SEL-351S

Protection System

Advanced distribution feeder solution with integrated protection, monitoring, and control

- Achieve sensitive and secure fault detection using comprehensive protection functions.

- Keep track of breaker status and help schedule maintenance with enhanced breaker monitoring.

- Enhance operation and simplify panels with large, easy-to-use operator controls and optional independent SafeLock® trip/close pushbuttons.

- Troubleshoot system-wide and local power quality disturbances using voltage sag, swell, and interruption (VSSI) reports.

SEL

Functional Overview

ANSI Numbers/Acronyms and Functions	
16 SEC	Access Security (Serial, Ethernet)
25	Synchronism Check
27	Undervoltage
32	Directional Power*
50BF	Breaker Failure Overcurrent
50N	Neutral-Ground Overcurrent
50 (P,G,Q)	Overcurrent (Phase, Ground, Neg. Seq.)
51N	Neutral-Ground Time-Overcurrent
51 (P,G,Q)	Time-Overcurrent (Phase, Ground, Neg. Seq.)
52PB	Trip/Close Pushbuttons*
59 (P,N,Q)	Overvoltage (Phase, Neutral, Neg. Seq.)
67N	Directional Neutral Overcurrent
67 (P,G,Q)	Directional Overcurrent (Phase; Ground, SEF*; Neg. Seq.)
79	Autoreclosing
81 (O,U,R)	Frequency (Over, Under, Rate)
85 RIO	SEL Mirrored Bits® Communications*
DFR	Event Reports
HMI	Operator Interface
LGC	SELogic® Control Equations
MET	High-Accuracy Metering
PMU	Synchrophasors
PQM	Voltage Sag, Swell, and Interruption*
SER	Sequential Events Recorder

Additional Functions	
BRM	Breaker Wear Monitor
HBL	Harmonic Blocking
LDE	Load Encroachment
LDP	Load Data Profiling*
LOC	Fault Locator
PPV	Phantom Phase Voltage
SBM	Station Battery Monitor

[1]Copper or fiber-optic   *Optional feature

Key Features

Complete Distribution System Protection

Protect lines and equipment using phase, negative-sequence, residual-ground, and neutral-ground overcurrent elements with directional control. The SEL-351S Protection System includes many advanced protection features that ensure secure and reliable operation, such as second-harmonic blocking and rate-of-change-of-frequency (ROCOF) controls.

Voltage Sag, Swell, and Interruption (VSSI)

Access power system disturbance information through the optional VSSI recorder for advanced power quality monitoring that allows you to troubleshoot system-wide and local power quality disturbances. The VSSI report captures power quality data related to voltage disturbances over a long period of time, including the magnitude of the currents and voltages, a reference voltage, and the status of the VSSI Relay Word bits.

