



MX2307A Model Shown

HOBO MX2307A, MX2310, and MX2311 Data Loggers

Models:

- Temp/RH/Soil Moisture (MX2307A)
- Temp/RH/PAR/Soil Moisture (MX2310)
- Temp/RH/GSR/Soil Moisture (MX2311)

Included Items:

- Screws
- Cable ties

Required Items:

- HOBOconnect app
- Mobile device with Bluetooth and iOS, iPadOS®, or Android™, or a Windows computer with a native BLE adapter or supported BLE dongle

Accessories:

- Solar radiation shield (RS1)
- Mounting bracket for solar radiation shield (MX2300-RS-BRACKET)
- Bracket mount (M-BRK)
- Plate mount for LI-COR light sensor bracket (M-PLT)
- Light sensor bracket (M-LBB)
- Mounting and leveling fixture for sensor (2003S)

The HOBO MX2307A Temp/RH & Soil Moisture Logger measures air temperature, relative humidity (RH), soil electrical conductivity (EC), volumetric water content (VWC), and soil temperature. The HOBO MX2310 Temp/RH, PAR & Soil Moisture Logger measures air temperature, RH, photosynthetically active radiation (PAR), EC, VWC, and soil temperature. The HOBO MX2311 Temp/RH, Solar & Soil Moisture Logger measures air temperature, RH, global solar radiation (GSR), EC, VWC, and soil temperature.

These Bluetooth®-enabled loggers are designed for wireless communication with a phone, tablet, or computer. Using the HOBOconnect® app, you can easily configure the logger and then download logged data to view or export for further analysis. The loggers can calculate minimum, maximum, average, and standard deviation statistics and be configured to indicate alarms at user-specified thresholds. The loggers also support burst logging, in which data is logged at a faster interval when sensor readings are above or below certain limits.

Specifications

Temperature Sensor

Range	-40 to 70°C (-40 to 158°F)
Accuracy	±0.2 °C (typical) within -40 to 70 °C
Resolution	0.008°C (.014 °F)
Drift	<0.01°C (0.018°F) per year
Response Time* Without Solar Radiation Shield	17 minutes in air moving 1 m/sec
Response Time* With Solar Radiation Shield	24 minutes in air moving 1 m/sec

Relative Humidity (RH) Sensor**

Range	0 to 100% RH, -40° to 70 °C exposure to conditions below -20°C (-4°F) or above 95% RH may temporarily increase the maximum RH sensor error by an additional 1%
Accuracy	±2.5% from 10% to 90% (typical) to a maximum of ±3.5% including hysteresis at 25°C (77°F); below 10% RH and above 90% RH ±5% typical
Resolution	0.01% RH
Drift	<1% per year typical
Response Time* Without Solar Radiation Shield	30 seconds in air moving 1 m/sec
Response Time* With Solar Radiation Shield	40 seconds in air moving 1 m/sec

Calculated Metrics	Vapor Pressure Deficit (VPD) in kPa, and Dew Point (computed from logged data)
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Temperature	-40 to 65°C (-40 to 149°F)
Temperature Dependence	±0.15% per °C maximum
Cosine Correction	Cosine corrected up to 82° angle of incidence
Azimuth	<±1% error over 360° at 45° elevation
Tilt	No error induced from orientation
Detector	High stability silicon photovoltaic detector (blue enhanced)
Sensor Housing	Weatherproof anodized aluminum case with acrylic diffuser and stainless steel hardware. O-ring seal on the sensor base.
Sensor Size	2.36 cm diameter x 3.63 cm (095" x 1.43")
Cable Length	1.8 m
Calculated Metrics	Accumulated PAR in mol/m ² , Daily Light Integral (DLI) in mol/m ² /day, Vapor Pressure Deficit (VPD) in kPa, and Dew Point (computed from logged data)

**Soil Moisture:
Volumetric Water
Content (VWC)**

Measurement Range (select one at configuration)****	0.00 to 1.0 m ³ /m ³ VWC in mineral soils 0.00 to 1.0 m ³ /m ³ VWC in soilless media Apparent Dielectric Permittivity: 1 (air) to 80 (water)
Accuracy	±0.03 m ³ /m ³ typical ±0.06 m ³ /m ³ maximum Apparent Dielectric Permittivity: ±1 ϵ_a
Resolution	0.001 m ³ /m ³ Apparent Dielectric Permittivity: 0.002 ϵ_a
Dielectric Measurement Frequency	70 MHz
Volume of Influence	1400 ml
Percent of Field Capacity (for VWC measurements only)	Range: 0 to 200% Resolution: 0.1%

Soil Temperature*****

Measurement Range	-40 to 70°C (-40 to 158°F)
Accuracy	±0.5°C from -40° to -20°C ±0.3°C from -20°C to 70°C
Resolution	0.1°C (0.18°F)

**Soil Bulk Electrical
Conductivity (EC)**

Measurement Range	0 to 20000 $\mu\text{S cm}^{-1}$
Accuracy	±5 % from 0 to 10000 $\mu\text{S cm}^{-1}$ ±8 % from 10000 to 20000 $\mu\text{S cm}^{-1}$
Resolution	1 $\mu\text{S cm}^{-1}$

**Photosynthetically
Active Radiation (PAR)
(MX2310)**

Range	0 to 3,000 $\mu\text{mol/m}^2/\text{s}$ (full sunlight)
Accuracy	±5% typical (LI-COR LI-190R factory calibration)
Offset	+/-1 μmol
Resolution	0.1 $\mu\text{mol/m}^2/\text{s}$
Spectral Range	400–700 nm (PAR waveband)
Linearity	Maximum deviation of 1% up to 3,000 $\mu\text{mol/m}^2/\text{s}$
Stability	≤ 2% change over one year

**Global Solar Radiation
(GSR) Sensor (MX2311)**

Range	0 to 1280 W/m ² (full sunlight)
Accuracy	±3% typical, ± 5% maximum (LI-200R Absolute Calibration)***
Offset	± 0.5 W/m ²
Resolution	0.05 W/ m ²
Spectral Range	400–1100 nm
Linearity	Maximum deviation of 1%
Stability	≤ 2% change over one year
Temperature	-40 to 65°C (-40 to 149°F)

