

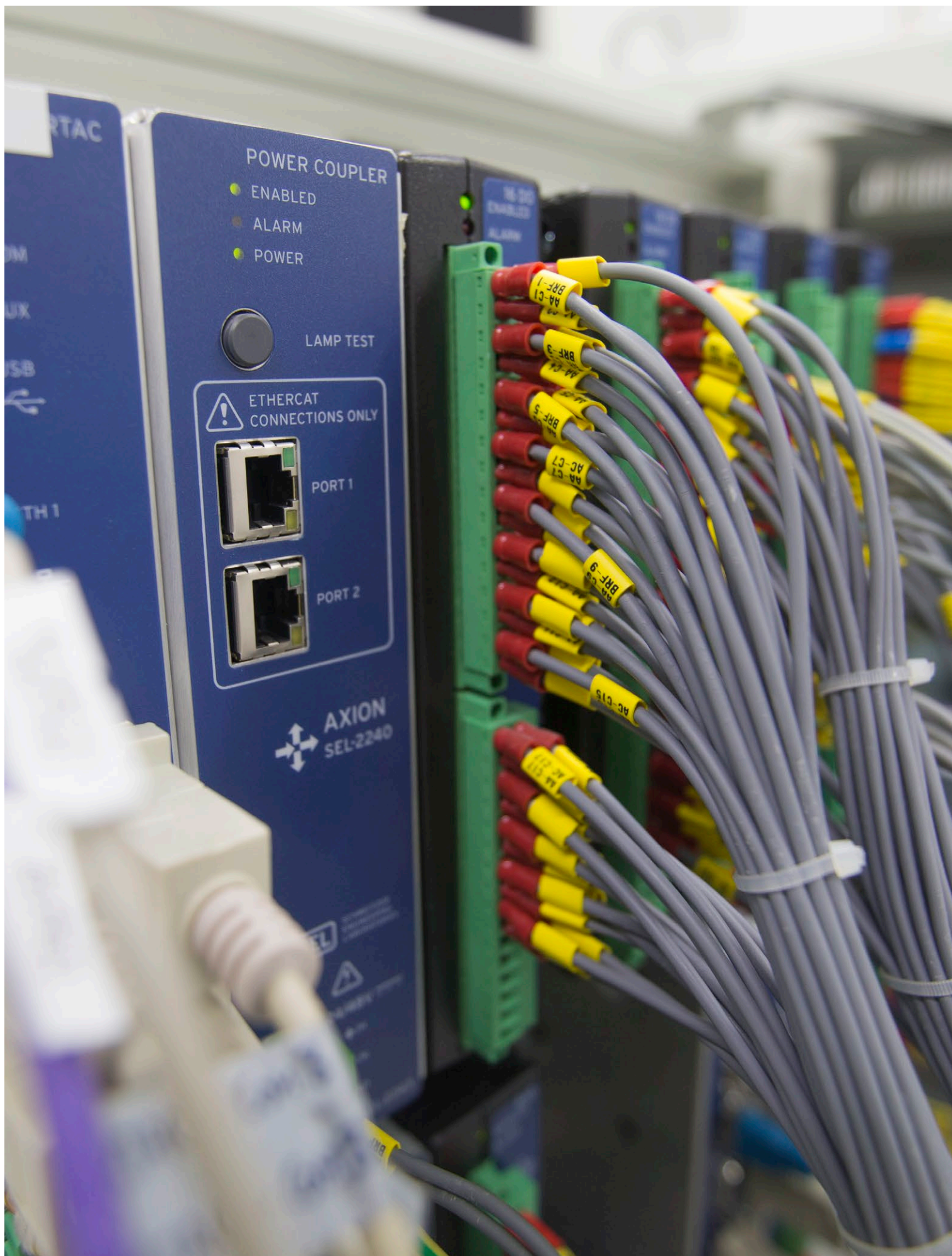
SEL Axion[®] Bay Controller



Comprehensive bay control and monitoring with an intuitive touchscreen interface and flexible design

- Reliable local control and monitoring of multiple substation bays from a single device
- Intuitive user interface with a 7-inch, 800 × 480 color touchscreen display
- Modular design with a variety of analog and digital I/O options for flexible, economical deployments
- Easy system integration with a range of industry-standard protocols, including IEC 61850, DNP3, and Modbus
- Simple configuration and custom bay screen design with ACSELERATOR RTAC[®] SEL-5033 and integrated ACSELERATOR[®] Bay Screen Builder SEL-5036 Software





Key Features

Complete Bay Control and Monitoring

The Axion Bay Controller combines the powerful logic engine of the SEL RTAC with a fully integrated, 7-inch touchscreen display and the full functionality of the SEL Axion's scalable architecture. Its modular configuration allows you to expand the device to control and monitor over a hundred switching devices in your substation bay. This flexible design scales to hundreds of digital and analog input and output points for a single panel. Control and monitor circuit breakers, disconnect switches, and earthing switches of multiple bays with a single Axion Bay Controller.

