As a more compact version of the SEL-3530, the SEL-3530-4 Real-Time Automation Controller (RTAC) is also a powerful automation platform that combines the best features of the embedded microcomputer form factor, embedded real-time operating system, and secure communications framework with IEC 61131-3 PLC programmability.

**Major Features and Benefits**

- **Simple Setup With ACSELERATOR RTAC® SEL-5033 Software.** Build a system quickly using preconfigured device templates for SEL relays and other communications connections. The Tag Processor provides methods to map data relationships between communications protocols visually.

- **Multiple Device Functions in One Reliable Device.** Use a single RTAC as a protocol gateway, RTU, logic processor, PAC, engineering port server, event processor, and system-wide SER logger/viewer.

- **Proven Reliability.** Depend on a rugged device designed and tested to meet or exceed protective relay standards for vibration, electrical surges, fast transients, and extreme temperatures, as well as meet or exceed IEEE 1613, Standard Environmental and Testing Requirements for Communications Networking Devices in Electric Power Substations.

- **IEC 61850.** Integrate high-speed control schemes between the RTAC and relays with IEC 61850 GOOSE peer-to-peer messaging. Poll and send data sets and reports from other IEDs with IEC 61850 MMS client/server.

- **Integrated HMI.** Build custom human-machine interface (HMI) displays quickly and easily without the need for mapping data tags. Because it is web-based, no special software is needed for viewing HMI displays.

- **Protection Against Malware and Other Cybersecurity Threats.** Protect your RTAC system with exe-GUARD®, which uses advanced cryptographic algorithms to authorize the execution of any program or service on the system. Any tasks not approved by the whitelist are blocked from operation.

- **User Security.** Assign individual user and role-based account authentication and strong passwords. Use Lightweight Directory Access Protocol (LDAP) for central user authentication.

- **Integrated Security Management.** Comply with NERC/CIP user authentication, logging, and port control requirements.

- **Standard IEC 61131-3 Logic Design.** Create innovative logic solutions directly in ACSELERATOR RTAC using any of the editor tools: Tag Processor, Structured Text, Ladder Logic, or Continuous Function Chart.

- **Flexible Protocol Conversion.** Apply any available client or server protocol on any serial or Ethernet port. Each serial port can be used in software-selectable EIA-232 or EIA-485 mode. The two rear Ethernet ports can optionally be copper or fiber-optic connectors.

- **Synchrophasor Technology Included.** Use the IEEE C37.118 client protocol to integrate synchrophasor messages from relays or PMUs in your system. These messages can be used for logic and control in the station or converted to DNP3 or other protocol for SCADA usage.

- **Standard Data Management.** Map and scale data points easily between protocols in small and large systems. You can also normalize IED data into common data types, time-stamp formats, and time zones.

- **Single-Point Engineering Access.** Gain engineering access to station IEDs through a single serial port, external modem, or high-speed network connection.
Product Overview

Functional Diagram

IEC 61131 Logic Engine
As depicted in the functional diagram, each RTAC includes an IEC 61131 logic engine that is preconfigured to have access for all system tags, IED data, diagnostics, alarms, security events, and communications statistics for use integrating your system. The system has no functional separation between those tags mapped for communications protocols and those used in programmable logic. This architecture greatly simplifies system configuration effort because no additional selection is required to identify tags used by the logic engine. You simply use any needed IED data, calculated values, and system tags in deterministic logic for the control of critical applications.

Management of the task-processing sequence and solve rate in the RTAC is similar to that for traditional PLCs or PACs. The fastest processing rate is 4 ms. Optimize the processor utilization by setting the processing rate no faster than necessary for your application.

Task processing in the logic engine includes protocol I/O, system management, and any custom logic programs you create using Structured Text (ST), Ladder Logic Diagram (LD), or Continuous Function Charts (CFC). CFC programs are a type of IEC 61131-3 Function Block Diagram (FBD) that provide more programming flexibility than standard FBDs. ACSELERATOR RTAC includes the IEC 61131-3 and Tag Processor editors you will use to manage any protocol information and custom logic needed for your system.

Manage User Accounts and Alarms in Web Server
The built-in RTAC web interface provides the ability to manage user accounts and system alarms remotely. Each user account has a unique username, password, and assigned role that defines system permissions. You can also configure the RTAC to use LDAP central authentication for user account management. The system includes web pages for monitoring user logs and maintaining network policies.

Logged tag values and system events provide a system-wide Sequence of Events report. View the logs online or use ODBC connectivity to download them to a central database.

