SEL-2240 Axion Bay Controller

Comprehensive Monitoring and Reliable Control for All Your Bay Control Applications

The SEL-2240 Axion Bay Controller combines modular I/O cards, advanced automation, a powerful logic engine, current and voltage measurement, a flexible color touchscreen HMI, and advanced communications protocols to provide comprehensive monitoring and reliable control for your bay control application. Choose from a variety of digital and analog modules to fit your application requirements. The advanced automation capability, combined with the diversity and flexibility of I/O modules, allows you to implement any blocking or interlocking scheme required by the switching devices in your substation. Use the Axion Controller as an economical yet powerful solution for monitoring and controlling one or more substation bays at the transmission or distribution level. Configure custom screens by using the Bay Screen Builder application in ACSELERATOR RTAC.
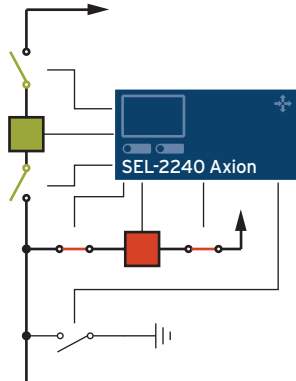
Major Features and Benefits

➤ **Switch Position Monitoring.** Monitor as many as four position states (open, close, alarm, and in-progress) of two-position switches, and as many as eight position states of three-position switches. Monitor as many switches as your application requires. Measure switch position directly by using digital input signals or indirectly by using other devices via communications protocols (e.g., IEC 61850).

➤ **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 ACSELERATOR RTAC by using any of the following editor tools: Tag Processor, Structured Text, Ladder Logic, or Continuous Function Chart.

➤ **Monitor and Control of Substation Equipment in Local or Remote Mode.** Perform local and remote control and monitoring of circuit breakers, disconnect switches, shunt reactors, and capacitor banks. The local touchscreen display makes the local control quick and efficient. Perform remote control and monitoring by using a variety of industry-standard protocols, such as IEC 61850, DNP3, Modbus, MIRRORED BITS communications, and IEC 60870-101/103/104.

➤ **Synchronism Check.** Use the SynchronismCheck function block to verify that the voltages on both sides of the breaker are within allowed phase and magnitude. The SynchronismCheck function block compensates for circuit breaker close time. Use selectable voltage sources as inputs for the synchronism check on each breaker.

➤ **Design Custom Screens to Meet Your System Needs.** Design bay screens, monitor screens, or meter screens by launching ACSELERATOR® Bay Screen Builder SEL-5036 Software for Axion Bay Controller. Display the bay configuration as a single-line diagram (SLD) on the touchscreen. Use ANSI and IEC symbols, along with analog and digital labels, for the SLD to indicate the status of breaker and disconnect switches, bus voltages, 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. Design these custom screens with the help of ACSELERATOR Bay Screen Builder in conjunction with ACSELERATOR RTAC. You can create as many as 25 custom screens.

➤ **Programmable Pushbuttons and LED Status Indication.** Program six pushbuttons to quickly perform custom control commands. Each pushbutton (located on the Axion Bay Controller front panel) includes two programmable tricolor LEDs. Seven general-purpose tricolor LEDs are available for alarms or any other local indication. Use IEC 61131-3 logic to program custom operator control and LED status functions.

➤ **Control Multiple Bays.** Control and monitor circuit breakers, disconnect switches, and earthing switches for multiple bays with a single SEL-2240 Axion Bay Controller system.

➤ **Flexible I/O Selections for Your Application.** Include hundreds of digital and analog I/O points in a single panel.

➤ **Distributed I/O.** Improve safety and reduce copper conductor and installation time by installing the remote Axion ac analog input modules and digital I/O modules in the substation yard, near the circuit breaker, and control the breakers and monitor current, voltages, and status of contact points from the substation control building.

➤ **Deterministic I/O Performance.** Update connected I/O at a deterministic processing interval; all inputs provide 1 ms SER time stamps.

➤ **Redundant Power Supplies for Maximum Availability.** Apply redundant power support with two load-sharing SEL-2243 power couplers for applications requiring two independent power sources.

➤ **Synchronized Current and Voltage Measurements.** Retrieve high-accuracy current and voltage measurements with the advantage of synchronized measurements. Multiple AC Analog Input modules in an Axion system sample all measurements at the same time to ensure a common reference for all voltages and currents. This enables many time-deterministic control applications without performing additional processing to align the measurements to a reference. Use this capability to accomplish complex control schemes including load shedding, microgrid control, and synchronism check.

➤ **Create Historic Data Logs.** Leverage the Dynamic Disturbance Recording (DDR) library to continuously record fundamental, rms, synchrophasor quantities, or I/O status data.

➤ **Sensor Integration.** Use the SEL-2245-22 DC Analog Input modules to integrate gas pressure, oil level, tap position sensor, or any other voltage (–10 to +10 Vdc) or current (–20 mA to +20 mA) sensor. Use the SEL-2600 Resistance Temperature Detector (RTD) Module to integrate RTD sensors. Sensors can also be integrated via communications protocols.

➤ **Low-Energy Analog (LEA) Inputs.** Eliminate outage costs by using the SEL-2245-221 Low Voltage Monitoring Input module to connect external split-core current transformers.

➤ **Secure Operation.** Manage user accounts and permissions to only allow access to the touchscreen to approved users.

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Product Overview

Functional Diagram
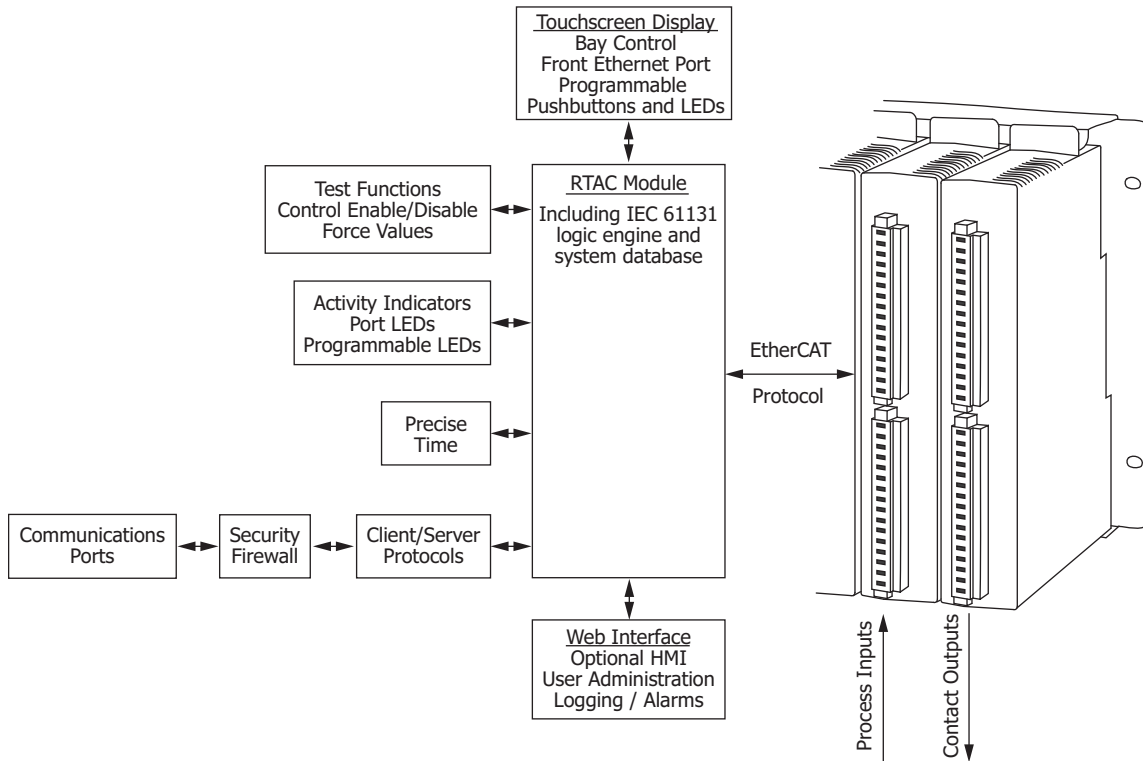
Figure 1   Functional Diagram

Flexible System Architecture

Today's monitoring and control applications need flexible system architectures and integrated security. The Axion Bay Controller meets these needs by using the SEL-2241 RTAC as the system CPU and providing modular and scaleable I/O. SEL designs all Axion hardware to published standards (see *Specifications* on page 15) and performs tests to verify that each component exceeds standards by adequate margins. The SEL-2243 Power Coupler is a highly reliable device that uses the same

power supply technology used in SEL protective relays. Configure the Axion to include single or redundant power couplers for critical applications. In redundant configurations, the pair of SEL-2243 modules actively share loads to supply power for the entire node. If one module should become unavailable, the remaining power coupler can accommodate the entire node with no loss of system capability. Employ dual power couplers for installations where you have dual power sources, one that is ac and one that is dc.

Figure 2   Modules Installed in Chassis/Backplane

Each Axion node is mounted in a chassis/backplane (model SEL-2242) that provides a means for each node to include a custom arrangement of modules. A single node can contain as many as nine modules. Use any combination, quantity, and sequence of modules that suits the application.

NOTE: The SEL-2242 backplane with 7-inch touchscreen display is compatible with the SEL-2241 RTAC module and does not support other RTAC variants.

The node does not need to be entirely full to function properly. Leave empty slots for future expansion as necessary. Many remote terminal unit (RTU) and control systems need more I/O points than will fit in a single Axion node. In those cases, use the EtherCAT protocol to connect multiple nodes together via a real-time Ethernet network. Through use of an Axion system EtherCAT network, you can use as many as 60 modules in a single network with no loss of speed or determinism. *Applications* on page 3 explores several possible network configurations. In each implementation, a single RTAC module provides logic functions and data concentration for the entire network.

