

Kyle® Form 5, Form 5 UDP, Form 5 DC NOVA Microprocessor-Based Recloser Controls Installation and Operation Instructions

Service Information
S280-79-10

Applicable to serial numbers above 3000 or beginning with CP57.



Figure 1.
Kyle® Form 5/UDP microprocessor-based recloser control.

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SAFETY FOR LIFE



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

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

SAFETY INFORMATION

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


A competent technician has these qualifications:


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


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

Hazard Statement Definitions

This manual may contain four types of hazard statements:

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


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


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


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


Safety Instructions

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

 **DANGER:** Hazardous voltage. Contact with hazardous voltage will cause death or severe personal injury. Follow all locally approved safety procedures when working around high 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 S280-79-10 provides installation and operation instructions for the Kyle Form 5 and Form 5 UDP microprocessor-based electronic recloser controls.

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

ISO 9001:2000-Certified Quality Management System

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 24 Vdc control battery in the Form 5 control is fully charged prior to shipment and is ready for use. In order to maintain sufficient charge to operate the control, the sealed lead acid battery should be charged after no more than three months of storage.

Note: Two 12 Vdc, 13 amp-hour batteries are available for use with the Form 5 Distribution Automation upgrade accessory.

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.

To keep the battery charged, energize the control's built-in charger with AC power applied to the user AC supply input connector block TB1, 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.

Battery Replacement

The 24 Vdc control battery has a life expectancy of 4 to 6 years. It is recommended that the battery be replaced after 4 years.

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/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 behind the operator panel of the control. A sealed, 24-volt, lead acid battery 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

If the control is equipped with the standard 24 Vdc lead-acid battery, the control maintains full operation from the battery power supply for a minimum of 32 hours at 20°C (24 hours at -40°C). To prevent battery damage, the control shuts down automatically upon detection of low battery voltage below 22.7 Vdc.

Control programming settings and parameters—including event recorder, duty monitor, and data profile metering parameters—are stored in non-volatile memory and retained upon loss of control power. The time/date clock resets to **0:00:00, 1970** upon loss of control power.

The AC power LED indicator on the operator panel of the control will turn off after 15 seconds upon loss of AC power. The indicator will illuminate immediately upon return 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. Refer to 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.

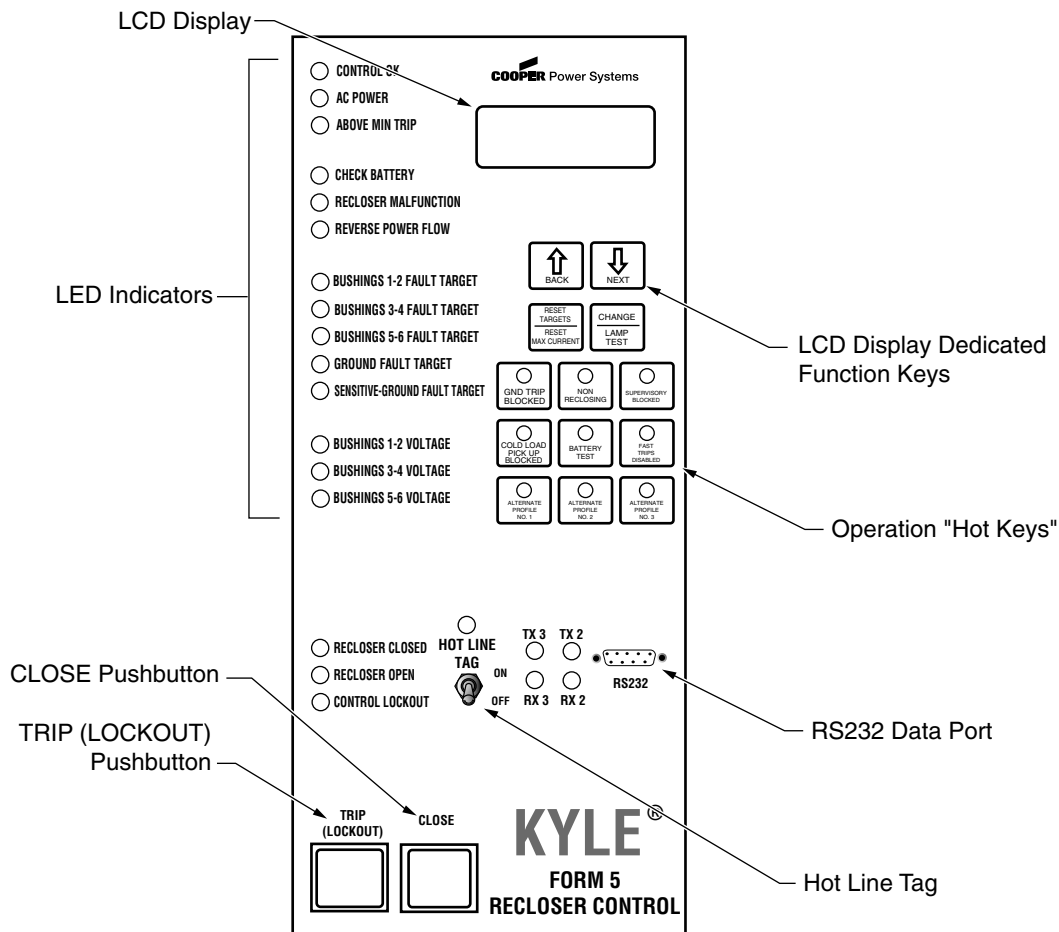


Figure 2.
Form 5 recloser control operator panel.

FORM 5 CONTROL DESCRIPTION

Current sensing is provided by three current transformers located in the recloser and interfaced to the Form 5 control via the control cable. This cable also supplies Trip, Close, and Recloser status, and connects to the Recloser Interface (RIF) module to provide isolation for reliable operation. Voltages for metering are 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 reclose, and the control resets to the start of its operating sequence after a preset time delay. If the fault is permanent, the control performs its complete programmed sequence of reclose commands and locks out with the recloser open. Once locked out, the control must be closed via the operator panel or SCADA communications. This resets the control to the start of the operating sequence.

The following chain of events occurs for an operating sequence of two trips to lockout:

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 restarted.

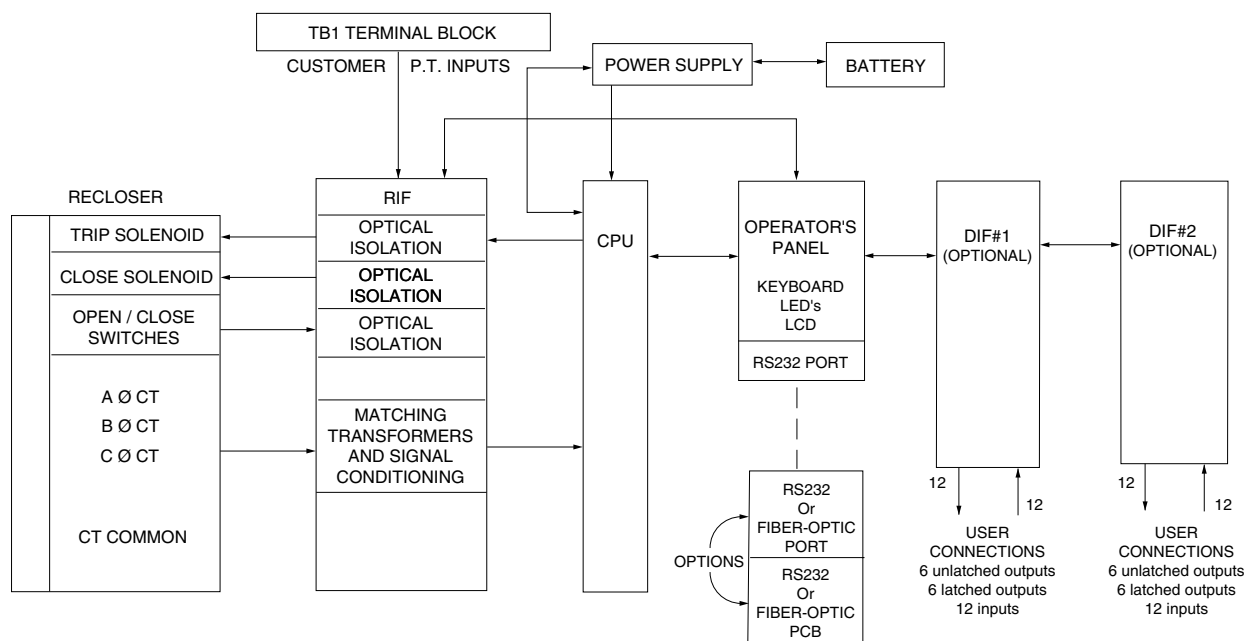


Figure 3.
Form 5 control operational flow diagram.

The Form 5 control is constructed in a modular fashion to simplify service and the addition of accessories (Figure 4). The standard configuration incorporates a Central Processing Unit (CPU) module, power supply module, Recloser Interface (RIF) module, and an operator panel.

Discrete Interface (DIF) module(s), the fiber-optic board and the RS-232 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, NOVA group, VSA/VSO group, and KFME/KFVME (50Hz) group.

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. Two sets of dip switches, located on the RIF front panel, utilize different switch positions to configure the desired voltage. See Figure 17.

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

Central 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.

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 can be customized for a remote or supervisory function. One Form 5 control can accommodate two DIF modules. See **DISCRETE INTERFACE (DIF) ACCESSORY** section of this manual.

Power Supply Module

The Power Supply module is designed to accept 100 to 134 Vac or 200 to 268 Vac user-supplied input power at either 50 or 60 Hz.

The Power supply module (connection P9) provides auxiliary power to radio communications units, RTUs and other accessories. The auxiliary output provides 24 Vdc (12 Vdc is available) for user loads. The auxiliary power supply has the capability to provide a load of up to 40 W peak (1 second) and 3 W average. The auxiliary power is fused and current-limited to prevent user loads from disabling the control.

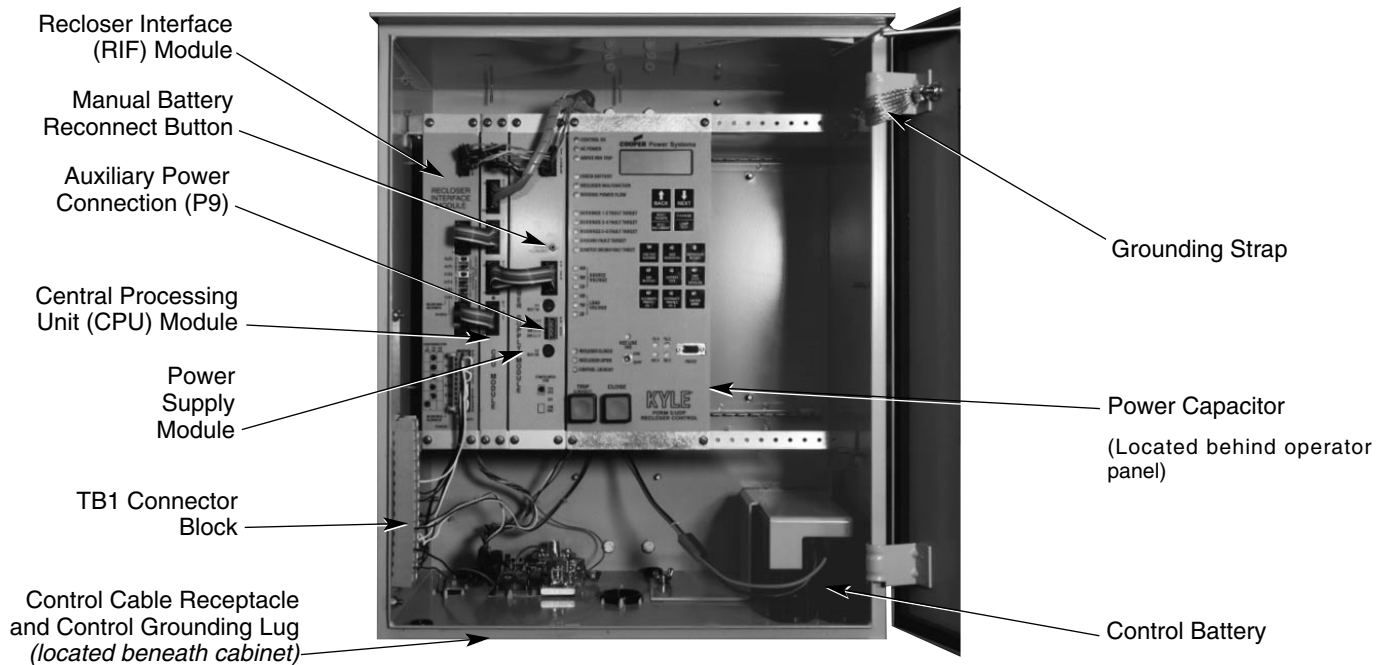


Figure 4. Form 5 UDP control operating panel with interface modules and radio mounting provisions.

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Form 5 Control Operator Panel

The Form 5 control operator panel (Figure 8) allows local operation and status interrogation through built-in operator controls and status displays. The operator panel contains LED indicators, operational pushbuttons, membrane-type functional/indication switches, backlit LCD display, and Hot Line Tag switch with indication. An RS-232 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 5 minutes of operator 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.

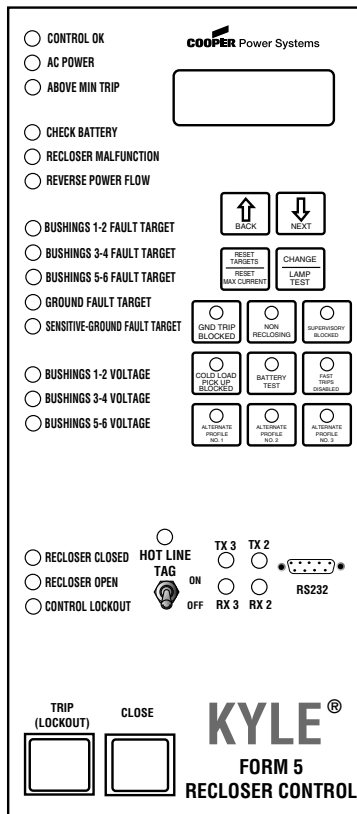


Figure 5. Form 5 control operator panel.

LED Indicators

The operator panel LED indicators (Figure 5) give instant information on the control and recloser status.

LED indicators include:

CONTROL OK

This green LED 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 LED is illuminated when the presence of ac input power to the control is sensed. The LED will turn off if ac power is lost for more than 10 seconds.

ABOVE MIN TRIP

This red LED 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.

CHECK BATTERY

This red indicator illuminates for two conditions:

1. Battery voltage is below 20 Vdc or drops 2Vdc or more during battery test.
2. 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 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.

REVERSE POWER FLOW

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

Note: Voltage sensor polarity and phase must be correct for reverse power flow to function properly.

BUSHINGS 1-2 FAULT TARGET

BUSHINGS 3-4 FAULT TARGET

BUSHINGS 5-6 FAULT TARGET

GROUND FAULT TARGET

SENSITIVE GROUND FAULT TARGET

These red target LEDs 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 or manual reset is accomplished by pressing the RESET TARGETS button on the control operator panel.

BUSHINGS 1-2 VOLTAGE

BUSHINGS 3-4 VOLTAGE

BUSHINGS 5-6 VOLTAGE

These red voltage LEDs 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.

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.

Note: The RECLOSER MALFUNCTION, RECLOSER OPEN, RECLOSER CLOSED, and RECLOSER LOCKOUT LEDs will flash upon detection of a trip failure. See the **Control Features** section of this manual.

TRIP (Lockout) Pushbutton

The TRIP pushbutton (Figure 2) provides front-panel access to trip (lockout) the recloser. When pressed, the TRIP push-button opens the recloser and locks out the control.

CLOSE Pushbutton

When pressed, the CLOSE pushbutton (Figure 2) returns the control to the initial or home position, closing the recloser. The control is ready for the start of a new trip/close sequence.

Note: Pressing the CLOSE pushbutton from the Lockout position, will initiate Cold Load Pickup (CLPU) protection, if the feature is first enabled from the interface software Protection Profile screen, and the COLD LOAD PICKUP BLOCKED LED on the operator panel is *not* lit.

If the recloser is closed, pushing the CLOSE pushbutton has no effect on the control. Depressing and holding the CLOSE pushbutton does not activate the Cold Load Pickup feature. See *Cold Load Pickup* in the **Control Features** section of this manual.

The Form 5 control has a Manual Close Delay feature that provides an interval of time from when the CLOSE pushbutton is depressed to the time when manual close operation is performed. See **Manual Close Delay** in the **Control Features** section of this manual.

LCD Display

The control operator panel has a large, backlit LCD display (Figure 6) used for viewing control parameters and monitoring system conditions. Data is organized into screens of information, with each display containing four lines of information, with up to 20 characters per line. Access to the screens 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 Screen 1. Refer to **LCD Display Screens** section of this manual.

NEXT Key

Pressing the NEXT key causes the LCD display to scroll to the next screen of available information. Pressing and holding the NEXT key causes the control to scroll to subsequent screens at the rate of about two screens per second.