Control Switches and Breakers

Measure and control switch and breaker positions directly using digital input signals or indirectly using other devices via communications protocols (e.g., IEC 61850). Monitor three states for breakers (open, close, and alarm), four states for two-position switches (open, close, alarm, and in-progress), and eight states for three-position switches.

7-Inch Color Touchscreen Display

Control breakers and switches locally using the 7-inch color touchscreen display. View status, alarms, and analog measurements for switchyard equipment. Display the bay configuration as a single-line diagram (SLD) on the touchscreen with as many as 25 custom displays. Use ANSI and IEC symbols, along with analog and digital labels, for the SLD to indicate breaker and disconnect switch status, bus voltages and line currents, and power flow through the breaker. In addition to SLDs, design custom screens to show the status of any digital or analog tag of the RTAC logic.

Programmable Pushbuttons and LED Status Indication

Program six pushbuttons to quickly perform custom control commands. Each pushbutton includes two programmable tricolor LEDs. Additionally, use up to seven general-purpose tricolor LEDs for alarms or other local indication. Customize pushbutton and LED functionality using IEC 61131-3 logic in the SEL RTAC versatile processing engine.

Design Custom Screens Using Intuitive Bay Screen Builder Software

Design bay screens, monitoring screens, or meter screens by launching the Bay Screen Builder application directly from acSELEATOR RTAC. Bay Screen Builder provides an intuitive and powerful interface to design bay screens to meet your application needs.

Local or Remote Control

Perform local and remote control of circuit breakers, disconnect switches, shunt reactors, and capacitor banks. When the local mode is active, the Axion Bay Controller will prevent remote control, maximizing safety and operational integrity. Perform remote control and monitoring using a variety of industry-standard protocols, such as IEC 61850, DNP3, Modbus, and IEC 60870-101/103/104.

Interlocking Control Logic

Use the powerful IEC 61131-3 logic to program complex automation functions, interlocking schemes, or bypass logic. Create innovative logic solutions directly in acSELEATOR RTAC by using a wide variety of programming editor tools, including the SEL RTAC Tag Processor, structured text, ladder logic, or continuous function charts.

Modular Design



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

Axion Components

SEL-2241 Real-Time Automation Controller (RTAC)

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-2245-221 Low-Voltage (LEA) Monitoring Module

SEL-2245-4 AC Metering Module

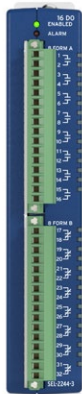
SEL-2245-411 Standard Current and Low-Voltage (LEA) Monitoring Module

SEL-2245-42 AC Protection Module

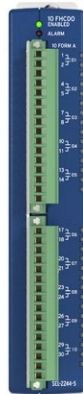
I/O Modules



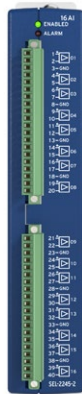
SEL-2244-2
Digital Input
Module



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-2245-4
AC Metering
Module



SEL-2245-42
AC Protection
Module

SEL-2244-2 Digital Input Module

The Digital Input Module includes 24 dry contact inputs with LED indicators and offers six input rating options: 24 Vac/Vdc, 48 Vac/Vdc, 110 Vac/Vdc, 125 Vac/Vdc, 220 Vac/Vdc, or 250 Vac/Vdc.

SEL-2244-3 Digital Output Module

The Digital Output Module includes 16 contact outputs with LED indicators and offers the option of Form A or Form B outputs.

SEL-2244-5 Fast High-Current Digital Output Module

The Fast High-Current Digital Output Module includes ten control outputs with LED indication that have high-current tripping capacity (10 A) and fast output rise time (<16 μ s at 125 V).

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-2245-4 AC Metering Module

Synchronized Current and Voltage Measurements

Employ the AC Metering Module with 4 CTs and 4 PTs 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.

