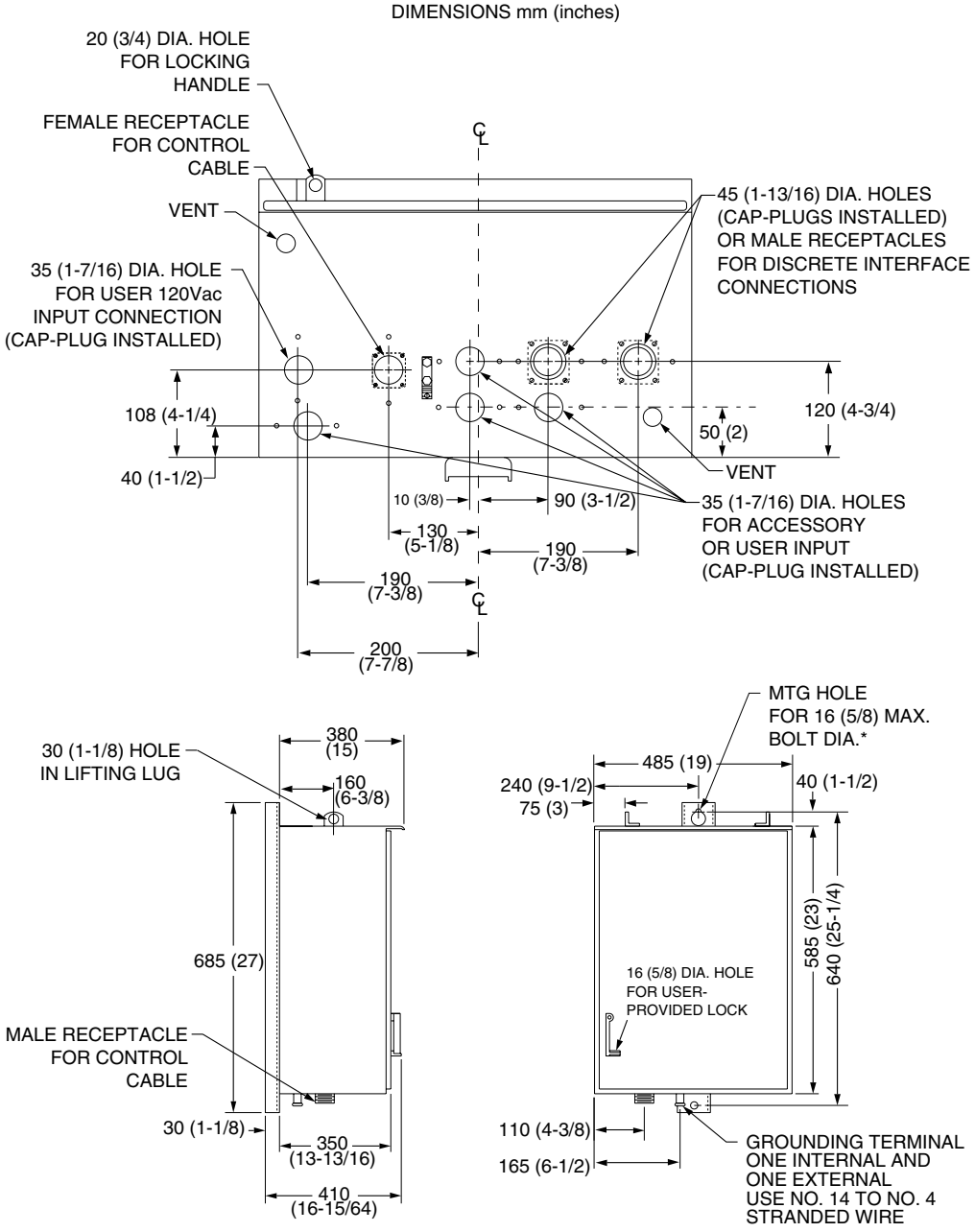
Mount the Form 5 recloser control in a convenient, accessible location. Mounting dimensions are provided in Figure 23.

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

Limits on control cable length are determined by the maximum distance between the control and recloser:

- Up to 125* feet for solenoid-operated reclosers (VWE, VWVE27, VWVE38X, WE, WVE27, WVE38X, and NOVA).
- Up to 35* feet for motor-operated reclosers (VSA12, VSA12B, VSA16, VSA20, VSA20A, VSO12, VSO16). Up to 135* feet for NOVA DC.

* These lengths are based on standard control cables. Consult your Cooper Power Systems representative if longer cable lengths are required.



CONTROL WEIGHT	52 kg (115 lbs)

* USER-PROVIDED HARDWARE

Figure 23.
Control cabinet mounting dimensions.

Control Cable

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

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

IMPORTANT: All external inputs to the Form 5 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.