Advanced Reclosing Capabilities and Sequence Coordination

Use synchronism-check and voltage condition logic to program up to four shots of automatic reclosing with automatic or manual supervision. Sequence coordination logic is built in to synchronize relay protection to downstream recloser operations.
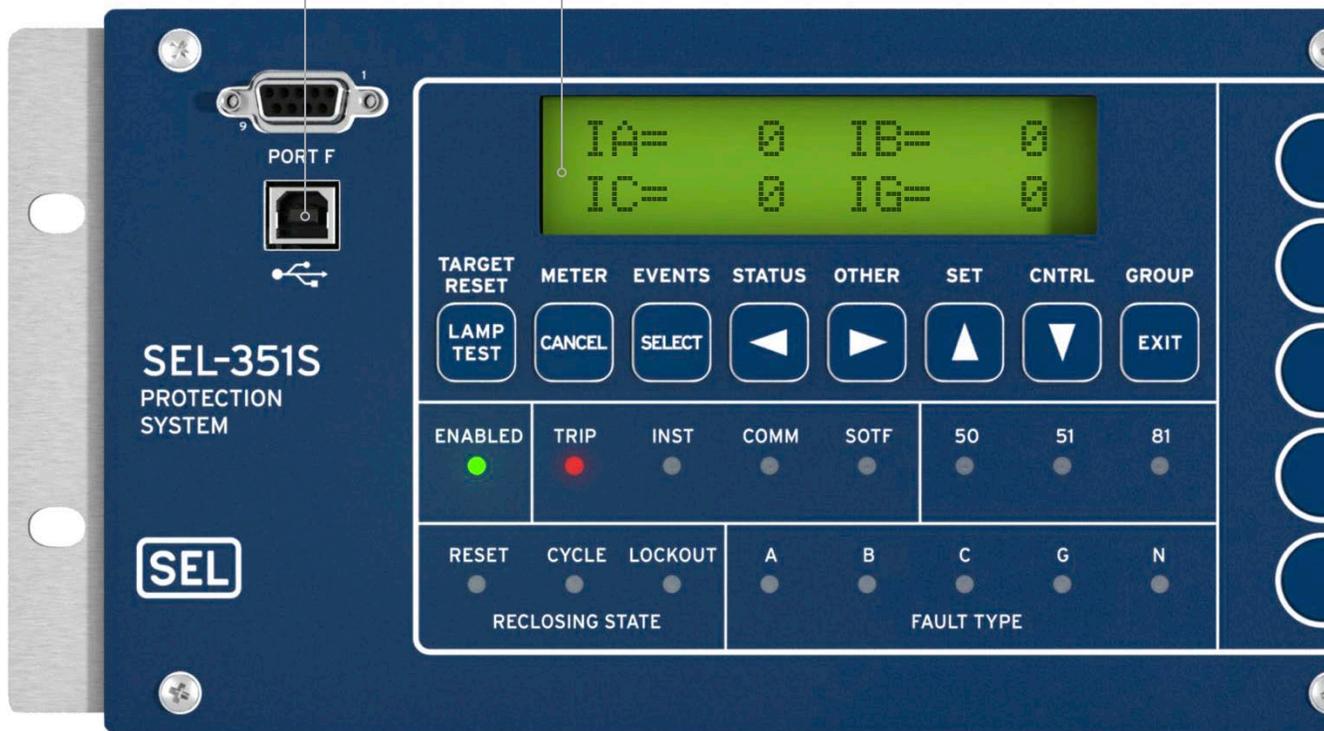
Reliable Breaker Control

Open or close the circuit breaker manually with the optional SafeLock trip/close pushbuttons, which provide direct control of the breaker independent of the relay. Switch contacts and indicating lamps are separately wired to screw-terminal blocks on the rear of the relay, and they are functional even if the relay is out of service. The trip/close pushbuttons are equipped with the SafeLock system to prevent inadvertent operation and facilitate lockout/tagout procedures.
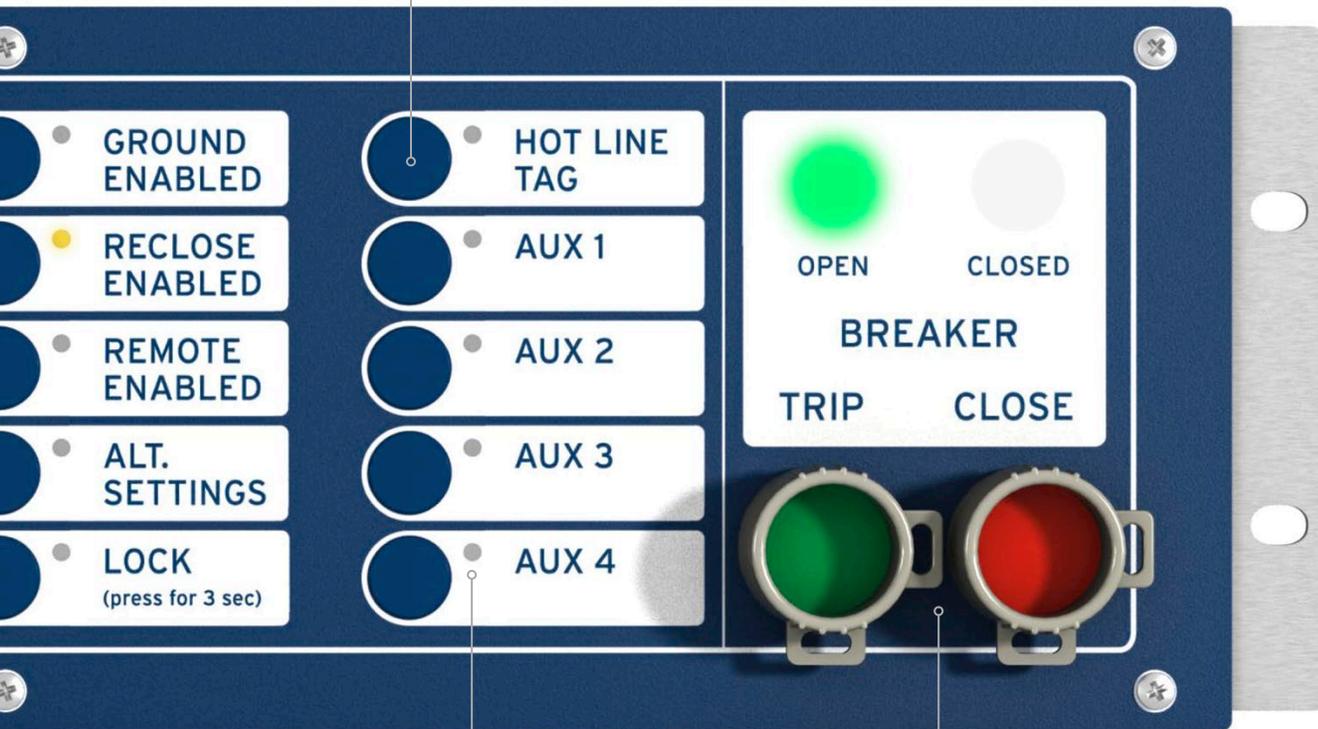
Product Overview