You can also configure Ethernet connections and monitor system status from the web interface. All of the Ethernet ports can operate on independent networks, or you can bind them for failover operation.

Flexible Engineering Access
Access Point Routers in the RTAC provide a means for creating transparent connections between any two ports. A transparent connection is a method for using the RTAC as a port server to connect remotely to an IED. Simple logic in the RTAC enables remote engineering access only through supervisory commands.
Seamless System Configuration

acSELERATOR RTAC is a Microsoft Windows compatible configuration software for offline and online use with the RTAC. A project in acSELERATOR RTAC contains the complete configuration, settings and logic, for an individual RTAC device. Preconfigured device templates are available for you to add all device and master connections to the project tree view.

Once you create the settings for a specific device connection, improve engineering efficiency by saving a custom device template for later use with similar projects. Share custom templates via email or network for even greater savings.

The Tag Processor view facilitates the mapping of operational data quickly between IEDs and SCADA. acSELERATOR RTAC is compatible with Microsoft Excel and other programs, so you can save time and increase accuracy by copying SCADA maps from the source.

Data Concentration and Protocol Conversion

Configure each serial or Ethernet port to use any of the client, server, or peer-to-peer protocols available for the RTAC. For example, when you use IEEE C37.118 protocol to receive synchrophasor messages, you can map analog or Boolean tags and time stamps to DNP3 and send the data to SCADA very efficiently. You can also map data to IEC 61850 GOOSE messages for high-speed control schemes.

Additionally, when you need to define relay connections in a primary/backup arrangement, use the Tag Processor to map relay tags so that the master stations will receive power system information only from the active relay.
Applications

Substation SCADA, Report Retrieval, Engineering Access, and Alarm Notification

The RTAC can act as a data concentrator by using protocols such as IEC 61850 MMS client, Modbus, DNP3, IEC 61850 GOOSE, or MIRRORED BITS® communications to integrate both serial and Ethernet IEDs. Enable logging on any system or IED tag to view and archive a station-wide event record.

The RTAC Ethernet connection provides a means to remotely access the system to monitor logs and diagnostics. First establish a remote connection with any IED connected to the RTAC through Engineering Access communications channels. Then use the ACSELERATOR QuickSet® SEL-5030 Software suite to manage protection and control settings for these relays remotely.

Synchrophasor Integration and Control

The RTAC can integrate synchrophasor messages from the IEEE C37.118 protocol into SCADA protocols, such as DNP3 or Modbus. Easily include the source PMU time stamps and time quality attributes in the SCADA message to allow for system-wide usage of synchrophasor data.

Within the RTAC logic engine, you can perform complex math and logic calculations on synchrophasor data from C37.118-compliant devices.

The RTAC also synchronizes the time clocks in attached devices that accept a demodulated IRIG-B time signal. The RTAC regenerates the demodulated IRIG-B signal from an external modulated or demodulated source; this signal is precise enough for synchrophasor applications.
Real-Time Control and Logic Processing

The built-in logic processor provides high-speed control and transfer of signals from SEL MIRRORED BITS devices or devices using other protocols. The RTAC can serve as the system controller and SCADA gateway to eliminate costly equipment (such as breakers, interposing relays, and wiring) while also reducing engineering and labor costs.

The intuitive ACSELERATOR RTAC software provides simple setup of analog and binary tags from any device in the system. Integrated tools scale values and create logic in a flexible IEC 61131-3 configuration environment.

You can take advantage of multiprotocol support to collect SCADA information, process control commands, and use NTP time synchronization through a single communications link to each Ethernet device.

Secure Communications and User Management

The RTAC and SEL accessories offer security for your automation network. Per-user security profiles provide compliance with role-based requirements. The system can employ intrusion detection, notification, and logging to help maintain perimeter integrity.

The RTAC includes security features so that your system complies with NERC/CIP requirements for auditing, logging, port control, web authentication, and password restrictions. The RTAC also supports central authentication through your existing LDAP server.

By including SEL serial and wireless encrypting devices with the RTAC, you can protect remote serial communications to recloser controls or other connected devices.
Control Systems

The custom logic, communications protocols, and I/O in the RTAC, SEL-2411, and SEL-2440 permit you to implement complete control systems, whether you perform discrete sequences, continuous control, monitoring, or asset management. SEL subjects its products to tests for harsh environments, so you can be confident that your control system will work reliably in tough applications. Minimize loop wiring and simplify commissioning by installing controls close to process equipment and integrating them with industry standard communications protocols. Additionally, the SEL-3354 Embedded Automation Computer can provide HMI and data archiving functions.

