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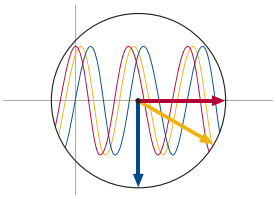
Find the *SEL SEL-421* at our website: ***Click HERE***

SEL-421

Protection, Automation, and Control System

High-Speed Line Protection With Bay Control

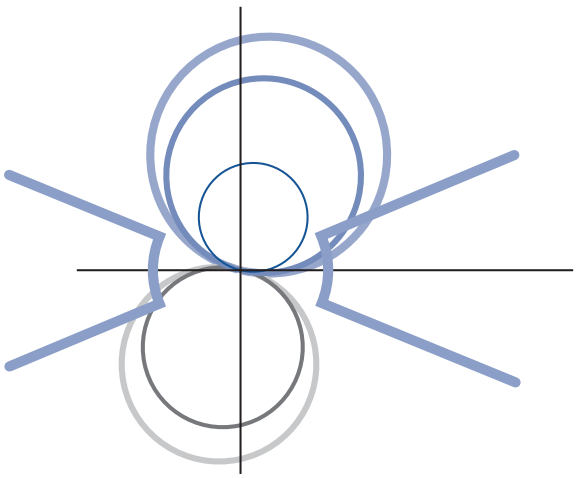




SEL Synchrophasors®

SEL IEC 61850

Apply innovative line protection as part of a comprehensive station automation package.



Features and Benefits

Protect

Select an SEL-421 Protection, Automation, and Control System with operating times to match your system requirements. Use standard-speed or subcycle elements for critical applications. Use Mirrored Bits® communications and high-speed outputs with all SEL-421 Relay models to improve operating times.

Control

Integrate a two-breaker, four-shot recloser and SELogic® control equations into a complete automation system. Initiate reclosing based on fault type, protection zone, or external conditions.

Measure

View data across the system with 10 µs time-stamping accuracy. Verify load angles and system impedances with measured values.

Automate

Apply Ethernet (FTP, Telnet, DNP3 LAN/WAN, SNTP, and IEC 61850) connectivity to simplify and speed information distribution. Integrate expanded SELogic control equations into your complete station automation system.

Monitor

Improve reliability with continuous checks of station batteries and relay health. Reduce costs through tailored maintenance intervals based on accumulated breaker duty and operating times. View relay read-only data, including settings, metering, event reports, relay status, and configuration, with built-in web server over Ethernet.

Making Electric Power Safer, More Reliable, and More Economical®

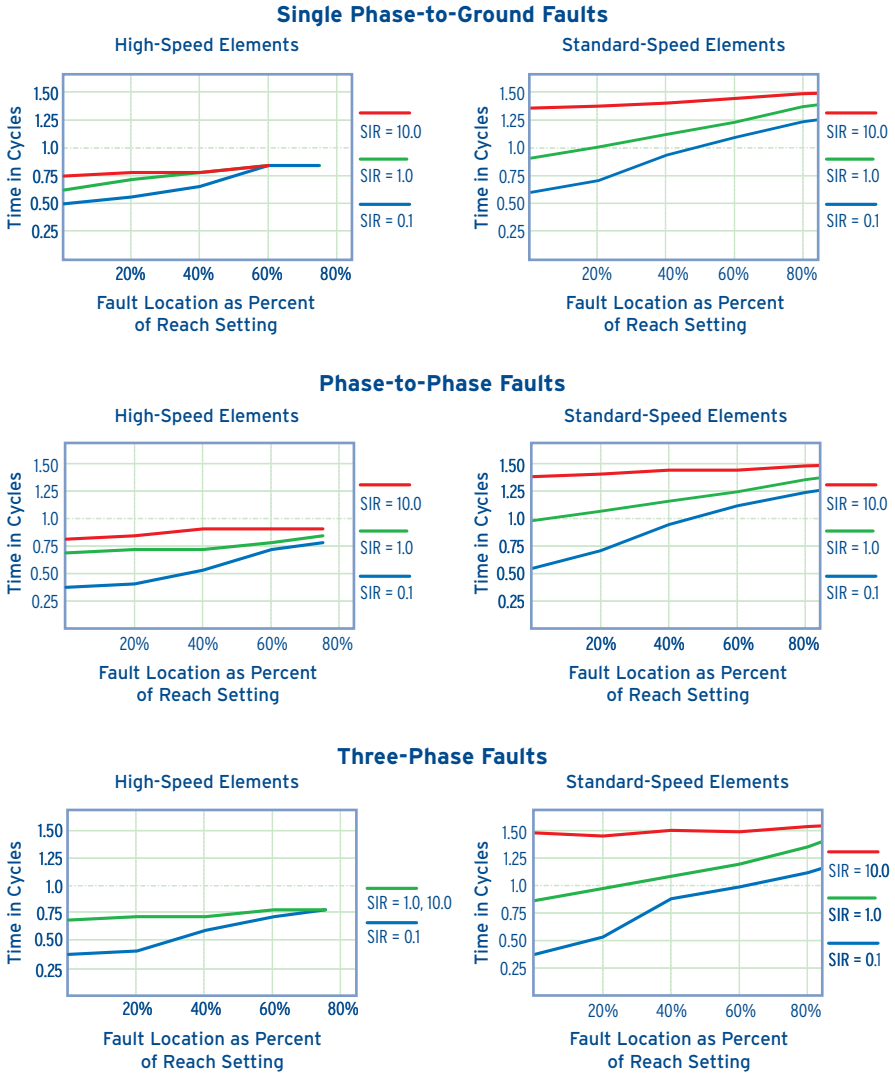
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Secure, High-Speed Tripping

