SEL-2240 Axion®

Modular Real-Time Automation Controller

Dependable control for harsh environments in a fully integrated, flexible platform

- Real-Time Automation Controller (RTAC) provides high-speed, deterministic control and performance.
- Modular design supports custom configuration of analog and digital I/O options.
- Hardware and components meet or exceed IEEE 1613 specifications for harsh conditions.
- Exe-GUARD® whitelist antivirus technology allows only authorized applications to run.
- Web-based HMI provides system-wide visualization and control.

SEL-2240 Axion

Features and Capabilities

- Dynamic disturbance and fault recording
- Programmable logic controller (PLC)
- Remote terminal unit (RTU)
- Web-based HMI
- Communications integration
- Built-in security
- Scalable solution
- Redundant power supplies
- Ultrarugged I/O
- Phasor measurement unit (PMU)

Industries Served

- Transportation
- Metals and mining
- Wastewater
- Energy
- Marine and offshore
- Paper production

SEL-2241 RTAC Module

Test Functions
- Control enable/disable
- Force values

Activity Indicators
- Port LEDs
- Programmable LEDs

Precise Time
- IRIG-B
- Network Time Protocol (NTP)

Web Interface
- Optional HMI
- User administration
- Logging and alarms

Client/Server Protocols

Security Firewall

Communications Ports

Chassis Options

4-Slot Axion Chassis

Apply the 4-slot chassis for small I/O control applications that require a small footprint.

Dual 4-Slot Axion Chassis

Employ the dual 4-slot chassis for small I/O or dual RTAC with I/O applications.

10-Slot Axion Chassis

Apply the 10-slot chassis for large I/O control and monitoring applications.

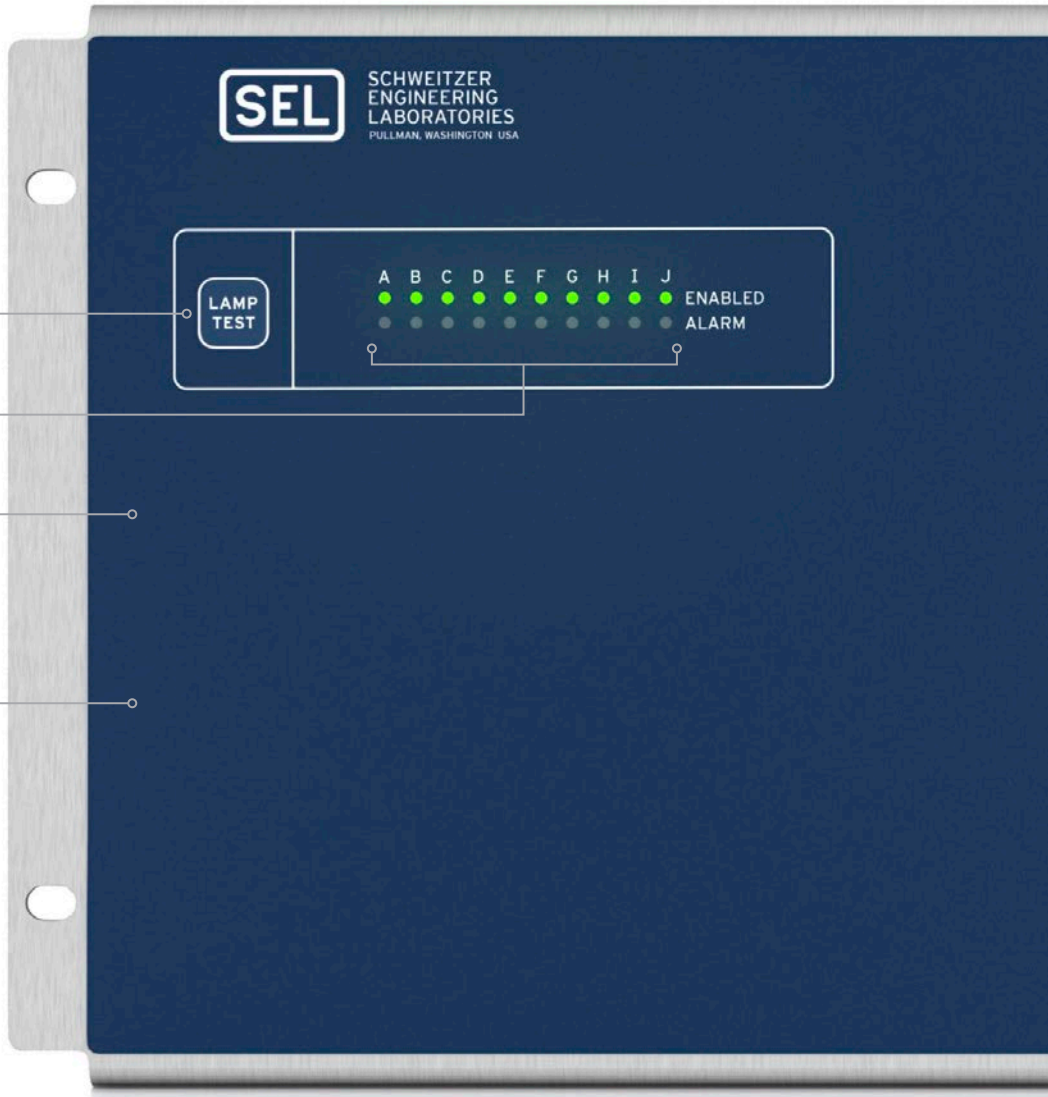
Product Overview

Lamp test pushbutton.

Diagnostic LEDs.

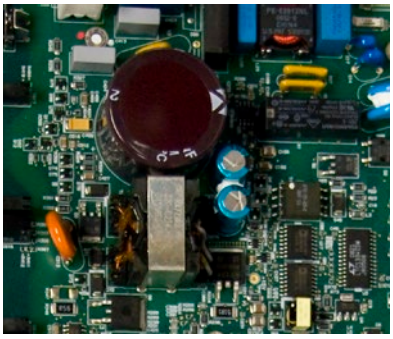
No fans or moving parts.

Wide operating temperature range (−40° to +85°C) for use indoors and in outdoor cabinets.



A powerful 32-bit microprocessor supports I/O, logic, security, and communications.

The Axion power coupler employs the same field-proven reliable design found in SEL protective relays, providing years of trouble-free operation.



