Major Features and Benefits

➤ **Two Operating Modes Provide Flexibility.** Supports point-to-point radio operation for higher performance and point-to-multipoint for efficient and economical data gathering from remote locations. In point-to-multipoint mode, as many as 63 nodes are supported and a repeater can be configured using two collocated radios.

➤ **Two RJ45 10/100BASE-T Ethernet Ports Provide Connectivity.** Offers a wireless LAN extension for an Ethernet LAN in a substation and compatibility with Ethernet field devices.

➤ **Operates in License-Free Frequency Bands for Simplicity and Lower Cost.** SEL-3060A uses the 900 MHz ISM band; SEL-3060B uses the 2.4 GHz ISM band.

➤ **Long-Range Operation Connects More Devices.** Supports communications links as far as 15 miles (SEL-3060A point-to-point), 10 miles (SEL-3060A point-to-multipoint and SEL-3060B point-to-point), or 7 miles (SEL-3060B point-to-multipoint).

➤ **High Data Rate for Higher Bandwidth Applications.** Transfers data at a rate of 1 Mbps, making the SEL-3060 suitable for synchrophasor data and surveillance video.

➤ **Offers Low Latency for Ethernet Control Applications.** Offers 6–12 ms latency for IEC 61850 GOOSE messages using point-to-point operation.

➤ **Low Power Requirements Reduce the Power Needed in Field Cabinets.** Requires less than 4 watts, making the SEL-3060 well-suited for battery backup in remote locations.

➤ **Operates in Harsh Environments.** Operates reliably between −40° and +85°C (−40° to +185°F), and complies with IEEE 1613, IEEE C37.90, and IEC 60255 standards.

➤ **Uses Encrypted Wireless Communication for Security.** Includes 128-bit AES encryption for wireless transmission. The SEL-3060 can also be paired with an SEL-3620 or SEL-3622 Security Gateway to increase security for the wired communication.

➤ **Easy-to-Use Interface Streamlines Radio Commissioning.** Includes intuitive SEL-3060 device webpage that simplifies configuration and management.
Product Overview

The SEL-3060 Ethernet Radio enables wireless communication from a substation to remote field devices for Distribution Automation applications including SCADA, Engineering Access, IEC 61850 GOOSE messaging, and synchrophasors. The SEL-3060 can also be used for primary or secondary wireless links between substations.

Standard Features

- Two RJ45 10/100 Ethernet ports
- Power input: 9–30 Vdc at less than 4 watts
- Output power: +20 dBm for SEL-3060A, +16 dBm ±2 dBm for SEL-3060B
- Receive sensitivity: –93 dBm at 1% packet error rate (PER) for SEL-3060A, –91 dBm at 5% PER for SEL-3060B
- Wall-mount chassis
- 128-bit AES encryption
- LEDs provide status and signal strength
- Web interface provides radio link statistics
- 10-year warranty

Applications

Distribution Automation

The primary application for SEL-3060 radios is providing communication for distribution automation. Typically, the radios are in a point-to-multipoint configuration with the access point in a control house at a substation. The radio nodes are located in cabinets with field devices, such as recloser controls, capacitor banks, voltage regulators, motor-operated switches, and meters.

The radios serve as cost-effective communications links to field devices and are much more affordable than running fiber cable. The communications link can be used for collecting SCADA information from field devices and for engineering access to devices. Because the SEL-3060 radio has a high data rate of 1 Mbps, the radio...
link can be used to collect synchrophasor data. Radio links can also be used for Ethernet-based control, such as IEC 61850 Generic Object-Oriented Substation Event (GOOSE) messaging.

**Substation to Substation**

![Primary Communications Link](image1)

![Secondary Communications Link](image2)

**Figure 3 Primary and Secondary Communications Links**

Two SEL-3060 radios can create a point-to-point link between two substations. This can be the primary communications link, or it can be a redundant link to a fiber cable. A point-to-point link utilizes two directional antennas and offers advantages for data rate, latency, and distance.

**Substation Surveillance Video**

![Transmit a Video Signal to the Control Enclosure](image3)

**Figure 4 Transmit a Video Signal to the Control Enclosure**

The high 1 Mbps data rate of the SEL-3060 makes it a good fit for transferring surveillance data from pole-mounted cameras to a digital video server in the substation control house. SEL-3060 wireless links allow users to retrofit a substation with cameras without digging trenches for new fiber cables between cameras and the control house.

**Connectivity to Serial Devices**

![Connect to Serial Devices](image4)

**Figure 5 Connect to Serial Devices**

The SEL-3060 can be connected to devices that only have serial ports through use of an SEL-2890 Ethernet Transceiver. Or, if security is important, the SEL-3622 can provide a Serial-to-Ethernet connection and also add security features like centralized access, activity logs, and VPN tunneling with IPsec.

