SEL-T400L NEW
Apply the SEL-T400L Time-Domain Line Protection for ultra-high-speed protection of transmission lines. With breakthrough time-domain technologies, the SEL-T400L trips securely in as fast as 1 ms, records events with a 1 MHz sampling rate, and locates faults to the nearest tower.

SEL-T4287 NEW
Test traveling-wave fault locators and line protective relays using the SEL-T4287 Traveling-Wave Test System, a simple-to-use, compact, and economical secondary pulse injection test set.

SEL-311L
Use the SEL-311L Line Current Differential Protection and Automation System with integral four-zone distance backup for easy-to-apply, high-speed line protection.

SEL-411L
Apply subcycle single- or three-pole line current differential, distance, and directional overcurrent protection with the SEL-411L Advanced Line Current Differential Protection, Automation, and Control System. Traveling-wave fault locating pinpoints faults to the nearest tower span.

SEL-421
Employ the SEL-421 Protection, Automation, and Control System for high-speed distance and directional protection and complete control of a two-breaker bay.

SEL-311C
Apply the SEL-311C Transmission Protection System for three-pole distance protection, reclosing, monitoring, and control of transmission lines.

SEL-311L
Use the SEL-311L Line Current Differential Protection and Automation System with integral four-zone distance backup for easy-to-apply, high-speed line protection.

SEL-387L
Use the SEL-387L Line Current Differential Relay for economical, easy-to-apply line protection with zero settings.
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- Standard feature
- Model option
- May be created using settings
ULTRA-HIGH-SPEED PROTECTION WITH AUXILIARY PROTECTION AND CONTROL FUNCTIONS

The SEL-T400L Time-Domain Line Protection is designed for speed, security, and ease of use. It is the only relay that trips in as fast as 1 ms without compromising security. Using a multifunction line-protective relay in parallel with the SEL-T400L provides a full suite of protection, control, and monitoring functions, including time-coordinated backup protection, breaker failure protection, reclosing with synchronism check, switch-onto-fault protection, and bay control.

OPTIMIZED SYSTEM LOADING

Set the phase distance and phase overcurrent elements independent of load to prevent load from causing the phase protection to operate. Under heavy load conditions, the measured impedance may fall inside the operating characteristic of a traditional phase distance element and cause an undesired operation. Traditional solutions involved reducing mho element reach or using a lenticular characteristic to prevent load encroachment. With built-in load-encroachment logic, two load regions are defined on the impedance plane and the relay rejects a minimum portion of the mho element characteristic, as shown. This allows you to securely apply distance protection elements on heavily loaded transmission lines.

SERIES-COMPENSATED LINES

Detect faults beyond a series capacitor and prevent Zone 1 overreach on series-compensated lines with optional logic in the SEL-421-5 Protection, Automation, and Control System and the SEL-411L-1 Advanced Line Differential Protection, Automation, and Control System. Series compensation increases the power transfer capability of transmission lines and improves power system stability. However, when faults occur on series-compensated lines, the resulting voltage inversion or current reversal may cause traditional line protection to misoperate.

It’s also important to enable this logic in parallel line applications where there is a series capacitor on the adjacent line. Series compensation logic achieves the desired sensitivity on the protected line, yet is still secure during the voltage inversion that may occur when the neighboring series-compensated line experiences a fault.
**IN-LINE TRANSFORMERS**

Use negative-sequence overcurrent elements in distance protection relays to protect transmission lines with in-line transformers. In differential relays, such as the SEL-411L, the Alpha Plane operating principle provides for true differential harmonic measurements and allows harmonic blocking, harmonic restraint, or both for security during the magnetizing inrush condition. Additionally, built-in settings allow the relay to perform proper vector group compensation, zero-sequence current balancing, and ratio matching per the principles of transformer differential protection.

**TRAVELING-WAVE FAULT LOCATING**

With advanced microprocessor relays, you can compute fault locations using four different methods: single-ended impedance-based, multi-ended impedance-based, single-ended traveling-wave fault locating (available in the SEL-T400L), and double-ended traveling-wave fault locating (available in the SEL-411L and SEL-T400L). Based on input data availability, the relay selects one method of fault locating to provide in a summary report.

