This sensor measures photosynthetically active radiation (PAR) and is designed to work with the HOBO RX Wireless Sensor Network in which data is transmitted wirelessly from the sensor mote across the network to the RX3000 station and then uploaded to HOBOlink® web-based software. With HOBOlink, you can monitor sensor readings, view graphs, set up alarms, download data, and more.

## Specifications

**Sensor**

| | |
|---|---|
| **Measurement Range** | 0 to 2500 µmol/m²/sec, wavelengths 400 to 700 nm (see Plot A) |
| **Accuracy** | ±5 µmol/m²/sec or ± 5%, whichever is greater in sunlight; Additional temperature induced error ±0.75 µmol/m²/sec/°C from 25°C (0.42 µmol/m²/sec/°F from 77°F) |
| **Angular Accuracy** | Cosine corrected 0 to 80 degrees from vertical; Azimuth Error <2% error at 45 degrees from vertical, 360 degree rotation |
| **Resolution** | 2.5 µmol/m²/sec |
| **Drift** | <±2% per year |

**Wireless Mote**

| | |
|---|---|
| **Operating Temperature Range** | -25° to 60°C (-13° to 140°F) with rechargeable batteries<br>-40 to 70°C (-40 to 158°F) with lithium batteries |
| **Radio Power** | 12.6 mW (+11 dBm) non-adjustable |
| **Transmission Range** | At least 304.8 m (1,000 ft) line of sight at 1.8 m (6 ft) from the ground, 457.2 m (1,500 ft) typical |
| **Wireless Data Standard** | IEEE 802.15.4 |
| **Radio Operating Frequencies** | RXW-LIA-900: 904–924 MHz<br>RXW-LIA-868: 866.5 MHz<br>RXW-LIA-922: 916–924 MHz |
| **Modulation Employed** | OQPSK (Offset Quadrature Phase Shift Keying) |
| **Data Rate** | Up to 250 kbps, non-adjustable |
| **Duty Cycle** | <1% |
| **Maximum Number of Motes** | 50 motes per one RX Wireless Sensor Network |
| **Battery Type/ Power Source** | Two AA 1.2V rechargeable NiMH batteries, powered by built-in solar panel or two AA 1.5 V lithium batteries for operating conditions of -40 to 70°C (-40 to 158°F) |
| **Battery Life** | With NiMH batteries: Typical 3–5 years when operated in the temperature range -20° to 40°C (-4°F to 104°F) and positioned toward the sun (see *Deployment and Mounting*), operation outside this range will reduce the battery service life<br>With lithium batteries: 1 year, typical use |
| **Dimensions** | Sensor: 4.1 cm height x 3.2 cm diameter (1.61 x 1.26 inches)<br>Cable length: 2 m (6.56 ft)<br>Mote: 16.2 x 8.59 x 4.14 cm (6.38 x 3.38 x 1.63 inches) |
| **Weight** | Sensor and cable: 109 g (3.85 oz)<br>Mote: 223 g (7.87 oz) |
| **Materials** | Sensor: Anodized aluminum housing with acrylic diffuser and O-ring seal<br>Mote: PCPBT, silicone rubber seal |
| **Environmental Rating** | Sensor and cable: Weatherproof<br>Mote: IP67 |
| **Compliance Marks** | FC  RXW-LIA-900: See last page<br>CE  RXW-LIA-868: The CE Marking identifies this product as complying with all relevant directives in the European Union (EU).<br>  RXW-LIA-922: See last page |

