ON THE COVER
On May 7, 2018, the Public Service Company of New Mexico (PNM) became the first utility in the world to use SEL-T400L relays with time-domain technology for tripping line breakers—a significant step in the next phase of electric power protection. Read their story at selinc.com/PNM.

Dr. Edmund O. Schweitzer, III, SEL president and chief technology officer, signs an enclosure that houses the SEL-T400L.
2019 TECHNOLOGY HIGHLIGHTS

TIME-DOMAIN LINE PROTECTION
Discover the SEL-T400L Time-Domain Line Protection, the world’s fastest transmission line relay.

SOFTWARE-DEFINED NETWORKING
Improve Ethernet performance in mission-critical applications with the SEL-2740S, the industry’s first field-hardened software-defined networking (SDN) switch.

TIME-DOMAIN LINK TECHNOLOGY
Introducing Time-Domain Link (TDL®) technology—a simple, fast, and secure solution for your digital secondary system.

WIRELESS FAULT DETECTION
Apply the SEL-F150 and SEL-FR12 Fault Transmitter and Receiver System to speed up distribution protection with fault indication in 6 ms.

WIRELESS FAULT DETECTION AND LOAD MONITORING
Apply the SEL-FT50 and SEL-FR12 Fault Transmitter and Receiver System to speed up distribution protection and load management.

SEL ICON®
Deterministic wide-area networking solution for high-performance protection applications.

MICROGRID SOLUTIONS
Intelligent control for seamless islanding as well as comprehensive generation and load management.

CYBERSECURITY SERVICES
Secure critical infrastructure with SEL defense-in-depth solutions and services.

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ABOUT SEL

OUR MISSION—MAKING ELECTRIC POWER SAFER, MORE RELIABLE, AND MORE ECONOMICAL

SEL invents, designs, manufactures, and supports a complete line of products and services for the protection, monitoring, control, automation, and metering of electric power systems. Our solutions range from comprehensive generator and transmission protection to distribution automation and control systems.

SEL teams offer services, education, and support for a variety of industries and throughout the power system. Our Engineering Services team provides engineering expertise and system solutions to customers worldwide. SEL University offers training that helps our customers meet the technical challenges of integrating digital technologies into their expanding power system infrastructure.

Every day we work to make electric power safer, more reliable, and more economical by focusing on innovation, quality, and customer service.

OUR HISTORY

Edmund O. Schweitzer, III, founded SEL in 1982 in Pullman, Washington. SEL introduced the world’s first digital protective relay to the electric power industry in 1984. The SEL-21 revolutionized the power protection industry by providing fault locating and real fault data at a much lower cost than traditional electromechanical relays. Today, we continue to set the standard for technology with the introduction of the world’s fastest transmission line relay, the SEL-T400L Time-Domain Line Protection.

As part of a long-term strategy for sustained growth, stability, and customer focus, SEL became an employee-owned company in 1994 and transitioned to 100 percent employee ownership in 2009. Our ownership value is at the heart of our employee owners’ hard work to reduce costs, increase quality, and create the superior products that enable us to fulfill our mission.
INDUSTRIES WE SERVE
From the beginning, we’ve provided solutions for electric utilities. As our company has grown, so have our product portfolio and the number of industries we serve. From airports and hospitals to the power grids of entire countries, SEL solutions are protecting and controlling critical operations around the world.
ENGINEERING IS OUR MIDDLE NAME
At SEL, we are passionate about our work, knowing it contributes directly to improving the reliability of electric power, keeping people safe, and helping customers conserve resources through efficiency, simplicity, and creativity.

We develop innovative products and services by focusing on the challenges our customers face. This helps us create the best solutions for a wide range of industries and applications. Every day, SEL engineers create new technologies and solutions to solve our industry’s challenges.

OUR COMMITMENT TO QUALITY
Because SEL equipment becomes part of critical—and complex—infrastructure, from the electric power grid to processing and manufacturing facilities, we focus on long-term reliability and quality.

We warranty our products for 10 years and design them to last more than 20 years, and after serving our customers for more than 30 years, we still don’t charge for repairs—regardless of the age of the product. Our free repair policy generates useful data that we use to drive product and service improvements. Constant improvement is an integral part of quality at SEL because of the lives and critical infrastructure our products protect.

“As engineers, we work every day to invent, design, and support products that monitor, control, and protect power systems installed all over the world. Serving our industry is a tremendous privilege and responsibility that we take very seriously. Listening to our customers’ requirements and needs, we strive to make our solutions innovative, reliable, easy to use, and secure. We invest in our people, tools, and facilities in order to produce designs that exceed our customers’ requirements. Engineering is our middle name, and it’s what we love to do.”

—Dave Whitehead
Chief Operating Officer
SERVICE AND SUPPORT YOU CAN COUNT ON
We understand the importance of local support, which is why we have application engineers, customer service representatives, and sales managers in over 100 offices worldwide. Our network of independent sales representatives and distributors provides additional sales support in many regions. This network of local experts supports SEL products and solutions in more than 160 countries, ensuring the best possible user experience.

SEL’s outstanding customer service and support reflect who we are. Our commitment to serving our industry is consistent with our values and ethics. We believe strongly in our core company values, which are not only an essential part of our working environment but also the way we view our community, industry, and the natural environment.

“Society depends upon safe, reliable, and economical electric power. At SEL, we take our responsibility to this industry seriously. We strive to exceed expectations with extraordinary customer service, with expert application engineers who are always available to provide technical support close to our customers, and with sales engineers who solve problems by teaching and by adding value with SEL technology and innovation.”

—David Costello
Senior Vice President of Sales and Customer Service
EXAMPLE PRODUCT APPLICATIONS

**GENERATORS**

- Comprehensive Generator Protection (SEL-300G, SEL-700G)
- Resistance Temperature Detection (SEL-2600)
- Ground Fault Protection (SEL-2664, SEL-2664S)

**DISTRIBUTED GENERATION (DG)**

- Intertie/Wind Generator Protection (SEL-700GT, SEL-700GW)
- Basic DG Protection (SEL-547)
- DG Interconnection Recloser Control (SEL-651R, SEL-651RA)

**TRANSMISSION LINES**

- Time-Domain Line Protection (SEL-T400L)
- Traveling-Wave Fault Location (SEL-T400L, SEL-411L)
- Subcycle Line Differential Protection (SEL-311L, SEL-411L)
- Subcycle Distance Protection (SEL-421, SEL-311C)
- Merging Unit With Built-In Distance Protection (SEL-421)

**POWER TRANSFORMERS**

- Five-Winding Transformer Differential and Voltage Protection (SEL-487E)
- Four-Winding Transformer Differential Protection (SEL-387)
- Three-Winding Transformer Differential and Voltage Protection (SEL-387E)
- Two-, Three-, and Four-Winding Transformer Differential and Voltage Protection (SEL-787, SEL-787-2/-3/-4)
- Transformer Monitoring (SEL-2414)

**DISTRIBUTION FEEDERS**

- Distribution Protection (SEL-351, SEL-351A, SEL-351S)
- Protection, Automation, and Bay Control (SEL-451)
- Feeder Protection With Arc-Flash Detection (SEL-751, SEL-751A)
- Voltage Regulator Control (SEL-2431)
- Capacitor Bank Control (SEL-734B)
- Wireless Fault Detection (SEL-FT50 and SEL-FRI12)

- Overhead and Underground Fault Indication (AR360, AR-OH, AR-URD, TPR, CR)
- Recloser Control (SEL-651R, SEL-651RA, SEL-351RS Kestrel®)
- Encrypted Wireless Communication (SEL-3031, SEL-3060, SEL-3061)
- Compact Satellite-Synchronized Precise Time (SEL-2401)
- Real-Time Automation Control (SEL-3505)
- Wireless Fault Detection and Load Monitoring (SEL-FLT and SEL-FLR, SEL-8301)
SUBSTATIONS

Satellite-Synchronized Precise Time (SEL-2401, SEL-2404, SEL-2407®, SEL-2488, SEL-3401)
Protection, Automation, and Bay Control (SEL-451)
Low-Impedance Bus Differential Protection (SEL-487B)
Capacitor Protection and Control (SEL-487V)
High-Impedance Differential Protection (SEL-587Z)
Power Quality and Revenue Metering (SEL-735)
Programmable Automation Control (SEL-2411, SEL-2440)
Annunciation and Notification (SEL-2522, SEL-2523, SEL-2533)
Merging Units With Built-In Protection (SEL-401, SEL-421)

