SEL-2241 Real-Time Automation Controller (RTAC)

Each SEL Axion® system requires an RTAC module to serve as the system CPU. The SEL-2241 RTAC has all of the communications and custom logic capabilities of the standalone RTAC modules, but is mounted in and receives power from the Axion backplane.

Front Panel

The following figure shows the RTAC status LEDs that aid system troubleshooting and the connectors for communications and wiring.

Figure 1 SEL-2241 RTAC Front Panel, Copper Ethernet

Mechanical Installation

Each SEL-2242 chassis/backplane has ten slots, labeled **A** through **J**. Only Slot **A** supports the SEL-2241 RTAC module.

To install the RTAC, tip the top of the module away from the chassis, align the notch on the bottom of the module with Slot **A** of the chassis, and place the module on the bottom lip of the chassis as *Figure 2* illustrates. The module is aligned properly when it rests entirely on the lip of the chassis.

Figure 2 Proper Module Placement

Next, carefully rotate the module into the chassis, making sure that the alignment pin fits into the corresponding slot at the top of the chassis (refer to *Figure 3*). Finally, press the module firmly into the chassis and tighten the chassis retaining screw.

Figure 3 Final Module Alignment

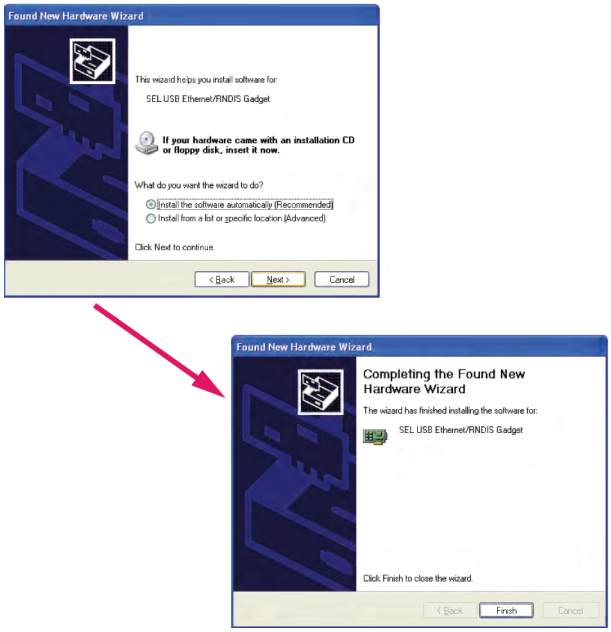
Connections

Communications Ports

NOTE: Never connect two RTACs via USB to one PC.

All web access, settings changes, and ODBC connections use either the RTAC Ethernet ports or the front USB type B port. Until you have configured the Ethernet interfaces on the RTAC, you will need to use the supplied USB type B cable to access the RTAC web interface. The ACSELERATOR RTAC installation will place the required USB driver on your PC so that you can allow Windows to install the driver automatically when it detects the USB connection. Plug the USB cable into the RTAC and into your PC. If you receive a prompt to connect to Windows Update, select **No, not at this time** and press **Next**. Then use the Windows Device Installation Wizard and follow the automatic install prompts to install the SEL USB driver.

After completing this step, you can use IP address 172.29.131.1 to access the RTAC web interface through the USB cable. See *Section 7: Security and Account Management* in the *ACSELERATOR RTAC SEL-5033 Instruction Manual* for RTAC web password setup.



The SEL-2241 has four nonisolated serial ports. You can select all RTAC serial ports through software to be either EIA-232 or EIA-485/EIA-422. You can configure any serial protocol on the RTAC to use any of these serial ports. See *Table 1* for the pinout of the RTAC serial ports.