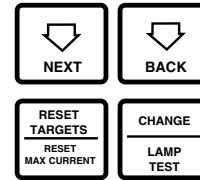


Figure 6.
LCD display and dedicated function keys.

BACK Key

Pressing the BACK key causes the LCD display to scroll to the previous screen of available information. Pressing and holding the BACK key causes the control to scroll to previous screen.

RESET TARGETS/RESET MAX CURRENT Key

Pressing the RESET TARGETS/RESET MAX CURRENT key resets the fault target indicators on the control operator panel. The fault current values shown on Screen 2 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 current and histogram values in LCD Display screens 34 through 37. This key will also reset the Trip Failure Detection feature. See the **Control Features** section of this manual.

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 operator panel. Security is enhanced by permitting a *only one* 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 state. While in the Lamp Test Mode, the control response to operator panel keys is disabled, except for the TRIP (LOCKOUT), CLOSE, and HOT LINE TAG switches.



LCD Display Screens

Every LCD display screen 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 screen. Demand metered values are indicated by (D) and instantaneous values by (I).

Screen 1 – Instantaneous Load Current

Screen 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

Screen 2 – Fault Targets

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

Screen 3 – Frequency Trip

3 Freq Trip	_____	Hz
Time	Date	
Present Freq	_____	Hz

Screen 4 – Voltage Trip

4 Ph1-N VTrip	_____	V
Ph3-N VTrip	_____	V
Ph5-N VTrip	_____	V
Time	Date	

Screen 5 – Power kWh

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

Screen 6 – S1 Phase-to-Neutral, Instant. Voltage

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

Screen 7 – S1 Phase-to-Phase, Instant. Voltage

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

Screen 8 – S2 Phase-to-Neutral, Instant. Voltage

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

Screen 9 – S2 Phase-to-Phase, Instant. Voltage

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

Screen 10 – Instantaneous Voltage

10 Instant S1-S2		
Ph1-2 Dif	_____	V
Ph3-4 Dif	_____	V
Ph5-6 Dif	_____	V

Screen 11 – Real Power

11 Tot	_____	kW
Ph1-2	_____	kW
Ph3-4	_____	kW
Ph5-6	_____	kW

Screen 12 – Instantaneous kVA

12 Tot	_____	kVA
Ph1-2	_____	kVA
Ph3-4	_____	kVA
Ph5-6	_____	kVA

Screen 13 – Instantaneous kVAR

13 Tot	_____	kVAR
Ph1-2	_____	kVAR
Ph3-4	_____	kVAR
Ph5-6	_____	kVAR

Screen 19 – Demand Phase-to-Neutral Voltage

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

Screen 14 – Instantaneous Power Factor

14 Tot	_____	PF
Ph1-2	_____	PF
Ph3-4	_____	PF
Ph5-6	_____	PF

Screen 20 – Demand Phase-to-Phase Voltage

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

Screen 15 – Instantaneous Total Harmonic Distortion Current

15 Gnd	_____	%THDI
Ph1-2	_____	%THDI
Ph3-4	_____	%THDI
Ph5-6	_____	%THDI

Screen 21 – Demand Voltage

21 Demand S1-S2		
Ph1-2(d)	_____	V
Ph3-4(d)	_____	V
Ph5-6(d)	_____	V

Screen 16 – Instantaneous Total Harmonic Distortion Voltage

16 Instant S1 Ph-N		
Ph1-N	_____	%THDV
Ph3-N	_____	%THDV
Ph5-N	_____	%THDV

Screen 22 – Demand Current

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

Screen 17 – Demand Phase to Neutral Voltage

17 Demand S1 Ph-N		
Ph1-N(d)	_____	V
Ph3-N(d)	_____	V
Ph5-N(d)	_____	V

Screen 23 – Demand kW

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

Screen 18 – Demand Phase-to-Phase Voltage

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

Screen 24 – Demand kVA

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



Screen 25 – Total kVAr and kVAr per Phase

25 Tot	_____	kVAr
Ph1-2(d)	_____	kVAr
Ph3-4(d)	_____	kVAr
Ph5-6(d)	_____	kVAr

Screen 26 – Demand Power Factor

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

Screen 27 – Demand THD Current

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

Screen 28 – Demand THD Voltage

28 Demand S1 Ph-N		
Ph1-N(d)	_____	%THDV
Ph3-N(d)	_____	%THDV
Ph5-N(d)	_____	%THDV

Screen 29 – Number of Trips for Ground and Phase

29 Gnd OC Trip	_____
Ph1-2 OC Trip	_____
Ph3-4 OCTrip	_____
Ph5-6 OC Trip	_____

Screen 30 – Number of SGF Trips and Total Trip Operations

30 SGF OC Trip	_____
Operations	_____

Screen 31 – 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.

31 Battery Monitor	
Normal	_____ V
Normal	_____ mA
Test	_____ V

Screen 32 – 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.

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

Screen 33 – 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.

33 Gnd MT	_____ A
Alt1 MT	_____ A
Alt2 MT	_____ A
Alt3 MT	_____ A

Screen 34 – Ground Max, Phase 1-2 Max Demand Currents

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

Screen 35 – Phase 3-4 Max, Phase 5-6 Max Demand Currents

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

Screen 36 – Ground Min, Phase 1-2 Min Demand Currents

36 Gnd Min	_____A
Time	Date
Ph1-2 Min	_____A
Time	Date

Note: Demand currents are a time integrated value and do not reflect minimum or maximum instantaneous currents. The demand integration time constant is set via the interface software demand metering screen. These are the same values displayed in the histogram screen.

Screen 37 – Phase 3-4 Min, Phase 5-6 Min Currents

37 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 Demand values.

Screen 38 – Fault Location

38 Fault Location	
Distance	_____miles
	<Control Identification>
Time	Date

Screen 39 – Control Information

39 CPU Firmware	X.XX
Firmware FW Database	X
	<Control Identification>
Time	Date

Screen 40 – 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.

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

Screen 41 – 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.

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

Operation/Indication Pushbuttons

Nine frequently used features are provided on the control operator panel (Figure 7).

Note: These features are activated from the keypad, control interface software or SCADA signal.

To initiate an operation from the operator panel, press the CHANGE/LAMP TEST key to enter the CHANGE mode. The operator has 10 seconds to select an operation and modify settings. If no changes are made, the control will return to its operational state prior to entering the CHANGE mode. This prevents accidental changing of settings.

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 operator panel.

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

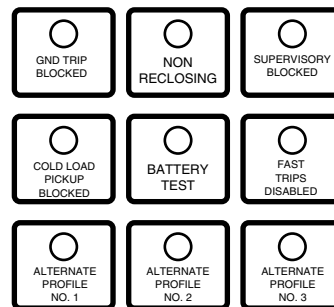


Figure 7.
Operation/indication pushbuttons.

GND TRIP BLOCKED

Ground Trip Blocked is activated by pressing the CHANGE/LAMP TEST key, then pressing the GND TRIP BLOCKED key. The red indicator illuminates.

NON RECLOSING

Non-reclosing mode disables any automatic reclosing operations. Non-reclosing does not alter the active TCC. The feature is activated by pressing the CHANGE/LAMP TEST key, then pressing the NON RECLOSING key. The red indicator illuminates.

SUPERVISORY BLOCKED

Supervisory Blocked disables supervisory SCADA and the interface software; remote SCADA remains active. 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.

Activation of the feature is restricted to the operator panel keypad by pressing the CHANGE/LAMP TEST key, then pressing the SUPERVISORY BLOCKED key.

COLD LOAD PICKUP BLOCKED

The Cold Load Pickup feature is blocked while the COLD LOAD PICKUP BLOCKED is active. 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.

Note: The Cold Load Pickup Blocked key is replaced by the SENSITIVE GROUND FAULT key on international controls.

BATTERY TEST

Depressing the BATTERY TEST key performs a control battery test. The red indicator illuminates and turns off automatically when the control has finished performing the test. Refer to the Battery Test Procedure 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.

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. During control operation, if the three alternate profile indicator lights are not illuminated, 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 communications interfaces.

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

Note: The minimum trip values for each protection profile are shown on Screens 32 and 33 of the LCD display. Check these minimum trip values prior to changing an alternate profile to avoid misoperation of the control under load conditions.

Note: On Form 5 UDP controls, Alternate Profile 3 is replaced with SWITCH MODE.

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 closing.

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

The Hot Line Tag feature (Figure 8) consists of a toggle switch and an 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 operator panel toggle switch to the ON position, or via SCADA command. Hot Line Tag is activated from the operator panel, communication Port 2, communication Port 3, or a Discrete Interface Module (DIF). All sources must be off to de-activate Hot Line Tag.

The Hot Line Tag feature may only be reset by the source which initiates the function. For example, if Hot Line Tag is activated at the operator panel, resetting the function is only possible at the operator panel, and not via SCADA command. For SCADA, Hot Line Tag must be disabled via the same port number where Hot Line Tag was originally enabled.



Figure 8.
Hot Line Tag Switch.

RS-232 Communication Port

The standard Form 5 control is equipped with a operator panel RS-232 port for interface with a personal computer running the Form 5 interface software program. This nine-pin female data communication equipment (DCE) Port 1 permits the uploading of all programming information stored in the control, including protection profiles, event recorder, data profiles, alarms, counters, and metering information. Port 1 provides a simple means to download operating parameters from a personal computer to the control. The protocol, baud rate and address for Port 1 are identified from the LCD display.

If a fiber-optic or RS-232 accessory board is connected to Port 2 (located on the back of the operator panel) any external electrical connection from the operator panel will disable the accessory board.

Note: The operator panel RS-232 port is intended only for temporary connection of a personal computer. Permanent serial communications must be made via the RS-232 or fiber-optic accessory board.

Battery Test Procedure

The condition of the control battery is tested by depressing the BATTERY TEST hot key on the operator panel. No external current/voltage meter is necessary for testing.

The control performs a self-test every 12 hours or when initiated by an external command. When a battery test is initiated, the spurious charge is first drained to allow the battery voltage to equalize. A 10-ohm, 55-watt 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 volts, 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 Screen 31, the Battery Monitor screen.
2. Record the NORMAL VOLTS and NORMAL CURRENT readings from the screen.

Note: Voltage should be between 25 to 31 volts with higher readings at colder temperatures. Under normal conditions with ac connected and the battery trickle charging, the current should read less than 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 -180 mA to -600mA depending on accessories connected.

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.

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 includes *any single-phase, all three phases, and single-phase with three-phase inhibit*. Response 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 panel or with the interface software or SCADA (Figure 9). Each profile has 14 TCC specifications plus reclose intervals, sequence coordination and reset times to maintain independent protection parameters.

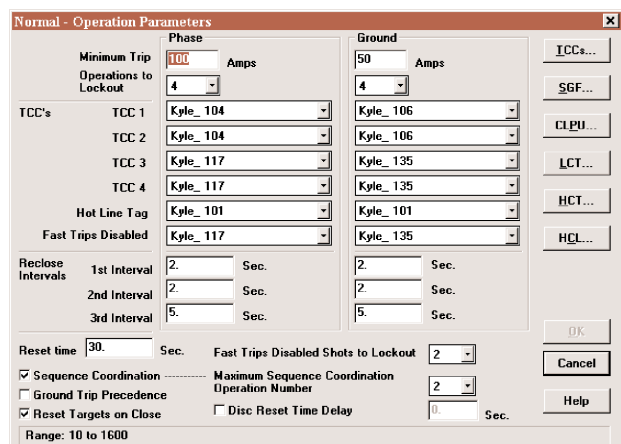


Figure 9. Interface software sample protection profile.

Power Metering

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

Power Factor Sign Metering

This feature allows a user to configure the sign that is applied to the power factor. The user may select between the standard definition of power factor (cosine of angle between current and voltage) or the Cooper Power Systems default of the power factor sign following power flow.

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 operator panel, interface software, or serial communications. This reference is changed by selecting the voltage sensor correction in the “Hardware” setup portion of the interface software.

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 9.

Trip Failure Detection

The Trip Failure Detection feature is an internal diagnostic alarm for verifying the proper operation of circuit tripping and fault clearing of the recloser. Trip Failure detection indicates the recloser has failed to trip all phases following a trip signal from the control. Failure to trip is assumed if a current of at least 10 Amps is detected approximately 2 seconds after the trip signal is initiated.

Upon activation of the feature, these four LEDs flash 1 second on, 1 second off (Figure 10):

- RECLOSER MALFUNCTION
- RECLOSER CLOSED
- RECLOSER OPEN
- CONTROL LOCKOUT

⚠ DANGER: Explosion. Stay clear of a recloser that is in a trip failure mode. A recloser in trip failure mode may explode resulting in death or severe personal injury. T271.0

⚠ WARNING: Hazardous voltage. This device is not a substitute for a visible disconnect. Follow all locally approved safety practices. Failure to follow proper safety practices can result in contact with high voltage, which will cause death or severe personal injury. G112.1

- AC POWER
- ABOVE MIN TRIP
- CHECK BATTERY
- RECLOSER MALFUNCTION
- REVERSE POWER FLOW
- BUSHINGS 1-2 FAULT TARGET
- BUSHINGS 3-4 FAULT TARGET
- BUSHINGS 5-6 FAULT TARGET
- GROUND FAULT TARGET
- SENSITIVE-GROUND FAULT TARGET
- BUSHINGS 1-2 VOLTAGE
- BUSHINGS 3-4 VOLTAGE
- BUSHINGS 5-6 VOLTAGE

- RECLOSER CLOSED
- RECLOSER OPEN
- CONTROL LOCKOUT

Figure 10. RECLOSER MALFUNCTION, RECLOSER CLOSED, RECLOSER OPEN and CONTROL LOCKOUT LEDs will blink for the affected phase as indication of Trip Failure.

IMPORTANT: The recloser must be isolated and de-energized immediately upon detection of trip failure. Follow proper procedures and safety practices to isolate and de-energize the recloser.

The Trip Failure Detection alarm may be triggered from many potential sources including mechanical, electrical, control, or interrupter failure. Interrupter failure may include loss of vacuum in a vacuum interrupter.

To clear Trip Failure Alarm, depress and hold the RESET TARGETS/RESET MAX CURRENTS keypad for 3 seconds. This also resets targets and demand currents.

Note: There is no remote reset available with the trip failure detection feature. It cannot be remotely turned off.

When the trip failure alarm is activated, an event is recorded and a status alarm activated (if enabled) and preserved during system resets.

To test the Trip Failure Detection feature, see **Testing With Type MET Tester** in the **TESTING AND TROUBLESHOOTING** section of this manual.

Manual Close Delay

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

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

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

The default setting has the feature disabled (0 seconds). The RECLOSER CLOSED LED indicates the status of the feature. See Figure 11.



Figure 11.
The blinking of the RECLOSER CLOSED LED indicates Manual Close Delay is active.

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 operator panel display (Figure 12) while complete analysis, including graphing capabilities, is provided from the Form 5 interface software.

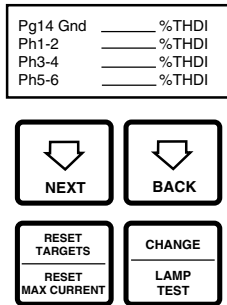


Figure 12.
Form 5 operator panel harmonic readout.

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 illuminates an operator-panel indicator. Response time to a reverse power condition is one second. An alarm is also available for remote interrogation.

Note: Voltage sensor polarity must be correct for reverse power flow to function properly.

Event Recorder

The Event Recorder maintains a 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. When the event recorder has reached its capacity, the oldest event is deleted as a new event is added.

Histograms

Demand metered voltages and currents can be reported using the histogram tool. It displays the number of occurrences of a variable versus its value in between user-defined minimum and maximum limits. Date and time are recorded for the maximum and minimum demand values.

Data Profiler

A fully configurable data profiler is available which allows the user to collect information by sampling demand 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.

Cold Load Pickup

Cold Load Pickup (CLPU) must be enabled through the interface software (Figure 13) before it can be activated remotely or from the CLOSE pushbutton on the operator panel. The CLPU feature provides the user with the ability to alter protection for abnormal system conditions. It is active for a programmable time interval which begins with each manual close. Once this time elapses, protection reverts back to the programmed sequence. Use the Form 5 control interface software to program the activation time and time-current characteristics applicable to Cold-Load Pickup.

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 protection settings.

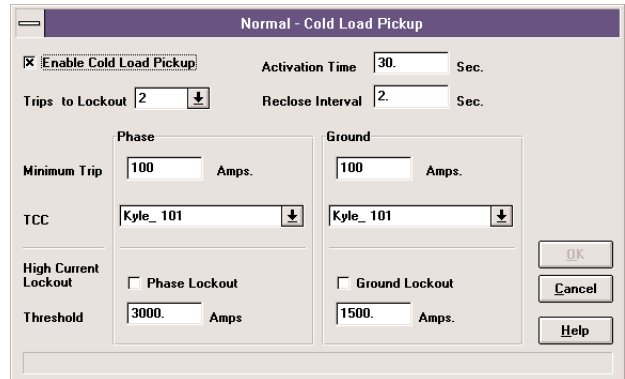


Figure 13.
Interface software Cold Load Pickup settings.