Rugged Computing (SEL-3355, SEL-3360)
Wide-Area Communications (SEL ICON®)
Modular I/O and Real-Time Automation Control (SEL-2240 Axion®)
Real-Time Automation Control (SEL-3530/3530-4, SEL-3555, SEL-3505/3505-3, SEL-3560)
Cybersecurity (SEL-3620, SEL-3622)
Rugged Ethernet Networking (SEL-2730M, SEL-2730U, SEL-2725, SEL-2740S)
Encrypted Wireless Communication (SEL-3031, SEL-3060, SEL-3061)
BLUETOOTH® Serial Communication (SEL-2924, SEL-2925)
High-Speed Remote I/O (SEL-2507)
Fiber-Optic Communication (Fiber-Optic Transceivers)

INDUSTRIAL/COMMERCIAL

Motor Protection (SEL-710, SEL-749M, SEL-849, motormAX®)
Power Quality and Revenue Metering (SEL-735)
Annunciation and Notification (SEL-2522, SEL-2523, SEL-2533)
Programmable Automation Control (SEL-2411, SEL-2411P, SEL-2440)

Feeder Protection With Arc-Flash Detection (SEL-751, SEL-751A)
Fast Motor Bus Transfer (SEL-451)
Rugged Computing (SEL-3355, SEL-3360)
Modular I/O and Real-Time Automation Control (SEL-2240 Axion)
EXAMPLE NETWORK COMMUNICATIONS DIAGRAM

Office Environment

Utility, Military, or Industrial Substation

Real-Time Automation Controller (RTAC)

Integrated Communications Optical Network

Ethernet Security Gateway

Remote I/O Module

Programmable Automation Controller

Discrete Programmable Automation Controller

Encryption Radio

GPS Clock

HMI

Remote Access

Link Type

Serial Fiber SEL-C805
Serial Fiber SEL-C808
Serial Wired EIA-232
IRIG-B
Wired Ethernet
Fiber Backbone
Fiber Ethernet
Wired EIA-48S
Other Wired
Encrypted Wireless

Engineering Control and Monitoring

Operations Wide-Area Visualization (Synchrophasors)

Firewall

Computer

SYNCHROVAC® Event

SYNCHROVAC® Central
SEL-849
Install the SEL-849 Motor Management Relay in motor protection applications for current-, voltage-, and thermal-based protection, arc-flash detection, and power metering.

SEL-300G
Apply the SEL-300G Generator Relay for comprehensive primary and backup generator protection for large and small machines.

SEL-710-5
Protect a full range of medium-voltage, three-phase induction and synchronous motors using the SEL-710-5 Motor Protection Relay.

SEL-700G
Install the SEL-700G Generator Protection Relay for utility and industrial generator protection. It offers an autosynchronizer, flexible I/O, and advanced communications.

SEL-749M
Protect low- and medium-voltage induction and synchronous motors. The reliable and economical SEL-749M Motor Relay also protects three-phase motors, including two-speed and reduced-voltage start motors.

SEL-2664S
Protect high-impedance grounded generators from ground faults at standstill, during startup, and while running with the SEL-2664S Stator Ground Protection Relay.

SEL-2664
Add the SEL-2664 Field Ground Module to the SEL-300G or SEL-700G to protect critical generator components. Or, add it to the SEL-2664S to protect rotor and stator windings from ground faults.

SEL-2600
Measure and transmit data from up to 12 resistance temperature detector (RTD) inputs and one contact input over a single fiber-optic link with the SEL-2600 RTD Module.
## APPLICATIONS

<table>
<thead>
<tr>
<th>SEL-300G</th>
<th>SEL-700G</th>
<th>SEL-700GT</th>
<th>SEL-700GW</th>
<th>SEL-2664S</th>
<th>SEL-710-5</th>
<th>SEL-749M</th>
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## PROTECTION

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<th>SEL-710-5</th>
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- Standard feature
- Model option
- May be created using settings
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-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.
## APPLICATIONS

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<th>SEL-411L</th>
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## PROTECTION

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## MISCELLANEOUS FEATURES

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• Standard feature  + Model option  f May be created using settings
SUBSTATION PROTECTION

**SEL-401**
Apply the SEL-401 Protection, Automation, and Control Merging Unit for substations with IEC 61850-9-2 Sampled Values (SV) systems. The SEL-401 is a standalone merging unit with phase overcurrent and breaker failure protection.

**SEL-421**
Employ the SEL-421-7 Protection, Automation, and Control Merging Unit in substations with IEC 61850-9-2 SV systems. The SEL-421-7 is the only standalone merging unit in the world with complete line protection built in.

**SEL-487E**
Provide high-speed transformer differential protection for up to five terminals as well as advanced monitoring, metering, automation, and control with the SEL-487E Transformer Protection Relay.

**SEL-787-2/-3/-4**
Apply advanced protection and monitoring with flexible communications to two-, three-, and four-terminal transformers with the SEL-787-2/-3/-4 Transformer Protection Relay.

**SEL-2414**
For new and existing transformers, apply the SEL-2414 Transformer Monitor for complete system monitoring and control.

**SEL-587Z**
Use the economical SEL-587Z High-Impedance Differential Relay to combine time-proven, high-impedance analog technology with the advantages of microprocessor technology.

**SEL-487B**
Use the SEL-487B Bus Differential and Breaker Failure Relay for bus differential and breaker failure protection, automation, and control in applications with up to seven terminals per relay.

**SEL-487V**
Protect and control grounded and ungrounded, single- and double-wye capacitor bank applications with the SEL-487V Capacitor Bank Protection and Control System.

**SEL-352**
Provide breaker failure protection and breaker control and monitoring with unparalleled flexibility using the SEL-352 Breaker Failure Relay.
### Transformer Protection and Monitoring

**Applications**

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**Protection**

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- Standard feature
- Model option
- May be created using relay elements, device word bits, analog quantities, and timers
## BUS PROTECTION

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### PROTECTION

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* Standard feature | + Model option | †/ 1/2/3 relay application

† May be created using settings
# Breaker Failure and Capacitor Bank Protection

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## Instrumentation and Control

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## Miscellaneous Features

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- Standard feature
- Model option
- May be created using relay elements and timers
DISTRIBUTION PROTECTION

SEL-751
The SEL-751 Feeder Protection Relay with arc-flash detection is the ideal solution for industrial and utility feeder protection. It offers innovative light sensing, flexible I/O, advanced communications, and an intuitive color touchscreen display.

SEL-551/551C
Apply SEL-551/551C Overcurrent/Reclosing Relays for distribution protection and control in new and retrofit installations.

SEL-451
Combine flexible overcurrent protection with complete substation bay control by using the SEL-451 Protection, Automation, and Bay Control System.

SEL-351
Choose the SEL-351 Protection System for transmission or distribution overcurrent protection, monitoring, and control.

SEL-351A
The SEL-351A Protection System is a low-cost, economical solution for distribution feeder protection.

SEL-351S
The SEL-351S Protection System offers comprehensive feeder and overcurrent protection perfect for industrial and utility feeder applications.

SEL-501
The SEL-501 Dual Universal Overcurrent Relay provides two complete and independent groups of protection in one low-cost unit for feeders, buses, transformers, motors, and breakers.
### APPLICATIONS

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### PROTECTION

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### INSTRUMENTATION AND CONTROL

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- Standard feature
- Model option
- May be created using settings
DISTRIBUTION CONTROL

**SEL-651R**
Apply the SEL-651R Advanced Recloser Control for automatic network reconfiguration, three-phase and single-phase tripping, and other distribution automation needs. It is compatible with popular reclosers.

**SEL-651RA**
The SEL-651RA Recloser Control is a powerful, cost-effective, and flexible recloser control for 14-pin applications. It is compatible with popular reclosers.

**SEL-351RS KESTREL®**
The SEL-351RS Kestrel Single-Phase Recloser Control provides integrated logic and communications and comprehensive protection for single-phase applications.

**SEL-FT50 AND SEL-FR12**
Apply the SEL-FT50 and SEL-FR12 Fault Transmitter and Receiver System to speed up distribution protection with fault indication in 6 ms.

**SEL-2431**
Optimize system voltage with the SEL-2431 Voltage Regulator Control by using directional voltage profiles and detailed tap change event reports.