Grounding the Control

The control cabinet must be grounded. A grounding connector on the underside of the cabinet will accommodate No. 14 solid through No. 4 stranded conductors. Suggested methods for grounding the control and recloser are shown in Figures 24 and 25.

It is important for effective surge protection that all control and power conductors for the Form 5 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.

Installation of the control 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.

IMPORTANT: In pole-mounted applications, a ground connection must be made between the transformer, recloser control, and SCADA equipment for proper protection of the equipment. The conductor size should be the same as the primary overhead conductor.

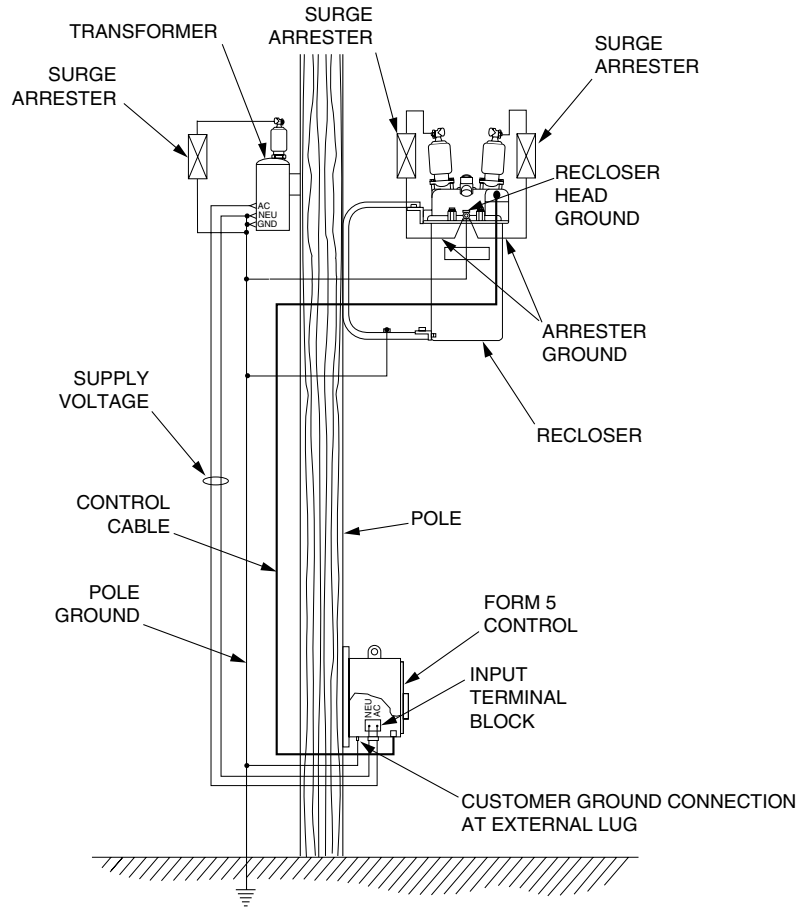


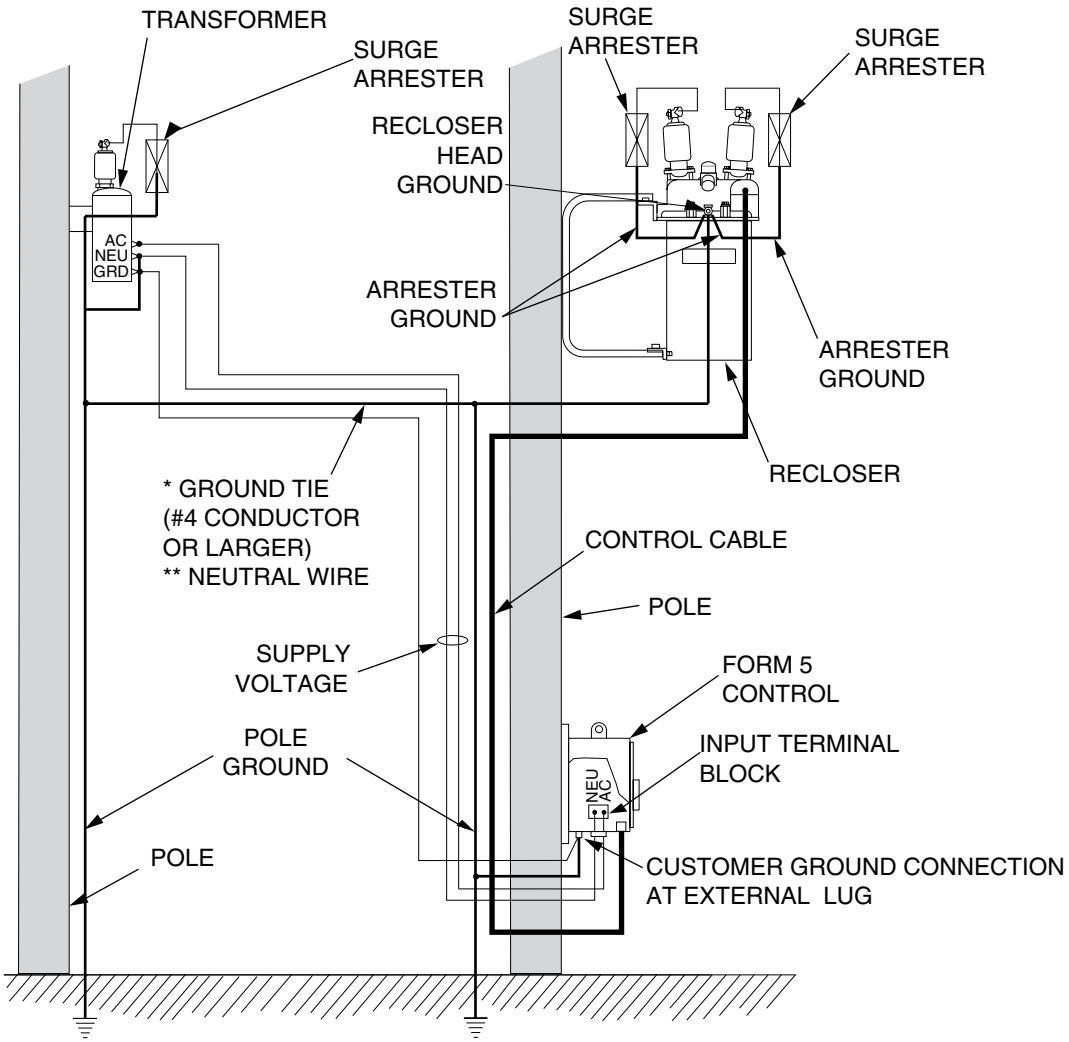
Figure 24.
Recommended grounding method for the Form 5 Control with local supply voltage transformer.

Installation of the control 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.

IMPORTANT: In pole-mounted applications, a ground connection must be made between the transformer, recloser control, and SCADA equipment for proper protection of the equipment. The conductor size should be the same as the primary overhead conductor.

IMPORTANT: All external inputs to the Form 5 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.



*3 WIRE UNGROUNDED SYSTEM
** 4 WIRE SYSTEM

Figure 25.
Recommended grounding method for the Form 5 Control 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 5 control is connected to terminal block TB1. (Located behind the operator panel, on the left side of the control. See Figure 26.)