**Repeater Mode**

![Repeater Mode](image5)

**Figure 6 Repeater Mode**

In radio networks, repeaters are commonly used to extend distances or route signals over a mountain or other obstacles to devices on the other side. In this example two SEL-3060 radios form a point-to-point link. At the repeater there is a second SEL-3060 which is the access point for a point-to-multipoint extension to three field devices. By using two radios at the repeater site, the throughput is not reduced and the range is maximized.
Configuration

SEL-3060 Discovery Tool

SEL offers a Window-based IP finder utility to easily find SEL-3060 radios and set their IP address. Then users can connect to each device radio webpage for configuration of the wireless settings (i.e., access point or node, number of nodes, etc.). After deploying the radios, the device webpage allows users to lock down the device to ensure that settings are not changed. The device webpage also includes a spectrum analyzer to use as a troubleshooting tool if radio interference problems occur.

Antenna Options

The following antennas are qualified for use with the SEL-3060 radio.

<table>
<thead>
<tr>
<th>Antenna Type</th>
<th>Maximum Allowed Gain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yagi antenna</td>
<td>16.15 dBi or less</td>
</tr>
<tr>
<td>Omnidirectional antenna</td>
<td>11.15 dBi or less</td>
</tr>
</tbody>
</table>

Table 1  Antennas Permitted for Use With the SEL-3060A 900 MHz Radio

<table>
<thead>
<tr>
<th>Antenna Type</th>
<th>Maximum Allowed Gain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yagi antenna</td>
<td>16.15 dBi or less</td>
</tr>
<tr>
<td>Omnidirectional antenna</td>
<td>15 dBi or less</td>
</tr>
<tr>
<td>Panel antenna</td>
<td>19 dBi or less</td>
</tr>
</tbody>
</table>

Table 2  Antennas Permitted for Use With the SEL-3060B 2.4 GHz Radio
SEL offers the following antennas as part of its complete radio solution.

### Table 3 900 MHz Antennas

<table>
<thead>
<tr>
<th>Name</th>
<th>SEL Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low-Profile 3 dBi Gain Omnidirectional, N Female Connector</td>
<td>235-0003</td>
</tr>
<tr>
<td>Vertical 7.15 dBi Gain Omnidirectional, N Female Connector</td>
<td>235-0232</td>
</tr>
<tr>
<td>Vertical 9.15 dBi Gain Omnidirectional, N Female Connector</td>
<td>235-0233</td>
</tr>
<tr>
<td>Three-Element 8.15 dBi Gain Yagi, N Female Connector</td>
<td>235-0009</td>
</tr>
<tr>
<td>Five-Element 11.1 dBi Gain Yagi, N Female Connector</td>
<td>235-0220</td>
</tr>
<tr>
<td>Eleven-Element 14.15 dBi Gain Yagi, N Female Connector</td>
<td>235-0222</td>
</tr>
<tr>
<td>Eighteen-Element 16.15 dBi Gain Yagi, N Female Connector</td>
<td>235-0224</td>
</tr>
<tr>
<td>Indoor 8” Vertical, TNC Male Connector</td>
<td>235-0108</td>
</tr>
</tbody>
</table>

### Table 4 2.4 GHz Antennas

<table>
<thead>
<tr>
<th>Name</th>
<th>SEL Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low-Profile 3 dBi Gain Omnidirectional, N Female Connector</td>
<td>235-0003</td>
</tr>
<tr>
<td>Vertical 10 dBi Gain Omnidirectional, N Female Connector</td>
<td>235-0227</td>
</tr>
<tr>
<td>15 dBi Gain Enclosed Yagi, N Female Connector</td>
<td>235-0225</td>
</tr>
<tr>
<td>19 dBi Gain Panel, N Female Connector</td>
<td>235-0228</td>
</tr>
<tr>
<td>Indoor 8” Vertical, TNC Male Connector</td>
<td>235-0108</td>
</tr>
</tbody>
</table>

### Front- and Rear-Panel Diagrams

**Figure 8 SEL-3060 Front Panels**

**Figure 9 SEL-3060 Rear Panel**
Dimensions

Figure 10 SEL-3060 Dimensions
Specifications

Compliance
Designed and manufactured under an ISO 9001 certified quality management system
Also see Table 5.

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: 151 mm x 210 mm x 44 mm
(5.96 in x 4.08 in x 1.73 in)
Weight: 0.39 kg (0.86 lb)

Communications

Communications Ports
Ethernet Ports
Ports: 2 rear
Rate: 10/100 Mbps
Rear Connectors: RJ45
Standard: IEEE 802.3

Protocols
Modbus TCP, TCP/IP, UDP, FTP, DNP3 LAN/WAN, HTTP Webpage Support, Telnet, SEL ASCII and Compressed ASCII, SEL Fast Messaging, IEEE C37.118 Synchrophasors, IEC 61850 GOOSE

Typical Latency
Point-to-Point (IEC 61850 GOOSE)
500-Byte Packet: 12.5 ms
Point-to-Multipoint (IEC 61850 GOOSE)
500-Byte Packet: ~50 ms (4 nodes simultaneously transmit GOOSE)