**SEL-734B**
The SEL-734B Advanced Monitoring and Control System includes low-energy analog inputs and provides advanced monitoring and control capabilities for applications such as capacitor bank control and feeder monitoring.
## APPLICATIONS

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<tr>
<td>Synchronism Check</td>
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<tr>
<td>Underfrequency Load Shedding</td>
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<tr>
<td>Undervoltage Load Shedding</td>
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## PROTECTION

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<th>SEL-351RS</th>
<th>SEL-651RA</th>
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<tbody>
<tr>
<td>25 (G,T) Generator/Intertie Synchronism Check</td>
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<tr>
<td>27/59 Under-/Overvoltage</td>
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<tr>
<td>32 Directional Power Elements</td>
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<td>50 (P,N,G,Q) Overcurrent Element (Phase, Neutral, Ground, Negative Sequence)</td>
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<td>51 (P,N,G,Q) Time-Overcurrent Element (Phase, Neutral, Ground, Negative Sequence)</td>
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<td>67 (P,N,Q) Directional Overcurrent (Phase, Neutral, Negative Sequence)</td>
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<td>78VS Vector Shift</td>
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<td>81 Over-/Underfrequency</td>
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<td>Separate Neutral Overcurrent</td>
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<td>Low-Energy Analog (LEA) Voltage Inputs</td>
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<td>Directional Sensitive Earth Fault Protection</td>
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<td>Pilot Protection Logic</td>
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<td>Rate-of-Change of Frequency (df/dt)</td>
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<td>Fast Rate-of-Change of Frequency</td>
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<tr>
<td>Arc Sense™ Technology (AST) High-impedance Fault Detection</td>
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<td>Phantom Phase Voltage</td>
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## INSTRUMENTATION AND CONTROL

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<tr>
<td>Fault Locating</td>
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<td>SELoooc™ Control Equations With Remote Control Switches</td>
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<td>SELoooc Counters</td>
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<td>Trip Coil Monitor</td>
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<td>Sequential Events Recorder</td>
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<td>IEC 61850</td>
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<td>Simple Network Time Protocol (SNTP)</td>
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<td>RMS Metering</td>
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* Standard feature  + Model option  ❌ May be created using settings
FAULT INDICATORS, SENSORS, AND CTs

**SEL-FLT AND SEL-FLR NEW**
Improve distribution reliability with the SEL-FLT and SEL-FLR Fault and Load Transmitter and Receiver System, which enables faster fault locating, reduces outage durations, and improves the average restoration time.

**ERL**
The ERL Electrostatic Reset Fault Indicator offers a battery-free design and automatic voltage reset for maintenance-free fault indication.

**AR360**
The AR360 Overhead AutoRANGER® constantly monitors the system load current in distribution systems up to 34.5 kV and automatically adjusts the trip threshold. It provides 360 degrees of visibility for fault indication.

**AR-OH**
The AR-OH Overhead AutoRANGER Fault Indicator constantly monitors the system load current in distribution systems up to 69 kV and automatically adjusts the trip threshold.

**RADIORANGER®**
The RadioRANGER Wireless Fault Indication System reduces the need to access vaults or open pad-mounted enclosures to retrieve the fault indicator status, reducing fault-locating time and improving safety.

**SEL-8301**
Optimize outage management and improve underground reliability with the SEL-8301 Underground Distribution Sensor.

**AR-URD**
Use the Dynamic Delayed Trip feature in the AR-URD Underground AutoRANGER Fault Indicator to improve coordination with upstream protection, maximizing reliable performance.

**PILC FCI**
Paper-Insulated Lead-Covered Cable Faulted Circuit Indicators feature a rugged design for use in applications with submersion in up to 15 feet of water.

**MR**
The MR Manual Reset Fault Indicator is an economical troubleshooting tool for overhead and underground applications.

**AR-OH**
The AR-OH Overhead AutoRANGER Fault Indicator constantly monitors the system load current in distribution systems up to 69 kV and automatically adjusts the trip threshold.

**RADIORANGER®**
The RadioRANGER Wireless Fault Indication System reduces the need to access vaults or open pad-mounted enclosures to retrieve the fault indicator status, reducing fault-locating time and improving safety.
VIN Voltage Indicators are line-powered and indicate the presence of voltage at or above 2 kV (phase to ground) by flashing a neon lamp. Easily install VINs on the test point of a 200 A elbow, 600 A T-body, or 600 A basic insulating plug.

GFD Apply the GFD Ground Fault Detector over a three-phase cable bundle at ground potential in switchgear to identify faults on circuits feeding medical facilities, mining equipment, and other industrial equipment.

CT Economically add SEL CTs to existing wiring and electrical equipment without interrupting service.
SEL-735 POWER QUALITY AND REVENUE METER
Achieve high-accuracy revenue and power quality metering for any application. The SEL-735 now offers 1 GB of recording memory for up to 20 years of storage. Multiple enclosure and mounting options are available.

METER INSTALLATION OPTIONS AND ACCESSORIES
Mount SEL meters and accessory devices into a variety of locations using a complete line of mounting kits. You can choose from rack-mount, wall-mount, indoor, or outdoor configurations.

ACSELERATOR METER REPORTS
Transform metering data into action with ACSELERATOR® Meter Reports SEL-5630 Software.

ACSELERATOR DATABASE API
Allow third-party systems to access ACSELERATOR Team® SEL-5045 Software data with the SEL-5230 ACSELERATOR Database API.
### SEL-735 Power Quality Options

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<th>Basic</th>
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<th>Advanced</th>
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<td>Harmonic Angles</td>
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<td>Samples Per Cycle</td>
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<td>Duration (Cycles)</td>
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<td>Wave View Oscillography</td>
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<td><strong>Load Profile Data</strong></td>
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<td>Recorders × Channels</td>
<td>1 × 16</td>
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<td>32 × 16</td>
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<td>Acquisition Rates</td>
<td>1–120 min</td>
<td>3–59 s, 1–120 min</td>
<td>3–59 s, 1–120 min</td>
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<td>Storage Duration for 10-Minute Interval Data</td>
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<td>16 Channels</td>
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<td>192 Channels</td>
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<td>1.5 years</td>
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<td>512 Channels</td>
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<td>3.5 years</td>
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<td><strong>Voltage Sag, Swell, Interruption (VSSI) Recorder</strong></td>
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<td>Typical Number of Summary Events</td>
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<td>Number of Detailed Rows</td>
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<td>&gt;130,000</td>
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<td>Minimum Disturbance Duration</td>
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<td>1/4 cycle</td>
<td>1/4 cycle</td>
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<td>Sampling Rate</td>
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<td>4 samples/cycle; 1 sample/day, adaptive</td>
<td>4 samples/cycle; 1 sample/day, adaptive</td>
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<td><strong>Sequential Events Recorder (SER)</strong></td>
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<td>Number of Events</td>
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<td>&gt;80,000</td>
<td>&gt;80,000</td>
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<td>Number of Channels Monitored</td>
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<td><strong>IEC 61000-4-30 PQ Compliance</strong></td>
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<tr>
<td>150/180-Cycle, 10-Minute, 2-Hour</td>
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<td>Class A</td>
<td>Class A</td>
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<tr>
<td>Flicker</td>
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<td>Class A (10-min, 2-hr updates)</td>
<td>Class A (1-min, 10-min, 2-hr updates)</td>
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<tr>
<td>Voltage Harmonics</td>
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<td>Class A</td>
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<tr>
<td>Current Harmonics</td>
<td>–</td>
<td>–</td>
<td>Class A</td>
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</table>
AUTOMATION CONTROL

**SEL-3530/3530-4**
SEL-3530/3530-4 Real-Time Automation Controllers (RTACs) provide complete and flexible system control with integrated security, seamless configuration, unified logic, and high reliability.

**SEL-3555**
The SEL-3555 RTAC is 55 times faster than other RTACs, providing powerful computing for large-scale automation projects.

**SEL-3505/3505-3**
SEL-3505/3505-3 Automation Controllers add powerful automation, reporting, and control to low-power, limited-space applications.

**SEL-3560E/3560S**
Use SEL-3560E/3560S Compact Industrial RTACs in applications where you need fast processing and a compact form factor.

**SEL-2240**
The SEL-2240 Axion® is a fully integrated, modular I/O and control solution ideally suited for utility and industrial applications.

**SEL-2440**
Apply the SEL-2440 DPAC Discrete Programmable Automation Controller for utility-grade I/O, powerful processing, flexible communications, and micro-second timing.

**SEL-2411**
The SEL-2411 Programmable Automation Controller (PAC) offers flexible I/O for automatic control, SCADA, station integration, remote monitoring, and plant control systems.

**SEL-2411P**
The SEL-2411P Pump Automation Controller is designed specifically for water and wastewater environments. It is a reliable, easy-to-set, easy-to-install, SCADA-ready controller for pumping applications.

