Designing for Recloser Compatibility With the SEL-651R Multi-Recloser Interface

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SEL SCHWEITZER ENGINEERING LABORATORIES

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Purpose

This document provides the SEL standards for the Multi-Recloser Interface (MRI), including system interface requirements and recommendations. Conformance to this guide provides minimum interface requirements but does not address all issues that may impact the recloser-to-recloser control system compatibility.

Definitions

Recloser: The primary switchgear apparatus that incorporates per-phase circuit interrupters for energizing or deenergizing the primary circuit.

Recloser Control: The IED used to initiate the recloser open and close operations; may be referred to as the control.

Recloser Control Cable: The cable between the recloser and recloser control through which all signaling takes place; may be referred to as the control cable.

Introduction

The MRI is intended to provide a common interface standard, which allows for flexibility in design and operational characteristics while allowing one single control variant to interface with multiple styles of reclosers. These styles include triple-single and three-phase, gang-operated models. While recloser-specific adapter cabling and modules may be used, the control hardware remains consistent. Recloser differences, such as status contact availability and form, e.g., (52a vs. 52b or 69a vs. 69b), as well as trip/close pulse time considerations, are handled in the control firmware and settings. The commonality of hardware greatly simplifies stocking, standardization, and management for system operators because a single control can be used with many different recloser styles.

System Overview

The MRI uses a compartmentalized design where the recloser provides the following to the control through the control cable:

- Access to both ends of trip/close coil(s)
- 69 status contact(s) to indicate position of the yellow operating handle
- 52a and/or 52b closed or open state of the recloser primary contacts
- Residually connected phase current transformer secondaries for use in metering and protection functions
- Connections to low-energy analog (LEA) voltage secondaries for use in metering and protection functions

The following functionalities are provided to the recloser from the control through the control cable:

- A controlled energy storage and release system for driving the magnetic actuators of the recloser (used for trip/close operations).
- A dc power source for active LEA circuitry
- Wetting voltage source for recloser 69, 52a, and 52b status contacts monitoring.

Pin Assignment and Connector Information

Table 1 provides the pin assignments (pinout) for the 42-pin MRI connector.

Table 1 42-Pin MRI Connector Pinout (Sheet 1 of 3)

Pin No.	Signal	Figure Reference	Notes
1	52a3	*Figure 9*	Monitored (non-wetted) side of recloser Phase 3 close indication status contact (for triple-single reclosers).
2	Close 1	*Figure 6*	Pin of control cable, where current flowing out of the recloser control through this pin, through the Phase 1 actuator coil, and returning through Pin 3 results in the closing of Phase 1 recloser primary contact (for triple-single reclosers). May function as the sole actuator coil for three-phase, gang-operated reclosers (see *Figure 5*).
3	Trip 1	*Figure 6*	Pin of control cable, where current flowing out of the recloser control, through this pin, through the Phase 1 actuator coil, and returning through Pin 2 results in the opening of Phase 1 recloser primary contact (for triple-single reclosers). May function as the sole actuator coil for three-phase, gang-operated reclosers (see *Figure 5*).
4	Close 2	*Figure 6*	Pin of control cable, where current flowing out of the recloser control through this pin, through the Phase 2 actuator coil, and returning through Pin 5 results in the closing of Phase 2 recloser primary contact (for triple-single reclosers).
5	Trip 2	*Figure 6*	Pin of control cable, where current flowing out of the recloser control, through this pin, through the Phase 2 actuator coil, and returning through Pin 4 results in the opening of Phase 2 recloser primary contact (for triple-single reclosers).
6	Close 3	*Figure 6*	Pin of control cable, where current flowing out of the recloser control through this pin, through the Phase 3 actuator coil, and returning through Pin 7 results in the closing of Phase 3 recloser primary contact (for triple-single reclosers).
7	Trip 3	*Figure 6*	Pin of control cable, where current flowing out of the recloser control, through this pin, through the Phase 3 actuator coil, and returning through Pin 6 results in the opening of Phase 3 recloser primary contact (for triple-single reclosers).
8	52a2	*Figure 9*	Monitored (non-wetted) side of recloser Phase 2 close indication status contact (for triple-single reclosers).
9	52a1	*Figure 9*	Monitored (non-wetted) side of recloser Phase 1 close indication status contact (for triple-single reclosers). May function as the sole close indication status contact (for three-phase, gang-operated reclosers, see *Figure 8*).
10	LEA Power Supply –	*Figure 9*	Return side of the LEA power supply.
11	LEA Power Supply +	*Figure 9*	Source side of the LEA power supply.
12	Not Connected	–	This pin is not connected.[a]
13	Not Connected	–	This pin is not connected.[a]
14	Not Connected	–	This pin is not connected.[a]

Table 1 42-Pin MRI Connector Pinout (Sheet 2 of 3)

Pin No.	Signal	Figure Reference	Notes
15	69	*Figure 9*	Monitored (non-wetted) side of combined 69 yellow operating handle lock-open indication status contacts (for triple-single reclosers with per-phase yellow operating handles). May connect to a single 69 yellow operating handle lock-open indication status contact (for three-phase, gang-operated reclosers, as shown in *Figure 8*, and triple-single reclosers with only one yellow operating handle).
16	52b3	*Figure 9*	Monitored (non-wetted) side of recloser Phase 3 open indication status contact (for triple-single reclosers).
17	52b2	*Figure 9*	Monitored (non-wetted) side of recloser Phase 2 open indication status contact (for triple-single reclosers).
18	Not Connected	–	This pin is not connected.[a]
19	VY Shield	*Figure 13*, *Figure 14*	Shield for Y-side LEA voltages within the control cable. This connection is grounded through the ground stud of the control cabinet.
20	VZ Shield	*Figure 13*, *Figure 14*	Shield for Z-side LEA voltages within the control cable. This connection is grounded through the ground stud of the control cabinet.
21	I1	*Figure 15*	Phase 1 CT secondary current. This pin connects to the polarity side of the Phase 1 current input of the control.
22	52b1	*Figure 9*	Monitored (non-wetted) side of recloser Phase 1 open indication status contact (for triple-single reclosers). May function as the sole open indication status contact (for three-phase, gang-operated reclosers, see *Figure 8*).
23	Not Connected	–	This pin is not connected.[a]
24	Not Connected	–	This pin is not connected.[a]
25	GND	*Figure 15*	Ground, shield for control cable.
26	Additional GND	*Figure 15*	Additional ground (undesignated).
27	CT Common	*Figure 15*	Common (residual) return for the residually connected phase CTs. This pin connects to the non-polarity side of the neutral current input of the control.
28	I2	*Figure 15*	Phase 2 CT secondary current. This pin connects to the polarity side of the Phase 2 current input of the control.
29	Wetting Voltage	*Figure 9*	Voltage source used to wet the recloser 69, 52a, and 52b status contacts for monitoring by the control.
30	V1Y_RET	*Figure 13*	Return for Phase 1 Y-side LEA voltage. May function as the sole return point for the Y-side (in cases where per-phase returns are not available, see *Figure 14*).
31	V2Y_RET	*Figure 13*	Return for Phase 2 Y-side LEA voltage.
32	V3Y_RET	*Figure 13*	Return for Phase 3 Y-side LEA voltage.
33	V2Z_RET	*Figure 13*	Return for Phase 2 Z-side LEA voltage.
34	V3Z_RET	*Figure 13*	Return for Phase 3 Z-side LEA voltage.
35	I3	*Figure 15*	Phase 3 CT secondary current. This pin connects to the polarity side of the Phase 3 current input of the control.
36	V1Y	*Figure 13*, *Figure 14*	Phase 1 Y-side LEA voltage.
37	V2Y	*Figure 13*, *Figure 14*	Phase 2 Y-side LEA voltage.
38	V3Y	*Figure 13*, *Figure 14*	Phase 3 Y-side LEA voltage.
39	V1Z_RET	*Figure 13*	Return for Phase 1 Z-side LEA voltage. May function as the sole return point for the Z -side (in cases where per-phase returns are not available, see *Figure 14*).