The optional high-speed elements available in the SEL-421 Relay use a combination of half-cycle filtered inputs with superimposed components to achieve very high-speed operation (see curves) while maintaining security for out-of-zone faults. Use an SEL-421 Relay with standard-speed elements where operate times of under 1.5 cycles are sufficient, with the capability to upgrade to subcycle operate times if system conditions change. Apply MIRRORED BITS communications between relays using fiber-optic transceivers for relay-to-relay signal transmission in 3–6 ms. CCVT transient detection, fast and secure loss-of-potential (LOP) blocking, and load-encroachment logic provide additional security in all SEL-421 models.

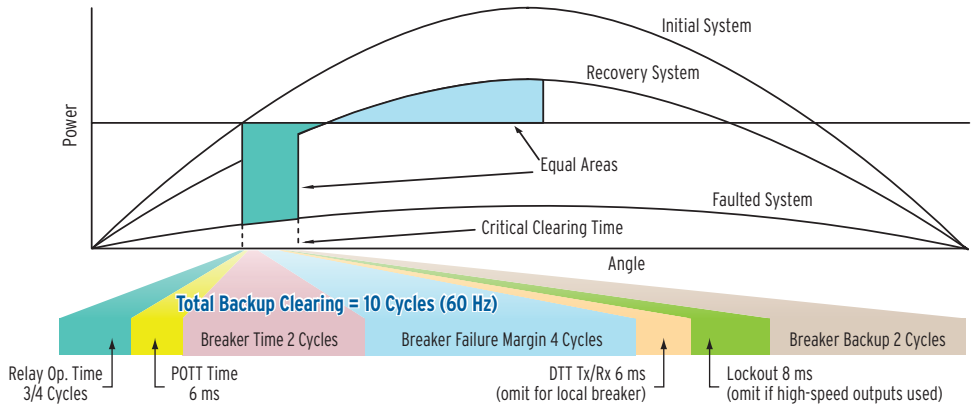
- Reduce equipment damage.
- Increase transmission line loading.
- Improve system stability.

Apply the SEL-421 Relay for critical system protection.