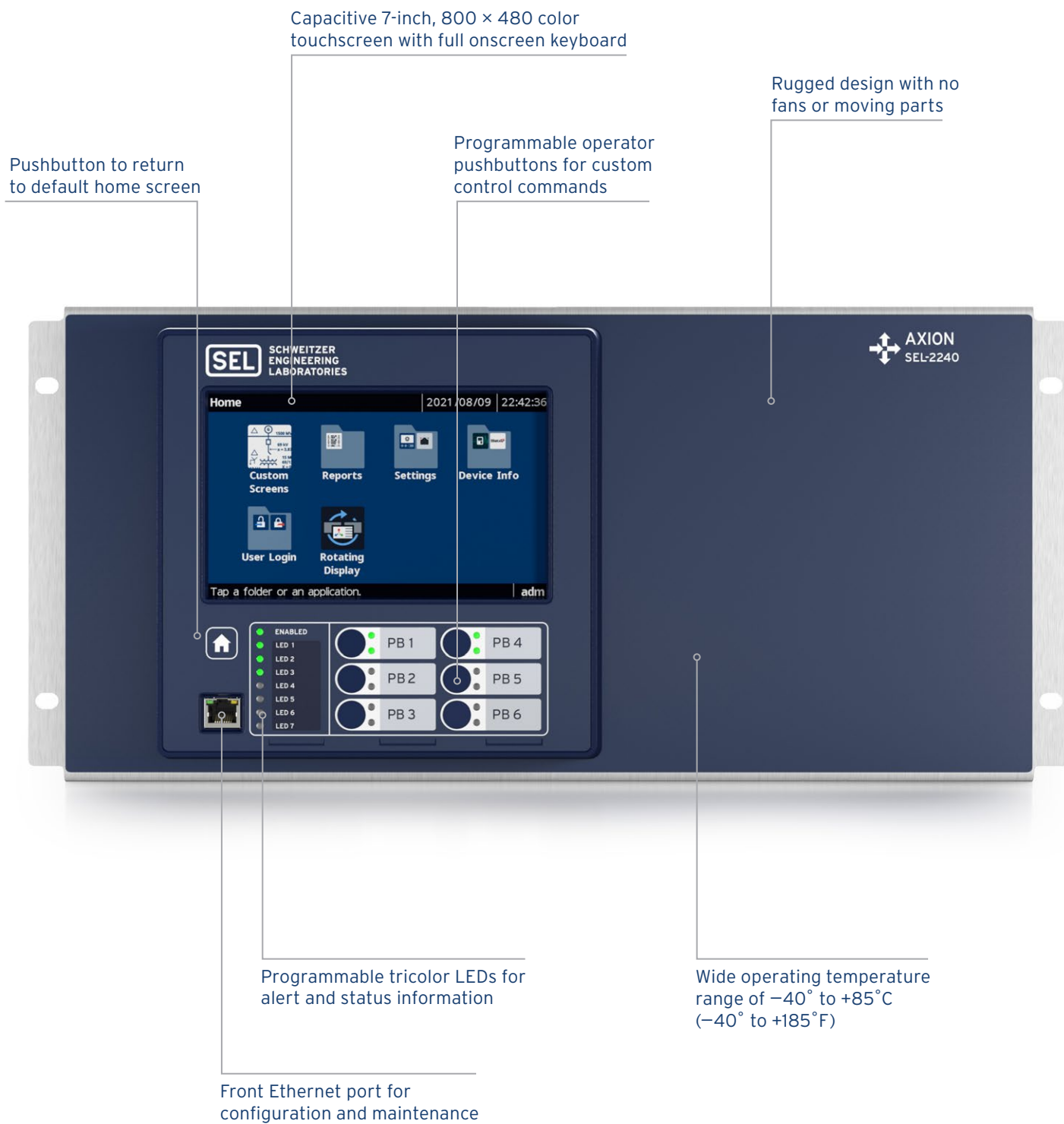
Remote Location of AC Metering Modules

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-2245-42 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.

Product Overview



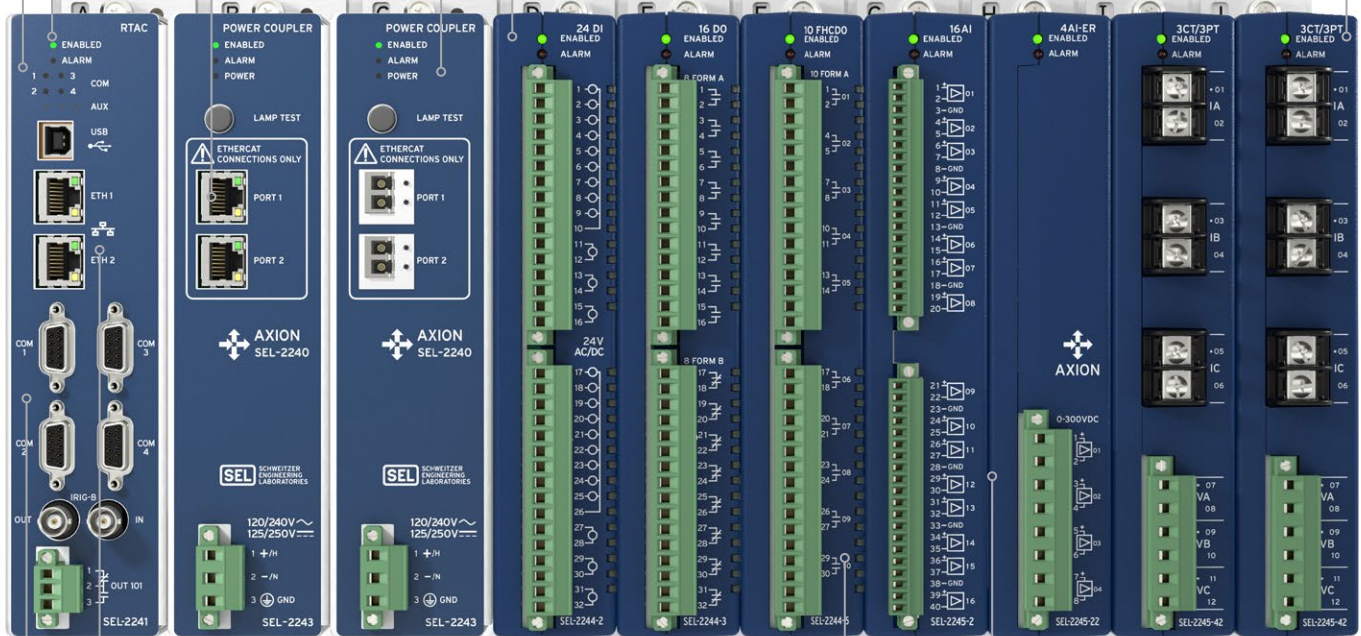
Serial activity and user-programmable LEDs

