

Type LS Loop Sectionalizing Control Accessory For the Form 4C Recloser Control; Installation and Operation Instructions

Service Information

S280-77-10

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Figure 1.
Kyle® Type LS loop sectionalizing control is housed
in the lower half of a double-sized Form 4C recloser
control cabinet.

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SAFETY FOR LIFE



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

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

SAFETY INFORMATION

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


A competent technician has these qualifications:


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


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

Hazard Statement Definitions

This manual may contain four types of hazard statements:

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


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

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


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

Safety Instructions


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

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


G103.3

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

G101.0

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

G102.1

 **WARNING:** Power distribution equipment must be 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 this equipment can result in death, severe personal injury, and equipment damage.

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PRODUCT INFORMATION

Introduction

Service Information S280-77-10 provides installation and operation information for the Kyle® Form 4C Type LS loop sectionalizing control. The Type LS control (Figure 2) is an accessory to the Form 4C recloser control and is housed in the lower half of a double-sized control cabinet.

For installation and operation instructions for the Form 4C control, refer to *Service Information S280-77-1*. For programming instructions for the Form 4C control, refer to *Service Information S280-77-4*.

If this control is used with a Kyle VWE, VWE27, VWVE38X, WE, WVE27 or WVE38X recloser, refer to *Service Information S280-40-2*. If used with a VSA-group recloser, refer to *Service Information S280-45-1*. If used with a VSO-group recloser, refer to *Service information, S280-57-1*.

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

Acceptance and Initial Inspection

Each control is completely assembled, tested and inspected at the factory. It is in good condition when accepted by the freight carrier for shipment.

Upon receipt, inspect the control thoroughly for damage incurred during shipment. If damage is discovered, file a claim with the carrier immediately.

Handling and Storage

If the control is to be stored for any appreciable time before installation, provide a clean, dry storage area. Be careful during handling and storage to minimize the possibility of damage.

If the control is stored in a humid atmosphere, make provisions to keep the control circuitry energized. Refer to the *Ac Supply Voltage Connections* section of this manual and connect the supply voltage. Refer to *Service Information S280-77-1* for additional information.

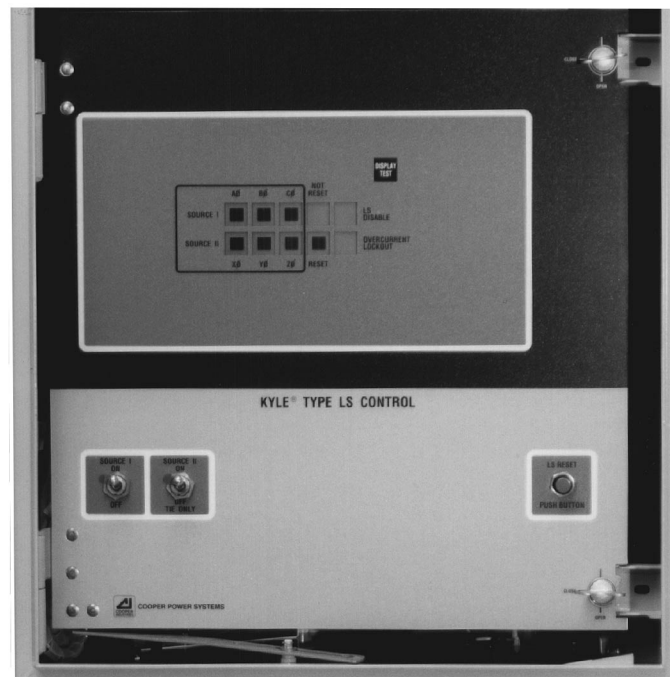


Figure 2.
Kyle® Type LS loop sectionalizing control.

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Loop Scheme Applications

Automatic circuit reclosers improve distribution system reliability by sectionalizing feeder lines into smaller segments, so that faults can be isolated and outage areas are minimized.

For a higher level of service reliability, adjacent feeders can be tied together with a normally-open recloser. This type of application is called a loop scheme.

The principle of operation of a loop scheme is to automatically sectionalize out the faulted portion of the line and then to connect the unfaulted portion to the alternate feeder.

A three-recloser loop scheme can improve the reliability of both feeders by 50%, compared to feeders without recloser protection. The size of the loop can be increased to include five reclosers. The operation of a five-recloser loop is similar. The faulted portion of the line is sectionalized out and the unfaulted portion is connected to the alternate feeder.

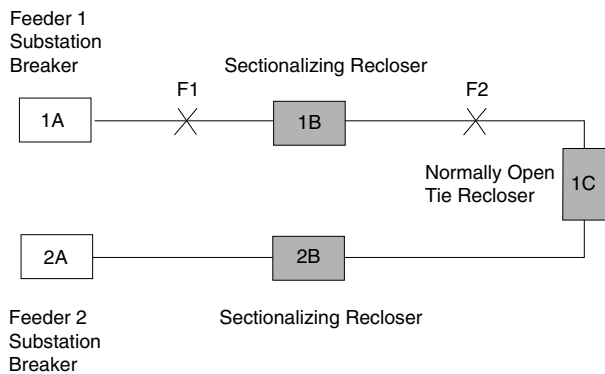


Figure 3.
Two feeders tied with a normally-open recloser to form a three-recloser loop scheme.

Three-Recloser Loop Operation

A three-recloser loop scheme is shown in Figure 3. Beginning at the substation bus, the first protective device on each feeder is the substation breaker. The next protective device is the normally-closed Sectionalizing Recloser. The normally-open Tie Recloser is located at the end of the feeder.

When a fault occurs at F1, the feeder recloser or breaker (1A) locks out. The LS control on recloser 1B senses loss of source-side voltage, and the LS control at the tie recloser 1C senses voltage loss on its 1B side. Timers begin in both controls.

The time delay at 1B expires first; the control opens recloser B1 and locks out. The time delay at 1C expires next; this control closes C1 restoring service to the unfaulted feeder section between 1B and 1C.

If instead the fault had occurred at F2, the following sequence would have ensued: 1B locks out after its fault protection sequence. 1C senses voltage loss on its 1B side. After its time delay expires, recloser 1C closes and, sensing fault current, trips and locks out. The unfaulted portion of the feeder, between 1A and 1B, remains in service.

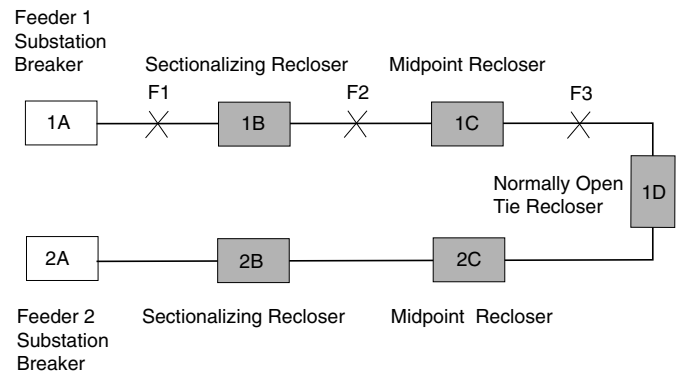


Figure 4.
Five-recloser loop scheme has sectionalizing and mid-point recloser on each feeder.

Five-Recloser Loop Operation

The five-recloser loop scheme (shown in Figure 4) is similar to the three-recloser loop scheme, except that an additional recloser, the Mid-point Recloser, is added to each feeder.

In a five recloser loop, each feeder is divided into three portions of approximately equal load. The extent of outage can be reduced to 33% of that which would occur on a radial feeder. It operates as follows.

A fault at F1 results in the lockout of 1A. The LS controls on reclosers 1B, 1C, and 1D sense loss of voltage and begin timing. The 1B time delay expires first; 1B opens and locks out. When the 1C time delay expires, its control reverts to a programmed alternate minimum trip setting to prepare for coordinated fault protection while being back-fed. When the 1D time delay expires the control closes recloser 1D. After these automatic operations the faulted section of the feeder is isolated and two thirds remains in service.

