



# SEL-3031 Serial Radio Transceiver

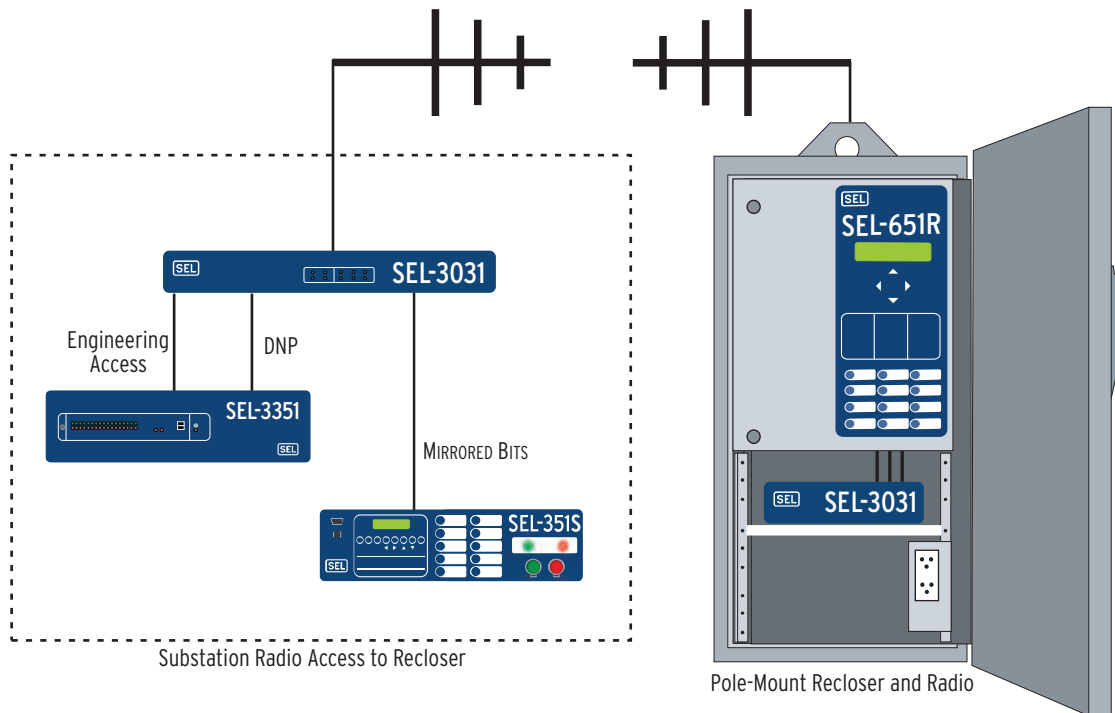
## 900-MHz Frequency-Hopping, Spread-Spectrum, Serial Encrypting Radio



### Major Features and Benefits

- ▶ **Dual Radio Operating Modes Provide Flexibility.** Supports point-to-point radio operation for fast teleprotection, distribution automation, distributed generation and economical backup protection. Provides point-to-multipoint (P2MP) radio operation for SCADA and other data gathering from remote locations.
- ▶ **Three Ports in One Radio Reduce Costs.** Simultaneously communicates with up to three independent ports and protocols.
- ▶ **Low Latency Enables Fast Control.** Transfers control commands with a typical 4.8-millisecond latency with SEL MIRRORED BITS<sup>®</sup> communications.
- ▶ **Strong Security Thwarts Attackers.** Protects critical data and repels malicious attacks with optional encryption card, using session authentication and strong 256-bit Advanced Encryption Standard (AES) technology.
- ▶ **Tough Radio Operates in Extreme Conditions.** Is designed, built, and tested for trouble-free operation in extreme temperature, electromagnetic interference, shock, and vibration conditions.
- ▶ **No Licensing Reduces Delays and Expenses.** Uses the license-free, 900-MHz ISM band for on-time, on-budget projects.
- ▶ **Mounting Options Simplify Installation.** Order your SEL-3031 in one of three different packages: rack-mount, wall-mount, and NEMA 3R prewired radio solution.
- ▶ **Multiple Protocols Satisfy Interconnection Requirements.** Communicate with industry-standardized byte-oriented protocols, such as DNP3, Modbus<sup>®</sup>, SEL MIRRORED BITS communications, IEEE C37.118 Synchrophasors, SEL Fast Messaging, and SEL ASCII.
- ▶ **Flexible Serial Port Options Match Integration Needs.** Order serial Port 1 as EIA-232, EIA-485, or optical fiber to easily connect to your existing devices.
- ▶ **Simple Settings Streamline Radio Commissioning.** Use ACSELEATOR QuickSet<sup>®</sup> SEL-5030 Software for all settings.
- ▶ **USB Management Port Conveniently Connects to PC.** Make settings changes, verify status information for proper installation, and verify radio performance without affecting the three serial channels.