Table 1 42-Pin MRI Connector Pinout (Sheet 3 of 3)

Pin No.	Signal	Figure Reference	Notes
40	V1Z	*Figure 13*, *Figure 14*	Phase 1 Z-side LEA voltage.
41	V2Z	*Figure 13*, *Figure 14*	Phase 2 Z-side LEA voltage.
42	V3Z	*Figure 13*, *Figure 14*	Phase 3 Z-side LEA voltage.
GND Tabs	Not Connected	–	These tabs are not connected.[a]

[a] Do not connect or short these pins.

Figure 1 shows a picture of the 42-pin control cable receptacle installed on the bottom of the recloser control cabinet. Note that the contacts are of the pin style.

Figure 1 Recloser Control 42-Pin Receptacle

Figure 2 shows a simplified depiction of the control receptacle showing contact positioning.

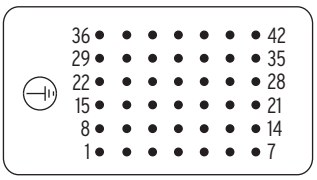

Figure 2 Recloser Control 42-Pin Receptacle Contact Position Designations

Figure 3 shows a picture of the 42-pin control cable plug that connects to the recloser control receptacle. Note that the contacts are socket style.

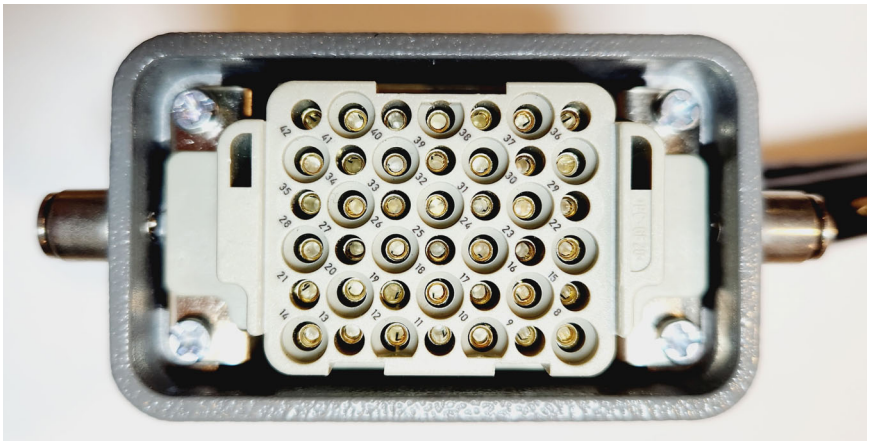

Figure 3 42-Pin Control Cable Plug

Table 2 provides example part numbers for the electrical contacts and the inserts that retain them. The specific part numbers listed are for general reference; other connectors may exist that are electrically and mechanically acceptable.

Table 2 42-Pin Receptacle and Plug Part Numbers

Location	Manufacturer	Contact Part No.	Insert Part No.	Description
Recloser Control Cabinet	Harting	09 15 000 6102	09 16 042 3001	Pin contact and pin contact insert (used on recloser control cabinet receptacle)
Recloser Tank/Junction Box	Harting	09 15 000 6102	09 16 042 3001	Pin contact and pin contact insert (typical connector used on recloser tank/J-box receptacle)
Recloser Control Cable	Harting	09 15 000 6203	09 16 042 3101	Socket contact and socket contact insert (used on control cable plug for the end connecting to the recloser control cabinet, also typical connector for the recloser end)

Trip/Close Interface

Triple-Single Recloser Interface Discussion

Figure 4 shows the trip/close circuits within a triple-single recloser, with a separate trip/close circuit for each phase. None of these circuits are grounded within the recloser. Phase 1 (between Pin 2 and Pin 3) is discussed here, but the same operating principles are applicable to Phase 2 (between Pin 4 and Pin 5) and Phase 3 (between Pin 6 and Pin 7).

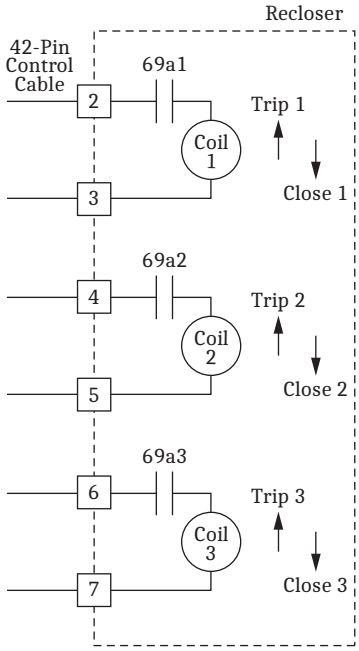

Figure 4 Trip/Close Circuits in Triple-Single Recloser

The 69a1 contact (if present) opens when its corresponding yellow operating handle (on the recloser) is pulled to the lock-open position, thus creating an open-circuit condition in the Phase 1 trip/close circuit and preventing any trip or close signals (from the control) from getting through. When the 69a1 contact is closed (yellow operating handle returned to the reset position), trip or close signals (from the control) can get through.

Voltage applied (plus to minus) from Pin 3 to Pin 2 causes a trip operation of Phase 1 (with trip current flow indicated).

Voltage applied (plus to minus) from Pin 2 to Pin 3 causes a close operation of Phase 1 (with close current flow indicated).