Alarms

Status and data alarms are available for many control parameters such as voltage, currents, thresholds. Data alarm function compares metered data to user-programmed alarm high and low limits and issues an alarm of user-specified priority if limits are exceeded. The status alarm function monitors status and issues an alarm of user-defined priority when the user programmed alarm conditions are met. The alarms are reported via communication ports and can be configured to trigger a data profile and event record. Alarms do not affect the protection functions of the control.

Fault Location

Fault Location provides an approximate distance of a fault from the the Form 5 Control The distance is based on the current fault magnitude, the type of fault, and system parameters entered by the user. The LCD display (Screen 38) identifies the estimated distance in miles or kilometers (km) from the control.

The fault location algorithm performs an impedance calculation based on:

- Single-phase to ground fault
- Phase-to-phase fault
- Double-line to ground fault
- Three-phase fault

This information is recorded as an event in the control Event Recorder for retrieval. The fault location algorithm does not require voltage sensing. If the location cannot be determined, no event is recorded and dashes are displayed on the LCD screen.

Setting the parameters for Fault Location is done through the interface software. The user enters line impedance parameters and system voltage information into the software via the Protection Profile menu. See Figure 14.

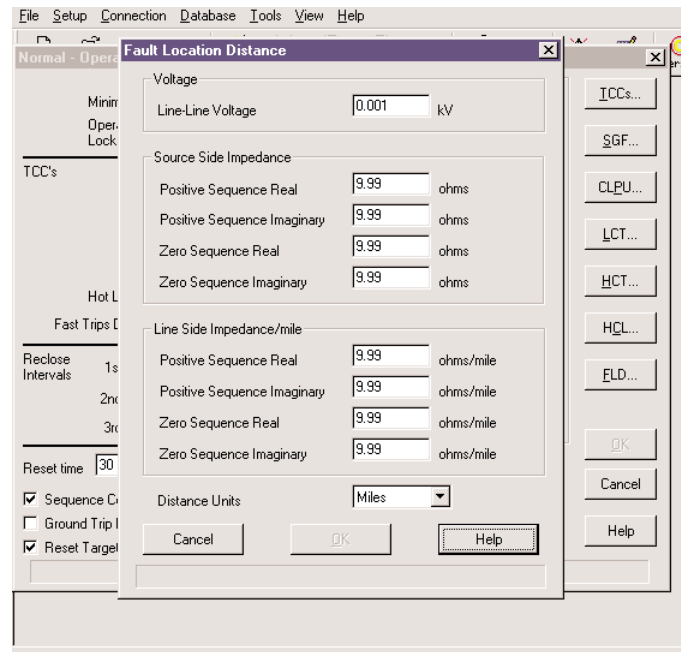


Figure 14.
Fault Location configuration screen.

The following system parameters must be entered via the Protection Profile menu for each profile:

- Nominal system line-to-line voltage
 - Note:** If the Fault Location feature is not desired, the nominal system voltage parameter should be set at 1.
- Source-side zero sequence and positive sequence impedance. This includes impedance up to the location of the Form 5 control.
- Line-side zero sequence and positive sequence impedance per mile or km.
- The distance units of the line impedance in miles or km.

IMPORTANT: Fault Location is not a protection function. Its purpose is to define a fault and provide its approximate location relative to the Form 5 control detecting the fault.

Refer to *Service Information S280-79-2 Form 5 Microprocessor-Based Recloser Control Programming Guide* for additional information.

Directional Sensitive Ground/Earth (SGF/SEF) Fault

The Directional SGF/SEF Fault feature adds directional capabilities to the SGF/SEF protection features. It provides a sensitive ground/earth trip if the fault is downline of the recloser on a radial distribution system. Directional SGF/SEF is used on ungrounded Delta systems for suppression of ground trips for faults occurring on other circuit branches.

The user sets the parameters for Direction SGF/SEF through the interface software via the Protection Profile menu. See Figure 15. In addition to the normal (non-directional) SGF/SEF settings, the user enters the following directional SGF/SEF parameters:

- Direction Enable

Note: If Direction Enable is not selected, SGF/SEF tripping occurs through normal (non-directional) settings.

- Maximum Torque Angle (-180° to 180°, in 1° increments)
- Torque Angle Width (10° to 90°, in 1° increments)
- Zero Sequence Voltage (V_0) Threshold (4 to 130 V)

The Maximum Torque Angle parameter determines the angle of maximum tripping sensitivity between the phase angle of the zero sequence voltage and current at the time of fault. The setting of this value depends on knowledge of the power system. Typically, a resistive fault has a value of 0°, and a capacitive fault has a value of 90°.

Torque Angle Width parameter restricts the tripping to an angle of plus or minus the specified width about the Torque angle setting. For example, if the Maximum Torque Angle is 45°, and the Torque Angle Width is set for 10°, then the control will trip at angles between 35° and 55°.

The Zero Sequence Voltage Threshold is used to set the threshold voltage below the disabled directional SGF/SEF tripping voltage.

Note: In most cases, a default value of 4 is adequate.

Directional SGF/SEF Fault is recorded as an event in the control Event Recorder for retrieval. Refer to *Service Information S280-79-2 Form 5 Microprocessor-Based Recloser Control Programming Guide* for additional information.

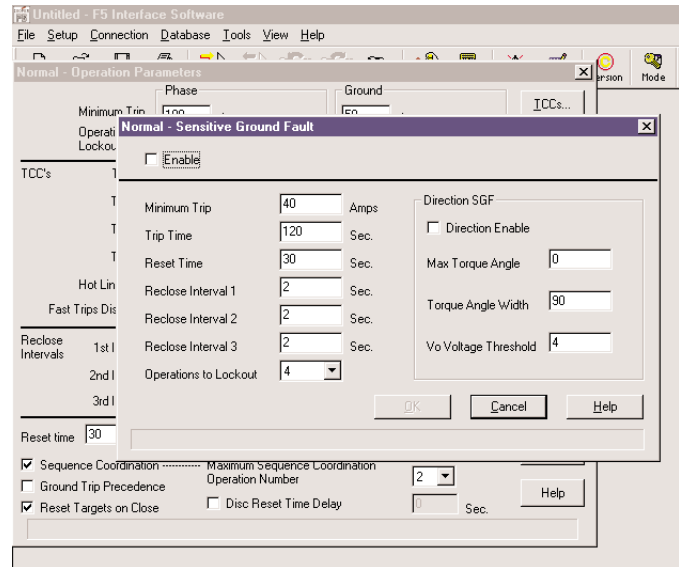


Figure 15.
Directional SGF/SEF configuration screen.

Communications

Communication Ports

The Form 5 control has three communication ports from the CPU module. Two of the three ports are user-accessible. Communication Port 1 is the operator panel LCD display where data is exchanged between the CPU and the operator panel. Though not user-configurable, Port 1 allows for flexible modifications to the front panel for custom applications.

The operator panel RS-232 communication Port 2 provides temporary local personal computer (PC) access when connected with a standard 9-pin cable. Port 2 provides a dual communication interface for the user. The port includes a software switch for two external connections; the operator panel RS-232 DB-9 connector, or the fiber-optic/RS-232 communication accessories. Local connection to the operator panel RS-232 connection takes precedence over the communication accessory. Disconnecting the operator panel RS-232 communication automatically reconnects the communication accessory to Port 2.

Accessory Ports 2 and 3 are resident on the back of the operator panel and can be configured to either 2179 or DNP3.0 protocols. Port 3 provides uninterrupted communication to the RS-232 or Fiber-Optic accessory, and is not affected by any other port or physical connection.

Figure 16 illustrates the communication configuration for serial ports 1, 2, and 3.

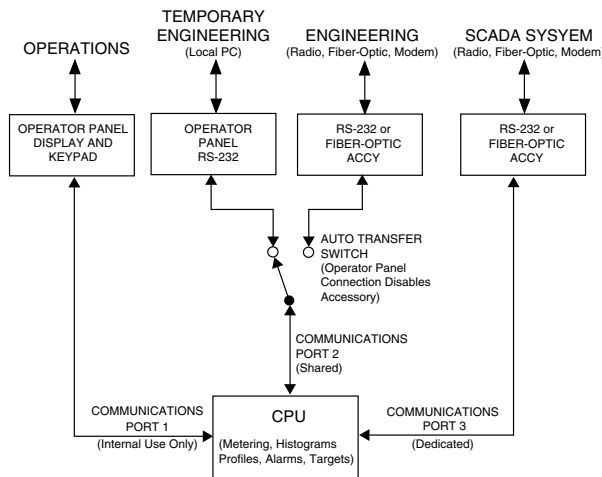


Figure 16.
Control communication port configuration.

Fiber-Optic/RS-232 Accessory

Two sets of receive and transmit LEDs (Figure 17) are provided on the operator panel for fiber-optic and RS-232 communications. The TX2 and RX2 LEDs illuminate when communicating with the operator panel RS-232 port. The TX3 and RX3 LEDs illuminate when communicating with either the fiber-optic or RS-232 interface accessory boards on communication Port 3.

The RS-232 accessory board and the fiber-optic accessory boards are located behind the operator panel. Each accessory board can be connected to either Port 2 or Port 3; no two boards can use the same port. The operator panel LEDs indicate the status of communication on the accessory boards. Temporary connections to the operator panel RS-232 port disables fiber-optic or RS-232 communication at Port 2.

Port 3 provides uninterrupted communication to a remote terminal unit (RTU). Refer to *S280-79-4 Form 5 Serial communications Accessory Operation Instructions* for additional information.

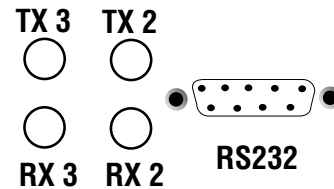


Figure 17.
Fiber-Optic/RS-232 receive and transmit LEDs and data port on the operator panel. The TX2 and RX2 LEDs illuminate during communication with the operator panel RS-232 port.

Protocols

Three protocols are available for the Form 5 control and are factory-configurable to communication Ports 2 and 3.

The protocols are:

- Cooper Power Systems 2179
- DNP3.0, Level 3
- S-Comm Protocol accessory

Protocol DNP3.0 includes “Unsolicited Report by Exception” functionality and Protocol 2179 includes 2-bit status functionality.

Complete documentation for Cooper Power Systems protocols are:

- *Reference Data R280-90-12, Serial Communication Protocol 2179*
- *Reference Data R280-90-13, Communication Point Database for Protocol 2179*
- *Reference Date R280-90-14, Communication Point Database for Protocol DNP3.0*

Control Information

Control information, including firmware version and database version, is factory installed and can not be altered by the user. This information is accessible from the LCD display, Screen 39.

Communication Ports 2 and 3 settings can be referenced from the LCD display, Screens 40 and 41 respectively. (Port 1 shares the same settings as Port 2.)

AUXILIARY POWER FOR ACCESSORIES

Connection P9 (Figure 18) on the Power Supply module provides 24Vdc (12Vdc is available) to power radio communication units, RTUs and other accessories. The auxiliary power provides 40W peak load capability. Auxiliary power is fused and current-limited to prevent user loads from disabling the control.

Customer 28V connections for auxiliary power are made to terminals 3 and 1 and are continually energized. Terminal 2 and 4 are not used at this time.

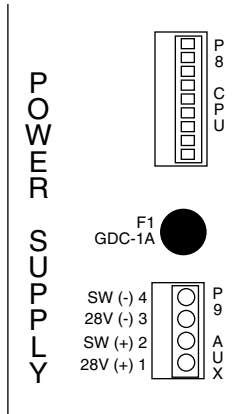


Figure 18.
Power Supply Module Connection P9 provides 24Vdc power to radio communication units.

RECLOSER INTERFACE (RIF) MODULE CONFIGURATION

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

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

To remove the RIF Module for configuration:

1. Disconnect the control battery.
2. Remove the four connectors from the front of the RIF Module.
3. Remove the nut and disconnect the grounding strap to the operator panel. See Figure 4.
4. Disconnect the wiring harness connectors from the bottom of the RIF Module.
Note: Press the locking tabs to release the harness connectors.
5. Remove the four 11 mm (.437 in) screws securing the board to the mounting bracket.
6. Pull the module out of the cabinet.

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

7. Configure the RIF board as shown in Figure 19.
8. After configuration, place the module back into position in the control cabinet and secure to the mounting bracket with screws previously removed.
9. Replace nut securing the RIF Module grounding strap
10. Replace all connectors on the front and bottom of the RIF Module.

Example shown for 120Vac operation:

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

*120Vac is factory-set configuration

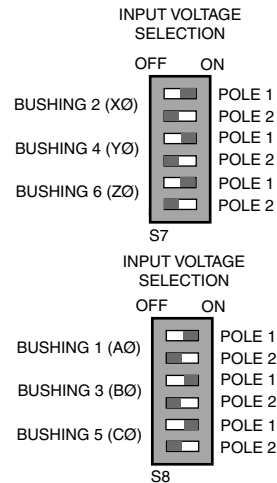


Figure 19.
Recloser Interface (RIF) Module indicates the factory-configured metering voltage (120Vac).

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.

While in the switch mode, all automatic open and close operations of the recloser (including overcurrent voltage and frequency) are blocked. Fault targeting, metering, alarms, and event recording functions are active.

This non-tripping fault indication state is initiated via a operator panel pushbutton (labeled SWITCH MODE), digital SCADA, or discrete SCADA. The UDP feature has local indication at the operator panel (LED), digital indication, and remote indication via status contacts on the Discrete Interface (DIF) module 1.

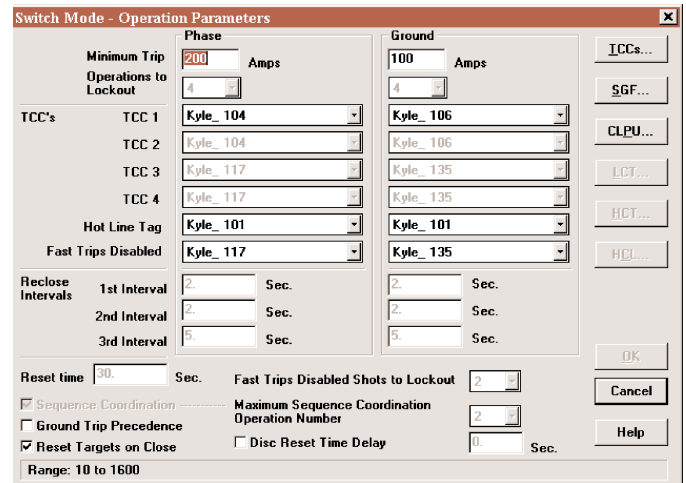


Figure 21.
Interface software Switch Mode settings.

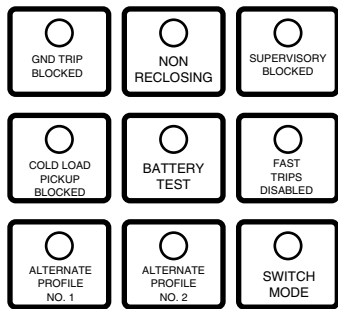


Figure 20.
Function/Indication pushbuttons for the Form 5 equipped with the UDP accessory.

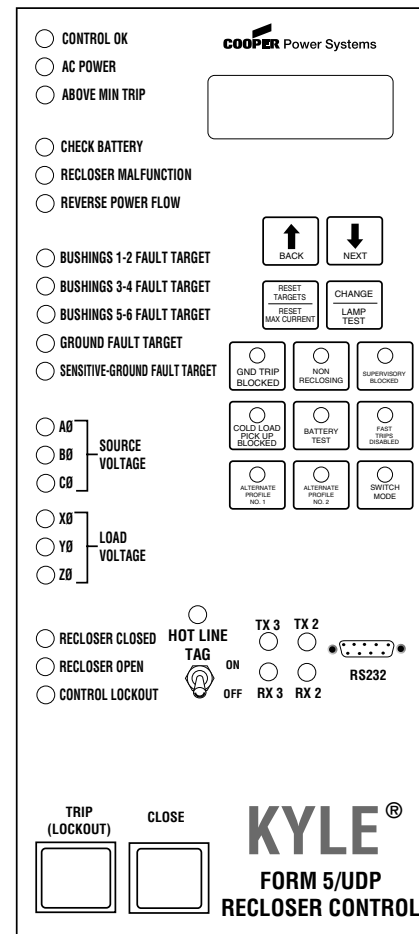


Figure 22.
Form 5/UDP Operator Panel.

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 DC NOVA recloser. See Figure 23.

The dc-to-dc converter board (Figure 24) 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.

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.