Ordering Options

Table 1   SEL-2241 RTAC Module

Ethernet Communication	Two Ethernet ports:
	    10/100BASE-T copper (standard)
	    100BASE-FX fiber-optic (optional)
	    100BASE-LX single-mode fiber-optic (optional)

Web-Based HMI	Basic runtime license and diagram builder software
Peer-to-Peer Protocols	IEC 61850 GOOSE
Client Protocols	IEC 61850 MMS
Server Protocols	IEC 61850 MMS, Ethernet/IP
Environment	Conformal coating for chemically harsh and high-moisture environments

Table 2   SEL-2242 Chassis/Backplane (Sheet 1 of 2)

Slot Configuration	10-slot, 4-slot, or dual 4-slot
Front Panel[a]	Bay Controller with 7-inch touchscreen display, 6 pushbuttons, and 19 programmable LEDs[b]

Table 2   SEL-2242 Chassis/Backplane (Sheet 2 of 2)

Mounting	Horizontal surface mount, 5U[c] Horizontal rack mount, 5U Horizontal Panel Mount, 5U (10-Slot or Dual 4-Slot)
Environment	Conformal coating for chemically harsh and high-moisture environments

[a] Front-panel options are not supported if the SEL-2242 is configured for surface mount.
[b] Only available with the 10-slot SEL-2242. Only compatible with an SEL-2241 RTAC that is shipped with R149 firmware or later.
[c] For applications compliant with IEC 60255-27, surface-mount units must be installed in IP4X enclosures.

Table 3   SEL-2243 Power Coupler

Voltage Range	24/48 Vdc or 120/250 Vac/Vdc
EtherCAT Communication	Two ports: RJ45 Ethernet (standard) LC fiber-optic multimode or single-mode (optional)
Environment	Conformal coating for chemically harsh and high-moisture environments

Table 4   SEL-2244-2 Digital Input Module

Input Ratings	24 Vac/Vdc 125 Vac/Vdc 48 Vac/Vdc 220 Vac/Vdc 110 Vac/Vdc 250 Vac/Vdc
Environment	Conformal coating for chemically harsh and high-moisture environments

Table 5   SEL-2244-3 Standard Current Digital Output Module

Output Types	16 Form A control outputs 8 Form A, 8 Form B control outputs 16 Form B control outputs
Environment	Conformal coating for chemically harsh and high-moisture environments

Table 6   SEL-2244-5 Fast High-Current Digital Output Module

Output Types	10 Form A control outputs 5 Form A, 5 Form B control outputs 10 Form B control outputs
Environment	Conformal coating for chemically harsh and high-moisture environments

Table 7   SEL-2245-2 DC Analog Input Module

Input Types	±20 mA, ±2 mA, ±10 V
Environment	Conformal coating for chemically harsh and high-moisture environments

Table 8   SEL-2245-22 DC Analog Input Extended Range Module

Input Types	0–300 V
Environment	Conformal coating for chemically harsh and high-moisture environments

Table 9   SEL-2245-221 Low-Voltage (LEA) Monitoring Module

Input Types	0–30 V peak
Environment	Conformal coating for chemically harsh and high-moisture environments

Table 10   SEL-2245-3 DC Analog Output Module

Output Types	±20 mA, ±10 V
Environment	Conformal coating for chemically harsh and high-moisture environments

Table 11   SEL-2245-4 AC Metering Module

Input Types	0–22 A, 5–400 V
Environment	Conformal coating for chemically harsh and high-moisture environments

Table 12   SEL-2245-42 AC Protection Module

Input Types	0–20 A, 6–300 V
Environment	Conformal coating for chemically harsh and high-moisture environments

Table 13   SEL-2245-411 Standard Current and Low-Voltage (LEA) Monitoring Module

Input Types	0–22 A, 0–30 V peak
Environment	Conformal coating for chemically harsh and high-moisture environments

Module Features

Front-Panel View

Rack-mounted chassis

Rear-Panel View

Slot identification is visible even when in use

Surface-mounted chassis

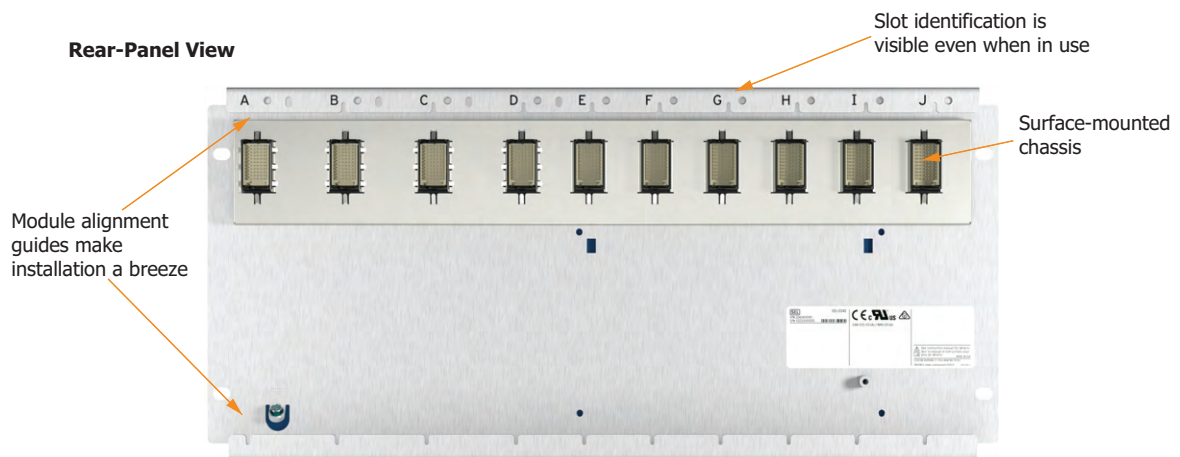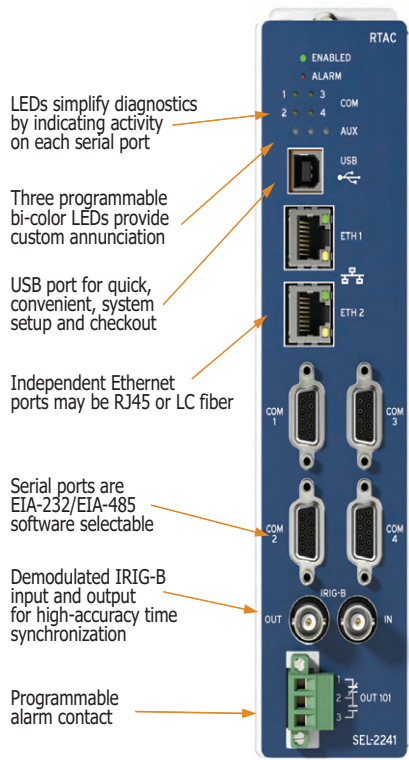Module alignment guides make installation a breeze

Figure 3   SEL-2242 10-Slot Chassis/Backplane

LEDs simplify diagnostics by indicating activity on each serial port

Three programmable bi-color LEDs provide custom annunciation

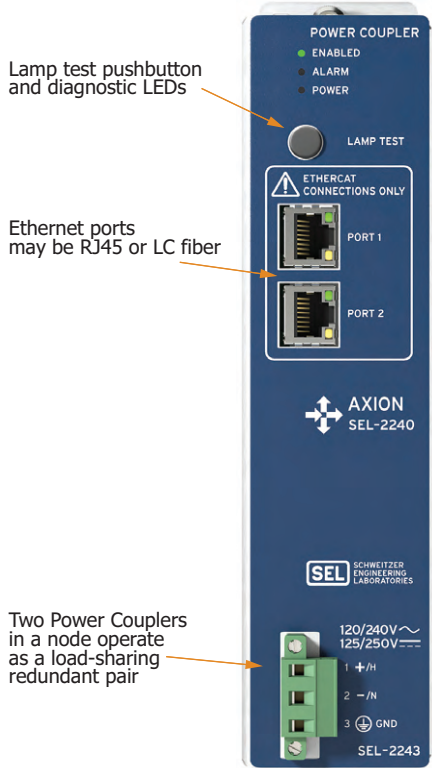USB port for quick, convenient, system setup and checkout

Independent Ethernet ports may be RJ45 or LC fiber

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

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

Programmable alarm contact

Figure 4   SEL-2241 RTAC Terminal-Side View

Lamp test pushbutton and diagnostic LEDs

Ethernet ports may be RJ45 or LC fiber

Two Power Couplers in a node operate as a load-sharing redundant pair

Figure 5   SEL-2243 Power Coupler Terminal-Side View
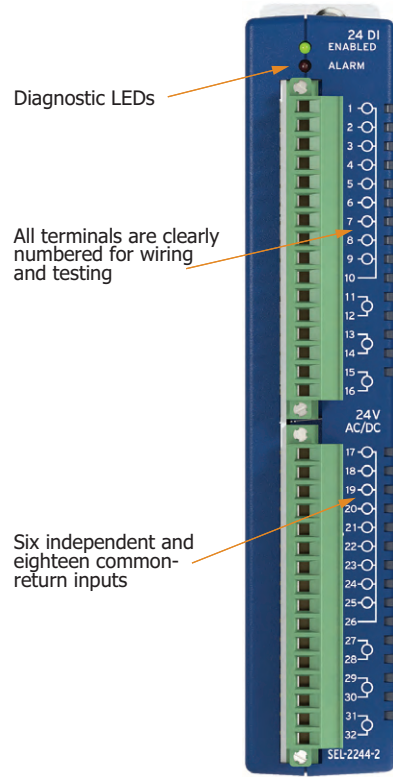
Diagnostic LEDs

All terminals are clearly numbered for wiring and testing

Six independent and eighteen common-return inputs

Figure 6   SEL-2244-2 Digital Input Module Terminal-Side View
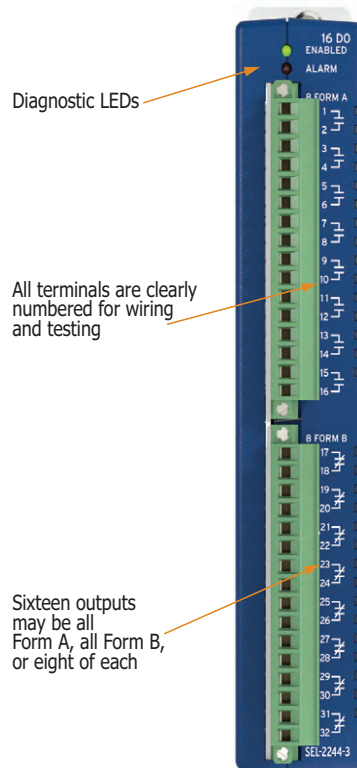
Diagnostic LEDs

