



The HOBO MX2502 PAR/Temp/Tilt Data Logger measures underwater photosynthetically active radiation (PAR), temperature, and tilt in a single device. This Bluetooth®-enabled logger is designed for wireless communication with a phone, tablet, or computer. Using the HOBOconnect® app, you can easily configure the logger then download logged data to view or export for further analysis. The logger can calculate minimum, maximum, average, and standard deviation statistics and be configured to indicate alarms at thresholds you specify. The logger also supports burst logging, in which data is logged at a faster interval when sensor readings are above or below certain limits. It offers a wide range of solutions for monitoring PAR, temperature, and tilt in numerous applications.

## Specifications

### Temperature Sensor

<b>Range</b>	-20° to 50°C (-4° to 122°F)
<b>Accuracy</b>	±0.2°C
<b>Resolution</b>	0.008°C (0.014°F)
<b>Drift</b>	<0.01°C (0.018°F) per year
<b>Response Time (90%)</b>	12 minutes in water (typical)

### Tilt Angle

<b>Range</b>	0 to 180° from vertical
<b>Accuracy</b>	±5°
<b>Resolution</b>	1°

### Photosynthetically Active Radiation (PAR)

<b>Range</b>	0 to 3,000 $\mu\text{mol}/\text{m}^2/\text{s}$ (full sunlight)
<b>Accuracy</b>	±5% typical (LI-COR LI-192 factory calibration)
<b>Offset</b>	+/- $\mu\text{mol}$
<b>Resolution</b>	0.16 $\mu\text{mol}/\text{m}^2/\text{s}$
<b>Spectral Range</b>	400–700 nm (PAR waveband)
<b>Linearity</b>	Maximum deviation of 1% up to 3,000 $\mu\text{mol}/\text{m}^2/\text{s}$
<b>Stability</b>	<= 2% change over one year
<b>Temperature Dependence</b>	±0.15% per °C maximum
<b>Cosine Correction</b>	Optimized for underwater and atmospheric use
<b>Azimuth</b>	<±1% error over 360° at 45° elevation
<b>Detector</b>	High stability silicon photovoltaic detector (blue enhanced)
<b>Sensor Housing</b>	Corrosion resistant metal with acrylic diffuser for saltwater and freshwater applications

### Calculated Metrics

#### Logger

<b>Operating Range</b>	-20° to 50°C (-4° to 122°F); fresh or saltwater; cannot be frozen in ice
<b>Radio Power</b>	1.0 mW (0 dBm)
<b>Transmission Range</b>	Approximately 30.5 m (100 ft) line-of-sight
<b>Wireless Data Standard</b>	Bluetooth Low Energy (Bluetooth Smart)
<b>Logging Rate</b>	1 second to 18 hours
<b>Logging Modes</b>	Fixed interval (normal, statistics) or burst
<b>Memory Modes</b>	Wrap when full or stop when full

## HOBO MX2502 Data Logger

### Models:

- MX2502, PAR/temp/tilt

### Included Items:

- Magnetic activation fob
- Light sensor cap

### Required Items:

- HOBOconnect app
- Mobile device with Bluetooth and iOS, or Android™, or a Windows computer with Bluetooth

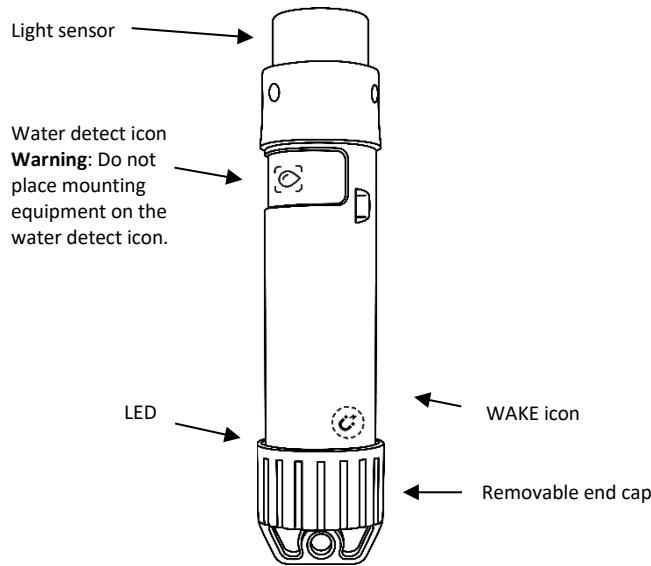
### Accessories:

- Lowering Frame (M-FRM)
- Bracket Mount (M-BRK-2)
- Wiper Clamp (M-CLP)