High-Speed Breaker Failure for Two Breakers

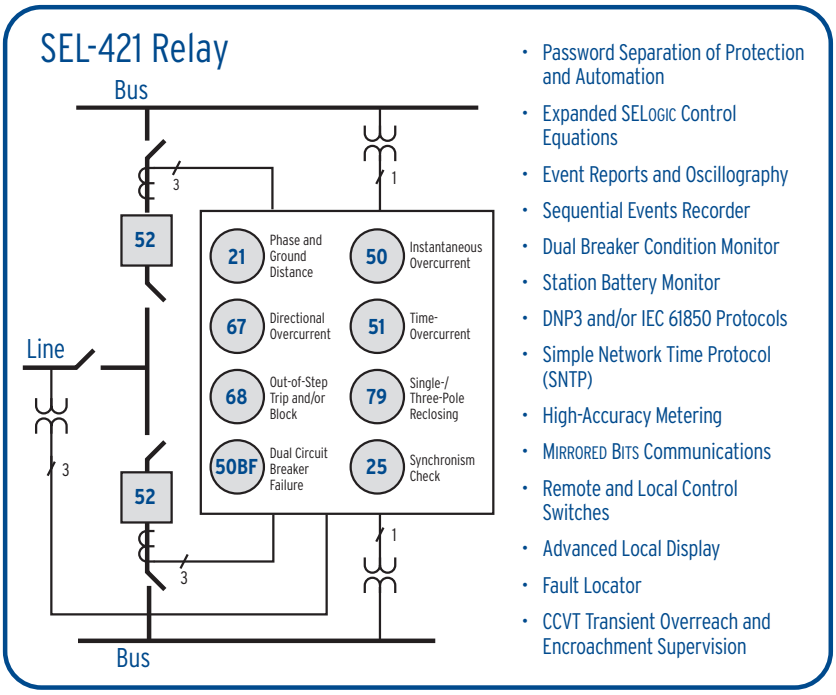
- Open-pole detection in less than 5/8 cycle allows shorter breaker failure margin times.
- Combine high-speed tripping and shorter breaker failure margin times to increase line loading (see figure at right) while maintaining stability.



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Complete Dual Breaker Control and Monitoring

- Reduce costs with combined protection and control for two circuit breakers.
- Connect six current inputs to provide complete bay control and protection. Individual breaker currents are monitored separately for accumulated duty and breaker failure. Currents can be combined in the relay to derive total line current.
- Configure the voltage inputs for two separate sources, or use two inputs for synchronizing across two breakers. If two sources are used, loss-of-potential logic can switch between the protection potentials without a loss of security.
- Provide complete instrumentation, reclosing, interlocking, SCADA, and digital fault recording (DFR) for a two-breaker bay.



Synchrophasor Measurements

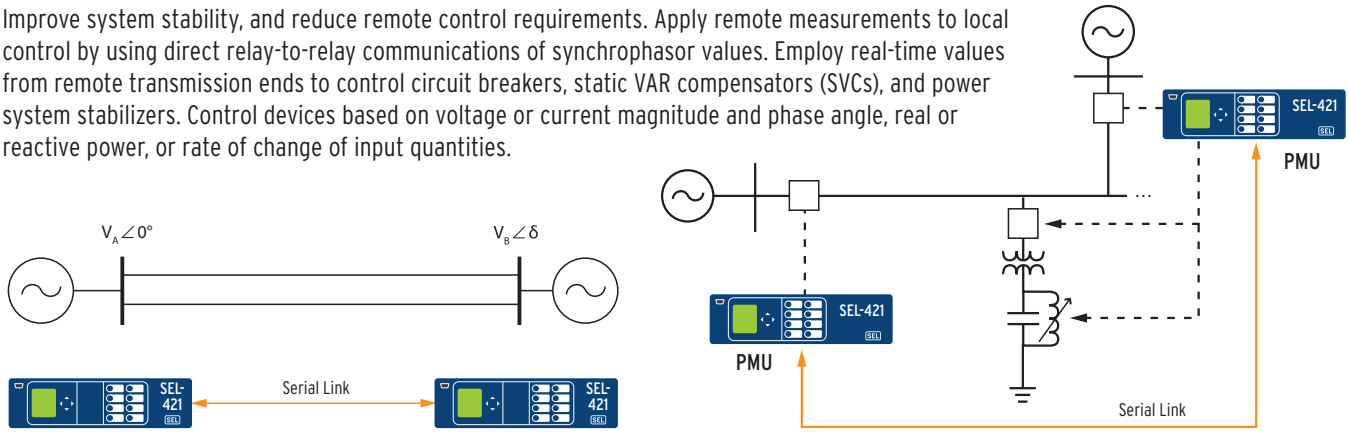
- Communicate IEEE C37.118 synchrophasor data to local or remote data concentrators through serial or Ethernet ports. UDP multicast and configurable data streams allow multiple clients to receive information for up to five independent IEEE C37.118 data streams.
- See phase angles and magnitudes from relays anywhere on the system at exactly the same instant in time with the MET PM command.
- Improve event analysis with microsecond time tagging. Voltages and currents are accurate to better than 0.25 of an electrical degree.
- Provide streaming data for wide-area disturbance recording. Voltages, currents, frequencies, and other internal measurements are sent at rates of 1–60 messages per second.



SEL-5078-2 SYNCHROWAVE® Central Software provides visualization and analysis of power system operating conditions.