Traveling-wave fault locating is the best method for series-compensated and parallel transmission line configurations because it measures the fault’s high-frequency wavefront and provides precise results regardless of the line configuration or fault impedance. Because traveling-wave fault locating provides greater accuracy, you can send crews to the nearest tower or span to quickly address the problem.

**IMPROVED SYSTEM STABILITY**

Select from either out-of-step (OOS) blocking of distance elements or OOS tripping during power swings. SEL transmission relays include multizone elements and logic for detection of an out-of-step condition.

The power-swing detection function differentiates faults from power swings and blocks distance or other relay elements from operating during stable or unstable power swings. The SEL-421 and SEL-411L come with a zero-setting OOS blocking function that is based on a swing-center voltage slope detector, OOS blocking detector, and three-phase fault detector. The zero-setting OOS function improves security during power swings without time-consuming and expensive system stability studies.
MHO AND QUADRILATERAL DISTANCE ELEMENTS
Select mho distance elements, quadrilateral distance elements, or both with SEL transmission relays. Some utilities prefer the mho distance elements because they are easy to set. However, other utilities favor the quadrilateral distance elements because they offer better resistive coverage. Quadrilateral elements provide the best protection for short lines where the impedance of the transmission line is the same magnitude as the fault resistance.

COMMUNICATIONS-ASSISTED TRIPPING
Configure protection for transmission lines without any need for external coordination devices. SEL transmission protection relays offer settings to accommodate many of the common pilot protection schemes, including permissive overreaching transfer trip (POTT), directional comparison unblocking (DCUB), and directional comparison blocking (DCB). These schemes work in both two- and three-terminal line applications.

CAPACITOR VOLTAGE TRANSFORMER (CVT)
TRANSIENT DETECTION
Detect CVT transients that can cause Zone 1 distance elements to overreach during external faults. If CVT transient blocking is enabled and the relay detects a high source-to-impedance ratio (SIR) when a Zone 1 distance element is picked up, the relay delays tripping for as long as 1.5 cycles to allow the CVT transient to stabilize. No settings are needed to enable this feature. The relay adapts automatically to different system SIR conditions by monitoring the measured voltage and current. If the distance calculation does not change significantly, the relay unblocks CVT transient blocking that results from low voltage and low current during close-in faults driven by a source with a high SIR. Therefore, Zone 1 distance elements operate without significant delay for close-in faults.
LONG TRANSMISSION LINES
Enable line-charging current compensation in the SEL-411L for enhanced sensitivity and security for long extra-high-voltage lines or cables. The charging current compensation is based on voltage signals and includes a built-in fallback response if the voltage source suffers loss-of-potential conditions or becomes unavailable. The function performs compensation on a per-phase basis and in the time domain. Therefore, the charging current compensation is accurate under balanced and unbalanced conditions and for line pickup with uneven breaker pole operation, internal faults, and external faults.

WEAK SYSTEMS AND INVERTER-BASED SOURCES
Choose a line current differential scheme for primary line protection when connecting wind farms to the utility grid. Fault current contributed from weak sources, such as doubly fed induction generators (DFIGs) in a wind farm, is just a fraction of the load current. This challenges any current-based distance or overcurrent protection method and requires weak infeed logic to properly protect the line. Line current differential schemes work best because the grid provides enough fault current to drive the differential signal up, while the inverter-based source doesn’t create restraining.

FOUR-TERMINAL AND PARALLEL TRANSMISSION LINES
Perform line current differential protection on lines with up to four terminals by using the 87L-over-Ethernet feature in the SEL-411L. You can use the SEL ICON® multiplexer to interconnect the SEL-411L Relays making up the differential zone. The SEL ICON ensures a dedicated LAN with the proper bandwidth and minimal latency needed for secure and reliable 87L-over-Ethernet communications.

Protect up to three terminals with serial connections with the 87L scheme either in the master mode or master-outstation mode. In the master mode, all the relays act as master units, receive all the differential data, and trip directly on the data. In the case of a missing channel, you can use the relays in the master-outstation mode, where a single master unit receives all the data and sends a direct transfer trip to the slave units through a trip bit in the 87L channel. If the relays are in the master mode and a channel is suddenly lost, the scheme will automatically switch into the master-outstation mode to maintain 87L protection.