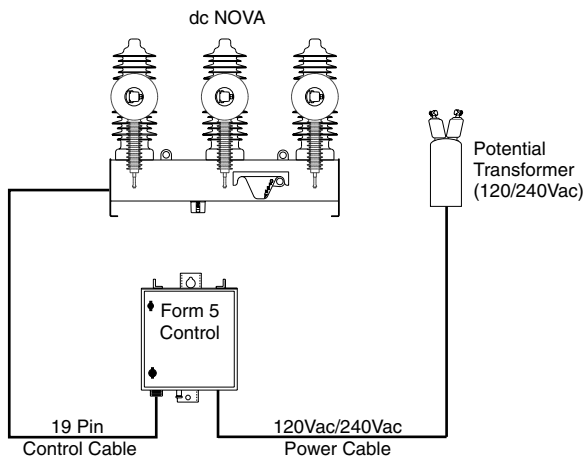


Figure 23.
Connections of a Form 5 control with dc NOVA accessory to a dc NOVA recloser.

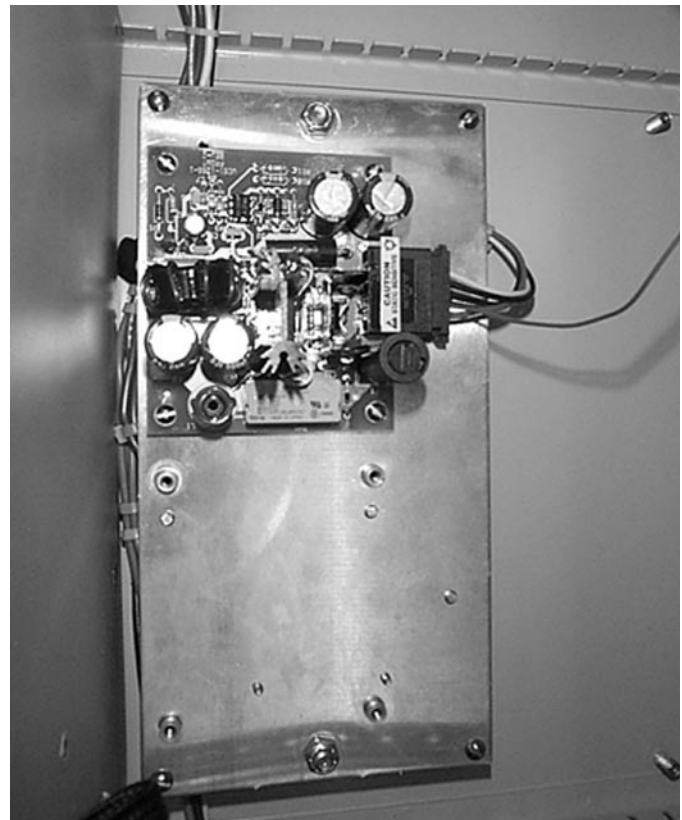


Figure 24.
Dc-to-dc converter located behind Form 5 operator panel (removed).

99007KM

DISCRETE INTERFACE (DIF) ACCESSORY

The Discrete Interface (DIF) module accessory (Figure 25) permits connection of contact-type input devices (switches, relays) and discrete indicating devices (relays, LEDs, lamps) to the Form 5 control to effect 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 have been factory-set and are shown in Figure 27.

IMPORTANT: Do not use DIF module for overcurrent protection. Digital SCADA can be used for this application. The control gives priority to TCC timing and issuing a trip signal rather than changing the status of a DIF output or responding to a DIF input.

The DIF module contains 12 factory-set inputs and outputs for discrete SCADA functions. 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 26.

Note: 28 Vdc (nominal) is provided from the DIF module 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 a 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 control power is removed.

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

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 25 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 27 shows customer connections to the DIF outputs at P2 and P3.

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 MOVs between the leads and ground. Failure to properly shield and protect leads can result in equipment damage and/or unintentional operation. G117.3

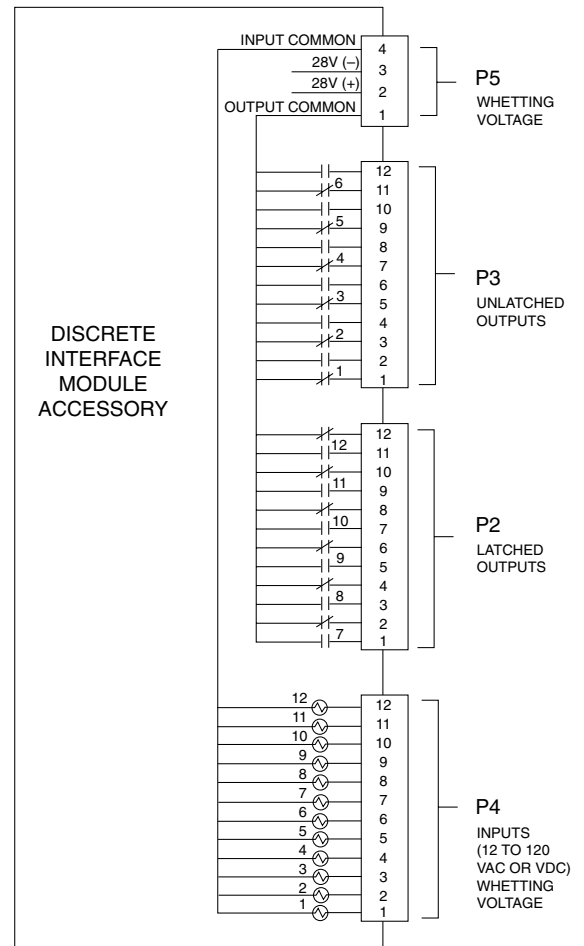


Figure 25. Discrete Interface (DIF) Module.

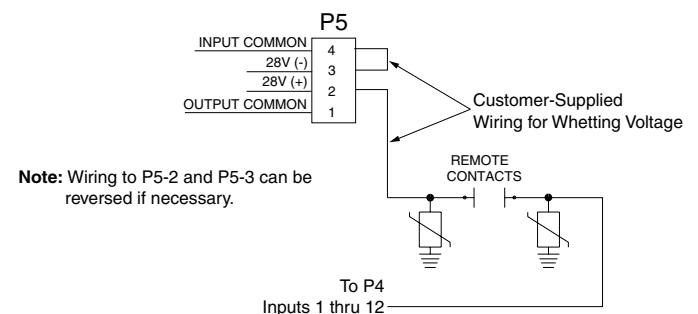


Figure 26. Customer connections for supplying whetting voltage to DIF inputs.

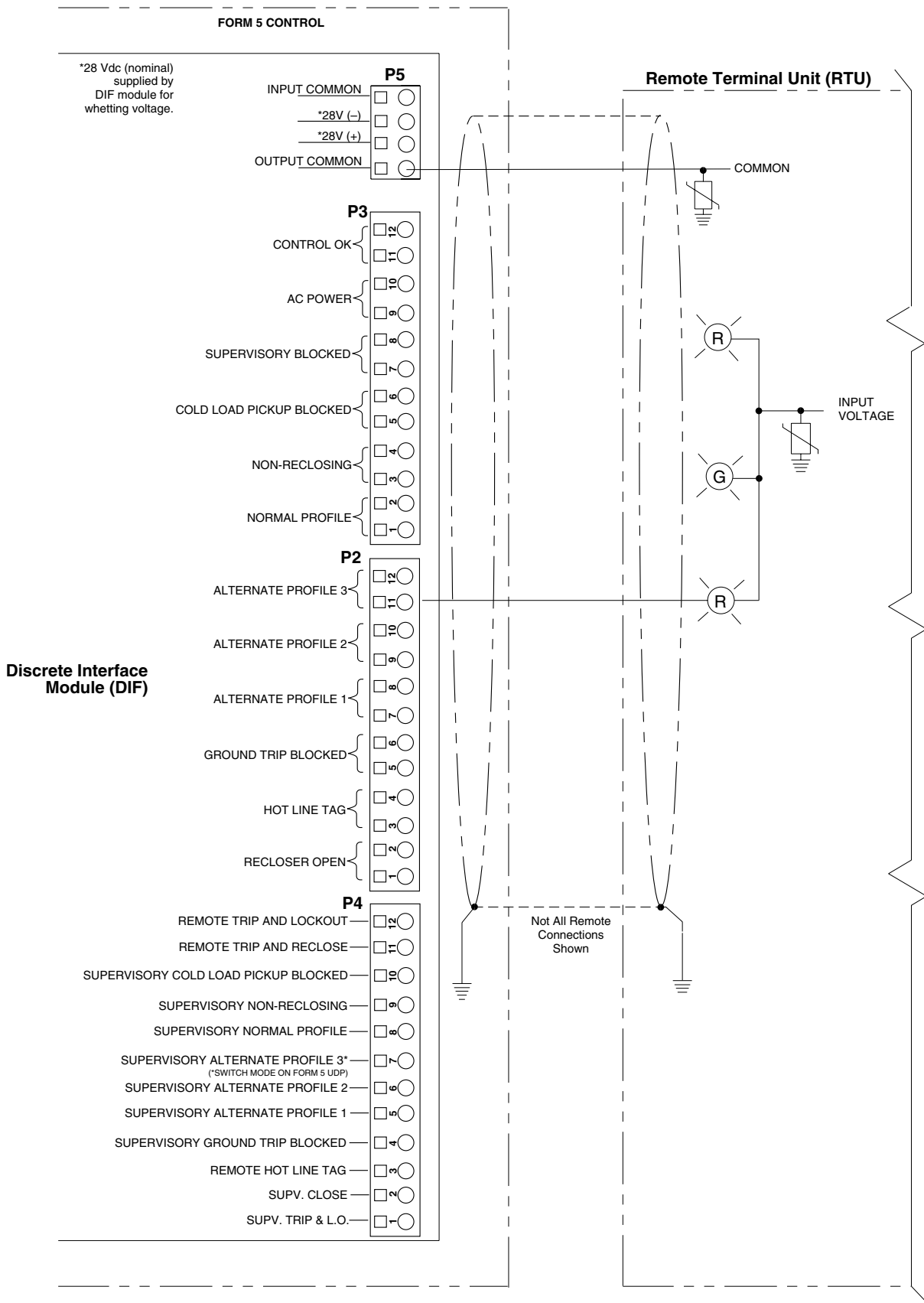


Figure 27. Customer connections to DIF module outputs with shielding and surge protection.



**TABLE 1
DIF Input Ratings**

Minimum Detection Level:	8 Vac	(50 or 60Hz)	10 Vdc
Maximum Operating Voltage:	135 Vac	(50 or 60Hz)	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 MOVs and capacitors. Opto Isolation from input to system.		

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 must not be used for powering external circuits. This is considered a dry contact input for customer connection.

**TABLE 2
Whetting Voltage Source
(Supplied by Internal Voltage Source of DIF Module)**

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

**TABLE 3
DIF 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)
Input Protection:	Shunting type using MOVs and capacitors

Standard and UDP Controls

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

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 operator panel. Remote Hot line Tag is activated by a maintained SCADA command, a serial command, or locally via a operator 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 operator 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. This feature is activated by a remote momentary signal. 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 requires a momentary signal 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.

Note: Supervisory Alternate Profile 3 replaced by Switch Mode on UDP controls.



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 operator panel. This input is inactive if the Supervisory function is disabled.
10	P4-10	Suprv Cold-Load Pickup Blocked	This input performs the same function as the COLD LOAD PICKUP BLOCKED key on the operator 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 proper operation. This input performs the same function as the TRIP (LOCKOUT) switch on the operator 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.

Note: Contacts shown in inactive mode.

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 operator 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 operator 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 operator panel. This output is active when the SUPERVISORY BLOCKED indicator on the operator 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 operator 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 operator 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 switched 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 operator 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 operator panel is illuminated.
10	P2-7 NO P2-8 NC	Alternate Profile 1	Latched	These outputs are active when the respective ALTERNATE PROFILE indicators on the operator 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	

***Note:** Supervisory Alternate Profile 3 replaced by Switch Mode on UDP controls.



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 operator 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 operator 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 operator 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

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

Note: Contacts shown in inactive mode.

Output	Connector	Function	Type	Description
1	P3-1 (NC) P3-2 (NO)	Control Lockout	Non-Latched	This output is active when the CONTROL LOCKOUT indicator is illuminated.
2	P3-3 (NC) P3-4 (NO)	Check Battery	Non-Latched	This output is active when the CHECK BATTERY indicator is illuminated.
3	P3-5 (NC) P3-6 (NO)	Reverse Power Flow	Non-Latched	This output is active when the REVERSE POWER FLOW indicator is illuminated.
4	P3-7 (NC) P3-8 (NO)	Fast Trips Disabled	Non-Latched	This output is active when the FAST TRIPS DISABLED indicator is illuminated.
5	P3-9 (NC) P3-10 (NO)	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 (NC) P3-12 (NO)	Recloser Malfunction	Non-Latched	This output is active when the RECLOSER MALFUNCTION indicator is illuminated.
7	P2-1 (NO) P2-2 (NC)	Bushings 1-2 Fault Target	Latched	This output is active when the BUSHINGS 1-2 FAULT TARGET indicator is illuminated.
8	P2-3 (NO) P2-4 (NC)	Bushings 3-4 Fault Target	Latched	This output is active when the BUSHINGS 3-4 FAULT TARGET indicator is illuminated.
9	P2-5 (NO) P2-6 (NC)	Bushings 5-6 Fault Target	Latched	This output is active when the BUSHINGS 5-6 FAULT TARGET indicator is illuminated.
10	P2-7 (NO) P2-8 (NC)	Ground Fault Target	Latched	Output is active when the GROUND FAULT TARGET indicator is illuminated.
11	P2-9 (NO) P2-10 (NC)	Sensitive Ground Fault Target	Latched	Output is active when the SENSITIVE GROUND FAULT TARGET indicator is illuminated.
12	P2-11 (NO) P2-12 (NC)	Sensitive Ground Fault Blocked	Latched	Output is active when Sensitive Ground Fault is blocked.



INPUT ACCURACY

Sensed Currents

Note: Control only, does not include sensor tolerance, but does include the phase current summing process.

Phase Current—Individual Phase Currents:

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

2 A to 20,000 A for 1000:1 CTs

4 A to 40,000 A for 2000:1 CTs

Accuracy: ± 1 mA from 10 mA to 125 mA

0.8% from 125 mA to 1600 mA

(Control only, does not include sensor tolerance.)

Ground Current—Vector Sum of Three-Phase Currents:

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

2 A to 10,000 A for 1000:1 CTs

4 A to 20,000 A for 2000:1 CTs

Accuracy: ± 3 mA from 10 mA to 125 mA

2.4% from 125 mA to 1600 mA

Sensed Source Voltages

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

Voltage measurement accuracy:

± 0.4 V from 5V to 80V

0.5% from 80V to 135V

INSTALLATION PROCEDURE

Initial Programming Prior to Installation

CAUTION: Equipment Misoperation. Do not connect this control to an energized recloser until all control settings have been properly programmed and verified. Refer to the programming information for this control. Failure to comply can result in control and recloser misoperation, equipment damage, and personal injury. G110.3

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

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

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.

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 Amps.

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

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 which mate with the female receptacle of the recloser on one end and the male receptacle of the control on the other end.

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

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.

Mounting the Control

Mount the Form 5 recloser control in a convenient, accessible location. Mounting dimensions are provided in Figure 28.

- 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 410 m (125* ft) for solenoid-operated reclosers (VWE, VWVE27, VWVE38X, WE, WVE27, WVE38X, and NOVA).
- Up to 10,7 m (35* ft) for motor-operated reclosers (VSA12, VSA12B, VSA16, VSA20, VSA20A, VSO12, VSO16).

Up to 41 m (135* ft) for NOVA DC.