Real-Time Control

Improve system stability, and reduce remote control requirements. Apply remote measurements to local control by using direct relay-to-relay communications of synchrophasor values. Employ real-time values from remote transmission ends to control circuit breakers, static VAR compensators (SVCs), and power system stabilizers. Control devices based on voltage or current magnitude and phase angle, real or reactive power, or rate of change of input quantities.

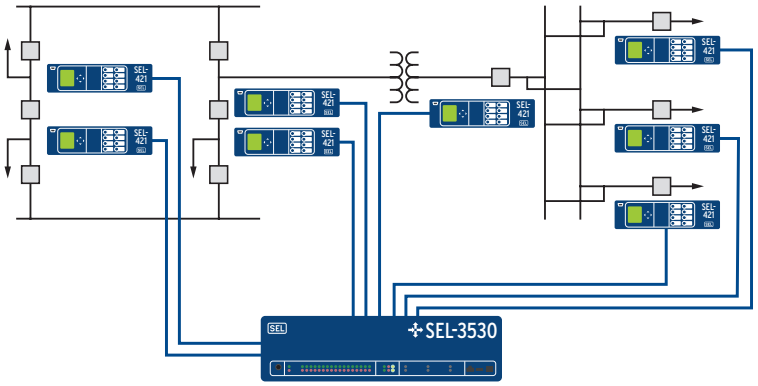


Share synchrophasor data between two or three SEL-421 Relays for special protection schemes or custom logic. Remote measurements are available in SELOGIC control equations for protection or automation.

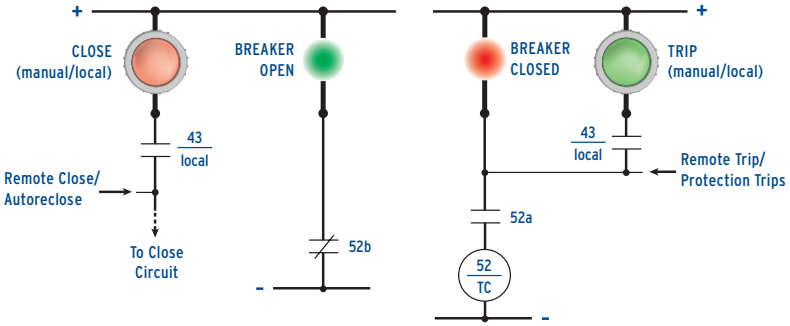
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Station Integration Reduces Substation Costs and Improves Information Flow

- Reduce costs using a station-based protection system with all relaying located at the breaker and with fiber communication to the station control building.
- Integrate primary and backup protection device functions with Mirrored Bits communications between SEL relays.
- Communicate via Ethernet or serial port to the SEL-421 Relay or SEL-3530 Real-Time Automation Controller (RTAC).
- Apply the SEL-421 Relay as bay control for a ring-bus, double-breaker, or breaker-and-a-half configuration.
- Record circuit breaker mechanical and electrical operating times in the SEL-421 Relay, comparing average and last trip times. Contact interrupting duty and motor run time are included for a complete view of the circuit breaker operational condition.
- Improve efficiency and simplify installation with more target LEDs and operator buttons. The 4U and 5U chassis have options for an additional eight target LEDs and four operator control buttons. Include arc-suppressed trip/close buttons for an enhanced solution.
- Display breaker status and control breaker position, even if the relay is not powered, with auxiliary breaker trip/close control buttons and indicating lamps.
- Indicate relay state and various trip conditions with 24 target LEDs, or configure them for specific applications.
- Meet operator control needs by modifying the 12 operator buttons to replace traditional panel switches.
- Monitor access history, setting changes, and security using internal relay data points.



