



# WSO-11 Wireless Sensor for Overhead Lines



## Major Features and Benefits

The SEL WSO-11 Wireless Sensor for Overhead Lines helps personnel locate faults quickly and easily by monitoring distribution circuits for faults and outages. Users can periodically log circuit load data for system analysis and remotely monitor the system via the On-Ramp Wireless RPMA<sup>®</sup> (Random Phase Multiple Access) Network. The WSO-11 includes the following additional features:

- ▶ **Event Detection.** Improve system reliability by remotely monitoring overhead distribution circuits for faults and outages.
- ▶ **AutoRANGER<sup>®</sup> Trip Logic.** Account for load variations throughout the entire system with the auto-adjusting trip threshold logic.
- ▶ **Extended Current Range.** Install the WSO-11 on distribution circuits with load current from 0 A to 600 A.
- ▶ **Long Battery Life.** Avoid costly maintenance with a battery life of over 14 years.
- ▶ **Network Connectivity.** Deploy the WSO-11 as part of the SEL Wireless Distribution Fault Indication System to report faults on overhead circuits quickly and remotely.
- ▶ **Field Upgradeable.** Perform over-the-air software updates.
- ▶ **5-Year Warranty.** Take advantage of an industry-leading 5-year warranty.

# Functional Overview

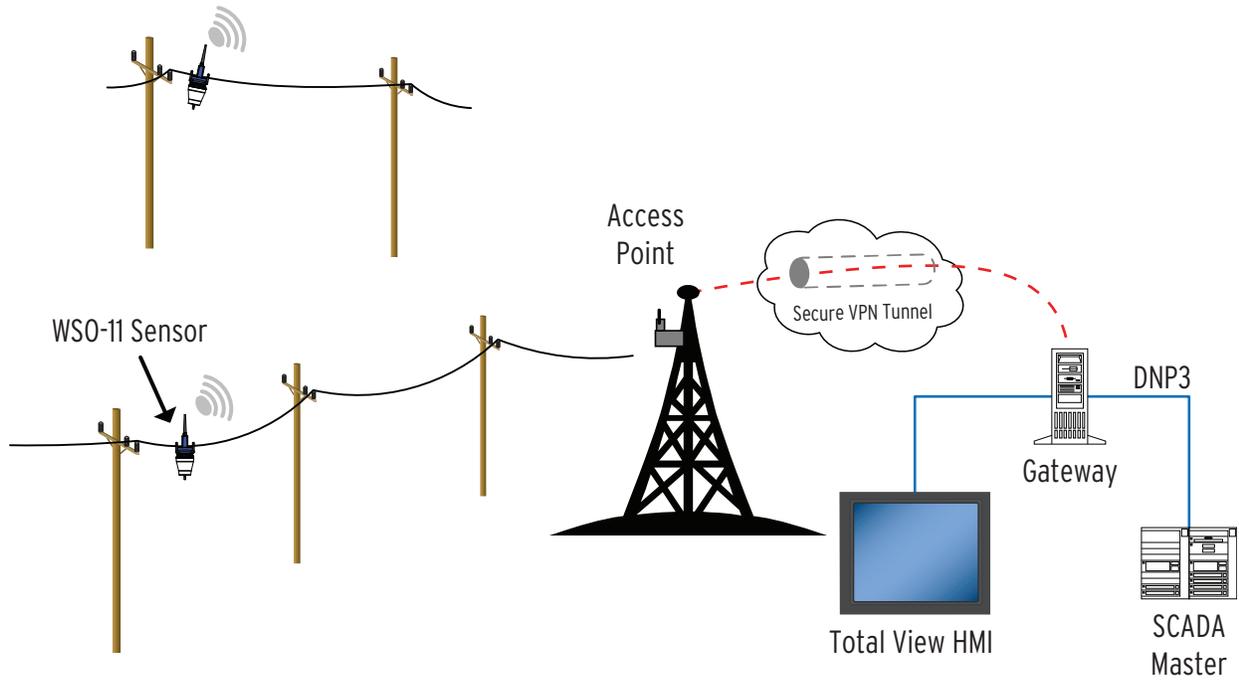


Figure 1 Complete Solution for Distribution Fault Location

# Device Overview

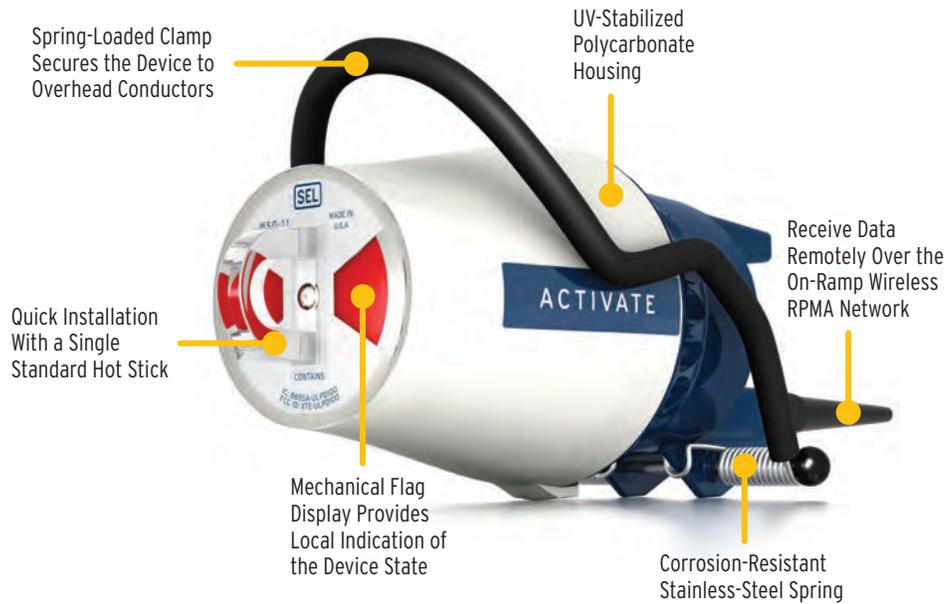


Figure 2 Device Overview

# WSO-11 Capabilities

## Fault Detection

Identify fault locations quickly and remotely on overhead distribution circuits. The WSO-11 automatically selects the best-fit trip threshold based on measured load current. Eight distinct trip thresholds from 50 A to 1200 A provide system-wide flexibility. When current exceeds the configured trip threshold, the WSO-11 determines whether the event is a permanent or a momentary fault. Select to have each fault status reported by exception, or at the next update interval.