If instead the fault occurs at F2, 1B locks out on fault protection. Loss of voltage at 1C and 1D start their timers. 1C delay expires first and its control reverts to its alternate minimum trip levels and its momentary non-reclosing feature. When the 1D delay expires, its control closes recloser 1D causing 1C to sense fault current. Recloser 1C trips, does not reclose, and its control locks out. The outage due to fault F2 is automatically limited to a small portion of the feeder.

A fault at F3 initiates events similar to that described for the fault at F2. Reclosers 1C and 1D open in sequence, limiting the F3 outage to one third of the feeder; two thirds remains in service.

CONTROL OPERATION

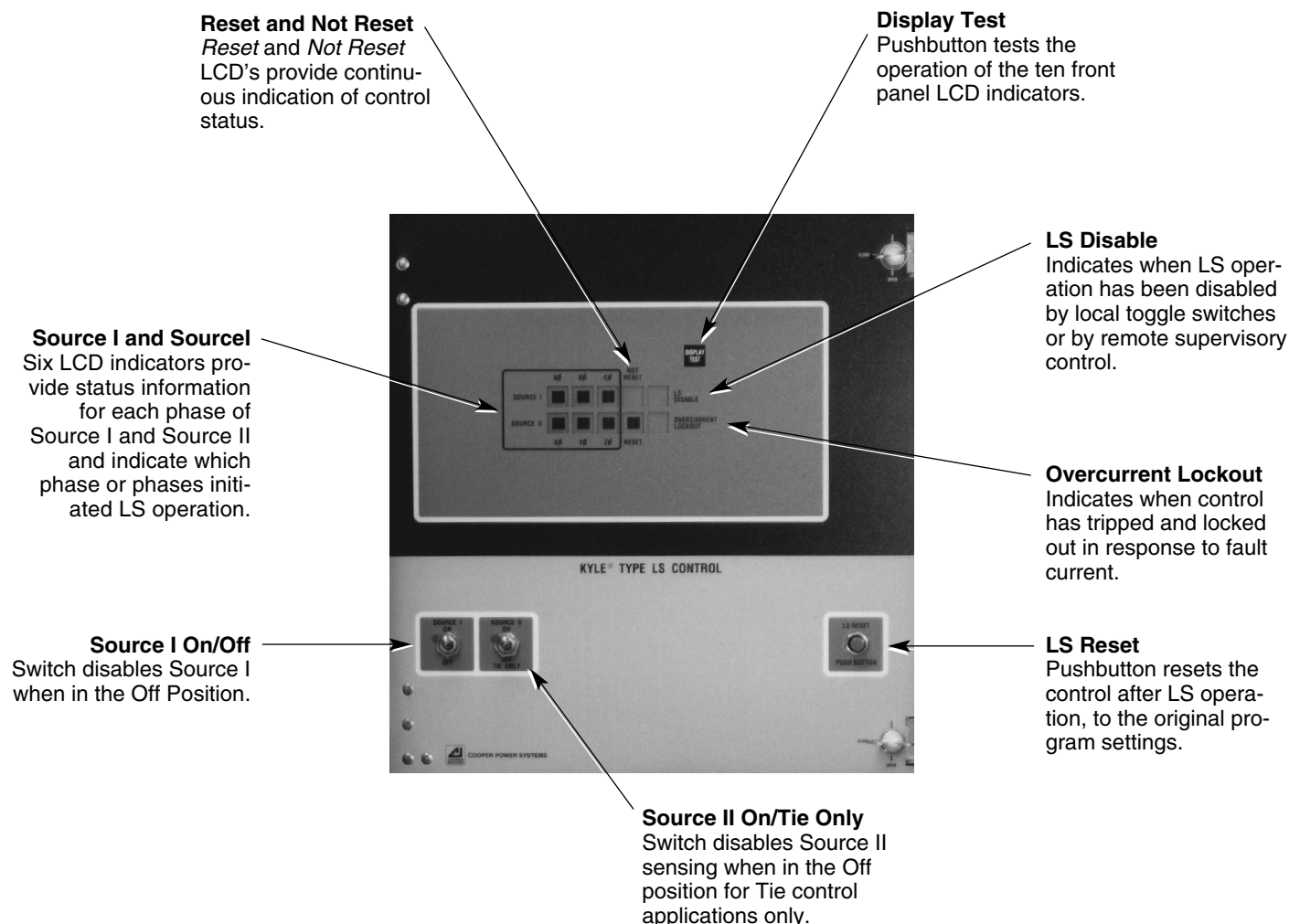


Figure 5.
Front panel components of Type LS loop sectionalizing control.

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Description of Control

The Kyle® Type LS loop sectionalizing control (Figure 5) is an accessory that supplements the operation of the Form 4C recloser control for application in distribution feeder loop sectionalizing schemes.

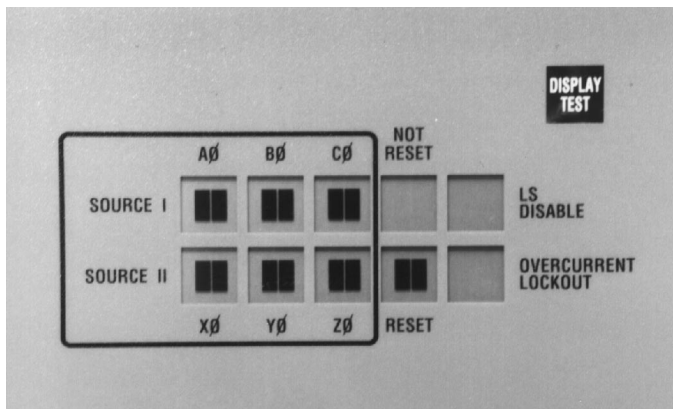
The Type LS control senses the loss of voltage and, after a predetermined time delay, signals the Form 4C recloser control to operate. The specific recloser control operation actuated by signal from the LS, depends on the overall circuit operation desired.

The LS control can be programmed for either the sectionalizing or tie mode of operation. The sectionalizing mode senses voltage on the source side of a normally closed recloser and is activated upon loss of source-side voltage. The tie mode of operation senses voltage on both sides of a normally open recloser and is activated upon loss of voltage on either side.

Control Components

The LS front panel (Figure 5) provides the operator interface for the lineman. It contains the LCD status indicators and toggle switches to enable or disable LS operation for Source I and Source II.

The back side of the swing-out front panel contains the LS control mode selection and programming switches. Initial programming of the control for the specific installation and any subsequent changes to the control's operating parameters, should be made only by a qualified technician or engineer.



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Figure 6.
LCD indicators on front panel of Type LS control.

The inside back panel of the control contains the power supply and voltage sensing circuit board, transfer relay, fuse blocks, customer connection terminals (including input connections, remote hotline tag, remote status and supervisory operations), a 120 Vac convenience outlet, and the auxiliary input/output circuit board which provides additional remote status and supervisory functions.

Control Panel

The upper portion of the LS control front panel (refer to Figure 6), consists of a cluster of 10 LCD indicators and a Display Test button.

Source I and Source II LCD Indicators

Source I status information is provided by three LCD indicators (Figure 6), labeled A Phase, B Phase and C Phase.

Source II status information is provided by three LCD indicators, labeled X Phase, Y Phase and Z Phase.

Initially, with both source I and source II energized, all six LCD indicators will be on. Whenever a loss of voltage occurs, the LCD indicators for the affected phase(s) will immediately turn off and the control will start timing.

If voltage is restored before the loss of voltage transfer delay time elapses (delay interval is programmed on the inside back panel dip switch bank labeled TD1), the LCD's will turn on again.