Client (Master) Protocols

- SEL Fast Messaging
- SEL ASCII
- DNP3 serial
- DNP3 LAN/WAN
- Modbus® RTU
- Modbus TCP
- IEC 60870-5 101/104
- LG 8979
- CP 2179
- IEEE C37.118.1a-2014 synchrophasors
- IEC 61850 MMS and MMS Client File Services
- FTP/SFTP

Server (Outstation) Protocols

- SEL Fast Messaging
- DNP3 serial
- DNP3 LAN/WAN
- Modbus RTU
- Modbus TCP
- IEC 60870-5-101/104
- LG 8979
- SES-92
- Syslog
- IEEE C37.118.1a-2014 synchrophasors
- IEC 61850 MMS and MMS Server File Services
- FTP/SFTP

Peer-to-Peer Protocols

- SEL Mirrored Bits® communications
- IEC 61850 GOOSE
- Network Global Variable List (NGVL)

Time-Synchronization Protocols

- IRIG-B
- NTP Client/Server
- Precision Time Protocol (PTP)

Fieldbus Protocols

- EtherCAT®

Ethernet Redundancy

- Parallel Redundancy Protocol (PRP)

Maximum Supported Modules and I/O

- 60 modules
- Digital inputs: 1,296 (all digital input system)
- Digital outputs: 864 (all digital output system)
- DC analog inputs: 256 (16 analog input modules allowed per system)
- Extended-range dc analog inputs: 64 (16 analog input modules allowed per system)
- DC analog outputs: 128 (16 analog output modules allowed per system, maximum of 3 analog output modules per node)
- AC metering inputs: 128 (16 CT/PT modules allowed per system)
- AC protection inputs: 96 (16 CT/PT modules allowed per system)

Product Overview

Serial activity and user-programmable LEDs.

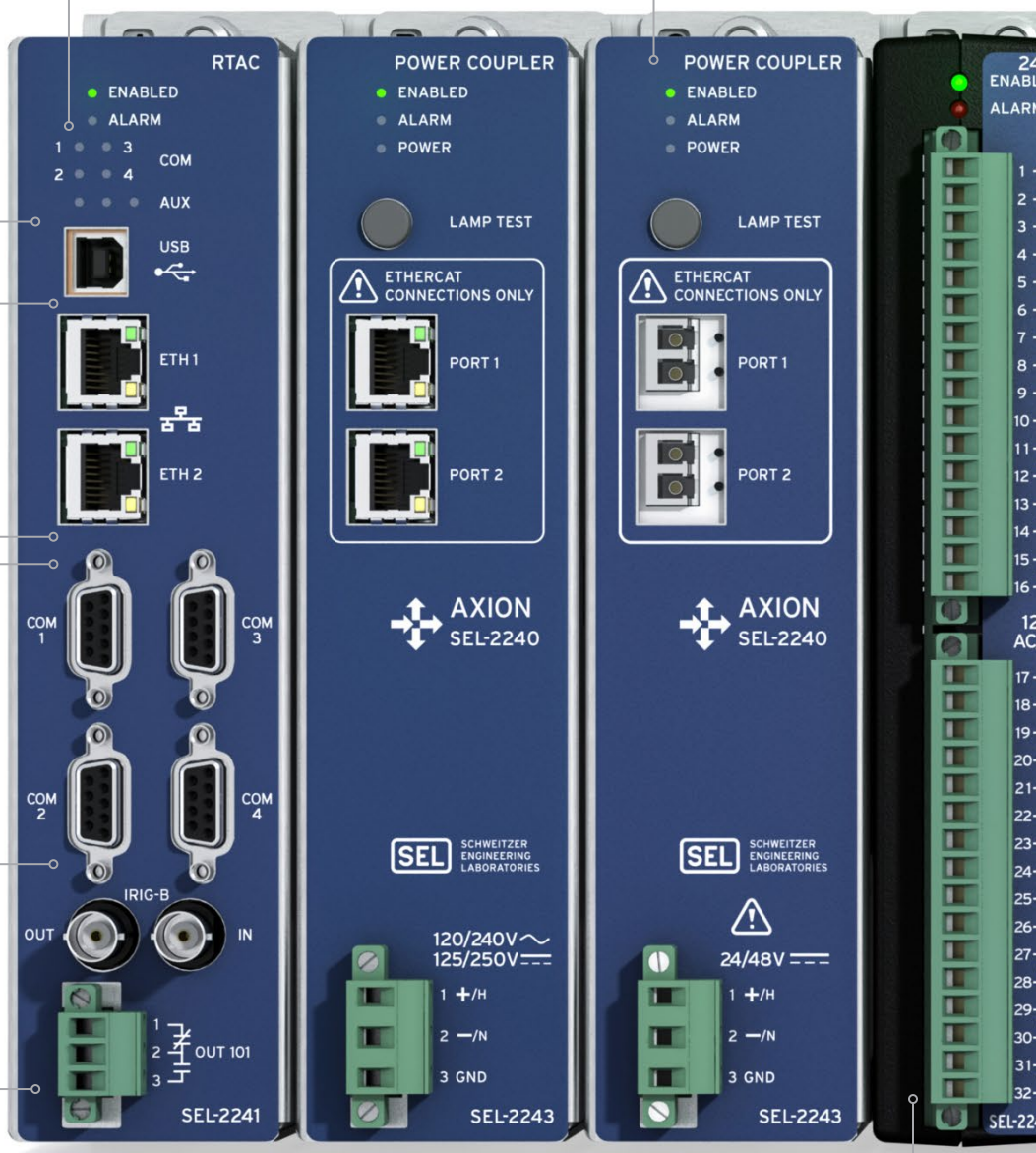
Optional redundant power supply.

The SEL-2241 RTAC Module is a dedicated RTAC. You can use one (or more) in a system to integrate I/O, substation intelligent electronic devices (IEDs), SCADA communications, and security applications all in one device.

Two independent Ethernet ports, available in either copper or LC fiber, are capable of operating on separate subnets.

Four serial ports, software-selectable for EIA-232/EIA-485.

Panel wiring harnesses are available to simplify field termination. Choose between 8', 16', and 20' lengths.