Figure 26.
Terminal Connector Block TB1.

Input power is required:

- To power the control
- To provide voltage and power metering
- For voltage detection for loop scheme accessory
- For the low voltage closing accessory
- For the convenience outlet accessory

Power to the control is provided via the Power Supply module which is factory configured for either 120 or 240 Vac operation. The power supply module is factory wired to TB-1 and protected by the 2 A fuse labeled FU2 on the power supply front panel.

For a standard installation (Form 5 and Form 5 UDP) without voltage metering or loop scheme operation, connect the incoming source to TB-1 points 2 (hot) and 4 (neutral) for both Wye and Delta connections as shown in Figures 29 and 30.

Note: An out-of-service Form 5 or Form 5 UDP control can be powered by connecting to TB1-2 and TB1-4.

Metering

Customer voltage inputs for metering are field configurable on the RIF module to accept 12, 120, or 240 Vac. However, the voltage applied to B-phase must match the power supply rating. The default settings for the RIF are displayed on the module panel.

Metering connections are made for TB-1. See Figures 27 and 28. Source I is conventionally considered the source side of the recloser and Source II is considered the load side.

See **RIF Module Configuration** section of this manual.

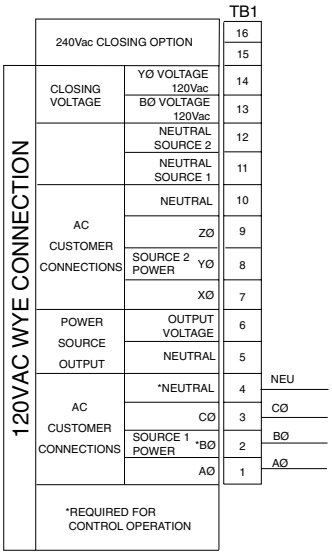


Figure 27.
Customer metering connection diagram for wye-connected systems.