If loss of voltage duration exceeds the programmed TD1 time delay, the LCD indicators for the affected phase(s) will remain off until reset manually with the front panel LS Reset pushbutton, or reset remotely with the Supervisory LS Reset function. If the control is programmed to operate in the Sectionalizing mode, it can be reset automatically with the Auto-Reset Switch in the On position. Refer to the *Auto Reset Switch* section on page 9.

Not Reset and Reset LCD Indicators

When the control is functioning in its normal operating state and source I and source II voltage is present, the front panel Reset LCD indicator will be on (shown in Figure 6).

When the LS control has operated in response to a loss of voltage, the Reset LCD will turn off and the Not Reset LCD will turn on. The Not Reset LCD will remain on until the control is reset manually with the front panel LS Reset pushbutton, reset remotely with the Supervisory LS Reset function, or reset automatically with the Auto Reset Switch set to the On position.

LS Disable LCD Indicator

The LS Disable LCD indicator will turn on when the LS control is disabled from either the front panel toggle switches or from supervisory control.

If the LS control is programmed to operate in the *Sectionalizing* mode, only the Source I On/Off front panel toggle switch is active and it will control the operation of the LS Disable LCD.

If the LS control is programmed to operate in the *Tie* mode, both the Source I and Source II toggle switches must be in the Off position to cause the LS Disabled LCD indicator to turn on.

Overcurrent Lockout LCD

The Overcurrent Lockout LCD will only turn on if the Form 4C control has operated to lockout as a result of fault current operation. This provides clear and convenient indication to the line technician that the control lockout is unrelated to the loss of voltage operation of the LS control.

The Overcurrent Lockout LCD also provides indication that the Auto-Reset function is disabled, which will prevent automatic closing into a fault if the following sequence occurs.

1. Recloser trips to lockout on fault current.
2. Loss of voltage causes the the control to time out on Loss of Voltage Transfer Time (switch bank TD1).
3. Restoration of system voltage occurs and the Auto-Reset function is On.

If the Auto-Reset function is Off, the control will not reset automatically and the control will not close.

The Overcurrent Lockout LCD can be reset either manually using the LS Reset pushbutton switch on the front panel of the control, or remotely with the Supervisory LS Reset function.

IMPORTANT: To ensure proper operation of the Overcurrent Lockout indicator, the Sensitive Ground Fault feature of the Form 4C control must be programmed as follows: Sensitive Ground Fault Access Code 120 must be On. Access Codes 121 and 122 must be set to 100% and Access Code 123 must be set to 120 seconds.

Display Test

The Display Test button, located in the upper right hand corner of the front panel, provides a convenient (push to test) means to test the operation of the LCD display.

Front Panel Switches

Source I Toggle Switch

The Source I toggle switch, located on the lower portion of the control front panel (Figure 7) controls input from the primary, or normal feeder, which is the sensing and supply involved when the recloser is used in a sectionalizing or midpoint application.

When set to the Off position, the Source I switch, disables the control from operating.

Source II Toggle Switch

The Source II toggle switch, located on the lower portion of the control front panel (Figure 7) controls input from the alternate feeder (also called the backfed feeder).

It is used when the control is programmed to operate in the tie mode. When set to the Off position, the Source II switch disables the LS control from operating in the tie mode.

Note: If the LS control is programmed to operate in the Sectionalizing mode (Control Type switch on inside of swing panel set to Sectionalizing), the Source II toggle switch will have no effect on control operation.

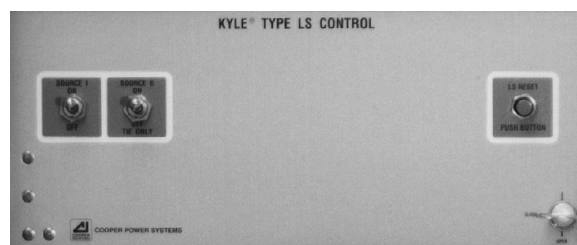


Figure 7.
Switches located on the lower portion of the LS control front panel.

LS Reset Switch

The LS control Reset pushbutton switch (shown in Figure 7) is located on the lower right hand portion of the control panel. Depressing the pushbutton will reset the control and any phase target LCD indicators that were on following operation of the LS control.

When the Reset button is pressed, the front panel Reset LCD indicator will turn on and will remain on until the next loop sectionalizing operation of the LS control.

PROGRAMMING THE CONTROL

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.

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LS Control Programming Panel

The Type LS control is programmed for automatic operation by using the programming switches located on the inside of the LS control swing panel (shown in Figure 8).

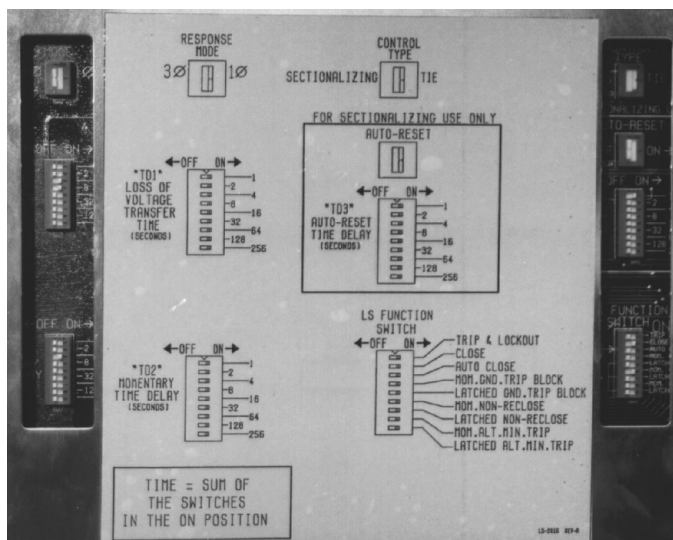
Programming the Control Settings

The Type LS control must be programmed with all necessary operating settings, prior to operation with an energized recloser. Changes in the control operating parameters should only be made by a qualified technician or engineer.

Response Mode Switch

The LS control Response Mode switch can be set to operate in either the single-phase response mode or the three-phase response mode.

In the single-phase response mode, a loss of any single phase will initiate the LS timing. In the three-phase response mode, all three phases must lose voltage before the LS control will begin timing. A loss of voltage is detected at 75 volts based upon 120 Vac input.



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Figure 8. Programming switches are located on the inside of the swing panel of the Type LS control.

Loss of Voltage Transfer Time (Switch Bank TD1)

The Loss of Voltage Transfer Time dip switches are used to program the length of time in seconds, before an LS control output function occurs.

Transfer timing is initiated upon detection of loss of voltage, in either the single-phase or three-phase response mode.

The programmed loss of voltage transfer time equals the sum of the values of the switches in the On position.

Momentary Time Delay (Switch Bank TD2)

the Momentary Time Delay (TD2) is initiated after the Loss of Voltage Transfer Time (TD1) has elapsed. This occurs simultaneously with the appropriate output functions programmed by the LS Function Switch.

For example: A Tie control may include a momentary non-reclose function to prevent multiple reclosings should the Tie recloser close into a fault.

The Momentary Time Delay dip switches are used to program the delay time in seconds. The programmed momentary delay time equals the sum of the values of the switches in the On position.

Control Type Switch

The Control Type switch is used to program the LS control to operate in either the Sectionalizing or Tie mode.

The Sectionalizing control mode is defined as the loss of voltage from a *single* source. The Tie control mode is defined as the loss of voltage from *two* sources. The tie control is used with a normally-open recloser, to connect two adjacent feeders.

The Sectionalizing control mode is used in different applications in the loop scheme and may be called by any of the following names: Sectionalizing, Feeder, Modified Sectionalizing, or Midpoint control.

The Tie control mode is typically referred to as the Tie control. The Tie control mode can also be used for one-way Tie controls, to allow closing of the recloser if loss of voltage is detected from one direction only.

For Sectionalizing Use Only

Auto-Reset Switch

The Auto-Reset dip switch is only to be used when the LS control is applied as a Sectionalizing control (Control Type Switch is set to the Sectionalizing mode). When programmed to the On position, the Auto-Reset switch will automatically reset the LS control and close the recloser upon restoration of system voltage.