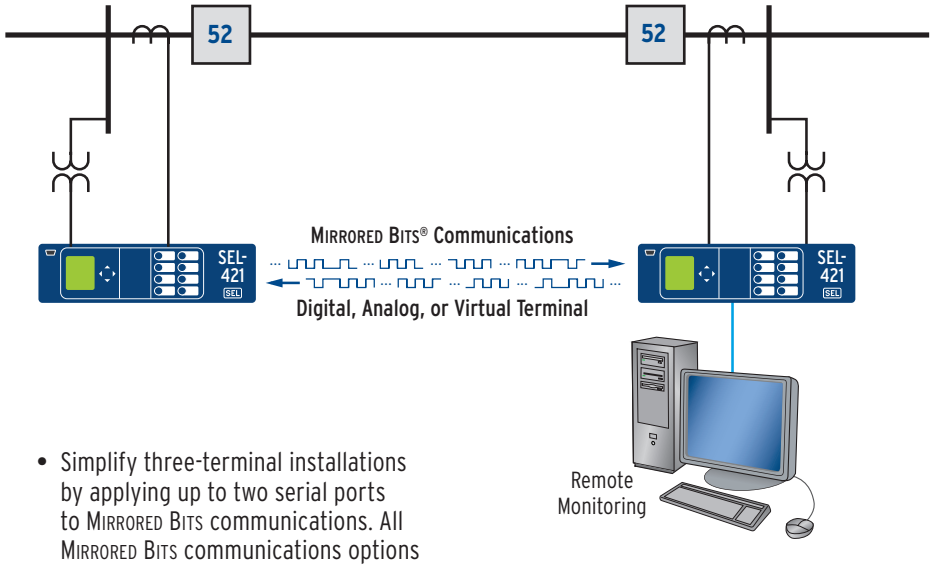
Substation integration example.



Suggested application.

Advanced Mirrored Bits Communications

- Transmit analog as well as digital information over high-speed serial communications paths. For example, limit equipment damage and system stress by reclosing whichever line end had the lowest fault current. Transmit up to seven analog values on each Mirrored Bits communications channel.
- Integrate virtual terminal Mirrored Bits communications to get complete information from a remote relay with only a connection to the local relay. All actions, such as settings or control, that could be done with a direct connection to the remote relay can be performed using Mirrored Bits communications. All information, such as event reports and metering, that could be obtained with a direct connection to the remote relay can be retrieved using Mirrored Bits communications. This is done without interfering with the protection bits also being transmitted.



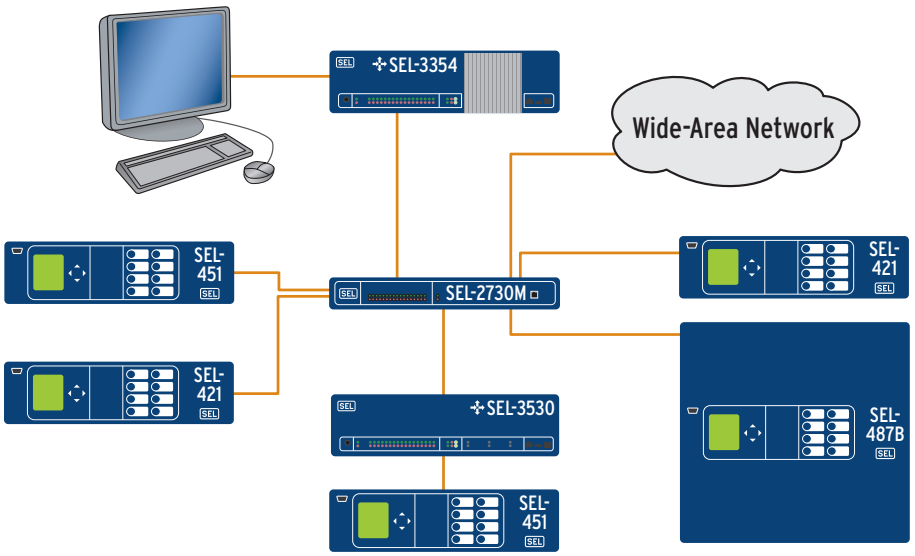
- Simplify three-terminal installations by applying up to two serial ports to Mirrored Bits communications. All Mirrored Bits communications options listed above are available on both ports.

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Integrate With Ethernet Networks

Connect the SEL-421 Relay directly to a local network with the built-in Ethernet interface or through the RTAC.

- Quickly send information through your networks with DNP3 LAN/WAN and/or IEC 61850 protocols.
- Provide seamless failover protection with Parallel Redundancy Protocol (PRP).
- Increase communications reliability with separate and redundant communications ports.
- Provide basic time synchronization over Ethernet with SNTP.
- Transfer data at high speeds (10 Mbps or 100 Mbps) for fast HMI updates and file uploads.
- Use popular Telnet applications for easy terminal communication with SEL relays and other devices.
- Transfer settings, events, and history files with popular FTP applications.
- Transmit synchrophasor data to multiple clients using UDP and TCP formats.



SEL offers complete Ethernet direct-connect solutions.



SEL-421 Ethernet port options.

Advanced Display and Controls for Next-Generation Substation Integration

SEL provides a worldwide, ten-year product warranty and −40° to +85°C temperature range—the best in the industry.