# Product Overview



**Figure 1 SEL-3031 Product Overview**

With the SEL-3031, you no longer need three sets of radios or expensive dedicated fiber-optics to transmit communications over long distances. The SEL-3031 provides three serial wireless interfaces on one device, making it the ideal solution for communications

challenges. *Figure 1* illustrates an application option, including DNP3 SCADA information, MIRRORED BITS control for reclosing coordination, and engineering access to the SEL-651R recloser control.

## SEL-3031 Base Unit

### Standard Features

- Three EIA-232 serial ports
- IRIG-B time-code input
- Power supply
  - Wall mount 9–30 Vdc
  - Rack mount 24/48 Vdc or 125/250 Vdc or Vac
  - NEMA 3R enclosure 125/250 Vac or Vdc, optional backup battery
- Form B alarm contact
- ACSELERATOR QuickSet SEL-5030 Software

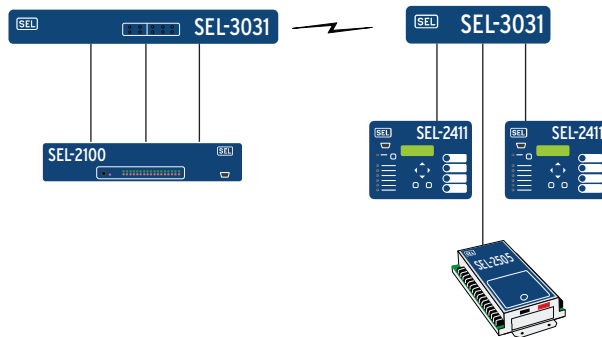
- +5 V pin 1 power for external transceivers
- Radio link statistics
- LEDs show protocol pass-through states per port on transmit and receive

### Optional Features

- Rack mount with internal substation power supply
- EIA-485 Port 1
- Fiber-optic Port 1 (SEL-2812 and SEL-9220-compatible)
- SEL-3044 Encryption Card (256-bit AES encryption)

# SEL-3031 Point-to-Point Applications

In a point-to-point application, SEL-3031 radios provide a direct connection between two devices. *Figure 2* shows an example point-to-point application. In this application, the communications path is a single line-of-sight, making directional antennas the preferred solution.

