SEL-651R
Advanced Recloser Control

The industry’s gold standard for recloser control

• Advanced recloser protection capabilities support coordinated high-speed fault isolation and restoration.
• Three- or single-phase tripping minimizes customer outages and improves reliability metrics.
• Arc Sense™ technology improves public safety and minimizes fire dangers caused by downed conductors.
• Fast islanding detection, precise synchronization, and IEEE 1547-2018 tripping let you safely interconnect distributed energy resources (DERs).
• Second-harmonic blocking secures overcurrent elements from transformer inrush.
Compatible With Popular Reclosers

The SEL-651R Advanced Recloser Control works with a wide range of reclosers for complete plug-and-work capability. All interfaces are designed and tested to exceed the IEEE C37.60 standard. Certificates are available at selinc.com/SEL-651R.

**G&W**
- Control Power Viper-S
- Viper-LT
- Viper-S
- Viper-SP
- Viper-ST
- Viper-G

**Other Reclosers**
- Elastimold Molded Vacuum Recloser (MVR)
- Joslyn TriMod 300R
- Joslyn TriMod 600R
- OVR 24-Pin (15 and 27 kV only)
- OVR 32-Pin (15, 27, and 38 kV)
- OVR 42-Pin (15, 27, and 38 kV)
- VR-3S (15 and 27 kV only)
- CXE
- NOVA Auxiliary Powered
- NOVA Control Powered
- NOVA NX-T
- NOVA Triple-Single
- RE
- RVE
- RXE
- VSA
- VSO
- VWE
- VVWE 27
- VVVE 38X
- WE
- WVE 27
- WVE 38X
- GVR*
- SDR Triple-Single
- SDR Three-Phase
- OSM_150

*When equipped with interface module

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**ANSI NUMBERS/ACYRONYMS AND FUNCTIONS**

- 16 SEC: Access Security (Serial, Ethernet)
- 25 (G,T): Generator/Intertie Synchronism Check
- 27: Undervoltage
- 32: Directional Power
- 50G: Best Choice Ground
- 50N: Neutral Overcurrent
- 50 (P,G,Q): Overcurrent (Phase, Ground, Negative Sequence)
- 51 (P,G,Q): Time Overcurrent (Phase, Ground, Negative Sequence)
- 51N: Neutral Time Overcurrent
- 59 (P,G,Q): Overvoltage (Phase, Ground, Negative Sequence)
- 67 (P,G,Q): Directional Overcurrent (Phase, Ground, Negative Sequence)
- 78VS: Vector Shift
- 79: Autoreclosing
- 81 (O,U,R): Frequency (Over, Under, Rate)
- 81RF: Fast Rate-of-Change of Frequency
- 85 RIO: SEL Mirrored Bits® Communications
- DFR: Event Reports
- HIZ: SEL Arc Sense™ Technology (AST)*
- HMI: Operator Interface
- LGC: SELlogic® Control Equations
- MET: High-Accuracy Metering
- PMU: Synchronphasors
- PQM: Voltage Sag, Swell, and Interruption
- SER: Sequential Events Recorder
- BRM: Breaker Wear Monitor
- HBL2: Second-Harmonic Blocking
- LDP: Load Data Profiling
- LOC: Fault Locator

**ADDITIONAL FUNCTIONS**

- 16 SEC: Access Security (Serial, Ethernet)
- 25 (G,T): Generator/Intertie Synchronism Check
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- 32: Directional Power
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- 50N: Neutral Overcurrent
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- PQM: Voltage Sag, Swell, and Interruption
- SER: Sequential Events Recorder

**Optional feature**
- Copper or fiber-optic
**Key Features**

**Plug-and-Work Compatibility for Many Reclosers**  
Interfaces for the SEL-651R are available for many different reclosers. Using a common recloser control across your system simplifies installation, reduces training, and reduces operation errors.

**Single-Phase Trip and Reclose**  
Reduce system and customer impacts with single-phase tripping and reclosing. You can improve reliability by maintaining service to customers who are not on the faulted phase of the feeder.