In parallel lines, the main issue is mutual coupling. Line current differential is immune to mutual coupling and is therefore very sensitive and secure in parallel-line applications.
SEL-T400L  NEW  
TIME-DOMAIN LINE PROTECTION

Starting Price
$12,000 USD

selinc.com/products/T400L
Select models typically ship in 2 days

The SEL-T400L provides ultra-high-speed protection of transmission lines. With breakthrough time-domain technologies, the SEL-T400L trips securely in as fast as 1 ms, records events with a 1 MHz sampling rate, and locates faults to the nearest tower. Adding the SEL-T400L to your line protection system can dramatically reduce your fault-clearing time and let you achieve the many benefits associated with speed.

Ultra-High-Speed Line Protection With Security—The SEL-T400L features a traveling-wave differential scheme (TW87) over a dedicated point-to-point fiber channel; an incremental-quantity distance element (TD21) that does not require communications; and a POTT scheme with traveling-wave (TW32) and incremental-quantity (TD32) directional elements over a digital or an analog protection channel. You can achieve 1–5 ms trip times, depending on the line length and system conditions.

Simplicity—Requiring only a few protection settings, the SEL-T400L is easy to learn, easy to apply, and easy to set. The relay settings require only very basic short-circuit studies and are greatly resilient to power system evolution and changing short-circuit levels.

High-Fidelity Recording—The SEL-T400L provides high-resolution voltage and current recording with a 1 MHz sampling rate and an 18-bit resolution. You can use the relay to record and analyze high-frequency transients, such as traveling waves from faults, switching events, breaker restrikes, and self-extinguishing faults. The SEL-T400L also streams time-stamped Fast Time-Domain Values (FTDV) to SEL-5611 SYNCHROWAVE® MegaScope® Software, allowing you to view wide-area power system events in real time with an unprecedented 1 µs resolution.

Accurate and Economical Fault Locating—The SEL-T400L includes traveling-wave fault-locating methods that work with or without communications. The SEL-T400L routinely locates faults within one tower span. The double-ended fault-locating method provides the fault location result within a few milliseconds, allowing the SEL-T400L to control autoreclosing depending on the location of the fault (such as in applications on lines with underground cable sections).

Testing Made Easy—Requiring only a few protection settings, the SEL-T400L is easy to commission. You can apply any standard relay test set for testing the TD21 distance and TD32 directional elements. The SEL-T4287 Traveling-Wave Test System provides end-to-end testing of the TW87 scheme, the TW32 element, and the traveling-wave fault locator. You can upload ultra-high-resolution current and voltage files (recorded by SEL-T400L Relays in the field or obtained from your transient simulation software) to the SEL-T400L and test the relay by executing built-in playback.
ANSI NUMBERS/ACRONYMS AND FUNCTIONS

1 Arming and Starting Logic
85 RIO SEL Mirrored Bits® Communications
94 High-Speed Trip-Rated Outputs
DFR 1 MHz Event Recorder
DTT Direct Transfer Trip Logic
FL Fault Locator (with traveling-wave and impedance methods, single-ended and double-ended)
HMI Operator Interface
LOP Loss-of-Potential Logic
MET Metering
POTT Permissive Overreaching Transfer Trip (POTT) Logic
SER Sequential Events Recorder
TD21 Incremental-Quantity Distance
TD32 Incremental-Quantity Directional
TD50 Incremental-Quantity Nondirectional Overcurrent Supervision
TD67 Incremental-Quantity Directional Overcurrent Supervision
TW32 Traveling-Wave Directional
TW87 Traveling-Wave Differential
TWDD Traveling-Wave Disturbance Detection

ADDITIONAL FEATURES AND FUNCTIONS

Preconfigured Trip Logic
Single-Pole Tripping Logic
Open-Pole Detection Logic
Adaptive Autoreclose Cancel Logic
Front-Panel USB 2.0 Port for Engineering Access
Ethernet Port for Engineering and SCADA Access
Multilevel Passwords for Secure Access
Electromagnetic Interference Monitoring
Enhanced Self-Monitoring
Fast Time-Domain Values (FTDV)

POWERFUL APPLICATIONS

The SEL-T400L is an easy-to-use ultra-high-speed and secure transmission line protective relay. It provides protection of two-terminal and multiterminal lines with in-line and adjacent series compensation, in three-pole and single-pole tripping applications, for single- or dual-breaker line terminations. The SEL-T400L also provides key line protection elements and schemes. For auxiliary functions, such as reclosing, synchronism check, breaker failure, communications protocols, and backup protection, you can use a companion relay, such as an SEL-421 Protection, Automation, and Control System or an SEL-411L Advanced Line Differential Protection, Automation, and Control System.