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

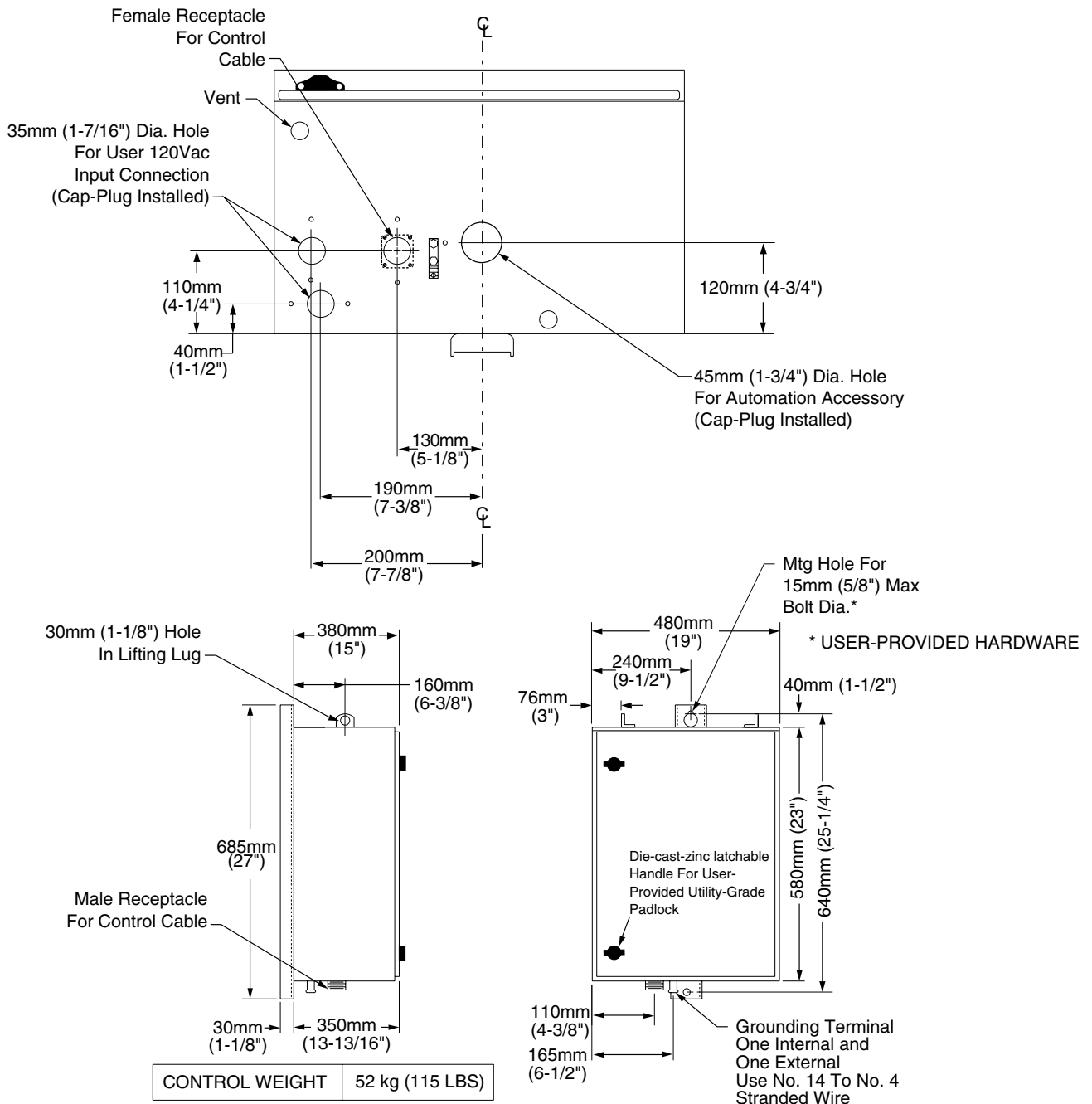



Figure 28.
Control cabinet mounting dimensions.

Grounding the Control

 **WARNING:** Hazardous Voltage. The 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, severe personal injury.

G115.1

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

Suggested methods for grounding the control and recloser are shown in Figures 29, 30, and 31.

Figure 29 illustrates grounding methods for 3-wire ungrounded and 4-wire multi-grounded systems with local supply voltage transformer.

Figure 30 illustrates grounding methods for 3-wire ungrounded and 4-wire multi-grounded systems with remote supply voltage transformer.

Figure 31 illustrates grounding on a 3-wire uni-grounded system.

For effective surge protection all control and power conductors for the Form 5 must be routed parallel to a corresponding ground path. For example, the AC power supply for the control should be parallel to and equal in length to the transformer ground path. The control cable should be parallel to and routed close to the recloser ground path.

Grounding with a Local Supply Voltage Transformer; 4-Wire Multi-Grounded, 3-Wire Ungrounded, or Impedance-Grounded

Installation of a Form 5 control with a local supply voltage transformer must include the following:

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

IMPORTANT: All external inputs to the Form 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.

4-Wire Multi-Grounded Systems

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

3-Wire Ungrounded and Impedance Grounded Systems

The use of a grounding mat may be required depending upon the local safety regulations defining the permissible step and touch potential levels. Consult local regulations for proper grounding procedures.

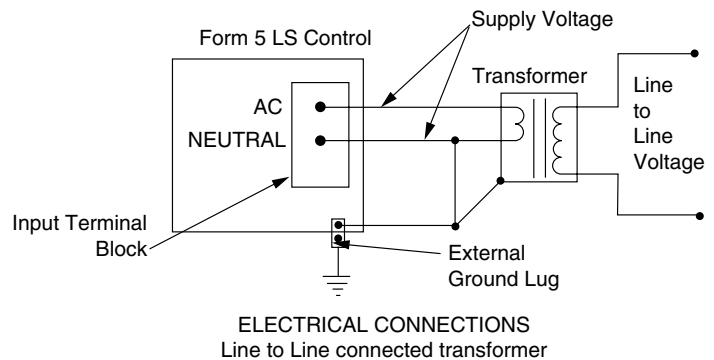
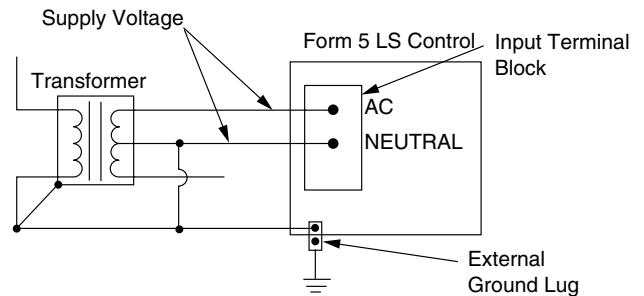
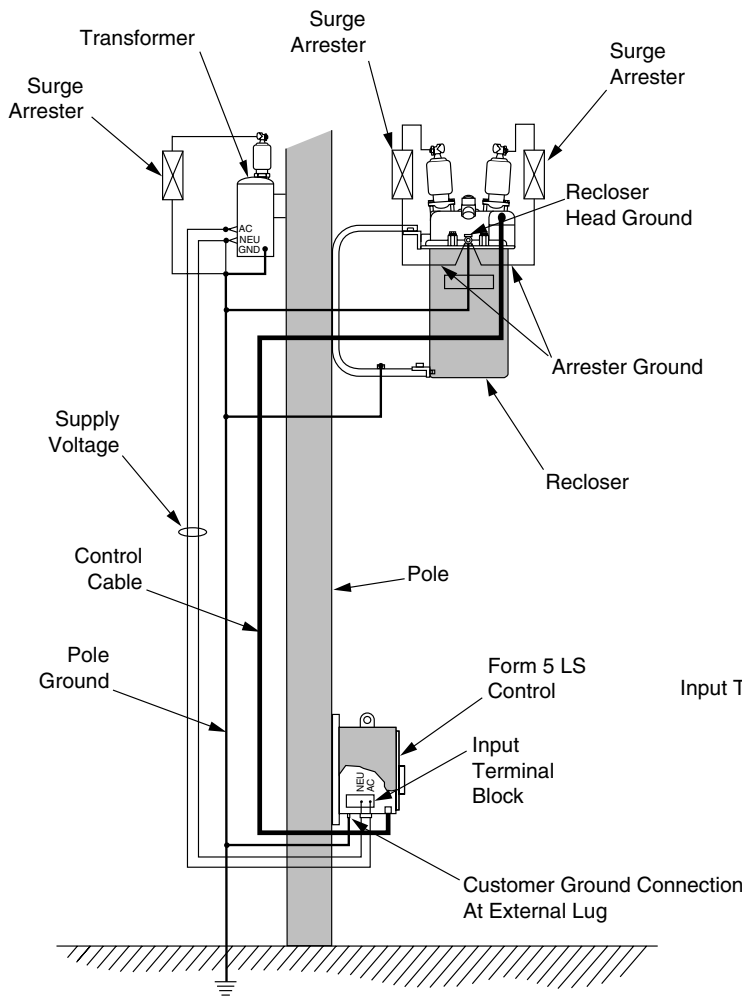


Figure 29. Recommended grounding method for the Form 5 Control installed on 4-wire multi-grounded, 3-wire ungrounded, or impedance-grounded systems with local supply voltage transformer.

Grounding with a Remote Supply Voltage Transformer; 4-Wire Multi-Grounded, 3-Wire Ungrounded, or Impedance-Grounded

Installation of a Form 5 control with a remote supply voltage transformer must include the following:

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

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

IMPORTANT: All external inputs to the Form 5 control must be routed within 8 inches of their corresponding ground. During a surge, a potential of approximately 1.5kV 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.

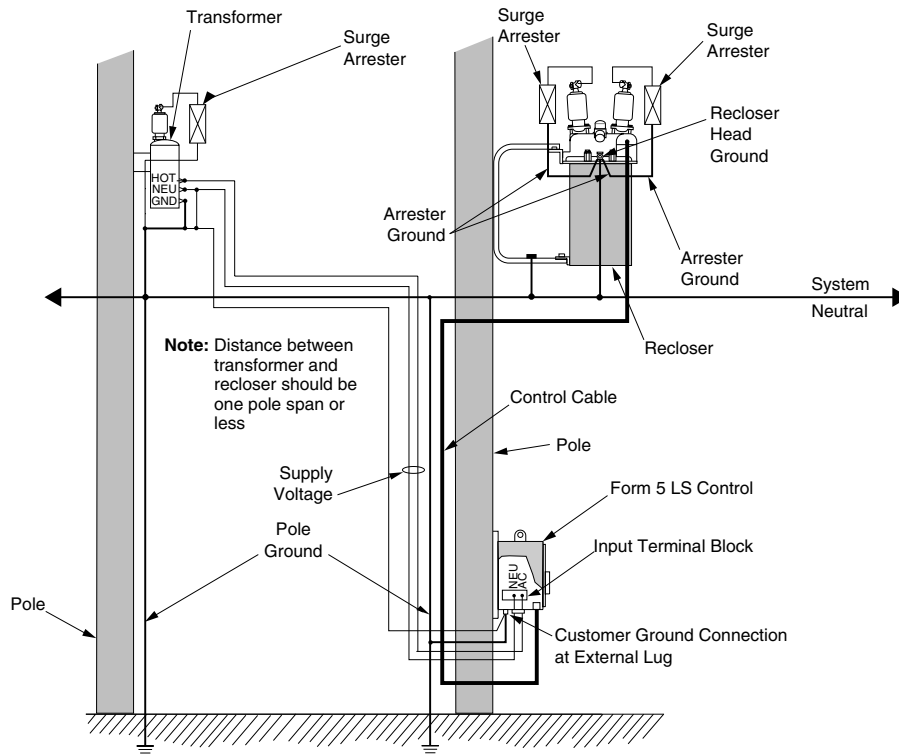
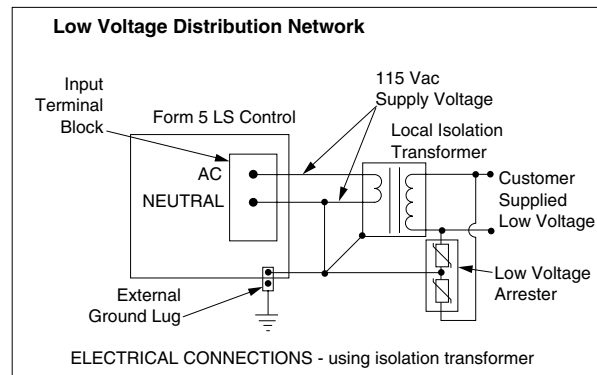
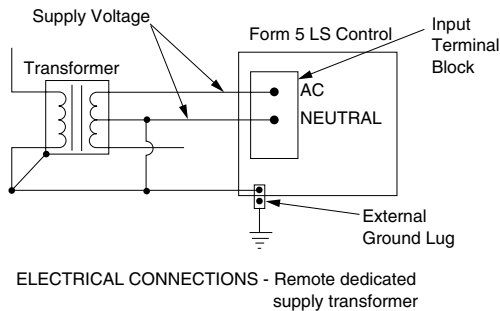
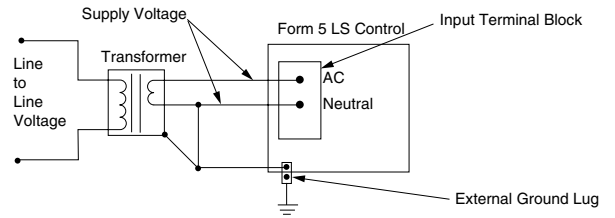


Figure 30. Recommended grounding method for the Form 5 Control installed on 4-wire multi-grounded, 3-wire ungrounded, or impedance-grounded systems with remote supply voltage transformer.

Grounding on a 3-Wire Uni-Grounded System

Installation of a Form 5 control on a 3-wire uni-ground system must include the following:

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



ELECTRICAL CONNECTIONS - Dedicated Supply Transformer

WARNING: Hazardous Voltage. Use locally approved operator safety procedures for proper insulation when maintaining this equipment. High Voltage step and touch potential is characteristic in uni-ground systems. Failure to comply can cause death or severe personal injury. T262.0

CAUTION: Exported Potential. Do not make direct electrical connections to remote devices. All SCADA equipment must be mounted locally or connected using the fiber-optic or radio communication accessory. Direct connections to remote devices can produce exported potential causing equipment damage or personal injury. T263.0

CAUTION: Hazardous Voltage. Do not use a shared low voltage network to power the recloser control unless the network is specifically designed to withstand maximum ground potential rise. Ground faults on a high voltage network can create a rise in ground potential. T264.0

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

IMPORTANT: All external inputs to the Form 5 control must be routed within 8 inches of their corresponding ground. During a surge, a potential of approximately 1.5kV 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.

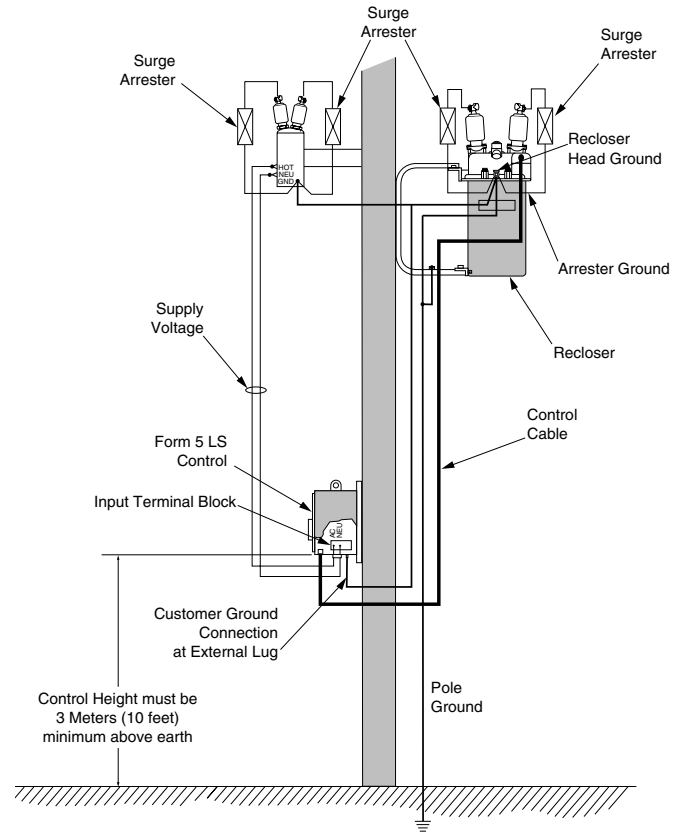


Figure 31. Recommended grounding method for the Form 5 Control installed on a 3-wire uni-grounded system.

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 33.

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 Supply Verification

Incoming power is routed to the Power Supply module which is factory configured for either 120 or 240 volt operation. The power supply module is factory wired to TB-1 and protected by the 3.15 Amp fuse labeled F2 on the power supply operator panel. A label on the Power Supply module indicates the proper voltage rating. See Figure 32.

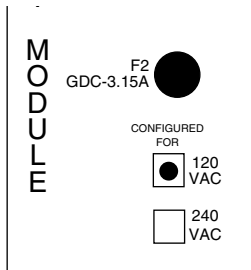


Figure 32. Label on Power Supply module indicates factory-configured voltage rating (120Vac).

Inserting and Releasing Wire Connections

In Terminal Block TB1, each terminal has a wire locking clamp that has to be opened to accept and secure the wire. A 3/32 inch flat-blade screwdriver is inserted into each terminal hole to open the locking clamp. Figure 34 provides the procedure for opening and securing the wire connections.

The wire is inserted into the terminal connection hole while the screwdriver is placed into the wire release and locking hole.

Follow the same procedure to release wire connections.

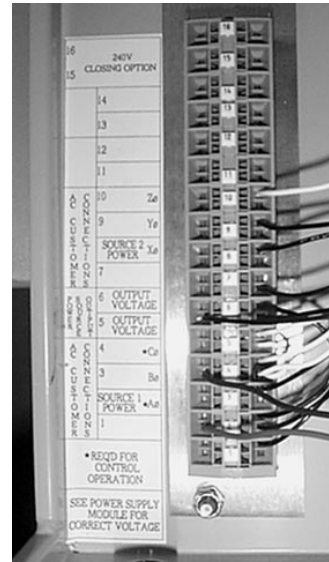


Figure 33. Terminal Connector Block TB1.

99003KM

Power Connections

Customer connections to TB1 vary upon application. TB1 connections provide power and metering inputs to the control. Figures 34 through 39 show the customer connections for 120 Vac and 240 Vac low voltage closing.