**High-Impedance Fault Detection**  
SEL AST detects many high-impedance faults and downed conductors while maintaining secure protection. AST in the SEL-651R puts high-impedance fault detection out on the feeder, reducing the likelihood of an undetected fallen conductor.

**Intertie Protection**  
Use the SEL-651R to interconnect microgrids and DERs to area electric power systems. It meets and exceeds the requirements for use at a point of interconnection or point of common coupling, per IEEE 1547-2018. Additionally, the SEL-651R supports fast islanding detection, which ensures that the DER is offline when the utility attempts to reclose on the feeder.

**Advanced Communications Interfaces and Protocols**  
Easily integrate the SEL-651R into SCADA or distribution automation systems. Both EIA-232 and EIA-485 serial ports are available as well as two metallic or one or two fiber Ethernet ports. Protocols include DNP3, Modbus®, and IEC 61850. A front USB port provides high-speed local access for loading settings or downloading reports.

**Six Voltage Inputs**  
The SEL-651R measures the voltage on both sides of the recloser, making it especially valuable in autonomously controlled distribution automation schemes. The low-energy analog (LEA) inputs allow the use of integrated voltage sensors, which reduce costs and simplify installation.

**Advanced Protection**  
The SEL-651R includes many advanced protection features that ensure secure and reliable operation, including second-harmonic blocking and rate-of-change-of-frequency (ROCOF) controls. These features minimize undesired operations associated with transformer inrush current and provide faster decoupling of distributed generation on a feeder.

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**A Single Multi-Recloser Interface Works With Several Reclosers**  
Stock one recloser control to support several recloser models. You can connect any of the following reclosers to the SEL-651R with the Multi-Recloser Interface:

<table>
<thead>
<tr>
<th>G&amp;W</th>
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<tbody>
<tr>
<td>Viper-LT</td>
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<td>Viper-ST</td>
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**Other Reclosers**  
- Elastimold MVR
- OVR 32-Pin (15, 27, and 38 kV)
- OVR 42-Pin (15, 27, and 38 kV)
- NOVA NX-T
- OSM_150
Product Overview

Optional software-programmable tricolored LEDs for improved status indication.

Programmable control pushbuttons and configurable labels for ease of operation.

EIA-232 front serial port provides local access.

Navigation controls make information readily accessible.

Standard three-point latch for improved physical security.

Single-door control option shown.
Two standard EIA-232 ports, an EIA-485 port, and a USB port provide several communications options.

Built-in synchrophasor measurements for real-time electrical quantities.

Standard six voltage inputs with PT and LEA options for measurements on both sides of the recloser.

Standard dual copper Ethernet ports and optional single or dual fiber ports for improved communications.

Standard multisession Modbus TCP and DNP3 and optional IEC 61850 for easy integration with existing systems.

64 SELogic variables replace traditional panel switches with 32 latching, 16 local, and 32 remote control points.

Single-door control option shown.
Applications

Advanced Control for Distribution Automation

Automatically reconfigure your distribution system with the SEL-651R to isolate faults and restore service quickly to impact the fewest customers. The SEL-651R is an integral part of SEL's distribution automation solution—DNA® (Distribution Network Automation). With DNA, you can improve reliability and increase operational efficiency while reducing operating costs.

Automatic Network Reconfiguration (ANR) improves service reliability by isolating permanently faulted segments and quickly restoring service to nonfaulted segments. You can apply the SEL-651R in various systems, either with or without communication between devices.

The SEL-651R includes logic and counter options to detect loss-of-voltage conditions that indicate upstream recloser openings. You can change the settings sensitivity in intermediate recloser controls before the tie recloser is closed. Reclose shot counting or time coordination let you determine the faulted segment.

The SEL-651R includes six voltage inputs to monitor voltages on both sides of the recloser, ensuring safe and secure ANR.