EtherCAT ports for Axion node expansion, available in either copper or LC fiber

RTAC module

Optional redundant power supply

Custom configuration of digital and analog I/O modules



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

Clearly numbered terminals for wiring and testing

Indicating LEDs for each input and output

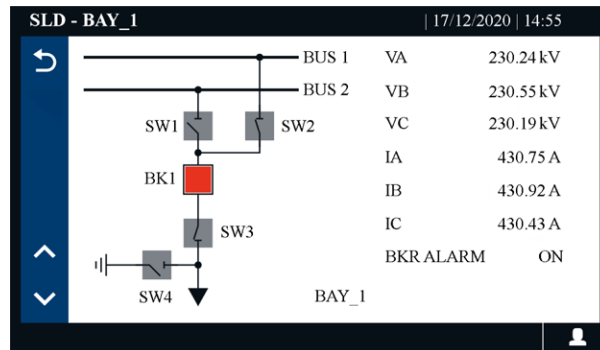
Four serial ports, software-selectable for EIA-232/EIA-485

Touchscreen Display

The Axion Bay Controller features a 7-inch, 800 × 480 color touchscreen interface, which provides a one-line diagram mimic display for bay control and monitoring. The interface also allows you to easily access Sequence of Events (SOE) logs, device information, module statuses, and more. A full onscreen keyboard allows you to easily enter credentials for the authentication required to issue control commands.

Bay Screens

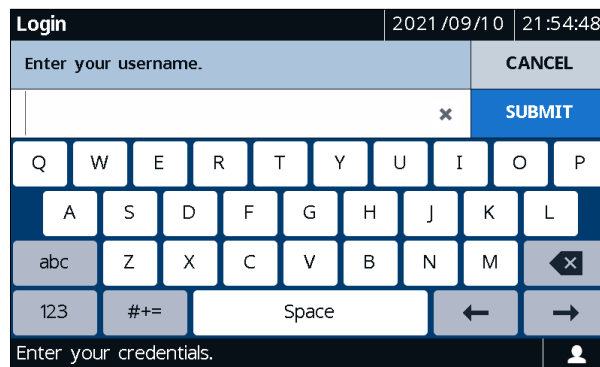
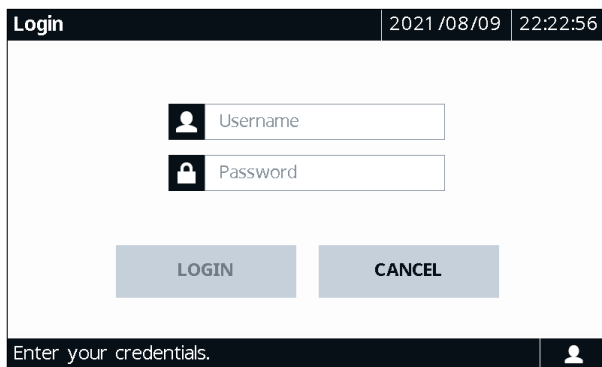
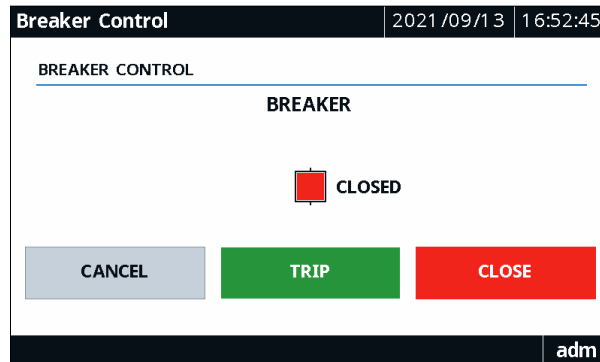
Select from predefined bay screens, or configure as many as 25 custom bay screens using the Bay Screen Builder application within ACSELERATOR RTAC. Within the 25 screens, you can control over 100 elements, including breakers, two-position disconnects, and 2 three-position disconnects. You can also view hundreds of analog and digital data in contextual displays.



Bay Control

To control a breaker or disconnect switch, simply tap the equipment's icon in the bay screen, select a command, and confirm your selection.

User authentication is required before issuing commands, providing robust security for device management and control. The full onscreen keyboard allows you to enter required credentials quickly and easily.



Alarm Screens

Stay informed using alarm functionality for the Axion Bay Controller touchscreen display. Create as many as 25 alarm panels, and customize aspects such as tile color and size, alarm messages, and flash operation. Use the intuitive Axion Bay Controller touchscreen to monitor and manage substation alarms onsite. An alarm summary screen provides a comprehensive overview of unacknowledged or active alarms.