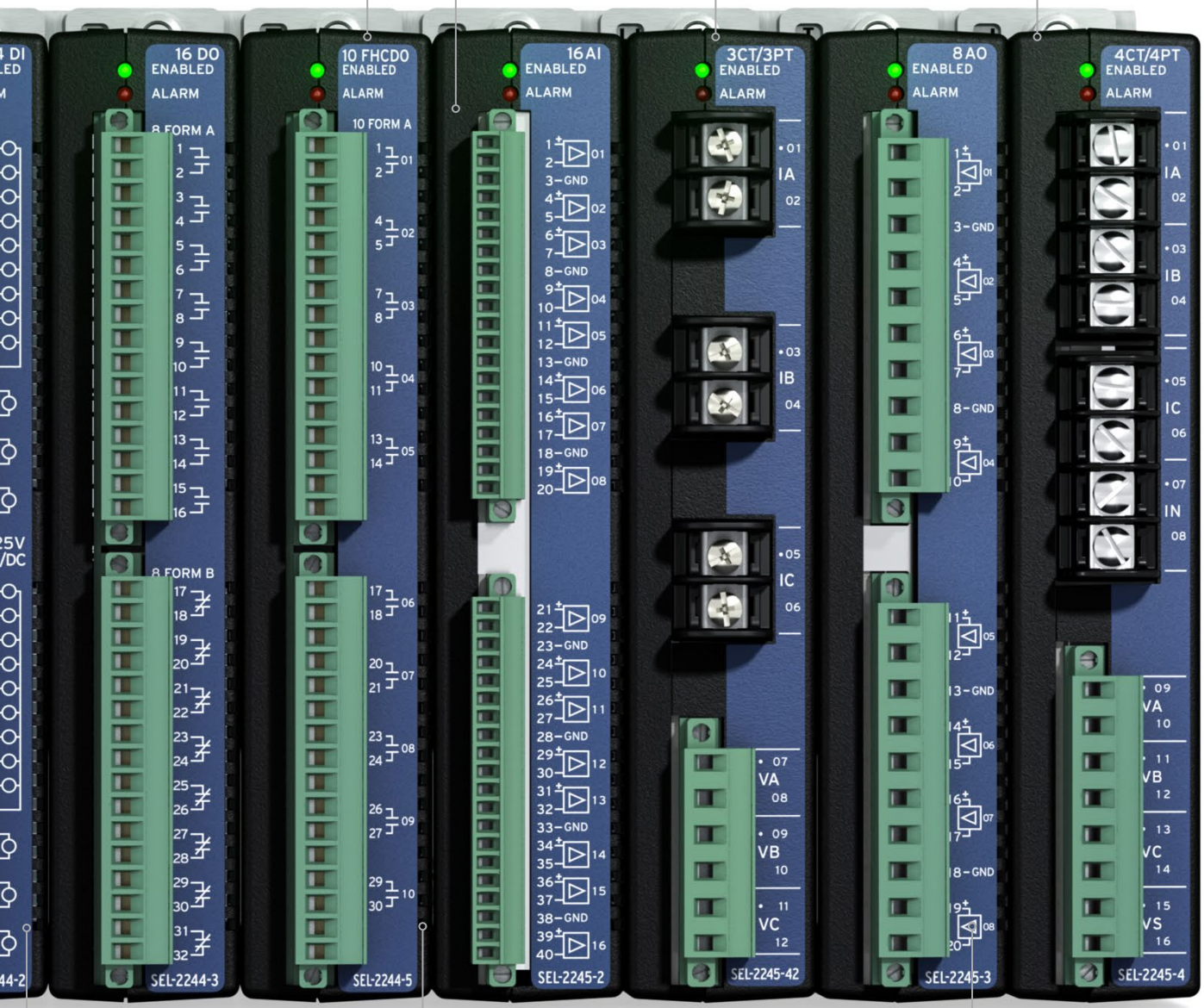
All digital inputs are rated for ac and dc operation and time-stamped to 1 ms accuracy.

Choose fast, high-current digital outputs for applications requiring fast action (<50 µs) or interrupting high current (up to 10 A).

DC analog inputs are software-selectable for ±20 mA, ±2 mA, or ±10 V input ranges.

Measure ac signals with three current and three voltage inputs for recording or protection functions.

Collect synchronized ac measurements (5—400 V, 0—22 A) with an accuracy of 0.1 percent on the SEL-2245-4 AC Metering Module.



All terminals are clearly numbered for wiring and testing.

Indicating LED for each input and output.

Self-sourcing dc analog outputs are software-selectable for ±20 mA or ±10 V.

Powerful Modular Design

SEL-2245-4
AC Metering Module

SEL-2245-3 DC
Analog Output Module

SEL-2245-2 DC
Analog Input Module With Event Recording

SEL-2245-22 DC
Analog Input Extended-Range Module

SEL-2245-42 AC
Protection Module

SEL-2245-4 AC Metering Module

Synchronized Current and Voltage Measurements

Employ the AC Metering Module to provide high-accuracy current and voltage measurements with the advantage of synchronized sampling. Multiple modules in an Axion system sample all measurements at the same time to ensure a common reference for all voltage, current, and power values. You can create time-deterministic power control applications without performing additional processing to align the measurements to a reference.

Remote Location of AC Metering Modules

Remotely locate AC Metering Modules in four-slot chassis with fiber-optic-connected power couplers to maintain electrical isolation. By locating the modules at the source CTs and PTs, you can reduce copper expenses. The Axion's deterministic EtherCAT network allows you to use fiber-optic-connected power couplers to locate chassis up to 5 km apart without adding any latency and while maintaining synchronized sampling in all locations. You can replace aging transducers by directly measuring CT and PT inputs with a higher-accuracy measurement device with a smaller physical footprint.

SEL-2245-3 DC Analog Output Module

The DC Analog Output Module includes eight software-settable current or voltage outputs, which can be sampled from −20 to +20 mA or −10 to +10 V. This module supports a ramp feature, allowing you to set a target value and a time to reach it. One SEL-2242 chassis can include up to three DC Analog Output Modules. These modules are ideal for transducer outputs or control set points for proportional integral derivative (PID) blocks.

SEL-2245-2 DC Analog Input Module With Event Recording

The DC Analog Input Module includes 16 inputs for measuring low-level dc signals. The inputs are user-configurable in pairs to measure signals within ±20 mA, ±2 mA, or ±10 V ranges. You can capture COMTRADE event reports of dc analog signals at a rate of 1 kHz for analysis.

SEL-2245-22 DC Analog Input Extended-Range Module

The DC Analog Input Extended-Range Module includes four inputs for measuring 0−300 Vdc signals. This makes it ideal for monitoring battery voltage or trip coil currents. You can capture COMTRADE event reports of the signals at a rate of 1 kHz for analysis.