Speed Up Distribution Protection

Combine the SEL-FT50 and SEL-FR12 Fault Transmitter and Receiver System with the SEL-651R for more intelligent protection. SEL-FT50 Fault Transmitters, located on branches, laterals, and the main line, wirelessly communicate the fault location to the SEL-651R in 6 ms. This allows you to adapt your coordination fast.

- Trip as fast as possible for main-line faults—no waiting for coordination of fuses or downstream recloser controls.
- Combine adaptive fuse-saving and fuse-blowing schemes based on the fault location.
- Disable reclosing for faults located in underground feeder sections.

Communicate directly with any SEL-651R via serial or Ethernet communications without the need of a field remote terminal unit (RTU).
High-Impedance Fault Detection

High-impedance faults, such as downed conductors on poorly conductive surfaces, create fault current levels that are too low to be detected by conventional overcurrent protection elements. The SEL-651R with AST detects many high-impedance faults while maintaining secure protection.

The SEL-651R with AST is easy to understand, set, and test. It includes straightforward protection algorithms with two sensitivity levels and a test mode.

Coordination

When AST is present in multiple devices on a single feeder, the relay or control closest to a high-impedance fault detects the stronger signal and isolates the fault to coordinate with other relays or controls on the system. This coordination isolates only the faulted segment of the line and minimizes the number of customers affected by a high-impedance fault. You can use communications between relays to improve AST protection performance on complex feeder arrangements or in the case of feeder reconfiguration.

Multilayer Security

Add the SEL-3622 Security Gateway for encrypted IPsec VPN access to the SEL-651R. The SEL-3622 also acts as a firewall and protects against malware with exe-GUARD® whitelist antivirus. The SEL-3622 authenticates users, manages passwords, logs and reports Syslog events, and has physical security sensors to alert on unauthorized access to the SEL-651R cabinet.
Apply Autosource Transfer Schemes

The SEL-651R lets you maintain reliable power for critical loads that require dual-feeder service. Using SEL Mirrored Bits communications technology between recloser controls, you can make intelligent operation decisions to bring nonfaulted loads back online. Mirrored Bits lets you communicate securely and share recloser status, source status, and other logic information between SEL-651R Recloser Controls.

Customize the return-to-normal action by incorporating a synchronism check for parallel source return or break-before-make when source voltages are not in phase.

Minimize Outage Impact on Customers With Single-Phase Tripping in the SEL-651R

Improve reliability by maintaining service to customers who are not on the faulted phase of the feeder. Available trip-reclose-lockout operation modes for single-phase tripping are:

- Three-phase trip/reclose, three-phase lockout.
- Single-phase trip/reclose, three-phase lockout.
- Single-phase trip/reclose, single-phase lockout.
- Single-phase trip/reclose, single-phase lockout, three-phase lockout if two or more phases are involved.

Protect DER Interconnections

Use the SEL-651R to interconnect microgrids and DERs to area electric power systems. Together, the SEL-651R and recloser provide a compact pole-top solution for interconnecting DERs with overhead distribution lines. Utilities, consultants, microgrid owners, and DER owners can use this solution at the point of common coupling, as defined in IEEE 1547-2018. The SEL-651R works with microgrid controllers and generator control systems, and provides fast islanding detection to ensure protection of the DER.

Apply Autosource Transfer Schemes

Use the SEL-651R as part of an autosource transfer scheme.
Monitoring and Metering

The SEL-651R measures signal distortions up to the 16th harmonic for each current and voltage input. The recloser control calculates total harmonic distortion and provides the value as a control element for alarming and tripping. You can reduce the installed cost of feeder control panels by avoiding separately mounted metering devices. SEL high-accuracy metered quantities include root-mean-square (rms) phase voltages, currents, and power.

Integration

Quickly integrate the SEL-651R into Ethernet or serial communications networks with standard DNP3 and Modbus protocols or optional IEC 61850. The SEL-651R comes standard with three independent EIA-232 serial ports, one EIA-485 port, one USB port, and two metallic Ethernet ports for external communication. Optional alternatives for the Ethernet ports include single fiber and dual-redundant fiber ports.