Alarms > Bay 1		2024/08/09	20:31:32
 	Field Overvolt	Coolant Overflow	Seal Gas Pressure
	Out of Step	Fan Failure	Trip Coil Fault
	Close Coil Fault	Load Unbalanced	Relay #110 Closed
Tap tile to view acknowledgment details.			LR

SOE Logs

Access the RTAC SOE logs, and see informative names that you can customize for your application. The SOE display includes date and time stamps with millisecond resolution.

Sequence of Events				2021/08/13	20:21:23
DATE	TIME	TAG NAME	MESSAGE		
21/08/13	20:01:23.092	Low SF6 pressure	Deasserted		
21/08/13	20:01:23.092	Breaker bl..nterlock	Deasserted		
21/08/13	18:44:21.192	Synch freq HIGH	Deasserted		
21/08/13	18:42:19.292	Low SF6 pressure	Asserted		
21/08/13	18:40:29.592	Synch freq HIGH	Asserted		
21/08/13	18:39:13.792	Breaker bl..nterlock	Asserted		
21/08/13	18:37:56.392	Disconnect..1 Closed	Asserted		
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Device Information

View important device information, including the SEL RTAC serial number, firmware version, project history, and more.

Device Information		2021/09/10	23:04:19
Host Name	SEL-2241-0030A728545A		
Device Name	Axion		
Device Location	Pullman, Washington		
Device Description	Substation 1 Controller		
Firmware Version	SEL-2241-R149-V0-CI-Z002142-D20210910		
Serial Number	3211120565		
Current Project	Axion Bay Controller		
Modified Time	21/09/10 15:00:53		

Module Status

View the Axion module status for each slot and node in the system. The Module Status screen conveniently indicates the operational or alarm status for all slots, including those in remote nodes.

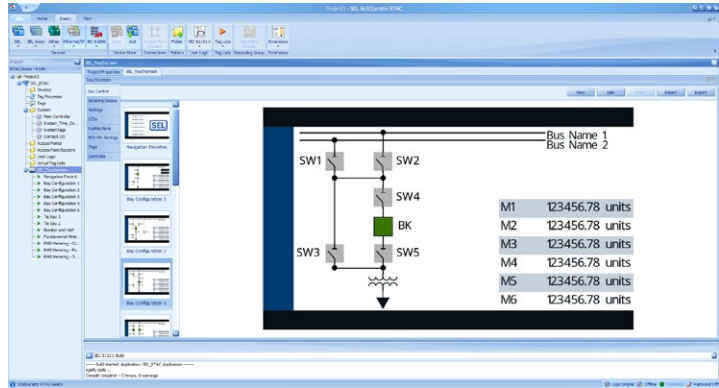
Module Status		2021/08/09	22:11:22							
Node 1										
Slot	A	B	C	D	E	F	G	H	I	J
Status	✓	✓	✓	✓	✓	✓	✓	●	●	●
Node 2										
Slot	A	B	C	D	E	F	G	H	I	J
Status	✓	✓	✓	✓	●	●	●	●	●	●

Configuration Software

Use ACSELERATOR RTAC to integrate IEC 61131 logic with control outputs and status inputs for custom bay screens, programmable pushbuttons, and tricolor LEDs. Select from a library of predefined function blocks for reliable implementation of control logic, including breaker operations, switch control, and synchronism check. This software also includes the Bay Screen Builder application that allows you to create resourceful screens that match your system.