Display navigation controls make more information readily accessible.

Detailed, programmable targets, with user-configurable labels, provide fast and simple information to assist dispatchers and line crews to enable rapid power restoration.

EIA-232 front serial port for quick, convenient system setup, checkout, and local access.



Large display facilitates installation and diagnostics while eliminating the need for panel meters.

Independent breaker trip/close pushbuttons, with indication, operate even if the relay is not powered.

High-accuracy (±0.5% of reading) RMS metering.

Programmable control pushbuttons and configurable labels provide local switches to replace traditional panel switches.

Relay pushbuttons and serial communications employ 32 latching switches, 32 local switches, and 32 remote switches in your automation system.

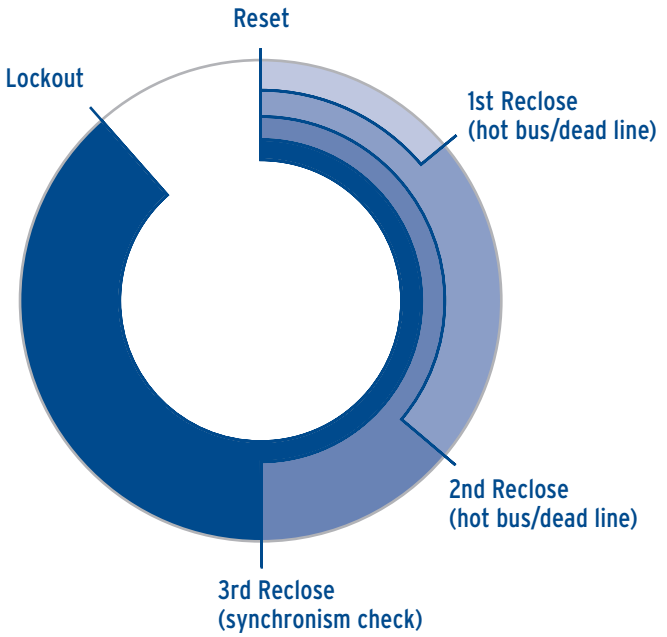
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Expanded SELogic Control Equations

Add programmable control functions to your protection and automation systems. New functions and capabilities enable the use of analog values in conditional logic statements.

- Include local and remote analog values in math functions for user-defined protection and control elements.
- Scale analog values for SCADA retrieval to save time and minimize errors.
- Initiate a remedial operational sequence based on load flow before fault conditions.
- Restrict breaker tripping in excessive duty situations without additional relays.

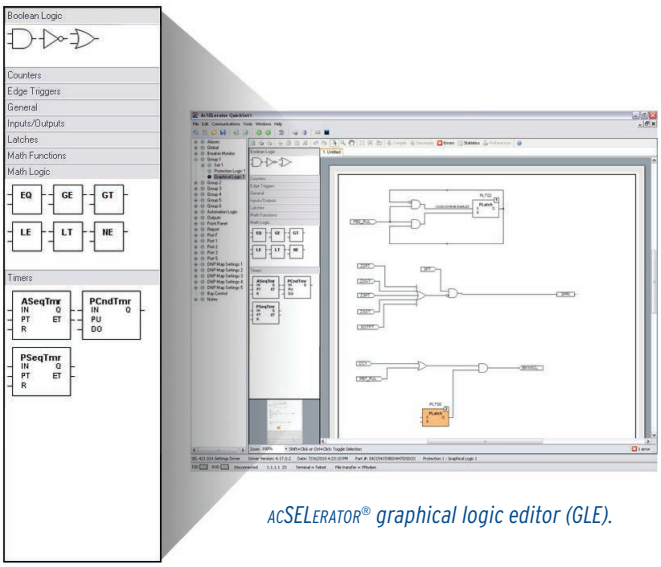
Operator Type	Operators	Comments
Boolean	AND, OR, NOT	Replaces existing SELogic® symbols
Edge Detection	F_TRIG, R_TRIG	Replaces existing SELogic symbols
Comparison	>, >=, =, <=, <, < >	
Arithmetic	+, -, *, /	
Numerical	ABS, SIN, COS, LN, EXP, SQRT	
Precedence Control	( )	Multiple and nested sets of parentheses
Count Up, Count Down, Timing, Sequence Timers		



Emulate a motor-driven reclose timer, including stall, reset, and drive-to-lockout conditions.