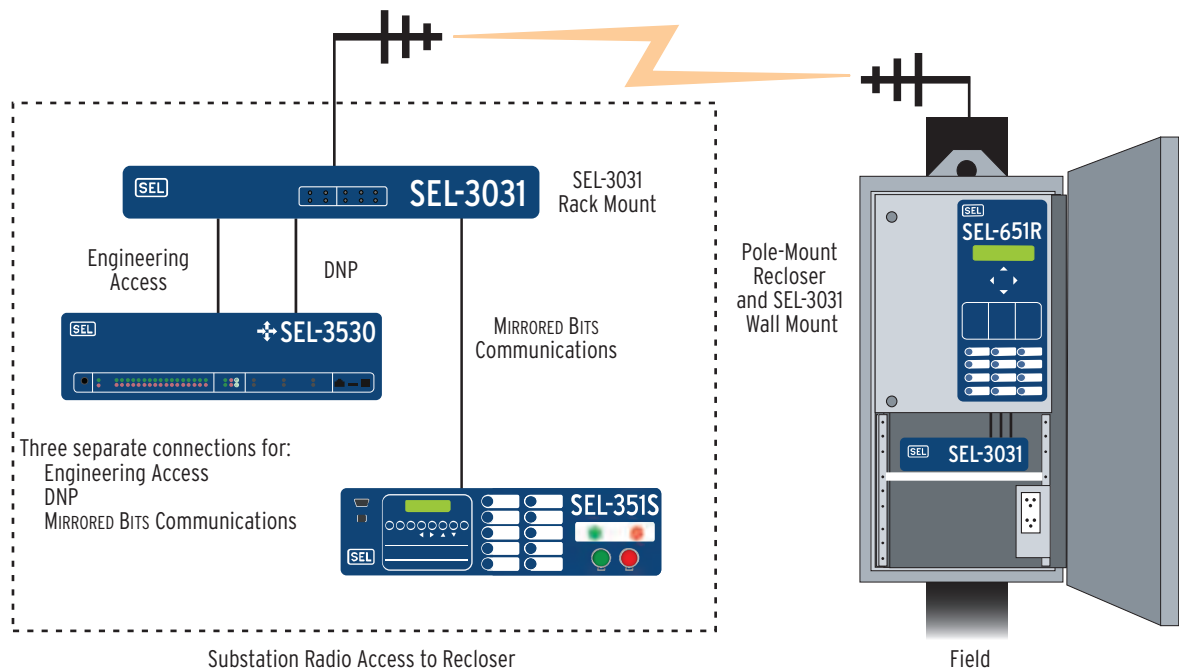


**Figure 2** Point-to-Point Communication

Point-to-point configurations are very useful when high-speed data are needed. The SEL-2100 processes and transfers all contact information passed through the SEL-2411 units and the SEL-2505.

## Recloser Control Access

With three serial ports on the SEL-3031 you can poll SCADA data, operate or control reclosing remotely, and include engineering access to the oscillographic event reports (see *Figure 3*). Normally, it would require installing multiple radios at one location to have access to all this information as well as rapid operation speed. The SEL-3031 allows you to install one radio and choose the type of information and protocol necessary for the application.



**Figure 3** Product Overview

## Remote Access Application

Many existing substations have no outside communication or use expensive, unreliable communication over leased lines. Other connection methods are often cost prohibitive or have right-of-way issues. One alternative is to use the SEL-3031 to send information to a local substation that has existing backhaul communications. *Figure 4* shows an example of how you can send information using the three serial ports on the radio. The SEL-3530 Real-Time Automation Controller (RTAC)

concentrates all the data in the remote substation and using DNP3 or SEL Fast Messaging sends back data to the local substation. The first RTAC port has all of the SCADA data from the remote substation. Another serial port, also going into the SEL-3530, provides engineering access to obtain event reports or SER (sequential events recorder) from any of the relays. Use the third port to transfer synchrophasor messages back to the local substation. Synchrophasors are powerful tools to determine the phase angle and power flow between substations.

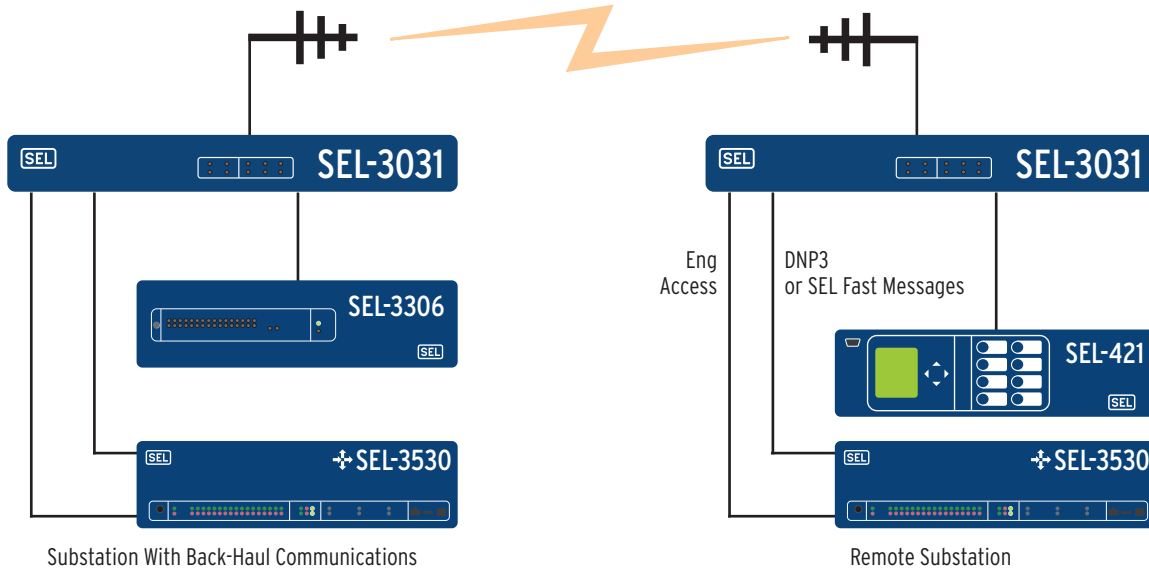


Figure 4 Remote Access

## Short-Distance Wireless I/O Application

In large, new or existing substations it can be difficult and expensive to add wiring or communications links to sense and control remote I/O points. The SEL-3031 can be used in applications where you need to transfer I/O