All terminals are clearly numbered for wiring and testing

Sixteen outputs may be all Form A, all Form B, or eight of each

Figure 7   SEL-2244-3 Standard Current Digital Output Module Terminal-Side View
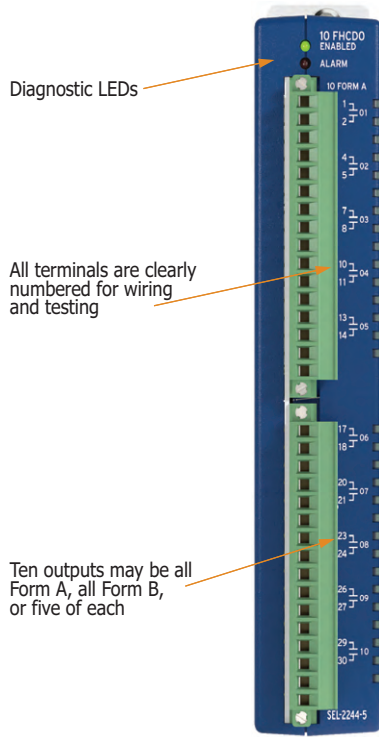
Figure 8   SEL-2244-5 Fast High-Current Digital Output Module Terminal-Side View

Figure 10   SEL-2245-22 Analog Input Extended Range Module Terminal-Side View
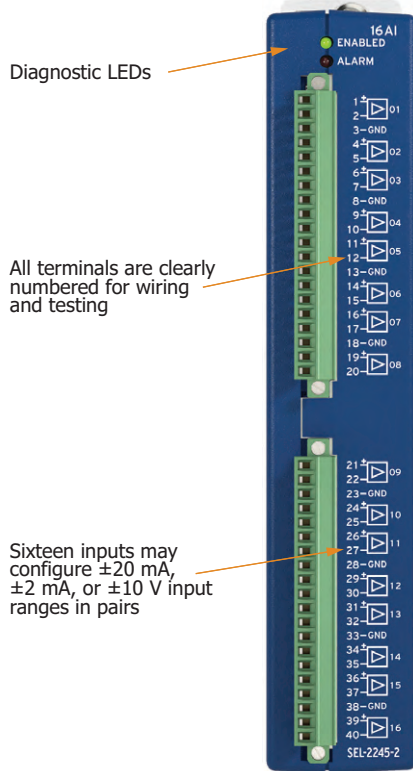
Figure 9   SEL-2245-2 DC Analog Input Module Terminal-Side View

Figure 11   SEL-2245-221 Low-Voltage (LEA) Monitoring Module

Diagnostic LEDs

All terminals are clearly numbered for wiring and testing

Eight outputs may configure ±20 mA or ±10 V output ranges
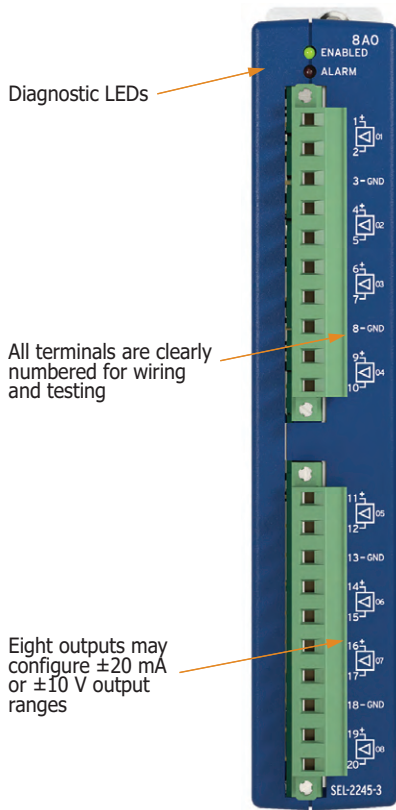
Figure 12   SEL-2245-3 DC Analog Output Module Terminal-Side View

Diagnostic LEDs

All terminals are clearly numbered for wiring and testing

Three CT and three PT inputs with two-wire connections
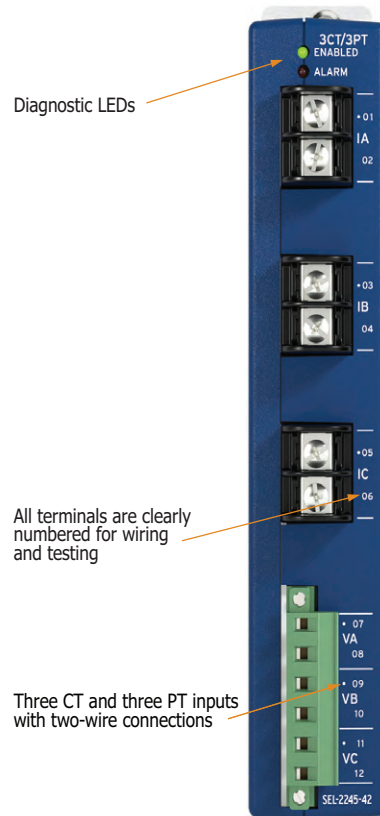
Figure 14   SEL-2245-42 AC Protection Module Terminal-Side View

Diagnostic LEDs

All terminals are clearly numbered for wiring and testing

Four CT and four PT inputs with two-wire connections
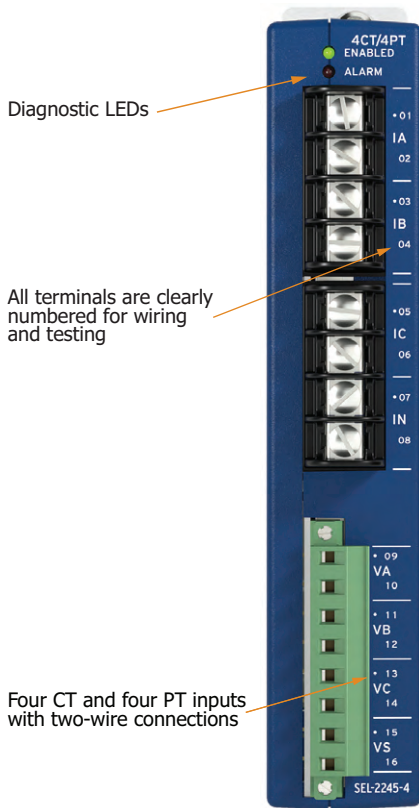
Figure 13   SEL-2245-4 AC Metering Module Terminal-Side View

Diagnostic LEDs

All terminals are clearly numbered for wiring and testing

Four CT and four low-voltage (LEA) inputs with two-wire connections
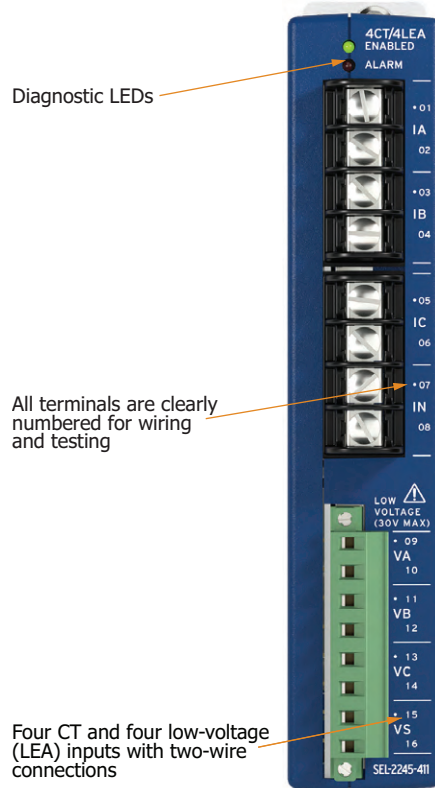
Figure 15   SEL-2245-411 Standard Current and Low-Voltage (LEA) Monitoring Module