This function is typically used in the five recloser loop scheme on the Sectionalizing recloser (shown in Figure 4). The Sectionalizing recloser is programmed to trip to lockout after the Loss of Voltage Transfer Time (TD1) has elapsed.

After the disturbance has been cleared and the Source I system voltage has been restored, automatic reset and closing of the Sectionalizing control will occur after the Auto-Reset Time Delay (TD3) times out. Automatic closing is disabled should the recloser trip due to an overcurrent.

Auto-Reset Time Delay (Switch Bank TD3)

The Auto Reset Time Delay (TD3) dip switches are used to program the time delay required for the voltage to be maintained, before an automatic reset will occur. The programmed delay time equals the sum of the values of the switches in the On position.

LS Function Switch

The nine-position LS function switch bank (Figure 9) programs the appropriate output functions to be performed after the Loss of Voltage Time Delay (TD1) times out.

In certain cases, more than one function will be selected to meet the desired application. For example: A Midpoint control may be required to change its minimum trip value and its sequence of operation after an LS operation. In this case, both the Latched Non-Reclose and the Latched Alt. Min. Trip functions will be set to the On position using the dip switches, while the balance of dip switches will be in the Off position.

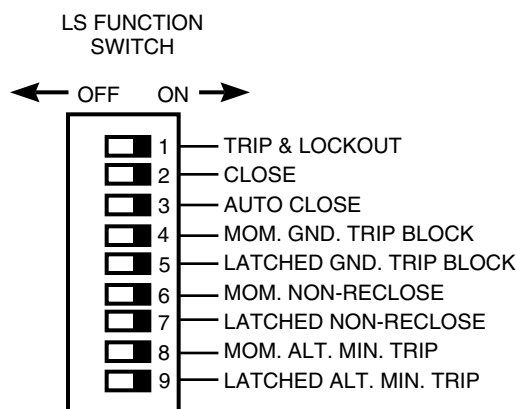


Figure 9.
LS Function Switch settings.

The nine options provided by the LS Function Switch are described as follows:

Trip and Lockout

Trip and Lockout trips the recloser open to lockout with no reclosing.

Close

The Close function closes the recloser and operates under cold load pickup per Access Code 12 Supervisory Close Reset Time of the Form 4C control.

Auto Close

Auto Close provides an automatic closing signal to the recloser control after an automatic reset of LS occurs. Auto Close is only used when the control is configured in the Sectionalizing mode with the Auto-Reset Switch On and programmed Auto-Reset Time Delay (switch bank TD3).

Auto Close provides automatic closing of the Sectionalizing control and recloser when voltage is restored after a LS operation.

Momentary Ground Trip Block

Momentary Ground Trip Block provides a momentary time delay to disable ground current sensing. The time delay is the programmed value for the Momentary Time Delay (switch bank TD2). The time delay can be set from 1 to 511 seconds, in increments of 1 second.

Latched Ground Trip Block

Latched Ground Trip Block disables ground current sensing after the programmed Loss of Voltage Transfer Time (switch bank TD1) times out.

Momentary Non-Reclose

Momentary Non-Reclose provides a momentary time delay to obtain non-reclosing. The control will operate with one trip to lockout on the first programmed time-current curve (TCC). The programmed TCC may be either TCC1 or TCC2. The time delay is the programmed value for Momentary Time Delay (switch bank TD2). The time delay can be set from 1 to 511 seconds, in increments of 1 second.*

Latched Non-Reclose

Latched Non-Reclose provides non-reclosing operation after the programmed Loss of Voltage Transfer Time (switch bank TD1) times out. The control will operate with one trip to lockout on the first programmed time-current curve (TCC). The programmed TCC may be either TCC1 or TCC2.

Note: When activating the Close and Non-Reclose (Momentary or Latched) features simultaneously via the LS Function Switch, Supervisory Close Reset Time (Form 4C Access Code No.12) has precedence over Non-Reclose. If all operations are programmed on TCC2, the control will trip on TCC2 before and after Code 12 has timed out.

Momentary Alternate Minimum Trip

Momentary Alternate Minimum Trip provides a momentary time delay to activate alternate minimum trip. The time delay is the programmed value for the Momentary Time Delay (switch bank TD2). The time delay can be set from 1 to 511 seconds, in increments of 1 second. Refer to Form 4C control Access Code 11, for additional information.

Latched Alternate Minimum Trip

Latched Alternate Minimum Trip enables alternate minimum trip after the programmed Loss of Voltage Transfer Time (switch bank TD1) times out.

INSTALLATION PROCEDURE

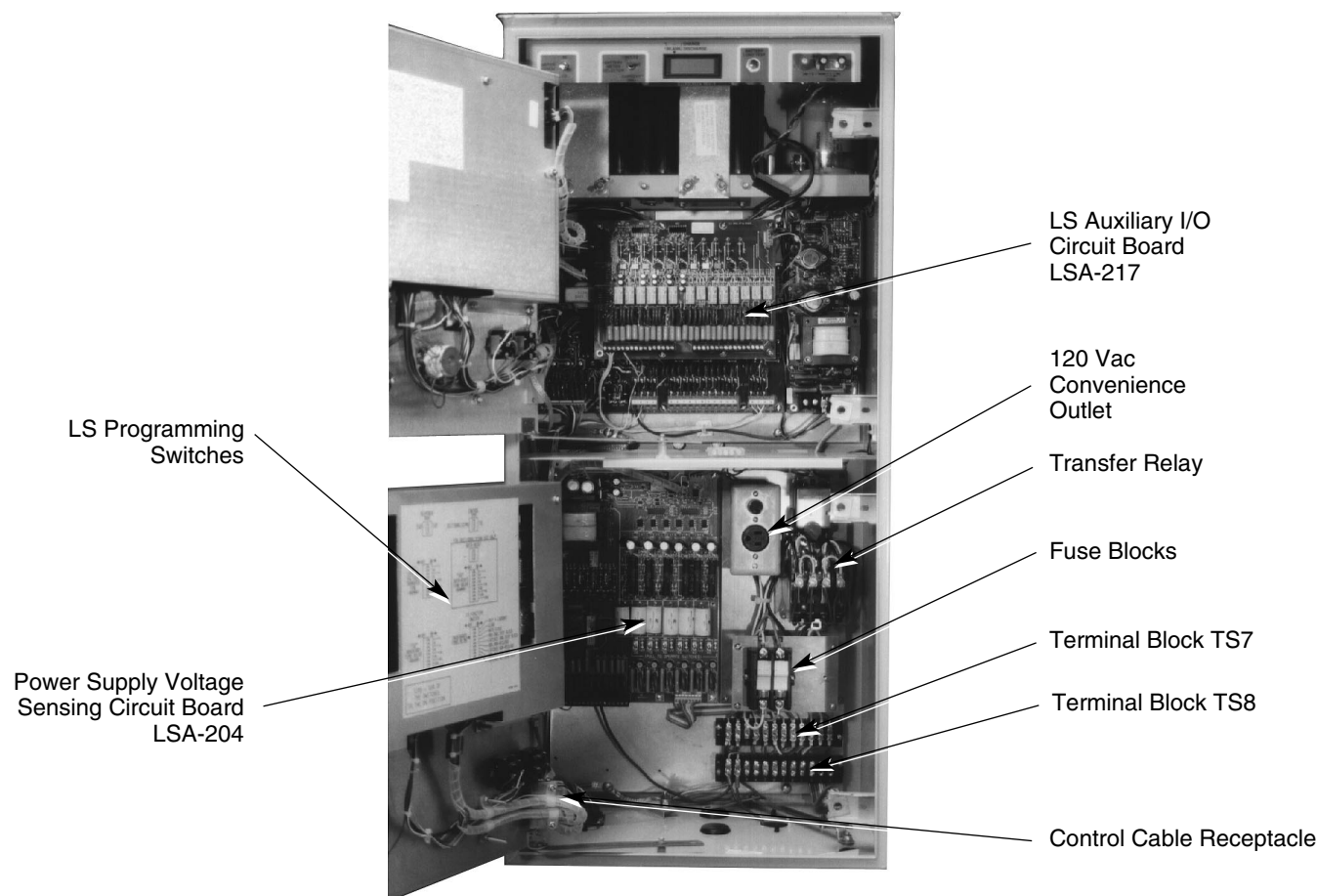


Figure 10.
Inside back panel of Form 4C/LS control.