over a few hundred meters back to the control house. *Figure 5* demonstrates how you can use three SEL-2505 Remote I/O Modules to transmit the status of 24 inputs and control 24 outputs. All of this information is transferred using SEL MIRRORED BITS to an SEL-3530 RTAC. Adding the SEL-3044 Encryption Card to the SEL-3031 adds encryption for MIRRORED BITS.

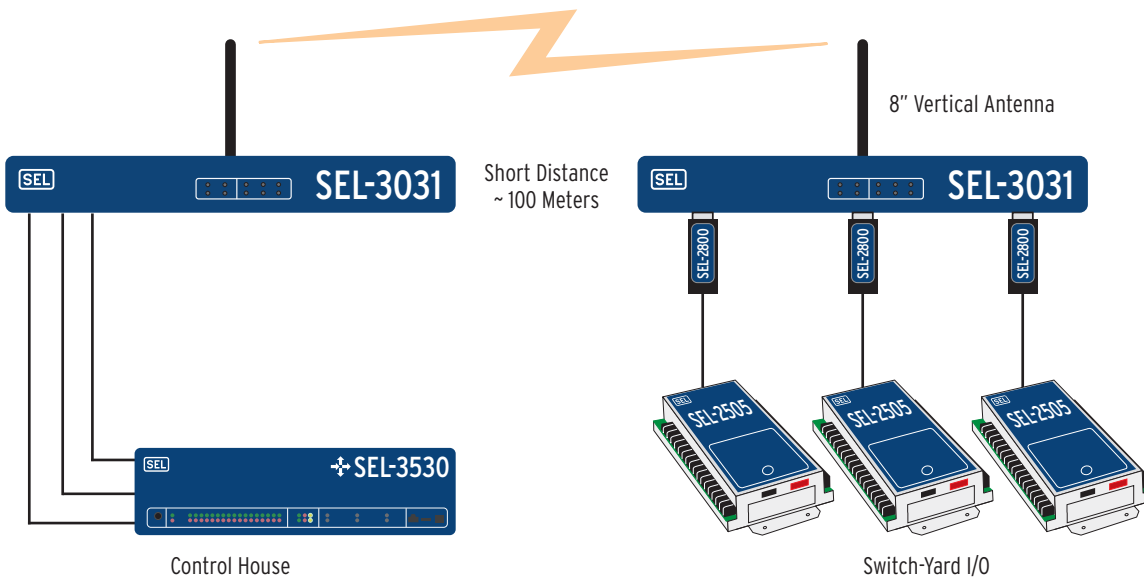


Figure 5 Short Distance Wireless I/O

# SEL-3031 Point-to-Multipoint Applications

Point-to-Multipoint (P2MP) offers flexibility when data gathering is needed from one central location. P2MP mode is designed to work with DNP3 or MODBUS to create a master/slave hierarchy where one master polls many slaves. P2MP configurations are useful when non-time critical data is needed from many locations.

## Metering and Control Application

Figure 6 shows how a common P2MP system would work using the SEL-3530 Real-Time Automation Controller (RTAC) as a data concentrator and SEL-651R as the remote devices. The RTAC transmits data to Port 1 of the Master SEL-3031. This data is wirelessly transmitted and received by all remote SEL-3031 radios. Each remote SEL-3031 transmits this message through Port 1 to the connected SEL-651R. All SEL-651R devices will see this transmitted message. The SEL-651R that has the correct address contained in the transmitted message will communicate back to the RTAC.