### RXW PAR Sensor

*Models:*

- RXW-LIA-900 (US)
- RXW-LIA-868 (Europe)
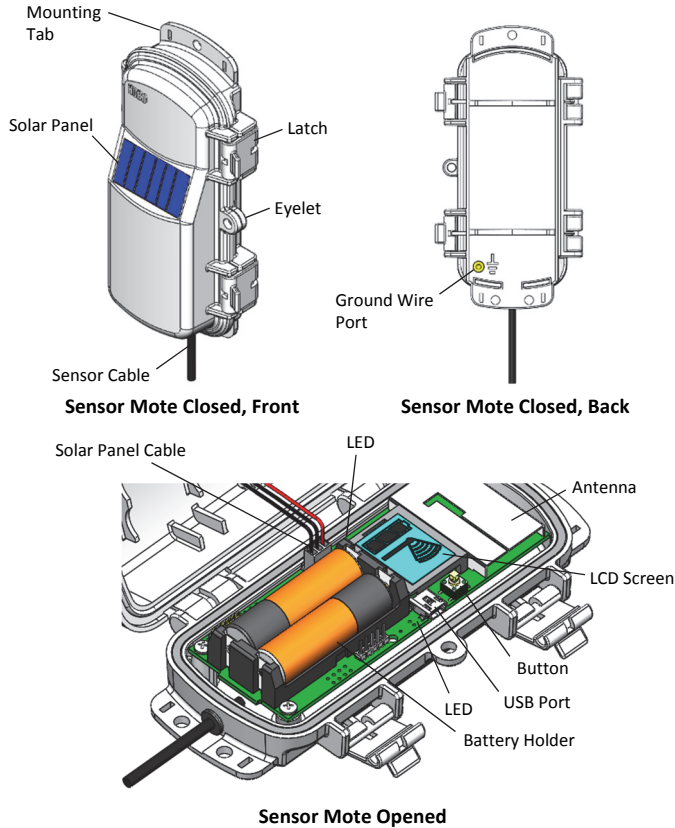- RXW-LIA-922 (Australia/NZ)

*Items Included:*

- Cable ties

*Accessories:*

- Light sensor mounting bracket (M-LBB)
- Light sensor level (M-LLA)

## Mote Components and Operation



**Sensor Mote Closed, Front**          **Sensor Mote Closed, Back**



**Sensor Mote Opened**

**Mounting Tab:** Use the tabs at the top and bottom of the mote to mount it (see *Deploying and Mounting*).

**Solar Panel:** Position the solar panel towards the sun to charge the mote batteries (see *Deploying and Mounting*).

**Sensor Cable:** This is the cable that connects the mote to the sensor.

**Eyelet:** Use this eyelet to attach a 3/16 inch padlock to the mote for security.

**Latch:** Use the two latches to open and close the mote door.

**Ground Wire Port:** Use this port to connect a ground wire (see *Deploying and Mounting*).

**Antenna:** This is the built-in antenna for the radio communications across the RX Wireless Sensor Network.

**Solar Panel Cable:** This cable connects the built-in solar panel to the mote circuitry.

**LEDs:** The blue LED to the left of the LCD screen blinks at 4 seconds during normal operation. It blinks more frequently when initially joining a network. If the mote is not currently part of a network, the blue LED will be off. If the LED is on and not blinking, there is a problem with the mote. Contact Technical Support at www.onsetcomp.com/support/contact. The yellow-green LED to the upper right of the batteries only blinks during the process of joining a network.

**Battery Holder:** The location where the rechargeable AA batteries are installed as shown (see *Battery Information*).

**USB Port:** Use this port to connect to the mote to a computer via USB cable if you need to update the firmware (see *Updating Mote Firmware*).

**Button:** Push this button for 1 second to illuminate the LCD or 3 seconds for the mote to search for an RX Wireless Sensor Network to join (see *Adding the Mote to the RX Wireless Sensor Network*).

**LCD Screen:** The mote is equipped with an LCD screen that displays details about the current status. This example shows all symbols illuminated on the LCD screen followed by definitions of each symbol in the table.



| LCD Symbol | Description |
|---|---|
|  | The battery indicator shows the approximate battery charge remaining. |
|  | This is a signal strength indicator. The more bars, the stronger the signal between motes. This icon will blink when you press the button on the mote to search for a network to join (see *Adding the Mote to the RX Wireless Sensor Network* for *details*). |
|  | This indicates that the mote is not part of a network. See *Adding the Mote to the RX Wireless Sensor Network* for details on how to add a mote to the network. |
|  | This indicates a problem with the sensor itself (the mote is operational). Check the sensor and make any adjustments to it as needed. Contact Onset Technical Support if the problem persists. |