REFRESHING SIMPLICITY

Designed with simplicity in mind, the SEL-T400L minimizes the number of settings and keeps the settings selection as straightforward as possible. The SEL-T400L uses preconfigured, easy-to-set protection logic. The relay requires only a handful of protection settings, and most of them are nameplate data, such as CT and PT ratios, line length and impedance, nominal voltage and frequency, and so on.

The SEL-T400L offers refreshing simplicity compared with feature-heavy multifunction intelligent electronic devices. Improve your workforce efficiency and enhance protection security by avoiding human errors when using the SEL-T400L.
HIGH-RESOLUTION OSCILLOGRAPHY

Using the SEL-T400L is like applying an oscilloscope to the power system. Now you can look at currents and voltages through a 1 MHz lens. The SEL-T400L stores as many as 50 events with a back-to-back recording capability and a duration of 1.2 seconds per event. The SEL-T400L also provides a 10 kHz COMTRADE file that contains currents and voltages sampled at 10 kHz, selected operating quantities, Relay Word bits, settings, and fault location and event summary data.

When using a direct fiber-optic channel, the local 1 MHz and 10 kHz records also contain remote voltages and line currents.

TESTING MADE EASY

The built-in current and voltage playback feature of the SEL-T400L opens new opportunities for relay testing. To test the relay, you can upload and play back transient current and voltage files recorded by other SEL-T400L Relays in the field or generated using transient simulation software. This capability allows a protection engineer to easily validate relay settings and carry out trip analysis using only a “bench top” relay (no test set required). It allows a commissioning engineer to test relay settings without the need for secondary injection after verifying the relay hardware, especially the voltage and current inputs and the tripping outputs.

Secondary injection testing of SEL-T400L I/O, metering, and incremental-quantity protection elements is straightforward and easy. Today’s relay test sets provide adequate signals to test incremental-quantity protection elements.

Use the SEL-T4287 to perform secondary injection testing of traveling-wave protection elements and the traveling-wave fault locator.

MEGASCOPE APPLICATIONS FOR REMOTE MONITORING AND DIAGNOSTICS

With voltages and currents sampled at an unprecedented rate and resolution (1 MHz, 18 bits), the SEL-T400L is a power data acquisition device for advanced remote monitoring and diagnostics applications. The relay streams the high-resolution FTDV data in real time via a Gigabit Ethernet port, opening a whole suite of new applications for viewing power system events. These applications run in real time on high-performance computing platforms, such as the SEL-3355 Computer. You can record and analyze insulation problems, breaker transient voltage recovery or restrike events, switching events, and other high-frequency signatures over wide areas using the SEL-T400L data. For the first time, you have the ability to monitor your system continually across multiple buses at a 1 MHz sampling rate. Contact SEL (selinc.com/support) to obtain a detailed format description and tools (such as the preliminary MegaScope client software) to experiment with this advanced SEL-T400L functionality.
UNPARALLELED FAULT-LOCATING ACCURACY

In the last two decades, protection engineers have come to expect an impedance-based fault locator as a standard feature in a line protective relay. From now on, expect line protective relays to offer traveling-wave fault locating with ten-fold better accuracy. The SEL-T400L incorporates a single-ended traveling-wave fault-locating method, which calculates the fault location by analyzing only the local current traveling waves without the need for a communications channel. The relay also provides a double-ended method, which uses the first traveling waves arriving at both line terminals and requires communications over the differential protection fiber-optic channel. The SEL-T400L performs fault-locating calculations within tens of milliseconds after the fault, and it issues an autoreclose cancel (ARC) signal for faults on the underground sections of hybrid lines with overhead and underground sections. The traveling-wave fault-locating technology in the SEL-T400L has a field-proven accuracy in the order of about one tower span, regardless of the line length.