Three-Phase, Gang-Operated Recloser Interface Discussion

The preceding discussion describes the trip/close operation of a triple-single recloser. Three-phase, gang-operated reclosers operate in a similar fashion with minimal modification.

Three-phase, gang-operated reclosers generally provide only a single coil for tripping/closing. When only a single coil is used, it should be wired as shown in *Figure 5*.

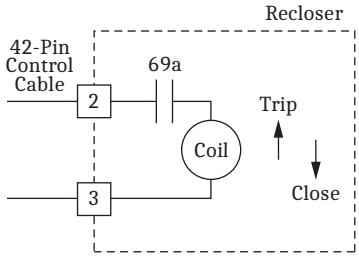

Figure 5 Trip/Close Circuits in Three-Phase, Gang-Operated Recloser

Trip/Close Coil Energy Discussion

The control supplies the voltage/energy used for the trip and close operations. *Table 3* describes the nominal coil voltage. This is the voltage the recloser control charges its energy storage system to. No specific trip/close pulse duration is required, as these times are usually unique to the specific recloser. The control can provide different pulse durations depending on the specific recloser used.

Contact SEL to review specific trip/close coil energy requirements.

Table 3 Trip/Close Circuit Voltage Output Specifications

Parameter	Value
Nominal Coil Voltage	155 Vdc

SEL-651R-2 Application Note

The SEL-651R-2 Recloser Control implementation uses a capacitor bank charged to 155 Vdc nominal with an allowable range of (152–160 Vdc) and three H-bridge MOSFET circuits for controlled delivery of the energy/current used to drive the trip/close coils during operations. *Figure 6* depicts the wiring connections used on the SEL-651R-2. See the latest instruction manual for the most up-to-date information.

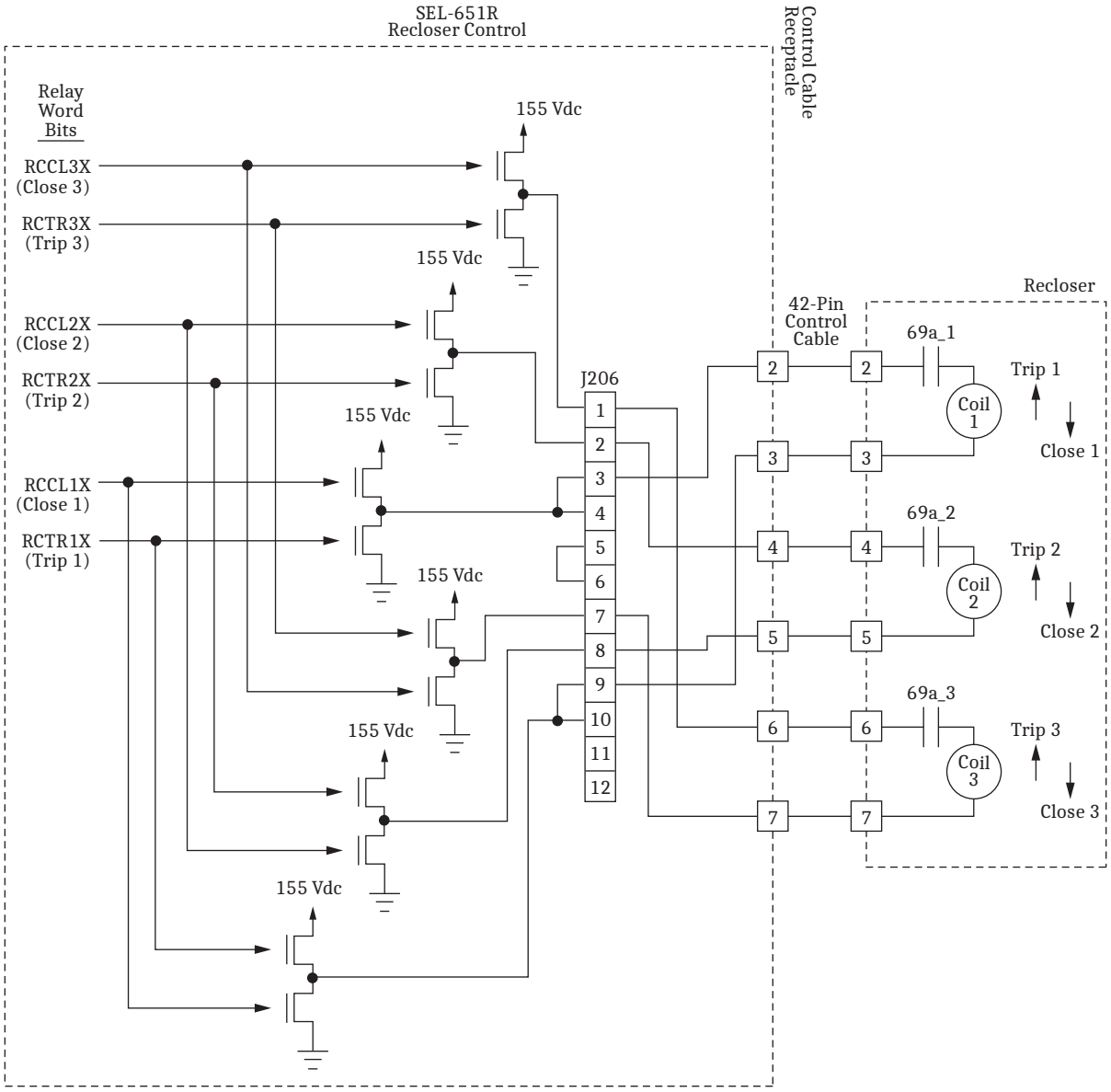

Figure 6 SEL-651R-2 Trip/Close Circuit Connections for the MRI

Recloser Status Indication Interface

Triple-Single Recloser Interface Discussion

Figure 7 shows the typical status contact monitoring connections for a triple-single recloser. Status contacts for 52a (recloser phase closed indication), 52b (recloser phase open indication), and 69b (yellow operating handle lock-open indication) are shown. Numerals 1, 2, and 3 in the 52a, 52b, and 69b labels correspond to respective recloser phases 1, 2, and 3. While 69b contacts, depicted and included in the following discussion, are preferred, 69a contacts can also be used. None of these circuits are grounded within the recloser.

Pin 29 in *Figure 7* brings 12 Vdc nominal voltage into the recloser (from the recloser control). This voltage migrates to the various 52a, 52b, and 69b dry contacts. The pins for these contacts (numbered 9, 8, 1, 22, 17, 16, and 15) are routed to separate, individual sensing inputs in the recloser control.

69b

Figure 7 shows per-phase 69b contacts (in the recloser) wired in a parallel configuration. The 69b1 contact closes when the corresponding yellow operating handle (for Phase 1 on the recloser) is pulled to the lock-open position, thus signaling a yellow operating handle operation to the recloser control, via Pin 15. Because of the parallel configuration of the per-phase 69b contacts in *Figure 7*, only the first yellow operating handle (that is pulled to the lock-open position) can be sensed, but no specific phase discernment can be made.