Use a powerful IEC 61131 logic engine to design custom control programs in the RTAC. You can set the logic solve rate and program execution order to meet your system requirements. Operate the RTAC as a master controller, and use SELOGIC® control equations in the SEL-2411 and SEL-2440 to perform distributed sequential or continuous control algorithms.

With a variety of physical interfaces and open protocol options, such as IEC 61850 GOOSE messaging, the RTAC makes system integration simple. It will reduce engineering time and complexity, so that you can focus on improving productivity and efficiency rather than on fixing communications problems.

Ordering Options

Table 1 SEL-3530-4 Ordering Options

<table>
<thead>
<tr>
<th>Ethernet Communication</th>
<th>Power Supply</th>
<th>Environment</th>
<th>Software Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 rear Ethernet ports, 10/100BASE-T copper (standard), 100BASE-FX multimode fiber optics (optional), 100BASE-LX single-mode fiber optics (optional)</td>
<td>125/250 Vdc; 120/240 Vac</td>
<td>Conformal coating for chemically harsh and high-moisture environments</td>
<td>Human-Machine Interface (HMI) IEC 61850 GOOSE IEC 61850 MMS client IEC 61850 MMS server</td>
</tr>
<tr>
<td>Mounting</td>
<td>Horizontal rack mount with side bracket</td>
<td>Horizontal panel mount</td>
<td>Horizontal half-rack mount</td>
</tr>
</tbody>
</table>
Panel Features

LEDs simplify diagnostics by indicating transmitted and received activity on each port.

Rugged enclosure withstands EMI, RFI, shock, and vibration.

Wide operating temperature range: +85°C to -40°C.

Lamp test pushbutton and diagnostic LEDs.

Programmable bicolor LEDs with configurable labels provide custom annunciation.

All terminals are clearly numbered and lettered for wiring and testing.

Independent Ethernet ports may be RJ45 or LC fiber.

Demodulated IRIG-B input and output for high-accuracy time synchronization.

Serial ports are EIA-232/EIA-485 software selectable.

Programmable input and alarm contact.
Dimensions

Figure 5  SEL-3530-4 Horizontal Rack-Mount With Bracket Dimensions

Figure 6  SEL-3530-4 Horizontal Rack-Mount (Side-by-Side) Dimensions
Figure 7 SEL-3530-4 Horizontal Rack-Mount (Half Rack) Dimensions

Figure 8 SEL-3530-4 Surface-Mount Dimensions
Figure 9  SEL-3530-4 DIN-Mount Dimensions

Figure 10  SEL-3530-4 Panel-Mount Dimensions
Specifications

Compliance
Designed and manufactured under an ISO 9001 certified quality management system
UL Listed to U.S. and Canadian safety standards (File E220228; NRAQ, NRAQ7)
CE Mark

General
Operating System
SEL Linux Yellowstone running Linux kernel 3.x with real-time preemption patches

Operating Temperature Range
–40° to +85°C (–40° to +185°F)
Note: Not applicable to UL applications.

Operating Environment
Pollution Degree: 2
Overvoltage Category: II
Insulation Class: 1
Relative Humidity: 5%–95%, noncondensing
Maximum Altitude: 2000 m

Weight (Maximum)
2.27 kg (5 lb)

Processing and Memory
Processor Speed: 533 MHz
Memory: 1024 MB DDR2 ECC RAM
Storage: 2 GB

Security Features
Account Management: User Accounts
User Roles
LDAP Central Authentication
Strong Passwords
Inactive Account Logouts
Intrusion Detection: Access/Audit Logs
Alarm LED
Alarm Contact
Encrypted
SSL/TLS, SSH
Communications: HTTPS

Automation Features
Protocols
Client
DNP3 Serial, DNP3 LAN/WAN, Modbus RTU, Modbus TCP, SEL ASCII, SEL Fast Messaging, LG 8979, IEEE C37.118, IEC 61850 MMS, CP2179, IEC 60870-5-101/104, SNMP, SES-92

Server

Peer-to-Peer
IEC 61850 GOOSE, SEL MIRRORED BITS Communications, Network Global Variables (NGVL), Parallel Redundancy Protocol

Fieldbus
EtherCAT Client

Engineering Access
Modes: SEL Interleaved, Direct
Port Server: Map Serial Ports to IP Ports
Secure Web Server: Diagnostic and Communications Data