<b>Start Modes</b>	Immediate, push button, date & time, or next interval
<b>Stop Modes</b>	When memory is full, push button, date & time, or after a set logging period
<b>Time Accuracy</b>	±1 minute per month 0° to 50°C (32° to 122°F)
<b>Battery Type</b>	2/3 AA 3.6 Volt lithium, factory replaceable
<b>Battery Life</b>	3 years, typical with logging interval of 1 minute and Bluetooth Always On enabled; 6 years, typical with logging interval of 1 minute and Bluetooth Always On & LED disabled. Faster logging intervals and statistics sampling intervals, burst logging, remaining connected with the app, excessive downloads, and paging may impact battery life.
<b>Memory</b>	195,000 measurements, maximum
<b>Full Memory Download Time</b>	Approximately 4-5 minutes; may take longer the further the device is from the logger
<b>Dimensions</b>	Diameter: 1.695" Length: 7.190"
<b>Weight</b>	Logger: 274 g (0.604 lb.) With packaging: 495 g (1.091 lb.)
<b>Materials</b>	Housing: ENTEC PINNACLE PP 4220H 4% COLOR LOADING 2U2069 BLACK Cap: BLACK DELRIN 500P
<b>Environmental Rating</b>	IP68 up to 30 m
<b>CE</b>	The CE Marking identifies this product as complying with all relevant directives in the European Union (EU).
<b>UKCA</b>	The UKCA marking identifies this product as complying with all relevant directives in the UK Declaration of Conformity.

\* Typical, up to 90% of change

## Logger Components and Operation



**End Cap:** This end cap is removable to allow visual access to the status LED. To remove, twist the end cap clockwise. To replace, twist the cap counterclockwise; do not overtighten.

**Status LED:** This LED blinks red 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.

**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*).

**WAKE Icon:** This icon indicates the activation point for the logger. To wake the logger, hold the magnetic activation fob on the WAKE magnet icon (see *Waking the Logger and Bluetooth Communication*).

**Important:** When storing or transporting the logger, keep the magnetic fob (or any other magnet) a minimum of 1" away from the logger so that you do not inadvertently drain the logger's battery.

**Water Detect Icon:** This icon indicates the required water level for detection. The logger must be submerged until the water reaches at least this icon for proper operation.

**Light Sensor:** This light sensor takes PAR measurements and is protected by a red light sensor cap. Replace the cap when the logger is not in use.

The logger can record two types of data: samples and events. Samples are the sensor measurements recorded at each logging interval (for example, the light measurement every minute). Events are independent occurrences triggered by a logger activity, such as Bad Battery or Host Connected. Events help you determine what was happening while the logger was logging.

## Waking the Logger and Bluetooth Communication

To communicate with the logger, you may need to wake up the logger using the magnetic fob. To do so, hold the magnetic fob on the WAKE magnet icon. This wakes the logger if it is asleep and turns on Bluetooth communication if it is off.



## Downloading the App and Connecting to a Logger

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

1. Download HOBOconnect 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/hoboconnect](http://www.onsetcomp.com/products/software/hoboconnect).

2. Open the app and enable Bluetooth in the device settings if prompted.

3. Wake the logger (see *Waking the Logger and Bluetooth Communication*).

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 holding the magnetic activation fob to the WAKE icon.
- Make sure the logger is within range of the mobile device or computer. The range for successful wireless communication out of water 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, then 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.
	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. <b>Note:</b> FW button is only visible when a firmware update is available online.
<p><b>Important:</b> 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.</p>	

## 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 HOBOconnect User Guide.

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. Tap Group to add the logger to a new or existing group. Type the group name in the field to create a new group.
4. Tap Logger Settings to configure the logger's logging settings.
  - **Logging Interval:** Customize the logging frequency unless it is operating in burst logging mode (see *Burst Logging*). **Note:** Minimum custom logging time is 1 second. **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 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.** The logger stops logging on button push in the app. This can be selected in addition to the other options.
  - **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 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.
- Power Saving Mode: Choose to enable or disable Bluetooth.

**Bluetooth Always Off:** The logger only advertises or regularly sends out a Bluetooth signal to the phone, tablet, or computer via the app when logger is woken up, thereby preserving as much battery power as possible.

**Bluetooth Off Water Detect:** The logger stops advertising or regularly sending out a Bluetooth signal when water is detected, thereby preserving as much battery power as possible.

**Bluetooth Always On:** The logger advertises while it is logging, which uses battery power.

- Show LED: Choose to enable or disable the status 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).
- 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.

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

6. Tap In-Air PAR to configure the logger's in-air PAR settings. Type the sensor or channel name. Choose to enable or disable logging. If enabled, the logger records in-air PAR data. If In-AIR PAR logging is enabled, Underwater PAR logging must also be enabled (see previous section). **Note:** Disregard underwater PAR data when recording In-AIR PAR measurements. **Note:** Disable In-AIR PAR logging when recording underwater PAR measurements.

7. 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.

8. Tap Tilt to configure the logger's tilt settings. Type the sensor or channel name. Choose to enable or disable logging. If enabled, the logger records tilt data. Set up an alarm(s) to trip when the tilt reading rises above or falls below a specified value. See *Setting Up Alarms* for more information.

