SEL-351R
Recloser Control

Quick-Start Installation and User's Guide

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SCHWEITZER ENGINEERING LABORATORIES, INC.

PM351RQS-01

PM351RQS-01

Table of Contents

List of Tables

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List of Figures

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Preface

About This Quick-Start Installation and User's Guide

This SEL-351R *Recloser Control Quick-Start Installation and User's Guide* helps you install, communicate with, set, and test the SEL-351R in its EZ ("easy") mode of operation. The EZ mode performs traditional recloser control functions and operations.

SEL designed the SEL-351R Recloser Control based on the SEL-351R Distribution Relay. The SEL-351R has full SEL-351 Relay functionality together with a modified user interface designed for recloser control. When using the SEL-351R as a traditional line recloser control, it is only necessary to access the EZ Level (Access Level E) Settings. See the *SEL-351R Recloser Control Instruction Manual* for complete information regarding the full functionality of the SEL-351R.

This *Quick-Start Installation and User's Guide* includes the following:

- *Preface*
- *Section 1: Installation*
- *Section 2: Communications*
- *Section 3: Front-Panel Interface*
- *Section 4: Settings*
- *Section 5: Testing*
- *Section 6: Battery*
- *Section 7: Convenience Outlet*
- *Section 8: Specifications*
- *Appendix A: Quick-Start Guide Change Information*
- *Appendix B: Reference*

Safety Information

This SEL-351R *Quick-Start Installation and User's Guide* does not cover all of the possible conditions or circumstances that can occur during the installation, operation, or testing of the SEL-351R. If additional information is necessary to install, communicate with, or make settings to the recloser control that is not provided in this documentation, please refer to the *SEL-351R Recloser Control Instruction Manual* or contact SEL for assistance.

Dangers, Warnings, and Cautions

This guide uses three kinds of hazard statements, defined as follows:

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

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

⚠CAUTION
Indicates a potentially hazardous situation that, if not avoided, **may** result in minor or moderate injury or equipment damage.

Safety Symbols

The following symbols are often marked on SEL products.

	**⚠CAUTION** Refer to accompanying documents.	**⚠ATTENTION** Se reporter à la documentation.
	Earth (ground)	Terre
	Protective earth (ground)	Terre de protection
	Direct current	Courant continu
	Alternating current	Courant alternatif
	Both direct and alternating current	Courant continu et alternatif
	Instruction manual	Manuel d’instructions

Safety Marks

The following statements apply to this device.

⚠DANGER Disconnect or de-energize all external connections before opening this device. Contact with hazardous voltages and currents inside this device can cause electrical shock resulting in injury or death.	**⚠DANGER** Débrancher tous les raccordements externes avant d'ouvrir cet appareil. Tout contact avec des tensions ou courants internes à l'appareil peut causer un choc électrique pouvant entraîner des blessures ou la mort.
⚠DANGER Contact with instrument terminals can cause electrical shock that can result in injury or death.	**⚠DANGER** Tout contact avec les bornes de l'appareil peut causer un choc électrique pouvant entraîner des blessures ou la mort.
⚠WARNING Use of this equipment in a manner other than specified in this manual can impair operator safety safeguards provided by this equipment.	**⚠AVERTISSEMENT** L'utilisation de cet appareil suivant des procédures différentes de celles indiquées dans ce manuel peut désarmer les dispositifs de protection d'opérateur normalement actifs sur cet équipement.
⚠WARNING Have only qualified personnel service this equipment. If you are not qualified to service this equipment, you can injure yourself or others, or cause equipment damage.	**⚠AVERTISSEMENT** Seules des personnes qualifiées peuvent travailler sur cet appareil. Si vous n'êtes pas qualifiés pour ce travail, vous pourriez vous blesser avec d'autres personnes ou endommager l'équipement.
⚠WARNING This device is shipped with default passwords. Default passwords should be changed to private passwords at installation. Failure to change each default password to a private password may allow unauthorized access. SEL shall not be responsible for any damage resulting from unauthorized access.	**⚠AVERTISSEMENT** Cet appareil est expédié avec des mots de passe par défaut. A l'installation, les mots de passe par défaut devront être changés pour des mots de passe confidentiels. Dans le cas contraire, un accès non-autorisé á l'équipement peut être possible. SEL décline toute responsabilité pour tout dommage résultant de cet accès non-autorisé.
⚠CAUTION There is danger of explosion if the battery is incorrectly replaced. Replace only with Ray-O-Vac® no. BR2335 or equivalent recommended by manufacturer. See Owner's Manual for safety instructions. The battery used in this device may present a fire or chemical burn hazard if mistreated. Do not recharge, disassemble, heat above 100°C or incinerate. Dispose of used batteries according to the manufacturer's instructions. Keep battery out of reach of children.	**⚠ATTENTION** Une pile remplacée incorrectement pose des risques d'explosion. Remplacez seulement avec un Ray-O-Vac® no BR2335 ou un produit équivalent recommandé par le fabricant. Voir le guide d'utilisateur pour les instructions de sécurité. La pile utilisée dans cet appareil peut présenter un risque d'incendie ou de brûlure chimique si vous en faites mauvais usage. Ne pas recharger, démonter, chauffer à plus de 100°C ou incinérer. Éliminez les vieilles piles suivant les instructions du fabricant. Gardez la pile hors de la portée des enfants.
⚠CAUTION The relay contains devices sensitive to Electrostatic Discharge (ESD). When working on the relay with the front panel removed, work surfaces and personnel must be properly grounded or equipment damage may result.	**⚠ATTENTION** Le relais contient des pièces sensibles aux décharges électrostatiques. Quand on travaille sur le relais avec les panneaux avant ou du dessus enlevés, toutes les surfaces et le personnel doivent être mis à la terre convenablement pour éviter les dommages à l'équipement

Conventions

Typographic Conventions

There are three ways to communicate with the SEL-351R:

- Using a command line interface on a PC terminal emulation window, such as Microsoft® HyperTerminal.
- Using the front-panel menus and pushbuttons.
- Using ACSELERATOR QuickSet® SEL-5030 Software.

The instructions in this manual indicate these options with specific font and formatting attributes. The following table lists these conventions.

Example	Description
STATUS	Commands, command options, and command variables typed at a command line interface on a PC.
n **SHO *n***	Variables determined based on an application (in bold if part of a command).
<Enter>	Single keystroke on a PC keyboard.
<Ctrl+D>	Multiple/combination keystroke on a PC keyboard.
Start > Settings	PC software dialog boxes and menu selections. The > character indicates submenus.
CLOSE	Recloser control front-panel pushbuttons.
ENABLE	Recloser control front- or side-panel labels.
RELAY RESPONSE MAIN > METER	Recloser control front-panel LCD menus. The > character indicates submenus.
Are you sure?	Recloser control responses visible on the PC screen.

Section 1
Installation

Overview

MOTOR-OPERATED RECLOSERS
Refer to SEL Application Guide AG99-10, Change Logic in SEL-351R Recloser Control for Motor-Operated Reclosers to modify a few settings for motor-operated reclosers (e.g., MVE, CVE, CXE, CZE, VSA).

This section provides:

- Hardware Overview
- Numbered Step-by-Step Installation Instructions
- Installation Instructions for Optional Connections
- Extra Detail

Compatibility

Install the SEL-351R Recloser Control in new or retrofit recloser installations in place of Kyle® Form 3, 3A, 4, 4A, 4C, and Type FXA and FXB controls. The SEL-351R is compatible with Cooper three-phase reclosers (with 24 Vdc trip/close circuits) that are compatible with the previously mentioned Kyle controls.

Hardware Overview

REMOVE SHIPPING SCREWS
The SEL-351R ships from the factory with three shipping screws. In order to open the swing panel, these screws (#10-32) must be removed. Refer to Figure 1.1.

GFCI = GROUND-FAULT CIRCUIT INTERRUPTER
The panel-mounted fuse holder in Figure 1.1 provides additional protection for the 120 Vac (GFCI) convenience outlet. Maximum loading is 10 A (see Table 1.3 and Section 7: Convenience Outlet).

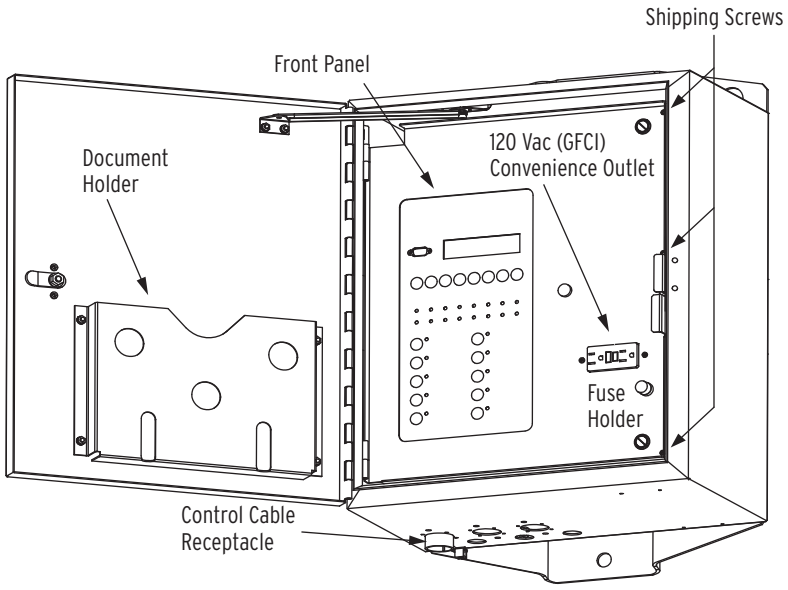


Figure 1.1 SEL-351R Recloser Control Enclosure With Swing Panel Closed

Reclosers With Internal Battery Charging Transformers

Some Cooper reclosers have an internal battery charging transformer (current transformer). This charging transformer is not used by the SEL-351R. Its 24 Vdc battery is charged from a user-supplied 120 Vac power source. If one of these reclosers is connected to the SEL-351R, this charging transformer is electrically shorted at the control cable receptacle (see *Figure 1.13*; pins K and L are shorted together and grounded).

Terminal Block

- Rail: DIN 3
- Screws: #6-32
- Lug width: 0.334" max. (8.5 mm)

Accessories

Accessories can be mounted on the back panel, above the terminal block. See *Figure 1.8* for more details.

Control Cable

The SEL-351R uses the same control cable that connects a Kyle Form 3, 3A, 4, 4A, 4C, or Type FXA or FXB control to a Cooper three-phase recloser.

Knockout Details and Uses

- 7/8" for 1/2" conduit fittings

See *Figure 1.5* for more knockout details.

Bring 120 Vac power, close power, three-phase voltage, external control, etc., in and out of the SEL-351R enclosure via the knockout holes.

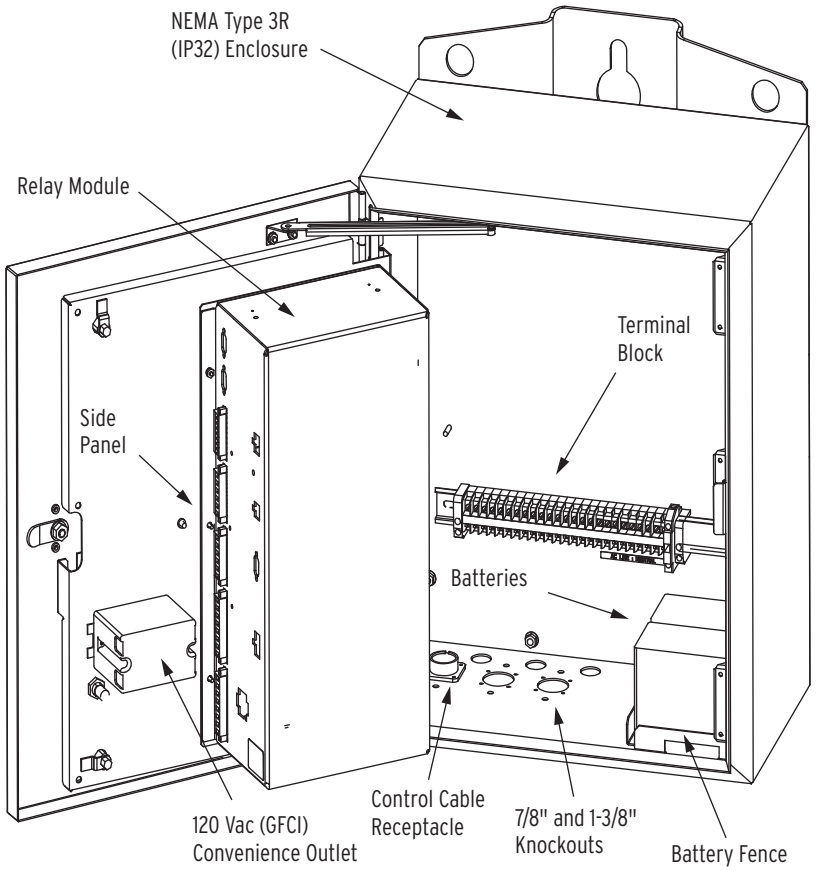


Figure 1.2 SEL-351R Recloser Control Enclosure With Swing Panel Open (wiring not shown)

Installation Step 1: Mount the Enclosure

⚠WARNING
Take proper precautions to prevent personal injury or equipment damage when lifting and mounting the SEL-351R. The unit weighs as much as 51 pounds (23.1 kg), including battery.

DO NOT TRANSPORT THE SEL-351R WITH THE BATTERY INSIDE THE ENCLOSURE!

⚠DANGER
If the recloser is energized while the control cable is disconnected from the recloser control, the CT secondaries in the control cable may generate dangerously high voltages. Do not come in contact with the pins or pin sockets in the control cable. Contact with high voltage can cause serious injury or death.

MOUNTING BOLTS The required 5/8" mounting bolt assemblies are **not** provided by SEL.

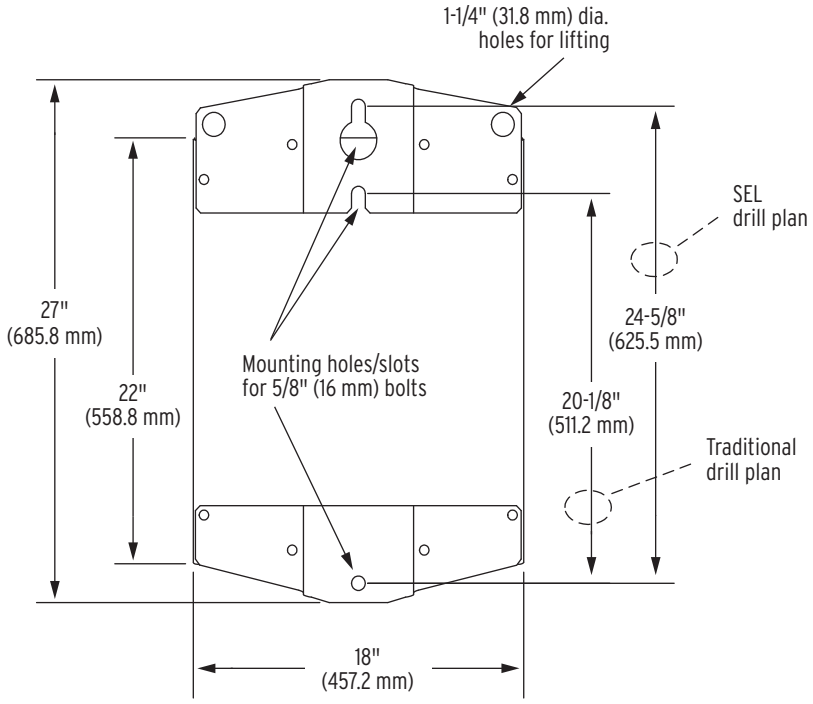


Figure 1.3 SEL-351R Recloser Control Dimensions and Mounting Drill Plan (Lift-To-Open Enclosure)

Important Notes for Installation Step 1

⚠WARNING
Take proper precautions to prevent personal injury or equipment damage when lifting and mounting the SEL-351R.

DO NOT TRANSPORT THE SEL-351R WITH THE BATTERY INSIDE THE ENCLOSURE!

1. Use either of the two drill plans detailed in *Figure 1.3*. The traditional drill plan (20-1/8 inches on center) is for retrofits of single-size Kyle enclosures–no extra drilling of the pole or mounting structure is needed.
2. Two 1-1/4-inch diameter lifting holes are provided on the top mounting bracket.
3. The unit weighs 84 pounds (38.1 kg), including battery.

Installation Step 2: Ground the Enclosure

EXTRA GROUNDING INSIDE ENCLOSURE
All other points that need grounding **inside** the SEL-351R enclosure are brought to the bolt at the floor of the enclosure (see Figure 1.13). This hex head bolt (#10-32, stainless steel) holds the grounding lug to the outside of the enclosure and protrudes through the floor of the enclosure.

GROUNDING LUG CONDUCTOR RANGE
The grounding lug can accommodate No. 14 through No. 4 conductor (solid or stranded).

ENCLOSURE OPENINGS
No openings into the SEL-351R enclosure should be left uncovered with the exception of the vented holes plugs provided by SEL. Any conduit or other wire entry must be properly sealed.

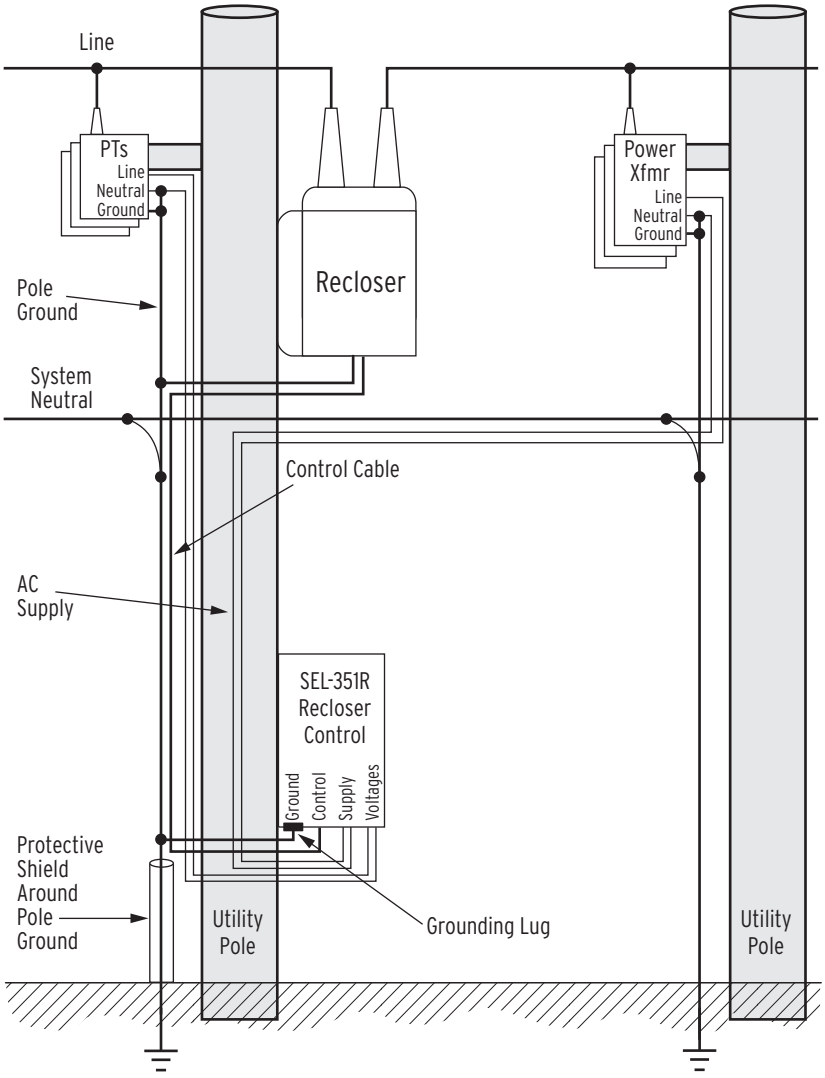


Figure 1.4 SEL-351R Customer Ground Connection to Required System Grounding

Important Notes for Installation Step 2

1. All devices interfacing to the SEL-351R must be connected to the same pole ground. *Figure 1.4* shows a suggested method of making these connections.
2. All connections to the SEL-351R must be routed in close proximity to and parallel to their corresponding ground paths for adequate surge protection. The connections and their ground paths should be approximately equal in length. Use applicable IEEE and IEC grounding standards. Follow the preceding recommendations to reduce high potentials from surges that can damage equipment.
3. External control wiring brought into the SEL-351R enclosure for connection to the extra I/O (output contacts **OUT101** through **ALARM** and optoisolated inputs **IN101** through **IN106**; see *Figure 1.9* and *Figure 1.12*) should be protected within shielded cables. The cable shields must be grounded at the grounding lug bolt **inside** the SEL-351R enclosure (see *Figure 1.13*).

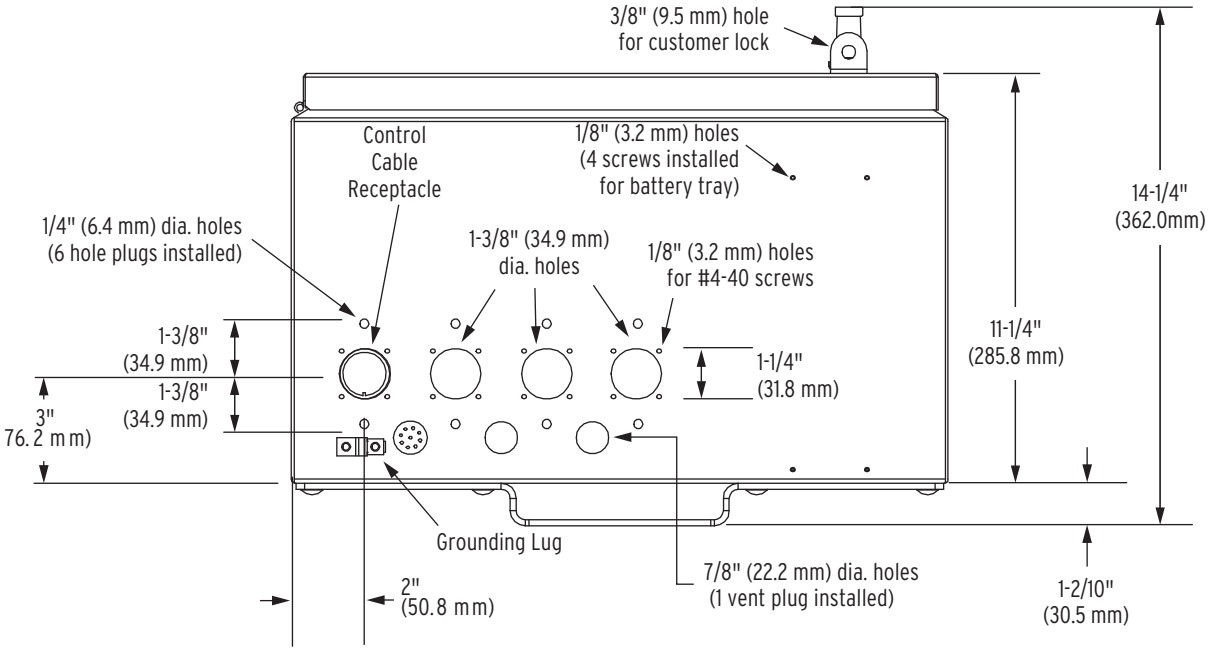


Figure 1.5 SEL-351R Recloser Control Grounding Lug Location and Other Dimensional Information (bottom view)

Installation Step 3: Connect the Battery

FRONT PANEL STILL DARK!
The front panel is still dark after connecting the battery. Installation Step 4 turns on the SEL-351R.

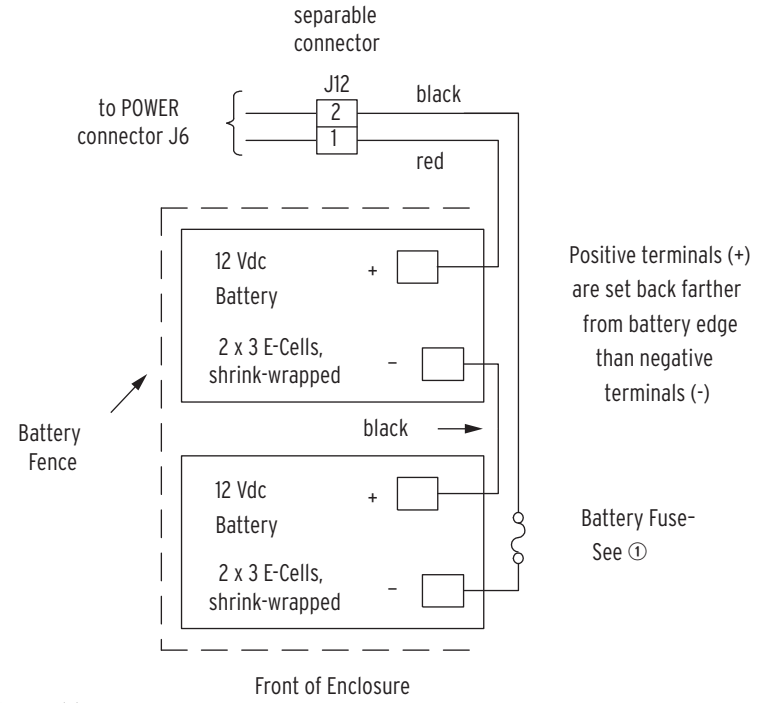
REPLACING A BATTERY?
Refer to Battery Replacement on page 6.5.

DO NOT TRANSPORT THE SEL-351R WITH THE BATTERY INSIDE THE ENCLOSURE!

COMPLETE WIRING DIAGRAM
See Figure 1.13.

TEST THE BATTERY?
To test the battery after it has been connected and the SEL-351R is turned on, refer to Section 6: Battery.

⚠CAUTION
Separable connector **J12** should be the first disconnected when removing batteries and the last connected when installing batteries. Do not leave **J12** connected without the batteries also connected. The tab disconnects on the battery wiring harness are energized and can short-circuit if they come in contact with the enclosure floor or each other, consequently damaging the internal power supply.



① See Table 1.3.

Figure 1.6 Battery Wiring Harness Connections

Set the batteries inside the battery fence as shown in *Figure 1.2*. Fasten and secure the hook and loop strap over the battery top. Connect the battery wiring harness as shown in *Figure 1.6*, following the instructions given in the

accompanying CAUTION. Note that the small jumper wire in the harness connects the (–) terminal of one 12 Vdc battery to the (+) terminal of the other 12 Vdc battery to make an effective 24 Vdc battery.

Installation Step 4: Wake Up the Control

Press the front-panel **WAKE UP** operator control, and the SEL-351R turns on. The following should be observed:

- **CONTROL ENABLED** LED illuminates
- **BATTERY PROBLEM** LED remains extinguished

If the unit does not turn on, check the following items:

- Battery is low-charged or dead
- Battery fuse is blown–see *Figure 1.6* and *Table 1.3*.

WAKE UP WITHOUT WAKE UP:
If Installation Step 4 is skipped, the SEL-351R will turn on automatically when Installation Step 6 is executed. Application of 120 Vac power always turns on the SEL-351R.

Installation Step 5: Connecting Three-Phase Voltage?

ENABLE FAULT LOCATION IF THREE-PHASE VOLTAGE IS CONNECTED
Use **SET n** command [**n** = 1 (main settings), **n** = 2 (alternate settings)]

Make line parameter settings:
Z1MAG, Z1ANG, Z0MAG, Z0ANG, LL

Enable fault locating:
EFLOC = Y

NO If not connecting three-phase voltage, go directly to *Installation Step 6: Connect the 120 Vac Power on page 1.7*.

YES If connecting three-phase voltage, read and understand the following subsections and then answer the following question:

Option 1: Connect Three-Phase and Synchronism Check Voltage on page 1.9 (see *Figure 1.8*)

Detail 1: Factory-Installed Terminal Block Voltage Jumpers on page 1.13 (see *Figure 1.11*)

Will the SEL-351R also be powered from the three-phase voltage (must be 120 Vac power)?

NO Go to *Installation Step 6: Connect the 120 Vac Power*, but first remove the factory-installed jumpers to voltage input **V1** (refer to the subsections listed above). After completing *Installation Step 6: Connect the 120 Vac Power* (and removing the factory-installed jumpers to voltage input **V1**), connect three-phase voltage before proceeding to *Installation Step 7: Verify Settings and Set Date and Time*.

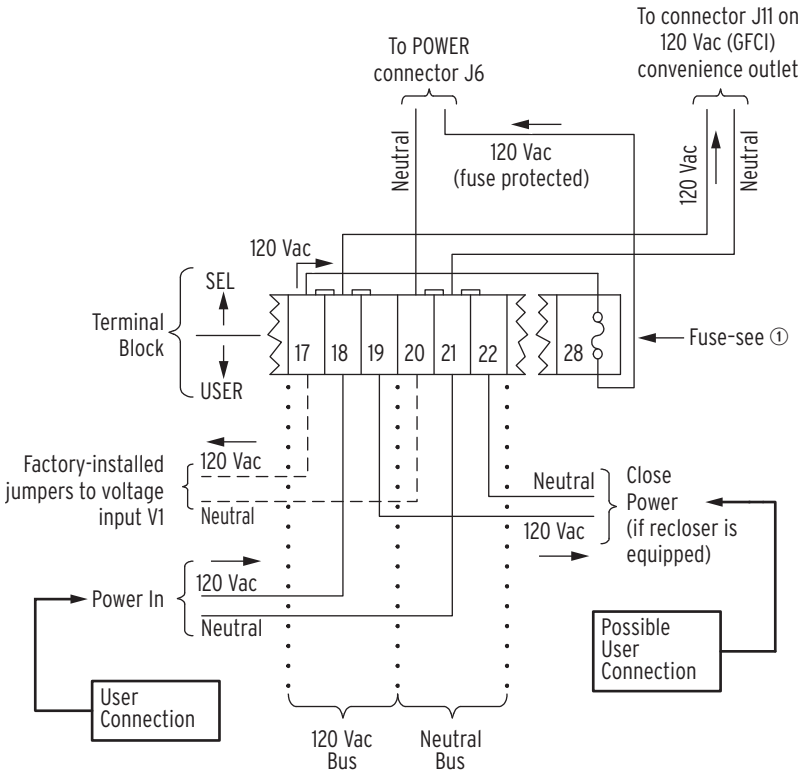
YES Skip *Installation Step 6: Connect the 120 Vac Power* and connect the three-phase voltage to the unit (refer to the subsections listed above).

Installation Step 6: Connect the 120 Vac Power

FRONT-PANEL INDICATION
When 120 Vac power is connected to the SEL-351R, the front-panel **AC SUPPLY** LED illuminates.

If still extinguished, check fuse in terminal block position **28**. The **AC SUPPLY** LED illuminates if the relay module is powered-up/functional and the battery is not discharging. The **AC SUPPLY** LED may flicker at times when tripping or closing, due to the battery momentarily discharging a bit.

120 VAC POWER ALSO ENERGIZES VOLTAGE INPUT V1
See Figure 1.11 for more information.



① See Table 1.3.

Figure 1.7 Vac Power Connections (120 Vac example)

Important Notes for Installation Step 6

1. The power brought into the enclosure is shown wired to terminal block positions **18** and **21**. Because terminal block positions **17**, **18**, and **19** are bused together as the 120 Vac bus and terminal block positions **20**, **21**, and **22** are bused together as the Neutral bus, the Power In can be connected to any of these terminals for respective 120 Vac and neutral connections. The same is true for the Close Power going out of the unit.
2. For reclosers equipped to be closed from 120 Vac power, Close Power can be brought out from the 120 Vac and Neutral buses as shown. Close operations are started with the 24 Vdc close circuit (detailed in *Figure 1.17*), but the power required to close the main contacts and compress the tripping springs in the recloser is usually either 120 Vac, as discussed here, or primary voltage. This depends on recloser construction.

Installation Step 7: Verify Settings and Set Date and Time

If the alternate settings are not going to be used, copy the main settings (Settings Group 1) to the alternate settings (Settings Group 2) with the **COPY** command (i.e., **COP 1 2**). The settings in both settings groups will then be the

⚠CAUTION
Do not connect the SEL-351R to an energized recloser until all control settings have been properly programmed and verified. Refer to Section 4: Settings for programming procedures. Failure to comply can result in control and recloser misoperation, equipment damage, and personal injury.

same. If the **ALTERNATE SETTINGS** operator control pushbutton is accidentally pressed (switching the active settings group), the SEL-351R still operates on the same settings. Refer to the *Factory EZ Settings on page 4.3* for more information on main and alternate settings.

Set the date and time with the **DATE** and **TIME** commands (**DAT** and **TIM**, respectively; see *Table 2.5*).

Installation Step 8: Disable Ground

Disable ground overcurrent tripping with the **GROUND ENABLED** operator control on the SEL-351R (corresponding LED extinguishes). Set other operator controls as desired for normal operation.

Installation Step 9: Connect the Control Cable

⚠DANGER
If the recloser is energized while the control cable is disconnected from the recloser control, the CT secondaries in the control cable may generate dangerously high voltages. Do not come in contact with the pins or pin sockets in the control cable. Contact with high voltage can cause serious injury or death.

Connect the control cable to the control cable receptacle at the bottom of the SEL-351R enclosure (see *Figure 1.5*. The SEL-351R uses the same control cable that connects a Kyle Form 3, 3A, 4, 4A, 4C, or Type FXA or FXB control to a Cooper three-phase recloser.

DO RECLOSER PRIMARY CONNECTIONS MATCH SEL-351R FACTORY CONNECTIONS? SEE FIGURE 1.14 AND FIGURE 1.15.

Installation Step 10: Metering Check (if recloser is closed)

Press the front-panel **METER** pushbutton and select the `INST` (instantaneous metering) option. Scroll through the instantaneous metering values (primary), checking current `IA`, `IB`, and `IC` magnitude and angle for expected phase rotation. The residual ground (`IG`) and neutral ground (`IN`) current displays should show relatively low current magnitudes, when compared to `IA`, `IB`, and `IC`, if system loading is well-balanced. The negative-sequence (`3I2`) current display should show relatively low current magnitude, when compared to `IA`, `IB`, and `IC`, if system loading is well-balanced and phase rotation is correct.

If system loading is well-balanced, but current display `IG`, `IN`, or `3I2` shows an abnormally high current level, suspect a wiring or setting problem. Solve this problem before enabling ground overcurrent tripping (you may need to take the SEL-351R out of service). See *Figure 1.14* and *Figure 1.15*.

In installations where single-phase 120 Vac power is the only voltage brought to the SEL-351R, the instantaneous metering values will display the expected primary value for VA, VB, and VC for assigned voltage input **V1**, **V2**, and **V3**; and **VS** will be equal to zero (0) or negligible. (See *Figure 1.11* for voltage input **V1** information.)

Installation Step 11: Enable Ground

LAST REQUIRED STEP!

ENERGIZE VOLTAGE INPUT V1 FOR AUTO-RECLOSING
Factory-default settings require that voltage input **V1** be energized (indicating presence of close power) in order for auto-reclosing to proceed after a reclose interval times out.