## RPMA Network Connection

Send WSO-11 packets over the RPMA Network. The WSO-11 transmits on the license-free 2.4 GHz ISM frequency band for reliable communication. View all the WSO-11 data with the On-Ramp Wireless Total View HMI, and send alerts via email to personnel.

## Local Display

Observe the state of the WSO-11 in the field with the integrated mechanical flag display. The reflective flag provides a visual alert for tripped or faulted sensors. Permanent faults are always indicated. In addition, you can configure the flag to indicate any combination of the following: permanent loss-of-current (LOC), momentary LOC, momentary fault, disturbance, and load pickup events.

Upon radio activation, the mechanical flag display trips. When the WSO-11 connects to the RPMA Network and arms, the flag resets, indicating that the sensor is ready to detect future events.

## Load Data Recording

Monitor load current with the WSO-11 and approximate circuit loading across the entire distribution circuit. The system records and reports load data at every update interval (24 hours by default). The WSO-11 sends load data in either average or peak values.

## Outage Detection

Detect outages on overhead distribution circuits to pinpoint the affected area. The WSO-11 detects a loss of current after any protection operation, and evaluates the duration to determine if it was a permanent or momen-

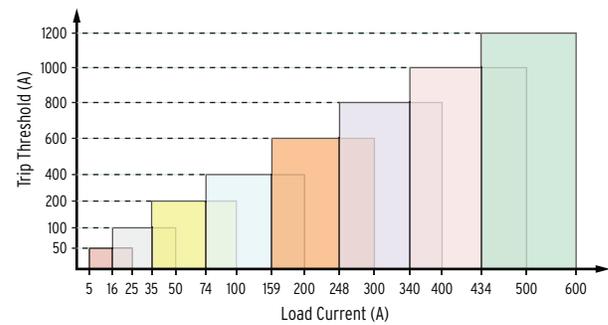


Figure 3 Trip Thresholds



Figure 4 On-Ramp Wireless Total View HMI



Figure 5 Local Display

tary outage. Configure the WSO-11 to report permanent or momentary outages by sending an exception packet, or to report it at the next update interval.