Diagrams and Dimensions
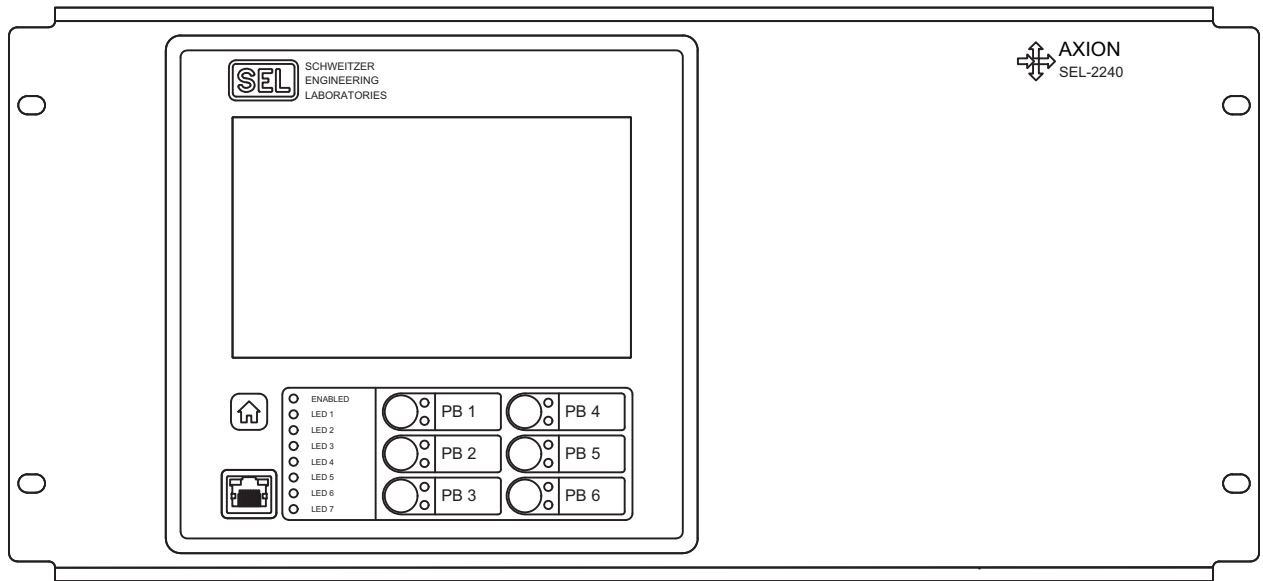
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Figure 16   SEL-2240 10-Slot Front-Panel 7-Inch Touchscreen Display (Rack Mount)
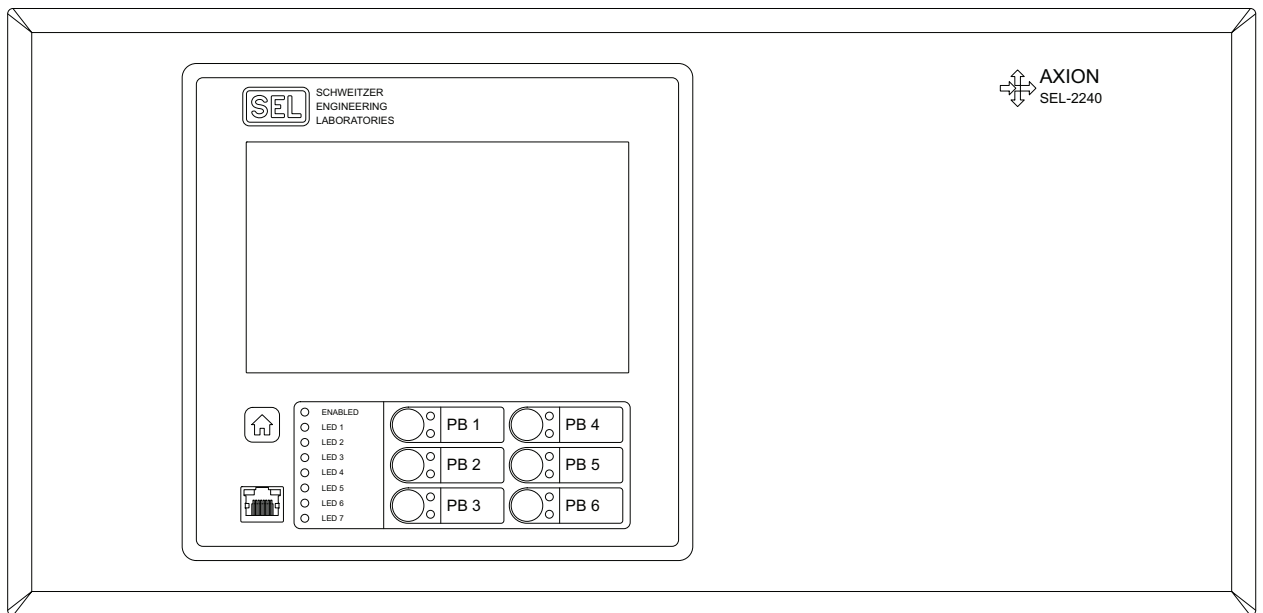
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Figure 17   SEL-2240 10-Slot Front-Panel 7-Inch Touchscreen Display (Panel Mount)
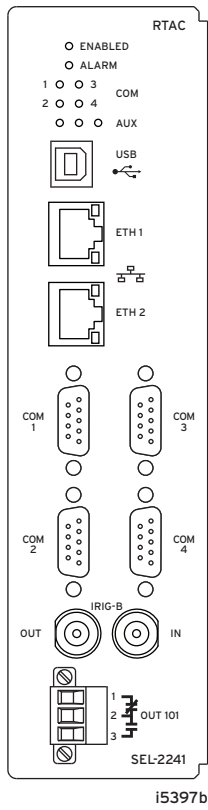
Figure 18   SEL-2241 Connections Diagram
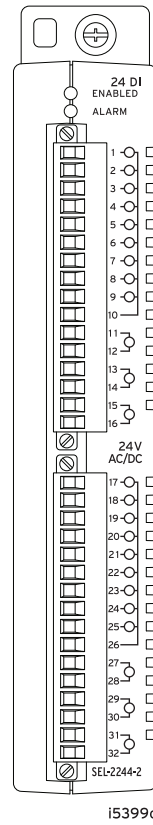
Figure 20   SEL-2244-2 Connections Diagram
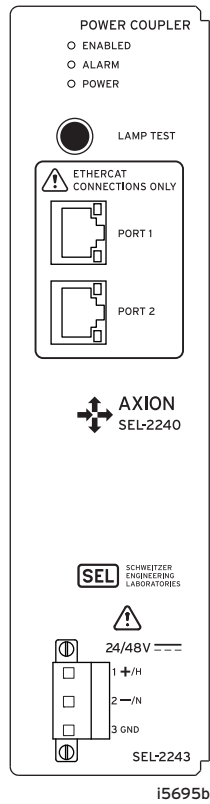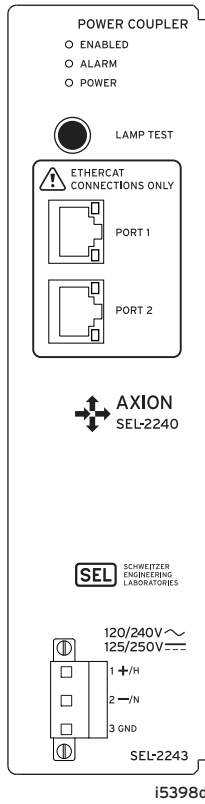
Figure 19   SEL-2243 Connections Diagrams
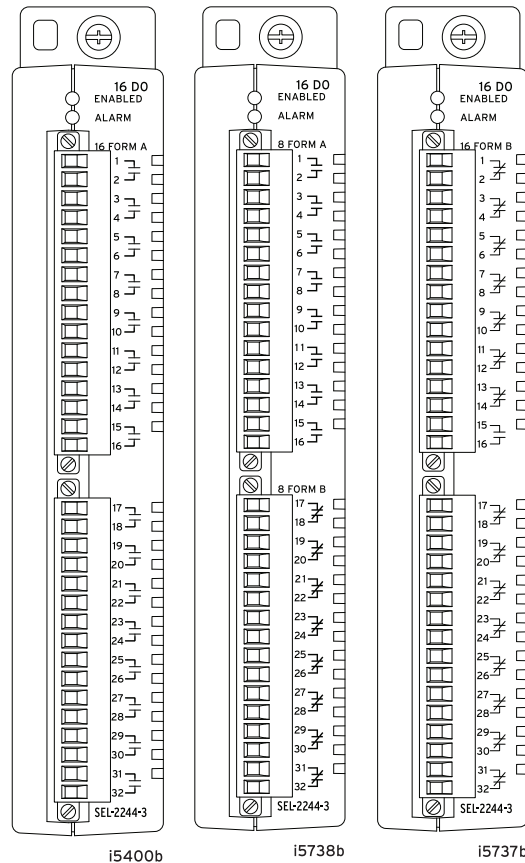
Figure 21   SEL-2244-3 Connections Diagrams
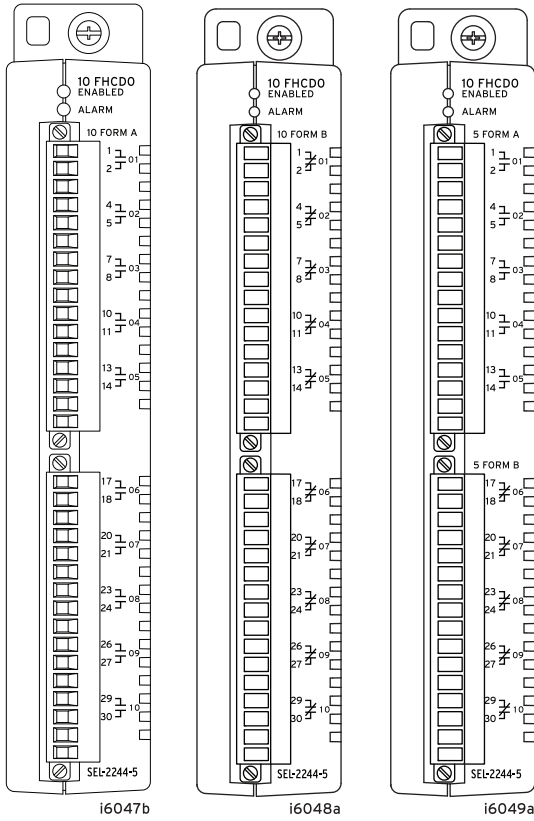
Figure 22 SEL-2244-5 Connections Diagrams
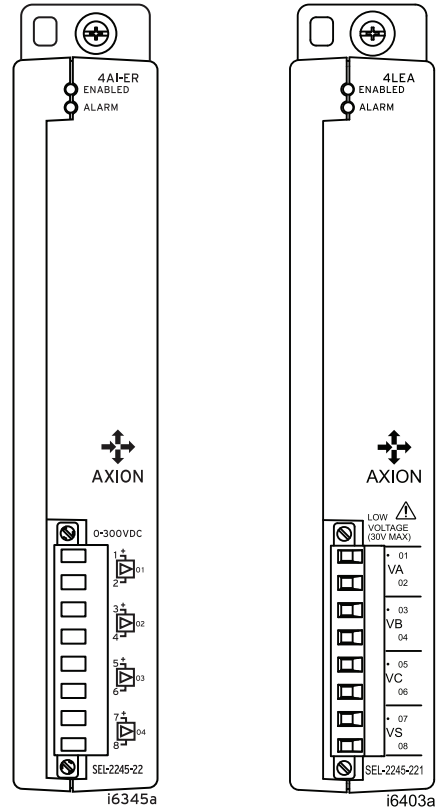
Figure 24 SEL-2245-22 and SEL-2245-221 Connections Diagrams
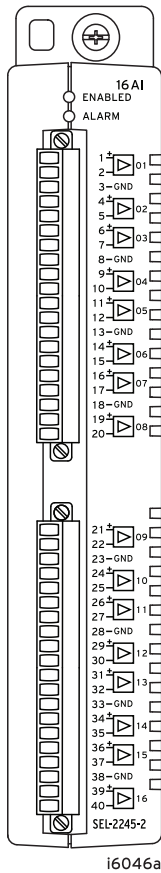
Figure 23 SEL-2245-2 Connections Diagram
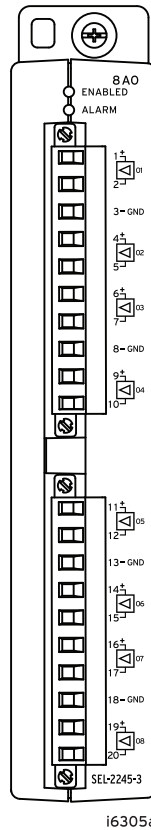
Figure 25 SEL-2245-3 Connections Diagram