Although a per-phase 69b contact arrangement is shown in *Figure 7* (corresponding to an individual yellow operating handle for each respective recloser Phase 1, 2, and 3), a single 69b contact can be installed in this Pin 15 position instead. This single 69b contact would correspond to a single yellow operating handle that operates all three recloser phases when pulled to the lock-open position (all three 69a contacts in *Figure 4* open and the single 69b contact substituted in *Figure 7* closes).

69a

If 69a contacts are provided (in the recloser), the operation is similar to 69b with the state of the contact inverted. The 69a contact opens when the corresponding yellow operating handle is pulled to the lock-open position, thus signaling a yellow operating handle operation to the recloser control via Pin 15. For cases with per-phase yellow operating handles, the corresponding per-phase 69a contacts are combined in series. In this case, only the first yellow operating handle (that is pulled to the lock-open position) can be sensed, but no specific phase discernment can be made.

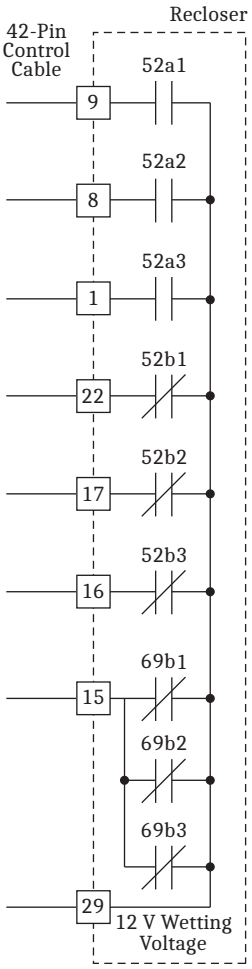

Figure 7 Status Indication Interface for Triple-Single Reclosers

Three-Phase, Gang-Operated Recloser Interface Discussion

The preceding discussion describes the status indication circuit of a triple-single recloser. Three-phase gang-operated reclosers operate in a similar fashion with minimal modification.

Three-phase, gang-operated reclosers generally provide only a single 52a (recloser closed indication) contact and/or 52b (recloser open indication) contact for status monitoring, as opposed to including per-phase contacts. When only single recloser status contacts are provided, they should be wired as shown in *Figure 8*. As with the triple-single reclosers discussed in the previous section, the single 69 status contact can be either 69b or 69a, but use of a 69b status contact is preferred. *Figure 8* depicts this type of configuration.

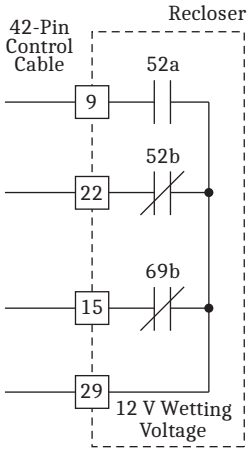

Figure 8 Status Indication Interface for Three-Phase Gang-Operated Reclosers

Wetting Voltage

The recloser control provides a 12 Vdc wetting voltage (Pin 29) that is used to wet the recloser 69, 52a, and 52b status contacts.

The recloser control wetting voltage source is grounded inside the control and is not user-serviceable.

If a short circuit occurs, the recloser control will current-limit the 12 V wetting source to minimize damage to the system.

Recloser Status Indications

Open/Closed Indications

A recloser can have only 52a, only 52b, or both 52a and 52b status indications. Providing both 52a and 52b contacts is helpful for detecting issues with the status reporting system, such as faulty contacts, loss of wetting voltage, and damaged/disconnected control cables.

Triple-single reclosers should include per phase 52a, 52b, or both indications.

Three-phase, gang-operated reclosers may include a single or per-phase 52a and/or 52b indications. If a single 52a/52b indication is used, it should be connected as shown in *Figure 8*.

Yellow Operating Handle Lock-Open Indications

Pulling the recloser yellow operating handle(s) to the lock-open position should cause both of the following actions:

- The recloser primary contacts to open
- The lock-open indication contact(s) to change state

Lock-open indication contacts may be either of the following styles:

- 69b contact closes when the yellow operating handle is pulled to the lock-open position
- 69a contact opens when the yellow operating handle is pulled to the lock-open position

Triple-single reclosers may have a single handle to operate all three phases or one handle per phase.

Three-phase, gang-operated reclosers have only one handle.

Per-phase 69 status contacts (if provided) must be combined before they leave the recloser because only a single signal line is provided (Pin 15). *Figure 7* shows a schematic depiction of combing per-phase 69b contacts.

Recloser Control Status Monitoring Inputs

The recloser control status inputs monitor the recloser 52a, 52b, and 69 status contacts.

SEL-651R-2 Application Note

The SEL-651R-2 implementation includes the use of two different styles of status inputs. This is based on existing hardware availability and not on varied performance requirements. See *Figure 9* for SEL-651R-2-specific wiring, including the labeling of the two styles of inputs.

Inputs IN105, IN106, and IN107 are optoisolated inputs. Inputs IN201, IN202, IN203, and IN204 are referred to as recloser status inputs. These are single-terminal inputs that are internally tied to ground. *Table 4* and *Table 5* provide specifications regarding the operational characteristics of the status inputs.

See the latest SEL-651R-2 instruction manual for the most up-to-date information.

Table 4 On-State Specifications for Optoisolated Status Inputs (IN1*xx*)

Parameter	Value
Guaranteed On-State Voltage Level	9.6 to 27 Vdc
Input Current Draw	4 to 10 mA

Table 5 Pickup and Dropout Specifications for Recloser Status Inputs (IN2*xx*)

Parameter	Value
Pickup Voltage Level	8 to 28 Vdc
Dropout Voltage Level	0 to 4 Vdc
Input Current Draw	1 to 10 mA