**SEL-3573**
The SEL-3573 Station Phasor Data Concentrator (PDC) connects to any IEEE C37.118-compliant phasor measurement unit (PMU) or client.
## APPLICATIONS

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<tr>
<th>Function</th>
<th>SEL-3555/3560E/3560S</th>
<th>SEL-3530</th>
<th>SEL-3530-4</th>
<th>SEL-3506/3506-3</th>
<th>SEL-3532/3533</th>
<th>SEL-2032</th>
<th>SEL-211</th>
<th>SEL-211P</th>
<th>SEL-2440</th>
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<tbody>
<tr>
<td>Collect, Scale Meter Data</td>
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<td>Collect Targets, Contact Input Status, Fault Location</td>
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<td>Enable Fiber-Optic Links</td>
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<td>Control Through Intelligent Electronic Device (IED) Outputs</td>
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<tr>
<td>Accept and Provide IRIG-B Time Synchronization</td>
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**Concentrate IED Data For:**

- Distributed Control System (DCS)
- SCADA Master or Remote Terminal Unit (RTU)
- Local or Remote HMI
- Transparent “Port Switch”
- Web Server HMI

## FEATURES

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<th>Feature</th>
<th>SEL-3555/3560E/3560S</th>
<th>SEL-3530</th>
<th>SEL-3530-4</th>
<th>SEL-3506/3506-3</th>
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<th>SEL-211</th>
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<td>Real-Time Operating System</td>
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## SERIAL PORT PROTOCOLS

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## NETWORK PROTOCOLS

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**Standard feature**  
**Model option**  
**With Ethernet option**  
**With Modbus Plus option**  
**Alarm contact only**  
**Not supported on SEL-3560S**
COMPUTING

**SEL-3355**
A server-class computer, the SEL-3355 Computer is built to withstand harsh environments in utility substations and industrial control and automation systems.

**SEL-3360S/3360E**
The SEL-3360S/3360E Compact Industrial Computers match the power and ruggedness of the SEL-3355 Computer and are ideal for limited-space applications.

**SEL-3390**
Add ports and connectivity to rugged computers with SEL-3390 PCIe Expansion Cards.

**SEL-9331**
Use the SEL-9331 Power Supply to power equipment in industrial environments where many power supplies cannot maintain operation.
### Applications

<table>
<thead>
<tr>
<th>Feature</th>
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<th>SEL-3360S</th>
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<td>Running Multiple Applications Simultaneously</td>
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<td>Installing Third-Party Software</td>
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<td>Embedding into Automation and Monitoring Systems</td>
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<td>Security Gateway to Help Satisfy NERC CIP Requirements</td>
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<td>Network Monitoring and Intrusion Detection</td>
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<td>Virtualization Server</td>
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<td>IRIG-B Time Distribution and Network Time Protocol (NTP) Conversion</td>
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<td>Video Surveillance Control and Archiving/Physical Security Monitoring and Notification</td>
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<td>SEL Secure Kiosk</td>
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### Supported Operating Systems

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<th>SEL-3360S</th>
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<tbody>
<tr>
<td>Microsoft Windows® 8/8.1, 10 IoT*; Windows Server® 2012 R2 Standard; Windows Server® 2016 Standard*; CentOS Linux® 6 and 7; Red Hat® Enterprise Linux® 6 and 7; VMware® ESXi™ 5.x–6.0; SEL Kiosk*; None (User-Loaded Operating System)</td>
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### Pre-installed Software

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<th>SEL-3355</th>
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<tr>
<td>McAfee® Whitelist Antivirus</td>
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<tr>
<td>SISCO AX-S4 IEC 61850 GOOSE OPC Server</td>
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### Hardware

<table>
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<tbody>
<tr>
<td>Intel® Xeon® E3-1505L Quad-Core 2.0 GHz 64-Bit CPU</td>
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<tr>
<td>Intel Xeon® E3-1515M Quad-Core 2.8 GHz 64-Bit CPU</td>
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<td>4 GB DDR4 ECC PC4-17000 (2,133 MHz) System Memory</td>
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<tr>
<td>Up to 32 GB DDR4 ECC PC4-17000 System Memory</td>
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<tr>
<td>Triple Independent Video Displays (2 DVI-D and 1 DisplayPort)</td>
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<tr>
<td>HD Audio Ports, Line In, Line Out, Microphone</td>
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<tr>
<td>Six USB Ports, USB 3.1-Compliant, 2.0 A Max. Current Limit Each (Up to 4 A Combined Front and 4 A Combined Rear)</td>
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<tr>
<td>Two 10/100/1000 Mbps Independent Copper Ethernet Ports</td>
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<tr>
<td>Two EIA-232 Serial Ports, DB-9 Connectors, 300 to 115,000 bps</td>
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<td>IRIG-B Input on COMI</td>
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<td>IRIG-B When Used With the SEL-3390E Network Card</td>
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<td>19&quot; Rack-Mount Chassis</td>
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<td>Wall-Mount Chassis</td>
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<td>Conductive Panel Mount</td>
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<td>Additional EIA-232/422/485 Serial Ports, RJ45 Connectors, 300 to 921,000 bps, IRIG-B Inputs/Outputs, +5 Vdc Power Via PCIe Cards</td>
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<td>Additional 10/100/1000 Mbps Ethernet Ports, Copper RJ45, or Fiber-Optic SFP LC Connectors Via PCIe Cards</td>
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<td>Solid-State Drives (2.5&quot; SLC, IMLC, MLC SATA II, 30 GB–2 TB Drives)</td>
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<td>Internal 120/230 Vac, 125/250 Vdc, or 48 Vdc Power Supply</td>
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<td>External Power Supply</td>
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<td>Alarm Contact, Alarm LED, Watchdog Processor</td>
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<td>Three Programmable Auxiliary Bicolor LEDs</td>
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### Legacy Hardware Option

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<tbody>
<tr>
<td>Intel Core™ i7-3555SLE Dual-Core 2.5 GHz 64-Bit CPU</td>
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<td>Intel Core i7-3612QE Quad-Core 2.1 GHz 64-Bit CPU</td>
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<td>4 GB DDR3 ECC PC3-10600 System Memory</td>
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<td>Up to 16 GB DDR3 ECC PC3-10600 System Memory</td>
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<tr>
<td>Dual Independent Video Displays (DVI-I [Digital + VGA] and DisplayPort)</td>
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<tr>
<td>Six USB Ports, USB 2.0-Compliant, 800 mA Current Limit Each</td>
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* Standard feature   + Model option   *Factory-orderable operating system
WAN AND LAN NETWORKS

SEL ICON®
The SEL ICON Integrated Communications Optical Network is a WAN multiplexer optimized for industrial and utility applications. By combining time-division multiplexing (TDM) and Ethernet transport options with a comprehensive range of data interfaces, the ICON makes it easy to migrate legacy network technologies to a packet-based solution.

SEL-2740S
The SEL-2740S Software-Defined Network Switch is the industry’s first field-hardened software-defined networking (SDN)-enabled switch and is designed to improve Ethernet performance in mission-critical applications.

SEL-3620/3622
The SEL-3620 Ethernet Security Gateway and SEL-3622 Security Gateway each function as a router, VPN endpoint, and firewall device. They can perform secure and proxy user access for serial- and Ethernet-based intelligent electronic devices (IEDs).

SEL-2730M/2730U
Apply SEL-2730M/2730U 24-Port Ethernet Switches to build reliable, safe Ethernet networks in electrical substations, plants, and other mission-critical sites.

SEL-3610
The SEL-3610 Port Server increases the number of serial ports available to communications processors and computers and allows serial products to communicate securely through Ethernet networks.

SEL-2725
The SEL-2725 Five-Port Ethernet Switch allows you to easily connect devices to Ethernet networks.

SEL-3025
The SEL-3025 Serial Shield® protects serial communications with bump-in-the-wire security and strong, authenticated access controls.