14
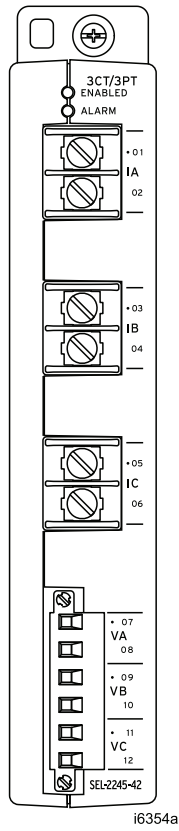
Figure 26   SEL-2245-42 Connections Diagram
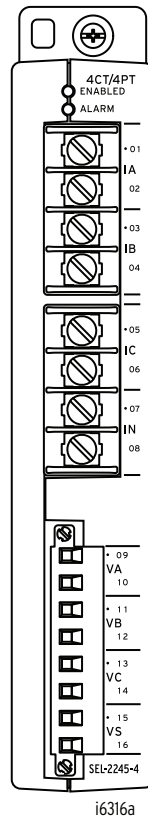
Figure 27   SEL-2245-4 and SEL-2245-411 Connections Diagrams

TOP

CABLE ACCESS VIEW

SIDE

LEGEND

in
[mm]
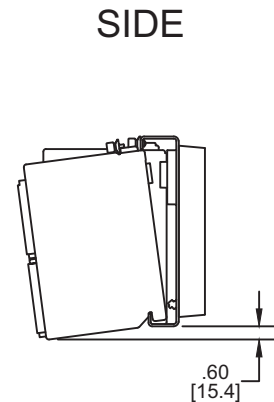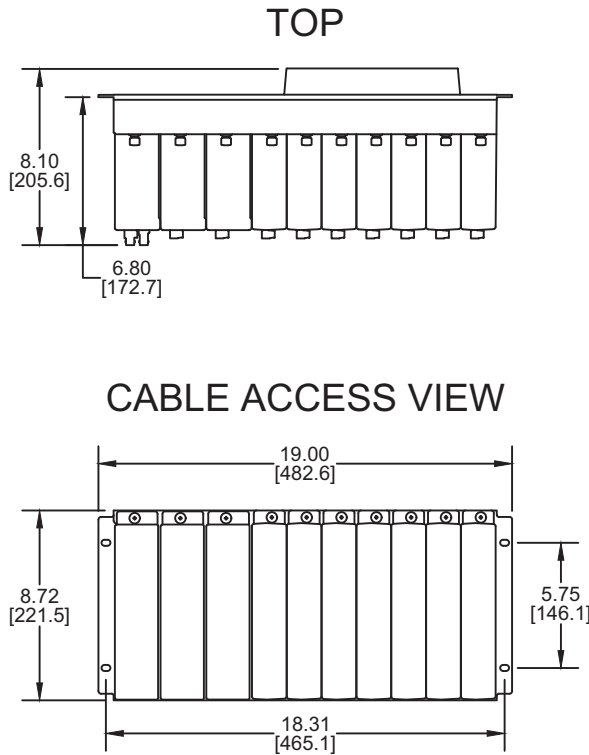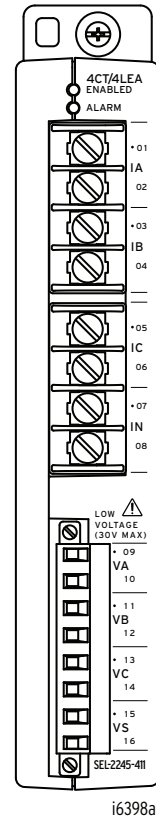
MINIMUM CLEARANCE REQUIRED
FOR MODULE REMOVAL

i9198a

Figure 28   SEL-2240 Dimensions for 10-Slot Rack With 7-Inch, Color Touchscreen Display (Rack Mount)

TOP

8.11
[206.1]

6.56
[166.7]

CABLE ACCESS VIEW   SIDE

17.75
[450.9]

4X Ø.25
[Ø6.4]

8.80
[223.5]

PANEL CUTOUT

5.75
[146.1]

18.31
[465.1]

19.76
[501.9]

9.61
[244.1]

5.75
[146.1]

18.31
[465.1]

.61
[15.4]

MINIMUM CLEARANCE REQUIRED
FOR MODULE REMOVAL

LEGEND

in
[mm]

i9406a
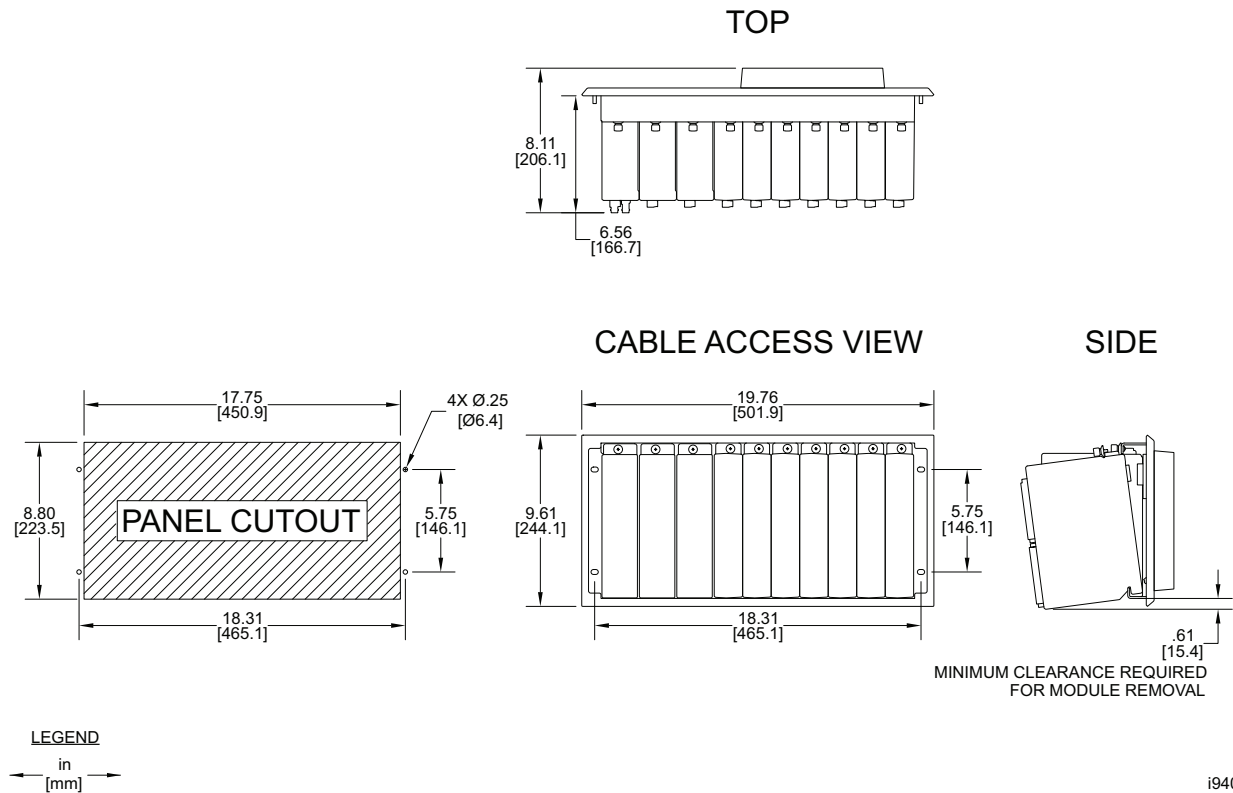
Figure 29   SEL-2240 Dimensions for 10-Slot Rack With 7-Inch, Color Touchscreen Display (Panel Mount)

Specifications

Compliance

Designed and manufactured under an ISO 9001 certified quality management system

SEL Axion operates at the specified limits on power up as soon as the device enables. Refer to the individual SEL Axion module datasheets for compliance and type test specifications.

UKCA Mark

Enclosure Protection

IP4X Front
IP2X Product Without SEL-2245-4, SEL-2245-411, and SEL-2245-42
IP1X Product With SEL-2245-4, SEL-2245-411, or SEL-2245-42
**Note:** If rear terminals are accessible during normal use, the product must be mounted in a locked enclosure or restricted area accessible by trained maintenance or operation personnel only.

Product Standards

IEC 60255-26:2013 - Relays and Protection Equipment: EMC
IEC 60255-27:2014 - Relays and Protection Equipment: Safety
IEC 60825-2:2004 +A1:2007 +A2:2010 for fiber-optic communications
IEC 61850-3:2013 - Comm Systems for Power Utility Automation

General

Operating System

SEL Linux® Yellowstone running Linux kernel 3.x with real-time preemption patches

Operating and Storage Temperature Range

–40° to +85°C (–40° to +185°F)
Units should be stored and transported in their original packaging.

Note: Operating temperature evaluated for UL ambient 0° to 40°C.
Note: The optional front-panel LCD is impaired for temperatures below –20°C and above +70°C.

Operating Environment

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

Dimensions

Refer to *Section 2: Installation* for dimensions.

Weight

SEL-2241 RTAC:	0.670 kg (1.47 lb)
SEL-2242 19 in Backplane:	3.24 kg (7.13 lb)
Panel Mount Bezel:	0.283 kg (0.625 lb)
SEL-2242 10-Slot (19 in Rack Width) With 7 in Touchscreen Display:	3.999 kg (8.80 lb)
SEL-2243-1 HV Coupler:	0.85 kg (1.87 lb)
SEL-2243-2 LV Coupler:	0.89 kg (1.97 lb)
SEL-2244-2 24 DI:	0.45 kg (1.00 lb)
SEL-2244-3 16 DO:	0.59 kg (1.30 lb)

SEL-2244-5 10 FHCDO: 0.57 kg (1.26 lb)

SEL-2245-2 16 AI: 0.51 kg (1.12 lb)

SEL-2245-22 4 AI-ER: 0.42 kg (0.92 lb)

SEL-2245-221 4 LEA: 0.42 kg (0.92 lb)

SEL-2245-3 8 AO: 0.46 kg (1.01 lb)

SEL-2245-4 4 CT/4 PT: 0.54 kg (1.18 lb)

SEL-2245-411
4 CT/4 LEA: 0.54 kg (1.18 lb)

SEL-2245-42 3 CT/3 PT: 0.73 kg (1.60 lb)

Module Burden

Table 14   Maximum Burden Per Module for Each Node

Module	Maximum Added Burden (W)[a]
SEL-2241 RTAC (Copper Ethernet)	12.5
SEL-2241 RTAC (Fiber Ethernet)	15
SEL-2242R Standard Rack-Mount Backplanes	1
SEL-2242 With Touchscreen Display	4
SEL-2243 Power Coupler (Fiber Ethernet)	5[b]
SEL-2243 Power Coupler (Copper Ethernet)	2.5[b]
SEL-2244-2 24 DI	2
SEL-2244-3 16 DO	8[c]
SEL-2244-5 10 FHCDO	6[c]
SEL-2245-2 16 AI	3
SEL-2245-22 4 AI-ER	2
SEL-2245-221 4 LEA	2
SEL-2245-3 8 AO	13
SEL-2245-4 4 CT/4 PT	3
SEL-2245-411 4 CT/4 LEA	3
SEL-2245-42 3 CT/3 PT	6
Feature Selections	**Typical Burden (W)**
No use of SEL-2241 Serial Port +5 Vdc	–3
Each DO port not energized (SEL-2241, SEL-2244-3, or SEL-2244-5 relay coil)	–0.3
Each AO port not energized (SEL-2245-2)	–0.7

[a] Values include worst-case real power consumption and do not include worst-case ac power factor correction (0.4). If the unit will not be used in wide temperature extremes, reduce power by up to 6%.