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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.

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Installation of the Form 4C/LS control should be done only by a qualified technician. Follow the installation instructions for the Form 4C control provided in *Service Information S280-77-1*. Refer to *S280-77-4* for programming instructions for the Form 4C control. Follow the instructions in the *Installation Procedure* section of this manual to install the Type LS control.

Supervisory and status connections are made to the LS Power Supply/Voltage Sensing circuit board LSA-204, located on the inside back panel on the lower left side of the double-sized cabinet (Figure 10). Connections are also made to the LS Auxiliary I/O circuit board located on the inside back panel in the upper portion of the double sized cabinet.

Refer to the *LS Power Supply/Sensing Board* and *LS Auxiliary I/O Board* sections for additional information. For additional details concerning customer connections, refer to the wiring and connection diagrams shown in Figures 11 and 12.

Ac Supply Voltage Connections

Incoming 120 Vac supply voltage should be connected to terminal block TS7 (Figure 12) located in the lower right corner of the control. The TS7 terminal block is used for single- or three-phase sensing and is connected in the wye configuration. Delta inputs are not acceptable. Terminal block TS8 is used for auxiliary connections, as needed.

Terminal positions TS7-11 and TS7-8 are used for B-phase and Y-phase voltages respectively, to provide supply voltage to the Form 4C control, the convenience outlet, and 120 Vac low-voltage closing. The transfer relay TR allows for 120 Vac power to be available when voltage is present at TS7-11 or TS7-8. The TR relay and 120 Vac bus are protected by fuses FS7 and FS8, which are Bussman 15 amp type FNM fuses.

LS Power Supply/Voltage Sensing Circuit Board

The LS Power Supply/Voltage Sensing circuit board (LSA-204 (shown in Figure 10) is located in the lower left corner of the control cabinet and provides input for the 120 Vac connections from terminal block TS7 to connector P1.

Connector P1 is located on the lower right side of the circuit board LSA-204. On the circuit board are small removable fuses identified as F2 through F7. There are 6 fuses, one for each incoming 120 Vac circuit. The fuses are Wickman 3.15 Amp type TR5-F no. 19373K. In series with the fuses are 6 toggle switches labeled SW1 to SW6, that are used to disable the appropriate 120 Vac input for testing the Type LS control.

Supervisory and status connections are made to the P2 terminal block located on the Power Supply/Voltage Sensing circuit board. Supervisory wiring requires a wetting voltage which must be specified at the time of order.

Five versions of the LSA-204 circuit board (labeled -1 through -5) are available to accommodate the customer-specified supervisory input voltage. The version number of the circuit board is identified by a label attached to the board. Refer to the following table and make sure that the supervisory input voltage is correct for the planned installation.

Circuit Board Version	Supervisory Voltage
LSA-204-1	120 Vac
LSA-204-2	12 Vdc
LSA-204-3	24 Vdc
LSA-204-4	48 Vdc
LSA-204-5	125 Vdc

Terminal Block P2

The removable 16-position P2 terminal block, located on the Power Supply/Voltage Sensing circuit board, contains supervisory control and status functions. All supervisory functions require a customer-supplied momentary wetting voltage for a duration of 0.2 seconds. For additional details concerning customer connections, refer to the wiring and connection diagrams shown in Figures 11 and 12.

Table 1
LS Control Supervisory Disable Logic

Source 1 Toggle Switch (On/Off)	Source 2 Toggle Switch (On/Off)	Control Type (Tie/Sect.)	Supervisory Switch (On/Off)	Supv. Signal (LS Disable On/Off)	Operation (LS Disabled/LS Normal)
X	X	X	On	Disable On	LS Disabled
On	X	X	X	Disable Off	LS Normal
X	On	Tie	X	Disable Off	LS Normal
Off	X	Sect.	X	Disable Off	LS Disabled
Off	Off	X	X	X	LS Disabled

X = Either one of the options.

IMPORTANT: Access Code 26, Momentary Contact, on the Form 4C control must be Off. The Form 4C control's supervisory function terminal blocks are not used. All supervisory control wiring is either connected to the LSA-204 Power Supply/Voltage Sensing circuit board or the LSA-217 LS Auxiliary I/O circuit board.

The LS Control includes latch relays that operate the Form 4C control. Therefore, the Form 4C control is responding to a maintained contact and requires Access Code 26 to be Off.

P2 Terminal 1: Remote Hot Line Tag On

The *Remote Hot Line Tag On* function disables all electrical closing of the recloser, including supervisory control and local control via the Form 4C control's Manual Control Switch. It also programs the Form 4C control to operate one trip to lockout on TCC 1.

The control will operate on TCC 1 regardless of the programmed sequence. This function is *not* controlled by the Supervisory On/Off switch and must be reset by the *Remote Hot Line Tag Off* to permit closing of the recloser.

P2 Terminal 2: Remote Hot Line Tag Off

The *Remote Hot line Tag Off* function allows closing of the recloser after a *Remote Hot Line Tag On* has been initiated. This function is not controlled by the Form 4C control Supervisory On/Off switch.

P2 Terminal 3: Remote/Supervisory Common

Terminal position 3 is the common lead to be used for remote and supervisory functions.

P2 Terminal 4: Supervisory LS Disable On

Supervisory LS Disable On provides a disabling operation for the Type LS control. The control will be disabled for either Tie or Sectionalizing type control operation.

Note: The LS Disable On function is controlled by the Form 4C control Supervisory On/Off Switch.

The LS Disable On function is controlled by applying the correct momentary supervisory voltage across terminals 3 and 4 for at least 0.2 seconds. Local disable can also be accomplished via the toggle switches on the front panel of the LS control. The logic between local and supervisory disable is shown in Table 1.

P2 Terminal 5: Supervisory LS Disable Off

Supervisory LS Disable Off returns the LS control to the normal state. This function is controlled by applying the correct momentary supervisory voltage across terminals 3 and 5 for at least 0.2 seconds. The logic between local and supervisory disable is shown in Table 1.

P2 Terminal 6: Supervisory LS Reset

The *Supervisory LS Reset* provides a signal to the Type LS control to reset to its normal condition after the control has completed a loop sectionalizing operation.

Supervisory LS Reset can be used to automatically reset and close the recloser, if the Auto-Close function of the LS Function Switch is in the On position (The Auto-Reset Switch can be in the Off position).

Status Indicators: Terminals 7 thru 16

All status indicators on terminal block P2 provide a SPST relay contact rated per the following table:

Contact Rating	Input Voltage
1 amp	120 Vac
2 amps	12 Vdc
2 amps	24 Vdc
1 amp	48 Vdc
0.6 amp	125 Vdc

P2 Terminals 7-8: Supervisory LS Disable Status

A closed *Supervisory LS Disable* contact indicates that the LS control is disabled via Supervisory LS Disable On. Local LS disable via LS control front panel toggle switches will not indicate a closed contact on the Supervisory LS Disable Status.

P2 Terminals 9-10: Hotline Tag Status

A closed *Hotline Tag Status* contact indicates that a *Remote Hotline Tag On* has been actuated.

P2 Terminals 11-12: Overcurrent Lockout Status

A closed *Overcurrent Lockout Status* contact indicates that the Form 4C control has tripped to lockout after experiencing current above the programmed phase or ground minimum trip values.