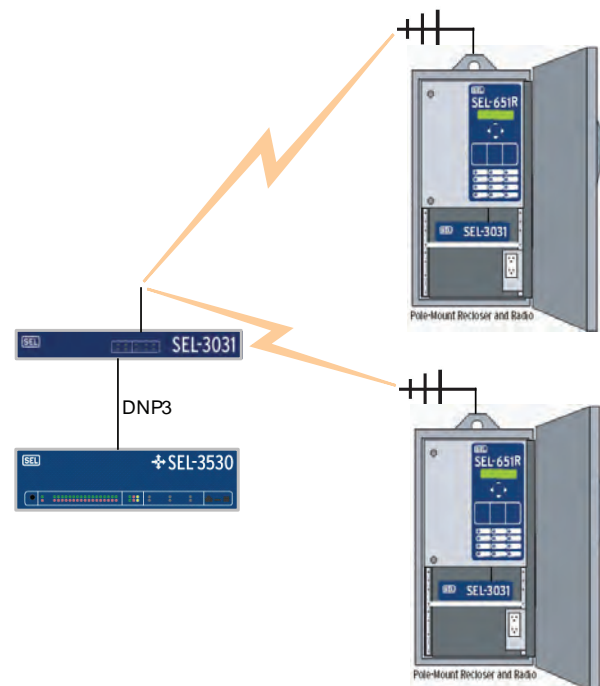


Figure 6 P2MP DNP3 SCADA Gathering

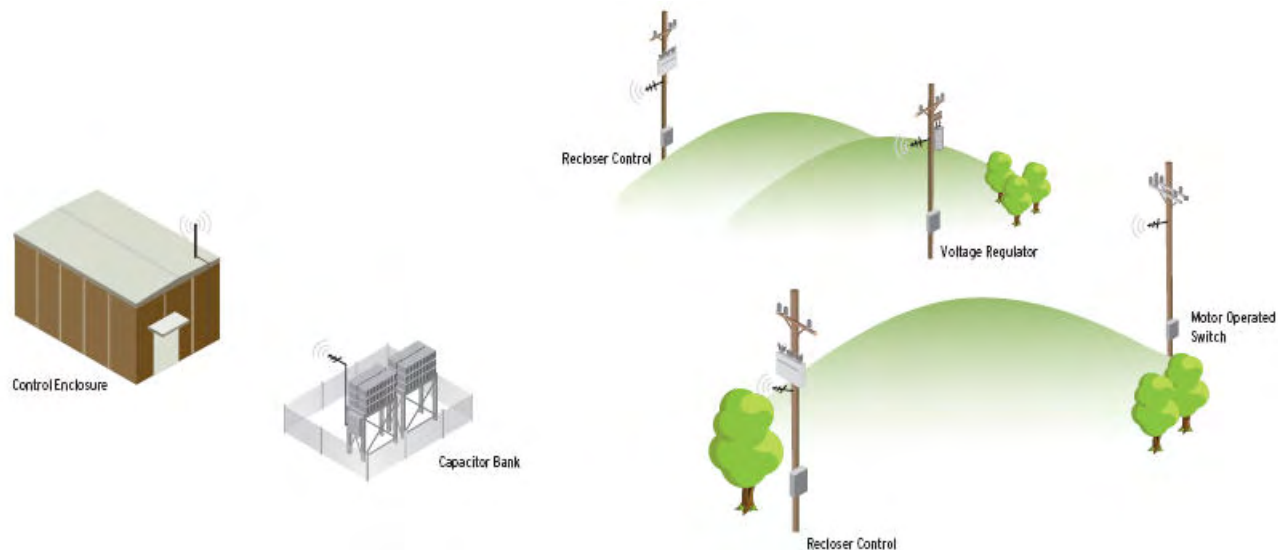


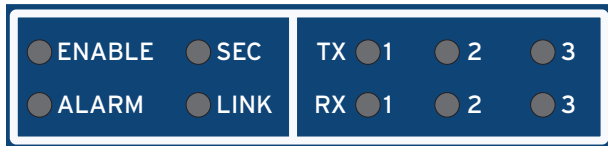
Figure 7 P2MP SCADA Data and Control

# SEL-3031 Features

## Indication and Function

The SEL-3031 front panel has 10 LEDs, as shown in *Figure 8*.

The **ENABLE** and **ALARM** LEDs provide radio system status updates and alerts should any hardware or software errors occur.



**Figure 8** Front-Panel LED Status Indication

The **SEC** LED is a multifunction LED that displays the status of the SEL encryption card (SEC). The LED indicates whether the encryption card is connected or enabled, and whether the card is properly set.

The **LINK** LED aids in installation and illuminates when the radio is properly linked.

The six **TX/RX** LEDs show communications activity on each of the three serial ports.

The rear-panel standard radio configuration is three EIA-232 ports, as shown in *Figure 9*.



**Figure 9** Rear Wall Mount

Port 1 can be ordered as EIA-232, EIA-485, or fiber-optic compatible with the SEL-2812.