Using an Ethernet connection, you can upload firmware to the SEL-651R in less than a minute. You can also download 60-cycle-length, 128-samples-per-cycle event reports.

The Ethernet ports provide access for local and remote engineering, SCADA, real-time protection and control, loop restoration, islanding detection, blocking, and fast bus tripping schemes. The SEL-651R works well in distribution automation systems, including loop schemes and high-speed, peer-to-peer systems.

acSELerator® Software

Save time and simplify settings with free acSELerator QuickSet® SEL-5030 Software. QuickSet lets you:

- Develop settings offline with a menu-driven interface and direct links to the instruction manual for easy help reference. You can speed up installation by copying existing settings files and modifying application-specific items.

- Quickly commission SEL-651R Recloser Controls. You can use settings templates to customize the interface so field personnel see only the settings they need when working with the recloser control. Sample templates for common applications are available on the SEL website.

- Access your settings template anytime. You can store templates on the SEL-651R and retrieve them for easy access in the field.

- See more prefault and post-fault data with high-resolution 60-cycle-length event reports at 128 samples per cycle to identify the root cause of problems or make decisions about system design.

Communications Protocols

- Mirrored Bits Communications
- IEEE C37.118 synchrophasors
- IEC 61850 GOOSE*
- IEC 61850 MMS*
- Modbus TCP
- Modbus RTU
- Telnet
- DNP3 Serial
- DNP3 IP
- Web server
- Simple Network Time Protocol (SNTP)
- FTP
- SEL Fast Messages
- ASCII
- IRIG-B

Communications Media

- 10/100BASE-T Ethernet
- 10/100BASE-FX Ethernet*
- EIA-232 serial
- EIA-485 serial
- USB Type B
- BNC (IRIG-B)

*Optional feature

View system data and streamline relay settings with QuickSet.
Customization

SEL offers a variety of accessories to optimize recloser control efficiency and operation. You can create a customized solution to meet your application needs. Some popular accessories include a cabinet heater, an accessory shelf, fuse blocks, and prewired connectors. Many accessories are available for factory installation or as field upgrade kits. Listed below are some of the accessories available to create a robust recloser solution.

**SEL-2401 Satellite-Synchronized Clock**
Provide precise time for synchrophasor measurements with the SEL-2401, which has ±100 nanosecond accuracy for automatically updated time.

**SEL-2925 BLUETOOTH® Serial Adapter**
Protect personnel from hazardous conditions by enabling them to control and monitor equipment from their trucks or other safe locations. The SEL-2925 transmits data up to 115,200 bits per second to distances of 100 meters (300 feet) in typical applications.

**SEL-3031 Serial Radio Transceiver**
Combine three serial ports into one radio, allowing up to three different connections and protocols to operate simultaneously. The spread-spectrum, frequency-hopping radio transmits data in the license-free 900 MHz ISM band, providing an economical communications path or backup communications system.

**SEL-3061 Cellular Router**
The SEL-3061 is a secure wireless communications solution designed for critical applications. For electric utilities, the router provides connectivity to devices like recloser controls, motor-operated switches, capacitor banks, voltage regulators, substations, and much more. The combination of serial and Ethernet ports provides application flexibility, and using public networks with secure tunneling makes installation easy without sacrificing security.

**SEL-3622 Security Gateway**
A router, VPN endpoint, and firewall device, the SEL-3622 can perform secure and proxy user access for the SEL-651R. The SEL-3622 helps create a user audit trail through strong, centralized, user-based authentication and authorization to the recloser control. The SEL-3622 secures your control system communications with a stateful deny-by-default firewall, strong cryptographic protocols, and logs for system awareness.

**Door Position Indication Switch**
Monitor the position of the enclosure door, and send an alarm to SCADA when the cabinet has been opened. You can use this simple security feature to detect and respond to unwanted intruders.

**SEL Fault Indicators and Sensors**
Team the SEL-651R with the SEL-FT50 and SEL-FR12 System or SEL faulted circuit indicators to provide fault location information for more intelligent protection decisions and to reduce restoration times.