Form 4C control Access Code 120 must be On. See front panel indicating lamps section of the *Installation Instructions for the Form 4C Control, Service Information S280-77-1*. This status contact follows the Overcurrent Lockout Indicator LCD on the front panel of the Form 4C control.

P2 Terminals 13-14: LS Reset Status

A closed *LS Reset Status* contact indicates that the LS control is in the Not-Reset mode.

P2 Terminals 15-16 Supervisory Status

A closed *Supervisory Status* contact indicates that the Form 4C control *Supervisory On/Off* switch is in the On position.

Note: The Supervisory On/Off switch status contact located on the standard Form 4C control I/O circuit board terminal block, positions 5 and 6, is not used. Terminal positions 5 and 6 are always shorted on the Form 4C standard I/O board terminal block, due to factory wiring.

LS Auxiliary Input/Output Circuit Board

The LSA-217 LS Auxiliary Input/Output circuit board is located in the upper portion of the double-sized control cabinet and mounted in the back panel of the Form 4C control above the standard Form 4C I/O circuit board as shown in Figure 10.

Note: The LS Auxiliary I/O circuit board replaces the functions of the standard and optional Form 4C I/O circuit boards and therefore, the optional Form 4C I/O board accessory KME4-77 is not required when a Form 4C/LS control package is specified.

The LSA-217 Auxiliary I/O circuit board provides additional supervisory functions and LS control functions for enhanced operation of the Form 4C/LS control package.

Supervisory and Status connections are made to two removable terminal blocks, AP1 and AP2, located at the bottom of the circuit board. Refer to the connection diagram in Figure 12. The terminal blocks are socket-mounted and can be removed for ease of user wiring.

Supervisory wiring requires a wetting voltage which must be specified at the time of order. Five versions of the LSA-217 circuit board (labeled -1 through -5) are available to accommodate the customer-specified supervisory input voltage. The version number of the circuit board is identified by a label attached to the board. Refer to the following table and make sure that the supervisory input voltage is correct for the planned installation.

Circuit Board Version	Supervisory Voltage
LSA-217-1	120 Vac
LSA-217-2	12 Vdc
LSA-217-3	24 Vdc
LSA-217-4	48 Vdc
LSA-217-5	125 Vdc

Terminal Block AP1

The 16-position AP1 terminal block, located on the LS Auxiliary Input /Output circuit board, contains the following supervisory control functions. All supervisory functions require a customer-supplied momentary wetting voltage for a duration of 0.2 seconds. For additional details concerning customer connections, refer to the connection diagram shown in Figure 12.

The supervisory function connections for ground trip block, non reclose, and alternate minimum trip have been isolated to activate (On) or deactivate (Off) each function (3-wire input). These functions are identical to the functions in the Form 4C control. Refer to *Service Information S280-77-1* for additional descriptive information on these functions.

AP1 Terminals 1-5: Factory Wiring

Factory Wiring terminals 1 through 5 are for factory use only and are not available for customer connection use.

AP1 Terminal 6: Supervisory Ground Trip Block Off

The *Supervisory Ground Trip Block Off* function allows normal ground current sensing.

AP1 Terminal 7: Supervisory Ground Trip Block On

The *Supervisory Ground Trip Block On* function disables ground current sensing.

AP1 Terminal 8: Supervisory Trip and Lockout

The *Supervisory Trip and Lockout* function trips the recloser open and locks out the control to prevent reclosing. The control remains locked-out until it is closed manually or by the supervisory close function.

AP1 Terminals 9-10: Spare Supervisory

The *Spare Supervisory* terminals are not used.

AP1 Terminal 11: Supervisory Trip

Supervisory Trip provides the ability to trip the recloser from a remote supervisory signal. Normal reclosing operations will follow, per the Form 4C control's programmed reclosing time and the availability of closing power.

AP1 Terminal 12: Supervisory Close

Supervisory Close initiates a closing signal to the recloser and modifies the control operating sequence to one delayed trip to lockout (cold load pickup mode) for a selected time interval. Refer to Form 4C control Access Code 12, Supervisory Close Reset Time to program the reset time interval.

AP1 Terminal 13: Supervisory Alternate Minimum Trip Off

The *Supervisory Alternate Minimum Trip Off* function disables the alternate minimum trip feature for both phase and ground trip. The Form 4C control will operate on the normal programmed minimum trip values. Refer to Form 4C control Access Code 01 for minimum trip values.

AP1 Terminal 14: Supervisory Alternate Minimum Trip On

The *Supervisory Alternate Minimum Trip On* function activates the alternate minimum trip feature for both phase and ground trip.

The Form 4C control will operate on the alternate programmed minimum trip values until switched off remotely, by the *Supervisory Alternate Minimum Trip-Off* function, or manually via the Form 4C front panel Alternate Minimum Trip Switch. Refer to Form 4C control Access Code 11 for alternate minimum trip values.

AP1 Terminal 15: Supervisory Non-Reclose Off

The *Supervisory Non-Reclose Off* function disables Supervisory Non-Reclose. The Form 4C control will operate following its programmed sequence of operations.

AP1 Terminal 16: Supervisory Non-Reclose On

The *Supervisory Non-Reclose On* function places the control in the non-reclosing mode.

In the event of an overcurrent when the control is in the non-reclosing mode, the Form 4C control and recloser will operate one trip to lockout on the programmed sequence time-current curve.

The control will operate in the non-reclosing mode until switched off remotely, by the *Supervisory Non-Reclose-Off* function.



Terminal Block AP2

The 16-position AP2 terminal block, located on the LS Auxiliary Input /Output circuit board, contains the following status functions. For additional details concerning customer connections, refer to connection diagram shown in Figure 13.

AP2 Terminals: 1-2 Spare Status

The *Spare Status* terminals are not used.

AP2 Terminals: 3-4 SGF (Sensitive Ground Fault) Target

A contact closure provides *Sensitive Ground Fault Target* indication. The Form 4C control Access Code 120 must be On.*

AP2 Terminals: 5-6 Ground Target

A contact closure provides *Ground Target* indication. The Form 4C control Access Code 120 must be On.*

AP2 Terminals: 7-8 Phase Target

A contact closure provides *Phase Target* indication. The Form 4C control Access Code 120 must be On.*

* For terminals 3 through 8, if the overcurrent lockout LCD and auto-closing are not required, the targets can be changed by turning Form 4C control Access Code 120 to the Off position. This allows target indication as follows:

AP2 Terminals	Phase Target
3-4:	Bushings 5-6
5-6:	Bushings 3-4
7-8:	Bushings 1-2

AP2 Terminals: 9-10 Lockout Status

A contact closure provides control *Lockout Status* indication from overcurrent, local, remote, supervisory or LS control operation.

AP2 Terminals: 11-12 Alternate Minimum Trip Status

A contact closure provides control *Alternate Minimum Trip Status* indication for local, supervisory or LS control operation.

AP2 Terminals: 13-14 Non-Reclosing Status

A contact closure provides control *Non-Reclosing Status* (the control is set to operate on one trip to lockout) indication for local, supervisory or LS control operation.

AP2 Terminals: 15-16 Ground Trip Block Status

A contact closure provides control *Ground Trip Block Status* indication for local, supervisory or LS control operation.