The antenna connector is a standard TNC female connector. SEL offers a full line of antennas and antenna cables to meet your application needs. See the SEL-3031 Model Option Table (MOT) for more information on these accessories.

## Protocol Support

The SEL-3031 requires minimal settings to function with popular industry protocols. In P2P mode, each serial port can support a variety of protocols, including DNP3, Modbus, MIRRORING BITS, IEEE C37.118 Synchrophasors, and SEL ASCII. You can use different protocols on different ports simultaneously. In P2MP mode, only Port 1 is used and supports DNP3, MODBUS, or any other byte-oriented addressable protocol.

## Encryption

The SEL-3031 can be ordered with an optional SEL encryption card. This card is a cryptographically-secure way to transmit sensitive data by radio in a P2P or P2MP network. Frequency-hopping, spread-spectrum communication is not sufficient to deter hackers. The encryption card provides 256-bit AES encryption and is FIPS 140-2 validated. The card can be ordered with the SEL-3031, or added later as a field upgrade.



**Figure 10** SEL-3044 Encryption Card

The card provides data confidentiality by encrypting passwords and other sensitive data. The encryption card ensures that messages are not forged, modified, spliced, reordered, or replayed.

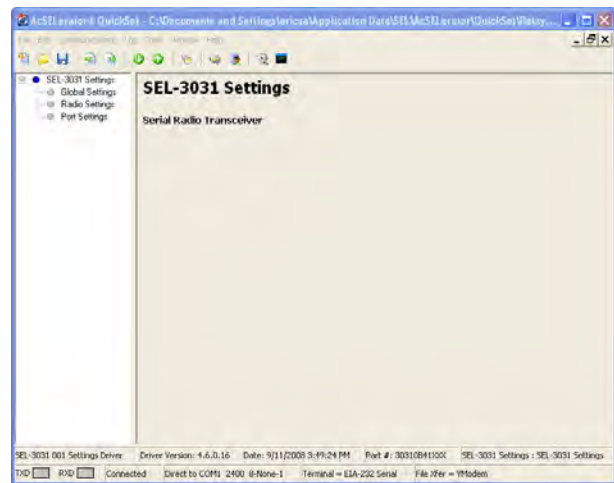
The local serial port connects to the device requiring data protection, e.g., SCADA, MIRRORING BITS, or RTU. The remote serial port connects through an untrusted wireless link to the other radio. The local interface exchanges plaintext (unencrypted) data between the protected device and the SEL-3031. The remote interface exchanges encrypted and/or authenticated data between the local and remote SEL-3031.

The serial port channel data speed is 19200 or 9600 bps when using the encryption card.

## Configuration and Commissioning Software

The included ACSELERATOR QuickSet software program simplifies device configuration and supports the following commissioning and analysis functions for the SEL-3031:

- Accesses settings creation help online
- Organizes settings with the device database manager
- Loads and retrieves settings using a simple USB communications link
- Monitors radio signal strength and power output during installation
- Shows radio link and frequency zone availability statistics