Microsoft® Windows®-Based Graphical User Interface

- Save engineering time while keeping flexibility. Communicate with the SEL-421 Relay through any ASCII terminal, or use the AcSELerator QuickSet® SEL-5030 Software graphical user interface.
- Develop settings offline with a menu-driven interface and completely documented help screens. Speed installation by copying existing settings files and modifying application-specific items.
- Simplify the settings procedure with rules-based architecture to automatically check interrelated settings. Out-of-range or conflicting settings are highlighted for correction.
- Transfer settings files by using a PC communications link with the SEL-421 Relay.
- Simplify the process of configuring your SEL-421 using the graphical logic editor (GLE) in AcSELerator QuickSet. The GLE allows you to view your SELogic control equations graphically, so your settings files can be documented for easier validation and commissioning. Convert existing SELogic control equations to easy-to-read diagrams, and save diagrams with your QuickSet settings.
- Design new SELogic control equations using the convenient diagram navigation tool, drag-and-drop interface, function block diagrams, and automatic layout function. Manage your control diagrams with a full element palette. The GLE will aid in reducing design errors as well as time and expense in commissioning relays.



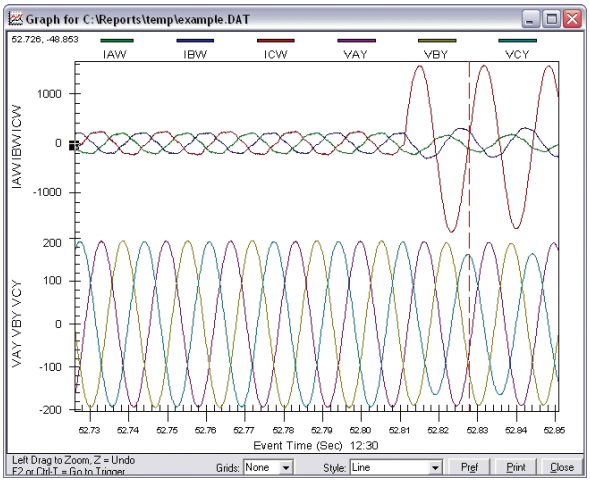
AcSELerator® graphical logic editor (GLE).

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Enhanced Event Analysis Software

Digital Fault Reports

- Apply the SEL-421 Relay as a multichannel (six voltages, six currents) digital fault recorder.
- Trigger event recording based on local or system faults, time of day (for statistical sampling), or heavy loading.
- Combine with an RTAC to automatically compile event reports for analysis.
- Open COMTRADE files from the SEL-421 Relay and other digital fault recorders with the included SEL ACSELERATOR QuickSet Software.
- Convert binary COMTRADE files to ASCII format for portability and ease of use.
- Select an event resolution from 1–8 kHz. Set the event report length from 0.25–5.00 seconds.



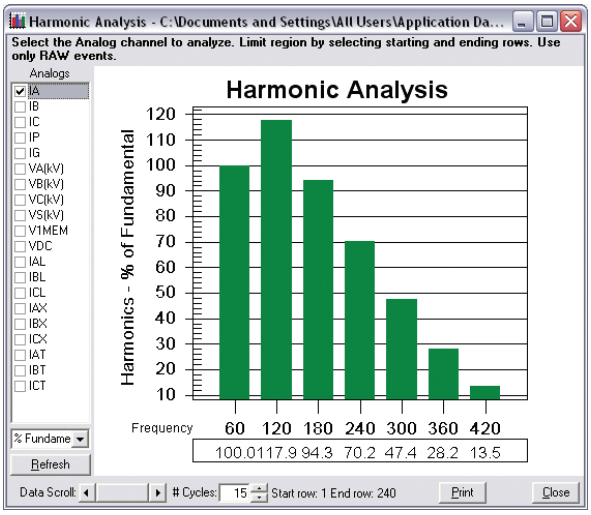
Fault reports improve event analysis.

Graphical Analysis

- Examine raw or filtered data to evaluate system or relay performance.
- Use the SEL-4000 Relay Test System to play back events into the SEL-421 Relay or other SEL relays to analyze the effects of setting or configuration changes on relay performance using real system events.