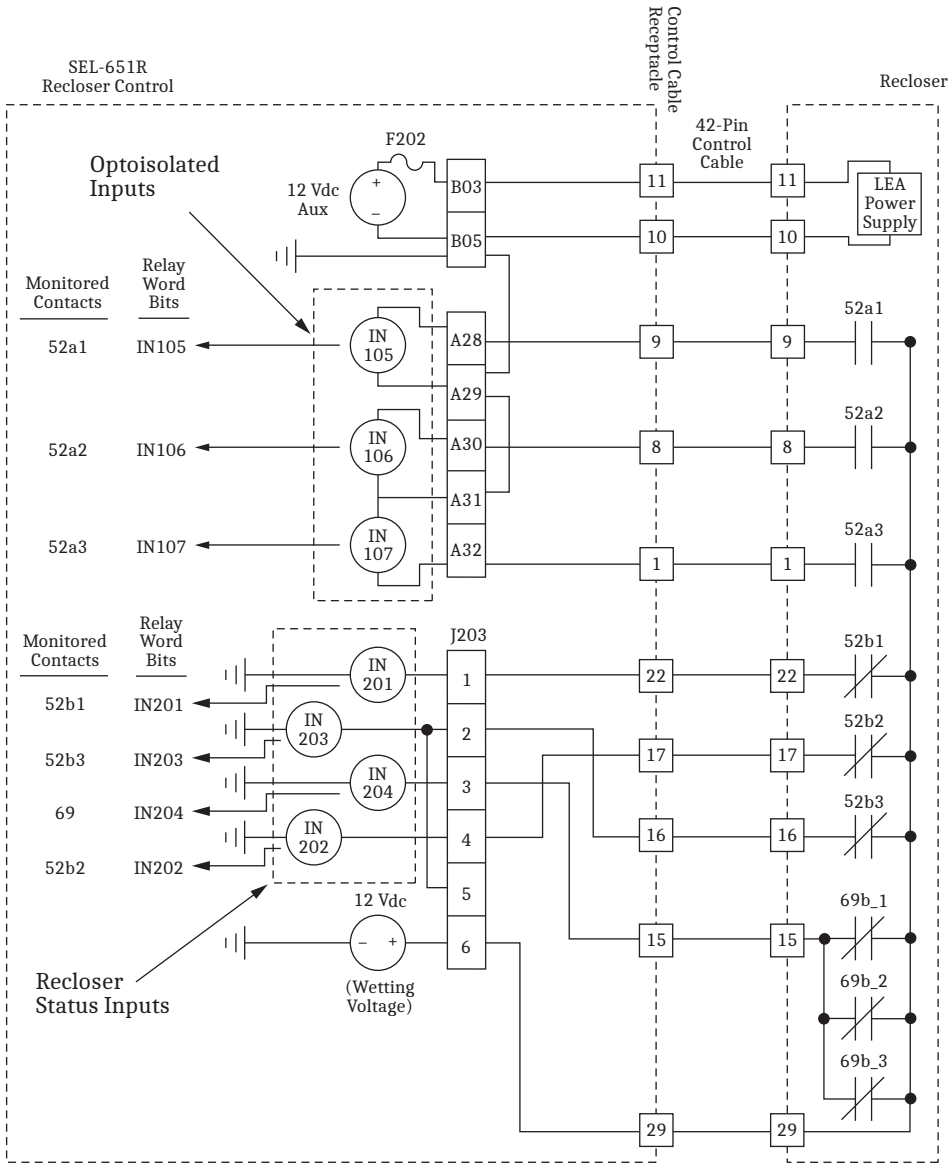

Figure 9 SEL-651R-2 Recloser Pole Status Monitoring Input and LEA Power Supply Connections

LEA Power Supply Circuit

Some low-energy analog (LEA) voltage sensors may benefit from having active circuitry. The recloser control provides a 12 Vdc nominal source to the recloser for powering active LEA circuitry. Pin 10 is used for negative (minus) and Pin 11 for positive (plus). The 12 V supply negative terminal is internally ground referenced at the control. The supply provides at least 3 W of power at 12 V. See *Figure 10* for a schematic depiction of connections. During trip/close operations, the supply may dip momentarily to as low as 9 Vdc.

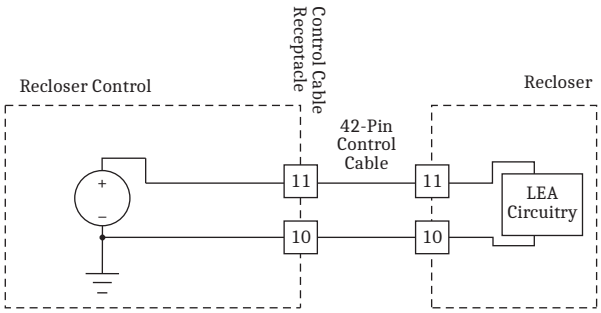

Figure 10 LEA Power Supply Wiring Connections

SEL-651R-2 Application Note

The SEL-651R-2 uses its 12 V auxiliary power supply as the LEA power supply. As such, any power drawn by the LEA functionality reduces the availability of power on the 12 V auxiliary supply for other functions, e.g., radios, clocks, etc. Likewise, the LEA power supply overcurrent protection is accomplished by virtue of the 12 V auxiliary power supply fusing. See *Figure 9* for SEL-651R-2-specific wiring for the 12 V LEA power supply. See the SEL-651R-2 instruction manual for auxiliary supply fusing and ratings, which can vary based on the part number ordered.

LEA Voltage Sensors

General Discussion

As many as six voltage secondary signals (two per phase, monitoring both sides of a given interrupter within the recloser) may be brought through the control cable to the control. Voltage sensors are typically integral to the recloser bushings, but sensors mounted externally to the bushing may also be routed through the control cable. Voltage signals routed through the control cable must meet the requirements outlined in this section.

Typically, sensors are simple, passive analog devices, either capacitive or resistive in nature. Active devices may need additional power; see *LEA Power Supply Circuit* on page 13 for additional information on the LEA power supply source.

Sensor Topology and Error Correction

The sensor circuitry is responsible for providing the voltage divider function. The high input impedance of the control LEA input means it contributes very little to the overall divider ratio and is intended to have no material impact on the divider ratio. *Figure 11* and *Figure 12* show the two typical voltage divider topologies.

The recloser control includes magnitude correction settings which can be used to correct for minor magnitude error in the sensor. Likewise, the recloser control includes phase angle correction settings that can be used to correct for the phase angle error caused by cable capacitance for resistive divider-style sensors.