See Figure 1.11 and Initial Conditions for Control Tests on page 5.2 for more information.

If desired for normal operation, enable ground overcurrent tripping with the **GROUND ENABLED** operator control on the SEL-351R (corresponding LED illuminates).

Option 1: Connect Three-Phase and Synchronism-Check Voltage

The SEL-351R has three analog voltage input terminal connections labeled **V1**, **V2**, and **V3**. Wiring to the power system (potential transformer connections and recloser primary bushing connections) can be random, but correct power system "A-B-C" designation is still needed within the SEL-351R algorithms. EZ Settings and Global EZ settings (True three-phase voltage connected, Phantom voltages, **V123** Terminal Conn., **I123** Terminal Conn., CT Polarity) define how the transition occurs between the power system wiring and the SEL-351R relay algorithms.

The factory default settings connect power system VA to relay voltage **V1** (e.g., EZ Setting #42 True three-phase voltage connected = N, EZ Setting #43 Phantom voltages = OFF, and EZ Setting #44 **V123** Terminal Conn.= A [see *Table 4.3*]).

While the SEL-351R is using EZ Settings, power system potential transformer connections "A-B-C" can be designated to **V1**, **V2**, and **V3** terminal connections by setting EZ Setting #42 True three-phase voltage connected = Y, and EZ Setting #44 **V123** Terminal Conn. = ABC (see *Figure 1.8*). See *Current and Voltage Connection Settings* in *Section 9* in the *SEL-351R Recloser Control Instruction Manual* for more details.

CONNECT 67 OR 120 VAC
Connect 67 Vac line-to-neutral or 120 Vac line-to-neutral to voltage inputs **V1**, **V2**, **V3**, or **VS**.

SYNCHRONISM CHECK WITH ANY PHASE
Voltage input **VS** can be connected to any phase. Besides synchronism check, **VS** can provide dead or hot line checks (see SEL-351R Instruction Manual).

ORDERING OPTIONS
Voltages **VB**, **VC**, and **VS** are an ordering option (see Figure 1.12).

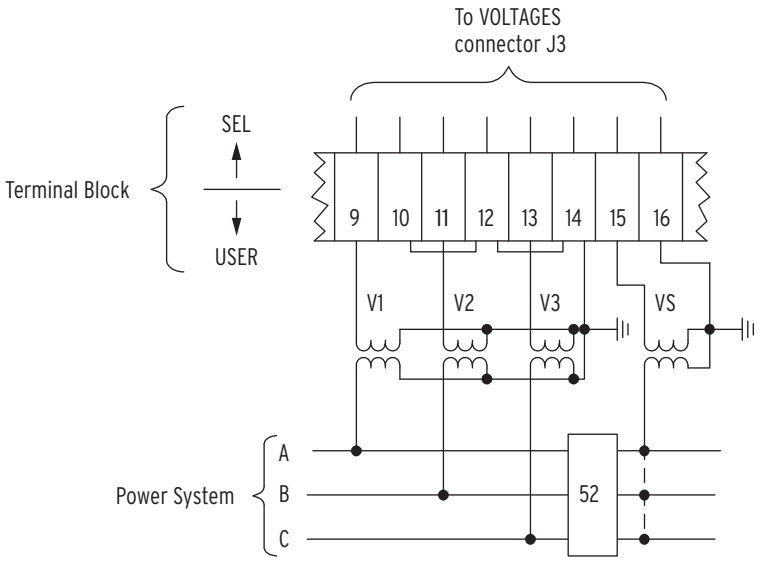


Figure 1.8 Three-Phase and Synchronism-Check Voltage Connections

Important Notes for Option 1

⚠DANGER
If three-phase voltage is brought separately to the SEL-351R, the factory-installed jumpers (bringing 120 Vac to voltage input **V1**) must be removed. (There is an exception to removing the factory-installed jumpers, see the Exception to the accompanying DANGER statement.) **No** parallel connection can exist between the 120 Vac power and the separate three-phase voltage brought into the SEL-351R enclosure.

1. Factory-installed jumpers connect terminal block positions **10**, **12**, and **14**. These jumpers make up the neutral point for three-phase voltage connections. These factory-installed neutral-point jumpers can be kept in place, even if three-phase voltage is not brought to the SEL-351R.
2. **Exception to the accompanying DANGER statement**: If three-phase voltage (rated 120 Vac line-to-neutral) is brought separately to the SEL-351R (see *Figure 1.8*) and is also required to provide 120 Vac power to the unit, then the factory-installed jumpers that provide 120 Vac to voltage input **V1** (see *Figure 1.11*) do **not** have to be removed. Do **not** make the Power In connections to terminal block positions **18** and **21** (detailed in *Figure 1.7*).

Option 2: Monitor External Contacts With 24 Vdc; Power Radio With 12 Vdc

VDC SOURCE RATINGS
Ratings for the user-available 12 and 24 Vdc sources are given in Table 1.1.

12 VDC TURNED ON WITH SETTING
See Table 4.3.

24 VDC FUSE
See Table 1.3 for more information on the fuse in terminal block position **26**.

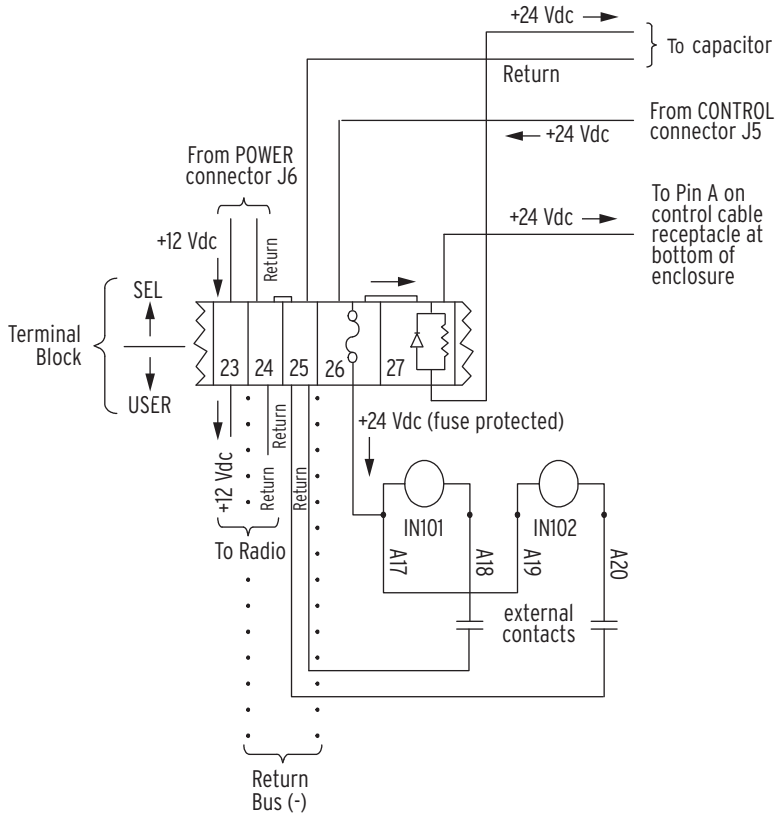


Figure 1.9 Monitor External Contacts Using 24 Vdc From the SEL-351R Recloser Control; 12 Vdc Connection

Important Notes for Option 2

⚠WARNING
No grounds can be installed on circuits connected to the 12 Vdc and 24 Vdc sources (terminal block positions **23** through **26**). These voltage sources are grounded inside the SEL-351R relay module.

⚠WARNING
If **external voltage** is used to energize the optoisolated inputs (**IN101** through **IN106**), **no** connections can be made from the optoisolated inputs to terminal block positions **23** through **26**. This external voltage is grounded at its source, not at the SEL-351R enclosure. The optoisolated inputs must be ordered with the appropriate dc voltage rating

1. Terminal block positions **24** and **25** are bused together as the Return bus (–). The Return bus is common for 12 Vdc and 24 Vdc connections. The Return electrically originates from **POWER** connector **J6**.
2. *Figure 1.9* shows optoisolated inputs **IN101** and **IN102** (on the SEL-351R side panel—see *Figure 1.12*) monitoring external contacts The wetting voltage is provided by 24 Vdc from terminal block position **26**.
3. External control wiring brought into the SEL-351R enclosure for connection to the extra I/O (output contacts **OUT101** through **ALARM** and optoisolated inputs **IN101** through **IN106**—see *Figure 1.12*) should be protected within shielded cables. The cable shields must be grounded at the grounding lug **inside** the SEL-351R enclosure (see *Figure 1.13*).

Table 1.1 Ratings for User-Available Voltage Sources (see Figure 1.9)

Voltage	Terminal Block Positions	Voltage Range	Maximum Capability
12 Vdc	23 (+), 24/25 (–; return)	11–14 Vdc	6 W continuous, 13 W for 1 second
24 Vdc	26 (+), 24/25 (–; return)	20–42[a] Vdc	0.1 A

[a] If 24 Vdc-rated optoisolated inputs (e.g., IN101 and IN102 in the example in Figure 1.9) are wetted with the 24 Vdc from terminal block position 26, the inputs can handle the possible upper voltage output (42 Vdc) from this 24 Vdc source. The inputs will be "on" at this upper limit.

Option 3: Mount Accessories Inside Enclosure

ACCESSORY PANEL
You can mount an accessory panel on the back panel studs of the SEL-351R enclosure, above the terminal block (see Figure 1.2). The accessory panel is not provided by SEL.

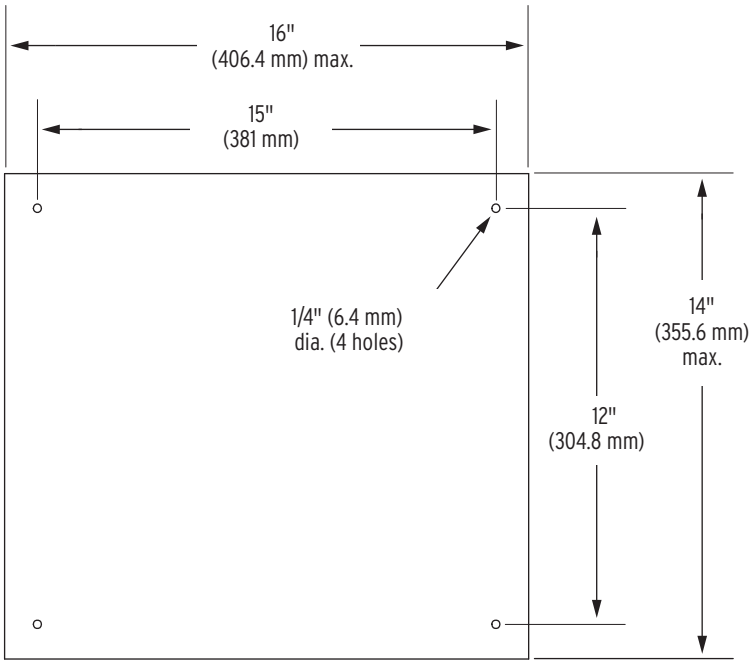


Figure 1.10 Recommended Dimensions and Drill Plan for User-Supplied Accessory Panel

Important Notes for Option 3

1. Accessory mounting is facilitated by four mounting studs protruding from the back panel of the SEL-351R enclosure. The location of these mounting studs relative to one another is shown with the locations of the 1/4-inch diameter holes in the recommended accessory panel in *Figure 1.10*.
2. Mounting stud details: #10-32; 5/8-inch (15.9 mm) length.
3. Refer to *Figure 1.1* and *Figure 1.2*. When the swing panel is closed, the distance between the back panel of the SEL-351R relay module and the back panel of the SEL-351R enclosure (above the terminal block) is 4 inches (101.6 mm). This does not include space taken up by mounting an accessory panel onto the mounting studs–this would subtract from the 4-inch dimension.

Detail 1: Factory-Installed Terminal Block Voltage Jumpers

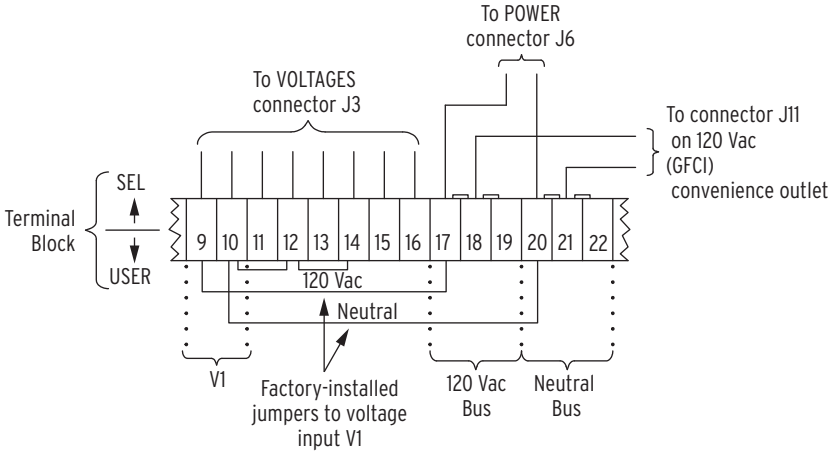


Figure 1.11 Factory-Installed Jumpers From 120 Vac Power Bus to Voltage Input V1 (120 Vac example)

Important Notes for Detail 1

1. Factory-installed jumpers bring 120 Vac to voltage input **V1** for installations where three-phase voltage is not brought separately to the SEL-351R unit. The 120 Vac power does not have to come from power system Phase A. Voltage input **V1** should be energized, either with the factory-installed jumpers or with three-phase voltage (see *Figure 1.8*).

   Voltage input **V1** provides frequency monitoring and close power indication. Factory-default settings require that voltage input **V1** be energized (indication of present close power) in order for auto-reclosing to proceed after a reclose interval times out. See *Initial Conditions for Control Tests on page 5.2* for additional details on voltage input **V1** detecting close power and other possible variations.

2. Factory-installed jumpers connect terminal block positions **10**, **12**, and **14**. These jumpers make up the neutral point for optional three-phase voltage connections (detailed in *Figure 1.8*). These factory-installed neutral-point jumpers can be kept in place, even if three-phase voltage is not brought to the SEL-351R.

3. **Exception to the accompanying DANGER statement**: If three-phase voltage (rated 120 Vac line-to-neutral) is brought separately to the SEL-351R (see *Figure 1.8*) and is also required to provide 120 Vac to power the unit, then the factory-installed jumpers that provide 120 Vac to voltage input **V1** do **not** have to be removed. Do **not** make the Power In connections to terminal block positions **18** and **21** (detailed in *Figure 1.7*).

⚠DANGER
If three-phase voltage is brought separately to the SEL-351R, the factory-installed jumpers (bringing 120 Vac to voltage input **V1**) must be removed. (There is an exception to removing the factory-installed jumpers, see Exception to the accompanying DANGER statement.) **No** parallel connection can exist between the 120 Vac power and the separate three-phase voltage brought into the SEL-351R enclosure.

Detail 2: Side Panel

Important Notes for Detail 2

1. A number of the connector terminals are not connected (**N/C**).The **N/C** option shown in the **VOLTAGES** connector **J3** legend (e.g., • **VS**, **VS**, or **N/C**) refers to an ordering option. Voltage channels **VB**, **VC**, and **VS** are an ordering option. Regardless of the voltage channels ordered, the wiring is in place between the terminal block and the **VOLTAGES** connector **J3** for all voltage channel positions (see *Figure 1.13*).
2. The extra I/O (output contacts **OUT101** through **ALARM** and optoisolated inputs **IN101** through **IN106**) is not needed for the basic recloser control functions. The extra I/O is available for SCADA connection or other control (see *Figure 1.9*) and is **not** polarity sensitive.

   The optoisolated inputs must be ordered with the appropriate dc voltage rating. Refer to the serial number sticker on the side panel for the optoisolated input voltage rating (listed under label: **EXT. CONTACT SENSING INPUTS**).

   The connectors for the extra I/O accept wire size AWG 24 to 12. Strip the wires to 0.31 inch (8 mm) and install with a small slotted-tip screwdriver.
3. Optoisolated inputs **IN101** through **IN106** can be configured via settings to operate on ac voltage. See *Optoisolated Inputs on page 8.1* for more information on ac operation.

Detail 3: Wiring Diagram

Important Notes for Detail 3

1. See *Table 1.3* for more information on the fuses in terminal block positions **26** and **28**, the fuse on the 120 Vac (GFCI) convenience outlet, and the battery fuse.
2. The wiring between the terminal block (positions **1**–**8**) and the control cable receptacle accommodates the current polarity of Cooper reclosers, as further detailed in *Figure 1.14*. If the SEL-351R is used with a circuit breaker, positions **1**–**8** would probably need to be rewired on the user side. *Figure 1.12* and *Figure 1.14* show the polarity/non-polarity terminals for the **CURRENTS** connector **J10**.
3. If the SEL-351R is used with a circuit breaker, positions **1**–**8** would probably need to be rewired on the user side. *Figure 1.12* and *Figure 1.14* show the polarity/non-polarity terminals for the **CURRENTS** connector **J10**.
4. In June 2001, the SEL-351R wiring was changed to accommodate two additional fuses (terminal block position **28** and battery wiring harness). Older units have the previous wiring found in *Figure B.1*.
5. In October 2004, the SEL-351R was updated to provide assignable power system VA, VB, VC, IA, IB, and IC to terminal inputs **V1**, **V2**, **V3**, **I1**, **I2**, and **I3** with EZ or Global Settings. *Figure B.2* shows the previous side panel terminal designations.

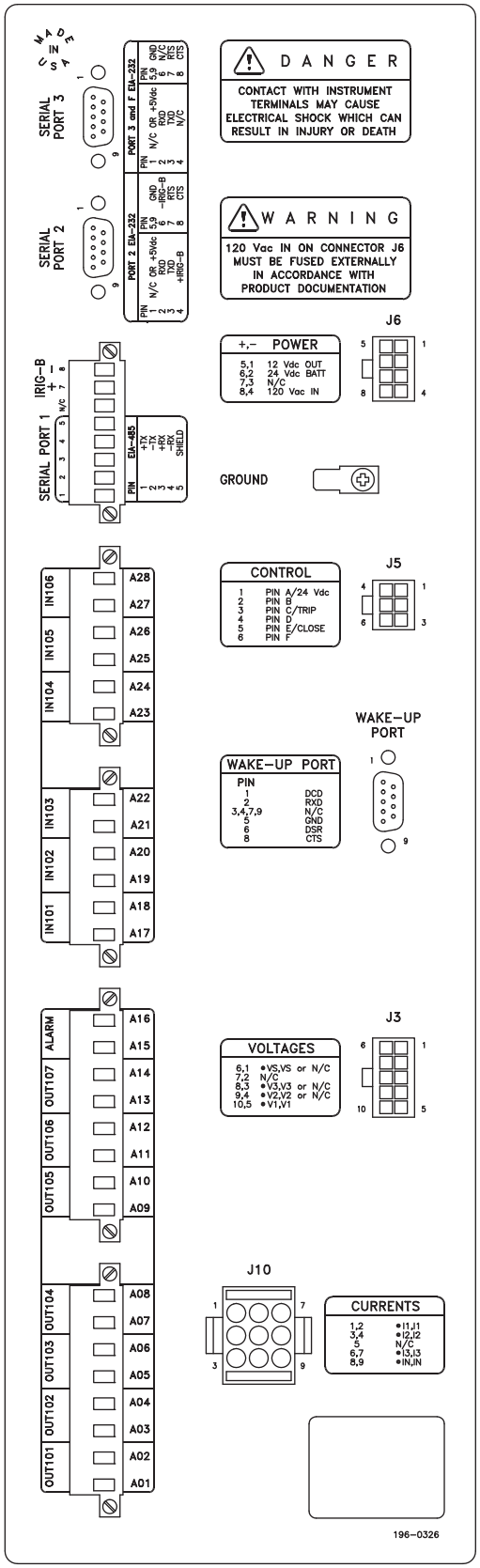
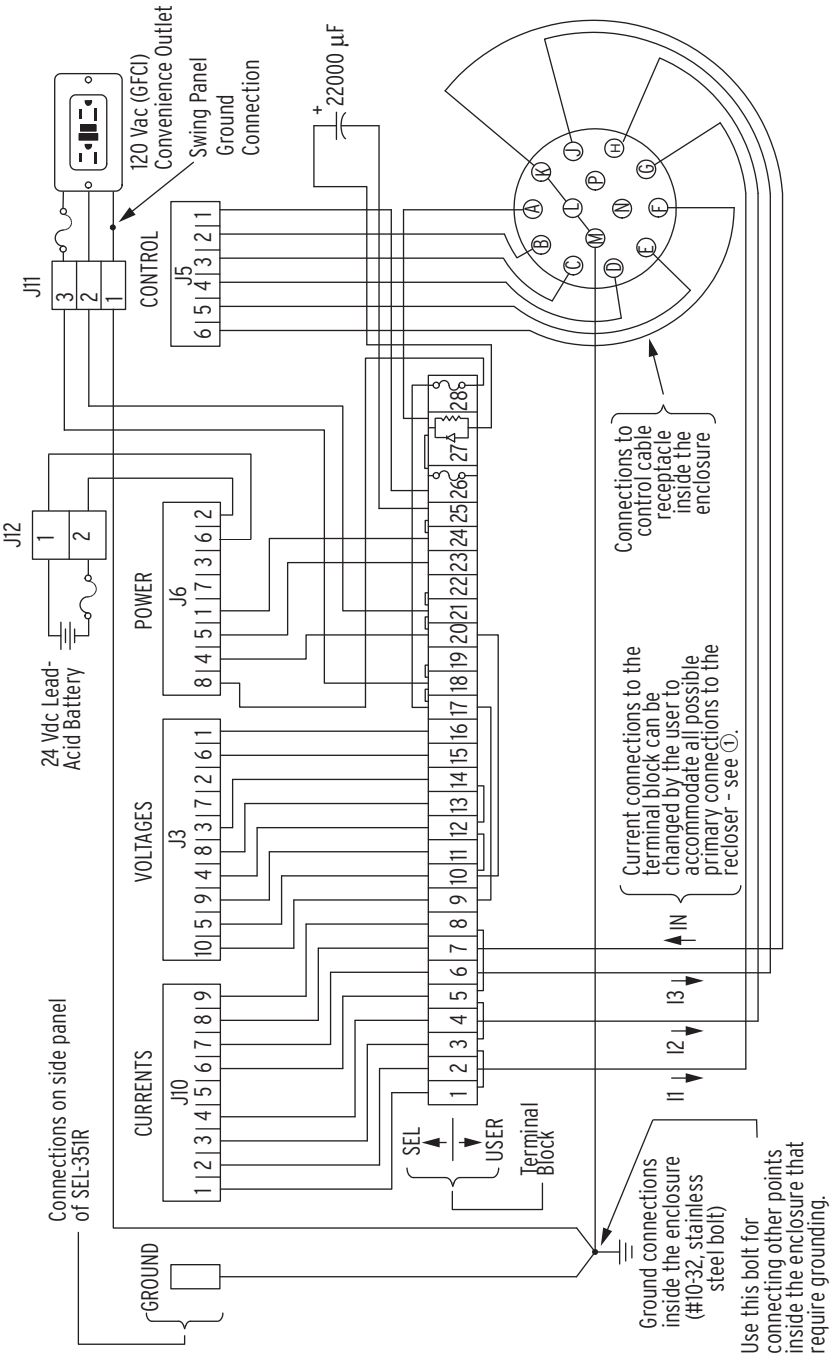


Figure 1.12 SEL-351R Recloser Control Side Panel



① See Figure 1.15.

Figure 1.13 SEL-351R Recloser Control Factory-Installed Wiring Inside the Enclosure

Detail 4: Current Polarity/Recloser Primary Connections

The SEL-351R has three current inputs **I1**, **I2**, and **I3** for terminal connections. Wiring to the power system current transformer connections can be random, but correct power system "A-B-C" designation is still needed within the SEL-351R algorithms. EZ or equivalent Global settings define how the transition occurs between the power system wiring and the SEL-351R Recloser Control algorithms. The SEL-351R can accommodate different power system relay phase assignments by rewiring or settings.

The factory default settings connect power system currents IA, IB, and IC to relay terminals **I1**, **I2**, and **I3**, respectively as shown in *Figure 1.14*.

Use EZ Setting #45 (see *Table 4.3*) as noted in *Figure 1.15* (and perhaps EZ setting #46) to accommodate other power system connections (or change corresponding Global settings IPCONN and CTPOL to transition the power system "A-B-C" designation to the SEL-351R Recloser Control algorithm). See *Section 9* in the *SEL-351R Recloser Control Instruction Manual* for more details.

SEL-351R FACTORY CONNECTIONS

All the connections shown inside the SEL-351R in Figure 1.14 are factory made. Only the current connections from the control cable receptacle to the user-side of the terminal block can be changed–see Figure 1.15.

RECLOSER PRIMARY CONNECTIONS

Traditional connections are assumed for primary currents I_A-I_B-I_C into recloser source-side bushing 1-3-5, respectively, in Figure 1.14. Figure 1.15 describes all other possible connections.

PHASE ROTATION IS A SEPARATE ISSUE

Figure 1.14 and Figure 1.15 address current polarity and recloser primary connections, not phase rotation.

Phase rotation is handled with the Phase Rotation setting in Table 4.3 and in Settings Descriptions on page 4.6.

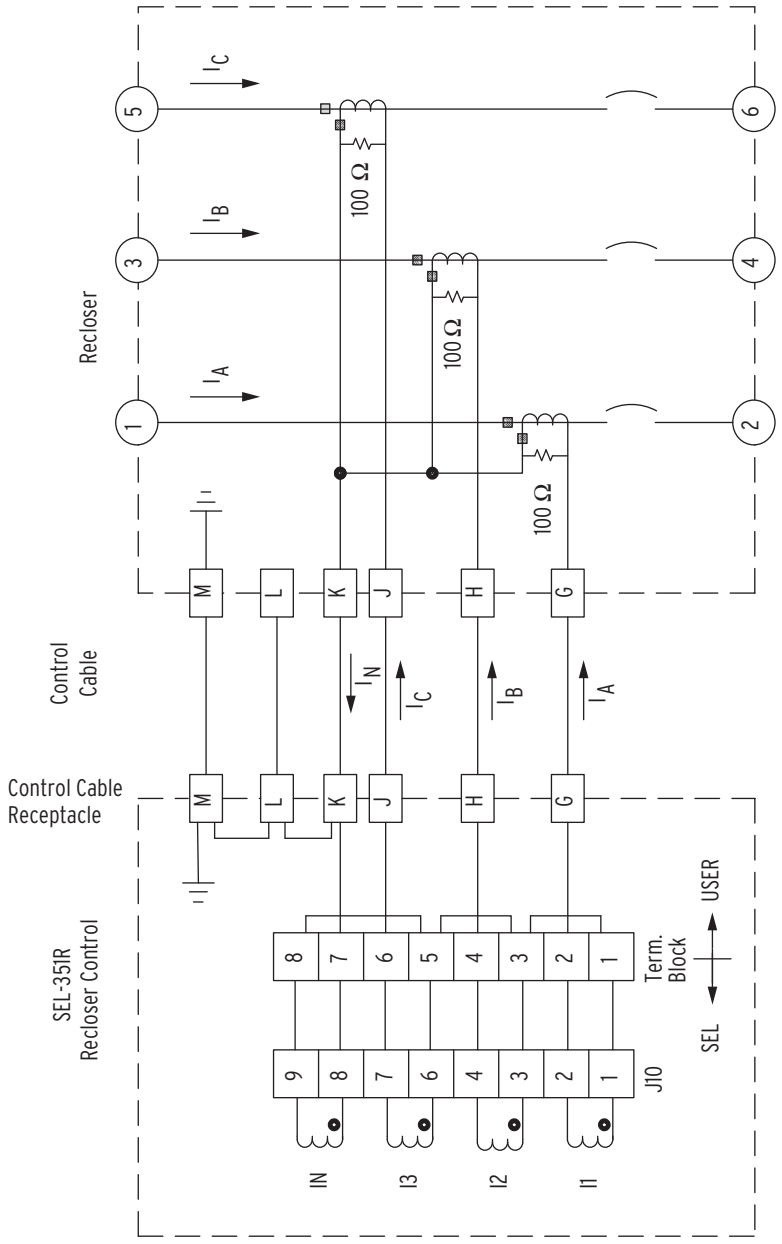


Figure 1.14 Current Polarity From Recloser Primary to SEL-351R Recloser Control Current Inputs

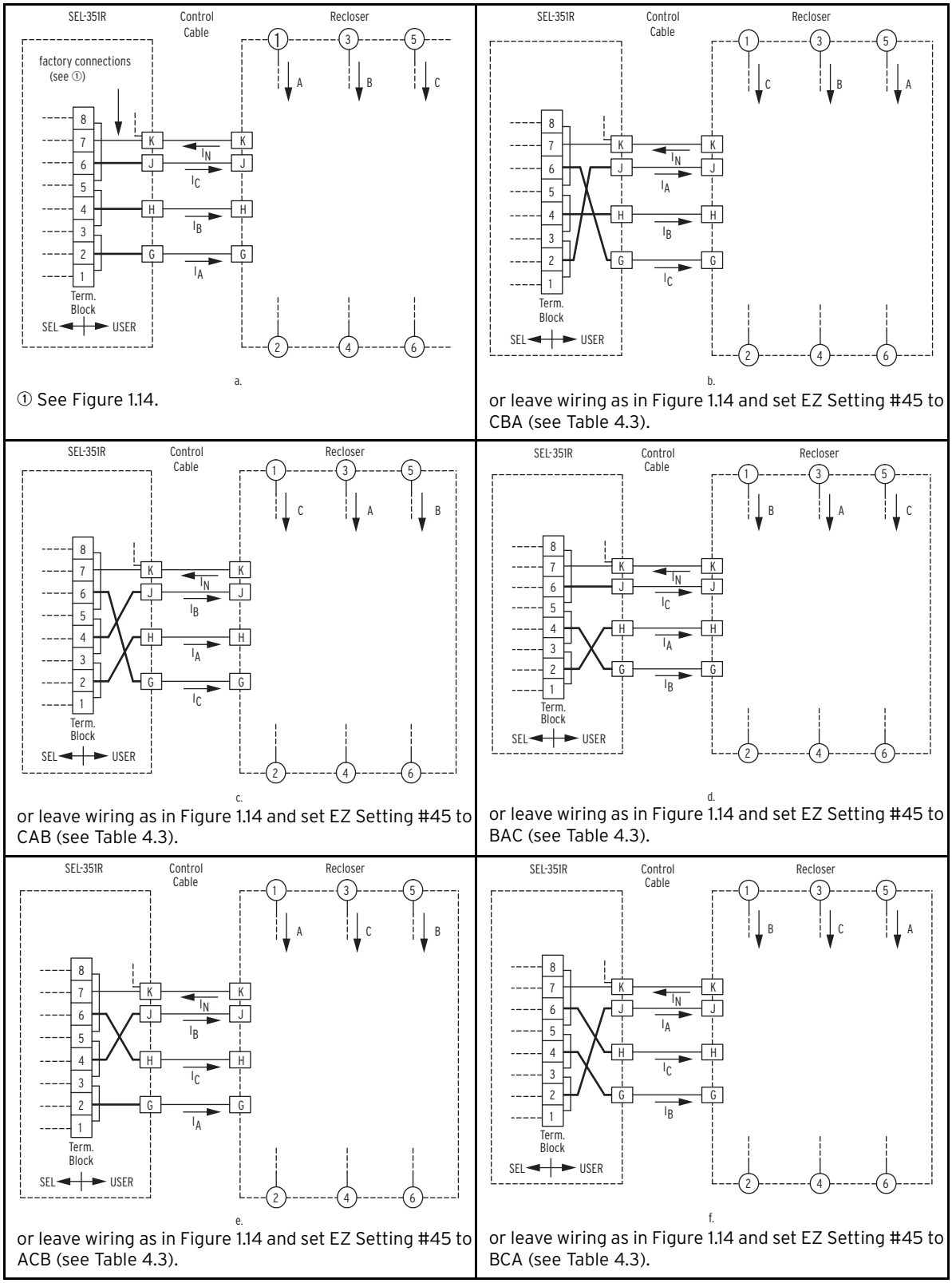


Figure 1.15 User Terminal Block Wiring or Setting Changes Accommodate All Possible Primary Connections to the Recloser (to keep consistent with SEL-351R Recloser Control current channel designations)

Detail 5: Control Cable Receptacle and Replacement Fuses

For additional information on wiring connections, refer to *Figure 1.13*.

Table 1.2 Control Cable Receptacle Pin Descriptions

A	24 Vdc	**H**	Terminal I2 Current
B	Monitored Trip Circuit Point	**J**	Terminal I3 Current
C	Trip	**K**	Residual Current Return
D	Monitored Trip Circuit Point	**L**	(not used in control)
E	Close	**M**	Recloser Ground
F	Monitored Close Circuit Point	**N**	(not connected)
G	Terminal I1 Current	**P**	(not connected)

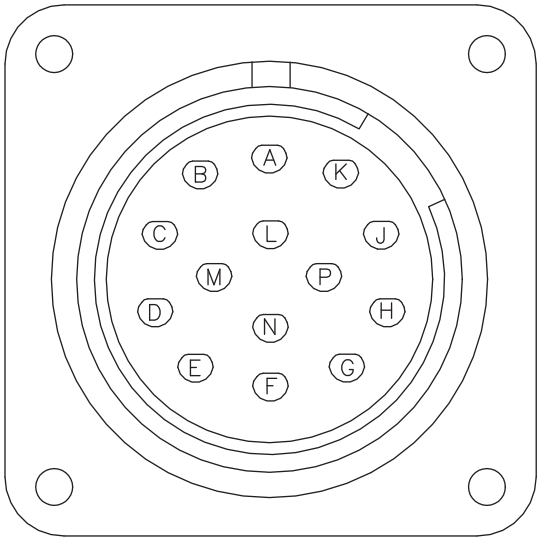


Figure 1.16 Control Cable Receptacle (viewed from inside SEL-351R enclosure)

Table 1.3 Replacement Fuses for the SEL-351R Recloser Control (see Figure 1.13) (Sheet 1 of 2)

Fuse Location	Ampere Rating	Dimensions	Manufacturer	Catalog Numbers	Purpose
Terminal block position **26** (see *Figure 1.9*)[a]	0.125 A	0.197 x 0.787" (5 x 20 mm)	Bussman	GMD-0.125	Protect accessible 24 Vdc (0.1 Amp load limit).
Swing panel-mounted fuse holder (in series with terminal **3** of connector **J11**)	15 A	0.25 x 1.25" (6.4 x 31.8 mm)	Littelfuse Bussman	314015 BK/ABC-15	Protect 120 Vac (GFCI) convenience outlet for overload or line-to-line short circuits (10 Amp load limit).