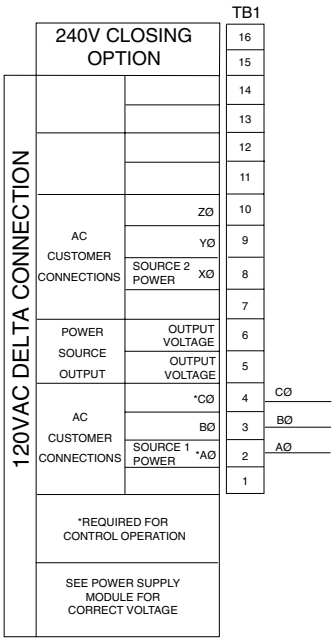


Figure 28.
Customer metering connection diagram for delta-connected systems.

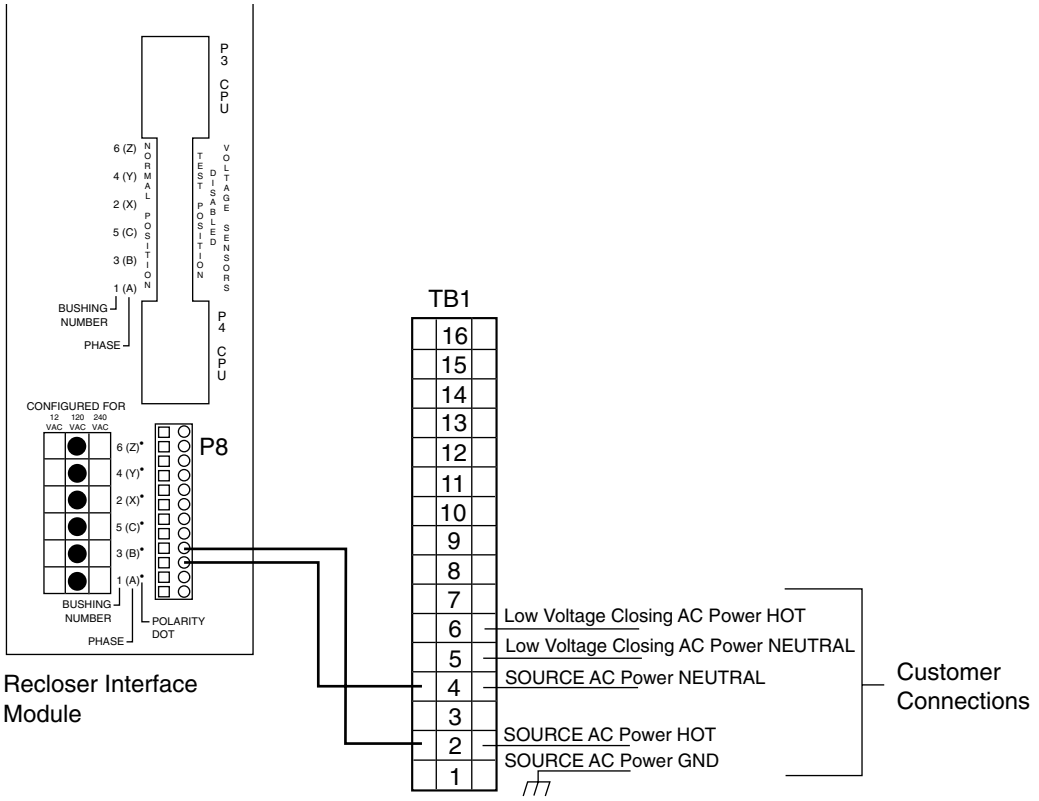


Figure 29.
Form 5 and Form 5 UDP Power and Low Voltage Closing customer connections to terminal block TB1 (Wye Connection).