Radio

Transmitter
Frequency Band:
SEL-3060A: 902–928 MHz ISM band
SEL-3060A3 (Brazil Firmware): 902.0–907.5, 915–928 MHz
SEL-3060B: 2.40000–2.46875 GHz ISM band
Technology: Digital Modulation
Modulation: Frequency Shift Keying (FSK)
Operating Mode: Point-to-Point, Point-to-Multipoint (63 nodes)
RF Connector: TNC
Power Output:
SEL-3060A: 20 dBm (100 mW)
SEL-3060B: 16 dBm ±2 dBm (40 mW)

Number of Channels
SEL-3060A: 12
SEL-3060B: 26
Channel Bandwidth: 2 MHz

Receiver
SELECT-3060A: ~93 dBm ± 2 dB at 1% PER
SELECT-3060B: ~91 dBm ± 2 dB at 5% PER

Distance:
SELECT-3060A Point-to-Point: 15 miles with 15 dB fade margin
SELECT-3060A Point-to-Multipoint: 10 miles with 15 dB fade margin
SELECT-3060B Point-to-Point: 10 miles with 15 dB fade margin
SELECT-3060B Point-to-Multipoint: 7 miles with 10 dB fade margin

Error Detection: 16-bit CRC
Forward Error Correction (FEC): 4:16 block code

Data Rate
Aggregate Data Rate: 1 Mbps

Encryption
AES 128-bit encryption for over-the-air data

Power Supply
Rated Supply Voltage: 12/24 Vdc
Input Voltage Range: 9–30 Vdc
Power Consumption: <4 W

Type Tests

Communications Equipment Tests
IEEE 1613-2003
Power Frequency Disturbances: IEC 61850-3:2002

Environmental Tests
Class 2 Endurance, Class 2 Response
IEC 60255-21-3:1993
Class 2
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° to 55°C, 6 cycles, 95% relative humidity
+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
2.4 kV on Ethernet Ports
RFI and Interference Tests

EMC Immunity

**Standard:** IEEE 1613, Class 1

**Electrostatic Discharge:**
- IEC 60255-2-2:2008
  - Severity Level 4
  - 8 kV contact discharge
  - 15 kV air 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 60255-22-3:2007 10 V/m
- IEC 61000-4-3:2008 10 V/m
- IEEE C57.90.2–2004 35 V/m

**Fast Transient, Burst Immunity:**
- IEC 60255-22-4:2008
  - 4 kV @ 5.0 kHz for power port
  - 2 kV @ 5.0 kHz for communications ports
- IEC 61000-4-4:2011
  - 4 kV @ 5.0 kHz for power port
  - 2 kV @ 5.0 kHz for communications ports

**Power Frequency Magnetic Field:**
- IEC 61000-4-8:2009
  - 1000 A/m for 3 seconds,
  - 100 A/m for 1 minute

**Damped Oscillatory Magnetic Field:**
- IEC 61000-4-10:2001
  - 100 A/m

**Voltage Dips, Short Interruptions and Voltage Variations on DC Input Power Port:**
- IEC 60255-11:2008
- IEC 61000-4-11:2004
- IEC 61000-4-17:2002
- IEC 61000-4-29:2000

**Surge Withstand Capability Immunity:**
- IEC 60255-22-1:2007
  - 2.5 kV common-mode, 1 kV differential-mode
  - IEEE C57.90.1–2002
    - 2.5 kV oscillatory, 4 kV fast transient

**Conducted RF Immunity:**
- IEC 60255-22-6:2001 10 Vrms
- IEC 61000-4-6:2008 10 Vrms

**Digital Radio Telephone RF Immunity:**
- EN50204-1995
  - Severity Level: 10 V/m at 900 MHz and 1.89 GHz

EMC Emissions

**Radiated Emissions**
- IEC 60255-25:2000
- FCC Part 15.247; ICES-001; RSS-247

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 5 Certifications by Country**

<table>
<thead>
<tr>
<th>Country</th>
<th>Authority</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>3060A</strong></td>
<td>Anatel</td>
<td>0781-15-7001</td>
</tr>
<tr>
<td>Brazil</td>
<td>IC</td>
<td>5303A-AW900MR</td>
</tr>
<tr>
<td>Canada</td>
<td>IFETEL</td>
<td>RCPSCSE14-0853</td>
</tr>
<tr>
<td>Mexico</td>
<td>FCC</td>
<td>R4N-AW900MR</td>
</tr>
<tr>
<td>Trinidad and Tobago</td>
<td>TATT</td>
<td>2/2/1/16937</td>
</tr>
<tr>
<td>USA</td>
<td>FCC</td>
<td>R4N-AW900MR</td>
</tr>
</tbody>
</table>

| **3060B**       | ACMA      | RCM             |
| Australia       | IC        | 5303A-AW2400MR  |
| Canada          | IFETEL    | RCPSCSE14-1847  |
| Mexico          | Ministry of Economic Development | RCM |
| New Zealand     | FCC       | R4N-AW2400MR    |
| USA             | FCC       | R4N-AW2400MR    |