SEL-2726U
The SEL-2726U Eight-Port Ethernet Switch is an unmanaged Ethernet switch with eight 10/100BASE-T ports supporting data transfer rates up to 100 Mbps.
## APPLICATIONS

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<th>SEL ICON</th>
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<th>SEL-2740S</th>
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<td>Connect Multiple Wired-Ethernet Devices to Network</td>
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<td>Convert Wired 10/100BASE-T Ethernet to Fiber-Optic 100BASE-FX Ethernet</td>
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## FEATURES

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<td></td>
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<tr>
<td>Ethernet Class of Service</td>
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## ETHERNET PORTS, CONNECTOR

<table>
<thead>
<tr>
<th></th>
<th>QUANTITIES</th>
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</thead>
<tbody>
<tr>
<td>Copper 10BASE-T, RJ45</td>
<td>0–16′ 3 3 3 3–5 0–16′ 0–20</td>
</tr>
<tr>
<td>Copper 10/100BASE-T, RJ45</td>
<td>4 2 2 2 0–2 0′ 16′ 0–20</td>
</tr>
<tr>
<td>Fiber-Optic 100BASE-FX, LC</td>
<td>4 4 0–4</td>
</tr>
<tr>
<td>Copper Gigabit Ethernet (GigE), RJ45</td>
<td>2′/4′ 0–4′ 0–4</td>
</tr>
<tr>
<td>Fiber-Optic GigE, LC</td>
<td>2′–6′ 4′</td>
</tr>
<tr>
<td>Small Form-Factor Pluggable (SFP) Cages</td>
<td>2′–6′ 4′</td>
</tr>
</tbody>
</table>

SEL-2730M supports STP plus IEEE 802.1D-2004 Rapid Spanning Tree Protocol (RSTP).

SEL ICON can support up to 16 Ethernet ports using 8-port Ethernet Access Modules or Ethernet Bridging Access Modules.

SEL-2730M base configuration supports sixteen 10/100BASE-T copper ports, with the option to substitute 100BASE-FX fiber-optic ports in groups of four.

SEL-2730M base configuration includes 4 copper GigE ports and 4 SFP cages for optional fiber-optic GigE ports.

SEL ICON uses SFP cages for SONET and GigE fiber-optic interfaces.

SEL-8021-L Line Module supports 2 fiber-optic Gigabit interfaces.

SEL-8036-1 Ethernet Bridging Access Module supports 4 fiber-optic 100BASE-FX/Gigabit interfaces.

SEL-5052 Server NMS Software provides LDAP centralized authentication for the ICON.
WIRELESS COMMUNICATIONS

SEL-3031
The SEL-3031 is a 900 MHz ISM serial data radio that supports point-to-point (P2P) and point-to-multipoint (P2MP) operational modes. In P2P mode, the SEL-3031 supports three serial data ports in one radio channel.

SEL-3060
The SEL-3060 Ethernet Radio is a simple, secure way to wirelessly extend Ethernet networks. The SEL-3060A operates in the 900 MHz license-free ISM frequency band, and the SEL-3060B uses the license-free 2.4 GHz band.

SEL-3061
The SEL-3061 Cellular Router provides remote access for devices using the public cellular radio network. It supports 4G LTE, 3G, and 2G cellular technologies.

SEL-2924
Carry an SEL-2924 Portable BLUETOOTH® Serial Adapter in your toolbox to connect to an EIA-232 port on a relay, controller, or other device. Using a laptop or smartphone, you can securely communicate with the device from up to 10 m (32 ft) away.

SEL-2925
Install an SEL-2925 BLUETOOTH Serial Adapter on an EIA-232 serial port in a control cabinet or panel to enable wireless communications from up to 100 m (328 ft) away.
### APPLICATIONS

<table>
<thead>
<tr>
<th>Feature</th>
<th>SEL-3031</th>
<th>SEL-3060</th>
<th>SEL-3061</th>
<th>SEL-2924</th>
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<tbody>
<tr>
<td>Wireless Communications for SCADA</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
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<td>High-Speed Teleprotection</td>
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<tr>
<td>Distribution Automation</td>
<td>+</td>
<td>+</td>
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<tr>
<td>Wireless Communications for Synchrophasor Data</td>
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<td>+</td>
<td>+</td>
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<td>Substation-to-Substation Communications Link</td>
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<td>Anti-Island Detection</td>
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<tr>
<td>Wireless Communications for Distributed Generation</td>
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<td>Permanent Wireless Cable Replacement</td>
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<td>Remote Engineering Access</td>
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<td>Short-Range Engineering Access</td>
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<tr>
<td>Wireless Backhaul Communications for Fault and Load Transmitters</td>
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### FEATURES

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<tr>
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<tbody>
<tr>
<td>915 MHz ISM Band (License-Free)</td>
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<tr>
<td>2.4 GHz ISM Band (License-Free)</td>
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<td>Low Latency for Teleprotection</td>
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<td>+</td>
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<tr>
<td>Compatible With SEL MIRRORMIR® Communications</td>
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<td>+</td>
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<td>+</td>
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<tr>
<td>Compatible With Modbus®</td>
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<td>+</td>
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<tr>
<td>Compatible With DNP3 and Typical Byte-Oriented Protocols</td>
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<td>Encryption</td>
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<tr>
<td>Point-to-Multipoint Capability</td>
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<td>+</td>
<td>+</td>
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<td>Cellular Capability</td>
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<td>EIA-232 Port (Quantity)</td>
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<td>Wired EIA-485 Port</td>
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<tr>
<td>Site Analysis Tool (Spectrum Analyzer)</td>
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<td>+</td>
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<tr>
<td>High Maximum Throughput (1 Mbps or greater)</td>
<td>+</td>
<td>+</td>
<td>+</td>
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<td>Device Status LEDs</td>
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<td>+</td>
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<tr>
<td>Visible Link Quality Indicator</td>
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### SETUP METHOD

<table>
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<tr>
<th>Feature</th>
<th>SEL-3031</th>
<th>SEL-3060</th>
<th>SEL-3061</th>
<th>SEL-2924</th>
<th>SEL-2925</th>
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<tbody>
<tr>
<td>USB Port</td>
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<td>+</td>
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<td>Secure Web Interface Via Ethernet Port</td>
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<td>+</td>
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<tr>
<td>Control (DIP) Switches</td>
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<td>Wireless Configuration</td>
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<tr>
<td>Simple Network Management Protocol (SNMP)</td>
<td>+</td>
<td>+</td>
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</tbody>
</table>

- Standard feature
- Model option
- f With SEL-3044 Encryption Card option
The SEL-2488 Satellite-Synchronized Network Clock receives GNSS time signals and distributes precise time via multiple output protocols, including IRIG-B and the Network Time Protocol (NTP), with ±40 ns accuracy.

The SEL-2401 Satellite-Synchronized Clock is a precise-time device with high-accuracy timing (±100 ns) for compact spaces.

The SEL-3401 Digital Clock provides a highly visible time display for use anywhere there are time-critical functions set by IRIG-B synchronization signals.

The SEL-9929 Satellite-Synchronized Clock Display Kit includes a satellite-synchronized clock, a large digital clock display, and all accessories to work right out of the box.

The SEL-3400 IRIG-B Distribution Module verifies time signals, simplifies cabling, and distributes precise time to 240 devices.

The SEL-3405 High-Accuracy IRIG-B Fiber-Optic Transceivers send delay-compensated demodulated IRIG-B signals up to 4 km (2.5 mi) over fiber-optic cable.

The SEL-3390T Universal Time Card is a PCIe card that provides complete time management for a computer, such as the SEL-3355 Computer.

The SEL-9524 GNSS Antenna is a rugged and reliable antenna for GNSS devices in critical infrastructure applications.
### APPLICATIONS
- Time Source for Substation
- Time Source for Industrial Applications
- Time Source for Phasor Measurement Unit (IEEE C37.118.1-2011 Synchrophasors)
- Time Source for Recloser
- Time Source for Line Current Differential Protection
- Time Source for Traveling-Wave Fault Location
- Time-Synchronized Event Reporting
- Long-Distance Viewing, 61 m (200 ft)

### TIME SOURCES AND TIME DISTRIBUTION

<table>
<thead>
<tr>
<th>Feature</th>
<th>SEL-2401</th>
<th>SEL-2404</th>
<th>SEL-2407^</th>
<th>SEL-3400</th>
<th>SEL-3401^</th>
<th>SEL-ICON^</th>
<th>SEL-2488</th>
<th>SEL-3390T</th>
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<tbody>
<tr>
<td>Demodulated IRIG-B Outputs (Quantity)</td>
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<td>4</td>
<td>6</td>
<td>4+</td>
<td>1 up to 8</td>
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<tr>
<td>Modulated IRIG-B Outputs (Quantity)</td>
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<td>GPS Satellite Tracking</td>
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<td>GLONASS Satellite Tracking (Reference Only)</td>
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<td>Demodulated IRIG-B Input</td>
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<td>•</td>
<td>1</td>
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<td>Synchronized Pulse Output</td>
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<tr>
<td>Network Time Protocol (NTP) Server</td>
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<tr>
<td>IEEE 1588 Precision Time Protocol (PTP) Grandmaster (With IEEE C37.238 Power System Profile)</td>
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<td>IEEE 1588 PTP Slave</td>
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<td>PTP-to-IRIG-B Converter</td>
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</table>