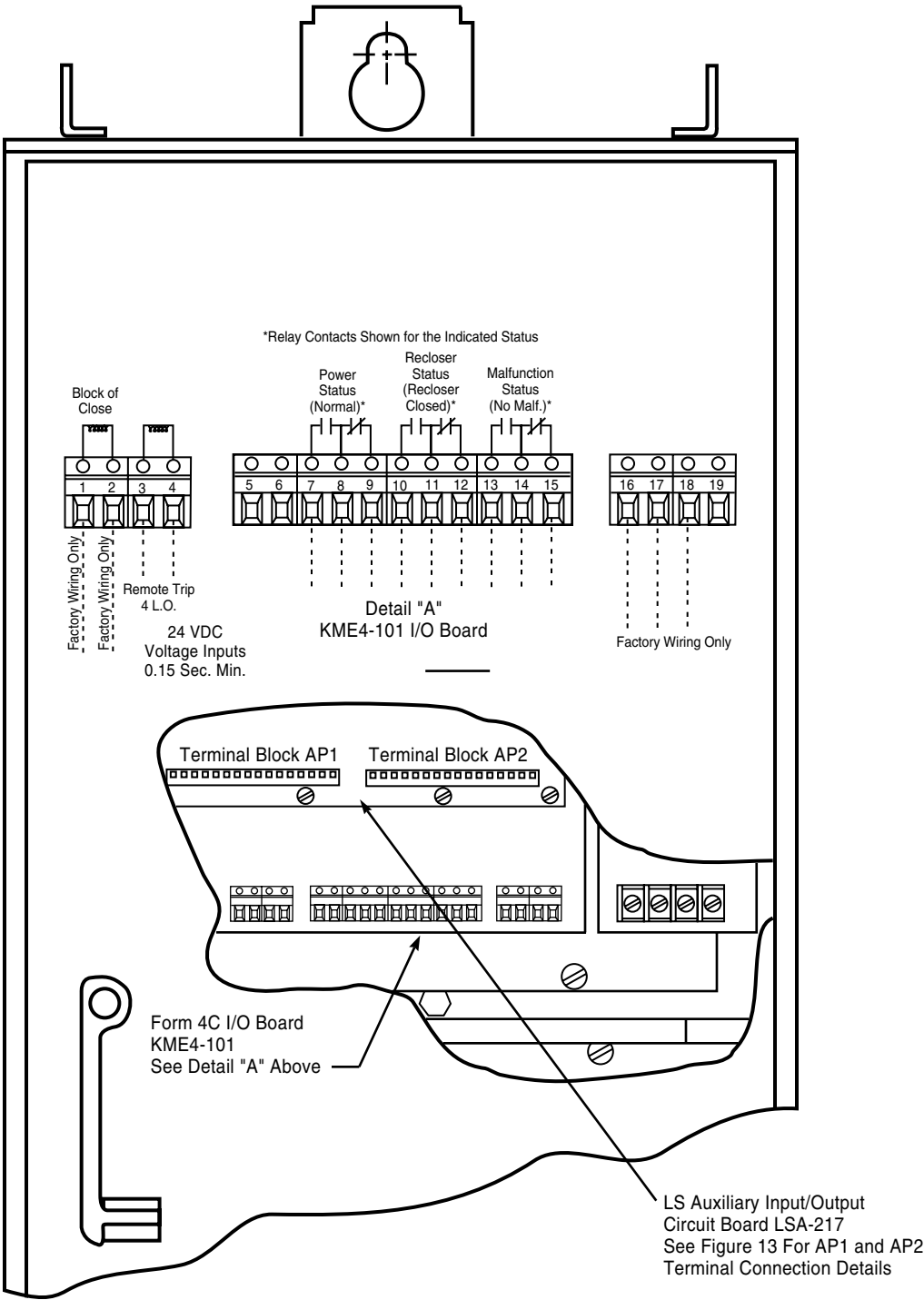
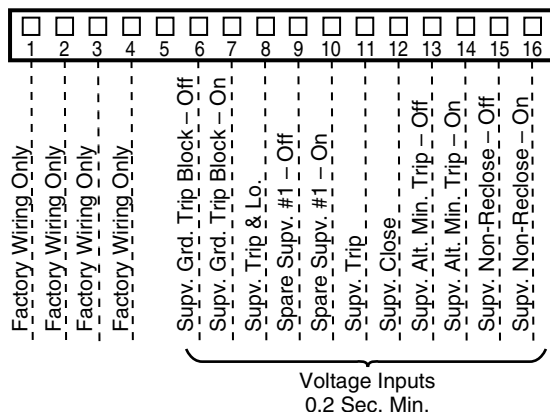


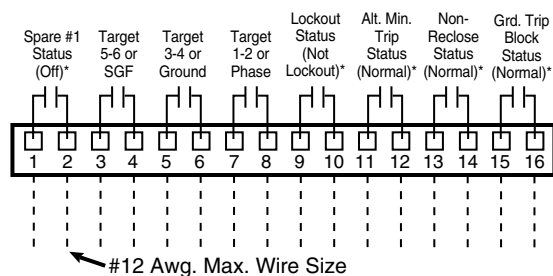
Figure 11.
Customer connections diagram for Form 4C/LS control.

Terminal Block AP1

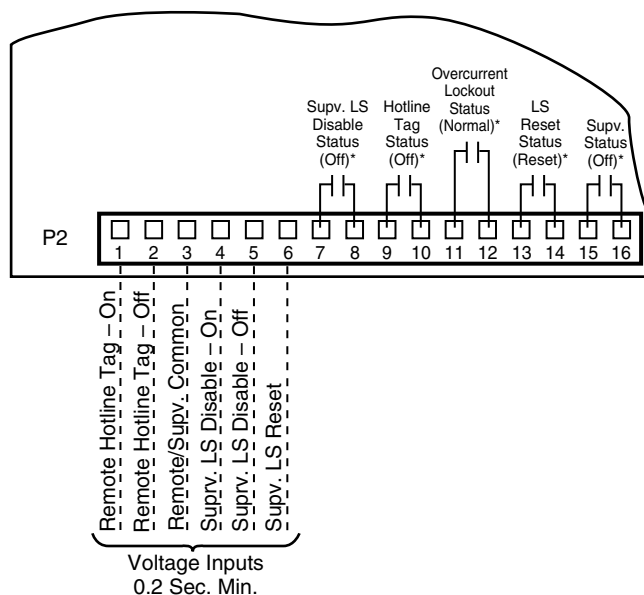


Terminal Block AP2

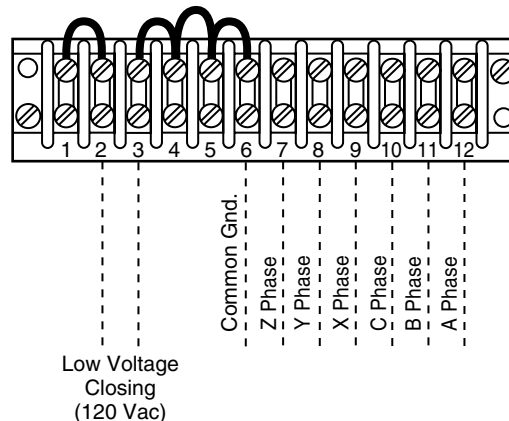
*Relay Contacts Shown for the Indicated Status



A-204 LS Power Supply/Voltage Sensing Circuit Board
Terminal Block P2



Terminal Block TS7
Located in Lower Right Corner of Back Panel of
Type LS Control Cabinet
(Wye Connections only)



Ratings Table For Output Status Contacts	
Input Voltage	Contact Rating
120Vac	1.0 A
12Vdc	2.0 A
24Vdc	2.0 A
48Vdc	1.0 A
125Vdc	0.6 A

Operating Current Requirements For Standard And Accessory Supervisory Inputs	
Input Voltage	Nominal Current
120 Vac	8mA
12Vdc	8mA
24Vdc	7mA
48Vdc	5mA
125Vdc	5mA

Operating Current Requirements For Remote Trip And Lockout Input	
Input Voltage	Nominal Current
120 Vac	11mA
12Vdc	75mA
24Vdc	37mA
48Vdc	19mA
125Vdc	11mA

Figure 12.
Detail views of customer connection terminal blocks.