This photo shows damage from a C-Phase-to-ground flashover fault. The double-ended traveling-wave fault location technology calculated a fault location of 109.74 km, and the damaged insulator was found at 109.29 km.
SEL-T400L OVERVIEW

USB 2.0 port for SEL Fast Meter and Fast SER protocols as well as for local engineering access.

Display for viewing metering, event, and fault location information.

Large slide-in label pocket for diagrams or asset labels.

High-speed trip-rated output contacts for ultra-high-speed protection.

LEDs show faulted phases, element operation, and status of the relay and communications.

Communications ports for connecting to a remote SEL-T400L (POTT and DTT applications), to a local SEL relay (breaker failure and autoreclose applications), or to an SEL remote I/O module for legacy applications over contact I/O. These ports are configurable to support Millisecond Mirrored Bits and IEEE C37.94.

IRIG-B time input for nanosecond-accurate event reports.

Gigabit communications port for remote engineering access with FTP and Telnet and for SCADA applications with DNP3, SEL Fast Meter, SEL Fast SER, and FTDV.

Gigabit communications port for the point-to-point fiber-optic differential protection channel.

Three voltage and six current inputs for single- and dual-breaker applications.

Universal power supply operating voltage range: 85–300 Vdc, 85–264 Vac.
SEL-T4287  
TRAVELING-WAVE TEST SYSTEM

Starting Price
$4,287 USD

selinc.com/products/T4287
Select models typically ship in 2 days

The SEL-T4287 is a simple-to-use, compact, and economical secondary pulse injection test set for traveling-wave fault locators and line protective relays.

**Versatile Applications** — The SEL-T4287 generates two three-phase sets of secondary traveling-wave currents. An optional voltage module accessory (low-inductance resistors) allows you to convert one or both current output sets into traveling-wave voltage signals. The SEL-T4287 lets you test current- or voltage-based fault locators or protection elements and schemes, including single- and multi-ended fault locators, traveling-wave directional elements, and traveling-wave differential schemes. You can time-synchronize or cross-trigger multiple SEL-T4287 sets to generate more than two three-phase traveling-wave signals with timing patterns as needed by the device under test (DUT).

**Secondary Traveling-Wave Injection** — Traveling-wave fault locators and protection elements and schemes measure sharp changes in their input currents and voltages with rise times as fast as 1 μs. These fault locators and relays respond to relative polarities and the relative timing of these sharp signal changes. The SEL-T4287 generates output current signals with the short rise time, adequately slow decay, and nanosecond precision necessary for testing standalone traveling-wave fault locators, traveling-wave protective relays, and traveling-wave fault locators embedded in line protective relays.

**Simple Test Parameter Configuration** — Specify line and fault parameters, and let the SEL-T4287 calculate and apply the traveling-wave test signals. A simple and intuitive SEL-T4287 HMI allows you to specify test parameters and offers full control of tests without a PC and software.

**End-to-End Testing** — Perform end-to-end testing of traveling-wave protection schemes and multi-ended fault locators with multiple SEL-T4287 test sets synchronized to substation satellite clocks via IRIG-B inputs. You can preconfigure each test set, schedule a test time, and let the multiple SEL-T4287 test sets apply the right test signals at all terminals of the line. The SEL-T4287 can test traveling-wave fault locators on lines with two or more terminals. End-to-end testing is a standard feature included in the base price and can be used with any IEEE C37.118-compliant satellite clock with IRIG-B output.

End-to-end testing of a multi-ended fault-locating system.
The SEL-421 provides high-speed distance and directional protection and complete control of a two-breaker bay. You can protect any transmission line using a combination of five zones of phase- and ground-distance and directional overcurrent elements. A graphical user interface provides logic and application templates for typical line protection schemes. Patented capacitively coupled voltage transformer (CCVT) transient overreach logic enhances the security of Zone 1 distance elements. Best Choice Ground Directional Element® logic optimizes directional element performance and eliminates many directional settings. Optional additional logic prevents Zone 1 overreach on series-compensated lines. In addition, you can select incremental components for subcycle operation on critical lines requiring high-speed fault clearing. Optional Time-Domain Link (TiDL®) technology and SEL Sampled Values (SV) technology using IEC 61850-9-2 transform the way you modernize your substation.