Table 1.3 Replacement Fuses for the SEL-351R Recloser Control (see Figure 1.13) (Sheet 2 of 2)

Fuse Location	Ampere Rating	Dimensions	Manufacturer	Catalog Numbers	Purpose
Terminal block position **28** (see *Figure 1.7*[a,b]	1 A	0.197 x 0.787" (5 x 20 mm)	Littelfuse Slo-Blo Type Bussman	218001 BK/GDC-1A	Protect SEL-351R relay module from overvoltage or internal short.
Battery wiring harness (see *Figure 1.6*)[b]	3 A	0.25 x 1.25" (6.4 x 31.8 mm)	Bussman Littelfuse 3AG Fast-Acting Type	AGC-3 312003	Protect battery and charger circuitry from inadvertent short.

[a] Spare fuse included in respective terminal block.
[b] The last two fuse entries in Table 1.3 are not found in earlier SEL-351R units. See explanation in Important Notes for Detail 3.

Detail 6: Trip and Close Circuits

CONTROL CABLE RECEPTACLE

Figure 1.17 shows only part of the control cable receptacle connections (pins A through F). Figure 1.13 and Figure 1.16 detail the rest of the control cable receptacle connections.

TRIP CIRCUIT DIFFERS FOR MOTOR-OPERATED RECLOSERS (E.G., MVE, CVE, CXE, CZE, VSA)

The differing trip circuit for Cooper three-phase motor-operated reclosers (as compared to Figure 1.17) requires a few settings to be modified. Refer to SEL Application Guide AG99-10, Change Logic in SEL-351R Recloser Control for Motor-Operated Reclosers.

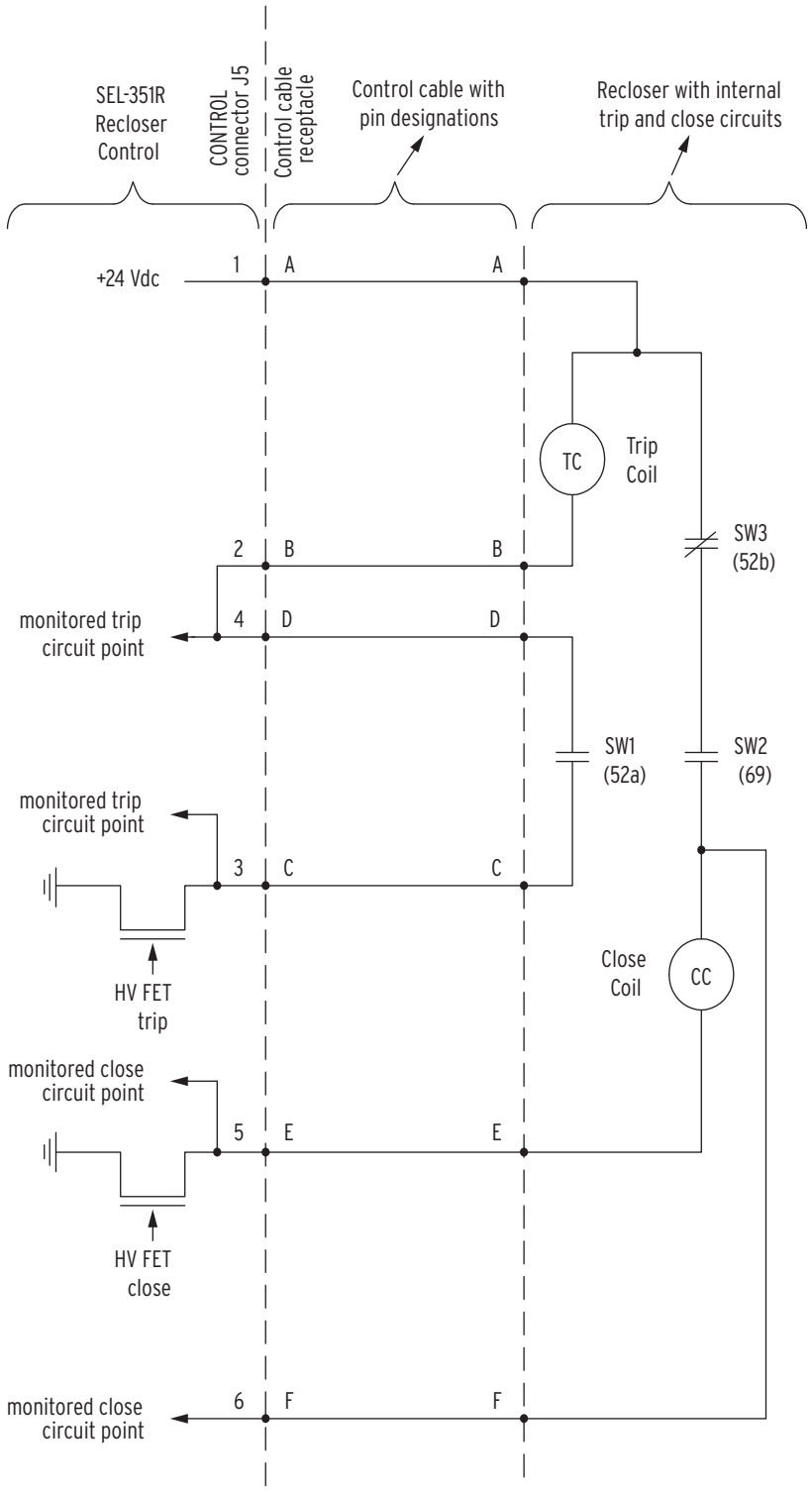


Figure 1.17 Trip and Close Circuit Connections

Important Notes for Detail 6

1. Separate high-voltage FETs (Field-Effect Transistors) trip and close the recloser. When an FET is “off,” it is an open circuit. When an FET is “on,” it is a short circuit, making up the trip or close circuit and energizing the corresponding trip or close coil. Normally, contacts SW1 (52a) and SW3 (52b) break the trip and close circuit currents, respectively. However, if required, the high-voltage FETs can break these currents.
2. Close operations are started with the 24 Vdc close circuit detailed above, but the power to close the main contacts and compress the tripping springs in the recloser is usually 120 Vac or primary voltage (see *Figure 1.7*).
3. Contact SW2 (69) opens and stays open when the external manual operating lever on the recloser is pulled to the lock-open position. With contact SW2 open, there is no way to close the recloser until the manual operating lever is reset again–contact SW2 is then closed.

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Section 2
Communications

Overview

Topics covered in this section:

- Serial Port Connectors
- Communications Cables
- Commands
- Access Levels
- Password Protection

You can view and change control settings, and obtain event and status information either from the front-panel interface or via one of the serial ports.

You can access many of the features of the SEL-351R Recloser Control from the front panel; however, some features can only be accessed from one of the serial ports. *Table 2.5* provides the serial port commands (with descriptions) as well as the corresponding front-panel pushbutton, if applicable.

Getting Started With Communications

HINT
For the best display, use VT-100 terminal emulation or the closest variation.

TERMINAL EMULATION PROGRAMS
Examples of PC-based terminal emulation programs include: Procomm Plus®, Relay Gold®, Microsoft® Windows® Terminal and HyperTerminal, SmartCOM®, and CROSSTALK®.

DEFAULT SETTINGS FOR SERIAL PORTS
Baud Rate = 2400
Data Bits = 8
Parity = N
Stop Bits = 1

Before you attempt communications with the SEL-351R, via either the serial ports or the front-panel interface, the following precautions must be taken:

- Verify that the SEL-351R has been properly installed and that the settings have been programmed by qualified personnel.
- Become familiar with and understand the information presented in this section, *Section 3: Front-Panel Interface*, and *Section 4: Settings*.

For serial port communications, the previous two precautions apply. You must also carry out the following:

Step 1. Select the appropriate communications cable (usually SEL Cable C234A—see *Table 2.4*).

Step 2. Choose a terminal emulation program on your personal computer (PC) to communicate with the SEL-351R.

Step 3. Set the communications parameters for the connected PC communications port to the default settings.

Step 4. Press the **<Enter>** key, and the SEL-351R will respond with a = prompt, which indicates Level 0 access is established–see *Table 2.7*.)

Communications Connections Example

You can connect the serial port to a computer serial port for local communications or to a modem for remote communications. Other devices useful for automated communications include the SEL-2032, SEL-2030, and SEL-2020 Communications Processors.

You can use a variety of terminal emulation programs on your personal computer to communicate with the SEL-351R. *Figure 2.1* presents some example SEL-351R communications connections (see *Table 2.4* and contact SEL for more information).

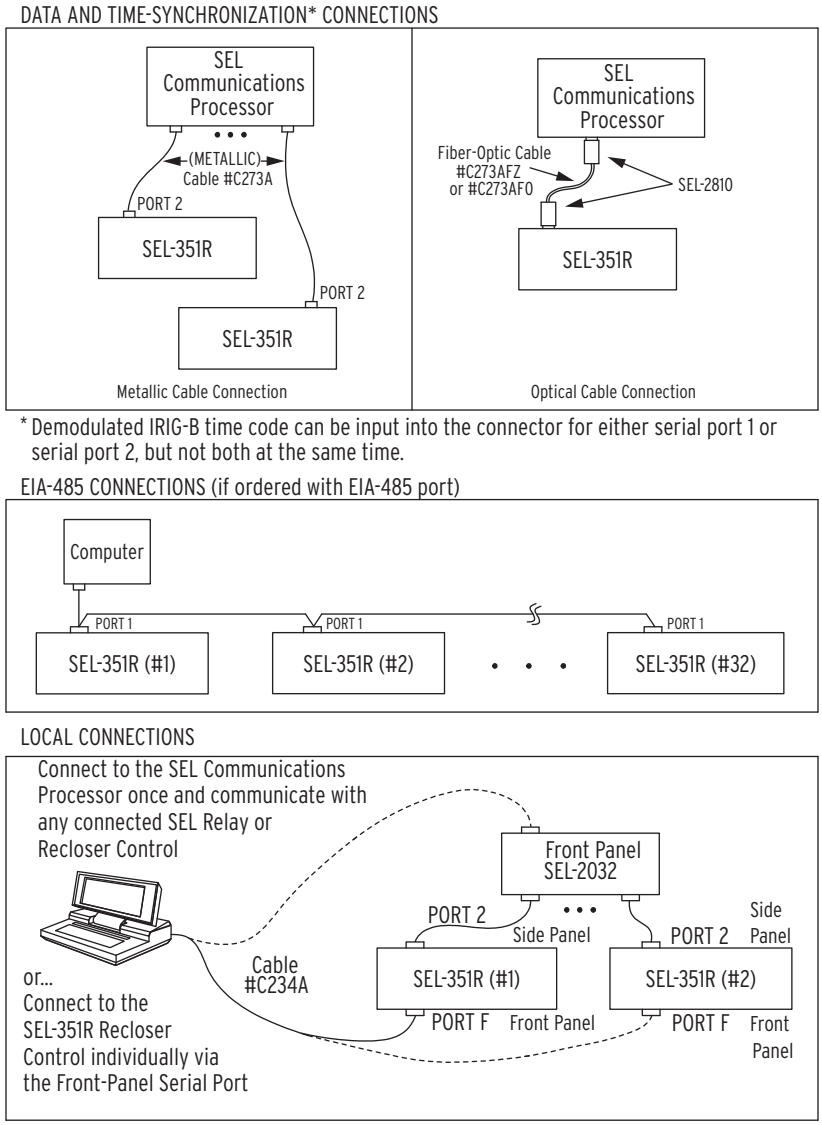

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Figure 2.1 SEL-351R Recloser Control Communications Connections Example

Serial Ports

WAKE-UP PORT
Figure 1.12 shows a Wake-Up Port. Its pin functions are defined in EIA-232 Pinout Functions for Ports 2, 3, and F and EIA-485 Pinout Functions for Port 1. See the front of Section 10 in the SEL-351R Recloser Control Instruction Manual for more information on the Wake-Up Port.

Three EIA 232 serial communications ports are available:

- Serial Port 2 (side panel)
- Serial Port 3 (side panel)
- Serial Port F (front panel)

An EIA-485 serial communications port is available as an ordering option:

- Serial Port 1 (side panel)

Serial Port Default Settings

The default settings for all serial ports are:

- Baud Rate = 2400
- Data Bits = 8
- Parity = N
- Stop Bits = 1

The serial port default settings can be changed from the front-panel interface or from the serial communications port itself. After connecting the appropriate communications cable and setting the terminal emulator, press the **<Enter>** key, and the control will respond with a = prompt, which indicates Level 0 access is established–see *Table 2.7*.

EIA-232 Pinout Functions for Ports 2, 3, and F

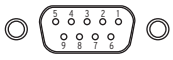


Figure 2.2 DB-9 Connector Pinout (Female) for EIA-232 Serial Ports

MAKE ONLY ONE IRIG-B CONNECTION
If making an IRIG-B connection, connect demodulated IRIG-B time code to either the serial Port 2 or serial Port 1 connector (see EIA-485 Pinout Functions for Port 1), but not both.

Table 2.1 EIA-232 Pinout Functions

Pin	Port 2	Port 3	Port F
1	N/C[a] or +5 Vdc	N/C[a] or +5 Vdc	N/C
2	RXD	RXD	RXD
3	TXD	TXD	TXD
4	+IRIG-B	N/C	N/C
5, 9	GND	GND	GND
6	-IRIG-B	N/C	N/C
7	RTS	RTS	RTS
8	CTS	CTS	CTS

[a] Pin 1 not connected for Ports 2 and 3 when shipped from the factory.

EIA-485 Pinout Functions for Port 1

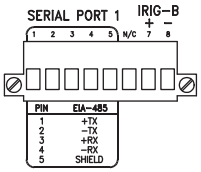


Figure 2.3 EIA-485 Pinout for Port 1

Table 2.2 EIA-485 Pinout Functions

Pin	Function	Pin	Function
1	+TX	5	SHIELD
2	–TX	6	N/C
3	+RX	7	+IRIG-B
4	–RX	8	–IRIG-B

CONVENIENT IRIG-B CONNECTION
Serial Port 2 provides the most convenient connection for demodulated IRIG-B time code. See the top of Figure 2.1 and SEL Cable C273A in Table 2.4, and the corresponding cable diagram.

Table 2.3 Serial Communications Port Pin Function Definitions

Pin Function	Definition
N/C	No Connection
+5 Vdc (0.5 Amp limit)	5 Vdc Power Connection
RXD, RX	Receive Data
TXD, TX	Transmit Data
IRIG-B	IRIG-B Time-Code Input
GND	Ground
SHIELD	Shielded Ground
RTS	Request To Send
CTS	Clear To Send
DCD	Data Carrier Detect
DTR	Data Terminal Ready
DSR	Data Set Ready

Communications Cables

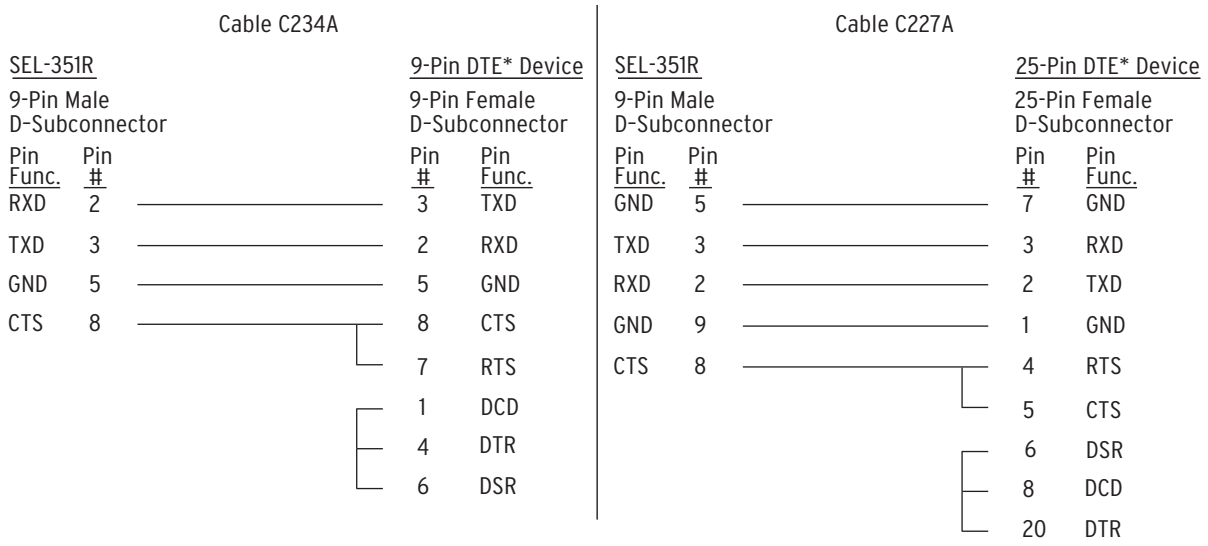
Table 2.4 SEL EIA-232 Serial Communications Cable Guide

Connect From	Connect To	SEL Cable
SEL-351R	Computer (9-pin)	C234A
SEL-351R	Computer (25-pin)	C227A
SEL-351R	SEL-2032, SEL-2030, or SEL-2020 Communications Processor	C273A
SEL-351R	Modem	C222

OTHER CABLES AVAILABLE
Table 2.4 lists the most commonly used cables (see corresponding cable diagrams on the following page). Contact SEL for information on other available cables.

Cable Diagrams

The following cable diagrams correspond to the cables listed in *Table 2.4* (most commonly used cables). The male/female references in the cable diagrams refer to the cable connectors, not the device they are connecting to (which would be the opposite gender). Contact SEL for information on other available cables.



*DTE = Data Terminal Equipment (Computer, Terminal, Printer, etc.)

Figure 2.4 SEL-351R to Computer

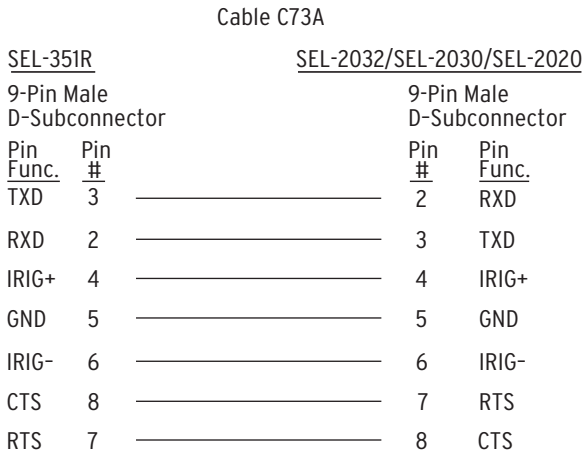


Figure 2.5 SEL-351R to SEL-2032/SEL-2030/SEL-2020 Communications Processor

Cable C222

SEL-351R 9-Pin Male D-Subconnector			*DCE Device 25-Pin Male D-Subconnector	
Pin Func.	Pin #		Pin #	Pin Func.
GND	5	———	7	GND
TXD	3	———	2	TXD (IN)
RTS	7	———	20	DTR (IN)
RXD	2	———	3	RXD (OUT)
CTS	8	———	8	CD (OUT)
GND	9	———	1	GND

*DCE = Data Communications Equipment (Modem, etc.)

Figure 2.6 SEL-351R to Modem

Commands

Commands, passwords, or settings you type appear in bold/uppercase: **DAKOTA**. Computer keys you press appear in bold/brackets: **<Enter>**.

The following serial port commands are available for use with the SEL-351R. Much of the information available from the serial port commands is also available via the front-panel pushbuttons (see *Pushbutton Primary Functions on page 3.4*).

The commands are shown in uppercase letters, but they can also be entered using lowercase letters.

Table 2.5 SEL-351R Recloser Control Command Summary (Sheet 1 of 3)

Access Level and Available Commands	Description	Corresponding Front-Panel Pushbutton
Access Level 0	The only operation that can be performed at Access Level 0 is to go to Access Levels 1 or E. The screen prompt is: = (see *Table 2.7*).	
ACC	Enter Access Level 1.	
EZA	Enter Access Level E.	
Access Level 1	The Access Level 1 commands primarily allow the user to look at information (e.g., settings, metering), not change it. The screen prompt is: => (see *Table 2.7*).	
2AC	Enter Access Level 2.	
BAC	Enter Breaker Access Level (Access Level B).	
BRE	Display breaker/recloser contact wear report.	OTHER
BRE A	Display breaker/recloser contact wear and trip operation report.	OTHER
COM	MIRRORED BITS® communications statistics.	
COU	Display SELOGIC® counter values (SEL-351R-2 only).	
DAT	Show date.	OTHER
DAT m/d/y	Enter date in this manner if Date Format setting DATE_F = MDY.	OTHER
DAT y/m/d	Enter date in this manner if Date Format setting DATE_F = YMD.	OTHER
EVE *n*	Show event report number *n* with 1/4 cycle resolution.	
EVE L *n*	Show event report number *n* with 1/16 cycle resolution.	
EVE R *n*	Show raw event report number *n* with 1/16 cycle resolution.	

Table 2.5 SEL-351R Recloser Control Command Summary (Sheet 2 of 3)

Access Level and Available Commands	Description	Corresponding Front-Panel Pushbutton
EVE C *n*	Show compressed event report number *n* for use with ACSELERATOR® Analytic Assistant SEL-5601 Software.	
EZA	Enter EZ Access Level (Access Level E).	
GRO	Display active group number.	GROUP
HIS *n*	Show brief summary of the *n* latest event reports.	EVENTS
HIS C	Clear the brief summary and corresponding event reports.	
IRI	Force synchronization attempt of internal relay clock to IRIG-B time-code input.	
MET *k*	Display instantaneous metering data. Enter *k* for repeat count.	METER
MET D	Display demand and peak demand data.	METER
MET E	Display energy metering data.	METER
MET M	Display maximum/minimum metering data.	METER
MET RD	Reset demand metering data.	METER
MET RE	Reset energy metering data.	METER
MET RM	Reset maximum/minimum metering data.	METER
MET RP	Reset peak demand metering data.	METER
QUI	Quit. Returns to Access Level 0. Terminates SEL Distributed Port Switch Protocol® (LMD) connection.	
SER *n*	Show the latest *n* rows in the Sequential Events Recorder (SER) event report.	
SER ***m n***	Show rows *m* through *n* in the Sequential Events Recorder (SER) event report.	
SER *d1*	Show rows in the Sequential Events Recorder (SER) event report from date *d1*.	
SER *d1 d2*	Show rows in the Sequential Events Recorder (SER) event report from date *d1* to *d2*. Entry of dates is dependent on the Date Format setting DATE_F (= MDY or YMD).	
SER C	Clear SER records from nonvolatile memory.	
SER D	List active chattering elements from the SER records and present auto-removal settings.	
SHO *n*	Show relay settings (overcurrent, reclosing, timers, etc.) for Group *n*.	SET
SHO L *n*	Show SELOGIC control equation settings for Group *n*.	
SHO EZ *n*	Show EZ settings for Group *n*.	SET
SHO FZ	Show FZ settings (global EZ settings).	SET
SHO G	Show global settings.	SET
SHO P *n*	Show Port *n* settings.	SET
SHO R	Show Sequential Events Recorder (SER) settings.	
SHO T	Show text label settings.	
STA	Show relay self-test status. **STA C** resets self-test warnings/failures.	STATUS
TAR R	Reset the front-panel tripping targets.	TARGET RESET
TAR *n k*	Display Relay Word row. If *n* = 0 through 60, display row *n*. If *n* is an element name (e.g., 50A1), display the row containing element *n*. Enter *k* for repeat count.	OTHER
TIM	Show or set time (24-hour time). Show time presently in the relay by entering just **TIM** (e.g., time 22:47:36 is entered with the following command: **TIM 22:47:36**).	OTHER
TRI	Trigger an event report.	

Table 2.5 SEL-351R Recloser Control Command Summary (Sheet 3 of 3)

Access Level and Available Commands	Description	Corresponding Front-Panel Pushbutton
Access Level E	The Access Level E commands allow the user to access and change the EZ settings as well as Level 1 commands. The screen prompt is: =+> (see *Table 2.7*).	
BTT	Display status of latest battery discharge test and the time remaining until next battery discharge test.	
BTT NOW	Force new battery discharge test immediately.	OTHER
SET EZ	Change recloser control EZ settings.	SET
SET FZ	Change recloser control global EZ settings.	SET
Access Level B	The Access Level B commands primarily allow the user to operate relay parameters and output contacts. All Access Level 1 and E commands can also be executed from Access Level B. The screen prompt is: ==> (see *Table 2.7*).	
BRE W	Preload breaker/recloser contact wear.	OTHER
BRE W A	Preload breaker/recloser contact wear and trip operation counters.	OTHER
BRE R	Reset breaker/recloser contact wear and trip operation counters.	OTHER
CLO	Close the circuit breaker.	
GRO *n*	Change active group to Group *n*.	GROUP
OPE	Open the circuit breaker.	
PUL *n k*	Pulse output contact *n* (OUT101 through OUT107, ALARM) for *k* (1–30) seconds. Parameter *n* must be specified; *k* defaults to 1 if not specified.	CNTRL
Access Level 2	The Access Level 2 commands allow unlimited access to relay settings, parameters, and output contacts. All Access Level 1, E, and B commands are available from Access Level 2. The screen prompt is: =>> (see *Table 2.7*).	
CAL	Enter Access Level C.	
CON *n*	Control Relay Word bit RB*n*, Remote Bit *n* where *n* = 1 through 8 (1 through 16 on the SEL-351R-2). Execute CON *n*, and the relay responds: CONTROL RBn. Then reply with one of the following: **SRB *n*** set Remote Bit *n* (assert RB*n*). **CRB *n*** clear Remote Bit *n* (deassert RB*n*). **PRB *n*** pulse Remote Bit *n* (assert RB*n* for 1/4 cycle).	
COP *m n*	Copy relay and logic settings from Group *m* to Group *n*.	
PAS 1	Change Access Level 1 password.	SET
PAS E	Change Access Level E password.	SET
PAS B	Change Access Level B password.	SET
PAS 2	Change Access Level 2 password.	SET
PAS C	Change Access Level C password.	
SET *n*	Change relay settings (overcurrent, reclosing, timers, etc.) for Group *n*.	SET
SET L *n*	Change SELOGIC control equation settings for Group *n*.	
SET EZ *n*	Change EZ settings for Group *n*.	SET
SET FZ	Change FZ settings (global EZ settings).	SET
SET G	Change global settings.	SET
SET P *n*	Change Port *n* settings.	SET
SET R	Change Sequential Events Recorder (SER) settings.	
SET T	Change text label settings.	
VER	Show version information.	

Event Reports

NOTE: The event report length is selectable: 15 or 30 cycles. More options are available to customize event reports.

Refer to the SEL-351R Recloser Control Instruction Manual for more event information.

Event reports are automatically triggered at the beginning of a fault and when the SEL-351R issues a trip. Event report length is 15 cycles (factory default). The latest twenty-eight 15-cycle event reports are stored in nonvolatile memory.

To obtain event report information, use the **EVE** command. There are numerous options that allow you to customize event information. For descriptions and examples of all options, refer to the *SEL-351R Recloser Control Instruction Manual*. The general command format is:

EVE [*n* **A D]**

The parameters in brackets [ ] are optional. *Table 2.6* defines the parameters [*n* A D] that can be issued with the **EVE** command to customize the report format.

Table 2.6 Event Report Parameters

Parameter	Description
n	Choose event number (1–28). Defaults to 1 if not specified.
A	Specifies that the analog section of the event is to be displayed (current, voltage, frequency, contact outputs, and optoisolated inputs).
D	Specifies that the digital section (Protection and Control Elements) of the event is to be displayed.

Summary event information can be viewed at the control front-panel LCD using the front-panel pushbuttons. Press the **EVENTS** pushbutton (primary function) and the appropriate left/right and up/down pushbuttons (secondary function) to view event information.

If no parameters are issued with the **EVE** command, then you will automatically receive both the analog (A) and digital (D) sections of the event report.

Access Levels and Password Protection

PASSWORDS REQUIRED WITH FRONT-PANEL PUSHBUTTONS?
See Pushbutton Primary Functions on page 3.4.

⚠WARNING
This device is shipped with default passwords. Default passwords should be changed to private passwords at installation. Failure to change each default password to a private password may allow unauthorized access. SEL shall not be responsible for any damage resulting from unauthorized access.

Issue serial port commands to the SEL-351R to view metering values, change recloser control settings, obtain event information, etc. The available serial port commands are listed in *Table 2.5*. The commands can be accessed only from the corresponding access level as shown in the table, but a higher access level can access the serial port commands in a lower access level.

Access Level 0 (the lowest access level)

Access Level 1

Access Level E (EZ access level)

Access Level B

Access Level 2 (the highest access level)

Access Level C (restricted access level; should be used under direction of SEL only)

As a security measure, entry to a particular access level (except Access Level 0) requires a unique password. This allows the user to set up a password system to deny unqualified or unauthorized personnel access to higher levels.

The SEL-351R ships from the factory with default passwords (see *Table 2.7*). If restrictions are to be placed on personnel using the SEL-351R, the factory default passwords must be changed. Make sure that password information is stored for future reference in the event that it is lost or forgotten.

Table 2.7 Access Level, Summary Information

Access Level	Access Command	Prompt	Factory Default Password	Description of Access Level Command Privileges
0		=		Signifies serial communications are established. The only operation available here is go to Access Level 1 or Access Level E.
1	**ACC**	=>	**OTTER**	Primarily allows you to only look at information (i.e., metering, settings), not change it.
E	**EZA**	=+>	**DAKOTA**	Primarily allows the user to change the EZ group settings and global EZ settings.
B	**BAC**	==>	**EDITH**	Primarily allows the user to operate output contacts or change the active setting group.
2	**2AC**	=>>	**TAIL**	Unlimited access to relay settings, parameters, and output contacts.
C	**CAL**	=>>	**CLARKE**	Restricted access level; should be used under direction of SEL only.

Change Passwords

LOST OR FORGOTTEN PASSWORD?
When passwords are lost or forgotten, you can set new passwords by putting the main board password jumper in place. See Password Jumper.

WANT TO OPERATE WITHOUT PASSWORDS?
See Disable Passwords.

The **PAS** command allows you to change existing passwords at Access Level 2. To change passwords, enter **PAS *x***, where *x* is the access level password being changed. The relay will prompt for the old password, new password, and a confirmation of the new password as follows:

```
=>>PAS 1 <Enter>

Old Password: *****

New Password: ***********
Confirm New Password: ***********

Password Changed
=>>
```

Passwords may include as many as 12 characters. Valid characters are listed in *Table 2.8*.

Record the new password in a safe place for future reference. Passwords cannot be viewed from the recloser control.

Table 2.8 Valid Password Characters

Alpha	A B C D E F G H I J K L M N O P Q R S T U V W X Y Z a b c d e f g h i j k l m n o p q r s t u v w x y z
Numeric	0 1 2 3 4 5 6 7 8 9
Special	! " # $ % & ' ( ) * + , - . / : ; < = > ? @ [\ ] ^ _ ` | ~

Upper- and lowercase letters are treated as different characters. Strong passwords consist of the maximum allowable characters, with at least one special character, number, lowercase letter, and uppercase letter. Strong passwords do not include a name, date, acronym, or word. The recloser control may issue a weak password warning if the new password can be strengthened. Examples of valid, distinct passwords include:

SDFdfa098&^# &*LKJoi09873 m,nYIO689&(*

Disable Passwords

If you wish to disable password protection for a specific access level (must be in Access Level 2), simply set the password to **DISABLE** (must be uppercase).

Password Jumper describes how password protection for **all** access levels can be disabled by a hardware password jumper.

Password Jumper

This subsection provides instructions for putting the password jumper in place if you wish to operate the SEL-351R without password protection or in the event that the passwords are lost or forgotten.

When the password jumper (**JMP6-A**) is ON (in place), password protection is disabled. *Figure 2.7* shows the general location of the password jumper.

While password protection is disabled, you can use the **PAS *x*** command at Access Level 2 to assign a new password to replace lost or forgotten passwords. The recloser control will not prompt for the old password, but it will prompt for a new password and a confirmation of the new password.

When the password jumper is OFF (removed/not in place), password protection is enabled. This is how the SEL-351R ships from the factory. With the password jumper OFF, the only way to disable password protection is with the **PAS** command (see *Disable Passwords*).

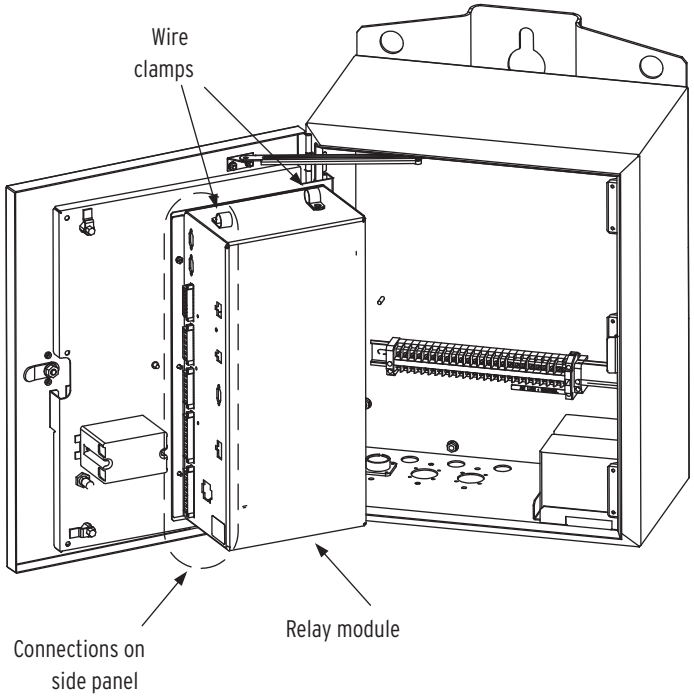
To change the password jumper position, carry out the following steps:

Step 1. De-energize the SEL-351R.

Step 2. Open the front panel of the enclosure.

Step 3. Unscrew wing nuts in the upper-right and the lower-right corners of the swing panel.

Step 4. Open the swing panel.



CAUTION
The relay contains devices sensitive to Electrostatic Discharge (ESD). When working on the relay with the front panel removed, work surfaces and personnel must be properly grounded or equipment damage may result.

NOTE FOR STEP 6: Hinges fit tightly—it may take some shimmying to lift the swing panel from the hinges.

Step 5. Disconnect all connections from the side panel of the SEL-351R relay module and remove the wire clamps. See above figure.

Step 6. Remove swing panel by lifting up.

Step 7. Take swing panel with the SEL-351R relay module to an ESD (Electrostatic Discharge) protected work area.

Step 8. Remove six hex nuts and shoulder washers on right and left sides of the SEL-351R relay module.

Step 9. Remove the SEL-351R relay module from the swing panel.

Step 10. Remove eight Phillips-head screws from the front and left side panel of the SEL-351R relay module.

Step 11. Disconnect the ribbon cables from the front panel.

Step 12. Remove the front panel of the SEL-351R relay module.

Step 13. Locate the jumper(s) to be changed (refer to *Figure 2.7*).

Change the jumper position.

Step 14. Reconnect ribbon cables to the front panel.

Step 15. Replace eight Phillips-head screws in the front and left side panel of SEL-351R relay module.

Step 16. Place the SEL-351R relay module in the swing panel.

Step 17. Replace six shoulder washers and hex nuts to the right and left sides of the SEL-351R relay module.

Step 18. Replace the swing panel to the hinges.