LS Voltage Status Circuit Board Accessory

The Type LS control can be equipped with the optional LS Voltage Status circuit board (LSA-218) that includes contacts to provide remote status indication of the voltage present at the recloser. Voltage status contacts are provided for all three phases of Source I and Source II for both direct voltage status and memory status. An LS control disable status contact is also included to provide remote indication that the LS control has been disabled from either the front panel toggle switches or via the Supervisory LS Disable function.

When included, the optional LS Voltage Status circuit board is located on the lower left corner of the back panel of the LS control cabinet.

Direct Voltage Status Contacts

The direct status contacts provide remote, real-time status of the voltage present at each individual phase. For example: If voltage is present at A-phase, the direct status contact (Terminal Block P2 terminals 15 and 16) will be closed.

Memory Status Contacts

The memory status contacts provide remote indication of one or more phases which lost voltage and caused the LS control to operate. The memory status contacts will follow the state of the LCD indicators located on the LS control front panel. Under normal control operation (when voltage is present), the memory status contacts will be Closed.

During a loss of voltage, the memory status contacts will open. (The direct status contacts will also open.) After the LS control Loss of Voltage Transfer Time delay (switch bank TD1) elapses, the control will operate. When voltage returns to the phase or phases which were lost, the memory status contacts will remain in the Open position, while the direct status contacts will return to the Closed position.

The memory status contacts will remain in the Open position until the LS control is reset via the front panel LS Reset Switch pushbutton, or the control is reset remotely via the Supervisory LS Reset function.

Terminal Block P2

The removable, 16-position P2 terminal block, located on the LS Voltage Status circuit board contains direct voltage status contacts and the LS control disable status contact. For additional details concerning customer connections, refer to the connection diagram in Figure 13.

P2 Terminals 1-2: Not Used

Terminals 1 and 2 are not used and not available for customer connection use.

P2 Terminals 3-4: LS Disable Status

A closed *LS Disable Status* contact indicates that the LS control is disabled via the LS control front panel toggle switches or via the Supervisory LS Disable function.

P2 Terminals 5-6: Z Phase Status

A closed *Z Phase Status* contact indicates that voltage is present for that phase.

P2 Terminals 7-8: Y Phase Status

A closed *Y Phase Status* contact indicates that voltage is present for that phase.

P2 Terminals 9-10: X Phase Status

A closed *X Phase Status* contact indicates that voltage is present for that phase.

P2 Terminals 11-12: C Phase Status

A closed *C Phase Status* contact indicates that voltage is present for that phase.

P2 Terminals 13-14: B Phase Status

A closed *B Phase Status* contact indicates that voltage is present for that phase.

P2 Terminals 15-16: A Phase Status

A closed *A Phase Status* contact indicates that voltage is present for that phase.

Terminal Block P3

The removable, 16-position P3 terminal block, located on the LS Voltage Status circuit board contains memory status contacts for Source I and Source II. For additional details concerning customer connections, refer to the connection diagram in Figure 13.

P3 Terminals 1-4: Not Used

Terminals 1, 2, 3 and 4 are not used and not available for customer connection use.

P3 Terminals 5-6: Z Phase Memory Status

A closed *Z Phase Memory Status* contact indicates that voltage is present for that phase. An open contact indicates that voltage has been lost for that phase. After voltage has been lost for that phase, the memory status contact will remain Open until the LS control is reset.

P3 Terminals 7-8: Y Phase Memory Status

A closed *Y Phase Memory Status* contact indicates that voltage is present for that phase. An open contact indicates that voltage has been lost for that phase. After voltage has been lost for that phase, the memory status contact will remain open until the LS control is reset.

P3 Terminals 9-10: X Phase Memory Status

A closed *X Phase Memory Status* contact indicates that voltage is present for that phase. An open contact indicates that voltage has been lost for that phase. After voltage has been lost for that phase, the memory status contact will remain open until the LS control is reset.

P3 Terminals 11-12: C Phase Memory Status

A closed *C Phase Memory Status* contact indicates that voltage is present for that phase. An open contact indicates that voltage has been lost for that phase. After voltage has been lost for that phase, the memory status contact will remain open until the LS control is reset.

P3 Terminals 13-14: B Phase Memory Status

A closed *B Phase Memory Status* contact indicates that voltage is present for that phase. An open contact indicates that voltage has been lost for that phase. After voltage has been lost for that phase, the memory status contact will remain open until the LS control is reset.

P3 Terminals 15-16: A Phase Memory Status

A closed *A Phase Memory Status* contact indicates that voltage is present for that phase. An open contact indicates that voltage has been lost for that phase. After voltage has been lost for that phase, the memory status contact will remain open until the LS control is reset.

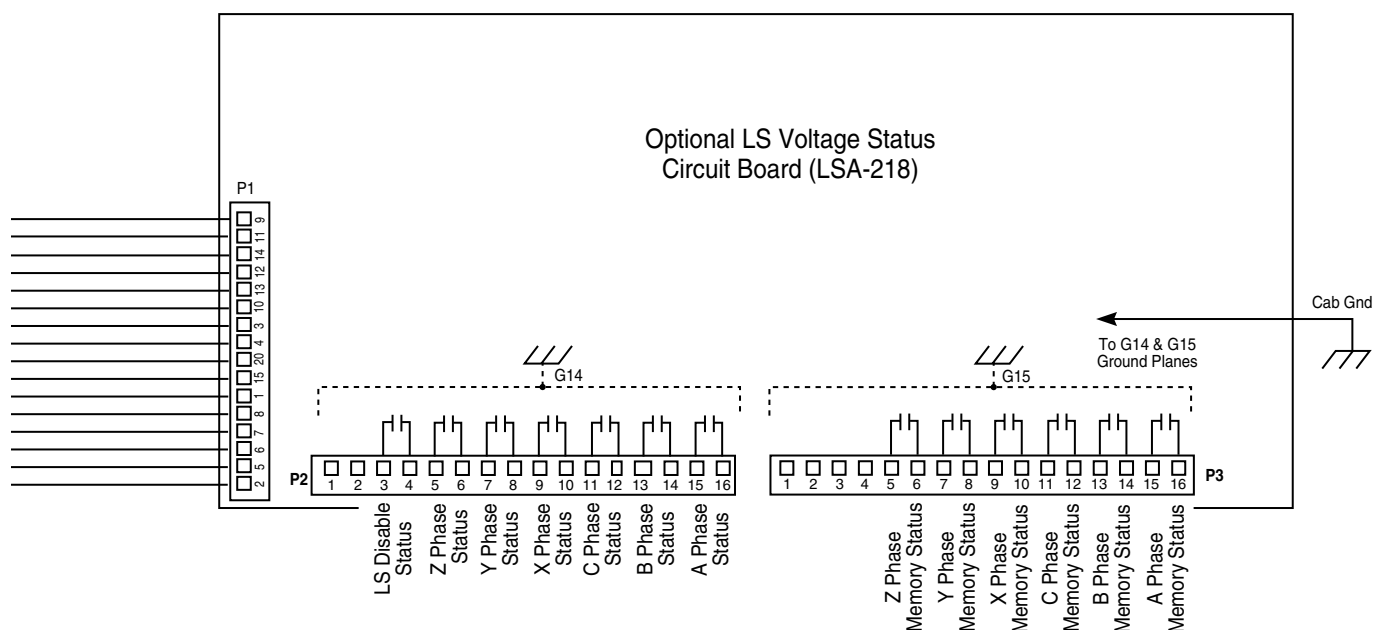



Figure 13.
LS Voltage Status accessory circuit board connection diagram.

MAINTENANCE 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 Parts

Replacement parts for Kyle controls are available through the factory service department. To order replacement parts, refer to the current Replacement Parts price list for catalog numbers and pricing. Contact your Cooper Power Systems Division sales 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 Division sales representative.

Factory Maintenance Classes

The factory service department offers maintenance training courses for Kyle recloser controls. These classes, taught by experienced factory service technicians, are held at the factory's in-house training facility. For further information, contact your Cooper Power Systems sales representative.



 **COOPER** Power Systems