## Inrush Restraint

Improve the dependability of reported fault events on circuits that implement an automatic reclosing scheme with inrush restraint. Upon detecting a protection operation (e.g., a loss of current), the sensor enters Inrush Restraint mode and will not register events based on inrush currents from reclosing attempts. The system automatically resets and rearms after restoration of load current.

## Configurable Update Interval

Optimize the update interval to achieve high-resolution load data. Configure the WSO-11 update interval to 6, 12, or 24 hours. Select shorter update intervals for finer-resolution load data. The system reports 24 load data points per update interval (e.g., a 6-hour update interval results in 15-minute load data resolution).

## Wireless Reporting

Retrieve data from the WSO-11 wirelessly by scheduled recurring reports or event-triggered reports. The WSO-11 provides the following reports:

- Periodic updates (24 hours by default)
- Exception reports
  - Deployment
  - Restoration
  - Permanent fault
  - Permanent loss of current
  - Momentary fault
  - Momentary loss of current
  - Disturbance
  - Load pickup

## Over-the-Air Updates

Upgrade the WSO-11 with the latest firmware and modify settings in the field by sending over-the-air updates. You can distribute over-the-air updates globally to all WSO-11 devices on the network, or target specific units.

## Long Battery Life

Reduce fault indicator maintenance and cost of ownership with the extended battery life of the WSO-11. The sensor has an operational life of over 14 years when configured with a 24-hour update interval and transmitting as many as 44 asynchronous exception reports per year. The sensor measures and reports the battery voltage in every transmitted packet, and alerts personnel when the battery is low.

## Applications

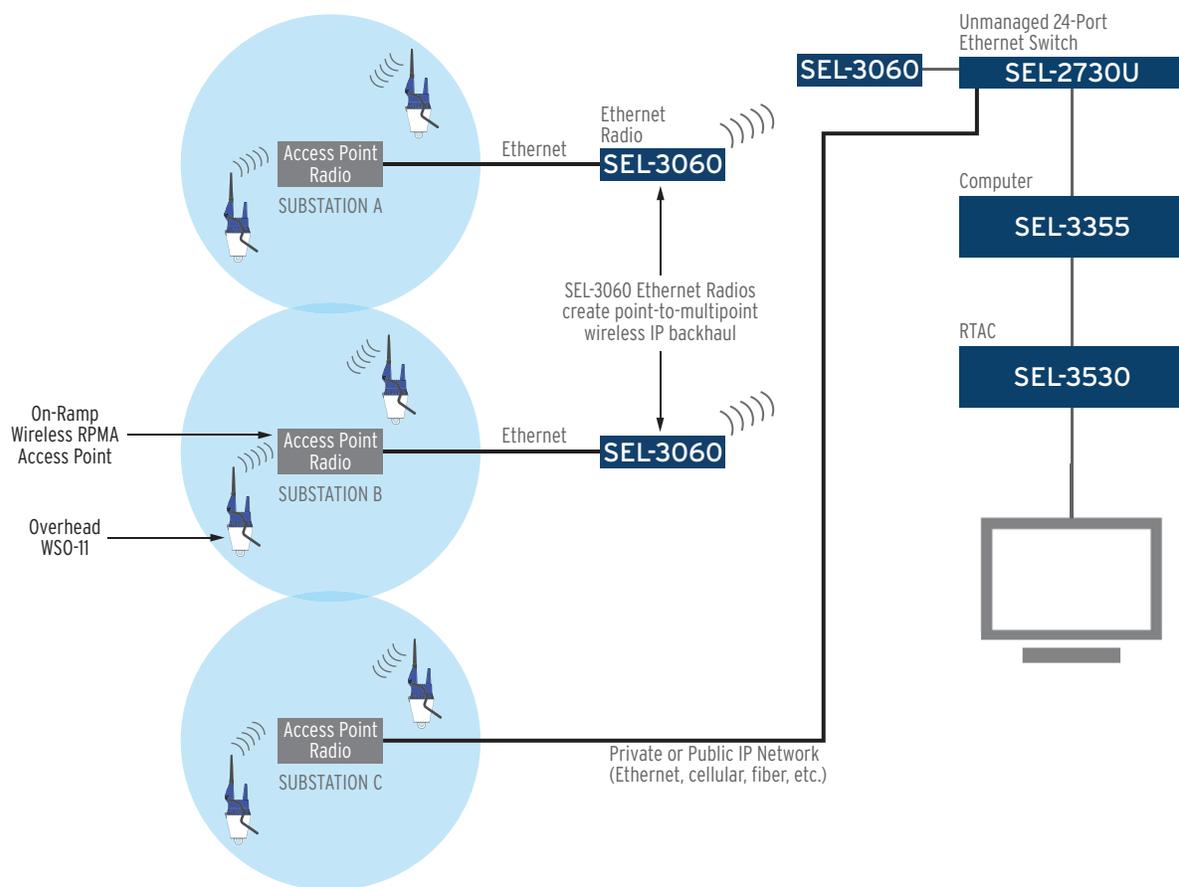
Expand WSO-11 deployment to all overhead distribution applications:

- Unfused taps
- Mid-feeder disconnect or sectionalizers
- Long feeders
- Overhead-to-underground transition points
- Feeders that experience recurring faults
- Lightly loaded circuits

# Wireless Distribution Fault Indication System

The SEL Wireless Distribution Fault Indication System locates and reports faults on overhead distribution circuits while collecting system statistics all within one solution. A centralized human-machine interface (HMI) improves situational awareness and helps improve system restoration times by reporting fault locations. SEL Engineering Services can integrate this system as part of an existing SEL DNA™ (Distribution Network Automation) system or into an existing SCADA and outage management system (OMS) infrastructure. The Wireless Distribution Fault Indication System also supports systems without SCADA by using an SEL-3530 Real-Time Automation Controller (RTAC) and embedded web-based HMI to provide a low-cost HMI for any operator with a network connection.

SEL Engineering Services provides a scalable wireless distribution fault indicator solution for overhead electric distribution circuits. The WSO-11 collects distribution system information from overhead circuits and transmits the collected data via integrated radio to an access point. Access points can connect via any available IP backhaul, including cellular, private radio network, and fiber, back to an SEL-3355 Computer. The SEL-3355 collects sensor data and passes these data to OMS, energy management systems (EMS), or SCADA systems. The optional RTAC with a built-in customizable HMI allows for visualization of critical application data.



**Figure 6** Wireless Distribution Fault Indication System

# Guideform Specification

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The Wireless Sensor shall provide the ability to collect load current, fault event data, etc. from overhead distribution lines, and transmit the data via an On-Ramp Wireless RPMA<sup>®</sup> Network. Its purpose is to collect and report system data, report fault information to reduce fault-locating times, and improve system reliability. Specific requirements are as follows:

- **Sensor Architecture.** The sensor housing shall be constructed of a molded ultraviolet (UV)-stabilized polycarbonate plastic suitable for outdoor applications. The sensor shall have a stainless steel spring-loaded clamp covered in a conductive EDPM rubber sleeve used for clamping to overhead conductors.
- **Application.** The sensor shall be capable of monitoring a single-phase conductor of an overhead three-phase radial distribution system.
- **System Voltage Range.** The sensor shall be applicable to an overhead radial distribution circuit with a nominal system voltage as high as 34.5 kV.
- **System Current Range.** The sensor shall be applicable to an overhead radial distribution circuit with load current equal to or greater than 0 A.
- **System Frequency.** The sensor shall be able to operate and detect faults on circuits in the 50 Hz to 60 Hz frequency range.
- **Display.** The sensor shall have a highly reflective electromechanical red-flag display.
- **Sensor Powering.** The sensor shall be powered by a 38 Ah 3.6 V lithium battery pack with a 20-year shelf life. The sensor battery health information shall be contained within the data packet wirelessly transmitted through the sensor radio.
- **Automatic Reset.** The sensor shall automatically reset either upon the restoration of load current of 5 A or greater, or after a user-defined timeout period.
- **Trip Logic.** The microcontroller-based circuit shall automatically select the trip threshold based on sampling of load currents. The sensor shall have a fault threshold range of 50 to 1200 A.
- **Trip Response Time.** The sensor shall have a delayed trip response time of 24 ms to improve sensor coordination with capacitor banks and other downstream sources of backfeed current into the fault.
- **Inrush Restraint.** The sensor shall have a loss-of-current activated inrush restraint feature to prevent false activations from inrush currents resulting from transformer energizing during automatic reclosing operations and when energizing the system.
- **Filtering.** The sensor shall include a low-pass filter that reduces the number of false activations by decreasing sensitivity to fault-level current waveforms with harmonic content.
- **Mounting Range.** The sensor shall be capable of an installation mounting outer diameter range of 4 mm to 38 mm (0.162 in to 1.50 in).
- **Environment.** The sensor shall operate at a temperature range of  $-40^{\circ}$  to  $+85^{\circ}\text{C}$  ( $-40^{\circ}$  to  $+185^{\circ}\text{F}$ ). Sensor materials shall be appropriate for the long service life and harsh environment associated with an overhead distribution application.
- **Reliability.** The vendor shall supply the actual measured Mean Time Between Failures (MTBF) for the device upon request.
- **Manufacturer.** The sensor shall be manufactured in the U.S.A.
- **Warranty.** The sensor shall have a five-year warranty.