Temperature Dependence	±0.15% per °C maximum
Cosine Correction	Cosine corrected up to 82° angle of incidence
Azimuth	<±1% error over 360° at 45° elevation
Tilt	No error induced from orientation
Detector	High stability silicon photovoltaic detector (blue enhanced)
Sensor Housing	Weatherproof anodized aluminum case with acrylic diffuser and stainless steel hardware. O-ring seal on the sensor base.
Sensor Size	2.36 cm diameter x 3.63 cm (0.95" x 1.43")
Cable Length	1.8 m
Calculated Metrics	Accumulated solar radiation in MJ/m ² , daily light integral (DLI) of solar
Logger	
Operating Range	-40 to 70°C (-40 to 158°F)
Radio Power	1mW (0 dBm)
Transmission Range	Approximately 30.5 m (100 ft) line-of-sight
Wireless Data Standard	Bluetooth Low Energy (Bluetooth Smart)
Logging Rate	1 second to 18 hours
Logging Modes	Fixed interval (normal, statistics) or burst
Memory Modes	Wrap when full or stop when full
Start Modes	Immediate, push button, date & time, or next interval
Stop Modes	When memory is full, push button, date & time, or after a set logging period
Time Accuracy	±1 minute per month 0° to 50°C (32° to 122°F)
Battery Type	2/3 AA 3.6 Volt lithium, user replaceable
Battery Life	2 years, typical with logging interval of 1 minute and Bluetooth Always On enabled; 4 years, typical with logging interval of 1 minute and Bluetooth Always On disabled. Faster logging intervals and statistics sampling intervals, burst logging, remaining connected with the app, excessive downloads, and paging may impact battery life.
Memory	195,000 measurements, maximum
Full Memory Download Time	Approximately 4-5 minutes; may take longer the further the device is from the logger
Dimensions	Logger housing: 10.8 x 5.08 x 2.24 cm (4.25 x 2.0 x 0.88 in.) Soil moisture sensor: 4.6 x 4.6 x 10.9 cm (1.81 x 1.81 x 4.31 in.) Soil moisture sensor needle length: 5.4 cm (2.14 in.) Soil moisture sensor needle diameter: 0.40 cm (0.16 in.) Sensor cable length: 2 m (6.56 ft)
Weight	<i>Unpackaged</i> MX2307A: 263 g (9.3 oz) MX2310: 333 g (11.8 oz) MX2311: 333 g (11.8 oz) <i>Packaged</i> MX2307A: 417 g (14.7 oz) MX2310: 490 g (17.3 oz) MX2311: 490 g (17.3 oz)
Materials	Acetal, silicone gasket, stainless steel screws Soil Moisture Sensor: ASA plastic body with polyurethane epoxy filling and stainless-steel pins Cable: PVC, UV resistant and rodent repellent (soil moisture sensor cable)
Environmental Rating	Logger: NEMA 6 and IP67
	The CE Marking identifies this product as complying with all relevant directives in the European Union (EU).



The UKCA marking identifies this product as complying with all relevant directives in the UK Declaration of Conformity.



See last page.

* Typical, up to 90% of change

** Per RH sensor manufacturer data sheet

*** Calibrated against an Eppley Precision Spectral Pyranometer (PSP) under natural daylight conditions. Absolute uncertainty under these conditions is $\pm 3\%$ typical; $\pm 5\%$ maximum.

**** The sensor data can be post-calibrated if necessary (e.g. the sensor is used in non-mineral soil types or higher than standard accuracy is required). Users can apply a calibration equation to the data exported from HOBOLink. The VWC range will depend on the calibration equation.

***** For additional accuracy, the sensor data can be post-calibrated for a particular soil by applying a calibration equation to the data exported from the app.

Logger Components and Operation



MX2307A model shown

Mounting Holes: Use the holes at the top and bottom of the logger to mount it (see *Mounting and Deploying the Logger*).

Alarm LED: This LED blinks red every 4 seconds when an alarm is tripped (unless Show LED is disabled as described in *Configuring the Logger*).

Status LED: This LED blinks blue every 4 seconds when the logger is logging (unless Show LED is disabled as described in *Configuring the Logger*). If the logger is waiting to start logging because it was configured to start On Button Push or with a delayed start, it blinks every 8 seconds.

Start Button: Press this button to wake up the logger; both the alarm and status LEDs blink. Once the logger is awake, press this button to move it to the top of the devices list in the app. Press this button for 3 seconds to start or stop the logger when it is configured to start or stop On Button Push (see *Configuring the Logger*). Both LEDs blink four times when you press the button to start or stop logging. Press this button for 10 seconds to reset a password (see *Setting a Password*).

External Light Sensor: This is the PAR sensor (MX2310) or GSR sensor (MX2311) attached to the bottom of the logger.

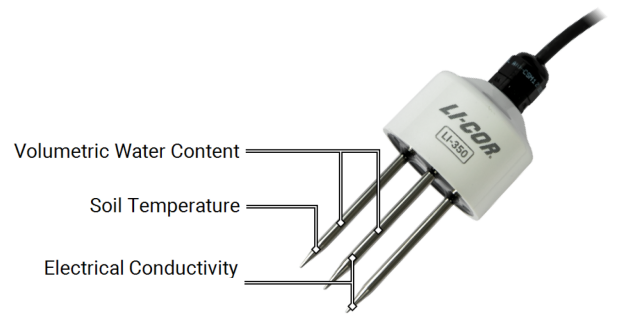
Soil Moisture Sensor: This is the soil moisture sensor attached to the bottom of the logger.

Vent: The RH sensor is located behind the vent.

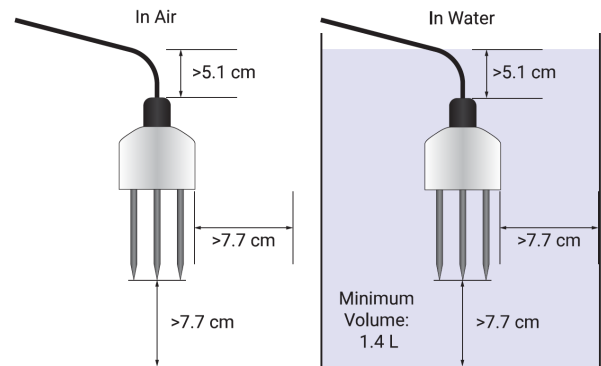
Soil Moisture Sensor Components and Operation

The soil moisture sensor measures VWC, soil temperature, and soil EC. It features stainless steel tines and circuitry that is enclosed in a water-tight housing and potting compound. The cable is equipped with a ferrite bead to minimize electrical interference.

