NOTICE: This bulletin is also applicable to Kyle product serial numbers beginning with the prefix CP57.

Reclosers

COOPER Power Systems

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

Service Information

S280-42-3

Applicable to Serial Numbers 9416 and above.

99015KM

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

Contents

SAFETY FOR LIFE

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

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

SAFETY INFORMATION

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

A competent technician has these qualifications:

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

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

Hazard Statement Definitions

This manual may contain four types of hazard statements:

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

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

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

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

Safety Instructions

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

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

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

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

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

PRODUCT INFORMATION

Introduction

Service Information S280-42-3 provides installation and operation instructions for the Kyle® Form 5/Triple-Single microprocessor-based electronic recloser controls. This control is used exclusively with Kyle® Type NOVA-TS reclosers. Refer to *Service Information S280-42-2 Type NOVA-TS Electronically-Controlled Recloser Installation and Operation Instructions* for additional information.

Read This Manual First

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

Additional Information

These instructions cannot cover all details or variations in the equipment, procedures, or process described, nor provide directions for meeting every possible contingency during installation, operation, or maintenance. When additional information is desired to satisfy a problem not covered sufficiently for the user's purpose, contact your Cooper Power Systems sales representative.

ANSI Standards

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

Quality Standards

ISO 9001:2000 Certified Quality Management System

Acceptance and Initial Inspection

Each Form 5/Triple-Single 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

Two 12 Vdc, 13- Amp-hour control batteries in the Form 5/Triple-Single control are fully charged prior to shipment and is ready for use.

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.

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.

To keep the batteries 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.

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.

Battery Replacement

In a typical application, the life expectancy of a lead acid battery is three to five years. To determine the state of the battery, perform a bench battery test. Battery replacement is recommended after four years for lead acid batteries or if the battery fails the bench battery test procedure. The Form 5/Triple-Single control batteries have different dimensions; therefore, if the replacement battery ordered is a different brand than the original battery, a kit with mounting hardware may be required.

Battery Disposal

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

Control Power

The primary source of power is factory configured for 120 Vac or 240 Vac. 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. The Kyle® Form 5/Triple-Single recloser control is equipped with two dc-to-dc converters, an interface circuit, and a fully shielded 26-pin cable.

The dc-to-dc converter boards (Figure 2) convert the control's 24 Vdc battery supply voltage to 53 Vdc to charge the trip/close capacitors in the NOVA mechanisms. The output of the boards is separately fused for short circuit protection.

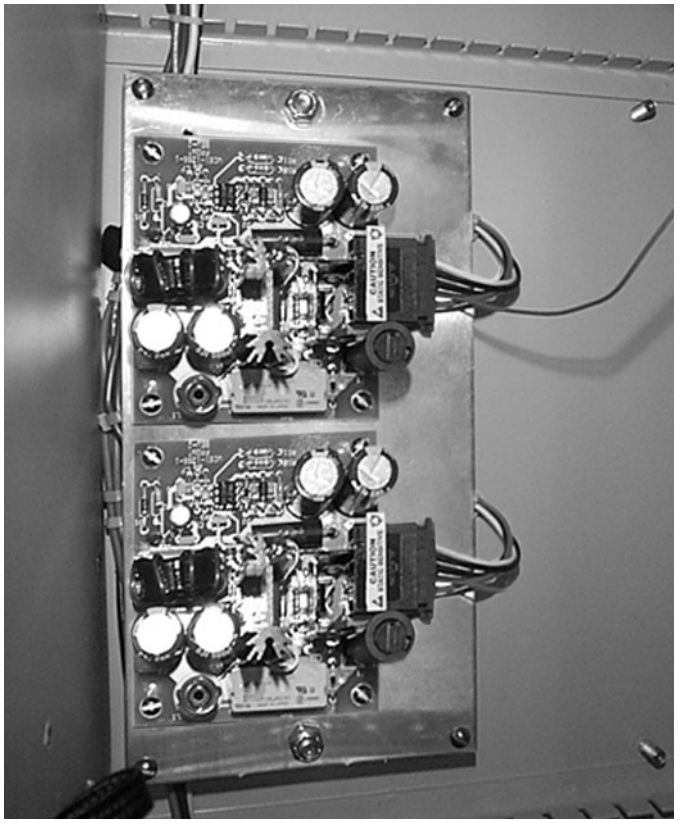
The dc-to-dc converter contains voltage monitoring and conditioning circuits which protect the battery from failure and provides trip/close operations without AC power. The 26-pin control cable interfaces the NOVA-TS Triple-Single recloser to the Form 5/Triple-Single control through the junction box.

Operation Upon Loss Of AC power

The control will maintain 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 20.5 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.



99007KM

Figure 2.
Dc-to-dc converters located behind Form 5/Triple-Single operator panel (removed).

Initializing the Control

Two methods are available to initialize the Form 5/Triple-Single control:

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

Method 2: Connect the battery terminals to the control and press the MANUAL BATTERY RECONNECT button located on the Form 5/Triple-Single 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.

FORM 5/TRIPLE-SINGLE CONTROL DESCRIPTION

The Kyle Form 5/Triple-Single microprocessor-based recloser control is designed for use with the Kyle NOVA-TS Triple-Single reclosers to provide automation of distribution feeders in line applications.

The Form 5/Triple-Single control operates three single-phase NOVA-TS reclosers representing phases A, B, and C.

Note: Phase A, B, and C sequence positions are independent of each other. For example, Phase A may be sequencing on TCC1 while Phase C may have sequenced to TCC3.

The Form 5/Triple-single control uses three modes of operation. All modes are configured through the user interface software.

Mode A: Three-phase trip, three-phase lockout.

Mode B: Single-phase trip, three-phase lockout

Mode C: Single-phase Trip, single-phase lockout.

The Form 5/Triple-Single control includes phase and ground current sensing as well as voltage sensing on a per-phase basis for both source and load. The control can compute and record current and voltage harmonics, power, power factor, and power flow direction from current and voltage measurements.

Programming, interrogation, and operations are accomplished utilizing the interface software program (see *Service Information S280-79-2*) via a personal computer. A personal computer is temporarily connected to the control through the operator panel RS-232 data port or remotely through additional communication ports.

The Form 5/Triple-Single control is constructed in a modular fashion to simplify service and the addition of accessories (see 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.

Phase Operation

In Mode A, all three phases trip and close. In Modes B and C, each phase operates on a separate four trip sequence, with protection parameters the same for all three phases. In Mode B all three phases trip to lockout when one phase sequences to lockout. In Mode C, each phase independently sequences to lockout.

Ground Operation

In Mode A, all three phases trip and close. In Modes B and C, ground tripping is active when all three phases are closed. Ground trip is disabled during the reclose interval of any one phase.

For faults above the ground minimum trip value, and below the phase minimum trip value, all three phases trip on ground and advance to the next sequence position.

For faults above the phase and ground minimum trip value, the control trips on the phase(s) above phase minimum trip, operating on the phase or ground TCC, whichever is faster. Only tripped phases advance in sequence and are counted as phase operations.

Note: Phase and ground share the same sequence position. As position sequence advances, the phase and ground TCCs advance.

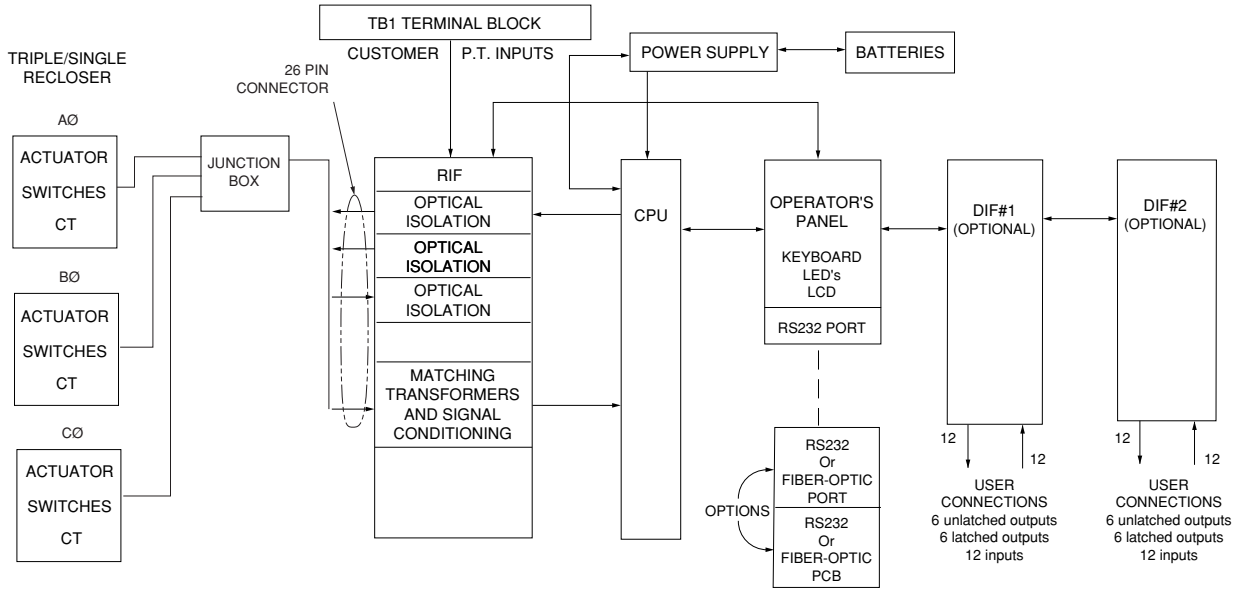


Figure 3.
Form 5/Triple-Single control operational flow diagram.

Sensitive Ground/Earth Fault Operation

Sensitive Ground/Earth Fault (SGF/SEF) is active when all three phases are closed. For SGF faults, all three phases trip at one time.

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 module provides three current transformer inputs, three open and close circuits and three sets of OPEN, CLOSE, and yellow operating handle LOCKOUT status inputs (one for each phase). These signals always indicate the true state of each Form 5/Triple-Single recloser, regardless of the position of the yellow operating handle.

One connector on the bottom of the control cabinet provides the connection for all three phases of the Kyle Type NOVA-TS recloser.

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/Triple-Single 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/Triple-Single control. The DIF module contains 12 inputs and 12 outputs for remote or supervisory functions. Each Form 5/Triple-Single 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 power to the auxiliary communication equipment such as transceivers and modems. 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.

If ac power is lost, the control batteries power the control until the battery voltage drops below 20.5 V at which point the power supply disconnects the battery from the load.

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

Form 5/Triple-Single Control Operator Panel

The Form 5/Triple-Single control operator panel (Figure 5) 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 RS232 port is also provided to permit the temporary connection of a personal computer 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.

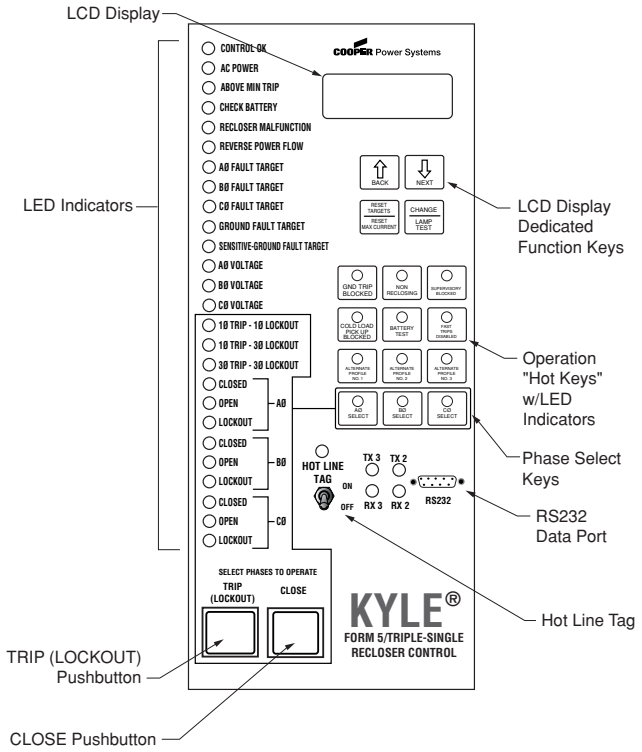


Figure 5.
Form 5/Triple-Single control operator panel.