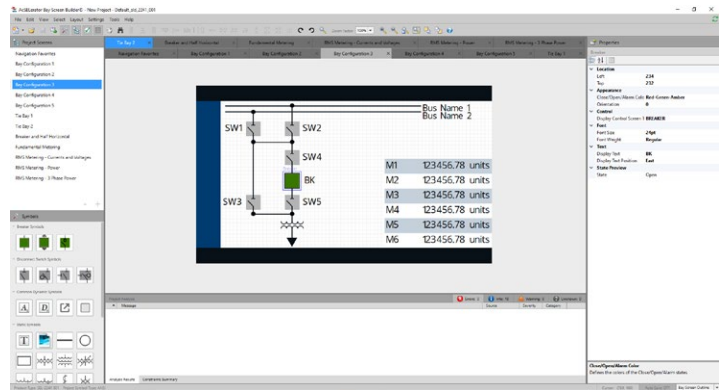
ACSELERATOR RTAC

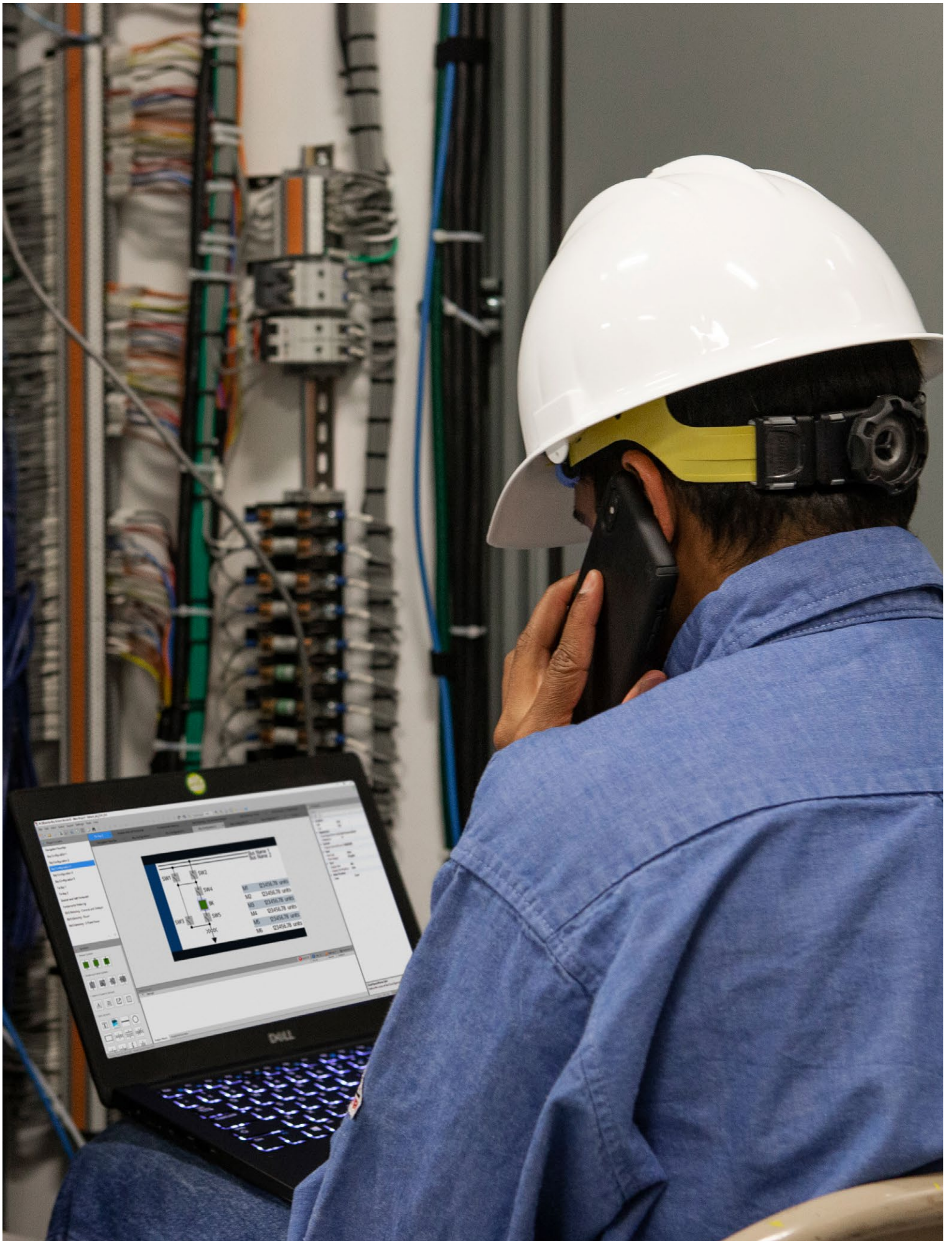
Design custom automation logic to control your system with ACSELERATOR RTAC, or monitor system performance using the prepopulated device tags. A flexible IEC 61131 configuration environment allows you to scale values and create logic equations by applying integrated tools. You can perform complex math 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. Additionally, use this software to configure communication protocols for substation integration and automation.



Bay Screen Builder

Use the new Bay Screen Builder application in ACSELERATOR RTAC to take control of the bay screen design, management, and deployment for your SEL devices supporting a touchscreen display. Work with Bay Screen Builder to customize bay screens according to your standards and to eliminate constraints associated with a fixed, noncustomizable set of bay screens provided with your device. Additionally, leverage the availability of both ANSI and IEC symbols in the design software to support a wide variety of projects.



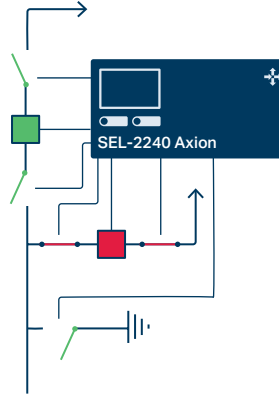


Applications

Choose from a variety of digital and analog modules to fit your application requirements. The advanced automation capabilities combined with the diversity and flexibility of I/O modules allow you to implement any blocking or interlocking scheme required by the switching devices in your substation. Use the Axion Bay Controller as an economical yet powerful solution for monitoring and controlling one or more substation bays at the transmission or distribution level.