WARNING: The tips of the tines are sharp and can cause a puncture injury. Handle probes with care.



The volume of influence of the VWC measurement extends beyond the edges of the sensor itself. During deployment, this volume should be free from interfering influences. Testing indicates that the measurement influence extends 2 cm above the top of the cable gland and 3 cm beyond the tips of the tines and horizontally 3 cm beyond the edge of the probe housing for a measurement volume of approximately 1.4 L.



When installing, ensure there are no air gaps around the tines. Air gaps, open air, pooled water, rocks, roots, or other objects in the volume of influence can affect measurement accuracy.

For more information about soil moisture sensor measurement principles and custom soil calibrations, see [Using the LI-300 and LI-350 Soil Moisture Sensors](#).

Downloading the App and Connecting to a Logger

Install the app to connect to and work with the logger.

1. Download HOBObconnect to a phone or tablet from the App Store® or Google Play™.

Download the app to a Windows computer from www.onsetcomp.com/products/software/hobobconnect.

2. Open the app and enable Bluetooth in the device settings if prompted.
3. Press the button on the logger to wake it up.
4. Under Devices, tap the logger tile to connect to the logger.

If the logger does not appear or if it is having trouble connecting, follow these tips:

- Make sure the logger is awake by pressing the start button. The alarm and status LEDs blink once when the logger wakes up. You can also press the button a second time to bring the logger to the top of the list if you are working with multiple loggers.

- Make sure the logger is within range of the mobile device or computer. The range for successful wireless communication is approximately 30.5 m (100 ft) with full line-of-sight.
- If there are several loggers in the area, move the logger to a location with fewer loggers. Interference sometimes occurs when numerous loggers are in one location.
- If your device can connect to the logger intermittently or loses its connection, move closer to the logger, within sight if possible.
- If the logger appears in the app, but cannot be connected, close the app then power down the device to force the previous Bluetooth connection to close.

Once the logger is connected, you can:

Tap this:	To do this:
	Specify logger settings and save them onto the logger to start logging. See <i>Configuring the Logger</i> .
	Start logging if the logger was configured to start with a button push. See <i>Configuring the Logger</i> .
	Tap to view live data.
	Download logger data. See <i>Downloading Data from the Logger</i> .
	Mark the logger as a favorite. You can then filter the list of devices to show only loggers marked as favorites.
	Lock the logger. Set a password for the logger so that it is not mistakenly stopped or reconfigured. See <i>Setting a Password</i> for more information.
	Manage Password. Reset your existing password or set a new password for the logger. See <i>Setting a Password</i> for more information.
	Reset or set the user calibration factor. The calibration factor must be in the range of 0.5 to 1.5. See <i>Calibrating the Sensor</i> for more information.
	Reset or enter the LI-COR calibration constant, serial number, and calibration date from the certificate of calibration. See <i>Calibrating the Sensor</i> for more information.
	Illuminate the logger LEDs for 4 seconds.
	Stop logging data (this overrides any Stop Logging settings described in <i>Configuring the Logger</i>).



Update the firmware on the logger. A logger readout will be completed automatically at the beginning of the firmware update process.

Important: Before updating the firmware on the logger, check the remaining battery level and make sure it is no less than 30%. Make sure you have the time to complete the entire update process, which requires that the logger remains connected to the device during the upgrade.

Configuring the Logger

Use the app to set up the logger, including setting alarms, selecting the options to start and stop logging, and choosing a logging mode. These steps provide an overview of setting up the logger. For complete details, see the HOBObconnect User Guide.

All Loggers

1. In the app under Devices, tap the logger tile to connect to the logger.
2. Tap Customize Configuration & Start to configure the logger. If the logger contains data that has not been downloaded, tap Yes to reconfigure it anyway or No to return to the previous screen.
3. Tap Logger Name & Group and type a name for the logger. If you do not enter a name, the app uses the logger's serial number as the name.
4. Tap Group to add the logger to a new or existing group. Type the group name in the field to create a new group.
5. Tap Logger Settings to configure the logger's logging settings.
 - **Logging Interval:** Choose a set logging frequency or customize it unless it is operating in burst logging mode (see *Burst Logging*). **Note:** Minimum custom logging time is 1 minute. **Note:** If an alarm is configured, the logger uses the logging interval as the rate to check for alarm conditions (alarms are not available if Burst Logging is selected). See *Setting Up Alarms* for more details.
 - **Logging Capacity:** View an estimate of the amount of data the logger's memory can retain at the selected settings.
 - **Start Logging:** Choose when logging begins.

On Save. Logging begins immediately after configuration settings are saved.

On Next Interval. Logging begins at the next even interval as determined by the selected logging interval.

On Button Push. Logging begins when you press either the Start/Stop logging button on the logger for 3 seconds or start logging with the app.

On Date/Time. Logging begins at a date and time you specify. Select the Date and Time.
 - **Stop Logging:** Choose when logging ends.

Never Stop (Overwrites Old Data). The logger does not stop at any predetermined time. The logger continues recording data indefinitely with newest data overwriting the oldest.

On Date/Time. The logger stops logging on a specific date and time that you specify.

After. The logger stops logging after a specific amount of time that you specify. For example, select 30 days if you want the logger to log data for 30 days after logging begins.

Stop When Memory Fills. The logger stops recording data when the memory is full.

Stop on Button Push. Logging stops when you press either the Start/Stop logging button on the logger for 3 seconds or stop logging with the app.

- **Logging Mode:** Choose how the logger records data.

Fixed Logging Mode. The logger records data for all enabled sensors and/or selected statistics at the logging interval selected (see *Statistics Logging* for details on choosing statistics options).

Burst Logging Mode. Logging occurs at a different interval when a specified condition is met. See *Burst Logging* for more information.

- **Calibrations:** View the calibration factor and date for the user calibration factor and calibration constant, serial number, and date for the LI-COR calibration constant.
- **Select the Soil Type** the logger is measuring in.

Mineral. For common soils.

Soiless. For potting soils, perlite, and peat moss.