Time-Code Input (Modulated IRIG-B)
Input Impedance: 2 kΩ
Accuracy: 500 μs

Time-Code Input (Demodulated IRIG-B)
On (1) State: V_{ih} ≥ 2.2 V
Off (0) State: V_{il} ≤ 0.8 V
Input Impedance: 1.5 kΩ
Accuracy: 250 ns

Time-Code Output (Demodulated IRIG-B)
On (1) State: V_{oh} ≥ 2.4 V
Off (0) State: V_{ol} ≤ 0.8 V
Load: 50 Ω
Output Drive Levels
Demodulated IRIG-B: TTL 120 mA, 3.5 Vdc, 25 Ω
Serial Port: TTL 2.5 mA, 2.4 Vdc, 1 kΩ

Network Time Protocol (NTP) Modes
NTP Client: As many as three configurable servers
NTP Server

Precise Time Protocol (PTP)
PTP Client: Peer delay request and end-to-end path delay supported

Communications Ports
Ethernet Ports
Ports: 2 rear
Data Rate: 10 or 100 Mbps
Rear Connectors: RJ45 Female or LC Fiber (single-mode or multimode, 100 Mbps only)

Serial Ports
Ports: 4
Type: EIA-232/EIA-485 (software selectable)
Data Rate: 300 to 115200 bps
Connector: DB-9 Female
Time Synchronization: IRIG-B
Power: +5 Vdc power on Pin 1 (500 mA maximum cumulative for four ports)

USB Ports
Ports: 1
1 Device Port: Type B

Fiber Optics
Class I LASER/LED
Data Rate: 100 Mbps
Connector Type: LC
Wavelength: 1300 nm
Multimode Option: 62.5 μm fiber
TX Max. Power: –14 dBm
TX Min. Power: –20 dBm
RX Sensitivity: –31 dBm
RX Overload: –14 dBm
Min. TX Level: –20 dBm
Min. RX Sensitivity: –31 dBm
Optical Budget: 11 dBm
Max. Distance: 2 km
Single-Mode Option: 9 μm fiber
TX Max. Power: –8 dBm
TX Min. Power: –15 dBm
RX Sensitivity: –25 dBm
RX Overload: –8 dBm
Min. TX Level: –15 dBm
Min. RX Sensitivity: –25 dBm
Optical Budget: 10 dBm
Max Distance: 15 km

**Input**

**Isolated Control Input**

Software settings:
- Pickup Level: 17–265 Vac/Vdc, within 5%
- Dropout Level: 15–238 Vac/Vdc, within 5%
- Pickup/Dropout Delay: 1–30000 ms
- Current draw at nominal dc voltage: 2–4 mA

**Output**

**Mechanical Durability:** 10 M no-load operations

**DC Output Ratings**

- Rated Operational Voltage: 250 Vdc
- Rated Voltage Range: 19.2–275 Vdc
- Rated Insulation Voltage: 300 Vdc
- Make: 30 A @ 250 Vdc per IEEE C37.90
- Continuous Carry: 6 A @ 70°C; 4 A @ 85°C
- Thermal: 50 A for 1 s
- Contact Protection: 360 Vdc, 40 J MOV protection across open contacts
- Operating Time (coil energization to contact closure, resistive load): Pickup/Dropout time ≤ 8 ms typical
- Breaking Capacity (10,000 Operations) per IEC 60255-0-20:1974:
  - 48 V 0.50 A L/R = 40 ms
  - 125 V 0.30 A L/R = 40 ms
- Cyclic Capacity (2.5 Cycles/Second) per IEC 60255-0-20:1974:
  - 48 V 0.50 A L/R = 40 ms
  - 125 V 0.30 A L/R = 40 ms

**AC Output Ratings**

- Rated Operational Voltage: 240 Vac
- Rated Insulation Voltage: 300 Vac
- Utilization Category: AC-15 (control of electromagnetic loads > 72 VA)
- Contact Rating Designation: B300 (B = 5 A, 300 = rated insulation voltage)
- Contact Protection: 270 Vac, 40 J
- Continuous Carry: 3 A @ 120 Vac
  - 1.5 A @ 240 Vac
  - 5 A
- Rated Frequency: 50/60 ± 5 Hz
- Operating Time (coil energization to contact closure): Pickup/Dropout Time: ≤ 8 ms
- Electrical Durability Make VA Rating: 360 VA, cosφ = 0.3
- Electrical Durability Break VA Rating: 360 VA, cosφ = 0.3

**Power Supply**

**Input Voltage**

- Rated Supply Voltage: 125–250 Vdc; 110–240 Vac, 50/60 Hz
- Input Voltage Range: 85–300 Vdc or 85–264 Vac
- 38.4–137.5 Vdc; 88–132 Vac
- 18–60 Vdc polarity dependent