## Typical Quantum Response

The PAR sensor is designed to detect photons between 400–700 nm in wavelength. Ideally the sensor would count photons with equal efficiency between 400–700 nm and no photons would be counted outside this range. However, in reality, this sensor undercounts photons between 400–550 nm and between 670–700 nm, and it overcounts photons between 550–670 nm. In most applications (where the sensor is used in natural sunlight) the error is not significant.
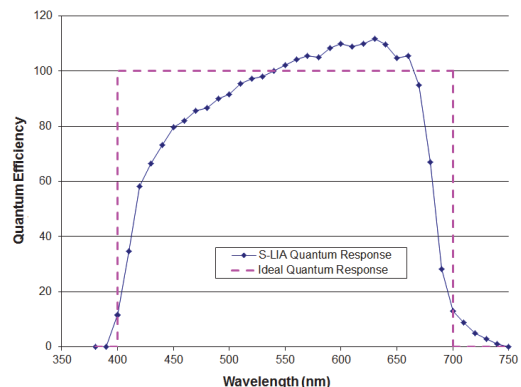


**Plot A: PAR Sensor Typical Quantum Response**

## Adding the Mote to the RX Wireless Sensor Network

The mote must join an RX Wireless Sensor Network before it can begin measuring PAR and transmitting data. This requires accessing the RX3000 Station and the mote at the same time so it is recommended that you complete these steps before deploying the mote.

> **Important:** If you have not configured the RX3000 Station with the RXW Manager, follow the instructions in the RX3000 Quick Start before continuing.

To add a mote to the RX Wireless Sensor Network:

1. If the LCD is blank on the RX3000 station, press any button to wake it up.

2. Press the Select button once (which shows the number of smart sensors installed) and then press it again once if the HOBO RXW Manager is installed in the left slot (module 1) or twice if it is installed on the right slot (module 2).
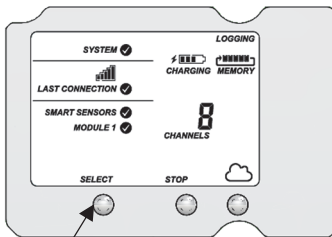


Press this button to view the module where the RXW Manager is installed

3. Press the Search button (the magnifying glass). The magnifying glass icon will blink while the RX3000 is in search mode.
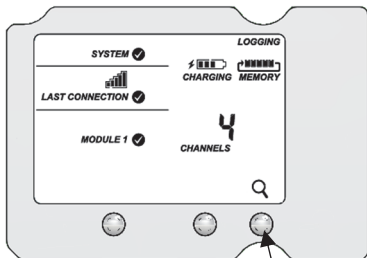


Press this button so the station is ready to have motes join the network

4. Open the mote door and install the batteries if you have not already done so.

5. Press the button on the mote for 3 seconds. The signal strength icon will flash and then cycle.
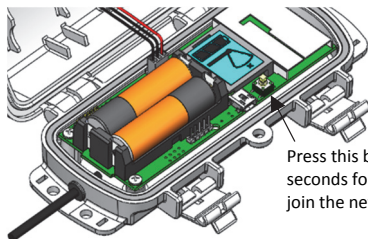


Press this button for 3 seconds for the mote to join the network

6. Watch the LCD on the mote. The signal strength icon and the LEDs will quickly blink while the mote searches for the wireless network. Once it has found the network, the icon will stop blinking and the signal strength bars will slowly

cycle from left to right. As the mote completes its registration process with the network, the "x" icon to the right of the signal strength icon will flash and the yellow-green LED will stop blinking. Once the registration is complete, the signal strength bars will stop cycling and remain solid and the channel count on the RX3000 LCD will be updated. This process may take up to five minutes. **Note:** The channel count on the LCD will increase by 2: one for PAR and one for the mote battery.

7. Press the Search button (the magnifying glass) on the RX3000 Station to stop searching for motes.
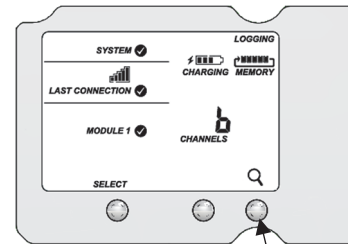


Press this button again to stop searching for motes

Measurements will be recorded at the logging interval specified in HOBOlink, transmitted to the RX3000 Station, and uploaded to HOBOlink at the next connection interval (readout). Use HOBOlink to monitor mote status and health. If a mote is temporarily offline, any logged data is saved until it is back online. In addition, if a mote is offline for 30 minutes, the RX3000 Station will automatically connect to HOBOlink and report the mote as missing. Once the mote is back online, any logged data will be uploaded the next time the RX3000 station connects to HOBOlink.