Harmonic Analysis

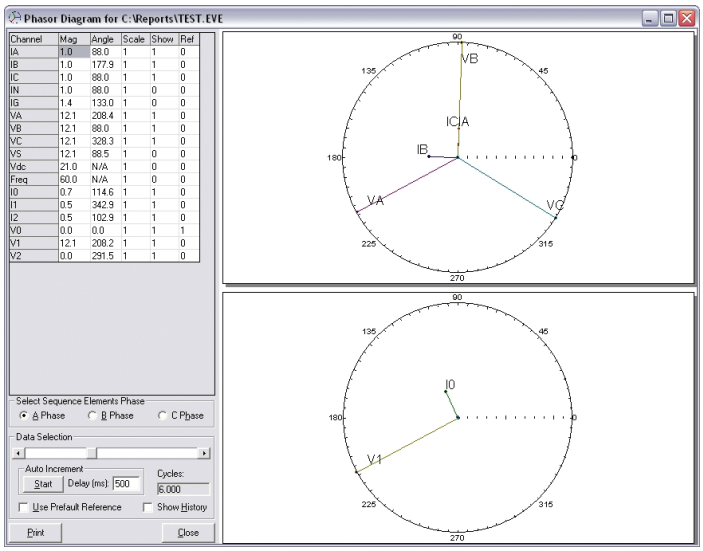
- Perform harmonic analysis of any voltage or current. Select the portion of the event report to examine: prefault, fault, or post-fault.
- Analyze line harmonic loading and station harmonic distortion without separate instruments.
- Graphically display system effects of switching operations, interconnections, or operator action to evaluate power quality impacts.
- Verify harmonic models and system frequency maps from simultaneous reports at different system locations.



Flexible analysis of voltages and currents.

Phasor Analysis

- Examine phasors from each sample to validate relay performance.
- Check protection quality and verify security to improve system reliability.
- View real-time phasors or examine phasor quantities from an event report.



Phasor view to verify connections and operations.

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SEL-421 Protection, Automation, and Control System

General Specifications

AC Current Inputs (6 total)

1 A or 5 A I_{nom} (specify on order); 3 x I_{nom} continuous; 100 x I_{nom} one-second thermal rating; linear to 20 x I_{nom} symmetrical

Burden 0.27 VA @ I_{nom} for I_{nom} = 5 A; 0.13 VA @ I_{nom} for I_{nom} = 1 A

AC Voltage Inputs (6 total)

300 V_{L-N} continuous (connect any voltage up to 300 Vac)

600 Vac for 10 seconds

Burden 0.03 VA @ 67 V; 0.06 VA @ 120 V; 0.8 VA @ 300 V

Output Contact Ratings (standard model)

30 A make per IEEE C37.90-1989 paragraph 6.7.2; 6 A continuous carry; MOV protected

Optional high-speed and high-current interrupting (10 A @ L/R = 40 ms) contacts available

Control Inputs

Range	15–265 Vdc
Accuracy	±5% plus ±3 Vdc
Maximum voltage	300 Vdc
Sampling rate	1/16 cycle
Typical burden	0.24 W @ 125 Vdc

Serial Communications Ports

Three rear-panel and one front-panel EIA-232 serial ports

SEL ASCII commands

SEL Fast Messages, DNP3

Serial data speed 300–57600 bps

Ethernet Communications Options

Provides IEC 61850, DNP3 LAN/WAN, FTP, SNTP, and Telnet protocols

Choose two media options from the following list:

10/100BASE-T twisted-pair network

100BASE-FX fiber-optic network

Synchrophasors

IEEE C37.118 Standard

Up to 50 messages per second (50 Hz system)

Up to 60 messages per second (60 Hz system)

Processing Specifications

AC voltage and current inputs: 8000 samples per second, 3 dB low-pass analog filter cut-off frequency of 3000 Hz

Digital filtering: Full-cycle cosine and half-cycle Fourier filters after low-pass analog and digital filtering

Protection and control processing: Eight times per power system cycle

Power Supply

24/48 Vdc	18–60 Vdc
48/125 Vdc or 125 Vac	38–140 Vdc or 85–140 Vac (30–120 Hz)
125/250 Vdc or Vac	85–300 Vdc or 85–264 Vac (30–120 Hz)

Frequency and Phase Rotation

60/50 Hz system frequency and ABC/ACB phase rotation are user settable

Operating Temperature

–40° to +85°C (–40° to +185°F)

–40° to +70°C (–40° to +158°F) with optional Ethernet

Note: LCD contrast impaired for temperatures below –20° and above +70°C

Humidity

5% to 95% without condensation

Weight (maximum)

3U rack-unit	8.0 kg (17.5 lbs)
4U rack-unit	9.8 kg (21.5 lbs)
5U rack-unit	11.6 kg (25.5 lbs)

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