**Power Consumption**

- AC: <30 VA
- DC: <30 W

**Interruptions**

- 20 ms @ 24 Vdc
- 20 ms @ 48 Vdc
- 50 ms @ 125 Vac/Vdc
- 100 ms @ 250 Vac/Vdc

**Fuse Rating**

- 125–250 V Model: 2.5 A, high breaking capacity, time lag T, 250 V (5x20 mm, T2.5AH 250 V)
- 48–125 V Model: 2.5 A, high breaking capacity, time lag T, 250 V (5x20 mm, T2.5AH 250 V)
- 24–48 V Model: 7.0 A, high breaking capacity, time lag T, 250 V (5x20 mm, T7.0AH 60 V)

**Environmental Tests**

- **Enclosure Protection:** IEC 60529:2001 + CRGD:2003
- **IP20 excluding the terminal blocks**
- **Vibration Resistance:** IEEE 1613-2009 + A1-2011 Vibration and Shock
  - IEC 60255-21-1:1988
  - Vibration Endurance, Severity: Class 1
  - Vibration Response, Severity: Class 2
- **Shock Resistance:** IEEE 1613-2009 + A1-2011 Vibration and Shock
  - IEC 60255-21-2:1988
  - Bump Test, Severity: Class 1
  - Shock Withstand, Severity: Class 1
  - Shock Response, Severity: Class 2
- **Seismic:** IEC 60255-21-3:1993
  - Quake Response, Severity: Class 2
- **Cold:** IEEE 1613-2009 + A1-2011 Service Conditions
  - IEC 60068-2-1:2007
  - –40°C, 16 hours
- **Dry Heat:** IEEE 1613-2009 + A1-2011 Service Conditions
  - IEC 60068-2-2:2007
  - 85°C, 16 hours
- **Damp Heat, Cyclic:** IEC 60068-2-30:2005
  - 25°–55°C, 6 cycles, 95% relative humidity

**Dielectric Strength and Impulse Tests**

- **Dielectric (HiPot):** IEEE 1613-2009 + A1-2011
  - IEC 60255-5:2000
  - Section 5: Dielectric Tests
  - IEEE C37.90-2005, Section 8: Dielectric Tests

- **Dielectric Strength Section:**
  - 2500 Vac for one minute on contact inputs, contact outputs
  - 3100 Vdc for one minute on power supply

- **Impulse:**
  - IEEE 1613-2009 + A1-2011, Impulse Section
  - IEC 60255-5:2000, Impulse Section
  - IEEE C37.90-2005, Impulse Section
  - Severity Level: 0.5 J, 5 kV
RFI and Interference Tests

EMC Immunity

Electrostatic Discharge Immunity:
- IEEE 1613-2003 ESD
- IEC 61000-4-2:2008
  Severity Level 4
  8 kV contact discharge
  15 kV air discharge

Magnetic Field Immunity:
- IEC 61000-4-8:2001
  1000 A/m for 3 seconds,
  100A/m for 1 minute
- IEC 61000-4-9:2001
  1000 A/m

Power Supply Immunity:
- IEC 60255-11:2008
- IEC 61000-4-11:2004
- IEC 61000-4-29:2000

Radiated RF Immunity:
- IEC 60255-22-3:2007; 10 V/m
- IEC 61000-4-3:2010, 10 V/m
- IEEE C37.90.2-2004, 35 V/m

Fast Transient, Burst Immunity:
- IEC 60255-22-4:2008
  4 kV @ 5.0 kHz
  2 kV @ 5.0 kHz for comm. ports

Surge Immunity:
- IEC 61000-4-5:2005
  1 kV line-to-line
  2 kV line-to-earth

Surge Withstand Capability Immunity:
- IEEE 1613-2009 + A1-2011,
  2.5 kV oscillatory, 4 kV fast transient
- IEEE 1613-2003 SWC
- IEC 60255-22-1:2007
  2.5 kV common-mode
  1.0 kV differential-mode
  1 kV common-mode on comm. ports

Conducted RF Immunity:
- IEC 60255-22-6:2001
- IEC 61000-4-6:2008
  10 Vrms

Digital Radio Telephone RF Immunity:
- ENV 50204:1995
  10 V/m at 900 MHz and 1.89 GHz

EMC Emissions

Radiated and Conducted Emissions:
- IEC 60255-25:2000
  Class A
  Severity Level: Class A