The BLUETOOTH® word mark and logos are registered trademarks owned by Bluetooth SIG, Inc., and any use of such marks by SEL is under license.
# SEL-651R Specifications

## General Specifications

<table>
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<tr>
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<tbody>
<tr>
<td></td>
<td>Other reclosers: Elastimold Molded Vacuum Recloser (MVR), Joslyn TriMod 300R, Joslyn TriMod 600R, OVR 24-Pin (15 and 27 kV only), OVR 32-Pin (15, 27, and 38 kV), OVR 42-Pin (15, 27, and 38 kV), and VR-3S (15 and 27 kV only)</td>
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<td></td>
<td>CXE, NOVA Auxiliary Powered, NOVA Control Powered, NOVA NX-T, NOVA Triple-Single, RE, RVE, RXE, VSA, VSO, VWE, VVVE 27, VVVE 38X, WE, WVE27, and WVE38X</td>
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<tr>
<td></td>
<td>GVR (when equipped with interface module) SDR Triple-Single and SDR Three-Phase</td>
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<td></td>
<td>OSM_150</td>
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<tr>
<td><strong>Current Inputs</strong></td>
<td>IA, IB, and IC: 1 A nominal</td>
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<tr>
<td></td>
<td>IN: 0.2 A nominal</td>
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<tr>
<td><strong>AC Voltage Inputs</strong></td>
<td>300 V maximum (PT)</td>
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<tr>
<td></td>
<td>8 V maximum LEA (IEEE C37.92)</td>
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<tr>
<td></td>
<td>Eaton (Cooper) internal LEA (37 V)</td>
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<tr>
<td></td>
<td>Lindsey SVMI LEA (200 V, 1 MΩ)</td>
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<tr>
<td></td>
<td>Siemens SDR LEA inputs</td>
</tr>
<tr>
<td><strong>Frequency and Phase Rotation</strong></td>
<td>60/50 Hz system frequency</td>
</tr>
<tr>
<td></td>
<td>ABC or ACB phase rotation</td>
</tr>
<tr>
<td><strong>Communications Ports</strong></td>
<td>EIA-232 (3 ports)</td>
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<tr>
<td></td>
<td>USB Type B</td>
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<td></td>
<td>EIA-485</td>
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<td></td>
<td>Ethernet port: Dual 10/100BASE-T RJ-45 connectors Single 100BASE-FX LC connector (optional) Dual 100BASE-FX LC connectors (optional)</td>
</tr>
<tr>
<td><strong>Communications Protocols</strong></td>
<td>SEL, IEC 61850 (optional), Mirrored Bits communications, Modbus, DNP3, ASCII protocols, SNTP, IEEE C37.118 (synchrophasors), built-in web server</td>
</tr>
<tr>
<td><strong>DER Interconnection</strong></td>
<td>IEEE 1547-2018</td>
</tr>
<tr>
<td><strong>Power Supply</strong></td>
<td>120 Vac, 230 Vac, 48 Vdc, or 125 Vdc</td>
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<tr>
<td></td>
<td>Rated range: 85–132 Vac; 170–265 Vac; 40–60 Vdc; or 100–137.5 Vdc</td>
</tr>
<tr>
<td><strong>Weight</strong></td>
<td>&lt;125 lbs without accessories</td>
</tr>
<tr>
<td><strong>Battery Reserve</strong></td>
<td>≥3.2 hours at −40°C, and ≥9.6 hours at +25°C (16 Ah standard)</td>
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<tr>
<td></td>
<td>≥8 hours at −40°C, and ≥24 hours at +25°C (40 Ah optional)</td>
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<tr>
<td><strong>Operating Temperature</strong></td>
<td>Relay module: −40° to +85°C (−40° to +185°F)</td>
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<tr>
<td></td>
<td>Batteries: −40° to +80°C (−40° to +176°F)</td>
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<tr>
<td></td>
<td>Entire SEL-651R unit: −40° to +55°C (−40° to +131°F)</td>
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