SEL-2245-42 AC Protection Module

The AC Protection Module includes three CTs with isolated returns and includes three PTs for measuring ac signals. This module has galvanically isolated inputs and can sample events at user-software-selectable rates of 1, 2, 4, 8, and 24 kHz. You can use up to 16 AC Protection Modules in one Axion system and realize synchronized measurements throughout all the modules. This enables time-deterministic control algorithms to take advantage of the common reference for all measurements, even those in distributed locations. You can collect IEEE C37.118.1a-2014-compliant synchrophasor data from up to 64 phasor quantities with an SEL-2241 RTAC Module. By using the SEL-3555 RTAC with the SEL-2245-42 Module, you can create advanced recording systems, including built-in SSD storage of recorded data.

Axion Module Components

SEL-2241 RTAC Module
SEL-2242 Chassis/Backplane
SEL-2243 Power Coupler
SEL-2244-2 Digital Input Module
SEL-2244-3 Digital Output Module
SEL-2244-5 Fast High-Current Digital Output Module
SEL-2245-2 DC Analog Input Module
SEL-2245-22 DC Analog Input Extended-Range Module
SEL-2245-3 DC Analog Output Module
SEL-2245-4 AC Metering Module
SEL-2245-42 AC Protection Module

Substation- and Plant-Grade Equipment

We designed, built, and tested the Axion chassis and modules with the same practices, processes, and standards that we use for our protective relays, information processors, and other products. This includes compliance with IEEE and IEC standards for electrostatic discharge, fast transients, radiated emissions, surge-withstand capability, dielectric strength, pulsed magnetic fields, disturbances, vibration, temperature, shock, and humidity. Specifications and tests are per the ANSI/IEEE C37.90, IEEE 1613, and IEC 60255 standards.

Visit **selinc.com/SEL-2240** to access product configurators for the SEL Axion.

SEL UNIVERSITY
POWER THROUGH KNOWLEDGE

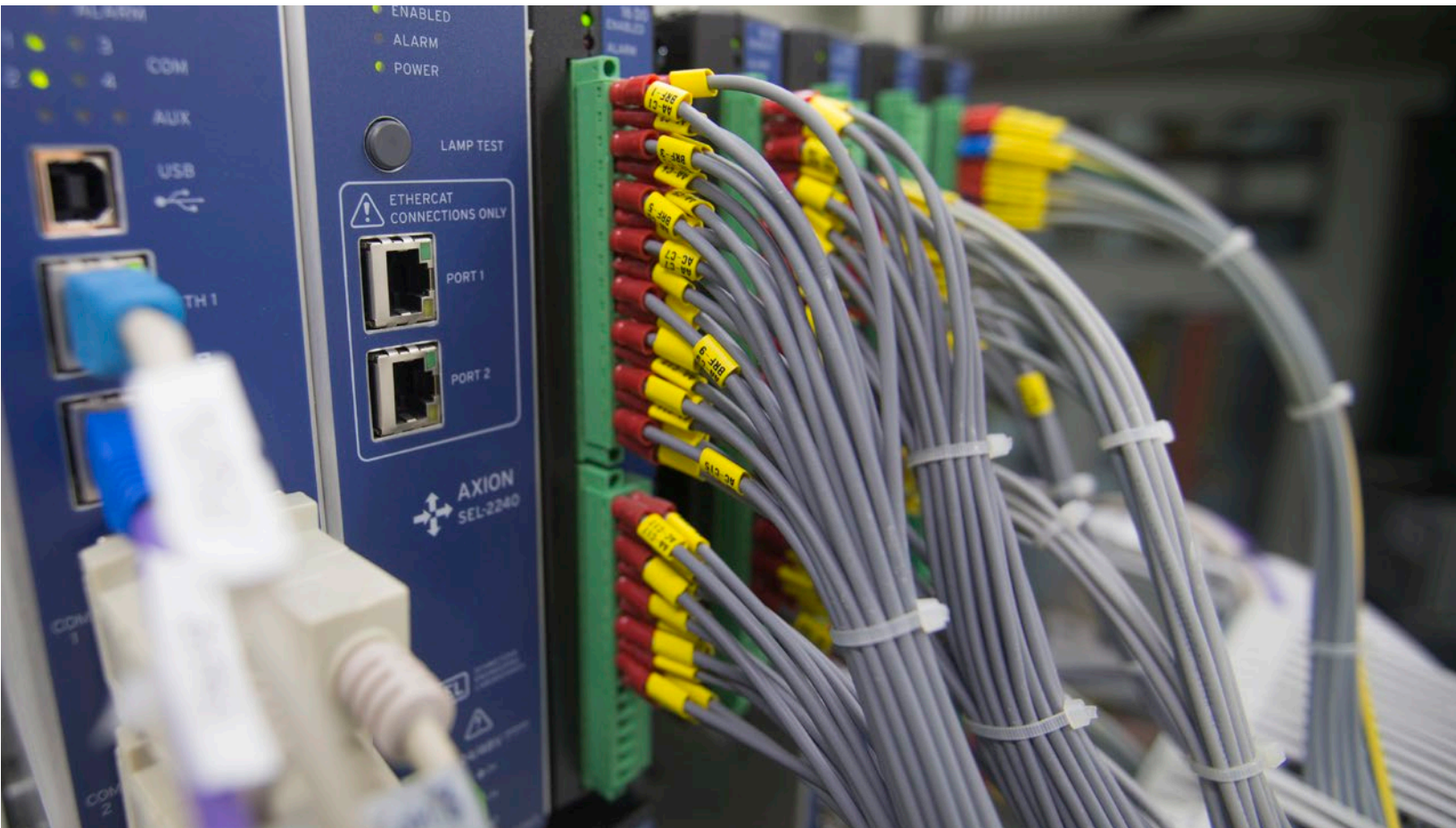
APP 3530

SEL-3530 Real-Time Automation Controller (RTAC)

3-day hands-on course

Learn to maximize the Axion's RTAC functionality by attending SEL University training. The APP 3530 course is highly interactive and activity-based. During APP 3530, in groups of two, you will configure a realistic communications scheme using the SEL-3530 Real-Time Automation Controller (RTAC). Each unit of this course will guide you, step-by-step, through configuring this communications scheme.