USB port simplifies local connections and speeds up relay communications.

Default displays or programmable custom messages notify personnel of power system events or relay status.

PORT F

IA=   0   IB=   0
IC=   0   IG=   0

SEL-351S
PROTECTION
SYSTEM

SEL

TARGET
RESET

LAMP
TEST

METER

CANCEL

EVENTS

SELECT

STATUS

◄

OTHER

►

SET

▲

CNTRL

▼

GROUP

EXIT

ENABLED   TRIP   INST   COMM   SOTF   50   51   81

RESET   CYCLE   LOCKOUT   A   B   C   G   N

RECLOSING STATE   FAULT TYPE

Programmable operator pushbuttons and optional user-configurable labels allow for ease of operation.

GROUND ENABLED

RECLOSE ENABLED

REMOTE ENABLED

ALT. SETTINGS

LOCK
(press for 3 sec)

HOT LINE TAG

AUX 1

AUX 2

AUX 3

AUX 4

OPEN

CLOSED

BREAKER

TRIP

CLOSE

Front-panel LEDs can be programmed to indicate custom alarms.

Optional SafeLock® trip/close pushbuttons and bright indicating LEDs allow breaker control independent of the relay.

High-current interrupting output contacts increase contact robustness and reliability.

Harmonic metering to the 16th harmonic enhances power quality analysis.

OUT101	OUT102	OUT103	OUT104	OUT105	OUT106	OUT107	ALARM	IN101	IN102	IN
A01 A02	A03 A04	A05 A06	A07 A08	A09 A10	A11 A12	A13 A14	A15 A16	A17 A18	A19 A20	A21

OUT201	OUT202	OUT203	OUT204	OUT205	OUT206	OUT207	OUT208	OUT209	OUT210	OU
B01 B02	B03 B04	B05 B06	B07 B08	B09 B10	B11 B12	B13 B14	B15 B16	B17 B18	B19 B20	B21

CLOSE	TRIP	CLOSED	OPEN
Z17 Z18	Z15 Z16	Z19 Z20	Z21 Z22

IA	IB	IC	IN
Z01 Z02	Z03 Z04	Z05 Z06	Z07 Z08

SafeLock® trip/close pushbuttons on the front panel are wired directly to these terminals to allow breaker control independent of the relay.*

Expanded I/O allows for flexible applications.*

Sensitive earth fault (SEF) protection accurately detects ground faults with low current values.*

Dual copper Ethernet port allows communication between devices and provides redundancy. Single or dual fiber-optic ports are also available.