See the HOBOlink Help for details on how to change the logging and connection intervals, view data, check mote status, add the mote to a map, and more.

## Deployment and Mounting

### Mounting and Positioning the Mote

- Use cable ties to mount the mote via the holes on the mounting tabs.

- Avoid mounting the mote near metal, which can cause interference with the signal.

- Position the mote towards the sun, making sure the solar panel is oriented so that it receives optimal sunlight throughout each season. It may be necessary to periodically adjust the mote position as the path of the sunlight changes throughout the year or if tree and leaf growth alters the amount of sunlight reaching the solar panel.

- Make sure the mote door is closed, with both latches fully locked to ensure a watertight seal.

- Consider using a 3/16 inch padlock to restrict access to the mote. With the mote door closed, hook a padlock through the eyelet on the right side of the door and lock it.

- To maximize the communication between motes, place the mote within 304.8–457.2 m (1,000–1,500 feet) and full line of sight with the next mote in the network and at least 1.8 m (6 feet) from the ground.

- If there is an obstruction between two sensor motes or between the sensor mote and the RXW Manager, then use an RXW Repeater (RXW-RPTR-xxx) mounted higher than the two motes. For example, if there is a hill or mountain between the sensor mote and the RXW Manager, place a repeater at the top of the hill between the sensor mote and the RXW Manager.

- There should not be more than five motes in any direction from a repeater or the RXW Manager. Data logged by a wireless sensor must travel or "hop" across the wireless network from one mote to the next until it ultimately reaches the RXW Manager at the RX3000 station. To make sure the data can successfully travel across the network, the sensor mote should not be more than five hops away from a repeater or manager.

- The RX Wireless Sensor Network can support a maximum of 50 motes.

- Use a #4-40 screw to attach a ground wire to the port on the back of the mote if you are deploying the mote in a location where lightning is a concern.

- Make sure the mote remains in a vertical position once it is placed in its deployment location for optimal network communications.
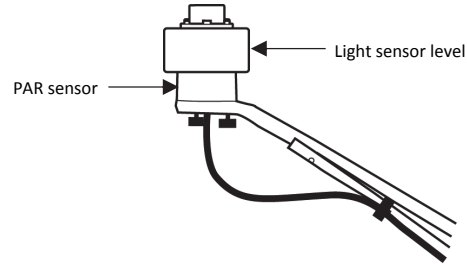
### Mounting the Sensor with a Bracket

It is recommended that you mount the PAR sensor with the light sensor mounting bracket (M-LBB) on a pole or tripod. Use the light sensor level (M-LLA) to make sure it is level on the bracket. To mount the PAR sensor using the bracket:

1. Attach the light sensor bracket to a 1¼ inch - 1$^5$/$_8$ inch pole with the provided U-bolts. **Note:** The bracket can also be mounted on a flat, vertical surface using four screws.

2. Position the PAR sensor on top of the light sensor bracket with its cable running through the slot in the bracket.

3. Using the two screws supplied, attach the sensor to the bracket through the two holes on either side of the slot. **Note:** Do not completely tighten the screws until you level the PAR sensor.

4. Position the bracket so it faces toward the equator, minimizing the chance of shading.

5. Mount the light sensor bracket on the mast with the two U-bolt assemblies, mounting it high enough on the mast to avoid the possibility of shading the PAR sensor. **Note:** If you mount the PAR sensor above eye level, it is recommended that you use a step ladder or other secure platform when leveling the sensor so that you can clearly view the light sensor level (M-LLA).



**PAR Sensor Bracket Mounting**
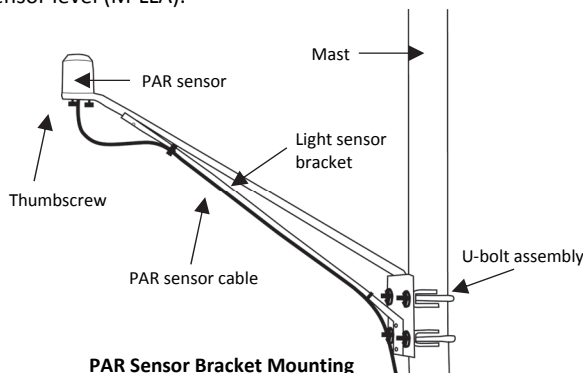
6. Make sure the screws holding the sensor to the mounting bracket are loose.