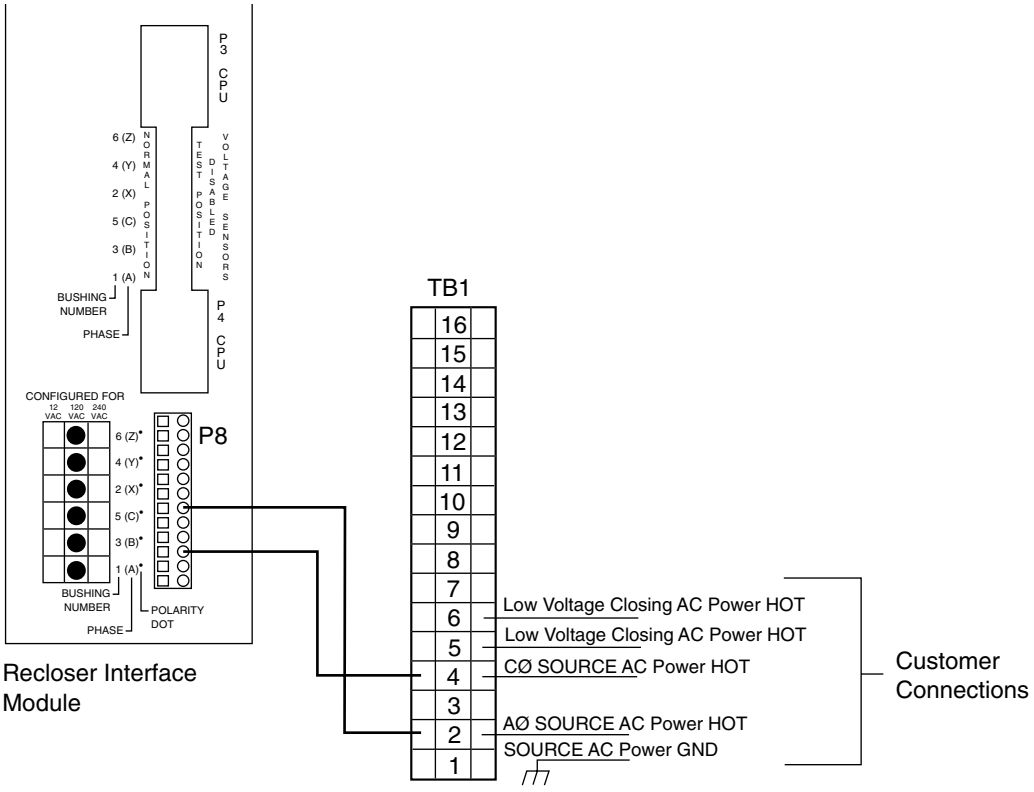


Figure 30.
Form 5 and Form 5 UDP Power and Low Voltage Closing customer connections to terminal block TB1 (Delta Connection).

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

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

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

1. Control properly mounted for the installation.
2. Recloser installed according to all locally approved standards and practices.
3. Control and recloser properly grounded in accordance with guidelines in this manual.
4. Control cable properly connected and supported.
5. Control battery connected.
6. Ac power connected to the control (ac power LED indicator is ON).
7. All control programming entered and verified by appropriate personnel.
8. Control clock set to the correct time. (Refer to the Setting the Control Clock section in *Service Information S280-79-2, Form 5 Recloser Control Programming Guide*.)
9. Customer connections for remote and supervisory operation checked and completed in accordance with proper shielding and surge protection.

TESTING AND TROUBLESHOOTING

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 5 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 5 control can be performed while connected to an operating recloser. These are the only tests performed on an installed, operating control. All other tests described in this TESTING AND TROUBLESHOOTING section require the Form 5 control to be removed from service, connected to a bypassed recloser, or tested at a location where the proper testing equipment is available.

1. Turn on the front panel display press the CHANGE/LAMP TEST button on the control front panel.
2. Scroll through the LCD display messages as described in the *LCD Display Messages* section of these instructions. (See **Form 5 Control Front Panel** section of this manual.)

   Check the operational values for currents, voltages, and other metering information.
3. Check that the LED for ac power is illuminated on the control front panel. This indicates the presence of ac power.
4. Test battery operation using the procedures described in the **Battery Test Procedure** section of these instructions.

Check CPU Status

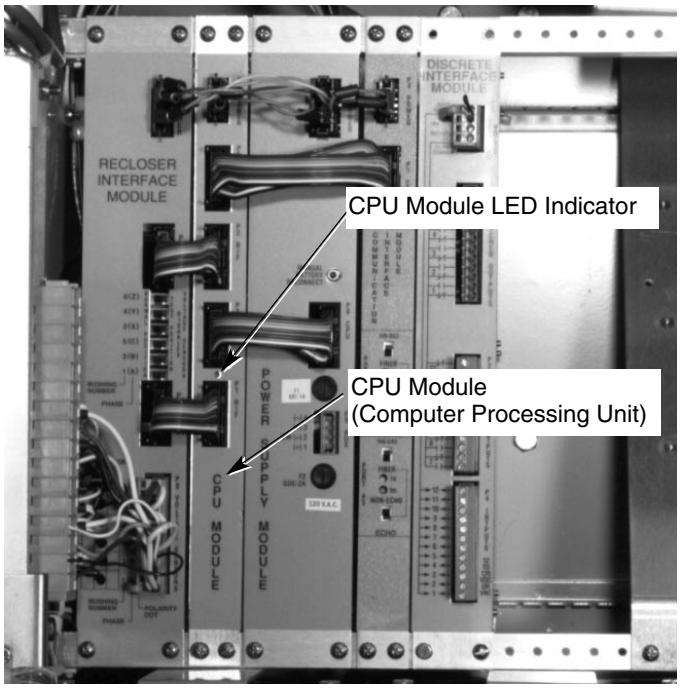
Check the operating status CPU module. Open the cabinet door and locate the LED indicator (see Figure 31).