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 15 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 when the control fails a battery test. A failed test can indicate any of these conditions:

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

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

RECLOSER 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 must be correct for reverse power flow to function properly.

AØ FAULT TARGET

BØ FAULT TARGET

CØ 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.

AØ VOLTAGE

BØ VOLTAGE

CØ 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.

1Ø TRIP - 1Ø LOCKOUT

1Ø TRIP - 3Ø LOCKOUT

3Ø TRIP - 3Ø LOCKOUT

Indicates the Triple -Single mode of operation (Modes C, B, A).

CLOSED, OPEN, and LOCKOUT LEDs

Each phase has its own set of status LEDs. See Figure 6. The CLOSED red indicator illuminates when the control senses the recloser mechanism is in the closed position. The OPEN green indicator illuminates when the control senses that the recloser mechanism is in the open position.

This green LOCKOUT 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).

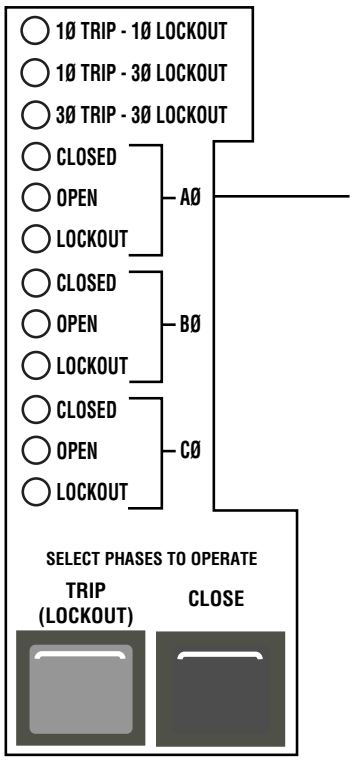


Figure 6.
Recloser status LEDs for each phase and manual trip and close pushbuttons.

TRIP (Lockout) Pushbutton

The TRIP pushbutton (Figure 6) provides front-panel access to trip (lockout) the recloser. When pressed, the TRIP push-button manually opens the recloser and locks out the control.

CLOSE Pushbutton

When pressed, the CLOSE pushbutton (Figure 6) manually 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/Triple-Single 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.

Phase Selection Keys

The Form 5/Triple-Single control has phase selection keys (Figure 7) for the user to indicate only which phase of the NOVA-TS Triple-Single recloser will operate when the manual TRIP (LOCKOUT) and CLOSE pushbuttons on the operator panel are pressed. When the TRIP or CLOSE buttons are pressed, only the phases that are selected (LED on) will trip or close. For complete operation instructions, refer to the **Manual Control Operation** section of this manual.

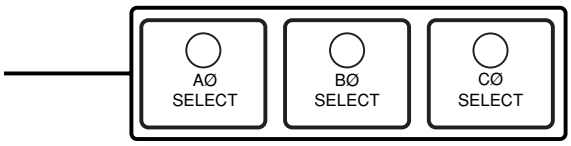


Figure 7.
Phase SELECT keys for operation with TRIP and CLOSE pushbuttons.

RS232 Communication Port

The standard Form 5/Triple-Single control is equipped with an operator panel RS232 port for interface with a personal computer running the Form 5/Triple-Single 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 RS232 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 RS232 port is intended only for temporary connection of a personal computer. Permanent serial communications must be made via the RS232 or fiber-optic accessory board.

LCD Display

The control operator panel has a large, backlit LCD display (Figure 8) used for viewing control parameters and monitoring system conditions. Data is organized into messages or “screens” of information, with each screen containing four lines of information, with up to 20 characters per line. Access to the messages is obtained through navigational keys which permit the user to scroll through the menu in a timely and efficient manner.

When an overcurrent trip occurs, the control automatically displays the fault current values as shown on the LCD display as Screen 2 (see **LCD Display Messages** section of this manual).

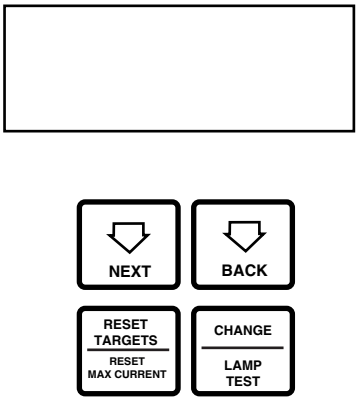


Figure 8.
LCD display and dedicated function keys.

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.

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 screens at a faster rate.

RESET TARGETS/RESET MAX CURRENT Key

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

Pressing and holding the RESET TARGETS/RESET MAX CURRENT key for three seconds will reset the minimum and maximum 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 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 message. 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 14 - Instantaneous Power Factor

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

Screen 15 - Instantaneous Total Harmonic Distortion Current

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

Screen 16 - Instantaneous Total Harmonic Distortion Voltage

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

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 18 - Demand Phase-to-Phase Voltage

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

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 20 - Demand Phase-to-Phase Voltage

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

Screen 21 - Demand Voltage

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

Screen 22 - Demand Current

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

Screen 23 - Demand kW

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

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 - SGF Overcurrent Trip and Operations Counter

30 SGF OC Trip	_____
Ph1-2 Ops	_____
Ph3-4 Ops	_____
Ph5-6 Ops	_____

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 9).

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 operator panel is in the power save mode.

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.

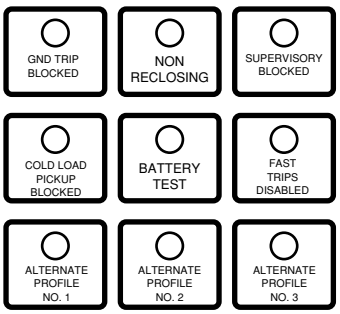


Figure 9.
Operation/indication pushbuttons.

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 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 key.

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 (CLPU) feature is blocked while the CLOD 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 (SGF) 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 **Battery Testing and Charging Procedures** in the **Testing** section of this manual for more information.

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.

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: 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/Triple-Single UDP controls, Alternate Profile 3 is replaced with SWITCH MODE. See **FORM 5 LS UNIVERSAL DEVICE PROTECTION (UDP)** section of this manual.

HOT LINE TAG ON/OFF Toggle Switch and LED Indicator

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

Hot Line Tag is provided for live-line work applications. All closing operations are disabled when the Hot Line Tag feature is activated. While active, the control utilizes an independent, user-selectable time-current curve for trip operations.

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

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

The Hot Line Tag feature (Figure 10) 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, the reset 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.

Note: Hot Line Tag automatically changes the mode of operation to 3-Phase Trip–3-Phase Lockout. If a fault occurs while in Hot Line Tag, all three phases trip once per the user-selectable TCC.

Figure 10.
Hot Line Tag Switch.

Manual Control Operation

Each single-phase unit in the NOVA-TS Triple-Single recloser represents either A, B, or C phase. Phase selection keys (Figure 7) are used to select a phase that will operate when a manual TRIP or CLOSE operation is activated.

Note: Before selecting a phase for operation, press the CHANGE/LAMP TEST key.

Manual operation of the yellow handles on the NOVA-TS triple-single recloser is used to open and lockout the phases, and disable the electrical and supervisory closing. The recloser mode of operation determines which phases open and close. The Form 5/Triple-Single control initiates the close signal.

WARNING: Hazardous Voltage. Do not rely on the open position of the yellow operating handle; it does not ensure that the line has been de-energized. Always establish a visible disconnect. Failure to follow proper safety practices can result in contact with high voltage, which will cause death or severe personal injury. G116.0

3Ø Trip – 3Ø Lockout (Mode A) or 1Ø Trip – 3Ø Lockout (Mode B)

If the control is in Three-Phase Trip – Three-Phase Lockout (Mode A) or Single-Phase Trip – Three-Phase Lockout (Mode B), all three phases are permanently selected and all three PHASE SELECT LEDs are illuminated.

When one phase is opened with the yellow operating handle, all three phases open and lockout The OPEN and LOCKOUT LEDs illuminate on the control panel.

IMPORTANT: Pushing the yellow operating handle to the CLOSE position *will not* close the recloser. All close operations are initiated by the Form 5/Triple-Single control.

With the yellow operating handle of the appropriate phase in the CLOSE position, press the CLOSE pushbutton on the control operator panel. All three phases close and the CLOSED LEDs for all three phases illuminate.

1Ø Trip – 1Ø Lockout (Mode C)

When in Single-Phase Trip – Single-Phase Lockout (Mode C) any combination of phases can be selected and the respective PHASE SELECT LED illuminates. Each selected phase must be closed individually.

When the selected phase is opened with the yellow operating handle, only that phase opens and locks out. The OPEN and LOCKOUT LEDs illuminate on the control panel.

With the yellow operating handle of the selected phase in the CLOSE position, press the CLOSE pushbutton on the control panel. The phase closes and the CLOSED LED for that phase illuminates.

IMPORTANT: Pushing the yellow operating handle to the CLOSE position *will not* close the recloser. All close operations are initiated by the Form 5/Triple-Single control.

IMPORTANT: If more than 5 minutes elapses since the last panel operation, all the LEDs, except CONTROL OK, will turn off and all three phases will be selected. Deselect the phases you do not want activated, and then press the TRIP or CLOSE button.

Control Features

The Form 5/Triple-Single 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/Triple-Single 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/Triple-Single control 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 Form 5/Triple-Single controls. A recloser trip is 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
- single-phase with three-phase inhibit.

Response mode facilitates protection 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, the interface software or SCADA (see Figure 11). Each profile has 14 TCC specifications plus reclose intervals, sequence coordination and reset times to maintain independent protection parameters.

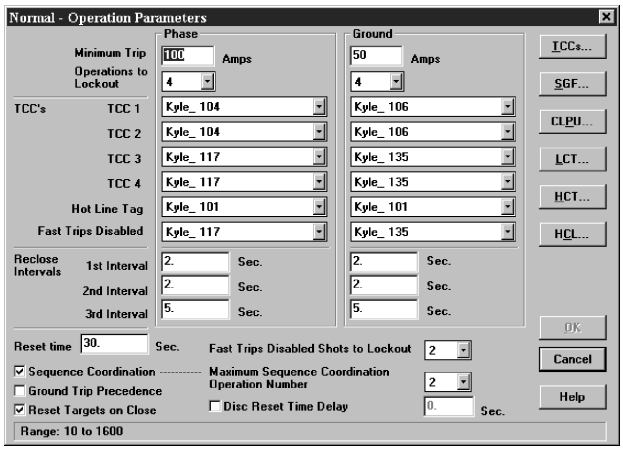


Figure 11.
Interface software sample protection profile.

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 selects between the definition of power factor (cosine of angle between current and voltage) or the power factor sign following power flow.

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 the following four LEDs flash 1 second on, 1 second off (see Figure 12):

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

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.