Apparent Dielectric Permittivity. Raw measurements that can be used in published equations such as the Topp equation to derive soil moisture data

- **Enable or disable Percent of Field Capacity:** To see soil moisture as the percent of field capacity, enable this and enter the field capacity for the soil at the site in Volumetric Water Content on a scale of 0.01 to 1.00. Note that the Percent of Field Capacity values reported are limited to the range of 0% to 200%. If you selected Apparent Dielectric Permittivity as your soil type, the option for Percent of Field Capacity is disabled.
- **Bluetooth Always On:** Choose to enable or disable Bluetooth Always On. If enabled, the logger advertises or regularly sends out a Bluetooth signal for the phone, tablet, or computer to find via the app while it is logging, which uses battery power. If disabled, the logger only advertises during logging when the button on the logger is pressed to wake it up, thereby preserving as much battery power as possible.
- **Show LED:** Choose to enable or disable Show LED. If disabled, the alarm and status LEDs on the logger are not illuminated while logging (the alarm LED does not blink if an alarm trips). You can temporarily turn on LEDs when Show LED is disabled by pressing the button on the logger for 1 second.

- **Update Saved Configuration:** Choose to enable or disable Update Saved Configuration. If enabled, the configuration settings are applied to the saved configuration that is used when tapping Start. Saved configurations can be applied to other loggers in the same family using the Start with Saved Configuration option.

6. Tap Temperature to configure the logger's temperature settings. Type the sensor or channel name. Choose to enable or disable logging. If enabled, the logger records temperature data. Set up an alarm(s) to trip when the temperature reading rises above or falls below a specified value. See *Setting Up Alarms* for more information.
7. Tap RH to configure the logger's RH settings. Type the sensor or channel name. Choose to enable or disable logging. If enabled, the logger records RH data. Set up an alarm(s) to trip when the RH reading rises above or falls below a specified value. See *Setting Up Alarms* for more information.
8. Tap Electrical Conductivity to configure the logger's EC settings. Choose to enable or disable logging. If enabled, the logger records EC data. Set up an alarm(s) to trip when the EC reading rises above or falls below a specified value. See *Setting Up Alarms* for more information.
9. Tap Volumetric Water Content (Mineral) to configure the logger's VWC settings. Choose to enable or disable logging. If enabled, the logger records VWC data. Set up an alarm(s) to trip when the VWC reading rises above or falls below a specified value. See *Setting Up Alarms* for more information.
10. Tap Soil Temperature to configure the logger's soil temperature settings. Choose to enable or disable logging. If enabled, the logger records soil temperature data. Set up an alarm(s) to trip when the soil temperature reading rises above or falls below a specified value. See *Setting Up Alarms* for more information.
11. Tap Vapor Pressure Deficit to configure the logger's vapor pressure deficit (VPD) settings. Type the sensor or channel name. Choose to enable or disable logging. If enabled, the logger records VPD. See *Calculating VPD, Dew Point, Accumulated PAR, DLI, Accumulated Solar Radiation, and DLI of Solar* for more information.
12. Tap Dew Point to configure the logger's dew point settings. Type the sensor or channel name. Choose to enable or disable logging. If enabled, the logger records dew point data. See *Calculating VPD, Dew Point, Accumulated PAR, DLI, Accumulated Solar Radiation, and DLI of Solar* for more information.

MX2310

13. Tap Photosynthetically Active Radiation to configure the logger's PAR settings. Type the sensor or channel name. Choose to enable or disable logging. If enabled, the logger records PAR data. See *Measuring PAR and GSR* for more information. Set up an alarm(s) to trip when the PAR reading rises above or falls below a specified value. See *Setting Up Alarms* for more information.
14. Tap Accumulated PAR to configure the logger's accumulated PAR settings. Type the sensor or channel name. Choose to enable or disable logging. If enabled, the

logger records accumulated PAR data. See *Calculating VPD, Dew Point, Accumulated PAR, DLI, Accumulated Solar Radiation, and DLI of Solar* for more information. Set up an alarm(s) to trip when the accumulated PAR reading rises above or falls below a specified value. See *Setting Up Alarms* for more information.

15. Tap Daily Light Integral to configure the logger's DLI settings. Type the sensor or channel name. Choose to enable or disable logging. If enabled, the logger records DLI. See *Calculating VPD, Dew Point, Accumulated PAR, DLI, Accumulated Solar Radiation, and DLI of Solar* for more information.

MX2311

16. Tap Solar Radiation to configure the logger's GSR settings. Type the sensor or channel name. Choose to enable or disable logging. If enabled, the logger records GSR data. See *Measuring PAR and GSR* for more information. Set up an alarm(s) to trip when the GSR reading rises above or falls below a specified value. See *Setting Up Alarms* for more information.
17. Tap Accumulated Solar Radiation to configure the logger's accumulated solar radiation settings. Type the sensor or channel name. Choose to enable or disable logging. If enabled, the logger records accumulated solar radiation data. See *Calculating VPD, Dew Point, Accumulated PAR, DLI, Accumulated Solar Radiation, and DLI of Solar* for more information. Set up an alarm(s) to trip when the accumulated solar radiation reading rises above or falls below a specified value. See *Setting Up Alarms* for more information.
18. Tap DLI of Solar Radiation to configure the logger's DLI of solar radiation settings. Type the sensor or channel name. Choose to enable or disable logging. If enabled, the logger records DLI of solar radiation. See *Calculating VPD, Dew Point, Accumulated PAR, DLI, Accumulated Solar Radiation, and DLI of Solar* for more information.

All Loggers

19. Tap Alarm Settings to configure the logger's alarm settings. See *Setting Up Alarms* for more information.
20. Tap LI-COR Cloud Connection to configure the logger's LI-COR Cloud® connection settings. If not connected, connect your LI-COR Cloud account by tapping Settings > LI-COR Cloud then tapping Connect Account or Create New Account. An account must be connected to upload data. See the HOBOnnect User Guide and LI-COR Cloud help for more information.
21. Tap Start at the top of the lefthand menu to save the configuration settings and start logging based on the settings you selected. Press the start button on the logger if it is set to start logging with a button push. See *Mounting and Deploying the Logger* for details on mounting and *Downloading Data from the Logger* for downloading.