Figures 34 through 37 illustrate customer connections for single-phase transformers. Figure 34 shows standard wiring with BØ transformer connected to TB1-2 location. Other phases should be connected from the single-phase transformer by wiring the BLACK wire from the Power Supply module to the terminal of the respective phase as shown in Figure 38 and 39. For example, Figure 39 shows connection from the Power Supply module to an AØ transformer.

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

Note: An out-of-service Form 5 or Form 5 UDP control (for either Wye or Delta) can be powered by connecting to TB1-2 (hot) and TB1-4 (neutral) to an appropriate power source.

IMPORTANT: Delta connections are *not* used on any Form 5 control accessory that utilizes the low voltage transfer relay.

Customer Connections for Metering

Customer voltage inputs for metering are field configurable on the RIF module to accept 12, 120, or 240 Vac. The incoming power supply must match the indication for incoming power on the RIF module. The factory-configured settings for the RIF are displayed on the module panel. See Figure 19.

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

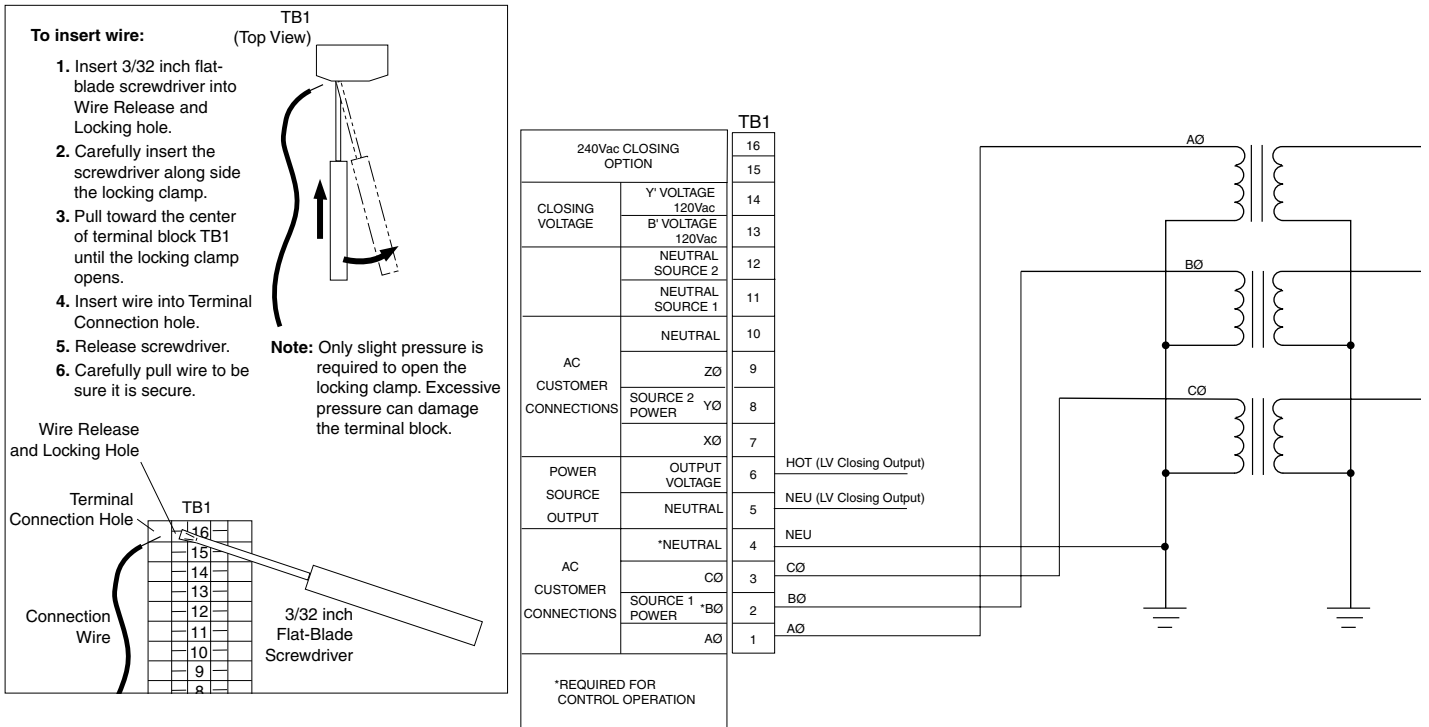


Figure 34. Form 5 and Form 5 UDP Power and Low Voltage Closing customer connections to terminal block TB1 (120Vac or 240Vac Wye Connection).

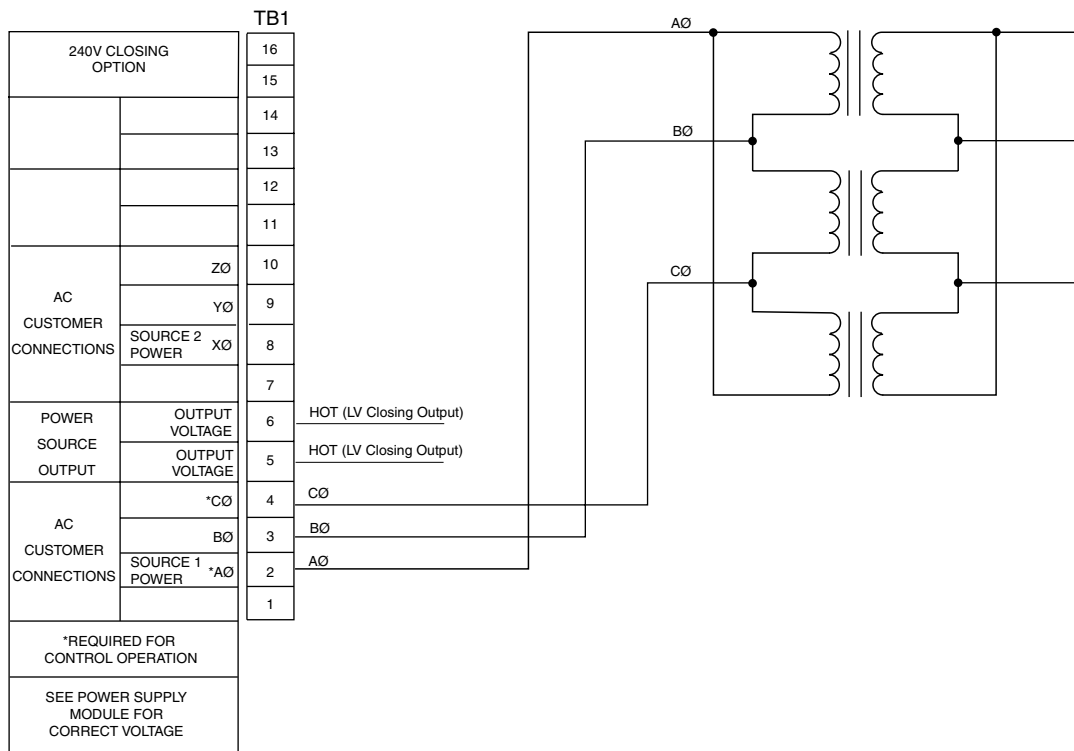


Figure 35. Form 5 and Form 5 UDP Power and Low Voltage Closing customer connections to terminal block TB1 (120Vac or 240Vac Delta Connection).

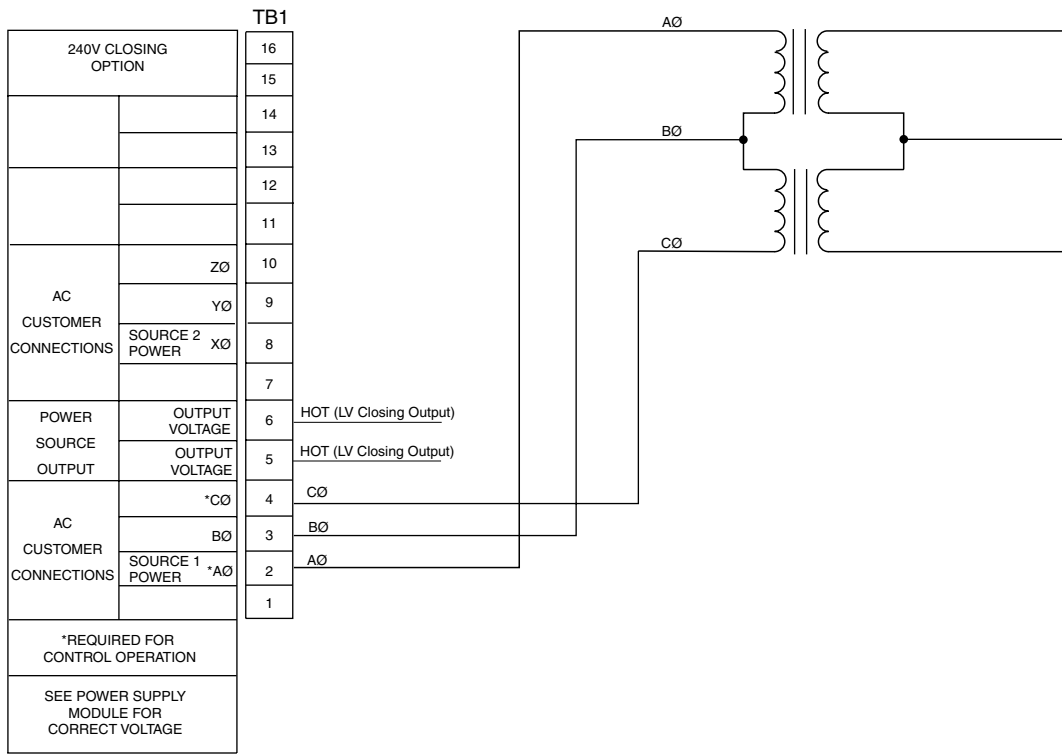


Figure 36.
Form 5 and Form 5 UDP Power and Low Voltage Closing customer connections to terminal block TB1 (120Vac or 240Vac Open-Delta Connection).

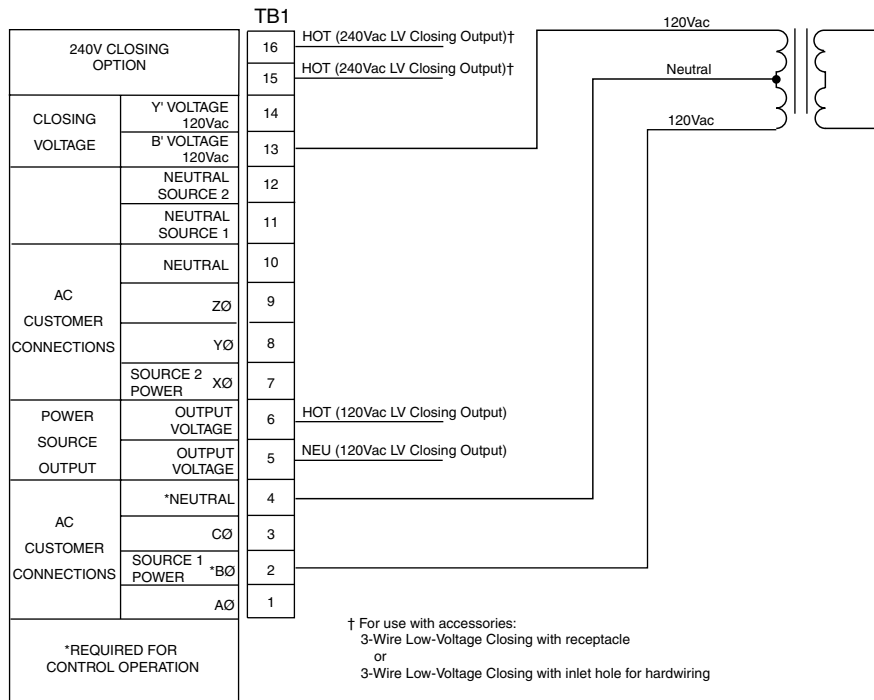


Figure 37.
Form 5 and Form 5 UDP Power and Low Voltage Closing customer connections to terminal block TB1 (3-wire, 240Vac Connection).

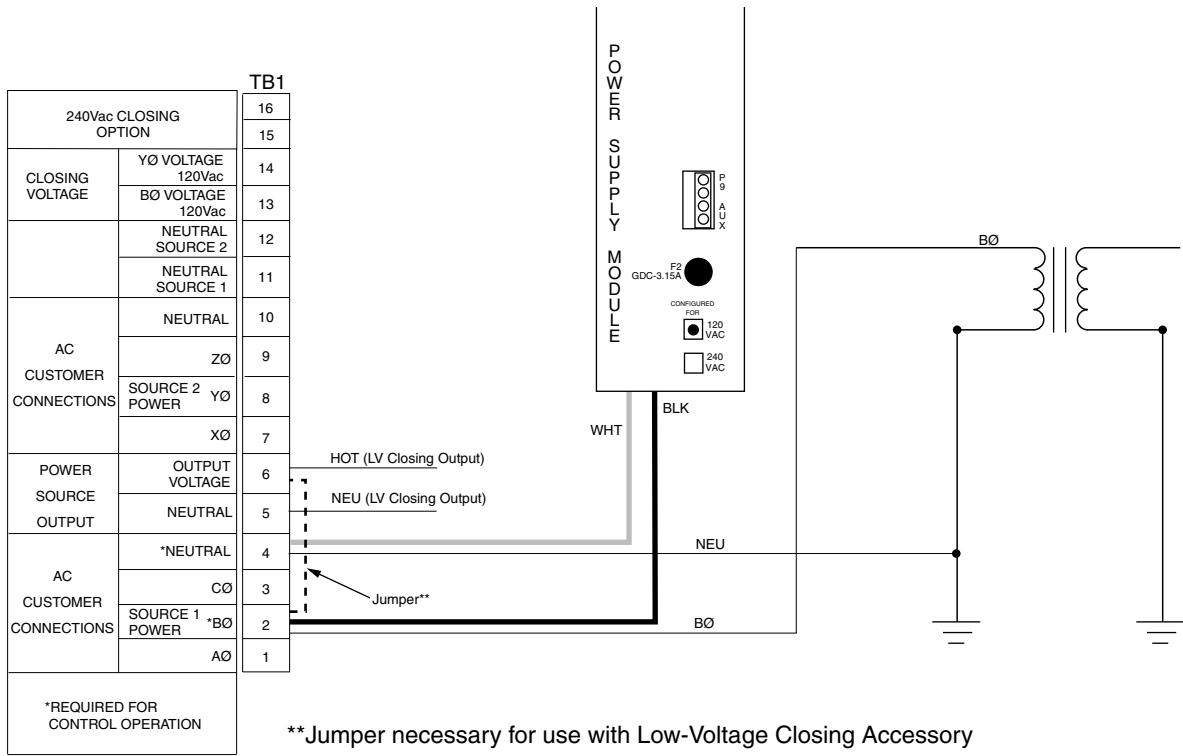


Figure 38.
Form 5 and Form 5 UDP Power and Low Voltage Closing customer connections to terminal block TB1 (Single-Phase Connection, Standard BØ Input).

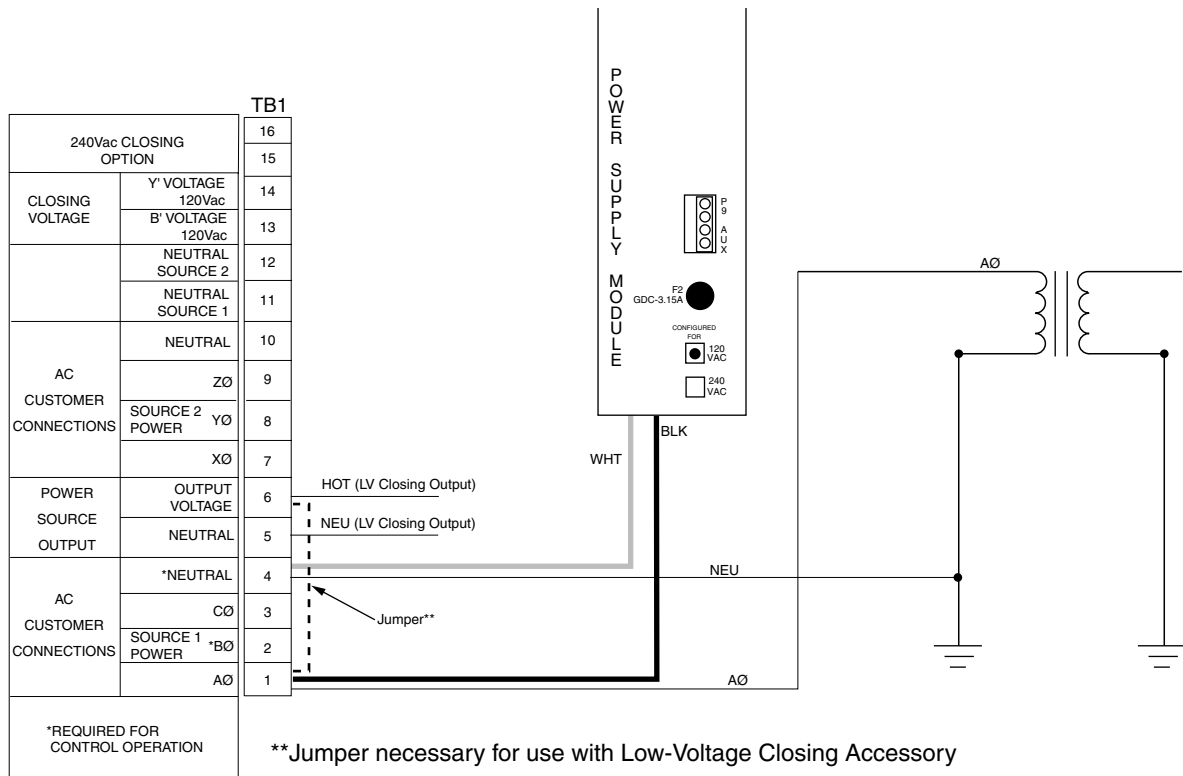




Figure 39.
Form 5 and Form 5 UDP Power and Low Voltage Closing customer connections to terminal block TB1 (Single-Phase Connection, AØ Input).