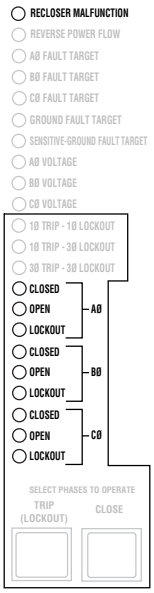


Figure 12.
RECLOSER MALFUNCTION, OPEN, CLOSED, and LOCKOUT LEDs will blink for the affected phase as indication of Trip Failure.

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.

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 CLOSED LED for the affected phase blinks indicating the feature is active. See Figure 13.

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

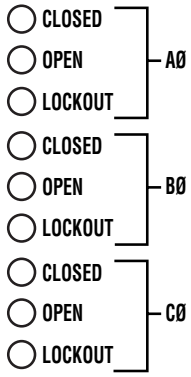


Figure 13.
CLOSED LED blinks for the affected phase as indication of Manual Close Delay.

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

The default setting has the feature disabled (0 seconds).

Voltage Metering

Six voltages (3-source and 3-load) are metered as standard on the Form 5/Triple-Single control. The user selects either line-to-neutral or line-to-line values from the control operator panel, interface software, or serial communications. The type of value is changed by selecting “Voltage Configuration” 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 (Figure 9), 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.

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 within user-defined minimum and maximum limits. Date and time are recorded for the maximum and minimum demand values.

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 and illuminates a front-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.

Harmonic Analysis

Extensive harmonic analysis is performed by the Form 5/Triple-Single 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 14) while complete analysis, including graphing capabilities, is provided from the Form 5/Triple-Single interface software.

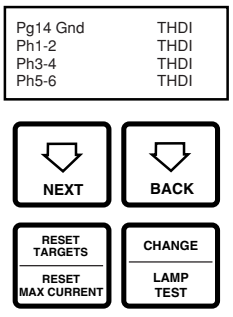


Figure 14.
Triple-Single operator panel harmonic readout.

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 capacity, the oldest event is deleted as a new event is added.

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 15) 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/Triple-Single control interface software to program the activation time and time-current characteristics applicable for 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.

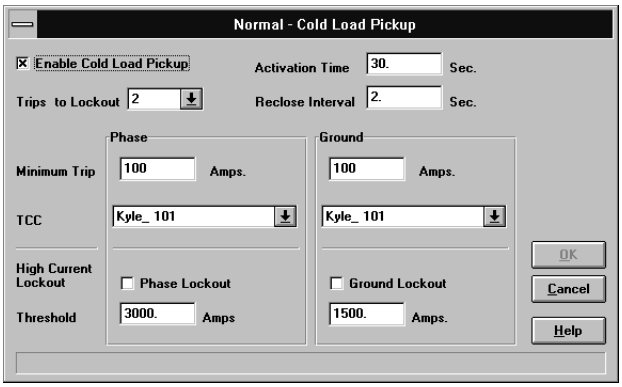


Figure 15.
Interface software Cold Load Pickup settings. (Accessed from the Operations Parameters screen. See Figure 11.)

Alarms

Status and data alarms are available for many control parameters such as voltage and current 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.

Status alarms are included for Modes A, B, and C as well as the following status alarms for each phase of the Kyle Type NOVA-TS Triple Single recloser:

- Open
- Closed
- Lockout
- Close Retry Active
- Close Fail
- Retry Fail
- Open Fail
- Neither Open or Closed
- Yellow Handle Active

Fault Location

Fault Location provides an approximate distance of a fault from the the Form 5/Triple-Single 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 16.

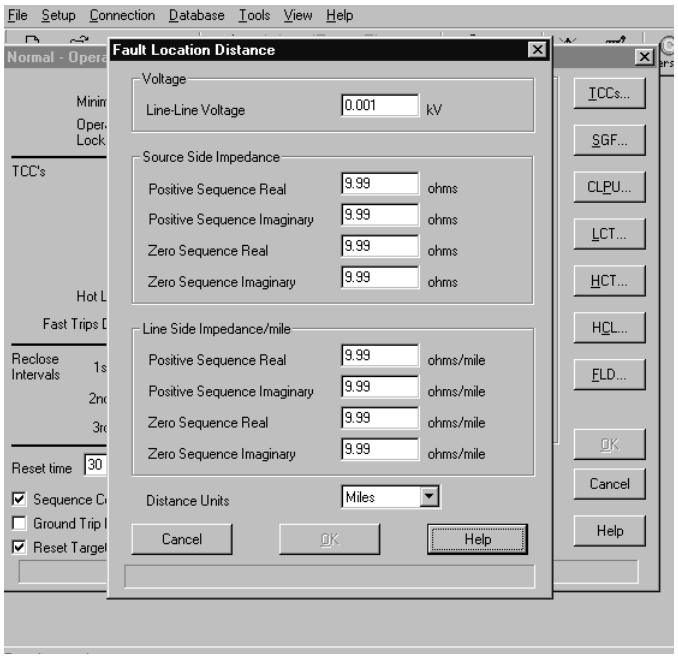


Figure 16.
Fault Location configuration screen.

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/Triple-Single 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/Triple-Single 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 17. 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.

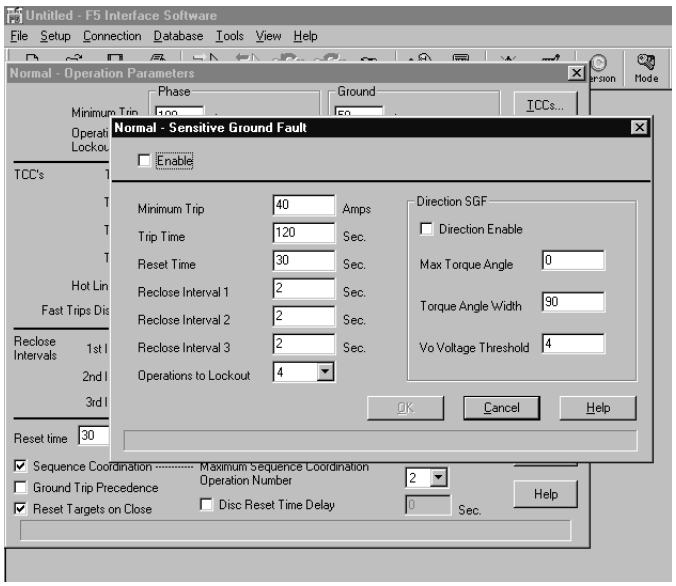


Figure 17.
Directional SGF/SEF configuration screen.

Communications

Communication Ports

The Form 5/Triple-Single 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 18 illustrates the communication configuration for serial ports 1, 2, and 3.

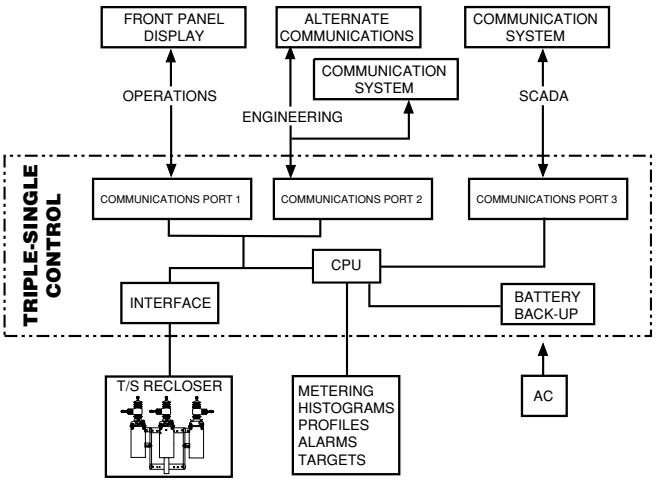


Figure 18.
Control communication port configuration.

Fiber-Optic and RS-232 Accessories

Two sets of receive and transmit LEDs (Figure 19) 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 S*ervice Information S280-79-4 Form 5 and Form 5/Triple-Single Recloser Control Fiber-Optic/RS-232 Serial Communications Accessory Operation Instructions* for additional information.

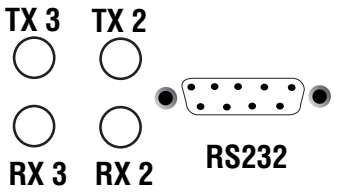


Figure 19.
Fiber-Optic/RS-232 receive and transmit LEDs and data port on the operator panel. The TX2 and RX2 LEDs illuminate during communication with the operator panel RS232 port.

Protocols

Three protocols are available for the Form 5/Triple-Single control and are configurable to serial 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, Screen 40 and 41 respectively.

AUXILIARY POWER FOR ACCESSORIES

Connection P9 (Figure 20) on the Power Supply module provides 28Vdc (12Vdc is available) to power radio communication units, RTUs and other accessories. The auxiliary power provides 40W peak load capability. Auxiliary power is fused at 1 Amp (F1) 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 continuously energized. Terminal 2 and 4 are not used at this time.

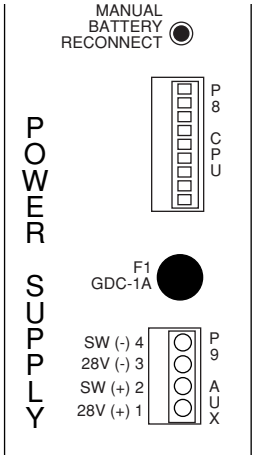


Figure 20.
Power Supply Module Connection P9 provides 28Vdc power to radio communication units.

RECLOSER INTERFACE (RIF) MODULE CONFIGURATION

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

The Recloser Interface (RIF) Module accepts either 12, 120, or 240 Vac voltage inputs for metering. The RIF Module is factory-configured at 120 Vac. The available voltages and their settings are indicated on the operator panel of the RIF module. Two sets of dip switches, located on the RIF operator panel, utilize different switch positions to configure the desired voltage. See Figure 21.

Configure the RIF board by positioning the dip switches to the desired voltage setting.

Reference the voltage table next to the switches. The ON position is to the left; the OFF position is to the right (Figure 21).

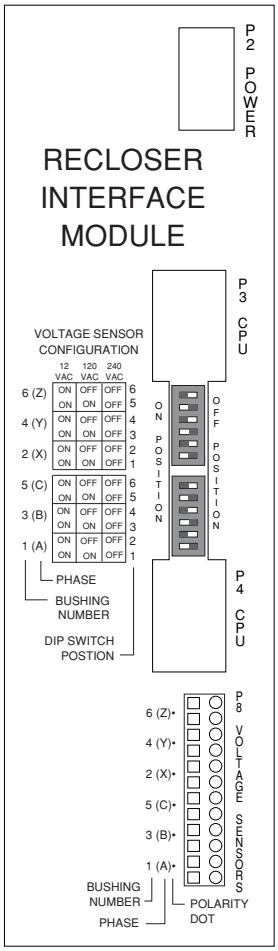


Figure 21.
Recloser Interface (RIF) Module configuration.

FORM 5/TRIPLE-SINGLE UNIVERSAL DEVICE PROTECTION (UDP) CONTROL

The UDP function allows the Form 5/Triple-Single 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) as shown in Figure 22, 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.

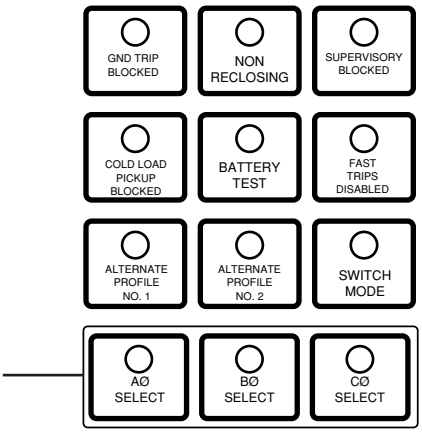


Figure 22.
Function/Indication pushbuttons for the Form 5/Triple-Single control equipped with the UDP accessory.