Setting Up Alarms

You can set an alarm to trip on the logger when a sensor reading rises above or falls below a specified value. Alarms alert you to problems so you can take corrective action. To set an alarm:

1. In the app under Devices, tap the logger tile to connect to the logger.
2. Tap Customize Configuration & Start then tap a Sensor/Channel in the lefthand menu. Tap Enable Logging if necessary then tap Alarms.
 - **Low:** Select if you want an alarm to trip when the sensor reading falls below the low alarm value. Enter a value to set the low alarm value.
 - **High:** Select if you want an alarm to trip when the sensor reading rises above the high alarm value. Enter a value to set the high alarm value.
 - **Duration:** Choose how much time should elapse before the alarm trips by selecting one of the following:

Cumulative Samples. The alarm trips once the sensor reading is out of the acceptable range for the selected duration any time during logging. For example, if the high alarm is set to 85°F and the duration is set to 30 minutes, the alarm trips once the sensor readings have been above 85°F for a total of 30 minutes since the logger was configured.

Consecutive Samples. The alarm trips once the sensor reading is out of the acceptable range continuously for the selected duration. For example, the high alarm is set to 85°F and the duration is set to 30 minutes, the alarm trips only if all sensor readings are 85°F or above for a continuous 30-minute period.
3. Tap Alarm Settings. In Show Visual Alarms Until, choose how the alarm indications are cleared:
 - **Logger Reconfigured.** The alarm icon indication appears until the next time the logger is reconfigured.
 - **Sensor in Limits.** The alarm icon indication displays until the sensor reading returns to the normal range between any configured high and low alarm limits.

When an alarm trips, the logger alarm LED blinks every 4 seconds (unless Show LED is disabled), an alarm icon appears in the app, and an Alarm Tripped event is logged. The alarm state clears when the readings return to normal if you have specified Sensor in Limits. Otherwise, the alarm state remains in place until the logger is reconfigured.

Notes:

- The logger checks alarm limits at every logging interval. For example, if the logging interval is set to 5 minutes, the logger checks the sensor readings against the configured high and low alarm setting every 5 minutes.
- The actual values for the high and low alarm limits are set to the closest value supported by the logger. In addition, alarms can trip or clear when the sensor reading is within the resolution specifications.
- When downloading data from the logger, alarm events can be displayed on the plot or in the data file. See *Logger Events* for more information.

Burst Logging

Burst logging is a logging mode that allows you to set up more frequent logging when a specified condition is met. For example, the logger is recording data at a 5-minute logging

interval and burst logging is configured to log every 30 seconds when the temperature rises above 85°F (the high limit) or falls below 32°F (the low limit). This means the logger records data every 5 minutes as long as the temperature remains between 85°F and 32°F. Once the temperature rises above 85°F, the logger switches to the faster logging rate and records data every 30 seconds until the temperature returns to 85°F. Logging then resumes every 5 minutes at the fixed logging interval.

Similarly, if the temperature falls below 32°F, the logger switches to burst logging mode again and records data every 30 seconds. Once the temperature rises back to 32°F, the logger returns to fixed mode, logging every 5 minutes. **Note:** Sensor alarms, statistics, and the Stop Logging option Never Stop (Overwrites Old Data) are not available in burst logging mode.

To set up burst logging:

1. In the app under Devices, tap the logger tile to connect to the logger.
2. Tap Customize Configuration & Start then tap Logger Settings. Tap Logging Mode then select Burst Logging Mode.
 - Burst Logging Interval: Set the burst logging interval, which must be faster than the logging interval. **Note:** The faster the burst logging rate, the greater the impact on battery life and the shorter the logging duration. Because measurements are being taken at the burst logging interval throughout the deployment, the battery usage is similar to what it would be if you had selected this rate for the fixed logging interval.
 - Temperature, RH, Volumetric Water Content (Mineral), Soil Temperature, Electrical Conductivity, Photosynthetically Active Radiation, Accumulated PAR, Solar Radiation, or Accumulated Soil Radiation depending on the logger:

Low. Select if you want an alarm to trip when the sensor reading falls below the low alarm value. Enter a value to set the low alarm value.

High. Select if you want an alarm to trip when the sensor reading rises above the high alarm value. Enter a value to set the high alarm value.

Notes:

- The high and low burst limits are checked at the burst logging interval rate whether the logger is in fixed or burst condition. For example, if the logging interval is set to 1 hour and the burst logging interval is set to 10 minutes, the logger always checks for burst limits every 10 minutes.
- If high and/or low limits are configured for more than one sensor, burst logging begins when any high or low condition goes out of range. Burst logging does not end until all conditions on all sensors are back within normal range.
- The actual values for the burst logging limits are set to the closest value supported by the logger.
- Burst logging can begin or end when the sensor reading is within the resolution specifications. This means the value that triggers burst logging may differ slightly from the value entered.
- Once the high or low condition clears, the logging interval time is calculated using the last recorded data point in burst logging mode, not the last data point recorded at the fixed

logging rate. For example, the logger has a 10-minute logging interval and logged a data point at 9:05. Then, the high limit is surpassed and burst logging begins at 9:06. Burst logging then continues until 9:12 when the sensor reading falls back below the high limit. Now back in fixed mode, the next logging interval is 10 minutes from the last burst logging point, or 9:22 in this case. If burst logging had not occurred, the next data point would have been at 9:15.

- A New Interval event is created each time the logger enters or exits burst logging mode. See *Logger Events* for details on plotting and viewing the event. In addition, if the logger is stopped with a button push while in burst logging mode, a New Interval event is automatically logged and the burst condition is cleared, even if the actual high or low condition has not cleared.

Statistics Logging

During fixed logging, the logger records data for enabled sensors and/or selected statistics at the logging interval selected. Statistics are calculated at a sampling rate you specify with the results for the sampling period recorded at each logging interval. The following statistics can be logged for each sensor:

- The maximum, or highest, sampled value
- The minimum, or lowest, sampled value
- An average of all sampled values
- The standard deviation from the average for all sampled values

For example, an MX2307A logger is configured with both the RH and temperature sensors enabled, and the logging interval is set to 5 minutes. The logging mode is set to fixed logging and all four statistics enabled and with a statistics sampling interval of 30 seconds. Once logging begins, the logger measures and records the actual RH and temperature sensor values every 5 minutes. In addition, the logger takes an RH and temperature sample every 30 seconds and temporarily stores them in memory. The logger then calculates the maximum, minimum, average, and standard deviation using the samples gathered over the previous 5-minute period and logs the resulting values. When reading out the logger, this results in 10 data series: two sensor series (with RH and temperature logged every 5 minutes) plus eight maximum, minimum, average, and standard deviation series (four for RH and four for temperature with values calculated and logged every 5 minutes based on the 30-second sampling).