ANSI NUMBERS/ACRONYMS AND FUNCTIONS

21 Phase and Ground Distance
25 Synchronism Check
27 Undervoltage
32 Directional Power
50 Overcurrent
50BF Dual Breaker Failure Overcurrent
51 Time Overcurrent
59 Overvoltage
67 Directional Overcurrent
68 Out-of-Step Block/Trip
79 Single-/Three-Pole Frequency
81 (O,U) Over-/Underfrequency
85 RIO SEL mirrored Bits Communication
DFR Event Reports
ENV SEL-2600*
HMI Operator Interface
LGC Expanded SEL logic® Control Equations
MET High-Accuracy Metering
PMU Synchrophasors
SER Sequential Events Recorder

ADDITIONAL FUNCTIONS

BRM Breaker Wear Monitor
LDE Load Encroachment
LOC Fault Locator
SBM Station Battery Monitor
SIP Software-Invertible Polarities
SV IEC 61850-9-2 Sampled Values Technology*
THM IEC 60255-Compliant Thermal Model
TiDL Time-Domain Link Technology*

*Copper or fiber-optic  *Optional feature
Programmable operator push-buttons with user-configurable labels allow front-panel customization.

Easy-to-use keypad aids simple navigation.

Front-panel display allows operators to control and view the status of disconnects and breakers.

Front-panel LEDs indicate custom alarms and provide fast and simple information to assist dispatchers and line crews with rapid power restoration.

User-selectable mimic screens show the system configuration in one-line diagram format.

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

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

Use one front and three rear EIA-232 ports for MIRR0RED BITS communications, DNP3, SCADA, and engineering access.

Choose from a vertical or horizontal, panel-mount or rack-mount chassis and different size options.

Six current and six voltage analog inputs support complete bay control and protection as well as two-breaker bay applications.

Communications protocols include FTP, Telnet, synchrophasors, DNP3 LAN/WAN, PRP, IEEE 1588 PTPv2, and IEC 61850 Edition 2.*

Power supply options include 24–48 Vdc; 48–125 Vdc or 110–120 Vac; or 125–250 Vdc or 110–240 Vac.

*Optional feature

**For PTPv2 implementation, Ports 5A and 5B must be ordered as an option.
SEL-421 OVERVIEW—TIDL OPTION

Commission button usage prompts the relay to communicate with the SEL-2240 Axion TiDL nodes.

4U chassis with mounting options (vertical or horizontal; panel or rack) accommodate users’ application needs.

LEDs indicate the connection status to a remote Axion TiDL node on a per-port basis.

Eight 100 Mbps fiber-optic EtherCAT® ports allow the TiDL-enabled relay to connect with eight remote Axion TiDL nodes and to receive remote analog and digital data over the network.

LEDs indicate a valid configuration and successful commissioning.

SEL-421 OVERVIEW—SV OPTION

The 4U chassis has various mounting options to accommodate users’ hardware needs.

Select fiber-optic, copper, or mixed Ethernet with separate ports for SV data and engineering access.

Power supply options include 24–48 Vdc; 48–125 Vdc or 110–120 Vac; or 125–250 Vdc or 110–240 Vac.
SEL-411L
ADVANCED LINE DIFFERENTIAL PROTECTION, AUTOMATION, AND CONTROL SYSTEM

Starting Price
$8,515 USD

The SEL-411L offers complete protection and control of any transmission line (short, long, or series-compensated) with up to four terminals. Differential protection with both phase- and sequence-based operating elements provides sensitivity and high-speed operation. Complete distance and directional elements provide standalone protection or backup protection in differential schemes in the event communications are lost. In addition to the differential protection, the SEL-411L includes all the features of the SEL-421 Protection, Automation, and Control System. Many popular fiber and multiplexed communications options are available. The SEL-411L accurately locates faults to within a tower span using optional traveling-wave fault locating. Optional SEL Sampled Values (SV) technology using IEC 61850-9-2 can transform the way you modernize your substation.