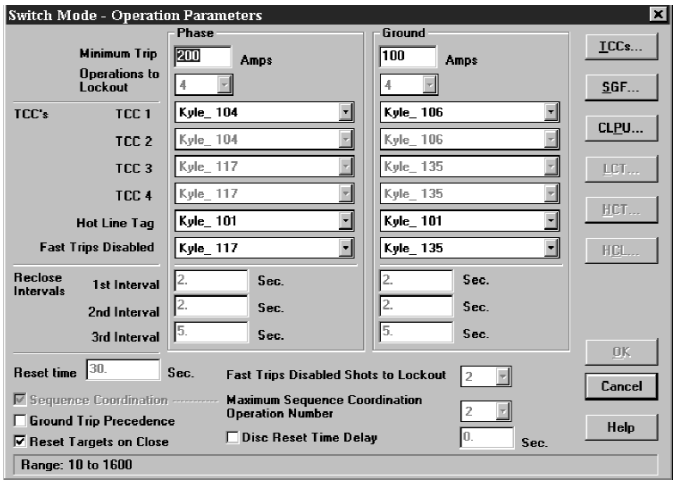


Figure 23.
Interface software Switch Mode settings.

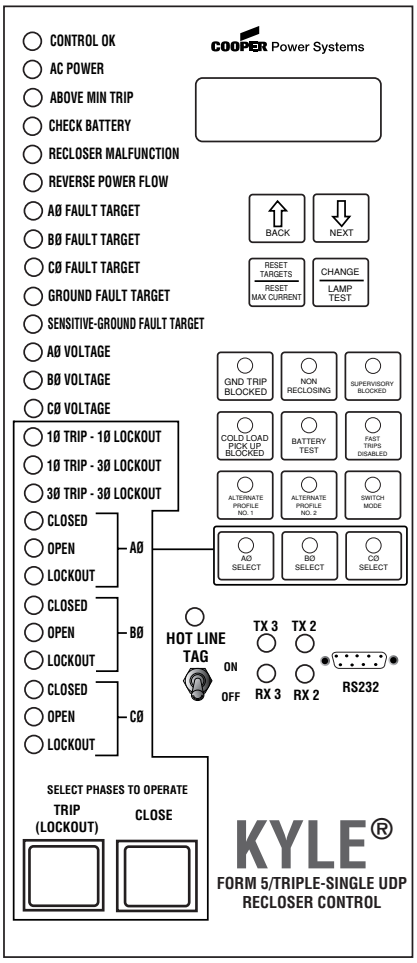


Figure 24.
Form 5/Triple-Single UDP Operator Panel.

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/Triple-Single 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: The DIF should not be used for overcurrent protection. The control gives priority to TCC timing and issuing a trip signal rather than changing the status of a DIF output or responding to a DIF input.

The DIF module contains 12 inputs and 12 outputs that are customized for a discrete SCADA function. Each Form 5/Triple-Single 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. 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 26 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.

CAUTION: Equipment damage; misoperation. External leads must be shielded and the shield must be grounded at both ends. Terminate each lead with a 320Vac, 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

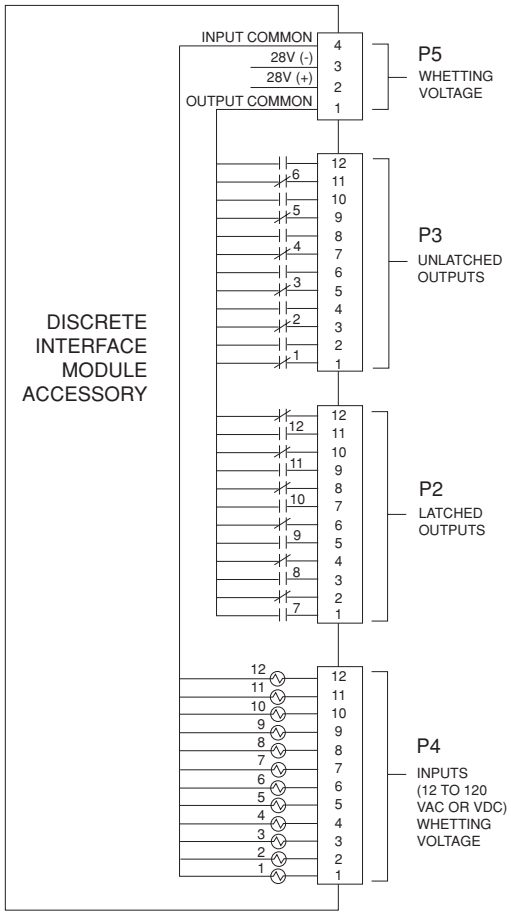


Figure 25.
Discrete Interface (DIF) Module.

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

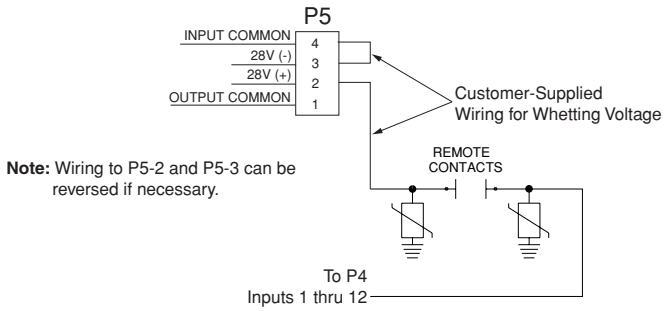


Figure 26.
Customer connections for supplying whetting voltage to DIF inputs.

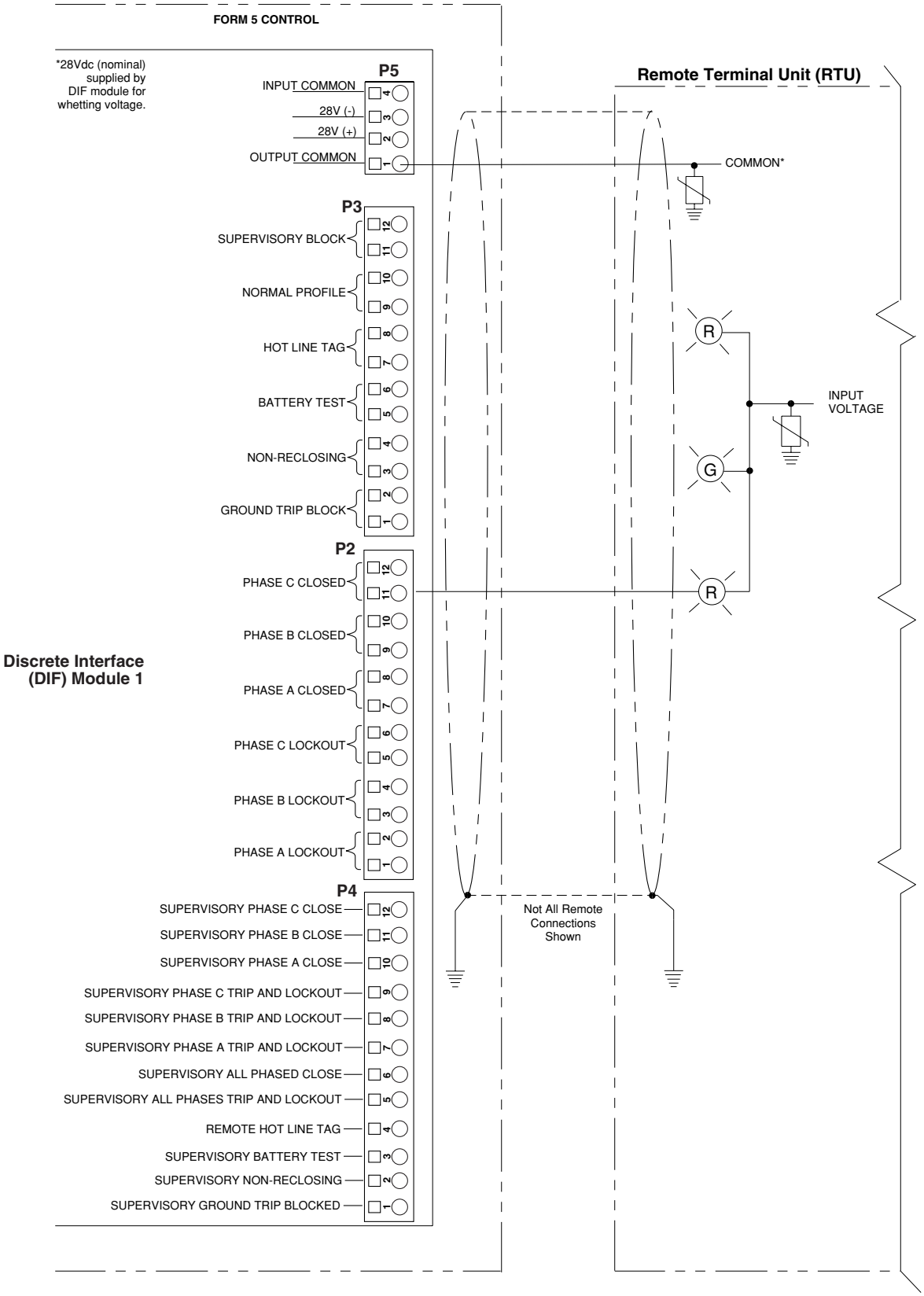


Figure 27.
Customer connections to DIF module outputs with shielding and surge protection.

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:	10k 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

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

Form 5/Triple-Single and Form 5/Triple-Single UDP Controls

Form 5/Triple-Single and Form 5/Triple-Single UDP control DIF inputs and outputs are described in the following pages.

Form 5/Triple-Single and Form 5/Triple-Single UDP Control DIF Module 1

Inputs

The DIF inputs are factory-configured as momentary (0.25 sec. duration) or maintained functions. When Supervisory is blocked, Supervisory signals are disabled, but Remote inputs are active. 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 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.
2	P4-2	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.
3	P4-3	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.
4	P4-4	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.
5	P4-5	Suprv. All Phases Trip & Lockout	Supervisory Trip and Lockout trips all three reclosers 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.
6	P4-6	Supervisory All Phases Close	Supervisory Close initiates a closing signal to all three reclosers. A ***momentary*** signal is required for proper operation.
7	P4-7	Suprv. Phase A Trip &Lockout	Supervisory Trip and Lockout for each phase 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.
8	P4-8	Suprv. Phase B Trip & Lockout	
9	P4-9	Suprv. Phase C Trip & Lockout	
10	P4-10	Suprv. Phase A Close	Supervisory Close for each phase initiates a closing signal to the recloser. A ***momentary*** signal is required for proper operation.
11	P4-11	Suprv. Phase B Close	
12	P4-12	Suprv. Phase C Close	

Form 5/Triple-Single and Form 5/Triple-Single 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)	Ground Trip Blocked	unlatched	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.
2	P3-3 (NC) P3-4 (NO)	Non-Reclosing	unlatched	This output is active when the NON-RECLOSING indicator in the operator panel is illuminated.
3	P3-5 (NC) P3-6 (NO)	Battery Test	unlatched	This output is active when the BATTERY TEST indicator on the operator panel is illuminated. This is a ***momentary*** function.
4	P3-7 (NC) P3-8 (NO)	Hot Line Tag	unlatched	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.
5	P3-9 (NC) P3-10 (NO)	Normal Profile	unlatched	Normal Profile is active only when Alternate Profiles are inactive. Normal reclosing operations will follow.
6	P3-11 (NC) P3-12 (NO)	Supervisory Blocked	unlatched	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.
7	P2-1 (NO) P2-2 (NC)	Phase A Lockout	Latched	These outputs are active when the respective phase has locked out.
8	P2-3 (NO) P2-4 (NC)	Phase B Lockout	Latched	
9	P2-5 (NO) P2-6 (NC)	Phase C Lockout	Latched	
10	P2-7 (NO) P2-8 (NC)	Phase A Closed	Latched	These outputs are active when the respective phase has closed.
11	P2-9 (NO) P2-10 (NC)	Phase B Closed	Latched	
12	P2-11 (NO) P2-12 (NC)	Phase C Closed	Latched	

Form 5/Triple-Single and Form 5/Triple-Single UDP Control DIF Module 2

Inputs

The DIF inputs are factory-configured as momentary or maintained functions. When Supervisory is blocked, Supervisory signals are disabled, but Remote inputs are active. 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	Remote All Phases Trip & Reclose	Remote Trip and Reclose initiates a trip operation followed by a reclose operation on all three phases. 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.
2	P4-2	Remote All Phases Lockout	All phases trip open and the control locks out. The feature can be used for tripping from external relays and alarms. A momentary signal is required for proper operation.
3	P4-3	Remote All Phases Close	All phases close upon a remote signal from the control to the reclosers.
4	P4-4	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.
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	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.
9	P4-9	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.
10	P4-10	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.
11	P4-11	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.
12	P4-12	Remote Hot Line Tag	Remote Hot Line Tag performs the same function 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.