Standard multisession Modbus® TCP, Modbus RTU, DNP3, and IEC 61850* provide communications flexibility.

MIRRORED BITS® communications provides fast and reliable relay-to-relay communication.

IN103 IN104 IN105 IN106

IRIG-B   PORT 5   SERIAL PORT 2   SERIAL PORT 3

A22 A23 A24 A25 A26 A27 A28

PORT 5A   PORT 5B

SERIAL PORT 1

T211 OUT212   IN201 IN202 IN203 IN204 IN205 IN206 IN207 IN208

B22 B23 B24   B25 B26 B27 B28 B29 B30 B31 B32 B33 B34 B35 B36 B37 B38 B39 B40

VA VB VC N   VS NS

POWER
+/H −/N

MADE IN USA
P/N 0351S7XHD4B5421
S/N 1110000000
Power Supply   125/250Vdc
                    120/230Vac 50/60Hz
                              <25W
Logic Input   125Vdc
Volts AC   300V Wye/Delta
Amps AC   5-PH, 5-N

GND
Z27

Z09 Z10 Z11 Z12   Z13 Z14 Z23 Z24   Z25 Z26

190-3457-01

Built-in phasor measurement unit allows wide-area power system monitoring.

EIA-485 port provides quick and easy engineering access.

*Optional feature

Applications

Comprehensive Protection Features

Instantaneous and Time-Overcurrent Elements With Second-Harmonic Blocking

- Use multiple instantaneous and time-overcurrent elements with SELOGIC control equations to coordinate protection with downstream devices. Best Choice Ground Directional Element® logic optimizes directional element performance and eliminates the need for many directional settings.

- Select from six levels of phase, negative-sequence, residual-ground, and neutral-ground instantaneous overcurrent elements to best fit your application.

- Use the second-harmonic blocking elements to detect transformer energization and block selected tripping elements until inrush conditions subside.

Communications-Assisted Tripping

Communications-assisted tripping schemes provide unit protection for transmission or networked distribution lines. No external coordination devices are required. Built-in scheme logic permits fast trip times, reducing fault durations that adversely impact system loads, power system equipment, and stability.

Apply MIRRORED BITS communications to communications-assisted tripping over traditional communications equipment. A MIRRORED BITS implementation has the advantages of increased reliability using less equipment, increased speed with no contact closure delay, better security through built-in channel monitoring, and reduced wiring complexity.
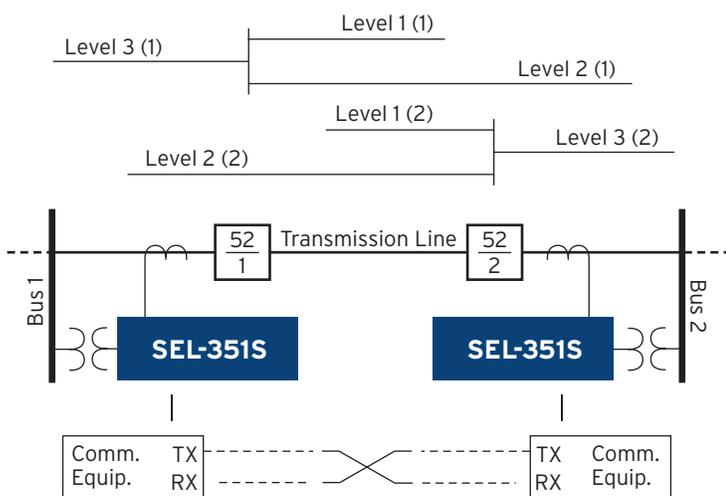
Flexible Frequency Elements

- Apply six levels of frequency elements to provide multilevel under- and overfrequency protection.

- Improve frequency control with four independent ROCOF elements. Each element includes logic to detect either increasing or decreasing frequency, allowing for control or switching actions, such as network decoupling or load shedding.