### FEATURES
- 76.2 mm (3.0 in) LED Display
- 14 mm (0.56 in) LED Display
- Rack-Mount Hardware
- Panel-Mount or Wall-Mount Hardware
- PCIe Integration Into a Computer
- Universal Power Supply
- Dual, Redundant, Hot-Swappable Power Supplies
- Power Over Ethernet (PoE) Power Sourcing Equipment (PSE)
- Secure Web Interface for Configuration
- Serial Ports for Configuration
- User-Based Accounts
- TCXO Holdover
- OCXO Holdover
- Time-Code Cable Delay Compensation
- IEEE C37.90 and IEC 60255 Surge and Environmental Standards Compliance

### ACCURACY

<table>
<thead>
<tr>
<th>Feature</th>
<th>SEL-2401</th>
<th>SEL-2404</th>
<th>SEL-2407^</th>
<th>SEL-3400</th>
<th>SEL-3401^</th>
<th>SEL-ICON^</th>
<th>SEL-2488</th>
<th>SEL-3390T</th>
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</thead>
<tbody>
<tr>
<td>Average Accuracy (ns)</td>
<td>&lt;100</td>
<td>&lt;100</td>
<td>&lt;100</td>
<td>&lt;40</td>
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<tr>
<td>Peak Accuracy (ns)</td>
<td>&lt;500</td>
<td>&lt;500</td>
<td>&lt;500</td>
<td>&lt;1,000</td>
<td>&lt;100</td>
<td></td>
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</tbody>
</table>

* Standard feature  † Model option/accessory  † With SEL-5860 Time Service Software
TRANSCEIVERS AND ADAPTERS

SEL-2800/2815
Improve safety, signal integrity, and reliability of EIA-232 communications by using multimode SEL-2800/2815 Fiber-Optic Transceivers instead of wire.

SEL-2810/2812/2814
Use EIA-232 multimode fiber-optic transceivers instead of wire. The SEL-2810 and SEL-2812 support IRIG-B time signals, while the SEL-2814 works with hardware flow control signals.

SEL-2829/2830/2831
Apply the SEL-2829/2830/2831 Single-Mode Fiber-Optic Transceiver/Modem to use two optical fibers instead of wire to transfer bidirectional serial data.

SEL-2820/2824
Apply the SEL-2820/2824 Multimode Fiber-Optic Transceivers to safely add isolated segments to multidrop and point-to-point EIA-485 networks.

SEL-2890
Add Ethernet connectivity to an SEL device using its EIA-232 serial port with the SEL-2890 Ethernet Transceiver.

SEL-9192
Connect remote terminal units (RTUs), communications processors, and other equipment with the SEL-9192 Utility-Grade USB Modem for dial-up or dial-out engineering access.

SEL-9220
Convert the EIA-485 port of an SEL-300 series relay to a point-to-point fiber-optic port with the SEL-9220 Fiber-Optic Adapter for SEL-300 Series Relays.

SEL-2894
Apply the SEL-2894 Interface Converter to transfer SEL MIRRORED BITS® communications via an IEEE C37.94 fiber-optic link through a communications multiplexer.

SEL-2886
Connect EIA-232 devices to an EIA-485 network with SEL-2886 EIA-232 to EIA-485 Interface Converters.
### CONNECTOR AND OPTICS

<table>
<thead>
<tr>
<th>Feature</th>
<th>SEL-2800</th>
<th>SEL-2810</th>
<th>SEL-2812</th>
<th>SEL-9220</th>
<th>SEL-2814</th>
<th>SEL-2815</th>
<th>SEL-2820</th>
<th>SEL-2824</th>
<th>SEL-2829</th>
<th>SEL-2830</th>
<th>SEL-2831</th>
<th>SEL-2894</th>
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<td>ST®, 850 nm Wavelength</td>
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<td>ST, 1,300 nm Wavelength</td>
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### FIBER COMPATIBILITY

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<th>SEL-2829</th>
<th>SEL-2830</th>
<th>SEL-2831</th>
<th>SEL-2894</th>
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<tbody>
<tr>
<td>200 μm Core Multimode Fiber (SEL-C805)</td>
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<td>50 or 62.5 μm Core Multimode Fiber (SEL-C807, SEL-C808)</td>
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<td>9 μm Core Single-Mode Fiber (SEL-C809)</td>
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### ELECTRICAL FEATURES

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<th>SEL-2830</th>
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<tbody>
<tr>
<td>EIA-232 Asynchronous Serial Data</td>
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<td>EIA-485 Asynchronous Serial Data</td>
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<td>Hardware Flow Control Lines With Data</td>
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<tr>
<td>Power From Electrical Port Pins</td>
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<tr>
<td>External Power Jack or Terminals</td>
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### DISTANCES

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<tr>
<th>Feature</th>
<th>SEL-2800</th>
<th>SEL-2810</th>
<th>SEL-2812</th>
<th>SEL-9220</th>
<th>SEL-2814</th>
<th>SEL-2815</th>
<th>SEL-2820</th>
<th>SEL-2824</th>
<th>SEL-2829</th>
<th>SEL-2830</th>
<th>SEL-2831</th>
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<tbody>
<tr>
<td>Minimum (metric)</td>
<td>1 m</td>
<td>1 m</td>
<td>1 m</td>
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<td>1 m</td>
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<tr>
<td>Minimum (U.S.)</td>
<td>3.28 ft</td>
<td>3.28 ft</td>
<td>3.28 ft</td>
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<td>3.28 ft</td>
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<tr>
<td>Maximum (metric)</td>
<td>500 m</td>
<td>500 m</td>
<td>5 km</td>
<td>4 km</td>
<td>5 km</td>
<td>15 km</td>
<td>500 m</td>
<td>4 km</td>
<td>23 km</td>
<td>80 km</td>
<td>110 km</td>
<td>16 km</td>
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<tr>
<td>Maximum (U.S.)</td>
<td>0.3 mi</td>
<td>0.3 mi</td>
<td>3.1 mi</td>
<td>2.48 mi</td>
<td>3.1 mi</td>
<td>9.3 mi</td>
<td>0.3 mi</td>
<td>2.48 mi</td>
<td>14.3 mi</td>
<td>49.7 mi</td>
<td>68.3 mi</td>
<td>2 km</td>
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* Standard feature
CABLES

**SEL-C804**
Use SEL-C804 Multimode Arc-Flash Detection Fiber-Optic Cables with the SEL-751, SEL-751A, and SEL-710-5 to detect arc-flash events.

**SEL-C805**
SEL-C805 200 μm Multimode Fiber-Optic Cable assemblies connect V-pin or ST® ports.

**SEL-C807**
SEL-C807 62.5/200 μm Multimode Fiber-Optic Cable assemblies connect ST ports.

**SEL-C808**
SEL-C808 62.5/125 μm Multimode Fiber-Optic Cable assemblies connect ST, SC, or LC ports.

**SEL-C809**
SEL-C809 9 μm Single-Mode Fiber-Optic Cable assemblies connect ST, SC, or LC ports.

**ELECTRICAL DATA CABLES**
SEL Electrical Data Cables reliably connect SEL products and other devices, including relays, information processors, computers, I/O modules, meters, clocks, and modems.

**COAXIAL CABLES**
Use SEL Coaxial Cables for GPS and radio antenna connections and IRIG-B time distribution.

**CATEGORY 5E ETHERNET CABLES**
For copper Ethernet connections, use high-quality, shielded twisted-pair (STP) Category 5e Ethernet cables.