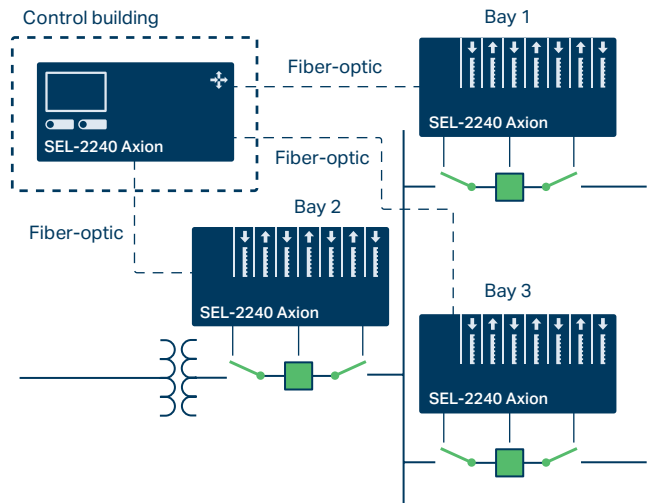
Controlling a Single- or Dual-Breaker Bay

Use a single Axion Bay Controller node to control a substation bay with as many as 3 breakers and 20 disconnect switches. Monitor the switch status and interlocking conditions. Operate the system in local or remote modes.



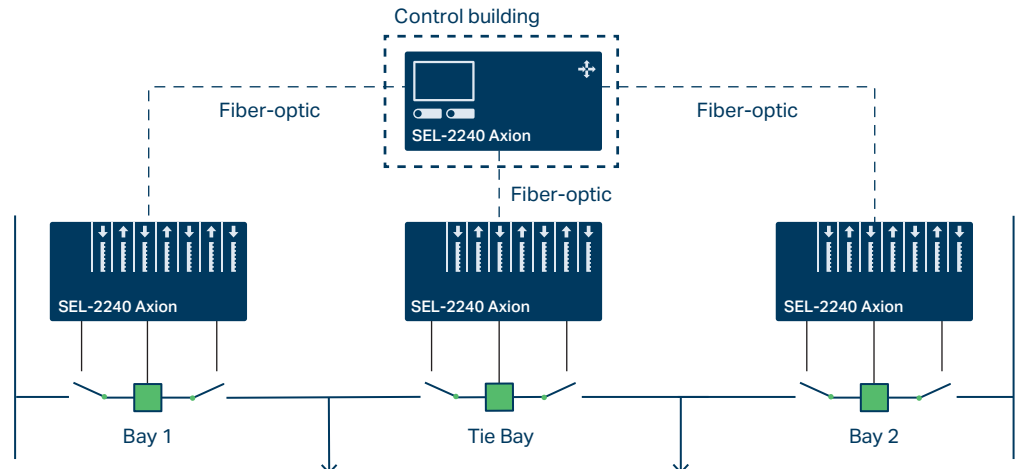
Controlling Multiple Bays With Distributed I/O

Deploy high-speed and deterministic fiber-optic communication from the control house in place of high-energy copper cables. Install ac measurement modules and digital I/O modules near assets in the substation yard, and perform bay control and monitoring from within the control house. Manage more than one bay with multiple custom screens on a single touchscreen display.