Before Placing the Control and the Recloser into Service

 **CAUTION:** Equipment misoperation. Do not connect this control to an energized recloser until all control settings have been properly programmed and verified. Refer to the programming information for this control. Failure to comply can result in control and recloser misoperation, equipment damage and personal injury. G110.3

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

1. Control properly mounted for the installation.
2. Recloser installed according to all locally approved standards and practices.

 **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

3. Control and recloser properly grounded in accordance with guidelines in this manual.
4. AC power connected to the control. (AC power LED indicator is illuminated.)
5. Control battery connected and tested for proper operation.
6. All control programming entered and verified by appropriate personnel.
7. Control clock set to the correct time.
8. Customer connections for remote and supervisory operation checked and completed in accordance with proper shielding and surge protection.
9. Control cable properly connected and supported.

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. Wake-up the operator panel display by pressing the CHANGE/LAMP TEST button on the control operator panel.
2. Scroll through the LCD display messages as described in the *LCD Display Messages* section of these instructions. Refer to **Form 5 Control operator 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 operator 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 of the CPU module. Open the cabinet door and locate the LED indicator (Figure 40).

The LED indicator on the CPU module should flash at a rate of one flash per second for normal 60 Hz operation (slightly faster for 50Hz).

Testing With Type MET Tester

The Kyle Type MET Electronic Recloser Control Tester (Figure 41) is used for testing the Form 5 control.

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

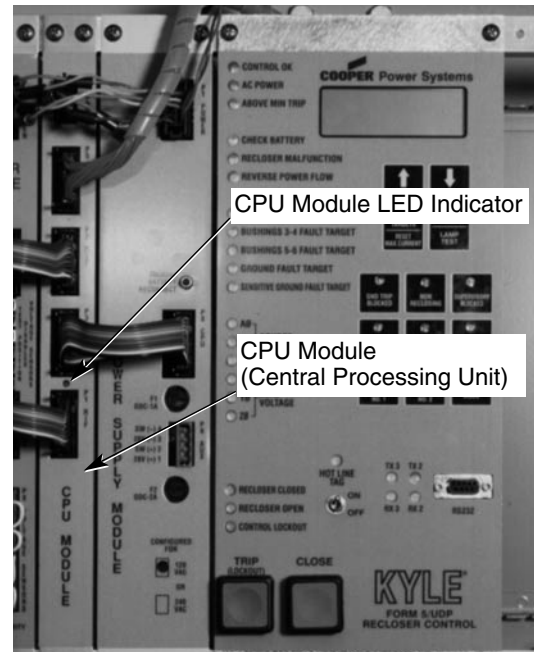


Figure 40.
Form 5 control CPU module.

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of all operating parameters. Refer to *Service Information S280-76-1 Type MET Electronic Recloser Control Tester Operator Instructions* for proper setup and use of the MET tester. Refer to **Form 5 Control Default Test Procedure** section of this manual for specific tests requiring the KMET 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.

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 3 seconds to reset the condition.



Figure 41.
Kyle Type MET electronic recloser control tester.

010028KM

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

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 44).

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 45). A 75kVA 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 200kVA 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.

WARNING: Hazardous voltage. Interconnect source leads X and Y and ground solidly to the recloser tank (Figure 45). 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

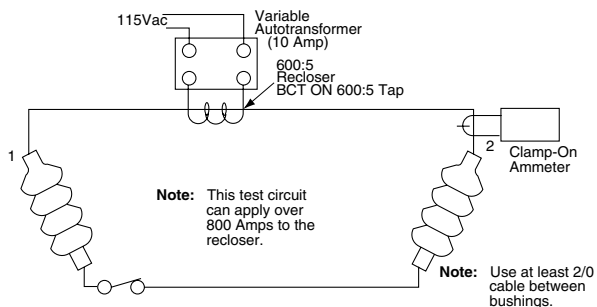


Figure 42. Alternate method of producing variable line current (substitute for T2 and W-X circuit in Figures 43 and 45).

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 230VAC power source. For information on energizing the recloser, refer to the appropriate motor-operated recloser installation manual.

Figure 43 shows a test circuit for motor-operated and solenoid-closing reclosers with low-voltage closing. 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 42.

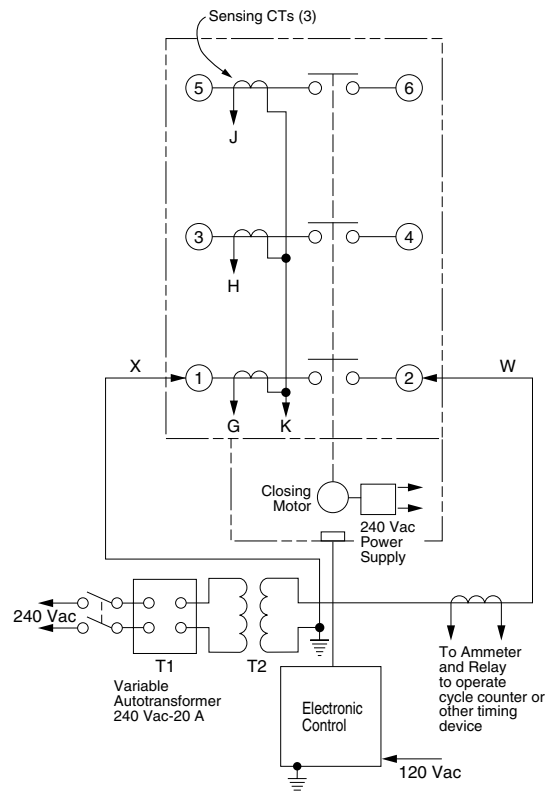


Figure 43. Suggested test circuit for motor-operated, solenoid-closing reclosers with low-voltage closing.

Electrical Closing—NOVA Reclosers

Type NOVA 3-phase reclosers utilize an interface circuit located in the mechanism housing. The electronic interface circuit controls the opening and closing signals to the magnetic actuator.

The Dc NOVA Recloser is tested with the dc-to-dc converter and 19-pin cable connected to the dc power supply.

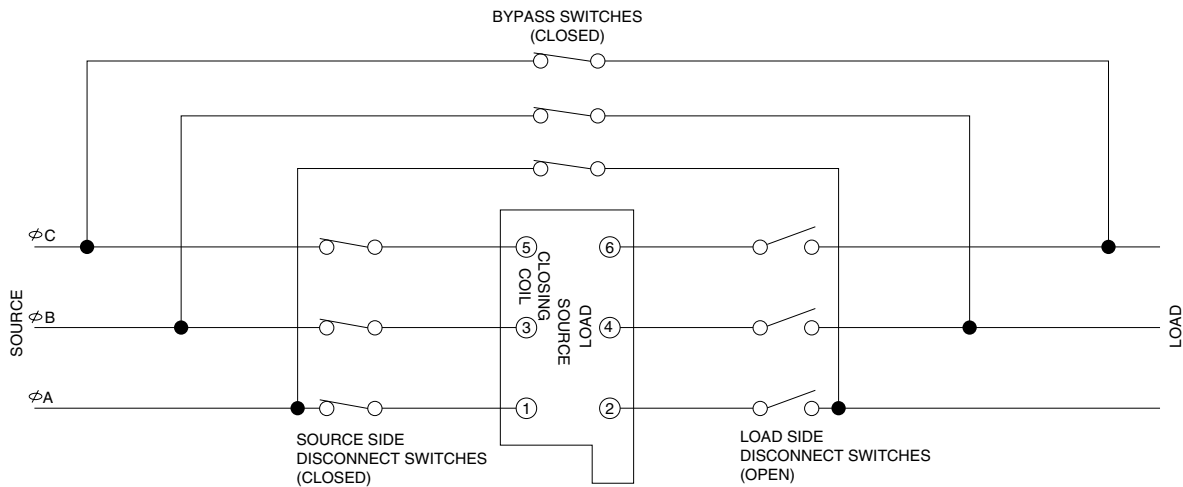


Figure 44.
Closing source-side switches of a bypassed “on-line” recloser provides closing solenoid power for automatic operation during testing.

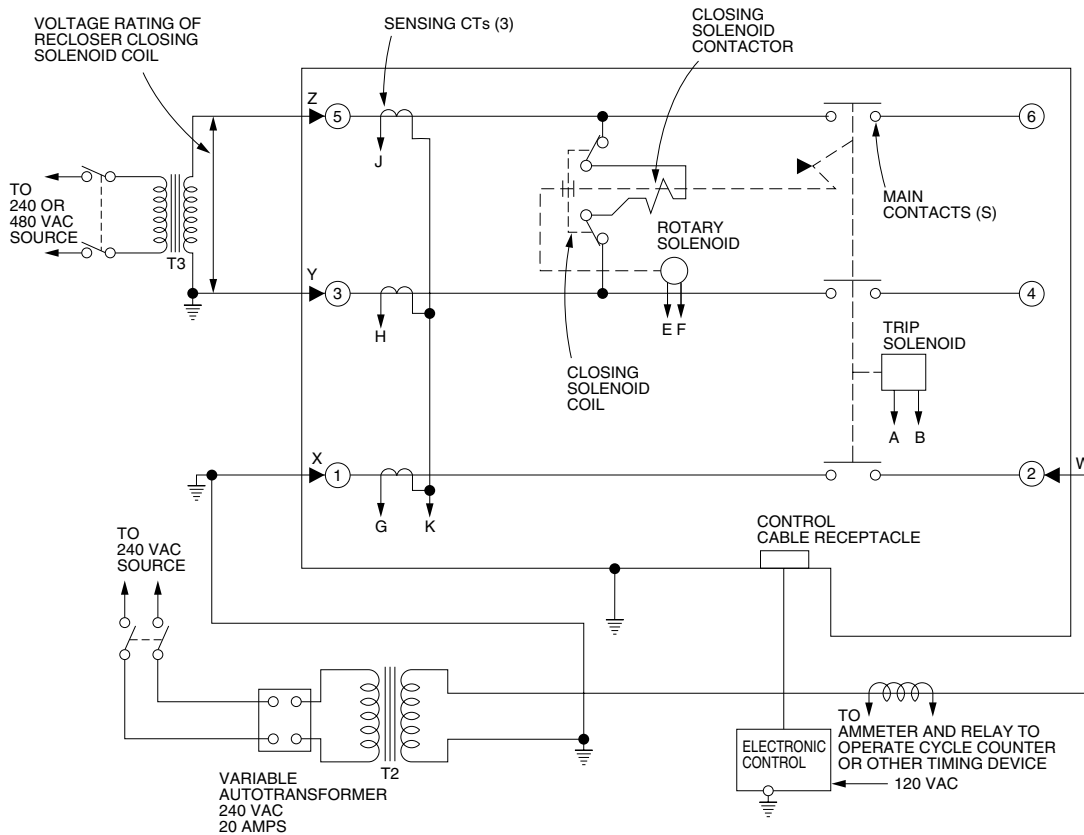


Figure 45.
Suggested test circuit for “shop-testing” solenoid-closing reclosers.

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.
2. Insert the tee-handled tool (available as an accessory) into the port, engaging the pin on the closing shaft (Figure 46).

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

3. Close the recloser by placing the yellow operating handle (located under the sleethood) into the up or CLOSED position and turning the closing tool one-quarter turn clockwise.

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

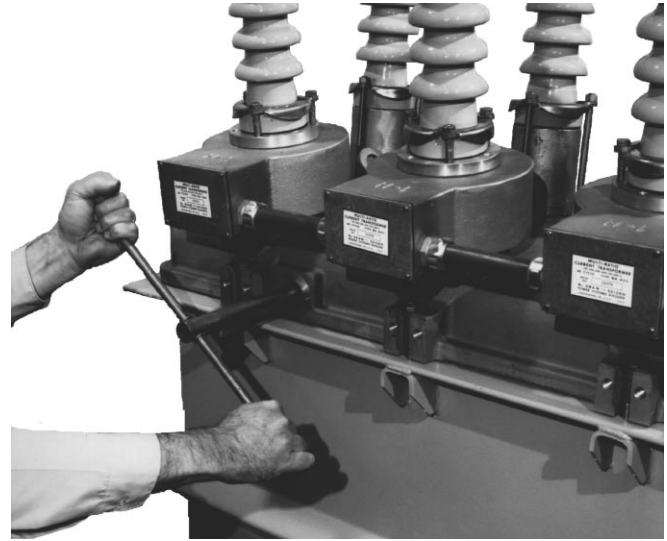


Figure 46. Using a manual closing tool to operate the recloser. 82284KMA-F

FORM 5 CONTROL DEFAULT TEST PROCEDURE



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.

IMPORTANT: The Form 5 DC NOVA control can not 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.

Use this procedure to test the Form 5 control with factory default control settings. Follow all cautions and warnings in these service instructions.

Before installation on an active feeder, the Form 5 control's final control settings must be fully tested using an appropriate test procedure. The Form 5 Control Default Test Sheet follows these instructions. The Form 5 Control Default Test Sheet Optimal Values gives the optimal values for the test results.

When performing these tests, change the Form 5 panel settings by first pressing the CHANGE button and then pressing the button of the function to be changed.

Initial Settings

1. Apply 120 (240) Vac to the control phase B and neutral for standard controls.
2. Plug in battery.
3. Verify control is programmed for all default settings.
 - Phase Minimum Trip is set to 100 amps.
 - Ground Minimum Trip is set to 50 amps.
4. Disable Sequence Coordination in normal profile using personal computer (PC).
5. Activate COLD LOAD PICKUP BLOCKED (LED is on) on Form 5 display panel.
6. Activate GROUND TRIP BLOCK (LED is on) on Form 5 display panel.

Test Battery Circuitry

IMPORTANT: The Battery Test procedure requires large current drain. Overuse of this procedure will drain the battery.

1. Press BACK button on display panel until Battery Test Screen 31 appears.
2. Record values for all settings.
3. Press CHANGE button on the display panel.
4. Press BATTERY TEST button on display panel.
5. Record values for all readings.

Test Phase Minimum Trip Values

1. Verify Ground Trip Block LED is on.
2. Set KMET Phase Selector S5 to A.
3. Set KMET switch S4 to 300 milliamperere range.
4. Set KMET Variac TR1 to zero.
5. Set KMET switch S2 to test fault current position.
6. Press the TRIP button on the display panel.
7. Press the CLOSE button on the display panel.
8. Slowly raise TR1 until Above Minimum Trip LED is on, on display panel. Control should trip out quickly for load currents above 105 milliamperes. Record value.
9. Repeat steps 4 – 8 for phases B and C (move KMET S5 to B, then C).
10. Change Form 5 control from Normal Profile to Alternate Profile 1.
11. Verify Cold Load Pickup Blocked (LED is on) on the display panel.
12. Repeat steps 2 – 9 for Form 5 Alternate Profiles 1, 2, and 3. The control is programmed to trip out at 200 milliamperes on the Alternate 1, 2, and 3 Profiles.

Note: If Cold Load Pickup LED is off, the control will trip on a time delayed Time Current Curve with two trips to lock-out for 30 seconds after closing in the control, per the default Cold Load Pickup control settings.

Note: If Alternate Profiles 1, 2, and 3 have the sequence coordination function enabled while testing the Form 5 control minimum trip values, it may result in the control skipping past the fast TCC curves during the test for minimum trip. The control will then lock out on the delayed TCC curves.

Note: If the Form 5 control has Switch Mode rather than Profile 3, the control will indicate current Above Minimum Trip, but will not trip out.

Test Ground Minimum Trip Values

1. Change the Form 5 control from an Alternate Profile to the Normal Profile (all three Profile LEDs are off). Disable Ground Trip Block (LED off).
2. Set KMET switch S4 to 100 milliamperere range.
3. Set KMET Variac TR1 to zero.
4. Set KMET switch S2 to test fault position.
5. Verify the Form 5 phase minimum trip values are higher than the ground trip values.
6. Set KMET Phase Selector S5 to A.
7. Press the TRIP button on the display panel.
8. Press the CLOSE button on the display panel.
9. Slowly raise TR1 until Above Minimum Trip shows on Form 5 control. Control should trip out for load currents above 50 milliamperes. Record values.
10. Repeat steps 4 – 9 for the Form 5 Alternate Profiles 1, 2, and 3. The control is programmed to trip out at 100 milliamperes on the Alternate 1, 2, and 3 Profiles.