To log statistics:

1. In the app under Devices, tap the logger tile to connect to the logger.
2. Tap Customize Configuration & Start then tap Logger Settings in the lefthand menu. Tap Logging Mode then select Fixed Logging Mode. Toggle Statistics to ON.

Note: Fixed Logging Mode records sensor measurements taken at each logging interval. The selections made in the Statistics section add measurements to the recorded data.
3. Select the statistics you want the logger to record at each logging interval: Maximum, Minimum, Average, and Standard Deviation. Average is automatically enabled when selecting Standard Deviation. Statistics are logged for all

enabled sensors. In addition, the more statistics you record, the shorter the logger duration and the more memory is required.

4. Tap Statistics Sampling Interval and select the rate to use for calculating statistics. The rate must be less than, and a factor of, the logging interval. For example, if the logging interval is 1 minute and 5 seconds was selected for the sampling rate, the logger takes 12 sample readings between each logging interval (one sample every 5 seconds for a minute) and use the 12 samples to record the resulting statistics at each 1-minute logging interval. **Note:** The faster the sampling rate, the greater the effect on battery life. Because measurements are being taken at the statistics sampling interval throughout the deployment, the battery usage is similar to what it would be if you had selected this rate for the fixed logging interval.

Calibrating the Sensor

It is recommended to calibrate the logger's PAR and GSR sensors every two years since sensor drift can occur and cause its readings to become higher or lower than the true PAR value. The logger can be calibrated with a user calibration factor and/or LI-COR calibration constant.

The user calibration factor is a manual adjustment based on the sensor's known behavior or reference measurements.

To add a user calibration factor:

1. In the app under Devices, tap the logger tile to connect to the logger.
2. Tap User Calibration Factor then input the value and tap Proceed. The number must be in the range of 0.5 to 1.5.
3. Tap Reset Calibration Factor to reset it.

LI-COR calibration constant is a value that is determined by the factory and is specific to each sensor. The calibration constant is provided on the sensor's LI-COR calibration certificate, which are available on the [LI-COR support website](#). **Note:** The serial number provided on the LI-COR calibration certificate is for the sensor, not the logger.

To add a LI-COR calibration constant:

1. In the app under Devices, tap the logger tile to connect to the logger.
2. Tap LI-COR Calibration Constant. Refer to your certificate of calibration for the LI-COR calibration constant, serial number, and calibration date values. Input the values then tap Proceed.
3. Tap Reset to reset the LI-COR calibration constant.

Setting a Password

You can create an encrypted password for the logger that is required if another device attempts to connect to it. This is recommended to ensure that a deployed logger is not mistakenly stopped or purposely altered by others. This password uses a proprietary encryption algorithm that changes with every connection.

To set a password:

1. In the app under Devices, tap the logger tile to connect to the logger.
2. Tap Lock Logger.

3. Type a password then tap Set. Lock Logger will change to Manage Password.

To change or reset a password:

1. In the app under Devices, tap the logger tile to connect to the logger.
2. Tap Manage Password.
3. Type a new password then tap Set or tap Reset to reset it to factory default. **Note:** The password can also be reset by pressing the button on the logger for 10 seconds.

Only the device used to set the password can then connect to the logger without entering a password; all other devices are required to enter the password. For example, if you set the password for the logger with your tablet and then try to connect to the logger later with your phone, you must enter the password on the phone but not with your tablet.

Similarly, if others attempt to connect to the logger with different devices, they are also required to enter the password.

Downloading Data from the Logger

To download data from the logger:

1. In the app under Devices, tap the logger tile to connect to the logger.
2. Tap Download Data. The logger will download data to the phone, tablet, or computer.
3. Once the download is complete, tap Done to return to the previous page or tap Export & Share to save the file in the specified format.
4. Tap Data on the lefthand menu to view, export, and share data files.

You can also upload data automatically to LI-COR Cloud. See the HOBObconnect User Guide and LI-COR Cloud help for more information.

Logger Events

The logger records the following internal events to track logger operation and status. You can view events in exported files or plot events in the app.

To plot events, tap Data Files in the lefthand menu then select a file to open.

Tap  (if applicable) then tap . Select the channels you want to plot (e.g., Temperature, RH, Volumetric Water Content (Mineral), Soil Temperature, Electrical Conductivity, Photosynthetically Active Radiation, Accumulated PAR, Solar Radiation, or Accumulated Soil Radiation) then tap OK. Additional channels can be selected depending on the logger's activity, as seen below:

Channel Name	Definition
Battery Data	The battery voltage was logged. Note: Battery data is only available in HOBObconnect, not the exported file.
Host Connected	The logger was connected to the mobile device.
Started	The logger started logging.
Stopped	The logger stopped logging.

Channel Name	Definition
Alarm Tripped/Cleared	An alarm has occurred because the reading was outside the alarm limits or back within range. Note: Although the reading may have returned to a normal range during logging, an alarm cleared event will not be logged if the logger was set up to maintain alarms until reconfigured.
New Interval	The logger has switched to logging at the burst logging rate or back to the normal rate.
Safe Shutdown	The battery level dropped below a safe operating voltage and the logger performed a safe shutdown.
End of File	Marks the end of data in the file.

Measuring PAR and GSR

The MX2310 sensor measures PAR in $\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$ at its measurement location.

- **PAR.** The range of light (400 to 700 nm) that the logger's sensor measures at the given moment. PAR values are sampled every 15 seconds throughout the specified logging interval then averaged together for one PAR value. If the logging interval is less than 1 minute, then only an instantaneous reading is taken.

The MX2311 sensor measures global solar radiation (GSR) in $\text{W}\cdot\text{m}^{-2}$ at its measurement location.

- **GSR.** The total amount of solar radiation (400–1100 nm) that the logger's sensor measures at the given moment. GSR values are sampled every 15 seconds throughout the specified logging interval, then averaged together for one GSR value. If the logging interval is less than 1 minute, then only an instantaneous reading is taken.