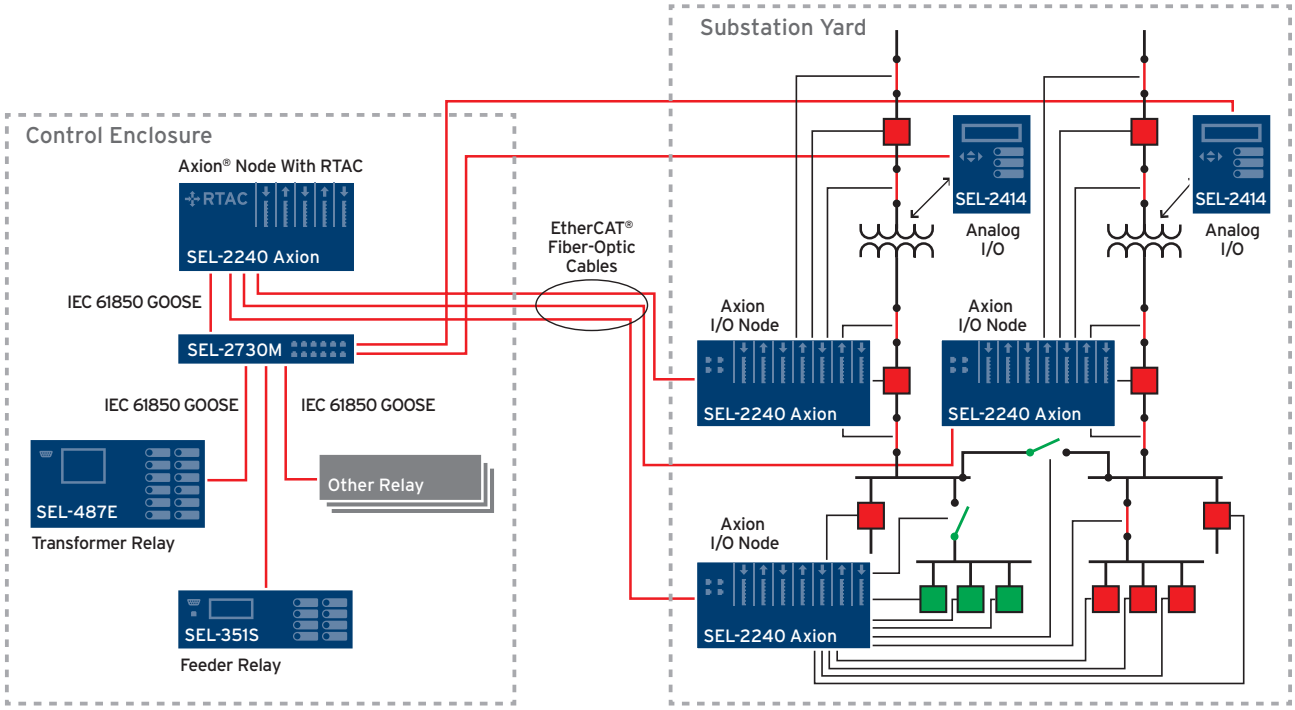
Visit **selinc.com/SELU** for more information.



Electric Utility Applications

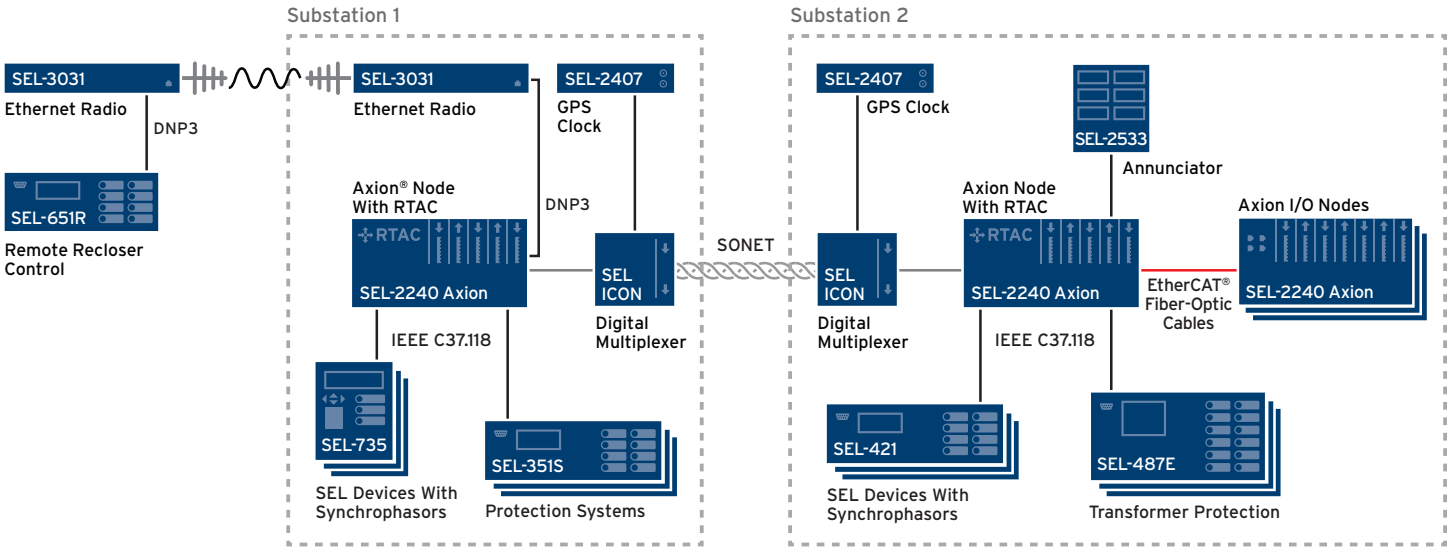
Substation Automation

Integrate substation I/O into a comprehensive substation control scheme that includes IEC 61850 GOOSE messaging. EtherCAT fiber-optic cables connect enclosures and substation yards for signal isolation and flexible modular placement.



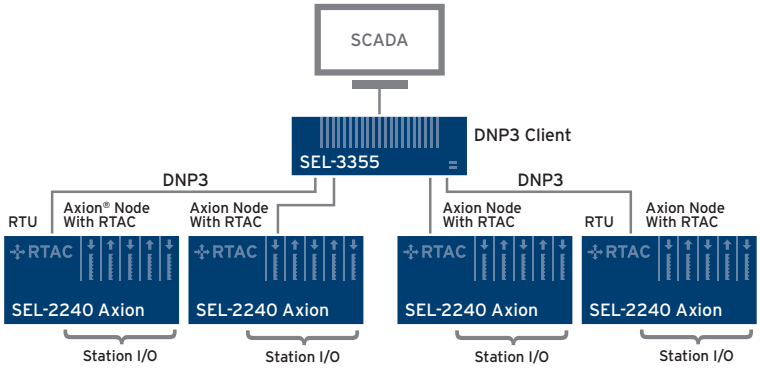
Smart Grid

Apply the SEL Axion as part of a wide-area power system monitoring and automation strategy.