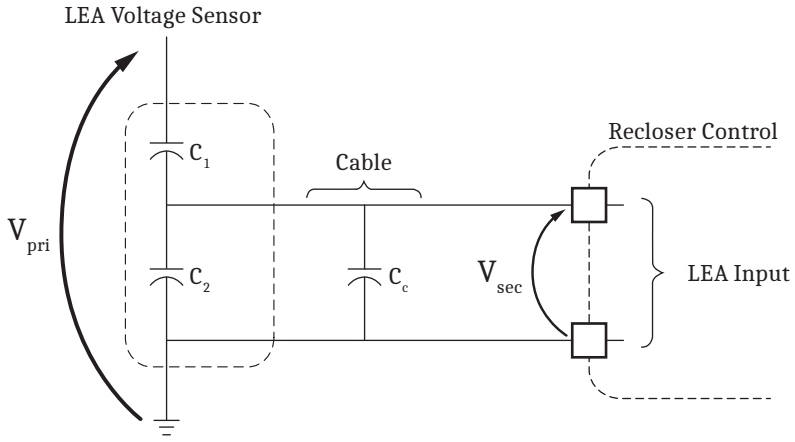

Figure 11 Capacitive Voltage Divider Topology

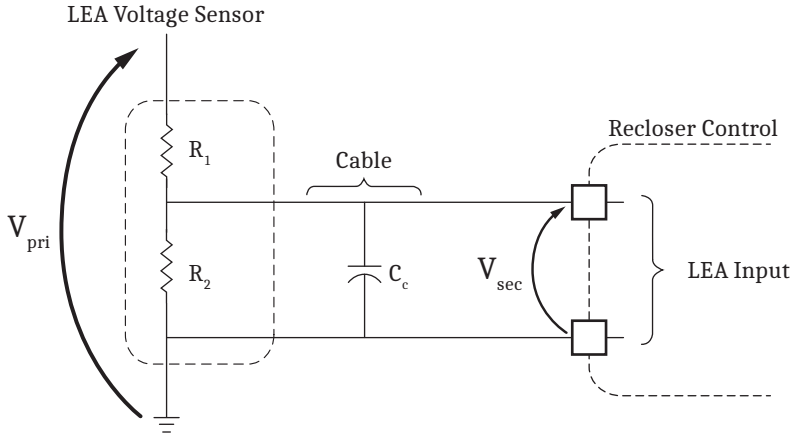

Figure 12 Resistive Voltage Divider Topology

Terminal Label Designations and Routing Availability

Voltage signals are designated by either VY or VZ depending on which side of the recloser the sensors are attached, along with the phase number. For example, the Phase 1 terminal on the Y side of the reclosers would be labeled V1Y.

When only three LEA voltage sensors are included within this interface (monitoring voltages on only one side of the recloser), those three sensors are wired through the VY side. Any connections to VZ terminals for other voltage monitoring needs, such as traditional PTs, are not wired through the control cable but by some other means.

Grounding and Shielding for Voltage Signals

A ground reference point for the LEA voltage sensor circuit(s) must be made. The control does not provide this ground point and it must be made external to the control (e.g., at the recloser).

The interface provides individual neutral/return paths for each of the six voltage signals. See *Figure 13* for a schematic depiction.

The recloser, control cable, or control may combine individual neutral/returns.

If neutral/returns are combined, the recommended combination is to combine each of the VY returns together and separately combine each of the VZ returns. If this is done, the pin designated as the Phase 1 return should be the single return point, one for VY (e.g., pin 30/V1Y_RET) and another for VZ (Pin 39/ V1Z_RET). See *Figure 14* for a schematic depiction.

SEL recommends that shielded, twisted-pair cable be used in construction for all LEA system components.

The control provides grounding points on Pin 19 and Pin 20, which are used for grounding the drain wires of the voltage signal cable EMI shields. Pin 19 is used for the VY-side wiring and Pin 20 the VZ-side wiring. See *Figure 13* and *Figure 14* for a schematic depiction of cable shield connections.

LEA Signal Voltage Level and Input Impedance

Table 6 provides specifications regarding the recloser control LEA voltage sensor input.

Table 6 LEA Voltage Sensor Input Specifications

Parameter	Value
8 Vac RMS Max LEA Voltage Ceiling	Connect voltage no higher than 6.5 Vac RMS L-N nominal, thus providing 1.5 Vac RMS L-N margin for accurately measuring overvoltage conditions
Recloser Control Input Impedance	1 MΩ resistive

Figure 13 and *Figure 14* shows an example wiring diagram depicting LEA voltage sensor wiring, including signal, neutral/return, and shield ground points. Capacitive voltage dividers are depicted, but dividers need not be capacitive in nature.