Calculating VPD, Dew Point, Accumulated PAR, DLI, Accumulated Solar Radiation, and DLI of Solar Radiation

The logger calculates select parameters from logged values. Available calculated parameters depend on the logger and the channels enabled for logging. These parameters are derived from logged values.

All Loggers

All loggers calculate VPD in kPa and dew point in C/F.

- **VPD:** The difference between the actual and saturation vapor pressures. VPD is measured by subtracting the actual vapor pressure, derived using RH, from the saturation vapor pressure.
- **Dew Point:** Derived from temperature and relative humidity.

MX2310

The MX2310 calculates accumulated PAR in mol/m^2 and DLI in $\text{mol}/\text{m}^2/\text{day}$.

- **Accumulated PAR.** The cumulative amount of PAR the sensor receives. Accumulated PAR is measured by summing

the PAR measurements and accounting for the duration, typically from the start of the day up to the latest logged value (mol/m^2).

- **DLI (of PAR):** A measure of the total amount of light received in a single day in a particular area. DLI can be used to quantify PAR as moles of photons per square meter per day ($\text{mol}/\text{m}^2/\text{day}$). See the LI-COR [Measuring Daily Light Integral with the LI-1500 Light Sensor Logger](#) quick start guide for more information.

Note on accumulated PAR and DLI: PAR data continuously accumulates throughout its deployment. Accumulated PAR does not reset after a new launch.

However, if the logger is stopped, read out, and left disconnected for more than 1 hour, it will enter storage mode. This resets both the accumulated PAR and DLI values. To prevent this, reconnect to or interact with the logger (e.g., by pressing a button) within 1 hour after stopping it.

MX2311

The MX2311 calculates accumulated solar radiation in MJ/m^2 and DLI of solar radiation in $\text{MJ}/\text{m}^2/\text{day}$.

- **Accumulated Solar Radiation.** The cumulative amount of solar radiation the sensor receives. Accumulated solar radiation is measured by summing the GSR measurements and accounting for the duration, typically from the start of the day up to the latest logged value (MJ/m^2).
- **DLI of Solar Radiation:** A measure of the total amount of light received in a single day in a particular area. DLI of solar radiation can be used to quantify GSR as megajoules per square meter per day ($\text{MJ}/\text{m}^2/\text{day}$). See the LI-COR [Measuring Daily Light Integral with the LI-1500 Light Sensor Logger](#) quick start guide for more information.

Note on accumulated solar radiation and DLI of solar radiation: GSR data continuously accumulates throughout its deployment. Accumulated solar radiation does not reset after a new launch.

However, if the logger is stopped, read out, and left disconnected for more than 1 hour, it will enter storage mode. This resets both the accumulated solar radiation and DLI of solar radiation values. To prevent this, reconnect to or interact with the logger (e.g., by pressing a button) within 1 hour after stopping it.

Installing the Soil Moisture Sensor

There are two installation methods for installing the soil moisture sensor: borehole or trench.

The soil moisture sensor can be installed two ways: on the soil surface or buried in a pit. For surface installations, press the tines fully into the soil.

The ideal installation is in a pit with the tines fully inserted into the side of the pit and soil back-filled with the same bulk density. Do not compact the soil or create voids.

WARNING: The tips of the tines are sharp and can cause a puncture injury. Handle probes with care.

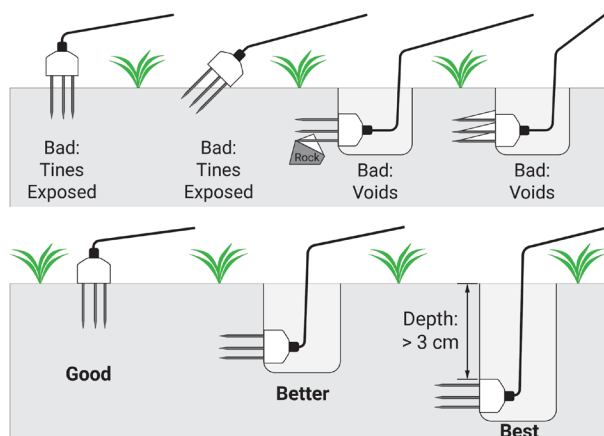
Installation

Whether the sensor is installed on the surface or in a pit, the entire length of the tines must be in contact with undisturbed soil in order to make accurate measurements. Any portion of a

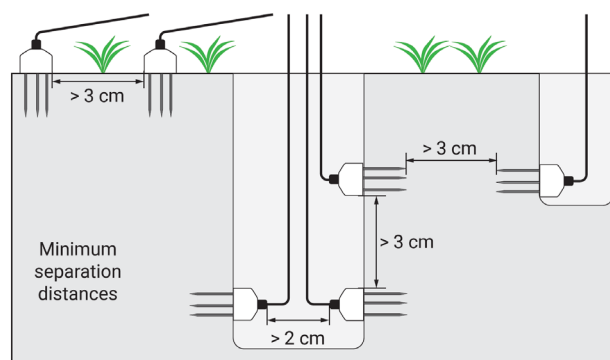
tine that is exposed to open air, air pockets, or pooled water can induce errors in the measurement.

To properly install the sensor, follow these guidelines:

- Press the tines into undisturbed soil.
- Do not touch the tines; oils from skin will affect measurements. Clean tines with mild detergent and water if touched.
- If a tine makes contact with a rock or root during insertion, install the probe in a different location. Do not push, as the rock may move, creating a void around the tine, or worse, the tine may bend.
- If the probe shifts after insertion, voids will be created around the tines. Install the probe in a different location.
- Be sure that the full length of each tine is in contact with undisturbed soil.
- Surface installation is good, but burying the probe in an excavation is better. An installation depth >3 cm is best.
- If installed in an excavation, back-fill the pit with soil of the same bulk density as before excavating. Be sure the probe does not move while back-filling the pit.



If installing multiple soil moisture sensors, maintain a minimum separation of 3 cm between the tips of tines and the edges of sensors. Maintain at least 2 cm between cable glands. Soil probes are sensitive to a volume that surrounds each probe. If they are too close to one another, sensors may cause interference with each other.