**Note: Supervisory Alternate Profile 3 replaced by Switch Mode on Form 5/Triple-Single UDP controls.

Form 5/Triple-Single and Form 5/Triple-Single 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)	Phase A Open	unlatched	The respective phase OPEN indicator is active when the recloser signals the control that the respective phase contacts are open.This output is active when the respective PHASE OPEN indicator is illuminated.
2	P3-3 (NC) P3-4 (NO)	Phase B Open	unlatched	
3	P3-5 (NC) P3-6 (NO)	Phase C Open	unlatched	
4	P3-7 (NC) P3-8 (NO)	Normal Profile	unlatched	Normal Profile is active when Alternate Profiles are inactive. Normal reclosing will follow.
5	P3-9 (NC) P3-10 (NO)	Alternate Profile 1	unlatched	These outputs are active when the respective ALTERNATE PROFILE indicators are illuminated on the operator panel.
6	P3-11 (NC) P3-12 (NO)	Alternate Profile 2	unlatched	
7	P2-1 (NO) P2-2 (NC)	Alternate Profile 3*	Latched	
8	P2-3 (NO) P2-4 (NC)	Cold-Load Pickup Blocked	Latched	This output is active when the COLD LOAD PICKUP BLOCKED indicator on the operator panel is illuminated.
9	P2-5 (NO) P2-6 (NC)	Fast Trips Disabled	Latched	This output is active when the FAST TRIP DISABLED indicator is illuminated.
10	P2-7 (NO) P2-8 (NC)	Sensitive Ground Fault Blocked	Latched	Output is active when Sensitive Ground Fault is blocked.
11	P2-9 (NO) P2-10 (NC)	Battery Test	Latched	This output is active when the BATTERY TEST indicator on the operator panel is illuminated. This is a ***momentary*** function.
12	P2-11 (NO) P2-12 (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.

Note: Supervisory Alternate Profile 3 replaced by Switch Mode on Form 5/Triple-Single UDP controls.

INPUT ACCURACY

Sensed Currents

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

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

Sensed Source Voltages

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

Voltage measurement accuracy:

± 0.4V from 5 V to 80V

0.5% from 80 V 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 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/Triple-Single interface software.

Control Cable

The control cable is fabricated with connectors on both ends.

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.

Triple-Single Control Junction Box

The Type NOVA-TS Triple-Single recloser is connected to the Form 5/Triple-Single recloser control at a junction box. See Figure 28.

IMPORTANT: The triple-single recloser junction box is mounted with all cable connections made at the bottom of the box.

- In a pole-mounting application, the junction box is mounted on the mounting frame.
- For substation applications, mount the junction box on the frame in a location between the Type NOVA-TS Triple-Single recloser and the Form 5/Triple-Single control.

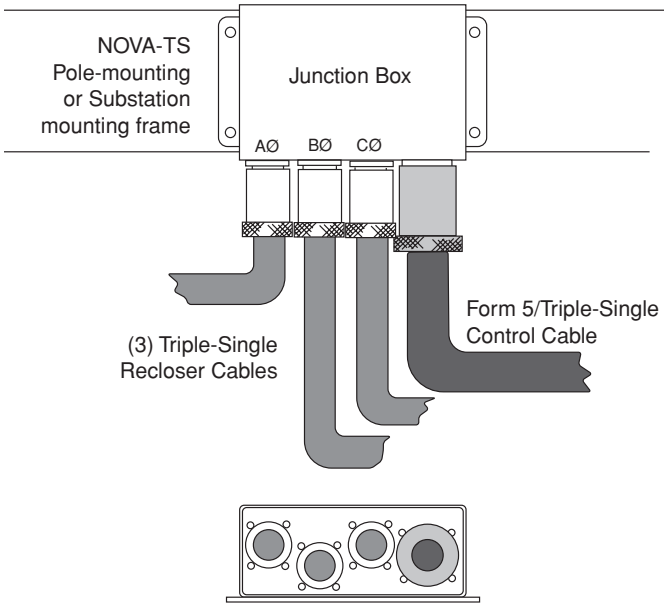


Figure 28.
NOVA-TS Triple-Single reclosers are connected to the Form 5/Triple-Single control through a junction box.

Mounting the Control

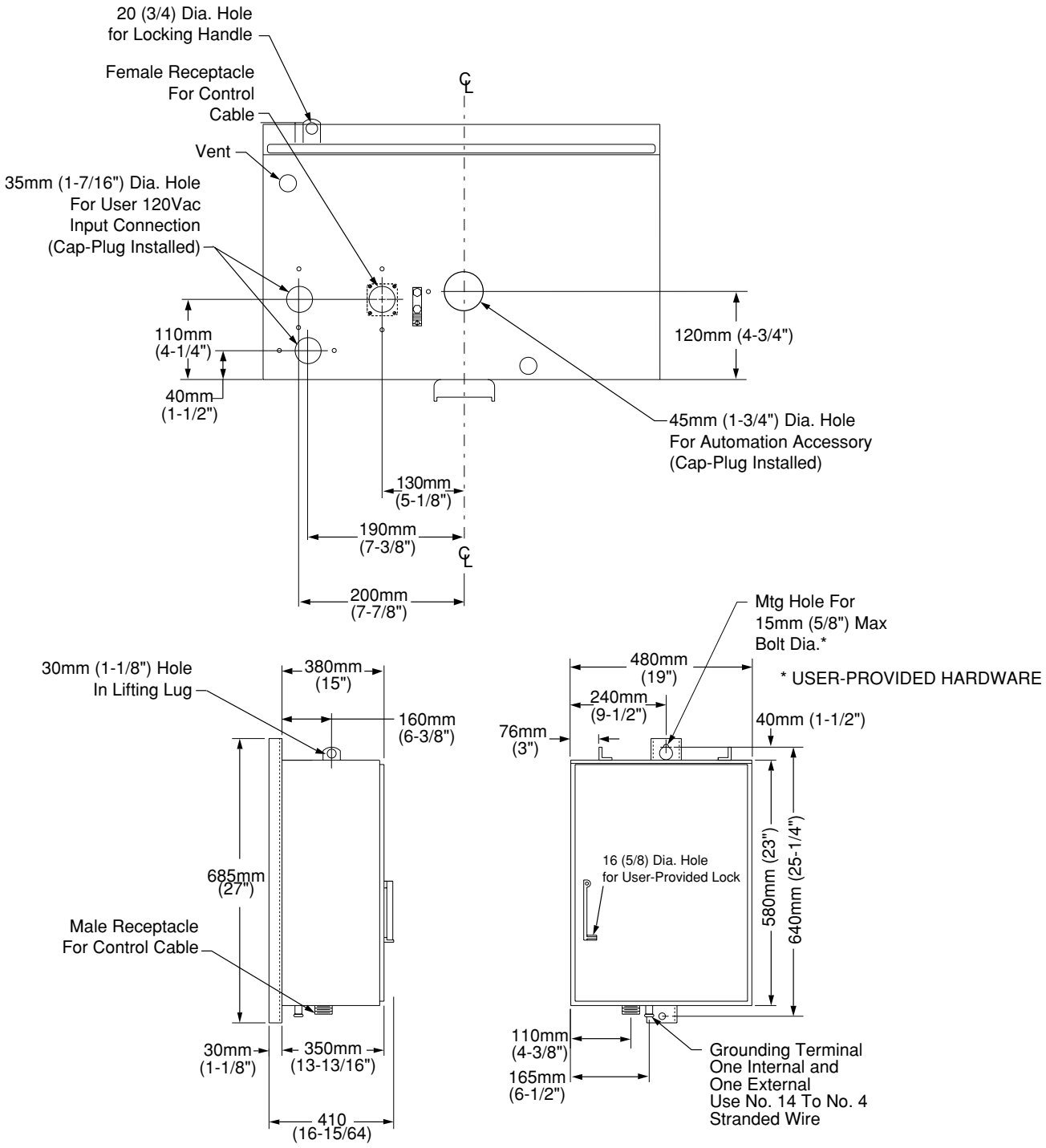
Mount the Form 5/Triple-Single recloser control in a convenient, accessible location. Mounting dimensions are provided in Figure 29.

For pole-mounted installation, a hole and keyway in the control mounting bracket accommodates a 5/8” bolt.

Limits on control cable length are determined by the maximum distance between the control, junction box, and NOVA-TS Triple-Single recloser:

- Up to 312 m (95* ft) for NOVA-TS Triple-Single recloser.

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



CONTROL WEIGHT	52 kg (115 LBS)

Figure 29.
Control cabinet mounting dimensions.

Grounding the Control

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

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

Suggested methods for grounding the control and recloser are shown in Figures 30, 31, and 32.

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

Figure 31 illustrates grounding methods for 3-wire ungrounded and 4-wire multi-grounded systems with remote supply voltage transformer.

Figure 32 illustrates grounding on a 3-wire uni-grounded system.