The LED indicator on the CPU module should flash at a rate of one flash per second for normal operation.

Testing With Type MET Tester

IMPORTANT: The Form 5 DC NOVA control cannot be tested with the standard Kyle MET Tester. A junction box accessory for the MET tester is available for testing the Form 5 DC NOVA control.

The Kyle Type MET Electronic Recloser Control Tester is used for testing the Form 5 control. See Figure 32.



970022KM

Figure 31.
Form 5 control CPU module.

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

IMPORTANT: When the control is open and current is present, the Trip Fail detection circuit in the Form 5 Control will activate when the Kyle Type MET Tester CALIBRATE switch is ON. Depress and hold the RESET TARGET keypad on the control for three seconds to reset the condition.

010028KM

Figure 32.
Kyle Type MET electronic recloser control tester.

Closing The Recloser During Testing

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

Electrical Closing—Solenoid-Operated Reclosers

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

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

For on-line testing, bypass the recloser, open the load-side disconnects, and keep the source-side disconnects closed. This will remove the recloser from service, but will keep line voltage supplied to the closing solenoid (Figure 35).

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

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

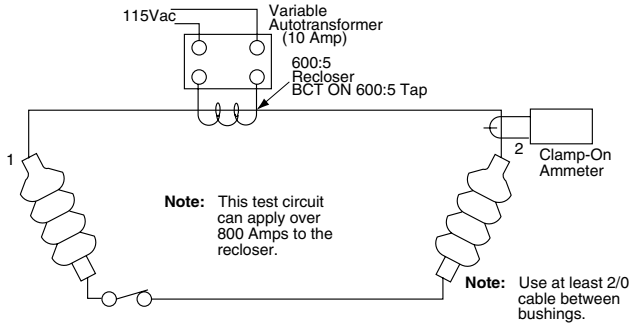


Figure 33.
Alternate method of producing variable line current (substitute for T2 and W-X circuit in Figures 34 and 36).

Electrical Closing—Motor-Operated 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 energized from a 230 Vac power source. For information on energizing the recloser, refer to the appropriate motor-operated recloser installation manual.

Figure 34 shows a test circuit for motor-operated reclosers. Since these reclosers require only a 240 Vac 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 33.

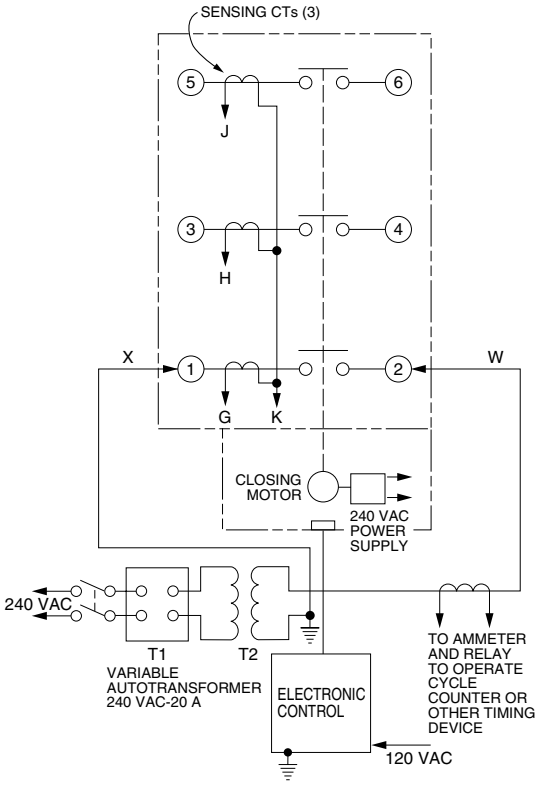


Figure 34.
Suggested test circuit for motor-operated reclosers.