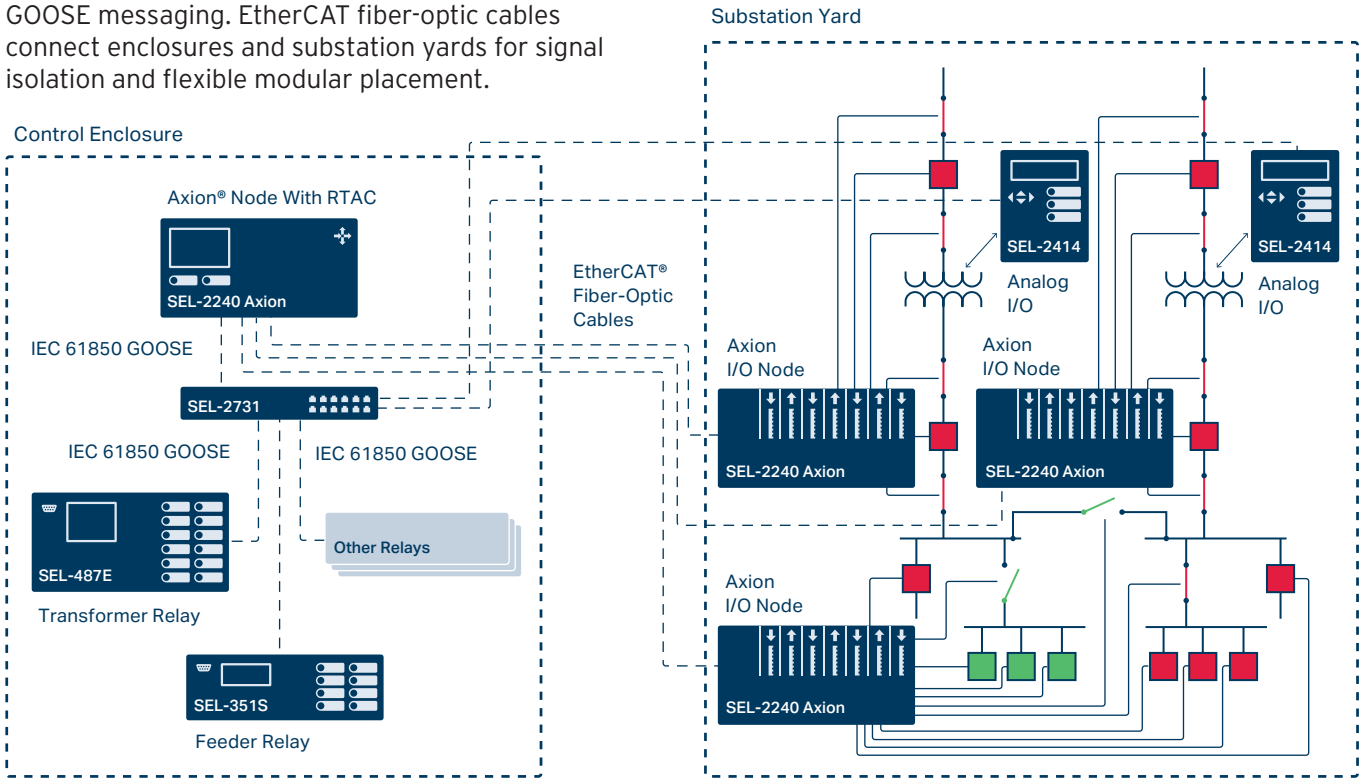
Controlling a Breaker-and-a-Half Scheme

Monitor and control breakers and switches in a breaker-and-a-half scheme. Ensure safe connections using synchronism check, and automate control operations with the SEL RTAC's powerful logic engine. Coordinate interlocking logic between the tie bay and bus bays.



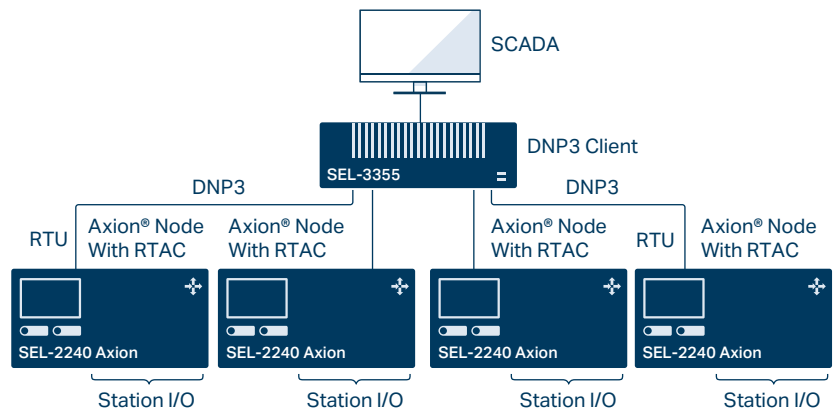
Substation Automation

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.



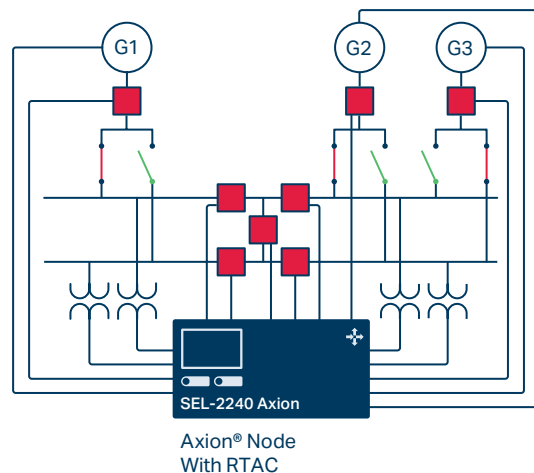
Substation RTU

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.



SEL-2240 Axion Specifications

Hardware

Processor Module	Processor speed: 533 MHz Memory: 512 MB DDR2 error-correcting code (ECC) RAM User storage: 2 GB
HMI	7-inch color touchscreen display, 800 × 480 pixels 6 programmable pushbuttons 19 programmable tricolor LEDs RJ45 female connector (engineering access only)
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 FHC 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 V_{L-N} in ac mode) 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 $+85^{\circ}$ C (-40° to $+185^{\circ}$ F) Note: The touchscreen display is impaired for temperatures below -20° C (-4° F) and above $+70^{\circ}$ C ($+158^{\circ}$ 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

Automation

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
Parallel Redundancy Protocol (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 Precision Time Protocol (PTP)

*Optional feature

EtherCAT® is a registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany.

Protocols

Client

CDC Type II
Courier
CP 2179
DNP3 Serial, DNP3 LAN/WAN
FTP/SFTP*
Flex Parse
IEC 60870-5-101/104
IEC 60870-5-103
IEC 61850 MMS and MMS Client File Services*
IEEE C37.118 Synchrophasors
LG 8979
Modbus RTU, Modbus TCP
SEL Protocols
SES-92
SNMP

Server

CDC Type II
DNP3 Serial, DNP3 LAN/WAN
EtherNet/IP—Implicit Message Adapter*
FTP/SFTP
IEC 60870-5-101/104
IEC 61850 MMS and MMS Server File Services*
IEEE C37.118 Synchrophasors
LG 8979
Modbus RTU, Modbus TCP
SEL Protocols
SES-92

Peer-to-Peer

IEC 61850 GOOSE*
Network Global Variable List (NGVL)
SEL MIRRORING BITS Communications

Field Bus Protocol

EtherCAT to SEL Axion I/O Modules

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