Table 1 Nonisolated Female DB-9 Ports

EIA-232	EIA-485/EIA-422
Pin 1: N/C or +5 Vdc (also DCD input on COM 1 if +5 Vdc is disabled)	Pin 1: N/C or +5 Vdc (also DCD input on COM 1 if +5 Vdc is disabled)
Pin 2: RXD	Pin 2: -RXD
Pin 3: TXD	Pin 3: -TXD
Pin 4: +IRIG-B (DTR jumper option for COM 1)	Pin 4: +IRIG-B
Pin 5: GND	Pin 5: GND
Pin 6: -IRIG-B (DSR jumper option for COM 1)	Pin 6: –IRIG-B
Pin 7: RTS	Pin 7: +TXD
Pin 8: CTS	Pin 8: +RXD
Pin 9: GND	Pin 9: GND

Table 2 Port Characteristics

Port	Port Interface	Cables
USB B	USB Type B to USB Type A	SEL-C664
ETH 1 and ETH 2	10/100BASE-T (RJ45 for Copper)	SEL-C627
COM 1–COM 4 (serial)	EIA-232 (Nonisolated)	SEL-C234A, SEL-273A, and SEL-C387 are popular selections
IRIG-B INput	Female BNC	SEL-C953
IRIG-B OUTput	Female BNC	SEL-C953

Outputs

Refer to *Specifications on page 4* for output contact ratings and *Figure* for terminal assignments. Configure the contact output under SystemTags (Contact Outputs Tab) in ACSELERATOR RTAC. You can change the name of the point, create an alias tag name, and initialize status values. The RTAC will use the initialized value until run time, when it uses the actual value.

Figure 4 shows that a trip coil has a resistive and inductive component. After a trip output has been closed for a long time, the current settles to a steady-state value. When the trip output opens, it tries to interrupt the inductive current that wants to continue to flow (V = L di/dt). This attempted interruption of current causes a large voltage spike that can turn into an arc. When the contacts bounce during the arc, they often weld closed. SEL has designed, tested, and specified the outputs for this application to prevent any such welding. See the *Breaking Capacity on page 5*.

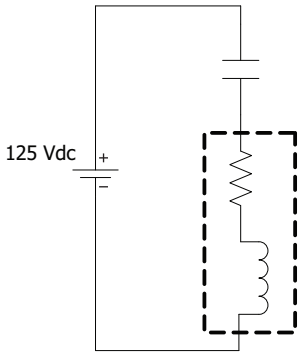


Figure 4 Inductive Interrupt of a Trip Output

LED Indicators

In addition to LEDs representing module status and communications activity, the SEL-2241 has three user-programmable bi-color LEDs. Configure these LEDs under SystemTags (LEDs Tab) in ACSELERATOR RTAC.

Field Serviceability

You can upgrade RTAC firmware and custom programming in the field or remotely over Ethernet. Self-tests provide status indication of errant conditions that can occur in the RTAC. You can map one or a combination of these or other status indications to the alarm contact to create a diagnostic alarm.

The real time clock battery and power coupler fuses are the only field-serviceable parts. Return all modules to SEL for any other servicing or maintenance.

The battery and fuses are only serviceable on units that are fully disconnected from any hazardous live voltage (such as connections to input power or OUT101).

Module Replacement

To replace the SEL-2241 RTAC, perform the following steps.

Step 1. Back up all RTAC settings. See *Section 1: Getting Started* in the *SEL-5033 Instruction Manual* for instructions on how to back up and restore RTAC projects.

Step 2. De-energize any power source connected to the power coupler(s) in the Axion node.

Step 3. Loosen retaining screws and remove the terminal strip for the alarm contact. Disconnect all communications cables.

Step 4. Loosen the chassis retaining screw at the top of the module.

Step 5. Tip the top of the module away from the chassis and lift it from the bottom lip.

Step 6. Install the new module according to the applicable mechanical installation instructions in this section.

Step 7. Make all necessary connections to the module according to the applicable connection instructions in this section.

Step 8. Apply power to the Axion node.

Step 9. Use IP address 172.29.131.1 to access the RTAC web interface through the supplied USB cable. See *Section 7: Security and Account Management* in the *SEL-5033 Instruction Manual* for RTAC web password setup. Also enable all necessary communications ports.