[b] Each SEL-2243 will draw a minimum of 11 W (quiescent) when the total burden of all other modules in the node is less than 11 W.

[c] All DO relay coils may be energized simultaneously and still meet specifications.

CPU Processing and Memory

Processor Speed:	533 MHz
Memory:	1024 MB DDR2 ECC RAM
Storage:	4 GB (2 GB reserved)

Security Features

Account Management:	User Accounts User Roles LDAP Central Authentication RADIUS Central Authentication Strong Passwords Inactive Account Logouts
Intrusion Detection:	Access/Audit Logs Alarm LED Alarm Contact
Encrypted Communication:	SSL/TLS, SSH, 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, CDC Type II, Courier, IEC 60870-5-103, Ethernet/IP Explicit Message Client
Server:	DNP3 Serial, DNP3 LAN/WAN, Modbus RTU, Modbus TCP, SEL Fast Messaging, LG 8979, SES-92, IEEE C37.118, IEC 61850 MMS, IEC 60870-5-101/104, FTP, SFTP, CDC Type II, Ethernet/IP Implicit Message Adapter
Peer-to-Peer:	SEL MIRRORED BITS Communications, IEC 61850 GOOSE, Network Global Variables (NGVL), Parallel Redundancy Protocol
Fieldbus:	EtherCAT Client (in RTAC), EtherCAT Server (I/O modules)
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:	2 kΩ
Accuracy:	500 ns

Time-Code Output (IRIG-B)

On (1) State:	$V_{oh} > 2.4$ V
Off (0) State:	$V_{ol} < 0.8$ V
Load:	50 Ω

Network Time Protocol (NTP) Modes

NTP Client:	As many as three configurable servers
NTP Server	

Simple Network Time Protocol (SNTP) Accuracy

±1 ms:	This does not take into account external factors such as network switches and topologies

Precise Time Protocol (PTP)

PTP Client:	Peer delay request and end-to-end path delay supported

Communications Ports (SEL-2241 RTAC)

Ethernet Ports (To Backplane)

Ports:	1
Data Rate:	Automatic
Protocols:	Dedicated EtherCAT port

Ethernet Ports (Terminal Side)

Ports:	2
Data Rate:	10 or 100 Mbps
Connector:	RJ45 Female or LC Fiber (Multimode or Single-Mode 100 Mbps only)

Fiber-Optic Ports (Class 1 LASER/LED)

Wavelength

1300 nm

Optical Connector Type

LC

Multimode Option

Link Budget:	11 dB
Min. TX Power:	–20 dBm
Min. RX Sensitivity:	–31 dBm
Fiber Size:	50–200 μm
Approximate Range:	2 km
Data Rate:	100 Mbps
Typical Fiber Attenuation:	–2 dB/km

Single-Mode Option

Link Budget:	10 dB
Min. TX Power:	–15 dBm
Min. RX Sensitivity:	–25 dBm
Fiber Size:	9 μm
Approximate Range:	15 km
Data Rate:	100 Mbps
Typical Fiber Attenuation:	–0.4 dB/km

Serial Ports

Ports:	4
Types:	EIA-232/EIA-485 (software selectable)
Data Rate:	300 to 115,200 bps
Connector:	DB-9 Female
Time Synchronization:	IRIG-B
Power:	+5 Vdc power on Pin 1 (500 mA maximum per SEL-2241)

USB Device Ports

1 Type B

Output (SEL-2241 RTAC)

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

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:	24 Vdc	0.75 A	L/R = 40 ms
	48 Vdc	0.50 A	L/R = 40 ms
	125 Vdc	0.30 A	L/R = 40 ms
	250 Vdc	0.20 A	L/R = 40 ms
Cyclic Capacity (2.5 Cycles/Second) Per IEC 60255-0-20:1974:	24 Vdc	0.75 A	L/R = 40 ms
	48 Vdc	0.50 A	L/R = 40 ms
	125 Vdc	0.30 A	L/R = 40 ms
	250 Vdc	0.20 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
Conventional Enclosed Thermal Current (I_{the}) Rating:	5 A
Rated Frequency:	50/60 ± 5 Hz
Operating Time (Coil Energization to Contact Closure, Resistive Load):	Pickup/Dropout time <8 ms typical
Electrical Durability Make VA Rating:	3600 VA, cosø = 0.3
Electrical Durability Break VA Rating:	360 VA, cosø = 0.3

Backplane (SEL-2242)

Ethernet Port

Port:	1
Data Rate:	10/100 Mbps
Connector:	RJ45 Female
Protocol:	Engineering Access

Note: SEL-2242 Ethernet port is included with the optional touchscreen, 10-slot model only.

Fuse Rating

Non-Serviceable:	2.5 A, 125 V, time lag T

Power Coupler (SEL-2243)

EtherCAT Ports

Ports:	2
Data Rate:	Automatic
Connector:	RJ45 Female or LC Fiber
Protocols:	Dedicated EtherCAT

RJ45 Ports

Cable Length:	<3 m

Fiber-Optic Ports (Class 1 LASER/LED)

Wavelength

1300 nm

Optical Connector Type

LC

Multimode Option

Link Budget:	11 dB
Min. TX Power:	–20 dBm
Min. RX Sensitivity:	–31 dBm

Fiber Size:	50–200 µm
Approximate Range:	2 km
Data Rate:	100 Mbps
Typical Fiber Attenuation:	–2 dB/km

Single-Mode Option

Link Budget:	10 dB
Min. TX Power:	–15 dBm
Min. RX Sensitivity:	–25 dBm
Fiber Size:	9 µm
Approximate Range:	15 km
Data Rate:	100 Mbps
Typical Fiber Attenuation:	–0.4 dB/km

Power Supply

AC Input Voltage (High-Voltage Model)

Note: Single phase.

| Nominal Supply Voltage: | 120–240 Vac, 50–60 Hz |
| Operational Voltage Range: | 85–264 Vac, 40–70 Hz |

DC Input Voltage (High-Voltage Model)

| Nominal Supply Voltage: | 125–250 Vdc |
| Operational Voltage Range: | 85–300 Vdc |

DC Input Voltage (Low-Voltage Model)

| Nominal Supply Voltage: | 24–48 Vdc |
| Operational Voltage Range: | 19.1–57.6 Vdc polarity-dependent |

Note: UL operational voltage range is equal to the nominal voltage range ±10 percent.

Fuse Rating

High-Voltage Model, F1:	3.15 A, high breaking capacity, time lag T, 250 V (5x20 mm, T3.15AH 250 V)
High-Voltage Model, F2 (Non-Serviceable):	8 A, high breaking capacity, time lag T, 60 Vdc (2.7x6.1 mm, T8A 60 Vdc)
Low-Voltage Model:	6.30 A, high breaking capacity, time lag T, 250 V (5x20 mm, T6.3AH 250 V)

Power Consumption: See *Table 14* for power per module.

Maximum AC Burden:	160 VA
Maximum DC Burden:	75 W
Interruptions:	30 ms @ 24 Vdc
	130 ms @ 48 Vdc
	50 ms @ 125 Vac/Vdc
	100 ms @ 250 Vac/Vdc

The following exceptions for the IEC 61850-3 acceptance criteria for normal equipment functioning regarding ac power dips and interruptions and dc voltage dips are applicable (refer to IEC 61850-3 subclause 7.5.5, Equipment functioning, and 7.5.6, Exceptions).

Power Supply	Requirement	Exception[a]
125 Vac	5 cycles (83,33 ms @ 60 Hz, 100 ms @ 50 Hz)	50 ms
	50 cycles	Not applicable[b]

[a] Voltage interruptions that are longer than the specified interruption duration result in a device restart.
[b] Equipment is not intended to be connected to power supply ports that are directly connected to a public low-voltage power supply network.

Max Inrush:	17 A
Isolation:	3100 Vdc
Redundant Installation:	Each node may have one or two SEL-2243 modules installed. When two are used, they operate in load-sharing mode.