Step 19. Reconnect all connections on the right-side panel of the SEL-351R relay module and attach the wire clamps.

Step 20. Close the swing panel.

Step 21. Reinstall wing nuts in the upper-right and lower-right corners of the swing panel.

Step 22. Re-energize the SEL-351R.

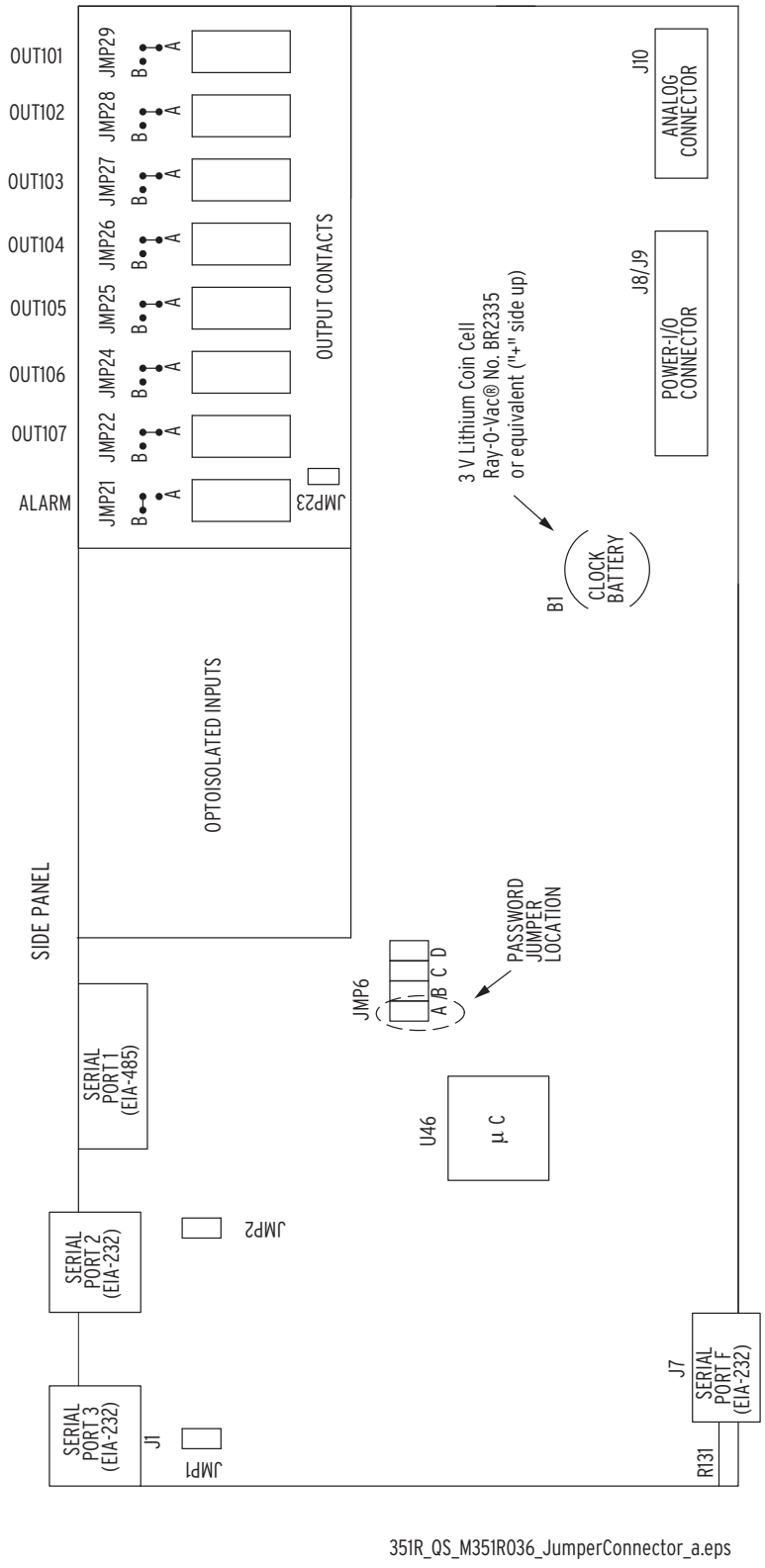


Figure 2.7 Jumper, Connector, and Major Component Locations on the SEL-351R Main Board

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Section 3
Front-Panel Interface

Overview

Topics covered in this section:

- Status and Trip Target LEDs
- Pushbuttons
- Operator Controls

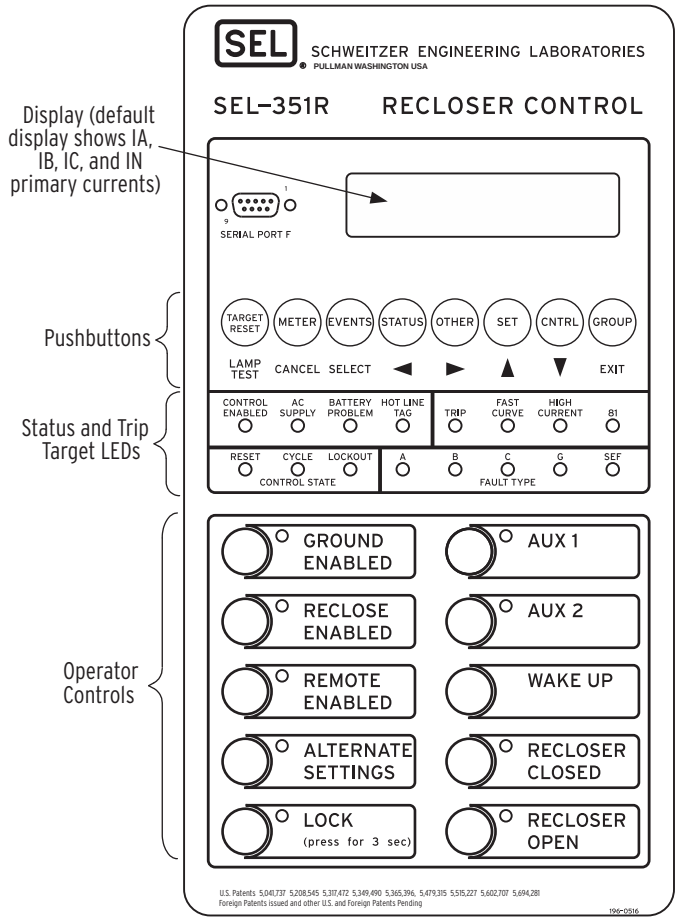


Figure 3.1 SEL-351R Front-Panel Interface

USER-CONFIGURABLE LABELS

The SEL-351R is available with user-configurable labels. Figure 3.2 shows the SEL-351R with default labels. The dashed lines in Figure 3.2 indicate the areas for user-configurable labels.

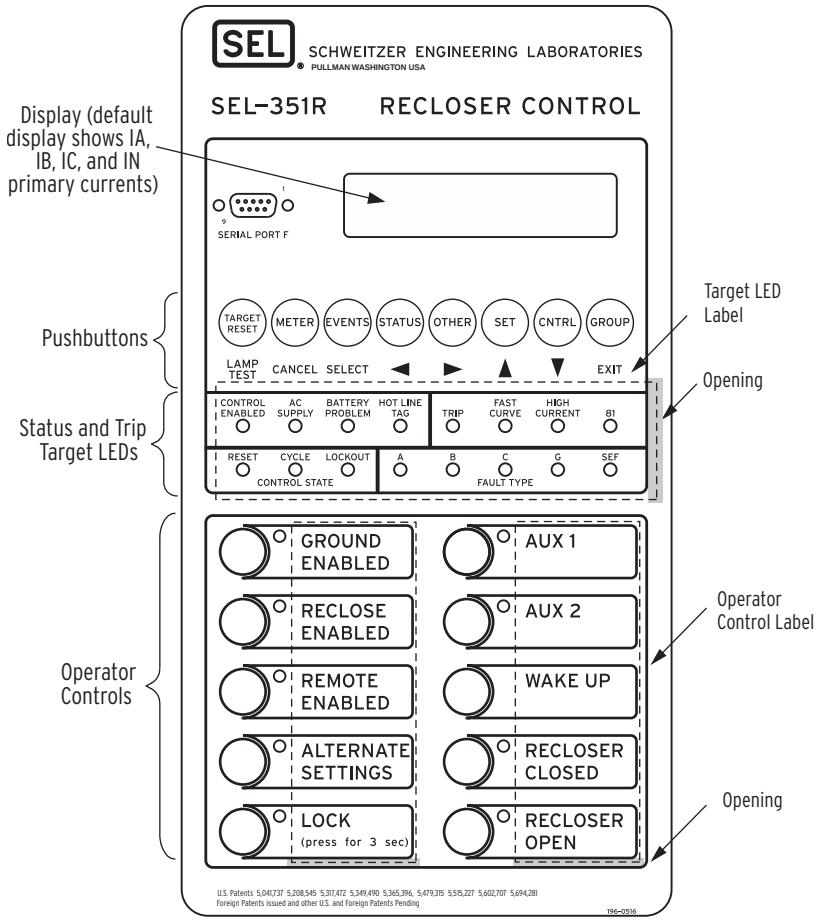


Figure 3.2 SEL-351R Front-Panel Interface Configurable Labels

Status and Trip Target LEDs

Most of the Status and Trip Target LEDs and Operator Controls can change function (if desired by the user) by programming at a higher logic level (see the *SEL-351R Recloser Control Instruction Manual*). This subsection discusses each function as shipped from the factory and inscribed on the front panel.

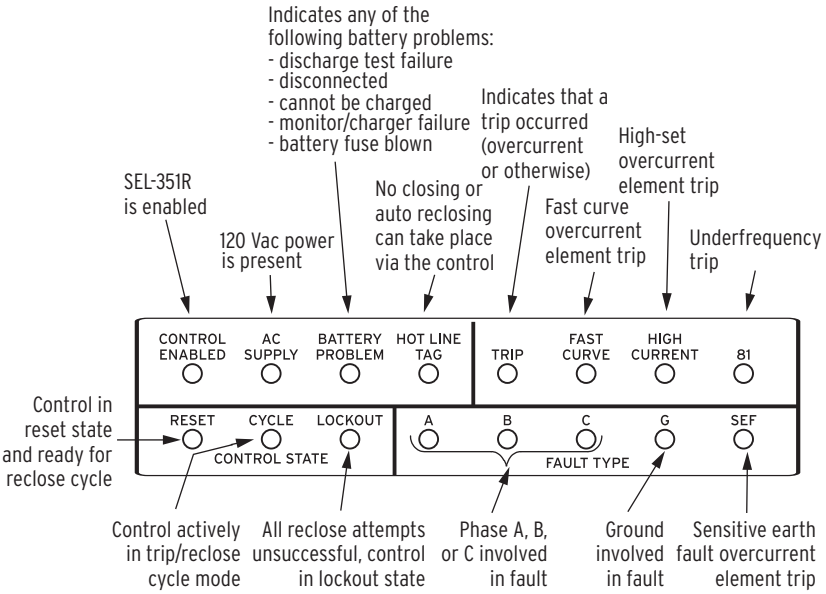


Figure 3.3 Status and Trip Target LEDs

Pushbuttons

The front-panel pushbuttons shown in *Figure 3.4* allow access to settings, metering values, event information, and other functions and information.

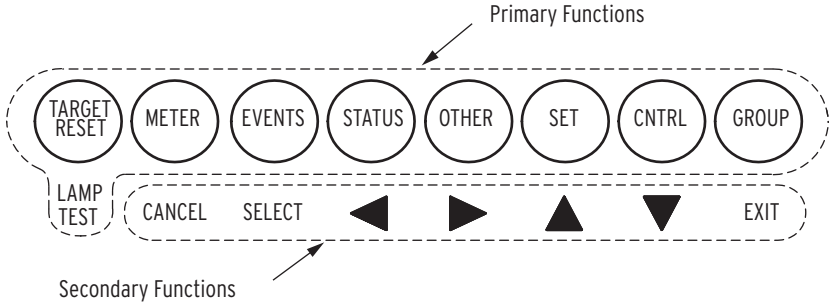


Figure 3.4 Primary and Secondary Functions of Front-Panel Pushbuttons

The front-panel pushbuttons (except **TARGET RESET/LAMP TEST**) have dual functions (primary and secondary functions). The primary function is the text printed on the pushbutton. After a primary function is selected (e.g., the **STATUS** pushbutton is pressed), the secondary function pushbuttons (e.g., **CANCEL**, **SELECT**, left/right arrows, up/down arrows, **EXIT**) are then enabled. The secondary functions allow the user to scroll through information, activate settings/control, etc., on the LCD. *Table 3.1* lists the primary and secondary functions for the pushbuttons shown in *Figure 3.4*.

Table 3.1 Front-Panel Pushbutton Secondary Functions

Primary Function	Secondary Function
TARGET RESET	**HELP** Provides help only with front-panel **SET** commands.
METER	**CANCEL** Cancel command edit or escape to upper command level.
EVENTS	**SELECT** Select displayed option or setting.
STATUS	←Scroll left on display.
OTHER	→Scroll right on display.
SET	↑ Scroll up on display or increment value.
CNTRL	↓Scroll down on display or decrement value.
GROUP	**EXIT** Exit entirely from command and return to default display.

Many of the pushbutton primary functions correspond to serial port commands. Some of the pushbutton primary functions require a password to execute. Refer to *Section 2: Communications* for serial port command, access level, and password information.

Pushbutton Primary Functions

Primary Function	Corresponding Serial Port Command	Access Level	Password for Front-Panel Access	Description
TARGET RESET LAMP TEST	**TAR R**	1	None	Illuminate all front-panel LEDs for 1 second and clear trip-latched targets **TRIP**, **FAST CURVE**, **HIGH CURRENT**, **81**, **A**, **B**, **C**, **G**, and **SEF**.

METER Primary Function	Corresponding Serial Port Command	Access Level	Password for Front-Panel Access	Description
INST	**MET**	1	None	Display instantaneous magnitudes (and angles if applicable) of meter values.
ENERGY				
DISPLAY	**MET E**	1	None	Display energy meter values.
RESET	**MET RE**	1	None	Reset energy meter values.
MAX/MIN				
DISPLAY	**MET M**	1	None	Display maximum/minimum metering values.
RESET	**MET RM**	1	None	Reset maximum/minimum metering values.
DEMAND				
DISPLAY	**MET D**	1	None	Display demand and peak demand meter values.
RESET	**MET RD**	1	None	Reset demand meter values.
	MET RP	1	None	Reset peak meter values.

Primary Function	Corresponding Serial Port Command	Access Level	Password for Front-Panel Access	Description
EVENTS	**HIS**	1	None	Show SEL-351R event data.

Primary Function	Corresponding Serial Port Command	Access Level	Password for Front-Panel Access	Description
STATUS	**STA**	1	None	Show SEL-351R diagnostic and battery information.

OTHER Primary Functions	Corresponding Serial Port Command	Access Level	Password for Front-Panel Access	Description
BTT	**BTT NOW**	E	Level E	Force 1 Amp load test on battery.
DATE	**DAT**	1	None	Show or set SEL-351R date.
TIME	**TIM**	1	None	Show or set SEL-351R time.
79	N/A	N/A	None	Show SEL-351R set reclosures and current reclose count.
TAR	**TAR**	1	None	Show status of internal SEL-351R elements on LCD display and second row of front-panel target LEDs.
BRK_MON				
DISPLAY	**BRE A**	1	None	Show recloser wear and trip operation counters.
RESET	**BRE R**	B	Level B	Reset recloser wear and trip operation counters.

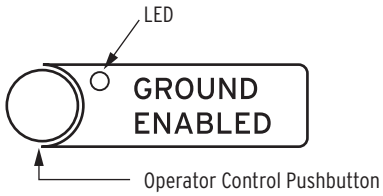
SET Primary Functions	Corresponding Serial Port Command	Access Level	Password for Front-Panel Access	Description
SHOW				
EZ	**SHO EZ**	1	None	Show EZ settings (Group 1–6).
FZ	**SHO FZ**	1	None	Show FZ settings (global EZ settings).
GROUP	**SHO**	1	None	Show GROUP settings (Group 1–6).
GLOBAL	**SHO G**	1	None	Show GLOBAL settings.
PORT	**SHO P**	1	None	Show PORT settings.
SET				
EZ	**SET EZ**	E	Level E	Set EZ settings (Group 1–6).
FZ	**SET FZ**	E	Level E	Set FZ settings (global EZ settings).
GROUP	**SET**	2	Level 2	Set GROUP settings (Group 1–6).
GLOBAL	**SET G**	2	Level 2	Set GLOBAL settings.
PORT	**SET P**	2	Level 2	Set PORT settings.
PASS	**PASS**	2	Level 2	Set passwords.

CNTRL Primary Functions	Corresponding Serial Port Command	Access Level	Password for Front-Panel Access	Description
EXTRA CONTROL	N/A	N/A	None	View position of or operate extra user-configured switch-type control.
POSITION				
OPERATE				
OUTPUT CONTACT	**PUL**	2	Level 2	Pulse output contact (**OUT101–ALARM**) for 1 second.
TEST				

GROUP Primary Functions	Corresponding Serial Port Command	Access Level	Password for Front-Panel Access	Description
ACTIVE GROUP				
DISPLAY	**GRO**	1	None	Show active setting group.
CHANGE	**GRO** *n*	B	Level B	Change active setting group to setting group *n*.

Operator Controls

Except for the **LOCK** operator control pushbutton, all the following operator control pushbuttons should be pressed momentarily to execute their function.

Press the **GROUND ENABLED** operator control pushbutton to enable/disable ground overcurrent and sensitive earth fault (SEF) element tripping. Corresponding LED illuminates to indicate the enabled state.	
Press the **RECLOSE ENABLED** operator control pushbutton to enable/disable auto reclosing. Corresponding LED illuminates to indicate the enabled state.	
Press the **REMOTE ENABLED** operator control pushbutton to enable/disable remote control. Corresponding LED illuminates to indicate the enabled state. **NOTE**: The **REMOTE ENABLED** operator control is not operable with the factory settings. See the SEL-351R *Recloser Control Instruction Manual* for information and ideas on how to program this control.	
Press the **ALTERNATE SETTINGS** operator control pushbutton to switch the active setting group between the main setting group (Setting Group 1) and the alternate setting group (Setting Group 2). Corresponding LED illuminates to indicate that the alternate setting group is active.	

Continually press the **LOCK** operator control pushbutton for three (3) seconds to engage/disengage the lock function. While this pushbutton is pressed, the corresponding LED flashes on and off, indicating a pending engagement or disengagement of the lock function. The LED illuminates constantly to indicate the engaged state. While the lock function is engaged, the following operator controls are "locked in position":

GROUND ENABLED	ALTERNATE SETTINGS
RECLOSE ENABLED	AUX 1
REMOTE ENABLED	AUX 2)

While "locked in position," these operator controls cannot change state if pressed–their corresponding LEDs remain in the same state. When the lock function is engaged, the **CLOSE** operator control cannot close the recloser, but the **TRIP** operator control can still trip the recloser.

See the *Global EZ Settings on page 4.21* (setting "Reset trip-latched LEDs on close") for options to defeat the 3-second delay on the **LOCK** operator control.

Press the **AUX 1** operator control pushbutton to enable/disable user-programmed auxiliary control. Corresponding LED illuminates to indicate the enabled state.

NOTE: The **AUX 1** operator control is not operable with the factory settings. See the SEL-351R *Recloser Control Instruction Manual* for information and ideas on how to program this control.

Press the **AUX 2** operator control pushbutton to enable/disable user-programmed auxiliary control. Corresponding LED illuminates to indicate the enabled state.

NOTE: The **AUX 2** operator control is not operable with the factory settings. See the SEL-351R *Recloser Control Instruction Manual* for information and ideas on how to program this control.

Press the **WAKE UP** operator control pushbutton to wake up the if the front panel is dark (the unit put itself to sleep after an extended outage). After the unit wakes up, the front panel illuminates, and the unit can then be interrogated via the front panel or serial port.

The **WAKE UP** operator control is also used to turn on the SEL-351R after the battery has been installed (see the installation steps in the *Section 1: Installation*).

The SEL-351R wakes up automatically from an extended outage when 120 Vac power returns to the unit.

Press the **CLOSE** operator control pushbutton to close the recloser. Corresponding **RECLOSER CLOSED** LED illuminates to indicate the recloser is closed.

The **CLOSE** operator control pushbutton does not have to be continually pressed to allow for cold load pickup (i.e., disable fast curves, and desensitize delay curves and SEF element). There is automatic allowance for cold load pickup. See the Cold Load Pickup Scheme (No. 33) settings in *Section 4: Settings*.

Option: Set a delay, so the operator can press the **CLOSE** operator control pushbutton and then move a safe distance away from the recloser before the SEL-351R issues a close (the **CLOSE** operator control comes with no set delay in the factory settings). With a set delay, press the **CLOSE** operator control pushbutton momentarily, and notice that the corresponding **RECLOSER CLOSED** LED flashes on and off during the delay time, indicating a pending close. Abort the pending close by pressing the **CLOSE** operator control pushbutton again or by pressing the **TRIP** operator control pushbutton. This delay setting for the **CLOSE** operator control is PB8D (range: 0 to 3600 cycles; factory set at 0 cycles—no delay). The delay is set via the **SET G** command (PB8D is not an EZ setting). See *Section 1: Factory-Set Logic* in the SEL-351R *Recloser Control Instruction Manual* for more information.

NOTE: The time-delay setting for the **PB8** operator control (global setting PB8D) should be left set to the factory default of PB8D = 0 cycles (no time delay) if the control is programmed to operate independently of the close logic. If PB8D > 0 cycles, the operation of corresponding Relay Word bit PB8 will be supervised by SELOGIC setting ULCL. If ULCL is asserted (logical 1), this operator will be effectively disabled.

(Model 0351RXXXXXXXXXX)

(Model 0351RXXXXXXX5XX)

Press the **TRIP** operator control pushbutton to trip the recloser (and take the control to the lockout state). Corresponding **RECLOSER OPEN** LED illuminates to indicate the recloser is open.

Option: Set a delay, so the operator can press the **TRIP** operator control pushbutton and then move a safe distance away from the recloser before the SEL-351R issues a trip (the **TRIP** operator control comes with no set delay in the factory settings). With a set delay, press the **TRIP** operator control pushbutton momentarily and notice the corresponding **RECLOSER OPEN** LED flashes on and off during the delay time, indicating a pending trip. Abort the pending trip by pressing the **TRIP** operator control pushbutton again or by pressing the **CLOSE** operator control pushbutton. This delay setting for the **TRIP** operator control is PB9D (range: 0 to 3600 cycles; factory set at 0 cycles–no delay). The delay is set via the **SET G** command (PB9D is not an EZ Setting). See *Section 1: Factory-Set Logic* in the SEL-351R *Recloser Control Instruction Manual* for more information.

NOTE: The time-delay setting for the **PB9** operator control (global setting PB9D) should be left set to the factory default of PB9D = 0 cycles (no time delay) if the control is programmed to operate independently of the trip logic.

(Model 0351RXXXXXXXXXX)

(Model 0351RXXXXXXX5XX)

Section 4
Settings

Overview

IMPORTANT: This Quick-Start Installation and User's Guide provides only information applicable to the EZ settings–settings associated with traditional recloser control operations.

MOTOR-OPERATED RECLOSERS
Refer to SEL Application Guide AG99-10, Change Logic in SEL-351R Recloser Control for Motor-Operated Reclosers to modify a few settings for motor-operated reclosers (e.g., MVE, CVE, CXE, CZE, VSA).

This section details the EZ ("easy") settings–the settings used to perform traditional recloser control operations.

Topics covered in this section:

- Curve Designations
- EZ ("Easy") Settings
- Global EZ Settings
- EZ Settings Sheets (end of this section)

Curve Information

CURVE MODIFIERS AVAILABLE FOR ANY CURVE TYPE
Constant Time Adder; Vert. Multiplier/ Time Dial; Min. Response Time

HIGH CURRENT OPTIONS AVAILABLE FOR PHASE AND GROUND
High Current Trip; High Current Lockout

Fast and delay curves are available for phase and ground overcurrent protection. These curves can be set with any of the numerous resident curve choices:

- Recloser Curves (see *Table 4.1*)
- US Curves (see *Table 4.2*)
- IEC Curves (see *Table 4.2*)
- User-Programmable Curves (see *Table 4.2*)

The recloser curves in *Table 4.1* show both the older electronic control designation and the newer microprocessor-based control designation. The recloser curves can be specified in a curve setting using either designation. For example, a given traditional recloser curve has the following two designations:

Older electronic control designation: A

Newer microprocessor-based control designation: 101

Traditional recloser curve A and curve 101 are the **same curve**–use either designation in making curve settings in the SEL-351R.

Table 4.1 Recloser Curve Designations (Sheet 1 of 2)

Recloser Curve Cross Reference–Old to New					
Old	New	Old	New	Old	New
A	101	P	115	7	152
B	117	R	105	8	113

NOTE: All 38 traditional recloser curves are available!

Table 4.1 Recloser Curve Designations (Sheet 2 of 2)

Recloser Curve Cross Reference–Old to New					
C	133	T	161	8PLUS	111
D	116	V	137	9	131
E	132	W	138	KG	165
F	163	Y	120	11	141
G	121	Z	134	13	142
H	122	1	102	14	119
J	164	2	135	15	112
KP	162	3	140	16	139
L	107	4	106	17	103
M	118	5	114	18	151
N	104	6	136		

Table 4.2 US, IEC, and User-Programmable Curve Designations

US Curve	Description
U1	moderately inverse
U2	inverse
U3	very inverse
U4	extremely inverse
U5	short-time inverse
IEC Curve	**Description**
C1	class A (standard inverse)
C2	class B (very inverse)
C3	class C (extremely inverse)
C4	long-time inverse
C5	short-time inverse
User-Programmable Curves (factory set)	**Description**
DEF_01	definite-time curve (0.1 seconds)
DEF_05	definite-time curve (0.5 seconds)
DEF_1	definite-time curve (1.0 seconds)
DEF_5	definite-time curve (5.0 seconds)

CURVES CONFORM TO STANDARD
The US and IEC curves conform to IEEE C37.112-1996 IEEE Standard Inverse-Time Characteristic Equations for Overcurrent Relays.

COOPER CURVES
Cooper 200 = IEC Inverse
Cooper 201 = IEC Very Inverse
Cooper 202 = IEC Extremely Inverse

USER DESIGNED CURVES
Created with SEL-5804 software. 3.5" high-density disk; requires Windows 3.1 or later.

The four (4) user-programmable curves are factory set as shown in *Table 4.2*, with definite-time characteristics. User-designed curves (created with the SEL-5804 TOC [Time-Overcurrent] Recloser Curve Designer software package) can be downloaded instead to any of the four user-programmable curves in the SEL-351R.

Factory EZ Settings

The SEL-351R ships with the factory EZ settings shown in *Table 4.3*. The corresponding number references provide a quick way to find the settings (or subsettings) in the *Settings Descriptions on page 4.6*.

VIEW EZ SETTINGS WITH COMMANDS
SHO EZ 1 (Group 1);
SHO EZ 2 (Group 2);
SHO FZ (Global).
See Table 2.5.

SET EZ SETTINGS WITH COMMANDS
SET EZ 1 (Group 1);
SET EZ 2 (Group 2);
SET FZ (Global).
See Table 2.5.

The reference to Settings Groups 1 and 2 at the top of *Table 4.3* refers to the two choices for the active setting group:

- Settings Group 1 = main settings
- Settings Group 2 = alternate settings

Refer to *Operator Controls on page 3.6* (**ALTERNATE SETTINGS** operator control pushbutton) for more information on how to switch between these two setting groups. In the factory EZ settings, these two setting groups are set the same.

The Global EZ settings at the end of *Table 4.3* apply to both settings Groups 1 and 2.

⚠WARNING
Anytime an EZ setting is changed, review all the EZ settings before enabling the new settings. Pay close attention in circumstances where a setting was once set to OFF or N and then later turned on (enabled)–other related settings may need to be turned on, though may still be set to OFF or N.

Those factory settings indicated with an [a] in *Table 4.3* are hidden with these particular factory settings. As a general rule, if a main setting is set to N, then the subsettings that follow are hidden. Setting "Phantom voltages from (VA,VB,VC,VAB,VBC,VCA,OFF)" is only available on SEL-351R-2 relays. *Settings Descriptions* explains the details behind hiding the settings. Complete setting ranges are also given in *Settings Descriptions*.

Table 4.3 EZ Settings Quick Reference (Sheet 1 of 3)

No.	Settings Groups 1 (Main) and 2 (Alternate) EZ Settings	Factory Settings
1	Control Identifier	RECLOSER R1
2	Circuit Identifier	FEEDER 2101
3	CT Ratio	1000.0
4	PT Ratio	100.0
5	Min. trip–phase (A pri.)	400.00
6	Min. trip–ground (A pri.)	100.00
7	Min. trip–SEF (A pri.)	OFF
8	Fast curve–phase	A
	Time dial–phase fast curve	1.00[a]
	EM reset–phase fast curve	N[a]
9	Fast curve–ground	1
	Time dial–ground fast curve	1.00[a]
	EM reset–ground fast curve	N[a]
10	Delay curve–phase	C
	Time dial–phase delay curve	1.00[a]
	EM reset–phase delay curve	N[a]
11	Delay curve–ground	13
	Time dial–ground delay curve	1.00[a]
	EM reset–ground delay curve	N[a]
12	Time delay–SEF (cycles)	0.00[a]
13	Operations–phase fast curve	2

Table 4.3 EZ Settings Quick Reference (Sheet 2 of 3)

No.	Settings Groups 1 (Main) and 2 (Alternate) EZ Settings	Factory Settings
14	Operations–ground fast curve	2
15	Operations to lockout–phase	4
16	Operations to lockout–ground	4
17	Operations to lockout–SEF	OFF[a]
18	Reclose interval 1 (cycles)	300.00
19	Reclose interval 2 (cycles)	600.00
20	Reclose interval 3 (cycles)	600.00
21	Reclose interval 4 (cycles)	0.00[a]
22	Reset time for auto reclose (cycles)	1800.00
23	Reset time from lockout (cycles)	600.00
24	Close power wait time (cycles)	900.00
25	Complex fast curve–phase (Y/N)	N
	Const. time adder–phase fast curve (cycles)	0.00[a]
	Vert. multiplier–phase fast curve	1.00[a]
	Min. response–phase fast curve (cycles)	0.00[a]
26	Complex fast curve–ground (Y/N)	N
	Const. time adder–ground fast curve (cycles)	0.00[a]
	Vert. multiplier–ground fast curve	1.00[a]
	Min. response–ground fast curve (cycles)	0.00[a]
27	Complex delay curve–phase (Y/N)	N
	Const. time adder–phase delay curve (cycles)	0.00[a]
	Vert. multiplier–phase delay curve	1.00[a]
	Min. response–phase delay curve (cycles)	0.00[a]
28	Complex delay curve–ground (Y/N)	N
	Const. time adder–ground delay curve (cycles)	0.00[a]
	Vert. multiplier–ground delay curve	1.00[a]
	Min. response–ground delay curve (cycles)	0.00[a]
29	High current trip–phase (Y/N)	N
	High current trip–phase (multiple)	OFF[a]
	Time delay–phase high current trip (cycles)	0.00[a]
	Activate high current trip–phase	OFF[a]
30	High current trip–ground (Y/N)	N
	High current trip–ground (multiple)	OFF[a]
	Time delay–ground high current trip (cycles)	0.00[a]
	Activate high current trip–ground	OFF[a]
31	High current lockout–phase (Y/N)	N
	High current lockout–phase (multiple)	OFF[a]
	Activate high current lockout–phase	OFF[a]

Table 4.3 EZ Settings Quick Reference (Sheet 3 of 3)

No.	Settings Groups 1 (Main) and 2 (Alternate) EZ Settings	Factory Settings
32	High current lockout–ground (Y/N)	N
	High current lockout–ground (multiple)	OFF[a]
	Activate high current lockout–ground	OFF[a]
33	Cold load pickup scheme (Y/N)	N
	Cold load pickup–phase (multiple)	OFF[a]
	Cold load pickup–ground (multiple)	OFF[a]
	Loss of load diversity time (cycles)	0.00[a]
	Restore min. trips–time limit (cycles)	OFF[a]
	Restore min. trip–phase (Y/N)	N[a]
	Restore min. trip–ground (Y/N)	N[a]
	Restore min. trip–SEF (Y/N)	N[a]
34	Sequence coordination (Y/N)	N
35	Ground trip precedence (Y/N)	N[a]
36	Underfrequency loadshedding (Y/N)	N
	Underfrequency pickup (Hz)	OFF[a]
	Underfrequency time delay (cycles)	6.00[a]
37	Demand meter time constant (min.)	5
	Global EZ Settings:	
38	System Frequency (Hz)	60
39	Phase Rotation	ABC
40	Recloser Wear Monitor (AUTO,Y,N)	AUTO
	Recloser type	OIL
	Interrupt rating (A pri.)	6000
41	Reset trip-latched LEDs on close (Y,Y1,N,N1)	Y
42	True three-phase voltage connected (Y,N)	N
43	Phantom voltages from (VA,VB,VC,VAB,VBC,VCA,OFF)	OFF
44	**V123** Terminal Conn. (A,B,C,AB,BC,CA,OFF)	A
45	**I123** Terminal Conn. (ABC,ACB,BAC,BCA,CAB,CBA)	ABC
46	CT Polarity (POS,NEG)	POS
47	Battery Amp-hours	8.0
48	% Battery capacity for sleep	20
49	Turn on the 12 V power (Y,N)	N
	Keep the 12 V power on while asleep (Y,N)	N[a]

[a] Factory defaults cause these settings to be hidden. As a general rule, if a main setting is set to N, the subsettings that follow are hidden.

Settings Descriptions

⚠WARNING
Anytime an EZ setting is changed, review all the EZ settings before enabling the new settings. Pay close attention in circumstances where a setting was once set to Off or N and then later turned on (enabled)–other related settings may need to be turned on, though may still be set to Off or N.

Settings Groups 1 (Main) and 2 (Alternate) EZ Settings

No.	Setting	Default	Range	Incr.
1	Control Identifier	RECLOSER R1	0–9, A–Z, - , / , . , space	

The Control Identifier setting contains the control installation designation (e.g., RECLOSER R1). This identifier is listed at the top of event, history, meter, and status reports (see *Table 2.5*).

➤ This setting may be up to 30 characters long.

➤ This setting cannot be made via the front-panel interface.

No.	Setting	Default	Range	Incr.
2	Circuit Identifier	FEEDER 2101	0–9, A–Z, - , / , . , space	

The Circuit Identifier setting contains the greater circuit or substation designation (e.g., FEEDER 2101). This identifier is listed at the top of event, history, meter, and status reports (see *Table 2.5*).

➤ This setting may be up to 30 characters long.

➤ This setting cannot be made via the front-panel interface.

No.	Setting	Default	Range	Incr.
3	CT Ratio	1000.0	1.0–6000.0	0.1

The CT Ratio (current transformer [CT] ratio) setting programs the SEL-351R to operate with a recloser CT ratio (e.g., for the common recloser CT ratio 1000:1, the setting CT Ratio = 1000.0 is made).