For effective surge protection all control and power conductors for the Form 5/Triple-Single control 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 the Form 5/Triple-Single control must include the following:

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

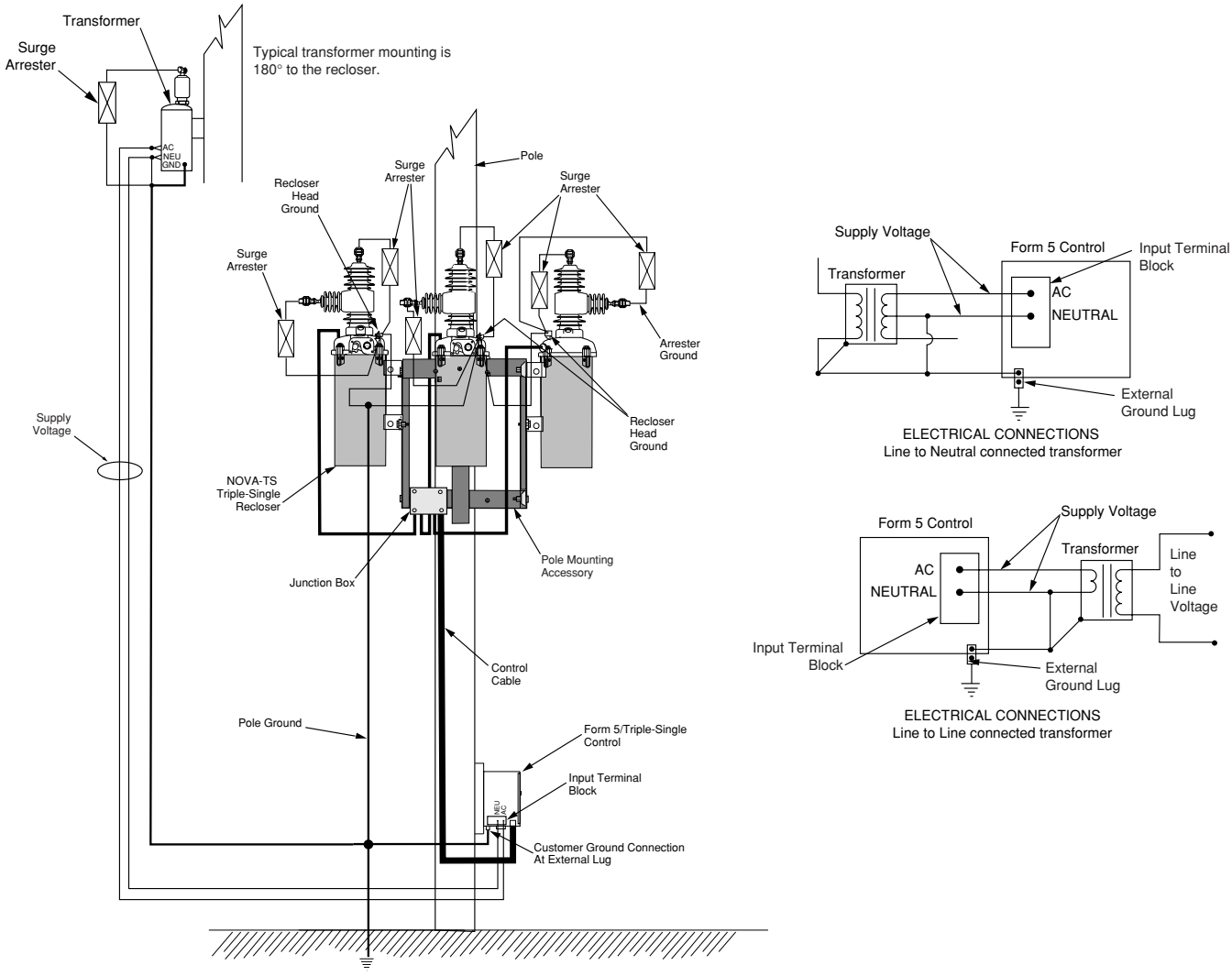


Figure 30.
Recommended grounding method for the Form 5/Triple-Single control installed on 4-wire multi-grounded, 3-wire ungrounded, or impedance-grounded systems with local supply voltage.

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

Installation of a Form 5/Triple-Single 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/Triple-Single 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.

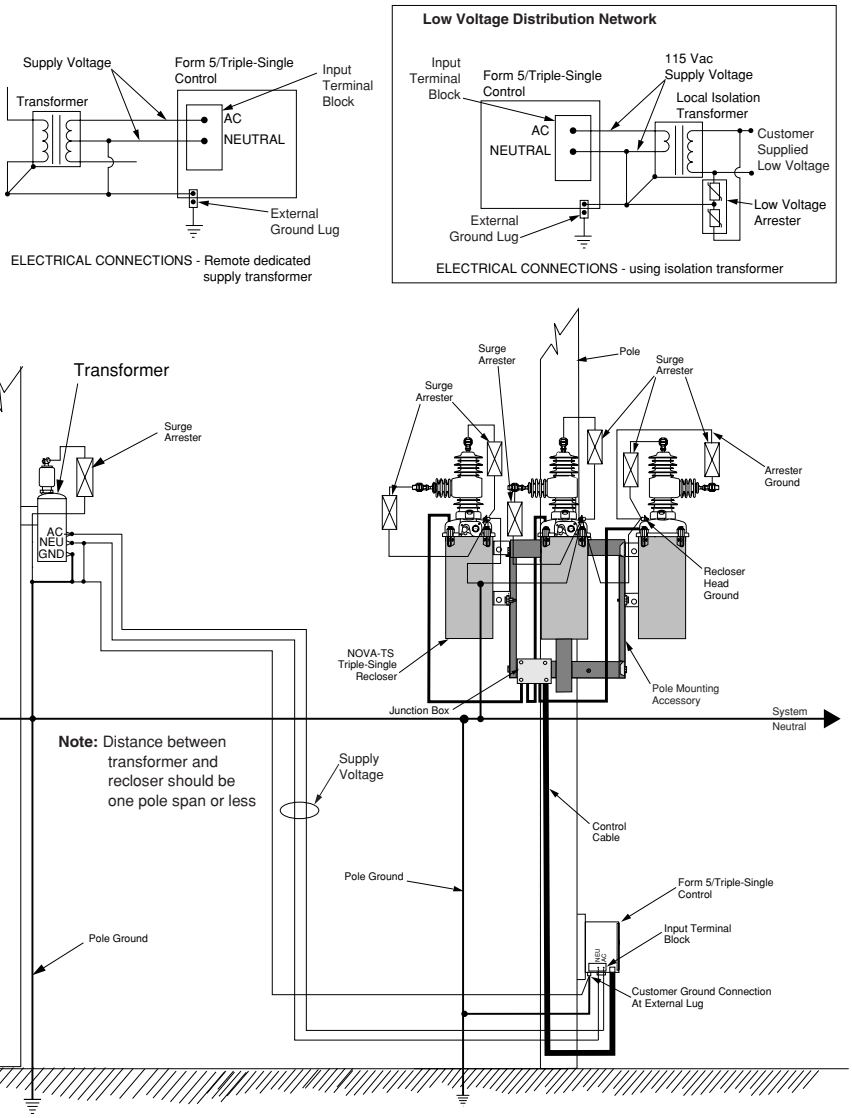


Figure 31.
Recommended grounding method for the Form 5/Triple-Single Control installed on 4-wire multi-grounded, 3-wire ungrounded, or impedance-grounded systems with remote supply voltage transformer.

Grounding on a 3-Wire Uni-grounded System

Installation of a Form 5/Triple-Single 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.

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/Triple-Single 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.

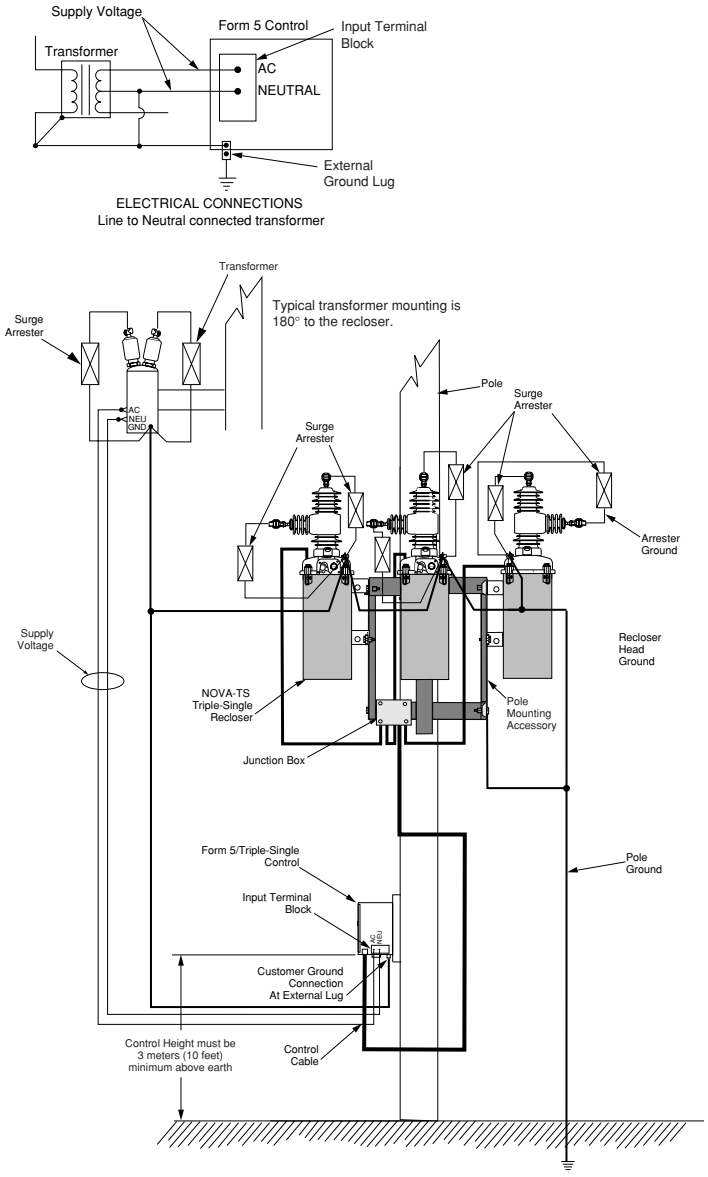


Figure 32.
Recommended grounding method for the Form 5/Triple-Single Control installed on a 3-wire uni-grounded system.

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/Triple-Single control is connected to terminal block TB1. (Located behind the operator panel, on the left side of the control. See Figure 34).

Input power is required:

- To power the control
- To provide voltage and power metering

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 33.

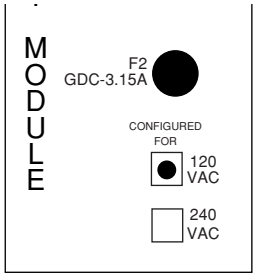


Figure 33.
Label on Power Supply module indicates factory-configured voltage rating (120Vac).

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 35 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.

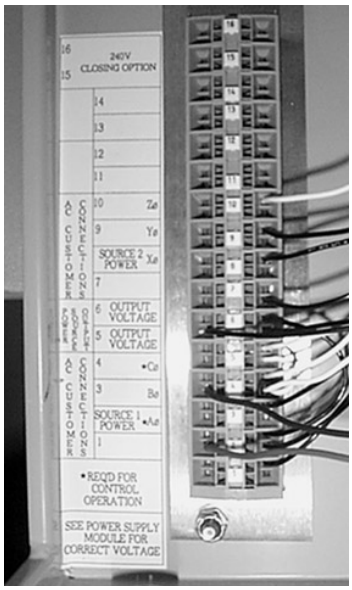


Figure 34. 99003KM
Terminal Connector Block TB1.

Power Connections

Customer connections to TB1 vary upon application. TB1 connections provide power and metering inputs to the control. Figures 35 through 40 show the customer connections for 120 Vac and 240 Vac low voltage closing.

Figures 35 through 38 illustrate customer connections for single- and three-phase transformers. Figure 35 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 Figures 39 and 40. For example, Figure 40 shows connection from the Power Supply module to an AØ transformer.

The transformer required for power should be 1kVA.

Note: The Form 5/Triple-Single or Form 5/Triple-Single UDP control (for either Wye or Delta) can be powered by connecting an appropriate power source to TB1-2 (hot) and TB1-4 (neutral).

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 21.