**Figure 11 ACSELERATOR QuickSet SEL-5030 Software**

# Mechanical Diagrams and Dimensions



Figure 12 SEL-3031 Rack-Mount Front Panel



Figure 13 SEL-3031 Rack-Mount Rear Panel



Figure 14 SEL-3031 Wall-Mount Front Panel



Figure 15 SEL-3031 Wall-Mount Rear Panel

## RACK-MOUNT CHASSIS

## WALL-MOUNT CHASSIS

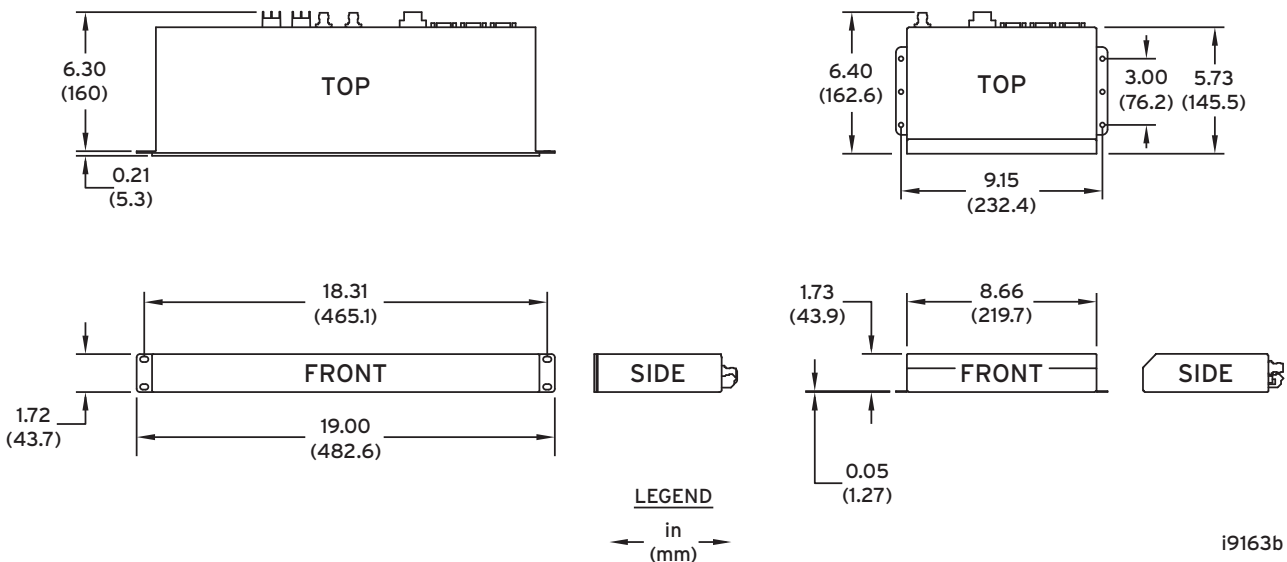


Figure 16 Rack- and Wall-Mount Dimensions

i9163b



# 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)  
 SEL-3044 Encryption Card  
 FIPS 140-2 validated  
 Also see *Table 1*.

## General

### Temperature Range

−40° to +85°C per IEC 60068-2-1 and 60068-2-2

### Operating Environment

Pollution Degree: 2  
 Relative Humidity: 5–95%, noncondensing  
 Maximum Altitude: 2000 m

### Dimensions

Wall Mount: 43.9 mm x 219.7 mm x 162.6 mm  
 (1.73 in x 8.66 in x 6.40 in)  
 Rack Mount: 43.7 mm x 482.6 mm x 160.0 mm  
 (1.72 in x 19.00 in x 6.3 in)

## Time-Code Input

### Port 2, Pins 4 and 6

Format: Demodulated IRIG-B  
 Input Impedance: 333 Ω  
 Accuracy: ± 5 milliseconds

## Alarm Contact

### Form B Contact

(open when energized and passes diagnostics)

Operating Voltage: 250 Vdc or 190 Vac  
 Dielectric Test Voltage: 500 Vrms  
 Continuous Carry: 6 A

## Communications

### Communications Ports

#### Serial Port 1

Data Speed Without Encryption Card: 38400 bps (disables Port 2), 19200 bps, or 9600 bps  
 Data Speed With Encryption Card: 19200 bps (disables Port 2) or 9600 bps

EIA-232, EIA-485 (ordering option)

Connector: 9-Pin Subminiature D

#### Fiber-Optic Ordering Option

Connectors: 2 ST (Tx and Rx)  
 Encoding SEL-2812/SEL-9220 Compatible  
 Wavelength: 850 nm multimode  
 Typical Tx Power: −13 dBm  
 Min. Rx Sensitivity: −29 dBm  
 Optical Budget: 16 dB  
 Compatible Fiber-Optic Core Diameter: 50, 62.5, or 200 μm

#### Serial Port 2, 3 Standard EIA-232

Data Speed Without Encryption Card: 19200 bps or 9600 bps  
 Data Speed With Encryption Card: 9600 bps  
 Connector: 9-Pin Subminiature D

### Protocols

Modbus, DNP3, SEL MIRRORRED BITS Communications (MB8), ACSELERATOR QuickSet SEL-5030 Software Support, SEL ASCII and Compressed ASCII, SEL Fast Messaging, IEEE C37.118 Synchronphasors

## Typical Latency

### SEL-3031

MIRRORRED BITS: 8.9 ms at 9600 bps  
 5.6 ms at 19200 bps  
 4.8 ms at 38400 bps  
 Standard: 4.9 ms at 9600 bps  
 4.3 ms at 19200 bps  
 3.8 ms at 38400 bps

### SEL-3031 With SEL-3044 Encryption Card

MIRRORRED BITS: 9.7 ms at 9600 bps  
 7.4 ms at 19200 bps  
 Standard: 5.7 ms at 9600 bps  
 5.3 ms at 19200 bps