Recommended External Overcurrent Protection

Breaker Type:	Standard
Breaker Rating:	15 A or 20 A at 250 Vdc
Current Breaking Capacity:	10 kA
Grounded Neutral System:	Device in series with the HOT or energized conductor
DC and Isolated Systems:	Device in series with both conductors

Optoisolated Control Inputs (SEL-2244-2)

When Used With DC Control Signals:

250 Vdc	ON for 200–275 Vdc	OFF below 150 Vdc
220 Vdc	ON for 176–242 Vdc	OFF below 132 Vdc
125 Vdc	ON for 100–135.5 Vdc	OFF below 75 Vdc
110 Vdc	ON for 88–121 Vdc	OFF below 66 Vdc
48 Vdc	ON for 38.4–52.8 Vdc	OFF below 28.8 Vdc
24 Vdc	ON for 15–30 Vdc	OFF for < 10 Vdc

When Used With AC Control Signals:

250 Vdc	ON for 170.6–300 Vac	OFF below 106 Vac
220 Vdc	ON for 150.3–264 Vac	OFF below 93.2 Vac
125 Vdc	ON for 85–150 Vac	OFF below 53 Vac
110 Vdc	ON for 75.1–132 Vac	OFF below 46.6 Vac
48 Vdc	ON for 32.8–60 Vac	OFF below 20.3 Vac
24 Vdc	ON for 14–27 Vac	OFF for < 5 Vac

Burden/Current Draw at Nominal DC Voltage:	2–6 mA (Except for 24 V, 8 mA)
Rated Insulation Voltage:	300 Vac
Rated Impulse Withstand Voltage (U_{imp}):	4000 V

Input Thermal Derating

SEL-2244-2 Digital Input Derating Curve
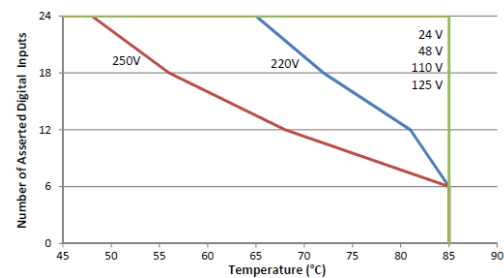
Control Outputs (SEL-2244-3 Standard Contacts)

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
Continuous Carry (UL/CSA Derating With All Outputs Asserted):	5 A @ < 60°C; 2.5 A 60 to 70°C
Thermal:	50 A for 1 s

Contact Protection:	350 Vdc, 145 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:	24 Vdc	0.75 A	L/R = 40 ms
	48 Vdc	0.50 A	L/R = 40 ms
	125 Vdc	0.30 A	L/R = 40 ms
	250 Vdc	0.20 A	L/R = 40 ms

Cyclic Capacity (2.5 Cycles/Second) Per IEC 60255-0-20:1974:	24 Vdc	0.75 A	L/R = 40 ms
	48 Vdc	0.50 A	L/R = 40 ms
	125 Vdc	0.30 A	L/R = 40 ms
	250 Vdc	0.20 A	L/R = 40 ms

AC Output Ratings

Rated Operational Voltage:	240 Vac
Rated Insulation Voltage (Excluding EN 61010-1):	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:	250 Vac, 145 J
Continuous Carry:	3 A @ 120 Vac 1.5 A @ 240 Vac
Conventional Enclosed Thermal Current (I_{the}) Rating:	5 A
Rated Frequency:	50/60 ±5 Hz
Operating Time (Coil Energization to Contact Closure, Resistive Load):	Pickup/Dropout time <8 ms typical
Electrical Durability Make VA Rating:	3600 VA, cosø = 0.3
Electrical Durability Break VA Rating:	360 VA, cosø = 0.3

Control Outputs (SEL-2244-5 Fast High-Current Contacts)

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
Continuous Carry (UL/CSA Derating With All Outputs Asserted):	5 A @ < 60°C; 2.5 A 60 to 70°C
Thermal:	50 A for 1 s
Contact Protection:	330 Vdc, 145 J MOV protection across open contacts

Operating Time (Coil Energization to Contact Closure, Resistive Load)

Pickup Time:	≤12 µs at 250 Vdc, 16 µs at 125 Vdc, 65 µs at 19.2 Vdc typical (results with 100 kΩ resistive load)
Dropout Time:	≤8 ms typical

Inductive Breaking Capacity (10,000 Operations) Per IEC 60255-0-20:1974:	24 Vdc	10 A	L/R = 40 ms
	48 Vdc	10 A	L/R = 40 ms
	125 Vdc	10 A	L/R = 40 ms
	250 Vdc	10 A	L/R = 20 ms

Cyclic Capacity (4 Cycles/Second Followed by 2 Min Idle Thermal Dissipation) Per IEC 60255-0-20:1974:	24 Vdc	10 A	L/R = 40 ms
	48 Vdc	10 A	L/R = 40 ms
	125 Vdc	10 A	L/R = 40 ms
	250 Vdc	10 A	L/R = 20 ms

AC Output Ratings

Rated Operational Voltage:	110/120/220/240 Vac
Voltage Range:	19.2–250 Vac
Rated Insulation Voltage:	250 Vac
Make:	30 A @ 240 Vac
Continuous Carry:	6 A @ 70°C; 4 A @ 85°C
Continuous Carry (UL/CSA Derating With All Outputs Asserted):	5 A @ < 60°C; 2.5 A @ 60° to 70°C
Thermal:	50 A for 1 s
Contact Protection:	250 Vac, 145 J MOV protection across open contacts

Operating Time (Coil Energization to Contact Closure, Resistive Load)

Pickup Time:	≤12 µs at 250 Vac, 16 µs at 125 Vac, 65 µs at 19.2 Vac typical (results with 100 kΩ resistive load)
Dropout Time:	≤8 ms typical

Note: Per IEC 60255-23:1994, using the simplified method of assessment.
Note: Make rating per IEEE C37.90-1989.

Fuse Rating	
Non-Serviceable:	4 A, 450 V, medium time lag M

DC Transducer (Analog) Inputs (SEL-2245-2)

Input Impedance

Current Mode:	200 Ω for ±20 mA 5000 Ω for ±2 mA
Voltage Mode:	10 MΩ

Input Range (Maximum)

±20 mA (transducers: 4–20 mA or 0–20 mA typical)
±2 mA (transducers: 0–1 mA or 0–2 mA typical)
±10 V (transducers: 0–5 V or 0–10 V typical)

Sampling Rate

1 ksps

Anti-Alias Filter

Corner Frequency:	330 Hz
Rolloff:	20 dBV per decade

Digital Filter

Corner Frequency:	Filter A: 16 Hz Filter B: 10 Hz Filter C: 0.2 Hz
50 Hz Rejection:	Filter A: > 30 dB Filter B: > 50 dB Filter C: > 70 dB
60 Hz Rejection:	Filter A: > 60 dB Filter B: > 70 dB Filter C: > 70 dB

Step Response

No Filter:	3 ms (10%–90% response)
Filter A:	23 ms (10%–90% response)
Filter B:	35 ms (10%–90% response)
Filter C:	700 ms (10%–90% response)

Common Mode Range

±35 Vdc between separate inputs
±250 Vdc all inputs to chassis

Isolation

500 Vac between inputs
2000 Vac all inputs to chassis

Accuracy at 25°C

ADC:	16 bit
Voltage Inputs (±10 V):	0.25% of full-scale typical 0.05% with field calibration 2% of full-scale maximum
High Current Inputs (±20 mA):	0.5% of full-scale typical 0.1% with field calibration 2% of full-scale maximum
Low Current Inputs (±2 mA):	0.5% of full-scale typical 0.1% with field calibration 4% of full-scale maximum

Accuracy Variation With Temperature

Inputs:	±0.015% per °C of full scale (±20 mA, ±2 mA, or ±10 V)
ADC:	±0.004% per °C

Triggered Waveform Recording

Sampling Rate:	1 kHz
Record Duration:	0.1 second increments from 0.5 s to 144 s
Record Pre-Trigger:	0.05 s minimum to a maximum of (record length minus 0.05 s)
Waveform File Format:	COMTRADE (IEEE C37.111-1999 compliant)

DC Analog Inputs Extended Range (SEL-2245-22 in DC Mode)

Input Impedance

>7 MΩ

Input Range (Maximum)

0–300 V

Sampling Rate

24 ksps

Anti-Alias Filter

Corner Frequency:	5 kHz
Rolloff:	20 dB per decade

Digital Filter

Corner Frequency:	Filter A: 16 Hz Filter B: 10 Hz Filter C: 0.2 Hz
50 Hz Rejection:	Filter A: > 30 dB Filter B: > 50 dB Filter C: > 70 dB
60 Hz Rejection:	Filter A: > 60 dB Filter B: > 70 dB Filter C: > 70 dB

Step Response

Group Delay (Pre-Filter):	5.3 ms
No Filter:	3 ms (10%–90% response)
Filter A:	23 ms (10%–90% response)
Filter B:	35 ms (10%–90% response)
Filter C:	700 ms (10%–90% response)

Common Mode Range

±250 Vdc between separate inputs
±250 Vac all inputs to chassis

Isolation

2500 Vrms between separate inputs
2500 Vrms all inputs to chassis

Accuracy at 25°C

ADC:	16 bit
Inputs:	0.25% of full scale typical 3% of full scale worst case

Accuracy Variation With Temperature (Inputs)

±0.015% per °C of full scale

Triggered Waveform Recording

Sampling Rate:	1, 2, 4, 8, 24 kHz
Record Duration:	0.1 second increments from 0.5 s to 144 s
Record Pre-Trigger:	0.05 s minimum to a maximum of (record length minus 0.05 s)
Waveform File Format:	COMTRADE (IEEE C37.111-1999 compliant)

DC Analog Outputs (SEL-2245-3)

Current Mode

Output Range:	–20.48 to +20.48 mA
Load Impedance:	0–750 Ω @ 20 mA, 100 µH

Voltage Mode

Output Range:	–10.24 to +10.24 volts
Load Impedance:	>2000 Ω, 1 µF

Step Response

1 ms (10%–90% response typical)

Isolation

2000 Vdc between outputs or ground

Accuracy at 25°C (Outputs)

Current Mode:	±0.3% of full-scale typical ±3% of full-scale worst case (average during an EMI event over a 1-second period)
Voltage Mode:	±0.2% of full-scale typical ±2% of full-scale worst case (average during an EMI event over a 1-second period)

Accuracy Variation With Temperature (Outputs)

±0.01% of full-scale/°K (current or voltage mode)

AC Metering Inputs (SEL-2245-4, SEL-2245-411, SEL-2245-221, and SEL-2245-22 Voltage Inputs in AC Mode)

Frequency:	50/60 Hz
Range:	45–65 Hz
Typical Accuracy	
SEL-2245-4 and SEL-2245-22:	±0.005 Hz above 20 V
SEL-2245-411 and SEL-2245-221:	±0.005 Hz above 500 mV
Worst-Case Accuracy	
SEL-2245-4 and SEL-2245-22:	±0.01 Hz above 20 V
SEL-2245-411 and SEL-2245-221:	±0.01 Hz above 500 mV
Phase Rotation:	ABC, ACB
Input Configuration:	3-Wire Delta, 4-Wire Wye
Update Interval	
Fundamental Metering:	200 Hz
RMS Metering:	5 Hz