# Dimensions

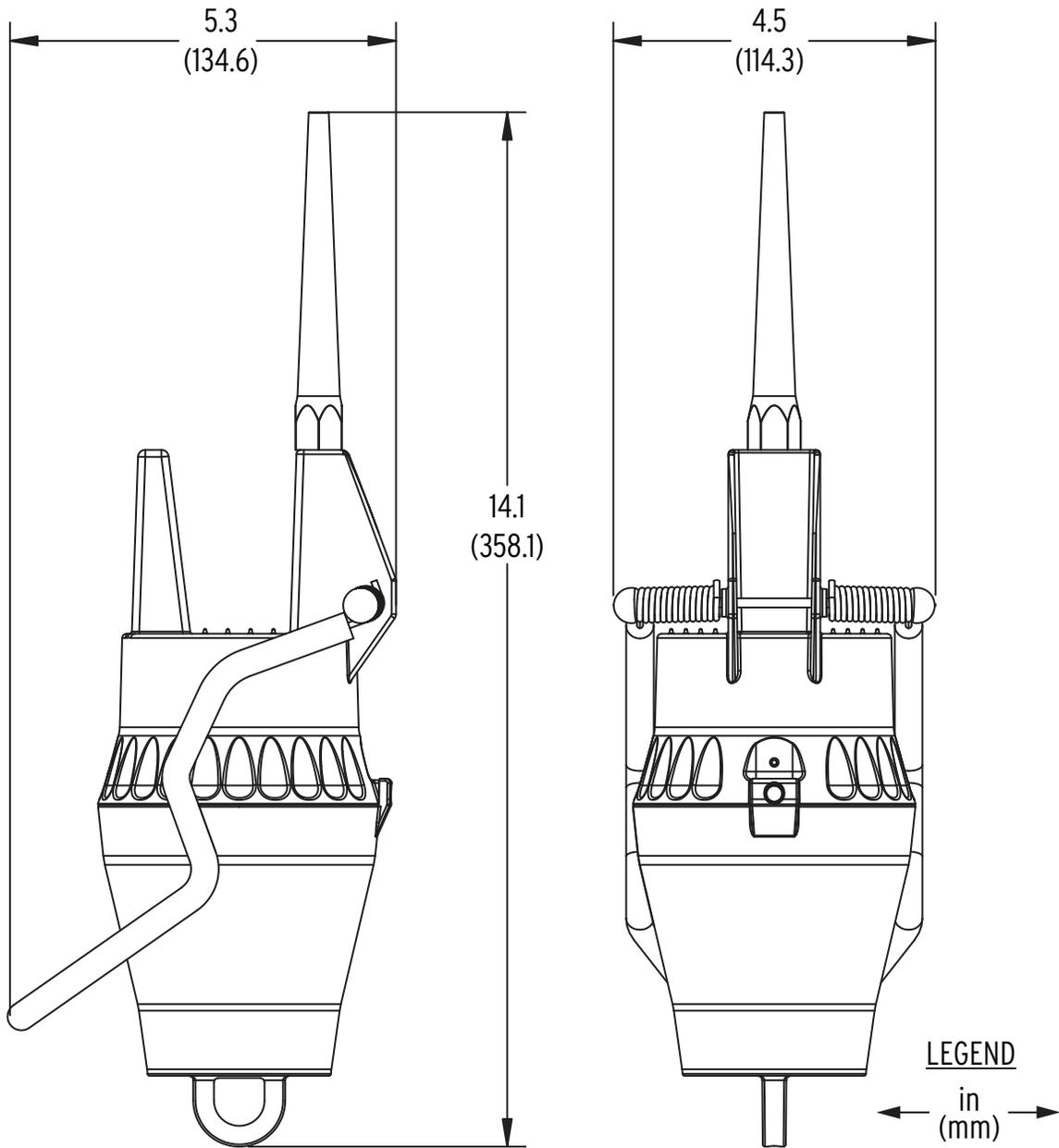


Figure 7 WSO-11 Dimensions

# Specifications

## Compliance

Designed and manufactured under an ISO 9001 certified quality management system

## General

Maximum Nominal System Voltage (L-L):	34.5 kV
Nominal Inrush Restraint Response Time:	75 ms
Outer Diameter Mounting Range:	4.1–38.1 mm (0.16–1.50 in)
Power:	High-capacity lithium battery with a 20-year shelf-life

## Fault Detection

Trip Threshold Range:	50–1200 A
Trip Threshold Accuracy (at 0.75" conductor diameter):	±30%
Maximum Fault Current:	25 kA
Nominal Trip Response Time:	24 ms (default)

## Load Measurement

Current Range:	0–600 A
Current Measurement Accuracy (at 0.75" conductor diameter):	±25% (5–600 A)

## Temperature

Operating:	–40° to +85°C (–40° to +185°F)
Storage:	–40° to +85°C (–40° to +185°F)

## Weight

728 g (1.6 lb)

## Radio

Operating Frequency:	2.4 GHz ISM band
Report Status Update:	24 hours (default)
Network:	On-Ramp Wireless RPMA Network Infrastructure

## Regulatory

Federal Communications Commission:	FCC Part 15, Subpart B (Unintentional Radiators)
Industry Canada:	ICES-003, Issue 5, Class B (Unintentional Radiators)

## Type Tests

Trip Current:	IEEE 495-2007 Test 4.4.9; –40°, +20°, and +85°C
Reset:	IEEE 495-2007 Test 4.4.10; –40°, +20°, and +85°C

## Electromagnetic Compatibility Immunity

Radiated Electromagnetic Field Immunity:	IEEE C37.90.2-2004 Severity Level: 20 V/m
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## Environmental

Temperature Cycling:	IEEE 495-2007 Test 4.4.1; 2 hours at –40°, +20°, and +85°C, 5 cycles
Rain:	MIL 810G 506.5, Procedure 1 Rain and Blowing Rain

## Vibration

Vibration Resistance:	IEC 60255-21-1:1988 Class 2 Endurance Class 2 Response IEEE 495-2007 Test 4.4.6
Shock Resistance:	IEC 60255-21-2:1988 Class 1 Shock Withstand Class 2 Shock Response Class 1 Bump Withstand IEEE 495-2007 Test 4.4.6
Seismic:	IEC 60255-21-3:1993 Class 2 Quake Response IEEE 495-2007 Test 4.4.6

## Regulatory Compliance

The radio module has been designed to meet the following standard: FCC-CFR Part 15.247 Radio Frequency Devices, Subparts A-General and B-Unintentional Radiators (testing is done at module level for Modular Approval).

**FCC ID: XTE-ULPENODE120 or XTE-ULPD100**

**IC: 8655A-ULPENODE120 or 8655A-ULPD100**

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

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

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For warranty details, visit [www.selinc.com](http://www.selinc.com) or contact your customer service representative.

RPMA is a registered trademark of On-Ramp Wireless, Inc.

WSO-11 Data Sheet

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