Step 10. Download the settings project from ACSELERATOR RTAC.

Real-Time Clock Battery Replacement

The only field-replaceable component is the real-time clock battery, which cannot be recharged. A lithium battery powers the clock (date and time) during loss or removal of the external power source. The battery is a 3 V lithium coin cell, Rayovac no. BR1632 or equivalent. At room temperature (25°C), the battery will operate nominally for ten years. When the device receives power from an external source, the battery experiences a low self-discharge rate. Thus, battery life can extend well beyond ten years.

To replace the real-time clock battery, perform the following steps.

Step 1. Follow the *SEL-2241 Disassembly* instructions to expose the circuit board.

Step 2. Locate the battery clip (holder) on the board.

Step 3. Carefully remove the battery from beneath the clip. Properly dispose of the old battery.

Step 4. Install the new battery with the positive (+) side facing up.

Step 5. Follow the *SEL-2241 Reassembly* instructions.

Step 6. Set the device date and time.

⚠DANGER
Disconnect or de-energize all external connections before opening this device. Contact with hazardous voltages and currents inside this device can cause electrical shock resulting in injury or death.

⚠CAUTION
The device contains devices sensitive to Electrostatic Discharge (ESD). When working on the device with the front panel removed, work surfaces and personnel must be properly grounded or equipment damage may result.

Jumpers

The SEL-2241 RTAC jumpers come preset and should not be moved except as *Section 3: Factory Reset* in the *SEL-2240 Instruction Manual* describes. *Table 3* shows the configurable jumper positions.

Table 3 Configurable Jumper Positions

Jumper	Position
JMP1	OPEN[a]
JMP2	OPEN[a]
JMP3	OPEN[a]
JMP4	1–2[a] Routes IRIG-B+ to COM 1 Pin 4 3–4 Routes DTR signal to COM 1 Pin 4 5–6[a] Routes IRIG-B ground to COM 1 Pin 6 7–8 Routes DSR signal to COM 1 Pin 6

[a] Factory-default position.

SEL-2241 Disassembly

To disassemble the SEL-2241 RTAC, perform the following steps.

Step 1. Disconnect any hazardous live voltage (such as connections to input power or OUT101).

Step 2. Follow the *Module Replacement* instructions.

Step 3. Remove the six retaining screws (two top, two rear, two bottom).

Step 4. Place the module on its side and lift the cover to expose the circuit board.

SEL-2241 Reassembly

To reassemble the SEL-2241 RTAC, perform the following steps.

Step 1. Gently close the cover until the retaining screw holes are aligned.

Step 2. Replace the six retaining screws.

Step 3. Follow the *Mechanical Installation* instructions.

Specifications

Compliance

Designed and manufactured under an ISO 9001 certified quality management system

UL Listed to U.S. and Canadian safety standards (File E220228; NRAQ, NRAQ7)

CE Mark

UKCA Mark

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 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.

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* in the *SEL-2240 Instruction Manual* for relay dimensions.

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, SNP, 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

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 Single-Mode or Multimode (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 115200 bps
Connector:	DB-9 Female
Time Synchronization:	IRIG-B
Power:	+5 Vdc power on Pin 1 (500 mA maximum per SEL-2241)

USB Ports

Device Ports:	1 Type B

Output Contact

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

Type Tests

Environmental Tests

Enclosure Protection:	IEC 60529:2001 + CRGD:2003 IP3X excluding the terminal blocks
Vibration Resistance:	IEC 60255-21-1:1988 Vibration Endurance, Severity: Class 2 Vibration Response, Severity: Class 2
Shock Resistance:	IEC 60255-21-2:1988 Bump Withstand, Severity: Class 1 Shock Withstand, Severity: Class 1 Shock Response, Severity: Class 2
Seismic:	IEC 60255-21-3:1993 Quake Response, Severity: Class 2
Cold, Operational and Cold, Storage:	IEC 60068-2-1:2007 –40°C, 16 hours
Dry Heat, Operation and Dry Heat, Storage:	IEC 60068-2-2:2007 +85°C, 16 hours
Damp Heat, Cyclic:	IEC 60068-2-30:2005 25°C to 55°C, 6 cycles, 95% relative humidity
Damp Heat, Steady State:	IEC 60068-2-78:2012 93% RH and 55°C for 10 days
Change of Temperature:	IEC 60068-2-14:2009 1 deg. per minute, –40° and +85°C, 5 cycles