7. Place the light sensor level on the PAR sensor.

8. Adjust the height of the thumbscrews to level the sensor (start with the thumbscrews protruding about 1/16 inch from the bracket).

9. Once the sensor is near level, tighten the Phillips head screws.

10. Check the light sensor level and repeat above steps if necessary.

11. When the sensor is level, remove the light sensor level from the sensor.



**Leveling the PAR Sensor on the Light Sensor Bracket**

### Mounting the Sensor on a Mounting Plate

To mount the light sensor using a mounting plate of your own design:

1. Drill a 0.56 (9/16) inch hole in the middle of the plate, then drill two #25 holes 1.063 (1-1/16) inches apart on either side of the center hole. Cut a 0.31 (5/16) inch-wide slot in the mounting plate as shown below. The plate should be a thickness of 1/8 inch or less.

2. Slide the sensor through the 0.31 (5/16) inch-wide slot.

3. Attach the sensor using two 6-32 x 3/8 inch screws and lock washers (not included).

4. Shim the sensor as necessary to level it
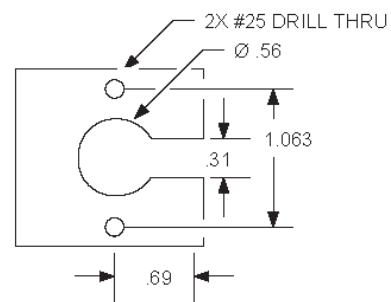


**Recommended Mounting Plate Dimensions**

### Sensor Mounting Guidelines

- Small errors in alignment can produce significant errors. Be certain that the sensor is mounted level.

- Mount the PAR sensor where it will not be in a shadow. Any obstruction should be below the plane of the sensor head. If that is not possible, try to limit obstructions to below 5 degrees, where the effect will be minimal.

- If possible, avoid locating the sensor in dusty locations. Dust, pollen, and salt residue that collect on the top of the sensor can significantly degrade accuracy.

- Refer to the station manual and Tripod Setup Guide at www.onsetcomp.com/support/manuals for more information regarding setting up stations.

## Sensor Operation

The PAR sensor averages measurements at a fixed rate of once a minute. The multiple samples are then averaged together and the average value is recorded at the logging interval. For example, when the logging interval is set at 10 minutes, each recorded data point will be the average of 10 measurements (1 sample per minute for 10 minutes).

## Maintenance

Dust on the sensor will degrade sensor accuracy. Periodically inspect the sensor, and if necessary, gently clean the diffuser with a damp sponge. Do not open the sensor as there are no user serviceable parts inside.

⚠️ **Warning***:* DO NOT use alcohol, organic solvents, abrasives, or strong detergents to clean the diffuser element on the PAR sensor. The acrylic material used in the PAR sensor can be crazed by exposure to alcohol or organic solvents. Clean the sensor only with water and/or a mild detergent such as dishwashing soap if necessary. It is recommended that you use vinegar to remove hard water deposits from the diffuser element. Under no circumstances should the sensor be immersed in any liquid.

The mote is designed for outdoor use, but should be inspected periodically. When inspecting the mote, do the following:

- Verify the mote is free of visible damage or cracks.

- Make sure the mote is clean. Wipe off any dust or grime with a damp cloth.

- Wipe off any water before opening the mote.

- Make sure the interior seal is intact and the latches are fully locked when the mote door is closed.

## Verifying Sensor Accuracy

It is recommended that you check the accuracy of the PAR sensor annually. The PAR sensor cannot be calibrated. Onset uses precision components to obtain accurate measurements. If the sensor is not providing accurate data, then it may be damaged.

## Updating Mote Firmware

If a new firmware version is available for the mote, use HOBOlink to download the file to your computer. Connect the mote to the computer with a USB cable (open the mote door and use the USB port to the right of the LCD). The mote appears as a new storage device in the computer's file storage manager. Copy the downloaded firmware file to the new storage device (the mote). After the file is copied, eject the storage device from the computer and disconnect the cable from the mote. The file will be installed automatically on the mote. **Note to**

**Mac® users:** A message may appear indicating the disk has not ejected properly. The mote is operational and you can ignore the message.