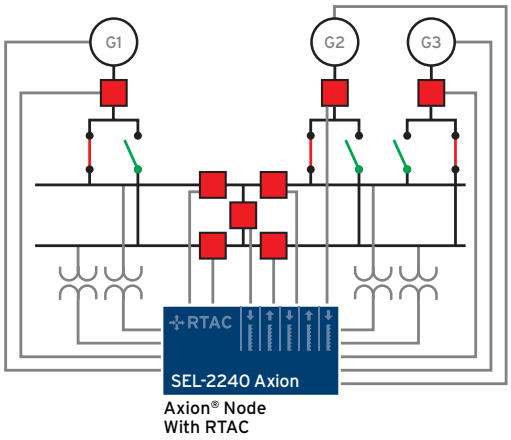
Substation RTU

Gather digital and analog signals from remote sites, and distribute the data over a variety of industry-standard protocols to a central SCADA system or HMI.



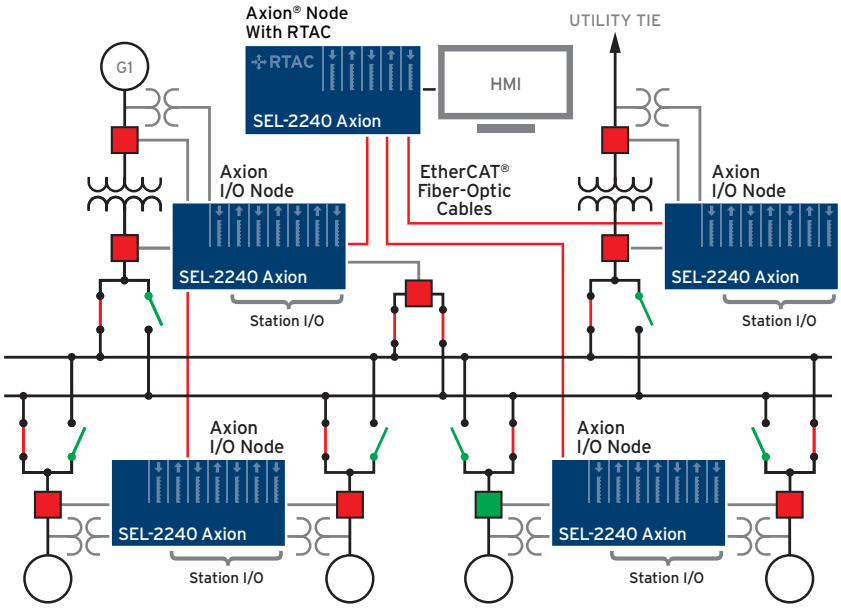
Autosynchronization

Use multiple AC Metering Modules and I/O modules to create advanced and highly scalable autosynchronization systems. You can automatically adjust the governor exciter controls as necessary to provide safe, secure, and unattended synchronization of generation onto the power system. With synchronized sampling from multiple CT/PT modules, the control algorithms for multiple governor exciters have access to all necessary time-aligned PT measurements in the same Axion system.



Load Shedding

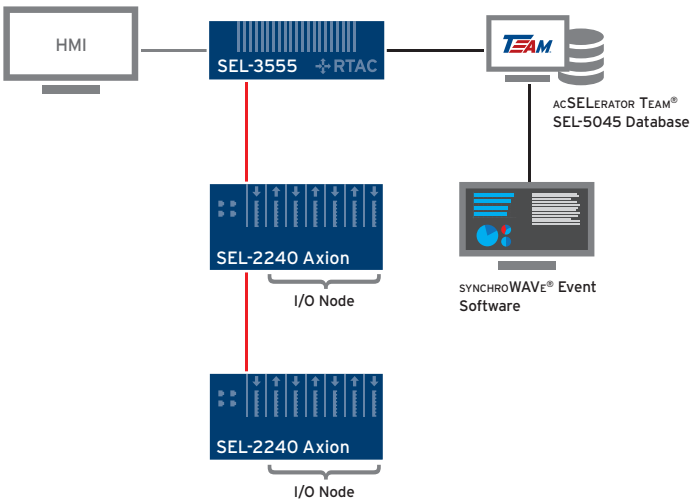
Eliminate the need for separate input, output, and control devices for industrial and microgrid load-shedding schemes. Combining system frequency and power measurements with the ability to add hundreds of binary inputs and outputs, the Axion consolidates the measurement, logic engine, and mitigation equipment into a single unit. Employing the AC Metering Module's frequency and power elements, the deterministic logic engine in the Axion incorporates system variables into fast-acting control logic for underfrequency or demand control load shedding.



Industrial Applications

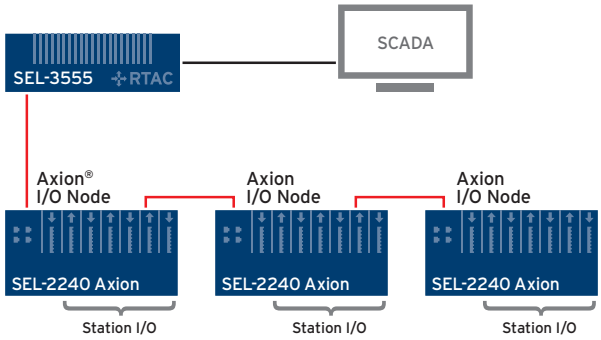
NEW Dynamic Disturbance and Fault Recording Systems

Use the SEL-3555 RTAC with Axion modules, including the SEL-2245-42 AC Protection Module, to develop advanced recording solutions that exceed the requirements of NERC PRC-002. The SEL-2245-42 Module features 24 kHz recording with recording group configuration for combining multiple module event reports, including digital values, into a single COMTRADE file. The SEL-3555 RTAC with SSD storage is the perfect controller for recording applications that need to maintain more than the minimum ten-day storage requirement for all fault records, dynamic disturbance records, and Sequence of Events records in the substation.