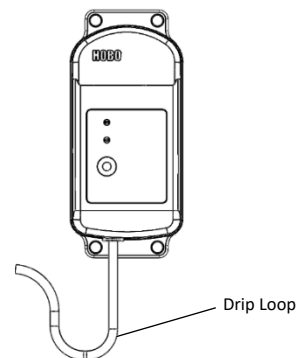


Mounting and Deploying the Logger

All Loggers

Follow these guidelines when deploying the logger:

- Mount the logger so the cables are coming out the bottom of the logger and not being pulled. Leave about 5 cm (2 inches) of drip loop in the cables where they come out of the logger to prevent water from entering the logger housing.



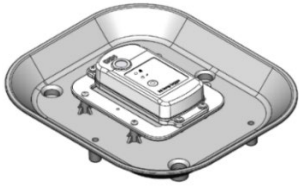
- Mount the logger high enough so that it will not get submerged during a rain storm.
- Use the included large screws or cable ties to mount the logger via the mounting holes. Use the screws to attach the logger to a wall or flat surface. Use the cable ties to affix the logger to a PVC pipe or mast. Make sure that the logger case is not bent when the logger is mounted as that could lead to water entry.

MX2310 and MX2311

Follow these guidelines when mounting and deploying the logger:

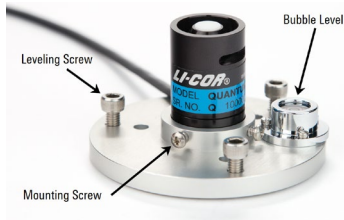
- If the logger is in sunlight at any time: A solar radiation shield is required. The logger must be mounted using the solar radiation shield bracket (MX2300-RS-BRACKET) to the underside of the mounting plate as shown.

For more details on the solar radiation shield, refer to the *Solar Radiation Shield Installation Guide* at www.onsetcomp.com/manuals/rs1.



- If the logger is not in sunlight: Use the included large screws or cable ties to mount the logger via the mounting holes. Use the screws to attach the logger to a wall or flat surface. Use the cable ties to affix the logger to a PVC pipe or mast.
Note: The logger must be mounted vertically or with the sensor vent facing down when not using the solar radiation shield.
- Mount the sensor with the mounting and leveling fixture to ensure it is level while taking measurements. Secure the sensor in the fixture by tightening the mounting screws against the sensor base. Level the fixture with the bubble level by adjusting the three leveling screws.

The fixture can then be secured to a structure with bolts or leveling screws placed through the three holes.



Protecting the Logger

Note: Static electricity may cause the logger to stop logging.

The logger has been tested to 8 KV, but avoid electrostatic discharge by grounding yourself to protect the logger. For more information, search for “static discharge” on onsetcomp.com.

Maintenance

To clean the soil moisture sensor and needles, use a mild detergent, such as liquid dish soap, and a nonabrasive sponge or cloth. Avoid detergents that contain lotions or moisturizers. Rinse the sensor and needles thoroughly with tap or deionized (DI) water. The logger is designed for outdoor use, but should be inspected periodically. Wipe off any dust or grime with a damp cloth.

Troubleshooting

If the soil moisture sensor readings are too low or slightly negative, check for air gaps around the sensor needles. These could be produced below the surface of the substrate when the needle contacts a large piece of material and pushes it out of the way, or if the sensor is not inserted perfectly linearly.

If the sensor readings are too high, make sure the media was not packed excessively or insufficiently during sensor

installation. Higher density can cause the sensor readings to be elevated.

Battery Information

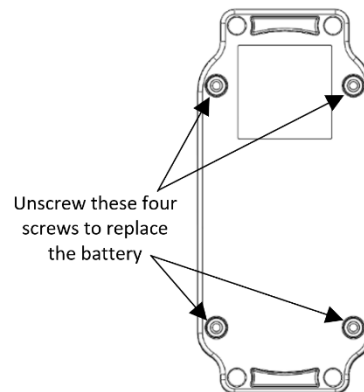
The logger requires one user-replaceable 2/3 AA 3.6 V lithium battery (HRB-2/3AA). Battery life is 2 years, typical with a logging interval of 1 minute, but may be extended to 5 years when the logger is configured with Bluetooth Always On disabled. Expected battery life varies based on the ambient temperature where the logger is deployed, the logging or sampling interval, frequency of offloading and connecting to the mobile device, number of channels that are active, and use of burst mode or statistics logging. Deployments in extremely cold or hot temperatures or logging interval faster than 1 minute can impact battery life. Estimates are not guaranteed due to uncertainties in initial battery conditions and operating environment.

Replacing the Battery

The logger requires one user-replaceable 2/3 AA 3.6 V lithium

1. Use a Phillips-head screwdriver to unscrew the four screws from the back of the logger.
2. Carefully separate the top and bottom of the logger enclosure.
3. Remove the old battery and insert the new battery observing polarity. It is recommended that you replace the desiccant (DESICCANT2) when replacing the battery.
4. Make sure the rubber seal is clean and free of any debris and then carefully reassemble the logger enclosure and screw in the four screws.

WARNING: Do not cut open, incinerate, heat above 85°C (185°F), or recharge the lithium battery. The battery may explode if the logger is exposed to extreme heat or conditions that could damage or destroy the battery case. Do not dispose of the logger or battery in fire. Do not expose the contents of the battery to water. Dispose of the battery according to local regulations for lithium batteries.



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.

NCC Statement (Taiwan)

經型式認證合格之低功率射頻電機，非經許可，公司、商號或使用者均不得擅自變更頻率、加大功率或變更原設計之特性及功能。

低功率射頻電機之使用不得影響飛航安全及干擾合法通信；經發現有干擾現象時，應立即停用，並改善至無干擾時方得繼續使用。前項合法通信，指依電信法規定作業之無線電通信。低功率射頻電機須忍受合法通信或工業、科學及醫療用電波輻射性電機設備之干擾。

Translation:**Article 12**

Without permission granted by the NCC, any company, enterprise, or user is not allowed to change frequency, enhance transmitting power or alter original characteristic as well as performance to an approved low power radio-frequency device.

Article 14

The low power radio-frequency devices shall not influence aircraft security and interfere with legal communications. If found, the user shall cease operating immediately until no interference is achieved. The said legal communications means radio communications is operated in compliance with the Telecommunications Act. The low power radio-frequency devices must be susceptible with the interference from legal communications or ISM radio wave radiated devices.



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