Current Inputs Phase and Neutral

I_{NOM}:	1 A or 5 A (no setting required)
Measurement Range:	0.050–22 A Continuous 22–100 A Symmetrical for 25 s
Thermal Withstand Limit:	500 A for 1 s
Typical Accuracy:	±0.1% Fundamental @ f_{NOM} and > 0.6 A ±0.1% RMS @ f_{NOM} and > 0.6 A
Worst-Case Accuracy:	±2% ± 0.005 A Fundamental ±1% ± 0.005 A RMS
Angle	
Range:	±180°
Typical Accuracy:	±0.1° Fundamental @ f_{NOM} and > 0.6 A
Worst-Case Accuracy:	±2° @ f_{NOM}
Burden:	<0.1 VA @ I_{NOM}

Voltage Inputs (SEL-2245-4 and SEL-2245-22 in AC Mode)

V_{NOM}:	300 V

Measurement Range:	5–400 L-N, 9–693 L-L Vac
	  Fundamental/RMS
	5–300 L-N, 9–520 L-L Vac
	  Fundamental/RMS (UL)

Maximum:	600 L-N, 1039 L-L Vac Fundamental/RMS for 10 s
Typical Accuracy:	±0.1% Fundamental @ f_{NOM} and > 20 V ±0.1% RMS@ f_{NOM}
Worst-Case Accuracy:	±2% Fundamental @ f_{NOM} ±1% RMS plus ±0.05 V
Angle	
Range:	±180°
Typical Accuracy:	±0.1° @ f_{NOM} and >20 V
Worst-Case Accuracy:	±2° @ f_{NOM}
Burden:	<0.1 VA

LEA Voltage Inputs (SEL-2245-411 and SEL-2245-221)

V_{NOM}:	1.5 V
Measurement Range:	30 Vac peak 0.05–22 Vac RMS
Maximum:	300 V_{L-N} RMS for 10 s (surge)
Typical Accuracy:	±0.1% RMS@ f_{NOM} and >50 mV ±0.1% Fundamental @ f_{NOM} and >50 mV
Worst-Case Accuracy:	±3% ±1 mV @ f_{NOM} Fundamental/RMS
Angle	
Range:	±180°
Typical Accuracy:	±0.1° @ f_{NOM} and > 50 mV
Worst-Case Accuracy:	±2° @ f_{NOM}
Burden:	<0.1 VA

Sequence Components (SEL-2245-4)

Values:	I0, I1, I2, V0, V1, V2
Typical Accuracy	
Magnitude:	±0.2% @ f_{NOM} and V > 6.7 V, I > 0.6 A
Angle:	±0.2° @ f_{NOM} and V > 6.7 V, I > 0.6 A
Worst-Case Accuracy	
Magnitude:	±3% @ f_{NOM} and V > 6.7 V, I > 0.6 A
Angle:	±0.2° @ f_{NOM} and V > 6.7 V, I > 0.6 A

Power and Power Factor Per Phase and Three-Phase (SEL-2245-4)

PA, PB, PC, 3P	
Typical Accuracy:	0.1% @ PF > 0.1
Worst-Case Accuracy:	2%

QA, QB, QC, 3Q	
Typical Accuracy:	0.1% @ PF < 0.9
Worst-Case Accuracy:	2%
SA, SB, SC, 3S	
Typical Accuracy:	0.1%
Worst-Case Accuracy:	2%
PFA, PFB, PFC, 3PF	
Typical Accuracy:	0.1% @ PF > 0.1
Worst-Case Accuracy:	2%

Power and Power Factor Per Phase and Three-Phase (SEL-2245-411)

PA, PB, PC, 3P	
Typical Accuracy:	0.1% @ PF ≥ 0.5
Worst-Case Accuracy:	2%
QA, QB, QC, 3Q	
Typical Accuracy:	0.1% @ PF ≤ 0.98
Worst-Case Accuracy:	2%
SA, SB, SC, 3S	
Typical Accuracy:	0.1%
Worst-Case Accuracy:	2%
PFA, PFB, PFC, 3PF	
Typical Accuracy:	0.1% @ Unity PF
Worst-Case Accuracy:	2%

Synchrophasor

Conformance:	IEEE C37.118.1-2011 as amended by IEEE C37.118.1a-2014 IEEE C37.118.2-2011
Accuracy:	Level 1 as specified by IEEE C37.118
Measurements:	Software selectable (P or M class)
Voltage:	VA, VB, VC, VS
Current:	IA, IB, IC, IN
Positive-Sequence:	V1, I1
Periodic:	Frequency and df/dt
Processing Rate:	120 Hz
Frequency Resolution:	±1.25 mHz*
Calculated Power Resolution:	±0.1%*

* Resolution values tested on SEL-2245-4 with 69 V voltage inputs, 0.6 A to 1 A current inputs, and 49.5 to 50.5 Hz frequency range.

Message Rates (60 Hz nominal):	1, 2, 4, 5, 10, 12, 15, 20, 30, 60, and 120* (messages/second)
Message Rates (50 Hz nominal):	1, 2, 5, 10, 25, 50, and 100* (messages/second)

* This message rate is only supported on the SEL-2245-4 and SEL-2245-411 Axion modules. Message rates are supported on the SEL-3350, SEL-3555, and SEL-3560.

Triggered Waveform Recording (SEL-2245-4, SEL-2245-411, SEL-2245-22, and SEL-2245-221)

Sampling Rates:	1, 2, 4, 8, 24 kHz software selectable
Record Duration:	0.1 second increments from 0.5 s to specified maximum for each sample rate.
Maximum Record Duration:	6 s @ 24 kHz 18 s @ 8 kHz 36 s @ 4 kHz 72 s @ 2 kHz 144 s @ 1 kHz
Record Pre-Trigger:	0.05 s minimum to a maximum of (record length minus 0.05 s)
Waveform File Format:	COMTRADE (IEEE C37.111-1999 compliant)

AC Protection Inputs (SEL-2245-42)

Frequency

Rated:	50/60 Hz
Range:	40–90 Hz
Typical Accuracy:	±0.005 Hz above 20 V
Worst-Case Accuracy:	±0.01 Hz above 20 V (±0.1 Hz for < 2.5 cycles during transients)

Phase Rotation

ABC, ACB

Input Configuration

3-Wire Delta, 4-Wire Wye

Update Interval

Fundamental Metering:	250 Hz
RMS Metering:	250 Hz
RMS Window Size:	1 cycle

AC Current Channels

Nominal Current:	1 A_{RMS} or 5 A_{RMS} (no setting required)
Current Range Rating (With DC Offset at X/R = 10, 1.5 Cycles):	0.1–91 A
Operational Range:	0.1–300 A_{RMS}
Measurement Range:	0.1–20 A_{RMS}
Thermal Withstand Limit:	15 A_{RMS} continuous 500 A_{RMS} for one second

Fundamental Measurement Accuracy

Magnitude:	±0.1%, typical, ±0.001 A ±2%, worst case, ±0.001 A
Phase:	±0.1°, typical at f_{NOM} and current > 0.4 A ±1°, over full rated temperature range ±2°, worst case

RMS Measurement Accuracy

Magnitude:	±0.1%, typical, ±0.001 A ±2%, worst case, ±0.001 A
Burden:	<0.1 VA

AC Voltage Channels

Rated Range:	67–240 V_{L-N}

Note: Rated Range refers to the IEEE C37.118 rating system.

Operational Range:	0–300 V_{L-N}
Accuracy Range:	6.7–300 V_{L-N}
Rated Insulation Voltage:	300 V_{L-N} continuous 600 V_{L-N} for ten seconds

Isolation (Galvanic Isolated Channels)

Channel-to-Ground:	2.5 kV_{RMS} for one minute
Channel-to-Channel:	2.5 kV_{RMS} for one minute

Fundamental Measurement Accuracy

Magnitude:	±0.1%, typical, plus ±0.05 V ±3%, worst case, plus ±0.05 V
Phase:	±0.1° @ f_{NOM}, typical ±1° @ f_{NOM}, over full rated temperature range ±2° @ f_{NOM}, worst case

RMS Measurement Accuracy

Magnitude:	±0.1%, typical, plus ±0.05 V ±3%, worst case, plus ±0.05 V
Burden:	<0.01 VA @ 67 V Impedance >500 kΩ

Sequence Components

Values:	I0, I1, I2, V0, V1, V2

Note: Sequence components are of the fundamental frequency.

Accuracy

Magnitude:	±1%, typical
Angle:	±0.5°, typical

Power and Power Factor (Per-Phase and Three-Phase)

Values:	PA, PB, PC, PAB, PBC, PCA QA, QB, QC, QAB, QAC, QCA SA, SB, SC, SAB, SBC, SCA PFA, PFB, PFC, P3, Q3, S3, PF3
Accuracy:	±1%, typical

THD and Noise (Accuracy)

±5% of measurement plus ±0.25%

Synchrophasors

Conformance:	IEEE C37.118.1-2011 as amended by IEEE C37.118.1a-2014 IEEE C37.118.2-2011
Accuracy:	Level 1 as specified by IEEE C37.118
Measurements:	Software selectable (P or M Class)
Voltage:	VA, VB, VC
Current:	IA, IB, IC
Positive-Sequence:	V1, I1
Periodic:	Frequency and df/dt
Processing Rate:	120 Hz
Frequency Resolution:	±1.25 mHz*
Calculated Power Resolution:	±0.1%*

* Resolution values tested with 69 V voltage inputs, 0.6 A to 1 A current inputs, and 49.5 to 50.5 Hz frequency range.

Message Rates (60 Hz nominal):	1, 2, 4, 5, 10, 12, 15, 20, 30, 60, and 120* (messages/second)
Message Rates (50 Hz nominal):	1, 2, 5, 10, 25, 50, and 100* (messages/second)

* Message rates are supported on the SEL-3350, SEL-3555, and SEL-3560.

Triggered Waveform Recording

Sampling Rates:	1, 2, 4, 8, 24 kHz software selectable

Transient Fault Record Length

Individual Records as Long as:	24 s for 24 kHz 72 s for 8 kHz 144 s for 4 kHz 288 s for 2 kHz 576 s for 1 kHz
Pre-Fault Time:	0.05 s to (max. event length – 0.05 s)
Data Format:	IEEE C37.111-2013 COMTRADE
File Naming:	IEEE C37.232 COMNAME

Fuse Rating

Non-Serviceable:	2.5 A, 125 V, time lag T

Technical Support

We appreciate your interest in SEL products and services. If you have questions or comments, please contact us at:

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