9. Tap Daily Light Integral (Underwater) to configure the logger's underwater DLI settings. Type the sensor or channel name. Choose to enable or disable logging. If enabled, the logger records underwater DLI data. See *Calculating Accumulated Underwater PAR and DLI* for more information.

10. Tap Accumulated Underwater PAR to configure the logger's accumulated underwater PAR settings. Type the sensor or channel name. Choose to enable or disable logging. If enabled, the logger records accumulated underwater PAR data. See *Calculating Accumulated Underwater PAR and DLI* for more information. Set up an alarm(s) to trip when the accumulated underwater PAR reading rises above a specified value. See *Setting Up Alarms* for more information.

11. Tap Alarm Settings to configure the logger's alarm settings. See *Setting Up Alarms* for more information.

12. 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 HOBOconnect User Guide and LI-COR Cloud help for more information.

13. Tap Start at the top of the lefthand menu to save the configuration settings and start logging based on the settings you selected. Tap Start 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:

- In the app under Devices, tap the logger tile to connect to the logger.
- 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 the lefthand menu. 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 in the lefthand menu. 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, Photosynthetically Active Radiation, and Accumulated PAR:
  - **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 MX2502 logger is configured with both the underwater PAR 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 underwater PAR and temperature values every 5 minutes. In addition, the logger takes an underwater PAR 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 underwater PAR and temperature logged every 5 minutes) plus eight maximum, minimum, average, and standard deviation series (four for underwater PAR 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. Under Logger Settings, 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 sensor every two years since sensor drift can cause readings to deviate from the true PAR value. If the user wishes to correct for this drift

instead of obtaining a new factory calibration, they can apply an adjustment using the user calibration constant.

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.

## 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 HOBOconnect 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 then select a file to open.

Tap  (if applicable) then tap . Select the channels you want to plot (e.g., Underwater PAR, In-Air PAR, Temperature, Tilt, Daily Light Integral (Underwater), Accumulated Underwater PAR) 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. <b>Note:</b> Battery data is only available in HOBOconnect, not the exported file.
Host Connected	The logger was connected to the mobile device.
Started	The logger started logging.
Stopped	The logger stopped logging.
Alarm Tripped/Cleared	An alarm has occurred because the reading was outside the alarm limits or back within range. <b>Note:</b> 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.
Water Detect	In: The logger is detecting moisture at the water detect location. The logger could be partially or completely submerged. Out: The logger is not detecting moisture at the water detect location.
Button Up/Down	The magnetic activation fob was used to activate/advertise the logger.
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 Underwater PAR and In-Air PAR

The logger's sensor measures underwater PAR and in-air 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.

## Calculating Accumulated Underwater PAR and DLI

The logger calculates accumulated underwater PAR in  $\text{mol}/\text{m}^2$  and Daily Light Integral (DLI) in  $\text{mol}/\text{m}^2/\text{day}$ . These parameters are derived from logged values.

- Accumulated Underwater PAR.** The cumulative amount of underwater PAR the sensor receives. Accumulated underwater PAR is measured by summing the underwater PAR measurements and accounting for the duration, typically from the start of the day up to the latest logged value ( $\text{mol}/\text{m}^2$ ).
- Daily Light Integral (Underwater):** A measure of the total amount of light received in a single day in a particular underwater 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 underwater PAR and DLI:** Underwater PAR data continuously accumulates throughout its deployment and resets automatically at midnight each day.

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 underwater PAR and DLI values. To prevent this, reconnect to or interact with it (e.g., by using the magnetic activation fob) within 1 hour after stopping.

## Battery Guidelines

The battery in the MX2502 is a 3.6 Volt lithium battery.

- Battery Life.** Refer to the Specifications to learn about [battery life](#). Actual battery life is a function of the number of deployments, logging interval, and operation/storage temperature of the logger. Frequent deployments with logging intervals of less than one minute, and continuous storage/operation at temperatures above 35°C result in significantly lower battery life. For example, continuous logging at a one-second logging interval results in a battery life of approximately one month.

To obtain the specified battery life, operate and store the logger at temperatures between 0° and 25°C (32° and 77°F).

- Battery Level:** The battery level shown for these loggers is based on the battery voltage. The Lithium batteries in these loggers maintain a flat voltage until they are near the end of their capacity. Therefore, it is best to replace the batteries or loggers based on how long they have been deployed. Once they have been used for 90% of the specified battery life, you should not use the loggers for extended deployments. If the loggers are deployed beyond this time, schedule frequent site visits to minimize the risk of data loss. Once the battery indication goes below 50% (when checked at room temperature), you should replace the loggers or return them to Onset or an authorized Onset service center for battery replacement and logger tune-up/recalibration.



**WARNING:** Do not cut open, incinerate, heat above 100°C (212°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.