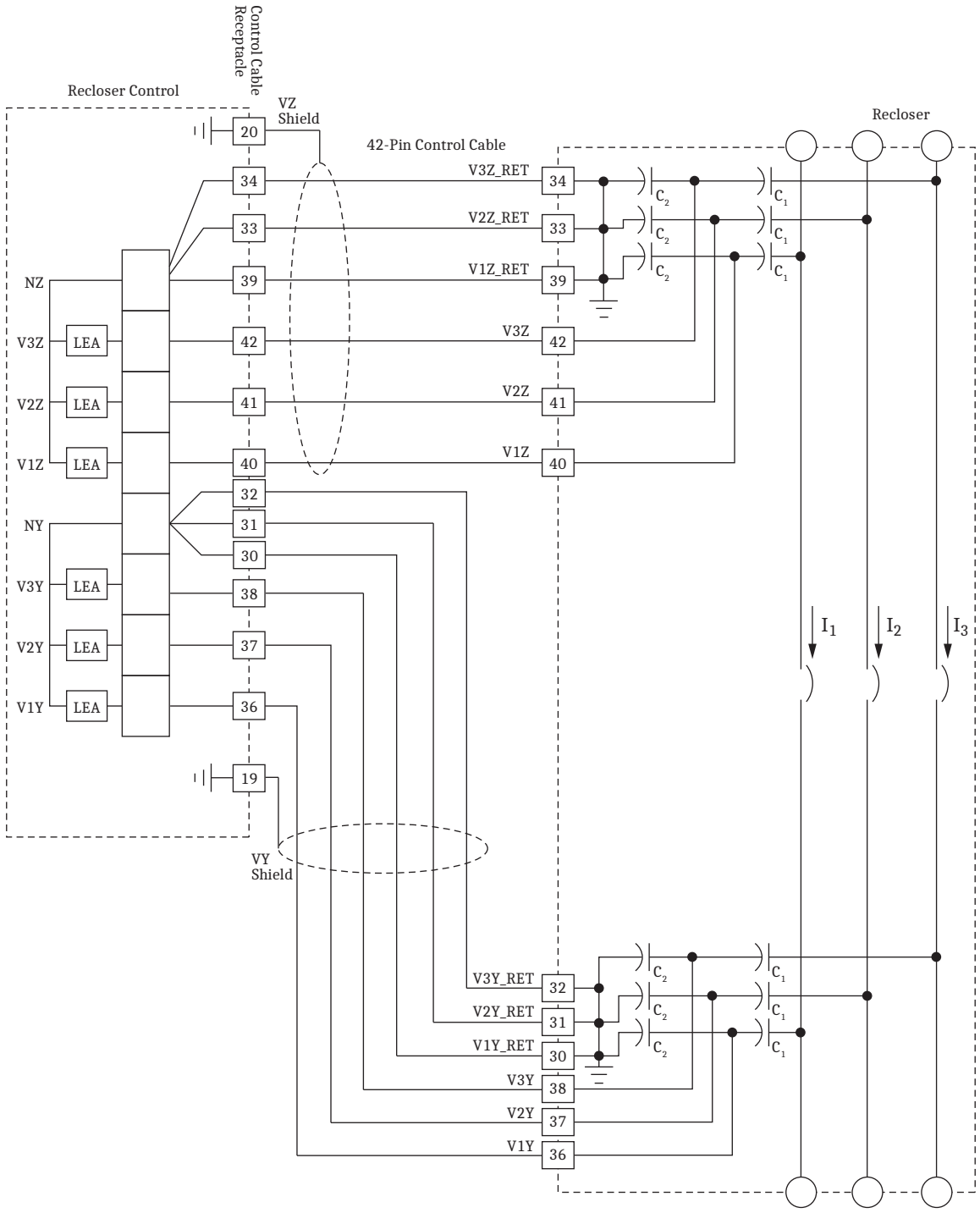

Figure 13 LEA Voltage Sensor Circuitry Connections

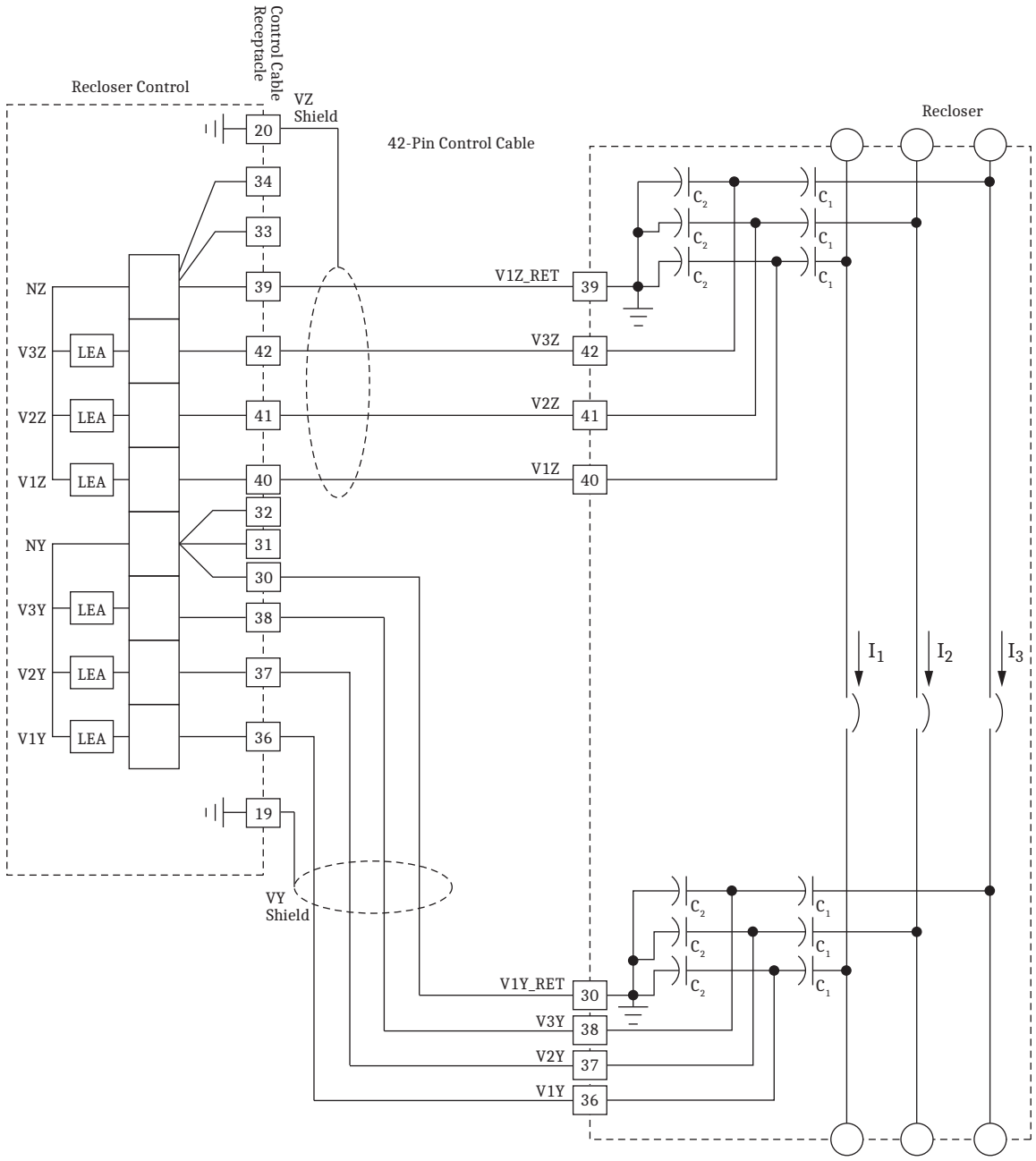

Figure 14 LEA Voltage Sensor Circuitry Connections for Combined Returns

CTs and General Grounding

General Discussion

The recloser must include per-phase CTs with the returns being connected residually for a total of four conductors.

The recloser control monitors per-phase CT currents and the residual current.

CT Residual Connection

The CT returns must be residually connected at the recloser (see *Figure 15* location A) and at the control (see *Figure 15* location B).

CT Polarity

The preferred CT polarity of the recloser is such that primary current flowing through the recloser bushings from the source side to the load side results in current flowing out of the recloser CT secondary polarity terminal and into the control polarity terminal.

CT Grounding

The CT circuit ground point should be within the recloser. No CT ground point is made within the control.

The CT circuit ground point should be made at the residual/return terminal (see *Figure 15* location C).

General Grounding

The following pins are connected to the ground lug at the bottom of the control cabinet.

- Pin 19 VY shield used to ground drain wires for LEA voltage signals; see *Grounding and Shielding for Voltage Signals* on page 15, *Figure 13*, and *Figure 14*
- Pin 20 VZ shield used to ground drain wires for LEA voltage signals; see *Grounding and Shielding for Voltage Signals* on page 15, *Figure 13*, and *Figure 14*
- Pin 25 Main ground, generally the shield for the control cable, providing a bond between the recloser tank ground and control cabinet ground lug connection through the control cable (*Figure 15*)
- Pin 26 Additional ground, which is not designated for a specific purpose and may be used for other grounding needs (*Figure 15*)