### Fast Dropout Breaker Failure Element

Detect a failed circuit breaker with built-in breaker failure detection elements and logic. High-speed, open-phase detection logic allows you to set the pickup current below the minimum load for sensitivity without sacrificing high-speed dropout.

Fault Locator

Reduce fault-locating and repair times with the built-in impedance-based fault locator and faulted phase indication. Efficiently dispatch line crews to isolate line problems and restore service faster.

Expanded SELOGIC Control Equations

SELOGIC control equations permit custom programming for traditional and unique protection and control functions. Add these programmable control functions to your protection and automation systems.


Communications-assisted tripping.
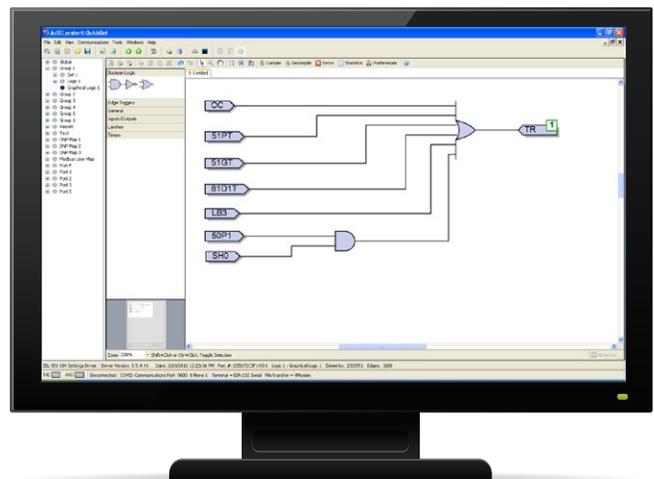
Operator Type	Operators
Boolean	+, *, !
Edge detection	/, \
Precedence control	( )

Create your own custom applications using powerful SELOGIC control equations.

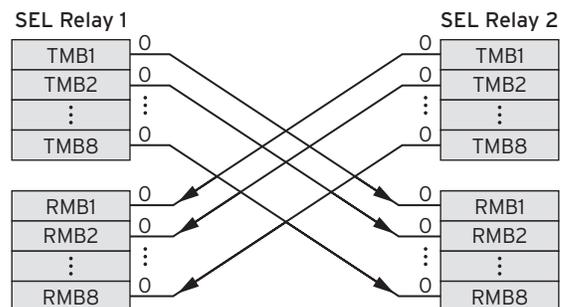## Advanced Communications

Integration With Ethernet Networks

- Connect the SEL-351S directly to a local network with the built-in Ethernet interface or through an SEL-3530 Real-Time Automation Controller (RTAC).

- Provide seamless failover protection with the Parallel Redundancy Protocol (PRP).

- Use DNP3 LAN/WAN, Modbus® TCP, and IEC 61850 to quickly send information through your networks.

- Increase communications reliability with separate and redundant communications ports.

- Transfer data at high speeds (10 Mbps or 100 Mbps) for fast human-machine interface (HMI) updates and file uploads.

- Use popular Telnet applications for easy terminal communication with SEL relays and other devices.

- Use popular FTP applications for easy transfer of settings, events, and history files.

- Transmit synchrophasor data to multiple clients using UDP and TCP formats.