➤ **IMPORTANT**: The following settings change in accordance to the CT Ratio setting:

Min. trip–phase (No. 5)

Min. trip–ground (No. 6)

Min. trip–SEF (No. 7)

No.	Setting	Default	Range	Incr.
4	PT Ratio	100.0	1.0–10000.0	0.1

The PT Ratio setting is the potential transformer (PT) ratio.

➤ For applications where single-phase 120 Vac power is the only voltage brought to the SEL-351R, the PT ratio should still be entered, otherwise the SEL-351R voltage metering information will **not** be accurate. Enter the effective power transformer ratio, relative to the 120 Vac secondary winding.

➤ When calculating the PTR, verify that the unit for the power transformer primary voltage is Vac not kVac.

No.	Setting	Default	Range	Incr.
5	Min. trip–phase	400.00	OFF, 50.00–3199.99 Amps primary	0.01

The Min. trip–phase setting determines the minimum phase current threshold for overcurrent detection in primary amps.

The displayed Amps primary setting range for Min. trip–phase is calculated by multiplying the effective Amps secondary range [0.05 to 3.20] by the CT Ratio (No. 3) [1000]:

No.	Setting	Default	Range	Incr.

(0.05 to 3.20) • 1000 = 50.00 to 3200.00 range (Amps primary)

If the CT Ratio setting changes, the displayed Amps primary setting range for Min. trip–phase changes accordingly. Due to processor calculations and rounding techniques, displayed range numbers may appear slightly different than expected (e.g., 3199.99 instead of 3200.00).

➤ **IMPORTANT:** If Min. trip–phase (No. 5), Min. trip–ground (No. 6), and Min. trip–SEF (No. 7) are all set to OFF, then overcurrent protection and reclosing are disabled.

➤ **IMPORTANT:** If Min. trip–phase is set to OFF, then the following settings are all hidden and set to OFF or N:

Fast curve–phase (No. 8)	Complex fast curve–phase (No. 25)
Delay curve–phase (No. 10)	Complex delay curve–phase (No. 27)
Operations–phase fast curve (No. 13)	High current trip–phase (No. 29)
Operations to lockout–phase (No. 15)	High current lockout–phase (No. 31)

No.	Setting	Default	Range	Incr.
6	Min. trip–ground	100.00	OFF, 5.00–3199.99 Amps primary	0.01

The Min. trip–ground setting determines the minimum ground current threshold for overcurrent detection in primary amps.

The displayed Amps primary setting range for Min. trip–ground is calculated by multiplying the effective Amps secondary range [0.005 to 3.20] by the CT Ratio (No. 3) [1000]:

(0.005 to 3.20) • 1000 = 5.00 to 3200.00 range (Amps primary)

If the CT Ratio setting changes, the displayed Amps primary setting range for Min. trip–ground changes accordingly. Due to processor calculations and rounding techniques, displayed range numbers may appear slightly different than expected (e.g., 3199.99 instead of 3200.00).

If Min. trip–ground is effectively set <0.1 Amp secondary (e.g., for CT ratio [No. 3] = 1000, Min. trip–ground <100.00 Amps primary), then the corresponding curves flatten out above 2.0 Amps secondary (e.g., for CT ratio [No. 3] = 1000, Fast curve–ground [No. 9] and Delay curve–ground [No. 11] flatten out above 2000 Amps primary).

➤ **IMPORTANT**: If Min. trip–phase (No. 5), Min. trip–ground (No. 6), and Min. trip–SEF (No. 7) are all set to OFF, then overcurrent protection and reclosing are disabled.

➤ **IMPORTANT**: If Min. trip–ground is set to OFF, then the following settings are all hidden and set to OFF or N:

Fast curve–ground (No. 9)	Complex fast curve–ground (No. 26)
Delay curve–ground (No. 11)	Complex delay curve–ground (No. 28)
Operations–ground fast curve (No. 14)	High current trip–ground (No. 30)
Operations to lockout–ground (No. 16)	High current lockout–ground (No. 32)

No.	Setting	Default	Range	Incr.
7	Min. trip–SEF	OFF	OFF, 5.00–1499.99 Amps primary	0.01

The Min. trip–SEF setting determines the minimum sensitive earth fault threshold for overcurrent detection set in primary Amps.

The displayed Amps primary setting range for Min. trip–SEF is calculated by multiplying the effective Amps secondary range [0.005 to 1.500] by the CT Ratio (No. 3) [1000]:

(0.005 to 1.500) • 1000 = 5.00 to 1500.00 range (Amps primary)

If the CT Ratio setting changes, the displayed Amps primary setting range for Min. trip–ground changes accordingly. Due to processor calculations and rounding techniques, displayed range numbers may appear slightly different than expected (e.g., 1499.99 instead of 1500.00).

➤ **IMPORTANT**: If Min. trip–phase (No. 5), Min. trip–ground (No. 6), and Min. trip–SEF (No. 7) are all set to OFF, then overcurrent protection and reclosing are disabled.

➤ **IMPORTANT**: If Min. trip–SEF is set to OFF, then the following settings are all hidden and set to zero (0) and OFF, respectively:

Time delay–SEF (No. 12) Operations to lockout–SEF (No. 17)

No.	Setting	Default	Range	Incr.
8	Fast curve–phase	A	OFF, U1–U5, C1–C5, recloser or user curve	

The Fast curve–phase setting selects the time-overcurrent curve for phase fast curve tripping. Curve designations are provided in *Table 4.1* and *Table 4.2*.

➤ This setting is hidden and set to OFF if Min. trip–phase (No. 5) is set to OFF.

➤ If Fast curve–phase is programmed with a US (U1–U5) or IEC (C1–C5) curve, enter the following two settings:

No.	Setting	Default	Range	Incr.
	Time-dial–phase fast curve	1.00	0.50–15.00 for US curves U1–U5 0.05–1.00 for IEC curves C1–C5	0.01 0.01

The Time-dial–phase fast curve setting shifts the US or IEC curve in time by the entered multiplier.

➤ This setting is hidden and nonoperative if Fast curve–phase is programmed with a recloser or user curve.

Setting	Default	Range	Incr.
EM reset–phase fast curve	N	Y/N	

The EM reset–phase fast curve setting enables the electromechanical reset emulation for the US or IEC curve, if set to Y.

➤ This setting is usually set to N, except for special applications.

➤ This setting is hidden and set to N if Fast curve–phase is programmed with a recloser or user curve.

No.	Setting	Default	Range	Incr.
9	Fast curve–ground	1	OFF, U1–U5, C1–C5, recloser or user curve	

The Fast curve–ground setting selects the time-overcurrent curve for ground fast curve tripping. Curve designations are provided in *Table 4.1* and *Table 4.2*.

If Min. trip–ground (No. 6) is effectively set <0.1 Amp secondary (e.g., for CT ratio [No. 3] = 1000, Min. trip–ground (No. 6) <100.00 Amps primary), then Fast curve–ground flattens out above 1.5 Amps secondary (e.g., for CT ratio [No. 3] = 1000, Fast curve–ground flattens out above 1500 Amps primary).

➤ This setting is hidden and set to OFF if Min. trip–ground (No. 6) is set to OFF.

➤ If Fast curve–ground is programmed with a US (U1–U5) or IEC (C1–C5) curve, enter the following two settings:

Setting	Default	Range	Incr.
Time-dial– ground fast curve	1.00	0.50–15.00 for US curves U1–U5 0.05–1.00 for IEC curves C1–C5	0.01 0.01

The Time-dial–ground fast curve setting shifts the US or IEC curve in time by the entered multiplier.

➤ This setting is hidden and nonoperative if Fast curve–ground is programmed with a recloser or user curve.

Setting	Default	Range	Incr.
EM reset–ground fast curve	N	Y/N	

The EM reset–ground fast curve setting enables the electromechanical reset emulation for the US or IEC curve, if set to Y.

➤ This setting is usually set to N, except for special applications.

➤ This setting is hidden and set to N if Fast curve–ground is programmed with a recloser or user curve.

No.	Setting	Default	Range	Incr.
10	Delay curve–phase	C	OFF, U1–U5, C1–C5, recloser or user curve	

The Delay curve–phase setting selects the time-overcurrent curve for phase delay curve tripping. Curve designations are provided in *Table 4.1* and *Table 4.2*.

➤ This setting is hidden and set to OFF if Min. trip–phase (No. 5) is set to OFF.

➤ If Delay curve–phase is programmed with a US (U1–U5) or IEC (C1–C5) curve, enter the following two settings:

Setting	Default	Range	Incr.
Time-dial– phase delay curve	1.00	0.50–15.00 for US curves U1–U5 0.05–1.00 for IEC curves C1–C5	0.01 0.01

The Time-dial–phase delay curve setting shifts the US or IEC curve in time by the entered multiplier.

➤ This setting is hidden and nonoperative if Delay curve–phase is programmed with a recloser or user curve.

Setting	Default	Range	Incr.
EM reset– phase delay curve	N	Y/N	

The EM reset–phase delay curve setting enables the electromechanical reset emulation for the US or IEC curve, if set to Y.

➤ This setting is usually set to N, except for special applications.

➤ This setting is hidden and set to N if Delay curve–phase is programmed with a recloser or user curve.

No.	Setting	Default	Range	Incr.
11	Delay curve–ground	13	OFF, U1–U5, C1–C5, recloser or user curve	

The Delay curve–ground setting selects the time-overcurrent curve for ground fast curve tripping. Curve designations are provided in *Table 4.1* and *Table 4.2*.

If Min. trip–ground (No. 6) is effectively set <0.1 Amp secondary (e.g., for CT ratio [No. 3] = 1000, Min. trip–ground [No. 6] <100.00 Amps primary), then Delay curve–ground flattens out above 1.5 Amps secondary (e.g., for CT ratio [No. 3] = 1000, Delay curve–ground flattens out above 1500 Amps primary).

➤ This setting is hidden and set to OFF if Min. trip–ground (No. 6) is set to OFF.

➤ If Delay curve–ground is programmed with a US (U1–U5) or IEC (C1–C5) curve, enter the following two settings:

Setting	Default	Range	Incr.
Time-dial– ground delay curve	1.00	0.50–15.00 for US curves U1–U5 0.05–1.00 for IEC curves C1–C5	0.01 0.01

The Time-dial–ground delay curve setting shifts the US or IEC curve in time by the entered multiplier.

➤ This setting is hidden and nonoperative if Delay curve–ground is programmed with a recloser or user curve.

Setting	Default	Range	Incr.
EM reset– ground delay curve	N	Y/N	

The EM reset–ground delay curve setting enables the electromechanical reset emulation for the US or IEC curve, if set to Y.

➤ This setting is usually set to N, except for special applications.

➤ This setting is hidden and set to N if Delay curve–ground is programmed with a recloser or user curve.

No.	Setting	Default	Range	Incr.
12	Time delay–SEF	0.00	0–16000.00 cycles	0.25 cyc.

The Time delay–SEF setting programs an intentional time delay for the definite-time SEF (sensitive earth fault) overcurrent element. This is in addition to the built-in 2-cycle time delay.

➤ This setting is hidden and set to zero (0) if Min. trip–SEF (No. 7) is set to OFF.

No.	Setting	Default	Range	Incr.
13	Operations– phase fast curve	2	OFF, 1–5	1

The Operations–phase fast curve setting determines the number of phase fast curve trip operations (e.g., if Operations–phase fast curve = 2, then the phase fast curve is enabled for the first two [2] trip operations).

- This setting is hidden and set to OFF if Fast curve–phase (No. 8) is set to OFF.
- This setting only enables the phase fast curve operations; it does not disable the phase delay curve (the phase delay curve is always active). Traditional protection schemes use fast curves followed by delay curves so the delay curves do not have to be defeated. If a slower first operation than second operation is desired, higher logic level settings changes are required.

No.	Setting	Default	Range	Incr.
14	Operations– ground fast curve	2	OFF, 1–5	1

The Operations–ground fast curve setting determines the number of ground fast curve trip operations (e.g., if Operations–ground fast curve = 2, then the ground fast curve is enabled for the first two [2] trip operations).

- This setting is hidden and set to OFF if Fast curve–ground (No. 9) is set to OFF.
- This setting only enables the ground fast curve operations; it does not disable the ground delay curve (the ground delay curve is always active, provided that the **GROUND ENABLED** operator control is on). Traditional protection schemes use fast curves followed by delay curves so the delay curves do not have to be defeated. If a slower first operation than second operation is desired, higher logic level settings changes are required.

No.	Setting	Default	Range	Incr.
15	Operations to lockout–phase	4	OFF, 1–5	1

The Operations to lockout–phase setting determines the total number of phase curve trip operations. The difference between setting Operations to lockout–phase and setting Operations–phase fast curve (No. 13) is the number of remaining phase delay curve operations (e.g., 4 – 2 = 2).

The setting range for Operations to lockout–phase adjusts according to Operations–phase fast curve (e.g., if Operations–phase fast curve = 2, then the range for Operations to lockout–phase is from 2 to 5).

- If Delay curve–phase (No. 10) = OFF, then Operations to lockout–phase is set automatically equal to Operations–phase fast curve, and there are no phase delay curve operations (e.g., 2 – 2 = 0).
- This setting is hidden and set to OFF if Min. trip–phase (No. 5) is set to OFF.
- **IMPORTANT**: If Operations to lockout–phase (No. 15), Operations to lockout–ground (No. 16), and Operations to lockout–SEF (No. 17) are all set to OFF, then overcurrent protection and reclosing are disabled.

  However, if both Min. trip–phase (No. 5) and Delay curve–phase (No. 10) are set to values other than OFF, the phase delay curve element is still active. If absolutely no phase protection is desired (e.g., “switch” mode), Min. trip–phase (No. 5) or Delay curve–phase (No. 10) must also be set to OFF.

No.	Setting	Default	Range	Incr.
16	Operations to lockout–ground	4	OFF, 1–5	1

The Operations to lockout–ground setting determines the total number of ground curve trip operations. The difference between setting Operations to lockout–ground and setting Operations–ground fast curve (No. 14) is the number of remaining ground delay curve operations (e.g., 4 – 2 = 2).

The setting range for Operations to lockout–ground adjusts according to Operations–ground fast curve (e.g., if Operations–ground fast curve = 2, then the range for Operations to lockout–ground is from 2 to 5).

- If Delay curve–ground (No. 11) = OFF, then Operations to lockout–ground is set automatically equal to Operations–ground fast curve, and there are no ground delay curve operations (e.g., 2 – 2 = 0).
- This setting is hidden and set to OFF if Min. trip–ground (No. 6) is set to OFF.
- **IMPORTANT**: If Operations to lockout–phase (No. 15), Operations to lockout–ground (No. 16), and Operations to lockout–SEF (No. 17) are all set to OFF, then overcurrent protection and reclosing are disabled.

  However, if both Min. trip–ground (No. 6) and Delay curve–ground (No. 11) are set to values other than OFF, the ground delay curve element is still active (provided the **GROUND ENABLED** operator control is on). If absolutely no ground protection is desired (e.g., “switch” mode), Min. trip–ground (No. 6) or Delay curve–ground (No. 11) must also be set to OFF.

No.	Setting	Default	Range	Incr.
17	Operations to lockout–SEF	OFF	OFF, 1–5	1

The Operations to lockout–SEF setting determines the number of SEF (sensitive earth fault) element trip operations.

- This setting is hidden and set to OFF if Min. trip–SEF (No. 7) is set to OFF.
- **IMPORTANT**: If Operations to lockout–phase (No. 15), Operations to lockout–ground (No. 16), and Operations to lockout–SEF (No. 17) are all set to OFF, then overcurrent protection and reclosing are disabled. See similar warnings for preceding setting number 15 and setting number 16.

Table 4.4 Seconds-to-Cycles Conversion (60 Hz)

Seconds	Cycles		Seconds	Cycles	
	(50 Hz)	(60 Hz)		(50 Hz)	(60 Hz)
0.3	15	18	15	750	900
0.5	25	30	20	1000	1200
1	50	60	30	1500	1800
2	100	120	45	2250	2700
3	150	180	60	3000	3600
5	250	300	90	4500	5400
7	350	420	120	6000	7200
10	500	600	180	9000	10800

for 50 Hz systems:
_____ seconds x 50 cycles/second = _____ cycles _____ minutes x 3000 cycles/minute = _____ cycles

for 60 Hz systems:
_____ seconds x 60 cycles/second = _____ cycles _____ minutes x 3600 cycles/minute = _____ cycles

No.	Setting	Default	Range	Incr.
18	Reclose interval 1	300.00	0–999999.00 cycles	0.25 cyc.
19	Reclose interval 2	600.00	0–999999.00 cycles	0.25 cyc.
20	Reclose interval 3	600.00	0–999999.00 cycles	0.25 cyc.
21	Reclose interval 4	0.00	0–999999.00 cycles	0.25 cyc.

The Reclose interval settings (1 through 4) are each successively and individually timed. Reclose interval timing cannot proceed until the following two conditions are met:

- The trip condition has gone away (minimum trip time is factory–set at 12 cycles).
- The recloser has opened.

At the end of a reclose interval, an auto reclose attempt is made.

The number of available Reclose interval settings corresponds to the highest set Operations to lockout (No. 15, 16, or 17) setting.

For example, if the highest set Operations to lockout setting is Operations to lockout–phase (No. 15) = 4, then settings Reclose interval 1, Reclose interval 2, and Reclose interval 3 are available (three reclose attempts). Because it is not available, Reclose interval 4 is hidden and set to zero (0).

The number of reclosing attempts (i.e., available Reclose interval settings) is always one less than the number of trip operations (e.g., 4 “trips” – 1 = 3 “reclosures”).

- All the Reclose interval settings are hidden and set to zero (0) if none of the Operations to lockout (No. 15, 16, or 17) settings are set greater than 1 (reclosing is disabled; 1 “trip” – 1 = 0 “reclosures”).
- If a Reclose interval setting is set to zero (0), the corresponding auto reclose attempt and any following auto reclose attempts are aborted.

No.	Setting	Default	Range	Incr.
22	Reset time for auto reclose	1800.00	0–999999.00 cycles	0.25 cyc.
23	Reset time from lockout	600.00	0–999999.00 cycles	0.25 cyc.

The Reset time for auto reclose setting qualifies an auto reclose of the recloser. The Reset time from lockout setting qualifies a manual/remote close of the recloser from the lockout state. Traditionally, the Reset time from lockout setting is set shorter than the Reset time for auto reclose setting.

Reset timing is blocked (and the reset timer is reloaded) if any overcurrent elements are picked up. Reset timing can only proceed if all the overcurrent elements are continually dropped out.

➤ Both the Reset time for auto reclose and Reset time from lockout settings are hidden and set to zero (0) if none of the Operations to lockout (No. 15, 16, or 17) settings are set greater than 1 (reclosing is disabled; 1 “trip” – 1 = 0 “reclosures”).

No.	Setting	Default	Range	Incr.
24	Close power wait time	900.00	OFF, 0–999999.00 cycles	0.25 cyc.

The Close power wait time setting is a time window that starts timing after a reclose interval times out. During this time window, the SEL-351R checks the 120 Vac connected to it:

➤ If the 120 Vac is present, this indicates that the close power to the recloser (120 Vac or primary voltage) is also present, and reclosing proceeds.

➤ If the 120 Vac is not present, this indicates that the close power to the recloser (120 Vac or primary voltage) is also not present and reclosing is stalled. If the 120 Vac is not present throughout the time window, reclosing is aborted at the end of the time window, and the SEL-351R goes to the lockout state.

The presence of 120 Vac is detected with voltage input **V1**. See subsection *Initial Conditions for Control Tests on page 5.2* for additional details on voltage input **V1** detecting 120 Vac.

➤ **IMPORTANT**: If Close power wait time is set to OFF, then the SEL-351R waits indefinitely for 120 Vac to appear, in order for reclosing to proceed–there is no restrictive time window.

➤ This setting is hidden and set to 0 cycles if none of the Operations to lockout (No. 15, 16, or 17) settings are set greater than 1 (reclosing is disabled; 1 “trip” – 1 = 0 “reclosures”). Previous firmware versions set it to OFF (instead of 0 cycles) for this condition.

No.	Setting	Default	Range	Incr.
25	Complex fast curve–phase	N	Y/N	

The Complex fast curve–phase setting enables the following three settings for the phase fast curve, if set to Y.

➤ This setting is hidden and set to N if Fast curve–phase (No. 8) is set to OFF.

Setting	Default	Range	Incr.
Const. time adder–phase fast curve	0.00	0–60.00 cycles	0.25 cyc.

The Const. time adder–phase fast curve setting adds a constant time to the phase fast curve, if set to other than 0 cycles.

➤ This setting is hidden and set to zero (0) if Complex fast curve–phase is set to N.

Setting	Default	Range	Incr.
Vert. multiplier–phase fast curve	1.00	0.10–2.00	0.01

The Vert. multiplier–phase fast curve setting shifts the phase fast curve in time, by the entered multiplier, if Fast curve–phase (No. 8) is programmed with a recloser or user curve. If no particular multiplier is desired, set Vert. multiplier–phase fast curve equal to 1.00.

➤ If Fast curve–phase (No. 8) is programmed with a US (U1–U5) or IEC (C1–C5) curve, Vert. multiplier–phase fast curve is hidden and nonoperative. The preceding Time–dial–phase fast curve (No. 8) subsetting provides the US and IEC curves with an effective vertical multiplier, instead.

➤ This setting has no multiplying effect on the Constant time adder–phase fast curve and Min. response time–phase fast curve settings. They all operate independently.

➤ This setting is hidden and set to 1.00 if Complex fast curve–phase is set to N and Fast curve–phase (No. 8) is programmed with a recloser or user curve.

No.	Setting	Default	Range	Incr.
	Min. response–phase fast curve	0.00	0–60.00 cycles	0.25 cyc.

The phase fast curve can trip no faster than the Min. response time–phase fast curve setting.

If the Min. response time–phase fast curve setting is set equal to zero (0), it has no effect on the phase fast curve. If the Min. response time–phase fast curve setting is set equal to 15 cycles, for example, the phase fast curve cannot trip on the portion of the curve that is faster than 15 cycles–the phase fast curve effectively flattens out at 15 cycles.

➤ This setting is hidden and set to zero (0) if Complex fast curve–phase is set to N.

No.	Setting	Default	Range	Incr.
26	Complex fast curve–ground	N	Y/N	

The Complex fast curve–ground setting enables the following three settings for the ground fast curve, if set to Y.

➤ This setting is hidden and set to N if Fast curve–ground (No. 9) is set to OFF.

Setting	Default	Range	Incr.
Const. time adder–ground fast curve	0.00	0–60.00 cycles	0.25 cyc.

The Const. time adder–ground fast curve setting adds a constant time to the ground fast curve, if set to other than 0 cycles.

➤ This setting is hidden and set to zero (0) if Complex fast curve–ground is set to N.

Setting	Default	Range	Incr.
Vert. multiplier–ground fast curve	1.00	0.10–2.00	0.01

The Vert. multiplier–ground fast curve setting shifts the ground fast curve in time, by the entered multiplier, if Fast curve–ground (No. 9) is programmed with a recloser or user curve. If no particular multiplier is desired, set Vert. multiplier–ground fast curve equal to 1.00.

➤ If Fast curve–ground (No. 9) is programmed with a US (U1–U5) or IEC (C1–C5) curve, Vert. multiplier–ground fast curve is hidden and nonoperative. The preceding Time–dial–ground fast curve (No. 9) subsetting provides the US and IEC curves with an effective vertical multiplier, instead.

➤ This setting has no multiplying effect on the Constant time adder–ground fast curve and Min. response time–ground fast curve settings. They all operate independently.

➤ This setting is hidden and set to 1.00 if Complex fast curve–ground is set to N and Fast curve–ground (No. 9) is programmed with a recloser or user curve.

Setting	Default	Range	Incr.
Min. response–ground fast curve	0.00	0–60.00 cycles	0.25 cyc.

The phase fast curve can trip no faster than the Min. response time–ground fast curve setting.

If the Min. response time–ground fast curve setting is set equal to zero (0), it has no effect on the ground fast curve. If the Min. response time–ground fast curve setting is set equal to 15 cycles, for example, the ground fast curve cannot trip on the portion of the curve that is faster than 15 cycles–the ground fast curve effectively flattens out at 15 cycles.

➤ This setting is hidden and set to zero (0) if Complex fast curve–ground is set to N.

No.	Setting	Default	Range	Incr.
27	Complex delay curve–phase	N	Y/N	

The Complex delay curve–phase setting enables the following three settings for the phase delay curve, if set to Y.

➤ This setting is hidden and set to N if Delay curve–phase (No. 10) is set to OFF.

Setting	Default	Range	Incr.
Const. time adder–phase delay curve	0.00	0–60.00 cycles	0.25 cyc.

No.	Setting	Default	Range	Incr.

The Const. time adder–phase delay curve setting adds a constant time to the phase delay curve, if set other than 0 cycles.

➤ This setting is hidden and set to zero (0) if Complex delay curve–phase is set to N.

Setting	Default	Range	Incr.
Vert. multiplier–phase delay curve	1.00	0.10–2.00	0.01

The Vert. multiplier–phase delay curve setting shifts the phase delay curve in time, by the entered multiplier, if Delay curve–phase (No. 10) is programmed with a recloser or user curve. If no particular multiplier is desired, set Vert. multiplier–phase delay curve equal to 1.00.

➤ If Delay curve–phase (No. 10) is programmed with a US (U1–U5) or IEC (C1–C5) curve, Vert. multiplier–phase delay curve is hidden and nonoperative. The preceding Time-dial–phase delay curve (No. 10) subsetting provides the US and IEC curves with an effective vertical multiplier, instead.

➤ This setting has no multiplying effect on the Constant time adder–phase delay curve and Min. response time–phase delay curve settings. They all operate independently.

➤ This setting is hidden and set to 1.00 if Complex delay curve–phase is set to N and Delay curve–phase (No. 10) is programmed with a recloser or user curve.

Setting	Default	Range	Incr.
Min. response–phase delay curve	0.00	0–60.00 cycles	0.25 cyc.

The phase delay curve can trip no faster than the Min. response time–phase delay curve setting.

If the Min. response time–phase delay curve setting is set equal to zero (0), it has no effect on the phase delay curve. If the Min. response time–phase delay curve setting is set equal to 15 cycles, for example, the phase delay curve cannot trip on the portion of the curve that is faster than 15 cycles–the phase delay curve effectively flattens out at 15 cycles.

➤ This setting is hidden and set to zero (0) if Complex delay curve–phase is set to N.

No.	Setting	Default	Range	Incr.
28	Complex delay curve–ground	N	Y/N	

The Complex delay curve–ground setting enables the following three settings for the ground delay curve, if set to Y.

➤ This setting is hidden and set to N if Delay curve–ground (No. 11) is set to OFF.

Setting	Default	Range	Incr.
Const. time adder–ground delay curve	0.00	0–60.00 cycles	0.25 cyc.

The Const. time adder–ground delay curve setting adds a constant time to the ground delay curve, if set other than 0 cycles.

➤ This setting is hidden and set to zero (0) if Complex delay curve–ground is set to N.

Setting	Default	Range	Incr.
Vert. multiplier–ground delay curve	1.00	0.10–2.00	0.01

The Vert. multiplier–ground delay curve setting shifts the ground delay curve in time, by the entered multiplier, if Delay curve–ground (No. 11) is programmed with a recloser or user curve. If no particular multiplier is desired, set Vert. multiplier–ground delay curve equal to 1.00.

➤ If Delay curve–ground (No. 11) is programmed with a US (U1–U5) or IEC (C1–C5) curve, Vert. multiplier–ground delay curve is hidden and nonoperative. The preceding Time-dial–ground delay curve (No. 11)–setting provides the US and IEC curves with an effective vertical multiplier, instead.

➤ This setting has no multiplying effect on the Constant time adder–ground delay curve and Min. response time–ground delay curve settings. They all operate independently.

➤ This setting is hidden and set to 1.00 if Complex delay curve–ground is set to N and Delay curve–ground (No. 11) is programmed with a recloser or user curve.

No.	Setting	Default	Range	Incr.
	Min. response–ground delay curve	0.00	0–60.00 cycles	0.25 cyc.

The ground delay curve can trip no faster than the Min. response time–ground delay curve setting.

If the Min. response time–ground delay curve setting is set equal to zero (0), it has no effect on the ground delay curve. If the Min. response time–ground delay curve setting is set equal to 15 cycles, for example, the ground delay curve cannot trip on the portion of the curve that is faster than 15 cycles the ground delay curve effectively flattens out at 15 cycles.

➤ This setting is hidden and set to zero (0) if Complex delay curve–ground is set to N.

No.	Setting	Default	Range	Incr.
29	High current trip–phase	N	Y/N	

The High current trip–phase setting enables the following three settings for phase high current tripping, if set to Y. Phase high current tripping is not affected by the cold load pickup scheme.

➤ This setting is hidden and set to N if Fast curve–phase (No. 8) and Delay curve–phase (No. 10) are both set to OFF.

Setting	Default	Range	Incr.
High current trip–phase	OFF	OFF, 1.00–49.99 multiples of Min. trip–phase	0.01

The High current trip–phase (multiples of Min. trip–phase) setting determines the phase current threshold for phase high current tripping.

Example: If High current trip–phase = 12.00 (multiples of Min. trip–phase) and Min. trip–phase (No. 5) = 400 Amps primary, then the phase current threshold for phase high current tripping operates at a value equal to:

12.00 • 400 Amps primary = 4800 Amps primary

The upper limit of this setting (50.00 multiples) is calculated from the Amps secondary range upper limit [20] and settings CT Ratio (No. 3) [1000] and Min. trip–phase (No. 5) [400]:

(20 • 1000)/400 = 50 multiples (upper limit)

Due to processor calculations and rounding techniques, displayed range numbers may appear slightly different than expected (e.g., 49.99 instead of 50.00).

➤ This setting is hidden and set to OFF if High current trip–phase is set to N.

Setting	Default	Range	Incr.
Time delay–phase high current trip	0.00	0–16000.00 cycles	0.25 cyc.

The Time delay–phase high current trip setting programs an intentional time delay for the phase high current tripping. If set to zero (0), phase high current tripping operates instantaneously.

➤ This setting is hidden and set to zero (0) if High current trip–phase is set to N.

Setting	Default	Range	Incr.
Activate high current trip–phase	OFF	OFF, 1–5	1

The Activate high current trip–phase setting determines when phase high current tripping is enabled (e.g., if Activate high current trip–phase = 2, then phase high current tripping is enabled for the second [2nd] trip operation and every following trip operation).

The setting range for Activate high current trip–phase adjusts according to Operations to lockout–phase (e.g., if Operations to lockout–phase = 4, then the range for Activate high current trip–phase is from 1 to 4).

➤ This setting is hidden and set to OFF if High current trip–phase is set to N.

No.	Setting	Default	Range	Incr.
30	High current trip–ground	N	Y/N	

The High current trip–ground setting enables the following three settings for ground high current tripping, if set to Y. Ground high current tripping is not affected by the cold load pickup scheme.

➤ This setting is hidden and set to N if Fast curve–ground (No. 9) and Delay curve–ground (No. 11) are both set to OFF.

No.	Setting	Default	Range	Incr.
	High current trip–ground	OFF	OFF, 1.00–199.99 multiples of Min. trip–ground	0.01

The High current trip–ground (multiples of Min. trip–ground) setting determines the ground current threshold for ground high current tripping.

Example: If High current trip–ground = 44.00 (multiples of Min. trip–ground) and Min. trip–ground (No. 6) = 100 Amps primary, then the ground current threshold for ground high current tripping operates at a value equal to:

44.00 • 100 Amps primary = 4400 Amps primary

The upper limit of this setting (200.00 multiples) is calculated from the Amps secondary range upper limit [20] and settings CT Ratio (No. 3) [1000] and Min. trip–ground (No. 6) [100]:

(20 • 1000)/100 = 200 multiples (upper limit)

Due to processor calculations and rounding techniques, displayed range numbers may appear slightly different than expected (e.g., 199.99 instead of 200.00).

➤ This setting is hidden and set to OFF if High current trip–ground is set to N.

Setting	Default	Range	Incr.
Time delay–ground high current trip	0.00	0–16000.00 cycles	0.25 cyc.

The Time delay–ground high current trip setting programs an intentional time delay for the ground high current tripping. If set to zero (0), ground high current tripping operates instantaneously.

➤ This setting is hidden and set to zero (0) if High current trip–ground is set to N.

Setting	Default	Range	Incr.
Activate high current trip–ground	OFF	OFF, 1–5	1

The Activate high current trip–ground setting determines when ground high current tripping is enabled (e.g., if Activate high current trip–ground = 2, then ground high current tripping is enabled for the second [2nd] trip operation and every following trip operation).

The setting range for Activate high current trip–ground adjusts according to Operations to lockout–ground (e.g., if Operations to lockout–ground = 4, then the range for Activate high current trip–ground is from 1 to 4).

➤ This setting is hidden and set to OFF if High current trip–ground is set to N.

No.	Setting	Default	Range	Incr.
31	High current lockout–phase	N	Y/N	

The High current lockout–phase setting enables the following two settings for phase high current lockout, if set to Y. Phase high current lockout is not affected by the cold load pickup scheme.

➤ This setting is hidden and set to N if Fast curve–phase (No. 8) and Delay curve–phase (No. 10) are both set to OFF.

Setting	Default	Range	Incr.
High current lockout–phase	OFF	OFF, 1.00–49.99 multiples of Min. trip–phase	0.01

The High current lockout–phase (multiples of Min. trip–phase) setting determines the exceeded phase current threshold at which the SEL-351R goes to the lockout state immediately when tripping.

Example: If High current lockout–phase = 13.00 (multiples of Min. trip–phase) and Min. trip–phase (No. 5) = 400 Amps primary, then the phase current threshold for phase high current lockout operates at a value equal to:

13.00 • 400 Amps primary = 5200 Amps primary

The upper limit of this setting (50.00 multiples) is calculated from the Amps secondary range upper limit [20] and settings CT Ratio (No. 3) [1000] and Min. trip–phase (No. 5) [400]:

(20 • 1000)/400 = 50 multiples (upper limit)

Due to processor calculations and rounding techniques, displayed range numbers may appear slightly different than expected (e.g., 49.99 instead of 50.00).

➤ This setting is hidden and set to OFF if High current lockout–phase is set to N.

No.	Setting	Default	Range	Incr.
	Activate high current lockout–phase	OFF	OFF, 1–5	1

The Activate high current lockout–phase setting determines when phase high current lockout is enabled (e.g., if Activate high current lockout–phase = 3, then phase high current tripping is enabled for the third [3rd] trip operation and every following trip operation).

The setting range for Activate high current lockout–phase adjusts according to Operations to lockout–phase (e.g., if Operations to lockout–phase = 4, then the range for Activate high current lockout–phase is from 1 to 4).

➤ This setting is hidden and set to OFF if High current lockout–phase is set to N.