## Battery Information

The mote uses two 1.2 V rechargeable NiMH batteries, charged by the built-in solar panel. The quality and quantity of solar light can affect whether the battery is sufficiently charged to last through the night and cloudy periods. Make sure the mote is placed in a location that will receive several hours of sunlight each day. If the mote does not receive enough sunlight to recharge the batteries, the battery life is estimated at 3–4 months. When batteries are regularly recharged, expected battery life is estimated at 3–5 years. Battery life varies based on the ambient temperature where the mote is deployed, the logging interval, the number of tripped alarms, and other factors. Deployments in extremely cold or hot temperatures can impact battery life. Estimates are not guaranteed due to uncertainties in initial battery conditions and operating environment.

Mote operation will stop when battery voltage drops to 1.8 V. Mote operation will return if the battery recharges to 2.3 V. If the batteries are unable to be recharged, replace them with fresh rechargeable batteries.

To replace rechargeable batteries:

1. Open the mote door.

2. Remove the old batteries and install the new ones observing polarity.

3. Make sure the solar panel cable is plugged in.



Make sure solar panel cable is installed when using rechargeable batteries
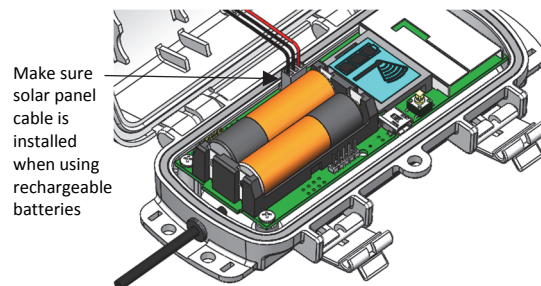
You can use two 1.5 V lithium batteries (HWSB-LI) for operation at the extreme ends of the mote operating range. Lithium battery life is an estimated at 1 year, but varies based on the ambient temperature where the mote is deployed, the logging interval, the number of tripped alarms, and other factors. Estimates are not guaranteed due to uncertainties in initial battery conditions and operating environment. When using lithium batteries, you must disconnect the solar panel cable because the batteries will not be recharged.

To install lithium batteries:

1. Open the mote door.

2. Remove any old batteries and install the new ones observing polarity.

3. Push in the side tab of the solar panel cable connector and pull the connector out of the cable port.

4. Place the connector in the slot on the inside of the mote door. Make sure the solar panel cables are tucked inside the door so that they do not interfere with the interior seal when the mote is closed.



Store the solar panel connector here when using lithium batteries
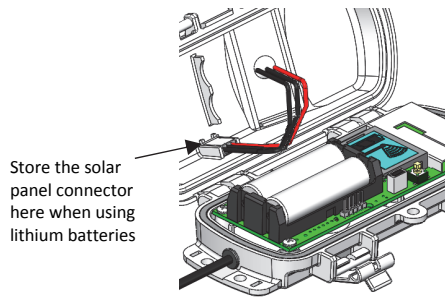
⚠ **WARNING:** Do not cut open, incinerate, heat above 85°C (185°F), or recharge the batteries. The batteries may explode if the logger is exposed to extreme heat or conditions that could damage or destroy the battery cases. Do not mix battery types, either by chemistry or age; batteries may rupture or explode. Do not dispose of the logger or batteries in fire. Do not expose the contents of the batteries to water. Dispose of the batteries according to local regulations.

**Federal Communication Commission Interference Statement**

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one of the following measures:

- Reorient or relocate the receiving antenna
- Increase the separation between the equipment and receiver
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected
- Consult the dealer or an experienced radio/TV technician for help

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 Caution:** Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.

**Industry Canada Statements**

This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

**Avis de conformité pour l'Industrie Canada**

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

To comply with FCC and Industry Canada RF radiation exposure limits for general population, the logger must be installed to provide a separation distance of at least 20cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter.

**ONSET**®
1-800-LOGGERS (564-4377) • 508-759-9500
www.onsetcomp.com/support/contact