**USB SERIAL CABLES**
Add a 1.8 m (6 ft) or 4.6 m (15 ft) EIA-232 serial port cable to a PC USB port to communicate with SEL relays and other devices with EIA-232 serial ports.
### CONNECTOR
- V-Pin
- ST®
- LC
- SC

### FIBER DIAMETER (CORE/OUTER)
- 1,000 μm
- 200 μm
- 62.5/200 μm
- 62.5/125 μm
- 9/125 μm

### WAVELENGTH
- 650 nm (Multimode)
- 850 nm (Multimode)
- 1,300 nm (Multimode)
- 1,300–1,550 nm (Single-Mode)

### FIBER COUNT
- Simplex (1 Fiber)
- Duplex (2 Fibers)
- Quad (4 Fibers)

### CABLE RATINGS
- Riser-Rated (OFNR)
- Plenum-Rated (OFNP)
- Water-Blocked
- Waterproof

### JACKET MATERIAL
- Polyvinyl Chloride (PVC)
- Polyethylene (PE)

### TERMINATION KITS
- V-Pin Termination Kit
- ST Termination Kit
- LC, ST, and SC Termination Kit

### OPTIONS
- Bulk (No Connectors)
- Pulling Loop

### FIBER-OPTIC COMPATIBILITY
- SEL-2800/2810/2820
- SEL-2812/2814/2815/2824/3405/9220
- SEL-2829/2830
- SEL-2831
- SEL-751/751A/710-5 Arc-Flash Detection
- Multimode Fiber-Optic Ethernet
- Single-Mode Fiber-Optic Ethernet

* Standard feature
REMOTE I/O

SEL-2505/2506/2507

SEL-2595
Use the SEL-2595 Teleprotection Terminal to securely transfer teleprotection signals through a high-speed IEEE C37.94 optical-fiber interface.

SEL-2515/2516
Extend contact I/O for SEL information processors with the SEL-2515 Remote I/O Module and the SEL-2516 Rack-Mount Remote I/O Module. They monitor the status of external contacts transmitted via SEL Fast Meter messages to a communications processor and can control contact outputs using SEL Fast Operate commands.

SEL-3094
Implement the SEL-3094 Interface Converter to convert electrical teleprotection interfaces to the IEEE C37.94 optical standard for improved safety, signal integrity, and communication over longer distances. Connecting an SEL-3094 to an ITU-T G.703, EIA-422, EIA-485, or EIA-232 device lets you use up to 2 km (1.2 mi) of optical fiber to link to an IEEE C37.94 multiplexer.

APPLICATIONS

<table>
<thead>
<tr>
<th></th>
<th>SEL-2505</th>
<th>SEL-2506</th>
<th>SEL-2507</th>
<th>SEL-2515</th>
<th>SEL-2516</th>
<th>SEL-2595</th>
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<tbody>
<tr>
<td>Save Wiring Via I/O Multiplexing</td>
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<td>I/O for SEL Relays/SEL-3530/SEL-2100</td>
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<td>I/O for Information Processors</td>
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<td>Transfer I/O to SEL-2505/2506/2507</td>
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<td>Transfer I/O to SEL-2507/T400L With Millisecond Mirrored Brts® Communications</td>
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<td>Transfer I/O to SEL-2594/2595</td>
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<td>Teleprotection</td>
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<td>Improve Safety With Optical Fiber</td>
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NUMBER OF I/O CHANNELS

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SERIAL COMMUNICATIONS PROTOCOLS

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<td>SEL Fast Messages</td>
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<td>IEEE C37.94</td>
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</table>

* Standard feature  With compatible SEL fiber-optic transceiver or interface option at relay or processor
ANNUNCIATION AND NOTIFICATION

SEL-2523
Provide local and remote notifications with the SEL-2523 Annunciator Panel, which includes programmable logic and up to four communications ports.

SEL-2522
Apply the SEL-2522 Alarm Panel with up to 36 inputs to easily view the status of alarms and operating events.

SEL-2533
Use the compact, ten-window SEL-2533 Annunciator to provide local and remote annunciation.

APPLICATIONS
- Local Visual Indication
- Remote Visual Indication
- Local Audible Indication
- Remote Audible Indication
- Telephone Dial-Out Messages
- Local SELogic® Control Equations and Time Tagging

MOUNTING AND LABELING
- Rack Mount
- Panel Mount
- User-Defined Slide-In Labels

INPUTS, OUTPUTS, AND HMI
- General-Purpose Digital Inputs: 36, 42, 14
- General-Purpose Digital Outputs: 1, 11, 14
- Alarm Digital Output: 1, 1, 1
- General Display LEDs/Windows: 36, 36, 10
- Enabled LED: 1, 1, 1
- Pushbuttons: 3, 4, 4
- Base Serial Ports: 3, 3
- Optional Additional EIA-232 or EIA-485 Port: 1, 1
- IRIG-B Time Input: 1, 1
- ISA Annunciation Alarm Sequence Choices: 2, 8, 8

SERIAL COMMUNICATIONS PROTOCOLS
- SEL Minatore® Bits* Communications
- SEL Fast Messages
- Send SEL Messenger Points
- Modbus® RTU
- DNP3 Level 2 Outstation

* Standard feature  + Model option
**ACCESSORIES AND TOOLS**

**SEL-4388**
Accelerate commissioning and bench testing of SEL Mirrored Bits® links and improve cable identification, training, and maintenance with the SEL-4388 Mirrored Bits Tester.

**SEL-4520**
Use the SEL-4520 Arc-Flash Test Module to conveniently test the operation of arc-flash detection relays installed in metal-clad and metal-enclosed switchgear.

**SEL-2652**
Verify circuit breaker or lockout relay trip coil and trip circuit connections with the SEL-2652 Trip Coil Monitor.

**SEL-9510**
Use the SEL-9510 Control Switch Module everywhere independent local control is needed. High-visibility status indication and arc-suppressed contacts are particularly ideal for breaker control.

**SEL-2126**
Apply the SEL-2126 Fiber-Optic Transfer Switch to reroute IEEE C37.94 communications for bypass breaker protection during circuit breaker or station bypass operations.

**SEL-2910**
Use the SEL-2910 Port Isolator to protect the EIA-232 ports of data terminal or communications equipment from induced voltages.

**SEL-9501/9502**
Decrease maintenance costs, increase contact reliability, and reduce destructive dc circuit overvoltages with the self-powered SEL-9501/9502 Contact Arc Suppressors.

**SEL-9321**
Convert high-voltage dc battery sources for use with communications or instrumentation devices with the SEL-9321 Low-Voltage DC Power Supply.

**SEL-9322**
Apply the SEL-9322 15 Vdc Power Supply for ac-to-dc or dc-to-dc conversion in harsh physical and electrical environments, including those found in substations.
SOFTWARE

ACSELERATOR ARCHITECT
ACSELERATOR Architect® SEL-5032
Software streamlines the configuration and documentation of IEC 61850 messages, controls, and reports.

ACSELERATOR QUICKSET
ACSELERATOR QuickSet® SEL-5030
Software is a tool to quickly and easily configure, commission, and manage devices for power system protection, control, metering, and monitoring.

ACSELERATOR BAY SCREEN BUILDER
ACSELERATOR® Bay Screen Builder
SEL-5036 Software enables the creation of custom bay screens for SEL devices with touchscreen displays.

SEL RTAC HMI
The SEL Real-Time Automation Controller (RTAC) HMI offers an easy way to visualize data to monitor and control your system.

ACSELERATOR DIAGRAM BUILDER
ACSELERATOR Diagram Builder™ SEL-5035
Software enables the creation and management of HMI visualization projects for the SEL RTACs in your system.

SYNCHROWAVE PDC
SEL-5073 SYCHROWAVE® Phasor Data Concentrator (PDC) Software provides synchrophasor aggregation and time alignment for downstream applications and inter-entity data sharing.

ACSELERATOR TEAM
ACSELERATOR Team® SEL-5045 Software automates the collection of power system data from multiple devices and stores the data in a central location for easy access.

SYNCHROWAVE CENTRAL
SEL-5078-2 SYCHROWAVE Central Software is a powerful solution for the display and analysis of time-synchronized synchrophasor data and relay event reports.

SYNCHROWAVE EVENT
SEL-5601-2 SYCHROWAVE Event Software allows you to display and analyze SEL relay event reports and COMTRADE files.
ENGINEERING SERVICES

PROTECTION SERVICES
Protection design, settings, testing, commissioning, and more.

ENGINEERING STUDIES AND SIMULATION SERVICES
Hardware-in-the-loop (HIL) testing services, feasibility studies, coordination reports, system stability assessments, and more.

ARC-FLASH RISK ASSESSMENT SERVICES
Flexible, customized arc-flash risk assessment services to improve employee safety and address regulations.

TRANSMISSION PLANNING SERVICES
Transmission planning analysis and design services over a wide range of study scenarios from 69 kV to 525 kV.

METERING SERVICES
Metering solutions for both producers and consumers of energy, including custom solutions for electric power, steam, water, or gas applications in new or existing facilities.

AUTOMATION SERVICES
SCADA and HMI systems, remote terminal unit (RTU) replacement, DNA® (Distribution Network Automation), event monitoring and collection, intelligent electronic device (IED) integration, condition monitoring, and NERC PRC-005 solutions.