No.	Setting	Default	Range	Incr.
32	High current lockout–ground	N	Y/N	

The High current lockout–ground setting enables the following two settings for ground high current lockout, if set to Y. High current lockout–ground is not affected by the cold load pickup scheme.

➤ This setting is hidden and set to N if Fast curve–ground (No. 9) and Delay curve–ground (No. 11) are both set to OFF.

Setting	Default	Range	Incr.
High current lockout–ground	OFF	OFF, 1.00–199.99 multiples of Min. trip–ground	0.01

The High current lockout–ground (multiples of Min. trip–ground) setting determines the exceeded ground current threshold at which the SEL-351R goes to the lockout state immediately when tripping.

Example: If High current lockout–ground = 45.00 (multiples of Min. trip–ground) and Min. trip–ground (No. 6) = 100 Amps primary, then the ground current threshold for ground high current lockout operates at a value equal to:

45.00 • 100 Amps primary = 4500 Amps primary

The upper limit of this setting (200.00 multiples) is calculated from the Amps secondary range upper limit [20] and settings CT Ratio (No. 3) [1000] and Min. trip–ground (No. 6) [100]:

(20 • 1000)/100 = 200 multiples (upper limit)

Due to processor calculations and rounding techniques, displayed range numbers may appear slightly different than expected (e.g., 199.99 instead of 200.00).

➤ This setting is hidden and set to OFF if High current lockout–ground is set to N.

Setting	Default	Range	Incr.
Activate high current lockout–ground	OFF	OFF, 1–5	1

The Activate high current lockout–ground setting determines when ground high current lockout is enabled (e.g., if Activate high current lockout–ground = 3, then ground high current tripping is enabled for the third [3rd] trip operation and every following trip operation).

The setting range for Activate high current lockout–ground adjusts according to Operations to lockout–ground (e.g., if Operations to lockout–ground = 4, then the range for Activate high current lockout–ground is from 1 to 4).

➤ This setting is hidden and set to OFF if High current lockout–ground is set to N.

No.	Setting	Default	Range	Incr.
33	Cold load pickup scheme	N	Y/N	

The Cold load pickup scheme setting enables the cold load pickup scheme when set to Y.

➤ This setting is hidden and set to N if Delay curve–phase (No. 10) is set to OFF and Delay curve–ground (No. 11) is set to OFF.

➤ If Cold load pickup scheme is set to Y, then you are prompted to program the following settings:

No.	Setting	Default	Range	Incr.
	Cold load pickup–phase	OFF	OFF, 1.00–49.99 multiples of Min. trip–phase	0.01

The Cold load pickup–phase setting determines the phase current threshold for overcurrent detection when the Cold load pickup scheme is active.

Example: If Cold load pickup–phase = 1.70 (multiples of Min. trip–phase), Min. trip–phase (No. 5) = 400 Amps primary, and the cold load pickup scheme is active, then the phase current threshold for overcurrent detection operates at a value equal to:

1.70 • 400 Amps primary = 680 Amps primary

The upper limit of this setting (50.00 multiples) is calculated from the Amps secondary range upper limit [20] and settings CT Ratio (No. 3) [1000] and Min. trip–phase (No. 5) [400]:

(20 • 1000)/400 = 50 multiples (upper limit)

Due to processor calculations and rounding techniques, displayed range numbers may appear slightly different than expected (e.g., 49.99 instead of 50.00).

➤ If Cold load pickup–phase is set to OFF, then the phase current threshold for overcurrent detection remains unchanged (threshold remains equal to Min. trip–phase [No. 5]).

➤ This setting is hidden and set to OFF if Cold load pickup scheme is set to N **or** Delay curve–phase (No. 10) is set to OFF.

Setting	Default	Range	Incr.
Cold load pickup–ground	OFF	OFF, 1.00–199.99 multiples of Min. trip–ground	0.01

The Cold load pickup–ground setting determines the ground current threshold for overcurrent detection when the Cold load pickup scheme is active (also applied to SEF element as the SEF current threshold for overcurrent detection).

Example: If Cold load pickup–ground = 1.50 (multiples of Min. trip–ground), Min. trip–ground (No. 6) = 100 Amps primary, and the cold load pickup scheme is active, then the ground current threshold for overcurrent detection operates at a value equal to:

1.50 • 100 Amps primary = 150 Amps primary

The SEF current threshold for overcurrent detection also operates at a value equal to 150 Amps primary when the cold load pickup scheme is active.

The upper limit of this setting (200.00 multiples) is calculated from the Amps secondary range upper limit [20] and settings CT Ratio (No. 3) [1000] and Min. trip–ground (No. 6) [100]:

(20 • 1000)/100 = 200 multiples (upper limit)

Due to processor calculations and rounding techniques, displayed range numbers may appear slightly different than expected (e.g., 199.99 instead of 200.00).

➤ If Cold load pickup–ground is set to OFF, then the ground current threshold for overcurrent detection remains unchanged (threshold remains equal to setting Min. trip–ground [No. 6]) and the SEF current threshold for overcurrent detection remains unchanged (threshold remains equal to setting Min. trip–SEF [No. 7]).

➤ This setting is hidden and set to OFF if Cold load pickup scheme is set to N **or** Delay curve–ground (No. 11) is set to OFF.

Setting	Default	Range	Incr.
Loss of load diversity time	0.00	0–999999.00 cycles	0.25 cyc.

The Loss of load diversity timer starts to time if **both** the following are true:

➤ The recloser is open.

➤ The control is in the lockout state or reclosing is defeated.

When the Loss of load diversity timer times out, the **cold load pickup scheme is activated**, causing the following to occur:

➤ Fast curves are disabled.

➤ Delay curves and SEF element are desensitized per preceding cold load pickup settings (the curves are not shifted–coordination is maintained).

When the recloser is closed, the cold load pickup scheme remains active. If the recloser remains closed, the current thresholds for overcurrent detection return **naturally** to their regular Min. trip (No. 5, 6, or 7) levels when the inrush current goes below these respective regular levels for at least 15 seconds. The respective fast curves are enabled again. This return to normal conditions is separate for phase, ground, and SEF elements (e.g., ground could return to normal before phase or SEF, depending on the subsidence rates of inrush currents).

➤ This setting is hidden and set to zero (0) if Cold load pickup scheme is set to N.

No.	Setting	Default	Range	Incr.
	Restore min. trips–time limit	OFF	OFF, 0–999999.00 cycles	0.25 cyc.

The Restore min. trips–time limit is an option to **force** current thresholds for overcurrent detection from temporary cold load pickup values back to regular Min. trip (No. 5, 6, or 7) levels. This time limit is set if the user is concerned about an overcurrent element being desensitized too long in the cold load inrush scheme (**force** the threshold back, do not let it return **naturally** as described with the preceding Loss of load diversity timer setting).

Restore min. trips–time limit ≠ OFF:

The Restore min. trips–time limit starts to time if the recloser is closed and both of the following are true:

- The cold load pickup scheme is active for at least one element (see preceding Cold load pickup and Loss of load diversity settings).
- At least one of the following three Restore min. trip settings is set to Y.

If the recloser remains closed, the Restore min. trips–time limit times out and selected current thresholds for overcurrent detection (see following three Restore min. trip settings) are forced back to their respective regular Min. trip (No. 4, 5, and 6) levels. The respective fast curves are also enabled again. The **natural** return to the regular Min. trip levels (described with the preceding Loss of load diversity timer setting) can also occur if the inrush current goes below the Min. trip level for at least 15 seconds **before** Restore min. trips–time limit times out.

Restore min. trips–time limit = OFF:

If the cold load pickup scheme is active, then the current thresholds for overcurrent detection can only return back to their regular Min. trip levels **naturally** as described with the preceding Loss of load diversity timer setting.

- This setting is hidden and set to OFF if Cold load pickup scheme is set to N.

Setting	Default	Range	Incr.
Restore min. trip–phase	N	Y/N	

Restore min. trip–phase = Y:

If the cold load pickup scheme is active, the phase current threshold for overcurrent detection is **forced** back to the regular Min. trip–phase (No. 5) level when the preceding Restore min. trips–time limit times out.

Restore min. trip–phase = N:

If the cold load pickup scheme is active, the phase current threshold for overcurrent detection can only return back to its regular Min. trip–phase level **naturally** as described with the preceding Loss of load diversity timer setting.

- This setting is hidden and set to N if Restore min. trips–time limit is set to OFF or Delay curve–phase (No. 10) is set to OFF.

Setting	Default	Range	Incr.
Restore min. trip–ground	N	Y/N	

Restore min. trip–ground = Y:

If the cold load pickup scheme is active, the ground current threshold for overcurrent detection is **forced** back to the regular Min. trip–ground (No. 6) level when the preceding Restore min. trips–time limit times out.

Restore min. trip–ground = N:

If the cold load pickup scheme is active, the ground current threshold for overcurrent detection can only return back to its regular Min. trip–ground level **naturally** as described with the preceding Loss of load diversity timer setting.

- This setting is hidden and set to N if Restore min. trips–time limit is set to OFF or Delay curve–ground (No. 11) is set to OFF.

Setting	Default	Range	Incr.
Restore min. trip–SEF	N	Y/N	

Restore min. trip–SEF = Y:

If the cold load pickup scheme is active, the SEF current threshold for overcurrent detection is **forced** back to the regular Min. trip–SEF (No. 7) level when the preceding Restore min. trips–time limit times out. The ground current threshold for overcurrent detection derived from setting Cold load pickup–ground is also applied to the SEF element (as the SEF current threshold for overcurrent detection).

Restore min. trip–SEF = N:

If the cold load pickup scheme is active, the SEF current threshold for overcurrent detection can only return back to its regular Min. trip–SEF level **naturally** as described with the preceding Loss of load diversity timer setting.

- This setting is hidden and set to N if Restore min. trips–time limit is set to OFF, Delay curve–ground (No. 11) is set to OFF, or Min. trip–SEF (No. 7) is set to OFF.

No.	Setting	Default	Range	Incr.
34	Sequence coordination	N	Y/N	

The Sequence coordination setting keeps the SEL-351R in step with a downstream recloser control, preventing the overreaching SEL-351R Fast curve elements from tripping for faults beyond the downstream recloser.

Sequence coordination advances the operations counter each time the following sequence occurs:

- The SEL-351R is in the reset state.
- Fast curve–phase (No. 8) or Fast curve–ground (No. 9) element picks up and starts timing for a fault.
- Fast curve–phase (No. 8) or Fast curve–ground (No. 9) element remains picked up for at least 1.25 cycles, but then drops out before tripping (fault was interrupted by downstream device closer to the fault).

When the operations counter is advanced beyond the corresponding Operations–phase fast curve (No. 13) or Operations–ground fast curve (No. 14), no more advancing of the operations counter occurs (the Fast curve elements are disabled). The Fast curve elements are enabled again (the operations counter is reset) after a time period equal to Reset time for auto reclose (No. 22).

- This setting is hidden **and** set to N if the Fast curve–phase and the Fast curve–ground settings are both set to OFF.

No.	Setting	Default	Range	Incr.
35	Ground trip precedence	N	Y/N	

Ground trip precedence = Y:

- If the ground fault current is above the Min. trip–ground (No. 6) level at the time of trip, the operations to lockout follows Operations to lockout–ground (No. 16).
- If ground fault current is below the Min. trip–ground (No. 6) level **and** phase fault current is above the Min. trip–phase (No. 5) level at the time of trip, the determination to go to lockout is controlled by Operations to lockout–phase (No. 15).

Ground trip precedence = N:

- If ground fault current is above the Min. trip–ground (No. 6) level **and** phase fault current is below the Min. trip–phase (No. 5) level at the time of trip, the determination to go to lockout is controlled by Operations to lockout–ground (No. 16).
- If phase fault current is above the Min. trip–phase (No. 5) at the time of trip, the determination to go to lockout is controlled by Operations to lockout–phase (No. 15).
- NOTE: The Operations to lockout–SEF (No. 17) is independent of Ground trip precedence.
- This setting is hidden and set to N if Operations to lockout–phase (No. 15) = OFF, Operations to lockout–ground (No. 16) = OFF, or the Operations to lockout–phase setting equals (=) the Operations to lockout–ground setting.

No.	Setting	Default	Range	Incr.
36	Underfrequency loadshedding	N	Y/N	

The Underfrequency loadshedding setting enables the underfrequency loadshedding scheme, if set to Y.

- If Underfrequency loadshedding is set to Y, enter the following two settings:

Setting	Default	Range	Incr.
Underfrequency pickup	OFF	OFF, 40.10–65.00 Hz	0.01 Hz

The Underfrequency pickup setting determines the frequency threshold for underfrequency loadshedding.

Setting	Default	Range	Incr.
Underfrequency time delay	6.00	2.00–16000.00 cycles	0.25 cyc.

The Underfrequency time delay setting determines the time delay for underfrequency loadshedding.

No.	Setting	Default	Range	Incr.
37	Demand meter time constant	5	5, 10, 15, 30, 60 minutes	

The Demand meter time constant setting determines the thermal demand meter response time.

Global EZ Settings

No.	Setting	Default	Range	Incr.
38	System Frequency	60	50, 60 Hz	

Enter nominal System frequency.

No.	Setting	Default	Range	Incr.
39	Phase Rotation	ABC	ABC, ACB	

Enter system Phase rotation.

No.	Setting	Default	Range	Incr.
40	Recloser Wear Monitor	AUTO	AUTO, Y, N	

Recloser Wear Monitor = Y:

The recloser wear monitor must be set at a higher level, with the **SET G** command (see *Section 8* in the *SEL-351R Recloser Control Instruction Manual*). G&W Viper-S recloser wear monitor settings are listed in *Section 8: Breaker/Recloser Contact Wear Monitor* in the *SEL-351R Recloser Control Instruction Manual*.

Recloser Wear Monitor = N:

The recloser wear monitor is turned off.

Recloser Wear Monitor = AUTO:

This setting is usually selected if a recloser is connected to the SEL-351R. Enter the following two settings:

Setting	Default	Range	Incr.
Recloser type	OIL	OIL, VAC1, VAC2	
Interrupt rating	6000	500–20000 Amps primary	1

These settings are derived from ANSI C37.61-1973/IEEE Standard 321–1973, IEEE Standard Guide for the Application, Operation, and Maintenance of Automatic Circuit Reclosers. Make these settings by finding your recloser model in *Table 4.5* and then entering the corresponding settings.

➤ These settings are hidden and nonoperative if Recloser Wear Monitor ≠ AUTO.

Table 4.5 Recloser Interrupt Data

Recloser Model	Recloser Type	Interrupt Rating (Amps primary)	Recloser Model	Recloser Type	Interrupt Rating (Amps primary)
RXE	OIL	6000	WVE38X	OIL	8000
RVE	OIL	6000	VSA12	VAC2	12000
WE	OIL	12000 (@ 4.8 kV)	VSA16	VAC2	16000
WE	OIL	10000 (@ 14.4 kV)	VSA20	VAC2	20000
VWE	VAC2	12000	VSA20A	VAC2	20000
VWVE27	VAC2	12000	VSA20B	VAC2	20000
VWVE38X	VAC2	12000	VSO12	VAC2	12000
WVE27	OIL	8000	VSO16	VAC2	16000

No.	Setting	Default	Range	Incr.
41	Reset trip–latched LEDs on close	Y	Y,Y1,N,N1	

Figure 3.3 shows the front-panel trip–latched LEDs. They are: **TRIP**, **FAST CURVE**, **HIGH CURRENT**, **81**, and all **FAULT TYPE** LEDs.

These LEDs latch in at the rising edge of trip and remain illuminated–even after power is turned off and then on again.

Reset trip–latched LEDs on close = Y or Y1:

The trip–latched LEDs extinguish automatically when the recloser closes.

Reset trip–latched LEDs on close = N or N1:

The trip–latched LEDs extinguish automatically (or are newly latched in) when the SEL-351R trips again.

Settings options Y1 and N1 disable the embedded 3–second qualifying time delay on the **LOCK** operator control (see *Operator Controls on page 3.6*). In this mode, the **LOCK** operator control effectively operates as the other operator controls, with no time delay.

No.	Setting	Default	Range	Incr.
42	True three–phase voltage connected	N	Y/N	

If True three–phase voltage is connected to the SEL-351R, the indication provided by **A**, **B**, and **C FAULT TYPE** LEDs is made more secure (see *Figure 3.3*).

No.	Setting	Default	Range	Incr.
43	Phantom voltages from	OFF	VA,VB,VC,VAB,VBC,VCA,OFF	

If True three–phase voltage is set to N on an SEL-351R, the phantom voltage setting is available. In this mode the relay generates three balanced voltages, for metering only, from a single phase–to–ground or phase–to–phase connected voltage. Regardless of the phase selected, the voltage must be physically connected to phase **V1** on the SEL-351R.

No.	Setting	Default	Range	Incr.
44	**V123** Terminal Conn. or **V123** Terminal Conn.	A	A,B,C,AB,BC,CA,OFF ABC,ACB,BAC,BCA,CAB,CBA	

The voltage terminal connection setting allows the transition from the power system A-B-C wiring to the SEL-351R recloser control terminals **V1-V2-V3**.

If True three-phase voltage (#42) is set to N and Phantom voltages (#43) is set to OFF, voltage terminal connections A, B, C, AB, BC, CA, and OFF are available. When settings are saved, if **V123** Terminal Connection setting is out of range, the setting defaults to A.

If True three-phase voltage is set to Y then voltage terminal connections ABC, ACB, BAC, BCA, CAB, and CBA are available. When settings are saved, if **V123** Terminal Connection setting is out of range, the setting defaults to ABC.

No.	Setting	Default	Range	Incr.
45	**I123** Terminal Conn.	ABC	ABC,ACB,BAC,BCA,CAB,CBA	

The current terminal connection setting allows the transition from the power system A-B-C wiring to the SEL-351R recloser control terminals **I1-I2-I3**. The default current setting wiring is shown in *Figure 1.14*.

No.	Setting	Default	Range	Incr.
46	CT polarity	POS	POS, NEG	

The CT Polarity setting provides an easy way to change the polarity of the measured current signals, thus the resulting power direction and impedances.

No.	Setting	Default	Range	Incr.
47	Battery Amp–hours	8.0	6.5–20.0 Amp–hours	0.1

If a different replacement battery is used, the Battery Amp–hours setting may have to be changed (set no greater than the battery rating; see *Battery Replacement on page 6.5*.

No.	Setting	Default	Range	Incr.
48	% Battery capacity for sleep	20	0–100%	1

The % Battery capacity for sleep setting is typically set at 20% capacity, so that the battery is not totally depleted during an extended outage.

- If the % Battery capacity for sleep setting (e.g., 20% capacity) is reached or the battery voltage measurement falls below 21.6 V during an extended outage, the SEL-351R goes to sleep, unless communications are actively ongoing with the SEL-351R.
- If the % Battery capacity for sleep is set at 0% capacity and the SEL-351R is operating on the battery during an extended outage, the SEL-351R goes to sleep when the battery voltage measurement falls below 21.6 V, unless communications are actively ongoing with the SEL-351R.
- If the battery voltage measurement falls below 20.4 V during an extended outage, the SEL-351R goes to sleep, regardless of any other conditions.

No.	Setting	Default	Range	Incr.
49	Turn on the 12 V power	N	Y/N	

The Turn on the 12 V power setting turns the 12 V power on when set to Y.

- See *Figure 1.9* and *Table 1.1* for information on how to access the 12 Vdc power and its capability rating.
- If the Turn on the 12 V power setting is set to Y, then you are prompted to enter the following setting:

Setting	Default	Range	Incr.
Keep the 12 V power on while asleep	N	Y/N	

Refer to the preceding % Battery capacity for sleep setting (No. 48).

Keep the 12 V power on while asleep = Y:

- If the SEL-351R goes to sleep, but the battery voltage measurement is above 21.0 V, the 12 Vdc power is kept on.
- If the battery voltage measurement falls below 21.0 V during an extended outage, the 12 Vdc power is turned off.
- The application for this feature involves keeping a radio or some device powered to receive a signal to transmit to the Wake–Up port to wake up the SEL-351R remotely (see the front of *Section 10* in the *SEL-351R Recloser Control Instruction Manual* for more information on the Wake–Up port).

Keep the 12 V power on while asleep = N:

- If the SEL-351R goes to sleep, the 12 Vdc power is turned off.
- This setting is hidden and set to N if Turn on the 12 V power is set to N.

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EZ Settings Sheets for the SEL-351R Recloser Control

⚠WARNING

Any time an EZ setting is changed, review all the EZ settings before enabling the new settings. Pay close attention in circumstances where a setting was once set to OFF or N and then later turned on (enabled)–other related settings may need to be turned on, though may still be set to OFF or N.

Settings Groups 1 (Main) and 2 (Alternate) EZ Settings (SET EZ n Command; n = 1, 2)

Control Identifier (30 characters)
Range: 0–9, A–Z, -, /, ., space
Incr.: --

Control Identifier (30 characters)
Range: 0–9, A–Z, -, /, ., space
Incr.: --

CT Ratio
Range: 1.0–6000.0
Incr.: 1

PT Ratio
Range: 1.0–10000.0
Incr.: 1

Min. trip–phase *Ranges given for CT Ratio = 1000.0*
Range: OFF, 50.00–3199.99 A primary
Incr.: 0.01

Min. trip–ground *Ranges given for CT Ratio = 1000.0*
Range: OFF, 5.00–3199.99 A primary
Incr.: 0.01

Min. trip–SEF *Ranges given for CT Ratio = 1000.0*
Range: OFF, 5.00–1499.99 A primary
Incr.: 0.01

Fast Curve–phase (see *Recloser Curve Designations on page SET.8*)
Range: OFF, U1–U5 (US), C1–C5 (IEC)
Incr.: --

Time dial–phase fast curve
Range: 0.50–15.00 (U1–U5), 0.05–1.00 (C1–C5)
Incr.: 0.01

EM reset–phase fast curve
Range: Y/N
Incr.: --

Fast Curve–ground (see *Recloser Curve Designations*)
Range: OFF, U1–U5 (US), C1–C5 (IEC)
Incr.: --

Time dial–ground fast curve
Range: 0.50–15.00 (U1–U5), 0.05–1.00 (C1–C5)
Incr.: 0.01

EM reset–ground fast curve
Range: Y/N
Incr.: --

Delay Curve–phase (see *Recloser Curve Designations*)
Range: OFF, U1–U5 (US), C1–C5 (IEC)
Incr.: --

Time dial–phase delay curve
Range: 0.50–15.00 (U1–U5), 0.05–1.00 (C1–C5)
Incr.: 0.01

EM reset–phase delay curve
Range: Y/N
Incr.: --

Delay Curve–ground (see *Recloser Curve Designations*)
Range: OFF, U1–U5 (US), C1–C5 (IEC)
Incr.: --

Time dial–ground delay curve
Range: 0.50–15.00 (U1–U5), 0.05–1.00 (C1–C5)
Incr.: 0.01

EM reset–ground delay curve
Range: Y/N
Incr.: --

Time delay–SEF
Range: 0–16000.00 cycles
Incr.: 0.25

Operations–phase fast curve
Range: OFF, 1–5
Incr.: 1

Operations–ground fast curve
Range: OFF, 1–5
Incr.: 1

Operations to lockout–phase
Range: OFF, 1–5
Incr.: 1

Operations to lockout–ground
Range: OFF, 1–5
Incr.: 1

Operations to lockout–SEF
Range: OFF, 1–5
Incr.: 1

Reclose interval 1
Range: 0–999999.00 cycles
Incr.: 0.25 _____

Reclose interval 2
Range: 0–999999.00 cycles
Incr.: 0.25 _____

Reclose interval 3
Range: 0–999999.00 cycles
Incr.: 0.25 _____

Reclose interval 4
Range: 0–999999.00 cycles
Incr.: 0.25 _____

Reset time from auto reclose
Range: 0–999999.00 cycles
Incr.: 0.25 _____

Reset time from lockout
Range: 0–999999.00 cycles
Incr.: 0.25 _____

Close power wait time
Range: OFF, 0–999999.00 cycles
Incr.: 0.25 _____

Complex fast curve–phase
Range: Y/N
Incr.:-- _____

Const. time adder–phase fast curve
Range: 0–60.00 cycles
Incr.: 0.25 _____

Vert. multiplier–phase fast curve
Range: 0.10–2.00 cycles
Incr.: 0.01 _____

Min. response–phase fast curve
Range: 0–60.00 cycles
Incr.: 0.25 _____

Complex fast curve–ground
Range: Y/N
Incr.:-- _____

Const. time adder–ground fast curve
Range: 0–60.00 cycles
Incr.: 0.25 _____

Vert. multiplier–ground fast curve
Range: 0.10–2.00 cycles
Incr.: 0.01 _____

Min. response–ground fast curve
Range: 0–60.00 cycles
Incr.: 0.25 _____

Complex delay curve–phase
Range: Y/N
Incr.:--

Const. time adder–phase delay curve
Range: 0–60.00 cycles
Incr.: 0.25

Vert. multiplier–phase delay curve
Range: 0.10–2.00 cycles
Incr.: 0.01

Min. response–phase delay curve
Range: 0–60.00 cycles
Incr.: 0.25

Complex delay curve–ground
Range: Y/N
Incr.:--

Const. time adder–ground delay curve
Range: 0–60.00 cycles
Incr.: 0.25

Vert. multiplier–ground delay curve
Range: 0.10–2.00 cycles
Incr.: 0.01

Min. response–ground delay curve
Range: 0–60.00 cycles
Incr.: 0.25

High current trip–phase
Range: Y/N
Incr.: --

High current trip–phase *(range given for CT Ratio = 1000.0)*
Range: 1.00–(20000/Min. trip–phase)
multiples of Min. trip–phase
Incr.: 0.01

Time delay–phase high current trip
Range: 0–16000.00 cycles
Incr.: 0.25

Activate high current trip–phase
Range: OFF, 1–5
Incr.: 1

High current trip–ground
Range: Y/N
Incr.: --

High current trip–ground *(range given for CT Ratio = 1000.0)*
Range: 1.00–(20000/Min. trip–ground)
multiples of Min. trip–ground
Incr.: 0.01

Time delay–ground high current trip
Range: 0–16000.00 cycles
Incr.: 0.25

Activate high current trip–ground
Range: OFF, 1–5
Incr.: 1

High current lockout–phase
Range: Y/N
Incr.: --

High current lockout–phase *(range given for CT Ratio = 1000.0)*
Range: 1.00–(20000/Min. trip–phase)
multiples of Min. trip–phase
Incr.: 0.01

Activate high current lockout–phase
Range: OFF, 1–5
Incr.: 1

High current lockout–ground
Range: Y/N
Incr.: --

High current lockout–ground
(range given for CT Ratio = 1000.0)
Range: 1.00–(20000/Min. trip–ground)
multiples of Min. trip–ground
Incr.: 0.01

Activate high current lockout–ground
Range: OFF, 1–5
Incr.: 1

Cold load pickup scheme
Range: Y/N
Incr.: --

Cold load pickup–phase *(range given for CT Ratio = 1000.0)*
Range: 1.00–(20000/Min. trip–phase)
multiples of Min. trip–phase
Incr.: 0.01

Cold load pickup–ground *(range given for CT Ratio = 1000.0)*
Range: 1.00–(20000/Min. trip–ground)
multiples of Min. trip–ground
Incr.: 0.01

Loss of load diversity time
Range: 0–999999.00 cycles
Incr.: 0.25

Restore min. trips–time limit
Range: OFF, 0–999999.00 cycles
Incr.: 0.25

Restore min. trip–phase
Range: Y/N
Incr.: --

Restore min. trip–ground
Range: Y/N
Incr.: --

Restore min. trip–SEF
Range: Y/N
Incr.: --

Sequence coordination
Range: Y/N
Incr.: --
_____

Ground trip precedence
Range: Y/N
Incr.: --
_____

Underfrequency loadshedding
Range: Y/N
Incr.: --
_____

Underfrequency pickup
Range: OFF, 40.10–65.00 Hz
Incr.: 0.01
_____

Underfrequency time delay
Range: 2–16000.00 cycles
Incr.: 0.25
_____

Demand meter time constant
Range: 5, 10, 15, 30, 60 minutes
Incr.: --
_____

Global EZ Settings (SET FZ Command)

System Frequency
Range: 50, 60 Hz
Incr.: --
_____

Phase Rotation
Range: ABC, ACB
Incr.: --
_____

Recloser Wear Monitor
Range: AUTO, Y, N
Incr.: --
_____

Recloser type
Range: OIL, VAC1, VAC2
Incr.: --
_____

Interrupt rating
Range: 500–20000 A pri.
Incr.: 1
_____

Reset trip-latched LEDs on close
Range: Y, Y1, N, N1
Incr.: --
_____

True three-phase voltage connected
Range: Y/N
Incr.: --
_____

Phantom voltages from
Range: VA, VB, VC, VAB, VBC, VCA, OFF
Incr.: --
_____

Voltage terminal connections (**V1**, **V2**, **V3**)

V123 terminal connections
If True three-phase voltage connected = N and Phantom voltages = OFF
Range: A, B, C, AB, BC, CA, OFF
Incr.: --
Or
If True three-phase voltage connected = Y, then
Range: ABC, ACB, BAC, BCA, CAB,CBA
Incr.: --

Current terminal connections (**I1**, **I2**, **I3**)

I123 terminal connections
Range: ABC, ACB, BAC, BCA, CAB, CBA
Incr.: --

CT polarity

Range: POS, NEG
Incr.: --

Battery Amp-hours

Range: 6.5–20.0 Amp-hours
Incr.: 0.1

% Battery capacity for sleep
Range: 0–100%
Incr.: 1

Turn on the 12 V power
Range: Y/N
Incr.: --

Keep the 12 V power on while asleep
Range: Y/N
Incr.: --

Recloser Curve Designations

Quick Reference for Curve Settings:

Fast Curve–phase
Fast curve–ground
Delay curve–phase
Delay curve–ground
Use any mix of old and new recloser curve designations when making curve settings.

Recloser Curve Cross Reference-Old to New					
Old	**New**	**Old**	**New**	**Old**	**New**
A	101	P	115	7	152
B	117	R	105	8	113
C	133	T	161	8PLUS	111
D	116	V	137	9	131
E	132	W	138	KG	165
F	163	Y	120	11	141
G	121	Z	134	13	142
H	122	1	102	14	119
J	164	2	135	15	112
KP	162	3	140	16	139
L	107	4	106	17	103
M	118	5	114	18	151
N	104	6	136		

US Curve	Description
U1	moderately inverse
U2	inverse
U3	very inverse
U4	extremely inverse
U5	short-time inverse
IEC Curve	**Description**
C1	class A (standard inverse)
C2	class B (very inverse)
C3	class C (extremely inverse)
C4	long-time inverse
C5	short-time inverse
User-Programmable Curves (factory-set)	**Description**
DEF_01	definite-time curve (0.1 seconds)
DEF_05	definite-time curve (0.5 seconds)
DEF_1	definite-time curve (1.0 seconds)
DEF_5	definite-time curve (5.0 seconds)

Section 5
Testing

Overview

TEST BATTERY WITH TYPE MET CONTROL TESTER?
The battery testing capability of the Type MET Control Tester is not used with the SEL-351R Recloser Control. See Section 6: Battery for battery test procedures used with the SEL-351R.

⚠CAUTION
Read the operating instructions accompanying the Type MET Electronic Recloser Control Tester for an understanding of the safety and operating issues related to the Type MET Control Tester. Pay special attention to all CAUTION, WARNING, and DANGER messages in the operating instructions accompanying the Type MET Electronic Recloser Control Tester.

Basic recloser control functions in the SEL-351R Recloser Control can be tested with the Type MET Electronic Recloser Control Tester (Type MET Control Tester). The tests covered in this section are:

- Control operation–sequencing through a reclose cycle with fast and delay curve operations
- Minimum-trip tests–for phase and ground
- Fast and delay curve checks–for phase and ground
- Reclosing tests–for reclose interval and reset times

Preceding sections in this guide explain how to set, operate, and communicate with the SEL-351R.

AC AMMETER on the Type MET Control Tester

The **AC AMMETER** has two scales:

- top scale: range 0 through 10
- bottom scale: range 0 through 3

Switch **S-4** (**AMMETER RANGE**) on the Type MET Control Tester has the following five range selections:

30 mA 100 mA 300 mA 1 A 3 A

Use the top scale of the **AC AMMETER** (0 through 10) when switch **S-4** (**AMMETER RANGE**) is set on the **100 mA** or **1 A** range selections. Use the bottom scale of the **AC AMMETER** (0 through 3) when switch **S-4** (**AMMETER RANGE**) is set on the **30 mA**, **300 mA**, or **3 A** range selections.

To convert the displayed current value on the **AC AMMETER** (in mA secondary or Amp secondary) to primary current values, multiply the displayed current value by the current transformer ratio (typically 1000:1 in reclosers). For example, if switch **S-4** (**AMMETER RANGE**) is set on the **300 mA** range selection (use bottom scale: range 0 through 3) and the **AC AMMETER** displays 2.6 (260 mA secondary) then:

0.26 Amp secondary • 1000 (Amps primary/Amps secondary)
= 260 Amp primary.

Testing In-Service Control

The SEL-351R can be removed from service for testing and placed back into service without opening the recloser and interrupting service. However, during the time the SEL-351R is out of service, overcurrent protection provided by this recloser installation is lost. Backup overcurrent protection from other locations needs to be checked for adequacy.

Removing the SEL-351R Recloser Control From Service

⚠CAUTION
To prevent unintentional tripping of the recloser, the SEL-351R must be removed from service prior to any testing.

⚠DANGER
If the recloser is energized while the control cable is disconnected from the recloser control, the CT secondaries in the control cable may generate dangerously high voltages. Do not come in contact with the pins or pin sockets in the control cable. Contact with high voltage can cause serious injury or death.

Step 1. Record settings and status of the front-panel operator controls so you can return to these settings and operator control status when testing is finished and the SEL-351R is placed back in service.

Step 2. Disable ground overcurrent tripping with the **GROUND ENABLED** operator control on the SEL-351R (corresponding LED extinguishes).

Step 3. Disconnect the control cable from the control cable receptacle at the bottom of the SEL-351R enclosure.

Placing the SEL-351R Recloser Control Back in Service

Step 1. Check that the battery is connected and all settings and operator control status are as desired for normal operation.

Step 2. Disable ground overcurrent tripping with the **GROUND ENABLED** operator control on the SEL-351R (corresponding LED extinguishes).

Step 3. Reconnect the control cable from the control cable receptacle at the bottom of the SEL-351R enclosure.

Step 4. If desired for normal operation, enable ground overcurrent tripping with the **GROUND ENABLED** operator control on the SEL-351R (corresponding LED illuminates).

Initial Conditions for Control Tests

SEL-351R Recloser Control

OBSERVE RECLOSER COUNT SEQUENCING DURING TESTING
See Pushbutton Primary Functions on page 3.4 (**OTHER** pushbutton—select 79).

REMEMBER, LOCK CONTROLS OTHER OPERATOR CONTROLS
See Operator Controls on page 3.6.

Step 1. De-energize the SEL-351R.