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

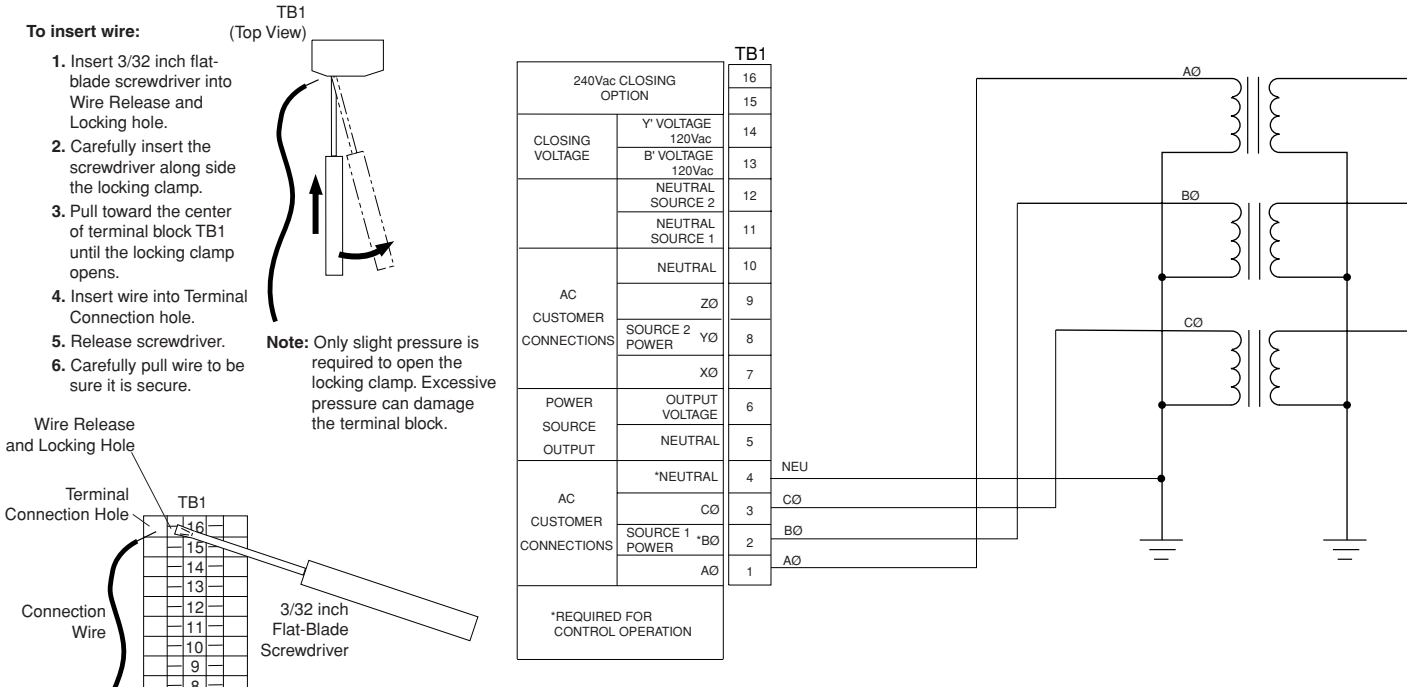


Figure 35.
Form 5/Triple-Single and Form 5/Triple-Single UDP Power customer connections to terminal block TB1 (120Vac/240Vac Wye Connection).

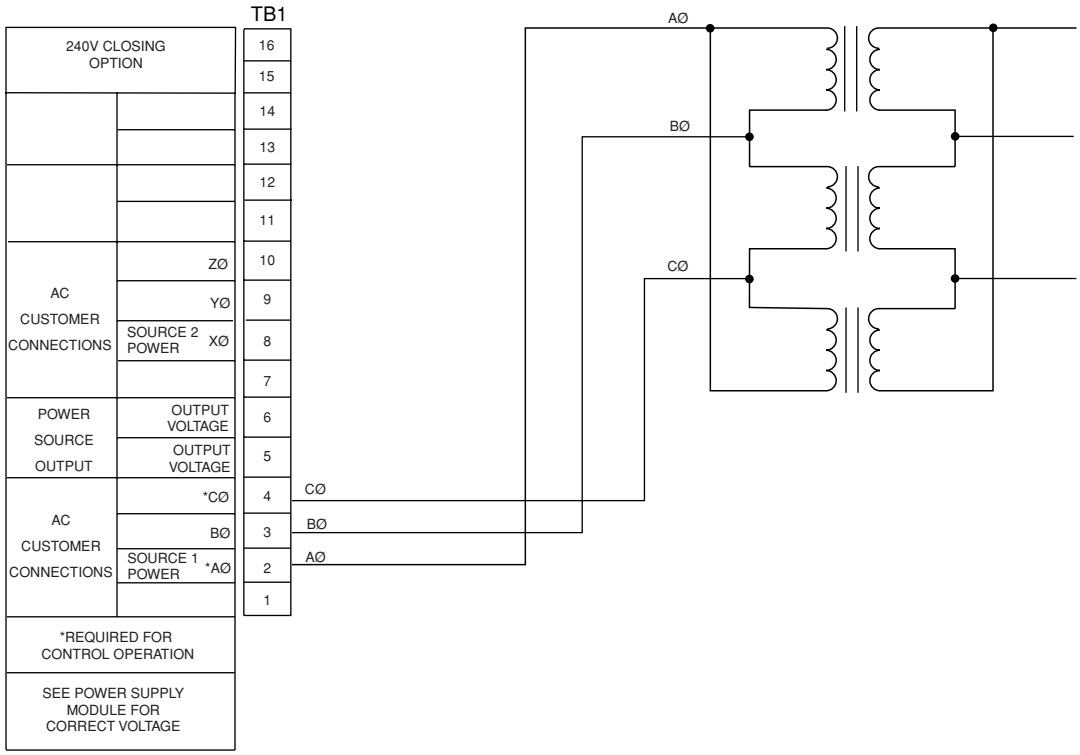


Figure 36.
Form 5/Triple-Single and Form 5/Triple-Single UDP Power customer connections to terminal block TB1 (120Vac/240Vac Delta Connection).

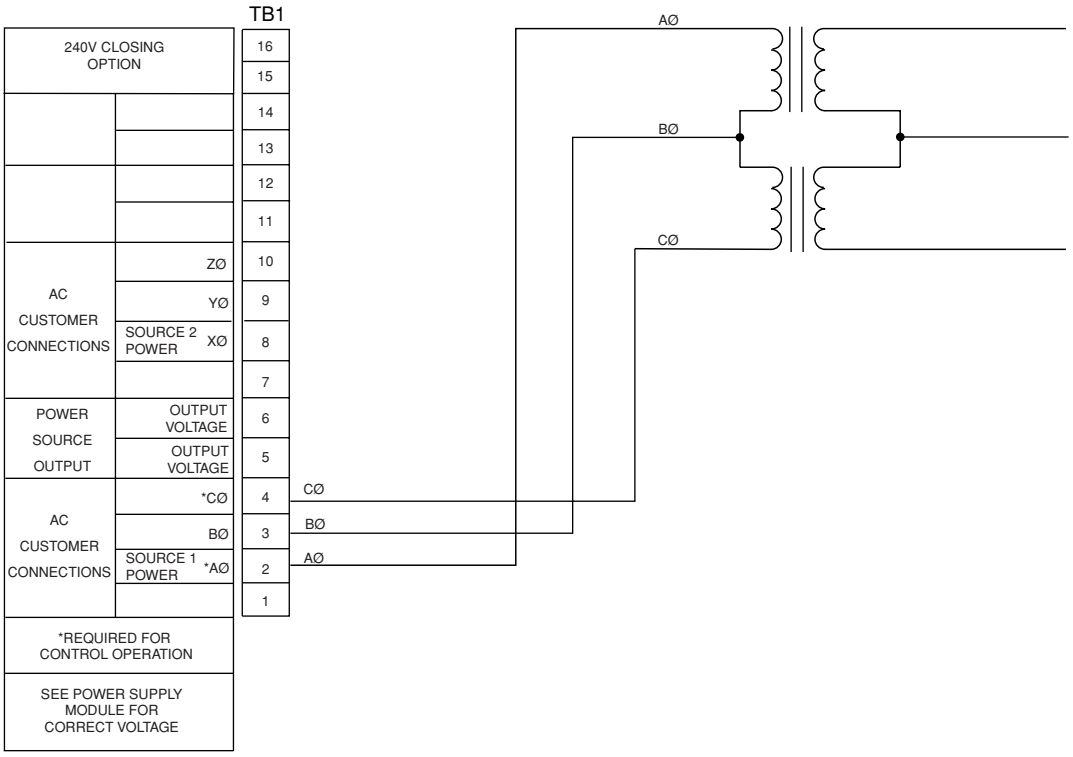


Figure 37.
Form 5/Triple-Single and Form 5/Triple-Single UDP Power customer connections to terminal block TB1 (120Vac/240Vac, Open-Delta Connection).

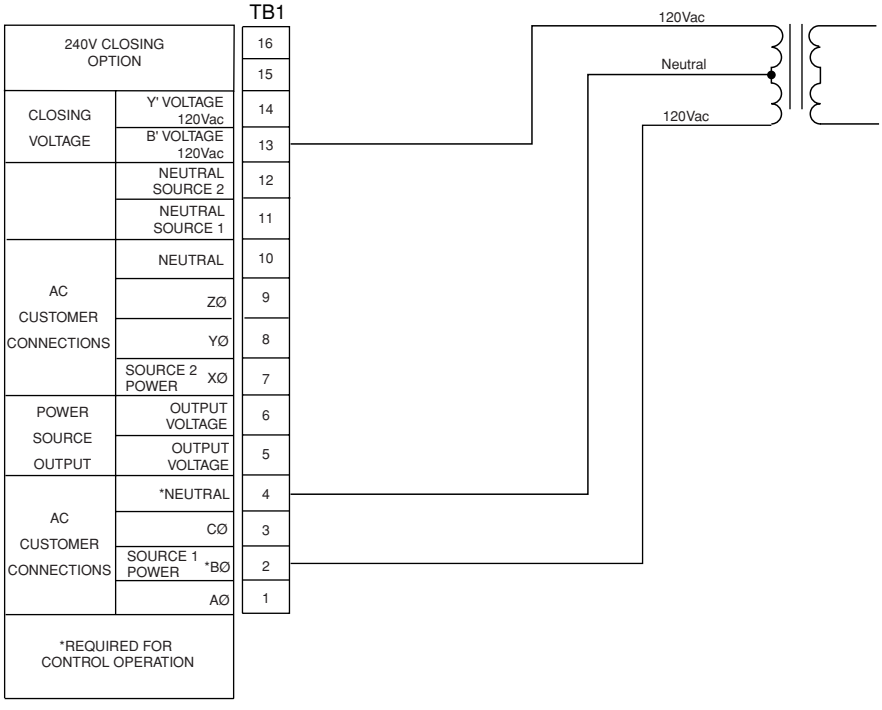


Figure 38.
Form 5/Triple-Single and Form 5/Triple-Single UDP Power customer connections to terminal block TB1 (3-Wire, 240Vac Connection).