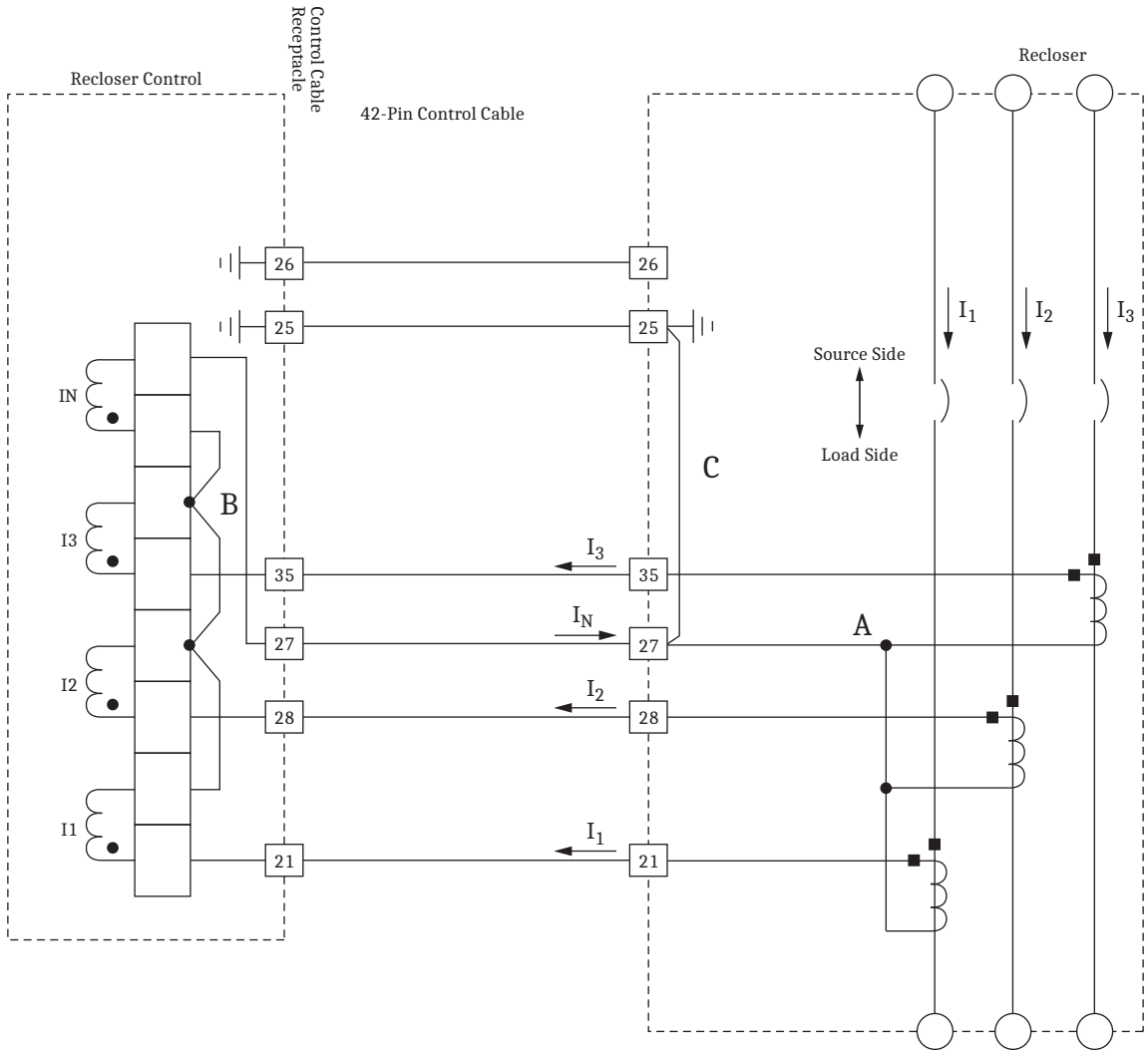

Figure 15 CT Circuitry and General Grounding Connections

SEL-651R-2 Application Note

Table 7 provides specific details related to CT ratings and burden. See the latest SEL-651R-2 instruction manual for the most up-to-date information.

Table 7 SEL-651R-2-Specific Details for Interfacing With CT Secondary Circuits

For Phase Current Channels	
Parameter	**Value**
Nominal Rating	1 A
Continuous Rating	3 A
CT Burden	0.13 VA at 1 A; 1.31 VA at 3 A.
For Neutral Current Channel	
Parameter	**Value**
Nominal Rating	0.2 A
Continuous Rating	15 A
CT Burden	<0.5 VA at 0.2 A.

Appendix: SEL-651R-2 Point-to-Point Connections

Table 8 shows the wiring point-to-point electrical connections as used on the base model 42-pin SEL-651R-2 with no installed accessories and 6 x 8 V LEA inputs.

Table 8 SEL-651R-2 Point-to-Point Connections (Sheet 1 of 2)

Pin No.	Signal	SEL-651R-2 Connection
1	52a3	A32
2	Close 1	J206-3
3	Trip 1	J206-9
4	Close 2	J206-2
5	Trip 2	J206-8
6	Close 3	J206-1
7	Trip 3	J206-7
8	52a2	A30
9	52a1	A28
10	LEA Power Supply –	B06
11	LEA Power Supply +	B03
12	Not Connected	Not Connected
13	Not Connected	Not Connected
14	Not Connected	Not Connected
15	69	J203-3
16	52b3	J203-2
17	52b2	J203-4
18	Not Connected	Not Connected
19	VY Shield	GND Stud
20	VZ Shield	GND Stud
21	I1	Z01
22	52b1	J203-1
23	Not Connected	Not Connected
24	Not Connected	Not Connected
25	GND	GND Stud
26	Additional GND	GND Stud
27	CT Common	Z08
28	I2	Z03
29	Wetting Voltage	J203-6
30	V1Y_RET	Z12
31	V2Y_RET	Z12
32	V3Y_RET	Z12
33	V2Z_RET	Z16
34	V3Z_RET	Z16
35	I3	Z05
36	V1Y	Z09
37	V2Y	Z10

NOTE: Units ordered without all 6 x 8 V LEA inputs omit the connections to pins 33, 34, 39, 40, 41, and 42.

Table 8 SEL-651R-2 Point-to-Point Connections (Sheet 2 of 2)

Pin No.	Signal	SEL-651R-2 Connection
38	V3Y	Z11
39	V1Z_RET	Z16
40	V1Z	Z13
41	V2Z	Z14
42	V3Z	Z15
GND Tab	Not Connected	Not Connected

Document Versions

Table 9 shows the revision history for this document.

Table 9 Specification Revision History

Date Code	Summary of Revisions
20230123	➤ Updated *Figure 12: Resistive Voltage Divider Topology*.
20221103	➤ Initial version.

Technical Support

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 99163-5603 U.S.A.
Tel: +1.509.338.3838
Fax: +1.509.332.7990
Internet: selinc.com/support
Email: info@selinc.com

SCHWEITZER ENGINEERING LABORATORIES, INC.
2350 NE Hopkins Court • Pullman, WA 99163-5603 U.S.A.
Phone: +1.509.332.1890 • Fax: +1.509.332.7990
selinc.com • info@selinc.com