Note: If Cold Load Pickup is activated (LED off), the control will trip on a time delayed TCC with two trips to lockout for 30 seconds after closing in the control, per the default Cold Load Pickup control settings.

Test Phase Timing

1. Set the Form 5 control to Normal profile (all Alternate Profile LEDs off).
2. Activate GROUND TRIP BLOCK (LED on). Ground Trip is blocked.
3. Set KMET Phase Selector S5 to phase A.
4. Set KMET switch S4 to 300 milliamperere range.
5. Press the Form 5 trip switch once to lock out the Form 5 control.
6. Set KMET phase selector S3 to Control Response.
7. While holding the KMET Test Fault Current Switch S2 in the Calibrate position, adjust the fault current to 200 percent fault (100 X 2 or 200 milliamperes).

Note: On newer controls, applying fault current while the control is locked out will set the Recloser Malfunction LED. This will not affect testing. To clear, press the Reset Targets button after all tests are complete.
8. Press the TRIP button on the display panel.
9. Press the CLOSE button on the display panel.
10. Set KMET Fault Switch S2 to test fault current position. Record timing readings from the KMET time clock for all trips on the A 2X ___ test sheet location.
11. Set KMET Test Set switch S4 to the 1A position.
12. Set KMET Phase Selector S5 to phase B.
13. Calibrate KMET fault current to 500 percent (100 X 5 or 500 milliamperes) using the KMET 1A range.
14. Press the TRIP button on the display panel.
15. Press the CLOSE button on the display panel.

16. Set KMET test set Fault Current Switch S2 to test fault current position. Record timings from the KMET test set for all trips on the B 5X ___ locations on the test sheet.
17. Set KMET Phase Selector S5 to phase C.
18. Calibrate KMET Phase Selector S5 to 1000% of fault (1000 milliamperes).
19. Press the TRIP button on the display panel.
20. Press the CLOSE button on the display panel.
21. Set KMET test set Fault Current Switch S2 to test fault current position. Record timings from the KMET test set for all trips on the C 10X ___ locations on the test sheet.
22. Repeat steps 2 – 21 for Alternate Profiles 1, 2, and 3. Note that the Phase minimum trip for the Alternate Profiles is 200 amps. The 200% fault will then be 400 milliamperes or .4 amp, the 500% fault will then be 1000 milliamperes or 1 amp, and the 1000% fault will then be 2000 milliamperes or 2 amps.

Test Ground Timing

1. Verify control is programmed for all default settings.
 2. Disable GROUND TRIP BLOCK (LED off). Ground Trip is active.
 3. Activate the Normal Profile (Alternate Profile LEDs off).
- Note:** When testing the ground trip timing circuit, the KMET test set applies a phase to ground fault to the Form 5 control. If the applied fault current exceeds the phase minimum trip value, the control may time out on the phase time current curve, which may be shorter than the proper ground time current curve. For this reason, the Form 5 phase minimum trip value should be increased to a higher value while testing Form 5 ground trip time current curves.
4. Increase the Form 5 phase minimum trip value to 1600 amperes.
 5. Set KMET Test Set switch S4 to the 300 milliamperere position.
 6. While holding the Fault Current Switch S2 in the Calibrate position, adjust the fault current to 200 percent fault (50 X 2 or 60 milliamperes).
 7. Press the TRIP button on the display panel.
 8. Press the CLOSE button on the display panel.
 9. Set KMET test set Fault Current switch S2 in the test fault current position. Record timings from the KMET test set for all trips on the G 2X ___ locations on the test sheet.
 10. Calibrate KMET fault current to 500 percent, (50 X 5 or 250 milliamperes).
 11. Press the TRIP button on the display panel.
 12. Press the CLOSE button on the display panel.



13. Set KMET test set Fault Current switch S2 in the test fault current position. Record timings from the KMET test set for all trips on the G 5X ___ locations on the test sheet.
14. Set KMET Test Set switch S4 to the 1A position.
15. Calibrate KMET fault current to 1000 percent, (50 X 10 or 500 milliamperes).
16. Press the TRIP button on the display panel.
17. Press the CLOSE button on the display panel.
18. Set KMET test set Fault Current switch S2 in the test fault current position. Record timings from the KMET test set for all trips on the G 10X ___ locations on the test sheet.
19. Repeat steps 4 – 18 for Alternate Profiles 1, 2, and 3. Note that the ground minimum trip for the Alternate Profiles is 100 amps. The 200% fault will then be 200 milliamperes, the 500% fault will then be 500 milliamperes, and the 1000% fault will then be 1000 milliamperes or 1 amps.
20. Return the Normal Profile Phase Minimum Trip Value to the pretest value, 100 amps.

Test Non-Reclose

1. Activate NON-RECLOSING (LED on).
2. Activate GROUND TRIP BLOCK (LED on).
3. Set KMET Phase Selector switch S5 to phase A.
4. Set Form 5 control to Normal Profile (all Alternate Profile LEDs off).
5. Adjust fault current to 200 percent or 200 milliamperes.
6. Press the TRIP button on the display panel.
7. Press the CLOSE button on the display panel.
8. Set KMET test set Fault Current Switch S2 to fault position.
9. Control should trip once, then indicate open and lockout. Record time value.
10. Disable NON-RECLOSE (LED off).
11. Repeat steps 5 – 8, to lockout. Record time value.

Test Cold Load Pickup Blocked

1. Disable COLD LOAD PICKUP BLOCKED (LED off).
2. CLOSE the Form 5 control.
3. Adjust fault current to 200 percent or 200 milliamperes.
4. Within 30 seconds of Step 3, set KMET test set Fault Current Switch S2 to fault position.

5. Control should trip twice on slow TCC curve, then indicate open and lockout. Record timing value.
6. Activate COLD LOAD PICKUP BLOCKED (LED on).
7. Repeat steps 2 – 4. Record value.

Test Fast Trips Disabled

1. Activate FAST TRIPS DISABLED (LED on).
2. CLOSE the Form 5 control.
3. Adjust fault current to 200 percent or 200 milliamperes.
4. Set KMET test set Fault Current Switch S2 to fault position.
5. Control should trip two times to lockout, on all slow TCCs, then indicate OPEN and lockout. Record value.
6. Deactivate Fast Trips Disabled (LED off).
7. Repeat steps 2 -4. Control should trip on two fast, two slow TCCs. Record values.

Test Hot Line Tag

1. CLOSE the Form 5 control.
2. Activate HOT LINE TAG (LED on).
3. Adjust fault current to 200 percent or 200 milliamperes.
4. Set KMET test set Fault Current Switch S2 to fault position.
5. Control should trip out once on the 101 TCC curve, then indicate open and lockout. Record value.
6. Verify that it is not possible to close the Form 5 control.
7. Deactivate HOT LINE TAG (LED off).
8. Verify that you can CLOSE the Form 5 control.

Test Reclose

1. Set KMET selector switch S3 to Control Reclose Reset.
2. Reset the KMET Time Clock if required.
3. Adjust fault current to 200 percent or 200 milliamperes.
4. Set KMET test set Fault Current Switch S2 to fault position.
5. After trip, turn fault switch S2 off.
6. Record reclose time.
7. Repeat steps 2 – 6 until control locks out.

Test Close Circuit Disable Fuse

This test is only applicable to Form 5 LS controls and standard Form 5 controls below Serial Number 3000.

1. Set KMET Fault Switch S2 to OFF.
2. CLOSE the Form 5 control.
3. Remove Close Circuit Disable fuse.
4. Adjust fault current to 200 percent or 200 milliamperes.
5. Set KMET test set Fault Current Switch S2 to fault position. The control will trip once.
6. Verify that it is not possible to close the Form 5 control.
7. Replace Close Circuit Disable fuse.
8. Verify it is now possible to CLOSE the Form 5 control.

Verify Instantaneous Demand Metering

1. Enable GROUND TRIP BLOCK (LED on).
2. Set KMET switch S2 to OFF.
3. Set KMET Phase Selector S5 to A.
4. Set KMET Variac to zero.
5. Set KMET switch S4 to the 100 milliampere range.
6. CLOSE Form 5 control.
7. Set KMET switch S2 to ON.
8. Set KMET Variac to read 80 milliamperes.
9. Scroll the Form 5 LCD screen to screen 1.
10. Verify Instantaneous metering on Phase A and Ground reads 80 milliamperes.
11. Set KMET Phase Selector S5 to B.
12. Verify Instantaneous metering on Phase B and Ground reads 80 milliamperes.
13. Set KMET Phase Selector S5 to C.
14. Verify Instantaneous metering on Phase C and Ground reads 80 milliamperes.



Form 5 Control Default Test Optimal Values						
2. Battery Circuitry	Volts	<i>28.0</i>	2.6 Volts		<i>28.0</i>	
	MA	<i>35</i>	2.6 MA		<i>550</i>	
	Volts	<i>27.0</i>	2.6 volts		<i>24.2</i>	
3. Phase Minimum Trip	Normal Profile	Phase A Amps	Phase B Amps	Phase C Amps		
		<i>100.5</i>	<i>100.3</i>	<i>100.7</i>		
	Profile #1	Phase A Amps	Phase B Amps	Phase C Amps		
		<i>200.9</i>	<i>200.2</i>	<i>200.5</i>		
	Profile #2	Phase A Amps	Phase B Amps	Phase C Amps		
		<i>200.9</i>	<i>200.2</i>	<i>200.5</i>		
	Profile #3	Phase A Amps	Phase B Amps	Phase C Amps		
	<i>200.9</i>	<i>200.2</i>	<i>200.5</i>			
4. Ground Minimum Trip	Normal	Ground Amps	<i>50.1</i>			
	Profile #1	Ground Amps	<i>100.3</i>			
	Profile #2	Ground Amps	<i>100.3</i>			
	Profile #3	Ground Amps	<i>100.3</i>			
5. Phase Timing	Trip to Lockout Sequence		1st	2nd	3rd	4th
	Normal	Phase A 2X	<i>0.161</i>	<i>0.164</i>	<i>1.416</i>	<i>1.421</i>
		Phase B 5X	<i>0.018</i>	<i>0.017</i>	<i>0.278</i>	<i>0.280</i>
		Phase C 10X	<i>0.016</i>	<i>0.014</i>	<i>0.088</i>	<i>0.086</i>
	Profile #1	Phase A 2X	<i>0.153</i>	<i>0.154</i>	<i>1.443</i>	<i>1.441</i>
		Phase B 5X	<i>0.015</i>	<i>0.014</i>	<i>0.273</i>	<i>0.275</i>
		Phase C 10X	<i>0.011</i>	<i>0.009</i>	<i>0.087</i>	<i>0.087</i>
	Profile #2	Phase A 2X	<i>0.153</i>	<i>0.154</i>	<i>1.443</i>	<i>1.441</i>
		Phase B 5X	<i>0.015</i>	<i>0.014</i>	<i>0.273</i>	<i>0.275</i>
		Phase C 10X	<i>0.011</i>	<i>0.009</i>	<i>0.087</i>	<i>0.087</i>
	Profile #3	Phase A 2X	<i>0.153</i>	<i>0.154</i>	<i>1.443</i>	<i>1.441</i>
		Phase B 5X	<i>0.015</i>	<i>0.014</i>	<i>0.273</i>	<i>0.275</i>
		Phase C 10X	<i>0.011</i>	<i>0.009</i>	<i>0.087</i>	<i>0.087</i>

Form 5 Control Default Test Optimal Values

6. Ground Timing	Trip Sequence		1st	2nd	3rd	4th	
	Normal	Ground 2X	0.214	0.212	3.894	3.896	
		Ground 5X	0.012	0.016	1.097	1.099	
		Ground 10X	0.008	0.014	0.652	0.653	
	Profile #1	Ground 2X	0.214	0.212	3.894	3.896	
		Ground 5X	0.012	0.016	0.952*	0.954*	
		Ground 10X	0.008	0.014	0.280*	0.276*	
	Profile #2	Ground 2X	0.214	0.212	3.984	3.896	
		Ground 5X	0.012	0.016	0.952*	0.954*	
		Ground 10X	0.008	0.014	0.280*	0.276*	
	Profile #3	Ground 2X	0.214	0.212	3.894	3.896	
		Ground 5X	0.012	0.016	0.952*	0.954*	
		Ground 10X	0.008	0.014	0.280*	0.276*	
	7. Non-Reclose	Enabled	Phase 2X	0.153	lockout	lockout	lockout
		Disabled	Phase 2X	0.152	0.153	1.420	1.433
8. Cold Load PickUp Blocked	Block Off	Phase 2X	1.420	1.433	lockout	lockout	
	Block On		0.158	0.154	1.420	1.433	
9. Fast Trips	Enabled	Phase 2X	1.419	1.422	lockout	lockout	
	Disabled	Phase 2X	0.155	0.156	1.418	1.424	
10. Hot Line Tag	No Reclose	Phase 2X	0.014	lockout	lockout	lockout	
	Enabled	Phase 2X	0.155	0.156	1.148	1.424	
11. Test Reclose	Reclose Sequence		1st	2nd	3rd	4th	
	Reclose Times		1.975	1.974	4.968	lockout	
12. Close Circuit Disable Fuse	Fuse Out	Can't Close?	Yes	No			
				XXX			
	Fuse In	Can Close?	Yes	No			
			XXX				
13. Instantaneous Demand Metering	Phase A	Phase B	Phase C				
	Amps 80	Amps 81	Amps 80				

*Refer to the **Test Ground Timing** section of this manual.



Form 5 Control Default Test Sheet

Date:

Serial No:

2. Battery Circuitry	Volts		2.6 Volts			
	MA		2.6 MA			
	Volts		2.6 volts			
3. Phase Minimum Trip	Normal Profile	Phase A Amps	Phase B Amps	Phase C Amps		
	Profile #1	Phase A Amps	Phase B Amps	Phase C Amps		
	Profile #2	Phase A Amps	Phase B Amps	Phase C Amps		
	Profile #3	Phase A Amps	Phase B Amps	Phase C Amps		
4. Ground Minimum Trip	Normal	Ground Amps				
	Profile #1	Ground Amps				
	Profile #2	Ground Amps				
	Profile #3	Ground Amps				
5. Phase Timing	Trip to Lockout Sequence		1st	2nd	3rd	4th
	Normal	Phase A 2X				
		Phase B 5X				
		Phase C 10X				
	Profile #1	Phase A 2X				
		Phase B 5X				
		Phase C 10X				
	Profile #2	Phase A 2X				
		Phase B 5X				
		Phase C 10X				
	Profile #3	Phase A 2X				
		Phase B 5X				
		Phase C 10X				

Form 5 Control Default Test Sheet

6. Ground Timing	Trip Sequence		1st	2nd	3rd	4th	
	Normal	Ground 2X					
		Ground 5X					
		Ground 10X					
	Profile #1	Ground 2X					
		Ground 5X					
		Ground 10X					
	Profile #2	Ground 2X					
		Ground 5X					
		Ground 10X					
	Profile #3	Ground 2X					
		Ground 5X					
		Ground 10X					
	7. Non-Reclose	Enabled	Phase 2X		lockout	lockout	lockout
		Disabled	Phase 2X				
8. Cold Load PickUp Blocked	Block Off	Phase 2X			lockout	lockout	
	Block On						
9. Fast Trips	Enabled	Phase 2X			lockout	lockout	
	Disabled	Phase 2X					
10. Hot Line Tag	No Reclose	Phase 2X					
	Enabled	Phase 2X					
11. Test Reclose	Reclose Sequence		1st	2nd	3rd	4th	
	Reclose Times						
12. Close Circuit Disable Fuse	Fuse Out	Can't Close?	Yes	No			
	Fuse In	Can Close?	Yes	No			
13. Instantaneous Demand Metering	Phase A	Phase B		Phase C			
	Amps	Amps		Amps			

REMOVE THE 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.

 **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

2. Disconnect control cable from the control.

3. De-energize ac power from the control.

4. Unplug the control battery.

RETURN THE CONTROL TO SERVICE

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

G110.3

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

1. Plug in the control battery.

2. Apply ac power to the control.

3. Verify that all control settings are correct.

4. Reconnect the control cable to the control.

5. 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 GND TRIP BLOCKED key.

Note: After the GND TRIP BLOCKED key is depressed, the red LED indicator will not be illuminated indicating GROUND TRIP BLOCKED is not active.

6. Reset the control clock after AC power has been re-applied. Refer to **Setting the Control Clock** in *Service Information S280-79-2 Form 5 Microprocessor-Based Recloser Control Programming Guide*.

ADDITIONAL INFORMATION

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

Replacement Kits

Replacement kits for the Kyle Form 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.