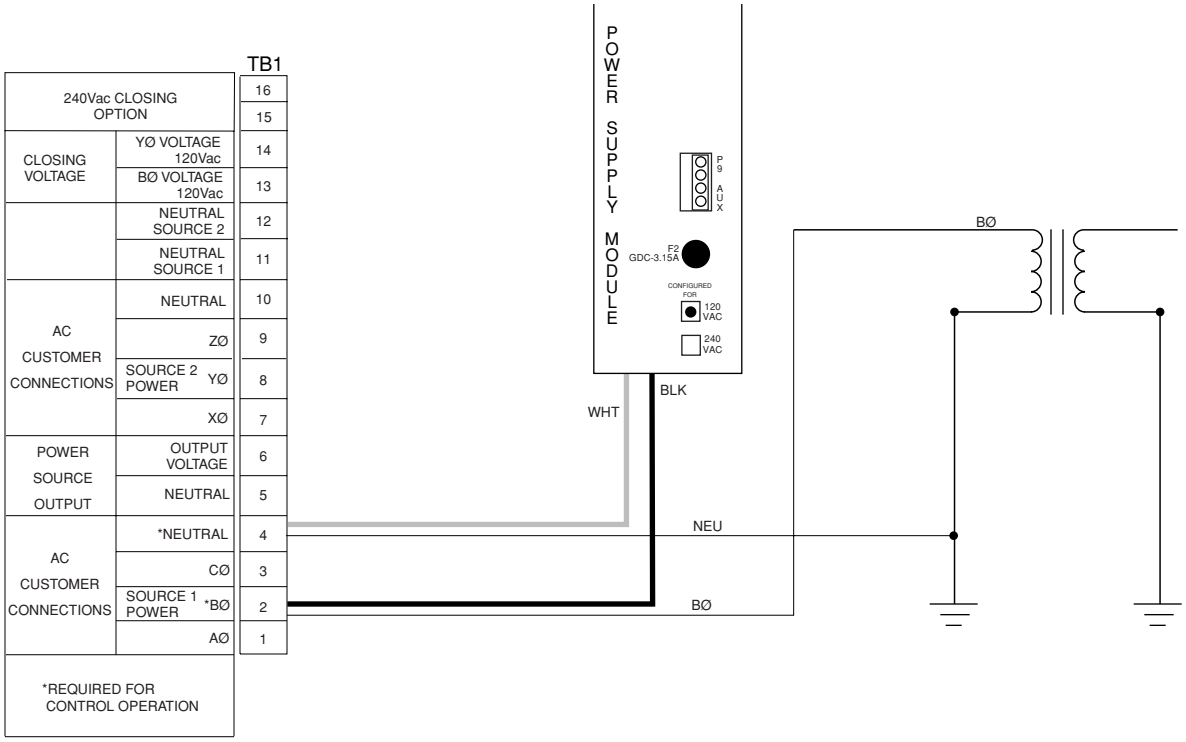


Figure 39.
Form 5/Triple-Single and Form 5/Triple-Single UDP Power and Low Voltage Closing customer connections to terminal block TB1 (Single-Phase Connection, Standard BØ Input).

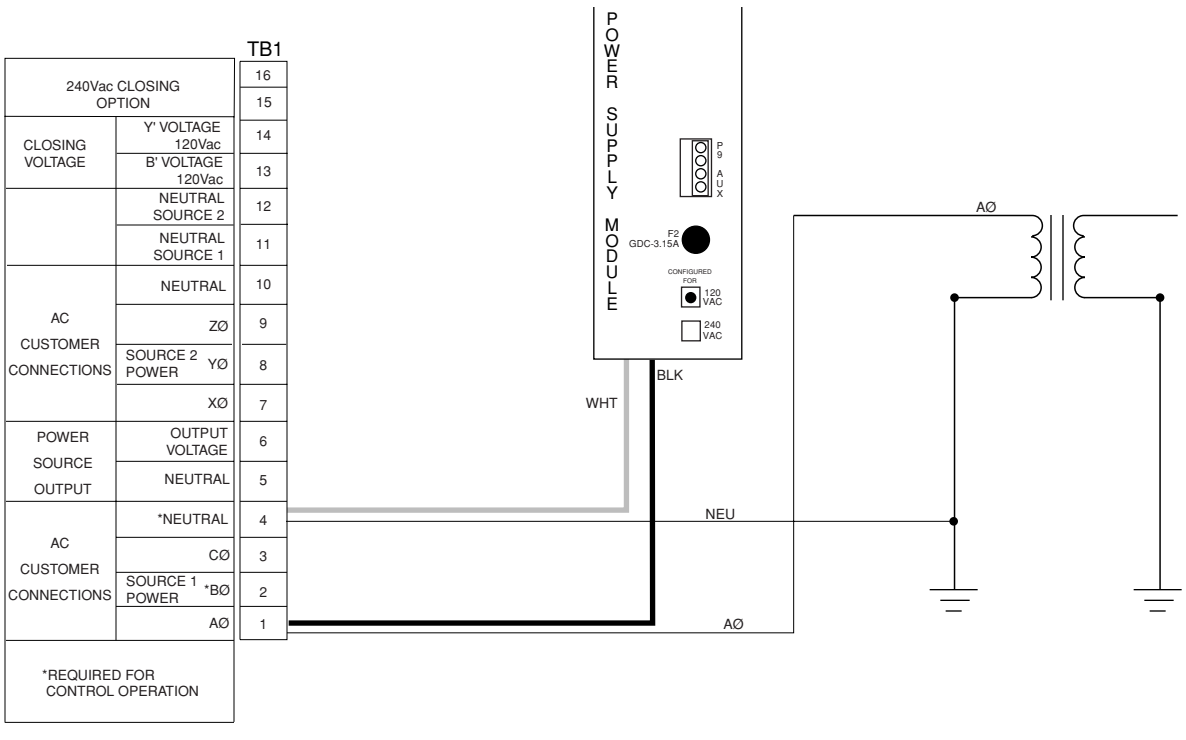


Figure 40.
Form 5/Triple-Single and Form 5/Triple-Single UDP Power and Low Voltage Closing customer connections to terminal block TB1 (Single-Phase Connection, AØ Input).

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

TESTING

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

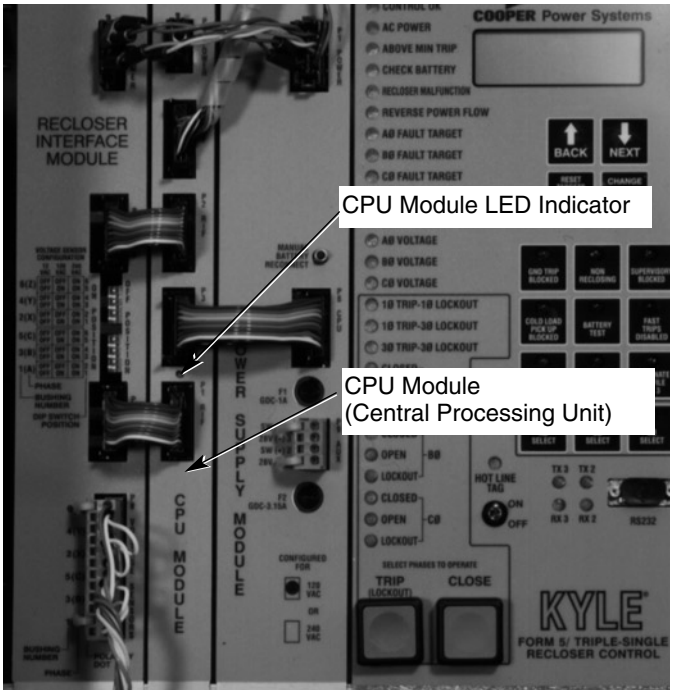
IMPORTANT: The Form 5/Triple-Single recloser control can be taken out of service for testing and placed back into service without de-energizing its recloser and interrupting the system. However, during the time the control is out of service, the recloser is inoperative.

Testing an Installed Control

The following tests to determine initial operation of the Form 5/Triple-Single control can be performed while connected to an operating recloser. This is the only test performed on an installed, operating control. The **Electrical Testing of NOVA-TS Triple-Single Reclosers** test described in this section requires the Form 5/Triple-Single control to be removed from service, connected to a bypassed recloser or tested at a location where the proper testing equipment is available.

1. Turn on the 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. See **Form 5/Triple-Single 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.



99016KM

Figure 41.
Form 5/Triple-Single control CPU module.

Check CPU Status

Check the operating status CPU module. Open the cabinet door and locate the LED indicator (see Figure 41).

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

Electrical Testing of NOVA-TS Triple-Single Reclosers

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

T223.2

Each unit in the Type NOVA-TS Triple-Single recloser utilize an interface circuit located in its mechanism housing. The electronic interface circuit controls the opening and closing signals to the magnetic actuator.

Figure 42 shows a test circuit for NOVA-TS reclosers with the Form 5/Triple-Single control.

Use this circuit to simulate load current and for testing minimum trip operation and sequencing the mechanism with the Form 5/Triple-Single control for each phase.

Remove the Control from Service

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

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

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

T204.2

4. Disconnect control cable from the control.
5. Disconnect the ground from the control.

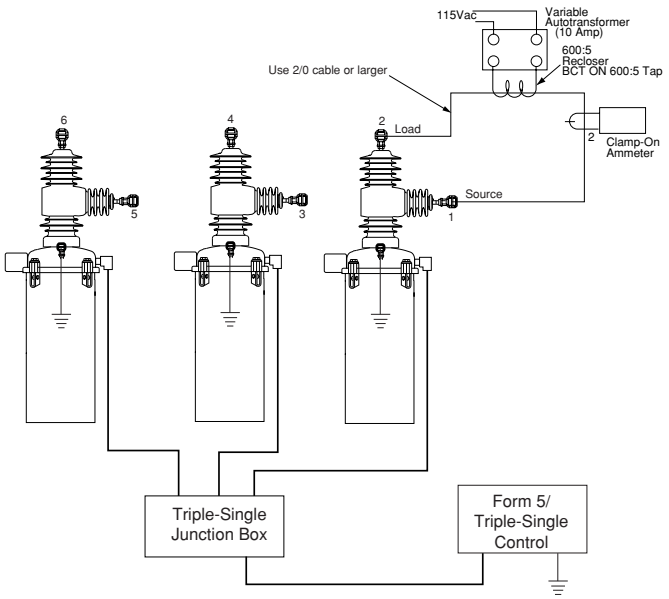


Figure 42.
Suggested test circuit for NOVA-TS Triple-Single reclosers with Form 5/Triple-Single control.

Battery Test Procedure

The condition of the control battery is tested by depressing the BATTERY TEST 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 -600 mA 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.

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.

Testing Procedure for Uninstalled Battery

CAUTION: Recloser misoperation. The control must be removed from service before disconnecting the control battery. Disconnecting the control battery from an in-service control may cause recloser misoperation (unintentional operation). Failure to comply can result in equipment damage or personal injury. T213.4

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

Refer to Table 4 and follow this procedure to perform a bench test on a control battery in a service shop:

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

If the battery fails the test or is at least four years old, it should be replaced. Refer to Table 4 for battery catalog part numbers.

Battery Charging

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

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

Use adapter KME5-325-1 to connect the two 12 volt batteries to the KA43ME7001 charger. Charge the battery with a KA43ME7001 (120 Vac) portable charger.

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

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

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

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

TABLE 4
Battery Bench Testing and Replacement Information

Control Type	Battery	Battery Catalog Part #	Voltage	Type	Amp/ Hour	Bench Test Load Condition for 5 sec.	Acceptable Voltage Drop at end of Test Load	Battery Tester	Battery Replacement Kit
Form 5/ Triple-Single high capacity	Hawker Genesis or Sonnenschein or Yuasa	KME5-134-1 KME5-134-2 KME5-134-3	24v (two 12v batteries)	Lead Acid	13 18 12	5Ω, 55 watt	2v or less	BATTERY TEST hot key on control panel	KME5-709-17 or KME5-709-12 or KME5-709-13

The Form 5/Triple-Single control batteries have different dimensions; therefore, if the replacement battery ordered is a different brand than the original battery, a kit with mounting hardware may be required to accommodate the replacement battery size.

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

Follow this procedure to return the control to service:

1. Connect cable to de-energized control and recloser.
2. Plug in the control battery.
3. Apply ac power to the control.
4. Verify that all control settings are correct.
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 reapplied. (Refer **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/Triple-Single 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/Triple-Single Microprocessor-Based Electronic Recloser Control and NOVA-TS Recloser. 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.

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KA2048-477 Rev: 02

COOPER Power Systems

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