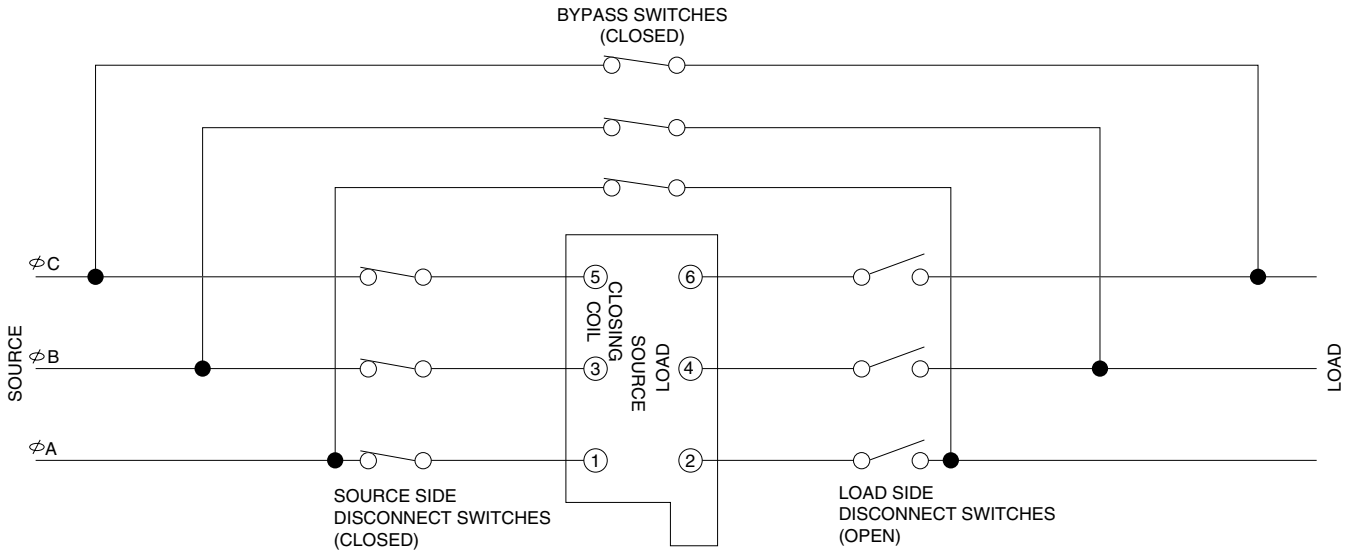


Figure 35.
Closing source-side switches of a bypassed "on-line" recloser provides closing solenoid power for automatic operation during testing.

