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](image)

**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 (shown in Figure 2) with Slot A of the chassis, and place the module on the bottom lip of the chassis as Figure 3 illustrates. The module is aligned properly when it rests entirely on the lip of the chassis.
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 4). Finally, press the module firmly into the chassis and tighten the chassis retaining screw.

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.
Outputs

Refer to Specifications on page 5 for output contact ratings and Figure 3 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 5 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 6.

Table 1 Nonisolated Female DB-9 Ports

<table>
<thead>
<tr>
<th>Port</th>
<th>Port Interface</th>
<th>Cables</th>
</tr>
</thead>
<tbody>
<tr>
<td>EIA-232</td>
<td>Pin 1: N/C or +5 Vdc (also DCD input on COM 1 if +5 Vdc is disabled)</td>
<td>Pin 1: N/C or +5 Vdc (also DCD input on COM 1 if +5 Vdc is disabled)</td>
</tr>
<tr>
<td>Pin 2: RXD</td>
<td>Pin 2: -RXD</td>
<td></td>
</tr>
<tr>
<td>Pin 3: TXD</td>
<td>Pin 3: -TXD</td>
<td></td>
</tr>
<tr>
<td>Pin 4: +IRIG-B (DTR jumper option for COM 1)</td>
<td>Pin 4: +IRIG-B</td>
<td></td>
</tr>
<tr>
<td>Pin 5: GND</td>
<td>Pin 5: GND</td>
<td></td>
</tr>
<tr>
<td>Pin 6: -IRIG-B (DSR jumper option for COM 1)</td>
<td>Pin 6: -IRIG-B</td>
<td></td>
</tr>
<tr>
<td>Pin 7: RTS</td>
<td>Pin 7: +TXD</td>
<td></td>
</tr>
<tr>
<td>Pin 8: CTS</td>
<td>Pin 8: +RXD</td>
<td></td>
</tr>
<tr>
<td>Pin 9: GND</td>
<td>Pin 9: GND</td>
<td></td>
</tr>
</tbody>
</table>

Table 2 Port Characteristics

<table>
<thead>
<tr>
<th>Port</th>
<th>Port Interface</th>
<th>Cables</th>
</tr>
</thead>
<tbody>
<tr>
<td>USB B</td>
<td>USB Type B to USB Type A</td>
<td>SEL-C664</td>
</tr>
<tr>
<td>ETH 1 and ETH 2</td>
<td>10/100BASE-T (RJ45 for Copper)</td>
<td>SEL-C627</td>
</tr>
<tr>
<td>COM 1–COM 4 (serial)</td>
<td>EIA-232 (Nonisolated)</td>
<td>SEL-C234A, SEL-273A, and SEL-C387 are popular selections</td>
</tr>
<tr>
<td>IRIG-B IN</td>
<td>Female BNC</td>
<td>SEL-C953</td>
</tr>
<tr>
<td>IRIG-B OUT</td>
<td>Female BNC</td>
<td>SEL-C953</td>
</tr>
</tbody>
</table>

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.

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>
<thead>
<tr>
<th>Jumper</th>
<th>Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>JMP1</td>
<td>OPEN(^a)</td>
</tr>
<tr>
<td>JMP2</td>
<td>OPEN(^a)</td>
</tr>
<tr>
<td>JMP3</td>
<td>OPEN(^a)</td>
</tr>
<tr>
<td>JMP4</td>
<td>1–2(^a) Routes IRIG-B+ to COM 1 Pin 4&lt;br&gt;3–4 Routes DTR signal to COM 1 Pin 4&lt;br&gt;5–6(^a) Routes IRIG-B ground to COM 1 Pin 6&lt;br&gt;7–8 Routes DSR signal to COM 1 Pin 6</td>
</tr>
</tbody>
</table>

\(^a\) Factory-default position.

SEL-2241 Disassembly

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

Step 1. Follow the Module Replacement instructions.
Step 2. Remove the six retaining screws (two top, two rear, two bottom).
Step 3. 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

### General

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

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

### Dimensions
- Refer to Section 2: Installation for relay dimensions.

### Weight (Fully Populated Node)
- 7.26 kg (16 lb)

### 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, CDC Type II, Courier, IEC 60870-5-103, EtherNet/IP Implicit Message Adapter

**Server:**

- Peer-to-Peer: SEL MIRRORED BITS Communications, IEC 61850 GOOSE, Network Global Variables (NGVL)
- 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: \( V_{ih} > 2.2 \text{ V} \)
- Off (0) State: \( V_{il} < 0.8 \text{ V} \)
- Input Impedance: 2 kΩ
- Accuracy: 500 ns

### Time-Code Output (IRIG-B)
- On (1) State: \( V_{oh} > 2.4 \text{ V} \)
- Off (0) State: \( V_{ol} < 0.8 \text{ V} \)
- Load: 50 Ω

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

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

### Communications Ports

#### Ethernet Ports (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)

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 (Ith) 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

Communication Product Testing
IEEE 1613-2009 + A1-2011 Performance Class 1

Environmental Tests
IP3X excluding the terminal blocks
Vibration Resistance: IEC 60255-1:1988
Vibration Endurance, Severity: Class 2
Vibration Response, Severity: Class 1
Bump Test, Severity: Class 1
Shock Withstand, Severity: Class 1
Shock Response, Severity: Class 1
Seismic: IEC 60255-1:1993
Quake Response, Severity: Class 1
Cold: IEC 60068-2-1:1997
–40°C, 16 hours
+85°C, 16 hours
Damp Heat, Cyclic: IEC 60606-2-30:2005
25°C to 55°C, 6 cycles, 95% relative humidity

Dielectric Strength and Impulse Tests
Impulse: IEC 60255-5:2000
Severity Level: 0.5 J, 5 kV
IEEE C37.90.2005 Severity Level: 0.5 J, 5 kV
Dielectric (HiPot): IEC 60255-5:2000
Severity Level: 2500 Vac on contact and outputs for 1 minute
IEEE C37.90.2005 Severity Level: 2500 Vac on contact and outputs for 1 minute
Insulation: IEC 60255-5:2000
Severity Level: 500 V for greater than 1 minute

RFI and Interference Tests
EMC Immunity
Electrostatic Discharge Immunity: IEEE C37.90.3:2001
IEEE 60255-22-2:2008
IEEE 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
IEEE 61000-4-3:2008
Severity Level: 10 V/m
IEEE 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

    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
    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
    IEC 60255-22-1:2007
    2.5 kV common-mode
    1.0 kV differential-mode

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
    Severity Level: Class A