ANSI NUMBERS/ACRONYMS AND FUNCTIONS

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<tr>
<th>Number</th>
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</tr>
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<td>THM</td>
<td>IEC 60255-Compliant Thermal Model</td>
</tr>
</tbody>
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*Optional feature
*SV subscriber relays have no analog input boards and instead receive voltages and current through Ethernet.
EIA-232 front serial port is quick and convenient for system setup and local access.

Eaton E10000004 standard interface is quick and convenient for system setup and local access.

Programmable operator pushbuttons with user-configurable labels allow front-panel customization.

User-selectable mimic screens show the system configuration in one-line diagram format.

Up to 24 programmable target LEDs with user-configurable labels alert operators in the substation to faulted phases, the relay’s status, and element operation.

Front-panel display allows operators to control and view the status of disconnects and breakers.

Three EIA-232 serial ports for MirrorBite communications, SCADA, and engineering access provide flexibility to communicate with other devices and control systems. The ports include demodulated IRIG-B for precise-time input.

Choose either fiber or copper connections for one or two 87L communications channels.

Communications protocols include FTP, Telnet, synchrophasors, DNP3 LAN/WAN, PRP, IEEE 1588 PTPv2,* and IEC 61850 Edition 2.**

Six current and six voltage analog inputs support protection for substations with dual-breaker schemes.

The power supply allows different options: 48/125 Vdc or 110/120 Vac, or 125/250 Vdc or 120/240 Vac.

*For PTPv2 implementation, Ports SA and SB must be used for engineering access and SCADA.

**Optional feature.

SEL-411L OVERVIEW
SEL-411L OVERVIEW—SV OPTION

Choose from power supply options such as 48–125 Vdc or 110–120 Vac, or 125–250 Vdc or 110–240 Vac.

Chassis options (for up to three I/O boards) and mounting options accommodate hardware needs.

Select fiber-optic, copper, or mixed Ethernet with separate ports for SV data and engineering access.

Six current and six voltage analog inputs support signal digitization and local protection schemes.
The SEL-311C provides protection, reclosing, monitoring, and control of transmission lines. Features include a four-shot recloser; patented capacitance voltage transformer (CVT) transient overreach logic to enhance the security of Zone 1 distance elements; and overcurrent elements with directional control, monitoring, and metering. You can apply three-pole tripping logic or select the SEL-311C-3 for single-pole tripping. The SEL-311C comes standard with EIA-232 serial ports and a 10/100BASE-T Ethernet port for local/remote access and system integration. IEEE C37.118-compliant synchrophasors improve situational awareness.
Simplify local connection and speed up relay communications with the front-panel USB port.

Use default displays, or program custom messages.

Optional field-configurable, programmable operator pushbuttons with user-configurable labels.

Independent terminals for SafeLock trip/close pushbuttons.

Optional expanded I/O.

Standard dual copper, optional single or dual fiber-optic Ethernet ports, or one copper and one fiber-optic Ethernet port.

High-current interrupting output contacts.

Advanced SELogic control equations.


Optional programmable front-panel LEDs for custom alarms.

Optional independent SafeLock® trip/close pushbuttons with high-visibility indication.

Optional field-configurable, programmable operator pushbuttons with user-configurable labels.

Built-in phasor measurement unit.

Mirrored Bits communications.

Standard EIA-485 or fiber-optic serial port, or optional fiber-optic serial port.
The SEL-311L offers four-zone distance and directional overcurrent backup for easy-to-apply, high-speed line current differential protection. Single or dual differential communications channels provide reliability and security. The SEL-311L can accommodate two- or three-terminal lines, even with weak infeed. In addition, measuring elements provide coordination with tapped loads. You can reduce total project construction and operation costs by integrating the included four-shot recloser and relay logic operators into your automation system.
The SEL-387L offers sensitive, fast (subcycle), and secure three-pole current differential protection with zero settings. Negative- and zero-sequence differential elements detect high-resistance ground faults while remaining secure for external faults. The Alpha Plane restraint principle provides security for CT saturation and channel asymmetry. Direct fiber and IEEE C37.94 synchronous optional interfaces are available. Channel monitoring provides measurement of communications quality and prevents misoperation due to channel failure.