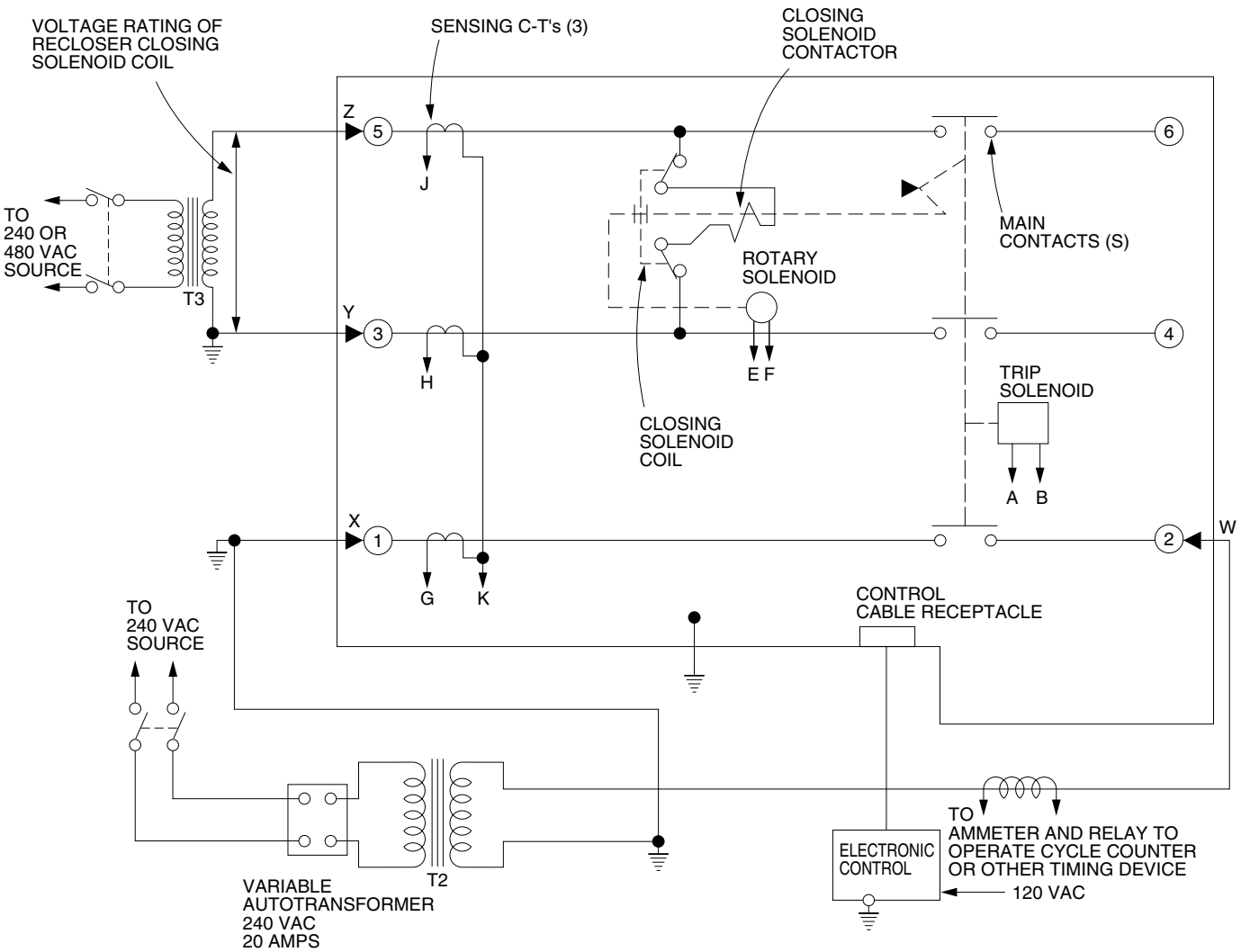


Figure 36.
Suggested test circuit for solenoid-closing reclosers.

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

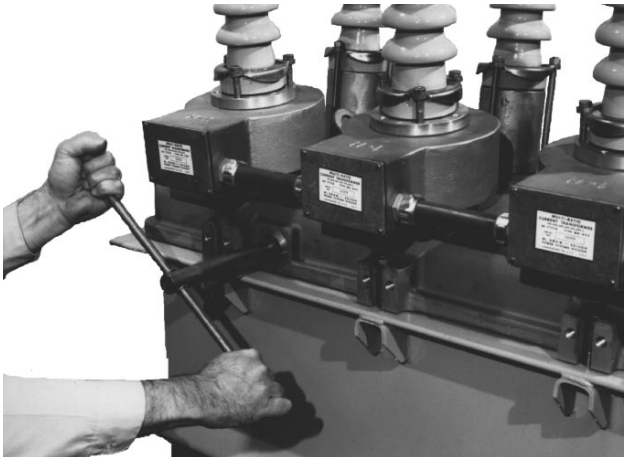
If high voltage for operating the closing solenoid is not available, manual closing can be substituted for electrical closing. However, not all control settings can be checked since manual closing is not synchronized with the closing coil control circuit in the control.

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 37).



82284KMA-F

Figure 37.
Using a manual closing tool to operate the recloser.

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.

Remove the Form 5 Control from Service

IMPORTANT: Disconnect switches for ac sensing and power connections are necessary to isolate the Form 5 Recloser Control for testing and servicing.

1. Enable GND TRIP BLOCKED to allow for ground trip to be disabled when re-energized.
   - **A.** Press the CHANGE/LAMP TEST key on the Operator Panel to enter the CHANGE mode.
     Note: The LCD Display Screen will indicate the amount of time available in CHANGE mode to make a change.
   - **B.** Depress the GND TRIP BLOCKED key.
     Note: After the GND TRIP BLOCKED key is depressed, the red LED indicator will illuminate to indicate GROUND TRIP BLOCKED is active.
2. Unplug the control battery.
3. Remove control ac sensing and power connections from the control using a separate disconnect switch.

WARNING: Hazardous voltage. If the recloser is energized while the control cable is disconnected, the CT secondaries can generate high voltages. Contact with high voltage can cause severe personal injury or death. T204.2

CAUTION: Personal Injury. Allow approximately 10 minutes for the 53 Vdc to dissipate from the 19-pin control cable connected to a control-powered NOVA recloser after the power to the recloser has been disconnected. Touching any of the 19 pins in the male end of the control cable plug prior to the dissipation of the 53 Vdc can result in personal injury or equipment damage. T302.0

5. Disconnect control cable from the control.
   Note: If the control is connected to a control-powered NOVA recloser, wait approximately 10 minutes for the 53 Vdc to dissipate from the control cable before touching the pins in the male end.
6. Disconnect the ground from the control.

Return the Form 5 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 the service shop, appropriate personnel must verify that all control settings are correct.
2. Reconnect the control cable to the control.
3. Control cable properly connected and supported.
4. Plug in the control battery.
5. Apply ac power to the control.
6. Disable GND TRIP BLOCKED.
   - **A.** Press the CHANGE/LAMP TEST key on the Operator Panel to enter the CHANGE mode.
     - **Note:** The LCD Display Screen will indicate the amount of time available in CHANGE mode to make a change.
   - **B.** Depress the illuminated GND TRIP BLOCKED key.
     - **Note:** After the GND TRIP BLOCKED key is depressed, the red LED indicator will no longer be illuminated indicating GROUND TRIP BLOCKED is not active.
7. Reset the control clock after ac power has been reapplied. Refer to **Setting the Control Clock** section in *Service Information S280-79-2, Form 5 Recloser Control Programming Guide*.

ADDITIONAL INFORMATION

Replacement Kits

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 for the Kyle Form 5 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 ordering 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 5 Microprocessor-Based Electronic Recloser Control and Reclosers. 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

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