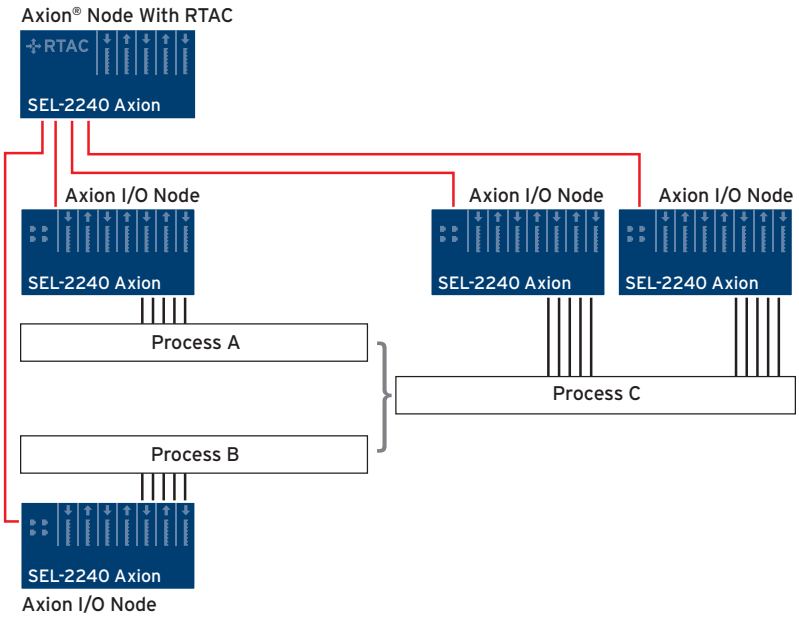
Distributed I/O Monitoring

Measure currents, voltages, or the status of contact points. You can use the data locally within the device, send the information to another device within the substation, or send the information to one or more databases for application by operators, engineers, planners, and administrators.



Process Control

Easily implement sequential control for critical processes, and apply IEC 61131 ladder programming to simplify control documentation and troubleshooting.



Other Applications

Synchronized CT/PT Measurements for Advanced Control

Employ synchronized CT/PT measurements from multiple Axion systems distributed across a substation and in other locations for advanced time-deterministic control applications, including load shedding and microgrid control.

System Security

Enable encryption for any engineering access channel or SCADA link. System security auditing, logging, and password management help you enforce government standards.

Flexible Synchrophasor Measurement Unit

Apply the Axion as a scalable and distributable PMU. The Axion was the first PMU in the world to fully comply with the IEEE Synchrophasor Measurement Test Suite Specification—Version 2. A single RTAC Module in the primary Axion node serves IEEE C37.118.1a-2014 synchrophasor data from remote Axion PMU nodes. Remote Axion nodes use the AC Metering Module at the measurement points.

IEC 61850 GOOSE Concentrator

Gather a variety of substation I/O with the Digital I/O Modules, and share the data with IEC 61850 GOOSE messages. The protocol flexibility of the RTAC allows you to concentrate data from non-IEC 61850 relays and convert these data to GOOSE messages.

Industrial Control System and PID Control

Create an ultrarugged PLC system by combining the standard IEC 61131-3 logic engine, integrated database, and flexible I/O. You can use ladder logic, structured text, or function chart programming for custom control strategies. In addition, advanced process control strategies are possible by implementing control function blocks, such as PID.

Remote I/O Expansion

Increase the number of I/O points with as many as 60 modules or six nodes connected to one resident SEL-2241 RTAC. Through EtherCAT connectivity, you can provide rapid, time-synchronized data acquisition rates to the expanded I/O points within your automation system.

Automatic Trip Coil Monitoring

Assess the health of a circuit breaker by capturing trip coil performance in real time. You can record trip coil dynamics, including current, voltage, and temperature during operations, and run automatic diagnostics to issue alerts for scheduling preventative maintenance.

NEW Recording Groups (COMTRADE and Axion I/O Combining)

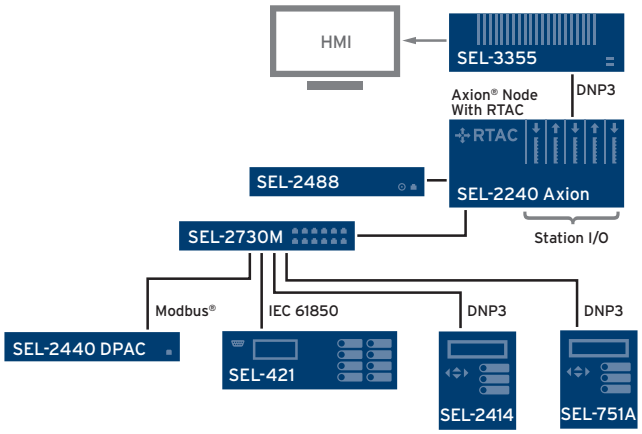
Combine data from the AC Protection, DI, and DO modules into a single COMTRADE file using the recording group functionality. You can record at rates of 1, 2, 4, 8, or 24 kHz, with up to 576 seconds of recording length at 1 kHz, allowing you to automatically collect events via MMS File Services or the Secure File Transfer Protocol (FTP).

EtherCAT Network Topologies

SEL-2243 Power Couplers provide not only hot-pluggable power supplies, but also fast, time-synchronized EtherCAT connections to remote Axion nodes. The Power Couplers create EtherCAT links in a star network topology, sequential network topology, or combination of both. You can apply single or dual power couplers in each Axion node based on connection or redundancy requirements.

Protocol Gateway

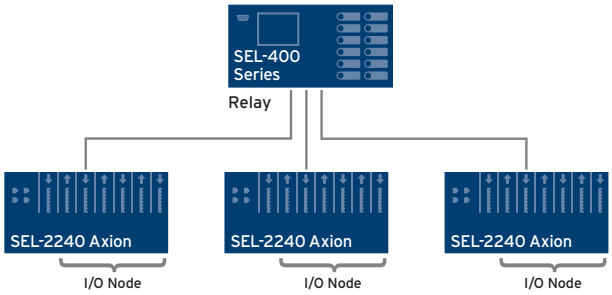
Collect downstream data with client protocols. Then, send these data to an upstream HMI, RTU, or SCADA master with server protocols, converting the data from one protocol to another in the process.