## Radio

### Transmitter

Frequency Band: 902–928 MHz ISM band  
 Modulation: GFSK  
 Operating Mode: Point-to-Point  
 RF Connector: TNC  
 Power Output: 1 W (30 dBm) to 100 mW (20 dBm) in steps of 1 dBm  
 Channel Bandwidth: 250 kHz

### Receiver

Sensitivity: −97 dBm, −104 dBi with ARQ on  
 Bit Error Rate (BER): <10<sup>−6</sup> at −97 dBm  
 Distance: 20 miles, line of sight  
 Error Detection: 32-bit CRC

## Power Supply

### Rated Supply Voltage

Wall-Mount Model: 12/24 Vdc  
 Low-Voltage Model: 24/48 Vdc  
 High-Voltage Model: 125/250 Vdc  
 110/240 Vac, 50/60 Hz

### Input Voltage Range

Wall-Mount Model: 9–30 Vdc  
 Low-Voltage Model: 18–60 Vdc  
 High-Voltage Model: 85–275 Vdc; 85–264 Vac

### Power Consumption

Wall Mount: < 5 W  
 Rack Mount: < 7 W

**Power Consumption With SEL-3044 Card**

Wall Mount:	< 6 W
Rack Mount:	< 8 W

**Type Tests****Communications Equipment Tests**

IEEE 1613-2003

**Environmental Tests**

Enclosure Protection:	IEC 60529:2001
Vibration Resistance:	IEC 60255-21-1:1988 Class 1 Endurance, Class 2 Response IEC 60255-21-3:1993 Class 2
Shock Resistance:	IEC 60255-21-2:1988 Class 1 shock withstand, bump, Class 2 shock response
Cold:	IEC 60068-2-1:2007 -40°C, 16 hours
Damp Heat, Cyclic:	IEC 60068-2-30:2005 25-55°C, 6 cycles, 95% relative humidity
Dry Heat:	IEC 60068-2-2:2007 +85°C, 16 hours

**Dielectric Strength and Impulse Tests**

Dielectric (HiPot):	IEC 60255-5:2000 IEEE C37.90-2005
Impulse:	IEC 60255-5:2000 0.5 J, 5 kV

**RFI and Interference Tests****EMC Immunity**

Standard:	IEEE 1613, Class 2
Electrostatic Discharge:	IEC 61000-4-2:2008 Severity Level 4 8 kV contact discharge 15 kV air discharge IEEE C37.90.3-2001 Severity Level 4 8 kV contact discharge 15 kV air discharge
Radiated RF Immunity:	IEC 61000-4-3:2008 10 V/m IEEE C37.90.2-2004 35 V/m
Fast Transient, Burst Immunity:	IEC 61000-4-4:2004 4 kV @ 2.5 kHz, and 5.0 kHz for communications ports, power supply, alarm contacts

Surge Withstand Capability Immunity:	IEC 60255-22-1:2007 2.5 kV common-mode, 1 kV differential-mode IEEE C37.90.1-2002 2.5 kV oscillatory, 4 kV fast transient for communications ports, power supply, alarm contacts
Conducted RF Immunity:	IEC 61000-4-6:2008 10 Vrms
Digital Radio Telephone RF Immunity:	ENV 50204-1995 Severity Level 10 V/m at 900 MHz and 1.89 GHz

**EMC Emissions****Radiated Emissions**

FCC Part 15.247; ICES-001; RSS-210

This device complies with Part 15 of the FCC rules. Operation is subject to the following two conditions:

1. This device may not cause harmful interference, and
2. This device must accept any interference received, including interference that may cause undesired operation.

FCC Part 15, Class A; ICES-003

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment.

This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications.

Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

FCC Section 15.21

Users manual for an intentional or unintentional radiator shall caution the user that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

**Table 1 Government Approvals**

Country	Authority	Reference	Part Number Starts With
USA and Colombia	FCC	ID: R34SEL-3031	3031
Canada	IC	4468A - SEL3031	3031
Mexico	COFETEL	RCPSCE10 - 0574	3031
Brazil	ANATEL	ID: 2671-11-7001 EAN: (01)07898936514 02 8	30311

# Notes

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This product is covered by the standard SEL 10-year warranty. For warranty details, visit [www.selinc.com](http://www.selinc.com) or contact your customer service representative.

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