Step 2. Ground the enclosure of the SEL-351R (see *Figure 1.4*).

Step 3. Connect the battery inside the SEL-351R enclosure–be sure of polarity (see *Figure 1.6*).

Step 4. Power the SEL-351R with 120 Vac (see *Figure 1.7*). The **CONTROL ENABLED** and **AC SUPPLY** LEDs illuminate.

Step 5. If reclosing tests are going to be performed, voltage input **V1** must be energized with nominal 120 Vac.

Energized voltage input **V1** is an **indication** that close power is present for reclosing the main contacts and compressing the tripping springs in the recloser. Close power is usually either 120 Vac or primary voltage, depending on recloser construction.

For installations without three-phase voltage, the factory-installed jumper to voltage input **V1** provides the required 120 Vac indication (see *Figure 1.7* and *Figure 1.11*).

For installations with three-phase voltage, the factory-installed jumper to voltage input **V1** is removed (see *Figure 1.8* and *Figure 1.11*).

But if three-phase voltage is not brought to the unit during testing, the factory-installed jumper to voltage input **V1** can be left in place to provide the required 120 Vac indication. Make sure to remove the factory-installed jumper to voltage input **V1** after testing, before three-phase voltage is brought to the unit for the actual installation.

Other variations are possible for close power indication. See *Reclose Supervision Logic* in *Section 1* of the *SEL-351R Recloser Control Instruction Manual*.

The battery must also be healthy (i.e., battery charges/discharges OK, passes load test) for reclosing to proceed. A trip may follow any reclose and thus full trip circuit integrity (which includes a healthy battery) is required.

Step 6. Disable all the functions controlled by the SEL-351R operator controls: **GROUND ENABLED**, **RECLOSE ENABLED**, **REMOTE ENABLED**, **ALTERNATE SETTINGS**, **LOCK**, **AUX 1**, and **AUX 2**. The corresponding LEDs for all these functions should then be extinguished, indicating that the features are disabled.

Step 7. Make appropriate settings for the SEL-351R, if needed.

Type MET Control Tester

⚠CAUTION
Read the operating instructions accompanying the Type MET Electronic Recloser Control Tester for an understanding of the safety and operating issues related to the Type MET Control Tester. Pay special attention to all CAUTION, WARNING, and DANGER messages in the operating instructions accompanying the Type MET Control Tester.

Step 1. De-energize Type MET Control Tester (not plugged in and switch **S-1** [**POWER 115 Vac**] is in the **OFF** position).

Step 2. Set knob switch **S-6** (**TEST SELECTOR**) to **BATT. VOLTS 40 V**.

Step 3. Set all other rotary switches (**S-3**, **S-4**, **S-5**, and **TR-1**) in the most counter-clockwise position.

Step 4. Set switch **S-9** (**GROUND TRIP**) to **NORMAL**. If setting Min. Trip–Ground < 10 Amp primary (1000:1 CT ratio), then set switch **S-9** (**GROUND TRIP**) to **LOW**.

Step 5. Set switch **S-2** (**FAULT CURRENT**) to **OFF**.

Step 6. For newer Type MET Control Testers with switches **S-11** (**DISPLAY MODE**) and **S-12** (**AUTO RESET**), set these to **UPDATE** and **ON**, respectively.

Step 7. Plug the power cord into a 115 Vac grounded outlet.

Step 8. Energize the tester by moving switch **S-1** (**POWER 115 Vac**) to **ON**.

Step 9. Connect the Type MET Control Tester to the SEL-351R with an appropriate test cable supplied with the tester.

Make the connection from the **CONTROL** receptacle on the Type MET Control Tester (using the elbow-plug end of the test cable) to the control cable receptacle at the bottom of the SEL-351R enclosure (using the straight-plug end of the test cable).

Step 10. Check the **RECLOSER SIMULATOR** lights (**OPEN**–Green; **CLOSED**–Red).

If the **OPEN** light is not illuminated, open the **RECLOSER SIMULATOR** by pressing the **TRIP** operator control pushbutton on the SEL-351R.

The **OPEN** light on the Type MET Control Tester and the corresponding **RECLOSER OPEN** LED on the SEL-351R both illuminate.

Step 11. Press pushbutton **S-10** (**RESET TIMER**) to reset the timer to zero.

Control Operation Tests

Phase Trip

Step 1. Check that the SEL-351R and Type MET Control Tester settings are as specified in *Initial Conditions for Control Tests on page 5.2* (including **RECLOSER SIMULATOR OPEN** and rotary switch **TR-1** [**FAULT CURRENT ADJUST**] in most counter-clockwise position).

Step 2. Disable ground overcurrent tripping with the **GROUND ENABLED** operator control on the SEL-351R (corresponding LED extinguishes).

Step 3. Enable reclosing with the **RECLOSE ENABLED** operator control on the SEL-351R (corresponding LED illuminates).

Step 4. Set switch **S-4** (**AMMETER RANGE**) to the appropriate range.

Refer to preceding *AC AMMETER on the Type MET Control Tester on page 5.1* for more information on selecting this range. Most often, the 1 Amp range will suffice.

Step 5. While holding switch **S-2** (**FAULT CURRENT**) in the **CALIBRATE** position, adjust switch **TR-1** (**FAULT CURRENT ADJUST**) clockwise until the **AC AMMETER** displays a current level corresponding to approximately 125–150% of the Min. trip–phase setting.

Release switch **S-2** (**FAULT CURRENT**), and it returns to the **OFF** position.

Step 6. Set switch **S-3** (**TIME SELECTOR**) to **CONTROL RESPONSE**.

a. For newer Type MET Control Testers with switches **S-11** (**DISPLAY MODE**) and **S-12** (**AUTO RESET**), set these to **UPDATE** and **ON**, respectively.

b. Press pushbutton **S-10** (**TIMER RESET**) to reset the timer to zero if needed.

Step 7. Close the **RECLOSER SIMULATOR** by pressing the **CLOSE** operator control pushbutton on the SEL-351R.

The **CLOSED** light on the Type MET Control Tester and the **RECLOSER CLOSED** LED on the SEL-351R both illuminate.

Wait a time period equal to the Reset time from lockout setting for the **CONTROL STATE RESET** LED on the SEL-351R to illuminate.

Step 8. Apply a fault to the SEL-351R by setting switch **S-2** (**FAULT CURRENT**) to the **TEST** position.

Observe a number of things going on with the SEL-351R target LEDs: the **CONTROL STATE RESET** LED extinguishes and the **CYCLE** LED illuminates; **TRIP** and **FAULT TYPE** LEDs illuminate with each trip.

At the end of the reclose cycle, the **CONTROL STATE CYCLE** LED extinguishes, and the **LOCKOUT** LED illuminates.

Step 9. Set switch **S-2** (**FAULT CURRENT**) back to the **OFF** position.

Step 10. Compare the number of phase fast and delay curve operations with the actual settings of the SEL-351R.

Step 11. Repeat steps 7 through 10 with switch **S-5** (**PHASE SELECTOR**) set at **B** (Phase B) and then at **C** (Phase C).

Step 12. Return the SEL-351R and Type MET Control Tester settings to those specified in *Initial Conditions for Control Tests on page 5.2* before proceeding to the next test.

Ground Trip

Step 1. Check that the SEL-351R and Type MET Control Tester settings are as specified in *Initial Conditions for Control Tests* (including **RECLOSER SIMULATOR OPEN** and rotary switch **TR-1** [**FAULT CURRENT ADJUST**] in most counter-clockwise position).

Step 2. Effectively disable phase overcurrent tripping by doubling (2 x) or tripling (3 x) setting value Min. trip–phase and making setting Operations–phase fast curve = OFF.

Step 3. Enable ground overcurrent tripping with the **GROUND ENABLED** operator control on the SEL-351R (corresponding LED illuminates).

Step 4. Enable reclosing with the **RECLOSE ENABLED** operator control on the SEL-351R (corresponding LED illuminates).

Step 5. Set switch **S-4** (**AMMETER RANGE**) to the appropriate range.

Refer to *AC AMMETER on the Type MET Control Tester on page 5.1* for more information on selecting this range.

Most often, the 300 mA range will suffice for ground overcurrent elements (usually set more sensitively than phase overcurrent elements).

Step 6. While holding switch **S-2** (**FAULT CURRENT**) in the **CALIBRATE** position, adjust switch **TR-1** (**FAULT CURRENT ADJUST**) clockwise until the **AC AMMETER** displays a current level corresponding to approximately 125–150% of the Min. trip–ground setting (make sure to look at the correct scale on the **AC AMMETER**).

Release switch **S-2** (**FAULT CURRENT**), and it returns to the **OFF** position.

Step 7. Set switch **S-3** (**TIME SELECTOR**) to **CONTROL RESPONSE**.

a. For newer Type MET Control Testers with switches **S-11** (**DISPLAY MODE**) and **S-12** (**AUTO RESET**), set these to **UPDATE** and **ON**, respectively.

b. Press pushbutton **S-10** (**TIMER RESET**) to reset the timer to zero if needed.

Step 8. Close the **RECLOSER SIMULATOR** by pressing the **CLOSE** operator control pushbutton on the SEL-351R.

The **CLOSED** light on the Type MET Control Tester and the **RECLOSER CLOSED** LED on the SEL-351R both illuminate.

Wait a time period equal to the Reset time from lockout setting for the **CONTROL STATE RESET** LED on the SEL-351R to illuminate.

Step 9. Apply a fault to the SEL-351R by setting switch **S-2** (**FAULT CURRENT**) to the **TEST** position.

Observe a number of things going on with the SEL-351R target LEDs: the **CONTROL STATE RESET** LED extinguishes and the **CYCLE** LED illuminates; **TRIP** and **FAULT TYPE** LEDs illuminate with each trip.

At the end of the reclose cycle, the **CONTROL STATE CYCLE** LED extinguishes, and the **LOCKOUT** LED illuminates.

Step 10. Set switch **S-2** (**FAULT CURRENT**) back to the **OFF** position.

Step 11. Compare the number of ground fast and delay curve operations with the actual settings of the SEL-351R.

Step 12. Enable phase overcurrent tripping by returning settings Min. trip–phase and Operations–phase fast curve to their normal setting values.

Step 13. Return the SEL-351R and Type MET Control Tester settings to those specified in *Initial Conditions for Control Tests on page 5.2* before proceeding to the next test.

Minimum-Trip Tests

Phase

Step 1. Check that the SEL-351R and Type MET Control Tester settings are as specified in *Initial Conditions for Control Tests* (including **RECLOSER SIMULATOR OPEN** and rotary switch **TR-1** [**FAULT CURRENT ADJUST**] in most counter-clockwise position).

Step 2. Check to make sure that the SEL-351R is programmed for at least one phase fast curve trip operation (setting Operations–phase fast curve ≥ 1).

Step 3. Disable ground overcurrent tripping with the **GROUND ENABLED** operator control on the SEL-351R (corresponding LED extinguishes).

Step 4. Disable reclosing with the **RECLOSE ENABLED** operator control on the SEL-351R (corresponding LED extinguishes).

Step 5. Set switch **S-4** (**AMMETER RANGE**) to the appropriate range.

Refer to *AC AMMETER on the Type MET Control Tester on page 5.1* for more information on selecting this range. Most often, the 1 Amp range will suffice.

Step 6. Close the **RECLOSER SIMULATOR** by pressing the **CLOSE** operator control pushbutton on the SEL-351R.

The **CLOSED** light on the Type MET Control Tester and the **RECLOSER CLOSED** LED on the SEL-351R both illuminate.

Wait a time period equal to the Reset time from lockout setting for the **CONTROL STATE RESET** LED on the SEL-351R to illuminate.

Step 7. Set switch **S-2** (**FAULT CURRENT**) to the **TEST** position.

a. Slowly adjust switch **TR-1** (**FAULT CURRENT ADJUST**) clockwise until the SEL-351R trips.

b. Set switch **S-2** (**FAULT CURRENT**) back to the **OFF** position.

c. To again read the current level that the phase fast curve tripped at (equal to setting Min. trip–phase), hold switch **S-2** (**FAULT CURRENT**) in the **CALIBRATE** position and again read the **AC AMMETER**.

d. Release switch **S-2** (**FAULT CURRENT**), and it returns to the **OFF** position.

Step 8. Repeat steps 6 and 7 with switch **S-5** (**PHASE SELECTOR**) set at **B** (Phase B) and then at **C** (Phase C).

Step 9. Return the SEL-351R and Type MET Control Tester settings to those specified in *Initial Conditions for Control Tests on page 5.2* before proceeding to the next test.

Ground

Step 1. Check that the SEL-351R and Type MET Control Tester settings are as specified in *Initial Conditions for Control Tests* (including **RECLOSER SIMULATOR OPEN** and rotary switch **TR-1** [**FAULT CURRENT ADJUST**] in most counter-clockwise position).

Step 2. Effectively disable phase overcurrent tripping by doubling (2 x) or tripling (3 x) setting value Min. trip–phase and making setting Operations–phase fast curve = OFF.

Step 3. Check to make sure that the SEL-351R is programmed for at least one ground fast curve trip operation (setting Operations–ground fast curve ≥ 1).

Step 4. Enable ground overcurrent tripping with the **GROUND ENABLED** operator control on the SEL-351R (corresponding LED illuminates).

Step 5. Disable reclosing with the **RECLOSE ENABLED** operator control on the SEL-351R (corresponding LED extinguishes).

Step 6. Set switch **S-4** (**AMMETER RANGE**) to the appropriate range.

Refer to *AC AMMETER on the Type MET Control Tester on page 5.1* for more information on selecting this range.

Most often, the 300 mA range will suffice for ground overcurrent elements (usually set more sensitively than phase overcurrent elements).

Step 7. Close the **RECLOSER SIMULATOR** by pressing the **CLOSE** operator control pushbutton on the SEL-351R.

The **CLOSED** light on the Type MET Control Tester and the **RECLOSER CLOSED** LED on the SEL-351R both illuminate.

Wait a time period equal to the Reset time from lockout setting for the **CONTROL STATE RESET** LED on the SEL-351R to illuminate.

Step 8. Set switch **S-2** (**FAULT CURRENT**) to the **TEST** position.

a. Slowly adjust switch **TR-1** (**FAULT CURRENT ADJUST**) clockwise until the SEL-351R trips.

b. Set switch **S-2** (**FAULT CURRENT**) back to the **OFF** position.

c. To again read the current level at which the ground fast curve tripped (equal to setting Min. trip–ground), hold switch **S-2** (**FAULT CURRENT**) in the **CALIBRATE** position and again read the **AC AMMETER** (make sure to look at the correct scale on the **AC AMMETER**).

d. Release switch **S-2** (**FAULT CURRENT**), and it returns to the **OFF** position.

Step 9. Enable phase overcurrent tripping by returning settings Min. trip–phase and Operations–phase fast curve to their normal setting values.

Step 10. Return the SEL-351R and Type MET Control Tester settings to those specified in *Initial Conditions for Control Tests on page 5.2* before proceeding to the next test.

Fast and Delay Curve Checks

Phase Fast Curve

Step 1. Check that the SEL-351R and Type MET Control Tester settings are as specified in *Initial Conditions for Control Tests* (including **RECLOSER SIMULATOR OPEN** and rotary switch **TR-1** [**FAULT CURRENT ADJUST**] in most counter-clockwise position).

Step 2. Check to make sure that the SEL-351R is programmed for at least one phase fast curve trip operation (setting Operations–phase fast curve ≥ 1).

Step 3. Disable ground overcurrent tripping with the **GROUND ENABLED** operator control on the SEL-351R (corresponding LED extinguishes).

Step 4. Disable reclosing with the **RECLOSE ENABLED** operator control on the SEL-351R (corresponding LED extinguishes).

Step 5. Set switch **S-4** (**AMMETER RANGE**) to the appropriate range.

Refer to *AC AMMETER on the Type MET Control Tester on page 5.1* for more information on selecting this range.

Most often, the 1 Amp range will suffice.

Step 6. While holding switch **S-2** (**FAULT CURRENT**) in the **CALIBRATE** position, adjust switch **TR-1** (**FAULT CURRENT ADJUST**) clockwise until the **AC AMMETER** displays a current level corresponding to the desired multiple of Min. trip–phase setting.

Release switch **S-2** (**FAULT CURRENT**), and it returns to the **OFF** position.

Step 7. Set switch **S-3** (**TIME SELECTOR**) to **CONTROL RESPONSE**.

Press pushbutton **S-10** (**TIMER RESET**) to reset the timer to zero if needed.

Step 8. Close the **RECLOSER SIMULATOR** by pressing the **CLOSE** operator control pushbutton on the SEL-351R.

The **CLOSED** light on the Type MET Control Tester and the **RECLOSER CLOSED** LED on the SEL-351R both illuminate.

Wait a time period equal to the Reset time from lockout setting for the **CONTROL STATE RESET** LED on the SEL-351R to illuminate.

Step 9. Apply a fault to the SEL-351R by setting switch **S-2** (**FAULT CURRENT**) to the **TEST** position.

After the SEL-351R trips, set switch **S-2** (**FAULT CURRENT**) back to the **OFF** position.

Step 10. Record the control response time on the timer, and then press pushbutton **S-10** (**RESET TIMER**) to reset the timer.

Step 11. Repeat steps 8 through 10 as many times as desired to gather data for the particular test point.

Step 12. Repeat steps 8 through 11 with switch **S-5** (**PHASE SELECTOR**) set at **B** (Phase B) and then at **C** (Phase C).

Step 13. To test the phase fast curve at another multiple of Min. trip–phase setting, repeat steps 5 through 12.

Step 14. Compare recorded control response times to the appropriate curve control response times.

Step 15. Return the SEL-351R and Type MET Control Tester settings to those specified in *Initial Conditions for Control Tests on page 5.2* before proceeding to the next test.

Phase Delay Curve

Step 1. Check that the SEL-351R and Type MET Control Tester settings are as specified in *Initial Conditions for Control Tests* (including **RECLOSER SIMULATOR OPEN** and rotary switch **TR-1** [**FAULT CURRENT ADJUST**] in most counter-clockwise position).

Step 2. Set the SEL-351R for no phase fast curve trip operations (setting Operations–phase fast curve = OFF).

Step 3. Disable ground overcurrent tripping with the **GROUND ENABLED** operator control on the SEL-351R (corresponding LED extinguishes).

Step 4. Disable reclosing with the **RECLOSE ENABLED** operator control on the SEL-351R (corresponding LED extinguishes).

Step 5. Set switch **S-4** (**AMMETER RANGE**) to the appropriate range.

Refer to *AC AMMETER on the Type MET Control Tester on page 5.1* for more information on selecting this range.

Most often, the 1 Amp range will suffice.

Step 6. While holding switch **S-2** (**FAULT CURRENT**) in the **CALIBRATE** position, adjust switch **TR-1** (**FAULT CURRENT ADJUST**) clockwise until the **AC AMMETER** displays a current level corresponding to the desired multiple of Min. trip–phase setting.

Release switch **S-2** (**FAULT CURRENT**), and it returns to the **OFF** position.

Step 7. Set switch **S-3** (**TIME SELECTOR**) to **CONTROL RESPONSE**.

Press pushbutton **S-10** (**TIMER RESET**) to reset the timer to zero if needed.

Step 8. Close the **RECLOSER SIMULATOR** by pressing the **CLOSE** operator control pushbutton on the SEL-351R.

The **CLOSED** light on the Type MET Control Tester and the **RECLOSER CLOSED** LED on the SEL-351R both illuminate.

Step 9. Apply a fault to the SEL-351R by setting switch **S-2** (**FAULT CURRENT**) to the **TEST** position.

After the SEL-351R trips, set switch **S-2** (**FAULT CURRENT**) back to the **OFF** position.

Step 10. Record the control response time on the timer, and then press pushbutton **S-10** (**TIMER RESET**) to reset the timer.

Step 11. Repeat steps 8 through 10 for as many times as desired to gather data for the particular test point.

Step 12. Repeat steps 8 through 11 with switch **S-5** (**PHASE SELECTOR**) set at **B** (Phase B) and then at **C** (Phase C).

Step 13. To test the phase delay curve at another multiple of Min. trip–phase setting, repeat steps 5 through 12.

Step 14. Enable the phase fast curve again by returning setting Operations–phase fast curve to its normal setting.

Step 15. Compare recorded control response times to the appropriate curve control response times.

Step 16. Return the SEL-351R and Type MET Control Tester settings to those specified in *Initial Conditions for Control Tests on page 5.2* before proceeding to the next test.

Ground Fast Curve

Step 1. Check that the SEL-351R and Type MET Control Tester settings are as specified in *Initial Conditions for Control Tests* (including **RECLOSER SIMULATOR OPEN** and rotary switch **TR-1** [**FAULT CURRENT ADJUST**] in most counter-clockwise position).

Step 2. Effectively disable phase overcurrent tripping by doubling (2 x) or tripling (3 x) setting value Min. trip–phase and making setting Operations–phase fast curve = OFF.

Step 3. Check to make sure that the SEL-351R is programmed for at least one ground fast curve trip operation (setting Operations–ground fast curve = 1).

Step 4. Enable ground overcurrent tripping with the **GROUND ENABLED** operator control on the SEL-351R (corresponding LED illuminates).

Step 5. Disable reclosing with the **RECLOSE ENABLED** operator control on the SEL-351R (corresponding LED extinguishes).

Step 6. Set switch **S-4** (**AMMETER RANGE**) to the appropriate range.

Refer to preceding *AC AMMETER on the Type MET Control Tester on page 5.1* for more information on selecting this range.

Most often, the 300 mA range will suffice for ground overcurrent elements (usually set more sensitively than phase overcurrent elements).

Step 7. While holding switch **S-2** (**FAULT CURRENT**) in the **CALIBRATE** position, adjust switch **TR-1** (**FAULT CURRENT ADJUST**) clockwise until the **AC AMMETER** displays a current level corresponding to the desired multiple of Min. trip–ground setting (make sure to look at the correct scale on the **AC AMMETER**).

Release switch **S-2** (**FAULT CURRENT**), and it returns to the **OFF** position.

Step 8. Set switch **S-3** (T**IME SELECTOR**) to **CONTROL RESPONSE**.

Press pushbutton **S-10** (**TIMER RESET**) to reset the timer to zero if needed.

Step 9. Close the **RECLOSER SIMULATOR** by pressing the **CLOSE** operator control pushbutton on the SEL-351R.

The **CLOSED** light on the Type MET Control Tester and the **RECLOSER CLOSED** LED on the SEL-351R both illuminate.

Wait a time period equal to the Reset time from lockout setting for the **CONTROL STATE RESET** LED on the SEL-351R to illuminate.

Step 10. Apply a fault to the SEL-351R by setting switch **S-2** (**FAULT CURRENT**) to the **TEST** position.

After the SEL-351R trips, set switch **S-2** (**FAULT CURRENT**) back to the **OFF** position.

Step 11. Record the control response time on the timer, and then press pushbutton **S-10** (**TIMER RESET**) to reset the timer.

Step 12. Repeat steps 9 through 11 as many times as desired to gather data for the particular test point.

Step 13. To test the ground fast curve at another multiple of Min. trip–ground setting, repeat steps 6 through 12.

Step 14. Compare recorded control response times to the appropriate curve control response times.

Step 15. If not continuing on to the following Ground Delay Curve test, then enable phase overcurrent tripping by returning settings Min. trip–phase and Operations–phase fast curve to their normal setting values.

Step 16. Return the SEL-351R and Type MET Control Tester settings to those specified in *Initial Conditions for Control Tests on page 5.2* before proceeding to the next test.

Ground Delay Curve

Step 1. Check that the SEL-351R and Type MET Control Tester settings are as specified in *Initial Conditions for Control Tests* (including **RECLOSER SIMULATOR OPEN** and rotary switch **TR-1** [**FAULT CURRENT ADJUST**] in most counter-clockwise position).

Step 2. Effectively disable phase overcurrent tripping by doubling (2 x) or tripling (3 x) setting value Min. trip–phase and making setting Operations–phase fast curve = OFF.

Step 3. Set the SEL-351R for no ground fast curve trip operations (setting Operations–ground fast curve = OFF).

Step 4. Enable ground overcurrent tripping with the **GROUND ENABLED** operator control on the SEL-351R (corresponding LED illuminates).

Step 5. Disable reclosing with the **RECLOSE ENABLED** operator control on the SEL-351R (corresponding LED extinguishes).

Step 6. Set switch **S-4** (**AMMETER RANGE**) to the appropriate range.

Refer to *AC AMMETER on the Type MET Control Tester on page 5.1* for more information on selecting this range.

Most often, the 300 mA range will suffice for ground overcurrent elements (usually set more sensitively than phase overcurrent elements).

Step 7. While holding switch **S-2** (**FAULT CURRENT**) in the **CALIBRATE** position, adjust switch **TR-1** (**FAULT CURRENT ADJUST**) clockwise until the **AC AMMETER** displays a current level corresponding to the desired multiple of Min. trip–ground setting (make sure to look at the correct scale on the **AC AMMETER**).

Release switch **S-2** (**FAULT CURRENT**), and it returns to the **OFF** position.

Step 8. Set switch **S-3** (**TIME SELECTOR**) to **CONTROL RESPONSE**. Press pushbutton **S-10** (**TIMER RESET**) to reset the timer to zero if needed.

Step 9. Close the **RECLOSER SIMULATOR** by pressing the **CLOSE** operator control pushbutton on the SEL-351R.

The **CLOSED** light on the Type MET Control Tester and the **RECLOSER CLOSED** LED on the SEL-351R both illuminate.

Step 10. Apply a fault to the SEL-351R by setting switch **S-2** (**FAULT CURRENT**) to the **TEST** position.

After the SEL-351R trips, set switch **S-2** (**FAULT CURRENT**) back to the **OFF** position.

Step 11. Record the control response time shown on the timer and then press pushbutton **S-10** (**TIMER RESET**) to reset the timer.

Step 12. Repeat steps 9 through 11 for as many times as desired to gather data for the particular test point.

Step 13. To test the phase delay curve at another multiple of Min. trip–phase setting, repeat steps 6 through 12.

Step 14. Enable the ground fast curve again by returning setting Operations–ground fast curve to its normal setting.

Step 15. Compare recorded control response times to the appropriate curve control response times.

Step 16. Enable phase overcurrent tripping by returning settings Min. trip–phase and Operations–phase fast curve to their normal setting values.

Step 17. Return the SEL-351R and Type MET Control Tester settings to those specified in *Initial Conditions for Control Tests on page 5.2* before proceeding to the next test.

Reclosing Tests

Voltage input **V1** must be energized with nominal 120 Vac for reclosing tests. See *Initial Conditions for Control Tests on page 5.2* for additional details.

Reclose Interval Times

Step 1. Check that the SEL-351R and Type MET Control Tester settings are as specified in *Initial Conditions for Control Tests* (including **RECLOSER SIMULATOR OPEN** and rotary switch **TR-1** (**FAULT CURRENT ADJUST**) in most counter-clockwise position).

Step 2. Disable ground overcurrent tripping with the **GROUND ENABLED** operator control on the SEL-351R (corresponding LED extinguishes).

Step 3. Enable reclosing with the **RECLOSE ENABLED** operator control on the SEL-351R (corresponding LED illuminates).

Step 4. If the SEL-351R is programmed for more than one phase fast curve trip operation (setting Operations–phase fast curve > 1), the reclose interval time preceding the second (or later) phase fast curve trip operation may be difficult to read on the MET Control Tester timer.

After the first reclose interval times out, the timer stalls, the recloser closes, the fault is applied again, and the SEL-351R trips again on the phase fast curve (if so programmed). The timer is not stalled long enough to be read–the SEL-351R trips right away on the phase fast curve, and the timer then begins timing again for the new reclose interval.

To solve this problem, set setting Operations–phase fast curve = OFF. Then all operations will be on the phase delay curve–providing more time to read the timer at the end of a reclose interval.

Step 5. Set switch **S-4** (**AMMETER RANGE**) to the appropriate range.

Refer to *AC AMMETER on the Type MET Control Tester on page 5.1* for more information on selecting this range.

Most often, the 1 Amp range will suffice.

Step 6. While holding switch **S-2** (**FAULT CURRENT**) in the **CALIBRATE** position, adjust switch **TR-1** (**FAULT CURRENT ADJUST**) clockwise until the **AC AMMETER** displays a current level corresponding to approximately 125–150% of the Min. trip–phase setting.

Release switch **S-2** (**FAULT CURRENT**), and it returns to the **OFF** position.

Step 7. Set switch **S-3** (**TIME SELECTOR**) to **CONTROL RECLOSE/RESET**.

Press pushbutton **S-10** (**TIMER RESET**) to reset the timer to zero if needed.

Step 8. Close the **RECLOSER SIMULATOR** by pressing the **CLOSE** operator control pushbutton on the SEL-351R.

The **CLOSED** light on the Type MET Control Tester and the **RECLOSER CLOSED** LED on the SEL-351R both illuminate.

Wait a time period equal to the Reset time from lockout setting for the **CONTROL STATE RESET** LED on the SEL-351R to illuminate.

Step 9. Apply a fault to the SEL-351R by setting switch **S-2** (**FAULT CURRENT**) to the **TEST** position.

Step 10. Record the reclose interval times as they appear on the timer after each reclose.

Step 11. For older MET Control Testers without switches **S-11** (**DISPLAY MODE**) and **S-12** (**AUTO RESET**), the timer stalls after each reclose–the time accumulates for each following reclose interval time.

Record the number displayed each time the timer stalls–the differences between adjacent noted times are the consecutive reclose interval times.

Step 12. For newer MET Control Testers with switches **S-11** (**DISPLAY MODE**) and **S-12** (**AUTO RESE**T) set per *Initial Conditions for Control Tests on page 5.2*, the timer resets for each new reclose interval time.

Record the number displayed each time the timer stalls–these noted times are the consecutive reclose interval times.

Step 13. Set switch **S-2** (**FAULT CURRENT**) back to the **OFF** position.

Step 14. Compare recorded reclose interval times to the set reclose interval times.

Note: Each recorded reclose interval time is extended by the Minimum trip duration time (factory set at TDURD = 12 cycles [= 0.2 seconds]). Setting TDURD is not accessible with the EZ settings (see the *SEL-351R Recloser Control Instruction Manual*).

Step 15. If setting Operations–phase fast curve was set **OFF** at the beginning of this test (for ease of reading the timer), enable the phase fast curve again by returning setting Operations–phase fast curve to its normal setting.

Step 16. Return the SEL-351R and Type MET Control Tester settings to those specified in *Initial Conditions for Control Tests on page 5.2* before proceeding to the next test.

Reset Times

Step 1. Check that the SEL-351R and Type MET Control Tester settings are as specified in *Initial Conditions for Control Tests* (including **RECLOSER SIMULATOR OPEN** and rotary switch **TR-1** [**FAULT CURRENT ADJUST**] in most counter-clockwise position).

Step 2. Disable ground overcurrent tripping with the **GROUND ENABLED** operator control on the SEL-351R (corresponding LED extinguishes).

Step 3. Enable reclosing with the **RECLOSE ENABLED** operator control on the SEL-351R (corresponding LED illuminates).

Step 4. Set switch **S-4** (**AMMETER RANGE**) to the appropriate range.

Refer to *AC AMMETER on the Type MET Control Tester on page 5.1* for more information on selecting this range. Most often, the 1 Amp range will suffice.

Step 5. Set switch **S-3** (**TIME SELECTOR**) to **CONTROL RESPONSE**.

Step 6. Set switch **S-2** (**FAULT CURRENT**) to the **TEST** position.

Step 7. Press pushbutton **S-10** (**TIMER RESET**) to reset the timer to zero.

Step 8. The **CONTROL STATE LOCK** LED should be illuminated.

Step 9. While monitoring the **CONTROL STATE RESET** and **LOCK** LEDs, close the **RECLOSER SIMULATOR** by pressing the **CLOSE** operator control pushbutton on the SEL-351R.

At the instant the **CONTROL STATE LOCK** LED extinguishes and the **RESET** LED illuminates, move switch **S-2** (**FAULT CURRENT**) quickly to the **OFF** position. The timer then stops.

Step 10. The displayed time corresponds to the Reset time from lockout setting, with a margin of error for how fast switch **S-2** (**FAULT CURRENT**) can be moved to the **OFF** position after the **RESET** LED is observed to illuminate.

Record this time.

Step 11. Set switch **S-2** (**FAULT CURRENT**) to the **TEST** position again.

Step 12. Press pushbutton **S-10** (**TIMER RESET**) to reset the timer to zero.

Step 13. Slowly adjust switch **TR-1** (**FAULT CURRENT ADJUST**) clockwise until the SEL-351R trips.

Quickly move switch **TR-1** (**FAULT CURRENT ADJUST**) back to zero (full counter-clockwise position).

Step 14. Monitor the **CONTROL STATE RESET** and **CYCLE** LEDs.

At the instant the **CONTROL STATE CYCLE** LED extinguishes and the **RESET** LED illuminates, move switch **S-2** (**FAULT CURRENT**) quickly to the **OFF** position. The timer stops.

Step 15. The displayed time corresponds to the Reset time from the auto reclose setting, with a margin of error for how fast switch **S-2** (**FAULT CURRENT**) can be moved to the **OFF** position after the **RESET** LED is observed to illuminate.

Record this time.

Step 16. Return the SEL-351R and Type MET Control Tester settings to those specified in *Initial Conditions for Control Tests on page 5.2* before proceeding to the next test.

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Section 6
Battery

Overview

BATTERY LIST
See Battery Replacement on page 6.5.

DO NOT TRANSPORT THE SEL-351R WITH THE BATTERY INSIDE THE ENCLOSURE!

When 120 Vac power is interrupted to the SEL-351R Recloser Control, a 24 Volt, 8.0 Amp-hour sealed lead-acid battery supplies power to the SEL-351R. The temperature-compensated battery monitor/charger monitors battery capacity, measures power supply load current, and calculates expected battery run time. A fully charged 8.0 Amp-hour battery supplies the trip and control power for 10 to 24 hours depending on ambient temperature and load.

After battery capacity discharges to a user-set threshold, the SEL-351R puts itself to sleep.

The SEL-351R wakes up if any of the following occur:

- 120 Vac power is restored
- A specific message is received by the EIA 232 Wake-Up port (see the front of *Section 10* in the SEL-351R *Recloser Control Instruction Manual*)
- The **WAKE UP** operator control is pressed

Battery-Related Settings

The following four battery-related settings are made with the **SET FZ** (global EZ settings) command:

- Setting battery Amp-hours (6.5–20.0)
- Percent battery capacity for sleep (0–100)
- Turn on the 12 V power (Y, N)
- Keep the 12 V power on while asleep (Y, N)

See *Section 4: Settings* for explanations and default settings.

Battery Status

REVIEW MAY BE NECESSARY
This battery test section makes use of front-panel pushbuttons and serial port commands. Review Section 2: Communications and Section 3: Front-Panel Interface if needed.

The status of the battery can be checked via the front panel or serial port.

Battery Status via Front Panel

WAS IT A LOAD TEST FAILURE?
If the **BATTERY PROBLEM** LED is illuminated and MODE displays neither NOBATT, nor FAIL, then the battery failed the latest load test. See Battery Load Test via Front Panel on page 6.3 and Battery Load Test via Serial Port on page 6.4.