Dielectric Strength and Impulse Tests

Impulse:	IEC 60255-5:2000 Severity Level: 0.5 J, 5 kV contact outputs; 0.5 J, 2 kV IRIG-B IN; 0.5 J, 1.5 kV Ethernet ports IEEE C37.90:2005 Severity Level: 0.5 J, 5 kV contact outputs; 0.5 J, 2 kV IRIG-B IN; 0.5 J, 1.5 kV Ethernet ports
Dielectric (HiPot):	IEC 60255-5:2000 Severity Level: 2.5 kVac on contact output for 1 minute; 2 kVdc on IRIG-B IN and Ethernet ports for 1 minute IEEE C37.90:2005 Severity Level: 2.5 kVac on contact output for 1 minute; 2 kVdc on IRIG-B IN and Ethernet ports for 1 minute
Insulation:	IEC 60255-5:2000 Severity Level: 500 V for greater than 1 minute

RFI and Interference Tests

EMC Immunity

Slow Damped Oscillatory Waves:	IEC 61000-4-18:2006 + A1:2010 Severity Level: 2.5 kV OUT101 common mode 1 kV differential mode 1 kV for Ethernet, Comms, IRIG
Electrostatic Discharge Immunity:	IEEE C37.90.3:2001 IEC 60255-22-2:2008 IEC 61000-4-2:2008 Severity Level 4 8 kV contact discharge 15 kV air discharge
Radiated RF Immunity:	IEEE C37.90.2:2004 Severity Level: 35 V/m IEC 61000-4-3:2008 Severity Level: 10 V/m IEC 60255-22-3:2007 Severity Level: 10 V/m
Digital Radio Telephone RF Immunity:	ENV 50204:1995 Severity Level: 10 V/m at 900 MHz and 1.89 GHz
Conducted RF Immunity:	IEC 60255-22-6:2001 Severity Level: 10 Vrms IEC 61000-4-6:2008 Severity Level: 10 Vrms
Surge Immunity:	IEC 60255-22-5:2008 Severity Level: 1 kV Line to Line, 2 kV Line to Earth IEC 61000-4-5:2005 Severity Level: 1 kV Line to Line, 2 kV Line to Earth
Fast Transient, Burst Immunity:	IEC 60255-22-4:2008 Severity Level: Class A: 4 kV, 5 kHz; 2 kV, 5 kHz on communications ports IEC 61000-4-4:2004 + CRGD:2006 Severity Level: 4 kV, 5 kHz
Power Supply Immunity:	IEC 61000-4-11:2004 IEC 61000-4-29:2000 IEC 60255-11:2008
Magnetic Field Immunity:	IEC 61000-4-8:2009 Severity Level: 1000 A/m for 3 seconds, 100 A/m for 1 minute IEC 61000-4-10:2001 Severity Level: 100 A/m
Surge Withstand Capability Immunity:	IEEE C37.90.1:2002, 2.5 kV oscillatory, 4 kV fast transient
Oscillatory Waves Immunity:	IEC 61000-4-12:2006 Ring Wave: 2 kV common, 1.0 kV differential Oscillatory: 2.5 kV common, 1.0 kV differential
Common Mode Disturbance Immunity:	IEC 61000-4-16:2002 Frequency: 0 Hz to 150 Hz Severity: Level 4, segment 4: 30 Vrms open-circuit, 15–150 kHz

Emissions

Radiated and Conducted Emissions:	IEC 60255-25:2000 FCC 15-107:2014 FCC 15-109:2014 Severity Level: Class A Canada ICES-001 (A) / NMB-001 (A)

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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