- Simplify wiring and installation by receiving a time signal over existing Ethernet networks using the Simple Network Time Protocol (SNTP). SNTP makes a good backup to more accurate IRIG-B time synchronization.
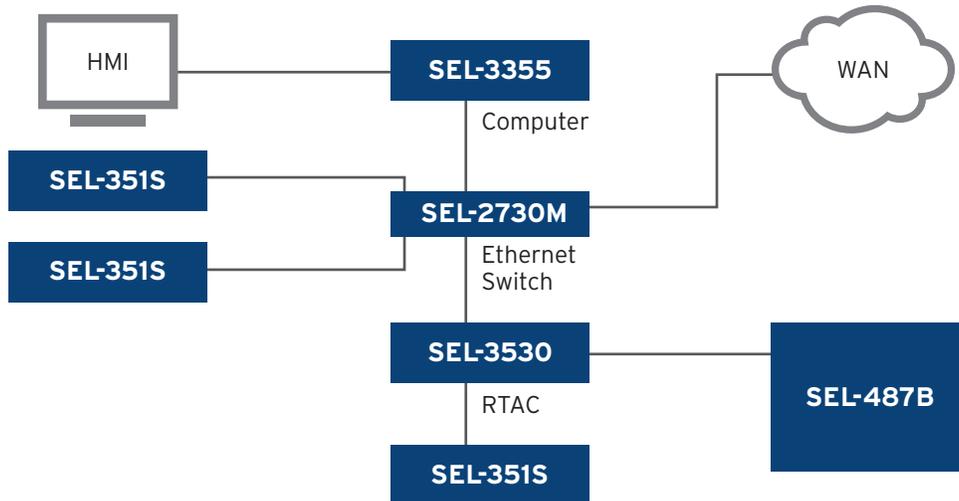
SEL offers complete Ethernet direct-connect solutions.

Enhanced MIRRORED BITS Communications

MIRRORED BITS communications technology provides bidirectional digital communications between devices. Use MIRRORED BITS communications to transmit/receive information between upstream relays and downstream recloser controls to enhance coordination and achieve faster tripping for downstream faults.

Improve performance with SEL MIRRORED BITS communications.

Monitoring and Metering

Enhanced Breaker Monitoring

Inspect reports for the most recent trip and close operating times and average operating times, or gather trending data for up to 128 previous operations. This information allows timely and economical scheduling of breaker maintenance.

Built-In Web Server

Access basic SEL-351S information on a standard Ethernet network with the built-in web server. View relay status, Sequential Events Recorder (SER) data, metering information, and settings through easy access within a local network. Upgrade your firmware remotely through the Ethernet connection. Web server access requires a relay password.

Synchrophasors

To significantly improve your system's performance, SEL offers complete synchrophasor solutions, including hardware, communications, data collection, viewing and analysis software, and data archiving. The SEL-351S provides real-time system state measurement with time-synchronized voltages and currents in the IEEE C37.118 standard format. In addition, SEL-5078-2 SYNCHROWAVE® Central Visualization and Analysis Software or third-party software allow you to view and analyze system phase angles, load oscillations, voltage profiles, and other critical system information.
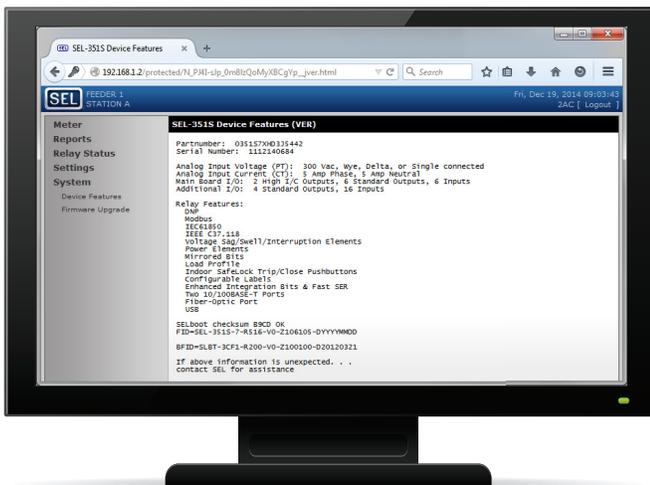
Web server menu screen.

Real-time SYNCHROWAVE Central data.

Easy to Set and Use

Implement Digitally Signed Firmware Upgrades

- The cryptographically secure signature ensures that the file has been provided by SEL and that its contents have not been altered.

- If the SEL-351S cannot verify the signature, it rejects the corrupted or altered firmware file.

Store Design Templates

- Store any number of files inside one compressed file up to 750 kilobytes, including AcSELERATOR QuickSet® SEL-5030 Software settings files, a QuickSet relay database containing a design template, or other files of your choice.

- QuickSet automatically verifies that settings match the design template upon retrieving the template from the relay.