Other Applications

Time-Domain Link (TiDL®) Technology

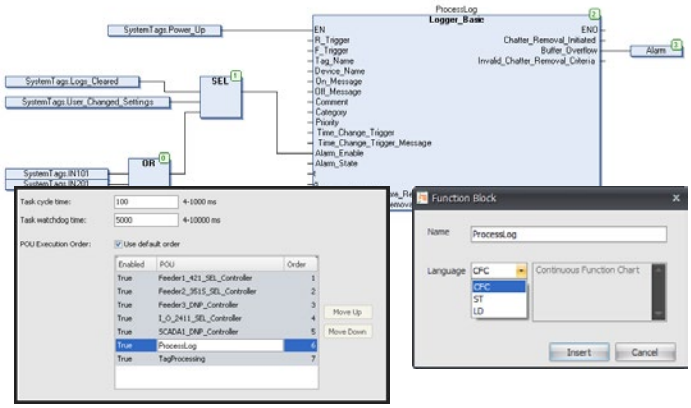
Employ the Axion and TiDL-enabled SEL-400 series relays to provide a simple, scalable, and robust solution for your digital substation. Axion nodes near the primary equipment can convert instrument transformer and digital I/O signals from analog to digital signals and transport the signals into the control house over optical fiber to SEL-400 series relays. The system uses point-to-point connections to create a digital substation solution without the need for network engineering or reliance on external time sources. By combining the proven protection of SEL-400 series relays with the modularity and reliability of the Axion, TiDL technology provides a scalable and flexible solution to meet your application needs.



Flexible Software

Implement Custom Logic Solutions

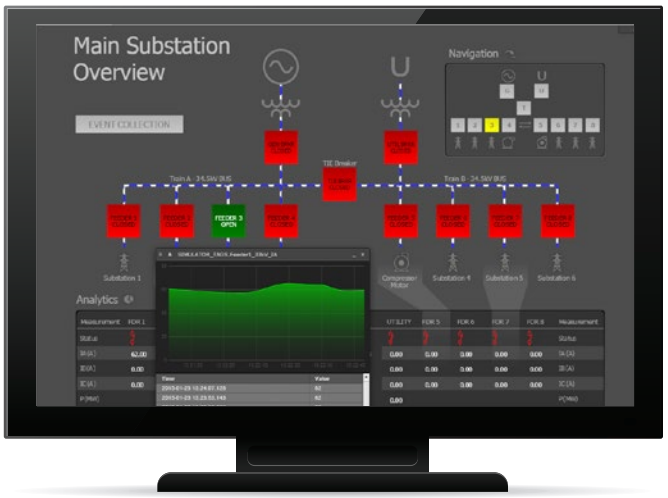
Design custom automation logic to control your system with ACSELERATOR RTAC® SEL-5033 Software, or monitor system performance using the prepopulated device tags. A flexible IEC 61131 configuration environment allows you to scale values and create logic equations by applying integrated tools. You can perform complex math and logic calculations on any data within the RTAC using the built-in IEC 61131 logic engine with continuous function chart (CFC), structured text (ST), or ladder diagram (LD) programming.



ACSELERATOR Diagram Builder™ SEL-5035 Software

Build custom HMI displays quickly and easily without the need for mapping data tags. Because the interface is web-based, you do not need special software to view HMI displays. Just enter the IP address of the Axion RTAC Module, and Diagram Builder imports all tags from the currently loaded ACSELERATOR RTAC project. The software lets you design custom HMI screens and then load the new HMI file into the RTAC to instantly view the HMI from any web browser on the network. With Diagram Builder, you can:

- Allow one or multiple authenticated users to interface with customized HMI screens.
- Access the RTAC HMI locally or remotely.
- Apply HMI trending and alarming.
- Quickly and easily visualize the data values over a definite period of time, both at design time and at run time.



SEL-2240 Axion Specifications

Hardware	
Processor Module	Processor speed: 533 MHz Memory: 512 MB DDR2 error-correcting code (ECC) RAM User storage: 2 GB
I/O Modules	Digital input: 24 contact inputs (24, 48, 110, 125, 220, or 250 Vac/Vdc) Standard digital output: 16 standard control outputs (all Form A, all Form B, or half and half) Fast high-current (FHC) digital output: 10 fast, high-current control outputs (all Form A, all Form B, or half and half) DC analog input: 16 transducer inputs (±20 mA, ±2 mA, or ±10 V software-selectable) DC analog input extended range: 4 inputs (0—300 Vdc or 6.7—300.0 VL-N in ac mode) DC analog output: 8 self-sourcing outputs (±20 mA or ±10 V software-selectable) **AC Metering Inputs** 4 current transformer inputs (0—22 A) 4 potential transformer inputs (5—400 V_{L-N}) **AC Protection Inputs** 3 current transformer inputs (0.1—20.0 A) 3 potential transformer inputs (6.7—300.0 V_{L-N}) Maximum modules per network: 60
Power Coupler	**Power Supply** 120/240 Vac, 50/60 Hz; 125/250 Vdc; or 24/48 Vdc Single or redundant supplies **EtherCAT Ports** Ports: 2 Connectors: RJ45 female or LC Protocol: EtherCAT
EtherCAT I/O Network	Data rate: Automatic
Operating Temperature	IEC performance rating: —40° to +85°C (—40° to +185°F)
Security	
Account Management	Lightweight Directory Access Protocol (LDAP) and Microsoft® Active Directory® user accounts User roles Strong passwords
Intrusion Detection	Access/audit logs Syslog Alarm LED Alarm contact
Secure Encrypted Communications	Transport Layer Security (TLS)/Secure Shell (SSH) HTTPS

SEL-2240 Axion Specifications Continued

Automation

Protocols	**Client** DNP3 Serial, DNP3 LAN/WAN, Modbus RTU, Modbus TCP, SEL ASCII, SEL Fast Messaging, IEEE C37.118, IEC 60870-5-101/104, IEC 61850 MMS, LG 8979, CP2179, and FTP/SFTP **Server** DNP3 Serial, DNP3 LAN/WAN, Modbus RTU, Modbus TCP, SEL Fast Messaging, IEEE C37.118, IEC 61850 MMS, IEC 60870-5-101/104, SES-92, LG 8979, and FTP/SFTP **Peer-to-Peer** SEL MIRRORED BITS communications, IEC 61850 GOOSE, and NGVL **Fieldbus** EtherCAT Client (in RTAC) and EtherCAT Server (I/O modules)
Engineering Access	SEL interleaved and direct transparent modes
Programmable Control	IEC 61131-3 logic engine **Programming Languages** Ladder diagram Structured text Continuous function chart Tag processor **Ethernet Redundancy** PRP

Time Modes

IRIG-B	Inputs modulated or demodulated; outputs demodulated
Time Protocols	NTP Client NTP Server (up to three configurable servers) Accepts time via PTP

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