CYBERSECURITY SOLUTIONS
Assessment, support, and development of control system security infrastructure to support NERC CIP standards as well as other security standards and regulations.

DESIGN AND DRAFTING SERVICES
Full substation design packages, site retrofits for existing electrical gear, or detailed design drawings related to power system protection, automation, metering, and control.

SUBSTATION PLANNING SERVICES
Comprehensive solutions for power and substation design projects from initial cost estimates to a completed substation.

GOVERNMENT ENGINEERING SOLUTIONS
Innovative, technologically advanced power management solutions for municipalities and government organizations, including branches of the military, national laboratories, and governmental agencies.
SYNCHRONIZING SYSTEMS
Conventional and advanced generator and microgrid synchronizing systems with automatic and manual synchronizing capabilities.

POWERMAX® POWER MANAGEMENT AND CONTROL SYSTEMS
Power management and control systems specifically engineered for industries with critical processes that need to stay online, improving power system reliability, personnel safety, and process uptime.

DIGITAL SECONDARY SYSTEM SOLUTIONS
SEL Time-Domain Link (TiDL®) and SEL Sampled Values (SV) solutions that advance how you protect and control the primary equipment in your substation.

MICROGRID SOLUTIONS
Comprehensive microgrid control, protection, and metering systems and tactical microgrid systems for mobile forward operating bases.

REMEDIAL ACTION SCHEMES
Custom solutions that maintain power system stability by detecting abnormal conditions and taking automatic corrective actions, including generation and load shedding and reactive compensation.

MOTORMAX® LOW-VOLTAGE MOTOR MANAGEMENT AND PROTECTION SYSTEM
A centralized motor management system that provides comprehensive control, protection, analysis, and monitoring for your motor control center (MCC).

CUSTOM PANEL AND ENCLOSURE SOLUTIONS
Custom protection, control, and metering panels; control cabinets; and retrofit doors to match your specifications.
MODERN SOLUTIONS FOR PROTECTION, CONTROL, AND MONITORING OF ELECTRIC POWER SYSTEMS

The most comprehensive work of its kind, this book consolidates new, modern solutions for protection, control, and monitoring of electric power systems.

You’ll find straightforward presentations and example applications of the following technologies:

- Time-synchronized protection, control, and monitoring.
- Wide-area protection and control using synchrophasors.
- Sensible cybersecurity and a security-in-depth tool kit.
- Distribution systems that deliver safe operation and rapid power restoration after faults.
- Transmission protection solutions that improve stability, detect power swings, and help you get the most out of your primary equipment.

Spanish version available

LOCATING FAULTS AND PROTECTING LINES AT THE SPEED OF LIGHT

Time-Domain Principles Applied

This book, composed of 15 technical papers, explains traveling waves and instantaneous incremental quantities for line protection and fault locating.

SENSIBLE CYBERSECURITY FOR POWER SYSTEMS

A Collection of Technical Papers Representing Modern Solutions

This book, composed of over 25 technical papers, provides an overview of power system cybersecurity challenges, opportunities, and solutions.

WIDE-AREA PROTECTION AND CONTROL SYSTEMS

A Collection of Technical Papers Representing Modern Solutions

This book, composed of 41 technical papers, covers the practical technology and solutions for wide-area protection and control that are in service today.

LINE CURRENT DIFFERENTIAL PROTECTION

A Collection of Technical Papers Representing Modern Solutions

This book, composed of 15 technical papers, addresses the design and application of line current differential protection, communications, and fault locating, from both the protection and communications perspectives.

AC MOTOR PROTECTION

This book, written for the practicing engineer, covers ac motor characteristics and protection principles in a concise and practical way.

ANALYZING AND APPLYING CURRENT TRANSFORMERS

This concise book explains fundamental concepts for nonlinear characteristics, accuracy ratings, and transient behavior of current transformers.
SEL UNIVERSITY

SEL University trains power system and industrial professionals, meeting your immediate and long-term workforce training needs. We offer various training options from fundamental power system protection, control, and monitoring principles to hands-on SEL product application and testing.

Aside from our high-quality course content and materials, our instructors are what truly set us apart. We provide the education and training you need, taught by our industry experts—the very same experts who design SEL equipment and solutions, support customers, and add to the field of knowledge through industry publications. We have nearly 200 certified instructors. Our instructors have trained tens of thousands of industry professionals worldwide.

COURSE TYPES

Power system—power system fundamentals for engineers.
Protection—power system protection fundamental principles and applications.
Communications—introductory and advanced networking and data communications fundamentals.
Application—hands-on settings and applications for SEL products.
Testing—hands-on relay testing and troubleshooting.
Systems—advanced hands-on integration and design.
Security—how to create more secure industrial control systems.

CLASSROOM-BASED TRAINING

Regularly Scheduled Courses
- Learn at convenient locations around the world.
- Take fundamentals and hands-on training courses.
- Network with other industry professionals.
- Register online easily for scheduled courses.

Custom Training
In an industry where time is valuable and training is crucial, we provide training that comes to you and meets your needs. You supply the training room, and we provide the equipment, course materials, and instructors for your custom training.
- Create a tailored experience—mix and match standard course material to meet your needs.
- Reduce travel expenses, and train more employees at one time.
- Address your company’s specific training needs in a confidential environment.

eLEARNING COURSES

SEL University offers computer- and web-based courses that give you flexible training options. These courses supplement and act as great precourses for traditional classroom courses. We offer two types of eLearning to best meet your needs.

Computer-Based Training (CBT)
Enjoy self-paced learning with our CBT courses. From our complimentary overview (CBT 101) to more detailed studies of specific SEL products, our CBT courses not only introduce our products but serve as the foundation for our in-depth, classroom-based courses. Our CBT courses address the needs of engineers and technicians alike.

Web-Based Training (WBT)
WBT courses are held in real time with live instruction to provide an exceptional experience without the expense of travel. Our WBT course topics relate to our products, such as event retrieval and analysis or dual-breaker reclosing, as well as fundamentals topics, like pilot communications, security, and symmetrical components.

Call one of our friendly training professionals at +1.509.338.4026. Or, browse the most up-to-date schedule of courses and register at selinc.com/selu.
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www.peakmeasure.com

**C** Matzinger-Keegan, Inc.  
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Fax: +1.949.852.1446  
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www.mkireps.com

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www.powernet-mcl.com

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www.arizonasunsales.com

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www.pro-techpower.com

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Fax: +1.847.439.4631  
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www.astareg.com

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www.powerconnections.com

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Fax: +1.866.862.3790  
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www.uandiproducts.com

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sales@atlanticpowersales.com  
www.atlanticpowersales.com

**M** Robinson Sales, Inc.  
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Fax: +1.802.463.1413  
support@robinsonsales.com  
www.robinsonsales.com
**2019 TECHNOLOGY HIGHLIGHTS**

**TIME-DOMAIN LINE PROTECTION**
Discover the SEL-T400L Time-Domain Line Protection, the world’s fastest transmission line relay.

**SOFTWARE-DEFINED NETWORKING**
Improve Ethernet performance in mission-critical applications with the SEL-2740S, the industry’s first field-hardened software-defined networking (SDN) switch.

**SEL ICON®**
Deterministic wide-area networking solution for high-performance protection applications.

**MICROGRID SOLUTIONS**
Intelligent control for seamless islanding as well as comprehensive generation and load management.

**CYBERSECURITY SERVICES**
Secure critical infrastructure with SEL defense-in-depth solutions and services.

**WIRELESS FAULT DETECTION**
Apply the SEL-FTSO and SEL-FR12 Fault Transmitter and Receiver System to speed up distribution protection with fault indication in 6 ms.

**WIRELESS FAULT DETECTION AND LOAD MONITORING**
Restore power faster and improve distribution reliability with the SEL-FLT and SEL-FR12 Fault and Load Transmitter and Receiver System.

**TIME-DOMAIN LINK TECHNOLOGY**
Introducing Time-Domain Link (TiDL®) technology—a simple, fast, and secure solution for your digital secondary system.

**WIRELESS FAULT DETECTION WITH TOUCHSCREEN HMI**
Visualize what you’re protecting—introducing the new touchscreen for the SEL-710-5 Motor Protection Relay.

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On the Cover
On May 7, 2018, the Public Service Company of New Mexico (PNM) became the first utility in the world to use SEL-T400L relays with time-domain technology for tripping line breakers—a significant step in the next phase of electric power protection. Read their story at selinc.com/PNM.