The **BATTERY PROBLEM** LED illuminates for any of the following battery problems:

- Load test failure
- Damaged or disconnected (battery cannot charge or discharge)
- Battery monitor/charger failure
- Battery fuse blown

Press the **STATUS** pushbutton on the front panel of the SEL-351R to access more battery status information. With the secondary function up/down arrow pushbuttons, move to different status screens. Those of interest for the battery are listed in *Table 6.1*:

Table 6.1 Battery Status Information Accessed From the Front Panel

Display	Description
MODE = CHARGE	battery is charged ≥ 90% (trickle charging)
MODE = HICHRG	battery is charged < 90% (high charging)
MODE = DISCHRG	battery is discharging
MODE = DISTST	battery load test in progress
MODE = NOBATT	battery is damaged, disconnected, or fuse is open (it cannot charge or discharge)
MODE = FAIL	battery monitor/charger failed or communications with the battery monitor/charger are permanently interrupted
MODE = NOMSG	Communications with the battery monitor/charger are temporarily suspended after power up, settings change, or active settings group change
%CAP = 0-100	Battery charge level (independent of temperature)
HRS_LFT =	hh:mm–hours and minutes left to run on battery in discharge mode before the SEL-351R puts itself to sleep (dependent on setting "% Battery capacity for sleep [0 100]"). Shows XX:XX if battery is charging.
5V_PSBC =	internal 5 V power supply level for battery monitor/charger
12V_AUX =	12 V power output level–available via terminal block positions 23 and 24–controlled by two 12 V settings in *Battery-Related Settings on page 6.1*
VBAT =	voltage level of 24 V battery
IBAT =	current level (in mA) at which the 24 V battery is charging or discharging (preceded by a minus sign for discharging) Approximately 8 mA (trickle charging) Approximately 150 mA (high charging)

Battery Status via Serial Port

Execute the **STATUS** command, and have the same information available via the preceding front-panel **STATUS** pushbutton.

Automatic Battery Load Test

The SEL-351R automatically load tests the 24 V battery about every 24 hours.

An internal 24-hour timer cumulatively times whenever the SEL-351R is in the charge mode (120 Vac is powering the SEL-351R and charging the battery). Even if the battery is fully charged, it is still trickle charged and thus, the SEL-351R is still in the charge mode.

After the 24-hour timer times out (and the SEL-351R is still in the charge mode), an internal 1 Amp load is automatically paralleled with the battery for as many as 5 seconds. If battery voltage drops below 22.0 V during this load test, the test stops and the **BATTERY PROBLEM** LED illuminates and stays illuminated until the next battery test is successful. This load test failure condition can be routed to an output contact if desired (see the *Battery System Monitor* subsection in *Section 8* of the *SEL-351R Recloser Control Instruction Manual*).

Battery Load Test via Front Panel

Step 1. Press the **OTHER** pushbutton on the front panel of the SEL-351R.

A new screen appears, with `BTT` (battery test) as one of the choices.

Step 2. With the secondary function arrow pushbuttons, move the underscore to `BTT`.

Step 3. To test the battery, press the secondary function **{SELECT}** pushbutton. The following are possible results:

a. If the battery monitor/charger has a problem, the following message is displayed:

```
Battery Charger
Board FAILED
```

The **BATTERY PROBLEM** LED would already be illuminated for this condition. The battery load test is not performed.

b. If the battery is damaged or disconnected (it cannot charge or discharge), the following message is displayed:

```
Battery failed or not present
```

The **BATTERY PROBLEM** LED would already be illuminated for this condition. The battery load test is not performed.

c. If the battery is okay (it is charging or discharging), the battery load test proceeds, and the following message is displayed:

```
Testing Battery
.  .  .  .  .  OK/FAIL
```

The periods on the second line appear consecutively as each second of the five-second load test times by. At the end of the test, `OK` or `FAIL` is displayed. If the battery fails the 1 Amp load test (same criteria as described in *Automatic Battery Load Test on page 6.3*), the **BATTERY PROBLEM** LED illuminates and stays illuminated until the next battery load test is successful. This load test failure condition can be routed to an output contact if desired (see the SEL-351R *Recloser Control Instruction Manual*).

Battery Load Test via Serial Port

Step 1. Execute the **BTT NOW** command, and the following are possible results:

a. If the battery monitor/charger has a problem, the following message is displayed:

```
Battery Charger Board FAILED
```

The **BATTERY PROBLEM** LED would already be illuminated for this condition. The battery load test is not performed for the execution of the **BTT NOW** command.

b. If the battery is damaged or disconnected (it cannot charge or discharge), the following message is displayed:

```
Battery failed or not present
```

The **BATTERY PROBLEM** LED would already be illuminated for this condition. The battery load test is not performed for the execution of the **BTT NOW** command.

c. If the battery is okay (it is charging or discharging), the following message is displayed:

```
Battery test initiated.  Duration 5 seconds
.
.
.
.
.
Battery test state is: OK/FAILED
```

The periods appear on each consecutive line as each second of the five-second battery load test times. At the end of the test, `OK` or `FAILED` is displayed. If the battery fails the 1 Amp load test (same criteria as described in *Automatic Battery Load Test on page 6.3*), the **BATTERY PROBLEM** LED illuminates and stays illuminated until the next battery load test is successful. This load test failure condition can be routed to an output contact if desired (see the SEL-351R *Recloser Control Instruction Manual*).

Step 2. Execute the **BTT** command to see how much time remains until the next automatic battery discharge test. If the battery is okay (it is charging or discharging), the following message is displayed:

```
Battery test state is:  OK/FAILED
Time until next battery test:  XX (hours)
```

The “next battery test” is the automatic load test described in *Automatic Battery Load Test*.

Battery Replacement

NEED TO CHANGE BATTERY AMP-HOURS SETTING?
If the replacement battery has a different Amp-hours rating than the previous battery, the battery Amp-hours setting can be changed (set no greater than the battery rating; see Section 4: Settings).

DO NOT TRANSPORT THE SEL-351R WITH THE BATTERY INSIDE THE ENCLOSURE!

⚠CAUTION
Refer to Figure 1.6. Separable connector **J12** should be the first disconnected when removing batteries and the last connected when installing batteries. Do not leave **J12** connected without the batteries also connected. The tab disconnects on the battery wiring harness are energized and can short-circuit if they come in contact with the enclosure floor or each other, consequently damaging the internal power supply.

The battery shipped with the SEL-351R consists of:

> Two 2 x 3 cell assemblies each consisting of six 2 V, 8 Ah sealed lead-acid E-cells (Hawker Energy Cyclon 0850-004). The six E-cells are shrink-wrapped to make up a 12 V battery by Rose Electronics, part number EPG-0497.

Two 12 V batteries are connected in series to make an effective 24 Vdc battery (see *Figure 1.6*). Only same model batteries can be connected together.

The tab sizes of the battery terminals are:

> Hawker Energy Cyclon 0850 004: 0.25 inch x 0.025 inch

If other batteries are substituted for the original batteries, both 12 V batteries must be changed and the new batteries must be the same model and rating as each other. The new amp hour rating can be entered too (set no greater than the battery rating; see *Section 4: Settings*, setting No. 47–Battery Amp-hours).

The red wire from the harness must be connected to the positive battery terminal (24 V), and the black wire must be connected to the negative terminal (see *Figure 1.6*).

Check the battery status, via the front panel or serial port (see *Battery Status via Front Panel on page 6.2* and *Battery Status via Serial Port on page 6.2*).

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Section 7
Convenience Outlet

Testing the 120 Vac (GFCI) Convenience Outlet

The GFCI (Ground-Fault Circuit-Interrupter) protection in the 120 Vac (GFCI) convenience outlet should be checked every month to make sure it is operating correctly, per the outlet manufacturer. Enter the test date in a conspicuous log. Refer to *Figure 1.1* and *Table 1.3* for more details.

CAUTION
If **{RESET}** button does not pop out or if test lamp remains illuminated (or voltmeter indicates 120 Vac power when **{RESET}** pushbutton **does not** pop out), DO NOT USE OUTLET.

Step 1. Push black **{TEST}** button.

Red **{RESET}** button should pop out from inner surface. This should result in 120 Vac power being **OFF**.

Step 2. Verify by plugging test lamp into the outlet or check with voltmeter. See accompanying CAUTION.

Step 3. If the GFCI tests okay, restore power by pushing the **{RESET}** button back in. THE **{RESET}** BUTTON MUST BE PUSHED FIRMLY AND FULLY INTO PLACE UNTIL IT LOCKS AND REMAINS DEPRESSED. After pressure has been removed, if the GFCI fails to reset properly, DO NOT USE OUTLET. Test lamp should again illuminate (or voltmeter indicates return of 120 Vac power).

NOTE: Applying greater than 120 Vac (e.g., 208 V) to recloser control may damage or destroy the GFCI outlet. Replace the GFCI outlet if this occurs.

Step 4. IF GFCI TRIPS BY ITSELF at any time, reset and perform test *Step 1*, *Step 2*, and *Step 3* above. If **{RESET}** button does not pop out when **{TEST}** button is depressed, DO NOT USE OUTLET.

Factory Assistance

We appreciate your interest in SEL products and services. If you have questions or comments, please contact us at:

Schweitzer Engineering Laboratories, Inc.
2350 NE Hopkins Court
Pullman, WA U.S.A. 99163-5603
Telephone: +1.509.332.1890
Fax: +1.509.332.7990
Internet: www.selinc.com
Email: info@selinc.com

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Section 8
Specifications

Compliance

ISO 9001:2008 Certified

General

AC Current Inputs

1 A nominal:	3 A continuous, linear to 20 A symmetrical; 100 A for 1 s
Burden:	0.13 VA @ 1 A 1.31 VA @ 3 A

Sensitive Earth Fault (SEF) Channel IN Current Input

0.05 A nominal:	1.5 A continuous, linear to 1.5 A symmetrical; 20 A for 1 s
Burden:	0.0004 VA @ 0.05 A, 0.36 VA @ 1.5 A

AC Voltage Inputs

300 V_{L-N} continuous, (connect any voltage up to 300 Vac). 600 Vac for 10 s.

Burden:	0.03 VA @ 67 V 0.06 VA @ 120 V 0.80 VA @ 300 V

Power Supply

106–140 Vac, 120 Vac nominal

12 V Radio Supply

11–14 Vdc, 6 W continuous, 13 W for 1 s

Output Contacts

Standard:

Make:	30 A per IEEE C37.90-1989
Carry:	6 A continuous carry at 70°C 4 A continuous carry at 85°C
1 s Rating:	100 A
MOV Protection:	270 Vac / 360 Vdc; 40 J
Pickup Time:	< 5 ms

Breaking Capacity (10000 operations, L/R = 40 ms):

24 V	0.75 A
48 V	0.50 A
125 V	0.30 A
250 V	0.20 A

Cyclic Capacity (2.5 cycle/second, L/R = 40 ms):

24 V	0.75 A
48 V	0.50 A
125 V	0.30 A
250 V	0.20 A

Note: Per IEC 60255-0-20:1974, using the simplified method of assessment.

Trip and Close Outputs

3 A continuous @ –40° to 40° C, 1 min @ 85°C

Make and Carry:	5 A for 0.2 s @ 1 s intervals

Optoisolated Inputs

DC Range

250 Vdc:	Pickup 200–300 Vdc; Dropout 150 Vdc
125 Vdc:	Pickup 105–150 Vdc; Dropout 75 Vdc
48 Vdc:	Pickup 38.4–60 Vdc; Dropout 28.8 Vdc
24 Vdc:	Pickup 15.0–30 Vdc

AC Range

250 Vdc:	Pickup 170.6–300 Vdc; Dropout 106 Vdc
125 Vdc:	Pickup 89.6–150 Vac; Dropout 53 Vac
48 Vdc:	Pickup 32.8–60 Vdc; Dropout 20.3 Vdc
24 Vdc:	Pickup 12.8–30 Vdc

Note: Optoisolated inputs draw approximately 4 mA of current. All current ratings are at nominal input voltages.

Frequency and Rotation

System Frequency:	50 or 60 Hz
Phase Rotation:	ABC or ACB
Frequency Tracking Range:	40.1–65 Hz

Note: Voltage connected to V1 required for frequency tracking.

Communications Ports

EIA-232:	1 Front; 2 Side
EIA-485 (optional):	1 Side, 2100 Vdc of isolation
Baud Rate:	300–38400 baud

Time-Code Input

Recloser control accepts demodulated IRIG-B time-code input at Port 1 (optional) and Port 2. Do not connect the time-code input into both Port 1 and Port 2 at the same time. Recloser control time is synchronized to within ±5 ms of time-source input.

Operating Temperature

Relay Module:	–40° to +85°C (–40° to +185°F)
Batteries:	–40° to +60°C (–40° to +140°F)
Entire SEL-351R Unit:	–40° to +50°C (–40° to +122°F)

Note: LCD contrast impaired for temperatures below – 20°C (–4° F). The entire SEL-351R unit was operation tested up to +70°C (+158°F). The 20°C (36°F) difference between the +50°C rating and +70°C allows for temperature rise due to sunlight.

Weight

38.1 kg (84 lbs) including batteries

Battery Specifications

Normal Capacity:	8.0 amp-hours at +25°C (+77°F)
Run Time:	20 hours at +25°C (+77°F) 8 hours at –40°C (–40°F)

Estimated Life:	4 years at +25°C (+77°F) 8 months at +60°C (+140°F)
Recharge Time:	55 hours at +25°C (+77°F)

Note: The above run times presume the following global EZ settings are made:
% Battery sleep capacity: 0% (no battery capacity retained)
Turn on the 12 V power: N (12 Vdc power off)

Type Tests

Environmental Test

Damp Heat Cyclic:	IEC 60068-2-30:1980 Test Ca; 55° C, 12 + 12-hour cycles, 95% humidity

Dielectric Strength and Impulse Tests

Dielectric:	IEC 60255-5:1977 IEEE C37.90-1989 2500 Vac on analogs, contact inputs, and contact outputs except Trip and Close; 3100 Vdc on power supply for 10 s; 2200 Vdc on EIA-485 communications port

Electrostatic Discharge Test

ESD:	IEC 60255-22-2:1996 (8 kV contact discharge all points except serial ports, 15 kV air discharge to all other points)

RFI and Interference Tests

1 MHz Burst Disturbance:	IEC 60255-22-1:1988 Level 3 (2500 V common, 1000 V differential)
Fast Transient Disturbance:	IEC 60255-22-4:1992 IEC 60801-4:1998 Level 4 (4000 V optional, 2000 V inputs)
Radiated EMI:	IEC 60255-22-3:1989 Level 3, 10 V/m IEEE C37.90.2-1995, 35 V/m

Exception:
5.5.2(2): Performed with 200 frequency steps per octave.
5.5.3: Digital Equipment Modulation Test not performed.
5.5.4: Test signal off between frequency steps to simulate keying.

Surge Withstand:	IEEE C37.90.1-1989 3.0 kV oscillatory; 5.0 kV fast transient

Vibration and Shock Tests

Sinusoidal Vibration:	IEC 60255-21-1:1988 Class 1
Shock and Bump:	IEC 60255-21-2:1988 Class 1
Seismic:	IEC 60255-21-3:1993 Class 2

Miscellaneous

Enclosure Protection:	IEC 60529:1989, IP32/NEMA 3R

Recloser Type Tests

ANSI/IEEE C37.60-1981, performed with the following reclosers: McGraw

Edison VWVE	27 kV, 12 kA interrupting 560 A continuous
Cooper NOVA	15 kV, 12.5 kA interrupting 630 A continuous
G&W VIPER SF6	15, 27, 38 kV, 12.5 kA interrupting 630 A continuous
G&W VIPER Solid Dielectric	15, 27, 38 kV, 12.5 kA interrupting 630 A continuous

Section 6.12
Cable Charging Current Interrupting test for automatic circuit reclosers and fault interrupters for AC systems, 5 A rms charging current interrupted, 20 close-open operations, randomly timed.

Section 6.13
Transformer Magnetizing Current Interruption test for automatic circuit reclosers and fault interrupters for AC systems, magnetizing current interrupted equal to 3.5% of the continuous current rating of the recloser, 20 close-open operations, randomly timed.

Section 6.14
Control Elements, SWC tests for automatic circuit reclosers and fault interrupters for AC systems, 1.0–1.5 MHz oscillatory test wave of crest voltage of 2.5–3.0 kV occurring in the first half-cycle, decaying to 50% in not less than 6 µs.

Section 6.2
Insulation (Dielectric) tests for automatic circuit reclosers and fault interrupters for AC systems, 1.2 • 50 µs voltage impulse (positive and negative) of crest voltage of 125 kV, applied to recloser with control connected.

ANSI/IEEE C37.60:2003, performed with the following recloser: Cooper Power Systems

Type:	VWVE
Voltage Rating:	27 kV
Current Break Rating:	12 kA
Continuous Current Rating	800 A

Section 6.13.1
Control Elements, SWC tests for automatic circuit reclosers and fault interrupters for AC systems, oscillatory and fast transient
surge tests, 1.0–1.5 MHz oscillatory test wave of crest voltage of 2.5–3.0 kV occurring in the first half-cycle, decaying to 50% in not less than 6 µs.

Section 6.13.2
Control Elements, SWC tests for automatic circuit reclosers and fault interrupters for AC systems, simulated surge arrester operation test, 7000 A surge test wave of crest voltage of 80% rated impulse withstand voltage.

Processing Specifications

AC Voltage and Current Inputs

16 samples per power system cycle, 3 dB low-pass filter cut-off frequency of 560 Hz.

Digital Filtering

One cycle cosine after low-pass analog filtering.
Net filtering (analog plus digital) rejects dc and all harmonics greater than the fundamental.

Protection and Control Processing

Four times per power system cycle.

Relay Elements

Instantaneous/Definite-Time Overcurrent Elements (50)

Current Pickup Range (A secondary)

1 A Nominal Channel:	0.05–20.00 A, 0.01 A steps 0.20–34.00 A, 0.01 A steps for phase-to-phase elements
SEF (0.05 A IN) Channel:	0.005–1.500 A, 0.001 A steps

Steady-State Pickup Accuracy

1 A Nominal Channel:	±0.01 A, ±3%

SEF (0.05 A IN) Channel: ±0.001 A, ±5%

Transient Overreach: ±5% of pickup

Time Delay: 0.00–16,000.00 cycles, 0.25–cycle steps

Timer Accuracy: ±0.25 cycle, ±0.1%

Time-Overcurrent Elements (51)

Current Pickup Range (A secondary)

1 A Nominal Channel: 0.05–3.2 A, 0.01 A steps

SEF (0.05 A IN) Channel: 0.005–0.160 A, 0.001 A steps

Steady-State Pickup Accuracy

1 A Nominal Channel: ±0.01 A, ±3%

SEF (0.05 A IN) Channel: ±0.001 A, ±5%

Transient Overreach: ±5% of pickup

Time Dials

US: ±0.5–15.0, 0.01 steps

IEC: 0.05–1.00, 0.01 steps

Recloser Curves: 0.10–2.00, 0.01 steps

Curve Timing Accuracy

1 A Nominal Channel: ±1.50 cycles, ±4% between 2 and 30 multiples of pickup

SEF (0.05 A IN) Channel: ±1.50 cycles, ±4% between 2 and 30 multiples of pickup

Under- (27)/Overvoltage (59) Elements

Pickup Ranges (V secondary)

Various Elements: 0.00–300.00 V, 0.01 V steps

Phase-to-Phase Elements: 0.00–520.00 V, 0.01 V steps

Steady-State Pickup Accuracy: ±2 V, ±5%

Transient Overreach: ±5%

Synchronism-Check Elements (25)

Pickup Ranges (V secondary)

Slip Frequency Pickup Range: df0.005–0.500 Hz, 0.001 Hz steps

Slip Frequency Pickup Accuracy: ±0.003 Hz

Phase Angle Range: 0–80°, 1° steps

Transient Accuracy: ±4°

Under-/Overfrequency Elements (81)

Frequency: 40.1–65.00 Hz, 0.01 Hz steps

Time Delays: 2.00–16,000.00 cycles, 0.25-cycle steps

Timer Accuracy: ±0.25 cycle, ±0.1%

Steady-State *plus* Transient Overshoot: ±0.01 Hz

Undervoltage Frequency Element Block Range: 25.00–300.00 V

SELOGIC Control Equation Variable Timers

Pickup Ranges

0.00–999,999.00 cycles: 0.25-cycle steps (reclosing relay and some programmable timers)

0.00–16,000.00 cycles: 0.25-cycle steps (some programmable and other timers)

Pickup/Dropout Accuracy: ±0.25 cycle, ±0.1%

Metering Accuracy

Accuracies are specified at 20°C and at nominal system frequency unless noted otherwise.

Voltages V_A, V_B, V_C, V_S, $3V_0$, V_1, V_2: ±0.2%, (67–300.0 V; wye connected)

Currents I_A, I_B, I_C: 1 A nominal ±3 mA, ±0.1% (0.1–20 A)

Temperature Coefficient: $[(0.0002\%)/(°C)^2] \bullet (\_\_°C–20°C)^2$ (see example below)

Phase Angle Accuracy: ±1.0°

Currents I_1, $3I_0$, $3I_2$: 1 A nominal ±0.01 A, ±3% (0.1–20.0 A)

I_N (SEF): 0.05 A IN nominal ±1 mA ±5% (0.01–1.5 A)

Example metering accuracy calculation for currents I_A, I_B, and I_C due to preceding stated temperature coefficient:

For temperature of 40°C, the additional error for currents I_A, I_B, and I_C is: $[(0.0002\%)/(°C)^2] \bullet (40°C–20°C)^2 = 0.08\%$

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Appendix A
Quick-Start Guide Change Information

Changes in this guide to date are summarized below (most recent revisions listed at top).

Table A.1 Quick-Start Guide Change Information

Revision Date	Summary of Revisions
The Quick-Start Guide Change Information section has been created to begin a record of revisions to this manual. All changes will be recorded in this Summary of Revisions table.	
20150126	**Preface** ➤ Updated *Safety Information*. **Section 7** ➤ Changed *Certifications* to *Compliance* and moved to the beginning of *Specifications*.
20140724	**Section 1** ➤ Corrected notes related to power supply and fuse ratings.
20110303	**Section 1** ➤ Added alternative Bussman fuses for 15 A and 1 A applications in *Table 1.3: Replacement Fuses for the SEL-351R Recloser Control*. **Section 4** ➤ Changed low end of pickup range for setting Min. trip-phase from 100.00 to 50.00 A primary in *Settings Descriptions*. ➤ Corrected current value (from 1500 to 2000 A primary) at which curve response flattens out for example in setting Min. trip-ground in Settings Descriptions. ➤ Corrected delay curve designation (from phase to ground) for setting Vert. multiplier-ground delay curve in *Settings Descriptions*. **Settings Sheets** ➤ Changed low end of pickup range for setting Min. trip-phase from 100.00 to 50.00 A primary. **Section 8** ➤ Changed low end of pickup range for 1 A Nominal Channel from 0.10 to 0.05 A secondary in *Time-Overcurrent Elements (51)*.
20100813	This revision includes the following changes: **Section 1** ➤ Corrected capacitor description in *Figure 1.13: SEL-351R Recloser Control Factory-Installed Wiring Inside the Enclosure* to 22000 µF. **Appendix B** ➤ Corrected capacitor description in *Figure B.1: SEL-351R Factory-Installed Wiring Inside the Enclosure (for units built before June 2001)* to 22000 µF.
20070802	This revision includes the following changes: ➤ Updated for firmware version R305.
20061016	This revision includes the following changes: **Section 1** ➤ Modified Table *1.3: Replacement Fuses for the SEL-351R Recloser Control*.
20050627	This revision includes the following changes: **Section 1** ➤ Added note to properly seal enclosure openings.

Table A.1 Quick-Start Guide Change Information

Revision Date	Summary of Revisions
20041130	This revision includes the following changes: **Section 1** ➤ Changed voltage inputs **VA**, **VB**, and **VC** to **V1**, **V2**, and **V3**. ➤ Changed current inputs **IA**, **IB**, and **IC** to **I1**, **I2**, and **I3**. ➤ Modified *Figure 1.15: User Terminal Block Wiring or Setting Changes Accommodate All Possible Primary Connections to the Recloser.* ➤ Changed description of control cable receptacle pins in *Table 1.2: Control Cable Receptacle Pin Descriptions* from Phase A, Phase B, and Phase C to Terminal **I1**, Terminal **I2**, and Terminal **I3**. **Section 2** ➤ Modified *Table 2.5: SEL-351R Recloser Control Command Summary.* ➤ Removed reference to viewing passwords. **Section 3** ➤ Removed PASS as a secondary function from under the SHOW function in the pushbutton primary functions table. **Section 4** ➤ Added **V123** Terminal Connections, **I123** Terminal Connections, and CT Polarity to *Table 4.3: EZ Settings Quick Reference*. ➤ Changed **VA** to **V1**. ➤ Modified description in *Table 4.5: Recloser Interrupt Data* of % Battery capacity and the setting to keep 12 V power on while asleep. **Settings Sheets** ➤ Added **V123** Terminal Connections, **I123** Terminal Connections, and CT Polarity. **Section 5** ➤ Changed **VA** to **V1**. **Section 6** ➤ Modified description of Automatic Battery Load Test. **Appendix B** ➤ Added *Figure B.2: SEL-351R Recloser Control Side Panel Prior to October 2004*.
20040820	This revision includes the following changes: Converted the guide from Microsoft® Word to Adobe® FrameMaker®. Moved Quick-Start Guide Change Information page to Reference section. Applied formats consistent with Typographic Conventions throughout the Guide. **Preface** ➤ Added Typographic Conventions used in this Guide. **Section 1: Installation** ➤ Updated *Figure 1.4: SEL-351R Customer Ground Connection to Required System Grounding* and *Figure 1.5: SEL-351R Recloser Control Grounding Lug Location and Other Dimensional Information (bottom view).* ➤ Updated text in *Installation Step 2: Ground the Enclosure.* **Section 2: Communication** ➤ Updated information in the section. ➤ Updated information in *Change Passwords* to advise the customer to use strong passwords. **Section 4: Settings** ➤ In Table 4.3: corrected Battery amp-hours factory setting from 6.5 to 8. ➤ In Global EZ Settings, No. 43, changed the Default from NO to OFF. **Section 8: Specifications** ➤ Updated Specifications.

Table A.1 Quick-Start Guide Change Information

Revision Date	Summary of Revisions
20021119	This revision includes the following changes: **Front-Panel Interface** ➤ Added figure describing configurable labels ordering option (see *Figure 3.2: SEL-351R Front-Panel Interface Configurable Labels*). ➤ Added notes to **{TRIP}** and **{CLOSE}** operator controls suggesting time-delay settings for configurable labels ordering option. **Settings** ➤ Edited Close power wait time setting notes. **Battery** ➤ Changed Status item IBAT trickle charging current to 8 mA from 15 mA.
20020215	This revision includes the following changes: ➤ Added **COU** and **COM** command to Table 4 and edited the **CON** command. **Settings** ➤ Added setting "Phantom voltages from (VA,VB,VC,VAB,VBC,VCA,OFF)" (SEL-351R-2 only) to provide more metering capability when three-phase voltages are not available.
20010518	This revision includes the following changes: Replaced Standard Product Warranty section with warranty statement on cover page. **Installation** ➤ Added two fuses (see *Table 1.3: Replacement Fuses for the SEL-351R Recloser Control (see Figure 1.13)* and *Figure 1.13: SEL-351R Recloser Control Factory-Installed Wiring Inside the Enclosure* for overall wiring view): - Terminal block position 28 (see *Figure 1.6: Battery Wiring Harness Connections*). - Battery wiring harness (see *Figure 1.7: Connections to 120 Vac Power Bus*). ➤ Settings enhancement allows optoisolated inputs **IN101** through **IN106** to operate on ac voltage (see *Detail 2: Side Panel (Figure 1.12)*). **Settings** ➤ Settings enhancement allows 3-second delay on the **{LOCK}** operator control to be defeated (see setting "Reset trip-latched LEDs on close" in *Global EZ Settings (SET FZ command)*). **Reference** ➤ Added new Reference section in back, for previous figures, etc.

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Appendix B
Reference

Replaced Figures

This figure has been replaced by *Figure 1.13*. See the explanation in the notes accompanying *Figure 1.13*.

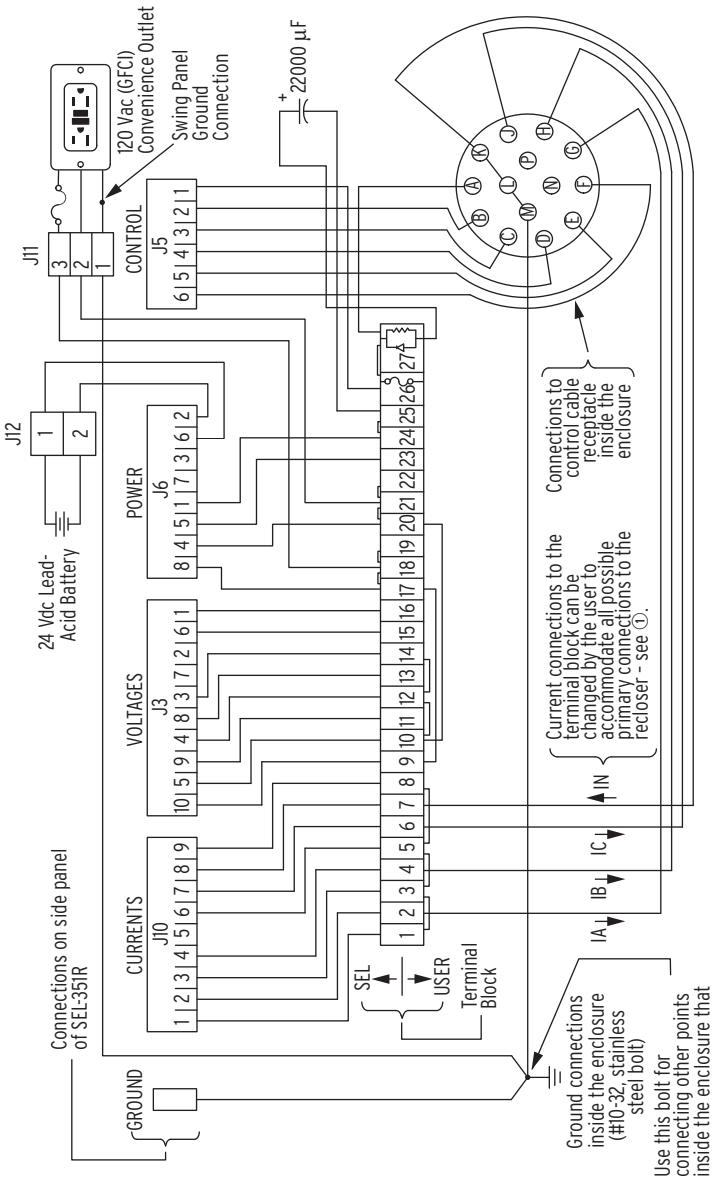

Figure B.1 SEL-351R Factory-Installed Wiring Inside the Enclosure (for Units Built Before June 2001)

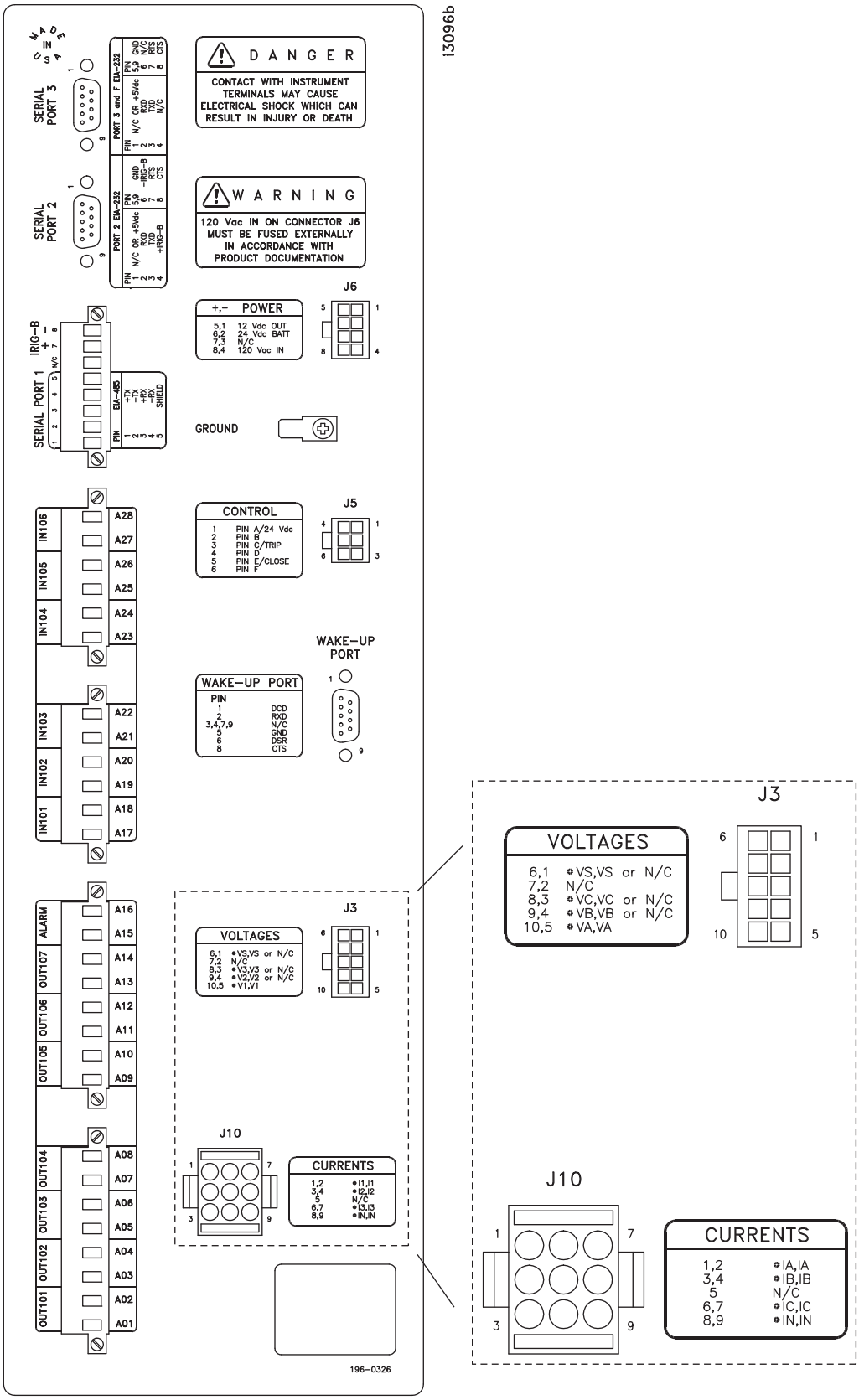

Figure B.2 SEL-351R Recloser Control Side Panel Prior to October 2004

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