Use QuickSet to Set, Monitor, and Control the SEL-351S

- Save engineering time while maintaining flexibility. Communicate with the SEL-351S through terminal software, or use the QuickSet graphical user interface.

- Develop settings offline with a menu-driven interface and completely documented help screens. Speed up installation by copying existing settings files and modifying application-specific items.

- Simplify the setting procedure with a rules-based architecture to automatically check interrelated settings. Out-of-range or conflicting settings are highlighted for correction.

- Streamline the configuration of IEC 61850-enabled relays with AcSELERATOR Architect® SEL-5032 Software.

- View COMTRADE files from the SEL-351S and other digital fault recorders with SEL-5601-2015 SYNCHROWAVE Event 2015 Software.

QuickSet design template.
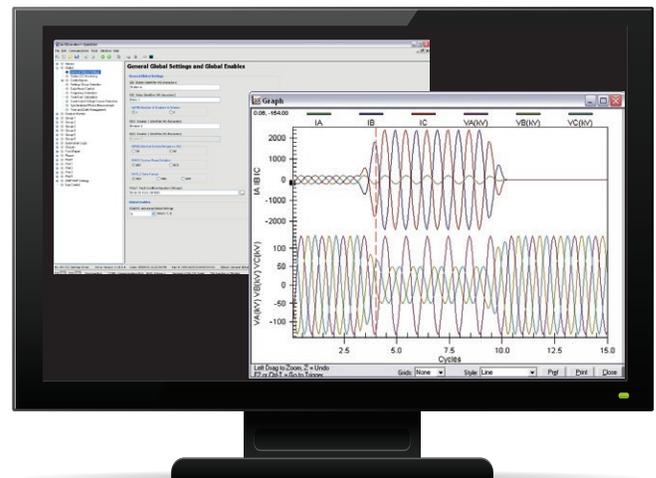
QuickSet settings form view and AcSELERATOR® event report.

SEL-351S Specifications

General

AC Current Inputs	IA, IB, and IC: 5 A or 1 A nominal
	IN: 5 A, 1 A, 0.2 A, or 0.05 A nominal
AC Voltage Inputs	300 V maximum
Output Contact Ratings	**Standard Output Contacts**
	Make: 30 A
	Carry: 6 A continuous carry at +70°C
	Breaking capacity: 0.20–0.75 A (depending on voltage)
	High-Current Interrupting Output Contacts
	Make: 30 A
	Carry: 6 A continuous carry at +70°C
	Breaking capacity: 10 A
Frequency and Phase Rotation	60/50 Hz system frequency
	ABC or ACB phase rotation
Communications Ports	EIA-232 (3 ports)
	USB Type B
	EIA-485
	Fiber-optic multimode ST® serial port (optional)
	Ethernet port:
	Dual 10/100BASE-T (RJ-45 connector)
	Single 100BASE-FX (LC connector) (optional)
	Dual 100BASE-FX (LC connector) (optional)
	Single 10/100BASE-T (RJ-45 connector) and single 100BASE-FX (LC connector) (optional)
Communications Protocols	SEL, IEC 61850 (optional), MIRRORED BITS communications (optional), Modbus, DNP3, ASCII protocols, SNTP, IEEE C37.118 (synchrophasors), built-in web server, FTP, PRP (optional), Telnet
Synchrophasors (IEEE C37.118 Standard)	Up to 50 messages per second (50 Hz system)
	Up to 60 messages per second (60 Hz system)
Processing	AC voltage and current inputs: 128 samples per cycle, 3 dB low-pass filter cut-off frequency of 3 kHz
	Digital filtering: Full-cycle cosine filters after low-pass analog and digital filtering
	Protection and control processing: 4 times per power system cycle
Power Supply	**125/250 Vdc or 120/230 Vac**
	Range: 85–350 Vdc or 85–264 Vac
	48/125 Vdc or 120 Vac
	Range: 38–200 Vdc or 85–140 Vac
	24/48 Vdc
	Range: 18–60 Vdc
Operating Temperature	−40° to +85°C (−40° to +185°F)

SEL **SCHWEITZER ENGINEERING LABORATORIES**

Making Electric Power Safer, More Reliable, and More Economical
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